

An underwater photograph showing a large school of small, silvery fish swimming in clear blue water. In the foreground, a large, textured, reddish-brown coral structure is visible, along with other smaller coral and marine life. The scene is brightly lit, suggesting a shallow depth.

VOLUME 2

COASTAL FISHES OF THE  
**WESTERN  
INDIAN  
OCEAN**

EDITED BY

Phillip C Heemstra • Elaine Heemstra • David A Ebert • Wouter Holleman • John E Randall







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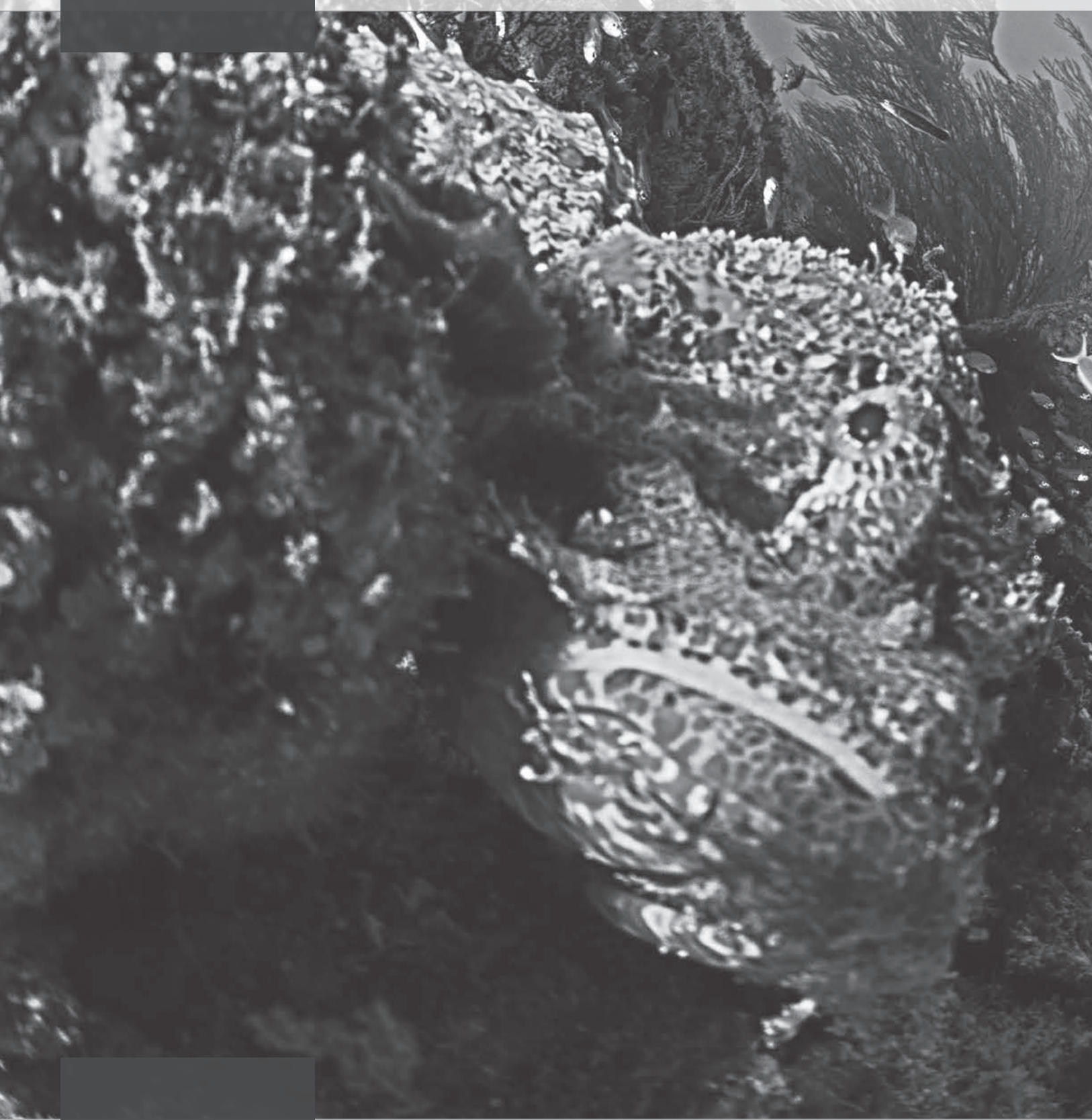


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CLASS

**OSTEICHTHYES**



*Bony Fishes*







# ORIGIN AND DIVERSITY OF EARLY TELEOSTEAN FISHES

Eric J Hilton

**EDITOR'S NOTE** This account of the origins of teleostean fishes looks at the relationships between groups of fossil fishes and their living relatives. The purpose of such research is to try to determine how the various major groups of fishes are related and when in geological time they had their origins. For many groups the only evidence these scientists have to work with is the fossil record, including the ages of the rock in which the fossils are found. Because of this, comparisons can only be made with the skeletal structures of living fishes. This is also a record of the history of the study of these relationships and of the scientists who have tried to answer these questions.

The account is very 'technical', because there are no common names for the fossil fishes, and many of the groups

no longer exist. Many of the terms used are unfamiliar and reading the chapter **Naming organisms and determining their relationships** in Volume 1 is recommended, as it will clarify some of the concepts.

Note also that the dagger symbol (†) means that the taxon is entirely extinct. Taxonomic names surrounded by quotation marks (" ") are demonstrably paraphyletic. Name derivations are from Jaeger (1978). A glossary is included herewith, although for anatomical terminology related to the skeleton of fishes, the reader is referred to Hilton (2011). Unless otherwise stated, all numbers of taxa for extant groups are derived from Nelson (2006).

## INTRODUCTION

With more than 27 000 species, teleostean fishes constitute well over half of all extant vertebrate diversity. The Teleostei is the most species-rich of the three major subgroups of Neopterygii, which also includes the Ginglymodi (gars, Order Lepisosteiformes, and their fossil relatives, including the †Semionotiformes and †Macrosemiiformes, Grande 2010) and the Halecomorphi (bowfins, Order Amiiiformes, and their fossil relatives, Grande & Bemis 1998). Because of their enormous diversity, teleosts have inspired many evolutionary biologists, and have formed the basis for many examples of the principles of evolution, from adaptive radiation (e.g., cichlids, Keenleyside 1991, Barlow 2002) and natural and sexual selection (e.g., sticklebacks, Bell & Foster 1994), to their role as model organisms for the study of evolution and development (e.g., zebra fish, Sprague *et al.* 2003; fugu, Yamanoue *et al.* 2009). Darwin originally used the Teleostei as an example of the sudden appearance of taxonomic groups in the fossil record as a test of his theory of evolution. Since that time the divergence of the Teleostei and its subgroups has been of great interest to evolutionary biologists as a framework for examining the processes, correlations, and tempo involved in evolutionary diversification generally (e.g., Arratia 2004; Cavin *et al.* 2007; Hurley *et al.* 2007; Friedman 2010).

The evolutionary history of the Teleostei has greatly intrigued systematic ichthyologists and there have been many reviews and syntheses of their origin and diversification over the years. Those of Regan (1909), Garstang (1931), Woodward (1942), Gosline (1960), Nelson (1969), Patterson (1977) and Arratia (2004) are but a few examples. In cladistic terms, determining the origin of the teleosts means determining their taxonomic extent – how large the group is – and which among other neopterygians, fossil and living, is their sister-group. By determining the sister-group relationships near the base of the teleosts and then reconstructing the hypothetical most-recent common ancestor of all teleosteans, the geological and ecological context for their origin can be inferred.

A number of taxa have been proposed to be important for such inference, and to determine the ancestral condition of teleosts. I review recent contributions aimed at organising the taxonomic groups of fishes at or near the base of teleostean phylogeny. I will first discuss the Teleostei as a taxonomic group, and then the diversity and evolution of subgroups of near-teleosts and basal teleosts, as well as recent hypotheses of interrelationships among these groups. Finally, I will discuss the geological and ecological context of the early teleostean radiation based on these studies.

# WHAT IS A TELEOST?

Greenwood *et al.*'s (1966) *Phyletic studies of teleostean fishes, with a provisional classification of living forms* is widely regarded as the beginning of the modern study of teleostean fishes. Although this study was not cladistic in its approach, the authors broke apart long-standing and indefinable groups of fishes, such as the Isospondyli and Malacopterygii, and provided lists of characters that supported forming various subgroups of teleosts, such as their Divisions I, II and III, and their various subgroups and off-shoots shown in Figure 1. These authors thought that the primary divisions of teleosts arose polyphyletically from †“pholidophoroid holostean” ancestors. Although rooted in an ancestor-to-descendant approach, this study set the stage for cladistic analyses that soon followed (e.g., Nelson 1969; Patterson 1973). It was not until the study by Patterson in 1977 (and also of Patterson & Rosen 1977, and others) that many of the fossil taxa such as †*Pholidophorus* and †*Leptolepis* were organised in a hierarchical manner relative to extant teleosts (Figure 2). Patterson's (1977) paper set the stage for the modern study of the basal phylogeny of teleosts, which is discussed in the remainder of this account.

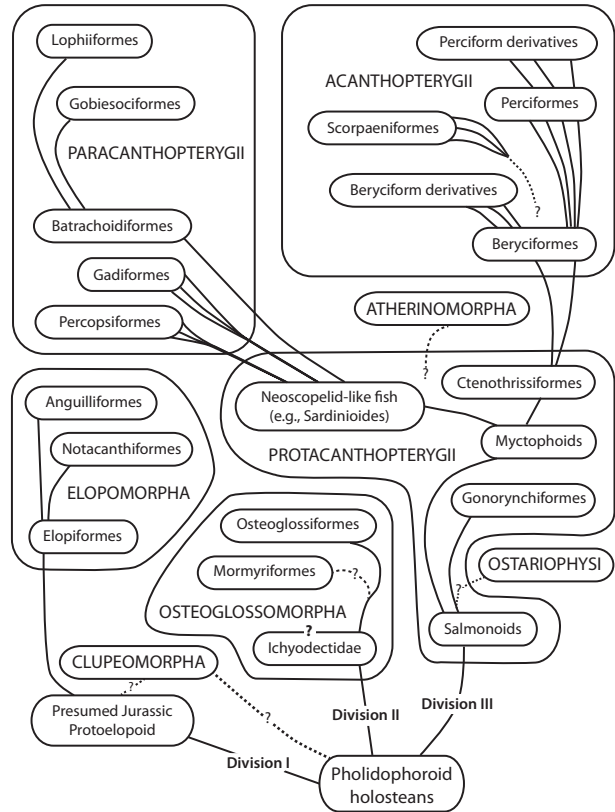


Figure 1 Phylogeny of Teleostei (from Greenwood *et al.* 1966).

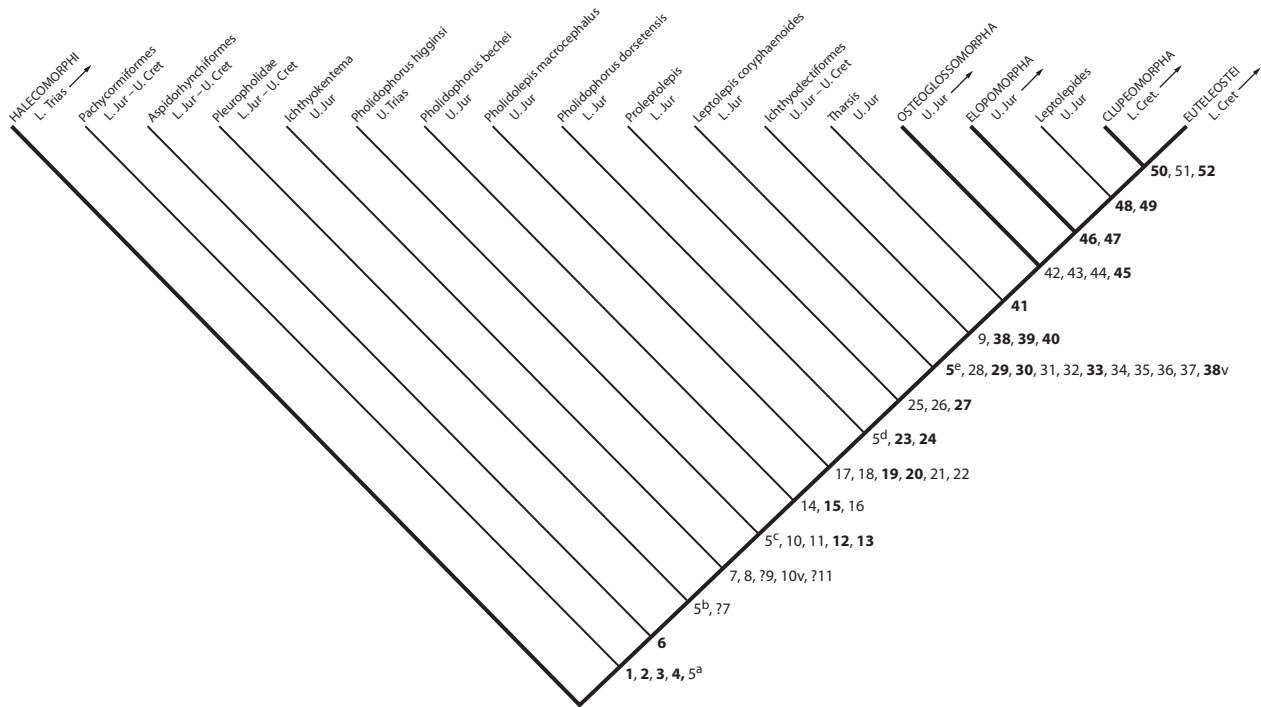


Figure 2 Phylogeny of Teleostei (from Patterson 1977).



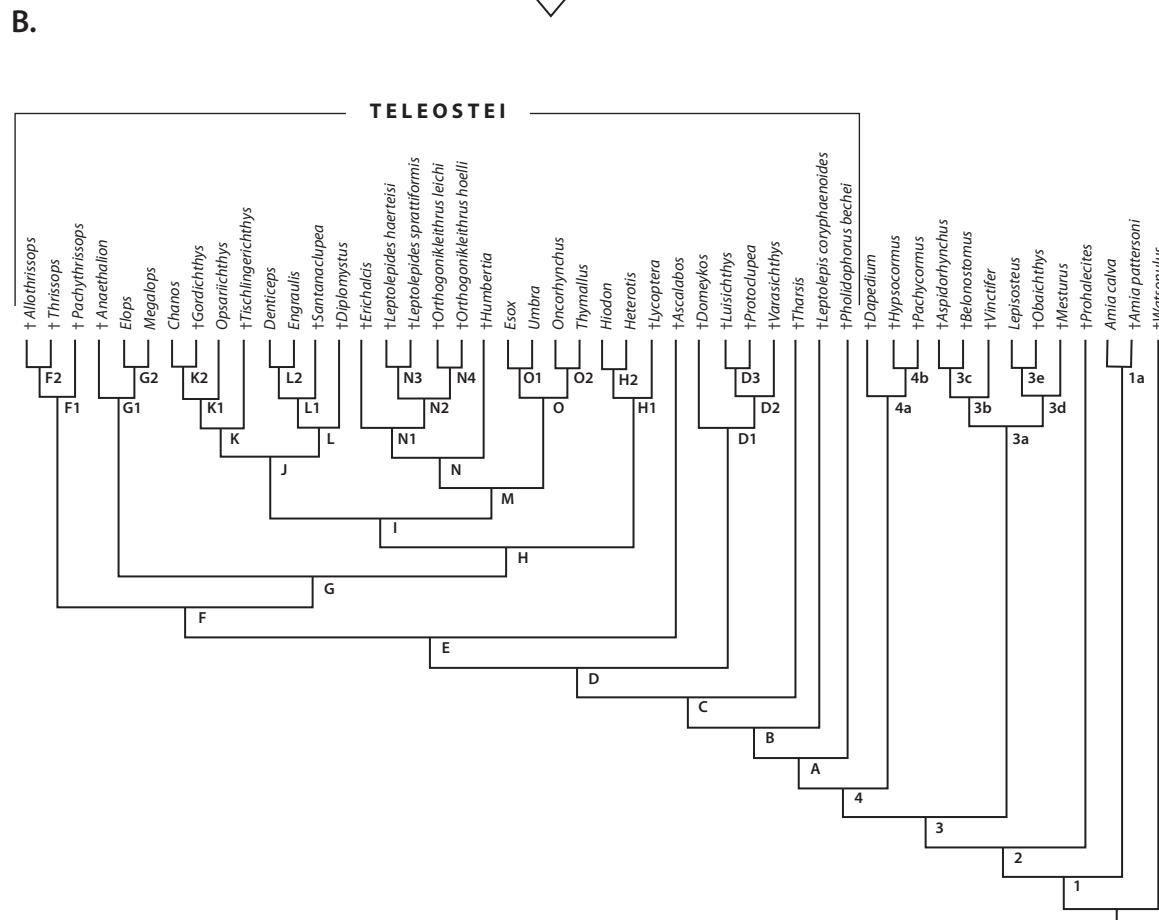
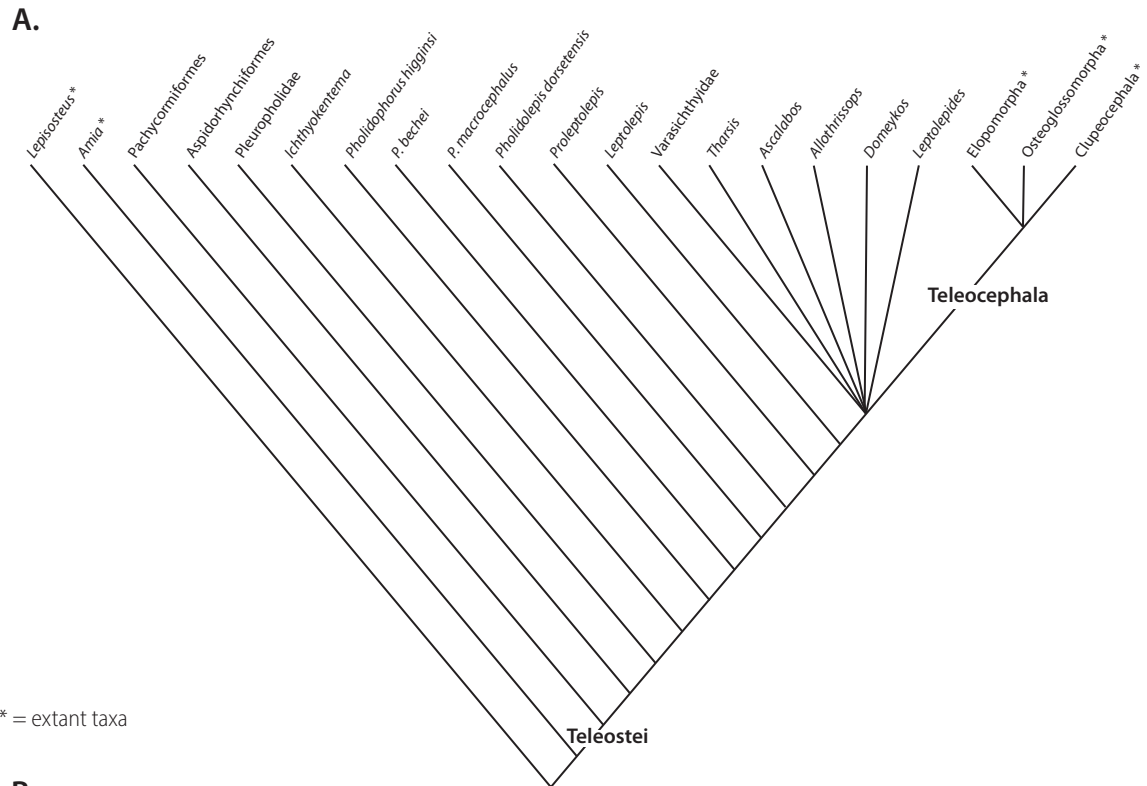
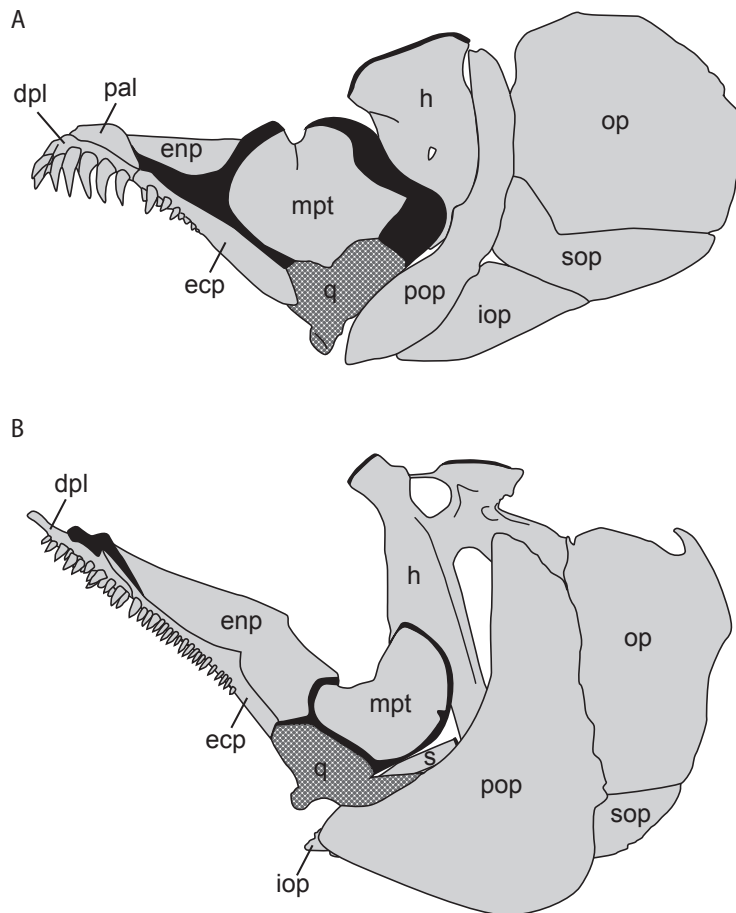


Figure 3 Phylogeny of Teleostei (A from De Pinna 1996, and B from Arratia 1999).

Two approaches have been used to identify which taxa should be included in the group called the Teleostei: a node-based approach, and a character-based approach. In a synthesis of teleostean systematics, De Pinna (1996) included within the Teleostei all neopterygians more closely related to each other than to Ginglymodi or Halecomorphi, and named the crown-group the Teleocephala, containing all extant teleosts: Osteoglossomorpha, Elopomorpha and Clupeocephala (Figure 3A; see Figure 12 for images of the fishes). De Pinna's Teleostei was defined by many synapomorphies, which included characters from the caudal skeleton, the gill and hyoid arches, jaws, braincase, axial skeleton, appendicular skeleton, and various soft-tissue systems. The taxonomic distribution of the characters he selected is, however, variable and some are not found in the stem-groups of his Teleostei. For Arratia (1997, 1999, 2004), by contrast, the Teleostei comprises all those taxa that share a unique and unambiguous synapomorphy – the presence of a posterodorsal process of the

quadrate (Figure 3B, Figure 4). In this definition, at least three groups of non-holostean neopterygians are excluded from Teleostei (but are included in her Teleosteomorpha), whereas other fossil taxa are included. In other words, De Pinna's Teleostei is roughly equivalent to Arratia's Teleosteomorpha. Wiley & Johnson (2010) adopted Arratia's definition of Teleostei in their classification, and considered teleosteans as "all fishes, fossil and living, that stem from the immediate ancestral species whose descendants include †*Pholidophorus bechei* [= †*Dorsetichthys bechei*, Arratia 2013] and all more apical teleosts, but which do not include descendants of the ancestor species of Holostei". This definition left open the possibility of expanding the Teleostei (as occurred with Arratia's 2013 definition of a monophyletic †Pholidophoridae; Figure 5). For the sake of consistency, and in recognition of the as-yet-unresolved relationships of several groups of neopterygians, I will use Wiley & Johnson's (2010) classification as a working definition of the Teleostei.



**Figure 4** Suspensorium of **A** *Amia calva* (drawn from Grande & Bemis 1998) and **B** *Hiodon alosoides* (drawn from Hilton 2002), showing posterior process of the quadrate (labelled **q**).

**Abbreviations:** **dpl** dermopalatine; **ecp** ectopterygoid; **enp** endopterygoid; **h** hyomandibula; **iop** interopercle; **mpt** metapterygoid; **op** opercle; **pal** palatine; **pop** preopercle; **q** quadrate; **s** symplectic; **sop** subopercle.

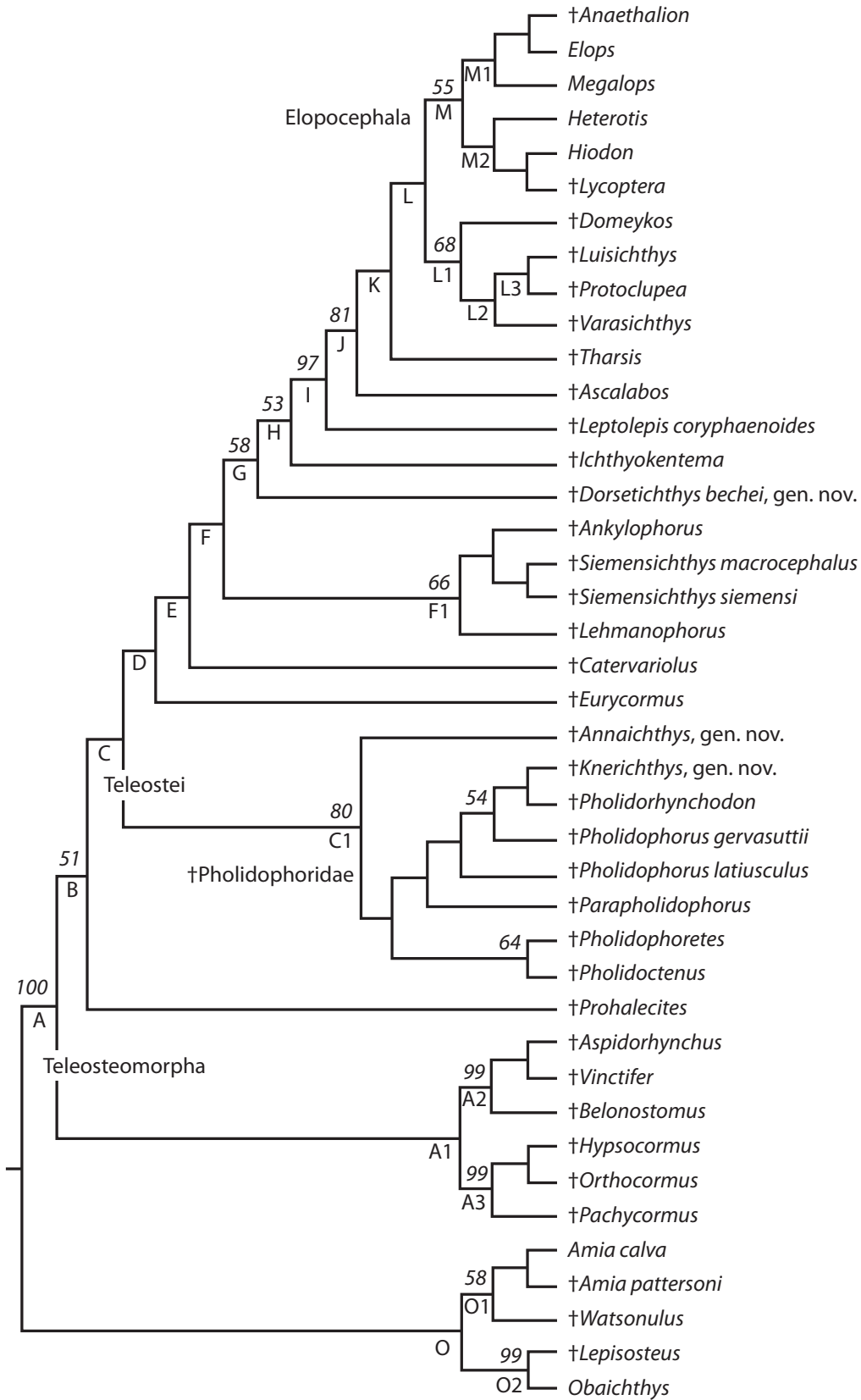


Figure 5 Phylogeny of Teleostei (from Arratia 2013).



## DIVERSITY OF BASAL TELEOSTS AND 'NEAR-TELEOSTS'

†*Pycnodontiformes* (from Greek *pychnos*, dense, strong or solid, and *odontos*, tooth).

In contrast to the †Pachycormiformes and †Aspidorhynchiformes (dealt with below and which are both taxonomically relatively depauperate with about 15 and six genera, respectively [Lambers 1992; Liston 2008; Friedman *et al.* 2010]), the †Pycnodontiformes are a taxonomically rich group of more than 30 genera. However, like the other two orders of 'near-teleosts', the †Pycnodontiformes have a characteristic bauplan (Figure 6A). They are typically small (<50 cm), deep-bodied fishes, similar to many modern reef-associated fishes (such as pomacanthids, chaetodontids and acanthurids), although †*Gyrodus circularis* reached lengths of 200 cm SL (Kriwet & Schmitz 2005; Kriwet 2008). This bauplan was extremely successful and the †Pycnodontiformes are known from the Late Jurassic through the Oligocene [140 to ~25 MYA] (Nursall 1996, 1999, 2010), and have been found nearly worldwide. In the words of Nursall (2010: 38), "The fish thrived in marine, brackish, and freshwater habitats. Many lived in shallow, reefal environments, with many of the swimming adaptations common to reef fishes, whatever their phylogeny (laterally compressed bodies; posteriorly placed dorsal and anal fins, elongated snouts, etc.). Some probably lived an open-water, pelagic life (†*Gyrodus* spp.), as suggested by Kriwet & Schmitz (2005). Large orbital size suggests that some were nocturnal (†*Gyrodus hexagonus*). Some were benthic (†*Coccodus armatus*). Some probably were cryptic (†*Ichthyoceros spinosus*). Some served as prey (Everhart 2007). Pycnodonts were a successful, significant component of the faunas and ecosystems in which they lived."

The monophyly of †Pycnodontiformes has been well established. Many of the synapomorphies for this group are related to their unique mode of feeding, with molariform teeth on the vomer and prearticular, and modifications of the skull, such as the reduction of the opercle and absence of the subopercle and interopercle (Poyato-Ariza & Wenz 2002; Kriwet 2005). Within the group, however, there is considerable variation in the structure of the skull, in part reflecting feeding modes of individual taxa, such as herbivorous grazers (Kriwet 2005). Much of this variation is reflected in the form of the teeth and tooth plates, which are important for the taxonomy of †pycnodontiform fishes. About 700 species have been named, but only ~80 are known from skeletal specimens; the rest are known only from their teeth (Kriwet 2004, 2005, 2008).

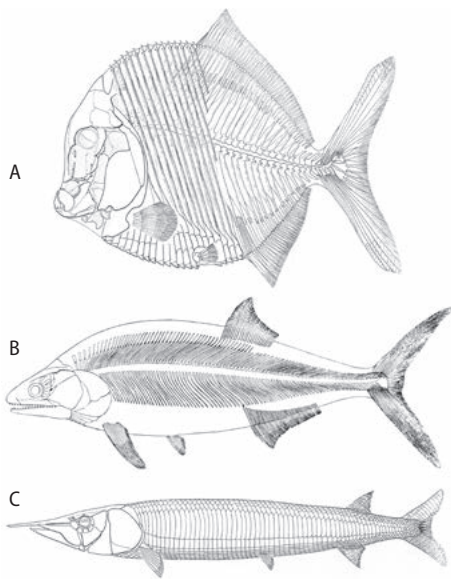
Nursall (2010) provided a list of characters for the group, which is a mixture of unique features that are presumed synapomorphic for †pycnodontiforms, and derived features

that are not necessarily limited to the order, such as a median vomer and a homocercal caudal fin. His diagnosis was also not based on a cladistic analysis. Given the variation in datasets used, it is not surprising that recent phylogenetic studies and their resulting classifications do not agree with each other. Based on their analysis of characters from the entire skeleton, Poyato-Ariza & Wenz (2002) recognised five families in the order, although they considered the phylogenetic affinities of many genera to be unclear. Kriwet (2005) focused on only cranial characters, including dentition, and arrived at a different set of relationships within the group.

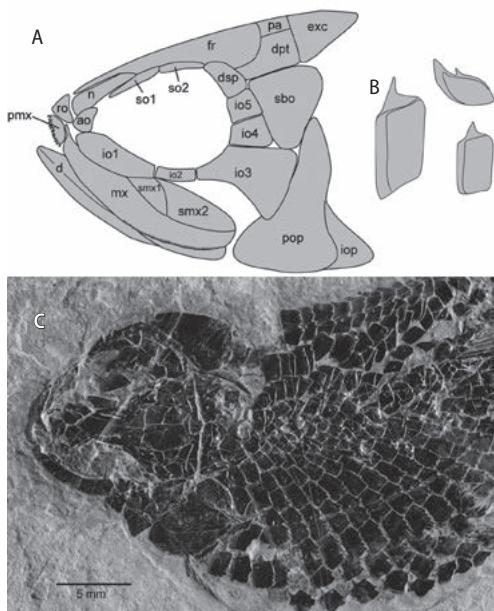
†*Pachycormiformes* (from Greek *pachys*, thick, and *kormos*, a stump or log).

The †Pachycormiformes are typically large-bodied marine fishes known from the Jurassic to the Late Cretaceous (~200 to 70 MYA) of Europe, North America, South America and Asia. The order includes at least 15 genera classified in a single family, the †Pachycormidae (Lambers 1992; Liston 2008; Friedman *et al.* 2010; Arratia & Schultze 2013). These pelagic and (largely) predatory fishes superficially resemble modern scombroids (tunas and relatives), with large pectoral fins, high aspect-ratio caudal fins, and a trend toward a longer head, giving them a 'tuna-like' profile (Figure 6B). There is, however, substantial morphological and ecological variation within the group; a †pachycormiforms subgroup, for example, includes four genera of fishes without teeth (Liston 2008; Friedman *et al.* 2010). These presumably filter-feeding fishes range from ~2 metres for †*Asthenocormus* to the 9-m-long †*Leedsichthys*, the largest bony fish known. †Pachycormiforms typically were large-bodied fishes with weakly ossified skeletons that are generally poorly preserved. Exceptions include the recently described, well-preserved †*Bonnerichthys* from the Upper Cretaceous of North America (Friedman *et al.* 2010) and a very well-preserved specimen of †*Orthocormus roeperi* described from the Late Jurassic of Germany (Arratia & Schultze 2013).

The order †Pachycormiformes can be defined on the basis of a number of synapomorphies; again, not all are found in all taxa. These include the presence of a rostrodermethmoid bone, the dermosphenotic forming the dorsal margin of the orbit, a 'scythe-like' pectoral fin with rays branching in an asymmetrical Y-pattern, and the presence of a hypural plate. The presence of peculiar 'uroneurals', which are median structures associated with vertebrae supporting the caudal fin (rather than paired structures, as are 'true' uroneurals; Figure 8B), can also be considered a synapomorphy of the group (Arratia & Lambers 1996; Schultze & Arratia 2013).



**Figure 6** Reconstructions of **A** †Pycnodontiformes (†*Neoprosclinetes penalvai*, from Maisey 1991), **B** †Pachycormiformes (†*Hypsocormus insignis*, from Woodward 1895), and **C** †Aspidorhynchiformes (†*Vinctifer comptoni*, from Maisey 1991).



**Figure 7** †Pholidophoridae **A** Reconstruction of skull of †*Dorsetichthys* (= †*Pholidophorus*) *bechei* (drawn from Nybelin 1966, and Arratia 2000). **B** Illustration of scales of †*Dorsetichthys* (= †*Pholidophorus*) *bechei* (drawn from Arratia 2000). **C** †*Pholidoctenus serianus* from the Late Triassic of Italy. Head and anterior portion of body showing skull roof, jaws, and body scales (MCSNB 2875; photo courtesy of G Arratia).

**Abbreviations:** **ao** antorbital; **d** dentary; **dpt** dermopterotic; **dsp** dermosphenotic; **exc** extrascapular; **fr** frontal; **io** infraorbital; **io1** interopercle; **mx** maxilla; **n** nasal; **pa** parietal; **pmx** premaxilla; **pop** preopercle; **ro** rostral; **sbo** suborbital; **smx** supramaxilla; **so** supraorbital.

†*Aspidorhynchiformes* (from Greek *aspidos*, a shield, and *rhynchos*, a beak or snout).

The †Aspidorhynchiformes are a group of more than 20 species in six genera, all included in †Aspidorhynchidae (see Arratia 2015; Gouiric-Cavalli 2015). The order is known from deposits from the Middle Jurassic to the Late Cretaceous (~150 to 70 MYA) of Europe, North and South America, Africa, Asia, Australia and Antarctica, and are best represented in North and South America and Europe (Brito 1997). These are largely marine fishes that are superficially like Beloniformes (the flyingfishes, halfbeaks and relatives), with a long snout (Figure 6C) formed primarily by the premaxillae, although both upper and lower jaws are elongate and the lower jaw has a unique median predentary bone. Their bodies are elongate and covered in heavy ganoid scales, those along the flanks are relatively tall and rectangular in shape (Figure 6C). The dorsal and anal fins are set far back, suggesting that these were ambush predators similar to lepisosteids (gars), esocids (pikes), and beloniform fishes.

In all recent studies the monophyly of †Aspidorhynchiformes has been well supported. Brito (1997) found four synapomorphies for the order: the presence of an occipital process formed by the intercalar and autopterotic bones, an elongate snout formed by the premaxillae (the “rostral tube” of Brito 1997), the posterior positioning of the preopercular sensory canal, and the presence of a predentary bone (see also Arratia 2013). Further, considering only the genera †*Aspidorhynchus*, †*Belonostomus*, and †*Vinctifer*, Brito concluded that †*Belonostomus* and †*Vinctifer* were sister-taxa, with †*Aspidorhynchus* as the sister-group of this clade. By contrast, Arratia (1999, 2000, 2013) – also only considering the three genera – suggested that †*Belonostomus* and †*Aspidorhynchus* were sister-taxa relative to †*Vinctifer*. Both these ‘models’ fit a Pangean origin for the †Aspidorhynchiformes sometime by the Late Jurassic (Brito 1997; Arratia 2000; Gouiric-Cavalli 2015) [Laurasia and Gondwana were largely separate by the Late Jurassic.] With the recent description of two new Southern Hemisphere genera of †Aspidorhynchidae (Gouiric-Cavalli 2015; Arratia 2015), the known Gondwanan diversity of the family (all six genera) was greater than that of Laurasia with only two genera, although records of †*Aspidorhynchus* from Antarctica need to be confirmed (Gouiric-Cavalli 2015).

†“*Pholidophoriformes*” (from Greek *pholidos*, a horny scale, and *phoros*, to bear).

The so-called †“pholidophorid”, or †“pholidophoriform” fishes, as commonly encountered in text book descriptions of teleostean diversity, form a non-monophyletic assemblage of generally small-bodied marine fishes. Louis Agassiz (1833–1844), who first described the genus †*Pholidophorus*, included it among his ‘ganoid’ fishes because of a scale jacket formed by heavy, interlocking ganoid scales (Figure 7). Many of the taxa historically placed within the †“Pholidophoriformes” are spread at the base of Teleostei (Arratia 2000, 2013). The †Pholidophoriformes *sensu stricto*, however, is limited to †*Pholidophorus* and those taxa that are more closely related to it than to any other teleost, although the taxonomic extent of even this genus is uncertain (Nybelin 1966; Zambelli 1986; Arratia 2000, 2013). Zambelli (1986) restricted the genus to include only two of the seemingly countless nominal species, †*P. latiusculus* and †*P. bechei*. †*Pholidophorus latiusculus*, the poorly preserved type-species for the genus, is known from the Late Triassic of Austria (Arratia 2013), and †“*P.*” *bechei*, one of the best known taxa among these fishes, is known from the Early Jurassic of England. This concept of †*Pholidophorus*, comprising at least these two taxa, was supported by Arratia (2000), based on details of the

frontal bones, among other characters. In a more recent and broader study of Triassic †“pholidophoriform” fishes, Arratia (2013) concluded that †“*P.*” *bechei* was best removed from the genus, and placed in a new genus †*Dorsetichthys*, which is more closely related to extant teleosts than to members of the family †Pholidophoridae *sensu stricto* (Figure 5; Arratia 2013).

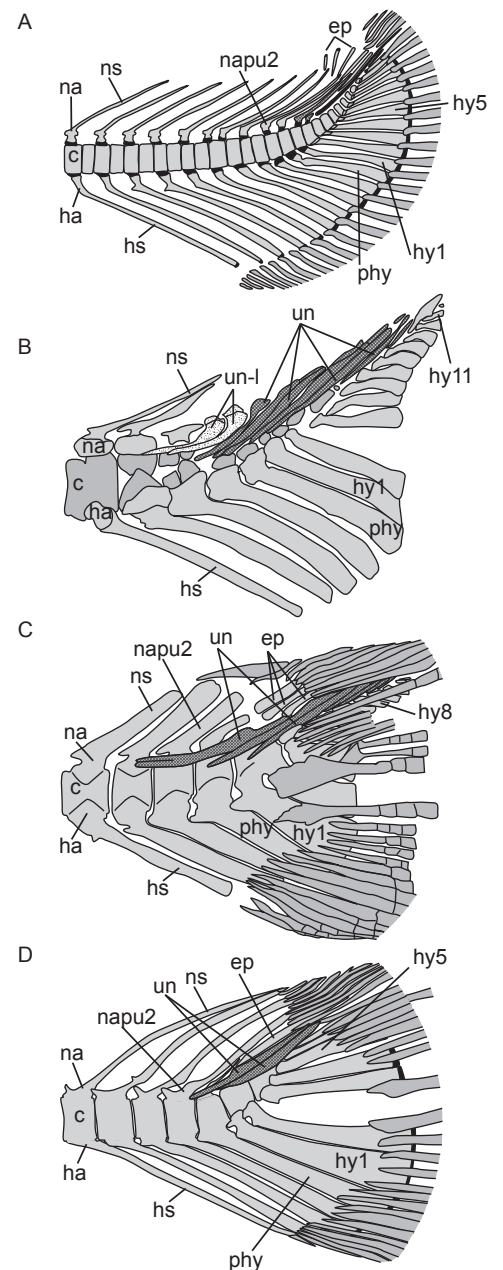
The sister-group relationship between †Pholidophoridae *sensu stricto* and all other teleostean fishes is supported by at least nine characters (Arratia 2013), which include having the quadrate-mandibular joint below the posterior half of the orbit, the presence of a so-called ‘leptolepid notch’ on the dentary (lost in crown-group teleosts), and the position of the dorsal fin above the anterior of the pelvic fins. Many taxa included in †“Pholidophoriformes” *sensu lato* (e.g., †*Eurycormus*) share with other teleosts a number of characters, most of which display varying degrees of homoplasy, including the presence of a quadrate with a posterodorsal process, elongation of some of the ural neural arches to form uroneurals (Figure 8; many of these fishes also have elongated neural arches in the preural region that resemble, but are not, true uroneurals – Schultze & Arratia 2013), having the propterygium fused to the first pectoral-fin ray, the absence of coronoid bones in the lower jaw, and the presence of a mobile premaxilla (Patterson & Rosen 1977; Arratia 1999).

†“*Leptolepiformes*” (from Greek *leptos*, thin or slender, and *lepidion*, a scale).

As for the †“Pholidophoriformes”, the traditional use of the order †“Leptolepiformes” has resulted in a dramatically polyphyletic assemblage of small, fusiform basal teleosts (Arratia 1997; Figure 9A). Many of the species have been described in the genus †“*Leptolepis*” (or others closely allied to it) for “stratigraphic or geographical reasons rather than on morphological grounds. Species sometimes have been referred to †*Leptolepis* simply because of stratophenetic resemblances such as small size, ossified vertebrae, thin scales, and Mesozoic age” (Maisey 1991: 272). Many of the taxa that have historically been assigned to this order (or to other variously ranked higher taxa bearing the root *Leptolep-*), have in recent phylogenetic analyses been found to be distributed throughout the Teleostei, for instance, †*Ascalabos* and †*Tharsis* are Teleostei *incertae sedis* (Arratia 1997); †*Anaethalion* in the Elopomorpha (Nybelin 1971); and †*Leptolepides* in the Euteleostei (Arratia 2008). Patterson & Rosen (1977) first demonstrated that this grouping, in its most general use, is not monophyletic, and has been supported in the more recent studies of Arratia (2004, 2008) and others.

The wide disparity between studies in families and higher taxa included with the †*Leptolepis*-like fishes, and the demonstrable polyphyly of the †“Leptolepiformes” *sensu lato*, led Arratia (1997) to suggest that using these high-rank names should be avoided. However, because of the widespread use of †“Leptolepiformes” as a taxon and because of the basal position of †*Leptolepis coryphaenoides*, the type species for the genus and the best known of the nominal taxa (Patterson & Rosen 1977), the †Leptolepiformes *sensu stricto*, should perhaps be limited to the type species, †*L. coryphaenoides*. As further well-preserved material is discovered and described, the taxonomic content of †Leptolepiformes likely will grow.

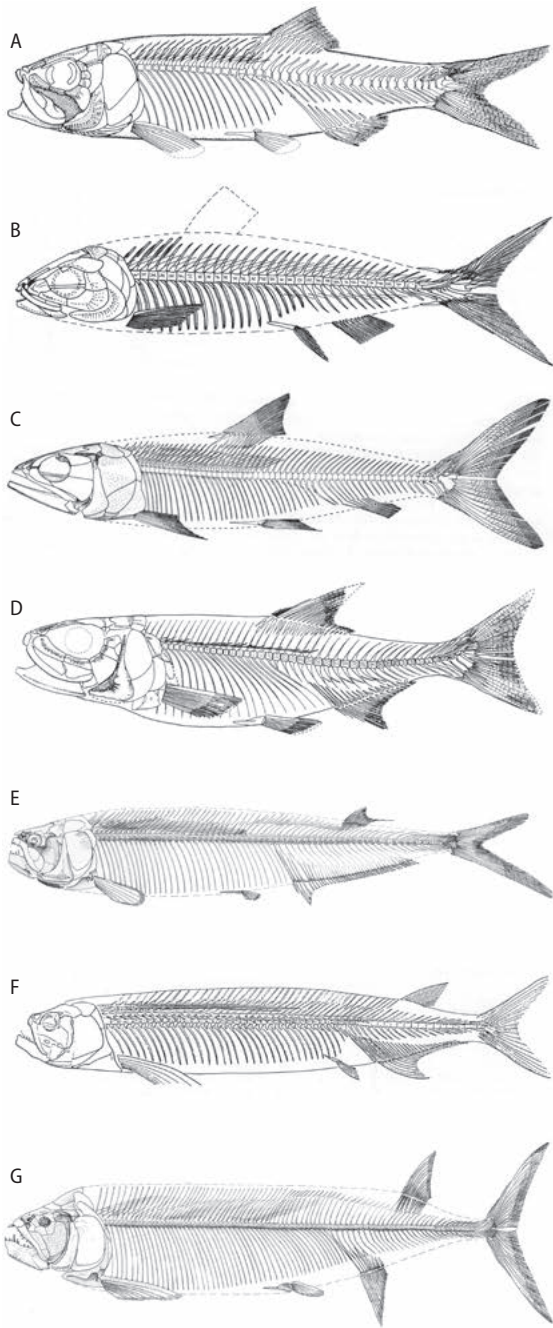
†*Leptolepis coryphaenoides* is known from the Early Jurassic of Europe, and is a small, marine fish with a generalised body form (Figure 9A). This species shares a number of characters with more derived teleosts, including the presence of a supraoccipital bone, the presence of cycloid scales, the presence of an urohyal, and a homocercal caudal skeleton (Arratia 2013; Figure 8C).



**Figure 8** Caudal skeletons from **A** *Amia calva* (drawn from Grande & Bemis 1998), **B** †*Eurycormus speciosus* (drawn from Schultze & Arratia 2013), **C** †*Leptolepis coryphaenoides* (drawn from Schultze & Arratia 2013), and **D** *Hiodon alosoides* (drawn from Hilton 2002) showing elongation of ural neural arches to form uroneurals in teleosts (uroneurals labelled **un**; note the ‘uroneural-like’ elongated bones associated with the preural vertebrae in †*Eurycormus* labelled **un-l**).

**Abbreviations:** **c** centrum; **ep** epural; **ha** haemal arch; **hs** haemal spine; **hy** hypural; **na** neural arch; **napu2** neural arch of preural 2; **ns** neural spine; **phy** parhypural; **un** uroneural; **un-l** uroneural-like bones of the preural vertebrae.





**Figure 9** Reconstructions of **A** †Leptolepiformes (†*Leptolepis coryphaenoides*, from Arratia 1996), **B–D** †Crossognathiformes (**B** †*Crossognathus sabaudianus*, from Taverne 1989; **C** †*Notelops brama*, from Forey 1977; **D** †*Varasichthys ariasi*, from Arratia 1997), and **E–G** †Ichthyodectiformes (**E** †*Eubiodectes libanicus*, from Cavin *et al.* 2013; **F** †*Cladocyclus gardneri*, from Maisey 1991; **G** †*Xiphactinus audax*, from Cavin *et al.* 2013).

†**Crossognathiformes** (from Greek *krossoi*, a fringe or tassel, and *gnathos*, a jaw).

Members of the Crossognathiformes have been historically included within different subgroups of teleosts (Forey 1977; Taverne 1989; Maisey 1991; Arratia 2008). Taverne (1989) brought together the †crossognathoids (e.g., †*Crossognathus*; Figure 9B) and the †pachyrhizodontoids (e.g., †*Notelops*; Figure 9C) and considered the order to be the sister-group to the Clupeocephala. However, Arratia (2008) and Arratia & Tischlinger (2010) interpreted the †Crossognathiformes to be basal teleosts below the level of †Ichthyodectiformes. These marine taxa all uniquely share the presence of a large posttemporal fossa surrounded by the epioccipital, pterotic, exoccipital and intercalar, and the presence of a large, well-developed extrascapular bone (Arratia & Tischlinger 2010).

Cavin (2001) suggested that the †crossognathiforms, as defined by Taverne (1989), were not monophyletic. Rather, he concluded that †crossognathoids were more closely related to the family †Varasichthyidae and that the †pachyrhizodontoids are basal euteleosts. The †Varasichthyidae is a group of five largely monotypic genera of generalised fusiform teleostean fishes known from Late Jurassic marine deposits of South America and Cuba (Figure 9D). All †varasichthyids have a series of tubules along the ventral limb of the preopercle and cycloid scales with transverse lines crossing the circuli in the middle of the scale, as well as a number of other characteristics. In contrast to most neopterygians and basal teleosts, †varasichthyids lack teeth on the parasphenoids.

Arratia (2008) and Arratia & Tischlinger (2010) re-examined the relationships among these groups, and concluded that all of these fishes (†Crossognathiformes *sensu* Taverne 1989, and †Varasichthyidae) and the genus †*Chongichthys* (of the Late Jurassic, South America) formed a monophyletic group. This clade is diagnosed by six characters, two of which are non-homoplastic (an enlarged extrascapular that reaches the posterior margin of the opercle and a large, roofed posttemporal fossa that is surrounded by the epioccipital, pterotic, exoccipital and intercalar). The †Crossognathiformes *sensu* Arratia & Tischlinger (2010) were also found to be within a polytomy with †*Ascalabos* and the group †Ichthyodectiformes + crown-group Teleostei, which all share the absence of a preopercular process on the posterior margin of the hyomandibula. This phylogeny supports a biogeographical connection between the eastern Pacific (western South America) and the western Tethys Ocean (western Europe) through a Caribbean corridor (Cuba) in the Late Jurassic. This is in addition to a more southern corridor through the central Atlantic connecting eastern South America (Brazil) and the Tethys (Europe, northern Africa, Australia) in the Cretaceous, as reflected in the distribution of †pachyrhizodontoids. Further resolution of the phylogeny of the †pachyrhizodontoids, however, is needed to better understand the biogeography of this group (López-Horgue *et al.* 2014). The occurrence of a †pachyrhizodontoid in the Late Cretaceous of the Iberian Peninsula represents the transition from the earlier non-teleostean fauna in the region (e.g., Amiiformes, Ginglymodi, †Pycnodontiformes) to one in which teleostean fishes became dominant (López-Horgue *et al.* 2014).

†*Ichthyodectiformes* (from Greek *ichthys*, a fish, and *dēktikos*, able to bite).

Like the †*Crossognathiformes*, the †*Ichthyodectiformes* have been allied to several groups of teleostean fishes, either as a whole (to the Osteoglossomorpha by Greenwood *et al.* 1966 and Taverne 1973, 1974; and to the Elopomorpha by Nelson 1973), or in part (to the clupeomorph genus *Chirocentrus* by Bardack 1965). Following Patterson & Rosen's (1977) revision of this group, it has been corroborated and widely accepted as a monophyletic group that is a close sister-group to the crown-group Teleostei (e.g., Arratia 1997, 1999, 2008). This order includes at least 30 known species and is known from the middle Jurassic (†*Occithrissops*) through the Late Cretaceous (e.g., †*Xiphactinus*). In contrast to the pattern seen in other groups of fishes from the same time period, the †*Ichthyodectiformes* do not show any distinct radiation in the Late Albian to Cenomanian time frame (~110 to 95 MYA), but a relatively constant diversity across its entire existence (Cavin *et al.* 2013). These marine fishes range greatly in size, from relatively small taxa such as †*Eubiodes* (Late Cretaceous, Lebanon, maximum known size ~32 cm) to the gigantic †*Xiphactinus* (Early Cretaceous, North America), which reached lengths of more than 4 m and was an apex-predator of the Western Interior Seaway of North America. All †*Ichthyodectiformes* were piscivorous predators with a fusiform body and high aspect-ratio caudal fins, indicating they were pelagic fishes suited for sustained swimming (Cavin *et al.* 2013) – a 4.0-m specimen of †*Xiphactinus* was preserved with an entire specimen of †*Gillicus* in its stomach.

Patterson and Rosen (1977) first defined the †*Ichthyodectiformes* as a distinct monophyletic group, based on the presence of an ethmo-palatine bone in the nasal capsule, enlarged coracoids that meet each other in the midline, the presence of uroneurals that cover the lateral face of the preural centra, and other characters, as synapomorphies. Within this group they recognised two primary groups: the †*Allothrissopoidei*, which included only the Late Jurassic European taxon †*Allothrissops* (though possibly also †*Thrissops* and †*Pachythrissops*, Arratia 1997), and the †*Ichthyodectoidei*, which was divided into two families: †*Ichthyodectidae* (Late Jurassic to Late Cretaceous; e.g., †*Ichthyodectes*, †*Xiphactinus* and †*Cladocyclus*) (Figure 9F, G) and †*Saurodontidae* (Cretaceous; †*Saurodon* and †*Saurocephalus*).

Maisey (1991) reconsidered the interrelationships within the †*Ichthyodectiformes* following his study of †*Cladocyclus* (Early Cretaceous, South America), and found the pattern of relationships to be more complicated than reflected in the classification of Patterson & Rosen (1977). Only the enlarged coracoid character of Patterson & Rosen

survived as a synapomorphy of the order, to which he added having teeth in a single series, and a long, falcate anal fin opposed by a short dorsal fin. He found that within the †*Ichthyodectiformes*, †*Occithrissops* is the sister-group of a series of small, generalised members of the order that formed a largely unresolved bush at the base. The †*Ichthyodectoidei sensu* Maisey (1991), similar in overall content to Patterson & Rosen's suborder, includes three families, the †*Cladocyclidae*, †*Saurodontidae* and †*Ichthyodectidae*, for the larger, more overtly predaceous, genera. Stewart (1999) concluded that †*Saurodontidae* was indeed monophyletic and that †*Cladocyclus* (the sole representative of †*Cladocyclidae* included in his analysis) was separate from the other †*ichthyodectoid* families. He also found that †*Ichthyodectidae sensu* Maisey (1991) was paraphyletic, with †*Gillicus* more closely related to †*Saurodontidae*, and that the relationship of †*Ichthyodectes* and †*Xiphactinus* was unresolved.

Based on a study of †*Eubiodes* (Figure 9E), along with some poorly known †*ichthyodectiform* taxa, Cavin *et al.* (2013) excluded †*Ascalabothrissops* and †*Pachythrissops* from the order, redefined and reconstituted the †*Cladocyclidae*, †*Ichthyodectidae* and †*Saurodontidae*, and considered †*Allothrissops*, †*Occithrissops* and †*Thrissops* to be basal to the three families. In this conception, the †*Ichthyodectiformes* was defined by 12 characters, including aspects of the jaws (e.g., retroarticular and angular contributing to the articular facet for the quadrate), median fins (anterior pterygiophores arranged in clusters and extending into interneural and interhaemal spaces), and the caudal-fin skeleton (e.g., eight hypurals). Of the three defined families, †*Ichthyodectidae* was found to be sister-group to †*Saurodontidae*, although this arrangement was based on homoplasy.

†*Ichthyodectiform* fishes are found worldwide, although more so in the Northern Hemisphere, which may be a bias in the fossil record and of fossil collecting (Cavin *et al.* 2013). Based on these authors' phylogeny, the basal †*Ichthyodectiformes* (†*Allothrissops*, †*Occithrissops* and †*Thrissops*) were in the Late Jurassic distributed along the western continental margins of Laurasia and Gondwana and the western portion of the Tethys Ocean. Through the early and mid-Cretaceous, with the opening of the central Atlantic Ocean, †*Ichthyodectiformes* were mostly found along the northern margin of western Gondwana as well as along the southern margin of the Tethys Ocean. By the Late Cretaceous there was a distinct northern distribution for the group (Cavin *et al.* 2013). It is suspected that vicariance likely influenced the speciation of these later †*Ichthyodectiformes*, as there were species pairs recovered in the European Western Boreal Chalk Sea and the North American Western Interior Sea Way (Cavin *et al.* 2013).

## CROWN-GROUP TELEOSTEI

Three primary divisions at the base of the crown-group are widely recognised: the Elopomorpha, Osteoglossomorpha and Clupeocephala. These groups have been largely recognised as monophyletic, both individually and collectively, in nearly all morphological and molecular analyses.

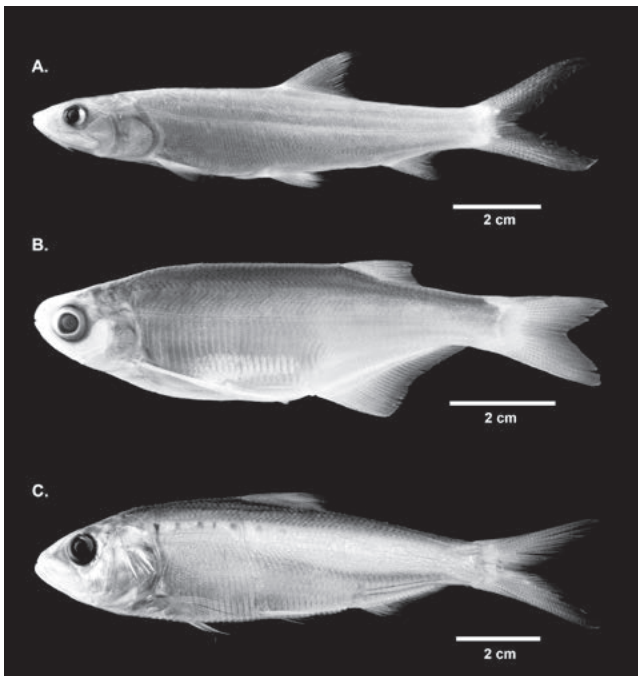
The **Elopomorpha** (from Greek *elopos*, a kind of sea-fish, and *morphē*, form) includes the tarpons and ladyfishes (Elopiiformes; Figure 10A), bonefishes (Albuliformes), spiny eels (Notacanthiformes), and the true eels (Anguilliformes). With more than 850 extant species (mostly Anguilliformes), elopomorphs form a large and diverse group. Virtually all elopomorphs are marine (only four species are considered freshwater), although there are many diadromous examples, including the eels of the genus *Anguilla*, which are a text-book example of catadromy. All elopomorphs share a peculiar form of larval stage, called a leptocephalus larva. Although there is a tremendous diversity in the external form of these larvae, their similarities and specialisations across the diversity of Elopomorpha are impressive, and include an elongate, laterally compressed body that is filled with a gelatinous substance covered by a thin layer of muscle, and a small tubular gut positioned along the ventral margin of the body. Other characters that support the monophyly of Elopomorpha include prenasal ossicles (Forey *et al.* 1996), a rostral commissure supported by the mesethmoid (Arratia 1999),

a compound preural 1 + ural 1 neural arch formed by a mass of cartilage (Arratia 1999), and a unique form of spermatozoa (Forey *et al.* 1996). The Elopomorpha is present in the fossil record by the Late Jurassic.

Among extant teleostean fauna, the **Osteoglossomorpha** (from Greek *osteon*, bone, *glōssa*, tongue, and *morphē*, form), the bony tongues, stand out as a heterogeneous group of fishes, ranging from the generalised, stereotypical basal teleostean body form of fishes such as the North American family Hiodontidae (mooneye and goldeye; Figure 10B) to the arowanas (Osteoglossidae, including *Arapaima*, one of the world's largest freshwater fishes), the featherback knifefishes (Notopteridae), and the elephant-nose fishes and the aba (Mormyroidei). Of the approximately 220 living species, more than 200 are in a single family, the Mormyridae, from Africa. These are weakly electric fishes that display an amazing spectrum of morphological and behavioural specialisations. The Osteoglossomorpha is unique among the major divisions of the crown-group teleosts, in that there are more genera known from the fossil record than from the modern fauna, and most of the non-mormyrid genera are either monotypic or represented by only a few species. This rich fossil record extends from the Early Cretaceous of China (e.g., †*Lycoptera*, Chang & Jin 1996).

All living osteoglossomorphs are freshwater fishes, and their distribution (which is largely Gondwanan in pattern) has been held as a primary example of vicariance biogeography (Nelson 1969). However, among the fossil taxa, particularly within the Osteoglossidae, there are a large number of marine forms. These do not seem to form a monophyletic group, suggesting that there was either a marine phase or there were multiple marine invasions sometime in the history of osteoglossids (Forey & Hilton 2010).

This group was named the Osteoglossomorpha by Greenwood *et al.* (1966), based on paired bones or processes on the second hypobranchial of the gill arch, and the presence of a so-called 'primary bite' between the parasphenoid and the median tooth plates of the basihyal and basibranchial bones. However, it has been shown that this 'parasphenoid-tongue bite apparatus' is a complex character formed by both plesiomorphic and apomorphic character states (Hilton 2001). The Osteoglossomorpha is consistently recovered as a monophyletic group in morphological and molecular analyses, and is supported by many skeletal characters, including having large teeth distributed along the length of the parasphenoid, the absence of supramaxillae and supraorbitals, four bones in the infraorbital series, and the presence of a single epural. While the systematics of these fishes has been intensively studied for the last 40 years (Taverne 1979; Li & Wilson 1996; Hilton 2003; Lavoué & Sullivan 2004; Wilson & Murray 2008; Lavoué 2016), there is still much to be learned about their anatomy, systematics and evolution.



**Figure 10** Photographs of **A** Elopomorpha (*Elops saurus*), **B** Osteoglossomorpha (*Hiodon alosoides*), and **C** Clupeocephala (*Alosa sapidissima*). © Virginia Institute of Marine Science



All living non-osteoglossomorph, non-elopomorph teleostean fishes form the **Clupeocephala** (from Greek *clupea*, small river fishes, and *kephalē*, head; Figure 10C). This is a morphologically, ecologically and behaviourally diverse clade of more than 26 000 species, found worldwide in virtually all aquatic habitats, from the highest mountain streams to the deepest ocean trenches. As a group, they have a long and rich fossil record, reaching back into the Late Jurassic.

The monophyly of Clupeocephala has been well established and is regarded as sound, even though relationships between its constituent taxa continue to be problematic, as one might expect in a group of so many taxa and with the potential for so much homoplasy and character reversal. No brief review can do justice to the questions involved in understanding the diversity of this group of fishes. The Clupeocephala share several morphological apomorphies. These include details of the lower jaw, where the retroarticular is excluded from the jaw joint, and the articular and angular bones are fused (Nelson 1973); the absence of the medial basibranchial tooth plates and of the tooth plates associated with pharyngobranchials 1–3 of the gill arches (Arratia 1997); and of the caudal skeleton, where the neural arch of the first ural centrum is reduced or absent, and the two anteriormost uroneurals are long, separated bones, with six or fewer hypurals (Arratia 1997). The Clupeocephala is also shown as monophyletic in most molecular analyses (e.g., Inoue *et al.* 2003; Near *et al.* 2012; Betancur-R *et al.* 2013).

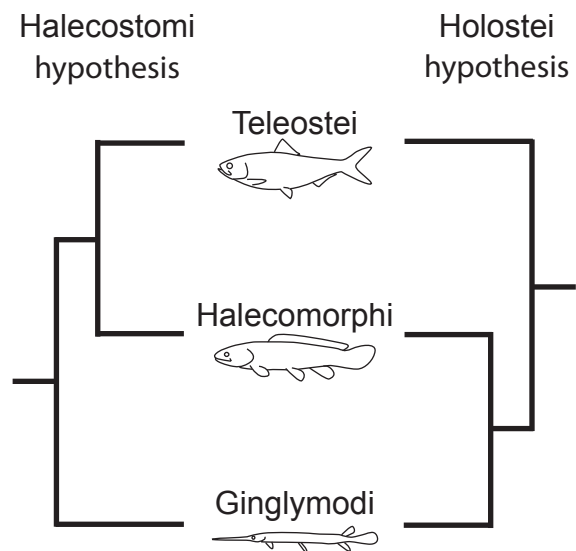
Within the crown-group Teleostei, the relationships among Osteoglossomorpha, Elopomorpha and

Clupeocephala are disputed. In one of the earliest applications of cladistic methodology to the study of the relationships among fossil and living fishes, Patterson (1977; also Patterson & Rosen 1977) postulated that the Osteoglossomorpha were basal, with Elopomorpha and Clupeocephala as each other's closest relatives. This was based on elopomorphs and clupeocephalans having only two uroneurals (rather than three or four as in *Hiodon*, the goldeneye of North America), which extend anteriorly beyond the second ural centrum, and in having epipleural bones throughout the abdominal region. Arratia (e.g., 1991, 1997, 1999) found Elopomorpha to occupy this more basal position. At least some so-called 'fish-like' or 'tailed' (i.e., non-eel-like) elopomorphs do retain a number of plesiomorphies: a gular plate, a suprpharyngobranchial bone, a mandibular sensory canal that opens posteriorly or medially, and the antorbital bone carry the infraorbital canal. The loss or change of these characters can be interpreted as synapomorphies for Osteoglossomorpha + Clupeocephala.

In several studies based on mitochondrial DNA data (e.g., Inoue *et al.* 2003), Osteoglossomorpha has been recovered as the basal relative to Elopomorpha, although there has also been a weakly supported group of Osteoglossomorpha + Elopomorpha recovered in some analyses (e.g., Broughton 2010). More recent molecular analyses which have included nuclear genes support Elopomorpha as the basal lineage of the teleosts, with Osteoglossomorpha as more closely related to Clupeocephala (Near *et al.* 2012; Betancur-R *et al.* 2013).

## INTERRELATIONSHIPS OF MAJOR GROUPS NEAR THE BASE OF TELEOSTEI

The interrelationships among the three major lineages of extant neopterygians, Ginglymodi, Halecomorphi, and Teleostei – dubbed the “gar-bowfin-teleost problem” – has been the focus of a great deal of research over the last 35 years (e.g., see Gardiner *et al.* 1996; Grande & Bemis 1998; Arratia 2001, 2004; Grande 2010; Figure 11). At issue is the origin of teleosts: there is considerable evolutionary space and many recognised taxa fit somewhere between the teleosts and either the ginglymodans or the halecomorphs. Patterson (1973) formally broke apart the long-standing group Holostei (= Ginglymodi + Halecomorphi). In his view, the halecomorphs – *Amia calva* (the bowfin) and those neopterygian fishes more closely related to it than to either ginglymodans or teleosts – were the sister-group of Teleostei. This he based on the presence of a mobile maxilla, an interopercle, epibranchials with uncinat processes, and median neural spines. This phylogeny and the resulting group Halecostomi was quickly and widely adopted among the systematic ichthyological community, though not universally – see Grande & Bemis 1998 for a review of alternative findings. Following a comprehensive examination of the anatomy and



**Figure 11** The two most frequent solutions to the “gar-bowfin-teleost” problem. See text for discussion.

systematics of Lepisosteiformes (building on an earlier study of the Amiidae by Grande & Bemis 1998), Grande (2010) found support for a monophyletic Holostei. Patterson's (1973) characters for Halecostomi were found to be problematic or incorrect, following detailed examination of newly discovered and finely prepared fossil taxa (e.g., the presence of an interopercle in basal gars). In Grande's (2010) analysis, the Holostei was supported by several characters, including two vertebral centra fused to the occiput, the absence of the pterotic bone, paired vomers in the adult, details of the lower jaw, and the presence of four hypobranchials. The Holostei has also been recovered in a number of molecular-based studies (Normark *et al.* 1991; Inoue *et al.* 2003; Near *et al.* 2012), as well as other recent morphological analyses (e.g., Hurley *et al.* 2007; Arratia 2013).

Arratia (2008) noted that in her concept of Teleostei, the group could be defined by the presence of a single, uniquely derived character – presence of a posteroventral process on the quadrate – and several characters that are mosaic in their distribution: the fusion between the propterygium, the presence of uroneurals and a mobile premaxilla. Although

acknowledging it differed from that of †pholidophorids and extant teleosts, Patterson (1973: 274) noted that the quadrate of †*Pachycormus* does have a “small postero-dorsal process”. Lambers (1992: 251) also reported the presence of a posteroventral process on the quadrate in †Pachycormiformes. Because of the significant morphological difference between the very small, weakly developed process found in the †pachycormiforms, and the elongate process of teleosts, Arratia (2004) considered the posteroventral process to be absent in †*Hypsocormus* and †*Pachycormus*, the two †pachycormiform genera included in her analysis.

The †Pachycormiformes have been regarded as more closely related to extant teleosts than to other extant neopterygian groups, based in part on the presence of uroneural-like elements in the caudal skeleton (Patterson 1973, 1977; although see discussion above) and a mobile premaxilla (limited in its movement potential, and only found in some †pachycormiforms, Lambers 1992; although see comments by Arratia & Schultze 2013), among other characters. There have been many misinterpretations of †pachycormiform anatomy, and most portions of the skeleton remain unknown

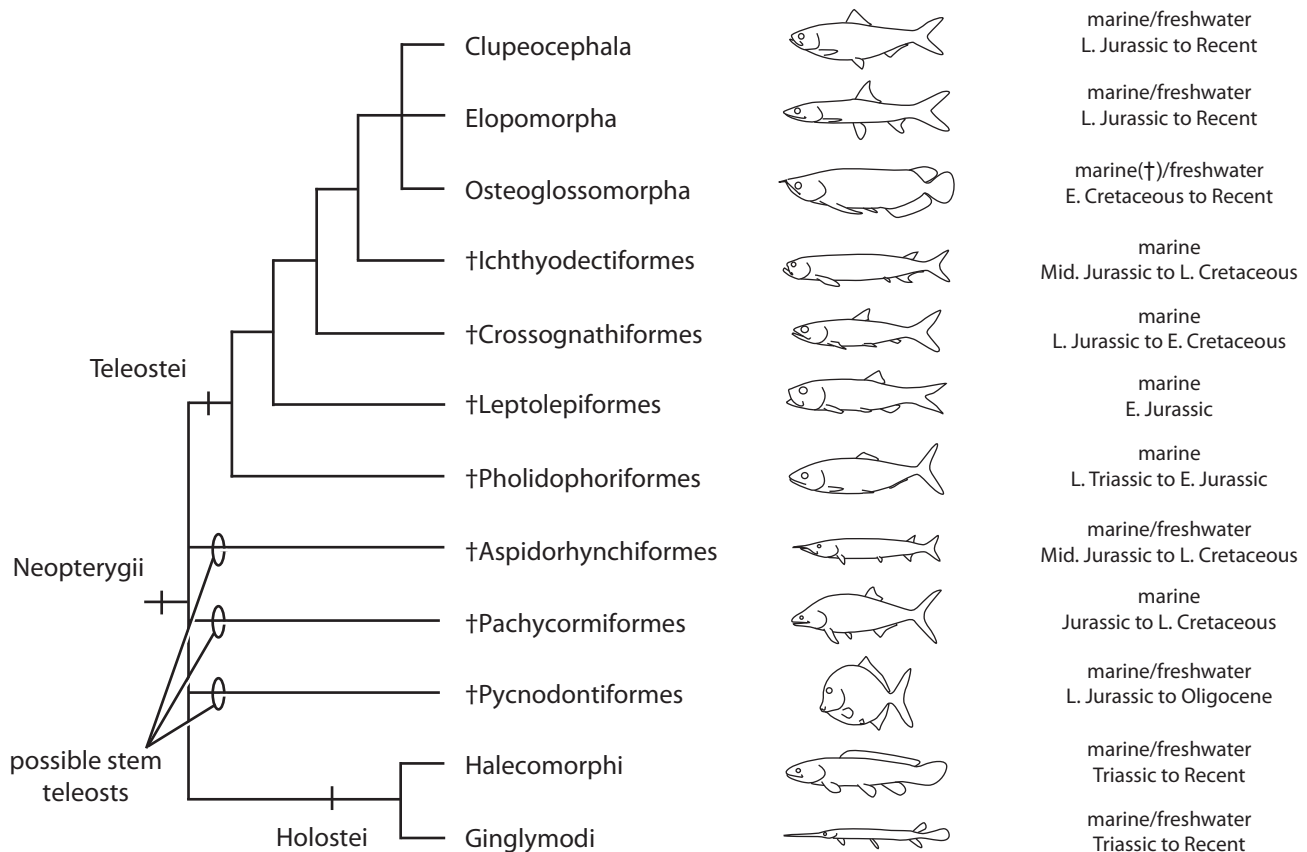


Figure 12 Consensus phylogeny of Neopterygii, with information on their age and ecology. See text for explanation and sources.

for most taxa included in the order due to lack of preservation, thereby complicating resolution of their relationships to other neopterygian fishes. Further, there are several characters that suggest these fishes lie outside the Teleostei, and, although the order is easily recognised because they are highly derived, they have been difficult to place phylogenetically (Arratia & Schultze 2013).

In most recent analyses and reviews, the †Aspidorhynchiformes have been suggested to be more closely related to extant teleostean fishes than to other neopterygians (e.g., Lauder & Liem 1983; De Pinna 1996; Arratia 1997), with many authors concluding that the order formed the most basal group following the split of the teleost lineage from the halecomorph and ginglymodan lineages. Arratia (1999) found the position of †Aspidorhynchiformes to be unresolved, with it being recovered as the sister-group of Ginglymodi, †Pachycormiformes, or Teleostei, depending on the choice of outgroup in her analyses. She suggested that further detailed information on the Jurassic members of the group was necessary, as these taxa tend to be more plesiomorphic than the more completely known †aspidorhynchiforms found in the Cretaceous (e.g., †*Vinctifer*, Maisey 1991; Brito 1997). For example, some of these later members of the group have uroneural-like elements in their caudal skeleton (Brito 1999).

Arratia (2013) recovered †Aspidorhynchiformes and †Pachycormiformes as sister-taxa based on several characters, including the position of the supramaxillae, the absence of a distinct coronoid process on the lower jaw, and a homocercal caudal skeleton (the latter homoplastic with ‘true teleosts’).

The †Pycnodontiformes have historically been allied with various groups of non-neopterygian and neopterygian actinopterygian groups (Nursall 2010). Patterson (1973) included them as a neopterygian group of uncertain affinity. Hurley *et al.* (2007) found †pycnodonts to be in a group that was sister to †pachycormids + teleosts. As she did for †Aspidorhynchiformes and †Pachycormiformes, Arratia (1999) found the position of †Pycnodontiformes to be unresolved among neopterygians and in her various analyses recovered the order (represented by †*Mesturus*) either as the sister-group of Ginglymodi or †Aspidorhynchiformes. Nursall (1996, 2010) argued for a sister-group relationship between †Pycnodontiformes and Teleostei, citing three shared characters: the absence of ganoine, a homocercal caudal fin, and two sclerotic bones. However, in the context of his analysis, only the relationships among three taxa were considered (†Dapediidae, †Pycnodontiformes and Teleostei). Further analysis is clearly needed to clarify the phylogenetic affinity of †Pycnodontiformes among Neopterygii.

## THE TEMPORAL, GEOGRAPHICAL AND ECOLOGICAL CONTEXTS OF TELEOSTEAN ORIGINS

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### Dating the origin of Teleostei

Recent estimates of the timing of the origin of Teleostei vary greatly. The earliest known fossil taxa within crown-group Teleostei are Jurassic, and the earliest taxa that are undisputed stem-group teleosts (i.e., members of †Pholidophoridae *sensu stricto*) are Late Triassic in age (oldest are possibly 228 MYA; Arratia 2013). This is older than any of the potential sister-groups of Teleostei (Figure 12), and therefore the sister-taxa are not informative for establishing an earlier appearance for Teleostei as a whole (i.e., they do not create a ‘ghost-lineage’ for Teleostei). What can be inferred directly from the fossil record is that by at least the Late Triassic, the Teleostei had diverged from its sister-group.

Molecular clock estimates for the origin of Teleostei generally recover much older estimates than palaeontological data, depending on the data these estimates are based on and the analytical approach taken. Peng *et al.* (2006) arrived at a Late Devonian origin for the group (355 MYA), whereas Inoue *et al.* (2003) concluded the crown-group teleosts

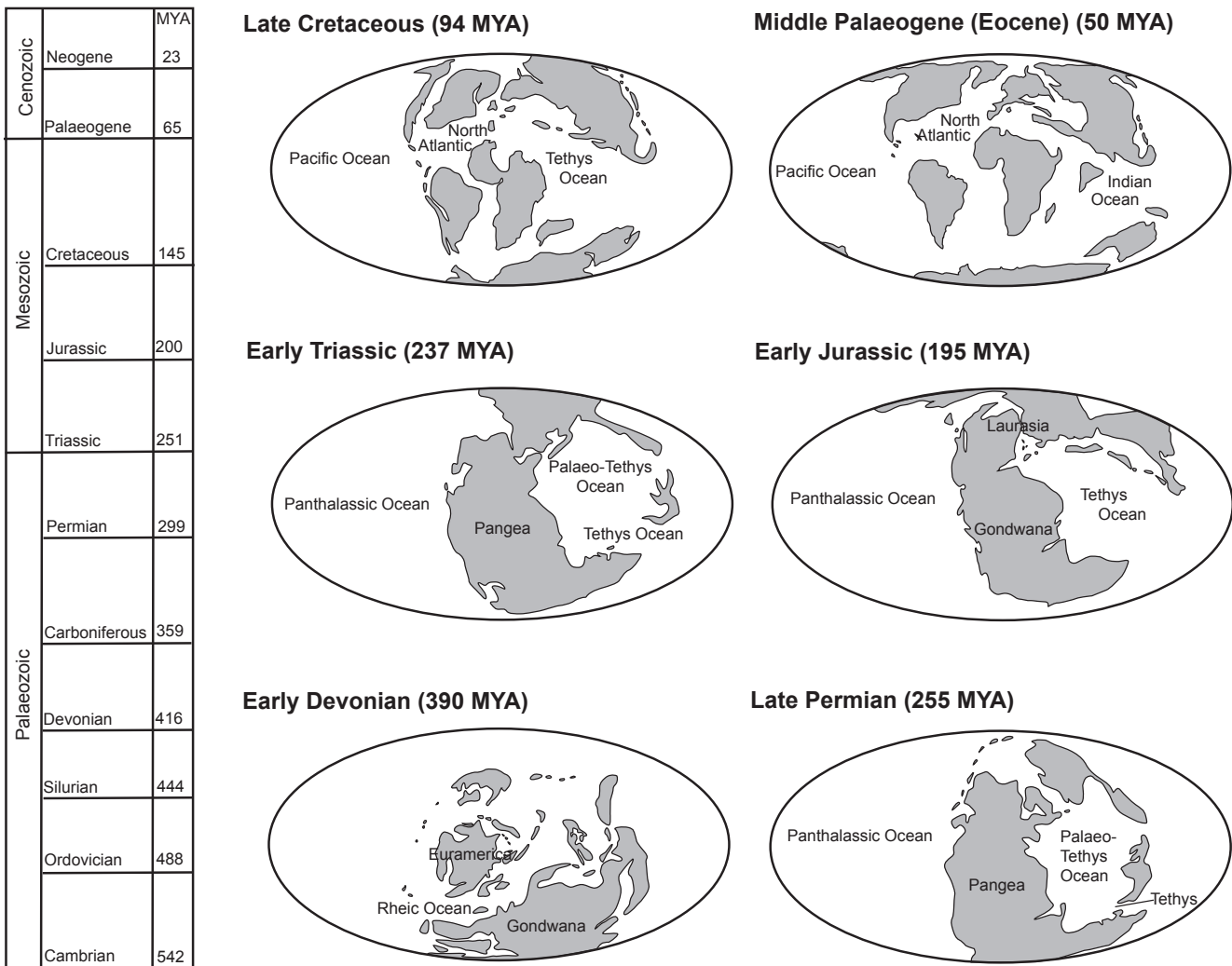
arose somewhere between the mid-Carboniferous and Early Permian (about 285 or 334 MYA, depending on type of analysis performed), suggesting a possible, yet improbable, nearly 20 million year silence in the teleostean fossil record. Similar estimates have been advanced in more recent time-calibrated phylogenetic studies as well (e.g., Near *et al.* 2012; Broughton *et al.* 2013; Betancur-R *et al.* 2013). In a study based on both morphological and molecular data, Hurley *et al.* (2007) also concluded that the origin of both Neopterygii and (crown-group) Teleostei were underestimated by palaeontological evidence. Among other results of this study (e.g., a whole-genome duplication event coincides with the origin of Teleostei), two are particularly noteworthy. First, the Palaeozoic origin of Neopterygii (Late Devonian to Early Permian time span indicates the estimate plus error) arrived at when analysing just the nuclear loci in this study, overlap the estimates from both mitochondrial loci (on the early side of estimate range) and fossils (on the late side). For Teleostei, by contrast, the three data sources produce three non-overlapping



estimates of age of divergence, with mitochondrial data yielding the earliest and fossils yielding the youngest date estimates.

Second, although estimates for the divergence of crown-group Teleostei based on analysis of nuclear loci are older than those derived directly from the fossil record, they differ from the palaeontological evidence by <50 million years, and are therefore much closer than other published molecular-based estimates of their origin. Furthermore, the divergence-time estimate range (including error) from nuclear data also comfortably contains the earliest known undisputed members of Teleostei, such as †*Prohalecites* and

the †*Pholidophoridae* (Arratia 2013) of the Mid- to Late Triassic. This suggests that the nuclear and fossil datasets may be more reflective of one another. While the fossil record of certain groups of basal teleosts, such as the Osteoglossidae or Elopomorpha, is by no means complete, it seems to be sufficient to some to draw some meaningful conclusions about the timing of their origin, and this can likely be extended to the teleosts as a whole. It is not tenable or reasonable to completely dismiss palaeontological estimates in deference to molecular clock estimates, particularly those that accept the absolute silence of the fossil record for such extreme durations (e.g., Peng *et al.* 2009).



**Figure 13** Geologic time scale and palaeomaps relevant to the evolution of Teleostei. Maps redrawn from the PALEOMAP project (<http://www.scotese.com/>).

## Ecology and palaeobiogeography of teleostean origins

Based on the phylogeny the most recent common ancestor of Teleostei was most likely a marine fish. This hypothesis must, however, acknowledge the bias of the fossil record. Early Mesozoic freshwater localities are rare compared to marine localities. While there are extensive Triassic freshwater faunas from northern Asia (Chang & Miao 2004), North America (Wilson & Bruner 2004), and from the Southern Hemisphere (López-Arbarello 2004), many of these remain poorly studied. The actinopterygian remains from these localities are dominated by non-neopterygian basal groups and other taxa outside of the teleost or near-teleost region of the phylogeny (e.g., †*Semionotus*). Jurassic freshwater localities from Asia do contain a number of † “pholidophorid” taxa, but this has been interpreted as an exceptional condition for these taxa rather than reflective of an environment associated with the groups as a whole (Patterson 1975; Chang & Miao 2004). Several marine localities containing early

teleosts or stem teleosts include better preserved specimens that may be ‘easier’ to place in a phylogenetic context (e.g., from Lyme Regis, England, and Solnhofen, Germany), and possibly bias these conclusions. As far as crown-group teleosts are concerned, a marine origin is also likely. Of the three primary groups, only Osteoglossomorpha are plesiomorphically restricted to freshwater environments; the only marine osteoglossomorph taxa are deeply nested within the group (Forey & Hilton 2010).

Given the known distribution of fossil taxa near the base of Teleostei, it is likely that the group originated in the near-shore environments along the margin of the Tethys Ocean (Figure 13). There is a close similarity of taxa between the marine Triassic fishes of southern China to those from Europe, indicating a connection between different parts of the Tethys Ocean (Chang & Miao 2004). Furthermore, biogeographic connections between Tethys localities and those of the eastern Pacific (i.e., the west coast of South America) have been noted for monophyletic groups well within Teleostei (Arratia 2008).

## CONCLUSIONS

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The diversity of both living and fossil teleostean fishes has driven an enormous amount of systematic and evolutionary research. Recent advances surrounding the origin of this singular group have been driven by two synergistic activities: the application cladistic principles of Hennig (1966) for elucidating the patterns of phylogeny, using both morphological and molecular data, and the careful assessment (and in many cases re-assessment, often many times over) of the anatomical forms found within this

diversity. The value of molecular data for phylogenetic reconstruction is without question. However, the oft-perceived notion that morphology has somehow been superseded by molecular data, or that morphology is any less valuable in recovering phylogeny at a variety of scales, is quite mistaken. True advances continuing to clarify the origin and diversification of teleostean fishes – both fossil and living forms – will come only from careful and judicious assessment of data from all sources.

*This is contribution number 3669 of the Virginia Institute of Marine Science, William & Mary.*

## GLOSSARY

**apomorphy** – an evolutionarily derived character or feature of an organism.

**bauplan** – a body plan; a generalised set of morphological features shared by a group of organisms, especially at higher levels of classification, such as a phylum.

**catadromy** – a life history strategy characterised by migration between marine habitats (used for reproduction) and freshwater habitats (used for growth).

**character-based approach** – an approach to defining a taxonomic group that includes all taxa that possess (at least ancestrally) a specified character or feature.

**character reversal** – the evolution of a character or feature of an organism to return to an ancestral condition.

**circuli** – a concentric ridge on a scale of a fish.

**cladistics** – a method for hypothesising relationships among organisms (phylogeny) by defining hierarchical groups defined by shared, derived features or characteristics (vs. defining groups based on overall similarity).

**crown-group** – a group comprising all extant members (and their extinct relatives) of a monophyletic group of organisms.

**falcate** – sickle-shaped.

**ganoid scale** – a thick, bony scale covered by a layer of a hard tissue (ganoine); typically rhomboid or diamond shape; adjacent scales articulate by a peg-and-socket articulation.

**ghost-lineage** – a branch of a phylogenetic tree that is inferred to have existed, but does not have a fossil record.

**Gondwana / Gondwanan** – southern supercontinent following the break-up of Pangea, which included portions of modern South America, Africa, Arabia, Australia, Antarctica, and India, among other smaller regions; present both prior to the formation of Pangea, and following its break-up in the Jurassic.

**high aspect-ratio caudal fin** – a caudal fin of a fish that is tall and narrow, such as that of a tuna or billfish.

**homoplasy / homoplastic** – a similar feature or characteristic that has evolved independently in different groups of organisms.

**incertae sedis** – a qualification to indicate that a taxon's phylogenetic affinities are uncertain within a more inclusive group of organisms.

**Laurasia** – the northern supercontinent following the break-up of Pangea, which included portions of modern North America and Asia.

**leptocephalus larva** – the transparent, ribbon-like, pelagic larva of eels and other elopomorph fishes.

**molecular clock estimates** – the estimates of time of divergence between taxa based on mutation rates of DNA.

**monophyly / monophyletic** – a group of organisms comprising the most recent common ancestor and all its descendants.

**node-based approach** – an approach to defining a taxonomic group that includes all taxa that share a most recent common ancestor.

**Pangea** – the large supercontinental landmass that persisted from the late Palaeozoic to the early Mesozoic eras.

**paraphyly / paraphyletic** – a taxonomic grouping that does not include all descendants of a most recent common ancestor.

**phylogeny / phylogenetic analysis** – the hierarchical evolutionary relationships among organisms, and the process for hypothesising such relationships.

**plesiomorphy / plesiomorphic** – an underived or 'primitive' character that cannot be used to define a group of organisms.

**polyphyly / polyphyletic** – a group of organisms (a clade) that has more than one ancestor and is defined on the basis of convergent features or characteristics.

**polytomy** – unresolved branches within an otherwise hierarchical hypothesis of relationships among organisms.

**sensu lato** – in a broad sense; the name of a taxonomic group used in such a way that it includes taxa that have been referred to a group, whether or not they have been robustly shown to share a most-recent common ancestor with that group.

**sensu stricto** – in the strict sense; a strictly defined taxonomic group; usually used to exclude taxa that were historically allied to a particular group but are of questionable relation to that group.

**sister-group** – two taxa of equal rank that share a common ancestor.

**stem-group** – the basal members of a taxon that are known exclusively as fossils, and that are hypothesised to lie outside of a crown-group taxon.

**stratophenetic** – relating to overall similarity in form and geologic age.

**synapomorphy / synapomorphic** – a shared, derived feature or characteristic (vs. a primitive characteristic) that is used to define a monophyletic taxon.

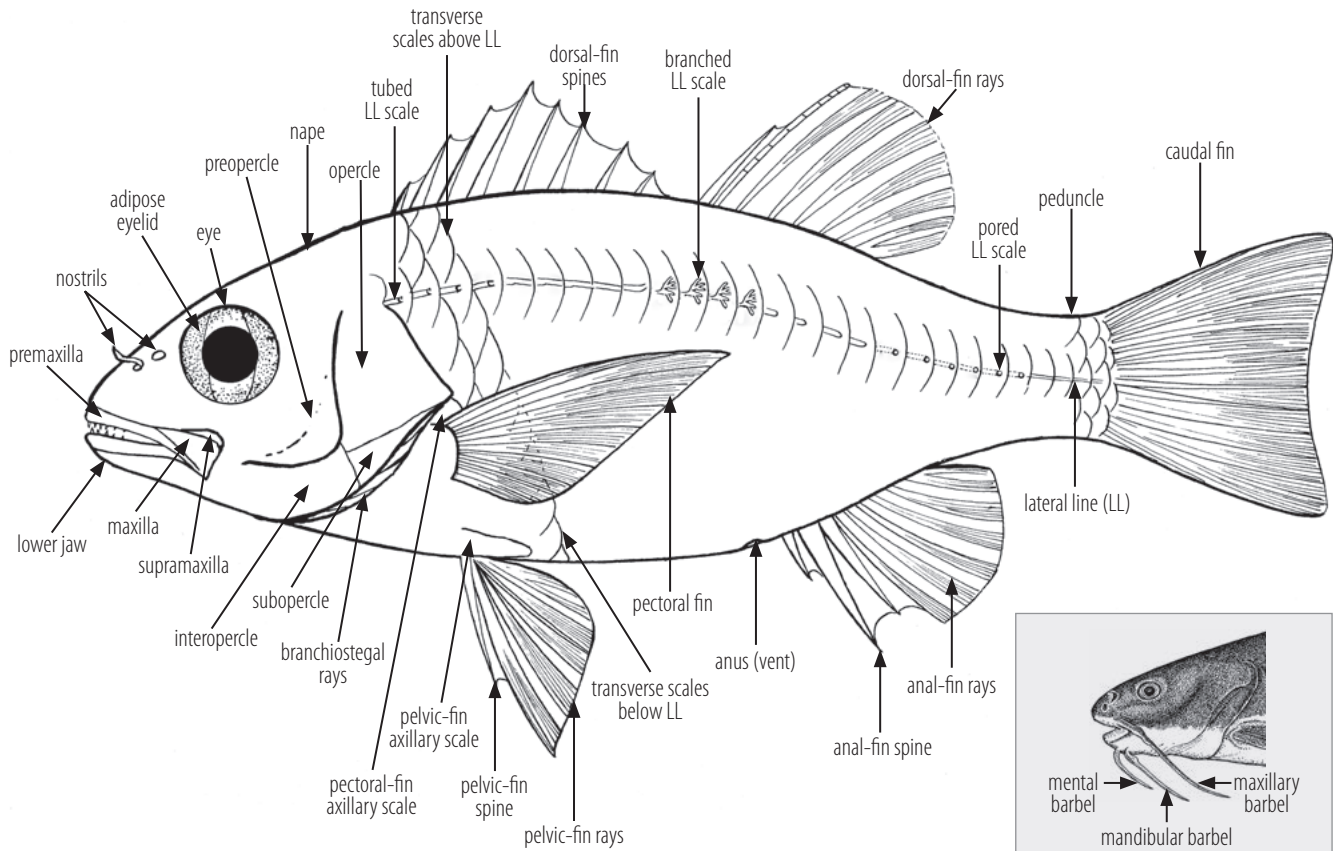
**time-calibrated** – the use of minimum ages from the palaeontological record to constrain molecular clock analyses.

**uncinate processes** – a hook-shaped projection.

**vicariance / vicariance biogeography** – an approach to understanding the distribution of organisms related to physical or biological separation between groups of organisms (in contrast to dispersal).



# ANATOMY OF BONY FISHES



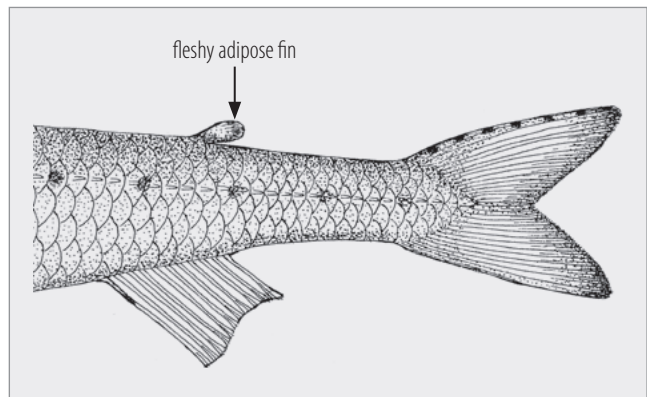
External features of a typical teleost fish

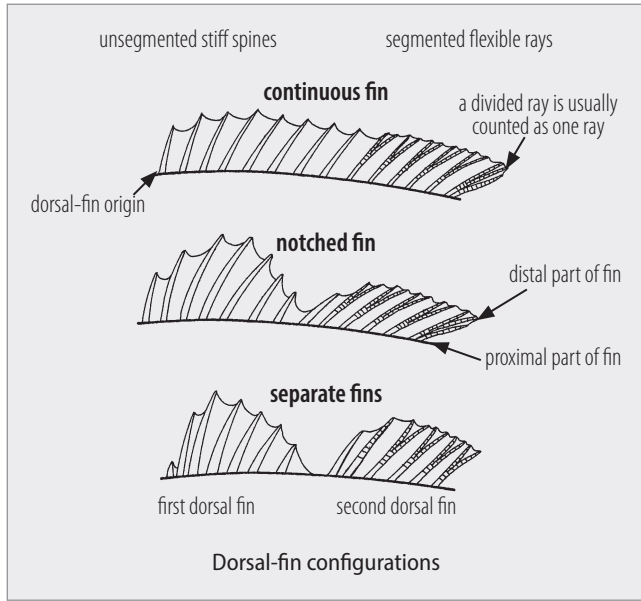
Types of barbels around mouth

## FINS

All normal bony fishes have vertical or **median fins**, which lie in the median (middle) vertical plane of a fish, and **paired fins**.

The **dorsal**, **anal** and **caudal** fins are the median fins. The dorsal fin may be single (the spines and soft rays forming a single unit) or may be divided into two separate fins, often with a single spine in front of the soft rays (only in the Tripterygiidae is the fin divided into three separate parts; some other species may have separate spines in front of the fin). Some fishes, such as lizardfishes and sea catfishes, also have a short fleshy fin, an **adipose fin**, posterior to the rayed dorsal fin. The Scombridae





(tunas), some carangids (kingfishes) and some other fishes have one or more separate **finlets** posterior to the dorsal and anal fins. The anal fin starts behind the vent and usually has three or fewer spines, and always more rays than spines. The caudal fin may be truncate, pointed, rounded, emarginate, forked, lunate or continuous. In fishes such as eels the dorsal, caudal and anal fins are joined together, while in most fishes the fins are not joined.

The **pectoral** and **pelvic** fins are the paired fins with both having a left and right fin. Pelvic fins are also known as ventral fins. In most fishes they are situated below the pectoral fin (**thoracic**); in some they are in front of the pectoral fins (**jugular**) and in others they are much further back (**abdominal**). Some species (e.g., puffers and adult ribbonfishes) have no pelvic fins, while others (e.g., some flatfishes and eels) have no pectoral fins. Flying fishes (Hemiramphidae) have extremely long pectoral fins, used to skim over the water. The distal part of a fin is the outer, marginal part; the basal or proximal part of a fin is closest to the body.

## SPINES AND RAYS

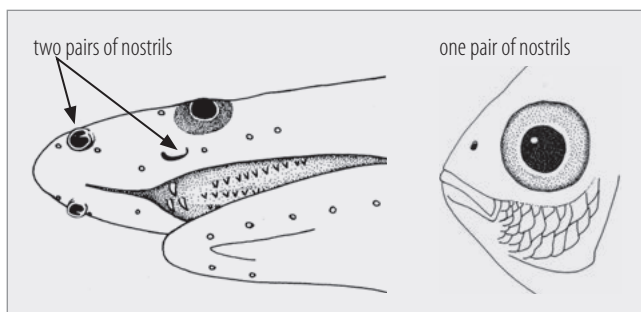
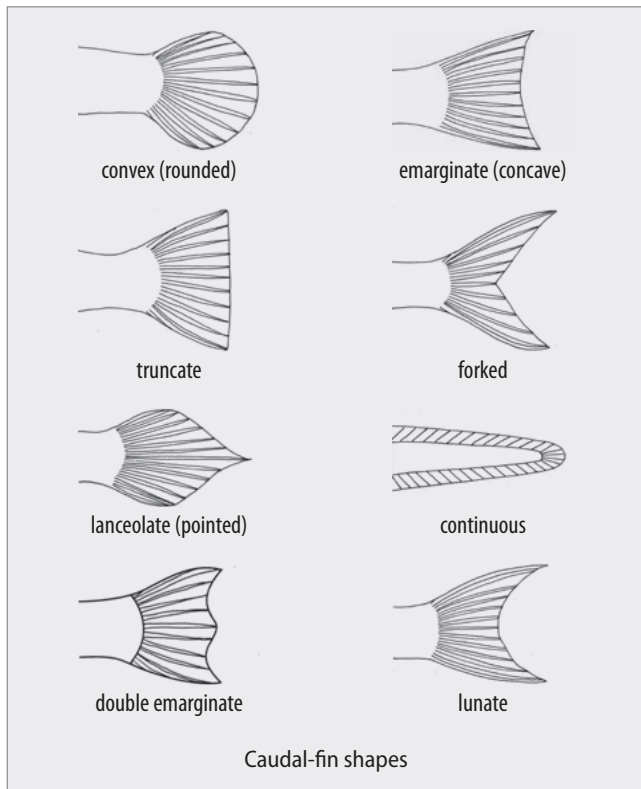
Most bony fishes have both spines and soft rays in their dorsal and anal fins. **Fin spines** are usually unbranched, unsegmented, single fin 'rays' at the front of the median fins or at the leading edge of the pelvic fins. The catfishes (Plotosidae and Ariidae) also have a serrated spine at the leading edge of the pectoral fins. Fin spines are usually stiff with sharply pointed tips, but some fishes (e.g., blennies) have soft, flexible spines. **Soft rays** (referred to as 'rays' in these volumes) are finely segmented and usually branched in most fishes, with left and right halves that are more-or-less fused to form a single branched ray. Soft rays are generally soft (flexible) and always segmented (articulated). The cross-striations (articulations) of soft rays are best seen if the fin is held up with a light behind it.

## THE HEAD

Nearly all fishes have **paired nostrils**, with an anterior and posterior nostril on each side of the snout, but a few fishes (e.g., damselfishes and frofishes) have only a single nostril on either side.

The skull of a bony fish is made up of many bones, as shown in the diagram on the next page. The **operculum** (pl. opercula) or gill cover protects the gills and is made up of four bones, the opercle, subopercle, preopercle and interopercle. The **upper jaw** usually consists of paired premaxillae, which carry the teeth, and paired maxillae, which seldom have teeth. Some fishes have a separate little bone, a supramaxilla, attached to the upper rear edge of the maxilla. The lower jaw consists of paired dentaries, fused in the midline, and which carry teeth, the anguloarticular with the quadrate, and the retroarticular.

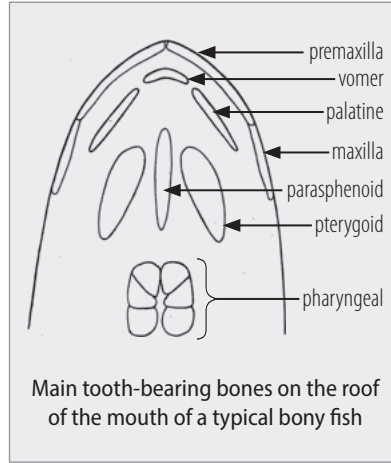
There are a number of bones in the roof of the mouth. The vomer, a single, median bone with palatine bones on each side, lies behind



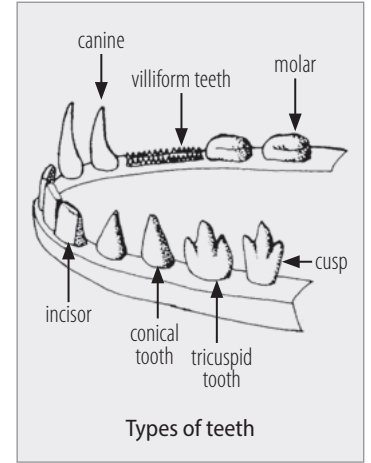
Source of anatomy diagrams in boxes: CFSA

the upper jaw, and may carry teeth. These teeth may be very small and can often only be found using a needle or something similar. Paired pterygoids, and a median parasphenoid (which carries teeth in some fishes), lie posterior to the vomer and palatines.

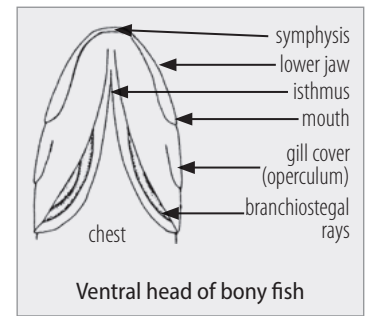
Fishes have **teeth** of a wide variety of shapes and sizes, related to their diets. Predators that feed on fish or cephalopods typically have large **canines**; herbivores that feed on algae or seagrasses have **incisors** which are flattened and often chisel-shaped, or fused into plates in some fishes. Planktivores generally have many, small, bristle-like **villiform** or **setiform** teeth. **Molars** are rounded and indicate a diet of hard-shelled prey. In many filter-feeders teeth are either minute or absent.



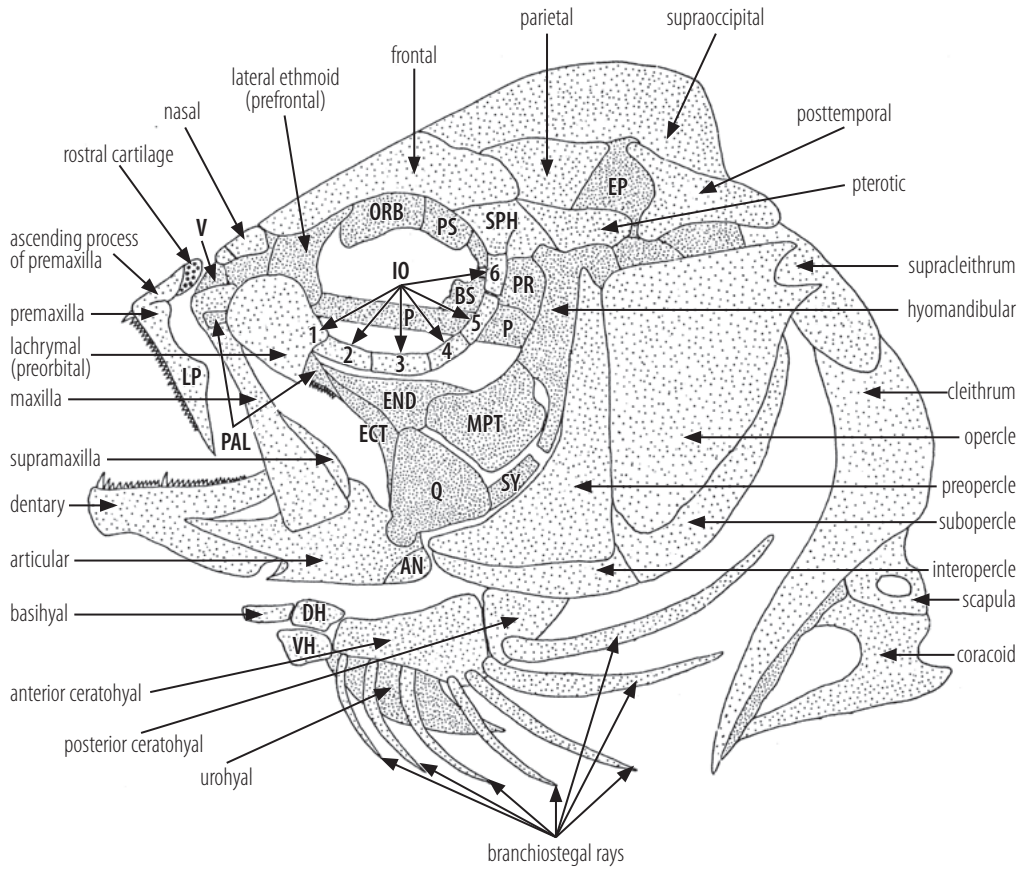
Main tooth-bearing bones on the roof of the mouth of a typical bony fish



Types of teeth



Ventral head of bony fish



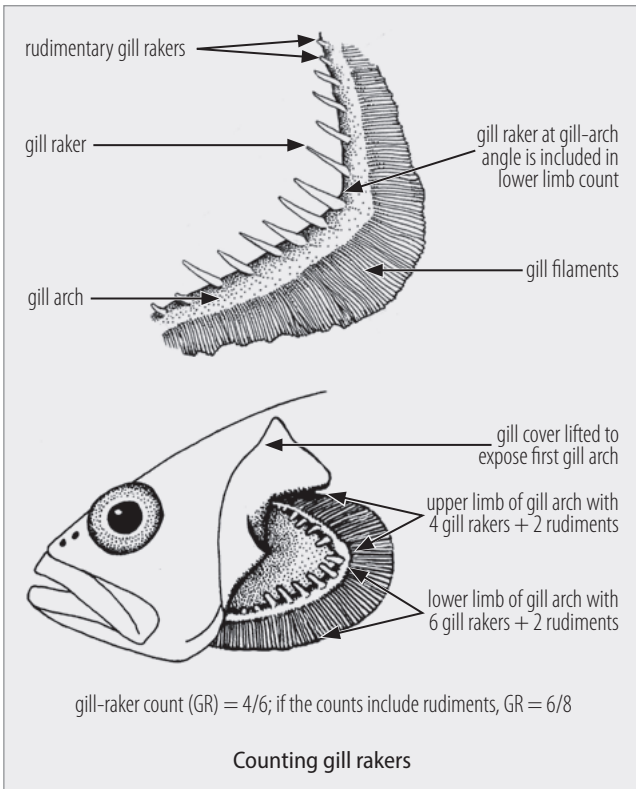
- AN** angular (retroarticular)
- BS** basisphenoid
- DH** dorsal hypohyal
- ECT** ectopterygoid
- END** endopterygoid
- EP** epioccipital
- IO** infraorbitals (1–6)
- LP** lateral process of premaxilla
- MPT** metapterygoid
- ORB** orbitosphenoid
- P** parasphenoid
- PAL** palatine
- PR** prootic
- PS** pterosphenoid
- Q** quadrate
- SPH** sphenotic
- SY** symplectic
- V** vomer
- VH** ventral hypohyal

Lateral view of a bony fish skull and pectoral fin skeleton based on a percoid fish. Only those bones that are referred to in the diagnosis of various fishes are labelled for identification. Non-percoid fishes may lack some of the bones here, or may have other additional bones. Source: SSF



## GILLS AND GILL ARCHES

The **branchiostegal rays** are slender, flat bones connected to paired **hyoid arches**. In most fishes these rays are visible when the gill covers are lifted. In some families the gill membranes are joined to the **isthmus**, or sides of the 'chest', with the gill openings more-or-less restricted. Blennies and some other groups have gill membranes of the left and right sides widely joined to each other and not connected to the isthmus, forming a free fold over the isthmus. Between the hyoid arches lie the four **gill arches**. The gills of fishes have numerous soft **gill filaments** along their rear (outer) edge. The anterior (inner) edge of the gill arch supports finger-like **gill rakers**. Most fishes have some gill rakers but others (e.g., great barracuda) have none. Gill rakers may also be numerous, long and slender as in plankton-feeding fishes (e.g., herring and anchovies) whose gill rakers sieve out microscopic food from the water passing through the gills. The number of rakers does not vary much and is often useful to identify species. Gill rakers on the first arch are always counted, unless otherwise stated. The raker in the angle of the arch is counted with the lower rakers. Only developed gill rakers (those rakers longer than their base width) are usually counted. The smaller rudimentary gill rakers (with length less than their base width) are not included in a gill-raker count unless this is specifically mentioned in a family, genus or species account.

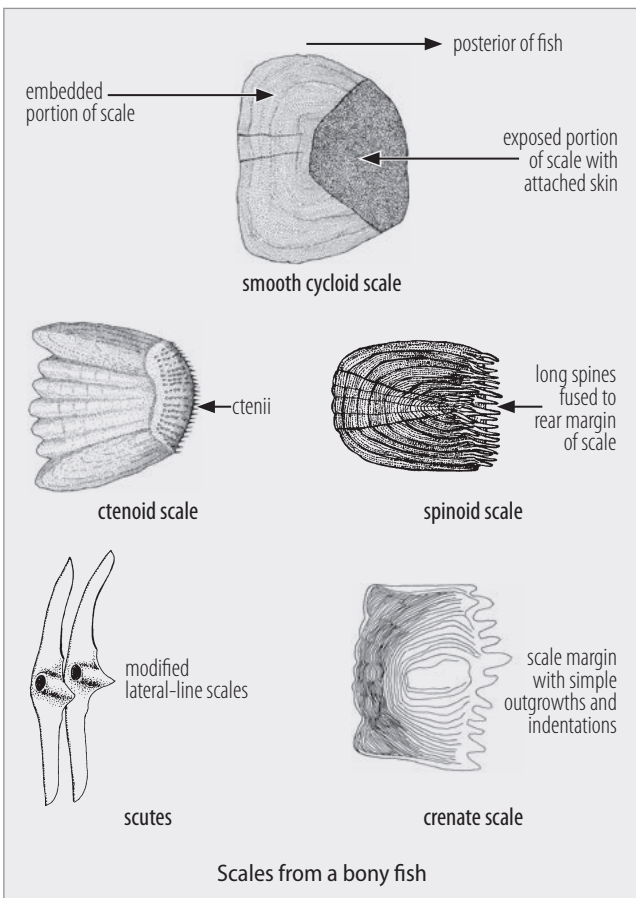


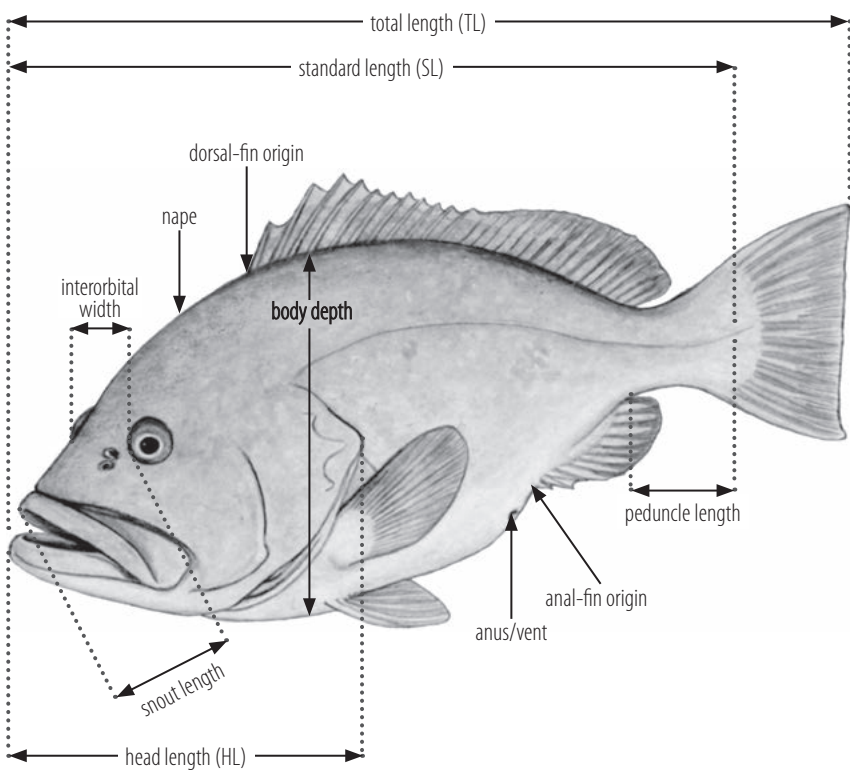
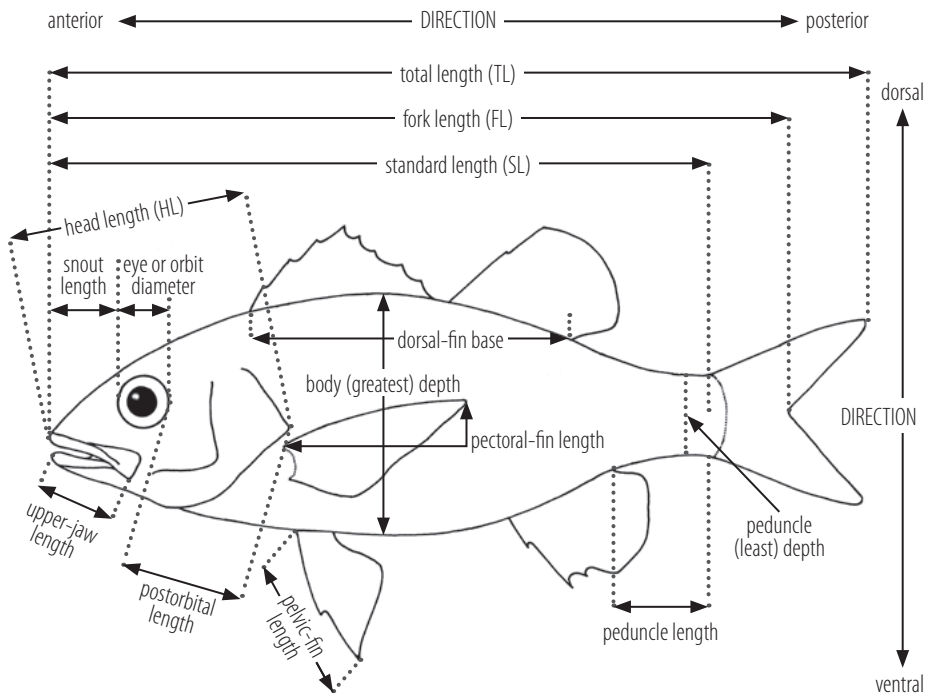
## SCALES

The scales of most fishes are either **cycloid** or **ctenoid**. Cycloid scales are smooth with a uniform edge; the exposed rear margin of ctenoid scales has indentations or small, tooth-like prickles (ctenii) giving them their rough texture when the fish is stroked from the caudal fin towards the head. There are three general types of ctenoid scales: **crenate scales** with a rear margin with several simple indents; **spinoid scales** with a group of long spines on their rear margin that are continuous with the main scale, and **ctenoid scales** with ctenii that are distinctly separate bony growths from the body of the scale.

As a fish grows, so the scales grow, and additions to the scale margins cause irregular seasonal growth bands or **annuli** which can be used to age some fishes. Scales may also be either **adherent** (firmly fixed) or **deciduous** and are easily shed. **Scutes** are modified (thickened) bony scales with a keel or a spiny point. Some kingfishes (family Carangidae) have their rear lateral-line scales modified as scutes with a median ridge ending in a pointed spine. Some dories and most anchovies, herrings and pilchards have a ventral midline of scutes (the scutes on some species may be feeble).

The **lateral line** usually consists of a series of pored scales that run from behind the gill opening, usually to the caudal-fin base (and sometimes onto the caudal fin). The number of lateral-line scales is often also diagnostic of species. A canal below these pored scales has sensory cells capable of detecting low-frequency vibrations such as the swimming movement of other fishes. These pored lateral-line scales are often counted, with the count stopping at the caudal-fin base.





Source: CFSA

**Note:** some illustrations in the species accounts indicate the position of the anus/vent with an arrow or line.

The following abbreviations are used for standard measurements and counts. Some species require specific measurements/counts and these are given in their accounts.

**FL fork length** – the length from the tip of the upper jaw or snout to the end of the shortest ray of the caudal fin of a forked caudal fin.

**GR gill rakers** – the number of gill rakers on the upper and lower arms of the first gill arch, given as 3–5/7–11 = 10–16 (the total is not always given).

**HL head length** – the length of the head from the tip of the upper jaw or snout, where it projects over the upper jaw, to the posterior bony edge of the opercle.

**LL lateral line** – the number of pored and/or notched scales in the lateral line is given as LL scales. Where a fish has no scales and only pores in the skin this is given as LL pores.

**LSS lateral scale series** – this is generally the number of scales from the upper end of the gill opening, often lying just above the LL, to the base of the caudal fin. This may vary for different fishes as not all species have the same LL configuration, and where different it is explained in the family account.

**SL standard length** – the length from the tip of the upper jaw or snout to the end of the hypural plate. This can usually be seen as a crease when the caudal fin is bent from side to side.

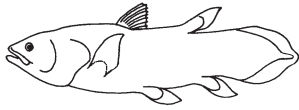
**TL total length** – the length from the tip of the snout to the end of the caudal fin.

# KEY TO ORDERS OF BONY FISHES

Shirleen Smith and Wouter Holleman

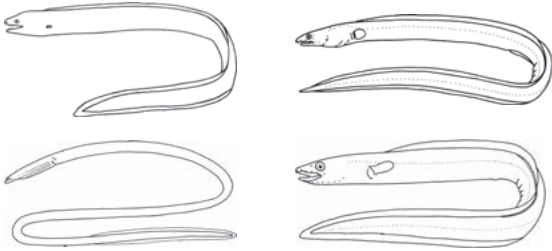
**NOTE: This key is for orders of bony fishes that occur in the Western Indian Ocean.**

- 1a Second dorsal, anal and paired fins as fringed lobes; caudal fin with extended middle portion .....  
 ..... **COELACANTHIFORMES, Latimeriidae (Coelacanth)** *Volume 5*

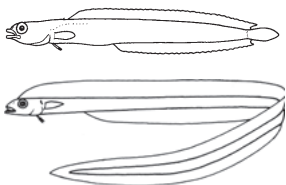


- 1b No fins as fringed lobes; caudal fin without extended middle portion ..... 2

- 2a Body long and snake-like; low dorsal and anal fins, without spines; pelvic fins absent; pectoral fins present or absent .....  
 ..... **ANGUILLIFORMES (Eels)** *Volume 2*

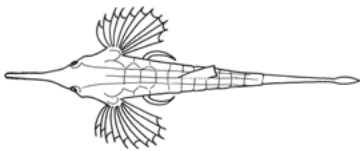


- 2b Body long and snake-like; dorsal- and anal-fin spines usually present; pelvic fins usually present; pectoral fins present .....  
 ..... **PERCIFORMES IN PART** *Volume 3: key*



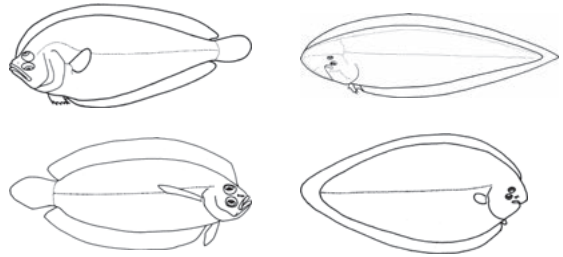
- 2c Body not long and snake-like ..... 3

- 3a Body depressed, completely encased in fused dermal plates; spinous dorsal fin absent; dorsal and anal fins with 5 rays; pectoral fins wing-like; pelvic fins with 1 spine and 2 or 3 rays, tentacle-like. ....  
 ..... **GASTEROSTEIFORMES IN PART Pegasidae (Seamoths)** *Volume 2*



- 3b Body not as above ..... 4

- 4a Body very compressed with both eyes on same side of head; very long dorsal and anal fins .....  
 ..... **PLEURONECTIFORMES (Soles, flounders and other flatfishes)** *Volume 5*



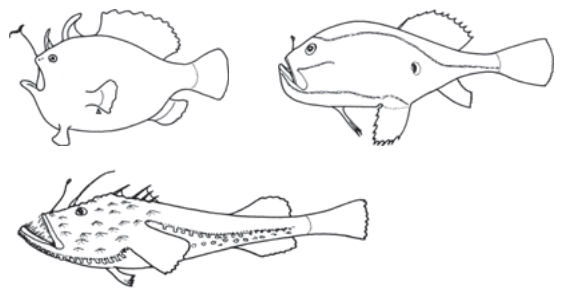
- 4b Body not compressed and eyes on opposite side of head ..... 5

- 5a Bony ridge below eye (suborbital stay), usually attached to preopercle; head spiny, sometimes with armoured plates; opercle and preopercle usually with spines; dorsal-fin spines often pungent .....  
 ..... **SCORPAENIFORMES IN PART (Scorpionfishes, lionfishes, stonefishes, flatheads and relatives)** *Volume 2*



- 5b Not as above ..... 6

- 6a First dorsal-fin spine on front of head, modified into a 'fishing rod and lure' (illicium) .....  
 ..... **LOPHIIFORMES (Anglerfishes, coffinfishes, monkfishes and batfishes)** *Volume 2*

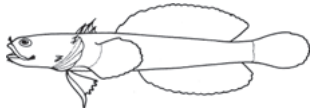


- 6b First dorsal-fin spine not modified into an illicium ..... 7

Continued ...

**KEY TO ORDERS OF BONY FISHES**

- 7a First dorsal fin low, separate, 3 spines, usually hidden by thick skin; no anal-fin spines; body naked or with small, embedded, cycloid scales; 3 lateral lines, middle and lower difficult to detect; head broad and depressed; pelvic fins jugular .....  
**BATRACHOIDIFORMES, Batrachoididae**  
 (Toadfishes) *Volume 2*



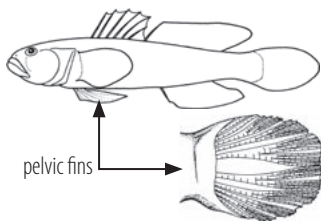
- 7b First dorsal fin not as above; body not shaped as above ..... 8

- 8a Pelvic fins formed into a sucking disc; dorsal and anal fins without spines ..... 9



pelvic fins forming sucking disc

- 8b Pelvic fins joined and disc-like, often with frenum (a membrane joining the two outer rays of each fin); dorsal and anal fins with spines ..... **PERCIFORMES, Gobiidae** (Gobies) *Volume 5*



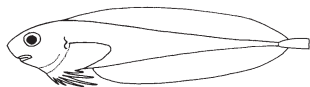
pelvic fins

- 8c Pelvic fins not formed into a disc or absent; dorsal and anal fins with or without spines ..... 10

- 9a Dorsal and anal fins short, with less than 20 rays .....  
**PERCIFORMES, Gobiesocidae** (Clingfishes) *Volume 4*



- 9b Dorsal and anal fins long, with more than 30 rays .....  
**SCORPAENIFORMES** IN PART **Liparidae** (Snailfishes) *Volume 2*



- 10a Dorsal fin without spines ..... 11

- 10b Dorsal fin with spines [separate fin with weak spines in **Solenostomidae** (Ghost pipefishes)] ..... 32

- 11a Pelvic fins present (may be rudimentary) ..... 12

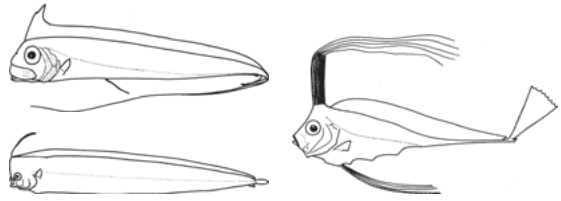
- 11b Pelvic fins absent ..... 28

- 12a Pelvic fins with visible spine ..... **PERCIFORMES** IN PART *Volume 3: key*  
 12b Pelvic fins without spine ..... 13

- 13a Pelvic fins present but rudimentary ..... 14

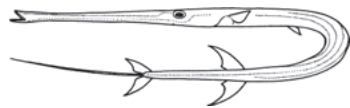
- 13b Pelvic fins present and well-developed ..... 15

- 14a Pelvic fins minute, or a single rudimentary ray; dorsal fin > 100 rays ..... **LAMPRIFORMES, Radiicephalidae, Lophotidae**  
 IN PART, **Trachipteridae** IN PART (Tapertail, crestfishes and ribbonfishes) *Volume 2*



- 14b Dorsal fin <100 rays ..... **PERCIFORMES** IN PART *Volume 3: key*

- 15a Snout long and tubular; caudal fin forked with 2 middle rays fused forming a filament; body without scales .....  
**GASTEROSTEIFORMES** IN PART **Fistulariidae**  
 (Flutemouths) *Volume 2*



- 15b Snout and caudal fin not as above ..... 16

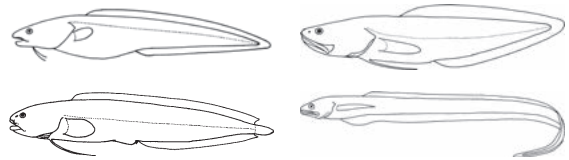
- 16a Pelvic fins 1 or 2 rays ..... 17

- 16b Pelvic fins >2 rays ..... 18

- 17a Pelvic fins long and ribbon-like (usually broken off); body long, compressed and ribbon-like .....  
**LAMPRIFORMES** IN PART **Regalecidae** (Oarfishes) *Volume 2*



- 17b Pelvic fins not as above; body tapered to a point; dorsal and anal fins long and confluent with caudal fin (except in **Bythitidae**) ..... **OPHIDIIFORMES, Ophidiidae, Dinematchthyidae, Bythitidae** (Cusk-eels and brotulas), **Carapidae** IN PART **Pyramodon** (Pearlfishes) *Volume 2*



Continued ...



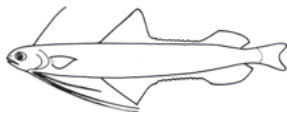
**KEY TO ORDERS OF BONY FISHES**

18a Two barbels on snout, single barbel on chin; body elongate; dorsal fin in 3 parts: single, unsegmented ray + groove with short, fleshy filaments + >40 segmented rays; pelvic fins 7 rays ..... **GADIFORMES** IN PART **Lotidae** (Rocklings) *Volume 2*



18b Not as above ..... 19

19a First dorsal fin a single, elongate ray on top of head; pelvic fins 5–7 rays, inserted under middle of head ..... **GADIFORMES** IN PART **Bregmacerotidae** (Codlets) *Volume 2*

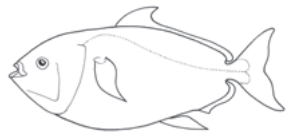


19b Dorsal fin divided, first with 10–12 rays, second >30 rays; V-shaped ridge on top of head ..... **GADIFORMES** IN PART **Merlucciidae** (Hakes) *Volume 2*



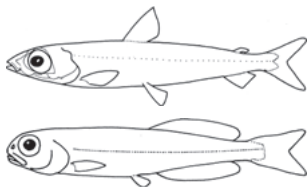
19c Not as above ..... 20

20a Body oval-shaped and compressed; dorsal fin 49–56 rays ..... **LAMPRIFORMES** IN PART **Lampridae** (Opahs) *Volume 2*



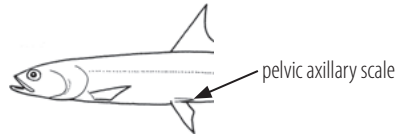
20b Body not oval and compressed ..... 21

21a Maxilla forms upper border of mouth; scales cycloid, without radii ..... **ARGENTINIFORMES**, **Argentinidae**, **Alepocephalidae** (Argentines and smooth-heads) *Volume 2*



21b Maxilla and scales not as above ..... 22

22a Pelvic axillary scale present (may be small, but noticeably larger than adjacent scales) ..... 23



22b Pelvic axillary scale vestigial or absent ..... 27

23a Branchiostegal rays >20 ..... **ELOPIFORMES**, **Elopidae**, **Megalopidae** (Ladyfishes and tarpons) *Volume 2*



23b Branchiostegal rays <20 ..... 24

24a Branchiostegal rays <6; anal fin <12 rays ..... **GONORYNCHIFORMES**, **Gonorynchidae**, **Chanidae** (Beaked sandfishes and milkfish) *Volume 2*



24b Branchiostegal rays 6 or more ..... 25

25a LL absent ..... **CLUPEIFORMES** (Herrings, sardines, pilchards and shads) *Volume 2*



25b LL present ..... 26

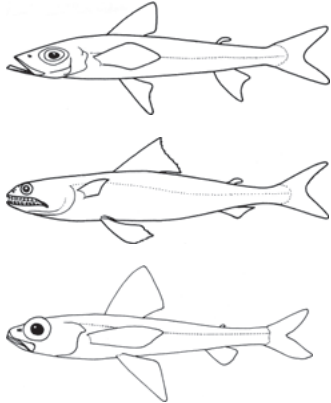
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**KEY TO ORDERS OF BONY FISHES**

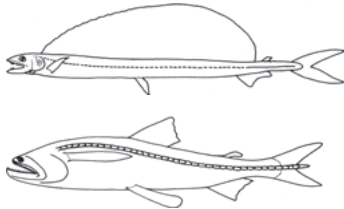
26a Mouth inferior, snout projecting well beyond lower jaw .....  
 ..... **ALBULIFORMES, Albulidae** (Bonefishes) *Volume 2*



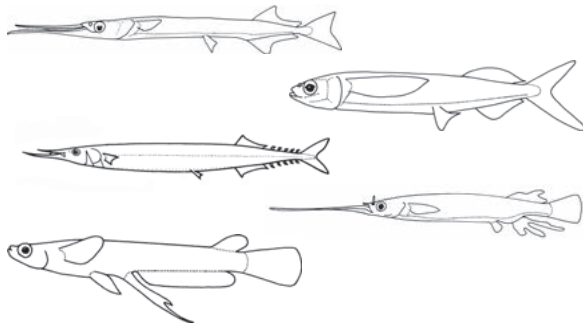
26b Mouth not inferior ..... **AULOPIFORMES, Chlorophthalmidae, Paraulopidae, Synodontidae** *IN PART* (Greeneyes, lizardfishes and cucumberfishes) *Volume 2*



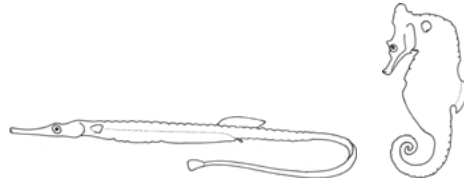
27a Pelvic fins >7 rays ..... **AULOPIFORMES, Alepisauridae, Synodontidae** *IN PART* (Lancetfishes and lizardfishes) *Volume 2*



27b Pelvic fins 7 rays or fewer ..... **BELONIFORMES** (Needlefishes, halfbeaks, ricefishes, sauries and flyingfishes) *Volume 2*

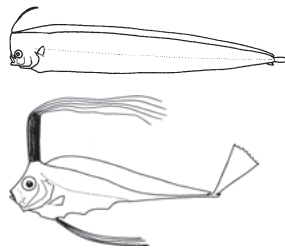


28a Upper jaw not produced; body covered with scutes or bony rings ..... **GASTEROSTEIFORMES** *IN PART* **Syngnathidae** (Pipefishes, pipehorses and seahorses) *Volume 2*



28b Not as above ..... **29**

29a Dorsal fin 120 or more rays; anal fin <21 rays or absent .....  
 ..... **LAMPRIFORMES, Lophotidae** *IN PART*, **Trachipteridae** *IN PART* (Crestfishes and ribbonfishes) *Volume 2*



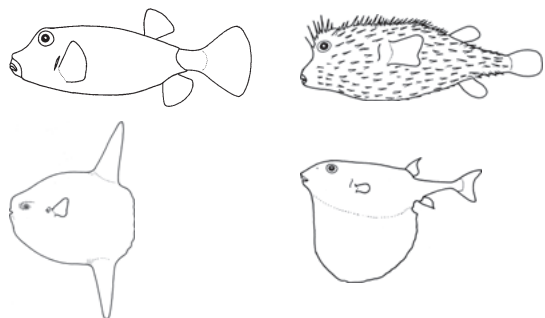
29b Not as above ..... **30**

30a Dorsal and anal fins confluent with caudal fin; body usually tapered to a point ..... **OPHIDIIFORMES, Carapidae** *IN PART* (Pearlfishes) *Volume 2*



30b Dorsal and anal fins not as above ..... **31**

31a Gill openings slit-like; opercular bones and branchiostegal rays covered in thick skin or bony plates and not visible; teeth fused to form dental plate, or if teeth are not fused, then the body is covered in bony carapace .....  
 ..... **TETRAODONTIFORMES** *IN PART* (Cowfishes, boxfishes, puffers and relatives) *Volume 5*



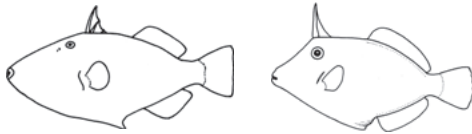
31b Not as above ..... **Order PERCIFORMES** *IN PART* *Volume 3: key*

*Continued ...*

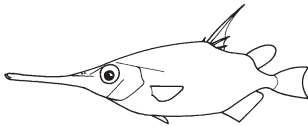
**KEY TO ORDERS OF BONY FISHES**

- 32a Anal-fin spines absent ..... 33
- 32b Anal-fin spines present ..... 40
  
- 33a Pelvic fins absent, rudimentary, or present without spine – if pelvic-fin spine present then embedded and not visible .... 34
- 33b Pelvic-fin spine visible ..... 37
  
- 34a Pelvic fins absent, or rudimentary [may be represented by a few scales] ..... 35
- 34b Pelvic fins present, not rudimentary ..... 36

- 35a Dorsal fin 2 or 3 spines; body covered with strong plate-like scales or skin like untanned leather with small round granulations ..... **TETRAODONTIFORMES** IN PART **Balistidae, Monacanthidae** (Triggerfishes and filefishes) *Volume 5*

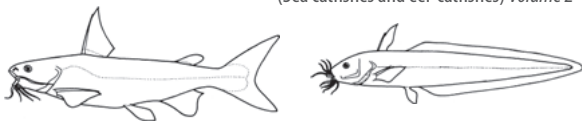


- 35b Dorsal fin 5–8 spines, 2nd distinctly enlarged; body with bony plates above pectoral fins and/or ventral midline, and scales with sharp ridges and spines ..... **GASTEROSTEIFORMES** IN PART **Macroramphosidae** (Snipefishes and bellowsfishes) *Volume 2*



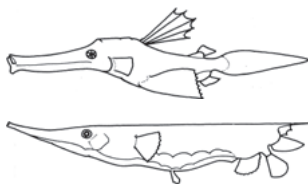
- 35c Not as above ..... **PERCIFORMES** IN PART *Volume 3: key*

- 36a Pelvic fins 6 or more rays; strong, sharp spine in front of dorsal and pectoral fins ..... **SILURIFORMES, Ariidae, Plotosidae** (Sea catfishes and eel-catfishes) *Volume 2*



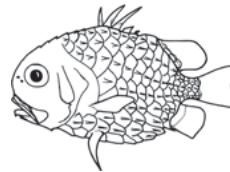
- 36b Pelvic fins 5 or fewer rays ..... **PERCIFORMES** IN PART *Volume 3: key*

- 37a Pelvic fins 1 spine, 6 rays; body covered with large stellate bony plates, or pelvic fins 1 spine, 4–6 rays; dorsal and caudal fins placed ventrally ..... **GASTEROSTEIFORMES** IN PART **Solenostomidae, Centriscidae** (Ghost pipefishes and shrimpfishes) *Volume 2*

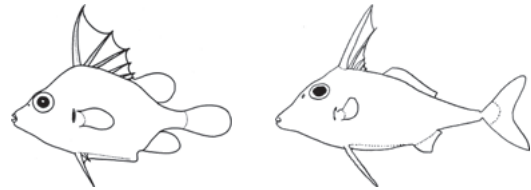


- 37b Combinations not as above ..... 38

- 38a Pelvic fins 1 spine, 5 rays, or the following combination: pelvic fins with 1 spine, 0–4 rays; scales cycloid or absent (skin smooth) ..... **PERCIFORMES** IN PART *Volume 3: key*
- 38b Pelvic fins 1 spine, 0–4 rays, scales not cycloid; skin not smooth ..... 39
  
- 39a Pelvic fins 1 spine, 2–4 rays; scales large, non-overlapping plates with posterior spine (looks like a pineapple) ..... **BERYCIFORMES** IN PART **Monocentridae** (Pineapplefishes) *Volume 2*



- 39b Pelvic fins 1 spine, 0–2 rays; scales not as above, skin like untanned leather with small round granulations ..... **TETRAODONTIFORMES** IN PART **Triacanthodidae, Triacanthidae** (Spikefishes and triplespines) *Volume 5*



- 40a Pelvic fins without spine, or if spine present, embedded or invisible to the naked eye, OR pelvic fins absent or rudimentary ..... 41
- 40b Pelvic fins present, with visible spine ..... 45

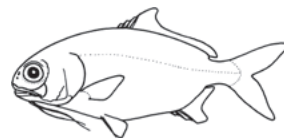
- 41a Pelvic fins either absent or rudimentary, or present and with <5 rays ..... **PERCIFORMES** IN PART *Volume 3: key*
- 41b Pelvic fins present and with 5 or more rays ..... 42

- 42a One or two barbels on lower jaw ..... 43
- 42b No barbels on lower jaw ..... 44

- 43a Snout an elongate tube; caudal fin pointed; barbel at tip of lower jaw single and fleshy ..... **GASTEROSTEIFORMES** IN PART **Aulostomidae** (Trumpetfishes) *Volume 2*



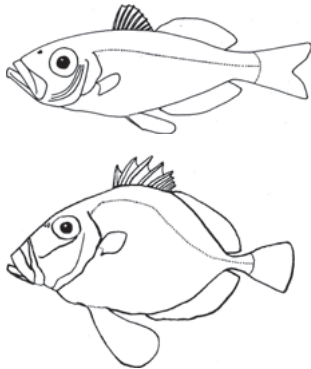
- 43b Snout not tube-like; caudal fin forked; 2 long barbels from middle of lower jaw ..... **POLYMIXIIFORMES, Polymixiidae** (Beardfishes) *Volume 2*



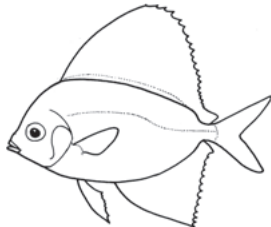
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**KEY TO ORDERS OF BONY FISHES**

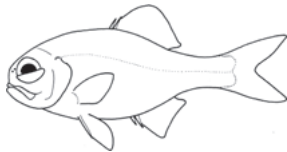
44a Dorsal fin 6–10 spines ..... **ZEIFORMES, Parazenidae, Zeidae** IN PART  
*Zenopsis* (Dories and parazens) *Volume 2*



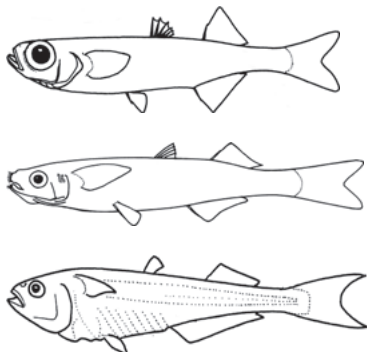
44b Dorsal fin 1 or 2, or >20 spines ..... **LAMPRIFORMES** IN PART  
*Veliferidae* (Velifers) *Volume 2*



45a Light organ present beneath eye; anal fin with 1  
or 2 spines ..... **BERYCIFORMES** IN PART *Anomalopidae*  
(Flashlight fishes) *Volume 2*



45b No light organ below eye; anal fin with 1 weak spine;  
LL absent; gill membranes not attached to isthmus .....  
..... **ATHERINIFORMES, Atherinidae, Atherionidae,**  
*Isonidae* (Silversides and surf sprites) *Volume 2*

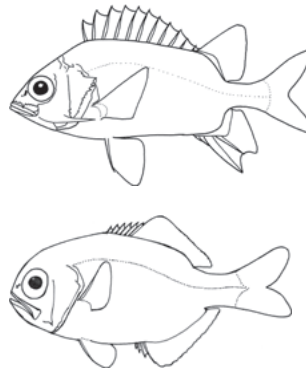


45c Not as above ..... 46

46a Gill membranes separate from each other ..... 47

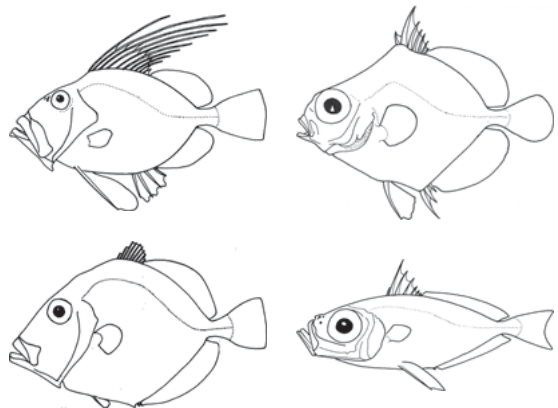
46b Gill membranes not separate from each other ..... 49

47a Dorsal fin 11–20 rays; anal fin 7–30 rays; pelvic fins 1 spine,  
>5 rays ..... **BERYCIFORMES** IN PART *Berycidae, Holocentridae,*  
*Trachichthyidae* (Squirrelfishes, soldierfishes, alfonosinos,  
roughies and slimeheads) *Volume 2*



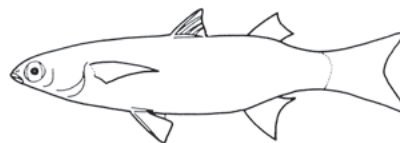
47b Not as above ..... 48

48a Pelvic fins 1 spine, 5–10 rays; and dorsal-, anal- and pectoral-  
fin rays unbranched ..... **ZEIFORMES, Cyttidae, Grammicolepididae,**  
*Oreosomatidae, Zeidae* IN PART *Zeus, Zeniontidae*  
(Dories, oreos and tinsselfishes) *Volume 2*



48b Pelvic fins 1 spine, 0–5 rays, and at least some dorsal-, anal- or  
pectoral-fin rays branched ..... **PERCIFORMES** IN PART *Volume 3: key*

49a LL absent; anal fin 2 or 3 spines, 7–12 rays, dorsal fin 4 spines,  
9 or 10 rays; scales present .....  
..... **MUGILIFORMES, Mugilidae** (Mulletts) *Volume 2*



49b Not as above ..... **PERCIFORMES** IN PART *Volume 3: key*



# ORDER ELOPIFORMES

Phillip C Heemstra

This small order comprises 2 families: the Elopidae, which are considered the most primitive of living bony fishes of the subclass Teleostei, and the Megalopidae. The two are sometimes grouped together because they share such characters as a median gular plate in the lower jaw, numerous branchiostegal rays, similar dentition, comparable position of fins, and leptocephalus larvae. Diagnostic characters are an elongate body, abdominal pelvic fins, unrestricted gill openings, a gular plate, cycloid scales, no fin spines, paired fins with long and narrow axillary scale, and both larvae and adults with forked caudal fin.



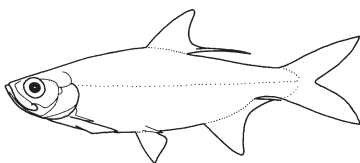
Head showing the position of the gular bone (stippled) in Elopiformes.

## KEY TO FAMILIES

- 1a Body round or oval in cross-section; scales small, LL scales 72–103; anal-fin base slightly shorter than dorsal-fin base ..... **ELOPIDAE**



- 1b Body distinctly compressed; scales large, LL scales 36–40; anal-fin base much longer than dorsal-fin base ..... **MEGALOPIDAE**



## GLOSSARY

**leptocephalus** – leaf-like larvae that are flat and transparent.

## FAMILY ELOPIDAE

### Ladyfishes

Phillip C Heemstra

Body elongate, subcylindrical; mouth terminal, lower jaw slightly projecting; villiform teeth on jaws, tongue and palate; long median bone (gular plate) on underside of lower jaw. Adipose eyelids on front and rear margins of eyes. One dorsal fin, at midbody; distal edge of dorsal fin and anal fin concave; pelvic fins below dorsal fin; pectoral fins on ventral third of body; caudal fin distinctly forked; no fin spines. Scales small, cycloid.

Worldwide in tropical to warm-temperate waters. One genus, *Elops* Linnaeus 1766, with 7 species, 1 in WIO.

### *Elops machnata* (Fabricius 1775)

Ladyfish or tenpounder

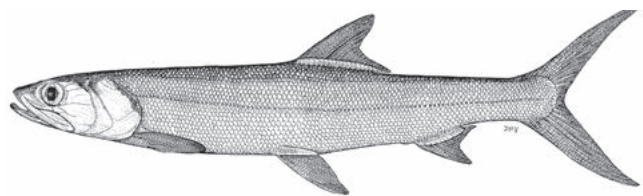
PLATE 1

*Argentina machnata* Fabricius in Niebuhr (ex Forsskål) 1775: 68, xiii (Jeddah, Saudi Arabia, Red Sea).

*Elops machnata*: Fraser 1973; SSF No. 36.2\*; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*.

Dorsal fin 22–27 rays; anal fin 15–18 rays; pectoral fins 17 or 18 rays. GR 7–9/13–15; branchiostegal rays 27–36; LL scales 90–103. In SL: body depth 5.3–8.3, HL 4.3–4.8, snout length 14–25, eye diameter 14–33, upper jaw 6.3–9.1, and lower jaw 5.6–9.1. Vertebrae 63–66.

Body brilliant silvery, fins dusky; pectoral-fin bases yellowish. Attains 120 cm FL.



*Elops machnata*, 33 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to South Africa (Mossel Bay), Socotra, Oman to India, Madagascar, Seychelles, Mauritius, Maldives and Sri Lanka; elsewhere to Bay of Bengal, Indonesia and Philippines.

**REMARKS** Prefers mangroves, rivers and estuaries in its early life stages, and shallow coastal areas and estuaries as adults. Feeds mainly on fishes, but also on crustaceans and molluscs. Caught by subsistence and artisanal fishers using traps and gillnets; a renowned gamefish that fights strongly, jumps from the water repeatedly, and usually breaks free; not esteemed as a food fish as the flesh is bland and full of fine bones.

## FAMILY MEGALOPIDAE

### Tarpons

Phillip C Heemstra

Body oblong, compressed, depth subequal to head length; mouth large, oblique; lower jaw projecting with elongate gular bone between mandibles; maxilla reaching vertical at rear edge of eye; broad bands of minute sharp teeth on maxilla, lower jaw, tongue, endopterygoids and parasphenoid. Eyes large, with transparent adipose eyelids over front and rear margins. Caudal fin distinctly forked; anal-fin base much longer than dorsal-fin base; last dorsal-fin ray elongate; paired fins with long narrow axillary scale at bases; no fin spines. Scales large, cycloid, and in ~9 rows around peduncle; no scales on head.

Solitary predators occurring in shallow sandy areas, including estuaries and rivers. Tolerate a wide range of salinities and pH, as well as oxygen-poor water, by rising to the surface to breathe air taken into the lung-like swimbladder. The leptocephalus larvae resemble those of eels, but with forked tail. One genus with 2 species.

## GENUS *Megalops* Lacepède 1803

Two species, 1 in WIO.

### *Megalops cyprinoides* (Broussonet 1782)

Oxeye tarpon

PLATE 1

*Clupea cyprinoides* Broussonet 1782: [39], Pl. [9] (Tana, New Hebrides [Tanna I., Vanuatu]).

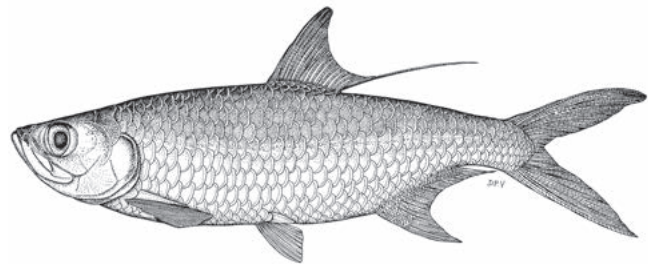
*Megalops filamentosus* Lacepède 1803: 289, 290, Pl. 13, Fig. 3 (Fort Dauphin, Madagascar).

*Megalops indicus* Valenciennes in Cuv. & Val. 1847: 388, Pl. 576 (Indian Ocean).

*Megalops cyprinoides*: SFSA No. 101\*; Van der Elst 1981\*; SSF No. 37.1\*; Randall & Anderson 1993; Skelton 1993\*; Randall 1995\*; Kuitert & Debelius 2001; Heemstra & Heemstra 2004.

Dorsal fin 17–21 rays, last ray long and filamentous; anal fin 24–31 rays; pectoral fins 15 or 16 rays; pelvic fins 10 or 11 rays; caudal fin large, lobes longer than head. GR 13–17/29–35; branchiostegal rays 23–27; LL scales 36–40. Vertebrae 67 or 68.

Head and body silvery, bluish green dorsally. Attains 60 cm TL (commonly 30–50 cm TL) and ~18 kg.



*Megalops cyprinoides*, 26 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Indo-Pacific (widespread), and also reported from some rivers far inland, including the lower Shire in Malawi, lower Zambezi and Save-Runde junction in Zimbabwe. WIO: Persian/Arabian Gulf, Oman to India and Sri Lanka, Red Sea to South Africa (KwaZulu-Natal; strays to Algoa Bay), Madagascar, Rodrigues and Maldives; elsewhere to Indonesia, Malaysia, Philippines, Taiwan, Micronesia, Australia and Society Is.

**REMARKS** Occurs in shallow sandy coastal areas, estuaries, mangroves, rivers and freshwater lakes. Long-lived, maximum age ~44 years; adults generally found at sea and breed offshore; juveniles commonly enter freshwater. Diverse diet of fishes, prawns, crustaceans and insects. Variously taken in artisanal fisheries, commercial landings, and as bycatch, as well as cultured in ponds.

## GLOSSARY

**endopterygoids** – paired dermal bones in the roof of the mouth of fishes.

**gular bone** – the median, dermal bone between the dentary bones of some primitive fishes (e.g., *Latimeria* and *Elops*).

**parasphenoid** – a bone in the middle at the base of the skull.

# ORDER ALBULIFORMES

Phillip C Heemstra

A group of extremely primitive living bony fishes, albuliform species are characterised by an inferior mouth and the mandibular sensory canals lying in an open groove of the dentary and angular bones of the lower jaw (except *Albula* with a small roof in the angular bones). Three families, with 8 genera and ~30 species, most of which occur worldwide in deep seas. Only the Albulidae occurs in WIO.

## FAMILY ALBULIDAE

### Bonefishes

Phillip C Heemstra

Body oblong to elongate, cylindrical. Mouth small, ventral, below projecting conical snout; teeth small and blunt, on jaws, vomer, palatines, pterygoids, tongue and roof of mouth, but no teeth on maxillae. Dorsal fin at midbody; anal fin small, set well behind dorsal fin; pelvic fins abdominal, their origin below rear end of dorsal fin; pectoral fins low on body, folding below ventrolateral dermal recess; narrow axillary process at pelvic-fin bases; no fin spines; caudal fin forked. Scales small, cycloid; lateral line inconspicuous, the scale tubes unbranched. Larvae transparent and ribbon-like, similar to the leptocephalus of eels but with forked caudal fin.

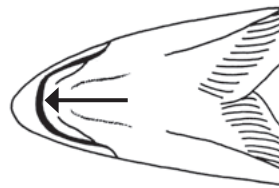
Targeted in commercial, recreational and subsistence fisheries throughout their ranges. The nomenclature of the family is currently in a state of revision; 2 or 3 genera recognised, with several generally morphologically indistinguishable but likely genetically distinct species.

## GENUS *Albula* Scopoli (ex Gronow) 1777

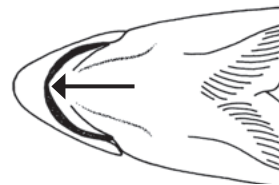
Early nomenclatural history of the genus is confused. Based on DNA analyses, Colborn *et al.* (2001) recognised 8 lineages of *Albula* worldwide; further research is needed to link these to taxonomic identities. Possibly at least 9 valid species (Wallace & Tringali 2010), 2 in WIO.

### KEY TO SPECIES

- 1a Lower jaw smoothly rounded in ventral view; snout length (tip of snout to rear of maxilla) 3–3.3 in HL; LL scales 69–78 ..... *A. glossodonta*



- 1b Lower jaw angular in ventral view; snout length 2.7–2.9 in HL; LL scales 61–65 ..... *A. oligolepis*



*Albula glossodonta* (Forsskål 1775)

Shortjaw bonefish

PLATE 1

*Argentina glossodonta* Forsskål in Niebuhr 1775: 68, xiii (Jeddah, Saudi Arabia, Red Sea; Al-Luhayya, Yemen, Red Sea).

*Albula vulpes* (non Linnaeus 1758): SFSA No. 99 [not drawing]; SSF No. 38.1\*.

*Albula glossodonta*: Winterbottom *et al.* 1989; Hidaka *et al.* 2004\*; Randall 2007\*; Hidaka *et al.* 2008\*.

Dorsal fin 14–18 rays; anal fin 7–9 rays; pectoral fins 16–20 rays; pelvic fins 9–11 rays. LL scales 69–78; GR 8–11/10–13; branchiostegal rays 10–14. Vertebrae 70–75.

Head and body silvery, dull green above, white below, with ~12 series of pale spots (one per scale) along upper two-thirds of body; black smudge on snout tip and in front of nostrils; anal fin and paired fins occasionally brownish; inner margin of caudal fin black. Attains 100 cm SL, ~10 kg.

**DISTRIBUTION** Indo-Pacific. WIO: confirmed records only from Red Sea and Mauritius; elsewhere, Japan, Tonga and Hawaii.

**REMARKS** Reports of *A. glossodonta* from other localities are dubious because of confusion with other species of *Albula*. Occurs over sandy bottom in shallow coastal areas and in mangroves and estuaries; solitary or in small groups. Spawns offshore throughout the year. Feeds on worms, small molluscs, crustaceans and fishes. Strong and fast-swimming: a superb gamefish, caught with lures on light tackle and fly rods. Not good eating because of numerous fine bones in the flesh. IUCN Red List conservation status Vulnerable.

*Albula oligolepis* Hidaka, Iwatsuki & Randall 2008

Slender bonefish

PLATE 1

*Albula vulpes* (non Linnaeus 1758): SFSA No. 99\* [in part]; SSF No. 38.1\*.

*Albula glossodonta* (non Forsskål 1775): Heemstra & Heemstra 2004\*.

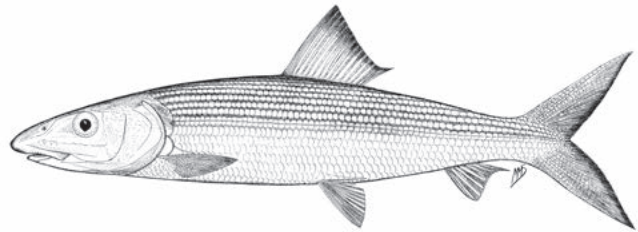
*Albula argentea* (non Forster 1801): Randall 1995: 53 [Fig. 80 labelled '*Albula forsteri*'].

*Albula* sp. D: Colborn *et al.* 2001.

*Albula oligolepis* Hidaka, Iwatsuki & Randall 2008: 59, Fig. 3 (Durban, KwaZulu-Natal, South Africa).

Dorsal fin 17–19 rays; anal fin 7–9 rays; pectoral fins 17–19 rays; pelvic fins 10 rays, and fin tips not reaching middle of anus. LL scales 61–65; GR 6–10/10–13; branchiostegal rays 12–15. Vertebrae 64–66.

Head and body silvery; dark longitudinal stripes on body between scale rows; snout tip and nostrils with black smudge; bases of paired fins bright yellow. Attains 90 cm SL.



*Albula oligolepis*, 33 cm TL (South Africa). Source: SFSA

**DISTRIBUTION** Indian Ocean and western Pacific (disjunct). WIO: Gulf of Oman, Somalia to South Africa (Eastern Cape), Seychelles, Mauritius, Réunion, India and Sri Lanka; elsewhere to western Thailand and northeastern Australia.

**REMARKS** Found in estuaries, over soft bottom.

**GLOSSARY**

**pterygoids** – bones of the roof and walls of the mouth in fishes, behind the palatines.



# ORDER ANGUILLIFORMES

David G Smith

Eels are elongate, snake-like fishes with a low and generally long dorsal fin and anal fin (either or both fins absent in a few species), usually confluent with a small caudal fin around the end of the tail; pectoral fins present or absent; no pelvic fins; all fins supported by soft rays; no fin spines; scales usually absent, or small and embedded; gill openings restricted to a small hole or slit on each side (united on the ventral midline in some).

The structural features of eels undoubtedly evolved in relation to a crevice-dwelling or sediment-burrowing existence; however, some have adapted to a wide variety of habitats, including the pelagic zone in the open ocean. Eels can be found from freshwater lakes, rivers and estuaries, to the depths of the ocean. They are most common in tropical and subtropical waters and are greatly diverse in and around coral reefs. Eels spawn in the open ocean and have a large, long-lived, pelagic larval stage called a leptocephalus. The delicate-looking larvae are strongly compressed, leaf-like, and completely transparent in life. Leptocephali are so unlike the adults in appearance that they were originally described as separate species and genera.

Most eels are small- to moderate-sized, but a few species (particularly the giant moray *Gymnothorax javanicus* and some species of *Conger*) can grow quite large. Some species, predominantly the freshwater eels *Anguilla*, are popular food fishes, but most are of little economic importance. Some large morays have been implicated in ciguatera poisoning. While eels are generally not aggressive towards divers, large ones can be dangerous if provoked, as many have sharp teeth and can inflict a serious bite. 'Look but don't touch' is a good rule to follow when underwater.

Because of reduction and convergence in many external features, eels can be difficult to identify. Body proportions, the presence or absence and location of fins, and the nature of the nostrils and gill openings are some features by which species are identified. An especially valuable character for species identification is the number of vertebrae, but this requires a radiograph and cannot be used in the field.

The cryptic habits of many eel species make them difficult to collect, and new species are constantly being discovered. About 14 families currently recognised worldwide, 13 in WIO, 10 of these with representatives at depths of <200 m; Derichthyidae, Nemichthyidae, Serrivomeridae are limited to deep midwaters of the Indo-Pacific and are not included here; the Heterenchelyidae occurs largely in the Atlantic. In some classifications the Cyematidae has been included in the Anguilliformes but is now placed in the order Saccopharyngiformes.

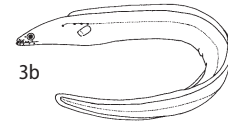
## KEY TO FAMILIES

### [WIO shallow-water representatives only]

- 1a LL pores 1–5 above and in front of gill openings; gill openings very small, lateral in position ..... 2
- 1b LL pores present >5 (may be small); gill openings larger, semicircular slits, lateral to ventral in position ..... 4
- 2a Posterior nostrils at or above level of upper margin of eyes ..... 3
- 2b Posterior nostrils at or below level of middle of eyes, sometimes opening into lip ..... **CHLOPSIDAE**



- 3a No pectoral fins ..... **MURAENIDAE**
- 3b Pectoral fins present ..... **MYROCONGRIDAE**

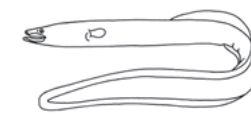


- 4a Anus well behind midlength; lower jaw usually projecting beyond upper jaw ..... **MORINGUIDAE**



- 4b Anus before to slightly behind midlength, and jaws usually equal; if anus well behind midlength then upper jaw projecting ..... 5

- 5a Small embedded scales present; lower jaw projecting beyond upper jaw ..... **ANGUILLIDAE**



- 5b Scales absent; jaws equal or upper jaw projecting ..... 6

Continued ...

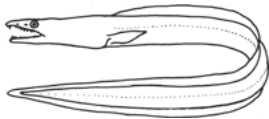
## KEY TO FAMILIES

- 6a Tip of tail hard and pointed, no caudal fin ..... **OPHICHTHIDAE**  
[IN PART]



- 6b Tip of tail variable, but caudal fin always present ..... 7

- 7a Prominent median row of teeth on vomer fang-like or blade-like, close-set, flanked on each side by row of much smaller teeth; pectoral fins well-developed ..... **MURAENOSOCIDAE**



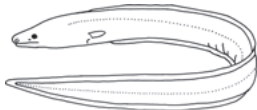
- 7b Teeth on vomer variable but not as above, never blade-like; pectoral fins variable in size, sometimes absent ... 8

- 8a Snout elongate, much longer than eye diameter; teeth on jaws small, multiserial, exposed when mouth is closed; no pectoral fins ..... **NETTASTOMATIDAE**



- 8b Snout not elongate; teeth generally concealed when mouth is closed; pectoral fins present or absent ..... 9

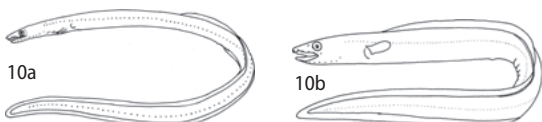
- 9a Teeth on vomer distinctly enlarged, in 1 row, but few in number ..... **SYNAPHOBRANCHIDAE** [*Dysomma*]



- 9b Teeth on vomer not as above ..... 10

- 10a Anterior branchiostegal rays greatly overlapping those of opposite side, not all attached basally to hyal bones; posterior nostrils either low on sides of head or opening as a slit in upper lip; median frontal sensory pore between eyes at their rear margin; upper lip without upturned flange; caudal fin reduced ..... **OPHICHTHIDAE** [IN PART]

- 10b Anterior branchiostegal rays not as above; position of posterior nostril variable, usually at or above mid-eye level; no median frontal sensory pore; upper lip with or without upturned flange; caudal-fin size variable ..... **CONGRIDAE**

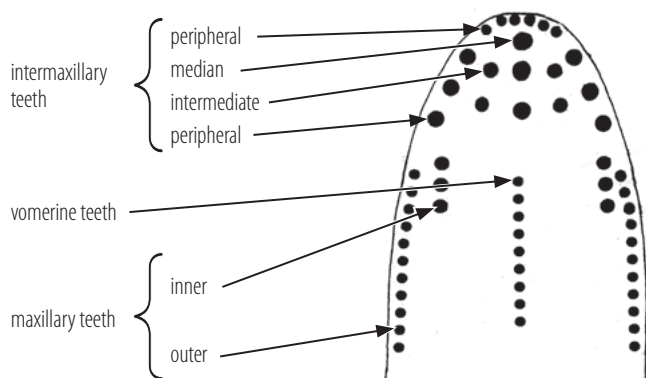


## FAMILY MURAENIDAE

## Moray eels

David G Smith and Eugenia B Böhlke

Body elongate, muscular, usually laterally compressed posteriorly. Dorsal profile of head above and behind eye often raised due to the development of strong head muscles. Eyes well-developed, about halfway from tip of snout to rictus. Snout short to elongate; jaws short to elongate, usually about equal. Mouth large, gape usually extending behind eye, lips without flanges. Teeth numerous and strong, with smooth or serrate margins, ranging from rounded molars to long, slender, sharp (sometimes depressible) canines. Intermaxillary (anterior) teeth in 1 or 2 peripheral rows in upper jaw, and usually 1–3 longer median teeth (sometimes missing in large individuals); maxillary teeth in one or more rows on each side of upper jaw. Vomerine teeth usually short, in 1 or 2 rows or in patch, but sometimes absent.



Muraenidae dentition, position of teeth in upper jaw.

Dentary teeth in one or more rows in lower jaw; in many species of Muraeninae, first 4 teeth are larger, sometimes forming short inner row. Pharyngeal jaws well-developed. Anterior nostrils tubular, near tip of snout; posterior nostrils a simple pore or in a tube, above level of eyes. Gill openings a small round hole or slit on midside of head. Dorsal fin and anal fin continuous with caudal fin around tail tip, and fins variously developed: Muraeninae with dorsal-fin origin usually on head (but fin origin not externally discernible in some species) and anal-fin origin immediately behind anus; Uropterygiinae with dorsal and anal fins both restricted to near tail tip. No pectoral fins (after metamorphosis) and no pelvic fins. No scales. No lateral-line pores on body, except for a few (usually 1 or 2) branchial pores above and before gill openings; pores on sides of head usually 3 near snout tip, 4 on upper jaw, 6 along lower jaw, and none behind eyes or in supratemporal commissure. Colour variable, from nearly uniform to distinctively patterned with spots, blotches, bars and/or reticulations.

Occur worldwide in shallow tropical reefs, mangroves, seagrass beds, estuaries and occasionally freshwater habitats (but not far from the sea); some species in temperate or deep waters (~100–500 m). Most species are nocturnal, but some are also found roaming reefs during the day. Carnivorous, feeding on a variety of crustaceans, octopuses and fishes, but mostly piscivorous: their long, slender, depressible canine-like teeth are suited to catching and holding a variety of bite-sized fishes that serve as prey; some species (*Echidna* and *Gymnomuraena*) have blunt molariform teeth that are used to crush hard-shelled prey such as small molluscs and crustaceans.

Eggs and larvae are pelagic. Several species are protandrous or synchronous hermaphrodites. Morays are not of commercial importance, but some species are caught in artisanal fisheries and used as food. Eating large morays (>4 kg) may cause ciguatera poisoning, which is sometimes fatal. On coral reefs, divers should be wary of reaching into holes that may be inhabited by morays, as they will bite when disturbed; likewise, some divers have been severely bitten by large morays after spearing them.

Morays and other eels are often difficult to identify because of variability in or the absence of distinctive features (scales, fin configurations, gill rakers, etc.) that are diagnostic in other fish species. Characters used to identify morays include median fin positions, tail length (determined by position of anus), body and head proportions, configuration of jaws, dentition, nostril shape and colour pattern. Both colour and dentition may change greatly with growth. Vertebral counts, while not useful for field identification, are a consistent and important character for species definitions. Predorsal vertebrae are those in front of a vertical at dorsal-fin origin; preanal vertebrae are those in front of a vertical at anal-fin origin. The mean vertebral formula (MVF) gives the mean values for counts of predorsal, preanal and total vertebrae, to the nearest whole number. Total length (TL) is from tip of snout to tail tip; preanal length is from tip of snout to mid-anus; head length (HL) is from tip of snout to gill openings; snout length is from tip of snout to front margin of eye; upper jaw length is from tip of snout to rictus of mouth; body depth is measured at gill openings (BD/GO) or at anus (BD/A). Tooth counts include recumbent teeth and obvious sockets; upper-jaw tooth counts include peripheral teeth of the intermaxillary. Pores are identified within sections of the lateralis canal system, following Böhlke (1989): branchial (above and before gill openings), supraorbital (at front of snout and on top of snout near anterior nostril), infraorbital (along upper jaw) and preoperculo-mandibular (along lower jaw); no supratemporal or post-ocular pores.

About 197 species and 15 genera, in 2 subfamilies (Smith 2012); at least 84 species in WIO, but the true diversity is probably greater. As more collections are made and those collections are studied more closely, additional species are likely to be described.

#### KEY TO SUBFAMILIES AND GENERA

- 1a Dorsal fin and anal fin restricted to rear of body, near tail tip ..... 2 [subfamily *Uropterygiinae*]



- 1b Dorsal-fin origin above or well before anus and usually on head; anal-fin origin just behind anus ..... 5 [subfamily *Muraeninae*]

- 2a Jaws elongate, and lower jaw protruding beyond upper jaw; eyes much closer to snout tip than to rictus ..... *Channomuraena*

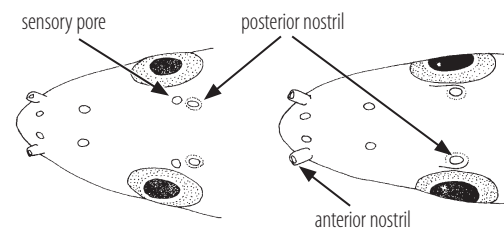
- 2b Jaws not elongate, and upper and lower jaws subequal; eyes about midway between snout tip and rictus ..... 3

- 3a Anus well behind midlength; tail much shorter than length of rest of body ..... *Scuticaria*

- 3b Anus near midlength; tail length approximately equal to length of rest of body ..... 4

- 4a Sensory pore present beside posterior nostril ..... *Anarchias*

- 4b No sensory pore beside posterior nostril ..... *Uropterygius*



4a

4b

- 5a Dorsal-fin origin behind anus ..... *Monopenchelys*

- 5b Dorsal-fin origin before anus, and usually on head ..... 6

- 6a Anterior nostrils funnel-shaped, with broad distal flap; tip of lower jaw with barbels; body extremely elongate, compressed, ribbon-like, and colour black, yellow or blue, with bright fin margins ..... *Rhinomuraena*

- 6b Anterior nostrils tubular; no barbels on lower jaw; body not ribbon-like ..... 7



6a

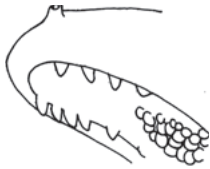


6b

Continued ...

## KEY TO SUBFAMILIES AND GENERA

- 7a Teeth stout, blunt, and some molariform (at least on vomer) ..... 8  
 7b Teeth sharp, pointed, long or moderate, though some may be relatively stout, but never molariform ..... 9



7a



7b

- 8a Anus well behind midlength; tail shorter than rest of body ..... *Gymnomuraena*  
 8b Anus near or slightly before midlength; tail length subequal to rest of body ..... *Echidna*

- 9a Body slender, extremely elongate; body depth at gill openings (BD/GO) 25–56 in TL ..... 10  
 9b Body usually less elongate, BD/GO 9–25 in TL (except *Gymnothorax phasmatodes* with BD/GO 27–31 in TL) ..... 11

- 10a Anus well before midlength, and tail ~ 2/3 TL; body uniformly dark brown and fins without white margins ..... *Strophidon*  
 10b Anus near midlength; body uniformly tan and fins with white margins ..... *Pseudechidna*

- 11a Jaws highly arched, meeting only at tips; elongate canine teeth visible when mouth closed ..... 12  
 11b Jaws straight, closing completely or with a slight gap; teeth hidden when mouth closed ..... 13

- 12a Anterior nostrils with large bilobed flap on rear margin ..... *Enchelynassa*



- 12b Anterior nostrils without large bilobed flap on rear margin ..... *Enchelycore*  
 13a Posterior nostrils in a distinct tube ..... *Muraena*  
 13b Posterior nostrils sometimes with a raised rim, but not in a distinct tube ..... *Gymnothorax*

## SUBFAMILY MURAENINAE

Dorsal fin and anal fin not restricted to near tail tip; anus near midlength; dorsal-fin origin before anus (except usually on head or above gill openings in *Monopenchelys acuta*); anal-fin origin immediately behind anus. Abundant and speciose, although the genera are poorly defined, thus the arrangement presented here reflects current usage and is provisional. Represented in WIO by 10 genera (*Echidna*, *Enchelycore*, *Enchelynassa*, *Gymnomuraena*, *Gymnothorax*, *Monopenchelys*, *Muraena*, *Pseudechidna*, *Rhinomuraena* and *Strophidon*). *Gymnothorax* is particularly ambiguous and is probably not monophyletic, as several of the species approach conditions found in other genera, especially in dentition and elongation of the body.

GENUS *Echidna* Forster 1788

Small- to large-sized with short jaws and molariform teeth covering roof of mouth in adults; dorsal-fin origin near gill openings; anus near midlength. Eleven species, 4 in WIO.

## KEY TO SPECIES

- 1a Body uniformly brown, without bars or blotches ..... 2  
 1b Body with bars or blotches, at least on tail ..... 3
- 2a Margins of fins, pores and nostrils pale ..... *E. leucotaenia*  
 2b Margins of fins, pores and nostrils same colour as body ..... *E. unicolor*
- 3a Body with alternating dark and pale bars ..... *E. polyzona*  
 3b Body with irregular snowflake-patterned blotches ..... *E. nebulosa*

*Echidna leucotaenia* Schultz 1943

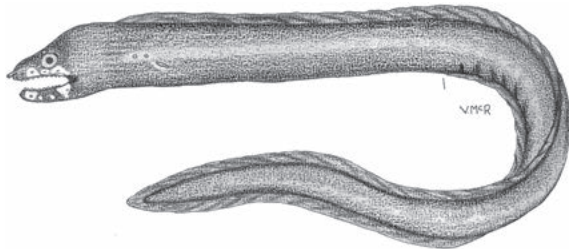
Whiteface moray

*Echidna leucotaenia* Schultz 1943: 22, Pl. 3 (reef at Enderbury I., Phoenix Is.); SSF No. 41.2\*; Winterbottom *et al.* 1989\*; Böhlke & Smith 2002; Heemstra & Heemstra 2004; Smith 2012.

In TL: preanal length 2.1–2.3, HL 7.3–8.6, BD/GO 14–21, and BD/A 16–24. In HL: snout length 5.3–6.8, upper jaw 2.6–3.4, and eye diameter 7.9–11. Teeth short or molariform; intermaxillary teeth in 3 rows, with 3 short median teeth; teeth on jaws biserial; vomerine teeth multiserial. Vertebrae: predorsal 5–7, preanal 50–53, total 122–130; MVF 6/51/126.



Body brown, with pale snout tip and fin margins; head darker dorsally, with contrasting pale pores and nostrils, but rictus dark. Attains 52 cm TL.



*Echidna leucotaenia*, 31 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal), Comoros, Seychelles and Chagos; elsewhere to Marshall Is., New Caledonia, Tonga, Phoenix Is. and Hawaii.

### *Echidna nebulosa* (Ahl 1789)

Snowflake moray

PLATE 1

*Muraena nebulosa* Ahl 1789: 7, Pl. 1, Fig. (Orientali India [Indonesia]).

*Muraena ophis* Rüppell 1830: 116, Pl. 29, Fig. 2 (Red Sea) [name preoccupied by *Muraena ophis* Linnaeus 1758].

*Muraena auloptera* De Filippi 1853: 168 (Mauritius, Mascarenes).

*Echidna nebulosa*: SSF No. 41.3\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Randall & Golani 1995\*; Böhlke & Smith 2002; Heemstra & Heemstra 2004\*; Letourneur *et al.* 2004; Smith 2012.

In TL: preanal length 1.9–2, HL 8.1–10, BD/GO 14–23, and BD/A 16–27. In HL: snout length 5.5–6.8, upper jaw 2.5–3.5, and eye diameter 10–13. Teeth short or molariform, uniserial or biserial, no canines; intermaxillary teeth in 3 rows, with 2 median teeth; vomerine teeth extending posteriorly beyond teeth on upper jaw. Vertebrae: predorsal 4–7, preanal 56–59, total 119–126; MVF 6/57/122.

Body yellowish to creamy background, with 2 rows of blackish brown stellate spots with yellow or orange centres (pale in preservation) and smaller irregular dark spots and flecks, and spots extend onto fins; snout and jaws pale. Attains 75 cm TL.



*Echidna nebulosa*, 33 cm TL (Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, Oman to South Africa (Eastern Cape), Mozambique Channel, Madagascar, Comoros, Seychelles, Mascarenes, St Brandon Shoals, Chagos and Maldives; elsewhere to Indonesia, southern Japan, Australia, New Caledonia, Hawaii and Panama.

**REMARKS** Common in shallow water, among rocks, seagrass beds and reefs; long-lived in aquaria.

### *Echidna polyzona* (Richardson 1845)

Barred moray

PLATE 1

*Muraena polyzona* Richardson 1845: 112, Pl. 55, Figs. 11–14 [no locality given].

*Muraena fascigula* Peters 1855: 459 (Mozambique).

*Pocilophis pikei* Bliss (ex Steindachner) 1883: 61 (Mauritius, Mascarenes).

*Echidna polyzona*: SSF No. 41.4\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall & Golani 1995; Böhlke & Smith 2002; Heemstra & Heemstra 2004; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

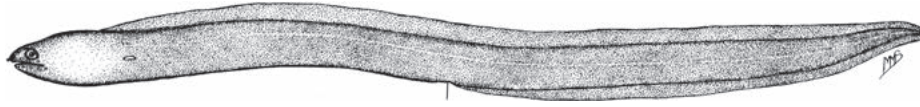
In TL: preanal length 1.8–2.2, HL 6.4–8.2, BD/GO 10–19, and BD/A 12–20. In HL: snout length 4.8–7, upper jaw 2.4–3.2, and eye diameter 7.8–13. Teeth stout or molariform, numerous and multiserial; intermaxillary teeth in 5 rows, with 3 median teeth; vomerine teeth forming plate on roof of mouth. Vertebrae: predorsal 5–7, preanal 48–54, total 119–126; MVF 6/52/122.

Body and fins pale background, with ~25 wide dark bars (small specimens distinctly barred, adults appear more mottled and bars become diffuse anteriorly, with head pale to mottled). Attains 72 cm TL.



*Echidna polyzona*, 30 cm TL (Mauritius). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Oman to South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to Taiwan, southern Japan, Australia, New Caledonia, Fiji, Marquesas Is. and Hawaii.



*Echidna unicolor*, 29 cm TL (Kenya). Source: Smith 1962

## *Echidna unicolor* Schultz 1953

### Unicolor moray

*Echidna unicolor* Schultz in Schultz *et al.* 1953: 106, Figs. 21d, 22 (lagoon reef at Rongelap Atoll, Marshall Is.); Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Smith 2012.

In TL: preanal length 2–2.2, HL 7.6–8.6, BD/GO 15–23, and BD/A 19–26. In HL: snout length 5.6–7.8, upper jaw 2.9–3.7, and eye diameter 7.4–13. Teeth stout or molariform, numerous, mostly biserial; intermaxillary teeth in rosette covering bone; vomerine teeth large, molariform, in 2 rows. Vertebrae: predorsal 5–7, preanal 49–55, total 117–127; MVF 6/52/122.

Body and fins uniformly tan or brown; narrow brown ring around eyes; head pores sometimes pale. Attains 36 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to Mozambique, Seychelles, Chagos and Maldives; elsewhere to Marshall Is., Australia, Tonga and Tuamotu Is.

**REMARKS** Uncommon; found on coral reefs, to ~27 m deep.

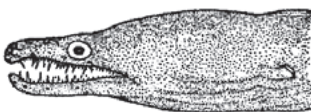
## GENUS *Enchelycore* Kaup 1856

Moderate- to large-sized with long arched jaws meeting only at tips; large fang-like teeth, exposed even when mouth is shut. Dorsal-fin origin near gill openings; anus near midlength. Eleven species, 4 in WIO.

### KEY TO SPECIES

- |    |   |                    |
|----|---|--------------------|
| 1a | Posterior nostril in long tube above eye; head and body with conspicuous multi-coloured pattern of spots and blotches ..... | <i>E. pardalis</i> |
| 1b | Posterior nostril not in long tube; body spotted or plain .....   | 2                  |

Continued ...



*Enchelycore bayeri*, 40 cm TL, holotype and head (Rongelap Atoll). Source: Schultz *et al.* 1953

### KEY TO SPECIES

- |    |  |                             |
|----|--|-----------------------------|
| 2a | Body brown, with white spots .....                                   | <i>E. nycturanus</i>        |
| 2b | Body plain brown or grey, without spots .....                        | 3                           |
| 3a | Anterior nostril long and funnel-shaped; jaws less slender .....     | <i>E. schismatorhynchus</i> |
| 3b | Anterior nostril not long and funnel-shaped; jaws very slender ..... | <i>E. bayeri</i>            |

## *Enchelycore bayeri* (Schultz 1953)

### Bowmouth moray

PLATE 1

*Gymnothorax bayeri* Schultz in Schultz *et al.* 1953: 124, Figs. 23f, 26 (Rongelap Atoll, Marshall Is.).

*Enchelycore bayeri*: Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Randall & Golani 1995; Böhlke & Smith 2002; Letourneur *et al.* 2004; Smith 2012.

In TL: preanal length 2.4–2.5, HL 7–7.9, predorsal length 7–7.8, BD/GO 20–28, and BD/A 21–35. In HL: snout length 4.4–4.7, upper jaw 2.3–2.5, and eye diameter 11–16. Jaws widely arched, meeting only at tips and exposing teeth; maximum gap between closed jaws ~ $\frac{3}{4}$  eye diameter. Teeth long and slender; intermaxillary teeth in 3 rows, with 3 needle-like, depressible, median fangs; maxillary teeth biserial, outer teeth numerous and variable in size, and inner teeth fewer, longer, depressible; vomerine teeth in small patch, biserial at front, uniserial at back; dentary teeth mostly uniserial, variable in size, but a few large depressible inner teeth anteriorly. Vertebrae: predorsal 8–11, preanal 49–53, total 146–153; MVF 10/51/149.

Body uniformly dark brown; fin margins white near tail tip. Attains 60 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Réunion, Chagos and Maldives; elsewhere to southern Japan, Marshall Is., Great Barrier Reef, Samoa, Society Is. and Line Is.

**REMARKS** Cryptic, on coral reefs, at 2–38 m.



*Enchelycore nycturanus*, 21 cm TL, paratype (South Africa).

## *Enchelycore nycturanus* Smith 2002

Night-sky moray

PLATE 1

*Enchelycore nycturanus* Smith 2002: 2, Figs. 1–3 (Aliwal Shoal, KwaZulu-Natal, South Africa); Smith 2012.

In TL: preanal length 2.4–2.5, HL 7.1–7.5, BD/GO 18–21, and BD/A 20–23. In HL: snout length 5.3–5.5, upper jaw 2.3–3, and eye diameter 10–12. Intermaxillary teeth in 5 rows, with median row of 2 or 3 long, needle-like, depressible fangs; maxillary teeth irregularly triserial, inner teeth largest; ~10 vomerine teeth, small and uniserial; dentary teeth biserial, inner teeth larger. Vertebrae: predorsal 5 or 6, preanal 53–56, total 147 or 148; MVF 5/55/147.

Body brown, with small to medium white spots extending onto fins; spots largest posteriorly, becoming smaller and more irregular on head and front part of body, and snout uniformly brown. Attains 22.3 cm TL.

**DISTRIBUTION** Known only from three specimens from Aliwal Shoal, South Africa.

## *Enchelycore pardalis* (Temminck & Schlegel 1846)

Dragon moray

PLATES 1 & 2

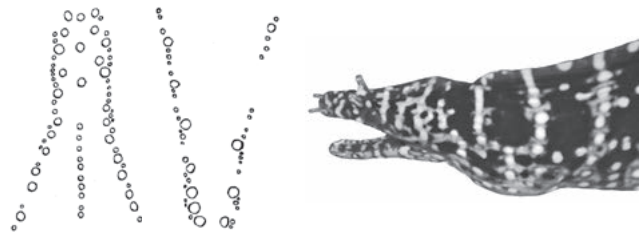
*Muraena pardalis* Temminck & Schlegel 1846: 268, Pl. 119 (Nagasaki, Japan).

*Enchelycore pardalis*: Winterbottom *et al.* 1989\*; Randall 1995\*; Böhlke & Smith 2002; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.1–2.3, HL 6.1–7.3, BD/GO 10–16, and BD/A 11–18. In HL: snout length 4.2–5.7, upper jaw 2.2–2.7, and eye diameter 11–18. Posterior nostril in long tube. Intermaxillary teeth in 5 rows, with 2 or 3 needle-like, depressible, median fangs; maxillary teeth biserial, outer teeth small and numerous, and inner teeth fewer, longer, depressible; vomerine teeth uniserial; lower jaw with outer series of variably sized small teeth and a few large depressible fangs in short inner row anteriorly. Vertebrae: 3–6 predorsal, 44–51 preanal, 119–126 total; MVF 4/47/123.

Striking multi-coloured pattern of bright white, reddish brown, and dark brown irregular spots on head, body and fins,

some spots ocellated and some bright red (in life), and others stretched into narrow bars. Attains 92 cm TL.



*Enchelycore pardalis*, dentition.

*Enchelycore pardalis* (South Africa).

Source: Weber & De Beaufort 1916

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**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Yemen, Kenya, Tanzania (Zanzibar), Mozambique and South Africa (Aliwal Shoal), Madagascar, Comoros, Réunion, Mauritius and Chagos; elsewhere to Korea, southern Japan, New Caledonia, Line Is., Marquesas Is. and Hawaii.

**REMARKS** Found on coral reefs, at 1–20 m; juveniles found in tidepools.

## *Enchelycore schismatorhynchus* (Bleeker 1853)

Funnel-nostril moray

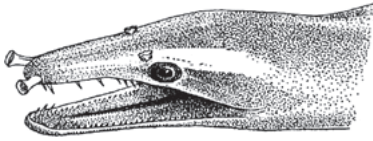
PLATE 2

*Muraena schismatorhynchus* Bleeker 1853: 301 (Bengkulu, Sumatra, Indonesia).

*Muraena hemprichii* Klunzinger 1871: 613 (Al-Qusayr, Egypt, Red Sea). *Enchelycore schismatorhynchus*: Winterbottom *et al.* 1989\*; Smith 2012.

In TL: preanal length 1.9–2.2, HL 7.2–8.2, BD/GO 16–21, and BD/A 17–27. In HL: snout length 4.6–5.5, upper jaw 2–2.3, and eye diameter 8.9–15. Anterior nostrils long and funnel-shaped; posterior nostrils with raised rim but not set in tube. Teeth long and slender, many fang-like; intermaxillary teeth in 3 rows, with 2 or 3 needle-like, depressible, median fangs; maxillary teeth biserial, with outer row of small teeth, and short inner row of larger teeth; vomerine teeth uniserial; lower jaw with outer series of small teeth and short inner series of larger teeth anteriorly. Vertebrae: predorsal 4–6, preanal 60–65, total 137–142; MVF 4/62/140.

Body brown or grey, with conspicuous pale fin margins.  
Attains ~120 cm TL.



*Enchelycore schismatorhynchus*, head. Source: Weber & De Beaufort 1916

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and Chagos; elsewhere to Indonesia, Philippines, Ryukyu Is., Caroline Is., New Guinea and Society Is.

**REMARKS** Found in shallow water, to ~5 m deep.

## GENUS *Enchelynassa* Kaup 1855

Large and elongate body, with long arched jaws exposing fang-like teeth. Dorsal-fin origin near gill openings; anus near midlength. Anterior nostrils in broad tube with bilobed flap; posterior nostrils in short tube with widely flanged rim. One species.

### *Enchelynassa canina* (Quoy & Gaimard 1824)

Indo-Pacific viper moray PLATES 2 & 8

*Muraena canina* Quoy & Gaimard 1824: 247 (Waigeo, Papua Barat, Indonesia; Bismarck Archipelago, New Guinea).

*Enchelynassa canina*: Winterbottom *et al.* 1989\*; Böhlke & Smith 2002; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

Diagnosis as for genus. In TL: preanal length 1.9–2.1, HL 7.1–8.8, BD/GO 11–20, and BD/A 16–23. In HL: snout length 5.3–5.9, upper jaw 2–2.5, and eye diameter 8.7–12. Teeth numerous, many long and fang-like; intermaxillary teeth in 5 rows, with 2 or 3 needle-like, depressible, median fangs; maxillary teeth biserial, outer teeth numerous and small, but variably sized, and inner teeth fewer and much larger; vomerine teeth uniserial, few and inconspicuous; dentary teeth uniserial posteriorly, biserial anteriorly, inner teeth large and depressible. Vertebrae: predorsal 6 or 7, preanal 62–64, total 141–147; MVF 6/63/142.

Head and body uniformly dark brown; fins with pale to tan margins; rear jaw pores sometimes pale. Attains possibly 250 cm TL.



*Enchelynassa canina*, 63 cm SL (Chagos). © R Winterbottom, ROM

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Réunion, Mauritius and Chagos; elsewhere to Australia, Indonesia, China, Japan, New Guinea, Tonga, Hawaii and Panama.

**REMARKS** Secretive; found in surge zones on outer reefs, at 20–30 m. May bite if provoked.

## GENUS *Gymnomuraena* Lacepède 1803

Large-sized and stout-bodied, with numerous molariform teeth covering roof of mouth; tail very short; dorsal-fin origin behind gill openings, and median fins obscured by flabby flesh; anus well behind midbody. One species.

### *Gymnomuraena zebra* (Shaw 1797)

Zebra moray

*Gymnothorax zebra* Shaw *in* Shaw & Nodder 1797: no page numbers, Pl. 322 (Sumatra, Indonesia).

*Gymnomuraena doliata* Lacepède 1803: 648–649, Pl. 19, Fig. 4 (New Britain, Bismarck Archipelago).

*Muraena molendinaris* Bennett 1833: 32 (Mauritius, Mascarenes).

*Gymnomuraena fasciata* Kaup 1856: 68 (Muscat, Oman, Arabian Sea).

*Echidna zebra*: SSF No. 41.5\*.

*Gymnomuraena zebra*: Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Randall 1995\*; Heemstra & Heemstra 2004; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

Diagnosis as for genus. In TL: preanal length 1.4–1.5, HL 8.5–11, BD/GO 15–21, and BD/A 15–26. In HL: snout length 5.8–8.8, upper jaw 2.6–4.1, and eye diameter 9.1–20. Teeth numerous, short and molariform, biserial to triserial on jaws;



teeth on intermaxillary continuous with multiserial teeth on vomer, covering roof of mouth. Vertebrae: predorsal 13–18, preanal 80–88, total 127–136; MVF 14/84/132.

Body dark brownish black, with numerous narrow yellowish bars (~25 in juveniles, to ~100 in adults). Attains 150 cm TL.



*Gymnomuraena zebra*, 70 cm TL (Kenya). Source: SSF

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, Oman to South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to Indonesia, southern Japan, New Guinea, Australia, New Caledonia, Hawaii, Galápagos Is. and Panama.

**REMARKS** Common in shallow waters.

**GENUS** *Gymnothorax* Bloch 1795

Dorsal-fin origin above gill openings in most species, to as far as just behind anus in a few species; anus near midlength. Teeth variable: few to numerous, short and stout to long and slender, smooth or serrate. Otherwise small- to very large-sized with variable characters; currently treated as a catch-all genus (with at least 14 generic synonyms) of generalised morays that do not fit into any other more specialised genera. Includes species formerly placed in *Siderea*. Currently ~102 species recognised, possibly 49 in WIO.

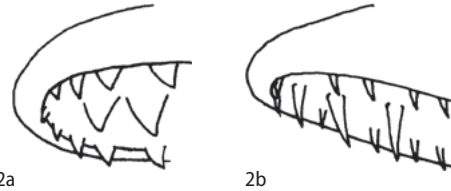
**KEY TO SPECIES**

- 1a Dorsal-fin origin >1 head length behind gill openings; body pale brown, with numerous diffuse dark brown spots posteriorly beyond head, front of head dark, and head pores set in pale spots ..... *G. fuscomaculatus*
- 1b Dorsal-fin origin before, over, or <1 head length behind gill openings ..... 2

Continued ...

**KEY TO SPECIES**

- 2a Teeth stout but conical, not molariform; median intermaxillary teeth enlarged but not fang-like; maxillary teeth biserial (except triserial in *G. kontodontos*), length of inner and outer rows nearly equal ..... 3
- 2b Teeth relatively slender and sharply pointed, and sometimes long and needle-like; median intermaxillary teeth, when present, usually fang-like and depressible; maxillary teeth biserial or uniserial: when biserial, outer row usually longer than inner row ..... 9



- 3a Usually a black blotch at gill opening; body tan to brown (may be yellow in life) and sometimes with faint mottling or reticulations, anterior nostril tubes white, and brown body-phases with blackish rim around eyes ..... *G. melatremus*
- 3b Gill opening not in conspicuous dark spot; body colour variable ..... 4
- 4a Head with small, discrete, linear patterns of brown or black dots ..... *G. griseus*
- 4b No linear pattern of small dark dots on head ..... 5
- 5a Maxillary teeth triserial; tail long, preanal length 2.5–2.8 in TL; body uniformly pale brown or greenish ..... *G. kontodontos*
- 5b Maxillary teeth biserial (rarely triserial); preanal length 2–2.6 in TL ..... 6
- 6a Body with large dark hexagonal spots separated by narrow pale interspaces ..... *G. flavoculus*
- 6b Body without large hexagonal spots ..... 7
- 7a Colouration mottled pale and dark brown; tip of snout and lower jaw paler than rest of head and body; eyes white in life ..... *G. thyrsoides*
- 7b Colour uniformly brown; head somewhat paler than body, but tip of snout and lower jaw not distinctly paler than rest of head; eyes not white ..... 8
- 8a One branchial pore; 5 rows of intermaxillary teeth ..... *G. herrei*
- 8b Two branchial pores; 3 rows of intermaxillary teeth ..... *G. pseudoherrei*
- 9a Maxillary teeth in 2 or more rows, inner teeth slightly larger than outer teeth, and inner row at least half length of outer row ..... 10
- 9b Maxillary teeth uniserial or with a few much longer teeth medial to main series ..... 12

Continued ...

## KEY TO SPECIES

- 10a Body dark brown or black, with small dark-edged white or yellow spots, and inside of mouth white; tip of tail white or yellow ..... *G. meleagris*
- 10b Body colour variable: if covered with small white spots, then some dark spots also present, especially anteriorly; tip of tail sometimes pale but not abruptly white ..... 11
- 11a Background colour usually dark brown, rarely pale brown or grey, and body irregularly spotted or mottled; head either uniformly brown or indistinctly mottled, with narrow dark ring around eyes; pale spots on tail, often extended into irregular bars ..... *G. buroensis* [throughout WIO]
- 11b Body colour highly variable: body and head often irregularly mottled or spotted, sometimes covered with small white spots, and usually with some small dark spots superimposed anteriorly; pale spots not forming irregular bars on tail ..... *G. eurostus* [antitropical]
- 12a Prominent black patch behind eyes; body uniformly or indistinctly mottled ..... 13
- 12b No black patch behind eyes; body colour variable ..... 14
- 13a Black patch from eyes to just behind rictus; areas surrounding anus and gill openings dark; nostrils and jaw pores coloured as head ..... *G. breedeni*
- 13b Black patch behind eyes not reaching rictus; no black spot at gill openings; posterior nostrils and jaw pores white ..... *G. monostigma*
- 14a Body colour uniform or nearly so ..... 15
- 14b Body barred, spotted, mottled or otherwise patterned ..... 20
- 15a Body and tail very elongate, BD/GO 27–31 in TL; colour uniformly pale yellow ..... *G. phasmatodes*
- 15b Body moderately elongate, BD/GO 9–28 in TL; colour not uniformly pale yellow ..... 16
- 16a Tail shorter than rest of body; colour reddish brown, fins with white edge, and head pores white ..... *G. hansii*
- 16b Tail as long as or longer than rest of body ..... 17
- 17a Head pores and nostrils white; body brownish, belly abruptly white, and anal-fin margin white ..... *G. angusticauda*
- 17b Head pores and nostrils not white; fin margins and body colour variable ..... 18
- 18a Head pores narrowly outlined in black; head and body dark brown, and fins darker posteriorly; anterior teeth finely serrate [inhabits coral reefs] ..... *G. pindae*
- 18b Head pores not outlined in black; body brown, fins same colour as body, but may have white margins; anterior teeth smooth [mainly inhabits turbid areas, not coral reefs] ..... 19
- 19a HL 5.8–7.5 in TL; fins with pale margins posteriorly; vertebrae 129–135 ..... *G. hepaticus* [Red Sea]
- 19b HL 7.7–9.4 in TL; no pale fin margins in juveniles, but large adults (>60 cm TL) sometimes with pale margins around tail tip; vertebrae 136–143 ..... *G. monochrous* [possibly Tanzania to Mozambique in WIO, and western Pacific]
- 20a Body with vertical bars ..... 21
- 20b Body with spots or complex colour pattern ..... 26
- 21a Head with horizontally elongated spots and pale interspaces forming reticulum; body and tail with 16–20 brown bars, extending onto fins; largest teeth finely serrate ..... *G. reticularis*
- 21b No reticulum on head; teeth smooth, not serrate ..... 22
- 22a Vertical dark bars narrow, not much wider than eye diameter [usually found deeper than 100 m] ..... 23
- 22b Vertical bars wider than eye diameter [usually found above 100 m] ..... 25
- 23a Areas of head and body between bars covered with fine dark brown reticulum; adjacent bars on tail merge onto anal-fin base; vertebrae ~137 ..... *G. berndti*
- 23b Head uniformly coloured; adjacent bars on tail not merging onto anal-fin base; vertebrae ~149 ..... 24
- 24a Anal-fin margin white; bars on sides of body not connecting ventrally ..... *G. ypsilon*
- 24b Anal-fin margin not white; bars on sides of body extend onto fins ..... *G. pikei*
- 25a Bars on head join across ventral midline to form complete rings; dark bars on body and tail narrower than pale interspaces ..... *G. enigmaticus*
- 25b Bars on head not joined ventrally to form complete rings; dark bars on body and tail wider than pale interspaces ..... *G. rueppelliae*
- 26a Body with spots ..... 27
- 26b Body with complex pattern of irregular blotches or reticulations ..... 39
- 27a Head, body and fins densely covered with irregular, small, overlapping brown spots; fin margins pale greenish yellow in juveniles; gill openings dark, inside of mouth dark brown ..... *G. flavimarginatus*
- 27b Body with discrete spots against contrasting background; fin margins variably coloured but not greenish yellow; colour of gill openings and inside of mouth variable ..... 28

Continued...

## KEY TO SPECIES

- 28a Body with pale spots on dark background ..... 29
- 28b Body with dark spots on pale background ..... 35
- 29a Anus behind midlength, preanal length <2 times in TL; body brown, covered with minute equally spaced white dots; teeth strong, triangular, distinctly serrate, and uniserial on jaws ..... *G. moluccensis*
- 29b Anus slightly before midlength, preanal length ≥2 times in TL; gill openings dark; pale spots forming reticulum on head, becoming larger and separated on body, and forming jagged vertical lines or bars on tail ..... 30
- 30a Brown midventral stripe, from chin to anus and along anal-fin base; spots coalesce into bars on tail ..... *G. elegans*
- 30b No brown midventral stripe; spots may be irregular posteriorly, but never coalesce into vertical bars ..... 31
- 31a Pale spots complex or rosette-like, with irregular borders ..... *G. baranesi*
- 31b Spots simple and discrete, with smooth borders ..... 32
- 32a Gill openings in dark blotch; inside of mouth yellow in life; body pale brown, becoming dark brown posteriorly, and with numerous small white spots, flecks or short lines anteriorly; body robust, BD/GO 9–14 in TL ..... *G. nudivomer*
- 32b Gill openings not in dark blotch; inside of mouth not yellow in life ..... 33
- 33a Teeth serrate; no median intermaxillary teeth [found at 190–290 m] ..... *G. sokotrensis*
- 33b Teeth smooth; median intermaxillary teeth present [found above ~50 m deep] ..... 34
- 34a Spots larger, those on head and front of body forming reticulations with narrow dark interspaces; vertebrae 131–142 ..... *G. johnsoni*
- 34b Spots smaller, eye-sized and ocellated, on rear of head, body, tail and fins (spots smaller in larger specimens); vertebrae 138–144 ..... *G. punctatus*
- 35a Gill openings in conspicuous dark blotch; head and body pale brown, covered with numerous large and small dark spots, crowded and coalesced in adults (distinct and separated in juveniles); adults enormous (reaching 2.2 m or more), with head swollen behind eyes ..... *G. javanicus*
- 35b Gill openings not in dark blotch ..... 36
- 36a Teeth slightly serrate (at least in large specimens); body buff, with 2 or 3 rows of large irregular dark brown spots, arranged one above the other, coalescing into bars posteriorly, and aligned with dark brown spots on dorsal fin and anal fin ..... *G. randalli*
- 36b Teeth never serrate; spots not arranged as above ..... 37
- 37a Body covered with minute blackish spots and circles that coalesce to form large diffuse blotches in adults, or overall appearance sometimes very dark, with tiny pale spots forming blotches; teeth short and stout, no long canines; vomerine teeth biserial (at least anteriorly) ..... *G. pictus* [IN PART]
- 37b Brown spots on body larger; teeth long and slender; vomerine teeth uniserial ..... 38
- 38a Body pale, with large, irregular, close-set black spots, and narrow pale interspaces, appearing as irregular reticulum; spots on rear part of dorsal fin not extended into oblique streaks ..... *G. favagineus*
- 38b Body pale brown, with 3 or 4 rows of pupil-sized well-separated irregular spots or blotches, extended into oblique streaks on dorsal fin ..... *G. fimbriatus*
- 39a Gill openings within conspicuous black blotch; body pale pinkish grey, with numerous dendritic brown blotches; teeth long and sharp, uniserial on jaws and vomer, and in 3 rows on intermaxillary ..... *G. megaspilus*
- 39b Gill openings not set in large black blotch ..... 40
- 40a Colour pattern python-like, with irregular well-defined black blotches coalesced over pale background; body and tail elongate, BD/GO 19–28 in TL; head small, HL 9–11 in TL; snout short, less than twice eye diameter [inhabits freshwater and estuaries] ..... *G. polyuranodon*
- 40b Colour not as above; body less elongate, BD/GO 11–23 in TL; head larger, HL 6.1–8.6 in TL; snout length more than twice eye diameter [not found in freshwater] ..... 41
- 41a Dorsal-fin origin above or slightly before gill openings; vomerine teeth biserial or at least staggered ..... 42
- 41b Dorsal-fin origin well before gill openings; vomerine teeth uniserial ..... 43
- 42a Body either pale, with groups of small black dots forming irregular circles, rosettes or polygons, or else body dark with large narrow polygons formed by irregular pale lines or groups of tiny pale dots ..... *G. pictus* [IN PART]
- 42b Body mainly dark, but sometimes pale with dark mottling; chin and throat paler; head pores in white areas; teeth moderate and stout, no long canines; 2 rows of low conical teeth on vomer ..... *G. richardsonii*
- 43a Pale streak on dorsal midline of snout; often 2–5 elongate dark blotches behind eyes; body brown, with irregular dark brown blotches on dorsal surface anteriorly, and with irregular yellowish blotches overall, becoming diffuse vertical bars on tail ..... *G. margaritophorus*
- 43b Colour not as above ..... 44

Continued ...

## KEY TO SPECIES

- 44a Head with conspicuous white marks, inclusive of pores on both jaws ..... 45
- 44b No conspicuous white markings on head, and pores not set in distinct white spots or bars ..... 47
- 45a Dark brown horizontal stripe directly behind eyes, bordered by white above and below; dark spots on body, joining and becoming darker on tail to form oblique bars on median fins ..... *G. zonipectis*
- 45b Markings on head variable, but not as above; oblique bars on median fins present or absent ..... 46
- 46a Alternating white and dark oblique bars on rear part of dorsal fin and anal fin; body usually with dark brown spots in matrix of pale brown, sometimes forming bars separated by pale areas; total vertebrae 105–109 ..... *G. robinsi*
- 46b Colour highly variable, but not with oblique bars on dorsal fin and anal fin; body mottled with darker brown, and 2 or more rows of irregular dark brown blotches often forming irregular dark bars; dark brown spot at rictus, preceded by bright white spot on lower jaw, and often white spot both above and behind dark rictus; head pores pale; total vertebrae ~120–130 ..... *G. chilospilus*
- 47a Body and fins pale, with overall dark reticulations enclosing pale spots and blotches, head dusky, and fin margins white; teeth serrate [found at 180–400 m] ..... *G. intesi*
- 47b Colour not as above; teeth smooth [inhabits shallow water] ..... 48
- 48a Body dark, with darker markings in form of indistinct rosettes (as if composed of densely packed tiny dots rather than solid lines and spots) ..... *G. pseudothyrsoides*
- 48b Body dark with pale markings ..... 49
- 49a Body dark brown or black, with irregular pale markings mottled within by darker brown, often snowflake- or lichen-like spots; anal fin with bright pale margin; anterior nostrils long, reaching or passing edge of upper lip when tubes pressed ventrally ..... *G. parini*
- 49b Body dark, with highly variable markings, but not as above; commonly with irregular pale reticulum formed of solid lines, typically extended into oblique streaks on rear part of body and dorsal fin; median fins sometimes with pale margins, but not bright and conspicuous; anterior nostrils shorter, tubes not reaching edge of upper lip when pressed ventrally ..... *G. undulatus*

*Gymnothorax angusticauda*

(Weber &amp; De Beaufort 1916)

Narrowtail moray

PLATES 2 &amp; 8

*Muraena (Priodonophis) angusticauda* Weber & De Beaufort 1916: 389, Fig. 388 (Schouten Is., New Guinea).*Gymnothorax angusticauda*: Randall & Golani 1995; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.1–2.2, HL 7.6–8.6, BD/GO 20–21, and BD/A 25–29. In HL: snout length 5.4–6.6, upper jaw 2.8–3.2, and eye diameter 8.9–9.6. Teeth few, uniserial, slightly serrate; intermaxillary teeth in 3 rows, with 3 median teeth (but often absent); vomerine teeth uniserial. Vertebrae: predorsal 4, preanal 59 or 60, total 143–152; MVF 4/59/146.

Body buff, paler ventrally; rictus and dorsal surface of head dusky; head pores in pale areas; median fins dusky, but anal-fin margin pale. Attains 50 cm TL.

*Gymnothorax angusticauda*, 39 cm TL (Red Sea). © SV Bogorodsky

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea; elsewhere, Indonesia and New Guinea.

**REMARKS** Uncommon.

**Note on dentition diagrams:** horizontal dentition diagrams and those with jaws placed side by side have upper jaw on left; both jaws vertical have upper jaw at top.



## *Gymnothorax baranesi*

Smith, Brokovich & Einbinder 2008

Aqaba moray

PLATE 9

*Gymnothorax baranesi* Smith, Brokovich & Einbinder 2008: 63, Figs. 1–4 (Eilat, Israel, Gulf of Aqaba, Red Sea); Smith 2012.

In TL: preanal length 2–2.1, HL 6.7–7.7, BD/GO 12–18, and BD/A 14–19. In HL: snout length 4.8–5.6, upper jaw 2.4–2.6, and eye diameter 11–13. Jaws arched in middle, not quite closing completely (more pronounced in larger specimens). Teeth large, triangular, smooth, uniserial on jaws, but sometimes also with 2 longer inner teeth; intermaxillary teeth in 3 rows, with 1–3 median teeth. Vertebrae: predorsal 6 or 7, preanal 52–55, total 137–142; MVF 6/54/140.

Body dark brown, with many moderate-sized pale spots, larger and more irregular anteriorly, discrete and irregularly rounded near end of tail. Attains at least 86 cm TL.

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Collected at ~200 m.

## *Gymnothorax berndti* Snyder 1904

Ladder moray

PLATE 2

*Gymnothorax berndti* Snyder 1904: 518, Pl. 4, Fig. 8 (Honolulu market, Oahu I., Hawaii); Randall & Anderson 1993\*; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.2, HL 6.6–7.3, BD/GO 11–14, and BD/A 13–20. In HL: snout length 4.5–5.1, upper jaw 2–2.5, and eye diameter 10–13. Teeth large, triangular, and uniserial on jaws; intermaxillary teeth in 3 rows, with 2 or 3 median teeth. Vertebrae: predorsal 4–6, preanal 52–58, total 136–139; MVF 5/54/137.

Body pale grey or tan, with fine dark reticulations and 29–35 narrow dark brown bars, often Y-shaped; dorsal fin with oblique brown bands and pale margin posteriorly; anal fin dark basally, with conspicuous pale margin. Attains 115 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Mauritius and Maldives; elsewhere to southern Japan, Australia, New Caledonia, northern Kermadec Ridge and Hawaii.

**REMARKS** Rare; known from relatively deep water, at 30–300 m.

## *Gymnothorax breedeni* McCosker & Randall 1977

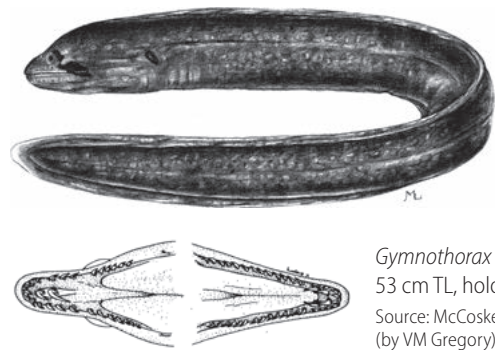
Blackcheek moray

PLATE 2

*Gymnothorax breedeni* McCosker & Randall 1977: 162, Figs. 1–3 (Itsandra, Grande Comore, Comoros); SSF No. 41.6\*; Randall & Anderson 1993; Randall & Van Egmond 1994\*; Winterbottom & Anderson 1997\*; Böhlke & Smith 2002; Smith 2012.

Body stout; tail not greatly tapering. In TL: preanal length 2.1–2.4, HL 7.6–8, BD/GO 12–13, and BD/A 14–16. In HL: snout length 5.2–6.9, upper jaw 2.6–2.8, and eye diameter 9.7–11. Teeth uniserial, long, slender and serrate; intermaxillary teeth in 3 rows, with 2 median teeth. Vertebrae: predorsal 3–6, preanal 52–55, total 128–131; MVF 4/53/129.

Body dark brown, with darker mottling on head, body and fins; usually with conspicuous black ring around eyes, extending as oblique black slash just behind mouth angle; gill openings set in black spot; tail tip white. Attains 54 cm TL.



*Gymnothorax breedeni*, 50 cm TL (Seychelles). Source: SSF

*Gymnothorax breedeni*, 53 cm TL, holotype dentition. Source: McCosker & Randall 1977 (by VM Gregory); courtesy of CAS

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, South Africa (Aliwal Shoal), Comoros, Seychelles (Bird I.), Chagos and Maldives; elsewhere to Christmas I., Caroline Is. and Marquesas Is.

**REMARKS** Uncommon; found on shallow coral and rocky reefs.

## *Gymnothorax buroensis* (Bleeker 1857)

Latticetail moray

PLATES 2 & 10

*Muraena buroensis* Bleeker 1857: 79 (Buru I., Moluccas, Indonesia). *Muraena corallina* Klunzinger 1871: 614 (Al-Qusayr, Egypt, Red Sea). *Gymnothorax buroensis*: SSF No. 41.7\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall & Golani 1995; Böhlke & Smith 2002; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

Body short and stout; tail not tapering. In TL: preanal length 2–2.2, HL 6.8–8.2, BD/GO 11–16, and BD/A 11–17. In HL: snout length 5.2–6.5, upper jaw 2.1–2.7, and eye diameter 6.9–10. Teeth numerous and multiserial, no long canines; intermaxillary teeth in 5 rows; teeth on jaws biserial or triserial; vomerine teeth uniserial. Vertebrae: predorsal 4–7, preanal 44–48, total 106–115; MVF 5/47/113.

Body dark brown or grey, with 3–5 rows of dark spots, forming diffuse dark bars on tail. Attains 39 cm TL.



*Gymnothorax buroensis*, 15 cm TL (Comoros).  
© R Winterbottom, ROM

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, Kenya to South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles, Réunion, Rodrigues, Chagos and Maldives; elsewhere to Indonesia, southern Japan, northern Australia, New Caledonia, Hawaii and Panama.

**REMARKS** Common in shallow tropical waters.

### *Gymnothorax chilospilus* Bleeker 1864

Lipspot moray

PLATES 2 & 9

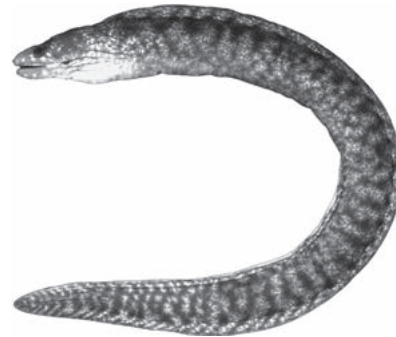
*Gymnothorax chilospilus* Bleeker 1864: 52 (East Indian Archipelago [Indonesia]); Winterbottom *et al.* 1989\*; Randall & Van Egmond 1994; Randall 1995\*; Böhlke & Smith 2002; Heemstra & Heemstra 2004\*; Letourneur *et al.* 2004; Smith 2012.

*Lycodontis perustus* Smith 1962: 437, Pl. 59, Fig. E (Pinda, Mozambique).

*Gymnothorax undulatus* (*non* Lacepède 1803): SSF No. 41.24\* [in part: photo of juvenile].

Dorsal-fin origin midway between eyes and gill openings; 2 pores between anterior and posterior nostrils. In TL: preanal length 2–2.3, HL 7–8.6, BD/GO 14–22, and BD/A 17–26. In HL: snout length 4.9–6.2, upper jaw 2.6–2.9, and eye diameter 7.4–11. Teeth uniserial or biserial, and long fangs present; 3 rows of intermaxillary teeth, with 3 fang-like median teeth; maxillary teeth of juveniles and females biserial, those of males uniserial; vomer with row of 6–8 short conical teeth. Vertebrae: predorsal 4–7, preanal 47–52, total 120–129; MVF 5/49/125.

Body brownish with complex and variable pattern of dark brown or pale markings, sometimes forming irregular vertical bars or rows of diffuse dark brown dendritic blotches, but body sometimes nearly uniformly brown; snout uniformly brown; posterior head pores in pale areas continuing around lower jaw; rictus black, preceded by bright white spot on lower jaw. Attains 51 cm TL.



*Gymnothorax chilospilus*, 37 cm TL (South Africa).  
PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Kenya to South Africa (Aliwal Shoal), Tanzania (Zanzibar), Madagascar, Comoros, Seychelles (Alphonse I.) and Mascarenes; elsewhere to Indonesia, southern Japan, Australia, Society Is., Rapa Iti and Hawaii.

**REMARKS** Common on tropical coral reefs, to ~45 m deep.

### *Gymnothorax elegans* Bliss 1883

Elegant moray

PLATE 3

*Gymnothorax elegans* Bliss 1883: 60 (Mauritius, Mascarenes); Ajiad & El-Absy 1986; SSF No. 41.8\*; Randall & Anderson 1993\*; Randall & Golani 1995; Böhlke & Smith 2002; Letourneur *et al.* 2004; Smith 2012.

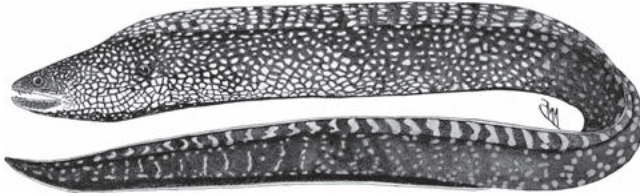
*Gymnothorax albomaculatus* Bliss 1883: 57 (Mauritius, Mascarenes).

In TL: preanal length 2.1–2.4, HL 7.5–9.9, BD/GO 13–19, and BD/A 18–26. In HL: snout length 4.5–6.9, upper jaw 2.2–2.8, and eye diameter 9–12. Teeth uniserial, large and triangular, the largest serrate; intermaxillary teeth in 3 rows, with 1 long median fang. Vertebrae: predorsal 2–5, preanal 52–57, total 138–150; MVF 3/54/143.

Body medium greenish brown, with dark brown midventral stripe from chin to anus; covered with pale yellowish spots, forming reticulum on head, spots larger and separated on body, and forming jagged vertical lines on tail; gill openings dark; fins with body colouration basally and pale margins. Attains 81 cm TL.



*Gymnothorax elegans*, 42 cm TL (South Africa). AD Connell © NRF-SAIAB



*Gymnothorax elegans*, 53 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique, South Africa (Aliwal Shoal), Madagascar, Réunion, Mauritius and Maldives; elsewhere to southern Japan, Samoa, Society Is. and Hawaii.

**REMARKS** Uncommon; typically found at 30–100 m.

## *Gymnothorax enigmaticus*

McCosker & Randall 1982

Black barred moray

PLATE 8

*Gymnothorax enigmaticus* McCosker & Randall 1982: 18, Figs. 1, 4 (Angaur I., Palau); SSF No. 41.9\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Böhlke & Smith 2002; Letourneur *et al.* 2004; Smith 2012.

In TL: preanal length 2.2–2.4, HL 7.5–9.8, BD/GO 15–23, and BD/A 16–24. In HL: snout length 5.2–6.1, upper jaw 2.3–2.8, and eye diameter 8.2–11. Teeth long and slender, uniserial on jaws and vomer; intermaxillary teeth in 3 rows, with 3 median fangs. Vertebrae: predorsal 4 or 5, preanal 49–53, total 126–134.

Body tan, with 16–20 narrow dark bars (distinct in juveniles, becoming diffuse and mottled in adults); bars connect ventrally on head and body and extend onto fins. Attains 57 cm TL.



*Gymnothorax enigmaticus*, 11 cm TL (Seychelles). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Sodwana Bay), Seychelles (Aldabra; Mahé), Réunion, Chagos and Maldives; elsewhere to Cocos (Keeling) Is., southern Japan, Palau, Australia, Samoa and Tuamotu Is.

**REMARKS** Common in shallow coastal waters, to ~16 m deep. Its banding pattern resembles sea snakes.

## *Gymnothorax eurostus* (Abbott 1860)

Salt and pepper moray

PLATES 3 & 8

*Thyrsoidea eurosta* Abbott 1860: 478 (Sandwich Is. [Hawaii]).

*Gymnothorax eurostus*: SSF No. 41.10\*; Böhlke & Smith 2002;

Heemstra *et al.* 2004; Letourneur *et al.* 2004; Smith 2012.

In TL: preanal length 2–2.3, HL 6.3–8.1, BD/GO 13–17, and BD/A 12–18. In HL: snout length 4.7–6.2, upper jaw 2.1–2.8, and eye diameter 6.8–11. Teeth numerous, short and sharp, biserial to multiserial; intermaxillary teeth in 5 rows, with 3 median teeth; teeth on jaws biserial in adults; vomerine teeth uniserial. Vertebrae: predorsal 4–6, preanal 45–50, total 116–126; MVF 5/48/120.

Colour pattern variable: usually dark brown with numerous small pale dots on head and body, and usually larger dark spots on front of body, sometimes in rows; body pattern of some specimens appears reticulated on tail and fins; roof of mouth same as head colour. Attains 60 cm TL.



*Gymnothorax eurostus*, 45 cm TL (S Mozambique). Source: SSF



*Gymnothorax eurostus*, dentition

Source: Böhlke & Randall 2000, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific to eastern Pacific (anti-equatorial). WIO: Mozambique, South Africa (Transkei region), Madagascar and Mascarenes; elsewhere to Cocos (Keeling) Is., southern Japan, Australia, New Caledonia, Lord Howe I., Kermadec Is., Austral Is., Marquesas Is., Hawaii, Easter I. and Costa Rica.

**REMARKS** Found on coral and rocky reefs, to ~20 m deep.

*Gymnothorax favagineus* Bloch & Schneider 1801

Honeycomb moray

PLATES 3 &amp; 8

*Gymnothorax favagineus* Bloch & Schneider 1801: 525, Pl. 105 (Tharangambadi, India); SSF No. 41.11\*; Randall & Anderson 1993; Randall 1995\*; Randall & Golani 1995; Böhlke & Smith 2002; Heemstra & Heemstra 2004\*; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

*Muraena python* Kaup 1856: 68, Pl. 10, Fig. 52 ('Africa').

*Lycodontis permistus* Smith 1962: 433, Pl. 55, Figs. A–B (Mahé, Seychelles).

*Gymnothorax permistus*: SSF No. 41.20\*.

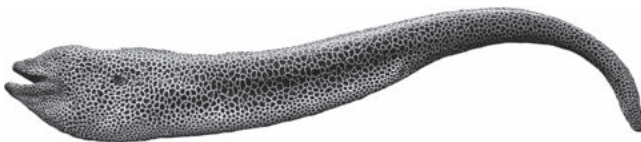
*Gymnothorax tessellata*: Allen & Steene 1987\*.

In TL: preanal length 2–2.2, HL 6.8–9.1, BD/GO 10–20, and BD/A 12–23. In HL: snout length 4.8–6.7, upper jaw 2.3–2.8, and eye diameter 8.7–18. Teeth moderately sized, uniserial on jaws; intermaxillary teeth in 3 rows, with 3 median teeth; vomerine teeth staggered or biserial. Vertebrae: predorsal 4–6, preanal 58–61, total 138–144; MVF 5/60/141.

Bold colouration of narrow yellow reticulations enclosing dark brown to black polygons (dark honeycomb-like pattern); colour of uniform intensity on head, body and fins, and continuing into mouth. Attains at least 180 cm TL, possibly ~250 cm TL.



*Gymnothorax favagineus*, 34 cm TL (Zanzibar). Source: SSF



*Gymnothorax favagineus*, 150 cm TL (Mozambique). © Alvheim © IMR

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Gulf of Oman to South Africa (Algoa Bay), Madagascar, Comoros, Seychelles, Réunion, Mauritius, Maldives, India and Sri Lanka; elsewhere to Indonesia, southern Japan, Australia and New Guinea.

*Gymnothorax fimbriatus* (Bennett 1832)

Darkspotted moray

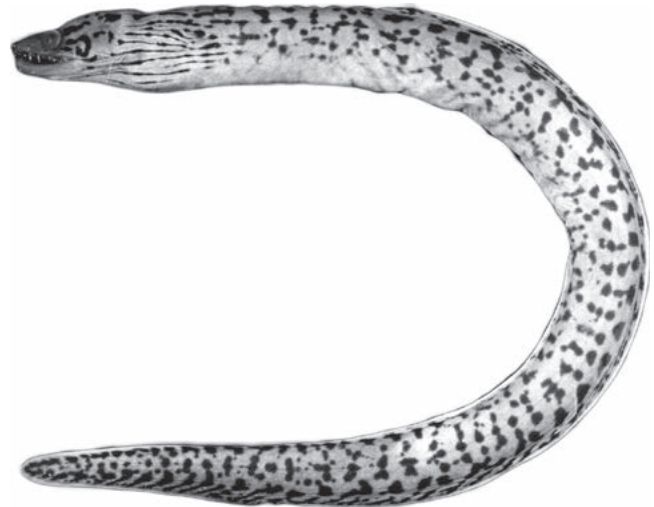
PLATE 3

*Muraena fimbriata* Bennett 1832: 168 (Mauritius, Mascarenes).

*Gymnothorax fimbriatus*: Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall & Van Egmond 1994; Böhlke & Smith 2002; Heemstra *et al.* 2004; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2–2.3, HL 6.8–8, BD/GO 14–19, and BD/A 15–25. In HL: snout length 4.5–5.8, upper jaw 1.9–2.7, and eye diameter 6.9–11. Teeth long and slender; intermaxillary teeth in 3 rows, with 3 long median fangs; upper-jaw teeth biserial anteriorly, lower-jaw teeth uniserial; vomerine teeth uniserial. Vertebrae: predorsal 4–6, preanal 51–56, total 128–142.

Body pale tan or brown, with 3 or 4 rows of small dark brown spots or blotches on body and tail, extending as oblique bars onto dorsal fin; conspicuous small and darker brown spots on head, extending in 2 or 3 oblique rows behind each eye; snout and dorsal surface of head may be yellowish; row of dark spots at base of anal fin; median fins with narrow pale margins. Attains 68 cm TL.



*Gymnothorax fimbriatus*, 32 cm TL (Mauritius). © JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar, Seychelles, Mascarenes, Chagos, India and Sri Lanka; elsewhere to Indonesia, Philippines, southern Japan, Mariana Is., Australia, New Caledonia, Marquesas Is. and Tuamotu Is.

**REMARKS** Common on tropical reefs, to ~50 m deep.



## *Gymnothorax flavimarginatus* (Rüppell 1830)

Yellowmargin moray

PLATES 3 & 8

*Muraena flavimarginata* Rüppell 1830: 119, Pl. 30, Fig. 3 (Red Sea).

*Muraena mauritiana* Kaup 1856: 65 (Mauritius, Mascarenes).

*Gymnothorax viridipinnis* Bliss 1883: 58 (Mauritius, Mascarenes).

*Lycodontis lemayi* Smith 1949: 108 (Inhaca I., Mozambique).

*Gymnothorax flavimarginatus*: SSF No. 41.12\*; Allen & Steene 1987\*;

Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall 1995\*;

Randall & Golani 1995; Böhlke & Smith 2002; Manilo & Bogorodsky 2003;

Heemstra *et al.* 2004; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2–2.2, HL 8.3–10, BD/GO 11–20, and BD/A 14–24. In HL: snout length 5.1–7, upper jaw 2.1–2.9, and eye diameter 8.6–12. Teeth stout and triangular; intermaxillary teeth in 3 rows, with 2 stout median teeth; teeth on jaws biserial anteriorly; vomerine teeth uniserial or staggered. Vertebrae: predorsal 5–7, preanal 54–61, total 132–140; MVF 5/58/136.

Body dark yellow-brown, covered with small darker brown or black overlapping spots and blotches giving speckled appearance; fins with body colouration, but typically with yellow or green margin on posterior portions of dorsal fin and caudal fin and entire anal fin; front of head dusky; nostrils yellow; black spot surrounding gill openings; inside of mouth dark brown. Attains 120 cm TL.

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, Oman to South Africa (Transkei region), Tanzania (Zanzibar), Madagascar, Mozambique Channel, Comoros, Seychelles, St Brandon Shoals, Mascarenes, Chagos, Maldives, India and Sri Lanka; elsewhere to southern Japan, Australia, New Caledonia, Hawaii and Panama.

**REMARKS** Common on coral and rocky reefs, to ~150 m deep.

## *Gymnothorax flavoculus* (Böhlke & Randall 1996)

Yellow-eye moray

PLATES 3 & 9

*Siderea flavocula* Böhlke & Randall 1996: 96, Figs. 1–5 (Masirah I.,

Oman, Arabian Sea).

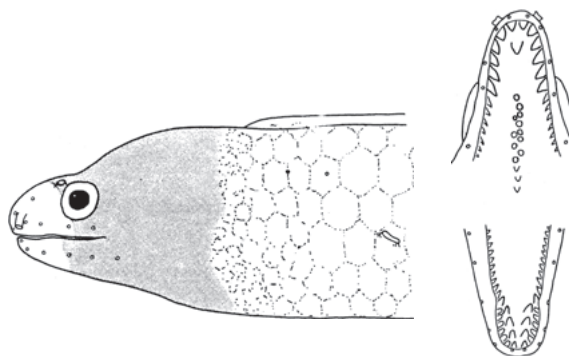
*Gymnothorax flavoculus*: Böhlke & Smith 2002; Manilo & Bogorodsky

2003; Smith 2012.

In TL: preanal length 2–2.1, HL 8.8–9.4, BD/GO 17–25, and BD/A 21–27. In HL: snout length 5.7–6.1, upper jaw 3.2–3.5, and eye diameter 9.5–11. Teeth short and stout; intermaxillary teeth in 3 rows, with 1 or 2 median teeth; maxillary teeth uniserial, conical, compressed and strongly recurved (juveniles also with inner row of larger teeth halfway back in jaw);

vomerine teeth biserial anteriorly; dentary teeth conical, slightly compressed and uniserial, except anteriorly. Vertebrae: predorsal 3 or 4, preanal 53–58, total 124–129.

Front half of head reddish brown or dark grey, except snout and front of lower jaw paler brownish pink; rear part of head, body and tail pale yellow background, with close-set diffuse dark brown blotches and pale interspaces forming vague reticulum; eyes bright yellow. Attains 41 cm TL.



*Gymnothorax flavoculus*, 31 cm TL, paratype, head and dentition.

Source: Böhlke & Randall 1996

**DISTRIBUTION** WIO: Gulf of Oman to southern Oman and Socotra.

**REMARKS** Known from few specimens, collected from tidepools and rocky reefs, at ~6 m deep.

## *Gymnothorax fuscomaculatus* (Schultz 1953)

Brownspeckled moray

PLATE 8

*Rabula fuscomaculata* Schultz in Schultz *et al.* 1953: 147, Fig. 30 (lagoon reef at Rongerik Atoll, Marshall Is.).

*Gymnothorax fuscomaculatus*: SSF No. 41.13\*; Winterbottom *et al.* 1989\*;

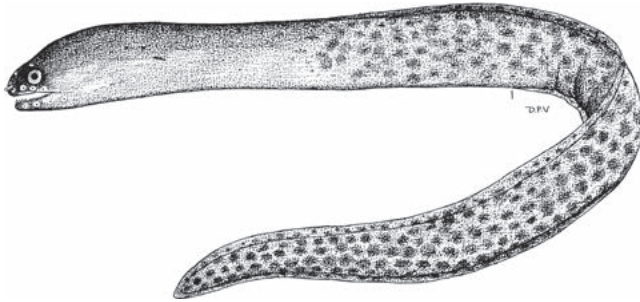
Randall & Anderson 1993; Böhlke & Smith 2002; Heemstra *et al.* 2004;

Smith 2012.

Dorsal-fin origin far behind head, closer to anus than to gill openings. In TL: preanal length 2–2.2, predorsal length 2.4–2.6, HL 7.5–9.3, BD/GO 14–20, and BD/A 19–28. In HL: snout length 4.8–6, upper jaw 2.4–3.4, and eye diameter 7.5–11. Teeth short and stout, uniserial to biserial; intermaxillary teeth in 3 rows, with 2 short median teeth; upper-jaw teeth biserial, lower-jaw teeth biserial anteriorly; vomerine teeth partially biserial. Vertebrae: predorsal 33–45, preanal 45–51, total 112–122; MVF 37/48/117.

Body tan or brown, unspotted anteriorly, and small diffuse brown spots beginning behind gill openings or sometimes at level of anus, and some individuals also with bright pale

spots; head pores in obvious contrasting pale areas; median fins same colour as body, with even row of small diffuse black spots on rear part, and margins yellow posteriorly. Attains 20 cm TL.



*Gymnothorax fuscomaculatus*, 17 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific (scattered). WIO: Mozambique, South Africa (Aliwal Shoal; Sodwana Bay), Madagascar, Comoros, Seychelles, Mauritius, Rodrigues and Maldives; elsewhere to Philippines, Mariana Is., Hawaii, Australia, New Caledonia, Marshall Is. and Pitcairn Is.

**REMARKS** Cryptic on coral reefs, to ~22 m deep.

### *Gymnothorax griseus* (Lacepède 1803)

Geometric moray

PLATE 10

*Muraenopsis grisea* Lacepède (ex Commerson) 1803: 629, 642, Pl. 19, Fig. 3 [Madagascar].

*Muraena geometrica* Rüppell 1830: 118, Pl. 30, Fig. 1 (Massawa, Eritrea, Red Sea).

*Muraena bilineata* Rüppell 1838: 84 (Jeddah, Saudi Arabia, Red Sea).

*Siderea schonlandi* Smith 1949: 109 (Mozambique).

*Siderea grisea*: SSF No. 41.26\*; Randall 1995\*; Randall & Golani 1995; Winterbottom & Anderson 1997.

*Gymnothorax griseus*: Winterbottom *et al.* 1989\*; Böhlke & Smith 2002; Heemstra *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.3–2.6, HL 8.7–10, BD/GO 16–20, and BD/A 16–25. In HL: snout length 5.7–6.8, upper jaw 3–3.5, and eye diameter 8.6–12. Teeth numerous, short and stout; intermaxillary teeth in 3 rows, with 2 short median teeth; teeth biserial on upper jaw, partially biserial on lower jaw; vomerine teeth in 2 or 3 rows. Vertebrae: predorsal 3–5, preanal 49–53, total 128–140; MVF 4/51/134.

Body and fins tan and mottled with small brown overlapping spots, but head, fins and tip of tail noticeably palest; head with distinct lines of dark dots marking head pores, and other lines may extend back irregularly to anus. Attains 53 cm TL.



*Gymnothorax griseus*, head (Mauritius).

**DISTRIBUTION** WIO: Red Sea, Oman to South Africa, Madagascar, Comoros, Seychelles, Mascarenes and Chagos.

**REMARKS** Synchronous hermaphrodite (adults with both male and female organs). Found in shallow coastal areas and on coral and rocky reefs. Diurnal, often seen accompanying foraging predators.

### *Gymnothorax hansi* Heemstra 2004

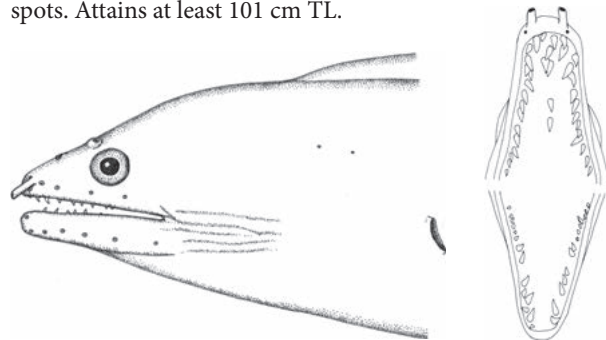
Short-tail chestnut moray

PLATE 11

*Gymnothorax hansi* Heemstra 2004: 2, Figs. 1–3 (Grande Comore, Comoros); Smith 2012.

In TL: preanal length 1.7–1.9, HL 8.3–8.6, BD/GO ~14, and BD/A 18–26. In HL: snout length 5.2–6.4, upper jaw 2.5–2.8, and eye diameter 10–13. Teeth sharp, caniniform, slightly curved, smooth or with minute serrations; intermaxillary teeth in 3 rows; teeth on jaws uniserial; vomerine teeth rudimentary or absent. Vertebrae: predorsal 4, preanal 82–84, total 183–185; MVF 4/83/184.

Head and body brown, paler ventrally; dorsal fin and anal fin brown anteriorly, blackish posteriorly, with bright white margins; nostrils and iris yellow; jaw pores located in white spots. Attains at least 101 cm TL.



*Gymnothorax hansi*, 101 cm TL, male holotype, head; 101 cm TL, adult female paratype, dentition (both Comoros). Source: Heemstra 2004

**DISTRIBUTION** Known only from three type specimens from Grande Comore.

**REMARKS** Collected at ~143 m.



*Gymnothorax hepaticus*, 32 cm TL (Red Sea).

## *Gymnothorax hepaticus* (Rüppell 1830)

Liverbrown moray

PLATE 3

*Muraena hepatica* Rüppell 1830: 120 (Red Sea).

*Muraena cinerascens* Rüppell 1830: 120 (Al-Muwaylih, Saudi Arabia, Red Sea).

*Gymnothorax hepaticus*: Randall & Golani 1995; Böhlke 2000; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 1.9–2.2, HL 5.8–7.5, BD/GO 13–22, and BD/A 15–25. In HL: snout length 4.9–6.8, upper jaw 2.2–2.9, and eye diameter 8.9–14. Teeth on jaws long, sharp, uniserial and few, but biserial anteriorly; intermaxillary teeth in 3 rows, with 3 long median fangs; vomerine teeth uniserial. Vertebrae: predorsal 4–7, preanal 55–60, total 128–138; MVF 5/56/131.

Body medium to dark brown, head and abdomen paler; fins with pale margins. Attains 84 cm TL.

**DISTRIBUTION** Red Sea and possibly elsewhere in WIO.

**REMARKS** Known from shallow turbid water. Records of *G. afer* Bloch 1795 and *G. monochrous* Bleeker 1856 in the Red Sea are probably misidentifications of this species (Randall & Golani 1995); likewise, records of *G. hepaticus* from the Pacific are probably *G. monochrous* (Smith 2012), but both *G. cinerascens* and *G. hepaticus* are valid species (Smith *et al.* 2019).

## *Gymnothorax herrei* Beebe & Tee-Van 1933

Small brown moray

PLATE 3

*Gymnothorax brunneus* Herre 1923: 212 (Analao, Batangas, Philippines)

[name preoccupied by *Gymnothorax brunneus* Nichols 1920].

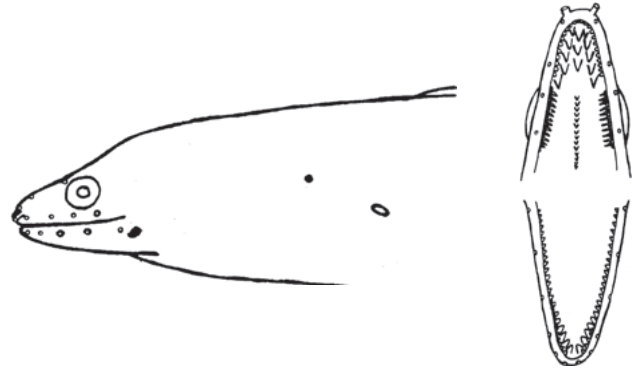
*Gymnothorax herrei* Beebe & Tee-Van 1933: 138 (Analao, Batangas,

Philippines) [replacement name for *Gymnothorax brunneus*];

Böhlke 2000\*; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.3, HL 7–9.8, BD/GO 14–23, and BD/A 16–24. In HL: snout length 5.4–7.1, upper jaw 2.6–3.4, and eye diameter 9.2–11. Teeth stout, numerous, biserial; intermaxillary teeth in 5 rows, with 2 or 3 stout median teeth; teeth on vomer and lower jaw extend behind those on upper jaw; maxilla very short. One branchial pore. Vertebrae: predorsal 7–11, preanal 45–50, total 108–122; MVF 9/47/114.

Body and fins brown, head slightly paler. Attains 25 cm TL.



*Gymnothorax herrei*, 16 cm TL, head and dentition (Indonesia).

Source: Böhlke 2000

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka; elsewhere to South China Sea, Philippines, Australia, New Guinea and Fiji.

**REMARKS** Known from shallow water. Records of *G. herrei* elsewhere in WIO are likely of *G. pseudoherrei*.

## *Gymnothorax intesi* (Fourmanoir & Rivaton 1979)

Reticulate moray

PLATE 9

*Lycodontis intesi* Fourmanoir & Rivaton 1979: 426, Fig. 16 (Lifou I., Loyalty Is.).

*Gymnothorax intesi*: Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 1.9–2, HL 8–8.7, BD/GO 11–18, and BD/A 18–26. In HL: snout length 4.6–5.5, upper jaw 2.2–2.7, and eye diameter 12–14. Teeth uniserial, few, strong and serrate; 5 or 6 intermaxillary teeth in 2 rows, and no median teeth; 8 or 9 maxillary teeth; dentary teeth 17–19. Vertebrae: predorsal 4–6, preanal 64–71, total 149–163; MVF 6/68/155.

Body and fins strongly patterned with brown reticulations enclosing small pale spots and blotches; head dusky or finely reticulated; dorsal fin with pale edge, and anal fin with broader pale margin. Attains 103 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Mauritius; elsewhere to Loyalty Is. and Kiribati.

**REMARKS** Found at 180–400 m.

*Gymnothorax javanicus* (Bleeker 1859)

Giant moray

PLATES 3 &amp; 9

*Muraena javanica* Bleeker 1859: 347 (Patjitan, Java, Indonesia).*Gymnothorax javanicus*: Allen & Steene 1987; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall & Golani 1995; Böhlke & Smith 2002; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

Adults large and robust. In TL: preanal length 2–2.2, HL 7.2–8.7, BD/GO 12–22, and BD/A 14–25. In HL: snout length 4.9–6.3, upper jaw 2–3.1, and eye diameter 7.5–14. Teeth on jaws large and stout, uniserial in adults; intermaxillary teeth in 3 rows, with 2 or 3 median teeth; vomerine teeth biserial. Vertebrae: predorsal 5–7, preanal 57–61, total 137–143; MVF 6/60/141.

Body and fins with tan background and speckled with large brown spots (more distinct in juveniles, becoming irregular and diffuse in adults); snout dusky or with small spots; gill openings in black blotch. Attains possibly 3 m TL, ~70 kg.

*Gymnothorax javanicus*, 92 cm TL, 48 cm TL (both Kenya). Source: Smith 1962

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to Mozambique, Madagascar, Comoros, Seychelles (Aldabra; Mahé), Mascarenes, Chagos and Maldives; elsewhere to Cocos (Keeling) Is., Indonesia, Ryukyu Is., Australia, New Caledonia, Pitcairn Is. and Hawaii.

**REMARKS** The largest species of moray in terms of weight. Common in shallow waters, to ~50 m deep. Large adults (>4 kg) have been implicated in ciguatera poisoning and may be fatal if eaten.

*Gymnothorax johnsoni* (Smith 1962)

Whitespotted moray

PLATES 3 &amp; 10

*Lycodontis johnsoni* Smith 1962: 438, Pl. 56, Figs. C–D (Algoa Bay, Eastern Cape, South Africa).*Gymnothorax johnsoni*: SSF No. 41.14\*; Baranes & Golani 1993\*; Randall & Golani 1995; Böhlke & Smith 2002; Manilo & Bogorodsky 2003; Letourneur *et al.* 2004; Smith 2012.

In TL: preanal length 2.1–2.3, HL 6.8–8.6, BD/GO 13–24, and BD/A 17–33. In HL: snout length 4.8–6.2, upper jaw 2.1–3.1, and eye diameter 9.2–12. Teeth long and slender, uniserial; intermaxillary teeth in 3 rows, with 3 long median fangs. Vertebrae: predorsal 4–6, preanal 53–57, total 131–142; MVF 5/55/139.

Body and fins medium brown with pale spots (well-separated in juveniles, numerous and close together in adults); spots on head and front of body forming reticulations with narrow dark interspaces, but lower jaw and thorax not spotted. Attains at least 88 cm TL (possibly 130 cm TL).

*Gymnothorax johnsoni*, 57 cm TL (South Africa).

**DISTRIBUTION** WIO: Red Sea, East Africa to South Africa (Algoa Bay), Madagascar, Réunion and Mauritius.

**REMARKS** Found over sand and rocky bottoms, at 15–400 m. Resembles *G. punctatus* but with larger spots in specimens of comparable size. Further study of the various pale-spotted morays is needed as they can be difficult to identify.

*Gymnothorax kontodontos* Böhlke 2000

Short-tooth moray

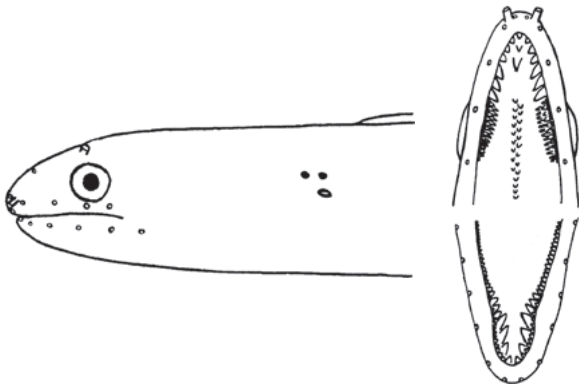
PLATE 4

*Gymnothorax* sp. 1: Winterbottom *et al.* 1989\*.*Gymnothorax kontodontos* Böhlke 2000: 411, Figs. 2g, 3e, 8 (Fanning I., Line Is.); Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.5–2.8, HL 8.3–9.7, BD/GO 16–20, and BD/A 18–22. In HL: snout length 4.6–5.4, upper jaw 2.5–3, and eye diameter 7–8.5. Teeth numerous, mostly short and stout, some rounded; intermaxillary teeth in 3 rows, with 2 stout median teeth; maxillary teeth in 3 rows; dentary teeth in 1 or 2 rows; vomerine teeth in 2 or 3 rows. Vertebrae: predorsal 7–9, preanal 40–43, total 126–135; MVF 8/42/131.

Freshly caught specimen with pale yellow or tan body (more coloured on head and snout than rest of body), fins paler; live specimens reportedly dark brown or greenish. Attains 18 cm TL.





*Gymnothorax kontodontos*, 17 cm TL, holotype head (left); 16 cm TL, paratype dentition (right) (both Johnson Atoll). Source: Böhlke 2000

**DISTRIBUTION** Indo-Pacific. WIO: Comoros and Chagos; elsewhere to Line Is., Hawaii and Johnston Atoll.

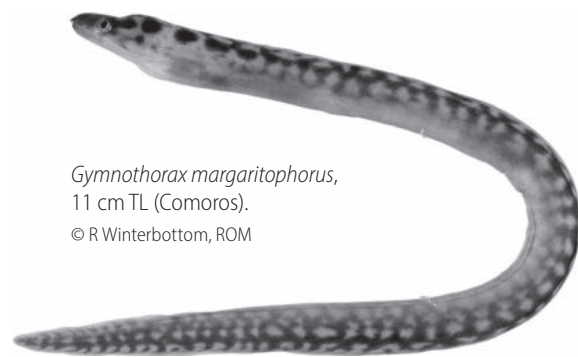
**REMARKS** Known from 6–26 m. Resembles *Echidna unicolor*, but differs primarily in the triserial maxillary teeth, paler colour, no dark ring around eyes and higher vertebral count.

***Gymnothorax margaritophorus*** Bleeker 1864  
Blackpearl moray PLATES 4 & 10

*Gymnothorax margaritophorus* Bleeker 1864: 53 (Ambon I., Moluccas, Indonesia); SSF No. 41.15\*; Winterbottom *et al.* 1989; Randall & Anderson 1993\*; Böhlke & Smith 2002; Heemstra *et al.* 2004; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.2–2.4, HL 7–7.6, BD/GO 16–21, and BD/A 16–24. In HL: snout length 4.6–5.7, upper jaw 2.2–2.7, and eye diameter 8–11. Teeth long and slender, many long fangs; intermaxillary teeth in 3 rows, with 3 long median fangs; teeth on upper jaw biserial in juveniles and adult females, uniserial in adult males; teeth on lower jaw biserial anteriorly; vomerine teeth uniserial. Vertebrae: predorsal 4–6, preanal 48–52, total 123–133; MVF 6/50/129.

Body brown with complex pattern of darker brown and pale reticulations, sometimes forming oblique bars on tail; head with pale mid-dorsal streak from snout to eyes, and row of 2–8 large darker brown elongate blotches extending back from eyes; fins with body pattern and pale margins. Attains at least 47 cm TL, possibly ~70 cm TL.



*Gymnothorax margaritophorus*,  
11 cm TL (Comoros).  
© R Winterbottom, ROM

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (Eastern Cape), Madagascar, Comoros, Seychelles, Mascarenes and Maldives; elsewhere to Indonesia, Ryukyu Is., Australia, Line Is. and Johnston Atoll.

**REMARKS** Common but cryptic; found on coral and rocky reefs, from shore to ~20 m deep.

***Gymnothorax megaspilus*** Böhlke & Randall 1995  
Largespot moray PLATES 4 & 9

*Gymnothorax megaspilus* Böhlke & Randall 1995: 2, Fig. 1 (Khuriya Muriya Is., Oman); Randall 1995\*; Böhlke & Smith 2002; Manilo & Bogorodsky 2003; Smith 2012.

In TL: preanal length 2.1–2.2, HL 6.6–7, BD/GO 13–15, and BD/A ~15. In HL: snout length 4.9–5.6, upper jaw 2.3–2.8, and eye diameter 8.9–11. Teeth on jaws and vomer long and sharp, uniserial; intermaxillary teeth in 3 rows, with 3 long median fangs. Vertebrae: predorsal 4 or 5, preanal 48–51, total 123–129; MVF 4/50/127.

Body with complex pattern of brown reticulations enclosing large pale blotches; gill openings set in large brownish spot; head patterned dorsally, and lower jaw and abdomen with faint pattern or no pattern; fins with body pattern, but pale bright margin on rear of dorsal fin and entire anal fin. Attains 60 cm TL.



*Gymnothorax megaspilus*,  
38 cm TL, holotype  
dentition (Oman).  
Source: Böhlke & Randall 1995

**DISTRIBUTION** WIO: Khuriya Muriya Is. (Oman) and Somalia.

**REMARKS** Collected at ~21 m.

*Gymnothorax melatremus* Schultz 1953

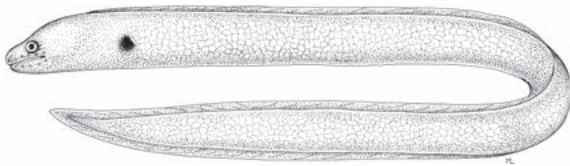
Golden dwarf moray

PLATE 8

*Gymnothorax melatremus* Schultz in Schultz *et al.* 1953: 120, Figs. 23d, 25 (ocean reef at Boby I., Bikini Atoll, Marshall Is.); SSF No. 41.16\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Randall & Van Egmond 1994; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.2–2.4, HL 7.9–9.5, BD/GO 13–20, and BD/A 17–23. In HL: snout length 4.1–5.9, upper jaw 2.2–3, and eye diameter 5.9–9.2. Teeth short and stout, no long fangs; intermaxillary teeth in 3 rows, with 1 or 2 stout median teeth; upper-jaw teeth in 2 short rows, and lower-jaw teeth with short inner row; vomerine teeth in 1 or 2 rows. Vertebrae: predorsal 2–5, preanal 48–54, total 132–149; MVF 4/53/139.

Head, body and fins usually uniformly pale brown, and often with faint dark reticulations, but sometimes body entirely bright golden yellow with deep blue eyes; gill openings in conspicuous dark spot; rear margin of eyes dark brown. Attains 30 cm TL.



*Gymnothorax melatremus*, 15 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (Aliwal Shoal), Comoros, Seychelles, Mauritius, Chagos and Maldives; elsewhere to southern Japan, Marshall Is., Australia, New Caledonia, Marquesas Is. and Pitcairn Is.

**REMARKS** Seldom seen; lives in holes and crevices on coral reefs, at 20–50 m. The wide range of vertebral counts along with recent genetic data suggest that this may represent a species-complex.

*Gymnothorax meleagris* (Shaw 1795)

Whitemouth moray

PLATE 8

*Muraena meleagris* Shaw in Shaw & Nodder 1795: no page number, Pl. 220 ('Southern Ocean').

*Thyrsoidea chlorostigma* Kaup 1856: 63 (Seychelles).

*Gymnothorax meleagris*: SSF No. 41.17\*; Randall & Anderson 1993\*; Winterbottom & Anderson 1997\*; Böhlke & Smith 2002; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.2–2.5, HL 6.7–8.5, BD/GO 11–18, and BD/A 12–18. In HL: snout length 4.9–6.2, upper jaw 2.1–2.7, and eye diameter 7.5–14. Teeth moderate, numerous; intermaxillary teeth in 5 rows, with 3 median teeth; teeth on jaws biserial; vomerine teeth in 1 row. Vertebrae: predorsal 4–6, preanal vertebrae 48–53, total 127–132; MVF 5/52/130.

Body and fins dark brown or black, densely covered with very small white to yellowish spots that are often darker edged; spots slightly sparser on tail, with pattern on tail tip irregular and pale; gill openings set in black spot; inside of mouth white. Attains possibly 120 cm TL (commonly ~80 cm TL).



*Gymnothorax meleagris*, 40 cm TL (WIO).

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Mozambique to South Africa (Algoa Bay), Madagascar, Comoros, Seychelles, Réunion, Chagos and Maldives; elsewhere to Cocos (Keeling) Is., southern Japan, New Caledonia, Lord Howe I., Austral Is., Pitcairn Is. and Hawaii.

**REMARKS** Found on coral reefs, to at least 36 m deep, preferring shallower water, and juveniles found in intertidal zones. Records of this species in the Red Sea are likely misidentifications of *G. buroensis* or *G. undulatus*.

*Gymnothorax moluccensis* (Bleeker 1864)

Sawtooth moray

*Priononophis moluccensis* Bleeker 1864: 48 (Ambon I., Moluccas, Indonesia).

*Gymnothorax moluccensis*: Randall & Golani 1995; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 1.8–1.9, HL 6.8–8.2, BD/GO 16–19, and BD/A 17–24. In HL: snout length 5.5–6.2, upper jaw 2.4–3, and eye diameter 10–13. Teeth strong and triangular, distinctly serrate; intermaxillary teeth in 3 rows, with 1 median tooth; teeth on jaws uniserial; vomerine teeth biserial anteriorly. Vertebrae: predorsal 6–8, preanal 58–63, total 130–138; MVF 7/61/133.

Body medium brown or brownish grey, with minute white dots on body, fins and tail; head pale, without spots. Attains ~39 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (Yemen) and South Africa (Sodwana Bay); elsewhere, Indonesia, Coral Sea and New Caledonia.

**REMARKS** Rare; secretive, known from coastal reefs, to ~28 m deep.

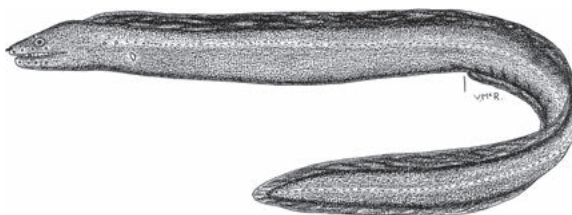
### ?*Gymnothorax monochrous* (Bleeker 1856)

Monochrome moray PLATE 11

*Muraena monochrous* Bleeker 1856: 384 (Ternate, Moluccas, Indonesia).  
*Gymnothorax monochrous*: SSF No. 41.18\*; Böhlke 2000; Böhlke & Smith 2002; Heemstra *et al.* 2004; Smith 2012.

In TL: preanal length 2–2.5, HL 7.7–9.4, BD/GO 14–21, and BD/A 15–25. In HL: snout length 5–5.9, upper jaw 2.2–2.7, and eye diameter 9–11. Teeth long, many long fangs; intermaxillary teeth in 3 rows, with 3 long median fangs; teeth on both jaws biserial anteriorly; vomerine teeth uniserial. Vertebrae: predorsal 4–6, preanal 56–61, total 136–143; MVF 4/58/139.

Body and fins uniformly brown, head and abdomen slightly paler; large specimens sometimes with pale margin around tail tip. Attains ~72 cm TL.



?*Gymnothorax monochrous*, 15 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique (Maputo Bay), possibly Tanzania and Rodrigues; elsewhere to Indonesia, Japan, Australia and New Caledonia.

**REMARKS** The definition and distribution of this species is uncertain, and its presence in the WIO should be considered provisional. Further studies are needed to distinguish better the various species of *Gymnothorax* displaying plain brown colouration.

### *Gymnothorax monostigma* (Regan 1909)

One-spot moray PLATE 11

*Muraena monostigma* Regan 1909: 438 (Raiatea, Society Is.).  
*Gymnothorax monostigmus*: Randall & Anderson 1993; Böhlke & Smith 2002.  
*Gymnothorax monostigma*: Smith 2012.

In TL: preanal length 1.8–2, HL 7.8–8.8, BD/GO 16–18, and BD/A 18–22. In HL: snout length 4.9–6.3, upper jaw 2.6–3.2, and eye diameter 11–14. Teeth large, distinctly serrate; intermaxillary teeth in 3 rows, with 3 long median teeth; maxillary teeth biserial anteriorly in small specimens, uniserial in adults; vomerine teeth uniserial or irregularly biserial; dentary teeth biserial anteriorly. Vertebrae: predorsal 7–10, preanal 59–62, total 129–133; MVF 8/61/132.

Body medium to dark brown, very slightly mottled; distinct black ring around eyes, extending backward as rectangular blotch; rear pores on jaw and posterior nostrils in conspicuous white or pale spots; fin margins pale, but often obscured in large specimens. Attains 65 cm TL.



*Gymnothorax monostigma*.  
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**DISTRIBUTION** Indo-Pacific. WIO: Maldives; elsewhere to Christmas I., Philippines, Micronesia, Samoa, Society Is., Marquesas Is. and Tuamotu Is.

**REMARKS** Rare; inhabits reefs and is mostly found off oceanic islands.

### *Gymnothorax nudivomer* (Günther 1867)

Yellow-mouth moray PLATES 4 & 10

*Muraena nudivomer* Günther in Playfair & Günther 1867: 127, Pl. 18 (Zanzibar, Tanzania).  
*Gymnothorax insignis* Seale 1917: 93 (Mauritius, Mascarenes).  
*Gymnothorax nudivomer*: SSF No. 41.19\*; Allen & Steene 1987\*; Randall & Van Egmond 1994\*; Randall 1995\*; Randall & Golani 1995; Böhlke & Smith 2002; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.1–2.3, HL 7.4–8.5, BD/GO 9.4–14, and BD/A 16–19. In HL: snout length 3.8–6.2, upper jaw 2–2.9, and eye diameter 8–15. Teeth large and triangular, largest teeth serrate; intermaxillary teeth in 3 rows, no median teeth in

large specimens, but 1 or 2 median teeth in juveniles; maxillary teeth biserial anteriorly in small specimens, uniserial in adults; vomerine teeth small and uniserial in juveniles, not apparent in adults; dentary teeth uniserial. Vertebrae: predorsal 2–4, preanal 50–55, total 132–139; MVF 3/52/135.

Body medium to pale brown anteriorly, becoming much darker towards tail; numerous small white spots on head, spots becoming larger, prominent, and darker edged on body and tail; fins with body pattern, but anal fin with irregular pale margin; gill openings in dusky blotch; inside of mouth bright yellow in life. Attains ~180 cm TL.

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, Oman to South Africa (Transkei region), Zanzibar, Madagascar, Seychelles (Bird I.), Réunion and Mauritius; elsewhere to Taiwan, southern Japan, Australia, New Caledonia, Marquesas Is. and Hawaii.

### *Gymnothorax parini* Collette, Smith & Böhlke 1991

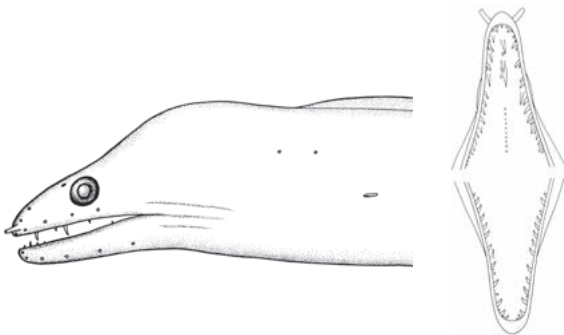
Lichen moray

PLATE 4

*Gymnothorax parini* Collette, Smith & Böhlke 1991: 344, Figs. 1–3 (Walters Shoals, Indian Ocean); Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.1–2.3, HL 6.8–8.1, and BD/A 16–22. In HL: snout length 4.3–5.2, upper jaw 1.9–2.4, and eye diameter 8.9–13. Teeth long and narrow, and long fangs present; intermaxillary teeth in 3 rows, with 3 or 4 long median fangs; teeth on jaws and vomer uniserial. Vertebrae: predorsal 3–5, preanal 53–58, total 143–152; MVF 4/56/147.

Body dark brown or black, with irregular pale blotches on head, body and fins, mottled within by darker brown, often snowflake- or lichen-like, sometimes as irregular bars; dorsal fin with narrow pale margin, and anal fin with conspicuous bright pale margin. Attains 72 cm TL.



*Gymnothorax parini*, head and dentition of 54-cm-TL holotype (Walters Shoals).

Source: Collette *et al.* 1991; © *Proc. Biol. Soc. Wash.*, Allen Press Publ. Services

**DISTRIBUTION** WIO: Walters Shoals (south of Madagascar).

**REMARKS** Caught by hook and line and by traps; known from 18–40 m.

### *Gymnothorax phasmatodes* (Smith 1962)

Ghost moray

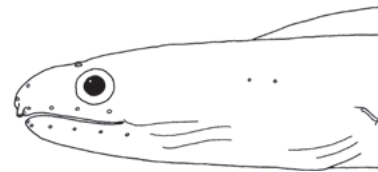
PLATES 4 & 9

*Lycodontis phasmatodes* Smith 1962: 436, Pl. 53, Figs. B, C, I (Inhaca I., Mozambique).

*Gymnothorax phasmatodes*: SSF No. 41.21\*; Randall 1995\*; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 1.7–2, HL 9.2–11, BD/GO 27–31, and BD/A 32–48. In HL: snout length 5.2–6.9, upper jaw 3–3.5, and eye diameter 7.5–12. Teeth long and slender; intermaxillary teeth in 3 rows, with 3 median fangs; teeth on jaws and vomer uniserial. Vertebrae: predorsal 5–7, preanal 74–80, total 160–174; MVF 6/78/168.

Body pale whitish tan, yellowish or very pale bluish grey, and palest ventrally; head, jaws and dorsal fin slightly dusky; head pores and posterior nostrils in pale spots; dorsal fin with pale bright blue margin in life (conspicuous pale margin in preservation). Attains 47 cm TL.



*Gymnothorax phasmatodes*, 34 cm TL, head (Madagascar). Source: Böhlke 1997

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf (Oman), Mozambique, South Africa, Madagascar and Mauritius; elsewhere to Indonesia, Philippines, New Guinea, Coral Sea and Fiji.

**REMARKS** Found in shallow water over sandy mud or coral rubble.

### *Gymnothorax pictus* (Ahl 1789)

Peppered moray

PLATES 4, 10 & 11

*Muraena picta* Ahl 1789: 8, Pl. 2, Fig. (Indonesia).

*Siderea picta*: SSF No. 41.27\*; Randall & Anderson 1993; Randall 1995\*; Randall & Golani 1995; Winterbottom & Anderson 1997; Letourneur *et al.* 2004; Fricke *et al.* 2009.

*Gymnothorax pictus*: Winterbottom *et al.* 1989\*; Böhlke & Smith 2002; Heemstra & Heemstra 2004; Smith 2012.



In TL: preanal length 1.9–2.2, HL 7–8.3, BD/GO 15–22, and BD/A 16–28. In HL: snout length 5.3–7.4, upper jaw 2.5–3.3, and eye diameter 8.4–16. Teeth short and stout, no long canines; intermaxillary teeth in 3 rows, with up to 3 stout median teeth; maxillary teeth uniserial; vomerine teeth in staggered row in juveniles, biserial and diverging anteriorly in adults; dentary teeth biserial anteriorly. Vertebrae: predorsal 7–11, preanal 56–62, total 113–135; MVF 9/58/131.

Colour highly variable: pale greyish background, with dark spots and circles in juveniles, peppered with small brownish olive to blackish green spots in adults, spots aggregating to form numerous large blotches or polygons, especially along midsides; abdomen pale in juveniles, patterned in adults; patterning denser dorsally than ventrally, and fins patterned as body. Attains possibly 140 cm TL.



*Gymnothorax pictus* (WIO). Source: SFSA



*Gymnothorax pictus*, 57 cm TL, dentition. Source: Böhlke & Randall 2000, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific to eastern Pacific (widespread).

WIO: Red Sea, Oman to South Africa (Sodwana Bay), Mozambique Channel, Madagascar, Comoros, Seychelles, Mauritius, Réunion, Chagos and Maldives; elsewhere to Andaman Is., Cocos (Keeling) Is., Indonesia, Philippines, southern Japan, Mariana Is., Australia, Marshall Is., Samoa, Pitcairn Is., Hawaii, Mexico, Galápagos Is. and Panama.

**REMARKS** Synchronous hermaphrodite. Common; often inhabits very shallow water. Feeds mainly on crustaceans.

***Gymnothorax pikei*** Bliss 1883

Pike's moray

PLATE 10

*Gymnothorax pikei* Bliss (ex Steindachner) 1883: 59 (Mauritius, Mascarenes); Böhlke & Smith 2002; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length ~2.1, HL 6.6–7.4, BD/GO ~14, and BD/A ~19. In HL: snout length 4.6–5.1, upper jaw 2.5–2.6, and eye diameter 12–15. Teeth long and slender, some canines; intermaxillary teeth in 3 rows, with 3 long median fangs; teeth on jaws and vomer uniserial. Vertebrae: predorsal 6, preanal 54–59, total 145–149.

Body pale grey-brown, with 25–30 narrow, branching, irregular blackish brown bands on body and tail, continuing across dorsal fin and irregularly coalescing ventrally; head uniformly dusky. Attains at least 90 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Réunion (photograph only) and Mauritius; elsewhere, New Guinea.

**REMARKS** Known only from two specimens, collected from relatively deep water.

***Gymnothorax pindae*** Smith 1962

Pinda moray

PLATES 4 & 10

*Gymnothorax pindae* Smith 1962: 430, Pl. 55, Fig. D (Pinda, Mozambique); Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall & Golani 1995; Böhlke 2000; Böhlke & Smith 2002; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.1–2.4, HL 5.8–7, BD/GO 11–15, and BD/A 14–22. In HL: snout length 4.8–6.1, upper jaw 2.4–3, and eye diameter 7.4–13. Teeth stout, largest anterior teeth serrate; intermaxillary teeth in 3 rows, usually 2 moderate median teeth; maxillary teeth of juveniles biserial anteriorly, those of adults uniserial; vomerine teeth small, sometimes staggered; dentary teeth mostly uniserial, anterior teeth large and serrate. Vertebrae: predorsal 5–7, preanal 42–46, total 118–124; MVF 6/44/121.

Body and fins uniformly brown, darker near tail tip. Attains 39 cm TL.



*Gymnothorax pindae*, 34 cm TL (Mauritius).



*Gymnothorax pindae*, 36 cm TL, dentition (Japan).  
Source: Hatooka 1988

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to Mozambique, Madagascar, Comoros, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to Taiwan, Amami Is. (Japan), Marshall Is., southern Great Barrier Reef, New Caledonia, Pitcairn Is. and Hawaii.

**REMARKS** Found on coral reefs, to ~40 m deep.

### *Gymnothorax polyuranodon* (Bleeker 1854)

Freshwater moray

PLATE 4

*Muraena polyuranodon* Bleeker 1854: 248 (Seram I., Moluccas, Indonesia).  
*Gymnothorax polyuranodon*: Böhlke & Smith 2002; Smith 2012.

Head snake-like, depressed, with short snout. Dorsal-fin origin slightly before gill openings. In TL: preanal length 1.8–2.5, HL 9–11, and BD/GO 18–28. In HL: eye diameter 10–12, and upper jaw ~3.5. Teeth conical, sharp and pointed, directed backwards; intermaxillary teeth in 5 rows, with 3 or 4 median teeth, of which 1 or 2 are compressed, recurved and depressible; maxillary teeth in 2 or 3 rows; dentary teeth in 3 rows anteriorly, 1 row posteriorly; vomerine teeth in 1 row of 5–10 teeth. Vertebrae: predorsal 9–16, preanal 67–75, total 141–148; MVF 12/70/144.

Body with numerous close-set irregular black blotches and pale interspaces, forming irregular reticulum with scribbled appearance. Attains 93 cm TL.



*Gymnothorax polyuranodon*, dentition. Source: Weber & De Beaufort 1916

**DISTRIBUTION** Indo-Pacific. WIO: Seychelles and Sri Lanka; elsewhere to Indonesia (Borneo; Moluccas), Philippines, Palau, New Guinea, Australia, New Caledonia, Vanuatu and Fiji.

**REMARKS** Prefers freshwater habitats, but also found in estuaries and in the sea.

### *Gymnothorax pseudoherrei* Böhlke 2000

False brown moray

PLATES 4 & 9

*Gymnothorax herrei* (non Beebe & Tee-Van 1933): Randall & Golani 1995.  
*Gymnothorax pseudoherrei* Böhlke 2000: 408, Figs. 2f, 3d, 7 (Selinog I., Mindanao, Philippines); Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.3, HL 7.2–9, BD/GO 14–20, and BD/A 16–26. In HL: snout length 4.9–6.8, upper jaw 2.6–3.2, and eye diameter 8.2–12. Teeth numerous, short and stout; intermaxillary teeth in 3 rows, and 2 median teeth; maxillary teeth biserial for entire jaw; vomerine teeth uniserial; dentary teeth biserial in juveniles, mostly uniserial in adults. Vertebrae: 5–9 predorsal, 44–50 preanal, total 110–118; MVF 6/47/114.

Body and fins medium to dark brown, with dark line along anal-fin base; head and rear part of tail usually pale; occasionally with dark streak on throat. Attains 30 cm TL.



*Gymnothorax pseudoherrei*, 11 cm TL (Saudi Arabia).  
© SV Bogorodsky

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Oman, Persian/Arabian Gulf, Maldives and Sri Lanka; elsewhere, Indonesia, Philippines, Australia and Solomon Is.

**REMARKS** Records of *Gymnothorax herrei* in the WIO (other than from Sri Lanka) refer to this species. Found in shallow water, generally <10 m.

## *Gymnothorax pseudothyrsoides* (Bleeker 1853)

False spotted moray PLATES 5 & 9

*Muraena pseudothyrsoides* Bleeker 1853: 778 (Makassar, Sulawesi, Indonesia); Böhlke & Smith 2002; Smith 2012.

*Gymnothorax pseudothyrsoides*: Randall 1995\*; Manilo & Bogorodsky 2003; Smith 2012.

In TL: preanal length 1.9–2.1, HL 6.4–8, BD/GO 10–20, and BD/A 12–21. In HL: snout length 5–6.1, upper jaw 2.1–2.8, and eye diameter 7.6–12. Teeth long and slender, some long canines; intermaxillary teeth in 3 rows, with 3 long median fangs; maxillary teeth biserial anteriorly in juveniles, uniserial in adults; vomerine teeth uniserial; dentary teeth uniserial, plus 4 large inner anterior teeth. Vertebrae: predorsal 3–5, preanal 53–61, total 122?–136; MVF 5/55/128.

Body grey or brown, with pattern of dark blotches formed by aggregations of smaller dark spots (on head, body and fins), the narrow interspaces appearing as diffuse pale yellow reticulum; lower jaw and abdomen paler; fins of juveniles with narrow pale margins. Attains 80 cm TL.



*Gymnothorax pseudothyrsoides*, 63 cm TL (Seychelles).  
PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Seychelles and India; elsewhere to Indonesia, Philippines, southern Japan, Australia and New Caledonia.

**REMARKS** Found on coral and rocky reefs, to ~15 m deep, and often in tidepools. This species' reticulated markings resemble certain individuals of *Gymnothorax undulatus*, creating possible confusion in identification.

## ?*Gymnothorax punctatus* Bloch & Schneider 1801

Dotted moray PLATES 5 & 10

*Gymnothorax punctatus* Bloch & Schneider 1801: 526 (Tharangambadi, India); Randall & Golani 1995; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.2, HL 7.2–8.4, BD/GO 14–23, and BD/A 19–31. In HL: snout length 5.2–6, upper jaw 2.3–2.7, and eye diameter 8.8–12. Teeth long, slender and smooth; intermaxillary teeth in 3 rows, with 3 median teeth; maxillary teeth biserial in juveniles, uniserial in adults; vomerine teeth uniserial; dentary teeth biserial anteriorly, uniserial posteriorly. Vertebrae (from Red Sea specimens): predorsal 5–7, preanal 55 or 56, total 138–144.

Body medium brown, with pale eye-sized ocellated spots on rear of head, body, tail and fins (spots smaller in larger specimens); snout and lower jaw brown, with dusky spot at rictus, and nostrils dark; dorsal fin with 1 or 2 rows of spots, and anal fin with 1 row of spots; fin margins not pale. Attains ~80 cm TL.

**DISTRIBUTION** WIO: Red Sea, India and Sri Lanka.

**REMARKS** It is not certain that the species reported from the Red Sea is the same as *Gymnothorax punctatus*, which was described from the east coast of India. Further studies are needed. The pale-spotted pattern of the Red Sea specimens resembles that of *Gymnothorax johnsoni*, but in like-sized individuals the spots of *G. punctatus* are smaller and more numerous.

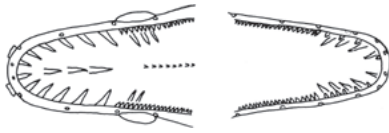
## *Gymnothorax randalli* Smith & Böhlke 1997

Broken bars moray PLATES 5 & 11

*Gymnothorax punctatofasciatus* (non Bleeker 1863): Randall & Golani 1995.  
*Gymnothorax randalli* Smith & Böhlke 1997: 185, Figs. 1–2, 8 (local fisherman at Lombok, Indonesia); Böhlke & Smith 2002; Smith 2012; Bogorodsky *et al.* 2014.

In TL: preanal length 2.2–2.3, HL 7.7–8.3, and BD/GO 20–25. In HL: snout length 5.7–6.9, upper jaw 2.8–3.3, and eye diameter 9.4–10. Teeth moderate, none caniniform, the largest slightly serrate in large specimens; intermaxillary teeth in 3 rows, with 3 median teeth; maxillary teeth uniserial in adults; vomerine teeth uniserial; dentary teeth biserial anteriorly, uniserial posteriorly. Vertebrae: predorsal 7–9, preanal 48–52, total 124–130; MVF 8/50/127.

Body pale tan, with 35–39 pairs of large brown spots along body and tail, aligned with row of spots on dorsal fin and anal fin, coalescing to form irregular bars posteriorly; head also spotted; anal fin with irregular pale margin. Attains at least 39.6 cm TL.



*Gymnothorax randalli*,  
27 cm TL, paratype  
dentition.

Source: Smith & Böhlke 1997,  
*Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (Egypt); elsewhere, Lesser Sunda Is. (Indonesia).

**REMARKS** Known from few specimens.

## *Gymnothorax reticularis* Bloch 1795

Decorated moray

PLATE 5

*Gymnothorax reticularis* Bloch 1795: 85, Pl. 416 [spelled *reticulatus* on Pl. and in Bloch & Schneider 1801] (Coromandel coast, India); Randall & Golani 1995; Böhlke & Smith 2002; Smith 2012; Stern & Goren 2013; Bogorodsky *et al.* 2014.

In TL: preanal length 2–2.2, HL 6.5–8.2, and BD/GO 16–18. In HL: snout length 5.6–7.8, upper jaw 2.3–3.5, and eye diameter 7.8–10. Teeth moderate, no canines, the largest slightly serrate; intermaxillary teeth in 2 outer rows, no median teeth; teeth on maxilla, vomer and dentary uniserial. Vertebrae: predorsal 5 or 6, preanal 48–51, total 114–126; MVF 6/49/119.

Head with longitudinal spots forming lines in branchial region; body and tail with 16–20 brown bars extending onto dorsal fin and anal fin; pale interspaces spotted dorsally. Attains 40 cm TL.



*Gymnothorax reticularis*,  
40 cm TL (Red Sea).  
© SV Bogorodsky

**DISTRIBUTION** Indian Ocean. WIO: Red Sea, East Africa, Pakistan and Mauritius; elsewhere, east coast of India.

**REMARKS** Previously confused with *Gymnothorax minor* from the western Pacific. Specimens from the Red Sea have more vertebrae than those from elsewhere (total vertebrae 124–126 and 117–122, respectively).

## *Gymnothorax richardsonii* (Bleeker 1852)

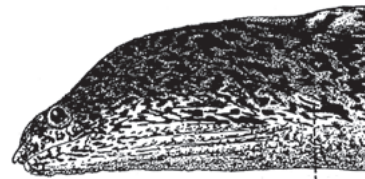
Spotted-lip moray

PLATE 5

*Muraena richardsonii* Bleeker 1852: 296 (Wahai, Sumatra, Indonesia).  
*Muraena diplodon* Peters 1855: 460 (Ibo, Quirimbas Is., Mozambique).  
*Muraena vermicularis* Peters 1855: 459 (Quirimba, Quirimbas Is., Mozambique).  
*Muraena modesta* Kaup 1860: 21, Pl. 4, Fig. 2 (Zanzibar, Tanzania).  
*Gymnothorax richardsonii*: SSF No. 41.22\* (as *richardsoni*); Randall & Anderson 1993; Fricke 1999; Böhlke & Smith 2002; Smith 2012.

Dorsal-fin origin above or just behind gill openings. In TL: preanal length 1.9–2.3, HL 6.5–8.5, BD/GO 14–24, and BD/A 15–23. In HL: snout length 5.2–8.5, upper jaw 2.4–3.3, and eye diameter 7.8–16. Teeth moderate and stout, no long canines; adult males with fewer teeth than juveniles and females; intermaxillary teeth in 3 rows, with 2–4 short median teeth in females (none in males); maxillary teeth biserial in juveniles and females, uniserial in males; vomerine teeth biserial or staggered; dentary teeth uniserial. Vertebrae: predorsal 7–11, preanal 46–52, total 112–117; MVF 9/50/115.

Head, body and tail with fine greyish reticulations on pale background; jaw pores in conspicuous white areas. Attains 34 cm TL.



*Gymnothorax richardsonii*,  
line indicates gill opening.  
Source: Weber & De Beaufort  
1916

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania (Zanzibar), Mozambique, Madagascar, Seychelles, Mauritius and Maldives; elsewhere to Indonesia, Taiwan, Philippines, southern Japan, New Caledonia, Tonga, Cook Is. and Society Is.

**REMARKS** Common on coral reefs, tidal flats and in mangroves.

## *Gymnothorax robinsi* Böhlke 1997

Dwarf moray

PLATE 5

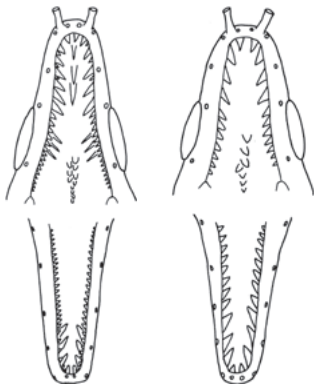
*Gymnothorax robinsi* Böhlke 1997: 648, Figs. 1–3 (off Tayandu, Kai Is., Indonesia); Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 1.8–2, HL 6.1–7.2, BD/GO 13–18, and BD/A 14–23. In HL: snout length 4.7–6.7, upper jaw 2.4–2.9, and eye diameter 6.9–8.8. Teeth moderate, males with fewer teeth than females; intermaxillary teeth in 3 rows, with 3 median fangs in juveniles and adult females (none in

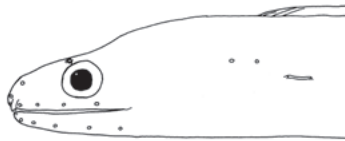


adult males); maxillary teeth biserial anteriorly in juveniles and females, uniserial in males; vomerine teeth biserial or staggered medially; dentary teeth biserial anteriorly in juveniles and females, uniserial in males. Vertebrae: predorsal 5–8, preanal 46–52, total 105–112; MVF 7/49/107.

Body and head reddish brown, variably patterned with pale lichenous spots and dark brown spots, the dark spots coalescing to form irregular vertical bars posteriorly; jaw pores in pale areas; body colouration extends onto median fins to create alternating bright white and brown oblique bars. Attains 18 cm TL.



*Gymnothorax robinsi*, 16 cm TL, female paratype, dentition (left); 15 cm TL, male paratype (right).  
Source: Böhlke 1997



*Gymnothorax robinsi*, 14 cm TL, holotype head.  
Source: Böhlke 1997

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Kosi Bay; Sodwana Bay; Mthatha River mouth), Mozambique, Bassas da India (Mozambique Channel), Seychelles and Maldives; elsewhere to Indonesia, Philippines, New Guinea and Fiji.

**REMARKS** Found on shallow coral reefs.

## *Gymnothorax rueppelliae* (McClelland 1844)

Banded moray

PLATE 8

*Dalophis rueppelliae* McClelland 1844: 213 (Red Sea).

*Muraena umbrofasciata* Rüppell 1852: 33 (Red Sea).

*Muraena interrupta* Kaup 1856: 67, Pl. 10, Fig. 51 (Red Sea).

*Gymnothorax signifer* Bliss 1883: 58 (Mauritius, Mascarenes).

*Gymnothorax rueppelliae*: Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Randall & Golani 1995; Winterbottom & Anderson 1997; Böhlke & Smith 2002 [as *rueppellii*]; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.1–2.3, HL 7.4–9, BD/GO 13–25, and BD/A 16–24. In HL: snout length 4.7–5.9, upper jaw 2.2–2.6, and eye diameter 7.9–11. Teeth long and slender, long fangs

present; intermaxillary teeth in 3 rows, with 3 long median fangs; teeth in both jaws uniserial in adults; vomerine teeth uniserial but hidden. Vertebrae: predorsal 4 or 5, preanal 50–55, total 125–135; MVF 5/52/131.

Background colour pale, with 16–22 broad dark bars, bar widths usually equal to interspaces, bars extending onto dorsal fin but not meeting ventrally on head and abdomen; bars distinct in juveniles, becoming diffuse anteriorly with growth; tip of snout and anterior nostrils dark or dusky, and often a dark mark at rictus; anal fin with conspicuous pale margin. Attains 76 cm TL.



*Gymnothorax rueppelliae*, 56 cm TL (Mauritius).  
© JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Réunion, Mauritius, Chagos, Maldives and Sri Lanka; elsewhere to Ryukyu Is., Australia, southern Great Barrier Reef, Loyalty Is. and Hawaii.

**REMARKS** Common on coral reefs, to ~40 m deep. Specimens from the Red Sea have fewer vertebrae than those from elsewhere (total vertebrae 124–128 and 130–135, respectively).

## *Gymnothorax sokotrensis* Kotthaus 1968

Socotra moray

PLATE 11

*Gymnothorax sokotrensis* Kotthaus 1968: 19, Figs. 107, 150 (off Socotra I.); Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2, HL 6.8, BD/GO 8.7, and BD/A 15. In HL: snout length 5.1, upper jaw 2.9, and eye diameter 15. Teeth few, large and serrate; intermaxillary teeth in 2 outer rows, no median teeth; teeth on maxilla, vomer and dentary uniserial. Vertebrae: predorsal 8, preanal 62, total 143.

Body reddish brown, with small evenly spaced pale spots overall; row of spots on fin margins partly coalesce to form pale margins. Maximum size unknown. Attains 45 cm TL.

**DISTRIBUTION** Known only from the holotype collected at Socotra.

**REMARKS** Found at 190–290 m. Similar to other white-spotted species from area, but not identifiable with any of these: resembles *Gymnothorax johnsoni* and *G. punctatus* in its colour pattern, but differs in having serrate teeth.

### *Gymnothorax thyrsoideus* (Richardson 1845)

White-eyed moray

PLATES 5 & 11

*Muraena thyrsoidea* Richardson 1845: 111, Pl. 48 [not 49], Fig. 1 (Canton [Guangdong], 'China seas').

*Gymnothorax thyrsoideus*: Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.3–2.6, HL 8.7–10, BD/GO 17–21, and BD/A 16–24. In HL: snout length 5–7.5, upper jaw 2.7–3.9, and eye diameter 9.1–14. Teeth numerous, short and stout; intermaxillary teeth in 3 rows, with 2 stout median teeth; maxillary teeth entirely biserial, rows short; vomerine teeth biserial, diverging anteriorly; dentary teeth biserial anteriorly. Vertebrae: predorsal 3–6, preanal 48–52, total 125–137; MVF 4/50/133.

Body often covered with greenish mucus; head pale or uniformly brown (without black dots); body and fins pale brown with small overlapping brown spots; fins and tail tip sometimes pale; eyes white in life. Attains 65 cm TL (commonly ~37 cm TL).

**DISTRIBUTION** Indo-Pacific. WIO: Maldives, India and Sri Lanka; elsewhere to Malaysia, Christmas I., China, southern Japan, Micronesia, northern Australia, Tonga, Line Is. and Tuamotu Is.

**REMARKS** Reports from the Red Sea are unconfirmed; probably does not occur west or south of the Maldives, where it is replaced by the similar-looking *G. griseus*. Found on coral and rocky reefs, at 1–35 m.

### *Gymnothorax undulatus* (Lacepède 1803)

Undulated moray

PLATES 5 & 11

*Muraenophis undulata* Lacepède (ex Commerson) 1803: 629, 642, 644, Pl. 19, Fig. 2 [no locality given].

*Gymnothorax undulatus*: SSF No. 41.24\* [in part]; Winterbottom *et al.* 1989; Randall 1995\*; Randall & Golani 1995 [in part]; Böhlke & Smith 2002; Heemstra *et al.* 2004; Heemstra & Heemstra 2004; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2–2.2, HL 6.5–7.8, BD/GO 12–21, and BD/A 14–22. In HL: snout length 4.7–6.8, upper jaw 2.1–2.7, and eye diameter 3–11. Teeth long and slender; intermaxillary teeth in 3 rows, with 3 median fangs; maxillary teeth uniserial in adults; vomerine teeth uniserial; dentary teeth biserial anteriorly. Vertebrae: predorsal 4–6, preanal 51–55, total 126–138; MVF 5/53/132.

Colour variable but with distinctive patterning: usually medium to dark brown or grey, with narrow pale undulating reticulations outlining large rectangular blotches, arranged in 2–4 longitudinal rows, often forming oblique bars posteriorly on dorsal fin; head dusky and unpatterned, often with yellowish cast on head in larger specimens; abdomen with faint or no patterning; fins with body pattern basally and pale margins (margins pale only posteriorly in large specimens). Attains 150 cm TL.



*Gymnothorax undulatus*, 46 cm TL (Seychelles). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific to eastern Pacific (widespread). WIO: Red Sea, East Africa to South Africa, Walters Shoals, Madagascar, Comoros, Seychelles, Mascarenes, Chagos, Maldives and Sri Lanka; elsewhere to southern Japan, Australia, New Caledonia, Gambier Is. (French Polynesia), Hawaii and Panama.

**REMARKS** Found on reef flats, coral reefs, seaward reefs and in shallow lagoons. The reticulations tend to become more irregular and obscure in larger individuals, creating possible confusion in identification. The account of *Gymnothorax undulatus* in Randall & Golani (1995: 868) was based in part on an undescribed species, to be described separately.



*Gymnothorax ypsilon*, 68 cm TL (Mascarene Ridge). © Alvheim © IMR

***Gymnothorax ypsilon*** Hatooka & Randall 1992

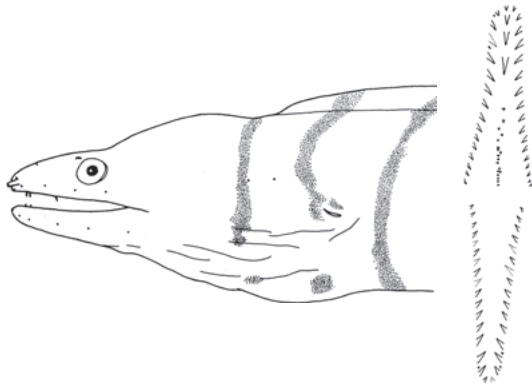
Y-barred moray

PLATE 6

*Gymnothorax ypsilon* Hatooka & Randall 1992: 183, Figs. 1–2 (near Uotsurijima I., Senkaku Is., Japan); Smith 2012.

In TL: preanal length 2.2–2.4, HL 7.3–8.3, BD/GO 14–22, and BD/A 16–26. In HL: snout length 4.6–5.1, upper jaw 2–2.5, and eye diameter 10–16. Teeth on jaws large, smooth, uniserial; intermaxillary teeth in 3 rows, with 1–3 median teeth. Vertebrae: predorsal 5–7, preanal 55–60, total 141–153; MVF 6/56/149.

Body pale brown, with 26–35 narrow dark bars, most branching dorsally to form Y-shaped bar; head unpatterned. Attains 89 cm TL.



*Gymnothorax ypsilon*, 72 cm TL, holotype, head and dentition (Japan). Source: Hatooka & Randall 1992

**DISTRIBUTION** Indo-Pacific. WIO: Mascarene Ridge; elsewhere, Japan and Hawaii.

**REMARKS** Occurs in relatively deep water, at 100–200 m.

***Gymnothorax zonipectis*** Seale 1906

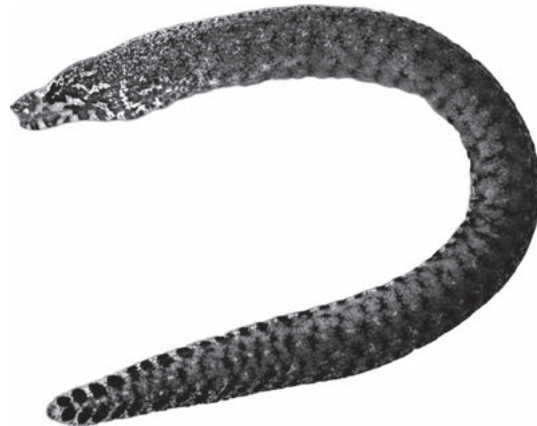
Barred-fin moray

PLATE 10

*Gymnothorax zonipectis* Seale 1906: 7, Fig. 1 (Tahiti, Society Is.); SSF No. 41.25\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Böhlke & Smith 2002; Letourneur *et al.* 2004; Fricke *et al.* 2009; Smith 2012.

In TL: preanal length 2.2–2.4, HL 6.9–8.2, BD/GO 13–19, and BD/A 15–23. In HL: snout length 3.7–5, upper jaw 2.1–2.7, and eye diameter 7.4–11. Teeth long and slender; intermaxillary teeth in 3 rows, with 3 median fangs; maxillary teeth biserial anteriorly in juveniles and females, uniserial in males; vomerine teeth staggered medially; dentary teeth biserial anteriorly, uniserial in males. Vertebrae: predorsal 4–7, preanal 47–50, total 123–130; MVF 6/48/126.

Body medium brown, with 3 or 4 rows of dark brown lichenous spots, aligning vertically to form oblique dark bars extending onto fins; conspicuous alternating dark and pale bars on posterior portion of fins; head brown or spotted, pores on jaws in pale spots which connect as bars across lower jaw; white blotch with dark borders extending behind mouth angle. Attains 48 cm TL.



*Gymnothorax zonipectis*, 28 cm TL (Seychelles). PC Heemstra © NRF-SAIAB



*Gymnothorax zonipectis*, dentition. Source: Hatooka & Iwata 1993

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Sodwana Bay to Aliwal Shoal), Comoros, Seychelles, Réunion, Mauritius, Chagos, Maldives and Sri Lanka; elsewhere to Taiwan, southern Japan, Australia, Great Barrier Reef, New Caledonia, Society Is. and Marquesas Is.

**REMARKS** Found on coral reefs and ledges, to ~46 m deep.

GENUS *Monopenchelys* Böhlke & McCosker 1982

Small-sized and slender with long jaws and 1 branchial pore. Dorsal-fin origin just behind anus; anus just before midlength. Teeth long and fang-like, numerous, and biserial on jaws. One species.

*Monopenchelys acuta* (Parr 1930)

Redface moray

PLATE 6

*Uropterygius acutus* Parr 1930: 16, Fig. 2 (West Caicos I., Bahamas [stomach content]).

*Monopenchelys acuta*: SSF No. 41 [genus included in key to genera; erroneous description of gill openings]; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.1–2.4, HL 7.3–8.6, BD/GO 19–38, and BD/A 20–34. In HL: snout length 5.3–9, upper jaw 2.3–3.4, and eye diameter 8.4–18. Teeth numerous, including long sharp canines; intermaxillary teeth in 5 rows across, with 3 median fangs; maxillary teeth biserial; vomerine teeth uniserial; dentary teeth biserial anteriorly. Gill openings midlateral. Vertebrae: predorsal 67–78; preanal 50–56, total 124–144; MVF 73/53/131.

Body and fins uniformly brown; head and tip of tail red or red-orange in life, pale in preservation. Attains 21 cm TL.



*Monopenchelys acuta*, 13 cm TL, dentition.

Source: Böhlke & Randall 2000, *Proceedings of the ANSP*

**DISTRIBUTION** Cosmopolitan in warm waters, with fragmented populations in western Atlantic (Bahamas to Lesser Antilles, Caribbean Sea and Mexico), southern Atlantic (Ascension I.) and Indo-Pacific. WIO: Comoros, Seychelles and Mauritius (Agaléga Is.); elsewhere, Fiji and Hawaii.

**REMARKS** Uncommon, but perhaps the most widely distributed species of moray, although detailed comparisons have not yet been made of populations in different areas. Found on coral heads and rocky ledges, at 13–54 m.

GENUS *Muraena* Linnaeus 1758

Dorsal-fin origin above gill openings; anus near midlength. Jaws not arched; teeth acute, smooth, not exposed when mouth closed; posterior nostrils in a distinct tube. Native to Atlantic and eastern Pacific oceans, one species has entered the northern Red Sea through the Suez Canal. Another species, *Muraena retifera*, was reported from the Arabian Sea (Sirajudheen & Bijukumar 2011), but this record needs to be confirmed.

*Muraena helena* Linnaeus 1758

Mediterranean moray

PLATE 6

*Muraena helena* Linnaeus 1758: 244 ('in Europe' [Mediterranean Sea]); Randall & Golani 1995.

In TL: preanal length 2.1–2.2, HL 8.2–8.7, BD/GO 13–15, and BD/A 15. In HL: snout length 4.6–5.2, upper jaw 2.4–3, and eye diameter 9.3–12. Teeth slender, compressed, uniserial in jaws; 2 median intermaxillary teeth; vomerine teeth in 1 row. Posterior nostrils distinctly tubular. Vertebrae: predorsal 4–5, preanal 59–63, total 137–148.

Head dark anteriorly, posterior part of head and anterior part of trunk mottled with small pale spots, and posteriorly the spots appear as polygonal blotches, becoming smaller and more widely spaced on tail; gill openings black. Attains 130 cm TL.

**DISTRIBUTION** Mediterranean Sea, eastern Atlantic (British Isles to Senegal, including Azores, Madeira and Canary Is.) and anti-Lessepsian migrant to northern Red Sea.

GENUS *Pseudechidna* Bleeker 1863

Body and tail slender and elongate; dorsal-fin origin before gill openings; anus before midlength. Teeth moderately sized and sexually dimorphic. One species.

*Pseudechidna brummeri* (Bleeker 1858)

White ribbon moray

PLATE 6

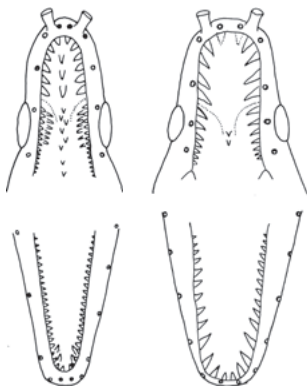
*Muraena brummeri* Bleeker 1858: 137 (Atapupu, Timor, Indonesia).

*Pseudechidna brummeri*: Randall & Anderson 1993; Böhlke & Smith 2002; Smith 2012.



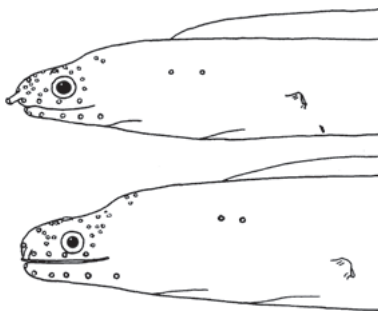
Diagnosis as for genus. In TL: preanal length 2.1–2.3, HL 11–16, BD/GO 39–56, and BD/A 43–75. In HL: snout length 6.4–9, upper jaw 3.4–4.2, and eye diameter 12–22. Teeth moderate, variable; intermaxillary teeth in 2 or 3 rows, with 3 moderate median teeth in juveniles and females, no median teeth in adult males; maxillary teeth biserial anteriorly in juveniles and females, uniserial and few in males; vomerine teeth few, staggered; dentary teeth biserial anteriorly in juveniles and females, uniserial in males. Vertebrae: predorsal 4–7, preanal 89–98, total 201–214; MVF 6/93/207.

Body evenly pale tan to slightly yellowish, and fins with bright white margins; top and sides of head conspicuously scattered with small black dots; anterior nostrils black distally, posterior nostrils and head pores with black rims. Attains 83 cm TL.



*Pseudechidna brummeri*, dentition, 51 cm TL, female (left); 51 cm TL, male (right).

Source: Böhlke 1997, *Proceedings of the ANSP*



*Pseudechidna brummeri*, 51 cm TL, female head (top); 51 cm TL, male (bottom).

Source: Böhlke 1997, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, Seychelles and Maldives; elsewhere to Indonesia, Taiwan, southern Japan, Philippines, Mariana Is., New Guinea, Samoa and Cook Is.

**REMARKS** Inhabits reef flats and shallow lagoons, typically burying itself in sand or rubble, to ~8 m deep.

## GENUS *Rhinomuraena* Garman 1888

Body ribbon-like, exceedingly long and compressed; dorsal-fin origin before gill openings; anus well before midlength. Anterior nostrils in long tube with distal flap; barbels at tips of upper and lower jaws. Colouration sexually dimorphic. One species.

### *Rhinomuraena quaesita* Garman 1888

Ribbon moray

PLATE 6

*Rhinomuraena quaesita* Garman 1888: 114, Fig. (Ebon I., Marshall Is.); Randall & Anderson 1993\*; Böhlke & Smith 2002; Letourneur *et al.* 2004; Smith 2012.

Diagnosis as for genus. In TL: preanal length 3.1–3.3, HL 15–20, BD/GO 60–101, and BD/A 68–116. In HL: snout length 6.2–8.4, upper jaw 2.7–3.4, and eye diameter 14–20. Teeth conical, sharp and similarly sized; intermaxillary teeth in 3 rows, usually 4 median teeth; teeth on jaws uniserial or staggered; vomerine teeth uniserial. Branchial pores 1–8; pores on upper jaw 5. Vertebrae: predorsal 5, preanal 89 and 90, total 276–281.

Brilliant colouration varying with growth and sexual condition: Juveniles (<65 cm TL) brown or black overall; pale slash along lower jaw; fins with bright pale margins. Adult males (>65 cm TL) bright iridescent blue body, snout and jaws yellow-orange to orange-grey; fins dark basally, with bright pale margins. Adult females (>118 cm TL) bright yellow body, fins, snout and jaws, and abdomen pale to bluish; fins with bright pale margins. Attains 122 cm TL.



*Rhinomuraena quaesita* (Mauritius).

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Park Rynie), Seychelles, Mauritius and Maldives; elsewhere to Indonesia (common), Taiwan, Philippines, Mariana Is., southern Japan, Marshall Is., Australia, New Caledonia, Samoa and Tuamotu Is.

**REMARKS** Protandrous hermaphrodite (born a male and then changes sex to female). Common only in parts of its range. Secretive, found in lagoons and on reefs, to ~57 m deep. Commercially captured for the aquarium trade.

GENUS *Strophidon* McClelland 1844

Body and tail very slender and snake-like, mostly cylindrical and extremely elongate; dorsal-fin origin on head, before gill openings; anus well before midlength, tail ~60% TL. Mouth very large; eyes closer to snout tip than to rictus; teeth long and sharp, numerous and biserial. One species.

*Strophidon sathete* (Hamilton 1822)

Slender giant moray

PLATE 6

*Muraenopsis sathete* Hamilton 1822: 17, 363 (Ganges River estuaries near Kolkata, India).

*Thyrsoidea longissima* Kaup 1856: 61 (Mumbai, India).

*Thyrsoidea macrura*: SSF No. 41.28\*; Letourneur *et al.* 2004.

*Muraena macrura*: Böhlke & Smith 2002.

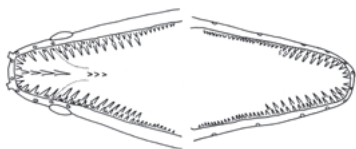
*Strophidon sathete*: Ajiad 1987; Randall & Anderson 1993\*; Randall & Golani 1995; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004; Fricke *et al.* 2009; Smith 2012.

Diagnosis as for genus. In TL: preanal length 2.3–2.9, HL 8.5–14, BD/GO 25–49, and BD/A 30–59. In HL: snout length 7.1–12, upper jaw 2.8–3.7, and eye diameter 11–24. Intermaxillary teeth in 3 rows, usually 4 median teeth; maxillary teeth biserial; vomerine teeth uniserial; dentary teeth biserial anteriorly. Branchial pores 3–7. Vertebrae: predorsal 8–11, preanal 73–82, total 186–208; MVF 10/78/196.

Head, body and fins uniformly brownish grey; series of pale slashes along lateral line. Attains possibly 4 m TL (commonly ~70 cm TL).



*Strophidon sathete*, 76 cm TL (South Africa). Source: Smith 1962



*Strophidon sathete*, 89 cm TL, dentition.

Source: Böhlke 1997, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to South Africa (Mbhashe River mouth, Eastern Cape), Madagascar, Mascarenes, Maldives, India and Sri Lanka; elsewhere to east coast of India, Andaman Is., Vietnam, Indonesia, Taiwan, Philippines, southern Japan, Mariana Is., Palau, New Guinea, Australia, New Caledonia and Society Is.

**REMARKS** The longest known moray. Usually inhabits brackish waters of estuaries; known to extend itself vertically from its burrow, rising and falling with the tide. Feeds on a variety of demersal fishes, prawns and crabs.

## SUBFAMILY UROPTERYGIINAE

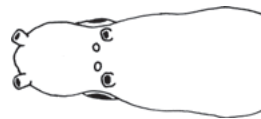
Dorsal fin and anal fin restricted to rear of body and confluent with caudal fin. Recognised as comprising 4 genera, all represented in WIO: *Anarchias*, *Channomuraena*, *Scuticaria* and *Uropterygius*.

GENUS *Anarchias* Jordan & Starks 1906

Dorsal fin and anal fin restricted to rear of body and confluent with tail tip; anus near midbody. Teeth long and sharp, biserial on both jaws; 2 branchial pores; 1 enlarged supraorbital pore next to posterior nostril. About 7 species, 3 in WIO.

## KEY TO SPECIES

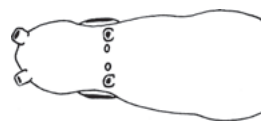
- 1a Supraorbital pore separated from posterior nostril by pigmented skin; pores on head not set in pale spots ..... *A. cantonensis*



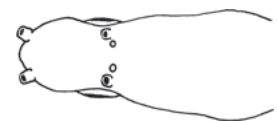
- 1b Supraorbital pore separated from posterior nostril by narrow unpigmented septum; pores on head set in pale spots ..... 2

- 2a Pore immediately above posterior nostril; body uniformly brown, sometimes with slight dark mottling; vertebrae 95–102 ..... *A. allardicei*

- 2b Pore located above and behind posterior nostril; body brown, and usually with variably sized pale spots or irregular markings; vertebrae 118–130 ..... *A. seychellensis*



2a



2b

## *Anarchias allardicei* Jordan & Starks 1906

### Nondescript moray

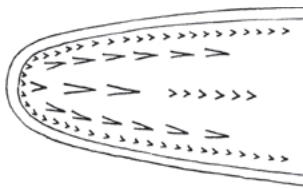
*Anarchias allardicei* Jordan & Starks in Jordan & Seale 1906: 204, Fig. 9 (Pago Pago, American Samoa); Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Böhlke & Smith 2002; Smith 2012.

*Anarchias fuscus* Smith 1962: 428, Pl. 53, Fig. G (Maputo Bay, Mozambique).

*Anarchias maldiviensis* Klausewitz 1964: 665, Fig. 1 (Rasdu Atoll, Maldives).

In TL: preanal length 2–2.2, HL 6.7–8.2, BD/GO 14–20, and BD/A 16–28. In HL: snout length 5.9–7.4, upper jaw 2.9–4, and eye diameter 10–14. Teeth numerous, caniniform, in 2 continuous rows on jaws, inner teeth longer and fewer; 3 long median intermaxillary teeth. Fourth supraorbital pore adjacent to and immediately above posterior nostril. Vertebrae: predorsal 85–92, preanal 87–92, total 97–102; MVF 88/89/99.

Body medium brown, occasionally slightly mottled but without distinct pattern; snout and lower jaw paler, head pores pale; fins and tip of tail bright yellow in life, pale in preservation. Attains 17 cm TL.



*Anarchias allardicei*, upper jaw dentition (Maldives).

Source: Klausewitz 1964



*Anarchias allardicei*, 13 cm TL, holotype of *A. fuscus* (Mozambique).

Source: Smith 1962

**DISTRIBUTION** Indo-Pacific (uncommon). WIO: Kenya, Mozambique, Chagos and Maldives; elsewhere to Taiwan, Australia, Samoa and Society Is.

## *Anarchias cantonensis* (Schultz 1943)

### Stellate reef moray

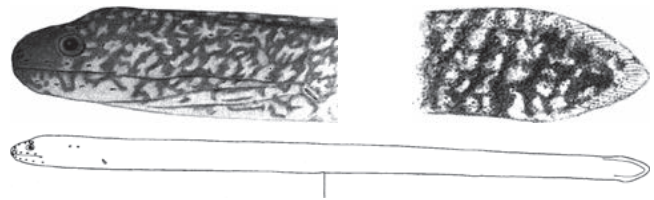
*Uropterygius cantonensis* Schultz 1943: 27, Pl. 4, Fig. 3a (lagoon of Canton I., Phoenix Is.).

*Anarchias cantonensis*: Randall & Anderson 1993; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.2, HL 6.9–8.5, BD/GO 14–23, and BD/A 16–25. In HL: snout length 5.4–7, upper jaw 2.4–3.1, and eye diameter 10–14. Teeth numerous, biserial on jaws; 3 median intermaxillary teeth; vomerine teeth uniserial. Fourth supraorbital pore above and before posterior nostril

and separated by pigmented septum. Vertebrae: predorsal 86–94, preanal 89–97, total 98–108; MVF 91/93/104.

Body medium brown, variably patterned with dark reticulum outlining pale stellate spots; lower jaw and abdomen pale and with less patterning. Attains 21 cm TL.



*Anarchias cantonensis*, holotype, lateral head and tail tip (Phoenix Is.).

Source: Schultz 1943

**DISTRIBUTION** Indo-Pacific. WIO: Maldives; elsewhere to China, Tonga, Phoenix Is. and Line Is.

**REMARKS** Found on coral reefs, at 1–25 m.

## *Anarchias seychellensis* Smith 1962

### Seychelles moray

PLATE 1

*Anarchias seychellensis* Smith 1962: 429, Pl. 53, Fig. F (Assumption I., Seychelles); SSF No. 41.1\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Fricke 1999; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.2–2.5, HL 8.3–10, BD/GO 20–26, and BD/A 22–33. In HL: snout length 4.8–6.5, upper jaw 2.5–3.2, and eye diameter 9.1–13. Teeth numerous, biserial; 3 median intermaxillary teeth. Fourth supraorbital pore adjacent, above and extending behind posterior nostril. Vertebrae: predorsal 105–120, preanal 113–123, total 118–132; MVF 111/117/126.

Body medium reddish brown background, with irregular pale spots, variable in size and complexity, sometimes forming slight pattern; head patterned dorsally, lower jaw and abdomen paler or without pattern; head pores set in pale areas; fins pale. Attains 29 cm TL.



*Anarchias seychellensis*, 18 cm TL, holotype (Seychelles). Source: SSF



*Anarchias seychellensis*, 24 cm TL, dentition.

Source: Böhlke & Randall 2000, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Tanzania, South Africa (Sodwana Bay), Comoros, Seychelles, Mauritius, Réunion, Chagos and Maldives; elsewhere to Ogasawara Is. (Japan), Hawaii, Australia, New Caledonia, Kermadec Is. and Easter I.

**REMARKS** May represent more than one species. Collected from over coral rubble, to ~22 m deep.

## GENUS *Channomuraena* Richardson 1848

Body cylindrical; dorsal fin and anal fin restricted to rear of body and confluent with tail tip; anus well behind midlength; tail 10–38% TL. Jaws long and broad, lower jaw projecting beyond upper jaw; teeth short and multiserial. Eyes much closer to snout tip than to rictus. Colouration uniform or banded. Two species, both in WIO.

### KEY TO SPECIES

- |    |  |                     |
|----|--|---------------------|
| 1a | Broad dark bars encircling body and head behind eyes; preanal length 1.4–1.6 in TL ..... | <i>C. vittata</i>   |
| 1b | Colour uniformly brown; preanal length ~1.1 in TL .....                                  | <i>C. bauchotae</i> |

## *Channomuraena bauchotae*

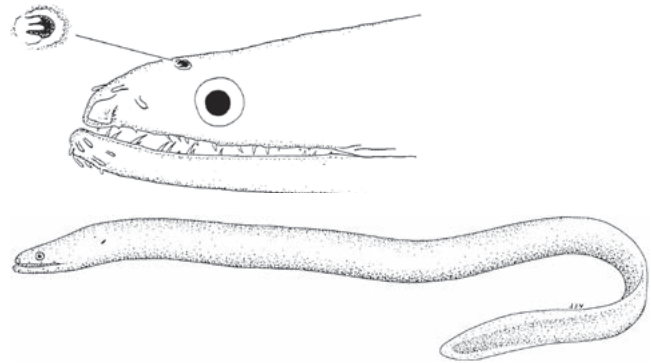
Saldanha & Quéro 1994

Uniform snake eel

*Channomuraena bauchotae* Saldanha & Quéro 1994: 308, Fig. 1 (Réunion, Mascarenes); Böhlke & Smith 2002.

Preanal length possibly ~91% TL [anus not visible when holotype was re-examined]; HL 6.4 in TL; BD/GO 22 in TL; upper jaw 2.5 in HL; eye diameter 5.6 in HL. Teeth short and recurved; teeth on jaws biserial; vomerine teeth uniserial. One or no branchial pores. Posterior nostrils a crenulate pore above and before eyes, with 3 barbels anteriorly; papillae on jaws. Vertebrae: predorsal 114 or 115, preanal 112–117, total 132; MVF 114/115/132.

Body uniformly brown. Attains at least 9 cm TL.



*Channomuraena bauchotae*, 9 cm TL, holotype and lateral view of head with posterior nostril detail (Réunion). Source: Saldanha & Quéro 1994

**DISTRIBUTION** Described from one specimen collected at Réunion.

**REMARKS** Taken at ~55 m. *Cirrimaxilla formosa* Chen & Shao 1995 from Taiwan and New Caledonia may be a synonym. The preanal length of 91% TL given in the description might have been measured to the anal-fin origin and not the anus, thus giving an unnaturally high value.

## *Channomuraena vittata* (Richardson 1845)

Broadbanded snake moray

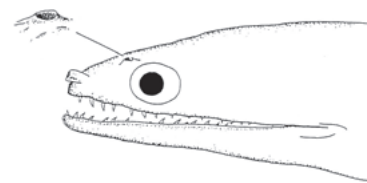
*Ichthyophis vittatus* Richardson 1845: 114, Pl. 53, Figs. 7–9 [locality uncertain: 'brought from China'].

*Gymnomuraena bennettii* Günther 1870: 135 (Mauritius, Mascarenes).

*Channomuraena vittata*: Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 1.4–1.6, HL 6.7–8.3, and BD/GO 10–16. In HL: upper jaw 2–3, snout length 8.3–14, and eye diameter 13–23. Teeth small and numerous; intermaxillary teeth in triangular patch continuous with vomerine teeth; maxillary and dentary teeth multiserial; 2 branchial pores. Vertebrae: predorsal 120–126, preanal 118–127, total 145–157; MVF 122/123/150.

Body pale to medium dark, with 13–16 broad dark bars encircling body and head behind eyes. Attains 150 cm TL (commonly 80 cm TL).



*Channomuraena vittata*. Source: Saldanha & Quéro 1994

**DISTRIBUTION** Western and eastern Atlantic and Indo-Pacific. WIO: Réunion and Mauritius.



GENUS *Scuticaria* Jordan & Snyder 1901

Body elongate and nearly cylindrical; dorsal fin and anal fin rudimentary, restricted to near tail tip; preanal length  $>\frac{2}{3}$  TL; tail length  $\sim\frac{1}{2}$  preanal length. Teeth small and sharp, biserial on jaws. Anterior nostrils short tubes at front of snout; posterior nostrils above front of eyes; 1 branchial pore. Two species, both in WIO.

KEY TO SPECIES

- 1a Body uniformly yellowish to dark brown ..... *S. okinawae*
- 1b Body pale brown or yellow, with large irregular dark spots ..... *S. tigrina*

*Scuticaria okinawae* (Jordan & Snyder 1901)

Shorttailed snake moray

PLATE 6

*Uropterygius okinawae* Jordan & Snyder 1901: 886, Fig. 22 (Okinawa, Ryukyu Is., Japan).

*Gymnomuraena brevicauda* Regan 1903: 414, Pl. 13, Fig. 1 (Mauritius, Mascarenes).

*Scuticaria unicolor* Seale 1917: 94 (Society Is.).

*Uropterygius sealei* Whitley 1932: 330 (Society Is.).

*Scuticaria okinawae*: Böhlke & Smith 2002; Smith 2012.

In TL: preanal length  $\sim 1.5$ , HL 13–14, BD/GO 24–32, and BD/A 32–29. In HL: snout length 5.5–6.8, upper jaw 2.7–3, and eye diameter 14–19. Teeth numerous; intermaxillary with 5 rows, 2–4 teeth in median row; teeth on jaws biserial, inner teeth long and slender, and outer teeth short, close-set; vomerine teeth few and widely spaced. Vertebrae: predorsal 167–169, preanal 168–171, total 169–177; MVF 168/170/174.

Body uniformly yellowish to dark brown. Attains 90 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Mauritius; elsewhere to southern Japan, Society Is. and Hawaii.

*Scuticaria tigrina* (Lesson 1828)

Leopard reef-eel

PLATES 6 & 11

*Ichthyophis tigrinus* Lesson 1828: 399 (Bora Bora, Society Is.).

*Gymnomuraena breviceps* Schmeltz 1879: 38 (Savai'i I., Samoa)

[unnecessary replacement name for *Ichthyophis tigrinus* Lesson].

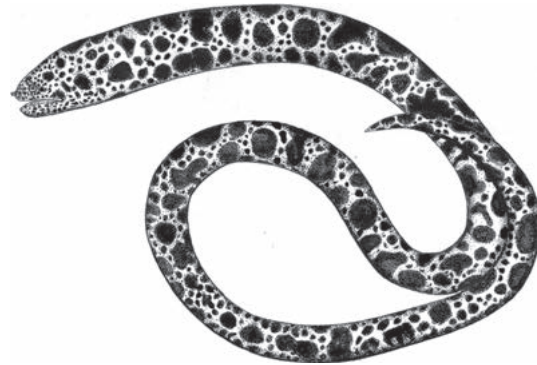
*Uropterygius tigrinus*: SSF No. 41.32\*.

*Scuticaria tigrina*: Randall 1995\*; Winterbottom & Anderson 1997; Böhlke & Smith 2002; Fricke *et al.* 2009; Smith 2012.

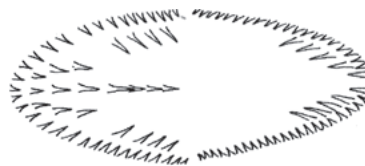
Anus far behind midlength. In TL: preanal length 1.4–1.6, HL 11–14, BD/GO 24–34, and BD/A 26–36. In HL: snout

length 5.3–7.2, upper jaw 2.8–3.4, and eye diameter 12–16. Teeth numerous; intermaxillary teeth in 5 rows, with 3 median teeth; teeth on jaws biserial, inner teeth tall and slender, and outer teeth short and close-set; vomerine teeth few, uniserial. One branchial pore. Vertebrae: predorsal 152–166, preanal 156–167, total 161–174; MVF 163/165/170.

Body pale yellowish brown with large irregular black spots, and snout and jaw with small black spots. Attains  $\sim 140$  cm TL.



*Scuticaria tigrina*, 109 cm TL (Zanzibar). Source: Smith 1962



*Scuticaria tigrina*, 71 cm TL, dentition.

Source: Böhlke & Randall 2000, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, Gulf of Oman, Kenya to South Africa (Aliwal Shoal), Seychelles, Mauritius, Réunion and Chagos; elsewhere to Taiwan, Kerama Is. (Japan), Hawaii, New Caledonia, Mexico, Panama and Galápagos Is.

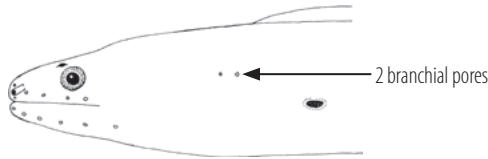
**REMARKS** Superficially resembles *Uropterygius polypilus*, which has anus near midlength. Uncommon and rarely seen; found on coral reefs, to  $\sim 18$  m deep. Recently recorded from the Red Sea.

GENUS *Uropterygius* Rüppell 1838

Small- to large-sized with nearly cylindrical body, sometimes laterally compressed; dorsal fin and anal fin restricted to rear of body and confluent with tail tip; anus before or near midlength. Teeth long and sharp, uniserial to multiserial, inner teeth longer. Branchial pores 1 or 2; no pore adjacent to posterior nostrils. Colouration uniform to highly spotted or patterned. Twenty-one species, 14 in WIO.

## KEY TO SPECIES

1a Two branchial pores ..... 2



1b One or no branchial pore ..... 4

2a Irregular white marks along chin, throat, snout and nape, and prominent white mark between eyes ..... *U. kamar*

2b Head dark, with small white spots or blotches but no bands ..... 3

3a Body usually dark brown with small white spots; vertebrae 129–139 ..... *U. alboguttatus*

3b Body dark brown, usually with irregular pale blotches; vertebrae 118–126 ..... *U. xanthopterus*

4a Maxillary teeth uniserial; body uniformly coloured ..... 5

4b Maxillary teeth in 2 or more rows; body colour uniform or patterned ..... 6

5a No vomerine teeth ..... *U. inornatus*

5b Vomerine teeth present ..... *U. golanii*

6a Body uniformly pale brown ..... 7

6b Body with spots, bars, reticulations or other markings ..... 8

7a Maxillary teeth biserial; gill opening at midside ..... *U. concolor*

7b Maxillary teeth multiserial; gill opening above midside ..... *U. genie*

8a Maxillary teeth biserial; gill opening at or below midside ..... 9

8b Maxillary teeth in >2 rows; gill opening at or above midside ..... 11

9a Body with large, discrete, round or oval dark spots; gill opening at midside ..... *U. polyspilus*

9b Body with reticulations or irregular markings; gill opening below midside ..... 10

10a Posterior nostril over middle of eye; body dark, with large irregular pale blotches ..... *U. macrocephalus*

10b Posterior nostril over front part of eye; body pale brown or grey, with fine dark reticulations ..... *U. micropterus*

11a Colour with numerous round, close-set, dark spots, giving gravel-like appearance ..... *U. marmoratus*

11b Colour not as above ..... 12

12a Head and front of body plain brown, rear part of body with small darker brown spots ..... *U. fuscoguttatus*

12b Colour not as above ..... 13

13a Head and body brown, with small darker spots, tending to form irregular bars posteriorly; 1 branchial pore always present ..... *U. supraforatus*

13b Body dark brown to black, with pale reticulations or irregular bars; usually no branchial pore ..... *U. nagoensis*

## *Uropterygius alboguttatus* Smith 1962

White-spotted reef-eel

PLATE 6

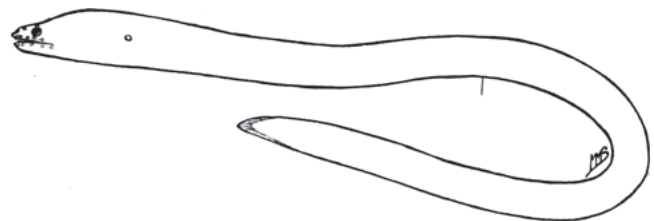
*Uropterygius alboguttatus* Smith 1962: 427, Pl. 60, Fig. E (Assumption I., Seychelles); Böhlke & Smith 2002; Smith 2012.

*Uropterygius xanthopterus* (non Bleeker 1859): SSF No. 41.33\*.

In TL: preanal length ~2.5, HL 9–10, BD/GO 21–29, and BD/A 23–42. In HL: snout length 5.7–6.9, upper jaw 2.3–3, and eye diameter 12–18. Gill opening at midside; 2 branchial pores. Teeth on jaws biserial; outer teeth small, recurved, somewhat compressed, and inner teeth long, conical, depressible; 5 or 6 large, depressible, median intermaxillary teeth; 6 or 7 small

vomerine teeth. Vertebrae: predorsal 116–124, preanal 119–127, total 129–139; MVF 120/124/134.

Body dark brown or mottled, with white dots on head and body, and sometimes with larger irregular blotches; dorsal-fin rudiment and tail yellow. Attains 35 cm TL.



*Uropterygius alboguttatus*, 35 cm TL, type (Seychelles). Source: Smith 1962



*Uropterygius alboguttatus*, 32 cm TL (Seychelles).

© JE Randall, Bishop Museum

**DISTRIBUTION** Indo-central Pacific, but apparently absent from Philippine-Indonesian area. WIO: Mozambique to South Africa (Sodwana Bay), Seychelles and Mascarenes.

**REMARKS** Resembles *Uropterygius xanthopterus*, with which it has been synonymised in the past; however, the two species are completely separated by vertebral counts and usually can be distinguished by colour pattern: *U. alboguttatus* with small white spots, and *U. xanthopterus* with larger, irregular, pale blotches (nevertheless, some specimens are ambiguous). Found on coral reefs, to ~25 m deep.

### *Uropterygius concolor* Rüppell 1838

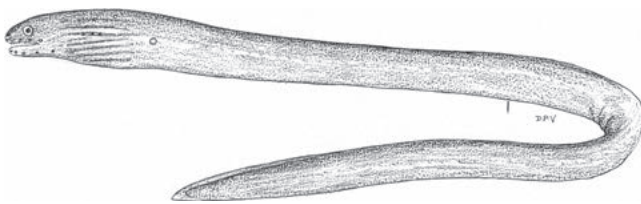
Unicolor snake moray

PLATE 7

*Uropterygius concolor* Rüppell 1838: 83, Pl. 20, Fig. 4 (Massawa, Eritrea, Red Sea); SSF No. 41.29\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Böhlke & Smith 2002; Letourneur *et al.* 2004; Smith 2012.  
? *Anarchias vermiformis* Smith 1962: 429, Pl. 53h, Fig. 6 (Zanzibar, Tanzania).

In TL: preanal length 2.3–2.4, HL ~9, BD/GO 21–27, and BD/A 23–34. In HL: snout length 5.9–7.2, upper jaw 2.4–3.2, and eye diameter 10–13. Gill opening at midside; 1 branchial pore. Teeth on jaws biserial; outer teeth small, recurved, somewhat compressed, and inner teeth long, conical, depressible; a few depressible median fangs on intermaxillary; 1 row of vomerine teeth. Vertebrae: predorsal 107–115, preanal 111–118, total 117–124; MVF 110/114/120.

Body uniformly brown or with irregular indistinct pale markings, and tail tip paler. Attains 32 cm TL.



*Uropterygius concolor*, 22 cm TL (Kenya). Source: SSF

**DISTRIBUTION** Known with certainty only from the Red Sea, although widely reported elsewhere in Indo-Pacific.

**REMARKS** Found on coral reefs, to ~25 m deep. The precise definition and distribution of this species is uncertain. Small brown specimens of *Uropterygius* from the Indo-Pacific are routinely identified as *U. concolor*, but they may not all be the same species. Further study is needed.

### *Uropterygius fuscoguttatus* Schultz 1953

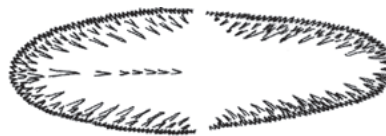
Brown-spotted reef-eel

PLATE 7

*Uropterygius fuscoguttatus* Schultz in Schultz *et al.* 1953: 156, Fig. 33 (lagoon off Amen I., Bikini Atoll, Marshall Is.); Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.2, HL 7.4–9.6, BD/GO 17–24, and BD/A 17–26. In HL: snout length 5.3–6.2, upper jaw 2.1–2.5, and eye diameter 7.3–10. Eyes closer to snout tip than to rictus. Gill opening above midside; 1 branchial pore. Teeth numerous; intermaxillary teeth in patch, 7–9 rows across; maxillary and dentary teeth in 3 or 4 irregular rows; vomerine teeth few, set on ridge. Vertebrae: predorsal 93–105, preanal 98–110, total 113–124; MVF 99/104/119.

Body pale reddish brown; head and front of body dusky, and small dark spots posteriorly on body and tail; adults also with reticulum on head, and spots or reticulum behind, but juveniles with spots only near tail tip; jaw pores pale. Attains 30 cm TL.



*Uropterygius fuscoguttatus*, 16 cm TL, dentition.

Source: Böhlke & Randall 2000, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Sodwana Bay), Comoros, Chagos and Maldives; elsewhere to Marshall Is., Australia, Loyalty Is., Pitcairn Is. and Hawaii.

**REMARKS** Found on coral reefs, at 3–25 m.

### *Uropterygius genie* Randall & Golani 1995

Toothy snake moray

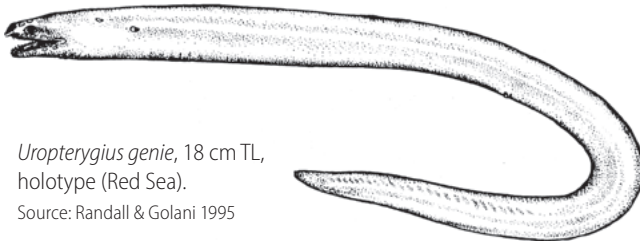
PLATE 7

*Uropterygius genie* Randall & Golani 1995: 872, Figs. 7–9 (Sinai Peninsula, Egypt, Red Sea); Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.1–2.2, HL 9.4–9.6, BD/GO ~23, and BD/A ~23. In HL: snout length ~8.6, upper jaw ~2.7,

and eye diameter ~13. Eyes over anterior third of gape. Gill openings high, above midsides; 1 branchial pore. Teeth in jaws multiserial (~5 rows), those in outer row smallest, progressively longer in inner rows; ~6 vomerine teeth, as long as longest maxillary teeth. Vertebrae: predorsal 102–105, preanal 111–114, total 121 or 122; MVF 104/113/122.

Body uniformly medium brown, fins yellowish brown; edge of eyes narrowly dusky; head pores and nostrils whitish. Attains 18 cm TL.



*Uropterygius genie*, 18 cm TL, holotype (Red Sea).  
Source: Randall & Golani 1995

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Similar small brown *Uropterygius* with multiple rows of sharp teeth have been found in scattered localities from the Indian Ocean to French Polynesia. Further study is needed to determine their relationships to *U. genie* and to each other.

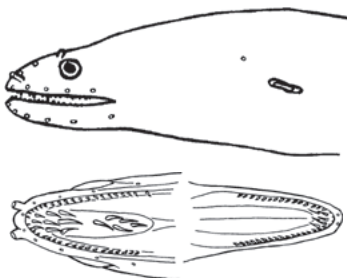
### *Uropterygius golanii* McCosker & Smith 1997

Viper reef-eel

*Uropterygius golanii* McCosker & Smith 1997: 1011, Fig. 3 (Strait of Jubal, Gulf of Suez, Red Sea); Böhlke & Smith 2002; Smith 2012.

In TL: preanal length ~2, HL 11.5–12.3, BD/GO 22–23, and BD/A 21–23. In HL: snout length 4.6–5.3, upper jaw 2.6–2.7, and eye diameter 12–13. Gill openings at midside; 1 branchial pore. Teeth few; maxillary teeth uniserial, small, compressed, recurved; intermaxillary with 3 rows of enlarged depressible fangs, and outer row of small teeth continuous with those of maxilla; vomerine teeth uniserial; lower jaw with outer series of small teeth, and 3–6 larger inner teeth at symphysis. Vertebrae: predorsal 134–138, preanal 136–141, total 145–148; MVF 136/139/147.

Body uniformly reddish brown. Attains 45 cm TL.



*Uropterygius golanii*, 40 cm TL, male holotype, head and dentition (Red Sea).  
Source: McCosker & Smith 1997

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Resembles *U. inornatus*, but grows larger and has teeth on vomer.

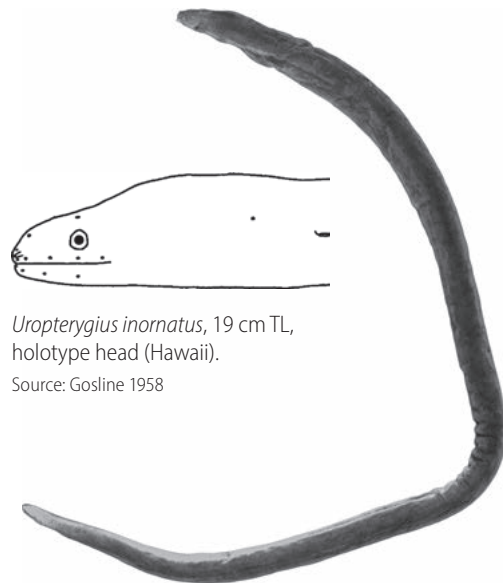
### *Uropterygius inornatus* Gosline 1958

Drab reef-eel

*Uropterygius inornatus* Gosline 1958: 225, Figs. 1e, 2a (Oahu I., Hawaii); Winterbottom *et al.* 1989\*; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.1–2.2, HL 10–13, BD/GO 21–26, and BD/A 25–35. In HL: snout length 4.2–5.4, upper jaw 2.4–3.1, and eye diameter 10–13. Gill opening at midside; 1 branchial pore. Teeth few; maxillary teeth uniserial, small, compressed, recurved; intermaxillary with 3 rows of enlarged depressible fangs, and outer row of small teeth continuous with those of maxilla; no teeth on vomer; lower jaw with outer series of small teeth, and 3–6 larger inner teeth at symphysis. Vertebrae: predorsal 109–124, preanal 111–126, total 116–133; MVF 116/117/124.

Body uniformly buff, but underside of head and tail tip paler. Attains 19 cm TL.



*Uropterygius inornatus*, 19 cm TL, holotype head (Hawaii).  
Source: Gosline 1958

*Uropterygius inornatus*, 11 cm SL (Chagos). © R Winterbottom, ROM

**DISTRIBUTION** Indo-Pacific. WIO: Chagos; elsewhere to Tonga, Pitcairn Is. and Hawaii.

**REMARKS** Resembles *U. golanii*, but smaller and lacks teeth on vomer. Found on coral reefs, at 8–18 m.



## *Uropterygius kamar* McCosker & Randall 1977

Bar-lip reef-eel

PLATE 7

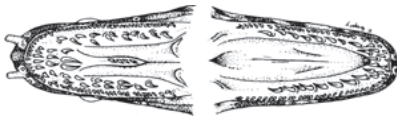
*Uropterygius kamar* McCosker & Randall 1977: 164, Figs. 3b, 4 (Grande Comore, Comoros); SSF No. 41.30\*; Winterbottom *et al.* 1989\*; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length ~2.4, HL ~10, BD/GO 20–27, and BD/A 26–33. In HL: snout length 5.7–6.6, upper jaw 2.5–3, and eye diameter 12–14. Gill opening at midside; 2 branchial pores. Upper jaw with outer row of small, compressed, closely spaced, recurved teeth, and 3 irregular rows of larger depressible inner teeth, innermost teeth largest; 2 or 3 depressible median fangs on intermaxillary; vomerine teeth uniserial; dentary teeth irregularly triserial, inner anterior teeth largest. Vertebrae: predorsal 109–118, preanal 120–125, total 134–140; MVF 115/124/138.

Body dark brown or mottled; head with irregular white bars and patches, including prominent band across top of head in front of eyes and covering posterior nostrils; anterior nostrils white. Attains 41 cm TL.



*Uropterygius kamar*, 41 cm TL (South Africa). Source: SSF



*Uropterygius kamar*, holotype dentition (Comoros). Source: McCosker & Randall 1977 (by VM Gregory); courtesy of CAS

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Sodwana Bay), Comoros, Seychelles (Amirante Is.), Mauritius (Agaléga Is.) and Chagos; elsewhere to Marshall Is. and Pitcairn Is.

**REMARKS** Found on coral reefs, to ~25 m deep.

## *Uropterygius macrocephalus* (Bleeker 1864)

Longhead reef-eel

PLATE 7

*Gymnomuraena macrocephalus* Bleeker 1864: 54 (Ambon I., Moluccas, Indonesia).

*Anarchias knighti* Jordan & Starks in Jordan & Seale 1906: 205, Fig. 10 (Apia, Upolu I., Samoa).

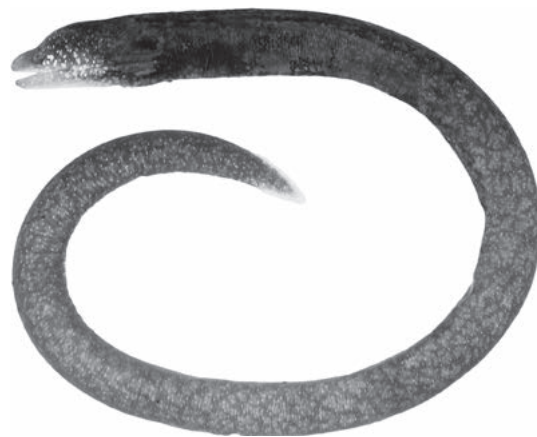
*Uropterygius macrocephalus*: Randall & Van Egmond 1994\*; Böhlke & Smith 2002; Letourneur *et al.* 2004; Smith 2012.

*Uropterygius makatei*: Randall & Golani 1995.

In TL: preanal length 2.1–2.2, HL 6.7–7.7, BD/GO 14–23, and BD/A 16–25. In HL: snout length 5.4–8.7, upper jaw

2.8–3.8, and eye diameter 14–19. Gill opening below midside; 1 branchial pore. Eyes relatively small. Maxillary teeth biserial, outer teeth small, compressed, recurved, and inner teeth larger, conical, depressible; 1 or 2 large depressible median fangs on intermaxillary; vomerine teeth uniserial, set on ridge; dentary teeth biserial, outer teeth small and recurved, and inner teeth large and depressible. Vertebrae: predorsal 84–99, preanal 86–100, total 102–119; MVF 92/94/110.

Colour variable, but body usually dark brown or black, with irregular pale blotches or sometimes darker reticulations. Attains 40 cm TL.



*Uropterygius macrocephalus*, 32 cm TL (Seychelles).

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**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, Seychelles and Mascarenes; elsewhere to Christmas I., Indonesia, southern Japan, Hawaii, Loyalty Is., Mexico and Peru.

## *Uropterygius marmoratus* (Lacepède 1803)

Marbled reef-eel

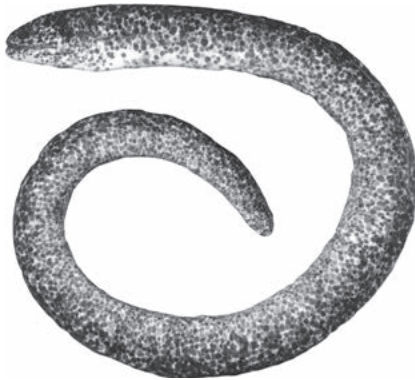
PLATE 7

*Gymnomuraena marmorata* Lacepède (ex Commerson) 1803: 648, 649 (New Britain, Bismarck Archipelago).

*Uropterygius marmoratus*: Anderson *et al.* 1998\*; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2.3–2.4, HL 9.9–13, BD/GO 19–24, and BD/A 20–25. In HL: snout length 6–8, upper jaw 2.5–3, and eye diameter 11–18. Gill opening near midside; 1 branchial pore. Teeth numerous; intermaxillary teeth in 7–9 rows; teeth on jaws irregularly triserial; vomerine teeth set on ridge, staggered or weakly biserial anteriorly, uniserial posteriorly. Vertebrae: predorsal 120–127, preanal 123–127, total 131–139; MVF 124/126/135.

Body and fins with overlapping small brown spots on pale background, giving marbled appearance; lower jaw and front of abdomen noticeably paler and with few or no spots. Attains 70 cm TL.



*Uropterygius marmoratus*, 70 cm TL (Marquesas Is.).

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*Uropterygius marmoratus*.

Source: Weber & De Beaufort 1916

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania, Mozambique and Maldives; elsewhere to Christmas I., southern Japan, Hawaii, Marquesas Is., New Guinea and New Caledonia.

**REMARKS** Found on coral reefs and sandy bottoms, at 1–20 m.

### *Uropterygius micropterus* (Bleeker 1852)

Short-finned reef-eel

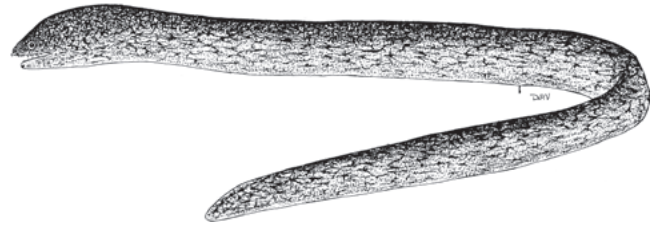
PLATE 7

*Muraena micropterus* Bleeker 1852: 298 (Wahai, Seram I., Moluccas, Indonesia).

*Uropterygius micropterus*: SSF No. 41.31\*; Randall & Golani 1995; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.2, HL 8.5–10, BD/GO 17–25, and BD/A 18–27. In HL: snout length 6.4–8.6, upper jaw 2.7–3.6, and eye diameter 12–18. Gill opening below midside; 1 branchial pore. Teeth on jaws biserial, outer teeth small and recurved, and inner teeth large, straight, depressible; 2 or 3 median intermaxillary teeth; vomerine teeth uniserial. Vertebrae: predorsal 102–109, preanal 104–110, total 113–119; MVF 106/108/117.

Body grey or pale brown, covered with reticulum of thin dark lines. Attains 28 cm TL.



*Uropterygius micropterus*, 24 cm TL (N Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to South Africa (Sodwana Bay), Comoros and Aldabra; elsewhere to Indonesia, Ryukyu Is. and Phoenix Is.

**REMARKS** Found on coral reefs, to ~25 m deep.

### *Uropterygius nagoensis* Hatooka 1984

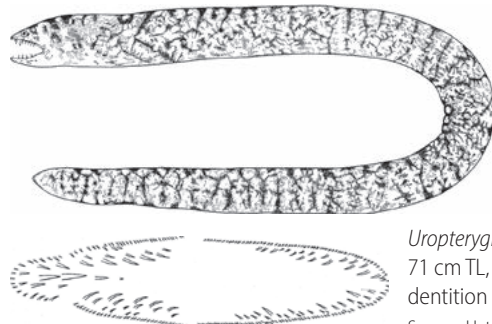
Blotchy reef-eel

PLATE 7

*Uropterygius nagoensis* Hatooka 1984: 20, Figs. 1–4 (Nago fish market, Okinawa, Japan); Randall & Golani 1995; Böhlke & Smith 2002; Smith 2012.

In TL: preanal length 2–2.2, HL 9.1–10.7, BD/GO 17–23, and BD/A 19–23. In HL: snout length 5.2–7.1, upper jaw 2–2.7, and eye diameter 10–12. Gill opening above midside; at most 1 branchial pore. Lower jaw projecting slightly beyond upper jaw. Maxillary teeth in 4 rows, teeth in outermost row very small and recurved, those of inner rows progressively larger, conical, depressible; intermaxillary teeth in 5 rows, outer teeth smallest, those in median row largest; vomerine teeth few, small, uniserial; dentary teeth triserial, outer teeth smallest. Vertebrae: predorsal 118, preanal 124 or 125, total 139 or 140; MVF 118/124/140.

Body brown, with large, irregular, interconnected dark blotches; pale interspaces becoming nearly white on head; conspicuous pale band across head behind eyes. Attains 71 cm TL.



*Uropterygius nagoensis*, 71 cm TL, holotype and dentition (Japan).

Source: Hatooka 1984

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea; elsewhere, southern Japan, Australia, Fiji, Tonga and Society Is.

**REMARKS** Found on coral reefs.

### *Uropterygius polyspilus* (Regan 1909)

Large-spotted reef-eel

PLATE 7

*Gymnomuraena polyspila* Regan 1909: 438 (Tahiti, Society Is.).

*Uropterygius polyspilus*: Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall & Golani 1995; Böhlke & Smith 2002.

Anus near midlength. In TL: preanal length 1.9–2, HL 10–12, BD/GO 20–24, and BD/A 23–30. In HL: snout length 6–8.1, upper jaw 3.1–4.2, and eye diameter 9.4–15. Gill opening at midside; 1 branchial pore. Maxillary teeth biserial, outer teeth small, recurved, and inner teeth longer, conical, depressible; intermaxillary teeth in 5 rows across; vomerine teeth uniserial, few; dentary teeth biserial, inner teeth larger. Vertebrae: predorsal 124–127, preanal 124–128, total 130–136; MVF 125/126/132.

Body medium brown, with large irregular dark brown spots in ~3 rows, and additional small spots in large individuals; snout and lower jaw either pale or with small spots; nostrils pale. Attains 78 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Tanzania, Comoros, Seychelles and Chagos; elsewhere to Philippines, Tahiti, Hawaii, Vanuatu, Line Is. and Society Is.

**REMARKS** Resembles *Scuticaria tigrina*, which has anus far behind midlength. Uncommon; found on coral reefs, at 1–20 m.

### *Uropterygius supraforatus* (Regan 1909)

Many-toothed reef-eel

PLATE 7

*Gymnomuraena supraforata* Regan 1909: 439 (Savai'i I., Samoa).

*Uropterygius supraforatus*: Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Böhlke & Smith 2002.

In TL: preanal length 2–2.3, HL 9.2–11, BD/GO 16–19, and BD/A 16–21. In HL: snout length 5.1–7.8, upper jaw 1.7–2, and eye diameter 7.4–10. Gill opening above midside; 1 branchial pore. Teeth numerous, filling mouth; intermaxillary teeth in 7–9 rows across; teeth on both jaws multiserial;

vomerine teeth few and uniserial. Vertebrae: predorsal 100–116, preanal 104–122, total 117–136; MVF 105/109?/125.

Body cream to reddish brown, with small dark brown spots on head, body and fins (spots discrete in juveniles, forming irregular vertical bars in adults); nostrils pale, and head pores with pale rims. Attains 40 cm TL.



*Uropterygius supraforatus*, dentition

Source: Gosline 1958

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Comoros, Chagos and Maldives; elsewhere to Philippines, Hawaii, Midway I., Samoa and Clipperton I.

**REMARKS** Found on coral reefs, to ~15 m deep.

### *Uropterygius xanthopterus* Bleeker 1859

Yellowtail snake moray

PLATE 7

*Uropterygius xanthopterus* Bleeker 1859: 350 (Patjitan, Java, Indonesia);

Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Böhlke & Smith 2002; Letourneur *et al.* 2004.

In TL: preanal length ~2.3, HL 8.2–10.6, BD/GO 16–27, and BD/A 19–30. In HL: snout length 5.5–6.2, upper jaw 2.2–2.8, and eye diameter 11–14. Gill openings at midside; 2 branchial pores. Maxillary teeth biserial, outer teeth small and recurved, and inner teeth larger, straight, depressible; intermaxillary teeth in 5 rows; vomerine teeth uniserial, set on ridge; dentary teeth biserial, outer teeth small and recurved, and inner larger, depressible. Vertebrae: predorsal 104–112, preanal 108–117, total 118–126; MVF 106/111/121.

Body brown, with irregular pale blotches, and tip of tail yellowish. Attains 30 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Mascarenes, Chagos and Maldives; elsewhere, mainly Indonesia and Philippines, less common at other West Pacific islands (where it is largely replaced by *U. alboguttatus*).

**REMARKS** Similar to *U. alboguttatus*, which has small white spots not larger pale blotches, but some specimens may be ambiguous.

## GLOSSARY

- antitropical** – the distribution pattern where a group is found north and south of, but not in, the tropics (also anti-equatorial).
- artisanal fisheries** – traditional fisheries involving skilled but non-industrialised fishers; typically a small-scale decentralised operation.
- biserial** – arranged in two rows or series.
- caniniform** – having the shape of a canine tooth.
- ciguatera poisoning (ciguatoxic)** – a type of food poisoning affecting the nervous system in humans caused by eating certain large reef fishes contaminated with ciguatoxin, a toxin produced by the dinoflagellate *Gambierdiscus toxicus*.
- multiserial** – arranged in several rows or series.
- protandrous hermaphrodite** – hermaphroditism that functions first as a male and then changes into a female.
- reticulum** – a network of intercellular fibres in certain tissues, with a fine, net-like appearance.
- rictus** – the corner or gape of the mouth.
- supratemporal commissure** – the lateral-line canal that crosses the back of the cranium.
- synchronous hermaphrodite** – a hermaphrodite with both ovaries and testes that function at the same time.
- uniserial** – arranged in a single row.

## FAMILY CHLOPSIDAE

## False morays

Kenneth A Tighe

Eels with moderately elongate, compressed body, with anus before midbody; dorsal fin and anal fin well-developed, confluent with caudal fin. Dorsal-fin origin over, slightly in front of, or approximately 1 or 2 snout lengths behind gill opening; anal-fin origin just behind anus; pectoral fins present or absent. Head length moderate (5–10 in TL); snout short to moderate, extending slightly beyond lower jaw. Eyes moderately to slightly reduced. No scales. Lateral line reduced to 1–3 pores in branchial region; head covered with small sensory papillae.

Small moray-like eels found on coral reefs (2 genera), in seagrass beds (1 genus), in anchialine habitats (1 genus), or in cryptic deepwater habitats of tropical seas. Eight nominal genera; 6 genera and 9 species in WIO.

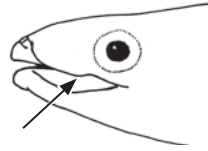
## KEY TO GENERA

- 1a Pectoral fins present ..... 2
- 1b No pectoral fins ..... 3
- 2a Teeth on vomer in single, irregular, median series ..... *Boehlkenchelys*
- 2b Teeth on vomer in 2 longitudinal series ..... *Kaupichthys*

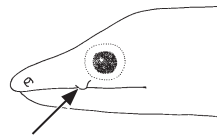
Continued ...

## KEY TO GENERA

- 3a Teeth on vomer in single, irregular, median series ..... *Robinsia*
- 3b Teeth on vomer in 2 longitudinal series ..... 4
- 4a Lower lip with well-developed downward-directed flap; posterior nostrils in mouth ..... *Chlorhinus*



- 4b Lower lip without flap; posterior nostrils not in mouth ..... 5
- 5a Posterior nostril on lip, covered with flap ..... *Chlopsis*



- 5b Posterior nostril a simple oval opening in front of eye ..... *Xenoconger*

GENUS *Boehlkenchelys* Tighe 1992

Body moderately elongate, slightly compressed; dorsal-fin origin above or slightly in front of gill opening; pectoral fins well-developed. Gape moderate, rictus behind rear margin of eye. Teeth long, slender, needle-like and depressible. Maxillary teeth in 6 or 7 irregular rows, teeth increasing in size from outer to inner; mandibular teeth similar, but in 5 or 6 irregular rows; teeth on vomer in single, sometimes irregular row. Anterior nostril tubular; posterior nostril a simple oval opening in front of middle of eye. Lateral line obsolete except for 2 or 3 pores in branchial region. Supraorbital pores 3; infraorbital pores 4; preoperculo-mandibular pores 8 (7 before rictus and 1 behind). One species.

*Boehlkenchelys longidentata* Tighe 1992

Longtoothed false moray

PLATE 12

*Boehlkenchelys longidentata* Tighe 1992: 20, Figs. 1–3 (northern Astrolabe Reef, Fiji).

*Kaupichthys nuchalis* (non Böhlke 1967): Winterbottom *et al.* 1989\*.



In TL: predorsal length 6.9–8.7, preanal length 2.6–3, HL 6.7–7.9, and body depth at anus 13–22. Total vertebrae 121–128; predorsal vertebrae 6–8; preanal vertebrae 34–37; precaudal vertebrae 88–95.

Body uniformly pale olive-brown to brown; bases of dorsal fin and caudal fin and rear part of anal fin darker. Attains ~20 cm TL.



*Boehlkenchelys longidentata*, 6 cm SL (Chagos).  
Source: Winterbottom et al. 1989

**DISTRIBUTION** Indo-Pacific. WIO: Chagos; elsewhere, Indonesia (Moluccas), Palau, Solomon Is. and Fiji.

**REMARKS** Found on coral reefs, at 12–65 m.

## GENUS *Chlorhinus* Lütken 1852

Body relatively short and stout, compressed posteriorly; dorsal-fin origin distinctly behind gill opening; anal-fin origin slightly before midbody; no pectoral fins. Posterior nostril within confines of mouth. Lower lip with well-developed downward-directed flap. At least 3 species, 1 in WIO.

### *Chlorhinus platyrhynchus* (Norman 1922)

Flatnose eel

*Brachyconger platyrhynchus* Norman 1922: 218, Fig. (New Britain I., Bismarck Archipelago).

*Chlorhinus platyrhynchus*: Böhlke & Smith 1968; Smith 1989.

In TL: predorsal length 3.6–4.2, preanal length 2–2.2, HL 4.5–5.5, and body depth at anus 15–19. Total vertebrae 106–113; predorsal vertebrae 18 or 19; preanal vertebrae 41–43; precaudal vertebrae 48–51.

Body uniformly pale brown to dark brown; median fins darker, especially posteriorly. Attains ~28 cm TL.



*Chlorhinus platyrhynchus*, 9 cm TL (N Mozambique).

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, Madagascar, Aldabra and Seychelles; elsewhere, Taiwan, New Guinea, Australia, French Polynesia and Hawaii.

**REMARKS** Found in seagrass beds, to ~8 m deep.

## GENUS *Chlopsis* Rafinesque 1810

Body relatively elongate; dorsal-fin origin distinctly behind gill opening; anal-fin origin slightly before midbody; no pectoral fins. Posterior nostril on lip, covered with flap. Four species, 1 in WIO.

### *Chlopsis dentatus* (Seale 1917)

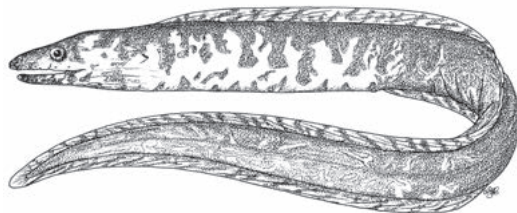
Mottled false moray

*Garmanichthys dentatus* Seale 1917: 80 (Barbados, West Indies).

*Chlopsis dentatus*: Böhlke 1956; Böhlke & Smith 1968; SSF No. 43.1\*.

In TL: predorsal length 6.6–7.7, preanal length 2.9–3.1, HL 7.1–8.6, and body depth at anus 15–25. Total vertebrae 121–126; predorsal vertebrae 7–9; preanal vertebrae 31–34.

Body of adults tan to yellow, thickly blotched or mottled with brown over body and fins. Attains ~20 cm TL.



*Chlopsis dentatus*, 20 cm TL (Indian Ocean). Source: SSF

**DISTRIBUTION** Kenya and Mozambique in WIO, and western North Atlantic (Barbados, Bermuda, Cuba, Mexico and Colombia).

**REMARKS** Taken in trawls; found at 64–355 m.

## GENUS *Kaupichthys* Schultz 1943

Body moderately elongate; dorsal-fin origin above or slightly behind gill opening; pectoral fins present. Head and snout moderate; rictus of jaw near rear margin of eye; lips without flange. Anterior nostril tubular, near tip of snout; posterior nostril either a slit opening on edge of lip and covered with a flap dorsally, or an oval opening on snout in front of eye. Worldwide in tropical to subtropical waters; 11 species, 4 in WIO (1 of these undescribed).

### KEY TO SPECIES

- |    |   |                         |
|----|---|-------------------------|
| 1a | Body pale with dark brown mottling; area around anterior nostrils and base of anterior nostrils dark brown to black ..... | <i>K. atronasus</i>     |
| 1b | Body tan to pale brown; anterior nostrils and base of anterior nostrils not dark .....                                    | 2                       |
| 2a | Pectoral fins shorter than eye diameter .....   | <i>K. brachyichirus</i> |
| 2b | Pectoral fins longer than eye diameter .....  | 3                       |
| 3a | Posterior nostrils a slit, opening on edge of lip, covered with a flap .....  | <i>K. hyoprорoides</i>  |
| 3b | Posterior nostrils oval, opening on snout in front of eyes .....  | <i>Kaupichthys</i> sp.  |

## *Kaupichthys atronasus* Schultz 1953

Black-nostril false moray

PLATE 12

*Kaupichthys atronasus* Schultz in Schultz *et al.* 1953: 65, Fig. 14 (lagoon coral head, Rongelap Atoll, Marshall Is.); Winterbottom *et al.* 1989\*.

In TL: predorsal length 6.4–6.9, preanal length 2.8–3.1, HL 7.1–7.7, and body depth at anus 19–24. Total vertebrae 110–115; predorsal vertebrae 9–11; preanal vertebrae 29–32; precaudal vertebrae 42–46.

Body buff to medium tan with dark reticulations; base of anterior nostril dark brown to black; area around eyes with dark pigment producing mask-like effect. Attains ~15 cm TL.



*Kaupichthys atronasus*,  
11 cm SL (Palau).  
© R Winterbottom, ROM

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aqaba, Red Sea, Gulf of Aden (Djibouti) and Chagos; elsewhere to Ryukyu Is., Micronesia, Marshall Is., southern Great Barrier Reef and Samoa.

**REMARKS** Found on coral reefs, at 1–35 m.

## *Kaupichthys brachyichirus* Schultz 1953

Shortfin false moray

*Kaupichthys brachyichirus* Schultz in Schultz *et al.* 1953: 67, Fig. 15 (lagoon off Amen I., Bikini Atoll, Marshall Is.); Böhlke & Smith 1967; Harmelin-Vivien 1976.

In TL: predorsal length 6.4–6.8, preanal length 3–3.2, HL 6.9–7.3, and body depth at anus 23–28. Total vertebrae 108–124; predorsal vertebrae 10 or 11; preanal vertebrae 29–33; precaudal vertebrae 45–49.

Body pale brown dorsally, paler ventrally; fins pale, except rear parts of dorsal fin and anal fin may be slightly darker. Attains ~16 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar and Mauritius; elsewhere to Ryukyu Is., Micronesia, southern Great Barrier Reef and French Polynesia.

## *Kaupichthys hyoprорoides* (Strömman 1896)

False moray

PLATE 12

*Leptocephalus hyoprорoides* Strömman 1896: 39, Pl. 4, Figs. 5–6 (central North Atlantic, north of Bahamas).

*Kaupichthys diodontus*: Smith 1965; Harmelin-Vivien 1976.

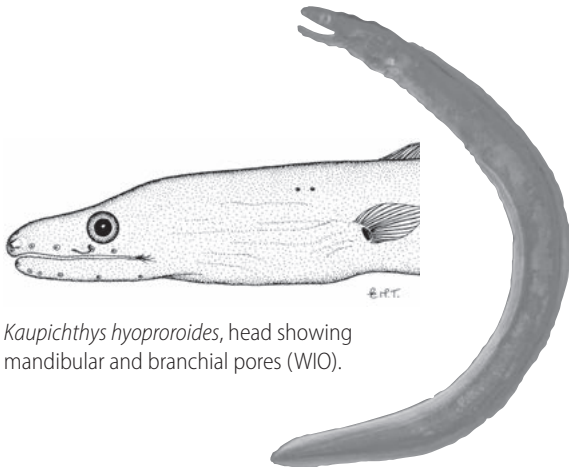
*Kaupichthys hyoprорoides*: Böhlke & Smith 1967; Winterbottom 1978; SSF No. 43.2\*; Winterbottom *et al.* 1989\*; Quéro & Saldanha 1995; Fricke 1999; Letourneur *et al.* 2004.

In TL: predorsal length 6.3–7.2, preanal length 3–3.6, HL 6.7–7.8, and body depth at anus 19–32. Total vertebrae 110–125; predorsal vertebrae 9; preanal vertebrae 26–28; precaudal vertebrae 43–48.

Body uniformly pale olive-brown to brown; bases of dorsal fin and caudal fin and rear part of anal fin sometimes slightly darker. Attains ~24 cm TL.

**DISTRIBUTION** Tropical waters of western Atlantic, and in WIO: South Africa (KwaZulu-Natal), Comoros, Mascarenes, St Brandon Shoals and Chagos.

**REMARKS** Found on coral reefs and rocky shores, to ~95 m deep. Distribution in the Indo-Pacific has been confused with the valid species *K. diodontus* Schultz 1943 and *K. japonicus* Matsubara & Asano 1960.



*Kaupichthys hyoprорoides*, head showing mandibular and branchial pores (WIO).

*Kaupichthys hyoprорoides*, 18 cm SL (Chagos).  
Source: Winterbottom *et al.* 1989

### *Kaupichthys* sp.

*Powellichthys* sp. (non Smith 1966): Winterbottom *et al.* 1989\*.

In TL: predorsal length 7.6–7.9, preanal length 2.5–2.6, HL 7–7.1, and body depth at anus 18–20. Total vertebrae 117–120; predorsal vertebrae 6 or 7; preanal vertebrae 35–39; precaudal vertebrae 82–86.

Body uniformly pale olive-brown to brown; bases of dorsal fin and caudal fin and rear part of anal fin darker. Attains ~17 cm TL.



*Kaupichthys* sp., 16 cm SL (Chagos).  
Source: Winterbottom *et al.* 1989 (by A Strange)

**DISTRIBUTION** Indo-Pacific. WIO: Chagos; elsewhere, Sulawesi, Philippines, Caroline Is., Solomon Is. and French Polynesia.

**REMARKS** Found on coral reefs, at 7–56 m.

### GENUS *Robinsia* Böhlke & Smith 1967

Body relatively elongate; dorsal-fin origin above to shortly behind gill opening; no pectoral fins. Head and snout moderate; rictus of jaw near rear margin of eye; lips without flange. Anterior nostril tubular, near tip of snout; posterior nostril a slit opening on edge of lip. One species.

### *Robinsia catherinae* Böhlke & Smith 1967

Catherine's false moray

PLATE 12

*Robinsia catherinae* Böhlke & Smith 1967: 3, Fig. 1 (Kenya);  
Böhlke & Smith 1968; Smith 1989.

In TL: predorsal length 7.1–7.7, preanal length 2.9–3.1, HL 8.3–9.1, and body depth at anus 13–30. Total vertebrae 133–137; predorsal vertebrae 8 or 9; preanal vertebrae 36–38; precaudal vertebrae 62–66.

Body distinctly bicoloured: brown above and white below. Attains ~20 cm TL.

**DISTRIBUTION** Records only from off Kenya in WIO, and Caribbean Sea (coast of Panama) in western North Atlantic (1 specimen).

**REMARKS** Taken in trawls at 140–243 m.

GENUS *Xenocoonger* Regan 1912

Body relatively elongate; dorsal-fin origin distinctly behind gill opening; anal-fin origin about one-third along body; no pectoral fins. Posterior nostril a simple oval opening in front of middle of eye. Two species, 1 in WIO.

*Xenocoonger fryeri* Regan 1912

Fryer's false moray

PLATE 12

*Xenocoonger fryeri* Regan 1912: 301 (Assumption I., Seychelles); Böhlke 1956; Böhlke & Smith 1968.

In TL: predorsal length 5.9–6.3, preanal length 2.6–3, HL 10.1–10.5, and body depth at anus 30–37. Total vertebrae 154–160; predorsal vertebrae 19 or 20; preanal vertebrae 47 or 48; precaudal vertebrae 100–103.

Body pale brown to dark brown, either uniform in colour or sometimes with dark spots, blotches or mottling under base colour. Attains ~50 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Assumption I. and Aldabra; elsewhere, Palau, New Caledonia, Fiji and Hawaii.

**REMARKS** Found in anchialine caves and pools.

## GLOSSARY

**anchialine habitats** – flooded, inland marine caves with no direct connection to the sea.

**rictus** – the corner or gape of the mouth.

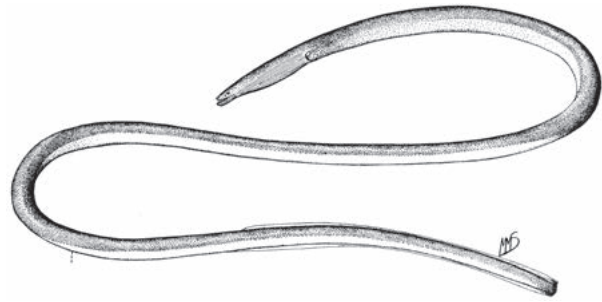
## FAMILY MORINGUIDAE

## Spaghetti eels

David G Smith

Body moderately to extremely elongate, cylindrical except near tip of tail; anus near or behind midlength; tip of tail soft and blunt. Dorsal fin, anal fin and/or pectoral fins present, but sometimes reduced; dorsal-fin origin far behind head. Eyes usually reduced in juveniles, and often in adults (not in mature *Moringua*). Mouth small to moderate, gape ending under or slightly behind eyes; lips without flange. Teeth conical, small to moderately enlarged, in 1 or 2 series on jaws and vomer; intermaxillary teeth largest, arranged in 2 longitudinal rows or a semicircle. Lateral line complete or present only in front of anus; head pores present only on lower jaw. No scales.

Two genera, one represented in WIO.



*Moringua* sp., 121 cm TL (S Mozambique). Source: SSF

GENUS *Moringua* Gray 1831

PLATE 12

Body extremely elongate (1 species to ~140 cm TL) and slender; anus far behind midlength; dorsal-fin origin about over anus; mouth small, lower jaw protrudes slightly beyond upper jaw. Appearance changes markedly with growth. Immature eels with eyes greatly reduced; pectoral fins rudimentary or absent; dorsal fin and anal fin low and inconspicuous, and caudal fin inconspicuous; body often pale yellow-orange, bluish below. Adults with large eyes; pectoral fins well-developed; dorsal fin and anal fin with raised lobes near end of tail and at a point anterior, giving an arrow-like appearance; body typically sharply bicoloured, dark above and pale below. Lateral line complete in all sizes. Males tend to be smaller than females and generally more exaggerated in their characters. Occur in shallow tropical waters worldwide, and are of no commercial importance; commonly found on sandy bottom around coral reefs, although seldom seen. Larvae are pelagic in the open ocean; immature eels tend to burrow in coral sand or shallow soft-bottom shores; and adults (particularly mature males) swim near the surface. In the WIO, species identifiable as *Moringua* are widely found wherever suitable habitat occurs, with the apparent exception of the Red Sea, where they have not been reported.

The species are morphologically very similar and difficult to identify as they have not yet been well characterised morphologically. A complicating factor is that the number of vertebrae, an important character in identifying eels, seems to differ between males and females in some species. Consequently, the species composition of *Moringua* is uncertain and much more work is needed to characterise them. *Smiths' Sea Fishes* listed 3 species: *Moringua ferruginea* Bliss 1883, *Moringua javanica* (Kaup 1856), and *Moringua microchir* Bleeker 1853. However, the true diversity is surely greater and the status of existing names is still uncertain. Recent work at Moorea, French Polynesia, including DNA analysis, indicates as many as 5 species may be present there, and it is unknown how these may relate to the species in the Indian Ocean since similar studies have not been done in this region.



## FAMILY ANGUILLIDAE

### Freshwater eels

David G Smith

Eels with robust body, compressed tail, and anus near midlength; dorsal fin and anal fin continuous around tail; dorsal-fin origin about midway between pectoral fins and anus, or about over anus; pectoral fins present. Head large and conical, dorsally flattened; mouth reaching to or below rear margin of eye; lower jaw protrudes beyond tip of snout; wide fleshy flange on upper and lower lips. Teeth granular, in patches on jaws and vomer. Lateral line complete, pores very small. Small embedded scales present, but not developed in juveniles. Colour typically olive, grey or green dorsally, sometimes mottled, and paler ventrally.

Catadromous fishes, breeding in the sea, with the leptocephalus larvae living only in the sea and then migrating to live in freshwater or estuaries as juveniles (glass eels and elvers) and adults. Females grow much larger than males. All species are commercially important and harvested or farmed and traded on a global scale, particularly for consumption, especially in Europe, China and Japan, where they are considered a delicacy. One genus.

## GENUS *Anguilla* Schrank 1798

About 19 species, plus additional subspecies, occurring worldwide; 4 species in WIO. Juveniles of the 3 long-finned species (i.e., not *Anguilla bicolor*) are often difficult to identify because the colour and tooth patterns are late to develop.

### KEY TO SPECIES

- |    |   |                       |
|----|---|-----------------------|
| 1a | Dorsal-fin origin above or just in front of vertical at anus .....  | <i>A. bicolor</i>     |
| 1b | Dorsal-fin origin about midway between pectoral-fin bases and anus .....  | 2                     |
| 2a | Head and body plain olive to brownish black dorsally, paler ventrally; band of teeth on each jaw broad, without toothless groove between innermost row and outer rows ...     | <i>A. mossambica</i>  |
| 2b | Head and body mottled with yellow and brown markings (at least in fish >20 cm TL); band of teeth on each jaw narrow, with toothless groove between inner and outer rows ..... | 3                     |
| 3a | Dorsal-fin origin distinctly nearer pectoral-fin bases than to anus .....   | <i>A. marmorata</i>   |
| 3b | Dorsal-fin origin slightly nearer anus than to pectoral-fin bases .....   | <i>A. bengalensis</i> |

## *Anguilla bengalensis* (Gray 1831)

African or Indian mottled eel

PLATE 13

*Muraena bengalensis* Gray 1831: Pl. 95, Fig. 5 (India).

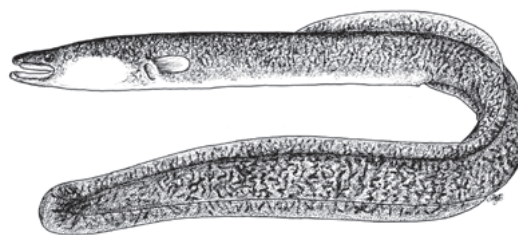
*Anguilla nebulosa* McClelland 1844: 179, Pl. 5, Fig. 2 (Bengal, India; Sandoway, Myanmar).

*Muraena (Anguilla) labiata* Peters 1852: 684 (Zambezi and Licuare rivers, Mozambique).

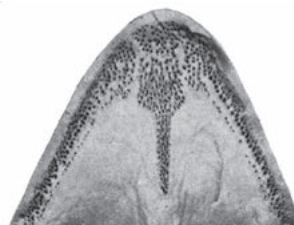
*Anguilla bengalensis labiata*: SSF No. 39.1\*.

Distance between verticals at dorsal-fin origin and anus 7–15% TL. Lips thick and prominent. Band of teeth on vomer narrows conspicuously before its midlength. Vertebrae 106–115.

Body olive-yellow, mottled with greenish brown, and paler ventrally. Attains 160 cm TL and ~20 kg.



*Anguilla bengalensis*, 43 cm TL (WIO). Source: SSF



*Anguilla bengalensis*, tooth pattern. Source: Jubb 1961

**DISTRIBUTION** Indian Ocean. WIO: South Africa to Kenya (and occasional vagrant to Arabian Peninsula), and Pakistan, India and Sri Lanka; elsewhere to Bangladesh and Nepal.

**REMARKS** Often difficult to distinguish from *A. marmorata*. Some workers have recognised the different populations in countries of East Africa and in the Indian Ocean region as separate species or subspecies (*A. bengalensis labiata* and *A. bengalensis bengalensis*, respectively); they differ in their vertebral counts (107–115 versus 106–112) and in certain proportions, but otherwise appear indistinguishable. Adults feed on fishes and crabs, and juveniles on aquatic insects and other invertebrates. IUCN Red List conservation status Near Threatened.

*Anguilla bicolor* McClelland 1844

Shortfin eel

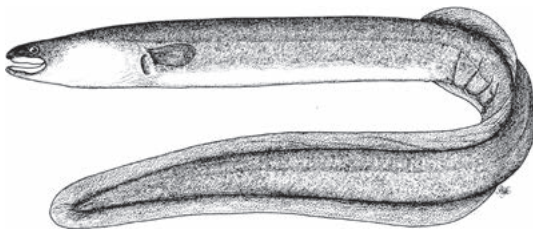
PLATE 13

*Anguilla bicolor* McClelland 1844: 178, 202, 209, Pl. 6, Fig. 1  
(Sandoway, Malay coast, India).

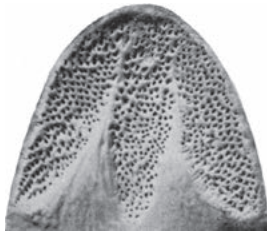
*Anguilla bicolor bicolor*: SSF No. 39.2\*.

Dorsal-fin origin almost directly above anus. Jaws and vomer with broad bands of closely spaced teeth; band of teeth on vomer occasionally narrow posteriorly. Vertebrae 106–115.

Body olive to dark bluish brown dorsally, paler ventrally from jaw to anus. Attains 100 cm TL.



*Anguilla bicolor*, 44 cm TL (WIO). Source: SSF



*Anguilla bicolor*, tooth pattern.  
Source: Jubb 1961

**DISTRIBUTION** Indo-Pacific. WIO: Somalia to South Africa, Madagascar, Seychelles, Mascarenes, India and Sri Lanka; elsewhere to Indonesia, northern China and Australia.

**REMARKS** Sometimes split into two subpopulations and listed as the subspecies *A. bicolor bicolor* in WIO, from East Africa to western Indonesia, and as *A. bicolor pacifica* in the western Pacific, from Indonesia to China and New Guinea. Thought to have three spawning grounds, one of which is off NE Madagascar in WIO.

*Anguilla marmorata* Quoy & Gaimard 1824

Madagascar mottled eel

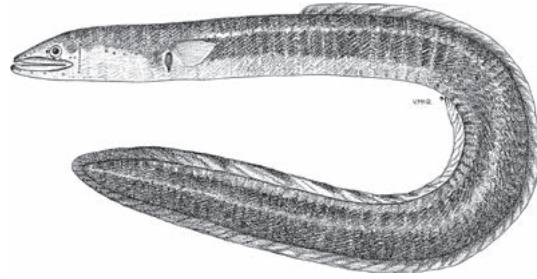
PLATE 13

*Anguilla marmorata* Quoy & Gaimard 1824: 241, Pl. 51, Fig. 2  
(Waigeo, Indonesia); SSF No. 39.3\*.

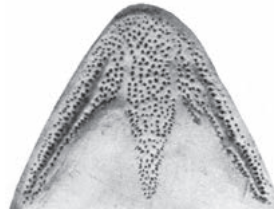
*Anguilla mauritiana* Bennett 1831: 128 (Mauritius, Mascarenes).

Distance between verticals at dorsal-fin origin and anus 14–19% TL. Lips thick. Band of minute teeth on vomer narrows considerably at its middle. Vertebrae 100–110.

Body yellowish to olive-brown, mottled with dark greenish brown, and paler ventrally; fins dark. Attains 150 cm TL and ~20 kg.



*Anguilla marmorata*, 52 cm TL (WIO). Source: SSF



*Anguilla marmorata*, tooth pattern.  
Source: Jubb 1961

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa, Madagascar and Mascarenes; elsewhere to Indonesia, Micronesia, southern Japan, Australia, New Caledonia and Marquesas Is.

**REMARKS** Has the widest geographical distribution among anguillids.

*Anguilla mossambica* (Peters 1852)

African longfin eel

PLATE 13

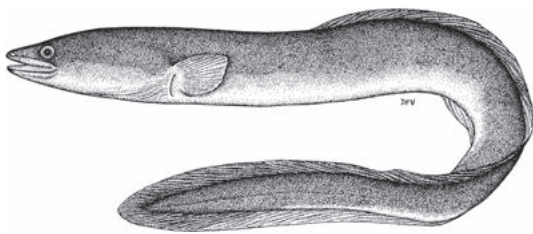
*Muraena (Anguilla) mossambica* Peters 1852: 684 (Lumbo River, Mozambique).

*Anguilla delalandi* Kaup 1856: 50, Pl. 8, Fig. 41 (South Africa).

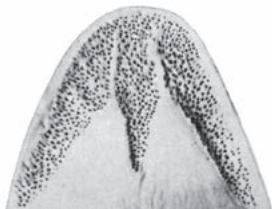
*Anguilla mossambica*: SSF No. 39.4\*.

Distance between verticals at dorsal-fin origin and anus 9–17% TL. Band of teeth on vomer narrow posteriorly. Vertebrae 100–106.

Body uniformly olive to greyish black dorsally, paler ventrally. Attains ~120 cm TL and ~5 kg.



*Anguilla mossambica*, 46 cm TL (South Africa). Source: Whitfield 1998



*Anguilla mossambica*,  
tooth pattern.  
Source: Jubb 1961

**DISTRIBUTION** WIO: Kenya to South Africa, Madagascar, Comoros and Mascarenes.

#### GLOSSARY

**catadromous** – a term for fishes that are spawned in the sea and enter freshwaters as juveniles to grow to maturity, then return to the sea to spawn and die. The opposite is anadromous, for fishes such as salmon that are spawned in rivers and then as juveniles migrate to the sea to mature.

## FAMILY CONGRIDAE

### Congers and garden eels

David G Smith and Phillip C Heemstra

Eels with long body, and compressed, often very narrow, tail; median fins continuous around tip of tail; dorsal-fin origin over, before or slightly behind gill openings; pectoral fins present in most species. Mouth moderate to small, terminal to slightly inferior; some species with thick lips or partly separate flap of skin (lip flange) along upper lip. Teeth typically small, sometimes prominent, uniserial to multiserial, on jaws and vomer. Posterior nostrils a simple opening or short tube before or below front margin of eyes. Lateral line complete, continuing onto head as obvious pores. No scales. Most species pale brown to black, usually paler below, with median fins often dark-edged; some species of *Heteroconger* with conspicuous colour patterns.

Adults benthic or benthopelagic, from shore to deep water; about a third of the species known from WIO are restricted to waters deeper than 200 m. Larvae are widespread

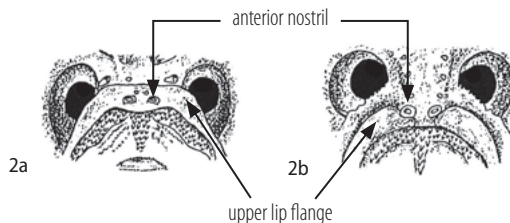
and abundant in the open ocean. A few species are used as food, but no special fishery exists for congrid in WIO. A large and still imperfectly known family, found in tropical to warm-temperate seas worldwide. About 30 genera and at least 100 species; 8 genera and at least 25 species with records above 200 m in WIO.

#### KEY TO GENERA

**[Note: Some species have slender tapering tails which are frequently damaged and regenerated; thus, proportional measurements based on TL are valid only for intact specimens.]**

- 1a Body extremely long and slender; pectoral fins and caudal fin reduced or absent; mouth oblique; lower jaw projecting beyond upper jaw ..... 2
- 1b Body moderately elongate; pectoral fins and tail well-developed; mouth horizontal; jaws equal or upper jaw projecting beyond lower jaw ..... 3

- 2a Upper lip flange continuous around tip of snout, enclosing anterior nostrils ..... *Heteroconger*
- 2b Upper lip flange not continuous around tip of snout, and anterior nostrils free of flange ..... *Gorgasia*



- 3a Preanal length <2.5 in TL; tail somewhat reduced, blunt and relatively stiff ..... *Ariosoma*
- 3b Preanal length >2.5 in TL; tail variable, usually relatively slender and flexible ..... 4

- 4a Teeth on jaws in 2 rows, outer teeth compressed and contiguous, forming a cutting edge; upper lip flange well-developed ..... *Conger*
- 4b Teeth on jaws in bands or, if in 2 rows, outer teeth not compressed or in contact (not forming a cutting edge); upper lip flange reduced or absent ..... 5

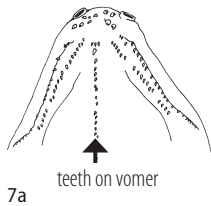
- 5a Tail blunt, tip slightly stiffened, and caudal fin short; upper lip flange narrow but distinct ..... 6
- 5b Tail slender and attenuate, tip soft and flexible, and caudal fin elongate; upper lip flange rudimentary or absent ..... 7

- 6a Lateral line with double row of pores, one row above canal and one row below ..... *Diploconger*
- 6b Lateral line with single row of pores ..... *Gnathophis*

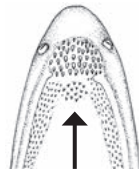
Continued ...

## KEY TO GENERA

- 7a Teeth on vomer in 1 long row, reaching rear end of tooth row on upper jaw ..... *Uroconger*  
 7b Teeth on vomer in rounded patch, ending far short of rear end of tooth row on upper jaw ..... *Rhynchoconger*



7a



7b

GENUS *Ariosoma* Swainson 1838

Body moderately stout, not greatly elongated; preanal length <2.5 in TL; caudal fin reduced, tail blunt and somewhat stiffened. Dorsal-fin origin over or in front of pectoral-fin bases. Eye diameter 1–1.6 times in snout length; upper lip

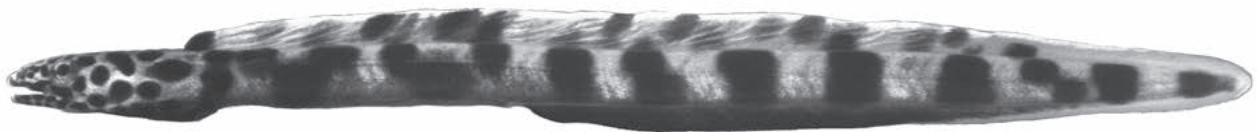
flange well-developed; posterior nostrils in front of eyes, below level of mid-eye. Teeth on jaws small and conical, in bands; teeth on vomer in narrow elongated patch.

Species similar in external appearance and difficult to distinguish, separated mainly by numbers of pores and vertebrae. Most species appear to be restricted in distribution. Based on abundance of leptocephali in plankton collections, these eels are quite common, but because of their cryptic and burrowing habits adult specimens are rare in collections. *Leptocephalus mauritianus* Pappenheim 1914, from Mauritius (see SSF No. 40.1), is considered a *nomen dubium* as this leptocephalus cannot be conclusively linked with any known adult of *Ariosoma*. Abbreviations used here in species descriptions: BD/A – body depth at anus; pore counts: IO – infraorbital, PA LL – preanal lateral line, POM – preoperculomandibular, SO – supraorbital, ST – supratemporal.

About 25 species recognised worldwide, but the number of valid species is probably greater; at least 11 species in WIO at depths of <200 m, 5 of which are undescribed.

Table 1 Distinctive characters of species of *Ariosoma* in WIO.

Species	Vertebrae	Preanal LL pores	Dorsal-fin rays	Anal-fin rays
<i>A. fasciatum</i>	154–159	52–56	?	?
<i>A. nigrimanum</i>	152–158	56–60	184	136
<i>A. ophidiophthalmus</i>	150–153	54–57	181–192	142–152
<i>A. sanzoi</i>	118–124	46–47	?	?
<i>A. scheelei</i>	112–120	38–44	146–178	119–135
<i>A. somaliense</i>	123–126	46–48	177–180	117–129
<i>Ariosoma</i> sp. 1	134–140	53–55	?	?
<i>Ariosoma</i> sp. 2	142–143	48–49	201	143
<i>Ariosoma</i> sp. 3	147	50	196	157
<i>Ariosoma</i> sp. 4	142–143	56–58	?	?
<i>Ariosoma</i> sp. 5	150	47–48	?	?



*Ariosoma fasciatum*, 15 cm TL (Hawaii). © JE Randall, Bishop Museum

*Ariosoma fasciatum* (Günther 1872)

Barred sand conger

PLATE 13

*Poecilconger fasciatus* Günther 1872: 673, Pl. 68 (Manado, Sulawesi, Indonesia).

*Ariosoma fasciatum*: Shen 1998\*; Randall 2007\*.

HL 5.5–5.7 in TL; BD/A 14–21 in TL. Pectoral fins longer than snout; snout longer than eye diameter. Anterior nostrils a short tube before lip flange; posterior nostrils about midway between snout tip and eyes. Teeth villiform, in bands on jaws and vomer. PA LL 52–56. Vertebrae 154–159.



Body pale with numerous, irregular, dark brown blotches and bars on body and dorsal fin; smaller and mostly round spots on head. Attains 60 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar and Mauritius; elsewhere to Indonesia, Marshall Is., Society Is. and Hawaii.

**REMARKS** Nocturnal; hides in its burrow during day. Occurs in sandy areas on or near coral reefs, at 2–32 m.

### *Ariosoma nigrimanum* Norman 1939

Black-pectoral conger

*Ariosoma nigrimanum* Norman 1939: 39, Fig. 12 (Gulf of Aden); Manilo & Bogorodsky 2003.

In TL: preanal length 2–2.1, predorsal length 5–5.7, HL 4.9–5.4, and BD/A 14–17. In HL: snout length 4.5–4.8, eye diameter 4.9–5.2, gill opening 4.4–5.7, interbranchial 8.2–9.7, and pectoral fins 2.6. Pore counts: PA LL 56–60; POM 11; IO 4 + 1 + 3; SO 6; ST 3. Dorsal fin 184 rays; anal fin 136 rays. Vertebrae 152–158.

Head and body buff, paler below; median fins with black edges; pectoral fins wholly dusky or black. Attains at least 39 cm TL.



*Ariosoma nigrimanum*, head of holotype (Gulf of Aden). Source: Norman 1939

**DISTRIBUTION** WIO: Gulf of Aden and Mozambique.

**REMARKS** Type specimens collected at ~220 m.

### *Ariosoma ophidiophthalmus* Karmovskaya 1991

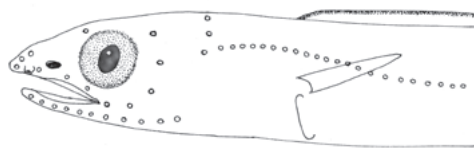
Snake-eye ariosoma

*Ariosoma ophidiophthalmus* Karmovskaya 1991: 891 [2], Fig. 2a (Saya de Malha Bank: 10°50' S, 61°10' E).

In TL: preanal length 2–2.2, predorsal length 5–5.1, HL 4.8, and body depth 11–13. In HL: snout length 5.2–5.4, eye diameter 4.5–4.9, and pectoral fins 3.1–3.2. Pore counts: PA LL 54–57; POM 11; IO 4 + 1 + 3; SO 5; ST 3. Eyes slightly oval, pupils elliptical with vertical axis. Dorsal-fin origin

slightly in front of pectoral-fin bases. Dorsal fin 181–192 rays; anal fin 142–152 rays. Vertebrae 150–153.

Preserved specimens with dark-edged median fins, and pale pectoral fins. Attains at least 36 cm TL.



*Ariosoma ophidiophthalmus*, ~33 cm TL, head, showing sensory pores (Saya de Malha Bank). Source: Karmovskaya 1991

**DISTRIBUTION** WIO: Saya de Malha Bank (type locality).

**REMARKS** Known only from two adults, trawled from 110–115 m.

### *Ariosoma sanzoi* (D'Ancona 1928)

Slender ariosoma

PLATE 13

*Leptocephalus sanzoi* D'Ancona 1928: 27, Pl. 2, Figs. 5–9a (Red Sea).  
*Ophisoma anago* (non Temminck & Schlegel 1846): D'Ancona 1928\*.  
*Ariosoma balearicum* (non Delaroche 1809): Bauchot & Blache 1979.  
*Ariosoma sanzoi*: Golani & Bogorodsky 2010.

In TL: preanal length 2–2.1, predorsal length 5.6–6.5, HL 5.3–5.8, and BD/A 16–22. In HL: snout length 4.3–5.3, eye diameter 4.1–5.1, upper jaw 3.4–3.9, and pectoral fins 2.4–4.1. Pore counts: PA LL 46–47; POM 10; IO 4 + 1 + 3; SO 6; ST 3. Vertebrae 118–124.

Body pale brown, head darker, and belly whitish; median fins with black margins. Attains 26 cm TL.

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Found along sandy shorelines in shallow water.

### *Ariosoma scheelei* (Strömman 1896)

Dwarf ariosoma

PLATE 13

*Leptocephalus scheelei* Strömman 1896: 21, Pl. 1, Figs. 6–7 (Malay Archipelago; western Atlantic).  
*Leptocephalus ophisomatis anagoini* D'Ancona 1928: 17, Pl. 2, Figs. 1–4 (Gulf of Aden and southern Red Sea).  
*Ophisoma anago* (non Temminck & Schlegel 1846): D'Ancona 1928\*.  
*Ariosoma* sp. a; *Ariosoma* sp. b: Kotthaus 1968\*.  
? *Ariosoma scheelei*: Castle 1968\*; SSF No. 40.2\*.

In TL: preanal length 2.2–2.5, predorsal length 5.3–6.4, HL 5.5–6.5, and BD/A 15–22. Pore counts: PA LL 38–44; POM 12 or 13; IO 4 + 1 + 3; SO 6; ST 3. Dorsal fin 146–178 rays; anal fin 119–135 rays. Vertebrae 112–120.

Body pale brownish olive, paler below; median fins with black margins. Attains 20 cm TL.



*Ariosoma scheelei*, 17 cm TL, female (top); 12 cm TL, larva (below).  
Source: Castle 1968

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea to South Africa (KwaZulu-Natal), Aldabra and India; elsewhere to Indonesia and Philippines.

### *Ariosoma somaliense* Kotthaus 1968

Somali ariosoma

*Ariosoma somaliense* Kotthaus 1968: 27, Figs. 121–122 (NE of Mogadishu, Somalia, Indian Ocean).

In TL: preanal length 2–2.1, predorsal length 5.3–6.3, HL 5–5.4, body depth 6–6.6, snout length 21–26, eye diameter 22–26, upper jaw 16–22, and pectoral fins 14–17. Pore counts: PA LL 46–48; POM 8; IO 4 + 1 + 3; SO ?5; ST 3. Dorsal-fin origin markedly in front of pectoral-fin bases. Dorsal fin 177–180 rays; anal fin 117–129 rays; pectoral fins 13 or 14 rays. Vertebrae 123–126.

Colour in life unknown; preserved specimens pale to medium brown, paler ventrally. Attains at least 17 cm TL.

**DISTRIBUTION** Known only from 12 type specimens from Somalia.

**REMARKS** Trawled from ~37–38 m.

### *Ariosoma* sp. 1

In TL: preanal length ~2, predorsal length 5.1–5.4, HL 4.5–5.4, and BD/A 13–15. In HL: snout length 4.7–5.1, eye length 4.5–4.8, and upper jaw 3.3–3.4. Pore counts: PA LL 53–55; POM 11; IO 4 + 1 + 3; SO 6; ST 3. Predorsal vertebrae 8 or 9; preanal vertebrae 55–57; total vertebrae 134–140.

Colour in life unknown; preserved specimens pale to medium brown, paler ventrally. Attains at least 35 cm TL.

**REMARKS** Collected from Red Sea.

### *Ariosoma* sp. 2

*Anago anago* (*non* Temminck & Schlegel 1846): Kotthaus 1968\*.

In TL: preanal length 2.2–2.4, predorsal length 5.5–5.8, HL 5.3–5.9, body depth 12–15, snout length 26–28, eye diameter 50–77, upper jaw 14–22, and pectoral fins 11–16. PA LL pores 48–49. Dorsal fin 201 rays; anal fin 143 rays; pectoral fins 12 rays. Vertebrae 142 or 143.

Colour in life unknown; preserved specimens pale to medium brown, paler ventrally. Attains at least 35 cm TL.

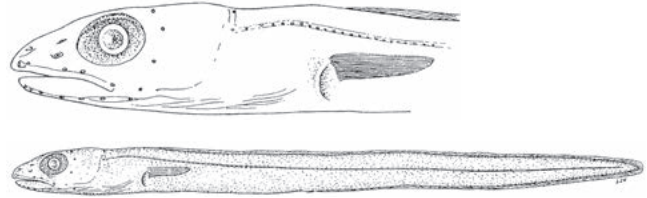
**REMARKS** Data based on four specimens, trawled from 74–94 m, from Gulf of Kutch, NW coast of India, Arabian Sea.

### *Ariosoma* sp. 3

*Ariosoma* sp. Quéro & Saldanha 1995: 78, Fig. 3 (Réunion).

In TL: preanal length 2.2, predorsal length 6, and HL 5. In HL: snout length 4.8, eye diameter 4.8, and upper jaw 3.2. PA LL pores 50. Dorsal fin 196 rays; anal fin 157 rays. Vertebrae 147.

Colour in life unknown; preserved specimen pale to medium brown, paler ventrally. Attains at least 19 cm TL.



*Ariosoma* sp. 3, 19 cm TL (Réunion). Source: Quéro & Saldanha 1995

**REMARKS** Known from one specimen, collected at 170–225 m, from western Mascarenes.

### *Ariosoma* sp. 4

?*Conger muraena anago* (*non* Temminck & Schlegel 1846): Barnard 1925 (southern Africa).

?*Ariosoma anago* (*non* Temminck & Schlegel 1846): Smith 1949\* [in part: KwaZulu-Natal specimen only, probably same one reported by Barnard].

In TL: preanal length ~2.1, predorsal length 6.5–6.8, HL 5.7–6, and BD/A 18–20. In HL: upper jaw 3.6–3.8, snout length 4.3–4.9, and eye diameter 4.4–5.1. PA LL pores 56–58. Vertebrae 142 or 143.

Colour in life unknown; preserved specimens pale to medium brown, paler ventrally. Attains at least 30 cm TL.

**REMARKS** Collected from South Africa (KwaZulu-Natal), at 40–164 m.

## *Ariosoma* sp. 5

In TL: preanal length 2.3, predorsal length 6.1, HL 5.5, and BD/A 19. In HL: upper jaw 3.8, snout length 5.2, and eye diameter 5.2. PA LL pores 47–48; SO pores 5. Vertebrae 150.

Colour in life unknown; preserved specimen pale to medium brown, paler ventrally. Attains at least 40 cm TL.

**REMARKS** Known from one specimen from southern Mozambique, collected at ~164 m.

## GENUS *Conger* Bosc (ex Cuvier) 1817

Dorsal-fin origin over or slightly behind pectoral fins; preanal length >2.5 in TL; tip of tail flexible. Eye diameter less than snout length. Upper lip flange well-developed; posterior nostril above level of mid-eye. Teeth on both jaws in 2 rows, outer teeth larger, close-set and compressed, forming a cutting edge. About 15 species, 2 in WIO.

### KEY TO SPECIES

- 1a Dorsal-fin origin over front half of appressed pectoral fins; sensory pore behind and above angle of mouth ..... *C. cinereus*
- 1b Dorsal-fin origin over or slightly behind tip of appressed pectoral fins; sensory pore behind and in line with angle of mouth ..... *Conger* sp.

## *Conger cinereus* Rüppell 1871

Moustache conger

PLATE 13

*Conger cinereus* Rüppell in Klunzinger 1871 (Red Sea); Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall 1995; Heemstra *et al.* 2004.

*Conger cinereus cinereus*: ?Kotthaus 1968; SSF No. 40.7\*.

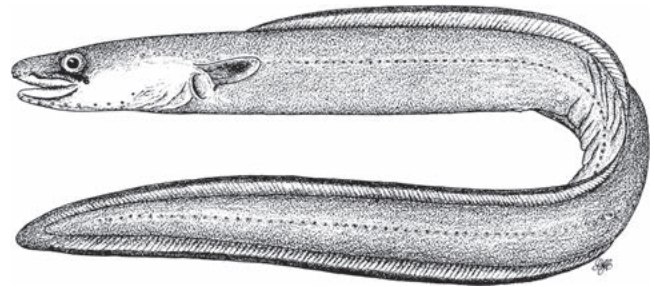
In TL: preanal length 2.7–3.2, predorsal length 7.1–7.9, HL 7.8–8.2, BD/A 17–23, snout length 30–37, eye diameter 45–59, and upper jaw 21–24. PA LL pores 37–41; 5th IO pore behind and above angle of mouth. Vertebrae 139–148.

Body brownish grey, yellow below, sometimes with



*Conger* sp., 49 cm TL (Gough I.). Source: Andrew *et al.* 1995

obscure darker bars; dark stripe below rear margin of eye; often dark spot on pectoral fins; median fins dark-edged. Attains 103 cm TL.



*Conger cinereus*, 43 cm TL. Source: SSF

**DISTRIBUTION** Indo-Pacific, including most of WIO: Oman, Red Sea to South Africa (Cape south coast), Madagascar, Comoros, Aldabra, Seychelles, Mascarenes, Chagos, Maldives and Sri Lanka; elsewhere to Indonesia, Japan, Australia, New Caledonia, Lord Howe I., Line Is., Rapa Iti, Pitcairn Is. and Hawaii.

**REMARKS** Occurs from shore to ~30 m deep; common on coral reefs.

## *Conger* sp.

Giant conger

PLATE 14

*Conger wilsoni* (non Bloch & Schneider 1801): Castle 1968\*; SSF No. 40.8\*; Randall & Anderson 1993; Heemstra *et al.* 2004.

*Conger vulgaris* (non Cuvier): Barnard 1925.

*Conger conger* (non Linnaeus 1758): Smith 1949\*.

*Conger jordani* (non Kanazawa 1958): Smith & Smith 1966\*.

In TL: preanal length 2.5–2.9, predorsal length 4.7–5.8, HL 7–8.3, BD/A 15–20, snout length 28–36, eye diameter 45–56, and upper jaw 19–25. PA LL pores 37–40; 5th IO pore behind and in line with angle of mouth. Dorsal-fin origin over or behind tip of appressed pectoral fins. Vertebrae 140–142.

Body brownish grey above, creamy white below; median fins with wide dusky margin. Attains 150 cm TL.

**DISTRIBUTION** Southern Mozambique and South Africa (KwaZulu-Natal) in WIO, and Gough I. in South Atlantic.

**REMARKS** Occurs in estuaries and along shore, to ~30 m deep. The identity of this species is problematic. Bloch & Schneider's (1801: 529) original brief description of *Gymnothorax wilsoni* reads: "*G. capite parvo, crasso viridi, maculis roseis latis ornato, pinna dorsali longitudine dorsi, ano capiti propinquiore quam apici caudae. Habitat in nova Hollandia, Banning dictus*" (*Gymnothorax* with small head, dark green [with] red spots laterally, dorsal fin runs the length of the dorsal [part of the body and tail], anus closer to head than to tip of the tail. Habitat Australia, [description copied from] Banning's manuscript). On the previous page is the rubric "*C. Dentibus palatines nullis*" [No teeth on palate]. This description is inadequate to determine even the family of this eel. The features "*maculis roseis*" and absence of teeth on the palate preclude all known species of *Conger*. It seems that this description was taken from the manuscript of a person named Banning, and that there never was a specimen of this species in Bloch's fish collection. Consequently, the nominal species *Gymnothorax wilsoni* Bloch & Schneider is considered a *nomen dubium*. Fricke's (1999) attempt to designate a neotype for *Gymnothorax wilsoni* was contrary to the criteria stipulated by the *International Code of Zoological Nomenclature* and is invalid.

## GENUS *Diploconger* Kotthaus 1968

Caudal fin short, tip of tail somewhat stiffened. Snout projecting well in front of lower jaw; upper lip flange narrow. Teeth granular, in bands on jaws; teeth on upper jaw visible when mouth closed; teeth on vomer in triangular patch. Lateral line with double row of pores, above and below LL canal, each pore at end of short tube. Appears to be related to *Gnathophis* Kaup 1859 (from Indo-Pacific) and *Scalanago* Whitley 1935 (1 species, from western Pacific), differing mainly in having 2 rows of LL pores (1 row in *Gnathophis*; multiple rows in *Scalanago*). One species.

### *Diploconger polystigmatus* Kotthaus 1968

Double-line conger

*Diploconger polystigmatus* Kotthaus 1968: 34, Figs. 134–137, 152 (Somalia, Indian Ocean).

In TL: preanal length 2.2–2.6, predorsal length 4.3–4.6, HL 5.4–6.6, body depth 15–18, tail length 1.6–1.8, snout length 19–23, eye diameter 20–24, and upper jaw 15–16. PA LL pores 28–32. Dorsal fin 138–146 rays; anal fin 102–112 rays; pectoral fins 11–13 rays. Vertebrae 107–109.

Body buff, with darker stripe along each side of lateral line; joint between supratemporal bones dark brown, and dark brown stripe from supratemporal area to snout tip; dark brown area on operculum; rear edge of median fins blackish brown. Attains 13 cm TL.



*Diploconger polystigmatus*, 11 cm TL, holotype (Somalia).

Source: Kotthaus 1968



**DISTRIBUTION** WIO: Somalia and southern Red Sea (Yemen).

**REMARKS** Trawled from 37–40 m off Somalia.

## GENUS *Gnathophis* Kaup 1859

Dorsal-fin origin over middle of pectoral fins. Caudal fin short, tip of tail blunt and slightly stiffened. Snout fleshy, protruding beyond lower jaw; upper lip flange narrow but distinct; anterior nostrils with scroll-like incision. Teeth granular, in bands on jaws and elongated patch on vomer. Lateral line inconspicuous. About 27 species recognised, but the number of valid species is probably greater; many are known from few specimens. Possibly 3 species in WIO coastal waters.

**Table 2** Distinctive characters of species of *Gnathophis* in WIO.

Species	Vertebrae	Preanal LL pores	Extra-elevated LL pores	Stomach colour
<i>G. capensis</i>	128–135	32–40	0	Black
<i>G. heterolinea</i>	120	28	8	Black
<i>Gnathophis</i> sp.	119–126	32–33	?	?



## *Gnathophis capensis* (Kaup 1856)

Southern conger

PLATE 14

?*Leptocephalus capensis* Kaup (ex Lalande) 1856: 153 (Cape of Good Hope, South Africa).

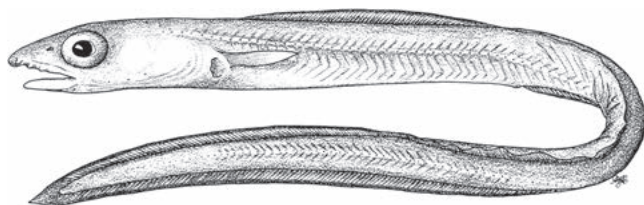
*Congermuraena australis* Barnard 1923: 442 (Tristan da Cunha; False Bay, South Africa).

*Ariosoma balearica* (non Delaroche 1809): Smith 1949.

*Gnathophis capensis*: SSF No. 40.9\*.

In TL: preanal length 2.4–2.7, predorsal length 5.3–6.1, HL 6–6.6, BD/A 20–25, pectoral fins 15–16, snout length 21–25, eye diameter 26–33, and upper jaw 16–19. PA LL pores 32–40. Dorsal fin 200–225 rays; anal fin 125–150 rays; pectoral fins 12–14 rays. Vertebrae 128–135.

Head and body olive brown; head may be silvery; median fins with dusky margin. Attains 88 cm TL.



*Gnathophis capensis*, 29 cm TL. Source: SSF

**DISTRIBUTION** Southern Africa (off Orange River mouth to Plettenberg Bay, South Africa, in WIO); also Tristan da Cunha Is. in southeastern Atlantic.

**REMARKS** Known from 100–120 m off South Africa. The name is based on a larva, but there is some uncertainty over its identity. The holotype is in poor condition, and the number of myomeres is unknown. The species currently being treated under this name is the most common species of *Gnathophis* off South Africa, but it is not the only one (see *Gnathophis* sp., below). Without the vertebral count, it cannot be determined with certainty which species *Leptocephalus capensis* represents. The next available name would be *Ariosoma australis* (Barnard 1923).

## *Gnathophis heterolinea* (Kotthaus 1968)

Outershelf conger

*Lemkea heterolinea* Kotthaus 1968: 33, Figs. 131–133, 152 (off Mombasa, Kenya).

In TL: preanal length 2.5, predorsal length 5.2, HL 5.4, BD/A 14, snout length 21, eye diameter 20, and upper jaw 16.

PA LL pores 28. Dorsal fin 180 rays; anal fin 124 rays; pectoral fins 11 rays. Vertebrae 120.

Colour not recorded. Attains at least 24 cm TL.



*Gnathophis heterolinea*, 24 cm TL, holotype (Kenya). Source: Kotthaus 1968

**DISTRIBUTION** WIO: Kenya and South Africa (KwaZulu-Natal).

**REMARKS** Known only from the holotype, collected at 177–243 m, and one specimen from off South Africa, at ~121 m.

## *Gnathophis* sp.

Strap conger

Species A: Barnard 1925.

*Gnathophis habenatus* (non Richardson 1848): Castle 1968\*; SSF No. 40.10\*.

In TL: preanal length ~2.6, predorsal length 4.8–5.2, HL 5.3–5.4, BD/A 22–27, pectoral fins 15–16, snout length 19–20, eye diameter ~27, and upper jaw 11–13. PA LL pores 32–33. Dorsal fin 173–178 rays; anal fin 129–132 rays; pectoral fins 13 rays. Vertebrae 119–126.

**DISTRIBUTION** WIO: South Africa (off southern Cape coast to East London).

**REMARKS** Known in WIO only from juveniles and larvae of questionable identity, collected at 82–90 m.

## GENUS *Gorgasia* Meek & Hildebrand 1923

Split-lip garden eels

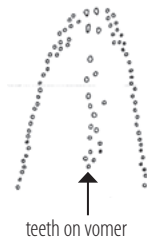
Body extremely long and slender, compressed behind head and tapering posteriorly; caudal fin reduced, tip of tail stiffened; pectoral fins reduced. Snout length less than eye diameter; upper lip flange interrupted medially at front of snout, anterior nostrils not included in lip. Mouth small, oblique; lower jaw projecting beyond upper jaw.

Inhabit clear-water current-prone sandy areas, often near coral reefs; mainly sessile, keeping tail buried in soft coral-sandy sediment while extending head and anterior part

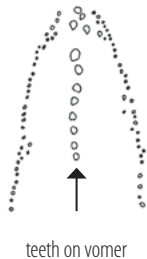
of body into water column to feed during day by picking individual zooplankton from the current. Usually occur in small aggregations to large colonies; males occupy a burrow near a female, and spawning occurs with a male and female entwined at their burrows. About 12 species, 4 in WIO.

## KEY TO SPECIES

- 1a Body buff, with pale bands; PA LL pores 11–16 ..... *G. preclara*  
 1b Body without pale bands; PA LL pores >20 ..... 2
- 2a Head and body grey to brown, with tiny yellow-tan flecks; most sensory pores ringed by pale circular area ..... *G. maculata*  
 2b Head and body mottled; sensory pores not enclosed in pale circular areas ..... 3
- 3a Papillose ridges on lower jaw; teeth on vomer multiserial; vertebrae 170–181 ..... *G. klausewitzii*



- 3b No papillose ridges on lower jaw; teeth on vomer more or less uniserial; vertebrae 170–177 ..... *G. sillneri*



### *Gorgasia klausewitzii* Quéro & Saldanha 1995

Fringe-jaw garden eel

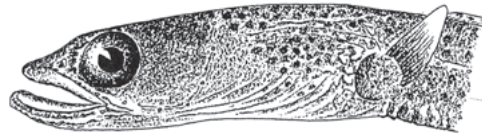
PLATE 14

*Gorgasia klausewitzii* Quéro & Saldanha 1995: 80, Figs. 4–5 (Réunion, western Mascarenes); Castle & Randall 1999\*.

Preanal length 2.5–2.6 in TL; predorsal length 5.4–7.5 in preanal length; HL 5.6–8.3 in preanal length. In HL: snout length 6.7–9.1, eye diameter 4.4–5.6, upper jaw 3.5–4.8, and BD/A 4.4–6.2. PA LL pores 39–44. Papillose ridges on lower

jaw; teeth on vomer multiserial. Predorsal vertebrae 8 or 9; preanal vertebrae 67–70; total vertebrae 170–181.

Body buff, mottled: front half with closely spaced dark round spots, and rear half with evenly scattered fine black speckles; spots continuing onto fins. Attains ~75 cm TL.



*Gorgasia klausewitzii*, 31 cm TL, head (Mauritius). Source: Castle & Randall 1999

**DISTRIBUTION** Indian Ocean. WIO: Comoros, Mauritius and Réunion; elsewhere, Andaman Is.

**REMARKS** Occurs in colonies of hundreds of individuals, at 10–225 m.

### *Gorgasia maculata* Klausewitz & Eibl-Eibesfeldt 1959

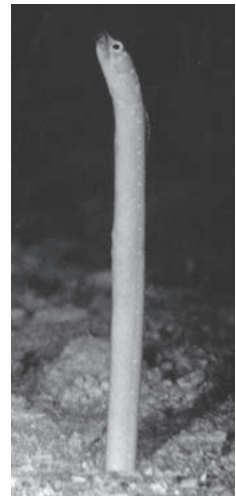
Freckled garden eel

PLATE 14

*Gorgasia maculata* Klausewitz & Eibl-Eibesfeldt 1959: 147, Figs. 13, 14, 17 (Tillanchong, Castle Bay, Nicobar Is.); Winterbottom *et al.* 1989\*; Debelius 1993\*; Randall & Anderson 1993\*; Kuiter 1998\*; Castle & Randall 1999\*.

Preanal length 2.5–2.8 in TL; predorsal length 5.5–7.8 in preanal length; HL 5.5–8.2 in preanal length. In HL: snout length 5.8–9, eye diameter 4.2–5.6, upper jaw 3.3–4.8, and BD/A 3.3–6.3. PA LL pores 29–41. Predorsal vertebrae 5–7; preanal vertebrae 57–65; total vertebrae 167–178.

Body pale grey to brown or tan, covered with tiny yellow-tan flecks; cephalic and LL pores in white circular areas. Attains 70 cm TL.



*Gorgasia maculata*, (Maldives). Source: Randall & Anderson 1993

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Seychelles, Mauritius, Réunion, Chagos and Maldives; elsewhere to Andaman Sea, Cocos (Keeling) Is., Indonesia, Philippines, New Guinea and Solomon Is.

**REMARKS** Found in large colonies, near tropical reefs, on sandy slopes exposed to currents, at 23–48 m.

**Gorgasia preclara** Böhlke & Randall 1981

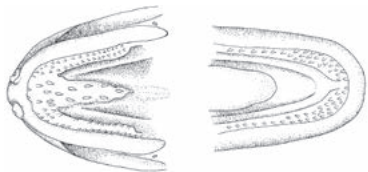
Banded garden eel

PLATE 14

*Gorgasia preclara* Böhlke & Randall 1981: 379, Figs. 1e, 4c, 5, 8 (Sumilon I., Philippines); Randall & Anderson 1993; Kuitert 1998\*; Castle & Randall 1999\*.

In TL: preanal length 2.1–2.3, predorsal length 13–15, HL 14–17, and BD/A 50–63. In HL: snout length 7.1–9.1, eye diameter 4.6–5.7, and upper jaw 4–4.8. PA LL pores 11–16. Predorsal vertebrae 6–9; preanal vertebrae 62–67; total vertebrae 144–152.

Head, trunk, and anterior portion of tail with alternating pale and orange-brown bars; pale bars on body progressively smaller and changing to vertically elongate spots posteriorly. Attains 40 cm TL.



*Gorgasia preclara*, upper and lower dentition (left to right). Source: Böhlke & Randall 1981



*Gorgasia preclara*, 32 cm TL, head of paratype. Source: Böhlke & Randall 1981

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aqaba and Red Sea (photographs only: Bogorodsky), and Maldives; elsewhere to Indonesia, Philippines, southern Japan, Coral Sea and New Guinea.

**REMARKS** Found singly or in small aggregations, near tropical coral reefs, on sandy slopes exposed to current, at 18–75 m (usually >30 m).

**Gorgasia sillneri** Klausewitz 1962

Speckled garden eel

PLATE 14

*Gorgasia sillneri* Klausewitz 1962: 97, Fig. 3 (Gulf of Aqaba, Red Sea); Debelius 1993\*; Castle & Randall 1999\*.

Preanal length 2.4–2.6 in TL; predorsal length 5.3–7.6 in preanal length; HL 6.9–8 in preanal length. In HL: snout length 6.3–8, eye diameter 5–5.6, upper jaw 3.3–4, and BD/A 4.7–5.8. PA LL pores 35–42. Teeth on vomer more or less uniserial. Predorsal vertebrae 7 or 8; preanal vertebrae 69 or 70; total vertebrae 170–177.

Body buff or grey, with close-set dark round spots. Attains 84 cm TL.



*Gorgasia sillneri*, 65 cm TL (Gulf of Aqaba). Source: Castle & Randall 1999

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Observed in colonies of thousands of eels, at 2–46 m.

**GENUS** *Heteroconger* Bleeker 1868

Full-lip garden eels

Body extremely long and slender, compressed behind head and tapering posteriorly; tip of tail stiffened. Pectoral fins and caudal fin rudimentary. Snout shorter than eye diameter; upper lip flange continuous around tip of snout, and enclosing anterior nostrils. Mouth oblique; lower jaw projecting beyond upper jaw.

Mainly sessile, often in large colonies in sandy areas, keeping their tail inserted in tubular burrow while extending head and anterior part of body into water column to feed on passing plankton (mainly copepods). Occur in tropical to warm-temperate waters of all oceans; 19 species recognised, 2 in WIO.

**KEY TO SPECIES**

- 1a Body with 5 prominent black blotches: pair at gill openings, another pair at midpoint of trunk, and 5th blotch midventrally at anus ..... *H. hassi*
- 1b Body without pairs of black blotches ..... *H. balteatus*

**Heteroconger balteatus** Castle & Randall 1999

Orange-spotted garden eel

PLATE 14

*Heteroconger balteatus* Castle & Randall 1999: 12, Figs. 2, 4, 11; Pl. 1a (Jeddah, Saudi Arabia, Red Sea).

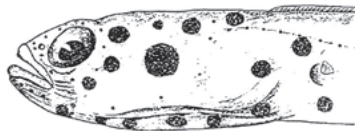
Preanal length 2.5–3 in TL; predorsal length 6.1–7.5 in preanal length; HL 5.7–6.7 in preanal length. In HL: snout length 8.7–9.3, eye diameter 4.7–5.7, upper jaw 4.6–5.1, and BD/A 3.7–4.3. PA LL pores 52–58. Pectoral fin a minute flap at upper end of gill opening. Predorsal vertebrae 5; preanal vertebrae 54–57; total vertebrae 156–161.

Head, body and median fins pale, with round to oval orange-brown spots, becoming larger towards tail; distinctive oblique white or pale bar ~1.5 HL behind pectoral fins. Attains 35 cm TL.



*Heteroconger balteatus*, upper and lower dentition (left to right) (Red Sea).

Source: Castle & Randall 1999



*Heteroconger balteatus*, 33 cm TL, holotype (Red Sea).

Source: Castle & Randall 1999

**DISTRIBUTION** Known only from three specimens collected at Jeddah.

**REMARKS** Taken at ~46 m.

### *Heteroconger hassi* (Klausewitz & Eibl-Eibesfeldt 1959)

Black-blotched garden eel

PLATE 14

*Xarifania hassi* Klausewitz & Eibl-Eibesfeldt 1959: 138, Figs. 6, 8, 15, 16 (Addu Atoll, Fedu I., Maldives).

*Heteroconger hassi*: Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; Kuitert 1998\*; Castle & Randall 1999\*.

In TL: preanal length 2.6–2.7, predorsal length 17–20, HL 17–18, snout length 111–125, and BD/A 53–67. PA LL pores 62–71. Vertebrae 165–171.

Body pale grey, covered with small, regularly spaced, dark round spots; 5 dark blotches on body: one around each gill opening, pair midway between gill opening and anus, and one midventrally around anus; juvenile (13 cm TL) dark brown to black with pale fins. Attains 40 cm TL.



*Heteroconger hassi*, 35 cm TL, paratype of *Taenioconger neocaledoniensis*, upper and lower dentition (left to right) (Red Sea).

Source: Castle & Randall 1999



*Heteroconger hassi*, 31 cm TL (Comoros). PC Heemstra © NRF-SAIAB

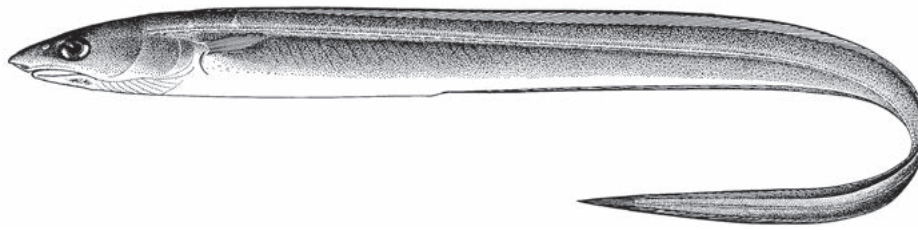
**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Mauritius, Réunion, Chagos and Maldives; elsewhere to southern Japan, Australia, New Caledonia, Tonga, Samoa and Line Is.

**REMARKS** Occurs on sandy slopes, at 7–45 m (usually deeper than ~15 m), in colonies of up to several hundred eels; withdraws into its burrow when approached.

### GENUS *Rhynchoconger* Jordan & Hubbs 1925

Body moderately elongated; tail slender, attenuate. Dorsal-fin origin in front of vertical at pectoral-fin base. Snout projecting well beyond lower jaw; upper lip flange narrow, and lower lip flange wide and upturned; anterior nostrils a short tube on ventrolateral side of snout tip, and posterior nostrils oval, in front of middle of eye. Teeth small, conical, in rounded patch on intermaxillary and vomer, and in narrow bands on jaws; intermaxillary tooth patch exposed when mouth closed. Six species tentatively recognised; 1 species in WIO in depths of <200 m.





*Rhynchoconger squaliceps*, ~45 cm TL, holotype of *R. ectenurus* (Taiwan). Source: Jordan & Richardson 1909

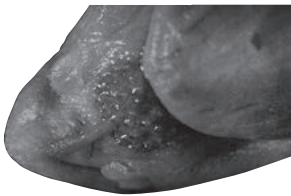
### *Rhynchoconger squaliceps* (Alcock 1894)

*Congromuraena squaliceps* Alcock 1894: 183 [15] (Bay of Bengal).

*Rhynchoconger ectenurus*: Kotthaus 1968\*; Ben-Tuvia 1993.

Preanal length 2.9–3.3 in TL; times in preanal length: predorsal length 2.4–2.6, HL 2.3–2.5, BD/A 7.9–9.3, snout length 8.6–9.7, eye diameter 12–15, and upper jaw 5.3–6.6. Mouth large, rictus below rear edge of eyes. PA LL pores 31. Vertebrae 152–159.

Colour not recorded. Attains 65 cm TL.



*Rhynchoconger squaliceps*, 35 cm TL, vomerine teeth (Arabian Sea). Source: Kotthaus 1968

**DISTRIBUTION** WIO: Arabian Sea to northwest India; elsewhere uncertain.

**REMARKS** Benthic, on soft bottom of continental shelf and slope. *Rhynchoconger ectenurus* (Jordan & Richardson 1909), described from Taiwan, is the name that has been commonly used for *Rhynchoconger* in the Indo-Pacific. Castle (1995: 710), however, showed that *Congromuraena squaliceps*, described from the Bay of Bengal, also belongs in *Rhynchoconger*. As the latter is an older name, it must take precedence over *ectenurus* if the two are considered conspecific; if they are different, then *squaliceps* must apply to the species in the Indian Ocean. More studies are needed on this genus.

### GENUS *Uroconger* Kaup 1856

Tail long and tapering; preanal length 2.6–3.1 in TL. Head small; snout projecting slightly beyond lower jaw; no flange on upper lip; pores on upper lip large and slit-like; anterior nostrils a short fleshy tube near front of snout, and posterior nostrils an oval pore before middle of eye. Teeth moderately large and acute; intermaxillary teeth in 2 transverse rows;

maxillary teeth biserial; teeth on vomer in 1 long row extending to rear of maxillary teeth. Three species, 1 in WIO in depths of <200 m.

### *Uroconger* spp. (Richardson 1845)

Longtail conger

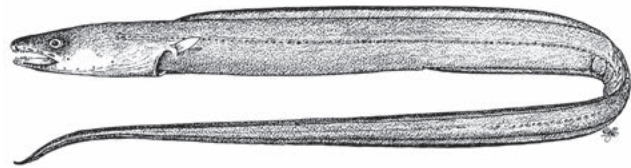
PLATE 14

*Congrus lepturus* Richardson 1845: 106, Pl. 56, Figs. 1–6 (Guangdong, China).

*Uroconger lepturus*: Castle 1968\*; Kotthaus 1968\*; SSF No. 40.12\*.

Preanal length 2.9–3.1 in TL. In preanal length: predorsal length 2.2–2.5, HL 2.1–2.6, and BD/A 6.7–10. In HL: snout length 3.7–4.2, eye diameter 7.1–8.3, and upper jaw 2.7–3. Length of gill opening about twice distance between their ventral ends. Pectoral fins short, length subequal to snout length, with 15 rays. PA LL pores 41–46. Vertebrae difficult to count, ~200.

Head and body buff dorsally, paler ventrally; fins darker. Attains 43 cm TL.



*Uroconger* sp. 32 cm TL. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Red Sea to South Africa (Thukela Bank) and Madagascar; elsewhere to Indonesia, Philippines, China, Japan and the central Pacific.

**REMARKS** Occurs offshore and in coastal areas; benthopelagic, over soft sandy mud bottom, at 18–700 m or more (usually <200 m). The name *Uroconger lepturus* (Richardson 1845) has been widely applied to all *Uroconger* in the Indo-Pacific, but recent studies indicate that numerous species exist. The genus needs to be studied over the entire range to determine how many species are involved and where they occur.

## FAMILY MURAENESOCIDAE

## Pike congers

David G Smith

Eels with robust, moderately elongated body, and compressed tail; pectoral fins well-developed; dorsal fin and anal fin continuous around tail; dorsal-fin origin slightly before pectoral-fin bases; anus slightly before midlength. Posterior nostrils in front of eyes. Mouth large, terminal, gape extends behind eye; teeth large, especially those at front of jaws and on vomer. Lateral line complete, but opening through complex system of multiple pores which are difficult to count. No scales.

Circumtropical; benthic in shallow to moderately deep water. Commercially important in some areas. Five genera; 2 genera and 3 species in WIO at depths of <200 m.

## KEY TO GENERA

- 1a Principal vomerine teeth large, round in section, very acute, with only minute cusps distally, the teeth widely separated; principal teeth on lower jaw directed outwards ..... *Congresox*
- 1b Principal vomerine teeth large, compressed, moderately acute, with sharp anterior and posterior edges and prominent basal cusps, teeth in contact or slightly separated; teeth on lower jaw erect or turned slightly inwards ..... *Muraenesox*

GENUS *Congresox* Gill 1890

Head and snout long and slender, snout projecting beyond lower jaw. Principal vomerine teeth slender, round in cross-section, arrow-shaped with small cusp at distal end, and widely separated; outer teeth in lower jaw directed strongly outwards. Two species, 1 in WIO.

*Congresox talabonoides* (Bleeker 1852)

Indian pike conger

*Conger talabonoides* Bleeker 1852: 20 (Jakarta, Java, Indonesia).*Congresox talabonoides*: Manilo & Bogorodsky 2003; Psomadakis *et al.* 2015

Pectoral-fin length ~4.1 in HL. LL pores before anus 35–40. Vertebrae 132–145.

Body greyish brown, paler ventrally; median fins edged in black. Attains ~250 m TL (commonly ~180 cm TL).

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Gulf of Aden, Pakistan, India and Sri Lanka; elsewhere to Bangladesh, Indonesia, Philippines and China.

**REMARKS** Found to ~100 m deep.

GENUS *Muraenesox* McClelland 1843

Head and snout moderately long, snout projecting beyond lower jaw. Teeth in contact with each other or slightly separated, forming saw-like ridge; principal vomerine teeth massive, strongly compressed, triangular, with sharp anterior and posterior edges and prominent basal cusps; outer teeth on lower jaw directed upwards or slightly inwards. Two species, both in WIO.

## KEY TO SPECIES

- 1a Interorbital width ~9–11 in HL; dorsal-fin rays before anus 47–59; LL pores before anus 33–39 ..... *M. bagio*
- 1b Interorbital width ~8–9 in HL; dorsal-fin rays before anus 66–78; LL pores before anus 40–47 ..... *M. cinereus*

*Muraenesox bagio* (Hamilton 1822)

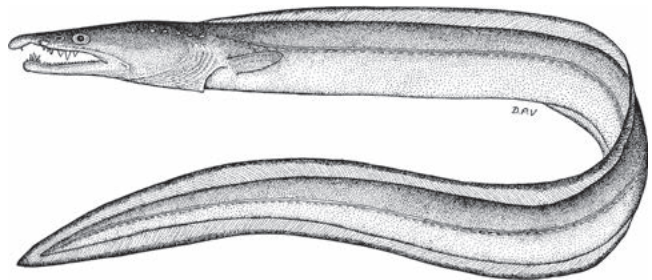
Common pike conger

PLATE 15

*Muraena bagio* Hamilton 1822: 24, 364 (Ganges River estuaries, India).*Muraenesox bagio*: SSF No. 45.1\*; Talwar & Jhingran 1991\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Diagnosis as for genus. Vertebrae 128–141; other characters as in key.

Body greyish brown, paler ventrally; median fins edged in black. Attains 200 cm TL (commonly 150–180 cm TL).



*Muraenesox bagio*, 48 cm TL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (KwaZulu-Natal), Madagascar and Mascarenes; elsewhere to Bay of Bengal, Indonesia, China, Australia and Fiji.

**REMARKS** Found in coastal waters and estuaries, from sublittoral zone to ~100 m deep. Nocturnal, feeding on benthic fishes and crustaceans.

## *Muraenesox cinereus* (Forsskål 1775)

Daggertooth pike conger

PLATE 15

*Muraena cinerea* Forsskål in Niebuhr 1775: 22, x (Jeddah, Saudi Arabia, Red Sea).

*Muraenesox cinereus*: Manilo & Bogorodsky 2003.

Diagnosis as for genus. Vertebrae 145–159; other characters as in key.

Body greyish brown, paler ventrally; median fins edged in black. Attains 220 cm TL (commonly ~80 cm TL).

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Persian/Arabian Gulf, west coast of India and Sri Lanka; Lessepsian migrant to Mediterranean Sea; elsewhere to Indonesia, Philippines, China, southern Japan, Mariana Is., northern Australia, Fiji and Tuvalu.

**REMARKS** Inhabits littoral zone to upper bathybenthic region, on soft bottom, commonly to ~300 m deep; also found in estuaries and sometimes enters freshwater. Feeds on small benthic fishes and crustaceans.

## FAMILY MYROCONGRIDAE

Slope eels

Phillip C Heemstra

Eels with moderately elongated and more or less compressed body, with anus near midlength; dorsal fin and anal fin well-developed and continuous around tail; dorsal-fin origin before vertical at gill opening; pectoral fins rounded, fin bases slightly oblique and set on lower half of body. Eyes well-developed; eye diameter about half snout length. Snout bluntly pointed; anterior nostril a short tube near front of snout, and posterior nostril a simple pore in front of upper part of eye. Mouth gape

ends behind vertical at rear margin of eye; no free lips. Teeth small and sharp, in many bands on jaws, and in long band of 1–3 rows on vomer. Gill opening slightly smaller than width of pectoral-fin base. Lateral line incomplete, with 4–7 LL pores anteriorly above each pectoral fin.

One genus, *Myroconger* Günther 1870, with 5 poorly known, mesopelagic and demersal species, found at ~50–640 m; 1 species known in WIO.

## *Myroconger seychellensis* Karmovskaya 2006

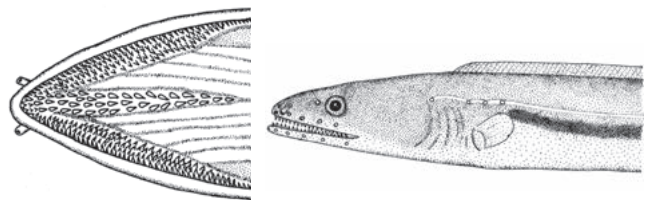
Seychelles slope eel

PLATE 15

*Myroconger seychellensis* Karmovskaya 2006: 590, Fig. 1 (Fortune Bank, SE of Mahé, Seychelles).

Body robust, its depth 14.5 in TL; HL 7.1 in TL; preanal length 1.9 in TL; eye diameter 8.3 in HL; snout length 3.9 in HL. Pectoral fin ~5 rays; dorsal fin 300 rays; anal fin 163 rays. Supraorbital pores 3: the 2 anterior pores (including terminal ethmoidal pore) in front of anterior nostril tube, and rear pore above base of nostril tube; suborbital canal with 4 pores along upper jaw, posteriormost pore below mid-eye, and anteriormost pore below base of anterior nostril tube; preoperculomandibular canal with 5 pores on left side of lower jaw, 4 pores on right side, and posteriormost pore slightly before rictus. Total vertebrae 130; predorsal vertebrae 7; preanal vertebrae 56.

Head and dorsal body brownish orange; fins and ventral body paler, with broad dark midlateral stripe from behind pectoral fin to caudal fin. Attains at least 19 cm TL.



*Myroconger seychellensis*, 19 cm TL, head and upper jaw dentition (Seychelles). Source: Karmovskaya 2006

**DISTRIBUTION** Known only from the holotype, a mature female, in Seychelles.

**REMARKS** Caught in a trap at 200 m.

## FAMILY SYNAPHOBANCHIDAE

## Cutthroat eels

David G Smith

Eels with stout to elongate body, and anus usually well before midbody. Pectoral fins present or absent. Dorsal-fin origin over gill opening to behind anus. Snout short to moderately elongate. Anterior nostril tubular, near tip of snout; posterior nostril on side of snout, at or below mid-eye level. Mouth usually large, gape extending behind eyes; jaws nearly equal, snout sometimes projects beyond lower jaw; lips without fleshy flange. Teeth usually small and conical, in one to several rows on jaws and vomer; some species with enlarged compound teeth on vomer. Eyes well-developed to reduced. Gill opening low on side of body, below pectoral fin when present, sometimes opening into a single median ventral slit. Lateral line variable, from complete to absent. Small embedded scales present in some species. Body typically brown or grey, sometimes counter-shaded, but without distinctive markings.

A large but poorly known family, with ~8 genera worldwide, occurring mainly in deep water. Four genera known in WIO, but only 1 genus represented at depths of <200 m.

GENUS *Dysomma* Alcock 1889

Pectoral fins present or absent. Anus far forward; trunk short, often less than one head length. Snout fleshy, plicate, papillose, overhanging tip of lower jaw. Dorsal-fin origin varies from slightly before gill opening to midway between gill opening and anus. Intermaxillary and vomerine teeth large and compound, arranged in pairs fused front to back. No scales. About 10 species known worldwide, but probably more exist; 3 species in WIO at depths of <200 m.

## KEY TO SPECIES

- |    |   |                          |
|----|---|--------------------------|
| 1a | No pectoral fins .....  | <i>D. dolichosomatum</i> |
| 1b | Pectoral fins present .....   | 2                        |
| 2a | About 6–10 large well-separated teeth on each side of lower jaw ..... | <i>D. anguillare</i>     |
| 2b | At least 16 teeth on each side of lower jaw .....                     | <i>D. polycatodon</i>    |

*Dysomma anguillare* Barnard 1923

Shortbelly eel

PLATE 15

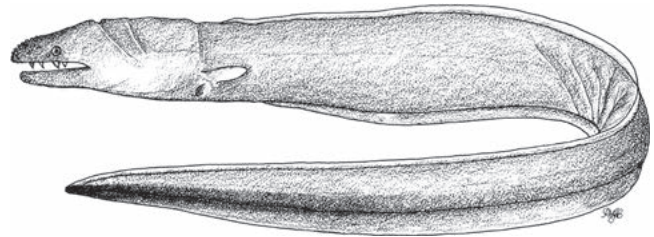
*Dysomma anguillaris* Barnard 1923: 443 (off Thukela River mouth, KwaZulu-Natal, South Africa).

*Dysomma anguillare*: SSF No. 46.2\*; Fricke *et al.* 2009.

*Dysomma zanzibarensis* Norman 1939: 44, Fig. 17 (Zanzibar, Tanzania).

Dorsal-fin origin about over pectoral-fin bases; anus close behind tip of appressed pectoral fins; trunk less than HL. Transverse pair of intermaxillary teeth; 4 large compound vomerine teeth set in soft tissue; maxillary teeth small, in bands; 6–10 large well-separated mandibular teeth. Vertebrae 119–130.

Body brown or grey, without markings; rear part of anal fin darker. Attains 52 cm TL.



*Dysomma anguillare*, 20 cm TL. Source: SSF

**DISTRIBUTION** Indo-Pacific and western Atlantic. WIO: South Africa (KwaZulu-Natal) and Tanzania (Zanzibar).

**REMARKS** Found to ~200 m (usually <100 m) deep. As currently understood, this appears to be a complex of species worldwide. Based on the type locality, the WIO form is the true *Dysomma anguillare*.

*Dysomma dolichosomatum* Karrer 1983

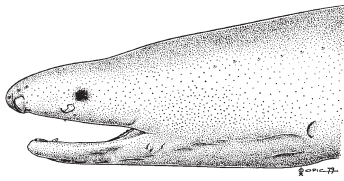
PLATE 15

*Dysomma dolichosomatum* Karrer 1983: 93, Fig. 28a–b (Madagascar).

No pectoral fins. Dorsal-fin origin about midway between gill opening and anus; trunk less than HL. Eyes very small. Transverse pair of intermaxillary teeth; 4 large compound vomerine teeth set in soft tissue; maxillary teeth small, in 3 rows; 5 large, compound, anterior mandibular teeth, deeply set in soft tissue, followed by band of much smaller teeth. Vertebrae 146–153.

Body pale brown or grey, without markings; rear part of anal fin darker. Attains 33 cm TL.





*Dysomma dolichosomatum*, 33 cm TL, head of holotype (Madagascar).

Source: Karrer 1983

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar; elsewhere, South China Sea.

**REMARKS** Known from 174–555 m.

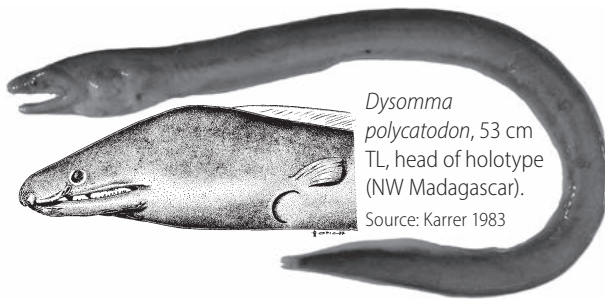
## *Dysomma polycatodon* Karrer 1983

PLATE 15

*Dysomma polycatodon* Karrer 1983: 89, Fig. 27a–b (NW Madagascar).

Pectoral-fin bases behind dorsal-fin origin; anus below tip of appressed pectoral fins; trunk less than HL. Transverse pair of intermaxillary teeth; 5 large compound vomerine teeth set in soft tissue; maxillary teeth small, in narrow bands; 2 large, caniniform, anterior mandibular teeth, followed by 20–25 much smaller teeth. Vertebrae 140.

Body pale brown or grey, without markings; rear part of anal fin darker. Attains 53 cm TL.



*Dysomma polycatodon*, 53 cm TL, head of holotype (NW Madagascar).

Source: Karrer 1983

*Dysomma polycatodon*, ~35 cm TL (Taiwan). © H-C Ho, NMMB-P

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar; elsewhere, Taiwan and Philippines.

**REMARKS** Known from 170–385 m.

## FAMILY NETTASTOMATIDAE

### Witch eels

David G Smith

Eels with slender, elongate body; anus before midlength; dorsal-fin origin over, before or slightly behind gill opening;

dorsal fin and anal fin continuous around tail; tail slender, attenuate (often broken and regenerated). No pectoral fins in species occurring in WIO. Snout long; mouth large, gape extends to rear margin of eye; no fleshy flange on upper or lower lips; some teeth visible when mouth closed. Teeth small, conical, in bands on jaws, vomer and sometimes palatines; also enlarged teeth sometimes present on vomer. Anterior nostril tubular, placed near tip of snout; posterior nostril variable in position, on lip, before eye, on top of head, or even on body behind head. Lateral line complete, continuing onto head as obvious pores. No scales. Body brown or dark grey to blackish, median-fin margins often black.

A poorly known family, with many of the species known only from larvae. Benthic on continental shelf and slope. Of no commercial significance. Six genera, 4 represented in WIO, but only 1 species known from depths of <200 m.

## GENUS *Saurenehelys* Peters 1864

No pectoral fins. Posterior nostril at level of mid-eye. Palatine teeth present; some vomerine teeth enlarged. Number of species uncertain; at least 1 species known in WIO, and possibly 4 others recorded only as larvae.

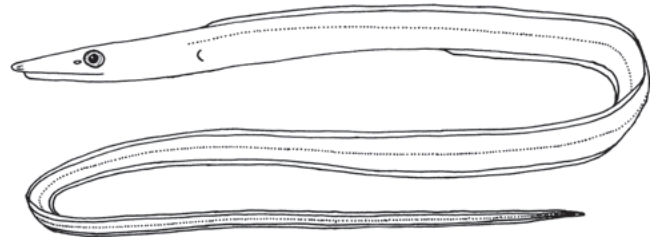
## *Saurenehelys elongatum* (Kotthaus 1968)

*Nettastoma elongatum* Kotthaus 1968: 25, Figs. 116–118, 151 (Indian Ocean, 12°25' N, 43°28.8' W to 12°22.7' N, 43°29.2' E).

*Saurenehelys elongatum*: Manilo & Bogorodsky 2003.

Preanal length ~4.2, predorsal length ~9.3, HL ~10, and body depth ~35 in TL; snout length 2.7–3.1, eye diameter 9.1–11, and gill opening 14–22 in HL.

Colour in life unknown. Attains at least 32 cm TL.



*Saurenehelys elongatum*, 27 cm TL, holotype (Gulf of Aden).

Source: Kotthaus 1968

**DISTRIBUTION** WIO: Gulf of Aden and Kenya.

**REMARKS** Known from 60–243 m.

## FAMILY OPHICHTHIDAE

### Snake-eels, sand-eels and worm-eels

John E McCosker

Eels with body ranging from stout to extremely elongate, snake-like or worm-like; cylindrical anteriorly, and cylindrical or compressed posteriorly; tip of tail hard, pointed and finless (subfamily Ophichthinae, except *Echelus*) or soft and flexible, with distinct fin rays visible (subfamily Myrophinae). Dorsal fin and anal fin present or absent, rarely elevated; pectoral fins present or absent; no pelvic fins; caudal fin small or absent. Snout pointed or rounded, foreshortened in some species; mouth moderate to large, terminal or inferior. Nostrils widely separated; anterior nostrils usually in short tube, posterior nostrils of most species set along edge of upper lip or within mouth. Eyes rudimentary to well-developed. Teeth variable in number, shape and size (typically pointed, but also molariform or caniniform), and uniserial to multiserial; vomer with or without teeth. Gill openings midlateral to entirely ventral, ranging from constricted (subfamily Myrophinae) to an elongate slit (subfamily Ophichthinae). Gill cavity (branchial region) expanded and reinforced by numerous thin overlapping branchiostegal rays (visible on radiographs, by dissection or by shining a bright light through throat area). Lateral line complete, often with well-developed pores on head and body; right and left sides connected by supraorbital and temporal canal crossing top of head, and a median pore usually present in each canal. No scales. Swimbladder present, often reduced. Colour highly variable, from uniformly pale to dark, often darker dorsally, or with various patterns of spots, stripes, bands, bars or saddles. Total length (TL) is from tip of snout to tip of tail; head length (HL) is from tip of snout to gill

opening; trunk length is from gill opening to mid-anus; tail length is from mid-anus to tip of tail; body depth is measured just behind gill openings and does not include the dorsal fin. The vertebral formula (VF) or mean vertebral formula (MVF) is the number or mean number of predorsal, preanal and total vertebrae.

Ophichthids differ from other eels in having numerous overlapping branchiostegal rays, and most differ from most other eels in having the posterior nostrils on the edge of the lip or inside the mouth. (Some members of family Congridae, particularly garden eels of subfamily Heterocongrinae, also have a reduced caudal fin, but some caudal-fin rays are nearly always present and the tail tip is not hard and pointed; garden eels are also characterised by a short snout and prominent upturned flange on upper lip.) Species of subfamily Myrophinae have a caudal fin, but are distinguished from other eels by the position of their posterior nostrils, and, like species of subfamily Ophichthinae, by a median pore in the transverse supraorbital canal on the head.

Identification of ophichthid eels can be difficult due to their often small size and limited number of diagnostic characters. Important features are position of the dorsal-fin origin, condition of the tail tip, and configurations of the snout, nostrils and teeth. Vertebral counts, while not practical for field identification, are consistent within species and are important characters for defining species. The vertebral formula represents the number of predorsal, preanal and total vertebrae. In subfamily Ophichthinae, the vertebral formula for species with the dorsal-fin origin either on the head or before the nape (tribe Callechelyini) is designated as head, preanal and total vertebrae; for species without median fins (tribe Sphagebranchini) the preanal vertebrae are those anterior to mid-anus.

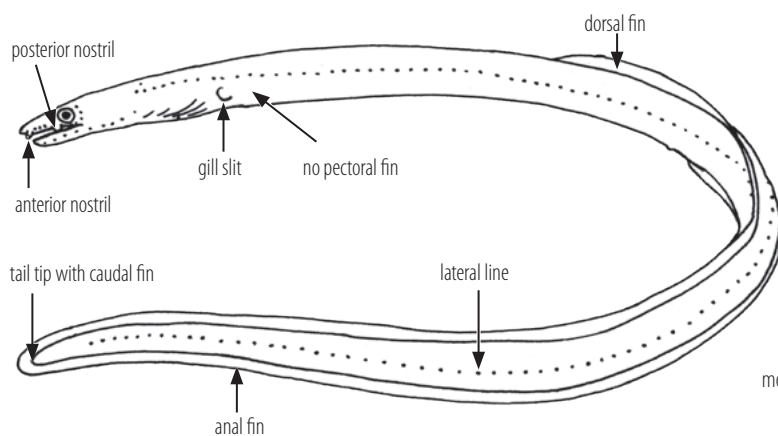


Diagram of a typical Myrophinae genus (*Scolecechelys*).

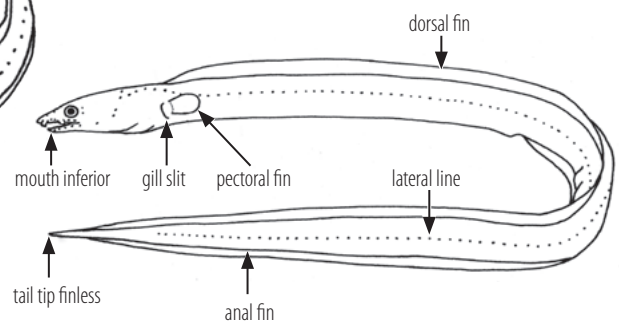


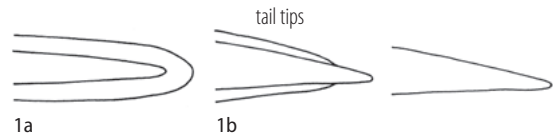
Diagram of a typical Ophichthinae genus (*Ophichthus*).

Occur in tropical, subtropical and temperate habitats, more commonly in continental waters than around islands. Almost all species are fossorial (not all species of *Benthenchelys*) and partly burrow in sandy, gravel or silty substrates (Ho *et al.* 2013), and are thus demersal nearshore, on coral reefs, and in rivers, streams and estuaries, from sandy intertidal areas to midwater depths of ~800 m or more, although most are demersal in depths shallower than 200 m. Often extremely abundant and probably important prey items for many piscivores. Their sharp snouts and tails and their often muscular and cylindrical bodies are well-adapted for burrowing, and many species spend most of their adult lives buried in shallow sedimentary substrates. Some forage over the bottom at night, and juveniles and adults are sometimes attracted to a light at the surface. Like all true eels, ophichthids have a pelagic leptocephalus larval stage, and they all spend some of their life at sea. Various larger species, particularly of subfamily Ophichthinae, are caught by trawl or hook-and-line; however, no directed fishery exists for them, as snake-eels are undesirable for human consumption because of their numerous intramuscular bones. Although not particularly aggressive, some of the larger snake-eels will bite if handled carelessly. Some species are boldly coloured and make interesting aquarium fish. Most reach ~1 m TL or less, but a few species attain ~2.5 m TL.

The most diverse and speciose family of true eels, with ~59 genera and at least 265 species; 29 genera and ~70 species in WIO. However, the diversity and taxonomy of ophichthids, particularly in the Indian Ocean, is not well known, and several species are known from single specimens. Several nominal species are listed in synonymies with a question mark, as their identification is more or less uncertain. And "*Leptocephalus*" *ophichthoides* D'Ancona 1928, from the Red Sea, has yet to be identified with an adult. Some confusion exists concerning eels originally described by JJ Kaup, as he published his generic and species descriptions twice in 1856, with different spellings for some species. Priority is given to the earlier treatment by Kaup (1856: *Uebersicht der Aale*) (mentioned in the preface of Kaup 1856: *Catalogue of the apodal fish in the collection of the British Museum*). It is important that specimens (particularly eels from deep water) that are not readily identifiable be deposited in museums for further study.

#### KEY TO GENERA

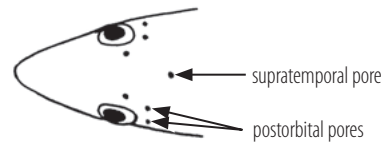
- 1a Tail tip flexible and caudal-fin rays covered by skin, but caudal fin present and confluent with dorsal fin and anal fin; gill openings either midlateral and constricted (opening diameter smaller than eye diameter), or along ventral third of flank and unconstricted (opening diameter larger than eye diameter) ..... 2
- 1b Tail tip a hard or fleshy finless point; gill openings unconstricted and midlateral to entirely ventral ..... 11



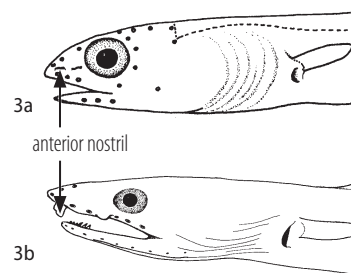
- 2a Gill openings ventral and unconstricted; no postorbital or supratemporal pores ..... *Echelus*



- 2b Gill openings midlateral and constricted; postorbital and supratemporal pores present ..... 3



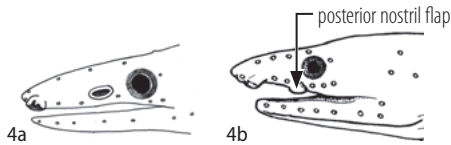
- 3a Eyes large: eye diameter subequal to snout length, ~6 times in HL; anterior nostrils non-tubular, and posterior nostrils on sides of snout; pectoral fins moderately developed ..... *Benthenchelys* [TRIBE BENTHENCHELYINI]
- 3b Eyes smaller: eye diameter at least twice in snout length, at least 10 times in HL; anterior nostrils tubular, and posterior nostrils either on sides of snout, along upper lip or within mouth; pectoral fins may be absent ..... 4 [TRIBE MYROPHINI]



Continued...

## KEY TO GENERA

- 4a Posterior nostrils before eyes, above upper lip, and not covered by flap; pectoral fins well-developed, longer than snout; preopercular pores 2 or 3 (2 in WIO species) ..... *Neenchelys*
- 4b Posterior nostrils either within upper lip and opening into mouth, or on upper lip and covered by flap; pectoral fins moderately developed, minute, or absent; preopercular pores 2 or 3 ..... 5



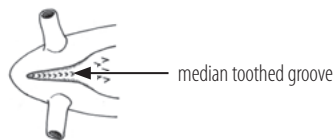
- 5a Pectoral fins present, moderately developed or minute; posterior nostrils within upper lip inside of mouth or along outer lip and covered by flap ..... 6
- 5b No pectoral fins; posterior nostrils on upper lip either inside or outside of mouth ..... 7
- 6a Pectoral fins minute but apparent; posterior nostrils on outer edge of lip and covered by flap ..... *Mixomyrophis*
- 6b Pectoral fins moderately developed; posterior nostrils within upper lip inside of mouth ..... *Myrophis*

- 7a Gill openings below lateral midline, their length subequal to distance between openings; posterior nostrils entirely outside of mouth, present as hole along upper lip preceded by flap; teeth conical and uniserial, and largest teeth as long as eye diameter ..... *Skythrenchelys*



- 7b Gill openings along lateral midline, constricted: their length distinctly less than distance between openings; posterior nostrils either along upper lip and preceded by flap, or inside upper lip and covered by flap, or entirely within mouth; teeth conical to blunt, uniserial to multiserial, and all teeth smaller than eye diameter ..... 8

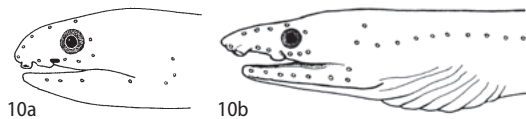
- 8a Underside of snout with prominent median toothed groove, extending between dermal folds and anterior nostril tubes; length of anterior nostril tube equal to eye diameter ..... *Schismorhynchus*



- 8b Underside of snout without median groove between dermal folds; anterior nostril tubes shorter than eye diameter ..... 9

- 9a Dorsal-fin origin behind vertical at anus; no teeth on vomer, intermaxillary teeth embedded or absent, and teeth on jaws minute or villiform ..... *Schultzidia*
- 9b Dorsal-fin origin before, at, or behind vertical at anus; teeth present on jaws and vomer ..... 10

- 10a Posterior nostrils a hole on outside of upper lip, preceded by flap; 1 pore on each side of snout between anterior and posterior nostrils; teeth blunt, in bands on jaws, and in broad patch across intermaxillary ..... *Muraenichthys*
- 10b Posterior nostrils on inside of upper lip, covered by flap; 2 pores on each side of snout between anterior and posterior nostrils; teeth usually conical, uniserial or biserial, and intermaxillary teeth not in broad patch ..... *Scolecenchelys*



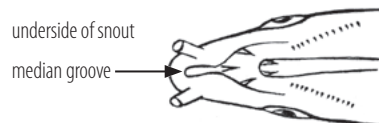
- 11a Dorsal fin generally elevated, its origin on nape; no pectoral fins; gill openings ventral, parallel or converging forward, and distance between gill openings less than their length ..... 12 [TRIBE CALLECHELYNI]



- 11b Dorsal-fin origin behind nape, or fin absent; pectoral fins present or absent; gill openings ventral or lateral ..... 13

- 12a Short crease in underside of snout not extending beyond bases of anterior nostrils; anteriormost intermaxillary teeth partially hidden by skin folds ..... *Xestochilus*

- 12b Median groove on underside of snout extends past anterior nostrils; anteriormost intermaxillary teeth exposed ..... *Callechelys*



- 13a No pectoral fins or fins vestigial; median fins reduced or absent; no large dark spots, stripes or saddles on body ..... 14

- 13b Pectoral fins generally as large as or larger than eye diameter (fins present as a small flap in two genera); median fins usually distinct; colouration spotted or striped ..... 20

[TRIBE OPICHTHINI]

Continued ...

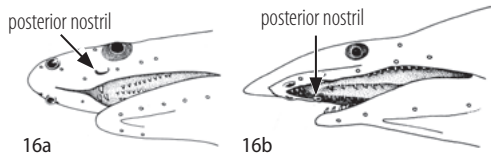


**KEY TO GENERA**

- 14a Gill openings ventral or nearly so; head pores distinct; fins present or absent ..... 15 [TRIBE SPHAGEBRANCHINI]
- 14b Gill openings midlateral, crescentic; head pores reduced; at least dorsal fin present ..... 19 [TRIBE BASCANICHTHYINI]

- 15a No fins ..... 16
- 15b Median fins present, although sometimes low and difficult to see ..... 17

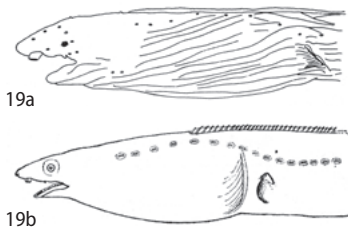
- 16a Posterior nostrils outside of mouth and with flap; anterior nostrils tubular; eyes moderately developed; preopercular pores 3 ..... *Apterichtus*
- 16b Posterior nostrils inside of mouth, with or without flap; anterior nostrils not tubular; eyes minute; preopercular pores 4 ..... *Ichthyapus*



- 17a Head narrows from occiput to just behind eyes, then continues evenly to slender pointed snout tip; body depth at gill openings 28–42 in TL; teeth on vomer large, recurved, uniserial ..... *Lamnostoma*
- 17b Head profile narrows evenly from posterior of head to snout; body more elongate, body depth at gill openings 41–50 in TL; teeth on vomer conical, not enlarged ..... 18

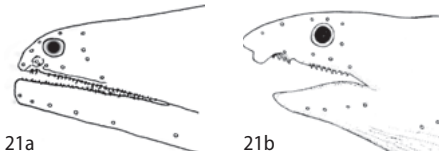
- 18a Anterolateral edge of gill openings with deep pouch; top of head nearly flat behind eyes ..... *Caecala*
- 18b Gill openings without deep pouch; head profile convex ..... *Yirrkala*

- 19a Dorsal-fin origin on nape, and fin length ~3–4 times HL; no pectoral fins or anal fin; tail length shorter, 3.2–3.4 in TL ..... *Phaenomonas*
- 19b Median fins extend nearly to tip of tail; pectoral fins minute, lappet-like at upper end of gill openings; tail long, ~1.8–2 in TL ..... *Bascanichthys*

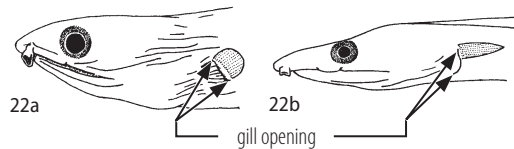


- 20a Upper lip with conspicuous fringe of short cirri ..... 21
- 20b Upper lip entire (smooth-edged), although nostril flaps may be present ..... 22

- 21a Snout short and blunt, its length subequal to eye diameter; upper and lower jaws subequal; lower lip fringed; large canine teeth on jaws and vomer; tail length roughly ~½ TL ..... *Brachysomophis*
- 21b Snout conical, length more than twice eye diameter; lower jaw shorter than upper jaw; no fringe on lower lip; teeth small and slender; tail length >½ TL ..... *Cirrhimuraena*

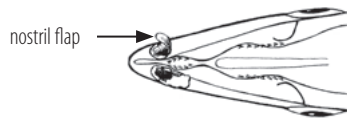


- 22a Teeth blunt, molariform or granular; pectoral-fin base extends along entire gill opening ..... 23
- 22b Teeth pointed; pectoral-fin base restricted to upper half of gill opening ..... 24



- 23a Dorsal-fin origin above or behind gill openings; pectoral fins well-developed; preopercular pores usually 3 ..... *Pisodonophis*
- 23b Dorsal-fin origin well in advance of gill openings; pectoral fins rudimentary; preopercular pores 2 ..... *Myrichthys*

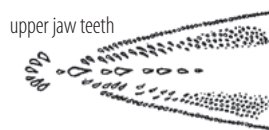
- 24a Conspicuous leaf-like flap on anterior nostrils; no teeth on vomer ..... *Phyllophichthus*



- 24b No leaf-like flap on nostrils; teeth usually present on vomer ..... 25

- 25a No teeth on vomer, or with at most 1–3 small embedded teeth; tail slightly less than half TL ..... *Leiuranus*
- 25b Teeth on vomer uniserial or multiserial; tail either longer or shorter than half TL ..... 26

- 26a Tail slightly ≤½ TL; upper jaw with outer row of small teeth and inner row of larger teeth in multiserial patch broadening posteriorly ..... *Xyrias*

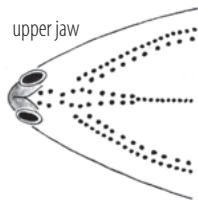


- 26b Tail >½ TL; upper jaw with 1–3 rows of teeth, not forming broad patch ..... 27

Continued...

## KEY TO GENERA

- 27a Snout elongate, slender, but swollen at tip, its length 3–5 in HL (varies with age); jaws of adults incapable of closing completely; dorsal-fin origin ~1–2 pectoral-fin lengths behind pectoral fins ..... *Ophisurus*
- 27b Snout overhanging lower jaw, its length 4–5 in HL; jaws not particularly slender and elongate ..... 28
- 28a Body extremely elongate, its depth ~80 times in TL; dorsal-fin origin in anterior trunk region; eyes large, eye diameter ~2.5 in snout length, and rear margin above corner of jaw; vomer with single tooth; body uniformly grey-black, only slightly darker dorsally ..... *Luthulenchelys*
- 28b Body usually not extremely elongate, its depth 20–50 times in TL (except ~60 times in TL in one questionable species); dorsal-fin origin ranging from over rear of head to front of trunk; eyes smaller, eye diameter generally >2.5 in snout length, and rear margin in advance of corner of jaw; vomer with many teeth; colouration variable, often marked, but generally uniform and darker dorsally ..... *Ophichthus*

GENUS *Apterichtus* Duméril 1806

(subfamily OPHICHTHINAE, tribe Sphagebranchini)

No fins. Snout acute, flat on underside; anterior nostrils tubular, and posterior nostrils outside of mouth and with flap. Gill openings ventral, converging forward. Preopercular pores 3 or 4 (WIO species with 3 pores). Revised by McCosker & Hibino (2015), 18 species; 1 species widespread in WIO, plus possibly 1 species at Seychelles.

## KEY TO SPECIES

- 1a Tail length  $> \frac{1}{2}$  TL; HL 17–20 in TL; vertebrae 154–166 ..... *A. flavicaudus*
- 1b Tail length  $< \frac{1}{2}$  TL; HL 12–14 in TL; vertebrae 131–142 ..... *A. klazingai*

*Apterichtus flavicaudus* (Snyder 1904)

Yellowtail sand-eel

PLATE 16

*Sphagebranchus flavicaudus* Snyder 1904: 516, Pl. 2, Fig. 4 (Auau Channel, between Maui and Lanai Is., Hawaii).

*Apterichtus flavicaudus*: McCosker 1977; Randall 2007.

Diagnosis as for genus. HL 17–20, body depth 43–66, and tail length 2.1–2.2 in TL. Teeth small, conical, uniserial on jaws and vomer. Vertebrae 154–166; MVF –/77/158.

Body tan, with numerous minute brown to dark brown spots on head, body and tail; white slash behind eyes to corner of jaw. Attains 57 cm TL.

**DISTRIBUTION** Western and central Pacific (including southeastern Australia and Hawaii) and possibly Seychelles in WIO (specimens not identifiable with certainty).

**REMARKS** Found in shallow sandy areas near reefs and in seagrass beds; trawled from 30–290 m.

*Apterichtus klazingai* (Weber 1913)

Sharpsnout sand-eel

PLATE 16

*Sphagebranchus klazingai* Weber 1913: 47, Fig. 9 (Banda Sea, Indonesia).

*Apterichtus klazingai*: McCosker 1977; SSF No. 42.1\*; Randall & Anderson 1993.

HL 12–14, body depth 45–72, and tail length 1.8–1.9 in TL. Teeth small, conical, uniserial on jaws and vomer. Vertebrae 132–141; MVF –/58/138.

Body buff background, with numerous small round brown spots on head, body and tail. Attains 44 cm TL.



*Apterichtus klazingai*, 39 cm TL. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal), Seychelles (Mahé), Comoros, Mascarenes and Maldives; elsewhere to Indonesia, New Caledonia, Fiji and Hawaii.

**REMARKS** Found on shallow sandy areas, in seagrass beds, and over coral and shell rubble, to ~50 m deep.

GENUS *Bascanichthys* Jordan & Davis 1891

(subfamily OPHICHTHINAE, tribe Bascanichthyini)

Slender-bodied and elongate; tail long, at least half of TL. Dorsal fin arises on nape; pectoral fins lappet-like and barely noticeable at upper corner of gill opening. Snout extends well in front of lower jaw; anterior nostrils tubular, and posterior nostrils open into mouth. Teeth small, conical, uniserial on jaws, and in 1 or 2 rows on vomer. Gill openings low-lateral, crescentic. At least 12 species, 1 in WIO.

*Bascanichthys kirkii* (Günther 1870)

Longtailed sand-eel

PLATE 16

*Ophichthys kirkii* Günther 1870: 89 (Rovuma Bay, Mozambique).

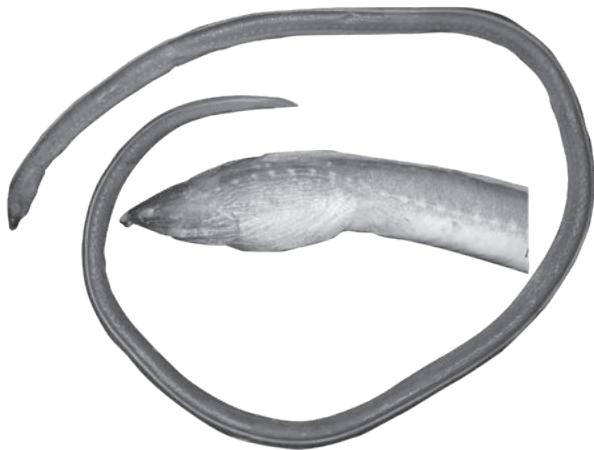
*Callechelys kirkii*: Deraniyagala 1952.

*Caecula kirkii*: Smith 1962\*.

*Bascanichthys kirkii*: McCosker 1977; SSF No. 42.2\*; Manilo & Bogorodsky 2003.

Diagnosis as for genus. HL 17–21, body depth 63–90, and tail length 1.8–2 in TL. Vertebrae 193–202.

Body olive dorsally, paler ventrally; lateral-line pores in white spots; fins pale. Attains 69 cm TL.



*Bascanichthys kirkii* (Taiwan). © H-C Ho, NMMB-P

**DISTRIBUTION** WIO: Gulf of Oman to South Africa (KwaZulu-Natal), India and Sri Lanka; elsewhere to Taiwan.

**REMARKS** Found in shallow sandy areas and estuaries. Possibly a junior synonym of *Bascanichthys longipinnis* (Kner & Steindachner 1867) from New Guinea and Samoa.

GENUS *Benthenchelys* Fowler 1934

(subfamily MYROPHINAE, tribe Benthenchelyini)

Body laterally compressed behind head; tail much longer than half TL. Dorsal-fin origin above anus; median fins continuous around tail tip; pectoral fins moderately developed. Eyes relatively large, eye diameter subequal to snout length. Snout blunt; nostrils simple, with slightly raised rims: anterior nostrils near tip of snout, and posterior nostrils crescentic, in front of and slightly below middle of eyes. Teeth conical, recurved, uniserial on jaws and vomer. Gill openings midlateral, constricted. Revised by Castle (1972). One species.

*Benthenchelys cartieri* Fowler 1934

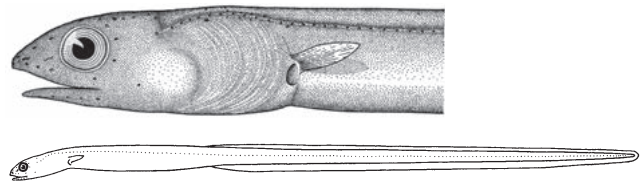
Pelagic snake-eel

*Benthenchelys cartieri* Fowler 1934: 267, Fig. 29 (between Panay and Negros Is., Philippines); McCosker 1977.

*Benthenchelys cartieri indicus* Castle 1972: 10 (northern Indian Ocean).

Diagnosis as for genus. HL 9–12, body depth 24–42, and tail length 1.4–1.6 in TL. Vertebrae 168–172.

Preserved specimens buff overall, but darker along abdomen and with scattered melanophores along lateral line. Attains 14 cm TL.



*Benthenchelys cartieri*, 12 cm TL, male holotype of *B. c. indicus* (N Indian Ocean). Source: Castle 1972

**DISTRIBUTION** Indo-Pacific. Northern Indian Ocean to central Pacific.

**REMARKS** Three subspecies are recognised: from the central Pacific, Sulu Sea, and northern Indian Ocean (Castle 1972). Males mature by ~12 cm TL. Apparently pelagic, as adults have been found only in midwater, at ~100–250 m.

GENUS *Brachysomophis* Kaup 1856

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body cylindrical, moderately elongate; tail length roughly half TL. Median fins distinct but terminating before tail tip. Eyes protuberant, in front of mid-jaw. Snout short, blunt; jaws

elongate, subequal; lower lip fringed; anterior nostrils a short fleshy tube on sides of snout about halfway between snout tip and eyes; posterior nostrils on edge of upper lip below front margin of eyes and hidden by flap. Teeth conical, in 1 or 2 rows on jaws, and fang-like and uniserial teeth on vomer. Gill openings low-lateral, crescentic. Revised by McCosker & Randall (2001). Seven species, 3 in WIO.

## KEY TO SPECIES

- 1a Tail  $\geq 50\%$  TL; body pale, with irregular brown smudges dorsally and along flanks ..... *B. cirrocheilos*  
 1b Tail  $\sim 40\text{--}50\%$  TL; body pale, darker dorsally, and with small or large spots (no irregular blotches or smudges) ..... 2
- 2a Head profile behind eyes relatively even, not deeply incised; snout short, 13–19 in HL; cirri on upper lip numerous, slender and elongate ..... *B. crocodilinus*  
 2b Head profile behind eyes deeply transversely incised; snout longer,  $\sim 8\text{--}11$  in HL; cirri on upper lip stubby, not numerous ..... *B. henshawi*

*Brachysomophis cirrocheilos* (Bleeker 1857)

Smudged snake-eel

PLATE 16

*Ophisurus cirrocheilos* Bleeker 1857: 89 (Ambon I., Moluccas, Indonesia).

*Ophichthys cirrochilus* Günther 1870: 65 [apparently intended as emendation of *Ophisurus cirrocheilos* Bleeker 1857].

*Brachysomophis cirrhocheilus*: Deraniyagala 1952\*.

*Brachysomophis cirrocheilos*: McCosker & Randall 2001\*; Manilo & Bogorodsky 2003.

Diagnosis as for genus. HL 7.1–9.1, body depth 20–34, and tail length 1.7–2 in TL; snout length 7.7–10 in HL. Cirri on upper lip well-developed, with cauliflower-like tips. Vertebrae 135–140; MVF 22/60/137.

Body pale background, with irregular brown smudges dorsally and along flanks. Attains 159 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Oman, Red Sea to Mozambique; elsewhere to Indonesia, Taiwan, Japan, New Guinea and Australia.

**REMARKS** Found on sandy bottom, at 2–38 m.

*Brachysomophis crocodilinus* (Bennett 1833)

Crocodile snake-eel

PLATE 16

*Ophisurus crocodilinus* Bennett 1833: 32 (Mauritius, Mascarenes [Ambon I., Moluccas, Indonesia]).

*Brachysomophis horridus* Kaup 1856: 45 (Tahiti, Society Is.); also Kaup 1856: 9, Pl. 1, Fig. 6.

*Brachysomophis crocodilinus*: SSF No. 42.3\*; McCosker & Randall 2001\*; Randall 2005\*.

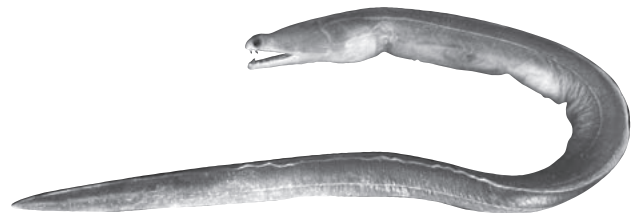
HL 6.2–7.7, body depth 25–40, and tail length 2.1–2.3 in TL; snout short, 13–19 in HL. Cirri on upper lip numerous, unbranched and slender, branched posteriorly. Vertebrae 116–124; MVF 16/60/120.

Body orange to brown dorsally, yellowish ventrally; lateral line and head pores typically in dark spots; fins pale. Attains 82 cm TL.



*Brachysomophis crocodilinus*, 57 cm TL, holotype of *B. sauropsis*, head with detail of upper left labial fringe (American Samoa).

Source: McCosker & Randall 2001



*Brachysomophis crocodilinus*, 14 cm TL (Aldabra). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania to South Africa (KwaZulu-Natal), Madagascar, Comoros, Aldabra, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to Indonesia, southern Japan, Micronesia, northern Australia, Tahiti and Johnston Atoll.

**REMARKS** Inhabits shallow water, to  $\sim 30$  m deep.



***Brachysomophis henshawi*** Jordan & Snyder 1904

Reptilian snake-eel

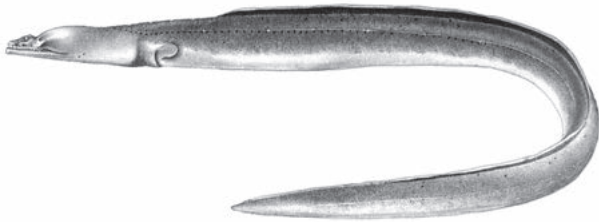
PLATE 16

*Brachysomophis henshawi* Jordan & Snyder 1904: 940 (Honolulu, Oahu I., Hawaii); McCosker & Randall 2001; Manilo & Bogorodsky 2003.

*Brachysomophis crocodilinus* (non Bennett 1933): Randall 1995\*, 2005\*.

HL 6.2–7.7, body depth 19–32, and tail length 2.1–2.2 in TL; snout length 8–11 in HL. Cirri on upper lip stubby, not numerous. Vertebrae 124–134; MVF 19/64/130.

Body mottled pale pinkish and brownish; head colour variable: individuals with pink, yellow, orange or red heads have been observed; irregular zigzag pattern of white spots on sides of head, and 5 or 6 white spots on sides of lower jaw; each LL pore in dark spot, and other small scattered dark brown spots above lateral line; dorsal fin of adults with dark stripe basally, and pale blue or white margin. Attains 101 cm TL.



*Brachysomophis henshawi*, 50 cm TL, holotype (Hawaii).

Source: Jordan & Evermann 1905

**DISTRIBUTION** Indo-Pacific. WIO: Oman (Arabian Sea) and Rodrigues; elsewhere to Indonesia, southern Japan, northern Australia, Society Is., Marquesas Is. and Hawaii.

**REMARKS** Found on reefs and partly buried in shallow sand, to ~35 m deep.

**GENUS *Caecula*** Vahl 1794

(subfamily OPHICHTHINAE, tribe Sphagebranchini)

Body cylindrical; tail length subequal to rest of body, tail tip hard. Dorsal fin and anal fin low but distinct; dorsal-fin origin ~1 gill-opening length behind gill slit. No pectoral fins. Gill openings ventral, converging anteriorly, with extra fold of skin forming pouch along anterolateral edge of gill slit. Eyes very small, covered by skin; eye diameter ~3 in snout length, ~22 in HL. Snout pointed, depressed, broad dorsally and projecting in front of lower jaw; underside of snout with 2 ridges diverging posteriorly and straddling premaxillary groove; an ear-shaped low crater with papilla on front of medial margin, and triangular flap on rear part of lateral margin. Anterior nostrils a downward-facing tube, lateral to each ridge under snout;

posterior nostrils an inconspicuous slit in upper lip before eyes, covered by flap with posteroventrally directed small external papilla. Teeth conical, uniserial on jaws and vomer. One species currently recognised.

***Caecula pterygera*** Vahl 1794

Duckbill snake-eel

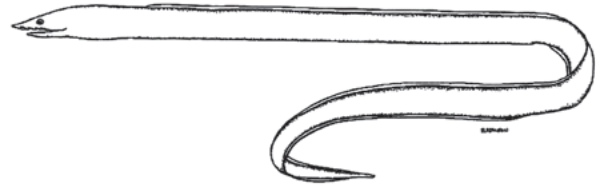
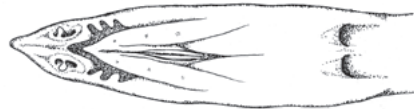
*Caecula pterygera* Vahl 1794: 153, Pl. 13 (East Indies [?]); Smith 1965\*, 1966; Manilo & Bogorodsky 2003.

*Sphagebranchus rostratus* Bloch 1795: 88, Pl. 419, Fig. 2 (East Indies [Suriname]).

*Ophichthys orientalis* (non McClelland 1844): Day 1878.

Diagnosis as for genus. HL 8.4–9.2, body depth 30–42, and tail length 1.9–2 in TL. LL pores 50–55 from end of head to anus; total LL pores (head to tip of tail) 118–125. Vertebrae 126–130; MVF 10/57/129.

Body olive-grey dorsally, fading to white ventrally; preserved specimens uniformly tan, slightly paler ventrally, and median fins pale. Attains 36 cm TL.



*Caecula pterygera*, 27 cm TL, and ventral view of head (E India).

Drawn by B Atkinson; courtesy of CAS

**DISTRIBUTION** WIO: South Africa (Kosi Bay), southern India and Sri Lanka; elsewhere, eastern India.

**REMARKS** Known from turbid waters of estuaries and shallow sand flats.

**GENUS *Callechelys*** Kaup 1856

(subfamily OPHICHTHINAE, tribe Callechelyini)

Body compressed posteriorly. Dorsal-fin origin on nape; no pectoral fins. Median groove on underside of snout extends past bases of anterior nostrils. Anterior nostrils in fleshy tube

near tip of snout; posterior nostrils a slit in upper lip below front edge of eyes, opening into mouth. Teeth conical and slender, in 1 row on jaws, and in 1 or 2 rows on vomer. Gill openings low-lateral to entirely ventral, converging forward, their length much greater than distance between them. Fifteen species (McCosker 1998; McCosker *et al.* 2011), 3 in WIO.

## KEY TO SPECIES

- |    |   |                      |
|----|---|----------------------|
| 1a | Distinct fleshy ridge from snout tip to dorsal-fin origin; teeth on vomer biserial; body yellow to tan background speckled with blackish brown coalescing spots ..... | <i>C. marmorata</i>  |
| 1b | No fleshy ridge on head; vomer with few teeth, not biserial; bold stripes along body .....  | 2                    |
| 2a | Tail short, its length 3.2–3.6 in TL .....  | <i>C. catostoma</i>  |
| 2b | Tail longer, its length 2.5–2.7 in TL .....   | <i>C. bitaeniata</i> |

*Callechelys bitaeniata* (Peters 1877)

Bicoloured snake-eel

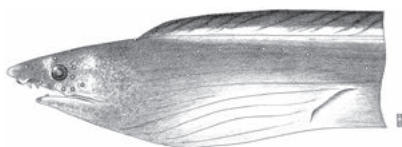
*Ophichthys bitaeniatus* Peters 1877: 556, Pl., Fig. 2 (Mombasa, Kenya).

*Callechelys bitaeniatus*: Storey 1939; Smith 1962\*; McCosker 1998\*.

*Callechelys canaliculatus* Smith 1958: 836, Pl. 27, Figs. A, B (Pinda, Mozambique).

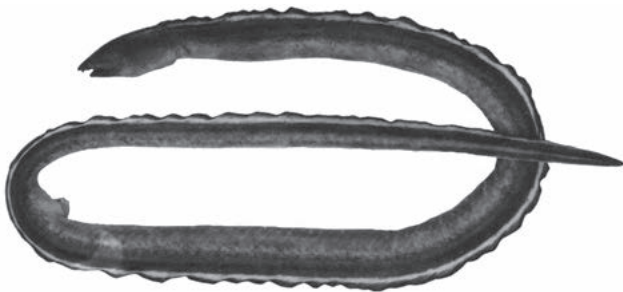
Diagnosis as for genus. HL 14–17, body depth 48–60, and tail length 2.5–2.7 in TL. Teeth on jaws uniserial; 2 pairs of large fangs on intermaxillary, and 3–5 fangs on vomer. Vertebrae 185–194; MVF –/109/189.

Body pale, with wide dark brown stripe dorsally, from dorsal-fin origin to tail tip, broadening on tail to cover whole sides; dorsal-fin base pale yellow, and margin dark brown to black; anal fin pale. Attains 82 cm TL.



*Callechelys bitaeniata*, ~56 cm TL, head (Mozambique).

Source: McCosker 1998 (by M Brown); courtesy of CAS



*Callechelys bitaeniata*, 79 cm TL, ripe female holotype of *C. canaliculatus* (N Mozambique). Source: Smith 1958

**DISTRIBUTION** WIO: Kenya to Mozambique, Aldabra and Seychelles.

**REMARKS** Inhabits seagrass beds and burrows in shallow sand.

*Callechelys catostoma* (Schneider 1801)

Blackstriped snake-eel

PLATE 16

*Sphagebranchus catostomus* Schneider (ex Forster) in Bloch & Schneider 1801: 536 (lagoon at Moorea, Tahiti, Society Is.) [based on Forster manuscript].

*Callechelys striatus* Smith 1958: 838, Pl. 27, Fig. C (Pinda, Mozambique); Smith 1962\*.

*Callechelys catostomus*: Randall & Anderson 1993; Winterbottom & Anderson 1997.

*Callechelys catostoma*: McCosker 1998\*; Randall 2005\*.

Diagnosis as for genus. HL 14–19, body depth 44–73, and tail length 3.2–3.6 in TL. Teeth on jaws uniserial; 2 large anterior fangs on intermaxillary between anterior nostrils, and 1 or 2 fangs on vomer. Vertebrae 195–205; MVF –/130/199.

Body cream-coloured, with broad lateral dark brown or black band; vent and median fins pale, but dorsal fin with thin dark margin. Attains 77 cm TL.



*Callechelys catostoma*, 47 cm TL, holotype of *C. striatus* (N Mozambique). Source: Smith & Smith 1963

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to Mozambique, Aldabra, Mauritius, Chagos and Maldives; elsewhere to southern Japan, western Australia, New Caledonia, Lord Howe I., Austral Is., Marshall Is. and probably Hawaii.

**REMARKS** Found in sandy areas, at 2–32 m.

*Callechelys marmorata* (Bleeker 1854)

Marbled snake-eel

PLATE 16

*Dalophis marmorata* Bleeker 1854: 247 (Sibolga, Sumatra, Indonesia).

*Callechelys marmoratus*: Smith 1962\*.

*Callechelys marmorata*: SSF No. 42.4\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993\*; McCosker 1998\*; Manilo & Bogorodsky 2003; Randall 2005\*; McCosker *et al.* 2011.

Diagnosis as for genus. HL 10–16, body depth 31–50, and tail length 2.7–2.9 in TL. Teeth on jaws uniserial; teeth on vomer neatly biserial, followed by 1 or 2 smaller teeth. Vertebrae 174–183; MVF –/109/180.

Body yellow to cream, with dark brown to black spots on body and fins, and head with smaller spots and freckles; fin margins mostly black. Attains 87 cm TL.



*Callechelys marmorata*. Source: Bleeker 1864

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Aldabra, Mauritius, Maldives and Chagos; elsewhere to Indonesia, Taiwan, New Caledonia and Society Is.

**REMARKS** Collected from sand and rubble bottom and in tidepools, to ~37 m deep.

**GENUS** *Cirrhimuraena* Kaup 1856

(subfamily OPHICHTHINAE, tribe Ophichthini)

Tail length more than half TL. Dorsal-fin origin on head or above gill openings; pectoral fins small or well-developed. Anterior nostrils tubular; posterior nostrils open into mouth. Upper lip with numerous cirri (no fringe on lower lip). Teeth small and slender. Gill openings small, in front of lower end of pectoral-fin bases. About 7 species, 2 in WIO.

**KEY TO SPECIES**

- |    |  |                      |
|----|--|----------------------|
| 1a | Pectoral fins elongate, 1.8–2 in HL; HL 2–2.2 in trunk length .....  | <i>C. inhacae</i>    |
| 1b | Pectoral fins shorter, 3.5–3.8 in HL; HL 3–3.8 in trunk length ..... | <i>C. playfairii</i> |

*Cirrhimuraena inhacae* (Smith 1962)

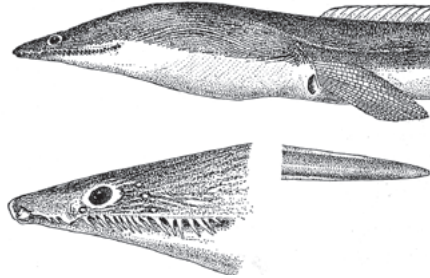
Inhaca fringelip eel

*Jenkinsiella inhacae* Smith 1962: 449, Fig. 1, Pl. 66d–e (Inhaca I., Mozambique).

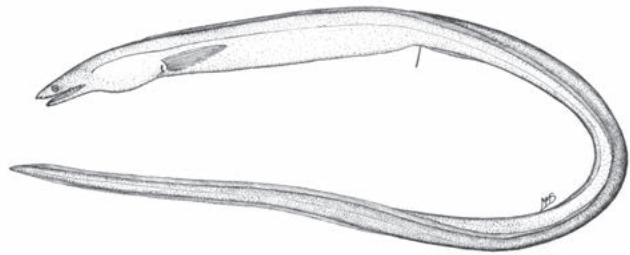
*Cirrhimuraena inhacae*: McCosker 1977; SSF No. 42.5\*.

Diagnosis as for genus. HL 9.5–10, body depth 28–30, and tail length ~1.4 in TL. Teeth small and slender, uniserial at front of jaws, biserial posteriorly; vomerine teeth biserial anteriorly, uniserial posteriorly. Vertebrae 166 or 167; MVF 8/46/166.

Preserved specimens dark brown, paler ventrally. Attains 23 cm TL.



*Cirrhimuraena inhacae*, anterior body; head detail showing labial cirri; and tip of tail. Source: Weber & De Beaufort 1916



*Cirrhimuraena inhacae*, 19 cm TL, holotype (S Mozambique). Source: SSF

**DISTRIBUTION** WIO: Mozambique, Madagascar and Comoros.

**REMARKS** Known from mangroves and shallow sandy areas. Possibly a junior synonym of the widespread Indo-Pacific species *Cirrhimuraena cheilopogon* (Bleeker 1860).

*Cirrhimuraena playfairii* (Günther 1870)

Fringelip snake-eel

PLATE 17

*Ophichthys playfairii* Günther 1870: 76 (Zanzibar, Tanzania).

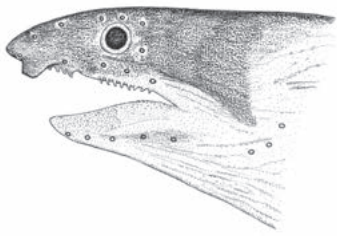
*Ophichthys arenicola* Klunzinger 1871: 609 (Al-Qusayr, Egypt, Red Sea).

*Jenkinsiella playfairii*: Smith 1962\*.

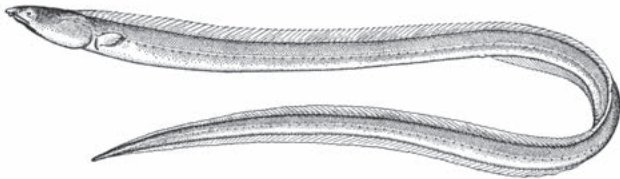
*Cirrhimuraena playfairii*: SSF No. 42.6\*.

Diagnosis as for genus. HL 11–14, body depth 35–40, and tail length ~1.5 in TL. Teeth small and slender, uniserial on jaws, and vomerine tooth patch broadening posteriorly. Vertebrae 179–187; MVF 3/62/182.

Body olive-brown, paler ventrally. Attains 39 cm TL.



*Cirrhimuraena playfairii*,  
29 cm TL, head (Aldabra).  
Source: SSF



*Cirrhimuraena playfairii*, ~26 cm TL, holotype of *Microdonophis macgregori* (Hawaii). Source: Jenkins 1903

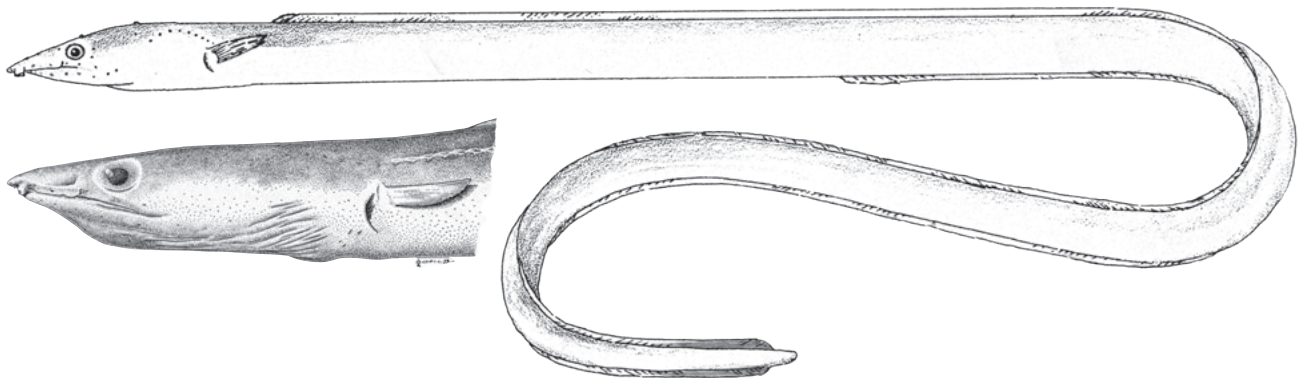
**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to South Africa (Kosi Bay), Comoros, Aldabra, Seychelles and Sri Lanka; elsewhere to Marquesas Is. and Hawaii.

**REMARKS** Known from shallow sandy areas.

## GENUS *Echelus* Rafinesque 1810

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body compressed posteriorly; tail length more than half TL. Dorsal-fin origin above pectoral-fin tips; median fins continuous at tail tip but caudal rays covered by skin. Snout conical, with median groove on underside. Anterior nostrils fleshy, tubular, near snout tip; posterior nostrils on upper lip in front of eyes, covered by lateral flap. No postorbital or supratemporal pores. Gill openings unstricted, nearly vertical, on lower third of body. Three species, 1 in WIO.



*Echelus uropterus*, lateral view; head of 43-cm-TL specimen (Mozambique Channel). Source: McCosker 1999 (lateral view); Karrer 1983 (head)

## *Echelus uropterus* (Temminck & Schlegel 1846)

Harelip snake-eel

PLATE 17

*Conger uropterus* Temminck & Schlegel 1846: 261 (Nagasaki, Japan).

*Myrophis uropterus*: Bleeker 1858.

*Echelus uropterus*: Jordan, Tanaka & Snyder 1913; Karrer 1983\*.

*Ophichthys unicolor* Regan 1908: 250, Fig. 1 (NE of Bird I., South Africa).

*Ophichthys triserialis* Barnard 1923: 444 (Algoa Bay, South Africa)

[secondarily preoccupied in *Ophichthys* by *Muraenopsis triserialis* Kaup 1856].

*Ophichthys algoensis* Barnard 1925: 498 [replacement name for *Ophichthys triserialis* Barnard 1923, preoccupied].

*Rhinophichthys unicolor*: McCosker 1999\*.

HL 8.3–8.7, body depth 31–52, and tail length 1.6–1.7 in TL. Eyes large, rear margin above rictus. Teeth numerous, small and blunt, in 2 or 3 irregular rows on jaws and vomer, and slightly sharper on outer row of jaws. Vertebrae 150–162; MVF 13/47/158.

Body uniformly tan, paler ventrally, and belly white; median fins colourless except black near tail tip. Attains 60 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: South Africa, Mozambique, Mozambique Channel, Madagascar and Aldabra; elsewhere to Taiwan, China, Japan, Micronesia, Australia and Tonga.

**REMARKS** Captured by trawl or dredge at 120–380 m. *Ophichthys unicolor* Regan and *O. triserialis* Barnard (and its replacement name *O. algoensis* Barnard), known only from two small and damaged holotypes, were provisionally referred to *Rhinophichthys* (McCosker 1999: 581). Subsequent examination of the holotype of *Conger uropterus* showed that it is the senior synonym of *O. unicolor* and *O. triserialis*.



GENUS *Ichthyapus* Brisout de Barneville 1847

(subfamily OPHICHTHINAE, tribe Sphagebranchini)

Body cylindrical, elongate; tail length slightly more than half TL. No fins. Eyes minute. Snout subconical, flat on underside, projecting well ahead of lower jaw. Anterior nostrils flush with snout (not tubular); posterior nostrils a slit in upper lip in front of eyes. Preopercular pores 3 or 4 (4 in WIO species). Teeth sharp, recurved, and uniserial on jaws and vomer. Gill openings ventral, longitudinal, converging forward. About 7 or 8 species, plus at least 2 undescribed; at least 2 species in WIO.

KEY TO SPECIES

- 1a Tail length 1.9–2 in TL; HL 7.8–8.7 in TL; vertebrae 101–108 ..... *I. acuticeps*
- 1b Tail length 1.6–1.8 in TL; HL 8.3–10.5 in TL; vertebrae 124–134 ..... *I. vulturis*

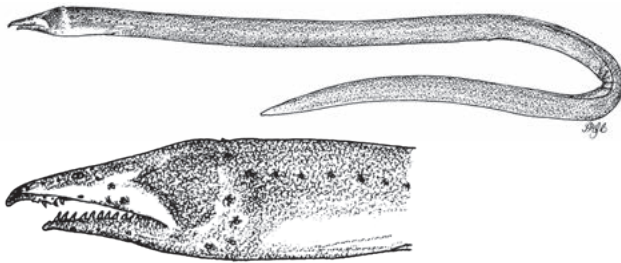
*Ichthyapus acuticeps* (Barnard 1923)

Sharpnose sand-eel

*Sphagebranchus acuticeps* Barnard 1923: 444 (off Thukela River mouth, KwaZulu-Natal, South Africa).  
*Caecula orientalis* (non McClelland 1844): Smith 1949.  
*Caecula acuticeps*: Smith 1962\*.  
*Ichthyapus acuticeps*: McCosker 1977; SSF No. 42.7\*.

Diagnosis as for genus. HL 7.8–8.7, body depth 34–50, and tail length 1.9–2 in TL. Vertebrae 101–108.

Body buff, paler ventrally; tip of snout dark, and darker markings on head. Attains 40 cm TL.



*Ichthyapus acuticeps*, 31 cm TL. Source: SSF

**DISTRIBUTION** WIO: endemic to South Africa (Thukela River to Durban, KwaZulu-Natal).

**REMARKS** Very similar to *Ichthyapus vulturis*, widespread in Indo-Pacific. Inhabits sandy or silty-sand bottom, at 40–110 m. The population off Durban (with 113–119 vertebrae and MVF –/46.5/116.5) may be a different species.

*Ichthyapus vulturis* (Weber & De Beaufort 1916)

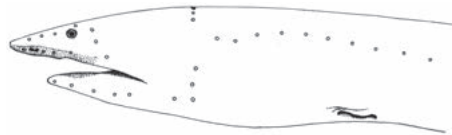
Vulture sand-eel

PLATE 17

*Sphagebranchus vulturis* Weber & De Beaufort 1916: 319 (Nasi Besar I., Sumatra, Indonesia).  
*Ichthyapus vulturis*: McCosker 1977, 2004.

Diagnosis as for genus. HL 8.3–10.5, body depth 32–42, and tail length 1.6–1.8 in TL. Vertebrae 124–134; MVF –/47/130.

Body buff, paler ventrally. Attains 45 cm TL.



*Ichthyapus vulturis*. Redrawn from Hatooka *et al.* 1995

**DISTRIBUTION** Indo-Pacific. WIO: Kenya (off Mombasa), Aldabra and Seychelles; elsewhere widespread to Indonesia, southern Japan, New Caledonia and Hawaii.

**REMARKS** Found in shallow sandy areas, at 1–5 m. Several species in the Indo-Pacific comprise the '*Ichthyapus vulturis* complex' (McCosker 2004).

GENUS *Lamnostoma* Kaup 1856

(subfamily OPHICHTHINAE, tribe Sphagebranchini)

Head bulbous posteriorly, narrowing sharply to eyes and to narrow pointed snout. No pectoral fins; dorsal-fin origin above or just behind gill openings. Anterior nostrils flush along snout; posterior nostrils on inside of upper lip. Teeth slender, pointed and recurved, uniserial on jaws and vomer. Gill opening a longitudinal slit with fold of skin alongside it on underside of head. This genus requires revision. It is likely that *Muraena fusca* Zuiw 1793 (type locality not given; holotype lost) and *Sphagebranchus brevirostris* Peters 1855 (from Mozambique Channel) are synonyms of either *Lamnostoma polyophthalma* or *L. orientale*. About 5 species, 3 in WIO (1 of these undescribed).

KEY TO SPECIES

- 1a Prominent pendulous barbel on upper lip between posterior nostril and eye; pale spots behind eyes and across nape; dorsal-fin origin ~¼ HL behind gill openings ..... 2
- 1b Small barbel on upper lip between posterior nostril and eye; pale spots on dorsal body but none on head; dorsal-fin origin above or slightly behind gill openings ..... *L. orientale*

Continued...

## KEY TO SPECIES

- 2a Body depth moderate, 28–35 in TL; no small black spots along dorsal fin and flanks; vertebrae 132–138 ..... *L. polyophthalmum*
- 2b Body thin, depth ~44 in TL; row of small black spots beneath dorsal-fin base and along flanks; vertebrae 151–153 ..... *Lamnostoma* sp.

*Lamnostoma orientale* (McClelland 1844)

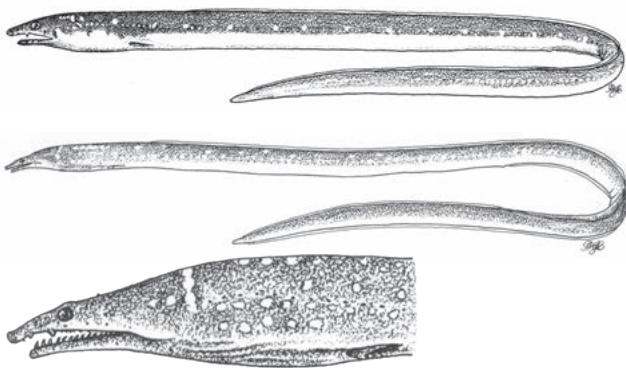
Oriental snake-eel

PLATE 17

*Dalophis orientalis* McClelland 1844: 213 (Coromandel coast, India).*Lamnostoma pictum* Kaup 1856: 50 (Visakhapatnam and Deccan, India).*Caecula orientalis*: Deraniyagala 1952\*.*Lamnostoma orientale*: SSF No. 42.8\*; Winterbottom *et al.* 1989\*; Randall 1995\*; Manilo & Bogorodsky 2003.*Lamnostoma orientale*: Kottelat 2013.

Diagnosis as for genus. HL ~8, body depth 31–42, and tail length ~2 in TL. Dorsal-fin origin just behind gill openings. Small barbel on upper lip between posterior nostril and eye. Vertebrae 132–141.

Body brown dorsally, with pale spots, but no spots on head; yellow ventrally. Attains 36 cm TL.

*Lamnostoma orientale*, 19 cm TL (top); 27 cm TL (bottom).

Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Red Sea, East Africa to South Africa (KwaZulu-Natal), Comoros, Chagos, India and Sri Lanka; elsewhere to east coast of India, Indonesia, New Guinea, New Caledonia and Marquesas Is.

**REMARKS** Found in mangroves, estuaries and rivers.

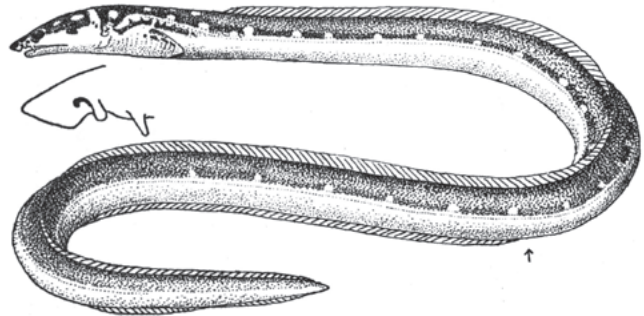
*Lamnostoma polyophthalmum* (Bleeker 1853)

Whitespotted snake-eel

*Dalophis polyophthalmus* Bleeker 1853: 299 (Pariaman, Indonesia).*Sphagebranchus polyophthalmus*: Kaup 1856.*Caecula polyophthalmus*: Deraniyagala 1952\*.

Diagnosis as for genus. HL 8–9, body depth 28–35, and tail length ~2 in TL. Prominent pendulous barbel on upper lip between posterior nostril and eye. Vertebrae 132–138; MVF 15/65/135.

Body yellowish brown dorsally, yellow ventrally; top of head and nape with double row of round yellowish spots; LL pores pale. Attains 32 cm TL.

*Lamnostoma polyophthalmum*, 24 cm TL, and diagram of head showing anterior nostril (left) and labial papilla outside posterior nostril slit.

Source: Weber &amp; De Beaufort 1916

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal), Madagascar, Comoros, Mauritius and Sri Lanka; elsewhere, Indonesia (Java and Sumatra).

**REMARKS** Also found in estuaries and rivers.

*Lamnostoma* sp.*Caecula pterygera* (non Vahl 1794): Smith 1966.

Diagnosis as for genus. HL ~9.3, body depth ~44, and tail length ~1.9 in TL. Dorsal-fin origin ~¼ HL behind gill openings. Prominent pendulous barbel on upper lip beneath leading edge of posterior nostril. Vertebrae 151–153; MVF 15/64/152.

Body yellow, with small black spots on flanks and beneath dorsal fin; unpigmented round spots on nape; fins pale. Attains at least 27 cm TL.

**REMARKS** Known from estuaries in South Africa (KwaZulu-Natal).

**GENUS** *Leiuranus* Bleeker 1853

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body cylindrical; anus at about midlength; tail slightly less than half TL. Median fins low; pectoral fins reduced. Groove on underside of snout. No barbels on lips. Anterior nostrils tubular, at tip of snout; posterior nostrils on inner edge of upper lip, with anterior flap. Teeth conical, uniserial; a few teeth on intermaxillary and front of vomer. Gill openings vertical, crescentic, shorter than isthmus. Two or 3 species, widespread in Indo-Pacific, including 1 in WIO.

*Leiuranus semicinctus* (Lay & Bennett 1839)

Halfbanded snake-eel

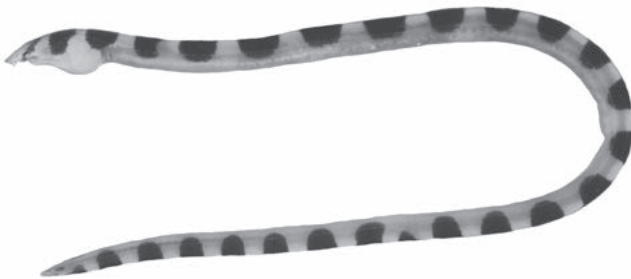
PLATE 17

*Ophisurus semicinctus* Lay & Bennett 1839: 66, Pl. 20,  
Fig. 4 (Oahu I.? [Hawaii]).

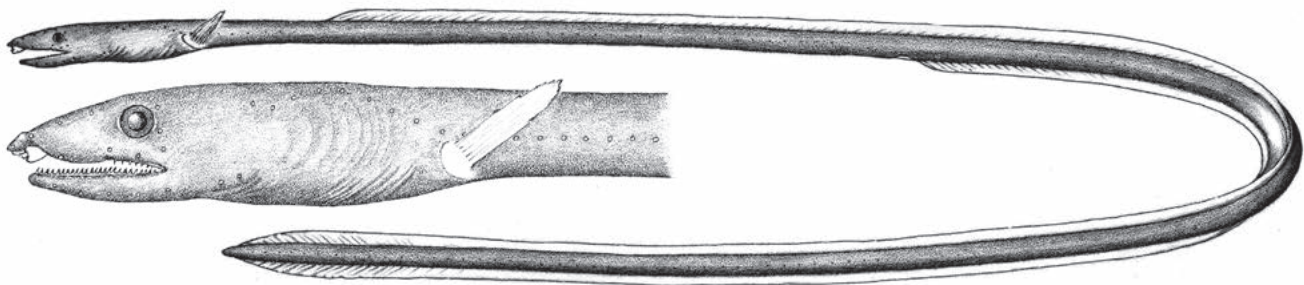
*Leiuranus semicinctus*: Deraniyagala 1952; McCosker 1977; SSF No. 42.9\*;  
Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Heemstra *et al.*  
2004; Randall 2005\*.

Diagnosis as for genus. HL 11–15, body depth 33–70, and tail length 1.9–2.1 in TL. Dorsal-fin origin above pectoral fins; pectoral fins short. Teeth on jaws conical, uniserial; 1–3 teeth on vomer. Vertebrae 164–171; MVF 9/71/168.

Body white to yellow or tan, with ~20–30 brownish black saddles, becoming rings on tail; dark form from Phoenix Is. in central Pacific has wider black saddles and bands, with narrower pale interspaces. Attains 66 cm TL.



*Leiuranus semicinctus*, 17 cm SL (Rodrigues). PC Heemstra © NRF-SAIAB



*Luthulenchelys heemstraorum*, 47 cm TL, holotype (South Africa) Source: McCosker 2007

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique (Inhaca I.), South Africa (Kosi Bay to Knysna), Madagascar, Comoros, Aldabra, Seychelles, Mascarenes, Chagos, Maldives and Sri Lanka; elsewhere to southern Japan, Australia, New Caledonia, Lord Howe I., Pitcairn Is. and Hawaii.

**REMARKS** Found in shallow sandy areas and in seagrass beds of lagoons and seaward reefs, usually to ~10 m deep.

**GENUS** *Luthulenchelys* McCosker 2007

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body extremely elongate, cylindrical anteriorly, and compressed posteriorly; tail length more than half TL. Median fins low; dorsal-fin origin behind pectoral fins; pectoral fins elongate. Snout blunt, jaws not elongate. Anterior nostrils in short tubes; posterior nostrils within upper lip. Eyes large, rear margins above corner of jaw. Teeth conical; biserial on upper jaw, uniserial on lower jaw; 1 tooth on vomer. Gill openings lateral, elongate and nearly vertical. One species.

*Luthulenchelys heemstraorum* McCosker 2007

Bigeye snake-eel

PLATE 17

*Luthulenchelys heemstraorum* McCosker 2007: 5, Figs. 1–4  
(KwaZulu-Natal, South Africa).

Diagnosis as for genus. HL 14, body depth 79, and tail length 1.6 in TL. VF 20/61/165.

Body uniformly grey-brown, slightly darker dorsally. Attains at least 47 cm TL.

**DISTRIBUTION** Known only from the holotype from South Africa.

**REMARKS** Dredged from ~460 m.

**GENUS** *Mixomyrophis* McCosker 1985

(subfamily MYROPHINAE, tribe Myrophini)

Body elongate, laterally compressed, particularly posteriorly; tail longer than head and trunk. Median fins low; dorsal-fin origin at or before midtrunk; pectoral fins a minute flap. Snout subconical, jaws not elongate. Anterior nostril tubular; posterior nostril on outer edge of lip and covered by a flap. Eyes large. Teeth small, conical, uniserial on jaws and vomer. Gill openings midlateral, present as a constricted opening. Two species: 1 in western Atlantic, 1 in Red Sea (WIO).

*Mixomyrophis longidorsalis*

Hibino, Kimura &amp; Golani 2014

Red Sea worm-eel

*Mixomyrophis longidorsalis* Hibino, Kimura & Golani 2014: 1, Figs. 1–2 (Gulf of Eilat, Israel, Red Sea).

Diagnosis as for genus. HL 8.4, body depth 40, and tail length 1.5 in TL. VF 22/53/177.

Body uniformly pale yellow, covered with small pale dots excluding ventral surface of gill basket and body.

**DISTRIBUTION** Known only from the holotype from the Gulf of Eilat.

**REMARKS** Beam-trawled from ~200 m.

**GENUS** *Muraenichthys* Bleeker 1853

(subfamily MYROPHINAE, tribe Myrophini)

Body laterally compressed posteriorly. No pectoral fins. Anterior nostrils tubular; posterior nostrils on outside of upper lip, preceded by flap; 1 pore on each side of snout between anterior and posterior nostrils. Teeth blunt, typically in bands on jaws, and in broad patch on intermaxillary. Gill opening a small vertical slit near ventral surface. This taxon requires further study. Seven or 8 species, 2 in WIO (1 of these undescribed).

**KEY TO SPECIES**

- 1a Body thin, its depth ~42 in TL; head short, HL ~11 in TL; dorsal-fin origin ~1 HL behind anus ..... *Muraenichthys* sp.  
 1b Body stouter, its depth 19–22 in TL; head less short, HL ~7–8 in TL; dorsal-fin origin just behind anus .... *M. schultzei*

*Muraenichthys schultzei* Bleeker 1857

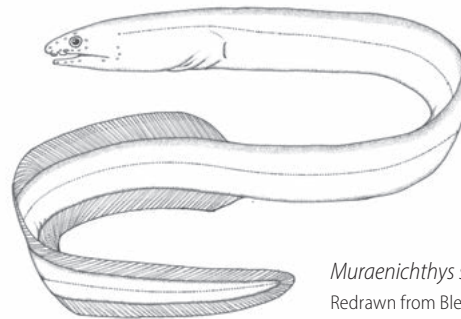
Bluntnose worm-eel

PLATE 17

*Muraenichthys schultzei* Bleeker 1857: 366 (Java, Indonesia); Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall 1995\*.

Diagnosis as for genus. HL 7–8, body depth 19–22, and tail length ~2.1 in TL. Vertebrae 122–132; MVF 47/46/128.

Body yellowish, with fine dark speckling dorsally. Attains 14 cm TL.



*Muraenichthys schultzei*.  
Redrawn from Bleeker 1864

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Red Sea to Mozambique (Pinda), Mauritius, Chagos and Maldives; elsewhere to Indonesia, southern Japan, Caroline Is., Marshall Is., Australia, New Caledonia, Tonga, Tuamotu Is. and Johnston Atoll.

**REMARKS** Known from shallow sandy areas of reef flats and lagoons. Blegvad & Løppenthin (1944) reported three specimens taken from the stomach of sea snakes. Smith's records (1958: 58; 1962: 461) from Aldabra, "based on two small specimens which cannot now be found," is a misidentification of *Scolecenchelys gymnota* (Bleeker 1857).

*Muraenichthys* sp.

Diagnosis as for genus. HL ~11, body depth ~42, and tail length ~1.8 in TL. Body elongate; dorsal-fin origin ~1 HL behind anus. Teeth blunt, uniserial on jaws, and biserial on vomer. VF 64/54/154.

Preserved specimen with uniformly buff body. Attains at least 14.5 cm TL.

**REMARKS** Known from one specimen, trawled at ~40 m, off Durban, KwaZulu-Natal, South Africa (29°12' S, 31°42' E). Tentatively included in *Muraenichthys* because of its posterior nostril condition; however, its teeth are atypical of the genus.



GENUS *Myrichthys* Girard 1859

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body compressed posteriorly; dorsal-fin origin on nape, well before gill openings; pectoral fins rudimentary. Anterior nostrils fleshy tubes overhanging tip of lower jaw; posterior nostrils hidden inside upper lip below eyes. Teeth molariform or granular. Gill opening an oblique slit on lower half of body in front of pectoral fin. Reviewed by McCosker & Rosenblatt (1993). Ten species, 2 in WIO.

KEY TO SPECIES

- 1a Dark rings completely or partially encircle head and body; anal fin ends well before end of dorsal fin and tail tip; body extremely elongate, its depth 51–68 in TL ..... *M. colubrinus*
- 1b Several longitudinal series of large dark spots along sides and on dorsal surface; median fins end near tail tip; body elongate, its depth 33–46 in TL ..... *M. maculosus*

*Myrichthys colubrinus* (Boddaert 1781)

Ringed snake-eel

PLATE 17

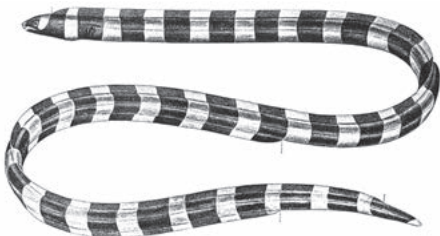
*Muraena colubrina* Boddaert 1781: 56, Pl. 2, Fig. 3 (Ambon I., Moluccas, Indonesia).

*Ophisurus fasciatus* Lacepède 1802: 686, 687 [no locality given].

*Myrichthys colubrinus*: Smith 1962\*; SSF No. 42.13\*; Winterbottom *et al.* 1989\*; McCosker & Rosenblatt 1993\*; Randall & Anderson 1993; Randall 1995\*, 2005\*.

HL 17–20, body depth 51–68, and tail length 1.8–1.9 in TL. Anal fin ends well before tail tip. Teeth blunt, biserial on jaws, and in 1 or 2 rows on vomer. Preopercular pores 2. Vertebrae 193–202; MVF 1/85/197.

Body cream-coloured background, partially or completely encircled with ~25–35 dark brown or black bands extending onto dorsal fin; some larger specimens with large dusky spots between bands, especially on trunk and tail. Attains 97 cm TL.



*Myrichthys colubrinus*, 56 cm TL. Source: Herre 1923

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Red Sea to Mozambique (Inhaca I.), Madagascar, Comoros, Seychelles, Mauritius, Chagos and Maldives; elsewhere to southern Japan, Australia, New Caledonia, Tuamotu Is. and Johnston Atoll, but not Hawaii.

**REMARKS** A remarkable mimic of several venomous hydrophiin sea snakes. Found over sand or rubble bottom and in seagrass beds.

*Myrichthys maculosus* (Cuvier 1816)

Spotted snake-eel

PLATE 17

*Muraena maculosa* Cuvier 1816: 232 [probably Indonesia].

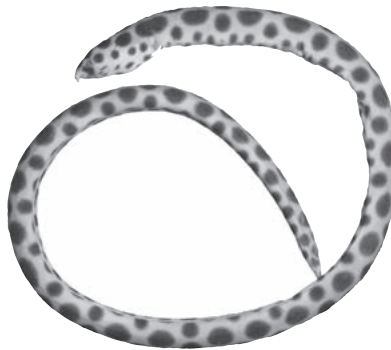
*Muraena tigrina* Rüppell 1830: 118, Pl. 30, Fig. 2 (Al-Muwaylih, Saudi Arabia, Red Sea).

*Ophichthys dromicus* Günther 1870: 80 (West Africa [probably African coast of Red Sea]).

*Myrichthys maculosus*: Blache 1975\*; SSF No. 42.14\*; Winterbottom *et al.* 1989\*; McCosker & Rosenblatt 1993\*; Randall & Anderson 1993\*; Randall 1995\*, 2005\*; Heemstra & Heemstra 2004\*.

Diagnosis as for genus. HL 12–16, body depth 33–46, and tail length ~1.7 in TL. Teeth blunt, biserial on jaws and vomer. Preopercular pores 2. Vertebrae 180–197; MVF 1/75/191.

Body cream-coloured (preserved specimens often greenish) background, with conspicuous large and small, round to oval, brown to brownish black spots. Attains 100 cm TL.



*Myrichthys maculosus*, 67 cm TL (Mauritius). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Oman, Red Sea, East Africa to South Africa (Eastern Cape), Madagascar, Comoros, Aldabra, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to southern Japan, Australia, Lord Howe I., Kermadec Is. and Panama, but not Hawaii.

**REMARKS** Often found during day among rocks and on sandy areas of reefs, but also in seagrass beds; burrows quickly, tail-first, into sand. Feeds on crustaceans and small fishes.

GENUS *Myrophis* Lütken 1852

(subfamily MYROPHINAE, tribe Myrophini)

Body stout to moderately elongate, laterally compressed throughout; tail longer than rest of body. Dorsal-fin origin before mid-trunk; pectoral fins moderately developed. Snout rounded. Anterior nostrils tubular, near snout tip; posterior nostrils along edge of upper lip and covered by flap. Gill openings small, lateral, below pectoral-fin base. About 8 species, 1 in WIO.

*Myrophis microchir* (Bleeker 1864)

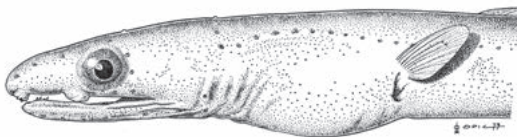
Olive worm-eel

PLATE 17

*Echelus microchir* Bleeker 1864: 40 (Makassar, Sulawesi, Indonesia).*Myrophis uropterus* (non Temminck & Schlegel 1846): Smith 1962\*; Dor 1970; McCosker 1977.*Myrophis lepturus* Kotthaus 1968: 40, Figs. 145–147 (Gulf of Aden).*Myrophis microchir*: Karrer 1983\*; Goren & Dor 1994; Allen & Erdmann 2012.

Diagnosis as for genus. HL 8.8–9.7, body depth 31–42, and tail length 1.5–1.6 in TL. Dorsal-fin origin above pectoral-fin tips; pectoral fins moderately developed. Eye diameter ~1.7 in snout length. Teeth small, slender and conical, mostly uniserial on jaws and vomer. Vertebrae 153–164; MVF 12/47/160.

Preserved specimens with uniformly pale brown body. Attains at least 56 cm TL.

*Myrophis microchir*, 22 cm TL, head. Source: Karrer 1983*Myrophis microchir*, 56 cm TL (Taiwan). © H-C Ho, NMMB-P

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Gulf of Aden to Mozambique (Pinda), Aldabra, Seychelles and Maldives; elsewhere to Indonesia, China, Japan, Marshall Is., Australia and Fiji.

**REMARKS** Inhabits shallow water, to ~60 m deep.

GENUS *Neenchelys* Bamber 1915

(subfamily MYROPHINAE, tribe Myrophini)

Body moderately to extremely elongated, compressed posteriorly; tail length more than half TL. Dorsal-fin origin posterior to gill openings; pectoral fins often well-developed, but shorter or longer than snout length, and fin minute in some. Snout subconical. Anterior nostrils in short tube near tip of snout; posterior nostrils an elongate slit on snout above upper lip and near front of eye. Preopercular pores 1 or (usually) 2. Teeth conical, mostly uniserial. Gill openings slit-like, small and lateral. Primarily demersal, but at least one species from Taiwan known to live in midwater. Revised by Ho *et al.* (2013), however new species have been subsequently discovered; most closely related to *Pseudomyrophis* Wade 1946. Nine species, at least 3 in WIO.

## KEY TO SPECIES

- |    |   |                       |
|----|---|-----------------------|
| 1a | Dorsal-fin origin well in front of anus .....   | 2                     |
| 1b | Dorsal-fin origin slightly behind anus .....  | <i>N. cheni</i>       |
| 2a | Dorsal-fin origin more posteriorly set, at midbody; pectoral fins minute .....                                  | <i>N. microtretus</i> |
| 2b | Dorsal-fin origin more anteriorly set, slightly behind pectoral-fin tips; pectoral fins longer than snout ..... | <i>N. buitendijki</i> |

*Neenchelys buitendijki* Weber & De Beaufort 1916

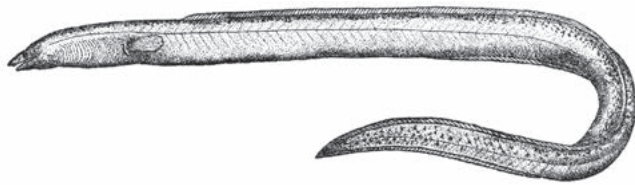
Fintail worm-eel

PLATE 17

*Neenchelys buitendijki* Weber & De Beaufort 1916: 268, Figs. 116–117 (Java, Indonesia); Mohamed 1958\*; Ho *et al.* 2013.

Diagnosis as for genus. HL 7.8–8.5, body depth 19–32, and tail length 1.5–1.8 in TL. Body relatively robust; dorsal-fin origin relatively forward, slightly behind pectoral-fin tips; pectoral fins well-developed, longer than snout. Teeth slender, conical, uniserial on jaws and vomer. Preopercular pores 2. Vertebrae 142–148.

Body uniformly yellowish grey with silvery hue; rear part of median fins dusky. Attains 30 cm TL.



*Neenchelys buitendijki*. Source: Mohamed 1958

**DISTRIBUTION** Indo-Pacific (few localities). WIO: India (Mumbai); elsewhere, Malaysia and Indonesia (Java and Sumatra).

**REMARKS** Trawled from over sand and mud bottom, at 2–18 m; active at night.

### *Neenchelys cheni* (Chen & Weng 1967)

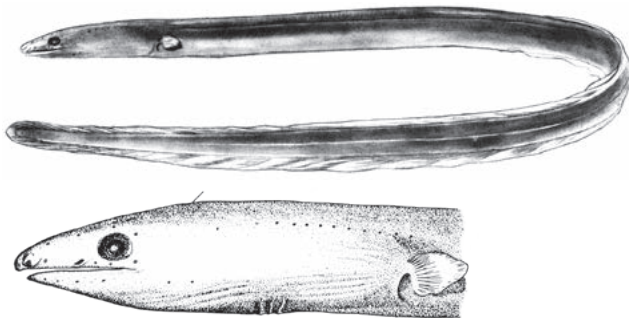
Backfin worm-eel

PLATE 17

*Myrophis cheni* Chen & Weng 1967: 39, Fig. 29 (Tungkang, Taiwan).  
*Neenchelys retropinna* Smith & Böhlke 1983: 80, Figs. 1–3 (Gulf of Oman).  
*Neenchelys cheni*: Ho *et al.* 2010; Ho *et al.* 2013.

Diagnosis as for genus. HL 10–11, body depth 33–50, and tail length 1.6–2 in TL. Dorsal-fin origin posteriorly set, slightly behind anus; pectoral fins well-developed. Teeth small and conical, uniserial on jaws and vomer. Preopercular pores 2. Vertebrae 181–184; MVF 59/57/182.

Preserved specimens pale brown, slightly darker dorsally; rear margins of median fins darker. Attains 39 cm TL.



*Neenchelys cheni*, 32 cm TL, holotype of *N. retropinna* (Gulf of Oman). Source: Smith & Böhlke 1983, *Proceedings of the ANSP*

**DISTRIBUTION** Indo-Pacific (few localities). WIO: Gulf of Oman; elsewhere, Vietnam, Taiwan and northern Australia (Arafura Sea).

**REMARKS** Collected from sandy or mud bottom, at 50–100 m; most specimens from Taiwan collected in midwater trawls.

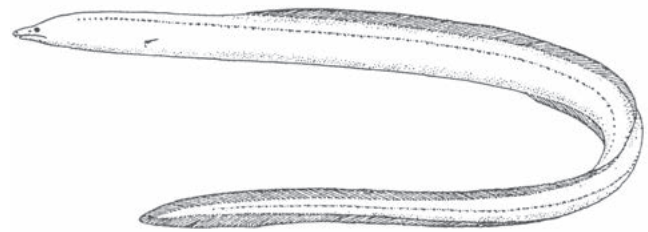
### *Neenchelys microtretus* Bamber 1915

Smallfin worm-eel

*Neenchelys microtretus* Bamber 1915: 479, Pl. 46, Fig. 3 (Gulf of Suez, Red Sea); Ho *et al.* 2013.

HL 7, body depth 26, and tail length ~1.7 in TL. Dorsal-fin origin at midbody, well in advance of anus; pectoral fins minute. Teeth slender, conical, uniserial on jaws and vomer. Preopercular pores 2. VF 24/56/151.

Preserved specimen uniformly pale. Attains at least 18.5 cm TL.



*Neenchelys microtretus*, 19 cm TL (Gulf of Suez). Source: Bamber 1915

**DISTRIBUTION** Known only from the holotype from the Gulf of Suez.

**REMARKS** May be a senior synonym of *N. parvipectoralis* Chu, Wu & Jin 1981, known from South China Sea off Vietnam and Taiwan.

## GENUS *Ophichthus* Ahl 1789

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body moderately to very elongate, cylindrical, but compressed posteriorly; tail length more than half TL. Dorsal-fin origin above or behind gill openings. Pectoral fins developed, slender or paddle-shaped. Snout and jaws moderately elongate; lips without numerous barbels or fringes; some species with 2 small barbels along upper lip on each side of snout. Anterior nostrils tubular; posterior nostrils open into mouth or along lower edge of upper lip. Eyes moderately to well-developed. Teeth conical and numerous, never caniniform, and uniserial or multiserial on jaws and vomer. Colouration variable, often marked, but generally uniform and darker dorsally. The genus *Ophichthus* (*sensu lato*) is the most speciose ophichthid, with ~65 species (plus several undescribed) occurring in tropical and subtropical waters; at least 17 species in WIO at depths above ~200 m. A worldwide revision is needed as several subgenera are recognisable within the genus.

## KEY TO SPECIES

- 1a Body colouration uniform, may be darker dorsally, but without large dark or ocellated spots or saddles; dorsal-fin origin at vertical above or behind pectoral-fin tips; pectoral fins either rounded or attenuate and elongate ..... 5
- 1b Body colouration pale, and with 1 or more dark or ocellated spots or dark saddles; dorsal-fin origin above gill openings; pectoral fins perfectly rounded, not elongate ..... 2
- 2a Broad brown or black saddle across rear of head; trunk and tail uniformly brown ..... *O. cephalozona*
- 2b No broad dark saddle at rear of head; numerous dark or ocellated spots or dark saddles on body and tail ..... 3
- 3a Body with 18–27 prominent dark saddles, including conspicuous wide saddle above gill opening, and also much golden to brown marbling (in life) on snout and face ..... *O. bonaparti*
- 3b Body with numerous dark or ocellated spots, not appearing as saddles ..... 4
- 4a Head and body with numerous ocellated spots, those on body in 3 regular alternating rows, and spots separated by pale interspaces ..... *O. polyophthalmus*
- 4b Head and body with numerous dark spots, those on body in 2 irregular rows, and spots about equal in size to interspaces ..... *O. erabo*
- 5a Body elongate to extremely elongate, its depth behind gill openings >40 in TL; body pale, fins may be darker ..... 6
- 5b Body stout to moderately elongate, its depth behind gill openings <40 in TL; body and fins pale, although median fins may be blackened near tail tip ..... 8
- 6a Teeth biserial or triserial; vertebrae <200 ..... 7
- 6b Teeth uniserial; vertebrae >200 ..... *O. macrochir*
- 7a Tail length 1.6–1.8 in TL; body depth at gill openings <60 in TL ..... *O. marginatus*
- 7b Tail length ~1.5 in TL; body depth at gill openings >60 in TL ..... *O. microcephalus*
- 8a Head short, HL 14–17 in TL ..... *O. serpentinus*
- 8b Head longer, HL <12 in TL ..... 9
- 9a Pectoral fins attenuate (slender); dorsal fin elevated ..... 10
- 9b Pectoral fins rounded ..... 13
- 10a Dorsal-fin origin above or slightly in front of gill openings; median-fin margins and pectoral fins of larger specimens dark; teeth on jaws uniserial ..... *O. altipennis*
- 10b Dorsal-fin origin above or behind pectoral-fin tips; pectoral fins and median fins (except near tail tip in some species) of larger specimens pale; teeth on jaws biserial ..... 11
- 11a Dorsal-fin origin ~1 HL behind pectoral-fin tips; 1 row of pale spots along lateral line ..... *O. hijala*
- 11b Dorsal-fin origin either above pectoral tips or <1 HL behind them; no row of pale spots along lateral line ..... 12
- 12a Anal fin pale overall; vertebrae 139–147 ..... *O. genie*
- 12b Anal fin mostly pale, but becoming black near tail tip; vertebrae 166 ..... *O. tomioi*
- 13a Dorsal-fin origin ~2 pectoral-fin lengths behind gill openings ..... *O. hirritus*
- 13b Dorsal-fin origin above gill openings ..... 14
- 14a HL <7 in TL, and tail length at least 1.9 in TL; teeth uniserial ..... *O. ishiyamorum*
- 14b HL >7 in TL, and tail length <1.9 in TL; teeth either uniserial or biserial ..... 15
- 15a Teeth on jaws uniserial; tail length ~1.6 in TL; 2 barbels along upper lip: behind base of anterior nostril, and below front edge of eyes ..... *O. apicalis*
- 15b Teeth on jaws biserial; tail length 1.7–1.8 in TL; lips without prominent barbels ..... 16
- 16a Dorsal-fin origin above mid-pectoral fins; teeth on vomer uniserial; HL ~8.4 in TL; median fins pale posteriorly ..... *O. echeloides*
- 16b Dorsal-fin origin behind pectoral-fin tips; teeth on vomer biserial; HL 9.2–9.8 in TL; median fins dark near tail tip ..... *O. brachynotopterus*



## *Ophichthus altipennis* (Kaup 1856)

Highfin snake-eel

PLATE 18

*Microdonophis altipennis* Kaup 1856: 43 (Sulawesi, Indonesia).

*Microdonophis altipinnis* Kaup 1856: 6, Pl. 1, Fig. 3 (Sulawesi, Indonesia).

*Ophichthus altipennis*: McCosker & Randall 2002; Manilo & Bogorodsky 2003; Randall 2005\*.

HL 9.3–10.4, body depth 25–38, and tail length 1.6–1.7 in TL. Body moderately elongate; dorsal and anal fins elevated; dorsal-fin origin above or slightly in front of gill openings; pectoral fins elongate. Two small barbels along ventral edge of upper lip (below eye and behind anterior nostril). Teeth conical and none enlarged, uniserial on jaws and vomer. Vertebrae 172–182; MVF 9/56/178.

Body tan to brown, and larger specimens much darker dorsally, with black dorsal-fin margin, and dusky pectoral fins; prominent pale area in front of eyes, and some small dark spots on head (along jaws and behind eyes). Attains 103 cm TL.



*Ophichthus altipennis*, 97 cm TL. Source: Bleeker 1864

**DISTRIBUTION** Western Pacific (widespread but patchy: Malaysia, Indonesia, Philippines, Japan, Marshall Is., Australia and Society Is.); one record from west coast of India in WIO.

**REMARKS** Burrows in sand and mud bottom with head protruding; inshore, to ~40 m deep.

## *Ophichthus apicalis* (Anonymous [Bennett] 1830)

Bluntnose snake-eel

PLATE 18

*Ophisurus apicalis* Anonymous [Bennett] 1830: 692 (Sumatra, Indonesia).

*Ophisurus unicolor* (non Regan 1908): Fowler 1934 [in part].

*Ophichthus apicalis*: Smith 1962\*; SSF No. 42.16\*.

HL 9–11, body depth 26–34, and tail length ~1.6 in TL. Body moderately elongate; dorsal-fin origin above or behind pectoral fins; pectoral fins slender. Two barbels along ventral edge of upper lip. Teeth small and sharp, uniserial on jaws, and biserial on vomer. Vertebrae 143–145; MVF 12/52/144.

Body pale brownish yellow, and fins paler. Attains 45 cm TL.



*Ophichthus apicalis*, 35 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (St Francis Bay) and Madagascar; elsewhere, Thailand, Indonesia, Philippines, Vietnam, China and Korea.

**REMARKS** Found at 1–22 m. The holotype is lost, thus the correct identity of this species is uncertain.

## *Ophichthus bonaparti* (Kaup 1856)

Brownsaddled snake-eel

PLATE 18

*Poecilcephalus bonaparti* Kaup 1856: 43; 1856: 5, Pl. 1, Fig. 2 (Ambon I., Moluccas, Indonesia).

*Ophisurus chrysozilios* Bleeker 1857: 8, 27, 88 [name not available].

*Poecilcephalus markworti* Kaup 1859: 10, Pl. 1, Fig. 1 [no locality given].

*Ophichthus bonaparti*: SSF No. 42.18; McCosker 2002\*; Randall 2005\*.

HL 12–13, body depth 33–38, and tail length 1.9–2.1 in TL. Body elongate; dorsal-fin origin behind pectoral-fin tips; pectoral fins small and rounded. Teeth stout and conical, uniserial on jaws and vomer. Vertebrae 156–164; MVF 10/84/160.

Body with 18–27 prominent dark saddles, including conspicuous wide saddle above gill opening, and much golden to brown marbling (in life) on snout and face; fins pale. Attains 75 cm TL.



*Ophichthus bonaparti*, ~60 cm TL. Source: Bleeker 1864

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal), Mauritius and Maldives; elsewhere to Indonesia, Philippines, Marshall Is. and Society Is.

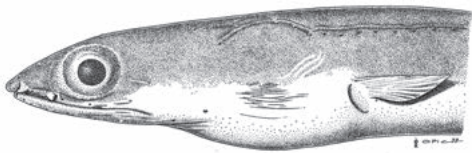
**REMARKS** Found on sand and mud bottom, at 1–20 m.

*Ophichthus brachynotopterus* Karrer 1983

*Ophichthus brachynotopterus* Karrer 1983: 73, Figs. 22a–b (Nosy Be, Madagascar); McCosker 2010.

HL 9.2–9.8, body depth 27–33, and tail length 1.7–1.8 in TL. Body moderately elongate; dorsal-fin origin ~1 HL behind gill openings; pectoral fins wedge-shaped. Eyes relatively large. Teeth numerous, small and conical, irregularly biserial on jaws and vomer. Vertebrae 170–178; MVF 27/64/174.

Body tan, paler ventrally; snout tip black, and anal-fin base dark posteriorly; anterior nostrils and fins pale. Attains 53 cm TL.



*Ophichthus brachynotopterus*, 44 cm TL, head of holotype.  
Source: Karrer 1983

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar; elsewhere, New Caledonia and Vanuatu.

**REMARKS** Little known; trawled from 355–580 m, but may occur at shallower depths.

*Ophichthus cephalozona* Bleeker 1864

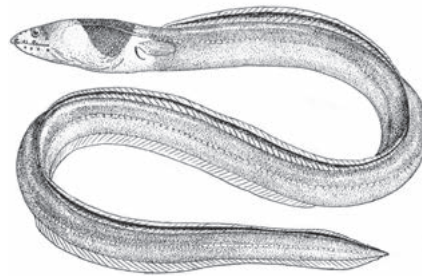
Darkshoulder snake-eel

PLATE 18

*Ophichthus cephalozona* Bleeker 1864: 49, Pl. 156, Fig. 2 (Singapore; Ambon I., Moluccas, Indonesia); McCosker 1977; Randall 2005\*.  
*Zonophichthus marginatus*: Whitley 1964.

HL 9.5–10.8, body depth 26–39, and tail length 1.8–1.9 in TL. Body fairly stout, but tail tip sharply pointed; dorsal-fin origin above mid-pectoral fins; pectoral fins rounded. Two small but notable barbels along ventral edge of upper lip. Teeth numerous, small, stout and pointed, uniserial on jaws and vomer. Vertebrae 154–157; MVF 12/66/156. [Data based on specimens from Micronesia and Australia.]

Body pale greyish brown dorsally, white ventrally; wide black band behind head surrounded by wide white bands; pectoral fins pale with white margins; median fins black with white or pale margins. Attains 115 cm TL.



*Ophichthus cephalozona*,  
31 cm TL.

Source: Weber & De Beaufort 1916

**DISTRIBUTION** Indo-Pacific. WIO: India (off Mumbai); elsewhere, Indonesia to Singapore, Taiwan, Indonesia, Philippines, southern Japan, Mariana Is., Marshall Is., northern Australia, New Guinea, Fiji and Society Is.

**REMARKS** Occupies muddy and sandy inshore areas; observed foraging at night over sandy bottom. Included here on the basis of Bal & Mohamed's (1957) records of this unmistakable species from off the west coast of India.

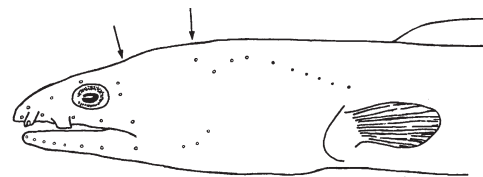
*Ophichthus echeloides* (D'Ancona 1928)

*Leptocephalus echeloides* D'Ancona 1928: 69, Pl. 4, Fig. 5 (Perim I., Yemen, Red Sea) [leptocephalus].

*Ophichthus echeloides*: McCosker, Baranes & Golani 1993\* [description of adult]; McCosker 2010.

Adult: HL 8.4, body depth 24, and tail length 1.7 in TL. Body moderately elongate; dorsal-fin origin above mid-pectoral fins; pectoral fins rounded. Teeth small and conical, biserial on jaws and uniserial on vomer. VF 11/50/125.

Preserved specimen tan, darker dorsally; fins and belly pale. Attains 52 cm TL.



*Ophichthus echeloides*, 52 cm TL, head of male, arrows indicate location of interorbital and temporal pores (Red Sea).

Source: McCosker *et al.* 1993

**DISTRIBUTION** WIO: Red Sea.

**REMARKS** Known only from the leptocephalus holotype, and also one adult caught by trammel net off Eilat, Israel, at 276–300 m.

## *Ophichthus erabo* (Jordan & Snyder 1901)

Blotched snake-eel

PLATE 18

*Microdonophis erabo* Jordan & Snyder 1901: 870, Fig. 17 (Misaki, Japan).

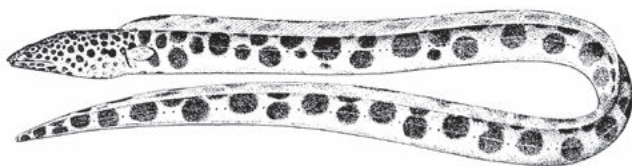
*Ophichthus retifer* Fowler 1935: 368, Fig. 9 (Durban, KwaZulu-Natal, South Africa).

*Ophichthus triserialis* (non Kaup 1856): Smith 1949\*.

*Ophichthus erabo*: McCosker 1977; McCosker & Randall 1982\*; SSF No. 42.19\*; Randall 2007\*.

HL 12–12.3, body depth 23–38, and tail length 2.2–2.3 in TL. Body stout to moderately elongate; dorsal-fin origin above pectoral-fin bases; pectoral fins rounded. Teeth stout and conical, uniserial on jaws and vomer. Vertebrae 151–155; MVF 8/77/153.

Head, body and anal fin pale, with numerous large brown semicircular spots; spots on head equal to eye diameter or smaller, and spots on body in 2 irregular rows, their size subequal to interspaces; dorsal fin with similar smaller and paler spots. Attains 85 cm TL.



*Ophichthus erabo* (Japan). Source: Jordan & Snyder 1901

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and South Africa (Sodwana Bay and Durban, KwaZulu-Natal); elsewhere to Taiwan, China and southern Japan and Hawaii.

**REMARKS** Digs itself into sand; dredged from off Sodwana Bay at 35–45 m.

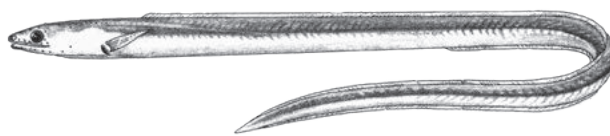
## *Ophichthus genie* McCosker 1999

Genie's snake-eel

*Ophichthus genie* McCosker 1999: 577, Figs. 2b, 3 (New Caledonia); McCosker 2010.

HL 9.9–10.7, body depth 19–29, and tail length 1.7–1.8 in TL. Body stout to moderately elongate; dorsal-fin origin above pectoral tips; pectoral fins elongate. Eyes large; mid-eye behind centre of upper jaw. Teeth small and conical, biserial on jaws and uniserial on vomer. Vertebrae 139–147; MVF 14/57/143.

Preserved specimens pale, covered with tiny dots dorsally; pectoral fins and median fins pale (no black margin posteriorly). Attains at least 34 cm TL.



*Ophichthus genie*, 23 cm TL, holotype (New Caledonia). Source: McCosker 1999

**DISTRIBUTION** Indo-Pacific. WIO: Maldives; elsewhere, New Caledonia.

**REMARKS** Various trawled from 215–500 m.

## *Ophichthus hijala* (Hamilton 1822)

Porpoise-ear eel

*Ophisurus hijala* Hamilton 1822: 20, Pl. 5, Fig. 5 (Ganges River, India).

*Anguilla* (*Ophisurus*) *puncticulata* Swainson 1839: 334 [unneeded new name for *Ophisurus hijala* Hamilton 1822].

*Pisodonophis hijala*: McCosker 1977.

HL 11.7–12.5, body depth 25–38, and tail length 1.6–1.7 in TL. Dorsal-fin origin ~1 HL behind head; pectoral fins moderately developed, rounded. Snout subconical; minute barbel on ventral edge of upper lip below mid-eye. Teeth numerous, small and pointed, in 2 irregular rows on upper jaw and vomer, and in 1 row on lower jaw. Vertebrae 153; MVF 24/52/153.

Body with fine brown speckling above midline, from head to tail; yellow ventrally; row of pale spots along lateral line; head and chin brown, throat yellow; all fins pale. Attains 45 cm TL.

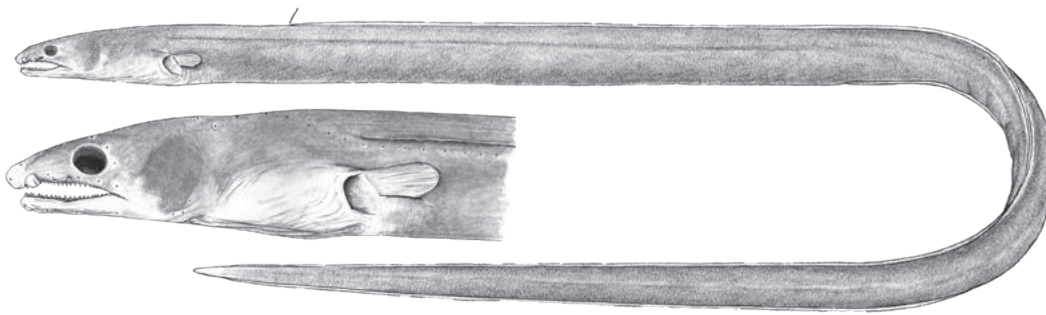


*Ophichthus hijala*, type of *Ophisurus hijala* (Bay of Bengal).

Source: Hamilton 1822

**DISTRIBUTION** Indian Ocean: Bay of Bengal (India and Myanmar); possibly extends to eastern edge of WIO islands.

**REMARKS** The status of this species remains uncertain, as the type specimens are lost. Recently collected specimens from Myanmar (two from the Irrawaddy River) fit Hamilton's original description. Common name derived from original description which stated "the natives have an imagination that it proceeds from the ear of the porpoise." Enters freshwater.



*Ophichthus hirritus*,  
52 cm TL, female  
holotype (Seychelles).  
Source: McCosker 2010

### *Ophichthus hirritus* McCosker 2010

Snarling snake-eel

*Ophichthus hirritus* McCosker 2010: 16, Figs. 16–18 (Seychelles).

HL 11.9–12.7, body depth 33–38, and tail  $\sim$ 1.7 in TL. Body moderately elongate; dorsal-fin origin  $\sim$ 2 pectoral-fin lengths behind gill opening; pectoral fins rounded. Teeth conical and none enlarged; biserial on upper jaw, uniserial on lower jaw, and biserial anteriorly and uniserial posteriorly on vomer. Vertebrae 171 or 172; MVF 19/62/171.

Preserved specimens uniformly brown, but paler on chin, throat, belly and fins; indistinct white spot surrounding anus. Attains at least 53 cm TL.

**DISTRIBUTION** Known only from three specimens from Seychelles.

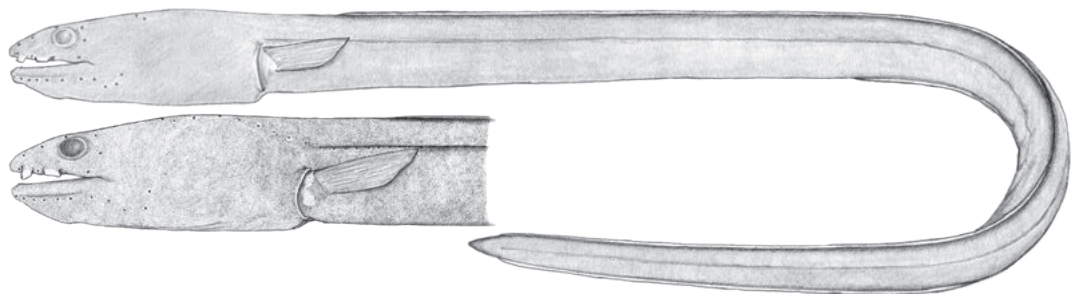
**REMARKS** Captured by trap at  $\sim$ 600 m, but may occur at shallower depths. Similar to *O. serpentinus* but differs in having 3 (not 2) preopercular pores, and in its head length, position of dorsal-fin origin, and vertebral count.

### *Ophichthus ishiyamorum* McCosker 2010

Ishiyama's eel

*Ophichthus ishiyamorum* McCosker 2010: 22, Figs. 22–25 (Gulf of Aden, Somalia).

*Ophichthus ishiyamorum*, 44 cm TL, male holotype (Gulf of Aden).  
Source: McCosker 2010



HL 6.8, body depth 22–24, and tail length 1.8–1.9 in TL. Stout-bodied; dorsal-fin origin slightly before vertical at pectoral-fin tips; pectoral fins wedge-shaped. Teeth sharp, moderate-sized, nearly uniserial on vomer and lower jaw, and biserial anteriorly on upper jaw. Vertebrae 130–132; MVF 15/50/131.

Body uniformly tan to grey, darker dorsally; nostrils, pectoral fins and anal fin pale; dorsal-fin black basally, and margin pale. Attains at least 44 cm TL.

**DISTRIBUTION** Known only from two specimens from the Gulf of Aden.

**REMARKS** Trapped and trawled at 258–400 m.

### *Ophichthus macrochir* (Bleeker 1852)

Bigfin snake-eel

PLATE 18

*Ophisurus macrochir* Bleeker 1852: 26 (Jakarta, Java, Indonesia).  
*Ophichthus macrochir*: McCosker 1977.

HL  $\sim$ 17, body depth 42–59, and tail length 1.4–1.6 in TL. Body extremely elongate; dorsal-fin origin just above or behind vertical at pectoral-fin tips; pectoral fins moderate, rounded. One small but prominent barbel between anterior and posterior nostrils. Numerous papillae along lips and inside mouth. Teeth minute, stout and conical; uniserial on jaws (biserial on lower jaw of large adults), biserial on vomer;



3 or 4 linear intermaxillary teeth (not in typical chevron pattern). MVF 11/70/221.

Body uniformly brown, paler below midline, and median fins slightly darker. Attains 92 cm TL.



*Ophichthus macrochir*, 51 cm TL. Source: Bleeker 1864

**DISTRIBUTION** Indo-Pacific. WIO: southern India; elsewhere to east coast of India (Chennai), Thailand, Indonesia (Java and Sumatra), Taiwan and Philippines.

**REMARKS** Collected from over sand and mud bottom, to ~25 m deep.

### *Ophichthus marginatus* (Peters 1855)

Plain snake-eel

PLATE 18

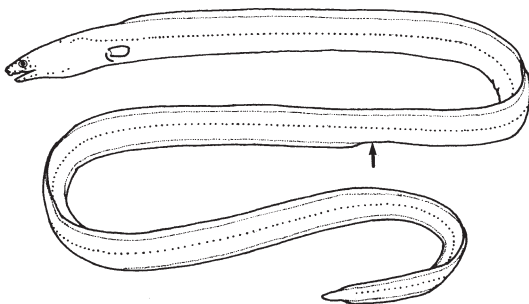
*Ophiurus marginatus* Peters 1855: 460 (Inhambane, Mozambique); 1855: 272.

*Ophichthus marginatus*: Smith 1962\*; SSF No. 42.20\*.

HL 14–18, body depth 43–48, and tail length 1.6–1.8 in TL. Body elongate; dorsal-fin origin behind pectoral-fin tips; pectoral fins not elongated. Teeth in 2 or 3 rows on jaws and vomer. Vertebrae 174–186; MVF 10/69/182.

Body uniformly olive-green to dark brown dorsally, paler ventrally. Attains at least 80 cm TL.

**DISTRIBUTION** WIO: Mozambique (Inhaca I.) to Aldabra, and one report from South Africa (Knysna); known from 10–721 m.



*Ophichthus marginatus*, 46 cm TL, and head detail (S Mozambique).

### *Ophichthus microcephalus* Day 1878

Shorthead snake-eel

*Ophichthys microcephalus* Day 1878: 665, Pl. 170, Fig. 2 (Malabar, India); Whitehead & Talwar 1976; Ferraris *et al.* 2000.

HL 19, body depth 70, and tail length 1.6 in TL. Body extremely elongate; dorsal-fin origin slightly ahead of pectoral-fin tips; pectoral fins slender, moderately elongate. Teeth numerous, stout, close-set, conical but not sharp, biserial on jaws, and irregularly triserial on vomer. VF 12/69/209.

Preserved specimens olive dorsally, yellow on sides; dark band on body along dorsal-fin base; fins pale. Attains 63 cm TL.



*Ophichthus microcephalus* (India). Source: Day 1878

**DISTRIBUTION** Known only from type specimens from India (Malabar coast).

### *Ophichthus polyophthalmus* Bleeker 1864

Many-eyed snake-eel

PLATE 18

*Ophichthys polyophthalmus* Bleeker 1864: 43 (Ambon I., Moluccas, Indonesia).

*Ophichthus polyophthalmus*: Smith 1962\*; SSF No. 42.21\*; Quéro & Saldanha 1995; Fricke 1999.

HL ~10.5, body depth 22–36, and tail length ~2.2 in TL. Stout-bodied to moderately elongate; dorsal-fin origin above pectoral-fin bases; pectoral fins rounded. Teeth stout and conical, uniserial on jaws and vomer. Vertebrae 141–148; MVF 8/74/145.

Head and body pale or pale salmon-coloured, covered with numerous yellowish brown ocellated spots, those on body in 3 regular alternating rows separated by pale interspaces; head with smaller closer-set ocellated spots, and smallest spots on chin and in front of eyes. Attains 50 cm TL.





*Ophichthus polyophthalmus*,  
40 cm TL (Hawaii).  
© JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal), Mozambique (Maputo Bay) and Mauritius; elsewhere to Indonesia, southern Japan, Micronesia, Marquesas Is. and Hawaii.

**REMARKS** Inhabits sand and rubble bottom near coral reefs, to ~25 m deep.

### *Ophichthus serpentinus* Seale 1917

Slender snake-eel

*Ophichthus serpentinus* Seale 1917: 84 (Cape of Good Hope, South Africa).

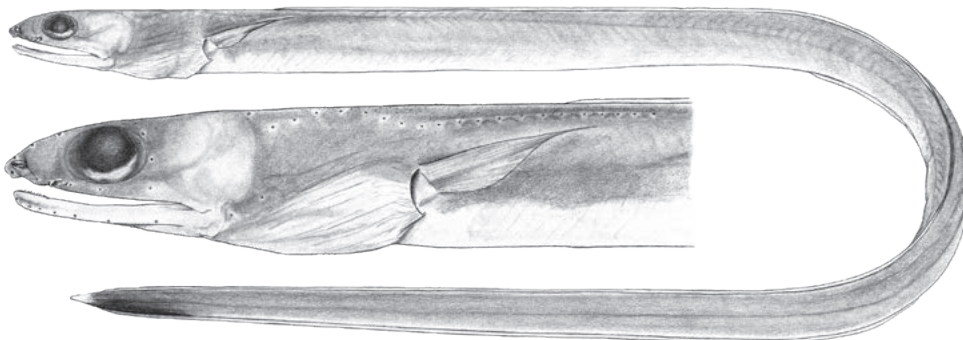
*Ophichthus karreri* Blache 1975: 733, Figs. 10–11 (southeastern Atlantic).

*Ophichthus bennettai* McCosker 1986: 2, Figs. 1–2 (southeastern Atlantic);  
SSF No. 42.17\*.

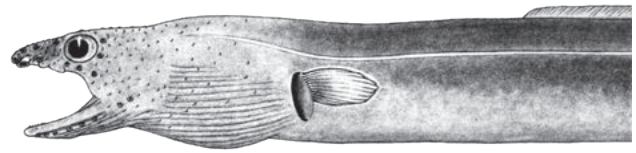
*Ophichthus serpentinus*: McCosker 2010.

HL 14.7–15.6, body depth 35–36, and tail length ~1.6 in TL. Body moderately elongate; dorsal-fin origin ~2–3 pectoral-fin lengths behind gill openings; pectoral fins rounded, shorter than jaws. Teeth conical and none enlarged: biserial on maxillary, uniserial on lower jaw, biserial anteriorly and uniserial posteriorly on vomer. Preopercular pores 2. Vertebrae 162–167; MVF 18/62/165.

Preserved specimens yellow to amber, covered with dark specks dorsally; fins pale. Attains 68 cm TL.



*Ophichthus tomioi*, 39 cm TL,  
male holotype (Philippines).  
Source: McCosker 2010



*Ophichthus serpentinus*, 68 cm TL, holotype of *O. bennettai*, head (South Africa). Source: McCosker 1986

**DISTRIBUTION** Southern Africa: Namibia in southeastern Atlantic, to south coast of South Africa in WIO.

**REMARKS** Primarily known from Agulhas Bank, at 235–390 m.

### *Ophichthus tomioi* McCosker 2010

Tomio's snake-eel

*Ophichthus tomioi* McCosker 2010: 32, Figs. 32–35 (San Bernardino Strait, Philippines).

HL 10–11, body depth 25–31, and tail length 1.6–1.7 in TL. Body moderately elongate; dorsal-fin origin above pectoral-fin tips; pectoral fins elongate. Eyes large; mid-eye behind centre of upper jaw. Teeth small and conical, biserial on jaws, and uniserial on vomer. Vertebrae 166–189; MVF 16/62/169.

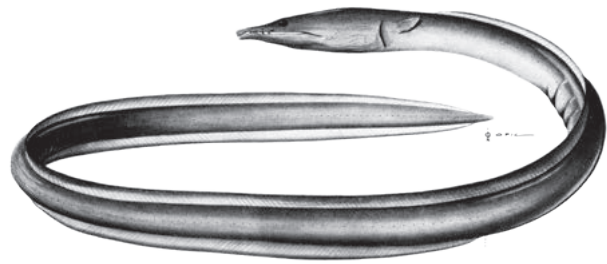
Preserved specimens pale, covered with dark specks dorsally; median fins pale, except anal-fin margin black posteriorly. Attains 45 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Seychelles; elsewhere, Philippines, Fiji and Marquesas Is.

**REMARKS** Collected at 300–423 m, but may occur at shallower depths. Similar to *O. genie*, but differs in greater number of vertebrae, and in a black (not pale) anal-fin margin.



*Ophisurus serpens*, 68 cm TL, head (South Africa). Source: Smith 1962



*Ophisurus serpens*, 191 cm TL (W Africa). Source: Blache & Saldanha 1972

## GENUS *Ophisurus* Lacepède 1800

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body cylindrical anteriorly, compressed posteriorly; tail much longer than rest of body. Dorsal-fin origin behind pectoral-fin tips; pectoral-fin length ~4–5 in HL. Snout attenuate, tip often spatulate; lower jaw with fleshy papilla at tip; jaws long and slender, not closing completely in adults. Teeth conical: small and sharp on sides of jaws, mostly biserial in upper jaw and uniserial in lower jaw; upper jaw also with canine tooth on each side at front, and lower jaw also with 5 or 6 canines on each side at front; vomer with row of 2 or 3 small fangs, followed by 4 or 5 large fangs. Anterior nostrils in short tube on sides of snout, nearer eyes than snout tip; posterior nostrils in upper lip, covered by flap, between eye and anterior nostril. Gill openings slightly oblique, crescentic, midlateral. Two species, 1 in WIO.

### *Ophisurus serpens* (Linnaeus 1758)

Serpent snake-eel

PLATE 19

*Muraena serpens* Linnaeus 1758: 244 (Mediterranean Sea; northeastern Atlantic).

*Ophisurus serpens*: Lacepède 1800; Smith 1962\*; SSF No. 42.23\*; Winterbottom *et al.* 1989; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*.

*Leptorhynchus capensis* Smith 1840: no page number, Pl. 6 (Cape of Good Hope, South Africa).

Diagnosis as for genus. HL 12–13, body depth 40–60, and tail length 1.5–1.6 in TL. Juveniles with shorter snout than adults (and thus can be mistaken for species of *Ophichthus*). Vertebrae 199–223; MVF 17/75/210.

Preserved specimens brown dorsally, pale ventrally (silvery in life); median-fin margins dark; LL pores in fine black spots. Attains 250 cm TL.

**DISTRIBUTION** Eastern Atlantic (Spain to South Africa), Mediterranean Sea, and Indian Ocean. WIO: South Africa to Mozambique (Inhambane) and Comoros.

**REMARKS** Found on continental shelf, on sand and mud bottom, from shore to ~300 m deep, and also in estuaries. The western Pacific species *O. macrorhynchos* Bleeker 1852 from China and Japan may be conspecific. Nocturnal, often caught by anglers on baited hooks. When swallowed alive, this eel often bores tail-first through the predator's intestines and becomes trapped in the abdominal cavity as it cannot penetrate the thicker abdominal wall; the mummified eel is occasionally found later when the predator is caught and cut up for food.

## GENUS *Phaenomonas* Myers & Wade 1941

(subfamily OPHICHTHINAE, tribe Bascanichthyini)

Body cylindrical, extremely elongate and slender; tail much shorter than rest of body. No fins other than short dorsal fin, originating on nape and extending ~1–4 HL beyond. Anterior nostrils tubular; posterior nostrils open into mouth. Teeth conical, uniserial. Gill openings sublateral, crescentic. Three species (McCosker & Böhlke 1984), 1 in WIO.

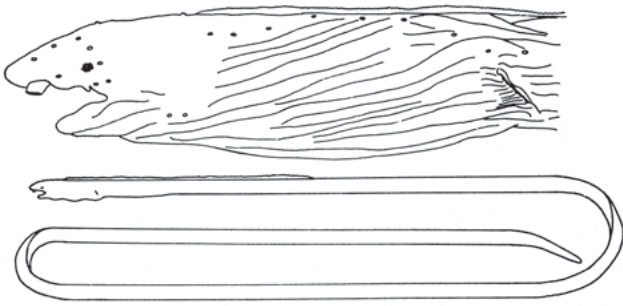
### *Phaenomonas cooperae* Palmer 1970

Maned sand-eel

*Phaenomonas cooperae* Palmer 1970: 219, Fig. 1 (lagoon reef at Betio, Tarawa, Gilbert Is., Kiribati); McCosker 1977; SSF No. 42.24\*.

Diagnosis as for genus. HL 26–31, body depth 118–152, and tail length 3.2–3.4 in TL. Dorsal fin short, extending from head to ~3–4 HL beyond origin. Vertebrae 243–270; MVF –/166/256.

Body and head pinkish, tail darker; preserved specimens entirely tan to pale. Attains 59 cm TL.



*Phaenomonas cooperae*, 59 cm TL (Palau). Source: McCosker 1975

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Aldabra and Seychelles; elsewhere to Marquesas Is. and Hawaii.

**REMARKS** Known from shallow sandy areas.

### GENUS *Phylloichthys* Gosline 1951

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body elongate, somewhat cylindrical and becoming more compressed posteriorly. Dorsal-fin origin above pectoral fins, which are well-developed; median fins become elevated before tail tip. Snout produced, conical. Anterior nostrils with prominent leaf-like flap; posterior nostrils on inside of upper lip, covered by flap. Teeth on jaws small and pointed, uniserial; no teeth on vomer. Gill openings crescentic slits on lower third of body. One species.

### *Phylloichthys xenodontus* Gosline 1951

Flapnose snake-eel

PLATE 19

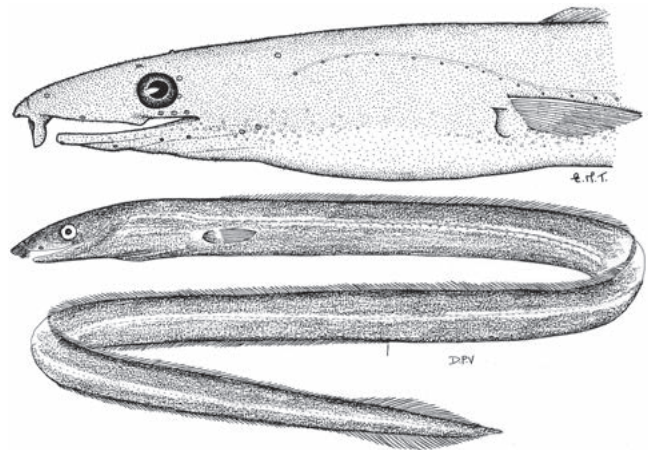
*Phylloichthys xenodontus* Gosline 1951: 316, Fig. 17a–b (Oahu I., Hawaii); McCosker 1977; SSF No. 42.25\*.

*Phylloichthys macrurus* McKay 1970: 4 (Upper Kalgan River, near Albany, Western Australia).

*Ophisurus serpens* (non Linnaeus 1758): Winterbottom *et al.* 1989\*; Winterbottom & Anderson 1997.

Diagnosis as for genus. HL 11–13, body depth 35–51, and tail length 1.8–2 in TL. Vertebrae 157–172; MVF 9/76/168.

Body olive yellow-brown dorsally, covered with minute dendritic dark specks; chin, throat, belly and all fins paler or yellowish. Preserved specimens uniformly tan, darker dorsally. Attains 42 cm TL.



*Phylloichthys xenodontus*, 27 cm TL (Kenya). Source: SSF

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea, Kenya to Mozambique (Inhaca I.), Comoros, Seychelles, Rodrigues and Chagos; elsewhere to Indonesia, Christmas I., Philippines, southern Japan, Australia, Society Is., Marquesas Is. and Hawaii.

**REMARKS** Found in shallow sandy areas, from near shore to ~20 m deep.

### GENUS *Pisodonophis* Kaup 1856

(subfamily OPHICHTHINAE, tribe Ophichthini)

Body moderately elongate, cylindrical anteriorly, compressed at tail. Dorsal-fin origin either above or behind pectoral fins; pectoral fins broad-based, rounded; median fins not continuous near tail tip. Snout tip rounded, overhangs lower jaw; jaws not elongated. Anterior nostrils in tube; posterior nostrils in upper lip and usually covered by flap. Teeth molariform or granular, none enlarged, multiserial on jaws and vomer, and more pointed in young than in adults. Colouration generally uniform.

The type specimens of several species have been lost and a comprehensive review of this genus is needed. The synonymies listed below are provisional. *Pisodonophis hoevenii* (Bleeker 1853) is known only from the ~22-cm holotype (from Sulawesi, Indonesia); two specimens reported by Blegvad [& Løppenthin] (1944) and cited by Randall (1995: 63) to have come from sea snake stomach contents, collected from the Persian/Arabian Gulf and Gulf of Oman, are likely based on specimens of *P. cancrivorus*. Six or 7 species, 3 in WIO.



**KEY TO SPECIES**

- 1a Dorsal-fin origin above middle of pectoral fins ..... *P. cancrivorus*
- 1b Dorsal-fin origin ~2–3 pectoral-fin lengths behind gill openings ..... 2
- 2a Chin and throat with brown speckling; vertebrae 151 ..... *P. micropterus*
- 2b No dark speckling on chin and throat; vertebrae 167–169 ..... *P. boro*

***Pisodonophis boro*** (Hamilton 1822)

Estuary snake-eel

PLATE 19

*Ophisurus boro* Hamilton 1822: 20, 363 (Ganges River estuary near Kolkata, India).

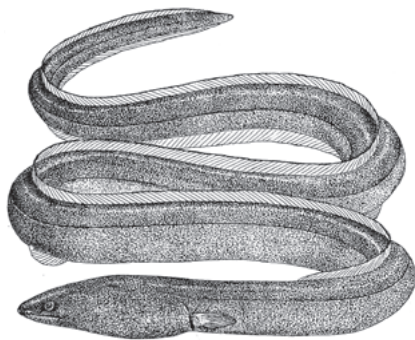
?*Ophisurus haranacha* Hamilton 1822: 21, 363 (estuaries near Kolkata, India).

?*Pisodonophis assamensis* Sen 1986: 241, Figs. 1–3 (Dolu River, Silchar District, Lower Assam, India).

*Pisodonophis boro*: SFSA No. 1100\*; McCosker 1977; SSF No. 42.26\*; Manilo & Bogorodsky 2003.

HL 9–12, body depth 30–36, and tail length 1.6–1.8 in TL. Dorsal-fin origin ~2–3 pectoral-fin lengths behind gill openings; pectoral fins paddle-shaped, not well-developed. Snout short, subconical. Teeth small, stout and blunt, in 2 or 3 irregular rows on jaws and vomer. Vertebrae 167–170; MVF 18/63/168.

Body brown dorsally, yellow ventrally; head and chin brown; throat and all fins yellow. Attains 100 cm TL.



*Pisodonophis boro*, 23 cm TL.  
Source: Weber & De Beaufort 1916

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Somalia to South Africa (Eastern Cape), Madagascar, Seychelles, southern India and Sri Lanka; elsewhere to east coast of India, Thailand, Indonesia, Taiwan, China, Philippines and Australia.

**REMARKS** Found in lagoons, estuaries, freshwater streams and rice paddies. Locally caught with bag nets as a food fish.

***Pisodonophis cancrivorus*** (Richardson 1848)

Longfin snake-eel

PLATE 19

*Ophisurus cancrivorus* Richardson 1848: 97, Pl. 50, Figs. 6–9 (Port Essington, Northern Territory, Australia [Arafura Sea]).

?*Ophisurus nigrepinnis* Liénard 1842: 90 (Mauritius, Mascarenes).

?*Ophichthus chilkinsis* Chaudhuri 1916: 445, Figs. 12–13 (Chilika Lake, Odisha, India).

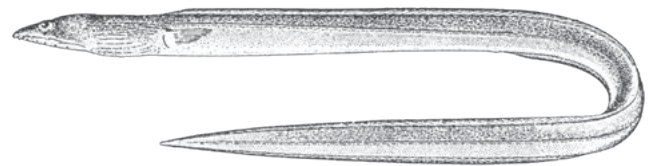
?*Ophichthus madagascariensis* Fourmanoir 1961: 102, Fig. 16 (Iranza I., Mozambique Channel).

*Pisodonophis cancrivorus*: SFSA No. 1100\*; McCosker 1977; SSF No. 42.27\*; Fricke 1999; Manilo & Bogorodsky 2003.

?*Pisodonophis macgregori* Jordan & Richardson 1908: 238, Fig. 2 (Manila, Philippines). Original genus should have been *Pisodonophis*.

HL 8.5–10, body depth 22–36, and tail length 1.6–1.7 in TL. Dorsal-fin origin above mid-pectoral fins; pectoral fins moderately developed. Snout subconical; 2 barbels along upper lip (one between eye and anterior nostril, and smaller one beneath eye). Teeth small, stout and blunt (molariform), in 2 or 3 irregular rows on jaws and vomer. Large individuals with wrinkled skin. Vertebrae 152–163; MVF 11/57/159.

Body brown or grey-brown dorsally, yellowish ventrally; head and chin brown; throat and fins yellow; dorsal-fin margin of adults black anteriorly (for ~1 HL), but often extending entire length of fin; anal-fin margin of adults black posteriorly. Attains 108 cm TL (commonly 50 cm TL).



?*Pisodonophis cancrivorus*, 25 cm TL, holotype of *P. macgregori* (Philippines). Source: Jordan & Richardson 1908

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique, South Africa (Algoa Bay), Madagascar and Mauritius; elsewhere to east coast of India, Bangladesh, Malaysia, Indonesia, Taiwan, southern Japan and Australia.

**REMARKS** Found in tidal channels, lagoons and estuaries, and enters freshwater. Observed congregating in loose groups, typically burrowing with just the head protruding. Fricke (1999) proposed that *Ophisurus nigrepinnis* Liénard 1842 (from Mauritius) is a senior synonym of this species. *Ophichthus madagascariensis* Fourmanoir 1961, known only from the terse description of one intact and four digested specimens found in the stomach of a lutjanid, caught at ~230 m, appears to be this species (although the type specimens are apparently lost).

*Pisodonophis micropterus* Bleeker 1863

*Pisodonophis micropterus* Bleeker 1863: 182 (Makassar Strait, Sulawesi, Indonesia) [misspelling of *Pisodonophis*]; Herre 1940.

Specimen from Saudi Arabia: HL 10.6, body depth 34, and tail length 1.7 in TL. Dorsal-fin origin well behind (~2 pectoral-fin lengths) gill openings; pectoral fins rounded. Snout short, subconical. Teeth small, stout and blunt, in 2 or 3 irregular rows on jaws and vomer. Vertebrae 17/55/151.

Body brown dorsally, yellow ventrally; head and chin brown, throat yellow, with fine brown speckling over chin and throat; all fins yellow, except dorsal-fin margin dark. Attains 56 cm TL.

**DISTRIBUTION** Indonesia in western Pacific; one specimen from Saudi Arabia provisionally recognised as this species.

**GENUS** *Schismorhynchus* McCosker 1970

(subfamily MYROPHINAE, tribe Myrophini)

Body moderately elongate, compressed posteriorly; tail longer than rest of body. Dorsal-fin origin on rear part of body. No pectoral fins. Snout conical, elongate, with prominent median toothed groove on underside. Anterior nostrils an elongate tube, as long as eye diameter; posterior nostrils on inside of upper lip. Gill openings small, constricted, midlateral. One species.

*Schismorhynchus labialis* (Seale 1917)

Splitsnout worm-eel

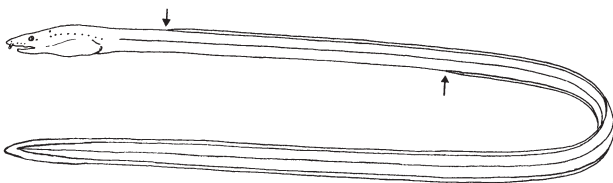
PLATE 19

*Muraenichthys labialis* Seale 1917: 79 (Arno Atoll, Marshall Is.).

*Schismorhynchus labialis*: McCosker 1970, 1977; Randall & McCosker 1975\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Randall 2007\*.

Diagnosis as for genus. HL 10–13, body depth 30–55, and tail length 1.6–1.7 in TL. Teeth conical, uniserial on jaws and vomer. Vertebrae 132–139; MVF 19/48/136.

Body uniformly pale. Attains 20 cm TL.



*Schismorhynchus labialis*, 17 cm TL (Easter I.). Source: Randall & McCosker 1975

**DISTRIBUTION** Indo-Pacific and eastern Pacific. WIO: Chagos and Maldives; elsewhere to New Caledonia, Hawaii, Johnston Atoll and Easter I.

**REMARKS** Found on shallow reefs.

**GENUS** *Schultzidia* Gosline 1951

(subfamily MYROPHINAE, tribe Myrophini)

Body moderately elongate, stout to compressed; tail longer than rest of body. Dorsal-fin origin 1.3–2 HL behind anus; no pectoral fins. Anterior nostrils in short tube; posterior nostrils on inside of upper lip. Teeth on jaws minute or villiform; no teeth on vomer. Gill openings small, constricted, lateral. Females with ripe eggs become very deep-bodied, and anal fin becomes elevated. At least 2 or 3 species, 2 in WIO.

**KEY TO SPECIES**

- |    |   |
|----|---|
| 1a | Body somewhat stout, its depth 23–26 in TL; eye diameter 10–12 in HL; vertebrae 145–160 ..... <i>S. johnstonensis</i> |
| 1b | Body more slender, its depth 30–45 in TL; eye diameter 15–21 in HL; vertebrae 131–139 ..... <i>S. retropinnis</i>     |

*Schultzidia johnstonensis* (Schultz & Woods 1949)

Tinyteeth worm-eel

PLATE 19

*Muraenichthys johnstonensis* Schultz & Woods 1949: 172,

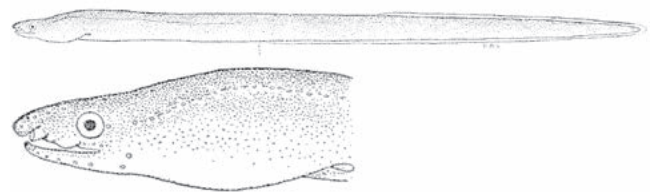
Fig. 1 (Johnston I, reef along northern side of atoll).

*Muraenichthys (Schultzidia) johnstonensis*: Gosline 1951 [new subgenus].

*Schultzidia johnstonensis*: Schultz *in* Schultz *et al.* 1953\*; McCosker 1970, 1977; Winterbottom *et al.* 1989\*; Randall & Anderson 1993.

Diagnosis as for genus. HL 8.5–9, body depth 23–26, and tail length 1.6–1.7 in TL. Teeth on jaws villiform. Vertebrae 145–160; MVF 76/51/150.

Head and body pale, with fine brown speckling dorsally and along lateral line. Attains 17 cm TL.



*Schultzidia johnstonensis*, 15 cm TL, holotype and head detail (Johnston I.). Source: Schultz *et al.* 1953

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Maldives, and possibly Chagos; elsewhere to Micronesia, Australia, Line Is., Johnston I. and Hawaii.

**REMARKS** Inhabits lagoons and reefs, to ~20 m deep or more.

*Schultzidia retropinnis* (Fowler 1934)

Velvet-tooth worm-eel

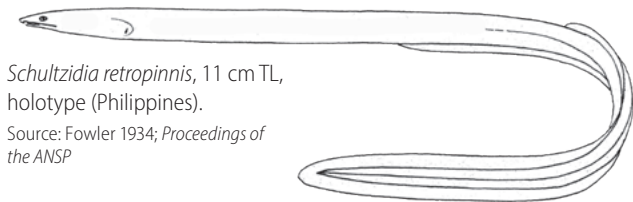
PLATE 19

*Muraenichthys retropinnis* Fowler 1934: 277, Fig. 37 (Tarataro I., Samar, Philippines).

*Schultzidia retropinnis*: Schultz in Schultz *et al.* 1953; McCosker 1970, 1977.  
?*Schultzidia* sp.: Randall & Anderson 1993.

Diagnosis as for genus. HL 8–10, body depth 30–45, and tail length 1.6–1.7 in TL. Teeth on jaws villiform. Vertebrae 131–139; MVF 67/47/134.

Body and head uniformly pale, and with fine brown speckling dorsally. Attains 12 cm TL.



*Schultzidia retropinnis*, 11 cm TL, holotype (Philippines).  
Source: Fowler 1934; *Proceedings of the ANSP*

**DISTRIBUTION** Western and central Pacific (widespread), including Philippines, Marshall Is., Australia and Solomon Is.; possibly Maldives in WIO.

**REMARKS** One 8-cm specimen from Maldives agrees with *S. retropinnis* in all characters except for its short jaw, which ends before the eyes (not extending beyond the eyes as in other specimens).

**GENUS** *Scolecenchelys* Ogilby 1897

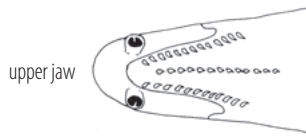
(subfamily MYROPHINAE, tribe Myrophini)

Body elongate, compressed posteriorly. No pectoral fins; median fins continuous with caudal fin; caudal-fin rays conspicuous, tail tip soft and flexible. Anterior nostrils tubular; posterior nostrils on inside of upper lip, covered by exterior flap; 2 pores on each side of snout between anterior and posterior nostrils. Teeth on jaws usually conical, in 1 or 2 rows; intermaxillary teeth not in broad patch. Gill openings very

small, midlateral. About 18–20 species (mostly identified as *Muraenichthys* in 19th and 20th century works); 5 species in WIO. *Chilorhinus* (*Muraenichthys*) *vermiformis* (Peters 1866) from Sri Lanka is a dubious species of *Scolecenchelys*.

**KEY TO SPECIES**

- 1a Dorsal-fin origin well in front of anus; teeth on upper jaw biserial ..... 2
- 1b Dorsal-fin origin above or behind anus (not notably in advance of it); teeth on upper jaw uniserial or biserial ..... 3
- 2a Dorsal-fin origin slightly before midlength; teeth on lower jaw biserial ..... *S. macroptera*
- 2b Dorsal-fin origin behind midlength but well in front of anus; teeth biserial at front but uniserial on sides of lower jaw ..... *S. xorae*
- 3a Teeth on upper jaw uniserial; body depth 50–53 in TL .....  
..... *S. erythraensis*
- 3b Teeth on upper jaw mostly biserial; body depth 25–40 in TL ... 4
- 4a Teeth on vomer biserial, but becoming uniserial posteriorly ..... *S. gymnota*
- 4b Teeth on vomer uniserial ..... *S. laticaudata*



*Scolecenchelys erythraensis*

(Bauchot & Maugé 1980)

Pale worm-eel

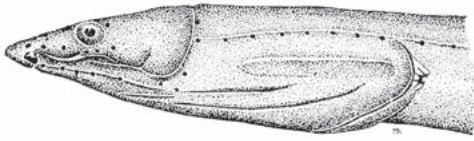
PLATE 19

*Muraenichthys erythraensis* Bauchot & Maugé 1980: 934, Figs. 1–2 (Gulf of Aqaba, Red Sea).

*Scolecenchelys erythraensis*: Goren & Dor 1994 [as *erythraensis*]; Castle & McCosker 1999.

HL 10–11, body depth 50–53, and tail length 1–1.9 in TL. Dorsal-fin origin above or slightly behind anus. Teeth conical, uniserial. Vertebrae 121–129; MVF 55/54/127.

Preserved specimens uniformly pale. Attains 16 cm TL.



*Scolecenchelys erythraensis*, 14 cm TL, head of holotype (Red Sea).  
Source: Bauchot & Maugé 1980

**DISTRIBUTION** WIO: northern Red Sea (Gulf of Aqaba and Gulf of Suez).

**REMARKS** Collected over sandy areas, from near shore to ~2 m deep.

### *Scolecenchelys gymnota* (Bleeker 1857)

Slender worm-eel

PLATE 19

*Muraenichthys gymnotus* Bleeker 1857: 90 (Ambon I., Moluccas, Indonesia); McCosker 1970, 1977; SSF No. 42.10\*.

*Muraenichthys schultzei* (non Bleeker 1857): Smith 1958.

*Scolecenchelys gymnota*: Castle & McCosker 1999; Randall 2005\*;  
Hibino *et al.* 2012\*.

HL 9–10, body depth ~40, and tail length ~1.7 in TL. Dorsal-fin origin ~½ HL behind anus. Teeth small and sharp: biserial on upper jaw, and uniserial on lower jaw; a few slender canines on intermaxillary; teeth on vomer biserial, becoming uniserial posteriorly. Vertebrae 126–136; MVF 52/50/129.

Body olive-green, belly yellow. Attains 33 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to South Africa (Cape Agulhas to KwaZulu-Natal), Madagascar and Mascarenes; elsewhere to Indonesia, southern Japan, Australia, New Caledonia, Line Is. and Pitcairn Is.

**REMARKS** Inhabits sandy areas, from shore to ~20 m deep.

### *Scolecenchelys laticaudata* (Ogilby 1897)

Redfin worm-eel

PLATE 19

*Myropterura laticaudata* Ogilby 1897: 247 (Fiji Is.).

*Muraenichthys laticaudata*: Smith 1958; McCosker 1970, 1977;  
SSF No. 42.11\*.

*Scolecenchelys laticaudata*: Castle & McCosker 1999.

HL 9–10, body depth 25–35, and tail length ~1.8 in TL.

Dorsal-fin origin at vertical just behind anus. Teeth small and sharp: mostly biserial on upper jaw, and uniserial on lower jaw and vomer; a few intermaxillary teeth. Vertebrae 126–147; MVF 57/58/140.

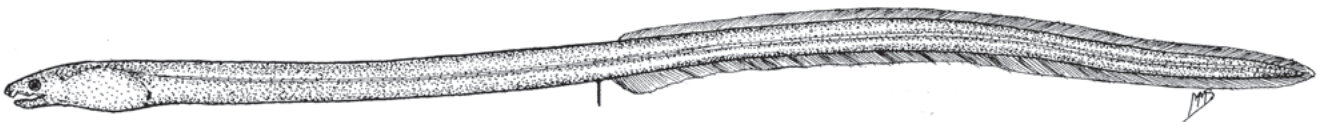
Body olive-green dorsally; median fins reddish. Attains 35 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (Gulf of Aqaba), East Africa to South Africa (Eastern Cape), Madagascar, Seychelles, Aldabra and Rodrigues; elsewhere to Mariana Is., Lord Howe I. and Pitcairn Is. (Ducie I.).

**REMARKS** Found in sandy areas, from shore to ~20 m deep.



*Scolecenchelys gymnota*, 33 cm TL (N Mozambique). Source: Smith 1962



*Scolecenchelys laticaudata*, 33 cm TL (N Mozambique). Source: Smith 1962





*Scolecenchelys macroptera*, ~20 cm TL. Source: Bleeker 1864



*Scolecenchelys xorae*, 25 cm TL, holotype (South Africa). Source: SSF

## *Scolecenchelys macroptera* (Bleeker 1857)

Longfin worm-eel

PLATE 20

*Muraenichthys macropterus* Bleeker 1857: 91 (Ambon I., Moluccas, Indonesia); Smith 1962\*; Randall & Anderson 1993.

*Scolecenchelys macroptera*: Castle & McCosker 1999; Heemstra *et al.* 2004.

HL 8.4–8.8, body depth 27–30, and tail length 1.6–1.8 in TL. Dorsal-fin origin slightly before midlength. Teeth small and conical: biserial on jaws; vomerine teeth biserial anteriorly, uniserial posteriorly. Vertebrae 127–132; MVF 24/47/130.

Preserved specimens uniformly tan, slightly darker dorsally, and fins pale. Attains 20 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique (Pinda), Rodrigues and Maldives; elsewhere to Indonesia, Philippines, Ryukyu Is., Mariana Is., Australia and Society Is.

**REMARKS** Found in sandy areas, from shore to ~20 m deep.

## *Scolecenchelys xorae* (Smith 1958)

Orangeheaded worm-eel

PLATE 20

*Muraenichthys xorae* Smith 1958: 126, Fig. 1 (Xora River mouth, Transkei region, South Africa); SSF No. 42.12\*.

*Scolecenchelys xorae*: Castle & McCosker 1999.

HL 9–10, body depth ~35, and tail length ~1.8 in TL. Dorsal-fin origin behind midlength. Snout blunt. Teeth small and conical: biserial on upper jaw; biserial at front of lower jaw, and uniserial on sides; uniserial on vomer; a few intermaxillary teeth. Vertebrae 139–144; MVF 42/56/140.

Body olive-yellow, belly greenish; head and tail tip orange. Attains 25 cm TL.

**DISTRIBUTION** WIO: South Africa (Algoa Bay to Port Edward), Madagascar, Réunion and Mauritius.

**REMARKS** Collected from tidepools.

## GENUS *Skythrenchelys* Castle & McCosker 1999

(subfamily MYROPHINAE, tribe Myrophini)

Tail laterally compressed, its length  $\leq \frac{1}{2}$  TL. Median fins low but apparent; dorsal-fin origin above anus or in trunk region; no pectoral fins. Snout conical, underside not grooved; jaws elongate. Anterior nostrils in short tube near tip of snout; posterior nostrils a hole preceded by small flap, entirely above edge of upper lip, slightly below and in advance of eyes. Teeth conical, largest teeth equal to eye diameter, uniserial on jaws and vomer. Gill openings below midline, relatively unconstricted and elongate. Two species, both in WIO.

### KEY TO SPECIES

- |    |   |                      |
|----|---|----------------------|
| 1a | Dorsal-fin origin over anus; body tan, and front of head and inside of mouth covered with numerous brown freckles ..... | <i>S. macrostoma</i> |
| 1b | Dorsal-fin origin at mid-trunk; body uniformly tan .....  | <i>S. zabra</i>      |

## *Skythrenchelys macrostoma* (Bleeker 1864)

Large-mouthed angry worm-eel

PLATE 20

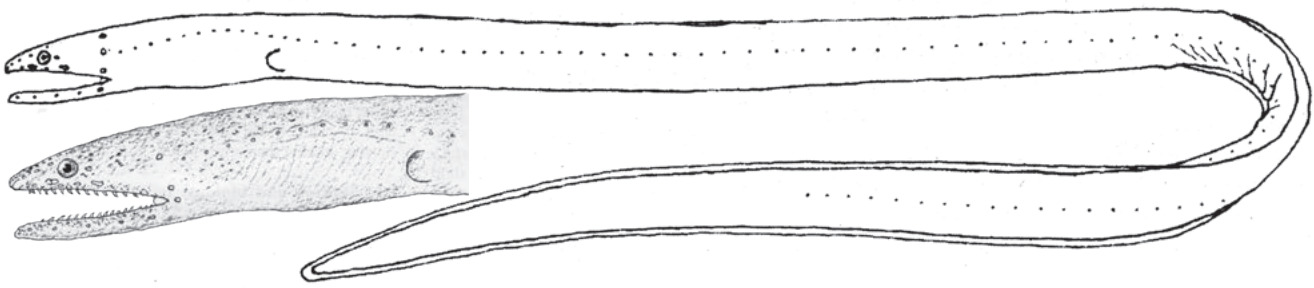
*Muraenichthys macrostomus* Bleeker 1864: 38 (Ambon I., Moluccas, Indonesia); McCosker 1977.

*Skythrenchelys lentiginosa* Castle & McCosker 1999: 119, Figs. 1d, 1f, 2b (Port Sudan, Red Sea).

*Skythrenchelys macrostoma*: Hibino *et al.* 2013\*.

HL 8.1–8.3, body depth 27–36, and tail length 1.8–2 in TL. Dorsal-fin origin above anus. Vertebrae 120–124; MVF 52/47/122.

Body tan, and front of head and inside of mouth with brown freckles. Attains 22 cm TL.



*Skythrenchelys macrostoma*, 17 cm TL, holotype (Red Sea). Source: Castle & McCosker 1999; © AMS

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (Port Sudan); elsewhere, Indonesia (Moluccas) and Philippines.

**REMARKS** Known only from three specimens, collected over sand bottom, to ~22 m deep.

*Skythrenchelys zabra* Castle & McCosker 1999

Glutinous worm-eel

PLATE 20

*Skythrenchelys zabra* Castle & McCosker 1999: 116, Figs. 1a–c, 2a (Thevara, Kerala, India).

HL 7.1–7.9, body depth 25–36, and tail length 2.2–2.5 in TL. Dorsal-fin origin near midlength. Vertebrae 112–122; MVF 33/57/119.

Body uniformly tan. Attains 30 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: southwestern India; elsewhere, Indonesia (Strait of Malacca), Philippines, Taiwan and northern Australia.

**REMARKS** Most specimens from India collected from a shallow turbid estuary; known from 2–180 m. Able to ingest very large prey.

**GENUS** *Xestochilus* McCosker 1998

(subfamily OPHICHTHINAE, tribe Callechelyini)

Dorsal-fin origin on nape; tip of tail hard; no pectoral fins. Snout short and acute, with short crease on underside not extending beyond bases of anterior nostrils. Anterior nostrils tubular; posterior nostrils on inside of upper lip. Gill opening low, lateral, vertical, its length much greater than distance between gill openings. One species.

*Xestochilus nebulosus* (Smith 1962)

Cloudy sand-eel

PLATE 20

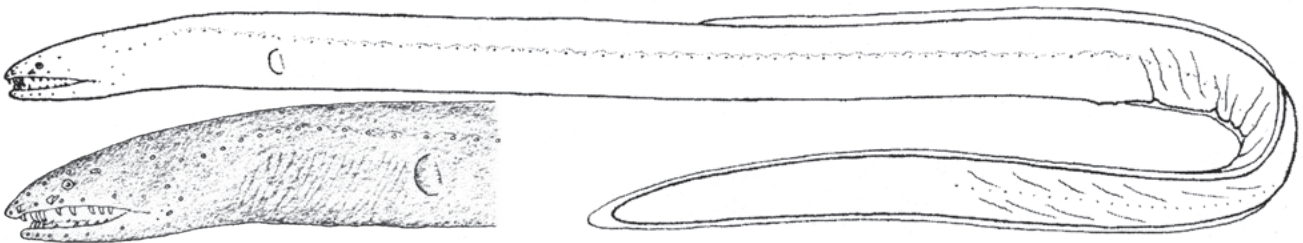
*Callechelys bitaeniatus* (non Peters 1877): Smith 1958.

*Callechelys nebulosus* Smith 1962: 452, Pl. 65, Fig. D (Pinda, Mozambique).

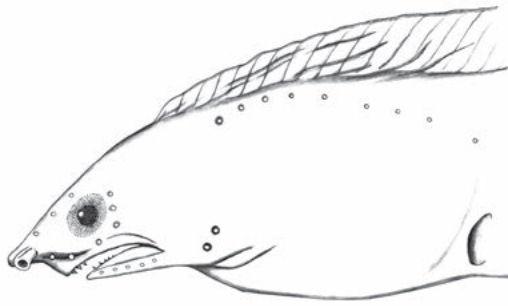
*Xestochilus nebulosus*: McCosker 1998\*.

Diagnosis as for genus. HL 14–18, body depth 46–55, and tail length 2.5–2.6 in TL. Teeth on jaws minute and conical, uniserial; 2 or 3 stout teeth on intermaxillary; 2 teeth on vomer. Vertebrae 155–165; MVF H/93/160.

Body tan to pale olive, with brown band along flanks in juveniles, but band interrupted in trunk region in adults, and brown spotting appears on head, throat and chest; at all sizes, corner of mouth and preopercular pores dark, and fin margins pale, except dorsal-fin margin dark in trunk region. Attains 47 cm TL.



*Skythrenchelys zabra*, 24 cm TL, holotype (India). Source: Castle & McCosker 1999; © AMS



*Xestochilus nebulosus*, 9 cm TL, head (N Mozambique).



*Xestochilus nebulosus*, 47 cm TL, holotype (N Mozambique).

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique (Pinda) and Seychelles; elsewhere to Andaman Is., Indonesia, Palau, Marshall Is. and Marquesas Is.

**REMARKS** Found in tidepools with sandy bottom, seagrass beds, and sandy areas of reefs, to ~42 m deep.

**GENUS** *Xyrias* Jordan & Snyder 1901

(subfamily OPHICHTHINAE, tribe Ophichthini)

Tail length ~½ TL. Dorsal-fin origin over or slightly behind pectoral-fin tips; pectoral fins slightly longer than snout. Snout pointed. Eyes located before midpoint of upper jaw. Upper jaw with outer row of minute sharp teeth and inner conical teeth in band broadening posteriorly; enlarged needle-like teeth at anterior end of jaws, and in 1 row on vomer. Anterior nostrils ovate, in short tube on upper lip directed laterally; posterior nostrils on edge of upper lip below front edge of eyes and covered by flap. Preopercular pores 2. Gill openings crescentic, on lower half of body. Revised by McCosker (1998) and McCosker *et al.* (2009). Four species, 2 in WIO.

**KEY TO SPECIES**

- 1a Eyes above middle of upper jaw; HL ~7–8 in TL; pectoral-fin length 3.5–4.5 in HL ..... *X. multiserialis*
- 1b Eyes well in front of middle of upper jaw; HL ~9–10 in TL; pectoral-fin length 5.3–6.1 in HL ..... *X. revulsus*

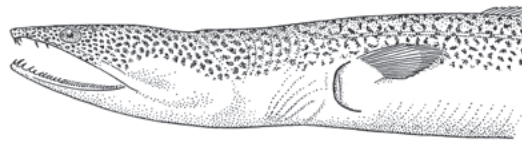
*Xyrias multiserialis* (Norman 1939)

Bowmouth snake-eel

*Ophichthus multiserialis* Norman 1939: 42, Fig. 15 (Gulf of Aden).  
*Ophisurus multiserialis*: Smith 1962\*; Randall 1995\* [misidentification].  
*Xyrias multiserialis*: McCosker 1998\*; Manilo & Bogorodsky 2003; McCosker *et al.* 2009\*.

HL 7.2–7.8, body depth 16–19, and tail length ~2.2 in TL. Dorsal-fin origin above or behind pectoral-fin tips. Snout length 2.3–2.9 in upper jaw; jaws bowed, mouth not closing completely. Vertebrae 140–141; MVF 17/67/140.

Head and body yellowish brown, with many small dark brown spots dorsally. Attains 76 cm TL.



*Xyrias multiserialis*, 63 cm TL, head and anterior body of holotype (Gulf of Aden). Source: Norman 1939

**DISTRIBUTION** WIO: Gulf of Aden and off Somalia.

**REMARKS** Trawled from 220–322 m. Randall's (1995) mention of a juvenile from southern Oman is based on *Ophisurus serpens*.

*Xyrias revulsus* Jordan & Snyder 1901

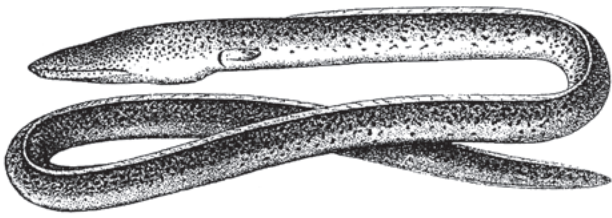
Freckled snake-eel

PLATE 20

*Xyrias revulsus* Jordan & Snyder 1901: 869, Fig. 16 (near Misaki, Japan); McCosker 1998\*; McCosker *et al.* 2009\*.

HL 9–9.6, body depth 36–43, and tail length 2.1–2.2 in TL. Dorsal-fin origin ~1 pectoral-fin length behind pectoral-fin tips. Snout length 2.7–3.4 in upper jaw length; jaws straight, mouth closes completely. Vertebrae 155–160; MVF 17/78/157.

Head and body buff, with many brown spots and freckles dorsally. Attains 113 cm TL.



*Xyrias revulsus*, 88 cm TL, female holotype (Japan).  
Source: Jordan & Snyder 1901

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal); elsewhere to South China Sea, Philippines, southern Japan, Arafura Sea and Australia.

**REMARKS** Known to ~300 m deep.

## GENUS *Yirrkala* Whitley 1940

(subfamily OPHICHTHINAE, tribe Sphagebranchini)

Body elongate, cylindrical; tail length  $\leq \frac{1}{2}$  TL. Dorsal-fin origin above or behind gill openings (except behind anus in one species); no pectoral fins. Snout subconical, underside flat. Anterior nostrils tubular; posterior nostrils outside of mouth. Teeth conical, mostly uniserial. Gill openings ventral. Preopercular pores 2. This genus requires revision. Primarily shallow-water substrate burrowers. About 14 species in Indo-Pacific, 5 in WIO.

### *Yirrkala lumbricoides* (Bleeker 1864)

Earthworm sand-eel

*Sphagebranchus lumbricoides* Bleeker 1864: 71, Pl. 188, Fig. 4 (Timor, Malay Archipelago) [subjectively invalid; secondarily preoccupied by *Ophisurus lumbricoides* Bleeker 1853 when both are in *Ophichthys*]; Bleeker 1865.

*Yirrkala lumbricoides*: McCosker 1977, 2007, 2011; SSF No. 42.28\*.

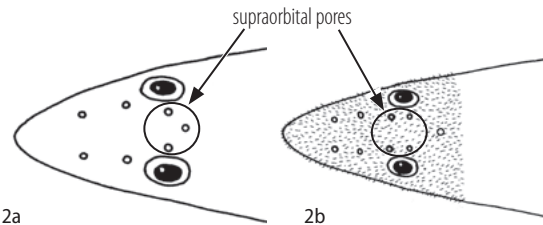
HL 13–17, body depth 50–80, and tail length 2–2.2 in TL. Dorsal-fin origin slightly before gill openings. Teeth conical and none enlarged, uniserial on jaws and vomer, but slightly biserial at front of vomer. Vertebrae 150–159; MVF 5/76/153.



*Yirrkala lumbricoides*. Source: Bleeker 1864

## KEY TO SPECIES

- 1a Dorsal-fin origin slightly in front of gill openings ..... 2  
1b Dorsal-fin origin behind gill openings ..... 4
- 2a Supraorbital pores 3; no microscopic fleshy bristles along edge of snout and lower jaw ..... 3  
2b Supraorbital pores 4; edge of snout and lower jaw with microscopic fleshy bristles ..... *Y. ori*



- 3a Groove on underside of snout extends in front of nostril bases; colour olive-brown, with fine brown speckling dorsally on body, snout, nape and cheeks, and some jaw pores set within brown spots ..... *Y. tenuis*  
3b Groove on underside of snout ends at base of anterior nostrils; body pink to nearly transparent in life, without brown speckles or spots ..... *Y. lumbricoides*
- 4a Dorsal-fin origin  $\sim \frac{1}{2}$  HL behind gill openings; series of distinct dark spots below anterior portion of lateral line ..... *Y. misolensis*  
4b Dorsal-fin origin behind anus; no dark spots below lateral line ..... *Y. omanensis*

Body pink to nearly transparent in life, uniformly tan in preservative. Attains 61 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal), Seychelles and Sri Lanka; elsewhere, Indonesia, Vietnam, southern Malay Archipelago, Philippines and northern Australia.

**REMARKS** Inhabits sandy areas, from near shore to ~45 m deep.



## *Yirkala misolensis* (Günther 1872)

Misol sand-eel

PLATE 20

*Ophichthys misolensis* Günther 1872: 426 (Misool [Misol] I., Irian Jaya, New Guinea, Indonesia).

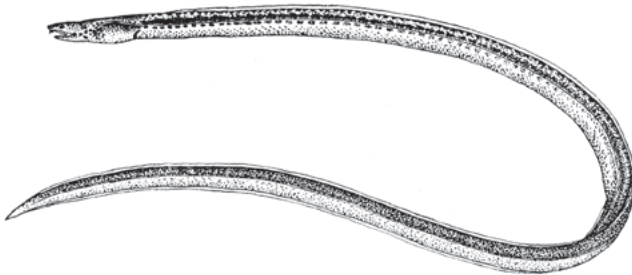
*Dalophis misolensis*: Jordan & Seale 1906.

*Yirkala maculata*: McCosker 1977; Randall & Anderson 1993.

*Yirkala misolensis*: McCosker 1977, 2011.

HL 15–17, body depth 43–56, and tail length ~2 in TL. Dorsal-fin origin ~½ HL behind gill opening. Teeth conical and none enlarged, uniserial on jaws and vomer. Vertebrae 166–169; MVF 12/75/168.

Preserved specimens tan, darker dorsally, with series of darker spots below anterior portion of lateral line, and paired series of spots beneath dorsal-fin base. Attains 48 cm TL.



*Yirkala misolensis*, 22 cm TL, holotype of *Caecula maculata* (Nicobar Is.). Source: Klausewitz 1964

**DISTRIBUTION** Indo-Pacific. WIO: Maldives; elsewhere, Nicobar Is., Vietnam, Taiwan and New Guinea, but probably more widespread.

**REMARKS** Found on coral reefs, to ~20 m deep.

## *Yirkala omanensis* (Norman 1939)

Oman sand-eel

*Sphagebranchus omanensis* Norman 1939: 43, Fig. 16 (Gulf of Oman).

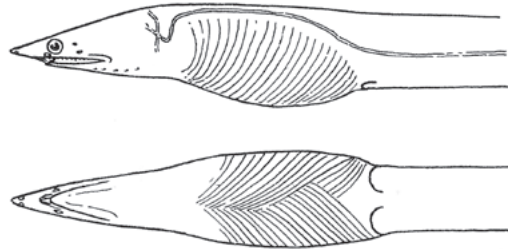
*Caecula omanensis*: Smith 1962\*.

*Ichthyapus omanensis*: Randall 1995\*; Manilo & Bogorodsky 2003.

*Yirkala omanensis*: McCosker 2011.

HL 13, body depth 66, and tail length 2.4 in TL. Dorsal fin minute, its origin behind anus. Teeth small and conical, uniserial on jaws, and biserial anteriorly on vomer. VF 79/76/140.

Body greyish brown, paler ventrally, and head variegated with brown. Attains at least 23 cm TL.



*Yirkala omanensis*, 23 cm TL, head of holotype (Gulf of Oman). Source: Norman 1939

**DISTRIBUTION** Known only from the holotype collected in Gulf of Oman.

**REMARKS** Taken at ~73 m. Generic placement dubious.

## *Yirkala ori* McCosker 2011

Durban sand-eel

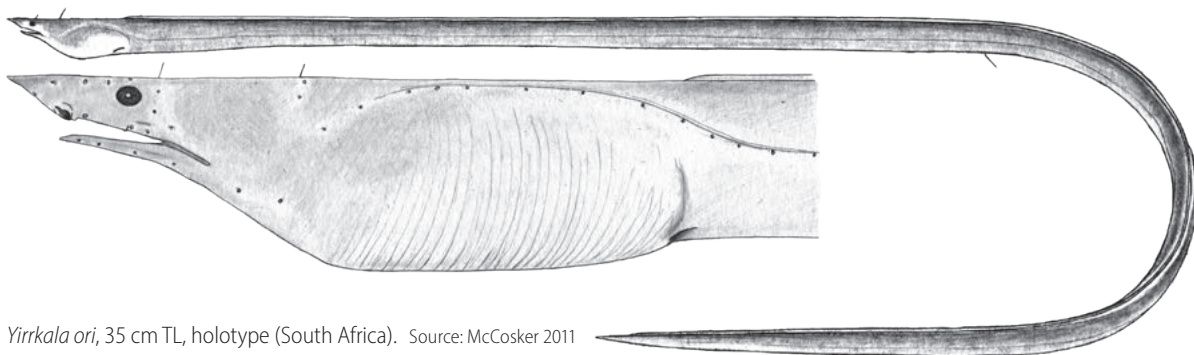
*Yirkala ori* McCosker 2011: 46, Figs. 1–3 (Addington Beach, Durban, KwaZulu-Natal, South Africa).

HL 15–16, body depth 57–67, and tail length ~2 in TL. Dorsal-fin origin slightly before gill opening. Teeth conical and none enlarged, uniserial on jaws and at front of vomer. Supraorbital pores 4. Vertebrae 149–152; MVF 6.5/74/150.

Body uniformly tan. Attains at least 44 cm TL.

**DISTRIBUTION** Known only from four type specimens collected in South Africa.

**REMARKS** Taken at ~20 m.



*Yirkala ori*, 35 cm TL, holotype (South Africa). Source: McCosker 2011

*Yirkala tenuis* (Günther 1870)

Thin sand-eel

PLATE 20

*Ophichthys tenuis* Günther 1870: 88 [no locality given: possibly Mauritius].*Caecula natalensis* Fowler 1934: 416, Fig. 5 (KwaZulu-Natal, South Africa).*Pantonora tenuis*: Smith 1965\*.*Yirkala tenuis*: McCosker 1977, 2011; SSF No. 42.29\*; Fricke 1999;Fricke *et al.* 2009.

HL 13–15, body depth 41–45, and tail length 2.1–2.3 in TL. Dorsal-fin origin slightly before gill opening. Teeth conical and none enlarged; uniserial on jaws, slightly biserial at front of vomer. Vertebrae 167–174; MVF 6/82/171.

Body olive-brown dorsally and dusky on head, paler ventrally. Attains 53 cm TL.

**DISTRIBUTION** WIO: Red Sea, East Africa to South Africa (Sodwana Bay), Mozambique (Inhaca I.), Seychelles, Réunion and Mauritius.

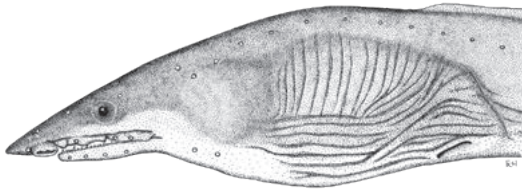
**REMARKS** Found in estuaries.

**GLOSSARY**

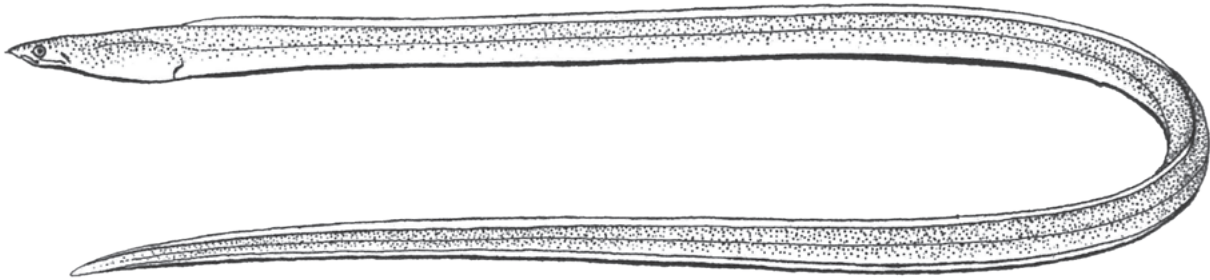
**hydrophiin sea snakes** – sea snakes with a tail like a fin.

**leptocephalus** – the transparent, ribbon-like, pelagic larva of eels and other elopomorph fishes.

**rictus** – the corner or gape of the mouth.



*Yirkala tenuis*, 48 cm TL, head (S Mozambique).



*Yirkala tenuis*, 30 cm TL, holotype (South Africa). Source: Fowler 1934, *Proceedings of the ANSP*

# ORDER CLUPEIFORMES

M Eric Anderson

These primitive teleosts have a fossil record dating to the Early Cretaceous. Phylogenetic analysis of genetic sequence data coupled with fossil age constraints places the origin of the group in the Middle Jurassic (Near *et al.* 2012). Phylogenetic relationships among and within the main lineages of clupeiforms based on molecular genetics were discussed by Lavoué *et al.* (2007) and Li & Orti (2007). Taxonomic works relevant to species in WIO, including fisheries methods and importance, are those of Whitehead (1985) and Whitehead *et al.* (1988), and an unpublished dissertation (Wongratana 1980) from which most of our knowledge of Indo-Pacific clupeoids derives.

Clupeiforms are distinguished by an otic capsule to swimbladder connection consisting of paired extensions of the swimbladder that enter the cranium to connect to the semicircular canals. The group also has a unique caudal-fin skeleton and characteristic skull features (Greenwood *et al.* 1966); pectoral fins inserted low on the body; pelvic fins abdominal; and no parasphenoid teeth, adipose fin, fin spines or lateral line on the body.

Five families, 84 genera and 364 species; classified into suborder Denticipitoidei, with a single species (*Denticeps clupeoides*, from West African rivers), and suborder Clupeoidei, with 4 families of great commercial importance (e.g., sardines, pilchards, herrings and anchovies). Characters in the keys here are those pertaining to WIO clupeiforms only.

Clupeotoxin poisoning is widespread but rare; it results from consumption of certain plankton-eating fish (such as herrings, anchovies and sardines), mostly in the tropics or subtropics, which have consumed a single-cell plant (dinoflagellates) that may produce palytoxin, which is tasteless and does not break down when the fish is cooked.

## KEY TO FAMILIES

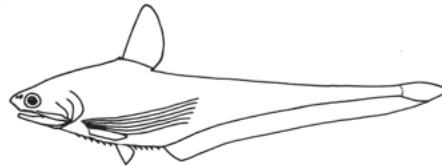
- 1a Jaw teeth minute or absent; dorsal-fin origin near body midpoint and in front of vertical through anal-fin origin (except *Opisthopterus tardoore* which has minute teeth); pelvic scute present ..... 2
- 1b Jaws with caniniform teeth; dorsal-fin origin well behind body midpoint and approximately at vertical through anal-fin origin; no pelvic scute ..... **CHIROCENTRIDAE**



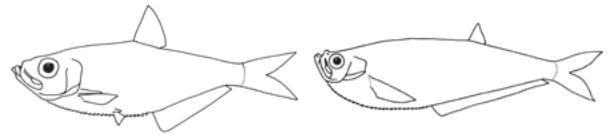
Continued...

## KEY TO FAMILIES

- 2a Upper jaw extending at most to beneath middle of eye; mouth terminal or subterminal, rarely inferior ..... 3
- 2b Upper jaw extending to well behind eye; mouth inferior and snout projecting ..... **ENGRAULIDAE**



- 3a Anal fin 35–67 rays; body deep and distinctly laterally compressed ..... **PRISTIGASTERIDAE**



- 3b Anal fin 12–26 rays; body usually fusiform, and cylindrical to compressed ..... **CLUPEIDAE**



## GLOSSARY

**adipose fin** – a small, fleshy fin behind the rayed dorsal fin, without bony elements.

**parasphenoid** – a bone in the middle at the base of the skull.

**pelvic scute** – a long, pointed scale above the pelvic-fin base.

**FAMILY CLUPEIDAE**

Herrings, sardines, pilchards and shads

M Eric Anderson

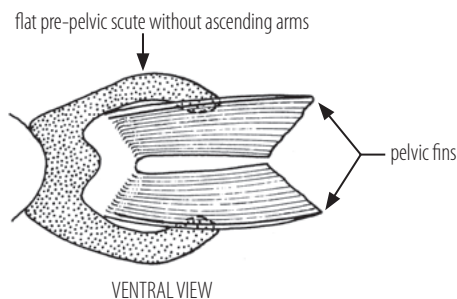
Small- to moderate-sized with fusiform to oval body; most species with complete series of scutes along belly, often creating a sharp keel; mouth small, more or less terminal; usually 2 supramaxillae in upper jaw (sometimes 1 or absent), and maxilla not reaching past eye; teeth minute, villiform, or absent. One dorsal fin; anal fin short, with 12–38 soft rays, fin origin well behind vertical through last dorsal-fin ray; no fin spines. Gill rakers typically long and slender, often numerous. Scales cycloid, usually deciduous, with vertical or posterior striae (best seen on dry or stained scales). No lateral line. Colour commonly blue, blue-green or brown dorsally, and flanks silvery; some species with darker markings on sides or behind gill cover.

Identification can be difficult and generally relies on fin formulae, striations on the head, and shape of the maxilla and/or supramaxilla. Mainly inshore, pelagic, schooling; juveniles of many species enter estuaries, and species of subfamily Pellonulinae tolerate freshwater. Most species reach ~10–20 cm SL, but the shad *Tenulosa ilisha* reaches 60 cm SL, and some West African freshwater species are dwarves, maturing by ~2 cm SL. Clupeoids occur in all major oceans and are very important commercially and in the marine food chain. *Ilisha* was formerly placed as a subfamily of Clupeidae, but has now been elevated to level of family Pristigasteridae. Six subfamilies recognised, with ~57 genera and 189 species; 5 subfamilies, 15 genera and 38 species in WIO.

**KEY TO SUBFAMILIES**

[Represented in WIO]

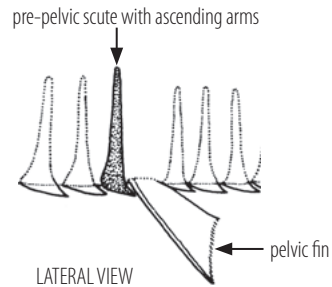
- 1a Pelvic scute flat against abdomen, W-shaped, without ascending arms; no other abdominal scutes present ..... *Dussumieriinae*



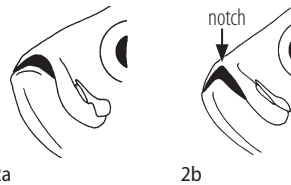
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**KEY TO SUBFAMILIES**

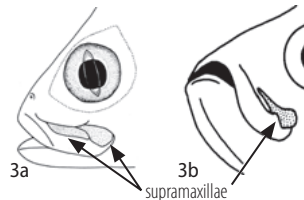
- 1b Pelvic scute with ascending arms; at least some pre-pelvic scutes present (except species of Pellonulinae with thin, unkeeled pre-pelvic scutes, and *Spratellomorpha bianalis* without pre-pelvic scutes) ..... 2



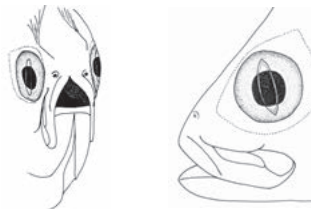
- 2a Profile of upper jaw rounded when viewed from front ..... 3
- 2b Profile of upper jaw notched when viewed from front ..... 4



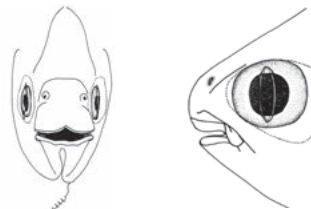
- 3a Two supramaxillae ..... **Clupeinae**
- 3b One supramaxilla ..... **Pellonulinae**



- 4a Mouth terminal; upper margin of lower jaw (dentary) directed posteriorly ..... **Alosinae**



- 4b Mouth inferior; upper margin of lower jaw directed laterally ..... **Dorosomatinae**





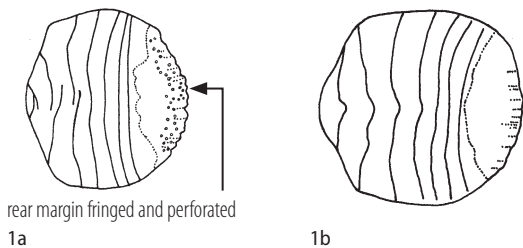
## SUBFAMILY ALOSINAE

### Shads

Moderate- to relatively large-sized shads (24–60 cm SL in WIO) with compressed body and prominent abdominal scutes. Lower jaw with wedge-shaped tip that fits into notch of upper jaw; 2 supramaxillae; teeth on jaws reduced or absent. Anal fin short and well behind dorsal fin. Seven genera and 31 species; 2 genera and 3 species in WIO.

#### KEY TO GENERA

- 1a Pectoral-fin axillary scales 4–6, roughly triangular; frontoparietal striae well-developed, with 8–14 ridges; rear margin of scales fringed and perforated; predorsal scales 13–16 ..... *Hilsa*
- 1b Single pectoral-fin axillary scale, elongate and pointed; frontoparietal striae weak or absent (covered by skin); rear margin of scales not fringed or perforated; predorsal scales 14–21 ..... *Tenulosa*



## GENUS *Hilsa* Regan 1917

Body deep, strongly compressed, depth greater than head length; abdomen V-shaped in cross-section. Top of head with numerous frontoparietal striae. Upper jaw with median notch. Gill rakers numerous (~100–175), number increasing with growth, and those on inner arches distinctly curled; outer row of gill filaments on first arch <math>< \frac{1}{2}</math> length of gill rakers. Scales on hind part of body with perforations on rear margin. One species with numerous synonyms (Whitehead 1985).

### *Hilsa kelee* (Cuvier 1829)

Kelee shad

PLATE 22

*Clupea kelee* Cuvier 1829: 320 (Visakhapatnam, India).

*Clupeonia blochii* Valenciennes in Cuv. & Val. 1847: 353 (Tharangambadi, India).

*Clupea durbanensis* Regan 1906: 4, Pl. 4 (Durban Bay, KwaZulu-Natal, South Africa).

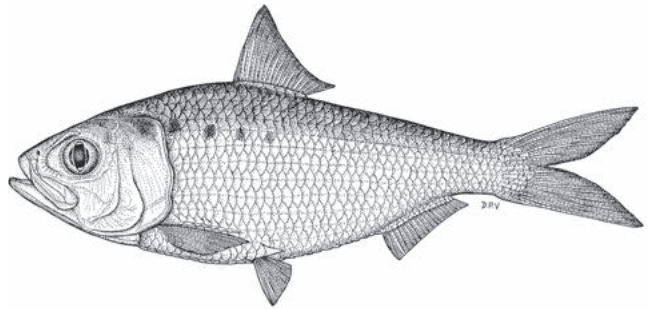
*Hilsa durbanensis*: Barnard 1925.

*Macrura kelee*: Smith 1949\*.

*Hilsa kelee*: Wongratana 1980\*; Whitehead 1985\*; SSF No. 54.5\*; Van der Elst 1988\*; Talwar & Jhingran 1991\*; Randall 1995\*; Whitfield 1998\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Diagnosis as for genus. Dorsal-fin rays 3 or 4 unbranched, 13–15 branched; anal-fin rays 2–4 unbranched, 15–19 branched; pectoral-fin rays 1 unbranched, 12–15 branched. LSS 39–44; scutes 15–17 + 12–14 = 28–30. GR 52–103/75–175; predorsal scales 13–16; branchiostegal rays 6; pseudobranchial filaments usually 22–36. Pectoral-fin axillary scales 4–6, pointed, triangular.

Body bluish green dorsally, sides silvery; black spot behind gill cover, often followed by 3–10 similar spots along flanks. Attains 27 cm SL (commonly ~16 cm SL).



*Hilsa kelee*, 19 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, South Africa (to Transkei region) and Madagascar; not found in Red Sea or Persian/Arabian Gulf; elsewhere, east coast of India to Bay of Bengal, Gulf of Thailand, Indonesia, China, Philippines and New Guinea.

**REMARKS** Marine, brackish and freshwater; anadromous. Feeds chiefly on phytoplankton.

## GENUS *Tenulosa* Fowler 1934

Body deep, compressed, depth greater than head length. Frontoparietal striae weak or absent, covered by flesh. Upper jaw with median notch. Gill rakers up to 250, number increasing with growth. Branchiostegal rays 6. Single, elongate pectoral-fin axillary scale. Rear margin of scales not perforated. Five species in Indo-Pacific, 2 in WIO.

## KEY TO SPECIES

- 1a HL 28–32% SL; caudal fin 25–31% SL; 3–6 black spots on flanks; LSS 44–47; lower GR 150–275 (in fish >11 cm SL) ..... *T. ilisha*
- 1b HL 25–27% SL; caudal fin 31–34% SL; no spots on flanks; LSS 37–42 (usually 38–41); lower GR 60–100 (in fish >11 cm SL) ..... *T. toli*

*Tenualosa ilisha* (Hamilton 1822)

Hilsa shad

PLATE 23

*Clupanodon ilisha* Hamilton 1822: 243, 382, Pl. 19, Fig. 73 (Ganges River estuaries, Kolkata, and Dhasa, India).

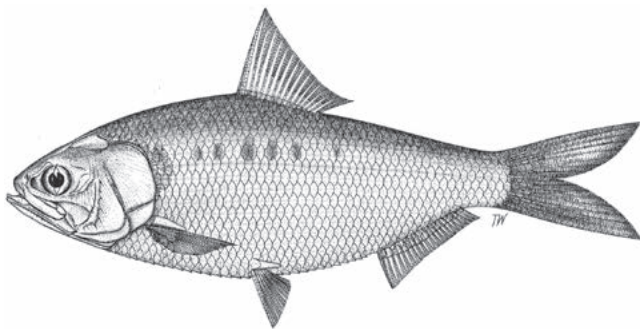
*Clupea palasah* Cuvier 1829: 320 (Visakhapatnam, India).

*Hilsa ilisha*: Talwar & Jhingran 1991\*.

*Tenualosa ilisha*: Wongratana 1980\*; Whitehead 1985\*; Randall 1995\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 14–16 branched; anal-fin rays 2–4 unbranched, 16–20 branched; pectoral-fin rays 1 unbranched, 12–15 branched. LSS 44–47; scutes 16–18 + 13–16 = 30–33. GR 115–120/150–275 (in fish >11 cm SL); predorsal scales 17–21; branchiostegal rays 6; frontoparietal striae 4–7, weak and covered by skin; pseudobranchial filaments 18–40. Upper jaw 11–13% SL; caudal fin 25–31% SL.

Body bluish green dorsally, and flanks silvery, with series of 3–6 black spots. Attains 60 cm SL.



*Tenualosa ilisha*, 14 cm SL. Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean. WIO: Arabian Sea and Persian/Arabian Gulf (Kuwait and Iraq to India); elsewhere to east coast of India, Myanmar, Thailand and Malaysia.

**REMARKS** Relatively widespread. Marine, pelagic and schooling; anadromous, ascending rivers up to 1 200 km (but usually 50–100 km) from the sea in India and Nepal; fast-swimming. Maximum age ~4–6 years, but difficult to age. Able to spawn multiple times during its spawning season. Highly exploited by commercial fisheries and a highly sought food source. IUCN Red List conservation status Near Threatened in Persian/Arabian Gulf.

*Tenualosa toli* (Valenciennes 1847)

Toli shad

PLATE 23

*Alausa toli* Valenciennes in Cuv. & Val. 1847: 435 (Puducherry, India).

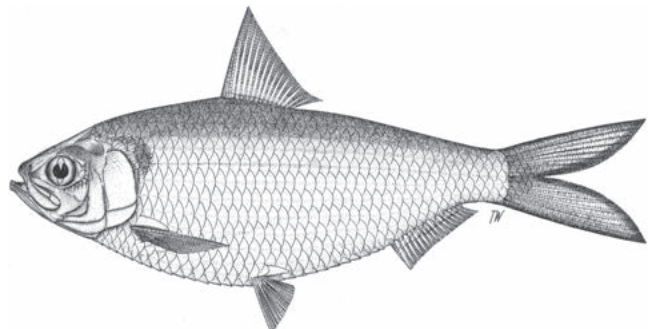
*Alausa argyrochloris* Valenciennes in Cuv. & Val. 1847: 440 (Mumbai, India).

*Hilsa toli*: Talwar & Jhingran 1991\*.

*Tenualosa toli*: Wongratana 1980\*; Whitehead 1985\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 14 or 15 branched; anal-fin rays 2 or 3 unbranched, 15–18 branched; pectoral-fin rays 1 unbranched, 13–15 branched. LSS 37–42; scutes 17 or 18 + 11–13 = 28–30; predorsal scales 14 or 15. GR 42–55/60–100 (in fish >11 cm SL); branchiostegal rays 6; frontoparietal striae few, covered by skin; pseudobranchial filaments 22–36. Upper jaw 10.5–12% SL; caudal fin 31–34% SL.

Body bluish green dorsally, flanks silvery; diffuse black blotch behind gill cover (no other markings). Attains 50 cm SL.



*Tenualosa toli*, 11 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: eastern Arabian Sea (Pakistan and India); elsewhere to central Indonesia.

**REMARKS** Of minor commercial importance.

## SUBFAMILY CLUPEINAE

### Herrings and sardines

Body slender to moderately deep; abdominal scutes 25–35, with ascending arms. Upper jaw rounded in front; 2 supramaxillae. Predorsal scales median, except not in most species of *Sardinella*. (Gill-raker counts here are for fish >4 cm SL.) Worldwide in tropical to cold-temperate seas (species of *Clupea* enter the Arctic Ocean); a few species occur only in freshwater. As for other clupeoids, many species are very important commercially. Sixteen genera and 72 species; 5 genera and 19 species in WIO.

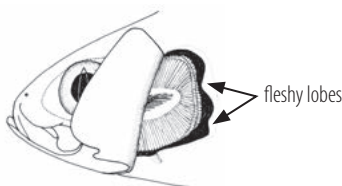
#### KEY TO GENERA

- 1a Upper jaw not reaching to beneath middle of eye (except in small specimens of some *Herklotsichthys*); gill cover smooth; last 2 anal-fin rays not elongate (if slightly produced, not twice length of preceding ray) ..... 2



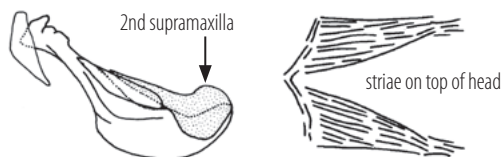
- 1b Upper jaw almost reaching to beneath middle of eye; strong radiating striae on gill cover; last 2 anal-fin rays elongate, twice length of preceding ray ..... *Sardinops*

- 2a Rear margin of gill opening with 2 fleshy lobes; pelvic fins with 8 or 9 rays, fin origin behind vertical through dorsal-fin origin .... 3



- 2b Rear margin of gill opening smooth, rounded; pelvic fins with 7 rays, fin origin in before or under vertical through dorsal-fin origin ..... *Escualosa*

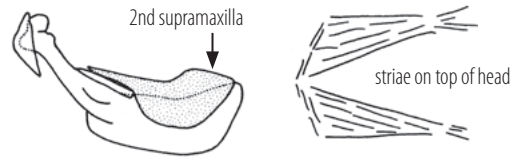
- 3a Rear part of 2nd supramaxilla symmetrical; frontoparietal striae on top of head with 7–19 ridges; last 2 anal-fin rays slightly longer than preceding ray ..... 4



Continued...

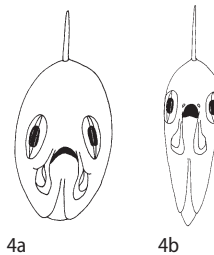
#### KEY TO GENERA

- 3b Rear part of 2nd supramaxilla asymmetrical; frontoparietal striae on top of head with 3–7 ridges; last 2 anal-fin rays not longer than preceding ray ..... *Herklotsichthys*



- 4a Lower GR 31–43; body subcylindrical, abdomen rounded in cross-section; scutes on belly weak ..... *Amblygaster*

- 4b Lower GR ~45–250 or more; body more compressed, abdomen keeled; scutes on belly prominent ..... *Sardinella*



## GENUS *Amblygaster* Bleeker 1849

Relatively large-sized sardines (to ~29 cm SL) with fusiform body and rounded belly; abdominal scutes weak (counts here are of pre-pelvic scutes + post-pelvic scutes). Two supramaxillae, symmetrical. Rear margin of gill opening with 2 fleshy lobes at rear of gill opening. Branchiostegal rays 5–7. Striae on scales few, vertical. Four species, all in WIO.

#### KEY TO SPECIES

- 1a Lower GR 44–49; branchiostegal rays 7; pre-pelvic scutes 8, flat, circular ..... *A. indiana*

- 1b Lower GR 23–43; branchiostegal rays 6; pre-pelvic scutes 16–18, compressed, denticular ..... 2

- 2a Lower GR 26–35; no spots on flanks; pyloric caeca 84–120 ... 3

- 2b Lower GR 33–43; series of 10–20 golden spots on flanks (black spots in preservative); pyloric caeca 140–234 ..... *A. sirm*

- 3a Predorsal length 48–50% SL; lower GR 23–32 ..... *A. clupeoides*

- 3b Predorsal length 50–53% SL; lower GR 31–35 ..... *A. leiogaster*

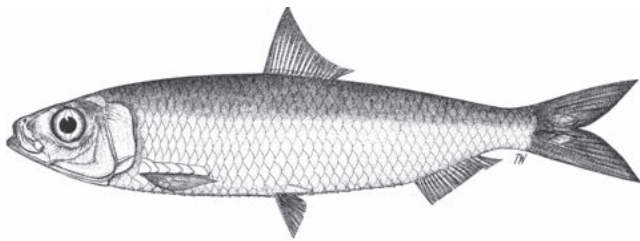
*Amblygaster clupeioides* Bleeker 1849

Blue-and-silver sardinella

*Amblygaster clupeioides* Bleeker 1849: 73 (Makassar Strait, Sulawesi, Indonesia); Wongratana 1980\*; Whitehead 1985\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003; Randall 2005\*.

Dorsal-fin rays 4 unbranched, 14 or 15 branched; anal-fin rays 3 unbranched, 14–16 branched; pectoral-fin rays 1 unbranched, 15–17 branched. LSS 40–44; scutes 17 or 18 + 13–15 = 30–33; predorsal scales 13–18. GR 12–14/26–31; branchiostegal rays 5 or 6; frontoparietal striae 11–15; pseudobranchial filaments 18–22; pyloric caeca 110–120 (in fish >10 cm SL).

Body dark (usually blue) dorsally, and flanks silvery, without spots. Attains 17 cm SL.



*Amblygaster clupeioides*, 15 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: southwestern India; elsewhere, possibly Bay of Bengal, and Indonesia to Fiji.

**REMARKS** Schooling in coastal waters. Feeds on zooplankton. Used as bait in tuna fisheries.

*Amblygaster indiana* Mary *et al.* 2017

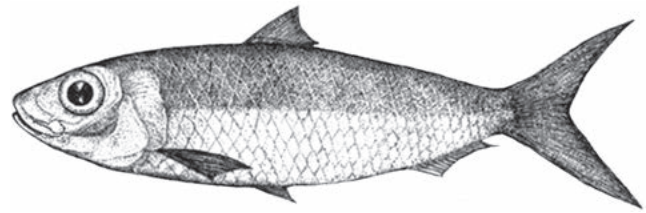
Indian sardinella

PLATE 21

*Amblygaster indiana* Mary, Balasubramanian, Selvaraju & Shiny 2017: 464 (Eraviputhenthurai, western India).

Dorsal-fin rays 17–19; anal-fin rays 17–19; pectoral-fin rays 16; pelvic-fin rays 7; LSS 40; pre-pelvic scutes 8, circular; GR 13–14 + 44–49 = 57–63; branchiostegal rays 7; frontoparietal striae 7–14; body depth 7.3–10.3 in SL.

Fresh colouration bluish green dorsally, flanks silvery; small dark blotches on dorsal fin between rays; tip of mouth and caudal fin black; top of head green. Attains 21 cm SL.



*Amblygaster indiana*, 21 cm SL (SW India). Source: Mary *et al.* 2017

**DISTRIBUTION** Known only from southwestern India.

*Amblygaster leiogaster* (Valenciennes 1847)

Smoothbelly sardinella

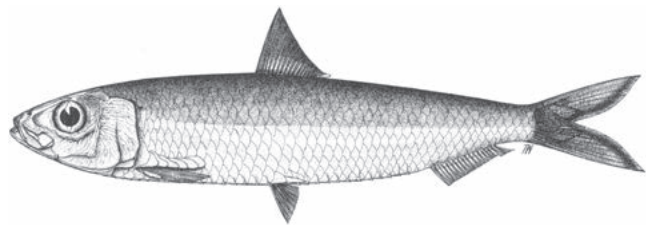
PLATE 21

*Sardinella leiogaster* Valenciennes in Cuv. & Val. 1847: 270 (Indian Ocean [Trincomalee, Sri Lanka?]).

*Amblygaster leiogaster*: Wongratana 1980\*; Masuda *et al.* 1984\*; Whitehead 1985\*; Allen 1997\*; Anderson *et al.* 1998; Munroe *et al.* 1999\*; Kimura *et al.* 2003\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 4 unbranched, 15 branched; anal-fin rays 3 unbranched, 14–17 branched; pectoral-fin rays 1 unbranched, 15 or 16 branched. LSS 40–43; scutes 17 or 18 + 13–15 = 30–33; predorsal scales 14–17. GR 13–16/31–35; branchiostegal rays 6; frontoparietal striae 12–16; pseudobranchial filaments 20–24; pyloric caeca 85–120 (in fish >18 cm SL).

Body blue dorsally, flanks silvery and without spots; dorsal fin usually dusky. Attains 24 cm SL.



*Amblygaster leiogaster*, 18 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania (Zanzibar) and Mauritius; across north Indian Ocean rim to Indonesia, southern Japan, New Guinea and northwestern Australia in western Pacific.

**REMARKS** Schooling in coastal waters, to ~50 m deep.



## *Amblygaster sirm* (Walbaum 1792)

Gold-spotted sardinella

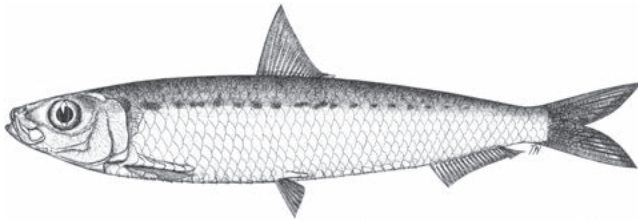
PLATE 21

*Clupea harengus* var. *sirm* Walbaum 1792: 38 (Red Sea).

*Amblygaster sirm*: Wongratana 1980\*; Masuda *et al.* 1984\*; Whitehead 1985\*; Randall 1995\*, 2005\*; Allen 1997\*; Winterbottom & Anderson 1997; Munroe *et al.* 1999\*; Kimura *et al.* 2003\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Dorsal-fin rays 4 unbranched, 14–16 branched; anal-fin rays 3 or 4 unbranched, 14–19 branched; pectoral-fin rays 1 unbranched, 15–18 branched. LSS 40–44; scutes 16–18 + 13–15 = 29–33; predorsal scales 12–16. GR 13–18/33–43; branchiostegal rays 6; frontoparietal striae 8–19; pseudobranchial filaments 13–28; pyloric caeca 140–234.

Body dark blue dorsally, flanks silvery and with distinctive series of 10–20 golden spots (darken quickly after death). Attains 23 cm SL.



*Amblygaster sirm*, 18 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique, Madagascar, Comoros, Seychelles, Mauritius and Réunion; elsewhere to Philippines, southern Japan, Australia, New Caledonia and Fiji.

**REMARKS** Occurs in coastal waters and lagoons, to ~75 m deep; schooling. Used as bait in tuna fisheries.

### GENUS *Escualosa* Whitley 1940

Small-sized sardines with strongly compressed, moderately deep body, and strongly keeled abdomen. Rear margin of gill cavity evenly rounded (no fleshy lobes); 2nd supramaxilla rectangular, and rear portion of maxilla enlarged. Pelvic fins with 7 rays. Distinguished by bright silvery midlateral stripe. Two species, 1 in WIO.

## *Escualosa thoracata* (Valenciennes 1847)

White sardine

PLATE 21

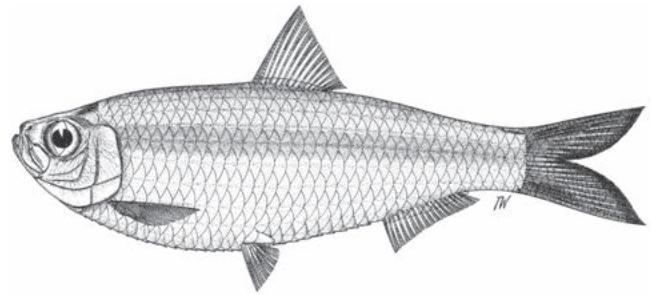
*Kowala thoracata* Valenciennes *in* Cuv. & Val. 1847: 363 (Puducherry, India).

*Meletta lile* Valenciennes *in* Cuv. & Val. 1847: 378 (Puducherry, India).

*Escualosa thoracata*: Wongratana 1980\*; Whitehead 1985\*; Randall 1995\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 12–14 branched; anal-fin rays ~3 unbranched, 14–18 branched; pectoral-fin rays 1 unbranched, 11–14 branched. LSS 35–40; scutes 17–19 + 10–12 = 28–30; predorsal scales 13–16. GR 16–25/27–40; branchiostegal rays 4–6; frontoparietal striae 7–11; pseudobranchial filaments 9–19.

Body whitish, with broad bright silver stripe along midbody; caudal fin with broad dark margin. Attains 10 cm SL.



*Escualosa thoracata*, 8 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Arabian Sea (Pakistan to India); elsewhere to Thailand, Indonesia, Philippines, New Guinea and Australia.

**REMARKS** Schooling in relatively shallow coastal waters; amphidromous; juveniles enter rivers and estuaries and then return to sea. Feeds on zooplankton and phytoplankton. Important component of clupeoid fishery off west coast of India.

### GENUS *Herklotsichthys* Whitley 1951

Small-sized herrings with compressed, moderately deep to fusiform body, and belly with row of keeled scutes. Rear margin of gill cavity with 2 fleshy lobes. Frontoparietal striae 3–7. Second supramaxilla asymmetrical. Pelvic fins with 8 rays. Coastal, pelagic, schooling; some enter estuaries. Twelve species in Indo-Pacific, 4 in WIO.

## KEY TO SPECIES

- 1a Palatine and pterygoid teeth present; pectoral-fin axillary scales slightly developed or absent; no orange spots behind gill opening or blue midlateral stripe ..... 2
- 1b No palatine or pterygoid teeth; pectoral-fin axillary scales long and pointed; body with 2 orange spots behind gill opening and blue midlateral stripe ..... *H. quadrimaculatus*
- 2a Dark spots on back or flanks ..... 3
- 2b No dark spots on body ..... *H. spilurus*
- 3a Dorsal-fin margin with large black blotch ..... *H. lossei*
- 3b Dorsal-fin translucent, no black blotch ..... *H. punctatus*

*Herklotsichthys lossei* Wongratana 1983

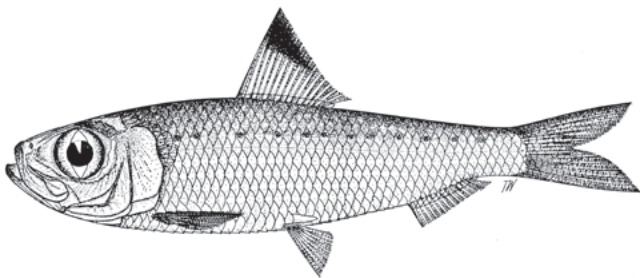
Gulf herring

PLATE 22

*Herklotsichthys lossei* Wongratana 1983: 392, Fig. 7 (Persian/Arabian Gulf); Whitehead 1985\*; Goren & Dor 1994; Randall 1995\*; Manilo & Bogorodsky 2003.

Body depth 26–28% SL. Dorsal-fin rays 4 unbranched, 14 or 15 branched; anal-fin rays 3 or 4 unbranched, 12–15 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 37–41; scutes 16–18 + 11–13 = 28–31; predorsal scales 10–17. GR 12–16/30–35; branchiostegal rays 6; frontoparietal striae 3–6; pseudobranchial filaments 14–18; pyloric caeca 35–43.

Body green dorsally, flanks silvery, and with series of small dark spots from behind gill cover to peduncle; dorsal-fin margin with large black blotch. Attains 8 cm SL.



*Herklotsichthys lossei*, 7 cm SL, adult holotype (Persian/Arabian Gulf). Source: Wongratana 1980

**DISTRIBUTION** WIO: Persian/Arabian Gulf.

**REMARKS** Marine.

*Herklotsichthys punctatus* (Rüppell 1837)

Spotback herring

*Clupea punctata* Rüppell 1837: 78, Pl. 21, Fig. 2 (Red Sea).

*Harengula arabica* Valenciennes in Cuv. & Val. 1847: 298 (Al-Muwaylih, Saudi Arabia, Red Sea).

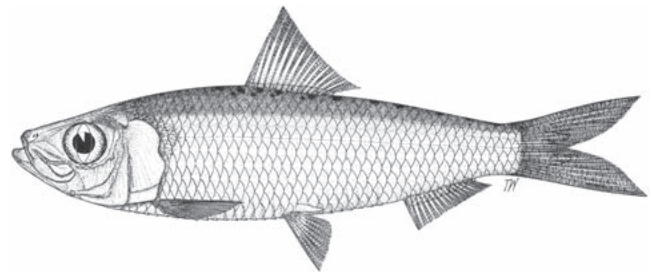
?*Spratella erythraea* (non Rüppell 1852): Klunzinger 1870.

*Harengula ovalis* (non Bennett 1830): Fowler 1941; Smith 1949.

*Herklotsichthys punctatus*: Wongratana 1980\*; Whitehead 1985\*; Randall 1995.

Body depth 24–30% SL. Dorsal-fin rays 3–5 unbranched, 13–16 branched; anal-fin rays 2–4 unbranched, 10–15 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 36–40; scutes 16–19 + 9–14 = 25–32; predorsal scales 12–15. GR 12–17/31–39; branchiostegal rays 6; frontoparietal striae 3–5; pseudobranchial filaments 11–17; pyloric caeca 29–34.

Body dark bluish dorsally, and flanks silvery, without spots, but with small dark spots on back, beside and behind dorsal-fin base; dorsal fin translucent. Attains 9 cm SL.



*Herklotsichthys punctatus*, 7 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** WIO: endemic to Red Sea, and possibly Gulf of Aden; Lessepsian migrant to eastern Mediterranean Sea.

*Herklotsichthys quadrimaculatus* (Rüppell 1837)

Goldspot or bluestripe herring

PLATE 22

*Clupea quadrimaculata* Rüppell 1837: 78, Pl. 21, Fig. 3 (Massawa, Eritrea, Red Sea).

*Harengula bipunctata* Valenciennes in Cuv. & Val. 1847: 98 (Massawa, Eritrea, Red Sea).

*Sardinella lineolata* Valenciennes in Cuv. & Val. 1847: 272 (Trincomalee, Sri Lanka).

*Clupeonia fasciata* Valenciennes in Cuv. & Val. 1847: 349 (Réunion, western Mascarenes).

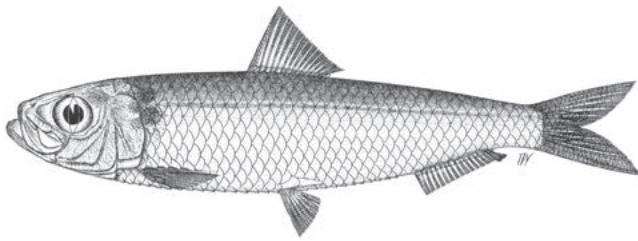
*Meletta obtusirostris* Valenciennes in Cuv. & Val. 1847: 375 (Seychelles).

*Meletta venenosa* Valenciennes in Cuv. & Val. 1847: 377 (Seychelles).

*Herklotsichthys quadrimaculatus*: Wongratana 1980\*; Whitehead 1985\*; SSF No. 54.4\*; Randall 1995\*, 1996\*, 2005\*; Allen 1997\*; Fricke *et al.* 2009.

Body depth 18–30% SL. Dorsal-fin rays 3 or 4 unbranched, 14–16 branched; anal-fin rays 2–4 unbranched, 13–18 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 38–45; scutes 16–19 + 10–14 = 27–33; predorsal scales 11–13. GR 13–18/26–37; branchiostegal rays 6 or 7; frontoparietal striae 3–8; pseudobranchial filaments 12–21; pyloric caeca 55–105. No palatine or pterygoid teeth.

Body dark blue dorsally, with bright blue narrow stripe beneath (fades after death), and flanks silvery; blue stripe preceded by 2 golden spots on operculum. Attains 14 cm SL.



*Herklotsichthys quadrimaculatus*, 11 cm SL. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea to South Africa (Algoa Bay), Madagascar, Seychelles, Réunion, Mauritius, India and Sri Lanka; Lessepsian migrant in eastern Mediterranean Sea; elsewhere to Japan, Australia, Samoa, and accidentally introduced to Hawaii.

**REMARKS** Brackish and marine; biology and introduction to Hawaii (where it is now abundant) reported by Williams & Clarke (1983) and Baldwin (1984). The names *H. punctata* or *H. punctatus* have been widely misused in the literature for this species.

## *Herklotsichthys spilurus* (Guichenot 1863)

Réunion herring

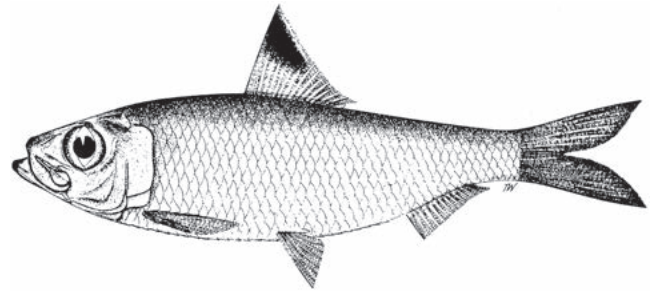
*Harengula spilura* Guichenot 1863: C-16 (Réunion, western Mascarenes).

*Herklotsichthys spilurus*: Wongratana 1980\* [as *spilura*]; Whitehead 1985\*;

Fricke 1999; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Body depth 28–35% SL. Dorsal-fin rays 4 or 5 unbranched, 13–15 branched; anal-fin rays 2–4 unbranched, 12–15 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 36–41; scutes 16 or 17 + 10–13 = 27–30; predorsal scales 11–15. GR 12–15/30–34; branchiostegal rays 6; frontoparietal striae 3–5; pseudobranchial filaments 13–16; pyloric caeca 27–35.

Body blue dorsally, flanks silvery; yellow or orange blotch behind gill opening; large black blotch on dorsal fin; no dark spots on back or flanks. Attains 9 cm SL.



*Herklotsichthys spilurus*, 8 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** WIO: Kenya, Zanzibar, Madagascar and Réunion (possibly now extinct at latter).

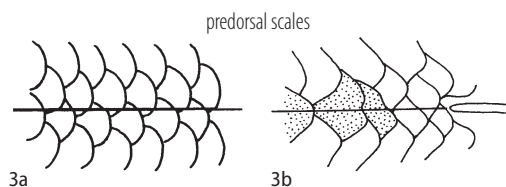
## GENUS *Sardinella* Valenciennes 1847

Moderate-sized sardines (to ~20 cm SL in WIO) with compressed and usually deep body as adults; anal-fin base well behind dorsal fin. Branchiostegal rays 5–7. Pelvic-fin rays 1 unbranched, 7 or 8 branched. Second supramaxilla symmetrical. Two fleshy lobes at rear margin of gill cavity. Frontoparietal striae 5–15. Scutes on belly well-developed. Marine, pelagic, schooling in coastal waters; juveniles of some species enter estuaries. Species are difficult to identify, especially juveniles; scale characters are best seen in adults. Twenty-one species, 9 in WIO.

### KEY TO SUBGENERA AND SPECIES

#### [WIO fish >8 cm SL]

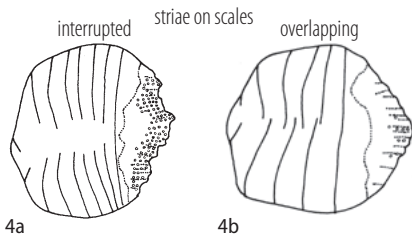
- 1a Pelvic fins 9 rays; anal fin 15–18 rays; lower GR 143–253; pseudobranchial filaments 18–28 ..... 2 [subgenus *Sardinella*]
- 1b Pelvic fins 8 rays; anal fin 17–22 rays; lower GR 38–126; pseudobranchial filaments 11–22 ..... 3 [subgenus *Clupeonia*]
- 2a HL 29–35% SL; lower GR 150–253 (usually >185) .... *S. longiceps*
- 2b HL 26–29% SL; lower GR 140–185 (usually <180) .... *S. neglecta*
- 3a All predorsal scales paired and overlapping; dorsal-fin origin with dark spot at base; caudal-fin tips without dark swaths ... 4
- 3b At least some predorsal scales median; no dark spot at dorsal-fin origin; caudal-fin tips with broad black swaths ..... *S. melanura* [IN PART]



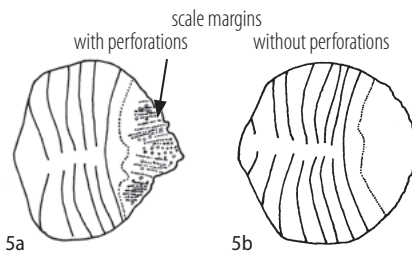
Continued ...

## KEY TO SUBGENERA AND SPECIES

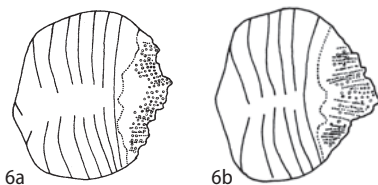
- 4a Abdominal scutes 30–35 (usually 32–34); vertical striae on scales interrupted by wide gap at centre; dorsal-fin origin with black spot at base ..... 5
- 4b Abdominal scutes 28–33 (usually 29–32); striae on scales either interrupted, overlapping or continuous at centre; dorsal-fin origin with or without black spot at base ..... 7



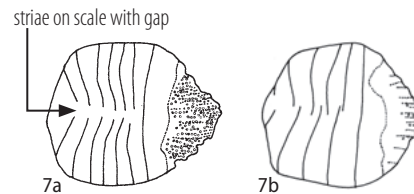
- 5a Body depth 22–30% SL; upper GR 18–46, and rakers with denticles; rear margin of scales with minute perforations ..... 6
- 5b Body depth 30–34% SL; upper GR 52–61, and rakers without denticles; rear margin of scales without perforations ..... *S. jussieui*



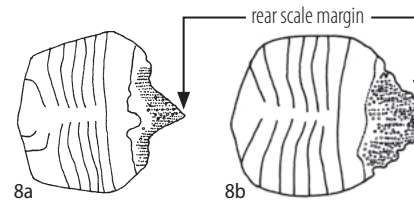
- 6a Scale perforations numerous and evenly distributed on rear margin; dorsal- and caudal-fin margins dusky ..... *S. gibbosa*
- 6b Scale perforations fewer and mostly in middle of rear margin; dorsal- and caudal-fin margins not dark ..... *S. sindensis*



- 7a Vertical striae on scales interrupted by gap at centre; base of dorsal-fin origin with black spot ..... 8
- 7b Vertical striae on scales continuous or overlapping at centre; dorsal-fin origin with or without black spot at base ..... 9



- 8a Rear of margin of scales with distinct produced centre in adults, and scale perforations mostly confined to centre of rear margin; upper GR 27–47 ..... *S. fimbriata*
- 8b Rear of margin of scales with slight or no produced centre, and with dense perforations over nearly entire rear margin; upper GR 20–36 ..... *S. albella*



- 9a Dorsal-fin origin with black spot at base; body depth 30–39% SL (fish >6 cm SL); caudal-fin margin with narrow dark band; pyloric caeca 60–73 ..... *S. brachysoma*
- 9b No black spot at base of dorsal-fin origin; body depth 25–30% SL; caudal-fin lobes with broad black swath; pyloric caeca 35–57 ..... *S. melanura* [IN PART]

***Sardinella albella*** (Valenciennes 1847)

White sardinella

PLATE 22

*Kowala albella* Valenciennes in Cuv. & Val. 1847: 362, Pl. 602 (Puducherry, India).

*Harengula dollfusi* Chabanaud 1933: 1, Figs. 1–2 (Gulf of Suez, Red Sea).

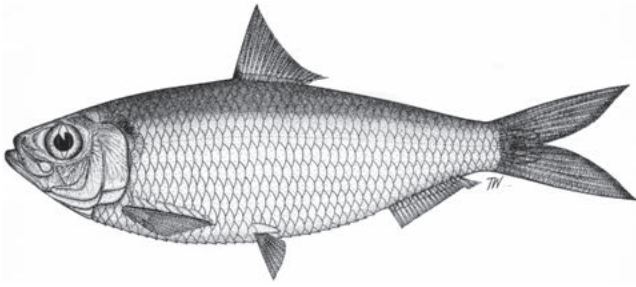
*Sardinella melanura* (non Cuvier): Smith 1949\*.

*Sardinella albella*: Wongratana 1980\*; Whitehead 1985\*; SSF No. 54.8\*; Randall 1995\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Body depth 25–39% SL (fish >5 cm SL). Dorsal-fin rays 3 or 4 unbranched, 14–16 branched; anal-fin rays 2 or 3 unbranched, 15–20 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 40–46; scutes 17–19 + 11–15 = 29–33; predorsal scales 11–17. GR 20–36/41–67; branchiostegal rays 6 or 7; frontoparietal striae 5–13; pseudobranchial filaments 13–22; pyloric caeca 33–63. Vertical striae on scales not meeting at centre.

Body bluish green dorsally, flanks silvery; black spot at dorsal-fin origin; caudal-fin margin with narrow dusky band. Attains 14 cm SL.





*Sardinella albella*, 10 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Red Sea to South Africa (KwaZulu-Natal), Madagascar and India; elsewhere to Gulf of Thailand, Indonesia, Philippines, Taiwan, New Guinea and northern Australia.

**REMARKS** Has slightly fewer scutes than the sympatric *S. sindensis*. Schooling; found to ~50 m deep. Of some commercial importance, especially along the coast of India and in artisanal fisheries in Mozambique; caught with seines and other net gear, but not harvested throughout its range.

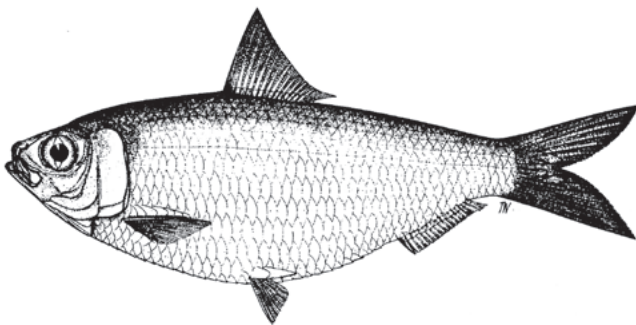
### *Sardinella brachysoma* Bleeker 1852

Deepbody sardinella

*Sardinella brachysoma* Bleeker 1852: 19 (Java, Indonesia); Wongratana 1980\*; Whitehead 1985\*; Munroe *et al.* 1999\*.

Body depth 30–39% SL. Dorsal-fin rays 4 unbranched, 13–16 branched; anal-fin rays 3 unbranched, 15–19 branched; pectoral-fin rays 1 unbranched, 14 or 15 branched. LSS 40–44; scutes 16–18 + 12–14 = 29–32; predorsal scales 12–17. GR 25–37/48–67; branchiostegal rays 6; frontoparietal striae 7–11; pseudobranchial filaments 15–19; pyloric caeca 53–72. Vertical striae on scales overlapping or continuous at centre; numerous perforations on rear margin of scales.

Body bluish green dorsally, flanks silvery; distinctive black spot at dorsal-fin origin. Attains 13 cm SL.



*Sardinella brachysoma*, 11 cm SL, adult lectotype. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar; elsewhere, India (Chennai), Indonesia and northern Australia.

### *Sardinella fimbriata* (Valenciennes 1847)

Fringescale sardinella

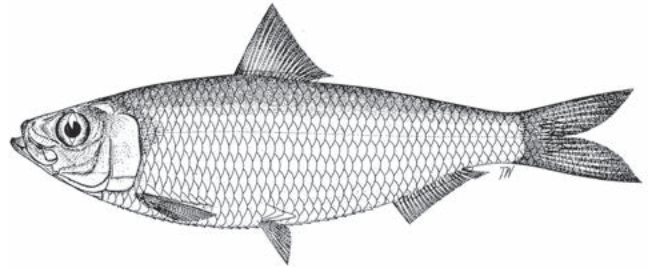
PLATE 22

*Spratella fimbriata* Valenciennes *in* Cuv. & Val. 1847: 359, Pl. 601 (Malabar coast, India).

*Sardinella fimbriata*: Wongratana 1980\*; Whitehead 1985\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Body depth 25–34% SL. Dorsal-fin rays 3 or 4 unbranched, 14–16 branched; anal-fin rays 2 or 3 unbranched, 16–19 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 41–45; scutes 17 or 18 + 12–14 = 29–32; predorsal scales 12–16. GR 27–47/54–83; branchiostegal rays 6 or 7; frontoparietal striae 7–12; pseudobranchial filaments 16–22; pyloric caeca 42–69. Striae on scales not meeting at centre; posterior scale perforations usually concentrated at centre of distinct rear projection in WIO fish.

Body bluish green dorsally, flanks silvery; black spot at dorsal-fin origin; tips of caudal fin and distal margin of dorsal fin dusky or black. Attains 14 cm SL.



*Sardinella fimbriata*, 10 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: southwestern India; elsewhere to Thailand, Philippines and New Guinea.

**REMARKS** Enters lagoons and estuaries.

### *Sardinella gibbosa* (Bleeker 1849)

Goldstripe sardinella

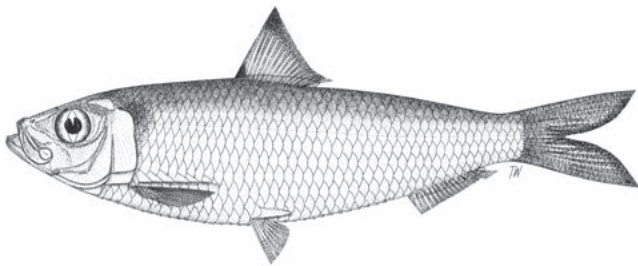
PLATE 22

*Clupea gibbosa* Bleeker 1849: 72 (Makassar, Indonesia).

*Sardinella gibbosa*: Wongratana 1980\*; Whitehead 1985\*; SSF No. 54.10\*; Randall 1995\*; Allen 1997\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Body depth 23–31% SL. Dorsal-fin rays 4 or 5 unbranched, 13–16 branched; anal-fin rays 2 or 3 unbranched, 14–19 branched; pectoral-fin rays 1 unbranched, 12–16 branched. LSS 42–47; scutes 17–20 + 13–16 = 32–35; predorsal scales 13–18. GR 23–36/43–66; branchiostegal rays 6 or 7; frontoparietal striae 8–15; pseudobranchial filaments 12–21; pyloric caeca 55–76. Striae on scales not meeting at centre; scale perforations numerous and more or less evenly distributed on rear margin.

Body blue dorsally, flanks silvery, and with narrow golden stripe just above midline from gill opening to caudal fin; dark spot at dorsal-fin origin. Attains 17 cm SL.



*Sardinella gibbosa*, 11 cm SL. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, South Africa (KwaZulu-Natal; possibly to Transkei) and Madagascar; elsewhere to Indonesia, Philippines, Taiwan and western Australia.

### *Sardinella jussieu* (Valenciennes 1847)

Mauritian sardinella

*Clupanodon jussieu* Lacepède (ex Commerson) 1803: 469,

Fig. 3 [*nomen dubium*] (Mauritius, Mascarenes).

*Clupeonia jussieu* Valenciennes in Cuv. & Val. 1847: 346, Pl. 599

(Mauritius, Mascarenes).

*Sardinella dayi* Regan 1917: 381 (Karwar, India); Whitehead 1973\*;

Wongratana 1980\*.

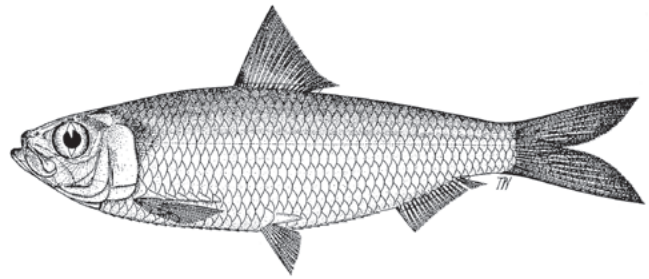
*Sardinella jussieu*: Smith 1949.

*Sardinella jussieu*: Whitehead 1973\*; Wongratana 1980\*; Fricke 1999

[as *jussieu*]; Manilo & Bogorodsky 2003 [as *jussieu*]; Fricke *et al.* 2009.

Body depth 28–37% SL. Dorsal-fin rays 4 unbranched, 15 or 16 branched; anal-fin rays 3 unbranched, 16–18 branched; pectoral-fin rays 1 unbranched, 13–15 branched. LSS 41–44; scutes 17 or 18 + 13 or 14 = 30–32; predorsal scales 13–15. GR 52–61/88–126; branchiostegal rays 6; frontoparietal striae 9–11; pseudobranchial filaments 15–19; pyloric caeca ~40–50+. Striae on scales not meeting at centre; no perforations on rear margin of scales.

Body blue dorsally, flanks silvery; black spot at dorsal-fin origin. Attains 12 cm SL.



*Sardinella jussieu*, 10 cm SL, adult (Mauritius). Source: Wongratana 1980

**DISTRIBUTION** WIO: Madagascar, Mauritius, Réunion, India and Sri Lanka.

### *Sardinella longiceps* Valenciennes 1847

Indian oil sardine

PLATE 22

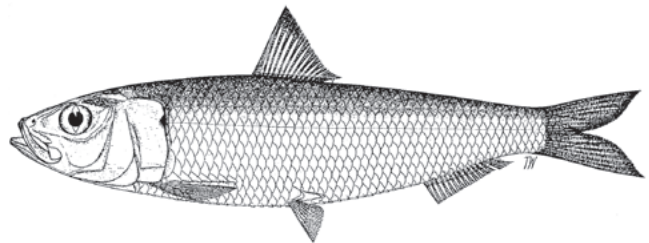
*Sardinella longiceps* Valenciennes in Cuv. & Val. 1847: 273 (Puducherry, India); Wongratana 1980\*; Whitehead 1985\*; Randall 1995\*; Manilo & Bogorodsky 2003.

*Sardinella neohowii* Valenciennes in Cuv. & Val. 1847: 274 (Malabar coast, India).

*Alausa scombrina* Valenciennes in Cuv. & Val. 1847: 442 (Malabar coast, India).

Body depth <30% SL. Dorsal-fin rays 4 unbranched, 13–15 branched; anal-fin rays 3 unbranched, 11–15 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 43–47; scutes 17–20 + 13–16 = 31–35; predorsal scales 13–17. GR 118–242/150–253; branchiostegal rays 6; frontoparietal striae 7–11; pseudobranchial filaments 18–28; pyloric caeca 150–188. Striae on scales not meeting at centre; no perforations on rear margin of scales.

Body blue dorsally, flanks silvery; upper rear margin of gill cover with distinct black spot; golden spot behind gill cover, and faint golden midlateral stripe extending to caudal fin. Attains 20 cm SL.



*Sardinella longiceps*, 12 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean. WIO: Somalia (Gulf of Aden) to southeastern India, and possibly to Andaman Sea; not found in Red Sea or Persian/Arabian Gulf; records from Indonesia and Philippines probably misidentifications of *S. lemuru* from eastern Indian Ocean and western Pacific.

**REMARKS** Highly migratory and schooling, along continental shelf, at 20–200 m. Fished throughout its range, with huge annual fluctuations in its population size and landings; the most important species in Indian fisheries.

## *Sardinella melanura* (Cuvier 1829)

Blacktip sardinella

PLATE 23

*Clupea melanura* Cuvier 1829: 318 (Vanikoro I., Santa Cruz Is.).

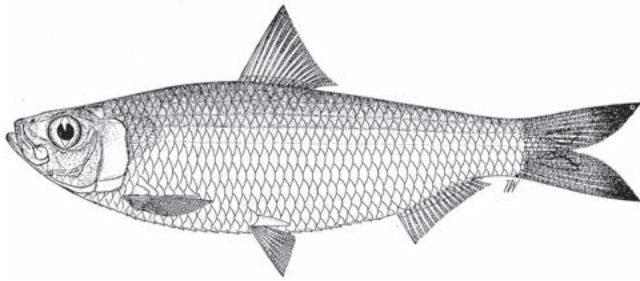
*Clupeonia commersoni* Valenciennes in Cuv. & Val. 1847: 350

(Mumbai, India).

*Sardinella melanura*: Smith 1949\*; Whitehead 1973\*, 1985\*; Wongratana 1980\*; Randall 1995\*, 2005\*; Fricke 1999; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Body depth 25–30% SL. Dorsal-fin rays 4 unbranched, 12–14 branched; anal-fin rays 2 or 3 unbranched, 14–17 branched; pectoral-fin rays 1 unbranched, 12–14 branched. LSS 38–43; scutes 15–18 + 11–14 = 27–31; predorsal scales 11–15. GR 20–40/38–74; branchiostegal rays 6; frontoparietal striae 6–10; pseudobranchial filaments 14–19; pyloric caeca 35–57. Vertical striae on scales not meeting at centre; no perforations on rear margin of scales.

Body bluish green dorsally, flanks silvery; distinctive black swaths on caudal-fin tips; no black spot at dorsal-fin origin. Attains 12 cm SL.



*Sardinella melanura*, 11 cm SL, adult (Mauritius). Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden to Kenya, Madagascar, Seychelles, Mauritius, Réunion and NW India; not found in Red Sea, Persian/Arabian Gulf, Bay of Bengal, western Indonesia and South China Sea; elsewhere, eastern Indonesia, Japan, Australia, New Caledonia, Santa Cruz Is. and Samoa.

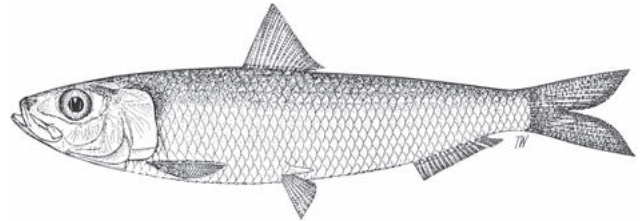
## *Sardinella neglecta* Wongratana 1983

East African sardinella

*Sardinella (Sardinella) neglecta* Wongratana 1983: 390, Fig. 4 (Formosa Bay, Kenya); Whitehead 1985\*; Manilo & Bogorodsky 2003.

Body depth 23–28% SL. Dorsal-fin rays 4 unbranched, 13–15 branched; anal-fin rays 3 unbranched, 13–15 branched; pectoral-fin rays 1 unbranched, 14–17 branched. LSS 45–47; scutes 18 or 19 + 13–16 = 32–35; predorsal scales 13–16. GR 108–166/143–188; branchiostegal rays 6; frontoparietal striae 7–11; pseudobranchial filaments 19–25; pyloric caeca 160–208. Striae on scales not meeting at centre; no perforations on rear margin of scales.

Body blue dorsally, flanks silvery; distinct black spot behind upper rear margin of gill cover, and faint golden spot behind gill opening, followed by golden midlateral stripe; no spot at dorsal-fin origin. Attains 13 cm SL.



*Sardinella neglecta*, 12 cm SL, adult holotype (Kenya).

Source: Wongratana 1980

**DISTRIBUTION** WIO: Kenya and Tanzania.

## *Sardinella sindensis* (Day 1878)

Sind sardinella

PLATE 23

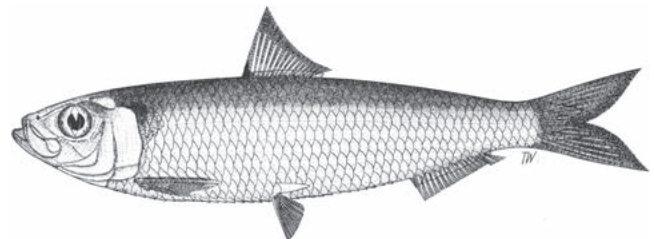
*Clupea sindensis* Day 1878: 638, Pl. 163, Fig. 2 (Karachi, Pakistan).

*Sardinella sindensis*: Whitehead 1973\* [in part]; Wongratana 1980\*;

Whitehead 1985\*; Randall 1995\*; Manilo & Bogorodsky 2003.

Body depth 21–35% SL. Dorsal-fin rays 4 unbranched, 13–16 branched; anal-fin rays 2 or 3 unbranched, 14–18 branched; pectoral-fin rays 1 unbranched, 13–16 branched. LSS 42–47; scutes 17–19 + 13–16 = 31–34; predorsal scales 12–17. GR 26–46/38–76; branchiostegal rays 6 or 7; frontoparietal striae 8–14; pseudobranchial filaments 13–21; pyloric caeca 53–73. Vertical striae on scales not meeting at centre; scale perforations few, concentrated in middle of rear margin.

Body blue dorsally, flanks silvery; black spot at dorsal-fin origin, and dorsal-fin margin dusky. Attains 17 cm SL.



*Sardinella sindensis*, 12 cm SL, adult. Source: Wongratana 1980



**DISTRIBUTION** WIO: Gulf of Aden to Persian/Arabian Gulf and India (Mumbai).

**GENUS** *Sardinops* Hubbs 1929

Body fusiform, not compressed; belly rounded, abdominal scutes weak. Upper jaw almost reaching to beneath middle of eye. Distinguished by operculum with downward-radiating bony striae; several dorsalmost lower gill rakers of first arch greatly shortened at juncture between upper and lower limbs. Dark spots along flanks. One species: all populations are very important commercially and in the marine food chain.

*Sardinops sagax* (Jenyns 1842)

Pilchard

PLATE 23

*Clupea sagax* Jenyns 1842: 134 (San Lorenzo I., Lima, Peru).

*Clupea ocellata* Pappe 1853: 20 (Cape of Good Hope, South Africa).

*Sardina sagax*: Barnard 1925.

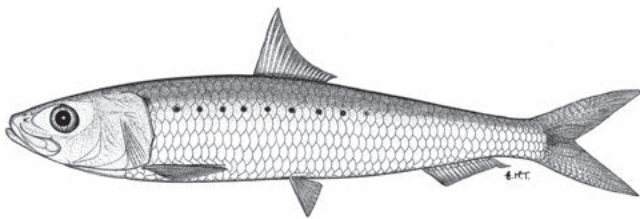
*Arengus sagax*: Smith 1949.

*Sardinops ocellatus*: Whitehead 1985\*; SSF No. 54.12\*; Van der Elst 1988\*; Fricke 1999.

*Sardinops sagax*: Whitehead 1985\*; Heemstra & Heemstra 2004\*.

Dorsal-fin rays 3 or 4 unbranched, 14–16 branched; anal-fin rays 3 or 4 unbranched, 15–18 branched; pectoral-fin rays 1 unbranched, 16 or 17 branched. LSS 50–60; lower GR 40–120 (in fish >4 cm SL), number increasing with growth; scutes 16–19 + 13–16. No teeth. Vertebrae 48–54.

Body dark greenish blue dorsally, flanks silvery white, with 1–3 rows of dark spots (usually 1 row in WIO populations). Attains 33 cm SL (commonly ~20 cm TL).



*Sardinops sagax*, 15 cm SL (South Africa). Source: SSF, composite

**DISTRIBUTION** WIO: southern Africa; elsewhere, Japan, Philippines, Australia, New Zealand and eastern Pacific from Alaska to Chile.

**REMARKS** Coastal species forming large schools; neritic, to ~200 m deep. Oviparous, with pelagic eggs and larvae. Maximum reported age ~25 years. Feeds on zooplankton crustaceans and phytoplankton. Stocks were formerly recognised as 4 species or subspecies (reviewed in Whitehead 1985) from the North Pacific, southeastern Pacific, southern Africa, and Australia/New Zealand. Parrish *et al.* (1989) showed that “subspecies” of *S. sagax* form one circumglobal, variable species. Lastly, Grant *et al.* (1998) confirmed 3 lineages, those in: southern Africa and Australia, Chile and California (eastern Pacific), and Japan (western Pacific). Larval development of the South African population was reported by Louw & O’Toole (1977), and its diet was reported by Van der Lingen (2002). The WIO population (formerly known as *S. ocellatus*) moves inshore during May and June for the famous spawning migration (‘sardine run’) up the east coast of South Africa, where thousands of tonnes are captured.

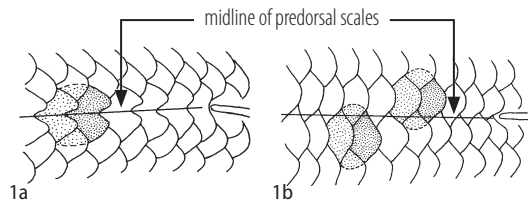
**SUBFAMILY DOROSOMATINAE**

Gizzard shads

Moderate-sized (<30 cm SL) shads with abdominal scutes. Mouth inferior or subterminal in WIO species; tip of lower jaw fits into notch in upper jaw; no teeth. Last dorsal-fin ray filamentous except in 2 genera. Stomach wall thick, gizzard-like. Occur in all three major oceans, but some are entirely freshwater. Reviewed by Nelson & Rothman (1973). Six genera and 24 species; 2 genera and 6 species in WIO.

**KEY TO GENERA**

- 1a Last dorsal-fin ray subequal to preceding ray; predorsal scales in median series ..... *Anodontostoma*
- 1b Last dorsal-fin ray greatly produced, filamentous; predorsal scales paired and overlapping one another in midline ..... *Nematalosa*





GENUS **Anodontostoma** Bleeker 1849

Moderate-sized (to 18 cm SL) shads with very deep compressed body. Last dorsal-fin ray not filamentous. Lower jaw with edges strongly flared outward; 2nd supramaxilla splint-like. Predorsal scales in distinct median series. Three species, 1 in WIO.

**Anodontostoma chacunda** (Hamilton 1822)

Chacunda gizzard shad PLATE 21

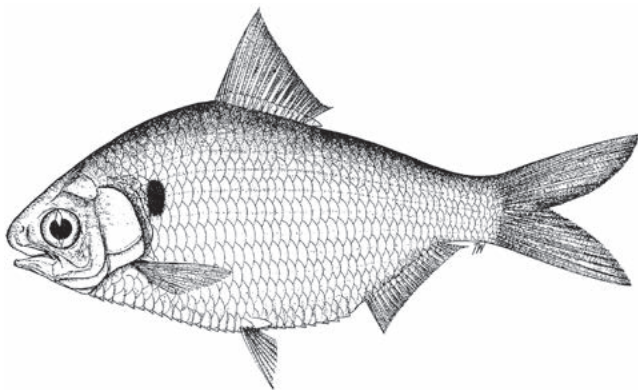
*Clupanodon chacunda* Hamilton 1822: 246, 283 (Ganges Delta, India).

*Clupanodon chanpole* Hamilton 1822: 249, 283, Pl. 18, Fig. 74 (Bengal, India).

*Anodontostoma chacunda*: Wongratana 1980\*; Whitehead 1985\*; Talwar & Jhingran 1991\*; Kottelat *et al.* 1993\*; Randall 1995\*, 2005\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Body depth increasing with size, 40–70% SL (fish >10 cm SL). Dorsal-fin rays 3 or 4 unbranched, 12–16 branched; anal-fin rays 2–4 unbranched, 15–20 branched; pectoral-fin rays 1 unbranched, 12–16 branched. LSS 38–45; scutes 15–18 + 9–12 = 26–29; predorsal scales 11–15, not paired. GR 50–100/55–95; branchiostegal rays 5; pseudobranchial filaments 9–25. Striae on scales overlapping at centre; rear margin of scales with minute fringes.

Body dark iridescent blue dorsally, flanks silvery, and top of head with bronze tinges; large black spot behind gill cover. Attains 18 cm SL.



*Anodontostoma chacunda*, 11 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf to India; elsewhere to Andaman Sea, Gulf of Thailand, Indonesia, Philippines, Caroline Is., northern Australia and Vanuatu.

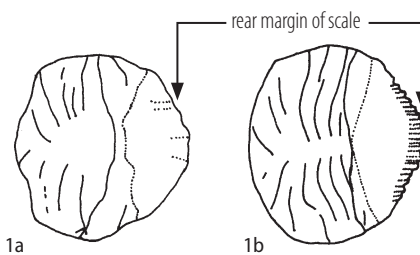
**REMARKS** Marine, brackish and freshwater.

GENUS **Nematalosa** Regan 1917

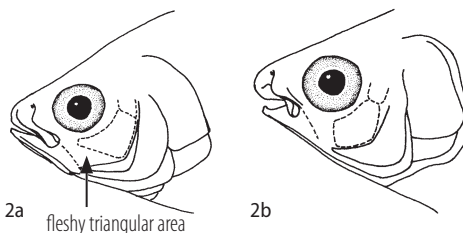
Large-sized (to ~33 cm SL) shads with compressed body and keeled abdominal scutes. Predorsal scales paired and overlapping in midline. Last dorsal-fin ray filamentous, longer than head length. Mouth usually inferior (subterminal in a few species); lower jaw flared outward before end of maxilla. Microphagous fishes with numerous gill rakers (up to 500 in some species), the number increasing with age. (In some accounts below, pre-pelvic scutes are divided into pre-pectoral scutes and post-pectoral scutes, defined as those scutes anterior to and posterior to vertical through pectoral-fin insertions.) Nine species, 5 in WIO.

KEY TO SPECIES

- 1a Rear margin of scales without fringes ..... 2
- 1b Rear margin of scales with fringes ..... 3



- 2a Fleshy triangular area above anteroventral arm of preopercle, separating it from 3rd suborbital bone; no grooves in flesh on top of head; black spot behind gill cover ..... *N. arabica*
- 2b Anteroventral arm of preopercle almost contacting 3rd suborbital bone (no fleshy gap); pair of shallow grooves in spongy flesh on top of head; line of black blotches behind gill cover to past dorsal fin ..... *N. galathea*



- 3a Dorsal fin usually with 13–14 branched rays; vertebrae 45–48; pre-pectoral scutes usually 6 or 7 ..... 4
- 3b Dorsal fin usually with 11–12 branched rays; vertebrae 43–45; pre-pectoral scutes usually 8 or 9 ..... *N. resticularia*
- 4a Anal fin usually with 16–18 branched rays; precaudal vertebrae usually 15 or 16; pre-pectoral scutes usually 6 ..... *N. nasus*
- 4b Anal fin usually with 18–20 branched rays; precaudal vertebrae usually 14 or 15; pre-pectoral scutes usually 7 ..... *N. persara*

*Nematalosa arabica* Regan 1917

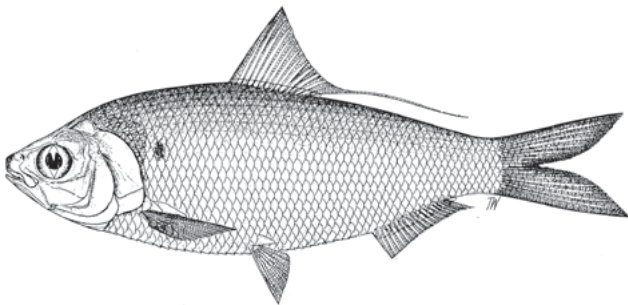
Arabian gizzard shad

PLATE 22

*Nematalosa arabica* Regan 1917: 313 (Muscat, Gulf of Oman, Arabian Sea); Whitehead 1962; Nelson & Rothman 1973\*; Wongratana 1980\*; Whitehead 1985\*; Randall 1995\*; Manilo & Bogorodsky 2003.

Body depth 34–39% SL (fish >5 cm SL). Dorsal-fin rays 4 or 5 unbranched, 13 or 14 branched; anal-fin rays 2 or 3 unbranched, 15–18 branched; pectoral-fin rays 1 unbranched, 14–16 branched. LSS 42–49; scutes 18 or 19 + 10–15 = 29–34; predorsal scales 17–21. GR 144–325/178–390 (fish >6 cm SL); branchiostegal rays 5 or 6; frontoparietal striae 2–5; pseudobranchial filaments 20–29. Maxilla straight (not bent downward posteriorly). Fleshy triangular area above anteroventral arm of preopercle, separating it from 3rd suborbital bone. Rear margin of scales smooth.

Back and flanks silvery; 7–9 narrow bronze stripes dorsally; often with black spot on shoulder; caudal-fin tips with narrow black edge. Attains 17 cm SL.



*Nematalosa arabica*, 10 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** WIO: Gulf of Aden to Pakistan; not known from Red Sea or Persian/Arabian Gulf.

*Nematalosa galathea* Nelson & Rothman 1973

Galathea gizzard shad

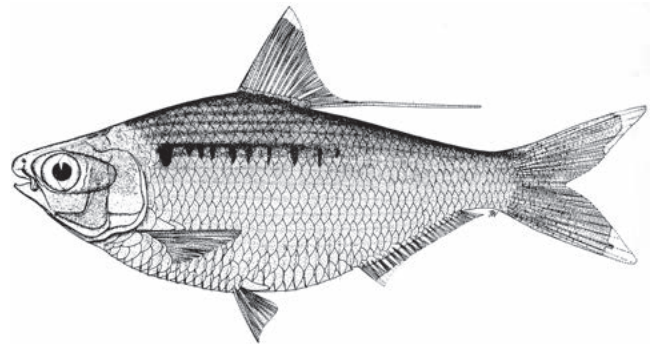
*Nematalosa galathea* Nelson & Rothman 1973: 158, Figs. 1a, 8b, 9, 13d (Gulf of Thailand; Andaman Sea); Whitehead 1985\*; Talwar & Jhingran 1991\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

*Nematalosa chanpole* (*non* Hamilton 1822): Wongratana 1980\*.

Body depth 36–44% SL (fish >10 cm SL). Dorsal-fin rays 4 unbranched, 11–13 branched; anal-fin rays 3 or 4 unbranched, 19–22 branched; pectoral-fin rays 1 unbranched, 12–14 branched. LSS 43–46; scutes 16 or 17 + 8–11 = 24–28; predorsal scales 16–19. GR 245–315/260–355 (in fish >13 cm SL); branchiostegal rays 5; frontoparietal striae 5–9; pseudobranchial filaments 22–27. Distinguished by pair of converging grooves

in spongy flesh on top of head. Maxilla bent downward posteriorly. Area above anteroventral arm of preopercle scarcely separated from suborbital bone series (no fleshy gap). Rear margin of scales smooth.

Back and flanks silvery, with 7 or 8 narrow horizontal stripes and line of ~5–10 vertically elongated dark spots on back. Attains ~16.5 cm SL.



*Nematalosa galathea*, 12 cm SL, adult paratype (Andaman Sea). Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean. WIO: southwestern India and Sri Lanka; elsewhere to east coast of India, Bay of Bengal, Andaman Sea, Gulf of Thailand, Singapore and Vietnam.

**REMARKS** Anadromous: lives in the sea and presumably breeds in freshwater. Harvested in subsistence fisheries.

*Nematalosa nasus* (Bloch 1795)

Bloch's gizzard shad

PLATE 22

*Clupea nasus* Bloch 1795: 116, Pl. 429, Fig. 1 (Malabar coast [probably Tharangambadi], India).

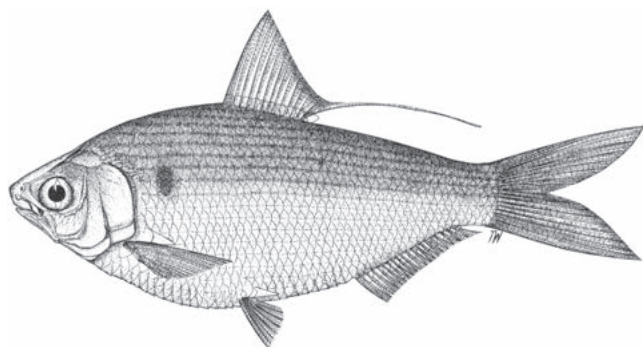
*Clupanodon nasica* Lacepède 1803: 468, 472 (Malabar coast, India) [unneeded new name for *Clupea nasus* Bloch].

*Nematalosa nasus*: Smith 1949\*; Whitehead 1962; Nelson & Rothman 1973\*; Wongratana 1980\*; Whitehead 1985\*; SSF No. 54.6\*; Nelson & McCarthy 1995; Randall 1995\*; Munroe *et al.* 1999\*.

Body depth 31–40% SL (>5 cm SL). Dorsal-fin rays 3–5 unbranched, 12–14 branched; anal-fin rays 2 or 3 unbranched, 18–23 branched; pectoral-fin rays 1 unbranched, 12–16 branched. LSS 46–49; scutes 17–19 + 11–13 = 28–32; predorsal scales 17–20. GR 120–305/135–310 (fish >5 cm SL); branchiostegal rays 6; frontoparietal striae 6–11; pseudobranchial filaments 16–28. Maxilla straight (not bent downward posteriorly). Area above anteroventral arm of preopercle scarcely separate from suborbital bone series (no fleshy gap); 3rd infraorbital bone expanded;

no supraorbital grooves. Pectoral-fin axillary scale present. Rear margin of scales distinctly toothed.

Body dark bluish brown dorsally, flanks silvery; dark spot behind gill cover; caudal-fin tips with black edges. Attains 22 cm SL.



*Nematalosa nasus*, 10 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden, Persian/Arabian Gulf (Bahrain, Iran, Saudi Arabia), Pakistan, India and Sri Lanka; single record from South Africa (Durban Bay); elsewhere to Andaman Sea, South China Sea, Philippines, Korea and southern Japan.

**REMARKS** Marine, brackish and freshwater. Relatively widespread; *Nematalosa persara* and *N. resticularia* have been confused with this species. Found in intertidal zones, around estuaries and in mangroves, to ~30 m deep. Harvested in subsistence fisheries with traps and nets.

### *Nematalosa persara* Nelson & McCarthy 1995

Persian gizzard shad

*Nematalosa persara* Nelson & McCarthy 1995: 380, Fig. 1 (Road Bay, Saudi Arabia [Persian/Arabian Gulf]).

Dorsal-fin rays 4 or 5 unbranched, 12–15 branched; anal-fin rays 2–4 unbranched, 17–21 branched; scutes 18–21 + 1 + 10–13 = 30–34; pre-pectoral scutes 7 (usually) or 8, and post-pectoral scutes 11–14 (usually 12); predorsal bones 8–10. Third infraorbital bone expanded and covering most of cheek. Rear edge of scales with minute denticles. Vertebrae 13–16 + 30–33 = 46–48.

Colour in life unknown; preserved specimens dark dorsally, flanks paler (probably silvery in life); dark spot on shoulder. Attains 15 cm SL.

**DISTRIBUTION** WIO: Persian/Arabian Gulf and northern Arabian Sea to Pakistan.

**REMARKS** Marine. Resembles *N. nasus*, differing slightly in average numbers of dorsal- and anal-fin rays.

### *Nematalosa resticularia* Nelson & McCarthy 1995

Threadgut gizzard shad

*Nematalosa resticularia* Nelson & McCarthy 1995: 379, Fig. 1 (Tarut I., Saudi Arabia, Persian/Arabian Gulf).

Dorsal-fin rays 3 or 4 unbranched, 11–14 branched; anal-fin rays 2–4 unbranched, 15–22 branched; scutes 18–22 + 1 + 10–13 = 30–34; pre-pectoral scutes 7–9 (usually 8), and post-pectoral scutes 10–13 (usually 12); predorsal bones 8–10. No supraorbital grooves; 3rd suborbital bone expanded and covering most of cheek. Rear edge of scales with minute denticles. Intestinal diverticula larger and fewer than that in *N. persara* and *N. nasus*. Vertebrae 13–16 + 28–32 = 43–45.

Colour in life unknown; preserved specimens dark dorsally, flanks paler (probably silvery in life); dark spot on shoulder. Attains at least 12 cm SL.

**DISTRIBUTION** WIO: Persian/Arabian Gulf (Saudi Arabia and Iran) and possibly Arabian Sea to Somalia (one specimen).

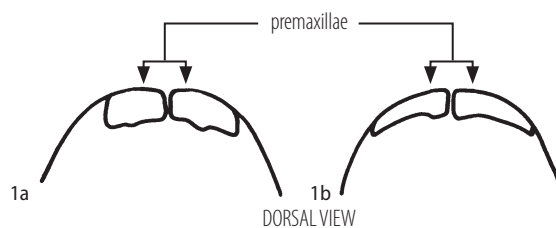
## SUBFAMILY DUSSUMIERIINAE

### Roundherrings

Pelvic scute flat, W-shaped; no other abdominal scutes. Branchiostegal rays 11–18 (tribe Dussumieriini) or 6–8 (tribe Spratelloidini). Chapman (1948) described the osteology of *Etrumeus micropus* and discussed the relationships of the roundherrings, as did Whitehead (1963). Four genera and 12 species; 3 genera and 7 species in WIO.

#### KEY TO GENERA

- 1a Premaxilla stout, rectangular; branchiostegal rays 11–20 ..... 2  
1b Premaxilla more elongate, roughly triangular; branchiostegal rays 6 or 7 ..... *Spratelloides*



Continued ...

## KEY TO GENERA

- 2a Pelvic-fin origin at vertical behind base of last dorsal-fin ray; adipose eyelid entirely covering eye; anal-fin rays 10–13; 1 supramaxilla ..... *Etrumeus*
- 2b Pelvic-fin origin under or slightly behind middle of dorsal fin; adipose eyelid only partly covering eye, leaving small dorsal slit; anal-fin rays 14–18; 2 supramaxillae ..... *Dussumieria*

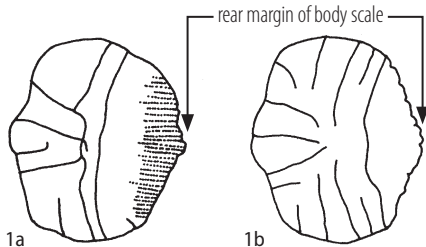
GENUS *Dussumieria* Valenciennes 1847

Body slender, compressed. Branchiostegal rays 12–18. Premaxilla rectangular. Pelvic fins under middle of dorsal fin, with 8 rays. Pelvic scute flat, W-shaped. Isthmus evenly tapering, without anterior lateral projections. Two species, both in WIO.

## KEY TO SPECIES

## [Fish &gt;5 cm SL]

- 1a Body depth ~22–29% SL; lower GR 19–26; branchiostegal rays 12–16; rear margin of body scales with minute horizontal striae ..... *D. acuta*
- 1b Body depth ~16–22% SL; lower GR 18–32; branchiostegal rays 13–18; rear margin of scales without striae ..... *D. elopsoides*

*Dussumieria acuta* Valenciennes 1847

Rainbow sardine

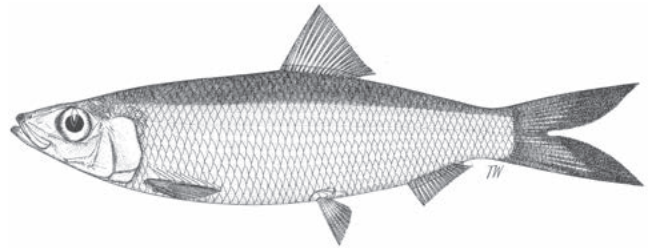
PLATE 21

*Dussumieria acuta* Valenciennes in Cuv. & Val. 1847: 467, Pl. 606 (Coromandel coast, India); Randall 1995\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 4 or 5 unbranched, 14–17 branched; anal-fin rays 3 or 4 unbranched, 11–14 branched; pectoral-fin rays 1 unbranched, 11–14 branched. LSS 52–59; predorsal scales

22–28. GR 11–15/19–26; branchiostegal rays 12–15 (rarely 16); pseudobranchial filaments 15–21; pyloric caeca usually 27–41. Rear margin of scales with numerous tiny striae radiating ~½ length of scale height.

Body iridescent blue dorsally, with bright golden stripe below (fades quickly after death), and flanks silvery; rear margin of scales in dorsalmost 3 rows (from dorsal-fin origin to caudal fin) with black markings; caudal-fin margin broadly dark. Attains 20 cm SL.



*Dussumieria acuta*, 11 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique to Arabian Sea, Gulf of Aden and Persian/Arabian Gulf; elsewhere to Bay of Bengal, Indonesia and Philippines.

**REMARKS** Mainly marine, inshore waters. Some of the earlier records of this species may have included *D. elopsoides*.

*Dussumieria elopsoides* Bleeker 1849

Slender rainbow sardine

PLATE 21

*Dussumieria elopsoides* Bleeker 1849: 12 (Madura Straits; Indonesia); Whitehead 1985\*; Randall 1995\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

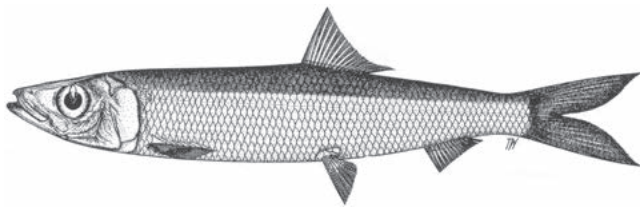
*Dussumieria hasseltii* Bleeker 1851: 422 (Java, Indonesia).

*Dussumieria productissima* Chabanaud 1933: 4, Figs. 3–4 (Gulf of Suez, Red Sea; Lake Timsah, Egypt).

Dorsal-fin rays 4 or 5 unbranched, 14–18 branched; anal-fin rays 3 or 4 unbranched, 11–15 branched; pectoral-fin rays 1 unbranched, 11–14 branched. LSS 54–63; predorsal scales 24–29. GR 7–16/18–32; branchiostegal rays 12–18; pseudobranchial filaments 13–23; pyloric caeca 36–60. Rear margin of scales without striae.

Body blue dorsally, with golden stripe below (fades after capture), flanks silvery; caudal-fin margin with dark band. Attains 20 cm SL.





*Dussumieria elopsoides*, 14 cm SL. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Red Sea to South Africa (Eastern Cape) and Madagascar; elsewhere to across eastern Indian Ocean, South China Sea, northern Australia and Solomon Is.

**REMARKS** Inshore marine.

## GENUS *Etrumeus* Bleeker 1853

Body slender, moderately compressed posteriorly. Premaxilla rectangular. Isthmus with anterior lateral projections. Transparent adipose tissue completely covering eyes. Pelvic scute flat, W-shaped. Longitudinal scale rows 48–56; gill rakers 41–56; branchiostegal rays 14–16. Vertebrae 48–56.

The key and species accounts here are adapted from DiBattista *et al.* (2012). The east-coast roundherring was previously regarded as circumglobal and known as *Etrumeus teres* (e.g., Whitehead & Wongratana 1986). Now, *E. wongratanai* is treated as the valid species in the Indian Ocean, and *E. golanii* as the valid species in the Red Sea. *Etrumeus teres* (DeKay 1842) is a junior synonym of the valid species *E. sadina* (Mitchill 1814), restricted to the Atlantic. Seven species, 3 in WIO.

### KEY TO SPECIES

#### [Fish >9 cm SL]

- 1a Pelvic-fin origin ~½ eye diameter behind base of last dorsal-fin ray; GR 43–51; vertebrae 52 or 53 ..... 2
- 1b Pelvic-fin origin below or slightly forward of base of last dorsal-fin ray; GR 51–56; vertebrae 50 ..... *E. whiteheadi*
- 2a GR 46–51; dorsalmost body scales with dark grey spot in centre ..... *E. golanii*
- 2b GR 43–47; no dark spot on body scales, but black edges on scales in upper 2 or 3 rows ..... *E. wongratanai*

## *Etrumeus golanii* DiBattista, Randall & Bowen 2012

Red Sea roundherring

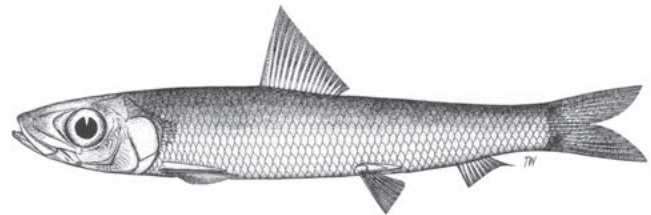
PLATE 21

*Etrumeus golanii* DiBattista, Randall & Bowen 2012: 451, Fig. 1 (off Cyprus, eastern Mediterranean Sea).

*Etrumeus teres* (non DeKay 1842): Whitehead 1963\* [in part], 1985\* [in part]; SSF No. 54.1\* [in part].

Dorsal-fin rays 4 unbranched, 15–18 branched; anal-fin rays 3 unbranched, 7 or 8 branched; pectoral-fin rays 1 unbranched, 14–16 branched; pelvic-fin rays 1 spine, 7 rays. LSS 53; transverse scale rows 11; predorsal scales 18; GR 13–15/33–36; branchiostegal rays ~15. Percentage SL: body depth 16–20%, HL 24–26%, eye diameter 8–10%, predorsal length 44–46%, and preanal length 82–88%. Vertebrae 52 or 53.

Body iridescent green dorsally, flanks silvery; dark spot on dorsalmost body scales. Attains 21 cm SL.



*Etrumeus golanii*, 6 cm SL, adult. Source: Wongratana 1986

**DISTRIBUTION** WIO: endemic to Red Sea, and Lessepsian migrant to eastern Mediterranean Sea.

**REMARKS** Marine; known to ~50 m deep.

## *Etrumeus whiteheadi* Wongratana 1983

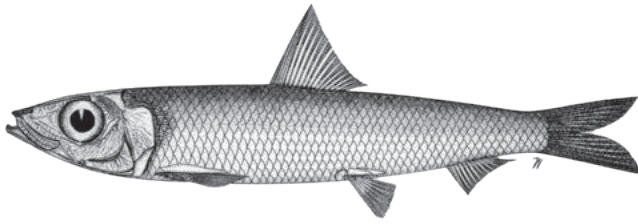
Redeye roundherring

PLATE 21

*Etrumeus whiteheadi* Wongratana 1983: 387, Fig. 1 (Algoa Bay, Eastern Cape, South Africa); Whitehead 1985\*; SSF No. 54.2\*; Randall 1995\*; Heemstra & Heemstra 2004\*; Tweddle & Anderson 2008; DiBattista *et al.* 2012\*.

Dorsal-fin rays 4 or 5 unbranched, 14–16 branched; anal-fin rays 3 or 4 unbranched, 8–10 branched; pectoral-fin rays 1 unbranched, 13–16 branched; pelvic-fin origin under or slightly in advance of base of last dorsal-fin ray. LSS 48–51; predorsal scales 15; transverse scales 11. GR 14–18/30–34 = 51–56; branchiostegal rays 11–14; pseudobranchial filaments 14–23. Vertebrae 50.

Body greenish black or blue dorsally (darkening with age), flanks silvery. Attains 22 cm SL.



*Etrumeus whiteheadi*, 17cm SL, adult holotype (South Africa).

Source: Wongratana 1983

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (off Thukela River mouth, KwaZulu-Natal) in WIO.

**REMARKS** Marine; epipelagic and inshore. Adults found mostly near bottom by day, at 100–400 m, but rise to near surface at dusk to feed. Juveniles occur mostly nearshore in large shoals. Food habits studied by Wallace-Fincham (1987), and reproduction by Roel & Melo (1990). The common name refers to bleeding in the eyes after capture. Commercially important to fisheries in its range, but appears to undergo natural fluctuations in population numbers.

### *Etrumeus wongratanae*

DiBattista, Randall & Bowen 2012

East-coast roundherring

PLATE 21

*Etrumeus wongratanae* DiBattista, Randall & Bowen 2012: 453, Fig. 3 (Durban beachfront, KwaZulu-Natal, South Africa).

*Etrumeus micropus* (non Temminck & Schlegel 1846): Barnard 1925; Smith 1949\*.

*Etrumeus teres* (non DeKay 1842): Whitehead 1963 [in part], 1985\*; SSF No. 54.1\* [in part]; Van der Elst 1988\*.

Dorsal-fin rays 4 unbranched, 17 or 18 branched; anal-fin rays 3 unbranched, 7 branched; pectoral-fin rays 1 unbranched, 14–16 branched; pelvic-fin rays 1 unbranched, 7 branched. LSS ~55; transverse scales ~13; predorsal scales ~17. GR 12–14/30–34 = 43–47; branchiostegal rays ~15. Percentage SL: body depth 18–21%, HL 24–27%, eye diameter 9–10%, predorsal length 45–48%, and preanal length 83–90%. Vertebrae 52 or 53.

Body iridescent blue-green dorsally (dark purplish grey in preservative), flanks and head silvery white; black edges on scales in upper 2 or 3 rows. Attains 18.5 cm SL.

**DISTRIBUTION** WIO: Somalia (Gulf of Aden) to South Africa (KwaZulu-Natal).

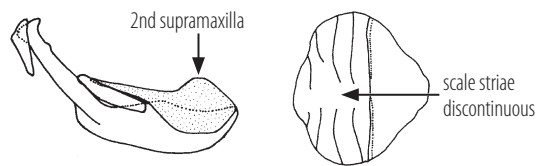
**REMARKS** Marine; known to ~26 m deep.

## GENUS *Spratelloides* Bleeker 1851

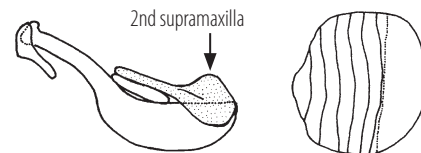
Body cylindrical; pelvic-fin origin under or slightly behind middle of dorsal fin. Branchiostegal rays 6–8 (usually 6 or 7). Two supramaxillae. Pelvic scute flat, W-shaped. Striae on scales few, vertical. Four species, 2 in WIO.

### KEY TO SPECIES

- 1a Bright silver band at midbody from gill cover to caudal-fin base; maxilla toothed; rear part of 2nd supramaxilla asymmetrical (lower part larger than upper); some striae on scales not meeting at centre; LSS 42–48 ..... *S. gracilis*



- 1b No silver band at midbody; maxilla toothless; rear part of 2nd supramaxilla more or less symmetrical; striae on scales meeting at centre; LSS 35–41 ..... *S. delicatulus*



## *Spratelloides delicatulus* (Bennett 1832)

Delicate roundherring

PLATE 23

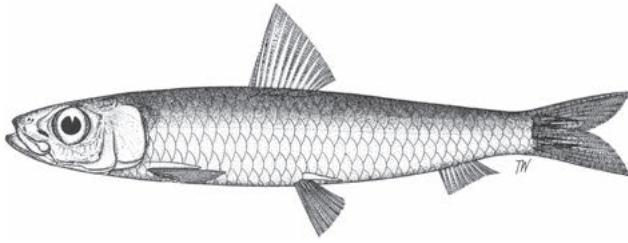
*Clupea delicatula* Bennett 1832: 168 (Mauritius, Mascarenes).

*Stolephorus delicatulus*: SFSA No. 107\*.

*Spratelloides delicatulus*: Gilchrist & Thompson 1917; Whitehead 1973\*, 1985\*; Wongratana 1980\*; SSF No. 54.13\*; Randall 1995\*, 2005\*; Winterbottom & Anderson 1997; Munroe *et al.* 1999\*; Kimura *et al.* 2003\*; Fricke *et al.* 2009.

Maxilla toothless; rear part of 2nd supramaxilla symmetrical, paddle-shaped. Dorsal-fin rays 2 unbranched, 9–12 branched; anal-fin rays 2 or 3 unbranched, 8 or 9 branched; pectoral-fin rays 1 unbranched, 10–12 branched. LSS 35–41 (usually 36–39); predorsal scales 8–13; vertical striae on scales continuous (not interrupted in centre), rear margin of scales smooth. GR 9–12/26–32; branchiostegal rays 6–8; pseudobranchial filaments 11–15; pyloric caeca 9–11.

Body bluish green dorsally, flanks silvery, but no bright band along midbody; 2 prominent black streaks on caudal fin for ~½ its length. Attains 9 cm SL.



*Spratelloides delicatulus*, 5 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Oman, Red Sea to South Africa (KwaZulu-Natal), Madagascar, Comoros, Seychelles, Réunion, Mauritius and Chagos; elsewhere to Indonesia, southern Japan, Marshall Is., Australia, New Caledonia, Samoa and Hawaii.

**REMARKS** Pelagic, schooling, inshore in clear waters, lagoons and along reef margins, to ~50 m deep. Feeds near surface on plankton. Used as bait in tropical Pacific Ocean tuna fisheries. Barnard's (1925) description of a "lateral silver stripe" is an error.

*Spratelloides gracilis* (Temminck & Schlegel 1846)

Silver-stripe roundherring

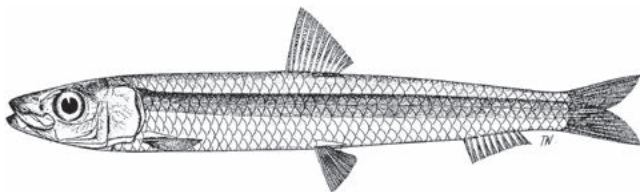
PLATE 23

*Clupea gracilis* Temminck & Schlegel 1846: 238, Pl. 108, Fig. 2 (Nagasaki, Japan).

*Spratelloides gracilis*: Wongratana 1980\*; Whitehead 1985\*; Randall 1995\*, 2005\*; Allen 1997\*; Winterbottom & Anderson 1997; Munroe *et al.* 1999\*; Kimura *et al.* 2003\*; Manilo & Bogorodsky 2003.

Maxilla toothed; rear part of 2nd supramaxilla asymmetrical (ventral portion longer than dorsal portion). Dorsal-fin rays 2 unbranched, 9–12 branched; anal-fin rays 2 unbranched, 9–12 branched; pectoral-fin rays 1 unbranched, 10–13 branched. LSS 42–48 (usually 42–46); predorsal scales 13–17; vertical striae on scales discontinuous (not meeting at centre). GR 7–13/19–37; branchiostegal rays 6 or 7; pseudobranchial filaments 9–17; pyloric caeca 11–14.

Body pale brown dorsally, with narrow black band separating wide bright silver band along midbody, and whitish below; no black streaks on caudal fin. Attains 9.5 cm SL.



*Spratelloides gracilis*, 7 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea to Tanzania (Zanzibar) and Chagos; elsewhere to Philippines, southern Japan, northern Australia, Samoa and Tuamotu Is.

**REMARKS** Common throughout much of its range; inshore, pelagic, schooling; fast-growing. Caught as food source and for bait.

**SUBFAMILY PELLONULINAE**

Freshwater herrings

Small- to very small-sized herrings (usually 5–10 cm SL); pelvic scute with ascending arms, and pre-pelvic and post-pelvic scutes reduced or absent in some genera. Dorsal fin short, with 12–18 rays; anal fin with 16–27 rays. Mouth terminal; no anterior supramaxilla. Occur mostly in tropical freshwater, but a few species enter fully saline bays or estuaries. Twenty-three genera and ~44 species; 3 monotypic genera in WIO.

**KEY TO GENERA AND SPECIES**

- 1a Anal-fin origin behind vertical through dorsal-fin insertion; lower GR 24–31; no gill rakers on rear surface of upper limb of 3rd arch ..... 2
- 1b Anal-fin origin in front of vertical through dorsal-fin insertion; lower GR 39–76; gill rakers on rear surface of upper limb of 3rd arch [freshwater and estuaries] ..... *Gilchristella aestuaria*
- 2a No pre-pelvic or post-pelvic scutes; last two anal-fin rays separated from rest of fin; 2nd supramaxilla about half length of maxilla ..... *Spratellomorpha bialalis*
- 2b Pre-pelvic scutes 5–8, without keels, and covered by scales (observed by removing scales); no post-pelvic scutes; last two anal-fin rays not separated from rest of fin; 2nd supramaxilla much less than half length of maxilla ..... *Ehirava fluviatilis*

**GENUS Ehirava** Deraniyagala 1929

Very small-sized, slender roundherring with abdomen rounded in cross-section; belly with 5–8 thin and unkeeled pre-pelvic scutes; no post-pelvic scutes. Teeth on jaws minute. Lower GR relatively few, 24–30; branchiostegal rays 5 or 6. Pelvic fins 8 rays, and fin origin slightly in front of dorsal-fin origin; anal-fin origin well behind dorsal-fin origin. One species.

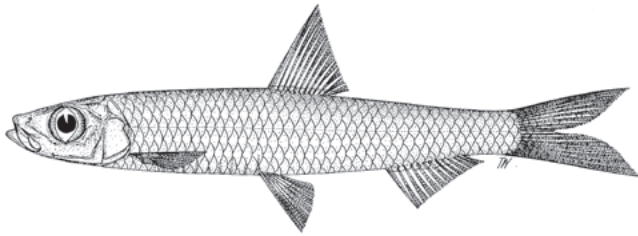
*Ehirava fluviatilis* Deraniyagala 1929

Malabar sprat

*Ehirava fluviatilis* Deraniyagala 1929: 35, Pl. 14 (Sri Lanka);  
Whitehead 1973\*, 1985\*; Wongratana 1980\*; Talwar & Jhingran 1991\*;  
Jayaram 1999; Manilo & Bogorodsky 2003.

Diagnosis as for genus. Dorsal-fin rays 2 or 3 unbranched, 11–13 branched; anal-fin rays 2 or 3 unbranched, 10–15 branched; pectoral-fin rays 1 unbranched, 10–13 branched. LSS 36–40; scutes 5–8 + 0; predorsal scales 12–14; pseudobranchial filaments 9–13. Caudal fin with 2 enlarged scales at base.

Head mostly silvery, and body iridescent off-pink. Attains 5 cm SL.



*Ehirava fluviatilis*, 5 cm SL, adult holotype (Sri Lanka).  
Source: Wongratana 1980

**DISTRIBUTION** WIO: southwestern India to Sri Lanka.

**REMARKS** Enters lagoons and estuaries. Commercially important locally.

**GENUS** *Gilchristella* Fowler 1935

Small-sized, slender roundherring with abdomen rounded in cross-section; belly with 6–9 thin and unkeeled pre-pelvic scutes, with dorsally-projecting arms hidden by scales; no post-pelvic scutes. Lower jaw slightly projecting beyond upper jaw; teeth on jaws minute, in 1 row. Lower GR highly variable, relatively numerous; branchiostegal rays 6 or 7. Pelvic fins 8 rays, and fin origin slightly in front of dorsal-fin origin. One species currently recognised.

*Gilchristella aestuaria* (Gilchrist 1913)

Estuarine roundherring

PLATE 22

*Spratelloides aestuarius* Gilchrist 1913: 55, Fig. (Swartkops River estuary, Port Elizabeth, South Africa; tidal rivers near East London, South Africa).

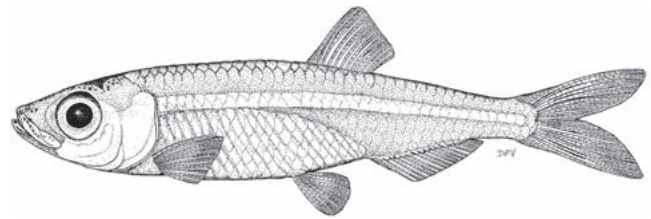
*Pellonulops madagascariensis* (non Sauvage 1883): Smith 1949\*.

*Ehirava madagascariensis*: Whitehead 1963 [East London/Buffalo River specimens].

*Gilchristella aestuaria*: Whitehead 1985\*; SSF No. 54.3\*; Skelton 1993\*; Whitfield 1998\*; Heemstra & Heemstra 2004\*.

Diagnosis as for genus. Dorsal-fin rays 3 unbranched, 11 or 12 branched; anal-fin rays 3 unbranched, 17 branched; pectoral-fin rays 1 unbranched, 10 or 11 branched; lower GR 39–76 (in fish >3.5 cm SL); scutes 6–9 + 0.

Adult males reddish, belly pale, and head silvery; females silvery blue; smaller fish whitish; translucent silvery stripe along rear part of midbody; black dots (melanophores) on top and sides of head and body. Attains 6.5 cm SL.



*Gilchristella aestuaria*, 6 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Southern African coastal river systems and estuaries: Namibia in southeastern Atlantic, to South Africa and at least southern Mozambique in WIO.

**REMARKS** Abundant in many areas; freshwater, brackish and marine. Diet studied by Blaber *et al.* (1981), Coetzee (1982) and Talbot & Baird (1985); larval development described by Haigh & Whitfield (1993). Specimens 41–53 mm SL from the Buffalo River, South Africa, were found to have 40–56 gill rakers, whereas in other localities the count was found to be 39–45 (Whitehead 1963, 1985); another study (Talwar & Whitehead 1971) found as many as 76 gill rakers, as well as other differences, prompting Whitehead (1985) and Whitehead & Wongratana (1986) to suggest there could be two species involved.

**GENUS** *Spratellomorpha* Bertin 1946

Very small-sized, slender roundherring; belly with single pelvic scute (no other scutes). Lower jaw slightly projecting beyond upper jaw. Lower gill rakers relatively few, 26–31; branchiostegal rays 6. Pelvic-fin origin well in front of dorsal-fin origin. One species.



*Spratellomorpha bianalis* (Bertin 1940)

Two-finned roundherring

PLATE 23

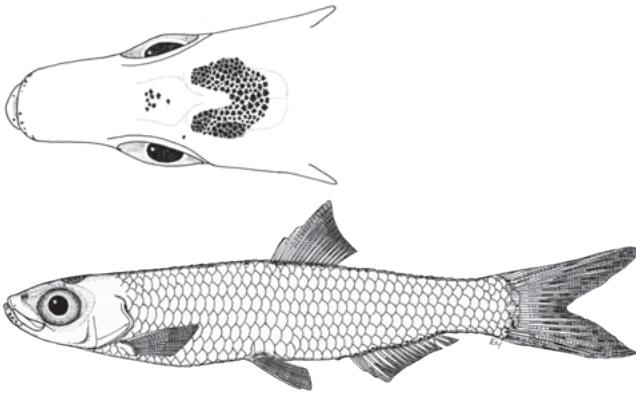
*Sauvagella madagascariensis* forme *bianalis* Bertin 1940: 300 (Madagascar).

*Sauvagella bianalis*: Bertin 1943\*; Whitehead 1963\*.

*Spratellomorpha bianalis*: Losse 1968\*; Talwar & Whitehead 1971; Whitehead 1973\*, 1985\*.

Diagnosis as for genus. Dorsal-fin rays 3 unbranched, 11–13 branched; anal-fin rays 3 unbranched, 11–13 branched, and last 2 rays separated from rest of fin by gap equal to ~3 rays; pectoral-fin rays 1 unbranched, 11 or 12 branched. LSS 42–45. Percentage SL: body depth 17–22%, HL 25–28%, and eye diameter 7–8%. Predorsal scales 53–63; pre-pelvic scales 49–55; preanal scales 69–76. Vertebrae 45 or 46.

Body uniformly greyish brown, with faint silvery midlateral stripe; caudal-fin base with 2 dark lines. Attains 4.5 cm SL.



*Spratellomorpha bianalis*, 36 mm SL, dorsal head view from same specimen (Kenya).

**DISTRIBUTION** WIO: range uncertain; possibly endemic to Madagascar, but records also from Kenya.

**REMARKS** Freshwater; rare. The distinctiveness of this taxon from the East African form needs further research.

**GLOSSARY**

- frontoparietal striae** – the slight ridges or grooves on the bones above and behind the eyes.
- pseudobranchial filaments** – filaments of the small, gill-like organ on the inner surface of the operculum.
- pterygoid teeth** – the teeth on the bones of the roof and walls of the mouth, behind the palatines.
- pyloric caecum (pl. caeca)** – a variously shaped diverticulum from the junction of the stomach and intestine; the pyloric caeca may be long and numerous, or short and few, or profusely branched, or even absent.
- supramaxillae** – small bones along the upper rear edge of the maxilla.

**FAMILY PRISTIGASTERIDAE**

Ilishas

M Eric Anderson

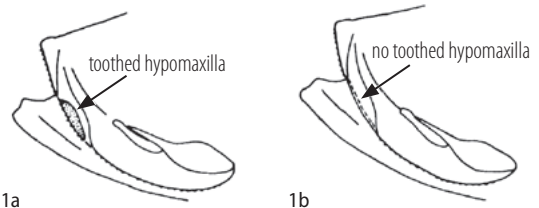
Body elongate and roughly fusiform (in WIO forms) or very deep-bodied (*Pristigaster* from the Amazon). Mouth small and upturned, lower jaw usually projecting in front of upper jaw; upper jaw of *Pellona* with toothed accessory bone (hypomaxilla). Gill rakers long, not numerous. One elevated dorsal fin; anal fin long; pectoral fins longer or shorter than head length; pelvic fins small or absent; caudal fin forked. No fin spines; fin rays branched and unbranched. No lateral line. Scales cycloid, deciduous, with vertical striae.

Small- to moderate-sized clupeoids, mostly silvery, in coastal areas and freshwater; filter-feeders. Several marine species are known to spawn in estuaries where juveniles may linger. Many species form a significant part of artisanal fisheries in their range, and several are regarded as an excellent bait in tuna fisheries. Formerly placed as a subfamily of Clupeidae, but here elevated to family level following Whitehead (1985). Ilishas from the Indian Ocean have been reviewed by Wongratana (1980) and Whitehead (1985). Nine genera and ~34 species; 3 genera and 9 species in WIO.

**KEY TO GENERA**

**[WIO forms only]**

- 1a Toothed hypomaxilla present in upper jaw; 5–8 enlarged pre-pelvic scutes under and behind pectoral-fin bases; pelvic-fin length 9–10% SL ..... *Pellona*
- 1b No toothed hypomaxilla in upper jaw (flesh may need to be removed); no enlarged pre-pelvic abdominal scutes; pelvic-fin length 3–7% SL ..... 2



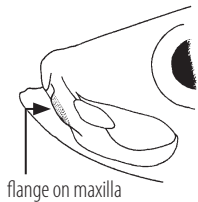
- 2a Pelvic fins present; dorsal-fin origin in front of anal-fin origin; branched anal-fin rays 32–49; pyloric caeca 24–76 ..... *Ilisha*
- 2b No pelvic fins; dorsal-fin origin well behind anal-fin origin; branched anal-fin rays 48–60; pyloric caeca ~22 ..... *Opisthopecterus*

GENUS *Ilisha* Richardson 1846

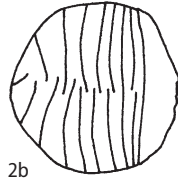
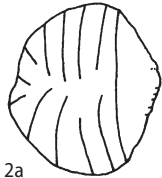
Moderate-sized (to ~40 cm SL), occurring in tropical to subtropical, marine, brackish and fresh water worldwide. Pelvic-fin rays 1 unbranched, 5 or 6 branched; dorsal-fin origin in front of anal-fin origin. Wongratana (1980) and Whitehead (1985) detail three swimbladder morphologies of *Ilisha*, in which 1 or 2 posterior tubes (post-coelomic prolongations) project from the body cavity through the caudal musculature (or no tubes in *I. sirishai*). Significant component of artisanal fisheries in some areas, especially India. Sixteen species, 7 in WIO.

## KEY TO SPECIES

- 1a No bony flange on outer edge of maxilla ..... 2  
 1b Distinct flange on outer edge of maxilla just behind premaxilla ..... *I. sirishai*



- 2a Vertical striae on scales discontinuous (not meeting at centre) ..... 3  
 2b Vertical striae on scales continuous or overlapping each other at centre ..... 4



- 3a Faint dark longitudinal band on midbody; abdominal scutes 25–30; total anal-fin elements 40–47; lower gill rakers 21–24; pyloric caeca ~38 ..... *I. striatula*  
 3b No dark band along sides; abdominal scutes 32 or 33; total anal-fin elements 48–52; lower gill rakers 18; pyloric caeca 24–26 ..... *I. compressa*
- 4a Abdominal scutes 24–33; pyloric caeca ~45–55 ..... 5  
 4b Abdominal scutes 28–38 (usually >30); pyloric caeca >70 ..... 6
- 5a Lower gill rakers 27 or 28 ..... *I. obfusata*  
 5b Lower gill rakers 21–25 ..... *I. melastoma*
- 6a Small dark spot behind upper edge of eyes; abdominal scutes 28–35 (usually 30–34) ..... *I. megaloptera*  
 6b No spot behind eyes; abdominal scutes 34–38 ..... *I. filigera*

*Ilisha compressa* Randall 1994

Thin ilisha

PLATE 23

*Ilisha compressa* Randall 1994: 895, Fig. 1 (Kuwait Bay, Persian/Arabian Gulf); Randall 1995\*; Carpenter *et al.* 1997\*.

Dorsal-fin rays 3 unbranched, 14 or 15 branched; anal-fin rays 4 unbranched, 44–47 branched; pectoral-fin rays 1 unbranched, 17 or 18 branched; caudal-fin rays 19 or 20. LSS 55 or 56; abdominal scutes 32 or 33. GR 10/18; branchiostegal rays 6. Percentage SL: body depth 31–32%, body width 9–10%, HL 23–24%, snout length ~7%, eye diameter 7–8%, pectoral-fin length ~19%, upper jaw 13%, predorsal length 48–49%, and preanal length 57–59%. Vertical striae on scales not meeting at centre. Predorsal bones (remnants of pterygiophores) 11. Swimbladder with 2 posterior tubes; pyloric caeca 24–26. Vertebrae 51.

Body yellowish grey dorsally, flanks and abdomen silvery; jaws blackish; dorsal fin, anal fin and pelvic fins whitish; pectoral fins yellow; caudal fin yellowish, becoming black towards margin. Attains 27 cm SL.

**DISTRIBUTION** WIO: Persian/Arabian Gulf, but may range more widely.

**REMARKS** Known to ~10 m deep.

*Ilisha filigera* (Valenciennes 1847)

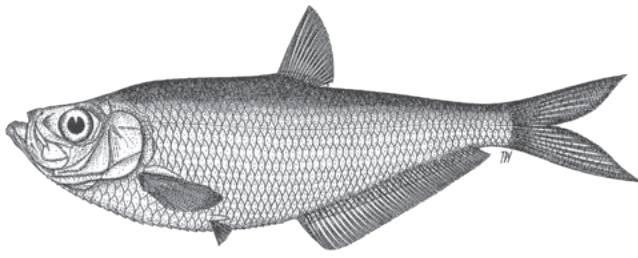
Coromandel ilisha

*Pellona filigera* Valenciennes in Cuv. & Val. 1847: 322 (Mumbai, India) [in part].

*Ilisha filigera*: Wongratana 1980\*; Whitehead 1985\*; Kottelat *et al.* 1993\*; Carpenter *et al.* 1997; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 14–17 branched; anal-fin rays 3 unbranched, 43–49 branched; pectoral-fin rays 1 unbranched, 14–17 branched. LSS 49–54; abdominal scutes 34–38. GR 9–12/19–23; branchiostegal rays 6. Body depth 31–35% SL; eye diameter 7–10% SL. Dorsal-fin origin at about midpoint of body; anal-fin origin under dorsal-fin base. Vertical striae on scales continuous at centre. Swimbladder with 1 posterior tube, on right side above anal-fin base; pyloric caeca ~76.

Body dark dorsally, flanks silvery; distal margins of fins black. Attains 22 cm SL.



*Ilisha filigera*, 19 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: India (Mumbai); elsewhere to east coast of India, possibly Andaman Sea, and South China Sea (Sarawak and Kalimantan, Borneo).

**REMARKS** Occurs in coastal waters; may enter estuaries.

### *Ilisha megaloptera* (Swainson 1839)

Bigfin ilisha

PLATE 23

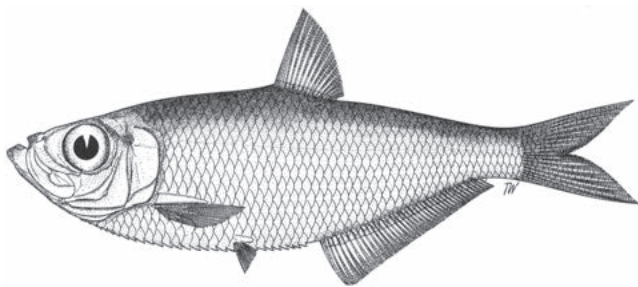
*Clupea (Platygaster) megalopterus* Swainson 1839: 294 (Visakhapatnam [Coromandel coast], India).

*Pellona dussumieri* Valenciennes in Cuv. & Val. 1847: 316 (Coromandel, India).

*Ilisha megaloptera*: Whitehead 1973\*, 1985\*; Wongratana 1980\*; Kottelat *et al.* 1993\*; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 13–15 branched; anal-fin rays 3 or 4 unbranched, 35–39 branched; pectoral-fin rays 1 unbranched, 14–17 branched. LSS 40–52; abdominal scutes 28–35 (usually 30–34). GR 8–11/18–23; branchiostegal rays 6. Body depth 29–39% SL; eye diameter 8–12% SL. Vertical striae on scales not meeting at centre. Swimbladder with 1 posterior tube, on right side above anal-fin base; pyloric caeca ~73.

Body dusky dorsally, flanks silvery; head and snout with yellow tinge; small black spot behind upper edge of eyes; dorsal fin and caudal fin yellowish, margins dusky. Attains 28 cm SL.



*Ilisha megaloptera*, 13 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Arabian Sea (India); elsewhere to Bay of Bengal (including Sundarbans), Andaman Sea, Java Sea, Malaysia (Sarawak) and China (Macao).

**REMARKS** Inhabits coastal waters and enters estuaries to spawn.

### *Ilisha melastoma* (Bloch & Schneider 1801)

Indian ilisha

*Clupea melastoma* Bloch & Schneider 1801: 427 (near Coromandel, India).

*Platygaster verticalis* Swainson 1838: 278 (Visakhapatnam, India).

*Clupea (Platygaster) indicus* Swainson 1839: 294 (Visakhapatnam, India).

*Pellona ditchoa* Valenciennes in Cuv. & Val. 1847: 313 (Visakhapatnam, India).

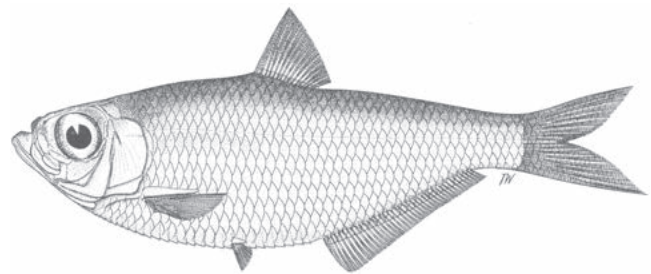
*Ilisha melastoma*: Whitehead 1973\*, 1985\*; Wongratana 1980\*;

Kottelat *et al.* 1993\*; Randall 1995\*; Carpenter *et al.* 1997;

Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 12–15 branched; anal-fin rays 3 or 4 unbranched, 32–44 branched; pectoral-fin rays 1 unbranched, 14–16 branched. LSS 38–43; abdominal scutes 24–33. GR 10–13/21–25; branchiostegal rays 5 or 6. Body depth 33–42% SL; eye diameter 9–12% SL. Dorsal-fin origin slightly before midpoint of body; anal-fin origin under rear part of dorsal-fin base. Vertical striae on scales continuous or overlapping across centre. Swimbladder with 2 posterior tubes; pyloric caeca ~51.

Body greenish dorsally, flanks silvery; dorsal fin and caudal fin yellowish, edged in black. Attains 17 cm SL.



*Ilisha melastoma*, 14 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf to Pakistan and India (Malabar coast); elsewhere to Bay of Bengal (Kolkata, India), Indonesia (Java), Arafura Sea, South China Sea and Taiwan.

**REMARKS** Occurs in coastal waters and enters estuaries to spawn.

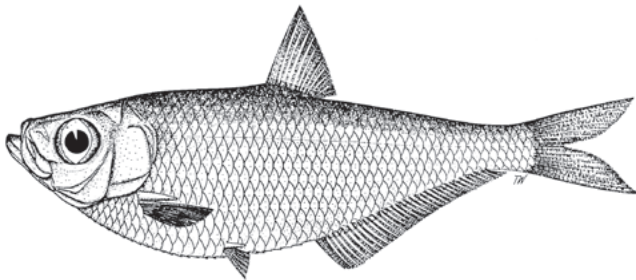
*Ilisha obfusca* Wongratana 1983

## Dusky ilisha

*Ilisha obfusca* Wongratana 1983: 397, Fig. 14 (Mumbai, India);  
Whitehead 1985\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 unbranched, 13 branched; anal-fin rays 3 or 4 unbranched, 36–38 branched; pectoral-fin rays 1 unbranched, 14 branched. LSS 40; abdominal scutes 27 or 28. GR 12 or 13/27 or 28; branchiostegal rays 6. Body depth 35–36% SL; eye diameter 9–10% SL. Dorsal-fin origin slightly before midpoint of body. Vertical striae on scales continuous or overlapping across centre. Swimbladder with 2 very short posterior tubes.

Colour in life unknown: presumably like that of other ilishas. Attains at least 12 cm SL.



*Ilisha obfusca*, 12 cm SL, adult holotype (NW India).  
Source: Wongratana 1983

**DISTRIBUTION** Northern Indian Ocean: India (records from Mumbai and Puducherry), but probably elsewhere in region.

**REMARKS** Known only from two specimens. Possibly widely misidentified in the past as *I. filigera* or *I. melastoma* and thus probably ranging at least across northern Indian Ocean.

*Ilisha sirishai* Seshagiri Rao 1975

## Lobejaw ilisha

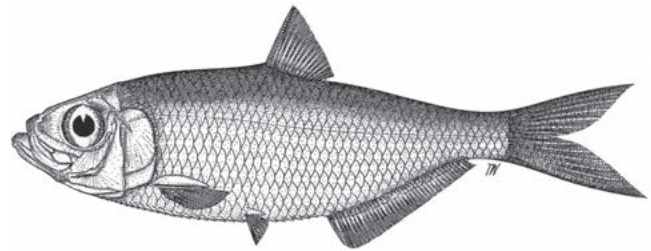
PLATE 24

*Ilisha sirishai* Seshagiri Rao 1975: 464, Figs. 1–2 (Visakhapatnam, India);  
Wongratana 1980\*; Whitehead 1985\*; Randall 1995\*; Carpenter *et al.*  
1997; Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 14 or 15 branched; anal-fin rays 3 or 4 unbranched, 36–40 branched; pectoral-fin rays 1 unbranched, 14–16 branched. LSS 40–43; abdominal scutes 26–30 (usually 28 or 29). GR 8–12/22–26; branchiostegal rays 6 or 7. Percentage SL: body depth 32–37%, HL ~28%, pectoral-fin length 11–17%, and eye diameter 8–10%. Dorsal-fin origin at or slightly before midpoint of body; anal-fin origin slightly

behind dorsal-fin base. Bony flange on outer edge of maxilla just below premaxilla. Vertical striae on scales continuous or overlapping across centre. Swimbladder without posterior tube/s; pyloric caeca 24 or 25.

Body dark dorsally, flanks silvery. Attains 23 cm SL.



*Ilisha sirishai*, 12 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Northern Indian Ocean: Persian/Arabian Gulf to Bay of Bengal and Gulf of Thailand.

**REMARKS** Inhabits coastal waters and presumably enters estuaries.

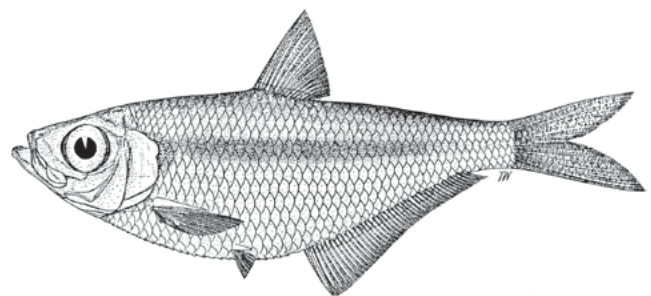
*Ilisha striatula* Wongratana 1983

## Banded ilisha

*Ilisha striatula* Wongratana 1983: 396, Fig. 13 (Pakistan); Whitehead 1985\*;  
Allen & Swainston 1988; Allen 1997; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 or 4 unbranched, 12–15 branched; anal-fin rays 3 or 4 unbranched, 37–44 branched; pectoral-fin rays 1 unbranched, 14–16 branched. LSS 40–44; abdominal scutes 25–30; GR 10–12/12–24; branchiostegal rays 6. Percentage SL: body depth 32–39%, eye diameter 9–11%, and pectoral-fin length 18–20%. Vertical striae on scales not meeting at centre. Swimbladder with 2 posterior tubes; pyloric caeca ~38.

Body dark greenish dorsally, flanks silvery, with faint dark band from gill cover to peduncle. Attains 22 cm SL.



*Ilisha striatula*, 11 cm SL, adult paratype (SE India). Source: Wongratana 1983



**DISTRIBUTION** Indian Ocean. WIO: eastern Arabian Sea (Pakistan and India); elsewhere to northwestern Australia.

**REMARKS** Resembles and often mistaken for *I. melastoma*, with which it is often caught. Inhabits coastal waters; may enter estuaries.

## GENUS *Opisthopterus* Gill 1861

Moderate-sized (to ~20 cm SL), silvery, occurring in coastal areas of tropical seas. Body elongate and strongly compressed, but belly convex in front. Abdominal scutes 26–35. Dorsal fin very small, well behind midpoint of body; anal fin long, its origin well before dorsal fin; no pelvic fins. Mouth pointing obliquely upward, with lower jaw projecting in front of upper jaw; rear of upper jaw not reaching middle of eye. A minor component of artisanal fisheries in many regions. Reviewed by Whitehead (1985). Six species, 1 in WIO.

### *Opisthopterus tardoore* (Cuvier 1829)

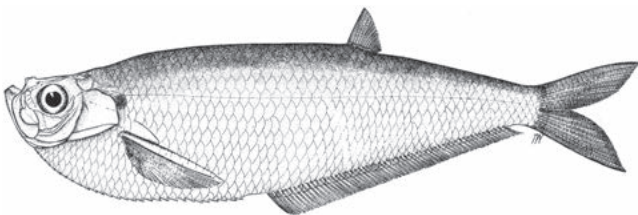
Tardoore

PLATE 24

*Pristigaster tardoore* Cuvier 1829: 321 (Puducherry, India).  
*Pristigaster elongata* Swainson 1838: 278 (Visakhapatnam, India).  
*Clupea (Pristigaster) indicus* Swainson 1839: 294 (Visakhapatnam, India).  
*Opisthopterus tardoore*: Whitehead 1973\*, 1985\*; Wongratana 1980\*;  
Talwar & Jhingran 1991\*; Kottelat *et al.* 1993\*; Randall 1995\*;  
Munroe *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal-fin rays 3 unbranched, 11–14 branched; anal-fin rays 3 unbranched, 48–60 branched; pectoral-fin rays 1 unbranched, 11–14 branched. LSS 46–51; abdominal scutes 29–35. GR 8–12/22–28; branchiostegal rays 6. Percentage SL: body depth 27–33%, HL 20–23%, and pectoral-fin length 21–26%. Vertical striae on scales not meeting at centre. Pyloric caeca ~22.

Body dark dorsally, flanks silvery; black spot behind upper end of gill opening. Attains 20 cm SL.



*Opisthopterus tardoore*, 14 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman to southern India; elsewhere to east coast of India (Chennai), possibly Myanmar, Gulf of Thailand and Java Sea.

**REMARKS** Inhabits coastal waters, estuaries and tidal zone of rivers. Aspects of its biology in India were studied by Radhakrishnan (1967, 1968).

## GENUS *Pellona* Valenciennes 1847

Small- to moderate-sized (~13–50 cm SL), in coastal areas and freshwater. Body moderately long, compressed. Abdominal scutes 22–37. Dorsal fin moderate, its origin near midpoint of body, and its insertion over anal-fin origin. Pelvic-fin rays 1 unbranched, 6 branched. Eyes large. Lower jaw projecting in front of upper jaw; toothed hypomaxilla present in upper jaw (between hind tip of premaxilla and lower bulge of maxilla blade). A minor component of artisanal fisheries in WIO. Reviewed by Whitehead (1985). Five species, 1 in WIO.

### *Pellona ditchela* Valenciennes 1847

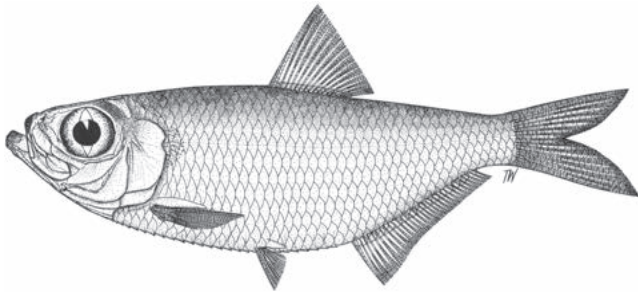
Indian pellona

PLATE 24

*Pellona ditchela* Valenciennes in Cuv. & Val. 1847: 314 (Visakhapatnam, India); Losse 1968; Whitehead 1973\*, 1985\*; Wongratana 1980\*;  
SSF No. 54.7\*; Allen & Swainston 1988; Talwar & Jhingran 1991\*;  
Kottelat *et al.* 1993\*; Randall 1995\*; Allen 1997; Munroe *et al.* 1999\*;  
Manilo & Bogorodsky 2003.  
*Pellona natalensis* Gilchrist & Thompson 1908: 202 (off south head of Thukela River, KwaZulu-Natal, South Africa).

Dorsal-fin rays 3 or 4 unbranched, 13–16 branched; anal-fin rays 3 or 4 unbranched, 31–38 branched; pectoral-fin rays 1 unbranched, 13–18 branched. LSS 37–44; abdominal scutes 25–29, and belly strongly keeled. GR 10–14/22–27. Percentage SL: body depth 25–36%, HL 25–33%, snout length 8–11%, eye diameter 8–12%, and pectoral-fin length 15–18%. Rear of upper jaw not reaching middle of eye. Vertical striae on scales slightly overlapping each other at centre. Swimbladder without posterior tubes; pyloric caeca 40–55.

Body pale brown with greenish tinge dorsally; flanks gold, becoming silver ventrally; head gold, with dusky snout and chin; faint dark spot behind upper end of gill opening. Attains 21 cm SL.



*Pellona ditchela*, 14 cm SL. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Madagascar, South Africa (KwaZulu-Natal) to Gulf of Oman, Pakistan and India; elsewhere to Andaman Sea, Indonesia, Philippines, Arafura Sea, northwestern Australia and New Guinea; not known from Red Sea and Persian/Arabian Gulf.

**REMARKS** Inhabits coastal areas, including mangroves, estuaries and freshwater. Used as bait in tuna fisheries.

#### GLOSSARY

**artisanal fisheries** – a traditional fishery involving skilled but non-industrialised fishers; typically a small-scale decentralised operation.  
**hypomaxilla** – small, paired, tooth-bearing bone behind the premaxilla and below the maxilla.

## FAMILY ENGRAULIDAE

### Anchovies

M Eric Anderson

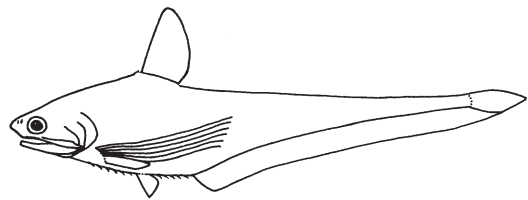
Small-sized (most to 10–20 cm SL) with subcylindrical or compressed body, long pig-like snout, and rounded and overhanging mouth; maxilla thin, reaching well past eye; usually 2 supramaxillae (some species of *Thryssa* with 1 supramaxilla or none). Gill rakers long and slender. Teeth usually minute. Eyes large, completely covered by adipose eyelid. One dorsal fin; caudal fin forked or small and pointed; no adipose fin; no fin spines; fin rays unbranched and branched. Scales cycloid, deciduous, with posterior striae. Modified scales (scutes) usually present along abdominal midline (no scutes in *Engraulis*); scutes may include single elongated pelvic scute immediately in front of pelvic fin, pre-pelvic scutes in front of pelvic scute, and post-pelvic

scutes behind pelvic-fin insertions. No lateral line. Body typically bluish green or pale brown dorsally with silvery flanks, and some species with distinct midlateral stripe.

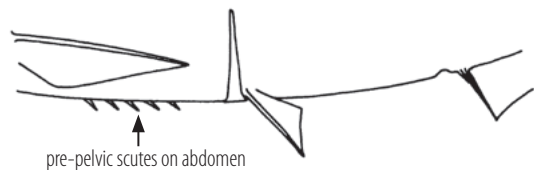
Coastal, marine, schooling fishes; some enter brackish or fresh water to feed or spawn. Very important commercially and in the marine food chain in all three major oceans. The family name is sometimes incorrectly spelled Engraulididae. Sixteen genera and ~139 species; 5 genera and 23 species in WIO.

#### KEY TO GENERA

- 1a Body and caudal region fusiform; caudal fin large and forked; anal fin not joined to caudal fin; upper pectoral-fin rays not free from one another ..... 2
- 1b Caudal region elongate and tapering; caudal fin small and pointed; anal-fin membrane joined to caudal fin; upper 6 or 7 pectoral-fin rays unbranched, elongate and free from one another ..... *Coilia*



- 2a At least pre-pelvic scutes present on abdomen, and spine-like scute in front of dorsal fin; body compressed ..... 3



- 2b No scutes on abdomen and no spine-like scute in front of dorsal fin; body subcylindrical ..... *Engraulis*
- 3a Pre-pelvic scutes sharp and needle-like, but no post-pelvic scutes; total anal-fin rays  $\leq 25$  ..... 4
- 3b Pre-pelvic and post-pelvic scutes present; total anal-fin rays 29–49 ..... *Thryssa*
- 4a Isthmus muscle not reaching forward to rear edge of gill membrane; ventral edge of urohyal exposed; preopercle canal restricted to preopercle ..... *Encrasicholina*
- 4b Isthmus muscle reaching forward beyond rear edge of gill membrane; preopercle canal with branches onto opercle ..... *Stolephorus*

**GENUS** *Coilia* Gray 1830

Grenadier anchovies

Moderate-sized anchovies (mostly 15–20 cm SL, some to ~35 cm SL) with tapering body but belly rounded before pelvic fins, and caudal fin small and pointed; dorsal fin elevated; pectoral fins attenuate, with several filamentous rays; pelvic-fin rays 1 unbranched, 5 or 6 branched; anal fin very long-based. Two main species groups are recognised based on the number of abdominal scutes, number of free upper pectoral-fin rays, and length of maxilla. Scute counts are given here as ranges of pre-pelvic plus post-pelvic scutes. Coastal marine and estuarine. The common name reflects their superficial resemblance to the deepsea grenadiers, family Macrouridae. Thirteen species; 3 species in WIO, with none of these along the West African coast or in Red Sea.

**KEY TO SPECIES**

- 1a Total scutes 12–15; maxilla short and not extending beyond gill cover; free upper pectoral-fin rays 6 (rarely 5); lower GR 23–27 ..... 2
- 1b Total scutes 36–44; maxilla moderate, reaching to pectoral-fin insertion; free upper pectoral-fin rays 7; lower GR 28–31 ..... *C. grayii*
- 2a Golden or pearly spots (light organs underneath scales) in rows on flanks and belly, and also on isthmus, edge of lower jaw, cheek and gill cover ..... *C. dussumieri*
- 2b No rows of light organs evident underneath scales on body..... *C. neglecta*

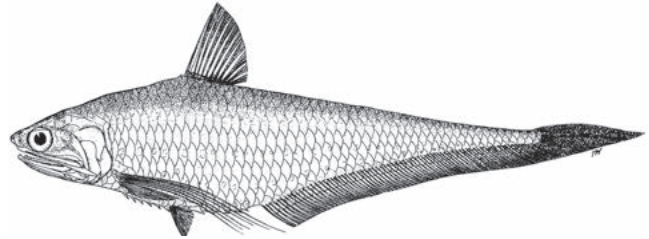
*Coilia dussumieri* Valenciennes 1848

Gold-spotted grenadier anchovy PLATE 24

*Coilia dussumieri* Valenciennes in Cuv. & Val. 1848: 81, Pl. 610 (Mumbai, India); Bal & Joshi 1956; Wongratana 1980\*; Whitehead *et al.* 1988\*; Talwar & Jhingran 1991; Kottelat *et al.* 1993; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin >80 branched rays; pectoral-fin rays 5 or 6 unbranched and filamentous, 8–11 branched. Dorsal-fin origin above or slightly behind pelvic-fin insertions. Maxilla short, not reaching rear edge of gill cover. Branchiostegal rays 9–12; pseudobranchial filaments 7–17; lower GR 23–26. Scutes 4–6 + 7–9 = 12–15; predorsal scales 10–14. Placement and number of light organs varies among individuals.

Body brown dorsally, flanks silvery; light organs on flanks and belly appear as rows of golden or pearly spots. Attains 20 cm SL.



*Coilia dussumieri*, 13 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean: west and east coasts of India to Thailand, Malaysia and Indonesia (Java and possibly Kalimantan).

**REMARKS** Commercially important, especially off west coast of India.

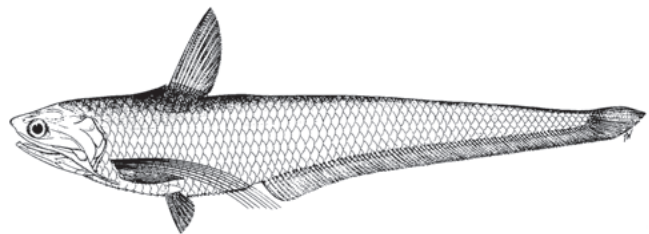
*Coilia grayii* Richardson 1845

Gray's grenadier anchovy PLATE 24

*Coilia grayii* Richardson 1845: no page number, Pl. 54, Figs. 1–2 ('China Seas'); Wongratana 1980\*; Whitehead *et al.* 1988\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 10 or 11 branched rays; anal fin >80 branched rays; pectoral fins 7 unbranched, 10–12 branched rays. Dorsal-fin origin above or slightly behind pelvic-fin origins. Maxilla moderate, nearly reaching pectoral-fin insertion. Branchiostegal rays 10 or 11; pseudobranchial filaments 18–24; lower GR 28–31. Scutes 12–15 + 22–29 = 36–44; predorsal scales 12–15. No light organs.

Body brown dorsally, flanks silvery. Attains 25 cm SL.



*Coilia grayii*, 21 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: southwestern India; elsewhere to east coast of India, Myanmar, possibly Andaman Sea (Thailand), Vietnam, Taiwan and East China Sea.

**REMARKS** Occurs in coastal areas and estuaries; apparently uncommon in India, but common in Vietnam and China.

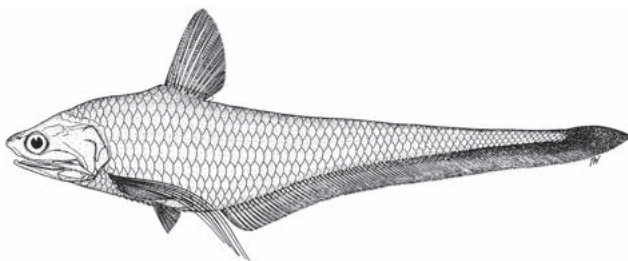
### *Coilia neglecta* Whitehead 1967

Neglected grenadier anchovy

*Coilia neglecta* Whitehead 1967: 33, Fig. 4 (Arabian Sea); Wongratana 1980\*; Whitehead *et al.* 1988\*; Talwar & Jhingran 1991; Kottelat *et al.* 1993; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin 3 unbranched, 96–107 branched rays; pectoral-fin rays 6 unbranched and filamentous, 9–11 branched. Dorsal-fin origin above or slightly before pelvic-fin insertions. Maxilla short, barely reaching edge of gill cover. Branchiostegal rays 10–13; pseudobranchial filaments 9–16; lower GR 23–27. Scutes 5–7 + 7–9 = 12–15; predorsal scales 11–14. No light organs.

Body brown dorsally, flanks silvery; anal-fin margin black. Attains 17 cm SL.



*Coilia neglecta*, 13 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: southern Pakistan, India and Sri Lanka; elsewhere to Bay of Bengal, Myanmar, Thailand, Malaysia and Indonesia (Borneo).

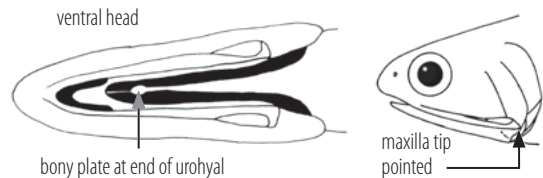
**REMARKS** Occurs in coastal areas, estuaries, river mouths and mangroves; apparently common. Caught as bycatch in small-scale fisheries; processed into fishmeal for shrimp farming.

### GENUS *Encrasicholina* Fowler 1938

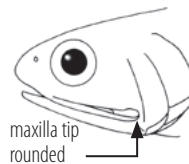
Small-sized anchovies (to ~8.5 cm SL) with long fusiform body and forked caudal fin; anal fin short; pelvic-fin rays 1 unbranched, 6 branched. Eyes large. No post-pelvic scutes. Mostly inshore and schooling, but *E. punctifer* is oceanic. Two species groups recognised: one with maxilla short with blunt tip, the other with maxilla longer with pointed tip (both groups represented in WIO). Five species, 3 in WIO, formerly usually placed in *Engraulis* or *Stolephorus*.

### KEY TO SPECIES

- 1a Maxilla with pointed tip, reaching rear edge of preopercle; anal-fin origin at vertical through or slightly behind dorsal-fin insertion; isthmus preceded by small bony plate on ventral end of urohyal; upper GR 19–25 on 1st arch, 6–9 on inner surface of 3rd gill arch ..... 2



- 1b Maxilla with bluntly rounded tip, reaching at most to front edge of preopercle; anal-fin origin at vertical well behind dorsal-fin insertion; isthmus preceded by small fleshy knob on ventral end of urohyal; upper GR 15–20 on 1st arch, 4 on inner surface of 3rd gill arch ..... *E. punctifer*



- 2a Dorsal and anal fins each with 2nd unbranched rays; portion of maxilla behind 2nd supramaxilla longer than broad; GR 7–9 on inner surface of 3rd arch ..... *E. heteroloba*
- 2b Dorsal and anal fins each with 3 unbranched rays (first of these tiny and firmly attached to 2nd ray); portion of maxilla behind 2nd supramaxilla as long as broad; GR 6 or 7 on inner surface of 3rd arch ..... *E. devisi*

### *Encrasicholina devisi* (Whitley 1940)

De Vis's anchovy

PLATE 24

*Amentum devisi* Whitley 1940: 404, Fig. 11 (Norman River mouth, Gulf of Carpentaria, Queensland, Australia).

*Stolephorus* sp. A: Whitehead 1967.

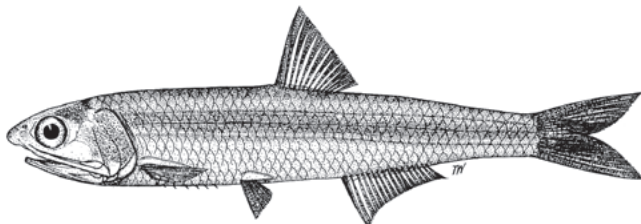
*Stolephorus devisi*: Wongratana 1980\*.

*Encrasicholina devisi*: Wongratana 1987; Whitehead *et al.* 1988\*; Randall 1995\*, 2005\*; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 11–14 branched rays; anal fin 3 unbranched, 14–18 branched rays; pectoral fins 1 unbranched, 11–14 branched rays. Tip of maxilla pointed, projecting beyond 2nd supramaxilla; small bony plate on urohyal before isthmus. Branchiostegal rays 12–15; pseudobranchial filaments 10–24; lower GR 20–27. LSS 37–43; predorsal scales 17–22; pre-pelvic scutes 3–6 (usually 5 or 6), needle-like.



Body bluish grey dorsally, with golden hue; bright silvery band on flanks, with thin blue line above it (in life). Attains 8 cm SL.



*Encrasicholina devisi*, 7 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Gulf of Aden, but apparently not Kenya, Red Sea, Persian/Arabian Gulf or India; elsewhere to Thailand, Indonesia, Philippines, southern China, Taiwan, Caroline Is., northern Australia, Fiji, Tonga and Samoa.

**REMARKS** Occurs in coastal areas and estuaries.

### *Encrasicholina heteroloba* (Rüppell 1837)

Shorthead anchovy

PLATE 24

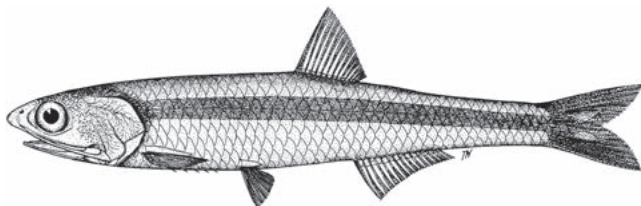
*Engraulis heteroloba* Rüppell 1837: 79, Pl. 21, Fig. 4 (Massawa, Eritrea, Red Sea).

*Stolephorus heterolobus*: Wongratana 1980\*.

*Encrasicholina heteroloba*: Wongratana 1987; Whitehead *et al.* 1988\*; Randall 1995\*, 2005\*; Wongratana *et al.* 1999\*; Kimura *et al.* 2003\*; Manilo & Bogorodsky 2003.

Dorsal fin 2 unbranched, 11–13 branched rays; anal fin 2 unbranched, 13–18 branched rays; pectoral fins 1 unbranched, 11–14 branched rays. Tip of maxilla pointed; small bony plate on urohyal before isthmus. Branchiostegal rays 11–15; pseudobranchial filaments 16–23; lower GR 22–30. LSS 39–44; predorsal scales 18–22; pre-pelvic scutes 4–6, needle-like.

Body beige dorsally, with dull silver or grey stripe on flanks (no blue line above it). Attains 12 cm SL (commonly 8 cm SL).



*Encrasicholina heteroloba*, 6 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to Mozambique and Madagascar; elsewhere to Bay of Bengal, Indonesia, southern Japan, Caroline Is., Australia, New Caledonia, Fiji and Samoa.

**REMARKS** Occurs inshore and in deep bays, and rarely enters mangroves. Marketed for human consumption and used as bait.

### *Encrasicholina punctifer* Fowler 1938

Buccaneer anchovy

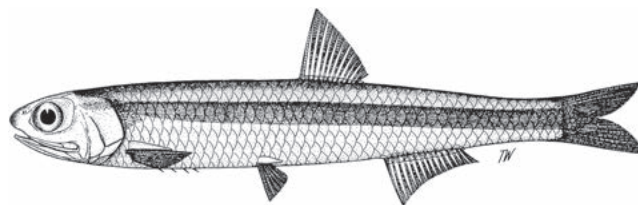
PLATE 24

*Encrasicholina punctifer* Fowler 1938: 157, Pl. 7, Fig. 13 (Fare Bay, Huahine I., Society Is.); Wongratana 1987; Whitehead *et al.* 1988\*; Randall 1995\*, 2005\*; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003.

*Stolephorus buccaneeri* Strasburg 1960: 396, Figs. 1b–2 (Niihau I., Hawaii); Wongratana 1980\*; Masuda *et al.* 1984\*.

Dorsal fin 2 unbranched, 10–14 branched rays; anal fin 2 unbranched, 12–15 branched rays; pectoral fins 1 unbranched, 12–16 branched rays. Tip of maxilla bluntly rounded; fleshy thickening on urohyal before isthmus. Branchiostegal rays 10–15; pseudobranchial filaments 17–27; lower GR 23–26, upper GR 15–20 on 1st arch. LSS 38–45; predorsal scales 17–20; pre-pelvic scutes 2–7, needle-like.

Body pale brown to pinkish grey dorsally, with broad bright silver band on sides. Attains 13 cm SL (commonly 8.5 cm SL).



*Encrasicholina punctifer*, 9 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: South Africa (KwaZulu-Natal) to Red Sea, Persian/Arabian Gulf, Pakistan, India and Sri Lanka; elsewhere to Thailand, Indonesia, Philippines, China, southern Japan, Australia, Solomon Is., New Caledonia, Fiji, Samoa, Society Is. and Hawaii.

**REMARKS** Epipelagic, both close inshore and oceanic, sometimes hundreds of miles from land, and occasionally enters atoll lagoons and deep bays. Marketed fresh, dried or processed (especially as *nuoc mam* fish sauce in Indo-China), and an important bait for tuna fisheries.

GENUS *Engraulis* Cuvier 1816

Moderate-sized, round-bodied anchovies (to ~20 cm SL); caudal fin forked; anal fin short, its origin at vertical distinctly behind dorsal-fin insertion. Eyes large. Maxilla short, just reaching preopercle (except longer in North Pacific *E. mordax*). Single pelvic scute immediately before pelvic-fin origin, but no pre-pelvic or post-pelvic scutes. Gill rakers slender and numerous (lower GR 27–45). Two species groups based on numbers of branched anal-fin rays and lower gill rakers, as well as shape of maxilla tip. Eight species; 1 species in WIO, although more research is needed to determine if the African and western Pacific forms are different at the species level.

*Engraulis capensis* Gilchrist 1913

Cape anchovy

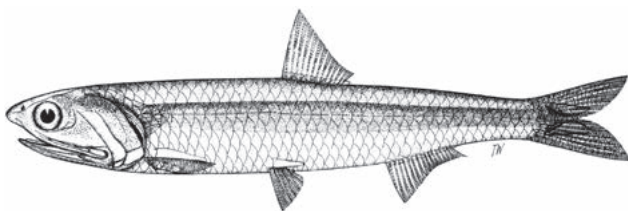
PLATE 24

*Engraulis capensis* Gilchrist 1913: 62, Fig. (Cape of Good Hope, South Africa); Barnard 1925.

*Engraulis japonicus* (non Temminck & Schlegel 1846): SFSA No. 123\*; Wongratana 1980\*; SSF No. 55.1\*; Van der Elst 1988\*; Heemstra & Heemstra 2004\*.

Dorsal fin 2 or 3 unbranched, 11–14 branched rays; anal fin 2 or 3 unbranched, 12–19 branched rays; pectoral fins 1 unbranched, 12–18 branched rays; pelvic fins 1 unbranched, 6 branched rays. Branchiostegal rays 12–16; pseudobranchial filaments 22–34, and filaments longer than eye diameter; lower GR 26–30, and small gill rakers present on posterior face of 3rd gill arch. LSS 38–45; predorsal scales 16–20.

Body brownish or greenish dorsally, silvery white below, with broad silvery band on flanks; caudal fin translucent with yellow tinge. Attains 17 cm SL.



*Engraulis capensis*, 6 cm SL. Source: Wongratana 1980

**DISTRIBUTION** Southeastern Atlantic from Namibia around Cape of Good Hope, and to Somalia, Mauritius and Seychelles in WIO.

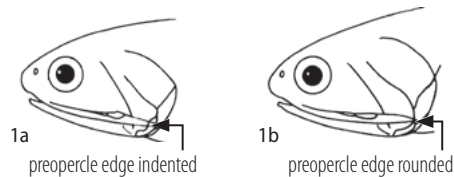
**REMARKS** Occurs to ~450 m deep. Thought by some authors to be synonymous with *Engraulis encrasicolus* (Linnaeus 1758) from the eastern Atlantic, Mediterranean Sea and other European seas.

GENUS *Stolephorus* Lacepède 1803

Small-sized anchovies (to ~15 cm SL) with moderately compressed body; pelvic-fin rays 1 unbranched, 6 branched; single spine-like predorsal scute, not attached to dorsal fin in some species; 1–8 needle-like pre-pelvic scutes; no post-pelvic scutes. Gill rakers slender, 18–35 on lower limb of 1st arch; isthmus reaching forward to border of branchiostegal membrane. The species are difficult to identify, with many overlapping characters. Nineteen species, 5 in WIO.

## KEY TO SPECIES

- 1a Posteroventral edge of preopercle indented near tip of maxilla ..... 2  
1b Posteroventral edge of preopercle evenly rounded ..... 3



- 2a Needle-like predorsal scute present; fine teeth on upper edge of ceratohyal; double pigment line on back behind dorsal fin ..... *S. insularis*  
2b No predorsal scute; no teeth on upper edge of ceratohyal; no pigment lines on back behind dorsal fin ..... *S. holodon*
- 3a Maxilla reaching to or slightly beyond rear edge of preopercle ..... 4  
3b Maxilla reaching to front of preopercle or very slightly beyond ..... *S. indicus*
- 4a Numerous black spots below eyes, on tip of lower jaw and roof of mouth; lower GR 19–25 (usually 20 or 21) ..... *S. waitei*  
4b No black spots on snout, lower jaw or roof of mouth; lower GR 21–35 (usually 23–28) ..... *S. commersonnii*

*Stolephorus commersonnii* Lacepède 1803

Commerson's anchovy

PLATE 25

*Stolephorus commersonnii* Lacepède (ex Commerson) 1803: 381, Pl. 12, Fig. 1 [Mauritius, Mascarenes] [based on Commerson's manuscript]; Wongratana 1980\*; Whitehead *et al.* 1988\*; Talwar & Jhingran 1991\*; Kottelat *et al.* 1993\*; Randall 1995\*; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003.

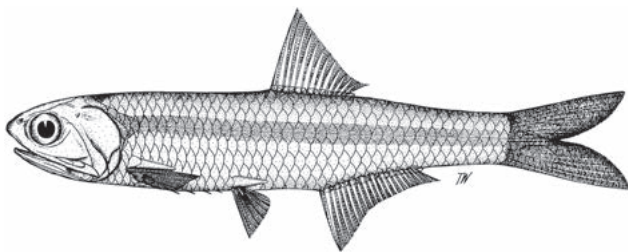
*Clupea tuberculosa* Lacepède 1803: 425, 460 (Mauritius, Mascarenes) [based on Commerson's manuscript].

*Anchoviella commersonii*: SFSA No. 119\*.

*Stolephorus rex* Jordan & Seale 1926: 380 (Kannur, Malabar coast, India).

Dorsal fin 3 unbranched, 12–14 branched rays; anal fin 3 unbranched, 17–20 (usually 18–19) branched rays, and fin origin at vertical behind middle of dorsal fin; pectoral fins 1 unbranched, 11–14 branched rays. Tip of adpressed pelvic fin reaching vertical through 4th or 5th dorsal-fin ray. Small teeth on dorsal surface of ceratohyal; tip of maxilla pointed; rear edge of preopercle rounded. Branchiostegal rays 11–14; pseudobranchial filaments 14–22; lower GR usually 23–28. LSS 35–38; predorsal scales 15–20; pre-pelvic scutes 0–5 (usually 2 or 3), needle-like.

Body translucent grey or tan, with silvery midlateral band; pair of darkish blotches behind occiput followed by pair of blackish lines on back to dorsal-fin origin. Attains 10 cm SL.



*Stolephorus commersonii*, 7 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Gulf of Aden to Tanzania (Zanzibar), Madagascar, Mauritius and western India; not known from Red Sea and Persian/Arabian Gulf; elsewhere to South China Sea, Australia and New Guinea.

**REMARKS** Also enters estuaries. Feeds on surface plankton.

### *Stolephorus holodon* (Boulenger 1900)

Thorny anchovy

PLATE 25

*Engraulis holodon* Boulenger 1900: 12, Pl. 3, Fig. 3 (Swartkops River, Eastern Cape, South Africa).

*Stolephorus holodon*: Barnard 1925; Wongratana 1980\*; SSF No. 55.2\*; Whitehead *et al.* 1988\*; Connell 1996; Whitfield 1998\*; Heemstra & Heemstra 2004\*.

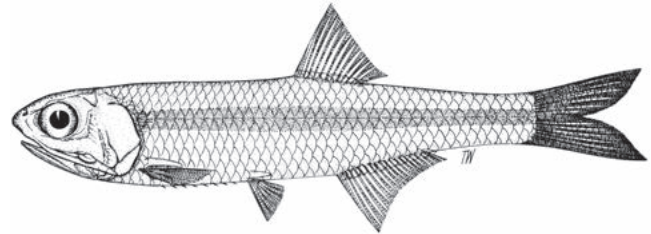
*Anchoviella holodon*: SFSA No. 120.

*Stolephorus commersonii* (*non* Lacepède): Winterbottom 1976; Blaber 1979.

Dorsal fin 3 unbranched, 12–15 branched rays; anal fin 3 unbranched, 17–20 branched rays; pectoral fins 1 unbranched, 10–14 branched rays. Tip of adpressed pelvic fin reaching vertical through dorsal-fin origin; anal-fin origin at vertical near mid-dorsal fin. No teeth on dorsal surface of ceratohyal; posteroventral edge of preopercle indented near tip of maxilla.

Branchiostegal rays 10–12; pseudobranchial filaments 14–21; lower GR 24–29. LSS 38–40; predorsal scales 19–21; pre-pelvic scutes 6–8.

Body pale brown, darker dorsally, with silvery midlateral band. Attains 8 cm SL.



*Stolephorus holodon*, 7 cm SL. Source: Wongratana 1980

**DISTRIBUTION** WIO: Kenya to South Africa (Algoa Bay).

**REMARKS** Feeds on midwater plankton, especially crustaceans. Spawns in summer nearshore or in estuaries; eggs pelagic.

### *Stolephorus indicus* (Van Hasselt 1823)

Indian anchovy

PLATE 25

*Engraulis indicus* Van Hasselt 1823: 329 (Visakhapatnam, India; Java, Indonesia) [based on Russell 1803].

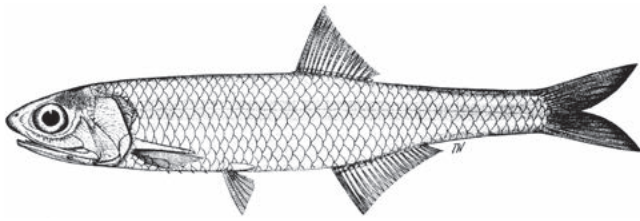
*Anchoviella indica*: SFSA No. 118\*.

*Stolephorus indicus*: Wongratana 1980\*; SSF No. 55.3\*; Whitehead *et al.* 1988\*; Talwar & Jhingran 1991; Kottelat *et al.* 1993\*; Randall 1995\*; Wongratana *et al.* 1999\*; Kimura *et al.* 2003\*; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004.

*Stolephorus extensus* Jordan & Seale 1926: 382 (Mauritius, Mascarenes).

Dorsal fin 3 unbranched, 11–14 branched rays; anal fin 3 unbranched, 14–19 branched rays; pectoral fins 1 unbranched, 12–16 branched rays. Tip of adpressed pelvic fin not reaching vertical through dorsal-fin origin; anal-fin origin at vertical through mid-dorsal fin. Rear edge of preopercle rounded. Branchiostegal rays 10–15; pseudobranchial filaments 17–26; lower GR 20–28. LSS 37–44; predorsal scales 18–22; pre-pelvic scutes 2–6.

Body translucent grey, pale yellowish tan dorsally and translucent silvery white below, with bright silvery midlateral band; opercle may be golden; dorsal surface of head stippled dark brown (no pigmented lines on back between head and dorsal fin); dorsal fin and caudal fin yellow with dark brown stippling. Attains 15 cm SL.



*Stolephorus indicus*, 13 cm SL. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Persian/Arabian Gulf, Red Sea, East Africa to South Africa and Mascarenes; elsewhere to Indonesia, South China Sea, Mariana Is., Caroline Is., Australia, New Caledonia and Tahiti.

### *Stolephorus insularis* Hardenberg 1933

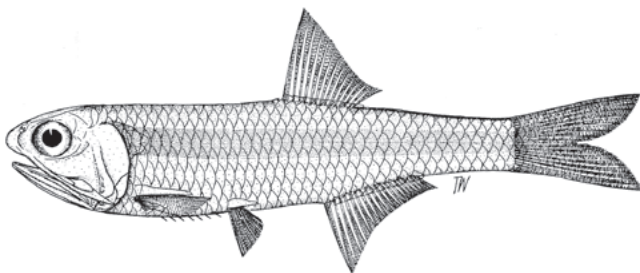
Hardenberg's anchovy

PLATE 25

*Stolephorus insularis* Hardenberg 1933: 249 (Java, Indonesia); Wongratana 1980\*; Whitehead *et al.* 1988\*; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003; Randall 2005\*.

Dorsal fin 3 unbranched, 11–14 branched rays; anal fin 3 unbranched, 16–20 branched rays; pectoral fins 1 unbranched, 10–13 branched rays. Tip of adpressed pelvic fin nearly reaching vertical through dorsal-fin origin; anal-fin origin at vertical slightly behind mid-dorsal fin. Small teeth on dorsal surface of ceratohyal; rear edge of preopercle indented. Branchiostegal rays 9–12; pseudobranchial filaments 13–19; lower GR 21–28. LSS 35–39; predorsal scales 18–21; pre-pelvic scutes 4–8 (usually 6 or 7).

Body pale brown dorsally, silvery below, with bright silver midlateral band; double pigment lines on back behind dorsal fin; caudal fin may be deep yellow. Attains 9 cm SL.



*Stolephorus insularis*, 5 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden to India; not known from Red Sea and Persian/Arabian Gulf; elsewhere to Myanmar, Gulf of Thailand, Java Sea, Taiwan and New Caledonia.

**REMARKS** Originally described by Hardenberg (1933) with four subspecies. Identifications are often dubious and the taxonomy of *Stolephorus* and *Encrasicholina* is currently in flux. Marine and brackish. Sometimes used as bait.

### *Stolephorus waitei* Jordan & Seale 1926

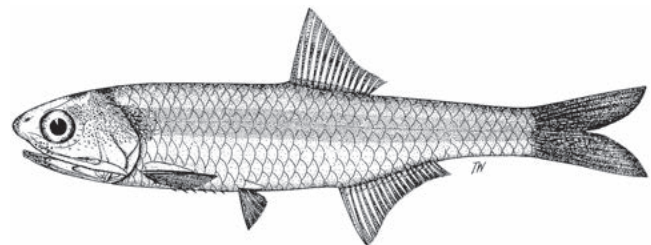
Spotty-face anchovy

PLATE 25

*Stolephorus waitei* Jordan & Seale 1926: 379 (Queensland, Australia); Wongratana 1980\*; Whitehead *et al.* 1988\*; Wongratana *et al.* 1999\*; Kimura *et al.* 2003\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 12–14 branched rays; anal fin 3 unbranched, 16–21 branched rays; pectoral fins 1 unbranched, 11–15 branched rays. Tip of adpressed pelvic fin rarely reaching vertical through dorsal-fin origin; anal-fin origin beneath rear part of dorsal fin. Rear edge of preopercle rounded. Branchiostegal rays 11–14; pseudobranchial filaments 14–24; lower GR 19–25 (usually 20 or 21). LSS 34–38; predorsal scales 16–20; pre-pelvic scutes 4–7.

Body pale cream-coloured, with numerous black spots on underside of snout, under eyes, and on lower jaw near tip and roof of mouth; fins translucent. Attains at least 10 cm SL.



*Stolephorus waitei*, 8 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: southern India (Cochin); elsewhere to Myanmar, Thailand, Java Sea, Philippines and Australia.

**REMARKS** Common; caught mainly with seines and light traps. Marketed fresh, salted, as fishmeal or used as bait.

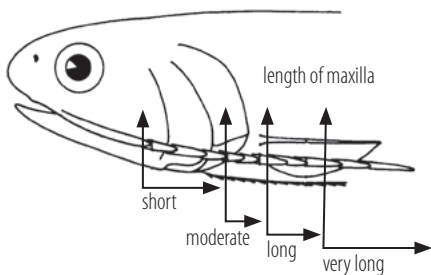


GENUS *Thryssa* Cuvier 1829

Small-sized anchovies (to ~14 cm SL) with laterally compressed body (greatly so in some species). Maxilla short to exceedingly long, reaching from middle of preopercle to well beyond adpressed pectoral-fin tip. Pelvic fins 1 unbranched, 6 branched rays; anal fin long-based, usually with 25–45 branched rays. Pre-pelvic and post-pelvic scutes present, total scutes 21–32; LSS usually 34–46; lower GR 10–61 (usually 11–32), with characteristic serrae on leading edge. Coastal, schooling. Twenty-four species, 11 in WIO.

KEY TO SPECIES

- 1a Maxilla short or moderate, reaching at most to edge of gill cover ..... 2
- 1b Maxilla longer, reaching to pectoral-fin origin or beyond adpressed fin tip ..... 7



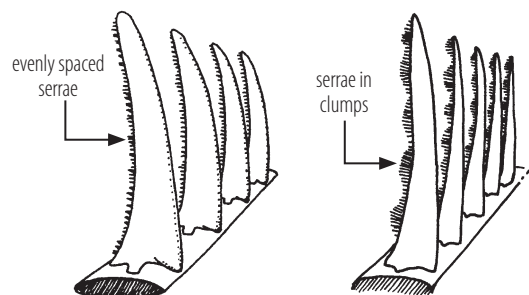
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- 2a Pre-pelvic scutes 14–20; anal fin 32–44 branched rays (usually 34–41); pseudobranchial filaments hidden, but tips sometimes exposed ..... 3
- 2b Pre-pelvic scutes 4–9; anal fin 24–32 branched rays (usually 26–29); pseudobranchial filaments 16–29, and filaments exposed ..... *T. baelama*
- 3a Lower GR 17–27 ..... 4
- 3b Lower GR 11–15 ..... *T. hamiltonii*
- 4a Lower GR 17–21 ..... 5
- 4b Lower GR 25–27 ..... *T. polybranchialis*
- 5a First supramaxilla small, oval ..... 6
- 5b First supramaxilla absent ..... *T. whiteheadi*

Continued ...

KEY TO SPECIES

- 6a Anal fin 38–44 branched rays (usually 41–43); body depth 25–28% SL; faint dark line along back ..... *T. purava*
- 6b Anal fin 34–38 branched rays (usually 35–37); body depth 34–37% SL; no dark line on back ..... *T. malabarica*
- 7a Maxilla long, extending to pectoral-fin origin or nearly to adpressed fin tip; lower GR 14–24 ..... 8
- 7b Maxilla extremely long, extending beyond pelvic-fin base to as far as anal-fin base; lower GR 10–12 ..... *T. setirostris*
- 8a Anal fin 29–40 branched rays (usually 30–38); tip of 1st pectoral-fin ray not elongate; no dark lines on back; tip of snout level with middle of eyes ..... 9
- 8b Anal fin 41–46 branched rays (usually 42–44); tip of 1st pectoral-fin ray elongated into short filament; pair of dark lines on back; tip of snout above upper rim of eyes ..... *T. daji*
- 9a First supramaxilla small, oval; no dark saddle on nape; dorsal-fin origin at midbody ..... 10
- 9b First supramaxilla absent; blotch behind each gill cover, joining to form saddle across nape; dorsal-fin origin slightly before midbody ..... *T. dussumieri*
- 10a Lower GR 13–17 (usually 14–16); serrae on leading edge of gill arches evenly spaced; anal-fin origin at vertical behind base of last dorsal-fin ray; dorsal-fin tip black ..... *T. mystax*
- 10b Lower GR 18–24 (usually 20–23); serrae on leading edge of gill arches in distinct clumps; anal-fin origin at vertical before base of last dorsal-fin ray; dorsal-fin tip unpigmented ..... *T. vitrostris*



10a

10b

Lower gill rakers. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

*Thryssa baelama* (Fabricius 1775)

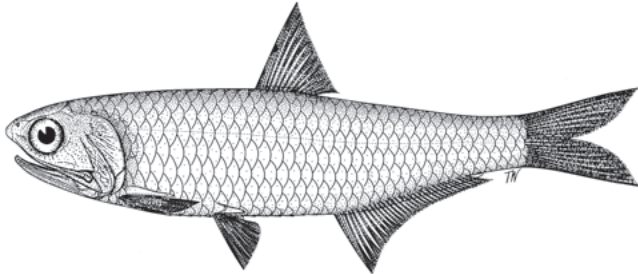
Baelama anchovy

PLATE 25

*Clupea baelama* Fabricius in Niebuhr (ex Forsskål) 1775: 72, xiii [Red Sea].*Engraulis nesogallicus* Bennett 1832: 168 (Mauritius, Mascarenes).*Engraulis polynemoides* Günther 1868: 394 (Madagascar).*Thryssa baelama*: Whitehead *et al.* 1988\*; Kottelat *et al.* 1993\*;Randall 1995\*, 2005\*; Fricke 1999; Wongratana *et al.* 1999\*;Kimura *et al.* 2003\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 12 branched rays; anal fin 3 or 4 unbranched, 24–32 (usually 26–29) branched rays; pectoral fins 1 unbranched, 11–14 branched rays. Dorsal-fin origin slightly before midbody; anal-fin origin at vertical distinctly beyond base of last dorsal-fin ray; pectoral-fin tip not reaching pelvic-fin base; tip of adpressed pelvic fin reaching well past vertical at dorsal-fin origin in adults. Maxilla short, reaching just beyond front edge of preopercle; 1st supramaxilla relatively long. Branchiostegal rays 12–15; pseudobranchial filaments 16–29, and filaments exposed. Scutes 4–9 + 7–10 = 12–18; pre-pelvic scutes 4–9, originating near pectoral-fin bases; LSS 34–39; predorsal scales 13–17.

Body dark brown to olive dorsally, top of head golden, and flanks silvery. Attains 15 cm SL.

*Thryssa baelama*, 11 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to East Africa, Madagascar, Seychelles and Mauritius; elsewhere to Indonesia, southern Japan, Mariana Is., Caroline Is., Australia, New Caledonia, Fiji, Tonga and Samoa.

**REMARKS** Often found in bays and mangroves. Used as bait in the Pacific.

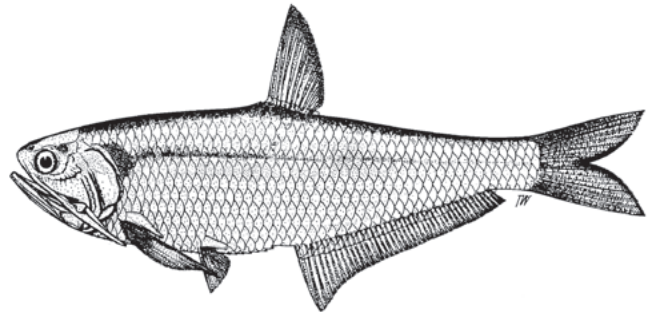
*Thryssa dayi* Wongratana 1983

Day's anchovy

*Thryssa (Scutengraulis) dayi* Wongratana 1983: 404, Fig. 24 (Mumbai, India); Whitehead *et al.* 1988\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 10 or 11 branched rays; anal fin 3 unbranched, 41–46 (usually 42–44) branched rays; pectoral fins 1 unbranched, 11–13 branched rays. Dorsal-fin origin slightly before midbody; anal-fin origin at vertical before base of last dorsal-fin ray; 1st ray of pectoral fin elongated into filament (its length subequal to eye diameter) and reaching beyond pelvic-fin base; tip of adpressed pelvic fin at vertical ~1 eye diameter before dorsal-fin origin. Tip of snout approximately level with upper rim of eyes. Maxilla long, reaching pectoral-fin base; 1st supramaxilla minute, oval. Branchiostegal rays 12–14; pseudobranchial filaments hidden under skin. Scutes 15 or 16 + 10 or 11 = 25–27; LSS 44–47; predorsal scales 20–22.

Body dark blue dorsally, with pair of dark lines on back; gill arches pinkish orange, and inside of gill cover yellow or golden. Attains 22 cm SL.

*Thryssa dayi*, 13 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** WIO: Arabian Sea (Pakistan and India).

*Thryssa dussumieri* (Valenciennes 1848)

Dussumier's anchovy

PLATE 25

*Engraulis dussumieri* Valenciennes in Cuv. & Val. 1848: 69 [no locality given: probably India].

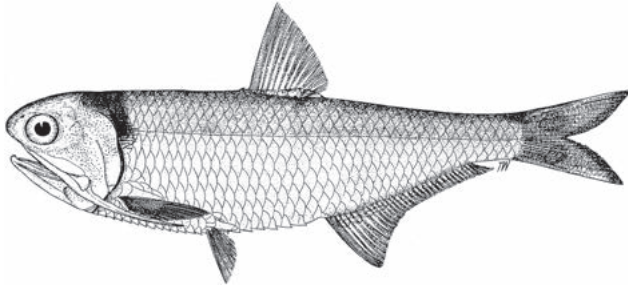
*Engraulis auratus* Day 1865: 312 (Kochi, India).

*Thryssa dussumieri*: Whitehead 1967 [spelled *Thrysa*]; Wongratana 1980\*; Whitehead *et al.* 1988\*; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 9–12 branched rays; anal fin 3 unbranched, 29–37 branched rays; pectoral fins 1 unbranched, 8–12 branched rays; pelvic fins 1 unbranched, 6 branched rays. Dorsal-fin origin slightly before midbody; anal-fin origin below or just beyond vertical through base of last dorsal-fin ray; pectoral fin reaching front half of pelvic fin; tip of adpressed pelvic fin reaching past vertical at dorsal-fin origin. Maxilla very long, reaching well beyond middle of pectoral fin

to as far as pelvic-fin base; 1st supramaxilla absent; lower jaw slender. Branchiostegal rays 11–14; pseudobranch hidden under skin (sometimes a few filament tips exposed); gill-arch serrae on inner edge in distinct clumps. Scutes 14–16 + 6–9 = 21–24; LSS 35–40; predorsal scales 14–18.

Body pale brown dorsally (no bands on back), silvery below; dark blotch behind upper edge of gill opening usually joining to form saddle across nape; fins may have yellow tinge. Attains 11 cm SL.



*Thyssa dussumieri*, 9 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan and India; elsewhere to Myanmar, Malaysia, Indonesia, Vietnam and Taiwan; not known from Gulf of Oman or Persian/Arabian Gulf, and no records from northern Australia.

**REMARKS** Fairly common.

### *Thyssa hamiltonii* (Gray 1835)

Hamilton's anchovy

PLATE 25

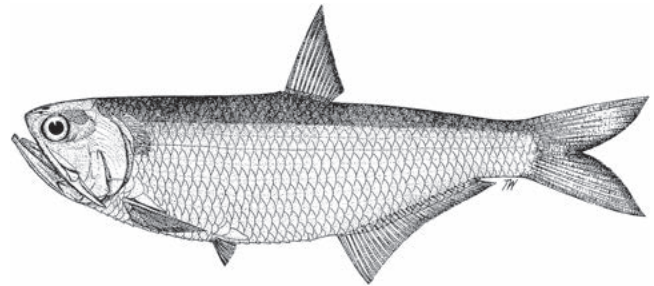
*Thyssa hamiltonii* Gray 1835: no page number, Pl. 92 (India) [based on Hardwicke drawing].

*Thyssa hamiltonii*: Wongratana 1980\*; Whitehead *et al.* 1988\*; Wongratana *et al.* 1999\*.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin 3 or 4 unbranched, 32–39 branched rays; pectoral fins 1 unbranched, 10–12 branched rays. Dorsal-fin origin at about midbody; anal-fin origin near vertical through base of last dorsal-fin ray; pectoral-fin tip just reaching pelvic-fin base; tip of adpressed pelvic fin not reaching vertical at dorsal-fin origin. Maxilla moderate, reaching just beyond rear edge of interopercle but not to pectoral-fin base; 1st supramaxilla minute, oval, but sometimes absent. Branchiostegal rays 12–14; pseudobranch hidden under skin, but filament tips sometimes exposed; lower GR 11–15. Scutes 15–20 + 9–12 = 26–31; LSS 41–46; predorsal scales 20–23.

Body olive-grey dorsally, with pigment lines on back, and silvery white below; head with faint golden tints, especially

on maxilla and opercle; darkish blotch of wavy lines behind upper edge of gill cover; dorsal, caudal, pectoral and pelvic fins yellowish; anal fin hyaline white. Attains 27 cm SL.



*Thyssa hamiltonii*, 14 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf to India; elsewhere to Myanmar, Andaman Sea, Indonesia, Philippines, Taiwan, southern Japan, New Guinea and northern Australia.

**REMARKS** Presumably enters estuaries. Commercially important locally.

### *Thyssa malabarica* (Bloch 1795)

Malabar anchovy

PLATE 25

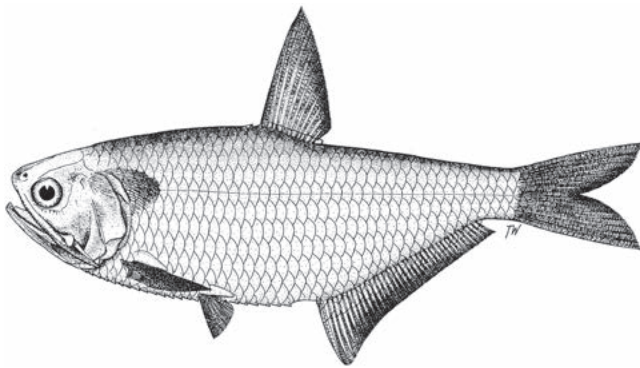
*Clupea malabaricus* Bloch 1795: 115, Pl. 432 (Tharangambadi, India).

*Clupea (Thyssa) cuvieri* Swainson 1839: 293 (Visakhapatnam, India) [based on Pl. 194 of Russell 1803].

*Thyssa malabarica*: Wongratana 1980\*; Whitehead *et al.* 1988\*.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin 3 unbranched, 34–38 (usually 35–37) branched rays; pectoral fins 1 unbranched, 11–13 branched rays. Deep-bodied (body depth 34–37% SL). Dorsal-fin origin slightly before midbody; anal-fin origin below or  $\sim\frac{1}{2}$  eye diameter behind vertical through base of last dorsal-fin ray; pectoral fin reaching front half of pelvic fin; tip of adpressed pelvic fin barely reaching vertical through dorsal-fin origin. Tip of snout above upper rim of eyes. Maxilla moderate, reaching to or just beyond rear edge of interopercle; 1st supramaxilla minute, oval. Branchiostegal rays 11–13; pseudobranch hidden under skin, but filament tips sometimes exposed. Scutes 14–17 + 8–10 = 23–26; LSS 37–43; predorsal scales 16–18.

Body brownish dorsally (no faint dark lines), silvery white below; dark stippling on maxilla, cheek, gill cover and paired fins; inside of gill cover golden yellow, and gill arches pinkish orange; anal fin yellow proximally, white distally. Attains 18 cm SL.



*Thyssa malabarica*, 12 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean. WIO: Pakistan, India and Sri Lanka; elsewhere to east coast of India in Bay of Bengal.

### *Thyssa mystax* (Bloch & Schneider 1801)

Moustached anchovy

PLATE 25

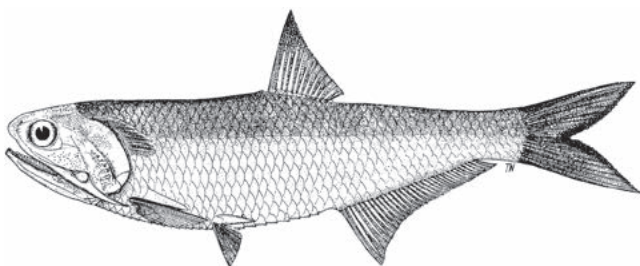
*Clupea mystax* Bloch & Schneider 1801: 426, Pl. 83 (Malabar, India).

*Engraulis hornelli* Fowler 1924: 41 (Kozhikode, India).

*Thyssa mystax*: Wongratana 1980\*; Whitehead *et al.* 1988\*; Wongratana *et al.* 1999\*.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin 3 unbranched, 29–37 branched rays; pectoral fins 1 unbranched, 10–12 branched rays. Dorsal-fin origin at about midbody; anal-fin origin at vertical near base of last dorsal-fin ray; pectoral fin nearly reaching pelvic fin; tip of adpressed pelvic fin reaching vertical at dorsal-fin origin. Maxilla long, nearly reaching pectoral-fin base; 1st supramaxilla minute, oval. Branchiostegal rays 13–16; pseudobranch hidden under skin; lower GR 13–17, serrae on leading edge of gill arches evenly spaced. Scutes 16–20 + 8–13 = 24–32; LSS 40–48; predorsal scales 15–23.

Body brown or bluish dorsally, flanks silvery; dark blotch of wavy lines behind upper edge of gill cover; gill cavity pale orange; dorsal-fin tip and caudal-fin margin black. Attains 16 cm SL.



*Thyssa mystax*, 14 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan and India; not known from Red Sea and Persian/Arabian Gulf; elsewhere to Myanmar, Gulf of Thailand, Vietnam, Indonesia and Philippines.

**REMARKS** Identification of this species is often confused. Abundant in parts of its range and commercially harvested.

### *Thyssa polybranchialis* Wongratana 1983

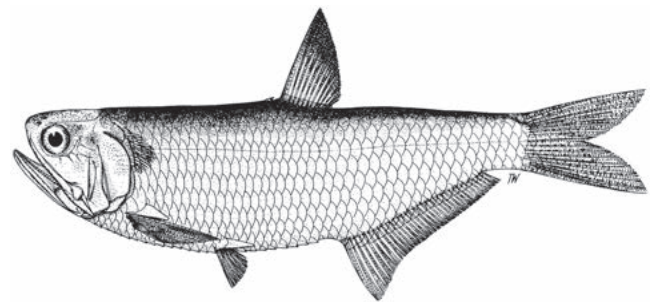
Humphead anchovy

PLATE 25

*Thyssa (Scutengraulis) polybranchialis* Wongratana 1983: 402, Fig. 21 (Mumbai, India); Whitehead *et al.* 1988\*.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin 3 or 4 unbranched, 35–39 branched rays; pectoral fins 1 unbranched, 11 or 12 branched rays. Distinct small hump at nape. Dorsal-fin origin at vertical slightly in front of midbody; anal-fin origin near vertical through last dorsal-fin ray; pectoral fin reaching to or just beyond pelvic fin; tip of adpressed pelvic fin not reaching vertical at dorsal-fin origin. Maxilla short, barely reaching rear edge of interopercle; 1st supramaxilla minute, oval, sometimes absent. Branchiostegal rays 12 or 13; pseudobranch hidden under skin; lower GR 25–27. Scutes 15–17 + 9 or 10 = 25–27; LSS 41–44; predorsal scales 18–20.

Body pale silvery blue, darker dorsally; dark blotch of wavy lines behind gill cover. Attains 17 cm SL.



*Thyssa polybranchialis*, 12 cm SL, adult paratype. Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean: India (west and east coasts) and possibly Sri Lanka.

**REMARKS** Often confused with other species in the past.



## *Thryssa purava* (Hamilton 1822)

Oblique-jaw anchovy

*Clupea purava* Hamilton 1822: 238, 382 (Ganges River estuaries, India).

*Clupea* (*Thryssa*) *megastoma* Swainson 1839: 293 (Visakhapatnam, India) [based on Pl. 190 of Russell 1803].

*Engraulis annandalei* Chaudhuri 1916: 419, Fig. 3 (off Nalabana I., Chilika Lake, Odisha, India).

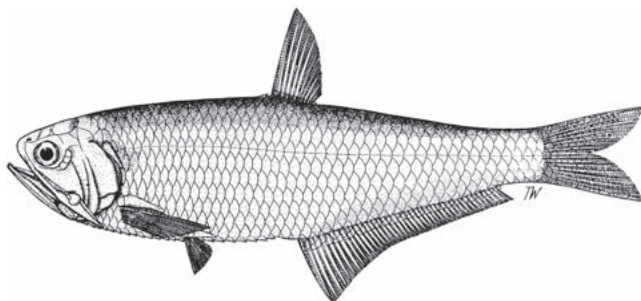
*Engraulis kempfi* Chaudhuri 1916: 421, Fig. 4 (off Barkul, Lower Chilika Lake, Odisha, India).

*Engraulis rambhae* Chaudhuri 1916: 423, Fig. 5 (Rambha Bay, Chilika Lake, Odisha, India).

*Thryssa purava*: Wongratana 1980\*; Whitehead *et al.* 1988\*; Talwar & Jhingran 1991; Manilo & Bogorodsky 2003.

Dorsal fin 3 unbranched, 9–11 branched rays; anal fin 3 or 4 unbranched, 38–44 (usually 41–43) branched rays; pectoral fins 1 unbranched, 10–13 branched rays. Body depth 25–28% SL. Dorsal-fin origin at vertical in front of midbody; anal-fin origin at vertical before or at base of last dorsal-fin ray; pectoral fin reaching to or slightly beyond pelvic-fin base; tip of adpressed pelvic fin well in front of vertical at dorsal-fin origin. Tip of snout slightly above horizontal through middle of eyes. Mouth oblique; maxilla moderate, reaching beyond gill cover but not to pectoral-fin base; 1st supramaxilla minute, oval. Branchiostegal rays 12–14; pseudobranch hidden under skin. Scutes 15–17 + 9–12 = 25–28; LSS 42–46; predorsal scales 19–23.

Body brown dorsally, with faint dark line along back, and flanks silvery; indistinct dark blotch behind upper end of gill cover. Attains 16 cm SL.



*Thryssa purava*, 9 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean. WIO: southwestern India and Sri Lanka; elsewhere to east coast of India, Bangladesh and possibly Myanmar.

**REMARKS** Apparently common; enters estuaries and brackish lagoons, such as Chilika Lake, India.

## *Thryssa setirostris* (Broussonet 1782)

Long-jaw anchovy

PLATE 25

*Clupea setirostris* Broussonet (ex Forster) 1782: [47], Pl. [11]

(near Tanna I., Vanuatu).

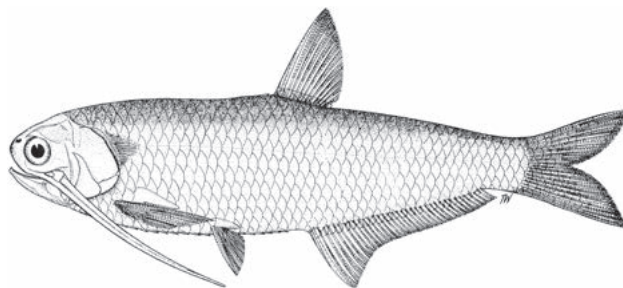
*Thryssa setirostris*: Barnard 1925; Whitehead & Wongratana 1986\*;

Whitehead *et al.* 1988\*; Kottelat *et al.* 1993\*; Randall 1995\*; Wongratana *et al.* 1999\*; Manilo & Bogorodsky 2003.

*Thrissocles setirostris*: SFSA No. 122\*.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin 3 or 4 unbranched, 29–36 branched rays; pectoral fins 1 unbranched, 11–13 branched rays. Dorsal-fin origin at vertical at about midbody; anal-fin origin at vertical near base of last dorsal-fin ray; pectoral fin reaching pelvic-fin origin; tip of adpressed pelvic fin reaching vertical behind dorsal-fin origin. Maxilla extremely long, reaching pelvic-fin base in small fish, and as far as anal-fin base in large adults; 1st supramaxilla small, ~¼ size of 2nd supramaxilla. Branchiostegal rays 10–12; pseudobranch hidden under skin; lower GR 10–12. Scutes 16–18 + 9 or 10 = 25–28; LSS 41–46; predorsal scales 19–22.

Body bluish grey dorsally (no lines), flanks silvery, and head with golden tints; small black blotch of wavy lines behind gill cover; fins yellow to deep yellow, except pelvic fins usually white. Attains 18 cm SL.



*Thryssa setirostris*, 13 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman to South Africa (Eastern Cape), across northern Indian Ocean rim to Pakistan and India, but not known from Red Sea and Madagascar; elsewhere to east coast of India, Thailand, Indonesia, Philippines, Taiwan, northern Australia, New Guinea, Solomon Is. and Vanuatu.

**REMARKS** Typically close inshore and enters bays and estuaries. Feeds mainly on planktonic crustaceans. Marketed fresh, salted or as fish meal; used as bait in tuna fisheries in South Pacific.

*Thryssa vitirostris* (Gilchrist & Thompson 1908)

Orange-mouth anchovy

PLATE 26

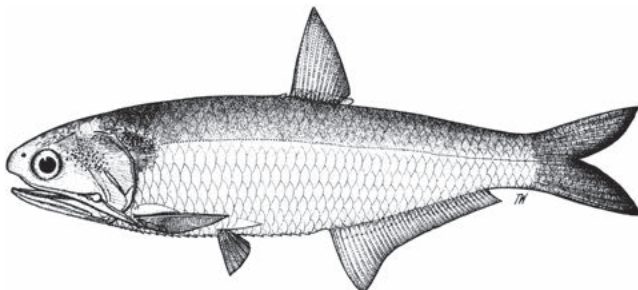
*Engraulis vitirostris* Gilchrist & Thompson 1908: 201 (Durban, KwaZulu-Natal, South Africa).

*Thryssa vitirostris*: Barnard 1925\*; Blaber 1979; Wongratana 1980\*; SSF No. 55.6\*; Van der Elst 1988\*; Whitehead *et al.* 1988\*; Randall 1995\*; Whitfield 1998\*; Manilo & Bogorodsky 2003.

*Thrissocles malabaricus* (non Bloch 1795): SFSA No. 121\*.

Dorsal fin 3 unbranched, 10–12 branched rays; anal fin 3 or 4 unbranched, 31–40 branched rays; pectoral fins 1 unbranched, 11 or 12 branched rays. Dorsal-fin origin at about midbody; anal-fin origin at vertical before or through base of last dorsal-fin ray; pectoral fin reaching at least to pelvic-fin base; tip of adpressed pelvic fin not reaching vertical at dorsal-fin origin. Maxilla long, reaching pectoral-fin base (or nearly so in small fish); 1st supramaxilla minute, oval. Branchiostegal rays 12–15; pseudobranch hidden under skin; lower GR 18–24, and serrae on inner edge in distinct clumps (especially in large adults). Scutes 16–19 + 8–12 = 24–30; LSS 40–44; predorsal scales 18–21.

Body pale blue-brown dorsally, flanks silvery; small dark blotch behind gill cover; gill cavity bright orange; fins may have yellow tinge. Attains 20 cm SL.



*Thryssa vitirostris*, 14 cm SL (South Africa). Source: Wongratana 1980

**DISTRIBUTION** Indian Ocean. WIO: Persian/Arabian Gulf to South Africa (Eastern Cape), Madagascar and southwestern India; not known from Red Sea or off Pakistan; elsewhere, east coast of India and possibly Myanmar.

**REMARKS** Enters estuaries and lagoons, likely as nursery areas.

*Thryssa whiteheadi* Wongratana 1983

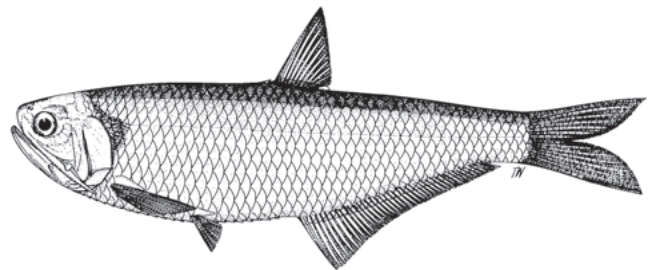
Whitehead's anchovy

PLATE 26

*Thryssa (Scutengraulis) whiteheadi* Wongratana 1983: 403, Fig. 22 (Basra, Iraq, Persian/Arabian Gulf); Whitehead *et al.* 1988\*; Randall 1995\*.

Dorsal fin 3 unbranched, 9–11 branched rays; anal fin 3 unbranched, 39–43 branched rays; pectoral fins 1 unbranched, 11–13 branched rays. Dorsal-fin origin at vertical slightly in front of midbody; anal-fin origin at vertical before or through base of last dorsal-fin ray; pectoral fin reaching to or slightly beyond pelvic-fin origin; tip of adpressed pelvic fin distinctly before vertical at dorsal-fin origin. Teeth on jaws relatively enlarged. Maxilla moderate, reaching just beyond interopercle; 1st supramaxilla absent. Branchiostegal rays 11 or 12; pseudobranchial filaments hidden under skin; lower GR 17–21. Scutes 15–17 + 10–12 = 25–27 (rarely 28); LSS 40–45; predorsal scales 18–21.

Body bluish grey dorsally, flanks silvery; often with indistinct dark blotch behind upper end of gill opening; fins hyaline white. Attains 21 cm SL.



*Thryssa whiteheadi*, 11 cm SL, adult. Source: Wongratana 1980

**DISTRIBUTION** WIO: Persian/Arabian Gulf and possibly Gulf of Oman.

**GLOSSARY**

**ceratohyal** – bone, or cartilage, in ventral part of hyoid arch.

**isthmus muscle** – the muscle that lies between the two gill chambers.

**post-pelvic scutes** – keeled scales along the midline of the 'belly', from pelvic fin to anal fin.

**pre-pelvic scutes** – keeled scales along the midline of the 'chest', in front of the pelvic fins.

**supramaxilla** – a small bone along the upper rear edge of the maxilla.

**urohyal** – bone at anterior floor of mouth, between the two sides of the hyoid arch.

## FAMILY CHIROCENTRIDAE

### Wolf-herrings

Phillip C Heemstra

Moderate-sized with elongate, highly compressed body; body depth subequal to HL, ~7 times in SL. Dorsal fin and anal fin well behind midbody, and anal-fin base about twice length of dorsal-fin base; pectoral fins set low; pelvic fins rudimentary, with 6 or 7 rays, set about midway between anal fin and pectoral fins; caudal fin deeply forked. Mouth large, oblique; lower jaw projecting in front of upper jaw, its articulation below front half of eyes; upper jaw with 2 forward-pointing canine teeth at symphysis, followed by ~30 teeth on each side; lower jaw with several large, compressed, dagger-like teeth, larger anteriorly; vomer with row of 4 or 5 minute teeth; small tooth patch on palatines. Nostrils contiguous, midway between snout tip and eyes. Eyes covered by transparent adipose tissue. Gill rakers short; branchiostegal rays 8, membranes separate, attached to front of isthmus. Scales small, cycloid, deciduous; no scutes along belly. No fin spines. No lateral line on body. Precaudal vertebrae 42–45; caudal vertebrae 27–31.

Resemble the plankton-feeding herrings and sardines of family Clupeidae, but instead are voracious predators of small schooling fishes, especially other clupeiforms, and also prawns and crabs. Occur in inshore waters and estuaries of tropical and subtropical areas of Indo-Pacific. One genus with 2 species, both in WIO.

## GENUS *Chirocentrus* Cuvier 1816

Two difficult-to-distinguish species, historically confused under the name *Chirocentrus dorab*.

### KEY TO SPECIES

- 1a Pectoral-fin length shorter, 11–13% SL and subequal to distance from centre of pupil to rear edge of opercle; dorsal fin and front part of anal fin blackish distally ..... *C. dorab*
- 1b Pectoral-fin length longer, 13–18% SL and distinctly greater than distance from centre of pupil to rear edge of opercle; dorsal fin and anal fin entirely pale ..... *C. nudus*

### *Chirocentrus dorab* (Fabricius 1775)

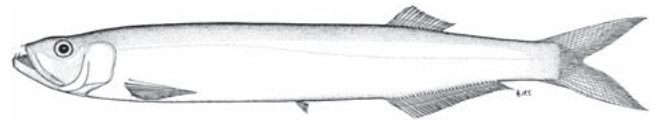
#### Black-edged wolf-herring

PLATE 26

*Clupea dorab* Fabricius in Niebuhr (ex Forsskål) 1775: 72, xiii (Jeddah, Saudi Arabia, Red Sea; Al-Mukha, Yemen, Red Sea).  
*Chirocentrus dorab*: Whitehead 1985\*; SSF No. 56.1\*; Randall 1995\*; Munroe *et al.* 1999\*.

Diagnosis as for family. Dorsal fin 16–19 rays; anal fin 29–36 rays; pectoral fins 14–16 rays; pelvic fins 7 rays; GR 1–4/10–16.

Head and body silvery, dark blue-green dorsally; dorsal fin and front part of anal fin blackish distally. Attains 100 cm SL (commonly ~60 cm SL).



*Chirocentrus dorab*, 33 cm TL (WIO). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Oman, Red Sea to South Africa (KwaZulu-Natal), Madagascar, Seychelles, Mascarenes, India and Sri Lanka; elsewhere to Indonesia, Philippines, China, southern Japan, Australia, Solomon Is., New Caledonia and Tonga.

**REMARKS** Occurs in warm continental waters, to ~120 m deep.

### *Chirocentrus nudus* Swainson 1839

#### Pale-fin wolf-herring

PLATE 26

*Chirocentrus russellii* Swainson 1838: 289 (Visakhapatnam, India) [based on 'Wallah' of Russell 1803; *nomen oblitum*].

*Chirocentrus nudus* Swainson 1839: 294 [Visakhapatnam, India] [based on Pl. 199 of Russell 1803]; Whitehead 1985\*; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003.

Diagnosis as for family. Dorsal fin 16–18 rays; anal fin 31–33 rays; pectoral fins 14 or 15 rays; pelvic fin 6 rays; GR 1–5/14–17.

Head and body silvery, dark blue dorsally; fins entirely pale. Attains ~120 cm SL.



*Chirocentrus nudus*, 32 cm SL (Mozambique). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, Kenya, Red Sea, Persian/Arabian Gulf, Pakistan and India; elsewhere to Thailand, Indonesia, Gulf of Carpentaria (Australia) and New Guinea.

# ORDER GONORYNCHIFORMES

Phillip C Heemstra

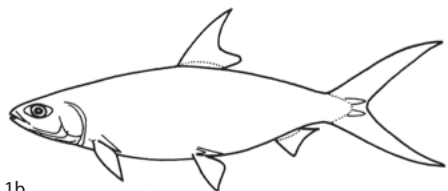
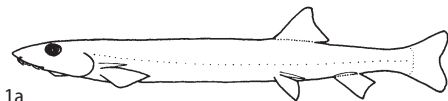
Believed to be closely related to the dominant freshwater group of fishes known as the Ostariophysi (Fink & Fink 1981). The ostariophysans comprise the Cypriniformes (minnows, carps and relatives), Characiformes (characins) and Siluriformes (catfishes), which together represent about three-quarters of the world's freshwater fishes.

Fishes with a slender, elongate body; mouth small and inferior; jaws toothless; epibranchial organ present; dorsal fin on rear half of body; pectoral-fin bases horizontal; pelvic fins abdominal; pectoral and pelvic fins with well-developed axillary process; no fin spines; eyes covered with skin; neural arch of 1st vertebra enlarged to form extensive joint with cranium.

Four families, of which 2 families occur only in freshwaters of tropical Africa, and 2 families are represented in WIO.

## KEY TO FAMILIES

- 1a Mouth inferior, on underside of snout; dorsal, anal and pelvic fins all on rear half of body ..... **GONORYNCHIDAE**  
1b Mouth terminal, at front of snout; dorsal fin and pelvic fins at midbody ..... **CHANIDAE**



## GLOSSARY

**epibranchial organ** – a paired dorsal diverticulum at the back of the pharynx in some osteoglossiform, cypriniform, gonorynchiform and clupeiform fishes.

## FAMILY GONORYNCHIDAE

### Beaked sandfishes

Phillip C Heemstra

Body extremely elongate and cylindrical, its depth 10–14% SL; head conical, snout bluntly pointed. Dorsal fin and anal fin set well behind midbody; caudal fin shallowly forked; pectoral fins on lower half of body; pelvic fins on underside of body below dorsal fin; paired fins with fleshy axillary process at fin origins; no fin spines. Mouth inferior, upper jaw protrusile; no teeth on jaws, but the endopterygoids and 2 basibranchials (inside the mouth) bear small conical teeth; a clover-shaped fleshy barbel on roof of mouth, and a fleshy barbel on underside of snout near tip; nostrils midlateral, close together and near snout tip. Body and head covered with small, strongly adherent, ctenoid scales; lateral-line tubes emerge between scales (no pored scales). Branchiostegal rays 4 or 5, membranes broadly joined to isthmus, gill openings restricted. Frontal bones of cranium fused to form single bony roof for the skull. No swimbladder.

Demersal on outer continental shelf and upper slope. A single genus, *Gonorynchus* Scopoli 1777, is recognised. The number of valid species has been long debated; in a revision of the genus, Grande (1999) recognised 5 species, with 1 in WIO.

### *Gonorynchus gonorynchus* (Linnaeus 1766)

Beaked sandfish

PLATE 26

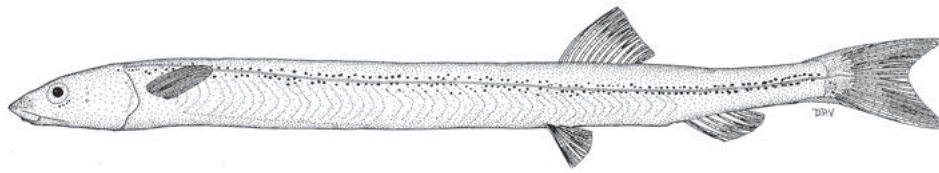
*Cyprinus gonorynchus* Linnaeus (ex Gronow) 1766: 528 (Cape of Good Hope, South Africa).

*Gonorynchus gonorynchus*: SFSa No. 102\*; SSF No. 57.1\*; Fricke 1999; Grande 1999\*; Fricke *et al.* 2009.

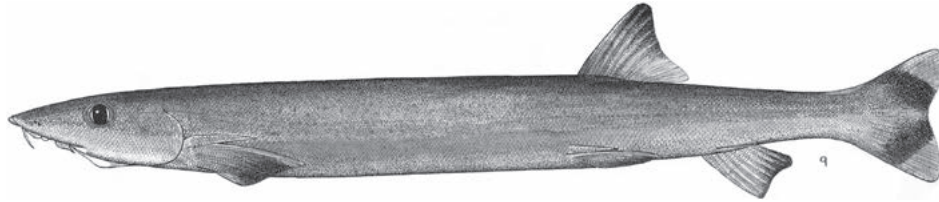
Diagnosis as for family. Dorsal fin 11–13 rays; anal fin 8–10 rays; pectoral fins 11 rays; pelvic fins 9 rays. LL scales 200–220; GR 10/13. Lower lip with elongate forked papillae. Vertebrae 62 or 63.

Head and body greyish brown dorsally, and ventral half of body and caudal-fin tips pink; inside of mouth and gills purplish. Attains 60 cm TL.





*Gonorynchus gonorynchus*, 8 cm SL, juvenile (South Africa). Source: SSF



*Gonorynchus gonorynchus*, 38 cm TL (South Africa). Source: SFSA

**DISTRIBUTION** Namibia and St Helena I. in southeastern Atlantic, to South Africa, Mozambique (Beira) and Madagascar in WIO; now extinct in Réunion.

**REMARKS** Feeds on invertebrates at night; burrows into sand or mud bottom during the day. Known to at least 330 m deep in WIO.

**GLOSSARY**

**basibranchial** – median ventral cartilage or bony element in a branchial arch, behind the tongue.  
**endopterygoids** – paired dermal bones in the roof of the mouth.

**FAMILY CHANIDAE**

**Milkfish**

Phillip C Heemstra

Body fusiform, slightly compressed, its depth subequal to HL, ~4 times in SL. Caudal fin large and deeply forked; dorsal fin tall, at midbody; anal fin small, far behind dorsal fin; pectoral fins on lower third of body; pelvic fins abdominal; paired fins falcate, with pointed skin flap at base; no fin spines. Mouth terminal, small; maxilla not reaching vertical at centre of eye; oesophagus with spiral folds and pharyngeal sacs behind 4th gill arches. No teeth in jaws. Eyes large, diameter greater than interorbital width and snout length. Gill rakers exceedingly fine and numerous (>200 on first arch); gill membranes united, forming free fold across isthmus; branchiostegal rays 4. Body covered with cycloid scales, but head naked; no scutes along belly. Lateral line inconspicuous. Swimbladder not connected to head.

Monotypic.

**GENUS *Chanos*** Lacepède 1803

Diagnosis as for family.

***Chanos chanos*** (Fabricius 1775)

Milkfish

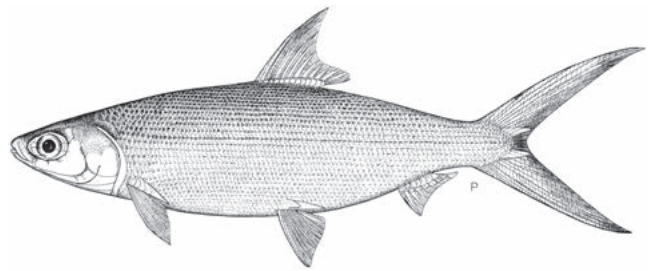
PLATE 27

*Mugil chanos* Fabricius in Niebuhr (ex Forsskål) 1775: 74, xiv (Jeddah, Saudi Arabia, Red Sea).

*Chanos chanos*: SFSA No. 105\*; SSF No. 58.1\*; Bagarinao 1994\*; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*.

Dorsal fin 13–17 rays; anal fin 9–11 rays; pectoral fins 15–17 rays; pelvic fins 10–12 rays. LL scales 75–91; scaly sheath at bases of dorsal fin and anal fin, and large axillary scales above pectoral fins and pelvic fins.

Body brilliant silvery, olive-green dorsally and white ventrally; fins darkened or with dark borders. Attains 180 cm SL (commonly ~100 cm SL).



*Chanos chanos*, 40 cm TL (WIO). Source: SFSA

**DISTRIBUTION** Tropical and warm-temperate waters of Indo-Pacific to eastern Pacific, and adjacent river systems. WIO: Qatar, Oman, Red Sea to South Africa (Swartvlei estuary), Madagascar, Seychelles, Mauritius, Chagos, Maldives,

India and Sri Lanka; elsewhere to Thailand, Indonesia, Philippines, Taiwan, southern Japan, Australia, Norfolk I., Marquesas Is., Hawaii and Panama; Lessepsian migrant to Mediterranean Sea.

**REMARKS** Occurs on continental shelf, around islands and reefs, and on soft bottoms; frequently enters estuaries and occasionally freshwater streams. Spawns in the sea, in clear waters at night, above sand or coral; females can produce up to 5 million eggs, which hatch in ~24 hours. Eggs and larvae pelagic up to ~2–3 weeks, and the ribbon-like larvae generally metamorphose in estuaries. Adults swimming in small to large

shoals in shallow water with their dorsal fin and upper caudal-fin lobe cutting the surface are often mistaken for sharks. Maximum age ~15 years. Larvae feed on plankton (copepods and diatoms); juveniles feed on detritus, filamentous algae, small crustaceans and worms; and adults feed on detritus, zooplankton, small crustaceans and small fishes. Commercially important in aquaculture in Southeast Asia, as they are able to thrive in water ~20–32 °C. The transforming larvae (fry ~10–17 mm TL) are easily collected with seines on beaches near river mouths and mangrove areas, and then transferred to ponds where they are reared to market size.

# ORDER SILURIFORMES

Patricia J Kailola

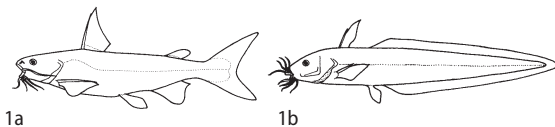
The Siluriformes comprises the families of catfishes; this order plus 3 others (the Cypriniformes, Characiformes and Gymnotiformes) comprise the superorder Otophysi. A main characteristic of ostariophysans is the Weberian apparatus, a structure connecting the inner ear to the swimbladder (Berra 2001) and involving modification of the anterior vertebrae. Siluriformes have 5 anterior vertebrae so modified, whereas species of the other orders have 4 modified vertebrae; the Siluriformes are also characterised by several other less-distinctive osteological features. Morphological features are: adipose fin usually present; front of dorsal fin and pectoral fins often with an unsegmented spine-like ray (referred to as a spine in descriptions); up to 4 pairs of barbels on head (one nasal, one maxillary, and two pairs on lower jaw), but often one or more pairs absent; maxilla usually toothless and small, supporting the maxillary barbel; eyes usually small; body either naked or covered with bony plates; caudal fin with 17 or 18 principal rays.

Some catfish species are venomous, but most are passive stingers, and some can generate electric charges. Although most are small to moderately sized, species in 2 families are among the smallest living vertebrates and mature at <10 mm TL, whereas 3 families have species that can reach lengths of >3 m. Most catfishes are omnivores (Lundberg & Friel 2003), but some have highly specialised diets. Members of 2 families (Clariidae and Heteropneustidae) possess air-breathing organs and can move over land. Most species of catfishes exhibit some form of parental care.

The classification of the catfishes is not settled (Nelson 1994; Berra 2001), although it is agreed that the Diplomystidae of South America is the most primitive family (Fink & Fink 1981). Thirty-four families, with ~436 genera and 2 855 species (Lundberg & Friel 2003), are presently recognised. The only 2 families with marine as well as freshwater forms are also those represented in WIO, while 13 other families of Old World catfishes inhabit only freshwaters of the region.

## KEY TO FAMILIES

- 1a Caudal fin forked; adipose fin present; no nasal barbels ..... **ARIIDAE**
- 1b Tail eel-like, bluntly rounded or pointed (caudal fin not separate); no adipose fin; nasal barbels present ..... **PLOTOSIDAE**



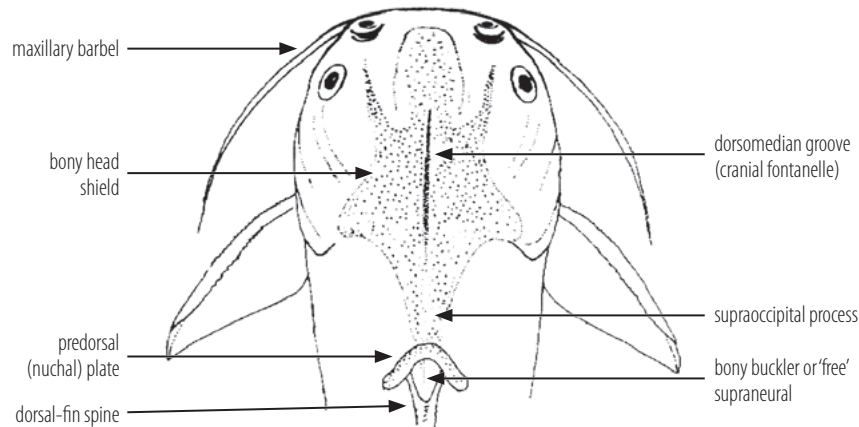
## FAMILY ARIIDAE

### Sea catfishes

Patricia J Kailola

Medium- to large-sized (~15–150 cm SL), body elongate, robust; head conical to rounded and depressed; mouth terminal to inferior, surrounded by 1–3 pairs of barbels: maxillary barbels (absent in *Batrachocephalus*), mandibular barbels (absent in *Osteogeneiosus*), and/or mental barbels (absent in *Batrachocephalus* and *Osteogeneiosus*). Dorsal surface of head smooth, rugose, striate or granular, its posterior portion (supraoccipital process) extending backward to meet predorsal (nuchal) plate in most taxa; bony head shield usually visible beneath thin skin, but sometimes concealed by thick skin and muscle tissue (*Galeichthys*); dorsomedian groove or cranial fontanelle extending from between nostrils to supraoccipital process. Teeth fine, wedge-shaped, conical and sharp, or granular; teeth on jaws in narrow or broad bands; when present, teeth on palate in large or small patches; teeth sometimes present on parasphenoid. Eyes usually free in orbit and not covered by skin. Nostrils paired and close-set on each side of snout; posterior nostrils more or less covered by skin flap. Dorsal fin situated before midlength of body, comprising a short broad bony buckler, 1 long and typically serrated spine, and 7 branched rays. Pectoral fins low-set, with 1 long, usually serrated spine and 9–13 branched rays. Pelvic fins with 6 branched rays. Adipose fin present above anal fin. Anal fin with 14–33 rays. Caudal fin deeply forked, with 15 principal rays, 13 branched. Branchiostegal rays 5–7; gill membranes joined together, either free from isthmus (attached only anteriorly) or attached to breast and restricting the gill openings; total GR 8–50+ on front edge of 1st arch, gill rakers always present along rear edge of 3rd and 4th arches and sometimes on rear edge of 1st and 2nd arches. Lateral line terminates at caudal-fin base by turning upwards or bifurcating over caudal-fin base. Body naked. Swimbladder robust and strong, usually ovate and sac-like, occasionally much depressed or with rear chamber in some species. Vertebrae (fused + precaudal + haemal + caudal) 5–8 + 5–20 + 2–9 + 19–37 = 43–67.

Inhabit marine, brackish and fresh waters of warm-temperate to tropical regions. Most species are confined to coastal and marine habitats, but some are found in freshwater rivers, streams and lakes; locally abundant in mangrove areas, large river estuaries and marine waters, to ~150 m deep. Nearly circumtropical, between ~35° N and 35° S, along continental



Dorsal view of head showing external features of a typical ariid catfish. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

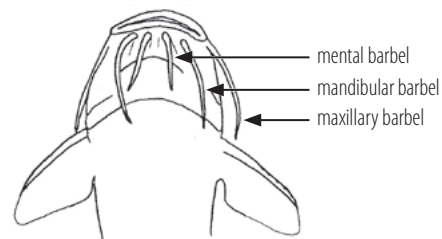
margins and often in coastal freshwaters on the western and eastern coasts of North, Central and South America; West, southern and East Africa, including Madagascar, the Red Sea and northwestern Indian Ocean; the Indian subcontinent (including Andaman Is.); and throughout Southeast Asia to southern Japan, New Guinea and northern Australia; absent from the Pacific Plate. A few marine species are widely distributed, whereas others (mainly freshwater species) have a limited distribution.

Ariids are renowned for their method of reproduction: the females produce large eggs (up to ~2 cm in diameter), which the male incubates in his buccal cavity after fertilisation until the young hatch and the yolksac is resorbed. Spawning appears to occur during mass aggregations, and brooding lasts for up to six weeks. Feed on a variety of items, including detritus and various invertebrates, plants and fishes. Most species are generally omnivorous (and frequently opportunistic scavengers), but some have specialised diets. Of considerable economic importance in many areas because of their usually relatively large size, local abundance, hardiness and flesh quality, but local populations can be easily decimated if brooding males are consistently harvested. Frequently considered a nuisance in gillnets because of their rigid, erectile spines that tangle and tear nets and can inflict painful wounds. Juveniles of some freshwater species make attractive aquarium fish.

Molecular analysis of the Ariidae by Betancur-R (2009) has prompted redefinition of some genera, realigned several species, and identified new genera and species. Pending a published re-assessment of ariid classification (matching those results to morphologies), Betancur-R has recommended retaining some of the 'old' genera and species placements (cf. Kailola 2004), except for the Southeast Asian *Nemapteryx* Ogilby 1908 (a monotypic genus restricted to Australia and New Guinea). Twenty-three (Kailola 2004) or 29 (Marceniuk & Menezes 2007) genera and possibly 135 valid species; at least 8 genera and 22 species in WIO.

KEY TO GENERA

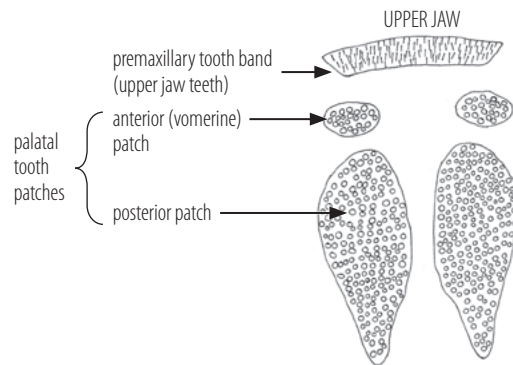
- 1a Three pairs of barbels around mouth ..... 3



- 1b One pair of barbels ..... 2

- 2a Mandibular barbels only ..... *Batrachocephalus*
- 2b Maxillary barbels only, long and stiff ..... *Osteogeneiosus*

- 3a Teeth on palate in 1–3 pairs of patches, located on front half of palate ..... 4



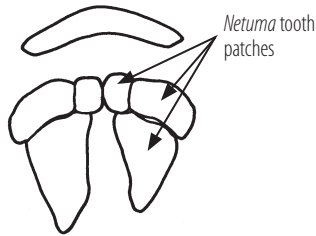
- 3b Teeth on palate in 2 pairs of patches, longitudinally arranged (all or many teeth in anterior patch may be missing); no gill rakers on rear edge of 1st arch, and often none on rear edge of 2nd arch; swimbladder with scalloped or creased sides ..... *Plicofollis*

Continued ...



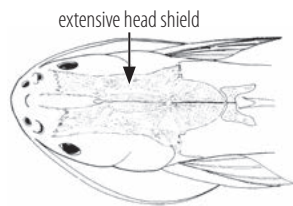
**KEY TO GENERA**

- 4a Teeth in 3 pairs of patches on palate, generally forming large triangle of 1 pair of inner vomerine tooth patches and 2 pairs of autogenous outer tooth patches; adipose fin small-based, situated over posterior half of anal fin; caudal-fin lobes slender and attenuated; body fusiform; GR on 1st arch 10–16; swimbladder with scalloped sides ..... *Netuma*



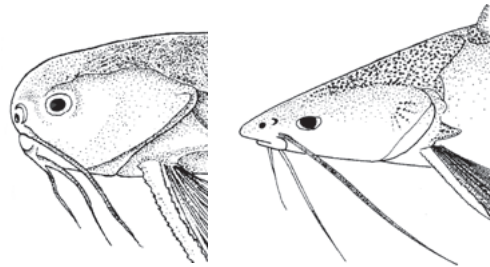
- 4b Teeth on palate in 1 or 2 pairs of patches; if 1 pair, then no teeth on vomer ..... 5

- 5a Head shield granular and extensive; supraoccipital process a broad triangle; predorsal (nuchal) plate large; adipose fin long-based ..... 6



- 5b Head shield smooth to very rough, sometimes with granules or pronounced ridges; supraoccipital process a narrow or moderate triangle; predorsal plate narrow ..... 7

- 6a Snout prominent; jaw teeth strong and fixed; sides of swimbladder scalloped or creased; peritoneum pale; dorsomedian fontanelle extending well past eye to above operculum ..... *Hemiaris*
- 6b Snout not prominent; jaw teeth strong and depressible; sides of swimbladder moderately smooth; peritoneum dark or with dark spots; dorsomedian fontanelle short and extending a short distance behind eye ..... *Hexanematichthys*



6a

6b

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- 7a Head shield smooth, covered by thick skin and muscle; supraoccipital process not keeled; 1 free supraneural exposed in dorsal surface between supraoccipital process and nuchal (predorsal) plate; rear cleithral process broad and fan-shaped in females; no pads on inner pelvic-fin rays of mature females ..... *Galeichthys*

- 7b Head shield rough, sometimes excessively so; supraoccipital process with median keel; no free supraneural exposed in dorsal surface; rear cleithral process triangular; mature females develop pads on inner pelvic-fin rays ..... *Arius*

**GENUS** *Arius* Valenciennes 1840

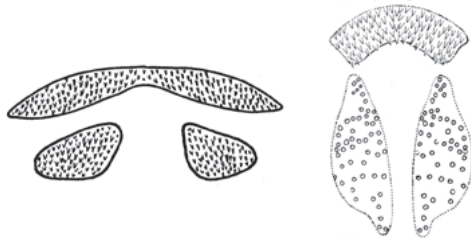
Head shield rough to very rough; supraoccipital process with median keel. Pectoral fins 10–12 rays; anal fin 17–23 rays. Teeth sharp-tipped, conical or granular, in 1 pair of patches on palate, situated anteriorly, medially or lengthwise; no teeth on vomer. Three pairs of barbels; bases of chin barbels evenly spaced (neither close-set nor wide apart). Gill openings moderately wide to slightly restricted; total GR on 1st arch 13–21; gill rakers present along rear edge of all arches; buccopharyngeal pads on gill arches poorly to well-developed. Lateral line usually bifurcates at caudal-fin base. Swimbladder rounded or heart-shaped, with smooth sides (not scalloped). Mature females develop pads on inner pelvic-fin rays. Indo-Pacific; ~20 valid species, at least 9 in WIO.

Betancur-R (2009) confirmed that the genus *Arius* is one of the major problems of ariid systematics. *Arius* here is recognised as most certainly heterogeneous, as it includes taxa belonging to at least one as yet undefined genus (e.g., *Arius nenga* [Hamilton 1822] and *A. macronotacanthus* Bleeker 1846). Here, non-Sahul Shelf taxa previously placed in *Nemapteryx* Ogilby 1908 (Kailola 2004) are classified as *Arius* Valenciennes 1840 (Betancur-R 2009). Similarly, the specific status of *A. jella* Day 1877 and *A. parvipinnis* Day 1877 is uncertain. The genus is largely restricted to India and Southeast Asia. *Arius africanus* Günther 1867 from Madagascar is listed as *incertae sedis* (cf. Ferraris 2007). It is a freshwater species that is occasionally found in estuaries after heavy rain.

## KEY TO SPECIES

- 1a Teeth on palate in 1 pair of roughly triangular or rounded patches, anteriorly set, the long axes diverging ..... 2
- 1b Teeth on palate in ovate, elongate patches, the long axes roughly parallel or converging ..... 6

palatal tooth patches



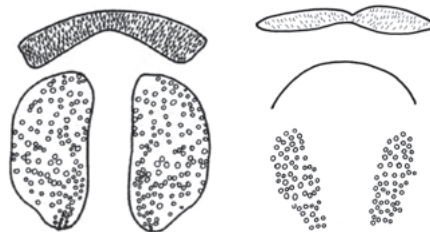
1a

1b

- 2a Maxillary barbels short, reaching only to eyes; gill openings partly restricted; dorsomedian fontanelle narrow and moderately deep posteriorly; total GR on 1st arch 22–26 ..... *A. subrostratus*
- 2b Maxillary barbels reach to head margin or beyond; gill openings not restricted; dorsomedian fontanelle open and deep at all stadia, sometimes teardrop-shaped ..... 3
- 3a Fin spines strong, compressed, thickened basally, rugose and pitted, granulated along leading edge, strongly serrated along rear edge; dorsal-fin spine tipped with filament; teeth sharp and strong, tooth patches on palate placed well forward and following curve of premaxillary tooth band ..... 4
- 3b Fin spines not as above; pectoral-fin spines robust and furrowed, inner edge with regular dentae; head shield moderately or sparsely granulated ..... 5
- 4a Tooth patches on palate more ovate or pear-shaped than triangular, their apices near midline, and the long axes parallel to curve of mouth; peduncle depth 2.2–2.4 in peduncle length ..... *A. macronotacanthus*
- 4b Tooth patches on palate distinctly triangular, apices towards midline, and the long axes at ~70° angle to curve of mouth; peduncle depth 1.7–2.2 in peduncle length ..... *A. nenga*



- 5a Snout and mouth broadly rounded; snout humped; barbels on chin thick and fleshy; tooth patches on palate elongate, oval or pyriform (their bases proximal, apices distal), and the axes long and parallel ..... *A. platystomus*
- 5b Snout rounded, mouth terminal; snout to dorsal-fin profile even; barbels on chin not thick and fleshy; tooth patches on palate ovate, the axes long and following curve of premaxillary tooth band ..... *A. sumatranus*
- 6a Premaxillary tooth band short, its width 3 in its length; pectoral-fin spines longer than dorsal-fin spine; anal fin 14–17 rays; anterior tips of palate tooth patches attenuated, but not extending far forward to premaxillary tooth band ..... *A. jella*
- 6b Premaxillary tooth band longer across jaw, its width 4–5 in its length; pectoral- and dorsal-fin spines subequal; anal fin 17–23 rays; anterior edges of palate tooth patches rounded or slightly acute ..... 7
- 7a Palatal tooth patches placed well forward or commencing well forward, not far behind band of premaxillary teeth ..... 8
- 7b Palatal tooth patches placed well back, oval, the long axes parallel or converging posteriorly; total GR on 1st arch 17–22; anal fin 19–23 rays ..... *A. maculatus*



7a

7b

- 8a Dorsal profile (snout to dorsal fin) somewhat convex; mouth gape rectangular, its width 31–38% HL; anal fin 17–19 rays; total GR on 1st arch 16–20; dorsal-fin tip usually without filament ..... *A. gagora*
- 8b Dorsal profile (snout to dorsal fin) straight; mouth gape curved, its width 36–42% HL; anal fin 17–22 rays; total GR on 1st arch 14–17; dorsal-fin tip usually with filament ..... *A. arius*

## ?*Arius africanus* Günther 1867

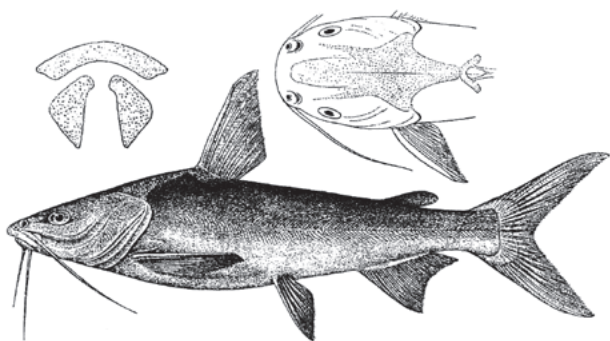
African sea catfish

*Arius falcarius* var. *africana* Günther in Playfair & Günther 1867: 114 (Pangani River, Tanzania).

*Arius africanus*: Boulenger 1911\*; Taylor 1986; Eccles 1992\*.

Pectoral fins 9–11 rays; anal fin 19–21 rays. Head shield rough and coarsely granulated; occipital process extensive, triangular; dorsomedian fontanelle narrow and straight. Snout short and broad, projecting slightly beyond mouth; predorsal profile straight; HL 3.8–4.2 in SL; eye diameter 1.5–1.6 in snout length, 4.5–5.5 in HL; maxillary barbels reach pectoral-fin bases. Premaxillary tooth band ~5 times longer than wide; teeth on palate granular, in 1 pair of large and triangular patches, narrowly separated at midline, the long axes diverging posteriorly. Fin spines slender, serrated along hind (inner) edge, subequal; fin lengths  $\frac{3}{5}$ – $\frac{4}{5}$ HL; adipose fin over middle of anal fin; peduncle depth ~2 in peduncle length; caudal-fin lobes moderately long. GR long, 14 or 15 on lower limb of 1st arch.

Body brownish dorsally, sides silvery, and white ventrally. Attains 25 cm TL.



?*Arius africanus*, 25 cm TL, upper tooth plates (top left), dorsal head (top right), and lateral view (Tanzania). Source: Boulenger 1911

**DISTRIBUTION** WIO: East Africa; not known from Madagascar.

**REMARKS** Inhabits inshore coastal waters, estuaries and rivers.

## *Arius arius* (Hamilton 1822)

Threadfin sea catfish

PLATE 27

*Pimelodus arius* Hamilton 1822: 170, 376 (estuaries of Bengal, India).

*Arius falcarius* Richardson 1845: 134, Pl. 62, Figs. 7–9 (Canton [Guangzhou], China).

*Arius cochinchinensis* Günther 1864: 170, Figs. (Cochinchina [southern Vietnam]).

*Arius boakeii* Turner 1867: 82 (Sri Lanka).

*Arius arius*: Day 1877\*, 1889; Kailola 1999\*, 2004; Manilo & Bogorodsky 2003; Ferraris 2007; Marceniuk & Menezes 2007.

*Arius malabaricus* Day 1877: 464, Pl. 107, Fig. 4 (Karnataka, India).

*Tachysurus arius*: Chandy 1954\*.

*Tachysurus malabaricus*: Chandy 1954\*; Misra 1976\*.

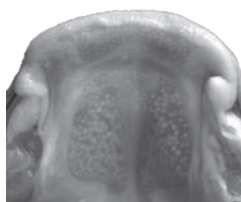
*Tachysurus maculatus* (non Thunberg 1792): Munro 1955\*; Misra 1976\*.

*Arius maculatus* (non Thunberg 1792): Jayaram 1982\*, 1984\*, 2006\*;

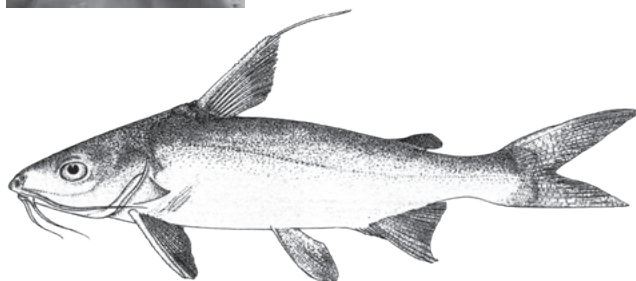
Talwar & Jhingran 1991; De Bruin *et al.* 1995\*.

Pectoral fins 10 rays; anal fin 17–22 rays. Head shield smooth anteriorly, series of granules and rugae posteriorly; dorsomedian fontanelle shallow, narrow, deeper posteriorly. Head profile almost straight; snout rounded to acute, its length about twice eye diameter; mouth width 36–42% HL; eye diameter 4–6 in HL; maxillary barbels usually extend beyond head margin, length 24–37% SL. Premaxillary tooth band 4–6.5 times longer (across mouth) than band width; teeth on palate in 1 pair of oval-elliptical patches, beginning well forward, the long axes usually parallel (patches extensive in larger fish); up to ~120 teeth (usually less), molariform, peg-like and blunt, or globular and short. Dorsal-fin spine 75–80% HL, tip with filament; pectoral-fin spines subequal to and slightly stronger than dorsal-fin spine; adipose-fin base 65–80% dorsal-fin base; peduncle moderately deep, 1.5–2.1 in peduncle length. Total GR on 1st arch 14–17. Lateral line bifurcates at caudal-fin base.

Body bluish brown dorsally, white ventrally; fins yellow, and pectoral- and dorsal-fin margins dark; adipose fin with large black spot. Attains 40 cm SL.



*Arius arius* upper tooth plates (Pakistan). © PN Psomadakis, FAO



*Arius arius*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Tropical waters of Indo-Pacific. WIO: Pakistan, India and Sri Lanka; elsewhere to Bangladesh, Thailand, Indonesia, South China Sea and possibly Philippines.

**REMARKS** Inhabits inshore coastal waters and estuaries. Of moderate importance in artisanal and subsistence fisheries; caught with trawls, seines and other net gear.

### *Arius gagora* (Hamilton 1822)

#### Gagora sea catfish

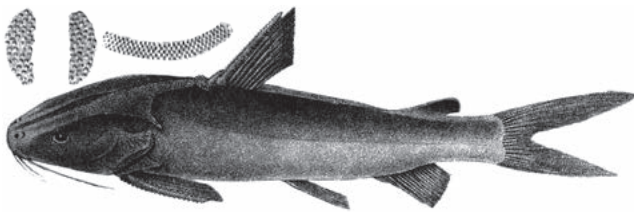
*Pimelodus gagora* Hamilton 1822: 167, 376, Pl. 10, Fig. 54 (estuaries of Bengal, India).

*Arius gagora*: Day 1877\*, 1889; Talwar & Jhingran 1991; Kailola 1999\*, 2004; Ferraris 2007.

*Tachysurus gagora*: Chandy 1954\*; Misra 1976\*; Jayaram 1982\*, 1984\*, 2006\*.

Pectoral fins 10 or 11 rays; anal fin 17–19 rays. Head shield smooth anteriorly, series of granules and rugae posteriorly; dorsomedian fontanelle shallow, narrow, deeper posteriorly. Head conical, predorsal profile evenly convex; HL 3.4–3.6 in SL; mouth terminal, gape rectangular, mouth width 24–36% HL; eyes directed dorsally, diameter 5–7 in HL; maxillary barbels 16–30% SL, barely reaching gill openings or extending to pectoral-fin bases. Premaxillary tooth band 4–5 times longer (across mouth) than band width; teeth on palate in 1 pair of oval-oblong patches, beginning well forward, the long axes parallel to each other or converging distally; teeth conical with rounded tips, peg-like and blunt. Dorsal-fin spine 51–72% HL, slightly shorter than pectoral-fin spines, tip rarely with filament; pectoral-fin spines with strong serrae along inner margin; adipose-fin base 58–102% dorsal-fin base; peduncle depth 1.7–2.2 in its length. Total GR on 1st arch 17–20. Lateral line bifurcates at caudal-fin base.

Body bluish grey dorsally, dull white ventrally; fins yellow; dorsal fin black-tipped; adipose fin with black blotch or outer half dark brown. Attains 91 cm TL (Jayaram 1982) or 46 cm TL (Jayaram 2006) (commonly 30 cm TL).



*Arius gagora*, upper tooth patches (top left), and lateral view (India).

Source: Day 1877

**DISTRIBUTION** Tropical waters of Indian Ocean: southwestern India and Sri Lanka to Bangladesh, Myanmar and Thailand.

**REMARKS** Found in inshore coastal waters, estuaries, and common in rivers to above tidal limits. Of moderate importance in artisanal and subsistence fisheries; caught with trawls, seines and other net gear.

### *Arius jella* Day 1877

#### Blackfin sea catfish

PLATE 27

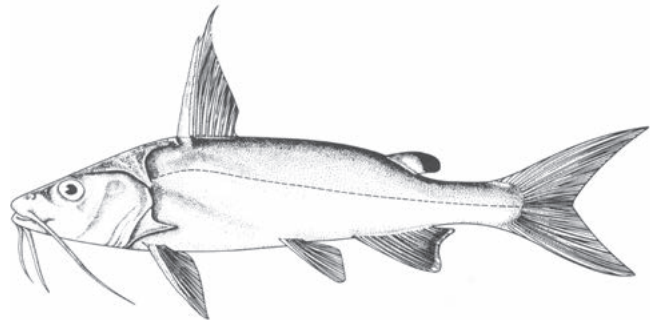
*Arius jella* Day 1877: 467, Pl. 106, Fig. 3 (Coromandel coast and Chennai, India); Day 1889; De Bruin *et al.* 1995\*; Manilo & Bogorodsky 2003; Kailola 2004; Ferraris 2007.

*Tachysurus jella*: Chandy 1954\*; Misra 1976\*; Jayaram 1982\*, 1984\*, 2006\*.

*Pseudarius jella*: Munro 1955\*.

Pectoral fins 10 or 11 rays; anal fin 14–18 rays. Head shield granulated; dorsomedian fontanelle narrow, deep posteriorly; sides of occipital process slightly curved. Predorsal profile straight; snout rounded; mouth width 37–40% HL; eyes directed dorsally, diameter 5–6 in HL, and ~1.9 in snout length; maxillary barbels moderately thick, length ~28% SL, reaching head margin or to pectoral-fin bases. Premaxillary tooth band short, its width ~3 in band length; teeth low, globular, in 1 pair of extensive, oblong and convex patches on palate, attenuated anteriorly but not extending far forward to jaw tooth band, and the long axes slightly converging posteriorly. Dorsal-fin spine subequal to HL less snout length, fin tip sometimes with filament; pectoral-fin spines longer and stronger than dorsal-fin spine, denticulate along inner margin; peduncle depth 1.8–2.1 in peduncle length. Total GR on 1st arch 17; very low gill rakers along rear edge of all arches; gill openings free. Lateral line curves upwards at caudal-fin base.

Body silvery, grey or bluish dorsally, white ventrally; fins yellow or dusky, anal-fin margin white; adipose fin with black blotch or outer half dark brown (apparently darker than in *A. arius*). Attains 31 cm TL.



*Arius jella*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Tropical waters of Indian Ocean: southwestern India and Sri Lanka to Bangladesh.

**REMARKS** Dhanze & Jayaram (1982: 97) believe that *A. jella* is only a subspecies of *A. gagora*. *Arius jella* is perhaps a synonym of *A. gagora* (Kailola 1999), yet its head shape contradicts that option. Inhabits estuaries, inshore coastal



waters, and rivers above tidal reaches. Of moderate importance in artisanal and subsistence fisheries; caught with trawls, seines and other net gear.

## *Arius macronotacanthus* Bleeker 1846

Large-spined sea catfish

PLATE 27

*Arius macronotacanthus* Bleeker 1846: 32 [159] (Jakarta, Java, Indonesia);

Day 1877\*; Jayaram 1982\*, 1984\*; Kailola 1999\*.

*Arius arius* (non Hamilton 1822): Cantor 1850.

?*Arius parvipinnis* Day 1877: 460, Pl. 113, Fig. 1 (Coromandel coast, India);

Day 1889; Jayaram 1982\*.

*Tachysurus macronotacanthus*: Chandy 1954\*; Misra 1976\*; Jayaram & Dhanze 1979.

*Tachysurus parvipinnis*: Chandy 1954\*; Misra 1976\*; Jayaram & Dhanze 1979.

*Nemapteryx macronotacanthus*: Kailola 2004.

*Nemapteryx macronotacantha*: Ferraris 2007.

Pectoral fins 10 or 11 rays; anal fin 18–21 rays. Head shield with clusters of sharp granules; lateral ethmoid prominent; dorsomedian fontanelle teardrop-shaped, deeper anteriorly; occipital process elevated, densely granulated and sharply keeled. Snout prominent, rounded to truncate; mouth strongly curved, gape wide, width 45–52% HL; jaws strong, lower jaw elevated at symphysis; eye diameter 5.6–6.5 in HL. All barbels long; maxillary barbels reach middle of pectoral fins or beyond, length 36–44% SL. Premaxillary teeth sharp, strong, slightly depressible, and partly exposed when mouth closed; teeth on palate conical, sharp and strong, in 1 pair of ovate or pear-shaped patches, apices towards midline, and the long axes parallel to curve of mouth. Fin spines strong, compressed, rugose, furrowed, pitted in larger individuals, granulated along leading edge, strongly serrated along hind (inner) edge; dorsal-fin spine thickened basally, its length subequal to HL, slightly longer than pectoral-fin spines, and tip with filament; adipose-fin base  $\frac{2}{3}$ – $\frac{4}{5}$  of dorsal-fin base; peduncle depth 2.2–2.5 in peduncle length. Total GR on 1st arch 14. Lateral line bifurcates at caudal-fin base.

Body bluish charcoal dorsally, white ventrally; paired fins bluish brown; anal fin dark; adipose fin with large black patch; barbels and dorsal-fin filament dark. Attains ~30 cm SL.

**DISTRIBUTION** Tropical waters of Indo-Pacific. WIO: Pakistan; elsewhere, east coast of India to Thailand and Indonesia (Java; Borneo).

**REMARKS** The synonymy of the Bleeker species and Day species cannot be confirmed nor disproved because of insufficient fresh material for comparative study. While the limited material examined determined that one or the other

nominal species examined does not justify separation, the geographical range does. Found in coastal waters, estuaries and the lower reaches of rivers. Of moderate importance in artisanal and subsistence fisheries; caught with trawls, seines and other net gear.

## *Arius maculatus* (Thunberg 1792)

Spotted sea catfish

PLATE 27

*Silurus maculatus* Thunberg 1792: 31, Pl. 1, Fig. 2 (China; Japan).

*Arius arius* (non Hamilton 1822): Bleeker 1858; Dhanze & Jayaram 1982\*;

Jayaram 1982\*, 1984\*, 2006\*.

*Arius malabaricus* Day 1877: 464, Pl. 107, Fig. 4 (Karnataka coast, India);

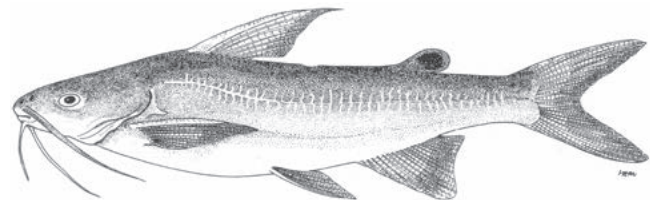
Jayaram & Dhanze 1981; Kailola 2004; Ferraris 2007.

*Tachysurus arius* (non Hamilton 1822): Chandy 1954\*.

*Arius maculatus*: Kailola 1999\*, 2004; Ferraris 2007; Marceniuk *et al.* 2012.

Pectoral fins 10 or 11 rays; anal fin 19–23 rays. Head shield and supraoccipital process striate, rugose and finely granular; dorsomedian fontanelle narrow, deeper posteriorly. Snout rounded; mouth width 27–41% HL; eye diameter 4.3–6.8 in HL; maxillary barbels 17–34% (mean 23%) SL, extending at most to pectoral-fin bases. Premaxillary tooth band 5–8.2 times longer than broad; teeth on palate in 1 pair of elongate oval patches, placed well back, the long axes tending to converge posteriorly; teeth up to ~40 (usually less), molariform to peg-like and conical with blunt tips. Dorsal-fin spine  $\frac{2}{3}$ – $\frac{4}{5}$  HL, and tipped with filament; pectoral-fin spines subequal to but slightly stronger than dorsal-fin spine; peduncle slender, its depth 1.8–2.4 in its length. Total GR on 1st arch 17–23. Lateral line bifurcates at caudal-fin base.

Body bluish brown dorsally, white ventrally; fins mostly yellow, margins of dorsal fin and caudal fin dark, and upper aspects of pectoral and pelvic fins and mid-anal fin dark; adipose fin with large black spot. Attains 40 cm SL.



*Arius maculatus*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan, southwestern India and Sri Lanka; elsewhere to Thailand, Malaysia, Indonesia, probably Philippines, China and Ryukyu Is.

**REMARKS** Other literature synonyms are *Arius angulatus* Bleeker 1846, *Arius chondropterygioides* Bleeker 1846, *Arius heckelii* Bleeker 1846 and *Arius viviparus* Bleeker 1846. Found in inshore coastal waters, estuaries and tidal reaches of rivers. Of moderate importance in artisanal and subsistence fisheries; caught with trawls, seines and other net gear.

## *Arius nenga* (Hamilton 1822)

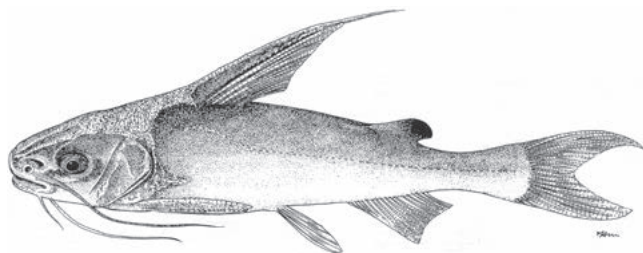
Nenga sea catfish

PLATE 27

*Pimelodus nenga* Hamilton 1822: 171, 376 (estuaries of Bengal, India).  
*Arius nenga*: Day 1877\*, 1889; Kailola 1999\*; Manilo & Bogorodsky 2003.  
*Tachysurus coelatus*: Chandy 1954\*.  
*Tachysurus nenga*: Chandy 1954\*; Jayaram & Dhanze 1979.  
*Tachysurus caelatus*: Munro 1955; Misra 1976; Jayaram & Dhanze 1979.  
*Nemapteryx nenga*: Kailola 2004; Ferraris 2007.  
*Nemapteryx caelata*: Ferraris 2007.

Pectoral fins 10 or 11 rays; anal fin 17–20 rays. Head shield ornate, with series of granules; lateral ethmoids prominent; dorsomedian head groove short and teardrop-shaped, deeper anteriorly. Snout rounded to truncate; mouth strongly curved, width 44–51% HL; jaws strong, lower jaw symphysis elevated; eye diameter 5.5–7 in HL; maxillary barbel 26–39% SL, reaching to mid-pectoral fin or beyond. Premaxillary teeth sharp, slightly depressible; teeth on palate conical, strong and sharp, in 1 pair of distinctly triangular patches, the apices towards midline, bases rounded or emarginate, the long axes at ~70° angle to curve of mouth. Fin spines variable (thick or thin) but strong, compressed, rugose, pitted in larger individuals, granulated along leading edge, serrated strongly along inner (hind) edge; dorsal-fin spine thickened basally, subequal to HL, and tipped with filament (very long in juveniles); pectoral-fin spines similar to dorsal-fin spine, length  $\frac{2}{3}$ – $\frac{3}{4}$  HL; adipose-fin base  $\frac{2}{3}$ – $\frac{3}{4}$  dorsal-fin base; peduncle depth 1.7–2.2 in peduncle length. Total GR on 1st arch 12–17. Lateral line bifurcates at caudal-fin base.

Body bluish charcoal or tan dorsally, with metallic golden sheen over back and sides; fins yellow, often with black margins and markings; adipose fin either entirely black or with large black spot; barbels and dorsal-fin filament black. Attains ~30 cm SL.



*Arius nenga*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan, India and Sri Lanka; elsewhere to east coast of India, Thailand, Malaysia and Indonesia (Bali; Kalimantan).

**REMARKS** Inhabits inshore turbid waters, estuaries and tidal reaches of rivers. Of moderate importance in artisanal and subsistence fisheries; caught with trawls, seines and other net gear. This work retains the synonymy suggested by Kailola (1999, 2004) as the status of the two nominal taxa remains unresolved. Although there is no type material of *Arius nenga*, two of the three syntypes of *Arius caelatus* are from India and the other is from Indonesia (Java), and those type specimens exhibit few meristic and morphometric differences. However, based on significant molecular distances between recently collected ‘*caelatus/nenga*’ material from Bangladesh and Indonesia, Betancur-R (pers. comm. 2009) suggested that two species are involved. Hence, either *nenga* is the valid name in India, and *caelatus* (excluding the two types from India) is the valid name in Indonesia; or, alternatively, *caelatus* (excluding the type specimen from Indonesia) is a junior synonym of *nenga* from India.

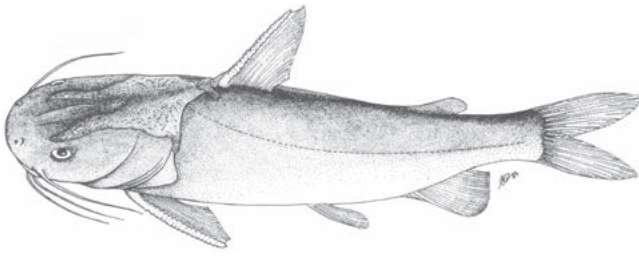
## *Arius platystomus* Day 1877

Flat-mouthed sea catfish

*Arius platystomus* Day 1877: 464, Pl. 107, Fig. 3 (Karnataka coast, India); Day 1889; Jayaram 1982\*, 1984\*; Talwar & Jhingran 1991; De Bruin *et al.* 1995\*; Manilo & Bogorodsky 2003; Kailola 2004.  
*Tachysurua platysomus*: Chandy 1954\*.  
*Pseudarius platystomus*: Munro 1955\*.  
*Tachysurus platystomus*: Misra 1976\*.  
*Plicofollis platystomus*: Ferraris 2007.

Pectoral fins 10 or 11 rays; anal fin 17–19 rays. Head shield smooth anteriorly, with scattered granules posteriorly; dorsomedian fontanelle wedge-shaped, deep and narrow posteriorly; occipital process strongly keeled. Predorsal profile convex before eyes and on nape; snout rounded; mouth broad, width 35–39% HL; eye diameter 3.8–6 in HL; HL 25–29% SL; maxillary barbels 28–29% SL, reaching pectoral-fin bases or beyond, and barbels on chin thick and fleshy. Teeth on palate blunt and conical or granular, in 1 pair of anteriorly set pyriform or oval patches, tapering posteriorly, the long axes parallel. Fin spines robust and furrowed, subequal to HL less snout length; pectoral-fin spines with regular serrae on inner edge; adipose-fin base almost as long as dorsal-fin base; peduncle depth 1.7–1.8 in peduncle length. Total GR on 1st arch 13–15.

Body blue-green dorsally, paler or white ventrally; fins dusky yellow or green; no dark blotch on adipose fin. Attains 30 cm SL.



*Arius platystomus*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indian Ocean: Pakistan, west and east coasts of India (rare on east coast), Sri Lanka and Myanmar.

**REMARKS** Found in inshore coastal waters, estuaries and rivers. Important commercially and in artisanal and subsistence fisheries; caught with trawls, seines and other net gear.

### *Arius subrostratus* Valenciennes 1840

Shovelnose sea catfish

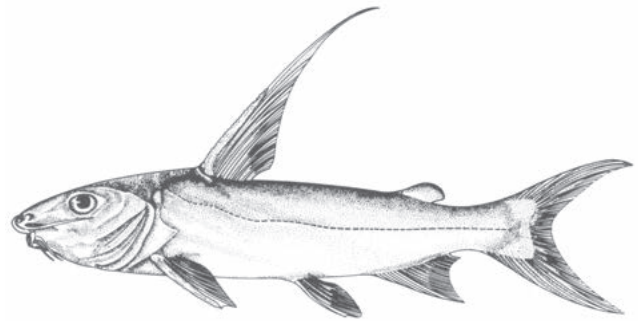
*Arius subrostratus* Valenciennes in Cuv. & Val. 1840: 62 (Malabar coast, India); Day 1877\*, 1889; Jayaram 1982\*, 1984\*; De Bruin *et al.* 1995\*; Kailola 2004; Ferraris 2007.

*Arius rostratus* Valenciennes in Cuv. & Val. 1840: 63 (Alleppey [Alappuzha], India).

*Tachysurus subrostratus*: Chandy 1954\*; Munro 1955\*; Misra 1976\*; Jayaram 1984\*.

Pectoral fins 9 or 10 rays; anal fin 17–20 rays. Head shield granular posteriorly; dorsomedian fontanelle shallow anteriorly, narrow and moderately deep posteriorly. Head dog-like with protruding and depressed snout, and predorsal profile slightly convex; HL 3.4–4 in SL; mouth inferior, small, its width 28–29% HL; eyes large, placed dorsolaterally, diameter 5–6 in HL, and 2.5–3 in snout length; maxillary barbels short, reaching at most to eyes. Teeth on palate short, conical and sharp, in 1 pair of small, triangular or oval, anteriorly set patches, the long axes diverging. Fin spines strong, each at least half HL, and dorsal fin tipped with filament; pectoral-fin spines serrated along inner edge; adipose-fin base  $\sim\frac{2}{3}$  dorsal-fin base; caudal-fin lobes broad. Total GR on 1st arch 22–26; buccopharyngeal pads well-developed; gill openings partly restricted. Lateral line bifurcates at caudal-fin base.

Body silvery bluish green, darker dorsally;  $\sim 15$  vertical series of gold spots along body; fins yellow, margins dusky. Attains 30 cm SL.



*Arius subrostratus*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan, southwestern India and Sri Lanka; elsewhere to Thailand and Singapore.

**REMARKS** Inhabits coastal waters and ascends rivers. Of minor importance in artisanal and subsistence fisheries; caught with seines and other net gear.

### *Arius sumatranus* (Anonymous [Bennett] 1830)

Goat catfish

*Bagrus sumatranus* Anonymous [Bennett] 1830: 691 (Sumatra, Indonesia). *Arius sumatranus*: Gunther 1864\*; Day 1871, 1877\*, 1889; Jayaram 1982\*; Burgess 1989; De Bruin *et al.* 1995\*; Tan & Ng 2000; Kailola 2004; Ferraris 2007.

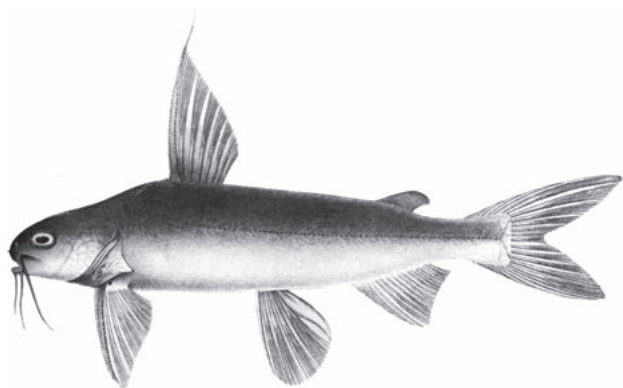
*Tachysurus sumatranus*: Chandy 1954\*; Jayaram & Dhanze 1979.

*Tachysurus venosus* (*non* Valenciennes 1840): Munro 1955\*.

*Arius venosus* (*non* Valenciennes 1840): Kailola 1999\*.

Pectoral fins 9 or 10 rays; anal fin 18–22 rays. Head shield smooth anteriorly, with scattered granules posteriorly; occipital process triangular with low median keel; dorsomedian fontanelle lanceolate, deeper posteriorly. Snout rounded; mouth subterminal, width 35–40% HL; HL 29–32% SL; eyes situated dorsolaterally, diameter 4–5 in HL; maxillary barbels 23–26% SL, extending to pectoral-fin bases. Premaxillary tooth band long and curved; teeth on palate almost conical, sharp, in 1 pair of well-separated rounded or somewhat triangular patches, anteriorly set. Fin spines subequal to HL less snout length; dorsal-fin spine slender and strong; pectoral-fin spines stouter and somewhat flattened, inner edge with regular dentae; adipose fin over rear half of anal fin; peduncle depth 2.4–2.5 in peduncle length. Total GR on 1st arch 17–20. Lateral line bifurcates at caudal-fin base.

Body silvery, bluish green or olive dorsally, white ventrally; all fins pale yellow, leading edges of dorsal fin, anal fin and caudal-fin upper lobe dark; adipose fin sometimes with diffuse dark patch; barbels pale yellow. Attains  $\sim 30$  cm SL.



*Arius sumatranus*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan, India and Sri Lanka; elsewhere to east coast of India, Bangladesh, Andaman Is., Thailand, Indonesia and Philippines.

**REMARKS** Inhabits coastal waters and estuaries. Likely important in some artisanal and subsistence fisheries; caught with hook and line, seines and other net gear.

## GENUS *Batrachocephalus* Bleeker 1846

One pair of short mandibular barbels only, reaching to eyes. Head rounded, snout blunt; mouth width 40–45% HL, gape extending to below eyes. Jaw teeth fixed, peg-like with blunt tips; palatal teeth conical but blunt, in broad, short longitudinal band on each side of palate, close to jaw teeth; no teeth on vomer. Fin spines strong and flattened, denticulate on both anterior and posterior edges. Rear cleithral process rugose and heavily ossified anteroventrally. Gill rakers club-shaped, present on rear edge of all arches; buccopharyngeal pads poorly developed. Lateral line bifurcates at caudal-fin base. Swimbladder almost triangular, with smooth sides. One species.

### *Batrachocephalus mino* (Hamilton 1822)

Frog-headed catfish

PLATE 27

*Ageneiosus mino* Hamilton 1822: 159, 375 (Upper Ganges estuaries, India).

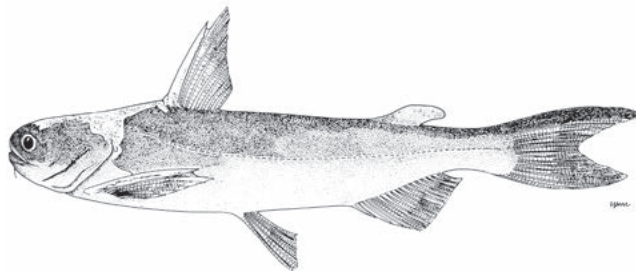
*Batrachocephalus ageneiosus* Bleeker 1846: 52 [176] (Jakarta, Java, Indonesia).

*Batrachocephalus micropogon* Bleeker 1858: 118 (Jakarta and Surabaya, Java, Indonesia).

*Batrachocephalus mino*: Day 1877\*, 1889; Munro 1955\*; Jayaram 1982\*, 1984\*, 2006\*; Talwar & Jhingran 1991; De Bruin *et al.* 1995\*; Kailola 1999\*, 2004; Ferraris 2007.

Diagnosis as for genus. Pectoral fins 8 or 9 rays; anal fin 19–22 rays. Head shield exposed, rugose; jaws strong, lower jaw prominent; eyes placed well forward, diameter 5–6.5 in HL. Dorsal-fin spine  $\frac{2}{3}$ – $\frac{3}{4}$  HL, slightly shorter than pectoral-fin spines; adipose-fin base  $\sim\frac{2}{3}$  dorsal-fin base. Total GR on 1st arch 15; gill openings restricted.

Body largely silvery, dark brown dorsally, white ventrally; fins dusky yellow, caudal-fin upper lobe dark. Attains at least 32 cm TL.



*Batrachocephalus mino*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan, India and Sri Lanka; elsewhere to east coast of India, Thailand, Myanmar, Malaysia and Indonesia.

**REMARKS** Found in coastal waters, estuaries and tidal reaches of rivers.

## GENUS *Galeichthys* Valenciennes 1840

Head not especially broad; head shield smooth, covered by skin and muscle; dorsomedian head groove shallow or not obvious; supraoccipital process long and narrow, flat to slightly convex and not keeled; nuchal plate always narrow, preceded by 'free' supraneural exposed in dorsal surface immediately behind supraoccipital process. Three pairs of barbels. Teeth on jaws and palate villiform and depressible, in wide premaxillary tooth band, and on each side of palate in small oval patch on vomer, confluent with larger crescentic or oval lateral patch, and the vomerine tooth patches slightly separated or touching at midline. Fin spines moderately thin; pectoral fins 9–13 rays; anal fin 15–20 rays. Rear cleithral process fan-shaped, its margin broadly rounded in females, angular or triangular in males. No fleshy pads on inner pelvic-fin rays of mature females. Gill rakers present on rear edge of all arches. Lateral line well-developed, curving upwards at caudal-fin base. Four species, 3 in WIO.



**KEY TO SPECIES**

- 1a Caudal-fin lobes rounded; peduncle short and thick (its depth >½ its length); both belly and underside of head anterior to isthmus densely covered with fine brown specks ..... *G. ater*
- 1b Caudal-fin lobes pointed; peduncle depth ≤½ its length; no spotting or speckles on underside of head (if present, only behind isthmus) ..... 2
  
- 2a Belly stark white, some violet-brown speckles laterally but never mid-ventrally; dorsal-fin spine at least 70% fin height; pectoral-fin spines reach at most vertical at hind edge of dorsal-fin base; free rear edge of adipose fin ~½ length of fin base; longitudinal septum of rear chamber of swimbladder without small transverse septum ..... *G. feliceps*
- 2b Belly densely covered with fine brown specks, but behind isthmus only; dorsal-fin spine <70% fin height; pectoral-fin spines reach to or beyond vertical at hind edge of dorsal-fin base; free rear edge of adipose fin ~½ length of fin base; longitudinal septum of rear chamber of swimbladder divided by 1 small transverse septum ..... *G. troworum*

***Galeichthys ater*** Castelnau 1861

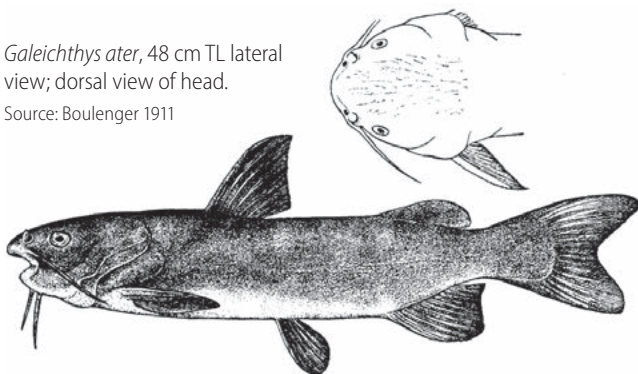
Black sea catfish PLATE 28

*Galeichthys ater* Castelnau 1861: 62 (Table Bay, Cape Town, South Africa); Boulenger 1911\*; SSF No. 59.2\*; Tilney & Hecht 1990\*; Heemstra & Heemstra 2004\*; Kulongowski 2010\*.  
*Galeichthys feliceps* (*non* Valenciennes 1840): Barnard 1925 [in part].

Pectoral fins 9–12 rays; anal fin 17 rays. Head short, HL 23–31% SL; snout blunt, well-rounded, length 31–48% HL; mouth width 46–57% HL; eye diameter 13–20% HL; maxillary barbels reach head margin; peduncle short and thick, its depth 7–14% SL; caudal-fin lobes distinctly rounded and subequal, fin not deeply forked. Dorsomedian head groove smooth and shallow, not reaching supraoccipital process. Palatal tooth patches touch at midline. Rear margin of cleithrum fan-shaped in females, triangular in males. Mature females with fatty (adipose) growth along pectoral-fin spines. Total GR on 1st arch 10–13.

*Galeichthys ater*, 48 cm TL lateral view; dorsal view of head.

Source: Boulenger 1911



Body brown, belly paler; distinguished by underside of head and belly covered with fine brown specks. Attains at least 48 cm TL.

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (southern KwaZulu-Natal) in WIO.

**REMARKS** Strictly marine. Of minor importance to fisheries; caught with trawls, seines and other net gear.

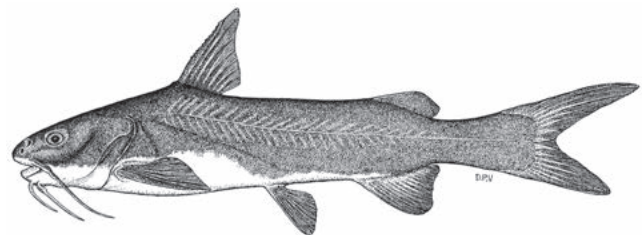
***Galeichthys feliceps*** Valenciennes 1840

White sea catfish PLATE 28

*Galeichthys feliceps* Valenciennes in Cuv. & Val. 1840: 29, Pl. 424 (Cape of Good Hope, South Africa); Boulenger 1911\*; Marais 1984\*; Coetzee & Pool 1985\*; SSF No. 59.3\*; Taylor 1986; Tilney & Hecht 1990\*; Heemstra & Heemstra 2004\*; Kulongowski 2010\*.  
 ?*Pimelodes fossor* Lichtenstein 1823: 112 (Cape of Good Hope, South Africa).  
*Galeichthys capensis* Smith 1840: no page number, Pl. 8 (Cape of Good Hope, South Africa).  
*Pimelodus peronii* Valenciennes in Cuv. & Val. 1840: 161 (Indian Ocean).  
*Bagrus bagrus feliceps*: Müller & Troschel 1849.  
*Galeichthys ocellatus* Gilchrist & Thompson 1916: 60, Fig. (Swartkops River, Algoa Bay, South Africa).

Pectoral fins 10–12 rays; anal fin 17–19 rays. HL 20–37% SL; snout blunt, 31–50% HL; mouth width 39–63% HL; eye diameter 12–22% HL; maxillary barbels reach pectoral-fin bases or beyond; dorsal-fin spine subequal to or >70% fin height; peduncle depth ~½ its length, and 7–9% SL; caudal fin deeply forked, its lobes slender and pointed, upper lobe longer. Dorsomedian head groove apparently lacking anteriorly, shallow before supraoccipital process. Palatal tooth patches touch at midline. Rear margin of cleithrum fan-shaped in females, triangular in males. No fatty (adipose) growth along pectoral-fin spines in mature females. Total GR on 1st arch 11–14.

Body violet-brown, with some lateral speckling; belly stark white. Attains 42 cm SL.



*Galeichthys feliceps*, 23 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (Mbashe River mouth, Transkei region) in WIO.

**REMARKS** Inhabits inshore waters and estuaries. Of minor importance to fisheries; caught with trawls, seines and other net gear.

### *Galeichthys troworum* Kulongowski 2010

Natal sea catfish

PLATE 28

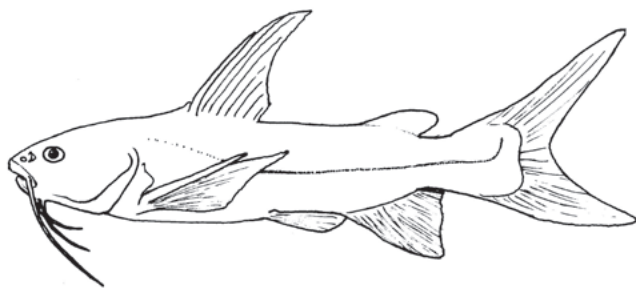
*Galeichthys trowi* Kulongowski 2010: 14, Figs. 3–6 (Coffee Bay, Eastern Cape, South Africa).

*Galeichthys feliceps*: SSF No. 59.3\* [in part].

*Galeichthys* sp.: Branch *et al.* 1994\*; King 1997\*.

Pectoral fins 12 or 13 rays; anal fin 19 or 20 rays. HL 26–42% SL; snout length 36–44% HL; mouth 41–59% HL; eye diameter 11–16% HL; maxillary barbels reach pectoral-fin bases; dorsal-fin spine 65–70% fin height; peduncle laterally compressed, its depth 8–12% SL; caudal fin deeply forked, its lobes pointed and slender, upper lobe longer. Dorsomedian head groove shallow. Palatal tooth patches slightly separated at midline. Rear margin of cleithrum fan-shaped, but more so in females. No adipose growth on pectoral fins of mature females. Total GR on 1st arch 12 or 13.

Body dark brown; underside of head and body paler brown or yellowish; belly with fine brown speckling posterior to isthmus only; adipose fin blackish. Attains 58 cm FL.



*Galeichthys troworum* (South Africa). Source: Kulongowski 2010

**DISTRIBUTION** WIO: endemic to southeastern coast of South Africa, from Kei River mouth to Kosi Bay.

**REMARKS** Entirely marine, in shallow coastal waters. Possibly of minor importance to artisanal fisheries; caught with hook and line, trawls, seines and other net gear. The original species name of *trowi* was incorrect and has been emended to *troworum* (Eschmeyer *et al.* 2018).

### GENUS *Hemiaris* Bleeker 1862

Snout prominent; mouth wide with thick lips, jaws strong and lower jaw upturned at symphysis; eyes small. Three pairs of short and strap-like barbels, bases of chin barbels well-staggered. Skull surface either smooth, venulose or granular; rear part of dorsomedian fontanelle broadly rounded or elongate; supraoccipital process broadly triangular. Fin spines thick and rugose, flattened. Teeth sharp, strong and fixed, not depressible; upper jaw teeth exposed when mouth shut; jaw teeth arranged in 2–5 well-spaced series or narrow bands; teeth on palate in 2 pairs of patches across front of palate, either small and narrow or large. Gill openings wide; gill rakers few (10–18), stiff, present or absent on rear edge of all arches. Adipose fin long-based. Pads present on pelvic fins of mature females. Swimbladder triangular, with scalloped or creased sides. Tropical waters of Indo-Pacific; ~5 species, 1 in WIO.

### *Hemiaris sona* (Hamilton 1822)

Sona sea catfish

PLATE 28

*Pimelodus sona* Hamilton 1822: 172, 376 (estuaries of Bengal, India).

*Bagrus gagorides* Valenciennes *in* Cuv. & Val. 1840: 441 (Ganges River, India).

*Arius sona*: Day 1877\*, 1889; Talwar & Jhingran 1991; De Bruin *et al.* 1995\*; Kailola 1999\*; Mishra & Srinivasan 1999; Manilo & Bogorodsky 2003; Jayaram 2006\*.

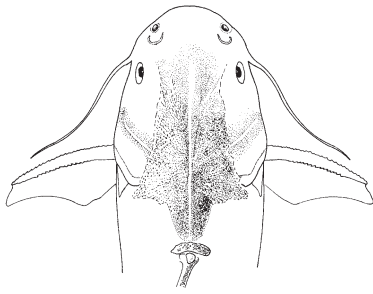
*Tachysurus sona*: Chandy 1954\*; Misra 1976\*; Jayaram 1982\*, 1984\*.

*Hexanematichthys sona*: Munro 1955\*.

*Hemiaris sona*: Kailola 2004; Ferraris 2007.

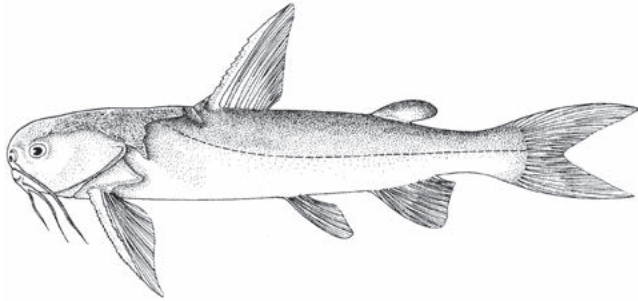
Head shield with strong radiating granules; supraoccipital process as wide as long, with low keel, sides and apex convex. Head depressed, ~1/3 broader than high; mouth width 50–55% HL; eyes dorsolateral, oval, diameter 6.8–9 in HL; maxillary barbels reach head margin. Jaw teeth sharp and fixed, not depressible; teeth on palate sharp and conical, in 2 pairs: large outer patches triangular and emarginate posteriorly, contiguous with smaller, rounded, inner patches. Dorsal-fin spine strong and granulated along leading edge; pectoral-fin spines longer than dorsal-fin spine and more granulated; pectoral fins 12 rays; anal fin 15–18 rays. Total GR on 1st arch 15 or 16; gill rakers present on rear edge of all arches.

Body brownish blue, with iridescent gold on back and sides, sometimes white or paler on belly and underside of head; often yellow around mouth, on peduncle and belly; anal, adipose, pectoral and pelvic fins dark grey to bluish black; dorsal fin and caudal-fin upper lobe dusky yellow; maxillary barbels dark brown. Attains ~92 cm SL.



*Hemirius sona*, lateral view, and dorsal view of head.

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**DISTRIBUTION** Indo-Pacific. WIO: Pakistan, India and Sri Lanka (records from East Africa are unconfirmed); elsewhere to east coast of India, Vietnam and Singapore.

**REMARKS** Inhabits coastal waters and estuaries. Important in artisanal and subsistence fisheries; caught with handlines, trawls, seines and other net gear.

## GENUS *Hexanematchthys* Bleeker 1858

Distinguished by broad and moderately depressed head, short and broad supraoccipital process, large butterfly-shaped nuchal plate (in older individuals), and long-based adipose fin. Three pairs of barbels around mouth. Fin spines strong and compressed; pectoral fins 9–11 rays; anal fin 16–20 rays. Dorsomedian fontanelle extends posteriorly a short distance beyond eyes. Teeth sharp and conical, those on palate forming 4 groups across front of palate. Total GR on 1st arch 12–18; no gill rakers along rear edge of 1st and 2nd arches. Mature females with pads on inner pelvic-fin rays. Swimbladder with moderately smooth sides; peritoneum dark or with dark spots. Thoracic vertebrae many (13–18). Tropical waters of Indo-Pacific; 2 species, 1 in WIO.

## *Hexanematchthys sagor* (Hamilton 1822)

Sagor sea catfish

PLATE 28

*Pimelodus sagor* Hamilton 1822: 169, 376 (estuaries of Bengal, India).

*Bagrus doroides* Valenciennes in Cuv. & Val. 1840: 448, Pl. 418 (Puducherry and Bengal, India).

*Arius sagor*: Day 1877\*, 1889; Jayaram 1982\*, 1984\*; Talwar & Jhingran 1991; Manilo & Bogorodsky 2003.

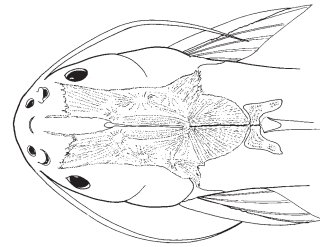
*Tachysurus sagor*: Chandy 1954\*; Jayaram & Dhanze 1979.

*Arius (Hexanematchthys) sagor*: Kailola 1999\*.

*Hexanematchthys sagor*: Kailola 2004; Ferraris 2007.

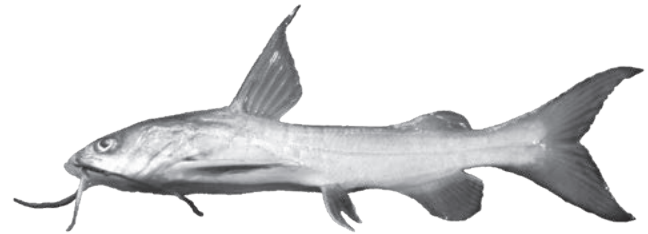
Body elongate; snout rounded; mouth width 42–50% HL; eyes placed forward, diameter 5.5–8 in HL; barbels strap-like, maxillary barbels 30–52% SL. Head shield extensive, granular or rugose; crescent-shaped transverse groove between nostrils. Jaw teeth strong and sharp, depressible; teeth on palate in 2 pairs of oval patches across front of palate, inner patches smaller than outer autogenous patches (tooth patches may be contiguous in larger fish). Pectoral-fin spines 1.2–1.4 in HL, longer and stronger than dorsal-fin spine, tipped with short filament; pectoral fins 9–11 rays; anal fin 16–19 rays. Total GR on 1st arch 12–18.

Body bluish brown dorsally, with regularly spaced vertical white streaks, and white ventrally; fins dusky or blackish distally, paired fins with narrow white margin; maxillary barbels dark brown; peritoneum fawn or dark grey. Attains 45 cm SL.



*Hexanematchthys sagor*, dorsal view of head.

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*Hexanematchthys sagor*, 6 cm SL (Thailand). © S Ratmuangkhwang, ACRSD

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan and India; elsewhere to east coast of India, Thailand, Singapore, Indonesia (Java; Borneo) and possibly Philippines.

**REMARKS** Inhabits inshore coastal waters and estuaries. Of some importance in artisanal and subsistence fisheries; caught with trawls and other net gear.

## GENUS *Netuma* Bleeker 1858

Body streamlined (fusiform), snout often prominent; head shield rugose or slightly granular; frontal bones tapered posteriorly; posterior apex of dorsomedian fontanelle V-shaped. Teeth fine, in 3 pairs of patches on palate (1 vomerine, 2 autogenous), but often coalescing to form single, large, triangular patch. Three pairs of barbels. Pectoral fins 10–12 rays; anal fin 14–21 rays; adipose fin small-based, placed over rear half of anal fin; caudal-fin lobes slender and tapered. Gill openings usually wide; total GR on 1st arch 10–16; no gill rakers on rear edge of 1st and 2nd arches (occasionally some rakers on upper limb). Lateral line bifurcates at caudal-fin base. Mature females develop pads on inner pelvic-fin rays. Swimbladder heart-shaped, with scalloped sides. Tropical waters of East Africa, Southeast Asia and northern Australia; 3 species, 2 in WIO.

### KEY TO SPECIES

- 1a Snout somewhat pointed, becoming more prominent with age; inner (vomerine) tooth patches always separated at midline; anal fin 14–17 rays; body with coppery or golden iridescence ..... *N. thalassina*
- 1b Snout rounded, not prominent with age; inner (vomerine) tooth patches unite across midline with age; anal fin 17–21 rays; body with bronze iridescence ..... *N. bilineata*

## *Netuma bilineata* (Valenciennes 1840)

Bronze sea catfish

PLATE 28

*Bagrus bilineatus* Valenciennes in Cuv. & Val. 1840: 434 (Puducherry, India; Yangon, Myanmar).

*Arius dayi* Dmitrenko 1974: 39, Figs. 1–2 (Masir Strait, Gulf of Oman).

*Netuma thalassina* (non Rüppell 1837): Taylor 1986.

*Arius bilineatus*: De Bruin *et al.* 1995\*.

*Arius* (*Netuma*) *bilineatus*: Kailola 1999\*.

*Netuma bilineatus*: Kailola 2004.

*Netuma bilineata*: Ferraris 2007.

Snout rounded; mouth subterminal; supraoccipital process a moderate triangle with straight or convex sides. Vomerine tooth patches unite across midline in larger fish. Pectoral fins 10–12 rays; anal fin 17–21 rays. Total GR on 1st arch 11–16. Total number of free vertebrae 46–52.

Body reddish or bluish brown, with bronze iridescence over back and sides; adipose fin dark brown. Attains 62 cm SL.



*Netuma bilineata*, 59 cm TL. © JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific. WIO: Yemen, Persian/Arabian Gulf, Pakistan and India; elsewhere to east coast of India, Myanmar, Malaysia, Indonesia, Philippines, South China Sea, New Guinea and northeastern Australia.

**REMARKS** Of moderate importance in artisanal fisheries; caught with trawls, hook and line, and seines.

## *Netuma thalassina* (Rüppell 1837)

Giant sea catfish

PLATE 29

*Bagrus thalassinus* Rüppell 1837: 75, Pl. 20, Fig. 2 (Massawa, Eritrea, Red Sea).

*Bagrus netuma* Valenciennes in Cuv. & Val. 1840, Vol. 14: 438, Pl. 417 (Puducherry, India).

*Bagrus laevigatus* Valenciennes in Cuv. & Val. 1840, Vol. 14: 439 (Red Sea).

*Arius nasutus* Valenciennes in Cuv. & Val. 1840, Vol. 15: 60 (Java, Indonesia; Malabar coast, India; Red Sea).

*Arius thalassinus*: Day 1877\*, 1889; Jayaram 1982\*, 1984\*; De Bruin *et al.* 1995\*; Misra & Srinivasan 1999.

*Tachysurus thalassinus*: Chandy 1954\*; Misra 1976; Jayaram & Dhanze 1979.

*Netuma serratus*: Munro 1955\*.

*Netuma thalassinus*: Munro 1955\*.

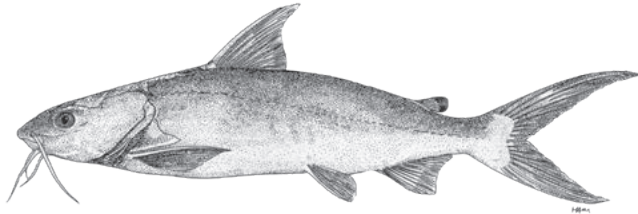
*Netuma thalassina*: Taylor 1986 [in part]; Kailola 2004; Ferraris 2007.

*Arius* (*Netuma*) *thalassinus*: Kailola 1999\*.

Snout angular in young, becoming prominent with age; mouth sub-inferior. Supraoccipital process a broad-based triangle with straight or convex sides. Vomerine tooth patches always separated at midline. Pectoral fins 10–12 rays; anal fin 14–17 rays. Total GR on 1st arch 12–15. Total number of free vertebrae 38–45.



Body greyish blue to fawn, back and sides with coppery or golden iridescence; outer half of adipose fin blackish. Attains 130 cm SL.



*Netuma thalassina*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: East Africa to Red Sea, Persian/Arabian Gulf, Pakistan and India; elsewhere to east coast of India, Myanmar, Malaysia, Indonesia, Philippines, South China Sea, New Guinea and eastern Australia.

**REMARKS** Inhabits coastal to deeper waters, from near shore to continental shelf margin, to ~180 m.

## GENUS *Osteogeneiosus* Bleeker 1846

One pair of maxillary barbels only; barbels long and stiff, extending to or beyond pectoral-fin bases. Head strongly depressed and skull heavily ossified, especially posteriorly; head shield rugose or granular, covered with smooth and thin skin; supraoccipital process elongate. Teeth in single band on each jaw; palatal teeth conical with blunt tips, in 2 large patches longitudinally arranged on palate margins, inner margin of patches concave; no teeth on vomer. Rear cleithral process short. Inner pelvic-fin rays thickened in mature females. Gill openings wide; gill rakers present on rear edge of all arches. Lateral line bifurcates at caudal-fin base. Swimbladder heart-shaped, with scalloped sides. One species.

### *Osteogeneiosus militaris* (Linnaeus 1758)

Soldier catfish

PLATE 29

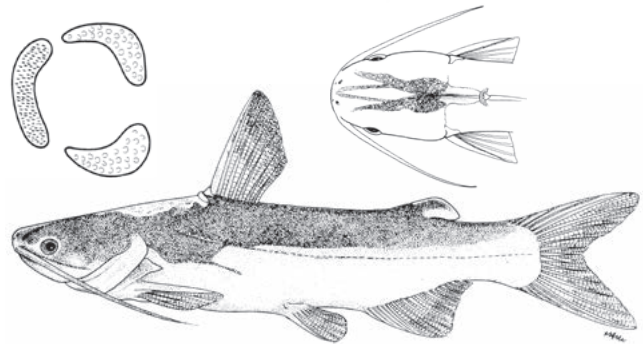
*Silurus militaris* Linnaeus 1758: 305 (Asia).

*Osteogeneiosus militaris*: Day 1877\*, 1889; Munro 1955\*; Jayaram 1982, 1984, 2006\*; Talwar & Jhingran 1991; De Bruin *et al.* 1995\*; Kailola 1999\*, 2004; Manilo & Bogorodsky 2003; Ferraris 2007.

Diagnosis as for genus. Snout truncate; mouth inferior, lips thin; eyes small, diameter 5.5–8 in HL. Ridges of frontal and dorsomedian fontanelle apparent through smooth skin

on head shield. Fin spines thin; dorsal-fin spine  $\frac{2}{3}$ – $\frac{3}{4}$  HL; pectoral-fin spines about four-fifths or subequal to dorsal-fin spine, front and hind margins denticulate; pectoral fins 9 or 10 rays; anal fin 19–22 rays; adipose-fin base  $\sim\frac{2}{3}$  or subequal to dorsal-fin base; caudal-fin lobes short and broad. Total GR on 1st arch 10 or 11.

Body bluish dorsally, white or cream ventrally; dorsal-fin margin and distal half of adipose fin dark blue or blackish. Attains 31 cm SL.



*Osteogeneiosus militaris*, upper tooth patches (top left), dorsal head (top right), and lateral view. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Tropical waters of Indo-Pacific. WIO: Pakistan and India; elsewhere to Bangladesh, Thailand, Vietnam, Singapore and Indonesia.

**REMARKS** Inhabits inshore waters, estuaries, lower courses of rivers, and coastal lake systems. Of minor fisheries importance; caught with trawls and seines.

## GENUS *Plicofollis* Kailola 2004

Mouth not large, head moderately long; dorsomedian fontanelle long. Three pairs of moderately thick and fleshy barbels, bases of chin barbels close together and nearly aligned. Jaw teeth slender, tooth bands short; teeth on palate in 2 pairs (rarely 1 pair) of autogenous plates, longitudinally arranged; teeth conical or molariform, many or all teeth in anterior pair of patches frequently missing, and individual teeth in posterior pair of patches sometimes lost; no teeth on vomer. Pectoral fins 10–13 rays; anal fin 14–21 rays; adipose fin over middle of anal fin. Total GR on 1st arch 10–17; no gill rakers on rear edge of 1st arch, and sometimes absent from rear edge of 2nd arch; gill openings reduced. Lateral line bifurcates at caudal-fin base. Swimbladder with scalloped or creased sides. Tropical waters of Indo-Pacific; at least 7 species, 3 in WIO.

## KEY TO SPECIES

- 1a Palate with 2 pairs of tooth patches: anterior patches smaller, posterior patches larger ..... 2
- 1b Palate with usually 1 pair (rarely 2 pairs) of tooth patches, if 2 pairs present, then anterior patch with  $\leq 3$  individual teeth; total GR on 1st arch 14–17; anal fin 15–20 rays; mouth width 26–34% HL; HL 30–31% SL ..... *P. layardi*
- 2a Posterior pair of tooth patches elongate, slender, the long axes diverging posteriorly; anal fin 14–17 rays; total GR on 1st arch 14 or 15; HL 22–28% SL ..... *P. dussumieri*
- 2b Posterior pair of tooth patches broad and tapering, the long axes converging posteriorly; anal fin 18–20 rays; total GR on 1st arch 9–12; HL 30–31% SL ..... *P. tonggol*

*Plicofollis dussumieri* (Valenciennes 1840)

## Blacktip sea catfish

PLATE 29

*Arius dussumieri* Valenciennes in Cuv. & Val. 1840: 84 (Malabar coast, India); Günther 1864; Day 1877\*, 1889; Jayaram 1982\*, 1984\*; Taylor 1986; Al-Hassan *et al.* 1987\*; De Bruin *et al.* 1995\*; Kailola 1999; Mishra & Srinivasan 1999; Manilo & Bogorodsky 2003.

*Arius kirkii* Günther 1864: 163, Fig. (Chupanga [Mozambique], Zambezi River); Taylor 1986.

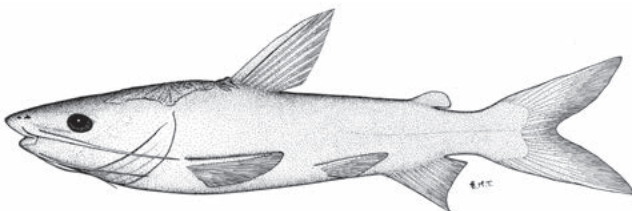
*Tachysurus dussumieri*: Chandy 1954\*; Jayaram & Dhanze 1979.

*Ariodes dussumieri*: Munro 1955\*; SSF No. 59.1\*.

*Plicofollis dussumieri*: Kailola 2004; Ferraris 2007; Marceniuk & Menezes 2007.

Mouth terminal, width 36–44% HL; HL 22–28% SL. Head shield sparsely granular; lateral ethmoids (before eyes) prominent in larger fish; dorsomedian fontanelle shallow and narrow, and deeper and distinct before supraoccipital process; supraoccipital process triangular, straight-sided, with strong and sharp keel. Anterior pair of palatal tooth patches smaller and ovate, posterior pair elongate and elliptical, the long axes diverging distally (teeth always present in anterior patches, although individual teeth may be lost from all patches); teeth conical, stout or peg-like, tips blunt or sharp. Pectoral fins 9–12 rays; anal fin 14–17 rays. Total GR on 1st arch 14 or 15; no rakers on rear edge of 1st and 2nd arches.

Body bluish green dorsally, silvery on sides and ventrally; fins yellowish to dusky, with blackish margins; adipose fin with black patch. Attains 62 cm SL.



*Plicofollis dussumieri*, 19 cm SL. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar, East Africa, Oman, Persian/Arabian Gulf, Pakistan, India and Sri Lanka; elsewhere to east coast of India, Thailand, Malaysia and Indonesia (Sumatra).

**REMARKS** Inhabits coastal waters and estuaries. Important in artisanal and subsistence fisheries; caught with handlines, traps, trawls and other net gear.

*Plicofollis layardi* (Günther 1866)

## Thin-spine sea catfish

PLATE 29

*Arius layardi* Günther 1866: 474, Pl. 15 (Sri Lanka); Ferraris 2007.

*Arius tenuispinis* Day 1877: 466, Pl. 107, Fig. 5 (Mumbai, India); Day 1889;

Talwar 1976; Jayaram 1982\*, 1984\*, 2006\*; Al-Hassan *et al.* 1987\*;

Talwar & Jhingran 1991; Randall 1995\*; Manilo & Bogorodsky 2003.

*Arius satparanus* Chaudhuri 1916: 430, Figs. 6–8 (Chilika Lake, Odisha,

India); Talwar & Jhingran 1991\*; Ferraris 2007.

*Tachysurus tenuispinis*: Chandy 1954\*; Jayaram & Dhanze 1979.

*Hemipimelodus tenuispinis*: Misra 1976.

*Tachysurus satparanus*: Jayaram & Dhanze 1979, 1981.

*Arius argyropleuron* (*non* Valenciennes [ex Kuhl & Van Hasselt]):

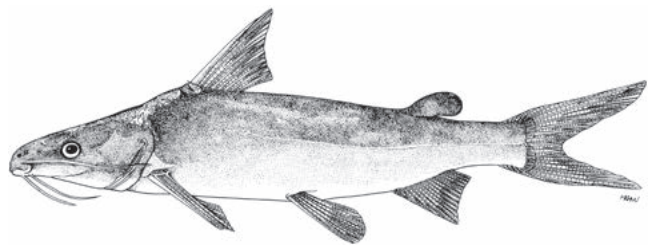
Kailola 1999.

*Plicofollis layardi*: Kailola 2004.

*Plicofollis tenuispinis*: Ferraris 2007.

HL 29–33% SL; snout blunt and depressed, longitudinally wrinkled in fresh material; mouth sub-inferior, mouth width 26–34% HL; eyes low-set, diameter 5–6.5 in HL; maxillary barbels almost reach pectoral-fin bases, length 20–28% SL. Head shield and supraoccipital process sparsely granular; dorsomedian fontanelle distinct and long, narrow, groove-like; supraoccipital process keeled. Teeth molariform, globular, few; teeth on palate usually in 1 pair of large shoe- or pear-shaped patches, situated well back, the long axes converging posteriorly; 1–3 teeth may be present in patch anteriorly. Fin spines slender, attenuated, as long as HL minus snout length; pectoral fins 10–12 rays; anal fin 16–19 rays; adipose-fin base 51–72% dorsal-fin base; peduncle depth 1.5–1.9 in peduncle length; caudal fin deeply forked, lobes rounded. Total GR on 1st arch 13–17.

Body dark grey dorsally and laterally, silvery grey ventrally; tips of dorsal, caudal and pectoral fins dark; adipose-fin margin dark. Attains 36 cm TL.



*Plicofollis layardi*, 19 cm SL. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf (Yemen; Kuwait), Pakistan, India and Sri Lanka; elsewhere to Myanmar and possibly Thailand and Malaysia.

**REMARKS** Inhabits inshore coastal waters, brackish coastal lagoons, and the lower reaches of rivers. Important in artisanal and subsistence fisheries; caught with handlines, traps, trawls and other net gear.

## *Plicofollis tonggol* (Bleeker 1846)

Roughback sea catfish

PLATE 29

*Arius crossocheilus* Bleeker 1846: 46 [172] (Jakarta, Java, Indonesia).

*Arius tonggol* Bleeker 1846: 292 (Jakarta, Java, Indonesia).

*Tachysurus crossocheilus*: Chandy 1954\*; Misra 1976.

*Tachysurus crossocheilus*: Jayaram & Dhanze 1979.

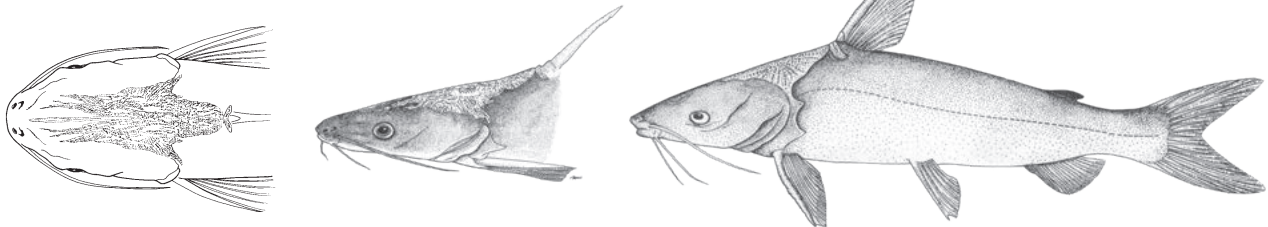
*Arius crossocheilus*: Jayaram 1982\*; Kailola 1999; Manilo & Bogorodsky 2003.

*Plicofollis crossocheilus*: Kailola 2004.

*Plicofollis tonggol*: Ferraris 2007.

Snout conical; mouth width 30–34% HL; HL 30–31% SL. Head shield rugose to granular, striate over supraoccipital process; supraoccipital process more oblong than triangular, its sides and apex convex; dorsomedian fontanelle shallow. Anterior pair of palatal tooth patches oval, posterior pair broadly oval or pear-shaped, the long axes oblique and tending to converge distally; teeth low, rounded and globular, some bluntly conical, much fewer teeth in anterior patches than in posterior patches (and individual teeth may be lost). Pectoral fins 9–12 rays; anal fin 18–20 rays. Total GR on 1st arch 9–12; no gill rakers on rear edge of 1st and 2nd arches.

Body bluish grey or brown dorsally, white ventrally; fins yellow, margins of dorsal, pectoral and pelvic fins black; adipose fin with black patch. Attains 40 cm TL.



*Plicofollis tonggol*, dorsal and lateral views of head; entire lateral view. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: India; elsewhere to Myanmar, Thailand, Malaysia, Indonesia and Philippines.

**REMARKS** Inhabits coastal waters and estuaries. Of some importance in artisanal and subsistence fisheries; caught with traps, lines, trawls and other net gear.

## GLOSSARY

**buccopharyngeal pads** – pads at the back of the mouth and beginning of the gut.

**cleithral process** – a process on the major bone of the pectoral girdle.

**dorsomedian fontanelle** – a gap between bones in the middle at the top of the skull, closed by a membrane.

**incertae sedis** – a qualification to indicate that a taxon's phylogenetic affinities are uncertain within a more inclusive group of organisms, and authors do not want to guess where a taxon belongs.

**lateral ethmoid** – the bone forming the front of the eye socket.

**nuchal plate** – a plate of bone at the neck.

**Pacific Plate** – that part of the Pacific Ocean floor bounded by the Aleutian Trench in the north, the trenches that extend from the Okhotsk Peninsula, past Japan, the Mariana Trench, to the Tonga and Kermadec trenches to cut through South Island, New Zealand, to the Antarctic Plate in the south. It is bounded on the east by mid-ocean ridges that extend past Easter Island to Baja California and along the west coast of North America to Alaska. It covers 103.3 million sq. km.

**parasphenoid** – a bone in the middle at the base of the skull.

**peritoneum** – the membrane lining the abdominal cavity.

**rugose** – with a rough or wrinkled surface.

**Sahul Shelf** – the section of continental crust which forms Australia and New Guinea.

**supraoccipital** – a median bone at the upper rear surface of the skull, frequently bearing an expanded crest (supraoccipital process).

FAMILY **PLOTOSIDAE**

## Eel-catfishes

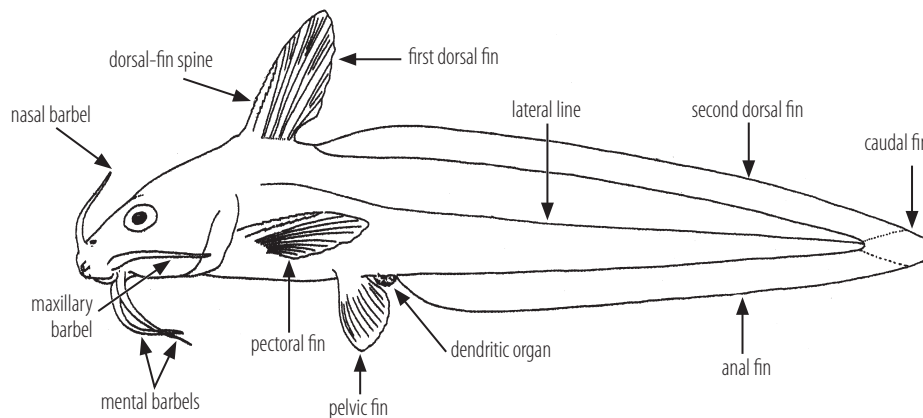
Wouter Holleman

Body elongate and tapering to a point; 2nd dorsal fin and anal fin confluent with caudal fin; mouth surrounded by 4 pairs of barbels (except one species with additional pair of barbel-like extensions on upper lip); no scales or bony plates. First dorsal fin with short, stout, venomous spine, with retrorse barbs along anterior and posterior edges, and 4–6 rays; pectoral fins with stout venomous spine, usually serrate, and 9–16 rays. Anterior nostrils a short tube, separated from slit-like posterior nostrils, just behind or at base of nasal barbels. Teeth small and conical

on upper jaw, granular on lower jaw and palate, with those on palate in crescentic or triangular patch.

Bottom-feeders, using barbels around the mouth to detect benthic invertebrates and fishes. Several of the marine species have a dendritic organ behind the anus, which is thought to function in salt excretion. As in all ostariophysan fishes, the first 5 vertebrae and modified ribs form a connection between the swimbladder and ear (Weberian apparatus), which substantially improves the hearing of these fishes; vertebral counts exclude the 5 vertebrae of the Weberian apparatus. Plotosids should be handled with care as the spines can cause painful or even fatal wounds.

Occur in tropical to subtropical waters of Indo-Pacific. Ten genera and ~47 species, ~17 limited to freshwaters of Australia and New Guinea; 1 genus and 5 species in WIO.



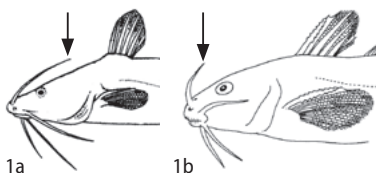
External features of a typical plotosid.

GENUS **Plotosus** Lacepède 1803

Dendritic organ posterior to anus; gill membranes separate and free from isthmus; branchiostegal rays 10–13 (usually 11); 4 pairs of barbels; lips without lobes or barbel-like extensions; anterior nostril a small tube at or above edge of upper lip; teeth present on premaxilla. Pectoral-fin spines stout, serrated on both edges. About 8 species, 5 in WIO.

## KEY TO SPECIES

- 1a Nasal barbels reaching past eyes and nearly to nape, their length more than twice distance from base of barbel to eye ..... *P. canius*  
 1b Nasal barbels not reaching past eyes ..... 2



Continued ...

## KEY TO SPECIES

- 2a Snout tip to dorsal-fin origin >25% SL; total median-fin rays ≤200 ..... 3  
 2b Snout tip to dorsal-fin origin <25% SL; total median-fin rays >200 ..... 4  
 3a Body usually with 2 or 3 prominent pale stripes in life (often indistinct in large fish), 2 extending onto head; GR 22–32 on anterior face of 1st arch; outer mental barbel >53% HL; eye diameter >15% HL ..... *P. lineatus*  
 3b Body uniformly brown dorsally, paler ventrally; GR 16 on anterior face of 1st arch; outer mental barbel <48% HL; eye diameter <15% HL ..... *P. fisdaha*  
 4a First dorsal fin 1–1½ times height of 2nd dorsal fin; GR 16–21 on anterior face of 1st arch ..... *P. nkunga*  
 4b First dorsal fin twice height of 2nd dorsal fin; GR 20–26 on anterior face of 1st arch ..... *P. limbatus*



## *Plotosus canius* Hamilton 1822

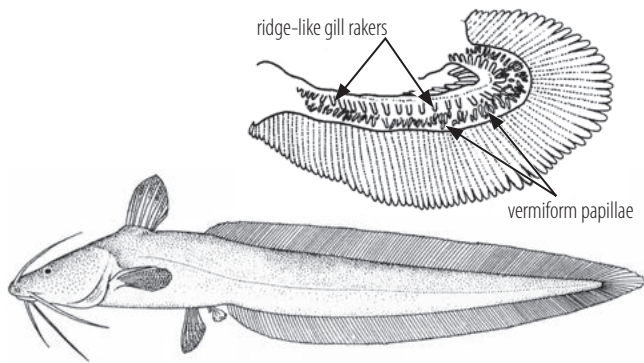
Gray eel-catfish

PLATE 29

*Plotosus canius* Hamilton 1822: 142, 374, Pl. 15, Fig. 44 (southern West Bengal, India); Gomon & Taylor 1982; Gomon 1984\*; Talwar & Jhingran 1991; Manilo & Bogorodsky 2003.

First dorsal fin 1 spine, 4 rays, last ray split to base; 2nd dorsal fin 124–143 rays; anal fin 106–131 rays; caudal fin 6–11 rays; total rays in confluent fins 247–281; pectoral fins 1 spine, 11–14 rays; pelvic fins 12–16 rays. First dorsal-fin height about twice that of 2nd dorsal fin; eyes small, diameter 7–12% HL; barbels long, nasal barbels extend past eyes and almost to nape. Teeth in upper jaw pointed, in 2 rectangular patches of 3 rows each; teeth in lower jaw in 2 patches of 4 or 5 rows each, anterior row of teeth pointed, subsequent rows molar-like. GR 22–26 on anterior edge of 1st arch, and large vermiform papillae present between gill rakers and filaments on both faces of following arches. Vertebrae 73–80.

Head and body dusky brown, underside of head and belly white, with white extending half way along anal fin. Preserved specimens brown dorsally, paler below, and fins occasionally with dark margins. Attains ~150 cm TL (commonly 80 cm TL).



*Plotosus canius*, 82 cm SL, lateral view and diagram of second gill arch. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: southwestern India and Sri Lanka; elsewhere to east coast of India, Bangladesh, Thailand, Indonesia, Philippines, New Guinea, western and northern Australia.

**REMARKS** Found mostly in lagoons, estuaries and the lower parts of rivers.

## *Plotosus fisadoha* Ng & Sparks 2002

Malagasy eel-catfish

*Plotosus fisadoha* Ng & Sparks 2002: 565, Fig. 1 (market at Fianarantsoa Province, Madagascar); Ferraris 2007; Yoshino & Kishimoto 2008.

First dorsal fin 1 spine, 4 rays, last ray split to base; 2nd dorsal fin 89 rays; anal fin 65–72 rays; caudal fin 10 rays; total rays in confluent fins 139–200; pectoral fins 1 spine, 11 or 12 rays; pelvic fins 10 or 11 rays. Head depressed and broad; eye diameter 13–14% HL; nasal barbels extend to rear margin of eyes. Teeth in both jaws small, peg-like or molariform in irregular rows. GR 16 on anterior edge of 1st arch. Vertebrae 58 or 59.

Preserved specimens uniformly brown on dorsal and lateral surfaces of head and body, belly paler brown with scattered melanophores; 1st dorsal fin and confluent fins hyaline, with dark brown margins; pectoral and pelvic fins hyaline, with sparse small dark brown spots. Attains at least 19 cm SL.

**DISTRIBUTION** Known only from two specimens from southeastern Madagascar.

**REMARKS** Caught in coastal waters; likely inhabits sandy and muddy bottom of coastal lagoons and estuaries.

## *Plotosus limbatus* Valenciennes 1840

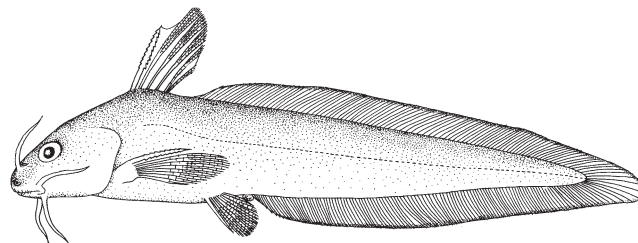
Darkfin eel-catfish

PLATE 29

*Plotosus limbatus* Valenciennes in Cuv. & Val. 1840: 422 (Malabar coast, India); Gomon & Taylor 1982; Gomon 1984\*; Randall 1995\*; Ng & Sparks 2002; Manilo & Bogorodsky 2003.

First dorsal fin 1 spine, 4–6 rays, last ray split to base; 2nd dorsal fin 106–133 rays; anal fin 87–126 rays; caudal fin 9–11 rays; total rays in confluent fins 210–243; pectoral fins 1 spine, 13–16 rays; pelvic fins 13–16 rays. First dorsal-fin height more than twice that of 2nd dorsal fin; eyes moderate, diameter 11–20% HL; nasal barbels extend to middle or rear of eyes; anterior nostrils on snout at edge of upper lip. Teeth in upper jaw pointed, in 2 rectangular patches of 2–4 rows each; teeth in lower jaw in 2 patches of 2–4 rows each, anterior row of teeth pointed, subsequent rows molar-like. GR 20–25 on anterior edge of 1st gill arch, and small papillae rarely present between gill rakers and filaments on both faces of following arches. Vertebrae 69–77.

Body and head reddish brown or grey, underside of head and belly slightly paler; fins darkest distally. Preserved specimens reddish to dark brown, pale brown ventrally; fins often blackish brown, usually with narrow black margins. Attains 58.5 cm TL.



*Plotosus limbatus*, 32 cm SL. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indian Ocean. WIO: central and southern Oman, Kenya, Comoros, southern India and Sri Lanka; not known from the Red Sea and Persian/Arabian Gulf.

**REMARKS** Occurs along open coasts and in estuaries.

### *Plotosus lineatus* (Thunberg 1787)

Striped eel-catfish

PLATE 30

*Silurus lineatus* Thunberg 1787: 31, footnote 13 (eastern Indian Ocean); Thunberg 1791\*.

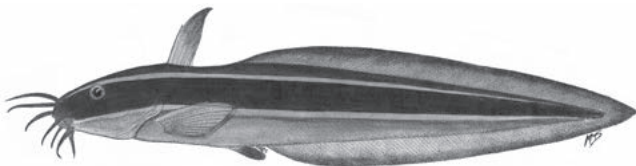
*Plotosus arab* Bleeker 1862: 111 (Tharangambadi, India); Smith & Smith 1963\*.

*Plotosus anguillaris*: Smith & Smith 1963\*, 1966\*; SFSa No. 163\* [in part: Pl. 6].

*Plotosus lineatus*: Smith 1980; Van der Elst 1981; Gomon & Taylor 1982; Gomon 1984\*; SSF No. 60.1\*; Golani 2002; Ng & Sparks 2002; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Bogorodsky *et al.* 2014.

First dorsal fin 1 spine, 4 rays, last ray split to base; 2nd dorsal fin 69–115 rays; anal fin 58–82 rays; caudal fin 9–11 rays; total rays in confluent fins 139–200; pectoral fins 1 spine, 9–13 rays; pelvic fins 10–13 rays. First dorsal-fin height about twice that of 2nd dorsal fin; eyes moderate to large, diameter 12–26% HL; nasal barbels extend to rear margin of eyes. Teeth in upper jaw pointed, in 2 patches of 2 or 3 rows each, each patch tapering to a point laterally; teeth in lower jaw in 3 rows, conical anteriorly, molar-like posteriorly. GR 22–32 on anterior edge of 1st gill arch; both faces of gill arches without papillae. Vertebrae 49–58.

Body brown, with 2 yellowish white longitudinal stripes (from nape and from below eyes to end of anal fin) (distinct but less so in large individuals); confluent fins whitish hyaline, with narrow black margin; paired fins hyaline. Preserved specimens brown or grey to black dorsally, grey laterally, white ventrally; longitudinal stripes pale (may be lost in old specimens). Attains 32 cm SL.



*Plotosus lineatus*, 23 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to South Africa (KwaZulu-Natal, rarely farther south), Comoros, Madagascar, Seychelles, Mascarenes and India; Lessepsian migrant to eastern Mediterranean Sea; elsewhere to east coast of India, Indonesia, Philippines, southern Japan, New Guinea, Australia, New Caledonia, Samoa and Society Is.

**REMARKS** Found in tidepools, along open coasts, occasionally in estuaries, and the only catfish occurring on coral reefs; sometimes enters freshwater. Adults in small groups or solitary, often in caves or under ledges; juveniles form dense aggregations near the substrate. Stings from the dorsal- and pectoral-fin spines of this species can be fatal.

### *Plotosus nkunga* Gomon & Taylor 1982

Stinging eel-catfish

PLATE 30

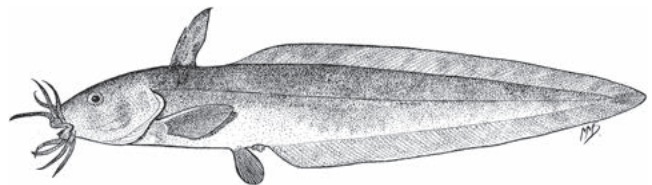
*Plotosus nkunga* Gomon & Taylor 1982: 3, Pl. 1 (Mbashe River, Eastern Cape, South Africa); Gomon 1984\*; SSF No. 60.2\*; Randall 1995\*; Heemstra & Heemstra 2004.

*Plotosus anguillaris* (*non* Bloch 1794): Gilchrist & Thompson 1917; Barnard 1925 [in part]; Fowler 1934 [in part]; Smith & Smith 1966.

*Plotosus limbatus* (*non* Valenciennes 1840): Smith 1975; Wallace 1975; ?Van der Elst 1981.

First dorsal fin 1 spine, 4 rays, last ray split to base; 2nd dorsal fin 104–120 rays; anal fin 88–109 rays; caudal fin 9 or 10 rays; total rays in confluent fins 202–237; pectoral fins 1 spine, 11–15 rays; pelvic fins 13–14 rays. First dorsal-fin height about same as that of 2nd dorsal fin; eyes moderate, diameter 11–18% HL; nasal barbels extend slightly beyond eyes. Teeth in upper jaw pointed, in 2 rectangular or triangular patches of 2–4 rows each; teeth in lower jaw in 2 patches of 3 or 4 rows each, anterior row of teeth pointed, subsequent rows molar-like in adults. GR 16–21 on anterior edge of 1st arch; all arches without papillae. Vertebrae 68–73.

Body greyish to reddish brown, underside of head and belly paler brown or cream; 2 faint longitudinal stripes sometimes present on body, from below 1st dorsal fin and first confluent with lateral line, and second line below it extending only midway along anal fin. Attains at least 73 cm TL.



*Plotosus nkunga*, 47 cm SL (WIO). Source: SSF

**DISTRIBUTION** WIO: South Africa (Knysna to Kosi Bay), likely to Tanzania (Zanzibar).

**REMARKS** Mostly marine along open coasts and in estuaries, but also enters freshwater.

#### GLOSSARY

vermiform – worm-like.

# ORDER ARGENTINIFORMES

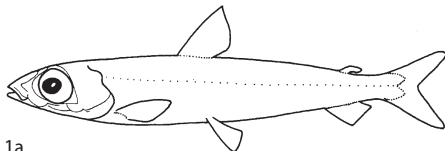
Phillip C Heemstra

Fishes possessing a crumenal organ (shallow pouch in posterolateral part of gill cavity), the narrow rear margin of which is supported by the 5th ceratobranchial and a unique accessory cartilage connecting the 5th ceratobranchial to posterodorsal tip of the 5th epibranchial, separating the organ from the branchial chamber (food particles are trapped in the upper part of the paired pouches by large, interlocking toothed gill rakers); usually without teeth on upper jaw (minute if present); anal-fin below adipose fin or below dorsal fin on rear half of body; anal fin 7–15 rays; postcleithrum present; swimbladder present.

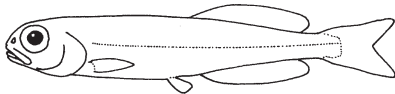
Most species occur in deep water (>1 000 m), but a few may be caught in trawls over the outer continental shelf. The order is arranged in 2 suborders and comprises 7 families, with 57 genera and ~203 species; 2 families in WIO. See Wylie & Johnson (in Nelson *et al.* 2010) for more information about this order.

## KEY TO FAMILIES

- 1a Dorsal fin at midbody, higher than anal fin; anal fin on rear fourth of body ..... **ARGENTINIDAE**  
 1b Dorsal fin and anal fin of similar height, and both fins on rear half of body ..... **ALEPOCEPHALIDAE**



1a



1b

## GLOSSARY

**ceratobranchial** – longest bones or cartilages of the branchial arches, situated immediately below the angle of the arch, between the epibranchials and the hypobranchials.

**epibranchials** – bone or cartilage forming the upper part of the gill arch, immediately above the angle of the arch.

**hypobranchials** – paired bones on the lower part of the gill arch.

**postcleithrum** – a bone behind the cleithrum of the pectoral girdle.

## FAMILY ARGENTINIDAE

### Argentines

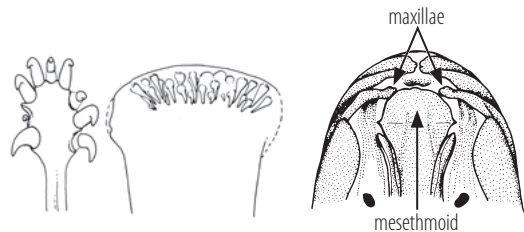
Phillip C Heemstra

Elongate, compressed, silvery body, its depth ~7 in SL. Dorsal fin high, at midbody; anal fin on rear quarter of body; adipose fin above anal fin; pelvic fins abdominal, below dorsal fin; pectoral fins below rear edge of opercle; no fin spines. Mouth terminal; upper jaw less than or subequal to eye diameter; no supramaxilla. Teeth on vomer and palatines; no teeth on upper jaw. Branchiostegal rays 4–6, membranes separate. Lateral line straight, from above gill opening to base of caudal fin. Scales cycloid. No photophores or other light organs scattered on body. Swimbladder present.

Mainly mesopelagic or demersal deep-sea fishes; collected with midwater and benthic otter trawls on the outer continental shelf and slope. Two genera and ~25 species; 3 species in WIO.

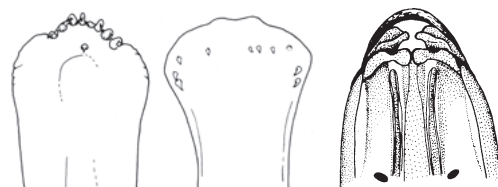
## KEY TO GENERA

- 1a Tongue with large teeth at front and sides; front end of vomer with band of closely spaced backward-curved teeth; maxillae separated at front of snout by front of ethmoid ..... *Argentina*



Tongue with large teeth (left), front of vomer with many teeth (middle), and maxillae separated at front of snout by mesethmoid (right).

- 1b Tongue and vomer with few tiny teeth on front edge; maxillae contiguous at front of snout ..... *Glossanodon*



Tongue with small teeth (left), front of vomer with few teeth (middle), and maxillae not separated by mesethmoid (right).

GENUS *Argentina* Linnaeus 1758

Diagnosis as for family. Tongue with large teeth at front and sides; front end of vomer with band of closely spaced backward-curved teeth; maxillae separated at front of snout by front of ethmoid bone; premaxilla not articulated with medial end of maxilla. Branchiostegal rays 4–6. Twelve species, 1 in WIO.

*Argentina euchus* Cohen 1961

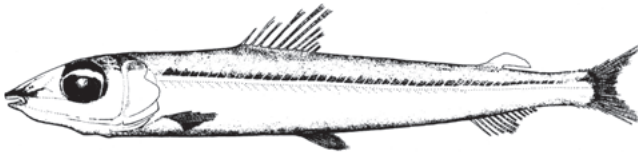
Smooth argentine

PLATE 30

*Argentina euchus* Cohen 1961: 19, Fig. 1 (off Xai-Xai, Mozambique); Cohen & Atsaiides 1969; SSF No. 61.1\*.

Dorsal fin 11 or 12 rays; anal fin 12–15 rays; pectoral fins 16–18 rays; pelvic fins 10 or 11 rays; LL scales 47–50; GR 6 on lower limb of 1st arch; branchiostegal rays 5. Body depth 6.5–8.4 in SL; HL 3.2–3.6 in SL. Vertebrae 47 or 48.

Preserved specimens silvery with dark brown band along flanks, paler below. Attains 15 cm TL.



*Argentina euchus*, 15 cm TL, paratype (S Mozambique). Source: Cohen 1961

**DISTRIBUTION** WIO: Kenya to South Africa (KwaZulu-Natal).

**REMARKS** Apparently rare; known from 240–590 m.

GENUS *Glossanodon* Guichenot 1867

Diagnosis as for family. Vomer and sometimes tongue with few tiny teeth on front edge; maxillae contiguous at front of snout. Both WIO species share the following features: anus immediately before anal-fin origin, no teeth on tongue, and branchiostegal rays 5. About 13 species, 2 in WIO.

## KEY TO SPECIES

- 1a Body depth 12–13% SL; HL 30–31% SL; small, dark brown spot on breast between pectoral-fin bases ..... *G. mildredae*  
 1b Body depth 15–17% SL; HL 33–34% SL; no dark brown spot between pectoral-fin bases ..... *G. melanomanus*

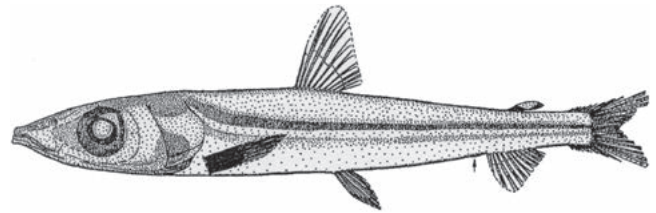
*Glossanodon melanomanus* Kobylansky 1998

Blackfin argentine

*Glossanodon melanomanus* Kobylansky 1998: 700, 727, Fig. 2 (off Handa, Somalia); Manilo & Bogorodsky 2003.

Dorsal fin 10 or 11 rays; anal fin 11 or 12 rays; pectoral fins 23 or 24 rays; pelvic fins 12 or 13 rays; GR 38 or 39 on lower limb of 1st arch. Teeth on lower jaw widely spaced; vomer and palatines with small teeth. Vertebrae 33 or 34 + 16 or 17 = 50 or 51.

Preserved fish with dark brown band below lateral line, from head to caudal-fin base; dorsal and caudal fins dark brown; pectoral fins pale brown, proximal half with numerous round black spots; peritoneum silvery with scattered chromatophores. Attains 20 cm TL.



*Glossanodon melanomanus*, 20 cm TL, female, holotype (Somalia). Source: Kobylansky 1998

**DISTRIBUTION** WIO: Somalia and Socotra.

**REMARKS** Known only from two trawls, on continental slope, at 150–302 m.

*Glossanodon mildredae* Cohen & Atsaiides 1969

Spotbreast argentine

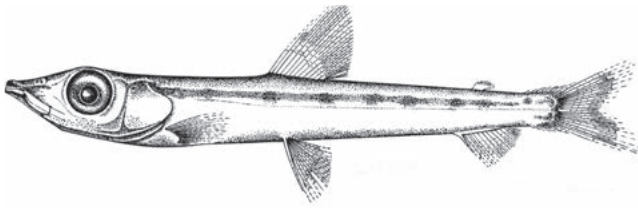
PLATE 30

*Glossanodon mildredae* Cohen & Atsaiides 1969: 34, Fig. 14 (off Dar es Salaam, Tanzania); Kobylansky 1998; Parin & Belyanina 2007.

Dorsal fin 10–13 rays; anal fin 13 rays; pectoral fins 23 rays; pelvic fins 12 or 13 rays; LL scales >55; GR 23 on lower limb of 1st arch. Lower jaw with ~10 short, widely spaced, conical teeth. Vertebrae 33 or 34 + 16 or 17 = 49–51.

Preserved specimens silvery with dark brown band above lateral line, from head to caudal-fin base, and 8–10 dark blotches spaced along band; peritoneum dusky, but gut unpigmented. Attains at least 12 cm TL.





*Glossanodon mildredae*, 6.5 cm SL, holotype (Tanzania).  
Source: Cohen & Atsides 1969 (by MH Carrington)

**DISTRIBUTION** WIO: Somalia (off Handa), Tanzania (off Dar es Salaam), Mozambique (off Maputo) and Madagascar.

**REMARKS** Known from 75–302 m.

## FAMILY ALEPOCEPHALIDAE

### Smooth-heads

Phillip C Heemstra

Body oblong to elongate, depth 6–7 in SL. Dorsal fin and anal fin similar, placed on rear half of body; pectoral fins rudimentary, on lower third of body; pelvic fins small, abdominal, at midbody near anal-fin origin; no fin spines. Eyes huge. Mouth terminal; upper jaw less than or subequal to eye diameter; minute teeth on premaxilla and lower jaw; maxilla usually toothless; 1 supramaxilla.

Mainly mesopelagic or demersal in deep sea, collected with midwater and benthic trawls, usually from continental slopes. About 23 genera and ~90 species; 1 species known from WIO, and often caught in trawls on the outer continental shelf (the family diagnosis above is based on this species).

### GENUS *Xenodermichthys* Günther 1878

No scales on head or body; photophores scattered over body as minute nodules; eye diameter greater than snout length. Two species, 1 known in WIO.

### *Xenodermichthys copei* (Gill 1884)

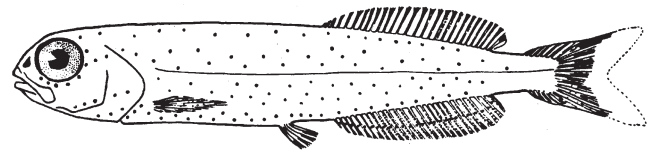
Bluntnout smooth-head

PLATE 30

*Aleposomus copei* Gill 1884: 433 (Gulf Stream, off Virginia, USA).  
*Xenodermichthys copei*: Sazonov & Ivanov 1980\*; SSF No. 64.18\*;  
Bernardes *et al.* 2005.

Dorsal fin 27–31 rays; anal fin 26–30 rays; pectoral fins 7 or 8 rays; pelvic fins 6 rays; GR 7–9/16–18. Vertebrae 46–50.

Head and body black; photophores pale blue. Attains 31 cm TL.



*Xenodermichthys copei*, 14 cm SL. Source: Holt & Byrne 1908

**DISTRIBUTION** Widespread in North and South Atlantic (not polar waters) and Indo-Pacific. WIO: Mozambique, South Africa and Madagascar Ridge; elsewhere to Tasman Sea and Great Australian Bight.

**REMARKS** Juveniles mesopelagic, adults bathypelagic and demersal; depth range ~100–2 650 m. Feeds primarily on small crustaceans.

#### GLOSSARY

**bathypelagic** – the deep part of the oceanic zone, from 1 000 m to 4 000 m.

**chromatophore** – pigment cell in the skin responsible for skin colour.

**demersal** – living on or just above the bottom of the sea or lake.

**mesopelagic** – the region of the oceanic zone from 200 m to 1 000 m.

**peritoneum** – the membrane lining the abdominal cavity.

**supramaxilla** – a small bone along the upper rear edge of the maxilla.

# ORDER AULOPIFORMES

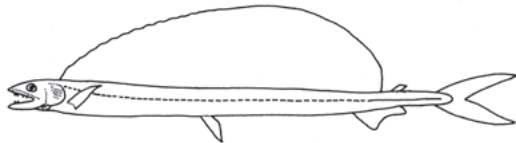
Martin F Gomon

Fishes with modified gill arches: 2nd pharyngobranchial greatly elongated posteriorly and extending away from 3rd pharyngobranchial, elongated uncinat process of 2nd epibranchial contacting 3rd pharyngobranchial, and 3rd pharyngobranchial lacking a cartilaginous condyle for articulation with the 2nd epibranchial (Johnson 1992); no swimbladder.

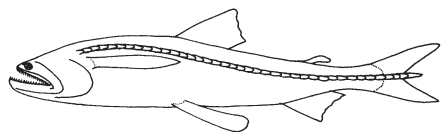
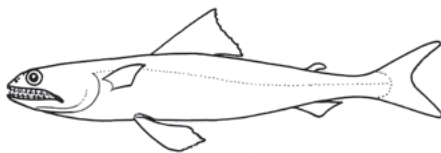
Relationships within this order and important features of the families are discussed by Baldwin & Johnson (1996), Sato & Nakabo (2002) and Davis (2010). Sixteen families, with ~44 genera and at least 250 species. All but two families are distributed primarily in deep water away from the continental shelf, and nearly half of the families inhabit mesopelagic and bathypelagic depths; 4 families in coastal waters of WIO.

## KEY TO FAMILIES

- 1a Body with scales (scales more or less deciduous and easily rubbed off, but presence can be seen by scale pockets); teeth on upper jaw in  $\geq 2$  rows (rarely uniserial) or in band of variable width ..... 2
- 1b No scales on body, except LL scales in some species; teeth on upper jaw in 1 row ..... **ALEPISAUROIDAE**



- 2a Gill rakers rudimentary or minute and spine-like; teeth on jaws distinct, needle-like or lanceolate; tongue with obvious teeth ..... **SYNODONTIDAE**

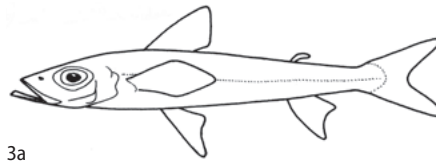


- 2b Gill rakers elongate and lathe-like; teeth on jaws small and cardiform, minute, or absent; tongue without teeth or with a few fine teeth ..... 3

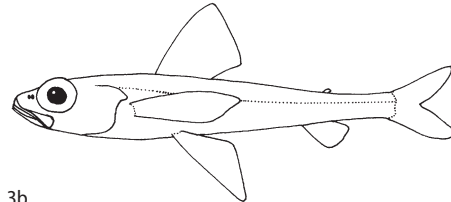
Continued...

## KEY TO FAMILIES

- 3a Innermost pelvic-fin ray unbranched, distinctly broader proximally than adjacent fin ray; lower jaw distinctly projecting in front of upper jaw, and exposed upper surface of jaw tip with 1 to many rows of small teeth; larger teeth and/or bony tabs directed anteriorly or anterolaterally in some species; teeth on jaws not overlapping onto lateral surfaces of premaxilla and dentary ..... **CHLOROPHTHALMIDAE**
- 3b Innermost pelvic-fin ray branched, about as broad proximally as adjacent ray; lower jaw projecting in front of upper jaw only slightly or not at all; teeth on jaws in broad bands, overlapping onto lateral surfaces of premaxilla and dentary ..... **PARAULOPIIDAE**



3a



3b

## FAMILY CHLOROPHTHALMIDAE

Greeneyes

Martin F Gomon

Body elongate and slender; most species almost cylindrical anteriorly, compressed posteriorly, and tapering towards both ends, with greatest body depth at dorsal-fin origin. Head pointed; bony surfaces on top of head mostly smooth. Opercular flap with bilobed free edge formed by both opercle and subopercle. Eyes usually huge, with aphakic (lensless) space for forward vision, close-set and positioned dorsolaterally; iris greenish or yellowish. Mouth large, extending to or nearly to centre of eyes; upper jaw not protractile; no supramaxilla; lower jaw projecting in front of upper jaw, and its exposed surface with one to many rows of small teeth, but larger teeth and/or bony tabs directed anteriorly or anterolaterally in some. Teeth in jaws small to

moderate, usually cardiform and depressible, and those in outer row slightly enlarged in some species; teeth also present on palatines, vomer and tongue. Dorsal fin 10 or 11 rays (no spines): first 2 rays always unbranched, others usually branched, and last ray always branched to its base; dorsal-fin origin just in front of pelvic-fin insertions. Pectoral fins 14–17 rays: first 2 rays and last ray always unbranched, other rays usually branched, and middle rays longest; pectoral-fin tip either not reaching to or else extending beyond pelvic-fin tip. Pelvic fins 9 rays, with first and last rays unbranched and other rays branched; inner rays slightly shorter than outermost, and broader proximally than adjacent ray; pelvic-fin bases close together and inserted abdominally, behind pectoral-fin origins and just behind dorsal-fin origin. Anal fin 7–10 rays: first 2 rays always unbranched, other rays branched, and last ray always branched to its base; anal fin set well behind dorsal fin. Small adipose fin over anal fin. Caudal fin forked, with 17 principal rays, 15 branched rays. Gill openings large; branchiostegal rays 8, gill membranes free from isthmus; gill rakers numerous and elongate on lower limb. Cycloid scales on head and body; scales on nape reaching to behind eyes, and scales also present on cheek, opercle, and proximally on procurrent and primary caudal-fin rays. No swimbladder.

Deepwater, bottom-dwelling on mud and sand, mostly on continental slope but occasionally near continental-shelf break, to 600 m or more. Eggs planktonic; larvae and juveniles pelagic. Feed mainly on small benthic invertebrates.

Two genera recognised: *Parasudis* Regan 1911, with 2 or 3 species in the Atlantic, and the circumglobal *Chlorophthalmus* with many species (and many undescribed). Most Indo-Pacific species of *Chlorophthalmus* occur in two distinct species-complexes: one complex rather widely distributed (including *C. acutifrons* and *C. nigromarginatus*), and the other complex far more restricted and with a significant number of undescribed species.

## GENUS *Chlorophthalmus* Bonaparte 1840

Mouth large, upper jaw reaching distinctly past front edge of eyes. Teeth in jaws small; no enlarged fixed canines on palatines or vomer. GR >14 on lower limb of 1st arch. Anus usually black, located closer to pelvic-fin insertions than to anal-fin origin, and separated from bases of inner pelvic-fin rays by 2 or 3 rows of scales. Seventeen species; at least 5 species (1 undescribed) in WIO recorded at depths of <280 m. A report of *C. agassizi* in the Indian Ocean (Norman 1939) is a misidentification.

## KEY TO SPECIES

- 1a Exposed tip of lower jaw smoothly curved, naked, without medial bony tab or distinct teeth along leading edge ..... 2
- 1b Exposed tip of lower jaw with medial bony tab and/or distinct teeth along leading edge ..... 3
- 2a Exposed tip of lower jaw with 1 or 2 rows of fine teeth posteriorly; HL 30–32% SL ..... *C. acutifrons*
- 2b Exposed tip of lower jaw with 3 or 4 rows of fine teeth posteriorly; head large, HL ~34% SL ..... *C. vityazi*
- 3a Exposed lower jaw tip terminating in transverse horizontal plate, corners produced to form strong tooth-like processes, without other teeth on leading edge of lower jaw .... *C. corniger*
- 3b Exposed lower jaw tip with distinct teeth on periphery (at least laterally), and corners of medial bony tab, if present, usually rounded ..... 4
- 4a Upper surface of exposed lower jaw tip covered with moderate-sized curved teeth in numerous ill-defined rows, teeth on leading edge sometimes slightly enlarged; head large, HL ~33–34% SL; vertebrae 48 ..... *Chlorophthalmus* sp.
- 4b Upper surface of exposed lower jaw tip with peripheral row of noticeably enlarged teeth splayed horizontally, and central rectangular bony tab followed by toothless, concave, bony surface, and then row of small depressible teeth on rear margin; head small, HL ~28–31% SL; vertebrae 50 or 51 ..... *C. punctatus*

## *Chlorophthalmus acutifrons* Hiyama 1940

Humpback greeneye

PLATE 31

*Chlorophthalmus acutifrons* Hiyama 1940: 171, Figs. 2–3a (Kumano-Nada, Japan); Kobylansky 2013; Bineesh *et al.* 2014.

Dorsal fin 11 or 12 rays; anal fin 9 or 10 rays; pectoral fins 15 or 16 rays, and fin tip reaching well short of pelvic-fin tip. LL scales 50–53; TSR 7.5 or 8.5/7.5 or 8.5; GR 2–4/15 or 16. Adults with pronounced hump at base of dorsal fin in lateral profile; head moderately long, HL ~30–32% SL; eye diameter ~28–34% HL; lower jaw jutting slightly beyond upper jaw, its exposed surface with smooth toothless front margin for most of its width, 1 or 2 rows (sometimes patches) of smaller teeth at lateral extremes, and 1 row of depressible teeth posteriorly. Vertebrae 45 or 46.

Head and body brown to grey dorsally, silvery laterally, and pink to white ventrally; several dark brown oblong patches on sides of body; dark grey on dorsal-fin margin and base, along inner edges of pelvic fins, and on much of caudal fin; anus black, surrounded by dark grey. Attains 25 cm SL.



*Chlorophthalmus acutifrons*, 19 cm SL (SW India). KV Akhilesh © CMFRI

**DISTRIBUTION** Indo-Pacific. WIO: southern India (Bineesh *et al.* 2014); elsewhere, Philippines, Taiwan, southern Japan, northern Australia and New Zealand.

**REMARKS** Known from 150–550 m.

### *Chlorophthalmus corniger* Alcock 1894

Spinyjaw greeneye

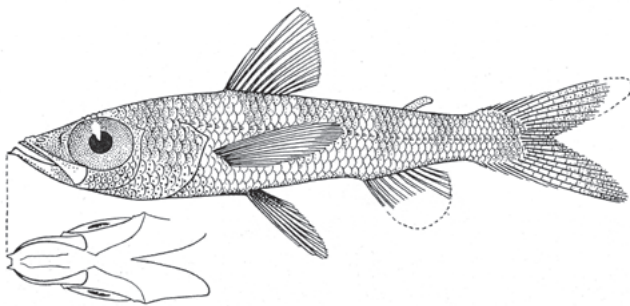
PLATE 31

*Chlorophthalmus corniger* Alcock 1894: 133 [19], Pl. 6, Fig. 5 (Bay of Bengal); Bineesh *et al.* 2014.

*Chlorophthalmus bicornis* Norman 1939: 25, Fig. 6 (Gulf of Aden); Sato & Nakabo 2002; Manilo & Bogorodsky 2003.

Dorsal fin 11 rays; anal fin 10 or 11 rays; pectoral fins 16 or 17 rays, and fin tip nearly reaching pelvic-fin tip. LL scales 48 or 49; GR 3 or 4/20 or 21. Head large, HL 34–40% SL; eye diameter ~30–35% HL; tip of lower jaw jutting well forward of upper jaw, terminating in transverse horizontal plate, its corners produced to form strong anteriorly directed spine-like processes. Vertebrae 44 or 45.

Body silvery grey, with numerous minute black spots, and also traces of darker broad crossbars in smaller individuals; caudal fin, pectoral fins and parts of pelvic fins black. Attains ~17 cm SL.



*Chlorophthalmus corniger*, 9 cm TL, holotype of *C. bicornis* (Aden). Source: Norman 1939

**DISTRIBUTION** Indian Ocean. WIO: Somalia, Gulf of Aden to Persian/Arabian Gulf and India; elsewhere to Indonesia (Java).

**REMARKS** Found at 220–500 m. Known in eastern Indian Ocean from immature individuals in which the prominent spines at the corners of the lower jaw had not yet fully developed; a recent genetic comparison of specimens of the same size and adults otherwise identified as *C. bicornis* shows they are the same species (Bineesh *et al.* 2014).

### *Chlorophthalmus punctatus* Gilchrist 1904

Spotted greeneye

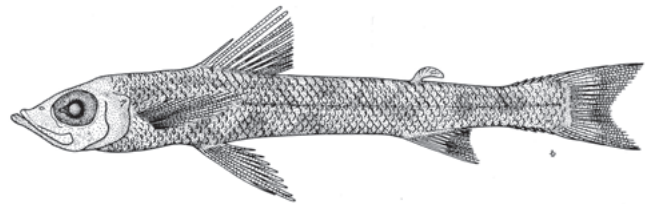
PLATE 31

*Chlorophthalmus punctatus* Gilchrist 1904: 15, Pl. 35 (off Lion's Head, Cape Point, South Africa); Gilchrist & Von Bonde 1924; Barnard 1925; Mead 1966; Shcherbachev 1981; SSF No. 76.9\*; Bianchi & Carpenter *in* Bianchi *et al.* 1993; Kobylansky 2013.

*Chlorophthalmus agassizi* (*non* Bonaparte 1840); Smith 1961.

Dorsal fin 11 rays; anal fin 10 rays; pectoral fins 15 rays, and fin tip not reaching pelvic-fin tip. LL scales 55 or 56; TSR 6.5/7.5; GR 2/19. Head relatively short, HL ~28–31% SL; eyes large, eye diameter ~39–46% HL; tip of lower jaw jutting well forward of upper jaw, its exposed surface with row of noticeably enlarged teeth splayed horizontally, and rectangular bony tab at centre, followed by toothless, concave, bony surface, and then 1 row of small depressible teeth. Vertebrae 50 or 51.

Head and body grey dorsally, silvery laterally, and pink to white ventrally; head, body and fins covered with fine black spots, and fine black lines along margins of scale rows descending obliquely backwards; dark brown patches revealed after death on nape, between dorsal fin and adipose fin, and on sides of body; anus broadly encircled with black, and broad inner margin of pelvic fins overlying anus also black. Attains at least 17 cm SL.



*Chlorophthalmus punctatus*, 12 cm SL. Source: SSF

**DISTRIBUTION** Reliable records from off South Africa in southeastern Atlantic, to Mozambique in WIO.

**REMARKS** Known from 280–580 m.



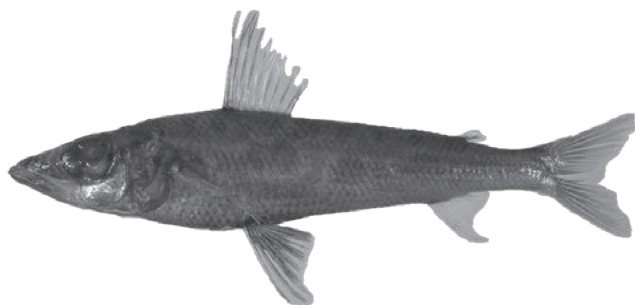
## *Chlorophthalmus vityazi* Kobylansky 2013

PLATE 31

*Chlorophthalmus vityazi* Kobylansky 2013: 376, Figs. 4–5  
(Madagascar, 12°24'8 S, 48°26'2 E [as published]).

Dorsal fin 11 rays; anal fin 9 rays; pectoral fins 15 rays, and fin tip not reaching pelvic-fin tip. LL scales 50; TSR 6.5/6.5; GR 2/17. Head moderate, HL ~34% SL; eyes moderate, eye diameter ~33% HL; tip of lower jaw jutting slightly in front of upper jaw, its exposed tip smoothly curved and naked, followed by 3 or 4 rows of fine teeth, band of teeth broadest at lateral corners. Vertebrae 45–47.

Head and body dusky dorsally, pale laterally and ventrally; round to oblong darker patches on sides (probably silvery in life); extremely fine black lines along margins of scale rows descending obliquely backward; small blackish specks densest on belly and chest; small dark blotch in pectoral-fin axil; dorsal fin pale grey with darker leading edge; caudal fin greyish; all other fins mostly pale, except inner margins of pelvic fins broadly black overlying anus; anus black, with pigmented area extending forward slightly. Attains at least 16 cm SL.



*Chlorophthalmus vityazi* (E Indian Ocean). © T Kawai, HUMZ

**DISTRIBUTION** Indian Ocean. WIO: Mozambique and Madagascar; elsewhere to Indonesia (Java).

**REMARKS** Collected off Mozambique and continental slope of Madagascar, at 170–280 m. Closely related to *Chlorophthalmus nigromarginatus* Kamohara 1953 from northwestern Australia and western Pacific.

## *Chlorophthalmus* sp.

PLATE 31

*Chlorophthalmus agassizi* (non Bonaparte 1840): Norman 1939.

Dorsal fin 11 rays; anal fin 10 rays; pectoral fins 15 rays, and fin tip not reaching pelvic-fin tip. LL scales 54 or 55; TSR 6.5/7.5;

GR 2/18 or 19. Head large, HL ~33–34% SL; eyes large, eye diameter ~38–40% HL; tip of lower jaw jutting well forward of upper jaw with rectangular bony tab at centre, often with 2 or 3 knobs on anterior margin, exposed dorsal surface with 5 or 6 undefined rows of curved teeth and medial toothless strip, teeth on front margin sometimes slightly enlarged and curved towards centre of jaw; teeth on exposed surface followed by 1 row of depressible teeth. Vertebrae 48.

Head and body dusky dorsally, pale laterally and ventrally; round to oblong darker patches on back and sides (probably silvery in life); fine black lines along margins of scale rows descending obliquely backward; some small blackish spots, especially on belly; dark blotch in pectoral-fin axil; fins mostly pale, except inner margins of pelvic fins overlying anus broadly black; anus black, pigmented area not extending far from it. Attains at least 16 cm SL.

**DISTRIBUTION** Indian Ocean. WIO: Kenya, Mozambique (off Xai-Xai); elsewhere, possibly western Indonesia.

**REMARKS** Collected at 170–430 m in WIO. Presumably part of a species-complex that includes *Chlorophthalmus albatrossis* Jordan & Starks 1904 from the western Pacific.

### GLOSSARY

**aphakic space** – a space in the eye of fishes which is said to either enlarge the binocular field of vision or enhance the relative illumination of a portion of the retina of the fish.

## FAMILY PARAULOPIDAE

### Cucumberfishes

Martin F Gomon

Body elongate, slender and cylindrical to somewhat cigar-shaped, compressed and tapering to slender peduncle. Head bluntly pointed, often with short snout; bony surface of head mostly smooth. Eyes large to huge, relatively close-set and positioned dorsolaterally to laterally, and with aphakic space for forward vision. Mouth large, terminal, and gape oblique; upper jaw not protractile, bordered its entire length by premaxilla, and extending nearly to centre of eye; no supramaxilla; tip of lower jaw jutting only slightly forward of upper jaw in some species, and without teeth on exposed surface. Teeth small, caniniform, in broad bands (not rows) on jaws, overlapping onto lateral surfaces of premaxilla and dentary; teeth present on jaws, vomer, palatines, pterygoids

and tongue. Dorsal fin 10 or 11 rays, first 2 rays always unbranched and other rays usually branched, last ray always branched to its base; dorsal fin just before midpoint of back, its origin just in front of pelvic-fin origins. Pectoral fins 13–20 rays, and fin tip not reaching pelvic-fin tip; first 2 rays and last ray always unbranched, other rays usually branched; middle rays longest. Pelvic fins 9 rays, first ray unbranched and all other rays branched; inner rays subequal or slightly shorter than outer rays, and all of similar width proximally; pelvic-fin bases close together and inserted abdominally, behind pectoral-fin origins and just behind dorsal-fin origin. Anal fin 8–11 rays, first 2 rays always unbranched and other rays branched, last ray always branched to its base; anal fin set well behind dorsal fin. Adipose fin over rear part of anal-fin base. Caudal fin forked, with 18 principal rays, 16 branched rays. Gill openings large; opercular flap with bilobed free edge formed by both opercle and subopercle; 4 gill arches, extending far forward into mouth, well in advance of angle of gape; gill rakers numerous and elongate on lower limbs. Branchiostegal rays 8, gill membranes free from isthmus. Cycloid scales on head and body; scales on nape reaching to back of eyes, and scales also on cheek, opercle, and proximally on procurrent and primary caudal-fin rays. No swimbladder.

Deepwater, bottom-dwelling on mud and sand, usually on outer continental shelf and upper slope, at ~40–1 000 m. Feed mainly on small free-swimming prey. One genus, *Paraulopus*, described in 2002; all nominal species had been previously referred to *Chlorophthalmus* of family Chlorophthalmidae.

## GENUS *Paraulopus* Sato & Nakabo 2002

Mouth terminal; lower jaw protruding forward of upper jaw slightly or not at all, and in dorsal aspect may be visible as thin edge around front of upper jaw; teeth in broad bands on jaws, overlapping onto lateral surfaces of premaxilla and dentary. This genus comprises two species-complexes: the Australasian *P. nigripinnis* complex with a mostly subtropical to temperate distribution, and the more tropical *P. oblongus* complex distributed from WIO to western Pacific. Fourteen species, 1 in WIO.

### *Paraulopus maculatus* (Kotthaus 1967)

African cucumberfish

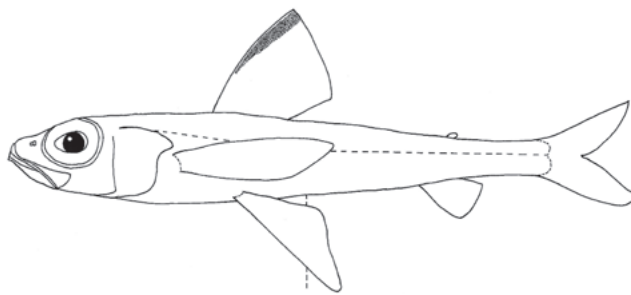
*Chlorophthalmus maculatus* Kotthaus 1967: 77, Figs. 76–81 (off Mombasa, Kenya).

*Paraulopus maculatus*: Sato & Nakabo 2002, 2003\*; Sato *et al.* 2010.

*Chlorophthalmus maculatus*: Manilo & Bogorodsky 2003\*.

Dorsal fin 11 rays; anal fin 8 or 9 rays; pectoral fins 19 rays, and fin tips reaching beyond dorsal-fin base. LL scales 42; TSR 2½/2½; GR 7/21 or 22. Vertebrae 25.

Body pale brown, with several black blotches on sides, pale spots on upper half of sides, and dark blotch on chest; dorsal fin with dark leading edge distally; caudal fin white; inside of mouth white. Attains at least 10 cm SL.



*Paraulopus maculatus*, 8 cm SL (Kenya). Source: Sato & Nakabo 2003

**DISTRIBUTION** Known only from type specimens collected off Kenya (Mombasa).

**REMARKS** Taken at 178–220 m.

## FAMILY SYNODONTIDAE

Lizardfishes

Barry C Russell

Body fusiform and slender, cylindrical (*Synodus*, *Saurida* and *Trachinocephalus*) or compressed (*Harpadon*); head depressed to compressed; bony surfaces on top of head slightly or very rugose. Eyes moderate or small, laterally directed. Adipose eyelid on anterior and posterior margins of eye. Mouth large, gape tending to be oblique. Upper jaw not protractile, bordered its entire length by premaxilla, its length >½ HL, and extending well past rear margin of eyes in adults; maxilla reduced (very slender and closely adherent to premaxilla (*Saurida*, *Synodus* and *Trachinocephalus*) or vestigial (*Harpadon*); supramaxilla small (1 supramaxilla in *Harpadon* and 2 supramaxillae in *Saurida*) or absent (*Synodus* and *Trachinocephalus*). Lower jaw with or without fleshy knob at tip. Teeth cardiform, moderately sized, usually short, pointed and depressible (not barbed), and in multiple rows; no distinct canines; teeth present on palatines (1 tooth band in *Synodus* and *Trachinocephalus*, and 2 tooth bands in *Saurida* and *Harpadon*) and also on tongue. Vomer present (*Saurida* and *Harpadon*) or absent (*Synodus* and *Trachinocephalus*). Opercular flap with free edge

formed by both opercle and subopercle. Gill openings large; gill membranes free from isthmus; 4 gill arches, extending far forward into mouth, well in advance of angle of gape; gill rakers rudimentary or minute and spine-like. Branchiostegal rays 12 (*Trachinocephalus*), 13 (*Saurida*), 15–18 (*Synodus*) or 17 (*Harpadon*). Head and body with cycloid scales (*Saurida*, *Synodus* and *Trachinocephalus*) or naked (body with deciduous scales in some species) except for series of scales along lateral line and on tail (*Harpadon*); scales on caudal fin either present on procurrent and primary rays (*Saurida*), present only on procurrent rays (*Trachinocephalus*), or entirely absent from fin (*Harpadon* and *Synodus*).

Fins with articulated soft rays, except for a few anterior, secondary caudal-fin rays, and usually none greatly prolonged (*Saurida tumbil* with elongated anterior dorsal-fin rays). Dorsal fin about midway on back, posterior to pelvic-fin insertions; first 2 rays always unbranched, the others usually branched, and last ray always branched to its base. Pectoral fins not reaching to or extending beyond pelvic-fin origins; first and last rays always unbranched, the others usually branched. Pelvic fins with 8 rays (*Synodus* and *Trachinocephalus*) or 9 rays (*Harpadon* and *Saurida*), and fins close-set and abdominal, behind pectoral-fin origins and before dorsal-fin origin; first and last rays unbranched, all others branched; inner rays of pelvic fins subequal or slightly longer than outer rays (*Harpadon* and *Saurida*) or distinctly ~2–3 times longer than outermost rays (*Synodus* and *Trachinocephalus*). Anal fin behind dorsal fin; first 2 rays always unbranched, the others branched or unbranched, and last ray always branched to its base. Adipose fin present over anal-fin base (except reduced or absent in *Synodus sageneus*). Caudal fin forked, with 19 principal rays, 17 branched rays. Anus just before anal-fin origin. Colour variable and usually well-camouflaged, often brown, reddish or silvery, with red, yellow or blue markings; peritoneum either pale with black spots on each side of midventral line or entirely black.

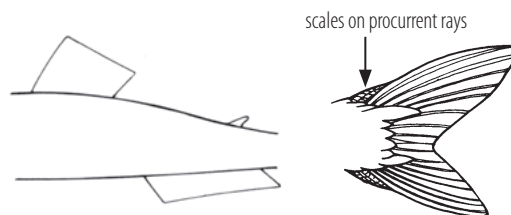
Inhabit rocky coral or muddy sand bottom, in coastal, estuarine and offshore continental-shelf waters, to ~300 m deep, but most species occur much shallower; often bury in soft substrate with just their eyes showing. Voracious predators, feeding mainly on other small fishes and crustaceans.

This family requires taxonomic revision. Recognition of the limits of the family Synodontidae as comprising the genera *Harpadon*, *Saurida*, *Synodus* and *Trachinocephalus* generally accords with the classification of Nelson (1984), except that the genus *Bathysaurus*, following the more recent work of Baldwin & Johnson (1996), is placed in the family Bathysauridae (suborder Giganturoidei). About 71 species; 4 genera and at least 25 species in WIO at depths of <200 m.

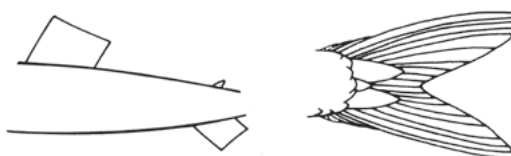
#### KEY TO GENERA

- 1a Pelvic fins 8 rays, inner rays ~2–3 times longer than outermost rays ..... 2  
 1b Pelvic fins 9 rays, inner rays subequal to or slightly longer than outer rays ..... 3

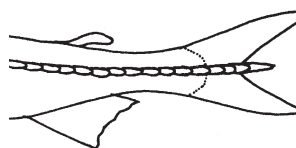
- 2a Anal fin 15–17 rays; anal-fin base longer than dorsal-fin base; scales present on procurrent caudal-fin rays ..... *Trachinocephalus*



- 2b Anal fin 8–11 rays; anal-fin base shorter than dorsal-fin base (except longer in *Synodus sageneus*); no scales on procurrent caudal-fin rays ..... *Synodus*



- 3a Body compressed; LL scales enlarged and extending as median lobe of caudal fin; no scales on primary caudal-fin rays ..... *Harpadon*



- 3b Body cylindrical; LL scales not enlarged and not extending beyond caudal-fin base; scales present on procurrent and primary caudal-fin rays ..... *Saurida*



GENUS *Harpadon* Lesueur 1825

Body and head compressed, bony surfaces on top of head not rugose. Eyes small. Snout short; mouth very wide, gape oblique, lower jaw longer than upper jaw; maxilla vestigial; 1 small supramaxilla; vomer present. Teeth on palatines in 2 bands, and also present on tongue. Dorsal fin about midway on back, its origin approximately over pelvic-fin insertions; adipose fin over rear half of anal-fin base, or adipose fin absent; anal fin well behind dorsal fin; pectoral fins not reaching pelvic-fin origin; pelvic fins 9 rays, inner rays subequal or slightly longer than outer rays. Head and body naked (or body with deciduous scales in some species), except for series of scales along lateral line and on caudal fin, or else fully scaled. Branchiostegal rays 16–26. Body typically brown or grey, and peritoneum black. Five species; 3 species in WIO, but only 1 of these at depths of <200 m.

*Harpadon nehereus* (Hamilton 1822)

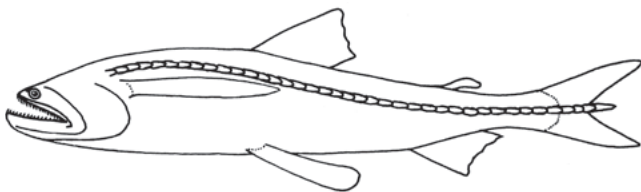
Bombay duck

PLATE 31

*Osmerus nehereus* Hamilton 1822: 209, 380 (Ganges Delta, India).*Salmo microps* Lesueur 1825: 48, Pl. 3 ('East Indian Seas').*Saurus ophiodon* Valenciennes in Cuv. & Val. 1850: 490 (Mumbai, Malabar, Coromandel, Puducherry and Ganges River mouth, India; Yangon, Myanmar; China; Malacca, Malaysia).*Harpadon nehereus*: Raj 1954; Bapat 1970; Klausewitz 1983; Manilo & Bogorodsky 2003.

Diagnosis as for genus. Dorsal fin 11–13 rays; anal fin 13–15 rays; pectoral fins 10–12 rays, fins long, reaching beyond pelvic-fin origins. Body flabby, naked anteriorly, but with deciduous scales on posterior half; LL scales ~40.

Body brown or grey, with fine black specks, somewhat translucent in life; fins dusky. Attains 40 cm SL.

*Harpadon nehereus* (India).

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to Somalia, Red Sea, Persian/Arabian Gulf, Gulf of Oman to India and Sri Lanka; elsewhere to Bay of Bengal, Andaman Sea, Gulf of Thailand, Malaysia, Indonesia (Java), Philippines, East China Sea, southern Japan, New Guinea and Sulu Sea.

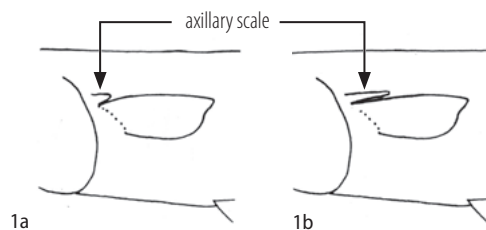
**REMARKS** Benthopelagic, over sandy-mud bottom; offshore for most of year, but gathers in large shoals in river deltas to feed during monsoons. Excellent food fish, typically caught with bag nets in tidal currents.

GENUS *Saurida* Valenciennes 1850

Body elongate and cylindrical; head depressed; bony surfaces on top of head at most slightly rugose. Snout blunt, shorter or longer than eye diameter. Mouth large, gape usually oblique; maxilla reduced (very slender and closely adherent to premaxilla); 2 small supramaxillae; vomer present. Teeth on palatines in 2 bands, and present on tongue. Dorsal fin about midway on back but posterior to pelvic-fin insertions; adipose fin over anal-fin base; pectoral fins not reaching to or else extending beyond pelvic-fin origins; distinguished by pelvic fins with 9 rays, inner rays subequal to or slightly longer than outer rays; anal fin posterior to end of dorsal fin. Branchiostegal rays 13–16. Cycloid scales on head and body, including on procurrent and primary caudal-fin rays. Colour variable, but often brown, reddish or silvery, and with red, yellow or blue markings; peritoneum either pale with 5–11 black spots on each side of midventral line, or entirely black. This genus requires revision, thus the key to species and nomenclature here are provisional. About 21 species; at least 7 species in WIO occurring at depths of <200 m (to date, *Saurida golanii* from the Gulf of Aqaba has been trawled at ~200–500 m).

## KEY TO SPECIES

- 1a Longest dorsal-fin ray at most 2–3 times as long as last ray; pectoral-fin axillary scale short and broad; all fins with series of dark bars or spots ..... 2
- 1b Longest dorsal-fin ray >3 times as long as last ray; pectoral-fin axillary scale long and pointed; no dark bars or spots on fins (except some species with dark marks on leading edge of dorsal- and/or caudal-fin rays) ..... 3

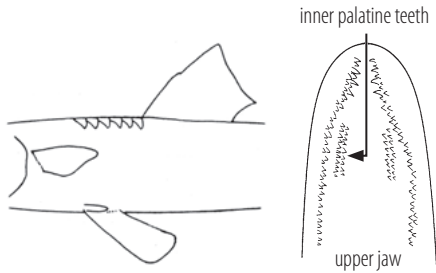


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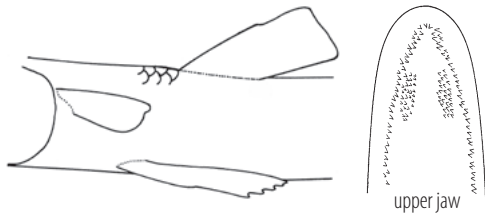


**KEY TO SPECIES**

- 2a Pectoral fins short, tips barely reaching pelvic-fin insertions and no closer to dorsal-fin origin than as far as 4th row of predorsal scales; pectoral-fin rays usually 12 (rarely 11 or 13); no vomerine teeth, and inner palatine teeth in 2 distinct rows; dark pigment always present on gill filaments and upper half of peritoneal cavity ..... *S. nebulosa*



- 2b Pectoral fins long, tips clearly extend past pelvic-fin insertions to within 2 or 3 scale rows of dorsal-fin origin; pectoral-fin rays usually 13 (rarely 12 or 14); small patch of vomerine teeth, and inner palatine teeth in ~3 poorly defined rows; gill filaments often without pigment, and peritoneal pigment usually restricted to narrow band over kidneys ..... *S. gracilis*



- 3a Pectoral fins very long (18–24% SL), extending to or beyond insertion of 1st dorsal-fin ray ..... *S. longimanus*
- 3b Pectoral fins short or moderately long (<18% SL), not reaching to or else extending only slightly beyond pelvic-fin bases ..... 4
- 4a Outer palatines with 2 rows of teeth anteriorly ..... 5
- 4b Outer palatines with 3 rows of teeth anteriorly ..... 6
- 5a LL scales 46–51 ..... *S. lessepsianus*
- 5b LL scales 54 or 55 ..... *S. tweddlei*
- 6a Pectoral fins barely reaching pelvic-fin bases; peduncle depressed, slightly wider than deep; middle pelvic-fin rays dusky; stomach and intestines pale whitish ..... *S. tumbil*
- 6b Pectoral fins reaching beyond pelvic-fin bases; peduncle laterally compressed, deeper than wide; pelvic fins unpigmented; stomach dark anteriorly, intestines black ..... *S. golanii*

*Saurida golanii* Russell 2011

Golani's lizardfish

PLATE 31

*Saurida golanii* Russell 2011: 22, Fig. 1 (Eilat, Israel, Gulf of Aqaba, Red Sea).  
*Saurida tumbil* (non Bloch 1795): Baranes & Golani 1993.

Dorsal fin 12 rays; anal fin 10 rays; pectoral fins 14 or 15 rays, and fins long, reaching beyond a line from base of pelvic fin to origin of dorsal fin. LL scales 53 or 54; TSR 4½/5½; no teeth on vomer.

Body brown dorsally, paler below lateral line, and dark pigment continuing 4 or 5 scale rows below lateral line; distal two-thirds of pectoral fins dusky; pelvic fins pale; dorsal, caudal and anal fins without bars or dark pigmentation; stomach dark anteriorly, intestines black. Attains 36 cm SL.

**DISTRIBUTION** WIO: northern Red Sea.

**REMARKS** Benthic, on soft sand-mud in relatively deep water; collected with trammel nets from ~200–500 m.

*Saurida gracilis* (Quoy & Gaimard 1824)

Graceful lizardfish

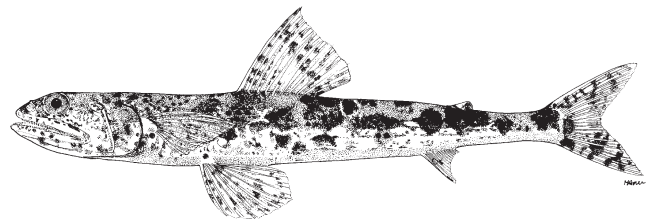
PLATE 32

*Saurus gracilis* Quoy & Gaimard 1824: 224 (Hawaii; Mauritius, Mascarenes).

*Saurida gracilis*: Dor 1984; Winterbottom *et al.* 1989; Goren & Dor 1994; SSF No. 79.2\* [1995]; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004; Fricke *et al.* 2009; Golani & Bogorodsky 2010.

Dorsal fin 11 (rarely 12) rays; anal fin 9 or 10 rays; pectoral fins 13 (rarely 12 or 14) rays, and fins long, tips reaching past pelvic-fin insertions to within 2 or 3 scale rows of dorsal-fin origin. LL scales 50–52; small tooth patch on vomer.

Body whitish, mottled with brown dorsally, and with 3 large blackish blotches on upper sides (behind dorsal fin, below adipose fin, and at caudal-fin base). Attains 32 cm SL.



*Saurida gracilis*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Red Sea, East Africa to South Africa (Algoa Bay), Madagascar, Comoros, Seychelles, Mascarenes and India; elsewhere to Bay of Bengal, Ryukyu Is., Australia, New Caledonia, Lord Howe I., Rapa Iti, Pitcairn Is. and Hawaii.

**REMARKS** Inhabits coral reefs, reef flats and inter-reef sandy bottom, mainly in shallow water, but to ~135 m deep.

## *Saurida lessepsianus*

Russell, Golani & Tikochinsky 2015

Lessepsian lizardfish

PLATES 32 & 33

*Saurida lessepsianus* Russell, Golani & Tikochinsky 2015: 560, Figs. 1–2 (Red Sea; Mediterranean Sea).

*Saurus badimottah*: Rüppell 1837 [in part].

*Saurida tumbil* (non Bloch 1795): Chabanaud 1932.

*Saurida gracilis* (non Quoy & Gaimard 1824): Chabanaud 1934.

*Saurida sinaitica* Dollfus in Gruvel 1936: 174 (Suez Canal) [name only, but not available]; Gruvel & Chabanaud 1937; Fowler 1956 [name in synonymy of *S. gracilis*]; Dor 1984 [name in synonymy of *S. gracilis*].

*Saurida undosquamis* (non Richardson 1848): Norman 1939; Fowler 1956; Ben-Tuvia 1966; Demidov & Viskrebentsev 1970; Bayoumi 1972; Dor 1984; Golani 1993; ?Manilo & Bogorodsky 2003; ?Heemstra & Heemstra 2004\*; Golani & Bogorodsky 2010.

*Saurida grandisquamis* (non Günther 1864): Ben-Tuvia 1953; Tortonese 1953; Oren 1957.

*Saurida macrolepis* (non Tanaka 1911): Inoue & Nakabo 2006; Fishelson *et al.* 2010; Golani & Bogorodsky 2010; Fishelson *et al.* 2011; Fishelson *et al.* 2012.

*Saurida* sp.: Bogorodsky *et al.* 2014.

Dorsal fin 11 or 12 rays; anal fin 10–12 rays; pectoral fins 13–15 rays, fins moderately long and extending to vertical between pelvic-fin origins and dorsal-fin origin; LL scales 47–51; 0–2 teeth on vomer.

Body brown dorsally, scale edges darker, and silvery white ventrally; series of ~9 dark elongate spots along lateral line; leading edge of caudal fin with 3–8 (usually 6 or 7) small blackish spots. Attains ~28 cm SL.



*Saurida lessepsianus*, 17 cm SL (Red Sea). © SV Bogorodsky

**DISTRIBUTION** WIO: East Africa to South Africa, Madagascar and Red Sea; Lessepsian migrant to Mediterranean Sea.

**REMARKS** Found on sandy mud bottom, to ~100 m deep. Has been previously misidentified in the Red Sea as *Saurida undosquamis* or *S. macrolepis*; likewise, records of *S. undosquamis* elsewhere in WIO likely refer to this species.

## *Saurida longimanus* Norman 1939

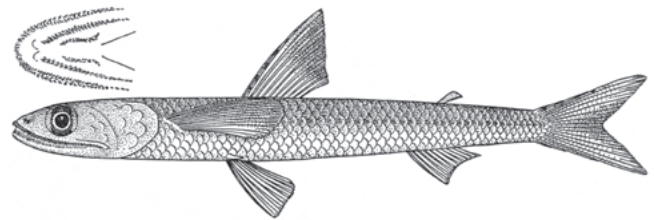
Longfin lizardfish

*Saurida longimanus* Norman 1939: 23, Fig. 5 (Gulf of Oman); Kotthaus 1967; Dutt & Sagar 1981; Manilo & Bogorodsky 2003; Inoue & Nakabo 2006; Bogorodsky *et al.* 2014\*.

?*Saurida isarankurai* (non Shindo & Yamada 1972): Muthiah & Neelakantan 1991.

Dorsal fin 11 or 12 rays; anal fin 10 or 11 rays; pectoral fins 14 rays, fins very long, tips extending well beyond pelvic-fin insertions to about middle of dorsal fin. LL scales 45–49; no teeth on vomer.

Body brownish above, silvery white below; row of indistinct dark oval blotches on lateral line; maxilla with distinctly dark upper margin; indistinct dark mark on opercular region; dorsal fin dusky distally; pectoral fins mostly blackish; caudal-fin upper lobe mostly pale, with row of 3–8 elongate indistinct dark spots along upper edge (number increases with growth), lower lobe somewhat dusky, and middle rays darkest. Attains 23 cm SL.



*Saurida longimanus*, 16 cm TL, holotype (Gulf of Oman).

Source: Norman 1939

**DISTRIBUTION** Indian Ocean. WIO: Red Sea, Gulf of Oman to Pakistan and India; elsewhere, southern Indonesia and northwestern Australia.

**REMARKS** Inhabits soft bottom in relatively deep water, at 50–280 m. WIO records of *Saurida isarankurai* are probably referable to this species.

## *Saurida nebulosa* Valenciennes 1850

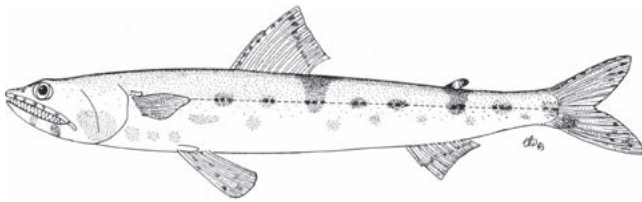
Clouded lizardfish

PLATE 32

*Saurida nebulosa* Valenciennes in Cuv. & Val. 1850: 504, Pl. 648 (Mauritius, Mascarenes); Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Dorsal fin 10 or 11 rays; anal fin 9 or 10 rays; pectoral fins 12 (rarely 11 or 13) rays, fins short, with tips only reaching pelvic-fin insertions or <4 scale rows before dorsal-fin origin. LL scales 50–52; no teeth on vomer; inner palatine teeth in 2 distinct short rows.

Body greenish grey, mottled with brown dorsally; midsides with 3 elongate blackish spots (beneath dorsal-fin insertion, posterior to adipose fin, and at upper part of caudal-fin base) and ~9 smaller blackish blotches, plus small grey blotches between and beneath each larger pair. Attains 17 cm SL.



*Saurida nebulosa*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, Comoros, Aldabra, Mauritius, Maldives and India; not known from Red Sea; elsewhere to Bay of Bengal, Indonesia, Philippines, Ryukyu Is., Australia, New Caledonia, Tonga, Society Is. and Hawaii.

**REMARKS** Inhabits shallow inshore waters, including lagoons, mangroves, seagrass beds, and mouths of freshwater streams, on silt or sand bottom, to ~6 m deep.

## *Saurida tumbil* (Bloch 1795)

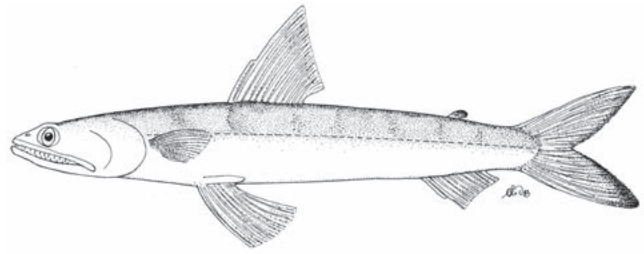
Greater lizardfish

PLATES 32 & 33

*Salmo tumbil* Bloch 1795: 112, Pl. 430 (Malabar or Tharangambadi, India). *Saurida tumbil*: Kotthaus 1967; Kyushin *et al.* 1982; Dor 1984; Baranes & Golani 1993; Goren & Dor 1994; SSF No. 79.2a\* [1995]; Carpenter *et al.* 1997; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004; Golani & Bogorodsky 2010; Russell 2011; Bogorodsky *et al.* 2014\*.

Dorsal fin 11–13 rays; anal fin 10 or 11 rays; pectoral fins 14 or 15 rays, and fins short, tip barely reaching pelvic-fin base. LL scales 50–53; small tooth patch on vomer.

Body brownish above, silvery white below; traces of faint darker crossbands on back, and scales on back often with silvery centres; dorsal-fin tip dusky; pectoral fins usually blackish; pelvic fins and anal fin translucent, but the former sometimes with dusky or blackish hue; caudal fin blackish posteriorly (particularly lower lobe); stomach and intestines whitish. Attains 42 cm SL.



*Saurida tumbil*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Arabian Sea, west coast of India to Pakistan, Persian/Arabian Gulf, Red Sea to South Africa and Madagascar; elsewhere to east coast of India, Bay of Bengal and northern Australia.

**REMARKS** Inhabits soft muddy bottom and open sandy areas, at 10–60 m.

## *Saurida tweddlei* Russell 2015

Spotted lizardfish

PLATE 32

*Saurida tweddlei* Russell 2015: 441, Figs. 1–3 (Mascarene Plateau). *Saurida undosquamis* (non Richardson 1848): Amaoka *et al.* 1976.

Dorsal fin 12 or 13 rays; anal fin 10–12 rays; pectoral fins 14 or 15 rays, fins moderately long and reaching pelvic-fin origins or slightly beyond. LL scales 53–55; TSR  $4\frac{1}{2}/5\frac{1}{2}$ ; 0–3 teeth on vomer.

Body brown dorsally, paler below lateral line, and dark pigment continuing 1 or 2 scale rows below lateral line; leading edge of dorsal fin with 8–16 blackish spots; pectoral fins dusky; pelvic fins pale yellow at base, otherwise translucent. Attains at least 40 cm SL.

**DISTRIBUTION** WIO: Mascarene Plateau.

**REMARKS** Bottom-dwelling on soft sandy mud; trawled from 57–127 m. Previously confused with *Saurida undosquamis*.

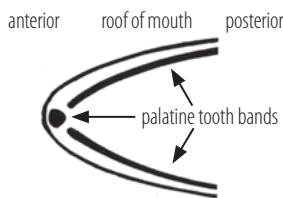
GENUS *Synodus* Scopoli 1777

Body fusiform and cylindrical; head depressed to slightly depressed; bony surfaces on top of head rugose. Snout triangular, shorter or longer than eye diameter. Mouth large, gape tending to be oblique; maxilla very slender and closely adherent to premaxilla; no supramaxilla; no vomer. Distinguished by teeth in single band on palatines; teeth also present on tongue. Dorsal fin about midway on back, behind pelvic-fin insertions; adipose fin over anal-fin base (except adipose fin reduced or absent in *Synodus sageneus*); pectoral fins either not reaching to or else extending beyond pelvic-fin origins; pelvic fins 8 rays, inner rays at most 2–3 times longer than outer rays; anal fin behind dorsal fin. Branchiostegal rays 15–18. Head and body with cycloid scales; no scales on procurrent and primary caudal-fin rays. Colour variable, but often brown, reddish or silvery, and with red, yellow or blue markings; peritoneum either pale with 5–11 black spots on each side of midventral line, or entirely black.

Gametes are released in midwater, ~4 m above substrate; eggs ~2.5–4.3 mm. Larvae are distinctive in possessing paired spots or patches of dark pigment in lining of the peritoneum and along midventral line of anal fin and peduncle; these spots persist internally in adults and are an aid to identification. About 45 species, 16 in WIO.

## KEY TO SPECIES

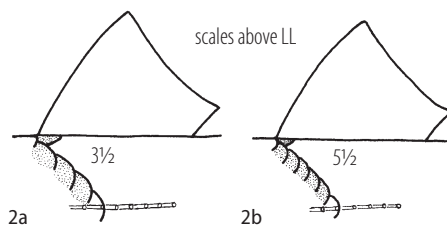
- 1a Anteriormost palatine teeth in discrete group and longer than more posterior teeth ..... 2



- 1b Anteriormost palatine teeth not in discrete group and not longer than other teeth ..... 7

- 2a Scales above lateral line  $3\frac{1}{2}$  (rarely  $4\frac{1}{2}$ ) ..... 3

- 2b Scales above lateral line  $5\frac{1}{2}$  (rarely  $6\frac{1}{2}$ ) ..... 5



## KEY TO SPECIES

- 3a Conspicuous spot or blotch on upper edge of operculum ..... *S. hoshinonis*

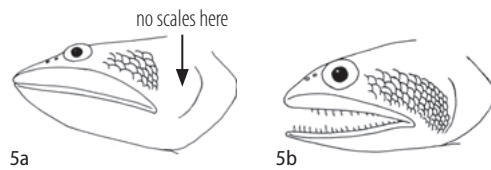
- 3b No conspicuous pigmented area on upper edge of operculum ..... 4

- 4a Flap on anterior nostrils long and triangular; peritoneal spots 14 ..... *S. randalli*

- 4b Flap on anterior nostrils long and spatulate; peritoneal spots 0–3 ..... *S. binotatus*

- 5a Cheeks naked ..... 6

- 5b Cheeks scaly ..... *S. variegatus*

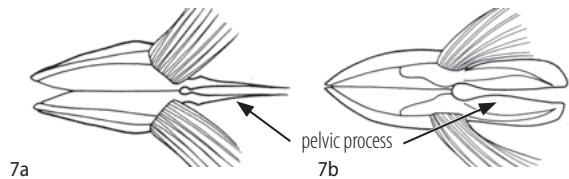


- 6a Peduncle with conspicuous black lateral spot; flap on anterior nostrils very short ..... *S. jaculum*

- 6b No conspicuous black spot on peduncle; flap on anterior nostrils long and slender ..... *S. dermatogenys*

- 7a Pelvic process narrow ..... 8

- 7b Pelvic process wide ..... 11



- 8a Peritoneum black ..... *S. kaianus*

- 8b Peritoneum pale or brown ..... 9

- 9a LL scales  $\geq 58$ ; dorsal fin with 2 broad bands ..... *S. gibbsi*

- 9b LL scales  $< 58$ ; dorsal fin with  $> 2$  narrow bars ..... 10

- 10a Snout distinctly rounded in dorsal view; length of nasal flap nearly equal to its base width ..... *S. oculus*

- 10b Snout pointed in dorsal view; length of nasal flap much greater than its base width ..... *S. macrocephalus*

- 11a Anal-fin base longer than dorsal-fin base ..... *S. sageneus*

- 11b Anal-fin base shorter than dorsal-fin base ..... 12

Continued...

Continued...



**KEY TO SPECIES**

- 12a Pectoral fin not reaching line between origins of dorsal fin and pelvic fin ..... 13
- 12b Pectoral fin extending to or beyond line between origins of dorsal fin and pelvic fin ..... 14
  
- 13a Upper edge of operculum with 2 distinct dark spots; no dark bars on body ..... *S. indicus*
- 13b No dark spots on upper edge of operculum; body with 4 or 5 dark pink or red bars on back ..... *S. rubromarmoratus*
  
- 14a Pectoral-fin tip extending to or just beyond line between origins of dorsal fin and pelvic fin; LL scales 48–58; peritoneal spots 8–13 ..... 15
- 14b Pectoral-fin tip extending well beyond line between origins of dorsal fin and pelvic fin; LL scales 58–60; peritoneal spots 14–17 ..... *S. usitatus*
  
- 15a LL scales 48–54; peritoneal spots 10–12 ..... *S. mascarensis*
- 15b LL scales 56–58; peritoneal spots 8 ..... *S. vityazi*

***Synodus binotatus*** Schultz 1953

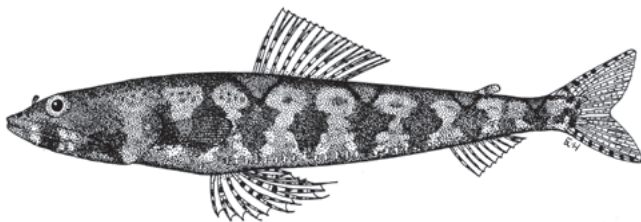
Two-spot lizardfish

PLATE 33

*Synodus binotatus* Schultz in Schultz *et al.* 1953: 35, Fig. 8 (lagoon reef, Kwajalein Atoll, Marshall Is.); Cressey & Waples 1984\*; Winterbottom *et al.* 1989; SSF No. 79.4\* [1995]; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004; Fricke *et al.* 2009.

Dorsal fin 12–14 (usually 13) rays; anal fin 8–10 (usually 9) rays; pectoral fins 12 rays, and fin reaching well beyond line between origins of dorsal fin and pelvic fin. LL scales 52–55 (usually 54); TSR 3½/5; anterior palatine teeth longest and in discrete group. Posterior pelvic process wide.

Body reddish brown, with series of 4 dark brown saddle-like bands and 3 paler brown bands between them (1st dark band at dorsal-fin origin); upper surface of snout tip with 2 conspicuous black spots; all fins barred; adipose fin with prominent pigment basally and spot or stripe distally; peritoneal spots 0–3. Attains 18 cm SL.



*Synodus binotatus*, 9 cm SL (South Africa). Source: SSF 1995

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Gulf of

Aden (Yemen), East Africa to South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles (Aldabra, Amirante Is.), Mascarenes, Chagos, Maldives and Sri Lanka; elsewhere to Philippines, southern Japan, Marshall Is., Solomon Is., Australia, New Caledonia, Fiji, Line Is., Gambier Is. and Hawaii.

**REMARKS** Common around shallow coral reefs, to ~30 m

deep. Solitary, typically resting on hard surfaces, often in a head-down position on slopes.

***Synodus dermatogenys*** Fowler 1912

Sand lizardfish

PLATES 33 & 34

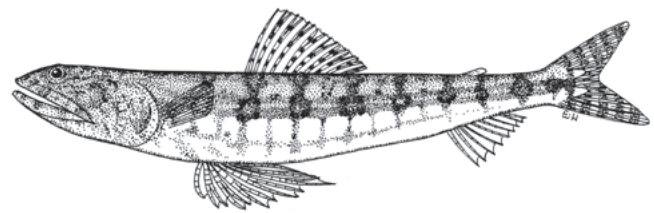
*Synodus dermatogenys* Fowler 1912: 566, Fig. 3 (Hawaii); SSF No. 79.5 [1995]; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004; Fricke *et al.* 2009; Golani & Bogorodsky 2010.

*Synodus variegatus* (*non* Lacepède 1803): Gosline & Brock 1960

[misidentification]; Cressey 1981 [misidentification in part]; ?Dor 1984; ?Winterbottom *et al.* 1989; ?Goren & Dor 1994; ?SSF No. 79.9\* [1995]; ?Fricke 1999; ?Manilo & Bogorodsky 2003; ?Heemstra *et al.* 2004; ?Heemstra & Heemstra 2004\*.

Dorsal fin 10–13 (usually 12) rays; anal fin 8–10 (usually 9) rays; pectoral fins 11–13 rays, and fin not reaching line between origins of dorsal fin and pelvic fin. LL scales 56–61 (usually 59); TSR 5½/7; anterior palatine teeth longest and in discrete group; flap on anterior nostrils long and slender. Posterior pelvic process wide.

Body pale tan background with dark brown pigmented areas, including 8 or 9 dark brown saddle-like bands, widest dorsally and constricted towards lateral line, then widening again to become diamond-shaped with elongated ventral apex; brown bands paler anterior to dorsal-fin origin, and alternating dark brown and pale brown to peduncle; narrow pale blue stripe on body passing just above the bands (stripe sometimes mottled with brown and may be indistinct); tip of snout usually with 4 terminal and 2 subterminal spots; all fins except anal fin usually with narrow dark bars perpendicular to rays; peritoneal spots 10–12. Attains ~24 cm SL.



*Synodus dermatogenys*, 15 cm SL (Comoros). Source: SSF 1995

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Oman, Red Sea, East Africa to South Africa (Algoa Bay), Madagascar, Comoros, Seychelles (Aldabra, Amirante Is., Farquhar Group), Mauritius, St Brandon Shoals, Chagos, Maldives and Sri Lanka; elsewhere to Indonesia, Philippines, New Guinea, Australia, New Caledonia, Lord Howe I., Fiji, Tuamotu Is., Marquesas Is., Pitcairn Is. and Hawaii.

**REMARKS** Benthic; frequently found on or near rock and coral bottom, at 5–60 m. Solitary or sometimes in pairs or small groups; often buries in the sand, leaving only its eyes and nostrils exposed. Often misidentified as *S. variegatus*.

*Synodus gibbsi* Cressey 1981  
Gibbs' lizardfish

*Synodus gibbsi* Cressey 1981: 18, Figs. 12–13 (Tanzania).

Dorsal fin 11–13 (usually 12) rays, and fin elevated, rounded; anal fin 10 or (usually) 11 rays; pectoral fins 13 or 14 (usually 13) rays, and fin reaching line between origins of dorsal fin and pelvic fin. LL scales 58–61 (usually 59); TSR  $3\frac{1}{2}/5\frac{1}{2}$ ; anterior palatine teeth not longest and not in discrete group. Posterior pelvic process narrow.

Preserved specimens with poorly distinguished saddle-like bands; dorsal fin with 2 or 3 conspicuous bars (the most conspicuous markings), and other fins unmarked; peritoneal spots 7 or 8. Attains ~18 cm SL.

**DISTRIBUTION** Known only from two type specimens collected from Tanzania.

**REMARKS** Taken from relatively deep water, at ~100–200 m.

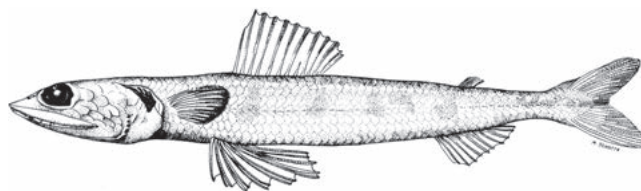
*Synodus hoshinonis* Tanaka 1917  
Blackear lizardfish

PLATE 33

*Synodus hoshinonis* Tanaka 1917: 38 (Hiro, Wakayama Prefecture, Japan); Cressey 1981; Dor 1984; Goren & Dor 1994; SSF No. 79.6\* [1995].

Dorsal fin 12–14 (usually 13) rays; anal fin 8–10 (usually 10 rays); pectoral fins 11 or 12 rays, and fin reaching line between origins of dorsal fin and pelvic fin. LL scales 55–57 (usually 55); TSR  $3\frac{1}{2}/5$ ; anterior palatine teeth longest and in discrete group. Posterior pelvic process wide.

Body with alternating pale and dark brown saddle-like patches, forming diamond-shaped patches at level of lateral line; no spots on snout, but conspicuous black spot on upper edge of opercle; fins pale; peritoneal spots 12 or 13. Attains ~32 cm SL (commonly ~12 cm TL).



*Synodus hoshinonis*, 11 cm TL. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and Mozambique, but probably more widespread; elsewhere, Andaman Sea, southern Japan, Arafura Sea, New Caledonia and northern New Zealand.

**REMARKS** Collected in bottom trawls over soft sediments, at 60–96 m.

*Synodus indicus* (Day 1873)

Indian lizardfish

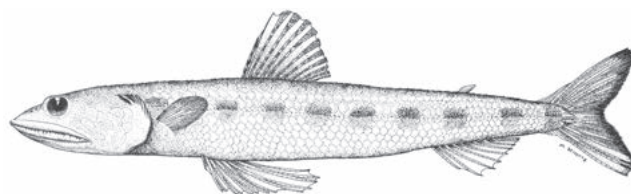
PLATES 33 & 34

*Saurus indicus* Day 1873: 526 (Chennai, India).

*Synodus indicus*: Barnard 1925; Menon & Yazdani 1968; Whitehead & Talwar 1976; Dor 1984; Goren & Dor 1994; SSF No. 79.7\* [1995]; Anderson *et al.* 1998; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*; Heemstra *et al.* 2006; Golani & Bogorodsky 2010. *Synodus dietrichi* Kotthaus 1967: 72 (Somalia).

Dorsal fin 11–13 (usually 12) rays; anal fin 9–11 (usually 10) rays; pectoral fins 13 rays, and fin not reaching line between origins of dorsal fin and pelvic fin. LL scales 52–58 (usually 56); TSR  $3\frac{1}{2}/5$ ; anterior palatine teeth not longest and not in discrete group. Posterior pelvic process wide.

Dorsal half of body darker than ventral half and somewhat mottled; 2 blotchy black streaks at upper edge of operculum; caudal fin with yellowish tinge; peritoneal spots 9–11. Attains ~19 cm SL.



*Synodus indicus*, 11 cm SL. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: southern Red Sea, Gulf of Aden, Tanzania (Zanzibar), Somalia to South Africa (Sodwana Bay), southern India and Sri Lanka; elsewhere to Andaman Sea, Indonesia, Philippines and northwestern Australia.

**REMARKS** Benthic, on current-prone soft bottom, usually at 20–100 m; buries itself in the sand.

## *Synodus jaculum* Russell & Cressey 1979

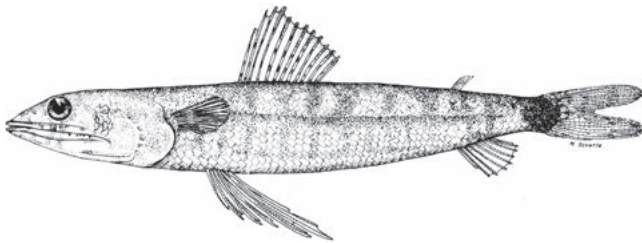
Javelin lizardfish

PLATE 33

*Synodus jaculum* Russell & Cressey 1979: 169, Fig. 2 (Lizard I., Great Barrier Reef, Australia); Cressey 1981; SSF No. 79.8\*; Winterbottom *et al.* 1989; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004.

Dorsal fin 11–13 (usually 12) rays; anal fin 8–10 (usually 9) rays; pectoral fins 12 or 13 rays, and fin reaching line between origins of dorsal fin and pelvic fin. LL scales 59–62 (usually 61); TSR  $5\frac{1}{2}$ – $6\frac{1}{2}$ /9; anterior palatine teeth longest and in discrete group. Posterior pelvic process wide.

Body with saddle-like and lateral brown to reddish brown bands; fins transparent; large black spot at caudal-fin base (not always evident on preserved specimens); peritoneal spots 11–13. Attains ~18 cm SL.



*Synodus jaculum*, 6 cm TL. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: East Africa to South Africa, Seychelles, Mauritius and Maldives; not known from Red Sea and Persian/Arabian Gulf; elsewhere to Philippines, southern Japan, Palau, Australia, New Caledonia, Chesterfield Is., Line Is., Society Is. and Marquesas Is.

**REMARKS** Benthic, on mixed sand and coral-rubble bottom, at 2–100 m, but frequently found swimming high above the substrate. Occasionally captured in bottom trawls.

## *Synodus kaianus* (Günther 1880)

Kai Island lizardfish

*Saurus kaianus* Günther 1880: 50, Pl. 23, Fig. C (Kai Is., Moluccas, Indonesia, Arafura Sea).

*Synodus kaianus*: Gilbert 1903; Cressey 1981.

Dorsal fin 10–13 (usually 12) rays; anal fin 10 or (usually) 11 rays; pectoral fins 12 or (usually) 13 rays, and fin reaching to or just beyond line between origins of dorsal fin and pelvic fin. LL scales 59–63 (usually 60); TSR  $3\frac{1}{2}$ /5; anterior palatine teeth not longest and not in discrete group; tip of lower jaw fleshy. Posterior pelvic process narrow.

Upper part of body uniformly dark, with 3 large blocks of darker pigment extending just below lateral line (below dorsal-fin origin, slightly posterior to dorsal fin, and below adipose fin), and distinguished by 3 patches between each of the larger blocks of pigment (3rd patch largest); peritoneum entirely black. Attains ~21 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Saya de Malha Bank; elsewhere, Indonesia (Timor Sea; Arafura Sea), South China Sea, southern Japan, northern Australia, Fiji and Hawaii.

**REMARKS** Found on soft bottom, at ~80–300 m.

## *Synodus macrocephalus* Cressey 1981

Large-head lizardfish

*Synodus macrocephalus* Cressey 1981: 27, Figs. 21, 26b (Somalia); Manilo & Bogorodsky 2003; Ho *et al.* 2010.

*Synodus macrops*: Cressey & Cressey 1979 [in part]; ?Goren & Dor 1994.

*Synodus cresseyi* Prokofiev 2008: 424 [invalid replacement name for *S. macrocephalus* Cressey].

Dorsal fin 11–13 (usually 13) rays; anal fin 9–11 (usually 10) rays; pectoral fins 12 rays, and fin reaching beyond line between origins of dorsal fin and pelvic fin. LL scales 55 or (usually) 56; TSR  $3\frac{1}{2}$ /5; anterior palatine teeth not longest and not in discrete group. Posterior pelvic process narrow.

Body darker above lateral line and with series of darker blotches along lateral line (blotches not well-defined nor distinct in all specimens); dorsal fin with 2 to 3 bars, and other fins unmarked; peritoneal spots 7. Attains ~8 cm SL.

**DISTRIBUTION** Indian Ocean. WIO: Somalia, Arabian Sea and Saya de Malha Bank; elsewhere to Andaman Sea.

**REMARKS** Occurs on soft bottom, at 51–250 m. Occasionally taken in shrimp trawls. Sometimes confused with *Synodus macrops* from Red Sea and Indo-Pacific.

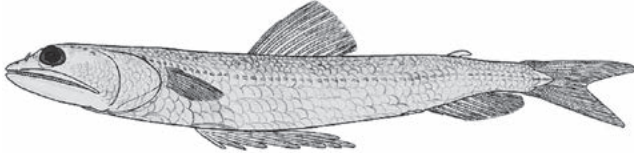
## *Synodus mascarensis* Prokofiev 2008

Mascarene lizardfish

*Synodus mascarensis* Prokofiev 2008: 430, Figs. 2, 5 (Mascarene Plateau).

Dorsal fin 12 or 13 rays; anal fin 9–11 rays; pectoral fins 13 rays, and fin extending to line between origins of dorsal fin and pelvic fin. LL scales 48–54; TSR  $3\frac{1}{2}$ /4; anterior palatine teeth not longest and not in discrete group. Posterior pelvic process wide.

Body pale, but darker dorsally, without contrasting markings on body or fins; peritoneal spots 10–12. Attains ~14 cm SL.



*Synodus mascarensis*, 14 cm SL (Mascarenes). Source: Prokofiev 2008

**DISTRIBUTION** Known only from type specimens from Mascarene Plateau.

**REMARKS** Trawled from over soft bottom, at 58–61 m.

### *Synodus oculus* Cressey 1981

Large-eye lizardfish

*Synodus oculus* Cressey 1981: 30, Figs. 24–26 (Macclesfield Bank, South China Sea); Manilo & Bogorodsky 2003.

Dorsal fin 12 or (usually) 13 rays; anal fin 9 or (usually) 10 rays; pectoral fins 12 rays, and fin reaching beyond line between origins of dorsal fin and pelvic fin. LL scales 54–57 (usually 56); TSR  $3\frac{1}{2}/4$ ; anterior palatine teeth not longest and not in discrete group. Posterior pelvic process narrow.

Body pale, but darker dorsally, without contrasting markings on body or fins; peritoneal spots 7 or 8. Attains ~18 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Somalia and Mascarene Plateau; elsewhere to Andaman Sea, Indonesia, South China Sea and Coral Sea (Chesterfield Is.).

**REMARKS** Collected on soft bottom at 44–96 m.

### *Synodus randalli* Cressey 1981

Randall's lizardfish

PLATES 33 & 34

*Synodus randalli* Cressey 1981: 33, Fig. 27 (off Port Sudan, Sudan, Red Sea); Dor 1984; Goren & Dor 1994; Randall 2009; Golani & Bogorodsky 2010.

*Synodus doaki* (non Russell & Cressey 1979): Baranes & Golani 1993; Manilo & Bogorodsky 2003.

Dorsal fin 13 rays; anal fin 8 rays; pectoral fins 12 rays, and fin extending beyond line between origins of dorsal fin and pelvic fin. LL scales 55; TSR  $3\frac{1}{2}/5\frac{1}{2}$ ; anterior palatine teeth longest and in discrete group. Posterior pelvic process wide.

Body with series of reddish brown saddle-like bands, and dorsal fin with 3 to 4 similarly coloured bars; conspicuous spot on adipose fin; peritoneal spots 14. Attains 13 cm SL.

**DISTRIBUTION** WIO: Red Sea to South Africa.

**REMARKS** Inhabits relatively deep water, at ~140–250 m. *Synodus doaki* recorded from the Gulf of Eilat, Red Sea, by Baranes & Golani (1993) is a misidentification of this species; Randall (2009) states that many other records of this species in the WIO may likewise be referable to *Synodus randalli*.

### *Synodus rubromarmoratus* Russell & Cressey 1979

Red-marbled lizardfish

PLATE 33

*Synodus rubromarmoratus* Russell & Cressey 1979: 172, Fig. 3 (Lizard I., Great Barrier Reef, Australia); Anderson *et al.* 1998; Heemstra *et al.* 2006.

Dorsal fin 10–12 (usually 11) rays; anal fin 9 rays; pectoral fins 11 or 12 rays, and fin not reaching line between origins of dorsal fin and pelvic fin. LL scales 54 or (usually) 55; TSR  $3\frac{1}{2}/5$  or 6; anterior palatine teeth not longer and not in discrete group. Posterior pelvic process wide.

Body pale with 4 or 5 dark red and pink saddle-like bands; head bright pink or red; dorsal fin, pectoral fins and pelvic fins with narrow reddish transverse bars; peritoneal spots 12 or 13. Attains ~18 cm SL.

**DISTRIBUTION** Western Pacific (including Philippines, Taiwan, Australia, New Caledonia and Hawaii). WIO: records based on specimens from South Africa (KwaZulu-Natal) and on photographs from the Maldives (Anderson *et al.* 1998) and Grande Comore I. (Heemstra *et al.* 2006).

**REMARKS** Inhabits mainly deeper water, to ~340 m, but also found in shallower water, often on coral-rubble bottom with coralline algae.

### *Synodus sageneus* Waite 1905

Spear-toothed lizardfish

*Synodus sageneus* Waite 1905: 58, Pl. 8, Fig. 1 (between Fremantle and Houtman Abrolhos, Western Australia); Cressey 1981.

*Xystodus sageneus*: Whitley 1943.



Dorsal fin 12 or 13 (usually 12) rays; anal fin 12–15 (usually 13) rays; pectoral fins 12 or 13 (usually 12) rays, and fin barely reaching line between origins of dorsal fin and pelvic fin. LL scales 51–55 (usually 52); TSR  $3\frac{1}{2}/5$ ; anterior palatine teeth not longest and not in discrete group. Posterior pelvic process wide. Distinguished by anal-fin base longer than dorsal-fin base.

Body yellowish above, silvery below, with faint and poorly defined diamond-shaped areas extending below lateral line; peritoneal spots 5 or 6. Attains ~23 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka (Cressey 1981); elsewhere, New Guinea, northwestern Australia and Great Barrier Reef.

**REMARKS** Benthic, usually on soft bottom, at 12–30 m.

### *Synodus usitatus* Cressey 1981

Ordinary lizardfish

PLATE 34

*Synodus usitatus* Cressey 1981: 42, Fig. 35 (off Haleiwa, Oahu I., Hawaii); Prokofiev 2008.

Dorsal fin 12 rays; anal fin 8 or (usually) 9 rays; pectoral fins 12 or 13 rays, and fin reaching to or just beyond line between origins of dorsal fin and pelvic fin. LL scales 58–60 (usually 58); TSR  $3\frac{1}{2}/5$ ; anterior palatine teeth not longer than posterior teeth, and not in a discrete group. Posterior pelvic process wide.

Body dull pink and densely mottled with small, irregular, dark brown blotches tending to form bars (~5 bars darker than blotches in between); faint bluish grey band above lateral line and another narrower one above it; narrow white band from pectoral-fin bases to lower caudal-fin base; upper lobe of caudal fin with 3 faint white crossbars and white tip; peritoneal spots 14–17. Attains ~12 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Mascarene Ridge; elsewhere, southern Indonesia, southern Japan and Hawaii.

**REMARKS** Benthic; trawled from 55–110 m.

### *Synodus variegatus* (Lacepède 1803)

Variegated lizardfish

PLATES 33 & 34

*Salmo variegatus* Lacepède (ex Commerson) 1803: 157, 224 [named *variegatus* and *varius* on those pages, respectively], Pl. 3, Fig. 3 (Mauritius, Mascarenes).

*Synodus varius*: Jordan & Evermann 1905 [in part].

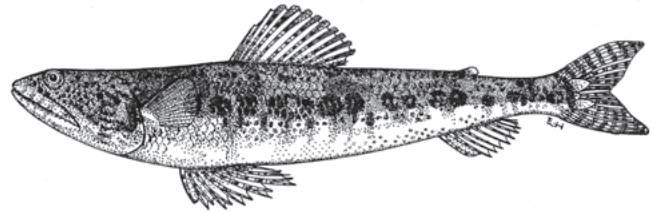
*Synodus ulae* Schultz in Schultz *et al.* 1953: 38 (Honolulu market, Oahu I., Hawaii) [in part].

*Synodus englemani* (non Schultz 1953): Cressey 1981; Dor 1984; Winterbottom *et al.* 1989; Goren & Dor 1994; SSF No. 79.9\* [1995]; Fricke 1999.

*Synodus variegatus*: Cressey 1981; Waples & Randall 1989; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009; Golani & Bogorodsky 2010.

Dorsal fin 11–13 (usually 13) rays; anal fin 8–10 (usually 9) rays; pectoral fins 13 rays, and fin not reaching line from base of pelvic fin to dorsal-fin origin. LL scales 60–62 (usually 61); TSR  $5\frac{1}{2}/7$ ; anterior palatine teeth longest and in discrete group. Posterior pelvic process wide.

Body with series of 5 irregular, hourglass-shaped, dark brown to reddish bars on upper half of body, the broad lower part on lateral line joined by broken brown to red midlateral stripe; each dark bar with narrow ventral extension separating longitudinal series of rectangular white spots; peritoneal spots 7–10. Attains ~30 cm SL.



*Synodus variegatus*, 30 cm SL (South Africa). Source: SSF 1995

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles (Aldabra, Amirante Is.), Réunion, Mauritius, St Brandon Shoals, Maldives, India and Sri Lanka; elsewhere to Bay of Bengal, Indonesia (Java), East China Sea, Sulu Sea, southern Japan, Marshall Is., New Caledonia, New Zealand (strays), Lord Howe I., Kermadec Is., Rapa Iti and Hawaii.

**REMARKS** Inhabits shallow coral reefs and nearby sandy areas, generally at 5–40 m, but to ~60 m deep.

### *Synodus vityazi* Ho, Prokofiev & Shao 2010

Vityaz lizardfish

*Synodus vityazi* Ho, Prokofiev & Shao 2010: 64, Figs. 2–3 (northeast of Madagascar).

Dorsal fin 12 or (rarely) 13 rays; anal fin 9 or 10 rays; pectoral fins 12 or 13 rays. LL scales 56–58; TSR  $3\frac{1}{2}/4$ ; anterior palatine teeth not longer than more posterior teeth. Posterior pelvic process wide.

Colour in life unknown; peritoneal spots 8. Attains ~10 cm SL.

**DISTRIBUTION** Known only from type specimens from Madagascar.

**REMARKS** Trawled at 30–40 m.

## GENUS *Trachinocephalus* Gill 1861

Body slender and slightly compressed laterally; head compressed; bony surfaces on top of head very rugose. Snout blunt and very short, its length always shorter than eye diameter. Mouth large, gape oblique; maxilla very slender and closely adherent to premaxilla; no supramaxilla; no vomer. Teeth on palatines in single band, and also present on tongue. Dorsal-fin origin slightly closer to tip of snout than to adipose fin, and behind pelvic-fin insertions; pectoral fins extend beyond pelvic-fin origins; pelvic fin 8 rays, inner rays ~2–3 times longer than outer rays; anal fin behind dorsal fin; adipose fin over anal-fin base. Branchiostegal rays 14. Head and body with cycloid scales; scales on only procurrent rays of caudal fin. One species in WIO.

### *Trachinocephalus trachinus*

(Temminck & Schlegel 1846)

Indo-Pacific bluntnose lizardfish

PLATES 33 & 34

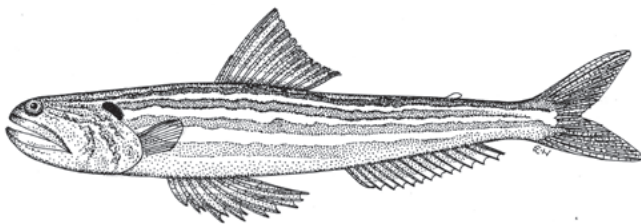
*Saurus trachinus* Temminck & Schlegel 1846: 231, Pl. 106, Fig. 2 (Nagasaki, Japan).

*Trachinocephalus myops* (non Forster in Bloch & Schneider 1801): Dor 1984; Goren & Dor 1994; SSF No. 79.10\* [1995]; Carpenter *et al.* 1997; Anderson *et al.* 1998; Manilo & Bogorodsky 2003; Fricke *et al.* 2009; Golani & Bogorodsky 2010; Bogorodsky *et al.* 2014\*.

*Trachinocephalus trachinus*: Polanco *et al.* 2016.

Diagnosis as for genus. Dorsal fin 11–14 rays; anal fin 13–18 rays; pectoral fins 11–13 rays. LL scales 51–61; TSR 3½/6.

Body with narrow, dark-edged, alternating pale blue and yellow stripes; oblique black spot at upper edge of gill opening. Attains ~23 cm SL.



*Trachinocephalus trachinus*, 22 cm TL (Mozambique). Source: SSF 1995

**DISTRIBUTION** Indo-Pacific in tropical to subtropical seas, including Red Sea to south coast of South Africa in WIO, and also at Hawaii, but not in eastern Pacific.

**REMARKS** Previously reported in the Indo-Pacific as *Trachinocephalus myops*, but Polanco *et al.* (2016) have shown that species to be restricted to the Atlantic. Found on soft bottom, in estuaries, bays and coastal waters, to ~200 m deep. Has minor importance to fisheries.

## GLOSSARY

**peritoneal spots** – pigment spots on the peritoneum.  
**peritoneum** – the membrane lining the abdominal cavity.

## FAMILY ALEPISAUROIDAE

### Lancetfishes

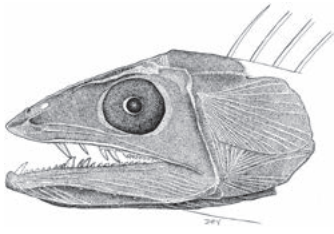
Phillip C Heemstra

Body greatly elongated and compressed, its depth less than HL, ~8 in SL. Head distinctly compressed, bones soft and smooth. Mouth large, terminal, upper jaw reaching past eyes; large fang-like teeth on jaws, vomer and palatines. Dorsal fin enormous, with 32–48 rays, and fin origin over or just behind gill opening; anal fin small, origin below rear of dorsal fin, with 13–18 rays; pectoral fins subequal to HL, with 12–15 rays, fin base horizontal and low on body; pelvic fins shorter than pectoral fins, with 8–10 rays, fin bases below middle of dorsal fin, horizontal and low on body; caudal fin distinctly forked; small adipose fin above rear of anal fin. No fin spines. Branchiostegal rays 7 or 8, membranes joined to isthmus. No scales, luminous organs or swimbladder. Vertebrae 47–51.

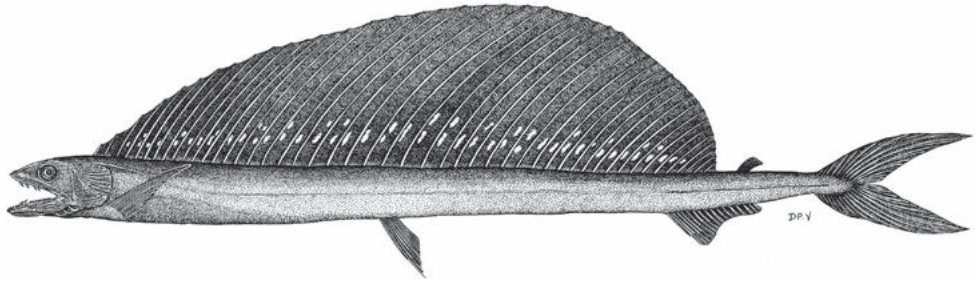
Large ambush predators; pelagic in the open ocean, usually in ~100–1 000 m. Circumglobal between approximately 40° N and 40° S. One genus, *Alepisaurus* Lowe 1833, with 2 species, both in WIO.

## KEY TO SPECIES

- 1a Snout shorter 31–37% HL; HL 6.2–8.5 in SL, >2 in distance between pectoral- and pelvic-fin origins; dorsal-fin origin distinctly in front of pectoral-fin origins ..... *A. brevirostris*
- 1b Snout longer, 41–47% HL; HL 4.3–6.3 in SL, 1.2–1.7 in distance between pectoral- and pelvic-fin origins; dorsal-fin origin over or behind pectoral-fin origins ..... *A. ferox*



*Alepisaurus brevirostris*, 132 mm HL (Marion I.) Source: Gon & Klages 1988



*Alepisaurus brevirostris*, 94 cm SL (Marion I.). Source: FSO

### *Alepisaurus brevirostris* Gibbs 1960

Shortsnout lancetfish

PLATE 35

*Alepisaurus brevirostris* Gibbs 1960: 2, Fig. 1 (western North Atlantic); Gibbs & Wilimovsky 1966\*; SSF No. 85.1\*; Gon & Heemstra 1990\*.

Eye diameter  $> \frac{1}{2}$  snout length; distance between pectoral- and pelvic-fin origins greater than distance between pelvic- and anal-fin origins. Dorsal fin 40–48 rays, no elongated rays and fin margin evenly convex; anal fin 13–16 rays; pectoral fins 12–14 rays, and fin origin below rear edge of gill cavity. GR 3–6/17–23.

Body iridescent brownish black dorsally, paler below; dorsal fin black, with row or rows of white spots some distance above fin base. Attains at least 98 cm TL.

**DISTRIBUTION** Circumglobal in tropical to cold-temperate seas.

**REMARKS** Bathypelagic, known to ~1 590 m deep. Feeds on euphausiids (krill) and fishes.

### *Alepisaurus ferox* Lowe 1833

Longsnout lancetfish

PLATE 35

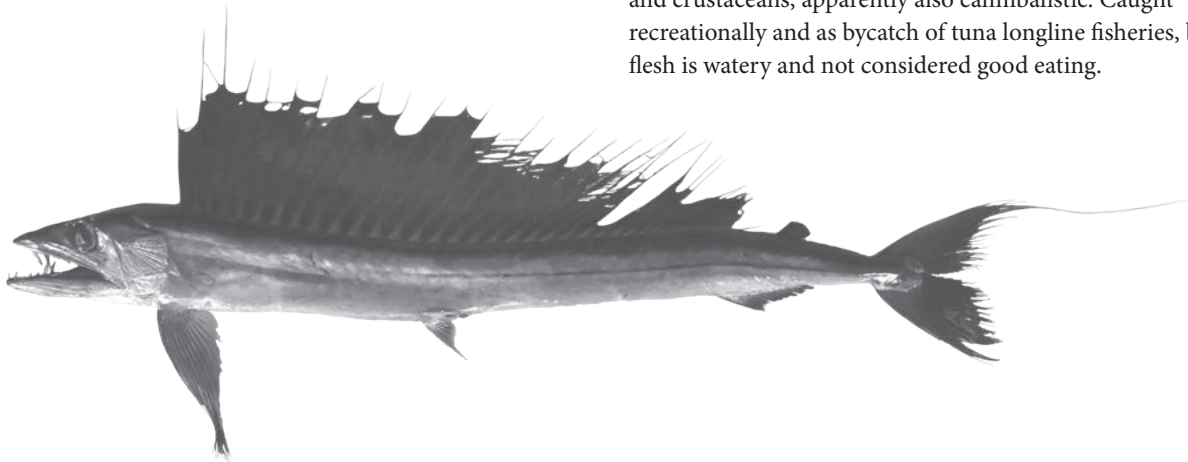
*Alepisaurus ferox* Lowe 1833: 104 (Madeira, eastern Atlantic); Gibbs & Wilimovsky 1966\*; SSF No. 85.2\*; Randall & Anderson 1993.

Eye diameter  $< \frac{1}{2}$  snout length; distance between pectoral- and pelvic-fin origins less than distance between pelvic- and anal-fin origins. Dorsal fin 32–45 rays, and fin margin distinctly indented, with a few anterior rays exerted well above fin margin; anal fin 13–18 rays; pectoral fins 12–15 rays, and fin origin below gill cavity. GR 3–7/16–24.

Body iridescent and rather pale, but slightly darker dorsally; fins brown to black; no white spots on dorsal fin. Attains 200 cm TL.

**DISTRIBUTION** Circumglobal in tropical to temperate seas, including Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (Sodwana Bay), Comoros and Maldives in WIO.

**REMARKS** Epipelagic to bathypelagic, from the surface to ~1 830 m deep. Feeds on fishes, cephalopods, tunicates and crustaceans; apparently also cannibalistic. Caught recreationally and as bycatch of tuna longline fisheries, but the flesh is watery and not considered good eating.



*Alepisaurus ferox*, 76 cm SL (India). KV Akhilesh © CMFRI

# ORDER LAMPRIFORMES

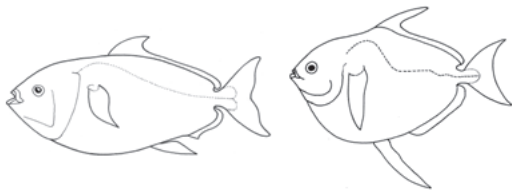
Phillip C Heemstra

A motley assemblage of fishes of various body shapes; upper jaw uniquely protrusile, with maxillae closely connected to the premaxillae but not ligamentously attached to the palatines (hence the maxillae move forward with the premaxillae as the mouth is protruded); no fin spines (except in Veliferidae); pelvic fins with 1–17 rays, or fins absent. Additional anatomical characters for this order are given by Olney *et al.* (1993) and Wiley & Johnson (2010).

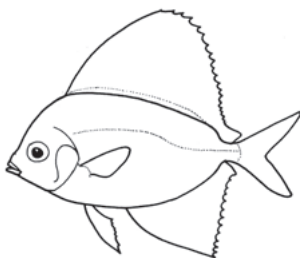
This disparate order comprises 7 families, with 12 genera and ~23 species worldwide. *Stylephorus chordatus* Shaw 1791, the single species of family Stylephoridae, is circumglobal in deep water (>500 m) and is not included in this book.

## KEY TO FAMILIES

- 1a Body deep, compressed, oval or disc-like, its depth  $\geq \frac{1}{2}$  SL; fins well-developed, caudal fin forked ..... 2
- 1b Body greatly elongate, depth 3–60 in SL; dorsal fin well-developed, other fins rudimentary or absent ..... 3
- 2a Dorsal-fin origin behind head, fin long-based and low, except for tall lobe at front; skin smooth, scales minute, cycloid and deciduous ..... **LAMPRIDAE**



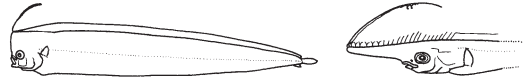
- 2b Dorsal-fin origin on head, fin tall and sail-like; skin moderately rough when stroked anteriorly; scales small, cycloid and deciduous ..... **VELIFERIDAE**



Continued ...

## KEY TO FAMILIES

- 3a Anus near caudal fin; maxilla slender, its width  $< \frac{1}{2}$  eye diameter; upper jaw slightly protrusile ..... **LOPHOTIDAE**



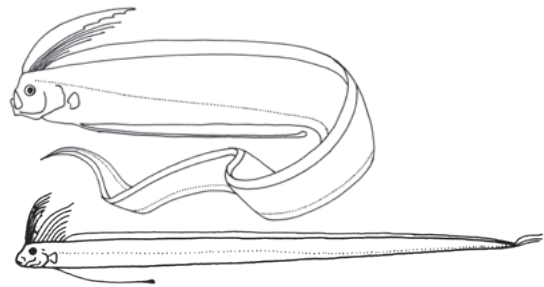
- 3b Anus near midbody; maxilla width  $> \frac{1}{2}$  eye diameter; upper jaw highly protrusile ..... 4

- 4a Anal fin rudimentary, about halfway between anus and last vertebra; LL scales continue past last vertebra, where canals of either side join to form a large, thin-walled tube carried on greatly elongated 'rays' that emanate from the ventral surface of the last 3 vertebrae; swimbladder well-developed ..... **RADIICEPHALIDAE**

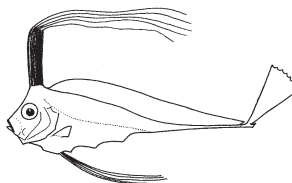


- 4b No anal fin and no swimbladder; lateral line extends to posteriormost vertebra ..... 5

- 5a Body greatly elongated, depth behind head 15–60 in SL; dorsal fin ~400 rays, the lateral edges of rays smooth .... **REGALECIDAE**



- 5b Body shorter, depth 4–10 in SL; dorsal fin 120–200 rays, with minute spines or prickles along the lateral edges ..... **TRACHIPTERIDAE**





## FAMILY LAMPRIDAE

### Opahs

Phillip C Heemstra

Body robust, oval and compressed; skin smooth: scales minute, cycloid, deciduous. Mouth protrusile; maxillae bound to premaxillae, moving forward with them as mouth is protruded; no teeth on jaws in adults, a few minute teeth in juveniles. Dorsal fin long-based, high at front and low thereafter; anal fin long-based and low; pectoral fins large, sickle-shaped, with horizontal base; pelvic fins large and paddle-shaped, inserted below midbody; caudal fin lunate, with 17 branched rays. No fin spines. Nostrils small, close-set, 2 on each side of snout. Branchiostegal rays 6; gill openings unstricted; gill rakers well-developed. Lateral line inconspicuous, in high arch over pectoral fins and then downward towards peduncle. Swimbladder large, anteriorly bifurcate. Vertebrae 43–46.

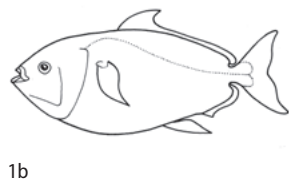
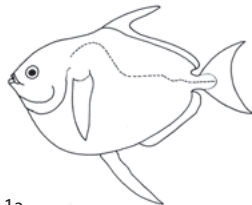
Pelagic in the open ocean of outer continental shelf at all life stages. The planktonic larvae are slender-bodied, with rapid and marked transformation by ~11 mm SL. Their principal means of locomotion (in cruising mode) are the strong pectoral fins, driven by enormous red muscles attached to an enlarged pectoral skeleton; they can also use their powerful caudal fin to rush prey or elude predators. Usually solitary, but known to school with tuna and other scombrids. Feed on squid, planktonic crustaceans and fishes.

One genus, *Lampris* Retzius 1799, with at least 2 species, both in WIO.

#### KEY TO SPECIES

##### [Fish >50 cm SL]

- 1a Body oval, depth 58–68% SL; pelvic fins inserted at vertical below rear of pectoral-fin bases; body purple or pink, with prominent pale spots ..... *L. guttatus*
- 1b Body oblong, depth 43–53% SL; pelvic fins inserted well behind pectoral fins; body bluish dorsally, silvery white below, without spots ..... *L. immaculatus*



### *Lampris guttatus* (Brünnich 1788)

Spotted opah

PLATE 35

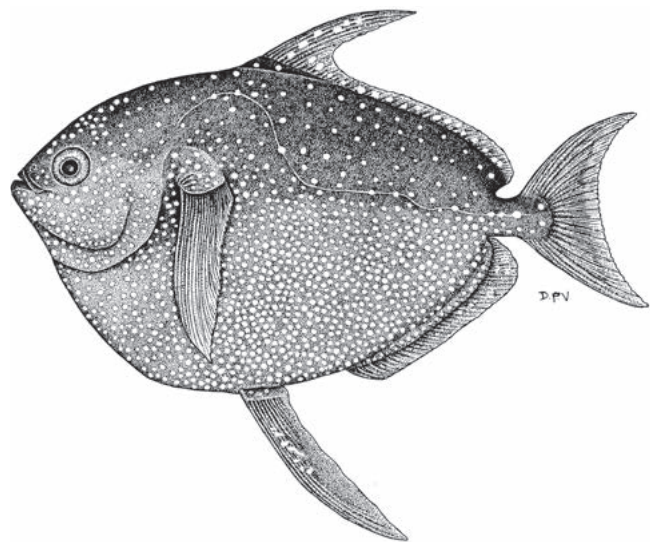
*Zeus guttatus* Brünnich 1788: 398, Pl. A (Helsingør, Denmark, Baltic Sea).

*Lampris regis*: SFSA No. 262 [in part: not illustration].

*Lampris guttatus*: SSF No. 117.1\*; Gon & Heemstra 1990\*; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

Body depth 58–68% SL. Dorsal fin 49–55 rays; anal fin 38–41 rays; pectoral fins 22–25 rays; pelvic fins 13–17 rays. GR 2/14.

Body pink to purple, with numerous round white spots (except no spots in small juveniles); front of snout and fins red. Attains 210 cm SL (commonly ~120 cm TL) and ~270 kg.



*Lampris guttatus*, 95 cm TL (South Africa). Source: FSO

**DISTRIBUTION** Circumglobal in tropical to temperate waters of all oceans (including Mediterranean Sea and Caribbean Sea), and incidental in subpolar waters.

**REMARKS** Usually found well offshore; epipelagic and mesopelagic, at 10–450 m. Feeds mainly on midwater fishes and squid. Flesh delicious; the huge pectoral-fin muscles resemble a fine beef steak in colour, texture and flavour, and the white muscle is also esteemed. Two species distinguishable by eye size may be represented, as confirmed by DNA analysis of specimens from a 2009 Honolulu fish auction; however, the distributions and scientific names of the ‘smalleye’ and ‘bigeye’ spotted opah remain uncertain.

*Lampris immaculatus* Gilchrist 1904

Southern opah

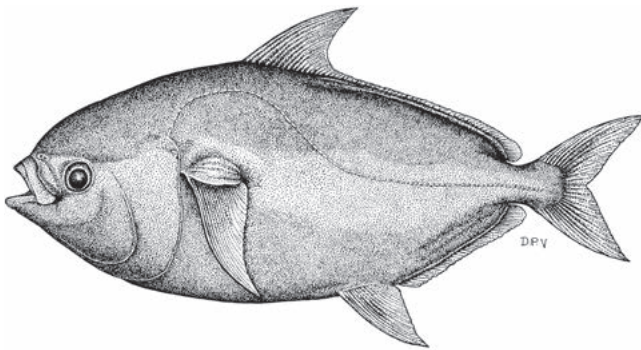
PLATE 35

*Lampris immaculata* Gilchrist 1904: 4, Pl. 22 (beach at Muizenberg, False Bay, South Africa); Barnard 1925\*; SFSA No. 262\* [in part: illustration only]; Parin & Kukuev 1983.

*Lampris immaculatus*: SSF No. 117.2\*; Gon & Heemstra 1990\*.

Body depth 43–53% SL. Dorsal fin 52–56 rays; anal fin 35–40 rays; pectoral fins 23 or 24 rays; pelvic fins 13–15 rays.

Body steely blue, and frequently reddish dorsally and/or posteriorly, and without pale spots; fins vermilion. Attains 110 cm TL.



*Lampris immaculatus*, 82 cm TL (Kerguelen Is.). Source: FSO

**DISTRIBUTION** Circumglobal in Southern Hemisphere, approximately south of 34° S, including both sides of the Cape of Good Hope, South Africa (e.g., Table Bay in the southeastern Atlantic and Jeffreys Bay in WIO).

**REMARKS** Parin & Kukuev (1983) re-established the validity of this species. Rare; known from ~50–485 m. Feeds on euphausiids (krill), squid and fishes.

**FAMILY VELIFERIDAE**

## Velifers

Phillip C Heemstra

Body disc-like or oblong, deep and strongly compressed, ventral profile from lower jaw to peduncle distinctly convex; body depth 1.6–2.2 in SL; head short, HL ~3–3.5 in FL. Scales thin, cycloid and deciduous, covering body and most of head, and forming scaly sheaths along bases of dorsal fin and anal fin (anterior rays of these fins are retractable into the sheaths).

Dorsal fin long, total elements (spines + segmented rays) 33–44; total anal-fin elements 25–35; pelvic fins 7–9 rays, first ray unbranched and the rest branched; caudal fin forked, with 17 branched rays. Mouth oblique; upper jaw very protrusile, maxilla bound to ascending processes of premaxilla, moving with it as the mouth protrudes, and maxilla partly covered by preorbital bone when mouth closed; no supramaxilla. No teeth. Branchiostegal rays 6, membranes narrowly joined to isthmus; gill arches 4, with slit medial to innermost arch. Swimbladder well-developed, bifurcates at anus, the 2 horns extending well past anal-fin origin; drumming muscles attach to 1st haemal spine. Vertebrae 16 + 17 or 18.

Rare fishes of the Indo-Pacific, also called sailfin moonfishes. Two genera, *Metavelifer* Walters 1960 and *Velifer* Temminck & Schlegel 1850, each with 1 species, both in WIO.

**KEY TO GENERA AND SPECIES**

- 1a Dorsal fin and anal fin enlarged, sail-like, each with 1 or 2 spines; dorsal fin 33 or 34 rays, and length of anterior rays subequal to body depth ..... *Velifer hypselopterus*
- 1b Dorsal fin and anal fin low; dorsal fin 20–22 spines, 5th or 6th spines longest and filamentous; dorsal fin 20–23 rays, and length of anterior rays subequal to eye diameter ..... *Metavelifer multiradiatus*

*Metavelifer multiradiatus* (Regan 1907)

Spotted velifer

PLATE 36

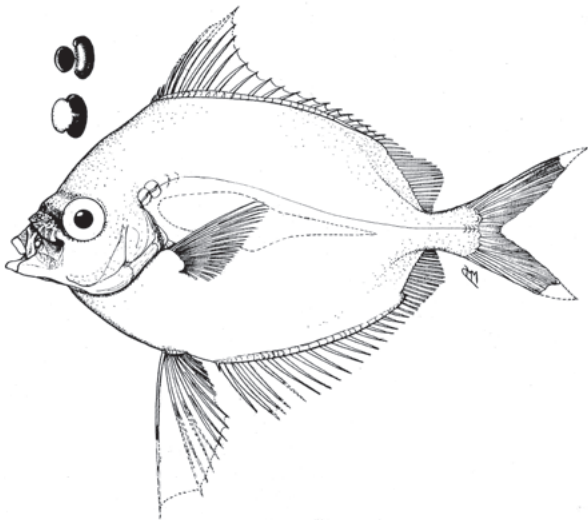
*Velifer multiradiatus* Regan 1907: 633 (northwestern coast of Australia).

*Velifer multispinosus* Smith 1951: 504, Pls. 11–12 (off Maputo, Mozambique).

*Metavelifer multiradiatus*: Walters 1960; SSF No. 118.1\*.

Dorsal fin 20–22 spines, 20–23 rays; anal fin 17 or 18 spines, 16–18 rays; pectoral fins 15 or 16 rays; pelvic fins 9 rays. LL scales 40–42; GR 3/9. Body depth 1.6–1.8 in SL; HL 3.4 in SL; eye diameter 2.9–3.1 in HL. Preorbital bone with notch on rear edge; maxilla hidden by preorbital when mouth closed.

Head and body greenish silver, with irregular olive-brown spots on body and head, and round spots on all fins; body also with 4 faint black bars: one from top of head through eyes to underside of head, irregular bar from dorsal-fin origin to pelvic fins, another darker and broader bar from middle of dorsal fin to front of anal fin, and last bar from rear end of dorsal fin to rear end of anal fin; anterior spines of dorsal fin white. Attains 28 cm TL.



*Metavelifer multiradiatus*, 21 cm TL, holotype of *Velifer multispinosus*, with posterior nostril (inset top) and anterior nostril (inset bottom) (S Mozambique). Source: Smith 1951

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique; elsewhere to southern Japan, Australia, New Caledonia, New Zealand and Hawaii.

**REMARKS** Rare; benthic on continental shelf and slope, and also around seamounts; known from 20–240 m.

### *Velifer hypselopterus* Bleeker 1879

Sailfin velifer

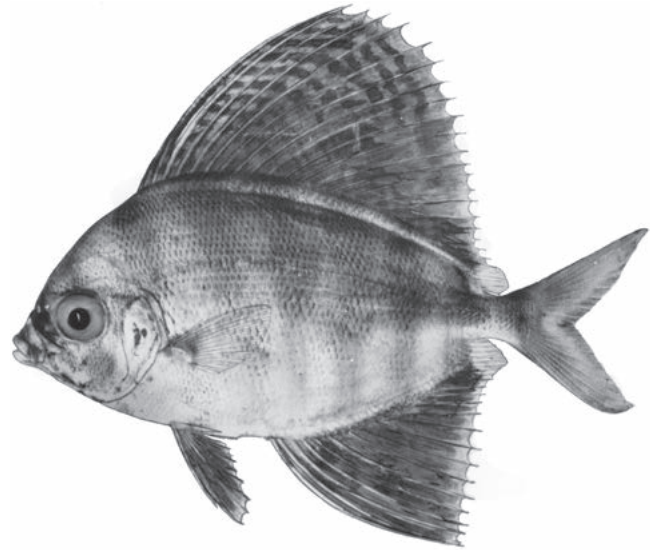
PLATE 36

*Velifer hypselopterus* Bleeker 1879: 16 (Japan) [based on *Velifer* of Temminck & Schlegel 1850]; Smith 1951\*; Walters 1960; SSF No. 118.2\*; Randall 1995\*.

*Velifer africanus* Smith 1953: 7, Pl. 1, Fig. 2 (Mozambique Channel).

Dorsal fin 1 or 2 spines, 33 or 34 rays; anal fin 1 spine (minute and concealed by scaly sheath at base of fin), 24 or 25 rays; pectoral fins 15 or 16 rays; pelvic fins 7 or 8 rays. LL scales ~72; GR 4/11 or 12. Body depth 2.1–2.2 in SL; HL 3–3.3 in SL; eye diameter 3–3.7 in HL. Preorbital bone with even edge, no notch posteriorly. Anterior dorsal- and anal-fin rays much longer than HL, and following rays gradually shorter.

Head and body silvery grey, with 6 or 7 faint brown bars; black blotch on nape; dorsal fin and anal fin pale bluish grey, with curved yellow bands; white-edged black spot on rear of dorsal fin; pectoral-fin bases black. Attains 40 cm TL.



*Velifer hypselopterus*, 22 cm TL, holotype of *V. africanus* (SW Madagascar). Source: Smith 1951

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (Algoa Bay), Mozambique Channel, Madagascar and Saya de Malha Bank; elsewhere, Vietnam, Indonesia (Arafura Sea), Philippines, Taiwan, southern Japan and northern Australia.

**REMARKS** Rare; occurs near reefs and also over soft bottom, at 25–110 m.

#### GLOSSARY

**drumming muscles** – the muscles that are attached to the swimbladder and produce drumming sounds when contracted.

**haemal spine** – spine on lower end of haemal arch in caudal vertebrae.

## FAMILY LOPHOTIDAE

### Crestfishes

Phillip C Heemstra

Body compressed, very elongate and ribbon-like; scales small, thin, cycloid, imbricate and extremely deciduous. Dorsal fin low and banner-like, running from forehead to caudal fin, and first 2 or 3 rays enlarged, longer than head; anal fin minute, located near caudal fin and just behind cloaca; pelvic

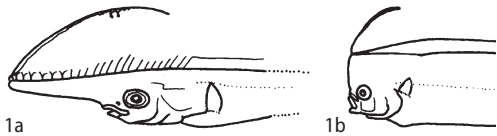
fins minute, on sides of body below and behind pectoral fins, or absent; no fin spines. Mouth small; upper jaw (including maxillae) protrusile, with maxilla reaching vertical at front edge of pupil when mouth closed; small canine teeth in 3 or 4 irregular rows at front of jaws and in 2 rows along rear half of jaws. Ink sac small and oblong or large and cylindrical, present behind swimbladder and opening into cloaca. Vertebrae at front and rear of body of same length; ribs present.

Epipelagic and mesopelagic in open ocean of tropical to subtropical seas; eggs and larvae also pelagic. Adults presumably feed on fishes and cephalopods. Capable of producing a cloud of ink when alarmed, much like many cephalopods.

Two genera: *Lophotus* Giorna 1809 (with at least 2 species, 1 in WIO) and *Eumecichthys* Regan 1907 (with 1 species, also in WIO).

#### KEY TO GENERA AND SPECIES

- 1a Forehead extending forward as a long compressed rostrum, projecting well in front of mouth; first 3 dorsal-fin rays and membrane forming long vertical crest at tip of rostrum; body slender, depth at pectoral-fin bases 19–30 in SL ..... *Eumecichthys fiski*
- 1b Forehead profile vertical or projecting only slightly in front of mouth; anterior dorsal-fin crest subequal to body depth; body depth 5–8 in SL ..... *Lophotus cristatus*



### *Eumecichthys fiski* (Günther 1890)

Unicorn crestfish

PLATE 36

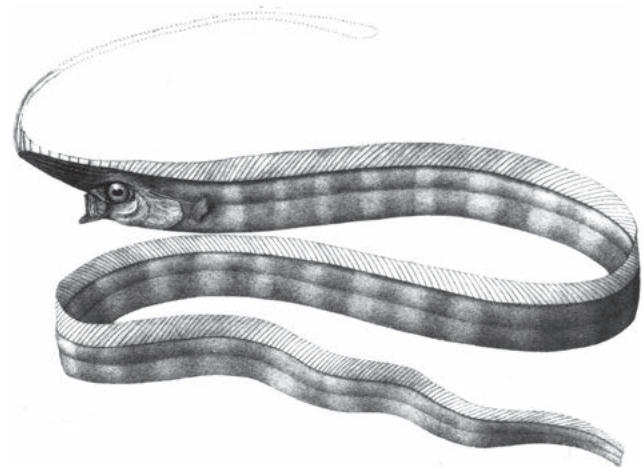
*Lophotes fiski* Günther 1890: 244, Pls. 19–20 (Cape of Good Hope, Kalk Bay, South Africa); Matsubara 1939\*; SFSA No. 267\*.

*Eumecichthys fiski*: Walters & Fitch 1960; Parin & Pokhil'skaya 1968\*; SSF No. 121.1\*; Roberts 2012.

Dorsal fin 310–392 rays; anal fin 5–9 rays; pectoral fins 12–15 rays; caudal fin 12 or 13 rays; GR 5/6. Adults with forehead greatly produced forwards as fleshy, compressed and tapering

rostrum, its length almost as long as rest of head (rostrum of juveniles much shorter). Body extremely elongate and compressed; depth at pectoral-fin bases 19–30 in SL. Dorsal-fin origin at front of rostrum; 2nd ray greatly elongated and bearing narrow crest-like membrane, the next 6 rays short and split to base. Anal fin of adults minute, immediately behind cloaca, and fin rays split into 2 series: one along each side of ventral keel; anal fin of juveniles with 5–7 simple rays. Caudal fin slightly longer than post-orbital part of head; rays simple and non-articulated (but lower rays elongated in a 58-mm-SL juvenile). Pectoral-fin bases horizontal, below rear edge of opercle. Pelvic fins rudimentary, below and behind rear end of pectoral-fin bases, or absent. Premaxilla and lower jaw with small slender canines, in 1 row at rear of lower jaw, and in 2 or 3 irregular rows at front of jaw; no teeth on vomer or palatines. Two minute nostrils on each side of snout. Swimbladder small, oblong, thick-walled, in front half of abdominal cavity; ink sac ~1 HL (without rostrum) behind swimbladder. Vertebrae 151–200.

Head and body silvery white, with 24–60 wide dusky vertical bands; dorsal fin and caudal fin crimson. Attains at least 92 cm SL, ~150 cm TL.

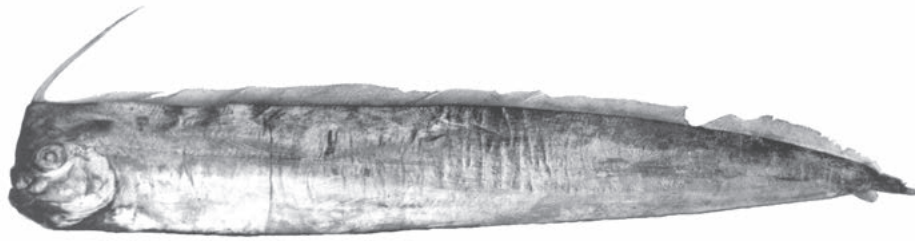


*Eumecichthys fiski*, 125 cm TL, holotype (South Africa). Source: Günther 1890

**DISTRIBUTION** Probably circumglobal, including South Africa (False Bay), India and Sri Lanka in WIO; Japan, Hawaii and Mexico in Pacific, and São Tomé in Atlantic.

**REMARKS** Rare, mesopelagic; known to ~1 000 m deep.





*Lophotus cristatus*, ~100 cm TL (South Africa).

***Lophotus cristatus*** Johnson 1863

Silver crestfish

PLATE 36

*Lophotes cristatus* Johnson 1863: 38 (Madeira); Goode & Bean 1895.

*Lophotus lacepede* (non Giorna 1809): SSF No. 121.2\* [in part];

Craig *et al.* 2004\*.

Dorsal fin 220–246 rays; anal fin 18 or 19 rays; caudal fin 16 rays; pectoral fins 13 rays; pelvic fins 5 rays. Forehead profile vertical or slightly canted forward. Body depth subequal to HL, ~5.2 in SL. Second ray of dorsal fin enlarged, with narrow crest-like membrane running its length; 1st ray of pectoral fins bony; pelvic fins rudimentary, set below and behind pectoral-fin bases. Front of jaws with 3–5 irregular rows of small canines, and sides of jaws with 1 or 2 rows of similar teeth; a few minute teeth on vomer and at front of palatines. Swimbladder well-developed, with thick-walled anterior chamber containing gas glands, and 2 thin-walled elongate posterior chambers running along each side of a long cylindrical ink sac. Vertebrae 124–152.

Head and body uniformly silvery; dorsal fin crimson. Attains at least 120 cm TL.

**DISTRIBUTION** Eastern Atlantic Ocean, Mediterranean Sea and Indian Ocean. WIO: South Africa (False Bay to East London) and Réunion.

**REMARKS** Rare; mostly known from strandings on beaches. Here considered distinct from the spotted crestfish *Lophotus lacepede* Giorna 1809, which seems confined to the northeastern Atlantic and western Mediterranean Sea.

**GLOSSARY**

**cloaca** – the cavity at the end of the digestive tract into which the genital tract also opens.

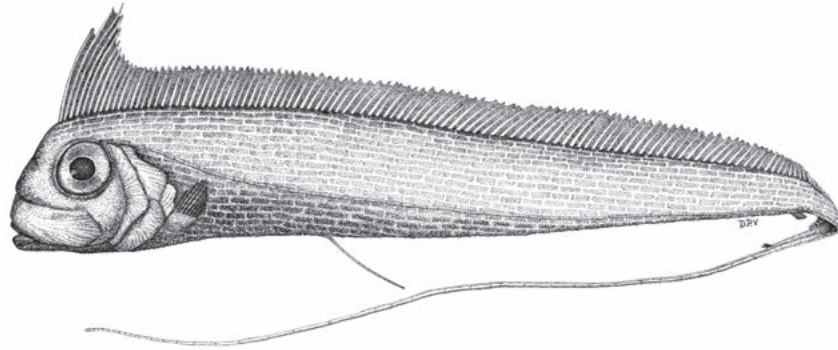
**FAMILY RADIICEPHALIDAE**

**Tapertail**

Phillip C Heemstra

Body greatly elongated and laterally compressed, its depth gradually decreasing from head to tail tip. Head short, its length slightly greater than body depth at rear edge of head; snout blunt, head profile steep; 1 round nostril on each side of snout. Dorsal fin long and low, from above front edge of eye to last vertebra, with elevated anterior crest formed by elongated 2nd–6th rays. Pectoral fins short, set low on body just behind opercle. Pelvic fins in adults reduced to single slender ray inserted on ventral surface ~1 HL behind head. Anal fin rudimentary, about halfway between last vertebra and anus. Caudal fin a greatly elongate tubular filament with two distinct parts: small upper lobe with 4 rays, and lower lobe with 7 rays, which emanate from ventral surface of last 3 vertebrae and enclose the lateral-line canals. Jaws greatly protrusile, ascending process of premaxilla extending more than four-fifths up front profile; maxillae exposed, broadly expanded and striate; no supramaxilla; upper jaw with patch of small sharp teeth, plus 1 much larger retrorse tooth on each side of premaxilla symphysis; lower jaw with row of 7–9 slender sharp teeth on each side of symphysis; 3 teeth on vomer, and 2 or 3 teeth on each palatine. No scales except for smooth (tubular) lateral-line scales; skin with numerous small pores and scattered soft papillae. Opercular bones striated, but edges smooth. Branchiostegal rays 7, the membranes separate. Gill arches 4; gill rakers 2 or 3/7 or 8. Lateral-line canal complete, comprising series of tubular scales, and beginning above opercle, curving downward posteriorly, continuing past last vertebra where the canals of either side join to form thin-walled tube supported by greatly elongated caudal ‘rays.’ Swimbladder well-developed; ink sac present. Cloaca located below 44th vertebra (~2 HL behind head) and it receives the urogenital ducts, anus and ink-sac discharge. Vertebrae 119–121.

Monotypic.



*Radiicephalus elongatus*, 31 cm SL (South Africa). Source: SSF

## *Radiicephalus elongatus* Osório 1917

### Tapertail

*Radiicephalus elongatus* Osório 1917: 114, Figs. 2–4 (coast of Morocco); Harrison & Palmer 1968 [designation of neotype from off coast of Morocco]; Karrer 1976\*; SSF No. 120.1\*.

Diagnosis as for family. Dorsal fin 156–160 rays; anal fin 6 or 7 rays; pectoral fins 10 rays. LL scales 112–120; GR 2 or 3/7 or 8. Body depth 8–10 in SL; HL 6–7 in SL; eye diameter 3.4–4 in HL. Precaudal vertebrae 38 or 39, and preanal vertebrae 44 or 45; ribs present on all precaudal vertebrae except for first 3.

Body and tail silvery in life; fins pale, but dorsal-fin base blackish. Attains 76 cm TL.

**DISTRIBUTION** Eastern Atlantic (Azores and Morocco) to South Africa (Cape Point), and western and eastern Pacific (off New Guinea and California Current, respectively).

**REMARKS** Known from few specimens. Larvae planktonic and adults mesopelagic. Feeds on midwater fishes, mainly myctophids (lanternfishes) and possibly euphausiids (krill).

## FAMILY REGALECIDAE

### Oarfishes

Tyson R Roberts

Body ribbon-like, extremely elongate and laterally compressed; body posterior to vent ~2–3 times longer than body anterior to vent (in complete specimens); body of autotomised fish ending in a characteristic healed-over scar (the terminus). Dorsal-fin extremely long, its origin above eyes and extending

to end of body or vertebral column, and anterior triangular finlet or 1 or 2 crests of elongated rays present; pectoral fins small (<HL), bases horizontal, fins vertically oriented when appressed to body; pelvic fins each consisting of single ray (usually broken off, especially after stranding); no anal fin; caudal fin of juveniles with 2–4 rays, but fin typically lost in adults. Snout greatly sloping; mouth oblique; maxilla large, upper jaw very protrusile; jaws usually toothless, rarely with a few widely separated and very small teeth. Opercular bones thin and striate. Lateral line from behind eyes to end of body. No scales, but body covered with caducous guanine crystals. No swimbladder.

Displays the unique adaptation of self-amputation or autotomy of the rear part of its body (evident in nearly all fish >1.5 m TL), which can occur repeatedly so that not only the caudal fin is missing but also as many as two-thirds of the total vertebrae present before autotomy (the lost parts are not regenerated). Epipelagic to mesopelagic in the open ocean, although apparently healthy individuals are sometimes found in shallow water and large adults often swim out of the water to strand themselves on the beach.

Two genera and at least 3 species, probably all in WIO.

#### KEY TO GENERA

- 1a Dorsal fin of large individuals with 2 greatly enlarged crests anteriorly, and crests separate from rest of fin; pelvic fins modified to form single elongated ray, ornamented along length with 3 or 4 short skin flaps; greatest body depth >HL; total GR in adults 33–60 ..... *Regalecus*
- 1b Dorsal fin of large individuals with single triangular finlet anteriorly, joined by interrational membrane to rest of fin; pelvic fins consist of single thick ray (probably always present in young stages, but invariably broken off near base of ray in larger fish); greatest body depth <HL; total GR ~8 ..... *Agrostichthys*

## GENUS *Agrostichthys* Phillipps 1924

Body extremely elongate, its depth immediately behind head 40–60 in SL. Dorsal fin extending from rear part of head to end of body, with small triangular finlet anteriorly, the first 2 rays greatly elongated (their length ~30–90% body length), and finlet continuous with rest of dorsal fin, not forming separate 'crest.' Pelvic fins of adults reduced to single thick ray, or fins absent (condition of pelvic fins in young unknown). Caudal fin (when intact) with 2 rays. Upper jaw extremely protrusile, forming trough-like proboscis when protruded, with anteroventral opening above lower jaw. Early life stages (eggs and larvae) poorly known. Probably has autotomy of the rear part of the body as in species of *Regalecus*, but this is not well documented. One species currently recognised.

### *Agrostichthys parkeri* (Benham 1904)

Streamer fish

PLATE 37

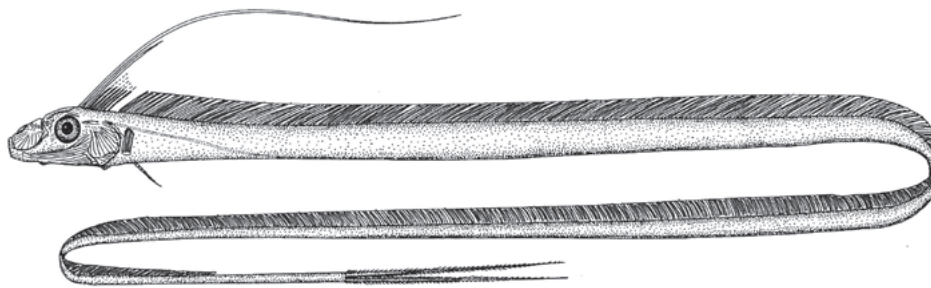
*Regalecus parkeri* Benham 1904: 198, Pl. 9 (washed ashore near Port Chalmers, Otago Harbour, New Zealand).

*Agrostichthys benhami* Scott 1934: 47, Pls. 7–8 (Ulverstone, NW Tasmania).

*Agrostichthys* cf. *parkeri*: Trunov 1982\*.

*Agrostichthys parkeri*: SSF No. 122.1\*; McDowall & Stewart 1999\*; Heemstra & Heemstra 2004.

Diagnosis as for genus. HL 2–3 times greatest body depth; eye diameter ~4 in HL. Dorsal fin with small triangular finlet anteriorly and first 2 rays greatly elongated (~30–90% TL); total dorsal-fin rays 500+. Pectoral fins short, with 8–11 rays. Pelvic fins shorter than HL. Caudal fin of 58-cm individual with 2 thick elongated rays bearing small spines; tail of 3.1-m female terminating in blunt tip with no caudal rays. Fleshy uvula-shaped protuberance below symphysis of lower jaw; juveniles with short, oblique, conical tooth on each side of symphysis of lower jaw, and adults with narrow band of cardiform teeth along distal part of lower jaw; vomer with 3 or 4 small teeth on each side, and 1 enlarged median tooth inclined posteriorly; no teeth on upper jaw or palatines.



*Agrostichthys parkeri*, 58 cm SL. Source: SSF

GR 1 or 2 rudiments + 6 or 7 developed rakers (not bristly as in *Regalecus*). Vertebrae 175–180.

Body, head and iris silvery; dorsal fin reddish. Attains 3 m TL.

**DISTRIBUTION** Circumglobal in Southern Hemisphere: southwestern and southeastern Atlantic (Argentina Trench and Falkland Is.; Namibia and South Africa) and western Pacific (Australia, New Zealand and Tasmania); likely to occur in Indian Ocean.

**REMARKS** Occurs in open ocean; usually collected near the surface, over continental slope (known from >40 specimens from around New Zealand, but only one specimen from off west coast of South Africa); seldom if ever becomes stranded, consequently there are fewer specimens of this species in museum collections than of *Regalecus*. A live fish found off New Zealand reportedly emitted an electric discharge.

## GENUS *Regalecus* Ascanius 1772

Body compressed, greatly elongated; body depth behind head subequal to HL, ~7–8 in preanal length. Juveniles (usually to ~30 cm TL, rarely to 80 cm TL) usually have a complete body, indicated by presence of caudal fin; in larger fish (>1 m TL), the rear part of body usually has been lost due to autotomy, thus larger specimens cannot be identified on the basis of total counts of dorsal-fin rays or vertebrae. Anterior part of dorsal fin forming 2 crests of greatly elongated rays: 1st crest usually with 5 thickened and relatively inflexible rays bound by membrane for the basal third of their lengths, thus moving as a unit; 2nd crest with 1–12 slender and highly flexible rays not bound by membrane, thus moving independently; dorsal-fin rays of 2nd crest also ornamented with 1–5 or more light-reflecting expansions along their length, the largest at tips. Pelvic fins modified as single, stiff, elongate ray, extending backward to above vent, also with reflective ornaments along length and at tips (rays frequently broken off at base in museum specimens).

Single nostril on each side of snout, just behind maxillary symphysis. Mouth toothless, or with a few teeth at front of lower jaw and small tuft of bristle-like teeth on vomer. Larger fish with 33–60 gill rakers covered with tough spiny bristles.

Biology little known. Nearly all very large fish are gravid females, indicating that they might be protandrous hermaphrodites; of 12 large adults of *R. russellii* examined in Japan, about half had testes and the other half had ovaries. Feeds mainly on planktonic crustaceans of the family Euophausiidae, but also probably insignificantly on fishes. Swims vertically, head up, by undulating the dorsal fin, and with the pelvic fins spread out and away from the body; presumably adopts this position in water column to spot prey silhouetted against light from the surface. Eggs ~2.5 mm, with thick reddish brown outer membrane, are produced in millions. Flesh unpalatable, soft and watery, even after prolonged cooking. Large individuals have no known predators: marine mammals and sharks, as well as dogs, cats, seagulls and humans avoid eating them. Why adult fish strand themselves is unknown, as strandings are not correlated with stormy weather or disease, but possibly the fish are attempting to reach the open sea. The elongate pelvic fins (the 'oars') are not used for swimming but have chemoreceptive organs (akin to tastebuds) that may be useful in prey selection. Large oarfish are a likely source of sea-serpent myths. Two species, both in WIO.

#### KEY TO SPECIES

- 1a Dorsal fin with 2 anterior crests: first crest of 4–6 elongated rays, bound by delicate membranes, and contiguous with second crest of 8–12 filamentous free rays; dorsal-fin rays 90–120 from fin origin to vertical at anus ..... *R. glesne*
- 1b Dorsal fin with single anterior crest of 5 or 6 elongated rays; dorsal-fin rays 58–83 from fin origin to vertical at anus ..... *R. russellii*

### *Regalecus glesne* Ascanius 1772

Coldwater oarfish

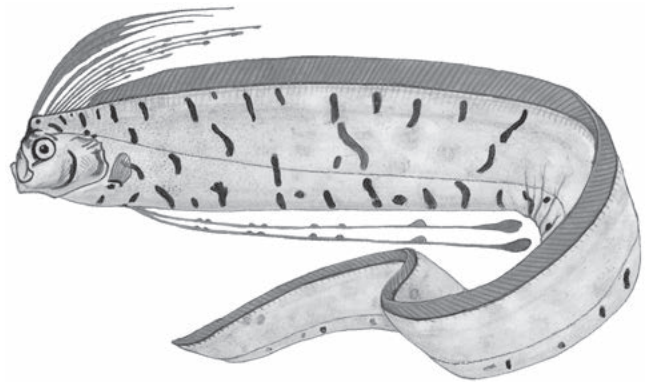
PLATE 37

*Regalecus glesne* Ascanius 1772: 5, Pl. 11 (Glesne, near Bergen, Norway); SFSA No. 263\*; Hulley & Rau 1969\*; Karrer 1975; Trunov 1982\*; SSF No. 122.2\*; Heemstra & Heemstra 2004\*; Roberts 2012.

Diagnosis as for genus. Dorsal fin of adults with 2 crests anteriorly, usually comprised of 5 or 6 + 5–7 crestal rays, plus

a highly variable number of normal rays posteriorly due to variable extent of autotomy; complete juveniles with 414–449 total dorsal-fin rays. Origin of 1st dorsal-fin crest in front of a vertical at front edge of eyes. In large subadults and adults, 1st dorsal-fin crest usually with 5 or 6 rays, and 2nd crest usually with 5–7 rays. GR of adults 33–47. Dorsal-fin rays to end of abdomen 90–120; vertebrae to end of abdomen 45–56.

Head and body brilliant silvery, with bluish streaks when alive (silvery pigment of body rubs off when touched); body with various blackish streaks and spots; dorsal fin and pelvic fins crimson. Attains ~11 m TL; the longest bony fish, with autotomised specimens reaching 8 m TL or more.



*Regalecus glesne*, 140 cm TL (South Africa). Source: CFSA

**DISTRIBUTION** Circumglobal, antitropical, from about 18°–72° N and 16°–52° S, including Mediterranean Sea; could possibly circumnavigate by means of the Antarctic Circumpolar Current (or West Wind Drift), but there are no records of its presence in this current or in any other Antarctic waters; present in southernmost part of WIO off southern Africa, but probably absent from rest of Indian Ocean.

**REMARKS** Chiefly mesopelagic, and generally solitary; occurs in open ocean, from surface to ~1 000 m deep (often <200 m). Uncommonly sighted in their natural habitat; most large specimens in museum collections result from beach strandings, and these usually have both dorsal-fin crests severely damaged. Broadcast spawners; eggs and larvae encountered near the surface. Found in relatively cold water as compared with *R. russellii*. As presently understood, *Regalecus glesne* has a long synonymy that includes at least 16 nominal species (Roberts 2012).



## *Regalecus russellii* (Cuvier 1816)

Warmwater oarfish

PLATE 37

*Gymnetrus russellii* Cuvier (ex Shaw) 1816: 244 (Visakhapatnam, India)  
[based on 'Russelian gymnetrus' of Shaw 1803: 195, Pl. 28, which in turn is based on description and drawing in Russell 1803: 40, Pl. 40].

*Gymnetrus russellii*: Günther 1861.

*Regalecus russellii*: Roberts 2012\* [neotype from Shikoku, Tosa Bay, Japan].

Diagnosis as for genus. Dorsal fin of adults (when undamaged) usually with 5 or 6 + 1 crestal rays, plus a highly variable number of normal rays due to variable extent of autotomy; juveniles with complete bodies (indicated by presence of caudal fin) with total dorsal-fin rays 333–371. GR 47–60 in adults. Dorsal-fin rays to end of abdomen 70–82. Vertebrae to end of abdomen 34–37.

Head and body silvery; body with various blackish streaks and spots; dorsal fin and pelvic fins crimson. Attains possibly 5.4 m SL or more.

**DISTRIBUTION** Atlantic and Indo-Pacific, with most records between 20° N and 20° S, including many along the Equator; northernmost and southernmost known extremes are 44° N (northern Hokkaido, Japan) and 35° S (southernmost South Africa).

**REMARKS** Numerous authors have corrected the spelling of the species name to *russelli*. Occurs in open ocean, from the surface to ~500 m deep; most large specimens in museum collections result from beach strandings. Apparently spawns in area west of Mariana Is. and very near Okinawa (Japan) in western Pacific, and possibly off South Africa (KwaZulu-Natal) in WIO. Found in relatively warm water as compared with *R. glesne*, and known to be sympatric with that species only in the southernmost part of WIO off southern Africa. Several central Indian Ocean photographic records of *Regalecus*, unidentified to species, fall within warmer waters (between 15° N and 15° S), and thus probably depict *R. russellii*. In Japanese waters, large individuals were observed as often occurring as male and female pairs.

### GLOSSARY

**autotomy or self-amputation** – the ability of certain animals to deliberately cast off part of the body, most commonly known in lizards that 'lose' part of their tail when threatened.

**protandrous hermaphrodites** – hermaphroditism that functions first as a male and then changes into a female.

## FAMILY TRACHIPTERIDAE

### Ribbonfishes

Phillip C Heemstra

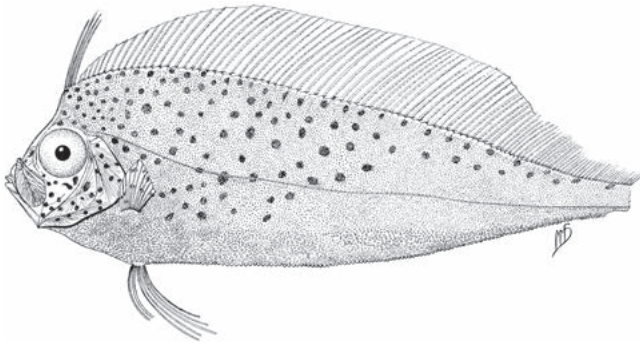
Head and body greatly compressed; tail compressed and elongated; caudal fin fan-like, and lower rays either reduced, rudimentary or absent. Dorsal fin long and low, from top of head to tip of tail, the soft (segmented) rays of juveniles with minute spines or prickles along their lateral edges but disappearing with growth; pelvic fins rudimentary or absent in adults; no anal fin. Mouth oblique, upper jaw highly protrusile; teeth minute or absent. Skin of adults with cartilaginous tubercles and pierced by numerous pores. Swimbladder rudimentary. Vertebrae 63–97, and posterior vertebrae of adults elongate; ribs absent.

Occur in open ocean, from near surface at night, to ~1 000 m deep during the day. The peculiar skin tubercles and dermal pore system are thought to reduce drag when the fish is swimming. Most species probably maintain a head-up position by means of undulations of the dorsal fin.

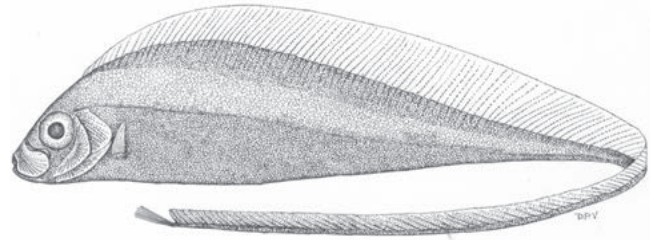
Three genera; although ~90 species have been described, only ~11 species are valid; 3 genera and 5 species in WIO. Species from South Africa were reviewed by Heemstra & Kannemeyer (1984).

### KEY TO GENERA

- 1a Caudal fin with 4–10 dorsal-fin rays approximately parallel to long axis of body; no ventral caudal-fin rays, and no elongate spiny plates or bony tubercles along ventral edge of tail ..... *Desmodema*
- 1b Caudal fin in two parts: 6–12 upper rays often raised nearly to right angle above long axis of body, and 1–5 lower rays (present as rudimentary spiny nubbins in *Trachipterus*); elongate spiny plates or bony tubercles along ventral edge of tail ..... 2
- 2a Lateral line runs along ventral edge of tail as row of elongate spiny plates; juveniles (<50 cm SL) with ventral edge of body distinctly scalloped; body depth 1.5–2.9 in distance from snout to anus ..... *Zu*
- 2b Lateral line well above ventral edge of tail; bony tubercles along ventral edge of tail (but no elongate spiny plates); ventral edge of body straight in lateral profile; body depth 3.7–4.1 in distance from snout to anus ..... *Trachipterus*



*Desmodema polystictum*, 9 cm TL, holotype of *Trachipterus woodi*, with tail missing (South Africa). Source: SFSA



*Desmodema polystictum*, 104 cm SL, adult (Pacific Ocean). Source: SSF

## GENUS *Desmodema* Walters & Fitch 1960

Body oblong and compressed; tail greatly elongated and attenuated, upper rays of caudal fin approximately parallel to body axis, and no lower rays; pelvic fins well-developed and distinctly elongated in juveniles <10 cm SL, but fins rudimentary or absent in adults; 2 nostrils in prejuveniles, rear nostril just in front of eye, disappears with growth. No supraneural bones; 7 dorsal-fin pterygiophores before neural spine of 1st vertebra. Two species: 1 in eastern central Pacific and 1 in Indo-Pacific.

### *Desmodema polystictum* (Ogilby 1898)

Polkadot ribbonfish

PLATE 37

*Trachipterus jacksoniensis polystictum* Ogilby 1898: 649 (Newcastle, New South Wales, Australia).

*Trachipterus woodi* Smith 1953: 504, Fig. 264b (Xora River mouth, Transkei, South Africa); Smith 1966\*.

*Desmodema polystictum*: Rosenblatt & Butler 1977\*; Heemstra & Kannemeyer 1984\*; SSF No. 119.1\*.

Dorsal fin 120–128 rays, first 4 rays elongated into crest on front of head in juveniles; pectoral fins small, with horizontal base and 12–14 rays; caudal fin with 7–10 upper rays approximately parallel to long axis of body, and no lower rays. Tail greatly elongated in adults; distance from snout to anus  $\sim\frac{1}{2}$  SL in adults,  $\sim\frac{2}{3}$  SL in prejuveniles. Eye diameter longer than snout length (including upper jaw). GR 2 or 3/9 or 10; median strip of small tubercles along abdomen (but not along

tail). Vertebrae: 71–74 total, 18–20 precaudal, 37–42 preanal.

Adults silvery, with reddish dorsal fin; juveniles  $\sim$ 10 cm SL silvery with numerous small black spots; dorsal fin of juveniles yellow with reddish edge, and pelvic fins mostly yellow but orange distally. Attains  $\sim$ 100 cm SL, 110 cm TL.

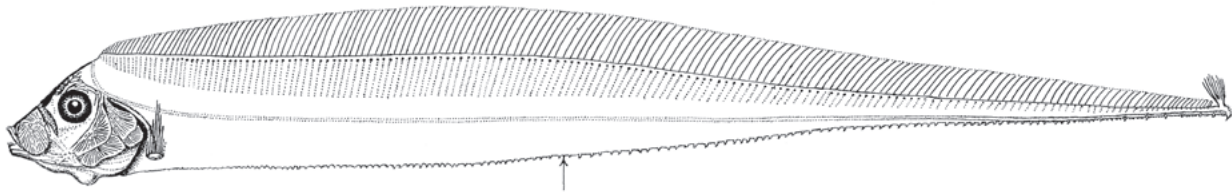
**DISTRIBUTION** Probably circumglobal in tropical seas.

WIO: South Africa (3 juvenile specimens: one from Xora River mouth, one trawled off the South Coast, and one from a tidepool at Simonstown, False Bay); also Pakistan and possibly India.

**REMARKS** Rare; epipelagic and mesopelagic in open ocean, to  $\sim$ 600 m deep. Adults probably live deeper, and young nearer the surface, however a 22-cm-TL juvenile was trawled at 596 m off South Africa.

## GENUS *Trachipterus* Goüan 1770

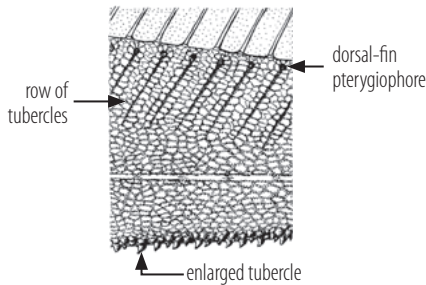
Body and tail greatly elongated, compressed and tapering; caudal fin small and fan-like, and lower rays present only as rudimentary spiny nubbins. One nostril on each side of snout. No scales, and no lateral-line plates along ventral edge of tail. Enlarged bony tubercles in band along ventral edge of abdomen and tail, and tubercles variously present along dorsal-fin pterygiophores. One pterygiophore before 1st neural spine, and 9 pterygiophores between 1st and 2nd neural spines. About 7 valid species, 2 in WIO.



*Trachipterus jacksonensis*, 21 cm TL, holotype of *Trachipterus nigrifrons* (South Africa). Source: SSF

**KEY TO SPECIES**

- 1a Tubercles on body distinct, with those along ventral edge of abdomen enlarged, pointed and slightly curved; tubercles in row along each side of dorsal-fin pterygiophores; pectoral fins 13 or 14 rays ..... *T. jacksonensis*



- 1b Tubercles distinct only along ventral edge of body and tail; tubercles irregular and crowded over dorsal-fin pterygiophores; pectoral fins 8–11 rays ..... *T. trachipterus*

**DISTRIBUTION** Probably circumglobal in Southern Hemisphere, including South Africa (Cape Town, Knysna and East London) and Réunion in WIO; elsewhere, Brazil, Argentina, southern Australia and New Zealand.

**REMARKS** Rare; known mostly from strandings on rocky shores and beaches. Mesopelagic in open ocean, possibly to ~1 000 m deep.

*Trachipterus trachipterus* (Gmelin 1789)

Peregrine ribbonfish or Mediterranean dealfish PLATE 37

*Cepola trachiptera* Gmelin 1789: 1187 (Adriatic Sea [Mediterranean Sea]).  
*Trachipterus arcticus* (non Brünnich 1788): Barnard 1948\*.  
 ?*Trachipterus iris*: Smith 1961.  
*Trachipterus trachipterus*: Palmer 1961\*; Heemstra & Kannemeyer 1984\*;  
 SSF No. 119.3\*.

*Trachipterus jacksonensis* (Ramsay 1881)

Blackflash ribbonfish

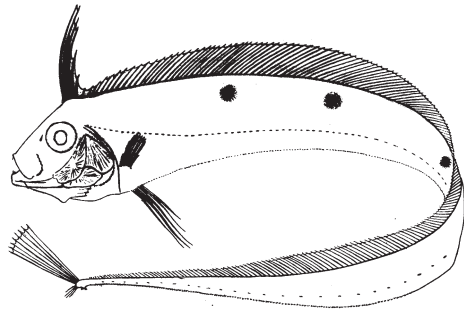
*Regalaeus jacksonensis* Ramsay 1881: 631, Pl. 20 (Manly Beach, Port Jackson, New South Wales, Australia).  
*Trachipterus nigrifrons* Smith 1956: 449, Fig. 1, Pl. 12 (East London, South Africa); Smith 1961, 1965.  
*Trachipterus jacksonensis*: Heemstra & Kannemeyer 1984\*; SSF No. 119.2\*.

Dorsal fin 166–173 rays, first 6 rays short and hair-like; pectoral fins 13 or 14 rays; caudal fin minute. GR 3–5/8; tubercles on ventral edge of abdomen enlarged, pointed and slightly curved, and those along dorsal-fin pterygiophores in rows. Eye diameter 6–7.3% distance from snout tip to anus; 5 small slender canine teeth on each side at front of lower jaw, and 0–6 teeth on each side in upper jaw; 1 large canine tooth on vomer, and 1 smaller tooth at front of each palatine. Vertebrae: 81–83 total, 31–34 precaudal, 44–48 preanal.

Head and body silvery, except front of head, interorbital area, dorsal rim of upper jaw and tip of lower jaw black. Attains 220 cm TL.

Dorsal fin 145–184 rays, the first 6 rays elongate; caudal fin fan-like. GR 3–5/8–10; tubercles distinct only along ventral edge of body and tail, and irregular along dorsal-fin pterygiophores. Eye diameter 8.4–8.9% distance from tip of snout to anus. No teeth in upper jaw; 0–5 teeth at front of lower jaw; 0–3 short conical teeth on vomer. Vertebrae: 84–96 total, 35–39 precaudal, 49–57 preanal.

Head and body silvery; juveniles with 3–5 dark round spots on upper sides of body and 1 or 2 along belly; with dusky blotch usually visible on body at bases of 20th–28th dorsal-fin rays; fins may be reddish. Attains possibly 300 cm TL.



*Trachipterus trachipterus*, juvenile. Source: SFSA

**DISTRIBUTION** South Africa (Table Bay to East London) and Atlantis Seamount; also Mediterranean Sea, eastern Atlantic (Morocco to Namibia), western Pacific (Japan and New Zealand) and eastern Pacific (Chile).

**REMARKS** Rare; mesopelagic, known to at least 600 m, but eggs and larvae frequently found near the surface. Swims with head up.

## GENUS *Zu* Walters & Fitch 1960

Displays remarkable transformation of the body and fins with growth. Prejuveniles (<25 cm SL) with pelvic-fin rays and anterior 4–6 dorsal-fin rays greatly elongated and filamentous, dorsal-fin rays with several small skin flaps attached to each ray, body compressed, and ventral edge of abdomen distinctly scalloped. Juveniles (~30–54 cm SL) with elongated dorsal- and pelvic-fin rays shrinking, ventral edge of abdomen nearly straight in lateral profile, and body less compressed. Adults (>55 cm SL) with no pelvic fins, no elongated dorsal-fin rays, ventral edge of abdomen smooth and slightly convex, and body robust, less compressed than other trachipterids. Caudal fin 6–12 upper rays, 1–5 lower rays. Scales deciduous, not apparent in prejuveniles. Lateral line with spiny plate-like scales; line curving gradually from above opercle to ventral edge of tail behind anus, where it is represented by 2 rows of staggered spiny plates (the spiny lateral-line scales along ventral edge of tail resemble the enlarged denticles of some skates in family Rajidae). One pterygiophore before 1st neural

spine, and 9 pterygiophores between 1st and 2nd neural spines. ‘Zu’ was the Babylonian god of storms, an appropriate name for a trachipterid, as these fishes are usually found thrown ashore in the wake of storms. Two species, both in WIO.

### KEY TO SPECIES

- 1a Body depth 20–26% SL; body of prejuveniles abruptly constricted behind anus; eye diameter 13–16% distance from snout to anus; LL plates 99–106 ..... *Z. cristatus*
- 1b Body depth 12–16% SL; body of prejuveniles not constricted behind anus; eye diameter 9–10% distance from snout to anus; LL plates 126–130 ..... *Z. elongatus*

## *Zu cristatus* (Bonelli 1820)

Scalloped ribbonfish

PLATES 37 & 38

*Trachipterus cristatus* Bonelli 1820: 487, Pl. 9 (Gulf of La Spezia, Italy, Mediterranean Sea); SFSA No. 264a\*.

*Zu cristatus*: Walters & Fitch 1960; Heemstra & Kannemeyer 1984\*; SSF No. 119.4\*.

Diagnosis as for genus. Dorsal fin 120–150 rays; pectoral fins 10–12 rays; pelvic fins 5–7 rays in prejuveniles; caudal fin fan-like. First 4 or 5 rays of dorsal fin and pelvic fins greatly elongated in prejuveniles, rudimentary or absent in adults. GR 2 or 3/8 or 9. Eye diameter 1.3–1.7 in lower jaw length. Upper jaw with 12–18 small canines; lower jaw with 8–16 teeth; vomer with 1–4 teeth; palatines with 1–3 canines. Vertebrae: 63–69 total, 22–24 precaudal, 32 preanal.

SURFACE



*Zu cristatus*, 10 cm TL, juvenile swimming in ocean (South Africa). Source: SSF



Adults silvery grey, paler ventrally; dorsal fin scarlet; caudal fin reddish black, darker distally. Young silvery, with ~6 wavy dark vertical bars on dorsal part of body, and 4 bars on ventral part of body; tail with ~6 complete black bars; caudal fin mostly blackish, but pale at base. Attains 120 cm SL.

**DISTRIBUTION** Probably circumglobal in tropical through temperate seas, including Mediterranean Sea, Kenya and South Africa (KwaZulu-Natal to Western Cape), and South Africa and Namibia in southeastern Atlantic.

**REMARKS** Mesopelagic in open ocean; trawled off Namibia at 557 m.

*Zu elongatus* Heemstra & Kannemeyer 1984

Tapertail ribbonfish

PLATE 38

*Zu elongatus* Heemstra & Kannemeyer 1984: 29, Figs. 9a–11b (off Cape Columbine, northwestern Cape, South Africa); SSF No. 119.5\*.

Diagnosis as for genus. Dorsal fin 142–147 rays; pectoral fins 11 or 12 rays; pelvic fins 7 rays in prejuveniles. LL plates 126–130; GR 2 or 3/7–9. Eye diameter 1.7–2 in lower jaw length. Vertebrae: 84–87 total, 29–31 precaudal, 38–40 preanal.

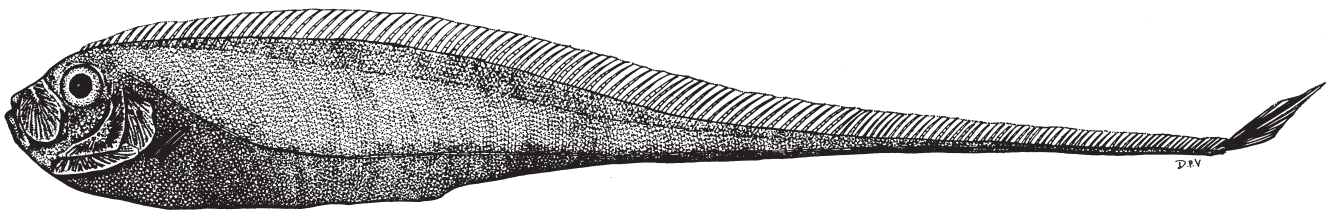
Preserved specimens buff, with 3 incomplete dark bars on body, and 5 dark bars on tail; front of head with dark triangular area extending down front of jaws to gular area; rear dorsal-fin rays and caudal-fin tip black. Attains 120 cm SL.

**DISTRIBUTION** Namibia and South Africa in southeastern Atlantic, and possibly the Cape Peninsula in WIO; elsewhere, New Zealand in southwestern Pacific.

**REMARKS** Trawled to 500 m. Known from off South Africa only from four specimens.

#### GLOSSARY

**gular area** – the area between the dentary bones; the throat.



*Zu elongatus*, 114 cm SL, adult, paratype (South Africa). Source: SSF

# ORDER POLYMIXIIFORMES

M Eric Anderson

Formerly classified in the Beryciformes, the single family of beardfishes (Polymixiidae) was shown to be more primitive than that group, as recognised by Zehren (1979) who first suggested they be removed from that order. Beardfishes have a fossil record, namely that of *Omosoma tselfatensis* Gaudant 1978, extending back to the Mid-Cretaceous (~100 MYA). A single extant genus, *Polymixia*.

## FAMILY POLYMIXIIDAE

### Beardfishes

M Eric Anderson

Body oblong, laterally compressed, more so in juveniles than adults. Paired barbels on chin, inserted well behind tip of lower jaw, and usually reaching back to vertical through pectoral-fin bases. One dorsal fin, often with black blotch anterodorsally, with 4–6 spines and 26–38 rays; anal fin with 3–5 spines and 13–18 rays; last dorsal- and anal-fin rays split to their bases; dorsal fin and anal fin naked and otherwise unpigmented; pectoral fins wedge-shaped, with 14–19 rays; pelvic fins with unbranched spine-like ray, and 6 soft rays; caudal fin forked, with 16 branched rays. Maxilla naked; 2 supramaxillae. Teeth on jaws villiform, in many bands anteriorly; teeth also present on vomer, palatines, endopterygoid and tongue. Branchiostegal rays 7: first 3 tiny, supporting the barbel, and not visible externally. Gill rakers well-developed. Scales spinoid, with triangular spines arranged in two patterns: one wedge-shaped, the other irregular-vertical. Lateral line complete, extending onto caudal fin; LL scales 29–39. Swimbladder present. Vertebrae 12–14 + 14–17 = 28–30.

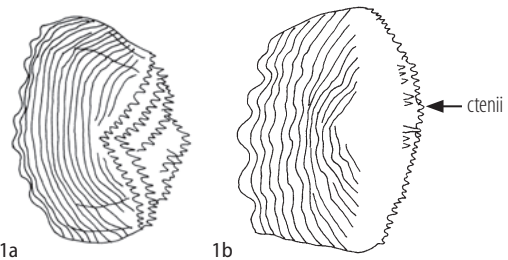
Worldwide in temperate to tropical seas; benthic, generally on the middle continental shelf to upper slope (reported depth range 18–770 m). Feed on benthic invertebrates and small fishes; observed keeping its barbels in contact with the bottom sediments while swimming. Of minor commercial importance in deep trawl fisheries; largest species attains ~60 cm TL.

One genus, *Polymixia* Lowe 1836, with 10 species, 3 in WIO (Kotlyar 1992).

#### KEY TO SPECIES

[As in couplet 2, the characters based on overlap may not be reliable in all specimens: the fleshy part of the snout in *P. berndti* may be damaged in trawls or become altered in specimens preserved with their mouths open; also, pelvic fin-ray development is not fully expressed in juvenile *P. berndti*.]

- 1a Scales before dorsal fin with ctenii arranged in wedge-shaped rows; GR 11; 14 or 15 scales in oblique row from dorsal-fin origin to lateral line ..... *P. busakhini* [known from below 400 m]  
 1b Scales before dorsal fin with ctenii in irregular vertical rows; GR 12–17; 10–14 scales in oblique row from dorsal-fin origin to lateral line ..... 2



- 2a Snout not protruding beyond upper jaw; adpressed tips of pectoral and pelvic fins on same vertical; soft dorsal fin 30–34 (usually 32–34) rays; GR 14–17; LL scales 34–37 ..... *P. fusca*  
 2b Snout protruding beyond upper jaw; tip of adpressed pelvic fin extends past tip of pectoral fin (except in juveniles); soft dorsal fin 28–34 (usually 29 or 30) rays; GR 12–14; LL scales 29–36 ..... *P. berndti*

### *Polymixia berndti* Gilbert 1905

Indo-Pacific beardfish

PLATE 38

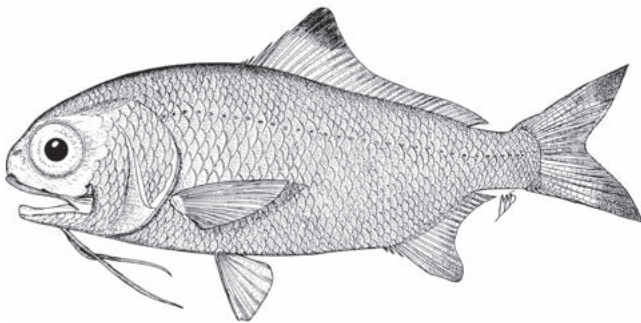
*Polymixia berndti* Gilbert 1905: 616, Pl. 78 (fish market, Honolulu, Oahu I., Hawaii); Smith 1966\*; Yamane & Okamura 1966\*; Kotlyar 1984\*, 1986, 1992, 1993, 1996\*, 2002; SSF No. 134.1\*; Smale *et al.* 1995; Adam *et al.* 1998; Fricke 1999.

*Polymixia nobilis* (*non* Lowe 1836): Barnard 1925; Smith 1949\*.

*Polymixia japonica* (*non* Günther 1877): Lachner 1955; Gosline & Brock 1960.

Dorsal fin 5 spines, 28–31 rays; anal fin 4 spines, 14 or 15 rays; pectoral fins 15–17 rays; pelvic fins 7 rays. Body depth 32–38% SL; HL 28–34% SL. Snout fleshy, overhanging upper jaw; snout length 5–9% SL. Pelvic-fin tip extends past pectoral-fin tip in large specimens; pre-pelvic length 34–42% SL; distance from pelvic-fin origin to anal-fin origin 26–36% SL. Paired barbels on chin under middle of eyes, their length 20–31% SL. Females with deeper bodies and longer 4th anal-fin spine than that of males. GR 3–5/8–11 = 12–14. Lateral line continuous; LL scales 29–36; total transverse body scale rows 52–56; scales before dorsal fin with 2 or 3 irregular vertical rows of triangular ctenii; scales 5 or 6 in vertical row from dorsal-fin origin to lateral line; scales 9–12 in oblique row from dorsal-fin origin to lateral line; scales 12–15 in oblique row from lateral line to anal-fin origin. Pyloric caeca 29–48. Vertebrae 13 or 14 + 15 or 16 = 29.

Body metallic blue-grey or dusky greenish dorsally, silvery white below; dorsal-fin spines and distal portion of anterior rays black; caudal fin dusky, with lobe tips black. Attains 48 cm SL.



*Polymixia berndti*, 15 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (KwaZulu-Natal), Madagascar, Mascarenes and Saya de Malha Bank; elsewhere to Japan, Australia, New Caledonia and Hawaii.

**REMARKS** Found at 18–585 m.

## *Polymixia fusca* Kotthaus 1970

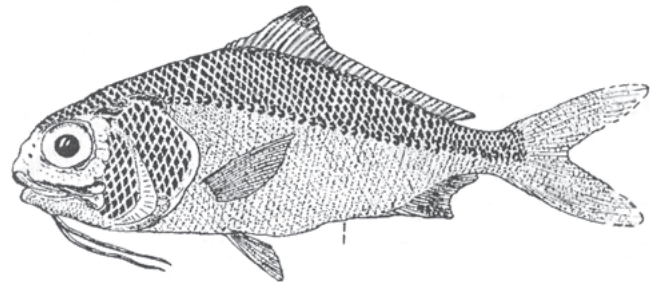
Brown beardfish

*Polymixia fusca* Kotthaus 1970: 56 (southwest of Socotra); Kotlyar 1984\*, 1992, 1993, 1996\*; Manilo & Bogorodsky 2003.

*Polymixia japonicus* (non Günther 1877): Woods & Sonoda 1973.

Dorsal fin 5 or 6 spines, 30–34 rays; anal fin 3–5 spines, 13–15 rays; pectoral fins 14–16 rays; pelvic fins 7 rays. Body depth 35–41% SL; HL 33–38% SL. Snout short, steep, not overhanging upper jaw; snout length 7–9% SL. Pelvic-fin tip on same vertical as pectoral-fin tip; pre-pelvic length 40–45% SL; distance from pelvic-fin origin to anal-fin origin 31–36% SL. Paired barbels on chin under eyes, their length 19–31% SL. GR 5–7/8–11 = 14–17. Lateral line continuous; LL scales 34–38; total transverse body scale rows 57–62; scales before dorsal fin with 3 irregular rows of triangular ctenii; scales 6–8 in vertical row from dorsal-fin origin to lateral line; scales 11–14 in oblique row from dorsal-fin origin to lateral line; scales 14–16 in oblique row from lateral line to anal-fin origin. Pyloric caeca 39–49. Vertebrae 13 + 16 = 29.

Preserved specimens brownish; upper part of head, cheeks and back dark brown; spinous part of dorsal fin with distal black blotch, other fin rays dusky with dark grey tips. Attains 24 cm SL.



*Polymixia fusca*, 14 cm SL (Yemen). Source: Kotlyar 1984

**DISTRIBUTION** Indian Ocean. WIO: Arabian Sea, from off Socotra to southern India; elsewhere, possibly to Andaman Sea.

**REMARKS** Found at 19–435 m.

# ORDER GADIFORMES

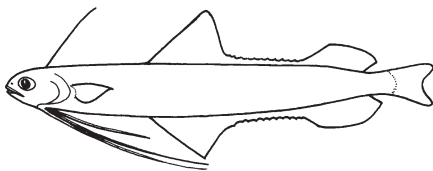
Phillip C Heemstra

Intermediate teleosts, with a non-otolith fossil record extending at least to the early Paleocene of Greenland (~60 MYA) (Rosen & Patterson 1969; Cohen 1984). Possess an apparently unique character complex consisting of 'X' and 'Y' bones in the caudal skeleton, which are specialised bones resembling an epural and the parahypural. Other important features include: an elongated 2nd dorsal fin and anal fin; lack of fin spines (except in 1st dorsal fin of the Macrouridae); dorsal- and anal-fin rays and their supporting pterygiophores more numerous than corresponding vertebrae; 4 gill arches, with slit behind posteriormost; 2 pairs of nostrils; scales cycloid; and, swimbladder well-developed (except absent in *Melanonus* and *Squalogadus*).

Consensus in the higher classification (of suborders and families) has been problematic; here Van der Laan *et al.* (2014) is followed. Ten families, 85 genera and 611 species are recognised, with new species being described regularly (especially in the family Macrouridae, not covered here); 3 families, 4 genera and ~12 species found in WIO. Occur worldwide, including high Arctic and Antarctic seas, from tidepools to abyssal depths. Important commercial fisheries exist for many gadids and merlucciids, mostly in the Northern Hemisphere.

## KEY TO FAMILIES

- 1a First dorsal fin a single elongate ray on top of head; pelvic fins jugular ..... **BREGMACEROTIDAE**

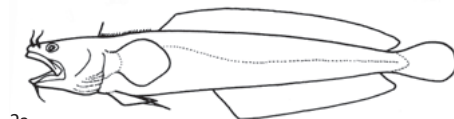


- 1b First dorsal-fin origin either on nape or behind head; pelvic fins thoracic ..... **2**

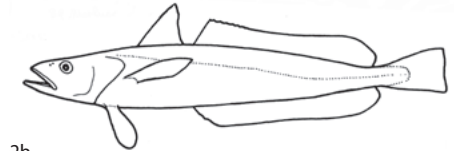
Continued ...

## KEY TO FAMILIES

- 2a First dorsal fin on nape, followed by row of minute, fleshy filaments; snout and chin with barbels; caudal fin rounded ..... **LOTIDAE**
- 2b First dorsal-fin origin above pectoral-fin bases, fin high and triangular; no barbels on head; caudal fin truncate to lunate ..... **MERLUCCIIDAE**



2a



2b

## GLOSSARY

**epural** – an elongate detached bone above the urostyle and behind the last neural spine supporting caudal fin rays.

**jugular** – located in front of the pectoral fins.

**non-otolith fossil record** – the fossil record based on the remains of fishes other than their otoliths; otoliths are rarely found with the remains of the animal and are often of limited value.

**parahypural** – the last haemal spine that forms part of the hypural plate.

**thoracic** – under the pectoral fins.



## FAMILY LOTIDAE

### Rocklings

Phillip C Heemstra

Body elongate, subcylindrical, and slightly compressed near caudal fin; body depth less than head length, 5.7–7 in SL. Single barbel on chin, and pair of barbels on snout near nostrils. Dorsal fins in three parts: single fleshy unsegmented ray on nape, followed by groove with row of short fleshy filaments, and then a long-based 2nd dorsal fin comprising segmented rays and running along rear two-thirds of body. Anal fin similar to rear part of dorsal fin. Pectoral fins midlateral, large and rounded, with bases before 2nd dorsal-fin origin. Pelvic fins with 7 rays, outer ray elongate, inserted on chest below pectoral fins or farther forward on isthmus. No fin spines. Gill opening extends above pectoral-fin base. Scales small, cycloid. Teeth in bands on jaws and vomer. First neural spine fused to skull; last vertebra supporting single hypural bone. Swimbladder not attached to skull.

Represented in the North Atlantic, Mediterranean Sea and Southern Hemisphere (including South Africa, Tristan da Cunha, Gough I., Saint-Paul and Amsterdam Is., Australia and New Zealand). Six genera and 21 species; 1 genus with 2 species known in WIO (the family diagnosis above is based on genus *Gaidropsarus*).

## GENUS *Gaidropsarus* Rafinesque 1810

Diagnosis as for family. Cryptic benthic fish of tidepools and shallow coastal waters, but North Atlantic species live in deeper water (to ~600 m) and are larger and of some commercial interest. Occur in warm-temperate waters of all oceans, from intertidal areas to the upper continental slope. This genus is greatly in need of revision. About 13 species, 2 in WIO.

### KEY TO SPECIES

- |    |  |  |
|----|--|--|
| 1a | Anal fin 37–43 rays; 2nd dorsal fin 43–52 rays | ..... <i>G. capensis</i>                 |
| 1b | Anal fin 50–59 rays; 2nd dorsal fin 56–70 rays | .....<br>..... <i>G. novaezealandiae</i> |

## *Gaidropsarus capensis* (Kaup 1858)

Cape rockling

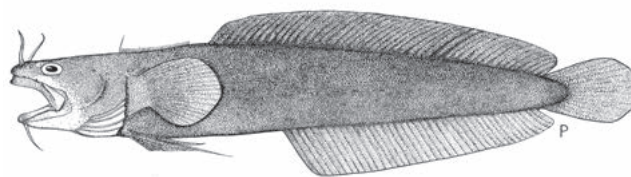
PLATE 39

*Lotella capensis* Kaup 1858: 90, Pl. 13 [no locality given: possibly Cape of Good Hope, South Africa].

*Gaidropsarus capensis*: SSF No. 88.1\*; Svetovidov 1986; Heemstra & Heemstra 2004\*.

Diagnosis as for genus. Body depth 5.7–6.1 in SL; HL 4.5–4.7 in SL; pectoral fins 18–21 rays. Vertebrae 44 or 45.

Head and body golden brown, pale below; median fins yellow. Attains 20 cm TL.



*Gaidropsarus capensis*, 18 cm TL (South Africa). Source: SSF

**DISTRIBUTION** South Africa (Cape Town to East London) in WIO; also reported from Walvis Ridge in southeastern Atlantic.

**REMARKS** Found in tidepools to ~50 m deep.

## *Gaidropsarus novaezealandiae* (Hector 1874)

Comb rockling

PLATE 39

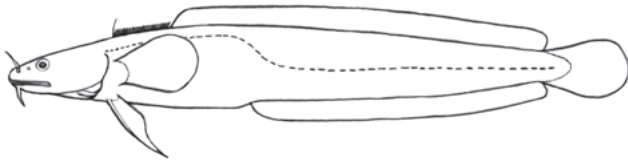
*Motella novaezealandiae* Hector 1874: 107, Pl. 18, Fig. 76b (Cape Campbell, Cook Strait, New Zealand).

*Gaidropsarus insularum* Sivertsen 1945: 8, Fig. 6 (Tristan da Cunha); Penrith 1967; SSF No. 88.2\*; Svetovidov 1986; Duhamel 1989.

*Gaidropsarus novaezealandiae*: Svetovidov 1986; Andrew *et al.* 1995\*.

Diagnosis as for genus. Body depth 5.7–6.1 in SL; HL 4.5–4.7 in SL; pectoral fins 20–21 rays; caudal fin rounded. Vertebrae 44–49.

Head and body reddish to grey-brown, paler or purplish grey ventrally; fins reddish. Attains 34 cm TL.



*Gaidropsarus novaezealandiae*, ~25 cm TL (Atlantic Ocean). Composite

**DISTRIBUTION** Oceans of Southern Hemisphere: off South Africa (Cape Peninsula) in WIO; also west coast of South Africa and Tristan da Cunha in South Atlantic; Saint-Paul and Amsterdam Is. in southern Indian Ocean; Nazca Ridge (southeastern Pacific) and Bromley Plateau (western South Atlantic); and Australia and New Zealand.

**REMARKS** Juveniles (<30 mm TL) are silvery and probably pelagic; larger juveniles and small adults occur in tidepools and shallow subtidal areas; larger adults found to ~50 m deep. Adults feed on small crustaceans and fishes.

## FAMILY MERLUCCIIDAE

### Hakes

Phillip C Heemstra

Body elongate and spindle-shaped, its depth less than head length; V-shaped ridge on top of head. One or 2 dorsal fins; pectoral fins midlateral, bases in front of 1st dorsal-fin origin; caudal fin either small and continuous with 2nd dorsal fin and anal fin, or prominent and separate from those fins. Mouth terminal, jaws equal or lower jaw projecting slightly; teeth on jaws long and acute; teeth also on vomer, but none on palatines. No barbels on chin or snout. Scales small and cycloid. First neural spine attached to supraoccipital; last vertebra supporting a single hypural bone (in species with a caudal fin). Swimbladder not attached to rear of skull.



V-shaped ridge on top of head of Merlucciidae specimens.

Benthopelagic or mesopelagic. Hake species are important commercial fish trawled in many parts of the world, and some species attain more than 100 cm TL. The classification of hakes has been treated by Cohen *et al.* (1990). Five genera and 23 species; 2 genera in WIO, but only 1 genus and 2 species at depths of <200 m.

### KEY TO GENERA

- 1a Caudal fin separate from 2nd dorsal fin and anal fin ..... *Merluccius*  
 1b Caudal fin continuous with 2nd dorsal fin and anal fin ..... *Macruronus* [deepwater genus]

## GENUS *Merluccius* Rafinesque 1810

Body elongate; head large, HL ~20–25% TL. Two separate dorsal fins; caudal fin separate from 2nd dorsal fin and anal fin. Hakes are subject to international conservation measures. Both species occurring in WIO are very important commercial species in the southeastern Atlantic, and also trawled in great quantity on the Agulhas Plateau. The biology of both species is very similar (Botha 1969, 1971, 1973). They undertake regular diurnal vertical migrations to feed near the surface at night and rest near the bottom by day; spawning occurs in September to January, in midwater over a wide area offshore. About 16 species, 2 in WIO.

### KEY TO SPECIES

- 1a Gill rakers without melanophores; vertebrae  
 23–26 + 24–28 = 49–53 ..... *M. capensis*  
 1b Gill rakers with prominent melanophores; vertebrae  
 26–28 + 28–30 = 54–58 ..... *M. paradoxus*

## *Merluccius capensis* Castelnau 1861

Shallow-water hake

PLATE 39

*Merluccius capensis* Castelnau 1861: 68 (South Africa); Barnard 1925\*; SFSA No. 257\*; Botha 1971\*; Inada 1981\*; SSF No. 89.4\*; Cohen *et al.* 1990\*; Heemstra & Heemstra 2004\*.

*Merluccius capensis capensis*: Franca 1960.

*Merluccius merluccius capensis*: Franca 1962.

Diagnosis as for genus. First dorsal fin 10–12 rays; 2nd dorsal fin 38–43 rays; anal fin 37–41 rays; pectoral fins 14–16 rays. Body depth 5–6.8 in SL; HL 3.3–3.7 in SL. GR 3–6/11–15 = 15–20.

Body pale brown dorsally, silvery to white ventrally; dorsal, caudal and pectoral fins generally with darker body colour, and anal fin whitish. Attains 140 cm TL (commonly ~50 cm TL).



*Merluccius capensis*, 68 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Southern Africa: from ~10° S along west coast of Africa in southeastern Atlantic, to Valdivia Bank (off Namibia), and Agulhas Bank (off South Africa) and southern Cape coast (to East London and possibly KwaZulu-Natal) in WIO.

**REMARKS** Occurs on continental shelf and slope, at ~50–1 000 m (usually 150–450 m). Juveniles (to ~64 cm TL) feed on small crustaceans and small deep-sea fishes (such as lanternfishes); larger individuals are piscivorous, feeding mainly on smaller hakes and jack mackerel.

### *Merluccius paradoxus* Franca 1960

Deepwater hake

PLATE 39

*Merluccius capensis paradoxus* Franca 1960: 28 (Namibia and western South Africa).

*Merluccius merluccius paradoxus*: Franca 1962.

*Merluccius paradoxus*: Botha 1971\*; Inada 1981\*; SSF No. 89.5.

Diagnosis as for genus. First dorsal fin 10–12 rays; 2nd dorsal fin 38–42 rays; anal fin 38–41 rays; pectoral fins 14–16 rays. Body depth 4.9–6.4 in SL; HL 3.5–3.8 in SL. GR 4–7/13–18 = 18–23.

Body dark brown or steely grey dorsally, silvery white ventrally; gill rakers with prominent melanophores; dorsal, caudal and pectoral fins generally with darker body colour, and anal fin whitish. Attains 115 cm TL (commonly ~60 cm TL).

**DISTRIBUTION** Southern Africa: Namibia (Cape Frio at ~18° S) in southeastern Atlantic, to South Africa (Durban, KwaZulu-Natal) and Madagascar Ridge in WIO.

**REMARKS** Closely resembles *M. capensis*, but generally found in deeper water, though the depth distributions of the 2 species overlap. Found near bottom, at ~200–1 000 m. Feeds on fishes, mysids, euphausiids and squid; young feed mainly on euphausiids (krill), but the diet becomes polyphagous with growth; cannibalism has been observed in larger individuals.

## GLOSSARY

**benthopelagic** – occurring near or just above the bottom of the sea.

**euphausiids** – shrimp-like, planktonic crustaceans which include krill.

**hypural** – the fan-shaped series of bones (sometimes fused to one or two plates) to which the caudal fin rays are attached.

**mesopelagic** – the region of the oceanic zone from 200 m to 1 000 m.

**mysids** – small, shrimp-like crustaceans found in all oceans and seas.

**neural spine** – the spine on the neural arch of a vertebra.

**polyphagous** – feeding on different kinds of food.

## FAMILY BREGMACEROTIDAE

### Codlets

M Eric Anderson

Body elongate, compressed posteriorly; head relatively small, mouth terminal; teeth on jaws and vomer minute, and no teeth on palatine. Two dorsal fins: the 1st a single ray on head, the 2nd long-based with 2 elevated lobes interposed by very short rays; anal fin with 2 lobes, similar to 2nd dorsal fin. Pelvic fins with 5–7 rays, outer 3 rays free; fins jugular (inserted under head), tips reaching beyond anal-fin origin. Branchiostegal rays 7; no pseudobranch; gill membranes free of isthmus. Scales cycloid. Lateral scale series (LSS) are counted from pectoral-fin insertion to caudal-fin base; transverse scale rows (TSR) are counted on a line through the 2nd dorsal-fin origin and anal-fin origin; counts of dorsal-fin rays are of the 2nd fin. Vertebrae 43–59.

Very small-sized (to <12 cm TL); mesopelagic and epipelagic in tropical and subtropical seas (one species enters estuaries). The systematics of the codlets requires more study; however, contributions have been made by D'Ancona & Cavinato (1965), Belyanina (1974) and Houde (1984), including information on larval transformation. One genus, *Bregmaceros* Thompson 1840, with 17 nominal species; 7 species in WIO, 2 of which are undescribed (AS Harold and R Simpson, University of Charleston, USA [pers. comm.]). The two undescribed species (not included here) both have high counts (for fin rays, scales, etc.) and certain other characters that place them closest to *B. atlanticus* among WIO species.

## KEY TO SPECIES

## [Late juveniles and adults]

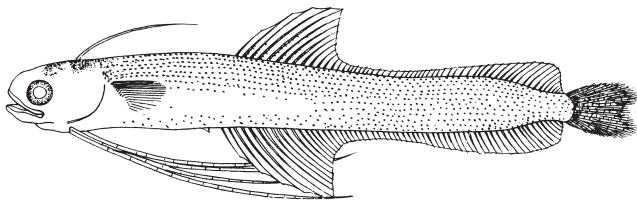
- |    |  |                         |
|----|--|-------------------------|
| 1a | TSR 9–11; LSS 40–75 .....  | 2                       |
| 1b | TSR 14–17; LSS 65–89 .....   | 3                       |
| 2a | LSS 40–52; TSR 9–11; black blotch on lower cheek behind jaws; 2nd dorsal fin 34–41 rays; anal fin 36–43 rays; pectoral fins 13–15 rays ..... | <i>B. rarisquamosus</i> |
| 2b | LSS 62–75; TSR 11–13; no black blotch behind jaws; 2nd dorsal fin 47–56 rays; anal fin 49–60 rays; pectoral fins 16–21 rays .....            | <i>B. atlanticus</i>    |
| 3a | LSS 72–89; anal fin 50–63 rays; 2nd dorsal fin 50–60 rays .....  | 4                       |
| 3b | LSS 65–75; anal fin and 2nd dorsal fin each with 42–55 rays .....  | <i>B. nectabanus</i>    |
| 4a | Fins black or nearly so; pectoral fins 18–20 rays; LSS 72–76 .....   | <i>B. mccllelandi</i>   |
| 4b | Fins hyaline, except with few melanophores on anterior lobe of 2nd dorsal fin; pectoral fins 15–17 rays; LSS 78–89 .....                     | <i>B. arabicus</i>      |

*Bregmaceros arabicus* D'Ancona & Cavinato 1965

*Bregmaceros arabicus* D'Ancona & Cavinato 1965: 59, Figs. 49–51 (Arabian Sea); Houde 1984\*; Okamura & Amaoka 1997\*.

Second dorsal fin 50–60 (usually 52–54) rays; anal fin 50–63 (usually 56 or 57) rays; pectoral fins 15–17 rays; caudal fin 27–34 rays, and fin shallowly forked. LSS 78–89; TSR 14–16. Body depth 12–17% SL; HL 16–18% SL; pelvic fins 46–56% SL. Vertebrae 50–54.

Body and top of head with scattered melanophores; fins hyaline except a few melanophores on 2nd dorsal-fin rays, especially anterior lobe. Attains 6 cm SL.



*Bregmaceros arabicus*, 39 mm SL, adult holotype (Arabian Sea).  
Source: D'Ancona & Cavinato 1965

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and Arabian Sea (Pakistan and India); elsewhere, Bay of Bengal, Taiwan and southern Japan.

*Bregmaceros atlanticus* Goode & Bean 1886

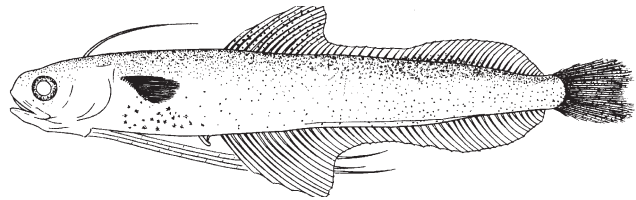
Antenna codlet

PLATE 40

*Bregmaceros atlanticus* Goode & Bean 1886: 165 (off Grenada, Caribbean Sea; off Florida, Gulf of Mexico); Goode & Bean 1896\*; D'Ancona & Cavinato 1965\*; Belyanina 1974\*; Houde 1984\*; SSF No. 92.1\*.

Second dorsal fin 47–56 (usually 50–54) rays; anal fin 49–60 (usually 52–55) rays; pectoral fins 16–21 rays; caudal fin 28–36 rays, and fin shallowly forked. LSS 62–75; TSR 11–13. Body depth 11–14% SL; HL 16–21% SL; pelvic fins 46–63% SL. Vertebrae 49–57 (usually 52 or 53).

Body pale, with peppering of melanophores mostly dorsally; fins hyaline except scattered melanophores in both lobes of 2nd dorsal fin. Attains 7 cm SL.



*Bregmaceros atlanticus*, 41 mm SL, adult (Arabian Sea).  
Source: D'Ancona & Cavinato 1965

**DISTRIBUTION** Tropical and subtropical waters of eastern Atlantic (Spain to Angola) and western Atlantic (New Jersey to the Guianas, including Gulf of Mexico), Mediterranean Sea, Arabian Sea and eastern Pacific.

**REMARKS** Pelagic and oceanic. Larval transformation reviewed by Houde (1981, 1984). Feeds mostly on planktonic crustaceans and phytoplankton. Unconfirmed records from WIO may be an undescribed species (A Harold, pers. comm.). The occurrence is retained here pending future confirmation.

*Bregmaceros mccllelandi* Thompson 1840

Unicorn cod

PLATE 40

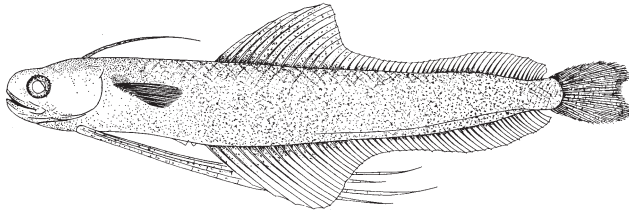
*Bregmaceros mccllelandi* Thompson (ex Cantor) 1840: 184, Fig. (Ganges Delta, India); SSF No. 92.2; Iwamoto 1999\*; Torii *et al.* 2003\*.  
*Asthenurus atripinnis* Tickell 1865: 32, Pl. 1 (Sittwe Harbour, Arakan, Myanmar).

*Bregmaceros* sp.: Cohen 1990\*.

Second dorsal fin 52–59 rays; anal fin 54–60 rays; pectoral fins 18–20 rays; caudal fin 27–31 rays. LSS 72–76; TSR 14 or 15. Body depth 13–19% SL; HL 13–17% SL; pelvic fins 47–58% SL. Vertebrae 52–55.



Top of head, cheeks and upper body dark, silvery white below; pectoral fins, caudal fin, and lobes of 2nd dorsal fin and anal fin black or nearly so. Attains 10 cm SL.



*Bregmaceros mccllelandi*, 55 mm SL, adult. Source: D'Ancona & Cavinato 1965

**DISTRIBUTION** Probably restricted to northern Indian Ocean, from Arabian Sea (Pakistan and India) to Bay of Bengal, Philippines and Gulf of Thailand.

**REMARKS** Neritic and also enters estuaries. Data here are from Torii *et al.* (2003), who also provide a lengthy synonymy. Numerous misidentifications, usually misspelled *B. maccllelandi*, throughout the literature (Bailly & Hureau 1995). Talwar & Kacker (1984) and Cohen (1990: as *Bregmaceros* sp.) reported this species to be of moderate commercial value in India.

### *Bregmaceros nectabanus* Whitley 1941

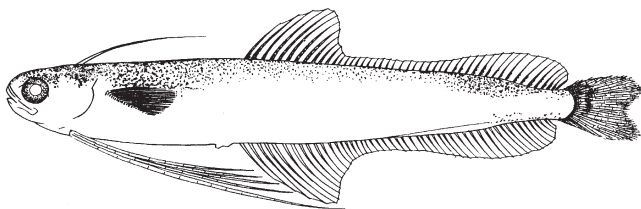
Smallscale codlet

PLATE 40

*Bregmaceros nectabanus* Whitley 1941: 25, Fig. 18 (Darwin, Northern Territory, Australia [Arafura Sea]); Munro 1950\*; D'Ancona & Cavinato 1965\*; Belyanina 1974\*; Masuda & Ozawa 1979; Houde 1984\*; SSF No. 92.3\*.

Second dorsal fin 42–55 (usually 47–50) rays; anal fin 42–55 (usually 50–52) rays; pectoral fins 15–20 rays; caudal fin 28–34 rays, and fin shallowly forked. LSS 65–75; TSR 15–17. Body depth 14–17% SL; HL 16–20% SL; pelvic fins 41–52% SL. Vertebrae 47–52.

Body pale brownish or yellowish white, with darker brown stripe along each side of back; fins hyaline, except 2nd dorsal fin with melanophores along most rays, especially in larger individuals. Attains 8 cm SL.



*Bregmaceros nectabanus*, 75 mm SL, adult (Japan). Source: D'Ancona & Cavinato 1965

**DISTRIBUTION** Tropical waters of eastern Atlantic (Morocco to Namibia) and Indo-Pacific. WIO: Red Sea, South Africa (Cape Point to Sodwana Bay) and Madagascar; elsewhere to Thailand, Taiwan, Japan, Australia and Fiji.

**REMARKS** Usually neritic; possibly undergoes vertical migration into and out of anoxic water.

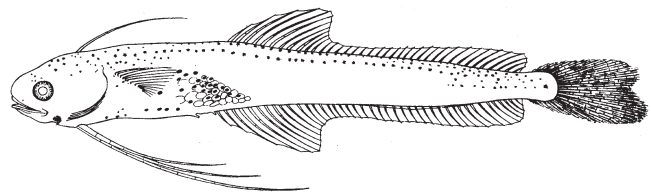
### *Bregmaceros rarisquamosus* Munro 1950

Big-eye unicorn codlet

*Bregmaceros rarisquamosus* Munro 1950: 39, Fig. 10 (Sek Harbour, north coast of New Guinea); D'Ancona & Cavinato 1965\*; Houde 1984\*; Torii *et al.* 2003\*.

Second dorsal fin 34–41 rays; anal fin 36–43 rays; pectoral fins 13–15 rays; caudal fin 26–34 rays, and fin shallowly forked. LSS 40–52; TSR 9–11. Body depth 11–13% SL; HL 16–19% SL; pelvic fins 34–56% SL. Vertebrae 43–48.

Body pale brown, with few melanophores mostly on dorsum and peduncle; fins hyaline; characteristic black blotch sometimes on lower cheek behind jaws, and similar smaller blotch at centre of end of peduncle. Attains 3 cm SL.



*Bregmaceros rarisquamosus*, 17 mm SL, adult. Source: D'Ancona & Cavinato 1965

**DISTRIBUTION** Indo-Pacific. WIO: Arabian Sea; elsewhere to Indonesia (Banda Sea), Palau and New Guinea.

**REMARKS** Neritic and oceanic. Females of just 16–17 mm are known with well-developed eggs.

#### GLOSSARY

**neritic** – the shallow pelagic zone over the continental shelf.  
**pseudobranch** – a small, gill-like organ on the inner surface of the operculum; the reduced first gill arch.

# ORDER OPHIDIIFORMES

Jørgen G Nielsen

Fishes with an elongate, tapered body, and with median fins extending along most of body; pelvic fins thoracic or jugular, with 1 or 2 soft rays, or fins absent; nostrils paired on each side of head; scales cycloid and minute, or absent; pterygiophores of dorsal and anal fins more numerous than associated vertebrae.

Classification within some groups of ophidiiforms is unsettled; the major works of Cohen & Nielsen (1978) and Nielsen *et al.* (1999) are followed here. Four families, 118 genera and 563 species; new species are described regularly. A few species, especially of the Southern Hemisphere ophidiid genus *Genypterus*, are commercially important. The former family Aphyonidae is considered a clade of Bythitidae.

## KEY TO FAMILIES

- 1a Viviparous, males with external intromittent organ (genital papilla); anterior nostrils immediately above upper lip; pelvic fins under opercle; caudal fin free or confluent with dorsal and anal fins ..... 2
- 1b Oviparous, males without intromittent organ; anterior nostrils well above upper lip; teeth present or absent on tongue; pelvic fins under opercle or further forward; caudal fin confluent with dorsal and anal fins ..... 3
- 2a Intromittent organ with penis cupped by fleshy hood; no bony pseudoclaspers; anterior anal-fin pterygiophore not extended; caudal fin confluent with, or not attached to dorsal and anal fins ..... **BYTHITIDAE**



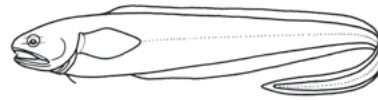
- 2b Intromittent organ with penis and 1–3 pairs of pseudoclaspers covered ventrally by fleshy hood; anterior anal-fin pterygiophores more or less extended; caudal fin not attached to dorsal and anal fins ..... **DINEMATICHTHYIDAE**



Continued...

## KEY TO FAMILIES

- 3a Pelvic fins absent; supramaxilla absent; anal-fin rays longer than opposing dorsal-fin rays; anal-fin origin in front of dorsal-fin origin (except in *Onuxodon parvibrachium*) ..... **CARAPIDAE**



- 3b Pelvic fins present; supramaxilla present; anal-fin rays shorter or subequal to opposing dorsal-fin rays; anal-fin origin behind dorsal-fin origin ..... **OPHIDIIDAE**



## GLOSSARY

**pterygiophores** – the three bones (distal, medial and proximal), sometimes some fused together, that support and articulate with the fin spines and rays.

**supramaxilla** – a small bone along the upper rear edge of the maxilla.

## FAMILY OPHIDIIDAE

### Cusk-eels

Jørgen G Nielsen and Franz Uiblein

Small- to large-sized (10–200 cm SL), with moderately elongate, somewhat eel-like body; dorsal fin and anal fin long, confluent with caudal fin; dorsal-fin rays normally slightly longer than opposing anal-fin rays, and anal-fin origin behind dorsal-fin origin; pelvic fins with 1 or 2 rays, or fins absent. Mouth large; supramaxilla present. Teeth usually small, densely distributed. Anterior nostril placed midway between upper lip and posterior nostril. Opercle usually with strong spine on rear edge. Gill rakers long, usually more than 7. Scales present.

Occur in all oceans, mostly in tropical waters. Mostly benthic; found in shallow water to >7 965 m deep.

Oviparous with pelagic larvae; the eggs of many species are known to float in a gelatinous mass. In WIO, *Brotula multibarbata* and *Genypterus capensis* have considerable economic importance.

About 52 genera and 266 species recognised; 9 genera and at least 18 species in WIO known from depths of <250 m.

**KEY TO GENERA**

**[Represented at depths of <250 m]**

- 1a Barbels present on snout and chin ..... *Brotula*
- 1b No barbels on snout and chin ..... 2
  
- 2a Pelvic fins far forward, under eyes ..... 3
- 2b Pelvic fins farther back, well behind eyes ..... 6
  
- 3a Preopercle with 3 sharp spines; pelvic fins 2 rays ..... *Hoplobrotula*
- 3b Preopercle without spines; pelvic fins 1 or 2 rays ..... 4
  
- 4a Head and body with 3 or 4 oblique black bands; pelvic fins 1 ray ..... *Sirembo*
- 4b No black bands on head and body; pelvic fins 2 rays ..... 5
  
- 5a Head scaly; body scales in regular rows ..... *Genypterus*
- 5b Head naked; body scales set at oblique angles ..... *Ophidion*
  
- 6a Head bones with large thin crests; opercular spine flat and weak ..... *Glyptopheadium*
- 6b Head bones without thin crests; opercular spine well-developed and thorn-like ..... 7
  
- 7a Upper part of body and dorsal fin with prominent spots, larger individuals with mottled dorsum; pseudobranchial filaments 25–30 ..... *Spottobrotula*
- 7b No spots on body; dorsal fin with ocelli in many species of *Neobythites*; pseudobranchial filaments 1–8 ..... 8
  
- 8a Body short with large head; upper jaw ending well behind eyes; colouration uniformly brownish; developed gill rakers on 1st arch 4–6 ..... *Pycnocraspedum*
- 8b Body elongate with small head; upper jaw ending below or slightly behind eyes; body colouration often with ocelli; developed gill rakers on 1st arch 6–34 ..... *Neobythites*

**GENUS *Brotula* Cuvier 1829**

Body robust and entirely covered with small, imbricate, cycloid scales; snout and chin each with 6 barbels; developed gill rakers ≤4; pelvic fins 2 rays, inserted well behind eyes. A revision of this genus is much needed. Circumglobal in tropical and subtropical seas. Possibly 5 species, 1 in WIO.

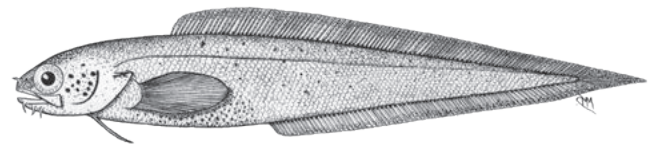
***Brotula multibarbata* Temminck & Schlegel 1846**

Bearded brotula PLATE 41

*Brotula multibarbata* Temminck & Schlegel 1846: 251, Pl. 111, Fig. 2 (Shimabara, Ariake Sea, Nagasaki Prefecture, Japan); Hubbs 1944; SSF No. 96.3\*; Winterbottom *et al.* 1989\*; Nielsen *et al.* 1999.

Diagnosis as for genus. Head narrower than body. Dorsal fin 109–139 rays; anal fin 80–106 rays; pectoral fins 22–26 rays. Teeth on vomer of adults in somewhat broad V-shaped band; juveniles with very narrow tooth bands on vomer and palatines.

Body of adults generally dusky brown, and median fins with submarginal black band and narrow white margin; juveniles paler overall. Attains 100 cm TL.



*Brotula multibarbata*, 5 cm TL, juvenile (N Mozambique). Source: SSF



*Brotula multibarbata*, 22 cm TL, adult (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea to South Africa (Eastern Cape), Seychelles, Rodrigues (Mascarenes) and Chagos; elsewhere to southern Japan, Australia, New Caledonia, Lord Howe I., Pitcairn Is. and Hawaii.

**REMARKS** Adults found nearshore on continental shelf and upper slope, to 650 m deep (usually near 200 m); larvae and juveniles often found far out in the ocean in surface waters. Nocturnal, inhabiting caves and crevices during the day. Feeds mainly on crabs, but also other crustaceans and fishes. Specimens from the Atlantic Ocean are referred to *B. barbata* (Bloch & Schneider 1801).

GENUS *Genypterus* Philippi 1857

Body elongate, with body scales in regular rows, and scales also on top and sides of head; postorbital length twice length of snout plus eye diameter; poorly developed rostral spine present, no opercular spine. Pelvic fins 2 rays, inserted below eyes. Occur on continental shelf and upper slope in temperate waters of Southern Hemisphere. Five species, 1 in WIO.

*Genypterus capensis* (Smith 1847)

Kingklip

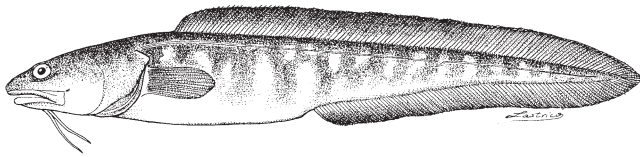
PLATE 41

*Xiphiurus capensis* Smith 1847: no page number, Pl. 31 (near Table Bay, South Africa); Smith & Smith 1966\*.

*Genypterus capensis*: Barnard 1927\*; SSF No. 96.9\*; Nielsen *et al.* 1999\*; Heemstra & Heemstra 2004\*.

Diagnosis as for genus. Dorsal fin 150 rays; anal fin 110 rays; GR 4. Maxilla reaches past eye.

Head and body usually pinkish to orange, mottled with spots and blotches, especially dorsally. Attains 180 cm TL.



*Genypterus capensis*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (Algoa Bay).

**REMARKS** Benthic, generally in rocky areas, at 50–500 m (usually ~250–350 m). Juveniles found in shallower waters. A sought-after commercial species caught by trawling and deep lines. The distinctiveness of this species and *G. blacodes* (Forster 1801) (from South America, Australia and New Zealand) is unclear.

GENUS *Glyptophidium* Alcock 1889

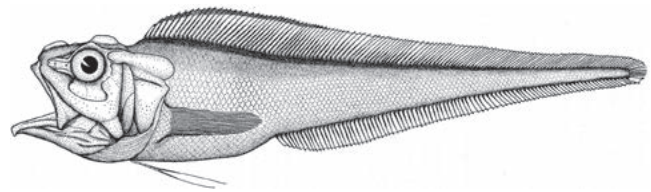
Head prominent, and rest of body strongly tapering to caudal tip; head bones with large thin crests; opercular spine flat and weak. Eye diameter equal to or greater than snout length. Pectoral fins 20–26 rays; pelvic fins 1 or 2 rays; GR 14–41. Precaudal vertebrae 11–13. Occur in Indo-Pacific. Seven species, 1 in WIO with records above 250 m.

*Glyptophidium macropus* Alcock 1894

*Glyptophidium macropus* Alcock 1894: 122, Pl. 6, Fig. 3 (Bay of Bengal); Nielsen & Machida 1988\*; Manilo & Bogorodsky 2003.

Diagnosis as for genus. Pelvic fins with 2 rays, 90–125% HL; GR 36–41; pseudobranchial filaments 7–11. Precaudal vertebrae 12 or 13; caudal vertebrae 53–58; median basibranchial tooth patches 2.

Eyes and sides of body silvery; snout and dorsal-fin margin brown. Attains 21 cm SL.



*Glyptophidium macropus*, 17 cm SL, male. Source: Nielsen & Machida 1988

**DISTRIBUTION** Indian Ocean: Gulf of Oman to east coast of India and Indonesia (Lesser Sunda Is.).

**REMARKS** Common; found at 40–550 m.

GENUS *Hoplobrotula* Gill 1863

Head blunt and body somewhat elongate; 3 sharp spines on preopercle and 1 spine on opercle. Eye diameter almost as long as or longer than snout. Pelvic fins 2 rays, inserted below eyes; developed GR 5 or 6. Precaudal vertebrae 13–15. Occur in Indo-Pacific. Three species, 1 in WIO.

*Hoplobrotula gnathopus* (Regan 1921)

False kingklip

PLATE 41

*Sirembo* (*Hoplobrotula*) *gnathopus* Regan 1921: 417 (off Umvoti River, KwaZulu-Natal, South Africa).

*Hoplobrotula gnathopus*: SSF No. 96.13\*; Nielsen *et al.* 1999\*.

Diagnosis as for genus. Dorsal fin 99–103 rays; anal fin 78–82 rays; pectoral fins 22–25 rays, and fins almost reaching anus; GR 4 or 5. Eye diameter greater than snout length. No rostral spine. Precaudal vertebrae 15.

Body reddish or pinkish; juveniles with several black bars continuing as blotches onto dorsal fin and anal fin, and adults with middle part of those fins black. Attains 48 cm TL.





*Hoplobrotula gnathopus*, 48 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: southern Mozambique to Agulhas Bank (off South Africa).

**REMARKS** Known from relatively few localities, at 180–826 m.

**GENUS** *Neobythites* Goode & Bean 1885

Body short, gradually tapering to pointed caudal fin; snout generally blunt, its length equal to or slightly longer than horizontal eye window (transparent part of eye, not bony orbit); preopercle with 0–2 (rarely 3) spines on rear edge; opercular spine strong. Pelvic fins 2 rays. Scales small, cycloid. Precaudal vertebrae 11–14. Colour patterns variably with or without distinct ocelli and/or faint bars on body and median fins. Occur in tropical and subtropical waters of all oceans; known to ~950 m deep. No larvae are yet known. Feed mostly on crustaceans, but also on gastropods, bivalves, foraminifera and fishes. Reviewed by Nielsen (1995, 2002). The most speciose ophidiid genus, with 54 species, at least 13 in WIO, plus other undescribed species are likely. All species known from WIO are included in the key, but 4 of these have never been recorded above 280 m.

**KEY TO SPECIES**

- 1a No spines on rear edge of preopercle (except 1 weak flat spine in *N. malhaensis*) ..... 2
- 1b Preopercle spines usually 2 (rarely 1 or 3 in *N. analis*) ..... 7
- 2a Dorsal fin without ocelli; dorsal fin and anal fin black medially, pale distally and proximally ..... *N. bimarginatus*
- 2b Dorsal fin with 1 or 2 ocelli; dorsal fin and anal fin not partially black ..... 3
- 3a Dorsal fin with 2 ocelli, and anterior ocellus in front of anus ..... *N. kenyaensis*
- 3b Dorsal fin with 1 ocellus, above or behind anus ..... 4

Continued ...

**KEY TO SPECIES**

- 4a Dark vertical bar on body below ocellus on dorsal fin; dorsal-fin origin above opercle ..... *N. malhaensis*
- 4b No dark vertical bar on body below ocellus on dorsal fin; dorsal-fin origin above or behind pectoral-fin origins ..... 5
- 5a Dorsal-fin ocellus above anus; developed GR 6 ..... *N. meteori*
- 5b Dorsal-fin ocellus above front part of anal fin; developed GR 10–13 ..... 6
- 6a Ocellus spot covering 6–8 dorsal fin rays; longest gill filaments 15.5–19% HL; orbit length 19.5–23.5% HL ..... *N. gloriae*
- 6b Ocellus spot covering 8–12 dorsal fin rays; longest gill filaments 5.4–16% HL; orbit length 21.5–27.5% HL ..... *N. stefanovi*
- 7a Teeth needle-like; indistinct brown band behind eyes and gill cover ..... *N. trifilis*
- 7b Teeth granular; no dark area between eyes and gill cover ..... 8
- 8a Dorsal fin with ocelli and/or large dark blotches ..... 9
- 8b No ocelli or large dark blotches on dorsal fin ..... 11
- 9a Dorsal fin with 7 or 8 dark blotches, and anal fin with 3 or 4 faint dark blotches; 4–10 faint dark vertical bars on body; developed GR 12–15 ..... *N. multistriatus*  
[collected off Réunion and Rodrigues, at 300–490 m]
- 9b Dorsal fin with either 2 distinct ocelli or ~6 indistinct ocelli; no faint dark bars on body; developed GR 8–10 ..... 10
- 10a Dorsal fin with 2 distinct ocelli; dorsal fin 94–98 rays ..... *N. crosnieri*
- 10b Dorsal fin with ~6 indistinct ocelli; dorsal fin 100–102 rays ..... *N. natalensis*  
[collected off KwaZulu-Natal, South Africa, and northwestern Madagascar, at 310–590 m]
- 11a Margins of dorsal fin and anal fin black; longest gill filaments 11–14% HL ..... *N. somaliaensis*  
[collected between Somalia and Yemen, at 300–490 m]
- 11b Dorsal-fin margin not black, but anal-fin margin may be black; longest gill filaments 4.4–7.7% HL ..... 12
- 12a Anal-fin margin black; rear end of vomerine tooth patch concave or straight ..... *N. analis*
- 12b Anal fin not black; rear end of vomerine tooth patch convex ..... *N. vityazi*  
[collected from Mozambique Channel at 280–760 m]

*Neobythites analis* Barnard 1927

Blackedge cusk-eel

*Neobythites analis* Barnard 1927: 75 (north of Thukela River mouth, KwaZulu-Natal, South Africa); Schwarzahns 1994\* [otoliths]; Nielsen 1995\*, 2002\*; Nielsen *et al.* 1999\*.

*Neobythites macrops* (*non* Günther 1887): Gilchrist & Thompson 1914.

Dorsal fin 99–107 rays; anal fin 84–89 rays; pectoral fins 25–27 rays; developed GR 9–11; gill filaments rather short, longest 5.4–7.7% HL; pseudobranchial filaments 3–6. Preopercle with 1 or 2 spines on rear margin. Teeth granular; vomerine tooth patch subtriangular. Total vertebrae 58–61; precaudal vertebrae 13 or 14.

Body mottled brown (fresh specimens), and median fins uniformly brown, except anal-fin margin entirely black (often evident in preserved specimens); eyes bluish. Attains at least 21 cm SL.



*Neobythites analis*, 20 cm SL, female (South Africa). Source: Nielsen 1995

**DISTRIBUTION** Southern Africa: South Africa (Cape Town) in southeastern Atlantic, and southern Mozambique southwards in WIO.

**REMARKS** Known in WIO from continental shelf and upper slope, at 99–366 m; one specimen caught west of Cape Town, at 1 830 m, is the only known *Neobythites* specimen from the eastern Atlantic.

*Neobythites bimarginatus*

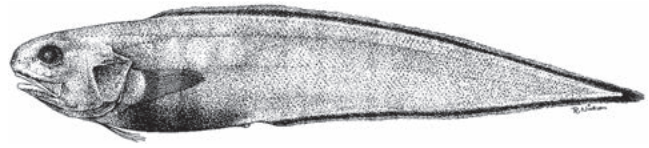
Fourmanoir &amp; Rivaton 1979

PLATE 41

*Neobythites bimarginatus* Fourmanoir & Rivaton 1979: 416, Fig. 9 (off New Caledonia); Nielsen & Uiblein 1993; Nielsen 2002; Nielsen & Uiblein 2014.

Dorsal fin 106–110 rays; anal fin 86–90 rays; pectoral fins 32 or 33 rays; developed GR 7–9; gill filaments 4.8–6.3% SL; pseudobranchial filaments 2. Preopercle without spines on rear margin. Teeth granular; vomer triangular. Total vertebrae 59–62; precaudal vertebrae 13 or 14.

Distal and proximal parts of dorsal fin and anal fin pale, middle part black; series of 6 or 7 pale areas on body immediately behind head. Attains at least 12 cm SL.



*Neobythites bimarginatus*, 11 cm SL (New Caledonia). Source: Nielsen 2002

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar; elsewhere from New Caledonia.

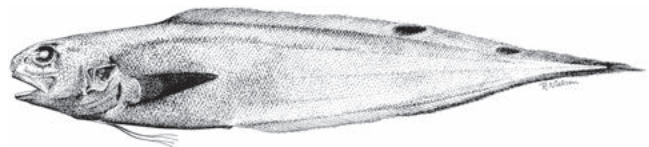
**REMARKS** Known from 13 specimens from off New Caledonia and neighbouring islands, at 296–530 m, and also one specimen collected off southern Madagascar, at 285 m (Nielsen & Uiblein 2014).

*Neobythites crosnieri* Nielsen 1995

*Neobythites crosnieri* Nielsen 1995: 4, Fig. 3 (off SW Madagascar); Nielsen *et al.* 1999\*; Nielsen 2002\*.  
*Neobythites* sp. 3: Schwarzahns 1994\*.

Dorsal fin 94–98 rays; anal fin 79–82 rays; pectoral fins 25–27 rays; developed GR 8–10; gill filaments 5–6.4% HL; pseudobranchial filaments 4 or 5. Preopercle with 2 spines on rear margin. Teeth granular; vomerine tooth patch triangular. Total vertebrae 57 or 58; precaudal vertebrae 13 or 14.

Body mottled brown; 2 ocelli on rear half of dorsal fin (well behind anus; ocellus spots subequal to eye diameter); dorsal- and anal-fin margins black posteriorly. Attains at least 19 cm SL.



*Neobythites crosnieri*, 19 cm SL, holotype (SW Madagascar). Source: Nielsen 1995

**DISTRIBUTION** WIO: Madagascar.

**REMARKS** Collected from six localities off the west coast of Madagascar, at 125–350 m.

*Neobythites gloriae* Uiblein & Nielsen 2018

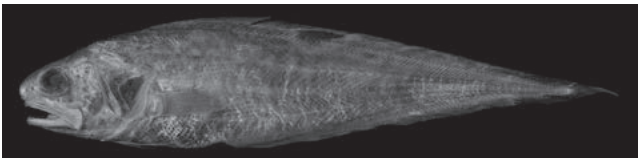
*Neobythites gloriae* Uiblein & Nielsen 2018: 158, Fig. 1A (Gulf of Oman, 25°02' N, 56°52' E).

*Neobythites steatiticus*: Nielsen 1995 [in part] (Persian/Arabian Gulf, Gulf of Oman).

*Neobythites stefanovi*: Nielsen & Uiblein 1993 and Nielsen 1995, 2002 [in part] (Gulf of Oman).

Dorsal fin 90–93 rays; anal fin 72–76 rays; pectoral fins 24–27 rays; developed GR 11–13, longest gill filaments 15.5–19% HL; pseudobranchial filaments 3–4. No spines on rear margin of preopercle. Teeth small, pointed, in 3–4 rows anteriorly; vomerine tooth patch circular. Total vertebrae 54–56; precaudal vertebrae 12.

Preserved specimens pale brown to mottled brown with rather indistinct lateral line; 1 distinct ocellus on dorsal fin well behind anus; horizontal diameter of dark ocellus spot about orbit length; dorsal and anal fins with pale- to dark-brown distal margins posteriorly, margins becoming darker towards dark caudal-fin tip. Attains at least 16 cm SL.



*Neobythites glorieae*, 16 cm SL, male holotype (Gulf of Oman).  
Source: Uiblein & Nielsen 2018

**DISTRIBUTION** Persian/Arabian Gulf to Gulf of Oman.

**REMARKS** Known only from preserved material collected in 1963 and earlier; trawled from seven localities on upper continental slope, at 272–320 m depth (inner Gulf of Oman) and 26 m depth (southern Persian/Arabian Gulf).

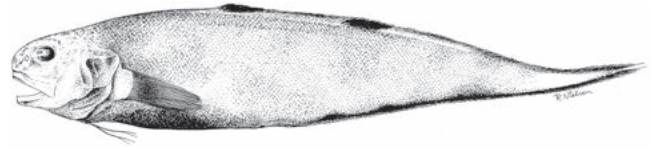
### *Neobythites kenyaensis* Nielsen 1995

PLATE 41

*Neobythites kenyaensis* Nielsen 1995: 5, Fig. 4 (off Kenya, 02°50' S, 40°31' E); Nielsen *et al.* 1999\*; Nielsen 2002\*; Uiblein & Nielsen 2019.  
*Neobythites steatiticus* (*non* Alcock 1894): Norman 1939.  
*Neobythites* sp. 7: Schwarzhans 1994\*.

Dorsal fin 29–102 rays; anal fin 80–84 rays; pectoral fins 26–32 rays; developed GR 8–10, longest gill filaments 6.9–12% HL; pseudobranchial filaments 2–4. No spines on rear margin of preopercle. Teeth granular (except needle-like on upper jaw of holotype); vomerine tooth patch subtriangular or diamond-shaped. Total vertebrae 55–59; precaudal vertebrae 13.

Body mottled brown, with 4–7 faint dark vertical bars; 2 ocelli on dorsal fin (anterior ocellus smaller; larger ocellus well behind anus); lips may be brown; rear third of dorsal fin dark; caudal fin and most of anal fin black; eyes and peritoneum bluish. Attains at least 16 cm SL.



*Neobythites kenyaensis*, 12+ cm SL, holotype (Kenya). Source: Nielsen 1995

**DISTRIBUTION** WIO: Kenya to KwaZulu-Natal, South Africa.

**REMARKS** Collected from nine localities on upper continental slope off East and southeastern Africa, at 238–457 m.

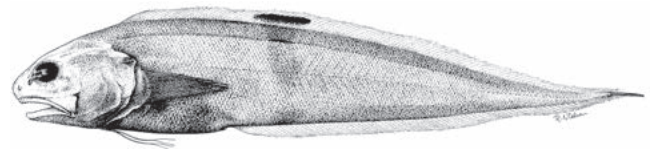
### *Neobythites malhaensis* Nielsen 1995

*Neobythites malhaensis* Nielsen 1995: 6, Fig. 5 (Saya de Malha Bank, 11°02' S, 62°15' E); Nielsen *et al.* 1999\*; Nielsen 2002\*; Uiblein & Nielsen 2018.

*Neobythites* sp.: Shcherbachev *et al.* 1986.  
*Neobythites* sp. 6: Schwarzhans 1994\*.

Dorsal fin 99–103 rays, and fin origin above opercle; anal fin 78–82 rays; pectoral fins 30 rays; developed GR 12 or 13, longest gill filaments 7.5–8.9% HL; pseudobranchial filaments 3 or 4. Preopercle with at most 1 weak flat spine on rear margin. Teeth on jaws needle-like; vomerine tooth patch triangular. Total vertebrae 57–59; precaudal vertebrae 13.

Distinguished by elongate ocellus on dorsal fin (covering 11–12 fin rays), just behind anus, with corresponding faint dark vertical bar on body; eyes blue; peritoneum brown. Attains at least 13.5 cm SL.



*Neobythites malhaensis*, 12 cm SL, male holotype (Saya de Malha Bank).  
Source: Nielsen 1995

**DISTRIBUTION** WIO: Saya de Malha Bank.

**REMARKS** Collected from three localities north of Mauritius, at 235–250 m.

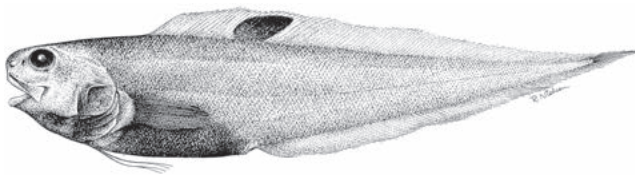
*Neobythites meteori* Nielsen 1995

*Neobythites meteori* Nielsen 1995: 7, Fig. 6 (off Socotra I.); Nielsen *et al.* 1999\*; Nielsen 2002\*; Uiblein & Nielsen 2018.

*Neobythites unimaculatus* (non Smith & Radcliffe 1913): Kotthaus 1979\*.

Dorsal fin 91 rays; anal fin 75 rays; pectoral fins 27 rays; developed GR 6, longest gill filaments 13.0% HL; pseudobranchial filaments 3. Preopercle with flat process on rear margin. Teeth needle-like; vomerine tooth patch triangular. Total vertebrae 53; precaudal vertebrae 13.

One conspicuous ocellus with distinct whitish outer ring on dorsal fin just above anus. Attains at least 10 cm SL.



*Neobythites meteori*, 10 cm SL, female holotype (off Socotra).

Source: Nielsen 1995

**DISTRIBUTION** WIO: Socotra.

**REMARKS** Known only from female holotype, collected at 175–337 m.

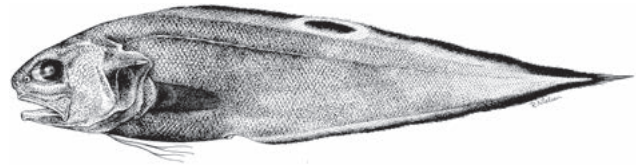
*Neobythites stefanovi* Nielsen & Uiblein 1993

*Neobythites stefanovi* Nielsen & Uiblein 1993: 110, Figs. 1–2 (Gulf of Aden, 14°48' N, 51°16' E); Nielsen 1995\*, 2002\*; Uiblein 1995; Nielsen *et al.* 1999\*; Uiblein & Nielsen 2018.

*Neobythites* sp. 10: Schwarzahns 1994\*.

Dorsal fin 89–95 rays; anal fin 73–78 rays; pectoral fins 24–26 rays; developed GR 10–13, longest gill filaments 5.4–16% HL; pseudobranchial filaments 2–6. No spines on rear margin of preopercle. Teeth needle-like, rarely granular; form of vomerine tooth patch variable. Total vertebrae 52–56; precaudal vertebrae 12.

Body mottled brown, with many dark melanophores ventrally; adults with 1 prominent ocellus on dorsal fin behind anus (less distinct in specimens <5 cm SL); margins of median fins black in larger specimens; eyes, gill cover and abdomen bluish; lateral line pale. Attains at least ~20 cm SL.



*Neobythites stefanovi*, 17 cm SL, male holotype (Gulf of Aden).

Source: Nielsen 1995

**DISTRIBUTION** WIO: Red Sea and Gulf of Aden.

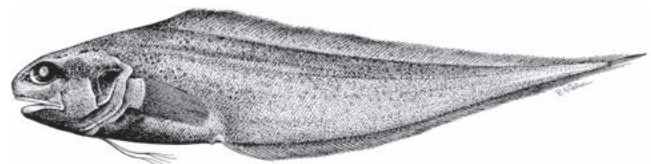
**REMARKS** Collected from the Red Sea at 434–804 m, and from the Arabian Sea at 80–549 m.

*Neobythites trifilis* Kotthaus 1979

*Neobythites trifilis* Kotthaus 1979: 11, Fig. 461 (off Socotra, 11°33' N, 52°54' E); Schwarzahns 1994\*; Nielsen 1995\*, 2002\*; Nielsen *et al.* 1999\*.

Robust body, with blunt snout; pelvic fins with 2 rays, thick and flattened in some specimens (except left pelvic fin of holotype with 3 thread-like rays); dorsal fin 99–105 rays; anal fin 83–89 rays; pectoral fins 28–30 rays; developed GR 7–10, and longest gill filaments 9.7–14% HL; pseudobranchial filaments 3–7. Preopercle with 2 spines on rear margin. Teeth needle-like; form of vomerine tooth patch variable. Lateral line distinct. Total vertebrae 58–61; precaudal vertebrae 12 or 13.

Dark area behind eyes; eyes and gill cover bluish; dusky band distally on dorsal fin and anal fin; no ocelli or bars. Attains at least 19 cm SL.



*Neobythites trifilis*, 16 cm SL, female holotype (off Socotra).

Source: Nielsen 1995

**DISTRIBUTION** WIO: Socotra.

**REMARKS** Trawled from five localities on lower continental shelf and upper slope, southeast of Socotra, off Somalia, at 175–420 m.



GENUS *Ophidion* Linnaeus 1758

Body slender, with body scales set at oblique angle, and head naked; pelvic fins with 2 unequally long rays, inserted below eyes; GR 4–7. Rostral spine may be present. Precaudal vertebrae 15–18. Circumglobal in tropical and subtropical coastal waters; 21 species, 1 in WIO.

*Ophidion smithi* (Fowler 1934)

Bigeye cusk-eel

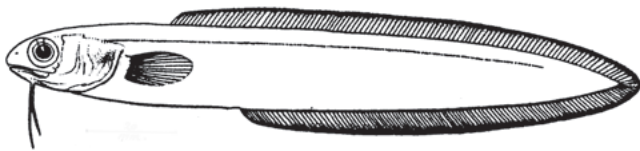
PLATE 41

*Otophidium smithi* Fowler 1934: 508, Fig. 52 (Durban, KwaZulu-Natal, South Africa).

*Ophidion smithi*: SSF No. 96.19\*; Randall & Van Egmond 1994\*.

Diagnosis as for genus. Dorsal fin 98 rays; anal fin 95 rays; pectoral fins 22 rays; GR 5.

Body pale brown dorsally, whitish below; margins of median fins black. Attains at least 14 cm TL.



*Ophidion smithi*, 15 cm TL, holotype (South Africa).

Source: Fowler 1934, *Proceedings of the ANSP*

**DISTRIBUTION** Indian Ocean. WIO: Red Sea to South Africa (KwaZulu-Natal), southern Madagascar and Seychelles; elsewhere to northwestern Australia.

**REMARKS** Known from 50–116 m. This species is questionably distinct from *O. genyopus* (Ogilby 1897) from southeastern Australia.

GENUS *Pycnocraspedum* Alcock 1889

Body short with large head; end of upper jaw well behind eyes; strong spine on opercle often covered by skin, and preopercle with 2–4 spines on rear margin. Eye diameter equal to or slightly less than snout length. Pectoral fins 24–28 rays; pelvic fins 2 rays; anterior gill arch with 4–6 long rakers; 2 median basibranchial tooth patches. Occur in Indo-Pacific and tropical eastern Atlantic. Five species, 1 in WIO.

*Pycnocraspedum squamipinne* Alcock 1889

PLATE 41

*Pycnocraspedum squamipinne* Alcock 1889: 386 (Bay of Bengal); Nielsen 1997; Nielsen *et al.* 1999.

Diagnosis as for genus. Dorsal fin 88–92 rays; anal fin 65–71 rays; pectoral fins 28 rays; pseudobranchial filaments 4. Total vertebrae 54.

Body uniformly brownish, without larger spots or stripes. Attains 13 cm SL.



*Pycnocraspedum squamipinne*, 10 cm TL. Source: Nielsen 1997; © Publications Scientifiques du Muséum national d'Histoire naturelle, Paris

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to northern Mozambique; elsewhere to Australia and New Caledonia.

**REMARKS** Uncommon; inhabits relatively deep water, typically at 200–500 m.

GENUS *Sirembo* Bleeker 1858

Body robust anteriorly, strongly tapering to caudal tip; entirely covered with overlapping cycloid scales. Pelvic fins 1 ray, inserted below or immediately behind eyes; developed GR 3–5 on 1st arch; pseudobranchial filaments 15–28. No spines on preopercle; opercular spine short, not reaching rear margin of opercle. Occur in Indo-Pacific. Five species, 1 in WIO.

*Sirembo jerdoni* (Day 1888)

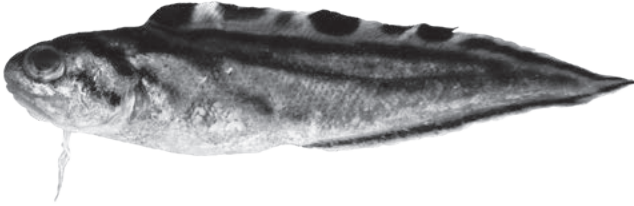
Brownbanded cusk-eel

PLATE 41

*Brotula jerdoni* Day 1888: 804 (Chennai, India); Menon & Rama Rao 1963\*. *Sirembo jerdoni*: Sainsbury *et al.* 1985\*; Cohen & Robins 1986\*; Nielsen *et al.* 1999\*; Nielsen *et al.* 2014\*.

Diagnosis as for genus. Dorsal fin 91–97 rays; anal fin 65–69 rays, and fin origin at midbody; pectoral fins 22–24 rays; pelvic fins inserted below or slightly behind eyes. Scale rows 5–7 between dorsal-fin origin and lateral line; 3 or 4 long gill rakers on 1st arch; pseudobranchial filaments 18–27. Teeth pointed, in rows on jaws, vomer and palatines.

Head and body pale ventrally, much darker dorsally; head and anterior body with 3–4 broad, oblique, dark blackish brown bands, inclining at different angles and for increasing lengths; dorsal fin with 3 or 4 large black spots, and sometimes with smaller spots placed in between (most prominent spot occasionally appears as partial ocellus with white ring); dorsal fin also with dark submarginal band posteriorly, and anal fin with similar narrower dark band for most of length; eyes bluish. Attains at least 17 cm SL.



*Siremba jerdoni*, 12 cm TL (Australia). © T Gloerfelt-Tarp

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Suez (Red Sea); elsewhere, east coast of India (Chennai), Indonesia (Sumatra), Vietnam, Philippines and northern Australia.

**REMARKS** Known to ~70 m deep.

## GENUS *Spottobrotula* Cohen & Nielsen 1978

Body relatively short and robust, its depth at anus 4.3–5.7 in SL; preanal length more than twice HL; head and body entirely covered with overlapping cycloid scales; developed GR 9–12; pseudobranchial filaments 30–40. Pelvic fins fleshy, with 2 rays bound together with tough skin; prominent skin flap above pectoral-fin bases. No spines on preopercle; strong short opercular spine. Precaudal vertebrae 15 or 16. Occurs in Indian Ocean; known from 22–515 m. Three species, 2 in WIO.

### *Spottobrotula mossambica*

Nielsen, Schwarzhans & Uiblein 2014

PLATE 42

*Spottobrotula mossambica* Nielsen, Schwarzhans & Uiblein 2014: 17, Figs. 2, 4, 7–9 (Mozambique Channel).  
*Spottobrotula mahodadi*: Cohen & Nielsen 1982 [in part].

Diagnosis as for genus. Snout rounded, slightly protruding over upper jaw symphysis; numerous small papillae on lips. Pectoral fins inserted below end of upper jaw, with 23–26 rays. Scale rows 14 or 15 between dorsal-fin origin and lateral line;

9–11 long gill rakers on 1st arch; pseudobranchial filaments 30–42. Teeth small and pointed, in irregular rows on jaws, vomer and palatines; 1 elongate basibranchial tooth patch. Total vertebrae 53–55; precaudal vertebrae 15 or 16.

Distinguished by broad black band from eyes to behind pectoral fins; dorsal surface of head and body with numerous pale spots (subequal to eye diameter); 3 dark ocelli on dorsal fin; anal fin with black submarginal band and narrow pale margin. Attains at least 29 cm SL.



*Spottobrotula mossambica*, 23 cm TL, paratype (Oman).  
E Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: Oman, Somalia and Mozambique Channel.

**REMARKS** Known from 22–82 m.

### *Spottobrotula persica*

Nielsen, Schwarzhans & Uiblein 2014

PLATE 42

*Spottobrotula persica* Nielsen, Schwarzhans & Uiblein 2014: 19, Figs. 4, 7–8 (Persian/Arabian Gulf).

Diagnosis as for genus. Snout rounded, slightly protruding over upper jaw symphysis. Dorsal fin 100 or 101 rays; anal fin 71–76 rays; pectoral fins 23 or 24 rays, and fins inserted below end of upper jaw. Scale rows 14 or 15 between dorsal-fin origin and lateral line; 10–12 long gill rakers on 1st arch; pseudobranchial filaments 32–35. Teeth small and pointed, in irregular rows on jaws, vomer and palatines; 1 elongate basibranchial tooth patch. Total vertebrae 54 or 55; precaudal vertebrae 15.

Head and body pale greyish brown, with numerous large white spots dorsally (no dark markings); 3 ocelli on dorsal fin; anal fin with black band; pectoral fins dark; lateral line distinctly brown. Attains at least 30 cm SL.

**DISTRIBUTION** Known only from four specimens from the Persian/Arabian Gulf.

**REMARKS** Trawled at 45–515 m.

## FAMILY CARAPIDAE

### Pearlfishes

Phillip C Heemstra

Body eel-like, cylindrical to compressed anteriorly, becoming compressed posteriorly and tapering to long slender tail; anus far forward. No scales on body, except LL scales in some species. Dorsal fin and anal fin begin at or near head and extend to tip of tail, and anal-fin rays longer than dorsal-fin rays; caudal fin rudimentary; pectoral fins usually present (very small or absent in some); no pelvic fins, except fins rudimentary and reduced to single ray in *Pyramodon*; no fin spines. Jaws with small conical teeth, but some species with a few enlarged canines or fang-like teeth; no supramaxilla. Branchiostegal membranes united or separate, but always free from isthmus. Swimbladder with or without rocker bone (for sound production). Counts of pectoral- and anal-fin rays anterior to vertical at dorsal-fin origin, and number of precaudal vertebrae are useful to confirm identifications.

Carapids display a uniquely specialised pelagic larval stage, called the vexillifer, which bears an elongated banner-like filament (*vexillum* meaning banner or flag in Latin) on the head in front of the dorsal fin. In some species, the vexillifer stage shrinks as much as 50% in length during its transitional stage, before assuming its role as a demersal juvenile. Most adults and juveniles are benthic, living as obligate inquilines within the body of invertebrate hosts, such as holothurians (sea cucumbers, which they enter through the anus), cushion starfishes and bivalve molluscs. Species of *Encheliophis* are parasites that feed on the internal tissues of their host; *Carapus* are commensals that only shelter by day in their host and otherwise emerge at night to feed on small crustaceans, fishes and worms; a few deepwater species appear to be free-living. Most carapids prefer a certain type of host (usually holothurians), and thus are not found in areas where these hosts are absent. Another characteristic of these fishes is the ability of some species to produce sounds. The common name pearlfish comes from the blister pearl formed when a fish dies inside its bivalve host, which covers its intruder with pearly nacre.

Worldwide in tropical and warm-temperate seas. The distinctive, relatively large-sized larvae occur in the open ocean; adults of inquiline species occur in the same habitats as their hosts (such as in estuaries, seagrass beds, coral and

rocky reefs, and on sandy or muddy bottom of the continental shelf); and the free-living species (*Pyramodon* and *Snyderidia*) are benthic or pelagic in ~80–2 000 m. The family was revised by Arnold (1956) and by Markle & Olney (1990), and several *Encheliophis* species were reassigned to *Carapus* by Parmentier *et al.* (2000). Eight genera and 38 species; 7 genera and 14 species in WIO.

#### KEY TO GENERA

- |    |  |                     |
|----|--|---------------------|
| 1a | Pectoral fins 24–29 rays; dorsal-fin origin over or before anal-fin origin .....   | 2                   |
| 1b | Pectoral fins 14–22 rays; dorsal-fin origin over first 3 anal-fin rays or well behind anal-fin origin .....  | 3                   |
| 2a | Pelvic fins rudimentary, reduced to single ray on isthmus .....  | <i>Pyramodon</i>    |
| 2b | No pelvic fins .....   | <i>Snyderidia</i>   |
| 3a | Jaws with 1 or more large recurved fangs at symphysis; dorsal-fin origin over first 3 anal-fin rays .....  | 4                   |
| 3b | No fangs in jaws; dorsal-fin origin well behind anal-fin origin .....  | 5                   |
| 4a | Body compressed: body depth $\geq$ HL, body width $\sim$ 3 in body depth; jaws with 1–4 large curved fangs at symphysis, followed by toothless gap and then band of numerous small conical teeth .....                       | <i>Onuxodon</i>     |
| 4b | Body cylindrical, tapering and slightly compressed posteriorly; body depth $\leq$ 1/2 HL and subequal to body width; jaws with 1 or 2 large recurved teeth at symphysis, and no toothless gap before conical jaw teeth ..... | <i>Eurypleuron</i>  |
| 5a | Rear part of maxilla attenuate and bound by skin to cheek; no developed gill rakers .....  | <i>Encheliophis</i> |
| 5b | Rear part of maxilla widest, tip free and moveable; 3 developed gill rakers on 1st arch .....  | 6                   |
| 6a | Upper and lower jaws with 1 or 2 large canines at symphysis, followed by multiserial band of small conical teeth behind canines; dorsal-fin origin over pectoral-fin tips, and over 12th anal-fin ray .....                  | <i>Echiodon</i>     |
| 6b | No large recurved canines at front of jaws; row of strongly recurved cardiform teeth hidden behind upper lip; dorsal-fin origin behind vertical at pectoral-fin bases .....  | <i>Carapus</i>      |

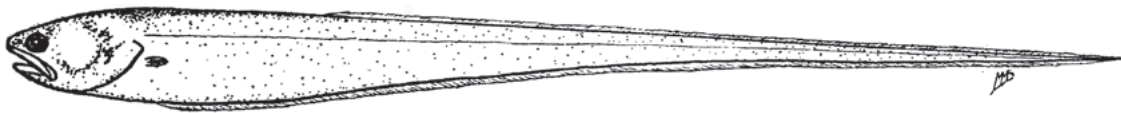
GENUS *Carapus* Rafinesque 1810

Dorsal-fin origin well behind anal-fin origin; pectoral fins 16–24 rays. No fangs or canines, and no toothless gap at symphyses of upper and lower jaws; premaxilla with outer row of recurved cardiform teeth, 2 or 3 rows of small conical teeth anteriorly, and 2–4 enlarged teeth at symphysis; dentary with outer row of conical teeth (becoming stouter, larger and more

spaced anteriorly, and gradually smaller posteriorly) and inner multiserial band of smaller conical teeth. Rear end of maxilla widest, free and moveable. First gill arch with 3 developed gill rakers at angle. Commensals that do not feed on the internal soft tissues of their hosts (Parmentier *et al.* 2000). Worldwide in tropical to warm-temperate waters. Seven species currently recognised, 4 in WIO.

## KEY TO SPECIES

- |  |   |
|--|---|
| <p>1a Pectoral fins short, 20–28% HL; eye diameter 11–15% HL, less than or subequal to snout length; snout length 13–24% HL; body uniformly dark reddish brown, covered with small stellate melanophores ..... <i>C. boraborensis</i></p> <p>1b Pectoral fins well-developed, 30–53% HL; eye diameter subequal to or greater than snout length; snout length 15–28% HL ..... 2</p> <p>2a Maxilla reaches to below eye; preanal length 95–114% HL; precaudal vertebrae 19–21 ..... <i>C. dubius</i></p> <p>2b Maxilla extends past rear edge of eye; preanal length 86–100% HL; precaudal vertebrae 15–19 ..... 3</p> | <p>3a Body translucent, but peritoneum brownish, covered with small white spots visible through transparent body muscles; row of 12–14 silver spots covering ribs; head and whole body covered with large, dark brown, stellate melanophores; swimbladder with distinct constriction under vertebrae 9–10 ..... <i>C. mourlani</i></p> <p>3b Body of fresh specimens mostly transparent without dark spots; ~10 silvery blotches over abdomen; large stellate melanophores over tip of snout and lower jaw; swimbladder without constrictions ..... <i>C. homei</i></p> |
|--|---|



*Carapus boraborensis*. Source: Smith 1955, composite

*Carapus boraborensis* (Kaup 1856)

Pinhead pearlfish

PLATE 42

*Fierasjer boraborensis* Kaup 1856: 99 (Bora Bora I., Society Is.).

*Carapus parvipinnis*: Smith 1955\*; SSF No. 97.4\*.

*Encheliophis boraborensis*: Markle & Olney 1990\*; Randall & Anderson 1993; Heemstra 1995\*.

*Carapus boraborensis*: Parmentier *et al.* 2000.

Percentage HL: eye diameter 11–15%, snout length 13–24%, pectoral-fin length 20–28%, predorsal length 177–215%, and preanal length 95–137%. Body thick and robust, richly pigmented. Pectoral fins 15–21 rays; 17 anal-fin rays anterior to

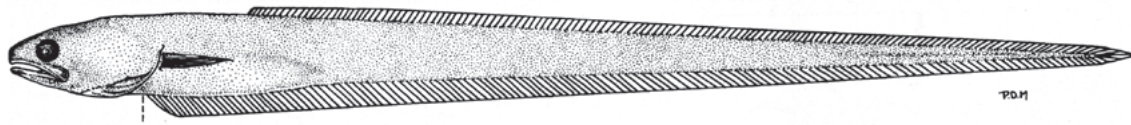
vertical at dorsal-fin origin. Precaudal vertebrae 15–17.

Body opaque golden brown or dark reddish brown, with small dark specks. Attains 33 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, South Africa (Sodwana Bay), Madagascar, Mauritius, Maldives and southern tip of India; elsewhere to Indonesia, Taiwan, Micronesia, New Guinea, Australia, New Caledonia and Society Is.

**REMARKS** Uncommon. Host is holothurians, especially *Thelenota ananas* and *Bohadschia argus*. Feeds on shrimp, juvenile carapids and other fishes.





*Carapus dubius*, ~10 cm TL. Source: Markle & Olney 1990

## *Carapus dubius* (Putnam 1874)

### Pacific pearlfish

*Fierasfer dubius* Putnam 1874: 344 (Panama Bay, eastern Pacific).

*Encheliophis dubius*: Markle & Olney 1990\*; Parmentier, Castro-Aguirre & Vandewalle 2000; Randall 2007\*.

*Carapus dubius*: Parmentier, Castillo *et al.* 2000; Parmentier & Bailly 2002.

Percentage HL: eye diameter 19–26%, snout length 17–23%, pectoral-fin length 41–53%, predorsal length 147–185%, and preanal length 95–114%. Pectoral fins 16–20 rays; 17–22 anal-fin rays anterior to vertical at dorsal-fin origin. Precaudal vertebrae 19–21.

Colour in life not recorded: probably silvery grey, with transparent median fins, and some internally scattered dark melanophores. Attains 15 cm TL.

**DISTRIBUTION** Eastern and central Pacific (widespread: Panama Bay, Gulf of California, Mexico to Ecuador, Galápagos Is., Cocos (Keeling) Is., and Hawaii [as waifs]); one dubious record from Madagascar in WIO.

**REMARKS** Uncommon throughout its range. Appears to be an obligate inquiline of various molluscs.

*Carapus homei*: Smith 1955 [in part]; Arnold 1956\* [in part]; SSF No. 97.2\*; Winterbottom *et al.* 1989\*; Parmentier *et al.* 2000.

*Encheliophis homei*: Markle & Olney 1990\*.

Percentage HL: eye diameter 15–22%, snout length 13–20%, pectoral-fin length 39–53%, predorsal length 163–188%, and preanal length 86–97%. Pectoral fins 17–21 rays; 18–25 anal-fin rays anterior to vertical at dorsal-fin origin. Precaudal vertebrae 15–17.

Internal anterior body and vertebral column reddish brown, with ~10 silver blotches along sides and large stellate melanophores on tip of snout and lower jaw, and rest of body and median fins transparent. Attains 19 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar, Seychelles, Mauritius and Chagos; not known from Red Sea or Arabian Sea; elsewhere to Indonesia, Taiwan, southern Japan, Marshall Is., Australia, New Caledonia, possibly Tasmania, Tuamotu Is. and Gambier Is.

**REMARKS** Uncommon but widely distributed. Hosted by holothurians, prefers *Stichopus chloronotus* and *Holothuria argus*, with a tendency towards sexual pairing inside the host. Feeds at night on shrimp, juvenile carapids and other fishes.

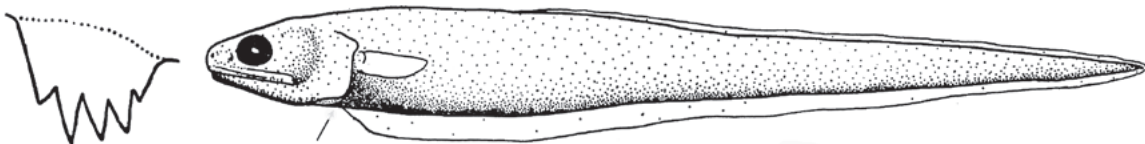
## *Carapus homei* (Richardson 1846)

### Silver pearlfish

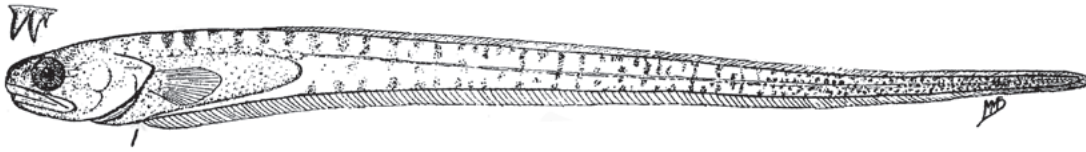
PLATE 42

*Oxybeles homei* Richardson 1846: 74, Pl. 44, Figs. 7–18 (Timor I., southern Malay Archipelago or Tasmania [Timor Sea]).

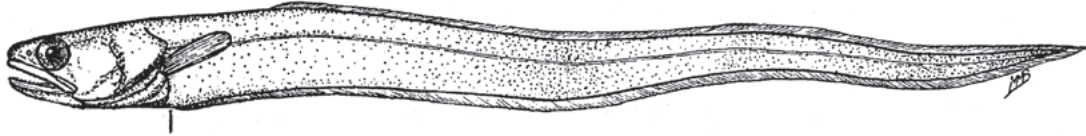
*Fierasfer neglectum* Peters 1855: 451 (Ibo I., Mozambique); Regan 1908.



*Carapus homei*, 14 cm TL, vomerine teeth (left) and lateral view (Indian Ocean). Source: Arnold 1956



*Carapus mourlani*, 8 cm TL, holotype of *C. pindae*, and vomerine teeth (top left) (N Mozambique). Source: SSF



*Carapus mourlani*, 9 cm TL, holotype of *C. mayottae* (Comoros). Source: Smith 1955

## *Carapus mourlani* (Petit 1934)

Cushion-star pearlfish

PLATE 42

*Fierasfer mourlani* Petit 1934: 393, Fig. 1 (Saro-drano, Madagascar);

Markle & Olney 1990\* [designation of neotype from Mauritius, Mascarenes].

*Carapus mayottae* Smith 1955: 415, Fig. 8 (Mayotte, Comoros).

*Carapus pindae* Smith 1955: 412, Fig. 7 (Pinda, Mozambique);

Arnold 1956.

*Oxybelus lumbricoides*: Regan 1908.

*Carapus mourlani*: Smith 1964; Trott 1970\*; Trott & Trott 1972;

SSF No. 97.3\*; Heemstra 1995\*; Parmentier 2000; Randall 2007.

Percentage HL: eye diameter 15–22%, snout 16–19%, pectoral-fin length 33–47%, predorsal length 1.47–185%, and preanal length 86–100%. Vomer with 2 or 3 large, stout, conical teeth surrounded by short, blunt, conical teeth. Maxilla extends well behind eye. Anal fin distinctly higher than dorsal fin; 18–25 anal-fin rays anterior to vertical at dorsal-fin origin; pectoral fins 16–20 rays. Precaudal vertebrae 15–17.

Body and head somewhat pale silvery grey to transparent, and more or less evenly scattered with small, stellate, dark brown melanophores; median fins transparent. Attains 17 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique, South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Mauritius and southwestern India; elsewhere to Indonesia, Taiwan, southern Japan, Caroline Is., Australia, New Caledonia, Marquesas Is. and Hawaii.

**REMARKS** Usually hosted by starfishes, with a preference for cushion starfish *Culcita* spp., but also found in a variety of holothurians. Feeds on shrimp, fishes, juvenile carapids, decapod crustaceans and worms.

## GENUS *Echiodon* Thompson 1837

Dorsal-fin origin over pectoral-fin tips; pectoral-fin rays 15–23. Teeth small and conical, except for 1 or 2 enlarged canines at symphyses of both jaws; upper jaw projecting ahead of lower jaw; rear end of maxilla widest, free and moveable. First gill arch with 3 developed gill rakers at angle. Swimbladder with ventral patch of tunic ridges on posterior chamber and without rocker bone. Apparently free-living. Thirteen species, 1 in WIO.

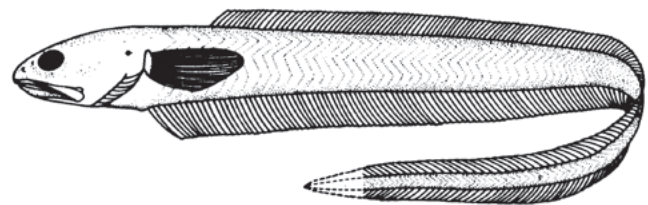
### *Echiodon coheni* Williams 1984

Bigeye pearlfish

*Echiodon coheni* Williams 1984: 415, Figs. 1a, 3 (Somalia coast); Markle & Olney 1990\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2011.

Percentage HL: horizontal diameter of bony orbit 21–25%, interorbital width 11–12%, upper jaw length 51–54%, predorsal length ~150%, and preanal length ~102%. Dorsal-fin origin over 12th anal-fin ray; anus below pectoral-fin bases. Pectoral fins 18 rays. Precaudal vertebrae 18.

Preserved specimens with cream-coloured head and body; melanophores on snout, lower jaw, nape, cheeks, around eyes, and concentrated along bases of dorsal fin and anal fin; peritoneum tan with scattered melanophores. Attains at least 15 cm TL.



*Echiodon coheni*, 14 cm TL, female holotype (Somalia). Source: Williams 1984

**DISTRIBUTION** Indo-Pacific: records from Somalia in WIO, and New Caledonia in western Pacific.

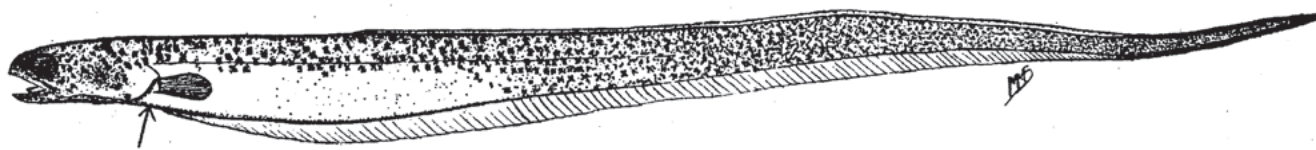
**REMARKS** Known in WIO from the two type specimens only, trawled from 75–175 m.

## GENUS *Encheliophis* Müller 1842

Maxilla immoveable and attenuated posteriorly, bound to premaxilla by short connective fibres and to cheek by skin (maxilla and premaxilla function as unit, preventing large gape); premaxilla with cardiform teeth and occasionally with small conical teeth; 1 row of small evenly spaced teeth on dentary; no fangs or enlarged canines; no diastema on premaxilla and dentary. Dorsal-fin origin well behind anal-fin origin; pectoral fins present or absent. Gill membranes united; gill rakers rudimentary. Swimbladder with thin, terminal, pigmented membrane or bulb, and without rocker bone or constrictions. Most species appear to be parasitic, feeding on the soft internal tissues of their invertebrate hosts. Five species, 3 in WIO.

### KEY TO SPECIES

- |    |   |                        |
|----|---|------------------------|
| 1a | No pectoral fins .....  | <i>E. vermicularis</i> |
| 1b | Pectoral fins present .....   | 2                      |
| 2a | Predorsal length 184–238% HL; pectoral fins 17–19 rays; precaudal vertebrae 26–32 ..... | <i>E. gracilis</i>     |
| 2b | Predorsal length 330% HL; pectoral fins 15 or 16 rays; precaudal vertebrae 20–22 .....  | <i>E. vermiops</i>     |



*Encheliophis gracilis*, 15 cm TL (Aldabra). Source: Smith & Smith 1963

## *Encheliophis gracilis* (Bleeker 1856)

Slender pearlfish

PLATE 42

*Oxybeles gracilis* Bleeker 1856: 105 (Banda I., Moluccas, Indonesia).

*Fierasfer punctatus* Fischer 1885: 74 (Mozambique) [larva]; Barnard 1927.

*Fierasfer gracilis*: Barnard 1927\*.

*Jordanicus gracilis*: SFSA No. 1010\*.

*Jordanicus punctatus*: Smith 1955\*.

*Encheliophis (Jordanicus) gracilis*: Arnold 1956\*.

*Encheliophis gracilis*: SSF No. 97.5\*; Winterbottom *et al.* 1989\*;

Markle & Olney 1990\*; Randall & Anderson 1993; Heemstra 1995;

Parmentier *et al.* 2000; Manilo & Bogorodsky 2003; Randall 2007\*.

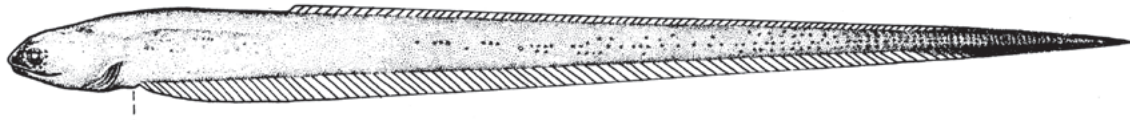
*Encheliophis boraborensis* (*non* Kaup 1856): Terashima *et al.* 2001.

Body depth about half HL, 15–24 in TL; predorsal length 184–238% HL. Pectoral fins 17–19 rays; 19–27 anal-fin rays anterior to vertical at dorsal-fin origin. Premaxilla with 1 row of cardiform teeth; dentary and palatines with 1 row of conical teeth; vomer with 3 or 4 stout recurved fangs. Precaudal vertebrae 26–32.

Body translucent with evident small dark spots; median fins transparent but caudal region blackish. Attains 28 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique, South Africa (KwaZulu-Natal), Madagascar, Aldabra, Seychelles, Mauritius, Chagos and Maldives; elsewhere to Indonesia, Australia, New Caledonia, Society Is. and Hawaii.

**REMARKS** Common; sometimes found as male–female pairs in their holothurian host.



*Encheliophis vermicularis*, ~13 cm TL. Source: Markle & Olney 1990

## *Encheliophis vermicularis* Müller 1842

### Worm pearlfish

*Encheliophis vermicularis* Müller 1842: 323 (Calatagan Lagoon, Batangas, Philippines); Markle & Olney 1990\*; Parmentier *et al.* 2000; Parmentier 2004\*.

Body depth  $> \frac{1}{2}$  HL, ~15 in TL; predorsal length 210–300% HL. No pectoral fins. Premaxilla with outer row of recurved cardiform teeth and inner row of conical teeth; dentary and palatines with 1 row of conical teeth; vomer with 6 or 7 small conical teeth. Precaudal vertebrae 21.

Body whitish grey, sides scattered with melanophores, and posteriormost body and fins entirely black. Attains 14 cm TL.

**DISTRIBUTION** Indo-Pacific, including Red Sea, Gulf of Aden and Mozambique in WIO, Indonesia to Philippines and Australia in western Pacific, and Galápagos Is. to Colombia and Gulf of California in eastern Pacific.

**REMARKS** Host is holothurians.

## *Encheliophis vermiops* Markle & Olney 1990

### Pygmy pearlfish

*Encheliophis vermiops* Markle & Olney 1990: 396, Figs. 34, 112 (sandbank towards wreck at Heron I., Queensland, Australia); Parmentier *et al.* 2000; Parmentier *et al.* 2010\*.

Body depth about half HL, ~28 in TL; predorsal length 235% HL; preanal length ~95% HL. Pectoral fins 15 or 16 rays, and fin length ~40% HL. Maxilla toothless; premaxilla with row of cardiform teeth; dentary and palatines with close-set cuneate teeth, and palatine teeth with forward orientation; vomer with 1 or 2 large teeth. Total vertebrae 98–109; precaudal vertebrae 18–23.



*Encheliophis vermiops*, 10 cm TL, holotype (Australia). Source: Markle & Olney 1990

Body with large stellate melanophores; median fins and pectoral fins transparent. Attains at least 14 cm TL.

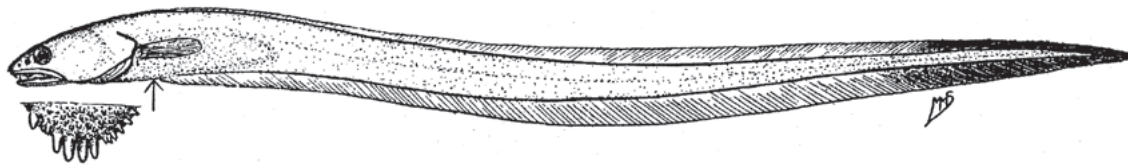
**DISTRIBUTION** Indo-Pacific: records from Mozambique (Inhaca I.) and Madagascar (Great Reef of Toliara) in WIO; and Australia (Capricorn Group, Great Barrier Reef) in western Pacific.

**REMARKS** Described from two adult type specimens from southern Great Barrier Reef, and one juvenile from Mozambique; and recently known from 9 specimens from off Madagascar. Hosted by holothurians (e.g., *Holothuria fuscopunctata*, off Madagascar).

## GENUS *Eurypleuron* Markle & Olney 1990

Dorsal-fin origin over pectoral-fin tips and above 3rd or 4th anal-fin rays; dorsal fin low, rays  $\sim \frac{1}{2}$  length of longest anal-fin rays; anus behind pectoral-fin bases. Rear part of maxilla free and moveable; premaxilla with band of blunt subconical teeth (smaller than those on lower jaw), band widening anteriorly and ending well before symphysis, with recurved canine on either side; vomer elevated, with 4 large, close-set conical teeth in median row, surrounded by similar but smaller teeth, and preceded by 1 short stout conical tooth; lower jaw with band of small, blunt, subconical teeth ending well before symphysis; 1 large recurved canine on one side of symphysis, 2 canines on other side. First gill arch with 3 developed rakers on lower limb at angle, plus 6 rudiments in front. Swimbladder simple, without rocker bone, constriction or tunic ridges. Males with expanded, plate-like parapophyses on abdominal vertebrae. One species.





*Eurypleuron owasianum*, 22 cm TL, holotype of *Carapus cinereus*, and vomerine teeth (below left) (S Mozambique). Source: SSF

## *Eurypleuron owasianum* (Matsubara 1953)

Eel pearlfish

*Carapus owasianus* Matsubara 1953: 29, Fig. 1 (off Owasi, Mie Prefecture, Japan).

*Carapus cinereus* Smith 1955: 409, Fig. 4 (Inhaca I., Mozambique); Arnold 1956; Smith 1961\*; SSF No. 97.1\*.

*Echiodon cinereus*: Williams 1984\*.

*Eurypleuron owasianum*: Markle & Olney 1990\*; Heemstra 1995\*.

Diagnosis as for genus. Percentage HL: predorsal length 121–135%, preanal length 106–130%, pectoral-fin length 38–65%, and eye diameter 14–20%. Pectoral fins 15 or 16 rays. Precaudal vertebrae 25.

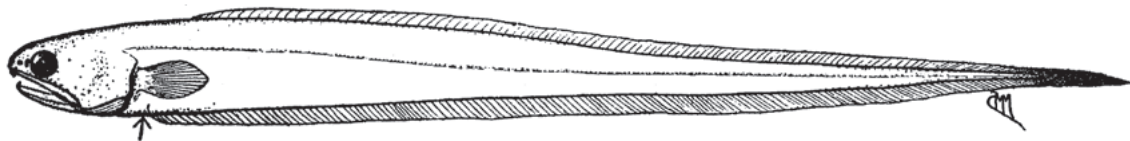
Body translucent with pink sheen; top of head speckled with minute melanophores; gills red; peritoneum silvery. Attains ~24 cm TL.

**DISTRIBUTION** Cosmopolitan, including Japan, Australia, New Zealand and Juan Fernandez Is. off Chile in Pacific, and Mozambique and South Africa in WIO.

**REMARKS** Uncommon; presumably free-living.

## GENUS *Onuxodon* Smith 1955

Body compressed, its depth more than HL. Dorsal fin rays short (longest about half length of longest anal-fin ray), dorsal-fin origin over anal-fin origin. Rear end of maxilla free and moveable; jaws with 1–4 distinctly enlarged curved canines (fangs) at symphysis, followed by toothless gap and then band of small conical teeth; vomer and palatines with small blunt conical teeth. First gill arch with 3 developed rakers on lower



*Onuxodon fowleri*, 9 cm TL (South Africa). Source: SSF

limb near angle. Anterior end of swimbladder connected to median rocker bone. Commensal inquilines of molluscs. Three species, 2 in WIO.

### KEY TO SPECIES

- |    |  |                         |
|----|--|-------------------------|
| 1a | Pectoral fins short, 16–29% HL; head and body deep and compressed: body depth at anal-fin origin subequal to HL, body width at anal-fin origin ~6.5% TL, and head width ~7% TL ..... | <i>O. parvibrachium</i> |
| 1b | Pectoral fins longer, 28–54% HL; head and body more cylindrical, body depth at anal-fin origin <HL .....   | <i>O. fowleri</i>       |

## *Onuxodon fowleri* (Smith 1955)

Pink pearlfish

PLATE 43

*Jordanicus fowleri* Smith 1955: 403 [Fig. 3: labelled *Carapus margaritiferae* Rendahl] (Kiritimati, Line Is.), based on *Jordanicus caninus* (non Günther 1862) of Fowler 1927: 30, Fig. 5 (Kiritimati, Line Is.).

*Onuxodon margaritiferae* (non Rendahl 1921): SSF No. 97.6\*.

*Onuxodon fowleri*: Markle & Olney 1990\*; Randall & Anderson 1993; Heemstra 1995\*; Randall 2007\*.

Body elongate, subcylindrical: body depth at anus 6–10% TL; HL ~12% TL; pectoral-fin length 30–50% HL; eye diameter 18–20% HL. Precaudal vertebrae 19–22.

Body translucent with pink sheen; vertebral column often dark; tail dusky. Attains 10 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Yemen, Kenya, South Africa (KwaZulu-Natal) and Madagascar; elsewhere to Indonesia, Australia, New Caledonia, Kermadec Is., Pitcairn Is., Marquesas Is., Line Is. and Hawaii.

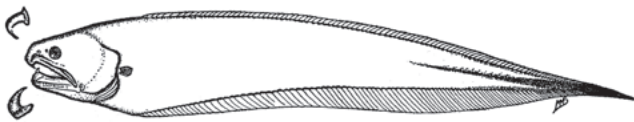
*Onuxodon parvibrachium* (Fowler 1927)

Hookjaw pearlfish

*Carapus parvibrachium* Fowler 1927: 31, Fig. 6 (in clam shell, Suva Bay [Viti Levu, Fiji]).*Onuxodon parvibrachium*: Smith 1955\*; Williams 1984; SSF No. 97.7\*; Markle & Olney 1990; Randall & Anderson 1993; Heemstra 1995\*; Randall 2007\*.

Body relatively deep and distinctly compressed, body depth at anus 6–8 in TL; HL ~12% TL; pectoral-fin length 16–29% HL; eye diameter 8–16% HL. Mouth oblique, with front of upper jaw hooked and projecting over front of lower jaw. Pectoral fins 14–16 rays. Precaudal vertebrae 22.

Colour in life (Smith 1955): translucent with pink sheen; snout and chin dusky to dark; dark speck at base of each anal-fin ray, pigment increasingly distinct posteriorly, and also at base of each dorsal-fin ray from mid-fin and beyond; median dusky band (about eye-diameter in width) on hind half or third of body, becoming totally dark at tip of tail. Attains 10 cm TL.



*Onuxodon parvibrachium*, 10 cm TL, and canine teeth (left) (Seychelles). Source: Smith & Smith 1963

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (KwaZulu-Natal), Madagascar, Seychelles and Maldives; elsewhere to Indonesia, southern Japan, Australia, New Caledonia, Fiji, Line Is. and Hawaii.

**GENUS** *Pyramodon* Smith & Radcliffe 1913

Dorsal-fin origin over or well before anal-fin origin; pectoral fins well-developed, with 22–30 rays; pelvic fins rudimentary and reduced to 1 slender ray inserted on isthmus. Rear end of maxilla expanded, free and moveable; premaxilla with large recurved fang at symphysis, and 2 small conical teeth mesial to and in front of each fang; short toothless gap behind each fang followed by band of short conical teeth; dentary with large canine tooth at symphysis, followed by 1 row of smaller teeth; vomer and palatines with small conical teeth. Branchiostegal rays 7; 1st gill arch with 3 developed rakers, plus several rudiments. Body with 3 inconspicuous lateral lines (Smith 1955). Swimbladder without rocker bone, constrictions or tunic ridges. Probably free-living. Four species, 2 in WIO.

**KEY TO SPECIES**

- 1a Pectoral fins with 24–26 rays; pectoral-fin length  $>\frac{2}{3}$  HL; preanal length 100–130% HL; precaudal vertebrae 14 or 15 ..... *P. ventralis*
- 1b Pectoral fins with 26–29 rays; pectoral-fin length subequal to HL; preanal length 130–150% HL; precaudal vertebrae 17–19 ..... *P. punctatus*

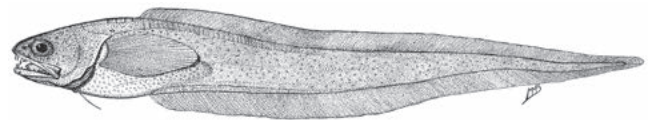
*Pyramodon punctatus* (Regan 1914)

Goliath pearlfish

*Cynophidium punctatum* Regan 1914: 16 (North Cape, New Zealand).*Pyramodon punctatus*: Regan 1914\*; SSF No. 97.8\*; Markle & Olney 1990\*.

Dorsal-fin origin over or slightly behind anal-fin origin; pectoral fins 26–29 rays, and fin length subequal to HL. Vomer with 1 large fang, plus small conical teeth. Precaudal vertebrae 17–19.

Body and head dark brown dorsally, pale brown on sides and ventrally; operculum and tail bluish grey; dorsal- and anal-fin margins dark posteriorly. Attains 62 cm TL.



*Pyramodon punctatus*, 29 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Eastern Cape); elsewhere, Australia and New Zealand.

**REMARKS** Rare; benthic on outer continental shelf and upper slope, in 120–730 m.

*Pyramodon ventralis* Smith & Radcliffe 1913

Silverbelly pearlfish

PLATE 43

*Pyramodon ventralis* Smith & Radcliffe 1913: 175, Pl. 17, Fig. 3 (near Dowora I., Moluccas, Indonesia); Smith 1955\*; Markle & Olney 1990\*; Heemstra 1995\*.

Dorsal-fin origin over or before anal-fin origin; pectoral fins 24–26 rays, and fins relatively large, their length  $>\frac{2}{3}$  HL. Swimbladder large, filling visceral cavity and extending past anus. Precaudal vertebrae 14 or 15.

Head and preanal region of body pale greyish brown, abdomen silvery; no dark margins on median fins. Attains 34 cm TL.



*Pyramodon ventralis*, 34 cm TL; 17 cm TL (Japan).

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa and Réunion; elsewhere to Indonesia, southern Japan, Australia, New Caledonia, New Zealand and Hawaii.

**REMARKS** Benthic or pelagic, in 79–470 m.

## GENUS *Snyderidia* Gilbert 1905

Body elongate, flaccid, compressed and tapering posteriorly. Dorsal-fin origin over anus; pectoral fins long and pointed. Teeth on dentary in 1 or 2 rows anteriorly, and with 1 or 2 large canines at symphysis, behind these 1–3 rows of short stout teeth, becoming larger posteriorly, with those at rectus large and strong; premaxilla with large fang plus 2 or 3 small conical teeth at symphysis, followed by band of 3 or 4 rows of teeth, inner teeth short, sharp and depressible, and outer teeth short and blunt; vomer with huge fang anteriorly, surrounded by group of short, strong teeth; palatines with 1 or 2 rows of teeth, stronger and more caninoid anteriorly than posteriorly. First gill arch with 3 developed rakers, plus 4–8 rudiments. No lateral line on body. Swimbladder small, without rocker bone, constrictions or tunic ridges. One species.

### *Snyderidia canina* Gilbert 1905

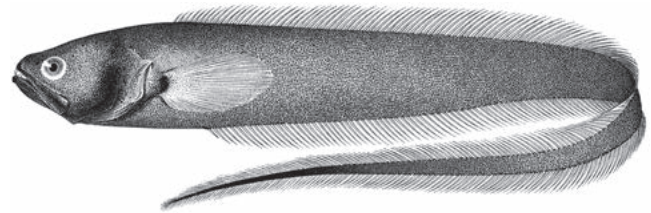
#### Dogtooth pearlfish

*Snyderidia canina* Gilbert 1905: 655, Pl. 92 (near Kauai I., Hawaii); Markle & Olney 1990\*.

*Snyderidia bothrops* Robins & Nielsen 1970: 287, Figs. 2–3 (Gulf of Guinea, eastern Atlantic).

Diagnosis as for genus. Percentage HL: predorsal length 111–132%, preanal length 124–168%, and pectoral-fin length 82–112% (longer than HL when fins undamaged). Dorsal-fin origin before anal-fin origin; 6–11 anal-fin rays anterior to vertical at dorsal-fin origin; pectoral fins 24–27 rays. Swimbladder small, not reaching past anus. Precaudal vertebrae 13–15.

Preserved specimens with grey to brown preanal area, covered with small round to irregular black spots; mouth, gill cavity and peritoneum black. Attains at least 31 cm TL.



*Snyderidia canina*, 31 cm TL, holotype (Hawaii). Source: Gilbert 1905

**DISTRIBUTION** Circumglobal in tropical to subtropical seas, except eastern Pacific: including Madagascar in WIO; Indonesia, Line Is., Hawaii in western Pacific; Gulf of Guinea, Caribbean Sea and Gulf of Mexico in Atlantic.

**REMARKS** Uncommon; probably free-living. Benthic or pelagic, in ~110–1 700 m.

## GLOSSARY

**cardiform teeth** – numerous, pointed teeth arranged in distinct rows.

**commensal** – the relationship between two animals where one benefits and the other does not, nor is harmed.

**cuneate teeth** – wedge-shaped teeth.

**diastema** – the gap between two teeth.

**holothurian** – sea cucumber, an elongate soft-bodied relative of the starfish.

**obligate inquiline** – an inquiline is an animal that exploits the living space of another (from the Latin *inquilinus*, a tenant).

**ocellus** – pigment pattern on body or fins forming a false eye.

**parapophysis (pl. parapophyses)** – a long, transverse process arising ventrally from the centrum of abdominal vertebrae; serves to support epipleural ribs when present and, in Gadidae, the gas bladder.

**rocker bone** – a bean-shaped bone which is drummed against the anterior end of the gas bladder to produce sound.

**tunic ridges** – ridges on the swimbladder.

## FAMILY BYTHITIDAE

### Livebearing brotulas

M Eric Anderson and Daniel M Cohen

Body moderately elongate, tail laterally compressed. Pelvic fins with single ray in WIO species. Two pairs of nostrils, anterior nostrils above upper lip in WIO genera. Branchiostegal rays 7–8; GR 2–4 developed, remainder rudimentary pads.

Scales present. Males without pseudoclaspers in subfamily Bythitinae (*Grammonus* and *Microbrotula*). Gonads bilobed in both sexes. Swimbladder present.

Worldwide in temperate to tropical seas; benthic, in tidepools to deep-sea floor. Size ranges from dwarf species of *Microbrotula* (<5 cm SL) to the large-sized slope-dwelling *Cataetx laticeps* (77 cm TL). Of no commercial interest. Two subfamilies, 32 genera and 118 species; 4 genera and 5 species in WIO.

#### KEY TO SUBFAMILIES AND GENERA

- 1a Caudal fin joined with dorsal and anal fins, not readily discernible ..... 2 [*Bythitinae*]  
 1b Caudal fin free of dorsal and anal fins, or connected by weak membranes but readily discernible ..... 3 [*Brosmophycinae*]



- 2a No palatine teeth; branchiostegal rays 8; pectoral fins 21–23 rays; caudal fin 8 rays ..... *Grammonus*  
 2b Palatine teeth present; branchiostegal rays 7; pectoral fins 14 rays; caudal fin 6 rays ..... *Microbrotula*  
 3a Eye diameter less than snout length; pectoral fins 17–24 rays; pectoral fin on peduncle; anal fin origin posterior to midbody ..... *Bidenichthys*  
 3b Eye diameter usually greater than snout length; pectoral fins 23–29 rays; no pectoral fin on peduncle; anal fin origin just anterior to midbody ..... *Brosmophyciops*

#### GENUS *Bidenichthys* Barnard 1934

Pelvic fins on elongate peduncle; head naked, body scaly; lateral line interrupted behind pectoral-fin margins. Cohen & Nielsen (1978) stated that *Bidenichthys capensis* has 8 branchiostegal rays; in the original description, Barnard (1934) found that two specimens had 7 branchiostegal rays, which has been subsequently confirmed in numerous specimens, although the error was repeated by Paulin (1995) and Nielsen & Cohen (1999). Three species: 2 endemic to New Zealand in western Pacific, and 1 endemic to South Africa in WIO.

#### *Bidenichthys capensis* Barnard 1934

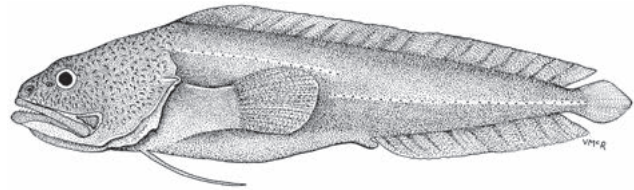
Freetail brotula

PLATE 43

*Bidenichthys capensis* Barnard 1934: 234, Fig. 3 (South Africa); Smith 1949\*; Cohen & Nielsen 1978\*; SSF No. 98.1\*; Nielsen & Cohen 1999\*.

Dorsal fin 66–72 rays; anal fin 34–38 rays; pectoral fins 21–23 rays; caudal fin 14–16 rays. Body depth at dorsal-fin origin 21–23% SL; HL 26–32% SL; eye diameter 12–18% HL; snout length 14–16% HL; pectoral-fin length 62–68% HL. Pectoral-fin peduncle longer than deep, and fins reach anus; pelvic fins reach half way to anus in young, less in adults. Teeth present on vomer and palatines, in bands in adults. Branchiostegal rays 7; developed GR 4. Vertebrae 13–15 + 25–28 = 38–41.

Adults yellowish brown; juveniles yellowish. Attains 10 cm TL.



*Bidenichthys capensis*, 45 mm SL (South Africa). Source: SSF

**DISTRIBUTION** WIO: endemic to South Africa, from False Bay to Eastern Cape (East London).

**REMARKS** Found in tidepools and on rocky reefs to 33 m deep.

#### GENUS *Brosmophyciops* Schultz 1960

Eye diameter equal to or greater than snout length; scales imbricate, arranged in transverse rows; head naked; maxilla with rear-pointing spine at posteroventral corner. One species.

#### *Brosmophyciops pautzkei* Schultz 1960

Slimy cuskeel

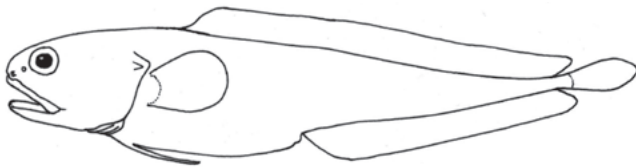
PLATE 43

*Brosmophyciops pautzkei* Schultz in Schultz *et al.* 1960: 386, Fig. 128 (lagoon at Arji I., Bikini Atoll, Marshall Is.); Cohen & Nielsen 1978\*; Dor 1984; Machida & Yoshino 1984\*; Winterbottom *et al.* 1989\*; Fricke 1999; Nielsen & Cohen 1999\*; Heemstra *et al.* 2004.



Diagnosis as for genus. Dorsal fin 76–84 rays; anal fin 55–62 rays; pectoral fins 23–29 rays; pelvic fins 1 ray, fins inserted under preopercle, their length variable but usually nearly as long as head; caudal fin 11 or 12 rays. Percentage SL: body depth 18–24%, HL 24–26%, predorsal length 27–31%, and preanal length 49–53%. Percentage HL: eye diameter 21–25%, snout length 10–15%, pectoral-fin length 63–69%, and pelvic-fin length 59–91%. Head ovoid; mouth subterminal; jaws slightly oblique, rear of upper jaw sheathed in fleshy fold. Teeth on jaws, vomer and palatines conical, curved backwards. Tongue with slender, anterior, prow-like extension. Anterior nostrils with small tube. Tip of chin with pair of pores. Opercle spine strong, rounded in cross-section. Branchiostegal rays 7, gill membranes free of isthmus, uniting under middle of eye or slightly behind it; developed GR 2 or 3; pseudobranchial filaments 2, reduced. Lateral line of free neuromasts obscure, midlateral, complete to tail tip. Scales small, cycloid; head naked; transverse body scale rows 72–80; oblique scales rows 20–22 from dorsal-fin base to anal-fin origin. Intromittent organ of males a short penis with fleshy, triangular hood. Pyloric caeca 2, reduced. Vertebrae 12 or 13 + 33–37 = 46–50.

Body and head brownish red, belly silvery; fins pale red; eyes black. Attains 7.5 cm TL.



*Brosmophyciops pautzkei*, 53 mm SL (Chagos).

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea to South Africa (Sodwana Bay), Madagascar, Comoros, Mascarenes, Chagos and Maldives; elsewhere to Indonesia, Japan, Marshall Is., Australia, Tonga and Pitcairn Is.

**REMARKS** Found from the intertidal zone to ~54 m deep on reefs.

## GENUS *Grammonus* Gill 1896

Body scales imbricate, head partially naked; no palatine teeth; tongue with anterior, prow-like projection; GR 8; lateral line of papillae in 2 rows; precaudal vertebrae 12. Moderately sized (to 19 cm), in tropical and subtropical seas, usually on reefs, in caves or over rubble areas. Reviewed by Cohen (1964) under a previous name, *Oligopodus* Risso 1810, a misspelling

of *Oligopodus* Lacepède 1800 (cf. *Pteraclis velifera* of family Bramidae). Seven species, 2 in WIO.

### KEY TO SPECIES

- |    |  |                      |
|----|--|----------------------|
| 1a | Dorsal fin 61–65 rays; anal fin 44–47 rays; pectoral fins 21–23 rays; vertebrae 41 or 42 ..... | <i>G. opisthodon</i> |
| 1b | Dorsal fin 75–87 rays; anal fin 50–62 rays; pectoral fins 23–25 rays; vertebrae 46 .....       | <i>G. robustus</i>   |

## *Grammonus opisthodon* Smith 1934

Bighead brotula

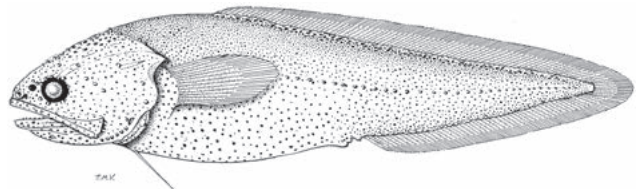
PLATE 43

*Grammonus opisthodon* Smith 1934: 92, Pl. 6, Fig. B (Port Alfred, Eastern Cape, South Africa); Nielsen & Cohen 1999\*.

*Grammonoides opisthodon*: Smith 1949\*; SFSA No. 1016\*; SSF No. 98.8\*.

Dorsal fin 61–65 rays; anal fin 44–47 rays; pectoral fins 21–23 rays; caudal fin 8 rays. Percentage SL: body depth 20–22%, HL 26–27%, predorsal length 35–37%, preanal length 56–58%, pre-pelvic length 20–21%, pectoral-fin length 16–17%, and pelvic-fin length 10–15%. Percentage HL: eye diameter 17–20%, snout length 20–22%. Rear margin of upper jaw expanded, with 2 small spines at posteroventral corner in holotype, single spine in smaller specimens; vomerine teeth 4–8, in 2 patches. Branchiostegal rays 8 (not 6 as stated in Smith 1934); developed GR 3. Lateral line of minute papillae in 2 rows. Scales minute, deciduous, absent in specimens <4 cm SL; LSS ~75–80. Intromittent organ of males a slender genital papilla between pair of blade-like pseudoclaspers. Vertebrae 13 + 28 or 29 = 41 or 42.

Body dark brownish purple, juveniles paler; body peppered with large melanophores, including head and pectoral-fin bases; pectoral-fin bases bright red. Attains 5 cm TL.



*Grammonus opisthodon*, 45 mm SL, holotype (South Africa). Source: SSF

**DISTRIBUTION** South Africa: from off Camps Bay in southeastern Atlantic, to Eastern Cape (Port Alfred) in WIO.

**REMARKS** Rare; known from littoral areas to 33 m deep.

**Grammonus robustus** Smith & Radcliffe 1913

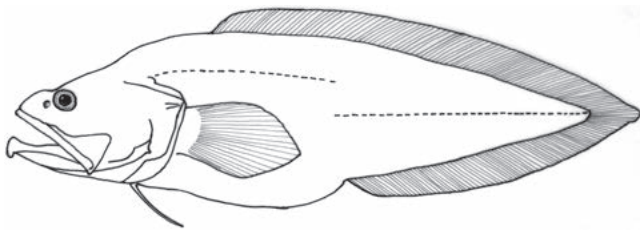
Humpback brotula

PLATE 43

*Grammonus robustus* Smith & Radcliffe in Radcliffe 1913: 168, Pl. 13, Fig. 4 (between Cebu and Leyte islands, Philippines); Norman 1939; Kamohara 1954\*; Nielsen & Cohen 1999; Manilo & Bogorodsky 2003.  
*Bythites lepidogenys* (non Smith & Radcliffe 1913): Kamohara 1952.  
*Oligopus robustus*: Cohen 1964; Cohen & Nielsen 1978.

Dorsal fin 75–87 rays; anal fin 50–62 rays; pectoral fins 23–25 rays; caudal fin 8 rays. Percentage SL: body depth 25–30%, HL 26–31%. Percentage HL: eye diameter 10–18%, snout length 19–23%, pectoral-fin length 59–70%, and pelvic-fin length 40–42%. Rear margin of upper jaw greatly expanded, with single spine at posteroventral corner; vomerine teeth present. Branchiostegal rays 8; developed GR 3. Lateral line of minute papillae in 2 rows, interrupted above anus. Scales minute, deciduous; oblique scale rows 12 from lateral line to dorsal-fin origin [holotype], 27 to anal-fin origin; LSS 75–85. Vertebrae 46 [holotype].

Body dark reddish brown, abdomen indigo, and fins blackish brown. Attains 23 cm TL.



*Grammonus robustus*, 21 cm SL (Japan). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea; elsewhere, East China Sea, Philippines and Japan.

**REMARKS** Rare; found on mud bottom, at 45–345 m.

**GENUS** *Microbrotula* Gosline 1953

Branchiostegal rays 7; caudal fin 6–9 rays; scales on head on cheek, occiput and opercle; antrorse spines at lower end of preopercle, covered with skin; anterior nostrils above upper lip; pectoral-fin peduncle short; precaudal vertebrae 11–13. Dwarf-sized (to ~6 cm SL) of Indo-Pacific reefs and reef rubble areas. Schwarzahns & Nielsen (2011) synonymised *Microbrotula polyactis* Anderson 2005 from Australia with *M. bentleyi* Anderson 2005 from WIO. Despite few morphological differences between the nominal forms, an ocean between their

distributions with great expanses of unsuitable habitat and their benthic lifestyle suggests the two may be cryptic species, requiring further genetic study to resolve their status. Seven or 8 species, 1 in WIO.

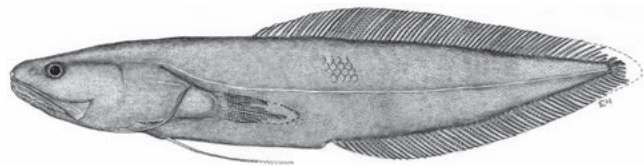
**Microbrotula bentleyi** Anderson 2005

PLATE 43

*Microbrotula bentleyi* Anderson 2005: 36, Fig. 1 (Aliwal Shoal, KwaZulu-Natal, South Africa); Schwarzahns & Nielsen 2011.

Dorsal fin 61–70 rays; anal fin 50–57 rays; pectoral fins ~15–17 rays, fins on short peduncle deeper than long; pelvic fins jugular, with 1 ray; caudal fin 7 or 8 rays. Percentage SL: body depth 13–17%, HL 28–29%, predorsal length 36–41%, and preanal length 50–52%. Percentage HL: eye diameter 11–14%, snout length 17–20%, pectoral-fin length 48–53%, and pelvic-fin length 28–68%. Head elongate, depressed; mouth subterminal, slightly oblique; rear of upper jaw sheathed in fleshy fold. Teeth on jaws, vomer and palatines minute, conical. Tip of tongue pointed. Opercle spine strong but completely embedded in skin; preopercle with antrorse spine at lower angle. Tip of snout, interorbital area and lower jaw with low sensory papillae. Lateral line mediolateral, with 8 low papillae anteriorly, followed by obscure free neuromasts. Branchiostegal rays 7, gill membranes free of isthmus, uniting behind eyes; no pseudobranch; developed GR 3. Scales moderate, cycloid, absent on head between and below eyes and snout; transverse body scale rows 54 or 55; oblique scales rows 16 from dorsal-fin base to anal-fin origin. Intromittent organ of males a conical papilla. Pyloric caeca 2. Vertebrae 11 or 12 + 33–35.

Body uniformly pale brown or grey; fins transparent pinkish. Attains ~4.5 cm TL.



*Microbrotula bentleyi*, 41 mm SL, female holotype (South Africa). Source: Anderson 2005

**DISTRIBUTION** WIO: Gulf of Aqaba (northern Red Sea) and South Africa (Aliwal Shoal).

**REMARKS** Solitary; inhabits protected reef crevices, at 9–55 m. Data here are from six specimens from WIO, corrected from Anderson (2005).

**GLOSSARY**

**antrorse** – pointing or curving anteriorly, specifically spines or fin elements.  
**imbricate** – overlapping evenly.  
**pseudoclasper** – an accessory male copulatory organ, inserted into the female during spawning.

**FAMILY DINEMATICHTHYIDAE**

**Viviparous brotulas**

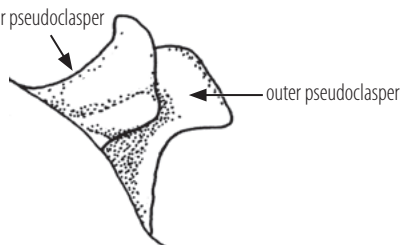
M Eric Anderson and Daniel M Cohen

Body moderately elongate, compressed posteriorly; caudal fin free from dorsal and anal fins. Pelvic fins present. Two pairs of nostrils. GR 0–7, elongate. Scales usually present. Males with hardened (sclerified or ossified) pseudoclaspers, 1 or 2 (rarely 3) pairs in cavity covered by a fleshy hood. Gonads bilobed. Swimbladder present.

Mostly found in tropical Indo-Pacific; benthic, cryptic inshore fishes. Adult size ranges from 22–197 mm SL. Of no commercial interest. Twenty-six genera, with 114 species worldwide (Møller *et al.* 2016); 5 genera and 10 species in WIO.

**KEY TO GENERA**

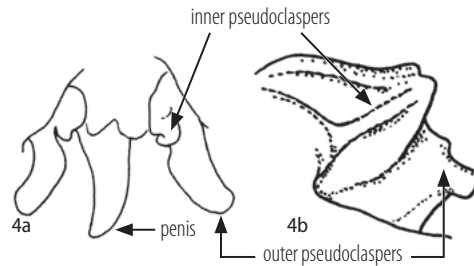
- 1a Anterior nostrils about midway between margin of eyes and upper lip; no upper preopercular pore ..... *Dinematichthys*
- 1b Anterior nostrils just above upper lip; upper preopercular pore present ..... 2
- 2a End of upper jaw not posteroventrally expanded ..... *Dermatopsoides*
- 2b End of upper jaw expanded ..... 3
- 3a Precaudal vertebrae 12; males with 2 pairs of pseudoclaspers, simple, similar in size ..... *Majungaichthys*
- 3b Precaudal vertebrae 11; outer pair of pseudoclaspers larger than inner pair ..... 4



Continued ...

**KEY TO GENERA**

- 4a Vertebrae 11 + 28–31; males with 2 pairs of pseudoclaspers, outer pair flap-like, smaller than inner pair which are broad, with 3 ridges (anteriorly, mesially and posteriorly), hidden in pocket of wide isthmus ..... *Mascarenichthys*
- 4b Vertebrae 11 + 31–35; outer pair of pseudoclaspers hook-like, much larger than inner pair ..... *Diancistrus*



Diagrams redrawn from Schwarzahns & Möller 2007

**GENUS *Dermatopsoides* Smith 1948**

Opercle spine embedded; maxilla not expanded posteroventrally; male pseudoclaspers simple, stick-like. Reviewed by Møller & Schwarzahns (2006). Four species, 3 of these endemic to temperate waters off South Africa, in southeastern Atlantic and/or WIO.

**KEY TO SPECIES**

- 1a No scales; pelvic fins not reaching beyond pectoral-fin tips; dorsal fin 60–86 rays; anal fin 36–59 rays; pectoral fins 16–19 rays ..... 2
- 1b Scales present; pelvic fins reach beyond pectoral-fin tips; dorsal fin 93–100 rays; anal fin 70 or 71 rays; pectoral fins 22–24 rays ..... *D. kasougae*
- 2a GR 17; dorsal fin 60–67 rays; anal fin 40–45 rays; pectoral-fin length 12–13% SL; vertebrae 37–40 ..... *D. talboti*
- 2b GR 10–14; dorsal fin 80–86 rays; anal fin 51–59 rays; pectoral-fin length ~10% SL; vertebrae 43 or 44 ..... *D. andersoni*

*Dermatopsoides andersoni*

Møller &amp; Schwarzahns 2006

Anderson's mud Brotula

PLATE 44

*Dermatopsoides andersoni* Møller & Schwarzahns 2006: 57, Figs. 12–13 (Algoa Bay, Eastern Cape, South Africa).

Dorsal fin 80–86 rays; anal fin 51–59 rays; pectoral fins 16–19 rays; pelvic fins 1 ray. Percentage SL: body depth 10–11%, HL 20–21%, pectoral-fin length ~10%, pelvic-fin length 11–12%, predorsal length 24–27%, preanal length 49–54%, eye diameter 1–2%, and snout length ~5%. Branchiostegal rays 6; GR 10–14. No scales. Vertebrae 43 or 44.

Head and body crimson, abdomen bluish grey, and unpaired fins pale red. Attains at least 6 cm SL.



*Dermatopsoides andersoni*, head (left) and male genital area showing pseudocaspers (right) (South Africa). Source: Møller & Schwarzahns 2006

**DISTRIBUTION** Known only from three specimens found in South Africa: records from Saldanha Bay in southeastern Atlantic, and Algoa Bay (Eastern Cape) in WIO.

**REMARKS** Taken from littoral areas.

*Dermatopsoides kasougae* (Smith 1943)

Orange Brotula

PLATE 44

*Dermatopsis kasougae* Smith 1943: 72, Fig. 3 (Kasouga River mouth, Eastern Cape, South Africa).

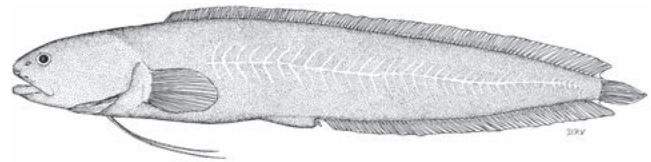
*Dermatopsoides kasougae*: Smith 1949; SFSA No. 1011\*; Cohen 1966; Cohen & Nielsen 1978; SSF No. 98.5\*; Nielsen & Cohen 1999; Møller & Schwarzahns 2006\*.

Dorsal fin 93–100 rays; anal fin 70 or 71 rays; pectoral fins ~22–24 rays; pelvic fins 1 ray; caudal fin 16 rays. Percentage SL [holotype]: body depth 16%, HL 24%, pectoral-fin length 12%, pelvic-fin length 19%, predorsal length 26%, preanal length 50%, and pre-pelvic length 17%. Percentage HL: eye diameter 13%, snout length 19%. Branchiostegal rays 6; GR 12 or 13, uppermost rakers on lower limb poorly developed. Scales minute, non-imbricate and embedded; sparse on nape. Vertebrae 46 or 47.

Colour in life salmon pink. Attains at least 6.5 cm TL.



*Dermatopsoides kasougae*, lower jaw (left) and male genital area (right) (South Africa). Source: Smith 1943



*Dermatopsoides kasougae*, 63 mm SL, holotype (South Africa). Source: SSF

**DISTRIBUTION** Known only from three type specimens collected from South Africa.

**REMARKS** Taken from littoral zone at a river mouth.

*Dermatopsoides talboti* Cohen 1966

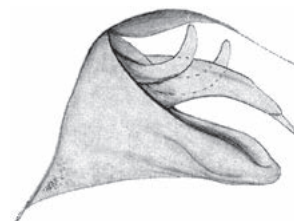
Lesser orange Brotula

PLATE 44

*Dermatopsoides talboti* Cohen 1966: 195, Fig. 5 (Bird I., Algoa Bay, South Africa); Cohen & Nielsen 1978; SSF No. 98.6\*; Nielsen & Cohen 1999\*; Møller & Schwarzahns 2006\*.

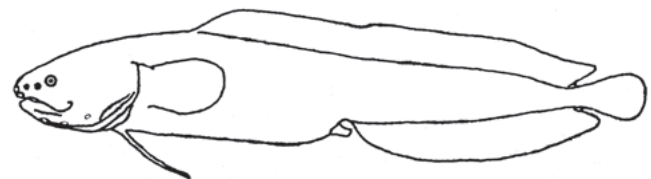
Dorsal fin 60–67 rays; anal fin 40–45 rays; pectoral fins 17 or 18 rays; pelvic fins 1 ray; caudal fin 15 or 16 rays. Percentage SL: body depth 12–13%, HL 22–27%, pectoral-fin length 12–13%, pelvic-fin length 11–15%, predorsal length 31–33%, preanal length 54–59%, eye diameter 1–2%, and snout length 5–6%. Branchiostegal rays 6; GR 17. No scales. Vertebrae 37–40.

Colour in life orangish. Attains at least 5.5 cm TL.



*Dermatopsoides talboti*, 40 mm SL, holotype and male genital area with hood pushed slightly forward (South Africa).

Source: Cohen 1966; © Proc. Biol. Soc. Wash., Allen Press Publ. Services





**DISTRIBUTION** WIO: endemic to south coast of South Africa, from False Bay to Algoa Bay.

**REMARKS** Known only from six type specimens, collected from littoral areas.

## GENUS *Diancistrus* Ogilby 1899

Anterior nostrils closer to upper lip than to posterior nostrils; lower jaw with fang-like teeth posteriorly; pelvic fins 2 rays; precaudal vertebrae 11. Small-sized, reef- or lagoon-dwelling fishes of tropical Indo-Pacific. Previously known from a single, rare southwestern Pacific species (*Diancistrus longifilis*) until the group was revised by Schwarzhans *et al.* (2005); 27 species, plus possibly 3 undescribed species, 1 in WIO.

### *Diancistrus alleni*

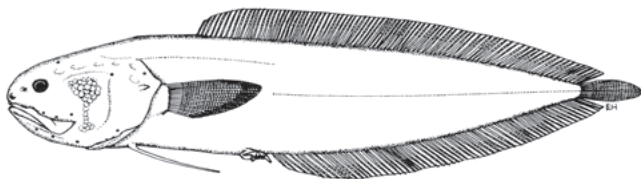
Schwarzhans, Møller & Nielsen 2005

Allen's coral brotula

*Diancistrus alleni* Schwarzhans, Møller & Nielsen 2005: 91, Figs. 9–11 (Lizard I., Queensland, Australia).

Dorsal fin 75–84 rays; anal fin 60–70 rays; pectoral fins 18–20 rays. Dorsal-fin origin above middle of pectoral fins; anal-fin origin in front of mid-TL. Percentage SL: body depth 17–21%, HL 25–29%, pectoral-fin length 14–20%, pelvic-fin length 18–28%, eye diameter 2–4%, interorbital width 4–8%, predorsal length 29–36%, and preanal length 43–57%. Total GR 13–18; pseudobranchial filaments 2. Outer pair of pseudoclaspers of males hook-like, tips bent outwards; inner pair connected to outer ones anteriorly. Vertebrae 11 + 31–35 = 42–45.

Colour in life unknown. Attains 7 cm SL.



*Diancistrus alleni*, ~50 mm SL, male. Source: based on Schwarzhans *et al.* 2005

**DISTRIBUTION** Indo-Pacific. WIO: Chagos and Maldives; elsewhere widespread to Indonesia, Australia, New Guinea, Vanuatu and Samoa.

**REMARKS** Solitary; inhabits coral-reef crevices.

## GENUS *Dinematichthys* Bleeker 1855

Anterior nostrils midway between upper lip and posterior nostrils, which are adjacent to eyes; scales on cheek, occiput and opercle; cirri present on snout; males with 2 pairs of small pseudoclaspers; precaudal vertebrae 10–12. Small-sized, cryptic, on shallow tropical and subtropical reefs of Indo-Pacific. Revised by Møller & Schwarzhans (2008). Two species, 1 in WIO.

### *Dinematichthys ilucoeteoides* Bleeker 1855

Yellow pygmy brotula

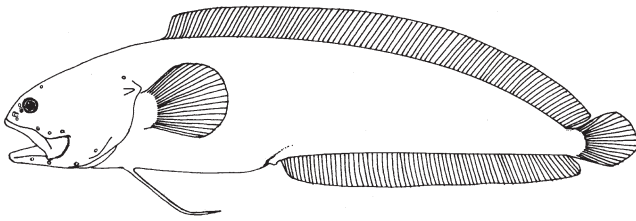
PLATE 44

*Dinematichthys ilucoeteoides* Bleeker 1855: 319 (Batu Is., western Sumatra, Indonesia); Smith & Smith 1963\*; Wourms & Bayne 1973; Winterbottom *et al.* 1989\*; Carpenter *et al.* 1997\*; Møller & Schwarzhans 2008\*; Fricke *et al.* 2009.

*Dinematichthys indicus* Machida 1994: 451, Figs. 1–3 (Chagos); Winterbottom & Anderson 1997; Nielsen & Cohen 1999; Heemstra *et al.* 2004; Schwarzhans *et al.* 2005.

Dorsal fin 75–92 rays; anal fin 59–71 rays; pectoral fins 21–24 rays; caudal fin 15 or 16 rays; pelvic-fin ray extends beyond anal-fin origin in juveniles, to just before anus in adults. Percentage SL: body depth 16–21%, HL 26–31%, predorsal length 29–32%, and preanal length 44–54%. Percentage HL (from Machida 1994): eye diameter 11–13%, snout length 9–24%, pectoral-fin length 54–61%, and pelvic-fin length 87–109%. Head ovoid, more rounded in larger fish; mouth terminal; jaws slightly oblique, rear of upper jaw not sheathed in fleshy fold. Teeth on jaws, vomer and palatines curved inwards. Opercle spine strong, mostly embedded in skin in larger fish. Anterior nostrils in very short tube. Tip of snout with short fringe of irregular papillae; tip of chin without pair of pores. Lateral line mediolateral, obscure. Branchiostegal rays 7, gill membranes free of isthmus, uniting well behind eyes; developed GR 3 or 4; pseudobranchial filaments 2, reduced. Scales small, cycloid, overlapping and extensive, present on head except between and below eyes and snout; transverse body scale rows 85–100; oblique scales rows 21 or 22 from dorsal-fin base to anal-fin origin. Intromittent organ of males with complex internal and external pseudoclaspers. Pyloric caeca 2, reduced. Vertebrae 10–12 + 30–34 = 41–45.

Colour variable, from uniformly yellow, reddish orange or pale brown; head whitish dorsally in some larger specimens; fins transparent in young. Attains 12 cm SL.



*Dinematchthys iluocoeteoides*, 90 mm SL (Chagos). Drawn from a photograph

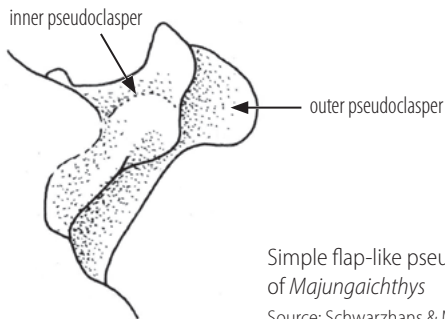
**DISTRIBUTION** Indo-Pacific (widespread). WIO: Persian/Arabian Gulf, Oman, Red Sea, East Africa to South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Mascarene Ridge, Mascarenes, Chagos and Maldives; elsewhere to Indonesia, Taiwan, southern Japan, Micronesia, Wake Atoll, Australia, New Caledonia, Tonga and Samoa.

**REMARKS** Found on reefs, at 1–26 m.

## GENUS *Majungaichthys*

Schwarzahns & Møller 2007

Tiny (to ~4 cm SL); head with scale patch on cheeks only, no scales on opercle; intromittent organ of males with 2 pairs of small pseudoclaspers, both simple and flap-like; total vertebrae 42–44; precaudal vertebrae 12. Two species, both in WIO.



Simple flap-like pseudoclasper of *Majungaichthys*  
Source: Schwarzahns & Møller 2011

### KEY TO SPECIES

- 1a Dorsal fin 71–75 rays; first ray of anal fin below dorsal-fin rays 20–21; distance from pelvic-fin base to anal-fin origin 25.5–28% SL ..... *M. agalegae*
- 1b Dorsal fin 78 or 79 rays; first ray of anal fin below dorsal-fin ray 24; distance from pelvic-fin base to anal-fin origin 30–30.5% SL ..... *M. simplex*

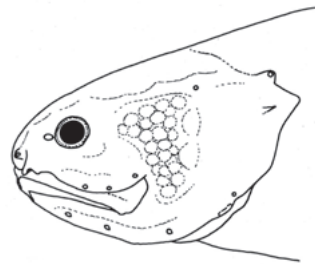
## *Majungaichthys agalegae*

Schwarzahns & Møller 2011

*Majungaichthys agalegae* Schwarzahns & Møller 2011: 167, Figs. 8–9 (Nosy Fisaka, northwestern Madagascar).

Dorsal fin 71–75 rays; anal fin 55–62 rays; pectoral fins 18 rays; caudal fin 15 rays. Percentage SL [holotype]: body depth 17%, HL 26%, predorsal length 31%, preanal length 47%, upper jaw 13%, and pectoral-fin length 17%. Head ovoid; mouth terminal; rear margin of upper jaw squared off and sheathed in fleshy flap. Anterior nostrils above thin upper lip. Opercular spine mostly hidden, with exposed tip. GR 16 (anterior arch [1 specimen]). Scale rows on cheek 6–8. Vertebrae 12 + 30–32 = 42–44.

Colour in life unknown. Attains at least 4 cm SL.



*Majungaichthys agalegae*, 40 mm SL, holotype (Madagascar).  
Source: Schwarzahns & Møller 2011

**DISTRIBUTION** WIO: Madagascar and Mauritius (Agaléga Is.).

**REMARKS** Known only from six specimens, collected on coral reefs to ~5 m deep.

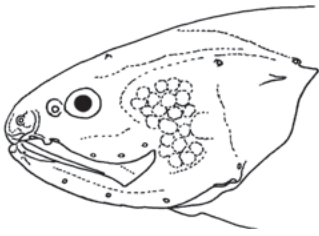
## *Majungaichthys simplex* Schwarzahns & Møller 2007

*Majungaichthys simplex* Schwarzahns & Møller 2007: 75, Figs. 30–31

(Chesterfield I., off northern Madagascar); Schwarzahns & Møller 2011.

Dorsal fin 78 or 79 rays; anal fin 58 or 59 rays; pectoral fins 20 rays; caudal fin 14 rays. Percentage SL: body depth 16–17%, HL 24–26%, predorsal length 30–33%, preanal length 47–50%, upper jaw ~13%, and pectoral-fin length 15–17%. Head ovoid; mouth terminal; rear margin of upper jaw squared off. Anterior nostril just above upper lip. Opercle spine with free tip; scale rows on cheek 7 or 8; GR (anterior arch) 13–15 (3 elongate). Vertebrae 12 + 31 or 32 = 43 or 44.

Colour in life unknown. Attains at least 4 cm SL.



*Majungaichthys simplex*, 37 mm SL, holotype (Madagascar).  
Source: Schwarzahns & Møller 2007



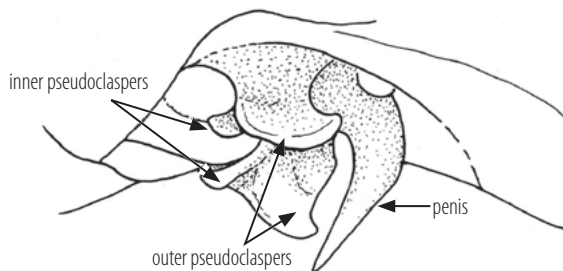
**DISTRIBUTION** WIO: northwestern Madagascar and tentatively Mauritius.

**REMARKS** Known from few specimens.

## GENUS *Mascarenichthys*

Schwarzahns & Møller 2007

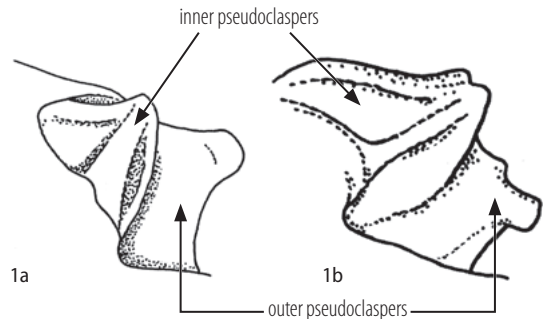
Intromittent organ of males with 2 pairs of pseudoclaspers, inner pair broad with 3 ridges (in anterior, posterior and mesial directions) and hidden under wide fleshy isthmus, tip of penis hooked; branchiostegal rays 6 or 7; scales on head on cheeks only; total vertebrae 39–43; precaudal vertebrae 11 or 12. Very small-sized (to ~5 cm SL). Intertidal and shallow subtidal brotulas of WIO: 2 tropical species and 1 from single warm-temperate locality.



Male intromittent organ of *Mascarenichthys remotus*  
Source: Schwarzahns & Møller 2011

### KEY TO SPECIES

- 1a Eye diameter 1.5–3.2% SL; pectoral fins 16–18 rays; outer pseudoclaspers of males longer than inner ..... 2  
1b Eye diameter 0.8–1.2% SL; pectoral fins 19 rays; outer pseudoclaspers of males shorter than inner .....  
..... *M. microphthalmus*



- 2a Eye diameter 1.5–2.7% SL; dorsal fin 62–73 rays; anal fin 46–56 rays; pectoral fins 16–18 rays ..... *M. heemstrai*  
2b Eye diameter 2.9–3.2% SL; dorsal fin 76 or 77 rays; anal fin 62 or 63 rays; pectoral fins 19 or 20 rays ..... *M. remotus*

Diagrams redrawn from Schwarzahns & Møller 2011

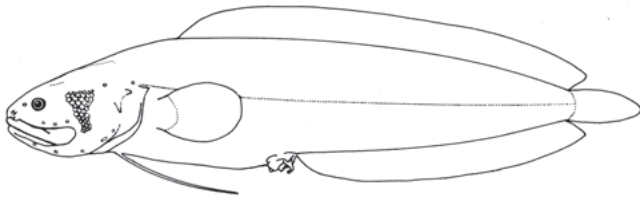
## *Mascarenichthys heemstrai*

Schwarzahns & Møller 2007

*Mascarenichthys heemstrai* Schwarzahns & Møller 2007: 78, Figs. 32–33 (Anonyme I., Mahé, Seychelles); Fricke *et al.* 2009; Schwarzahns & Møller 2011.

Dorsal fin 62–73 rays; anal fin 46–56 rays; pectoral fins 16–18 rays; caudal fin 15 or 16 rays. Percentage SL: body depth 13–19%, HL 23–28%, predorsal length 29–36%, preanal length 44–52%, upper jaw 11–14%, pectoral-fin length 12–16%, and eye diameter 1.5–2.7%. Head ovoid, mouth terminal; rear margin of upper jaw rounded. Anterior nostrils just above upper lip. Opercle spine with free tip. GR (anterior arch) 13–18 (3 elongate). Scale rows on cheek 5–7 (above line through infraorbital pores) + 3 or 4 (below line through infraorbital pores). Males with outer pair of pseudoclaspers flap-like with pointed tips, slightly longer than inner pair. Vertebrae 11 + 28–31 = 39–42.

Body dull yellow. Attains at least 5 cm SL.



*Mascarenichthys heemstrai*, ~45 mm SL, male (Seychelles). Composite

**DISTRIBUTION** WIO: Mozambique, Seychelles, Réunion, Mauritius and St Brandon Shoals.

**REMARKS** Known from intertidal zone and back-reef lagoons, to ~2 m deep.

### *Mascarenichthys microphthalmus*

Schwarzahns & Møller 2007

*Mascarenichthys microphthalmus* Schwarzahns & Møller 2007: 81, Figs. 34–35 (Bird I., Algoa Bay, Eastern Cape, South Africa); Schwarzahns & Møller 2011.

Dorsal fin 67–69 rays; anal fin 52–55 rays; pectoral fins 19 rays; caudal fin 16 rays. Percentage SL: body depth 12–13%, HL 24–25%, predorsal length ~31%, preanal length ~48%, upper jaw 12–13%, pectoral-fin length 13–14%, and eye diameter 0.8–1.2%. Head ovoid, mouth terminal; rear margin of upper jaw rounded. Anterior nostrils just above upper lip. Opercle spine with free tip. GR (anterior arch) 14 or 15 (3 elongate). Scale rows on cheek 6 + 3. Males with outer pair of pseudoclaspers shorter than inner pair. Vertebrae 11 + 29 or 30 = 40 or 41.

Colour in life unknown. Attains at least 4 cm SL.



*Mascarenichthys microphthalmus*, 40 mm SL, male holotype (South Africa). Source: head from Schwarzahns & Møller 2007

**DISTRIBUTION** Known only from two type specimens collected from South Africa.

**REMARKS** Taken from a subtidal area.

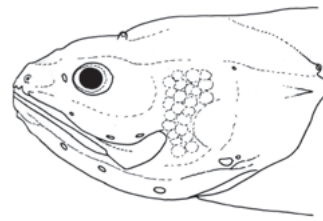
### *Mascarenichthys remotus*

Schwarzahns & Møller 2011

*Mascarenichthys remotus* Schwarzahns & Møller 2011: 170, Figs. 11–12 (Rivière Banane, Rodrigues I., western Mascarenes).

Dorsal fin 76 or 77 rays; anal fin 62 or 63 rays; pectoral fins 19 or 20 rays. Percentage SL: body depth 14–15%, HL 25–26%, predorsal length 31–32%, preanal length 46–47%, upper jaw ~13%, pectoral-fin length 16–17%, and eye diameter 2.9–3.2%. Head ovoid; mouth terminal; rear margin of upper jaw irregularly rounded, ensheathed. Anterior nostrils just above upper lip. Opercular spine with free tip. GR (anterior arch) 14 or 15. Scale rows on cheek 4 + 2. Males with outer pair of pseudoclaspers flap-shaped, bent laterally, with pointed tips; inner pair small, narrow, anteriorly inclined, not hidden below isthmus. Vertebrae 12 + 30 or 31 = 42 or 43.

Colour in life unknown. Attains at least 3 cm SL.



*Mascarenichthys remotus*, 30 mm SL, holotype (Rodrigues). Source: Schwarzahns & Møller 2011

**DISTRIBUTION** Known only from two type specimens collected from Rodrigues.

**REMARKS** Taken from a coral reef at 21–22 m.



# ORDER BATRACHOIDIFORMES

David W Greenfield

The order Batrachoidiformes comprises the single family Batrachoididae and was long considered to be most closely related to the order Lophiiformes (including goosefishes, frogfishes and deepsea anglers). However, recent molecular and anatomical studies have suggested relationships with other diverse sister groups, particularly the suborder Callionymoidei (dragonets) of the order Perciformes.

## FAMILY BATRACHOIDIDAE

### Toadfishes

David W Greenfield

Small- to medium-sized (~6–57 cm SL) with large, broad, flattened head and tapering body. Mouth wide, terminal, usually with barbels and/or fleshy flaps around it; teeth moderately strong in jaws and on roof of mouth. Eyes on top of head and directed upwards. Spines present on opercle and often subopercle (always in WIO species). Two separate dorsal fins: 1st dorsal fin immediately behind head, with 2 or 3 spines often hidden in thick skin (3 short, strong spines in WIO species); 2nd dorsal fin long-based, with 15–25 soft rays (17–24 rays in WIO species). Anal fin shorter than 2nd dorsal fin, with 12–28 soft rays (13–18 rays in WIO species). Pectoral fins large with broad base. Pelvic fins jugular, with 1 spine, 3 soft rays. Glandular tissue may be present in opercular region, on pectoral-fin rays and membranes, and/or pectoral-fin axil. Lateralis system very well-developed, with 1–3 lines, and each pore usually with a small tentacle on each side. Skin with small embedded cycloid scales or naked. Species of *Porichthys* (New World) have photophores (light organs) along their sides and ventral surface. Species in the subfamily Thalassophryinae (New World) have hollow venomous spines in the 1st dorsal fin and on the opercle. Swimbladder well-developed and used for sound production in many species. Vertebrae 25–47. Usually drab-coloured, often brownish and with darker saddles, bars or spots, although a few species are brightly coloured. Eye diameter is that of the exposed iris; counts of LL pores are difficult to determine due to extreme wrinkling of the skin and thus may be underestimated.

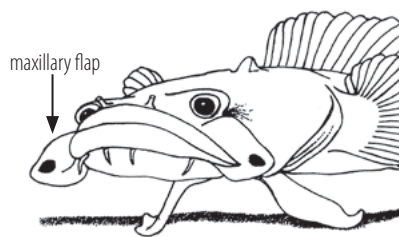
Usually found in marine habitats, but some species move into brackish or freshwater habitats, and some New World species are confined to freshwater. Bottom-dwelling, ranging from littoral areas to deep water (at least 366 m). They often

hide in sediment or rock crevices, and are ambush predators that feed mainly on molluscs, crustaceans and fishes, and some feed on sea urchins; species of *Porichthys* are known to feed in the water column at night.

Twenty-three genera and 83 described species, divided into 4 subfamilies: Porichthyinae (*Porichthys* with 14 species, and *Aphos* with 1 species) and Thalassophryinae (*Daector* with 5 species, and *Thalassophryne* with 6 species) are the most derived and are restricted to the New World; Batrachoidinae, with 6 genera and 23 species, also occurs only in the New World; Halophryinae, with 13 genera and ~30 species, occurs in the Old World, except for the genus *Triathalassothia* with 2 species in southeastern South America. Nine genera and 17 species in WIO (all members of subfamily Halophryinae).

#### KEY TO GENERA

- |    |  |                        |
|----|--|------------------------|
| 1a | Body completely scaleless .....  | 2                      |
| 1b | Body with at least some scales (embedded and may be difficult to see) .....  | 7                      |
| 2a | Fleshy maxillary flap with eye spot on each side of mouth .....  | <i>Bifax</i>           |
| 2b | No maxillary flap at sides of mouth .....  | 3                      |
| 3a | No axillary foramen above pectoral fin .....   | 5                      |
| 3b | Axillary foramen at top of pectoral-fin axil .....   | 4                      |
| 4a | Cirri present over eyes; no long tentacle on anterior nostrils; no glandular tissue on head; HL <3 in SL .....                                       | <i>Colletteichthys</i> |
| 4b | No cirri over eyes; long tentacle present on anterior nostrils; glandular tissue on head and above eyes forming ridges; body long, HL >3 in SL ..... | <i>Austrobatrachus</i> |
| 5a | One or more cirri above each eye .....   | <i>Allenbatrachus</i>  |
| 5b | No cirri above eyes .....  | 6                      |



Continued ...

## KEY TO GENERA

- 6a Pelvic fins reach anus; eye diameter equal to or greater than fleshy interorbital width; head deep, ~1.5 in HL; LL pores 33–39 in upper series ..... *Chatrabus* [IN PART: *C. felinus*]
- 6b Pelvic fins not reaching anus; eye diameter less than interorbital width; head more flattened, its depth >2 in HL; LL pores 20–25 in upper series ..... *Batrachthys*
- 7a Two or 3 prominent multifid cirri above each eye ..... 8
- 7b No obvious cirri above eyes ..... 9
- 8a Scales on body extend forward to 1st dorsal-fin base; anterior nostril with single pointed tentacle; pectoral fins spotted; anal fin 13–15 rays ..... *Barchatus*
- 8b Scales restricted to rear half of body, deeply embedded and not obvious; anterior nostril with large tuft of tentacles; no spots on pectoral fins; anal fin 15–17 rays ..... *Riekertia*
- 9a Upper part of pectoral-fin axil with more or less funnel-shaped pocket ..... *Perulibatrachus*
- 9b No pocket on upper part of pectoral-fin axil .....  
..... *Chatrabus* [IN PART: *C. hendersoni* and *C. melanurus*]

## GLOSSARY

**foramen** – an opening through bone or tissue.

GENUS *Allenbatrachus* Greenfield 1997

Head moderately depressed, wider than deep, lower jaw protruding, and body compressed. Dorsal fin 3 robust spines without venom glands, 18–22 rays; anal fin 16–19 rays; pectoral fins 19–22 rays. Opercle with 3 spines, subopercle with 2 spines and 1 subopercular filament. Foramen on each side of dorsocranium behind eyes, bordering sphenotic and frontal bones. No foramen or shallow pit in pectoral-fin axil; accessory upper pectoral-fin radial totally ossified. No glandular tissue at pectoral-fin axil or on pectoral-fin rays or membranes. Gill opening extends down five-sixths of pectoral-fin base. Three lateral lines. No scales on body. Vertebrae 9 + 17–20 (including terminal caudal centrum). Three species, 1 in WIO.

*Allenbatrachus meridionalis*

Greenfield & Smith 2004

Madagascar toadfish

PLATE 44

*Allenbatrachus meridionalis* Greenfield & Smith 2004: 569, Figs. 1–5 (market at Maroantsetra, Madagascar); Greenfield *et al.* 2008.

Dorsal fin 3 spines, 22 rays; anal fin 19 rays; pectoral fins 19–22 rays. HL 2.5–3, head width 3.2–4, and head depth 4–6 in SL; eye diameter 4.1–7.3 in HL. Orbital cirri and maxillary barbels simple and pointed. Teeth sharp and pointed. LL pores 22–30 in upper series.

Head and body pale to dark brown, with irregular black blotches. Attains at least 20 cm SL.



*Allenbatrachus meridionalis*, 19 cm SL, paratype (Madagascar).

Source: Greenfield & Smith 2004 (by SG Monden); courtesy of CAS

**DISTRIBUTION** WIO: Madagascar and Réunion.

**REMARKS** Also found in estuaries and freshwater.

GENUS *Austrobatrachus* Smith 1949

Head moderately depressed, wider than deep, lower jaw protruding, and body compressed. Dorsal fin 3 robust spines without venom glands, 20–23 rays; anal fin 15–18 rays; pectoral-fins 18–21 rays. Opercle with 3 spines, subopercle with 1 spine and 2 subopercular filaments. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. No cirri over eyes. Anterior nostril with tentacle. No maxillary flap at sides of mouth. Axillary foramen at top of pectoral-fin axil; accessory upper pectoral-fin radial almost all cartilage with only small ossified area. Glandular tissue on head and above eyes, forming ridges; no glandular tissue on pectoral-fin rays or membranes. Gill opening extends below pectoral-fin base. Two lateral lines. No scales on body. Two species, both in WIO.

## KEY TO SPECIES

- 1a Body with dark brown or black spots on sides and at pectoral-fin bases; 2nd dorsal fin solid-coloured; snout length ~5% SL; eye diameter subequal to peduncle depth ..... *A. iselesele*
- 1b Body crossed with dark brown bars or blotches (no spots); 2nd dorsal fin crossed by pale lines; snout length ≤3% SL; eye diameter slightly greater than half peduncle depth .....  
..... *A. foedus*

## *Austrobatrachus foedus* (Smith 1947)

Puzzled toadfish

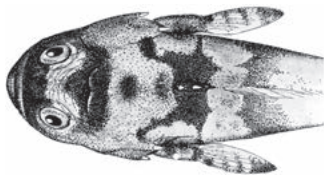
PLATES 44 & 45

*Pseudobatrachus foedus* Smith 1947: 820 (Great Kei River and Algoa Bay, South Africa).

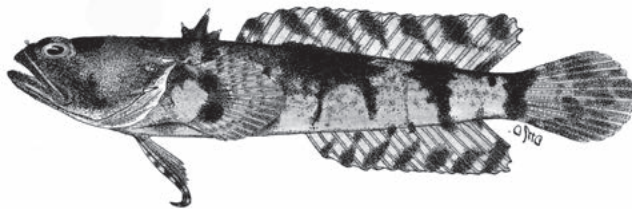
*Austrobatrachus foedus*: SSF No. 100.1\*; Greenfield 2006, 2012.

Dorsal fin 3 spines, 20 or 21 rays; anal fin 16 or 17 rays; pectoral fins 18–21 rays. HL ~3.3, head width ~4.2, and head depth ~6.7 in SL; eye diameter ~6 in HL. LL pores 48–55 in upper series.

Head and body yellowish brown, with dark brown bars or blotches (no spots); 2nd dorsal fin crossed by pale lines. Attains 27 cm TL.



*Austrobatrachus foedus*, 19 cm TL (South Africa). Source: SSF



**DISTRIBUTION** WIO: south coast of South Africa (Coffee Bay to Algoa Bay, Eastern Cape).

## *Austrobatrachus iselesele* Greenfield 2012

Zulu toadfish

PLATE 45

*Austrobatrachus iselesele* Greenfield 2012: 58, Figs. 1–5 (Park Rynie, KwaZulu-Natal, South Africa).

Dorsal fin 3 spines, 21–23 rays; anal fin 15–18 rays. HL 3.5–3.7, head width 3.2–3.5, and head depth 2.1–2.3 in SL; eye diameter 3.7–4.5 in HL. LL pores ~47 in upper series.

Head and body brown with greenish tinge; numerous small dark brown to black spots on sides, pectoral-fin bases, dorsum and along 1st dorsal-fin base; fins solid coloured. Attains at least 23 cm SL.



*Austrobatrachus iselesele*, 23 cm TL (South Africa).

AD Connell © NRF-SAIAB

**DISTRIBUTION** Known only from three specimens collected from South Africa.

**REMARKS** Taken from reef crevices. Feeds on whole molluscs.

## GENUS *Barchatus* Smith 1952

Head depressed, wider than deep, lower jaw protruding slightly, and body compressed. Dorsal fin 3 robust spines without venom glands, 17–20 rays; anal fin 13–15 rays; pectoral fins 24–27 rays. Opercle with 3 spines, subopercle with 2 spines and 2 subopercular filaments. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. Two or 3 large multifid cirri above each eye. Large, deep, funnel-shaped pit in upper portion of pectoral-fin axil, often with venetian-blind-like gland below; accessory upper pectoral-fin radial totally ossified. Gill opening extends far below pectoral-fin base, almost to pelvic fin. Body with scales. Two species, both in WIO.

### KEY TO SPECIES

- |    |   |                     |
|----|---|---------------------|
| 1a | Single large multifid tentacle above rear margin of each eye; anterior nostril wide at base and then tapering; dorsal fin 3 spines, 18 rays; anal fin 13 or 14 rays; pectoral fins 24 or 25 rays .....  | <i>B. cirrhosus</i> |
| 1b | Two tentacles (cirri) above each eye (anterior tentacle smaller, posterior tentacle larger); anterior nostril long and slender; dorsal fin 17 rays; anal fin 15 rays; pectoral fins 26 or 27 rays ..... | <i>B. indicus</i>   |

*Barchatus cirrhosus* (Klunzinger 1871)

Red Sea toadfish

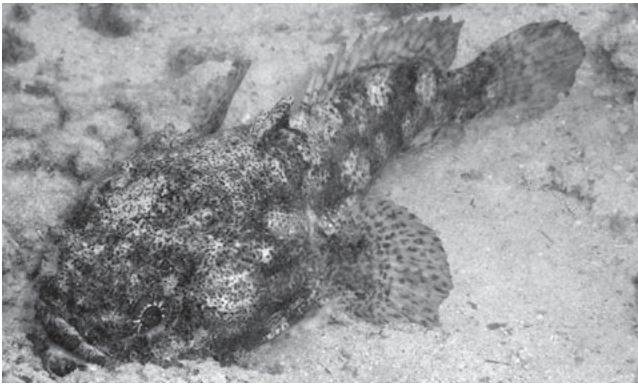
PLATE 45

*Batrachus cirrhosus* Klunzinger 1871: 500 (Al-Qusayr, Egypt, Red Sea); Greenfield *et al.* 2008; Greenfield 2014\*.

*Thalassothia cirrhosa*: Baranes & Golani 1993; Goren & Dor 1994.

Dorsal fin 3 spines, 18 rays; anal fin 13 or 14 rays; pectoral fins 24 or 25 rays. HL 2.1–2.2, head width 2.6–2.8, and head depth 3.9–4.1 in SL; eye diameter 4.2–7.6 in HL. Reticulated raised skin pattern just behind eyes and in interorbital space; 1 large tentacle above each eye; anterior nostril with 1 long, pointed tentacle. Scales on body extend forward to 1st dorsal-fin base.

Head and body whitish yellow, with irregular brown blotches; pectoral fins spotted. Attains 35 cm TL.



*Barchatus cirrhosus* (Red Sea). © A Ryanskiy

**DISTRIBUTION** WIO: Red Sea.

**REMARKS** Formerly incorrectly placed in genus *Thalassothia* Berg 1895, which is a synonym of the New World genus *Thalassophryne* Günther 1861 (Collette 1966).

*Barchatus indicus* Greenfield 2014

Somalian toadfish

PLATE 45

*Barchatus indicus* Greenfield 2014: 668, Figs. 1–5 (Gulf of Aden, Somalia).

Dorsal fin 3 spines, 17 rays; anal fin 15 rays; pectoral fins 26 or 27 rays. HL 2.2–2.3, head width 2.8–3.2, and head depth 4.1–4.2 in SL; eye diameter 4.8–5.4 in HL. Interorbital space smooth; 2 tentacles above each eye; anterior nostril long and pointed. Scales on body extend forward to 1st dorsal-fin base.

Head and body whitish yellow, with irregular brown blotches; pectoral fins spotted. Attains at least 16.5 cm SL.

**DISTRIBUTION** WIO: Gulf of Aden.

GENUS *Batrachthys* Smith 1934

Head moderately to greatly depressed, wider than deep, lower jaw not protruding, and body compressed. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. Dorsal fin with 3 robust spines without venom glands. Opercle with 3 spines, subopercle with 2 spines and 1 subopercle filament. No cirri above eyes. Accessory upper pectoral-fin radial either totally ossified (*B. albofasciatus*) or cartilaginous (*B. apiatus*). No foramen, shallow pit or glandular tissue in pectoral-fin axil; glandular tissue present on pectoral-fin membranes. Pelvic fins not reaching anus. Gill opening extends below pectoral-fin base. Three lateral lines. No scales on body. Two species, both in WIO; *Batrachthys felinus* Smith 1952 was moved to *Chatrabus* by Greenfield *et al.* (2008).

## KEY TO SPECIES

- 1a Network of fine skin ridges dorsally on head, most prominent between eyes; head very depressed, its depth ~10 in SL ..... *B. apiatus*
- 1b No network of skin ridges dorsally on head; head less depressed, its depth ~7.1 in SL ..... *B. albofasciatus*

*Batrachthys albofasciatus* Smith 1934

White-ribbed toadfish

PLATE 45

*Batrachthys albofasciatus* Smith 1934: 99, Pl. 5, Fig. B (Great Fish Point, Eastern Cape, South Africa); SSF No. 100.2\*; Greenfield *et al.* 2008.

Dorsal fin 3 spines, 19 rays; anal fin 14 rays; pectoral fins 20 rays. Head depressed, its depth 2.1 in HL, 7.1 in SL; head width 3.3 in SL; HL 3.4 in SL; eye diameter less than fleshy interorbital width. LL pores 23 in upper series.

Head and body pale brown, with scattered dark blotches, and narrow vertical white bars on rear half of body. Attains at least 12 cm TL.

**DISTRIBUTION** Known only from two specimens from South Africa: the holotype from Great Fish Point, and another from Hluleka, Transkei region, Eastern Cape.

*Batrachthys apiatus* (Valenciennes 1837)

Snakehead toadfish

PLATE 45

*Batrachus apiatus* Valenciennes *in* Cuv. & Val. 1837: 477 (Cape of Good Hope, South Africa).



*Amphichthys ophiocephalus* Smith 1947: 819 (Port Alfred to Great Kei River, South Africa).

*Gymnobatrachus ophiocephalus*: SFSA No. 1216\*.

*Batrachthys apiatus*: SSF No. 100.3\*; Greenfield *et al.* 2008.

Dorsal fin 3 spines, 18–21 rays; anal fin 14–18 rays; pectoral fins 16–19 rays. Head greatly depressed, its depth ~3 in HL, and ~10 in SL; HL ~3 in SL; head width ~4.3 in SL; eye diameter ~5.5 in HL, and less than interorbital width. Network of fine skin ridges dorsally on head, most prominent between eyes. LL pores 19–25 in upper series.

Head and body pale tan, crossed with distinctive dark brown bars. Attains ~9 cm TL.



*Batrachthys apiatus*, 8 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: endemic to South Africa, from Saldanha Bay in southeastern Atlantic, to Mthatha River (Eastern Cape).

**REMARKS** Found in the intertidal zone and brackish river mouths.

**GENUS** *Bifax* Greenfield, Mee & Randall 1994

Body compressed; head greatly depressed, with wide flat frontal bones sloping downwards anteriorly to fuse with vomer; lower jaw protruding. Dorsal fin 3 robust spines without venom glands, 23 or 24 rays; anal fin 15–18 rays; pectoral fins 20 or 21 rays. Opercle with 3 spines, subopercle with 1 spine and 1 subopercular filament. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. Accessory upper pectoral-fin radial totally ossified. Shallow pit above pectoral-fin axil; glandular tissue in pectoral-fin axil and on body under pectoral fins, but none on pectoral-fin rays or membranes. Gill opening extends well below pectoral-fin base, almost to pelvic-fin base. Two lateral lines. No scales on body. Vertebrae 29 or 30. One species.

*Bifax lacinia* Greenfield, Mee & Randall 1994

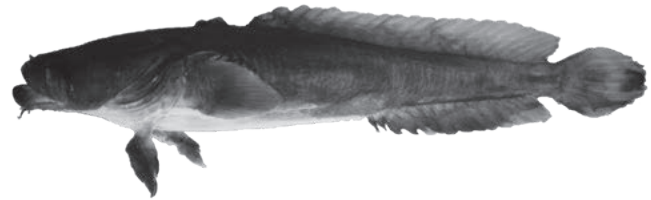
Two-faced toadfish

PLATE 45

*Bifax lacinia* Greenfield, Mee & Randall 1994: 278, Pls. 1–3 (Mahallah, Oman, Arabian Sea); Randall 1995\*; Manilo & Bogorodsky 2003; Greenfield *et al.* 2008.

Diagnosis as for genus. HL 2.7–4.3, head width 3.1–3.5, and head depth 6.3–8.3 in SL; eye diameter 5.9–9.3 in HL. Fleshy flap with eye spot present on each side of mouth, at rear end of maxilla. LL pores 47–56 in upper series.

Top of head and dorsum dark grey-brown, paler on sides; lower surface of head and belly white; tip of upper jaw yellow, and maxillary flaps bright yellow with black eye spot; dorsal fins, caudal fin, pectoral fins, pelvic-fin tips and anal-fin margin bright yellow. Attains 28 cm SL.



*Bifax lacinia*, 22 cm SL, holotype (Oman). © JE Randall, Bishop Museum

**DISTRIBUTION** WIO: Oman.

**REMARKS** Collected at ~6 m from crevices in rocky walls.

**GENUS** *Chatrabus* Smith 1949

Head slightly or moderately depressed, wider than deep, lower jaw slightly protruding, and body compressed. Dorsal fin 3 robust spines without venom glands, 18–23 rays; anal fin 14–18 rays; pectoral fins 21–25 rays. Opercle with 3 spines, subopercle with 2 spines and 2 or 3 subopercular filaments. Nasal barbels present. No tentacles over eyes. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. Accessory upper pectoral-fin radial completely ossified. No foramen, shallow pit or glandular tissue in pectoral-fin axil; glandular tissue present on pectoral-fin rays and membranes. Gill opening extends slightly below pectoral-fin base. One to 3 lateral lines. Scales present or absent. Vertebrae 29–32. Four species, 3 in WIO.

## KEY TO SPECIES

- |    |   |                      |
|----|---|----------------------|
| 1a | Body naked .....  | <i>C. felinus</i>    |
| 1b | Body with scales .....  | 2                    |
| 2a | Roof of mouth blackish; pectoral fins without dark markings; reticulated pattern of raised skin on snout and at front of interorbital space ..... | <i>C. hendersoni</i> |
| 2b | Roof of mouth white; pectoral fins with irregular dark bars; no raised reticulated skin on snout .....  | <i>C. melanurus</i>  |

*Chatrabus felinus* (Smith 1952)

Big-eye toadfish

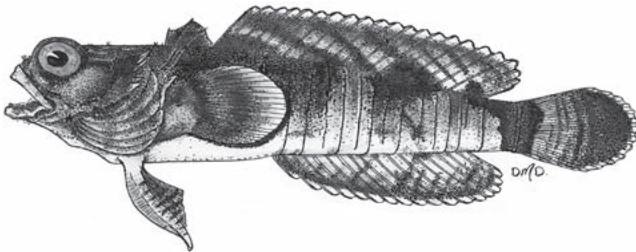
PLATE 46

*Batrachichthys felinus* Smith 1952: 320 (Port Alfred, Eastern Cape, South Africa); SSF No. 100.4\*.

*Chatrabus felinus*: Greenfield *et al.* 2008.

Dorsal fin 3 spines, 19–22 rays; anal fin 17 or 18 rays; pectoral fins 20–23 rays. HL ~3.4 in SL; head width ~3.4 in SL; head depth ~5.3 in SL, ~1.5 in HL; eye diameter ~3.2 in HL, and equal to or greater than interorbital width. LL pores 33–39 in upper series.

Head and body brown, with darker blotches forming irregular crossbars on sides; pectoral fins and caudal fin occasionally with dusky crossbars. Attains 19 cm TL.



*Chatrabus felinus*, 18 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: endemic to south coast of South Africa (Cape Agulhas, Western Cape, to Port Alfred, Eastern Cape).

*Chatrabus hendersoni* (Smith 1952)

Chocolate toadfish

PLATE 46

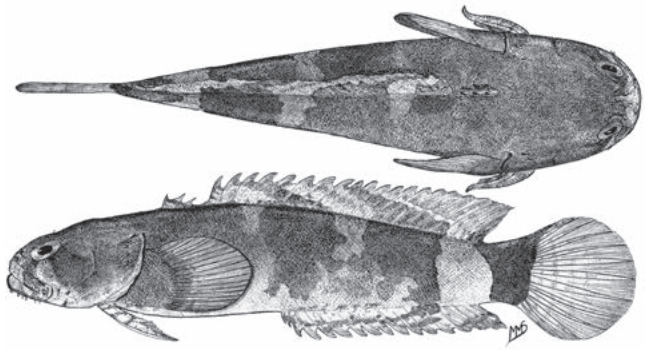
*Tharbacus hendersoni* Smith 1952: 336, Fig. 3 (Algoa Bay, South Africa).

*Chatrabus hendersoni*: SSF No. 100.5\*; Greenfield *et al.* 2008.

Dorsal fin 3 spines, 20–23 rays; anal fin 17 or 18 rays; pectoral fins 22–25 rays. HL 3.1–3.8, head width 3.8–4.1, and head depth 5.5–6.4 in SL; eye diameter 3.4–4.4 in HL. Squamation

variable, but often with scales forward onto head and in front of pelvic fins. LL pores 36–42 in upper series.

Head dark brown, and body brown with 3 or 4 darker crossbars; reticulated pattern of raised tissue on snout and interorbital space; pectoral fins yellow-orange; caudal fin orange-brown, without dark markings; roof of mouth blackish. Attains 22 cm TL.



*Chatrabus hendersoni*, 19 cm TL, holotype (South Africa). Source: SSF

**DISTRIBUTION** WIO: endemic to south coast of South Africa (Algoa Bay to Storms River mouth, Eastern Cape).

*Chatrabus melanurus* (Barnard 1927)

Humpback toadfish

PLATE 46

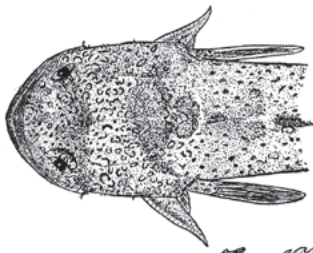
*Batrachoides melanurus* Barnard 1927: 78 (Agulhas Bank to KwaZulu-Natal, South Africa); also Barnard 1927: 994, Pl. 37, Fig. 1.

*Tharbacus vanecki* Smith 1952: 333, Fig. 2 (Port Alfred, Eastern Cape, South Africa).

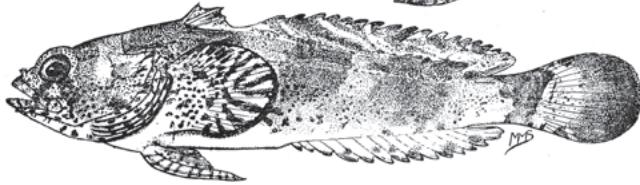
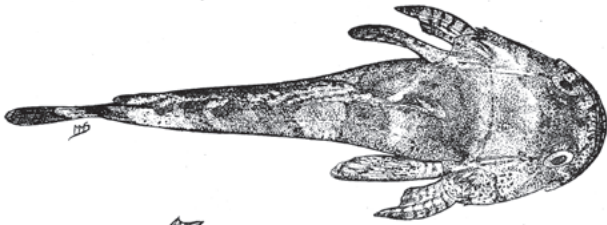
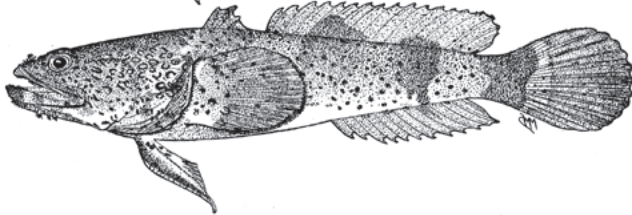
*Chatrabus melanurus*: SSF No. 100.6\*; Greenfield *et al.* 2008.

Dorsal fin 3 spines, 20 or 21 rays; anal fin 15–17 rays; pectoral fins 21–25 rays. HL 2.8–3.1, head width 3.5–4.3, and head depth 4.6–5.8 in SL; eye diameter 3.1–3.6 in HL. No reticulated pattern of raised skin on snout and interorbital space. Squamation variable, but often without scales anterior to dorsal fin and pelvic fins. LL pores 33–41 in upper series.

Body buff, crossed by 4 dark brown to black bars, and top of head dark brown to black; ventral surface and roof of mouth white; dorsal fins and anal fin also buff, with irregular oblique brown bars; pectoral fins with dark spots or bands; pelvic fins white, crossed by ~10 dark brown bars; caudal fin brown with white margin. Attains 26 cm TL.



*Chatrabus melanurus*, 25 cm TL, holotype of *C. damaranus*, dorsal head and lateral view (Namibia). Source: SSF



*Chatrabus melanurus*, 18 cm TL, holotype of *Tharbacus vanecki*, dorsal and lateral views (South Africa). Source: SSF

**DISTRIBUTION** Southern Africa: Angola in southeastern Atlantic, to South Africa (Port St Johns, Eastern Cape) in WIO.

**REMARKS** Type specimens collected at 46–183 m.

**GENUS** *Colletteichthys* Greenfield 2006

Head moderately depressed, wider than deep, lower jaw protruding, body compressed. Dorsal fin 3 robust spines without venom glands, 19 or 20 rays; anal fin 14–16 rays; pectoral fins 20–24 rays. Opercle with 3 spines, subopercle with 1 short spine (but often with small second point below it) and 2 subopercular filaments. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. Accessory upper pectoral-fin radial totally ossified. Funnel-shaped pit at top of pectoral-fin axil, with glandular tissue extending from ventral margin of pit into axil. No glandular tissue on pectoral-fin rays or membranes. Gill opening extends well below lower pectoral-fin base. Three lateral lines. No scales on body. Vertebrae 27. Three species, possibly all in WIO.

**KEY TO SPECIES**

- 1a Two or 3 tentacles (cirri) above each eye ..... *C. dussumieri*
- 1b Single tentacle above each eye ..... 2
- 2a Anal fin with usually 16 rays; dorsal fin usually 20 rays; all fins yellow ..... *C. flavipinnis*
- 2b Anal fin with usually 15 rays; dorsal fin usually 19 rays; fins grey and crossed with white lines ..... *C. occidentalis*

*Colletteichthys dussumieri* (Valenciennes 1837)

Flat toadfish

PLATE 46

*Batrachus dussumieri* Valenciennes in Cuv. & Val. 1837: 474, Pl. 367 (Malabar coast, India).

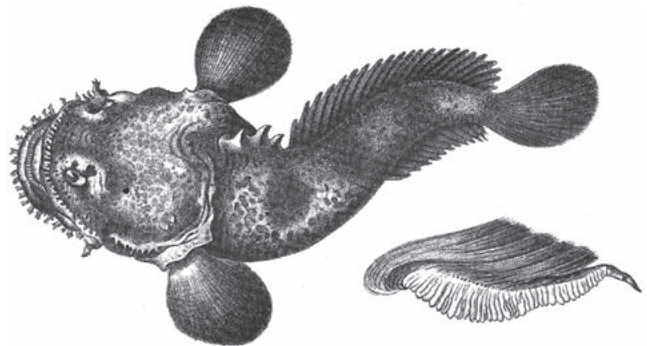
*Austrobatrachus dussumieri*: Menon 1963; Hutchins 1981, 1984;

Randall 1995\*; Carpenter *et al.* 1997; Manilo & Bogorodsky 2003.

*Colletteichthys dussumieri*: Greenfield 2006, 2012; Greenfield *et al.* 2008, 2012.

Dorsal fin 3 spines, 20 rays; anal fin 15 or 16 rays. HL 2.4–2.9, head width 3–3.4, and head depth 4.3–5.5 in SL; eye diameter 3.4–4.8 in HL. Two or 3 tentacles over each eye. Funnel-shaped pit at top of pectoral-fin axil, and glandular tissue in axil. LL pores 43–53 in upper series.

Head and body brown, shading to white ventrally; dark brown blotches on head, near 1st dorsal fin, on caudal peduncle, and larger band under 2nd dorsal fin; fins brown with darker markings. Attains 27 cm TL.



*Colletteichthys dussumieri*, dorsal view and pelvic fin detail. Source: Cuvier & Valenciennes 1837

**DISTRIBUTION** WIO: southwestern India.

**REMARKS** Previously often placed in genus *Austrobatrachus*.



*Colletteichthys flavipinnis*

Greenfield, Bineesh &amp; Akhilesh 2012

Yellowfin toadfish

PLATE 46

*Colletteichthys flavipinnis* Greenfield, Bineesh & Akhilesh 2012: 24, Figs. 1–3, 6–7 (off Thoothukudi, India).

Dorsal fin 3 spines, 19 or (usually) 20 rays; anal fin 14–16 (usually 16) rays; pectoral fins 20–22 rays. HL 2.5–2.8, head width 3.2–3.7, and head depth 4.4–5.1 in SL; eye diameter 4.1–5.8 in HL. Single tentacle over each eye. LL pores 38 in upper series.

Body pale brown background, with dark brown to black markings; all fins yellow. Attains at least 13.5 cm SL.

**DISTRIBUTION** Indian Ocean: off Thoothukudi area of southeastern India and adjacent Jaffna area of Sri Lanka.

*Colletteichthys occidentalis* Greenfield 2012

Arabian toadfish

PLATE 46

*Colletteichthys occidentalis* Greenfield 2012: 65, Figs. 3–4 (Bahrain Harbour, Persian/Arabian Gulf).*Austrobatrachus dussumieri* (non Valenciennes 1837): Hutchins 1984 [in part]; Randall 1995\* [in part]; Carpenter *et al.* 1997 [in part].

Dorsal fin 3 spines, 19 or 20 (usually 19) rays; anal fin 14 or (usually) 15 rays; pectoral fins 22–24 rays. HL 2.4–2.8, head width 3–3.4, and head depth 3–4.7 in SL; eye diameter 4.3–6.1 in SL. Single tentacle over each eye. LL pores 32–39 in upper series.

Head and body pale brown, shading to white ventrally, with dark brown blotches on head and 4 irregular bars on body; fins grey, crossed by white lines. Attains at least 16 cm SL.

*Colletteichthys occidentalis*, 12 cm SL, holotype. © JE Randall, Bishop Museum

**DISTRIBUTION** WIO: Persian/Arabian Gulf (Jana I., Saudi Arabia) to Pakistan and India (Kutch District).

GENUS *Perulibatrachus* Roux & Whitley 1972

Head moderately depressed, wider than deep, lower jaw not protruding, and body compressed. Dorsal fin 3 robust spines without venom glands, 17–19 rays; anal fin 13–17 rays; pectoral fins 19–26 rays. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. Opercle with 3 spines, subopercle with 3 spines and 2 subopercular filaments. No cirri over eyes. Accessory upper pectoral-fin radial not ossified; more or less funnel-shaped pocket present in upper pectoral-fin axil. Glandular tissue present in pectoral-fin axil, and present or absent on pectoral-fin rays and/or membranes. Gill opening extends well below pectoral-fin base. One or 2 lateral lines. Body with scales. Vertebrae 26–29. Four species, possibly 2 in WIO.

## KEY TO SPECIES

- 1a Head wide, its width 2.3–2.4 in HL; eyes small, 5.2–5.9 in HL; funnel-shaped pocket of pectoral-fin axil shallow; pectoral fins 21–23 rays; dorsal fin 17 rays; anal fin 13 rays; body covered with many small dark spots; anterior nostril with 1 tentacle ..... *P. aquilonarius*
- 1b Head narrow, its width ~3.4 in SL; eyes large, ~2.8 in HL; funnel-shaped pocket of pectoral-fin axil deep; pectoral fins 19 rays; dorsal fin 18 rays; anal fin 14 rays; body without small dark spots, but crossed by 3 dark bars; anterior nostril with 2 major tentacles ..... *P. kilburni*

*Perulibatrachus aquilonarius* Greenfield 2005

Northern toadfish

PLATE 46

*Perulibatrachus aquilonarius* Greenfield 2005: 77, Fig. 1a–b (Ennur Fisheries Station, Chennai, India); Greenfield *et al.* 2008; Bineesh & Greenfield 2011\*.

Dorsal fin 3 spines, 17 or 18 rays; anal fin 13 rays; pectoral fins 21–23 rays. Head relatively wide: HL 2.2–2.4, head width 2.3–2.7, and head depth 3.4–3.9 in SL; eye diameter 5.2–5.9 in HL; interorbital space wide, ~4.9 in HL. Funnel-shaped pocket in pectoral-fin axil shallow. LL pores 36–41 in upper series.

Head and body pale brown, and body and fins covered with many small, irregularly shaped, dark brown spots. Attains 27 cm SL.





*Perulibatrachus aquilonarius*, 19 cm SL, holotype (India).  
Source: Greenfield 2005; courtesy of CAS

**DISTRIBUTION** Known only from two specimens from Indian Ocean: records from Chennai and Thoothukudi, India.

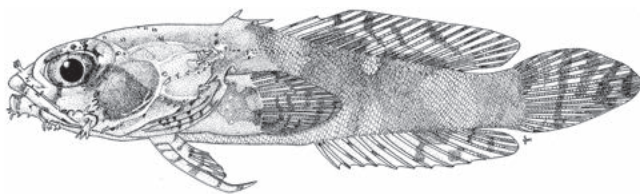
### *Perulibatrachus kilburni* Greenfield 1996

Kilburn's toadfish

*Perulibatrachus kilburni* Greenfield 1996: 902, Figs. 1–2 (off Kosi Bay, KwaZulu-Natal, South Africa); Greenfield 2005; Greenfield *et al.* 2008; Bineesh & Greenfield 2011.

Dorsal fin 3 spines, 18 rays; anal fin 14 rays; pectoral fins 19 rays. HL 2.4, head width 3.4, and head depth 3.9 in SL; eyes large, eye diameter 2.8 in HL; interorbital space narrow, 8.4 in HL. Funnel-shaped pocket in pectoral-fin axil deep. LL pores 36 in upper series.

Preserved specimen with cream background, 3 dark bars across body, and intensely white narrow interorbital bar. Attains 56 mm SL.



*Perulibatrachus kilburni*, 56 mm SL, holotype (South Africa).  
Source: Greenfield 1996 (by SG Monden)

**DISTRIBUTION** Known only from the holotype collected from South Africa.

**REMARKS** Taken at ~75 m, on coral rubble and sandstone bottom.

## GENUS *Riekertia* Smith 1952

Head depressed, wider than deep, lower jaw protruding slightly, and body compressed. Dorsal fin 3 robust spines without venom glands, 18–20 rays; anal fin 15–17 rays; pectoral fins 24 or 25 rays. Opercle with 3 spines, subopercle with 2 spines and 3 subopercular filaments. Dorsocranium completely covered by muscle, no exposed bone under skin; no foramen on dorsocranium. Two or 3 large multifid cirri above each eye. Accessory upper pectoral-fin radial cartilaginous; large, deep, funnel-shaped pit in upper portion of pectoral-fin axil, often with venetian-blind-like gland below it. Gill opening extends far below pectoral-fin base, almost to pelvic-fin base. Body with scales. One species.

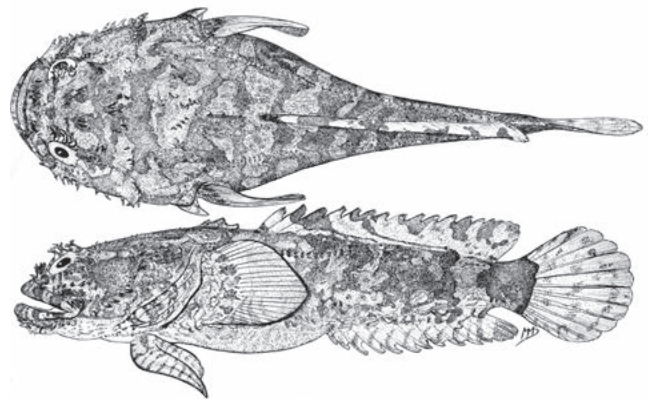
### *Riekertia ellisi* Smith 1952

Broadbodied toadfish

*Riekertia ellisi* Smith 1952: 325, Fig. 1 (Pondoland, Eastern Cape, South Africa); SSF No. 100.9\*; Greenfield *et al.* 2008.

Diagnosis as for genus. HL 2.5–2.8, head width 2.6–2.9, and head depth 4.7–5.2 in SL; eye diameter 5.1–5.5 in HL. Reticulated raised skin pattern in entire interorbital area; anterior nostril with large tuft of tentacles; 3 subopercular filaments. Scales on body restricted to rear, but deeply embedded and not obvious. Accessory pectoral-fin radial cartilaginous. Vertebrae 29.

Preserved specimens mostly dark brown, mottled with paler brown, and body crossed by 7–9 irregular indistinct dark bars; pectoral fins pale, tips partly dusky (no spots). Attains at least 29 cm TL.



*Riekertia ellisi*, 20 cm TL, holotype (South Africa). Source: SSF

**DISTRIBUTION** WIO: endemic to South Africa (Durban, KwaZulu-Natal, to Port St Johns, Eastern Cape).

# ORDER LOPHIIFORMES

Theodore W Pietsch

The highly specialised anglerfishes are so unusual among fishes that they can hardly be confused with anything else. With only a few exceptions, all recognised species are equipped with a dorsal-fin spine, placed on the head or tip of the snout, modified to serve as a luring apparatus. This highly mobile spine, the illicium (from the Latin *illici*, an enticement or decoy), bears a cutaneous structure at its tip, called the esca (Latin for food or bait). Depending on the species, the esca may be a simple fleshy swelling, a tuft of filaments, a cluster of worm-like appendages, or (in the case of deep-sea species) a complex bioluminescent organ containing light-emitting bacteria.

The body shape of anglerfishes is highly variable, ranging from elongate and depressed or flattened to globose and somewhat laterally compressed, but in all cases their appearance is closely related to their habitat and mode of feeding. Without the need for the usual streamlined shape of other fishes, most anglerfishes have short bodies and huge heads. While remaining perfectly motionless for long periods of time, with their body often mimicking a sponge, rock or piece of coral, they lie in wait for smaller fishes or invertebrates to pass by, while wriggling their illicium and esca to attract potential prey to their cavernous mouth. The mouth is enormous (except for ogocephalids, which have a small ventral mouth), the upper jaw more or less protrusile, and the gill cover greatly enlarged, although the gill openings are restricted to narrow, tube-like structures placed just below or behind the pectoral-fin bases. By extreme and sudden expansion of the mouth and gill cavity, followed by a sudden opening of the mouth, prey are easily captured in a single, instantaneous gulp. Along with a huge mouth, equipped with teeth that vary from small and villiform to extremely large and fang-like, most anglerfishes have a highly expansible throat and stomach, enabling them to engulf extremely large prey. They feed on other fishes and various crustaceans (crabs and shrimps). When full, the bulging belly adds to their grotesque appearance. The bottom-dwelling members of the order have especially large, flexible pectoral fins, set low on the body and mounted on unusually long bases, which are used to 'walk' along the substrate or clamber among rocks and coral. The skin is often covered with numerous close-set spines, warts, and cutaneous filaments or flaps. They range from brightly coloured with complex patterns to uniformly grey, brown or black.

The mode of reproduction is unique to this order. The ovaries, fused to one another at the midline, are either lobular or tightly rolled like a double scroll: species with scrolled

ovaries release numerous tiny eggs embedded in a large, buoyant, scroll-shaped mucous sheath, while those with lobular ovaries lay relatively large demersal eggs and generally provide some form of parental care. In the normally large-sized lophiids (monkfishes or goosefishes) the mucous sheath or so-called egg-raft may reach 12 m and contain more than 3 million eggs.

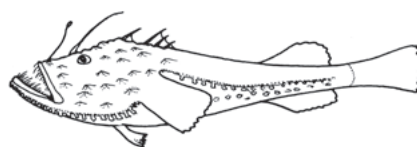
Anglerfishes occur worldwide in all temperate to tropical oceans and seas, where they occupy highly diverse habitats: benthic members range from the intertidal zone to abyssal depths exceeding 3 600 m, on muddy, sandy and rocky bottoms, or on coral and rocky reefs; pelagic species (deepsea Ceratioidei) are meso-, bathy- and abyssopelagic. Sexually mature adults range in size from 1.7 metres (40 kg) in the bottom-living lophiids to a mere 6.2 millimetres in some males of the pelagic Ceratioidei. Monkfishes and goosefishes are delicious eating and marketed either fresh or frozen; antennariids (frogfishes) are important in the aquarium trade. Of the anglerfish species on the IUCN Red List, *Lophius vomerinus* (Cape monkfish) of southern Africa is listed as Near Threatened, and *Brachionichthys hirsutus* (spotted handfish), of southern Australia and Tasmania, is assessed as Critically Endangered.

The order is divided into 5 suborders and comprises 18 families, with 65 genera and ~325 species; 9 families in WIO, but only 4 of these families with species known from depths of <200 m.

## KEY TO FAMILIES

### [All depths]

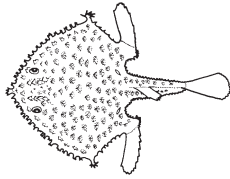
- 1a Pelvic fins present (may be withdrawn beneath skin in some chaunacids) ..... 2
- 1b No pelvic fins ..... 5
- 2a Head and body greatly depressed ..... 3
- 2b Head and body globose or slightly compressed laterally ..... 4
- 3a At least 3 free dorsal-fin spines on top of head; body naked; mouth very large, with long fang-like teeth ..... **LOPHIIDAE**



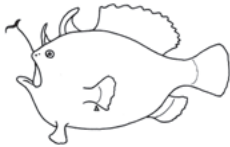
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## KEY TO FAMILIES

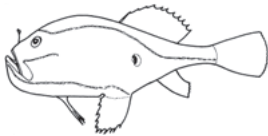
- 3b Single, short dorsal-fin spine (illicium) lying in cavity between eyes; body encased in armour of hard, spiny, consolidated scales; mouth small, inferior, with villiform teeth ..... **OGCOEPHALIDAE**



- 4a First spine of dorsal fin (illicium) elongate, usually with distinct esca but not fitting into a depression on snout; 2nd and 3rd spines of dorsal fin well-developed but covered by skin; cutaneous filaments or appendages nearly always present ..... **ANTENNARIIDAE**



- 4b First spine of dorsal fin (illicium) short and stubby, with esca fitting into U-shaped depression on snout; 2nd and 3rd spines of dorsal fin entirely hidden beneath skin; rough, loose skin covered with small spine-like scales ..... **CHAUNACIDAE**



- 5a Dorsal fin 12–17 rays (>3 times the number of anal-fin rays) ...  
..... **MELANOCETIDAE** [deep water]
- 5b Dorsal fin 4–8 rays ..... **6**
- 6a Mouth vertical to strongly oblique; 2 or 3 club-shaped caruncles (fleshy, wart-like glands) present on dorsal midline in front of soft-rayed dorsal fin ..... **CERATIIDAE** [deep water]
- 6b Mouth oblique to nearly horizontal; no fleshy wart-like caruncles on dorsal midline ..... **7**
- 7a Second spine of dorsal fin minute, hidden beneath skin of head ..... **8**
- 7b Second spine of dorsal fin well-developed, with light-bearing organ at tip, but retracted beneath the skin in larger specimens (>3 cm TL), with its presence indicated by a small pore ..... **DICERATIIDAE** [deep water]
- 8a Skin with large plate-like scales, each bearing a median spine (females), or dense layer of dermal spinules covering the skin (males) ..... **HIMANTOLOPHIDAE** [deep water]
- 8b Skin commonly smooth and naked or with scattered microscopic spinules ..... **ONEIRODIDAE** [deep water]

## FAMILY LOPHIIDAE

### Monkfishes

John H Caruso

Head and anterior part of body broad, strongly to moderately depressed, and rear part of body tapering. Bones on dorsal and lateral surfaces of head with numerous, prominent protuberances and short conical spines, prominent humeral spine anterodorsal to pectoral-fin base, and prominent frontal ridges between eyes. Skin smooth, very loose over body and underside of head; scaleless, except for inconspicuous lateral-line scales; dorsal surface usually with abundant fleshy tendrils or tassels, especially conspicuous on lateral margin of head and around lower jaw. Opercle greatly reduced, with rear part disappearing into loose skin. Dorsal fin divided into spinous cephalic and post-cephalic portions and a soft-rayed portion;

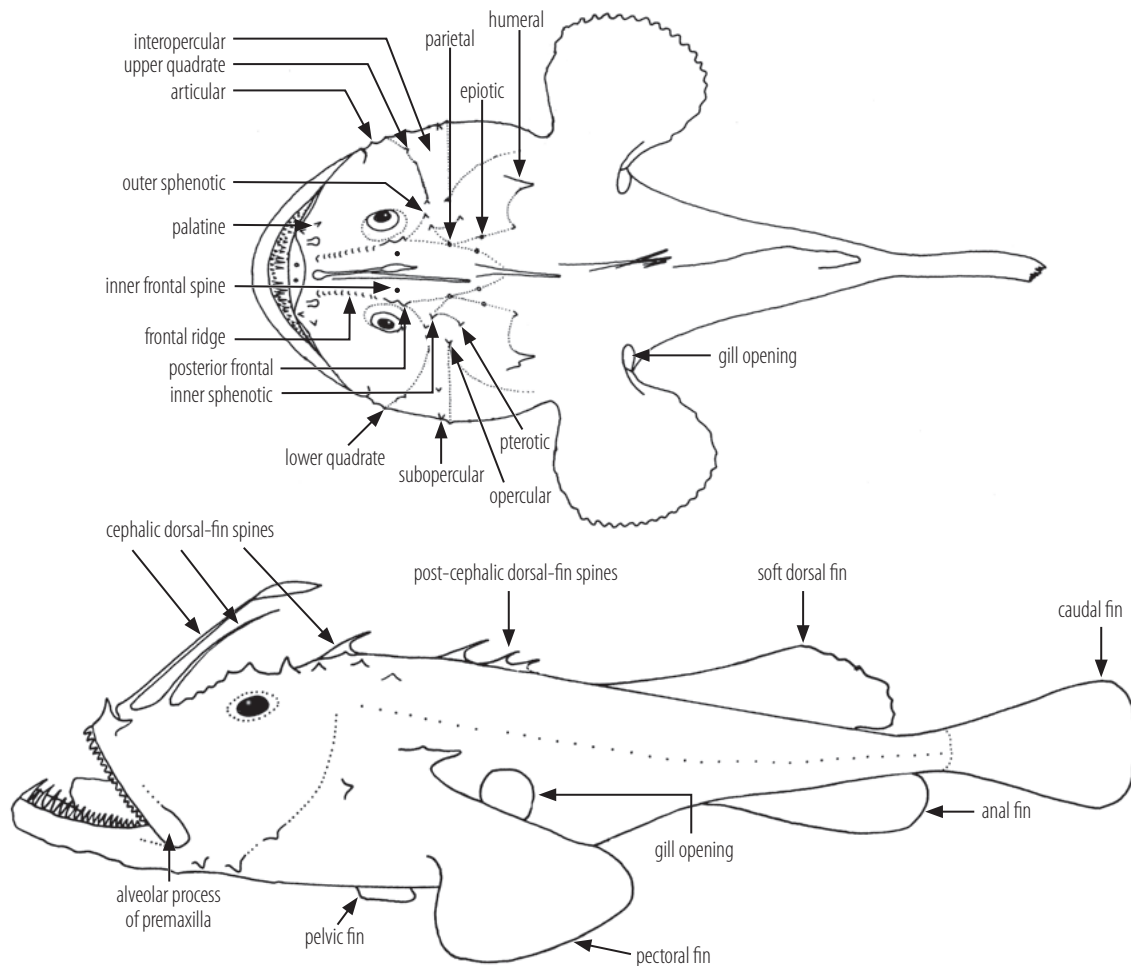
1–3 isolated cephalic dorsal-fin spines on head, the 1st spine modified as angling apparatus (illicium), usually with a fleshy esca at tip (used to attract prey); 1–3 relatively short post-cephalic dorsal spines connected by membrane behind head; soft dorsal fin with 8–12 rays on rear part of body. Anal fin with 6–10 rays, and fin located below soft dorsal fin. Pectoral fins attached to shoulder girdle by 2 greatly elongated arm-like radials. Pelvic fins small, on underside of head, anterior to pectoral fins. Caudal fin truncate, with 8 rays, outermost rays unbranched and other rays branched. Mouth enormous, with lower jaw projecting beyond upper jaw; several rows of long, slender, depressible fang-like teeth in lower jaw; strong fang-like teeth on palatines and medial portion of premaxilla; 1 row of small, fixed, recurved teeth on outer portion of premaxilla. Gill opening reduced, located near or just behind arm-like pectoral-fin base. Vertebrae 18–31.

Worldwide in all but polar seas; most species occur on the outer continental shelf and upper slope, at 25–1 500 m or more. Moderate- to large-sized, bottom-dwelling, sedentary

predators. Excellent to eat, and consequently some species are of considerable economic importance. Four genera and ~32 species; 3 genera and 5 species in WIO.

## KEY TO GENERA

- |   |  |
|---|--|
| <p>1a Head and body rounded, not depressed; no 3rd cephalic dorsal-fin spine, and no humeral, articular, quadrate and subopercle spines ..... <i>Sladenia</i> [not represented in WIO]</p> <p>1b Head and body depressed; 3rd cephalic dorsal-fin spine present, and humeral, articular, quadrate and subopercle spines present ..... 2</p>   | <p>3a Floor of mouth with distinct pattern of dark anastomosing lines or pale circles on dark background; frontal ridges and outer surfaces of maxilla and dentary covered with low conical spines; 1 (lower) quadrate spine; 2 interopercular spines; dorsal fin 8 rays; anal fin 6 rays; vertebrae 18 or 19 ..... <i>Lophiomus</i></p> <p>3b Floor of mouth either pale or dusky but without distinct colour pattern; frontal ridges covered with low rounded knobs and/or ridges, but outer surfaces of maxilla and dentary smooth; 2 (upper and lower) quadrate spines; 1 interopercular spine; dorsal fin 9–12 rays; anal fin 8–10 rays; vertebrae 26–31 ..... <i>Lophius</i></p> |
| <p>2a Frontal ridges smooth, not rugose; gill opening extending well in front of pectoral-fin base; 2 articular spines (1 anterior to and 1 posterior to jaw joint); single (inner) sphenotic spine ..... <i>Lophiodes</i></p> <p>2b Frontal ridges rugose, bearing low conical spines or rounded knobs and ridges; gill opening restricted to below and behind pectoral-fin base; 1 articular spine, anterior to jaw joint; 2 (inner and outer) sphenotic spines ..... 3</p> |  |



Dorsal and lateral views of a typical lophiid showing external features.



GENUS *Lophiodes* Goode & Bean 1896

Head and body moderately flattened; 2 articular spines (1 anterior to and 1 posterior to jaw joint). Additional characters, shared in part with other lophiid genera but forming a complex unique to *Lophiodes*, are: frontal ridges smooth, without raised knobs or spines; gill opening extending below, behind and partially in front of pectoral-fin base; 3 cephalic dorsal-fin spines; 0–3 post-cephalic dorsal-fin spines, some or all of which may be embedded; soft dorsal fin with 8 rays; anal fin 6 rays; inner sphenotic spine well-developed, outer sphenotic spine present as low rounded knob; epiotic spine rudimentary; 1 (lower) quadrate spine; 1 or 2 interopercular spines; humeral spine well-developed, but variable in shape; compound ural centrum round in cross-section and without transverse processes. Vertebrae 19. About 19 species, 3 in WIO.

KEY TO SPECIES

- 1a Dorsal fin 6 spines; supraorbital ridges strongly elevated and interorbital area strongly concave, forming deep U-shaped trough between eyes; inner sphenotic spine recurved; no inner frontal spine ..... 2
- 1b Dorsal fin <6 spines; supraorbital ridges not strongly elevated and interorbital area flat or slightly concave (no deep U-shaped trough between eyes); inner sphenotic spine straight, not recurved; inner frontal spine present ..... *L. mutilus*
  
- 2a Peritoneum pale ..... *L. gracilimanus*
- 2b Peritoneum black ..... *L. insidiator*

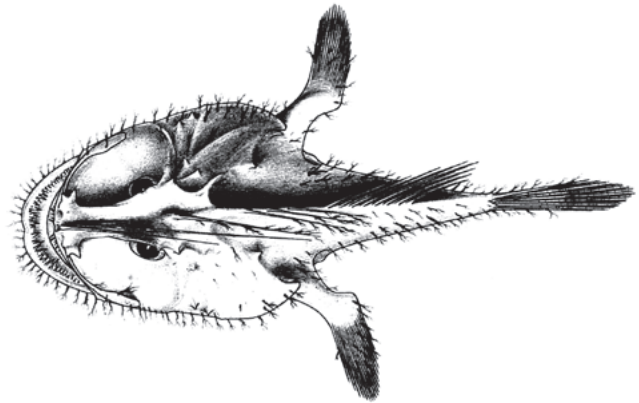
*Lophiodes gracilimanus* (Alcock 1899)

*Lophius gracilimanus* Alcock 1899: 54 (off Malabar coast, India); Alcock 1890\*.  
*Lophiodes gracilimanus*: Caruso 1981, 1999; Manilo & Bogorodsky 2003.

Dorsal fin 3 free cephalic spines + 3 joined post-cephalic spines, with tendrils present, and 8 rays; anal fin 6 rays; pectoral fins 14–16 rays. Snout narrow, 5.3–6.7 in HL. Times in SL: HL 2.2–2.8, illicium length 2.7–4.2, 2nd dorsal-fin spine 1.6–3.2, and 3rd dorsal-fin spine 2.3–3.2. When pulled back, 2nd dorsal-fin spine reaches to dorsal-fin spines 4 or 5; 3rd dorsal-fin spine reaches to base of soft dorsal fin. Supraorbital crests elevated and interorbital area strongly concave, forming deep U-shaped trough between eyes. Both sphenotic spines recurved, and distance between sphenotic spines (2.2–2.8 in HL) greater than distance between spines at rear of frontal (3–3.8 in HL); no inner frontal spine. Tendrils prominent on body, inconspicuous on head, and no tendrils on illicium.

When retracted, illicium reaches to between sphenotic and parietal spines; esca with pennant-like flap, long cirri, pale translucent bulb, and usually with dark, stalked, eye-like appendages. Teeth on alveolar process of premaxilla straight, not recurved.

Head, body and pectoral fins uniformly dark brown above, tendrils darker, and body only slightly paler below; ventral surface of pectoral fins darker distally, but ray tips pale; inside of mouth pale, except for dark patch behind lower pharyngeal tooth plates; illicium paler than head, and esca pale or translucent; peritoneum pale. Attains 16.5 cm TL.



*Lophiodes gracilimanus*, type (India). Source: Alcock 1900

**DISTRIBUTION** Indian Ocean. WIO: India (Malabar coast); elsewhere, Bay of Bengal and Indonesia.

**REMARKS** Inhabits tropical waters, at 125–300 m.

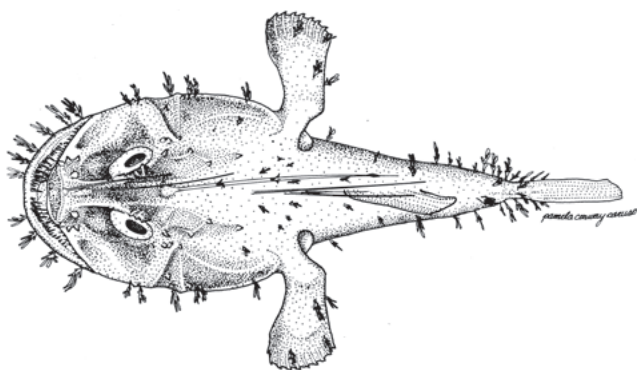
*Lophiodes insidiator* (Regan 1921)

Natal monkfish PLATE 47  
*Chirolophius insidiator* Regan 1921: 418 (off Umvoti River, KwaZulu-Natal, South Africa).  
*Chirolophius (Pyrenophorus) crosnieri* Le Danois 1975: 77, Figs. 52, 59 (western Somal Basin, northern Madagascar).  
*Chirolophius (Pyrenophorus) phycoides* Le Danois 1975: 82, Fig. 55 (Madagascar Basin, northwestern Madagascar).  
*Lophiodes insidiator*: Caruso 1981; SSF No. 101.1\*.

Dorsal fin 3 free cephalic spines + 3 joined post-cephalic spines, and 8 rays; anal fin 6 rays; pectoral fins 14–18 rays. Snout narrow, 5.5–5.9 in HL. Times in SL: HL 2.6–3, illicium length 2.8–5.6, 2nd dorsal-fin spine 2–3.8, and 3rd dorsal-fin spine 2.2–2.7. When pulled back, 2nd dorsal-fin spine reaches to between epiotic spines and end of neurocranium; 3rd spine reaches to between bases of dorsal-fin rays 1–4; 4th spine reaches to between bases of dorsal-fin rays 5–8; and 6th spine

reaches to base of soft dorsal fin. Supraorbital crests elevated and interorbital area strongly concave, forming deep U-shaped trough between eyes; each supraorbital ridge with up to 4 radial ridges in front of spines at rear of frontal. Both sphenotic spines recurved, and distance between sphenotic spines (1.9–2.3 in HL) greater than distance between spines at rear of frontal (2.8–3.3 in HL); no inner frontal spine. Numerous tendrils on lateral margins of head and body, on dorsal surface of pectoral fins, and on dorsal-fin spines 2–6. No tendrils on illicium, which when retracted reaches to between sphenotic spines and end of neurocranium; esca with pennant-like flap, long cirri, pale translucent bulb, and usually with dark, stalked, eye-like appendages. Teeth on alveolar process of premaxilla straight, not recurved.

Head, body and pectoral fins pale to dark brown above, paler below; membranes of soft dorsal fin and caudal fin unpigmented or faintly pigmented; anal fin slightly darker distally; inside of mouth pale, except for dark patch on floor of mouth behind lower pharyngeal tooth plates, and dark brown mottling on tongue; illicium paler than body; tendrils on dorsal-fin spines dark; peritoneum black. Attains 30 cm TL.



*Lophiodes insidiator*, 20 cm TL. Source: SSF (by PC Caruso)

**DISTRIBUTION** Possibly restricted to WIO: South Africa (KwaZulu-Natal) to Mozambique, Saya de Malha Bank and northern Madagascar.

**REMARKS** Known from 225–575 m.

### *Lophiodes mutilus* (Alcock 1894)

Smooth monkfish

PLATE 47

*Lophius mutilus* Alcock 1894: 179 [11] (Bay of Bengal, India); Alcock 1895\*.

*Lophius lugubris* Alcock 1894: 118 (west of Colombo lighthouse, Sri Lanka).

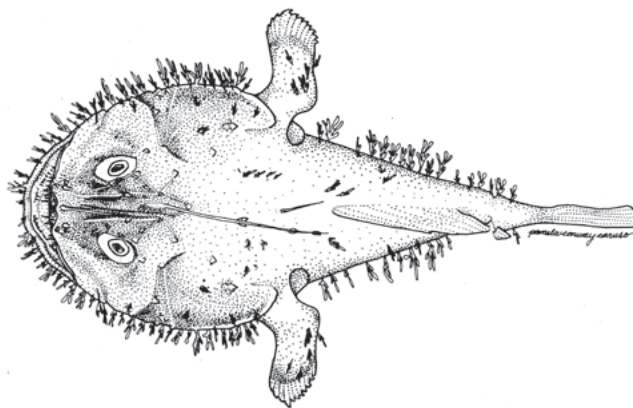
*Lophiodes mutilus*: Goode & Bean 1895; Caruso 1981, 1983;

SSF No. 101.2\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

*Lophiodes lugubris*: Goode & Bean 1895.

Dorsal fin 3 free cephalic spines + 2 joined post-cephalic spines, and 8 rays; anal fin 6 rays; pectoral fins 15–18 rays. Snout narrow, 5.1–6.2 in HL. Times in SL: HL 2.3–2.8, illicium length 2.8–4.2, 2nd dorsal-fin spine 3.3–4.9, and 3rd dorsal-fin spine 1.6–2.8. When pulled back, 2nd dorsal-fin spine short, reaches only to between parietal and epiotic spines; 3rd dorsal-fin spine long and stout, with numerous lateral pairs of small cirri, reaches to between middle of soft dorsal fin and base of caudal-fin rays; 4th dorsal-fin spine absent; 5th and 6th dorsal-fin spines slender and without cirri, one or both spines may be embedded. Supraorbital crests not strongly elevated and interorbital area not strongly concave (no deep U-shaped trough between eyes). Sphenotic spines straight, not recurved; distance between sphenotic spines (2.1–2.5 in HL) only slightly greater than distance between spines at rear of frontal (2.2–2.8 in HL); inner frontal spine present (usually reduced in size in large specimens). Illicium long and slender, without cirri, when retracted reaches to between parietal and epiotic spines; esca bulb-shaped, and without cirri or other appendages.

Colouration of head, body and dorsal surface of pectoral fins highly variable, pale to dark brown or grey dorsally, paler ventrally; pectoral fins darker distally, but ray tips pale; cirri on lateral margins of head and body and on 3rd dorsal-fin spine dark brown; illicium same as body colour or paler; esca pale; peritoneum dark. Attains 45 cm TL.



*Lophiodes mutilus*, 32 cm TL. Source: SSF (by PC Caruso)

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Somalia to South Africa (KwaZulu-Natal), Madagascar, Réunion and Sri Lanka; elsewhere to Andaman Is., Indonesia, Philippines, Taiwan, southern Japan, northern Australia, New Guinea, New Caledonia, Tasman Sea and Vanuatu.

**REMARKS** Known from 234–760 m.

## GENUS *Lophiomus* Gill 1883

Head and body strongly depressed; frontal ridges and outer surfaces of maxilla and dentary rough, covered with short conical spines; 2 interopercular spines. Additional characters, shared in part with other lophiid genera but forming a complex unique to *Lophiomus*, are: gill opening extends below and behind pectoral-fin base; dorsal fin 6 spines, cephalic and post-cephalic portions both well-developed; soft dorsal fin 8 rays; anal fin 6 rays; inner and outer sphenotic spines well-developed, and a third posteriormost sphenotic spine frequently present; epiotic spine well-developed; 1 articular spine, anterior to jaw joint; 1 (lower) quadrate spine; humeral spine well-developed and complex; compound ural centrum depressed, transverse processes present. Vertebrae 18 or 19. One species.

### *Lophiomus setigerus* (Vahl 1797)

Blackmouth anglerfish

PLATE 47

*Lophius setigerus* Vahl 1797: 215, Pl. 3, Figs. 5–6 (off China, Pacific Ocean).

*Lophius viviparus* Bloch & Schneider 1801: 142, Pl. 32 (off China, Pacific Ocean) [unexplained new name for *Lophius setigerus*].

*Lophiomus setigerus*: Gill 1883; Gilbert 1890 [non *Lophiomus setigerus*]; Jordan & Evermann 1898 [description of *Lophiodes caulinaris*]; SSF No. 101.3\*; Manilo & Bogorodsky 2003.

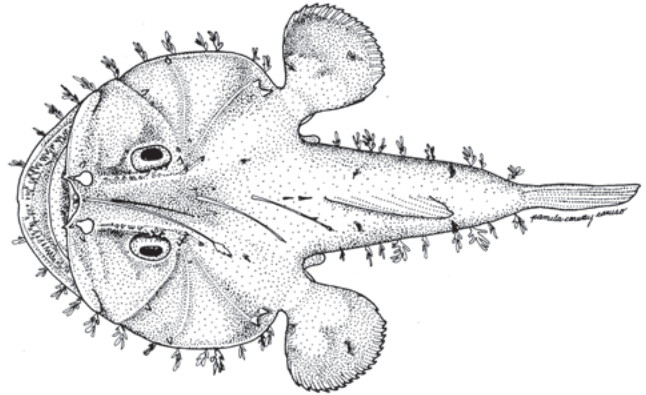
*Lophius indicus* Alcock 1889: 302 (south of Ganjam, India, Bay of Bengal); Alcock 1898\*; Regan 1903.

*Chirolophius malabaricus* Samuel 1963: 116 (Kerala coast, India).

Diagnosis as for genus. Dorsal fin 3 free cephalic spines + 3 joined post-cephalic spines, and 8 rays; anal fin 6 rays; pectoral fins 21–25 rays. Times in SL: HL 2.5–3.1, illicium length 2.4–4.3, 2nd dorsal-fin spine 4.8–7.6, and 3rd dorsal-fin spine 3.9–7.4. When pulled back, 2nd dorsal-fin spine short and stout, reaches to between sphenotic and pterotic spines; 3rd dorsal-fin spine long and slender, reaches to between 5th or 6th spine; 4th dorsal-fin spine long and slender, reaches to soft dorsal fin; 5th and 6th dorsal-fin spines very short (6th often imbedded). Illicium long and slender, when retracted reaches to sphenotic spines in small specimens, or to level of humeral spine in large specimens; esca with well-developed pennant-like flap, long cirri, and usually 2 stalked bulb-like appendages (resembling the eyes of decapods). Numerous tendrils on 2nd dorsal-fin spine, none on 3rd through 6th spines.

Body uniformly pale to dark brown dorsally, paler ventrally; fins pigmented as adjacent areas of body; 2nd dorsal-fin spine dark, 3rd through 6th spines pale; floor of mouth in small specimens dark brown or black, with numerous pale circular patches, becoming pattern of anastomosing black lines in

larger specimens; illicium pale; stalked bulb-like appendages of esca dark; peritoneum usually dusky, but infrequently either extremely pale or dark. Attains 40 cm TL.



*Lophiomus setigerus*, 24 cm TL. Source: SSF (by PC Caruso)

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea, East Africa to South Africa; elsewhere to Malaysia, Taiwan, Sea of Japan, Marshall Is., Australia, New Caledonia and Fiji.

**REMARKS** Found at ~30–800 m.

## GENUS *Lophius* Linnaeus 1758

Head and body strongly depressed; frontal ridges rough, covered with low rounded knobs or transverse ridges; parietal spine large; upper and lower quadrate spines present; soft dorsal fin 9–12 rays; anal fin 8–10 rays. Additional characters, shared in part with other lophiid genera but forming a complex unique to *Lophius*, are: gill opening extends below and behind pectoral-fin base; dorsal fin 6 spines, cephalic portion well-developed, but post-cephalic portion reduced; both sphenotic spines (inner and outer) well-developed; epiotic spine well-developed; 1 articular spine, anterior to jaw joint; 1 interopercular spine; humeral spine well-developed, and bearing 2 or 3 smaller spines; compound ural centrum depressed, transverse processes present. Vertebrae 26–31. Eight species, 1 in WIO.

### *Lophius vomerinus* Valenciennes 1837

Cape monkfish

PLATE 47

*Lophius vomerinus* Valenciennes in Cuv. & Val. 1837: 381 (Cape of Good Hope, South Africa); SSF No. 101.5\*; Leslie & Grant 1991\*; Heemstra & Heemstra 2004\*.

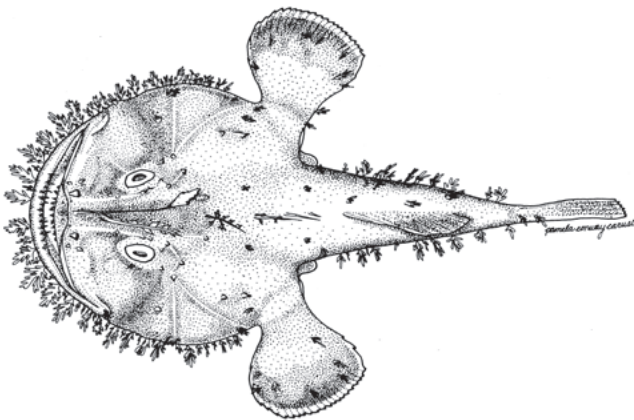
*Lophius upsicephalus* Smith 1841: no page number, Pl. 9 (Cape of Good Hope, South Africa); SSF No. 101.4\*.

*Lophiopsis vomerinus*: Guichenot 1868.

*Lophius piscatorius*: Hora & Mukerji 1936.

Dorsal fin 3 free cephalic spines + 3 post-cephalic spines, 3rd and 4th spines long, and 9 or 10 rays; anal fin 9 rays; pectoral fins 22–26 rays. Times in SL: HL 2.8–3.2, illicium length 4–8.9, 2nd dorsal-fin spine 4.6–6.2, and 3rd dorsal-fin spine 5.5–20.8. Esca a simple pennant-like flap.

Head, body and pectoral fins uniformly dark brown above, pale tan to white below; soft dorsal fin pigmented as body surface; pectoral fins darker distally, and ventral surface white with dark brown band on distal third; pelvic fins white; anal fin white proximally, medium brown distally; all fin rays with pale tips; inside of mouth dark behind tongue; peritoneum variable, usually pale with little pigmentation, but may be dark brown to black. Attains 100 cm TL.



*Lophius vomerinus*, 17 cm TL. Source: SSF (by PC Caruso)

**DISTRIBUTION** Southern Africa: northern Namibia (south of Walvis Ridge) in southeastern Atlantic, to South Africa (KwaZulu-Natal) in WIO.

**REMARKS** Found on muddy bottoms, from subtidal zone to upper continental slope, at ~150–400 m. Probably moves into deeper water as it grows. An important commercial species. IUCN Red List conservation status Near Threatened.

#### GLOSSARY

**alveolar process of premaxilla** – the thickened ridge on the premaxilla that contains the tooth sockets.

**anastomosing lines** – lines that join each other.

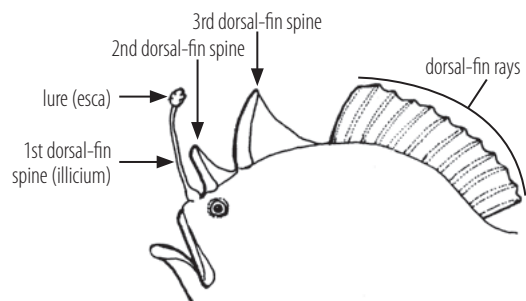
**peritoneum** – the membrane lining the abdominal cavity.

## FAMILY ANTENNARIIDAE

### Anglerfishes or frogfishes

Rachel J Arnold and Theodore W Pietsch

Body globose, short, deep, slightly compressed; mouth large, oblique to vertical, with numerous small villiform teeth. Eyes small, lateral. Gill opening a small pore behind and below pectoral-fin base. Dorsal fin comprised of 3 isolated spines on top of head, widely separated from soft-rayed portion of fin located on rear of body; highly modified 1st spine (illicium) usually bearing a well-developed terminal lure (esca); 2nd and 3rd spines well-developed, covered by thick skin.



Head of an anglerfish to show modified dorsal-fin spines. Source: CFSA

Pectoral fins not divided into upper and lower portions, fin base broadly joined to body or forming elongate fleshy stalk. Skin spinulose or naked, often with membranous filaments or flaps. Usually 2 colour phases: a more common pale phase with tawny, yellow, brown or russet background, usually overlaid with black, brown, pink or bright yellow streaks, bars and/or spots; dark phase with dark brown to dusky background, with blackish streaks, bars or spots, and tips of paired-fin rays often white.

Ovaries of most species are tightly rolled (resembling a double scroll), and the eggs are released embedded in a large, buoyant gelatinous mass. Size up to ~50 cm TL (most species <20 cm TL). Antennariids spend the greater part of their lives sitting on the bottom in shallow water or, as in the case of *Histrio histrio*, clinging to floating *Sargassum* seaweed. Despite their sedentary nature, most are voracious carnivores that sit motionless waiting for smaller fish to pass by, at which time they wriggle their lure (esca) to attract the potential prey within striking distance of their cavernous mouth. In many cases the morphology and movement of the esca appears to mimic a small fish, crustacean or worm, and its structure is distinctive for most species. When the prey enters the anglerfish's strike zone, it is engulfed by a split-second thrust of the jaws as the mouth cavity expands up to 12 times its resting volume, sucking in the prey and a large volume of

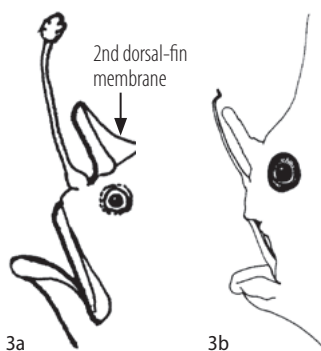


water in one motion. The high-speed gulp of an anglerfish (measured to take 6 milliseconds) is even quicker than that of the stonefish *Synanceia verrucosa* Bloch & Schneider 1801 (which takes 15 milliseconds to engulf its prey). With its huge mouth, enormous stomach, and greatly expandable body (due to loose skin, the absence of ribs, and scales reduced to minute dermal spinules or skin naked), the anglerfish is capable of taking exceptionally large prey, even a fish significantly larger than itself. Caught incidentally in bottom trawls, and only occasionally eaten by local populations; mainly of value only in the aquarium trade.

Monograph on the systematics and biology of frogfishes by Pietsch & Grobecker (1987). Fourteen genera and ~49 species; 4 genera and 13 species in WIO.

#### KEY TO GENERA

- 1a Pectoral- and pelvic-fin rays bifurcate ..... *Fowlerichthys*
- 1b Pectoral-fin rays simple, and only last ray of pelvic fins bifurcate ..... 2
  
- 2a Pectoral-fin bases short, broadly connected to body; pelvic fins short, 10–20% SL; skin rough, entirely covered with extremely close-set spinules [inhabit coral or rocky reefs and muddy or sandy bottom] ..... 3
- 2b Pectoral-fin bases elongate and slender; pelvic fins long, >25% SL; skin smooth, often with membranous filaments or flaps [quasi-pelagic, typically inhabit floating *Sargassum* seaweed] ..... *Histrio*
  
- 3a Second dorsal spine membranously attached to head ..... *Antennarius*
- 3b Second dorsal spine free, not connected to head by membrane ..... *Antennatus*



## GENUS *Antennarius* Daudin 1816

Body covered with close-set bifurcate dermal spinules; body with or without darkly pigmented ocelli on sides. Illicium naked; esca conspicuous; 2nd spine of dorsal fin membranously attached to head. Dorsal fin 3 isolated spines, 11–14 rays; anal fin 6–10 rays; pectoral fins 8–14 rays, fin bases broadly attached to sides of body; only posteriormost pelvic-fin ray bifurcate; caudal peduncle present, no membrane behind last ray of dorsal and anal fins; all caudal-fin rays bifurcate. Individuals typically have 19 vertebrae and can reach ~18 cm SL. Eleven species, 6 in WIO.

#### KEY TO SPECIES

- 1a Illicium about twice length of 2nd spine of dorsal fin ..... 2
- 1b Illicium subequal to 2nd spine of dorsal fin ..... 4
  
- 2a Anal fin 8 rays; dorsal fin 13 (rarely 11 or 12) rays; pectoral fins 11 (rarely 10) rays; membrane behind 2nd spine of dorsal fin thick, its thickness at attachment to spine equal to or greater than spine width ..... *A. commerson*
- 2b Anal fin 6 or 7 rays; dorsal fin 12 (rarely 11 or 13) rays; pectoral fins 9–11 rays; thickness of membrane behind 2nd spine of dorsal fin much less than spine width ..... 3
  
- 3a Second spine of dorsal fin slightly tapering from base, membrane thin and covered with dermal spinules except along margin; head and body sometimes with low, rounded, wart-like swellings; esca with broad, laterally compressed appendage and several slender filaments at base ..... *A. pictus*
- 3b Second spine of dorsal fin thicker distally, membrane thin and naked or with few scattered dermal spinules; head and body with large, protruding, wart-like swellings; esca resembles a small fish ..... *A. maculatus*
  
- 4a Esca an oval tuft of numerous slender filaments; no ocelli on body ..... *A. hispidus*
- 4b Esca comprised of 2–7 elongate worm-like appendages or a cluster of flattened leaf-like appendages; body with or without 2 or 3 darkly pigmented ocelli encircled by lightly pigmented ring ..... 5
  
- 5a No ocelli on body, but body typically entirely covered with elongated blotches or streaks (may be absent or faint in dark individuals); body with or without numerous fine filaments ..... *A. striatus*
- 5b Body typically with 2 or 3 prominent dark ocelli on sides, each encircled by lightly pigmented ring; elongated dark blotches present only on dorsal and anal fins; body without numerous fine filaments ..... *A. indicus*

*Antennarius commerson* (Lacepède 1798)

Commerson's frogfish

PLATES 47 &amp; 48

*Lophius commerson* Lacepède (ex Commerson) in Anonymous 1798: 681 (Mauritius, Mascarenes).

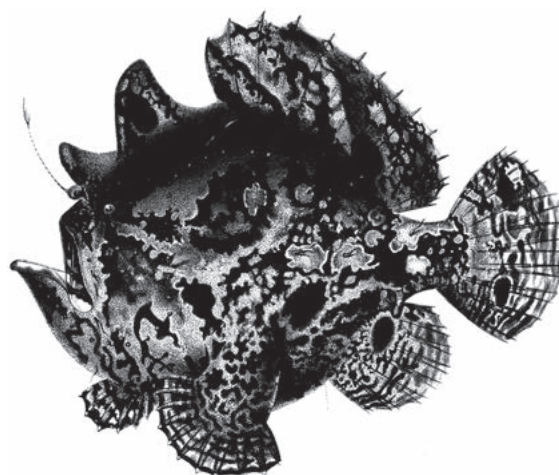
*Lophius commerson* Latreille 1804: 74 (Mauritius, Mascarenes).

*Chironectes caudimaculatus* Rüppell 1838: 141, Pl. 33, Fig. 2 (Sinai coast, Gulf of Suez, Red Sea).

*Antennarius commerson*: SSF No. 102.2\* [as *commersoni*]; Pietsch & Grobecker 1987 [as *commersoni*]; Fricke 1999; Randall 2007\*; Fricke *et al.* 2009; Arnold & Pietsch 2012; Fricke *et al.* 2013.

Head and body more or less covered with low, rounded, wart-like swellings (but unlike warts of *A. maculatus*); delicate cirri abundant on chin and between 3rd spine and soft-rayed portion of dorsal fin. Esca broad and laterally compressed, with one to several smaller compressed appendages (<20% illicium length) arising from base; illicium 19–25% SL, nearly twice length of 2nd spine of dorsal fin; illicial pterygiophore terminating distinctly behind upper jaw symphysis; 2nd spine of dorsal fin 10–17% SL, slightly tapering from base and straight or slightly curved backwards, some fish with slight indentation in front of spine base, membrane behind spine usually as thick as spine, nearly always completely covered with dermal spinules, and extending to base of 3rd spine; 3rd spine 22–28% SL, curved backwards. Eye diameter 2.6–3.9% SL. Dorsal fin 13 (rarely 11 or 12) rays; anal fin 8 rays; pectoral fins 11 (rarely 10) rays.

Live colour highly variable: body bright pink or mottled tawny, with small brownish spots; brown with purple and black mottling; bright yellow or brownish orange with small scattered dark brown spots and a few large brown-black patches (yellow specimen in captivity changed to brick-red in 3 weeks); bright red, scattered with numerous darker red circular spots overall; green with purple and white mottling; or solid black; no large dark spots on belly; white saddle on peduncle, between 2nd and 3rd dorsal-fin spines (including rear half of membrane and tip of 2nd spine), and between 3rd spine and soft-rayed dorsal fin; irregular white patch dorsally on pectoral-fin bases; tips of paired-fin rays white. Pale phase covered with fine dark spots (except not on naked inner surfaces of paired fins), or mottled with russet to tawny patches of variable size, or sometimes with dark brown or black circular spots; caudal fin with dark, more or less interconnected blotches, giving appearance of narrow, irregular, vertical bars. Dark phase often with black body, without markings but with white-tipped pectoral-fin rays, or black or brown body with white to pink, green or blue irregular patches. Preserved specimens green, tan, brown or black; illicium usually banded; usually 1–15 short dark bars radiating from eyes. Attains 29 cm SL.



*Antennarius commerson*. Source: Bleeker 1865

**DISTRIBUTION** Indo-Pacific to tropical eastern Pacific. WIO: Red Sea, East Africa to South Africa (Eastern Cape), Mozambique Channel, Madagascar, Comoros, Seychelles, Mascarenes, Maldives and Sri Lanka; elsewhere to Indonesia, southern Japan, Australia, New Caledonia, Lord Howe I., Society Is., Hawaii and Panama.

**REMARKS** Found on coral and rocky reefs, to ~45 m deep.

*Antennarius hispidus* (Bloch & Schneider 1801)

Shaggy frogfish

PLATES 47 &amp; 48

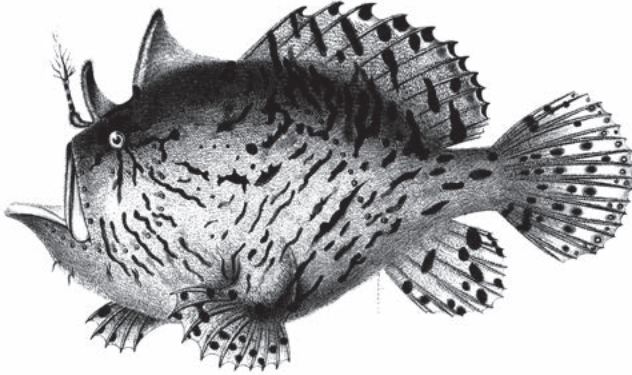
*Lophius hispidus* Bloch & Schneider 1801: 142 (Coromandel coast, India).

*Antennarius hispidus*: SSF No. 102.4; Pietsch & Grobecker 1987; Fricke 1999; Manilo & Bogorodsky 2003; Fricke *et al.* 2009; Arnold & Pietsch 2012.

Esca a dense oval tuft of numerous slender filaments, its length 8–10% SL; illicial pterygiophore nearly always extending in front of upper jaw symphysis; illicium naked, 11–18% SL, subequal to length of 2nd spine of dorsal fin; 2nd spine more or less straight, connected to head by membrane that terminates well before 3rd spine; 3rd spine 20–26% SL, curved backwards. Posterior two-thirds of maxilla naked and tucked beneath folds of skin, only extreme anterior end directly covered with spinulose skin. Eye diameter 4.3–7.5% SL. Dorsal fin 11–13 rays, last 2–4 rays bifurcate; anal fin 7 rays, usually all bifurcate, but occasionally only last 3–5 divided; pectoral fins 10 or 11 rays, all simple; last ray of pelvic fins bifurcate. Caudal peduncle distinct.

Body typically pale yellow to brownish orange in life, usually covered with numerous dark streaks or elongate blotches, typically radiating from eyes and extending to above pectoral fins; similar, more or less parallel markings from

pectoral region onto soft dorsal fin and anal fin; and caudal fin similarly banded (but pale and dark extremes without markings also exist). Pale phase with up to 10 (usually 6–8) dark streaks radiating from eyes; belly without elongate streaks but occasionally with scattered, dark, circular spots. Black phase with white-tipped pectoral-fin rays. Preserved specimens beige, pale yellow, orange, dark tawny or black; filaments on front of esca more or less darkly pigmented, but without spots; illicium banded. Attains 15 cm SL.



*Antennarius hispidus*. Source: Bleeker 1865

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (Eastern Cape), Réunion and India; elsewhere to east coast of India, Malaysia, Indonesia, Taiwan, South China Sea, northern Australia, Loyalty Is. and Fiji.

**REMARKS** Occurs in tropical and subtropical waters, usually associated with eelgrasses and sponges on flat open sand or mud bottom, to ~90 m deep.

### *Antennarius indicus* Schultz 1964

Indian frogfish

PLATE 48

*Antennarius indicus* Schultz 1964: 182, Pl. 3 (Visakhapatnam, India); Pietsch & Grobecker 1987; Randall 1995\*; Manilo & Bogorodsky 2003; Jawad & Al-Mamry 2009; Arnold & Pietsch 2012.

Esca large, with cluster of flattened leaf-like appendages (some as long as 80% illicium length); illicium subequal to or slightly longer than 2nd spine of dorsal fin; 2nd spine 12–15% SL, straight to slightly curved backwards, slightly hooked at tip, and without dermal spinules; membrane behind 2nd spine not extending across depressed naked area to 3rd spine, and membrane usually not divided by dense cluster of spinules into naked dorsal and ventral portions, but ventral portion of membrane thick and covered with spinules; 3rd spine 19–26% SL. Eye diameter 3.6–6.7% SL. Dorsal fin 12 rays, last

2 or 3 rays bifurcate; anal fin 7 rays; pectoral fins 12 or 13 rays, all simple; last ray of pelvic fins bifurcate.

Body brown to tawny in life, with dark brown to black bars on fins, or interconnected dark blotches forming distinct bars when fins appressed to body; 2 or 3 prominent, pale-edged, dark ocelli on body (1 below soft dorsal fin, 1 slightly smaller on midbody above and behind pectoral-fin base, and occasionally 1 even smaller directly below dorsal-fin ocellus and near anal-fin base); underside of pectoral fins creamy white, with large, close-set, dark brown spots. Preserved specimens with whitish or beige fins, and body darker beige, brown, tawny, russet or grey, with darker mottling, particularly evident on head and belly; 5 or 6 oblique dark bars on soft dorsal fin, 3 or 4 bars on anal fin, usually 4 (more vertical) bars on caudal fin, and 3 or 4 bars across outer surface of paired fins; chin and belly nearly always lightly speckled; up to 8 short dark bars radiating from eyes, and pale horizontal streak through eyes in some specimens; bases of esca appendages with small dark spots; illicium faintly banded. Attains 19 cm SL.

**DISTRIBUTION** Indian Ocean. WIO: Pakistan, Oman, Gulf of Aden, Tanzania (Zanzibar), Seychelles, Lakshadweep and Sri Lanka; elsewhere to east coast of India (Coromandel coast).

**REMARKS** Found on coral and rocky reefs, to ~30 m deep.

### *Antennarius maculatus* (Desjardins 1840)

Warty frogfish

PLATES 48 & 49

*Chironectes maculatus* Desjardins 1840: 1, Pl. 2 (Mauritius, Mascarenes).  
*Antennarius maculatus*: Grobecker 1981; Pietsch 1984; Pietsch & Grobecker 1987; Anderson *et al.* 1998; Fricke 1999; Arnold & Pietsch 2012.

Head, body and fins covered with numerous wart-like swellings (more conspicuous with growth). Esca a broad, laterally compressed appendage, at least half length of illicium, strongly resembling a small fish, and with one to several smaller compressed appendages at base; illicium length 26–34% SL, nearly twice length of 2nd spine of dorsal fin; illicial pterygiophore terminating distinctly behind upper jaw symphysis; 2nd spine 14–18% SL, usually with conspicuous indentation before base, thickness of membrane along attachment to spine distinctly less than spine width, membrane nearly always without dermal spinules, and membrane reaching base of 3rd spine; no naked depression between spines 2–3; 3rd spine 24–27% SL. Eye diameter 5.8–7.8% SL. Dorsal fin 12 (rarely 11) rays; anal fin 7 (rarely 6) rays; pectoral fins 10 (rarely 11) rays.

Body cream, yellow, greenish yellow, deep brown or black in life, scattered with numerous brown to black circular spots of various sizes, except no large dark spots on belly; white, pink, red or russet saddles and irregular patches (in life and in preserved specimens); esca mottled white and dark brown, with proximal eye-like pigment spot on each side, and 4 or 5 dark vertical bands immediately distal to eye-spots, and 2 paler bands near tip. Pale phase covered with numerous, variously sized, dark brown or black circular spots; brown to pinkish orange saddles on peduncle and shoulder (usually extending onto dorsal surface of pectoral-fin bases); additional brown to pinkish orange irregular patches on 2nd and 3rd dorsal-fin spines, chin, corners of jaw, and sides of body behind pectoral-fin bases. Dark phase covered with scattered, variously sized, round black spots; pinkish brown to brown elongate saddles on peduncle and shoulder (usually extending onto opercular region and upper surface of pectoral-fin bases); additional irregular pale patches located as in pale phase; tips of pectoral- and pelvic-fin rays white. Preserved specimens whitish, beige, yellow, brown or blackish; illicium faintly banded in some specimens; usually 1–9 short dark bars radiating from eyes. Attains 8.5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: southern Mozambique, Mauritius and Maldives; elsewhere, Indonesia, Singapore, South China Sea, Philippines, Ryukyu Is., Mariana Is., Solomon Is. (Guadalcanal), Bismarck Archipelago, Australia, New Caledonia, Tuamotu Is. and Hawaii.

**REMARKS** Collected at 1–11 m.

### *Antennarius pictus* (Shaw 1794)

Painted frogfish

PLATE 48

*Lophius pictus* Shaw in Shaw & Nodder 1794; no page number, Pl. 176 (Tahiti, Society Is.).

*Antennarius nigromaculatus* Playfair 1869: 239 (Zanzibar, Tanzania).

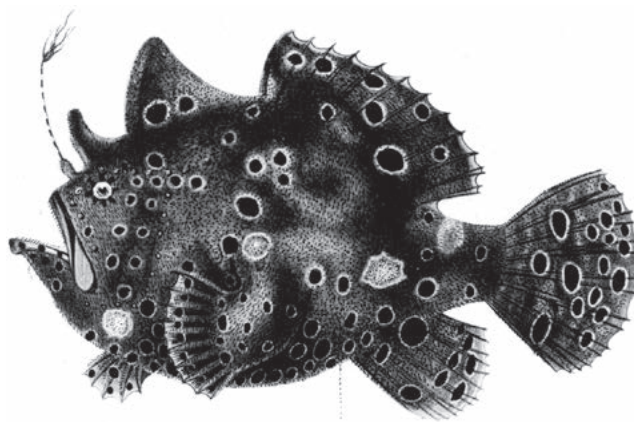
*Antennarius pictus*: Gill 1879; SSF No. 102.6\*; Pietsch & Grobecker 1987; Goren & Dor 1994; Randall 1995\*; Manilo & Bogorodsky 2003; Arnold & Pietsch 2012.

*Antennarius argus* Fowler 1903: 172, Pl. 8 (Zanzibar, Tanzania).

Head and body sometimes partially or fully covered with low, rounded, wart-like swellings (but unlike warts of *A. maculatus*). Esca a broad, laterally compressed appendage,  $\geq \frac{1}{2}$  length of illicium, with one to several smaller compressed appendages arising from base; illicium 19–32% SL, nearly twice length of 2nd spine of dorsal fin; anterior end of illicial

pterygiophore terminating distinctly behind upper jaw symphysis; 2nd spine 9–17% SL, curved backwards and slightly tapered from base, membrane thickness along attachment to spine less than spine width, membrane covered with dermal spinules (except not along outer edge and in small triangular area just behind spine tip) and extending to base of 3rd spine; 3rd spine 20–29% SL. Eye diameter 3.8–7.2% SL. Dorsal fin 11–13 rays; anal fin 6 or 7 rays; pectoral fins 9–11 rays.

Body dark blue to black in life, scattered with yellow spots on head, body and fins; pale blue band across median-fin margins; illicium and tips of paired fins white; body occasionally yellow-green with black spots and irregular patches of pink, or body orange with red spots, or dark russet with whitish pectoral fins; head, body and fins sometimes scattered with variously sized dark brown to black circular spots and mottled with irregular pink and white patches; inside of mouth with black and white dendritic pattern. Pale phase with numerous, variously sized, dark circular spots on head, body and fins; pale saddles on peduncle and shoulder; irregular patches, particularly on nape, cheeks and pectoral region. Dark phase with solid black body and no conspicuous markings or with white-tipped pectoral-fin rays. Preserved specimens tawny, dark brown or black, without banding on illicium, but with up to 12 short dark stripes radiating from eyes. Attains 24 cm SL.



*Antennarius pictus*. Source: Bleeker 1865

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to South Africa (Aliwal Shoal), Madagascar, Seychelles and Mascarenes; elsewhere to Indonesia (Moluccas), Philippines, Guam, Marshall Is., New Guinea, Australia, New Caledonia, Lord Howe I., Tonga, Samoa, Society Is. and Hawaii.

**REMARKS** Found to ~75 m deep.



## *Antennarius striatus* (Shaw 1794)

Striated frogfish

PLATES 48 & 49

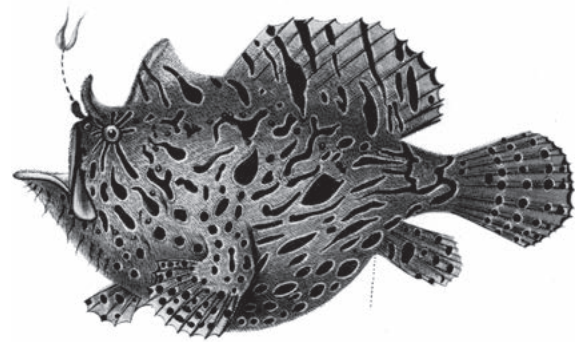
*Lophius striatus* Shaw in Shaw & Nodder 1794: no page number, Pl. 175 (Tahiti, Society Is. [French Polynesia]).

*Antennarius fuliginosus* Smith 1957: 222, Fig. 5 (Durban, KwaZulu-Natal, South Africa).

*Antennarius striatus*: Pietsch 1984; SSF No. 102.7\*; Pietsch & Grobecker 1987; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003; Parenti & Pietsch 2003; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009; Arnold & Pietsch 2012.

Esca with 2–5 cylindrical, worm-like appendages, short and stout (<4% SL) to extremely long and slender (28% SL), each appendage occasionally bearing smaller, more slender, secondary filaments, and esca without distinct eye-like spots; illicial pterygiophore nearly always extending in front of upper jaw symphysis; illicium naked, length 14–23% SL; 2nd spine 11–19% SL, more or less straight; membrane behind 2nd spine not divided into naked dorsal and ventral portions, and terminating well before base of 3rd spine; 3rd spine 17–29% SL, curved backwards. Posterior two-thirds of maxilla naked and tucked beneath folds of skin, only anterior end covered with spinulose skin. Eye diameter 3.5–7.4% SL. Dorsal fin 11 or 12 rays, last 1–4 bifurcate; anal fin 6 or 7 rays, usually all bifurcate but occasionally only last 3–5 divided; pectoral fins 9–12 rays, all simple; last ray of pelvic fins bifurcate. Caudal peduncle present, no membrane behind last rays of dorsal and anal fins.

Live colour typically pale yellow to orange, but may be green, grey, brown or almost white, and usually covered overall with numerous dark brown to black streaks or elongate blotches, typically radiating from eyes and extending to above pectoral fins; similar, more or less parallel, markings extending onto soft dorsal fin and anal fin, and caudal fin similarly banded (but pale and dark extremes without markings also exist). Pale phase with up to 12 (usually 7–10) dark streaks radiating from eyes; belly without elongate markings but usually scattered with dark circular spots. Black phase with white-tipped pectoral-fin rays (black individuals observed changing to yellow-striped phase in ~5 weeks). Preserved specimens beige, pale yellow, orange, dark yellow-brown or black; worm-like appendages of esca occasionally reddish pink; illicium nearly always darkly banded. Attains 15.5 cm SL.



*Antennarius striatus*. Source: Bleeker 1865

**DISTRIBUTION** Circumglobal in tropical to subtropical waters of Atlantic and Indo-Pacific, but not eastern Pacific. WIO: Red Sea to South Africa (Algoa Bay) and Mascarenes; elsewhere to Japan, Australia, New Caledonia, Society Is. and Hawaii.

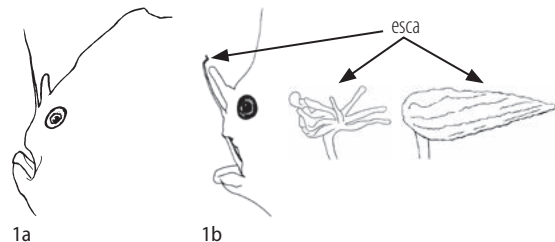
**REMARKS** Generally associated with eelgrass beds and sponges, on flat open sand or mud bottoms, to ~219 m deep.

### GENUS *Antennatus* Schultz 1957

Body covered with close-set bifurcate dermal spinules; body with or without darkly pigmented ocelli on sides. Illicium naked or with dermal spinules; esca absent or present; second spine of dorsal fin free, not connected to head by membrane. Dorsal fin 3 isolated spines, 11–14 rays; anal fin 6–8 rays; pectoral fins 8–12 rays, fin bases broadly attached to sides of body; only posteriormost pelvic-fin ray bifurcate; caudal peduncle absent or present; all caudal-fin rays bifurcate. Individuals typically have 19 vertebrae and are small, not exceeding ~9.5 cm SL. Twelve species, 5 in WIO.

#### KEY TO SPECIES

- 1a Esca barely distinguishable or absent; illicium tapering to fine point; 3rd spine of dorsal fin immobile, bound to head by skin ..... 2  
1b Esca conspicuous; 3rd spine of dorsal fin mobile although joined to head by skin ..... 3



Continued...

## KEY TO SPECIES

- 2a Anal-fin rays branched; pectoral fins 9 or 10 rays; caudal peduncle reduced, last ray of dorsal and anal fins connected to peduncle just before outermost caudal-fin rays; head and body covered with pale, close-set, parallel lines ..... *A. linearis*
- 2b Anal-fin rays usually all unbranched; 2nd spine of dorsal fin 6.5–9.8% SL; pectoral fins usually 11 or 12 (occasionally 10) rays; caudal peduncle not evident, last ray of dorsal and anal fins connected by membrane to bases of outermost caudal-fin rays; no pale parallel lines on head and body ..... *A. tuberosus*
- 3a Caudal peduncle not evident; last ray of dorsal and anal fins connected by membrane to bases of outermost caudal-fin rays ..... *A. coccineus*
- 3b Caudal peduncle distinctly present; no membrane behind last ray of dorsal and anal fins ..... 4
- 4a Illicium slightly shorter than 2nd spine of dorsal fin, illicium length 5–9% SL; pectoral fins 8–10 (rarely 10) rays ..... *A. dorehensis*
- 4b Illicium length subequal to 2nd spine of dorsal fin, 9–15% SL; pectoral fins 9–12 (rarely 9) rays ..... *A. nummifer*

*Antennatus coccineus* (Lesson 1831)

Scarlet frogfish

PLATES 48 &amp; 49

*Chironectes coccineus* Lesson (ex Cuvier) 1831: 143, Pl. 16, Fig. 1 (Mauritius, Mascarenes).

*Antennarius leucus* Fowler 1934: 512, Fig. 53 (Durban, KwaZulu-Natal, South Africa).

*Antennarius immaculatus* Le Danois 1970: 91, Fig. 2 (Eilat, Israel, Gulf of Aqaba, Red Sea).

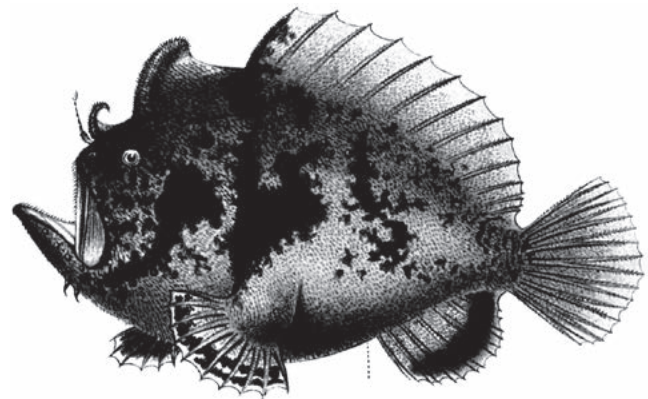
*Antennarius coccineus*: SSF No. 102.1\*; Pietsch & Grobecker 1987; Winterbottom *et al.* 1989; Goren & Dor 1994; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Fricke *et al.* 2009; Jawad & Al-Mamry 2009.

*Antennatus coccineus*: Arnold & Pietsch 2012.

No distinct caudal peduncle; last ray of dorsal and anal fins joined by membrane to bases of outermost caudal-fin rays. Illicium length 8.8–13% SL, subequal to 2nd spine of dorsal fin; esca variously a simple unpigmented sphere of folded tissue (usually associated with a few short, basal filaments) or a more elongate tapering appendage with a variable number of slender filaments, and occasionally with a cluster of dark spherical swellings at its base. Second spine of dorsal fin 7–15% SL, strongly curved backwards, usually completely covered with close-set dermal spinules which occasionally form discrete clusters leaving naked spaces between; shallow, naked depression usually present between dorsal-fin spines 2–3;

3rd spine 17–27% SL, curved backwards. Gill opening adjacent to or on pectoral-fin base. Eye diameter 5.3–8.2% SL. Dorsal fin 12 rays; anal fin 7 or 8 rays; pectoral fins 9–12 rays; last ray of pelvic fins bifurcate.

Live colour highly variable: body tawny or mostly red, but also yellow with tinge of orange (a yellow specimen changed from orange to russet after 5 days in captivity), or mottled many colours, most conspicuously irregular areas of pink, or sometimes entirely densely mottled dark brown; no large dark spots on belly; series of 5 vertical spots on caudal fin. Preserved specimens with similarly variable colouring: body often reddish, covered with darker red spots and numerous black spots; illicium usually faintly banded; up to 13 short dark stripes radiating from eyes. Attains ~9 cm SL.



*Antennatus coccineus*. Source: Bleeker 1865

**DISTRIBUTION** Indo-Pacific to tropical eastern Pacific. WIO: Gulf of Oman, Red Sea, East Africa to South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles, Mascarenes, Chagos, Maldives and Sri Lanka; elsewhere to Indonesia, Ryukyu Is., New Guinea, Australia, New Caledonia, Lord Howe I., Hawaii, easternmost island groups of Pacific Plate, Panama and Chile.

**REMARKS** Found on coral and rocky reefs, to ~75 m deep.

*Antennatus dorehensis* (Bleeker 1859)

New Guinean frogfish

PLATES 48 &amp; 49

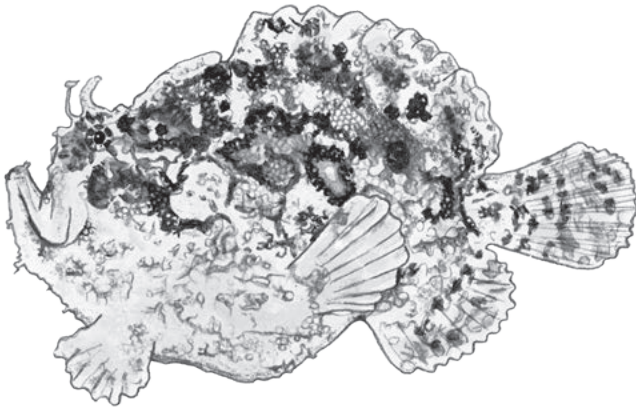
*Antennarius dorehensis* Bleeker 1859: 21 (Doreh Bay, New Guinea); SSF No. 102.3\*; Pietsch & Grobecker 1987.

*Antennatus dorehensis*: Arnold & Pietsch 2012.

Esca a simple oval appendage or more elongate, tapering, and nearly always ventrolaterally directed, without basal filaments or pigmented swellings; illicium length 5–10% SL, shorter than 2nd spine of dorsal fin; 2nd spine 7–13% SL, not connected

to head by membrane, slightly curved backwards, and mostly covered with close-set dermal spinules; may have slight naked depression between spines 2–3; 3rd spine 19–30% SL, curved backwards. Gill opening adjacent to or on pectoral-fin base. Eye diameter 3.9–8% SL. Dorsal fin 11–13 rays; anal fin usually 7 (rarely 8) rays; pectoral fins 8–10 rays; last ray of pelvic fins bifurcate. Caudal peduncle distinct.

Body dark violet to brownish grey in life, covered with irregular whitish spots and blotches, and sometimes with faint dark spot below dorsal fin. Preserved specimens pale grey, brown or black, with numerous white or grey spots and blotches; dorsal- and anal-fin rays white-tipped; distal half of pectoral-fin rays white, peppered with dark spots; caudal-fin margin conspicuously pale; no banding on illicium; sometimes with short faint bars radiating from eyes. Attains at least 7 cm TL.



*Antennatus dorehensis*, 50 mm SL (Comoros).

**DISTRIBUTION** Indo-Pacific. WIO: Kenya, Mozambique (Inhaca I.), Comoros and Aldabra; elsewhere to Cocos (Keeling) Is., Indonesia, Philippines, Ryukyu Is., Mariana Is. (Saipan), New Guinea and Tahiti.

**REMARKS** Known from tidepools and shallow coral and rocky reefs, in 0.4–2.4 m.

### *Antennatus linearis* Randall & Holcom 2001

Pygmy anglerfish

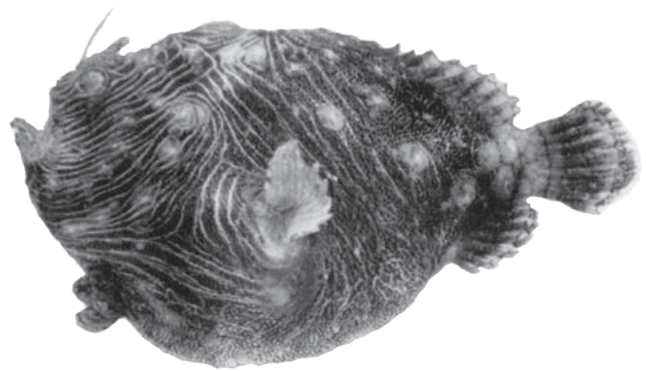
PLATE 48

*Antennatus tuberosus* (non Cuvier 1817): SSF No. 102.8\* [in part]; Pietsch & Grobecker 1987 [in part].

*Antennatus linearis* Randall & Holcom 2001: 138, Figs. 1–4 (off Kahe Point, Oahu I., Hawaii); Arnold & Pietsch 2012.

Esca absent; illicium naked, 1.4–2 times length of 2nd spine of dorsal fin; 2nd spine 10–13% SL, slightly tapered, mobile, folding into shallow groove posteriorly, membrane between rear edge of spine and head rudimentary; 3rd spine ~21–23% SL, thick and straight, tightly bound to head by thick skin. Dorsal fin 12 rays, up to last 5 branched; anal fin 7 rays, usually most branched; pectoral fins 9 or 10 rays; caudal fin 9 rays, middle 7 branched. Caudal peduncle short, last ray of dorsal and anal fins joined to peduncle just before bases of outermost caudal-fin rays.

Colour in life: lines on head and anterior part of body orangish brown, but mostly blackish on body; complex lace-like pattern of fine white lines superimposed on linear pattern of posterodorsal part of body and soft dorsal fin and anal fin. Preserved specimens: head and body pale, with 3 sets of numerous, parallel, curving, blackish lines (extending downward and posteriorly on body, then curving forward on abdomen; on head curving upward and posteriorly from chin; and in small triangular area behind head and converging on pectoral-fin bases); large, obscure, dark blotches on body (as a result of the dark lines within blotches becoming broader and darker); dense wart-like clusters of dermal spinules on body usually pale, but small clusters on head may be dark; soft dorsal fin blackish, with whitish blotches, except outer membranes translucent; anal fin similar to soft-rayed dorsal fin but with irregular double submarginal dark line; pectoral fins pale, with series of fine blackish lines; pelvic-fin bases same colour as body, fins pale distally with dark lines forming reticulated pattern; caudal fin pale, with transverse blackish line across base, broad blackish bar in middle of fin, and narrow submarginal zone of dark lines. Attains at least 6 cm SL.



*Antennatus linearis*, 60 mm TL (N Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique to South Africa (KwaZulu-Natal), Comoros and Aldabra; elsewhere to Indonesia (Moluccas) and Hawaii.



*Antennatus nummifer* (Cuvier 1817)

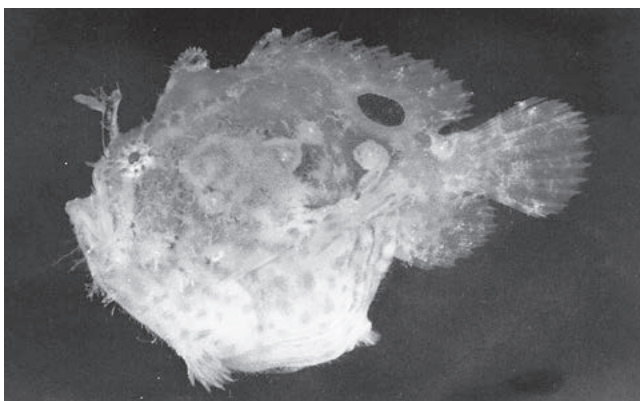
Spotfin frogfish

PLATES 48 &amp; 49

*Chironectes nummifer* Cuvier 1817: 430, Pl. 17, Fig. 4 [no locality given].*Chironectes chlorostygma* Valenciennes (ex Ehrenberg) in Cuv. & Val. 1837: 426 (Massawa, Eritrea, Red Sea).*Antennarius nummifer*: Schinz 1822; SSF No.102.5\*; Pietsch & Grobecker 1987; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Fricke *et al.* 2009.*Antennatus nummifer*: Arnold & Pietsch 2012.

Esca variously a simple unpigmented sphere of irregularly folded tissue (usually associated with a few short, basal filaments) to an elongate, tapering appendage with a variable number of slender filaments and usually a cluster of dark spherical swellings at base; illicium length 9–15% SL, subequal to length of 2nd spine of dorsal fin; 2nd spine more or less straight, usually completely covered with close-set dermal spinules (but spinules often discretely clustered, leaving naked spaces between); shallow naked depression between spines 2–3 nearly always present; 3rd spine 18–28% SL, curved backwards. Gill opening adjacent to or on pectoral-fin base. Eye diameter 5.1–8.8% SL. Dorsal fin 12 or 13 rays; anal fin 7 or 8 rays; pectoral fins 10–12 rays; last ray of pelvic fins bifurcate. Caudal peduncle distinct.

Body yellow, brownish orange, pink or red in life; head brown to russet, grading to greenish brown or brown on body and fins, and belly slightly paler and without dark spots; scattered, irregular, greenish white blotches overall; soft dorsal-fin base nearly always with black spot encircled with diffuse greenish ring. Pale phase often scattered with slightly darker (sometimes bright pink-red) irregular blotches; dorsal, anal and caudal fins often peppered with numerous dark spots. Dark phase with white-tipped pectoral-fin rays. Preserved specimens beige, pink, brown or black; illicium usually faintly banded; up to 10 short dark bands radiating from eyes. Attains ~9 cm SL.

*Antennatus nummifer*, 23 mm SL (Mauritius). © JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific, central Atlantic and islands of eastern Atlantic (including Azores, Madeira, Canary Is. and St Helena I.). WIO: Persian/Arabian Gulf, Red Sea to South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles, Mascarenes and Maldives; elsewhere to east coast of India, Indonesia, Hong Kong, Japan, Micronesia, Australia, New Caledonia, northern New Zealand, Society Is. and Hawaii.

**REMARKS** Found on coral and rocky reefs, to ~176 m deep.

*Antennatus tuberosus* (Cuvier 1817)

Tuberculated frogfish

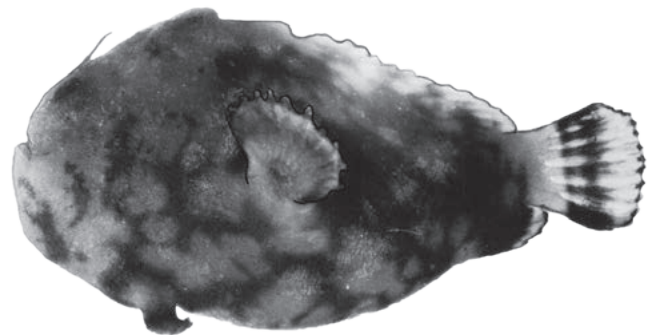
PLATES 48 &amp; 49

*Chironectes tuberosus* Cuvier 1817: 432 (Mauritius, Mascarenes).*Antennarius unicoloris* Bennett 1827: 374, Pl. 9, Fig. 1 (Madagascar).*Antennatus tuberosus*: Myers & Shepard 1980; SSF No. 102.8\*;

Goren &amp; Dor 1994; Fricke 1999; Arnold &amp; Pietsch 2012.

No distinct esca; illicium more or less tapering to fine point, length 15–27% SL, ~1.5–2 times length of 2nd spine of dorsal fin; 2nd spine 6.5–9.8% SL, cylindrical, not tapering, straight to slightly curved backwards. Dorsal fin 11–13 rays, last 2–7 bifurcate; anal fin 7 or 8 rays, usually all simple; pectoral fins 10–12 rays, all simple; pelvic-fin rays all simple.

Head and body pale yellow, yellow or slate-grey, with irregular dark brown reticulations joining dark brown blotches and marbling; whitish scab-like pattern on head; caudal fin white, with pale vertical bar and variegated dark marbling. Dark grey fish observed changing to pale yellow within ~2 weeks in captivity. Attains at least 7 cm SL.

*Antennatus tuberosus*, 35 mm TL (Seychelles). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, Madagascar, Comoros, Seychelles, Mauritius and Chagos; elsewhere to Indonesia (Moluccas), Philippines, Japan, Mariana Is., Marshall Is., New Guinea, New Caledonia, Tonga, Line Is., Pitcairn Is. and Hawaii.

**REMARKS** Known to ~73 m deep.



## GENUS *Fowlerichthys* Barbour 1941

Body covered with close-set bifurcate dermal spinules; 1 to 3 darkly pigmented ocelli on sides, each encircled by lightly pigmented ring; illicium length subequal to 2nd spine of dorsal fin, which is connected to head by membrane; caudal peduncle present, the membranous posteriormost margin of soft-rayed dorsal and anal fins attached to body distinctly anterior to base of outermost caudal-fin rays; dorsal rays 12–14, all usually bifurcate (posteriormost 7–9 bifurcate in *F. scriptissimus*); anal fin 7–10 rays, all bifurcate; pectoral fins 11–14 rays, usually all bifurcate (simple in juveniles <15 mm SL, and in all life stages of *F. radiosus*); all pelvic-fin rays bifurcate. Individuals typically have 20 vertebrae and are large, often exceeding 25 cm SL. Five species, 1 in WIO.

### *Fowlerichthys scriptissimus* (Jordan 1902)

Calico frogfish

PLATE 48

*Antennarius scriptissimus* Jordan 1902: 373, Fig. 4 (Boshu, Chiba Prefecture, Japan); Manilo & Bogorodsky 2003; Fricke *et al.* 2009.  
*Antennarius sarasa* Tanaka 1916: 143 (Tokyo fish market, Japan); Randall 1995; Fricke 1999.  
*Fowlerichthys scriptissimus*: Arnold & Pietsch 2012.

Esca a simple oval appendage with numerous, more or less parallel, vertically aligned folds, breaking into dense cluster of short filaments in larger specimens; esca  $\leq 20\%$  illicium length; illicium 7–11% SL, with dermal spinules along front edge in larger specimens; 2nd spine of dorsal fin 8–10% SL, more or less curved backwards; membrane behind 2nd spine not divided into naked dorsal and ventral portions by cluster of spinules, dorsal portion thin, ventral portion thick and usually covered with spinules, membrane nearly reaching 3rd spine in adults but shorter in juveniles; depression between dorsal-fin spines 2–3 naked in smaller fish, spinulose in large specimens; 3rd spine 20–23% SL, curved backwards. Eye diameter 3–6.1% SL. Dorsal fin 13 rays, last 3–9 bifurcate; anal fin 8 rays; pectoral fins 13 rays, all bifurcate; pelvic-fin rays all bifurcate.

Distinguished by dark ocellus below dorsal fin, encircled by pale ring (weakly developed in some specimens, and not shown by Tanaka [1916] in drawing of holotype of *Antennarius sarasa*). Preserved specimens beige, grey, brown or dark russet, and heavily mottled with darker reticulations overall except for inner surfaces of paired fins; irregular narrow dark banding on fins: up to 15 oblique bars on soft-rayed dorsal fin, 4 oblique bars on anal fin, 5 or 6 vertical bars on caudal fin, and ~3 bars across outer surface of paired fins; illicium banded; esca with dark base; 7–16 short dark stripes radiating from eyes. Attains 30 cm SL.

**DISTRIBUTION** Indo-Pacific (few records). WIO: Oman and Réunion; elsewhere, Philippines, southern Japan and New Zealand.

**REMARKS** Known from 73–185 m.

## GENUS *Histrio* Fischer 1813

Body smooth, nearly always without dermal spinules (except single, tiny, crescent-shaped spinule rarely associated with each pore of acoustico-lateralis system), but everywhere covered with tiny, rounded, close-set papillae; body without darkly pigmented ocelli on sides. Two cutaneous cirri on mid-dorsal line of snout between symphysis of premaxillae and base of illicium. Illicium naked; esca distinct. Pectoral-fin bases elongate, stalk-like; pelvic fins relatively larger than those of other anglerfishes, length  $>25\%$  SL, and all rays simple; caudal peduncle present, no membrane behind last ray of dorsal and anal fins; outermost caudal-fin rays simple, innermost 7 bifurcate. Typically 19 vertebrae. One species.

### *Histrio histrio* (Linnaeus 1758)

Sargassumfish

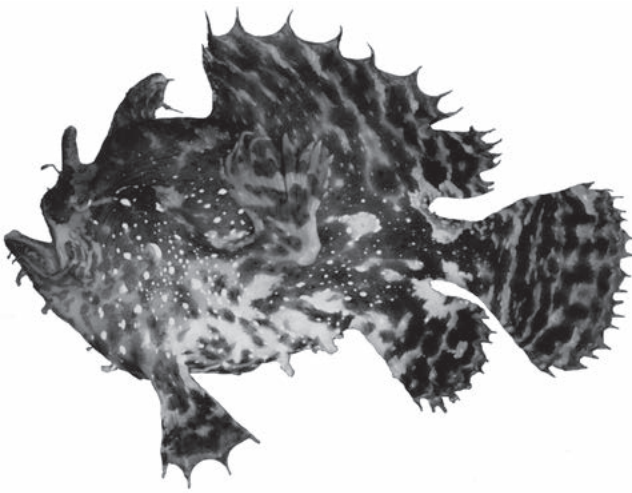
PLATES 48 & 49

*Lophius histrio* Linnaeus 1758: 237 [Sargasso Sea].  
*Antennarius nitidus* Bennett 1828: 375, Pl. 9, Fig. 2 [possibly Cape of Good Hope, South Africa].  
*Chironectes nesogallicus* Valenciennes in Cuv. & Val. 1837: 401 (Mauritius, Mascarenes).  
*Histrio histrio*: McCulloch 1922; SSF No. 102.9\*; Pietsch & Grobecker 1987; Randall 1995; Fricke 1999; Manilo & Bogorodsky 2003; Fricke *et al.* 2009; Arnold & Pietsch 2012.

Head, body and fins covered with numerous, compressed, cutaneous appendages. Esca an oval or tapering appendage, with numerous, more or less parallel folds running from base to tip, and cluster of short slender filaments arising from base; illicium  $< \frac{1}{2}$  length of 2nd spine of dorsal fin, 4.5–9.3% SL; anterior end of illicial pterygiophore terminating distinctly behind upper jaw symphysis, illicium appearing to emerge from base of 2nd spine; 2nd spine 13–19% SL, narrow, straight to slightly curved backwards, densely covered with cutaneous papillae and appendages, not connected to head by membrane; 3rd spine 19–29% SL, narrow (subequal to width of 2nd spine), slightly curved backwards, broadly connected to head by membrane, and membrane densely covered with cutaneous papillae and appendages. Posterior end ( $\sim \frac{1}{4}$ ) of maxilla tucked beneath folds of skin. Eye diameter 5–8.7% SL. Dorsal fin

11–13 rays, last 2 or 3 bifurcate; anal fin 6–8 rays, last 2–6 bifurcate; pectoral fins 9–11 rays, all simple; pelvic-fin rays all simple. Vertebrae 18 or 19; caudal centra 13 or 14.

Live colour and patterning highly variable, capable of rapidly changing from bleached-out grey-white to patterned with streaks and mottling of browns, olive and yellow, with numerous small brown to black spots and sometimes irregular narrow white lines; cutaneous filaments white; pectoral and pelvic fins sometimes edged with orange; no banding on illicium; dark bars or streaks radiating from eyes, usually continuous with mottling on head and body. Attains 14 cm SL.



*Histrio histrio*, 74 mm SL (South Africa). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Circumglobal in tropical to subtropical waters of Atlantic and Indo-Pacific. WIO: Red Sea to South Africa (Algoa Bay), Madagascar, Seychelles, Mascarenes, Chagos, Maldives, India and Sri Lanka; elsewhere to Indonesia, Philippines, Japan, New Guinea, Australia, New Caledonia, New Zealand, Tonga and Galápagos Is. (but not most of central and eastern Pacific).

**REMARKS** Semipelagic, often found inhabiting floating *Sargassum* seaweed.

#### GLOSSARY

**acoustico-lateralis system** – the sensory system that includes the ears and lateral line.

**bifurcate** – split or divided into two parts; forked at tip.

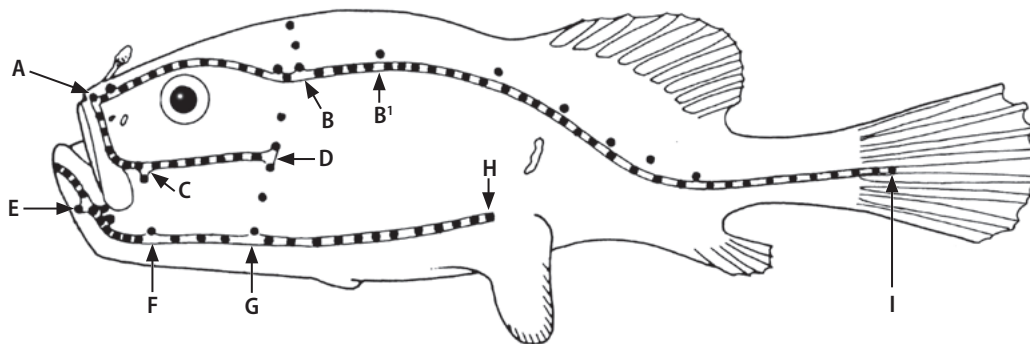
**Pacific Plate** – that part of the Pacific Ocean floor bounded by the Aleutian Trench in the north, the trenches that extend from the Okhotsk Peninsula, past Japan, the Mariana Trench, to the Tonga and Kermadec trenches, to cut through South Island, New Zealand, to the Antarctic Plate in the south. It is bounded on the east by mid-ocean ridges that extend past Easter Island to Baja California and along the west coast of North America to Alaska. It covers 103.3 million sq. km.

## FAMILY CHAUNACIDAE

### Coffinfishes, sea toads and frogmouths

Hsuan-Ching Ho and John H Caruso

Body globose, tapering to caudal fin; head large, globular, elevated posteriorly or roughly cuboid, and bearing prominent open lateral-line canals. Eyes dorsolateral and covered with clear dermal membrane broadly joined to surrounding skin. Mouth large, oblique to nearly vertical, with relatively small, sharp, slender teeth. Dorsal fin with spinous and soft-rayed portions: spinous dorsal fin with 1 short spine just behind tip of snout, in front of scaleless ovoid depression or patch of skin, and modified as angling apparatus (illicium), with raspberry-shaped esca (lure) at tip consisting of dense cluster of short cirri (creating a mop-like appearance); additional cephalic dorsal-fin spines present as embedded vestiges, and no post-cephalic dorsal-fin spines; soft-rayed dorsal fin on rear part of



Landmarks for neuromast counts in Chaunacidae. **AB** = supraorbital series; **AC** = premaxillary; **BB'** = anterior lateral line; **BD** = upper preopercular series; **CD** = suborbital series; **DG** = lower preopercular series; **EF** = mandibular series; **FG** = hyomandibular series; **GH** = pectoral series; **BI** = lateral line. Source: Ho *et al.* 2013

body, with 10–12 rays. Anal fin below soft dorsal fin, with 5–7 rays. Pectoral fins narrow and paddle-like, attached to shoulder girdle by greatly elongated arm-like radial bones, and with 10–15 rays. Pelvic fins in front of pectoral fins. Skin on head and body very loose, densely covered with dermal denticles (short spine-like scales); opercle greatly reduced with rear part disappearing into loose skin. Gill opening a small circular pore, located behind arm-like pectoral-fin base. Single open lateral-line canal on body joins conspicuous lateral-line canals on head, and extends onto caudal-fin base; LL neuromasts 17–50 (terminology for lateral-line neuromast counts and landmarks follows Gomon & Ho 2008). Body pink, reddish, orange or rose-coloured, some species with diffuse pale yellow or olive-green spots.

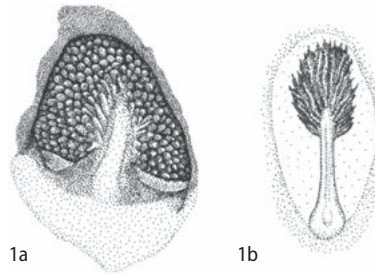
Small- to moderate-sized (to ~40 cm TL), bottom-dwelling; found worldwide in all but polar seas. Most species inhabit the outer continental shelf and slope, at ~90–2 600 m or more. Two genera and ~29 species: *Chaunacops* inhabit depths of >1 000 m; *Chaunax* contains 3 species groups: the *C. abei*-group, with 17 species (5 in WIO); the *C. fimbriatus*-group, with 6 species (2 in WIO); and the *C. pictus*-group, with 3 species (1 in WIO). Five species in WIO with records above 200 m.

## GENUS *Chaunax* Lowe 1846

Anal fin 6 or usually 7 rays. Skin finely spinulose with closely spaced dermal denticles; no deep notch on post-maxillary process of premaxilla; anteroventral process of articular bone short; length of vertical section of cleithrum about half length of horizontal section; intersphenotic width narrow (4.4–6.6 in SL); illicium short (15–30 in SL). Neuromast series (see Gomon & Ho 2008; Ho *et al.* 2013): supraorbital (AB) 10–13 (usually 11 or 12); suborbital (CD) 5–8 (usually 6 or 7); mandibular (EF) 5–8 (usually 6 or 7); pectoral (GH) 10–19; premaxillary (AC) 6–8 (usually 7 or 8); upper preopercular (BD) 2–4; lower preopercular (DG) 3–5; and main body line, including on caudal fin (BI) 29–50. Twenty-five nominal species; at least 7 species in WIO, but only 5 of these at depths of <200 m. *Chaunax flammeus* Le Danois 1979 is known from off Madagascar at 760–810 m; *C. russatus* Ho, Roberts & Stewart 2013 is known from the southern Indo-Pacific at 510–1 200 m.

## KEY TO SPECIES

- 1a Illicial cavity strongly concave, black; esca dark brown or black anterodorsally, pale or white posteroventrally ..... *C. penicillatus*  
 1b Illicial cavity flat, pigmented as surrounding area; esca pale to dark brown ..... 2



- 1a Front of esca in illicial cavity, *Chaunax penicillatus* (left) and *C. fimbriatus/C. abei* groups (right) (both South Africa).  
 2a Cirri present on dorsal surface of head and usually in cluster above eyes; complex reticulate pattern on front of head sometimes present ..... 3 [*C. fimbriatus*-species group]  
 2b No cirri on dorsal surface of head; body with or without round spots on dorsal surface ..... 4 [*C. abei*-species group]  
 3a Body uniformly reddish; DG neuromasts 4; GR 11 or 12 on 2nd arch [deep water] ..... *C. flammeus*  
 3b Body covered with irregular brownish and dark brown patches and pale chain-like reticulate pattern; DG neuromasts 3; GR 8 or 9 on 2nd arch ..... *C. africanus*  
 4a GR 14 or 15 on 2nd arch; gill chamber and gill rakers blackish [deep water] ..... *C. russatus*  
 4b GR ≤12 on 2nd arch; gill chamber and gill rakers pale ..... 5  
 5a Spinules on dorsal surface stout, some bifurcated; body pale greyish red background, with small green spots surrounded by yellow; GR 9 or 10 on 2nd arch; BD neuromasts 2 ..... *C. atimovatae*  
 5b Spinules on dorsal surface slender and strongly curved, never bifurcate; body with moderately sized green spots without yellow surround, or body uniformly pale pink; GR 11 or 12 (rarely 10) on 2nd gill arch; BD neuromasts 3 (rarely 2) ..... 6  
 6a Cirri on esca uniformly dark brown; body covered with green spots (may become faded in preserved specimens) ..... *C. heemstraorum*  
 6b Cirri on esca pale or at most pale brown-tipped; body uniformly pale pink when fresh, uniformly pale in preservation ..... *C. apus*

*Chaunax africanus* Ho & Last 2013

African coffinfish

PLATE 50

*Chaunax africanus* Ho & Last 2013: 442, Figs. 4–5 (north of Beira, Mozambique).

Dorsal fin 12 rays; anal fin 7 rays; pectoral fins 13 or 14 rays; caudal fin 9 rays. LL neuromast series: BD = 2, CD = 6 or 7, DG = 3, FG = 3, GH = 10–12, and BI = 31 or 32. GR 8 or 9 on 2nd arch. Percentage SL: HL ~43%, head width ~24%, illicium length 2.8–4.4%, illicial trough length 5.5–6%, pre-illicium length 5.3–6.2%, upper jaw length 22–23%, post-anus length 32–36%, post-dorsal-fin length 16–18%, post-anal-fin length 12–14%, caudal-peduncle depth ~10%, and caudal-fin length 28–29%. A species in the *C. fimbriatus*-species group with: body covered with stout spinules; cirri on dorsal surface of head and supraocular membrane, each cirrus accompanied by a higher spinule; 3 or 4 pairs of spinules bridging each neuromast; illicium short and stout; illicial trough small, shallow, oval; broad band of spinules in front of illicial trough.

Body of preserved specimens with irregular brown patches and pale chain-like reticulate pattern, extending onto front of lower jaw, pectoral fins and caudal fin; irregular long brown bars radiating from eyes and at soft-rayed dorsal-fin base; esca with numerous thin pale cirri with brown tips; gill chamber and buccal cavity pale; peritoneum black. Attains 30 cm TL.

**DISTRIBUTION** Known only from two type specimens collected from Mozambique.

**REMARKS** Taken at 162–200 m.

*Chaunax apus* Lloyd 1909

Pink frogmouth

PLATE 50

*Chaunax apus* Lloyd 1909: 169 (Bay of Bengal, Myanmar).

Dorsal fin 12–13 rays; anal fin 7 rays; pectoral fins 12 or 13 rays; caudal fin 9 rays. LL neuromast series: BD = 3, CD = 5–7, DG = 3, FG = 3, GH = 13–17, and BI = 33–38. GR 11 or 12 on 2nd arch. Percentage SL: HL 38–41%, head width 14–17%, illicium length 2.8–3.4%, illicial trough length 4.5–6.3%, pre-illicium length 4.1–5.6%, upper jaw length 19–21%, post-anus length 33–39%, post-dorsal-fin length 17–20%, post-anal-fin length 13–18%, caudal-peduncle depth 7.1–8.1%, and caudal-fin length 27–30%. A species in the *C. abei*-species group with: body relatively long; simple slender and curved spinules

covering body; no cirri on top of head and supraocular membrane; usually 3 pairs of spines bridging each neuromast; illicium short and stout; illicial trough broad, oval; narrow band of spinules in front of illicial trough.

Fresh specimens uniformly pinkish or reddish; pale ventrally; cirri on esca pinkish or pale; gill chamber, buccal cavity and gill rakers pale; peritoneum black. Preserved specimens uniformly pale. Attains ~35 cm TL.

**DISTRIBUTION** Indo-Pacific, widespread in WIO.

**REMARKS** Known from 195–969 m. Similar to *C. nudiventer* from the tropical Pacific, but differs in having spinules densely covering ventral surface, BD neuromast series usually 3, and lacking greenish or reddish spots on dorsal surface. Also similar to *C. russatus* and *C. mulleus* but differs in having 3 spines on each side of neuromast (vs. 1); 12 rakers on 2nd gill arch (vs. 14 or 15); and pale gill arch and gill chamber (vs. greyish).

*Chaunax atimovatae* Ho & Ma 2016

Southern frogmouth

PLATE 50

*Chaunax atimovatae* Ho & Ma 2016: 176, Figs. 1A–C, 2 (off Mozambique).

Dorsal fin 12 rays; anal fin 7 rays; pectoral fins 12 or 13 rays; caudal fin 9 rays. LL neuromast series: BD = 2, CD = 6 or 7, DG = 3, FG = 3, GH = 11–14, and BI = 31–36. GR 9 or 10 on 2nd arch. Percentage SL: HL 38–44%, head width 16–20%, illicium length 4.3–5.3%, illicial trough length 6.2–9.2%, pre-illicium length 3.8–5.6%, upper jaw length 19–21%, post-anus length 27–37%, post-dorsal-fin length 15–19%, post-anal-fin length 13–16%, caudal-peduncle depth 7.7–8.4%, and caudal-fin length 27–35%. A species in the *C. abei*-species group with: body relatively stout and robust; some simple stout and bifurcated spinules covering body; no cirri on top of head and supraocular membrane; usually 3 pairs of spinules bridging each neuromast; illicium slender; illicial trough narrow; broad band of spinules in front of illicial trough.

Fresh specimens with dorsal surface with small irregular green spots surrounded by reddish grey background; pale ventrally; bright white flap-like cirri along margins of body and jaws; preserved specimens with dorsal surface covered with small irregular grey spots on uniformly paler greyish background; pale ventrally; cirri on esca dark brown; gill chamber, buccal cavity and gill rakers pale; peritoneum black, with small pale areas ventrally. Attains ~25 cm TL.





*Chaunax atimovatae*, 8 cm SL (Mozambique). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: Mozambique, South Africa (KwaZulu-Natal) and Madagascar.

**REMARKS** Found at 145–509 m. Similar to *C. abei* in NW Pacific region, but with fewer bifurcated spinules and different colouration.

### *Chaunax heemstraorum* Ho & Ma 2016

Heemstras' frogmouth

PLATE 50

*Chaunax heemstraorum* Ho & Ma 2016: 182, Fig. 4A–C (off Mozambique).

Dorsal fin 12 rays; anal fin 7 rays; pectoral fins 12 or 13 rays; caudal fin 9 rays. LL neuromast series: BD = 2–4, CD = 5–7, DG = 3 or 4, FG = 3, GH = 14–18, and BI = 38–41. GR 10–12 on 2nd arch. Percentage SL: HL 39–43%, head width 15–17%, illicium length 2.5–2.8%, illicial trough length 4.8–6.7%, pre-illicium length 4.7–6.1%, upper jaw length 19–20%, post-anus length 34–39%, post-dorsal-fin length 18–22%, post-anal-fin length 17–21%, caudal-peduncle depth 7.4–8.1%, and caudal-fin length 28–31%. A species in the *C. abei*-species group with: body moderately long; simple slender and slightly curved spinules covering body; no cirri on top of head and supraocular membrane; usually 3 pairs of spines bridging each neuromast; illicium short and stout; illicial trough broad, oval; broad band of spinules in front of illicial trough.

Fresh specimens with reddish background and medium-sized irregular green spots dorsally; pale ventrally; cirri on esca dark brown; gill chamber, buccal cavity and gill rakers pale; peritoneum black. Preserved specimens with uniformly pale background and irregular grey spots (or all spots may become faded); pale ventrally. Attains ~25 cm TL.



*Chaunax heemstraorum*, 19 cm SL, holotype (Mozambique). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Southern Africa: South Africa in southeastern Atlantic, to Mozambique, Kenya and Madagascar in WIO.

**REMARKS** Known from 172–774 m. Similar to *C. nudiventer* from the tropical Pacific, but differs in having spinules densely covering ventral surface, BD neuromast series usually 3, and ventral surface of smaller specimens lacking melanophores.

### *Chaunax penicillatus* McCulloch 1915

Pencil coffinfish

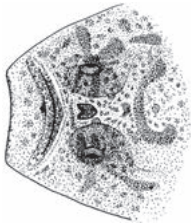
PLATE 50

*Chaunax penicillatus* McCulloch 1915: 167, Pl. 33, Fig. 2 (SW of Cape Everard, Victoria, Australia); SSF No. 103.1\*; Ho & Last 2013.

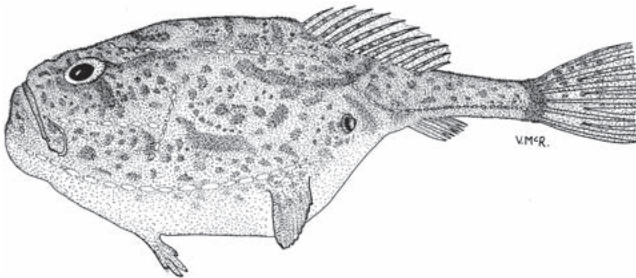
Dorsal fin 12 rays; anal fin 7 rays; pectoral fins 12 or 13 rays; caudal fin 9 rays. LL neuromast series: BD = 2, CD = 6 or 7, DG = 3, FG = 3, GH = 10–12, and BI = 31–35. GR 8 or 9 on 2nd arch. Percentage SL: HL 37–42%, head width 21–23%, illicium length 1.6–2.2%, illicial trough length 3.9–5.5%, pre-illicium length 4.2–4.8%, upper jaw length 20–23%, post-anus length 26–30%, post-dorsal-fin length 15–18%, post-anal-fin length 14–15%, caudal-peduncle depth 7.5–8.6%, and caudal-fin length 28–33%. A species in the *C. pictus*-species group with: slender and slightly curved spinules covering body; 1–6 (usually 3) pairs of spines bridging each neuromast; black and very deep illicial trough; illicium extremely short; esca covered by numerous stout black (anterior face) and white (posterior face) cirri; space between illicial trough and upper jaw very narrow.

Fresh specimens with dorsal surface with irregular yellowish to greenish broad vermicular pattern or irregular patches on orange-red background, and occasionally with large blackish

blotches; body of preserved specimens uniformly creamy white, sometimes with greyish blotches; buccal cavity pale; gill chamber pale with large blackish patch; peritoneum black. Attains ~35 cm TL.



*Chaunax penicillatus*, 26 cm TL  
(South Africa). Source: SSF



**DISTRIBUTION** Indo-Pacific (widespread). WIO: Kenya to South Africa and Madagascar; elsewhere to India, Indonesia, Philippines, Taiwan, Japan, Australia, New Caledonia, New Zealand and French Polynesia.

**REMARKS** Occurs at ~200–700 m. Description here based on WIO specimens; the fewer LL neuromasts in the pectoral and body-line series show slight differences from those of western Pacific populations.

## FAMILY OGCOEPHALIDAE

### Batfishes

Hsuan-Ching Ho and M Eric Anderson

Head and anterior portion of body greatly flattened and forming rounded, triangular or box-shaped disc, and posterior portion of body tail-like; some species with horn-like rostrum projecting forward from top of head. Body well-armoured with scales modified into pyramidal tubercles (and greatly modified into bucklers in some genera) or appearing as fine prickles; the spiny apices often multifid, especially those around edge of body, and lateral-line scales each with 2 or 3 projecting prongs. First dorsal-fin spine and its pterygiophore modified

into angling apparatus comprised of illicium (relatively short rod) and esca (fleshy tip), retractable into deeply concave cavity at front of head, with the illicial bone characteristically shaped in each genus; remainder of dorsal fin posteriorly set on tail portion of body, with 4–6 (rarely 3 or 7) rays (except fin much reduced or absent in *Halicmetus*). Pectoral fins large and leg-like, extending from laterally directed lobes with the support bones (radials) forming an 'elbow.' Pelvic fins small, on underside of disc, in advance of pectoral fins, with rudimentary spine and 5 soft rays (fins much reduced in *Coelophrys*). Anal fin appears as small lappet, with 3 or 4 rays, well behind anus. Caudal fin 9 rays. Mouth small, inferior and nearly horizontal; teeth villiform, in bands or patches, on tongue, jaws and upper pharyngeals, and also on palate in some genera. Gill pore just above inner side of pectoral-fin lobe. Gill arches 2½ or 2 (meaning the innermost arch is composed of either 1 row of gill filaments, namely the hemibranch, or entirely without filaments); gill rakers short, tubercular and with minute denticles, or else appear as flat pads with or without denticles (the latter not in WIO species). Body plain to mottled or brightly coloured.

Tiny to small-sized (~6–50 cm SL), superficially resembling rays but both paired fins serving as 'legs' on which batfishes hop or walk along the bottom; sluggish, mainly bottom-dwelling as adults, generally on outer continental shelf and upper slope. Occur in tropical and warm-temperate waters of all 3 major oceans, but the greatest diversity occurs in tropical waters of Indo-Pacific. Of little commercial importance due to their small size, but sometimes kept in aquariums.

The only synopsis of this family was given by Bradbury (1967). Methods of measuring lengths of dorsal fin, pectoral fins, anal fin and caudal fin follow Ho *et al.* (2009). Ten genera and at least 78 species, plus several undescribed species; 2 genera and at least 9 species in WIO known from depths of <200 m, and many other species in WIO occurring below 200 m, such as one from east of Mauritius found as deep as ~4 000 m.

#### KEY TO GENERA

[7 genera in WIO, but only 2 represented at depths of <200 m]

- 1a Disc markedly box-shaped or globose; pelvic fins minute; eyes laterally directed; peduncle very short (except for 1 species) ..... *Coelophrys* [deep water or benthopelagic]
- 1b Disc distinctly flattened; pelvic fins not minute; eyes dorsolaterally directed; peduncle longer than anal fin ..... 2

*Continued...*

## KEY TO GENERA

- 2a Disc markedly triangular; rostrum with horn-like spine at tip ..... *Malthopsis*
- 2b Disc rounded, dome-shaped or subtriangular; rostrum a broad plate without horn-like spine at tip ..... 3
- 3a Disc outline markedly rounded; gill arches 2½; black tongue-like appendage at base of illicium, and cirri on lower margin of esca ..... *Halieutaea*
- 3b Disc outline less rounded; gill arches 2; no appendage at base of illicium, and no cirri on lower margin of esca ..... 4
- 4a Scales in form of bucklers and small prickles; anterior margin of disc truncated, with rostrum a bony plate, usually short of anterior margin of disc ..... *Halicometus* [deep water]
- 4b Scales in form of tubercles; anterior margin of disc pointed, with rostrum a triangular shelf extending beyond anterior margin of disc ..... 5
- 5a Symphysis of upper jaw with deep notch; teeth present on corner of outer margin of premaxilla ... *Solocisquama* [deep water]
- 5b Symphysis of upper jaw without deep notch; no teeth on corner of outer margin of premaxilla ..... 6
- 6a Esca with 2 rounded, well-separated lower lobes; teeth on tongue forming 2 small well-separated patches ..... *Halieutopsis* [deep water]
- 6b Esca a triangular bulb; teeth on tongue forming 2 elongate patches closely attached to each other .... *Dibranchus* [deep water]

## GENUS *Halieutaea* Valenciennes 1837

Disc outline distinctly rounded; gill arches 2½, last arch with single row of gill filaments; esca with 1 tongue-like upper lobe and 2 rounded, poorly separated lower lobes; cirri present on lower margin of esca; black tongue-like appendage at base of illicium. Rostrum not forming broad shelf significantly overhanging mouth. Teeth on tongue in 2 well-separated paddle-shaped patches (each patch with long inner prolongation in 1 species) or in single oval patch; no teeth on vomer or palate. Scales tubercle-like and variously sized; interspaces naked or covered in prickles. This genus is in great need of systematic review; most nominal forms are very similar and have often been misidentified, and there are certainly undescribed species represented in collections. About 10 valid species; at least 5 nominal species and 3 undescribed species in WIO; of these *H. hancocki* Regan 1908 (from off

South Africa; Plate 51), *H. nigra* Alcock 1891 (from Indo-Pacific) and *Halieutaea* sp. 3 (from Mascarenes) are known only at depths of >200 m.

## KEY TO SPECIES

- 1a Rostrum may extend slightly beyond mouth; teeth on tongue in 2 paddle-shaped patches, each with long inner prolongation ..... *H. indica*
- 1b Rostrum short of mouth; teeth on tongue in oval patch with short and blunt inner prolongation ..... 2
- 2a Body uniformly and densely covered with short simple tubercles on dorsal and ventral surfaces, with some larger tubercles scattered on dorsal surface; no enlarged granular tubercles on sides of tail ..... *H. hancocki* [known from >200 m]
- 2b Body loosely covered by tall and slender tubercles, interspaces naked or with small tubercles; ventral surface naked, or with scattered black neuromasts, small granular tubercles or prickles ..... 3
- 3a Ventral surface with obvious black neuromasts ..... *H. nigra*  
[known only from >300 m]
- 3b No neuromasts on ventral surface, or neuromasts small and pale (difficult to detect) ..... 4
- 4a Ventral surface covered with small trifid granules and spinules ..... 5
- 4b Ventral surface naked ..... 6
- 5a Dorsal colouration includes scattered reticulate patches; ventral surface black and densely covered with spinules ..... *Halieutaea* sp. 1
- 5b Dorsal colouration includes dots on brownish vermicular patterns and row of small spots on outer margin of disc ..... *Halieutaea* sp. 2
- 6a Dorsal colouration includes symmetrical pair of oval black spots and pair of round pale patches; pectoral fins 14 or 15 (usually 14) rays ..... *H. fitzsimonsi*
- 6b Colouration not as above; pectoral fins 12–14 (usually 13) rays ..... 7
- 7a Peritoneum blackish; esca brown or black; thick brown reticulations on dorsal surface ..... *H. liogaster*
- 7b Peritoneum pale with small black dots; esca pale; thin broken dark line on dorsal surface ..... *Halieutaea* sp. 3  
[known only from >200 m]

*Halieutaea fitzsimonsi* (Gilchrist & Thompson 1916)

Circular seabat

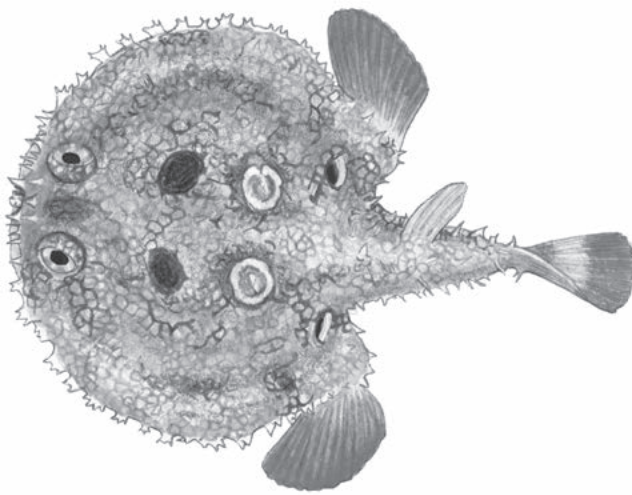
PLATE 51

*Halieutichthys fitzsimonsi* Gilchrist & Thompson 1916: 58, Fig. (Algoa Bay, Eastern Cape, South Africa); Barnard 1927.

*Halieutaea fitzsimonsi*: Smith 1935, 1949\*; Smith & Smith 1966\*; SSF No. 104.2\*.

Dorsal fin 4 or 5 rays; anal fin 4 rays; pectoral fins 14 or 15 rays. Percentage SL: HL 29–35%, head width 25–30%, eye diameter 10–12%, interorbital width 9–11%, predorsal length 69–75%, pre-anus length 67–72%, preanal length 78–84%, upper-jaw length 15–19%, dorsal-fin length 15–18%, pectoral-fin length 29–33%, anal-fin length 17–19%, and caudal-fin length 25–30%. Disc circular, slightly wider than long; rostrum not overhanging mouth. Body covered in high, robust tubercles, and interspaces naked; 3 or 4 enlarged granular tubercles on sides of tail; ventral surface entirely naked.

Body pinkish to reddish grey dorsally, with dark reticulations; symmetrical pair of oval black spots and pair of rounded pale patches at centre of disc; pectoral fins and caudal fin red or purplish, often with black margins; bright red ventrally. Attains 30 cm TL.



*Halieutaea fitzsimonsi* (Madagascar).

**DISTRIBUTION** Tanzania to South Africa (Plettenberg Bay) and Madagascar in WIO; possibly also to western Pacific.

**REMARKS** Found on flat bottom, at 20–457 m. Records from the western Pacific (Taiwan, Philippines, Japan, Solomon Is. and New Caledonia) may represent a different species.

*Halieutaea indica* Annandale & Jenkins 1910

Indian handfish

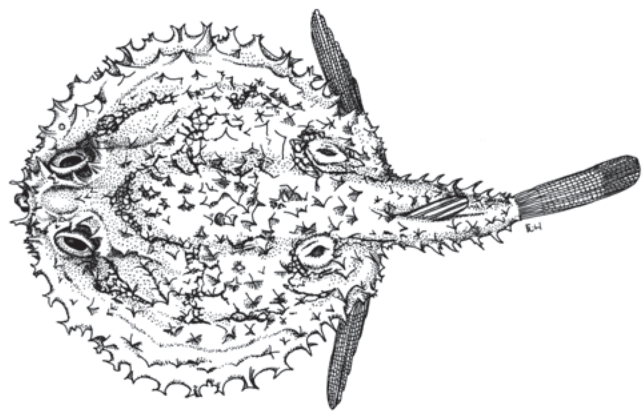
PLATE 51

*Halieutaea indica* Annandale & Jenkins 1910: 19, Pl. 2, Fig. 4 (off Odisha, India, Bay of Bengal).

*Halieutaea spicata* Smith 1965: 39, Pl. 11a (beach at Isipingo, Durban, KwaZulu-Natal, South Africa); SSF No. 104.4\*.

Dorsal fin 4 or 5 rays; anal fin 3 or 4 rays; pectoral fins 12 or 13 rays. Percentage SL: HL 29–32%, head width 25–28%, eye diameter 10–12%, interorbital width 7–9%, predorsal length 71–75%, pre-anus length 69–73%, preanal length 77–81%, upper-jaw length 14–16%, dorsal-fin length 13–16%, pectoral-fin length 25–28%, anal-fin length 17–19%, and caudal-fin length 27–31%. Disc circular, about as long as wide; rostrum may extend slightly beyond front margin of disc. Teeth on tongue in 2 paddle-shaped patches, each with long rear prolongation. Dorsal surface covered with medium-sized simple or bifurcate tubercles; no enlarged granular tubercles on sides of tail; ventral surface naked or with many scattered granular spinules.

Disc pale yellow-brown, with some symmetrical brown reticulations on dorsal surface; pectoral fins yellow-orange distally, with thin white band across middle of fins; 2 orange bars on caudal fin (bars brown in preservative); ventral surface pinkish. Attains 15 cm TL.



*Halieutaea indica*, 5 cm SL (South Africa).

**DISTRIBUTION** Indo-Pacific (widespread). WIO: South Africa (KwaZulu-Natal), Mozambique Channel, Madagascar, Seychelles and Pakistan; elsewhere to east coast of India, Indonesia, Philippines, China, Japan and Australia.

**REMARKS** Found on muddy bottom, at ~20–215 m. Indian Ocean specimens have shorter and more needle-like bifurcate tubercles on the dorsal surface than do fish from the western Pacific.



## *Halieutaea liogaster* Regan 1921

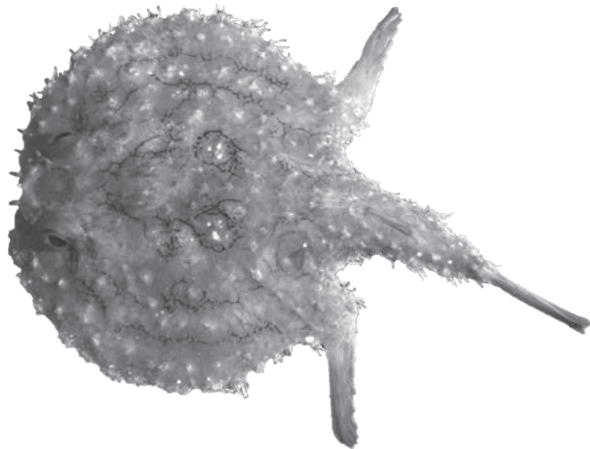
African circular seabat

PLATE 51

*Halieutaea liogaster* Regan 1921: 419 (off Umvoti River, KwaZulu-Natal, South Africa); Gilchrist 1922; Barnard 1927.

Dorsal fin 4 or 5 rays; anal fin 4 rays; pectoral fins 12–14 rays. Percentage SL: HL 29–34% SL; head width 25–28%, eye diameter 10–13%, interorbital width 9–11%, pre-dorsal length 68–76%, pre-anus length 62–72%, preanal length 75–81%, upper-jaw length 17–22%, dorsal-fin length 11–15%, pectoral-fin length 24–29%, anal-fin length 14–18%, and caudal-fin length 24–31%. Disc wider than long; rostrum not overhanging mouth. Disc covered with tall and strong tubercles, interspaces naked; 3 or 4 enlarged granular tubercles on sides of tail; ventral surface entirely naked.

Dorsal surface pinkish- to reddish-grey, with dark reticulations; no symmetrical oval black spots at centre of disc; ventral surface coral red; pectoral fins and caudal fin red or purplish, often with black margins. Attains 25 cm TL.



*Halieutaea liogaster*, 9 cm SL (Mozambique). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: Mozambique to South Africa (KwaZulu-Natal and Eastern Cape) and Madagascar.

**REMARKS** Found at 89–353 m. Previously considered a junior synonym of *H. fitsimensi* (Gilchrist & Thompson 1916), which has a pair of oval brown patches on disc.

## *Halieutaea* sp. 1

Black-belly batfish

Dorsal fin 4 rays; anal fin 4 rays; pectoral fins 13 rays. Percentage SL: HL 34%, head width 28%, eye diameter 13%, interorbital width 11%, predorsal length 72%, pre-anus length

68%, preanal length 77%, upper-jaw length 18%, dorsal-fin length 13%, pectoral-fin length 32%, anal-fin length 18%, and caudal-fin length 30%. Disc circular, wider than long; rostrum not overhanging mouth. Disc covered with granular tubercles, and interspaces loosely covered with smaller tubercles; 3 or 4 large tubercles on sides of tail; ventral surface densely covered with small simple tubercles and scattered granular forked tubercles.

Preserved specimen with several irregular patches of fine reticulations on pale greyish background; dorsal fin darker than disc, and other fins pale with broad black margins; uniformly blackish ventrally.

**REMARKS** Known only from one specimen (9 cm TL), collected off northern Mozambique at ~208 m.

## *Halieutaea* sp. 2

Alcock's batfish

Dorsal fin 4 or 5 rays; anal fin 3 or 4 rays; pectoral fins 13 or 14 rays. Percentage SL: HL 31–35%, head width 25–29%, eye diameter 11–12%, interorbital width 10–11%, predorsal length 73–76%, pre-anus length 32–36%, preanal length 42–48%, upper-jaw length 19–22%, dorsal-fin length 12–14%, pectoral-fin length 24–28%, anal-fin length 14–17%, and caudal-fin length 25–30%. Disc wider than long; rostrum not overhanging mouth. Disc covered with tall and strong tubercles, and interspaces covered with small simple or forked tubercles; 3 or 4 large granular tubercles on sides of tail; ventral surface loosely covered with small simple tubercles, and scattered granular forked tubercles.

Fresh specimens reddish brown dorsally, with many black dots on broad deep brown reticulations; outer margin of disc with irregular row of dots from gill pores to tail; all fins red-grey, with broad black margins; bright red ventrally. In preserved specimens, red colour fades but other markings are retained. Attains 25 cm TL.

**DISTRIBUTION** Indo-Pacific (possibly widespread). WIO: Red Sea to India; elsewhere to South China Sea (common), Japan and Australia.

**REMARKS** Usually found at <100 m, sometimes nearshore. Records of this species in the Red Sea and some areas of the Indian Ocean were previously referred to *Halieutaea stellata* (Vahl 1797).

GENUS *Malthopsis* Alcock 1891

Disc markedly triangular; rostrum with broad base, strongly pointed and long, overhanging mouth; gill arches 2. Esca a single oval bulb bearing 2 small cirri on dorsal margin. Scales in the form of bucklers and simple prickles; subopercular bucklers usually well-developed, with some enlarged spines. Teeth on vomer and palate forming 3 quadrangular patches; teeth on tongue in 2 elongate close-set patches. Body uniformly yellowish brown to grey or dark brown, and usually with ocelli, spots, patches or reticulations; peritoneum pale. About 11 valid species (Ho 2013), plus several undescribed species represented in collections; 5 species in WIO, but *M. retifera* (Ho *et al.* 2009) from off Somalia is known only from 375–420 m.

## KEY TO SPECIES

- |    |  |   |
|----|--|---|
| 1a | Ventral surface covered with minute prickles, sometimes mixed with small bucklers .....  | 2   |
| 1b | Ventral surface covered only with bucklers, and rest of body naked .....   | 3   |
| 2a | Bucklers on body blunt; ventral surface covered with minute prickles, plus some small bucklers in front of pelvic-fin bases; fine reticulate pattern on dorsal surface ..... | <i>M. bradburyae</i>                        |
| 2b | Bucklers on body pointed; ventral surface covered with mix of small bucklers and minute prickles; some small black patches or spots on dorsal surface .....                  | <i>M. australiana</i>                       |
| 3a | Two anteriorly directed spines on subopercle buckler; vomer with elongate patch of villiform teeth; pectoral fins 14 or 15 rays .....  | <i>M. mitrigeria</i>                        |
| 3b | One anteriorly directed spine on subopercle buckler; vomer with rectangular patch of villiform teeth; pectoral fins 12 or 13 (rarely 11 or 14) rays .....                    | 4   |
| 4a | Dorsal surface with reticulate pattern and 5 pairs of black dots on disc margin .....  | <i>M. retifera</i> [known only from >300 m] |
| 4b | Body uniformly greyish to dark brown, but with some black dots on dorsal surface; no reticulate pattern on dorsal surface and no black dots on edge of disc .....            | <i>M. gigas</i>                             |

*Malthopsis australiana* Ho 2013

Southern African triangular batfish

PLATE 52

*Malthopsis australiana* Ho 2013: 294, Figs. 3–5 (off Mozambique).*Malthopsis lutea* (non Alcock 1891): Smith 1961\*.*Malthopsis tiarella* (non Jordan 1902): SSF No. 104.8\*.

Dorsal fin 4 or 5 rays; anal fin 3 or 4 rays; pectoral fins 12 or 13 rays. Percentage SL: HL 25–30%, head width 21–26%, eye diameter 11–15%, interorbital width 7–10%, rostral length 6–11%, predorsal length 64–69%, pre-anus length 53–58%, preanal length 78–82%, mouth width 11–15%, dorsal-fin length 14–20%, pectoral-fin length 21–25%, anal-fin length 14–19%, and caudal-fin length 23–27%. Body less robust; disc flattened, head slightly elevated above disc; rostrum directed forward horizontally. Eyes small; interorbital space wide and forming deep groove. Dorsal surface covered with low conical bucklers, and numerous prickles in interspaces; subopercle buckler blunt, without well-developed spines; ventral surface densely covered with mix of minute prickles and small flat bucklers, and bucklers on breast slightly larger and denser than those on belly. Anal fin reaches to or beyond caudal-fin base when fully laid back.

Fresh specimens uniformly yellowish brown dorsally, with some darker patches or small spots on dorsal surface and sides of tail; cirri along sides of disc and tail white; pelvic fins and anal fin pale; caudal fin with pale brown base, broad brownish band, and narrow pale margin; ventral surface uniformly pale. Preserved specimens uniformly brownish dorsally, with yellowish to pale brown bucklers, and small irregular dark brown patch on each shoulder (some with additional brown patch before gill pores, and some with small spots running from shoulder to gill pores); fins pale, and sometimes black-tipped (except not pectoral fins). Attains at least 8.4 cm SL.

**DISTRIBUTION** WIO: Mozambique (Maputo), South Africa (KwaZulu-Natal and Eastern Cape) and Madagascar.

**REMARKS** Bottom-dwelling on outer continental shelf, at 170–700 m, but one paratype collected from an estuarine lagoon (Coffee Bay, South Africa). Records from the Indian Ocean were previously referred to *M. tiarella* Jordan 1902 (known from Taiwan and Japan); *M. lutea* Alcock 1891 is known from Andaman Sea only.



*Malthopsis austraficana*, 7 cm SL (top); 6 cm SL (bottom), paratypes (Mozambique). PC Heemstra © NRF-SAIAB

### *Malthopsis bradburyae* Ho 2013

Bradbury's triangular batfish

PLATE 52

*Malthopsis bradburyae* Ho 2013: 290, Figs. 1–2 (Tanzania).

Dorsal fin 5 or 6 rays; anal fin 3 or 4 rays; pectoral fins 12 or 13 rays. Percentage SL: HL 26–30%, head width 21–25%, eye diameter 11–14%, interorbital width 8–10%, rostral length 6–9%, predorsal length 65–70%, pre-anus length 53–58%, preanal length 78–83%, mouth width 13–16%, dorsal-fin length 17–20%, pectoral-fin length 21–24%, anal-fin length 15–21%, and caudal-fin length 24–29%. Body less robust; disc flattened, head slightly elevated above disc; rostrum moderately long and pointed, directed forward horizontally (not upward). Eyes small; interorbital space broad and forming deep groove. Dorsal surface covered with blunt bucklers and numerous prickles; ventral surface densely covered with prickles and small bucklers, some larger bucklers on breast; subopercle buckler blunt, without well-developed spines; ventral surface densely covered with minute prickles and some

small bucklers in front of pelvic-fin bases, plus some larger bucklers scattered on breast. Anal fin nearly reaches caudal-fin base when fully laid back.

Preserved specimens uniformly creamy yellowish, some with fine brown reticulations on shoulder, but no brown band on peduncle. Attains at least 7.2 cm SL.

**DISTRIBUTION** Known only from eight type specimens collected from Tanzania.

**REMARKS** Taken on the upper continental shelf at ~100 m.

### *Malthopsis gigas* Ho & Shao 2010

Giant triangular batfish

PLATE 52

*Malthopsis gigas* Ho & Shao 2010: 13, Figs. 2–5 (Tashi fish market, Yilan, Taiwan).

Indian Ocean specimens: dorsal fin 5 or 6 rays; anal fin 3 or 4 rays; pectoral fins 11–14 rays. Percentage SL: HL 27–31%, head width 25–28%, eye diameter 12–15%, interorbital width 5–9%, rostral length 3–12%, predorsal length 67–71%, pre-anus length 55–58%, preanal length 79–84%, mouth width 14–16%, dorsal-fin length 16–29%, pectoral-fin length 21–26%, anal-fin length 16–20%, and caudal-fin length 24–30%. Body very robust; head well-elevated above disc; rostrum thick and pointed, directed forward and upward. Eyes large; interorbital space wide and flat. Dorsal surface heavily covered with strong conical bucklers, with some small flat bucklers in interspaces; subopercle buckler bears strong spines (one directed forward, and others directed outward and backwards); ventral surface densely covered with medium-sized bucklers.

Body uniformly grey to dark brown, often with small black spots on dorsal surface and dark band on peduncle; fins dark, except anal fin may be paler; ventral surface pale to brownish grey. Attains ~14 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Somalia, South Africa (KwaZulu-Natal) and Madagascar; elsewhere to Japan, New Zealand and French Polynesia.

**REMARKS** Indian Ocean specimens often have a smaller rostrum than Pacific Ocean specimens, suggesting geographically distinct populations. Found on outer continental shelf to upper slope, at 275–438 m in Indian Ocean, and at 210–650 m in western Pacific.

*Malthopsis mitrigeria* Gilbert & Cramer 1897

Two-spine batfish

PLATE 52

*Malthopsis mitrigeria* Gilbert & Cramer 1897: 434, Pl. 48, Figs. 1–2 (Hawaii); Jordan & Evermann 1905\*.*Malthopsis mitrigeria*: Gilbert 1905; Bradbury 1967; Masuda *et al.* 1984\*; Okamura 1986\*; SSF No. 104.7\*; Adam *et al.* 1998.*Malthopsis triangularis* Lloyd 1909: 169 (Andaman Sea); Smith 1949\*.

Dorsal fin 4 or 5 rays; anal fin 3 or 4 rays; pectoral fins 13–15 rays. Percentage SL: HL ~29%, head width ~29%, eye diameter ~14%, interorbital width ~11%, rostral length ~8%, predorsal length ~68%, pre-anus length 55%, preanal length ~79%, mouth width ~14%, dorsal-fin length ~13%, pectoral-fin length ~23%, anal-fin length ~16%, and caudal-fin length ~23%. Body relatively small; disc markedly triangular, usually very wide. Eyes moderately large; interorbital space wide and flat; broad space between rostral base and illicial cavity. Dorsal surface scattered with large, smooth, blunt bucklers, and some small flat bucklers on edges of disc; interspaces mostly naked; subopercle buckler flat, greatly produced laterally and slightly curved, with spines directed forward, upward and backwards; central portion of ventral surface covered with bucklers similar to those on dorsal surface. Vomer with wide band of

villiform teeth. Anal fin far short of caudal-fin base when fully laid back.

Fresh specimens yellowish to greenish dorsally, without reticulations; paler ventrally; fins pale bluish to black in small specimens, becoming yellow-brown with dark markings in larger fish. Attains 8 cm SL.

**DISTRIBUTION** Probably continuous across tropical Indo-Pacific. WIO: South Africa (off Cape Point to KwaZulu-Natal), Madagascar and Maldives; elsewhere to Taiwan, southern Japan, northern Australia, New Caledonia, New Zealand and Hawaii.

**REMARKS** Known in WIO from 90–460 m. Specimens from the Indian Ocean have a pointed rostrum, and specimens from the western Pacific have a blunter rostrum, suggesting two populations may be present.

**GLOSSARY**

**hemibranch** – a gill with filaments only on one side of gill arch.

**pterygiophores** – internal bones that attach dorsal- and anal-fin rays to internal musculature.



# ORDER MUGILIFORMES

Javad Ghasemzadeh

Mulletts are currently recognised as belonging to the percomorph series Smegmamorpharia, order Mugiliformes, comprising the single family Mugilidae. Synapomorphies diagnosing the order are also those diagnosing the family, for which two synapomorphies are: 1) a pectoral girdle associated with 3 extrascapular bones, the 3rd (posteriormost) extremely elongate (Stiassny 1993); and 2) a distinctive configuration of the dorsal fin and its supports: namely, 4 dorsal-fin spines, the anteriormost 3 spines robust and crowded; 1st pterygiophore inserting behind the 6th or 7th neural spine, robust and much larger than succeeding ones; 3 very small spineless pterygiophores between the spinous and soft-rayed dorsal fins; all 7 pterygiophores anterior to the 2nd dorsal fin lacking distal radials; and, 2nd dorsal fin with 1 thin spine (segmented at its distal tip), 7–10 soft rays (Nelson *et al.* 2010).

## FAMILY MUGILIDAE

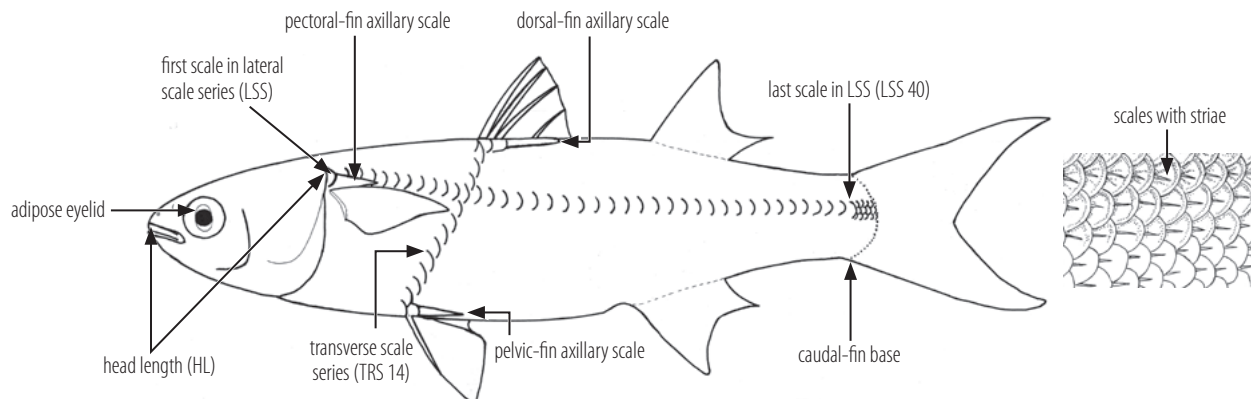
### Mulletts

Javad Ghasemzadeh

External morphology remarkably similar among species, resulting in confusion in their identification. Body moderately elongate and subcylindrical (size range ~20–90 cm TL), compressed posteriorly; head broad and depressed in most, and almost completely scaly; 2 well-separated dorsal fins on rear half of body. Eyes often partly covered by adipose eyelid; 2 nostrils anterior to each eye. Mouth terminal or inferior; premaxilla protrusile; maxilla almost or entirely hidden beneath preorbital bone. Teeth small and hidden or absent on lips, and variably developed on palatines, vomer,

endopterygoids, tongue and basihyal. First dorsal fin roughly midway between snout tip and caudal-fin base, with 4 spines, and elongate scaly process at base; 2nd dorsal fin with 9–11 segmented rays, first ray short, slender, unbranched and frequently mistaken for a spine. Anal fin slightly in advance of 2nd dorsal fin, with 2 or 3 spines, 8–12 rays. Pectoral fins inserted high on body, with 14–20 rays, short spur at base, and with or without elongate axillary scale. Pelvic fins sub-abdominal, with 1 spine, 5 rays, long axillary scale, and elongate wedge-shaped interpelvic scaly flange. Caudal fin symmetrical, distinctly forked in most species, truncate or emarginate in a few species. No visible lateral line. Scales moderate to large, cycloid or ctenoid, with 1 or more longitudinal rows of striae, and scales of *Moolgarda* and *Crenimugil* with crenulated membranous rear margin; all fins except 1st dorsal fin more or less scaly; LSS (lateral scale series from upper insertion of pectoral fin to caudal-fin base) 24–64; TRS (transverse rows of scales between 1st dorsal-fin base and pelvic-fin base) 8–16. Gill arches modified as branchial basket for filter feeding, with specialised pharyngobranchial organ and pharyngeal sulcus, which vary in size and shape between species; gill rakers long and slender, variable in size, their numbers increasing with growth (hence, not dependable for species identification). Stomach muscular, usually gizzard-like (except in *Agonostomus*), with a variable number of pyloric caeca; intestine long and elaborately convoluted. Body usually dark olive, blue, brown, greenish or greyish dorsally, silvery or yellowish ventrally, and flanks silvery, with pale yellowish tinge in some species; dark stripes often present on some transverse rows of scales; fins usually dusky, except pelvic fins often pale yellow with dusky margins. Vertebrae 24–26.

Most species are euryhaline, inhabiting coastal marine waters, estuaries and brackish lagoons, to 20 m or deeper.



External features of a typical mugilid.

Some species migrate up rivers and return to brackish waters or to the sea for spawning; coastal species usually spawn offshore. Typically form schools, and some species are prone to leap from the water, a habit which may enable them to escape an approaching predator or seine. Feed mostly on fine algae, diatoms, small invertebrates and detritus by filtering large quantities of sediment through the gill rakers and browsing on submerged surfaces. Many species are of commercial importance; caught with castnets, setnets, liftnets and beach seines. Owing to their rapid growth and hardiness, a few species have been cultured successfully.

The most recent worldwide account of the Mugilidae was presented by Thomson (1997), who accepted as valid 14 of 40 described genera, and 62 of 280 nominal species. Ghasemzadeh (1998, unpublished thesis) reviewed the systematics, phylogeny and distribution of Indo-Pacific and Australian mullets; using morphological and osteological data, he recognised as valid 18 of 40 genera worldwide, and also described a new genus, *Paramugil* (Ghasemzadeh *et al.* 2004); he specifically recognised 14 genera and 27 species in Indo-Pacific waters. Due to the present lack of consensus among mullet taxonomists about morpho-anatomical characters and molecular findings, a conservative approach to naming genera and species has been taken in this text. Twenty genera and 71 species worldwide; probably 8 genera and ~20 species in WIO.

**Note:** Van der Elst & Wallace (1976) published a useful article on the identification of fry of the species; even though their key does not include all the species included here, it is given at the end of this family chapter to aid with identification of small juveniles.

## KEY TO GENERA

- 1a Anal fin 2 spines in adults; lips thick and without papillae, lamellae or crenulations; teeth sessile (i.e., directly attached to jaw bones); no adipose eyelid; maxilla hidden; stomach without gizzard; scales ctenoid ..... *Agonostomus*
- 1b Anal fin 3 spines in adults (sometimes 2 spines in young <6 cm SL); lips thick or thin; teeth on jaws distal-type; adipose eyelid present or absent; maxilla exposed or hidden; stomach muscular with gizzard; scales cycloid or ctenoid ..... 2
- 2a Lips thin, upper lip with 1 row of spatulate or villiform teeth; anal fin 9 rays; no adipose eyelid; scales mostly cycloid, LSS 43–45; maxilla exposed, relatively robust in lateral view, gradually narrowing and slightly curved downwards towards rear ..... *Myxus*
- 2b Lips thin or thick and with crenulations or longitudinal lobes; anal fin  $\leq 9$  rays ( $\leq 10$  pterygiophores); adipose eyelid variably developed or absent; scales cycloid or ctenoid; 2nd dorsal fin 9 rays (9 pterygiophores); pyloric caeca  $\geq 2$  ..... 3

Continued ...

## KEY TO GENERA

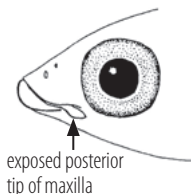
- 3a Anal fin 3 spines, 8 rays (9 pterygiophores in adults) ..... 4
- 3b Anal fin 3 spines, 9 rays (10 pterygiophores in adults) ..... 5
- 4a Caudal fin forked; adipose eyelid well-developed; teeth on vomer, palatines, tongue and basihyal; pyloric caeca simple with 2 branches; scales cycloid; LSS 37–43 ..... *Mugil*
- 4b Caudal fin truncate, with rear margin nearly straight; no adipose eyelid; teeth on vomer, tongue and basihyal, but no teeth on palatines; pyloric caeca with >15 branches; scales weakly ctenoid in adults, cycloid in juveniles; LSS 26–28 ..... *Ellochelon*
- 5a Scales ctenoid, without membranous finger-like rear margin; pectoral-fin axillary scale rudimentary or absent; rear end of maxilla either visible posteroventral to corner of closed mouth or completely or partially concealed when mouth closed ..... 6
- 5b Scales ctenoid and with membranous finger-like rear margin; pectoral-fin axillary scale present and distinct; maxilla slender and weakly curved downwards posteriorly, rear end completely concealed posteroventral to corner of closed mouth ..... 7



- 6a Preorbital bone deeply notched; lips with distinct rugose fringe, upper lip thick and split into longitudinal lobes, and lips deeply folded into preorbital notch at corner of mouth; pyloric caeca 3 ..... *Oedalechilus*



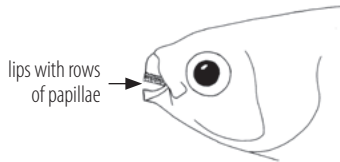
- 6b Preorbital bone moderately notched, broad and squarish at posteroventral border and slightly kinked at serrate anterior margin; lips thin and simple; maxilla robust and S-shaped, rear end distinctly curved downwards and visible posteroventral to corner of closed mouth; pyloric caeca 5 or 6 ..... *Chelon*



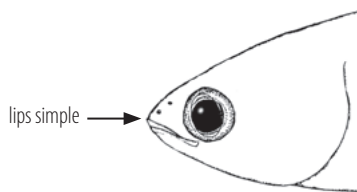
Continued ...

**KEY TO GENERA**

- 7a Upper lip more or less thick, with enlarged crenulations or papillae on lower portion; lower lip thin, simple or fringed with row of fine crenulations; no adipose eyelid over iris (present only as narrow ring around eyes) ..... *Crenimugil*



- 7b Both lips thin and simple, without crenulations or papillae; adipose eyelid variably developed or absent ..... *Moolgarda*



**GENUS** *Agonostomus* Bennett 1832

Body robust, head narrow; interorbital region markedly convex; preorbital bone massive, without folds or ridges, not kinked; no adipose eyelid. First dorsal-fin origin nearer snout tip than caudal-fin base; anal fin 2 spines; caudal fin forked. Mouth oblique in juveniles, less so in adults; corner of mouth at level of lower rim of eye in small fish, and well below rim of eye in large fish; end of upper jaw on line of gape, positioned at vertical with anterior half of eye in small fish, but under anterior half of eye in large fish; maxilla straight, not curving downwards behind mouth corner, maxilla pad not visible below and behind mouth corner. Lips thick, without external papillae or crenulations; height of upper lip at mid-gape  $> \frac{1}{2}$  eye diameter; lower lip not turned down, entire, and slightly recessed behind upper lip; no symphyseal knob and no fleshy lobes externally between lower jaws. Teeth in several rows, directly attached to jaw bones, inner rows multicuspidate in some species; teeth present on tongue, endopterygoids, vomer and palatines. No opercular spine. Scales ctenoid; no pectoral-fin axillary scale. Stomach not gizzard-like; pyloric caeca 2. Three species, 1 in WIO.

*Agonostomus telfairii* Bennett 1832

Fairy mullet

PLATE 53

*Agonostomus telfairii* Bennett 1832: 166 (Mauritius, Mascarenes); Fricke *et al.* 2009.

*Nestis cyprinoides* Valenciennes in Cuv. & Val. 1836: 167, Pl. 317 (Réunion and Mauritius, Mascarenes).

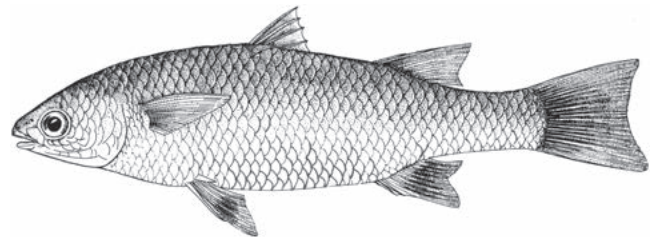
*Nestis dubuloides* Valenciennes in Cuv. & Val. 1836: 171 (Mauritius, Mascarenes); Fricke 1999.

*Agonostomus telfairii* var. *catalai* Pellegrin 1932: 426 (Upper Mananano, Madagascar); Pellegrin 1933\*.

*Agonostomus catalai*: Thomson & Luther 1984\*.

Diagnosis as for genus. Second dorsal fin 9 rays; anal fin 2 spines, 10 rays; pectoral fins 1 spur, 17 rays. GR 27–32/34–42. Body robust, depth 24–26% SL; head bluntly rounded, HL 24–27% SL. Upper lip height subequal to eye diameter, its median upper edge expanded and filling obvious concavity in snout. Teeth incisor-like, unicuspid, slightly curved, barely showing in lower jaw. Tongue without median ridge. Preorbital bone filling space between lip and eye, lower edge reaching below lower rim of eye. Pectoral fins reaching front half of eyes when laid forward, and reaching to anterior  $\frac{1}{3}$ – $\frac{1}{2}$  of pelvic fins when laid back (not to tip of pelvic-fin spine, and not to below 1st dorsal-fin origin); 2nd dorsal-fin origin over anterior quarter of anal-fin base; anal fin higher than 2nd dorsal fin, but both fins higher than 1st dorsal fin. Scales with short mucous canals; head naked to between posterior nostrils and anterior rim of eyes; 2nd dorsal fin and anal fin sparsely scaled anteriorly; LSS 42–44; TRS 12 or 13.

Body olive-brown dorsally, yellowish white below; fins brownish; iris purple. Attains ~36 cm SL (commonly 20 cm SL).



*Agonostomus telfairii*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** WIO: Madagascar, Comoros, Seychelles, Réunion and Mauritius.

**REMARKS** Inhabits freshwater, with occasional incursions into estuaries.

GENUS *Chelon* Artedi 1793

Mouth terminal; lips thin, without fleshy ornamentation or fleshy lamellae at lower jaw symphysis. Maxilla curved downwards, S-shaped at rear tip and visible posteroventral to corner of closed mouth; angle of dentary symphysis variably obtuse. Upper lip with 1 outer row of relatively close-set teeth, and 1 or 2 irregular rows of smaller wider-set teeth behind it. Lower lip directed forwards, not folding down, with single high symphyseal knob (except feebly double symphyseal knob in *C. subviridis*); teeth on lip minute and often wholly embedded in lip tissue in older fish (thus appearing edentate in most species). Teeth simple, ciliiform or setiform (except tricuspid teeth in *C. tricuspiciens*) on tongue and endopterygoids, and variably present on vomer, palatines and basihyal. Tongue usually keeled or domed medially. Adipose eyelid variably developed over iris, but reduced to rim around eyes in some species. Nostrils nearer to each other than to lip or eyes; posterior nostril below or level with upper rim of eye. Preorbital bone kinked anteriorly, with serrate anterior margin, and posteroventral end usually squarish. Scales ctenoid; the shape and number of striae on scales variable within some species (e.g., *C. dumerili*). Pectoral fins inserted at level of upper rim of eye; no axillary scale. Anal fin 3 spines in adults, 9 rays, fin origin well in front of 2nd dorsal-fin origin. Pharyngobranchial organ denticulate area, sulcus, and valve sizes variable between different species. Pyloric caeca 4–6. At least 17 species, 10 in WIO.

## KEY TO SPECIES

- 1a Teeth in upper lip tricuspid ..... *C. tricuspiciens*  
 1b Teeth in upper lip unicuspid ..... 2
- 2a LSS >42; pyloric caeca 4; adipose eyelid covering iris or present as rim around eye ..... 3  
 2b LSS <42; pyloric caeca >4; adipose eyelid variably developed ..... 4
- 3a LSS 44–50; adipose eyelid covering iris; upper lip with 1 row of peg-like teeth ..... *C. abu*  
 3b LSS 43–48; adipose eyelid present as rim around eye; upper lip with villiform teeth ..... *C. richardsonii*
- 4a Mid-dorsal line of body anterior to 1st dorsal fin moderately to sharply keeled ..... *C. carinatus*  
 4b Mid-dorsal line of body anterior to 1st dorsal fin not keeled ..... 5

## KEY TO SPECIES

- 5a Scales anterior to 1st dorsal fin with  $\geq 5$  mucous canals ..... *C. dumerili*  
 5b Scales anterior to 1st dorsal fin with 1 or 2 mucous canals ..... 6
- 6a Adipose eyelid moderately developed, covering most of iris ..... 7  
 6b Adipose eyelid poorly developed, present as rim around eyes ..... 8
- 7a Body elongate, relatively slender; head pointed and depressed dorsally, HL greater than body depth; eyes relatively small, diameter 20–26% HL; 1st dorsal-fin origin usually nearer caudal-fin base than snout tip, but often midway between; caudal-fin margin black; LSS 30–35; TRS 9–13 ..... *C. tade*  
 7b Body moderately robust; head broad, dorsally flattened and bluntly pointed, HL subequal to body depth; eye diameter 23–30% HL, longer than snout length; caudal-fin margin dusky; LSS 28–32 (rarely 27 or 33); TRS 10–12 ..... *C. subviridis*
- 8a Body moderately robust; upper lip with outer row of small, close-set, peg-like unicuspid teeth at the edge and 2–4 inner rows of smaller, wider-set, irregularly scattered teeth (inner rows well-spaced from front row, and more evident in fish >8 cm SL); lower lip sometimes with 1 row of small villiform teeth (often absent), and teeth present on vomer, palatines, endopterygoids, tongue and basihyal; caudal fin forked; LSS 30–35; TRS 10–12 ..... *C. macrolepis*  
 8b Body elongate or moderately robust; upper lip with 1 row of small, curved, unicuspid or setiform teeth, and 1–5 inner rows of smaller teeth; lower lip sometimes with 1 row of villiform teeth (often absent), and no teeth on palatines; LSS 28–32; caudal fin forked or emarginate ..... 9
- 9a Body elongate, moderately deep, and compressed at peduncle, body depth at 1st dorsal-fin origin 22–23% SL; 2nd dorsal fin and anal fin emarginate; pelvic-fin origins midway between pectoral-fin origins and 1st dorsal-fin origin; caudal fin forked, with dark margin; upper lip with 1 row of small, curved, close-set unicuspid teeth; scales on upper flanks dark-edged, giving reticulated appearance, and upper rows of scales with dark horizontal streaks; teeth present on vomer, endopterygoids, tongue and basihyal, no teeth on palatines ..... *C. alata*  
 9b Body moderately robust, and well-compressed at peduncle, body depth at 1st dorsal-fin origin 26–33% SL; pelvic-fin origins closer to pectoral-fin origins than to dorsal-fin origin; caudal fin emarginate and dusky; scale rows on upper flanks with faint longitudinal lines; upper lip with 1 row of close-set setiform teeth, and 1 inner row of well-spaced villiform teeth; teeth present on endopterygoids and basihyal, no teeth on vomer and palatines ..... *C. melinopterus*

Continued...



## *Chelon abu* (Heckel 1843)

Abu mullet

PLATE 53

*Mugil abu* Heckel 1843: 1097 [107] (Tigris River, near Mosul, Iraq).

*Mugil pseudoteles* Pietschmann 1912: 268 (Shatt al-Arab at Basra, Iraq).

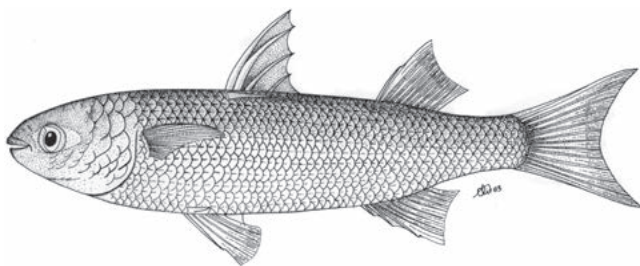
*Mugil (Liza) hishmi* Misra in Hora & Misra 1943: 10, Fig. 5 (rivers and hors [? marshes], Iraq).

*Mugil (Liza) abu zarudnyi* Berg 1949: 852, Figs. 73–75 (upper part of Karun River, Iran); Svetovidov 1949\*.

*Liza abu*: Thomson & Luther 1984\*; Kuronuma & Abe 1986\*; Coad 1991, 1995; Ünlü *et al.* 2000.

Pectoral fins 1 spur, 16 or 17 rays. Body moderately robust, depth 24–25% SL; head bluntly pointed, HL 22–24% SL; interorbital region slightly convex, its width less than twice eye diameter; eye diameter greater than snout length; corner of mouth slightly behind anterior nostril; end of upper jaw reaching vertical at front rim of eye. Adipose eyelid somewhat covering iris. Preorbital bone slender, filling space between lip and eye, and slightly notched. Upper lip with 1 row of peg-like teeth; lower lip with scattered ciliate teeth. No teeth on vomer and palatines. Tongue with high keel, recessed at anterior tip. First dorsal-fin origin nearer snout tip than caudal-fin base, 1st spine considerably longer than 2nd spine, 4th spine weak and not reaching behind tip of 3rd spine when fin raised; scaly process reaching half distance along membrane behind 4th spine. Second dorsal-fin origin at vertical over anterior third of anal-fin base; anal fin not as high as 1st dorsal fin, but higher than 2nd dorsal fin. Pectoral fins reaching rear half of eyes when laid forward, and not quite reaching vertical from 1st dorsal-fin origin when laid back, but reaching  $\frac{1}{3}$ – $\frac{1}{2}$  along pelvic fins (but not to spine tip). Pelvic-fin origins at vertical nearer 1st dorsal-fin origin than pectoral-fin origins, axillary scale  $\sim\frac{1}{2}$  length of spine. Caudal fin moderately forked. GR 28–32/44–58. LSS 44–50; TRS 14 or 15; head naked to behind posterior nostril; 12 or 13 predorsal scales; 8 or 9 interdorsal scales; bases of 2nd dorsal fin and anal fin with some scales anteriorly; 15 circumpeduncular scales. Pyloric caeca 4.

Head and body pale greenish brown dorsally; silvery on flanks and abdomen. Attains 20 cm SL (commonly 17 cm SL).



*Chelon abu*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** WIO: rivers entering Persian/Arabian Gulf (i.e., Tigris, Euphrates, Shatt al-Arab, Karun and Karkheh). Lessepsian migrant to Mediterranean Sea.

**REMARKS** Enters brackish waters of estuaries or mangroves for spawning. This species is now placed in the genus *Planiliza* (Durand *et al.* 2012; Durand & Borsa 2015).

## *Chelon alata* (Steindachner 1892)

Diamond mullet

PLATE 53

*Mugil alatus* Steindachner 1892: 364 [8, 133] (rivers and Antananarivo Bay, Madagascar).

*Mugil diadema* Gilchrist & Thompson 1911: 42 (Durban Bay, KwaZulu-Natal, South Africa); Barnard 1925\*; Marshall 1957\*.

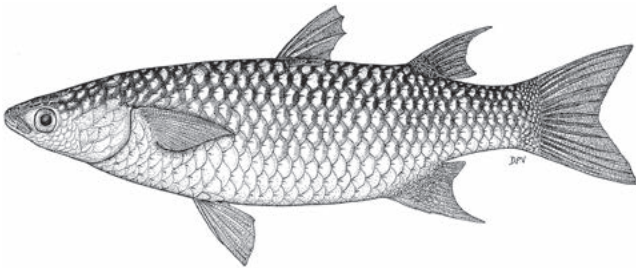
*Mugil compressus* (*non* Günther 1861): Smith 1935\*.

*Pteromugil diadema*: SFSA No. 881\*.

*Liza alata*: Smith 1975\*; Thomson & Luther 1984\*; SSF No. 222.2\*; Liu & Shen 1991\*; Shen 1993\*; Thomson 1997\*; Fricke 1999.

Pectoral fins 1 spur, 15–17 rays. Body elongate, moderately deep (depth 22–32% SL), and compressed at peduncle; head pointed and almost flattened dorsally, HL 22–25% SL, and longer than or subequal to body depth; snout pointed, its length usually subequal to or shorter than eye diameter in fish <8 cm SL, but longer than eye diameter in larger fish; interorbital region slightly convex, its width sometimes more than twice eye diameter. Adipose eyelid poorly developed as narrow rim around eyes. Preorbital bone broad anterodorsally, anterior margin serrate and slightly emarginate, and posteroventral end broad and squarish. Nostrils close-set, midway between eyes and snout tip. Upper lip with 1 outer row of small, curved, close-set unicuspid teeth, and  $\leq 5$  irregular inner rows of smaller teeth. Lower lip with 1 row of ciliiform teeth (but teeth often absent in adults). Teeth present on endopterygoids, tongue, vomer and basihyal; no teeth on palatines. Tongue high-keeled. First dorsal-fin origin nearer caudal-fin base than snout tip; 1st spine slightly longer than or subequal to 2nd spine; scaly process long, reaching beyond 4th spine. Second dorsal-fin origin at vertical behind anterior  $\frac{1}{3}$ – $\frac{1}{2}$  of anal-fin base, both fins emarginate and subequal; 2nd dorsal fin higher than 1st dorsal fin. Pectoral fins reaching to below 1st dorsal-fin origin. Pelvic fins subequal to pectoral fins; pelvic-fin origins midway between origins of pectoral fins and 1st dorsal fin; axillary scale  $\sim\frac{1}{2}$  length of spine. Caudal fin forked, upper lobe may be slightly longer than lower lobe. GR 20–22/50–60. LSS 29–32; TRS 10–12; predorsal scales 19–22; bases of 2nd dorsal fin, anal fin and caudal fin scaly. Pyloric caeca 5. [Also included at end in key to juveniles.]

Body pale brown dorsally, flanks dusky brown, abdomen yellowish in small specimens, or white with yellowish tinge in adults; opercle and cheek yellowish; scales on flanks, especially upper part of body, with dark edges giving diamond-shaped reticulate appearance, and upper rows of scales with dark horizontal streaks; 1st dorsal fin olive with dark tinge; 2nd dorsal fin grey, darkest at tip; pectoral fins greyish yellow, dusky at bases and upper margins; pelvic fins and anal fin yellow; caudal fin yellowish grey, dusky distally. Attains ~65 cm TL (commonly 35 cm SL).



*Chelon alata*, 19 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** WIO: Mozambique (Luabo) to South Africa (Algoa Bay), Madagascar and Mauritius.

### *Chelon carinatus* (Valenciennes 1836)

Keeled mullet

PLATE 53

*Mugil carinatus* Valenciennes (ex Ehrenberg) in Cuv. & Val. 1836: 148 (Red Sea); Bleeker 1853; Day 1865, 1876, 1888; Klunzinger 1870; Sauvage 1891; Fowler 1925; Pellegrin 1933; Pillay 1962; Pandey & Sandhu 1992.  
*Chelon klunzingeri*: Day 1888; Randall 1995.  
*Mugil klunzingeri*: Day 1888.  
*Liza carinata*: Trewavas & Ingham 1972\*; Masuda *et al.* 1984\*; Thomson & Luther 1984\*.

Pectoral fins 1 spur, 15–17 rays. Body moderately robust, depth 24–26% SL; head wide, flattened dorsally and bluntly pointed, HL 28–30% SL. Adipose eyelid covering ~½ of iris. Maxilla extending to or slightly past front rim of eye. Upper lip with 1 row of tiny teeth along edge; no visible teeth on lower lip. No teeth on vomer and palatines. Tongue slightly keeled. First dorsal-fin origin equidistant between snout tip and caudal-fin base. Second dorsal-fin origin at vertical over anterior quarter of anal fin. Pectoral fins when laid back usually barely reaching vertical at 1st dorsal-fin origin. Caudal fin emarginate or forked. GR 30–36/41–62. Scales with moderately long mucous canals, and double canals on some dorsal scales, scales fewer on flanks; LSS 32–38; TRS 13; predorsal scales 11, thickened in midline and forming ridge; 2nd dorsal fin and anal fin somewhat scaly anteriorly and along bases. Pyloric caeca 5.

Body greenish grey dorsally, silvery below; golden tinge around eyes; basal half of dorsal, caudal and pectoral fins with fine black spots. Attains 20 cm TL.



*Chelon carinatus*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** WIO: Red Sea, Persian/Arabian Gulf, Pakistan and India; Lessepsian migrant to Mediterranean Sea.

**REMARKS** Mainly inhabits marine coastal waters.

### *Chelon dumerili* (Steindachner 1870)

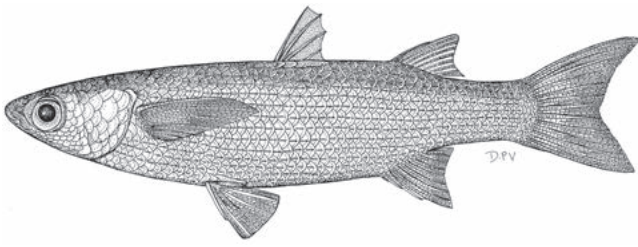
Grooved mullet

PLATE 53

*Mugil dumerili* Steindachner 1870: 959 [15] (St Louis, Senegal).  
*Mugil canaliculatus* Smith 1935: 630, Fig. 15, Pls. 16–18 (Knysna, Western Cape, South Africa).  
*Strializa canaliculatus*: SFSA No. 884\*.  
*Liza dumerili*: Smith 1975\*; SSF No. 222.3\* [as *dumerilii*].

Pectoral fins 1 spur, 16 rays. Body slender, depth 24–25% SL; head wide, dorsally flattened and bluntly pointed, HL 24–25% SL. Adipose eyelid reduced to rim around eyes. Upper lip with 1–3 rows of sparse, short teeth; lower lip with villiform teeth in young fish, but no teeth in older fish. Teeth present on tongue, endopterygoids, vomer and palatines. First dorsal-fin origin equidistant between snout tip and caudal-fin base. Second dorsal-fin origin at vertical only slightly behind anal-fin origin. Pectoral fins when laid forward reach to between eye and anterior nostril, fin length 90–96% HL. Pelvic-fin origins distinctly nearer pectoral-fin origins than 1st dorsal-fin origin. GR 18–25/40–47. Scales with moderately long mucous canals: 5–8 canals on anterior dorsal scales, 2–4 canals on posterior dorsal scales, and usually 1 canal on most flank scales (some with 2 or 3 canals); head naked to anterior nostrils; predorsal scales 12 or 13; bases of 2nd dorsal fin and anal fin sparsely scaly anteriorly; LSS 36–39; TRS 13 or 14. Pyloric caeca 6. [Also included at end in key to juveniles.]

Body dark olive dorsally, flanks silvery, and abdomen yellowish white. Attains 40 cm SL.



*Chelon dumerili*, 11 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Eastern Atlantic (Mauritania to Namibia) and Indian Ocean. WIO: South Africa (False Bay and common on Cape south coast) to southern Mozambique (Bazaruto).

**REMARKS** Enters estuaries and tidal rivers, which are used as nursery areas.

### *Chelon macrolepis* (Smith 1846)

Largescale mullet

PLATE 53

*Mugil macrolepis* Smith 1846; no page number, Pl. 28, Fig. 2 (rivers and freshwater lakes, South Africa); Boulenger 1916; Fowler 1925; Pellegrin 1933; Smith 1935; Herre 1939; John 1955; Pillay 1962; Goren & Dor 1994; Heemstra *et al.* 2004.

*Mugil smithii* Castelnau 1861: 47 (Table Bay, South Africa) [proposed independently of *Mugil smithii* Günther 1861, based on *Mugil capensis* of Smith 1846]; Sauvage 1891.

*Mugil crenilepis* Castelnau 1861: 49 (Gamtoos River mouth, South Africa).

*Mugil olivaceus* Day 1876: 357 ('seas of India,' ascending rivers); Day 1889.

*Mugil troschelii*: Day 1878\*.

*Mugil hoefleri*: Steindachner 1882; Boulenger 1916.

*Liza macrolepis*: Herre 1939; John 1955; SFSA No. 886\*; Wallace & Van der Elst 1975\*; Masuda *et al.* 1984; Talwar & Kacker 1984; Thomson & Luther 1984\*; SSF No. 222.5\*; Winterbottom *et al.* 1989\*; Skelton 1993\*; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*.

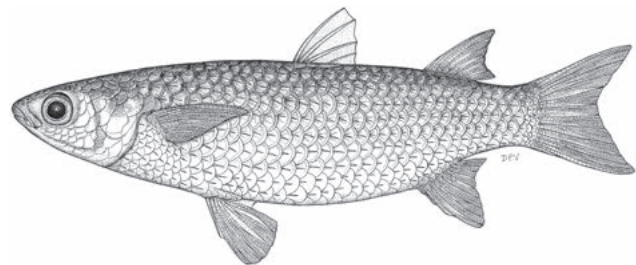
*Chelon macrolepis*: Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Fricke *et al.* 2013.

*Chelon persicus* Senou, Randall & Okiyama *in* Randall 1995: 235, Fig. 611 (Doha fish market, Qatar, Persian/Arabian Gulf).

Pectoral fins 1 spur, 14–16 rays. Body moderately robust, depth 26–33% SL; head dorsally flattened, bluntly pointed, HL 26–32% SL, and subequal to body depth; eye diameter 23–28% HL, and longer than snout; interorbital region slightly convex, its width less than twice eye diameter. Adipose eyelid usually reduced to narrow rim around eyes. Preorbital bone broad anterodorsally, broad and squarish posteroventrally. Upper lip dentition distinctive with 1 row of very close-set, small, peg-like unicuspid teeth at edge, and 2–4 inner rows of wider-set, smaller, irregularly scattered teeth (inner tooth rows more evident in fish >8 cm SL). Lower lip with 1 row of

villiform teeth, or teeth frequently absent. Teeth present on tongue, endopterygoids, vomer, palatines and basihyal. Tongue high-keeled. First dorsal-fin origin distinctly closer to caudal-fin base than snout tip; 1st spine longer than 2nd spine; scaly process long, reaching beyond 4th spine. Second dorsal-fin origin at vertical just behind anterior  $\frac{1}{4}$ – $\frac{1}{2}$  of anal fin, both fins emarginate. Dorsal fins subequal in height but shorter than anal fin. Pectoral fins not reaching to below 1st dorsal-fin origin. Pelvic fins shorter than pectoral fins; pelvic-fin origins closer to pectoral-fin origins than to 1st dorsal fin. Caudal fin forked. GR 26–42/53–78. Scales relatively large; LSS 30–35; TRS 10–12; dorsal-fin bases densely scaly anteriorly, and fins often entirely scaly; caudal fin scaly. Pyloric caeca 5 or 6. [Also included at end in key to juveniles.]

Body greenish grey dorsally, flanks and abdomen silvery; dorsal fins grey or bluish, moderately dusky; pectoral fins yellowish grey, with dusky upper margins, golden base, and sometimes dark spot at insertion; pelvic fins and anal fin white, frequently with yellowish tinge; caudal fin bluish grey with dusky margin; usually golden ring around iris. Attains 40 cm SL (commonly 25–30 cm SL).



*Chelon macrolepis*, 19 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Persian/Arabian Gulf, Oman, Red Sea, East Africa to South Africa (Eastern Cape), Madagascar, Seychelles, Rodrigues and Chagos; elsewhere to Bay of Bengal, China Sea, Japan, Marianas Is., northern Australia, New Caledonia, Cook Is., Tuamotu Is. and Marquesas Is.

**REMARKS** This species is now placed in the genus *Planiliza* (Durand *et al.* 2012; Durand & Borsa 2015).

### *Chelon melinopterus* (Valenciennes 1836)

Giantscale mullet

PLATE 53

*Mugil melinopterus* Valenciennes (ex Quoy & Gaimard) *in* Cuv. & Val. 1836: 146, Pl. 314 (Vanikoro I., Santa Cruz Is.).

*Mugil oligolepis* (non Bleeker 1859): Day 1878.

*Liza oligolepis* (non Bleeker 1859): SFSA No. 885\*.

*Ellochelon luciae* Penrith & Penrith 1967: 69, Fig. 1 (St Lucia estuary, KwaZulu-Natal, South Africa); Wallace & Van der Elst 1975\*.



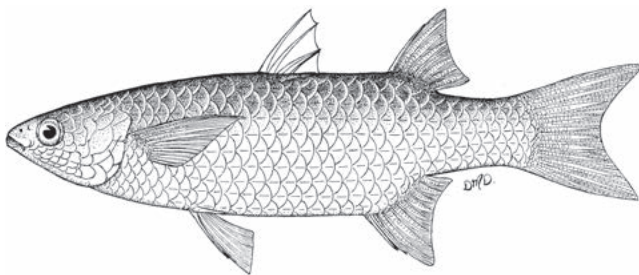
*Liza luciae*: Smith 1975\*; SSF No. 222.4\*; Heemstra & Heemstra 2004.

*Liza melinoptera*: SSF No. 222.6\*.

*Chelon melinopterus*: Senou 1997; Fricke *et al.* 2009.

Pectoral fins 1 spur, 14 or 15 rays. Body moderately robust, and well-compressed at peduncle; dorsal profile relatively convex; body depth at 1st dorsal-fin origin 26–33% SL, body depth at anus 24–28% SL, and peduncle depth 12–14% SL. Head pointed, deeper than wide, almost flattened dorsally; HL 26–30% SL, and subequal to body depth. Snout blunt and depressed, profile nearly straight to 1st dorsal-fin origin in adults, snout length shorter than eye diameter; eye diameter 23–27% HL; interorbital width less than twice eye diameter. Adipose eyelid usually reduced to narrow rim around eyes. Preorbital bone broad, serrate anterior margin moderately kinked, posteroventral end broad and squarish. Upper lip with 1 row of close-set, short, slightly curved setiform teeth along edge, and inner row of fine well-spaced teeth. Lower lip directed forwards, with 1 row of small villiform teeth (but teeth frequently absent). Teeth present on tongue, endopterygoids and basihyal; no teeth on vomer and palatines. Tongue with high keel. First dorsal-fin origin distinctly nearer caudal-fin base than snout tip; 1st spine longer than 2nd spine; scaly process long, reaching past 4th spine. Second dorsal-fin origin at vertical almost behind middle of anal-fin base, both fins emarginate; height of both dorsal fins and anal fin subequal. Pectoral fins not reaching to below 1st dorsal-fin origin, their length 19–24% SL, 66–79% HL, and less than HL minus snout length. Pelvic fins shorter than pectoral fins, fin origins closer to pectoral-fin origins than to 1st dorsal-fin origin. Caudal fin emarginate. GR 40–45/46–60. Scales large; bases of 2nd dorsal fin and anal fin scaly; predorsal scales 17–21; interdorsal scales 7 or 8; LSS 28–31; TRS 9 or 10; circumpeduncular scales 16; caudal fin scaly. Pyloric caeca 5 or 6. [Also included at end in key to juveniles.]

Body olive-brown to pale brown dorsally, flanks silvery, abdomen whitish; faint longitudinal stripes along upper scale rows; 1st dorsal fin dusky olive; 2nd dorsal fin and caudal fin grey with darker specks; pectoral fins greyish, dusky at base and upper margin; pelvic fins and anal fin white. Attains 22 cm SL, 30 cm TL (commonly 18 cm TL).



*Chelon melinopterus*, 22 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden to South Africa (KwaZulu-Natal), Madagascar, Seychelles, Réunion, India and Sri Lanka; elsewhere to Philippines, South China Sea, Ryukyu Is., New Guinea, Australia, New Caledonia, Tonga and Marquesas Is.

### *Chelon richardsonii* (Smith 1846)

Southern mullet

PLATE 53

*Mugil richardsonii* Smith 1846: no page number, Pl. 29, Fig. 1 (Cape Seas, South Africa); Günther 1861; Kner 1865\*.

*Mugil multilineatus* Smith 1846: no page number, Pl. 30, Fig. 2 (east and west coasts, and rivers and lakes of Cape Colony, South Africa); Bleeker 1860; Günther 1861\*.

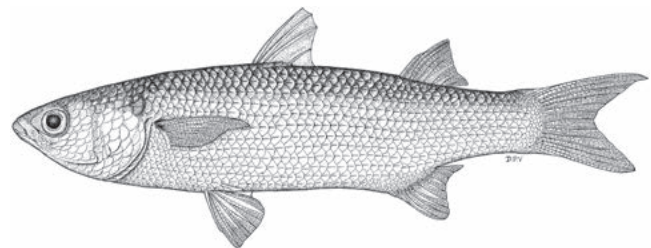
*Liza ramada* (non Risso 1827): Smith 1949\*; SFSA No. 887\*.

*Liza richardsonii*: Poll 1959\*; SSF No. 222.7\*; Heemstra & Heemstra 2004\*.

*Mugil richardsoni*: Smith 1965\*; Smith & Smith 1966\*; Wallace & Van der Elst 1975\*; Van der Elst & Wallace 1976\*; Van der Elst 1981\*.

Pectoral fins 1 spur, 15–18 rays. Body slender, elongate, depth 22–23% SL; head moderately wide, dorsally flattened, HL 25–28% SL. Adipose eyelid reduced to narrow rim around eyes. Preorbital bone wide, filling space between lip and eye, and kinked anteriorly. Upper lip with row of villiform teeth at edge, and scattered smaller teeth behind; lower lip edentate, lip folding up at rear end and obscuring upper lip. Teeth present on tongue, endopterygoids, vomer and palatines. First dorsal-fin origin slightly nearer snout tip than caudal-fin base; 2nd dorsal-fin origin behind anterior third of anal fin. Pectoral fins not reaching to eyes when laid forward, and reaching to above anterior third of pelvic fins when laid back. Caudal fin somewhat lunate. GR 30–35/50–57. LSS 43–48; TRS 15; bases of 2nd dorsal fin and anal fin scaly anteriorly. Pyloric caeca 4. [Also included at end in key to juveniles.]

Body bluish grey dorsally, flanks silvery, white ventrally. Attains 40 cm SL (commonly 30 cm SL).



*Chelon richardsonii*, 16 cm SL (South Africa). Source: Whitfield 1998



**DISTRIBUTION** Southern Africa: Angola in southeastern Atlantic, to South Africa (St Lucia) in WIO.

**REMARKS** Less abundant in warmer waters; juveniles known from Berg River, on west coast of South Africa, to Kwelera River, Eastern Cape.

### *Chelon subviridis* (Valenciennes 1836)

Greenback mullet

PLATE 53

*Mugil subviridis* Valenciennes in Cuv. & Val. 1836: 115 (Ganges River, India); Günther 1861; Day 1865, 1878; Goren & Dor 1994; Manilo & Bogorodsky 2003.

*Mugil dussumieri* Valenciennes in Cuv. & Val. 1836: 147 (Mumbai and Coromandel coast, India); Blegvad & Løppenthin 1944\*; John 1955\*.

*Mugil jerdoni* Day 1876: 352 ('seas of India'); Deva-Sundaram 1951\*.

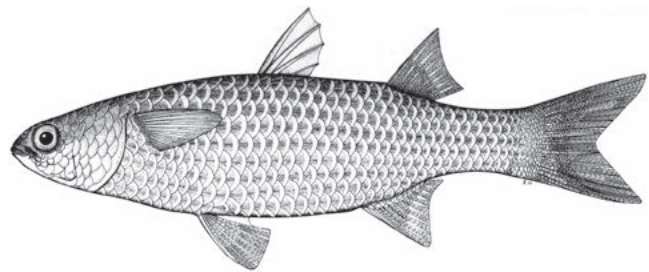
*Mugil alcocki* Ogilby 1908: 21 (Chennai, India) [based on *Mugil subviridis* of Günther 1861: 423].

*Liza subviridis*: Talwar & Kacker 1984; Thomson & Luther 1984\*; Thomson 1997.

*Chelon subviridis*: Randall 1995\*.

Pectoral fins 1 spur, 14–17 rays. Body moderately robust, depth 26–32% SL, dorsal profile relatively straight; head broad, dorsally flattened, bluntly pointed, HL 23–24% SL and subequal to body depth; snout blunt, length usually shorter than eye diameter. Adipose eyelid covering at least half of iris (not yet distinct in fish <4 cm SL). Preorbital bone triangular, expanded anterodorsally, serrate anterior margin moderately kinked, posteroventral end broad and squarish. Upper lip with 1 row of small, close-set, setiform teeth anteriorly, and 1 or 2 rows of sparse villiform teeth behind. Lower lip directed forwards, bearing feeble double symphyseal knob and 1 row of villiform teeth (teeth often absent in larger fish). Maxilla produced into terminal hook at rear tip. No teeth on vomer, palatines and basihyal. Tongue with high keel. First dorsal-fin origin usually nearer caudal-fin base than tip of snout, but sometimes midway between; 1st dorsal-fin spine subequal to or slightly shorter than 2nd spine. Second dorsal-fin origin at vertical behind anterior  $\frac{1}{3}$ – $\frac{1}{2}$  of anal fin, both fins moderately curved, higher than 1st dorsal fin. Pectoral fins not reaching to below dorsal-fin origin. Caudal fin moderately forked. GR 30–36/42–62. LSS 28–33; TRS 10–12; 2nd dorsal fin and anal fin densely scaly; predorsal scales 18–23; interdorsal scales 7–9; 16 or 17 circumpeduncular scales. Pyloric caeca 5.

Head brownish, body dark green dorsally, silvery laterally, white ventrally; 5 or 6 indistinct dark stripes along upper scale rows; dorsal fins pale green to greyish; pectoral fins faint green to yellowish, often with blue spot at insertions; pelvic fins and anal fin pale yellow; caudal fin bluish with black margin (especially in fresh specimens). Attains ~40 cm TL (commonly 25 cm SL).



*Chelon subviridis*, 13 cm SL (South Africa). © D Cyrus

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, East Africa to southern Mozambique (Pomene) to South Africa (KwaZulu-Natal to Eastern Cape), southwestern India and Sri Lanka; elsewhere to Bay of Bengal.

**REMARKS** This species is now placed in the genus *Planiliza* (Durand *et al.* 2012; Durand & Borsa 2015).

### *Chelon tade* (Fabricius 1775)

Tade mullet

*Mugil crenilabis tade* Fabricius in Niebuhr (ex Forsskål) 1775: 74,

xiv (unspecified locality, Red Sea); Klunzinger 1870, 1884; Day 1889;

Deva-Sundaram 1951; Pillay 1951, 1962; John 1955.

*Mugil bontah* Bleeker 1853: 48 (Puducherry and West Bengal, India).

*Mugil belanak*: Day 1878, 1889; Pandey & Sandhu 1992.

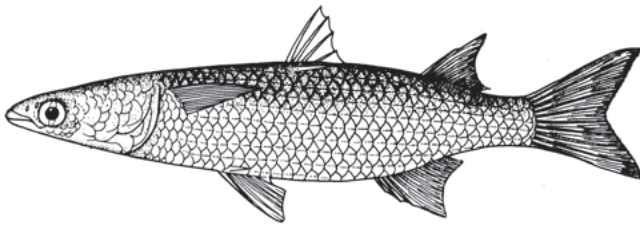
*Liza tade*: Munro 1955\*; Talwar & Kacker 1984; Thomson & Luther 1984\*;

Goren & Dor 1994; Thomson 1997.

Pectoral fins 1 spur, 15–17 rays. Body elongate, relatively slender, depth 22–31% SL. Head broad, pointed, dorsally depressed; HL 21–31% SL, and subequal to body depth; snout bluntly pointed, length usually shorter than eye diameter in fish ~16 cm SL, but subequal to or greater than eye diameter in larger fish; interorbital width sometimes more than twice eye diameter. Adipose eyelid covering most of iris (but not distinct in fish <4 cm SL). Posteroventral end of maxilla covered by skin sheath but visible as a pad at corner of closed mouth. Preorbital bone broad anterodorsally, serrate anterior margin moderately kinked, posteroventral end broad and squarish. Upper lip with one front row of fine, close-set setiform teeth and 2–5 (sometimes more) inner rows of smaller setiform teeth. Lower lip bearing double symphyseal knob, and 1 row of villiform teeth (often missing in larger fish). No teeth on vomer, palatines and basihyal. Tongue with high keel. First dorsal-fin origin usually nearer caudal-fin base than tip of snout, but often midway between; 1st dorsal-fin spine slightly shorter than 2nd spine. Second dorsal-fin origin at vertical behind  $\frac{1}{3}$ – $\frac{1}{2}$  anal-fin base; 2nd dorsal and anal fins subequal in

height, but higher than 1st dorsal fin, and both fins moderately curved. Pectoral fins do not reach 1st dorsal-fin origin. Caudal fin moderately forked. GR 36–45/47–65. LSS 30–35; TRS 9–13; bases of 2nd dorsal fin and anal fin scaly, and fins often sparsely scaly distally. Pyloric caeca 5 or 6.

Body olive-brown dorsally, flanks silvery, white ventrally; 5–7 indistinct longitudinal stripes along upper scale rows; dorsal fins pale brown to greyish; pectoral fins pale brown to yellow, often with blue spot at insertion; pelvic fins and anal fin pale yellow; caudal fin greyish to pale blue, margin usually black. Attains 70 cm TL (commonly 35 cm SL).



*Chelon tade*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indian Ocean. WIO: Red Sea, Arabian Sea, Persian/Arabian Gulf, west coast of India, and Sri Lanka; elsewhere to east coast of India.

**REMARKS** This species is now placed in the genus *Planiliza* (Durand *et al.* 2012; Durand & Borsa 2015).

### *Chelon tricuspidentis* (Smith 1935)

Striped mullet

PLATE 54

*Mugil tricuspidentis* Smith 1935: 618, Fig. 10, Pls. 17–18 (Knysna, Western Cape, South Africa); Smith & Smith 1966\*.

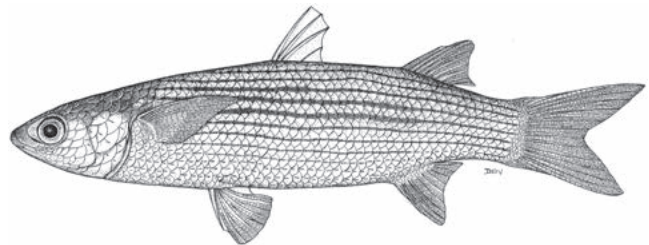
*Heteromugil tricuspidentis*: SFSA No. 882\*; Edwards 1971.

*Liza tricuspidentis*: Wallace & Van der Elst 1975\*; Van der Elst & Wallace 1976\*; Blaber 1977\*; Van der Elst 1981\*; Thomson & Luther 1984\*; SSF No. 222.8\*; Heemstra & Heemstra 2004.

Pectoral fins 1 spur, 17 or 18 rays. Body robust, depth 24–27% SL; head moderately wide, bluntly pointed, HL 23–25% SL. Adipose eyelid reduced to rim around eyes. Preorbital bone wide, filling space between lip and eye, kinked anteriorly. Rear end of maxilla at vertical just behind posterior nostril. Upper lip with 2 rows of tricuspid teeth, and scattered teeth between rows; lower lip toothless. Teeth unicuspid on tongue, endopterygoids and vomer; no teeth on palatines. First dorsal-fin origin equidistant between snout tip and

caudal-fin base; 2nd dorsal-fin origin at vertical over anterior quarter of anal fin; anal fin higher than 2nd dorsal fin, and both fins falcate and higher than 1st dorsal fin. Caudal fin lunate. GR 32–34/55–62. Scales with narrow and moderately long mucous canals, some scales dorsally and a few on flanks with double or branching canals; head naked before anterior nostrils; 2nd dorsal fin and anal fin densely scaly; LSS 42–45; TRS 14 or 15. Pyloric caeca 6. [Also included at end in key to juveniles.]

Body greenish brown dorsally, flanks silvery, white ventrally. Attains commonly 15–35 cm SL.



*Chelon tricuspidentis*, 17 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Southern Africa: Angola in southeastern Atlantic, to South Africa (Palmiet River estuary, on south coast, to Kosi estuary, KwaZulu-Natal) in WIO.

### GENUS *Crenimugil* Schultz 1946

Snout blunt in profile, usually shorter than eye diameter. Mouth terminal, gape horizontal; maxilla relatively slender, posterior part weakly curved inwards at corner of mouth and concealed when mouth closed; lower jaw wider than long, angle of dentary symphysis obtuse. Upper lip with papillae or crenulations on lower portion; lower lip simple or fringed with row of fine crenulations. Teeth present on endopterygoids, tongue and basihyal; no teeth on lips, vomer and palatines. Tongue raised medially, forming shallow ridge. Adipose eyelid reduced to narrow ring around eyes. Posterior nostril reaching above level of upper rim of eye, and anterior nostril below this; inter-nostril distance less than width of posterior nostril. Preorbital bone not kinked but weakly concave anteriorly, posteroventral end squarish. Pectoral fins inserted at level of upper rim of eyes; axillary scale long and pointed. Anal fin with 3 spines in adults, 9 rays, fin origin at vertical slightly in front of 2nd dorsal-fin origin. Scales ctenoid, with membranous finger-like margin. Pyloric caeca 7–10. Two species, 1 in WIO.

## *Crenimugil crenilabris* (Forsskål 1775)

Fringelip mullet

PLATE 54

*Mugil crenilabris* Forsskål in Niebuhr 1775: xiv, 73 (Red Sea); Bonnaterre 1788; Bloch & Schneider 1801; Shaw 1804; Rüppell 1835; Valenciennes 1836; Günther 1861; Kner 1865; Klunzinger 1870\*, 1884\*; Günther 1877; Day 1878; Norman 1922\*; Barnard 1925\*; Roxas 1934; Smith 1935\*, 1937\*, 1949\*, 1975\*; Van der Elst & Wallace 1976\*.

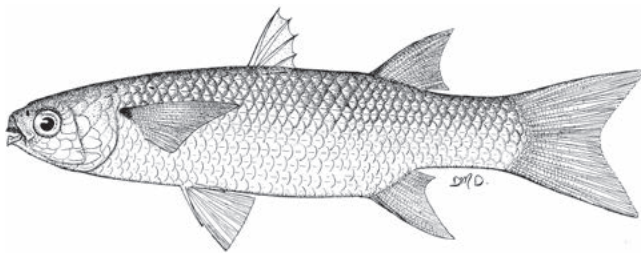
*Mugil fasciatus* Valenciennes (ex Ehrenberg) in Cuv. & Val. 1836: 125 (Red Sea).

*Mugil rueppellii* Günther 1861: 458 (Red Sea).

*Crenimugil crenilabris*: SFSA No. 880\*; Randall 1983\*; Masuda *et al.* 1984\*; Thomson & Luther 1984\*; SSF No. 222.1\*; Winterbottom *et al.* 1989\*; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

Diagnosis as for genus. First dorsal-fin spines slender, first spine longest; 2nd dorsal fin 9 rays; pectoral fins 1 spur, 15–17 rays. Dorsal profile of head and body almost straight; body moderately deep, 25–31% SL; head deeper than wide, relatively flattened dorsally; HL 25–32% SL, and HL greater than body depth in juveniles, but less so in fish >15 cm SL; snout length 18–24% HL; eye diameter 23–30% HL; interorbital region wide and almost flat, its width >1.5 times eye diameter, and subequal to postorbital length. Upper lip remarkably thick, developing up to 10 (usually 5 or 6) rows of papillae on lower third (visible in fish >3 cm SL), the papillae largest in lower rows and with bifid or flat tips. Lower lip thin, folded out and downwards, with crenate edge and 1 or 2 rows of papillae on inner surface. Nostrils almost equidistant from each other, the rim of eyes, and the hind margin of upper lip. Dorsal fins deeply emarginate; anal fin higher than 2nd dorsal fin, but both fins higher than 1st dorsal fin; caudal fin forked. GR 35–45/58–78. LSS 36–40; TRS 12–14; predorsal scales extending forward nearly to posterior nostrils; both dorsal fins almost completely scaly. [Also included at end in key to juveniles.]

Body olive-green to bluish brown dorsally, flanks silvery, abdomen whitish; distinct dark purplish spot at upper insertion of pectoral fins. Attains commonly 25–35 cm TL.



*Crenimugil crenilabris*, 25 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Red Sea, Mozambique to South Africa (Great Fish River, Eastern Cape),

Madagascar, Seychelles, Chagos and Lakshadweep; elsewhere to Indonesia, southern Japan, Wake Atoll, Marshall Is., Australia, Lord Howe I., Rapa Iti, Tuamotu Is. and Marquesas Is.

**REMARKS** Widespread in shallow waters, especially around coral reefs.

## GENUS *Ellochelon* Whitley 1930

Body robust, head broad and dorsally flattened; anal-fin origin distinctly in front of 2nd dorsal-fin origin; peduncle relatively deep; caudal fin truncate. Mouth terminal; maxilla curved downwards, S-shaped at rear end and visible posteroventral to corner of closed mouth; angle of dentary symphysis obtuse. Lips thin; no fleshy ornamentation or lamellae at lower jaw symphysis. Teeth of juveniles simple, villiform or setiform, in 1 or 2 rows on each lip; teeth absent or inconspicuous in adults, and present on vomer, endopterygoids, tongue and basihyal; no teeth on palatines. No adipose eyelid. Preorbital bone with weakly kinked serrate anterior edge and squarish posteroventral end. Nostrils nearer to each other than to lip or eyes. Scales weakly ctenoid in adults, cycloid in juveniles; no pectoral-fin axillary scale. Stomach with up to 26 branched pyloric caeca. One species.

## *Ellochelon vaigiensis* (Quoy & Gaimard 1825)

Squairetail mullet

PLATE 54

*Mugil vaigiensis* Quoy & Gaimard 1825: 337, Pl. 59, Fig. 2 (Waigeo, Indonesia).

*Mugil macrolepidotus* Rüppell 1830: 140, Pl. 32, Fig. 2a–b (Red Sea); Valenciennes 1836; Cantor 1850.

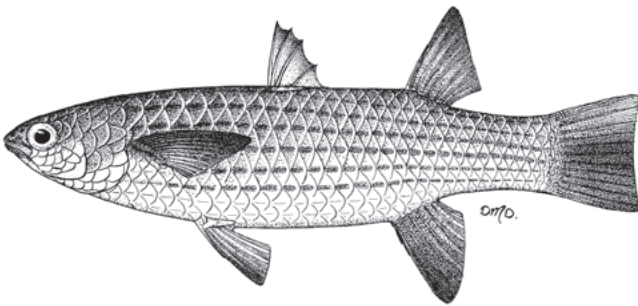
*Ellochelon vaigiensis*: SFSA No. 883\*; Randall 1995\*; Manilo & Bogorodsky 2003.

*Liza vaigiensis*: Smith 1975\*; Thomson & Luther 1984\*; SSF No. 222.9\*; Fricke 1999; Heemstra & Heemstra 2004; Fricke *et al.* 2009.

Diagnosis as for genus. Dorsal profile of head and body almost straight, body depth 27–31% SL; head wider than deep (proportionately less so in juveniles), HL 26–32% SL; snout blunt, its length 21–30% HL, and greater than eye diameter in adults but less than eye diameter in juveniles; interorbital area nearly flat, and frequently more than twice eye diameter. Upper lip with 1 or 2 rows of very short, unicuspid, setiform teeth in juveniles and some adults; lower lip directed forwards, bearing double symphyseal knob and 1 row of ciliiform teeth (long, fine and numerous) in juveniles and some adults. Tongue raised and medially convex. Dorsal fins truncate or feebly emarginate,

1st dorsal-fin origin distinctly closer to caudal-fin base than to snout tip; anal fin slightly higher than 2nd dorsal fin, and both fins higher than 1st dorsal fin. Second dorsal fin 9 rays; anal fin 3 spines, 8 rays; pectoral fins 1 spur, 15–17 rays. GR 28–32/40–61. Scales relatively large; predorsal scales 14–17; both dorsal fins densely scaly, 1st dorsal-fin scaly process long and extending beyond 4th spine; interdorsal scales 7 or 8; LSS 26–28; TRS 8–10; circumpeduncular scales 16. Stomach with developed gizzard; pyloric caeca 26–48, most divided into two branches. [Also included at end in key to juveniles.]

Body greenish to olive-brown dorsally, dull yellowish brown to silvery on flanks, abdomen white to pale yellow; ~6 dark longitudinal stripes along scale rows; pectoral fins black in juveniles, lower margin yellowish in adults; pelvic fins dull yellow, slightly dusky; median fins dusky grey, with yellow tinge, and darker towards margins; iris yellowish in young, but with yellow patches in adults. Attains ~60 cm TL (commonly 35 cm SL).



*Ellochelon vaigiensis*, 28 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific (widespread and common). WIO: Red Sea, Oman to South Africa (northern Eastern Cape), Madagascar, Seychelles, Réunion and Maldives; elsewhere to Bangladesh, Indonesia, Philippines, China, southern Japan, Marshall Is., New Guinea, Australia, New Caledonia, Society Is., Rapa Iti and Marquesas Is.

**REMARKS** Found in lagoons, estuaries, mangroves, lower reaches of streams, over reef flats and in other shallow coastal areas, usually with tidal influence.

**GENUS** *Moolgarda* Whitley 1945

Mouth terminal; maxilla slender, weakly curved downwards posteriorly, posterior tip completely or partially concealed when mouth closed; angle of dentary symphysis ~90° to more

obtuse. Both lips thin and simple, without crenulations or papillae; lower lip directed forwards, not folding down, and bearing single or double symphyseal knob at tip. Teeth on lips minute and villiform or absent. Teeth present on tongue and endopterygoids; no teeth on vomer and palatines; basihyal variously toothed. Tongue keeled. Nostrils widely separated; anterior nostril nearer lip than posterior nostril; posterior nostril reaching above upper rim of eye. Adipose eyelid variably developed, absent in some species. Interorbital region flat to slightly convex. Preorbital bone with serrate anterior margin, weakly concave and not kinked, and posteroventral end narrow. Pectoral fins long, usually extending beyond vertical at 1st dorsal-fin origin, their upper insertion level with or slightly higher than upper rim of eye. Second dorsal-fin origin above anal-fin origin or anterior third of anal fin. Anal fin with 3 spines in adults. Caudal fin emarginate or forked. Scales ctenoid, with membranous finger-like rear margin; pectoral and pelvic fins each with long axillary scale, and 1st dorsal fin with prominent scaly process. Pyloric caeca 4–9, unbranched. Possibly 8 species, 4 in WIO.

#### KEY TO SPECIES

- |    |   |                     |
|----|---|---------------------|
| 1a | Adipose eyelid reduced to rim around eyes; circumpeduncular scales 19 or 20; 2nd dorsal-fin origin above or just behind anal-fin origin, both fins falcate; pectoral fins moderately falcate; caudal fin deeply emarginate or forked  | 2                   |
| 1b | Adipose eyelid present; circumpeduncular scales 16; 2nd dorsal-fin origin above or beyond anterior quarter of anal fin, both fins emarginate to moderately falcate; caudal fin emarginate to forked   | 3                   |
| 2a | LSS 32–36 (usually 35)  | <i>M. buchanani</i> |
| 2b | LSS 37 or 38  | <i>M. seheli</i>    |
| 3a | Body moderately robust; 2nd dorsal-fin origin at vertical behind anterior third of anal fin, both fins emarginate to slightly falcate, moderately scaled; pectoral fins falcate and long, 22–29% SL, distinctly longer than HL minus snout length, and often subequal to HL (75–101% HL); caudal fin falcate; LSS 32–36 (usually 35); pyloric caeca 5–8 | <i>M. cunnesius</i> |
| 3b | Body robust; 2nd dorsal-fin origin at vertical through anterior third of anal fin, both fins emarginate, fin bases scaled anteriorly; pectoral fins 21–25% SL, longer than HL minus snout length; caudal fin moderately forked; LSS 33–37; pyloric caeca 4  | <i>M. robustus</i>  |



## *Moolgarda buchanani* (Bleeker 1853)

Longfin mullet

PLATE 54

*Mugil buchanani* Bleeker 1853: 99 (Hooghly River, Kolkata, India); Day 1878, 1889; Pellegrin 1898; Smith 1935\*.

*Mugil ceylonensis* Günther 1861: 446, Fig. (Sri Lanka); Gilchrist & Thompson 1911\*; Boulenger 1916\*; Barnard 1925\*.

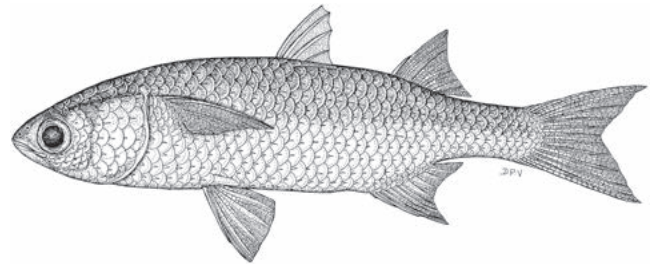
*Valamugil buchanani*: Smith 1949\*, 1975\*; Thomson 1954, 1997; SFSA No. 888\*; Wallace & Van der Elst 1975\*; Thomson & Luther 1984\*; Kuronuma & Abe 1986; SSF No. 222.12\*; Heemstra & Heemstra 2004\*.

*Moolgarda pedaraki*: Randall 1995\*.

First dorsal fin 4 spines; 2nd dorsal fin 9 rays; anal fin 3 spines, 9 rays; pectoral fins 1 spur, 14–17 rays. Body robust, depth at 1st dorsal-fin origin 29–34% SL, depth at anus 25–31% SL; peduncle depth 12–14% SL. Head deeper than wide, flattened dorsally, bluntly pointed; HL 25–31% SL, slightly shorter than body depth; snout blunt and short, 18–30% HL; eye diameter 24–31% HL, slightly longer than snout. Adipose eyelid reduced to rim around eyes. Mouth terminal; maxilla slender, weakly curved downwards, extending posteroventrally and completely or partially concealed at corner of mouth; angle of dentary symphysis obtuse. Upper lip thin or slightly thickened, and lower lip directed forwards with prominent symphyseal knob; each lip with 1 row of villiform teeth or teeth frequently absent. Teeth present on endopterygoids, tongue and basihyal; no teeth on vomer and palatines. Tongue with high keel. Preorbital bone with serrate anterior margin, weakly concave and not kinked, posteroventral end narrow and almost squarish, not pointed. Nostrils wide-set; posterior nostrils reaching above upper rim of eye. First dorsal-fin origin usually midway between snout tip and anterior end of peduncle, or nearer to latter. Second dorsal-fin origin at vertical through anal-fin origin, or just slightly behind it, and both fins falcate; anal fin slightly higher than 2nd dorsal fin, both fins higher than 1st dorsal fin. Pectoral fins falcate and long (22–31% SL, 73–107% HL, and often greater than HL minus snout length), insertions at vertical through 1st dorsal-fin origin or beyond 2nd spine. Pelvic fins much shorter than pectoral fins, inserted below and about midway between rear margin of head and 1st dorsal-fin origin. Caudal fin deeply emarginate to moderately forked. GR 31–41/34–55. Scales ctenoid, with membranous finger-like margin; 19 or 20 scales from snout tip to 1st dorsal-fin origin; 8 or 9 interdorsal scales; 2nd dorsal fin and anal fin mostly scaly, caudal-fin base scaly; pectoral-fin axillary scale distinct and long; LSS 32–36; TRS 10–14; circumpeduncular scales 20. Stomach conical, gizzard-like; pyloric caeca 6–9. [Also included at end in key to juveniles.]

Body pale greenish brown to bluish green dorsally, flanks and abdomen silvery; upper rows of scales with faint dark longitudinal stripes; dorsal fins bluish; pectoral fins yellowish,

with dark blue spot at origin; pelvic fins and anal fin pale yellowish or bluish; caudal fin conspicuously blue in life, margin moderately dusky; often with small golden patch on upper operculum and on iris. Known to attain 100 cm TL.



*Moolgarda buchanani*, 12 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Oman to South Africa (Cape south coast), and to India and Sri Lanka; elsewhere to Indonesia, Philippines, southern Japan, Mariana Is., Australia and New Guinea.

**REMARKS** Common. Very similar in external morphology and osteology to *M. seheli* but distinguishable by its more robust body and LSS count. This species has subsequently been placed in the genus *Crenimugil* (Durand *et al.* 2012; Durand & Borsa 2015).

## *Moolgarda cunnesius* (Valenciennes 1836)

Longarm mullet

PLATE 54

*Mugil cunnesius* Valenciennes *in* Cuv. & Val. 1836: 114 (Mumbai and Coromandel coast, India; Moluccas, Indonesia); Günther 1861; Klunzinger 1870, 1884; Day 1878; Barnard 1925; Smith 1935.

*Mugil strongylocephalus* Richardson 1846: 249 (Hong Kong); Smith 1935\*, 1949\*; SFSA No. 879\*.

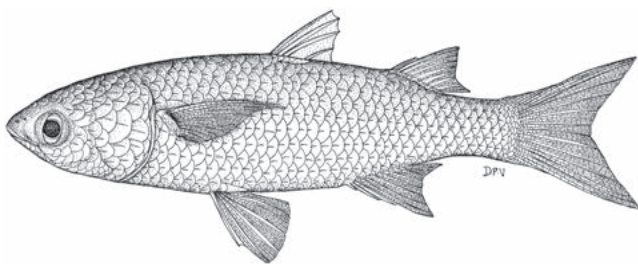
*Valamugil cunnesius*: Thomson 1974\*; Smith 1975\*; Wallace & Van der Elst 1975\*, 1986\*; Thomson & Luther 1984\*; SSF No. 222.13\*; Skelton 1993\*; Goren & Dor 1994; Fricke 1999; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

*Moolgarda cunnesius*: Randall 1995\*; Manilo & Bogorodsky 2003.

First dorsal fin 4 spines; 2nd dorsal fin 9 rays; anal fin 3 spines, 9 rays; pectoral fins 1 spur, 14–16 rays. Body moderately robust, depth at 1st dorsal-fin origin 26–33% SL, depth at anus 23–30% SL; peduncle depth 11–14% SL. Head deeper than wide, flattened dorsally, bluntly pointed; HL 26–32% SL, shorter than body depth; snout blunt and short, 15–26% HL; eye diameter 24–31% HL, longer than snout; interorbital area slightly convex. Adipose eyelid extending across half of iris. Preorbital bone with serrate anterior margin,

weakly concave and not kinked, posteroventral end narrow, squarish. Mouth terminal; maxilla slender and weakly curved downwards, extending posteroventral to corner of mouth and completely or partially concealed; angle of dentary symphysis obtuse. Upper lip thin or slightly thickened; lower lip thin, directed forwards, bearing prominent symphyseal knob; each lip with 1 row of villiform teeth or teeth frequently absent. Teeth present on endopterygoids, tongue and basihyal; no teeth on vomer and palatines. Tongue with high keel. Nostrils wide-set; posterior nostril reaching above upper rim of eye; anterior nostril nearer to lip than to posterior nostril; inter-nostril distance subequal to width of posterior nostrils. First dorsal-fin origin usually nearer snout tip than caudal-fin base, but frequently midway. Second dorsal-fin origin at vertical behind anterior third of anal fin, both fins falcate; anal fin higher than 2nd dorsal fin, both fins higher than 1st dorsal fin. Pectoral fins falcate and long, reaching beyond 1st dorsal-fin origin, 22–31% SL, 73–107% HL, and often greater than HL minus snout length. Pelvic fins much shorter than pectoral fins, inserted below and about midway between rear margin of head and 1st dorsal-fin origin. Caudal fin forked. GR 28–36/33–50. Scales ctenoid, with membranous finger-like margin; 17–20 scales from snout tip to 1st dorsal-fin origin; 7 or 8 interdorsal scales; 2nd dorsal fin and anal fin moderately scaly; LSS 32–36; TRS 10–13; circumpeduncular scales 16; caudal-fin base scaly; pectoral-fin axillary scale long. Stomach conical, gizzard-like; pyloric caeca 5–8. [Also included at end in key to juveniles.]

Body greenish grey to bluish brown dorsally, flanks and abdomen silvery; opercle with shiny golden tinge; faint longitudinal stripes along upper scale rows (formed by long mucous-canal arrangements on scales); pectoral fins bluish yellow, with dark blue spot at upper insertion; pelvic fins and anal fin yellowish white; 2nd dorsal fin and caudal fin with thin black margin. Attains 45 cm TL.



*Moolgarda cunnesius*, 12 cm SL (S Mozambique). Source: Whitfield 1998

**DISTRIBUTION** Indo-Pacific (prevalent). WIO: southwestern India, Persian/Arabian Gulf, Red Sea, Oman to South Africa, Madagascar and Réunion; elsewhere to Thailand, Indonesia, Philippines, Japan, Marianas Is., New Guinea, Australia and New Caledonia.

## *Moolgarda robustus* (Günther 1861)

Robust mullet

PLATE 54

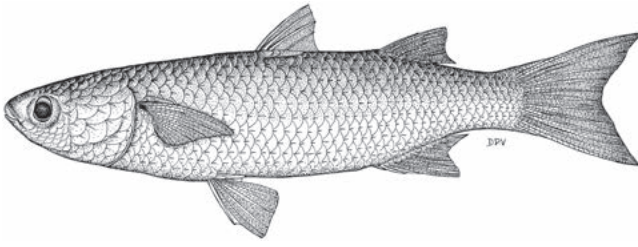
*Mugil robustus* Günther 1861: 432 (coast of Madagascar); Bleeker 1874\*; Sauvage 1891\*; Boulenger 1916\*; Barnard 1925\*; Pellegrin 1933\*; Smith 1935\*, 1949\*; SFSA No. 878\*.

*Valamugil robustus*: Blaber & Whitfield 1977; Thomson & Luther 1984\*; SSF No. 222.14\*; Fricke 1999; Heemstra *et al.* 2004; Heemstra & Heemstra 2004.

*Moolgarda robusta*: Fricke *et al.* 2009.

First dorsal fin 4 spines; 2nd dorsal fin 9 rays; anal fin 3 spines, 9 rays; pectoral fins 1 spur, 15 rays. Body robust, depth at 1st dorsal-fin origin 25–30% SL, depth at anus 23–28% SL; peduncle depth 11–12% SL. Head wide, dorsally flattened, bluntly pointed, HL 24–28% SL; snout blunt and short, 21–25% HL; eye diameter 28–31% HL, longer than snout. Adipose eyelid covering most of iris posteriorly and less anteriorly. Mouth terminal; maxilla slender, weakly curved downwards posteriorly to corner of mouth and completely or partially concealed; angle of dentary symphysis almost obtuse. Lips thin; lower lip directed forwards bearing prominent symphyseal knob and some scattered ciliate teeth. Teeth present on basihyal and endopterygoids; no teeth on palatines, tongue and upper lip. Tongue domed with low median ridge. Preorbital bone serrate anterior margin straight to feebly concave, its posteroventral end narrow, not pointed. Nostrils wide-set; posterior nostrils not above upper rim of eye. First dorsal-fin origin equidistant between snout tip and caudal-fin base. Second dorsal-fin origin at vertical behind anterior third of anal fin, both fins emarginate; anal fin higher than 2nd dorsal fin, both fins higher than 1st dorsal fin. Caudal fin moderately forked. Pectoral fins reaching rear half of eyes when laid forward, not reaching 1st dorsal-fin origin when laid back; axillary scale long. Pelvic fins much shorter than pectoral fins, inserted below and nearer to 1st dorsal-fin origin than to rear margin of head. GR 22–30/34–40. Scales ctenoid, with membranous finger-like rear margin; head naked to posterior nostrils; 21–25 scales from snout tip to 1st dorsal-fin origin; 7–9 interdorsal scales; bases of 2nd dorsal fin and anal fin scaly anteriorly; LSS 37–39; TRS 12 or 13; circumpeduncular scales 16 or 17. Stomach conical and gizzard-like; pyloric caeca 6. [Also included at end in key to juveniles.]

Body bluish green to greyish brown dorsally, flanks and abdomen silvery; 2nd dorsal fin and caudal fin with black margin; pectoral fins pale yellow, with diffuse dark spot at upper insertion; pelvic fins and anal fin yellowish white. Attains at least 30 cm SL.



*Moolgarda robustus*, 12 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** WIO: South Africa (Eastern Cape) to southern Mozambique, Madagascar and Mascarenes.

**REMARKS** This species has been placed in the genus *Osteomugil* (Durand *et al.* 2012; Durand & Borsa 2015).

### *Moolgarda seheli* (Fabricius 1775)

Bluespot mullet

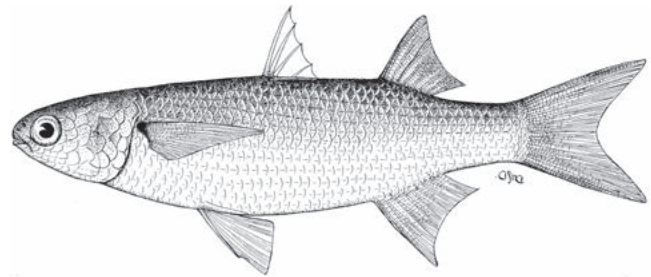
PLATE 55

- Mugil crenilabis* var. *seheli* Fabricius in Niebuhr (ex Forsskål) 1775: 73, xiv (Al-Luhayya, Yemen, Red Sea); Klunzinger 1870, 1884\*; Day 1878, 1889; Boulenger 1916; Barnard 1925; Fowler 1925, 1934; Norman 1930; Smith 1935\*; Pillay 1962; ?Winterbottom *et al.* 1989; Goren & Dor 1994; Heemstra *et al.* 2004.
- Mugil caeruleomaculatus* Lacepède 1803: 385 [no locality given]; Day 1878; Sauvage 1891; Weber & De Beaufort 1922; Smith 1935\*; Marshall 1951.
- Mugil axillaris* Valenciennes in Cuv. & Val. 1836: 131 (Mauritius, Mascarenes); Sauvage 1891.
- Valamugil seheli*: Smith 1949\*, 1975\*; John 1955; SFSA No. 889\*; Masuda *et al.* 1984; Talwar & Kacker 1984; Thomson & Luther 1984\*; SSF No. 222.15\*; Thomson 1997; Heemstra *et al.* 2004.
- Valamugil coeruleomaculatus*: John 1955.
- Moolgarda seheli*: Randall 1995\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

First dorsal fin 4 spines; 2nd dorsal fin 9 rays; anal fin 3 spines, 9 rays; pectoral fins 1 spur, 16–18 rays. Body moderately robust, depth at 1st dorsal-fin origin 29–33% SL, depth at anus 25–30% SL; peduncle depth 9–14% SL. Head usually deeper than wide, flattened dorsally, bluntly pointed, HL 25–30% SL, and slightly shorter than body depth; snout short and blunt, 16–27% HL; eye diameter 22–33% HL, longer than snout; interorbital region slightly convex, its width more than twice eye diameter in fish >18 cm SL. Adipose eyelid reduced to rim around eyes. Mouth terminal; maxilla slender, weakly curved downwards posteriorly, extending posteroventral to corner of mouth and completely concealed; angle of dentary symphysis obtuse. Upper lip thin or slightly thickened; lower lip directed forwards, bearing prominent symphyseal knob; each lip with 1 row of villiform teeth or teeth frequently absent. Teeth present on endopterygoids, tongue and basihyal;

no teeth on vomer and palatines. Tongue with high keel. Preorbital bone with serrate anterior margin, weakly concave and not kinked, posteroventral end narrow and squarish, not pointed. Nostrils wide-set; posterior nostrils reaching above upper rim of eye; anterior nostril nearer lip than posterior nostril; inter-nostril distance subequal to width of posterior nostril. First dorsal-fin origin usually midway between snout tip and caudal-fin base, or nearer to latter; 1st dorsal-fin spine shorter than 2nd spine; scaly process extending beyond 4th spine. Second dorsal-fin origin at vertical through anal-fin origin or just slightly beyond, both fins falcate; anal fin slightly higher than 2nd dorsal fin, both fins higher than 1st dorsal fin. Pectoral fins at vertical beyond 1st dorsal-fin origin, long, 23–30% SL, often greater than HL minus snout length; axillary scale distinct and long. Pelvic fins much shorter than pectoral fins, inserted below and midway between rear margin of head and 1st dorsal-fin origin; axillary scale shorter than pelvic spine. Caudal fin forked. GR 20–45/39–73. Scales ctenoid, with membranous finger-like margin; 19–22 scales from snout tip to 1st dorsal-fin origin; 9 interdorsal scales; 2nd dorsal fin and anal fin mostly scaly; LSS 36–40; TRS 12–14; circumpeduncular scales 20; caudal fin scaly. Stomach wedge-shaped and gizzard-like; pyloric caeca 7–9. [Also included at end in key to juveniles.]

Body bluish brown to bluish green dorsally, flanks and abdomen silvery; upper rows of scales with faint dark longitudinal stripes; pectoral fins bluish yellow, with dark blue spot at upper insertion; pelvic fins and anal fin yellowish; dorsal fins and caudal fin bluish, caudal fin dusky towards margin. Attains 50 cm TL.



*Moolgarda seheli*, 20 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Oman to South Africa (Sundays River estuary, Eastern Cape), Madagascar, Seychelles, Mascarenes and possibly Chagos; elsewhere to east coast of India, Indonesia, Philippines, China, southern Japan, Australia, New Caledonia, Norfolk I., Tonga and Marquesas Is.

**REMARKS** This species has been placed in the genus *Planiliza* (Durand *et al.* 2012; Durand & Borsa 2015).

GENUS *Mugil* Linnaeus 1758

Mouth terminal; lips thin, simple, without papillae or crenulations. Lower lip projecting forward horizontally, not folded downwards. Teeth on lips setiform, and attached to long fibrous strands embedded in lip tissue, usually in 1 or more rows, outer row more prominent and simple-tipped, inner rows usually unicuspid (bicuspid in some species); teeth tend to be lost or embedded in lip tissue in older fish. Maxilla and premaxilla straight, in line with anterior edge of preorbital bone, and gently curved posteroventrally, rear tip usually exposed behind closed mouth. Lower jaw with central symphyseal knob; angle of dentary symphysis acute, forming 90° angle and more obtuse with age in some species. Teeth present on endopterygoids; no teeth on vomer, palatines and basihyal in all species. Tongue flat or moderately convex medially, with patches of teeth in some species. Nostrils nearer lip and eyes than to each other; posterior nostril level with upper rim of eye or slightly above. Adipose eyelid prominent, extending over eye to pupil (except in juveniles <3 cm SL). Preorbital bone moderately narrow, anterior serrate edge straight or slightly concave. Pectoral fins inserted almost at level of upper rim of eyes, with prominent axillary scale. Anal fin with 2 spines in juveniles, 3 spines in adults. Scales weakly ctenoid; minute cycloid scales frequently superimposed on main body scales, especially in occipital region. Stomach distinctly gizzard-like; pyloric caeca 2; intestine elongate and convoluted. Possibly 20 species, 1 in WIO.

*Mugil cephalus* Linnaeus 1758

Flathead mullet

PLATE 55

*Mugil cephalus* Linnaeus 1758: 316 ('European sea'); Boulenger 1916\*; Smith 1935\*, 1948\*, 1949\*, 1975\*; Deva-Sundaram 1951\*; Pillay 1951\*; Thomson & Luther 1984\*; SSF No. 222.10\*; Winterbottom *et al.* 1989; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009; Whitfield *et al.* 2012.

*Mugil crenilabis* our Fabricius in Niebuhr (ex Forsskål) 1775: 74, xiv [Red Sea]; Rüppell 1835; Klunzinger 1870, 1884; Day 1878; Boulenger 1916.

*Mugil constantiae* Valenciennes in Cuv. & Val. 1836: 107 (freshwaters near Constance [?], Mediterranean Sea [syntypes: Cape of Good Hope, South Africa]); Smith 1846; Günther 1861.

*Mugil cephalotus* Valenciennes in Cuv. & Val. 1836: 110 (Malabar coast and Puducherry, India); Günther 1861; Sauvage 1891.

*Mugil borbonicus* Valenciennes in Cuv. & Val. 1836: 113 (Réunion, Mascarenes).

*Myxus superficialis* Klunzinger 1870: 831 (Al-Qusayr, Egypt, Red Sea).

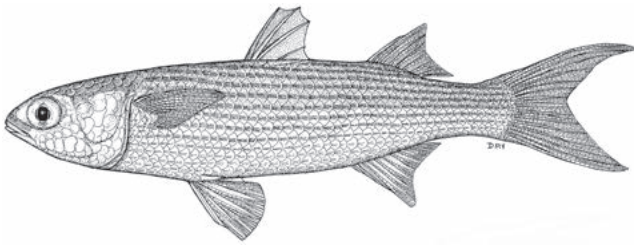
*Myxus caecutiens* Günther 1876: 397 (Rodrigues I., Mascarenes).

*Myxus barnardi* Gilchrist & Thompson 1914: 83 (Durban Bay, KwaZulu-Natal, South Africa); Barnard 1925.

First dorsal fin 4 spines; 2nd dorsal fin 9 rays; anal fin 3 spines, 8 rays; pectoral fins 1 spur, 15–17 rays. Body robust, moderately deep, dorsal profile moderately convex, ventral profile broadly curved, body depth 24–27% SL. Head broad and dorsally flattened, HL 24–32% SL; snout blunt, profile obtuse. Mouth terminal, slightly oblique; rear part of maxilla visible when mouth closed. Lips thin, teeth distal-type, tend to be lost or embedded in lip tissue in adults. Upper lip with 1 or 2 outer rows of relatively close-set, simple, curved setiform teeth, followed by 2–5 rows of smaller well-spaced bicuspid teeth. Lower lip directed forward, with prominent symphyseal knob and 1 row of close-set, marginal, curved setiform teeth, and ≥2 rows of bicuspid teeth (less conspicuous compared with teeth on upper lip). Endopterygoids with large patch of villiform teeth; no teeth on vomer, palatines, tongue and basihyal. Preorbital bone relatively narrow, serrate anterior edge straight or slightly concave. Nostrils closer to snout tip and eyes than to each other; anterior nostril a single pore, posterior nostril ovoid and slit-like. Adipose eyelid extensive, covering up to half of pupil (less in fish <3 cm SL). Second dorsal-fin origin slightly behind anal-fin origin. Pectoral fins inserted high on body, almost at level of upper rim of eye, extending short of vertical at 1st dorsal-fin origin. Pelvic fins inserted perpendicular to rear third of pectoral fins, extending beyond vertical at 1st dorsal-fin origin. Caudal fin forked, almost entirely scaly. GR 32–34/55–62. Scales weakly ctenoid, with minute secondary cycloid scales over most of body scales, particularly on occipital region, and more noticeable in larger fish; scales from snout tip to 1st dorsal-fin origin 21–24; bases of 2nd dorsal fin and anal fin with small scales anteriorly, and pectoral fins covered with minute scales; pectoral-fin axillary scale long; LSS 38–43; TRS 13 or 14; circumpeduncular scales 19–21. Pyloric caeca 2. [Also included at end in key to juveniles.]

Body olive-green dorsally in marine habitats, flanks silvery, abdomen whitish, with 6 or 7 dark stripes along lateral scale rows (stripes less conspicuous ventrally); body dark blue to dusky brown dorsally in rivers and estuarine habitats, flanks dull silvery; fins mostly dusky, except pelvic fins dull yellowish; dorsal fins greyish blue; pectoral fins with whitish margin, and dark purple to blue spot at insertion; anal fin and caudal fin yellowish green; golden ring around iris (fades in preserved specimens). Attains ~60 cm TL (possibly 90 cm TL; commonly ~35 cm SL).





*Mugil cephalus*, 17 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** Apparently circumglobal in tropical to warm-temperate seas and estuaries, including Black Sea, Mediterranean Sea, and Red Sea to southern Africa and throughout WIO.

**GENUS** *Myxus* Günther 1861

Mouth terminal; lips thin, smooth, lacking fleshy lamellae at corner of mouth or lower jaw symphysis. Snout pointed, subequal to eye diameter. Maxilla wide, moderately curved downwards over premaxilla, almost S-shaped at rear tip, and visible below corner of closed mouth; angle of dentary symphysis almost perpendicular in small fish, obtuse in larger fish. Upper lip with 1 row of close-set spatulate or villiform teeth; lower lip directed forwards, bearing single symphyseal knob and 1 row of villiform teeth. Teeth present on vomer, palatines, endopterygoids, tongue and basihyal. Tongue flat. Nostrils nearer to each other than to eyes or lip; posterior nostrils not reaching above level of upper rim of eye. No adipose eyelid. Interorbital region moderately convex. Preorbital bone broad; serrate anterior margin straight or slightly concave; posteroventral end squarish and pointed. Upper insertion of pectoral fins at level of upper rim of eye. Anal fin 3 spines, 9 rays. Scales mostly cycloid, variably ctenoid on breast, lower flanks and interdorsal area. Stomach elongate, moderately developed in pyloric region, but not gizzard-like; pyloric caeca 2–6. Two species, 1 in WIO.

***Myxus capensis*** Valenciennes 1836

Freshwater mullet

PLATE 55

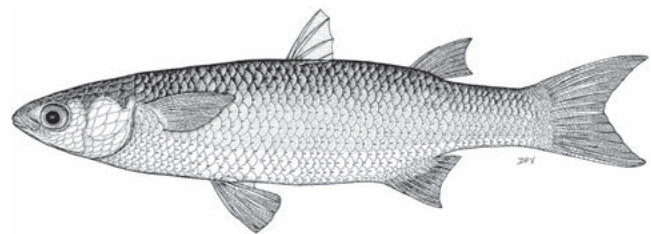
*Myxus capensis* Valenciennes in Cuv. & Val. 1836: 108 (Cape Sea); Thomson & Luther 1984\*; SSF No. 222.11\*; Skelton 1993\*; Heemstra & Heemstra 2004\*.

*Mugil euronotus* Smith 1846: no page number, Pl. 29, Fig. 2 (Cape Seas, South Africa); Bleeker 1860; Smith 1935\*.

*Trachystoma euronotus*: Smith 1935\*; SFSA No. 890\*; Van der Elst & Wallace 1976\*.

Diagnosis as for genus. First dorsal fin 4 spines; 2nd dorsal fin 9 rays; anal fin 3 spines, 9 rays; pectoral fins 1 spur, 16 rays. GR 42–45/60–70; LSS 43–45; TRS 14 or 15. Body slender to moderately robust, depth 24–26% SL, dorsal profile almost straight, ventral profile gently convex. Head pointed, deeper than wide, more or less flattened dorsally; HL 25–27% SL, and subequal to body depth; snout pointed, subequal to eye diameter; interorbital region moderately convex. Mouth terminal; maxilla wide, moderately curved downwards over premaxilla, almost S-shaped at posterior tip, exposed behind corner of closed mouth; angle of dentary symphysis almost perpendicular in small specimens, more obtuse in larger fish. Lips thin, without ornamentation. Upper lip with 1 row of relatively large, close-set, dilated spatulate teeth with strangulate tips (in fish >3.5 cm TL). Lower lip directed forwards, bearing single symphyseal knob and row of fine villiform teeth. Teeth present on vomer, palatines and endopterygoids, and tongue with small villiform teeth. No adipose eyelid. Nostrils close-set. Preorbital bone large, broad, serrate anterior margin straight or slightly concave, posteroventral end squarish and pointed. First dorsal-fin origin nearer caudal-fin base than snout tip; up to one-third of anal-fin base in front of 2nd dorsal fin. Pectoral fins not reaching vertical at 1st dorsal-fin origin, and barely reaching eyes when folded forward; no axillary scale. Caudal fin forked. Scales cycloid anterior to 1st dorsal fin; scales ctenoid on breast, lower flanks and interdorsal area; bases of 2nd dorsal fin and anal fin scaly anteriorly. Stomach elongate and moderately developed in pyloric region, but not gizzard-like; pyloric caeca 5 or 6. [Also included at end in key to juveniles.]

Body dark olive-green dorsally, upper flanks greenish, lower flanks silvery, and abdomen white; pectoral, dorsal and caudal fins greenish brown to dusky. Attains ~50 cm TL (commonly 20 cm TL).



*Myxus capensis*, 23 cm SL (South Africa). Source: Whitfield 1998

**DISTRIBUTION** WIO: endemic to South Africa (Kosi Bay to Knysna).

**REMARKS** Spends most of its life in freshwater, ascending rivers as far as it can go, returning to the sea to spawn. Adults seldom found outside rivers along the Cape south coast.

GENUS *Oedalechilus* Fowler 1903

Mouth terminal, gape horizontal; maxilla curved downwards posteriorly, and visible at corner of closed mouth; angle of dentary symphysis distinctly obtuse. Lips edentate and forming minor folds at each corner of mouth, joining posteriorly, and tucked under deep preorbital notch. Teeth present on endopterygoids, vomer, palatines, tongue and basihyal. Tongue flat with low median ridge. Adipose eyelid absent or reduced to thin rim around eyes. Preorbital bone broad and squarish posteriorly, deeply notched anteriorly to accommodate the thick lip folds. Nostrils nearer to each other than to lip or eyes; anterior nostril with high cutaneous rim; posterior nostril slit-like, and positioned below or level to upper rim of eye. Pectoral fins inserted at level of upper rim of eyes; no axillary scale. Anal fin with 3 spines in adults, fin origin well in advance of 2nd dorsal-fin origin. Scales weakly ctenoid. Pyloric caeca 3; intestine long and convoluted. Two species, 1 in WIO.

*Oedalechilus labiosus* (Valenciennes 1836)

Hornlip mullet

PLATE 55

*Mugil labiosus* Valenciennes in Cuv. & Val. 1836: 125 (Red Sea; Mumbai, India); Günther 1861; Klunzinger 1870; Day 1878, 1889; Weber 1913; Smith 1935.

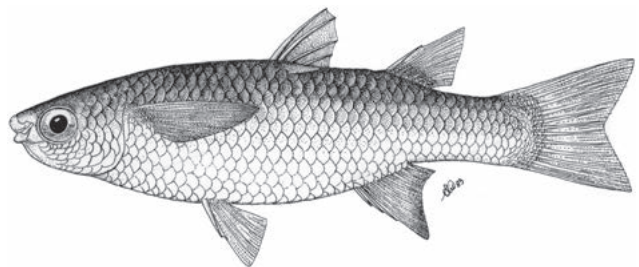
*Plicomugil labiosus*: Schultz in Schultz *et al.* 1953; Pillay 1962.

*Oedalechilus labiosus*: Randall 1983\*, 1995\*; Thomson & Luther 1984\*; Goren & Dor 1994; Manilo & Bogorodsky 2003.

First dorsal fin 4 spines; 2nd dorsal fin 9 rays; anal fin 3 spines, 9 rays; pectoral fins 1 spur, 16–18 rays. Body moderately deep, 27–35% SL, dorsal profile almost straight, slightly steep. Head deeper than wide, relatively flattened dorsally, HL 25–30% SL; snout blunt, length 20–28% HL, and shorter than eye diameter; interorbital region almost flat, its width nearly twice eye diameter. Lower jaw markedly wider than long; angle of dentary symphysis distinctly obtuse. Upper lip thick and high,

with deep transverse fold near its lower edge, splitting it into upper and lower lobes. Lower lip thin, directed forwards, fringed with 1 row of papillae except in angular (concave or V-shaped) symphysis. First dorsal-fin origin distinctly nearer caudal-fin base than snout tip; 1st dorsal-fin spine longer than others; scaly process long. Second dorsal-fin origin behind  $\frac{1}{2}$ – $\frac{3}{4}$  of anal fin, both fins emarginate; anal fin higher than 2nd dorsal fin, both fins higher than 1st dorsal fin. Pectoral fins not reaching 1st dorsal-fin origin; no axillary scale. Pelvic fins much shorter than pectoral fins, inserted below and nearer to rear margin of head than to 1st dorsal-fin origin. Caudal fin emarginate. GR 32–34/55–62, shorter than gill filaments. Scales weakly ctenoid; 19–21 scales from snout tip to 1st dorsal-fin origin; 8 or 9 interdorsal scales; bases of 2nd dorsal fin and anal fin scaly anteriorly; LSS 33–36; TRS 11 or 12; circumpeduncular scales 16. Stomach wedge-shaped and gizzard-like; pyloric caeca 3.

Body olive to olive-brown dorsally, flanks silvery, abdomen whitish; all fins dusky, except pelvic fins pale yellow; small black spot at upper insertion of pectoral fins. Attains ~45 cm TL (commonly 20 cm SL).



*Oedalechilus labiosus*. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Gulf of Oman, Red Sea, East Africa to Madagascar, Seychelles, Aldabra, Lakshadweep, India and Sri Lanka; elsewhere to Thailand, Malaysia, Indonesia, Philippines, Japan, Marshall Is., Solomon Is., Australia, New Caledonia and Samoa.

## KEY TO JUVENILE MUGILIDS

### [Developed from Van der Elst & Wallace, 1976]

LSS 26–31:

- a Caudal fin emarginate or forked; teeth on upper jaw weak, if present, and more numerous than any teeth on lower jaw; LSS 28–31 [WIO: Mozambique to South Africa] ..... *Chelon melinopterus*
- b Caudal fin truncate; no teeth on upper jaw; LSS 26–28 [Indo-Pacific] ..... *Ellochelon vaigiensis*

LSS 29–32; teeth on upper jaw more numerous than any teeth on lower jaw; diamond-shaped scale pattern visible in specimens >3.5 cm SL [WIO: East Africa] ..... *Chelon alata*

LSS 30–35, and teeth on upper jaw 25–30 (teeth flattened with square tops, often in 2 close-set rows in specimens ~5 cm SL); pectoral fins do not reach to below 1st dorsal-fin origin [Indo-Pacific] ..... *Chelon macrolepis*

LSS 32–36, and no teeth on upper jaw:

- a Snout blunt; maxilla hidden when mouth closed; no adipose eyelid at any length [Indo-Pacific] ..... *Moolgarda buchani*
- b Snout pointed; maxilla partly exposed when mouth closed; adipose eyelid present in specimens >5 cm SL [Indo-Pacific] ..... *Moolgarda cunnesius*

LSS 36–39, and teeth on upper jaw 13–21, small, flattened, expanded at apex; numerous wavy mucous canals develop on back and predorsal scales at 5.5–6.5 cm SL [eastern Atlantic to WIO] ..... *Chelon dumerili*

LSS 37–39, and no teeth on upper jaw; at most 1 mucous canal per scale; adipose eyelid develops with growth [WIO] ..... *Moolgarda robustus*

LSS 37–40, and papillae on lips (instead of teeth) become visible at ~2 cm SL [Indo-Pacific] ..... *Crenimugil crenilabis*

LSS 38–42, no papillae on lips, and no teeth on jaws [Indo-Pacific] ..... *Moolgarda seheli*

LSS 39–43, and jaws with about equal numbers of curved, pointed teeth; adipose eyelid develops with growth; anal fin 2 spines, 9 rays, becoming 3 spines, 8 rays at >5.5 cm SL [circumglobal] ..... *Mugil cephalus*

LSS 42–45, and teeth present on both jaws, their tricuspid nature becomes obvious at 2.5–3 cm SL [southern Africa] ..... *Chelon tricuspidens*

LSS 42–48, and teeth on both jaws simple, bluntly pointed and not close-set [southern Africa] ..... *Chelon richardsonii*

LSS 43–45, and teeth present only on upper jaw; amber-coloured pinched apex of teeth becomes distinct at >3.5 cm SL [WIO: South Africa] ..... *Myxus capensis*

## GLOSSARY

**distal-type teeth** – borne on distal extreme of long and closely packed fibrous strands, derived from jaw bones and supported by lip tissue.

**edentate** – without teeth.

**pharyngeal sulcus** – a groove on either side of the pharyngobranchial chamber, part of the filter-feeding mechanism.

**sessile teeth** – directly attached to jaw bones.

**strangulate** – close-set, dense, not sparse.

# ORDER ATHERINIFORMES

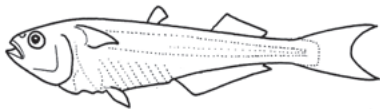
Walter Ivantsoff

The status and relationships of this order have been contested for many years. Rosen & Parenti (1981) considered this order to have an affinity with the Cyprinodontiformes (killifishes and live-bearers). Later work by Stiassny (1990) suggested that the mugiloids are the sister-group of series Atherinomorpha, while the work of Dyer & Chernoff (1996) suggested a sister-group relationship with the order Cyprinodontes. The higher relationships of the atherinomorphs is still in a state of flux, as reported by Sparks & Smith (2004).

Three families of atheriniforms occur off East Africa in WIO. Species of that group can be recognised by the following characters: 2 widely separated dorsal fins, 1st dorsal fin with 3–8 flexible spines, and 2nd dorsal fin with 1 spine, 11–17 rays; anal fin with 1 weak spine, 1 unbranched ray and 11–28 branched rays; pectoral fins inserted high on body; pelvic fins with 1 spine, 5 rays, the fin origins variable in relationship to verticals through pectoral-fin tips and 1st dorsal-fin origin; mouth small and terminal, with premaxilla not extending beyond vertical through middle of pupil; rostral cartilage variable in size, free to slide in atherinids when mouth is open; scales cycloid, thin, rarely large; eggs large, demersal, with adhesive filaments and with oil droplets at the vegetative pole.

## KEY TO FAMILIES

- 1a Body highly compressed, forming sharp keel ventrally, with greatest body depth just behind head; HL less than body depth; anal fin 21–28 rays ..... **ISONIDAE**

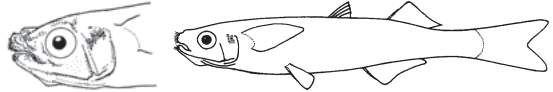


- 1b Body cylindrical, greatest depth usually over midbody; HL greater than body depth; anal fin 11–17 rays ..... **2**

Continued...

## KEY TO FAMILIES

- 2a Front of head and external surface of jaws with minute denticles; anus well behind pelvic-fin tips ..... **ATHERIONIDAE**



- 2b No external denticles on head; anus close to pelvic-fin tips (either in front, at, or behind tips) ..... **ATHERINIDAE**



## GLOSSARY

**adhesive filaments** – filaments that attach the eggs to the substrate.

**demersal** – living on or just above the bottom of the sea or lake.

**vegetative (or vegetal) pole** – the side of an egg opposite to the 'animal' pole; cell growth is slower in the vegetal pole which contains more yolk.

## FAMILY ISONIDAE

### Surf sprites

Walter Ivantsoff

Small-sized (~4–8 cm TL) and elongate, with very compressed body, forming sharp keel ventrally; greatest body depth just behind head, and then abruptly narrowing to peduncle; head length less than body depth. Distinguished by slit behind last gill arch. Premaxilla restricted by frenum and not protractile (unlike family Atherinidae), and its dorsal process very short.



Two dorsal fins: 1st dorsal fin tiny with 3–7 spines, and 2nd dorsal fin with 1 weak spine, 10–17 rays; pectoral fins inserted high on body, cleithrum long and extending downwards to ventral body keel; pelvic fins tiny; anal-fin base long, fin with 20–28 branched rays; caudal fin forked. No lateral line. No scales on head and front of body; scales elsewhere on body numerous, cycloid, small and deciduous.

Separated by Saeed *et al.* (2006) from the family Notocheiridae (with 1 species, *Notocheirus hubbsi* Clark 1937, known from Chile and the southern coast of Argentina) on the basis of major internal morphological differences. Biology little known; occur in shallow water close to shoreline, commonly in surf and waves, and around rocky headlands or reefs. One genus, *Iso* Jordan & Starks 1901, with 5 species in Indo-Pacific, 1 in WIO.

### *Iso natalensis* Regan 1919

Surf sprite

PLATE 55

*Iso natalensis* Regan 1919: 200, Fig. 3 (Durban, KwaZulu-Natal, South Africa); SFS No. 891\*; SSF No. 112.1\*; Manilo & Bogorodsky 2003; Saeed *et al.* 2006.

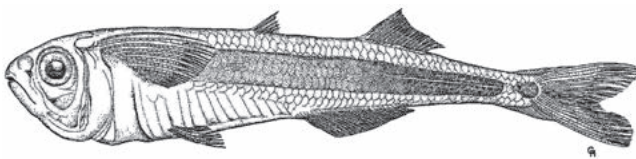
*Iso flosindicus* Herre 1944: 46 (beach at Visakhapatnam, India).

*Tropidostethus natalensis*: Schultz 1948.

*Tropidostethus flosindicus*: Schultz 1948; Smith & Smith 1966\*.

First dorsal fin 3–6 spines; 2nd dorsal fin 1 spine, 12–17 rays; anal fin 1 spine, 21–28 rays; pectoral fins 1 spine, 12–14 rays; lower GR 10–13. Midlateral scales 40–66. Body depth 3.3–3.5 in SL; HL 4.1–5.5 in SL; eye diameter 2.5–3.6 in HL. Premaxilla with sparse, strong canine teeth.

Body translucent, but lower portion of head and abdomen silvery (making fish difficult to see in water); broad bright silvery band from pectoral-fin bases to peduncle, plus silvery spot on peduncle, and peritoneum silvery. Preserved specimens opaque pale yellow or yellow-brown; midlateral stripe, opercle, eyes and abdomen either silvery or brown; interdorsal space blackish. Attains 8 cm TL.



*Iso natalensis*, 4 cm SL (Indian Ocean). Drawn by G Rankin

**DISTRIBUTION** Indian Ocean (widespread). WIO: South Africa (Cape Agulhas) to East Africa, Comoros, Pakistan and India; elsewhere to Andaman Is.

**REMARKS** Frequently occurs in large aggregations in strong surf, close to shoreline and often near rocks. The types of *I. natalensis* and *I. flosindicus* Herre 1944 have been found to be indistinguishable from one another; likewise counts and measurements from specimens from East Africa, Pakistan, and the west coast of India reveal no differences.

## FAMILY ATHERINIDAE

### Silversides

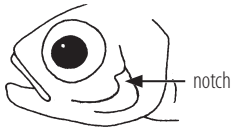
Seishi Kimura

Small-sized (commonly 5–10 cm SL) with slender, cylindrical or somewhat compressed body and round belly; no small denticular spines in rows on head. Mouth small and terminal; rear of upper jaw not extending to rear margin of eye. Two well-separated dorsal fins: 1st dorsal fin with 3–8 flexible spines separated from each other at bases; 2nd dorsal fin 1 spine, 7–13 soft rays; anal fin 1 spine, 8–21 rays; pectoral fins high on sides of body, with 10–19 rays; pelvic fins abdominal to sub-abdominal, with 1 spine, 5 rays; caudal fin forked. No lateral line. Scales cycloid, relatively large, and rear margins with notches, crenulations or spatular outgrowth in some species. Body typically greenish or greenish brown dorsally, silvery ventrally, and with broad silvery midlateral band.

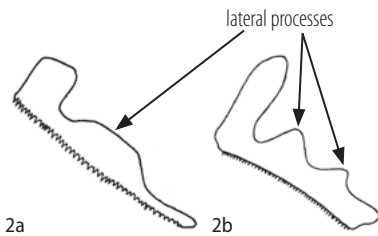
Occurs in shallow, tropical to temperate marine, estuarine, and sometimes adjacent freshwater areas of all oceans; often found along beaches and in seagrass areas. Feed mainly on zooplankton, phytoplankton and small benthic crustaceans. Eggs with entangling filaments on chorion. Of little commercial importance, but caught as food fishes or bait in some areas; important forage species for larger fishes and seabirds. Sasaki & Kimura (2014) indicated polyphyletic and paraphyletic relationships in some genera and the existence of cryptic species. Twelve genera and ~69 species; 3 genera and 10 species in WIO.

**KEY TO GENERA**

- 1a No notch in rear margin of preopercle; transverse scale rows (TSR) 8–11 ..... *Atherina*  
 1b Preopercle with notch; TSR 6 ..... 2

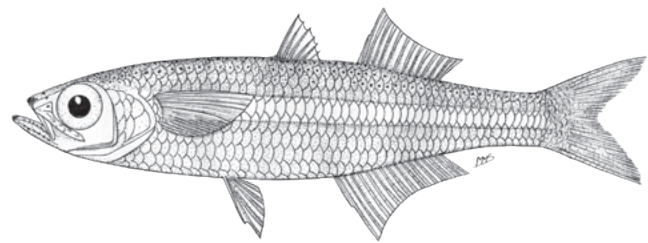


- 2a Premaxilla with 1 lateral process ..... *Atherinomorus*  
 2b Premaxilla with 2 lateral processes ..... *Hypoatherina*



Anterior lateral process of premaxilla with rounded tip; upper margin of dentary ascending distally, with prominent process at rear; upper jaw reaching to or beyond vertical through front margin of eye. Midlateral band narrow, its width about 80–90% of midlateral scales (4th or 5th row) at level of anal-fin origin. Anus between pelvic-fin origin and tips. Vertebrae 18–20 + 24–26 = 43–46.

Body translucent except for silvery breast, abdomen and midlateral band; head dark dorsally, silvery ventrally; tip of snout and opercle dark; iris silvery; dorsal and dorsolateral scale pockets fringed with black; anal-fin base black; caudal fin blackish. Attains 11 cm SL.



*Atherina breviceps*, 8 cm TL (South Africa). Source: Smith 1949

**GENUS** *Atherina* Linnaeus 1758

Premaxilla slightly tapering posteriorly; ascending process of premaxilla long and slender, its height ~3 in its maximum width; anterior and posterior lateral processes of premaxilla relatively narrow and deep, but anterior process may be slightly deeper than posterior process. Upper rear margin of dentary with prominent process; upper rear limb of dentary with round posteroventral corner. Anterior preopercular ridge without notch just above corner. First dorsal-fin origin and anus both before vertical through adpressed pelvic-fin tips. Scales small, TSR 8–11 (cf. TSR 6 in species of *Hypoatherina* and *Atherinomorus*). Five species in Mediterranean Sea and eastern Atlantic, with 1 species extending around Cape of Good Hope into WIO.

*Atherina breviceps* Valenciennes 1835

Cape silverside

PLATE 55

*Atherina breviceps* Valenciennes in Cuv. & Val. 1835: 445 (Cape of Good Hope, South Africa); Ivantsoff 1984; SSF No. 111.1\*; Skelton 1993\*; Heemstra & Heemstra 2004\*.

First dorsal fin 5–7 spines; 2nd dorsal fin 1 spine, 11–14 rays; anal fin 1 spine, 15–18 rays; pectoral fins 1 unbranched ray, 13–15 branched rays; midlateral scales 43–46; predorsal scales 20–23; interdorsal scales 7–10; GR on lower arch 19–22.

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (KwaZulu-Natal) in WIO.

**REMARKS** Found along coastline and in estuaries and coastal lakes; forms schools, especially in springtime. Feeds on phytoplankton and rotifers, switching to mostly amphipods as adults.

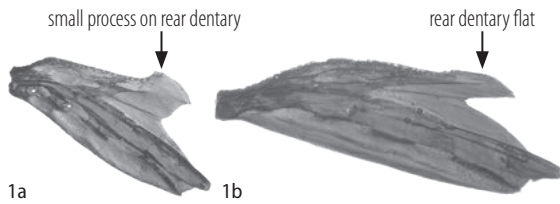
**GENUS** *Atherinomorus* Fowler 1903

Premaxilla tapering posteriorly; ascending process of premaxilla short and wide, its height <2 into its maximum width; single lateral processes of premaxilla wide and low. Upper rear margin of dentary with small or no process; upper rear limb of dentary pointed. Anterior preopercular ridge with deep notch just above corner. TSR 6. Anus situated near adpressed pelvic-fin tips in adults. DNA analysis indicates that *Atherinomorus* as currently recognised consists of 3 or more phylogenetic groups (clades), which will probably result in division of the genus (Sasaki & Kimura 2014). Eleven species, 4 in WIO.

**KEY TO SPECIES**

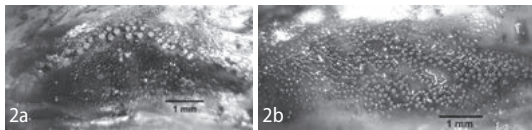
1a Upper rear margin of dentary with small process ..... *A. duodecimalis*

1b Upper rear margin of dentary flat, without process ..... 2



2a Teeth on endopterygoid relatively large, forming obvious ridges ..... *A. forskalii*

2b Teeth on endopterygoid minute, scattered, not forming ridges ..... 3



3a Silvery midlateral band wide, its lower margin nearly reaching centre of 4th scale row at level of anal-fin origin; midlateral scales 40–44 ..... *A. lacunosus*

3b Silvery midlateral band narrow, its lower margin just reaching to lower margin of 3rd scale row at level of anal-fin origin; midlateral scales 38–41 ..... *A. pinguis*

***Atherinomorus duodecimalis*** (Valenciennes 1835)

Tropical silverside

PLATE 56

*Atherina duodecimalis* Valenciennes in Cuv. & Val. 1835: 458 (Sri Lanka).

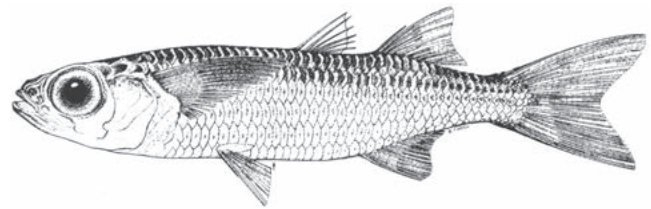
*Atherinomorus endrachtensis* (non Quoy & Gaimard 1825): Ivantsoff & Crowley 1991 [in part]; Allen 1997.

*Atherinomorus duodecimalis*: Myers 1999; Ivantsoff & Crowley 2000 [in part?]; Kimura *et al.* 2001\*.

First dorsal fin 4–6 spines; 2nd dorsal fin 1 spine, 8–11 rays; anal fin 1 spine, 11–14 rays; pectoral fins 1 unbranched ray, 13–16 branched rays; midlateral scales 33–38; predorsal scales 15–18; interdorsal scales 5–8; GR on lower arch 19–26. Upper margin of dentary ascending distally, with small process at rear end; rear of upper jaw not extending beyond vertical through front margin of pupil. Midlateral band narrow, its width  $\sim\frac{1}{2}$ – $\frac{3}{4}$  width of midlateral scale at level of anal-fin origin. Anus situated between pelvic-fin origin and tips. Vertebrae 18–21 + 17–20 = 36–40.

Head and body faintly greenish tan dorsally, silvery laterally and on abdomen; snout dusky; midlateral band brilliant silvery, upper edge with greenish line; dorsal and dorsolateral

scale pockets fringed with dark brown; iris silvery, with black blotch dorsally in some specimens; narrow iridescent silvery band along pectoral-fin bases; all fin rays fringed with dark dots or lines; fin membranes hyaline, except caudal fin opaque ventrolaterally and margin blackish. Attains ~8 cm SL.



*Atherinomorus duodecimalis*, 5 cm SL (SW Pacific). Source: SSF (by B Thorn)



*Atherinomorus duodecimalis*, 6 cm SL (Aldabra). © S Kimura, FRLM

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar, Comoros, Aldabra, Seychelles and Sri Lanka; elsewhere to Thailand, Indonesia, Philippines, Japan, New Guinea, Great Barrier Reef and New Caledonia.

**REMARKS** Broadly distributed along open coasts and into mangrove estuaries; generally schools in calm waters.

***Atherinomorus forskalii*** (Rüppell 1838)

Red Sea hardyhead silverside

PLATE 56

*Atherina forskalii* Rüppell 1838: 132, Fig. 1 (Jeddah, Saudi Arabia, Red Sea).

*Atherina lacunosa* (non Forster 1801): Günther 1876 [in part].

*Atherina pinguis* (non Lacepède 1803): Klunzinger 1870 [in part]; Klunzinger 1884.

*Atherinomorus forskalii*: Kimura *et al.* 2007\*.

First dorsal fin 4–6 spines; 2nd dorsal fin 1 spine, 8–10 rays; anal fin 1 spine, 11–15 rays; pectoral fins 1 unbranched ray, 13–16 branched rays; midlateral scales 39–43; predorsal scales 16–19; interdorsal scales 5–8; GR on lower arch 20–23. Upper margin of dentary almost flat distally, no distinct process at rear end; rear of upper jaw reaching at most to vertical through front margin of pupil (not centre of pupil). Teeth on endopterygoids relatively large, forming obvious ridges. Lower margin of midlateral band reaching to or just below lower margin of midlateral scale row at level of anal-fin origin.

Anus located near pelvic-fin tips. Vertebrae 21–24 + 18–21 = 40–44.

Head and body pale brown or greenish tan dorsally (pale or dark brown in preservative), silvery laterally and on opercle and abdomen; snout dusky; midlateral band brilliant silvery with pale brownish line on upper edge (band silvery when guanophores intact or else black in preservative); dorsal and dorsolateral scale pockets edged in black or dark brown; iris silvery with black blotch dorsally in most specimens; dotted black line sometimes present ventrolaterally on body; fin membranes hyaline (dusky in preservative), except caudal-fin margin blackish; black blotch on pectoral fins in some specimens. Attains ~13 cm SL.

**DISTRIBUTION** WIO: endemic to Red Sea, and Lessepsian migrant to eastern Mediterranean Sea.

**REMARKS** Inshore pelagic schooling fish. Feeds on zooplanktons. Spawning season in summer.

### *Atherinomorus lacunosus* (Forster 1801)

Wide-banded hardyhead silverside

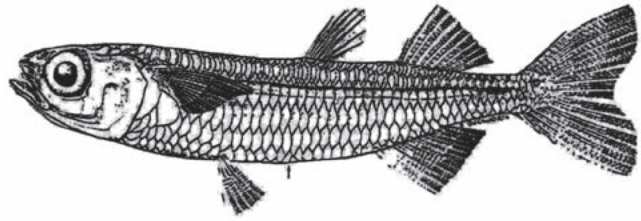
PLATE 56

*Atherina lacunosus* Forster in Bloch & Schneider 1801: 112, xxxi (New Caledonia [Balade, NE Grande Terre]); Günther 1876 [in part].  
*Atherina pinguis* (non Lacepède 1803): Günther 1861; Klunzinger 1870.  
*Atherina forskalii* (non Rüppell 1838): Günther 1861; Klunzinger 1884.  
*Pranesus pinguis ruppelli* Smith 1965: 617, Pl. 99b (Jeddah, Saudi Arabia, Red Sea).  
*Atherinomorus lacunosus*: Whitehead & Ivantsoff 1983 [in part]; Winterbottom *et al.* 1989; Ivantsoff & Crowley 1991, 2000 [in part]; Fricke 1999; Bucciarelli *et al.* 2002 [in part]; Heemstra *et al.* 2004; Kimura *et al.* 2007\*; Fricke *et al.* 2009; Fricke *et al.* 2013.

First dorsal fin 5–7 spines; 2nd dorsal fin 1 spine, 9–11 rays; anal fin 1 spine, 12–16 rays; pectoral fins 1 unbranched ray, 14–17 branched rays; midlateral scales 40–44; predorsal scales 17–21; interdorsal scales 6–8; GR on lower arch 18–24. Upper margin of dentary almost flat distally, no distinct process at rear end; rear of upper jaw reaching to vertical between front margin and centre of pupil. Teeth on endopterygoids relatively small, not forming obvious ridges. Lower margin of midlateral band nearly reaching centre of 4th scale row at level of anal-fin origin. Anus located near or usually behind pelvic-fin tips. Vertebrae 21–24 + 18–22 = 41–45.

Head and body pale brown or greenish tan dorsally, silvery laterally and on opercle and abdomen; snout dusky; midlateral band brilliant silvery with pale brownish line on upper edge; dorsal and dorsolateral scale pockets edged in black or dark brown; iris silvery; fin membranes hyaline, except caudal-fin

margin blackish; black blotch on pectoral fins in most specimens. Attains ~15 cm SL.



*Atherinomorus lacunosus*, 7 cm SL (Chagos).

Source: Ivantsoff & Crowley 1999 (by B Duckworth)

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Oman, Red Sea to South Africa (Eastern Cape), Mozambique Channel, Madagascar, Seychelles, Mascarenes and Chagos; elsewhere to Indonesia, Philippines, southern Japan, northern Australia and Tonga, but not known from Andaman Sea.

**REMARKS** Common in large schools in shallow waters, including lagoons. Feeds on planktonic crustaceans; an important forage species for larger fishes and seabirds.

### *Atherinomorus pinguis* (Lacepède 1803)

Narrow-banded hardyhead silverside

PLATE 56

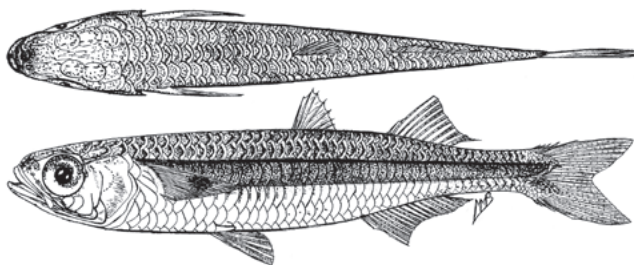
*Atherina pinguis* Lacepède (ex Commerson) 1803: 371, 373, Pl. 11, Fig. 1 (Mauritius, Mascarenes); Günther 1861 [in part].  
*Atherina pectoralis* Valenciennes in Cuv. & Val. 1835: 447 (Mascarenes and Australia).  
*Atherinomorus lacunosus* (non Forster 1801): Whitehead & Ivantsoff 1983 [in part]; Ivantsoff & Crowley 1991 [in part], 2000 [in part].  
*Atherinomorus pinguis*: Kimura *et al.* 2007\*.

First dorsal fin 4–6 spines; 2nd dorsal fin 1 spine, 9–11 rays; anal fin 1 spine, 12–16 rays; pectoral fins 1 unbranched ray, 14–16 branched rays; midlateral scales 38–41; predorsal scales 16–20; interdorsal scales 6–8; GR on lower arch 19–23. Upper margin of dentary almost flat distally, no distinct process at rear end; rear of upper jaw reaching to or beyond vertical through front margin (rarely to centre) of pupil. Teeth on endopterygoids relatively small, not forming obvious ridges. Lower margin of midlateral band barely reaching lower margin of midlateral scale row at level of anal-fin origin. Anus usually located just before (rarely beyond) pelvic-fin tips. Vertebrae 20–23 + 19 or 20 = 39–43.

Head and body faintly bright brown or greenish tan dorsally, silvery laterally and on opercle and abdomen; snout dusky; midlateral band brilliant silvery with pale brownish or yellowish green line on upper edge; dorsal and dorsolateral



scale pockets fringed with black or dark brown; iris silvery; fin membranes hyaline, except caudal-fin margin blackish; black blotch on pectoral fins in most specimens. Attains ~14 cm SL.



*Atherinomorus pinguis*, 14 cm TL. Source: Smith 1965

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Persian/Arabian Gulf, East Africa to South Africa and Mascarenes; elsewhere to Indonesia, southern Japan and Australia.

**GENUS** *Hypoatherina* Schultz 1948

Premaxilla not tapering posteriorly (except somewhat tapering in *H. golanii*); ascending processes of premaxilla long and slender, its height >2.7 into its maximum width; anterior and posterior lateral processes of premaxilla narrow and deep (anterior process may be slightly deeper). Upper rear margin of dentary with prominent process; upper rear limb of dentary with round or somewhat angular (never pointed) posteroventral corner. Anterior preopercular ridge with deep notch just above corner. Anus situated near addressed pelvic-fin tips in adults. TSR 6; height of exposed area in midlateral scale row wide, almost equal to maximum height of scale, and almost same height as scales in the rows just above and below (i.e., the 2nd and 4th rows). The genus was redefined and revised by Sasaki & Kimura (2014). Ten species, 5 in WIO.

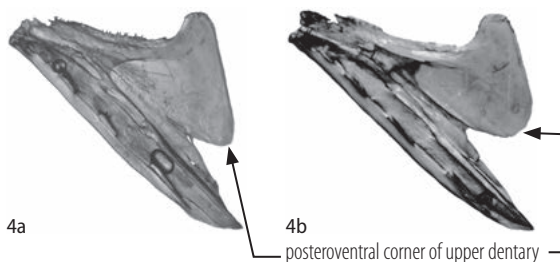
**KEY TO SPECIES**

- 1a Maxilla not slanted downwards posteriorly; midlateral scales with indented rear margins; anterior predorsal scales with spatulate outgrowth on rear margin ..... *H. golanii*
- 1b Maxilla usually slanted downwards posteriorly; midlateral scales usually with rear margins entire (not indented); no outgrowths on rear margins of predorsal scales ..... 2

Continued ...

**KEY TO SPECIES**

- 2a Anus slightly in front of or at addressed pelvic-fin tips in adults ..... *H. klunzingeri*
- 2b Anus behind addressed pelvic-fin tips in adults ..... 3
- 3a Body compressed, maximum body width <math>\lt; \frac{3}{4}</math> body depth; midlateral band wide, its lower margin nearly reaching centre of 4th scale row at level of anal-fin origin ..... *H. barnesi*
- 3b Body cylindrical or subcylindrical, maximum body width >math>\gt; \frac{3}{4}</math> body depth; midlateral band moderate, its lower margin barely reaching lower margin of midlateral scale row at level of anal-fin origin ..... 4
- 4a Upper rear limb of dentary with somewhat angular posteroventral corner; GR on lower arch 19–25; midlateral scales 2½–6½ between levels of pectoral-fin tips and 1st dorsal-fin origin; pectoral-fin length 15–20% SL ..... *H. temminckii*
- 4b Upper rear limb of dentary with round posteroventral corner; GR on lower arch 22–26; midlateral scales 4½–7 between levels of pectoral-fin tips and 1st dorsal-fin origin; pectoral-fin length 14–18% SL ..... *H. gobio*



*Hypoatherina barnesi* Schultz 1953

Slender silverside

PLATE 56

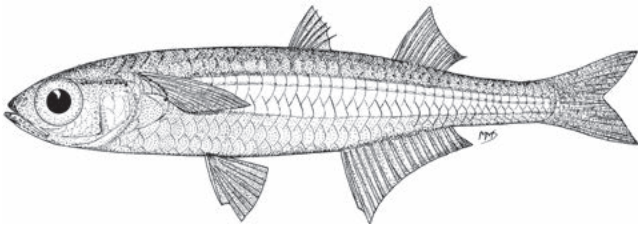
*Hypoatherina barnesi* Schultz in Schultz *et al.* 1953: 304, Fig. 47 (lagoon off Rongelap I., Rongelap Atoll, Marshall Is.); SSF No. 111.5\*; Winterbottom *et al.* 1989; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003; Sasaki & Kimura 2014.

*Allanetta klunzingeri* (non Smith 1965): Smith 1965 [in part].

First dorsal fin 5–7 spines; 2nd dorsal fin 1 spine, 9–11 rays; anal fin 1 spine, 12–15 rays; pectoral fins 1 unbranched ray, 13–16 branched rays; midlateral scales 39–42; predorsal scales 17 or 18; interdorsal scales 7–9; GR on lower arch 15–20. Body compressed, maximum width ~½–⅔ its depth; pectoral fins short, 13–16% SL. Midlateral band wide, its lower margin nearly reaching centre of 4th scale row at level of anal-fin origin. Anus situated at about midpoint between addressed pelvic-fin tips and anal-fin origin. Vertebrae 22–24 + 19–21 = 42–44.

Head and body pale brown or greenish tan dorsally, silvery semi-transparent ventrally; dorsal and dorsolateral scale pockets edged with black; midlateral band bluish silver, upper edge nearly reaching upper margin of midlateral scale row at level of anal-fin origin, and band extends to caudal-fin upper and lower lobes; snout, pectoral- and anal-fin bases dusky; no small black dots ventrolaterally on body, and no black crescent mark in front of eyes.

Preserved specimens with head and body brown dorsally, pale brown ventrally; dorsal and dorsolateral scale pockets edged with black; midlateral band dark indigo blue, upper edge nearly reaching upper margin of midlateral scale row at level of anal-fin origin, and band extends to caudal-fin upper and lower lobes; snout, pectoral- and anal-fin bases black; no small black dots ventrolaterally on body, and no black crescent mark in front of eyes. Attains 10 cm SL.



*Hypoatherina barnesi*, 8 cm TL (WIO). Source: Smith 1949

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa, Madagascar, Comoros, Aldabra, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to southern Japan, Marshall Is., Australia, New Caledonia and Cook Is.

**REMARKS** Often found around atolls and in lagoons.

### *Hypoatherina gobio* (Klunzinger 1884)

Gudgeon silverside

PLATE 56

*Atherina cylindrica* Klunzinger 1870: 834 (Red Sea) [objectively invalid; preoccupied by *Atherina cylindrica* Valenciennes 1835].

*Atherina gobio* Klunzinger 1884: 130, Pl. 11, Fig. 4 (Al-Qusayr, Egypt, Red Sea) [replacement name for *Atherina cylindrica* Klunzinger 1870].

*Hypoatherina gobio*: Schultz 1948; Sasaki & Kimura 2014 [lectotype].

*Allanetta afra* (non Peters 1855): Smith 1965 [in part]; Dor 1984; Goren & Dor 1994.

*Hypoatherina temminckii* (non Bleeker 1854): SSF No. 111.6\* [in part]; Goren & Dor 1994 [in part]; Sasaki & Kimura 2011 [in part].

First dorsal fin 5–8 spines; 2nd dorsal fin 1 spine, 8–10 rays; anal fin 1 spine, 10–13 rays; pectoral fins 1 unbranched ray, 14–18 branched rays; midlateral scales 39–42; predorsal scales 17–19; interdorsal scales 7–9; GR on lower arch 22–25. Body

depth 15–18% SL; peduncle depth 5.8–6.9% SL; interorbital width narrow, 30–38% HL; pectoral-fin length 14–18% SL. Upper rear limb of dentary with round posteroventral corner. Upper edge of midlateral band not reaching upper margin of midlateral scale row at level of anal-fin origin, lower edge nearly reaching lower margin of midlateral scale row, and band extends to caudal-fin upper lobe. Rear margins of midlateral scales entire or only slightly notched; predorsal scales without posterior outgrowths. Anus situated behind adpressed pelvic-fin tips in adults. Vertebrae 21–24 + 17–20 = 40–43.

Head and body greenish or brownish grey dorsally, silvery ventrally; midlateral band dark bluish silvery; dorsal and dorsolateral scale pockets fringed with black; indistinct small black dots ventrolaterally on body; snout, upper pectoral- and anal-fin bases dusky; caudal-fin margin blackish. Attains 9 cm SL.



*Hypoatherina gobio*, 7 cm TL (Red Sea). © JE Randall, Bishop Museum

**DISTRIBUTION** WIO: possibly endemic to Red Sea.

**REMARKS** *Atherina gobio* has long been synonymised with *Hypoatherina temminckii* by many authors. Although molecular phylogeny indicates that *Hypoatherina gobio* and *H. temminckii* are different species (Sasaki & Kimura 2014), the two species are very similar and nearly impossible to distinguish based on external morphology. However, *H. gobio* has a round posteroventral corner of the upper rear limb of the dentary (versus somewhat angular corner in *H. temminckii*), 22–26 lower GR (versus 19–25), 4½–7 midlateral scales between levels of pectoral-fin tips and 1st dorsal-fin origin (versus 2½–6½).

### *Hypoatherina golanii* Sasaki & Kimura 2012

Red Sea silverside

PLATE 56

?*Hypoatherina barnesi* (non Schultz 1953): Ivantsoff 1984; Goren & Dor 1994.

*Hypoatherina golanii* Sasaki & Kimura 2012: 1, Figs. 1–3 (Eilat, Israel, Red Sea); Sasaki & Kimura 2014.

First dorsal fin 4–7 spines; 2nd dorsal fin 1 spine, 8–10 rays; anal fin 1 spine, 10–13 rays; pectoral fins 1 unbranched ray,

15–17 branched rays; midlateral scales 40–43; predorsal scales 18–21; interdorsal scales 7–9; GR on lower arch 22–26. Rear end of maxilla not slanted downwards. Midlateral scales with several notches on their rear margin; anterior predorsal scales with spatular outgrowth on their rear margin; axillary scale not extending posteriorly. Midlateral band slightly narrower than or equal to midlateral (3rd) scale row at level of anal-fin origin, and band extends to caudal-fin upper and lower lobes. Anus situated at or behind adpressed pelvic-fin tips (slightly before tips in small specimens <4 cm SL). Vertebrae 23–25 + 19–21 = 43–45.

Head and body greenish grey dorsally, silvery ventrally; dorsal and dorsolateral scale pockets fringed with black; midlateral band silvery indigo blue; small black dots ventrolaterally on body, arranged in 1–3 straight or irregular lines; snout, lower jaw, upper edge of opercle, upper pectoral-fin bases and anal-fin base blackish.

Preserved specimens with head and body brown dorsally, pale brown ventrally; dorsal and dorsolateral scale pockets fringed with black; midlateral band dark indigo blue or dark brown; small melanophores ventrolaterally on body, arranged in 1–3 straight or irregular lines; snout, lower jaw, upper edge of opercle, upper pectoral-fin bases and anal-fin base blackish. Attains ~8 cm SL.



*Hypoatherina golanii*, 8 cm TL, paratype (Red Sea).  
PC Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: possibly endemic to Red Sea.

### *Hypoatherina klunzingeri* (Smith 1965)

African silverside

PLATE 56

*Allanetta klunzingeri* Smith 1965: 623, Pl. 100d, Fig. 6 (Inhaca I., Mozambique).

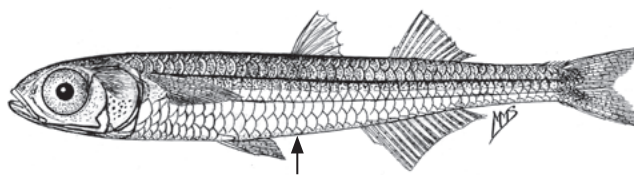
*Hypoatherina barnesi* (non Schultz 1953): SSF No. 111.5\* [in part]; Ivantsoff & Crowley 1999 [in part].

*Hypoatherina klunzingeri*: Sasaki & Kimura 2014\*.

First dorsal fin 4–6 spines; 2nd dorsal fin 1 spine, 10 or 11 rays; anal fin 1 spine, 14–16 rays; pectoral fins 1 unbranched ray, 14 or 15 branched rays; midlateral scales 38 or 39; predorsal scales 18; interdorsal scales 7 or 8; GR on lower arch 18. Maxilla slanted downwards posteriorly, with round rear upper

corner. Rear margins of midlateral scales notched. Anus situated slightly before or at adpressed pelvic-fin tips in adults. Vertebrae 22 + 20 or 21 = 42 or 43.

Head and body greenish or brownish grey (uniformly brown in preservative), silvery laterally; dorsal and dorsolateral scale pockets fringed with black (grey in preservative); midlateral band bluish silvery (indigo blue in preservative), upper edge not reaching upper margin of midlateral scale row at level of anal-fin origin, lower edge reaching lower margin of midlateral scale row; no small black dots ventrolaterally on body, and no black crescent mark in front of eyes. Attains at least 6 cm SL.



*Hypoatherina klunzingeri*, 6 cm TL, type (S Mozambique). Source: Smith 1965

**DISTRIBUTION** WIO: Mozambique to South Africa (KwaZulu-Natal).

**REMARKS** Similar to *H. barnesi* in counts of fin rays and gill rakers; however, this species has the anus situated nearly at the adpressed pelvic-fin tips and just below the 1st dorsal-fin origin (versus *H. barnesi* with anus almost at midpoint between pelvic-fin tips and anal-fin origin and behind vertical through 1st dorsal-fin origin).

### *Hypoatherina temminckii* (Bleeker 1854)

Samoan silverside

PLATE 56

?*Atherina brachypterus* Bleeker 1851: 243 (Banda Is., Indonesia); Weber 1921; Schultz 1948.

*Atherina temminckii* Bleeker 1854: 506 (Pariaman, Sumatra; Jakarta, Java, Indonesia).

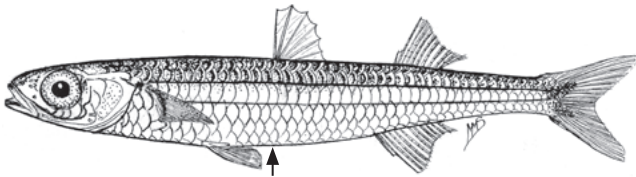
*Atherina afra* Peters 1855: 436 (Mozambique).

*Hypoatherina temminckii*: SSF No. 111.6 [in part]; Ivantsoff & Crowley 1999; Sasaki & Kimura 2014 [neotype].

First dorsal fin 5–9 spines; 2nd dorsal fin 1 spine, 8–10 rays; anal fin 1 spine, 10–13 rays; pectoral fins 1 unbranched ray, 15–19 branched rays; midlateral scales 38–42; predorsal scales 16–18; interdorsal scales 7–9; GR on lower arch 19–25. Body depth 13–19% SL; peduncle depth 5.7–7.6% SL; interorbital width narrow, 29–38% HL; ascending process of premaxilla long and slender, its height >5 in its maximum width, but shorter than horizontal length of premaxilla. Midlateral scales

entire or slightly notched on rear margin; predorsal scales not extending posteriorly; axillary scale usually elongated posteriorly. Anus situated behind adpressed pelvic-fin tips in adults. Vertebrae 21–24 + 17–20 = 39–43.

Head and body greenish grey dorsally, brilliant silvery laterally; dorsal and dorsolateral scale pockets edged in black; midlateral band glossy indigo blue, its upper edge pale yellow or pale green; small black dots ventrolaterally on body; usually no black crescent mark in front of eyes (indistinct if present); snout, pectoral-fin bases, and caudal-fin margin blackish; fin membranes hyaline. Attains 12 cm TL.



*Hypoatherina temminckii*, 11 cm TL (N Mozambique). Source: Smith 1965

**DISTRIBUTION** Indo-Pacific, except probably central Pacific and Red Sea. WIO: Somalia to Mozambique, Madagascar, Seychelles, Mauritius and Maldives; elsewhere to Thailand, southern Japan, Australia, New Caledonia and Fiji.

## FAMILY ATHERIONIDAE

### Pricklenose silversides

Walter Ivantsoff

Small-sized and elongate; distinguished from family Atherinidae by head heavily adorned with tiny denticles. Dyer & Chernoff (1996) separated species of *Atherion* Jordan & Starks 1901 on the basis of three internal characters: structure of the parasphenoid, shape of the mandibular muscle tendon, and presence of dermal teeth (odontodes).

Occur in Indo-Pacific; non-migratory and generally found in aggregations in shallow waters. One genus with 3 species, 1 in WIO.

#### GLOSSARY

**chorion** – the layer of tissue surrounding an oocyte, egg, or embryo.

**endopterygoid** – paired dermal bones in the roof of the mouth of fishes.

### *Atherion africanum* Smith 1965

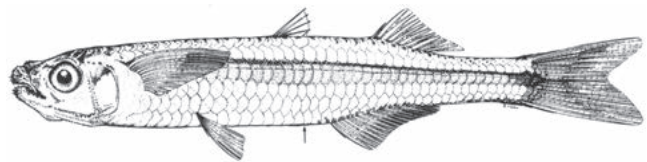
#### Pricklenose silverside

*Atherion africanus* Smith 1965: 607, Pl. 98b, Fig. 2 (Inhaca I., Mozambique); SSF No. 111.4\*.

*Atherion africanum*: Heemstra & Heemstra 2004.

First dorsal fin 3–5 spines; 2nd dorsal fin 1 spine, 10–12 rays; anal fin 1 spine, 14–17 rays; pectoral fins 10–13 rays; LL scales 41–44; GR 2 or 3/1/10 or 11. Body depth 5.4–7.5 in SL; HL 4.3–5 in SL; eye diameter 2.9–3.1 in HL. Premaxilla relatively short, not reaching vertical through front margin of orbit; surface of premaxilla heavily armoured with tiny denticles, also present on dentary, and along edges of preopercle, opercle and infraorbitals. No notch in edge of preopercle. Crest-like structures along edges of postorbital canals. No teeth on vomer or palatines.

Live fish blue-green and translucent. Preserved specimens yellow-brown or brown-green; top of head dark and upper body dusky, with scales well-outlined by chromatophores; midlateral band silvery or brown; abdomen may be brown if peritoneum shows through. Pigmentation on head and body variable, ranging from spots on chin, cheeks and lower half of body, to little or no pigmentation in those areas. Attains 5.5 cm TL.



*Atherion africanum*, 4 cm TL (S Mozambique). Source: SSF (by B Thorn)

**DISTRIBUTION** WIO: South Africa (Sodwana Bay), Mozambique (Inhaca I.), Madagascar and Comoros, and likely to Lakshadweep and India.

**paraphyletic** – a taxonomic grouping that does not include all descendants of a most recent common ancestor.

**polyphyletic** – a group of organisms (a clade) that has more than one ancestor and is defined on the basis of convergent features or characteristics.



# ORDER BELONIFORMES

Bruce B Collette and  
Lynne R Parenti

Fishes with a slender to somewhat deep, short to elongate body; single soft-rayed dorsal and anal fins, and anal fin of males in some species modified for transfer of sperm bundles or spermatophores; pectoral fins falcate, set high on sides, and may be enlarged; pelvic fins abdominal, with 5–7 rays, and fins may be enlarged; caudal fin rounded, truncate, emarginate or forked, with more principal rays in lower lobe than in upper lobe; all suborbital bones absent except for first, or first and last; parietals small or absent; lower pharyngeal bones separate or fused into a triangular plate; no dorsal hypohyal and interhyal; interarcual cartilage absent; 2nd and 3rd epibranchials relatively small; 1st and 4th pharyngobranchial absent, and 2nd pharyngobranchial vertically re-oriented; pored lateral-line scales, when present, along ventral margin of body; scales thin, cycloid; oviparous or viviparous.

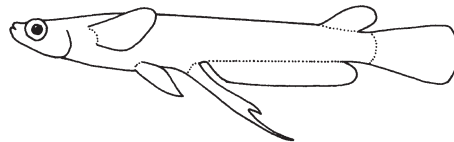
The Beloniformes together with the Atheriniformes and Cyprinodontiformes constitute the Atherinomorpha (Rosen & Parenti 1981). A monophyletic Atherinomorpha has been recovered in both morphological (Rosen 1964; Rosen & Parenti 1981; Parenti 1993, 2005) and molecular analyses (Setiamarga *et al.* 2008). Atherinomorphs are distinguished by a unique set of reproductive characters. The eggs are large and demersal, usually with long and short adhesive filaments on the zona pellucida or chorion (absent in *Exocoetus*, most scomberesocids, and all viviparous or live-bearing species), and have many oil droplets at the vegetal pole (Rosen & Parenti 1981; Collette *et al.* 1984; Parenti 1993, 2005); yolk is fluid, not granular (Parenti & Grier 2004). Spermatogonia are restricted to the distal ends of the testis lobules (Grier *et al.* 1980; Parenti & Grier 2004). There is coupling during mating; fertilisation may be external or internal, followed by a prolonged developmental period of 1–2 weeks or more in annual cyprinodontiforms. Atherinomorphs are also distinguished by the form of the superficial (A1) division of the adductor mandibulae which has two tendons (1st inserted on the maxilla, 2nd on the lachrymal); no supraneurals; the suborbital series is represented solely by a lachrymal or by a lachrymal and dermosphenotic, and 1 or 2 anterior suborbitals in some species; single or double disc-shaped ethmoid ossification (Rosen 1964); supracleithrum reduced or absent; dorsal gill arches with large 4th epibranchial and no 4th pharyngobranchial (Rosen & Parenti 1981); medial hook-like projection and ventral flange on 5th ceratobranchial (Stiassny 1990); lateral process of pelvic bone and distal end of

pleural rib are closely associated and may be connected via a ligament (Parenti 1993); olfactory sensory epithelium arranged in sensory islets (Yamamoto 1982; Parenti 1993); separation of afferent and efferent circulation during development; and saccus vasculosus absent (Parenti 2005).

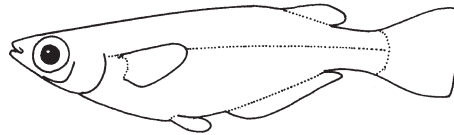
Rosen & Parenti (1981) and Parenti (2005) recognise 2 suborders of the order Beloniformes. The suborder Adrianichthyoidei contains only the family Adrianichthyidae, which inhabits brackish and fresh waters of East and South Asia and the Indo-Australian Archipelago as far east as Timor-Leste (Parenti 2008; cf. family Adrianichthyidae, this volume). The suborder Exocoetoidei is divided into 2 superfamilies with 5 families (Aschliman *et al.* 2005): superfamily Scomberesocoidea (Belonidae and Scomberesocidae) and superfamily Exocoetoidea (Hemiramphidae, Zenarchopteridae and Exocoetidae), which live in marine, brackish and freshwater habitats. All 6 families in WIO.

## KEY TO FAMILIES

- 1a Body short and laterally compressed; no pored LL scales; nostril openings paired; ventral pharyngeal bones separate ..... **ADRIANICHTHYDAE**



- 1b Body elongate, subcylindrical or slightly laterally compressed; pored LL scales run along ventral margin of body; nostril a pit with protruding tentacle; ventral pharyngeal bones fused into triangular plate ..... **2**



- 2a Both jaws elongate; paired fins not enlarged; rostral bones joined by sutures ..... **3**
- 2b Lower jaw elongate or not; pectoral and/or pelvic fins enlarged; rostral bones separate ..... **4**

Continued ...

## KEY TO FAMILIES

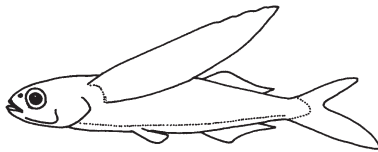
- 3a Dorsal and anal fins each followed by 4–6 separate finlets; jaws subequal to or shorter than head as measured from the corner of mouth ..... **SCOMBERESOCIDAE**



- 3b No finlets behind dorsal and anal fins; jaws longer than head as measured from the corner of mouth ..... **BELONIDAE**

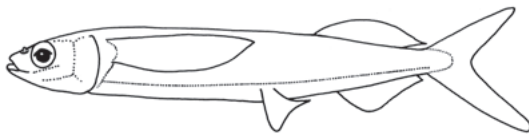


- 4a Jaws not elongate or projecting forward from snout; pectoral fins longer than head ..... **EXOCOETIDAE**



- 4b Lower jaw elongate (except in adult *Oxyporhampus*) and upper jaw triangular, projecting forward from snout; pectoral fins shorter than head as measured from the tip of upper jaw (except in *Euleptorhampus*) ..... 5

- 5a Nasal papilla rounded or fan-shaped, mostly confined to nasal fossa; caudal fin emarginate or forked; anal-fin rays of males not modified ..... **HEMIRAMPHIDAE**



- 5b Nasal papilla elongate and pointed, extending well out of nasal fossa; caudal fin rounded or truncate; some anal-fin rays of males modified, may be greatly elongate ..... **ZENARCHOPTERIDAE**



## GLOSSARY

- adductor mandibulae** – main muscle that closes the jaw.  
**afferent circulation** – taking blood to an organ.  
**cyprinodontiforms** – an order of small, mostly freshwater fishes.  
**dorsal hypohyal, interhyal, epibranchials, ceratobranchials and pharyngobranchial** – bones of the pharyngeal arch.  
**efferent circulation** – taking blood from an organ.  
**interarcual cartilage** – a cartilage in the pharyngeal arch.  
**nasal fossa** – the cavity or pit, containing nasal papillae, into which the nostrils open.  
**parietals, dermosphenotic, ethmoid** – bones of the cranium.  
**pleural rib** – the ribs of the ‘rib cage’ around the viscera.  
**saccus vasculosus** – an organ associated with the hypothalamus of many jawed fishes, that seems to be able to sense the seasons.  
**spermatogonia** – cells produced early on in the formation of spermatozoa.  
**supracleithrum** – the dorsalmost bone of the pectoral girdle in bony fishes, usually articulated with the posttemporal bone of the skull.  
**vegetal pole** – the side of an egg opposite to the ‘animal’ pole; cell growth is slower in the vegetal pole which contains more yolk.  
**zona pellucida or chorion** – the layer of tissue surrounding an oocyte, egg, or embryo.

## FAMILY ADRIANICHTHYIDAE

## Ricefishes

Lynne R Parenti

Tiny to small-sized (~2–19 cm SL) with laterally compressed body. Eyes moderate to relatively large. Mouth terminal, small to large, not protrusile. Teeth small, unicuspid, in single or multiple rows on premaxilla and dentary; males and/or females may have several enlarged teeth on distal portion of upper and lower jaws. One soft-rayed dorsal fin, set posteriorly; pectoral fins falcate, set relatively high on sides; caudal fin rounded, truncate or lanceolate, forming incipient lobes. Dorsal- and anal-fin rays of males longer and thicker than those of females, and often with bony tubercles (contact organs) on distal segments of anal-fin rays, and anal-fin rays form gonopodium in males of one species. Scales small to moderate, cycloid; LSS 24–85; no pored LL scales. Body translucent or transparent in life, sometimes scattered

with tiny melanophores concentrated at pectoral-fin bases, and males may be more darkly pigmented than females; typically with dark brown or black line on dorsal surface of head to dorsal-fin origin, midlateral black line from head to caudal-fin base, black line along anal-fin base, and black submarginal line on dorsal and ventral portion of caudal fin.

Surface-feeding, schooling, and mostly lacustrine in fresh and brackish waters. Omnivorous, yet feed principally on copepods, insect larvae, small molluscs and crustaceans. Oviparous with internal or external fertilisation; females may carry a cluster of fertilised eggs near urogenital opening prior to depositing eggs on foliage. Of limited importance in the aquarium trade. One species, *Oryzias latipes* (Temminck & Schlegel 1846), is widely used in experimental biology. Two genera and ~37 species; 1 genus and 3 species in WIO.

## GENUS *Oryzias* Jordan & Snyder 1906

Body slender to deep, laterally compressed, often translucent in life. Eyes moderate to relatively large, and orbits meet dorsal surface of head. Dorsal surface of head slightly convex just anterior to eyes. Anal fin with 13–32 rays, and males may have bony contact organs (tubercles) on distal segments of rays; first 6 anal-fin rays form a gonopodium in males of one species. Both pelvic fins present in males; right pelvic fin absent in females of one species. Maxilla present or absent. Total vertebrae ≤34. Attain <6 cm SL. Inhabit principally brackish waters, estuaries and mangroves. About 33 species, 3 in WIO. *Oryzias carnaticus* and *O. dancena* have been confused in the literature and have been referred to *O. melastigma*, a junior synonym of the latter, as demonstrated by Roberts (1998). *Oryzias setnai* had been known since its description as *Horaichthys setnai*; the new combination was published in a phylogenetic analysis and taxonomic revision of the family by Parenti (2008), on which the following accounts are based.

### KEY TO SPECIES

- 1a Body deep, laterally compressed, translucent in life; anal fin 19–24 rays; anal-fin rays of males may have bony contact organs on distal portion, but rays not forming gonopodium; males and females with both pelvic fins; maxilla present ..... 2
- 1b Body slender, elongate, nearly transparent in life; anal fin 27–32 rays; first 6 rays of males elaborate and elongate, separated from rest of anal fin as gonopodium, but no bony contact organs on distal portion of rays; males with both pelvic fins, females with left pelvic fin only; maxilla absent ..... *O. setnai*

Continued...

### KEY TO SPECIES

- 2a Moderately deep-bodied, body depth at least 3.5 in SL; pectoral fins 11–13 rays; upper jaw with strongly convex upper margin and no dark brown to black outline or median notch; if present, broad mid-dorsal stripe not well-defined; females with enlarged teeth on posterior portion of premaxilla; vertebrae 28–30 ..... *O. carnaticus*
- 2b Very deep-bodied, body depth <3 in SL; pectoral fins 10 or 11 rays; upper jaw with nearly straight or slightly convex transverse margin with dark brown or black outline, and some specimens with median notch; broad dark brown to black mid-dorsal stripe from occiput to dorsal-fin origin; no enlarged teeth on posterior portion of premaxilla in females; vertebrae 28 or 29 ..... *O. dancena*

## *Oryzias carnaticus* (Jerdon 1849)

### Spotted ricefish

*Aplocheilus carnaticus* Jerdon 1849: 331 (river passing by Vaniyambadi, Carnatic region, India).

?*Panchax cyanophthalma* Blyth 1858: 288 (Kolkata market, India).

?*Panchax argenteus* Day 1868: 706 (near Chennai, India); Whitehead & Talwar 1976; Ferraris *et al.* 2000.

?*Haplochilus argenteus*: Day 1873.

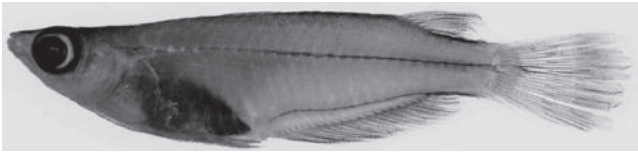
*Oryzias melastigma*: Smith 1938; Herre 1939, 1941; Hubbs 1941; Rosen 1964; Schrey 1978\*; Rahman 1989; Pethiyagoda 1991; Talwar & Jhingran 1991; Seegers 1997\*.

*Oryzias carnaticus*: Labhart 1978; Schrey 1978; Roberts 1998; Menon 1999; Parenti 2008\*.

Deep-bodied and laterally compressed, body depth at least 3.5 in SL; dorsal body profile relatively straight from head to dorsal-fin origin, ventral body profile somewhat convex from head to anal-fin origin; dorsal fin and anal fin project slightly beyond primary body profile. Dorsal fin 6 or 7 rays; anal fin 21–24 rays; pectoral fins 11–13 rays; pelvic fins 6 rays, innermost rays connected proximally by membrane to body; caudal fin truncate. Mouth terminal; jaws subequal or lower jaw projecting slightly beyond upper jaw. Teeth enlarged on posterior portions of premaxilla and dentary in males, and only on premaxilla in females. Scales relatively large, cycloid; LSS 26–30. Branchiostegal rays 5. Genital papilla short and tubular in males, large and bilobed in females. Males with filamentous dorsal- and anal-fin rays, and anal-fin rays with bony contact organs distally. Vertebrae 28–30.

Body translucent in life. Preserved specimens with diffuse row of faint melanophores on dorsal surface of head to dorsal-fin origin (specimens from Odisha State, India, with small, relatively dense dark brown chromatophores on dorsal surface of head and body sometimes forming small discrete blotches); midlateral black line from head to caudal-fin base

continuing onto caudal-fin membrane of rays just above and below midline; discrete black line along anal-fin base; dorsal- and anal-fin membranes with scattered melanophores; area of black peritoneum subrectangular in females, smaller and subtriangular in males. Attains ~32 mm SL.



*Oryzias carnaticus*, 27 mm SL, male. © T Britt Griswold

**DISTRIBUTION** Indian Ocean. WIO: Sri Lanka; elsewhere, east coast of India, Bangladesh and Andaman Is. (probably introduced).

**REMARKS** Found principally in coastal and brackish waters, but also in freshwater habitats, such as paddy fields and canals.

### *Oryzias dancena* (Hamilton 1822)

Deep-bodied ricefish

PLATE 57

*Cyprinus dancena* Hamilton 1822: 342, 393 (estuary below Kolkata) [based on an unpublished drawing].

?*Aplocheilus melastigmus* McClelland 1839: 301, 427, Pl. 42, Fig. 3 (Kolkata, India).

*Aplocheilus maclellandi* Bleeker 1854: 323 (India) [based on McClelland 1839: Pl. 55, Fig. 4, as Hamilton's lost figures of *Cyprinus dancena*]; Bleeker 1860 [as *maclellandi*].

?*Panchax cyanophthalmus* Blyth 1858: 288 (Kolkata market, India).

?*Panchax argenteus* Day 1868: 706 (Chennai, India); Whitehead & Talwar 1976; Ferraris *et al.* 2000.

?*Haplochilus argenteus*: Day 1873.

*Haplochilus melastigmus*: Day 1873.

*Haplochilus melastigma*: Day 1877; Duncker 1912.

*Oryzias melastigma*: Smith 1938; Rosen 1964; Schrey 1978\*; Rahman 1989; Pethiyagoda 1991\*; Talwar & Jhingran 1991; Seegers 1997\*; Menon 1999.

*Panchax melastigma*: Munro 1955.

*Oryzias melanostigma*: Jayaram 1981.

*Oryzias dancena*: Roberts 1998\*; Parenti 1999, 2005\*, 2008\*; Magtoon & Termvidchakorn 2009.

*Panchax cyanophthalmus*: Menon 1999.

Body laterally compressed and relatively deep, body depth ~3 in SL; ventral body profile convex from head to anal-fin origin, especially in larger specimens; dorsal fin and anal fin do not project significantly beyond primary body profile. Dorsal fin 6–8 rays; anal fin 19–24 rays; pectoral fins 10 or 11 rays; pelvic fins 6 rays, innermost rays connected proximally by membrane to body; caudal fin truncate to slightly rounded. Mouth terminal; jaws subequal or lower jaw projecting slightly

beyond upper jaw. Teeth enlarged on posterior portion of premaxilla and dentary in males only. Scales relatively large, cycloid; LSS 25–28. Branchiostegal rays 4 or 5. Genital papilla short and tubular in males, large and single-lobed in females. Males with filamentous dorsal- and anal-fin rays, and anal-fin rays with bony contact organs distally. Vertebrae 28 or 29.

Body translucent in life or may be greyish brown in males, pale brown in females; dorsal-fin margin white; anal-fin margin white distally, with thin bright blue submargin distally. Preserved specimens with discrete row of melanophores on dorsal surface of head to dorsal-fin origin; midlateral black line from head to caudal-fin base continuing onto caudal-fin membrane of rays just above and below midline; faint black line along anal-fin base; dorsal- and anal-fin membranes with scattered melanophores; area of black peritoneum subrectangular in females, smaller and subtriangular in males. Attains ~30 mm SL.

**DISTRIBUTION** Indian Ocean. WIO: Sri Lanka; elsewhere, east coast of India, Bangladesh, Myanmar and Thailand.

**REMARKS** Found principally in coastal and brackish waters such as estuaries and mangroves, but also freshwater habitats such as paddy fields.

### *Oryzias setnai* (Kulkarni 1940)

Anu

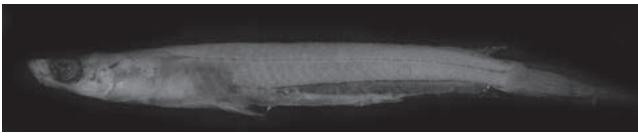
*Horaichthys setnai* Kulkarni 1940: 385, Figs. 2–4 (creeks near Mumbai, India); Hubbs 1941; Hubbs & Hubbs 1945; Silas 1959; Rosen 1964; Menon & Yazdani 1968; Parenti 1987; Talwar & Jhingran 1991; Menon 1999; Jayaram 2010; Kottelat 2013.

*Oryzias setnai*: Parenti 2008.

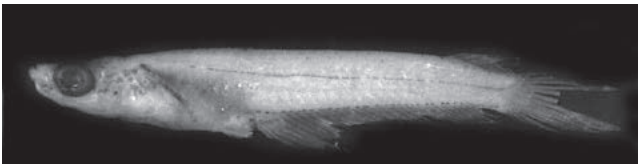
Body elongate, slender, compressed laterally; ventral body profile relatively straight from head to anal-fin origin; dorsal fin and anal fin do not project significantly beyond primary body profile. Dorsal fin 6 or 7 rays; anal fin 27–32 rays; pectoral fins 10 rays; pelvic fins 5 rays, and innermost rays connected proximally by membrane to body; caudal fin with elongate middle rays. Mouth subterminal; lower jaw projecting slightly beyond upper jaw; maxilla absent. Teeth enlarged on posterior portion of premaxilla in both males and females. Scales relatively large, cycloid; LSS 32–34; no pored LL scales. Branchiostegal rays 4. Females bilaterally asymmetrical with only left pelvic bone and pelvic-fin rays, and urogenital opening left of ventral midline in most specimens. Males with first 6 anal-fin rays elaborate and elongate, separated from rest of anal fin as gonopodium, but rays without bony contact organs. Vertebrae 31–34.



Body nearly transparent in life. Preserved specimens with diffuse row of melanophores on dorsal surface of head to dorsal-fin origin; upper jaw, body, and dorsal- and anal-fin membranes scattered with minute melanophores; midlateral black line from head to caudal-fin base continues onto caudal-fin membrane of rays just above and below midline; interrupted, horizontal dark brown bar from eye to tip of the lower jaw in some specimens; faint black line along anal-fin base; urogenital region with dense brown to black spots. Attains ~22 mm SL.



*Oryzias setnai*, ~20 mm SL, male. SJ Raredon © Smithsonian Institution



*Oryzias setnai*, ~20 mm SL, female. SJ Raredon © Smithsonian Institution

**DISTRIBUTION** WIO: India (west coast, from near Gulf of Kutch to Thiruvananthapuram, Kerala).

**REMARKS** Among the smallest known fish species in India. Transparent, surface-dwelling, in fresh and brackish waters of quiet creeks, backwaters, puddles and stagnant brackish pools. Males produce small encapsulated sperm bundles; females lay eggs after internal fertilisation. Feeds on the larvae of mosquitoes and other insects, as well as crustaceans (including copepods) and diatoms.

#### GLOSSARY

**bony contact organs** – in *Oryzias*, dermal bony outgrowths that project from a fin ray, surrounded by epidermis through which the bony outgrowths may protrude.

**gonopodium** – the modified anal-fin rays of males of certain fishes with internal fertilisation, and is used to transfer sperm bundles or spermatophores to females.

**lacustrine** – living in lakes.

## FAMILY EXOCOETIDAE

### Flyingfishes

Iliia B Shakhovskoy and Bruce B Collette

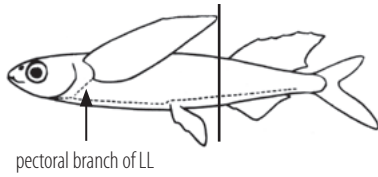
Body elongate, subcylindrical to laterally compressed, and usually flattened ventrally. No fin spines; dorsal and anal fins posterior in position, their bases opposite; pelvic fins abdominal, with 6 rays; pectoral fins enlarged, high on sides, very long, extending past dorsal-fin origin; caudal fin forked, lower lobe longer than upper lobe. Jaws short, upper jaw rounded; teeth very small or absent. Nasal organ a pit with protruding lobate tentacle. Gill rakers well-developed. Lower pharyngeal bones fused; 3rd pair of upper pharyngeal bones not fused. Scales large, cycloid, easily detached. Lateral line along ventral contour of body. Juveniles often with a single or pair of chin barbels, and usually quite unlike adults in colour pattern and relative size of fins. Vertebrae 35–52.

Occur in coastal waters and open ocean as typical members of the epipelagic fish community, in surface waters to ~20 m deep. They tend to emerge rapidly from the water and glide over a fairly long distance by means of their expanded pectoral fins (and also enlarged pelvic fins in ‘four-winged’ species) before dropping back into the sea. The pectoral fins are usually held flat against the body in the water, but are quickly erected and held perpendicular to the body when a fish leaps into the air. Feed mostly on small crustaceans and other planktonic animals; can be attracted to lights at night. Eggs of most species are demersal, with sticky filaments that attach to floating or anchored vegetation; larvae pelagic. Size range 11–38 cm SL. Known in tropical to temperate seas; locally abundant in warm seas and commercially fished and used for food in some areas.

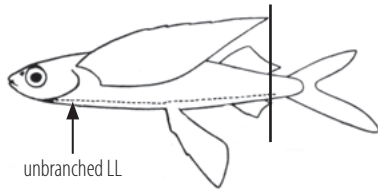
Six or 7 genera (*Cheilopogon* is included in *Cypselurus* by some authors) and 65–70 species; 6 genera and at least 23 species in WIO. Generic classification revised by Parin (1961); western Pacific species were reviewed by Parin (1960, 1961, 1996, 1999), WIO species by Parin (1984), and South African species by Heemstra & Parin (1986).

KEY TO GENERA

- 1a Pelvic fins not reaching anal-fin origin (except barely reaching in juveniles of *E. monocirrhus* <4 cm SL); pelvic-fin origins closer to snout tip than to caudal-fin base ..... *Exocoetus*
- 1b Pelvic fins reach beyond anal-fin origin; pelvic-fin origins closer to caudal-fin base than to snout tip ..... 2
- 2a Pectoral fins not reaching past anal-fin base; lateral line with upward branch to pectoral-fin base; upper jaw protrusile ..... *Parexocoetus*

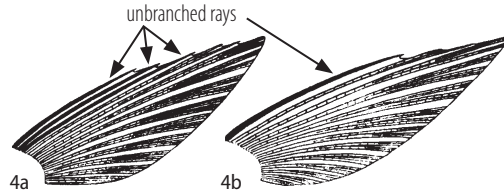


- 2b Pectoral fins usually reaching past anal-fin base; lateral line not branched near pectoral-fin base; upper jaw not protrusile .... 3

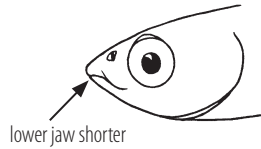


- 3a Anal-fin origin in front of 3rd dorsal-fin ray; number of dorsal-fin rays usually fewer or same (rarely 1 more) as in anal fin; no chin barbels in juveniles ..... *Hirundichthys*
- 3b Anal-fin origin under or behind 3rd dorsal-fin ray; dorsal fin usually with 2–4 more rays than in anal fin (*Cheilopogon pinnatibarbatus* with rarely at most 1 more ray); juveniles with or without chin barbels ..... 4
- 4a Upper 2–4 pectoral-fin rays unbranched; no chin barbels in juveniles ..... *Prognichthys*

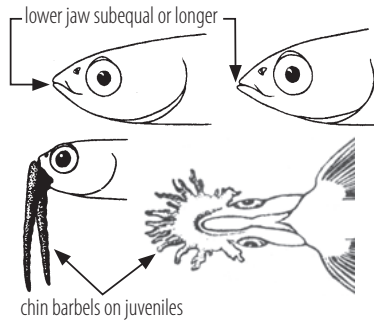
- 4b Only uppermost pectoral-fin ray unbranched; juveniles with or without chin barbels ..... 5



- 5a Lower jaw usually slightly shorter than upper jaw; usually at least some jaw teeth tricuspid (all teeth unicuspid in *Cypselurus hexazona*); juveniles with or without single chin barbel ..... *Cypselurus*



- 5b Jaws subequal or lower jaw slightly longer than upper jaw; jaw teeth mostly unicuspid or with small supplementary cusps laterally; juveniles with 2 chin barbels (fused into napkin-like fringed appendage in *Cheilopogon pinnatibarbatus*) ..... *Cheilopogon*



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GENUS *Cheilopogon* Lowe 1841

Pelvic fins long, bases closer to caudal-fin base than to snout tip; pectoral fins long, reaching dorsal-fin base or beyond; anal-fin origin usually under or behind 3rd dorsal-fin ray. Mouth not protrusile; lower jaw subequal to or slightly longer than upper jaw; jaw teeth mostly unicuspid. Lateral line not branched near pectoral-fin base. Juveniles with 2 chin barbels, sometimes fused into wide-fringed appendage. About 25–30 species, at least 8 in WIO, and several with distinct subspecies.

KEY TO SPECIES OR SUBSPECIES

- 1a Predorsal scales 39–47; HL 4.5–5 in SL; juveniles with chin barbels fused into wide, napkin-like, fringed appendage ..... *C. pinnatibarbatus altipennis*
  - 1b Predorsal scales 24–42; HL 4–4.6 in SL; juveniles with pair of chin barbels ..... 2
- C. pinnatibarbatus altipennis*



Continued...

**KEY TO SPECIES OR SUBSPECIES**

- 2a Predorsal scales 24–34; pectoral fins dark or grey with pale triangular crossband ..... 3
- 2b Predorsal scales 28–42; pectoral fins not coloured as above ... 5
  
- 3a Dorsal fin and pelvic fins with prominent black spot; jaw teeth noticeable with magnification; chin barbels of juveniles with flap-like appendage in proximal part ..... *C. abei*
- 3b Dorsal fin and pelvic fins without prominent black spot (grey spot may be present in smaller specimens of *C. intermedius*); jaw teeth barely visible with magnification; chin barbels of juveniles without proximal flap-like appendage ..... 4
  
  
- 4a No palatine teeth; pelvic-fin insertions nearer rear margin of head than origin of caudal-fin lower lobe; length of chin barbels of juveniles >15% SL ..... *C. furcatus neimani*
- 4b Palatine teeth usually present; pelvic fins inserted about midway between rear margin of head and origin of caudal-fin lower lobe; length of chin barbels of juveniles <10% SL ..... *C. intermedius*
  
- 5a Pectoral fins of adults uniformly dark (fish >20 cm SL) ..... 7
- 5b Pectoral fins of adults with small dark spots on paler background ..... 6
  
- 6a Head length shorter than distance from dorsal-fin origin to caudal-fin base; pelvic-fin origins nearer rear margin of head than caudal-fin base; dorsal fin 14–16 (rarely 13) rays ..... *C. atrisignis*
- 6b Head length about equal to distance from dorsal-fin origin to caudal-fin base; pelvic-fin origins midway between rear margin of head and caudal-fin base; dorsal fin 12–14 rays ..... *C. suttoni*
  
- 7a Predorsal scales 28–35; pectoral fins dark brown ..... *C. pilonotopterus*
- 7b Predorsal scales 33–41; pectoral fins dark blue ..... *C. cyanopterus*

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***Cheilopogon abei*** Parin 1996

Abe's flyingfish

PLATE 57

*Cheilopogon abei* Parin 1996: 303, Fig. 1 (near Admiralty Is., Bismarck Archipelago); Parin 1999\*; Parin & Sundaram 2011\*.

*Exocoetus nigricans* (non Bennett 1840): Bleeker 1871.

*Cypselurus nigricans* (non Bennett 1840): Weber & De Beaufort 1922.

*Cypselurus exsiliens* (non Linnaeus 1771): Chandy 1954.

*Cypselurus katoptron* (non Bleeker 1865): Abe 1956\*; Parin 1960\*; ?Kotthaus 1969\*.

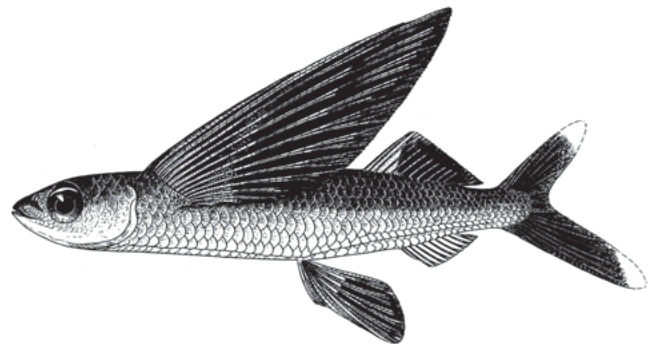
*Cheilopogon* spp. 2–4: Kovalevskaya 1980\* [in part].

*Cheilopogon nigricans* (non Bennett 1840): Bianchi 1985\*; Parin 1984\*; SSF No. 116.3\*; Winterbottom *et al.* 1989; Fricke 1999; Fricke *et al.* 2009.

*Cheilopogon* cf. *nigricans*: Parin & Lakshminarayana 1993.

Dorsal fin 12–16 rays; anal fin 9–11 rays; pectoral fins 1 unbranched ray, 12–15 branched rays. Predorsal scales 22–29; total GR 21–27. Body depth 5.5–6.6, HL 3.9–4.2, and pectoral-fin length 1.4–1.5 in SL; anal-fin origin below 6th or 7th dorsal-fin rays; pelvic fins reach to middle of anal-fin base or slightly further, origins much nearer rear margin of head than origin of caudal-fin lower lobe. Palatine teeth present. Lateral line not branched. Juveniles with elevated dorsal fin, and pair of chin barbels, their length up to ~35% SL, each bearing small lateral flap. Vertebrae 41–43.

Body dark iridescent blue dorsally, silvery white ventrally; dorsal fin and pelvic fins each with prominent black spot; pectoral fins black with pale margin, their central portion crossed by yellowish (rarely greyish) stripe becoming narrower towards upper margin. Juveniles with dark bars on sides (up to 6 bars in smallest specimens). Attains 25 cm SL.



*Cheilopogon abei*. Source: Parin 1996

**DISTRIBUTION** Indo-Pacific. WIO (widespread): north of 15–20° S, and juveniles carried southward to South Africa (KwaZulu-Natal: Park Rynie and Pumula); not known from Red Sea and Persian/Arabian Gulf; elsewhere to Philippines, Taiwan, northern Australia and Solomon Is.

**REMARKS** Epipelagic, in neritic waters and open ocean.

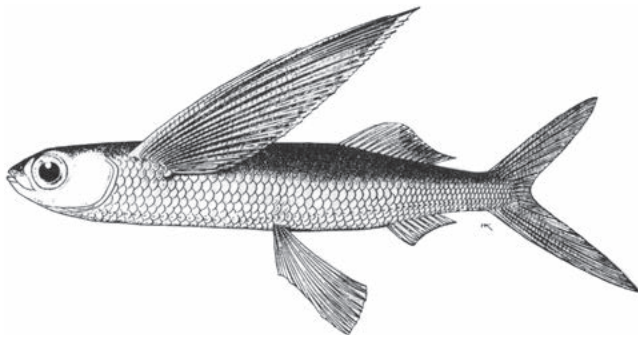
*Cheilopogon atrisignis* (Jenkins 1903)

Glider flyingfish

*Cypsilurus atrisignis* Jenkins 1903: 436, Pl. 3 (Oahu I., Hawaii).*Cypselurus atrisignis*: Imai 1959\*; Parin 1960\*; Chen 1987\*.*Cheilopogon atrisignis*: Parin 1961\*, 1984\*, 1996, 1999\*; Heemstra & Parin 1986 [key only]; Parin & Lakshminarayana 1993; Abe 1994\*.*Cypselurus spilopterus* (*non* Valenciennes 1847): Jones & Kumaran 1980\* [in part?].

Dorsal fin 13–16 rays; anal fin 9–11 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. Head shorter than distance between dorsal-fin origin and origin of caudal-fin upper lobe; pectoral fins long, 1.4–1.5 in SL; anal-fin origin 4–6 rays behind dorsal-fin origin; pelvic fins reach well beyond anal-fin origin, their origins nearer hind margin of head than origin of caudal-fin lower lobe. Palatine teeth present. Predorsal scales 33–40 (rarely 31); total GR 21–27. Lateral line not branched. Juveniles with 5 dark bars on sides of body; elongate dorsal fin; and 2 flattened, anteriorly fused chin barbels, their length up to 30% SL. Vertebrae 43–45.

Body dark iridescent blue or reddish dorsally, pale ventrally; pectoral fins brownish, with numerous scattered dark spots; dorsal fin usually with black spot; pelvic fins spotted in juveniles, usually without spots in adults. Attains 33 cm SL.

*Cheilopogon atrisignis*, 32 cm TL (Hawaii). Source: Parin 1960*Cheilopogon atrisignis*, head of juvenile (left); 29 cm SL adult (below). © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Tropical Indo-Pacific to eastern Pacific (widespread). WIO: Somalia to Madagascar and eastwards; not known from Red Sea and Persian/Arabian Gulf.

**REMARKS** Epipelagic, in neritic waters and open ocean.

*Cheilopogon cyanopterus* (Valenciennes 1847)

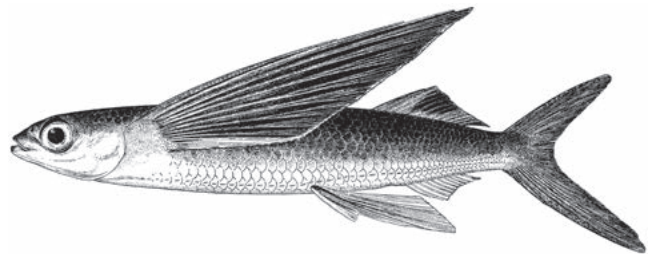
Blackwing flyingfish

PLATE 57

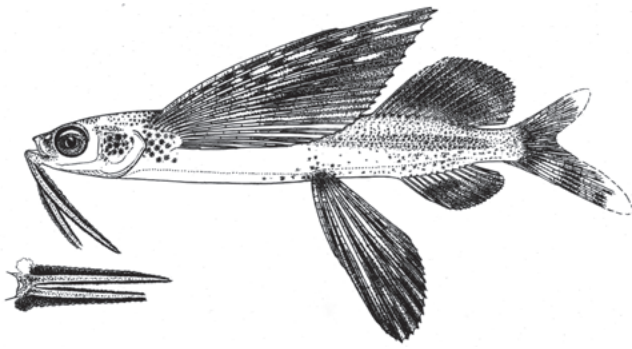
*Exocoetus cyanopterus* Valenciennes in Cuv. & Val. 1847: 97 (Bahia State, Brazil); Barnard 1925.? *Exocoetus bahiensis* Ranzani 1842: 362, Pl. 38, Fig. 1 (Brazil); Barnard 1925.? *Cypselurus hewitti* Smith 1935: 181 (Port Alfred, Eastern Cape, South Africa); SFSA No. 214.*Cypselurus cyanopterus*: Abe 1955\*; Parin 1960; Jones & Kumaran 1965\*, 1980\* [in part]; Gibbs & Staiger 1970\*; Gibbs 1981\*; Chen 1987\*.*Cheilopogon cyanopterus*: Parin & Besednov 1965; Kovalevskaya 1977\*; Parin 1984\*; SSF No. 116.1\*; Winterbottom *et al.* 1989; Parin & Lakshminarayana 1993; ?Goren & Dor 1994; Parin 1996, 1999\*; Fricke 1999; Manilo & Bogorodsky 2003; Fricke *et al.* 2009; ?Golani & Bogorodsky 2010.

Dorsal fin 12–14 rays; anal fin 9–11 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. HL 4–4.5 in SL, about equal to distance between dorsal-fin origin and origin of caudal-fin upper lobe; pectoral fins 1.3–1.5 in SL (65–70% SL); anal-fin origin below 4th–6th dorsal-fin rays; pelvic fins reach beyond middle of anal-fin base, their origins nearer rear margin of head than origin of caudal-fin lower lobe. Palatine teeth usually present. Predorsal scales 33–41; total GR 21–28. Lateral line not branched. Juveniles with elongate dorsal fin, and pair of long chin barbels (subequal to SL in some individuals). Vertebrae 42–46.

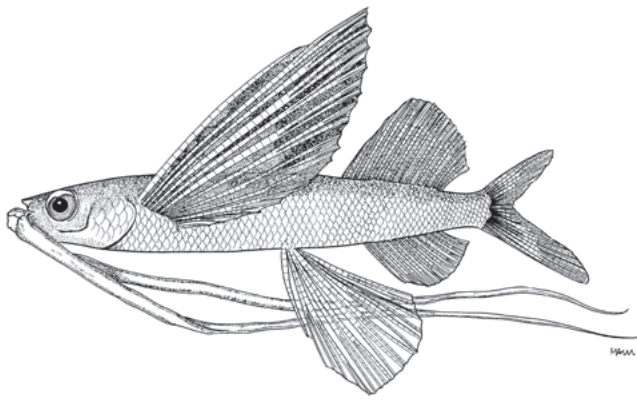
Body dark iridescent blue dorsally, silvery white ventrally; pectoral fins uniformly bluish black; dorsal fin with prominent black spot. Attains 34 cm SL.

*Cheilopogon cyanopterus*, 27 cm SL (Atlantic Ocean). Source: Bruun 1935





*Cheilopogon cyanopterus*, 6 cm SL, juvenile (South Africa).  
Source: SSF (by GN Pokhilskaya)



*Cheilopogon cyanopterus*, 5 cm SL, juvenile (Atlantic Ocean).  
Modified from Breder 1938; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Tropical waters of Atlantic, Indian and western Pacific oceans. WIO: Socotra, Kenya, South Africa (KwaZulu-Natal and possibly Eastern Cape), Madagascar, Comoros, Seychelles and Chagos; not known from Persian/Arabian Gulf, and occurrence in Red Sea needs confirmation; elsewhere to Indonesia, Japan, northern Australia and Solomon Is.

**REMARKS** Epipelagic, in neritic waters and open ocean.

### *Cheilopogon furcatus neimani*

Parin & Belyanina 1998

Spotfin flyingfish

PLATE 58

*Cheilopogon furcatus neimani* Parin & Belyanina 1998: 593 [569]

(Indian Ocean: 11°58' N, 64°58' E).

*Exocoetus altipinnis* (non Valenciennes 1847): Day 1889.

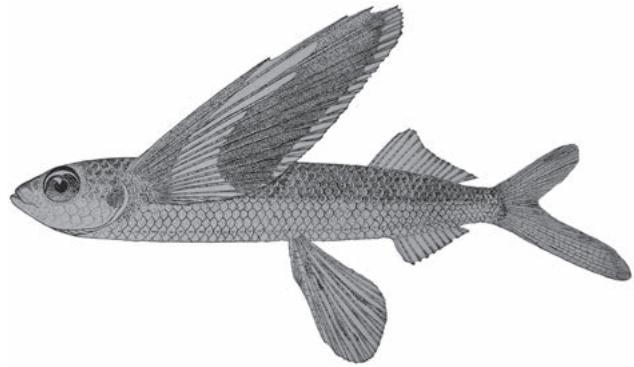
*Cypselurus furcatus*: SFS No. 211\*.

*Cheilopogon unicolor* (non Valenciennes 1847): Parin 1961\*; Gorbunova & Parin 1963\*; Kovalevskaya 1980 [in part]\*.

*Cheilopogon furcatus*: Parin 1984\*; SSF No. 116.2\*; Winterbottom *et al.* 1989; Fricke 1999; Heemstra *et al.* 2004; Fricke *et al.* 2009.

Dorsal fin 11–14 rays; anal fin 8–11 rays; pectoral fins 1 unbranched ray, 13–16 branched rays. Body depth 5.2–6.3, HL 4–4.5, and pectoral-fin length 1.4–1.6 in SL; anal-fin origin below 5th–7th dorsal-fin rays; pelvic fins reach well past middle of anal-fin base, their origins much nearer rear margin of head than origin of caudal-fin lower lobe. No palatine teeth. Predorsal scales 25–34; total GR 17–26. Juveniles with pair of chin barbels, long and tapering (up to 50% SL), retained up to 10–19 cm SL. Vertebrae 43–46.

Body dark iridescent blue dorsally, silvery white ventrally; pectoral fins dark grey (faded in larger specimens), with broad pale margin, central portion crossed by pale stripe becoming narrower towards upper margin; pelvic fins pale (often with traces of dark pigment in fish <23 cm SL); no black spot on dorsal fin. Juveniles with 6 dark bars on sides; paired fins variegated; chin barbels with pale fleshy shaft and dark membrane. Attains 30 cm SL.



*Cheilopogon furcatus neimani*, 23 cm SL (NW Indian Ocean).  
Source: Parin & Belyanina 1998 (by TN Belyanina)

**DISTRIBUTION** Tropical waters of Indian Ocean (widespread). WIO: northern Arabian Sea (Pakistan) to South Africa (probably Algoa Bay) and Madagascar; not known from Red Sea, Gulf of Aden or Persian/Arabian Gulf.

**REMARKS** Oceanic; rare in coastal waters. Other distinct subspecies of *C. furcatus* occur in the Atlantic and Pacific oceans.

### *Cheilopogon intermedius* Parin 1961

Intermediate flyingfish

PLATE 58

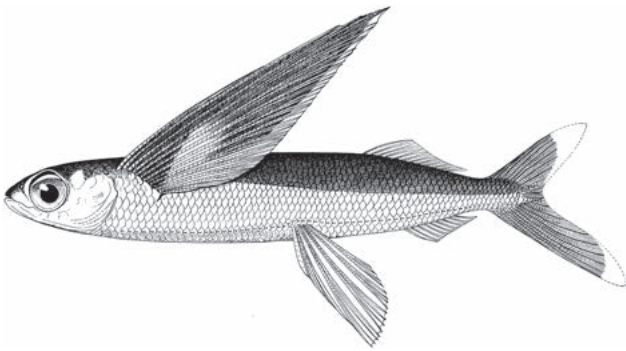
*Cheilopogon (Ptenichthys) intermedius* Parin 1961: 74 [27], Fig. 13

(06°15' S, 153°44' E); ?Kotthaus 1969\*; Kovalevskaya 1975\*; Parin & Lakshminarayana 1993; Parin 1984, 1996, 1999\*.

*Cheilopogon furcatus* (non Mitchill 1815): ?Jones & Kumaran 1980\*.

Dorsal fin 11–13 rays; anal fin 8–10 rays; pectoral fins 1 unbranched ray, 13–15 branched rays. Body depth 5.2–5.9 in SL; HL 4.1–4.4 in SL; pectoral fins 1.5–1.6 in SL, fins nearly reaching to or beyond end of dorsal fin; pelvic fins extend beyond midpoint of anal fin, insertions about midway between rear margin of head and origin of caudal-fin lower lobe (or slightly closer to former). Palatine teeth usually present. Predorsal scales 25–30; total GR 21–25. Juveniles with moderately elongate dorsal fin, and 2 short chin barbels. Vertebrae 44–47.

Body dark iridescent blue dorsally, silvery white ventrally; pectoral fins grey with more or less distinct oblique transverse band, and occasionally pale margin; pelvic fins with traces of dark pigmentation along rays, disappearing in large fish; anal fin transparent; dorsal fin and caudal fin grey. Juveniles with dark bars on sides; paired fins mottled; chin barbels black. Attains 22 cm SL.



*Cheilopogon intermedius*, 21 cm SL. Modified from Parin 1961; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Lakshadweep and India; elsewhere to Palau and Solomon Is.

**REMARKS** Epipelagic, in nearshore and neritic waters. Of minor importance to fisheries.

## *Cheilopogon pinnatibarbus altipennis*

(Valenciennes 1847)

Smallhead flyingfish

PLATE 58

*Exocoetus altipennis* Valenciennes in Cuv. & Val. 1847: 109, Pl. 560

(Cape of Good Hope, South Africa); ?Barnard 1925 [in part?].

*Exocoetus solandri* Valenciennes in Cuv. & Val. 1847: 129 (Seychelles);

Günther 1866, 1889\*.

*Exocoetus longipinnis* Castelnau 1861: 64 (Agulhas Bank, South Africa); ?Barnard 1925.

*Cypselurus bahiensis* (non Ranzani 1842): SFSA No. 212\* [in part].

*Cypselurus pinnatibarbus*: Gibbs & Staiger 1970\* [in part].

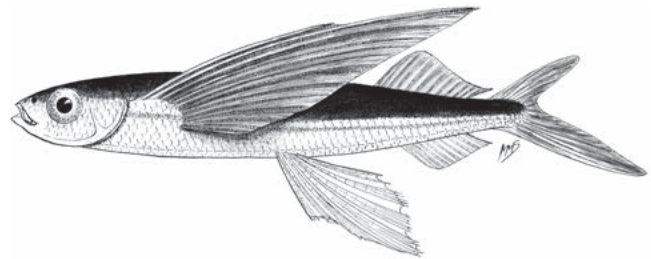
*Cheilopogon pinnatibarbus altipennis*: SSF No. 116.4; Gon & Klages 1988.

*Cheilopogon pinnatibarbus*: Collette & Parin 1991; Andrew *et al.* 1995\*.

*Cheilopogon altipennis*: Heemstra & Heemstra 2004\*.

Dorsal fin 12–14 rays; anal fin 9–12 rays; pectoral fins 1 unbranched ray, 13–15 branched rays. Body depth 5.7–7.5, HL 4.5–5, and pectoral-fin length 1.3–1.5 in SL; anal-fin origin below 4th–6th dorsal-fin rays; pelvic fins reach last anal-fin ray, their origins nearer rear margin of head than origin of caudal-fin lower lobe. Palatine teeth small, usually present. Predorsal scales 39–45; total GR 20–25. Juveniles elongate, with high dorsal fin (similar to *Parexocoetus*), and chin barbels fused into wide, napkin-like, fringed appendage. Vertebrae 49–51.

Body dark iridescent blue dorsally, silvery white ventrally; dorsal fin with or without black spot; pectoral fins dark brownish grey, with pale narrow transverse stripe (fish 20–30 cm SL). Attains 38 cm SL.



*Cheilopogon pinnatibarbus altipennis*, 30 cm TL, adult (S Mozambique). Source: SFSA

**DISTRIBUTION** Subtropical waters of southeastern Atlantic. WIO: southern Mozambique, South Africa (Kosi Bay to Cape Point), Agulhas Bank, Madagascar Ridge (Walters Shoals) and Seychelles; elsewhere, near Saint-Paul and Amsterdam Is., and Marion I. (Prince Edward Is.).

**REMARKS** Neritic. Other distinct subspecies occur in most subtropical seas.

## *Cheilopogon pilonotopterus* (Bleeker 1865)

Stained flyingfish

PLATE 58

*Exocoetus pilonotopterus* Bleeker 1865: 113 (Padang, Sumatra, Indonesia).

*Exocoetus bahiensis* (non Ranzani 1842): Bleeker 1866–72; Day 1889

[in part]; Günther 1910.

*Cypselurus quindecimradiatus* Fowler 1900: 482, Fig. 17 (Thornton I., Caroline Atoll, South Pacific).

*Exocoetus tahitensis* Seale 1906: 13, Fig. 3 (Tahiti, Society Is.);

Günther 1910.

*Cypselurus bahiensis* (non Ranzani 1842): Weber & De Beaufort 1922; Fowler & Ball 1925.

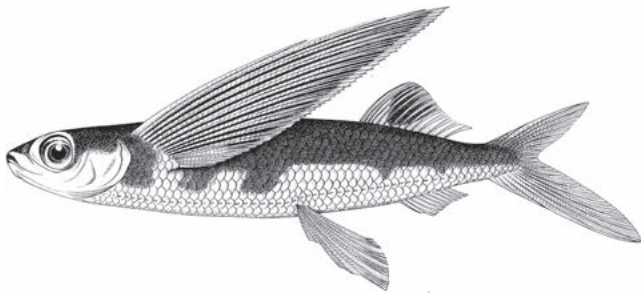
*Cypselurus bahiensis* (non Ranzani 1842): Fowler 1928; Herre 1953; SFSA No. 212 [in part].

*Cypselurus pilonotopterus*: Woods & Schultz 1953; Parin 1960\*.

*Cheilopogon pilonotopterus*: Kovalevskaya 1977\*; Abe 1994\* [in part?]; Parin 1996, 1999\*.

Dorsal fin 13 or 14 rays; anal fin 9–11 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. HL 3.8–4.1 in SL; pectoral-fin length 1.4–1.5 in SL; anal-fin origin below 6th–8th dorsal-fin rays; pelvic fins reach middle of anal-fin base, their origins nearer hind margin of head than origin of caudal-fin lower lobe. Palatine teeth present. Predorsal scales 28–35; total GR 24–27. Lateral line not branched. Juveniles with elongate dorsal fin, and pair of long chin barbels (up to ~50% SL). Vertebrae 43 or 44.

Body dark with brownish violet or reddish tinge dorsally, silvery white ventrally; pectoral fins dark brown, with narrow white margin; dorsal fin with prominent black spot. Attains 38 cm SL.



*Cheilopogon spilonopterus*, 31 cm SL, adult. Source: Parin 1960

**DISTRIBUTION** Tropical Indo-Pacific to eastern Pacific. WIO: East Africa to South Africa (Cape Peninsula), and eastwards (unconfirmed reports from Red Sea); elsewhere to Indonesia, Japan, Australia, New Caledonia, Austral Is., Hawaii, Revillagigedo Is., Malpelo I. and Galápagos Is.

**REMARKS** Epipelagic, in neritic waters and open ocean. Of minor importance to fisheries in Polynesia.

### *Cheilopogon suttoni* (Whitley & Colefax 1938)

Sutton's flying fish

PLATE 58

*Maculocoetus suttoni* Whitley & Colefax 1938: 288, Pl. 14, Fig. 1 (Nauru, Gilbert Is.).

*Cypselurus poecilopterus* (non Valenciennes): Hornell 1923.

*Cypselurus vitiazi* Parin 1958: 1412 (near Bonin Is. [Ogasawara Is.], Japan).

*Cypselurus spilopectus* (non Valenciennes): Imai 1959\*.

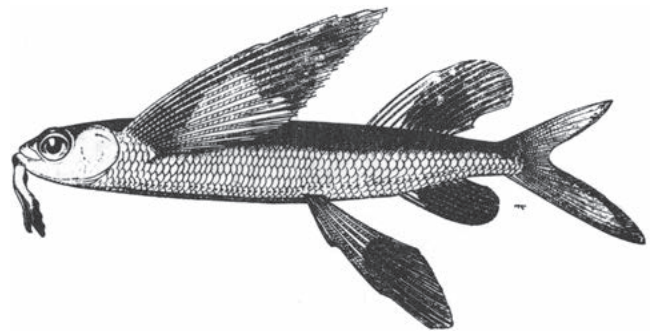
*Cypselurus suttoni*: Parin 1960\*; Randall *et al.* 1997.

*Cheilopogon suttoni*: Parin 1961\*, 1984\*, 1996, 1999\*; Parin & Besednov 1965; SSF No. 116 [key only]; Parin & Lakshminarayana 1993; Abe 1994\*; Manilo & Bogorodsky 2003.

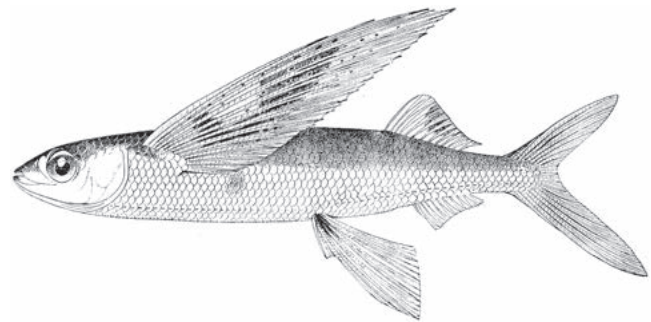
Dorsal fin 12–14 rays; anal fin 9–11 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. Body depth 5.7–7.5 in SL; HL 4.2–4.5 in SL, about equal to distance from dorsal-

fin origin to origin of caudal-fin upper lobe; pectoral fins long, 1.4–1.7 in SL; anal-fin origin below 4th–6th dorsal-fin rays; pelvic fins reach beyond anal-fin origin, inserted about midway between rear margin of head and origin of caudal-fin lower lobe. Palatine teeth present. Predorsal scales 30–42; total GR 21–27. Juveniles with elongate dorsal fin, and 2 flattened, anteriorly fused chin barbels, their length up to ~26% SL. Vertebrae 44–47.

Body dark iridescent blue or greenish blue dorsally, pale ventrally; dorsal fin usually with black spot; pectoral fins pink or reddish in life, grey or brownish in preservative, with a variable number of scattered dark spots; pelvic fins spotted in juveniles, without spots in adults; juveniles with 5–9 bars on sides. Attains 29 cm SL.



*Cheilopogon suttoni*, 16 cm SL. Source: Parin 1960



*Cheilopogon suttoni*, 28 cm SL. Source: Parin 1960

**DISTRIBUTION** Tropical Indo-Pacific (widespread). WIO: Gulf of Aden to India; not known from Red Sea and Persian/Arabian Gulf; elsewhere to east coast of India, Ryukyu Is., northwestern Australia, Gilbert Is., Vanuatu, Marquesas Is., Line Is. and Hawaii.

**REMARKS** Epipelagic, in neritic waters and open ocean. Important for fisheries in Bay of Bengal.

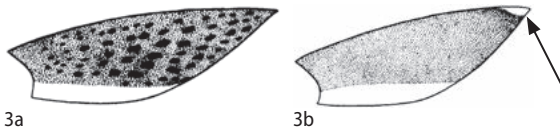


GENUS *Cypselurus* Swainson 1838

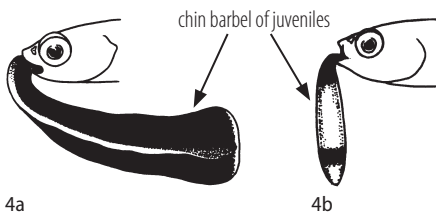
Pectoral fins long, reaching dorsal-fin base or beyond; pelvic fins long, bases closer to caudal-fin base than to snout tip; anal-fin origin under or behind 3rd dorsal-fin ray. Mouth not protrusile. Lower jaw subequal to or shorter than upper jaw; usually at least some jaw teeth tricuspid (all teeth unicuspid in *C. hexazona*). Lateral line not branched. Juveniles with or without single chin barbel. About 11 species, 5 in WIO. (Note: the genus *Cypselurus* is under taxonomical revision and the number of species will increase.)

## KEY TO SPECIES

- 1a Jaw teeth conical, none tricuspid; usually no palatine teeth; juveniles with 6 dark bars on sides of body, and no chin barbel ..... *C. hexazona*
- 1b Usually at least some jaw teeth tricuspid; palatine teeth usually present; juveniles usually without dark bars on sides (if present, 4 bars at most), and with or without single chin barbel ..... 2
- 2a Pelvic-fin origins much nearer rear margin of head than origin of caudal-fin lower lobe; no chin barbels in juveniles ..... 3
- 2b Pelvic-fin origins about midway between rear margin of head and origin of caudal-fin lower lobe; juveniles with single chin barbel ..... 4
- 3a Pectoral fins with numerous dark spots ..... *C. poecilopterus*
- 3b Pectoral fins usually with conspicuous pale tip, no dark spots ..... *C. oligolepis*



- 4a Predorsal scales usually 27–32; dorsal fin 10–12 rays; HL ~0.95–1.1 in distance between dorsal- and caudal-fin origins; pelvic fins usually pigmented; chin barbel of juveniles triangular in cross-section ..... *C. naresii*
- 4b Predorsal scales usually 24–28; dorsal fin 12–14 rays; HL ~1.1–1.25 in distance between dorsal- and caudal-fin origins; pelvic fins usually unpigmented; chin barbel of juveniles broadly flattened ..... *C. angusticeps*

*Cypselurus angusticeps* Nichols & Breder 1935

Narrowhead flyingfish

PLATE 58

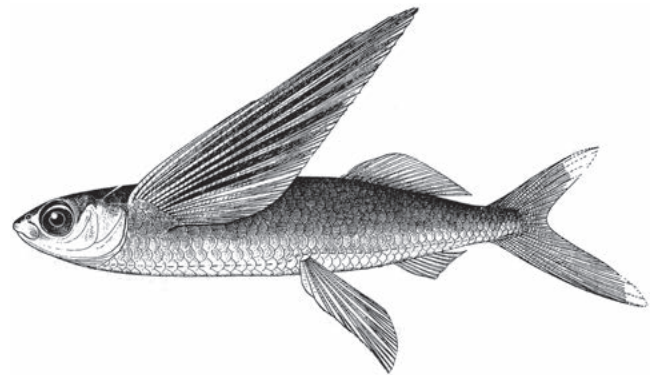
*Cypselurus angusticeps* Nichols & Breder 1935: 2, Fig. 2 (Negonego I., Tuamotu Is.); Parin 1961\*, 1984\*, 1996, 1999\*; Kovalevskaya 1982\*; Chen 1987\*; Abe 1994\*.

*Cypselurus unicolor* (non Valenciennes): Woods & Schultz 1953.

*Cypselurus* sp. juv.: Parin 1960\*.

Dorsal fin 12–14 rays; anal fin 7–10 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. HL 3.8–4.2 in SL, 1.1–1.25 in distance between dorsal-fin origin and origin of caudal-fin upper lobe; pectoral-fin length 1.4–1.5 in SL; anal-fin origin below 5th–7th dorsal-fin rays; pelvic fins reach middle of anal-fin base or beyond, their origins midway between or slightly closer to rear margin of head than to origin of caudal-fin lower lobe. Palatine teeth usually present; usually at least some jaw teeth tricuspid. Predorsal scales 23–30; total GR 20–24. Juveniles with flattened chin barbel, its length up to ~33% SL. Vertebrae 39–43.

Body dark blue dorsally, silvery white ventrally; dorsal fin grey; anal fin transparent; pectoral fins brownish grey, becoming transparent below rays 7–9, and fin margin and tip usually transparent; pelvic fins usually not pigmented. Attains 26 cm SL.



*Cypselurus angusticeps*, 23 cm SL. Source: Parin 1961

**DISTRIBUTION** Indo-Pacific (widespread), and separate population at Socorro I. (Mexico) in eastern Pacific. WIO: Arabian Sea, Gulf of Aden, East Africa to Madagascar, Comoros, Seychelles and Chagos; not known from Red Sea, Gulf of Oman and Persian/Arabian Gulf; elsewhere to southern Japan, northwestern Australia, New Caledonia, Austral Is., Tuamotu Is. and Hawaii.

**REMARKS** Epipelagic, in neritic waters and open ocean; most abundant off oceanic islands.



## *Cypselurus hexazona* (Bleeker 1853)

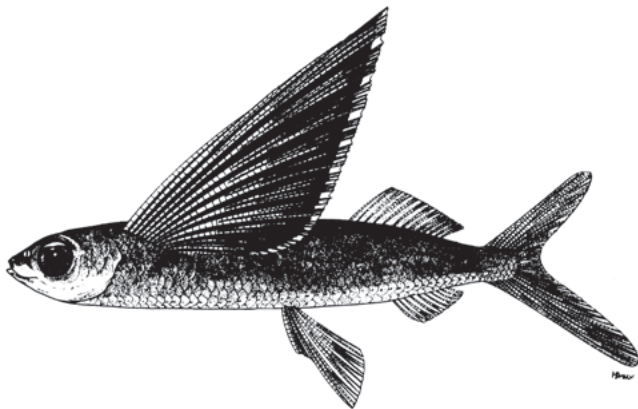
Darkbar flyingfish

PLATE 58

*Exocoetus hexazona* Bleeker 1853: 206 (Muntok, Banka, Indonesia).  
*Cypselurus brevis* (non Weber & De Beaufort 1922): Parin & Besednov 1965\*.  
*Cypselurus bruuni* Kotthaus 1969: 15, Fig. 167 (off Goa, India).  
*Cypselurus formosus* Kotthaus 1969: 17, Figs. 168–169 (off Goa, India).  
*Cheilopogon hexazona*: Parin 1984.  
*Cypselurus hexazona*: Belyanina 1993\*; Parin 1996, 1999\*; Manilo & Bogorodsky 2003; Parin & Bogorodsky 2011\*.

Dorsal fin 11–14 rays; anal fin 8–11 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. Body depth 4.9–5.6 in SL; HL 3.9–4.3 in SL, 1.08–1.24 in distance from dorsal-fin origin to origin of caudal-fin upper lobe; pectoral-fin length 1.5–1.6 in SL; anal-fin origin below 5th–6th dorsal-fin rays; pelvic fins 4–4.5 in SL, origins nearer rear margin of head than origin of caudal-fin lower lobe, and fins extend to anterior  $\frac{1}{2}$  of anal fin. Jaw teeth unicuspid, few in number, often in single row; usually no palatine teeth. Predorsal scales 23–30; total GR 19–26. No chin barbels in juveniles. Vertebrae 40–42.

Body dark blue dorsally, silvery white ventrally; dorsal fin uniformly pale grey (no spots); pectoral fins dark, with transparent lower and posterior margins, sometimes with pale tip, and traces of oblique transverse pale stripe in lower part; pelvic fins and anal fin transparent. Juveniles (25–60 mm SL) with 6 dark bars on sides of body. Attains 18 cm SL.



*Cypselurus hexazona*, 18 cm SL. Modified from Parin & Besednov 1965; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Kenya, Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman and Persian/Arabian Gulf; elsewhere to Indonesia, Philippines, southern Japan, New Guinea and Australia.

**REMARKS** Epipelagic, in nearshore waters, extremely rare in open sea. Of no importance to fisheries. According to the

latest data, seven species belonging to two genera were mixed under the name *Cypselurus hexazona*; four of these species are present in WIO (Shakhovskoy & Parin 2019). Unfortunately, due to specificity of the publishing process, accounts for these species were not included in the chapter.

## *Cypselurus naresii* (Günther 1889)

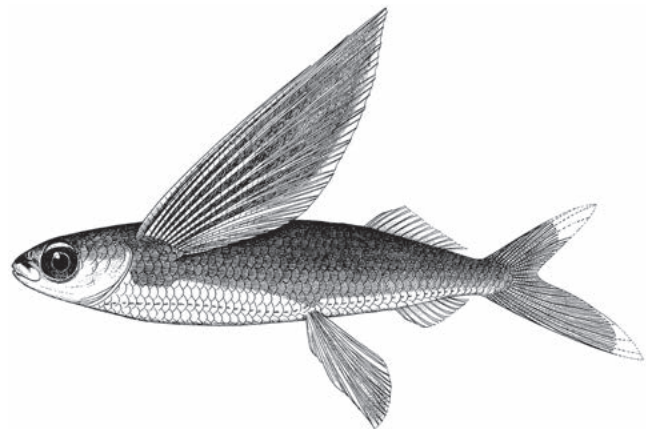
Pharao flyingfish

PLATE 59

*Exocoetus naresii* Günther 1889: 36, Pl. 1, Fig. A (between Fiji and Vanuatu).  
*Cypselurus naresii*: Weber & De Beaufort 1922.  
*Cypselurus naresii*: Imai 1955\* [in part?], 1959\* [in part?]; Parin 1961\*, 1984\*, 1996, 1999\*; Kovalevskaya 1982\*; Chen 1987\*;  
Winterbottom *et al.* 1989; Parin & Lakshminarayana 1993; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.  
*Cypselurus comatus naresii*: Parin 1960.  
*Cypselurus comatus* (non Mitchill 1815): Kotthaus 1969\*.  
*Cypselurus oligolepis* (non Bleeker 1865): Randall 1995\* [in part].

Dorsal fin 10–12 rays; anal fin 7–9 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. Body depth 4.8–5.5 in SL; HL 3.8–4.2 in SL, 0.95–1.1 in distance from dorsal-fin origin to origin of caudal-fin upper lobe; pectoral fins long, 1.4–1.6 in SL; anal-fin origin below 4th–7th dorsal-fin rays; pelvic fins extend well beyond anal-fin origin, their insertions about midway between rear margin of head and origin of caudal-fin lower lobe (or closer to latter). At least some jaw teeth tricuspid; palatine teeth present. Predorsal scales 26–32; total GR 19–25. Juveniles with single chin barbel, its length up to ~91% SL, basal portion triangular in cross-section. Vertebrae 40–45.

Body dark iridescent blue or greenish blue dorsally, pale ventrally; dorsal fin uniformly greyish (no black spot); pectoral fins brownish, becoming unpigmented below 9th ray; pelvic fins usually with more or less prominent grey spot in adults, entirely dark in juveniles. Attains 23 cm SL.



*Cypselurus naresii*, 20 cm SL. Source: Parin 1961

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Oman, Gulf of Aden to Mozambique, Madagascar, Mascarenes and Chagos; not known from Red Sea and Persian/Arabian Gulf; elsewhere to southern Japan, Australia, New Caledonia and Fiji.

**REMARKS** Epipelagic, in neritic waters and open ocean. Of minor importance to fisheries.

### *Cypselurus oligolepis* (Bleeker 1865)

Largescale flyingfish

PLATE 59

*Exocoetus oligolepis* Bleeker 1865: 109 (Singapore; Java and Sumatra, Indonesia; Bali; Makassar, Sulawesi; Labuka, Batjan; Banda Is.); Bleeker 1866–72\*.

*Exocoetus brachysoma* Bleeker 1865: 111 (Java, Indonesia; Makassar, Sulawesi; Labuka, Batjan; Ambon I.).

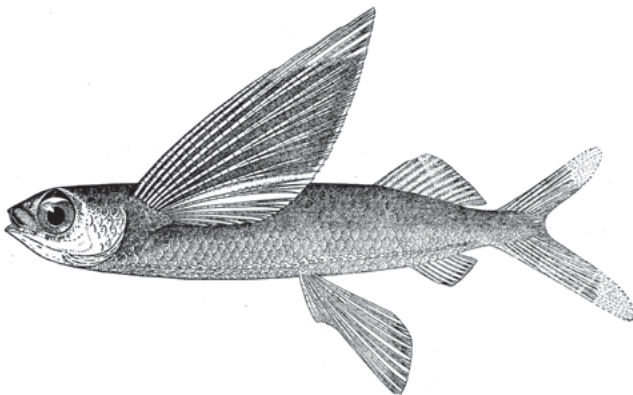
*Exocoetus neglectus* Bleeker 1865: 112 (Priaman, Sumatra, Indonesia; Singapore; Labuka, Batjan).

*Cypselurus oligolepis*: Weber & De Beaufort 1922.

*Cypselurus oligolepis*: Woods & Schultz 1953; Parin 1960, 1984\*, 1996, 1999\*; Jones & Kumaran 1965\*, 1980\*; Parin & Besednov 1965\*; Belyanina 1993\*; Parin & Lakshminarayana 1993; Goren & Dor 1994; Randall 1995 [in part]; Manilo & Bogorodsky 2003.

Dorsal fin 10–13 rays; anal fin 7–9 rays; pectoral fins 1 unbranched ray, 13–15 branched rays. Body depth 4.7–5.5 in SL; HL 3.6–4.3 in SL, 1.06–1.16 in distance between dorsal-fin origin and origin of caudal-fin upper lobe; pectoral fins long, 1.4–1.7 in SL; pelvic fins reach well beyond anal-fin origin, their insertions much nearer to rear margin of head than to origin of caudal-fin lower lobe; anal-fin origin below 4th–7th dorsal-fin rays. Palatine teeth present; jaw teeth mostly tricuspid. Predorsal scales 23–29; total GR 20–23. No chin barbels in juveniles. Vertebrae 39–41.

Body dark iridescent greenish blue dorsally, pale ventrally; dorsal fin uniformly greyish (no black spot); pectoral fins greyish brown, lower portion and tip colourless; pelvic fins dark in juveniles, and transparent in adults. Attains 18 cm SL.



*Cypselurus oligolepis*, 16 cm SL. Source: Parin & Besednov 1965

**DISTRIBUTION** Tropical Indo-Pacific. WIO: Red Sea and Persian/Arabian Gulf, Socotra, Kenya, Comoros and Lakshadweep; elsewhere to Thailand, Vietnam, Indonesia, Singapore, southern China, Taiwan, Philippines, Australia and Solomon Is.

**REMARKS** Epipelagic, in nearshore waters, rarely in open ocean. Of limited importance to fisheries in Thailand, Indonesia and Philippines.

### *Cypselurus poecilopterus* (Valenciennes 1847)

Yellow-wing flyingfish

PLATE 59

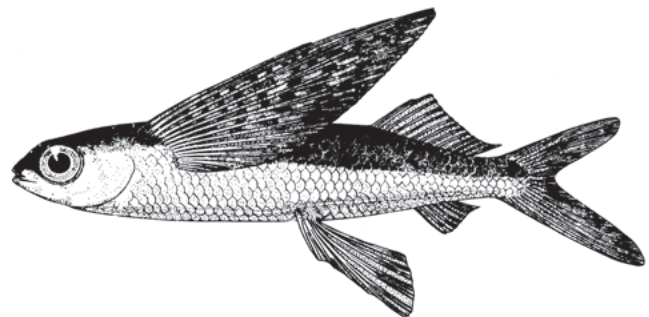
*Exocoetus poecilopterus* Valenciennes in Cuv. & Val. 1847: 112, Pl. 561 (New Britain, Bismarck Archipelago); Bleeker 1866–72.

*Cypselurus poecilopterus*: Weber & De Beaufort 1922\*.

*Cypselurus poecilopterus*: Woods & Schultz 1953; Abe 1954\*; Parin 1960\*, 1984\*, 1996, 1999\*; Chen 1987\*; Winterbottom *et al.* 1989; Belyanina 1993\*; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Fricke *et al.* 2009; Shakhovskoy & Parin 2010\*.

Dorsal fin 11–13 (rarely 14) rays; anal fin 7–9 (rarely 10) rays; pectoral fins 1 unbranched ray, 13–16 branched rays. Body depth 4.2–5.7 in SL; HL 3.8–4.3 in SL, shorter than distance from dorsal-fin origin to origin of caudal-fin upper lobe; pectoral-fin length 1.4–1.6 in SL; anal-fin origin below 5th–7th dorsal-fin rays; pelvic fins reach well beyond anal-fin origin, their insertions nearer rear margin of head than origin of caudal-fin lower lobe. Palatine teeth present; jaw teeth mostly tricuspid. Predorsal scales 23–32; total GR 19–28. Juveniles robust, without chin barbels. Vertebrae 40–44.

Body dark iridescent blue or greenish blue dorsally, pale ventrally; dorsal fin greyish, sometimes with small dark spots (usually in juveniles); pectoral fins yellowish brown (brownish grey in preservative) with black or brown spots; pelvic fins transparent, sometimes with scanty small black spots, but fins of smaller specimens may be yellow in life (greyish brown in preservative) with dark spots. Attains 27 cm SL.



*Cypselurus poecilopterus*, 23 cm TL. Source: Abe 1954

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Gulf of Aden, East Africa to Madagascar, Mascarenes, Chagos, India and Sri Lanka; not known from Red Sea, northernmost Arabian Sea and Persian/Arabian Gulf; elsewhere to Thailand, Indonesia, northern Japan, Australia, Gilbert Is. and Samoa.

**REMARKS** Epipelagic, in neritic waters and open ocean; most abundant off oceanic islands. Of minor importance to fisheries in Vietnam, Thailand, Indonesia and Japan. Divergent populations in the Arabian Sea and waters of Japan (cf. Shakhovskoy & Parin 2010) probably deserve separate subspecies status.

**GENUS** *Exocoetus* Linnaeus 1758

Upper jaw protrusile; teeth on jaws rudimentary or absent. Dorsal fin and anal fin low, their origins situated opposite each other, longest rays in anterior parts; pectoral fins very long, reaching nearly to caudal-fin base; pelvic fins short, far from reaching anal fin in adults, their bases closer to snout tip than to caudal-fin base. Lateral line not branched (except some specimens of *E. monocirrhus* with a rudimentary upward branch near pectoral-fin base).

Five species, at least 2 in WIO. *Exocoetus gibbosus* Parin & Shakhovskoy 2000 from the South Pacific (Western Australia to Easter I.) and possibly the eastern Indian Ocean (one specimen) and *E. obtusirostris* Günther 1866 from the tropical and subtropical Atlantic might also occur in WIO. Those species have GR 23–29, no chin barbels in juveniles, and paler (grey or beige) pectoral fins in adults.

**KEY TO SPECIES**

- 1a GR 22–28; 7–8½ scale rows between dorsal-fin origin and lateral line; pectoral fins of adults brown or dark brown; cleithrum with posterolateral process; juveniles (<8 cm SL) humpbacked, body depth 19–29% SL, pelvic fins elongate (16–33% SL), and with single chin barbel ..... *E. monocirrhus*
- 1b GR 28–37; 6–6½ scale rows between dorsal-fin origin and lateral line; pectoral fins of adults grey or pale brown; cleithrum without posterolateral process; juveniles (<8 cm SL) elongate, body depth 16–20% SL, pelvic fins short (13–16% SL), and without chin barbel ..... *E. volitans*

*Exocoetus monocirrhus* Richardson 1846

Barbelled two-wing flyingfish

PLATE 59

*Exocoetus monocirrhus* Richardson 1846: 265 (Sea of China).

*Exocoetus georgianus* Valenciennes in Cuv. & Val. 1847: 136 (Indian Ocean: 05° S, 90° E).

*Exocoetus melanopus* Günther 1868: 459 (Zanzibar, Tanzania).

*Exocoetus volitans* (non Linnaeus 1758): Weber & De Beaufort 1922\* [in part]; SFA No. 210\*.

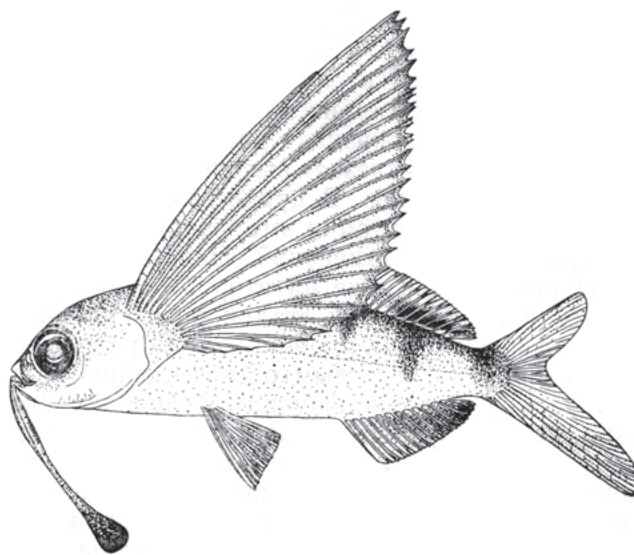
*Halocypselus obtusirostris* (non Günther 1866): Breder 1928\*.

*Halocypselus borodini* Nichols & Breder 1932: 1, Fig. 1 (Mauritius, Mascarenes).

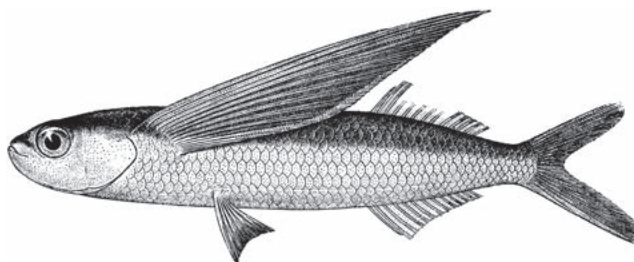
*Exocoetus monocirrhus*: Abe 1955\*; Parin 1960\*, 1984\*, 1996, 1999\*; Kovalevskaya 1964\*, 1980\*; Kotthaus 1969\*; Bianchi 1985\*; SSF No. 116.5\*; Chen 1987\*; Winterbottom *et al.* 1989; Belyanina 1993; Fricke 1999; Parin & Shakhovskoy 2000\*; Heemstra *et al.* 2004; Fricke *et al.* 2009.

Dorsal fin 12–14 rays; anal fin 12–15 rays; pectoral fins 1 unbranched ray, 12–16 branched rays. Body depth 4.9–6.2 in SL (3.4–5.2 in SL in juveniles <8 cm SL); HL 3.7–4.2 in SL; pectoral fins 1.3–1.4 in SL; pelvic fins not reaching anal fin (except in small juveniles), their origins nearer snout tip than caudal-fin base. Jaw teeth very sparse, sometimes absent; usually no palatine teeth. Predorsal scales 17–23; 7–8½ scale rows from dorsal-fin origin to lateral line; total GR 22–28. Juveniles humpbacked, with chin barbel. Vertebrae 41–44.

Body dark iridescent blue dorsally, silvery white ventrally; pectoral fins usually dark brown, with narrow pale margin; caudal fin greyish or brownish; other fins unpigmented; juveniles often with 3 black bars on sides. Attains 21 cm SL.



*Exocoetus monocirrhus*, 7 cm TL, juvenile. Source: Kovalevskaya 1964



*Exocoetus monocirrhus*, 17 cm TL, adult. Source: Abe 1955



**DISTRIBUTION** Southeastern Atlantic (St Helena Bay), Indo-Pacific and eastern Pacific. WIO: Gulf of Aden, East Africa to South Africa (False Bay), Madagascar, Mascarenes and Chagos; not known from Red Sea, Gulf of Oman and Persian/Arabian Gulf; elsewhere to Indonesia, Japan, Australia, Marquesas Is., Hawaii, Baja California, Galápagos Is. and Peru.

**REMARKS** Occurs mainly in open ocean.

## *Exocoetus volitans* Linnaeus 1758

Tropical two-wing flyingfish

PLATE 59

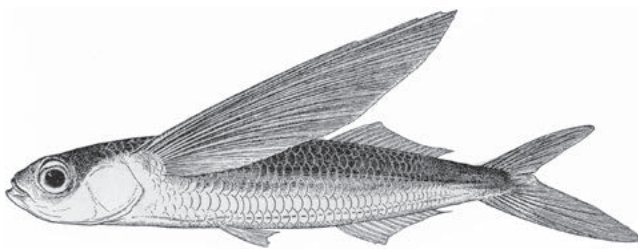
*Exocoetus volitans* Linnaeus 1758: 316 (open ocean off Europe and America); Bruun 1935\*; Breder 1938\*; Abe 1957\*; Parin 1960\*, 1984\*, 1996, 1999\*; Kovalevskaya 1964\*, 1980\*; Balasubrahmanyam *et al.* 1967\*; Kotthaus 1969\*; Gibbs 1981\*; Bianchi 1985\*; Grudtsev *et al.* 1986; SSF No. 116.6\*; Chen 1987\*; Belyanina 1993; Winterbottom *et al.* 1989; Fricke 1999; Parin & Shakhovskoy 2000\*; Heemstra *et al.* 2004; Fricke *et al.* 2009.

*Exocoetus evolans* Linnaeus 1766: 521 (Caribbean Sea; Brazil; India).

*Halocypselus evolans*: Barnard 1925.

Dorsal fin 13–16 rays; anal fin 12–15 rays; pectoral fins 1 unbranched ray, 12–15 branched rays. Body depth 5.1–6.5 in SL (5.0–6.2 in SL in juveniles <8 cm SL); HL 3.4–4.1 in SL; pectoral fins 1.3–1.4 in SL; pelvic fins not reaching anal fin, their origins nearer snout tip than caudal-fin base. Usually no teeth on jaws and palatines. Predorsal scales 16–21; 6–6½ scale rows from dorsal-fin origin to lateral line; total GR 28–37. Juveniles elongate, without chin barbels. Vertebrae 43–46.

Body dark iridescent blue dorsally, silvery white ventrally; pectoral fins and caudal fin greyish, other fins unpigmented; juveniles sometimes with 2 black bars on sides. Attains ~18 cm SL.



*Exocoetus volitans*, 16 cm SL (Atlantic). Source: Bruun 1935

**DISTRIBUTION** Circumglobal in tropical waters; southwestern-most occurrence in WIO off South Africa, at 34°27' S, 25°57' E; not known from Red Sea, Gulf of Oman and Persian/Arabian Gulf.

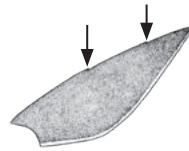
**REMARKS** Occurs offshore in open ocean; the most abundant flyingfish of open seas, but of no importance to fisheries.

## GENUS *Hirundichthys* Breder 1928

Pelvic fins long, insertions closer to caudal-fin base than to snout tip; pectoral fins long, extending to dorsal-fin base or beyond; anal-fin origin under or ahead of 3rd dorsal-fin ray. Mouth not protrusile; lower jaw subequal to or slightly longer than upper jaw. Jaw teeth unicuspid. Lateral line not branched. Juveniles elongate, with mottled paired fins, and no chin barbels. Two subgenera recognised by Parin (1961); ~10 species, 4 in WIO.

### KEY TO SPECIES OR SUBSPECIES

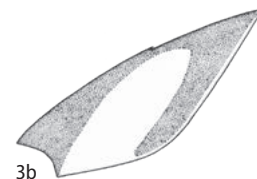
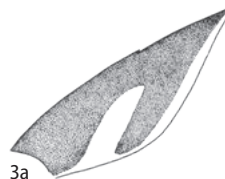
- 1a Pectoral fins with 1 unbranched ray ..... 2  
1b Pectoral fin with 2 unbranched rays ..... *H. rufipinnis*



- 2a Pectoral fins of adults with large contrast 'mirror'; pectoral fins of juveniles usually with broad membrane between 1st and 2nd rays, and 2nd ray much shorter than 3rd ray ..... 3  
2b Pectoral fins of adults with or without small non-contrast 'mirror'; pectoral fins of juveniles usually with narrow membrane between 1st and 2nd rays, and 2nd ray subequal to or only slightly shorter than 3rd ray ..... *H. oxycephalus coromandelensis*



- 3a Palatine teeth usually present; pectoral fins of adults with pale triangular 'mirror' across fin to 4th–7th rays and not along entire fin; juveniles (<8.5 cm SL) usually with underside of lower jaw unpigmented; vertebrae 44–47 ..... *H. speculiger*  
3b No palatine teeth; pectoral fins of adults with large 'mirror' (pale transverse band) across nearly entire fin, reaching 2nd or 3rd ray; juveniles with underside of lower jaw pigmented; vertebrae 43 or 44 ..... *H. indicus indicus*



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## *Hirundichthys indicus indicus*

Shakhovskoy & Parin 2013

Indian mirrorwing flyingfish

PLATE 60

*Hirundichthys indicus indicus* Shakhovskoy & Parin 2013: 133, Fig. 9 (western central Indian Ocean).

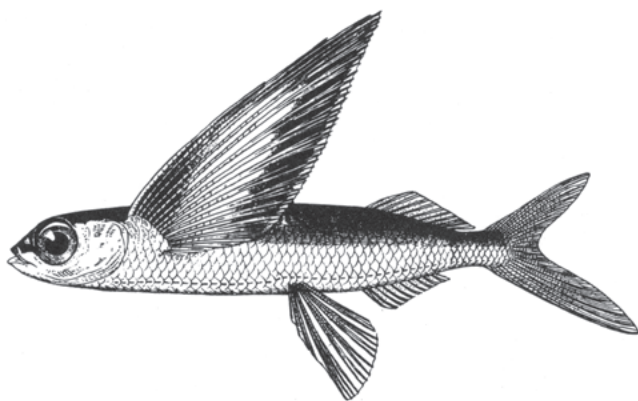
*Hirundichthys coromandelensis* (non Hornell 1923): Parin 1961\*, 1984\*; Kovalevskaya 1972\* [in part]; ?Vijayaraghavan 1973\* [in part]; Bianchi 1985\*; Sommer *et al.* 1996\*; ?Jayawardane & Dayaratne 1998; Barman & Mishra 2006\*.

*Hirundichthys oxycephalus* (non Bleeker 1853): Kotthaus 1969\*.

*Hirundichthys speculiger* (non Valenciennes 1847): Parin & Lakshminarayana 1993 [in part].

Dorsal fin 10–12 rays; anal fin 10–12 rays; pectoral fins 1 unbranched ray, 16–19 branched rays. Body depth 5.0–6.2, HL 3.8–4.2, and pectoral-fin length 1.3–1.7 in SL; pelvic fins reach well beyond anal-fin origin, their origins nearer head than origin of caudal-fin lower lobe; dorsal-fin origin usually in front of anal-fin origin (may be in line with it or rarely slightly behind). No palatine teeth. Predorsal scales 26–35; 6–7½ scale rows from dorsal-fin origin to lateral line; total GR 25–33. Juveniles (<8 cm SL) usually with broad membrane between 1st and 2nd pectoral-fin rays, 2nd ray usually much shorter than 3rd ray (fish <12 cm SL). Vertebrae 43 or 44.

Body dark dorsally, pale ventrally; pectoral fins dark with large ‘mirror’ (pale transverse band) passing through fin and reaching 2nd or 3rd ray; pelvic fins transparent; dorsal fin and anal fin grey; caudal fin brown. Juveniles with underside of lower jaw pigmented; pelvic fins dark, with narrow pale margin (at 4–9.5 cm SL); pectoral-fin ‘mirror’ appears at ~8 cm SL and covers nearly entire fin. Attains 19 cm SL.



*Hirundichthys indicus indicus*. Source: Parin 1961

**DISTRIBUTION** Western and central Indian Ocean, north of 15° S, from East Africa (09°31' S, 41°29' E) to 96° E; not known from Red Sea, Gulf of Oman, Persian/Arabian Gulf and eastern Arabian Sea.

**REMARKS** Epipelagic, mainly in open ocean, but probably approaches neritic areas during spawning season. A different subspecies, *H. indicus orientalis*, is present in the eastern Indian Ocean.

## *Hirundichthys oxycephalus coromandelensis*

(Hornell 1923)

Coromandel flyingfish

PLATE 60

*Cypselurus coromandelensis* Hornell 1923: 107 Coromandel coast, India); Nayudu 1923\*; Chandy 1954\*; Arora & Banerji 1957.

*Hirundichthys affinis* (non Günther 1866): Norman 1939\*.

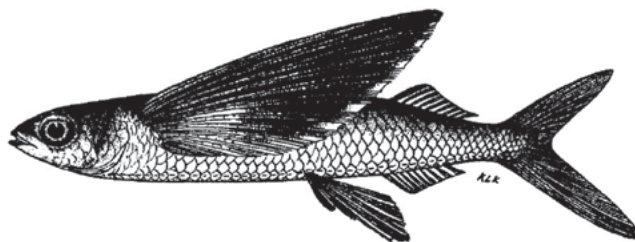
*Hirundichthys oxycephalus* (non Bleeker 1853): Jones & Kumaran 1965\*, 1980\*; Bianchi 1985\*; Parin & Lakshminarayana 1993\*; Randall 1995\*; Jayawardane & Dayaratne 1998; Parin 1999\* [in part]; Barman & Mishra 2006\*.

*Hirundichthys coromandelensis*: Vijayaraghavan 1973\* [in part?].

*Hirundichthys oxycephalus coromandelensis*: Shakhovskoy & Parin 2013\*.

Dorsal fin 8–12 rays; anal fin 10–12 rays; pectoral fins 1 unbranched ray, 14–17 branched rays. Body depth 5–6.7, HL 3.8–4.3, and pectoral-fin length 1.4–1.5 in SL; pelvic fins reach well beyond anal-fin origin, their insertions nearer head than origin of caudal-fin lower lobe (or rarely located midway); dorsal-fin origin usually in line with or behind anal-fin origin (rarely slightly in front of it). Usually no palatine teeth. Predorsal scales 29–35; 5½–7½ scale rows from dorsal-fin origin to lateral line; total GR 26–33. Juveniles (<11.5 cm SL) usually with narrow membrane between 1st and 2nd pectoral-fin rays, 2nd ray subequal to or only slightly shorter than 3rd ray. Vertebrae 41–45.

Body dark dorsally, pale ventrally; pectoral fins brown or dark brown, with or without small non-contrast ‘mirror’, and with pale margin; pelvic fins transparent; dorsal fin and anal fin grey; caudal fin brown. Juveniles pigmented on underside of lower jaw; pelvic fins dark, with narrow pale margin (fish 4–9 cm SL); very small pectoral-fin ‘mirror’ appears at >12 cm SL, and reaches only to 7th–9th rays. Attains 21 cm SL.



*Hirundichthys oxycephalus coromandelensis*, 16 cm SL. Source: Jones & Kumaran 1965

**DISTRIBUTION** Indian Ocean, north of Equator. WIO: Somalia to Oman, western India and Sri Lanka; and one specimen recorded from eastern Mediterranean Sea (Shakhovskoy & Parin 2013); not known from Red Sea, Gulf of Aden or Persian/Arabian Gulf; elsewhere to Bay of Bengal and Andaman Sea.

**REMARKS** Epipelagic, in neritic waters and open ocean. Two other subspecies are recognised: *H. oxycephalus oxycephalus* from eastern Indian Ocean to western Pacific, and *H. oxycephalus frereensis* from New Guinea. Important in fisheries of India and Sri Lanka.

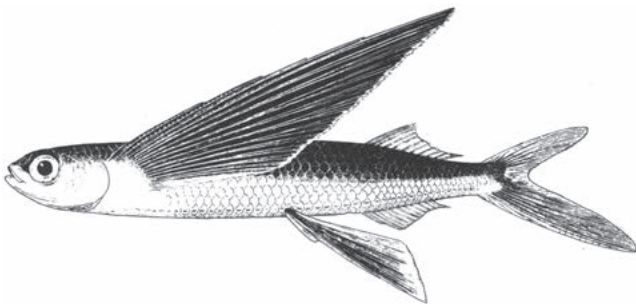
### *Hirundichthys rufipinnis* (Valenciennes 1847)

Redfin flyingfish PLATE 60

*Exocoetus rufipinnis* Valenciennes in Cuv. & Val. 1847: 99 (Paita, Peru).  
*Exonautes cribrosus*: McCulloch 1929.  
*Danichthys rondeletii* (non Valenciennes 1847): Bruun 1935\* [in part].  
*Cypselurus speculiger* (non Valenciennes 1847): Fowler 1945.  
*Hirundichthys rondeletii* (non Valenciennes 1847): Kovalevskaya 1972\* [in part], 1980\* [in part]; Parin 1984\*; SSF No. 116.7\*; Belyanina 1993; Andrew *et al.* 1995.  
*Danichthys cribrosus*: Paulin *et al.* 1989.  
*Hirundichthys* (*Danichthys*) (*rondeletii*) *rufipinnis*: Parin & Belyanina 2002.

Dorsal fin 9–13 rays; anal fin 10–14 rays; pectoral fins 2 unbranched rays, 15–18 branched rays. Body depth of adults 5.5–7, HL 4.4–5.1, and pectoral-fin length 1.2–1.4 in SL; anal-fin origin before 2nd dorsal-fin ray; pelvic fins reach well past anal-fin origin, their insertions nearer rear margin of head than origin of caudal-fin lower lobe (or located midway). Usually no palatine teeth. Predorsal scales 26–32; GR 24–32. Juveniles elongate, without chin barbels. Vertebrae 44–47.

Body dark iridescent blue dorsally, silvery white ventrally; dorsal fin and caudal fin greyish; pectoral fins uniformly dark, with narrow pale margin; other fins hyaline. Juveniles with pale body and dark paired fins. Attains ~27 cm SL.



*Hirundichthys rufipinnis*, 20 cm SL (Atlantic Ocean). Source: Bruun 1935

**DISTRIBUTION** Circumglobal in subtropical waters of Southern Hemisphere. WIO: South Africa (Western Cape) to probably southern Mozambique Channel, and eastwards through 28°18' S, 62°31' E.

**REMARKS** Occurs in open ocean.

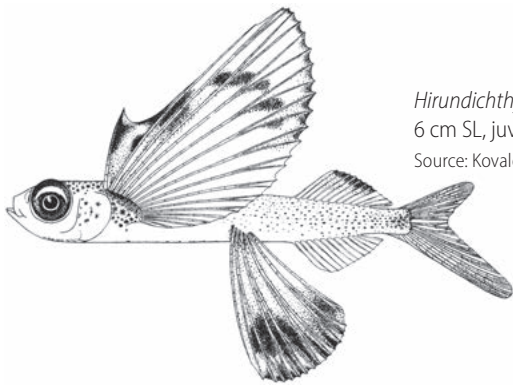
### *Hirundichthys speculiger* (Valenciennes 1847)

Mirrorwing flyingfish PLATE 60

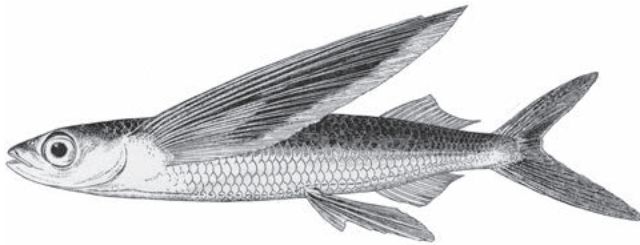
*Exocoetus speculiger* Valenciennes in Cuv. & Val. 1847: 94 (Mauritius, Mascarenes); Bleeker 1866–72\*; Günther 1866, 1910.  
*Exocoetus nigripennis* Valenciennes in Cuv. & Val. 1847: 108 (Da Nang [Tourane], Vietnam, China Sea); Herre 1953.  
*Exocoetus volitans* (non Linnaeus 1758): Jordan & Meek 1885 [in part]; Jordan & Evermann 1896 [in part].  
*Cypsilurus speculiger*: Jordan & Seale 1906\*.  
*Cypsilurus* (*Exonautes*) *speculiger*: Weber & De Beaufort 1922.  
*Cypselurus rubescens* (non Rafinesque 1818): Fowler & Ball 1925; Fowler 1928; Tinker 1944.  
*Exonautes speculiger*: McCulloch 1929.  
*Cypselurus speculiger*: Seale 1935; Woods & Schultz 1953.  
*Hirundichthys speculiger*: Bruun 1935\*; Breder 1938\*; Imai 1954\*; Abe 1956\*; Parin 1960\*, 1984\*, 1996, 1999\*; Menon & Rama-Rao 1967\*; Kovalevskaya 1972\*, 1980\*; Gibbs 1981\*; SSF No. 116.8\*; Chen 1987\*; Winterbottom *et al.* 1989; Belyanina 1993, 1994\*; Grove & Lavenberg 1997; Fricke 1999; Barman & Mishra 2006\*; Shakhovskoy & Parin 2013\*.

Dorsal fin 10–13 rays; anal fin 10–13 rays; pectoral fins 1 unbranched ray, 15–20 branched rays. Body depth 5.5–6.6, HL 3.7–4.7, and pectoral-fin length 1.3–1.6 in SL; dorsal-fin origin in line with or behind anal-fin origin (rarely slightly ahead of it); pelvic fins reach well past anal-fin origin, their insertions nearer rear margin of head than origin of caudal-fin lower lobe. Palatine teeth usually present. Predorsal scales 26–35; 5½–7½ scale rows from dorsal-fin origin to lateral line; total GR 22–31. Juveniles (<9 cm SL) usually with broad membrane between 1st and 2nd pectoral-fin rays, 2nd ray usually much shorter than 3rd ray (fish <12 cm SL). Vertebrae 44–47.

Body dark iridescent blue dorsally, silvery white ventrally; pectoral fins dark, with pale triangular 'mirror' reaching 5th to 6th (rarely to 4th or 7th) rays, and pale margin; dorsal fin and anal fin greyish; pelvic fins transparent; caudal fin brown. Juveniles (<7.5 cm SL) usually unpigmented on underside of lower jaw; pelvic fins dark, with wide pale margin (fish 8–12 cm SL); pectoral-fin 'mirror' appears at ~11.5 cm SL and reaches 6th–9th rays. Attains ~25 cm SL.



*Hirundichthys speculiger*,  
6 cm SL, juvenile.  
Source: Kovalevskaya 1980



*Hirundichthys speculiger*, 22 cm SL (Atlantic Ocean). Source: Bruun 1935

**DISTRIBUTION** Circumglobal in tropical waters. WIO: northern Arabian Sea (south of 20° N) to South Africa (False Bay), Mauritius, Chagos and Sri Lanka; not known from Red Sea, Gulf of Aden, Gulf of Oman and Persian/Arabian Gulf.

**REMARKS** Oceanic; rare in coastal areas. Of no importance to fisheries.

**GENUS** *Parexocoetus* Bleeker 1865

Pectoral fins reach at most to rear of anal-fin base; anal-fin origin opposite dorsal-fin origin. Middle dorsal-fin rays distinctly longer than anterior rays; pelvic fins reach past anal-fin origin, their insertions nearer origin of caudal-fin lower lobe than snout tip. Upper jaw protrusile. Teeth on jaws, palatines, vomer, pterygoids and tongue. Lateral line with upward branch near pectoral-fin base. Three species, 2 in WIO.

**KEY TO SPECIES**

- 1a Dorsal fin 9–12 rays, longest rays scarcely reach origin of caudal-fin upper lobe; anal fin 10–12 rays; predorsal scales 16–20 ..... *P. mento*
- 1b Dorsal fin 11–14 rays, longest rays reach well past origin of caudal-fin upper lobe; anal fin 12–14 rays; predorsal scales 19–25 ..... *P. brachypterus*

*Parexocoetus brachypterus* (Richardson 1846)

Sailfin flyingfish

PLATE 60

*Exocoetus brachypterus* Richardson (ex Solander) 1846: 265 (Tahiti, Society Is.; China Sea).

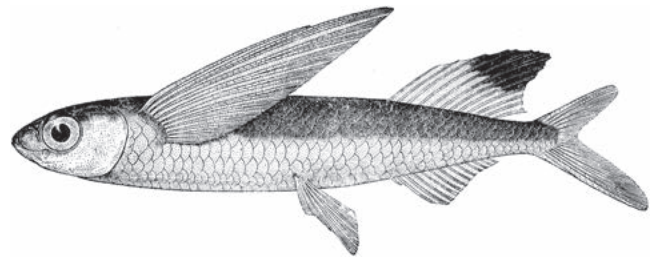
*Parexocoetus mesogaster* (?non Bloch): Barnard 1925.

*Parexocoetus brachypterus brachypterus*: Abe 1955\*.

*Parexocoetus brachypterus*: Parin 1960\*, 1984\*, 1996, 1999\*; Gibbs 1981\*; SSF No. 116.9\*; Chen 1987\*; Winterbottom *et al.* 1989; Belyanina 1993; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003.

Dorsal fin 11–14 rays; anal fin 12–14 rays; pectoral fins 1 unbranched ray, 11–13 branched rays. Body depth 5–6.5, HL 4.1–4.5, and pectoral-fin length 1.7–2 in SL; pelvic fins reach beyond anal-fin origin, their insertions slightly nearer origin of caudal-fin lower lobe than snout tip; dorsal fin high, middle rays longest, reaching well beyond origin of caudal-fin upper lobe when depressed. Predorsal scales 19–25; GR 23–30. Juveniles with 2 short chin barbels (length <12% SL); barbels often remain in adults. Vertebrae 38–41.

Body dark iridescent greenish blue dorsally, silvery white ventrally; dorsal-fin base and posterior rays pale, rest of fin black; pelvic fins greyish; other fins transparent. Attains 15 cm SL.



*Parexocoetus brachypterus*, 16 cm TL. Source: Abe 1955

**DISTRIBUTION** Indo-Pacific, and a separate population in tropical eastern Pacific (Ecuador, Colombia, Panama). WIO: Red Sea, East Africa to South Africa (KwaZulu-Natal), Madagascar, Seychelles, Réunion, Mauritius and Chagos; elsewhere to Indonesia, southern Japan, Australia, Tonga, Marquesas Is. and Hawaii.

**REMARKS** Epipelagic, in neritic waters, rarely in open ocean. Not important as a food fish but occasionally taken by fisheries.



***Parexocoetus mento*** (Valenciennes 1847)

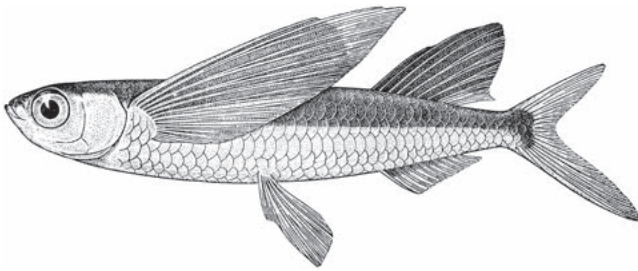
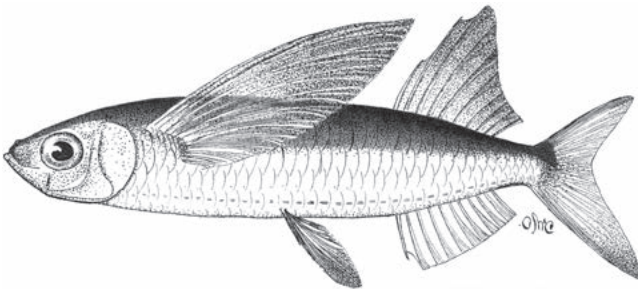
African sailfin flyingfish

PLATE 61

*Exocoetus mento* Valenciennes in Cuv. & Val. 1847: 124 (Puducherry, India).*Exocoetus gryllus* Klunzinger 1871: 586 (Al-Qusayr, Egypt, Red Sea).*Parexocoetus brachypterus* (non Richardson 1846): Weber & De Beaufort 1922\*; SFSA No. 215; Jones & Kumaran 1980\*.*Parexocoetus mento*: Barnard 1925; Parin 1960, 1984\*, 1999\*; Kovalevskaya 1965\*; Parin & Besednov 1965; Kotthaus 1969\*; SSF No. 116.10\*; Chen 1987\*; Randall 1995\*.*Parexocoetus brevipinnis* (non Valenciennes): Woods & Schultz 1953 [counts only].*Parexocoetus mento mento*: Abe 1956\*.

Dorsal fin 9–12 rays; anal fin 10–12 rays; pectoral fins 1 unbranched ray, 12–14 branched rays. Body depth 4.5–5, HL 3.7–4, and pectoral-fin length 1.8–2.1 in SL; pelvic fins reach beyond anal-fin origin, bases slightly nearer origin of caudal-fin lower lobe than snout tip; dorsal fin high, middle rays longest, almost reaching origin of caudal-fin upper lobe when depressed. Predorsal scales usually 16–20; total GR 25–30. Juveniles with bony knob at front of lower jaw. Vertebrae 35–37.

Body dark iridescent greenish blue dorsally, silvery white ventrally; bluish black band from behind central part of pectoral-fin base to side of caudal peduncle; dorsal fin mostly blackish; pectoral fins blackish above, hyaline below, with pale tips; caudal fins greyish; other fins transparent. Attains ~13 cm SL.

*Parexocoetus mento*, 14 cm TL. Source: Abe 1956*Parexocoetus mento* (S Mozambique). Source: SSF

**DISTRIBUTION** Tropical Indo-Pacific. WIO: Persian/Arabian Gulf, Red Sea, Tanzania, Mozambique, South Africa (KwaZulu-Natal), India and Sri Lanka; Lessepsian migrant to Mediterranean Sea; elsewhere to southern Japan, Marshall Is., northern Australia and Fiji.

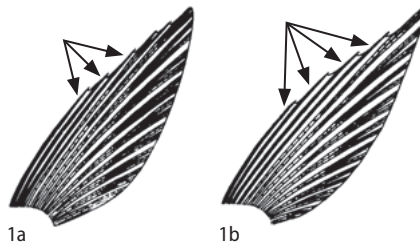
**REMARKS** Epipelagic, nearshore. Of minor importance to coastal fisheries. Subspecies *P. mento atlanticus* Bruun 1933 was described in the eastern Atlantic. But this subspecies is doubtful.

**GENUS** *Prognichthys* Breder 1928

Pectoral fins with 2–4 unbranched rays; pelvic fins reach well past anal-fin origin, their origins much nearer rear margin of head than origin of caudal-fin lower lobe. Upper jaw not protrusile; lower jaw slightly shorter than upper jaw. Lateral line not branched. Juveniles robust, without chin barbels. About 6 species, 2 in WIO.

**KEY TO SPECIES**

- 1a Pectoral fins with 3 unbranched rays ..... *P. brevipinnis*  
 1b Pectoral fins with 4 unbranched rays ..... *P. sealei*



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***Prognichthys brevipinnis*** (Valenciennes 1847)

Shortfin flyingfish

PLATE 61

*Exocoetus brevipinnis* Valenciennes in Cuv. & Val. 1847: 123 (Lambom I., New Ireland, Papua New Guinea).*Cypselurus zaca* Seale 1935: 349, Pl. 21, Fig. 1 (Suva, Fiji) [in part].*?Cypselurus nigripennis* (non Valenciennes 1847): SFSA No. 213.*Prognichthys brevipinnis*: Parin 1960, 1984\*, 1996, 1999\*; Kotthaus 1969\*; Kovalevskaya 1980; SSF No. 116.11\*; Chen 1987\* [in part?];

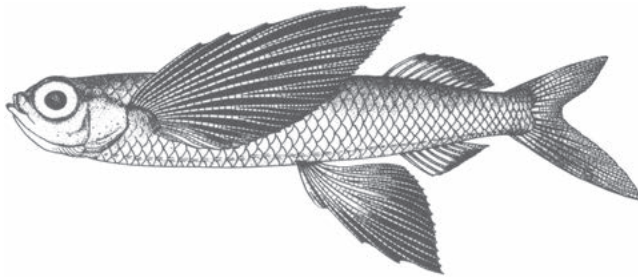
Belyanina 1993\*; Parin &amp; Lakshminarayana 1993; Randall 1995\*.

*Prognichthys gibbifrons* (non Valenciennes 1847): Jones & Kumaran 1980\* [in part?].

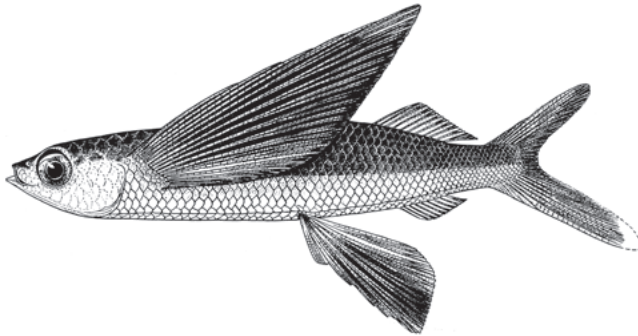


Dorsal fin 10 or 11 rays; anal fin 8–10 rays; pectoral fins 3 unbranched rays, 13–15 branched rays. Body depth 5.1–6.3 in SL; HL 4–4.3 in SL (shorter than distance from dorsal-fin origin to origin of caudal-fin upper lobe); pectoral-fin length 1.4–1.5 in SL; anal-fin origin below 3rd–5th dorsal-fin ray. Jaw teeth unicuspid; no palatine teeth. Predorsal scales 25–29; GR 26–31. Vertebrae 41–45.

Body dark iridescent blue dorsally, silvery white ventrally; pectoral fins grey, ventral part and tip transparent; dorsal fin and caudal fin grey, other fins hyaline (pelvic fins in some specimens with dark pigment between rays 2–5); paired fins of juveniles black. Attains 19 cm SL.



*Prognichthys brevipinnis*, 9 cm SL. Source: Seale 1935



*Prognichthys brevipinnis*, 15 cm SL. Source: Parin 1999 (by GN Pokhilskaya)

**DISTRIBUTION** Tropical Indo-Pacific. WIO: Oman, Gulf of Aden, Arabian Sea, East Africa to South Africa (St Lucia), and to Maldives and India; elsewhere to Indonesia, Vietnam, Ryukyu Is. and Fiji.

**REMARKS** Neritic. Of minor importance to coastal fisheries in Vietnam.

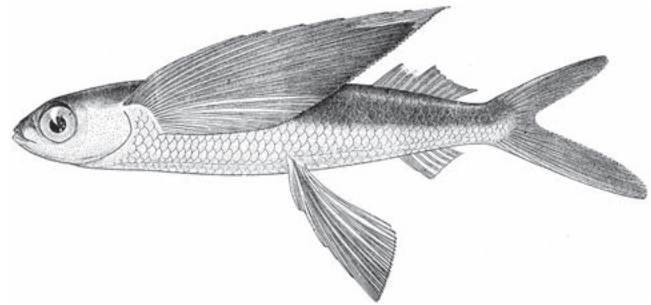
### *Prognichthys sealei* Abe 1955

Shortnose flyingfish

PLATE 61

*Prognichthys sealei* Abe 1955: 185, Figs. 1–3 (east of Miyako I., Ryukyu Is., Japan); Parin 1960\*, 1984\*, 1996, 1999\*; Kovalevskaya 1980\*; Winterbottom *et al.* 1989; SSF No. 116.12\*; Fricke 1999. ?*Cypselurus zaca* Seale 1935: 349, Pl. 21, Fig. 2 (Suva, Fiji Is.) [in part].

Diagnosis as for genus. Distinguished from *P. brevipinnis* only by pectoral fins with 4 unbranched rays, 12–14 branched rays. Body colour resembles *P. brevipinnis*. Attains 19 cm SL.



*Prognichthys sealei*, 24 cm TL. Source: Abe 1955

**DISTRIBUTION** Tropical Indo-Pacific to eastern Pacific. WIO: East Africa to South Africa (2 juvenile specimens: St Lucia, KwaZulu-Natal, and off Port Elizabeth, Eastern Cape), Mascarenes and Chagos; not known from Red Sea, Gulf of Aden, Arabian Sea and Persian/Arabian Gulf; elsewhere to southern Japan, Polynesia, Hawaii, Central America and Galápagos Is.

**REMARKS** Common, oceanic. Of no importance to fisheries.

## FAMILY HEMIRAMPHIDAE

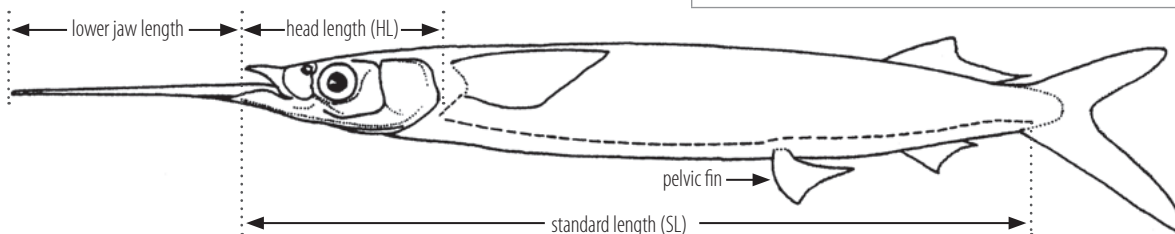
## Halfbeaks

Bruce B Collette

Body elongate; upper jaw short and triangular (except anterior margin straight in *Oxyporhamphus*), usually with minute teeth, and lower jaw usually elongate, with small teeth. Nasal fossae in front of eyes with protruding tentacle. No fin spines; dorsal fin and anal fin posteriorly set; pelvic fins abdominal, with 6 rays; pectoral fins usually short. Lateral line runs along ventral margin of body, beginning at throat, with branch to pectoral-fin origin. Scales cycloid, moderately large, smooth, and easily detached. SL is measured from tip of upper jaw to caudal-fin base; relative position of pelvic fins is denoted by  $P_1-P_2/C$ : distance from pectoral-fin origins to pelvic-fin origins/distance from pelvic-fin origins to caudal-fin origin; preorbital distance is measured from posterior margin of preorbital bone to the rear edge of premaxilla, whereas preorbital length is the measurement of the preorbital bone, from its anterior to posterior margins.

Most species are marine, but ~40 species in 4 genera inhabit freshwaters. Omnivorous, feeding on floating seagrasses, crustaceans and small fishes. Live near the surface and prone to leap and skitter at the surface; species of the offshore genus *Euleptorhamphus* leap from the water and glide across the surface much like flying fishes. Protectively coloured blue or green dorsally, silvery white on sides and ventrally; tip of lower jaw bright red or orange in most species, coloured by carotenoid pigments (especially zeaxanthin, astaxanthin and beta-doradexanthin). Eggs of most species with sticky threads that attach to floating vegetation. Eggs and larvae of Beloniformes were reviewed by Collette *et al.* (1984). Three freshwater genera are viviparous (Meisner 2001). Not of great commercial importance, although many species are regularly found in local markets, as the flesh is excellent and consumed fresh, dried-salted or smoked; also important as bait for catching billfishes. Caught mainly with seines and pelagic trawls, and with dip nets under lights at night.

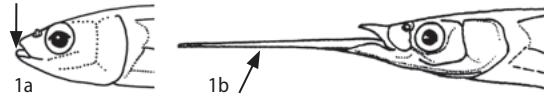
Eight genera (and two subgenera of *Hyporhamphus*) and 57 species (Collette 2004); 5 genera and at least 22 species in WIO (Collette 1999).



Measurements of a typical hemiramphid.

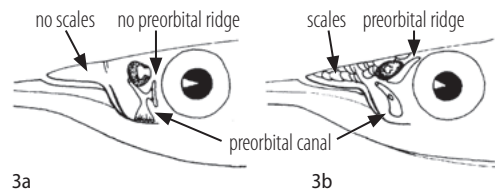
## KEY TO GENERA OR SUBGENERA

- 1a Lower jaw not noticeably elongate; anterior margin of upper jaw straight, not forming triangular projection; pectoral fins long, 30–35% SL ..... *Oxyporhamphus*  
 1b Lower jaw elongate; anterior margin of upper jaw forming prominent triangular projection; pectoral fins <28% SL ..... 2

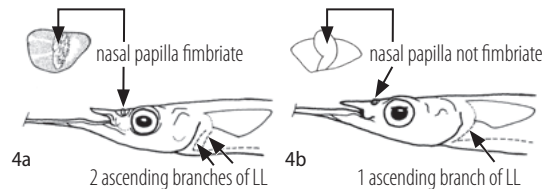


- 2a Body compressed and ribbon-like; dorsal fin and anal fin each with 20–25 rays; pectoral fins 7–9 rays, fin length 25–28% SL ..... *Euleptorhamphus*  
 2b Body not ribbon-like; dorsal fin 12–18 rays, and anal fin 10–19 rays; pectoral fins 10–14 rays, and fins short, <20% SL ..... 3

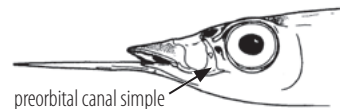
- 3a Upper jaw naked; no preorbital ridge ..... *Hemiramphus*  
 3b Upper jaw scaly; preorbital ridge well-developed ..... 4



- 4a Nasal papillae fimbriate; upper jaw arched; GR 47–78; lateral line with 2 ascending branches: 1st behind opercle, 2nd near pectoral-fin origin ..... *Rhynchorhamphus*  
 4b Nasal papillae not fimbriate; upper jaw flat or nearly flat; GR 19–47; lateral line with 1 branch ascending towards pectoral-fin origin ..... 5 [*Hyporhamphus*]



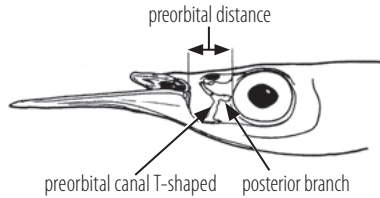
- 5a Preorbital canal simple, without posterior branch; caudal fin emarginate or slightly forked ..... *Hyporhamphus* (*Hyporhamphus*)



Continued ...

**KEY TO GENERA OR SUBGENERA**

- 5b Preorbital canal T-shaped, with posterior branch; caudal fin distinctly forked ..... *Hyporhamphus (Reporhamphus)*



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**GENUS** *Euleptorhamphus* Gill 1859

Body greatly elongate and strongly laterally compressed, almost ribbon-like; body depth of adults 11–14 in SL (up to 26 in SL in young ~8 cm SL); body width 1.7–2 in body depth; HL 6.3–7.4 in SL. Interorbital region concave; no preorbital shelf; preorbital canal without posterior branch. Nasal papilla fan-shaped, not fimbriate. Upper jaw with triangular projection, jaw length 0.6–0.8 in its width (jaw length ~0.3 in its width in young ~8 cm SL). Lower jaw of adults very long, 2.2–2.7 in SL, 0.3–0.4 in HL. Jaw teeth in 3 rows, unicuspid in anterior part of both jaws, tricuspid in middle and posterior parts; teeth present on vomer and tongue (in elongate strip, sometimes distributed along centre line). Pectoral fins long, 3.6–4 in SL; pelvic fins short, 23–26 in SL, nearer caudal-fin base than pectoral-fin origins ( $P_1-P_2/P_2-C = 1.1-1.3$ ); anal-fin origin under 4th–6th dorsal-fin ray, fin base 1.1–1.2 in dorsal-fin base; caudal-fin lower lobe greatly elongate. Pectoral branch of lateral line single. Upper jaw, opercle, and suborbital and interorbital regions scaly; no scales on fins. Swimbladder simple. Two species, 1 in the Atlantic and 1 in Indo-Pacific.

*Euleptorhamphus viridis* (Van Hasselt 1823)

Indo-Pacific ribbon halfbeak PLATE 61

*Hemiramphus viridis* Van Hasselt 1823: 131 (Visakhapatnam, India; Java, Indonesia) [assumed based on Russell 1803: Pl. 178].

*Hemiramphus longirostris* Cuvier 1829: 286 (Visakhapatnam, India) [available from footnote as from Russell 1803: Pl. 178].

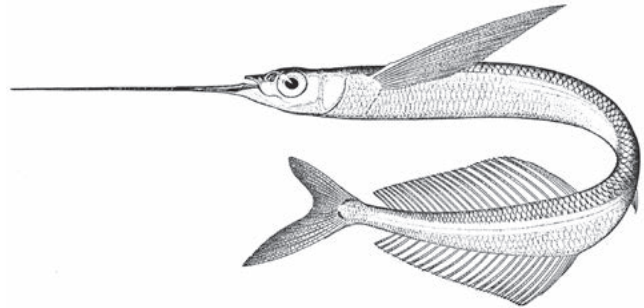
*Euleptorhamphus longirostris*: Smith 1965\*.

*Euleptorhamphus viridis*: Parin 1964; Collette 1974, 1999\*; Parin *et al.* 1980; Dor 1984; Collette & Su 1986; SSF No. 115.1\*; Randall & Anderson 1993; Fricke *et al.* 1999.

Dorsal fin 21–25 (rarely 20) rays; anal fin 20–24 (rarely 25) rays; pectoral fins 8 or 9 rays; predorsal scales 48–72. GR on

1st arch 6–9/18–23 = 25–32 (rarely 24 to 34); GR on 2nd arch 3–5/13–19 = 16–24. Vertebrae 44–46 + 26–29 = 70–75.

Body blue-green dorsally, silvery below; fold of skin at sides of lower jaw grey with transverse black bands. Attains 40 cm SL.



*Euleptorhamphus viridis* (Hawaii). Source: Jordan & Evermann 1905

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Red Sea, East Africa to South Africa (Algoa Bay), Madagascar, Seychelles and Mauritius; elsewhere to east coast of India, Indonesia, southern Japan, southern Australia, New Caledonia, New Zealand, Tonga, Kermadec Is., Hawaii, California and Peru.

**REMARKS** Usually oceanic. Matures at ~25 cm SL. Differs from the Atlantic ribbon halfbeak *Euleptorhamphus velox* Poey 1868 in having one more dorsal- and anal-fin ray on average, and either 8 pectoral-fin rays or 9 rays plus a small splint (*E. velox* with 7 pectoral-fin rays, and with or without a small splint).

**GENUS** *Hemiramphus* Cuvier 1816

Dorsal fin 11–15 rays; anal fin 9–14 rays; pectoral fins 10–13 rays. GR 25–48 on 1st arch; GR 20–37 on 2nd arch. Body rather deep and laterally compressed, its cross-section an elongate-oval; body depth 5.9–7 in SL, its width 1.3–2.1 in its depth; HL 3.7–4.7 in SL. Interorbital region flat; no preorbital shelf; preorbital canal with posterior branch. Nasal papilla fan-shaped, not fimbriate. Upper jaw blunt, length much less than width; lower jaw 3–4.5 in SL. Jaw teeth in 2–4 rows, all tricuspid; no teeth on vomer or tongue; pharyngeal teeth generally tricuspid, sharp, but those in rear rows on lower pharyngeal and 3rd upper pharyngeal with thickened or recurved edges. Pelvic fins short (8.8–10.7 in SL), much nearer caudal-fin base than pectoral-fin origins ( $P_1-P_2/P_2-C = 1.2-1.6$ ); anal-fin origin under 4th–8th ray of dorsal fin; caudal fin deeply forked, lower lobe longer than upper lobe. Pectoral branch of lateral line double: anterior branch along lower edge of opercle (on front margin of cleithrum) shorter, posterior branch extending to pectoral-fin base. Opercle, and

suborbital and interorbital regions scaly; predorsal scales 32–43; anterior rays of dorsal fin and anal fin covered with scales; no scales on upper jaw. Juveniles with transverse bands of pigment on body, and dorsal, anal, pelvic and caudal fins pigmented to some degree. Swimbladder honeycomb-like. Vertebrae 30–41 + 16–19 = 50–59. Ten species: 3 in Atlantic, 1 in eastern Pacific, and 6 in Indo-Pacific; 4 species in WIO.

## KEY TO SPECIES

- 1a Pectoral fins 4.8–5.4 in SL (fin length greater than distance from their origin to anterior margin of nasal fossa); GR 33–46 (usually  $\geq 36$ ); predorsal scales 35–43 (usually  $> 37$ ) ..... *H. lutkei*
- 1b Pectoral fins 5.2–6.8 in SL (fin length less than distance from their origin to anterior margin of nasal fossa); GR 25–37 (usually  $< 36$ ); predorsal scales 32–39 (usually  $< 37$ ) ..... 2
- 2a Dorsal-fin margin pigmented, anterior lobe not well-developed; body width 1.8–2 in body depth; no spots on sides of body in adults ..... *H. archipelagicus*
- 2b Dorsal fin pigmented anteriorly, and anterior lobe well-developed; body width 1.3–2.8 in body depth; adults with spots on sides of body ..... 3
- 3a Adults without bars on sides of body; length of lower jaw usually less than or subequal to HL ..... *H. marginatus*
- 3b Adults with 3–9 (usually 4–6) dark bars on sides; length of lower jaw greater than HL ..... *H. far*

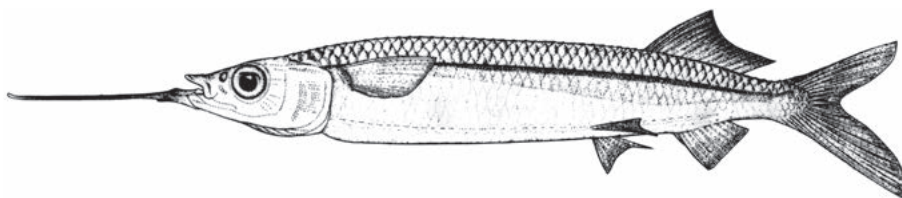
*Hemiramphus archipelagicus*

Collette & Parin 1978

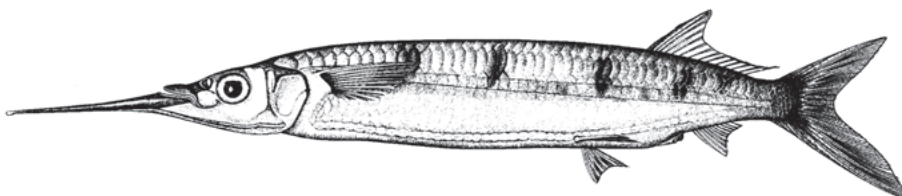
Island halfbeak

*Hemiramphus archipelagicus* Collette & Parin 1978: 732, Fig. 1a (Vietnam, Gulf of Thailand); Parin *et al.* 1980\*; Collette 1999\*, 2004.

Dorsal fin 12–15 rays; anal fin 10–13 rays; pectoral fins 12 rays; predorsal scales 32–37. GR 6–8/19–24 = 25–32. Pectoral fins



*Hemiramphus archipelagicus*, 19 cm SL, mature male holotype (off SW Vietnam). Source: Collette & Parin 1978 (by K Hiratsuka Moore)



*Hemiramphus far*, 26 cm SL (Philippines). Source: Collette 1974 (by K Hiratsuka Moore)

short, not reaching past nasal pit when folded forward. Vertebrae 34–37 + 16 or 17 = 50–54.

Body bluish dorsally, silvery white below, without vertical bars on sides; upper jaw dark, fleshy tip bright red; caudal-fin upper lobe yellowish. Attains 23 cm SL, 34 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: India and Sri Lanka; elsewhere to Gulf of Thailand, Indonesia, Philippines, Samoa and Tonga.

**REMARKS** Inhabits nearshore waters, but juveniles may be found with floating plants carried out to sea. Taken in India with purse seines at Karwar, and with dol nets at Mumbai; marketed fresh or dried-salted.

*Hemiramphus far* (Fabricius 1775)

Black-barred halfbeak

PLATE 61

*Esox far* Fabricius in Niebuhr (ex Forsskål) 1775: 67 (Al-Luhayya, Yemen, Red Sea).

*Esox gladius* Lacepède 1803: 295, 313, Pl. 7, Fig. 3 ('East Indies and America').

*Hemiramphus commersonii* Cuvier 1829: 286 (Indian Ocean; Indonesia).

*Hemiramphus obesus* Castelnau 1861: 64 (Durban, KwaZulu-Natal, South Africa).

*Hemiramphus far*: Smith & Smith 1963\*; Collette 1974\*, 1999\*; Parin *et al.* 1980\*; Dor 1984; Talwar & Kacker 1984\*; Collette & Su 1986\*; SSF No. 115.2\*; Randall 1995\*; Fricke *et al.* 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Fricke *et al.* 2013.

*Hemiramphus far*: Smith 1965\*.

*Hemiramphus marginatus* (*non* Forsskål 1775): Smith 1965.

Dorsal fin 12–14 (rarely 11) rays; anal fin 10–12 rays; pectoral fins 11–13 rays; predorsal scales 32–39. GR 6–10/19–26 = 25–36. Pectoral fins short, not reaching past nasal pit when folded forward. Vertebrae 39–40 + 15–17 = 54–57.

Body bluish dorsally, silvery white below, with 3–9 vertical short dark bars on sides; upper jaw dark, fleshy tip bright red; dorsal-fin tip and caudal-fin upper lobe yellowish; caudal-fin lower lobe bright blue in life. Attains 35 cm SL, 44 cm TL.



**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (common), East Africa to South Africa (Knysna), Mozambique Channel, Madagascar, Seychelles, Mascarenes and India; Lessepsian migrant to eastern Mediterranean Sea; elsewhere to Indonesia, Philippines, southern Japan, Australia, New Caledonia, Samoa and Tonga.

**REMARKS** Found in close proximity of coastlines and islands, including brackish waters, and chiefly in areas of rich submerged vegetation. Adults feed mainly on seagrasses, but also on green algae and diatoms. Caught with gillnets, shore seines, dragnets, or by drifting a fine line with tiny hooks baited with shrimp; marketed mostly fresh or dried-salted.

### *Hemiramphus lutkei* Valenciennes 1847

Lutke's halfbeak

PLATE 61

*Hemiramphus lutkei* Valenciennes in Cuv. & Val. 1847: 49 (Buru, Indonesia); Parin *et al.* 1980\*; Talwar & Kacker 1984\*; Collette & Su 1986\*; Randall & Anderson 1993; Collette 1999\*.

*Hemiramphus marginatus* (*non* Forsskål 1775): Smith & Smith 1963.

Dorsal fin 12–15 rays; anal fin 10–13 rays; pectoral fins 10–12 rays; predorsal scales 35–43. GR 9–14/24–32 = 33–46. Pectoral fins long, 4.8–5.4 in SL, reaching forward of nasal pit when folded forward. Vertebrae 36–41 + 15–18 = 52–57.

Body dark grey-blue dorsally, silvery below; no spots or vertical bars on sides; upper jaw dark, underside and fleshy tip bright red; caudal-fin upper lobe bluish. Attains 30 cm SL, 40 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania (Zanzibar), Comoros, Mozambique, South Africa (St Lucia), Madagascar, India and Sri Lanka; elsewhere to Indonesia, southern Japan, Mariana Is. and western Pacific.

**REMARKS** Found farther offshore than other *Hemiramphus* species, and juveniles and immature individuals are relatively common far from shore, usually among floating plants or algae. Caught with *kolachi vala* drift nets along the southwest coast of India; marketed mostly fresh or dried-salted.

### *Hemiramphus marginatus* (Forsskål 1775)

Blackedge halfbeak

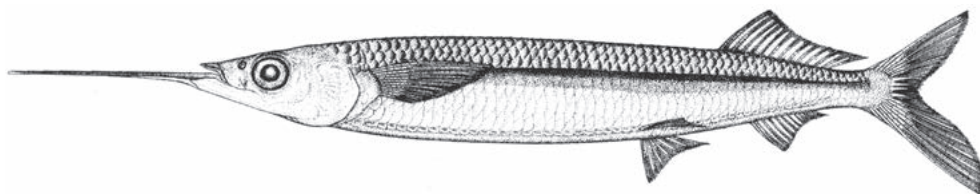
*Esox marginatus* Forsskål in Niebuhr 1775: 67, xiii (Jeddah, Saudi Arabia, Red Sea).

*Hemiramphus marginatus*: Kuronuma & Abe 1972\*; Parin *et al.* 1980\*; Dor 1984; Randall 1995\*; Manilo & Bogorodsky 2003.

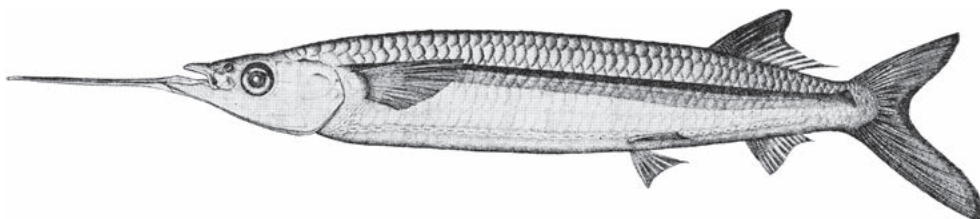
Dorsal fin 12–14 (rarely 11) rays; anal fin 11–13 (rarely 10) rays; pectoral fins 11–13 rays. GR on 1st arch 8–10/22–27 = 30–36 (rarely 37); GR on 2nd arch 4–6/17–22 = 23–28 (rarely 22). Body width 1.6–1.8 in body depth; HL 3.7–4.2 in SL; lower jaw 3.7–4.5 in SL, 1–1.1 in HL (usually less than or subequal to HL). Interorbital width approximately equal to eye diameter (greater in large specimens). Dorsal fin with well-pronounced anterior lobe; anal-fin origin under 5th–7th dorsal-fin ray, length of base 1.6–1.8 in dorsal-fin base; pectoral fins 5.6–6.6 in SL, subequal to distance between pectoral-fin origin and anterior margin of pupil. Anterior parts of median fins scaly; predorsal scales 33–36. Vertebrae 34–36 + 15–18 = 50–53.

Body dark grey-blue dorsally, silvery below; dorsal fin grey anteriorly, first 2 rays darker, and fin black posteriorly; pectoral fins transparent; pelvic fins and anal fin black; caudal fin pale, with traces of dark pigment in middle of lower lobe. Attains 26 cm SL.

**DISTRIBUTION** WIO: Red Sea, northern Arabian Sea and Persian/Arabian Gulf.



*Hemiramphus lutkei*, 22 cm SL (Sri Lanka). Source: Parin *et al.* 1980 (by K Hiratsuka Moore)



*Hemiramphus marginatus*, 24 cm SL (Persian/Arabian Gulf). Source: Parin *et al.* 1980 (by K Hiratsuka Moore)

## SUBGENUS

*Hyporhamphus (Hyporhamphus)* Gill 1859

Two subgenera recognised: *Hyporhamphus* Gill 1859 and *Reporhamphus* Whitley 1931; subgenus *Hyporhamphus* differs from subgenus *Reporhamphus* in having a simple preorbital canal, without posterior branch, and caudal fin truncate or weakly forked with lower lobe slightly longer than upper lobe.

Dorsal fin 12–17 rays; anal fin 13–19 rays; pectoral fins 10–13 rays. GR on 1st arch 5–13/13–40 = 19–51; GR on 2nd arch 2–9/13–38 = 16–47. Body fairly small, moderately compressed, oval in cross-section; body depth 6.3–14 in SL (proportion increasing with growth), width 1.1–1.8 in depth; HL 3.9–5.7 in SL. Upper jaw blunt or pointed, its length less than or greater than its width (length divided by width

0.6–1.3). Lower jaw elongate, 2.9–7.6 in SL, 0.65–1.8 in HL (proportion decreasing with growth). Jaw teeth in 3–8 rows, tricuspid or unicuspid; no teeth on vomer or tongue; teeth on lower pharyngeal and 3rd upper pharyngeal tricuspid in anterior part of plate, tricuspid or blunt in centre, and blunt in posterior part. Nasal papilla not fimbriate. Interorbital region flat; preorbital ridge present; upper jaw, opercle, and suborbital and interorbital regions scaly. Pectoral fins short, 5.8–9.2 in SL; pelvic fins short, 9.8–19.5 in SL, outer rays slightly longer than inner rays, and fins nearer pectoral-fin origins than caudal-fin origin or else midway between ( $P_1-P_2/P_2-C = 0.5-1.15$ ); anal-fin origin in front of dorsal-fin origin or under 1st–3rd dorsal-fin rays. Pectoral branch of lateral line single. Scales moderately large; predorsal scales 30–63; scales present or absent on anterior parts of dorsal fin and anal fin. Swimbladder simple (one-chambered). Vertebrae 28–37 + 16–20 = 45–55. About 25 species, 6 in WIO.

## KEY TO SPECIES

- |    |  |    |  |
|----|--|----|--|
| 1a | Teeth in both jaws mostly unicuspid, tricuspid only posteriorly; dorsal fin naked, anal fin with scales to rays 1–3 ..... 2  | 3a | Preorbital distance 1.3–2 in eye diameter, 0.8–1.2 in upper jaw length ..... <i>Hy. (Hy.) limbatus</i> |
| 1b | Teeth in both jaws mostly tricuspid; anterior parts of dorsal fin and anal fin with scales (to dorsal-fin rays 3–7 and anal-fin rays 3–8) ..... 3  | 3b | Preorbital distance 1.8–2.7 in eye diameter, 1.5–2.2 in upper jaw length ..... 4                       |
| 2a | Distance from pelvic-fin origins to caudal-fin base 0.9–1 in distance from pectoral-fin origins to pelvic-fin origins; preorbital canal with single median pore ..... <i>Hy. (Hy.) capensis</i>        | 4a | GR 41–53; $P_1-P_2/P_2-C = 0.65-0.8$ ..... <i>Hy. (Hy.) xanthopterus</i>                               |
| 2b | Distance from pelvic-fin origins to caudal-fin base 0.8–0.9 in distance from pectoral-fin origins to pelvic-fin origins; preorbital canal usually with 2 median pores ..... <i>Hy. (Hy.) unicuspis</i> | 4b | GR 23–28; $P_1-P_2/P_2-C = 0.8-1.1$ ..... 5  |
|    |  | 5a | Preorbital distance 2.1–2.7 in eye diameter ..... <i>Hy. (Hy.) sindensis</i>                           |
|    |  | 5b | Preorbital distance 1.9–2 in eye diameter ..... <i>Hy. (Hy.) improvisus</i>                            |

*Hyporhamphus (Hyporhamphus) capensis*

(Thominot 1886)

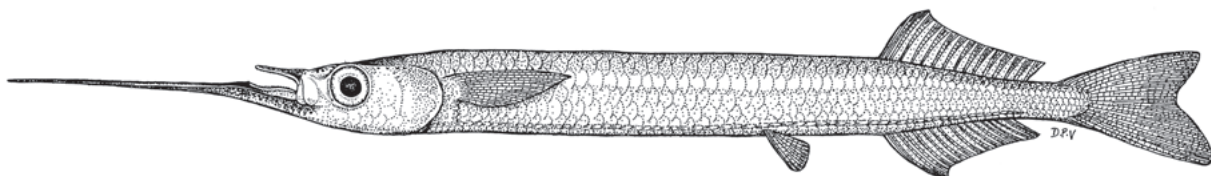
Cape halfbeak

PLATE 62

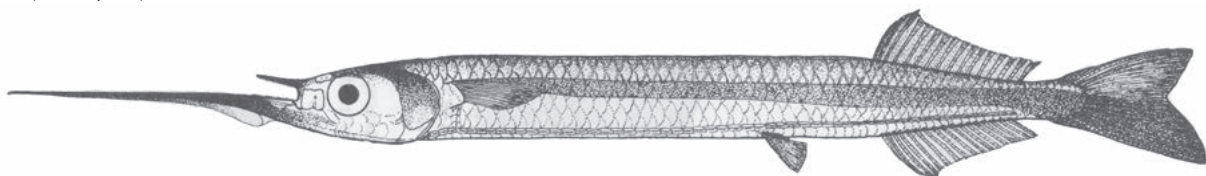
*Hemiramphus capensis* Thominot 1886: 166 (Cape of Good Hope, South Africa).

*Hemiramphus knysnaensis* Smith 1933: 144, Pls. 10–11, Fig. 1a (Knysna, South Africa); Smith 1965\*.

*Hyporhamphus (Hyporhamphus) capensis*: Parin *et al.* 1980; SSF No. 115.4\*.



*Hyporhamphus (Hy.) capensis*, 12 cm SL (South Africa). Source: Whitfield 1998



*Hyporhamphus (Hy.) capensis*, 18 cm TL, male holotype of *Hemiramphus knysnaensis* (South Africa). Source: Smith 1933

Dorsal fin 14–17 rays; anal fin 15–17 rays; pectoral fins 10 or 11 rays. GR on 1st arch 9–11/22–25 = 31–36; GR on 2nd arch 3–5/17–21 = 21–26. Body depth 10.1–10.9 in SL in adults, 8.7–9.4 in SL in fish 53–80 mm SL; body width 1.4–1.8 in body depth; HL 4.3–4.8 in SL. Upper jaw pointed, its width 1–1.1 in its length in fish >8 cm SL (proportionately shorter in smaller specimens: width in length ~0.6 in fish ~5 cm SL, or 0.8–1 in fish 69–73 mm SL). Lower jaw 2.9–4.4 in SL, 0.7–1 in HL. Jaw teeth in 2–4 rows, sharp and mostly unicuspid (tricuspid in posterior part of lower jaw). Preorbital distance 1.5–1.7 in eye diameter, 1.4–1.8 in upper jaw length; preorbital canal narrow in upper part, becoming noticeably wider ventrally; middle pore at anterior margin or rarely in central part. Pectoral-fin length 6.9–8.4 in SL; pelvic-fin length 11.7–14.4 in SL, fins approximately midway between pectoral-fin origins and caudal-fin base ( $P_1-P_2/P_2-C = 0.9-1$ ). No scales on dorsal fin; anal fin with at most 2 or 3 scales on first 2 membranes; predorsal scales 35–38. Vertebrae 30–34 + 16–18 = 46–52.

Body green dorsally, white below; silvery lateral stripe widens posteriorly; lower half of caudal fin dark grey. Attains 14 cm SL.

**DISTRIBUTION** Southern Africa: South Africa (False Bay) to southern Mozambique (Lake Piti) in WIO.

**REMARKS** Found in fresh, brackish and coastal marine waters. Males mature by ~10 cm SL, females by ~10.5 cm SL; ripe and partially spawned individuals recorded in October, December and March. Omnivorous; juveniles feed largely on tiny crustaceans, such as amphipods and isopods, switching to diet of predominantly aquatic plants at larger sizes in summer.

### *Hyporhamphus (Hyporhamphus) improvisus*

(Smith 1933)

Delagoa halfbeak

*Hemirhamphus improvisus* Smith 1933: 142, Fig. 1b, Pl. 11 (Maputo Bay, Mozambique).

*Hyporhamphus improvisus*: Smith 1965.

*Hyporhamphus delagoae* (non Barnard 1925): Parin *et al.* 1980.

*Hyporhamphus (Hyporhamphus) improvisus*: Collette 1982; SSF No. 115.5\*.

Dorsal fin 12–14 rays; anal fin 13–15 rays; pectoral fins 11 or 12 rays. GR on 1st arch 6–10/18–21 = 24–30; GR on 2nd arch 3–5/15–17 = 18–22. Body depth 8–8.8 in SL; body width 1.3–1.4 in body depth; HL 4.5–4.6 in SL. Upper jaw pointed, its width equal to its length; maxillary teeth tricuspid, in 2–4 rows. Lower jaw 3.5–3.6 in SL, 0.78 in HL. Preorbital distance short, 1.9–2 in eye diameter, ~1.9 in upper-jaw length; preorbital canal narrow in upper part, becoming slightly wider ventrally. Pectoral-fin length 6.8–7.6 in SL; pelvic fins about midway between opercle margin and caudal-fin base ( $P_1-P_2/P_2-C = 0.85-0.95$ ), fin length 11.6–12.3 in SL. Anterior parts of dorsal fin and anal fin scaly; predorsal scales 31–38. Vertebrae 31 + 16 or 17 = 47 or 48.

Body pale green dorsally, white below; lateral stripe dark, not widening posteriorly; caudal-fin upper margin greyish. Attains 22 cm TL.

**DISTRIBUTION** WIO: endemic to Mozambique (Quelimane to Maputo Bay).

### *Hyporhamphus (Hyporhamphus) limbatus*

(Valenciennes 1847)

Congaturi halfbeak

PLATE 62

*Hemirhamphus limbatus* Valenciennes in Cuv. & Val. 1847: 44 (Malabar coast, India).

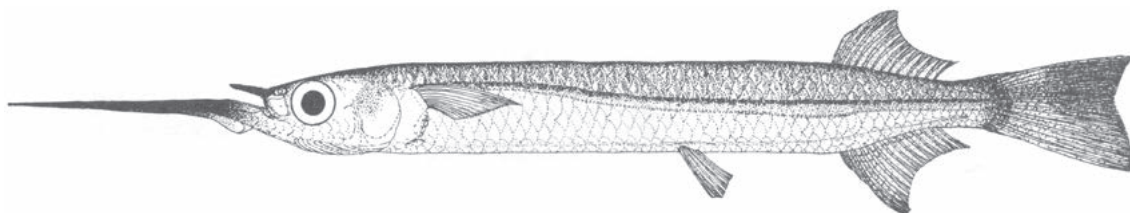
*Hyporhamphus unifasciatus* (non Ranzani 1841): Munro 1955\*.

*Hemirhamphus gorakhpurensis* Srivastava 1967: 93, Fig. (Maheshera Tal, Uttar Pradesh, India).

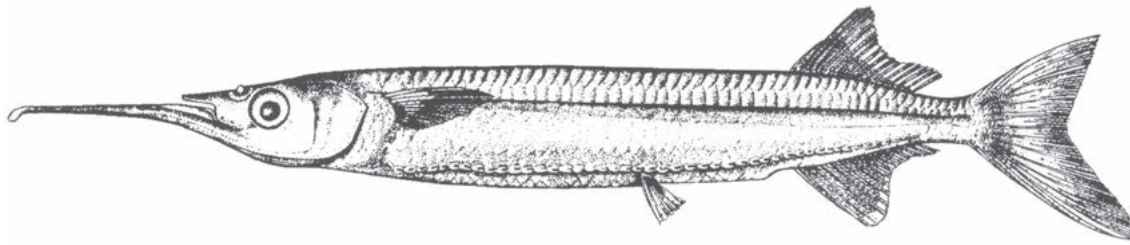
*Hyporhamphus (Hyporhamphus) limbatus*: Parin *et al.* 1980; Collette & Su 1986; Collette 1999\*.

*Hyporhamphus limbatus*: Talwar & Kacker 1984.

Dorsal fin 12–16 rays; anal fin 13–16 rays; pectoral fins 10–12 rays. GR on 1st arch 6–12/19–25 = 23–37; GR on 2nd arch 2–5/14–23 = 16–28. Upper jaw short, triangular, its width 0.6–0.8 in its length. Lower jaw subequal to or longer than HL. Preorbital distance 1.3–2 in eye diameter, 0.8–1.2 in upper jaw length. Upper jaw and anterior part of dorsal and anal fins scaly; predorsal scales 30–38. Vertebrae 28–32 + 16–19 = 45–50.



*Hyporhamphus (Hy.) improvisus*, 22 cm SL, type (S Mozambique). Source: Smith 1933



*Hyporhamphus (Hy.) limbatus*, ~17 cm SL. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

Body greenish dorsally, white below; silvery lateral stripe widens posteriorly; fleshy tip of upper jaw reddish. Attains ~17 cm SL (commonly 13 cm SL), 22 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf to India; elsewhere to east coast of India, Bangladesh, Myanmar and China.

**REMARKS** Coastal, frequently entering estuaries and lakes; permanent resident of brackish-water lakes Chilika and Pulicat in India. Breeding season extends over most of year but concentrated in summer. Fecundity varies from ~555–9 065 eggs ~1.3 mm in diameter; eggs attached by filaments to algae and hatch in ~1 week. Caught with cast nets in India; marketed fresh or dried-salted.

### *Hyporhamphus (Hyporhamphus) sindensis*

(Regan 1905)

Sind halfbeak

PLATE 62

*Hemirhamphus sindensis* Regan 1905: 318 (Karachi, Pakistan).

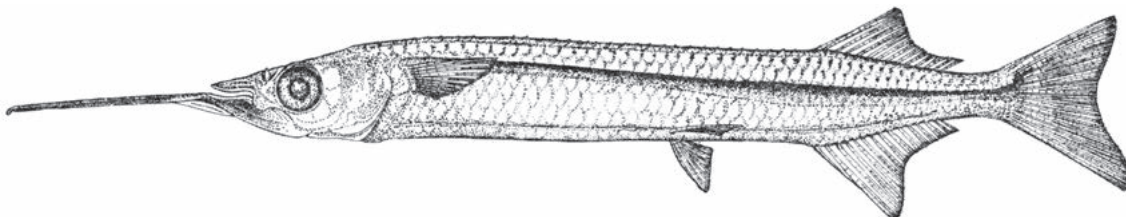
*Hyporhamphus (Hyporhamphus) sindensis*: Parin *et al.* 1980\*.

*Hyporhamphus sindensis*: Randall 1995\*; Manilo & Bogorodsky 2003.

Dorsal fin 13–15 rays; anal fin 14–17 rays; pectoral fins 12 or 13 rays; predorsal scales 31–36. GR on 1st arch 5–10/18–23 = 24–33; GR on 2nd arch 3–6/17–22 = 21–25. Body depth 7.4–9.7 in SL; body width 1.3–1.5 in body depth; HL 3.9–4.6 in SL. Upper jaw slightly pointed, its width 0.8–1.1 in its length. Lower jaw short, 3.8–6.9 in SL, 0.9–1.7 in HL. Jaw teeth tricuspid, in 4–8 rows on both jaws. Preorbital distance very short, 2.1–2.7 in eye diameter, 1.5–2.2 in upper jaw length; preorbital canal wide, slightly wider ventrally; middle pore situated in centre of canal or at its anterior margin (1 specimen with 2 pores). Dorsal and anal fins with well-pronounced anterior lobe, and anterior part of fins scaly (in largest fishes up to 6th–8th dorsal-fin ray, and 9th–11th anal-fin ray); anal-fin origin under dorsal-fin origin or 1st–2nd dorsal-fin rays, length of base 1–1.1 in dorsal-fin base; pectoral fins 6.5–8 in SL, subequal to or longer than distance from fin origin to mid-eye; pelvic fins 11.4–15.5 in SL, fins midway between pectoral-fin origins and caudal-fin base or slightly nearer to former ( $P_1-P_2/P_2-C = 0.8-1.05$ ). Vertebrae 29–33 + 16–19 = 47–50.

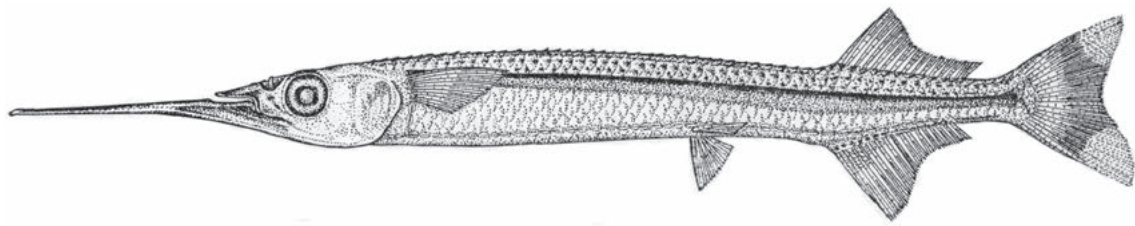
Body silvery, with pale grey-brown tinge dorsally; narrow midlateral stripe bright silver; tip of lower jaw red; caudal-fin upper lobe with yellow tinge. Attains 17.5 cm SL.

**DISTRIBUTION** WIO: Persian/Arabian Gulf (Kuwait; Bahrain; Tarut Bay, Saudi Arabia), eastwards in Arabian Sea to Pakistan (Astola I. and Karachi) and southwestern India.



*Hyporhamphus (Hy.) sindensis*, 15 cm SL (Pakistan). Source: Parin *et al.* 1980 (by K Hiratsuka Moore)





*Hyporhamphus (Hy.) unicuspis*, 12 cm SL, mature female holotype (Thailand). Source: Collette & Parin 1978 (by K Hiratsuka Moore)

## *Hyporhamphus (Hyporhamphus) unicuspis*

Collette & Parin 1978

Simpletooth halfbeak

PLATE 62

*Hyporhamphus (Hyporhamphus) unicuspis* Collette & Parin 1978: 743, Fig. 2c (Ko Talibong, Thailand); Parin *et al.* 1980\*.

*Hyporhamphus unicuspis*: Randall 1995\*; Manilo & Bogorodsky 2003.

Dorsal fin 14 or 15 (rarely 16) rays; anal fin 16–18 rays; pectoral fins 10 or 11 (rarely 12) rays. GR on 1st arch 9–11/20–23 = 30–34; GR on 2nd arch 4–6/17–20 = 20–26 (rarely to 30). Body depth 7.3–12.1 in SL; body width 1.3–1.7 in body depth; HL 4.1–4.6 in SL. Upper jaw slightly pointed, its width 0.85–1.15 in its length. Lower jaw 2.9–4.3 (rarely to 5.3) in SL, 0.8–1.1 in HL (proportion decreasing with growth: jaw length 0.7–0.8 in HL in fish 73–84 mm SL). Jaw teeth in 3–5 rows, small, sharp, and mostly unicuspid (tricuspid only at rear of lower jaw). Preorbital distance 1.4–1.6 in eye diameter, 1.2–1.5 in upper jaw length; preorbital canal narrow, slightly widened ventrally, and usually with 2 middle pores. Pectoral fins 7.6–8.9 in SL; pelvic fins 13–15 in SL, fins nearer pectoral-fin origins than caudal-fin base ( $P_1-P_2/P_2-C = 0.8-0.9$ ). No scales on dorsal fin; some scales present between 1st and 3rd anal-fin rays; predorsal scales 36–40 (rarely 33). Vertebrae 31–33 + 17–20 = 49–51.

Body greenish dorsally, white below, with silvery lateral stripe; tip of lower jaw orange-red. Attains 14.5 cm SL.

**DISTRIBUTION** Indian Ocean. WIO: Persian/Arabian Gulf to India; elsewhere to east coast of India and Andaman Sea (Thailand).

**REMARKS** Males mature at ~8.5 cm SL, females at ~11 cm SL.

## *Hyporhamphus (Hyporhamphus) xanthopterus*

(Valenciennes 1847)

Yellowfin halfbeak

PLATE 62

*Hemiramphus xanthopterus* Valenciennes in Cuv. & Val. 1847: 47 (freshwaters of Alleppey, India).

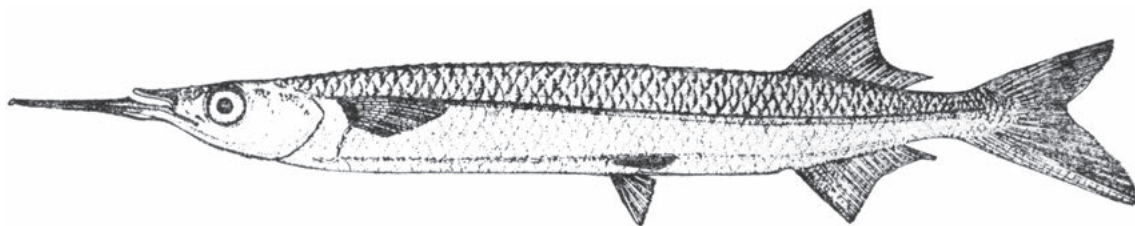
*Hyporhamphus (Hyporhamphus) xanthopterus*: Kurup & Samuel 1980; Parin *et al.* 1980\*; Collette 1982\*; Nair *et al.* 1983.

Dorsal fin 14–16 rays; anal fin 14–17 rays; pectoral fins 12 or 13 rays; predorsal scales 33–38. GR on 1st arch 10–13/31–40 = 41–53; GR on 2nd arch 7–9/31–38 = 39–47 (distinguished from other Indo-Pacific members of subgenus by higher gill-raker count). Lower jaw short, 1.2–1.8 in HL (most similar to *Hyporhamphus neglectus* and *H. sindensis*).  $P_1-P_2/P_2-C = 0.65-0.8$ .

Body greenish dorsally, white below, with silvery lateral stripe; tip of lower jaw orange-red; fins yellow, their colour stronger in males than in females. Attains 20 cm SL.

**DISTRIBUTION** WIO: southwestern India, fresh and brackish waters of lakes of Kerala (especially Vembanad Lake and Vellayani Lake) and adjacent marine waters.

**REMARKS** Males mature by ~11 cm SL, females by ~13.5 cm SL; fecundity 1 000–1 300 eggs of 1.1–1.4 mm diameter. Caught in artisanal fisheries of Kerala, India, using small nets cast from canoes. IUCN Red List conservation status Vulnerable.



*Hyporhamphus (Hy.) xanthopterus*, 16 cm SL (SW India). Source: Collette 1982 (by K Hiratsuka Moore)

## SUBGENUS

***Hyporhamphus (Reporhamphus)*** Whitley 1931

Differs from subgenus *Hyporhamphus* in having a deeply forked caudal fin and preorbital lateral-line canal with posterior branch. Eleven species, all marine and confined to Indo-Pacific; 6 species in WIO.

## KEY TO SPECIES

- 1a Preorbital length very long, 1–1.2 in eye diameter, 0.7–0.9 in upper jaw length; lower jaw long, 0.7–0.9 in HL ..... *Hy. (R.) balinensis*
- 1b Preorbital length 1.4–2.2 in eye diameter, 0.9–1.4 in upper jaw length; lower jaw shorter, 0.8–2 in HL ..... 2
- 2a Preorbital length 1.4–1.9 in eye diameter; pectoral fins 7.7–10 in SL ..... 3
- 2b Preorbital length 1.7–2.2 in eye diameter; pectoral fins 6.8–8.2 in SL ..... 5
- 3a Predorsal scales 33–39; anal fin 13–16 (usually 14 or 15) rays; distance from pelvic-fin origins to caudal-fin base 0.9–1 in distance from pectoral-fin origins to pelvic-fin origins ..... *Hy. (R.) gamberur*
- 3b Predorsal scales 37–44; anal fin 15–18 rays; distance from pelvic-fin origins to caudal-fin base 1–1.2 in distance from pectoral-fin origins to pelvic-fin origins ..... 4
- 4a Preorbital length 1.4–1.7 in eye diameter; upper jaw width 0.6–0.9 in its length ..... *Hy. (R.) affinis*
- 4b Preorbital length 1.6–1.9 in eye diameter; upper jaw width 0.8–1 in its length ..... *Hy. (R.) erythrorinchus*
- 5a Tip of upper jaw pointed; lower jaw length subequal to HL, but up to ~1.4 in HL in large fish; GR 33–47 (usually 38–43); distance from pelvic-fin origins to caudal-fin base 1.1–1.3 in distance from pectoral-fin origins to pelvic-fin origins ..... *Hy. (R.) dussumieri*
- 5b Tip of upper jaw blunt and rounded; lower jaw shorter than HL, and up to twice in HL in large fish; GR 26–36; distance from pelvic-fin origins to caudal-fin base 0.9–1.1 in distance from pectoral-fin origins to pelvic-fin origins ..... *Hy. (R.) quoyi*

***Hyporhamphus (Reporhamphus) affinis***

(Günther 1866)

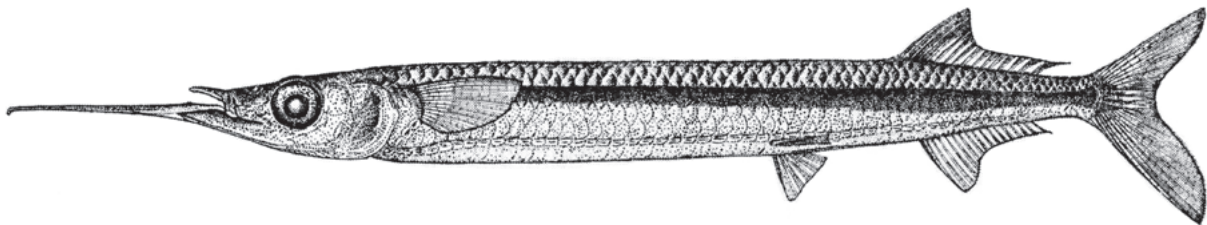
Reef halfbeak

PLATE 62

*Hemirhamphus affinis* Günther 1866: 267 (South Seas [South Pacific]).*Hemirhamphus (Hyporhamphus) delagoae* Barnard 1925: 498 (Maputo Bay, Mozambique); Smith 1933\*; Barnard 1937.*Hyporhamphus dussumieri* (*non* Valenciennes 1847): Smith & Smith 1963\*; Smith 1965.*Hyporhamphus balinensis* (*non* Bleeker 1858): Smith 1965.*Hyporhamphus delagoae*: Smith 1965.*Hyporhamphus (Reporhamphus) affinis*: Collette 1974\*, 1982; Parin *et al.* 1980\*; Dor 1984; Collette & Su 1986\*; SSF No. 115.3\*.*Hyporhamphus affinis*: Randall & Anderson 1993; Winterbottom & Anderson 1997.

Dorsal fin 15–17 (rarely 14) rays; anal fin 15–18 (rarely 19) rays; pectoral fins 11–13 rays. GR on 1st arch 8–12/21–29 = 30–41; GR on 2nd arch 2–5/17–25 = 20–30. Body depth 8.8–11.6 in SL; body width 1.1–1.4 in body depth (to ~1.5 in juveniles); HL 4–4.4 in SL (4.2–4.5 in juveniles <10 cm SL), proportion increasing with growth. Upper jaw somewhat pointed, its width 0.6–0.9 in its length. Lower jaw of adults 3.5–5.1 (rarely to 5.8) in SL, 0.8–1.2 (rarely to 1.4) in HL (in juveniles: 2.7–3.8 in SL, 0.6–0.9 in HL), proportion decreasing with growth. Jaw teeth in 3–5 rows in both jaws, tricuspid, with supplementary lateral cusps, or unicuspid. Preorbital length 1.4–1.7 in eye diameter (to ~1.9 in juveniles), 0.9–1.2 in length of upper jaw; posterior branch of preorbital canal forms obtuse angle with anterior portion; ventral pore wide, upper pore large. Pectoral fins 7.7–10 in SL, subequal to or slightly less than distance from fin origin to mid-eye; pelvic fins 14.5–16.2 in SL, fins slightly nearer caudal-fin base than pectoral-fin origins ( $P_1-P_2/P_2-C = 1.1-1.2$ ). Anterior lobe of dorsal fin well-developed in adults, barely developed in juveniles; anterior part of dorsal fin (up to 7th–9th ray) and entire anal fin scaly; predorsal scales 37–44. Vertebrae 36–40 + 17–20 = 54–59.

Body greenish or deep bluish green dorsally, pale silvery white below; silvery lateral stripe, widening posteriorly; fins pale except caudal fin bluish. Attains 26 cm SL.



*Hyporhamphus (R.) affinis*, 24 cm SL (Marshall Is.). Source: Parin *et al.* 1980 (by K Hiratsuka Moore)

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Comoros and East Africa to South Africa (Sodwana Bay); elsewhere to Philippines, New Guinea, Australia, New Caledonia and Pacific Ocean islands (apparently absent from Indo-Malaysian Archipelago and Hawaii).

**REMARKS** Found chiefly around coral reefs and islands, but farther from shore than *H. dussumieri*, which has a similar range.

### *Hyporhamphus (Reporhamphus) balinensis*

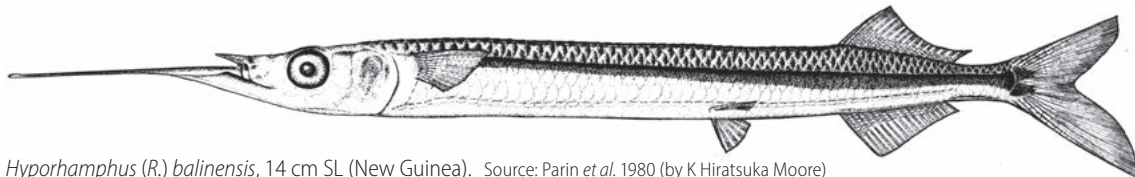
(Bleeker 1858)

Balinese halfbeak

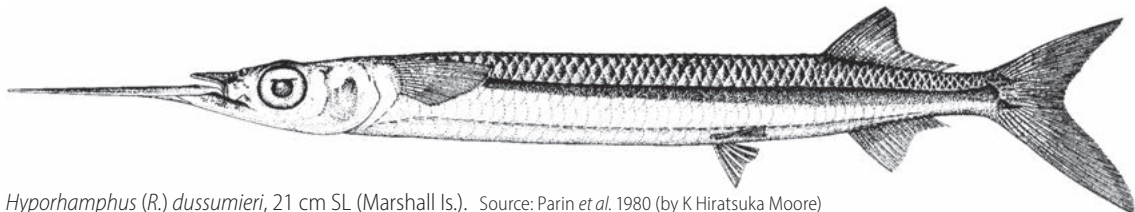
*Hemiramphus balinensis* Bleeker 1858: 170 (Bali Sea).

*Hyporhamphus (Reporhamphus) balinensis*: Parin *et al.* 1980\*; Dor 1984; Collette 1999\*.

Dorsal fin 15–17 (rarely 14) rays; anal fin 16–19 rays; pectoral fins 10–12 rays. GR on 1st arch 6–11/21–27 = 29–38; GR on 2nd arch 3–6/16–22 = 20–26. Body depth 8.3–11.5 in SL; body width 1.2–1.5 in body depth (1.5–1.7 in juveniles); HL 4.2–4.8 in SL (4.5–5.2 in juveniles <10 cm SL), proportion of HL increasing with growth. Upper jaw triangular and pointed, width 0.6–0.7 in length. Lower jaw 3.1–3.8 in SL, 0.7–0.9 in HL (in juveniles: to ~1.7 in SL, and to ~0.35 in HL), proportion of jaw length decreasing with growth. Jaw teeth in 3–5 rows on both jaws, very small, sharp, and unicuspid or with additional lateral cusps. Preorbital length 1–1.1 in eye diameter (to ~1.6 in juveniles), 0.6–0.85 in upper jaw length; posterior branch of preorbital canal forms obtuse angle with anterior branch; ventral pore very wide. Pectoral-fin length 9.5–11.4 in SL, subequal to or slightly greater than distance from fin origin to rear edge of eye; pelvic fins 17–18 in SL, fins midway between pectoral-fin origins and caudal-fin base ( $P_1-P_2/P_2-C = 0.95-1.1$ ). Anterior lobe of dorsal fin barely pronounced; anterior part of dorsal fin (up to 7th–9th ray) and entire anal fin scaly; predorsal scales 40–46 (rarely 39). Vertebrae 36–39 + 18–21 = 55–59.



*Hyporhamphus (R.) balinensis*, 14 cm SL (New Guinea). Source: Parin *et al.* 1980 (by K Hiratsuka Moore)



*Hyporhamphus (R.) dussumieri*, 21 cm SL (Marshall Is.). Source: Parin *et al.* 1980 (by K Hiratsuka Moore)

Body greenish dorsally, white below, with silvery lateral stripe; tip of lower jaw orange-red. Attains 16.5 cm SL.

**DISTRIBUTION** Indo-Pacific (widespread). WIO: southern Red Sea to Mozambique Channel and Sri Lanka; elsewhere to Andaman Is., Indonesia, New Guinea and Samoa.

**REMARKS** Neritic, in coastal waters. Matures at ~12–13 cm SL.

### *Hyporhamphus (Reporhamphus) dussumieri*

(Valenciennes 1847)

Dussumier's halfbeak

PLATE 62

*Hemiramphus dussumieri* Valenciennes *in* Cuv. & Val. 1847: 33, Pl. 554 (Seychelles).

*Hemiramphus reynaldi* Valenciennes *in* Cuv. & Val. 1847: 39 (Trincomalee, Sri Lanka; Kolkata, India).

*Hyporhamphus dussumieri*: Smith & Smith 1963\*; Talwar & Kacker 1984\*; Randall & Anderson 1993; Fricke *et al.* 2013.

*Hyporhamphus (Reporhamphus) dussumieri*: Collette 1974\*, 1999\*; Parin *et al.* 1980\*; Collette & Su 1986\*.

Dorsal fin and anal fin each with 14–17 rays; pectoral fins 11 or 12 rays. GR on 1st arch 10–14/25–32 = 33–47; GR on 2nd arch 3–7/21–29 = 25–36. HL 4.3–4.8 in SL. Upper jaw short, triangular, width 0.6–0.9 in length. Lower jaw length 4.2–5.9 in SL, 1–1.4 in HL, proportion decreasing with growth. Preorbital length 1.7–2.2 in eye diameter, 1.1–1.4 in upper jaw length. Pelvic fins nearer caudal-fin base than pectoral-fin origins; distance from pelvic-fin origins to caudal-fin base 1.1–1.3 in distance from pectoral-fin origins to pelvic-fin origins. Upper jaw, anterior part of dorsal fin and entire anal fin scaly; predorsal scales 37–44. Vertebrae 35–40 + 16–20 = 52–60.

Body greenish dorsally, silvery white below; fleshy tip of lower jaw red. Attains 30 cm SL (commonly 19 cm SL).

**DISTRIBUTION** Tropical Indo-Pacific. WIO: Mozambique Channel, Seychelles, Maldives and Sri Lanka; elsewhere to Indonesia, Hong Kong, Philippines, Okinawa (Japan), Marshall Is., New Guinea, Australia, Tonga and Tuamotu Is.

**REMARKS** Common around islands and coral reefs. Caught mostly with shore seines; marketed fresh or dried-salted.

## *Hyporhamphus (Reporhamphus) erythrorinchus* (Lesueur 1821)

Mascarene halfbeak

*Hemiramphus erythrorinchus* Lesueur 1821: 137 (Mauritius, Mascarenes).

*Hyporhamphus (Reporhamphus) erythrorinchus*: Parin *et al.* 1980\*.

*Hyporhamphus erythrorinchus*: Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 16–18 (usually 17) rays; anal fin 17 or 18 (rarely 16) rays; pectoral fins 12 or 13 rays. GR on 1st arch 9–13/25–30 = 35–43; GR on 2nd arch 4–6/21–27 = 25–32. Body depth 9.5–12.5 in SL; body width 1.1–1.5 in body depth; HL 4.4–4.9 in SL. Upper jaw pointed, its width 0.8–1 in its length. Lower jaw 4.3–5.1 in SL, 0.9–1.2 in HL in adults >18 cm SL (3.4–3.9 in SL, 0.75–0.9 in HL in fish 10.5–15 cm SL). Preorbital length 1.6–1.9 in eye diameter, 1.1–1.4 in upper jaw length; posterior branch of preorbital canal forms obtuse angle with anterior branch, ventral pore very wide. Pectoral fins 7.8–8.9 in SL; pelvic fins 13.7–16.3 in SL, fins slightly nearer caudal-fin base than pectoral-fin origins ( $P_1-P_2/P_2-C = 1-1.2$ ); anal-fin base 1.1–1.2 in dorsal-fin base. Anterior lobe of dorsal fin well-pronounced; dorsal and anal fins in large fish almost completely covered with scales; predorsal scales 40–43. Vertebrae 39–41 + 18–20 = 57–60.

Body greenish dorsally, white below, with silvery lateral stripe; tip of lower jaw orange-red. Attains 25 cm SL.

**DISTRIBUTION** WIO: Réunion, Mauritius and St Brandon Shoals.

## *Hyporhamphus (Reporhamphus) gamberur*

(Rüppell 1837)

Red Sea halfbeak

PLATE 62

*Hemiramphus gamberur* Rüppell 1837: 74 (Massawa, Eritrea, Red Sea).

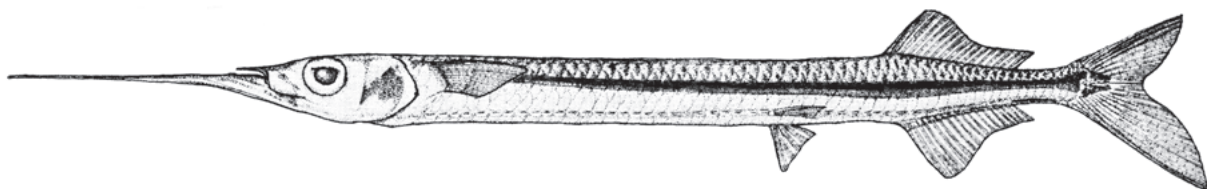
*Hyporhamphus (Reporhamphus) gamberur*: Parin *et al.* 1980; Dor 1984.

Dorsal fin 14 or 15 rays; anal fin 13–16 rays; pectoral fins 11–13 rays. GR on 1st arch 9–12/24–30 = 35–41; GR on 2nd arch 3–7/20–27 = 24–30. Body depth 9.9–11.4 in SL; body width 1.2–1.5 in body depth; HL 4–4.7 in SL. Upper jaw slightly pointed, width 0.6–0.8 in length. Lower jaw 4–5.4 in SL, 1–1.3 in HL, proportion decreasing with growth. Jaw teeth in 3–5 rows on both jaws, small, unicuspid or with additional lateral cusps. Preorbital length 1.5–1.8 in eye diameter (to ~2.2 in juveniles), 0.9–1.1 in upper jaw length; posterior branch of preorbital canal forms obtuse angle with anterior branch, ventral pore wide. Pectoral fins 7.9–9.3 in SL, subequal to distance from fin origin to at most mid-eye; pelvic fins 12–14.6 in SL, fins slightly nearer pectoral-fin origins than caudal-fin base ( $P_1-P_2/P_2-C = 0.85-1.05$ ). Dorsal and anal fins extensively scaly; predorsal scales 33–39. Vertebrae 32–36 + 16–18 = 49–53.

Body greenish dorsally, white below, with silvery lateral stripe; tip of lower jaw orange-red. Attains 22 cm SL.

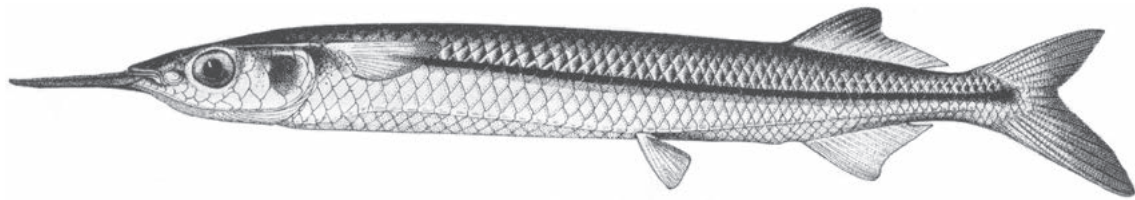
**DISTRIBUTION** WIO: Red Sea and Gulf of Aden.

**REMARKS** Females mature by ~10.5 cm SL.



*Hyporhamphus (R.) erythrorinchus*, 13 cm SL (St Brandon Shoals). Source: Parin *et al.* 1980 (by K Hiratsuka Moore)





*Hyporhamphus (R.) quoyi*, 20 cm SL, holotype of *Hemiramphus mioprurus* (Japan). Source: Jordan & Dickerson 1908

## *Hyporhamphus (Reporhamphus) quoyi*

(Valenciennes 1847)

### Quoy's halfbeak

PLATE 62

*Hemiramphus quoyi* Valenciennes in Cuv. & Val. 1847: 35 (Port Dorey, New Guinea).

*Hemiramphus gaimardi* Valenciennes in Cuv. & Val. 1847: 36 (New Guinea) [in part].

*Hyporhamphus (Reporhamphus) quoyi*: Collette 1974, 1999\*; Parin *et al.* 1980; Collette & Su 1986\*.

*Hyporhamphus quoyi*: Talwar 1964; Talwar & Kacker 1984.

Dorsal fin 14–17 (usually 16) rays; anal fin 13–17 (usually 15 or 16) rays; pectoral fins 11–13 rays. GR on 1st arch 6–14/18–25 = 26–36 (rarely to 39); GR on 2nd arch 3–7/16–25 = 20–31. HL 4.2–4.7 in SL. Upper jaw short, scaly, blunt and rounded, width 0.5–0.6 in length. Lower jaw shorter than head length (1.1–2 in HL; 4.7–8.6 in SL), proportion decreasing with growth. Preorbital length 1.7–2.2 in eye diameter, 0.9–1.2 in upper jaw length. Posterior branch of preorbital lateral-line canal present. Pelvic fins approximately midway between pectoral-fin origins and caudal-fin base, distance from pelvic-fin origins to caudal-fin base 0.9–1.1 in distance from pectoral-fin origins to pelvic-fin origins. Anterior part of dorsal fin and entire anal fin scaly; predorsal scales 36–43 (usually 37–40). Vertebrae 34–40 + 15–19 = 51–57.

Body greenish dorsally, silvery white below; fleshy tip of lower jaw red. Attains 31 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: India (less common) and Sri Lanka; elsewhere to Thailand, Indonesia, southern Japan, New Guinea and northern Australia.

**REMARKS** Inhabits more turbid and brackish (estuarine) waters than does *Hyporhamphus dussumieri* and is not found around oceanic islands. Females mature by ~12.5 cm SL. Feeds on seagrasses, green algae, diatoms and polychaetes. Caught mostly with shore seines, and also on hooks attached to miniature sailed rafts (*mural-thoondi*) in India; marketed fresh or dried-salted.

## GENUS *Oxyporhamphus* Gill 1864

### Flying halfbeaks

Dorsal fin 12–15 rays; anal fin 13–17 rays; pectoral fins 11–13 rays; GR 26–36. Body elongate, laterally compressed, its cross-section an elongated oval; body depth 5.5–6 in SL; body width 1.4–1.6 in body depth; HL 4–4.8 in SL. Upper jaw short, without pointed projection. Lower jaw of adults short (snout length 11–17 in SL), but strongly projecting (up to 4 in SL) in young 'halfbeak stage' (fish 3.5–4.5 cm SL), and apparently breaking off at fish lengths of 5–10 cm SL. (In contrast to other halfbeaks, snout length in *Oxyporhamphus* is measured from tip of lower jaw to front edge of eye.) Jaw teeth with supplementary cusps, frequently tricuspid. Interorbital region convex; no preorbital shelf; no posterior branch of preorbital canal; nasal papilla not fimbriate. Pectoral fins elongate (2.6–3.3 in SL), nearly reaching pelvic-fin origins. Pelvic fins short (7.3–11.1 in SL), set about midway between pectoral-fin origins and caudal-fin origin, or closer to latter ( $P_1-P_2/P_2-C = 0.95-1.35$ ). Caudal-fin lower lobe greatly elongate. Opercle, and suborbital and interorbital regions scaly; predorsal scales 27–34; no scales on fins. Pectoral branch of lateral line single. Swimbladder simple (one-chambered) at all sizes, or alveolar (multi-chambered) in adults. Vertebrae 30–33 + 17–19 = 47–51.

*Oxyporhamphus* has been considered to be a halfbeak by most recent authors (e.g., Parin *et al.* 1980; Collette 2004), sister-group to *Hemiramphus* (Lovejoy *et al.* 2004). Some recent authors have placed this genus as the separate family Oxyporhamphidae (Parin *et al.* 1980; Collette 2004) or have considered it as belonging to the flyingfishes of family Exocoetidae (Dasilao *et al.* 1997). Two species, each with 2 subspecies recognised: *O. convexus* (Weber & De Beaufort 1922) from the Indo-Pacific, and *O. micropterus* (Valenciennes 1847) which is worldwide; 2 species (one with 2 subspecies) in WIO.

## KEY TO SPECIES AND SUBSPECIES

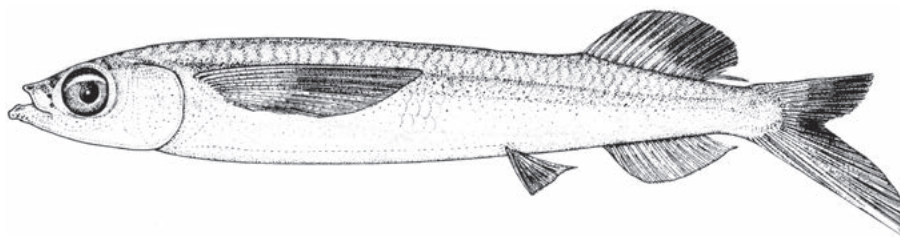
- 1a Swimbladder of adults multi-chambered (>12 cm SL); pelvic-fin margins of juveniles (3–9 cm SL) intensely pigmented; distance from pelvic-fin origins to caudal-fin base 1.35–1.5 in distance from pectoral-fin origins to pelvic-fin origins ..... 2 [*O. convexus*]
- 1b Swimbladder simple (one-chambered) at all sizes; pelvic fins of juveniles unpigmented or with slight pigmentation only on outer rays; distance from pelvic-fin origins to caudal-fin base 0.95–1.2 in distance from pectoral-fin origins to pelvic-fin origins ..... *O. micropterus micropterus*
- 2a GR 26–33 (usually 27–31) ..... *O. convexus convexus*
- 2b GR 30–36 (usually 31–34) ..... *O. convexus bruuni*

*Oxyporhamphus convexus*

(Weber &amp; De Beaufort 1922)

*Hemirhamphus convexus* Weber & De Beaufort 1922: 159 (Timor, Malaysia).

Dorsal fin 13–15 (rarely 12) rays; anal fin 14 or 15 (rarely 16) rays; predorsal scales 28–34; GR on 2nd arch 3 or 4/16–19 = 19–22. Snout length of adults 12.2–14.8 in SL, 3–3.3 in HL (in young 3–7 cm SL: 4–5 in SL, 1–1.2 in HL); skin folds along sides of lower jaw in juveniles forming expanded lobes anteriorly. Pectoral fins of adults 2.8–3.3 in SL (3.4–5.4 in young 4.3–7 cm SL). Pelvic fins nearer caudal-fin base than edge of opercle ( $P_1-P_2/P_2-C = 1.1-1.4$ ), and  $P_2-C$  distance 1.35–1.5 in  $P_1-P_2$  distance (cf. 0.95–1.2 in *O. micropterus*); pigmentation intense on pelvic-fin margins of juveniles 3–9 cm SL (cf. slight pigmentation on fins of juvenile *O. micropterus*). Anal-fin origin under dorsal-fin rays 2–4, length of anal-fin base 1–1.4 in dorsal-fin base. Swimbladder of adults multi-chambered (cf. one-chambered in *O. micropterus*); division of the many small compartments begins anteriorly, at ~10 cm SL, and is complete by ~17 cm SL (Tibbetts *et al.* 2007).

**REMARKS** Two subspecies recognised, both in WIO.*Oxyporhamphus convexus convexus*, adult. Source: Collette 1999 (by K Hiratsuka Moore)*Oxyporhamphus convexus bruuni*

Parin, Collette &amp; Shcherbachev 1980

*Oxyporhamphus convexus bruuni* Parin, Collette & Shcherbachev 1980: 159, Figs. 42–43 (Arabian Sea, 16°49' N, 62°03' E, at surface); Dor 1984; Collette 2004.

Diagnosis as for genus and species. Distinguished from nominal subspecies by greater number of gill rakers: GR on 1st arch 30–36 (usually 31–34). Attains 16 cm SL.

**DISTRIBUTION** Red Sea, Gulf of Aden and northern Arabian Sea in WIO.*Oxyporhamphus convexus convexus*

(Weber &amp; De Beaufort 1922)

PLATE 63

*Oxyporhamphus convexus convexus*: Parin *et al.* 1980\*; Collette & Su 1986; Collette 2004.

Distinguished from nominal species by lower number of gill rakers; GR on 1st arch 6–8/20–25 = 26–32 (rarely 33).

Pelvic fins blackish (except inner ray) and dark distally (even in young); skin folds along sides of lower jaw of juveniles black. Attains 17.5 cm SL.



*Oxyporhamphus convexus convexus*, 6 cm SL, juvenile.  
Source: Parin *et al.* 1980 (by K Hiratsuka Moore)

**DISTRIBUTION** Indo-Pacific. WIO: East Africa and Madagascar; elsewhere to east coast of India, Indonesia, Malaysia and Philippines.**REMARKS** Generally neritic (unlike *O. micropterus micropterus* which is most common in open ocean). Mature by ~14 cm SL.

## *Oxyporhamphus micropterus*

(Valenciennes 1847)

*Exocoetus micropterus* Valenciennes in Cuv. & Val. 1847: 127, Pl. 563  
(King George Sound, Western Australia).

*Hemiramphus cuspidatus* Valenciennes in Cuv. & Val. 1847: 56, Pl. 557  
(Indian Ocean [stomach content]).

Swimbladder one-chambered at all sizes (cf. multi-chambered in adult *O. convexus*). Pelvic fins set farther forward,  $P_2$ -C distance 1–1.2 in  $P_1$ - $P_2$  distance (cf. 1.1–1.4 in *O. convexus*); pelvic fins of juveniles (3–9 cm SL) slightly pigmented (cf. intense pigmentation on pelvic-fin margins of juvenile *O. convexus*).

**REMARKS** Two subspecies recognised, 1 in WIO.

## *Oxyporhamphus micropterus micropterus*

(Valenciennes 1847)

*Evolantia micropterus*: Smith & Smith 1963\*.

*Oxyporhamphus micropterus micropterus*: Parin *et al.* 1980; Collette & Su 1986; Fricke 1999; Collette 2004.

*Oxyporhamphus micropterus*: Randall & Anderson 1993.

Dorsal fin 13–15 rays; anal fin 14–16 (rarely 13) rays. GR on 1st arch 7–9/21–26 = 28–34 (rarely 35); GR on 2nd arch 3–5/16–18 = 20–23; predorsal scales 28–33. Snout length of adults 12–14.5 in SL, 3.1–3.2 in HL (in young 4–6 cm SL: 4.6–5.1 in SL, 1.2–1.3 in HL); skin folds along lower jaw of juveniles not forming enlarged lobes anteriorly. Anal-fin origin under dorsal-fin rays 3–4, length of anal-fin base 1.1–1.3 in dorsal-fin base. Pectoral fins of adults 2.6–3.2 in SL (3.7–4.9 in young 3.5–6 cm SL). Pelvic fins about midway between pectoral-fin origins and caudal-fin base ( $P_1$ - $P_2$ / $P_2$ -C = 1–1.2).

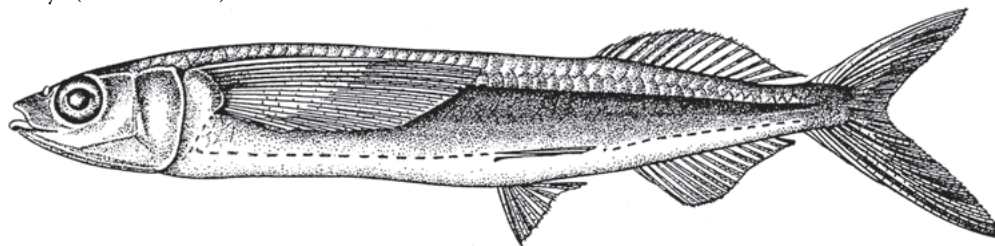
Pelvic fins of adults transparent (except margins sometimes pigmented), and fins of young transparent or with dots of pigment on outer rays (fish <9 cm SL). Attains 18.5 cm SL.

**DISTRIBUTION** Indo-Pacific to central Pacific (widespread). WIO (20° N–20° S): Red Sea, East Africa to South Africa (Transkei region), Madagascar, Seychelles, Mauritius, Maldives, India and Sri Lanka; elsewhere to southern Japan, Mariana Is., northern Australia, Tonga and Hawaii.

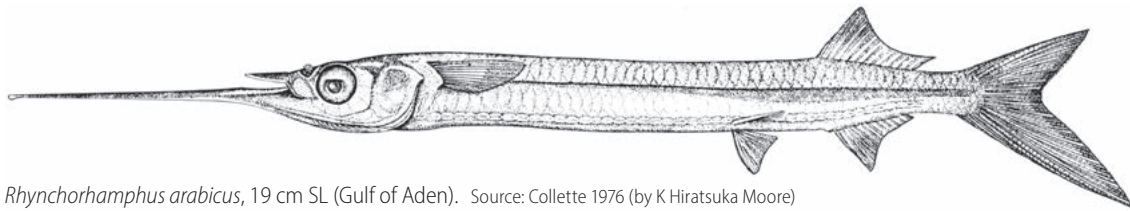
**REMARKS** Oceanic and not associated with coastal waters at any life stage. Comparisons: differs from Atlantic subspecies *O. micropterus similis* Bruun 1935 in slightly fewer gill rakers on 1st arch: mean GR 30.7 (versus GR 32 in *O. m. similis*); fewer predorsal scales: mean ~31 (versus ~30 in *O. m. similis*); and pelvic fins nearer caudal-fin base than edge of opercle (cf. closer to opercle in *O. m. similis*).

## GENUS *Rhynchorhamphus* Fowler 1928

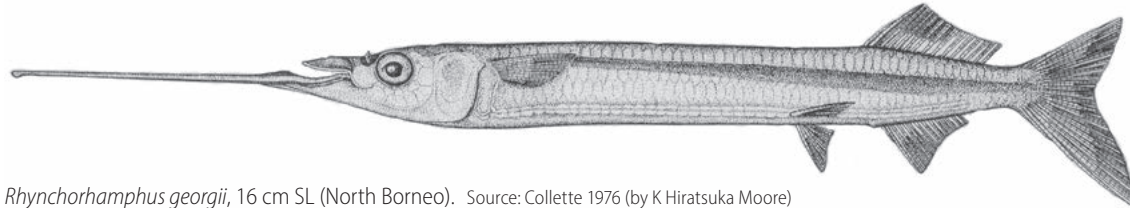
Dorsal fin 13–17 (usually 14–16) rays; anal fin 12–16 (usually 13–15) rays; total dorsal- plus anal-fin rays 25–32 (usually 27–30); pectoral fins 10–12 (usually 11) rays. Upper jaw length subequal to or longer than its width. Preorbital canal a long narrow tube with 1 or 2 central pores in addition to openings at ends of dorsal and ventral arms of canal, without posterior branch. Differs from all other genera in having fimbriate nasal papilla, large domed upper jaw, and high gill-raker count (GR 47–78 on 1st arch; GR 40–68 on 2nd arch). Differs from all other genera except *Hemiramphus* in having 2 ascending branches of lateral line (not 1; no branch in *Dermogenys*); additional branch is anterior and parallel to branch to pectoral-fin base. Differs from *Hemiramphus* in having scales on upper jaw, and swimbladder entire (as in *Hyporhamphus*), not divided into separate chambers. Vertebrae 37–40 + 16–19 = 54–59. Occur in Indo-Pacific; 4 species, 3 in WIO.



*Oxyporhamphus micropterus*, 15 cm SL, adult (Gulf of Mexico). Source: Collette 1999 (by MH Carrington)



*Rhynchorhamphus arabicus*, 19 cm SL (Gulf of Aden). Source: Collette 1976 (by K Hiratsuka Moore)



*Rhynchorhamphus georgii*, 16 cm SL (North Borneo). Source: Collette 1976 (by K Hiratsuka Moore)

## KEY TO SPECIES

- |    |   |                       |
|----|---|-----------------------|
| 1a | GR on 2nd arch 63–68; GR on 1st arch 69–78.....   | <i>R. arabicus</i>    |
| 1b | GR on 2nd arch 45–63; GR on 1st arch 52–71.....   | 2                     |
| 2a | Total dorsal- plus anal-fin rays 25–28 (rarely 29 or 30); width of triangular portion of upper jaw 0.90–1.17 in its length..... | <i>R. malabaricus</i> |
| 2b | Total dorsal- plus anal-fin rays 28–32 (rarely 26 or 27); width of triangular portion of upper jaw 1.04–1.5 in its length.....  | <i>R. georgii</i>     |

*Rhynchorhamphus arabicus*

Parin & Shcherbachev 1972

Arabian halfbeak

*Rhynchorhamphus arabicus* Parin & Shcherbachev 1972: 569 [523], Fig. (southern Yemen); Collette 1976\*; Parin *et al.* 1980\*; Manilo & Bogorodsky 2003.

Dorsal fin 14 or 15 rays; anal fin 12–14 rays; total dorsal- plus anal-fin rays 26–29; predorsal scales 38–41. Upper jaw relatively long, 5.2–5.8% SL. GR on 1st arch 16–19/51–56 = 68–78; GR on 2nd arch 9–11/52–55 = 61–68 (GR count higher than other species in genus, but overlaps with *R. malabaricus*). Vertebrae 37 or 38 + 16–18 = 53–55.

Colour in life unknown. Attains at least 19.7 cm SL.

**DISTRIBUTION** WIO: Gulf of Aden (Yemen and Somalia).

**REMARKS** Similar to *R. malabaricus* in having fewer total dorsal- plus anal-fin rays on average than found in *R. georgii* and *R. naga*. Both *R. arabicus* and *R. malabaricus* average fewer vertebrae (usually 54 or 55) than found in *R. naga* and *R. georgii* (with usually 55–57).

*Rhynchorhamphus georgii* (Valenciennes 1847)

George's halfbeak

PLATE 63

*Hemiramphus georgii* Valenciennes in Cuv. & Val. 1847: 37, Pl. 555 (Mumbai and Coromandel, India).

*Hemiramphus russeli* Valenciennes in Cuv. & Val. 1847: 32 (Puducherry, India).

*Hemiramphus leucopterus* Valenciennes in Cuv. & Val. 1847: 48 (Mumbai, India).

*Hemiramphus plumatus* Blyth 1858: 288 (Sri Lanka).

*Rhynchorhamphus georgii*: Parin & Shcherbachev 1972; Collette 1976\*; Parin *et al.* 1980\*; Collette & Su 1986\*; Randall 1995\*; Manilo & Bogorodsky 2003.

Dorsal fin 13–16 (rarely 17) rays; anal fin 13–16 rays; total dorsal- plus anal-fin rays 27–32; predorsal scales 36–45. GR on 1st arch 10–14/36–44 = 47–67; GR on 2nd arch 6–9/35–47 = 41–63 (GR count on 1st arch is intermediate compared with *R. arabicus* with GR 69–78; less than but overlapping with count in *R. malabaricus* with GR 57–71, mean 64.7; and more than but overlapping with count in *R. naga* with GR 47–59, mean 52.4). Comparisons: sum of dorsal- and anal-fin rays usually  $\geq 29$ , separating it from most *R. arabicus* and *R. malabaricus* with  $\leq 28$ . *Rhynchorhamphus georgii* and *R. naga* average higher vertebral counts (55–57) than both *R. arabicus* and *R. malabaricus* (54 or 55). *Rhynchorhamphus georgii* has more highly domed upper jaw than other species of genus, and both upper jaw and snout are significantly longer: upper jaw 4.6–7.5% SL, mean 6.3% SL (cf. 4–6.9%, mean 5.1–5.7% for other 3 species); upper jaw 21.6–32.3% HL, mean 27.6% HL (cf. 20.3–30.7%, mean 22.4–24.8% for other 3 species); snout length 8.3–10.6 SL%, mean 9.4% SL (cf. 6.5–10.1%, mean 8.5–9.1% for other 3 species); snout length 36.5–44% HL, mean 41.2% HL (cf. 35.1–42.4%, mean 38.1–39.6% for other 3 species). Vertebrae 37–40 + 16–19 = 54–59.

Body silvery grey above lateral line, white below; dorsal fin and caudal fin dark grey. Attains 23 cm SL.



**DISTRIBUTION** Indo-Pacific (widespread). WIO: Persian/Arabian Gulf and Arabian Sea to India and Sri Lanka; elsewhere to Bay of Bengal, Malaysia, China and northern Australia.

**REMARKS** Found in marine coastal waters.

## *Rhynchorhamphus malabaricus* Collette 1976

### Malabar halfbeak

*Rhynchorhamphus malabaricus* Collette 1976: 84, Fig. 8b (Myliddy near Kankasanturai, Sri Lanka); Parin *et al.* 1980\*; Talwar & Kacker 1984\*.

*Hemirhamphus georgii* (*non* Valenciennes 1847): Devanesan 1937; Devanesan & Chidambaram 1953.

*Hyporhamphus georgii* (*non* Valenciennes 1847): Talwar 1964.

Dorsal fin 13–15 rays; anal fin 12–15 rays; total dorsal- plus anal-fin rays 25–30; predorsal scales 35–41. GR on 1st arch 15–20/46–50 = 57–71; GR on 2nd arch 9–11/45–47 = 52–62. Comparisons: distinguished by sum of dorsal- and anal-fin rays usually  $\leq 28$  (25–30), compared with usually  $\geq 29$  (26–32) in *R. georgii*. Upper jaw relatively wide, its length divided by its width 0.9–1.2 (mean 1), similar to *R. arabicus* with 0.9–1 (mean 0.95). Upper jaw relatively short, 2.8–3.7% SL (mean 3.3%), differing from *R. georgii* and *R. naga* (3–7.2% SL, mean 4% and 4.8%, respectively), but proportion broadly overlapping with *R. arabicus* (3.3–3.7% SL, mean 3.5%). Vertebrae 37–39 + 16–18 = 54–56.

Body silvery grey dorsally, white below, with dark stripe along lateral line; caudal-fin margin dark. Attains 25.5 cm SL.

**DISTRIBUTION** Indian Ocean: confined to southern third of Indian subcontinent, from Malabar coast to Coromandel coast, including Gulf of Mannar and Palk Bay, between Sri Lanka and India.

**REMARKS** Males mature by ~14 cm SL, females by ~13.5 cm SL. Adults feed mainly on *Cymodocea* seagrasses and green algae, but switch to pteropods and other pelagic

invertebrates during the spawning season (March–April). Eggs are attached to seaweeds. Very important economically in Palk Bay on southeastern coast of India, where salted roe are considered a delicacy.

### GLOSSARY

**fimbriate** – with a fringed margin.

**kolachi vala nets** – a kind of a drag net.

**nasal fossa** – the cavity or pit, containing nasal papillae, into which the nostrils open.

**neritic** – the shallow pelagic zone over the continental shelf.

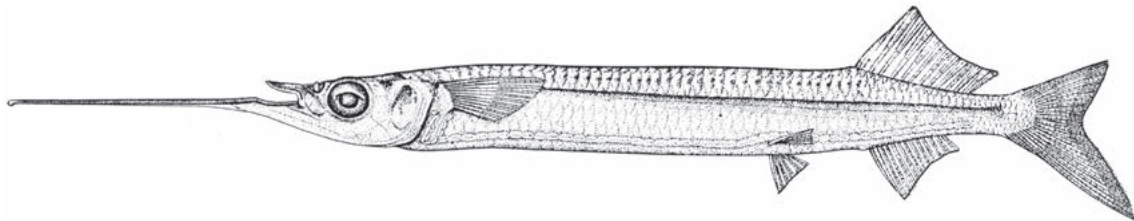
## FAMILY ZENARCHOPTERIDAE

### Internally-fertilising halfbeaks

Bruce B Collette

Body elongate, usually with short triangular upper jaw and prolonged lower jaw; nostrils in small pit anterior to eyes, with elongate nasal papilla extending well beyond nasal fossa. Dorsal and anal fins posterior in position, several anal-fin rays modified in males; pectoral fins usually short; pelvic fins abdominal, with 6 rays; caudal fin truncate or rounded. No fin spines. Lateral line running downwards from pectoral-fin origin and then back along ventral margin of body. Scales moderately large, cycloid, smooth and easily shed. Standard length measured from tip of upper jaw to caudal-fin base.

Marine, estuarine or freshwater; mostly carnivorous, feeding on insects that fall into the water and also crustaceans. Live near the surface where they are prone to leap and skitter, and protectively coloured for this mode of life by being green or blue dorsally and silvery white laterally and ventrally; tip of lower jaw bright red or orange in most species (due to carotenoid pigments, especially zeaxanthin, astaxanthin and beta-doradexanthin). All genera are apparently internally fertilising; three genera restricted to freshwater (outside WIO region) are viviparous (Meisner 2001).



*Rhynchorhamphus malabaricus*, 17 cm SL, holotype (Sri Lanka). Source: Collette 1976 (by K Hiratsuka Moore)

The subfamily Zenarchopterinae was raised to family level based on molecular and morphological evidence (Lovejoy *et al.* 2004; Aschliman *et al.* 2005). Five genera and ~54 species recognised by Collette (2004) but several more have been described since then; 1 genus and 2 species in WIO.

## GENUS *Zenarchopterus* Gill 1864

Nasal pit reduced, and nasal papilla elongate, extending well beyond nasal fossa; caudal fin rounded. Most species are estuarine or freshwater. All species are apparently oviparous but are probably internally fertilising (Meisner & Collette 1999); sperm is packaged in the form of unencapsulated sperm bundles called spermatozeugmata (Grier & Collette 1987). Thirty-five nominal species, of which ~20 appear valid (Collette 2004); 2 species in WIO.

### KEY TO SPECIES

- 1a Adult males with 6th and 7th anal-fin rays greatly elongate, reaching beyond caudal-fin base, and 2 rays of dorsal fin (among 3rd–5th rays) elongate; dorsal fin 11 or 12 rays; vertebrae 42 or 43 ..... *Z. dispar*
- 1b Adult males with 6th anal-fin ray greatly elongate, and 1 or 2 dorsal-fin rays (4th and/or 5th ray) elongate; dorsal fin 10 or 11 rays; vertebrae 38–40 ..... *Z. gilli*

## *Zenarchopterus dispar* (Valenciennes 1847)

Feathered river halfbeak

PLATE 63

*Hemiramphus dispar* Valenciennes in Cuv. & Val. 1847: 58, Pl. 558

(Madagascar; Labouane River, Java, Indonesia; ?Moluccas, Indonesia).

*Zenarchopterus dispar*: Munro 1955\*; Smith & Smith 1963.

Dorsal fin 11 or 12 rays; anal fin 12 or 13 rays; pectoral fins 9 or 10 rays; GR on 1st arch 4 or 5/11–14 = 15–18; GR on 2nd arch 1 or 2/11–14 = 13–15. Upper jaw distinctly wider than long (width divided by length 1–1.2); lower jaw much longer than head (HL divided by lower jaw length 0.5–0.7); pectoral fins shorter than head (HL divided by pectoral-fin length 1.3–1.6). Adult males with 6th and 7th anal-fin rays thickened

and elongate, both rays reaching well beyond caudal-fin base, and 4th and/or 5th dorsal-fin rays elongate and thickened. Predorsal scales 29–36. Vertebrae 28 + 14 or 15 = 42 or 43.

Body silvery, olive-brown dorsally; snout uniformly brown (no dark band on midline); median fins with yellow tinge. Attains 12 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Kenya, Mozambique, Madagascar, Aldabra, Seychelles, India and Sri Lanka; elsewhere to east coast of India, Thailand, Indonesia, Malaysia, Philippines, New Guinea, Australia, Solomon Is., New Caledonia, Fiji, Tonga and Samoa.

**REMARKS** Occurs in mostly brackish or marine coastal waters. Males mature by ~10 cm SL, females by ~8.5 cm SL.

## *Zenarchopterus gilli* Smith 1945

Viviparous halfbeak

PLATE 63

*Hemiramphus brevirostris* Günther (ex Kner) 1866: 274 ('East Indies').

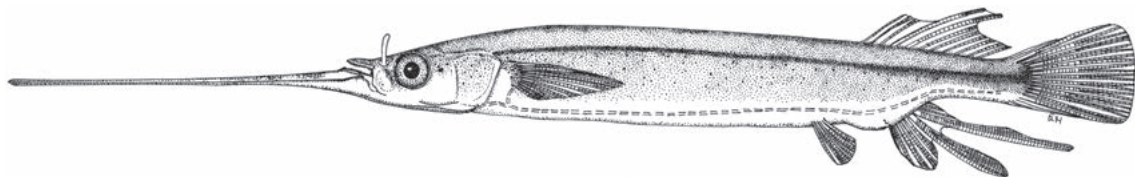
*Zenarchopterus gilli* Smith 1945: 432 ('East Indies') [replacement name for *Hemiramphus brevirostris* Günther 1866, preoccupied]; Talwar & Jhingran 1991.

Dorsal fin 10–12 rays; anal fin 10–13 rays; pectoral fins 9 or 10 rays. Upper jaw about as long as wide; lower jaw much longer than HL; pectoral fins much shorter than HL. Adult males with 4th dorsal-fin ray elongate, thickened distally, and curving back to caudal-fin base, and 6th anal-fin ray greatly elongate, reaching caudal-fin tip. Predorsal scales 26–31. Vertebrae 25–27 + 11–14 = 38–40.

Body silvery, brownish dorsally; snout uniformly brown (no prominent dark line along midline). Attains 20 cm TL.

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Madagascar, Seychelles, and possibly India and Sri Lanka; elsewhere to east coast of India, Andaman Is., Indonesia, Malaysia, Philippines, Caroline Is., Guam, New Guinea, northern Australia and Fiji.

**REMARKS** Occurs in marine and probably brackish waters in a variety of habitats.



*Zenarchopterus dispar*, 11 cm SL (Seychelles). Composite

## FAMILY BELONIDAE

### Needlefishes

Bruce B Collette

Elongate body, with upper and lower jaw extended into long beak, with small sharp teeth. Dorsal and anal fins positioned posteriorly; pelvic fins abdominal, with 6 soft rays; pectoral fins short; no fin spines. Nostrils in pit in front of eyes. Lateral line runs downwards from pectoral-fin origins (except in *Ablennes* and some freshwater genera) and then along ventral margin of body. Scales small, cycloid (smooth), deciduous.

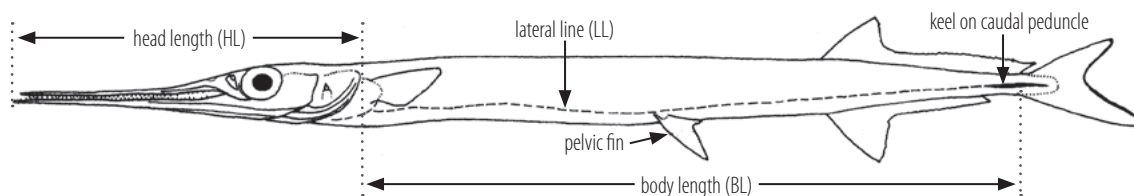
Live at the surface and protectively coloured for this mode of life, with green or blue dorsum, silvery white on lower sides and belly, and usually with a dusky or dark blue stripe along sides; fleshy tip of lower jaw frequently red or orange. Most needlefishes go through a 'halfbeak' stage where the lower jaw elongates before the upper jaw (Boughton *et al.* 1991). Some species may attain 2 m TL. Eggs of most species attach with sticky threads to floating vegetation. Eggs and larvae of Beloniformes were reviewed by Collette *et al.* (1984). Because the beak is often broken, body length (BL) is measured from the opercle margin to caudal-fin base. Carnivorous, feeding largely on small fishes which they catch sideways in their beaks. Tend to leap and skitter at the surface, and some people have been injured when accidentally struck by a large needlefish, particularly at night when the fishes are attracted by lights. Flesh excellent to eat, although some people have misgivings about eating these fishes because of the green colour of the bones. Caught by cast net, trolling at the surface with near-surface lures, and in floating gillnets.

Ten genera and 35 species; most species marine, but 4 genera and 12 species are restricted to freshwater. Five genera and at least 9 species in WIO.

#### KEY TO GENERA

- |    |   |                    |
|----|---|--------------------|
| 1a | Gill rakers present .....   | 2                  |
| 1b | Gill rakers absent .....  | 3                  |
|    |   |                    |
| 2a | Gill rakers 7–14; peduncle strongly depressed, with well-developed lateral keel; dorsal fin 11–16 rays; anal fin 15–20 rays ..... | <i>Platybelone</i> |

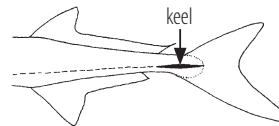
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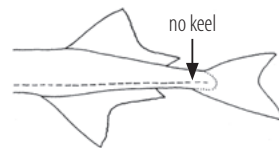
Measurements of a typical belonid.

#### KEY TO GENERA

- |    |   |                     |
|----|---|---------------------|
| 2b | Gill rakers 27–35; peduncle rounded or slightly compressed; dorsal fin 16–20 rays; anal fin 21–23 rays .....  | <i>Petalichthys</i> |
| 3a | Body strongly compressed, with series of 12–14 vertical bars on sides; pectoral fins falcate .....  | <i>Ablennes</i>     |
| 3b | Body rounded in cross-section, no vertical bars on sides; pectoral fins rounded or pointed but not falcate .....  | 4                   |
|    |   |                     |
| 4a | Caudal fin distinctly forked, with lower lobe longer than upper lobe; narrow, raised, dark lateral keel on peduncle; juveniles with expanded black lobe in rear part of dorsal fin .... | <i>Tylosurus</i>    |



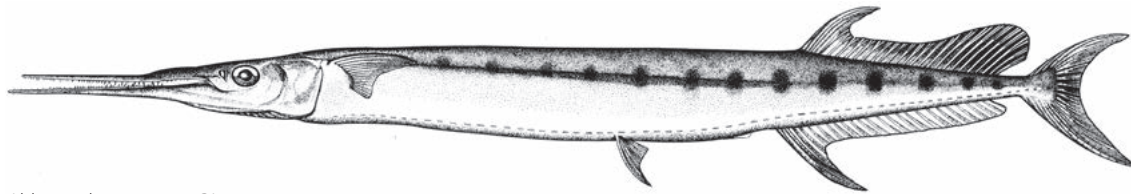
- |    |   |                    |
|----|---|--------------------|
| 4b | Caudal fin rounded or truncate; no keel on peduncle; rear part of dorsal fin without expanded black lobe at all sizes ..... | <i>Strongylura</i> |
|----|---|--------------------|



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## GENUS *Ablennes* Jordan & Fordice 1887

Body greatly compressed; sides with series of prominent vertical bars; pectoral fins falcate; preorbital bone porous. Lacks the branch of lateral line ascending to the pectoral-fin base, as present in other genera. Molecular data (Lovejoy *et al.* 2004) show *Ablennes* to be more closely related to *Tylosurus* than to *Strongylura*. Similar to *Tylosurus* in having many pectoral- and dorsal-fin rays and vertebrae; both genera have a melanistic rear dorsal-fin lobe in juveniles, which is lost in adult *Tylosurus* but retained in adult *Ablennes*. Resembles *Strongylura* in lacking a keel on peduncle, in having more anal- than dorsal-fin rays, and a distinct halfbeak stage in juveniles, but differs in the presence of dark vertical bars on sides and falcate pectoral fins. One species.



*Ablennes hians*, 42 cm BL. Source: Collette & Parin 1970 (by K Hiratsuka Moore)

## *Ablennes hians* (Valenciennes 1846)

Flat needlefish

PLATE 63

*Belone hians* Valenciennes in Cuv. & Val. 1846: 432, Pl. 548 (Bahia, Brazil).  
*Belone melanostigma* Valenciennes (ex Ehrenberg) in Cuv. & Val. 1846: 450  
(Massawa, Eritrea, Red Sea); Klunzinger 1871.

*Ablennes hians*: Munro 1955\*; Parin 1967\*; Collette & Parin 1970\*;  
Kuronuma & Abe 1972\*; Jones & Kumaran 1980\*; Dor 1984; Talwar &  
Kacker 1984\*; SSF No. 113.1\*; Randall & Anderson 1993; Randall 1995\*;  
Winterbottom & Anderson 1997; Collette 1999\*; Fricke 1999;  
Heemstra *et al.* 2004; Heemstra & Heemstra 2004; Fricke *et al.* 2009.

Diagnosis as for genus. Dorsal fin 23–26 rays; anal fin 24–28 rays; pectoral fins 13–15 rays. Body elongate and greatly compressed laterally; anterior part of dorsal and anal fins with high falcate lobe; no keel on peduncle; caudal fin lunate. Right gonad greatly reduced or absent in males, absent in females. Vertebrae 87–93.

Body bluish green dorsally, silvery white below; broad dark blue stripe along sides, and 12–14 prominent, dark, vertical bars on body; tip of lower jaw red; rear part of dorsal fin with elevated black lobe in juveniles and adults. Attains >90 cm BL, 140 cm TL.

**DISTRIBUTION** Circumglobal in tropical and warm-temperate seas. WIO: Oman and Red Sea to Mozambique, South Africa (Algoa Bay), Madagascar, Seychelles, Mascarenes, St Brandon Shoals and Chagos.

**REMARKS** Pelagic, mostly in offshore surface waters; inshore occurrences are more frequent around islands than along mainland coasts, but never in freshwater. Feeds mainly on small fishes. Caught primarily by casting, trolling or with lures near the surface, but also with seines and drift nets; marketed mostly fresh.

## GENUS *Petalichthys* Regan 1904

Gill rakers present, as in *Belone* and *Platybelone*; no teeth on vomer. Molecular evidence (Lovejoy *et al.* 2004) shows this genus to be most closely related to *Belone*. One species.

### *Petalichthys capensis* Regan 1904

Cape needlefish

*Petalichthys capensis* Regan 1904: 129 (Port Elizabeth, Eastern Cape, South Africa); SFSA No. 225\*; Smith & Smith 1966\*; Day *et al.* 1970; SSF No. 113.2\*; Heemstra & Heemstra 2004.

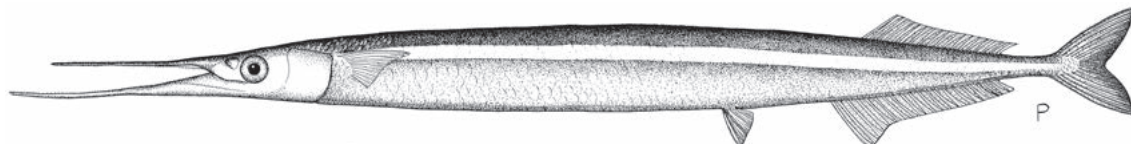
*Belone megalolepis* [*nomen novum*] Mees 1962: 51 (Port Elizabeth, Eastern Cape, South Africa).

Dorsal fin 16–19 rays; anal fin 21–23 rays; pectoral fins 10–12 rays. Body depth 9.1–12.6 in BL; HL 2–2.6 in BL. GR 4 or 5/24–30 = 27–35. Vertebrae 45 or 46 + 26 or 27 = 71–73.

Body bluish dorsally, silvery below. Attains 26 cm BL, 35 cm SL.

**DISTRIBUTION** WIO: endemic to South Africa, from southern KwaZulu-Natal to False Bay.

**REMARKS** Found shoaling offshore.



*Petalichthys capensis*, 28 cm TL (South Africa). Source: SSF



GENUS *Platybelone* Fowler 1919

Differs from all other needlefishes in having a greatly depressed peduncle, with wide, flattened keel; gill rakers present, as in *Belone* and *Petalichthys*. Relatively slender, body depth 20–25 in SL (cf. 12–23 for other WIO species: Randall 1995); lower jaw extension greater than in most other genera (Boughton *et al.* 1991), tip of upper jaw falling short of tip of lower jaw, even in adults; pectoral fins not falcate, with 10–12 (usually 11) rays; caudal fin forked, upper and lower lobes subequal. Body bluish green dorsally, silvery below, with dark blue stripe along sides; fins without pigment. Feeds mainly on small fishes. Caught mainly by casting, surface trolling or with near-surface lures, but also with seines and trammel nets, often using lights. Circumglobal in tropical seas; pelagic, inhabiting offshore surface waters but particularly abundant around islands. A polytypic species with 7 subspecies recognised, found worldwide in tropical and subtropical waters (Parin 1967; Collette & Parin 1970; Collette 2003), 2 subspecies in WIO.

*Platybelone argalus* (Lesueur 1821)

Keeltail needlefish

KEY TO SUBSPECIES

- 1a Anal fin 17–20 (usually 18) rays; dorsal fin 12–15 (usually 13 or 14) rays; vertebrae 69–75 ..... *P. a. platyura*
- 1b Anal fin 15–17 (usually 16) rays; dorsal fin 12–14 (usually 12) rays; vertebrae 62–65 ..... *P. a. platura*

*Platybelone argalus platura* (Rüppell 1837)

PLATE 63

*Belona argalus* Lesueur 1821: 125, Pl. (Guadeloupe I., West Indies).  
*Belone platura* Rüppell 1837: 73, Pl. 20, Fig. 1 (Massawa, Eritrea, Red Sea); Klunzinger 1871.  
*Platybelone argalus platura*: Parin 1967\* [as *argala platura*]; Collette & Parin 1970; Dor 1984; Randall 1995\*.

Dorsal fin 12–14 rays; anal fin 15–17 rays. Predorsal scales 108–116. Vertebrae 62–65.

Attains 26 cm BL, 45 cm TL.

**DISTRIBUTION** WIO: Red Sea and Persian/Arabian Gulf.

*Platybelone argalus platyura* (Bennett 1832)

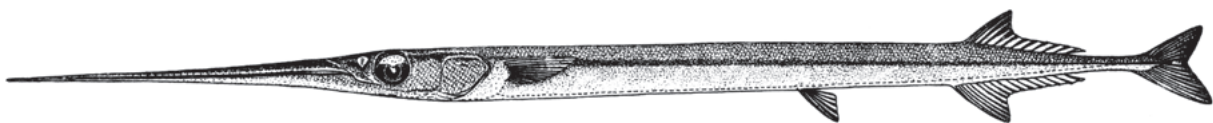
PLATE 63

*Belone platyura* Bennett 1832: 168 (Mauritius, Mascarenes); Jones & Kumaran 1980\*.  
*Platybelone argala platyura*: Parin 1967.  
*Platybelone argalus platyura*: Collette & Parin 1970; Talwar & Kacker 1984\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Winterbottom & Anderson 1997; Collette 1999\*; Fricke 1999; Heemstra *et al.* 2004.

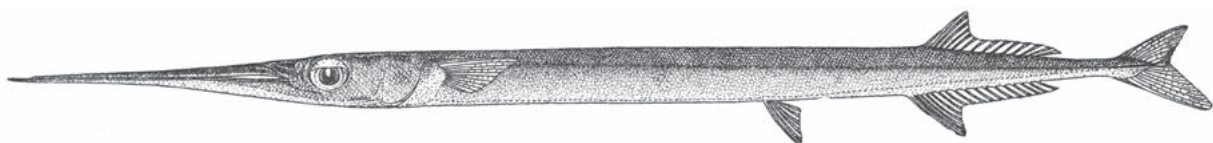
Dorsal fin 12–15 rays; anal fin 17–20 (usually) 18 rays. Predorsal scales 106–129 (mean 114). Vertebrae 69–75 (usually 70 or 71).

Attains at least 26 cm BL, 38 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: East Africa to South Africa (Kosi Bay), Seychelles, Mauritius and Chagos; elsewhere to many island groups in western and central Pacific, including Ogasawara Is. (Japan), Lord Howe I., Kermadec Is., Rapa Iti and Hawaii.



*Platybelone argalus platura*, 26 cm TL. Source: Parin 1967



*Platybelone argalus platyura*, 39 cm TL. Source: Parin 1967

GENUS *Strongylura* Van Hasselt 1824

Body almost cylindrical, slightly compressed or strongly flattened on sides, in cross-section round, ellipsoid or almost rectangular; pectoral fins rounded or pointed but not falcate; caudal peduncle slightly laterally compressed, width less than depth, without lateral keel. Genus probably not monophyletic (Boughton *et al.* 1991; Lovejoy 2000; Lovejoy *et al.* 2004).

Fourteen species, 3 in WIO.

## KEY TO SPECIES

- 1a Dorsal fin 12–15 rays; anal fin 15–18 rays; prominent black spot at caudal-fin base; vertebrae 59–65 ..... *S. strongylura*
- 1b Dorsal fin 17–21 rays; anal fin 21–26 rays; no spot at caudal-fin base; vertebrae 72–83 ..... 2
- 2a Predorsal scales 103–113, crowded together at back of head; no scales at bases of dorsal and anal fins; no diffuse distal dark spot on pectoral fins; vertebrae 72–76 ..... *S. incisa*
- 2b Predorsal scales 121–160, not crowded together at back of head; bases of dorsal and anal fins scaly; diffuse distal dark spot on pectoral fins; vertebrae 80–83 ..... *S. leiura*

*Strongylura incisa* (Valenciennes 1846)

Reef needlefish

PLATE 63

*Belone incisa* Valenciennes in Cuv. & Val. 1846: 451 (Indian Ocean).

*Strongylura incisa*: Parin 1967\*; Jones & Kumaran 1980\*; Collette 1999\*.

Dorsal fin 18–20 rays; anal fin 21–24 rays; pectoral fins 11–13 rays. Head large, HL 2.4–2.5 in SL, strongly flattened from sides, upper surface with deep median groove, and radial striation of skull and upper surface of snout apparent and distinctive. Eye diameter ~10 in HL, 2.2–2.4 in postorbital distance. Dorsal and anal fins rather large, with enlarged anterior lobes; dorsal-fin origin somewhat behind vertical through anal-fin origin (above 4th–6th anal-fin ray). Scaly cover of head strongly developed: scales present on cheek, opercle, in preorbital and suborbital areas, on lower jaw, and in medial depression of upper surface of head; predorsal scales

moderately large, 103–113, crowded just behind head; dorsal- and anal-fin bases not scaly. Vertebrae 72–76.

Body dark grey, with narrow silvery lateral stripe, white ventrally; prominent elongate spot between opercle and preopercle above level of pectoral-fin origin; cheeks with clumped patches of melanophores; fins hyaline with scattered melanophores; pectoral fins with slight yellow tinge. Attains 50 cm BL, 76 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Maldives; elsewhere to Nicobar Is., Indonesia, South China Sea, Japan, Philippines, New Guinea, northern Australia (Great Barrier Reef) and Oceania.

**REMARKS** Coastal, primarily near coral reefs.

*Strongylura leiura* (Bleeker 1850)

Yellowfin needlefish

PLATE 63

*Belone leiurus* Bleeker 1850: 94 (Jakarta, Java, Indonesia).

*Belone tenuirostris* Blyth 1858: 287 (near mouth of Hooghly River, India, Bay of Bengal).

*Belone natalensis* Günther 1866: 243 (KwaZulu-Natal, South Africa).

*Tylosurus leiurus*: Munro 1955\*; Kuronuma & Abe 1972\*.

*Strongylura leiura leiura*: Parin 1967\*; Randall 1995\*.

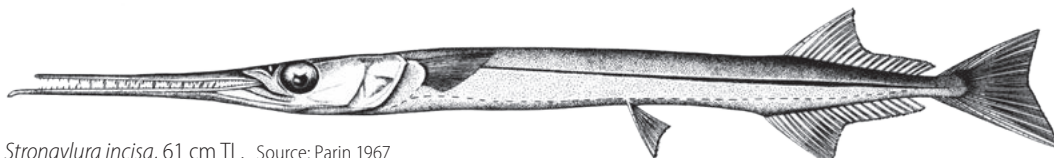
*Strongylura leiura*: Talwar & Kacker 1984; SSF No. 113.3\*; Randall &

Anderson 1993; Collette 1999\*; Fricke 1999; Heemstra & Heemstra 2004;

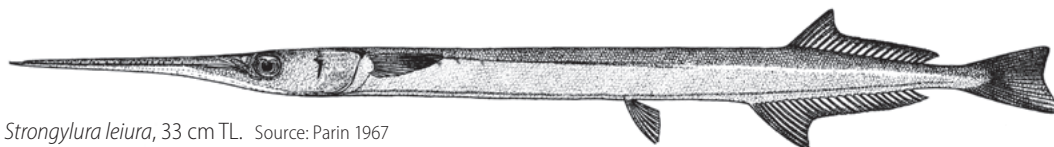
Fricke *et al.* 2009; Fricke *et al.* 2013.

Dorsal fin 17–21 rays; anal fin 22–26 rays; pectoral fins 11 or 12 rays. Anterior parts of dorsal and anal fins form distinct lobes; dorsal-fin origin over 7th–10th anal-fin ray. Predorsal scales small, 121–160; dorsal- and anal-fin bases scaly. Vertebrae 49–52 + 30–32 = 80–83.

Head and body greenish dorsally, white ventrally; silver stripe along sides widening posteriorly; pectoral fins with dark spot distally, fin tips yellow in adults; pelvic fins whitish; tips of dorsal- and anal-fin lobes yellowish, some black pigment along middle of fins; caudal fin dark, with yellowish tinge on upper lobe. Attains 46 cm BL, 73 cm TL (larger specimens from western Pacific may be a separate subspecies).



*Strongylura incisa*, 61 cm TL. Source: Parin 1967



*Strongylura leiura*, 33 cm TL. Source: Parin 1967

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf to southwestern India, and to South Africa (KwaZulu-Natal), Mozambique Channel, Comoros, Seychelles and Mascarenes; elsewhere to east coast of India, Indonesia, Philippines, China, central Japan, New Guinea and Australia.

**REMARKS** Inhabits coastal areas, also entering estuaries. Feeds mainly on small fishes. Caught with driftnets, shore seines and purse seines; marketed fresh.

### *Strongylura strongylura* (Van Hasselt 1823)

Spot-tail needlefish

PLATE 63

*Belone strongylura* Van Hasselt 1823: 130 (Visakhapatnam, India) [based on drawing in Russell 1803: 61, Pl. 176].

*Strongylura caudimaculata* Van Hasselt 1824: 374 (Visakhapatnam, India) [based in part on Russell 1803: 61, Pl. 176].

*Tylosurus strongylurus*: Munro 1955\*.

*Strongylura strongylura*: Parin 1967\*; Jones & Kumaran 1980\*; Talwar & Kacker 1984\*; Randall 1995\*; Collette 1999\*.

Dorsal fin 12–15 rays; anal fin 15–18 rays; pectoral fins 10–12 rays. Anterior parts of dorsal and anal fins form moderate lobes; caudal fin rounded or truncate, not emarginate or forked. Predorsal scales relatively large, 100–130; dorsal- and anal-fin bases scaly. Vertebrae 59–65.

Body greenish dorsally, silvery laterally, white ventrally; pectoral, pelvic and anal fins pale; dorsal and anal fins with some pigment along middle of rays; caudal fin pale, with prominent round black spot near base; dorsal-fin lobe and caudal-fin margin yellow in adults; leading edge of anal fin orange. Attains 26 cm BL, 40 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf to Pakistan, India and Sri Lanka; elsewhere to east coast of India, Philippines, southern China and northern Australia.

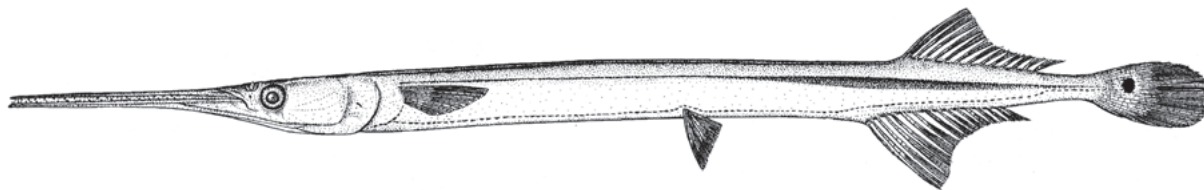
**REMARKS** Inhabits coastal areas and mangrove-lined lagoons, and enters freshwater. Feeds mainly on small fishes, especially clupeoids. Caught by casting or surface trolling, with near-surface lures, and with cast nets and seines, often using lights; marketed fresh.

### GENUS *Tylosurus* Cocco 1833

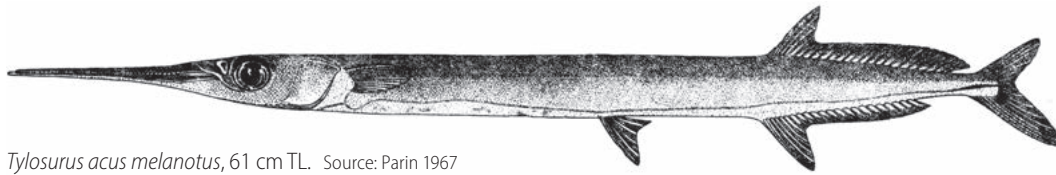
Differs from *Ablennes* and *Strongylura* in having more rays in the dorsal fin than in anal fin (instead of vice versa). Shares several specialisations with *Ablennes*, including a deeply forked caudal fin with lower lobe longer than upper, relatively numerous vertebrae and dorsal- and anal-fin rays, and a melanistic rear lobe in dorsal fin of juveniles (dark lobe lost in adult *Tylosurus*, but retained in adult *Ablennes*). Loss of this lobe is achieved in different ways in species of *Tylosurus*: it is sloughed off in *T. crocodilus* but resorbed in *T. acus*. Five of 6 species have a narrow, black, raised keel on peduncle (keel not well-developed in *T. gavialoides* from Australia). Two polytypic species, *T. acus* and *T. crocodilus*, are almost worldwide in tropical and subtropical waters, plus 3 species in Indo-Pacific; 3 species in WIO.

#### KEY TO SPECIES AND SUBSPECIES

- 1a Dorsal- and anal-fin lobes relatively low compared to body length (lobe heights 10.5–13.3 and 9.7–11.7 in BL, respectively); pectoral and pelvic fins relatively short (fin lengths 8–12.4 and 10–14.1 in BL, respectively); dorsal fin 24–27 (usually 25) rays; anal fin 22–24 (usually 23) rays; left gonad greatly reduced or absent; vertebrae 90–95 ..... *T. a. melanotus*
- 1b Dorsal- and anal-fin lobes relatively high compared to body length (lobe heights 5.4–10.6 and 5.5–8 in BL, respectively); pectoral and pelvic fins relatively long (fin lengths 6.6–8.3 and 7.3–10.6 in BL, respectively); dorsal fin 19–25 (usually 20–22) rays; anal fin 19–22 (usually ≤21) rays; left gonad distinct although shorter than right; vertebrae 75–86 ..... 2
- 2a HL and snout length 2–2.6 and 3–4.3 in BL, respectively; upper and lower jaw teeth directed anteriorly in juveniles; dorsal fin 21–25 (usually 21 or 22) rays; anal fin 18–23 (usually 21) rays; vertebrae 79–86 ..... *T. c. crocodilus*
- 2b HL and snout length 1.6–2 and 2.3–3.1 in BL, respectively; jaw teeth erect at all sizes; dorsal fin 19–21 (usually 20) rays; anal fin 19–22 (usually 19 or 20) rays; vertebrae 75–78 ..... *T. choram*



*Strongylura strongylura*, 60 cm TL. © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission



*Tylosurus acus melanotus*, 61 cm TL. Source: Parin 1967

### *Tylosurus acus* (Lacepède 1803)

The species of *Tylosurus* with the highest numbers of vertebrae, and dorsal- and anal-fin rays. *Tylosurus acus* has a longer, more slender beak, head and body than *T. crocodilus*. Large specimens of *T. acus* are long, graceful fish, whereas large specimens of *T. crocodilus* are stubbier and heavier-bodied. Correlated with a longer body (i.e., more vertebrae), *T. acus* has proportionately smaller body parts: lower dorsal- and anal-fin lobes and shorter pectoral and pelvic fins (*T. crocodilus* has larger body proportions at any given BL because it is a shorter fish, i.e., has fewer vertebrae). Left gonad greatly reduced or absent in both sexes; ratio of left-gonad length to right-gonad length ranges from 2.3–15.5+ (cf. 1.1–1.7 in *T. crocodilus*). A polytypic species, almost worldwide in tropical and subtropical seas within the 23.9 °C isotherm. Pelagic; inhabits offshore waters more often than *T. crocodilus*, but also found in coastal waters.

### *Tylosurus acus melanotus* (Bleeker 1850)

Agujon needlefish

PLATE 64

*Belone melanotus* Bleeker 1850: 94 (Jakarta, Java, Indonesia).

*Belone appendiculatus* Klunzinger 1871: 580 [140] (Al-Qusayr, Egypt, Red Sea).

*Tylosurus acus melanotus*: Parin 1967\*; Collette & Parin 1970; Dor 1984; Talwar & Kacker 1984\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall 1995\*; Winterbottom & Anderson 1997; Collette 1999\*.

*Strongylura melanota*: Jones & Kumaran 1980\*.

*Thalassosteus appendiculatus*: Jones & Kumaran 1980\*.

Dorsal fin 24–27 rays; anal fin 22–24 rays; pectoral fins 13 or 14 rays. Anterior part of dorsal and anal fins with relatively low lobe; pectoral and pelvic fins relatively short. In BL: HL 2.1–2.4, snout length 3–3.7, dorsal-fin lobe 10.5–13.3, anal-fin lobe 9.7–11.7, pectoral-fin length 8–12.4, and pelvic-

fin length 10–14.1. Predorsal scales 270–340. Vertebrae 90–95.

Body dark bluish dorsally, silvery white below; elevated black lobe in posterior part of dorsal fin in juveniles, lost with growth. Attains 60 cm BL, 86 cm SL.

**DISTRIBUTION** Indo-Pacific to offshore islands of eastern Pacific. WIO: Red Sea to Mozambique, South Africa, Comoros and Chagos; elsewhere to central South Pacific, including to Cocos (Keeling) Is., Indonesia, southern Japan, Australia, New Guinea, Tonga and Marquesas Is. to Revillagigedo Is.

**REMARKS** Feeds mainly on small fishes. Caught by casting or surface trolling, and with near-surface lures, seines and gillnets, often with lights; marketed mostly fresh, with the flesh of good quality.

### *Tylosurus choram* (Rüppell 1837)

Red Sea needlefish

PLATE 64

*Belone choram* Rüppell 1837: 72 (Red Sea); Klunzinger 1871.

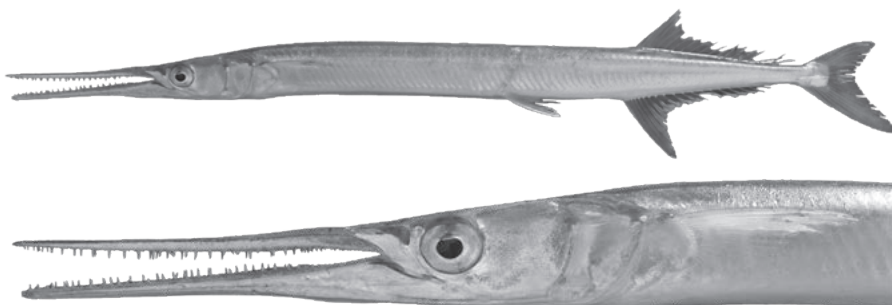
*Belone robusta* Günther 1866: 242 (Egypt, Red Sea); Klunzinger 1871.

*Tylosurus choram*: Parin 1967\*; Collette & Parin 1970\*; Dor 1984; Talwar & Kacker 1984\*; Randall 1995\*.

Dorsal fin 19–24 rays; anal fin 19–22 rays; pectoral fins 13–15 rays. HL 1.6–2 in BL; snout length 2.3–3.1 in BL. Jaw teeth always erect. Predorsal scales 280–310. Vertebrae 75–78.

Body greenish dorsally, silvery on sides and ventrally. Attains 45 cm BL, 69 cm SL.

**DISTRIBUTION** WIO: Red Sea, Oman and Persian/Arabian Gulf; Lessepsian migrant to Mediterranean Sea; possibly elsewhere in Indo-Pacific.



*Tylosurus choram*, 42 cm SL (specimen identified by SV Bogorodsky; Qatar).

© SV Bogorodsky



**REMARKS** Head length and snout length intermediate between *T. crocodilus* and *T. acus*; has more vertebrae than *T. crocodilus* and fewer than *T. acus*.

## *Tylosurus crocodilus crocodilus*

(Péron & Lesueur 1821)

Hound needlefish

PLATE 64

*Belona crocodila* Péron & Lesueur in Lesueur 1821: 129 (Mauritius, Mascarenes).

*Belone koseirensis*: Klunzinger 1871: 579 (Al-Qusayr, Egypt, Red Sea).

*Tylosurus crocodilus*: Munro 1955\*; Talwar & Kacker 1984\*; Heemstra & Heemstra 2004\*.

*Tylosurus crocodilus crocodilus*: Parin 1967\*; Collette & Parin 1970\*; Dor 1984; SSF No. 113.4\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall 1995\*; Winterbottom & Anderson 1997; Collette 1999\*; Fricke 1999.

*Strongylura gigantea*: Jones & Kumaran 1980\*.

Dorsal fin 21–25 (usually 22 or 23) rays; anal fin 18–22 (usually 22 or 23) rays; pectoral fins 13–15 (usually 14 or 15) rays. In BL: HL 2–2.6, snout length 3–4.3, dorsal-fin lobe 5.4–10.6, anal-fin lobe 5.5–8, pectoral-fin length 6.6–8.3, and pelvic-fin length 7.3–10.6. Anterior part of dorsal and anal fins with high lobes; pectoral and pelvic fins relatively long. Predorsal scales 270–340. Both right and left gonads present, right gonad longer than left. Vertebrae 79–86.

Body dark bluish green dorsally, silvery below; dark blue stripe along sides; elevated black lobe in rear part of dorsal fin in juveniles, lost with growth. Attains 83 cm BL, 124 cm SL.

**DISTRIBUTION** Circumglobal in tropical to warm-temperate seas; replaced in the tropical eastern Pacific by *T. crocodilus fodiator*. WIO: Red Sea to South Africa (Knysna), Mozambique Channel, Mascarenes, Chagos and India.

**REMARKS** Pelagic; inhabits coastal waters more often than *T. acus*, but also found offshore. Feeds mainly on small fishes. Large individuals may be dangerous when leaping from the water. Caught by casting or surface trolling, and with near-surface lures, purse seines and drift nets; marketed mostly fresh.

## FAMILY SCOMBERESOCIDAE

### Sauries or skippers

Phillip C Heemstra

Small- to moderate-sized, body elongated, slender and compressed; jaws of adults elongated, forming a beak about twice post-orbital head length. Dorsal and anal fins set on rear half of body, anterior portion of fins with 8–12 joined rays, followed by row of 4–7 isolated finlets; pelvic fins small, set at midbody; pectoral fins shorter than post-orbital head length; caudal fin deeply forked, with short rounded lobes. Body and opercle covered with small scales. Body length (BL) is measured from rear edge of eye to caudal-fin base.

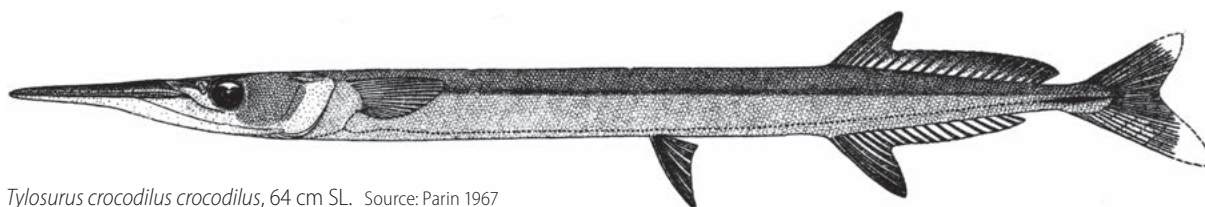
Epipelagic in large schools in open ocean. Feed on small pelagic crustaceans, fish eggs and larvae; preyed upon by a variety of pelagic predators (such as porpoises, tuna, billfish, dorado, swordfish and wahoo). Two genera and 4 species; 1 genus and 2 species in WIO.

## GENUS *Scomberesox* Lacepède 1803

Teeth in upper jaw biserial on beak, uniserial behind; swimbladder present or absent; ovary single or paired. Previously considered monotypic with 2 subspecies. The classification here follows Collette (2004) in considering *Nanichthys* a synonym of *Scomberesox*.

### KEY TO SPECIES

- |    |   |                       |
|----|---|-----------------------|
| 1a | GR 39–51; pectoral fins 12–15 rays; peduncle length and depth subequal .....                | <i>S. scombroides</i> |
| 1b | GR 19–26; pectoral fins 10 or 11 rays; peduncle length more than twice peduncle depth ..... | <i>S. simulans</i>    |



*Tylosurus crocodilus crocodilus*, 64 cm SL. Source: Parin 1967

*Scomberesox scombroides* (Richardson 1843)

Southern saury

PLATE 64

*Sairis scombroides* Richardson 1843: 26 (Dusky Bay, New Zealand)

[based on Solander manuscript and various illustrations].

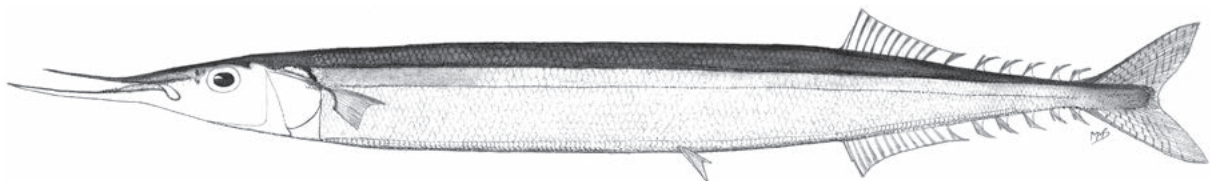
*Scomberesox saurus scombroides*: SSF No. 114.2\*.*Scomberesox saurus*: Gomon *et al.* 1994\*.*Scomberesox scombroides*: Fricke 1999; Collette 2004.

Dorsal fin + finlets 14–18; anal fin + finlets 17–21; pectoral fins 12–15 rays; total GR 39–51; LSS 107–128. Body depth at pelvic-fin origins 13–14% BL; eye diameter 3.7–5.9% BL; upper beak slender and fragile, slightly shorter than lower beak. Teeth in lower jaw well-developed, subequal to post-orbital HL. Lateral line extends over anal finlets. Swimbladder thin and fragile; ovary paired, bilateral lobes.

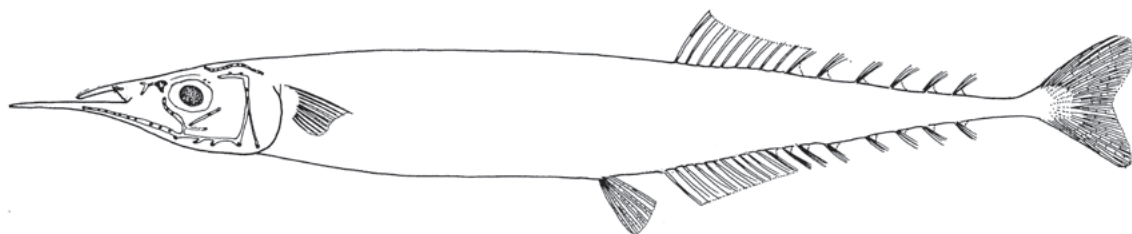
Body dark brown to dark blue dorsally, with broad silvery midlateral band just above lateral line; dark blue or green spot at pectoral-fin base. Attains 30 cm BL, ~50 cm TL.

**DISTRIBUTION** Circumglobal but antitropical in Southern Hemisphere, from Equator to ~45° S, including South Africa (Eastern Cape to west coast) and Mascarenes in WIO.

**REMARKS** In accord with Gill (1999), this Southern Hemisphere taxon is recognised as a valid species. Previously recognised as a subspecies of *Scomberesox saurus* Walbaum 1792 by Hubbs & Wisner (1980).



*Scomberesox scombroides*, 35 cm TL (South Africa). Source: SSF



*Scomberesox simulans*, 9 cm TL, holotype of *Nanichthys simulans* (south central Atlantic). Drawn from Hubbs & Wisner 1980

*Scomberesox simulans* (Hubbs & Wisner 1980)

Dwarf saury

*Scomberesox scutellatum* (*non* Lesueur 1821): Valenciennes 1846.*Nanichthys simulans* Hubbs & Wisner 1980: 531, Fig. 5 (central South Atlantic); SSF No. 114.1\*.*Scomberesox simulans*: Collette 2004.

Dorsal fin + finlets 14–16; anal fin + finlets 17–20; pectoral fins 10 or 11 rays; total GR 19–26; LSS 77–91. Body depth at pelvic-fin origins 10–14% BL; eye diameter 4.1–6.4% BL; upper beak ~½ length of lower beak. Teeth in lower jaw in 1 row at front, in 2 rows behind. Lateral line extends to vertical at pelvic-fin origins. No swimbladder; single, median ovary.

Head and body iridescent blue-green, silvery ventrally. Attains ~8 cm BL, ~13 cm TL.

**DISTRIBUTION** Atlantic (between 40° N and 40° S) and Indian oceans. WIO: Kenya and Mauritius.

**REMARKS** Too small to be of commercial interest.

# ORDER BERYCIFORMES

M Eric Anderson

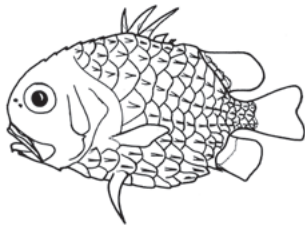
An ill-defined group of primitive acanthopterygians (Rosen 1973; Zehren 1979; Lauder & Liem 1983). The inclusion of certain families in this order is based on the presence or absence of apparently primitive characters, but such criteria are of dubious value in the recognition of natural (monophyletic) taxa.

Body oblong to circular; fin spines usually well-developed (rudimentary or absent in anoplogasterids and in the dorsal and anal fins of diretuids); pelvic fins with strong spine and 6–12 rays (except 3 or 4 rudimentary rays in Monocentridae); caudal fin with true (unpaired) procurrent spines and 18 or 19 principal rays.

Seven families; 5 families occur as coastal fishes in WIO.

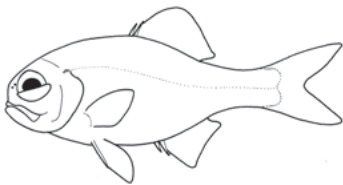
## KEY TO FAMILIES

- 1a Pelvic fins with 1 huge spine (which can be locked erect), 3 or 4 rudimentary rays; scales enlarged, with sharp ridges and spines, forming a bony armour (resembling a pineapple or pineapple) ..... **MONOCENTRIDAE**



- 1b Pelvic fins 1 spine, 6–12 rays; body not encased in bony armour ..... 2

- 2a Prominent light organ immediately below eyes ..... **ANOMALOPIDAE**

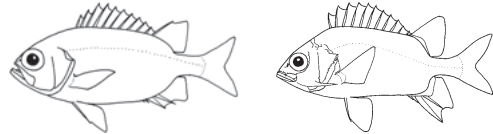


- 2b No light organ below eyes ..... 3

Continued ...

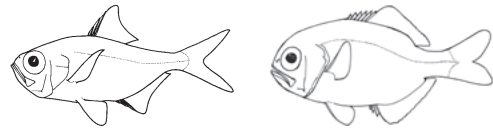
## KEY TO FAMILIES

- 3a Dorsal fin 10–13 spines ..... **Holocentridae**



- 3b Dorsal fin 3–8 spines ..... 4

- 4a Anal fin 4 spines, 12–30 rays; each maxilla with 2 supramaxillae ..... **Berycidae**



- 4b Anal fin 2 or 3 spines, 8–12 rays; each maxilla with 1 supramaxilla ..... **Trachichthyidae**



## FAMILY MONOCENTRIDAE

### Pineapplefishes

Phillip C Heemstra

Moderate-sized with oval but somewhat compressed body, with enlarged, bony, plate-like scales, bearing sharp carinate spines, and fused to form a solid bony armour. Snout short, bluntly rounded; light organ on lower jaw. Two dorsal fins: 1st dorsal fin with 4–7 stout, ridged spines, without interconnecting membranes; 2nd dorsal fin with 11 or 12 soft (segmented) rays, connected by transparent membrane; anal fin similar to 2nd dorsal fin; pelvic fins with 1 large spine, which can be locked erect and fits into groove along sides of belly when depressed, and 3 or 4 tiny rays; caudal fin forked, lobes short, with rounded tips, 17 branched rays.

Found at 3–400 m; solitary and demersal. Two genera and 4 species, 1 in WIO. The monotypic *Cleidopus gloriamaris* De Vis 1882 is endemic to Australia; it has strongly curved jaws, a narrow suborbital space, and the light organ at sides of lower jaw (hidden when mouth is closed).

## GENUS *Monocentris* Bloch & Schneider 1801

Jaws straight; light organ containing luminescent bacteria at front of lower jaw under chin. Three species, 1 in WIO.

### *Monocentris japonica* (Houttuyn 1782)

Pineapplefish

PLATE 65

*Gasterosteus japonicus* Houttuyn 1782: 329, Pl. 2 (Nagasaki, Japan).

*Monocentris japonicas*: SFSA No. 284\*; SSF No. 128.1\*; Kotlyar 1986\*;  
Randall 1995\*; Kotlyar 1996\*; Michel 1996\*.

*Monocentris japonica*: Fricke 1999; Heemstra & Heemstra 2004\*;  
Fricke *et al.* 2009; Jawad *et al.* 2014.

First dorsal fin 5–7 spines; 2nd dorsal fin 11 or 12 rays; anal fin 9–11 rays; pectoral fins 13–15 rays; GR 5–7/11–14. Body depth 1.3–1.9 in SL; head depth 1.8–2.4 in SL. Jaws straight; villiform teeth on jaws and palatines, none on vomer. Head naked; LL scales 12–17. Vertebrae 11 + 15.

Head, body and fins yellow; body scales outlined in black. Attains 17 cm TL.



*Monocentris japonica*, ventral view of lower jaw (Mozambique), with arrows pointing to light organs near symphysis (left); 11 cm SL (below) (Mozambique). © Alvhelm © IMR



**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Red Sea, Oman to South Africa (Mossel Bay), Comoros, Madagascar, Mauritius, Réunion, Saya de Malha Bank, India and Sri Lanka; elsewhere to Indonesia, Philippines, Taiwan, China, Japan, Australia, northern New Zealand and Kermadec Is.

**REMARKS** Nocturnal, found in caves and under ledges, on coral and rocky reefs and also sandy bottoms near wrecks and reefs. Juveniles occur in shallow water and appear to move deeper as they mature. Seen in caves with coelacanth in Comoros, in 200–300 m (Heemstra *et al.* 2006). Occasionally thrown ashore in rough seas. Light organ on lower jaw is used to locate prey (benthic crustaceans).

## FAMILY ANOMALOPIDAE

### Flashlight fishes

John E McCosker

Small-sized with prominent light organ beneath each eye; body deep or somewhat fusiform, laterally compressed. Dorsal fin continuous or divided into separate spinous and soft-rayed portions. Snout blunt; mouth oblique. Teeth small, in bands on jaws and palatines, none on vomer. Gill rakers well-developed. Scales minute, strongly ctenoid.

The light organ with its luminous bacteria can be occluded using rotational or lid-like mechanisms to block the light produced. The fish uses the light to see by, to communicate, to confuse predators, and to attract prey. Adults of most species live in deep water (below ~100 m) during the day, and typically ascend the reef face to feed during moonless nights (biology reviewed by McCosker 1977). Occur in all tropical oceans, but rarely seen because of their nocturnal, secretive behaviour.

Six genera and 9 species, 1 in WIO, although others are likely to be found. *Anomalops katoptron*, for instance, is widely distributed from Indonesia to the central South Pacific. Reviewed by Baldwin *et al.* (1997) and Ho & Johnson (2012).

#### KEY TO GENERA

- 1a Dorsal fin single, continuous; midventral scutes discontinuous; light organ longer than eye diameter, with black eyelid-like flap which can be raised to cover the organ ..... *Photoblepharon*
- 1b Dorsal fin divided into separate spinous and soft-rayed portions; midventral scutes continuous; light organ shorter than eye diameter, without black flap to cover it ..... *Anomalops*



GENUS **Photoblepharon** Weber 1902

Body deep. Dorsal fin single, continuous; anal fin 1 spine; no spine in pelvic fins; midventral scutes discontinuous; LL scales enlarged; GR 25–30 on 1st arch. Light organ large, longer than eye, with black eyelid-like flap which can be raised to cover the organ. Two species, 1 in WIO. *Photoblepharon palpebratum* (Boddaert 1781) (but often misspelt *palpebratus*) is widely distributed from central Indonesia to the central Pacific.

KEY TO SPECIES

- 1a Anteriormost LL pore preceded by large white spot on dorsal corner of opercle; pelvic-fin rays usually 7 ..... *P. palpebratum*  
[eastern Indian Ocean to central Pacific]
- 1b No white spot on opercle; pelvic-fin rays 6 ..... *P. steinitzi*

***Photoblepharon steinitzi*** Abe & Haneda 1973

Flashlight fish

PLATE 65

*Photoblepharon* sp.: Fridman 1972.

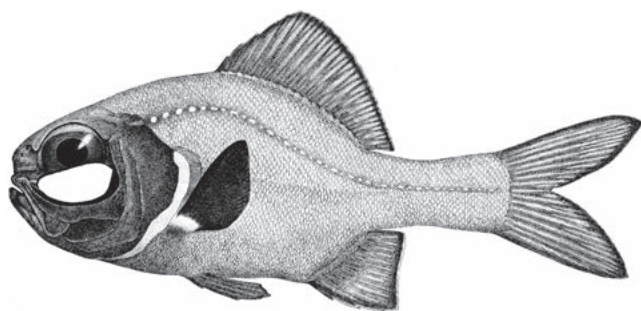
*Photoblepharon palpebratus steinitzi* Abe & Haneda 1973: 57, Figs. 1–4 (Ras Barqqa, Egypt, Red Sea); SSF No. 129.1\*.

*Photoblepharon palpebratus* (non Boddaert 1781): McCosker & Lagios 1975.

*Photoblepharon steinitzi*: McCosker & Rosenblatt 1987.

Dorsal fin 2 or 3 spines, 16–18 rays; anal fin 1 or 2 spines, 13 or 14 rays; pectoral fins 15–17 rays; pelvic fins 1 spine, 5 or 6 rays; GR 7 or 8 + 21 or 22. Body depth 2.3–2.6 in SL; HL 1.9–2.1 in SL; eye diameter 3.4 in HL.

Body and fins dark brown to grey-black. Attains 10 cm TL.



*Photoblepharon steinitzi*, ~10 cm TL; the white area below the eye is luminous (Comoros). Source: SSF

**DISTRIBUTION** WIO: Red Sea (Gulf of Aqaba) and Comoros (Grande Comore I.); probably more widely distributed.

**REMARKS** Occupies crevices and caves of deep reefs diurnally, and transits to shallow water at night to feed, particularly during new moon.

FAMILY **BERYCIDAE**

Alfonsinos

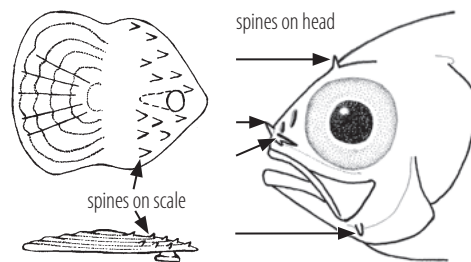
M Eric Anderson

Body oval, compressed; HL ~3 in SL; anterior part of head with 1–4 pairs of spines (*Beryx*) or without spines (*Centroberyx*). Snout short and steep; nostrils usually large. Eyes large, round. Mouth large, oblique; maxilla naked, 2 supramaxillae; jaw teeth small, in bands, and teeth present on vomer and palatines. Dorsal fin triangular, 3–7 spines, 12–20 rays, 1st–3rd rays often elongated; anal fin 3 or 4 spines, 12–30 rays; pectoral fins cuneate, 13–19 rays; pelvic fins 1 spine, 7–13 rays; caudal fin forked, 16 or 17 branched rays. Branchiostegal rays 7 or 8; gill rakers well-developed, 22–34 on 1st arch. Lateral line single, complete; LL pored scales 36–82. Scales large, thin, spinoid; fleshy disc often present on inner surface of scales in *Beryx*. Swimbladder present; pyloric caeca 20–100. Vertebrae 10 + 14 or 15.

Occur on continental shelf near slope break and upper slope, at ~200–600 m, but may shoal upwards to shallower depths, especially at night. Two genera and 8 species; both genera and 5 species in WIO.

KEY TO GENERA

- 1a Dorsal-fin base shorter than anal-fin base; spines cover exposed surface of scales; no midventral scutes on belly between pelvic fins and anus; anterior part of head with 1–4 pairs of spines; dorsal fin 3–5 spines ..... *Beryx*



- 1b Dorsal-fin base longer than anal-fin base; no spines on surface of scales, but rear margin of scales with spinules; row of midventral scutes on belly between pelvic fins and anus; no spines on anterior part of head; dorsal fin 5–7 spines ..... *Centroberyx*

Scale diagrams redrawn from Kotlyar 1993

GENUS *Beryx* Cuvier 1829

Anterior part of head with 1–4 pairs of spines; no spinules on anterior edge of nasal bone; exposed surface of scales covered with spines, and usually a fleshy disc-shaped pad on inner surface of scales; no scutes on ventral midline. Dorsal-fin base shorter than anal-fin base; dorsal fin 3–5 spines, 12–20 rays, some specimens with prolonged ray; anal fin 3 spines, 25–30 rays; pelvic fins 1 spine, 9–13 rays; total LL scales 61–82. Three species, all in WIO. Two species are locally abundant and taken commercially in moderate quantities, reduced to fishmeal and oil or sold fresh, but are more valued as a food fish in Asia.

## KEY TO SPECIES

- 1a Inner surface of scales with ovoid, cartilaginous pad near margin; anal-fin origin in front of vertical at dorsal-fin insertion; pyloric caeca 23–100 ..... 2
- 1b Inner surface of scales without pad near rear margin; dorsal-fin insertion over anal-fin origin; pyloric caeca 12–20 ..... *B. mollis*
- 2a Four pairs of spines on head: above eyes, in front of nostrils, below nostrils at base of lower jaw, and on vertical with spines above eyes; dorsal fin 16–20 rays ..... *B. decadactylus*
- 2b One pair of spines on head in front of eyes; dorsal fin 13–15 rays ..... *B. splendens*

*Beryx decadactylus* Cuvier 1829

Alfonsino

PLATE 65

*Beryx decadactylus* Cuvier in Cuv. & Val. 1829: 151 [no locality given]; Lowe 1843; Günther 1887; Fowler 1911, 1928\*; McCulloch 1914; Maul 1954\*, 1986\*; Krefft 1961\*, 1976; Penrith 1967; Abe & Maruyama 1971\*; Woods & Sonoda 1973\*; Busakhin 1982\*; Masuda *et al.* 1984\*; SSF No. 126.1\*; Winterbottom *et al.* 1989; Mundy 1990; Kotlyar 1996; Fricke 1999; Fricke *et al.* 2009.

*Beryx delphini* Valenciennes in Cuv. & Val. 1833: 454 (SE of Madagascar [stomach content]); Krefft 1961.

*Beryx longipinnis* Barnard 1925: 504 (Sodwana Bay, KwaZulu-Natal, South Africa); Barnard 1927\*; Fowler 1936.

*Actinoberyx longipinnis*: Smith 1949.

Dorsal fin 3–5 spines, 16–20 rays; anal fin 3 or 4 spines, 25–30 rays; pectoral fins 14–18 rays; pelvic fins 1 spine, 9 or 10 rays. GR 5–7/16–19. Percentage SL: body depth 40–50%, HL 30–38%, length of dorsal-fin base 19–24%, length of anal-fin base 35–36%, predorsal length 44–59%, preanal length ~55–60%, and distance from dorsal-fin insertion to caudal-fin base 30–37%. Percentage HL: snout length 23–26%, eye diameter 37–46%. Anal-fin origin at vertical with dorsal-fin rays 8 or 9; pelvic-fin origins beneath pectoral-fin insertions,

pelvic fins may be elongate in young. Lateral line continuous; LL pored scales 56–61, total LL scales 60–73. Scales with irregular vertical rows of spines, forming low parallel ridges; disc-shaped pad present on inner surfaces; scales enlarged on dorsal- and anal-fin bases; fulcral scale present in pelvic-fin axil; scales on cheek in 4 or 5 rows; length of head spines decreases with age. Pyloric caeca 74–100.

Top of head, jaws, iris, back and fins bright red; sides of body and gill cover silvery pink. Attains 60 cm TL.



*Beryx decadactylus*, 37 cm TL (Sapmer Seamount).

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**DISTRIBUTION** Circumglobal in Atlantic and Indo-Pacific, including Mediterranean Sea. WIO: South Africa (Eastern Cape), southern Madagascar, Seychelles, Mascarenes, Chagos and Sapmer Seamount.

**REMARKS** Inhabits coastal waters and open ocean near seamount areas, at ~7–1 000 m.

*Beryx mollis* Abe 1959

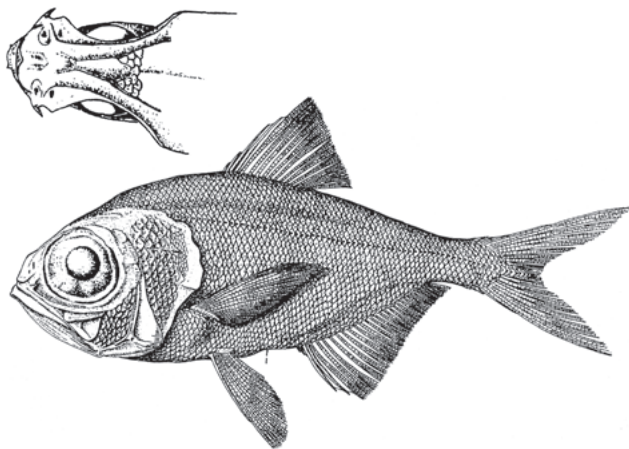
PLATE 65

*Beryx mollis* Abe 1959: 157, Pls. 4–6 (Sagami Bay, Japan); Zama & Yasuda 1979; Busakhin 1982\*; Kotlyar 1993\*, 1996; Yoshino *et al.* 1999; Yoshino & Kotlyar 2001.

Dorsal fin 4 spines, 12–14 rays; anal fin 4 or 5 spines, 24–31 rays; pectoral fins 15–19 rays; pelvic fins 1 spine, 10 or 11 rays. GR 6 or 7/16–20. Percentage SL: body depth 35–45%, HL 31–38%, length of dorsal-fin base 16–22%, length of anal-fin base 28–37%, predorsal length 45–52%, preanal length 56–64%, and distance from dorsal-fin insertion to caudal-fin base ~40–45%. Percentage HL: snout length 16–25%, eye diameter 33–47%. Anal-fin origin below dorsal-fin insertion; pelvic-fin origins slightly in front of vertical at pectoral-fin insertions, pelvic fins of adults about as long as pectoral fins.

Lateral line continuous; total LL scales 64–77. Scales with rows of triangular spines; no disc-shaped pad on inner surfaces; scales enlarged on dorsal- and anal-fin bases; fulcral scale in pelvic-fin axil well-developed; scales on cheek in 6 or 7 rows; 1 pair of spines on head lateral to anterior nostrils. Pyloric caeca 12–20.

Body and fins pinkish red, with silvery tones on sides of body (overall colour paler than other *Beryx* species); caudal-fin lobes darker than body. Attains 41 cm TL.



*Beryx mollis*, 21 cm SL (off Somalia). Source: Kotlyar 1993

**DISTRIBUTION** Indo-Pacific (probably widespread in tropical to temperate waters). WIO: records from Socotra and Error Seamount (off Somalia); elsewhere, Vietnam, South China Sea, Japan and New Caledonia.

**REMARKS** This species was lost in synonymy with *B. splendens* for at least 20 years (Zama & Yasuda 1979; Busakhin 1982), so many museum specimens may be misidentified. Found at ~200–900 m.

### *Beryx splendens* Lowe 1834

Slender alfonsino

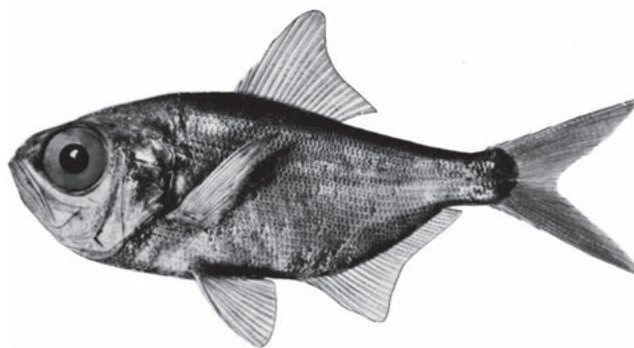
PLATE 65

*Beryx splendens* Lowe 1834: 142 (Madeira) [text only: Fig. is of *B. decadactylus*]; Lowe 1838\*; Günther 1887; McCulloch 1929; Fowler 1936\*; Smith 1949\*; Kreff 1961, 1976\*; Abe 1972; Karrer 1973; Woods & Sonoda 1973\*; Busakhin 1982\*; Masuda *et al.* 1984\*; Maul 1986\*; SSF No. 126.2\*; Kotlyar 1987; Dubochkin & Kotlyar 1989; Ivanin 1989; Winterbottom *et al.* 1989; Mundy 1990\*; Smale *et al.* 1995\*; Adam *et al.* 1998\*; Heemstra & Heemstra 2004.

Dorsal fin 3–5 spines, 12–15 rays; anal fin 4 spines, 25–32 rays; pectoral fins 14–19 rays; pelvic fins 1 spine, 9–13 rays. GR 5–7/16–21. Percentage SL: body depth 29–37%, HL 29–36%, length of dorsal-fin base 15–22%, length of anal-fin base 26–34%, predorsal length 37–46%, preanal length 50–67%, and distance

from dorsal-fin insertion to caudal-fin base 36–44%. Percentage HL: snout length 20–26%, eye diameter 29–40%. Dorsal-fin base shorter than anal-fin base; anal-fin origin below 10th or 11th dorsal-fin ray; pelvic-fin origins slightly in front of vertical through pectoral-fin insertions; pectoral fins longer than pelvic fins in adults. Lateral line continuous; LL pored scales 65–70, total LL scales 69–82. Scales with wedge-shaped rows of triangular ctenii, not forming ridges; disc-shaped pad present on inner surfaces; scales enlarged on dorsal- and anal-fin bases; fulcral scale present in pelvic-fin axil; scales on cheek in 5 or 6 rows; 1 pair of spines on head lateral to anterior nostrils. Pyloric caeca 23–34.

Head, iris, back, fins, mouth and gill chambers bright red, sides of body silvery pink. Attains 70 cm TL.



*Beryx splendens*, 24 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Tropical to subpolar waters of all three major oceans, except eastern Pacific.

**REMARKS** Found at 25–1 240 m.

### GENUS *Centroberyx* Gill 1862

Dorsal-fin base longer than anal-fin base. No ctenii on exposed surface of scales, but minute spinules present on rear margin; total LL scales 36–62. No pairs of spines on head, but anterior edge of nasal bone with spinules. Dorsal fin 5–7 spines; anal fin 12–16 rays; pelvic fins 7 rays. *Trachichthodes* Gilchrist 1903 and *Austroberyx* McCulloch 1911 are synonyms of *Centroberyx*. Five species, 2 in WIO.

#### KEY TO SPECIES

- 1a LL scales 40–47; 15 transverse scale rows between lateral line and anal-fin origin; total GR 30–34 ..... *C. spinosus*
- 1b LL scales 53–62; 17 or 18 transverse scale rows between lateral line and anal-fin origin; total GR 26–29 ..... *C. druzhinini*

*Centroberyx druzhinini* (Busakhin 1981)

PLATE 66

*Trachichthodes druzhinini* Busakhin 1981: 1729, Figs. 1–3 (Saya de Malha Bank).

*Centroberyx druzhinini*: Busakhin 1982\*; Masuda *et al.* 1984\*; Kotlyar 1993, 1996; Masuda & Kobayashi 1994\*; Konishi 1999.

Dorsal fin 5–7 spines, 12–15 rays; anal fin 4 spines, 15–17 rays; pectoral fins 13 rays; pelvic fins 1 spine, 7 rays. GR 5–9/16–23. Percentage SL: body depth 39–42%, HL 31–36%, length of dorsal-fin base 34–35%, length of anal-fin base 28–29%, predorsal length 42–47%, preanal length 58–64%, and caudal-fin base 39–42%. Percentage HL: snout length 23–28%, eye diameter 31–34%. Dorsal-fin origin at vertical through pelvic-fin origins; anal-fin origin at vertical through middle of dorsal fin; pectoral fins longer than pelvic fins. Lateral line continuous, not extending onto caudal-fin rays; LL scales 53–62. Scales with uniformly sized denticles on rear margin (no ctenii on exposed surface); scales on cheek in 5 rows; small fulcral scale present in pelvic-fin axil; no pairs of spines on head, but rough areas around eyes and on cheeks.

Head and body bright red dorsally, rest of body silvery pink; caudal fin red, other fins pink or red. Attains 25 cm TL.



*Centroberyx druzhinini*, 21 cm SL (South Africa). L Scott © ASCLME

**DISTRIBUTION** Indo-Pacific. WIO: South Africa, Madagascar, Saya de Malha Bank and Mauritius; elsewhere, Philippines, South China Sea, southern Japan and New Caledonia.

**REMARKS** Found at ~100–200 m.

*Centroberyx spinosus* (Gilchrist 1903)

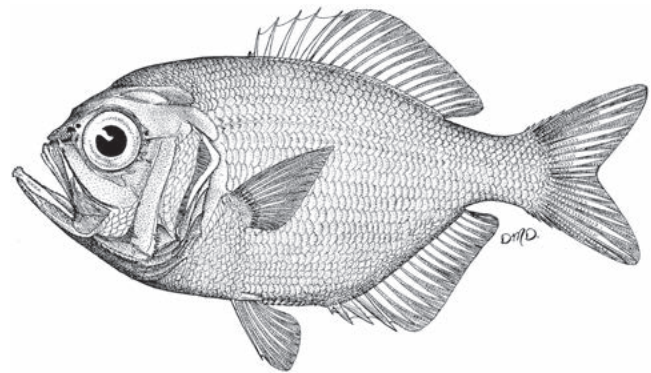
PLATE 66

*Trachichthodes spinosus* Gilchrist 1903: 204, Pl. 13, Fig. 1 (Cape Morgan, Kei River mouth, Eastern Cape, South Africa); Barnard 1925\*; Fowler 1935; Smith 1949\*.

*Centroberyx spinosus*: Busakhin 1982\*; SSF No. 126.3\*; Smale *et al.* 1995; Kotlyar 1996.

Dorsal fin 5 or 6 spines, 14 or 15 rays; anal fin 4 spines, 14–16 rays; pectoral fins 13 rays; pelvic fins 1 spine, 7 rays. GR 10 or 11/20–22. Percentage SL: body depth 47–53%, HL 35–40%, length of dorsal-fin base 38–43%, length of anal-fin base 32–34%, predorsal length 38–44%, preanal length 58–64%, and caudal-fin base 28–33%. Percentage HL: snout length 15–20%, eye diameter 31–47%. Dorsal-fin origin at vertical through pelvic-fin origins; anal-fin origin at vertical through middle of dorsal fin; pectoral fins longer than pelvic fins. Lateral line continuous, not extending onto caudal-fin rays; LL scales 40–47. Scales with spines of varying lengths on rear margin, no ctenii on exposed surface; scales on cheek in 5 rows; fulcral scale in pelvic-fin axil well-developed; no pairs of spines on head.

Top of head, iris, dorsum and caudal fin bright red, rest of body golden; caudal-fin base and margin white (the former area wider in juveniles than adults); dorsal, anal and paired fins unpigmented in young, paired fins become yellow or golden in adults. Attains 25 cm TL.



*Centroberyx spinosus*, 6 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: South Africa (Umdloti, KwaZulu-Natal to Cape Barracouta, Western Cape).

**REMARKS** Found at 24–366 m.

**GLOSSARY**

**dorsal-fin insertion** – the rear end of the fin, at the last ray; the anterior end of the fin is the origin.

**fulcral scale** – spine-like scales on the dorsal margin of the caudal fin.

**pectoral-fin insertion** – lower or rear end of the fin; the upper end of the fin is the origin.

**scutes** – modified (thickened) bony scales with a keel or spiny point.



## FAMILY TRACHICHTHYIDAE

### Slimeheads and roughies

M Eric Anderson

Body oval, compressed; head with large skin-covered sensory canals; 2 supramaxillae; jaw teeth minute, in bands. Dorsal-fin base about twice length of anal-fin base; pelvic fins 1 spine, 6 rays; caudal fin forked, peduncle narrow. Scales spinoid; scales on ventral midline enlarged as scutes; lateral-line scales enlarged, but only slightly so in *Paratrachichthys*. Colour pinkish, orange or reddish dorsally and silvery below, or body entirely black or brown. Size range 13–60 cm TL.

Most family members are bathyal as adults. Eight genera and ~50 species. The key here distinguishes only the 3 genera represented in WIO with species occurring on the outer continental shelf.

#### KEY TO GENERA

- 1a Dorsal fin 7–9 spines; spinous dorsal-fin base equal or subequal to anal-fin base ..... *Gephyroberyx*
- 1b Dorsal fin 5–7 spines; spinous dorsal-fin base shorter than anal-fin base ..... 2
- 2a Anus between pelvic-fin bases; pectoral fins 11–13 rays; row of abdominal scutes from anus to anal-fin origin; lateral-line scales slightly enlarged ..... *Paratrachichthys*
- 2b Anus immediately anterior to anal-fin origin; pectoral fins 14–16 rays; no scutes between anus and anal-fin origin; lateral-line scales greatly enlarged ..... *Hoplostethus*

## GENUS *Gephyroberyx* Boulenger 1902

Scales small, adherent; abdominal scutes well-developed; lateral-line scales with median spine; dorsal fin usually 8 spines. One species.

### *Gephyroberyx darwinii* (Johnson 1866)

Darwin's slimehead

PLATE 66

*Trachichthys darwinii* Johnson 1866: 311, Pl. 32 (Madeira).

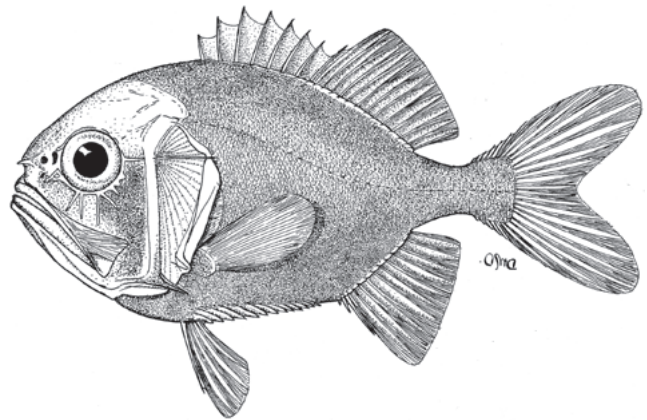
*Gephyroberyx darwinii*: Barnard 1925; Fowler 1936; Smith 1949\*;

SSF No. 127.1\*; Kotlyar 1996\*; Adam *et al.* 1998.

*Gephyroberyx orbicularis* Smith 1947: 796 (off Algoa Bay, Eastern Cape, South Africa).

Dorsal fin 7–9 spines, 12–15 rays; anal fin 3 spines, 10–12 rays; pectoral fins 13–16 rays. Percentage SL: body depth 43–57%, HL 33–42%, eye diameter 6–13%, upper jaw 22–27%, predorsal length 41–49%, and preanal length 67–76%. Head depth subequal to HL. GR 4–7/1/9–14 = 15–23. Scales spinoid, ovoid, those near lateral line with raised central spine; LL scales 26–31, enlarged; abdominal scutes 8–12. Vertebrae 11–13 + 13–15 = 26 or 27.

Body reddish dorsally, bluish silver ventrally; all fins bright red. Attains 50 cm TL.



*Gephyroberyx darwinii*, 12 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Circumglobal in all three major oceans. WIO: Kenya, South Africa (Eastern Cape), Madagascar, Nazareth Bank, Maldives and southwestern India.

**REMARKS** Found at 146–1 210 m.

## GENUS *Hoplostethus* Cuvier 1829

Ventral abdominal scutes well-developed in some species; LL scales roughly triangular, without median spine; anus in front of anal-fin origin; dorsal fin 5–7 spines. Twenty-two species, in all three major oceans; 10 species in WIO on the upper continental slope, only 1 of which sometimes occurs on the outer continental shelf.

### *Hoplostethus mediterraneus* Cuvier 1829

Silver roughy or Mediterranean slimehead

PLATE 66

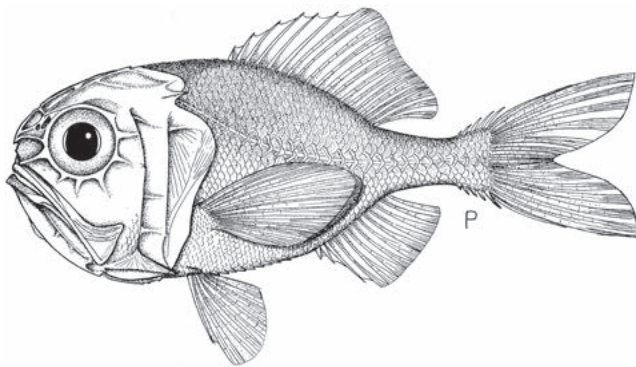
*Hoplostethus mediterraneus* Cuvier in Cuv. & Val. 1829: 469, Pl. 97

(off Nice, France, Mediterranean Sea); Barnard 1925; Smith 1949\*;

Karrer 1973; Kotlyar 1980\*, 1986\*, 1996\*; SSF No. 127.4\*.

Dorsal fin 6 or 7 spines, 12–14 rays; anal fin 3 spines, 9–11 rays; pectoral fins 14–16 rays. Percentage SL: body depth 42–52%, HL 34–43%, eye diameter 11–16%, upper jaw 24–30%, predorsal length 44–52%, and preanal length 58–70%. Head depth subequal to HL; anal-fin base longer than spinous portion of dorsal-fin base. GR 6–8/1/12–17 = 20–25. Scales ctenoid, triangular; LL scales 25–30, enlarged; abdominal scutes 6–8. Vertebrae 10 or 11 + 15 or 16 = 26 or 27.

Body reddish dorsally, silvery blue ventrally; fins translucent reddish to orange. Attains 30 cm TL.



*Hoplostethus mediterraneus*, 8 cm TL, juvenile (South Africa). Source: SSF

**DISTRIBUTION** Atlantic to western Pacific (Australia and New Zealand) and western Mediterranean Sea. WIO: South Africa, Mozambique and Walters Shoals, but probably more widespread.

**REMARKS** Found at 140–1 200 m.

**GENUS** *Paratrachichthys* Waite 1899

Abdominal scutes well-developed; lateral-line scales ovoid, only slightly enlarged; anus between pelvic-fin bases. Ten species, in all three major oceans; 1 species in WIO.

*Paratrachichthys sajademalensis* Kotlyar 1979

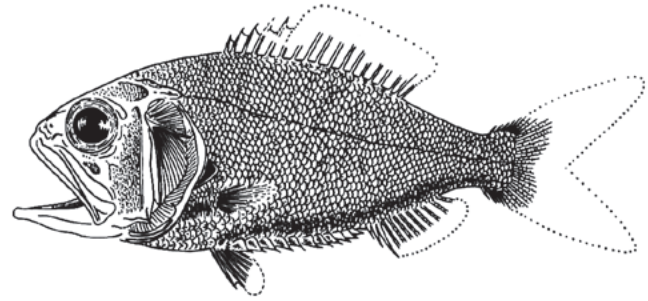
Seamount roughy

*Paratrachichthys (Aulotrachichthys) sajademalensis* Kotlyar 1979: 730 [137], Figs. 1–2 (southeastern Saya de Malha Bank); Yamakawa 1984; Kotlyar 1996; Manilo & Bogorodsky 2003.

Dorsal fin 5 spines, 13 or 14 rays; anal fin 3 spines, 8–10 rays; pectoral fins 11–13 rays; pelvic fins 1 spine, 6 rays. Percentage SL: body depth 33–38%, HL 31–40%, eye diameter 9.5–13%,

upper jaw 22–26%, predorsal length 39–45%, and preanal length 63–73%. Head depth less than HL; anal-fin base longer than spinous portion of dorsal-fin base. GR 5–7/1/11–14 = 18–21. Scales spinoid, with few enlarged spines; LL scales 26–30, slightly enlarged; abdominal scutes 9–11. Vertebrae 13 + 13 or 14 = 26 or 27.

Body dark red dorsally, dark blue ventrally; cheeks and operculum silvery; fins translucent pink. Attains 13 cm TL.



*Paratrachichthys sajademalensis*, 10 cm SL, female holotype (Saya de Malha Bank). Source: Kotlyar 1979

**DISTRIBUTION** Indo-Pacific. WIO: Somalia, Socotra and Mascarene Ridge (Nazareth Bank, Saya de Malha Bank and Réunion); elsewhere, Kyushu-Palau Ridge (Japan).

**REMARKS** Found at 143–360 m.

## FAMILY HOLOCENTRIDAE

### Squirrelfishes and soldierfishes

John E Randall and Phillip C Heemstra

Body oblong to ovate, moderately compressed; head bones exposed, rugose, with distinct grooves and ridges, and some head bones with spines; operculum and suborbitals with series of spinules. Eyes large. Mouth moderate, maxilla reaches past front edge of eyes; 2 supramaxillae; snout with median premaxillary groove when upper jaw is protruded; nasal organ in prominent subtriangular cavity (fossa) in front of eyes; villiform teeth on jaws, vomer and palatines. Dorsal fin divided into spinous and soft-rayed portions, but deeply notched before last spine, with 10–13 spines, 11–18 rays; anal fin with 4 spines, 7–16 rays; pelvic fins with 1 spine, 7 rays; caudal fin forked, with 17 branched rays. Branchiostegal rays 8, membranes attached to anterior end of isthmus. Scales strongly spinoid and firmly attached. Lateral line complete; pored LL scales 32–57. Body, head and fins usually red or partially red. Vertebrae 26–29.

Small- to medium-sized; occur in tropical and subtropical seas, most species in shallow water but a few may be found deeper, to ~640 m. Inhabit coral reefs and rocky bottoms; tend to hide in caves during day, coming out at night to feed on larger zooplankton, small benthic crustaceans and small fishes.

Two distinct subfamilies: Holocentrinae (3 genera) characterised by a long and stout spine (which may be venomous) at corner of preopercle, 7–10 anal-fin rays, and moderately pointed snout; Myripristinae (5 genera) with either no spine or a short broad-based spine at preopercle angle, 10–16 anal-fin rays, some teeth in lower jaw outside the gape, and a blunter snout. There are also differences in structure of the swimbladder and shape of the otoliths. Shimizu & Yamakawa (1979) reviewed the Holocentrinae of Japan, and Randall & Heemstra (1985) reviewed the Holocentrinae of WIO. Greenfield (1974) revised the genus *Myripristis*; Randall & Guézé (1981) supplemented this with a review of Red Sea species, and Randall & Greenfield (1996) revised the genus again. Eight genera and 84 species; 6 genera and 38 species in WIO.

## SUBFAMILY HOLOCENTRINAE

### Squirrelfishes

Preopercle angular, with long spine at angle; premaxilla with long ascending process; hyomandibula double-headed, and narrow mucous canals on dorsal aspect of cranium. Two genera in WIO.

#### KEY TO GENERA

- 1a Last spine of dorsal fin much closer to 1st ray than to penultimate spine; lower jaw projecting; body depth 2.9–3.7 in SL ..... *Neoniphon*
- 1b Last spine of dorsal fin about equidistant from penultimate spine and 1st ray; jaws subequal (rarely with lower jaw slightly protruding); body depth 2.3–3.5 in SL ..... *Sargocentron*

## GENUS *Neoniphon* Castelnau 1875

Dorsal fin with 11 spines, 11–14 rays, and fin notched to its base before last spine; 3rd spine of anal fin enlarged and longer than pelvic- or dorsal-fin spines, and anal-fin rays 7–9; lower

jaw projecting distinctly in front of upper jaw. Most authors previously used *Flammeo* Jordan & Evermann 1898 as the valid name for this genus. However, Randall & Heemstra (1985) showed that it should be replaced by *Neoniphon* Castelnau 1875; the type species, *N. armatus* Castelnau 1875, is a synonym of *N. sammara* (Fabricius 1775). Five species: 1 restricted to Atlantic, 4 in WIO.

#### KEY TO SPECIES

- 1a Scales above lateral line to midbase of spinous dorsal fin 3½; LL scales 42–47; body silvery pink, with longitudinal yellow stripes ..... *N. aurolineatus*
- 1b Scales above lateral line to midbase of spinous dorsal fin 2½; LL scales 36–43; no yellow stripes on body ..... 2
- 2a Pectoral fins 12–14 (usually 13) rays; spinous dorsal fin hyaline, with some dark red streaks distally, but no black markings ..... *N. argenteus*
- 2b Pectoral fins 13–15 (usually 14) rays; spinous dorsal fin with large black markings ..... 3
- 3a Anal fin 7 or 8 rays; spinous dorsal fin with large black spot on first 3 membranes ..... *N. sammara*
- 3b Anal fin 9 rays; broad black median band across entire spinous dorsal fin ..... *N. opercularis*

## *Neoniphon argenteus* (Valenciennes 1831)

Silver squirrelfish

PLATE 68

*Holocentrum argenteum* Valenciennes in Cuv. & Val. 1831: 502 (New Guinea).

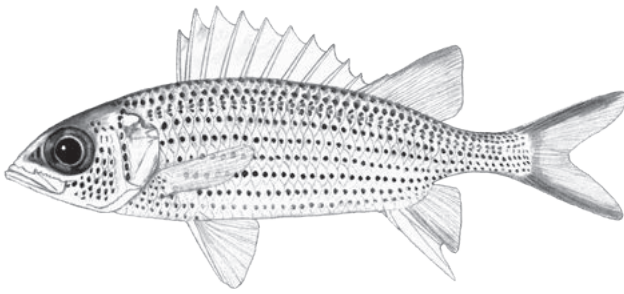
*Holocentrus laeve*: Smith 1955.

*Neoniphon argenteus*: Randall & Heemstra 1985\*; SSF No.132.1\*;

Winterbottom *et al.* 1989; Randall & Anderson 1993; Winterbottom & Anderson 1997; Fricke 1999.

Dorsal fin 11–13 rays; anal fin 7–9 rays; pectoral fins 12–14 rays; GR 5–7/9–12. Body depth 3–3.7 in SL; HL 2.7–3.4 in SL. LL scales 38–43; oblique rows of scales on cheek 4.

Head and body silvery, scales often with blackish spot in centre (except LL scales with black-edged, pale red spot); spinous dorsal fin translucent, margin white, and first 2 membranes with some red submarginally; other fins whitish, except upper and lower margins of caudal fin broadly red, and anterior soft dorsal- and anal-fin rays reddish. Attains 24 cm TL.



*Neoniphon argenteus*, 13 cm SL (Aldabra).

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania, northern Mozambique, Aldabra, Seychelles, Mauritius, Lakshadweep, Chagos and Maldives; elsewhere widespread to Japan, Australia, Marshall Is., Marquesas Is. and Rapa Iti.

**REMARKS** Found in lagoons, at 3–20 m.

### *Neoniphon aurolineatus* (Liénard 1839)

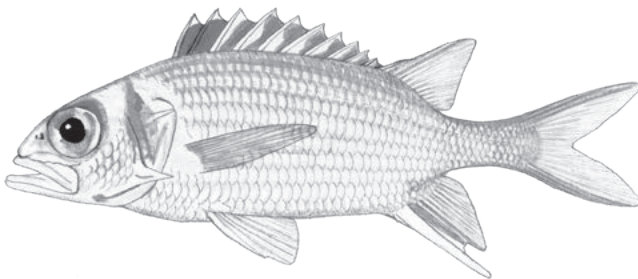
Yellow-striped squirrelfish

PLATE 68

*Holocentrum aurolineatum* Liénard 1839: 32 (Mauritius, Mascarenes).  
*Neoniphon aurolineatus*: Randall & Heemstra 1985\*; SSF No. 132.2\*;  
Randall & Anderson 1993; Fricke *et al.* 2009.

Dorsal fin 12–14 rays; anal fin 8 or 9 rays; pectoral fins 13–15 rays; GR 5–7/11–13. Body depth 3.3–3.9 in SL; HL 2.8–3.1 in SL. LL scales 42–47; oblique rows of scales on cheek 5.

Body silvery pink, with narrow yellow horizontal stripes following scale rows; anterior 2 dorsal-fin spines and membranes mostly red, with white tips, and remaining membranes also red; soft-rayed dorsal, caudal and anal fins with translucent membranes and red rays; upper and lower margins of caudal fin broadly red; paired fins pinkish white. Attains 25 cm TL.



*Neoniphon aurolineatus*, ~14 cm SL (Réunion).

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar, Comoros, Aldabra, Mauritius, Réunion and Maldives; elsewhere to Japan, Australia, Marquesas Is. and Hawaii.

**REMARKS** Widely distributed, but apparently rare; found in or near caves and crevices, from 30–188 m (most specimens in 40–70 m).

### *Neoniphon opercularis* (Valenciennes 1831)

Blackfin squirrelfish

PLATE 69

*Holocentrum operculare* Valenciennes in Cuv. & Val. 1831: 501 (Lambom I., New Ireland, Bismarck Archipelago).

*Holocentrus opercularis*: Smith 1955\*, 1961.

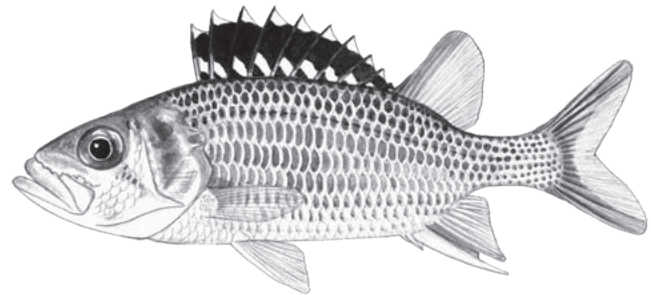
*Neoniphon opercularis*: Randall & Heemstra 1985\*; SSF No. 132.3\*;

Winterbottom *et al.* 1989; Winterbottom & Anderson 1997;

Fricke *et al.* 2009.

Dorsal fin 12–14 rays; anal fin 8 or 9 rays; pectoral fins 14 rays; GR 5–8/11–13. Body depth 2.9–3.3 in SL; HL 2.7–3.1 in SL. LL scales 36–41; oblique rows of scales on cheek 5.

Body iridescent silvery, with dark red or black vertical mark on each scale; spinous dorsal fin reddish black, with triangular white membrane tips and oblique white bands at base of each membrane; soft-rayed dorsal and anal fins with translucent membranes and red rays; pectoral fins pinkish; pelvic fins pinkish white; opercle silvery red with vertically elongate, blackish red area; caudal fin leading edges red, grading to yellow-orange posteriorly. Attains 35 cm TL.



*Neoniphon opercularis*, 24 cm SL (Mauritius).

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique (Bazaruto) to South Africa (Sodwana Bay), Réunion, Mauritius, St Brandon Shoals and Chagos; elsewhere to Japan, Micronesia, New Caledonia and Line Is.; not in Red Sea.

**REMARKS** Much less common than *N. sammara*, though it occurs in same habitat, to ~54 m deep.



**Neoniphon sammara** (Fabricius 1775)

Spotfin squirrelfish

PLATE 69

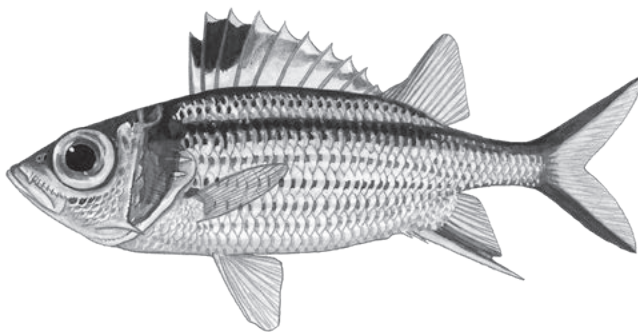
*Sciaena sammara* Fabricius in Niebuhr (ex Forsskål) 1775: 48, xii (Jeddah, Saudi Arabia, Red Sea).

*Holocentrus sammara*: SFSA No. 294\*.

*Neoniphon sammara*: Randall & Heemstra 1985\*; SSF No. 132.4\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall 1995\*, 1998\*; Winterbottom & Anderson 1997; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

Dorsal fin 11–13 rays; anal fin 8 rays; pectoral fins 13–15 rays; GR 6–8/10–13. Body depth 3–3.6 in SL; HL 2.9–3.2 in SL. LL scales 38–43; oblique rows of scales on cheek 4 or 5.

Body pinkish silvery dorsally, silvery below, with dark reddish black spot on each scale and reddish brown stripe along lateral line; spinous dorsal fin brownish, with large reddish black blotch on membranes 3–4, spine tips white and membranes white basally; leading edges of soft-rayed dorsal fin and anal fin reddish; pectoral fins pale pink; pelvic fins white; leading edges of caudal-fin lobes red. Attains 32 cm TL.



*Neoniphon sammara*, 16 cm SL (Comoros). Source: CFSA

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Oman to South Africa (Aliwal Shoal), Comoros, Madagascar, Seychelles, Mascarenes and Chagos; elsewhere to Indonesia, Japan, Australia, Tonga, Pitcairn Is., Line Is. and Hawaii.

**REMARKS** Common shallow-water species but not as secretive as other holocentrids; usually found on patch reefs of branching corals, to ~30 m deep. Feeds at night, mainly on crustaceans. Although Smith (1964: 295) reported two holocentrids (19.5-cm-TL *N. sammara* and 15.2-cm-TL *Sargocentron diadema*) from ~405 m off Durban, South Africa, this depth is far beyond the usual range of these species, thus the specimens may have been mislabelled.

**GENUS** *Sargocentron* Fowler 1904

Dorsal fin 11 spines, 12–16 rays, last spine about equidistant from penultimate spine and 1st ray, and fin deeply notched before soft-rayed part; 3rd spine of anal fin enlarged, longer than pelvic- or dorsal-fin spines, anal-fin rays 8–11; preopercle with large spine at angle. About 33 species, 16 in WIO. Revised by Randall (1998).

**KEY TO SPECIES**

1a Scales above lateral line to base of middle dorsal-fin spines 3½; lower jaw slightly projecting; spinous dorsal fin uniformly dark red, without dark or pale markings, and large, oval, dark red spot on preopercle behind eye ..... *S. spiniferum*

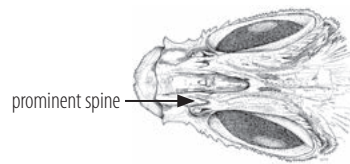
1b Scales above lateral line to base of middle dorsal-fin spines 2½; lower jaw not projecting; colour not as above ..... 2

2a One or 2 prominent retrorse spines between nasal fossa and premaxillary groove; medio-posterior margin of nasal bone (hence, edge of premaxillary groove) with 1 or 2 small retrorse spines; maximum size likely <8 cm SL ..... 3

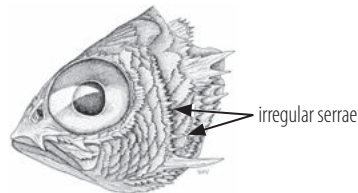
2b No spines between nasal fossa and premaxillary groove, and none on edge of premaxillary groove (except in *S. microstoma*); maximum size >13 cm SL ..... 4

3a Preopercular serrae irregularly sized (especially on lower half of vertical limb), with some spines 3 or 4 times longer than adjacent ones; pectoral-fin rays 14; maxilla reaching vertical at centre of eye, upper jaw length 2.6–2.8 in HL ..... *S. inaequalis*

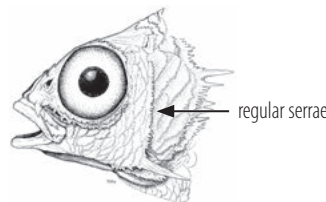
3b Preopercular serrae gradually and uniformly increasing in length ventrally; pectoral-fin rays usually 15; upper jaw not reaching past vertical at front edge of pupil, its length 2.9–3.2 in HL ..... *S. macrosquamis*



prominent spine



irregular serrae



regular serrae

Continued...

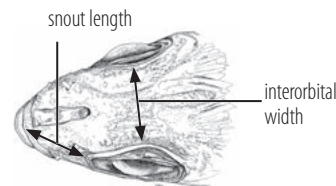
## KEY TO SPECIES

- 4a LL scales 33–39 ..... 5  
 4b LL scales 38–55 ..... 10
- 5a Dorsal fin usually 14 rays; membranes of spinous dorsal fin not incised; head profile nearly straight; opercular membrane with black spot dorsally ..... *S. violaceum*  
 5b Dorsal fin usually 13 rays; membranes of spinous dorsal fin incised; head profile distinctly convex; no black spot on opercular membrane ..... 6
- 6a Snout length 3.4–4 in HL; body depth 2.7–3 in SL ..... 7  
 6b Snout short, 4.2–5.1 in HL; body depth 2.4–2.8 in SL ..... 8
- 7a Third spine of anal fin 1.5–1.8 in HL; HL 2.6–2.9 in SL; LL scales usually 34; upper lip of adults thickened medially and protruding before lower lip of closed mouth ..... *S. melanospilos*  
 7b Third spine of anal fin 1.4–1.6 in HL; HL 2.5–2.8 in SL; LL scales usually 35; upper lip of adults not protruding before lower lip ..... *S. marisrubri*
- 8a No oval blackish spot at base of dorsal-fin rays; no prominent lateral spine at front end of serrated ridge below eyes; LL scales usually 37 ..... *S. seychellense*  
 8b Oval blackish blotch at base of dorsal-fin rays; prominent lateral spine at front end of serrated ridge below eyes; LL scales usually 34 or 35 ..... 9



- 9a Oblique scale rows on cheek 4; LL scales usually 34; interorbital width 3.9–4.4 in HL; upper jaw length 2.4–2.6 in HL; dark pigment on pelvic fins mainly on 1st ray ..... *S. praslin*  
 9b Oblique scale rows on cheek 5; LL scales usually 35; least interorbital width 4.5–5.2 in HL; upper jaw length 2.5–2.75 in HL; dark pigment on pelvic fins confined to tips of outer membranes ..... *S. rubrum*
- 10a Preopercular spine long, 3.5–4.7 in HL; LL scales 38–43 ..... 11  
 10b Preopercular spine short, 4.8–8.2 in HL; LL scales 42–55 ..... 12
- 11a Premaxillary groove not reaching past vertical at front edge of eyes; oblique scale rows on cheek 5; dorsal fin usually 14 rays; edge of nasal fossa with or without spinules; body red, without stripes; prominent silvery white spot on peduncle at dorsal-fin base, or peduncle and entire rear third of body silvery white ..... *S. caudimaculatum*

- 11b Premaxillary groove reaches well past vertical at front edge of eyes; oblique scale rows on cheek 4; dorsal fin usually 13 rays; no spinules at edge of nasal fossa; body with alternate stripes of red and silvery white; no silvery white spot on peduncle ..... *S. tiereoides*
- 12a Preopercular spine of adults subequal to eye diameter; longest dorsal-fin spine 2.6–3.5 in HL; body red with faint silvery stripes, those on lower part showing blue iridescence; maximum size ~27 cm SL ..... *S. tiere*  
 12b Preopercular spine of adults  $\leq \frac{1}{2}$  eye diameter; longest dorsal-fin spine 1.5–2.3 in HL; body distinctly striped with red and silvery white; maximum size <16 cm SL ..... 13
- 13a Third spine of anal fin enlarged, subequal to HL, and reaching past vertical at caudal-fin base when depressed; nasal bone with 1 or 2 spinules at medio-posterior edge; LL scales 48–55; body mostly white, with red longitudinal stripes ..... *S. microstoma*  
 13b Third spine of anal fin distinctly shorter than HL, not reaching vertical at caudal-fin base; no spinules on medio-posterior edge of nasal bone; LL scales 41–49 ..... 14
- 14a Interorbital width greater than snout length; pelvic fins 1.5–1.8 in HL; body usually covered with blackish dots ..... *S. punctatissimum*



- 14b Interorbital width subequal to or shorter than snout length; pelvic fin 1.3–1.5 in HL; body not covered with blackish dots ..... 15
- 15a Pectoral fins usually 14 rays; spinous dorsal fin reddish black (membrane tips white), usually with longitudinal white band along front half of fin; longitudinal stripes on body distinct in preserved specimens ..... *S. diadema*  
 15b Pectoral fins usually 15 rays; spinous dorsal fin red (membrane tips white), with curved white band along middle of fin formed by series of white spots (one per membrane) beginning at base of 1st membrane; longitudinal stripes on body faint in preserved specimens, and usually a dusky blotch on 1st or 2nd membrane of spinous dorsal fin ..... *S. ittodai*

## *Sargocentron caudimaculatum* (Rüppell 1838)

Tailspot squirrelfish

PLATE 70

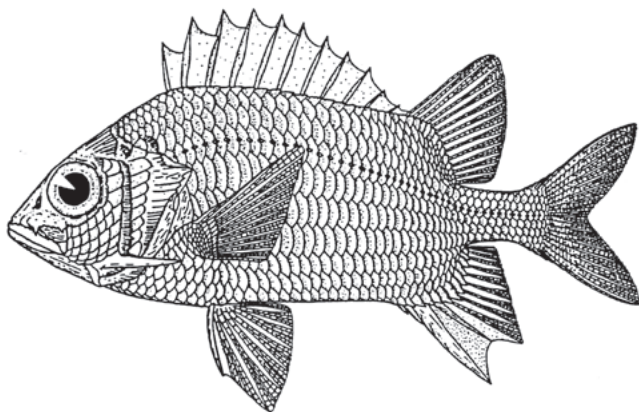
*Holocentrus caudimaculatus* Rüppell 1838: 97, 103 (Red Sea); Smith 1955, 1961.

*Holocentrus andamanensis*: Smith 1951\*, 1953.

*Sargocentron caudimaculatum*: Randall & Heemstra 1985\*; SSF No. 132.5\*; Winterbottom *et al.* 1989; Randall 1995\*, 1998\*; Fricke 1999; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

Dorsal fin 13–15 rays; anal fin 9 rays; pectoral fins 13–15 rays. Body depth 2.5–2.9 in SL; HL 2.4–3.1 in SL; preopercular spine subequal to eye diameter. LL scales 38–43.

Head and body red, scales posteriorly edged in silver; silvery white spot anterodorsally on peduncle (often disappearing after death), and sometimes entire rear half of body silvery white; white line usually present along edge of preopercle and rear and upper edges of opercle; spinous dorsal fin mottled red and whitish, triangular membrane tips orange-red. Attains 25 cm TL.



*Sargocentron caudimaculatum*, 16 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Oman to South Africa (relatively common at Sodwana Bay; to East London), Madagascar, Mascarenes, St Brandon Shoals and Chagos; elsewhere to Japan, Australia, Pitcairn Is., Marquesas Is. and Hawaii.

**REMARKS** One of the most common squirrelfishes on reefs; found at 2–30 m.

## *Sargocentron diadema* (Lacepède 1801)

Crown squirrelfish

PLATE 70

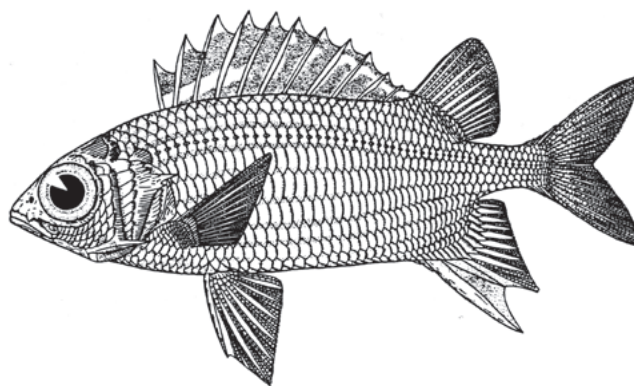
*Holocentrus diadema* Lacepède (ex Commerson) 1801: Pl. 32,

Fig. 3 [no locality given]; Lacepède 1802; SFSA No. 296\*.

*Sargocentron diadema*: Jones & Kumaran 1980; Randall & Heemstra 1985\*; SSF No. 132.6\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall 1995\*, 1998\*; Winterbottom & Anderson 1997; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

Dorsal fin 12–14 rays; anal fin 8–10 rays; pectoral fins 13–15 rays; GR 5–7/12–14. Body depth 2.7–3.2 in SL; HL 2.9–3.5 in SL. Nasal fossa small, without spinules. LL scales 46–50; oblique rows of scales on cheek 5 or 6.

Body with alternating stripes of red and silvery white, red stripes much broader than white; peduncle whitish; spinous dorsal fin deep red to reddish black, membrane tips white, usually with curving longitudinal white band along lower third of fin, beginning at base of 1st membrane and band often higher in rear half of fin. Attains 17 cm TL.



*Sargocentron diadema*, 11 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Oman to South Africa (Algoa Bay), Madagascar, Comoros, Seychelles, Mascarenes, Chagos, Maldives, Lakshadweep and Sri Lanka; elsewhere to Indonesia, Japan, Australia, Pitcairn Is. and Hawaii.

**REMARKS** Wide-ranging and abundant on coral reefs, usually in 2–42 m (see also Remarks for *N. sammara*).

## *Sargocentron inaequalis* Randall & Heemstra 1985

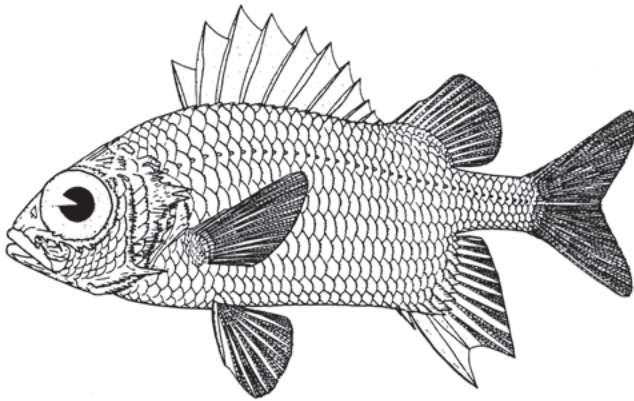
Lattice squirrelfish

PLATE 70

*Sargocentron inaequalis* Randall & Heemstra 1985: 8, Pl. 1g, Figs. 6–7 (Salomon Is., Chagos Archipelago); SSF No. 132.7\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Winterbottom & Anderson 1997; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 13 rays; anal fin 9 rays; pectoral fins 13 or 14 rays; GR 6 or 7/11–13. Body depth 2.5–2.7 in SL; HL 2.5–2.6 in SL. LL scales 38–41; scales from lateral line to midbase of spinous dorsal fin 2½; oblique rows of scales on cheek 4–6.

Head, body and fins red; lateral and ventral body scales mostly white with red margins, forming narrow longitudinal red lines joined by curved lines of rear edges of scales; no black or white markings on fins. Attains 11 cm SL.



*Sargocentron inaequalis*, 8 cm SL, paratype (Seychelles). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Seychelles, Réunion, Chagos and India; elsewhere, Line Is. (probably more widespread).

**REMARKS** One of the smaller species in the genus.

### *Sargocentron ittodai* (Jordan & Fowler 1902)

Samurai squirrelfish

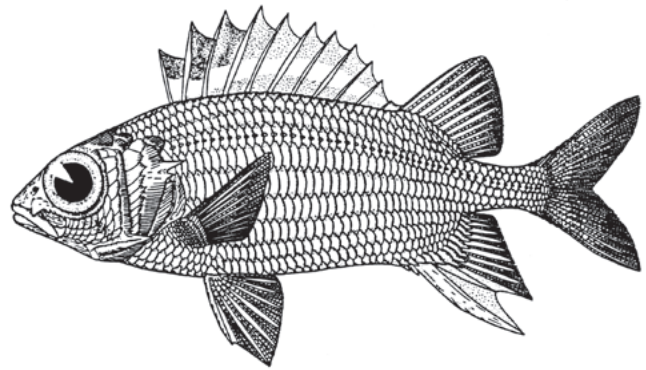
PLATE 70

*Holocentrus ittodai* Jordan & Fowler 1902: 16, Fig. 4 (Naha, Okinawa, Japan).

*Sargocentron ittodai*: Randall & Heemstra 1985\*; SSF No. 132.8\*; Randall 1998\*; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 13 or 14 rays; anal fin 8–10 rays; pectoral fins 14–16 rays; caudal-fin lobes rounded; GR 5–7/12–14. Body depth 2.8–3.1 in SL; HL 2.8–3.1 in SL. LL scales 43–47; oblique rows of scales on cheek 4 or 5.

Body with red and white stripes following scale rows, red stripes slightly narrower than white ones; spinous dorsal fin red, with white tips and curved band of white spots along middle; inner surface of pectoral-fin base with black spot. Attains 20 cm TL (~17 cm TL in WIO).



*Sargocentron ittodai*, 13 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, South Africa (KwaZulu-Natal), Comoros, Seychelles, Réunion and Mauritius; elsewhere to Christmas I., Japan, Caroline Is., Australia, Line Is. and Marquesas Is.; not known from continental Asia and Indo-Malayan Archipelago except for northern Luzon, Philippines.

**REMARKS** Found on coral reefs, in 2–70 m; rare in WIO.

### *Sargocentron macrosquamis* Golani 1984

Dwarf squirrelfish

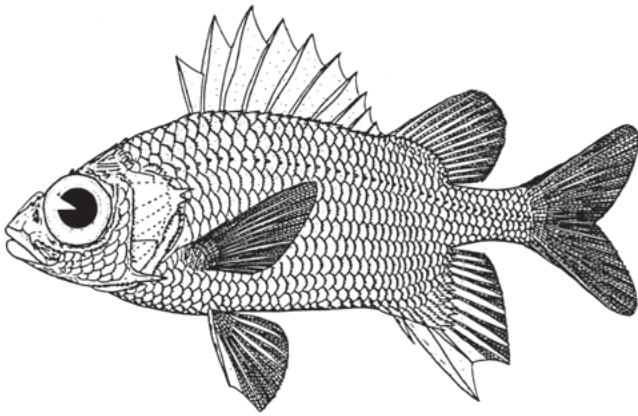
PLATE 70

*Sargocentron macrosquamis* Golani 1984: 40, Figs. 1–2 (D'Arros I., Amirantes Is., Seychelles); Randall & Heemstra 1985\*; SSF No. 132.9\*; Winterbottom *et al.* 1989; Randall & Anderson 1993\*; Winterbottom & Anderson 1997; Randall 1998\*.

Dorsal fin 13 or 14 rays; anal fin 8–10 rays; pectoral fins 14–16 rays; GR 5–7/10–13. Body depth 2.3–2.5 in SL; HL 2.5–2.7 in SL. One or 2 retrorse spines between nasal fossa and edge of premaxillary groove; 1 or 2 minute spines on edge of premaxillary groove. LL scales 40–45; cheek scales not in distinct oblique rows; scales on opercle much larger than those on preopercle.

Body red, with narrow silvery bar on each scale, shading to lavender-white ventrally on head and abdomen; dorsal fin red, with whitish streak behind and adjacent to each dorsal spine; other fins with red rays and translucent membranes. Attains 9 cm TL.





*Sargocentron macrosquamis*, 5 cm SL (Maldives). Source: Randall 1998

**DISTRIBUTION** WIO: Red Sea (Gulf of Aqaba and Sinai Peninsula), Kenya, Tanzania (Zanzibar), Mozambique, Comoros, Seychelles, Mauritius, Chagos and Maldives.

**REMARKS** Found in 4–22 m.

### *Sargocentron marisrubri*

Randall, Golani & Diamant 1989

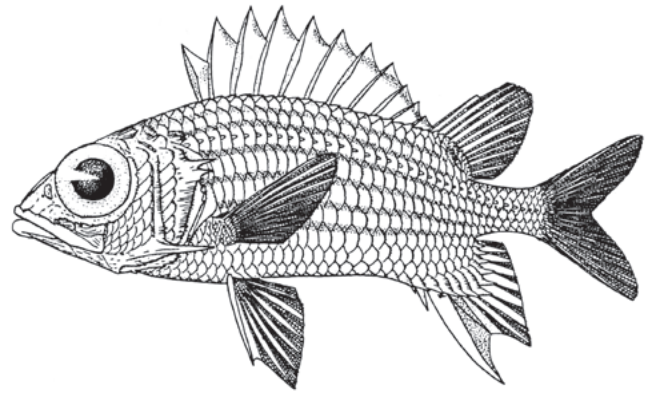
Red Sea squirrelfish

PLATE 70

*Sargocentron marisrubri* Randall, Golani & Diamant 1989: 189, Figs. 1–4 (fringing reef, north of Port Sudan Harbour, Sudan, Red Sea); Randall 1998; Khalaf & Zajonz 2007.

Dorsal fin 13 rays; anal fin 8 or 9 rays; pectoral fins 14 rays; GR 6 or 7/10 or 11. Body depth 2.7–2.9 in SL; HL 2.5–2.8 in SL; snout length 3.4–4 in HL; upper jaw length 2.2–2.3 in HL; upper lip of adults not thickened and not projecting above lower lip. Preopercular spine 3.6–5 in HL; edge of nasal fossa with 0–2 spinules; 3rd spine of anal fin 1.4–1.6 in HL. LL scales 35 or 36 (usually 35); scales above lateral line 2; oblique rows of scales on cheek 5.

Body colour variable: pale red with silvery iridescence dorsally, shading to silvery white ventrally, and with faint pale red stripes following scale rows, or else golden with scale centres pale yellow; head red dorsally, silvery pink over opercle and ventrally; large oval black spot at base of soft-rayed dorsal fin, smaller spot usually present at midbase of caudal fin and on base of soft-rayed portion of anal fin; pectoral-fin axils black; spinous dorsal fin with red spines, and membranes either translucent whitish or with white spot in middle of each membrane; soft rays of other median fins pale yellow, except for red upper and lower margins of caudal fin. Attains 22 cm TL.



*Sargocentron marisrubri*, 12 cm SL, holotype (Red Sea). Source: Randall 1998

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Found in 39–350 m.

### *Sargocentron melanospilos* (Bleeker 1858)

Blackspot squirrelfish

PLATE 71

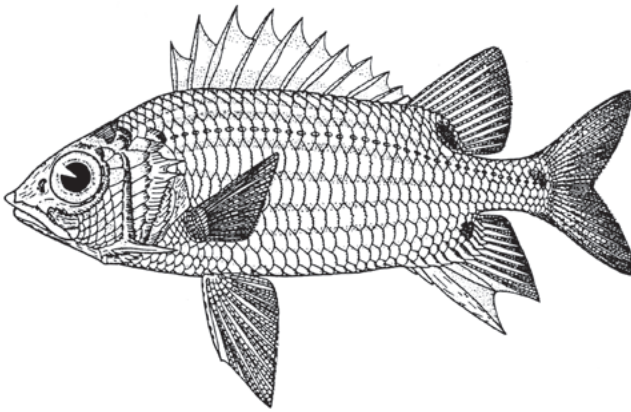
*Holocentrum melanospilos* Bleeker 1858: 2 (Ambon I., Moluccas, Indonesia).

*Holocentrus cornutus* (non Bleeker 1854): Smith 1955; Smith & Smith 1963\*.

*Sargocentron melanospilos*: Randall & Heemstra 1985\*, 1986\*; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 12–14 rays; anal fin 9 or 10 rays; pectoral fins 14 rays; GR 6–8/10–12. Body depth 2.7–3 in SL; HL 2.6–2.9 in SL; snout length 3.6–4.4 in HL; upper jaw length 2.3–2.4 in HL, median part of upper lip of adults thickened and projecting over lower lip. Preopercular spine 3.5–3.7 in HL; edge of nasal fossa with 1–4 spinules; 3rd spine of anal fin 1.5–1.8 in HL. LL scales 33–36; scales above lateral line 2½; oblique rows of scales on cheek 5.

Body red to pink, with silvery white to brassy stripes from scale centres; head red with silvery white streak above maxilla, extending obliquely onto cheek, and 3 silvery white vertical streaks on opercle; large oval blackish spot at base of soft dorsal-fin rays, and smaller, fainter spot at base of anal-fin rays and also on midbase of caudal fin; black spot in pectoral-fin axil; spinous dorsal fin red, with white tips and row of whitish blotches through middle of membranes. Attains 25 cm TL.



*Sargocentron melanospilos*, 18 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania (Zanzibar), Comoros, Seychelles, Aldabra, Maldives and Réunion; elsewhere to Indonesia, Japan, Marshall Is., Australia, New Caledonia and Samoa.

**REMARKS** Found in 5–90 m.

### *Sargocentron microstoma* (Günther 1859)

Slender squirrelfish

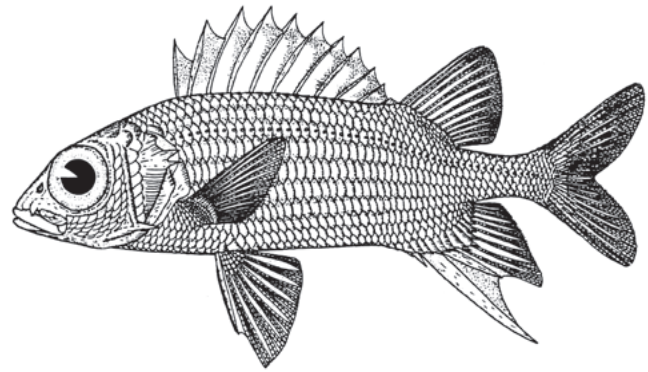
PLATE 71

*Holocentrum microstoma* Günther 1859: 34 (Ambon I., Moluccas, Indonesia); Günther 1875\*.

*Sargocentron microstoma*: Shimizu & Yamakawa 1979; Randall & Heemstra 1985\*; SSF No. 132.11; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall 1998\*.

Dorsal fin 12–14 rays; anal fin 9 or 10 rays; pectoral fins 14 or 15 rays; GR 6–8/13–15. Body depth 3–3.5 in SL; HL 2.8–3.4 in SL; preopercular spine  $< \frac{1}{2}$  eye diameter; 3rd spine of anal fin extremely long, 1–1.2 in HL. LL scales 48–55; oblique rows of scales on cheek 5.

Body red, with silvery white stripes of variable width, paired with red stripes and converging on peduncle; head red dorsally, silvery white ventrally; faint red band from eye to angle of preopercle; spinous dorsal fin with red spines, translucent whitish membranes with broad irregular submarginal red zone, and white tips (progressively less so posteriorly); other fins with translucent membranes and pale red rays, except long 2nd spine of anal fin white, followed by broad zone of red; upper and lower margins of caudal fin red. Preserved specimens usually with dark blotch on first 2 membranes of spinous dorsal fin. Attains 16 cm SL.



*Sargocentron microstoma*, 12 cm SL (Society Is.). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Seychelles (Astove I.), Chagos and Maldives; elsewhere to Indonesia, Philippines, Japan, Micronesia, Australia, French Polynesia and Hawaii.

**REMARKS** Apparently rare in WIO; most specimens collected from 1–35 m.

### *Sargocentron praslin* (Lacepède 1802)

Dark-striped squirrelfish

PLATE 71

*Perca praslin* Lacepède (ex Commerson) 1802: 397, 419 (Port Praslin, New Britain [New Georgia, Solomon Sea]).

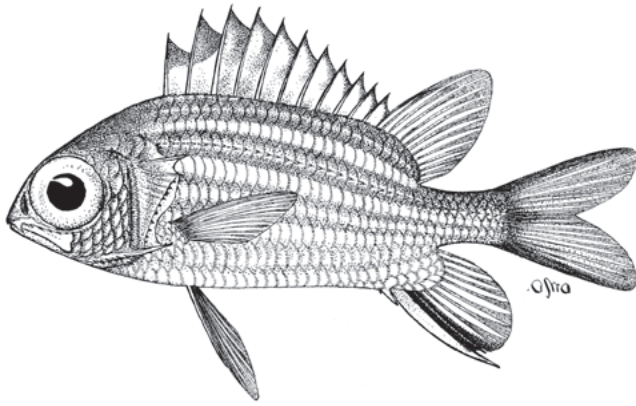
*Holocentrus rubrum* (*non* Forsskål 1775): SFSA No. 295\*.

*Holocentrus ruber* (*non* Forsskål 1775): Smith & Smith 1963\*.

*Sargocentron praslin*: Randall & Heemstra 1985\*; SSF No. 132.12\*; Randall 1998\*; Fricke 1999; Manilo & Bogorodsky 2003.

Dorsal fin 12 or 13 rays; anal fin 8 or 9 rays; pectoral fins 13–15 rays; GR 6–8/10–12. Body depth 2.5–2.8 in SL; HL 2.6–3 in SL. Upper edge of preorbital bone with prominent, laterally projecting spine below front edge of eye, followed by row of much smaller retrorse spinules. LL scales 33–36; oblique rows of scales on cheek 4.

Body silvery white, with ~3 dark brown stripes dorsally, brassy brown stripes ventrally: uppermost stripe expanding to elongate spot at base of soft-rayed dorsal fin, and second stripe expanding onto dorsal surface peduncle; head reddish brown, with silvery white bar along rear margin of preopercle, and oblique silvery white band below eye extending to lower corner of preopercle; spinous dorsal fin dusky white, with broad irregular submarginal reddish black band, and tips white; soft-rayed portion of dorsal and anal fins pale yellowish with reddish rays; membrane of spinous portion of anal fin dark reddish black; leading edges of caudal fin narrowly brown. Attains 25 cm SL.



*Sargocentron praslin*, 13 cm TL. Source: SFSA

**DISTRIBUTION** Indo-Pacific. WIO: Kenya, Mozambique (Ibo), Madagascar, Aldabra and Mauritius, and possibly South Africa; elsewhere, Nicobar Is., Christmas I., Japan, Marshall Is., Australia, Solomon Is., Samoa and Society Is.

**REMARKS** Typically found in exposed clear-water areas, even large tidepools, to ~20 m deep.

### *Sargocentron punctatissimum* (Cuvier 1829)

Speckled squirrelfish

PLATE 71

*Holocentrum lacteoguttatum* Cuvier in Cuv. & Val. 1829: 214 (Indian Ocean).

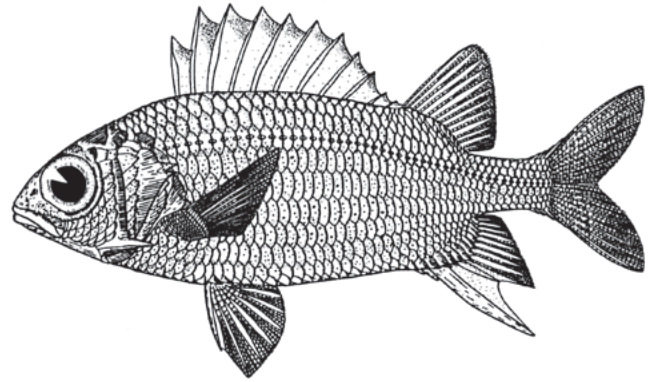
*Holocentrum punctatissimum* Cuvier in Cuv. & Val. 1829: 215 (Strong I., Caroline Is.).

*Holocentrus lacteoguttatus*: SFSA No. 297\*; Smith 1955; Smith & Smith 1963\*.

*Sargocentron punctatissimum*: Randall & Heemstra 1985\*; SSF No. 132.13\*; Winterbottom & Anderson 1997; Randall 1998; Fricke 1999; Heemstra *et al.* 2004; Fricke *et al.* 2009.

Dorsal fin 12–14 rays; anal fin 9 rays; pectoral fins 14–16 rays; GR 5–7/10–12. Body depth 2.7–3.1 in SL; HL 3–3.5 in SL. Nasal fossa without spines; preopercular spine length ~½ eye diameter. LL scales 41–47; oblique rows of scales on cheek 5.

Body silvery red, sometimes with blue-green iridescence dorsally, red tending to concentrate in narrow stripes; scales of head and body finely dotted with dark brown; operculum reddish silver, with red bar from upper end of gill opening to pectoral-fin base, and narrower bar along rear margin of preopercle; spinous dorsal fin translucent whitish, with broad outer red zone, and white blotch on each membrane below red zone. Attains 16 cm SL.



*Sargocentron punctatissimum*, 13 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Tanzania to South Africa (Algoa Bay), Madagascar, Comoros, Seychelles, St Brandon Shoals, Mascarenes, Chagos and Maldives; Lessepsian migrant in Mediterranean Sea; elsewhere to Indonesia, Japan, Caroline Is., Australia, Hawaii and Easter I.

**REMARKS** Most common on reefs and rocky shores exposed to wave action, and often found in tidepools; most specimens collected from <3 m.

### *Sargocentron rubrum* (Forsskål 1775)

Russet squirrelfish

PLATE 71

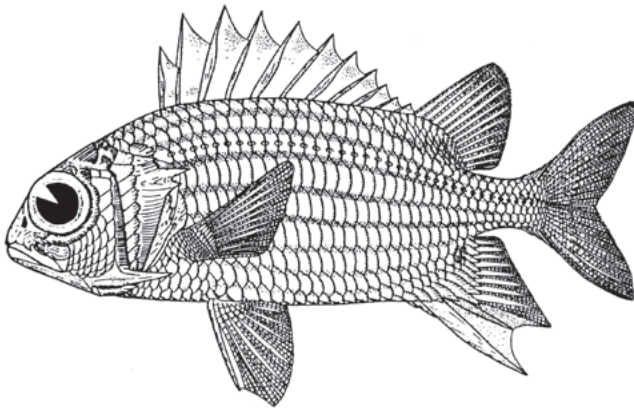
*Sciaena rubra* Forsskål in Niebuhr 1775: 48, xi (Port Sudan Harbour, Sudan, Red Sea).

*Sargocentron rubrum*: Randall & Heemstra 1985\*; SSF No. 132.14\*; Randall 1995\*, 1998\*; Bogorodsky *et al.* 2014.

Dorsal fin 12–14 rays; anal fin 8–10 rays; pectoral fins 13–15 rays; GR 6–8/9–12. Body depth 2.4–2.8 in SL; HL 2.7–2.9 in SL; snout short and blunt, its length 4.3–4.7 in HL. Opercular spine subequal to eye diameter in adults; upper edge of 1st suborbital bone with small lateral spine; nasal fossa without spinules. LL scales 34–38; oblique rows of scales on cheek 5.

Body with alternating stripes of brownish red or red and silvery white, usually with oblong dark brown spot at base of soft-rayed dorsal fin, and lesser spot at bases of anal and caudal fins; dorsal-fin spines pale red and membranes red, except white tips on all but last 2 spines, and squarish whitish area slightly below middle of each membrane (but not first membrane); tips of pelvic-fin rays 2–6 and adjacent membranes blackish red. Attains 27 cm SL.





*Sargocentron rubrum*, 14 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Oman to India and Sri Lanka; Lessepsian migrant to Mediterranean Sea; not known from any WIO island groups or from East Africa, but may occur there; elsewhere, Japan, Australia, New Caledonia and Tonga.

**REMARKS** Found on reefs and rocky areas of protected inshore waters, to ~84 m deep.

### *Sargocentron seychellense* (Smith & Smith 1963)

Yellow-tipped squirrelfish

PLATES 71 & 72

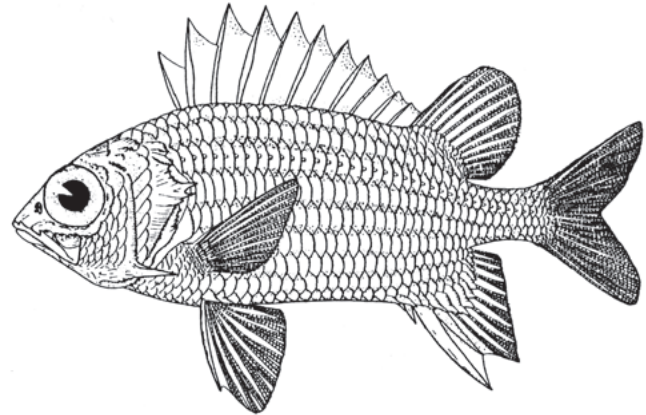
*Holocentrus seychellensis* Smith & Smith 1963: 9, Pl. 87, Fig. E (Mahé, Seychelles).

*Sargocentron seychellense*: Randall & Heemstra 1985\*; SSF No. 132.15\*; Winterbottom *et al.* 1989; Winterbottom & Anderson 1997; Randall 1998\*; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 12 or 13 rays; anal fin 8–10 rays; pectoral fins 13–15 rays; GR 6 or 7/10–12. Body depth 2.4–2.7 in SL; HL 2.6–2.9 in SL. Upper edge of preorbital with row of posterolaterally projecting spines, anteriormost largest; nasal bone and fossa without spinules. LL scales 35–39; oblique rows of scales on cheek 5.

Body with alternating stripes of brownish red (darker dorsally) and silvery white, of about equal width; 2 pairs of brownish red stripes on sides of body converging on peduncle; head red dorsally, yellowish ventrally; opercle silvery with 2 brownish red bars, and an oblique reddish brown band from eye to corner of preopercle; pectoral-fin base dark red, axils dark brown; spinous dorsal fin with pale red spines,

membranes red basally, white in middle, and broadly yellow distally; other fins mainly yellowish, except upper and lower margins of caudal fin red. Attains 25 cm SL.



*Sargocentron seychellense*, 14 cm SL (Seychelles). Source: Randall 1998

**DISTRIBUTION** WIO: Madagascar, Comoros, Seychelles, Réunion, Mauritius, St Brandon Shoals and Chagos.

**REMARKS** Found in shallow water, on coral reefs and rocky shores. The record of '*Adioryx seychellensis*' from Maputaland, KwaZulu-Natal, South Africa (Smith 1980), is erroneous.

### *Sargocentron spiniferum* (Forsskål 1775)

Sabre squirrelfish

PLATE 72

*Sciaena spinifera* Forsskål in Niebuhr 1775: 49, xii (Jeddah, Saudi Arabia, Red Sea).

*Holocentrus spiniferus*: Smith 1951\*, 1953; Smith & Smith 1963\*.

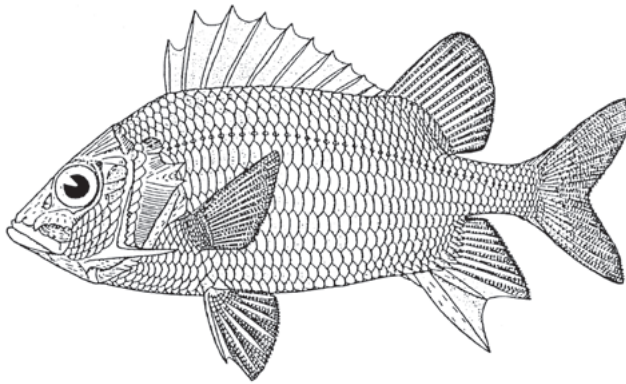
*Sargocentron spiniferum*: Randall & Heemstra 1985\*; SSF No. 132.16\*;

Randall 1995\*, 1998\*; Fricke 1999; Heemstra *et al.* 2004; Fricke *et al.* 2009.

Dorsal fin membranes only slightly incised in spinous portion, 14–16 rays; anal fin 9 or 10 rays; pectoral fins 14–16 rays; GR 6 or 7/12–14. Body depth 2.4–2.6 in SL; HL 2.5–3.1 in SL. Preopercular spine usually longer than eye diameter in fish >20 cm SL; nasal bone and fossa without spinules posteriorly; front end of nasal bone usually with 1 or 2 short spines. LL scales 41–45; oblique rows of scales on cheek 5.

Head and body red, edges of scales silvery white; spinous dorsal fin uniformly red, other fins orange-yellow; vertical ovate crimson spot on preopercle behind eye; pectoral-fin axils with crimson blotch divided by white line. Attains ~45 cm TL.





*Sargocentron spiniferum*, 22 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Red Sea, Tanzania to South Africa (Knysna), Madagascar, Comoros, Mascarenes and St Brandon Shoals; elsewhere to Malaysia and Indonesia (few records), Japan, Australia, Pitcairn Is., Marquesas Is., Marshall Is. and Hawaii.

**REMARKS** The largest of the squirrelfishes. Found on coral and rocky reefs, often in caves, from 1–122 m. Feeds nocturnally on crustaceans, especially crabs.

### *Sargocentron tiere* (Cuvier 1829)

Red squirrelfish

PLATE 72

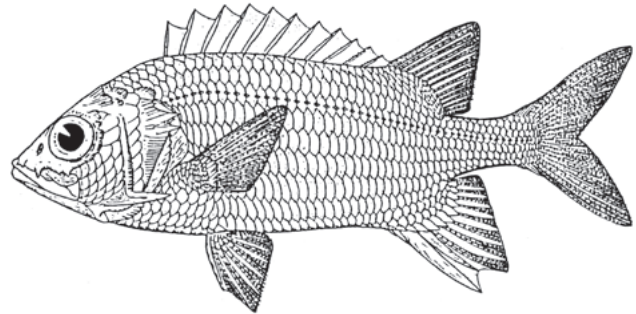
*Holocentrum tiere* Cuvier in Cuv. & Val. 1829: 202 (Matavai barrier reef, Tahiti, Society Is.).

*Sargocentron tiere*: Randall & Heemstra 1985\*; SSF No. 132.17\*; Winterbottom *et al.* 1989; Randall 1998\*; Fricke 1999; Heemstra *et al.* 2004; Fricke *et al.* 2009.

Dorsal fin membranes only slightly incised in spinous portion, 13–15 rays; anal fin 9 or 10 rays; pectoral fins 13–15 rays; GR 7–9/13–16. Body depth 2.7–3 in SL; HL 2.9–3.3 in SL; dorsal-fin spines short, 4th spine usually longest, 2.6–3.5 in HL. Front end of nasal bone with 2 short spines; no spines on nasal fossa, rear part of nasal bone and upper edge of preorbital; preopercular spine at least  $\sim\frac{2}{3}$  or subequal to eye diameter. LL scales 46–52; oblique rows of scales on cheek 5.

Head and body red, without distinct white stripes or markings, except may exhibit 2 white bars on body at night; fins red, except spinous dorsal-fin membranes white at tips,

and with an oblong white spot at middle of all membranes other than first 2; leading edge of pelvic fins and anal fin white. Attains 33 cm TL.



*Sargocentron tiere*, 21 cm SL (Japan). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar, Aldabra, Seychelles, Mascarenes and Chagos; elsewhere to Indonesia, Japan, Australia, Line Is., Pitcairn Is. and Hawaii.

**REMARKS** An insular coral-reef species that occurs more often on exposed reefs than on sheltered ones, in 1–26 m.

### *Sargocentron tiereoides* (Bleeker 1853)

Pink squirrelfish

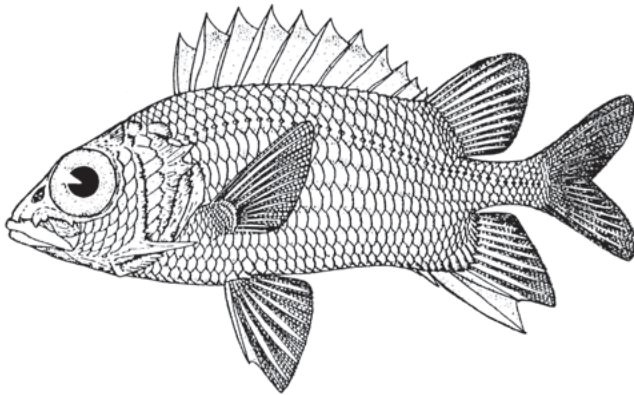
PLATE 72

*Holocentrum tiereoides* Bleeker 1853: 334 (Ambon I., Moluccas, Indonesia).

*Sargocentron tiereoides*: Randall & Heemstra 1985\*; SSF No. 132.18\*; Winterbottom *et al.* 1989; Randall 1998\*; Fricke *et al.* 2009.

Dorsal fin 12–14 rays; anal fin 9 or 10 rays; pectoral fins 13 or 14 rays; GR 6–8/12–14. Body depth subequal to HL, 2.7–3 in SL; preopercular spine usually  $>\frac{3}{4}$  eye diameter; premaxillary groove extending to vertical at front edge of eyes; front of nasal bone with 2 short diverging spines, rear part usually without spinules. LL scales 39–44; oblique rows of scales on cheek 4.

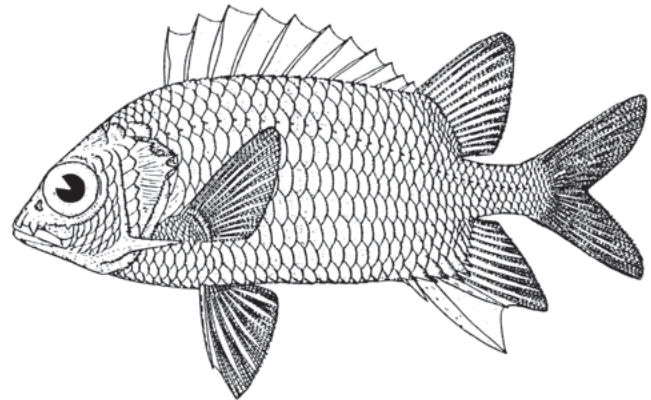
Body silvery pink, with longitudinal red stripes, the interspaces of about equal width; spinous dorsal fin pink, with submarginal dark red band, and membrane tips white; other fins pale red to yellowish red; leading edges of pelvic and anal fins white, with submarginal darker red band; pectoral-fin bases darker red; upper and lower edges of caudal fin darker red. Attains 16 cm SL.



*Sargocentron tiereoides*, 12 cm SL (Solomon Is.). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, South Africa (Sodwana Bay), Comoros, Réunion, Maldives and Chagos; elsewhere to Christmas I., Indonesia, Philippines, Japan, Australia, Pitcairn Is., Solomon Is., Tuamotu Is. and Hawaii.

**REMARKS** Rare; found on coral reefs, in 6–45 m.



*Sargocentron violaceum*, 12 cm SL (Palau). Source: Randall 1998

**DISTRIBUTION** Indo-Pacific. WIO: Kenya, Mozambique, Aldabra, Seychelles, Chagos, Maldives and Lakshadweep; elsewhere to Indonesia, Japan, Australia, New Caledonia, Samoa and Line Is.

**REMARKS** Inhabits coral reefs, in 1–15 m; strictly nocturnal.

### *Sargocentron violaceum* (Bleeker 1853)

White-edged squirrelfish

PLATE 72

*Holocentrum violaceum* Bleeker 1853: 335 (Ambon I., Moluccas, Indonesia).

*Holocentrus violaceus*: Smith & Smith 1963\*.

*Sargocentron violaceus*: Winterbottom *et al.* 1989; Randall 1998\*.

*Sargocentron violaceum*: Randall & Heemstra 1985\*; SSF No. 132.19\*.

Dorsal fin membranes not incised in spinous portion, 12–15 rays; anal fin 9 rays; pectoral fins 13 or 14 rays; GR 6–8/12 or 13. Body moderately deep, 2.3–2.6 in SL; HL usually less than body depth, 2.6–3 in SL; preopercular spine subequal to eye diameter. No serrated ridge on upper edge of suborbital bones; front end of nasal bone with 2 short, diverging spines, rear part usually without spinules; edge of nasal fossa with 1–3 spinules. LL scales 33–37; oblique rows of scales on cheek 4 or 5.

Body brownish to purplish red, each scale with vertical silvery white line; head red to brownish red, cheek scales purplish with white edges; membrane between and above opercular spines blackish; spinous dorsal fin pale red to purplish red, narrow triangular membrane tips white, with submarginal bright red band; other fins with pale purplish red rays and translucent red membranes; membranes between 3rd and 4th anal-fin spines red; upper and lower edges of caudal fin red. Attains 34 cm TL.

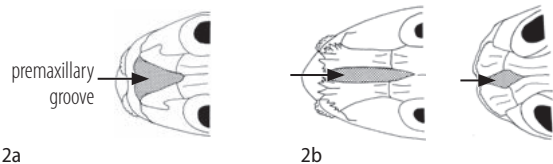
## SUBFAMILY MYRIPRISTINAE

### Soldierfishes

No large spine at corner of preopercle; dorsal fin 11 or 12 spines (penultimate spine shortest, last spine joined to 1st soft ray, and fin notched to its base), 13–17 rays; anal fin 4 spines, 10–14 rays; pectoral fins 14–17 rays; LL scales 27–44. Four genera in WIO.

#### KEY TO GENERA

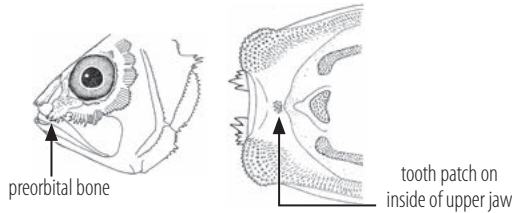
- 1a Dorsal fin 11 or 12 spines, 13–15 rays, and fin divided to base before last spine; GR 19–32 on lower limb ..... *Myripristis*  
 1b Dorsal fin 12 spines (except *Ostichthys delta* with 11 spines), 13 or 14 rays, and fin continuous but deeply notched before rayed part; GR 11–18 on lower limb ..... 2  
 2a Premaxillary groove (between nasal bones on middle of snout) broadly V-shaped ..... *Ostichthys*  
 2b Premaxillary groove narrow and elongate or rhomboidal ..... 3



Continued ...

**KEY TO GENERA**

- 3a LL scales 28–30; preorbital bone with sharp spines overhanging upper jaw; small tooth patch on posteroventral surface of premaxilla symphysis ..... *Pristilepis*



- 3b LL scales 32–42; preorbital without spines overhanging upper jaw; no tooth patch on premaxilla symphysis ..... *Plectrypops*



**GENUS** *Myripristis* Cuvier 1829

No enlarged spine at angle of preopercle; dorsal fin 11 spines (penultimate spine shortest), 13–17 rays; vertebrae 26. Twenty-eight species, 12 in WIO.

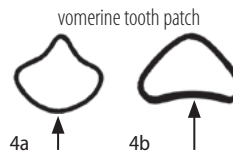
**KEY TO SPECIES**

- 1a LL scales 26–32 ..... 2  
 1b LL scales 32–44 (32 if dorsal fin yellow) ..... 9
- 2a One scale (rarely 2) on pectoral-fin axil (inner or medial side of fin base); median-fin margins broadly black (broadest on caudal-fin lobes and elevated parts of soft-rayed portions of dorsal and anal fins); spinous dorsal fin blackish, with submarginal unpigmented zone; maximum size 25 cm SL ..... *M. adusta*
- 2b Pectoral-fin axils either without scales or with numerous scales; median-fin margins not black, but sometimes a black blotch or streak distally on caudal-fin lobes or elevated parts of soft-rayed portions of dorsal and anal fins; spinous dorsal fin not blackish ..... 3
- 3a Two pairs of symphyseal tooth patches at tip of lower jaw, just outside gape (lower pair usually absent in fish <9 cm SL); LL scales 25–29 ..... 4
- 3b One pair of tooth patches, 1 patch on each side of symphysis, at tip of lower jaw just outside gape; LL scales 27–32 ..... 6

Continued ...

**KEY TO SPECIES**

- 4a Prominent black blotch distally on caudal-fin lobes as well as margins of soft dorsal fin and anal fin; no scales in pectoral-fin axil; total GR 32–38; vomerine tooth patch triangular with rounded corners; maximum size ~24 cm SL ..... *M. botche*
- 4b No black markings on fins; small scales in pectoral-fin axil; total GR 26–43; rear edge of vomerine tooth patch concave; maximum size ~16 cm SL ..... 5



- 5a Soft-rayed dorsal fin, anal fin and pelvic fins tipped yellow; pectoral-fin length 1.5–1.8 in HL; total GR 26–31 ..... *M. xanthacra*
- 5b Soft-rayed dorsal fin, anal fin and pelvic fins tipped with red in life; pectoral-fin length 1.4–1.5 in HL; total GR 36–43 ..... *M. hexagona*
- 6a Dorsal-fin rays usually 14; GR on lower limb usually 25; lower jaw slightly or strongly projecting ..... 7
- 6b Dorsal-fin rays usually 15; GR on lower limb usually 27–29; lower jaw inferior or only slightly projecting ..... 8
- 7a Interorbital width 4.3–5.8 in HL; lower jaw prominently projecting; spinous dorsal fin broadly orange-yellow distally ..... *M. berndti*
- 7b Interorbital width 3.7–4.4 in HL; lower jaw slightly projecting; spinous dorsal fin red distally ..... *M. murdjan*
- 8a Scales on dorsum with broad dark brown or black edges, those on nape almost completely black; interorbital width 4.1–4.5 in HL ..... *M. seychellensis*
- 8b Scales on dorsum without dark brown or black edges; interorbital width 3.6–4.1 in HL ..... *M. violacea*
- 9a Dark brown bar from upper end of gill opening to pectoral-fin axil; anal fin 14–16 rays; dorsal fin 15–17 rays; LL scales 37–44 ..... *M. kuntee*
- 9b Dark brown pigment in region of gill opening, if present, confined to opercular membrane; anal fin 11–15 rays; dorsal fin 13–16 rays; LL scales 32–40 ..... 10
- 10a Dark brown pigment of opercular membrane ending at or slightly below opercular spine; anal fin 13–15 rays; dorsal fin 14–16 rays; front of lower jaw fits into shallow notch in upper jaw ..... *M. pralinia*
- 10b Dark brown pigment of opercular membrane, when present, extending well below opercular spine (usually to level of upper pectoral-fin base); anal fin 11–13 rays; dorsal fin 13–15 rays; front of lower jaw fits into deep notch in upper jaw ..... 11

Continued ...

## KEY TO SPECIES

- 11a No dark brown pigment on opercular membrane; fins orange-red, and spinous dorsal fin tipped white; LL scales 35–40.....  
..... *M. vittata*
- 11b Opercular membrane dark brown; caudal fin and most of dorsal, anal and pelvic fins yellow, spinous dorsal fin not tipped white; LL scales 32–38 ..... *M. chryseres*

*Myripristis adusta* Bleeker 1853

Shadowfin soldierfish

PLATE 66

*Myripristis adustus* Bleeker 1853: 108 (Ambon I., Moluccas, Indonesia); Smith & Smith 1963\*; Greenfield 1974\*; Randall & Anderson 1993.

*Myripristis melanostictus* (non Bleeker 1863): Smith 1955\*, 1961.

*Myripristis adusta*: SSF No. 132.20\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall & Greenfield 1996\*; Winterbottom & Anderson 1997; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 14 or 15 rays; anal fin 12–14 rays, 4th spine of anal fin longer than 3rd; pectoral fins 15 or 16 rays; GR 10–13/23–27 = 35–40. Body depth 2–2.5 in SL; HL 2.5–3 in SL; interorbital width 3.2–4.9 in HL. Lower jaw symphysis with 1 or 2 pairs of tooth patches, just outside gape, and jaw slightly projecting when mouth closed. LL scales 27–29; pectoral-fin axil with 1 (rarely 2) scales.

Body greenish silver dorsally, scales rimmed with black, paler ventrally, scales rimmed with yellowish brown; large black spot on opercular spine; spinous dorsal fin reddish black, paler basally with bluish white submarginal band; pectoral fins pinkish with fin axil blackish; remaining fins bluish, soft-rayed dorsal fin, anal and caudal fins broadly tipped with reddish black. Attains 32 cm TL.



*Myripristis adusta*, 21 cm TL (Comoros). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique to South Africa, Madagascar, Comoros, Seychelles, Réunion, Mauritius, Chagos, Maldives and Lakshadweep; elsewhere to Indonesia, Japan, Australia, Tuamotu Is. and Hawaii.

**REMARKS** The largest species of *Myripristis*. Shelters in caves or beneath ledges in reefs by day, often in small aggregations, in 2–24 m.

*Myripristis berndti* Jordan & Evermann 1903

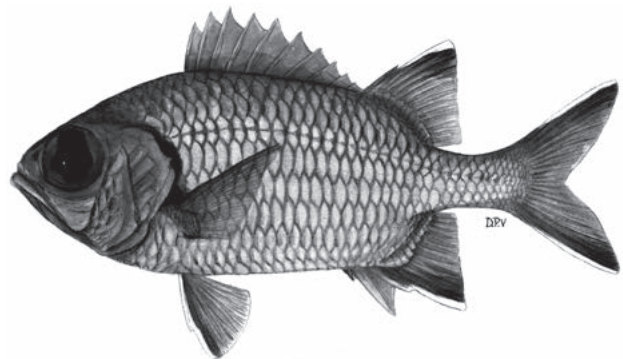
Bigscale soldierfish

PLATES 66 &amp; 67

*Myripristis berndti* Jordan & Evermann 1903: 170 (Honolulu, Oahu I., Hawaii); Jordan & Evermann 1905\*; Randall & Guézé 1981\*; SSF No. 132.21\*; Winterbottom *et al.* 1989; Randall & Anderson 1993\*; Randall & Greenfield 1996\*; Fricke 1999; Winterbottom & Anderson 1997; Heemstra *et al.* 2004; Fricke *et al.* 2009.

Dorsal fin 13–15 rays; anal fin 11–13 rays, 3rd and 4th spines of anal fin subequal; pectoral fins 15 rays; total GR 35–42. Body depth 2.3–2.6 in SL; interorbital width 4.3–5.8 in HL. Lower jaw of adults prominently projecting when mouth closed; pair of tooth patches at symphysis, just outside gape. LL scales 28–31; inner side of pectoral-fin axil with small scales.

Body silvery pink, sometimes yellowish, scale edges red; opercular membrane blackish brown, lower half usually silvery; naked part of pectoral-fin axil black; spinous dorsal-fin margin yellow to orange yellow; other fins red, with leading edges white and often with submarginal black streak. Attains 30 cm TL.



*Myripristis berndti*, 15 cm SL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Kenya, Mozambique to South Africa (Aliwal Shoal), Madagascar, Seychelles, Réunion, Mauritius, Chagos and Maldives; elsewhere to Cocos (Keeling) Is., Indonesia, Japan, Australia, Norfolk I., Kermadec Is., Rapa Iti, Hawaii, Galápagos Is., Clipperton I. and Costa Rica.

**REMARKS** Found on coral reefs and rocky shores exposed to surge; most specimens collected from 10–25 m, but reported to 159 m.



## *Myripristis botche* Cuvier 1829

Pale soldierfish

PLATE 67

*Myripristis botche* Cuvier 1829: 151 (Visakhapatnam, India) [based on Russell 1803\*]; Randall & Guézé 1981\*; Randall & Anderson 1993; Randall & Greenfield 1996\*; Heemstra *et al.* 2004; Fricke *et al.* 2009.  
*Myripristis melanostictus* (non Bleeker 1863): SSF No. 132.25\*.

Dorsal fin 13–15 rays; anal fin 11 or 12 rays, 4th spine of anal fin slightly longer than 3rd; pectoral fins 14 or 15 rays; total GR 32–38. Body depth 2.1–2.5 in SL; interorbital width 4.5–5.6 in HL. Mouth terminal or lower jaw slightly projecting; 2 pairs of tooth patches at lower jaw symphysis, just outside gape; vomerine tooth patch triangular with rounded corners. LL scales 27–29; no scales on pectoral-fin axil.

Head red anteriorly; postorbital head and body silvery white, edges of scales red (but dark reddish brown on nape and anterodorsally on body); opercular membrane black from ~½ distance from opercular spine to pectoral-fin base; broad red bar along edge of gill opening to pectoral-fin axil; spinous dorsal fin whitish basally, red distally; other median fins red with white leading edges, and lobe tips with large black spots; paired fins whitish. Attains 30 cm TL.



*Myripristis botche*, 21 cm SL (South Africa). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, East Africa to South Africa (Sodwana Bay), Seychelles, Réunion, Rodrigues, Maldives, India and Sri Lanka; elsewhere to east coast of India, Indonesia, Philippines, Japan, Australia and Vanuatu.

**REMARKS** Generally found below 25 m; caught in trawls to ~70 m.

## *Myripristis chryseres* Jordan & Evermann 1903

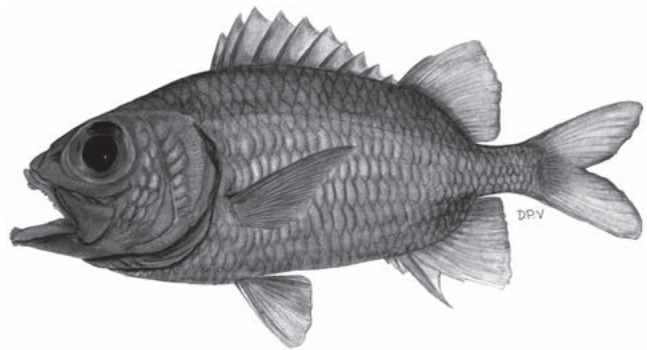
Yellowfin soldierfish

PLATE 67

*Myripristis chryseres* Jordan & Evermann 1903: 171 (Hilo, Hawaii Is.); Jordan & Evermann 1905\*; Greenfield 1974; SSF No. 132.22\*; Randall & Greenfield 1996\*; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 13–15 rays; anal fin 11–13 rays, 3rd spine of anal fin distinctly longer than 4th; pectoral fins 15 rays; total GR 33–38. Interorbital width 4–4.8 in HL. Lower jaw projecting when mouth closed, and front of jaw fitting into deep notch in upper jaw with mouth closed; 1 pair of tooth patches at lower jaw symphysis, just outside gape; vomerine tooth patch triangular with rounded corners. LL scales 32–38; no scales on pectoral-fin axil.

Body pale red, scale edges darker red, body sometimes suffused with yellow; black on opercular membrane extends well below opercular spine; spinous dorsal fin mottled yellow and red, membrane tips red; other median fins more yellow than red, with red margins; pectoral fins with pale red rays; leading edge of pelvic fins white, first 2 rays yellow, and rest of fin pale red. Attains 25 cm TL.



*Myripristis chryseres*, 19 cm SL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aqaba, Red Sea to South Africa (Sodwana Bay; Aliwal Shoal), Comoros, Réunion, Mauritius and Sri Lanka; elsewhere to Japan, Australia, Society Is. and Hawaii.

**REMARKS** Found in moderately deep water, generally below 25 m, and recorded to ~350 m.

## *Myripristis hexagona* (Lacepède 1802)

Doubletooth soldierfish

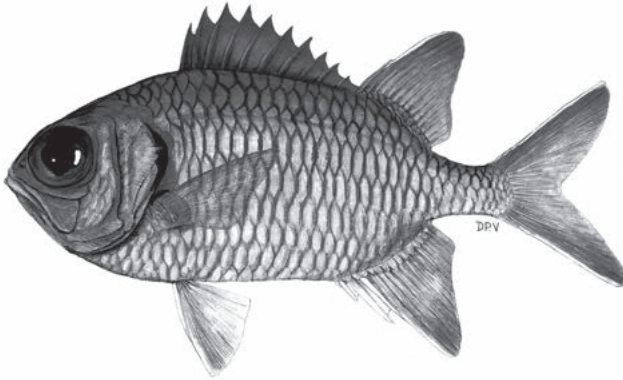
PLATE 67

*Lutjanus hexagonus* Lacepède 1802: 180, 213 [Sumatra, Indonesia].  
*Myripristis hexagonus*: Randall & Guézé 1981\*.  
*Myripristis hexagona*: SSF No. 132.23\*; Randall & Greenfield 1996\*;  
Fricke *et al.* 2009.

Dorsal fin 13–15 rays; anal fin 12 or 13 rays, 3rd and 4th spines of anal fin subequal; pectoral fins 14–16 rays; GR 12–15/24–29 = 36–43. Interorbital width 4.1–5.1 in HL. Lower jaw prominently projecting; 2 pairs of tooth patches at lower jaw symphysis, just outside gape (juveniles <7.5 cm SL with 1 pair);

vomerine tooth patch broadly V-shaped. LL scales 25–28; numerous small scales on pectoral-fin axil.

Body silvery white, scale edges dark red to reddish brown dorsally, paler red ventrally; blackish pigment of opercular membrane extending approximately to upper end of pectoral-fin axil; spinous dorsal fin pale red, whitish basally, bright red distally; other fins translucent whitish, with pale red rays, except pelvic-fin rays nearly white. Attains 20 cm TL.



*Myripristis hexagona*, 13 cm SL (Philippines). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Tanzania, Mozambique, South Africa, Madagascar, Seychelles, Réunion and Mauritius; elsewhere to Indonesia, Philippines, Japan, Australia, Tonga and Samoa.

**REMARKS** Found in protected waters of lagoons and bays, often in areas of soft sediments on reefs. Number of gill rakers progressively higher in populations from west to east (Randall & Greenfield 1996).

### *Myripristis kuntee* Cuvier 1831

Epaulette soldierfish

PLATE 67

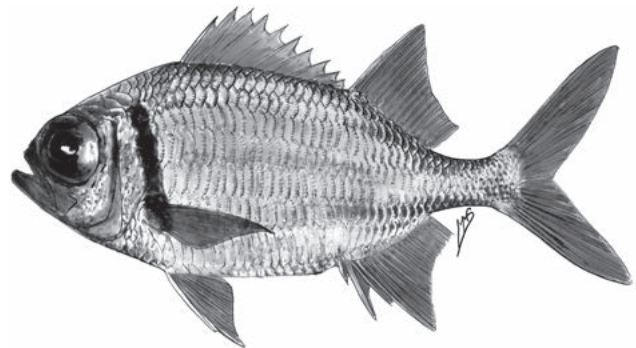
*Myripristis kuntee* Cuvier in Cuv. & Val. 1831: 487 (based on 'Sullanarookuntee' of Russell 1803\*, and specimen from Mauritius, Mascarenes); Greenfield 1974\*; SSF No. 132.24\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall & Greenfield 1996\*; Winterbottom & Anderson 1997; Heemstra *et al.* 2004.

*Myripristis borbonicus* Valenciennes in Cuv. & Val. 1831: 489 (Réunion, western Mascarenes).

*Myripristis pralinus* (*non* Cuvier 1829): Smith 1955\*.

Dorsal fin 15–17 rays; anal fin 14–16 rays, 3rd spine of anal fin shorter than 4th; pectoral fins 15 rays; total GR 33–41. Interorbital width 3–5 in HL. Pair of tooth patches at lower jaw symphysis, just outside gape. LL scales 37–44; no scales on pectoral-fin axil.

Body orange-red to red dorsally, silvery pink below lateral line; broad reddish brown bar from upper end of gill opening to pectoral-fin axil; spinous dorsal fin hyaline pinkish basally and broadly yellow distally; soft-rayed dorsal and anal fins hyaline, with large red spot on outer part of lobe; caudal fin red, brighter towards margin; paired fins hyaline, pelvic fins with red streak on 2nd ray; leading edges of all fins (other than spinous dorsal fin) white. Attains 20 cm TL.



*Myripristis kuntee*, 18 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to Indonesia, Philippines, Japan, Australia, Tonga, Marquesas Is. and Hawaii.

### *Myripristis murdjan* (Fabricius 1775)

Blotchey soldierfish

PLATE 67

*Sciaena murdjan* Fabricius in Niebuhr (ex Forsskål) 1775: 48, xii (Jeddah, Saudi Arabia, Red Sea).

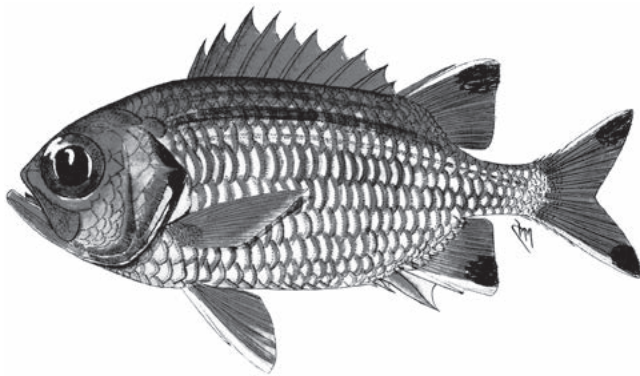
*Myripristis axillaris* Valenciennes in Cuv. & Val. 1831: 491 (Mauritius, Mascarenes).

*Myripristis murdjan*: SFSA No. 298\*; Greenfield 1974; SSF No. 132.26\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall & Greenfield 1996; Winterbottom & Anderson 1997; Fricke 1999; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

Dorsal fin 13–15 rays; anal fin 11–13 rays, 3rd and 4th spines of anal fin subequal; pectoral fins 14–16 rays; total GR 36–43. Interorbital width 3.7–4.4 in HL. Lower jaw strongly protruding

when mouth closed; 1 pair of tooth patches at lower jaw symphysis, just outside gape. LL scales 27–32; numerous small scales on pectoral-fin axil.

Body red to dusky red, paler ventrally, scale edges darker; black on opercular membrane usually not extending below level of pupil; spinous dorsal fin pinkish white basally, broadly red to orange-red distally; other median fins and pelvic fins with red rays and translucent red membranes, narrow white leading edge (except for pectoral fins) and broad red submarginal zone. Attains 27 cm TL.



*Myripristis murdjan*, 16 cm TL (Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Gulf of Aden, Oman to South Africa (Sodwana Bay; Aliwal Shoal), Madagascar, Comoros, Seychelles, Mascarenes, St Brandon Shoals, Chagos, Maldives, Lakshadweep and India; elsewhere to Indonesia, Philippines, Japan, Micronesia, Australia, Tonga, Samoa and Hawaii.

**REMARKS** Inhabits coral reefs, in 1–50 m.

### *Myripristis pralinia* Cuvier 1829

Scarlet soldierfish

PLATE 67

*Myripristis pralinus* Cuvier in Cuv. & Val. 1829: 170 (Port Praslin, New Ireland, Bismarck Archipelago); Greenfield 1974\*.

*Myripristis pralinia*: SSF No. 132.27\*; Winterbottom *et al.* 1989; Randall & Anderson 1993; Randall & Greenfield 1996\*; Winterbottom & Anderson 1997.

Dorsal fin 14–16 rays; anal fin 13–15 rays; pectoral fins 15 rays; total GR 35–42. Interorbital width 2.8–4 in HL. One pair of tooth patches at lower jaw symphysis, just outside gape. LL scales 34–40; no scales on pectoral-fin axil.

Head, body and fins scarlet, paler ventrally; upper part of opercular membrane black; black blotch in pectoral-fin axil; fins hyaline red; spinous dorsal fin whitish basally, and spines 1–4 with white tips; other median fins with white leading edge, bright red submarginally. Attains 20 cm TL.



*Myripristis pralinia*, 10 cm SL (Comoros). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Seychelles, Chagos, Maldives and Sri Lanka; elsewhere to Indonesia, Philippines, Japan, Guam, Australia, Line Is. and Marquesas Is.

**REMARKS** Found on coral reefs, in 1–31 m. Previous records of *M. pralinia* from the coast of East Africa were presumably misidentifications of *M. kuntee*.

### *Myripristis seychellensis* Cuvier 1829

Seychelles soldierfish

PLATE 68

*Myripristis seychellensis* Cuvier in Cuv. & Val. 1829: 172 (Seychelles); Randall & Guézé 1981\*; SSF No. 132.28\*; Randall & Greenfield 1996\*.

Dorsal fin 14 or 15 rays; anal fin 13 rays, 3rd and 4th spines of anal fin subequal; pectoral fins 14 or 15 rays; GR 12–15/25–29. Interorbital width 3.6–4.5 in HL. Mouth terminal or slightly inferior; 1 pair of tooth patches at lower jaw symphysis, just outside gape. LL scales 28; pectoral-fin axil mostly covered with small scales.

Body pale red to pinkish white, scale edges red; opercular membrane black as far as or beneath lower edge of eye, and red below; pectoral-fin axil black on naked upper part, white on scaled part; spinous dorsal fin translucent red basally, broadly orange-red distally; soft-rayed dorsal, anal, caudal, and pelvic fins with white leading edge, followed by broad red zone (which may contain a blackish streak), and remainder of fin yellowish red. Attains 23 cm TL.





*Myripristis seychellensis*, 12 cm SL (Mauritius). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: Madagascar, Chagos, Comoros, Seychelles, Mauritius, Réunion, Saya de Malha Bank and St Brandon Shoals.

**REMARKS** Reported from depths of 2–21 m. Observed in caves at Mahé, Seychelles, with several more common species: *M. adusta*, *M. berndti*, *M. kuntee*, *M. murdjan* and *M. violacea*.

### *Myripristis violacea* Bleeker 1851

Lattice soldierfish

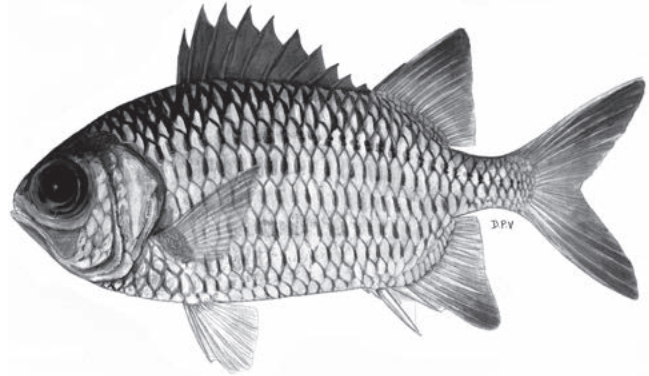
PLATE 68

*Myripristis violaceus* Bleeker 1851: 234 (Banda Neira, Moluccas, Indonesia); Greenfield 1974\*.

*Myripristis violacea*: SSF No. 132.29\*; Winterbottom *et al.* 1989; Randall & Greenfield 1996\*; Fricke *et al.* 2009.

Dorsal fin 14–16 rays; anal fin 12–14 rays, 3rd and 4th spines of anal fin subequal; pectoral fins 15 rays; total GR 38–48. Interorbital width 3–5 in HL. Mouth terminal or lower jaw slightly projecting when mouth closed; 1 pair of tooth patches at lower jaw symphysis, just outside gape. LL scales 27–29; scales usually present on pectoral-fin axil.

Body silvery to silvery pink (sometimes bluish silvery dorsally), edges of scales above lateral line dark (nearly black) and progressively more red ventrally; opercular membrane dusky red; pectoral-fin axil brownish red to black; spinous dorsal fin red to orange-red distally, translucent whitish, tinged with red basally; soft-rayed dorsal, anal and caudal fins pale red basally, broadly bright red distally. Attains 20 cm TL.



*Myripristis violacea*, 11 cm SL (Mauritius). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles, Réunion, Mauritius, Chagos and Maldives; elsewhere to Cocos (Keeling) Is., Indonesia, Philippines, Japan, Australia, Tuamotu Is., Marshall Is. and Marquesas Is.

**REMARKS** Usually found on shallow protected reefs, in 1–24 m.

### *Myripristis vittata* Valenciennes 1831

Immaculate soldierfish

PLATE 68

*Myripristis vittatus* Valenciennes *in* Cuv. & Val. 1831: 370 (Mauritius, Mascarenes); Greenfield 1974\*.

*Myripristis vittata*: SSF 132.30\*; Winterbottom *et al.* 1989\*; Eichler & Lieske 1994\*; Randall & Greenfield 1996\*; Fricke *et al.* 2009.

Dorsal fin 13–15 rays; anal fin 11 or 12 rays, 3rd spine of anal fin longer than 4th; pectoral fins 15 rays; GR 11–13/23–26. Interorbital width 2.3–3.3 in HL. Mouth terminal or slightly inferior; 1 pair of tooth patches at lower jaw symphysis, just outside gape. LL scales 35–40; no scales at base of pectoral-fin axil.

Body nearly uniformly red or orange-red, with faint stripes on body due to paler scale centres; opercular membrane and pectoral-fin axils dark red; dorsal-fin spine tips and leading edges of soft-rayed dorsal and anal fins white, followed by broad red band. Attains 18 cm TL.





*Myripristis vittata*, 12 cm SL (Comoros). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique (Pomene) to South Africa (Aliwal Shoal), Comoros, Madagascar, Seychelles, Réunion, Mauritius, Chagos and Maldives; elsewhere to Indonesia, Philippines, Taiwan, Japan, Australia, Marquesas Is. and Hawaii.

**REMARKS** Found on reefs, in 3–70 m (usually >20 m).

***Myripristis xanthacra*** Randall & Guézé 1981

Yellowtipped soldierfish

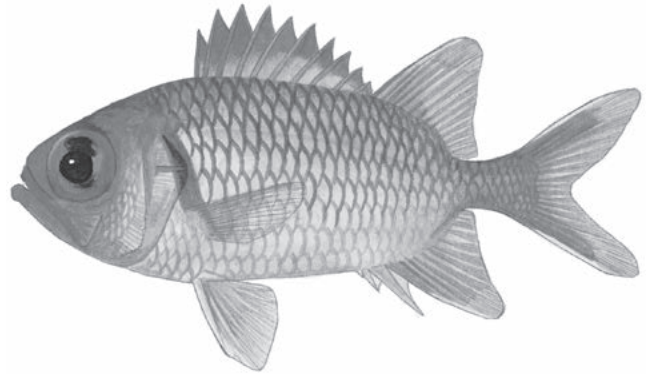
PLATE 68

*Myripristis xanthacrus* Randall & Guézé 1981: 6, Figs. 1c, 4, 10 (entrance to Suakin Harbour, Sudan, Red Sea).

*Myripristis xanthacra*: Randall & Greenfield 1996.

Dorsal fin 13–15 rays; anal fin 10–13 rays, 3rd and 4th spines of anal fin subequal; pectoral fins 14 or 15 rays; GR 13–16/26–31. Body depth 2.2–2.5 in SL; HL 2.7–2.9 in SL; interorbital width 4.3–4.8 in HL; pectoral-fin length 1.5–1.8 in HL; longest anal-fin spine 1.8–2.4 in HL. Lower jaw projecting; 2 pairs of tooth patches anteriorly on lower jaw, just outside gape. LL scales 26–29; most of pectoral-fin axil with small scales; spinelets on scale edges coarse.

Head and body silvery pink to silvery red, edges of scales brownish red dorsally, red at centre, and paler ventrally; broad dark red band from upper end of gill opening to pectoral-fin axil, enclosing darker opercular membrane; spinous dorsal fin pink basally, broadly orange distally; soft-rayed dorsal, anal and caudal fins red, broadly tipped with yellow. Attains 20 cm TL.



*Myripristis xanthacra*, 10 cm SL (Red Sea).

**DISTRIBUTION** WIO: southern Red Sea and Gulf of Aden.

**REMARKS** Found in 1–18 m. A record from Oman is an error (Randall & Greenfield 1996). Distinguished from *M. chryseres* which has soft-rayed dorsal fin, anal and caudal fins yellow except basally, LL scales 32–38, and single pair of tooth patches at front of lower jaw. *Myripristis xanthacra* is more closely related to the allopatric *M. hexagonus*.

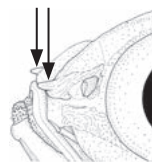
**GENUS *Ostichthys*** Jordan & Evermann 1896

No enlarged spine at angle of preopercle, or short spine only; snout with median premaxillary groove broadly V-shaped; dorsal-fin spines 11–13; anal-fin spines 4; vertebrae 26. Benthic, to ~360 m (usually >150 m). The generic revision by Randall *et al.* (1982) recognised 1 Indo-Pacific and 1 western Atlantic species; 3 more Indo-Pacific species have since been described. Most species are represented by few museum specimens. Twelve species, 4 in WIO.

**KEY TO SPECIES**

- 1a Dorsal fin 11 spines; LL scales 27 or 28; peduncle depth less than its length, and ~½ length of 3rd anal-fin spine ..... *O. delta*
- 1b Dorsal fin 12 spines; LL scales 28–30; peduncle depth subequal to its length, and >½ length of 3rd anal-fin spine ..... 2

- 2a Front end of nasal bone of adults with spine reaching to upper lip; GR 26–30 ..... *O. acanthorhinus*



- 2b No spine at front end of nasal bone in adults; GR 20–25 ..... 3

Continued...

## KEY TO SPECIES

- 3a Scales above lateral line to 5th spine of dorsal fin  $3\frac{1}{2}$ ; longest dorsal-fin spine 1.8–1.9 in HL; last dorsal-fin spine midway between penultimate spine and first dorsal-fin ray ... *O. sufensis*
- 3b Scales above lateral line to 5th spine of dorsal fin  $2\frac{1}{2}$ ; longest dorsal-fin spine 2–2.4 in HL; space between last 2 dorsal-fin spines at least twice length of space between last dorsal-fin spine and first dorsal-fin ray ..... *O. archiepiscopus*

*Ostichthys acanthorhinus*

Randall, Shimizu &amp; Yamakawa 1982

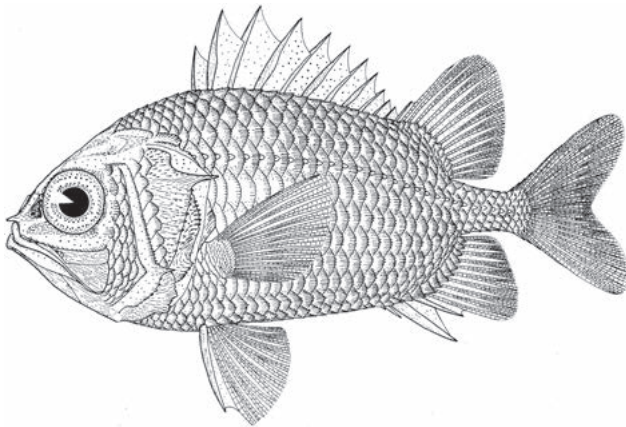
Spinysnout soldierfish

PLATE 69

*Ostichthys acanthorhinus* Randall, Shimizu & Yamakawa 1982: 10, Figs. 6–7 (Gulf of Oman); Baranes & Golani 1993; Manilo & Bogorodsky 2003.

Dorsal fin 12 or 13 spines, 13 or 14 rays; anal fin 10 or 11 rays; pectoral fins 16 or 17 rays; GR 26–30. Head profile nearly uniformly convex; snout short, 5.2–6 in HL; front end of nasal bone with spine reaching to upper lip; spine at corner of preopercle small in adults, longer in juveniles; last dorsal-fin spine slightly longer than penultimate spine; space between last dorsal-fin spine and first soft ray  $\sim\frac{1}{2}$  distance between last 2 spines. LL scales 28 or 29; scales from 5th spine of dorsal fin to lateral line  $3\frac{1}{2}$ .

Body entirely red. Attains 22 cm TL.



*Ostichthys acanthorhinus*, 18 cm SL, holotype (Gulf of Oman).

Source: Randall *et al.* 1982

**DISTRIBUTION** Indian Ocean. WIO: Gulf of Aqaba, Red Sea, Gulf of Oman and India (Kerala); elsewhere, Andaman Is., Indonesia (Bali) and northern Australia.

**REMARKS** Found in ~200–600 m; collected as bycatch of trawlers.

*Ostichthys archiepiscopus* (Valenciennes 1862)

Longsnout soldierfish

PLATE 69

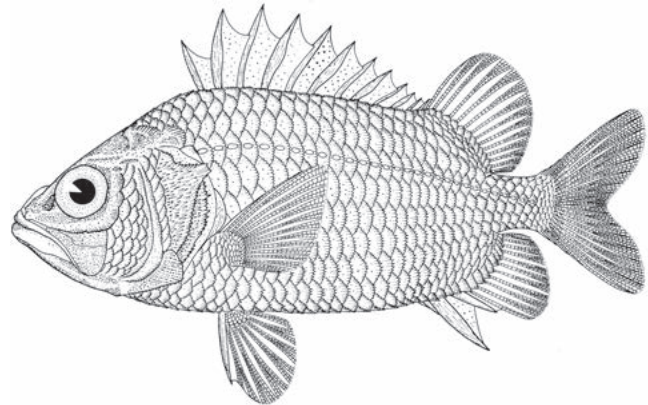
*Myripristis archiepiscopus* Valenciennes 1862: 1169 [5] (Réunion, western Mascarenes).

*Myripristis pillwaxii* Steindachner 1893: 150 (Yokohama, Japan or Honolulu, Oahu I., Hawaii).

*Ostichthys archiepiscopus*: Randall *et al.* 1982\*; SSF No. 132.31; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 12 spines, 13–15 rays; anal fin 11 or 12 rays; pectoral fin 15 rays; GR 23–30. Head profile nearly straight; snout long, 3.7–4.3 in HL; no spine at front end of nasal bone or at corner of preopercle in adults; last dorsal-fin spine slightly shorter than penultimate spine; space between last dorsal-fin spine and first ray  $\sim\frac{1}{2}$  distance between last 2 spines. LL scales 28–30; scales from 5th spine of dorsal fin to lateral line  $2\frac{1}{2}$ .

Body red, with stripes created by squarish whitish spots, one per scale. Attains 32 cm TL.



*Ostichthys archiepiscopus*, 20 cm SL (Japan). Source: Randall *et al.* 1982

**DISTRIBUTION** Indo-Pacific. WIO: Réunion and Mauritius; elsewhere to Indonesia, Ryukyu and Ogasawara Is., Mariana Is., Society Is. and Hawaii.

**REMARKS** Taken by trawls and hook and line, in 146–400 m.

*Ostichthys delta* Randall, Shimizu & Yamakawa 1982

Redcoat soldierfish

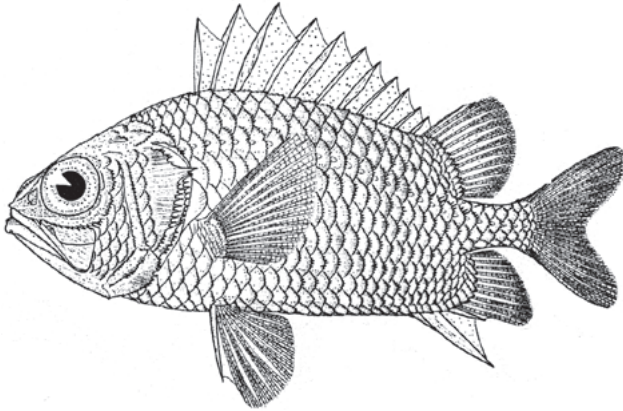
PLATE 69

*Ostichthys delta* Randall, Shimizu & Yamakawa 1982: 18, Fig. 11 (Saint-Paul Bay, Réunion, western Mascarenes); SSF No. 132.32; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 11 spines, 13 or 14 rays; anal fin 10–12 rays, fin origin below origin of soft-rayed dorsal fin; pectoral fins 16 or 17 rays; GR 20–22. Head profile slightly convex; snout not

long, 4.2–4.8 in HL; no spine at front of nasal bone or at corner of preopercle in adults; vomerine teeth in nearly triangular patch (V-shaped in other species). LL scales 27 or 28; scales from 5th spine of dorsal fin to lateral line  $2\frac{1}{2}$ .

Body uniformly red. Attains 20 cm TL.



*Ostichthys delta*, 15 cm SL, holotype (Réunion). Source: Randall *et al.* 1982

**DISTRIBUTION** Indo-Pacific. WIO: Comoros and Réunion; elsewhere, Samoa (probably more widespread).

**REMARKS** Type specimens caught by trammel net, in 150–200 m. Only one other species, *O. ovaloculus* Randall & Wrobel 1988, from Tahiti, has 11 dorsal-fin spines.

### *Ostichthys sufensis* Golani 1984

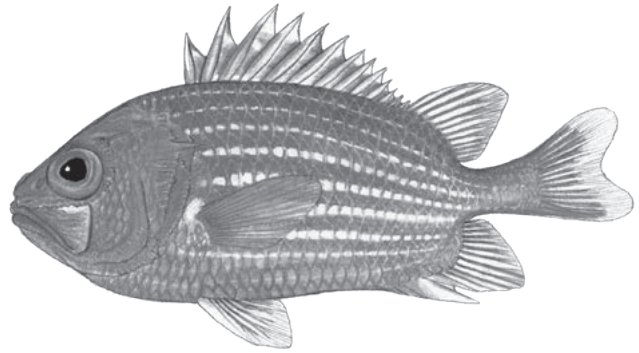
Red Sea soldierfish

PLATE 69

*Ostichthys hypsipterygion sufensis* Golani 1984: 98, Fig. 1 (Nuweiba, Egypt, Gulf of Aqaba, Red Sea); Baranes & Golani 1993; Goren & Dor 1994.

Dorsal fin 12 spines, 13 rays, fin margin deeply notched before soft-rayed portion; anal fin 11 rays; pectoral fins 15 rays; GR 20. Head profile convex; snout short, 4.8–5.6 in HL, maxilla widely expanded posteriorly; no spine at front of nasal bone or at corner of preopercle in adults; 3rd spine of dorsal fin longest, 1.8–1.9 in HL; last dorsal-fin spine slightly shorter than penultimate spine; space between last dorsal-fin spine and 1st ray about equal to space between last 2 spines. Palatine tooth patches reach horizontal line through vomerine tooth patch. LL scales 28 or 29; scales from 5th spine of dorsal fin to lateral line  $3\frac{1}{2}$ ; vertical row of 8 or 9 scales at base of opercle; median pre-pelvic scales 14.

Head and body red, and body with narrow white stripes created by series of elongate white spots, one at centre of each scale. Attains 21 cm TL.



*Ostichthys sufensis*, 14 cm SL (Red Sea).

**DISTRIBUTION** WIO: northern Red Sea.

**REMARKS** Golani (1984) reported two specimens caught with gillnet, at ~300 m, in the Gulf of Aqaba, as a Red Sea subspecies of *O. hypsipterygion*, based on a narrower peduncle (peduncle depth 8.3–8.5% SL, compared to 8.9–9.6% SL for *O. hypsipterygion hypsipterygion*) and fewer pre-pelvic and opercular-base scales. A 16.5-cm specimen collected off Eilat, Gulf of Aqaba, at ~200 m, has peduncle depth 9.5% SL, similar to specimens from Japan, but the pattern of vomerine and palatine teeth and scale-count differences are valid, thus *O. sufensis* is treated as a species.

### GENUS *Plectrypops* Gill 1862

No large spine at angle of preopercle; nasal bones projecting over upper jaw; last dorsal-fin spine shortest; 3rd spine of anal fin longest; vertebrae 27. *Holotrachys* Günther 1874 is a synonym. Two species: 1 in western Atlantic and 1 in Indo-Pacific.

### *Plectrypops lima* (Valenciennes 1831)

Shy soldierfish

PLATE 70

*Myripristis lima* Valenciennes *in* Cuv. & Val. 1831: 493 (Mauritius, Mascarenes).

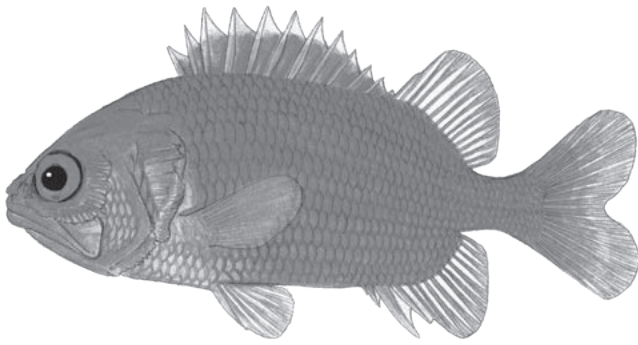
*Holotrachys lima*: Smith 1955\*.

*Plectrypops lima*: SSF No. 132.34\*; Winterbottom *et al.* 1989; Winterbottom & Anderson 1997; Heemstra *et al.* 2004.

Dorsal fin 12 spines, 14–16 rays; anal fin 10–12 rays; pectoral fins 16 or 17 rays; total GR 22–25. Body depth 2.3–2.6 in SL; HL 2.4–4.6 in SL; dorsal-fin spines short, longest spine ~3 in HL. LL scales 39–42; scales above lateral line to 5th spine of dorsal fin  $4\frac{1}{2}$ .

Body uniformly bright red. Attains 16 cm TL.





*Plectrypops lima*, 10 cm SL (Comoros). Source: SSF

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Mozambique, South Africa (Sodwana Bay; Aliwal Shoal), Madagascar, Comoros, Seychelles, Chagos, Mauritius and Rodrigues; elsewhere to Cocos (Keeling) Is., Japan, New Caledonia, Lord Howe I., Tonga, Rapa Iti, Hawaii, Revillagigedo Is., Clipperton I. and Easter I.

**REMARKS** Found in shallow water, typically hiding in deep recesses of coral reefs by day, from shore to ~32 m deep.

## GENUS *Pristilepis*

Randall, Shimizu & Yamakawa 1982

Premaxillary groove (between nasal bones) elongate, narrow; nasal bones projecting over upper jaw; slightly enlarged spine at angle of preopercle; dorsal fin 12 spines, last spine shortest; anal fin 4 spines; vertebrae 29. One species.

### *Pristilepis oligolepis* (Whitley 1941)

Spinyface soldierfish

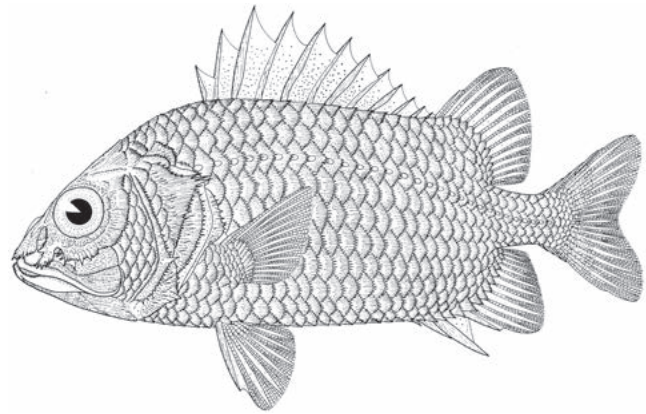
PLATE 70

*Holotrachys oligolepis* Whitley 1941: 28, Pl. 1, Fig. 19 (between Cape Naturaliste and Geraldton, Western Australia).

*Pristilepis oligolepis*: Randall *et al.* 1982\*; SSF 132.35\*; Fricke 1999; Fricke *et al.* 2009.

Dorsal fin 14 or 15 rays; anal fin 11 or 12 rays; pectoral fins 15 or 16 rays; GR 6–8/13 or 14. Body depth 2.2–2.5 in SL; HL 2.4–2.5 in SL. LL scales 28–30; scales above lateral line to midbase of spinous dorsal fin 2½.

Head and body reddish orange, each scale with white spot forming pattern of longitudinal white lines. Attains 30 cm TL.



*Pristilepis oligolepis*, 20 cm SL (Japan). Source: Randall *et al.* 1982

**DISTRIBUTION** Indo-Pacific to eastern Pacific. WIO: Comoros and Réunion; elsewhere to Japan, Australia, Lord Howe I., Hawaii and Easter I.

**REMARKS** Found in 14–220 m.

## GLOSSARY

**nasal fossa** – the cavity or pit, containing nasal papillae, into which the nostrils open.

**retorse spines** – pointing or curved backward.

**rhomboidal** – diamond-shaped.

**rugose** – with a rough or wrinkled surface.

**spinoid (scales)** – modified ctenoid scales with spines fused to the surface and/or posterior margin.

**spinules** – small, spine-like structures.

**supramaxilla** – a small bone along the upper rear edge of the maxilla.

**symphyseal (or symphyial)** – relating to a symphysis.

**symphysis** – the median point or junction of the two halves of the jaws; an immoveable joint between two bones.

**villiform** – having the appearance of velvet or fine bristles of a brush.



# ORDER ZEIFORMES

Phillip C Heemstra

Fishes with a disc-like or oblong body, more or less compressed; dorsal fin continuous or deeply notched before soft rays, with 5–11 spines, 22–37 rays; anal fin 0–4 spines, 20–38 rays; pelvic fins thoracic, with or without a spine, 5–10 rays; caudal fin rounded or shallowly forked, with 13 or 15 principal rays and 11 or 13 branched rays; dorsal-, anal- and pectoral-fin rays unbranched; gill arches 3½, without slit behind last hemibranch; branchiostegal rays 7 or 8.

The order comprises 6 families, all present in coastal waters of WIO. The family definitions and generic assignments have changed recently in view of morphological (mainly osteological) information provided by Tyler *et al.* (2003).

## KEY TO FAMILIES

- 1a Mouth minute, not protrusile; upper jaw length <½ eye diameter; caudal fin 13 branched rays; scales vertically elongate ..... **GRAMMICOLEPIDIDAE**



- 1b Mouth moderate to large, protrusile; upper jaw length >½ eye diameter; caudal fin 11 branched rays; scales absent or small, but not vertically elongate ..... **2**

- 2a Body depth subequal to HL, 2.3–3.1 in SL; anal fin with 1 weak spine or spine absent ..... **ZENIONTIDAE**



- 2b Body depth distinctly greater than HL, 1.9–2.1 in SL; anal fin with 1–4 small to large spines ..... **3**

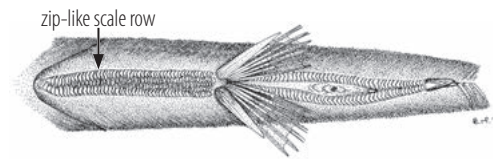
Continued ...

## GLOSSARY

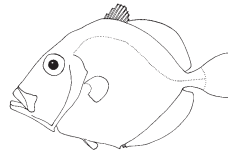
**hemibranch** – a gill with filaments only on one side of gill arch.  
**isthmus** – the lower part of the head that separates the two gill chambers.

## KEY TO FAMILIES

- 3a Zip-like double row of enlarged curved scales on ventral surface, from front of isthmus to converging behind anus; dorsal and anal fins with sheath of 2 rows of scales along each side of fin base ..... **CYTTIDAE**



- 3b No zip-like row of enlarged scales along ventral surface; no scaly sheath at base of dorsal and anal fins ..... **4**



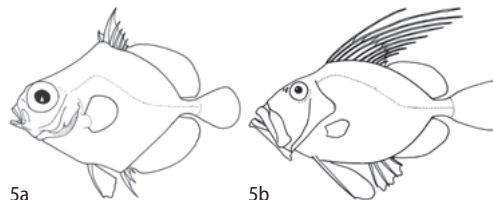
- 4a Caudal fin shallowly forked, with 9 branched rays; body oblong, its depth subequal to HL, 2.5–3.1 in SL ..... **PARAZENIDAE**



- 4b Caudal fin truncate or rounded, with 11 branched rays; body rhomboid or disc-like, depth distinctly greater than HL, 1.3–2.3 in SL ..... **5**

- 5a Preorbital depth (least distance from eye to maxilla) narrow, distinctly <½ eye diameter; dorsal fin 4–8 spines, spines grooved ..... **OREOSOMATIDAE**

- 5b Preorbital depth greater than eye diameter; dorsal fin 5–10 spines, spines not grooved ..... **ZEIDAE**



5a

5b

## FAMILY ZEIDAE

## Dories

Phillip C Heemstra

Disc-shaped, compressed body and head; body depth greater than HL, 1.5–2.8 in SL. Ventral part of abdomen and chest region with bony scutes. Head bones thin. Mouth oblique, large; lower jaw projecting, upper jaw greatly protrusile, maxilla exposed when mouth closed; lips well-developed; a few minute, conical or villiform teeth at front of jaws and on vomer, no teeth on palatines. Eyes above horizontal axis through upper jaw symphysis; eye diameter 2.3–5.5 in HL and less than upper jaw length. Dorsal fin 8–11 spines, 22–37 rays, and fin with distinct notch before rays; anal fin 1–4 spines, 19–27 rays; dorsal-, anal- and pectoral-fin rays unbranched; pelvic fins larger than pectoral fins; caudal fin 11 branched rays. Branchiostegal rays 7; membranes free from isthmus; gill arches  $3\frac{1}{2}$  (no opening medial to 4th arch); gill rakers rudimentary. Lateral line inconspicuous. Body naked or scales minute, spinoid or cycloid, and deciduous.

Moderate-sized (22–90 cm TL); occur in tropical and temperate seas, near the bottom, at 35–460 m. Two genera and 6 species; 2 genera and 3 species in WIO.

## KEY TO GENERA

- 1a Bony bucklers along base of spiny and soft-rayed portions of dorsal fin; anal fin 3 spines, 24–26 rays ..... *Zenopsis*  
 1b No bony bucklers along spiny dorsal-fin base; anal fin 4 (rarely 5) spines, 20–23 rays ..... *Zeus*

GENUS *Zenopsis* Gill 1862

Body disc-shaped or rhomboidal (juveniles) to oval (adults), much compressed; no scales except along lateral line; upper jaw extremely protrusile. Row of bony bucklers, each with small central spine, along each side of dorsal- and anal-fin bases; pelvic fins 6 or 7 rays, no spine; anal fin 3 spines. Four species, 1 in WIO.

*Zenopsis conchifer* (Lowe 1852)

## Buckler dory

PLATE 73

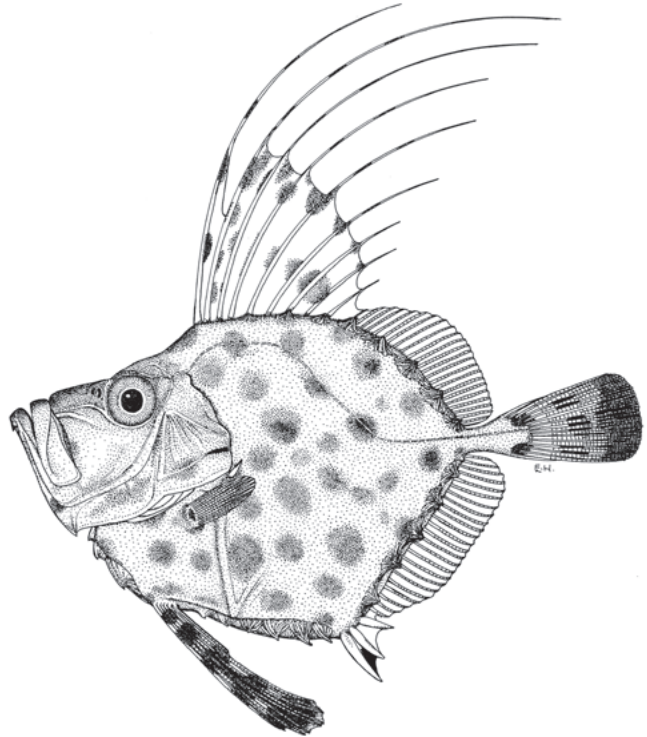
*Zeus conchifer* Lowe 1852: 247 (off Madeira, NE Atlantic).

*Zenopsis conchifer*: Smith 1949; Heemstra 1980\*; SSF No. 138.3\*;

Tyler *et al.* 2003\*.

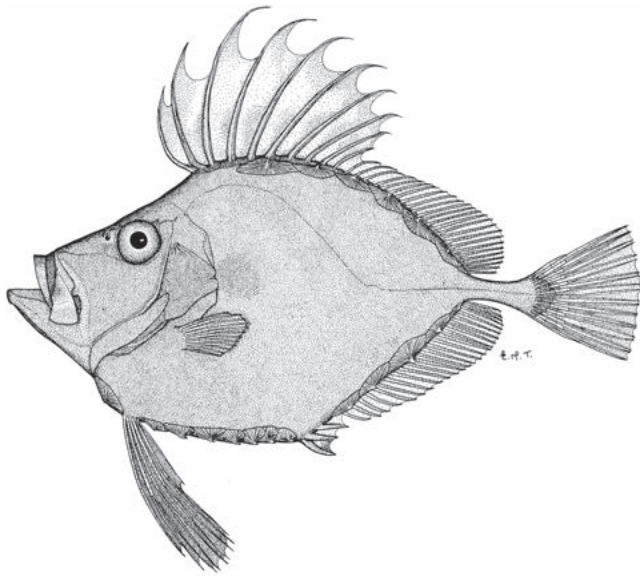
Dorsal fin 9 or 10 elongate, filamentous spines, 24–27 rays; anal fin 3 spines, all moveable, 24–26 rays; pectoral fins 12 rays; pelvic fins 6 or 7 rays, 1st ray split along its entire length but unsegmented. Dorsal- and anal-fin spines with low longitudinal ridges. Body oval or disc-shaped, strongly compressed, depth 1.5–2 in SL; HL 2.4–2.8 in SL; eye diameter 3.5–4.7 in HL; peduncle least depth ~3 in peduncle length and 3.5–5% SL. One to 3 large bony bucklers, each with low central spine and radiating ridges, along each side of spinous dorsal fin; 4 or 5 bucklers along each side of soft-rayed dorsal fin; and 5–7 bucklers along anal-fin base. Ventral midline of isthmus with 2 or 3 bucklers in front of pelvic fins, and 7 pairs of keeled bony bucklers between pelvic fins and anal fin. Curved conical teeth in 1 or 2 rows on jaws, and a few small canines on vomer. Vertebrae 12 + 23 or 13 + 22.

Body and head silvery grey, often with faint dusky spot above and behind pectoral fins; pelvic fins and spinous portion of dorsal fin blackish. Juveniles silvery, with several ill-defined dark spots. Attains 80 cm TL, ~3.2 kg.



*Zenopsis conchifer*, 9 cm SL, juvenile (Angola).

Source: Tweddle & Anderson 2008



*Zenopsis conchifer*, 14 cm SL (South Africa). Source: SSF

**DISTRIBUTION** Atlantic Ocean (Canada to Argentina; Ireland to South Africa), and WIO: South Africa (False Bay) to India.

**REMARKS** Females mature at ~40 cm TL. Demersal, on muddy or silty-sand bottoms, in 50–360 m; solitary or in small aggregations. Feeds mainly on fishes, but also crustaceans and squid.

**GENUS** *Zeus* Linnaeus 1758

Body oval, strongly compressed; dorsal head profile straight; body covered with minute rudimentary embedded scales (not discernible on fish <12 cm SL). Breast and belly compressed ventrally, with 2 rows of 7–10 large keeled scutes from pelvic fins to anal-fin origin; 1 large scute covering most of isthmus and a few smaller ones in front of it. Pelvic fins separate, with 1 spine, 6 or 7 rays. Curved conical teeth in 1 or 2 rows on jaws, and a few small canines on vomer. Vertebrae 12 + 23 or 13 + 22 = 35. Two species, both in WIO.

**KEY TO SPECIES**

- 1a Five to 7 large bony bucklers, each with 1–3 spines, along each side of soft dorsal- and anal-fin bases; usually large blue-black, yellow-edged ocellus at midbody below lateral line. . . . . *Z. faber*
- 1b Row of 9–13 small spines along each side of soft dorsal- and anal-fin bases; body dusky silver, often with faint dusky blotch above lateral line and below anterior dorsal-fin rays. . . . . *Z. capensis*

*Zeus capensis* Valenciennes 1835

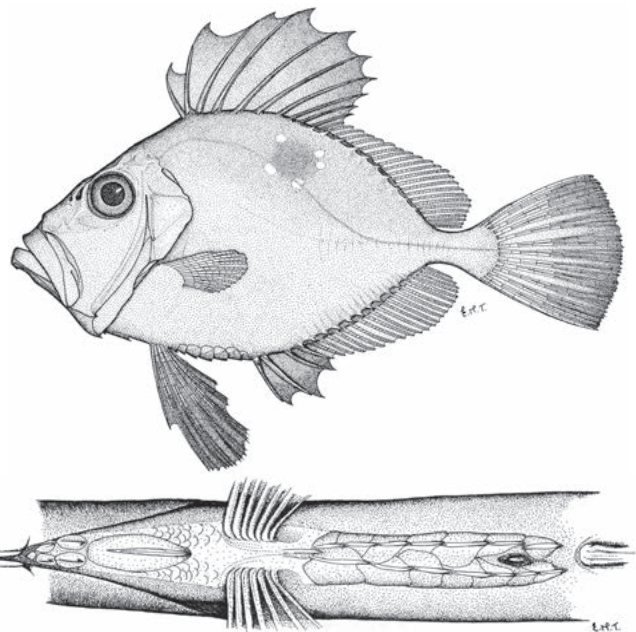
Cape dory

PLATE 73

*Zeus capensis* Valenciennes in Cuv. & Val. 1835: 23 (Cape of Good Hope, South Africa); Barnard 1925\*; Heemstra 1980\*; SSF No. 138.4\*; Tyler *et al.* 2003; Heemstra & Heemstra 2004.  
*Zeus faber* (non Linnaeus 1758): Smith 1949\*.

Dorsal fin 9 or 10 spines, spines 2–8 elongate, but not filamentous, 22–24 rays; anal fin 4 spines, all moveable and with longitudinal grooves, 20–22 rays; pectoral fins 13 or 14 rays; pelvic fins 1 spine, 6 rays. Body disc-shaped, strongly compressed, depth 1.8–2.1 in SL; HL 2.4–2.6 in SL; eye diameter 2.9–3.4 in HL; peduncle depth 1.2–1.4 in peduncle length and 6.6–7.6% SL. Belly compressed; ventral edge with 2 rows of 7 keeled scutes, each with a retrorse spine, from pelvic fins to anal-fin origin; 9–12 broad-based spines along each side of soft dorsal- and anal-fin bases.

Body and head silvery grey or brownish, often with faint dusky blotch bordered by 5 or 6 silver spots below posterior dorsal-fin spines and above lateral line. Attains 90 cm TL (females larger than males).



*Zeus capensis*, 28 cm SL; chest and belly with 2 rows of bony bucklers (South Africa). Source: SSF

**DISTRIBUTION** Southern Africa: Namibia (St Helena Bay) in southeastern Atlantic, to Mozambique (Beira) in WIO.

**REMARKS** Females mature at 34–38 cm TL (4 years) and attain ~90 cm TL, ~6 kg (13 years); males mature at 25–28 cm TL and attain ~45 cm TL. Found on muddy or silty-sand bottoms, in 35–294 m.



*Zeus faber* Linnaeus 1758

John dory

PLATE 73

*Zeus faber* Linnaeus 1758: 267 (Seas of Europe); Heemstra 1980\*;  
SSF No. 138.5\*; Tyler *et al.* 2003\*; Heemstra & Heemstra 2004\*.

*Zeus japonicus* Valenciennes *in* Cuv. & Val. 1835: 24 (Japan); Smith 1949\*  
[Fig. 270 is *Zeus capensis*].

Dorsal fin 9–11 spines, spines 3–7 greatly elongated and filamentous, 22–24 rays; anal fin 4 spines, all moveable, 22–24 rays; pectoral fins 13 or 14 spines; pelvic fins 1 spine, 6 or 7 rays; dorsal- and anal-fin spines with low longitudinal ridges. Body disc-shaped, strongly compressed, depth 1.5–2 in SL; HL 2.2–2.6 in SL; eye diameter 3.7–4.9 in HL; peduncle depth 1.2–1.4 in peduncle length and 6.6–7.6% SL. Belly compressed; ventral surface with 2 rows of 7–10 keeled bony scutes, each with a retrorse spine, from pelvic fins to anal-fin origin; 5–8 bony bucklers along each side of soft-rayed dorsal- and anal-fin bases.

Head and body silvery bronze, with golden or brownish wavy horizontal streaks; usually a large blue-black, yellow-edged ocellus at midbody below lateral line. Attains 90 cm TL, ~8 kg (males ~13 years, females ~15 years).



*Zeus faber*, 35 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Eastern Atlantic (Norway to South Africa), North Sea, Baltic Sea, Black Sea, Mediterranean Sea and Indo-Pacific. WIO: Mozambique to South Africa (False Bay), Madagascar and Saya de Malha Bank; elsewhere to Japan, Australia and New Zealand.

**REMARKS** Juveniles (8–25 cm TL) feed on small demersal fishes; adults (30–90 cm TL) prey on larger, schooling, pelagic species. Caught in trawls over muddy or silty-sand bottoms, in 20–400 m.

## FAMILY CYTTIDAE

## Zipper dories

Phillip C Heemstra

Body strongly compressed and disc-shaped; dorsal fin continuous, but distinctly notched before soft rays; caudal fin truncate. Mouth large, oblique, greatly protrusile; narrow band of minute conical teeth on jaws, and similar teeth on vomer. Dorsal fin 8–10 spines, 35–37 rays; dorsal-fin spines slender, the longest subequal to longest dorsal-fin ray; anal fin 1 or 2 small spines, 35–39 rays; caudal fin truncate, 11 branched rays; dorsal-, anal- and pectoral-fin rays unbranched. Pelvic fins close together, below pectoral fins, with well-developed spine and 6 soft rays. Ventral surface of abdomen with zip-like double row of scutes, from front of isthmus to pelvic fins, where the rows open to include the anus and then converge at anal-fin origin. Dorsal fin and anal fin with scaly sheath of 2 rows of scales along each side of fin bases, but no scutes, bucklers or spines on body at these fin bases. Body covered with small spinoid scales; cheeks scaly. Branchiostegal rays 7; gill arches 3½ (no slit behind last hemibranch). Vertebrae 11 + 31.

One genus, *Cyttus* Günther 1860, with 3 species confined to Southern Hemisphere; 1 species in WIO.



## *Cyttus traversi* Hutton 1872

Zipper dory

PLATE 73

*Cyttus traversi* Hutton 1872: 19 (Saltwater Creek, Canterbury, New Zealand); James 1976\*; Heemstra 1980\*; SSF No. 138.2\*; Gomon *et al.* 1994\*; Heemstra & Heemstra 2004.

*Cyttoides jacksoni* Smith 1947: 795 (off Algoa Bay, South Africa).

Dorsal fin 9 or 10 spines, 35–37 rays; anal fin 2 spines, 36–38 rays; pectoral fins 17 or 18 rays; pelvic fins 1 spine, 6 rays; lower GR 12, with 4 rudiments. Body depth 1.4–1.6 in SL; HL 2–2.6 in SL; eye diameter 2.6–4 in HL.

Adults silvery, with upper body and fins faintly reddish; pectoral-fin bases black. Juveniles (<10 cm SL) silvery with dark brownish blotches, median black stripe from interorbital area to dorsal-fin origin, and along dorsal-fin base to upper surface of peduncle; dorsal-fin spines and pelvic-fin rays with dark brown or pale appendages. Attains 65 cm TL.



*Cyttus traversi*, 36 cm SL, lectotype of *Cyttoides jacksoni* (South Africa).  
Source: SSF

**DISTRIBUTION** Indo-Pacific and eastern Atlantic. WIO: south coast of South Africa and southern Mozambique; elsewhere, Walvis Ridge (off Namibia and South Africa) in southeastern Atlantic, south coast of Australia and New Zealand.

**REMARKS** Adults demersal at ~200–800 m. The distinctive juvenile stage of this species is very similar to those of some carangid fishes (e.g., *Alectis* and *Selene*) and is evidently pelagic; the filamentous dorsal- and pelvic-fin rays, with their numerous appendages, look much like the trailing tentacles of some siphonophores (e.g., *Forskalia edwardsi*).

## GLOSSARY

**bucklers** – bony plates located at the base of certain fins or on the belly.

**demersal** – living on or just above the bottom of the sea or lake.

**hemibranch** – a gill with filaments only on one side of gill arch.

**scutes** – a modified (thickened) bony scale with a keel or spiny point.

**siphonophores** – colonial, free-swimming or floating pelagic hydrozoans, mostly delicate and transparent with long filamentous tentacles.

## FAMILY PARAZENIDAE

### Parazens

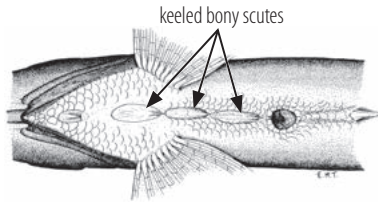
Phillip C Heemstra

Head and body compressed, oblong; body slender to moderately deep, depth 1.3–3 in SL. Mouth large, oblique, greatly protrusile; maxilla widely expanded posteriorly and mostly exposed when mouth is closed; no supramaxilla. Teeth on jaws small, slender, conical, in 1 or 2 rows; vomer with a few short teeth; no teeth on palatines. Two contiguous dorsal fins: 1st dorsal fin with 6–8 slender spines, 2nd dorsal fin with 26–36 rays (weakly developed locking mechanism between first 2 dorsal-fin spines present in *Parazen*); anal fin 1 minute spine (in *Cyttopsis* this spine is sometimes fused to the pterygiophore, and the 1st anal-fin ray loses segmentation at ~10 cm SL, becoming ossified and like a 2nd spine in large specimens), 27–33 rays; pectoral fins 13–16 rays, fin length subequal to eye diameter; dorsal-, anal- and pectoral-fin rays unbranched; pelvic fins abdominal, no spine, 1 unbranched ray and 7–9 branched rays, fin origin behind vertical at pectoral-fin bases; caudal fin rounded or forked, 11 branched rays. Branchiostegal rays 7. Lateral line single, originating on body at upper end of opercle and gradually descending to midlateral region of peduncle (previous reports of 2 lateral lines for *Parazen* were based on confused observation of the midlateral septum as a remnant of a lateral line without its scales). Scales small, deciduous, weakly spinoid (*Parazen*) or cycloid (*Cyttopsis* and *Stethopristes*); head naked, the bones thin and soft, and opercular bones weakly serrate. Vertebrae 32–34.

Closely related to family Zeidae. Three genera and 4 species; 2 genera and 2 species in WIO.

## KEY TO GENERA

- 1a Dorsal fin usually 7 (rarely 8) spines; pelvic fins midway between pectoral-fin bases and anus, with 9 rays; pectoral fins 13–15 (usually 14) rays; row of 3 elongate, keeled bony scutes, each ending in a spine, between pelvic-fin bases and anus; scales cycloid ..... *Cyttopsis*



- 1b Dorsal fin 8 spines; pelvic fins slightly in front of pectoral-fin bases, with 7 rays; pectoral fins 15 or (usually) 16 rays; no bony scutes between pelvic-fin bases and anus; scales spinoid ..... *Parazen*

GENUS *Cyttopsis* Gill 1862

Bony discontinuous ridge along each side of soft dorsal- and anal-fin bases, formed by lateral expansions of distal ends of pterygiophores. Thoracic area flattened, broadly V-shaped; pelvic fins widely separated, distance between fin origins (10–13% SL) less than twice distance from middle of branchiostegal membranes to fin origins. Median row of 3 large keeled scutes, each ending in a spine, between pelvic fins and anus; scutes better developed in juveniles, with 3 or 4 smaller scutes set at anterior end of V-shaped isthmus. Two species, 1 in WIO. *Cyttopsis cypho* (Fowler 1934) from the Philippines has fewer LL scales and a dusky spot on lateral line below middle dorsal-fin rays; Fowler (1934: Fig. 103) wrongly shows the dorsal- and anal-fin rays as branched.

*Cyttopsis rosea* (Lowe 1843)

Rosy dory

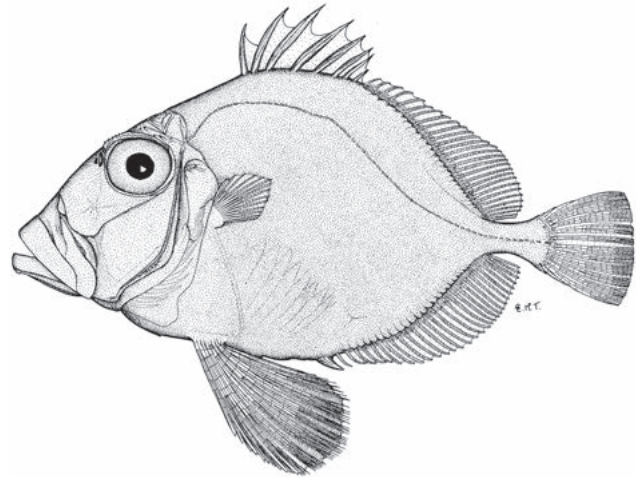
PLATE 74

*Zeus roseus* Lowe 1843: 85 (off Madeira).*Paracyttopsis scutatus* Gilchrist & Von Bonde 1924: 18, Pl. 5 (KwaZulu-Natal, South Africa); Barnard 1925.*Zen scutatus*: Norman 1939; Smith 1949.*Cyttopsis roseus*: Heemstra 1980\*; SSF No. 138.1\*; Tyler *et al.* 2003\*.

Dorsal fin 7 or 8 spines, 28–30 rays; anal fin 1 or 2 spines, 28–30 rays, compressed, immovable, 1st spine much larger than 2nd; pectoral fins 13 or 14 rays; caudal fin rounded. Dorsal- and anal-fin spines longitudinally ridged and grooved, more apparent in juveniles. Jaws with bands of villiform,

granular teeth; similar teeth on vomer. Body depth 1.7–2 in SL; HL 2.4–2.7 in SL; eye diameter 2.3–2.9 in HL, 13–18% SL; interorbital width 1.6–2 in eye diameter; peduncle depth 5.3–6.7% SL. GR rudimentary low knobs, 1 or 2/8–10. Vertebrae 32.

Head and body reddish silvery. Attains 31 cm TL.



*Cyttopsis rosea*, 19 cm SL (South Africa). Source: SSF

**DISTRIBUTION** Atlantic Ocean (Canada to Caribbean Sea; Ireland and Bay of Biscay to Gabon) and Indo-Pacific. WIO: Somalia to South Africa (KwaZulu-Natal), Maldives and India; elsewhere to Japan, Australia, New Caledonia and New Zealand.

**REMARKS** Demersal, at 150–600 m.

GENUS *Parazen* Kamohara 1935

Head naked, the bones thin and soft, and opercular bones weakly serrate. Gill rakers short and flattened, 2 on upper limb, 8 on lower limb (including rudiments). Eyes large, diameter  $\sim \frac{1}{3}$  HL, slightly less than snout length. Vomer with a few short stout teeth. Dorsal-, anal- and pectoral-fin rays unbranched; pelvic fins 1 unbranched ray and 5 or 6 branched rays, and fin origin behind vertical at pectoral-fin bases; caudal fin forked. Vertebrae 34. One species.

*Parazen pacificus* Kamohara 1935

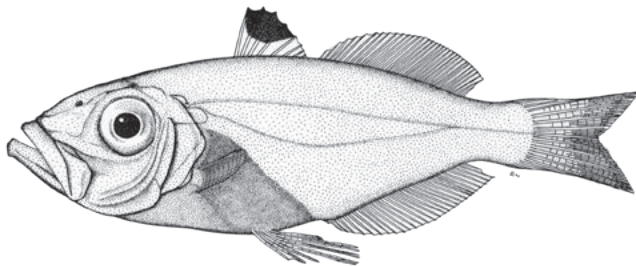
Parazen

PLATE 74

*Parazen pacificus* Kamohara 1935: 245 [247 in English], Fig. (Mimase, Kochi Prefecture, Japan); Kotlyar 2001\*; Tyler *et al.* 2003\*.

Diagnosis as for genus. Body depth slightly less than HL, 2.6–2.9 in SL; 1st dorsal fin 8 slender spines; 2nd dorsal fin 26–30 rays; anal fin 1 spine, 30–33 rays; pectoral fins 15 or 16 rays.

Head and body reddish dorsally, silvery below; fins whitish; large black blotch on first dorsal-fin margin. Attains 25 cm SL.



*Parazen pacificus*, 7 cm SL (Tanzania). Source: Heemstra 1999

**DISTRIBUTION** Western Atlantic (Gulf of Mexico, Cuba, Puerto Rico and Colombia) and Indo-Pacific. WIO: Tanzania to South Africa (KwaZulu-Natal); elsewhere, reportedly common in Japan, but patchy elsewhere.

**REMARKS** Rare, benthic, over continental slope. Caught in bottom trawls from 150–600 m.

## FAMILY OREOSOMATIDAE

### Oreos

Phillip C Heemstra

Small- to moderate-sized (~18–60 cm TL), body oblong to rhomboidal, deep and compressed; body depth greater than HL, 1.3–1.9 in SL. Head large, broad, dorsally flattened, bones thin and superficially rough. Eyes huge, diameter greater than snout length, 40–50% HL. Mouth oblique; lower jaw projecting, upper jaw protrusile; maxilla exposed when mouth closed. Teeth minute, in 1 or 2 rows at front of jaws, and present or absent on vomer. Dorsal fin 4–8 spines, 27–36 rays, fin margin deeply notched before soft rays; anal fin 2–4 spines, 25–34 rays; pectoral fins small and rounded, longest ray subequal to eye diameter; pelvic fins 1 spine, 5–7 branched rays; caudal fin rounded, 11 branched rays; dorsal-, anal- and pectoral-fin rays unbranched. Branchiostegal rays 7, membranes free from isthmus; gill arches 3½ (no opening medial to partial 4th arch); gill rakers rudimentary. Lateral line complete to caudal-fin base. Scales minute, spinoid and adherent, or cycloid and deciduous; most prejuveniles with expanded abdomen and areas of enlarged modified scales forming protuberances of various shapes and sizes. Vertebrae 34–43.

Most oreosomatids have a prolonged, large-sized (~5–8 cm SL), pelagic prejuvenile stage, which usually looks unlike the demersal adult. Eggs and larvae float near the surface, and prejuveniles may drift for several months (4–5 years for some species) in surface currents before transforming to the juvenile stage and taking up residence near the bottom on the continental slope. Adults are demersal on the continental slope and outer shelf, generally at depths well below 200 m. Slow-growing and not mature until ~30 years old, and may live beyond 100 years. Vulnerable to overfishing because of their slow growth and low productivity.

Occur in temperate waters of all oceans, but most common in Southern Hemisphere and of some commercial importance off Japan, Australia and New Zealand. Four genera and ~10 species; all 4 genera and possibly 4 species in WIO, with the currently extralimital species *Allocyttus guineensis* also included here.

#### KEY TO GENERA OR SPECIES

[Juveniles and adults, 10–51 cm TL; descriptions of prejuvenile stages are included in the species accounts.]

- 1a Opercle entirely scaly; 1st visible spine of dorsal fin longer than 2nd spine; dorsal fin 31–36 rays; pelvic fins 1 spine, 5 rays ..... *Pseudocyttus maculatus*
- 1b Opercle partly scaly; 1st visible spine of dorsal fin much shorter than 2nd spine; dorsal fin 26–34 rays; pelvic fins 1 spine, 6 or 7 rays ..... 2
- 2a Scales on sides of body smooth and deciduous; eye diameter 52–60% HL; opercle scaly with strong horizontal ridge on upper part ..... *Oreosoma atlanticum*
- 2b Most body scales spinoid and adherent; eye diameter 41–52% HL; opercle with radiating bony striae ..... 3
- 3a Predorsal profile (nape) straight, slightly convex or slightly concave; dorsal-fin spines + rays 32–41 ..... *Allocyttus*
- 3b Predorsal profile (nape) distinctly concave and then rising abruptly before dorsal-fin origin; dorsal-fin spines + rays 38–42 ..... *Neocyttus* [deep water]

#### GENUS *Allocyttus* McCulloch 1914

Body oblong to rhomboidal, compressed, and predorsal profile straight or slightly convex or concave. Body depth 46–73% SL; HL 40–47% SL; eye diameter 39–49% HL. Dorsal- and anal-fin spines short; 2nd spine of dorsal fin <½ eye diameter. Scales spinoid and strongly adherent, some with blunt conical tubercle at centre of scale. Four species, 1 or 2 in WIO.



## KEY TO SPECIES

- 1a Scales adherent and strongly spinoid; adults (>30 cm TL) with 2 horizontal rows of enlarged scales on abdomen; juveniles (<25 cm TL) with swollen abdomen bearing 2 curved rows of large blister-like outgrowths, upper row just below pectoral fins and lower row just above pelvic fins ..... *A. verrucosus*
- 1b Scales adherent but smooth to touch; no enlarged scales or wart-like tubercles on abdomen ..... *A. guineensis*

*Allocyttus guineensis* Trunov & Kukuev 1982

## Chocolate oreo

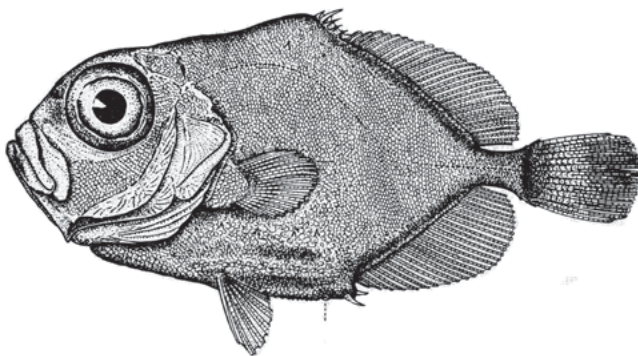
?*Neocyttus helgae* (non Holt & Byrne): Backus *et al.* 1965\*.

*Allocyttus guineensis* Trunov & Kukuev in Trunov 1982: 45,

Fig. (off Angola); SSF No. 139.1\*; Karrer 1990.

Body oblong; predorsal profile slightly concave in adults, slightly convex in prejuveniles (<70 mm SL). Body depth 55–78% SL; HL ~40% SL; eye diameter 42–46% HL. Dorsal fin 4–6 spines, 30–32 rays; anal fin 2 spines, 26–29 rays; pectoral fins 17 or 18 rays; pelvic fins 1 spine, 6 rays. Fin spines weak, longest dorsal- and anal-fin spines <½ eye diameter. Total GR 22–26. Scales small, cycloid and adherent, with blunt conical tubercle at centre of each; cheek and upper part of opercle scaly, main part with fine radiating bony striae. Prejuvenile specimen (73 mm SL) with distinctly swollen abdomen and swollen area before and below dorsal-fin spines, and scales of swollen areas enlarged.

Adults uniformly dark brown. Attains at least 23 cm SL.



*Allocyttus guineensis*, 23 cm SL, holotype (Angola).

Source: Trunov & Kukuev 1982

**DISTRIBUTION** Eastern Atlantic: Mauritania to Angola, northern Gulf of Guinea, and South Africa (off Cape Town).

**REMARKS** Included here in the likelihood of its being found in WIO off South Africa (False Bay). Adults known from 230–1 900 m.

*Allocyttus verrucosus* (Gilchrist 1906)

## Warty oreo

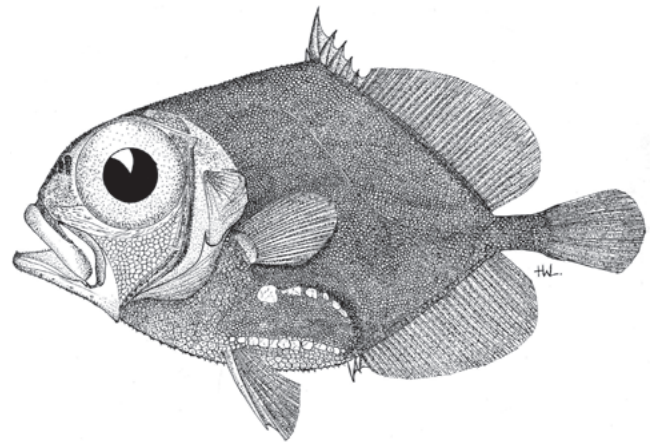
PLATE 74

*Cyttosoma verrucosum* Gilchrist 1906: 151, Pl. 40 (off Cape Point, South Africa).

*Allocyttus verrucosus*: SFSA No. 227\*; Trunov 1982; Uyeno *et al.* 1983\*; SSF No. 139.2\*; James *et al.* 1988\*; Bray 1994 [Fig. 380 labelled '*Oreosoma atlanticum*'].

Body rhomboidal, predorsal profile straight to slightly convex or concave. Body depth 57–67% SL (juveniles 8–22 cm SL, to adults 23–38 cm SL); HL 39–46% SL; eye diameter 39–50% HL. Dorsal fin 5–8 short spines (1st spine shorter than 2nd which is <½ eye diameter), 27–33 rays; anal fin 2 or 3 spines, 25–30 rays; pectoral fins 17–20 rays; pelvic fins 1 spine, 6 rays. Teeth villiform, in band on jaws and small patch on vomer. Total GR 20–27. Scales small, adherent, with blunt conical tubercle at centre; abdomen with 2 horizontal rows of enlarged scales forming small wart-like excrescences. Prejuvenile (36 mm SL) with abdomen grossly swollen, resembling a tumour-like appendage, bearing 2 curved rows of large blister-like outgrowths, the upper row just below pectoral fins and the lower row just above pelvic fins. Vertebrae 34–37.

Body of adults blackish violet to pale blue-grey, and prejuveniles greenish silvery dorsally, with large dark grey blotches; inside of mouth and gill cavity black. Attains 43 cm SL, age ~140 years.



*Allocyttus verrucosus*, ~20 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Eastern Atlantic (Mauritania to South Africa, and Walvis Ridge), western Atlantic (Suriname, Brazil and Uruguay), western to eastern Pacific (Australia, New Zealand and Chile), and in WIO: South Africa (False Bay) to Mozambique Channel and Walters Shoals.



**REMARKS** Males mature at 18–25 cm TL, and females at 23–28 cm TL. Adults demersal in large shoals on continental slope and on seamounts and undersea ridges, in ~400–1 500 m; juveniles pelagic and found near the surface. Feeds on a variety of crustaceans (mainly shrimp), fishes and squid.

**GENUS** *Oreosoma* Cuvier 1829

*Oreosoma* Cuvier 1829 has priority over *Cyttosoma* Gilchrist 1904. One species.

*Oreosoma atlanticum* Cuvier 1829

Ox-eye oreo

PLATE 75

*Oreosoma atlanticum* Cuvier in Cuv. & Val. 1829: 515, Pl. 99 [labelled

*O. coniferum*] (Atlantic Ocean); Smith 1961\*; SSF No. 139.4\*;

James *et al.* 1988\*.

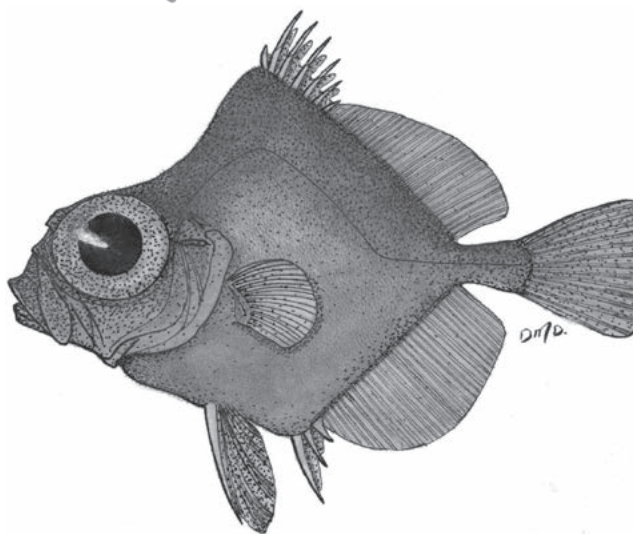
*Cyttosoma boops* Gilchrist 1904: 6, Pl. 23 (off Cape Point, South Africa); SFSA No. 275\*.

Predorsal profile strongly concave and then rising abruptly. Adults (>11 cm SL) extremely deep-bodied, body depth 57–72% SL; HL 36–40% SL; eye diameter 50–60% HL; peduncle relatively long and slender, depth 5.2–6.7% SL, length 9.7–12% SL. Dorsal fin 6–8 spines (2nd spine 3–4 times longer than 1st spine), 28–30 rays; anal fin 3 or 4 spines, 27–30 rays; pectoral fins 19–22 rays; pelvic fins 1 strong and rugose spine, 6 or 7 rays. Teeth villiform on jaws, none on vomer. Total GR 25–32. Opercle partly scaly, with distinct, serrate, horizontal ridge behind middle of eye and no radiating bony striae. Scales small, cycloid, adherent; LSS 82–98. Prejuveniles (<10 cm SL) oval, broadly triangular in cross-section; head, upper and rear parts of body compressed, but lower part of body (from chest to above anal fin) grossly expanded; lateral margin of lower abdomen with 5 pairs of symmetrically arranged cones: 1st pair directed anteriorly and the last pair posteriorly, and central pair largest; 1 cone on either side of anus and a pair of cones in front of pelvic-fin bases, all projecting ventrally; single cone before anus and 2 pairs between anus and pelvic fins; several small cones or tubercles along midventral area; 2 pairs of dorsally projecting cones on predorsal area. Vertebrae 36–38.

Head and body blackish violet; cones and irregular blotches on body iridescent greenish silvery. Attains 21 cm TL.



*Oreosoma atlanticum*, 11 cm TL, anterior view (South Africa). Source: SSF



*Oreosoma atlanticum*, 15 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Circumglobal in Southern Hemisphere (except South America), including southeastern Atlantic (off Tripp Seamount, on Walvis Ridge, and off Cape Town, South Africa), and in WIO between 30° and 35° S, from South Africa to southern Mozambique (Maputo); pelagic prejuveniles also known from Australia and New Zealand.

**REMARKS** Adults recorded southeast of Tripp Seamount in 220–1 500 m.

GENUS *Pseudocyttus* Gilchrist 1906

Prejuveniles originally described as *Xenocyttus* Abe 1957.  
One species.

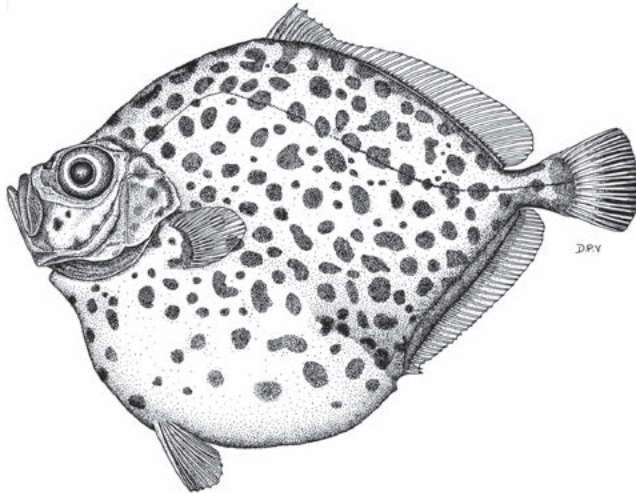
*Pseudocyttus maculatus* Gilchrist 1906

Rough-edge oreo

PLATE 75

*Pseudocyttus maculatus* Gilchrist 1906: 153, Pl. 41 (off Cape Point, South Africa); Trunov 1982; SSF No. 139.5\*; James *et al.* 1998\*.  
*Xenocyttus nemotoi* Abe 1957: 228, Pls. 1–2 (Antarctic Ocean); Gon & Heemstra 1990\*.

Body oval, compressed; predorsal profile convex. Body depth of juveniles to adults (15–30 cm SL) 53–62% SL; HL 34–38% SL; eye diameter 37–43% HL. Prejuveniles (<10 cm SL) nearly circular and strongly compressed, abdomen slightly swollen, and with 3 small protuberances in horizontal line halfway between pectoral-fin bases and anal-fin origin. Dorsal fin 5 or 6 spines (1st spine longer than 2nd), 31–36 rays; pectoral fins 19–22 rays; pelvic fin 1 spine (not reaching anus), 5 branched rays; anal-fin 2 or 3 spines, 27–30 rays. All fin spines weak, longest less than eye diameter. Teeth villiform on jaws, no teeth on vomer.



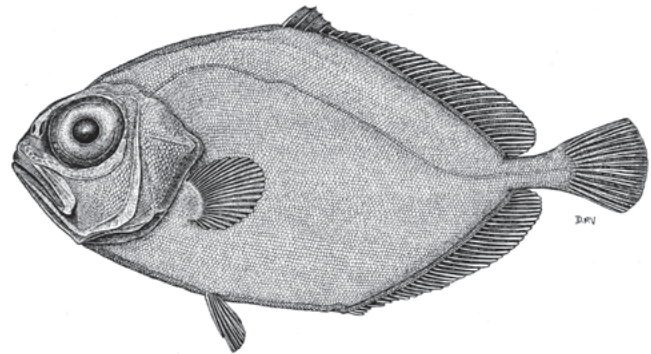
*Pseudocyttus maculatus*, 16 cm SL (South Africa). Source: FSO

Total GR 24–34. Scales small, cycloid and adherent; body scales limpet-shaped, scales on dorsal surface with short, sharp central spine; adults with band of rough scales or tubercles (each with 1–3 small spines) along dorsal and ventral margins of body, from head to peduncle; opercle covered with scales (but no horizontal ridge or radiating striae); LSS 82–98. Vertebrae 40–43.

Fresh adult ripe female (50 cm TL) deep brown with darker fins; prejuveniles silvery grey, with numerous small black spots, fainter on abdomen. Attains 68 cm TL, ~5 kg (age ~100 years).

**DISTRIBUTION** Circumglobal in temperate and polar seas of Southern Hemisphere, including northern part of Walvis Ridge and Namibia to South Africa (off Cape Town) in southeastern Atlantic. WIO: Agulhas Plateau, Kerguelen Is., South Africa to Mozambique Channel and Walters Shoals; elsewhere, Australia, New Zealand, Tasmania, Argentina and Chile.

**REMARKS** Transition from prejuvenile to juvenile stage occurs at 14–18 cm SL. Juveniles pelagic near the surface, usually in association with krill; adults demersal at 44–734 m; tends to aggregate around seamounts. Targeted in its broad geographic range and taken as a bycatch in *Hoplostethus atlanticus* (roughy) fishery.



*Pseudocyttus maculatus*, 31 cm SL (South Africa). Source: FSO

## FAMILY ZENIONTIDAE

### Dwarf dories

Phillip C Heemstra

Small-sized and oblong (to 16 cm SL), body compressed but belly ventrally flattened; body depth subequal to HL (with upper jaw retracted), 2.3–2.7 in SL. Head bones thin, with several serrate ridges. Eye diameter distinctly greater than snout length, 1.9–2.8 in HL. Mouth vertical when closed; lower jaw projecting, upper jaw extremely protrusile, and its length (from symphysis of retracted premaxillae to rear end of maxilla) subequal to eye diameter; with mouth closed, maxilla slips under preorbital bone and the upper lip overlaps front part of preorbital bone; lips well-developed. Teeth minute, conical and few, at front of jaws; no teeth on vomer and palatines. Dorsal fin continuous but deeply notched before soft rays, with 6 or 7 spines (front edge of 2nd spine distinctly serrate, and 2nd and 3rd spines can be locked erect), 25–31 rays. Pectoral fins small and rounded, with 15–17 rays, length of longest ray  $\sim\frac{1}{2}$  eye diameter. Pelvic fins widely separated and much longer than pectoral fins, with 1 strong serrated spine that can be locked erect and 6 branched rays. Anal fin 1 weak spine (rarely 2 spines), 23–28 rays. Caudal fin 11 branched rays, 2 or 3 spiniform procurrent rays (on both upper and lower edges). Dorsal-, anal- and pectoral-fin rays unbranched. Branchiostegal rays 7, membranes free from isthmus; gill arches  $3\frac{1}{2}$  (no medial opening to partial 4th arch); total GR 13–16, with 1–3 rudiments on lower limb, and 2 or 3 rudiments on upper limb. Lateral line inconspicuous. Scales minute, spinoid. Vertebrae 25–27.

The family name Zeniontidae is used here following Nelson (2006); Paxton *et al.* (1989) states that Macrourocyttidae is an older family-group name. One genus with 2 or 3 species, 2 in WIO.

## GENUS *Zenion* Jordan & Evermann 1896

Nothing has been published on the biology of these species, which occur near bottom, in 180–700 m, in a variety of habitats. Of no commercial interest as food fish because of their small size. Reported from the Atlantic and Indo-Pacific. Two valid species. The characters thought to differentiate *Zenion longipinnis* Kotthaus 1970 and *Z. japonicus* Kamohara 1934 (both synonyms of the nominal species *Z. hololepis*) are erroneous. Specifically, in both nominal species the course

of the lateral line is the same and the isthmus of *Z. hololepis* is completely scaly, although the scales are missing from the holotype due to abrasion in the trawl and the pelvic-fin membrane in *Zenion* species is fragile and easily torn in trawls.

### KEY TO SPECIES

- |    |   |
|----|---|
| 1a | Body depth less than length of anal-fin base; anal fin 1 spine, 28–32 rays ..... <i>Z. leptolepis</i>   |
| 1b | Body depth greater than length of anal-fin base; anal fin 1 spine, 23–28 rays ..... <i>Z. hololepis</i> |

## *Zenion hololepis* (Goode & Bean 1896)

Dwarf dory

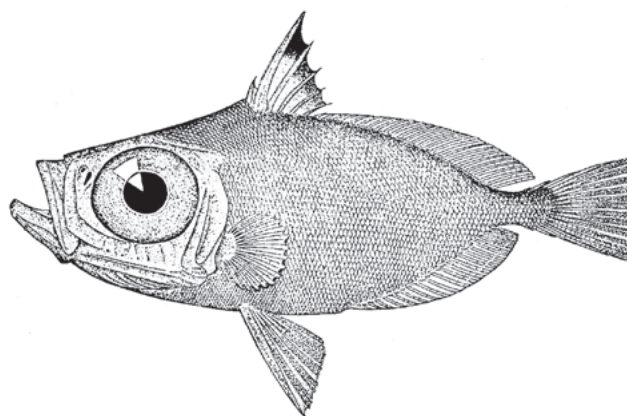
PLATE 75

*Cyttus hololepis* Goode & Bean 1896: 225, Pl. 65, Fig. 233 (off Yucatán, Caribbean Sea).

*Zenion hololepis*: SFSA No. 272\*; SSF No. 141.1\*.

Diagnosis as for family. Body depth 2.3–2.7 in SL. Dorsal fin 6 or 7 spines, 23–28 rays; pectoral fins 16 or 17 rays; pelvic fins 1 spine, 6 rays. Total GR 16–18; LL scales 67.

Body dusky silver and reddish dorsally, head reddish orange; margin of spinous dorsal fin black. Attains 11 cm SL.



*Zenion hololepis*, ~8 cm TL, type. Source: Goode & Bean 1896

**DISTRIBUTION** Western and eastern Atlantic, North Pacific (Japan), and in WIO: Kenya to Mozambique (Xai-Xai).

**REMARKS** Bathydemersal, over mud and sand bottoms, in 180–700 m.

*Zenion leptolepis* (Gilchrist & Von Bonde 1924)

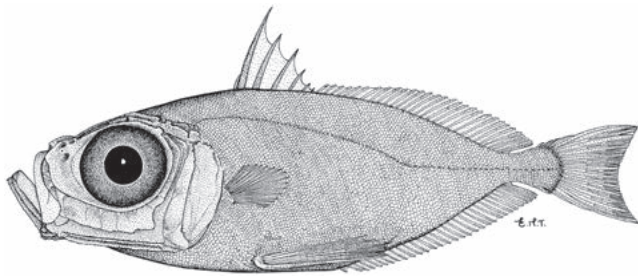
Elongate dory

PLATE 75

*Cyttus leptolepis* Gilchrist & Von Bonde 1924: 17 (KwaZulu-Natal, South Africa).*Zenion leptolepis*: SFSA No. 273; SSF No. 141.2\*; Adam, Merrett & Anderson 1998; Tyler, O'Toole & Winterbottom 2003.

Diagnosis as for family. Body depth 2.3–2.7 in SL. Dorsal fin 6 or 7 spines, 28–33 rays; pectoral fins 15–17 rays; pelvic fins 1 spine, 5 or 6 rays. Total GR 15–18; LL scales ~54.

Body dusky silver. Attains 16 cm SL.



*Zenion leptolepis*, 6 cm TL (Kenya). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (KwaZulu-Natal) to Mozambique (off Quisanga), Kenya, Saya de Malha Bank and south of St Brandon Shoals; elsewhere, New Zealand.

**REMARKS** Bathypelagic; known from 185–700 m.

**FAMILY GRAMMICOLEPIDIDAE**

## Tinsselfishes

Phillip C Heemstra

Head and body greatly compressed, oval as adults, and diamond-shaped as juveniles; body depth much greater than HL, 1.4–2.3 in SL; HL 2.9–4.4 in SL. Mouth minute, upper jaw protrusile, its length ~½ eye diameter; maxilla ridged, bound to ascending process of premaxilla and loosely connected to palatines, and not reaching vertical at front edge of eye; jaws with 1 or 2 rows of minute conical teeth; vomer without teeth or with 3 or 4 minute teeth. Two contiguous dorsal fins: 1st dorsal fin with 5–7 spines, 2nd dorsal fin with 27–34 rays; anal fin 2 spines, 27–35 rays; pectoral fins much shorter than HL; dorsal-, anal- and pectoral-fin rays unbranched; pelvic fins 1 slender spine, 6 rays; caudal fin 13 branched rays. Branchiostegal rays 7,

membranes joined to isthmus; gill arches 3½, no slit behind last hemibranch, and pseudobranchiae present; gill rakers rudimentary, with flat tooth plates attached to skin covering 1st gill arch. Scales vertically elongated, covering body, cheeks and opercle; row of small spines along each side of dorsal- and anal-fin bases.

Worldwide, except eastern Pacific and polar seas. Adults benthopelagic, commonly at ~100–900 m. Two monotypic genera: *Grammicolepis* Poey 1873 and *Xenolepidichthys* Gilchrist 1922; both species in WIO.

**KEY TO GENERA AND SPECIES**

- 1a Dorsal fin 2 spines, 39–41 rays; juveniles (<24 cm SL) with 10 or 11 widely separated, spiny scutes on sides of body and peduncle ..... *Grammicolepis brachiusculus*
- 1b Dorsal fin spines + rays 32–35; no spiny scutes on sides of body at any life stage ..... *Xenolepidichthys dalgleishi*

*Grammicolepis brachiusculus* Poey 1873

Thorny tinsselfish

PLATE 76

*Grammicolepis brachiusculus* Poey 1873: 403 [1], Pl. 12 (Havana, Cuba); Quéro 1979\*; Trunov 1982; SSF No. 140.1\*; Tyler *et al.* 2003.

*Xenolepidichthys americanus* (*non* Nichols & Firth 1939): Barnard 1948\*; SFSA No. 279a.

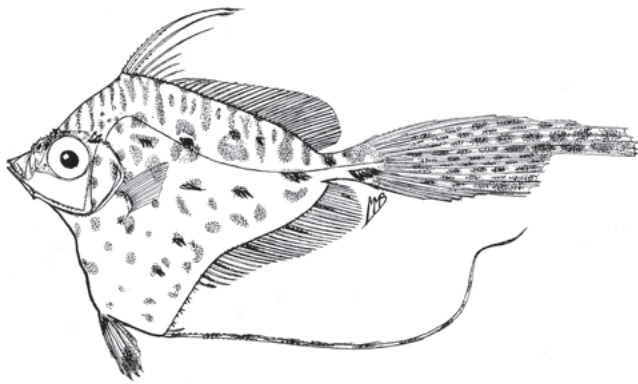
*Daramattus armatus* Smith 1960: 231, Pls. 3–4 (East London, South Africa); Smith 1968\*.

*Daramattus barnardi* Smith 1968: 8 (off Table Bay, South Africa) [based on *Xenolepidichthys americanus* of Barnard 1948: 363, Fig. 7, Pl. 9].

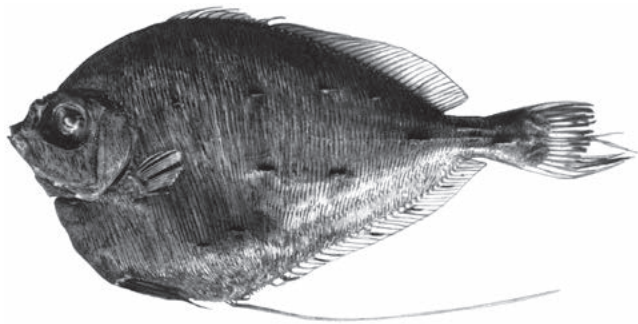
Dorsal fin 6 or 7 spines, 32–34 rays; anal fin 2 spines, 31–35 rays; pectoral fins 14–16 rays; caudal fin 13 branched rays. Spines along bases of dorsal fin and anal fin 36; LL scales 110; GR rudimentary, 1 or 2/12. Body depth 1.4–1.6 in SL (juveniles), 2–2.3 in SL (adults); HL 3.2–3.8 in SL (juveniles), ~4.4 in SL (adults). Body of prejuveniles with conspicuous horizontally flattened spiny scutes, and 1st spine of anal fin, 2nd spine of dorsal fin, and caudal-fin rays greatly elongated (each usually longer than HL); metamorphosis begins at 25–30 cm SL, with spiny scutes lost and elongated fin rays greatly shortened as body becomes more elongate in adults. First spine of dorsal fin minute and articulates with pterygiophore extending to base of 1st neural spine. Vertebrae 43–46.

Body silvery dorsally, often mauve below. Juveniles with several irregular black spots on body; anal fin with ~5 black bars; caudal fin with black spots. Attains 64 cm TL.

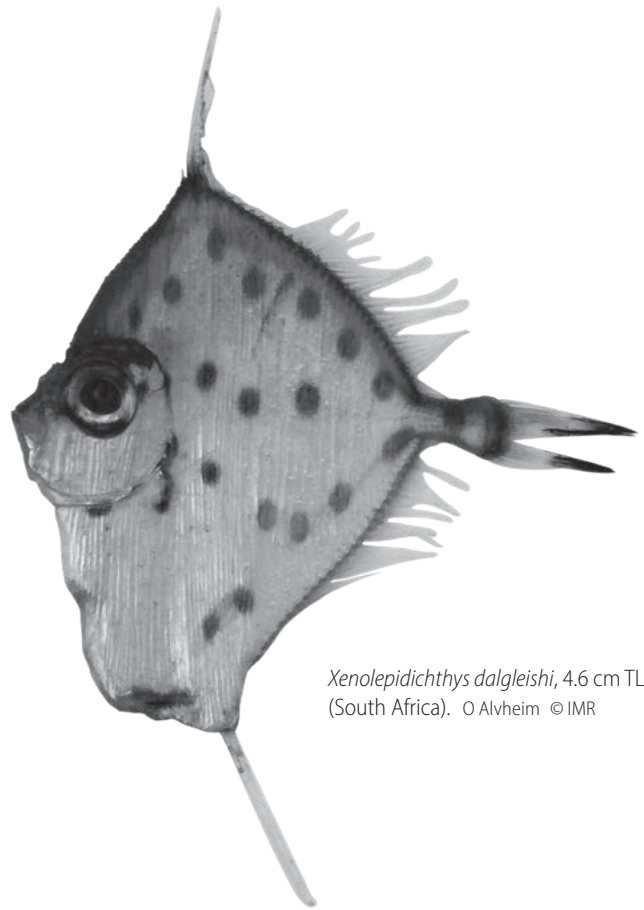




*Grammicolepis brachiusculus*, 10 cm SL, holotype of *Daramattus armatus* (South Africa). Source: Smith 1960



*Grammicolepis brachiusculus*, 24 cm TL, holotype of *Daramattus barnardi* (South Africa). Source: SSF



*Xenolepidichthys dalgleishi*, 4.6 cm TL (South Africa). O Alnheim © IMR

**DISTRIBUTION** Atlantic (Cuba to Suriname; Azores and Spain to South Africa) and Indo-Pacific. WIO: South Africa (False Bay to Durban, KwaZulu-Natal); elsewhere, Japan and Hawaii.

**REMARKS** Benthopelagic, at ~180–1 000 m.

### *Xenolepidichthys dalgleishi* Gilchrist 1922

Spotted tinselfish

PLATE 76

*Xenolepidichthys dalgleishi* Gilchrist 1922: 73, Pl. 12, Fig. 1 (off KwaZulu-Natal, South Africa); Smith 1935\*; Barnard 1948\*; SFSA No. 279; SSF No. 140.2\*.

Dorsal fin 5 spines, 27–29 rays; anal fin 2 spines, 27–29 rays; pectoral fins 14 or 15 rays. Spines along dorsal-fin base 29; spines along anal-fin base 26 or 27. Body depth 0.8–1.2 in SL; HL 2.9–3.7 in SL; eye diameter 2–2.5 in HL (specimens 5–12 cm SL). Vertebrae 36–39.

Body silvery, with several diffuse round black spots; anterior pelvic-fin rays and caudal-fin margin black. Attains 15 cm TL.

**DISTRIBUTION** Atlantic (Virginia to Brazil; Senegal to South Africa) and Indo-Pacific. WIO: South Africa (Western Cape) to Tanzania, Mozambique Channel and Madagascar; elsewhere, Philippines, Japan, Australia, New Zealand, New Caledonia, Fiji and Tonga.

**REMARKS** Benthopelagic, on continental slope, at 128–885 m (usually ~200–400 m).

# ORDER

# GASTEROSTEIFORMES

Kate A Moots

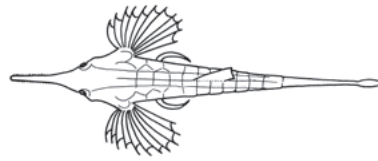
This order comprises 11 families, with at least 350 species of rather odd-looking, specialised fishes. Johnson & Patterson (1993), Britz & Johnson (2002), Takata & Sasaki (2005), and Keivany & Nelson (2006) all discuss characters supporting the monophyly of the order. However, relationships based on analyses of mitochondrial DNA sequence data do not support its monophyly (Miya *et al.* 2001; Miya *et al.* 2003; Kawahara *et al.* 2008; Song *et al.* 2014; Longo *et al.* 2017), although the groups retrieved are inconsistent from one analysis to the next and the researchers suggest that the alternative groupings are affected by which taxa are included in the analyses.

Gasterosteiforms reportedly date from as early as the Upper Cretaceous (100–66 MYA) (Sorbini 1981), with considerable diversity reported from the Eocene (56–33.9 MYA) (Blot 1980). The most basal 4 families — Hypoptychidae (sand eels), Aulorhynchidae (tubesnouts), Gasterosteidae (sticklebacks) and Indostomidae (armoured sticklebacks) — are not present in WIO. The remaining 7 families are all part of a monophyletic Syngnathoida (Keivany & Nelson 2006). The most speciose family is the Syngnathidae (pipefishes and seahorses), with more than 300 species.

Mostly coastal, although some species are found in brackish and fresh water. Most occur in <30 m, although individuals have been collected from >1 000 m. Most species attain <15 cm TL; pygmy seahorses mature at <20 mm TL, whereas flutemouths may exceed 1.5 m TL. Most gasterosteiforms feed by using their tubular snout to suck in small crustaceans, larval fishes and other small invertebrates; the larger trumpetfishes may hunt for larger prey items in association with goatfishes, snappers, emperors or groupers. Species may be solitary, paired, found in small groups, or form large schools. Modes of reproduction vary from broadcast spawning (e.g., shrimpfishes), to nesting with male-guarding (e.g., sticklebacks), to females brooding the developing embryos between the pectoral fins (e.g., ghost pipefishes), to males brooding the developing embryos in a pouch (e.g., seahorses). Not generally consumed as food fishes, although they may be ground into fishmeal. The greatest threats to these fishes seem to be their use in East Asia as a medicinal ingredient (which led to the listing of all seahorses in CITES Appendix II), their commercial sale as dried souvenir curios, and habitat degradation of their favoured nearshore environments. A few species are important in the aquarium trade, but their food requirements make them a challenge even for the experienced aquarist.

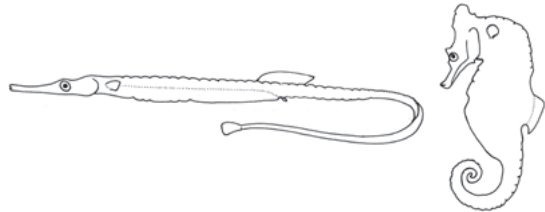
## KEY TO FAMILIES

- 1a Rostrum of fused nasal bones projecting over inferior protrusile mouth; pectoral fins larger than trunk, horizontally expanded and wing-like; trunk broad and depressed ..... **PEGASIDAE**



- 1b Mouth at tip of elongated, tubular snout; pectoral fins smaller than head, vertically oriented, and often minute or absent; trunk either laterally compressed or elongate ..... **2**

- 2a No pelvic fins; trunk and tail enclosed in series of bony rings; gill openings restricted to small dorsolateral pore on each side of head ..... **SYNGNATHIDAE**



- 2b Pelvic fins present; trunk and tail naked or with scales, spinules, denticles or plates that do not form complete rings; gill openings not restricted ..... **3**

- 3a Body elongate, diameter of head and body similar; maximum length >30 cm ..... **4**

- 3b Body not elongate, laterally compressed and much deeper than head depth at level of eyes; maximum length <30 cm ..... **5**

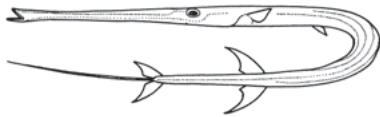
- 4a Caudal fin rounded; 8–12 isolated dorsal spines preceding soft dorsal fin of 22–28 rays; anal fin 23–28 rays; body slightly compressed, with small scales; fleshy barbel at tip of lower jaw; anus closer to anal fin than to pelvic fins ..... **AULOSTOMIDAE**



Continued ...

**KEY TO FAMILIES**

- 4b Caudal fin forked, with middle 2 rays fused into filament almost as long as head; dorsal fin 13–20 rays (no spines, but row of elongated bony plates may precede soft rays); anal fin 13–20 rays; body slightly depressed and naked in adults (juveniles with rows of small hooked spinules); no barbel at tip of lower jaw; anus closer to pelvic fins than to anal fin ..... **FISTULARIIDAE**

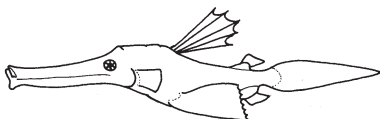


- 5a Dorsal margin of body deformed, terminates at 1st dorsal-fin spine, such that the 2nd and 3rd spines, dorsal-fin rays, and caudal fin are ventral in position; body with thin, smooth, transparent bony plates, resulting in thin, glassy ventral edge; most commonly observed in vertical, head-down position ..... **CENTRISCIDAE**

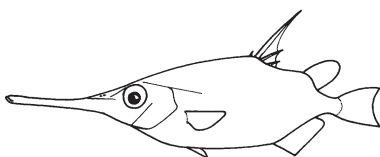


- 5b Body terminates in a 'typical' caudal fin; body with embedded, sharp denticles or stellate, spiny plates; orientation in water column variable ..... **6**

- 6a First dorsal fin with 5 long, weak spines, all similar in length; 2nd dorsal fin with 17–22 unbranched rays on an elevated fin base; stellate, spiny plates embedded in thin skin, and no scales; pelvic fins of females as large as caudal fin and expanded to serve as a brood pouch ..... **SOLENOTOMIDAE**



- 6b First dorsal fin 4–8 spines, 2nd spine very long and stout; 2nd dorsal fin 11–19 rays; dorsolateral bony plates present on body, and scales embedded, sharp and denticle-like; pelvic fins of males and females small, about size of eyes ..... **MACRORAMPHOSIDAE**



**FAMILY PEGASIDAE**

**Seamoths**

Phillip C Heemstra

Small, bizarre-looking fishes with body greatly flattened and encased in bony plates formed of highly modified, fused scales. Dorsal and anal fins each with 5 unbranched rays, both fins set just behind carapace; pectoral fins enlarged, horizontal, with 10–12 unbranched rays; pelvic fins abdominal, with 1 slender spine and 2 contiguous rays, bound by membrane to the spine to form a slender, curved, claw-like appendage used for walking on the bottom. Tail enclosed in bony rings, but flexible; caudal fin truncate or rounded, with 8 unbranched rays. Preopercle greatly expanded medially; opercle and subopercle minute. Anterior rostrum comprising elongated nasal bones, fused along midline and projecting well in front of mouth. Mouth small, upper jaw protrusile; jaws toothless. Branchiostegal rays 5, filamentous, extending backwards and dorsally to a restricted gill opening. Gill filaments with 2 rows of small, rounded tufts attached to gill arches. No swimbladder. Vertebrae 19–22: 7 precaudal, the anterior 6 sutured together, 7th and 8th centra moveable, and 12–15 caudal vertebrae.

Related to pipefishes and seahorses (family Syngnathidae), which also have an armour of bony rings. However, pegasids are benthic fishes that rest or crawl along the bottom, often taking refuge on coral reefs or camouflaged on coarse sand or gravel substrates, or lie perched in a bushy crinoid. Unlike the pipefishes, in which the male carries the fertilised eggs until they hatch, male and female pegasids pair off as typical pelagic marine spawners. Their large colourful pectoral fins may be used for display (to impress females) and also for herding prey (small crustaceans). The biology of *Eurypegasis draconis* was described by Herold & Clark (1993). Osteology and phylogenetic relationships were treated by Pietsch (1978); excellent family revision was presented by Palsson & Pietsch (1989). Two genera and 5 species, all restricted to Indo-Pacific; 3 species in WIO.

**KEY TO GENERA**

- 1a Tail short (33–48% SL), with 8 or 9 bony rings; pectoral fins 9–12 unbranched segmented rays ..... *Eurypegasis*  
 1b Tail long (46–68% SL), with 11–14 bony rings; pectoral fins 9–19 unbranched spinous or soft rays ..... *Pegasis*

GENUS *Eurypegasus* Bleeker 1863

Tail with 8 or 9 laterally moveable rings; carapace with 3 pairs of dorsolateral plates and 4 pairs of ventrolateral plates; 2 deep pits on top of head, one behind each bony orbit; eyes not visible in dorsal view. Two species, 1 in WIO.

*Eurypegasus draconis* (Linnaeus 1766)

Broad seamoth

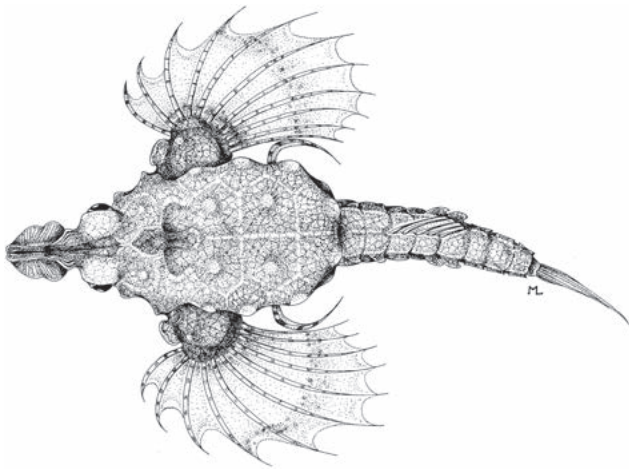
PLATE 76

*Pegasus draconis* Linnaeus 1766: 418 (India [Indonesia]).

*Eurypegasus draconis*: SSF No. 142.1\*; Palsson & Pietsch 1989\*; Herold & Clark 1993; Fricke 1999; Kuitert 2003\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Pectoral fins 9–12 flexible segmented rays; body depth 19–34% SL; interpectoral width 37–56% SL; rostrum length 11–39% SL.

Colour variable: dorsal and lateral parts of head and body usually brown with dark reticulum, but can change quickly to match the environment; pectoral fins hyaline, with broad white margin, and small brown spots forming irregular longitudinal stripes; median fins with small brown spots in irregular series. Attains 8.5 cm SL.



*Eurypegasus draconis*, 9 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific (widespread). WIO: northern Red Sea to South Africa (Algoa Bay), Madagascar, Comoros, Réunion, Mauritius, Maldives, Lakshadweep and India; elsewhere to Indonesia, Philippines, China, southern Japan, Marshall Is., Australia, New Caledonia, Lord Howe I., Tahiti and Marquesas Is.

**REMARKS** Found on sand or silt bottoms, at 3–91 m. Monogamous, with male and female pairs usually occurring

together; this pair bonding ensures the availability of a mate for spawning, and single fish have little opportunity to find a mate. When a single male approaches a pair, the paired male intrudes to prevent the single male from contact with his female partner. During the day, the pair crawls over the bottom using their leg-like pelvic fins, with the male closely following the female. Spawning occurs daily during the summer months. Able to shed their mucus skin in one piece, which is left as a transparent replica of the body, head and fins. Targeted for use in traditional Chinese medicine and also sold in the aquarium trade. IUCN Red List conservation status Data Deficient.

GENUS *Pegasus* Linnaeus 1758

Tail elongated and slender, with 11–14 rings, penultimate 2 or 3 rings fused together; carapace with 3 pairs of dorsolateral plates and 4 pairs of ventrolateral plates; pectoral fins 9–12 unbranched rays; no deep pits on top of head; eyes visible in dorsal view. Three species, 2 in WIO.

## KEY TO SPECIES

- 1a Tail rings 12: first 9 bony rings moveably articulated, last 3 fused together and dorsoventrally flattened; terminal tail ring with a pair of posteriorly directed spines; pectoral fins with 9–12 flexible segmented rays, and 5th ray not enlarged or thicker than other rays ..... *P. volitans*
- 1b Tail rings 11: first 8 bony rings moveably articulated, 9th and 10th rings fused together; pectoral fins with 10–12 unsegmented rays, and 5th ray enlarged, stiff and distinctly thicker than other rays ..... *P. laternarius*

*Pegasus laternarius* Cuvier 1816

Sabre seamoth

PLATE 76

*Pegasus laternarius* Cuvier 1816: 332 ('Indian seas'); Palsson & Pietsch 1989\*.*Pegasus volans* (*non* Linnaeus 1766): Johnstone 1904.

Body depth 16–24% SL; interpectoral width 33–49% SL. Distinguished by enlarged 5th pectoral-fin rays and relatively short rostrum (most developed in adult males).

Body dark brown dorsally and laterally; pale brown ventrally. Attains 8 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Mannar (Sri Lanka and southern tip of India); elsewhere to Gulf of Thailand, South China Sea, Taiwan and Japan.

**REMARKS** Usually captured by trawls on muddy bottoms, at 27–91 m. IUCN Red List conservation status Vulnerable.



*Pegasus volitans* Linnaeus 1758

Longtail seamoth

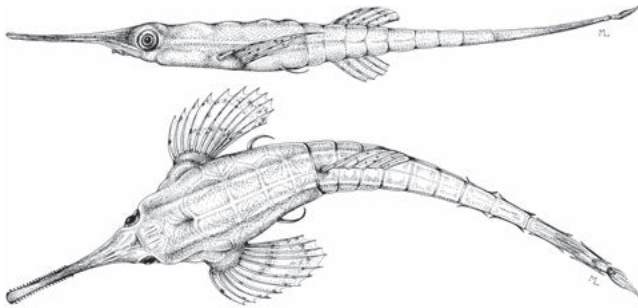
PLATE 77

*Pegasus volitans* Linnaeus 1758: 338 (several localities); Palsson & Pietsch 1989\*; Randall 1995\*.

*Pegasus natans*: SFSA No. 372\*; SSF No. 142.2\*.

Body depth 7–11% SL; rostrum length 17–33% SL; carapace width 13–17% SL; tail longer than carapace plus head.

Body pale brown to dark brown or black dorsally and laterally; pale ventrally; dorsal part of rostrum with 2 brown-black blotches alternating with yellow-white blotches; dark stripe from side of rostrum through eye and side of head to pectoral-fin base; tail with 6 dark bands; pale phase with numerous reddish brown and brown-black spots and blotches on dorsal surface, and dark phase with irregular yellow blotches dorsally. Attains 17.5 cm SL.



*Pegasus volitans*, 8 cm TL, lateral and dorsal views (S Mozambique).  
Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Oman, East Africa to South Africa (Aliwal Shoal) and Gulf of Mannar; elsewhere to Myanmar, Indonesia, Malaysia, South China Sea, Singapore, Philippines, Taiwan, Japan, New Guinea and Australia.

**REMARKS** Found on muddy and sandy bottoms, often in association with prawns, and occasionally in seagrass; known from surface to ~73 m deep. The species name *volitans* (Latin: 'to fly') is misleading. Although the large pectoral fins resemble wings, these benthic fishes rarely leave the bottom, and their pectoral fins are not designed for gliding as in the true flyingfishes of family Exocoetidae.

**FAMILY SOLENOSTOMIDAE**

Ghost pipefishes

Kate A Moots

Body short and laterally compressed, deepest between 1st dorsal-fin origin and pelvic-fin insertions; head large,  $> \frac{1}{3}$  SL; snout elongate, tubular and ending in small, vertically oriented, toothless mouth. Skin thin and embedded with stellate spiny plates, the number and position of which are taxonomically important features (Jungersen 1910; Orr & Fritzsche 1993). Mandibular barbel single and unbranched. Olfactory capsule a triangular open pit, with species-specific and sexually dimorphic numbers of spatulate lamellae. Gill filaments tufted, and pseudobranch often visible through opercle. Two widely separated dorsal fins, 1st elongate and weak, with 5 spines; 2nd dorsal fin and anal fin similar, rounded, opposite one another, with unbranched rays. Pectoral fins rounded, with unbranched rays. Pelvic fins opposite 1st dorsal fin, with 1 weak spine, 6 branched rays; in females, pelvic fins unite with breast expanding to form a brood pouch that encloses the developing young; cotypephores develop from skin overlying the rays and provide attachment for eggs and the exchange of gases to developing embryos (Wetzel & Wourms 1995). Peduncle defined as beginning at last complete ring (of 3 stellate plates on body) below anal fin and extending to caudal-fin base. Caudal fin truncate, rounded or lanceolate, with unbranched principal rays.

Body of most individuals with 2 or 3 elongate large dark blue or black spots between first 3 or 4 dorsal-fin spines (may or may not be visible in live fish); some individuals also with 2 elongate pale-coloured spots distal to the dark spots and approaching dorsal-fin margin. All fins typically same as body colour, except distal half of 2nd dorsal fin and anal fin usually hyaline. Males tend to be smaller than females; females of larger species may reach 11 cm SL. Transforming larvae show the least difference between species, making them particularly hard to identify as preserved specimens. Larvae are presumed to be pelagic after leaving the female's brood pouch. Transforming larvae and adults are found in a variety of habitats, including muddy open substrates, rocky reefs, rich coral reefs, or in association with vegetation. Known to ~95 m deep.

Feed on zooplankton and small invertebrates taken from the water column and from off the substrate or sessile invertebrates, such as sponges or hard or soft corals. Presumed to be 'annual species,' completing their entire lifecycle in ~1 year. Once the larvae leave the female's brood pouch, they are not seen again until the transforming larvae appear just before the breeding season. Transforming larvae are about adult-size; breeding adults seem to be present only seasonally.

Anecdotal evidence suggests that ghost pipefishes may be able to change sex. Adults are often seen in pairs or small groups, often with their head in a downward position; adults may also appear to drift with local eddies, resembling floating seagrass, until pursued by a potential predator or diver. Ghost pipefishes can be maintained in aquaria by advanced aquarists, but need a calm tank with gentle water circulation, adequate shelter, a refuge, and a large and nearly continuous supply of live food.

Confined to Indo-Pacific; 1 genus with 4–6 species (the validity of *Solenostomus leptosoma* Tanaka 1908 and *S. paegnius* Jordan & Thompson 1914 are debatable as they are not morphologically well-distinguishable from the other four species); at least 3 species in WIO. An additional undescribed species is probable in WIO, variously referred to as the Irish setter ghost pipefish, rufous ghost pipefish or fuzzy ghost pipefish, it appears similar in general body shape to *S. cyanopterus* but differs in having extensive branching red filaments covering its body and fins, creating a hairy appearance (see *Solenostomus* cf. *cyanopterus*; Plate 77). This fish prefers open substrates and is more commonly seen oriented horizontally rather than with head downwards.

## GENUS *Solenostomus* Lacepède 1803

### KEY TO SPECIES

- 1a Fifth dorsal- and anal-fin plates present; caudal-fin membrane deeply incised; nasal lamellae of males completely fill nasal cavity; cutaneous papillae profuse, finger-like and often bifid; in life, body hyaline with mosaic of variously coloured spots, bands, lines and reticulations over body, fins and cutaneous papillae ..... *S. paradoxus*
- 1b Fifth dorsal- and anal-fin plates absent; caudal-fin membrane entire or only slightly incised; nasal lamellae of males fill only half of nasal cavity; no cutaneous papillae, or else cutaneous papillae with broad bases and branching extensively and resembling red algae; in life, body generally uniform in colour, sometimes with weak spotting ..... 2
- 2a Fourth dorsal- and anal-fin plates present; pectoral fins 22–25 rays; peduncle relatively narrow, its depth  $\sim\frac{1}{2}$  its length; caudal fin truncate to slightly rounded, and fin membrane always entire; in life, body and fins green, usually with paler mottling ..... *S. halimeda*
- 2b Fourth dorsal- and anal-fin plates absent; pectoral fins 25–28 rays; peduncle of adults relatively broad, its depth almost equal to its length; caudal fin lanceolate to elliptical, and fin membrane often slightly incised; in life, body and fins yellow, olive, green, brown, black, pink or red, sometimes with weak spotting ..... *S. cyanopterus*

## *Solenostomus cyanopterus* Bleeker 1854

### Robust ghost pipefish

PLATE 77

*Solenostoma cyanopterus* Bleeker 1854: 507 (Wahai, Seram I., Moluccas, Indonesia); Barnard 1925\*, 1947\*.

*Solenostoma cyanopterus*: Playfair & Gunther 1867\*; Klunzinger 1871; Pratap 1985\* [as *cyanopterus*].

*Solenostomus bleekerii* Duméril 1870: 498 (Mauritius, Mascarenes).

*Solenostomus cyanopterus*: Jungersen 1910\*; De Silva 1956 [as *cyanopterus*]; Sanches 1963; Fishelson 1966\*; Jones & Kumaran 1980; Tortonese 1980; SSF No. 146.1\*; Orr & Fritzsche 1993\*; Randall & Anderson 1993; Wetzel & Wourms 1995; Debelius 1998\*; Kuitert 1998\*, 2004\*; Fricke 1999; Gerlach 2001; Orr *et al.* 2002\*; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Dorsal fin 5 spines, 16–22 rays; anal fin 17–21 rays; pectoral fins 25–28 rays; pelvic fins 1 spine, 6 rays. (Counts of dorsal- and anal-fin rays appear to be lower for specimens from Red Sea than for specimens from remainder of range.) HL 2–2.5 in SL; snout length 2.9–4.7 in SL. Snout relatively deep (especially in larger males), its depth 6.4–7.3 in HL. Epioccipital ridges parallel or slightly convergent. Second dorsal- and anal-fin plates each 3. Peduncle with  $\sim$ 8 stellate plates, and about as deep as long (peduncle length  $\sim$ 13.7 in SL; peduncle depth  $\sim$ 16.7 in SL). Caudal fin lanceolate to elliptical, and fin membrane often slightly incised. Cutaneous papillae generally absent. Males with 8–23 nasal lamellae which occupy  $\sim\frac{1}{2}$  of olfactory pit in elliptical pattern.

Body background colour variable in life: yellow-orange, olive, green, brown, black, pink or red; older individuals typically also with purple, pink, white or reddish patches scattered along body (appearing remarkably similar to encrusting red coralline algae or ‘reef cement’ found throughout tropical reefs). Preserved specimens often spotted with small patches of melanin, and fins become increasingly reddish with scattered patches of melanin. Attains  $\sim$ 11 cm SL,  $\sim$ 16 cm TL.



*Solenostomus cyanopterus*, 46 mm SL (South Africa).

PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea to South Africa (KwaZulu-Natal to False Bay), Madagascar, Comoros, Réunion, Mauritius, St Brandon Shoals, Maldives, India and Sri Lanka; elsewhere to Indonesia, Philippines, southern Japan, Marianas Is., Solomon Is., Australia, New Caledonia and Fiji.

**REMARKS** Collected from surface waters to  $\sim$ 28 m deep.

## *Solenostomus halimeda*

Orr, Fritzsche & Randall 2002

Halimeda ghost pipefish

PLATE 77

*Solenostomus* sp.: Kuitert 1998\*; Debelius 1999\*.

*Solenostomus halimeda* Orr, Fritzsche & Randall 2002: 101, Figs. 1–6  
(Mermaid Reef, Central Lagoon, Rowley Shoals, Australia); Kuitert 2004\*.

Dorsal fin 5 spines, 16–18 rays; anal fin 17–19 rays; pectoral fins 22–25 rays; pelvic fins 1 spine, 6 rays. HL 1.9–2.2 in SL; snout length 2.7–3.3 in SL. Snout not greatly expanded, its depth 8.5–10.1 in HL. Epioccipital ridges parallel. Second dorsal- and anal-fin plates each 4. Peduncle with ~10 stellate plates, and about twice as long as deep (peduncle length ~12.2 in SL; peduncle depth ~25.6 in SL). Caudal fin slightly rounded to truncate, and fin membrane entire. Branching red filaments always present at ventral midpoint of snout, and occasionally in patches on body and fins. Males with ~15 nasal lamellae which fill ~½ of olfactory pit.

Body background colour usually green, yellow or olive (resembling green macroalgae *Halimeda*); older individuals typically also with small patches of purple, pink, white or reddish on body and especially in diagonal line across eyes (resembling encrusting red coralline algae); red branching filaments (resembling branching red algae) present at ventral midpoint of snout, and occasionally as patches on body and fins. Preserved specimens often spotted with small patches of melanin. Attains ~5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Maldives (South Miladhunmadulu [Noonu] Atoll; Ari Atoll [photographs]); elsewhere to Mariana Is., Marshall Is., New Guinea and Australia.

**REMARKS** The smallest species of ghost pipefish; females mature at 34–47 mm SL. Collected from surface waters to ~23 m deep.

## *Solenostomus paradoxus* (Pallas 1770)

Ornate ghost pipefish

PLATE 77

*Fistularia paradoxa* Pallas 1770: 32 (Ambon I., Moluccas, Indonesia).

*Solenostoma paradoxum*: Johnstone 1904.

*Solenostomus paradoxus*: Jungersen 1910; De Silva 1956; Orr & Fritzsche 1993\*; Randall & Anderson 1993; Debelius 1998\*; Fricke 1999; Orr *et al.* 2002; Kuitert 2004\*; Fricke *et al.* 2009.

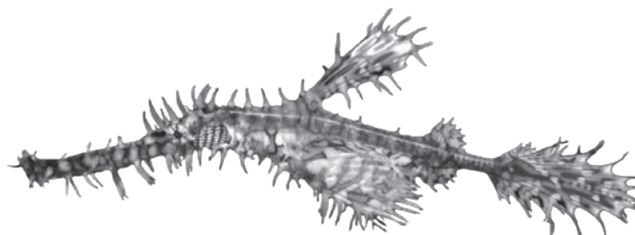
*Solenostoma laciniatum* Willey 1910: 102 (Dutch Bay, Nagal Paar, north of Chilaw, Sri Lanka).

*Solenichthys paradoxus*: Klausewitz 1972.

*Solenostomus cyanopterus*: Fishelson 1981\*.

Dorsal fin 5 spines, 17–21 rays; anal fin 18–22 rays; pectoral fins 23–25 rays; pelvic fins 1 spine, 6 rays. (Counts of dorsal- and anal-fin rays appear to be lower for specimens from Red Sea than for specimens from remainder of range.) HL 1.9–2.7 in SL; snout length 2.6–3.9 in SL. Snout not greatly expanded, snout depth 9.1–10.8 in HL. Epioccipital ridges divergent, expanded posteriorly. Second dorsal- and anal-fin plates each 5. Peduncle with ~10 stellate plates; peduncle narrow, its depth ~3 in its length (peduncle length ~8 in SL; peduncle depth ~26.3 in SL). Caudal fin round to ovate, and fin membrane deeply incised. Cutaneous papillae profuse, present as both simple finger-like projections and bifid, typically on snout ridges, at spiny tips of stellate plates on body and fin bases, and at margins of 1st dorsal fin, caudal fin and pelvic fins. Males with 15–21 nasal lamellae which completely fill olfactory pit.

Body hyaline, but generally with mosaic of orange, red, purple, white, yellow and/or black spots, bands, lines and/or reticulations over body, fins and cutaneous papillae. Preserved specimens often spotted with small patches of melanin. Attains ~11 cm SL.



*Solenostomus paradoxus*, 64 mm SL (Indonesia). © JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to South Africa (KwaZulu-Natal to False Bay), Comoros, Mauritius, Maldives and Sri Lanka; elsewhere to Indonesia, Philippines, southern Japan, New Guinea, southeastern Australia, New Caledonia, Fiji and Tonga.

**REMARKS** Commonly seen near crinoids, gorgonians and sea fans, to ~35 m deep.

### GLOSSARY

**cotylephore** – a flap of skin that develops on the inner side of the pectoral fins of females, and in which the eggs are wrapped to provide them with nourishment.

**cutaneous papillae** – small papillae on the skin.

**epioccipital ridges** – a ridge on a bone that lies above the eye.

**pseudobranch** – a small, gill-like organ on the inner surface of the operculum; the reduced first gill arch.

## FAMILY SYNGNATHIDAE

### Pipefishes, pipehorses, seahorses and sea dragons

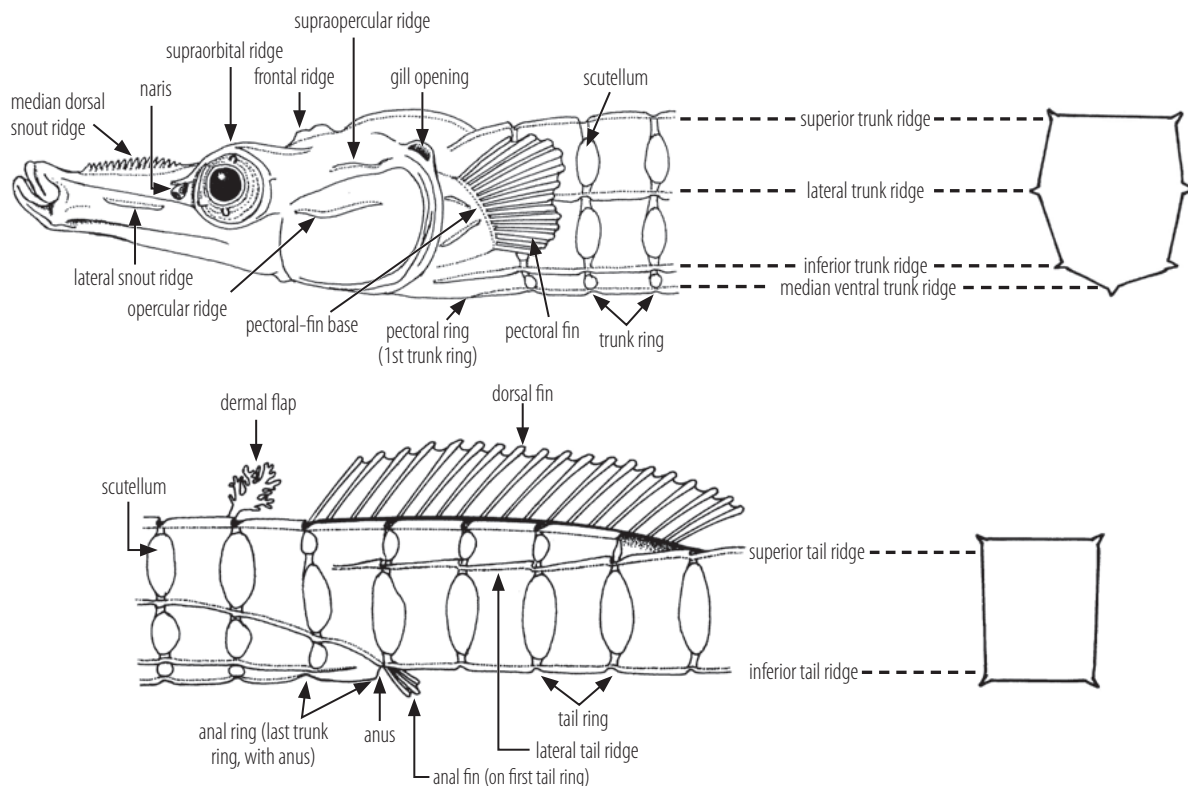
Kate A Moots

Syngnathids are typically slender fishes with a body enclosed in a series of ring-like dermal plates. Pipefishes are typically elongate (~15 cm TL). Seahorses differ by holding the head at right angles to the body and in having a prehensile tail. Pipehorses hold the head essentially in line with the body, and also have a prehensile tail. Sea dragons are larger, tend to hold the head at nearly right angles to the body, have neither a caudal fin nor prehensile tail, and have large leafy extensions from the body. The snout of syngnathids is elongate, tubular, and ends in a small, vertically oriented, toothless mouth (except in adult *Bulbonaricus*, which has a small inferior mouth and lacks a snout). No fin spines, and fin rays unbranched in all species (except *Kyonemichthys rumengani* with 2nd anal-fin ray branched, and dorsal-fin rays branched except for 1st ray). Dorsal fin with 7–75 rays, except no dorsal fin in the demersal *Apterygocampus*, *Bulbonaricus* and *Penetopteryx*. Anal fin tiny (often difficult to see), with 2–6 rays, or anal fin absent (in *Anarchopterus*, *Apterygocampus*, *Bryx*, *Bulbonaricus*, *Entelurus*, 1 species of *Hippichthys*, *Kimblaesus*, *Nannocampus*, *Nerophis*,

*Notiocampus*, *Penetopteryx*, *Pseudophallus* and *Siokunichthys*). Pectoral fins absent in demersal *Apterygocampus*, *Bulbonaricus*, *Entelurus*, *Nannocampus*, *Nerophis*, *Notiocampus* and *Penetopteryx*, otherwise fin with 5–27 rays. No pelvic fins in all forms. Caudal fin absent in seahorses (*Hippocampus*), most demersal pipehorses (*Acentronura*, *Idiotropiscis*, *Solegnathus* and *Syngnathoides*), sea dragons (*Haliichthys*, *Phycodurus* and *Phyllopteryx*), as well as the pipefishes *Nerophis*; otherwise caudal fin present with 4–11 rays. Gill openings pore-like and just above posterodorsal angle of opercle (except in *Hippocampus tyro* which has a single slit-like mid-dorsal pore).

Many syngnathids are particularly colourful and are beginning to be well-photographed by divers. Unfortunately, preserved specimens of many species do not have accompanying photographs, so it is not always possible to associate photographs with particular species.

Males brood eggs on the ventral surface of the trunk or tail. The extent of the brood pouch varies from non-existent (with eggs randomly attached and completely unprotected) to a sac-like fleshy pouch that opens through an anteromesial slit or pore. Intermediate brood-pouch forms are of the following types: very short pouch folds, resulting in exposed eggs that nestle into indented compartments on the male's belly; longer pouch folds that nearly but not entirely enclose the eggs (semi-pouch closure); pouch folds long enough to meet ventrally and then tuck in so that eggs in the right and left sides of the



Lateral section of generalised pipefish showing selected features of head (top) and trunk (bottom).



pouch are separated (inverted pouch closure); or pouch folds overlapping so that a narrow groove is formed between the two folds (everted pouch closure). Male brood pouches may be protected by pouch plates, which are extensions of the lateral plates of the trunk or tail.

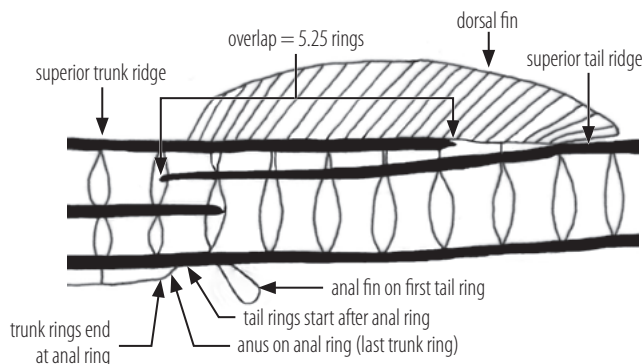


Diagram to show discontinuous superior trunk and superior tail ridges and how to count the overlapping rings.

Syngnathids can be difficult to distinguish, and discriminating among species requires specialised terminology and precise definitions of the characteristics. Trunk rings are counted from the first complete ring behind the gill opening (usually bearing the pectoral-fin bases) to include the ring with the anus (the anal ring). Tail rings are counted from the first ring past the anus (the ring usually bearing the anal fin) to the ring before the caudal-fin base. Total rings are the sum of the trunk and tail rings in a single individual. Fin rays are all counted separately. The dorsal-fin origin may be on the trunk or tail and is recorded in quarter-ring intervals. Similarly, the number of subdorsal rings is scored to the nearest quarter ring for each individual, with values for subdorsal trunk rings and subdorsal tail rings counted independently. Scutella (singular: scutellum) are small plates often intercalated between rings, which may or may not bear longitudinal keels. The rings of syngnathids develop longitudinal ridges that are important systematic characters. For instance, the superior ridges on the trunk and tail may be either confluent or else overlap below the dorsal fin. Similarly, the inferior ridges on the trunk and tail may be either confluent or else overlap near the anal ring. In addition, there is a lateral ridge on the trunk, which may end midlaterally near the anal fin, angle upward to join the superior tail ridge, or else angle downward to join the inferior tail ridge. Finally, some species have a well-developed midventral trunk ridge, which creates a hexagonal or heptagonal trunk cross-section and a rectangular tail cross-section.

Standard length (SL) is measured from the tip of the closed lower jaw to the end of the last tail ring. In species without a caudal fin, total length (TL) is measured from the tip of the closed lower jaw to the end of the body. To measure the TL of a seahorse, bend a length of narrow-gauge wire from the tip of the closed lower jaw to the rear edge of the opercle, along the

lateral ridge of the trunk, and then along the lateral surface of the tail to its tip; straighten the wire and measure its length with callipers (however, this is equivalent to the SL of Lourie 2003). Although this method is laborious, it provides data that are most comparable to other syngnathids. Head length (HL) is the distance from the tip of the closed lower jaw to the rear edge of the bony opercle. Snout length is the distance from the tip of the closed lower jaw to the anterior bony margin of the orbit. Snout depth is measured as the least depth of the snout behind the mouth and in front of the eyes.

Kuiter (2001) introduced the use of a subdorsal spine formula for seahorses (*Hippocampus*). Subdorsal spines commonly form at the intersection of a body ridge and a ring joint just below the dorsal fin. Because the superior trunk and tail ridges are discontinuous in seahorses, the first term of the formula consists of the number of spines on the superior trunk ridge, separated by a slash from the extent values for each of the superior tail-ridge spines. Each of the extent values for the superior tail-ridge spines ranges from 0 to 1, with '0' indicating no spine developed, '0.5' indicating a small or poorly developed spine, and '1' indicating presence of a well-developed spine. Variation within a species is given as a range for each location (e.g., 0.5–1 indicates that the spine in that location is poorly to well-developed). Thus, the subdorsal spine formula 3 / 1, 0, 0.5–1, 0.5 indicates the following: 3 subdorsal spines on the superior trunk ridge / inferior tail ridge with 4 ring intersections that could bear spines: 1st intersection with well-developed spine, 2nd without spine, 3rd with poorly to well-developed spine, and 4th with poorly developed spine.

Adult syngnathids tend to be demersal, at <150 m deep, and common in locations with rich coral and algal growth (probably as a function of microinvertebrate abundance), especially on coral, rocky or sponge reefs, and in seagrass beds and mangroves. Some species have colonised freshwater. Adults have been collected at <10 cm to >400 m deep. For some species, the young leave the male to become pelagic, and juveniles have been collected more than 100 km offshore. Other species lack an obvious pelagic stage. Pipefishes are often seen moving across the substrate by swimming with the pectoral fins and dorsal fin as well as by undulations of the entire body, yet are surprisingly agile and readily elude capture by humans. Seahorses and pipehorses tend to spend much of their time with the tail coiled around plants or some part of the substrate, and tend to swim using pectoral fins and dorsal fin. Sea dragons tend to float in the water column in areas where they are camouflaged.

The diet of most syngnathids is poorly known. Individual food items taken are generally limited by the small mouth and are sucked into the tubular snout by the flaring of the opercles and dropping the branchial basket. Microinvertebrates, especially crustaceans, seem to make up the bulk of the diet and must be provided as live food in aquaria. Some species

may act as 'cleaners' for other fishes. Although no predator specialises on syngnathids, Kleiber *et al.* (2011) noted that 82 species of invertebrates, fishes, sea turtles, water birds, and marine mammals were documented as collectively preying on 25 species of pipefishes and 9 species of seahorses.

Syngnathids are often studied as exemplars of male parental care in fishes. Some syngnathids also show significant courtship, pair-bonding and/or spawning behaviours, with anecdotal reports of individual pairs recognising one another for many consecutive days (Michael 2001). Aquarists document some seahorses living up to 5–6 years, and some sea dragons and pipefishes up to 5–10 years. The largest species, the pipefish *Leptoichthys fistularius*, may reach 65 cm SL, with the largest WIO species likely the pipefish *Trachyrhamphus bicoarctatus*, at ~39 cm SL, and the smallest species the Sodwana pygmy seahorse, *Hippocampus nalu*, attains 22 mm TL.

Syngnathids in nearshore habitats are subject to significant habitat loss as well as the effects of destructive fishing methods in many tropical marine waters where they were once common. Seahorses continue to be commercially exploited as curios and for medicinal uses and aphrodisiacs in Asia. Many syngnathids are sought-after as aquarium fishes, suitable for the advanced aquarist or public aquaria. Exploitation has led to the listing of

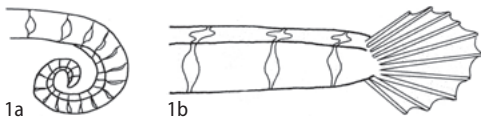
all *Hippocampus* species in Appendix II of CITES, describing them as not currently threatened with extinction, but, if trade is not closely controlled, as likely to become threatened with extinction. One WIO species, *Syngnathus watermeyeri*, is listed in the IUCN Red List as Critically Endangered because it occurs only in a few South African estuaries that show declining habitat quality and because mature individuals are no longer seen. *Hippocampus capensis* is listed as Endangered because of its restricted distribution, small population size and negative effects of human encroachment, and *H. barbouri*, *H. comes*, *H. kuda*, *H. spinosissimus* and *H. trimaculatus* are listed as Vulnerable due to declining populations; *Microphis insularis* is listed as Vulnerable because of its restricted occurrence in locations affected by human encroachment.

Found primarily in subtropical to tropical marine waters of the Atlantic, Pacific and Indian oceans, but some species extend into temperate waters and others into freshwater. Found throughout WIO and in the Red Sea. Many genera within WIO show disjunct distributions; a few species are exclusively coastal, whereas others occur exclusively at island localities. About 57 valid genera and at least 345 recognised species worldwide; 26 genera and at least 84 described species and 7 undescribed species in WIO.

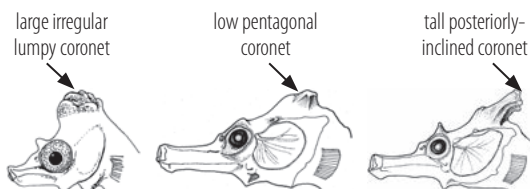
#### KEY TO GENERA OR SPECIES

[Note: Diagrams of the principal patterns of body ridges from specimens with the head of the fish to the left.]

- 1a Tail prehensile, typically with fleshy transverse pads on ventral surface of distal rings; no caudal-fin rays in subadults and adults (brood-pouch young and planktonic juveniles of *Acentronura* may have caudal-fin rays) ..... 2
- 1b Tail not prehensile and never with fleshy transverse pads on ventral surface of distal rings; caudal-fin rays present (although fin may be small) in subadults and adults ..... 7



- 2a Body usually in vertical position, with head most often held at right angle (>70°) to longitudinal axis of body; occipital region of skull usually with 'coronet' (low in *H. capensis*, *H. fuscus* and *H. trimaculatus*); eggs in male's sealed brood pouch with single anteromesial opening and no pouch plates present ..... *Hippocampus* [at least 18 species in WIO]



- 2b Body usually in horizontal position, with head more or less in line with longitudinal axis of body; occipital region of skull smooth or bearing ridges or crests, but lacking a 'coronet' ..... 3
- 3a Pectoral fins absent in subadults and juveniles (>12 cm TL); head small, HL >13 in TL; lateral trunk ridge confluent with inferior tail ridge and trunk rings 17–33, tail rings 46–82; dorsal fin 24–44 rays; male brood pouch on trunk ..... *Nerophis* [not yet known from WIO, but possible anti-Lessepsian migrant from Mediterranean Sea]
- 3b Pectoral fins present; head larger, HL 4.9–9.6 in TL; lateral trunk ridge ends on tail and is confluent with lateral or superior tail ridge, or if confluent with inferior tail ridge then trunk rings 9–13 and tail rings 39–52; dorsal fin 15–19 rays; male brood pouch on tail ..... 4
- 4a Snout <1/2 of head, its length 2.4–3.6 in HL; opercular ridge present and usually complete; inferior trunk and tail ridges discontinuous, with lateral trunk ridge confluent with inferior tail ridge; dorsal-fin base elevated, and fin with 15–19 rays; pectoral fins 12–17 rays; males with sealed brood pouch under tail, with single anteromesial opening; maximum size ~8 cm TL ..... 5



Continued ...

**KEY TO GENERA OR SPECIES**

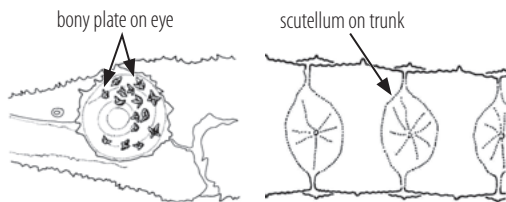
4b Snout >½ of head, its length 1.5–1.9 in HL; no opercular ridge; inferior trunk ridge continuous, joining inferior tail ridge; dorsal-fin base not elevated, and fin with 30–51 rays; pectoral fins 22–26 rays; young brooded under trunk or tail, but males without brood pouch, plates or folds; attains >25 cm TL ..... **6**

5a Trunk rings 12 or 13; tail rings 39–46; dorsal fin 16–19 rays, all rays unbranched, and fin origin on trunk ..... *Acentronura*  
[3 species in WIO]

5b Trunk rings 9; tail rings 52; dorsal fin 15 rays, only first ray unbranched, and fin origin on 9th tail ring ..... *Kyonemichthys rumengani*

6a No tiny bony plates on sclera of eyes; trunk dorsoventrally compressed; trunk rings 15–18; trunk ridges low, with at most finely denticulate edges; no scutella; dermal flaps well-developed in juveniles, often absent in adults; young brooded under trunk; maximum size ~25–28 cm TL ..... *Syngnathoides biaculeatus*

6b Tiny bony plates on sclera of eyes; trunk laterally compressed; trunk rings 21–27; trunk ridges heavily sculptured, with short spine or knob near middle of each ring's upper and lower ridges; scutella present, conical or with an elevated median ridge; no dermal flaps (all life stages); young brooded under tail; attains >40 cm TL ..... *Solegnathus hardwickii*  
[reported from Mauritius only by Duméril 1870, probably in error; Plate 95]

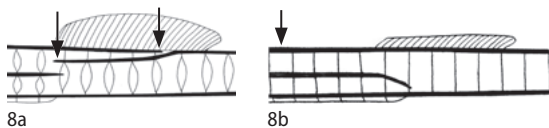


7a No anal fin ..... **8**

7b Anal fin present ..... **13**

8a Superior trunk ridge and superior tail ridge discontinuous, with tail ridge beginning laterally under dorsal fin and then angling dorsally; opercular ridge usually complete in WIO specimens; pectoral-fin base with 2 distinct ridges in WIO specimens .... **9**

8b Superior trunk ridge and superior tail ridge continuous; opercular ridge (if present) crossing ~½ of opercle; pectoral-fin base without ridges ..... **10**

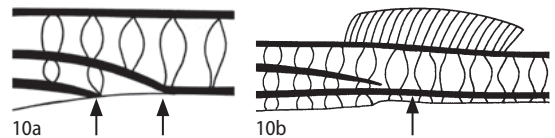


9a Trunk rings 16–18 (usually 17 rings in WIO specimens); dorsal fin usually 29–32 rays; ground-colour of body pink, with dorsum and sides weakly banded by incomplete dark bars (~4 or 5 rings wide) and ~13–15 reticulate paler bars (~0.5–1.5 rings wide) in WIO specimens ..... *Bryx analicarens*

9b Trunk rings 14–16 (in specimens lacking an anal fin); dorsal fin usually 26–28 rays; body ground-colour grey to tan or dark brown, with dorsum and sides plain ..... *Hippichthys* sp.

10a Inferior trunk ridge and inferior tail ridge discontinuous, with lateral trunk ridge joining inferior tail ridge, and inferior trunk ridge ending at anal ring; dorsal fin (if present) either 13 or 14 rays or 24–33 rays; pectoral fins (if present in adults) 5–7 rays ..... **11**

10b Inferior trunk ridge and inferior tail ridge continuous; dorsal fin (if present) 14–26 rays; pectoral fins (if present in adults) 8–13 rays ..... **12**

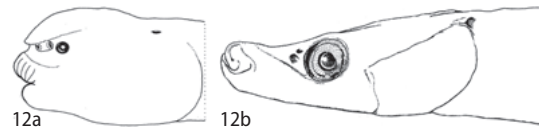


11a Trunk rings 17–19; no dorsal fin in subadults and adults, but larvae and planktonic individuals with dorsal-fin rays 26–30; no pectoral fins in subadults and adults, but larvae and planktonic individuals with pectoral-fin rays 10 or 11; males with brood-pouch plates ..... *Penetopteryx taeniocephalus*

11b Trunk rings 8–14; dorsal fin either 13 or 14 rays or 24–33 rays; pectoral fins 9–13 rays; males without brood-pouch plates ..... *Siokunichthys* [4 species in WIO]

12a Snout bulbous and very short, with inferior mouth in adults; trunk rings 15–17 and total rings 57–63; dorsal fin absent in subadults and adults, but planktonic and non-metamorphosed individuals with dorsal-fin rays 22–26; dorsal-fin origin on 2nd or 3rd tail ring, and subdorsal rings 7.0–8.5 ..... *Bulbonaricus* [2 species in WIO]

12b Snout tubular, with terminal mouth; trunk rings 12–15 and total rings 47–56; dorsal fin 14–24 rays; dorsal-fin origin between penultimate trunk ring and 1st tail ring, and subdorsal rings 3.0–6.25 ..... *Nannocampus* [3 species in WIO]



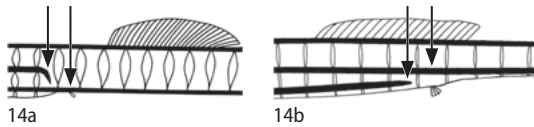
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## KEY TO GENERA OR SPECIES

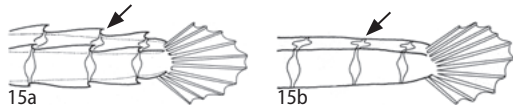
- 13a Superior trunk and tail ridges continuous ..... 14  
 13b Superior trunk and tail ridges discontinuous ..... 19



- 14a Inferior trunk and tail ridges continuous, such that lateral trunk ridge ends between last trunk ring and 20th tail ring ..... 15  
 14b Inferior trunk and tail ridges discontinuous, such that lateral trunk ridge confluent with inferior tail ridge ..... 18



- 15a Tail ridges with rear edges flared laterally, producing hook-like posterior tips; simple dermal flaps present on eyes, head and body ..... *Phoxocampus* [2 species in WIO]  
 15b Tail ridges entire to finely denticulate, although last one or two tail rings may show microserrations; no simple dermal flaps on body, but may be present elsewhere ..... 16



- 16a Trunk rings 13; tail rings 26 or 27; pectoral fins 8 or 9 rays; snout short and wide, its length 2.7–3 in HL, its depth 1.4–2.1 in snout length ..... *Campichthys nanus*  
 16b Trunk rings 14–17; tail rings 32–40; pectoral fins 10–16 rays; snout longer and narrower, its length 2.1–2.8 in HL; its depth 2.4–4.4 in snout length; attains >6 cm SL ..... 17

- 17a Dorsal fin 22–27 rays, fin origin on tail ring 1–3; anal fin 2 rays; opercular ridge complete and straight; trunk rings 14 or 15; tail rings 37–40 ..... *Ichthyocampus carce*  
 17b Dorsal fin 18–21 rays, fin origin on penultimate and ultimate trunk rings; anal fin 4 rays; opercular ridge restricted to front half or entirely lacking; trunk rings 15–17 (usually 16); tail rings 32–37 ..... *Festucalex* [2 species in WIO]

- 18a Tail rings 17–25; pectoral fins 18–23 rays, and fin emarginate; head relatively long (HL 3.4–7.1 in SL); opercular ridge complete; no dermal flaps; dorsal-fin base not elevated; head and body ridges easy to see; male brood pouch under trunk ..... *Choeroichthys* [3 species in WIO]  
 18b Tail rings 33–60; pectoral fins 5–13 rays, and fin rounded; HL 10.8–14.4 in SL; opercular ridge vestigial; dermal flaps branched or frilled and present on head, trunk and first third of tail; dorsal-fin base somewhat elevated anteriorly with loose surrounding membrane; head and body ridges nearly concealed by skin (difficult to see); male brood pouch under tail ..... *Lissocampus bannwarthi*

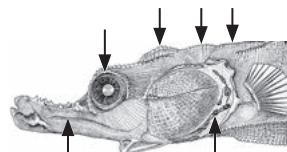
- 19a Inferior trunk and tail ridges continuous ..... 20  
 19b Inferior trunk and tail ridges discontinuous, and lateral trunk ridge confluent with inferior tail ridge ..... 25

- 20a Simple dermal flaps on eyes and often on remainder of head; male brood pouch with semi-pouch closure ..... *Cosmocampus* [4 species in WIO]  
 20b No dermal flaps; male brood pouch with inverted, everted or semi-pouch closure ..... 21

- 21a Eyes large, protruding laterally; snout depth ~1.5 in eye diameter, and snout almost uniform in diameter in front of eyes ..... 22  
 21b Eyes smaller, not protruding; minimum snout depth about equal to eye diameter, and snout increasing in diameter in front of eyes ..... 23

- 22a Pectoral-fin base usually with 2 low ridges; trunk slightly V-shaped ventrally, and dorsum slightly indented between superior trunk ridges; male brood pouch with semi-pouch closure, no pouch plates, and pouch folds barely covering outermost eggs ..... *Corythoichthys* [6 species in WIO]  
 22b Pectoral-fin base with 1 indistinct ridge centred on lateral trunk ridge; trunk flat dorsally and ventrally; male brood pouch presumably with inverted pouch closure, pouch plates present, and pouch folds covering eggs ..... *Syngnathus macrophthalmus*  
 [known only from northern Red Sea at >15 m deep]

- 23a Snout with 1 or more groups of lateral spines and/or ridges; orbital, prenuchal, nuchal, and frontal ridges generally present, microserate and obvious; demersal subadults to adults with at least 1 tiny bony plate on each gill membrane ..... *Bhanotia fasciolata*  
 [not yet known from WIO, but from Andaman Is., Malaysia and Indonesia]



- 23b Snout lacking lateral spines and/or ridges; orbital, prenuchal, nuchal and frontal ridges low and smooth or absent; no tiny bony plates on gill membranes ..... 24

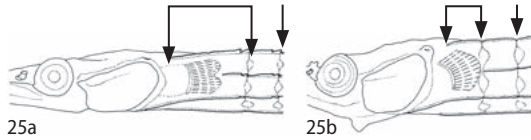
- 24a Median ventral trunk ridge usually prominent; tail nearly square in cross-section; anal fin typically <4 rays (small and difficult to count); males with everted brood-pouch closure; body ground-colour typically shades of brown; adults usually attain 10–16 cm SL ..... *Hippichthys* [5 species in WIO]  
 24b Median ventral trunk ridge usually inconspicuous; tail usually narrower dorsally than ventrally, relatively trapezoidal in cross-section; anal fin typically 3 or 4 rays (small and difficult to count); males with inverted brood-pouch closure; body ground-colour typically shades of green; adults usually attain <11 or >30 cm SL ..... *Syngnathus* [5 species in WIO]

Continued ...



**KEY TO GENERA OR SPECIES**

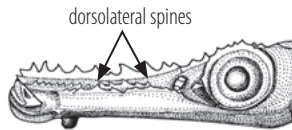
- 25a First trunk ring clearly longer than 2nd trunk ring ..... 26
- 25b First trunk ring shorter than or equal to 2nd trunk ring ..... 28



- 26a Trunk rings 21–24; tail rings 41–63; body very long, and HL 9.7–16 in SL; pectoral fins rounded; caudal fin 8 or 9 rays, fin often reduced in length and with slightly longer and thicker lowermost ray; males incubate brood under tail rings ..... *Trachyrhamphus* [3 species in WIO]

- 26b Trunk rings 15–20; tail rings 11–23; body long to short, and HL 3.4–5.3 in SL; pectoral fins emarginate; caudal fin 10 rays, fin large and often flag-like; males incubate brood under trunk rings ..... 27

- 27a Snout with 1–5 small dorsolateral spines; male brood-pouch folds forming semi-pouch closure; body with longitudinal lateral stripe ..... *Doryrhamphus* [4 species in WIO]



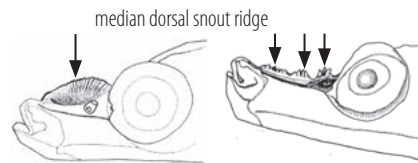
- 27b Snout without dorsolateral spines; male brood pouch without folds (eggs are laterally exposed); body with transverse bands in WIO specimens ..... *Dunckerocampus* [2 species in WIO]

- 28a Caudal fin 8 or 9 rays ..... 29
- 28b Caudal fin 10 rays ..... 30

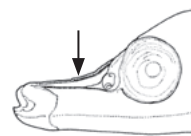
- 29a Pectoral fins 8–13 rays; caudal fin usually 8 rays; median dorsal snout ridge with 1–3 projections; male brood pouch under tail, and pouch folds present; tiny dermal flaps often present ..... *Minyichthys myersi*

- 29b Pectoral fins 15–23 rays; caudal fin usually 9 rays; median dorsal snout ridge low, entire; male brood pouch under trunk, without pouch folds; no dermal flaps or filaments ..... *Microphis* [8 species in WIO]

- 30a Eyes with simple unbranched dermal flaps (additional dermal flaps and cirri from simple unbranched to highly branched and exceptionally large, found on snout, head, opercle, nape and body); median dorsal snout ridge either a continuous convex arc or broken into 1–3 groups of spines or short ridge-like elevations; lateral snout ridge or spine present or absent ..... *Halicampus* [7 species in WIO]



- 30b Eyes without dermal flaps or filaments, but simple or sparsely branched flaps may be present elsewhere on head and/or body; median dorsal snout ridge low, entire, somewhat concave in lateral profile; no lateral snout ridge or spine ..... *Micrognathus* [2 species in WIO]



Head and tail drawings sourced from Dawson (1985)

**GENUS *Acentronura* Kaup 1853**

Trunk rings 12 or 13; tail rings 39–46; dorsal fin 16–19 rays; subdorsal rings 3.0–1.5 + 1.0–2.5 = 3.25–4.75; pectoral fins 12–17 rays; anal fin 4 rays; no caudal fin in subadults and adults. HL 5.9–8.2 in TL; snout length 2.4–3.6 in HL; snout depth 2–4 in snout length. Superior trunk and tail ridges continuous; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge. Median dorsal snout ridge low; opercular ridge usually complete, angled upward; pectoral-fin base with 0–2 ridges; body ridges distinct, those on trunk and first half of tail often with knob or spine

near middle of each ring. Scutella vestigial or absent. Dorsal-fin base elevated. Tail unmistakably prehensile. Dermal filaments or flaps present. Male brood pouch forms sac that opens through anteromesial pore; pouch plates slender and elongate; pouch under first 8–13 tail rings. Head bent slightly downward from longitudinal body axis. Females more slender than males and more pipefish-like in appearance. The Atlantic species of *Amphelikturus* (1 or 2 species) and the Australian species of *Idiotropiscis* (3 species) are often considered part of *Acentronura*, but here they are treated as separate genera. Currently 4 species recognised, 2 of these in WIO, plus 1 undescribed.

## KEY TO SPECIES

- 1a Tail rings 46; snout relatively long (snout length <2.5 in HL; snout depth >3.3 in snout length); dorsal-fin origin on last 3 trunk rings ..... *Acentronura* sp.
- 1b Tail rings <44; snout relatively short (snout length 2.8–3.4 in HL; snout depth 2.4–3 in snout length); dorsal-fin origin on last 1.5–2.5 trunk rings ..... 2
- 2a Dorsal fin 16–19 (usually 17) rays; tail rings 42 or 43; male brood pouch over tail rings 1–13 ..... *A. mossambica*
- 2b Dorsal fin 15 or 16 (usually 16) rays; tail rings 39 or 40; male brood pouch over tail rings 1–10 ..... *A. tentaculata*

*Acentronura mossambica* Smith 1963

Mozambique pygmy pipehorse

PLATE 78

*Acentronura mossambica* Smith 1963: 522, Pl. 76, Figs. F–G (Inhaca I., Mozambique); SSF No. 145.1\*; Kuitert 2004\*.

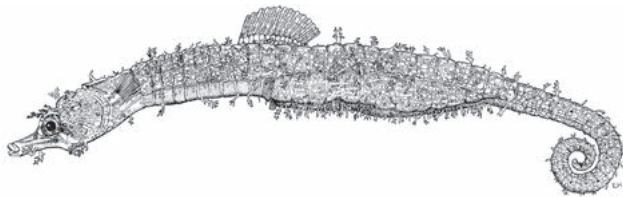
*Acentronura gracillima* (non Temminck & Schlegel 1850): Smith 1951, 1953.

*Acentronura tentaculata* (non Günther 1870): Dawson 1984, 1985.

?*Syngnathoides algensis* Fourmanoir 1955: 210 (Dzaoudzi, Mayotte, Comoros).

Rings 12 or 13 + 42 or 43; dorsal fin 16–19 rays; subdorsal rings 2.5–1.5 + 1.5–2.75 = 4.0–4.25; pectoral fins 13–16 rays. HL 6–7 in TL; snout length 2.8–3.3 in HL; snout depth 2.4–3 in snout length. Small multifid dermal flaps scattered over head and body. Male brood pouch under first 12 or 13 tail rings.

Body mainly brown; some dermal flaps blackish. Attains 63 mm TL.



*Acentronura mossambica*, 63 mm TL male (S Mozambique).

**DISTRIBUTION** WIO: Tanzania (Zanzibar) to Mozambique (Inhaca I. and Morrumbene District).

**REMARKS** Marine; found at mouths of estuaries, among weeds, to at least 10 m deep. The description of *Syngnathoides algensis* from the Comoros may be this species but is too brief to be certain.

*Acentronura tentaculata* Günther 1870

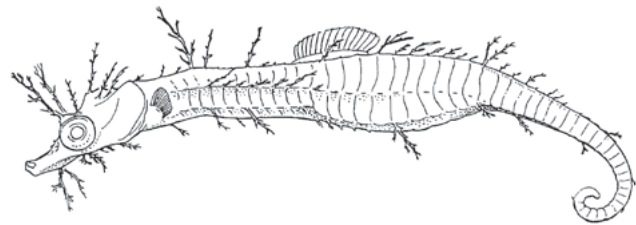
Hairy pygmy pipehorse

PLATE 78

*Acentronura tentaculata* Günther 1870: 516 (Gulf of Suez, Red Sea); Smith 1963; Dawson 1985\*; Randall 1995; Manilo & Bogorodsky 2003; Kuitert 2004\*; Al-Jufaili *et al.* 2010.

Rings 12 + 39 or 40; dorsal fin 15 or 16 rays; subdorsal rings 2.5–1.5 + 1.5–2.5 = 3.25–4.0; pectoral fins 12–14 rays. HL 5.9–6.7 in TL; snout length 3–3.6 in HL; snout depth 2–2.6 in snout length. Dermal filaments usually long, multifid, and abundant in adults. Male brood pouch under first 8–10 tail rings.

Body tan to green or dark brown; the long thin dermal filaments resemble branching brown algae. Attains 50 mm TL.



*Acentronura tentaculata*, 45 mm TL, male holotype (Gulf of Suez).

Source: Fraser-Brunner & Whitley 1949; © AMS

**DISTRIBUTION** WIO: Red Sea, Persian/Arabian Gulf and Oman.

**REMARKS** Records of this species from Indonesia, Philippines, Australia and New Guinea should probably be recognised as *A. breviperula*. Marine; found in shallow water among seagrasses and algae.

*Acentronura* sp.

Aliwal pygmy pipehorse

PLATE 78

Rings 13 + 46; dorsal fin 17 rays; subdorsal rings 3.0 + 1.75 = 4.75; pectoral fins 14 or 15 rays. HL 5.9 in TL; snout length 2.5 in HL; snout depth 3.4 in snout length. Elongate dermal filaments present dorsally on head and trunk, and smaller multifid or palmate dermal flaps present dorsally on tail.

Body pale brown; dermal flaps on head and trunk pink, flaps on tail darker; oblique white bar through eyes, expanding slightly on cheeks and opercles; white spots scattered along body, with large spot before dorsal fin. Maximum size unknown.

**REMARKS** Known from one specimen (44-mm-TL female) from South Africa (Aliwal Shoal).

**GENUS** *Bryx* Herald 1940

Rings 14–18 + 30–39; dorsal fin 21–33 rays; subdorsal rings 1.75–0 + 4.5–7.5 = 5.0–7.5; pectoral fins 9–14 rays; no anal fin; caudal fin 10 rays. HL 7.6–12.7 in SL; snout length 2.3–3.7 in HL; snout depth 0.7–3.9 in snout length. Superior trunk and tail ridges discontinuous; lateral trunk ridge straight, ending near anal ring; inferior trunk and tail ridges continuous. Median dorsal snout ridge low; opercular ridge either complete or incomplete; pectoral-fin base with 0–2 ridges; body ridges low, with margins entire to denticulate. Scutella indistinct to prominent, not keeled. Dorsal-fin base not elevated. Dermal flaps present or absent. Male brood pouch with everted or semi-pouch closure, pouch plates slightly enlarged, and pouch under first 10–19 tail rings. Four species, 1 in WIO.

*Bryx analicarenis* (Duncker 1915)

Pink pipefish

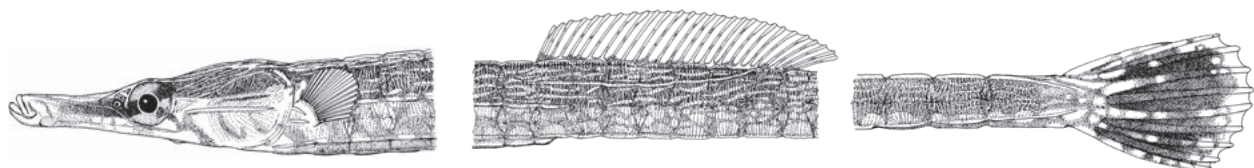
*Syngnathus analicarenis* Duncker 1915: 83 (Makran coast, Baluchistan, Pakistan); Smith 1963.

*Bryx analicarenis*: Fritzsche 1980; Dawson 1981\*, 1982; Randall 1995; Golani & Bogorodsky 2010.

Rings 16–18 + 35–39; dorsal fin 27–33 rays; subdorsal rings 1.75–0 + 5.25–7.25 = 5.5–7.5; pectoral fins 13 or 14 rays. HL 8.9–10.7 in SL; snout length 2.3–2.6 in HL; snout depth 2.9–3.9 in snout length. Opercular ridge straight and usually complete; pectoral-fin base usually with 2 distinct ridges; head and body ridges entire, without denticles and dermal flaps. Male brood pouch with everted closure; pouch under first 17–19 tail rings.

Background colour pink; dorsum and sides weakly banded with incomplete dark bars (~4 or 5 rings wide) and ~13–15 reticulate paler bars (~0.5–1.5 rings wide); caudal-fin margin pale. Females with ventrolateral side of snout pale with dark line running along lower third of blotch, and pale bar extending posteroventrally from eyes. Males with brown head and opercle. Attains 125 mm SL.

**DISTRIBUTION** WIO: Pakistan, Persian/Arabian Gulf, Red Sea, Eritrea, Tanzania, Madagascar and Seychelles.



*Bryx analicarenis*, 12 cm SL (Bahrain).

**REMARKS** Marine; reported from tidepools, among seagrasses and on reef flats, to ~45 m deep.

**GENUS** *Bulbonaricus* Herald 1953

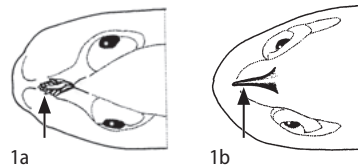
Pughead pipefishes

Rings 15–17 + 40–46; dorsal fin 22–26 rays in planktonic and non-metamorphosed fish, and fin absent in adults and subadults; 0 + 7.0–8.5 subdorsal rings, and dorsal-fin origin on 2nd or 3rd tail ring; pectoral fins 9–13 rays in planktonic and non-metamorphosed fish, fins absent in demersal fish; no anal fin; caudal fin 10 rays. Superior and inferior trunk ridges continuous with their respective tail ridges; lateral trunk ridge straight, terminating near anal ring. Frontal process (largely concealed by skin) extending in front of eyes, either V-shaped in dorsal view, with spiny or denticulate edges or rounded in cross-section; no opercular ridge; pectoral-fin bases without ridges; body ridges indistinct. Scutella inconspicuous or absent. Dorsal fin without elevated base. No dermal flaps. Male brood pouch with semi-pouch closure, pouch plates short, pouch folds present, and pouch under first 20 tail rings. Planktonic and non-metamorphosed individuals with distinct snout and terminal mouth; metamorphosed demersal individuals have pug-nosed head (not a tubular snout), with inferior mouth and fleshy lips. At least 3 species, 2 in WIO, although the WIO form of *B. davaoensis* may prove to be a distinct species.

**KEY TO SPECIES**

**[Metamorphosed demersal individuals]**

- 1a Frontal process V-shaped in dorsal view, the dorsal margins spinose or denticulate ..... *B. brucei*
- 1b Frontal process spine-like and round in cross-section, the margins without spines or denticulations ..... *B. davaoensis*



Drawings sourced from Dawson (1985)

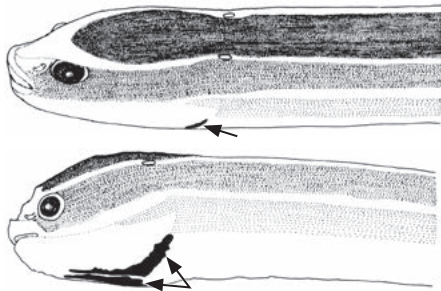
*Bulbonaricus brucei* Dawson 1984

Bruce's pughead pipefish

*Bulbonaricus brucei* Dawson 1984: 569, Figs. 5–6 (central lagoon, Pangani, Maziwe I., Tanzania).

Rings 15 or 16 + 43–45; dorsal fin 22 rays; subdorsal rings 7.5, beginning on 3rd tail ring; pectoral fins 9 or 10 rays in planktonic and non-metamorphosed fish, fins absent in demersal fish. Frontal process V-shaped with spinose margins.

Males with dark green dorsal stripe, olive-green midlateral stripe and greenish mauve ventrolateral stripe, each separated by white longitudinal stripe; posterior and ventral margins of opercle dark red. Females with stripes similar to males but more mauve in colour. Preserved specimens very pale. Attains 45 mm SL.



*Bulbonaricus brucei*, 44 mm SL, male, head colouration (arrows show bright red ventral mark) (Tanzania). Source: Dawson 1984

**DISTRIBUTION** Known only from six type specimens from Tanzania.

**REMARKS** Marine. Collected among polyps of *Galaxea clavus*, at ~1 m deep.

*Bulbonaricus davaoensis* (Herald 1953)

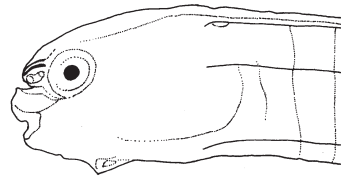
Davao pughead pipefish

PLATE 78

*Ichthyocampus davaoensis* Herald in Schultz *et al.* 1953: 242, Fig. 37 (Gulf of Davao, Mindanao, Philippines).*Bulbonaricus davaoensis*: Dawson 1980\*, 1984\*.

Rings 16 or 17 + 40–45; dorsal fin 22–26 rays; subdorsal rings 7.0–8.5, and dorsal-fin origin on 2nd or 3rd tail ring; pectoral fins 9–13 rays in planktonic and non-metamorphosed fish, fins absent in demersal fish. Frontal process spine-like and round in cross-section.

Body green dorsally, with pale blue longitudinal streak, and white ventrally, with median ventral green streak; underside of head white; ventral margin of opercle bright red; caudal-fin membranes with melanophores. Preserved specimens very pale. Attains 43 mm SL.



*Bulbonaricus davaoensis*, 41 mm SL, metamorphosing adult. Source: Dawson 1984

**DISTRIBUTION** Indo-Pacific. WIO: Kenya (near Mombasa); elsewhere, Indonesia, Philippines, Taiwan, Japan, Australia and Fiji.

**REMARKS** Marine; planktonic fish taken from upper 200 m over depths of 610–7 120 m, and metamorphosed demersal fish known from coral habitats, among polyps of *Galaxea fascicularis*, at 2–8 m.

**GENUS** *Campichthys* Whitley 1931

Rings 13–17 + 26–36; dorsal fin 16–19 rays; subdorsal rings 1.25–0.25 + 2.5–4.25 = 3.5–5.0; pectoral fins 7–11 rays; anal fin 3 or 4 rays; caudal fin 8 or 10 rays. HL 7.1–10.5 in SL; snout length 2.6–3.3 in HL; snout depth 1.4–2.3 in snout length. Superior and inferior trunk ridges continuous with their respective tail ridges; lateral trunk ridge ends midlaterally between last trunk ring and 4th tail ring. Median dorsal snout ridge a continuous elevated crest or a series of short crests or knob-like elevations; opercular ridge usually complete, angled dorsally; pectoral-fin base with 0–1 ridges; body ridges entire to finely denticulate. Trunk V-shaped but not keeled. Scutella without longitudinal ridge or keel. Dorsal-fin base not elevated. Tiny dermal flaps usually present on eyes, and slightly larger flaps on head. Male brood pouch (where known) with everted closure; pouch plates absent or barely enlarged; pouch under first 9–17 tail rings. Four species, plus at least 3 undescribed species; 1 species in WIO.

*Campichthys nanus* Dawson 1977

Pixy pipefish

*Campichthys nanus* Dawson 1977: 641, Fig. 16 (Pinda, Mozambique).

Rings 13 + 26 or 27; dorsal fin 18 or 19 rays; subdorsal rings 1.0–0.5 + 4.0–4.25 = 4.75–5.0; pectoral fins 8 or 9 rays; caudal fin 10 rays. HL 7.8–8.3 in SL; snout length 2.7–3 in HL; snout depth 1.4–2.1 in snout length. Median dorsal snout ridge with 2 crests; opercular ridge only on anterior third of opercle; pectoral-fin base sculptured, but without ridges; lateral trunk ridge ends on last trunk ring or 1st tail ring. No dermal flaps. Male brood pouch with enlarged plates, pouch folds wide, and pouch under first 9 tail rings.



One specimen uniformly pale tan; second specimen (male) darker brown, with 5 pale narrow bars crossing dorsum of trunk. Attains at least 25 mm SL.

**DISTRIBUTION** Known only from two type specimens from Mozambique, one caught on a reef top.

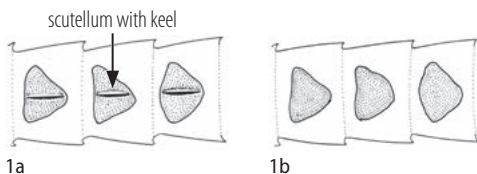
**REMARKS** Records from Djibouti, Oman and Yemen may be an undescribed species, and records from Taiwan are likely not this species.

**GENUS** *Choeroichthys* Kaup 1856

Rings 14–21 + 17–25; dorsal fin 17–34 rays; subdorsal rings 7.25–2.5 + 0–2.5 = 3.75–8.25; pectoral fins 17–23 rays; anal fin 3 or 4 rays; caudal fin 10 or 11 rays. HL 3.4–7.3 in SL; snout length 1.7–2.5 in HL; snout depth 1.9–7.2 in snout length. Superior trunk and tail ridges continuous; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge. Median dorsal snout ridge low; opercular ridge complete; body ridges distinct, margins entire to finely denticulate. Scutella with or without keels. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch with semi-pouch closure, pouch plates and folds present, and pouch under trunk rings 2–20. Eight species, 3 in WIO.

**KEY TO SPECIES**

- 1a Scutella keeled; dorsal fin 27–34 rays; total subdorsal rings 6.25–8.25 ..... *C. sculptus*
- 1b Scutella not keeled; dorsal fin 17–25 rays; total subdorsal rings 3.75–6.0 ..... 2



- 2a Trunk rings 18 or 19; front portion of dorsal fin brown and rear portion pale; tail rings with slight tapering to tail tip ..... *C. smithi*
- 2b Trunk rings 15–17; dorsal fin entirely pale; tail rings with marked tapering to tail tip ..... *C. valencienni*

Drawings sourced from Dawson (1985)

*Choeroichthys sculptus* (Günther 1870)

Sculptured pipefish

PLATE 78

*Doryichthys sculptus* Günther 1870: 185 (Fiji).

*Doryrhamphus macgregori* Jordan & Richardson 1908: 246, Fig. 7 (Calayan, Babuyan I., Philippines).

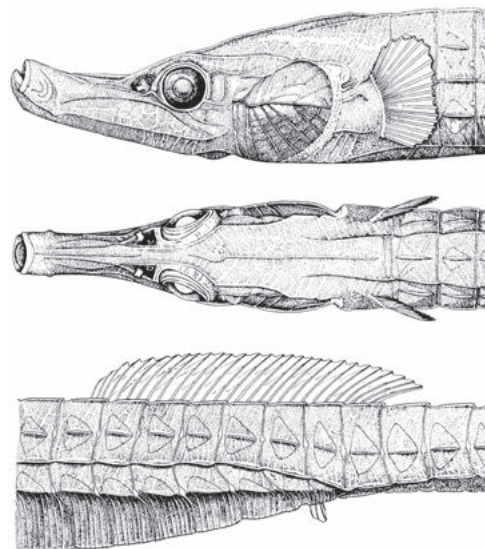
*Microphis ocellatus* Snyder 1909: 598 (Naha, Okinawa Is., Japan).

*Choeroichthys sculptus*: Duncker 1915; Weber & De Beaufort 1922;

Smith 1963\*; Dawson 1976\*, 1985\*; SSF No. 145.2\*; Winterbottom *et al.* 1989; Fricke *et al.* 2009.

Rings 18–21 + 21–25; dorsal fin 27–34 rays; subdorsal rings 7.25–4.0 + 0.5–2.5 = 6.25–8.25; pectoral fins 18–23 rays; anal fin 4 (rarely 3) rays; caudal fin 10 (rarely 11) rays. HL 4.9–7.3 in SL; snout length 2–2.5 in HL; snout depth 2.2–3.5 in snout length. Median dorsal snout ridge low, sometimes absent anteriorly and elevated posteriorly; body ridges typically notched between rings. Prominent odontoid processes on premaxillae and mandibles. Scutella conspicuous, each scutellum with prominent longitudinal, laterally projecting keel. Male brood pouch under trunk rings 3–20.

Body pale tan to dark brown (darker in East African specimens); usually with diffuse dark spot surrounding nares, and dark stripe on opercle; dorsal fin mainly pale. Males with or without dark spot on upper part of each trunk ring, and typically with 3 dark-margined ocelli on lower part of each trunk ring, followed by 2 rows of dark spots on tail. Females and juveniles without ocelli but usually with 4 dark lateral spots or blotches on each trunk ring, fading on tail. Attains 80 mm SL.



*Choeroichthys sculptus*, 53 mm SL, male (Fiji). Source: Dawson 1976

**DISTRIBUTION** Indo-Pacific. WIO: Kenya, Tanzania, Mozambique (Inhaca I.), Madagascar, Seychelles, Réunion, Chagos, Maldives and possibly India (Kapoor *et al.* 2002); elsewhere from Philippines to southern Japan, Fiji, Kiribati and French Polynesia.

**REMARKS** Marine; most commonly found in reef habitats at <3 m deep.

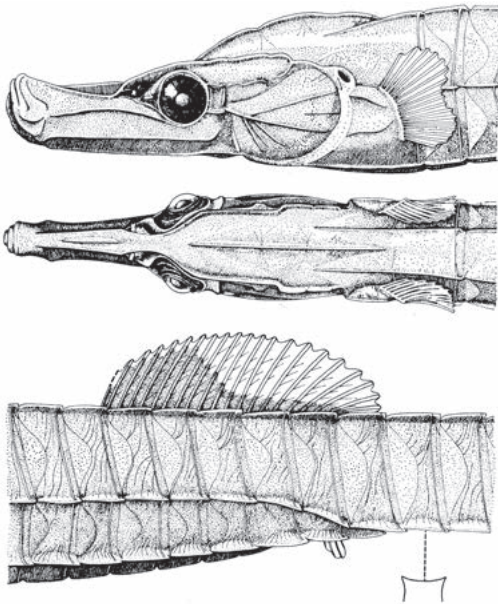
*Choeroichthys smithi* Dawson 1976

Shortfin pipefish

*Choeroichthys smithi* Dawson 1976: 51, Figs. 5, 7 (Inhaca I., Mozambique); SSF No. 145.3\*; McKenna & Allen 2005.? *Choeroichthys* n. sp. Smith 1951: 53 (Maputo Bay, Mozambique).*Choeroichthys valencienni* (non Kaup 1856): Gabie 1960\*.*Choeroichthys suillus* (non Whitley 1951): Smith 1963\*.

Rings 18 or 19 + 18–22; dorsal fin 17–23 rays; subdorsal rings 5.0–3.25 + 0–1.5 = 3.75–5.5; pectoral fins 17–21 rays; anal fin 4 rays; caudal fin 10 rays. HL 4.3–6.2 in SL (proportionally longer in small specimens); snout length 2.2–2.5 in HL; snout depth 1.9–3 in snout length. Median dorsal snout ridge absent anteriorly and elevated posteriorly; body ridges indented or notched between rings. Scutella not keeled. Male brood pouch under trunk rings 2–17.

Body tan to dark brown, sometimes with irregular dark streaks; dorsal fin brown anteriorly, with pale margin, colour reduced posteriorly to continuous brown stripe along proximal  $\frac{1}{4}$ – $\frac{1}{2}$  of fin, and distal part of fin hyaline. Attains 56 mm SL.

*Choeroichthys smithi*, 44 mm SL, female holotype (S Mozambique).

Source: Dawson 1976

*Choeroichthys smithi*, 44 mm SL, female holotype (S Mozambique). Source: Smith 1963

**DISTRIBUTION** WIO: Mozambique (Pinda, Inhaca I. and Quilalea I.), South Africa (Durban, KwaZulu-Natal) and Madagascar.

**REMARKS** Marine; collected among seagrasses, at <3 m deep.

*Choeroichthys valencienni* Kaup 1856

Indian short-bodied pipefish

PLATES 78 &amp; 79

*Choeroichthys valencienni* Kaup 1856: 55, 75, Pl. 3 [not 2],Fig. 6 (Mauritius, Mascarenes); Duncker 1915; Carpenter *et al.* 1997\*; Kuitert 2004\*; Fricke *et al.* 2009.*Doryichthys valencienni*: Günther 1870.*Choeroichthys brachysoma* (non Bleeker 1855): Smith 1963\*;Winterbottom *et al.* 1989\*; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Al-Jufaili *et al.* 2010.

Rings 15–17 + 18–21; dorsal fin 20–25 rays; subdorsal rings 4.75–3.5 + 0.25–1.5 = 3.75–6.0; pectoral fins 20–22 rays; anal fin 4 rays; caudal fin 10 rays. HL 3.8–4.8 in SL; snout length 1.9–2.2 in HL; snout depth 3.4–7.2 in snout length. Median dorsal snout ridge low; body ridges only slightly indented or notched between rings. Scutella not keeled. Male brood pouch under trunk rings 2–15.

Body tan to dark brown, either plain or marbled or with irregular faint narrow stripes; usually with dark lateral stripe on each side of snout, through eyes and onto opercles; dorsal fin pale. Males usually with incomplete row of spots above lateral trunk ridge and complete row of spots below. Females usually with row of dark spots above and below lateral trunk ridge. Attains 52 mm SL.

**DISTRIBUTION** Indian Ocean. WIO: Persian/Arabian Gulf, Gulf of Oman, Red Sea, Mozambique, Madagascar, Seychelles, Réunion, Mauritius, Chagos, Maldives, India and Sri Lanka; elsewhere, possibly Thailand.

**REMARKS** Marine; most common among seagrasses and in reef and coral habitats, at <10 m deep, but reported to ~27 m. Replaced by *C. brachysoma* from Mentawai Is. (Indonesia) to Australia and throughout Pacific Ocean.

**GENUS** *Corythoichthys* Kaup 1853

Rings 14–19 + 29–41; dorsal fin 22–36 rays; subdorsal rings 4.0–7.75, and dorsal-fin origin between rear margin of penultimate trunk ring and rear margin of 2nd tail ring; pectoral fins 12–18 rays; anal fin 3 or 4 rays; caudal fin 10 rays. HL 5.7–12 in SL; snout length 1.5–2.8 in HL; snout depth 3.5–11.9 in snout length. Superior trunk and tail ridges discontinuous; lateral trunk ridge straight, ending near anal ring; inferior trunk and tail ridges continuous. Snout slender, with low median dorsal snout ridge, and little expanded in front of eyes; eyes protrude laterally, but lack expanded lateral margins; frontal, prenuchal and nuchal ridges present to slightly elevated; opercular ridge low, usually complete; pectoral-fin base usually with 2 low ridges; body ridges distinct, indented to distinctly notched between rings, the margins denticulate to entire in subadults and adults, and

spinulose to serrate in juveniles. Trunk slightly V-shaped ventrally, and dorsum slightly indented between superior ridges. Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch with semi-pouch closure, pouch folds barely covering outermost eggs, no pouch plates, and pouch under first 8–18 tail rings.

This genus likely includes a number of undescribed species, especially given the geographic variation in colour patterns (Kuitert 2004). Unfortunately, there are no published morphological data that correspond exactly to these colour patterns. Therefore, it is unclear whether the differences in colour patterns represent species-specific differences or geographic variations in widespread species (Dawson 1977). In the absence of a more recent revision, the following accounts are based on colour patterns, morphological counts and measurements of individuals from the WIO, as much as possible. About 14 species, 6 in WIO.

**KEY TO SPECIES**

- |  |  |
|--|--|
| <p>1a Snout short: 9.2–9.5 in SL, snout length 2.3–2.5 in HL, snout depth 4.6–4.9 in snout length; pectoral fins usually 13–15 rays ..... 2</p> <p>1b Snout longer: 6.8–8.6 in SL, snout length 1.7–2.1 in HL, snout depth 6–9.1 in snout length; pectoral fins usually 15–17 rays... 3</p> <p>2a Trunk rings usually 15; tail rings usually 36 or 37; pectoral fins usually 13 or 14 rays; dorsal fin may have spotting at base, but otherwise transparent; males without dark blotch on ventral part of anal ring, and without dark lateral stripes on head ..... <i>C. amplexus</i></p> <p>2b Trunk rings usually 16; tail rings usually 34–36; pectoral fins usually 14 or 15 rays; dorsal fin with 3 or 4 irregular rows of spots, including marginal band; males with dark indigo-blue blotch (often outlined in yellow) on ventral part of anal ring (becomes black with preservation), and 2 dark lateral stripes on head..... <i>C. flavofasciatus</i></p> <p>3a Snout exceptionally long and narrow: HL ~6.8 in SL, snout length ~1.7 in HL, snout depth ~9.1 in snout length; colour pattern generally includes rows of golden to red-brown spots, which may merge to form dashes or short stripes, but colour not diminishing towards tail ..... <i>C. schultzi</i></p> <p>3b Snout moderately long: HL 8–8.6 in SL, snout length 2–2.1 in HL, snout depth 6–7 in snout length; colour pattern variable, but colour usually diminishing towards tail, with last ¼–½ of body almost entirely pale and translucent ..... 4</p> | <p>4a Trunk rings 16; golden spot usually covering entire opercle (spot underlain by melanophores that show as black opercle after preservation); ventrolateral part of 2nd–5th trunk rings of both males and females with black pigment, but not forming central blotches or transverse bars ..... <i>C. nigripectus</i></p> <p>4b Trunk rings usually 17; no spot on opercle, or else spot not covering entire opercle (and opercle not becoming black after preservation); ventral part of 2nd–5th trunk rings of both males and females with diffuse brown-black blotches or transverse bars ..... 5</p> <p>5a Tail rings 33–36, total rings 49–54; dorsal-fin origin usually on last trunk ring; snout longer and thicker (HL ~8 in SL; snout depth ~6 in snout length); dorsal fin clear; top of head with scattered melanophores or stripes, but without V-shaped red-brown mark; opercle either with stripes or plain, but without obvious spot; ventral parts of 2nd–5th trunk rings with prominent black bars or with paired spots outlined in yellow in males, and with paired blotches in females..... <i>C. haematopterus</i></p> <p>5b Tail rings 37–41, total rings 54–58; dorsal-fin origin usually on 1st tail ring; snout shorter and thinner (HL ~8.4 in SL; snout depth ~6.8 in snout length); dorsal fin usually with 2 or 3 irregular rows of red-brown spots; top of head with red-brown marking, usually V-shaped; opercle with large dusky brown spot; ventrolateral parts of 2nd–5th trunk rings of both males and females with diffuse brown-black blotch or blotches ..... <i>C. insularis</i></p> |
|--|--|



*Corythoichthys amplexus* Dawson & Randall 1975

Brown-banded pipefish

PLATE 79

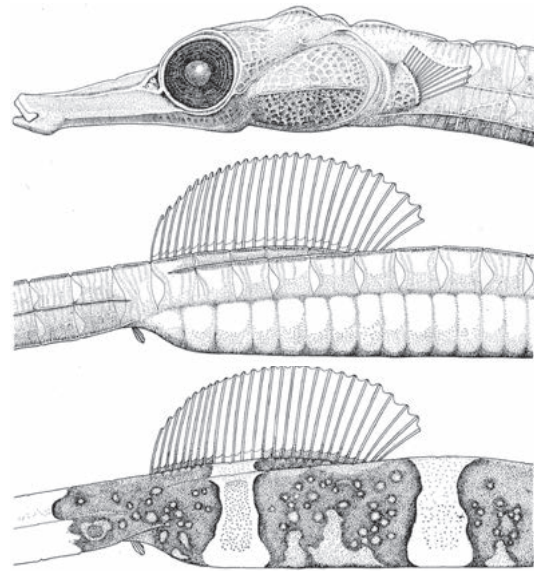
*Corythoichthys amplexus* Dawson & Randall 1975: 271, Figs. 6–7 (Beqa Lagoon, patch of reef between Stuart and Yanuca Is., Fiji); Randall 1995\*; Winterbottom & Anderson 1997; Manilo & Bogorodsky 2003; Al-Jufaili *et al.* 2010.

?*Corythoichthys* sp. 4: Kuitert 2004\* (Oman).

?*Corythoichthys* sp. 5: Kuitert 2004\* (Seychelles).

Rings 14–16 + 35–39 = 50–54; dorsal fin 23–29 rays; subdorsal rings 4.5–6.0, and dorsal-fin origin from last quarter of last trunk ring to front edge of 2nd tail ring (fin origin usually on first half of 1st tail ring); pectoral fins 12–15 rays; anal fin 4 rays. HL 8.4–12 in SL; snout length 2.1–2.8 in HL; snout depth 3.7–5.4 in snout length. Superior trunk ridge usually smooth, but may show fine denticulations; superior and inferior trunk ridges indented to notched between rings, and all other ridges smooth, with slight indentations only between the superior tail ridges. Nares open externally through single oval pore with slight valve-like posterolateral flap. Male brood pouch under first 9–15 tail rings.

Body ground-colour alternating bands of opaque pale cream to milky yellow, and red-brown to red (each band ~1–2 rings wide), usually resulting in 15–22 dark bands; pale bands usually broken by brown to red ocellated or outlined spots, and dark bands broken by white to cream ocellated or outlined spots (ocelli and spotting may obscure banding pattern, especially in WIO individuals); ≥30 orange to red-brown lateral dots forming 2 or 3 irregular rows just above inferior trunk ridge; opaque white dashes often on anterior, superior and inferior body ridges; snout with opaque white and red to red-brown spots, and red to red-brown reticulations dorsally and laterally, and scattered melanophores ventrally; eyes, top of head and opercle with red to red-brown reticulations; gold to orange spot often obvious just behind pectoral fins, and pectoral fins and dorsal fin with some spotting at bases, but otherwise transparent; ventrolateral portion of opercle red to red-brown, with fewer spots and reticulations than rest of head; no median stripe on ventral surface of head; ventral part of 1st trunk ring usually with poorly defined black and/or yellow lateral stripes or spots (males and females); ventral portion of anal ring not dusky (males and females); caudal fin with pink to red membranes and white margin. Females with scattered chromatophores on ventral and ventrolateral part of 2nd–4th trunk rings; in most males these chromatophores merge into dark blotches. Attains 97 mm SL.



*Corythoichthys amplexus*, 7 cm SL, male holotype (Fiji).

Source: Dawson & Randall 1975

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Red Sea (Towartit Reef, Sudan), South Africa (Sodwana Bay), Seychelles, St Brandon Shoals, Chagos and Sri Lanka; elsewhere to Gulf of Thailand, Indonesia, Philippines, Australia, New Guinea, Fiji and Samoa.

**REMARKS** Marine; often seen in groups and collected from among corals, at 9–31 m. Specimens from WIO may represent one or two undescribed species.

*Corythoichthys flavofasciatus* (Rüppell 1838)

Yellow-banded pipefish

PLATE 79

*Syngnathus flavofasciatus* Rüppell 1838: 144 (Gulf of Suez, Red Sea).

*Corythoichthys sealei* Jordan & Starks in Jordan & Seale 1906: 213, Fig. 18 (Apia, Upolu I., Samoa).

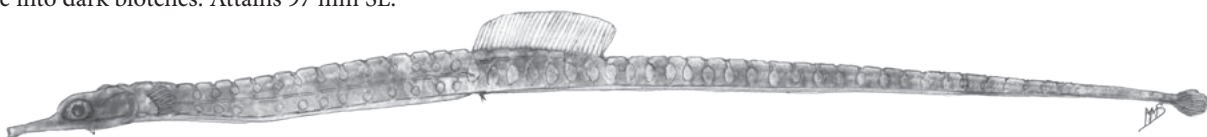
*Corythoichthys serrulifer* Fowler 1938: 136, Pl. 8 (Papeete, Tahiti, Society Is.).

*Corythoichthys flavofasciatus conspicillatus* (Jenyns): Smith 1963\*.

*Corythoichthys flavofasciatus flavofasciatus* (Rüppell): Smith 1963.

*Corythoichthys flavofasciatus*: Dawson 1977\*, 1985; Winterbottom *et al.* 1989\*; Goren & Dor 1994; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Kuitert 2004\*; Fricke *et al.* 2009.

?*Corythoichthys* sp. 6: Kuitert 2004\*.



*Corythoichthys flavofasciatus*, 10 cm TL, female (Mozambique). Source: Smith 1963



Rings 15–17 + 32–38 = 48–55; dorsal fin 26–35 rays; subdorsal rings 5.75–7.25, and dorsal-fin origin from rear edge of penultimate trunk ring to first half of 1st tail ring; pectoral fins 13–17 rays; anal fin 3 or 4 rays. HL 6.8–10.9 in SL; snout length 1.9–2.6 in HL; snout depth 3.5–6.3 in snout length. Superior trunk ridge slightly elevated, smooth, slightly indented between rings, and all other ridges smooth; body appears slightly squared. Nares open externally through single oval pore with slight valve-like posterolateral flap. Male brood pouch under first 11–16 tail rings.

Background colour translucent pale creamy, banded by alternating paler yellow to orange bands and darker red to brown-black bands; 6 dark bands on trunk extending across dorsal surface, but usually not beyond lateral ridge; 9–16 dark bands on tail extending across dorsal surface to inferior tail ridge (dark bands tend to become more red posteriorly): bands may be nearly solid blocks of pigment, emarginate or broken into reticulate patterns with ground-colour showing through; 3 or 4 rows of 10–30 small red to black spots, usually running longitudinally between lateral and inferior trunk ridges; body ridges often outlined in opaque white, sometimes resulting in white longitudinal stripes running length of trunk and tail; tip of snout often with mid-dorsal, opaque white line; snout translucent pink, with red-brown spots often coalescing into lateral stripe crossing eyes and onto opercles above opercular ridge (this stripe may be expanded on opercle to form red-brown spot); some individuals also have stripe passing from ventral snout, below eyes, to merge with beginning of row of lateral spots on trunk; ventral part of 2nd–5th trunk rings with diffuse patches of melanophores (males and females); top of head between eyes variable, from unmarked to exhibiting yellow to black median line, and top of head behind eyes usually with dark red-black blotch; lower part of head and 1st trunk ring usually with median dark stripe; dorsal fin usually with 3 or 4 irregular rows of yellow, pink, red, brown or black spots, sometimes alternating with opaque white spots on same rays; caudal fin usually with pink to red membranes and white margin. Males with indigo-blue blotch outlined in yellow (becomes obvious black blotch after preservation) on venter of anal ring. Attains 116 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Red Sea, Gulf of Aden, Somalia to Mozambique, Madagascar, Comoros, Seychelles, Mascarenes, St Brandon Shoals, Chagos and Maldives; elsewhere to Cocos (Keeling) Is., southern Japan, Mariana Is., Wake I., Marshall Is., Australia, Vanuatu, Fiji, Cook Is. and French Polynesia.

**REMARKS** Marine; collected as deep as 25 m, but most specimens taken on algal and coral substrates in <10 m. Specimens from WIO may represent an undescribed species.

## *Corythoichthys haematopterus* (Bleeker 1851)

Reef-top pipefish

PLATE 80

*Syngnathus fasciatus* Gray 1830: no page number, Pl. 89, Fig. 2 ('Ambryna' [?Ambon I., Moluccas, Indonesia]) [objectively invalid; preoccupied by *Syngnathus fasciatus* Risso 1810]; Smith 1949.

*Syngnathus haematopterus* Bleeker 1851: 258 (Banda Neira [Banda Is., Indonesia, Banda Sea]).

*Syngnathus conspicillatus* (non Jenyns 1842): Lunel 1881.

*Corythoichthys haematopterus*: Smith 1963\*; Dawson 1977\*, 1985\*; Randall 1995\*; Fricke 1999; Fricke *et al.* 2009.

?*Corythoichthys* sp. 9: Kuitert 2004\*.

Rings 16–18 + 33–36 = 49–54; dorsal fin 23–31 rays; subdorsal rings 4.75–6.5, and dorsal-fin origin from rear edge of penultimate trunk ring to front half of 1st tail ring; pectoral fins 13–18 rays; anal fin 3 or 4 rays. HL 6.3–9.4 in SL; snout length 1.9–2.4 in HL; snout depth 3.8–8 in snout length. Superior trunk ridge elevated with fine granulations, and indented or notched between rings, and all other ridges smooth, with slight indentations only between superior tail ridges. Body appears slightly squared. Nares open externally through single oval pore with slight valve-like posterolateral flap. Male brood pouch under first 11–18 tail rings.

Two colour patterns in WIO, with individuals bridging the extremes. Either: 1) overall colour pattern striking, with body translucent pearly grey, broken dorsally by darker grey bands that become black bars laterally; usually with 1–3 fine yellow lines, outlined in black, longitudinally along dorsal and dorsolateral surfaces; below these, 3 or 4 fine black lines, outlined in white, running longitudinally along lateral surface, and lines expanding where they merge with lateral black bars which may break into fine reticulations; often  $\geq 20$  black lateral dots just above inferior trunk ridge; superior and inferior trunk ridges often outlined stark white. The darker grey forms of this colour pattern with 4 or 5 broad bands on trunk, and 4–11 broad bands on tail, becoming progressively less distinct posteriorly; snout often pink, with isolated black spots and broken lateral stripe continuing across eyes to merge with central black stripe on opercles; opercular stripe outlined in white and surrounded by similar C-shaped black stripe running superiorly and inferiorly; top of head between eyes with 2 parallel black lines, merging with yellow lines above opercle and extending onto trunk. Or: 2) overall colour pattern more drab, with body translucent pearly grey, slightly darker grey laterally between lateral and inferior ridges and fading posteriorly; often  $\geq 20$  white lateral dots just above inferior trunk ridge; white dashes, sometimes with red to yellow centres, outlining the trunk and tail ridges, without obvious banding; snout pink to red, with single broken black lateral stripe inferior to eyes and below the white opercular ridge (sometimes outlines in red or yellow); some males with entire

lower head and operculum yellow. All WIO individuals with dorsum and venter of head grey with scattered melanophores that may form longitudinal lines or reticulations; dorsal fin transparent; ventral portion of 2nd–5th trunk rings with prominent black bars or paired spots outlined in yellow in males, and with paired blotches in females; ventral portion of anal ring usually yellow in males, but never dusky in males or females; caudal fin usually pale pink to transparent. Attains 198 mm SL.



*Corythoichthys haematopterus*, variation of female throat markings.  
Source: Smith 1963



*Corythoichthys haematopterus*, variation of male throat markings.  
Source: Smith 1963

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Red Sea to Mozambique, Madagascar, Aldabra, Seychelles, Réunion, Maldives, India (Tamil Nadu) and Sri Lanka; elsewhere to Indonesia (Sunda Is.), Vietnam, China, southern Japan, Caroline Is., New Guinea, Australia, Solomon Is. and Vanuatu.

**REMARKS** Marine; collected from up to ~20 m deep, but most commonly seen on algal-covered substrates in coral-rich habitats in <10 m. Specimens from WIO may represent one or two undescribed species.

### *Corythoichthys insularis* Dawson 1977

Cheeked pipefish

PLATE 80

*Corythoichthys insularis* Dawson 1977: 324, Figs. 16–17 (D'Arros I., Amirante Is., Seychelles); Kuitert 2004\*.

Rings 17 or 18 + 37–41 = 54–58; dorsal fin 26–30 rays; subdorsal rings 5.0–6.0, and dorsal-fin origin from rear quarter of last trunk ring to front edge of 2nd tail ring; pectoral fins 14–16 rays; anal fin 4 rays. HL 8.2–9.5 in SL; snout length 1.9–2.1 in HL; snout depth 6–8.2 in snout length. Superior trunk ridges with fine denticulations and notched between rings, and all other ridges smooth, with slight indentations

only between superior tail ridges. Nares open externally through single oval pore with slight valve-like posterolateral flap. Male brood pouch under first 11.5–13.5 tail rings.

Body generally translucent pale cream to dusky tan, with longitudinal red-brown to golden lines and dashes, and stark opaque white dashes; dorsal edges of rings with red-brown to yellow-brown or opaque white transverse dashes;  $\geq 20$  opaque white lateral dots just above inferior trunk ridge; opaque white markings usually joining to form very narrow rings between rings 3–4, 8–9, 13–14, 17–18, 21–22 and 25–26, fading posteriorly, creating impression of ~4 darker broad bands on trunk and  $\geq 5$  on tail; 1st trunk ring usually with isolated transverse dusky bar, often extending to pectoral-fin base; ventral and ventrolateral part of 2nd–5th trunk rings of both males and females with diffuse brown-black blotch or blotches; ventral portion of anal ring not dusky in males or females; snout with red-brown and opaque white spots; eyes often with transverse and/or longitudinal red-brown dashes; top of head with red-brown markings, often in V-shape (point of V between eyes); opercle usually with large dusky brown spot, ventrolateral margin of opercle often dark; ventral surface of snout usually with 2 longitudinal dusky lines; underside of head often with pair of brown to golden blotches behind eyes and in front of gills, sometimes extending anteriorly and posteriorly; dorsal fin usually with 2 or 3 irregular rows of red-brown spots; caudal fin usually white to creamy pink, with white margin. Attains 92 mm SL.

**DISTRIBUTION** WIO: Comoros, Amirante Is. (Seychelles), Mauritius and Maldives.

**REMARKS** Marine; often found in groups associated with outer seaward reefs, and also inside caves with rich invertebrate diversity, at 15–43 m. One collection from Fiji likely represents a similar but distinct species.

### *Corythoichthys nigrippectus* Herald 1953

Black-breasted pipefish

PLATE 80

*Corythoichthys nigrippectus* Herald in Schultz *et al.* 1953: 275, Fig. 41b (lagoon off Airukijiji [Arji] I., Bikini Atoll, Marshall Is.); Dawson 1977\*, 1985\*; Goren & Dor 1994.  
? *Corythoichthys* sp. 12: Kuitert 2004\*.

Rings 16 + 36–39 = 52–55; dorsal fin 25–30 rays; subdorsal rings 4.75–5.75, and dorsal-fin origin from last half of last trunk ring to first half of 1st tail ring; pectoral fins 13–17 rays; anal fin 3 or 4 rays. HL 6.8–9.8 in SL; snout length 1.9–2.3 in HL; snout depth 5–7.8 in snout length. Superior trunk ridge slightly elevated, smooth or with fine denticulations, and notched between rings, and all other ridges smooth, with slight

indentations only between superior tail ridges. Nares open externally through single oval pore with slight valve-like flap. Male brood pouch under first 12–15 tail rings.

Body generally translucent pink to red dorsally, and pink to orange laterally; ground-colour broken by creamy to yellow bars, fading posteriorly to mostly creamy after dorsal fin; dorsum marked with bright red longitudinal ‘chain-link’ lines that break into dashes and then dots after dorsal fin;  $\geq 20$  stark opaque white lateral dots just above inferior trunk ridge; lateral trunk ridge often marked with opaque white dashes; darker ground-colour usually broken to form narrow indistinct pale rings, suggesting 4 broad bands on trunk, and 3–11 bands on tail, becoming progressively less distinct. Snout with isolated opaque white spots and brown spots forming broken stripe, continuing as diffuse red stripe through eyes and red line behind eyes, to red markings on top of head; ventral surface of snout usually clear; underside of head dark brown to black, especially under opercle; ventrolateral portion of 2nd–5th trunk rings usually underlain by melanophores (more obvious after preservation); ventral portion of anal ring not dusky (males and females); top of head with red V- to Y-shaped pattern (opening to rear), meeting markings from eye to continue over top edge of opercle; opercle usually golden, entirely underlain by melanophores (opercle black after preservation); dorsal fin with 2 or 3 irregular rows of red spots; caudal fin with scattered melanophores on membranes, and usually pink to red rays and white margin. Attains 110 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and Comoros; elsewhere, Great Nicobar I. (Andaman Sea), Mariana Is., Caroline Is., Marshall Is., New Caledonia and Society Is.

**REMARKS** Marine; often found in pairs in coral-rich habitats, in  $< 30$  m, and seen on floors of caves (Kuitert 2004). Populations in the Red Sea appear disjunct from those in the Pacific and differ slightly in meristic counts and colour pattern. As indicated by Dawson (1977) and Kuitert (2004), this disjunction may represent some west–east decrease in meristics as well as poor representation in collections, or it may represent distinct species differences; however, the records of a specimen from Great Nicobar I. and a photograph of what appears to be *C. nigripectus* from Grande Comore I. suggest the species is underrepresented in collections.

## *Corythoichthys schultzi* Herald 1953

Schultz’s pipefish

PLATE 81

*Corythoichthys schultzi* Herald in Schultz *et al.* 1953: 271, Fig. 42 (lagoon off Airukijji [Arji] I., Bikini Atoll, Marshall Is.); Dawson 1977\*, 1985\*; Winterbottom *et al.* 1989\*; Goren & Dor 1994; Kuitert 1998\*; Fricke 1999; Terashima *et al.* 2001\*; Fricke *et al.* 2009.

?*Corythoichthys* sp. 11: Kuitert 2004\*.

Rings 15–17 + 32–38 = 48–55; dorsal fin 25–30 rays; subdorsal rings 4.5–6.0, and dorsal-fin origin from front edge of last trunk ring to last quarter of 1st tail ring; pectoral fins 14–18 rays; anal fin 3 or 4 rays. HL 6–8.1 in SL; snout length 1.5–2 in HL; snout depth 6.6–11.9 in snout length. Superior trunk ridges slightly elevated, with fine denticulations, and notched between rings, and all other ridges smooth, with slight indentations only between superior tail ridges. External opening of nares variable: some individuals with single oval pore with slight valve-like flap, others with partially united flaps resulting in near separation of incurrent and excurrent openings, and still others with 2 distinct narial openings. Male brood pouch under first 12–18 tail rings.

Body generally translucent pearly cream to grey, marked with longitudinal red-brown to orange or golden dashes merging to form lines, as well as stark opaque white dashes (particularly on body ridges) (markings may appear more bold and outlined in some populations, especially from Maldives and Chagos); 1 or 2 rows of  $\geq 20$  red-brown to golden ocellated lateral dots just above inferior trunk ridge; longitudinal lines and dashes and any darker ground-colour usually broken to form very narrow indistinct pale rings, suggesting 4 broad bands on trunk and 5–9 broad bands on tail, bands becoming progressively less distinct posteriorly; snout with isolated brown and opaque white spots; brown stripe beginning on snout, running through middle of eyes and across opercles, becoming more red posteriorly; another darker parallel stripe from rear margin of eyes across lower edge of opercles; top of head with orange to red-brown dashes; opercle usually with large dusky brown spot or 3rd stripe above other stripes; underside of snout usually with 2 lateral dusky lines of melanophores; underside of head often with indistinct lyre-shaped pattern of melanophores, merging with spot on 1st ventral trunk ring; ventral part of 1st–5th trunk rings (males and females) often with melanophores surrounding single central spot on each ring, but without uniformly black pigment or transverse bars; ventral portion of anal ring yellow in some males, but never dusky in males or females; dorsal fin occasionally with irregular basal row of red-brown to orange spots; caudal fin usually with white margin, centre of fin pink to red, and with scattered melanophores on rays (which may mask red colour); spots on male brood pouch may be ocellated. Attains 150 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Comoros, Seychelles, Mauritius, Chagos, Maldives and Sri Lanka; elsewhere to Thailand, Indonesia (Sulawesi), Ryukyu Is., Marshall Is., Australia and Tonga.

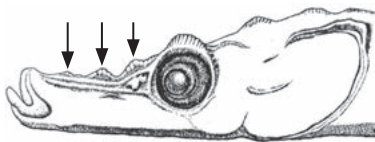
**REMARKS** Marine; found to ~30 m deep. Specimens from WIO may represent one or two undescribed species.

GENUS *Cosmocampus* Dawson 1979

Rings 14–18 + 24–41; dorsal fin 16–30 rays; subdorsal rings 2.75–0 + 2.25–7.25 = 3.75–8.0; pectoral fins 9–18 rays; anal fin 2–4 rays; caudal fin 10 rays. HL 5.3–13.2 in SL; snout length 1.2–4 in HL; snout depth 1.4–10.2 in snout length. Superior trunk and tail ridges discontinuous; lateral trunk ridge straight, ending near anal ring; inferior trunk and tail ridges continuous; median dorsal snout ridge low, entire, denticulate or with short dorsal projections; opercular ridge complete or incomplete; pectoral-fin base with 1 or 2 ridges; body ridges low to slightly elevated, sometimes with spine-like points on rear angles of tail rings, margins entire to serrate. Dorsal-fin base not elevated. Scutella not keeled. Simple dermal flaps usually present. Male brood pouch with semi-pouch closure, pouch plates present or absent, pouch folds present, and pouch under first 10–21 tail rings. Sixteen species, 4 in WIO.

## KEY TO SPECIES

- 1a Dorsal fin 16–20 rays; median dorsal snout ridge with 2–4 subtriangular projections ..... *C. banneri*



- 1b Dorsal fin 22–27 rays; median dorsal snout ridge with 0–2 subtriangular projections ..... 2

- 2a Trunk rings 16 or 17; subdorsal trunk rings 2.5–1.5; pectoral fins 11 or 12 (usually 11) rays ..... *C. darrosanus*

- 2b Trunk rings 14 or 15; subdorsal trunk rings 1.5–0.25; pectoral fins 12–18 rays ..... 3

- 3a Pectoral fins 12–15 rays; HL 7.9–10.4 in SL; snout length 2.5–3.1 in HL; snout depth 2.1–3 in snout length ..... *C. investigatoris*

- 3b Pectoral fins 16–18 rays; HL 5.3–6.8 in SL; snout length 1.6–1.9 in HL; snout depth 5.4–7.9 in snout length ..... *C. maxweberi*

Drawing sourced from Dawson & Randall (1975)

*Cosmocampus banneri* (Herald & Randall 1972)

Roughridge pipefish

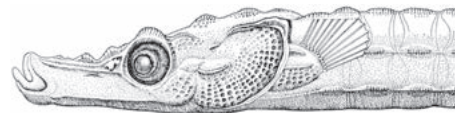
PLATE 81

*Syngnathus banneri* Herald & Randall 1972: 135, Fig. 4 (reef off Ishigaki City harbour, Ishigaki I., Ryukyu Is., Japan).

*Cosmocampus banneri*: Dawson & Randall 1975\*; SSF No. 145.4\*; Winterbottom *et al.* 1989\*; Goren & Dor 1994; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Kuitert 2004\*.

Rings 15 + 27–30; dorsal fin 16–20 rays; subdorsal rings 1.75–0.25 + 2.75–4.0 = 3.75–4.75; pectoral fins 11–14 rays; anal fin 3 or 4 rays. HL 7–8.3 in SL; snout length 2.2–2.7 in HL; snout depth 2.8–3.6 in snout length. Median dorsal snout ridge with 3 or 4 distinct semi-isolated subtriangular projections; lateral snout spine present; opercular ridge crosses front  $\frac{1}{3}$ – $\frac{1}{2}$  of opercle; pectoral-fin base with 2 ridges; body ridges notched or deeply indented between rings, distal third or more of tail with principal ridges elevated, flared laterally, and produced to points on rear angles of rings; 10–12 tiny dermal flaps present on eyes and elsewhere on head. Male brood pouch under first 10–12 tail rings.

Body ground-colour pale tan, sometimes with dusky bars on dorsum, usually with indications of short brown bars (often broken in middle) on venter of pectoral ring and on lower half of sides and venter of trunk rings 2–10; some individuals with narrow bar running posteroventrally from eyes to front of opercles; opercle often golden. Attains 58 mm SL.



*Cosmocampus banneri*, 43 mm SL, female (Seychelles).

Source: Dawson & Randall 1975

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Red Sea, Mozambique, South Africa (Sodwana Bay; Aliwal Shoal), Comoros, Seychelles, Mauritius, Rodrigues, Chagos and Maldives; elsewhere to Cocos (Keeling) Is., Christmas I., Indonesia, Philippines, Taiwan, Ryukyu Is., Marshall Is., New Caledonia and Fiji.

**REMARKS** Marine; found in coral or reef habitats, to ~30 m deep.



*Cosmocampus banneri*, 5 cm SL, brooding male. Source: SSF



## *Cosmocampus darrosanus*

(Dawson & Randall 1975)

### D'Arros pipefish

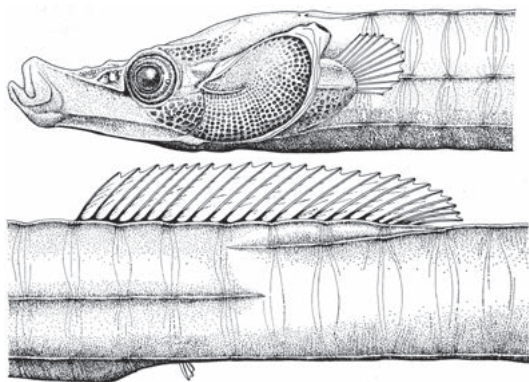
*Syngnathus darrosanus* Dawson & Randall 1975: 269, Figs. 4–5 (off eastern side of D'Arros I., Amirante Is., Seychelles).

*Syngnathus lumbricoides* Maugé 1981: 61, Fig. 1 (Ifaty, SW Madagascar).

*Cosmocampus darrosanus*: Dawson 1985\*.

Rings 16 or 17 + 29–31; dorsal fin 22 or 23 rays; subdorsal rings 2.5–1.5 + 3.75–4.75 = 5.75–6.5; pectoral fins 11 or 12 rays; anal fin 3 rays. HL 7.9–10.1 in SL; snout length 2.6–3.1 in HL; snout depth 1.7–2.3 in snout length. Median dorsal snout ridge emarginate or with 1 or 2 low subtriangular projections; lateral snout ridge very low, without obvious spines; opercular ridge upturned, usually incomplete (absent in large specimens); last third or more of tail with main ridges slightly elevated, slightly flared laterally, and with rear angles of rings forming inconspicuous points; 17 or 18 tiny dermal flaps usually present on eyes and elsewhere on head.

Body ground-colour tan to dark brown; paler mottling may encircle each ring or every 4 or 5 rings; upper snout and tip of lower jaw very pale, with tan to brown area extending anterodorsally from lower jaw to eyes and posteroventrally from eyes to throat. Attains 74 mm SL.



*Cosmocampus darrosanus*, 47 mm SL, female holotype (Seychelles).

Source: Dawson & Randall 1975

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, Madagascar and Seychelles; elsewhere, Guam and Australia (Queensland).

**REMARKS** Marine; found on reef flats and in tidepools in <3 m.

## *Cosmocampus investigatoris* (Hora 1926)

### Investigator pipefish

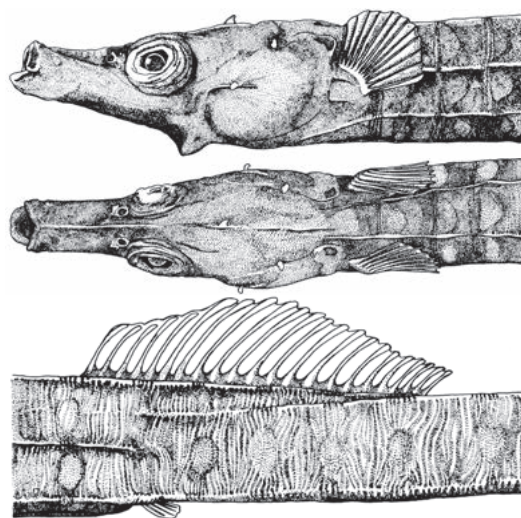
PLATE 81

*Syngnathus investigatoris* Hora 1926: 461, Pl. 11, Fig. 4 (Mergui Harbour, Myanmar); Dawson 1981\*.

*Cosmocampus investigatoris*: Dawson 1985\*; Randall 1995\*.

Rings 15 + 31–33; dorsal fin 22–24 rays; subdorsal rings 1.5–1.0 + 4.0–4.75 = 5.0–5.25; pectoral fins 12–15 rays. HL 7.9–10.4 in SL; snout length 2.5–3.1 in HL; snout depth 2.1–3 in snout length. Median dorsal snout ridge entire, moderately elevated posteriorly; no lateral snout ridge; opercular ridge angled upward, complete in juveniles, crosses only  $\sim\frac{1}{3}$  of opercle in large specimens; pectoral-fin base with 1 ridge in juveniles, 2 ridges in larger fish; superior body ridges slightly elevated. Dermal flaps usually present on eyes and elsewhere on head.

Body ground-colour green, tan or brown; white stripe runs from anterodorsal part of snout through eyes to front end of opercular ridge, and  $\sim$ 11 white bars across dorsum, separated by darker interspaces 3–5 rings wide; small white spots on rear parts of main ridges; dorsal fin with 3–5 rows of white spots; dermal flaps white. Attains 72 mm SL.



*Cosmocampus investigatoris*, 72 mm SL, female or juvenile (Persian/Arabian Gulf). Source: Dawson 1981

**DISTRIBUTION** Indian Ocean. WIO: Persian/Arabian Gulf, Gulf of Oman and Sri Lanka; elsewhere to Indonesia, Myanmar and Gulf of Thailand.

**REMARKS** Marine; collected to  $\sim$ 15 m deep.

*Cosmocampus maxweberi* (Whitley 1933)

Weber's pipefish

PLATE 81

*Syngnathus punctatus* Weber 1913: 113, Fig. 39 (Saleh Bay, Sumbawa I., Lesser Sunda Is., Indonesia) [preoccupied by *S. punctatus* Rafinesque 1810].

*Syngnathus (Parasyngnathus) maxweberi* Whitley 1933: 66 (Saleh Bay, Sumbawa I., Lesser Sunda Is., Indonesia).

*Cosmocampus maxweberi*: Goren & Dor 1994.

Rings 14 or 15 + 29–32; dorsal fin 23–27 rays; subdorsal rings 1.25–0.25 + 4.25–5.5 = 5.25–6.0; pectoral fins 16–18 rays; anal fin 4 rays. HL 5.3–6.8 in SL; snout length 1.6–1.9 in HL; snout depth 5.4–7.9 in snout length. Median dorsal snout ridge entire; lateral snout ridge short and low, sometimes absent; opercular ridge complete or incomplete; pectoral-fin base with 2 ridges; body ridges not strongly elevated; last third or more of tail with rear angles of rings forming points parallel to main ridges; 1–4 tiny dermal flaps on eyes. Male brood pouch under first 10–12 tail rings, and pouch without plates.

Body ground-colour red-brown, with darker shading on rear half of each ring; ~8 diffuse pale bars across dorsum; sides of trunk may have vertical row of 1–3 small pale spots; anteroventral portion of opercle dark; underside of snout and throat pale. Attains 79 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aqaba (Red Sea); elsewhere, Indonesia to Marshall Is., New Guinea, Australia and Samoa.

**REMARKS** Marine; collected from reef or coral bottoms, to ~36 m deep (most common at >4 m), but planktonic juveniles have been taken in upper 85 m over depths of 1 565–2 010 m.

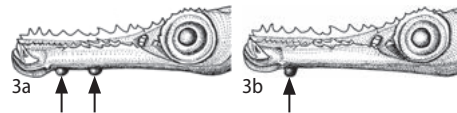
**GENUS** *Doryrhamphus* Kaup 1856

Rings 15–20 + 11–23; dorsal fin 16–29 rays; subdorsal rings 5.0–0.75 + 1.0–4.75 = 3.5–8.25; pectoral fins 17–23 rays, median rays shortest; anal fin 4 rays; caudal fin 10 rays. HL 3.4–5.3 in SL; snout length 1.5–2.7 in HL; snout depth 3.9–12.6 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low to moderately elevated, entire, and irregularly emarginate, denticulate or

spinulose; snout with 1–5 rows of dorsolateral spinules, and subadult to adult males with 0–2 bony or fleshy ventrolateral projections on snout; opercular ridge complete; pectoral ring (1st trunk ring) clearly longer than 2nd trunk ring, and usually with 2 ridges; main ridges of each ring with 1 or 2 prominent spines distally, and ridge margins entire. Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch with semi-pouch closure, no pouch plates, pouch folds present, and eggs deposited on trunk rings 1–20. Eleven species, plus several undescribed species likely; 4 species in WIO.

**KEY TO SPECIES**

- |    |  |                        |
|----|--|------------------------|
| 1a | Tail rings 11 or 12 .....  | 2                      |
| 1b | Tail rings 13–17 .....   | 3                      |
|    |  |                        |
| 2a | Trunk rings 15 or 16; dorsal fin 18–20 rays; pectoral fins 18–20 rays; subadult to adult males with 1 bony ventrolateral projection on snout .....         | <i>D. abbreviatus</i>  |
| 2b | Trunk rings 18 or 19; dorsal fin 21 rays; pectoral fins 22 or 23 rays; subadult to adult males with 2 fleshy ventrolateral projections on snout .....      | <i>D. aurolineatus</i> |
|    |  |                        |
| 3a | Trunk rings 16; dorsal fin over 2.5–1.75 trunk rings (4.75–5.75 total rings); subadult to adult males with 2 bony ventrolateral projections on snout ..... | <i>D. bicarinatus</i>  |
| 3b | Trunk rings 17–19; dorsal fin over 4.5–3.5 trunk rings (6.0–7.75 total rings); subadult to adult males with 1 bony ventrolateral projection on snout ..... | <i>D. excisus</i>      |

*Doryrhamphus abbreviatus* Dawson 1981

Red Sea pipefish

PLATE 82

*Doryrhamphus excisus abbreviatus* Dawson 1981: 9, Fig. 4 (Strait of Jubal, Gulf of Suez, Red Sea); Goren & Dor 1994; Randall 1995.

*Doryrhamphus excisus* (non Kaup 1856): Smith 1963.

Rings 15 or 16 + 11 or 12; dorsal fin 18–20 rays; subdorsal rings 4.5–3.0 + 1.0–2.25 = 5.0–6.0; pectoral fins 18–20 rays. HL 3.5–4.2 in SL; snout length 2.0–2.5 in HL; snout depth 4.1–5.3 in snout length. Principal body ridges with 1 spine on each ring; subadult to adult males with 1 bony ventrolateral projection on snout.



*Doryrhamphus abbreviatus*, 32 mm SL, female paratype (Red Sea). Source: Dawson 1981

Body ground-colour orange-brown, with blue upper-lateral stripe from rear margin of eyes to base of caudal-fin rays; throat and edges of male brood pouch also blue; dorsum of snout yellow; dark stripe from tip of snout through eyes; mid-dorsal stripe orange; caudal fin markings variable: with orange dorsally and ventrally, and black tending to form C-shape or circle around central orange spot. Attains 43 mm SL.

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Marine; found in reef and tidepool habitats, to ~9 m deep.

*Doryrhamphus aurolineatus* Randall & Earle 1994

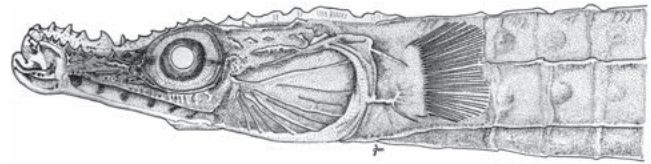
Orangestripe pipefish PLATE 82

*Doryrhamphus aurolineatus* Randall & Earle 1994: 283, Fig. 1, Pl. 1 (small cave, east side of Masirah I., Oman); Randall 1995\*; Manilo & Bogorodsky 2003.

Rings 18 or 19 + 11 or 12; dorsal fin 21 rays; subdorsal rings 4.5–4.0 + 2.0 = 6.0–6.5; pectoral fins 22 or 23 rays. HL ~4 in SL; snout length 2.6–2.7 in HL; snout depth 6.8–7 in snout length. Median dorsal snout ridge on front  $\frac{3}{4}$  of snout, with 5 spines, hindmost spine curving anteriorly; main body ridges with 1 spine on each ring; subadult to adult males with 2 fleshy ventrolateral projections on snout. Male brood pouch under trunk rings 2–18.

Body ground-colour grey-brown, with blue cast dorsally and orange cast laterally (but body not orange with blue stripe); dark spots on lower lateral margins of snout;

mid-dorsal stripe bright orange; caudal fin black, with irregular bright orange spot in centre. Attains 35 mm SL.



*Doryrhamphus aurolineatus*, 35 mm SL, female holotype (Oman). Source: Randall & Earle 1994

**DISTRIBUTION** Known only from two specimens collected from Oman.

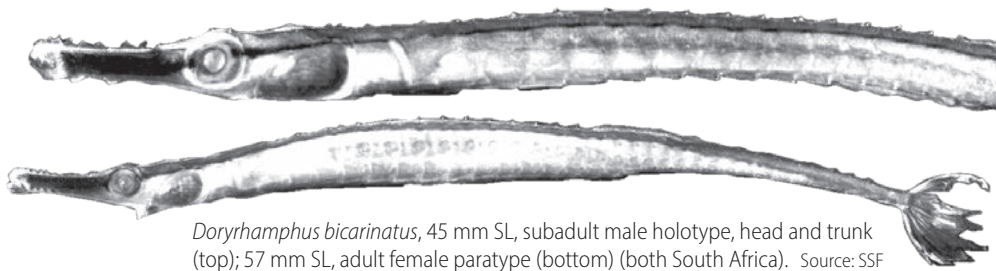
**REMARKS** Taken at ~11 m.

*Doryrhamphus bicarinatus* Dawson 1981

Narrowstripe pipefish, double-chin pipefish PLATES 82 & 83

*Doryrhamphus bicarinatus* Dawson 1981: 13, Figs. 8–10 (Sodwana Bay, South Africa); Dawson 1985\*; SSF No. 145.5\*; Anderson *et al.* 1998\*; Kuitert 2000\*, 2004\*; Fricke *et al.* 2009; Pinault *et al.* 2013.

Rings 16 + 16 or 17; dorsal fin 20–23 rays; subdorsal rings 2.5–1.75 + 2.75–4.0 = 4.75–5.75; pectoral fins 19–22 rays. HL 4.4–5.3 in SL; snout length 2–2.1 in HL; snout depth 5.3–8.2 in snout length. Median dorsal snout ridge runs from tip of snout to nares, with ~11 spines; main body ridges with 1 spine on each ring; subadult to adult males with 2 bony ventrolateral projections on snout. Male brood pouch under trunk rings 1–15.



*Doryrhamphus bicarinatus*, 45 mm SL, subadult male holotype, head and trunk (top); 57 mm SL, adult female paratype (bottom) (both South Africa). Source: SSF



*Doryrhamphus bicarinatus*, 45 mm SL, subadult male holotype, lateral head and trunk, dorsal head and trunk, lateral mid-body (South Africa), and caudal fin (southern Africa). Source: Dawson 1981



Body ground-colour orange-brown, with narrow blue stripe with black edges from front margin of eyes to caudal-fin base; dark stripe from tip of snout to front margin of eyes; dark spots on lower lateral margin of snout; mid-dorsal stripe orange; dorsal and ventral margins of caudal fin white, fin submarginally black, with white central blotch haloed with yellow, orange and red. Attains 80 mm SL.

**DISTRIBUTION** WIO: S Mozambique (Bazaruto) to South Africa (Sodwana Bay and Aliwal Shoal), Réunion and Maldives.

**REMARKS** Marine; collected from coral reefs, at 1–32 m.

### *Doryrhamphus excisus* Kaup 1856

Bluestripe pipefish

PLATE 82

*Doryrhamphus excisus* Kaup 1856: 54, Pl. 3, Fig. 5 (Massawa, Eritrea, Red Sea [probably Indian Ocean, perhaps Mauritius]); Smith 1963; Dawson 1981\*, 1985\*; SSF No. 145.6\*; Randall & Earle 1994\*; Heemstra *et al.* 2004; Kuitert 2004\*.

*Doryrhamphus melanopleura* (*non* Bleeker 1858): Smith 1953\*, 1963\*.

*Microphis mayottae* Fourmanoir 1955: 210 (Dzaoudzi, Mayotte, Comoros).

*Doryrhamphus excisus excisus*: Winterbottom *et al.* 1989\*; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Al-Jufaili *et al.* 2010.

Rings 17–19 + 13–16; dorsal fin 21–26 rays; subdorsal rings 4.5–3.5 + 2.25–3.75 = 6.0–7.75; pectoral fins 20–23 rays. HL 3.3–4.6 in SL; snout length 2–2.7 in HL; snout depth 4.1–6.2 in snout length. Median dorsal snout ridge runs from tip of snout to nares, with ~11 spines; main body ridges with 1 spine on each ring; subadult to adult males with 1 bony ventrolateral projection on snout. Male brood pouch under trunk rings 1–17.

Body ground-colour orange-brown, with blue upper-lateral stripe from tip of snout to caudal-fin base; underside of snout, throat and edges of male brood pouch also blue; dark stripe from tip of snout through eyes to rear edge of opercles; mid-dorsal stripe orange; caudal-fin markings variable: base black, followed by orange bar, and then usually a central orange bar with black above and below, and upper and lower margins may be blue. Attains 66 mm SL.

**DISTRIBUTION** WIO: Persian/Arabian Gulf, Gulf of Oman, Kenya to South Africa (Xora River mouth), Comoros, Seychelles, Mascarenes, St Brandon Shoals, Chagos, Maldives and Sri Lanka.

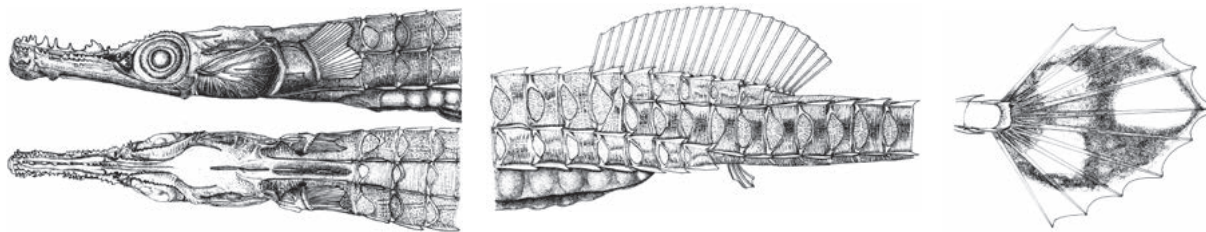
**REMARKS** Marine; commonly found over rocky or coral bottoms, to ~49 m deep. Replaced by *D. abbreviatus* in the Red Sea, and by *D. melanopleura* (Bleeker 1858) in the Pacific, but it is unclear whether *D. excisus*, *D. melanopleura* or both are present in the eastern Indian Ocean.

### GENUS *Dunckerocampus* Whitley 1933

Rings 15–17 + 16–22; dorsal fin 20–30 rays; subdorsal rings 3.0–0 + 2.0–4.25 = 2.75–6.75; pectoral fins 18–23 rays, middle rays shortest; anal fin 4 rays; caudal fin 10 rays. HL 3.6–5.3 in SL; snout length 1.4–2.2 in HL; snout depth 5.9–20.8 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge. Median dorsal snout ridge low to moderately elevated, entire, and irregularly emarginate, denticulate or spinulose; opercular ridge complete; pectoral ring (1st trunk ring) clearly longer than 2nd trunk ring, and usually with 2 ridges; juveniles with 2 spines on main ridges



*Doryrhamphus excisus*, 45 mm SL, brooding male (Chagos). Source: SSF



*Doryrhamphus excisus*, 41 mm SL, brooding male, lateral head and trunk, dorsal head and trunk, lateral mid-body (Chagos), and caudal fin (Mozambique). Source: Dawson 1981



of each ring, penultimate spine reduced with increased SL, becoming vestigial or obsolete in large specimens. Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Males without brood-pouch plates or folds; eggs deposited on trunk rings 1–15. Seven species, plus possibly 1 undescribed species; 2 species in WIO.

#### KEY TO SPECIES

- 1a Opercle with 1 dark band, trunk with 8–11 dark bands, and tail with 8–13 dark bands (~22–34 dark bands in total) ..... *D. boylei*
- 1b Opercle with 4–6 dark bands, trunk with 30–42 dark bands, and tail with 18–59 dark bands (~50–111 dark bands in total) ..... *D. multiannulatus*



*Dunckerocampus boylei*, 16 cm SL (South Africa). PC Heemstra © NRF-SAIAB



*Dunckerocampus multiannulatus*, 16 cm SL, male (Gulf of Aqaba). Source: SSF

### *Dunckerocampus boylei* Kuitert 1998

Broad-banded pipefish

PLATE 82

*Dunckerocampus boylei* Kuitert 1998: 82, Figs. 1–3 (Flic-en-Flac, Mauritius, Mascarenes); Kuitert 2004\*.

*Doryrhamphus dactyliophorus* (non Bleeker 1853): Dawson 1985\*; SSF No. 145.7\*; Goren & Dor 1994.

*Dunckerocampus dactyliophorus* (non Bleeker 1853): Smith 1963\*; Herald & Randall 1972.

Rings 16 or 17 + 20–22; dorsal fin 20–22 rays; subdorsal rings 0.75–0 + 3.0–3.75 = 3.25–4.0; pectoral fins 18–20 rays. HL 4.5–4.8 in SL; snout length 1.4–1.6 in HL; snout depth 11.2–12.9 in snout length.

Head and body with alternating red-brown and white bands: dark bands ~1½–2 times as wide as pale bands, each band with darker margin, especially dorsally; 4–8 dark bands on snout (often partially joined), followed by dark band through eyes, dark band across opercles, 8–11 dark bands on trunk (sometimes with anterior bands co-joined), and 8–13 dark bands on tail (total dark bands 22–34); caudal fin with white upper and lower margins, black posterior margin, and red-brown centrally. Attains 160 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: northern Red Sea, South Africa (Aliwal Shoal), Seychelles and Mauritius; elsewhere, Indonesia (Bali) and Timor-Leste.

**REMARKS** Marine; found at 20–95 m.

### *Dunckerocampus multiannulatus* (Regan 1903)

Many-banded pipefish

PLATE 83

*Doryichthys multiannulatus* Regan 1903: 413, Pl. 13, Fig. 3 (Mauritius, Mascarenes).

*Acanthognathus multiannulatus*: Duncker 1915.

*Dunckerocampus bentuviae* Fowler & Steinitz 1956: 273, Fig. 22 (Eilat, Israel, Gulf of Aqaba, Red Sea); Herald & Randall 1972.

*Dunckerocampus dactyliophorus bentuviae* (non Fowler & Steinitz 1956): Smith 1963\* [in part]; Goren & Dor 1994.

*Dunckerocampus dactyliophorus multiannulatus*: Smith 1963\* [in part].

*Dunckerocampus multiannulatus*: Herald & Randall 1972; Kuitert 2004\*.

*Doryrhamphus multiannulatus*: Dawson 1985\*; SSF No. 145.8\*; Winterbottom *et al.* 1989\*; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003; Fricke *et al.* 2009.

Rings 16 + 18–20; dorsal fin 20–23 rays; subdorsal rings 1.0–0.25 + 2.0–4.0 = 3.0–4.5; pectoral fins 18–22 rays. HL 3.6–4.7 in SL; snout length 1.4–1.7 in HL; snout depth 10–15.6 in snout length. Eggs deposited on trunk rings 1–15.

Head and body with alternating narrow red-brown and white bands, about equal in width, and usually darker dorsally; 7–10 dark bands on head, 4–6 bands across opercle, 30–42 bands on trunk, and 18–59 bands on tail (total dark bands 50–111); bands on trunk may fuse midlaterally (so that 2 dorsal bands combine to form 1 lateroventral band); bands sometimes absent from last ½ of tail; snout often with bands partially fused to form lateral stripe with yellow stripe below black; caudal-fin upper and lower margins white, black between most of rays, red-brown along rays, and white mark at fin base. Attains 165 mm SL.

**DISTRIBUTION** Indian Ocean. WIO: Red Sea, South Africa (Sodwana Bay), Comoros, Seychelles, Mauritius, Chagos and Maldives; elsewhere to Thailand.

**REMARKS** Marine; commonly found among corals and in reef caves, at <20 m, but reported to ~45 m deep.

## GENUS *Festucalex* Whitley 1931

Rings 14–20 + 31–40; dorsal fin 18–28 rays; subdorsal rings  $2.5-0.25 + 3.25-5.5 = 4.25-6.5$ ; pectoral fins 10–17 rays; anal fin 4 rays; caudal fin 10 rays. HL 6.1–9.7 in SL; snout length 1.7–2.7 in HL; snout depth 2.5–6.5 in snout length. Superior and inferior trunk ridges continuous with corresponding tail ridges; lateral trunk ridge not deflected near anal ring, ends midlaterally between last trunk ring and 14th tail ring; venter of trunk V-shaped, but not keeled; median dorsal snout ridge entire or with shallow emarginations; opercular ridge restricted to front half of opercle, sometimes lacking; pectoral-fin base with 0–2 ridges; body ridges entire to minutely denticulate, not serrate, some species with a few knobs or spine-like emarginations on last one or two rings. Scutella not keeled. Dorsal-fin base not elevated. Dermal flaps present or absent. Male brood pouch with semi-pouch closure, pouch plates only slightly enlarged, pouch folds present, and pouch under first 12–17 tail rings. At least 9 species, 2 in WIO (1 of these undescribed).

### KEY TO SPECIES

- 1a Pectoral fins 10–12 (usually 11 or 12) rays, and fin base without prominent ridges; median dorsal snout ridge low and entire; ridges of last 1 or 2 tail rings entire; opercular ridge low and indistinct ..... *F. erythraeus*
- 1b Pectoral fins 14 rays, and fin base with 2 ridges; median dorsal snout ridge with 2 peaks and broken between peaks; ridges of last 1 or 2 tail rings micro serrate; opercular ridge extends across half of opercle ..... *Festucalex* sp.

## *Festucalex erythraeus* (Gilbert 1905)

Red pipefish

PLATE 83

*Ichthyocampus erythraeus* Gilbert 1905: 613, Fig. 238 (off Molokai I., Hawaii).

*Ichthyocampus townsendi* Duncker 1915: 96 (Makran coast, Pakistan; Maldives); Smith 1963.

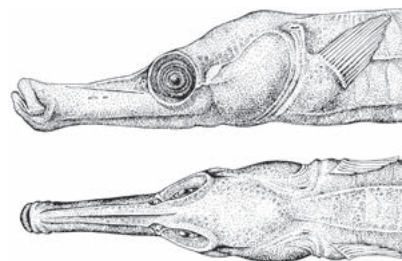
*Ichthyocampus philippinus* Fowler 1938: 43 (Tinakta I., Sulu Archipelago, Philippines).

*Festucalex erythraeus*: Dawson 1977\*; SSF No. 145.9\*.

*Festucalex townsendi*: Kuitert 2004\*.

Rings 15–17 + 32–37; dorsal fin 18–20 rays; subdorsal rings  $1.25-0.25 + 3.5-5.5 = 4.25-5.75$ ; pectoral fins 10–12 rays. HL 8–8.8 in SL; snout length 2.1–2.6 in HL; snout depth 2.5–3.9 in snout length. Mouth usually vertically oriented, with tips of premaxilla and dentary almost dorsal to jaw articulation. Median dorsal snout ridge elevated near middle of snout; opercular ridge low and indistinct; adults without prominent ridges on pectoral-fin bases; lateral trunk ridge crosses at most 1 tail ring, not projecting. Sometimes a few tiny dermal flaps present on head. Male brood pouch under tail rings 1–17.

Body red, with 10–12 greenish white mottled saddles; darker red superior, lateral and inferior trunk ridges, appearing as dashes along sides; scattered white spots along trunk and tail ridges; snout paler than body, with tiny white dermal flaps; vertical yellow bar just in front of opercle. Preserved specimens pale to tan, and faintly mottled or with indications of 10–12 indistinct pale bars crossing sides and dorsum. Attains 82 mm SL.



*Festucalex erythraeus*, 79 mm SL, female, head (Solomon Is.). Source: Dawson 1977



*Festucalex erythraeus*, 7 cm SL, female. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Mozambique, South Africa (Aliwal Shoal), Seychelles and Maldives; elsewhere to Indonesia, Philippines, Japan, Solomon Is. and Hawaii.

**REMARKS** Marine; found at 5–81 m. This species may ultimately be split into *Festucalex townsendi* (with rings 15 or 16 + 32–34; Indian Ocean to Indonesia), *F. philippinus* (with rings 17 + 35–37; Philippines) and *F. erythrinus* (with rings 16 + 35–37; Pacific Ocean from Japan to Hawaii), but there are too few specimens to determine the limits of these species.

### *Festucalex* sp.

Rings 16 + 35; dorsal fin 21 rays; subdorsal rings 0.5 + 4.5 = 5.0; pectoral fins 14 rays. HL 8.5 in SL; snout length 2.2 in HL; snout depth 4.1 in snout length. Mouth posteriorly inclined, with tips of premaxilla and dentary before jaw articulation. Median dorsal snout ridge rising to peak near rear third of snout, then absent, then rising to larger peak just in front of eyes; opercular ridge well-developed for ~½ length of opercle; pectoral-fin bases with 2 ridges; lateral trunk ridge ends on last trunk ring with no inferior deflection; ridges of last 1 or 2 tail rings with micro-serrations.

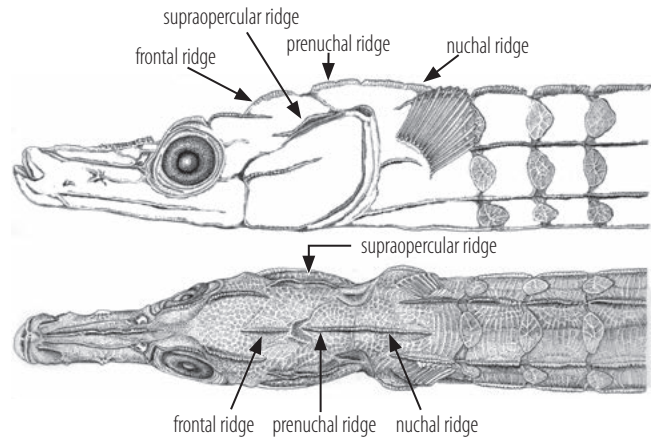
Colour in life unknown.

**REMARKS** Known from one specimen (60.7-mm-SL female) from South Africa (Kosi Bay, KwaZulu-Natal), collected near a river mouth, at ~50 m.

## GENUS *Halicampus* Kaup 1856

Rings 13–18 + 25–42; dorsal fin 15–26 rays; subdorsal rings 3.0–0 + 0.5–5.5 = 2.75–6.5, and dorsal-fin origin between front margin of antepenultimate trunk ring and middle of 1st tail ring; pectoral fins 10–20 rays; anal fin 2–4 rays; caudal fin 9 or 10 rays. HL 4.7–16.9 in SL; snout length 1.5–4.4 in HL; snout depth 1.2–16 in snout length. Superior trunk and tail ridges discontinuous, overlapping by 1.5–5.75 rings; inferior trunk ridge ends on anal ring; lateral trunk ridge continuous with inferior tail ridge; median dorsal snout ridge always present and may be continuous, with 1–3 groups of spines or else short ridge-like elevations; lateral snout ridge or spines present or absent; rim of orbit may or may not be elevated, often with spines or flared ridges; frontal, prenuchal, nuchal and supraopercular ridges absent to strongly projecting; opercular ridge either complete and angled upward towards gill opening,

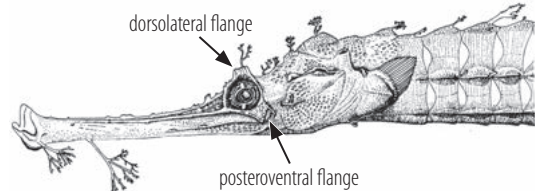
incomplete or absent; pectoral-fin base often projecting laterally, with or without 1 or 2 ridges; body ridges low to strongly elevated, the margins entire, serrate or denticulate, and occasionally with spines, and occasionally notched between rings. Scutella not keeled. Dorsal-fin base sometimes elevated; when elevated, subdorsal rings also slightly arched. Unbranched dermal flaps typically present on eyes; unbranched to highly branched dermal flaps or cirri often present elsewhere on snout, head, opercle, nape and body, and occasionally developed as large feather-like extensions. Male brood pouch with everted or semi-pouch closure, pouch plates and pouch folds present, and pouch under first 10–16 tail rings. This genus requires revision. At least 15 species, 7 in WIO.



*Halicampus* head ridges.

### KEY TO SPECIES

- 1a Tail rings 25–29; HL 4.5–5.5 in SL; snout long, its length 1.5–1.8 in HL; snout depth 9.2–16 in snout length; rim of orbit usually with large flanges projecting dorsolaterally and posteroventrally; smaller individuals with large feather-like dermal flaps on 8–10 superior body ridges ..... *H. macrorhynchus*

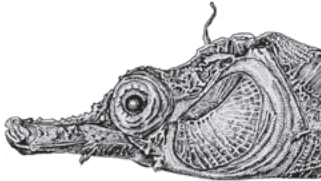


- 1b Tail rings 31–42; HL 7.7–16.9 in SL; snout shorter, its length 2–4.4 in HL; snout depth 1.2–5.3 in snout length; rim of orbit with small spines or serrations and without large flanges; no large feather-like dermal flaps on superior body ridges ..... 2

Continued ...

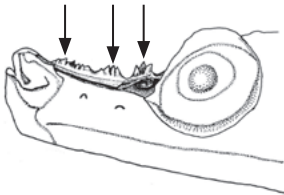
## KEY TO SPECIES

- 2a Trunk rings 17 or 18; pectoral fins 15–20 rays; snout short and thin in adults, snout length 2–2.6 in HL, snout depth 3.3–5.3 in snout length; most of dorsal fin on trunk rather than on tail (subdorsal rings 3.0–1.25 + 0.5–2.5); many tiny spinules on median dorsal snout ridge, sides of snout, rim of orbit and head; spines on body ridges of young and juveniles may be bifurcate ..... *H. grayi*



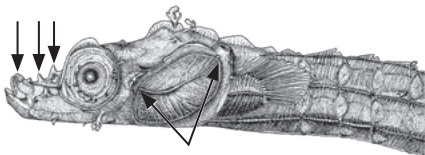
- 2b Trunk rings 13–15; pectoral fins 10–14 rays; snout not short or thin in adults, snout length 2.5–4.4 in HL, snout depth 1.2–3.2 in snout length; most of dorsal fin on tail rather than on trunk (subdorsal rings 1.5–0 + 2.5–5.5); median dorsal snout ridge, sides of snout, rim of orbit and head with or without spines, bumps and/or flanges, but not covered in tiny spinules; spines on body ridges of young and juveniles not bifurcate ..... 3

- 3a Trunk rings 15; median dorsal snout ridge discontinuous, with 2–4 (usually 3 or 4) clusters of spines or multifid ridge-like crests, anteriormost groups usually flattened and linear, posteriormost group with spines pointing in many directions (in adults), and sides of snout with 1 or 2 conical bumps ..... *H. mataafae*

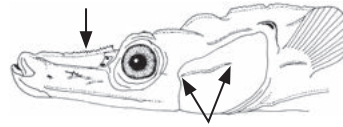


- 3b Trunk rings 13 or 14; median dorsal ridge continuous, or, if median dorsal snout ridge discontinuous, with 2 or 3 flat spines or ridge-like elevations, posteriormost with 2 or 3 points, and sides of snout with 3 flat to conical spines ..... 4

- 4a Median dorsal snout ridge discontinuous, with 2 or 3 flat spines or ridge-like elevations; opercular ridge complete and angled dorsally; pectoral fins 13 or (usually) 14 rays; body ridges notched between rings ..... *H. spinirostris*



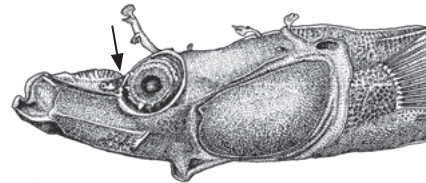
- 4b Median dorsal snout ridge continuous; opercular ridge incomplete in adults, usually crossing <math>< \frac{1}{2}</math> of opercle in subadults and juveniles; pectoral fins 10–13 rays; body ridges not notched between rings ..... 5



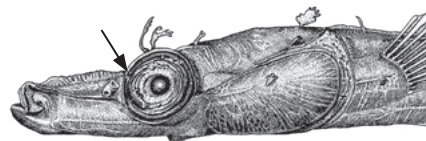
- 5a Snout moderately long, its length 2.6–2.9 in HL; each side of snout with 2 blunt spines at midlength, often with smaller spines near rear of upper jaw; median dorsal snout ridge low, almost linear; denticulate elevated margins on prenuchal and supraopercular ridges; pectoral fins 12 or 13 rays ..... *H. zavorensis*

- 5b Snout short, its length 3–4.4 in HL; sides of snout without spines, bumps or ridges; median dorsal snout ridge high, arcuate to rectangular; prenuchal and supraopercular ridges essentially absent; pectoral fins 10–13 (usually 11 or 12) rays ..... 6

- 6a Tail rings 37–42; median dorsal snout ridge ending before eyes; pectoral-fin bases usually not protruding laterally and without lateral ridge; frontal and nuchal ridges slightly elevated ..... *H. boothae*



- 6b Tail rings 31–36; median dorsal snout ridge ending between eyes; pectoral-fin bases usually protruding slightly, with 1 lateral ridge; frontal and nuchal ridges not elevated ..... *H. dunckeri*



Head drawings sourced from Dawson (1985)



## *Halicampus boothae* (Whitley 1964)

Booth's pipefish

PLATE 83

*Micrognathus boothae* Whitley 1964: 162, Fig. 3 (Lord Howe I.).

*Halicampus boothae*: Dawson 1985\*.

Rings 13 or 14 + 37–42; dorsal fin 18–24 rays; subdorsal rings 1.0–0 + 3.25–5.5 = 4.0–6.5; pectoral fins 10–12 rays; anal fin 3 or 4 rays; caudal fin 10 rays. HL 11.9–16.9 in SL; snout length 3–3.8 in HL; snout depth 1.7–3.1 in snout length. Superior trunk and tail ridges overlapping by 4.25–4.5 rings; median dorsal snout ridge a high, continuous, arched flange, with last two-thirds of margin serrate or spinulose for ~20–25 points, ending in front of eyes; sides of snout without spines or ridges; rim of orbits barely elevated, without spines or flared ridges; frontal and nuchal ridges slightly elevated, and prenuchal and supraopercular ridges essentially absent; opercular ridge absent in large adults, and crosses <math>< \frac{1}{2}</math> of opercle in smaller individuals; pectoral-fin bases not protruding laterally, usually without lateral ridge; body ridges slightly elevated, with superior ridges more so, rear portions of superior trunk ridges finely denticulate, but not notched. Dorsal-fin base not elevated. Unbranched dermal flaps usually present on eyes, and occasionally elsewhere on head and body. Male brood pouch under first 11–13 tail rings.

Body ground-colour variable: dark brown, red, orange or pale tan, usually with 10 or 11 irregularly mottled contrasting blotches dorsally and sometimes extending onto sides; ventral trunk rings often with dark bars; small contrasting spot (pale on dark individuals and dark on pale individuals) between rings on lateral and ventral ridges; tip of snout and lower jaw usually paler than body ground-colour; dermal flaps usually pale tan. Attains 166 mm SL.

**DISTRIBUTION** Indo-Pacific (possibly a species-complex). WIO: Comoros (Mayotte I.) and South Africa (Aliwal Shoal); elsewhere, Indonesia to Japan, Australia, New Caledonia, Lord Howe I., Fiji and Tonga.

**REMARKS** Marine; collected at 2–30 m, usually on rocky or coral reefs. May be a species-complex, with one species in the southwestern WIO, another in the northeastern Pacific, and a third in the southeastern Pacific (Dawson 1985; Kuitert 2004).

## *Halicampus dunckeri* (Chabanaud 1929)

Dusky pipefish

PLATE 84

*Micrognathus dunckeri* Chabanaud 1929: 170, Figs. 2–3 (Ambon I., Moluccas, Indonesia).

*Halicampus dunckeri*: Dawson 1985\*; SSF No. 145.10\*; Goren & Dor 1994. ?*Halicampus* sp. 1: Kuitert 2004\* [Red Sea and African population].

Rings 14 + 31–36; dorsal fin 16–20 rays; subdorsal rings 1.25–0 + 2.5–4.5 = 3.75–5.25; pectoral fins 10–13 rays; anal fin 2 or 3 rays; caudal fin 9 or 10 rays. HL 9.6–14.7 in SL; snout length 3–4.4 in HL; snout depth 1.8–3.1 in snout length. Superior trunk and tail ridges overlapping by 3.5–5.75 rings; median dorsal snout ridge a high, continuous, arcuate to rectangular flange, with rear margin serrate or spinulose for ~20–25 points, ending between eyes; sides of snout without spines or ridges; rim of orbits slightly elevated, without spines or flared ridges; frontal, prenuchal, nuchal and supraopercular ridges essentially absent; opercular ridge absent in large adults, but crosses up to half of opercle in smaller individuals; pectoral-fin bases barely protruding laterally, usually with 1 lateral ridge; body ridges slightly elevated, with superior ridges more so, and rear portions of superior and lateral ridges finely serrate but not notched. Dorsal-fin base not elevated. Occasionally few small dermal flaps and cirri on snout, head, operculum or body ridges, but typically with numerous small dermal flaps surrounding eyes. Male brood pouch under first 13–16 tail rings.

Body ground-colour usually dark brown to brown (occasionally paler, almost tan), with 10 or 11 irregularly mottled contrasting blotches dorsally; ventral trunk rings often with dark bars; dark individuals often with small white spot between rings on ventral ridge; tip of snout and lower jaw usually pale in dark individuals; dermal flaps usually pale tan. Attains 115 mm SL.

**DISTRIBUTION** Indo-Pacific (possibly a species-complex). WIO: Gulf of Aqaba (Red Sea), South Africa (Sodwana Bay), Seychelles (Île du Nord and Mahé) and St Brandon Shoals; elsewhere to Indonesia, Philippines, Japan, Palau, New Guinea, Australia, New Caledonia, Solomon Is. and French Polynesia.

**REMARKS** Marine; collected to ~20 m deep, usually on coral or rocky reefs or sandy bottoms. May be a species-complex, with one or more new species in the WIO (see Dawson 1985; Kuitert 2004).



*Halicampus dunckeri*, 9 cm SL, presumptive female (South Africa). Source: SSF

*Halicampus grayi* Kaup 1856

Mud pipefish, Gray's pipefish

PLATE 84

*Halicampus grayi* Kaup 1856: 22 (India; Australia) [*nomen nudum*]; Kaup 1853 [name only]; Dawson 1985\*; Manilo & Bogorodsky 2003.

*Halicampus conspicillatus* Kaup 1856: 22 [= *H. grayi* Kaup 1856, by Opinion 53 of ICZN].

*Halicampus koilomatodon*: Smith 1963\*.

Rings 17 or 18 + 32–37; dorsal fin 19–22 rays; subdorsal rings 3.0–1.25 + 0.5–2.5 = 3.0–4.25; pectoral fins 15–20 rays; anal fin 4 rays; caudal fin 10 rays. HL 7.7–10.9 in SL; snout length 2–2.6 in HL; snout depth 3.3–5.3 in snout length; snout proportionally shorter, and nuchal region proportionally deeper in adults than in juveniles and young (<9 cm SL). Median dorsal snout ridge and sides of snout with small separate spines and spinules; rim of orbits slightly elevated, with tiny spines but not flared ridges; frontal, prenuchal, nuchal and supraopercular ridges slightly elevated; opercular ridge usually complete, dorsally directed; pectoral-fin bases protruding laterally, but without distinct lateral ridge; body ridges slightly elevated, not notched, often with bump on last third of each trunk ring; rear tail ridges denticulate to spiny; spines on body ridges of young and juveniles may be bifurcate. Dorsal-fin base elevated, with subdorsal rings also slightly arched. Adults with a few small dermal flaps and cirri on snout, head, operculum, body ridges and scutella, and numerous small dermal flaps surrounding eyes (juveniles with fewer dermal flaps and cirri).

Body ground-colour brown, olive or grey; many individuals irregularly mottled with no other obvious pattern; some individuals with 4–6 diffuse dark bars on dorsum of trunk and extending slightly onto sides (each ~1 ring wide), followed by 3 paler rings that may fade to very pale centrally; 7–9 diffuse dark bars on dorsum and sides of tail (each ~2 rings wide), followed by paler bars (each also ~2 rings wide); sides of 12th–13th trunk rings occasionally with diffuse dark spot; snout, head, opercle and pectoral-fin bases often marked with fine dark dots on pale grey background; eyes and rear part of snout sometimes darker than rest of head. Attains 200 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden (1 specimen) and Sri Lanka (1 specimen); elsewhere to Thailand, Indonesia, Philippines, Taiwan, Japan, Marshall Is., Gilbert Is., Australia and Tahiti.

**REMARKS** Marine; adults and subadults usually collected from muddy bottoms, at 3–90 m, but juveniles have been trawled from the upper 100 m in open waters. Individuals on bottom may be covered in a mud-and-silt camouflage.

*Halicampus macrorhynchus* Bamber 1915

Ornate pipefish

PLATE 85

*Halicampus macrorhynchus* Bamber 1915: 480, Pl. 46, Fig. 4 (Gulf of Suez, Red Sea); Goren & Dor 1994; Kuitert 2004\*; Al-Jafaili *et al.* 2010.

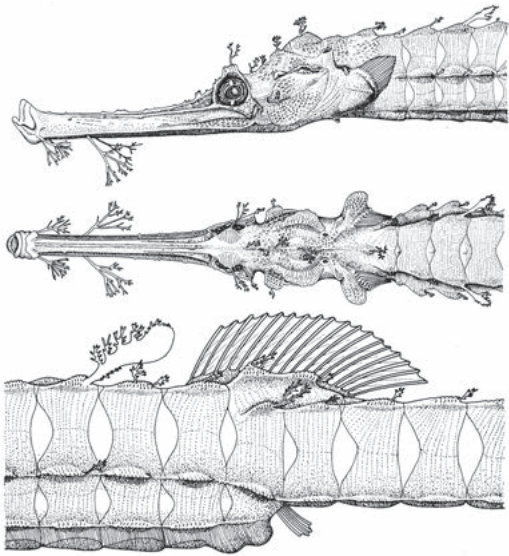
*Phanerotokeus gohari* Duncker 1940: 85, Figs. 1–3 (Al-Ghardaqa [Hurghada], Egypt, Red Sea); Dawson & Randall 1975.

*Halicampoides macrorhynchus*: Fowler 1956\*.

*Phanerotokeus macrorhynchus*: Smith 1963\*.

Rings 14 or 15 + 25–29; dorsal fin 18–19 rays; subdorsal rings 1.75–0.5 + 1.25–2.5 = 2.75–3.5; pectoral fins 16–19 rays; anal fin 4 rays; caudal fin 10 rays. HL 4.7–5.5 in SL; snout length 1.5–1.8 in HL; snout depth 9.2–16 in snout length in adults (6.2–8.5, in juveniles 7–10 cm SL). Superior trunk and tail ridges overlapping by 1.5–2.25 rings; median dorsal snout ridge low, consisting of series of tiny separate spines and short ridges; sides of snout with several tiny spines; rim of orbits elevated, with tiny spines anteriorly, and flared dorsolaterally on supraorbital ridge and ventrolaterally on postorbital ridge; frontal, prenuchal and nuchal ridges slightly elevated with denticulate margins; supraopercular ridge expanded as broad flat lateral projection; opercular ridge complete, dorsally directed, with front  $\frac{1}{3}$ – $\frac{1}{2}$  projecting laterally; pectoral-fin bases protruding laterally, with 1 strongly projecting lateral ridge; margins of superior and inferior ridges elevated, with granular, denticulate or serrate edges, and notched or indented between rings; body concave between ridges, and trunk with distinct keel. Dorsal-fin base slightly elevated, with subdorsal rings also slightly arched. Juveniles (~7–10 cm SL) with 2 pairs of highly branched, elongate dermal cirri on snout; smaller branched dermal cirri usually present on operculum and supraorbital, suborbital, frontal, prenuchal, nuchal and body ridges; numerous unbranched dermal flaps surrounding eyes; and 8–10 pairs of large flattened feathery or leaf-like dermal flaps variably present on superior ridge of 3rd trunk ring and about every 3 or 4 rings thereafter. Adults with reduced dermal flaps and cirri, such that they usually have branched or unbranched dermal cirri on head, operculum and body ridges; also with numerous unbranched dermal flaps surrounding eyes. Male brood-pouch plates small; pouch under first 15 or 16 tail rings.

Body ground-colour highly variable: yellow to green, red-brown or dark brown (most individuals seem to match the reef bottom); markings on body, cirri and dermal flaps also highly variable in colour and extent, with ~8–10 diffuse paler bars (~1 ring wide) interspersed with 2 or 3 darker bars across sides and/or dorsum; scutella often outlined in darker contrasting colour. Attains 162 mm SL.



*Halicampus macrorhynchus*, 15 cm SL (Solomon Is.).

Source: Dawson & Randall 1975

**DISTRIBUTION** Indo-Pacific. WIO: northern Red Sea (Gulf of Aqaba and Gulf of Suez), Oman, South Africa (Kosi Bay), Comoros (Mayotte I.) and Mauritius; elsewhere to Taiwan, Japan, Australia, New Guinea, Solomon Is. and Fiji. Photographs suggest the species is also present northeast of the Mascarene Ridge, and off Thailand, Singapore, Indonesia, East Timor and Philippines.

**REMARKS** Marine; most adult specimens collected at <30 m, on rocky and coral reefs, often found hiding within extensive algal growth, but a single adult was reported from a bottom trawl at 180–300 m. Presumed to have planktonic larvae which recruit onto reefs by ~70–80 mm SL.

### *Halicampus mataafae* (Jordan & Seale 1906)

Samoa pipefish

PLATE 86

*Corythoichthys mataafae* Jordan & Seale 1906: 213, Fig. 19 (coral reefs off Mulinu'u, Upolu I., Samoa).

*Micrognathus mataafae*: Smith 1963\*.

*Halicampus mataafae*: Dawson 1985\*; SSF No. 145.11\*; Winterbottom *et al.* 1989\*; Goren & Dor 1994; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Fricke *et al.* 2009; Al-Jufaili *et al.* 2010.

Rings 15 + 33–36 (usually 34–36 in WIO); dorsal fin 21–26 (usually 21–24) rays; subdorsal rings 1.25–0.5 + 3.5–5.0 = 4.5–5.75; pectoral fins 12–14 (usually 13 or 14) rays; anal fin 2 or (usually) 3 rays; caudal fin 10 rays. HL 10.2–13 in SL; snout length 2.5–4 in HL; snout depth 1.2–2.7 in snout length. Superior trunk and tail ridges overlapping by 4.25–5.25 rings; median dorsal snout ridge discontinuous, with 2–4 clusters of spines or multifid ridge-like crests, anteriormost group usually flattened and linear, posteriormost group with spines pointing in many directions in adults; each side of snout with 1 or 2 conical bumps; rim of orbits slightly elevated, without spines or flared ridges; margins of supraorbital, postorbital, frontal, prenuchal, nuchal and supraopercular ridges not elevated; opercular ridge crosses  $\frac{1}{3}$ – $\frac{3}{4}$  of opercle in subadults and adults; pectoral-fin bases protruding laterally, with 1 distinct ridge; body ridges slightly elevated; margins of superior ridges smooth anteriorly to minutely serrate posteriorly, not notched. Dorsal-fin base not elevated. Unbranched dermal flaps commonly present on eyes and occasionally on orbital rims, snout, opercle, head and dorsalmost ridges. Male brood-pouch plates small; pouch under first 10–13 tail rings.

Body ground-colour brown to tan, often with 9–11 barely visible, reticulated, irregular white bars (~ $\frac{1}{2}$ –1 ring wide) dorsally, with first 3–5 bars extending onto sides, usually preceded and/or followed by darker blotch and then separated by 2 mottled rings; ventral portion of anterior trunk pale brown, fading to white posteriorly; ventral part of snout with irregular brown to red-brown blotches, sometimes merging to form reticulated pattern on cheek; ventral half of opercle dark brown, often with creamy ventral margin; pectoral-fin bases often paler than surrounding body; lateral trunk ridge, inferior trunk ridge, inferior tail ridge, and some parts of superior trunk ridge often outlined in contrasting red-brown, with 1 small white spot near end of each ring's ridge, and tiny white dots along each ridge; the larger dermal flaps with brown to red-brown bases, but otherwise tan to cream (colour pattern may be nearly obliterated in darker individuals; this colour pattern reported for WIO and some parts of Pacific). Attains 130 mm SL.



*Halicampus mataafae*, 73 mm SL, subadult (Australia). Source: SSF

**DISTRIBUTION** Indo-Pacific (possibly a species-complex). WIO: northern Red Sea, Oman, Tanzania, Mozambique, South Africa (Sodwana Bay), Seychelles, Réunion, Mauritius, St Brandon Shoals, Salomon Atoll, Chagos and Sri Lanka; elsewhere, Thailand (Ko Miang and Phuket), Vietnam, Philippines, Taiwan, Palau, Marshall Is., New Guinea, Australia, New Caledonia, Vanuatu, Fiji, Tonga and American Samoa.

**REMARKS** Marine; collected to ~21 m deep, from shallow reef pools, and rocky and coral reefs. May represent a species-complex, with an undescribed species in the WIO and the nominal species ranging from the west coast of Thailand to American Samoa. WIO specimens tend to have proportionally slightly longer heads and usually one additional pectoral-fin ray. The diagnosis here covers the entire variation, but the usual values reported are for fish in WIO.

### *Halicampus spirostris* (Dawson & Allen 1981)

Spiny-snout pipefish

PLATE 86

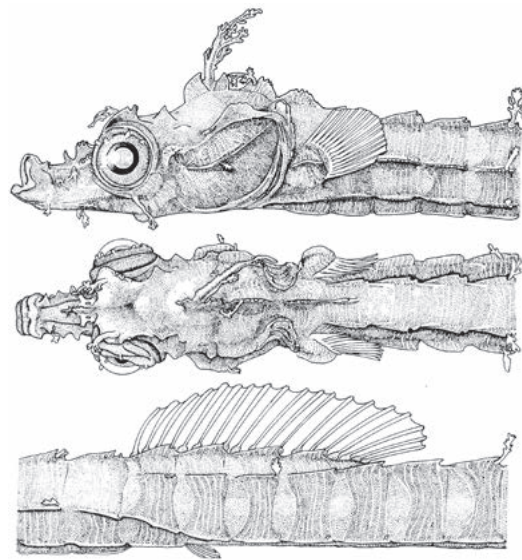
*Micrognathus spirostris* Dawson & Allen 1981: 65, Figs. 1–3

(off Tantabiddi Creek, North West Cape, Western Australia).

*Halicampus spirostris*: Dawson 1985.

Rings 14 + 33–35; dorsal fin 19 or 20 rays; subdorsal rings 1.5–0.5 + 3.25–4.5 = 4.25–5.0; pectoral fins 13 or 14 rays; anal fin usually 3 rays; caudal fin 10 rays. HL 10–11.3 in SL; snout length 3.1–3.8 in HL; snout depth 1.7–2.2 in snout length. Superior trunk and tail ridges overlapping by 4.5 rings; median dorsal snout ridge discontinuous, with 2 or 3 flat spines or ridge-like elevations, posteriormost of these with 2 or 3 points; each side of snout with 3 flat to conical spines, anteriormost spine flat and dorsolateral, middle spine conical and midlateral, and posteriormost spine conical and dorsolateral; rim of orbits slightly elevated, with 3 or 4 tiny spines, ventrally flared outward; supraorbital ridges also flared outward, ending in 3 or 4 tiny spines, followed by 1 or 2 spines; post-orbital with conical spine; frontal with high notched ridge; elevated margins on prenuchal, nuchal and supraopercular ridges denticulate; opercular ridge complete, angled dorsally; pectoral-fin bases protruding laterally, with 1 distinct ridge; body ridges elevated and notched between rings; margins of superior ridges smooth anteriorly, denticulate posteriorly, ending in 1 or 2 terminal spinules. Dorsal-fin base not elevated. Unbranched dermal flaps on eyes, but elongate branching flaps on sides of snout, suborbital and median dorsal head ridges, operculum, pectoral-fin bases, superior ridges and lateral ridges. Male brood pouch under tail rings 1–13; pouch plates angled laterally.

Body ground-colour pale yellow to tan, with 9–11 diffuse, irregular creamy bars (~½–1 ring wide dorsally, ¼–½ ring wide ventrolaterally) crossing dorsum and extending onto sides; first 4 or 5 dorsal bars usually preceded and/or followed by darker bar and then separated by 2 mottled rings; ventral portion of anterior trunk brown; ventral part of snout with 2 irregular brown bars, sometimes merging; ventral half of opercle dark brown, often with yellow-brown ventral margin; tips of dorsal- and pectoral-fin rays brown, fins otherwise hyaline; larger dermal flaps with brown bases, but otherwise tan to creamy. Attains 140 mm SL.



*Halicampus spirostris*, 69 mm SL, paratype (W Australia).

Source: Dawson & Allen 1981

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka; elsewhere, Thailand, Vietnam, Taiwan, Japan, Kwajalein Atoll (Marshall Is.), Australia and American Samoa.

**REMARKS** Marine; collected at 5–18 m, usually on coral reefs or rocky habitats.

### *Halicampus zavorensis* Dawson 1984

Zavora pipefish

PLATE 86

*Halicampus zavorensis* Dawson 1984: 2, Figs. 1–2 (Ponta de Závora,

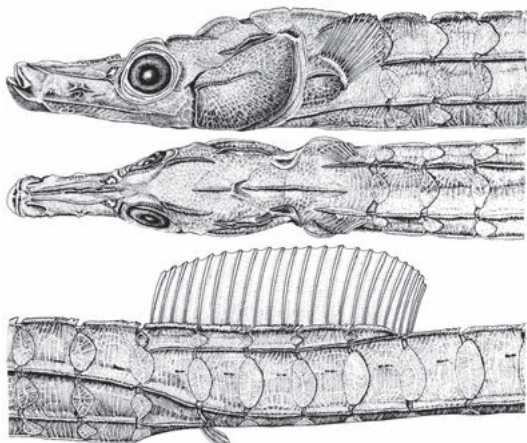
Mozambique); Dawson 1985\*; SSF No. 145.12\*; Randall 1995\*; Manilo & Bogorodsky 2003; Kuitert 2004\*.

Rings 14 + 36 or 37; dorsal fin 22–24 rays; subdorsal rings 1.0–0.75 + 4.0–4.5 = 5.0–5.25; pectoral fins 12 or 13 rays; anal fin 3 or 4 rays; caudal fin 10 rays. HL 8.8–11 in SL; snout length 2.6–2.9 in HL; snout depth 2.3–3.2 in snout length.



Superior trunk and tail ridges overlapping by 4.75–5 rings; median dorsal snout ridge low, continuous, and rear half often edged with 14–21 tiny spinules; each side of snout with 2 blunt spines at midlength, often with smaller spines near rear of upper jaw; dorsal rim of orbits slightly elevated with denticulate margin; denticulate elevated margins also distinct on supraorbital, frontal, prenuchal, nuchal and supraopercular ridges; opercular ridge incomplete in adults, crossing  $\frac{1}{3}$ – $\frac{1}{2}$  of opercle; pectoral-fin bases protruding laterally, with 1 ridge; body ridges slightly elevated; margins of superior ridges denticulate, becoming serrate posteriorly, and last few rings with 4–8 spinules. Dorsal-fin base not elevated. Unbranched dermal flaps usually present on eyes, sometimes on opercle and head, and occasionally on lateral ridge of a few trunk rings. Male brood pouch under tail rings 1–12.

Body ground-colour cream to tan, with 11–15 diffuse, irregular brown bars (~ $\frac{1}{2}$ –1 ring wide) crossing dorsum and extending onto sides; each dorsal bar followed by pale bar and then 2 or 3 mottled rings (mottling particularly obvious on body ridges); dark lateral bars often preceded by diffuse pink spot just below superior trunk ridge; lower sides and venter with mottled brown bars on ring margins, alternating with creamy to white bars on centre of each ring; lower part of snout with 3 or 4 irregular yellow or brown bars; opercle with reticulated pattern of brown on cream to tan background; iris with radiating brown lines, becoming reticulate dorsally and posteriorly. Attains 100 mm SL.



*Halicampus zavorensis*, 94 mm SL, female holotype (S Mozambique).  
Source: Dawson 1984

**DISTRIBUTION** WIO: Gulf of Oman (Sūr), Mozambique (Ponta de Závora) and South Africa (Aliwal Shoal).

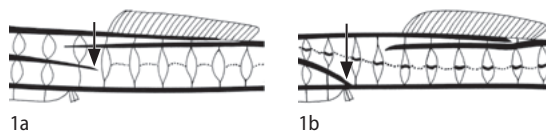
**REMARKS** Marine; collected at 14–26 m at Aliwal Shoal, and presumably from tidepools at Ponta de Závora and at ~4 m at Sūr.

**GENUS** *Hippichthys* Bleeker 1849

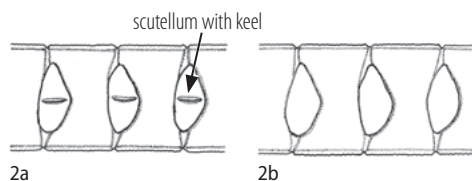
Rings 12–17 + 32–42; dorsal fin 20–31 rays; subdorsal rings 2.0–0 + 3.25–7.25 = 4.25–7.25, and dorsal-fin origin from penultimate trunk ring to rear margin of 3rd tail ring; pectoral fins 13–18 rays; anal fin 0–4 rays; caudal fin 10 rays. HL 5.6–12.7 in SL; snout length 1.3–3.6 in HL; snout depth 1.5–7.8 in snout length. Superior trunk ridge and superior tail ridge discontinuous; lateral trunk ridge straight or deflected ventrally near anal ring; inferior trunk and tail ridges continuous. Median dorsal snout ridge low, entire; opercular ridge complete, straight; median ventral trunk ridge often prominent; pectoral-fin bases with 2 low ridges; median ventral trunk ridge often prominent in subadults and adults; body ridges distinct, little elevated, and margins essentially entire. Scutella with or without longitudinal keels. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch with everted closure, pouch plates and pouch folds present, and pouch under first 11–22 tail rings. Two subgenera and at least 7 species; 5 species in WIO, 1 of which is undescribed.

**KEY TO SPECIES**

- 1a End of lateral trunk ridge not deflected ventrally on anal ring; sides of trunk typically with 5–7 irregular rows of ocelli; sides of tail typically with large, rectangular, pale blotch on or above inferior tail ridge ..... *H. penicillus*
- 1b End of lateral trunk ridge strongly deflected ventrally on anal ring, potentially joining inferior ridge; sides of trunk with prominent bars on each ring or with tiny spots without halos; sides of tail typically with irregular pale blotches on or below inferior tail ridge ..... 2



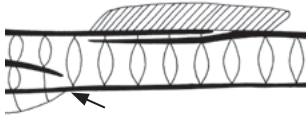
- 2a Some scutella with longitudinal keel (fish >8 cm SL); snout relatively long, its depth 3.6–6.2 (mean 4.8) in snout length; sides of trunk typically with prominent bars on each ring ..... *H. spicifer*
- 2b Scutella not keeled (fish >8 cm SL); snout relatively short, its depth 1.9–5.4 (mean <3.6) in snout length; sides of trunk typically with tiny spots without halos ..... 3



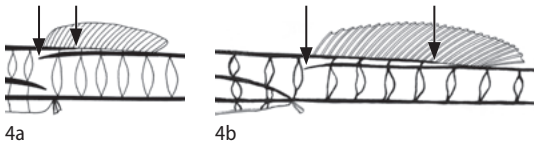
Continued...

## KEY TO SPECIES

- 3a No anal fin ..... *Hippichthys* sp.  
 3b Anal fin present ..... 4



- 4a Overlap of superior ridges occurs on 1.25–2.75 rings below dorsal fin; tail rings 32–35; subdorsal trunk rings 2.0–0.25; trunk rings 12–14; dorsal fin with 3 or 4 dark spots on each ray ..... *H. cyanospilos*  
 4b Overlap of superior ridges occurs on 3.25–5.25 rings below dorsal fin; tail rings 36–43; subdorsal trunk rings 0.25–0; trunk rings 14–16; dorsal fin usually entirely hyaline ..... *H. heptagonus*

*Hippichthys cyanospilos* (Bleeker 1854)

Blue-speckled pipefish

PLATE 87

*Syngnathus cyanospilos* Bleeker 1854: 114 (Banda Neira [Banda Is., Indonesia, Banda Sea]); Smith 1963\*.

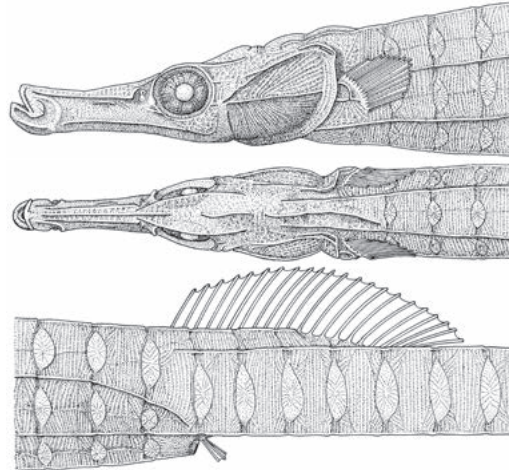
*Syngnathus mossambicus* Peters 1855: 465 (Lumbo, Mozambique); Peters 1855: 277.

*Hippichthys cyanospilos*: Dawson 1978\*, 1985\* [as *H. cyanospilus*]; SSF No. 145.13\*; Goren & Dor 1994 [as *H. cyanospilus*]; Randall 1995\* [as *H. cyanospilus*]; Carpenter *et al.* 1997\*; Manilo & Bogorodsky 2003 [as *H. cyanospilus*].

Rings 12–14 + 32–35; dorsal fin 20–28 rays; subdorsal rings 2.0–0.25 + 3.25–5.75 = 4.25–6.25; pectoral fins 12–16 rays; anal fin 2 or 3 rays. HL 7.5–9.8 in SL; snout length 1.3–2.6 in HL; snout depth 2.6–5.4 in snout length. Lateral trunk ridge ends near anal ring or frequently joins inferior tail ridge (does not join superior or lateral tail ridges); overlap of superior ridges

on 1.25–2.75 rings below dorsal fin. Scutella not keeled. Male brood pouch under first 11–17 tail rings.

Body ground-colour yellowish to green or brown; lower part of snout white in females, often pale in males; sides of head and body often mottled or blotched, and with tiny white to pale blue spots; venter of trunk without dark bars, often red or orange in males, shading to dark brown or black on median trunk ridge; dorsal fin with 3 or 4 dark spots on each ray; male brood pouch edged in black. Attains 156 mm SL.



*Hippichthys cyanospilos*, 12 cm SL, female (New Guinea).

Source: Dawson 1978

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Gulf of Oman, Red Sea, Kenya to South Africa (Kosi Bay; possibly to Port St Johns), Madagascar, Seychelles, Mauritius, India and Sri Lanka; elsewhere to Indonesia (western Sumatra and Java), Vietnam, Philippines, China, Palau, New Guinea, Australia and Fiji.

**REMARKS** Brackish and marine; found in estuaries and coastal areas, in <2 m. When sympatric with *H. spicifer* and *Hippichthys* sp. this species is nearest to the sea, in salinities up to 36.7‰ (Millard & Broekhuysen 1970).



*Hippichthys cyanospilos*, 10 cm SL (S Mozambique). Source: SSF

## *Hippichthys heptagonus* Bleeker 1849

Madura pipefish

PLATE 87

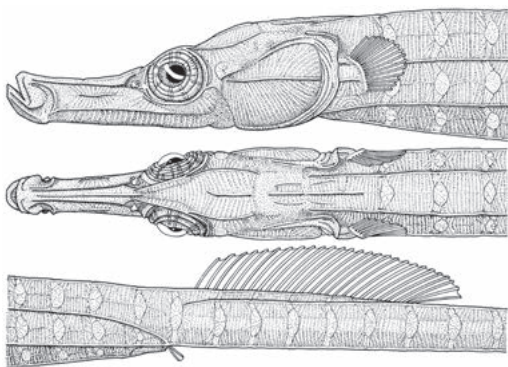
*Hippichthys heptagonus* Bleeker 1849: 15 (Madura I., Indonesia); Dawson 1978\* [in part], 1985\* [in part]; SSF No. 145.14\* [in part]; Talwar & Jhingran 1991.

*Syngnathus djarong* Bleeker 1853: 22 (Panimbang, Java, Indonesia); Smith 1963 [in part].

?*Ichthyocampus ponticerianus* Kaup 1856: 31, 74 (Puducherry and Asom, India; Makassar, Indonesia).

Rings 14–16 + 36–43; dorsal fin 23–30 rays; subdorsal rings 0.25–0 + 5.0–7.0, and dorsal-fin origin on last quarter of last trunk ring to rear margin of (usually) 1st tail ring; pectoral fins 13–16 rays; anal fin 2 or 3 rays. HL 8.6–12.7 in SL; snout length 1.9–2.8 in HL; snout depth 2.6–4.4 in snout length. Overlap of superior ridges on 3.5–5.25 (mean 4.3) rings below dorsal fin. Scutella not keeled. Male brood pouch under first 11–20 tail rings.

Body ground-colour tan to dark brown, often without distinctive markings; dorsum and sides of body plain, mottled or with indications of narrow pale bars; venter of trunk usually dusky brown to rusty red in females, shading to dark brown near median trunk ridge, and infrequently with faint transverse bars; dorsal fin usually hyaline, but rays sometimes streaked brown. Attains 140 mm SL.



*Hippichthys heptagonus*, 96 mm SL, female (New Guinea).

Source: Dawson 1978

**DISTRIBUTION** Indo-Pacific. WIO: possibly southern India and Sri Lanka; elsewhere to Thailand, Indonesia, Philippines, China, Japan, Palau, New Guinea, Solomon Is. and Australia.

**REMARKS** Freshwater, brackish and marine; found in shallows of lakes, rivers, streams, estuaries and harbours. Taxonomy uncertain: it is unclear whether specimens from India (Cheranellore) and Sri Lanka (Trincomalee, Negombo Point and Kelani River) are *H. heptagonus* or the belly pipefish *Hippichthys* sp. of the southern African coast.

## *Hippichthys penicillus* (Cantor 1849)

Beady pipefish

PLATE 87

*Syngnathus penicillus* Cantor 1849: 1368 [386] (Penang, Malaysia).

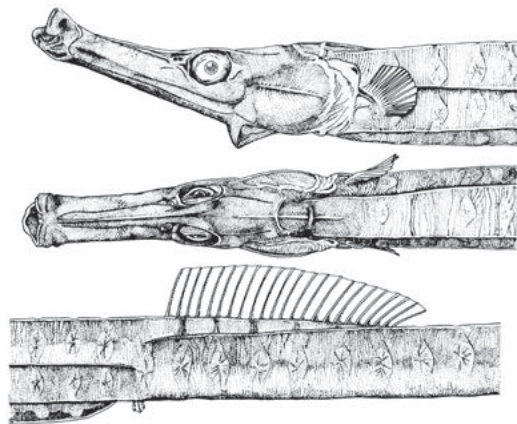
*Syngnathus argyrostictus* Kaup (ex Kuhl & Van Hasselt) 1856: 33 (Java, Indonesia).

*Parasyngnathus penicillus*: Dawson 1981\*.

*Hippichthys penicillus*: Dawson 1985\*; Randall 1995\*; Manilo & Bogorodsky 2003.

Rings 15–17 + 35–41; dorsal fin 23–31 rays; subdorsal rings 0.5–0 + 5.0–7.25 = 5.0–7.25, and dorsal-fin origin between last half of last trunk ring and last quarter of 2nd tail ring; pectoral fins 14–18 rays; anal fin 2 or 3 rays. HL 5.6–9.2 in SL; snout length 1.5–2.2 in HL; snout depth 3.3–7.8 in snout length. Overlap of superior ridges on 4.75–5.5 rings below dorsal fin. Scutella usually not keeled in subadults and adults. Male brood pouch under first 15–24 tail rings.

Body ground-colour tan to brown, dorsum sometimes with indications of ~10 narrow pale bars separated by darker interspaces 3–5 rings wide; usually with dark lateral stripe on head and often with dark spots or shading on lower half of snout; sides of trunk typically with 5–7 irregular rows of ocelli; sides of tail rings usually with rectangular pale blotch on or above inferior ridge; ventral trunk yellow or orange. Attains 172 mm SL.



*Hippichthys penicillus*, 10 cm SL, female (Persian/Arabian Gulf).

Source: Dawson 1981

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Persian/Arabian Gulf and India (Karnataka and Kerala); elsewhere to Thailand, Indonesia, Philippines, China, Japan, New Guinea and Australia.

**REMARKS** Freshwater, brackish and marine; found in shallow inshore waters, seagrasses, mangroves, estuaries, lower reaches of stream and rivers, but also in salinities of 40‰ in the Persian/Arabian Gulf.



*Hippichthys spicifer* (Rüppell 1838)

Bellybarred pipefish

PLATE 88

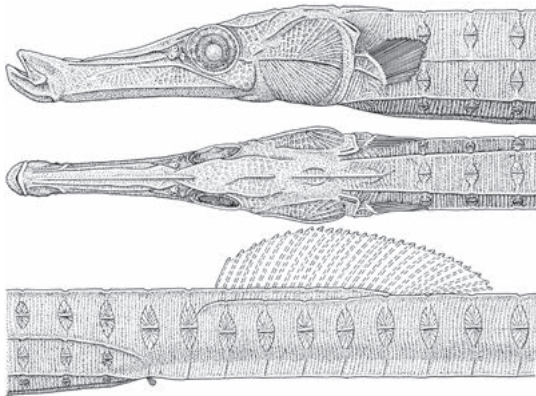
*Syngnathus spicifer* Rüppell 1838: 143, Pl. 33, Fig. 4 (El Tur, Sinai Peninsula, Egypt, Red Sea); Smith 1953\*, 1963\*.

*Micrognathus suvensis* Herre 1935: 396 (Suva Harbour, Viti Levu I., Fiji).

*Hippichthys spicifer*: Dawson 1978\*, 1985\*; SSF No. 145.15\*; Goren & Dor 1994.

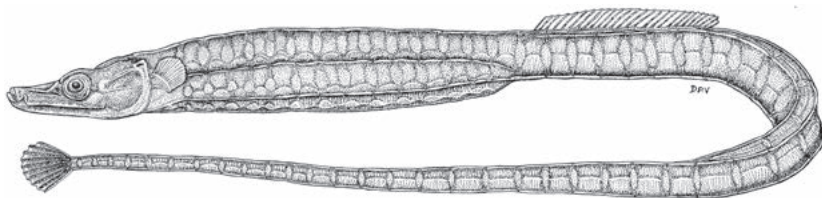
Rings 14–16 + 36–41; dorsal fin 25–30 rays; subdorsal rings 5.0–6.0, and dorsal-fin origin usually on 2nd or 3rd tail ring; pectoral fins 15–18 rays; anal fin 3 or 4 rays. HL 6.9–10.3 in SL; snout length 1.8–2.2 in HL; snout depth 3.6–6.2 in snout length. Overlap of superior ridges on 3.5–5.25 rings below dorsal fin. Scutella keeled. Male brood pouch under first 12–22 tail rings.

Dorsum and sides of head and body plain brown, mottled or blotched; underside of snout pale or spotted with brown; venter of trunk often with 13–15 prominent dark brown bars and yellow interspaces; dorsal fin usually hyaline. Attains 170 mm SL.



*Hippichthys spicifer*, 13 cm SL, male (Sri Lanka). Source: Dawson 1978

**DISTRIBUTION** Indo-Pacific. WIO: northern Red Sea (Egypt, Jordan), Kenya, Tanzania, Mozambique, South Africa (to Kwelera River, Eastern Cape), Madagascar, Comoros, Seychelles, Mauritius, Pakistan, India and Sri Lanka; elsewhere to Andaman Is., Indonesia, southern Japan, Mariana Is., Caroline Is., Australia, New Caledonia and Samoa.



*Hippichthys* sp., 12 cm SL (South Africa). Source: Whitfield 1998

**REMARKS** Brackish and marine; usually found in shallow coastal and estuarine waters, sometimes among mangroves. When sympatric with *H. cyanospilos* and *Hippichthys* sp., this species is farthest from the ocean, in salinities of 8.3–20.9‰ (Millard & Broekhuysen 1970).

*Hippichthys* sp.

Belly pipefish

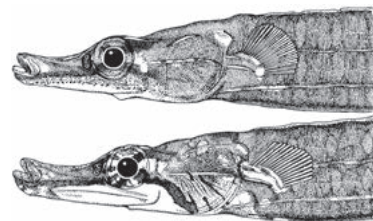
*Hippichthys heptagonus* (non Bleeker 1849): Dawson 1978\* [in part], 1985 [in part]; SSF No. 145.14\* [in part]; Heemstra & Heemstra 2004.

*Syngnathus djarong* (non Bleeker 1853): Smith 1951, 1953, 1963\* [in part].

Rings 14–16 + 38–41; dorsal fin 25–29 rays; subdorsal rings 5.5–7.0, and dorsal-fin origin on 1st–2nd tail rings; pectoral fins 13–16 rays; no anal fin. HL 8.9–12.1 in SL; snout length 2.1–3.6 in HL; snout depth 1.9–5.4 in snout length. Lateral trunk ridge ends near anal ring, but frequently joins inferior tail ridge (does not join lateral or superior tail ridges). Overlap of superior ridges on 2.25–5.25 rings below dorsal fin. Scutella not keeled. Male brood pouch under first 17–19 tail rings.

Body ground-colour grey or tan to dark brown, often without distinctive markings; dorsum and sides of body plain, mottled or with indications of narrow pale bars; venter of trunk usually dusky brown, shading to dark brown near median ridge; dorsal fin usually hyaline. Attains 120 mm SL.

**REMARKS** Known from South Africa (KwaZulu-Natal) in WIO, from the shallows of lakes, rivers, streams, estuaries and harbours. When sympatric with *H. cyanospilos* and *H. spicifer*, the belly pipefish is intermediate between these two species, in salinities of 9.1–35.2‰ (Millard & Broekhuysen 1970). Previously recognised as part of *H. heptagonus*. It is likely that literature records from Madagascar (De Silva 1956), Mozambique (Smith 1969: Inhaca I.), Tanzania (Eccles 1992) and Kenya (Dawson 1985) are also this undescribed species. It is unclear whether specimens from India (Cheranellore) and Sri Lanka (Trincomalee, Negombo Point and Kelani River) are also this species or *H. heptagonus*.



*Hippichthys* sp., ~10 cm SL, male, head (top); 10 cm SL, female, head (bottom) (both South Africa).

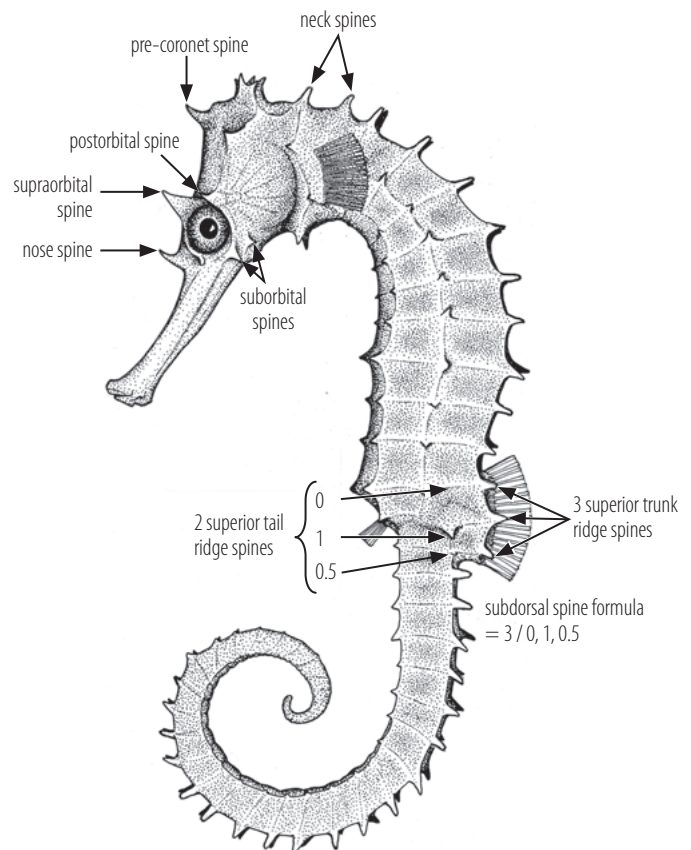
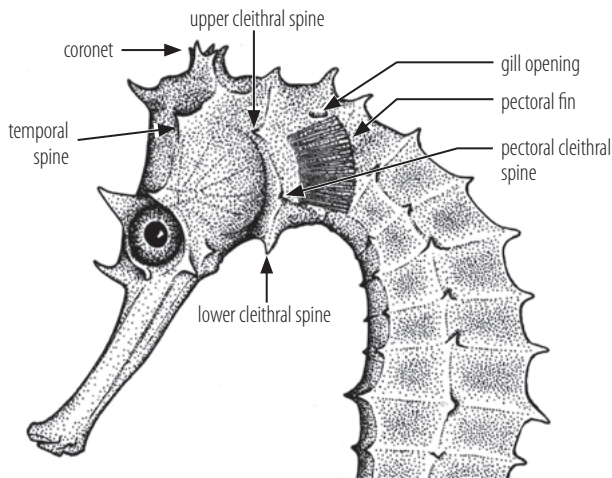


GENUS *Hippocampus* Rafinesque 1810

Body usually maintained in vertical position, with head most often at right angles (>70°) to longitudinal axis of body, although capable of a large range of movement in the median plane. Rings 8–14 + 28–49; dorsal fin 7–31 rays; subdorsal rings 5.0–1.5 + 0.5–2.25; pectoral fins 9–20 rays; anal fin 3–5 rays; no caudal fin. WIO specimens: HL 4.1–6.8 in TL; snout length 1.7–4.1 in HL; snout depth 1.1–6.9 in snout length. Superior trunk and tail ridges discontinuous and overlapping under dorsal-fin base; lateral trunk ridge confluent with inferior tail ridge; inferior trunk ridge ends at last trunk ring; median ventral trunk ridge ends at penultimate trunk ring; median dorsal snout ridge sometimes present as nose spine; opercular ridge short or absent; median ventral trunk ridge often prominent; pectoral-fin bases without ridges; trunk and tail ridges distinct, usually at least slightly elevated, often bearing knobs, tubercles or spines at centre of bony elements that make up rings (usually more pronounced in juveniles than in adults). Dorsal-fin base may be slightly elevated. Dermal flaps and filaments often present. Spines on coronet, head, trunk and tail usually much more prominent in juveniles, although they may be entirely absent in some species or in larger individuals. Male brood pouch usually abdominal, sealed except for a single anteromesial opening, and without pouch plates. Body colour may change from dark to pale

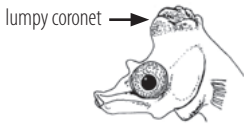
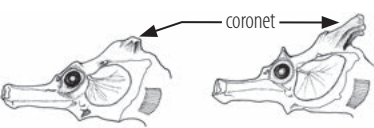
or vice versa, within minutes, by contracting or dilating the pigment cells in the skin (a feature which renders colour descriptions difficult).

Species of seahorses have been particularly difficult to recognise and diagnose. Thus, many spiny species have been recognised and subsequently considered synonyms of *H. histrix*, only to be later described as a separate species or identified as other spiny species. Likewise, many smooth-bodied species have been recognised and subsequently considered synonyms of *H. kuda*, only to be later described as separate or identified as other smooth-bodied species. This difficulty in diagnoses is particularly true for species in the WIO, which are poorly represented in many collections. Furthermore, in most localities it is difficult to capture individuals for scientific study, and photographs are frequently taken without voucher specimens, making it difficult or impossible to match photos to species descriptions. Seahorse taxonomy is beginning to stabilise, but many questions remain, and thus species designations should be considered tentative. Unfortunately, commercial exploitation of seahorses makes this taxonomic task more difficult and yet more critical as millions are harvested each year (Vincent *et al.* 2011). All *Hippocampus* species are listed under Appendix II of CITES. Occur in the Atlantic, Pacific and Indian oceans, in tropical to warm-temperate waters. Seventy-seven species currently recognised; at least 18 species in WIO (3 undescribed).



*Hippocampus* spination (above); counting spine ridges (right).

## KEY TO SPECIES

- 1a Trunk greatly expanded frontward between neck and anus, with potbelly extending forward to below tip of snout; dorsal-fin base rises to rear, forming triangular projection at end of trunk; body ground-colour brownish orange, with almost polygonal pattern of darker reticulations outlined in white ..... *H. nalu* 2
- 1b Trunk not greatly expanded frontward between neck and anus (body not potbellied); dorsal-fin base elevated or not, but not forming triangular projection; body ground-colour variable, but not as above ..... 2
- 2a Coronet forming large, irregular, lumpy mass on posterodorsal portion of head, and without spines or ridges; head with lower cleithral ring spine only; head, trunk and tail bright yellow to bright orange, with slightly darker saddles across dorsum ..... *Hippocampus* sp. 3
-  lumpy coronet →
- 2b Coronet present or absent, but not forming large lumpy mass on head; head spines in addition to lower cleithral spines variably present; ground-colour variable, with orange or yellow individuals marked at least with spots on head and snout .... 3
-  coronet →
- 3a Single mid-dorsal gill opening on neck ridge between coronet and cleithral ridge; 14 trunk rings; superior tubercles of trunk rings 1–8 doubled, moderate in size, approximately equal to iris diameter ..... *H. tyro*
- 3b Gill openings lateral, usually near upper cleithral ring spine (if spine present); 10 or 11 trunk rings; superior spines, tubercles or bumps on trunk rings single ..... 4
- 4a Tiny body size, adults attain <4 cm TL ..... 5
- 4b Larger body size, adults attain >6 cm TL ..... 6
- 5a Dorsal fin 14 rays; tail rings 28; no nose spine; temporal spine bifurcate; very long spines (longer than eye diameter) on some superior, lateral and inferior trunk ridges and superior tail ridges; coronet low, with prominent vertical spine ..... *H. debelius*
- 5b Dorsal fin 11 or 12 rays; tail rings 31; nose spine present; temporal spine simple and straight; very low rounded knobs on trunk and tail ridges; coronet tall, erect and columnar, with front and rear ridges ..... *H. lichtensteinii*
- 6a Long spines (>eye diameter) present on superior, lateral and inferior trunk ridges and superior tail ridge in adults ..... 7
- 6b Short spines, tubercles or bumps ( $\leq$ iris diameter) present on superior, lateral and inferior trunk ridges and superior tail ridge in adults ..... 10
- 7a Superior spines enlarged on each trunk and tail ring; snout depth 4.8–6.9 in snout length; 1–4 white or pale-coloured bars on snout; tiny dermal flaps only surrounding iris ..... *Hippocampus* sp. 1
- 7b Superior spines enlarged on alternate rings or every 3rd or 4th trunk and tail ring; snout depth 3.6–4.5 in snout length; snout with spots or dark bars (no white bars); long thin dermal flaps or filaments on snout, head and neck or superior spines ..... 8
- 8a Tail rings 38 or 39; HL 4.2–4.5 in TL; snout length 1.8–2 in HL; superior spines enlarged on alternate tail rings; white spots coalesce to form dashes along lateral trunk ridge ..... *H. jayakari*
- 8b Tail rings 34–36; HL 5.4–5.8 in TL; snout length 2–2.5 in HL; superior spines enlarged on every 3 or 4 tail rings; white spots (if present) do not form dashes along lateral trunk ridge ..... 9
- 9a Dorsal fin 19 or 20 rays, pectoral fins 16 or 17 rays; HL 5.4–5.6 in TL, snout length 2–2.3 in HL; rear suborbital spine slightly smaller than front spine; no spines before pectoral-fin bases ..... *Hippocampus* sp. 2
- 9b Dorsal fin 17 rays, pectoral fins 15 rays; HL ~5.8 in TL, snout length 2.4–2.5 in HL; rear suborbital spine slightly larger than front spine; 2 short spines in front of pectoral-fin bases ..... *H. spinosissimus*
- 10a Large dark spots at bases of ridge-like knobs on trunk rings 1, 4 and 7 (described as eye-like spots mimicking crabs) ..... 11
- 10b No large dark spots at bases of ridge-like knobs of any trunk rings ..... 12
- 11a Coronet tall, posteriorly inclined and broadly rounded; supraorbital spine large, sharp, but not hooked; small triangular nose spine; neck spines present only as low ridge; lower cleithral ring spine present but not hooked ..... *H. camelopardalis*
- 11b Coronet low, retrorse, with 5 blunt tubercles; supraorbital spines hooked; no nose spine; 2 sharp triangular neck spines; lower cleithral ring spine sharp and hooked posteriorly ..... *H. trimaculatus* [IN PART]

Continued ...

## KEY TO SPECIES

- 12a Coronet present only as small bump in adults; supraorbital, postorbital, suborbital, temporal and cleithral ring spines only present as low bumps; front half of snout often much paler than rest of body ..... *H. capensis*
- 12b Coronet present, usually with 5 knobs, points or spines; at least some head spines present as more than low bumps; front half of snout usually similar in colour to rest of body ..... 13
- 13a No dermal filaments or flaps in adults ..... 14
- 13b Dermal filaments or flaps present in adults ..... 16
- 14a Supraorbital spines hooked; no nose spine; 2 sharp triangular neck spines; lower cleithral ring spine sharp and hooked posteriorly; tail rings 38–42; HL 5.6–6.6 in TL ..... *H. trimaculatus* [IN PART]
- 14b Supraorbital spines straight, not hooked, and rear spine(s) larger than front spine(s); nose spine present; neck spines present as low ridge; lower cleithral ring spine(s) sharp but not hooked; tail rings 34–38; HL 4.8–5.5 in TL ..... 15
- 15a Small triangular nose spine; 1 lower cleithral ring spine; some individuals appear to have attached algae ..... *H. borboniensis*
- 15b Prominent anteriorly directed nose spine; 2 lower cleithral ring spines; skin without any attached algae ..... *H. comes*
- 16a Tail rings 39–41; spines moderate, subequal to iris diameter; single, long, sharp supraorbital spine; long pre-coronet spine; coronet moderate to low, but with 4 or 5 sharp spines; adults attain >17 cm TL ..... *H. suezensis*
- 16b Tail rings 33–38; spines, tubercles and ridges low, less than iris diameter; supraorbital spines paired, short or absent; pre-coronet spine short to incorporated into coronet, or absent; coronet without sharp spines; adults attain <17 cm TL ..... 17
- 17a HL 4.5–5.2 in TL; short triangular supraorbital spine directed backward (resulting in 'square' profile above eyes); coronet low to moderate, projecting posteriorly, with 2–5 flanges or rounded tubercles ..... *H. kuda*
- 17b HL 5.1–5.7 in TL; 0–2 sharp supraorbital spines, not posteriorly directed; coronet without flanges or tubercles ... 18
- 18a Dorsal fin 14–17 rays; pectoral fins 14–16 rays; 2 short sharp supraorbital spines; small dermal flaps or filaments present, commonly above eyes ..... *H. fuscus*
- 18b Dorsal fin 18–20 rays; pectoral fins 18 rays; supraorbital spine tiny or absent; tiny dermal flaps or attached algae or detritus often obscuring trunk and tail ..... *H. natalensis*

## *Hippocampus borboniensis* Duméril 1870

Réunion seahorse

PLATE 88

*Hippocampus borboniensis* Duméril 1870: 520 (Réunion, Mascarenes); Smith 1963\*; Lourie *et al.* 1999\*; Kuitert 2004\* [as *borboriensis*]; Fricke *et al.* 2009.

*Hippocampus novaehollandiae*: Barnard 1927; Smith 1963\*.

*Hippocampus kuda* (*non* Bleeker 1852): Kuitert 1998\*.

*Hippocampus trimaculatus*: SSF No. 145.20\* [in part].

*Hippocampus whitei*: SSF No. 145.21\*; Fricke 1999.

Rings 11 + 34–38; dorsal fin 16–18 rays; subdorsal rings 2.0–1.5 + 1.0–1.75; pectoral fins 15–17 rays; anal fin 4 rays. HL 4.8–5.5 in TL; snout length 2.1–2.8 in HL; snout depth 3.1–3.6 in snout length. Subdorsal spine formula 3 / 0–0.5, 1, 0–0.5; 2 supraorbital spines, rear spine largest; low postorbital spine; 2 or 3 low rounded suborbital spines; small triangular nose spine; moderate temporal spine; low rounded pre-coronet

spine; neck spines present as low ridge; small upper cleithral, moderate pectoral cleithral, and moderate lower cleithral ring spines. Ventral trunk ridge low; spines on trunk and tail ridges low and rounded; superior and inferior ridge spines of every 4 or 5 rings slightly larger. Coronet pentagonal, low, with 5 distinct and rounded knobs but no sharp spines. No dermal filaments. Male brood pouch abdominal, under tail rings 1–8.

Body colour variable: background dusky greyish green, greenish brown, reddish brown to white, and with dusky yellow, orange or red spots contrasting with ground-colour; areas of marbling on head and rings tend to have slightly enlarged spines (minimally enlarged on rings 1, 7, 16, 20, 24 and 27 or 28); may have submarginal black band on dorsal fin, and scattered black spots near rear of fin base; some individuals appear to have attached algae on skin. Males sometimes with dark ventral trunk ridge. Attains 140 mm TL.



*Hippocampus borboniensis*, 60 mm TL, female (S Mozambique).  
Source: Smith 1963

**DISTRIBUTION** WIO: Kenya to South Africa, Madagascar, Seychelles, Réunion, Mauritius and Maldives.

**REMARKS** Marine; collected from 5–60 m, with shallow populations reported from among seagrasses and deeper populations from soft bottoms and sponge habitats. Similar to *H. trimaculatus*, and reports of that species from South Africa and Tanzania are almost certainly *H. borboniensis*.

### *Hippocampus camelopardalis* Bianconi 1854

Giraffe seahorse

PLATE 88

*Hippocampus camelopardalis* Bianconi 1854: 68 (Mozambique);  
Bianconi 1855; Smith 1963\*; SSF No. 145.16\*; Fricke 1999;  
Lourie *et al.* 1999\*; Kuitert 2004\*, 2009\*.

*Hippocampus subcoronatus* Günther in Playfair & Günther 1867: 139,  
Pl. 20, Fig. 4 (Zanzibar, Tanzania; Mozambique).

Rings 11 + 35–38; dorsal fin 19–22 rays; subdorsal rings 2.5–1.75 + 1.5–2.25; pectoral fins 17 or 18 rays; anal fin 4 or 5 rays. HL 4.9–5.7 in TL; snout length 2.4–2.9 in HL; snout depth 3–3.4 in snout length. Subdorsal spine formula 3 / 0–0.5, 0.5–1, 0–0.5; large sharp supraorbital spine; low postorbital spine; 1 or 2 low rounded suborbital spines; small triangular nose spine; moderate temporal spine; low triangular pre-coronet spine; neck spines present as low ridges; moderate triangular upper cleithral, pectoral cleithral and lower cleithral spines. Ventral trunk ridge low; spines on trunk and tail ridges appear as low rounded knobs, and superior and inferior spines of every 3 or 4 trunk rings and every 2 or 3 tail rings slightly



*Hippocampus camelopardalis*, 30 mm TL, female (S Mozambique).  
Source: Smith 1963

**DISTRIBUTION** WIO: Tanzania, Zanzibar, Mozambique, South Africa, Madagascar and Mauritius.

**REMARKS** Brackish and marine; inhabits shallow reefs and estuaries, mainly found in seagrasses and algae beds or on shallow reefs.

### *Hippocampus capensis* Boulenger 1900

Knysna seahorse

PLATE 88

*Hippocampus capensis* Boulenger 1900: 11, Pl. 3, Fig. 2 (Knysna estuary, Western Cape, South Africa); Smith 1963\*; Smith & Smith 1966\*; SSF No. 145.17\*; Whitfield 1998\*; Lourie *et al.* 1999\*; Kuitert 2004\*; Heemstra & Heemstra 2004\*.

larger (spines larger and more obvious in small individuals, becoming knobs and ridges in larger individuals). Coronet almost triangular, with 5 or 6 points and transverse ridge in small individuals, but very tall, posteriorly inclined and broadly rounded in larger individuals. Smaller individuals often with well-developed dermal filaments and flaps on head and trunk. Male brood pouch abdominal, under first 6 or 7 rings.

Body ground-colour dusky yellow to greyish olive or marbled with white, red, brown and black spots, flecks and squiggles; underside of head, trunk and tail cream to yellow, except between spines of ventral trunk ridge where ridge is often black; dark spots (described as eye-spots mimicking crabs) at bases of ridge-like knobs (most obvious on trunk rings 1, 4 and 7), with paler bases and tips; same type of halo-like spots on sides of coronet and often on base of pre-coronet spine and last dorsal trunk knob; dorsal fin with 1–3 dark submarginal bands. Attains 150 mm TL.



Rings 10–11 + 32–37; dorsal fin 16–18 rays; subdorsal rings 3.0–2.0 + 1.0; pectoral fins 14–17 rays; anal fin 3 or 4 rays. HL 6–6.8 in TL; snout length 2.6–3.1 in HL; snout depth 2.4–3.1 in snout length. Subdorsal spine formula 3 / 0, 0–0.5, 0–0.5; supraorbital and postorbital spines each present as very low bump; 2 low rounded suborbital bumps; slight ridge present instead of nose spine; temporal spine a very low bump; low rise in place of pre-coronet spine; neck spine present as low ridge; upper, pectoral and lower cleithral ring spines present as low bumps. Ventral trunk ridge visible on some males as low keel on last 2–4 trunk rings; trunk ridges without spines in larger individuals, but ridges may have rounded knobs or spines in small individuals; anterior portions of superior and inferior tail ridges may have spines or knobs in smaller individuals, but not in large individuals. Pentagonal coronet barely distinguishable as small bump on midline of head in small individuals and adults, but large individuals lack coronet entirely. Dermal filaments and flaps sometimes attached to dorsal surface of head and trunk. Male brood pouch abdominal, under first 5–9 rings.

Body ground-colour typically brown, black or green, with mottling, but some individuals may be largely white, yellow, orange, beige, green, brown or black; front half of snout often much paler than body; dorsal fin usually with submarginal black band, and often with yellow margin in darker individuals. Attains 130 mm TL.



*Hippocampus capensis*, 70 mm TL, male (South Africa). Source: Whitfield 1998

**DISTRIBUTION** WIO: endemic to south coast of South Africa, from Knysna, Keurbooms, Swartvlei and possibly Klein Brak estuaries.

**REMARKS** Primarily estuarine; adults characteristically found in sites with high submerged vegetation cover, especially eelgrass *Zostera capensis*, to ~20 m deep. IUCN Red List conservation status Endangered.

## *Hippocampus comes* Cantor 1849

Tiger-tail seahorse

PLATE 89

*Hippocampus comes* Cantor 1849: 1371, Pl. 11, Fig. 2 (Sea of Penang, Malaysia); Bleeker 1874, 1879.

*Hippocampus mannulus* Cantor 1849: 1370, Pl. 11, Fig. 1 (Sea of Penang, Malaysia).

*Hippocampus kuda*: Smith 1963\* [in part].

Rings 11 + 34–37; dorsal fin 17–19 rays; subdorsal rings 2.25–1.5 + 1.0–1.75; pectoral fins 16–19 rays; anal-fin rays unknown. HL 5–5.3 in TL; snout length 1.9–2.5 in HL; snout depth 3.4–4.4 in snout length. Subdorsal spine formula 3 / 0, 0–0.5, 0–0.5; 1 or 2 blunt retrorse supraorbital spines; postorbital spines present; 2 suborbital spines; prominent anteriorly directed nose spine; temporal spine rounded; stout and blunt pre-coronet spine; neck spine present as high ridge; upper cleithral and pectoral cleithral ring spines present in addition to 2 lower cleithral ring spines. Ventral trunk ridge indistinct; trunk ridges with spines or rounded knobs; anterior portions of superior and inferior tail ridges may have spines or knobs. Coronet pentagonal, small and low, with 5 distinct spines or rounded knobs. No dermal flaps or filaments. Male brood pouch abdominal, under first 5 or 6 rings.

Body ground-colour usually bright yellow, orange or dark brown, with dark banding across tail; spines or knobs may also have dark band just below the tips; pale-coloured individuals may also have dark patches on body, roughly forming banded or mottled pattern; snout usually yellow, with a few darker spots that do not form bars; iris with fine white radiating lines, alternating with darker orange or brown, and sclera yellow to orange, without radiating white lines but usually with dark spots. Attains 160 mm TL.



*Hippocampus comes* (Indonesia). © A Ryanskiy

**DISTRIBUTION** Indo-Pacific. WIO: southern India and Sri Lanka (reports from Mauritius are likely incorrect); elsewhere, Andaman Sea, Vietnam to Malacca Strait (Malaysia and Indonesia) and Philippines.

**REMARKS** Marine; adults found on reefs rich in corals and sponges, to ~20 m deep, and also among kelp and *Sargassum*. One of the most commonly traded seahorse species. IUCN Red List conservation status Vulnerable.

### *Hippocampus debelius* Gomon & Kuitert 2009

Softcoral seahorse

PLATE 89

*Hippocampus debelius* Gomon & Kuitert 2009: 41, Figs. 3–5 (Hurghada, Erg Camel, Egypt, Red Sea).

*Hippocampus lichtensteinii* (non Kaup 1856): Debelius 1998\*; Lourie *et al.* 1999\*; ?Kuitert 2004\*.

Rings 10 + 28; dorsal fin 14 rays; subdorsal rings 2.0 + 0.5; pectoral fins 10 or 11 rays; anal fin 4 rays. HL ~5 in TL; snout length ~3 in HL; snout depth ~2.2 in snout length. Subdorsal spine formula 2 / 0, 0; 2 lateral supraorbital spines, rear spine longest; small postorbital spine; small spine anteroventral to eyes; short suborbital spine; no nose spine, pre-coronet spine or neck spines; temporal spine bifurcate; small lower cleithral ring spine. Trunk and tail ridges hidden by thick skin; long superior ridge spines on trunk rings 1–2, 4–5 and 9–10; long lateral ridge spines on trunk rings 4–5, 6–7 and 9–10; long inferior ridge spines on trunk rings 6–7 and 8–9; long superior ridge spines on tail rings 4, 8, 11 and 14. Dorsal-fin base slightly elevated. Coronet low, angular, with prominent vertical spine on dorsal midline, followed by slightly smaller lateral pair of spines. No dermal flaps on head, trunk and tail, except for ~6–8 dermal filaments ringing iris. Male brood pouch abdominal, under first 4 or 5 rings.

Body ground-colour white to pale yellow, with contrasting narrowly spaced orange-brown to bright yellow stripes or striations; dorsal midline of head and trunk often white; spine bases yellowish brown to orange, tips darker, and anterior trunk spines with additional central dark band; scattered melanophores between dorsal-fin rays. Attains 35 mm TL.

**DISTRIBUTION** WIO: endemic to northern Red Sea.

**REMARKS** Marine; lives on soft corals, gorgonians and hydroids, generally matching the host's colour, at 15–40 m.

### *Hippocampus fuscus* Rüppell 1838

Drab seahorse

PLATE 89

*Hippocampus fuscus* Rüppell 1838: 143, Pl. 33, Fig. 3 (Jeddah, Saudi Arabia, Red Sea); Smith 1963\*; Goren & Dor 1994; Debelius 1998\*; Lourie *et al.* 1999\*; Kuitert 2004\*.

*Hippocampus obscurus* Ehrenberg in Klunzinger 1871: 653 (Red Sea).  
? *Hippocampus brachyrhynchus* Duncker 1914: 295 (India); Lourie *et al.* 1999; Kuitert 2009.

Rings 11 + 33–37; dorsal fin 14–17 rays; subdorsal rings 2.5–1.5 + 1.0–1.75; pectoral fins 14–16 rays; anal fin 4 rays. HL 5.1–5.7 in TL; snout length 2.4–3 in HL; snout depth 2.5–2.8 in snout length. Subdorsal spine formula 3 / 0, 0.5, 0.5; 2 short sharp supraorbital spines; short postorbital spine; 1 or 2 small triangular suborbital spines; triangular nose spine small in larger individuals, also often with triangular spine on dorsal midline of snout; low triangular temporal spine; no pre-coronet spine; neck spines represented by low ridge; upper cleithral, pectoral cleithral and lower cleithral ring spines present. Ventral trunk ridge with low spines; superior and lateral trunk ridges with roughened blunt bumps; inferior trunk ridge largely without bumps, spines or tubercles; no front inferior tail spines; superior tail spines present as roughened blunt bumps, but sometimes absent near tail tip. Coronet low to barely present, often roughened but without sharp spines. Small dermal flaps or filaments present, most commonly above eyes. Male brood pouch abdominal, under first 5 or 6 rings.

Body ground-colour yellow-brown to dark-grey or black, usually with large pale saddles over back, particularly across neck, first 1 or 2 trunk segments, and trunk segments 7–9; dense tiny white to creamy yellow spots usually visible through entire ground-colour, and paler individuals sometimes with scattered dark spots; fins generally lightly pigmented and without spots or bands. Attains 120 mm TL.

**DISTRIBUTION** WIO: Red Sea and possibly Arabian Sea (photographs only); Lessepsian migrant to Mediterranean Sea (Golani & Fine 2002).

**REMARKS** Marine; generally found <10 m deep, often associated with shallow protected algal-reefs or seagrass beds.

### *Hippocampus jayakari* Boulenger 1900

Spiny seahorse, Jayakar's seahorse

PLATE 89

*Hippocampus jayakari* Boulenger 1900: 51, Fig. (Muscat, Oman, Gulf of Oman, Arabian Sea); Smith 1963\*; Debelius 1998\*; Lourie *et al.* 1999\*; Manilo & Bogorodsky 2003; Kuitert 2004\*; Fricke *et al.* 2009; Jawad *et al.* 2011.

*Hippocampus histrix* (non Kaup 1856): Randall 1983\*, 1995\*; Khalaf & Disi 1997.

Rings 11 + 38 or 39; dorsal fin 18 or 19 rays; subdorsal rings 2.0 + 1.0–2.0; pectoral fins 17 or 18 rays; anal fin 4 rays. HL 4.2–4.5 in TL; snout length 1.8–2 in HL; snout depth 3.8–4.3 in snout length. Subdorsal spine formula 3 or 4 / 0, 0, 0.5–1, 0–0.5; 1 long sharp supraorbital spine; 1 or 2 low postorbital spines; 2 sharp suborbital spines, rear spine slightly larger; large triangular retrorse nose spine; large temporal spine, often at beginning of low ridge flanking coronet, and ridge often with middle and rear spines as well; very long and sharp pre-coronet spine; 2 long neck spines; moderate upper cleithral, moderate pectoral cleithral, and very long lower cleithral ring spines (these spines often doubled). Ventral trunk ridge high, with moderate to long spines; superior, lateral and inferior trunk ridges usually bearing high and sharply pointed spines; 1st inferior tail spines also moderately high and sharp; superior spines enlarged on alternate tail rings. Coronet moderate to low, with 4 long and sharp, somewhat retrorse spines, and coronet may be flanked by ridges beginning and ending with low spine. Long thin dermal filaments variably present on snout, head and neck. Male brood pouch abdominal, under first 6 or 7 rings.

Body yellow to pale brown, with many fine brilliant white spots; white spots coalesce to form dashes along lateral trunk ridge and may coalesce to form larger spots and reticulations on snout, sides and back; spots on snout identical in shape, size and surrounding colour to spots on sides, but do not form bars across snout; nose spine white or nearly so; ventral head and trunk often white or paler than ground-colour, but ventral keel dark brown to black in large individuals; dorsal spines often dark just below tips, but may have white bases; some individuals with few scattered melanophores on dorsal-fin rays; eye ring white. Attains 130 mm TL.

**DISTRIBUTION** WIO: Gulf of Aqaba (Red Sea) to Gulf of Oman, Persian/Arabian Gulf and Pakistan (Karachi).

**REMARKS** Marine; often seen in rubble-algae habitats with sparse seagrasses and in soft-bottom habitats on sponges, in <20 m. Has been maintained in public aquaria in Israel. Often confused with *H. histrix*, a rare but widespread Indo-Pacific species (Lourie *et al.* 2004), or with the African thorny seahorse *Hippocampus* sp. 1.

## *Hippocampus kuda* Bleeker 1852

Spotted seahorse

PLATE 89

*Hippocampus kuda* Bleeker 1852: 82 (Singapore); Smith 1963 [in part]; SSF No. 145.19 [in part]; Goren & Dor 1994; Randall 1995\*; Fricke 1999; Lourie *et al.* 1999\*; Heemstra & Heemstra 2004; Kuitert 2004\*.

*Hippocampus rhynchomacer* Duméril 1870: 519 (Singapore; China; Kochi, India).

*Hippocampus taeniops* Fowler 1904: 501, Pl. 7 (Padang, Sumatra, Indonesia).

*Hippocampus horai* Duncker 1925: 475, Fig. (Andaman Is.).

*Hippocampus kuda multiannularis* Raj 1941: 156 (Chennai coast, India).

*Hippocampus raji* Whitley 1955: 44 (India).

Rings 11 + 34–38; dorsal fin 15–18 rays; subdorsal rings 2.0–1.75 + 1.0–2.0; pectoral fins 15–18 rays; anal fin 4 rays. HL 4.5–5.2 in TL; snout length 2–2.6 in HL; snout depth 2.5–3.9 in snout length. Subdorsal spine formula 3 / 0.5–1, 0.5–1, 0.5–1; short triangular supraorbital spine posteriorly directed, often resulting in squarish profile above eyes; low postorbital spine; low suborbital spine; no nose spine; temporal spine present as low bump or absent; low pre-coronet spine, sometimes anteriorly incorporated into base of coronet; 2 ridge-like triangular neck spines; moderate upper cleithral, low pectoral cleithral, and tubercle-like lower cleithral ring spines. Ventral trunk ridge high to low; superior, lateral and inferior trunk ridges usually bearing low tubercles, and anterior superior tail tubercles also low. Coronet low to moderate, posteriorly projecting, with 2–5 flanges or rounded tubercles. Long, thin, often branched dermal filaments variably present, especially associated with supraorbital spine and coronet, and possibly present on dorsal tubercles of trunk rings 1, 4, 7 and 11, and on tail rings 4, 7, 9, 11 and 14. Male brood pouch abdominal, under first 5–7 rings.

Body ground-colour pale creamy yellow to red, brown or black; paler individuals often marked by tiny red-brown spots across head, trunk and tail; contrasting dorsal saddles often present across trunk rings 1, 4, 7 and 11, and tail rings 4, 7, 9, 11 and 14; dorsal fin with narrow dark submarginal band. Attains 170 mm TL.

**DISTRIBUTION** Indo-Pacific (likely a species-complex).

WIO: Kenya, Mozambique, South Africa, Madagascar, Maldives and Sri Lanka; elsewhere to Andaman Sea, Indonesia, Singapore, Ryukyu Is., New Guinea and Australia.

**REMARKS** Brackish and marine; found in shallow inshore waters, harbours, estuaries, mangroves, lower reaches of rivers and on reef flats, but also reported as deep as 70 m and drifting at sea. This species is almost certainly a species-complex, but its apparent preference for estuaries and rivers may result in groups of individuals being washed out to sea during extreme weather events and later establishing populations across a wide geographic area. Most commonly confused with *H. natalensis*, which has fewer tail rings, more dorsal-fin rays, a smaller head and significant differences in spination. Extensively traded. IUCN Red List conservation status Vulnerable.

*Hippocampus lichtensteinii* Kaup 1856

Lichtenstein's seahorse

*Hippocampus lichtensteinii* Kaup 1856: 8 [probably Red Sea or Japan]; Smith 1963; Goren & Dor 1994; Lourie *et al.* 1999\*.

Rings 10 + 31; dorsal fin 11 or 12 rays; subdorsal rings 2.0 + 0.5; pectoral fins 11 or 12 rays; anal-fin rays unknown. HL 5.1–5.8 in TL; snout length 2.9–3.6 in HL; snout depth 1.5–2 in snout length. Subdorsal spine formula 2 / 0, 1; 2 low lateral supraorbital spines, rear spine longest; nose and temporal spines present; no pre-coronet and neck spines; small lower cleithral ring spine. No ventral trunk ridge; very low rounded knobs on trunk and tail ridges. Dorsal-fin base slightly elevated. Coronet tall, erect and columnar, with front and rear ridges. Male brood pouch abdominal, under first 5 or 6 rings.

Original description only mentions brownish ground-colour, with 6–10 paler bars on tail. Attains at least 40 mm TL.

**DISTRIBUTION** Unknown: possibly Red Sea (WIO), and/or possibly Japan in western Pacific.

**REMARKS** Known from few specimens. Kaup (1856) thought that specimens in the Museum für Naturkunde in Berlin were probably from the Red Sea.

*Hippocampus nalu* Short *et al.* 2020

Sodwana pygmy seahorse

PLATE 90

*Hippocampus nalu* Short *et al.* 2020: 144, Figs. 1–6 (Sodwana Bay, South Africa)

?*Hippocampus* sp. 7: Kuitert 2000\* (Hachijo-jima I., Izu Is. and Ogasawara Is., Japan).

?*Hippocampus* sp. 1: Kuitert 2004\* (Hachijo-jima I., Izu Is. and Ogasawara Is., Japan).

Rings 12 + 29–30; dorsal fin 12 rays; subdorsal rings 3 + 1, pectoral fins 10 rays, anal fin 4 rays. HL 4.3–4.9 in TL; snout length 3.9–4.1 in HL; snout depth 1.2 in snout length. Subdorsal spine formula 3 / 0–0.5, 0–1, 0; 2 supraorbital spines, rear spine largest; no apparent postorbital or suborbital spines; 1 triangular nose spine; prominent temporal spine; low precoronet spine; prominent spines on first ring of superior trunk ridges, and bifid very prominent spines on second ring of superior trunk ridges; no upper cleithral spine, with moderate pectoral and lower cleithral spines. Trunk and tail ridges largely absent; with enlarged spines on superior trunk ridge rings 5, 11 and 12; enlarged spines on lateral trunk ridge rings 5 and 8; smaller individuals may have spines on the inferior trunk ridges; spines on superior tail ridge

rings on tail rings 5, 9, 12 and 16. Trunk greatly expanded frontward, between neck and anus, with potbelly protruding as far forward as below snout. Dorsal-fin base rises to rear, forming triangular projection at end of trunk. Coronet moderately tall, with rectangular base. Gill opening single and mid-dorsal. Appears to have dermal filaments or attached algae on coronet and trunk. Tiny dermal flaps or spines on sclera of eyes. Male brood pouch thoracic.

Body ground-colour cream-brown, with nearly polygonal pattern of darker reticulations; reticulating polygons not equally sized and without obvious pattern, but areas between polygons sometimes filled with white; juveniles appear to lack the polygonal markings of the adults. Attains 22 mm TL.

**DISTRIBUTION** WIO: only known from South Africa (Sodwana Bay).

**REMARKS** Marine; collected from 12–17 m, associated with short algal turf in coral/sand spur and groove reefs, with significant swells and current. Morphologically most similar to *Hippocampus japapigu* (Short *et al.* 2018), and *H. pontohi* (Lourie and Kuitert 2008).

*Hippocampus natalensis* Von Bonde 1923

Cryptic seahorse

PLATE 90

*Hippocampus natalensis* Von Bonde 1923: 9, Pl. 1, Fig. 1 (KwaZulu-Natal, South Africa).*Hippocampus mohnikei* (*non* Bleeker 1853): Günther 1866.*Hippocampus kuda* (*non* Bleeker 1852): Smith 1963 [in part]; SSF No. 145.19\* [in part].*Hippocampus fuscus* (*non* Rüppell 1838): Lourie *et al.* 1999 [in part].

Rings 11 + 33 or 34; dorsal fin 18–20 rays; subdorsal rings 2.0–1.5 + 1.0; pectoral fins 18 rays; anal fin 4 rays. HL 5.3–5.6 in TL; snout length 2–2.6 in HL; snout depth 2.4–3.6 in snout length. Subdorsal spine formula 3 / 0–0.5, 0.5–1, 0.5; supraorbital spine tiny or absent; postorbital spine present as bump; 2 small triangular suborbital spines; triangular nose spine present only in small individuals; temporal spine present as bump; pre-coronet spine small or absent; neck spines present as triangular ridge; upper cleithral, pectoral cleithral, and lower cleithral ring spines present. Ventral trunk ridge low or absent; superior, lateral and inferior trunk ridges with low blunt tubercles (may be obscured in larger individuals); inferior tail tubercles tend to be larger than superior tubercles on same tail ring. Coronet low, roughly pentagonal, posteriorly directed and without spines. Tiny dermal flaps and attached algae or detritus often obscuring trunk and tail. Male brood pouch abdominal, under first 5–7 rings.



Body ground-colour grey-brown to orange or yellow, with tiny white to creamy yellow spots, sometimes forming horizontal and/or vertical rows; trunk and tail also with slightly larger black to deep red spots; tip of snout usually slightly paler than rest of snout and head; some individuals with large pale saddles over trunk, tail and occasionally across neck; dorsal fin with 1 or 2 irregular, sometimes faint, submarginal dark bands and yellow margin; iris and often surrounding sclera with fine white lines radiating outward and sometimes onto head. Attains 115 mm TL.

**DISTRIBUTION** WIO: South Africa (KwaZulu-Natal) and possibly to Mozambique (Pomene; photographs only).

**REMARKS** Marine; observed to >50 m deep, most often with the head pulled tightly against the ventral margin of trunk, so that the neck is arched. Records of *H. mohnikei* (a western North Pacific species) from Tanzania, and records of *H. fuscus* (a Red Sea and Arabian Sea species) from South Africa, Madagascar, Mauritius and Réunion are likely to be of *H. natalensis*.

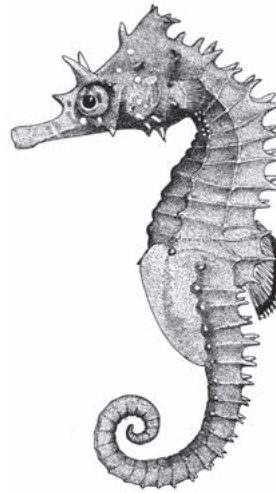
### *Hippocampus spinosissimus* Weber 1913

Hedgehog seahorse

*Hippocampus spinosissimus* Weber 1913: 120, Fig. 44 (Sapeh Strait, Indonesia); Weber & De Beaufort 1922\*; Lourie *et al.* 1999.

Rings 11 + 34; dorsal fin 17 rays; subdorsal rings 2.25–2.0 + 1.5; pectoral fins 15 rays; anal fin 4 rays. HL 5.8 in TL; snout length 2.4–2.5 in HL; snout depth 3.6 in snout length. Subdorsal spine formula 3 / 0.5, 1, 0; long, sharp, often anterolaterally directed supraorbital spine; 1 long sharp postorbital spine; 2 sharp triangular suborbital spines, rear spine largest; large, triangular, forward-directed nose spine; large sharp temporal spine; long, sharp, backward-directed pre-coronet spine; 2 long sharp neck spines; long upper cleithral, pectoral cleithral and lower cleithral ring spines; 2 short spines in front of pectoral-fin base. Ventral trunk ridge high with moderate spines; superior, lateral and inferior trunk ridges with high and sharply pointed spines, especially on trunk rings 1, 4, 7 and 11; anterior superior and inferior tail spines also high and sharp on each ring, but especially on tail rings 4, 7 and 11. Coronet moderate to high, with 5 sharp spines diverging from pentagonal top. Dermal flaps, filaments and/or attached algae may be present on head, trunk and tail. Male brood pouch abdominal, under tail rings 1–6.

Preserved specimens with yellow-brown body and white spots and dashes, especially on head and snout; ventral trunk ridge dark in large males; dorsal fin with or without dark submarginal band. Attains 75 mm TL.



*Hippocampus spinosissimus*, ~60 mm TL, male holotype (Indonesia).  
Source: Weber 1913

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka; elsewhere to east coast of India, Indonesia, Malaysia, Vietnam, Philippines and northern Australia.

**REMARKS** Brackish and marine; usually reported from relatively deep water, to 70 m or more. Type material reportedly collected from sand-bottoms and among scallops; otherwise observed (in Philippines) on silty to sandy bottoms, in shallow depressions associated with submerged wood, macroalgae, sponges, octocorals, sea pens, sea stars and sea urchins (Morgan & Panes 2008). The description here is based on Weber (1913) and Weber & De Beaufort (1922) since the taxonomy of spiny seahorses from the Indo-Pacific is currently confused and uncertain. The only specimens that can be absolutely assigned to the species are the two type specimens from Sapeh Strait; however, spiny seahorses with relatively short snouts from the eastern Indian Ocean and Southeast Asia may be attributable to this species. Similar to *H. histrix* (except *H. spinosissimus* with much shorter snout), *H. grandiceps* (which has much longer snout) and *H. moluccensis* (which has shorter supraorbital and body spines). An abundant seahorse-species bycatch in trawl fisheries. IUCN Red List conservation status Vulnerable.

### *Hippocampus suezensis* Duncker 1940

Egyptian seahorse

PLATE 91

*Hippocampus suezensis* Duncker 1940: 86 (Gulf of Suez, Red Sea); Smith 1963; Goren & Dor 1994; Manilo & Bogorodsky 2003; Kuitert 2004\*; Jawad *et al.* 2011\*.

*Hippocampus kelloggi* (*non* Jordan & Snyder 1901): Lourie *et al.* 1999 [in part].

*Hippocampus kuda* (*non* Bleeker 1852): Khalaf & Disi 1997.

Rings 11 + 39–41; dorsal fin 17–20 rays; subdorsal rings 2.0–1.5 + 1.0–1.25; pectoral fins 17 or 18 rays; anal fin 4 rays. HL 4.9–6.2 in TL; snout length 1.7–2.6 in HL; snout depth 2.2–3.2 in snout length. Subdorsal spine formula 3 / 0, 1, 0; 1 long sharp supraorbital spine; 1 blunt postorbital spine; 2 small triangular suborbital spines; triangular nose spine small in larger individuals; triangular temporal spine; long pre-coronet spine, posteriorly joined to coronet by peaked ridge; 2 long and often multifid neck spines; upper cleithral, pectoral cleithral, and lower cleithral ring spines present. Ventral trunk ridge with moderate spines; superior, lateral and inferior trunk ridges with moderate blunt spines; anterior inferior tail spines moderate, blunt; superior spines enlarged on each tail ring except near tail tip. Coronet moderate to low, with 4 or 5 sharp spines. Dermal flaps and/or attached algae often extending from spines. Male brood pouch abdominal, under first 7 or 8 rings.

Body ground-colour dusky brown to black, with tiny white to creamy yellow spots, often forming series of fine striations; iris and sclera with fine radiating white lines on reddish brown or dark brown background. Attains 275 mm TL.

**DISTRIBUTION** WIO: probably restricted to Red Sea, Arabian Sea, Persian/Arabian Gulf and Gulf of Oman.

**REMARKS** Marine; found to ~35 m deep, often associated with soft corals. Frequently misidentified as *H. kuda* (Lourie *et al.* 2004). *Hippocampus kelloggi* appears to have very similar colouration, but is possibly restricted to the western Pacific (Japan Sea and China Sea), is less spiny, and has a longer and narrower snout.

### *Hippocampus trimaculatus* Leach 1814

Three-spot or longnose seahorse

*Hippocampus trimaculatus* Leach in Leach & Nodder 1814: 104 ('Indian and Chinese seas'); Smith 1963\*; SSF No. 145.20 [in part]; Lourie *et al.* 1999\*; Bijukumar *et al.* 2008; Murugan *et al.* 2008\*.

*Hippocampus mannulus* (non Cantor 1850): Günther 1866.

*Hippocampus takakurae* Tanaka 1916: 423, Pl. 115, Fig. 341 (Hojo, Chiba Prefecture, Japan).

Rings 11 + 38–42; dorsal fin 18–21 rays; subdorsal rings 2.0–1.5 + 1.75–2.0; pectoral fins 16–19 rays; anal fin 4 rays. HL 5.6–6.6 in TL; snout length 1.9–2.4 in HL; snout depth 2.7–3.6 in snout length. Subdorsal spine formula 3 / 0–0.5, 0.5, 0.5; supraorbital spines pointed, strongly retrorse; postorbital spine present as low bump; suborbital spines present as 1 or 2 low bumps; no nose spine; temporal spine present as low bump; pre-coronet spine lacking or entirely merged

with coronet; 2 sharp ridge-like neck spines; upper cleithral and pectoral cleithral spines low or absent; lower cleithral ring spine sharp, strongly retrorse. Ventral trunk ridge low; superior, lateral and inferior trunk ridges with moderate blunt spines, but trunk rings 1, 4, 7 and 11 with slightly longer spines; anterior superior and inferior tail spines also moderate and blunt, but spines on tail rings 5–6, 10, 14, 17 and 20–21 slightly longer. Coronet low, retrorse, with 5 blunt tubercles. No dermal flaps or filaments. Male brood pouch abdominal, under first 5–8 rings.

Body ground-colour golden orange to brown; ventral trunk ridge may be dark brown; large dark spots on lateral surface and base of trunk spines 1, 4 and 7 (more obvious in paler individuals and more common in males than in females). Attains 137 mm TL.

**DISTRIBUTION** Indo-Pacific. WIO: southern India (Kerala) and probably Sri Lanka; elsewhere to east coast of India (to Chennai), Japan, Australia and Tahiti.

**REMARKS** Marine; reported as common in seagrasses and seaweeds in <5 m from India (Murugan *et al.* 2008), but typically trawled from waters >15 m deep, in areas with gravel, sand and dead bivalves (Lourie *et al.* 1999); may live in association with octocorals and seawhips (Choo & Liew 2003). Reports of this species from Tanzania and South Africa (Morgan Bay, Eastern Cape) are most likely *H. borboniensis*. Extensively traded internationally. IUCN Red List conservation status Vulnerable.

### *Hippocampus tyro* Randall & Lourie 2009

PLATE 91

*Hippocampus tyro* Randall & Lourie 2009: 19, Figs. 1–2 (Poivre Atoll, Amirante Is., Seychelles).

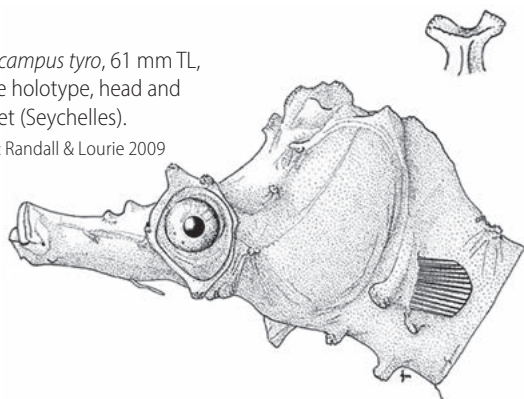
Holotype: rings 14 + 38; dorsal fin 15 rays; subdorsal rings 3.0; pectoral fins 14 or 15 rays; anal-fin rays unknown. HL ~6.2 in TL; snout length ~2.8 in HL; snout depth ~2.2 in snout length. Subdorsal spine formula 2 / 1, 1. Two lateral supraorbital spines, front spine largest; 1 small suborbital spine; 2 small spines behind suborbital spines; 2 nose spines, rear spine largest; 2 small temporal spines; pre-coronet spine arrow-like; neck spines present as ridge; large, rugose pectoral cleithral ring spine and moderate lower cleithral ring spine. Ventral trunk ridge prominent, with moderate spine on 1st ring; spines of trunk and tail ridges low, blunt and knob-like; superior spines of trunk rings 1–8 doubled; slightly enlarged superior spines of trunk rings 3 and 7; slightly enlarged superior spines of tail rings 4, 8 and 11. Coronet low, oval and cup-like in dorsal view, with rugose spines projecting laterally.

Gill opening single, slit-like and mid-dorsal. Dermal filaments slender, branched and leaf-like, on enlarged superior spines of trunk and tail.

Body ground-colour pale brown dorsally, with orange cast on tail, pale to white ventrally; white blotches on head, body and tail; trunk and tail ridge spines white with dark brown filaments on many spines. Attains at least 61 mm TL.

*Hippocampus tyro*, 61 mm TL, female holotype, head and coronet (Seychelles).

Source: Randall & Lourie 2009



**DISTRIBUTION** Known only from the holotype from Seychelles.

**REMARKS** Dredged from 43–48 m among *Stylophora pistillata*, *Montipora digitata* and *Dendrophyllia* corals.

## *Hippocampus* sp. 1

African thorny seahorse

PLATE 89

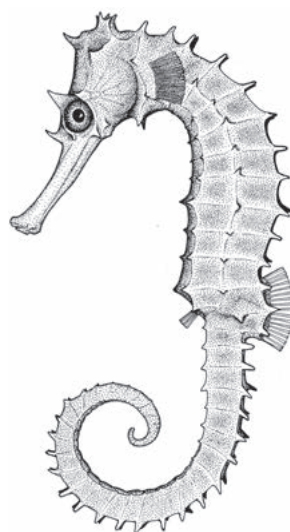
*Hippocampus histrix* (non Kaup 1856): Fowler 1935\*; Smith 1963\*; SSF No. 145.18\*; Khalaf & Disi 1997\*.

*Hippocampus jayakari* (non Boulenger 1900): Debelius 1998\*; Kuitert 2004\*.

Rings 11 + 33–37; dorsal fin 16–19 rays; subdorsal rings 2.0–1.5 + 1.5–2.0; pectoral fins 17 or 18 rays; anal fin 4 rays. HL 4.1–4.9 in TL; snout length 1.7–1.9 in HL; snout depth 4.8–6.9 in snout length. Subdorsal spine formula 3 / 0, 1, 0–0.5; long, sharp supraorbital and postorbital spines; 2 sharp triangular suborbital spines, rear spine slightly smaller; large, triangular, retrorse nose spine; large temporal spine; long and sharp backward- or dorsally directed pre-coronet spine, followed by peaked ridge that merges anteriorly with coronet; 2 long and sharp, often multifid neck spines; long upper cleithral, pectoral cleithral, and lower cleithral ring spines. Ventral trunk ridge high, with moderate spines; superior, lateral and inferior trunk ridges with high and sharply pointed spines; anterior inferior tail spines also high and sharp; superior spines enlarged on each tail ring except near tail tip. Coronet moderate to low, but with 4 or 5 sharp spines. Tiny

dermal flaps ringing iris. Male brood pouch abdominal, under first 7 or 8 rings.

Body ground-colour bright yellow to pale brown; paler saddle between trunk rings 5–7, usually with tiny orange-brown spots, and 4–6 similar pale saddles with tiny darker spots variably present on tail; tiny white spots variably present on head posteriorly, back and sides; underside of head and trunk usually same as body ground-colour, but ventral keel dark brown to black in large individuals; 1–4 white or pale bars on snout; nose spine black-tipped, and almost all other spines dark-tipped; dorsal fin almost entirely transparent but may have scattered melanophores forming 2 indistinct submarginal bands. Attains 176 mm TL.



*Hippocampus* sp. 1, 5 cm from crown to tail curve (South Africa). Source: SSF

**DISTRIBUTION** WIO: possibly northern Red Sea (Gulf of Aqaba), Gulf of Oman, Tanzania, Mozambique, South Africa, Madagascar, Seychelles, Mauritius and Réunion.

**REMARKS** Most similar to *H. histrix* from the Pacific. Marine; often seen in rubble-algae habitats with sparse seagrasses, and in soft-bottom habitats with sponges and soft corals, typically in <10 m.

## *Hippocampus* sp. 2

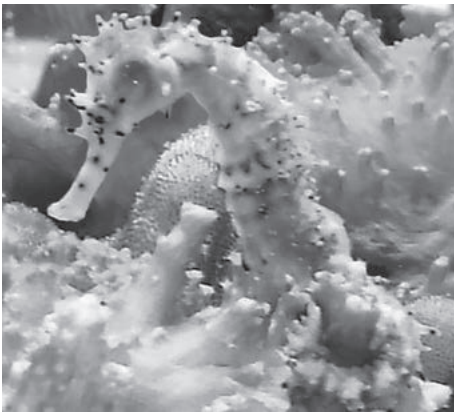
African short-snouted thorny seahorse

PLATE 90

Rings 11 + 34–36; dorsal fin 19 or 20 rays; subdorsal rings 1.75–1.5 + 1.5–1.75; pectoral fins 16 or 17 rays; anal fin 4 or 5 rays. HL 5.4–5.6 in TL; snout length 2–2.3 in HL; snout depth 3.3–4.5 in snout length. Subdorsal spine formula 3 / 0, 1, 0. One or 2 long and sharp supraorbital spines; 1 sharp postorbital spine; 1 or 2 sharp suborbital spines, rear spine slightly smaller; sharp nose spine; large temporal spine; long

sharp pre-coronet spine, followed by peaked ridge that merges anteriorly with coronet; 2 sharp ridge-like neck spines; long upper, pectoral and lower cleithral ring spines (lower cleithral ring spines may be doubled). Ventral trunk ridge high, with long spines; superior, lateral and inferior trunk ridges with high and sharply pointed spines, especially on trunk rings 1, 4, 7 or 8 and 11; anterior superior and inferior tail spines also high and sharp, especially on tail rings 1 or 2, 4, 6 and 9. Coronet moderate to high, with 2–5 sharp spines. Long dermal flaps or filaments may extend from tips of superior spines.

Body ground-colour in life possibly creamy yellow to orange; head and trunk with irregular small spots; most spines with subterminal black bands; ventral keel dark in larger individuals; dorsal fin with diffuse submarginal band across last 4 rays. Attains 140 mm TL.



*Hippocampus* sp. 2  
(South Africa).  
© J Kamminga

**DISTRIBUTION** WIO: possibly Red Sea, Tanzania, Mozambique, South Africa, Madagascar, Seychelles, Mauritius and Réunion.

**REMARKS** Most similar to *H. jayakari* from Red Sea and Arabian Sea, and also similar to *Hippocampus* sp. 1, which otherwise has a much longer head and snout.

### *Hippocampus* sp. 3

Sodwana puff seahorse

PLATE 90

Counts and proportional measurements not available (known only from photographs). Appears to lack all spines typically found on the head and neck of most seahorses, except the lower cleithral ring spine. No ventral trunk ridge; very low, rounded trunk and tail ridges. Body not potbellied between neck and anus. Dorsal-fin base slightly elevated, but not forming triangular projection at end of trunk. Coronet tall and very broad, appearing as lumpy mass on posterodorsal part of head, without spines or ridges. Position of brood pouch in males unknown.

Body ground-colour bright orange to yellow; one individual seen with slightly darker saddles across dorsum. Estimated size in photographs <30 mm TL.

**REMARKS** Known only from photographs taken at Bikini Reef, Sodwana Bay, South Africa, at ~20 m deep. A pygmy species, most similar to *H. ponto* in colour and size, but differing from that species (and almost all other pygmy seahorses) in not having a potbellied trunk, and in having a triangular dorsal-fin base as well as smooth skin, without filaments, flaps or extensions. Head similar-looking to *Idiotropiscus lummitzeri*, but, like other seahorses, *Hippocampus* sp. 3 holds its head at right angles to the trunk. It also appears to lack dermal filaments or attached algae.

### GENUS *Ichthyocampus* Kaup 1853

Rings 14 or 15 + 37–40; dorsal fin 22–27 rays; subdorsal rings 0 + 4.5–5.5 = 4.5–5.5, and dorsal-fin origin on tail ring 1–3; pectoral fins 14–16 rays; anal fin 2 rays; caudal fin 10 rays. HL 8.5–10.9 in SL; snout length 2.2–2.8 in HL; snout depth 2.4–3.9 in snout length. Superior and inferior trunk and tail ridges continuous; lateral trunk ridge deflected ventrally near anal ring and may or may not join inferior ridge; median dorsal snout ridge slightly elevated; opercular ridge complete and straight; pectoral-fin bases with 2 low ridges; body ridges distinct, with margins entire to granular. Trunk V-shaped and keeled. Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Male brood-pouch closure everted, pouch plates and pouch folds present, and pouch under first 14–20 tail rings. Considered monotypic, but may include *I. bikiniensis* Herald 1953, which is known only from two planktonic transforming larvae (the primary types).

### *Ichthyocampus carce* (Hamilton 1822)

Indian freshwater pipefish

*Syngnathus carce* Hamilton 1822: 13, 362 (tidal area of Ganges River, India).

?*Ichthyocampus ponticerianus* Kaup 1856: 31, 74 (Puducherry and Assam, India; Makassar, Indonesia).

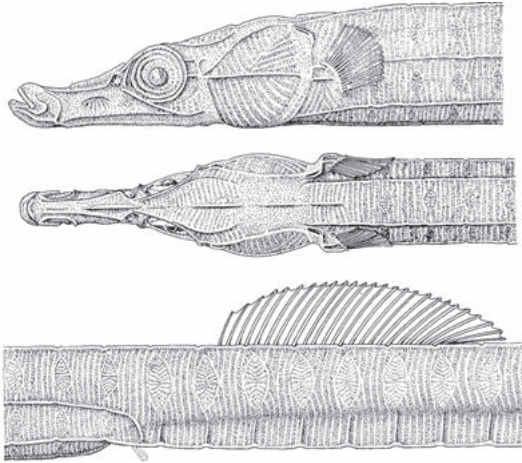
*Ichthyocampus carce*: Dawson 1977\*, 1985\*; Kuitert 2004\*.

Diagnosis as for genus.

Body ground-colour brown, with mottling and fine, irregular, paler diffuse bars; each trunk ring usually with pale spot or blotch on or above inferior ridge; dark line extends from eyes to lower jaw, splitting to run posterodorsally and



posteroventrally from each eye. Females generally with black spots on ventrolateral margin of snout; belly and breast crimson red, and fine barring on body enhanced during courtship (in males and females). Attains 120 mm SL.



*Ichthyocampus carce*, 82 mm SL, male (Sri Lanka). Source: Dawson 1977

**DISTRIBUTION** Indo-Pacific. WIO: India (Mumbai and southwards) and Sri Lanka; elsewhere to east coast of India, Thailand, Malaysia and Indonesia.

**REMARKS** Freshwater, brackish and marine; found mostly in rivers, streams and estuaries.

**GENUS** *Kyonemichthys* Gomon 2007

Head bent slightly downward from longitudinal body axis, body also bent; tail slightly prehensile; females much more slender than males and more pipefish-like in appearance. Rings 9 + 52; dorsal fin 15 rays, all rays except first ray branched; subdorsal rings 0 + 2.5 = 2.5, and dorsal-fin origin on tail ring 9; pectoral fins 12 rays; anal fin 3 rays; no caudal fin. HL ~9.6 in TL; snout length ~3.1 in HL; snout depth ~1.4 in snout length. Superior trunk and tail ridges continuous; lateral trunk ridge confluent with inferior tail ridge; inferior trunk and tail ridges discontinuous, with inferior trunk ridge ending at about anal ring but obscured by swollen trunk. Trunk greatly enlarged ventrally at trunk rings 3–5, slightly enlarged at trunk rings 6–7, and moderately enlarged at trunk rings 8–9. Median dorsal snout ridge present as 2 bumps (smaller bump in front of nares and larger bump between nares); dorsal rim of orbits raised, with granular sculpturing completely encircling eyes; opercular ridge low and complete; pectoral-fin bases with 2 ridges: dorsal ridge low and plate-like, ventral ridge

larger and star-shaped; superior body ridge and inferior tail ridge distinct, with rounded spines or bumps on rear angles of superior trunk rings 1, 4 and 8, and on superior tail rings 5, 9, 11, 15 and 19; trunk rounded ventrally. Scutella vestigial or absent. Dorsal-fin base elevated, often as 2 rounded bumps. Dermal filaments elongate and variable in length, most obvious on crown of head, and on dorsum of trunk ring 8 and tail ring 5; dermal flaps variably present, may have attached sessile invertebrates or algae. Male brood pouch forms sac that opens through anteromesial pore; pouch under first 7 or 8 tail rings. One species.

*Kyonemichthys rumengani* Gomon 2007

Pygmy pipedragon, thread pipefish

PLATE 91

*Kyonemichthys rumengani* Gomon 2007: 27, Figs. 1–3 (Lembeh Strait, Sulawesi, Indonesia); Golani & Bogorodsky 2010.

Diagnosis as for genus.

Body ground-colour golden brown to grey, with pale or dark speckling; edges of spines or bumps of ridges may be darker; ventral side of back of head and trunk darker than dorsum, but tail paler; fins transparent, often with rosy or pink tint; filaments on head and trunk red to pink, and filaments on tail red, brown or green. Attains 30 mm TL.

**DISTRIBUTION** Indo-Pacific: records from the Red Sea, Indonesia, New Guinea, the Philippines, and Japan.

**REMARKS** Marine; collected at 6–20 m, and has been found holding onto algae, mud, muck or silt.

**GENUS** *Lissocampus* Waite & Hale 1921

Rings 12–17 + 33–60; dorsal fin 13–19 rays; subdorsal rings 2.5–0.5 + 0.5–2.25 = 2.25–4.25; pectoral fins 5–13 rays; anal fin 3 or 4 rays; caudal fin 10 rays. HL 10.8–14.4 in SL; snout length 2.6–4 in HL; snout depth 1.2–2.9 in snout length. Superior trunk and tail ridges continuous; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low to clearly elevated, entire; opercular ridge vestigial or obsolete; pectoral-fin bases without ridges; trunk and tail ridges low, inconspicuous. Scutella not keeled. Dorsal-fin base somewhat elevated anteriorly, with loose surrounding membrane. Dermal flaps usually present. Male brood pouch with everted or semi-pouch closure, no pouch plates, pouch folds present and pouch under first 12–18 tail rings. Five species, 1 in WIO.

*Lissocampus bannwarthi* (Duncker 1915)

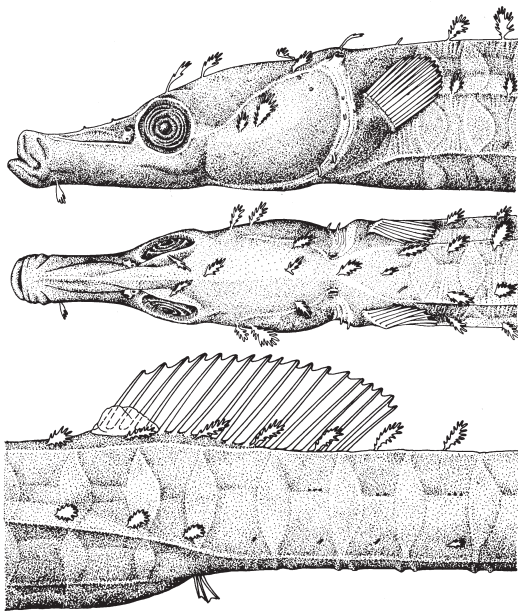
Suez pipefish

PLATE 91

*Ichthyocampus bannwarthi* Duncker 1915: 93 (Gulf of Suez, Egypt, Red Sea); Smith 1963.*Lissocampus bannwarthi*: Dawson 1977\*, 1985\*; Goren & Dor 1994; Kuitert 2004\*.

Rings 17 + 33–35; dorsal fin 18 or 19 rays; subdorsal rings 2.25–1.5 + 1.75–2.25 = 3.75–4.25; pectoral fins 11–13 rays. HL 10.8–11.9 in SL; snout length 2.6–2.8 in HL; snout depth 2.5–2.9 in snout length. Median dorsal snout ridge low; opercular ridge vestigial. Dermal flaps branched or frilled on head, trunk and first third of tail; flaps simple on last third of tail. Male brood pouch under first 17 or 18 tail rings.

Body ground-colour pale to tan, with ~20 diffuse dark bars across dorsum and sides, each bar usually with irregular patch of ocellated brown to blackish spots; trunk rings usually with pale spots on lower sides; dark line extends from eyes to lower jaw, slightly paler line runs posterodorsally, and another dark line runs posteroventrally from eyes; ventral part of head pale, with black spots on ventrolateral margin; anterior basal part of dorsal-fin membrane usually with brownish blotch. Attains 134 mm SL.



*Lissocampus bannwarthi*, 12 cm SL, presumptive female, neotype (Red Sea). Source: Dawson 1977

**DISTRIBUTION** WIO: northern Red Sea (Gulf of Suez and Gulf of Aqaba); a specimen from Seychelles (Picard I., Aldabra) may also be this species.

**REMARKS** Known only from a few specimens. Marine; collected from <5 m deep, sometimes among small rocks on sand.

**GENUS** *Micrognathus* Duncker 1912

Rings 14–20 + 27–32; dorsal fin 16–24 rays; subdorsal rings 1.75–0 + 2.25–6.0 = 3.25–7.0, and dorsal-fin origin between front margin of penultimate trunk ring and rear margin of 1st tail ring; pectoral fins 9–15 rays; anal fin 2–4 rays; caudal fin 10 rays. HL 6.9–11.3 in SL; snout length 2.2–4 in HL; snout depth 1.6–4 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends on anal ring; lateral trunk ridge continuous with inferior tail ridge; median dorsal snout ridge low, entire, somewhat concave in lateral profile; opercular ridge complete in young, incomplete to obsolete in subadults and adults; superior and inferior ridges low to somewhat elevated. Scutella not keeled. Dorsal-fin base not elevated in subadults and adults. Dermal flaps often present (but not on eyes), and simple or sparsely branched. Male brood pouch with everted closure, pouch plates and pouch folds present, and pouch under first 10–18 tail rings. Eight species, 2 in WIO.

**KEY TO SPECIES**

- 1a Superior and inferior ridges of posterior tail rings not angled laterally nor ending in protruding hook-like points; trunk rings 15–17 (rarely 15); pectoral fins 11–13 rays ..... *M. andersonii*
- 1b Superior and inferior ridges of posterior tail rings angled laterally and ending in protruding hook-like points; trunk rings 14–16 (usually 15); pectoral fins 9–11 (usually 10) rays ..... *M. brevirostris*



1a



1b

Tail drawings sourced from Dawson (1985)



*Micrognathus andersonii*, 7 cm SL. Source: SSF

## *Micrognathus andersonii* (Bleeker 1858)

Shortnose pipefish

PLATES 91 & 92

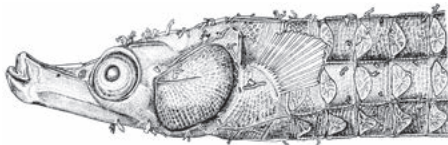
*Syngnathus andersonii* Bleeker 1858: 465 (Cocos [Keeling] Is.).

*Micrognathus brevisrostris* (non Rüppell 1838): Duncker 1915 [in part]; Smith 1952, 1953, 1963 [in part].

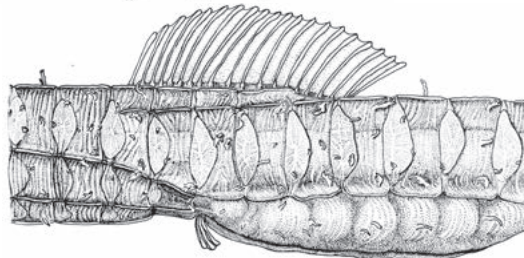
*Micrognathus andersonii*: Dawson 1982\*; SSF No. 145.22\*; Goren & Dor 1994; Randall 1995\*.

Rings 15–17 + 27–32; dorsal fin 17–24 rays; subdorsal rings 1.75–0.25 + 2.5–5.0 = 3.75–5.75; pectoral fins 11–13 rays; anal fin usually 3 rays. HL 8.1–10.4 in SL; snout length 2.6–3.4 in HL; snout depth 1.6–2.8 in snout length. Superior and inferior ridges of posterior tail rings not angled laterally nor ending in protruding hook-like points. Dermal flaps usually short, often with frilled margins or short distal branches. Male brood pouch under first 13–18 tail rings.

Body ground-colour pale to dark brown, with some spotting, mottling or blotching; often with 9–13 narrow bars crossing dorsum and part of sides, but typically not crossing lower half of sides and venter of trunk; often with 1–4 prominent dark blotches between lateral and superior trunk ridges. Attains 78 mm SL.



*Micrognathus andersonii*, 57 mm SL, brooding male (Gulf of Suez). Source: Dawson 1982



**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Gulf of Oman, Red Sea, East Africa to South Africa (Xora River mouth, Eastern Cape), Madagascar and southern India; elsewhere to Indonesia, Philippines, China, southern Japan,

Micronesia, Palau, New Guinea, Solomon Is., Australia, New Caledonia, Fiji, Tonga and Samoa.

**REMARKS** Marine; collected from tidepools, among seagrasses, and on reef flats and sand flats, usually in <2 m, but recorded to 5.2 m deep.

## *Micrognathus brevisrostris* (Rüppell 1838)

Thorntail pipefish

*Syngnathus brevisrostris* Rüppell 1838: 144 (Massawa, Eritrea, Red Sea).

*Micrognathus brevisrostris*: Duncker 1915; Smith 1951, 1952, 1953\*, 1963\*; Smith & Smith 1963.

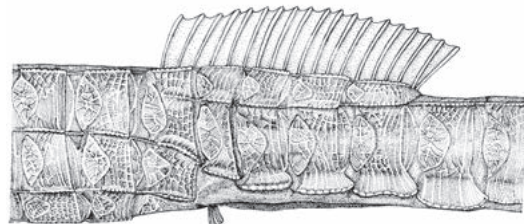
*Micrognathus brevisrostris brevisrostris*: Dawson 1982\*, 1985\*; Goren & Dor 1994; Kuitert 2000\*.

Rings 14–16 + 28–31; dorsal fin 18–21 rays; subdorsal rings 1.25–0.25 + 3.75–4.75 = 4.25–5.5; pectoral fins 9–11 rays; anal fin 2–4 rays. HL 8.7–11.3 in SL; snout length 2.9–4 in HL; snout depth 1.6–2.3 in snout length. Superior and inferior ridges of posterior tail rings flared laterally, with rear angles produced to hook-like points. Dermal flaps usually short, slender, and simple to bifurcate. Male brood pouch under first 9–14 tail rings.

Body ground-colour pale to dark brown, sometimes with indications of dark bars crossing lower half of sides and venter of trunk, and with irregular narrow lines or bars on head. Attains 62 mm SL.



*Micrognathus brevisrostris*, 52 mm SL, male (Red Sea). Source: Dawson 1982





**DISTRIBUTION** WIO: endemic to Red Sea (Gulf of Suez and Gulf of Aqaba to Strait of Perim).

**REMARKS** Marine; collected from tidepools and among *Stylophora* corals, at <2 m.

## GENUS *Microphis* Kaup 1853

Rings 15–22 + 20–39; dorsal fin 25–74 rays; subdorsal rings 12.0–0.25 + 3.0–9.5 = 5.25–16.5; pectoral fins 15–23 rays; anal fin 3 or 4 rays; caudal fin 8–10 (usually 9) rays. HL 4.2–11.7 in SL; snout length 1.4–2.8 in HL; snout depth 2.2–13.7 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent

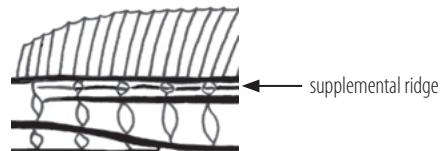
with inferior tail ridge; median dorsal snout ridge low, entire; opercle with or without complete ridge in adults, may also have supplemental opercular ridges; pectoral-fin bases with or without distinct ridges; lateral and inferior trunk ridges may be obscured or distinct, sometimes with supplemental ridges between main body ridges. Scutella with or without longitudinal keels. Dorsal-fin base not elevated. No dermal flaps or filaments. Male brood-pouch plates vertical to strongly convergent, no pouch folds, and pouch originates on trunk rings 1–3. Adults typically found in estuarine or freshwater habitats, but juveniles may be found offshore and adults may get washed out to sea. Five subgenera (3 considered genera by some authors, with *M. argulus* recognised as *Coelonotus argulus* by Kottelat 2013, Delrieu-Trottin *et al.* 2015 and Fricke *et al.* 2018, and *M. ocellatus* recognised as *Lophocampus ocellatus* by Kottelat 2013) and at least 25 species; possibly 8 species in WIO.

### KEY TO SPECIES

- 1a Subdorsal trunk rings 12.0–10.0; subdorsal tail rings 3.0–4.5 ..... *M. fluviatilis*
- 1b Subdorsal trunk rings 4.5–0.25; subdorsal tail rings 5.5–9.5 ... 2
- 2a Snout long: HL 4.2–5.3 in SL, snout length 1.5–1.8 in HL, snout depth 7.2–11.3 in snout length ..... 3
- 2b Snout short: HL 5.6–11.7 in SL, snout length 2–2.7 in HL, snout depth 2.5–7 in snout length ..... 4
- 3a Opercle with 2–7 ridge-like striae below longitudinal ridge; trunk rings 20–22 (usually 21); snout often darker brown than body ..... *M. brachyurus*
- 3b Opercle with ridge-like striae above and below longitudinal ridge; trunk rings 19–22 (usually 20); snout generally same shade as body ..... *M. millepunctatus*
- 4a Trunk subdorsal rings 4.5–2.0; dorsal fin 42–63 rays; no striae below opercular ridge (if present) ..... 5
- 4b Trunk subdorsal rings 1.75–0.25; dorsal fin 32–42 rays; striae present below a distinct and complete opercular ridge ..... 7



- 5a Snout relatively thick: snout depth 2.5–3.4 in snout length; larger individuals typically with supplemental ridge between superior trunk ridge and lateral tail ridge; scutella usually keeled, especially in large individuals ..... *M. argulus*



- 5b Snout thinner: snout depth 3.6–7 in snout length; no supplemental lateral ridges; scutella not keeled ..... 6
- 6a Tail rings 24–27, subdorsal tail rings 5.75–7.5; pectoral-fin bases usually with 2 prominent ridges, and middle pectoral-fin rays longest; sides of each trunk ring often with pale centred spot ..... *M. cuncalus*
- 6b Tail rings 32–34, subdorsal tail rings 7.5–9.5; pectoral-fin bases usually only with upper ridge, and middle pectoral-fin rays shortest; sides of trunk rings without pale spots ..... *M. vaillantii*
- 7a Trunk rings 17–19 (usually 18); dorsal fin 32–38 rays; scutella not keeled; sides of trunk with pale dashes broken by dark spots ..... *M. insularis*
- 7b Trunk rings 15–17 (usually 16); dorsal fin 37–42 rays; dorsal scutella of 1st and 2nd trunk rings sometimes keeled; sides of trunk with ocellated spots ..... *M. ocellatus*

Head drawing (3a) sourced from Dawson (1985)



## *Microphis argulus* (Peters 1855)

Flatnosed river pipefish

PLATE 93

*Syngnathus argus* Peters 1852: 685 (Anjouan I., Comoros) [objectively invalid; preoccupied by *Syngnathus argus* Richardson 1840]; Peters 1868\*.

*Syngnathus argulus* Peters 1855: 278 (streams of St Johanna, Anjouan I., Comoros).

*Coelonotus biocellatus* Günther 1870: 188 (?East Indian Archipelago).

*Syngnathus platyrhynchus* Duméril 1870: 571 (Nuku Hiva, Marquesas Is.).

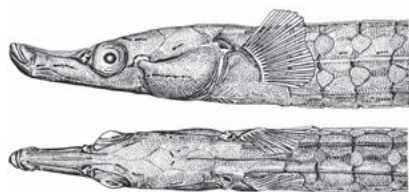
*Syngnathus muraena* (non Kaup 1856): Sauvage 1891\*.

*Coelonotus argulus*: Pellegrin 1933; Arnoult 1959; Smith 1963\*; Mauge 1978.

*Microphis argulus*: Dawson 1984\*, 1985\*; Keith *et al.* 2006\*.

Rings 16 or 17 + 36–39; dorsal fin 42–49 rays; subdorsal rings 4.25–2.25 + 7.5–9.25 = 10.5–13; pectoral fins 15–18 rays, middle rays shortest; anal fin 3 rays; caudal fin 9 rays. HL 8.5–11.7 in SL; snout length 2.3–2.7 in HL; snout depth 2.5–3.4 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge (both indistinct); median dorsal snout ridge very low, entire; opercular ridge short and indistinct; pectoral-fin bases with prominent upper ridge; larger individuals typically with supplemental ridge between superior trunk ridge and anterior part of lateral tail ridge. Scutella keeled in larger individuals. Male brood-pouch plates slightly convergent; eggs in pouch in 2–4 transverse rows.

Body ground-colour grey-brown, usually with ocellated dark spots on upper and lower lateral scutella of most trunk rings as well as scutella of anterior tail rings; adults with prominent dark spots on pectoral-fin bases and beneath fin, but small specimens (<90 mm SL) without distinctive markings. Attains 132 mm SL.



*Microphis argulus*,  
11 cm SL, female.

Source: Dawson 1984

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Mauritius, Réunion and possibly Madagascar; elsewhere to Indonesia, Ryukyu Is., New Guinea, Solomon Is., New Caledonia, Fiji, Samoa and Marquesas Is.

**REMARKS** Freshwater and brackish, and possibly less commonly marine; found in coastal rivers, streams and estuaries. Sauvage (1891), Pellegrin (1933), Arnoult (1959) and Mauge (1978) reported the species from Madagascar, although Dawson (1984) was unable to find specimens there.

## *Microphis brachyurus* (Bleeker 1854)

Shorttailed river pipefish

PLATE 93

*Syngnathus brachyurus* Bleeker 1854: 16, Fig. 208 (Panimbang, western Java; Pariaman, western Sumatra, Indonesia).

*Doryichthys auronitens* Kaup 1856: 59 (Makassar, Sulawesi, Indonesia).

*Syngnathus polyacanthus* Bleeker 1856: 77 (Manado, Sulawesi, Indonesia).

*Microphis bleekeri* Day 1865: 265, Fig. (river at Kochi, India); Günther 1870; Day 1878.

*Microphis jouani* Duméril 1870: 592 (New Caledonia).

*Doryichthys philippinus* Fowler 1918: 13, Fig. 6 (Philippines).

*Doryrhamphinarium brachyurum* Fowler 1922 (Sri Lanka); De Silva 1956.

*Microphis brachyurus*: Menon 1961; Pethiyagoda 1991\*; Sumith *et al.* 2011.

*Oostethus brachyurus*: Smith 1963\* [in part].

Rings 20–22 + 21–24; dorsal fin 37–47 rays; subdorsal rings 2.0–0.25 + 6.5–8.75 = 7.5–9.5; pectoral fins 19–22 rays, middle rays shortest; anal fin 4 rays; caudal fin 9 rays, middle rays may be greatly elongated in juveniles. HL 4.2–5.3 in SL; snout length 1.5–1.8 in HL; snout depth 7.2–11.3 in snout length. Superior trunk and tail ridges discontinuous under rear part of dorsal fin; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low, entire; opercular ridge complete, with 2–7 ridge-like striae below it; pectoral-fin bases with 2 prominent ridges; body ridges finely denticulate to entire in adults, but juveniles may also bear short spines on posterior angles of each ring. Scutella not keeled. Male brood-pouch plates well-developed and vertically oriented; eggs in pouch in 4–14 transverse rows.

Body colour variable: ground-colour usually plain brown to golden yellow, usually darkest anteriorly and laterally; fine pale punctations on body (especially along lower half of trunk), and diffuse red to yellow stripe below lateral trunk ridge; snout often darker brown than body, but with irregular pale bars or blotches on sides; upper and lower caudal-fin margins orangish; iris brown. Males sometimes with red bar on opercle. Juveniles sometimes with 3 or 4 broad brownish bands on tail. Attains 206 mm SL.



*Microphis brachyurus*, 16 cm TL (South Africa). Source: SFSA

**DISTRIBUTION** Indo-Pacific. WIO: South Africa, India (Western Ghats of Kerala State; Cuddalore District) and Sri Lanka; elsewhere to east coast of India, Nicobar Is., Indonesia, Philippines, Japan, Palau, New Guinea, Solomon Is., Australia, New Caledonia, Vanuatu, Fiji, Samoa and Society Is.

**REMARKS** Most WIO specimens currently reported as *M. brachyurus* (cf. Skelton 1993) are recognised here as *M. millepunctatus*. Freshwater, brackish and marine; most commonly found in estuaries and coastal rivers and streams, but also considered salt tolerant (Pethiyagoda 1991), with juveniles reported from harbours and collected in offshore plankton and nekton samples.

### *Microphis cuncalus* (Hamilton 1822)

Crocodile-tooth river pipefish

*Syngnathus cuncalus* Hamilton 1822: 12, 362 (estuaries near Kolkata, India).

*Dorichthys cunculus*: Munro 1955.

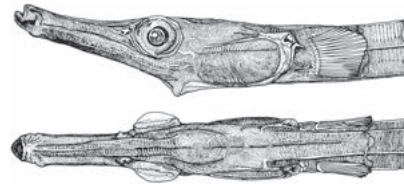
*Paramicrophis schmidti* Klauswitz 1955: 326, Figs. 1a–c (Mumbai, India).

*Microphis cuncalus*: Dawson 1984\*, 1985\*; Talwar & Jhingran 1991; Kuitert 2009\*; Abraham *et al.* 2011.

Rings 16–18 + 24–27; dorsal fin 47–56 rays; subdorsal rings 3.5–2.0 + 5.75–7.5 = 8.5–10.25; pectoral fins 16–19 rays, middle rays longest; anal fin 4 rays, and fin sometimes in distinct groove separated from anus by transverse septum; caudal fin 9 rays. HL 7.3–8.8 in SL; snout length 2–2.3 in HL; snout depth 4.7–7 in snout length. Superior trunk and tail ridges discontinuous under rear part of dorsal fin; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low, entire; opercular ridge complete, and without striae below longitudinal ridge; pectoral-fin bases usually with 2 prominent ridges; body ridges distinct, with superior trunk ridges often strongly elevated in adult females. Scutella not keeled. Male brood-pouch plates well-developed and vertically oriented (not convergent).

Body ground-colour grey-green to grey-brown, dorsal ridge slightly darker, and venter grey-white; may have brown to black dusky broken stripe from sides of snout, through eyes, along

upper margin of opercle, to sides of body and tail; pale spots or blotches just below longitudinal stripe and laterally centred on each ring; operculum often iridescent silvery; caudal fin sometimes red in life; iris red-brown. Attains 152 mm SL.



*Microphis cuncalus*, 11 cm SL, subadult (E India).

Source: Dawson 1984

**DISTRIBUTION** Indian Ocean: India (Mumbai to Chennai) and Sri Lanka to Bangladesh.

**REMARKS** Freshwater and brackish; collected from rivers and estuaries.

### *Microphis fluviatilis* (Peters 1852)

Freshwater pipefish

PLATE 93

*Syngnathus fluviatilis* Peters 1852: 685 (Tete, Zambezi River, Mozambique).

*Syngnathus zambezensis* Peters 1855: 465 (Tete, Zambezi River, Mozambique) [unnecessary replacement name for *S. fluviatilis* Peters 1852].

*Belonichthys zambezensis* Peters 1868: 109, Pl. 20, Fig. 5 (Molumbo and Zambezi rivers, Mozambique); Duméril 1870.

*Doryichthys mento* Günther 1870 (East Africa) [misidentification].

*Belonichthys sanctipauli* Sauvage 1879: 45, Pl. 1, Fig. 1 (St Paul I., southern Indian Ocean [?]).

*Belonichthys fluviatilis*: Duncker 1915; Barnard 1925; Smith 1949\*, 1963\*, 1975, 1980; Kähnsbauer 1976.

*Microphis fluviatilis*: Dawson 1984\*, 1985\*; SSF No. 145.23\*; Skelton 1993\*.

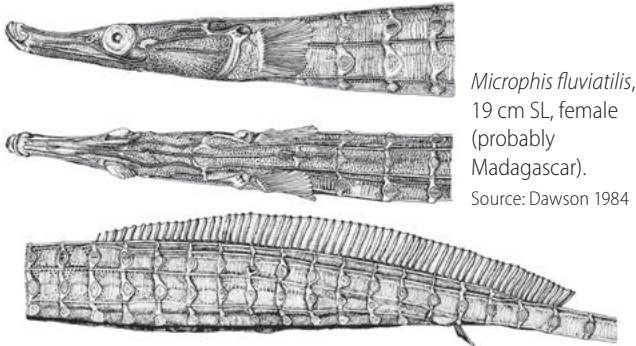
Rings 18–20 + 21–23; dorsal fin 60–69 rays; subdorsal rings 12.0–10.0 + 3.0–4.5 = 14.0–15.75; pectoral fins 15–20 rays, middle rays shortest; anal fin 4 rays; caudal fin 9 rays. HL 5.6–9.4 in SL; snout length 2.3–2.5 in HL; snout depth 3.2–4.8 in snout length. Superior trunk and tail ridges discontinuous under rear part of dorsal fin; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low, entire; opercular ridge complete and without striae below it; pectoral-fin bases usually with 1 weak ridge; body ridges distinct, with one or more supplemental ridges above lateral trunk ridge in



*Microphis fluviatilis*, 15 cm SL, female (Tanzania). Source: SSF

large individuals. Scutella keeled on upper trunk. Male brood-pouch plates well-developed and slightly convergent; eggs in pouch in up to 6 transverse rows.

Body ground-colour brownish green; lower jaw and snout with dark lateral stripe, continuing faintly behind eyes; diffuse dark spots or ocelli variably present on lateral trunk ridge; upper margin of opercle dark, lower portion often iridescent silvery. Attains 200 mm SL.



*Microphis fluviatilis*,  
19 cm SL, female  
(probably  
Madagascar).  
Source: Dawson 1984

**DISTRIBUTION** WIO: Kenya (Athi-Galana-Sabaki River), Tanzania, Mozambique, Zimbabwe, South Africa (Mthatha River and Coffee Bay, Eastern Cape) and Madagascar.

**REMARKS** Freshwater, brackish and marine; collected from rivers and estuaries. The record of Sauvage (1879) from Saint-Paul I. is questionable; specimens reported from the Philippines are also highly questionable as indigenous populations.

### *Microphis insularis* (Hora 1925)

Andaman river pipefish

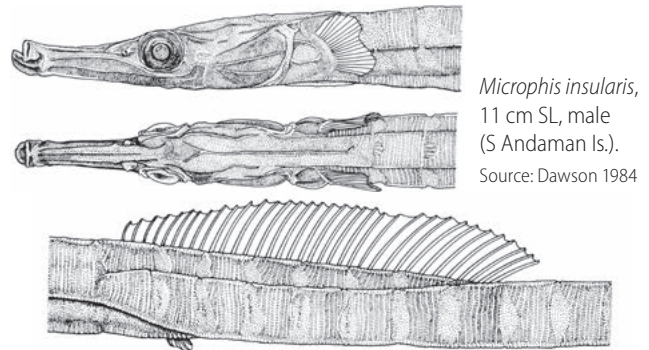
*Doryichthys insularis* Hora in Annandale & Hora 1925: 38, Pl. 2, Fig. 1 (Birchgunge, Andaman Is.); Menon & Yazdani 1968 [as *Doryichthys insularis*].

*Microphis insularis*: Dawson 1984\*, 1985\*.

Rings 17–19 + 30–33; dorsal fin 32–38 rays; subdorsal rings 1.75–0.5 + 5.5–7.5 = 6.75–8.0; pectoral fins 17–19 rays, middle rays shortest; anal fin 4 rays; caudal fin 9 rays. HL 8.2–10 in SL; snout length 2–2.3 in HL; snout depth 4.1–5.5 in snout length. Superior trunk and tail ridges discontinuous under entire dorsal fin; inferior trunk ridge ends at anal ring; lateral trunk

ridge confluent with inferior tail ridge; median dorsal snout ridge low, entire; opercular ridge complete, with striae below ridge; pectoral-fin bases usually with 2 prominent ridges; body ridges in adults distinct, with finely denticulate margins; superior ridges elevated above rest of dorsum. Scutella not keeled. Male brood-pouch plates essentially vertically oriented, not convergent; eggs in pouch in at least 4 transverse rows.

Body ground-colour presumably green to brown in life. Preserved specimens with dark irregular bars on sides of snout; dark stripe from eyes, along cheeks, onto upper margin of opercles and to pectoral-fin bases; lateral trunk and tail ridges with series of pale dashes, broken by dark spots at beginning of anterior trunk rings. Attains 150 mm SL.



*Microphis insularis*,  
11 cm SL, male  
(S Andaman Is.).  
Source: Dawson 1984

**DISTRIBUTION** Indian Ocean. WIO: Seychelles and Comoros (Grande Comore I.); elsewhere, Andaman Is. (reportedly fairly common).

**REMARKS** Freshwater and brackish; found in streams and rivers. IUCN Red List conservation status Vulnerable.

### *Microphis millepunctatus* (Kaup 1856)

Thousand-spot river pipefish

PLATES 92 & 93

*Doryichthys millepunctatus* Kaup 1856: 60 (Madagascar; Réunion, Mascarenes).

*Microphis brachyurus* (non Bleeker 1854): Pellegrin 1933; Smith 1934\*, 1949\*; SSF No. 145.24\*; Skelton 1993\*.

*Oostethus brachyurus* (non Bleeker 1854): Smith 1963\* [in part], 1975, 1980.

*Oostethus brachyurus millepunctatus*: Dawson 1979\*.

*Microphis brachyurus millepunctatus*: Dawson 1984, 1985\*.

*Microphis millepunctatus*: Kuitert 2004\*; Keith *et al.* 2006\*.



*Microphis millepunctatus*, 11 cm SL, brooding male (South Africa). Source: SSF



Rings 19–22 + 20–22; dorsal fin 39–45 rays; subdorsal rings 2.5–0.75 + 6.25–8.0 = 8.25–10.0; pectoral fins 19–23 rays, middle rays shortest; anal fin 3 or 4 rays; caudal fin 9 or 10 rays. HL 4.3–5.2 in SL; snout length 1.5–1.8 in HL; snout depth 7.2–9.3 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low, entire; opercular ridge distinct and complete, with striae above and below it; pectoral-fin bases usually with 2 prominent ridges; body ridges in adults finely denticulate to entire, but juveniles may also bear short spines on rear angles of each ring. Scutella not keeled. Male brood-pouch plates essentially vertically oriented, not convergent; eggs in pouch in at least 6 transverse rows.

Body ground-colour yellowish brown to dark green, often darkest anteriorly and laterally; often with ~12 fine white to bluish punctations on each ring (especially along lower half of trunk and underside of tail), and diffuse red to yellow stripe below lateral trunk ridge; edges of rings often paler than rest of ring; snout generally same as body colour but with irregular pale bars or blotches on sides; lower jaw and snout with broken, narrow, dark lateral stripe, continuing faintly behind eyes; upper margin of opercle dark, and lower portion often iridescent silvery. Juveniles often with 3 or 4 broad brownish bands on tail. Attains 154 mm SL.

**DISTRIBUTION** WIO: Kenya (Shimoni), Mozambique Channel (Bassas da India), South Africa (2 km below Umzimkulu River confluence, KwaZulu-Natal), Madagascar, Comoros, Réunion and Mauritius.

**REMARKS** Freshwater, brackish and marine; collected from estuaries, brackish ponds and freshwater streams, but planktonic juveniles have been captured in oceanic waters as well. WIO specimens of *M. brachyurus* that are not from India or Sri Lanka should be considered *M. millepunctatus*.

### *Microphis ocellatus* (Duncker 1910)

Ocellated river pipefish

PLATE 93

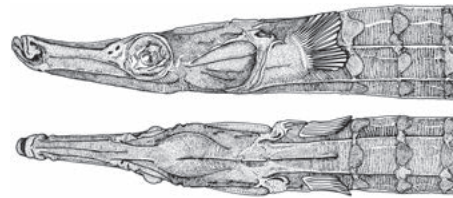
*Doryichthys ocellatus* Duncker 1910: 28, Fig. A (Sri Lanka).

*Microphis ocellatus*: Dawson 1984\*; Pethiyagoda 1991\*; Sumith *et al.* 2011.

Rings 15–17 + 27–32; dorsal fin 37–42 rays; subdorsal rings 1.5–0.25 + 6.5–8.0 = 7.75–8.75; pectoral fins 17–19 rays, middle rays shortest; anal fin 4 rays; caudal fin 9 rays. HL 8.4–10.1 in SL; snout length 2.1–2.5 in HL; snout depth 3.6–4.8 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge

low, entire; opercular ridge distinct and complete, with 2 striae below it; pectoral-fin bases usually with 2 prominent ridges; body ridges finely denticulate to entire in adults, but juveniles may also bear short spines on rear angles of each ring. Scutella usually not keeled, although some specimens show keels on 1 or 2 dorsal trunk scutella. Male brood pouch begins on 2nd trunk ring; pouch plates vertically oriented, usually convergent (contacting those of opposite side on ventral midline); eggs in pouch in 2 layers in 2–4 transverse rows.

Body ground-colour red-brown dorsally, fading to yellow-grey laterally; black spots bordered with white (ocellated), centred on lateral trunk ridge at beginning of each trunk ring (except not on 1st ring), and small pale spots scattered across other trunk and tail ridges; darker brown stripe along dorsolateral part of snout, through eyes and onto cheek, continuing as less distinct stripe across opercle and onto trunk above lateral ridge; upper and lower caudal-fin margins yellow; iris yellow-red. Brooding males may have dark brown pouch plates. Attains ~130 mm SL.



*Microphis ocellatus*,  
9 cm SL, female  
(Indonesia).

Source: Dawson 1984

**DISTRIBUTION** Indian Ocean: India and Sri Lanka to Indonesia (western Sumatra).

**REMARKS** Freshwater; most specimens collected from slow-moving streams or rivers, where they are often seen wrapping their tails around submerged roots.

### *Microphis vaillantii* (Jullerat 1880)

Malagasy river pipefish

*Hemithylacus leiaspis* (non Bleeker 1853): Kaup 1856; Sauvage 1891.

*Coelonotus vaillantii* Jullerat 1880: 176 (Madagascar).

*Coelonotus liaspis* (non Bleeker 1853): Pellegrin 1933; Arnould 1959.

*Coelonotus leiaspis* (non Bleeker 1853): Smith 1963.

*Microphis* (*Coelonotus*) *leiaspis* (non Bleeker 1853): Dawson 1985.

*Microphis vaillantii*: Kuitert 2004.

Rings 16–18 + 32–34; dorsal fin 53–63 rays; subdorsal rings 4.5–2.5 + 7.5–9.5 = 10.75–13.0; pectoral fins 16–19 rays, middle rays shortest; anal fin 4 rays; caudal fin 8 or 9 rays. HL 8.1–10.7 in SL; snout length 2.2–2.6 in HL; snout depth 3.6–4.9 in snout length; trunk depth of adult females somewhat greater than that of adult males (average depth ~2.3 in HL in



females, versus 3.3 in HL in males). Superior trunk and tail ridges discontinuous; inferior trunk ridge indistinct, ends on anal ring; lateral trunk ridge indistinct and confluent with inferior tail ridge; median dorsal snout ridge low, entire; opercular ridge indistinct or absent in adults, but may be complete and distinct in juveniles; pectoral-fin bases usually with upper ridge; body ridges entire, and no supplemental ridges on trunk. Scutella not keeled. Male brood-pouch plates slightly convergent; eggs in pouch in 4–6 transverse rows.

Body ground-colour probably plain brown dorsally, fading to yellow ventrally; some specimens with dark brown stripe from rear margin of eyes onto dorsolateral sides of trunk; scutella sometimes outlined in darker brown. Attains 147 mm SL.

**DISTRIBUTION** WIO: Madagascar and St Brandon Shoals.

**REMARKS** Appears to be freshwater, brackish and marine, and found in streams, rivers, estuaries and oceanic waters. Originally described from Madagascar, but the holotype and other specimens at MNHN show coordinates from near St Brandon Shoals; additional specimens have been taken from Madagascar as recently as 1960. Distinguished from *M. leiaspis* by more tail rings (32–34 versus 31–33), fewer pectoral-fin rays (16–19 versus 17–20), and distribution (Madagascar and St Brandon Shoals versus western Pacific: Indonesia to Japan, New Guinea, Solomon Is., New Hebrides, New Caledonia and Fiji).

**GENUS** *Minyichthys* Herald & Randall 1972

Rings 17–21 + 34–42; dorsal fin 21–33 rays; subdorsal rings 2.0–0.5 + 5.0–7.75 = 6.25–10.25; pectoral fins 8–13 rays; anal fin 2 or 3 rays; caudal fin 8 rays. HL 6.9–9.4 in SL; snout length 2.3–3.8 in HL; snout depth 1.1–3 in snout length. Superior trunk and tail ridges discontinuous; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge with 1–3 projections; opercular ridge low, crosses half to all of opercle; pectoral-fin bases without distinct ridges; body ridges distinct, sometimes elevated and flared laterally on rear tail rings. Scutella not keeled. Dorsal-fin base not elevated. Often with tiny dermal flaps. Male brood pouch closure everted, pouch plates and folds present, and pouch under first 13–17 tail rings. Four species, 1 in WIO.

*Minyichthys myersi* (Herald & Randall 1972)

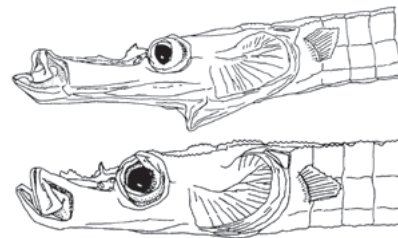
Myer's pipefish

PLATE 94

*Micrognathus (Minyichthys) myersi* Herald & Randall 1972: 137, Figs. 5–6 (Cocos I., Guam, Mariana Is.).

Rings 17–19 + 36–42; dorsal fin 25–33 rays; subdorsal rings 2.75–1.75 + 4.75–7.75 = 7.0–10.25; pectoral fins 12 or 13 rays. HL 7–8.5 in SL; snout length 2.3–3.2 in HL; snout depth 1.7–3 in snout length. Median dorsal snout ridge with 2 projections; opercular ridge crosses more than half of opercle, deflected dorsally; ridges of distal tail rings slightly flared laterally, with hook-like rear angles in larger specimens (>40 mm SL). Male brood pouch under tail rings 1–13.

Body ground-colour pale brown, with narrow dark bars on opercle, ~22 poorly defined dark bars on body, and paler areas between bars stippled; dark stripe runs anteroventrally and posteroventrally from eyes. Attains 58 mm SL.



*Minyichthys myersi*, 43 mm SL, male holotype (top); 41 mm SL, female paratype (bottom) (both Guam). Source: Herald & Randall 1972

**DISTRIBUTION** Indo-Pacific. WIO: Mauritius and St Brandon Shoals; elsewhere, Moluccas (Indonesia), Philippines, Guam, New Guinea and Society Is.

**REMARKS** Marine; found in coral and rubble habitats, to ~31 m deep.

**GENUS** *Nannocampus* Günther 1870

Rings 12–15 + 32–43 (indistinct); dorsal fin 14–24 rays; subdorsal rings 2.0–0 + 3.5–5.5 = 3.0–6.25, and dorsal-fin origin from front margin of penultimate trunk ring to last quarter of 1st tail ring; pectoral fins 5–7 rays or fins absent; no anal fin; caudal fin 10 rays. HL 9.9–15.1 in SL; snout length 2.7–4.1 in HL; snout depth 1–2.3 in snout length. Superior and inferior trunk and tail ridges continuous; lateral trunk ridge ends near anal ring, may be straight or deflected ventrally; median dorsal snout ridge entire, low to distinctly elevated

above upper rim of orbit; opercular longitudinal ridge vestigial or absent; body ridges entire, indistinct. Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch with everted or semi-pouch closure, pouch plates present, and pouch under first 11–13 tail rings. Two subgenera and at least 4 or 5 species; 3 species in WIO (1 of these undescribed).

## KEY TO SPECIES

- 1a No pectoral fins in subadults and adults; subdorsal rings 2.0–1.0; total subdorsal rings 5.0–6.25 ..... 2 [subgenus *Nannocampus*]  
 1b Pectoral fins present; subdorsal rings 1.0–0; total subdorsal rings 4.25–5.75 ..... *N. pictus* [subgenus *Mannarichthys*]
- 2a Dorsal fin 20 rays; subdorsal rings 1.0 + 4.0; tail rings 43; body ground-colour red in life [deep water]. ..... *Nannocampus* sp.  
 2b Dorsal fin 21–24 rays; subdorsal rings 2.0–1.25 + 3.5–4.5; tail rings 40–42; body ground-colour tan to pale brown in life [shallow water] ..... *N. elegans*

*Nannocampus elegans* Smith 1953

Elegant pipefish

PLATE 94

*Nannocampus* sp.: Smith 1951.

*Nannocampus elegans* Smith 1953: 516, Fig. 355a (Xora River mouth, Eastern Cape, South Africa); Smith 1963\*; Dawson 1977, 1979\*, 1985\*; SSF No. 145.25\*; Kuitert 2004\*.

Rings 12–14 + 40–42; dorsal fin 21–24 rays; subdorsal rings 2.0–1.25 + 3.5–4.5 = 5.25–6.25; no pectoral fins in subadults and adults. HL 10.5–15.1 in SL; snout length 3–3.9 in HL; snout depth 1.1–1.8 in snout length. Median dorsal snout ridge

low; lateral trunk ridge deflected slightly on last 2 or 3 trunk rings. Male brood pouch under first 11 or 12 tail rings.

Body ground-colour tan to pale brown, with darker brown markings, often resulting in mottled or streaked appearance; males may have pale blue spots on trunk (~3 or 4 spots per ring); dorsal-fin margin deep red. Attains 114 mm SL.

**DISTRIBUTION** WIO: Mozambique (Inhaca I.) and South Africa (Boteler Point to Great Fish River).

**REMARKS** Marine; found in shallow tidepools and reef habitats.

*Nannocampus pictus* (Duncker 1915)

Painted reef pipefish

PLATE 94

*Ichthyocampus pictus* Duncker 1915: 95 (Gulf of Mannar, Sri Lanka); Smith 1963\*.

*Mannarichthys pictus*: Dawson 1977\*.

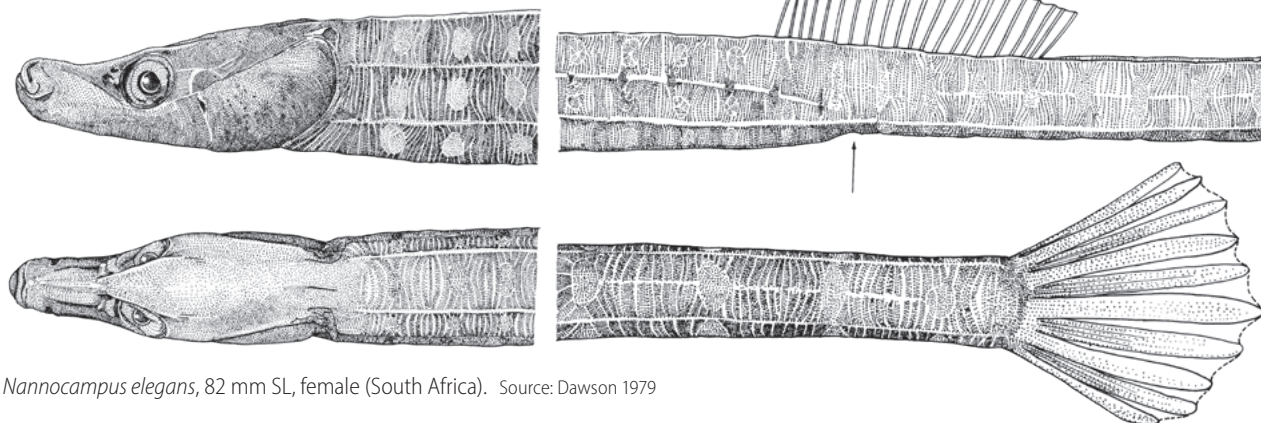
*Nannocampus pictus*: Dawson 1985; SSF No. 145.26\*; Fricke 1999; Fricke *et al.* 2009.

Rings 13 or 14 + 34–41; dorsal fin 18–22 rays; subdorsal rings 1.25–0 + 3.5–5.5 = 4.25–5.75; pectoral fins 5–7 rays. HL 10.2–14.2 in SL; snout length 2.7–3.3 in HL; snout depth 1.4–2 in snout length. Lateral trunk ridge deflected slightly on last 2 or 3 trunk rings. WIO specimens with fewer tail rings than those from India, Sri Lanka, and Australia (34–36 versus 37–41); specimens from Sri Lanka and India usually with fewer dorsal-fin rays than those from East Africa, St Brandon Shoals, Seychelles, Mauritius and Australia (18 or 19 versus 19–22). Male brood pouch under first 11 or 12 tail rings.

Body ground-colour tan to pale brown, with darker brown markings, often resulting in mottled or streaked appearance;



*Nannocampus elegans*, 50 mm SL, holotype (South Africa). Source: Smith 1953

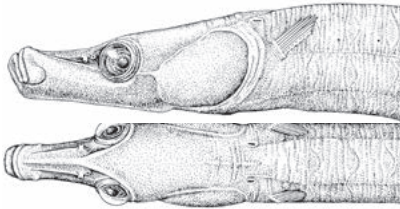


*Nannocampus elegans*, 82 mm SL, female (South Africa). Source: Dawson 1979

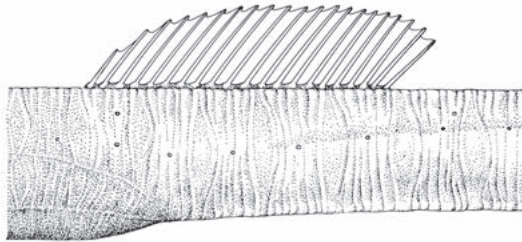


*Nannocampus pictus*, 75 mm TL, female (Mozambique). Source: Smith 1963

lateral trunk ridge and inferior tail ridge may have dark spots on each ring; median trunk ridge often dark; irregular dark line from tip of lower jaw to opercle. Attains 90 mm SL.



*Nannocampus pictus*, 76 mm SL (NE Australia). Source: Dawson 1977



**DISTRIBUTION** Indo-Pacific. WIO: Kenya, Mozambique and South Africa (KwaZulu-Natal), Comoros, Seychelles, Réunion, Mauritius, St Brandon Shoals, India and Sri Lanka; elsewhere to Australia (Queensland).

**REMARKS** Marine; found on algal beds, reefs and among corals, to ~9 m deep.

### *Nannocampus* sp.

Deepwater nanno

PLATE 94

Rings 14 + 43; dorsal fin 20 rays; subdorsal rings 1.0 + 4.0–4.5 = 5.0; no pectoral fins. HL ~10.3 in SL; snout length ~2.8 in HL; snout depth ~2.3 in snout length. Median dorsal snout ridge low; lateral trunk ridge deflected slightly on last trunk ring.

Body ground-colour red, with ~5 white saddles; tip of snout, upper jaw, and underside of head and snout (but not lower jaw) white; incomplete white bars forming series of vertical dashes along inferior trunk ridge between rings; tiny white spots scattered over ventrolateral surface of tail; dorsal fin transparent. Maximum size unknown.

**REMARKS** Known from one specimen (54 mm SL), collected from South Africa (Aliwal Shoal, KwaZulu-Natal), at 30–31 m.

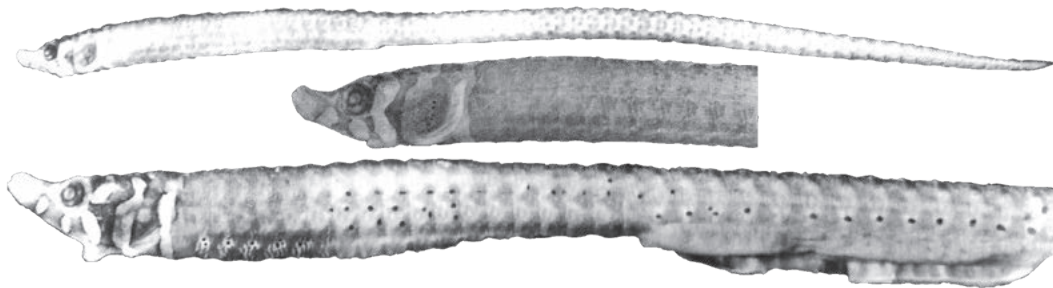
### GENUS *Penetopteryx* Lunel 1881

Rings 17–19 + 30–43; dorsal fin 26–30 rays in larvae and planktonic fish, fins absent in subadults and adults; subdorsal rings 1.5–0 + 9.25–10.0 = 7.75–11.0; pectoral fins 10–12 rays in larvae and planktonic fish, fins absent in subadults and adults; no anal fin; caudal fin 10 rays. HL 8.5–13.1 in SL; snout length 3.2–4.1 in HL; snout depth 1.2–1.6 in snout length. Superior trunk and tail ridges continuous; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low, usually entire; no opercular ridge; body ridges low and indistinct. Trunk V-shaped but not keeled. Scutella large, not keeled. No dermal flaps. Male brood pouch with semi-pouch closure, pouch plates and folds present, and pouch under first 12–17 tail rings. Two species, 1 in WIO.

### *Penetopteryx taeniocephalus* Lunel 1881

Warpaint pipefish

*Penetopteryx taeniocephalus* Lunel 1881: 275, Pl., Figs. 1a–e (Mauritius, Mascarenes); Smith 1963\*; Dawson & Allen 1978\*; Dawson 1980\*; Letourneur *et al.* 2004.



*Penetopteryx taeniocephalus*, 60 mm female with head detail (top); 64 mm SL male (bottom) (both Madagascar). Source: Dawson & Allen 1978

Rings 18 or 19 + 41–43; dorsal fin 27–30 rays in larvae and planktonic fish, and fin origin between tail rings 1–2.5; subdorsal rings 7.75–9.0; pectoral fins 11 rays in planktonic fish. HL 10.6–13.1 in SL; snout length 3.3–4.1 in HL; snout depth 1.2–1.6 in snout length. Male brood pouch under first 12–14 tail rings.

Body ground-colour yellow-green; demersal fish with 4 or 5 pale blotches radiating from eyes, and 2 pale bars across opercle; ~3 blackish spots on middle third of trunk, spots often continuing onto last trunk rings and first tail rings. Females with row of 4–7 small blackish spots between pale bars, but otherwise unmarked. Males with 1–4 dark spots and pale reticulations on ventrolateral part of first third of trunk, and ventral trunk sometimes bright red. Attains 73 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar, Réunion and Mauritius; elsewhere to Indonesia, Philippines, Vanuatu and Kiribati.

**REMARKS** Marine; collected over gravel and rubble, to ~1.5 m deep, and juveniles and larvae planktonic.

## GENUS *Phoxocampus* Dawson 1977

Rings 15–17 + 26–32; dorsal fin 20–24 rays; subdorsal rings 2.5–0.25 + 2.75–5.5 = 4.5–6.5; pectoral fins 11–15 rays; anal fin 3 or 4 rays; caudal fin 10 rays. HL 6.4–9.4 in SL; snout length 2.2–3.1 in HL; snout depth 1.8–2.9 in snout length. Superior and inferior trunk and tail ridges continuous; lateral trunk ridge ending midlaterally between last trunk ring and 20th tail ring; median dorsal snout ridge low, with several low points; opercular ridge angled dorsally, complete or incomplete; pectoral-fin bases with 2 distinct ridges; trunk ridges slightly elevated; tail ridges angled laterally, with rear angles enlarged to hook-like points. Trunk somewhat V-shaped, but not keeled. Scutella not keeled. Dorsal-fin base not elevated. Simple dermal flaps usually present on eyes, head and body. Male brood pouch with semi-pouch closure, pouch plates and folds present, and pouch under first 10–14 tail rings. Four species, 2 in WIO.

## KEY TO SPECIES

- 1a Lateral trunk ridge ends on last trunk ring or 1st tail ring; tail rings 25–28 ..... *P. diacanthus*  
 1b Lateral trunk ridge ends on 1st–5th tail ring (usually on 3rd or 4th ring); tail rings 29–32 ..... *P. belcheri*

## *Phoxocampus belcheri* (Kaup 1856)

Rock pipefish

PLATE 95

*Ichthyocampus belcheri* Kaup 1856: 30, Pl. 5, Fig. 39 (China, NW Pacific); Smith 1963\*.

*Ichthyocampus nox* Snyder 1909: 598 (Naha, Okinawa I., Ryukyu Is., Japan).

*Phoxocampus belcheri*: Dawson 1977\*, 1985\*; SSF No. 145.27\*.

Rings 16 or 17 + 29–32; dorsal fin 20–24 rays; subdorsal rings 2.0–0.25 + 3.5–5.5 = 4.75–6.5; pectoral fins 11–13 rays; anal fin 3 or 4 rays. HL 7.1–9.4 in SL; snout length 2.4–3.1 in HL; snout depth 1.8–2.8 in snout length. Lateral trunk ridge ends on trunk ring 1–5; opercular ridge usually incomplete in subadults and adults. Male brood pouch under first 10–14 tail rings.

Body ground-colour tan to dark brown, or infrequently pale; dorsum with 9–11 diffuse pale bars; sides with dark areas and white spots and flecks, which may form checkerboard pattern. Subadult and adult males with dark and pale bars radiating from eyes, and pale bar on opercle. Females usually with plain head. Attains 73 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (Israel), Kenya to South Africa (Bizana, Eastern Cape), Madagascar, Comoros, Seychelles, Mauritius, Maldives and India; elsewhere, Cocos (Keeling) Is., Andaman Is., Thailand, Malaysia, Indonesia, Philippines, Japan, New Guinea, Solomon Is., New Caledonia, Vanuatu and Fiji.

**REMARKS** Marine; found in tidepools and on rocky and coral reefs, to ~15 m deep.



*Phoxocampus belcheri*, 61 mm SL, brooding male (Kenya). Source: SSF



## *Phoxocampus diacanthus* (Schultz 1943)

Pale-blotched pipefish

PLATE 95

*Ichthyocampus diacanthus* Schultz 1943: 75, Pl. 8 (reef at Alofa'u, Tutuila I., American Samoa).

*Phoxocampus diacanthus*: Dawson 1977, 1985\*.

Rings 15 or 16 + 25–28; dorsal fin 20–24 rays; subdorsal rings 2.5–1.25 + 2.75–4.0 = 4.5–6.0; pectoral fins 13–15 rays; anal fin 4 rays. HL 6.4–7.9 in SL; snout length 2.2–2.6 in HL; snout depth 2.4–2.9 in snout length. Lateral trunk ridge ends on last trunk ring or 1st tail ring; opercular ridge incomplete in subadults and adults. Male brood pouch under first 12–14 tail rings.

Body ground-colour either tan or dark brown, with uneven markings in contrasting shades of brown or tan; body irregularly blotched or mottled or dorsum with 9–11 diffuse bars, last bar circling base of tail; sides with white spots and flecks. Attains 87 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Mauritius and Sri Lanka; elsewhere to Indonesia, Philippines, China, Palau, Mariana Is., Marshall Is., Australia, New Caledonia, Fiji and Samoa.

**REMARKS** Marine; found in rocky and coral habitats, usually at 4–25 m, but reported to ~40 m deep.

## GENUS *Siokunichthys* Herald 1953

Rings 8–14 + 43–60; dorsal fin 13–33 rays; subdorsal rings 0 + 3.25–9.0, and dorsal-fin origin on tail ring 1–7; pectoral fins 8–13 rays; no anal fin; caudal fin 10 rays. HL 11.4–17.6 in SL; snout length 1.9–5 in HL; snout depth 1–4.6 in snout length. Superior trunk and tail ridges continuous; superior tail ridge may be arched under dorsal fin; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge low, entire; opercular ridge present or absent; pectoral-fin bases without ridges; body ridges low, indistinct. Scutella inconspicuous, not keeled. Dorsal-fin base at most slightly elevated. No dermal flaps. Male brood pouch with semi-pouch closure, no pouch plates but pouch folds present, and pouch under first 8–19 tail rings. Six species, 4 in WIO.

## KEY TO SPECIES

- 1a Trunk rings 10–14; dorsal fin 24–33 rays; subdorsal rings 6.25–9.0; dorsal-fin origin on tail ring 2.5–5, and fin base not elevated; superior tail ridge not arched under dorsal fin ..... 2
- 1b Trunk rings 8; dorsal fin 13 or 14 rays; subdorsal rings 3.25–4.5; dorsal-fin origin on tail ring 7, and fin base slightly elevated; superior tail ridge slightly arched under dorsal fin ..... *S. southwelli*
- 2a Tail rings 50–53; trunk rings 10–12; snout short, its length 3.7–5 (mean 4.2) in HL, its depth 1–1.3 (mean 1.2) in snout length ..... *S. bentuviai*
- 2b Tail rings 52–60; trunk rings 12–14; snout long, its length 2.2–4 (mean <3) in HL, its depth 1.2–4.6 (mean >2.2) in snout length ..... 3
- 3a Tail rings 52 or 53 in WIO specimens; snout long and slender, its length 2.2–2.6 (mean 2.4) in HL, its depth 2.7–4.6 (mean 3.5) in snout length ..... *S. herrei*
- 3b Tail rings 56–60; snout moderately long and deep, its length 2.3–4 (mean 3) in HL, its depth 1.2–3.4 (mean 2.2) in snout length ..... *S. breviceps*

## *Siokunichthys bentuviai* Clark 1966

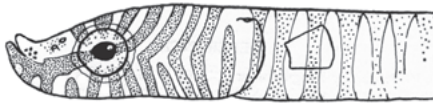
Bentuvia's pipefish

PLATE 95

*Siokunichthys bentuviai* Clark 1966: 4, Figs. 1–2 (Nocra, Dahlak Archipelago, Eritrea, Red Sea); Ben-Tuvia 1976 [as *bentuviae*]; Dawson 1983\*, 1985\*.

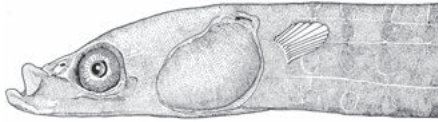
Rings 10–12 + 50–53; dorsal fin 24–28 rays; subdorsal rings 6.25–7.75, and dorsal-fin origin on tail ring 2.75–5; pectoral fins 11–13 rays. HL 14.9–16.7 in SL; snout length 3.7–5 in HL, and slightly longer than eye diameter; snout depth 1–1.3 in snout length. Dorsal margin of upper jaw not reaching horizontal through upper rim of orbit. Superior tail ridge not arched under dorsal fin; no opercular longitudinal ridge. Dorsal-fin base not elevated. Male brood pouch under first 10–19 tail rings.

Head with 6–8 orange to green bars and trunk rings 3–8 with pale pink to olive bars; ventral part of head with opaque white bars extending onto ventrolateral sides of snout, head and opercle; yellow to orange or pink horizontal stripe through eyes; iris green. Attains 60 mm SL.



*Siokunichthys bentuviai*, 56 mm SL, to show live colour pattern (Red Sea).

Source: Clark 1966



*Siokunichthys bentuviai*, 58 mm SL, brooding male, paratype (Red Sea).

Source: Dawson 1983

**DISTRIBUTION** WIO: northern Red Sea to Gulf of Aden.

**REMARKS** Marine; found over sand and coral, and among branches of soft coral *Zenia* sp., to ~9 m deep.

### *Siokunichthys breviceps* Smith 1963

Softcoral pipefish

PLATE 95

*Siokunichthys breviceps* Smith 1963: 525, Pl. 80, Figs. J–M (Pinda, Mozambique); Dawson 1983\*, 1985\*.

Rings 12–14 + 56–60; dorsal fin 27–33 rays; subdorsal rings 7.0–9.0, and dorsal-fin origin on tail ring 2.5–4.5; pectoral fins 11–13 rays. HL 12.4–17.6 in SL; snout length 2.3–4 in HL, and clearly longer than eye diameter; snout depth 1.2–3.4 in snout length. Dorsal margin of upper jaw not reaching horizontal through upper rim of orbit. Superior tail ridge not arched under dorsal fin; no opercular ridge. Dorsal-fin base not elevated. Male brood pouch under first 8–17 tail rings.

Head and trunk with orange to brown solid bars which have translucent centres posteriorly, alternating with slightly wider translucent bars which may have short orange to brown bars within them; lower jaw with 4 darker spots in a horizontal row; lacks stripe through eyes. Attains 80 mm SL.



*Siokunichthys breviceps*, 70 mm SL, female or immature male, paratype (Mozambique). Source: Dawson 1983

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique; elsewhere, Indonesia to Philippines, Great Barrier Reef and New Caledonia.

**REMARKS** Marine; found on corals or coral rubble, to ~22 m deep.

### *Siokunichthys herrei* Herald 1953

Herre's pipefish

PLATE 95

*Siokunichthys elongatus* Herre (ex Herald) 1953: 212 [not available; name only].

*Siokunichthys herrei* Herre 1953: 212 [name only]; Herald in Schultz *et al.* 1953: 254, Fig. 38 (north end of Siokun Bay, Mindanao, Philippines); Dawson 1983\*, 1985\*; Goren & Dor 1994.

Rings 12–14 + 52–58; dorsal fin 27–31 rays; subdorsal rings 6.75–8.5, and dorsal-fin origin on tail ring 2.75–4; pectoral fins 10–13 rays. HL 12.1–14.2 in SL; snout length 2.2–2.6 in HL, and snout 2–3 times greater than eye diameter; snout depth 2.7–4.6 in snout length. Dorsal margin of upper jaw usually not reaching horizontal through upper rim of orbit. Superior tail ridge not arched under dorsal fin; no opercular ridge. Dorsal-fin base not elevated. Male brood pouch under at least first 8 tail rings.

Top and sides of head and side of snout with olive to brown spots, outlined in white, with scattered tiny white spots elsewhere; body white below and otherwise covered with tiny, very light olive to brown spots. Attains 76 mm SL.



*Siokunichthys herrei*, 70 mm SL, female or immature male (Fiji).

Source: Dawson 1983

**DISTRIBUTION** Indo-Pacific. WIO: northern Red Sea (Israel); elsewhere, Indonesia to Philippines, New Guinea, Solomon Is., New Caledonia and Fiji.

**REMARKS** Marine, to ~37 m deep; observed among *Xenia* soft corals, to ~10 m deep. Red Sea specimens have fewer tail rings than fish from the Pacific (52 or 53 vs. 55–58) and may represent an undescribed species.

### *Siokunichthys southwelli* (Duncker 1910)

Southwell's pipefish

*Urocampus southwelli* Duncker 1910: 30, Figs. B–C (Marichchukkaddi Bay, Sri Lanka).

*Siokunichthys southwelli*: Dawson 1983\*, 1985.

Rings 8 + 49 or 50; dorsal fin 13 or 14 rays; subdorsal rings 3.25–4.5, and dorsal-fin origin on tail ring 7; pectoral fins 8–10 rays. HL ~11.4 in SL; snout length ~1.9 in HL, and 2–3 times greater than eye diameter; snout depth ~3–4 in snout length. Dorsal margin of upper jaw not reaching horizontal through upper rim of orbit. Superior tail ridge slightly arched under

dorsal fin; opercular ridge low, crosses third of opercle. Dorsal-fin base slightly elevated. Male brood pouch under at least first 8 tail rings.

Body uniformly yellowish brown. Attains at least 43 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka; elsewhere, Philippines (Mindoro I.).

**REMARKS** Known only from four specimens (2 from Sri Lanka and 2 from Philippines), collected to ~4 m deep.

## GENUS *Syngnathoides* Bleeker 1851

Rings 15–18 + ~40–54; dorsal fin 38–49 rays; subdorsal rings 2.0–0.25 + 7.5–10.5 = 8.5–11.75; pectoral fins 20–24 rays; anal fin 4 rays; no caudal fin. HL 4.9–6.3 in TL; snout length ~1.7–1.8 in HL; snout depth 5.3–7.8 in snout length. Inconspicuous odontoid processes present on dentary. Superior and inferior trunk and tail ridges continuous; inferior trunk ridge inconspicuous and located on venter of trunk; lateral trunk ridge ends just below superior tail ridge near end of dorsal-fin base; median dorsal snout ridge low, entire; no opercular ridge; pectoral-fin bases protuberant, with 2 ridges; body ridges low, entire to finely denticulate. Trunk dorsoventrally compressed. Dorsal-fin base not elevated. Tail slender, prehensile. No scutella. Dermal flaps well-developed in juveniles, but often absent in adults. Brood area on males an open compartment, without pouch plates or folds, and eggs deposited under modified trunk rings 3–16. One species.

## *Syngnathoides biaculeatus* (Bloch 1785)

Alligator pipehorse, double-ended pipehorse PLATE 96

*Syngnathus tetragonus* Thunberg 1776: 301, Pl. 4, Figs. 1–2 (Java, Indonesia).

*Syngnathus biaculeatus* Bloch 1785: 10, Pl. 121, Figs. 1–2 (Indian Ocean).

*Syngnathoides blochii* Bleeker 1851: 259 (Banda Neira [Banda Is., Indonesia]).

*Gasterotokeus biaculeatus*: Playfair 1867.

*Stigmatophora unicolor* Castelnau 1875: 49 (Port Walcott, Western Australia).

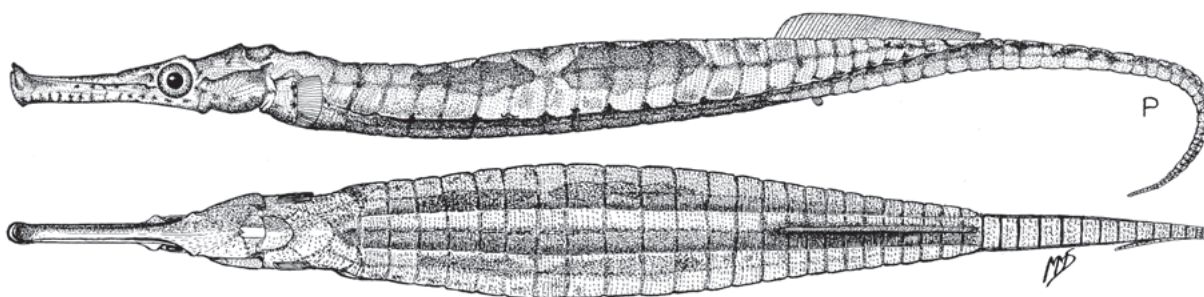
*Syngnathoides biaculeatus*: Smith 1963\*; Dawson 1985; SSF No. 145.28\*; Goren & Dor 1994; Fricke 1999; Manilo & Bogorodsky 2003.

Diagnosis as for genus.

Body ground-colour variable, from grey to green to brown, and mottled; often with narrow broken black line, with white above, from snout, through eyes, and along sides above inferior ridge. Females may have 2 rows of dark spots or blotches on ventral side of some trunk rings. Attains 28 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Red Sea, Gulf of Aden, Kenya to South Africa (False Bay, Western Cape), Madagascar, Comoros, Seychelles, Mauritius, India and Sri Lanka; elsewhere, Indonesia, Philippines, southern Japan, Palau, Pohnpei (Micronesia), Marshall Is., New Guinea, Australia, New Caledonia, Tonga and Samoa.

**REMARKS** Marine; generally found hidden among vegetation in coastal shallows.



*Syngnathoides biaculeatus*, 15 cm TL (S Mozambique). Source: SSF



*Syngnathoides biaculeatus*, 18 cm SL, presumptive female (Indonesia). Source: SSF

GENUS *Syngnathus* Linnaeus 1758

Rings 13–24 + 28–58; dorsal fin 21–50 rays; subdorsal rings 6.5–0 + 3.25–11.0 = 4.75–14.0; pectoral fins 6–17 rays; anal fin 2–4 rays; caudal fin 9 or 10 rays. HL 5.3–11.2 in SL; snout length 1.5–3.1 in HL; snout depth 2.3–13.2 in snout length. Superior trunk and tail ridges discontinuous; lateral trunk ridge ends near anal ring or is confluent with superior tail ridge; inferior trunk and tail ridges continuous; median dorsal snout ridge low and essentially entire; opercular ridge often prominent and complete in early juveniles, may be incomplete or absent in subadults and adults; pectoral-fin bases usually with 1 or 2 longitudinal ridges; body ridges slightly elevated, usually indented rather than notched between rings, margins usually entire to finely denticulate in adults, but often spiny in early juveniles. Scutella not keeled. Dorsal-fin base not strongly elevated in subadults and adults. Small dermal flaps present only in some *S. auliscus* individuals. Male brood pouch with inverted closure, pouch plates present, and pouch under first 8–25 tail rings. This genus appears to be polyphyletic. At least 40 species currently recognised, 5 in WIO.

## KEY TO SPECIES

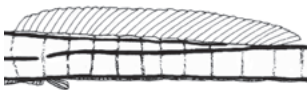
- 1a Pectoral fins 6–8 rays; head and snout short, HL 9.6–10.7 in SL, snout length 2.8–3.1 in HL; pectoral-fin base largely below lateral trunk ridge ..... *S. watermeyerii*



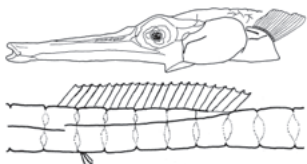
- 1b Pectoral fins 10–16 rays; head and snout long, HL 6.7–9.4 in SL, snout length 1.5–2.8 in HL; pectoral-fin base almost centred at lateral trunk ridge ..... 2

- 2a Trunk rings 18–22; superior trunk ridge continues onto tail rings 7–9 ..... *S. temminckii*

- 2b Trunk rings 13–18; superior trunk ridge continues onto tail rings 1–7 ..... 3



- 3a Snout relatively long and narrow, snout depth 8.3–9.1 in snout length; superior tail ridge begins on last trunk ring ..... *S. safina*

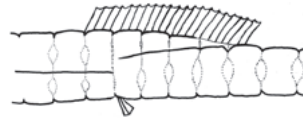


Continued...

## KEY TO SPECIES

- 3b Snout shorter and broader, snout depth 2.9–7.6 in snout length; superior tail ridge begins on 1st or subsequent tail rings ..... 4

- 4a Dorsal fin extends onto 4 or 5 tail rings (subdorsal rings 2.0–0 + 4.0–5.0); pectoral fins 14–16 rays; HL ~6.7 in SL; superior trunk ridge continues onto first few tail rings ..... *S. macrophthalmus*



- 4b Dorsal fin extends onto >5 tail rings (subdorsal rings 1.75–0 + 5.75–7.75); pectoral fins 10–14 rays; HL 7–9.3 in SL; superior trunk ridge continues onto tail rings 5–7 ..... *S. abaster*

*Syngnathus abaster* Risso 1827

Black-striped pipefish

PLATE 96

*Syngnathus abaster* Risso 1827: 182 [probably Nice, France, Mediterranean Sea]; Dawson in Daget *et al.* 1986; Coad 1998.

*Syngnathus algeriensis* Günther (ex Playfair) 1870: 164 (confluence of Wed Cherif and Wed Bou-Hamdan rivers, Algeria); Smith 1963\*; Smith & Smith 1963; Dawson in Whitehead *et al.* 1986.

Rings 13–18 + 32–41; dorsal fin 23–40 rays; subdorsal rings 1.75–0 + 5.75–7.75 = 5.75–9.25, and dorsal-fin origin between penultimate trunk ring and 1st tail ring; pectoral fins 10–14 rays; anal fin 3 or 4 rays; caudal fin 9 or 10 rays. HL ~7–9.3 in SL; snout length 1.9–2.8 in HL; snout depth 2.9–6.3 in snout length. Superior trunk ridge continues onto tail rings 5–7; lateral trunk ridge confluent with superior tail ridge; inferior trunk and tail ridges continuous; median dorsal snout ridge low; opercular ridge short; body ridges prominent and smooth. Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch under first 15–19 tail rings.

Body ground-colour green to dark brown, often counter-shaded with white to yellow venter, yellow to brown sides below the lateral trunk ridge, and dark green to dark brown above lateral trunk ridge; commonly with contrasting dark spots or bars on sides, and small pale spots scattered across body and concentrated on body ridges (especially in dark individuals); head dark dorsally, underside white; dorsal-fin base often with dark spots or a stripe. Attains 210 mm TL in Black Sea, ~155 mm TL elsewhere.

**DISTRIBUTION** Eastern Atlantic (Bay of Biscay to Portugal) and throughout Mediterranean Sea, Black Sea and Sea of Azov; has possibly migrated through Suez Canal into Red Sea in WIO.



**REMARKS** Freshwater, brackish and marine; found in streams and rivers, and most commonly in estuaries and marine environments, to ~5 m deep. Often associated with detritus or vegetation in sand or mud habitats.

## *Syngnathus macrophthalmus* Duncker 1915

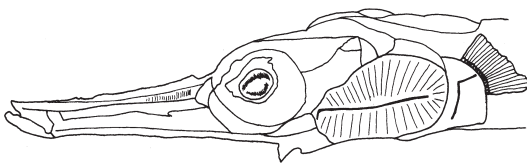
Hurghada pipefish

PLATE 96

*Syngnathus macrophthalmus* Duncker 1915: 85 (Gulf of Suez, Red Sea); Smith 1963\*; Dawson 1985\*; Paulus 1992\*; Goren & Dor 1994.

Rings 13 or 14 + 34–36; dorsal fin 22–25 rays; subdorsal rings 2.0–0 + 4.0–5.0 = 4.75–6.0, and dorsal-fin origin between front margin of penultimate trunk ring and rear margin of 2nd tail ring; pectoral fins 14–16 rays; anal fin 3 or 4 rays; caudal fin 10 rays. HL ~6.6–6.7 in SL; snout length 1.9–2.1 in HL; snout depth 6.6–7.6 in snout length. Superior trunk ridge continues onto tail ring 3; lateral trunk ridge ends on last trunk ring or 1st tail ring, not confluent with superior tail ridge; superior tail ridge begins on 1st tail ring; inferior trunk and tail ridges confluent; median dorsal snout ridge ends near front margin of orbit; opercular ridge complete, prominent, and straight in juveniles; pectoral-fin bases with 1 indistinct ridge, and fin base almost centred on lateral trunk ridge; body ridges prominent and entire (finely serrated in juveniles), superior ridges somewhat elevated. Tail trapezoidal in cross-section, with wider ventral side (not hourglass-shaped in cross-section). Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch under first 16 or 17 tail rings.

Body ground-colour tan to brown, with broad diffuse darker bars on back and sides of trunk and anterior tail; underside of trunk yellowish white; scutella with pale spotting; dorsal fin transparent; caudal fin with pale margins and dark centrally. Attains ~122 mm TL.



*Syngnathus macrophthalmus*, 6 cm SL, holotype (Red Sea).  
Source: Paulus 1992

**DISTRIBUTION** WIO: endemic to Red Sea (Gulf of Suez; Hurghada, Egypt; Aqaba, Jordan).

**REMARKS** Marine; reported from ~15 m deep on outer reef slope, and from a 60-m trawl.

## *Syngnathus safina* Paulus 1992

Wreck pipefish

PLATE 96

*Syngnathus safina* Paulus 1992: 28, Figs. 1–2, 5, 7–8 (Gulf of Aqaba, Red Sea); Kuiter 2004\*.

Rings 15 + 33 or 34; dorsal fin 22 or 23 rays; subdorsal rings 0.75–0.33 + 5.0–5.33; pectoral fins 15 or 16 rays; anal fin 3 or 4 rays; caudal fin 10 rays. HL 6.8–7.5 in SL; snout ~1.8 in HL; snout depth 8.3–9.1 in snout length. Superior trunk ridge continues onto 5th tail ring; lateral trunk ridge ends on last trunk ring, not confluent with superior tail ridge; superior tail ridge begins on last trunk ring; inferior trunk and tail ridges confluent; median dorsal snout ridge ends near front margin of orbit; opercular ridge angled dorsally, crossing  $\frac{1}{3}$ – $\frac{1}{2}$  of opercle; pectoral-fin bases with 2 prominent ridges, and fin base almost centred on lateral trunk ridge; body ridges prominent, somewhat elevated and entire, without spines. Dorsal-fin base not elevated. Tail hourglass-shaped in cross-section (laterally concave and flat dorsally and ventrally). Scutella not keeled.

Body ground-colour sandy brown to red or pink; dorsum and sides weakly banded with incomplete diffuse dark bars (~3–5 rings wide) and ~12–14 reticulate paler bars (~0.5–1.5 rings wide), and dorsum also with tiny pale blue spots; lateral and inferior trunk ridges and inferior tail ridge outlined with white dashes; fins transparent. Attains at least 77 mm SL.



*Syngnathus safina*, 7 cm SL, holotype (Red Sea). Source: Paulus 1992

**DISTRIBUTION** WIO: endemic to northern Red Sea.

**REMARKS** Marine; known only from two specimens, hand-caught on low reef with rubble and sandy bottom, at 23–33 m.



*Syngnathus temminckii*, 19 cm SL (South Africa).

Source: Whitfield 1998

## *Syngnathus temminckii* Kaup 1856

African longnose pipefish

PLATE 97

*Syngnathus temminckii* Kaup 1856: 36 (Cape of Good Hope, South Africa); Heemstra & Heemstra 2004\*; Kuitert 2004\*.

*Syngnathus brachyrhynchus* Kaup 1856: 42 (Réunion, Mascarenes).

*Syngnathus alternans* Günther 1870: 162 (Seychelles).

*Syngnathus coquerelii* Duméril 1870: 575 (Madagascar); Sauvage 1891.

*Syngnathus acus* (non Linnaeus 1758): Barnard 1925; Smith 1963\*;

Smith & Smith 1966\*; Dawson 1985\* [in part]; SSF No. 145.29\*.

*Syngnathus pelagicus* (non Linnaeus 1758): Smith 1963\*.

Rings 18–22 + 37–47; dorsal fin 31–45 rays; subdorsal rings 2.0–0.25 + 6.75–10.0 = 7.75–10.75; pectoral fins 11–14 rays; anal fin 4 rays; caudal fin 10 rays. HL 7.2–9.4 in SL; snout length 1.5–2 in HL; snout depth 6.2–8.7 in snout length. Superior trunk ridge continues onto tail rings 7–9; inferior trunk ridge confluent with inferior tail ridge; lateral trunk ridge usually ends near anal ring, but may join superior tail ridge; median dorsal snout ridge low and entire; opercular ridge short; pectoral-fin bases without distinct longitudinal ridges, and fin base almost centred on lateral trunk ridge; body ridges prominent and smooth, with slight indentations between rings. Scutella not keeled. Dorsal-fin base not elevated. No dermal flaps. Male brood pouch under first 20–25 tail rings.

Body ground-colour pale green to dark brown (depending on habitat); superior and lateral ridges often outlined as white dashes; inferior ridges often with white spots between adjacent rings; many individuals with smaller pale spots and dashes along back and sides, and sometimes with broad variegated dorsolateral saddles. Attains 32 cm SL.

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (Thukela Bank, KwaZulu-Natal) in WIO.

**REMARKS** Brackish and marine; common in South African estuaries, often associated with eelgrasses (*Zostera* sp.), and also reported from offshore trawl samples, to at least 110 m deep. Variation within *S. temminckii* is larger than expected and may represent a species-complex in the WIO. Reported from Réunion by Kaup (1856) and from the Seychelles by Günther (1870), but these records have not been substantiated subsequently. Specimens collected in 1889 from Zanzibar may also be this species. Reports of *Syngnathus pelagicus* (a long-snouted Atlantic species) from Mauritius, Madagascar and South Africa are likely *S. temminckii* (*sensu lato*).

## *Syngnathus watermeyer* Smith 1963

Watermeyer's pipefish

PLATE 97

*Syngnathus watermeyer* Smith 1963: 538, Pl. 82, Figs. G–H (Bushmans River, Eastern Cape, South Africa); Dawson 1985\*; SSF No. 145.30\*; Heemstra & Heemstra 2004; Kuitert 2004\*.

Rings 16–18 + 37–40; dorsal fin 28–33 rays; subdorsal rings 1.0–0 + 6.0–7.25 = 6.75–7.75, and dorsal-fin origin on front margin of last trunk ring to middle of 1st tail ring; pectoral fins 6–8 rays; anal fin 3 or 4 rays; caudal fin 9 rays. HL 9.6–10.7 in SL; snout length 2.8–3.1 in HL; snout depth 2.3–3.1 in snout length. Superior trunk ridge continues onto 4th–6th tail ring; lateral trunk ridge almost meets superior tail ridge (ridges usually discontinuous); inferior trunk and tail ridges confluent; median dorsal snout ridge low, smooth; opercular



*Syngnathus watermeyer*, 12 cm SL (South Africa). Source: Whitfield 1998

ridge short; pectoral-fin bases without distinct longitudinal ridges, but fin base largely below lateral trunk ridge; body ridges smoothly rounded, not prominent. Dorsal-fin base not elevated. Scutella not keeled. No dermal flaps. Male brood pouch under tail rings 1–21; pouch folds barely inverted.

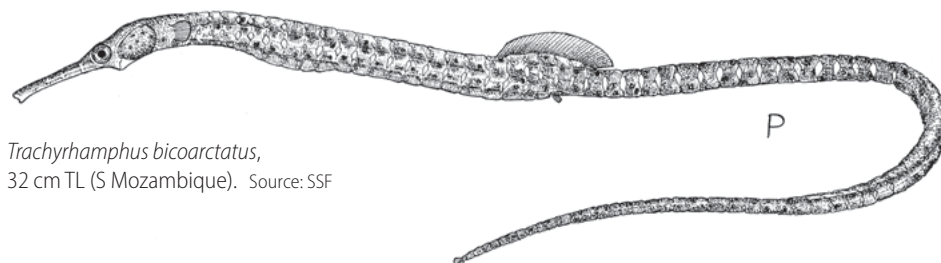
Body ground-colour greenish brown, gradually lightening laterally and ventrally to creamy yellow; close-set dark lines on head, and close-set pale lines on body; trunk and tail ridges outlined in white dashes; opercle brown above, golden below. Attains ~125 mm SL.

**DISTRIBUTION** WIO: endemic to South Africa on Eastern Cape coast (apparently restricted to Bushmans, Kariega, Kasouga and East Kleinemonde river estuaries, and transplanted to West Kleinemonde river estuary).

**REMARKS** Known only from areas of tidal influence and reliant on freshwater pulses, typically in association with eelgrasses *Zostera capensis* and *Ruppia cirrhosa* (Whitfield 1995). IUCN Red List conservation status Critically Endangered.

## GENUS *Trachyrhamphus* Kaup 1853

Rings 21–24 + 41–63, 1st trunk ring clearly longer than 2nd; dorsal fin 24–32 rays; subdorsal rings 4.0–2.0 + 1.75–3.5 = 4.75–6.5; pectoral fins 14–19 rays; anal fin 4 rays; caudal fin 8 or 9 rays, and fin rounded, truncate, or obliquely angular in subadults and adults. HL 9.7–16 in SL; snout length 1.5–2.8 in HL; snout depth 2.9–11.1 in snout length. Superior trunk and tail ridges discontinuous, trunk ridge arched dorsally on subdorsal rings; inferior trunk ridge ends at anal ring; lateral trunk ridge confluent with inferior tail ridge; median dorsal snout ridge slightly elevated above nostrils, and entirely to irregularly denticulate; opercular ridge low, complete or incomplete; pectoral-fin bases without distinct ridges; body ridges low, essentially entire. Scutella not keeled. Dorsal-fin base slightly elevated. Dermal flaps present or absent in adults, and those on dorsum of body exceptionally elongate in planktonic young. Male brood pouch with everted closure, pouch plates barely enlarged, and pouch under first 15–25 tail rings. Three species, all in WIO.



*Trachyrhamphus bicoarctatus*,  
32 cm TL (S Mozambique). Source: SSF

## KEY TO SPECIES

- 1a Tail rings 41–53; median dorsal snout ridge with tiny or prominent irregular denticulations; snout length 1.9–2.8 (mean 2) in HL; snout depth 2.9–7 (mean <6) in snout length ..... 2
- 1b Tail rings 53–65; median dorsal snout ridge entire or with low rear emarginations, but not denticulate or serrate; snout length 1.5–2 (mean 1.7) in HL; snout depth 5.2–11.1 (mean 7.5) in snout length ..... *T. bicoarctatus*
- 2a Snout length 2.2–2.8 (mean 2.5) in HL; snout depth 2.9–4.7 (mean 3.9) in snout length; median dorsal snout ridge with prominent irregular denticulations; pectoral fins 14–18 (usually 15–17) rays ..... *T. serratus*
- 2b Snout length 1.9–2.1 (mean 2) in HL; snout depth 4.8–7 (mean 5.9) in snout length; median dorsal snout ridge with tiny denticulations; pectoral fins 16–19 (usually 17 or 18) rays ..... *T. longirostris*

## *Trachyrhamphus bicoarctatus* (Bleeker 1857)

Double-ended or bent-stick pipefish

PLATES 97 & 98

*Syngnathus bicoarctatus* Bleeker 1857: 99 (Ambon I., Moluccas, Indonesia).

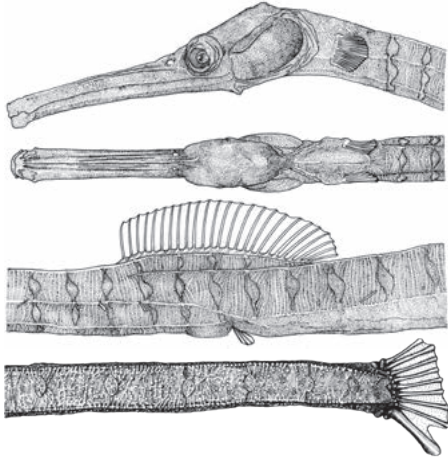
*Syngnathus zanzibarensis* Günther in Playfair & Günther 1867: 140, Pl. 20, Fig. 5 (Zanzibar, Tanzania).

*Yozia bicoarctata erythraeensis* Dollfus & Petit 1938: 500 (Gulf of Suez, Red Sea); Smith 1963\*; Dawson *et al.* 1979\*.

*Trachyrhamphus bicoarctatus*: Dawson 1984\*; SSF No. 145.31\*; Kuitert 2004\*.

Rings 21–24 + 53–65; dorsal fin 24–32 rays; subdorsal rings 4.0–2.0 + 1.75–3.5 = 4.75–6.5; pectoral fins 15–19 rays; caudal fin 8 or 9 rays. HL 9.9–13 in SL; snout length 1.5–2 in HL; snout depth 5.2–11.1 in snout length. Snout straight in small fish (<15 cm SL), arcuate in subadults and adults; median dorsal snout ridge entire, without denticulations or else with low emarginations posteriorly. Caudal fin truncate or obliquely angular in subadults and adults, lowermost ray thickest and longest. Small fish sometimes with tiny dermal flaps around eyes; planktonic juveniles (<10.5 cm SL) with 6 pairs of elongate dermal appendages on dorsum: 1 pair on 3rd or 4th trunk ring, and 5 pairs on last third of tail. Male brood pouch under first 13–22 tail rings.

Body ground-colour variable, from nearly white to almost black; tip of snout often pale in dark fish; body plain, spotted or mottled, and some specimens with 12 or 13 pale saddles (~1–3 rings wide) crossing dorsum and sides of tail. Attains ~39 cm SL.



*Trachyrhamphus bicoarctatus*, 30 cm SL, male (New Caledonia), and typical *T. bicoarctatus* tail. Source: Dawson 1984

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Gulf of Oman, Red Sea, Kenya to South Africa (KwaZulu-Natal), Madagascar, Comoros, Seychelles, Mauritius, St Brandon Shoals, Maldives and Sri Lanka; elsewhere to east coast of India, Nicobar Is., Indonesia, Philippines, Japan, Mariana Is., New Guinea, Australia and New Caledonia.

**REMARKS** Marine; collected over sand, rubble, reef and seagrass bottoms, at ~1–42 m.

### *Trachyrhamphus longirostris* Kaup 1856

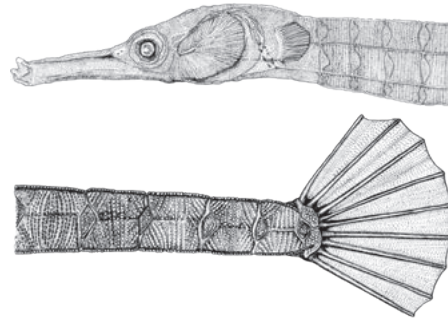
Long-snouted pipefish

PLATE 98

*Trachyrhamphus longirostris* Kaup 1856: 24, 74 (China, NW Pacific).  
*Syngnathus ceylonensis* Günther 1870: 168 (Sri Lanka; Zanzibar, Tanzania).  
*Yozia intermedia*: Smith 1963\*.

Rings 21–24 + 42–53; dorsal fin 26–30 rays; subdorsal rings 3.75–2.25 + 1.75–3.25 = 4.75–6.0; pectoral fins 16–19 rays; caudal fin 9 rays. HL 9.7–13.1 in SL; snout length 1.9–2.1 in HL; snout depth 4.8–7 in snout length. Median dorsal snout ridge entire, and snout essentially straight in small specimens; ridge usually with tiny denticulations, and snout somewhat arcuate in most adults. Caudal fin rounded in most subadults and adults, but sometimes more or less stubby in very large fish. Juveniles (7.5–8.5 cm SL) with 2 pairs of elongate dermal appendages on dorsum of 36th or 37th and 45th tail rings, and broadly flattened dermal flap above each eye. Male brood pouch under first 15–24 tail rings.

Body tan to brown, usually without distinct markings; sometimes with 12 or 13 diffuse dark bars (~1–2 rings wide) crossing dorsum and sides of body. Attains ~31 cm SL.



*Trachyrhamphus longirostris*, 24 cm SL, female or immature male head (Philippines), and typical *T. longirostris* tail. Source: Dawson 1984

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (Eritrea), Tanzania (Zanzibar), Madagascar, India and Sri Lanka; elsewhere to Indonesia, Malaysia, Philippines, China, Japan, New Guinea and Australia.

**REMARKS** Marine; taken in dredge and trawl collections, at ~16–92 m.

### *Trachyrhamphus serratus*

(Temminck & Schlegel 1850)

Crested pipefish

*Syngnathus serratus* Temminck & Schlegel 1850: 272, Pl. 120, Fig. 4 (Japan); Dawson 1984\*, 1985\*.

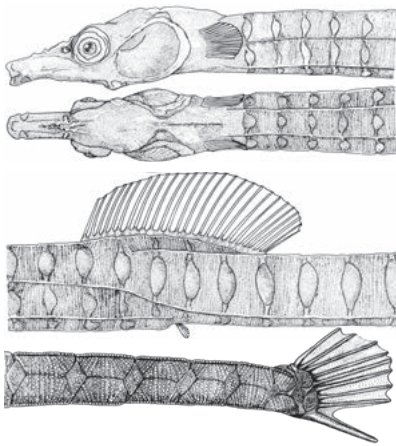
*Typhlus rostro cristatoserrato* Kaup 1856: 23 [name not available; mentioned in synonymy].

*Trachyrhamphus serratus*: Dawson 1985; Manilo & Bogorodsky 2003.

Rings 21–23 + 41–49; dorsal fin 24–29 rays; subdorsal rings 3.5–2.0 + 1.75–3.5 = 4.75–6.0; pectoral fins 14–18 rays; caudal fin 8 or 9 rays. HL 11.6–16 in SL; snout length 2.2–2.8 in HL; snout depth 2.9–4.7 in snout length. Snout somewhat arcuate in lateral profile; median dorsal snout ridge barely elevated on posterior half of snout, ridge typically margined with prominent irregular denticulations. Caudal fin truncate or obliquely angular in subadults and adults, lowermost ray thickest and longest. Planktonic juveniles usually with ≥2 pairs of elongate dermal appendages on dorsum of last third of tail. Male brood pouch under first 16–25 tail rings.

Body mainly brown, plain or mottled, usually with 12 or 13 dark bars (2–3 rings wide) separated by pale interspaces (3 or 4 rings wide) crossing dorsum and sides; inferior ridges often with white spots, especially on trunk; snout sometimes pale near tip. Attains at least 31 cm SL.





*Trachyrhamphus serratus*, 22 cm SL, female or immature male (W India) and typical *T. serratus* tail. Source: Dawson 1984

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan (Karachi), India and Sri Lanka; one record from Mauritius (Kähsbauer 1950) is questionable; elsewhere, east coast of India, Myanmar, Singapore, Taiwan, China, Korea and Japan.

**REMARKS** Marine; taken in trawls at ~14–92 m.

#### GLOSSARY

**demersal** – living on or just above the bottom of the sea or lake.  
***Galaxea clavus*** – a species of coral.  
***Galaxea fascicularis*** – a species of coral.  
**naris (pl. nares)** – nostril.  
**nuchal region** – pertaining to the nape.  
**odontoid process** – a small, bony process on the dorsum of the second vertebra; also a small, tooth-like bony process on the dentary (part of the upper jaw).  
**prehensile** – able to grasp, and used as an anchor around a variety of objects in the wild and coiled ventrally in preservative.  
**sclera of eye** – the outer, protective layer of the eye; outside of the pupil and the iris.  
**scutella** – the shield-shaped, bony elements between trunk and body rings; the rectangular, fused body scales of Syngnathidae.

## FAMILY AULOSTOMIDAE

### Trumpetfishes

Phillip C Heemstra

Moderate-sized with very elongate, somewhat compressed body, head compressed; snout produced into elongate tube; body covered with small ctenoid scales. First dorsal fin with

8–13 short, isolated spines; 2nd dorsal fin with soft rays, set opposite anal fin; pelvic fins reach anus, with no spines and 6 branched rays; caudal fin rounded, with 5 + 5 branched rays (no filament). No teeth in upper jaw; minute teeth at front of lower jaw; elongate band of teeth on vomer. Barbel at symphysis of lower jaw. Branchiostegal membranes separate, free from isthmus, with 4 or 5 rays; gill arches 4, with slit behind last gill arch, and no gill rakers. Vertebrae 59–64, the first 4 fused and greatly elongated.

A common reef predator, feeding on small fishes and prawns. Often conceals itself by floating in a vertical head-down position among the branches of gorgonians, or will commonly swim alongside a large fish moving over the reef until it is near enough to rush and capture its prey. One genus, *Aulostomus* Lacepède 1803, with 3 species, 1 in WIO.

### *Aulostomus chinensis* (Linnaeus 1766)

Chinese trumpetfish

PLATE 99

*Fistularia chinensis* Linnaeus 1766: 515 [in part: type locality 'India orientali,' as restricted by Shaw 1804 [Indonesia]; China; Brazil [erroneous]].

*Aulostomus valentini*: SFSA No. 360\*.

*Aulostomus chinensis*: Wheeler 1955; SSF No. 143.1\*; Winterbottom *et al.* 1989; Bowen *et al.* 2001; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004; Fricke *et al.* 2009.

Dorsal fin 8–13 isolated spines + 3 spines, 23–27 rays; anal fin 3 spines, 23–26 rays; pectoral fins 16 rays. Body depth 7–9 in SL; HL 2.8–3.1 in SL. Body with 3 bony plates along dorsal midline just behind head.

Various colour phases: body generally brownish to green and often with pale vertical bars, or entirely yellow; dark stripe along dorsal- and anal-fin bases; black spot at pelvic-fin bases; round black spot usually on middle of upper caudal-fin rays, and another spot sometimes on middle of lower rays. Attains 80 cm TL.

**DISTRIBUTION** Indo-Pacific to eastern Pacific (widespread).

WIO: Oman, Kenya to South Africa (Eastern Cape), Madagascar, Comoros, Seychelles, Mascarenes, Chagos, Maldives and Sri Lanka; not known from Red Sea; elsewhere to Cocos (Keeling) Is., southern Japan, Micronesia, Australia, Great Barrier Reef, New Caledonia, northern New Zealand, Lord Howe I., Tonga, Pitcairn Is., Marquesas Is., Wake Atoll, Hawaii, Easter I., Galápagos Is., Gulf of California and Panama.



*Aulostomus chinensis*, 53 cm SL (South Africa). © RE Stobbs

FAMILY **FISTULARIIDAE**

## Flutemouths

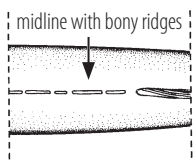
Phillip C Heemstra

Body extremely elongate, slightly depressed; snout greatly elongated, tubular. Mouth small, teeth minute. No fin spines. Caudal fin forked, but 2 middle rays fused to form a long median filament; pelvic fins 6 rays. Anus close behind pelvic fins. The tubular snout is a very efficient device for sucking in the small fishes and crustaceans on which these stealthy predators feed.

One genus, *Fistularia* Linnaeus 1758, with 4 species, 2 in WIO. Genus reviewed by Fritzsche (1976).

## KEY TO SPECIES

- 1a Body with slender bony ridges along dorsal midline, in front of and behind dorsal fin; posterior lateral-line ossifications end in a retrorse spine ..... *F. petimba*



- 1b No bony ridges along dorsal midline of body; no spines on lateral-line ossifications ..... *F. commersonii*

*Fistularia commersonii* Rüppell 1838

Smooth flutemouth

PLATE 99

*Fistularia commersonii* Rüppell 1838: 142 (Al-Muwaylih, Saudi Arabia, Red Sea); Fritzsche 1976\*; SSF No. 144.1\*; Winterbottom *et al.* 1989; Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

*Fistularia petimba* (non Lacepède 1803): SFSA No. 361\*.

Dorsal fin 15–17 rays; anal fin 14–16 rays; pectoral fins 13–15 rays. No bony ridges along dorsal midline. Upper and lateral ridges of snout serrate on proximal third; upper ridges diverge

at third of distance (from eye to mouth) and then converge again; posttemporal ridges smooth. Vertebrae: 4 fused + 46 or 47 precaudal + 34 caudal.

Body uniformly olive-green or brownish dorsally, with pair of blue or green lines and/or rows of blue spots, but occasionally assumes dark barred pattern; silvery white ventrally; median fins pinkish distally; caudal filament white. Attains 150 cm SL.

**DISTRIBUTION** Indo-Pacific and eastern Pacific (widespread). WIO: Red Sea (and Lessepsian migrant to Mediterranean Sea), Kenya to South Africa (Mossel Bay), Madagascar, Comoros, Seychelles, Mascarenes, Chagos and Maldives; elsewhere to Andaman Is., Indonesia, Philippines, southern Japan, Marianas Is., Marshall Is., Australia, Great Barrier Reef, New Zealand, New Caledonia, Samoa, Rapa Iti, Marquesas Is., Wake Atoll, Hawaii, Galápagos Is., Easter I., Gulf of California and Panama.

**REMARKS** Inhabits coral reefs and seagrass beds, to at least 120 m deep.

*Fistularia petimba* Lacepède 1803

Serrate flutemouth

PLATES 99 &amp; 100

*Fistularia petimba* Lacepède 1803: 89 (Straits of New Britain, Bismarck Archipelago; Réunion, western Mascarenes; Antilles); Fritzsche 1976; Winterbottom *et al.* 1989; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004; Fricke *et al.* 2009; Bogorodsky *et al.* 2014.

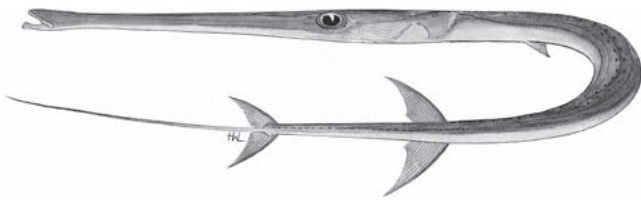
*Fistularia villosa* Klunzinger 1871: 516 (Al-Qusayr, Egypt, Red Sea); SFSA No. 362.

Dorsal fin 14–17 rays; anal fin 14 or 15 rays; pectoral fins 15–17 rays. Slender bony ridges along dorsal midline. Upper, lateral and lower ridges on snout serrate; posttemporal ridge with large antrorse serrae. Vertebrae: 4 fused + 46 precaudal + 26 caudal.

Body reddish to orange-brown dorsally, silvery ventrally. Attains ~150 cm SL.



*Fistularia commersonii*, 29 cm FL (Mozambique). © Alvheim © IMR



*Fistularia petimba*, 46 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Circumglobal in tropical to subtropical seas, except eastern Pacific. WIO: Red Sea, Persian/Arabian Gulf, Oman to South Africa (Mossel Bay) and to India, Madagascar, Mascarenes, Chagos and Maldives.

**REMARKS** Benthopelagic, in coastal areas over soft bottoms, at ~10–219 m (usually 18–57 m).

## FAMILY MACRORAMPHOSIDAE

### Snipefishes and bellowsfishes

Phillip C Heemstra

Body oblong, oval or rhomboid, deep and much compressed; snout produced into long tube, with small toothless mouth at end. Bony plates on body above pectoral fins and/or along ventral midline of belly; dorsal fin continuous or divided into 2 fins, set on rear half of body, with 5–8 spines, and 2nd spine distinctly enlarged; anal fin 17–21 rays; pelvic fins rudimentary. Scales similar to shark denticles, with sharp ridges and spines. Swimbladder present. Body length (BL) is measured as SL minus snout length. Demersal or pelagic, on outer continental shelf and upper slope, at 18–1 000 m. Three genera and ~12 species; all genera and 5 species in WIO.

#### KEY TO GENERA

- 1a Dorsal-fin spines and rays separated by distinct gap; body depth (at anus) at least twice in BL; 2nd dorsal fin 11–13 rays, fin base distinctly shorter than anal-fin base; no patch of bristles on nape; no exposed bony plates on body ..... *Macroramphosus*
- 1b Dorsal fin contiguous; body depth less than twice in BL ..... 2
- 2a Skin rough, scales minute but visible to naked eye and very spiny; orbit rims spiny ..... *Centriscopus*
- 2b Skin velvet-like, scales microscopic; no distinct spines on orbit rims ..... *Notopogon*

## GENUS *Centriscopus* Gill 1863

Body depth greater than HL. Dorsal profile of adults hump-backed, with concavity above and just behind eyes and prominent hump above gill openings; some specimens (>15 cm SL) with patch of short bristles on dorsal hump. Second dorsal-fin spine elongate, slightly moveable, its rear edge serrate. One species, restricted to oceans of Southern Hemisphere.

### *Centriscopus humerosus* (Richardson 1846)

Banded snipefish

PLATE 100

*Centriscopus humerosus* Richardson 1846: 56, Pl. 34, Figs. 5–6 (South Australia); Günther 1861.

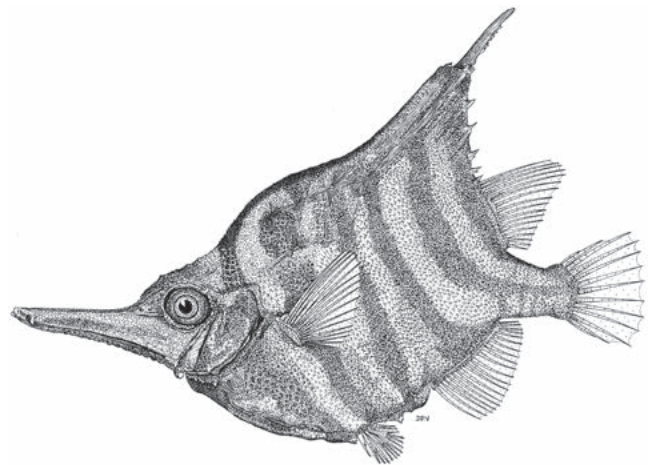
*Centriscopus humerosus*: Gill 1862; Hutton 1872; Duhamel 1989\*, 1995\*.

*Centriscopus humerosus* var. *obliquus* Waite 1911: 170, Pl. 26 (New Zealand); Regan 1914.

*Centriscopus obliquus*: Mohr 1937\*; SFSA No. 365\*; SSF No. 147.1\*.

Dorsal fin 7 spines, 16–18 rays; anal fin 17–21 rays; pectoral fins 15–17 rays. Snout length 2.6–3 in BL; orbit diameter 3–3.2 in snout length; distance from base of 1st dorsal-fin spine to 1st anal-fin ray 1.4–1.6 in BL. Body with 4 fused, indistinct bony shields dorsally, with 4th shield extending to base of 2nd dorsal-fin spine; 3 bony scutes forming midventral keel between 5 pairs of bony scutes extending from isthmus to pelvic fins, and hindmost scute terminating in a spine; 2 other small uneven scutes between pelvic fins and anus: 1st spinous, 2nd crenulated.

Males pale pink or white, with 5 or 6 vaguely defined, oblique, dark red bands, last band along dorsal-fin base and top of peduncle. Females dusky reddish dorsally and posteriorly; abdomen pale with curved reddish marks; dark S-shaped stripe along rear edge of opercle and dorsal edge of body. Attains 30 cm SL.



*Centriscopus humerosus*, 19 cm SL (South Africa). Source: SSF

**DISTRIBUTION** Circumglobal in Southern Hemisphere, including South Africa (Cape Columbine in eastern Atlantic to False Bay in WIO); elsewhere, Saint-Paul and Amsterdam Is., Australia, New Zealand, Chile, Argentina, Tristan da Cunha and Gough I.

**REMARKS** Trawled from 35–1 000 m in Australia, but usually at 400–750 m (May & Maxwell 1986).

## GENUS *Macroramphosus* Lacepède 1803

Body oblong, body depth (between base of 2nd dorsal-fin spine and anus) less than snout length; 2nd dorsal-fin base less than half length of anal-fin base; scales minute, imbricate (no skin visible between scales). Two species are recognised (Clarke 1984; Miyazaki *et al.* 2004). The conspecific status of *Macroramphosus* species from Japan, Australia and the WIO (and elsewhere) has yet to be demonstrated; Miyazaki *et al.* (2004) observed that the patterns of bony plate formation in the larvae were significantly different for Japanese, Atlantic and eastern Pacific populations. The names *Macroramphosus gracilis* and *Macroramphosus scolopax* are provisionally used for the slender and deep-body snipefishes of the WIO, respectively.

### KEY TO SPECIES

- 1a Body reddish orange in life (adults and juveniles), pale in alcohol; abdomen swollen in larvae and juveniles, the ventral body profile notched at anus; body depth >45% BL; snout length <43% BL; 2nd dorsal-fin spine 24–46% BL, fin reaching past vertical at caudal-fin base, and rear edge of spine coarsely serrate in fish >5 cm SL; eye diameter >13% BL ..... *M. scolopax*
- 1b Body uniformly dark in larvae and juveniles, dark or brownish dorsally in adults; abdomen not swollen in larvae and juveniles, ventral body profile straight; body depth <40% BL; snout length >50% BL; 2nd dorsal-fin spine 18–33% BL, not reaching past vertical at caudal-fin base, rear edge of spine smooth in fish larger than ~5 cm SL; eye diameter <11% BL ..... *M. gracilis*

## *Macroramphosus gracilis* (Lowe 1839)

Slender snipefish

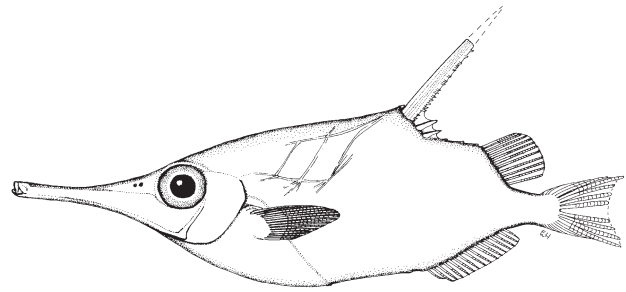
PLATE 100

*Centriscus gracilis* Lowe 1839: 86 (off Madeira).

*Macroramphosus gracilis*: Mohr 1937: 53, Pl. 1, Fig. 3; Pl. 2, Figs. 5–6 [in part]; Clarke 1984; Miyazaki *et al.* 2004\*.

Dorsal fin 6–8 spines, 11–13 rays; anal fin 16–19 rays; pectoral fins 15 or 16 rays; GR 4–6/12–16.

Head and body of adults dark or brownish dorsally; juveniles uniformly dark. Attains 15 cm TL.



*Macroramphosus gracilis*, 9 cm SL (South Africa).

**DISTRIBUTION** Worldwide in temperate and subtropical seas, including northern WIO to South Africa (Eastern Cape), Madagascar and India.

**REMARKS** Pelagic over outer continental shelf and upper slope, sometimes in huge schools. Feeds mainly on planktonic copepods. Known from 18–633 m in WIO.

## *Macroramphosus scolopax* (Linnaeus 1758)

Deep-body snipefish

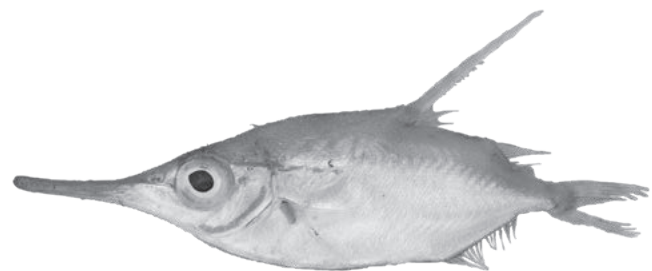
PLATE 100

*Balistes scolopax* Linnaeus 1758: 329 (Mediterranean Sea).

*Macroramphosus scolopax*: Mohr 1937\*; Clarke 1984; SSF No. 147.2\*; Manilo & Bogorodsky 2003; Miyazaki *et al.* 2004\*; Bilecenoglu 2006.

Dorsal fin 6–8 spines, 11–13 rays; anal fin 18–20 rays; pectoral fins 15–17 rays; GR 3–6/12–15.

Body of adults reddish orange dorsally, silvery below. Attains 20 cm TL.



*Macroramphosus scolopax*, 11 cm TL (Mozambique). © Alvhheim © IMR

**DISTRIBUTION** Worldwide in temperate and subtropical seas. Western and eastern Atlantic (abundant), Mediterranean Sea and Indo-Pacific. WIO: South Africa (Plettenberg Bay) to Mozambique, Madagascar and southern India.

**REMARKS** Most common on outer continental shelf and upper slope, on sandy bottoms, at 25–600 m. Adults normally demersal to midwater, feeding mainly on a variety of demersal invertebrates (gammarid shrimps, isopods, copepods,



decapods and bryozoans). Locally abundant, found in large schools, and regularly captured as bycatch in purse seines.

## GENUS *Notopogon* Regan 1914

Body compressed, disc-like; dorsal fin raised anteriorly, fin margin vertical from front end of peduncle; 3 ill-defined bony plates on each side of body dorsally, the 3rd plate extending to bases of 1st and 2nd dorsal-fin spines; dorsal fin 15–17 rays; anal fin 16–20 rays; dorsal-fin base subequal to anal-fin base. Scales microscopic, similar to shark denticles. Five species, 2 in WIO.

### KEY TO SPECIES

- |    |   |                      |
|----|---|----------------------|
| 1a | Skin rough; snout length 20–28% SL (fish >10 cm SL) ..... | <i>N. xenosoma</i>   |
| 1b | Skin smooth, velvet-like; snout length 28–38% SL .....    | <i>N. macrosolen</i> |

## *Notopogon macrosolen* Barnard 1925

Smooth bellowsfish

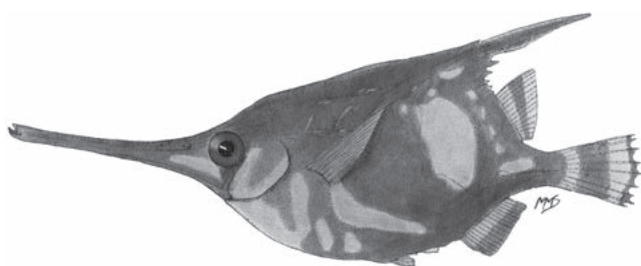
PLATE 100

*Notopogon macrosolen* Barnard 1925: 498 (Table Bay, Cape Town, South Africa); SSF No. 147.4\*.

*Notopogon lilliei* (*non* Regan 1914): SSF No. 147.3\*; Andrew *et al.* 1995.

Dorsal fin 7 spines, 16 rays; anal fin 18–20 rays; pectoral fins 17 or 18 rays. Dorsal body profile from above eyes to base of 2nd dorsal-fin spine slightly convex. Adult males (>20 cm SL) with small patch of bristles on nape; no bristle patch in females.

Body of adults reddish with several irregular white spots and streaks. Attains 31 cm SL.



*Notopogon macrosolen*, 22 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Records from Namibia, west and south coasts of South Africa, and Tristan da Cunha and Gough Is. in the south-central Atlantic Ocean.

**REMARKS** Found at 194–500 m. An incidental bycatch of trawls.

## *Notopogon xenosoma* Regan 1914

Longspine bellowsfish

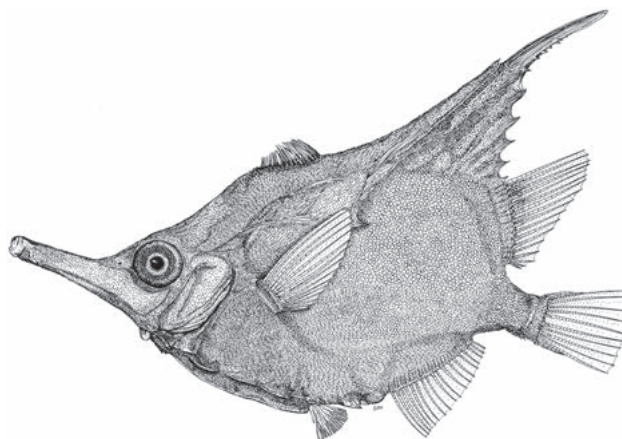
PLATE 100

*Notopogon xenosoma* Regan 1914: 14 (Cape North, New Zealand); SSF No. 147.5\*; Duhamel 1989\*, 1995\*.

*Macrorhamphosus natalensis* Gilchrist 1922: 57, Pl. 12, Fig. 2 (KwaZulu-Natal, South Africa).

Dorsal fin 7 spines, 14–17 rays; anal fin 16–19 rays; pectoral fins 15–17 rays; 2nd dorsal-fin spine longer than snout. Most adults with patch of long bristles on dorsal hump.

Body uniformly reddish brown. Attains 17 cm TL.



*Notopogon xenosoma*, 7 cm SL, syntype of *Macrorhamphosus natalensis* (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (west coast to KwaZulu-Natal), southern Madagascar and Walters Shoals; elsewhere to south coast of Australia, New Caledonia and New Zealand.

**REMARKS** Known from 125–710 m.

### GLOSSARY

**crenulated** – having a margin shaped into small, rounded scallops.

## FAMILY CENTRISCIDAE

### Shrimpfishes

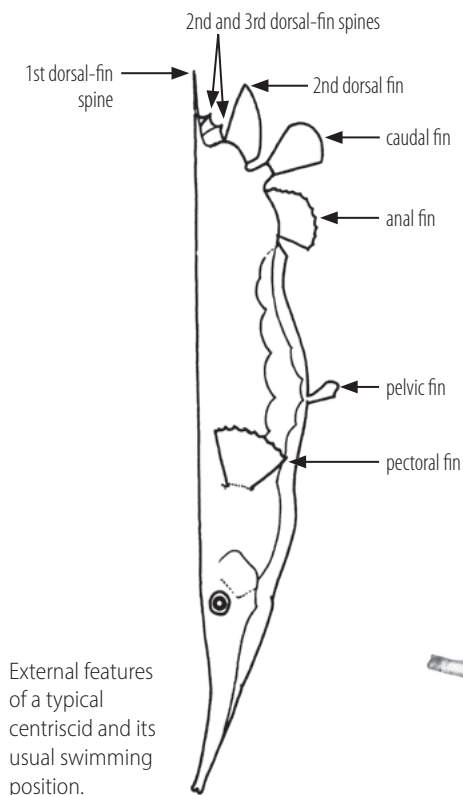
Phillip C Heemstra

Head and body elongate, extremely compressed, encased almost completely by thin, transparent, ridged plates, forming a shell-like armour, the ventral edge sharp and stiff; dorsal edge of body rounded, and thickened and elongated posteriorly in adults, forming a strong extension to the 1st dorsal-fin

spine, which is enlarged and elongated. Juveniles (~9 mm) have the usual horizontally oblong fish shape, but as it grows the rear end of the body gradually bends ventrally, and in adults the dorsal fins assume the position normally occupied by the caudal fin, which becomes displaced ventrally and precedes the 2nd dorsal fin. Snout elongate, tubular, with small toothless mouth at tip; nostrils close-set, just in front of mid-eye. Pectoral fins based midlaterally, well behind head. Pelvic fins small, often rudimentary, and joined to form a single fin in adults, usually with a weak spine on each side of base and 8 unbranched rays, the fins cuneate in males, arrowhead-shaped in females, and located at about midbody. Except for the 1st dorsal fin, the median-fin rays are soft, segmented and unbranched. Exoskeleton (outer shell) provided with openings for the mouth, nostrils, gill openings (along rear edge of operculum) and median-fin bases. No scales or lateral line.

Bizarre-looking relatives of the pipefishes, shrimpfishes occur in shallow water over sandy or muddy bottom and often hide among branching corals, long-spined sea urchins, seagrasses and mangrove roots. Usually swim vertically, in a head-down position, usually in small groups, as they scan the bottom looking for prey (small invertebrates, especially crustaceans). Unlike pipefishes, in which the males carry the eggs until they hatch, shrimpfishes release their buoyant eggs and sperm into the sea when they spawn. Popular as aquarium fishes; often on exhibit at oceanariums in South Africa, where they can be seen swimming in small shoals, like miniature soldiers on parade.

Two genera and 4 species; both genera and 3 species in WIO.



External features of a typical centriscid and its usual swimming position.



*Aeoliscus punctulatus*, 15 cm TL (Kenya). Source: Smith & Smith 1963

#### KEY TO GENERA

- 1a First spine of dorsal fin moveably articulated to bony rear extension of body; pectoral-fin base at edge of 2 lateral body plates ..... *Aeoliscus*
- 1b First spine of dorsal fin immoveable, fused with bony rear extension of dorsal edge of body; pectoral-fin base at middle of lateral body plate ..... *Centriscus*

#### GENUS *Aeoliscus* Jordan & Starks 1902

First spine of dorsal fin hinged at base, slightly moveable. Two species, both in WIO.

#### KEY TO SPECIES

- 1a Body depth 6.5–7.5 in SL; series of small black spots on head and body; first spine of dorsal fin short, <1/2 body depth, and joint of spine above tip of 2nd dorsal fin ..... *A. punctulatus*
- 1b Body depth 8–12 in SL; no black spots on head and body; first spine of dorsal fin distinctly >1/2 body depth, and joint of spine well behind tip of 2nd dorsal fin ..... *A. strigatus*

#### *Aeoliscus punctulatus* (Bianconi 1854)

Spotted shrimpfish

PLATE 101

*Amphisile punctulata* Bianconi 1854: 221, Pl. 1, Fig. 2 (Mozambique); Bianconi 1855\*.

*Amphisyle brevispina* Peters 1855: 450 (Inhambane and Mozambique I., Mozambique).

*Centriscus punctulatus*: Mohr 1937\*.

*Aeoliscus punctulatus*: SFSA No. 369\*; SSF No. 148.1\*; Heemstra & Heemstra 2004\*; Kuitert & Debelius 2006\*.

First dorsal fin 4 spines; 2nd dorsal fin 10 or 11 rays; anal fin 12 or 13 rays; pectoral fins 11 rays; pelvic fins 4 rays; caudal fin 11 rays. Body depth 5–7 in SL; HL 2.5–2.8 in SL. Distance between 1st spine of dorsal fin and 2nd dorsal-fin origin less than body depth.

Head and body pale green, with widely spaced small black spots. Attains 19 cm TL.

**DISTRIBUTION** WIO: Red Sea, Gulf of Aden, Kenya to South Africa (KwaZulu-Natal) and Seychelles.

*Aeoliscus strigatus* (Günther 1861)

Striped shrimpfish

PLATE 101

*Amphisile strigata* Günther 1861: 528, 566 (Java, Indonesia).

*Centriscus strigatus*: Mohr 1937\*

*Aeoliscus strigatus*: Smith & Smith 1963\*.

First dorsal fin 3 or 4 spines; 2nd dorsal fin 9–12 rays; anal fin 10–12 rays; pectoral fins 10–12 rays; pelvic fins 3–5 rays. Body depth 8–12 in SL; HL 2.5–3.5 in SL; length of 1st dorsal-fin spine >½ body depth, and distance between base of spine and 2nd dorsal-fin origin greater than body depth.

Head and body pale, variably coloured, with dark midlateral stripe from snout tip to rear of body. Attains ~14 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania and Seychelles; elsewhere, Andaman Is., Indonesia, southern Japan, Micronesia, eastern Australia and New Caledonia.

**REMARKS** Often hides among the long spines of the sea urchin *Diadema*.

**GENUS** *Centriscus* Linnaeus 1758

First spine of dorsal fin fused to bony rear extension of dorsal edge of body; pectoral-fin base set in middle of lateral body plate. Two species, 1 in WIO.

*Centriscus scutatus* Linnaeus 1758

Groovy shrimpfish

PLATE 101

*Centriscus scutatus* Linnaeus 1758: 336 (East India); Mohr 1937\*; Randall 1995\*; Manilo & Bogorodsky 2003.

First dorsal fin 3–5 spines; 2nd dorsal fin 10–12 rays; anal fin 11–13 rays; pectoral fins 10 or 11 rays; pelvic fins 1 spine, 3–5 rays; caudal fin 9 rays. Body depth 6–8 in TL; HL 3–4 in TL; length of 1st dorsal-fin spine >½ body depth, and distance between base of spine and 2nd dorsal-fin origin much less than body depth. Interorbital space concave, with median groove extending onto occiput. Lateral body plates with oblique sutures.

Head and body silvery with pinkish tinge; abdomen dark grey with silvery vertical lines. Attains 17 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and Persian/Arabian Gulf, Oman (Muscat); elsewhere to Indonesia, Australia and Japan.

**REMARKS** Found over soft bottom, at 5–80 m.

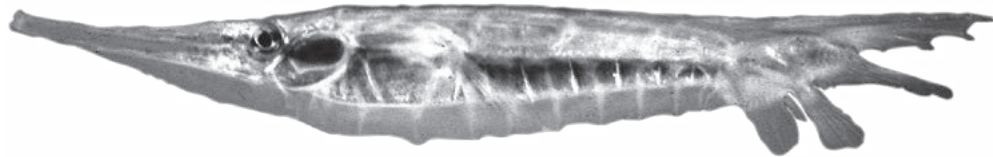
**GLOSSARY**

**cuneate** – wedge-shaped.

**exoskeleton** – hard outer parts that form an external skeleton to support and protect the body.



*Aeoliscus strigatus*, 13 cm TL (WIO).



*Centriscus scutatus*, 9 cm TL (Kuwait). © JE Randall, Bishop Museum

# ORDER SCORPAENIFORMES

Stuart G Poss

Fishes of the order Scorpaeniformes display remarkably varied morphologies, which has led to much disagreement about their origin and evolutionary relationships. Consequently, scientific opinion about which species should be included and how they should be classified has differed greatly among investigators. Historically, generally accepted views of their interrelationships have undergone repeated change. Yet, that the group itself has remained more or less cohesive is a testament to the influence of the pioneering work of Cuvier, the founder of comparative anatomy.

In his first major work on the group, in 1816, Cuvier linked these fishes (and many others) under the *Percoïdes*. In an 1829 revision he restricted the *Percoïdes* to include a broad variety of acanthopterygian fishes. These are fishes with so-called mailed-cheeks in which the 3rd infraorbital bone is expanded and in contact (or nearly so) with the preopercle to form a suborbital stay. Cuvier included some species long regarded as not closely related (e.g., the sticklebacks *Gasterosteus*, and the pineapplefishes *Monocentris*). However, what constitutes a 'mailed-cheek' and how the suborbital stay should be evaluated as a character has remained debatable. Some authors (e.g., Matsubara 1943) argued that the stay evolved through backward extension of the 3rd infraorbital, from a primitive condition (such as found in species of *Sebastes*) in which it only weakly abuts the preopercle, if at all, to a more advanced state, with a stronger and broader connection with the preopercle. Others, such as Eschmeyer & Hureau (1971), argued that the suborbital stay in *Sebastes* is reduced. Given that a variety of lengths and shapes are evident, it is probable that both modes of evolution of the bone have occurred in different groups.

With the advent of cladistics, interpretations of this feature and others have been used to establish the interrelationships of the groups currently included in the order Scorpaeniformes (cf. Yabe 1985; Ishida 1994; Imamura 1996, 2004; Imamura & Shinohara 1997, 1998; Mandrytsa 2001; Imamura & Yabe 2002; Chen *et al.* 2003; Miya *et al.* 2003; Smith & Wheeler 2004; Miya *et al.* 2006; Shinohara & Imamura 2007). These studies confirm the pre-cladistic conclusions of earlier authors (e.g., Frehofer 1963; Quast 1965) that Cuvier's *Percoïdes* is polyphyletic rather than monophyletic, showing that the hexagrammoid-cottoid lineages (greenlings-sculpins) are quite distinct from the scorpaenoid (scorpionfishes), platycephaloid (flatheads) and trigloid (sea robins) lineages. It is also likely that the lineages differentiated from other percoid fishes early in their

evolution, and possibly include taxa not currently recognised. Moreover, these studies show there is limited evidence of a sister-group relationship between these two main lineages relative to other acanthomorphs as had been proposed by numerous early workers (e.g., Regan 1913; Berg 1940; Matsubara 1943, 1955). A broad variety of acanthomorphs have been proposed as sister-groups to the scorpaeniforms – for example, the gobioids (Starks 1911; Winterbottom 1993), trachinoids (Moi & Johnson 1997; Smith & Wheeler 2004) and gasterosteids (Rendahl 1933; Miya *et al.* 2003), as have some pre-acanthomorph taxa (cf. Chen *et al.* 2003; Smith & Wheeler 2004). Likewise, there is controversy about including other taxa that evidently have almost certainly lost their mailed-cheeks, such as the Patacidae (Australian prowlfishes) (Mandrytsa 1993, 2001; Ishida 1994). The many different interpretations and conclusions about interrelationships suggested by morphological and molecular studies have yet to be reconciled for both theoretical and technical reasons, with much disagreement most apparent with respect to the affinities of the anoplopomatids (sablefishes), platycephalids and triglids.

A meagre fossil record, which dates to the lower Eocene (55.8–48.6 MYA), shows that some features of several extant genera had originated by the Miocene (23–5.3 MYA), a timing roughly consistent with the origin of *Sebastes* as suggested by Hyde & Vetter (2006). However, a few authors (i.e., Meynard *et al.* 2012; Near *et al.* 2012; Betancur-R *et al.* 2013) propose a much earlier, Cretaceous origin for the order as a whole. The fossil record is too fragmentary to limit the number of possible choices between conflicting suggested evolutionary histories, making the determination of the rates at which many features have evolved difficult to establish. Unfortunately, molecular studies of these fishes have relied predominantly on mitochondrial DNA, which provides little direct insight into the evolution of nuclear DNA (likely under stronger selection) that encodes and regulates the organisation and development of their morphology.

For the purposes of this book, the order Scorpaeniformes is restricted to include only scorpaenoid–platycephaloid–trigloid fishes. The Cottiformes, which includes the hexagrammoid-cottoid lineage and possibly anoplopomatoid fishes, does not occur in the Indian Ocean, except marginally for a few cottoids of Southern Hemisphere origin and one (*Liparis fishelsoni* Smith 1967, from the Red Sea) of remarkable, if not doubtful provenance. The Scorpaeniformes, thus restricted, includes



roughly 700 species that are found predominantly in coastal waters of continental shelves of tropical and temperate seas, although many species are endemic to oceanic island habitats.

Nearly all are benthic, with some benthopelagic species. Most are found nearshore, from the surface to ~150 m, but some reach depths of ~1 100 m. Fifteen families and ~173 species in WIO.

**KEY TO FAMILIES**

- 1a Head encased in expanded bones firmly attached to each other ..... 2
- 1b Head not encased in bony armour ..... 4

- 2a Body covered with bony plates; barbels present on lower jaw ..... **PERISTEDIIDAE**

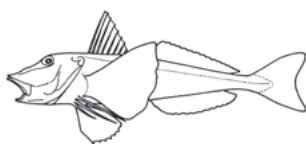


- 2b Body not covered with bony plates ..... 3

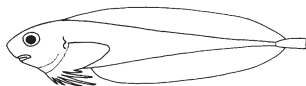
- 3a Preopercle with very long spine; 1 or 2 isolated dorsal-fin spines on nape; pectoral fins greatly expanded and wing-like ..... **DACTYLOPTERIDAE**



- 3b Preopercle with short spine; no isolated dorsal-fin spines; 3 lowermost pectoral-fin rays free ..... **TRIGLIDAE**



- 4a Pelvic fins absent or joined to form a disc; dorsal and anal fins confluent with caudal fin, tail tapering ..... **LIPARIDAE**



- 4b Pelvic fins present and normal; dorsal, anal and caudal fins separate ..... 5

- 5a Single nostril on either side of head; dorsal-fin origin over eyes ..... **CONGIOPODIDAE**



- 5b Two nostrils on either side of head; dorsal-fin origin behind eyes (except in Aploactinidae) ..... 6

- 6a Two separate dorsal fins; head strongly depressed ..... 7

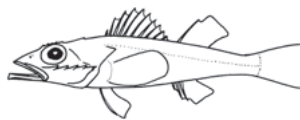
- 6b Dorsal fin single; head not strongly depressed ..... 9

- 7a Lateral row of spiny scutes; lowermost pectoral-fin rays free ..... **HOPLICHTHYIDAE**

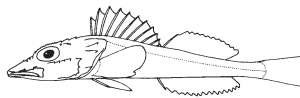


- 7b No row of scutes midlaterally; body scales normal or as pointed prickles ..... 8

- 8a Pelvic fins inserted below pectoral-fin bases, and anal fin with 3 spines ..... **PARABEMBRIDAE**



- 8b Pelvic fins inserted below pectoral-fin bases, and anal fin without spines ..... **BEMBRIDAE**



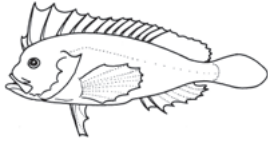
- 8c Pelvic fins inserted behind pectoral-fin bases, and anal fin without spines ..... **PLATYCEPHALIDAE**



Continued...

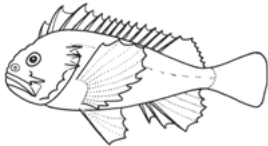
## KEY TO FAMILIES

- 9a Scales tack-like, if present, forming spinous points on a nearly circular base; most species with fleshy papilla in front of isthmus ..... **APLOACTINIDAE**



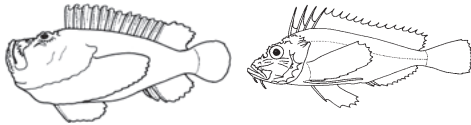
- 9b Scales normal; no fleshy papilla in front of isthmus ..... **10**

- 10a Dorsal-fin origin above or before eyes; lachrymal moveable ..... **TETRAROGIDAE**



- 10b Dorsal-fin origin behind eyes; lachrymal not moveable ..... **11**

- 11a Scales greatly reduced or absent, body sometimes covered with wart-like protuberances ..... **SYNANCEIIDAE**



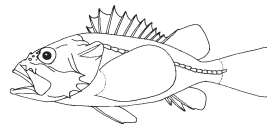
- 11b Body with typical overlapping scales, or body extremely compressed and scales present as small spiny papillae ..... **12**

- 12a Lowermost pectoral-fin ray free; barbels present on chin ..... **APISTIDAE**

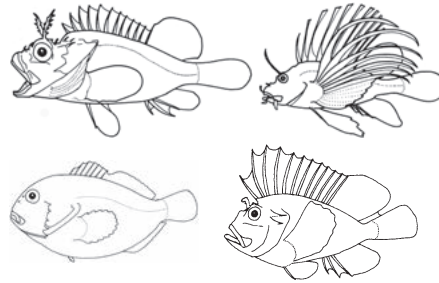


- 12b No free pectoral-fin rays; no barbels on chin ..... **13**

- 13a Lateral line a continuous trough, roofed by thin scales ..... **SETARCHIDAE**



- 13b Lateral line of tubed scales, sometimes buried ..... **SCORPAENIDAE**



## GLOSSARY

**acanthomorphs** – the Acanthomorpha is the formal name for the ray-finned fishes.

**cladistics** – a method for hypothesising relationships among organisms (phylogeny) by defining hierarchical groups defined by shared, derived features or characteristics (vs. defining groups based on overall similarity).

**monophyletic** – a group of organisms (a clade) comprising the most recent common ancestor and all its descendants.

**polyphyletic** – a group of organisms (a clade) that has more than one ancestor and is defined on the basis of convergent features or characteristics.

**sister-group relationship** – two taxa of equal rank that share a common ancestor.

## FAMILY SCORPAENIDAE

### Scorpionfishes and lionfishes

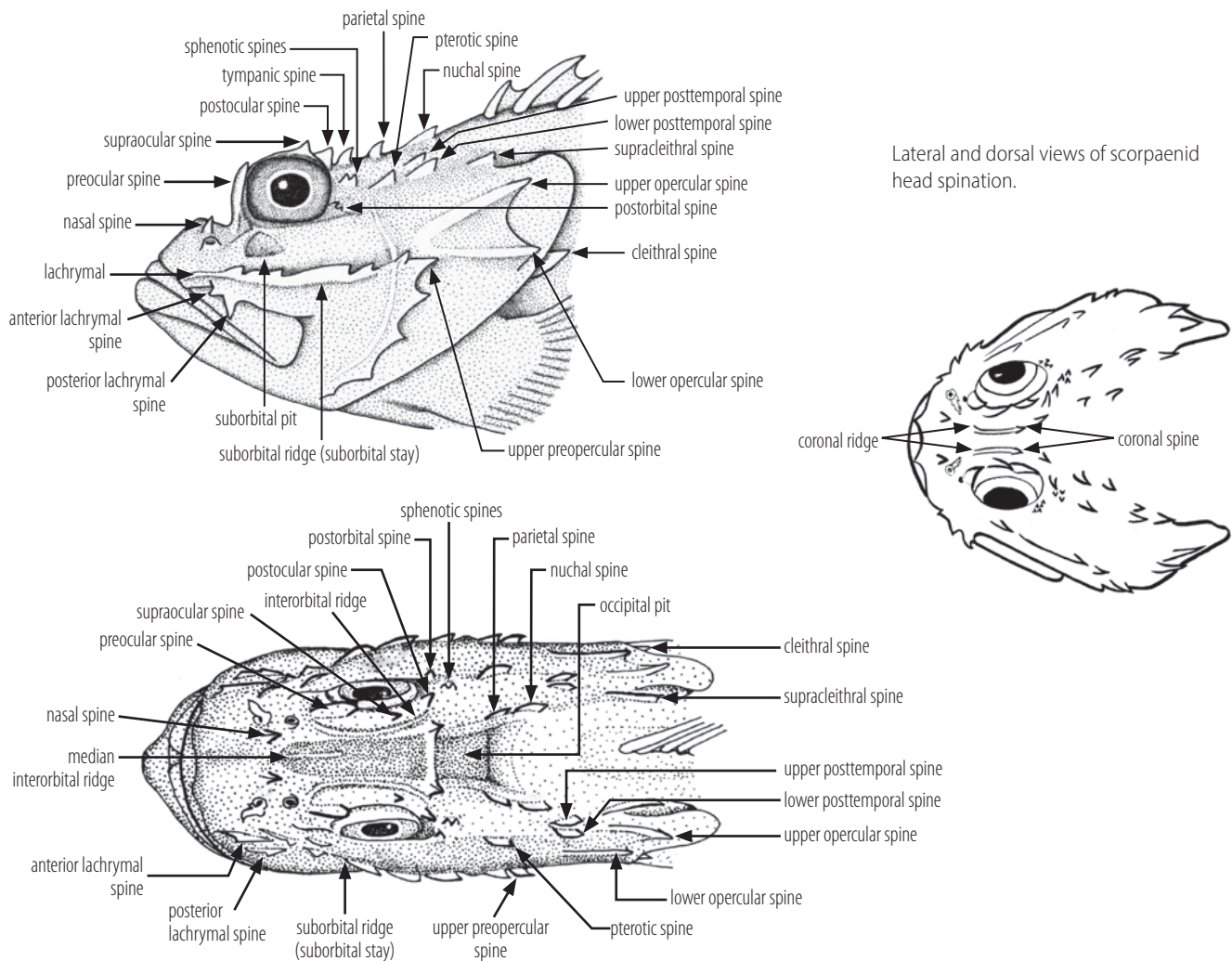
Stuart G Poss and Hiroyuki Motomura

The largest family of scorpaenoids, characterised by suborbital stay or ridge (an extension of 3rd suborbital bone) that is usually broadly and firmly attached to the preopercle, and most species with numerous (usually diagnostic) head spines. Body usually weakly compressed anteriorly, depth 21–50% SL; head moderate to large, HL 37–50% SL, and typically with ridges and spines. Dorsal fin with 7–14 strong, sharp spines, usually with venom glands associated with grooves on either side of the spines, and fin often notched before rays; anal fin with 2–4 (usually 3) strong, sharp spines, also usually with venom glands; pelvic-fin spines may also bear venom glands. Last ray of dorsal and anal fins counted as 1½ when divided to base and carried on a single pterygiophore, or counted as 1 ray when not split to base. Longitudinal scale series (LSS) counted just above the lateral line from supracleithral spine to caudal-fin

base. Well-developed striated swimbladder musculature that is extrinsic in nearly all species, musculature present even in the absence of a swimbladder. Vertebrae 24–26.

This family includes the most venomous fishes. Found in tropical to temperate seas worldwide; nearly all species occur inshore in <200 m, but some are found on the continental shelf to at least 1 500 m. Most species live on or near the bottom among rocks and corals; however, some are found exclusively on soft, sand/mud, trawable bottom, and a few deepwater species are at least partially epipelagic. Although most are highly camouflaged, sedentary, suction-feeding ambush predators, some exhibit bright or aposematic colouration and actively forage, either crepuscularly or nocturnally. Feed predominantly on invertebrates, particularly crustaceans, although many species feed on fishes, particularly as they grow to a larger size. Some species are preyed upon by other fishes, notably groupers and sharks, but also by octopuses, seals and cetaceans.

Three subfamilies, with 26 genera and ~218 species; at least 20 genera and 71 species in WIO.



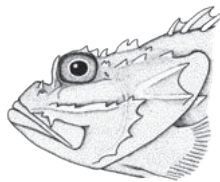
Lateral and dorsal views of scorpaenid head spination.

## KEY TO SUBFAMILIES AND GENERA

- 1a Two postorbital bones; suborbital stay on 3rd infraorbital usually somewhat T-shaped, with base of inverted 'T' inclined somewhat posteroventrally and relatively narrowly attached to preopercle; usually 2 or 3 postorbital bones; maxillary tendon of A1 subdivision of musculus adductor mandibulae relatively long ..... **20 [Sebastinae]**
- 1b One or no postorbital bones; suborbital stay on 3rd infraorbital not T-shaped, but with relatively broad attachment to preopercle; 1 or no suborbital bones; maxillary tendon of A1 subdivision of musculus adductor mandibulae relatively short ..... **2**
- 2a Opercle of adults usually with single weak ridge (2 ridges in larvae), typically ending in small spine or without spine; suborbital bones relatively deep, flat and thin, with only small spinules when spines present; medial surface of 3rd suborbital relatively flat ..... **3 [Pteroinae]**
- 2b Opercle usually with 2 relatively strong ridges ending in a spine (in some species the uppermost ridge forms 2 or more spines); suborbitals 1–4 relatively sculptured, their depth narrow or moderate, and usually with 2 or 3 distinct large spines; medial surface of 3rd suborbital usually concave ..... **7 [Scorpaeninae]**



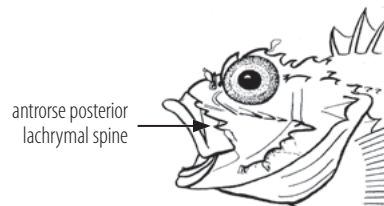
2a



2b

- 3a All pectoral-fin rays unbranched in both juveniles and adults ..... **Pterois**
- 3b At least some pectoral-fin rays branched in juveniles and adults (usually those immediately below upper 1 or 2 rays) ..... **4**
- 4a Dorsal-fin spines relatively short,  $< \frac{1}{2}$  body depth and nearly equal in length to dorsal-fin rays; lower jaw strongly upturned; mandible with scales and serrated ridges ..... **Brachypterois**
- 4b Dorsal-fin spines relatively long,  $> \frac{1}{2}$  body depth and much longer than dorsal-fin rays; lower jaw moderately upturned; mandible without scales or serrated ridges ..... **5**
- 5a Preopercle with 4 spines, 3rd uppermost spine notably enlarged and often with multiple points; pectoral fins 15–18 rays; males with thin bony crest above orbit ..... **Ebosia**
- 5b Preopercle with 3 spines, none notably enlarged; pectoral fins 17–21 rays; males without a bony crest above orbit ..... **6**
- 6a Anal fin 3 spines,  $5\frac{1}{2}$  or  $6\frac{1}{2}$  rays; interorbital area naked; caudal fin shorter than head ..... **Dendrochirus**

- 6b Anal fin usually 2 spines,  $7\frac{1}{2}$ – $9\frac{1}{2}$  rays; interorbital area scaly; caudal fin longer than head, with outer rays filamentous in larger individuals ..... **Parapterois**
- 7a Body ovate, nearly round; gill slits fused and tightly attached to isthmus; pelvic fins diminutive, with 1 spine, 3 rays; lachrymal with large, relatively broad, moveable spine ..... **Caracanthus**
- 7b Body relatively elongate; gill slits largely free of isthmus; pelvic fins relatively large, with usually 1 spine, 5 or  $5\frac{1}{2}$  rays ..... **8**
- 8a Lateral line incomplete, not reaching caudal-fin base; LL scales 3–8 ..... **Phenacoscorpius**
- 8b Lateral line complete, reaching caudal-fin base; LL scales 20–54, and usually 1 or 2 scales extending onto caudal fin ..... **9**
- 9a Posterior lachrymal spine hooked forward (antrorse, but not pronounced in small juveniles) ..... **Parascorpaena**

antrorse posterior  
lachrymal spine

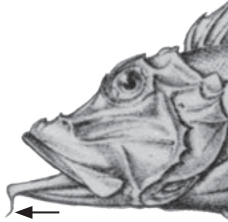
- 9b Posterior lachrymal spine directed either ventrally or (more commonly) posteroventrally (except in young of some species), or spine absent ..... **10**
- 10a Scales on flanks pseudocycloid or reduced to a small spiny point and widely scattered on body; head and body strongly compressed ..... **11**
- 10b Scales on flanks ctenoid, particularly above lateral line; head and body sometimes slightly compressed (not markedly so) ..... **14**
- 11a Scales reduced to small, widely scattered points (prickly papillae); head and body extremely compressed; dorsal-fin margin either weakly notched or not notched, and soft-rayed dorsal fin attached to caudal fin; anteriormost dorsal-fin spine 23–26% SL ..... **Taenianotus**
- 11b Scales on flanks pseudocycloid, without points in posterior field; body notably compressed, but not extremely so; dorsal-fin distal margin with pronounced notch after last spine; anteriormost dorsal-fin spine 11–22% SL ..... **12**
- 12a Tympanic and posttemporal spines present; body depth 32–40% SL ..... **Pteroidichthys**
- 12b Tympanic and posttemporal spines absent; body depth 38–54% SL ..... **13**

Continued ...



**KEY TO SUBFAMILIES AND GENERA**

- 13a Lower jaw with single, median barbel at symphysis ..... *Pogonoscorpius*



- 13b Lower jaw with multiple cirri or flaps (except *Rhinopias argolibia* without cirri) ..... *Rhinopias*

- 14a Dorsal fin 13 (very rarely 12 or 14) spines ..... *Scorpaenodes*

- 14b Dorsal fin 12 (very rarely 13) spines ..... 15

- 15a No teeth on palatines ..... 16

- 15b Palatine teeth present (except absent in *Sebastapistes fowleri*) ..... 17

- 16a Distinct spot between dorsal-fin spines 1–2 or 2–3; 4th spine longer than other dorsal-fin spines in specimens >5–6 cm SL ..... *Iracundus*

- 16b No distinct spot between anterior dorsal-fin spines; 4th spine not notably longer than other dorsal-fin spines ..... *Scorpaenopsis*

- 17a Pectoral fins without branched rays (except abnormally), even in large specimens ..... *Pontinus*

- 17b Pectoral fins with branched rays (except in small juveniles), usually in upper half or third of fin (except uppermost 1 or 2 rays not branched) ..... 18

- 18a Scales on breast relatively numerous immediately in front of pelvic fins, most not deeply embedded; scales relatively numerous and not strongly embedded behind eyes, on opercles and over rear of occiput ..... 19

- 18b Scales either absent on anterior part of breast, or, when present, few and usually deeply embedded; scales behind eyes, on opercles and over rear of occiput usually few and strongly embedded or entirely absent ..... *Scorpaena*

- 19a No slit behind last hemibranch; dorsal fin 7½–10½ rays [usually shallow water, <50 m] ..... *Sebastapistes*

- 19b Small slit present behind last hemibranch (except in some larger specimens of some species); dorsal fin 9½–11½ rays [deep water, usually >75 m] ..... *Neomerinthe*

- 20a Third infraorbital bone relatively broad and strongly attached to preopercle; dorsal fin 11–13 spines, 11½–14½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–21 rays; LSS 50–65; vertebrae 24 or 25; body pale red or rosy pink, with variable darker saddles on dorsum ..... *Helicolenus*

- 20b Third infraorbital bone relatively pointed posteriorly, weakly and narrowly attached to preopercle; dorsal fin 13 spines, 13½ or 14½ rays; anal fin 3 spines, 6½ rays; pectoral fin 18 or 19 rays; LSS 73–77; vertebrae 26 ..... *Sebastes*  
[as yet no confirmed records of *Sebastes capensis* (Gmelin 1789) east of Cape Agulhas, South Africa, but recorded ~100 km to the west]

Drawing sourced from Regan (1908)

**SUBFAMILY PTEROINAE**

**GENUS *Brachyterois* Fowler 1938**

Dorsal fin 13 (rarely 14) spines, relatively short, not elongate, but interspinous membranes strongly incised, and 9½ or 10½ rays; pectoral fins elongate, reaching to or past last anal-fin ray. Mouth strongly upturned, at ~65–70° angle from horizontal; no dermal flaps or cirri on head; lachrymal with serrate ridges on ventral and lateral surfaces in specimens >5 cm SL. One species.

***Brachyterois serrulata* (Richardson 1846)**

Sawcheek scorpionfish

PLATE 101

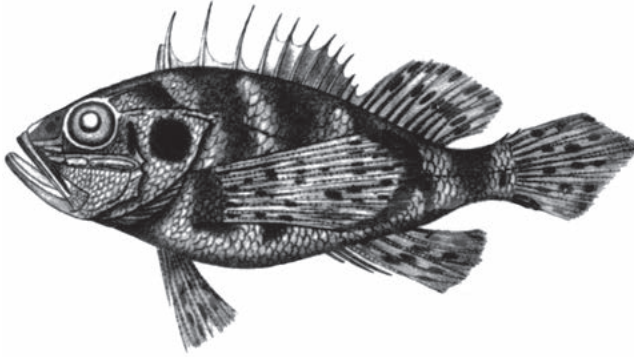
*Sebastes serrulatus* Richardson 1846: 215 (off southern Taiwan).

*Brachyterois serrulatus*: Dor 1984; Goren & Dor 1994; Krupp *et al.* 2000; Mandrytsa 2001; Manilo & Bogorodsky 2003.

*Brachyterois serrulata*: Randall 1995; Golani & Bogorodsky 2010.

Diagnosis as for genus. Dorsal-fin spines 2–4 longest, ~2–2.3 in HL; anal fin 3 spines, 5½ rays; pectoral fins 15 or 16 rays. Bones of head with numerous minute spinules, number increasing with growth. GR 16–18.

Body brown or grey dorsally, with numerous reddish streaks and spots, and usually 3 dusky saddles; underside of head and belly pale; large dark blotch on opercle; soft-rayed dorsal fin and caudal fin dusky or nearly black, spotted with red; spinous dorsal fin and anal fin somewhat paler and with more red. Attains ~10 cm SL.



*Brachypterois serrulata*, 11 cm TL (Bay of Bengal). Source: Alcock 1889

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea, Oman, Gulf of Oman (Iran), Pakistan, India and Madagascar; elsewhere to Myanmar, Philippines, Taiwan, Japan and Australia.

**REMARKS** Infrequently seen; found on mud bottom, in ~5–256 m.

## GENUS *Dendrochirus* Swainson 1839

### Lionfishes

Head and occasionally body with numerous flaps. Dorsal-fin spines elongate, and interspinous membranes strongly incised for nearly entire length of spines; pectoral fins with branched rays, fins not reaching caudal fin; anal fin 3 spines, 5½ or 6½ rays; caudal fin shorter than head. Swimbladder length less than twice its width. Vertebrae 9 + 15 = 24. Distinguished from *Pterois* by branched pectoral-fin rays; however, whether *Dendrochirus* species actually form a clade distinct from *Pterois* is debatable (cf. Kochzius *et al.* 2003). Furthermore, *D. biocellatus* is notably distinct from other species of the genus. Five species, 3 in WIO.

### KEY TO SPECIES

- 1a Lachrymal with elongate rounded tentacle on ventroposterior margin; 2 or 3 distinct ocelli on soft-rayed portion of dorsal fin ..... *D. biocellatus*
- 1b Lachrymal without elongate rounded tentacle on ventroposterior margin, but a flattened, fimbriate cirrus may be present; dorsal-fin rays weakly spotted but without ocelli ..... 2
- 2a Dorsal-fin spines relatively short, longest spine ~1.7 in body depth; pectoral fins with 10 wide dark bars that strongly contrast and regularly alternate with somewhat narrower, often yellowish or whitish, pale areas; no inverted Y- or T-shaped marking at caudal-fin base ..... *D. hemprichi*
- 2b Dorsal-fin spines relatively long, about equal to or slightly longer than body depth; pectoral fins usually greyish green distally, except at margin, with 4 or 5 weak, somewhat irregular, pinkish or reddish bars over middle of fin; inverted Y- or T-shaped reddish brown mark at caudal-fin base ..... *D. zebra*

## *Dendrochirus biocellatus* (Fowler 1938)

### Ocellated lionfish

PLATE 102

*Nemapterois biocellatus* Fowler 1938: 81, Fig. 36 (off Jolo Light, Jolo I., Philippines); Klauswitz 1969.

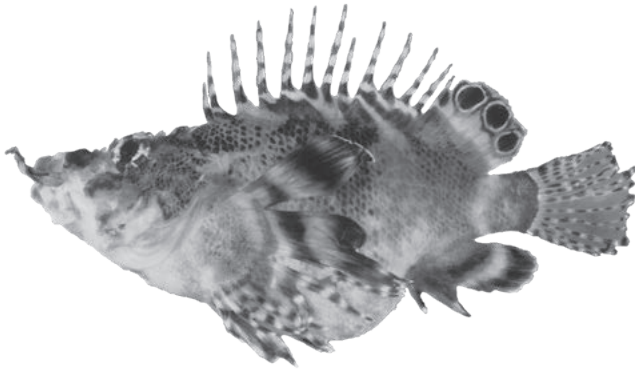
*Dendrochirus biocellatus*: Parmentier 1988\*; Debelius 1993; Chabanet 1994; Eichler & Lieske 1994\*; Lieske & Myers 1994; Fricke 1999; Letourneur *et al.* 2004; Taquet & Diringier 2007.

*Nemapterois biocellata*: Cornic 1987.

Dorsal fin 13 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 20 or 21 rays. Dorsal-fin interspinous membranes deeply incised, more so anteriorly; pectoral fins large, rounded, with little or no incision of rays in upper half of fin, but with pronounced incisions between thicker unsegmented fin rays in lower half of fin. Tentacle at lower rear margin of lachrymal nearly always prominent and usually barred, its length more than twice eye diameter. GR 5 or 6/1/9–11 = 15–18. LL scales 23–26; LSS 48–51.

Head dusky or nearly black dorsally, white in interorbital area; oblique white bar from anterior margin of orbit, across lachrymal, to base of large tentacle (this tentacle usually barred); body greyish orange dorsally, with broad, nearly black, diffuse saddles, and reddish orange ventrally; 2 or 3 ocelli on

soft-rayed portion of dorsal fin, spots ringed with yellow or gold and black, usually larger than eye diameter, except 3rd spot when present usually smaller than eye; pectoral fins with alternating diffuse dark bars, middle bar broadest and darkest, others narrower and poorly defined, and lower thickened fin rays with alternating white and dusky bars; anal fin black, with curved white bar and narrow white margin; caudal-fin membranes nearly transparent, with alternating black and white dashes over fin rays. Attains ~12 cm SL.



*Dendrochirus biocellatus*, 12 cm SL (Comoros). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Comoros and Mauritius; elsewhere to Philippines, southern Japan, Mariana Is., Solomon Is., Australia, New Caledonia, Tuamotu Is. and Line Is.

**REMARKS** Found at 30–50 m.

## *Dendrochirus hemprichi*

Matsunuma, Motomura & Bogorodsky 2017

Red Sea dwarf lionfish

PLATE 102

*Pterois brachyptera* (non Cuvier 1829); Klunzinger 1870, 1884; Weber 1913; Gruvel & Chabanaud 1937.

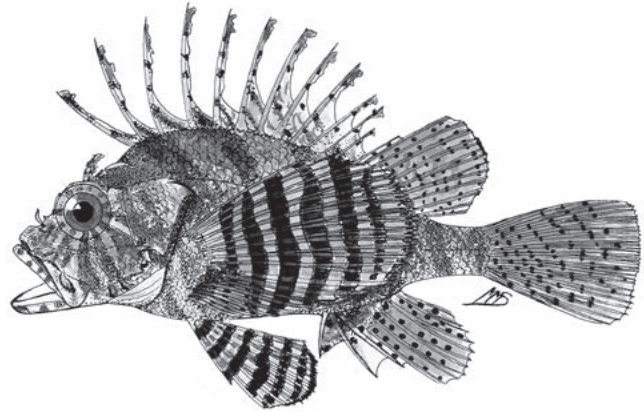
*Pterois* (*Dendrochirus*) *brachypterus* (non Cuvier 1829); Klunzinger 1884; Tortonese 1937.

*Dendrochirus brachypterus* (non Cuvier 1829): Smith 1950\*, 1957; Bentuvia & Steinitz 1952; Saunders 1960; Smith & Smith 1963\*; SFSA No. 1050\*; Maugé 1967; Tortonese 1968; Jones 1969; Bayoumi 1972; Fishelson 1975, 1977, 1978, 1997; Frøiland 1976\*; Randall 1983\*; Dor 1984; SSF No. 149.4\*; Eichler & Lieske 1994\*; De Troch *et al.* 1996; Khalaf & Disi 1997\*; Almeida *et al.* 1999 [as *brachypterus*]; Pereira 2000; Almeida *et al.* 2001 [as *brachypterus*]; McKenna & Allen 2005; Schneider *et al.* 2005; Lugendo 2007; Golani & Bogorodsky 2010.

*Dendrochirus hemprichi* Matsunuma, Motomura & Bogorodsky 2017: 30, Figs. 2a, 6, 17–20 (near Eilat, Israel, Gulf of Aqaba, Red Sea).

Dorsal fin 13 spines, 8½ or 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16–18 rays. Dorsal-fin interspinous membranes incised nearly to base anteriorly, and membranes of anterior spines fringed with small cirri along posterior edges; longest dorsal-fin rays ~1.7 in body depth; pectoral fins large, most fin membranes weakly incised (most incised between lowermost 7 rays). Supraocular cirrus usually short, if present. GR 3–5/1/9–12 = 13–17. LL scales 23–25; LSS 39–50.

Body dark reddish brown to scarlet red, with 5 or 6 broad, darker saddles, sometimes with pale areas (white, reddish or yellow) between them; 3 indistinct dark red bars below eyes; dorsal-fin spines red or reddish brown, with small dark spots, fin membrane banded greenish or yellowish and pale; pectoral fins with 4–10 dark brown to reddish bars, alternating with pale whitish to yellowish areas, but less distinct on distal and ventral parts of fin. Attains 10 cm SL.



*Dendrochirus hemprichi*, 10 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** WIO: Red Sea, Yemen, Somalia to South Africa, Madagascar and Seychelles.

**REMARKS** Found inshore, to ~70 m deep.

## *Dendrochirus zebra* (Cuvier 1829)

Zebra lionfish

PLATE 102

*Pterois zebra* Cuvier in Cuv. & Val. 1829: 367 (Ambon I., Moluccas, Indonesia; Mauritius, Mascarenes; New Guinea); Günther 1860; Guichenot 1863; Playfair & Günther 1867; Day 1875, 1878, 1889; Peters 1876, 1883; Pearson 1912; Barnard 1927; Gudger 1929; Mendis 1954\*.

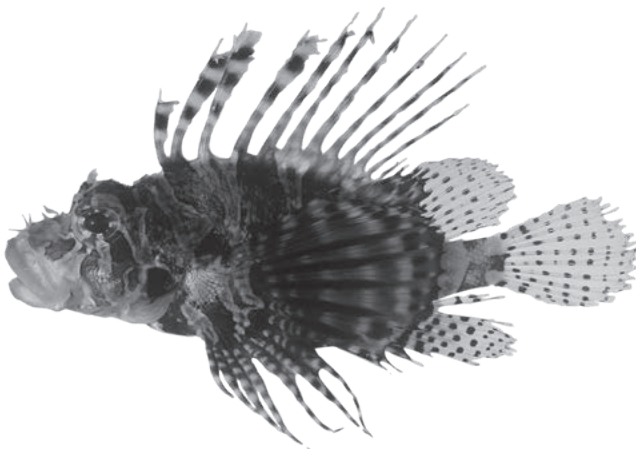
*Pseudomonopterus* (*Dendrochirus*) *zebra*: Bleeker 1875, 1876, 1879\*.

*Dendrochirus zebra*: Herre 1941; Smith 1950, 1957\*; Smith & Smith 1953; Munro 1955; SFSA No. 1049; Baissac 1968, 1976; Harmelin-Vivien 1976; SSF No. 149.5\*; Fischer *et al.* 1990\*; Letourneur 1991, 1992; Kuitert 1993\*, 1998\*; Letourneur *et al.* 1993; Eichler & Lieske 1994\*; Fricke 1999;

Pereira 2000; Mandrytsa 2001; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Letourneur *et al.* 2004; Schneider *et al.* 2005; Lugendo 2007; Golani & Bogorodsky 2010.

Dorsal fin 13 spines, 10½ or 11½ rays; anal fin 3 spines, 6½ or 7½ rays; pectoral fins 17 rays. Dorsal-fin membranes deeply incised anteriorly, nearly to fin base; longest dorsal-fin spines equal to or greater than body depth; pectoral fin membranes not incised, except between lower unbranched rays which are incised along ¼–½ length of rays. Supraocular cirrus usually long, banded (rarely absent). GR 4 or 5/1/9–12 = 14–18. LL scales 22–27; LSS 45–48.

Body and fins with 7 or 8 broad, dark brown or brownish red bars separated by paler, cream or white areas, often interspersed with narrower, slightly more obscure bars; bars on head primarily radiate from eyes, with bar from orbit to subopercle and lower part of opercle prominent and sometimes nearly black; dorsal-fin spines alternating between transverse dark and pale bands; dorsal- and anal-fin rays white or nearly so, with regularly arranged nearly black spots, and fin membranes transparent; pectoral fins greenish or greyish distally, with pinkish or reddish bars over rays more proximally, and usually with 1 or 2 irregular darker reddish brown bars at base between paler pinkish areas, and white or yellow spot in axil; pelvic fins dusky grey-black; tipped Y- or nearly T-shaped brownish red bar on peduncle. Attains 20 cm SL.



*Dendrochirus zebra*, 10 cm SL (Mauritius). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Kenya to Mozambique, Comoros, Seychelles, Mascarenes, Chagos, Maldives and India; elsewhere to Thailand, Vietnam, Indonesia, Philippines, Taiwan, southern Japan, Palau, New Guinea, Australia, New Caledonia, Vanuatu, Fiji, Tonga, Samoa and Society Is.

**REMARKS** Found from tidepools to ~80 m deep; one record from 600 m is questionable.

**GENUS** *Ebosia* Jordan & Starks 1904

Helmeted lionfishes

Dorsal fin 12 or 13 spines, 9½ or 10½ rays; anal fin 3 spines, 7½–9½ rays; pectoral fins 15–18 rays, some middle rays branched, membranes only weakly incised, and fins reaching caudal-fin base; caudal fin rounded and long, but without distinctly elongated rays. Posteroventral margin of lachrymal broad, with 2 distinct, pungent spines that point posteroventrally over maxilla. Parietal ridge elevated to thin bony crest in males. Vertebrae 9 + 15 = 24 (rarely 23). Four species, 3 in WIO.

**KEY TO SPECIES**

- |    |   |                      |
|----|---|----------------------|
| 1a | Postorbital length 19–24% SL (usually 21–24%); scale rows above lateral line 4 or 5 (usually 4).....  | <i>E. falcata</i>    |
| 1b | Postorbital length 17–21% SL (usually 18–20%); scale rows above lateral line 4–6 (usually 5) .....  | 2                    |
| 2a | Longest pelvic-fin ray 30–38% SL (usually 34%); longest pectoral-fin ray 53–58% SL (usually 58%); longitudinal scale rows above lateral line 44–46..... | <i>E. saya</i>       |
| 2b | Longest pelvic-fin ray 31–44% SL (usually 37%); longest pectoral-fin ray 55–74% SL (usually 66%); longitudinal scale rows above lateral line 47–51..... | <i>E. vespertina</i> |

*Ebosia falcata* Eschmeyer & Rama-Rao 1978

Falcate lionfish

PLATE 102

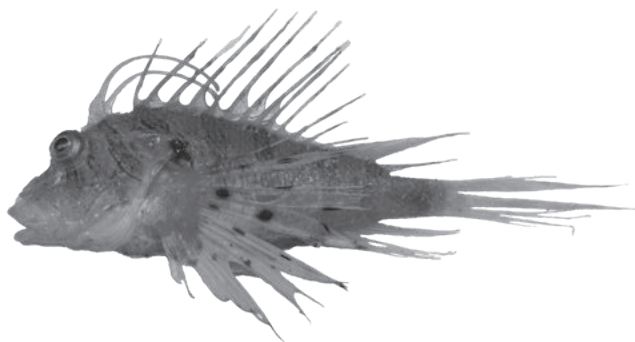
*Ebosia falcata* Eschmeyer & Rama-Rao 1978: 66, Figs. 1–3 (Somalia); Mandrytsa 2001; Das 2003; Manilo & Bogorodsky 2003.

Body relatively compressed. Dorsal fin 12 or 13 spines, interspinous membranes deeply incised, and 9½ or 10½ rays; anal fin 3 spines, 7½–9½ rays, some rays branched in larger specimens; pectoral fins 17 or 18 rays (usually 2 or 3 branched rays, to 11 or 12 branched rays in larger specimens); caudal fin with branched rays in larger specimens. Head spination variable, spines with multiple points; lachrymal with 2–4 spines over maxilla, plus a ridge of spines on lateral face; suborbital ridge typically with >10 variously shaped spinous points, usually not pungent; no upper posttemporal spine; preopercle with 3 spines, lowermost broad and often with multiple points, uppermost without supplemental spine; nasals



tubular, with only trace of a spine, if present. Supraocular cirrus present, typically dark and relatively broad, but not greatly elongate. Anterior nostrils with tab-like or frond-like flap. Parietal crest low in females, longer in males, and very long in large males. GR 4–6/1/9–11 = 14–17. Scales ctenoid, weakly attached (often lost on capture); interorbital area, occiput and snout naked; LL scales ~23–25; LSS ~40.

Colour in life probably mostly red. Attains ~11.5 cm SL.



*Ebosia falcata*, 17 cm TL (Myanmar). © Alveim © IMR

**DISTRIBUTION** WIO: Yemen, northern Somalia, and southwestern India; elsewhere, Myanmar.

**REMARKS** Known from relatively few specimens, from 47–243 m.

### *Ebosia saya* Matsunuma & Motomura 2014

Saya lionfish

*Ebosia saya* Matsunuma & Motomura 2014: 294, Figs. 1–4, 10a–c (Saya de Malha Bank).

Body relatively compressed. Dorsal fin 12 or 13 spines (membranes deeply incised), 9½ or 10½ rays (branched distally in larger specimens); anal fin 3 spines, 7½–9½ rays (branched in larger specimens); pectoral fins 17 or 18 rays, at least 2 or 3 branched (up to 12 branched in larger specimens), membranes barely incised, and rays reach to caudal-fin base; caudal fin long and rounded, rays branched in larger specimens. Head spination variable, spines with multiple points; lachrymal with 1–4 spines over maxilla, plus ridge of spines on lateral face; spines on suborbital ridge with anterior and posterior sections, with 4–10 and 3–9 spines, respectively; nasals tubular, without spines; no dorsal posttemporal spine; preopercle with 5 spines, lowermost 2 much reduced, uppermost without supplemental spine. Parietal forms thin elevated crest, low in females and longer in males. Supraocular cirrus present, typically dark and relatively broad, but not greatly elongate and relatively small

in larger specimens. Anterior nostril with tab-like or frond-like flap. GR 4 or 5/1/9 or 10 = 15 or 16. Body scales ctenoid, weakly attached and often lost on capture; interorbital region, occiput and snout naked; area between sphenotic, pterotic and posttemporal spines with small patch of pseudocycloid scales; LL scales unknown (lost in all specimens); LSS 44–46.

Body pale reddish or pinkish brown, with 4–6 darker saddles, and cream ventrally; membranes of pectoral fins and caudal fin with much yellow; pectoral fins with a few dark scattered spots, and usually a larger dark mark above pectoral-fin base just behind opercle. Attains at least 90 mm SL.

**DISTRIBUTION** Known only from type specimens collected from Saya de Malha Bank.

**REMARKS** Taken at 110–115 m.

### *Ebosia vespertina* Matsunuma & Motomura 2015

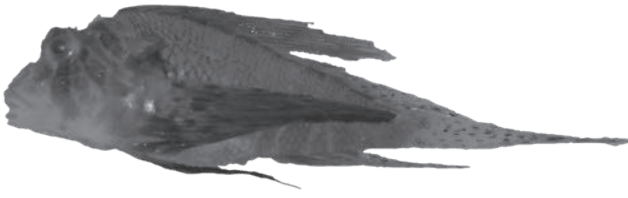
Western falcate lionfish

PLATES 102 & 103

*Ebosia vespertina* Matsunuma & Motomura 2015: 112, Figs. 1–7 (off Mozambique).

Dorsal fin 13 spines (membranes deeply incised), 9½ rays (branched in larger specimens); anal fin 3 spines, 7½ or 8½ rays (branched in larger specimens); pectoral fins 17 or 18 rays, at least 2 or 3 branched (12 branched in larger specimens), membranes barely incised, and rays reach to caudal-fin base; caudal fin long and rounded, rays branched in larger specimens. Body relatively compressed. Head spination variable, spines with multiple points. Lachrymal with 1–4 spines over maxilla, plus ridge of spines on lateral face; suborbital ridge with anterior and posterior sections, with 4–10 and 3–9 spines, respectively; nasals tubular, without spines; no dorsal posttemporal spine; preopercle with 5 spines, lowermost 2 much reduced, uppermost without supplemental spine. Parietal forms thin elevated crest, low in females and longer in males. Supraocular cirrus present, typically dark and relatively broad, but not greatly elongate and relatively smaller in larger specimens. Anterior nostrils with tab-like or frond-like flap. GR 4 or 5/1/9 or 10 = 15 or 16. Body scales ctenoid, weakly attached; interorbital region, occiput and snout naked; area between sphenotic, pterotic and posttemporal spines with small patch of pseudocycloid scales; LL scales unknown (lost upon capture); LSS 44–46.

Body pink or pinkish grey, with 4 or 5 darker reddish brown saddles; dorsal-fin membranes dark brown or nearly black; lower jaw, branchiostegal region and caudal fin distinctly yellow. Attains at least 11 cm SL.



*Ebosia vespertina*, ~6 cm SL (Madagascar). M Lee © AV2010

**DISTRIBUTION** WIO: Mozambique to South Africa (Durban) and southeastern Madagascar.

**REMARKS** Known from 54–110 m.

## GENUS *Parapterois* Bleeker 1876

Dorsal fin 12 or (usually) 13 spines,  $8\frac{1}{2}$ – $10\frac{1}{2}$  (usually  $9\frac{1}{2}$ ) rays; anal fin usually 2 spines; pectoral fins 18–21 (usually 19 or 20) rays, all branched. Cranium somewhat elevated, with relatively wide area between upper jaw and orbit; preopercle with 3 spines. Two species, both in WIO.

### KEY TO SPECIES

- 1a No scales on midline of interorbital area (but sometimes present in groove just anterior to orbits); HL 39–44% SL, head depth 21–25% SL; cirrus on rear spine of lachrymal usually not extending beyond level of rear margin of maxilla, except in young; upper margin of orbit higher than or level with dorsal-fin origin in adults, but may be lower in young; apex of ascending process of premaxilla distinctly below lower margin of orbit (may reach to level of lower margin of pupil in young)..... *P. macrura*
- 1b Scales present on midline of interorbital area; HL 34–40% SL, snout length 11–14% SL; cirrus on posterior spine of lachrymal usually extending beyond level of rear margin of maxilla (may not reach end of maxilla in some adults); upper margin of orbit distinctly below level of dorsal-fin origin; top of bulge on snout usually level with midline of pupil (in lateral view), sometimes located between levels of ventralmost margins of pupil and orbit in adults..... *P. heterura*

## *Parapterois heterura* (Bleeker 1856)

Blackfoot firefish

PLATE 103

*Pterois heterurus* Bleeker 1856: 33 (Ambon I., Moluccas, Indonesia).

*Pterois heterura*: Günther 1860.

*Parapterois heterurus*: Bleeker 1876\*, 1878\*; Herre 1952; Smith 1957; Eschmeyer & Rama-Rao 1978; SSF No. 149.6\*; Fischer *et al.* 1990\*; Manilo & Bogorodsky 2003; Motomura 2004\*; Voronina & Volkova 2007.

*Pterois nigripinnis* Gilchrist 1904: 2, Pl. 20 (off Umhlanga River mouth, KwaZulu-Natal, South Africa).

*Pterois jordani* Regan 1905: 20 (Inland Sea, Japan).

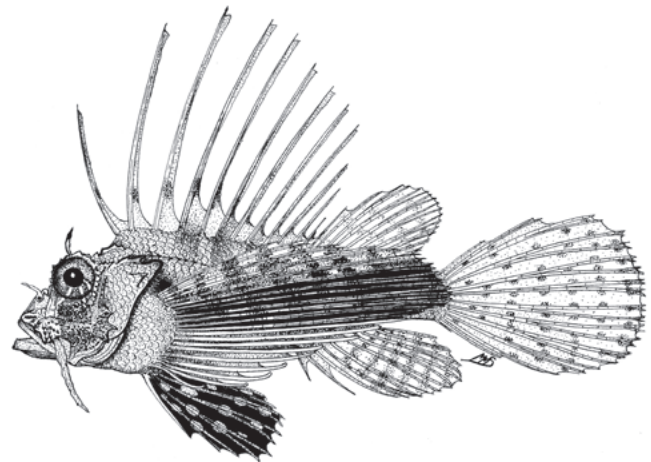
*Pterois macrurus* (non Alcock 1896): Barnard 1927; Smith 1949.

*Ebosia pavo* Schmidt 1931: 109, Figs. 18–19 (Nagasaki, Japan).

*Parapterois heterura*: Schneider *et al.* 2005.

Dorsal fin 13 spines, without flaps at posterior edges or tips of anterior spines,  $9\frac{1}{2}$  rays; anal fin 2 spines, 7 or 8 rays; pectoral fins 18–20 rays. Upper margin of orbit slightly below level of dorsal-fin origin. Interorbital area scaly, relatively deep, with narrow, but relatively slender groove between closely spaced interorbital ridges. Fleshy, elongate, cirrus on rear lobe of lachrymal extends beyond rear margin of maxilla; supraoccipital cirrus relatively short; rear margin of anterior nostrils with relatively well-developed elongate and frond-like cirrus. GR 4–6/1/9–11 = 14–16. LL scales 22–25 (scales often lost); LSS 45–51.

Body with dark brown or brownish red bars extending from dorsal-fin base to ventrum, with tan areas in between which enclose paler and more diffuse bars; similar dark bars on head below eyes; snout tip and jaws orange-red; supraocular cirrus variably dark or pale, with dark, relatively round spot at tip; cirrus at rear of lachrymal pale, but often dusky along posterior edge; dorsal-fin membranes orange-red; medial surface of pectoral fins bright orange or orange-red distally, and dark brown with wavy brilliant blue streaks proximally, and lateral surface with prominent dark reddish brown bands alternating with reddish orange or paler brown areas; caudal fin nearly transparent, with small brownish spots over fin rays. Attains at least 17.5 cm SL.



*Parapterois heterura*, 10 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Socotra, Somalia to South Africa (KwaZulu-Natal); elsewhere, Indonesia, Philippines, Taiwan and Japan.

**REMARKS** Found at 2–300 m.

## *Parapterois macrura* (Alcock 1896)

*Pterois macrura* Alcock 1896: 303 [3], Pl. 18 (Malabar coast, India); Alcock & Anderson 1898\*; Alcock 1899; Kurian 1953; Menon & Yazdani 1968; Menon & Rama-Rao 1975.

*Parapterois macrura*: Mandrytsa 1990, 2001; Motomura 2004; Matsunuma *et al.* 2013; Psomadakis *et al.* 2015.

Dorsal fin 12 or 13 spines, 8½ or 9½ rays; anal fin 2 spines, 7½ or 8½ rays; pectoral fins 19 or 20 rays; 1 or 2 upper caudal-fin rays filamentous. Upper margin of orbit above level of dorsal-fin origin; area between eyes and upper margin of lachrymal and suborbital bones broad; cirrus on lower edge of lachrymal about twice as long as wide, not reaching rear margin of maxilla. Anterior nostrils with moderately large flap-like cirrus on rear margin; posterior nostrils a large hole, without fringing tube or cirri. GR 4–6/1/9–11 = 14–17. LL scales 22 or 23; vertical scale rows 43–49; no scales between posterior nostrils.

Head and body reddish brown, with dark narrow vertical bars on flanks and beneath eyes; a flap with small black spots sometimes present on tip of 1st dorsal-fin spine; upper and lower edges of pectoral fins orange-red. Attains 16.5 cm SL.

**DISTRIBUTION** WIO: Oman and Pakistan to southwestern India.

**REMARKS** Known from 41–271 m.

## GENUS *Pterois* Oken 1817

Dorsal fin 12 (rarely) or 13 spines, all spines except last 3 elongate, and interspinous membranes deeply incised for nearly entire length of spines; anal fin 3 spines. Interorbital area narrow, deeply concave, and with weak ridges; occiput relatively short, flat. Suborbital ridge without spines in young, but with increasing number of small spines with growth. No teeth on palatines. Scales variable, but mostly small and pseudocycloid (cf. larger and mostly ctenoid in species of subgenus *Pteropterus*); scales present between dorsal-fin origin and rear of occiput. Swimbladder more than twice as long as wide; extrinsic swimbladder musculature inserts directly onto swimbladder without attaching to cleithrum. Vertebrae 9 + 15 = 24.

Twelve species, 7 in WIO. The molecular work of Kochzius *et al.* (2003) and Kochzius & Blohm (2005) suggest that some species and populations are assignable to subgenus

*Pteropterus* Swainson 1839 (as recognised by Smith [1957] and Mandrytsa [2001]) or may be more closely related to *Dendrochirus*, which is not readily separated from *Pterois*. These genera are in need of revision.

### KEY TO SPECIES

- |    |  |                           |
|----|--|---------------------------|
| 1a | Pectoral fins short, reaching only to 3rd ray of anal fin.....   | <i>P. brevipectoralis</i> |
| 1b | Pectoral fins long, reaching caudal-fin base or beyond.....  | 2                         |
| 2a | Depth of lachrymal greater than orbit diameter; suborbital stay relatively distant from orbit; scales pseudocycloid, vertical scale rows 70–95; pectoral fins 13 or 14 rays; dorsal fin 13 or 14 spines..... | 3                         |
| 2b | Depth of lachrymal less than orbit diameter; suborbital stay relatively close to orbit; scales primarily ctenoid, vertical scale rows 46–60; pectoral fins 16–19 rays; dorsal fin 12 or 13 spines.....       | 4                         |
| 3a | Dorsal- and anal-fin rays and caudal fin without dark spots; pectoral fins usually 13 rays.....  | <i>P. russelii</i>        |
| 3b | Dorsal- and anal-fin rays and caudal fin with numerous dark spots; pectoral fins usually 14 rays.....  | <i>P. miles</i>           |
| 4a | Dorsal fin usually 13 spines; supraocular cirrus very short or absent, diminishing in size with growth.....  | <i>P. mombasae</i>        |
| 4b | Dorsal fin usually 12 spines; supraocular cirrus (tentacle) typically very long.....   | 5                         |
| 5a | Supraocular cirrus usually pale, not banded; upper end of dark bars on flanks usually bifurcate, rarely trifurcate; peduncle with 2 longitudinal white stripes that may merge anteriorly.....                | 6                         |
| 5b | Supraocular cirrus distinctly banded black and white, and with black flaps projecting laterally; upper end of dark bars on flanks not forked; peduncle with vertical to oblique bands.....                   | <i>P. antennata</i>       |
| 6a | Longest pelvic-fin ray 48–72% SL; dark lateral bars relatively narrow, width of 4th bar (measured at dorsal-fin base) 5.8–9.3% SL.....   | <i>P. cincta</i>          |
| 6b | Longest pelvic-fin ray 37–53% SL; dark lateral bars relatively broad, width of 4th bar 6.5–11.3% SL.....   | <i>P. radiata</i>         |

*Pterois antennata* (Bloch 1787)

Broadbarred lionfish

PLATE 104

*Scorpaena antennata* Bloch 1787: 21, Pl. 185 (Ambon I., Moluccas, Indonesia); Bloch 1788; Bloch & Schneider 1801.

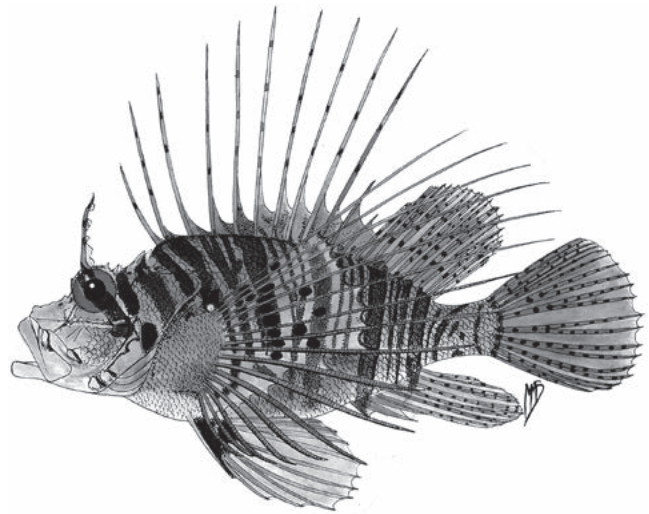
*Pterois antennata*: Cuvier in Cuv. & Val. 1829; Liénard 1839; Günther 1860; Guichenot 1863; Playfair & Günther 1867; Gudger 1929; Norman 1939; Smith 1957; Fourmanoir & Guézé 1963; Jones 1969; Baissac 1976, 1990; Harmelin-Vivien 1976; SSF No. 149.7\*; Cornic 1987\*; Winterbottom *et al.* 1989; Fischer *et al.* 1990\*; Letourneur 1991, 1992, 1998; Debelius 1993; Chabanet 1994; Eichler & Lieske 1994\*; Al-Abdessalaam 1995; Randall 1995\*; Kemp 1998; Fricke 1999; Pereira 2000; Rao *et al.* 2000; Gell & Whittington 2002; Devi & Rao 2003; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Letourneur *et al.* 2004; Field 2005\*; McKenna & Allen 2005; Schneider *et al.* 2005; Fishelson 2006; Gillibrand *et al.* 2007; Voronina & Volkova 2007.

*Pterois ellioti* Meek 1897: 169, Pl. 40 ('west coast of Africa' [Berbera, Somalia]); Ibarra & Stewart 1987.

*Pteropterus antennata*: Smith 1957; Smith & Smith 1963\*.

Dorsal fin 13 spines (longest spines longer than body depth; membranes incised nearly to base),  $10\frac{1}{2}$ – $12\frac{1}{2}$  rays; anal fin 3 spines,  $6\frac{1}{2}$  rays; pectoral fins 16 or 17 rays, all unbranched, and membranes deeply incised  $\frac{1}{2}$ – $\frac{3}{4}$  length of rays. Head and body of variable width. Head spines small, pungent, increasing in number with growth, most notably those spines in row on suborbital bones and immediately above and behind orbit. Interorbital area with deep groove. Supraorbital tentacle long, often fimbriate. Slit behind last gill arch small to moderate. GR 4 or  $5/1/8$ – $10$  = 13–16. Scales ctenoid, except weakly ctenoid or mostly pseudocycloid on lower flanks, breast, and anterior to pectoral fins; LL scales 24–27; LSS 46–60.

Head and body with red or reddish brown bars with narrow white or pale margin, bars narrower posteriorly, those on peduncle narrowest, irregular, oblique; supraoccipital tentacle banded white and dark brown or black; large pale or white cirrus at rear end of lachrymal and another near tip of maxilla; dark brown or black spot on subopercle; dorsal fin spines alternating from nearly black to white, except proximally where they are paler and reddish; upper part of pectoral-fin bases often with small white spot, fin membranes with dark spots proximally, and filamentous rays white to pale red. Attains ~20 cm TL.



*Pterois antennata*, 18 cm TL (N Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Oman to South Africa (Protea Bank), Madagascar, Comoros, Seychelles, Mascarenes and Chagos; a report from the Red Sea by Field (2005) needs confirmation (Golani & Bogorodsky 2010); elsewhere to Indonesia, southern Japan, Wake Atoll, Australia, Society Is., Marquesas Is. and Line Is.

**REMARKS** Crepuscular and nocturnal; found mainly on coral reefs, in caves or under ledges, inshore to at least 76 m deep.

*Pterois brevipectoralis* (Mandrytsa 2002)

Short-finned lionfish

PLATE 104

*Pteropterus* sp.: Mandrytsa 2001.

*Pteropterus brevipectoralis* Mandrytsa 2002: 129, Fig. (Saya de Malha Bank); Voronina & Volkova 2007.

*Pterois brevipectoralis*: Matsunuma & Motomura 2013.

Dorsal fin 13 spines,  $10\frac{1}{2}$  rays; anal fin 3 spines,  $6\frac{1}{2}$  rays; pectoral fins usually 16 rays, fins relatively short, almost reaching 3rd anal-fin spine, and membranes notably incised. Large adults with large fan-like skin flaps on tip of posterior lachrymal spine and on preopercle margin; no supraocular cirrus. GR 4 or  $5/1/10$  or  $11$  = 15–17. Scales ctenoid on head and upper body; LL scales 25 or 26; vertical scale rows 53–55.



Head and body mostly whitish, pinkish dorsally and on jaws; numerous narrow red bands on sides, and reddish band across eyes; opercle with blackish blotch; pectoral-fin rays with several reddish bands distally, 6–10 dark blotches on membranes, and margin black; pelvic fins dark red, margin blackish; caudal fin transparent, with numerous tiny dark spots on rays. Attains ~15 cm SL.

**DISTRIBUTION** WIO: Saya de Malha Bank and St Brandon Shoals.

**REMARKS** Found in 57–90 m.

### *Pterois cincta* Rüppell 1838

Red Sea lionfish

PLATE 104

*Pterois cincta* Rüppell 1838: 108, Pl. 26, Fig. 3 (Jeddah, Saudi Arabia, Red Sea); Günther 1860; Playfair & Günther 1867; Klunzinger 1870; Day 1875 [in part], 1878\*; Roux-Estève & Fourmanoir 1955; Kuronuma & Abe 1986.

*Pterois radiata* (non Cuvier 1829): Klunzinger 1884; Abel 1960; Fishelson 1975; Randall 1983; Tortonese 1983; Dor 1984; Khalaf & Disi 1997; Rilov & Benayahu 2000; Khalaf & Kochzius 2002; Golani & Bogorodsky 2010.

Body relatively compressed. Dorsal-fin rays usually 12 spines, 10–12 (usually 11) rays; anal fin 3 spines, 5½ or 6½ rays, membranes incised nearly to base; pectoral fins 15–18 (usually 16) rays; anal-fin rays relatively long, length of longest ray 40.4% (35.8–44.8%) SL. Dorsal-fin origin above front edge of opercle; rays relatively long, length of longest ray 35.8% (30.9–40.5%) SL; spines longer than body depth. Pectoral fins long, reaching past caudal-fin base in juveniles and nearly to caudal-fin margin in adults (lengths of upper 7 rays on average 91–104% SL), and membranes deeply incised for ~½ of ray. Longest pelvic-fin rays ~60% (48–72%) SL, extending beyond base of posteriormost anal-fin ray when depressed. Caudal fin rounded. Snout with 3 barbels anteriorly; flap on anterior nostrils with finely ciliate margin; supraocular tentacle long, simple, slender, typically twice eye diameter; postorbital sensory canal absent or not connected to sphenotic spine. GR 4 or 5/1/7–11 = 12–16. Scales on head and body mostly ctenoid, especially well-developed in predorsal area; scales pseudocycloid on underside of head, breast, abdomen and pectoral-fin bases; LL scales 24–26; LSS 51–57.

Body with 5 broad dark orangish or reddish brown bars (last 2 bars narrowest), separated by thin white lines, and diverging to form some triangular reddish brown areas dorsally and ventrally; bars on head and anterior part of body typically darker, and oblique bar with white margins runs through eye; peduncle with 2 relatively narrow, nearly horizontal, white

lines on either side of an oblique reddish band; pectoral fins dark reddish proximally, pink or white distally (no dark spots), membranes nearly transparent. Attains 16 cm SL.

**DISTRIBUTION** WIO: endemic to Red Sea.

### *Pterois miles* (Bennett 1828)

Devil firefish

PLATE 105

?*Scorpaena mahe* Lacepède 1801: 259, 278, Pl. 17, Fig. 3 (Mahé, Seychelles); Fishelson 2006; Allen & Erdman 2008.

*Scorpaena miles* Bennett 1828: no page number, Pl. 9 (south coast of Sri Lanka).

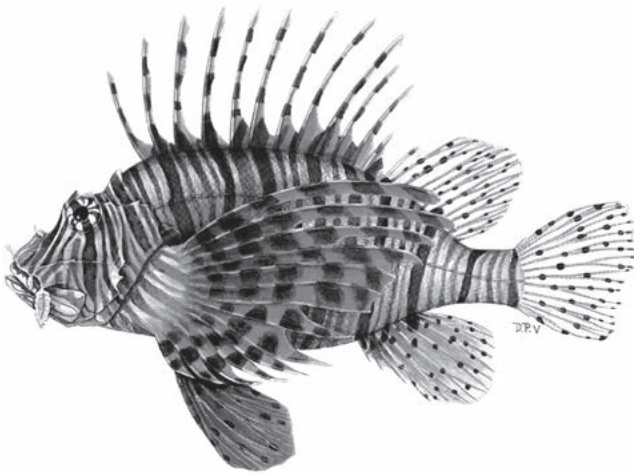
*Pterois muricata* Cuvier in Cuv. & Val. 1829: 363 (Red Sea; Réunion, Mascarenes); Sauvage 1891.

*Scorpaena volitans* (non Linnaeus 1758): Bennett 1834\*.

*Pterois volitans* (non Linnaeus 1758): Günther 1860; Tennent 1861; Klunzinger 1870, 1884; Day 1889; Barnard 1927; Deraniyagala 1933; Fowler 1935; Smith 1949\*, 1950\*, 1957\*; Mendis 1954; Munro 1955; Fourmanoir 1957\*; Smith & Smith 1963\*; Maugé 1967; Jones 1969; Randall 1983; Dor 1984; Kuronuma & Abe 1986; Schultz 1986; Cornic 1987\*; Doubilet & Ghisotti 1993; Fridman & Malmqvist 1994; Goren & Dor 1994; Pereira 2000; Schneider *et al.* 2005; Fishelson 2006. *Pterois miles*: Günther 1860; Tennent 1861; Day 1875\*, 1889; Gilchrist & Thompson 1908; Bamber 1915; Deraniyagala 1933; Blegvad & Løppenthin 1944; Smith 1949; Mendis 1954; Munro 1955; Dor 1984; SSF No. 149.8\*; Winterbottom *et al.* 1989; Fischer *et al.* 1990\*; Bernadsky & Goulet 1991; Collette & Parin 1991; Edwards & Shepherd 1992; Golani & Sonin 1992; Eichler & Lieske 1994\*; Randall 1995\*; De Troch *et al.* 1996; Carpenter *et al.* 1997\*; Khalaf & Disi 1997\*; Field & Field 1998\*; Golani 1998; Almeida *et al.* 1999; Fricke 1999; Pereira 2000; Whitfield *et al.* 2002; Kochzius *et al.* 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004; Field 2005\*; McKenna & Allen 2005; Schneider *et al.* 2005; Tessier *et al.* 2005; Gillibrand *et al.* 2007; Hamner *et al.* 2007; Lugendo *et al.* 2007; Allen & Erdman 2008\*; Fricke *et al.* 2009; Tyler *et al.* 2009; Golani & Bogorodsky 2010.

Dorsal fin 13 spines, interspinous membranes incised nearly to base, 9½–11½ elongate rays; anal fin 3 spines, 6½ or 7½ rays; pectoral fins with 12–14 long rays, reaching past anal-fin base in adults, and membranes feathery. Supraocular cirrus usually fimbriate, if present. GR 4 or 5/1/8–11 = 14–17. LL scales 20–27; LSS 84–95.

Head and body with pale background and numerous dark red or reddish brown vertical bars, typically of irregular width; 3 or 4 broad stripes radiate from eyes; supraocular cirrus usually dark brown or black, sometimes faintly barred; dorsal-fin spines with dark brown, dark grey or dark red areas alternating with nearly white areas; dorsal-, anal- and caudal-fin rays with numerous black spots, membranes translucent. Attains 35 cm SL.



*Pterois miles*, 19 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Indian Ocean, Lessepsian migrant to Mediterranean Sea, and invasive in western Atlantic and Caribbean Sea. WIO: Persian/Arabian Gulf, Oman, Red Sea, Kenya to South Africa (Eastern Cape), Madagascar, Comoros, Seychelles, Mascarenes, Chagos and Sri Lanka; elsewhere to Indonesia.

### *Pterois mombasae* (Smith 1957)

Mombasa turkeyfish

PLATE 105

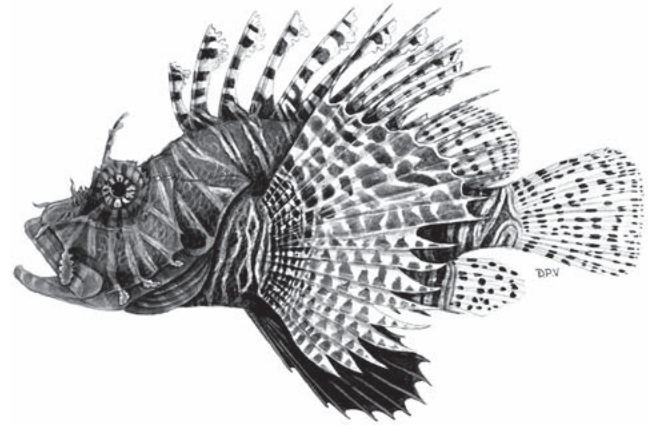
*Pteropterus mombasae* Smith 1957: 80, Fig. 7, Pl. 6d (reef near Mombasa, Kenya).

*Pterois mombasae*: SSF No. 149.9\*; Poss & Mee 1995; Randall 1995\*; Pereira 2000; Mandrytsa 2001; Manilo & Bogorodsky 2003; Venkataraman 2003; Field 2005\*; McKenna & Allen 2005; Voronina & Volkova 2007; Ramesh *et al.* 2008 [misspelled *Petrois*]; Psomadakis *et al.* 2015.

Dorsal fin 13 spines, 10½ rays; anal fin 3 spines, 5½–7½ (usually 6½) rays; pectoral fins 17–20 rays. Dorsal-fin origin above anterior edge of opercle; dorsal-fin spines 8 or 9 usually longest, 30–35% SL (spines easily broken). Maxilla extends to before front margin of pupil. Numerous head spines bifid or multifid; lachrymal and suborbital ridge with numerous small spines (≥10 in larger fish); preopercle with 3 spines. Small cirrus at both preocular spine and supraocular spine; often cirri on snout and at upper margin of pupil. Scales on body mostly ctenoid; scales present between rear of occiput and dorsal-fin origin. GR 4 or 5/1/8–10 = 13–16. LL scales 24–27; LSS 38–51.

Body mostly red-orange or brownish red dorsally, somewhat paler ventrally, and salmon-pink on breast and chin; dark reddish brown ocellus on subopercle; colours darkest in

broad, roughly vertical bars, alternating from broad to narrow, with white or pale pink in between, except on peduncle where bars are incomplete and more irregular, and some bars appear to radiate from eyes; dorsal-fin spines and membranes annulated with black, dark grey or brown, separated by white or pinkish regions; soft median-fin membranes usually pinkish and nearly transparent but with numerous small black spots. Attains 16.5 cm SL.



*Pterois mombasae*, 11 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indian Ocean. WIO: Red Sea, Pakistan to South Africa (Aliwal Shoal), Seychelles and Sri Lanka.

**REMARKS** Found in 5–65 m. Western Pacific specimens previously identified as *P. mombasae* have recently been described as *P. paucispinula* Matsunuma & Motomura 2014.

### *Pterois radiata* Cuvier 1829

Radial lionfish

PLATE 105

*Pterois radiata* Cuvier (ex Parkinson) *in* Cuv. & Val. 1829: 369 (Tahiti, Society Is.); Klunzinger 1884; Day 1889; Smith 1957; Abel 1960; Tortonese 1968; Jones 1969; Froiland 1972; Randall 1983\*; Dor 1984; SSF No. 149.10\*; Bouhlel 1988; Fischer *et al.* 1990\*; Nougier & Refait 1990; Eichler & Lieske 1994\*; Randall 1995\*; Khalaf & Disi 1997\*; Field & Field 1998\*; Kuitert 1998\*; Pereira 2000; King & Fraser 2002\*; Garpe & Öhman 2003; Field 2005; McKenna & Allen 2005; Schneider *et al.* 2005; Fishelson 2006; Tyler *et al.* 2009; Golani & Bogorodsky 2010. *Pteropterus radiata*: Swainson 1839; Smith 1957\*; Smith & Smith 1963\*; Maugé 1967; Halstead 1970\*; Mandrytsa 2001.

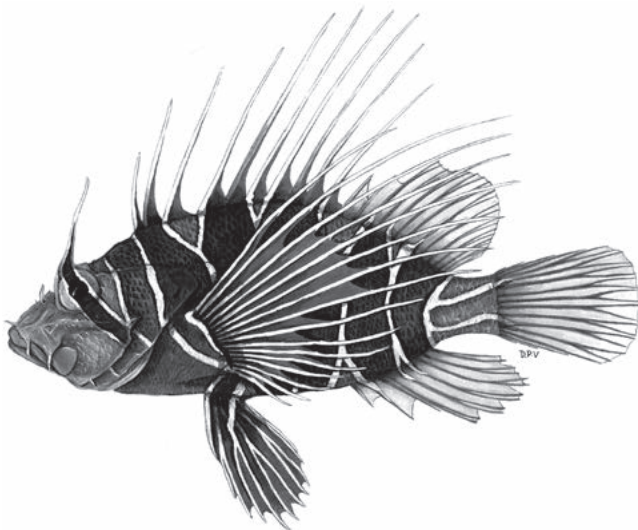
*Pterois* (*Pseudomonopterus*) *vittata* Sauvage 1878: 135, Pl. 1, Fig. 10 (Nuku Hiva, Marquesas Is.).

*Scorpaena barffi* Curtiss 1944: 11 (lagoon near Tautira, Tahiti, Society Is).

*Pteropterus radiatus*: Bouhlel 1988.

Body relatively compressed. Dorsal fin 12 (rarely) or 13 spines, 11½ rays; anal fin 3 spines, 5½ or 6½ rays; pectoral fins 16 rays (longest ray ~45% SL). Dorsal-fin origin above front edge of opercle; fin spines longer than body depth, and fin membranes incised nearly to base; pectoral fins long, reaching past caudal-fin base in juveniles and nearly to caudal-fin margin in adults, fin membranes deeply incised for ~½ of fin; caudal fin rounded. Head spines small but increasing in number with growth; lachrymal with clusters of spines radiating in 5 or 6 ridges; suborbital ridge of juveniles with 1 antrorse and 2 retrorse spines, and spines becoming more numerous with growth. Maxilla extends to vertical between front margins of orbit and pupil. Snout with 1–4 tentacles anteriorly; flap on anterior nostrils with finely ciliate margin; supraocular tentacle long, simple, slender, typically twice orbit diameter; preopercle often with a few tentacles on rear margin near angle of preopercle. GR 4/1/9–11 = 14–16. Scales on head and body mostly ctenoid, especially well-developed near predorsal area; scales pseudocycloid on underside of head, breast, abdomen and pectoral-fin bases. LL scales 23–25; LSS 49–56.

Body with wide dark orangish or reddish brown bars separated by thin white lines, diverging to form some triangular reddish brown areas dorsally and ventrally; bars on head and anterior part of body typically darker, and oblique bar with white margins runs through eye; peduncle with 2 relatively narrow, nearly horizontal, white lines on either side of an oblique reddish band; pectoral-fin rays dark reddish proximally, white distally (no dark spots), rays pale red or pink, membranes nearly transparent. Attains ~15 cm SL.



*Pterois radiata*, 10 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Oman to South Africa (Sodwana Bay), Comoros, Seychelles and India; not known from Red Sea; elsewhere to Cocos (Keeling) Is., Indonesia, Taiwan, southern Japan, Marshall Is., Australia, Samoa and Tuamotu Is.

**REMARKS** Relatively uncommon; appears to prefer shallow rocky reefs, at 0.5–27 m, but its depth

**DISTRIBUTION** is poorly documented.

### *Pterois russelii* Bennett 1831

Plaintail lionfish

PLATE 105

*Gasterosteus kodipungi* Russell 1803: 25, Pl. 133, index [not proposed as binomial].

*Pterois russelii* Bennett (ex Russell) 1831: 128 ([Coromandel coast] India); Day 1877\*; Smith 1949, 1957\*; Munro 1955; Smith & Smith 1963\*; Poss & Mee 1995; Randall 1995\*; Carpenter *et al.* 1997\*; Pereira 2000; Mandrytsa 2001; Heemstra & Heemstra 2004; Golani & Bogorodsky 2010; Psomadakis *et al.* 2015.

*Pterois kodipungi* Bleeker 1852: 450 (Bangka, Jakarta and Padang, Indonesia); Barnard 1927.

*Pseudomonopterus (Pterois) kodipungi*: Bleeker 1876.

*Pterois miles* (non Bennett 1828): Gilchrist & Thompson 1908; Frøiland 1972; Dor 1984.

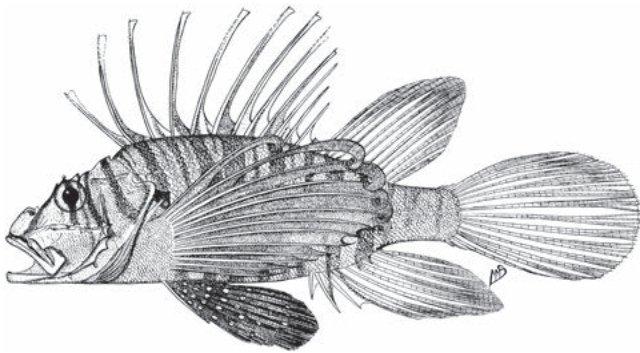
*Pterois russelii*: Blegvad & Løppenthin 1944; Smith 1950; Poss & Rama-Rao 1984; SSF No. 149.11\*; Baissac 1990; Fischer *et al.* 1990\*; Al Sakaff & Esseen 1999; Schneider *et al.* 2005.

?*Pterois lunulata* (non Temminck & Schlegel 1843): Cornic 1987\*; Randall 1995\*.

Dorsal fin 13 spines, 11½ rays; anal fin 3 spines, 7½ rays; pectoral fins 13 rays. Dorsal-fin spines longer than body depth, fin origin immediately anterior to pectoral-fin bases; pectoral fins extend to caudal-fin margin in young, but only to caudal fin-base in adults, fin membranes deeply incised. Interorbital area concave and scaly. GR 4–6/1/9–12 = 15–18. LL scales 21–28; LSS 67–75.

Head, body and fins red or reddish pink, with ~16 brown or reddish brown vertical bars on body alternating with narrower whitish bars; pectoral fins reddish or pinkish, with black spots over 2 uppermost rays, small white spots typically present in axil, and large black spot over cleithrum; some reddish spots but no dark spots on median fins. Attains 30 cm SL.





*Pterois russelii*, 25 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: Pakistan, Persian/Arabian Gulf, Gulf of Oman, Tanzania to South Africa, Madagascar, Mascarenes and India; elsewhere to Bay of Bengal, Thailand, Malaysia, Indonesia, Philippines, Taiwan and Australia.

**REMARKS** Found to at least ~60 m deep, probably occurs deeper.

## SUBFAMILY SCORPAENINAE

### GENUS *Caracanthus* Krøyer 1845

#### Coral crouchers

Head and body compressed, relatively rounded or ovate in lateral and transverse profile, and dorsal profile of head notably rounded. Head with strong bony (but not pungent) knobs, especially in mid- and post-orbital area; head and body densely covered with dermal tubercles or papillae not associated with scales. Pectoral fins very short, rays greatly thickened at base, but strongly branched distally. Pelvic fins minute, often deeply inserted and difficult to see, with 1 spine, 2 or 3 rays. Lachrymal moveable, usually with 2 spines (1st small; 2nd very large, triangular and pointing ventrally); 2nd and 3rd suborbitals relatively narrow, curved posteroventrally to firmly unite at base of upper preopercular spine; no postorbital bones. No teeth on palatines. Gill slits restricted through firm connection between branchiostegal membranes and isthmus. No scales, except on lateral line. Species of *Caracanthus* have been found to be hermaphroditic (Cole 2003; Wong *et al.* 2005; Sadovy de Mitcheson & Liu 2008). This genus is in need of revision. Possibly 4 or 5 species, 2 or 3 in WIO, with the status of fish from India and Sri Lanka uncertain and type specimens evidently lost. There are unverified reports of *C. maculatus* (Gray 1831) from Lakshadweep (Jones 1969) and Mauritius (Baissac 1990).

#### KEY TO SPECIES

- 1a Body grey or brown, covered with small red-orange spots or blotches; relatively large notch between dorsal-fin spines and rays; pectoral fins 13–15 rays ..... *C. madagascariensis*
- 1b Body colouration relatively uniform, usually brown, orangish red or greyish, often darker above lateral line; dorsal fin only weakly notched between spinous and soft-rayed portions; pectoral fins 12 or 13 rays ..... *C. unipinna*

### *Caracanthus madagascariensis* (Guichenot 1869)

#### Madagascar coral croucher

PLATE 101

*Crossoderma madagascariensis* Guichenot 1869: 195, Pl. 12, Fig. 1 (Toliara, Madagascar).

?*Amphiprionichthys zeylonensis* Day 1870: 515 (off Galle, Sri Lanka); Whitehead & Talwar 1976.

*Caracanthus madagascariensis*: Bleeker 1874; Sauvage 1875\*; SSF No. 153.1\*; Winterbottom *et al.* 1989; Fricke 1999; Letourneur *et al.* 2004; McKenna & Allen 2005.

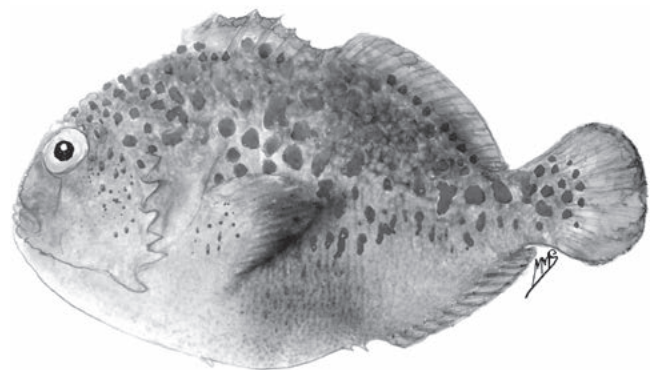
?*Micropus zeylonicus*: Day 1875; Mendis 1954.

*Caracanthus maculatus* (non Gray 1831): Regan 1908; Smith 1957\*, 1958\*, 1961\*; Smith & Smith 1963\*.

*Caracanthus zeylonicus*: Fourmanoir 1957\*; Arnoult *et al.* 1958.

Dorsal fin 7 or 8 spines, 12 or 13 rays; anal fin 2 spines, 11 or 12 rays; pectoral fins 13–15 rays. Lachrymal with single spine or knob plus much larger spine.

Body greyish brown, with irregular red-orange spots, denser dorsally. Attains 5 cm SL.



*Caracanthus madagascariensis*, 5 cm TL (N Mozambique). Source: SSF

**DISTRIBUTION** WIO: Mozambique, Madagascar, Comoros, Seychelles, Mauritius, Chagos, Maldives and Sri Lanka.

**REMARKS** Lives among branching corals. *Amphiprionichthys zeylonensis* Day 1870 from Sri Lanka may be a synonym, and some authors have treated this species as a synonym of *Caracanthus maculatus* (Gray 1831). Detailed study of the differences between these nominal forms is needed.



## *Caracanthus unipinna* (Gray 1831)

Pygmy coral croucher

PLATE 102

*Micropus unipinna* Gray 1831: 20 (Pacific Ocean); Günther 1860; Pfeffer 1893; Alcock 1896; Steindachner 1901.

*Amphiprionichthys apistus* Bleeker 1855: 173 (Cocos [Keeling] Is.).

*Centropus staurophorus* Kner 1860: 531 [3], Fig. 1 (Zanzibar, Tanzania).

?*Caracanthus unipinna*: Peters 1876, 1883; Bleeker 1879; Sauvage 1891; Regan 1908; Baissac 1955; Smith 1957; Hiatt & Strasburg 1960; Maugé 1967; Tyler 1971; SSF No. 153.2\*; Letourneur *et al.* 2004; McKenna & Allen 2005; Fricke *et al.* 2009.

*Micropus longipinnis* Jatzow & Lenz 1898: 505, Pl. 34, Fig. 2 (Zanzibar, Tanzania).

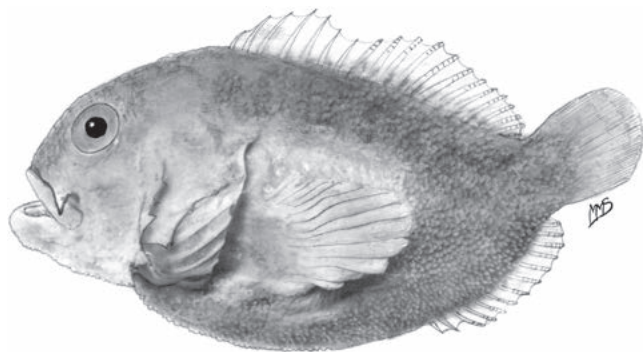
*Caracanthus zeylonicus* (*non* Day 1870): Smith 1931; Fourmanoir 1957\*; Arnoult *et al.* 1958.

*Caracanthus unipinnus*: Smith 1958\* [in part]; Smith & Smith 1963\*; Randall 1975.

*Caracanthus unipinnis*: Baissac 1968.

Dorsal fin 7 or 8 spines, 12 or 13 rays; anal fin 2 spines, 11 or 12 rays; pectoral fins 12 or 13 rays. Dorsal fin continuous or barely notched. Lachrymal with 1 long spine and 2 small lump-like spines at front of bone, immediately before and below eye.

Body relatively uniformly brown, orangish red or greyish, without spots, but often darker above lateral line. Attains 5 cm SL.



*Caracanthus unipinna*, 4 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Tanzania to South Africa (Sodwana Bay), Comoros, Madagascar, Seychelles, Réunion, Mauritius and Chagos; elsewhere to southern Japan, Australia, New Guinea, Tonga and Pitcairn Is.

**REMARKS** Records from the Red Sea and Persian/Arabian Gulf need confirmation. Found in shallow water among *Acropora* and *Pocillopora* corals.

## GENUS *Iracundus* Jordan & Evermann 1903

Lachrymal with 2 spines over maxillary (1st spine points forward; 2nd spine broad, pointing posterolaterally); suborbital ridge without spines except for 1 spine at rear before preopercle; preopercular spines short, usually only 3 developed, with no supplemental preopercular spine at base of the uppermost spine. Dorsal fin with 4th spine notably elongate in specimens >5 cm SL. No palatine teeth. Vertebrae 9 + 15 = 24. One species.

## *Iracundus signifer* Jordan & Evermann 1903

Decoy scorpionfish

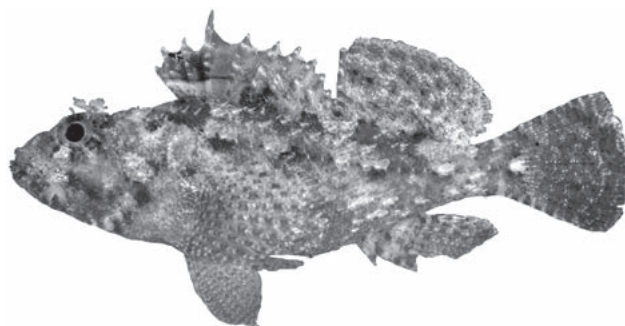
PLATE 103

*Iracundus signifer* Jordan & Evermann 1903: 210 (Honolulu, Oahu I., Hawaii); Madden 1973; Shallenberger & Madden 1973; Eschmeyer & Randall 1975\*; SSF No. 149.12\*; Cornic 1987; Debelius 1993; Lieske & Myers 1994; Fricke 1999; Smith & Wheeler 2004; Shinohara & Imamura 2007\*.

*Iracundus signifer rarotongae* Whitley 1965: 114 (Cook Is.).

Diagnosis as for genus. Dorsal fin 12 spines (in adults, 4th spine elongate and succeeding spines progressively shorter), 9½ or 10½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17 or (usually) 18 rays. GR 7/1/12–15 = 20–23. LL scales 25 or 26; LSS 65–75.

Body white with red mottling in ~4 oblique, irregular, interrupted saddles; small black spot between dorsal-fin spines 2–3. Attains 13 cm SL.



*Iracundus signifer*, 8 cm SL (Comoros). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: South Africa, Comoros, Réunion and Mauritius, but may occur more widely in the region; elsewhere to southern Japan, New Guinea, Australia, Pitcairn Is., Tuamotu Is. and Hawaii.

**REMARKS** Found on coral reefs, from near surface to at least 217 m deep.

GENUS *Neomerinthe* Fowler 1935

Lachrymal with weak, rounded anteroventral margin, with 2 spines (1st smaller, directed ventrally; 2nd larger, directed posteroventrally); no coronal spines. Interorbital area concave, with distinct ridges but without spine posteriorly. Occiput moderate-sized, nearly flat, but usually slightly rounded, without depression or pit. Pectoral fins with simple divided rays, lower rays unbranched, and membranes distinctly incised. Teeth present on palatines. Slit behind last hemibranch small or absent. Lateral line complete. Scales ctenoid on head and body. Vertebrae 9 + 14 or 15 = 23 or 24 (rarely 23).

This heterogeneous taxon is not well-defined and is in need of revision. Because of irregular variation in head spination and subtle allometry of some features, simple ratios cannot be uncritically used to distinguish species, making them difficult to identify. Eighteen nominal species, of which as few as 12 are valid; 3 species in WIO. *Neomerinthe nielsenii* (the most distinctive member of the genus) was assigned to a new genus, *Neoscorpaena*, by Mandrytsa (2001). This may be appropriate, but until differences between the Atlantic and Pacific species are more clearly understood and accepted, we adopt a taxonomically conservative position and include the species here. One nominal species, *Neomerinthe bathyperimensis* Zajonz & Klausewitz 2002, is known only from an abnormal holotype and is likely a junior synonym of *N. erostris* (Motomura *et al.* 2015), but more detailed comparison is required as additional specimens from the southern Red Sea become available. *Neomerinthe bauchotae* Poss & Duhamel 1991 is known only from deep water at Saint-Paul and Amsterdam Is. in the southern Indian Ocean.

## KEY TO SPECIES

- 1a Lateral face of lachrymal with or without small spine at anterior end of suborbital ridge, with subsequent bones on ridge bearing 3–9 spines; dorsal-fin membranes near base of spines 7–10 often with blotches; vertical scale rows 26–37 ..... *N. nielsenii*
- 1b Lateral face of lachrymal with small spine at anterior end of suborbital ridge, with subsequent bones on ridge bearing 3 (1 + 2) or rarely 4 (1 + 3) spines; dorsal-fin membranes near base of spines 7–10 without pronounced blotches; vertical scale rows 36–47 ..... 2

Continued ...

## KEY TO SPECIES

- 2a Snout relatively blunt, profile nearly parallel to anterior margin of orbit and at ~55–60° angle from horizontal; preopercle with 5 spines in adults, each separated by single pore; maxilla reaches level between middle of pupil and rear margin of pupil ..... *N. erostris*
- 2b Snout relatively pointed, profile at ~45–55° angle from horizontal; preopercle with 4 (rarely 3) spines in adults, uppermost 2 spines usually separated by 2 pores ..... *N. bucephalus*

*Neomerinthe bucephalus* (Alcock 1896)

Curvedspine scorpionfish

*Scorpaena bucephalus* Alcock 1896: 302 [2] (Malabar coast, India);

Alcock 1898\*; Menon &amp; Yazdani 1968; Menon &amp; Rama-Rao 1975.

*Pontinus spilstius* (non Gilbert 1905): Matsubara 1943\*.? *Neomerinthe procurva* Chen 1981: 54, Figs. 22, 49 (off Daxi, Taiwan); Poss & Duhamel 1991.

Dorsal fin 12 spines (posteriormost spine often curving forward near tip), 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 18–20 (usually 19) rays. Snout relatively pointed, profile at ~45–55° angle from horizontal; maxilla reaches to level between rear margin of pupil and rear margin of orbit. Lateral face of lachrymal with small spine at front of suborbital ridge, with subsequent bones on ridge bearing 3 (1 + 2) or rarely 4 (1 + 3) spines. Preopercle with 5 spines in adults, uppermost 2 spines usually separated by 2 pores. GR 4–6/1/9–14 = 15–21. LL scales 23–26; LSS 36–47. Swimbladder present.

Body red to pinkish, with darker red or reddish brown saddles or blotches, somewhat paler ventrally; no pronounced dark blotches on dorsal-fin membranes near bases of spines 7–10. Attains 14 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: southern India; elsewhere to Indonesia, Philippines, Taiwan, New Guinea and New Caledonia.

**REMARKS** Found at ~50–600 m.

## *Neomerinthe erostris* (Alcock 1896)

Bluntnose scorpionfish

*Scorpaena erostris* Alcock 1896: 302 [2] (off Sri Lanka); Alcock 1898\*; Herre 1945; Mendis 1954; Menon & Yazdani 1968; Eschmeyer 1998.

*Scorpaena gibbifrons* Fowler 1938: 58, Fig. 23 (Cabugan Grande I., Surigao Strait, Philippines).

*Parascorpaena erostris*: Munro 1955.

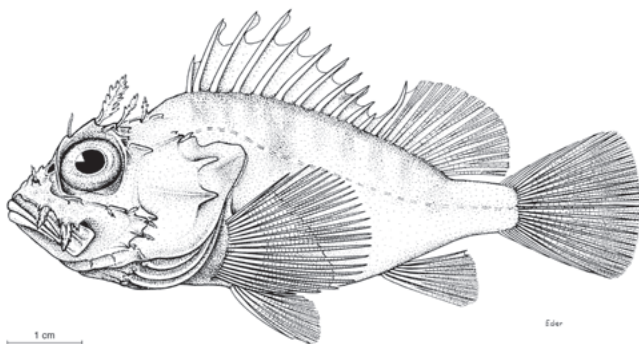
*Neomerinthe rotunda* Chen 1981: 53, Figs. 22, 47 (off Kaohsiung, Taiwan).

*Neomerinthe bathyperimensis* Zajonz & Klausewitz 2002: 148 (Strait of Perim, northwest of Perim I., Yemen, Red Sea); Golani & Bogorodsky 2010; Motomura *et al.* 2011.

*Neomerinthe erostris*: Motomura *et al.* 2015.

Dorsal fin 12 spines,  $9\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 18 or 19 rays, membranes of middle and lower rays deeply incised, fins reaching base of 2nd anal-fin spine. Head profile rounded; snout blunt and relatively steep, its profile nearly parallel to anterior margin of orbit, and at  $\sim 55\text{--}60^\circ$  angle from horizontal; maxilla extends to level of rear margin of orbit, or slightly beyond; orbit relatively large (diameter 13–17% SL). Lachrymal with slight lobe anterior to 2 spines that extend over maxilla (1st spine smaller, pointing almost directly ventrally; 2nd spine 2–3 times larger than 1st, pointing posteroventrally); 2nd suborbital with 1 spine; 3rd suborbital with 2 spines. GR 4–7/1/8–13 = 14–19. LL scales 20–25; LSS 30–38.

Body mostly red, with some darker markings on dorsum. Attains  $\sim 9.5$  cm SL.



*Neomerinthe erostris*, 7 cm SL, holotype of *N. bathyperimensis* (Red Sea). Source: Zajonz & Klausewitz 2002

**DISTRIBUTION** Indo-Pacific. WIO: southern Red Sea, Kenya, South Africa (Thukela Bank), Madagascar, Réunion, India and Sri Lanka; elsewhere to Indonesia, Philippines, Taiwan, Solomon Is., Chesterfield Is., New Caledonia, Vanuatu, and Wallis and Futuna Is.

**REMARKS** Found over mud bottom, at 58–330 m.

## *Neomerinthe nielseni* (Smith 1964)

Spotfin scorpionfish

PLATE 103

*Sebastapistes nielseni* Smith 1964: 298, Pl. 30c (Durban, KwaZulu-Natal, South Africa).

*Neomerinthe nielseni*: SSF No. 149.14\*; Poss & Duhamel 1991.

*Neoscorpaena nielseni*: Mandrytsa 2001; Motomura *et al.* 2011.

Dorsal fin 12 spines,  $9\frac{1}{2}$ – $11\frac{1}{2}$  rays, all membranes strongly incised; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 17–19 rays, lowermost rays unbranched and enlarged, projecting beyond middle and upper rays which are branched and more slender. Suborbital ridge with  $\sim 3$ – $9$  spines, usually 1 weak spine on lachrymal, 2 spines on 1st suborbital, and 3 or 4 spines on 2nd suborbital. GR 4–7/1/9–12 = 16–20. LL scales 22–26, often lost or poorly developed; vertical scale rows 26–37.

Live colour probably mostly red. Preserved specimens with dusky smudges on body, and dark spot at 8th dorsal-fin spine. Attains  $\sim 21.5$  cm SL.



*Neomerinthe nielseni*, 7 cm TL (N Mozambique). O Alnheim © IMR

**DISTRIBUTION** WIO: South Africa (KwaZulu-Natal), Mozambique, Madagascar, Seychelles and Réunion.

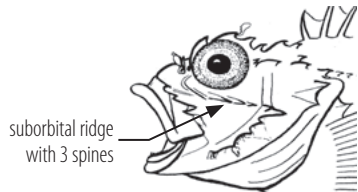
**REMARKS** Known from 90–507 m (most records 175–225 m).

## GENUS *Parascorpaena* Bleeker 1867

Dorsal fin 12 (rarely 13) spines,  $8\frac{1}{2}$  or  $9\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays. Lachrymal with 2 spines on ventral margin, posteriormost retrorse, its point curved forward (except in small juveniles); 2nd suborbital with 2 slightly curved ridges, one above the other; occiput with pit. Scales on body primarily pseudocycloid (rarely with weak ctenii). Vertebrae  $9 + 15 = 24$ . At least 5 or 6 species, 3 or 4 in WIO.

## KEY TO SPECIES

- 1a Suborbital ridge with 3 spines or spinous points: 1st point somewhat below middle of eye, 2nd and 3rd points behind eye and close together ..... 2



- 1b Suborbital ridge with usually 2 (rarely 3) spines or spinous points at or behind rear margin of eye (no spinous point below pupil) ..... *P. aurita*

- 2a Spinous dorsal fin of males with distinct black blotch (mostly at spines 8–11), females with smaller or no spot; supraocular cirrus relatively small or absent; body reddish in life, without dark brown mottling; a few teeth near lower jaw symphysis longer and more canine-like than other teeth in jaws, which are smaller, villiform ..... *P. mcadamsi*

- 2b No black blotch on spinous dorsal fin in either sex; supraocular cirrus usually long, often longer than orbit diameter; body colouration includes some dark brown mottling, and peduncle with a couple of large pale areas; all teeth in lower jaw relatively small, villiform ..... *P. mossambica*

*Parascorpaena aurita* (Rüppell 1838)

## Golden scorpionfish

PLATE 103

*Scorpaena aurita* Rüppell 1838: 106, Pl. 27, Fig. 2 (Massawa, Eritrea, Red Sea); Peters 1855; Klunzinger 1870; Kossmann & Räuber 1877; Sauvage 1891.

*Scorpaena erythraea* (non Cuvier 1829): Günther 1860.

*Scorpaena picta* (non Cuvier 1829): Bleeker 1874; ?Sauvage 1891; ?Munro 1955; ?Jones 1969; ?Manilo & Bogorodsky 2003.

*Scorpaena bleekeri* Day 1878: 747 [149], Pl. 36, Fig. 2 (Andaman Is.); Giltay 1933; Munro 1955.

*Scorpaena haplodactylus* (non Bleeker 1853): Day 1889.

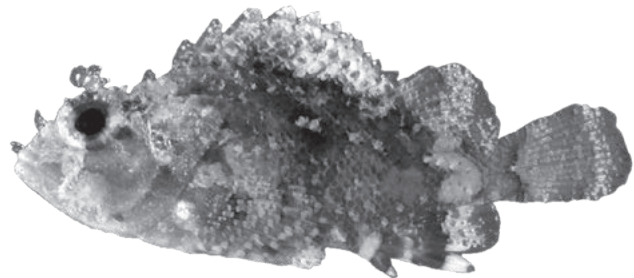
*Parascorpaena bleekeri*: Munro 1955\*.

*Parascorpaena aurita*: Smith 1957\* [in part: *P. mossambica* placed in synonymy], 1969; Maugé 1967; Nagabhushanam & Rao 1972; Day 1974; Harmelin-Vivien & Bouchon 1976; Dor 1984; Kimani *et al.* 1996; Almeida *et al.* 2001; Schneider *et al.* 2005; Lugendo *et al.* 2007; Motomura *et al.* 2009\*; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; pectoral fins 15–18 rays. Body immediately behind head above lateral line often with numerous flaps of skin. Supraocular cirrus smooth, its margin not fringed. Suborbital ridge usually with 1 spine on ventral

ridge of 2nd suborbital, 2 spines on 3rd suborbital. Occipital pit present. Maxilla extends to level between rear margin of pupil and rear margin of orbit. Teeth in lower jaw near symphysis all villiform, none enlarged. GR 4–6/1/6–11 = 11–17. LL scales 22–25; LSS 38–43.

Body mottled brown, denser dorsally, often with more red over breast, near vent, and on pectoral and pelvic fins; cheeks and sides of head often nearly black; no dark spot on spinous dorsal fin in either sex. Attains 15 cm TL.



*Parascorpaena aurita*, 35 mm SL (Seychelles). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Kenya to Mozambique, Madagascar, Seychelles and southwestern India; elsewhere likely to Andaman Sea, Taiwan, Philippines, New Guinea and Australia.

**REMARKS** Found inshore on reefs, to ~45 m deep. What is possibly this species has been reported as *P. picta* (Cuvier 1829) from Lakshadweep (Jones 1969) and the Gulf of Mannar (Munro 1955). Although *P. aurita* may be found in the western Pacific, many records are based on misidentifications of *P. picta* (Motomura *et al.* 2009).

*Parascorpaena mcadamsi* (Fowler 1938)

## McAdam's scorpionfish

PLATE 103

*Scorpaena mcadamsi* Fowler 1938: 60, Fig. 24 (Jolo Light, Jolo I., Philippines).

*Parascorpaena maculipinnis* Smith 1957: 57, Pl. 2a (Bazaruto I., Mozambique); Smith 1980; Schneider *et al.* 2005.

*Scorpaena mossambica* (non Peters 1855): Blanc & Postel 1958.

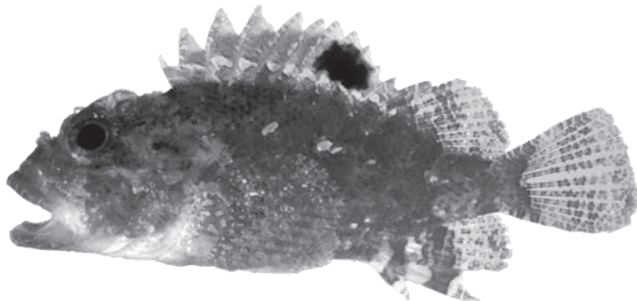
*Parascorpaena mcadamsi*: SSF No. 149.15\*; Fricke 1999; Pereira 2000; McKenna & Allen 2005; Schneider *et al.* 2005; Voronina & Volkova 2007; Motomura *et al.* 2011.

Dorsal fin 12 (rarely 13) spines, 8½ or 9½ rays; pectoral fins 15–17 (usually 16) rays. Suborbital ridge with 3 spines or spinous points (1st point on ventral ridge of 2nd suborbital near middle of eye, 2nd and 3rd points close together on 3rd suborbital behind eye). No distinct occipital pit. Supraocular



cirrus often small or absent. Some teeth near lower jaw symphysis notably longer and more canine-like than villiform teeth elsewhere on jaws. GR 3–5/1/7–9 = 11–14. LL scales 22–24; LSS 35–41.

Body mottled red and white, sometimes with a few white spots on lateral line, and usually without dark blotches or enlarged spots. Males with prominent, irregular black spot on rear part of spinous dorsal fin; females with smaller or no spot. Attains 8 cm SL.



*Parascorpaena mcadamsi*, 4 cm SL (South Africa). © R Winterbottom, ROM



*Parascorpaena mcadamsi*, head spination (WIO). Source: Smith 1957

**DISTRIBUTION** Indo-Pacific. WIO: Kenya to South Africa (Transkei region), Madagascar, Comoros, Réunion and Mauritius; elsewhere to Indonesia, Vietnam, Philippines, Taiwan, Japan, Marshall Is., New Guinea, Australia, New Caledonia, Fiji and Society Is.

**REMARKS** Found inshore on reefs; collected to ~40 m deep.

### *Parascorpaena mossambica* (Peters 1855)

Mozambique scorpionfish PLATE 103

*Scorpaena mossambica* Peters 1855: 434 (Ibo, Mozambique); Sauvage 1891\*; Fourmanoir 1957\*.

*Scorpaena longicornis* Playfair in Playfair & Günther 1867: 47, Pl. 8, Fig. 1 (Zanzibar, Tanzania) [in part]; ?Bamber 1915.

*Scorpaena zanzibarensis* Playfair in Playfair & Günther 1867: 47, Pl. 8, Fig. 2 (Zanzibar, Tanzania); Jatzow & Lenz 1898.

*Scorpaena durbanensis* (non Gilchrist & Thompson 1909): Fowler 1925.

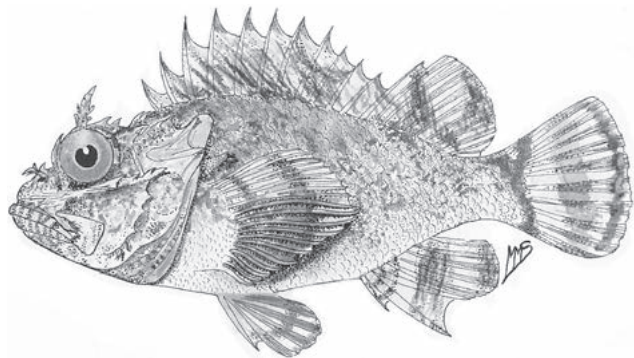
*Parascorpaena armata* (non Sauvage 1873): Munro 1955.

*Parascorpaena aurita* (non Rüppell 1838): Smith 1957 [in part]; Smith & Smith 1963\*; Rama-Rao 1970\*; Jones *et al.* 1972.

*Parascorpaena mossambica*: ?Dor 1984; SSF No. 149.16\*; De Troch *et al.* 1996; Almeida *et al.* 1999; Pereira 2000; Gell & Whittington 2002; McKenna & Allen 2005; Schneider *et al.* 2005; Lugendo *et al.* 2007; Nyunja *et al.* 2009; Fricke *et al.* 2016.

Dorsal fin 12 spines, 9½ rays; pectoral fins 15–17 rays. Suborbital ridge with 3 spines (1 spine on ventral ridge of 2nd suborbital, and 2 spines on 3rd suborbital). Supraocular cirrus usually long, often longer than orbit diameter. Occiput of shallow or moderate depth. Teeth near lower jaw symphysis all villiform, none enlarged. GR 3–5/1/6–10 = 11–16. LL scales 23 or 24; LSS 36–42.

Body colour variably red, orangish, reddish brown or brown; often with scattered (sometimes black) blotches and spots on head and body, and white mottling especially ventrally. Attains at least 12 cm SL.



*Parascorpaena mossambica*, 8 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and Gulf of Aqaba, Kenya to South Africa (Xora River mouth), Madagascar, Comoros, Seychelles, Réunion, Mauritius, Chagos and Sri Lanka; elsewhere, possibly to Great Nicobar I., Indonesia, Thailand, Vietnam, Philippines, Taiwan, China, Japan, Marshall Is., Australia, Solomon Is., New Caledonia, Fiji, Samoa, Society Is. and Pitcairn Is.

**REMARKS** Fish from the western and central Pacific may prove to be a separate species (Motomura *et al.* 2011).

### GENUS *Phenacoscorpius* Fowler 1938

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 15–20 rays. Teeth present on dentary, premaxillary, vomer and pharyngeals. Suborbital ridge with single row of ≥5 spines; second spine on preopercle sometimes absent in larger individuals. Scales ctenoid. Lateral line incomplete, usually with 4–7 tubed scales. Vertebrae 9 + 16 = 25. Four species, 1 in WIO.

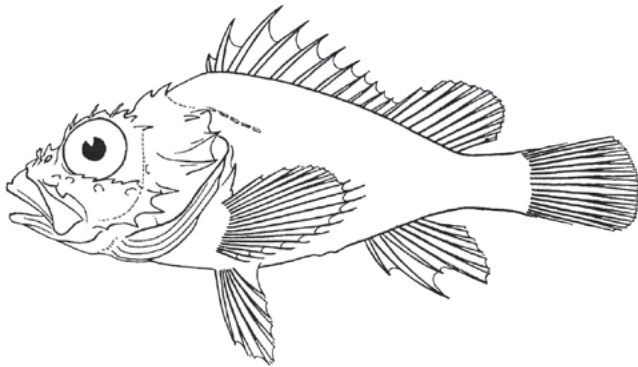
*Phenacoscorpius adenensis* Norman 1939

Aden scorpionfish

*Phenacoscorpius adenensis* Norman 1939: 94, Fig. 29 (Gulf of Aden);  
Smith 1957, 1958; Smith & Smith 1963\*; Marshall 1964; SSF No. 149.17\*;  
Poss & Duhamel 1991; Mandrytsa 1992; Voronina & Volkova 2007;  
Motomura *et al.* 2011; Motomura *et al.* 2012.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays;  
pectoral fins 16–18 rays, middle rays branched. Spines on  
head well-developed and relatively pungent, often blade-like.  
Lachrymal with anterior spine developed only as broad curved  
lobe, with posteroventral margin also lobate, or forming weak  
spinous point, plus usually a weak spine on lateral face; 2 or 3  
spines on 2nd suborbital, and 3 or 4 spines on 3rd suborbital,  
all forming relatively pronounced and continuous ridge; no  
postorbital bone. Teeth on palatines weak or absent. GR 5  
or 6/1/10–13 = 17–20. Body covered with weakly ctenoid  
scales; pseudocycloid scales on ventral margin of cheeks,  
pectoral-fin bases, breast and belly; LL scales 4–10; LSS 37–42.  
Swimbladder present.

Preserved specimens with 3 or 4 broad dusky saddles on  
dorsum immediately below dorsal fin; dark spot between  
dorsal-fin spines 7–9 (possibly prominent only in males);  
diffuse dusky vertical bar near middle of caudal fin. Attains  
8 cm SL.



*Phenacoscorpius adenensis*, 10 cm TL, holotype (Gulf of Aden).  
Source: Norman 1939

**DISTRIBUTION** WIO: Gulf of Aden, Yemen, Somalia,  
South Africa (Eastern Cape), Madagascar and Walters Shoals.

**REMARKS** Known from 108–736 m.

**GENUS** *Pogonoscorpius* Regan 1908

Head large, snout relatively long with concave profile; mouth  
extremely large and superior, directed upwards at ~60°  
angle from horizontal. Head spines mostly weak and poorly  
developed; lachrymal with 2 weakly developed spines over  
maxilla. No teeth on palatines. Scales small, pseudocycloid.  
One species, closely related to *Rhinopias*, and may be  
eventually assigned to that genus.

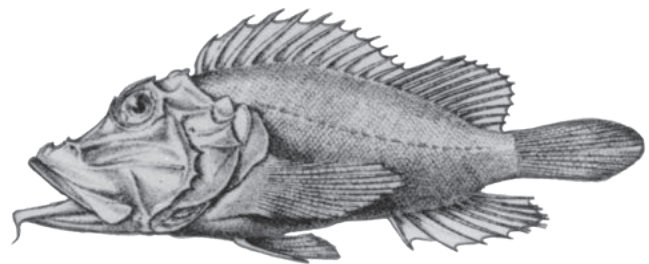
*Pogonoscorpius sechellensis* Regan 1908

Goateed scorpionfish

*Pogonoscorpius sechellensis* Regan 1908: 236, Pl. 28, Fig. 3 (Seychelles);  
Smith 1957\* [as *sechellensis*]; Smith & Smith 1963\* [as *sechellensis*];  
Eschmeyer *et al.* 1973; Mandrytsa 2001\*.

Diagnosis as for genus. Dorsal fin 12 spines, 9½ rays; anal  
fin 3 spines, 5½ rays; pectoral fins 18 rays, all unbranched.  
HL 46% SL; snout length 20% SL; jaw length ~24% SL. Small  
median barbel at lower jaw symphysis. Some supplemental  
preopercular spines present. GR ~7/1/8 = 16. LSS ~60  
(many scales missing on holotype).

Colour shortly after capture yellowish with reddish fins;  
preserved specimen with dark markings distally on dorsal-fin  
membrane between spines 7–8. Attains at least 52 mm SL.



*Pogonoscorpius sechellensis* (Seychelles). Source: Regan 1908

**DISTRIBUTION** Known only from the holotype collected  
from Seychelles.

**REMARKS** Taken at ~68 m. Closer comparison with  
species of *Rhinopias* is required as additional specimens  
become available.

GENUS **Pontinus** Poey 1860

Dorsal fin 12 spines (2nd and 3rd elongate in some species, their length increasing proportionately with growth),  $9\frac{1}{2}$  or  $10\frac{1}{2}$  rays; anal fin 3 spines, usually  $5\frac{1}{2}$  rays; pectoral fins 15–20 rays, usually all unbranched. Suborbital ridge with 3 or 4 spines (1st spine on lateral face or lachrymal may be absent; 2nd and 3rd spines on 3rd suborbital); lachrymal with 2 spines over maxilla; supplemental preopercular spines present: 1st largest, 2nd much smaller or sometimes absent, 3rd and 4th present, and 5th tiny or absent; no upper posttemporal spine in some species. Occiput relatively wide and extremely flat, without a pit. Teeth present on vomer and palatines. Slit behind last hemibranch. Scales on body ctenoid; cheeks, postorbital area and occiput with some scales, and maxilla sometimes with scales. Peritoneum pale. Vertebrae  $9 + 15 = 24$ . Sixteen species, 1 in WIO.

**Pontinus nigerimum** Eschmeyer 1983

Blacklash scorpionfish

PLATE 104

*Sebastes nematophthalmus* (non Günther 1860): Günther 1860 [in part: Mauritius].

*Sebastichthys nematophthalmus* (non Günther 1860): Bleeker 1874, 1879.

?*Sebastes hexanema* (non Günther 1880): Alcock 1891; Herre 1941.

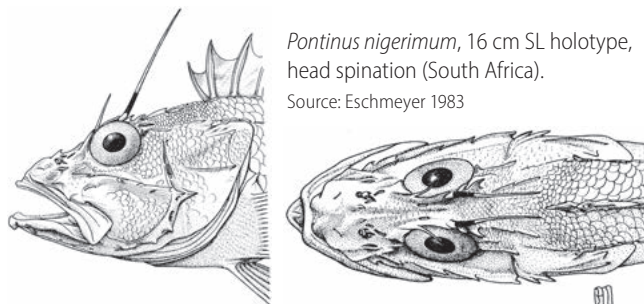
?*Scorpaena* nov. sp.: Fourmanoir & Guézé 1963\*.

?*Pontinus nigerimum* Eschmeyer 1983: 3, Fig. 1 (KwaZulu-Natal, South Africa); SSF No. 149.19\*; Motomura *et al.* 2011.

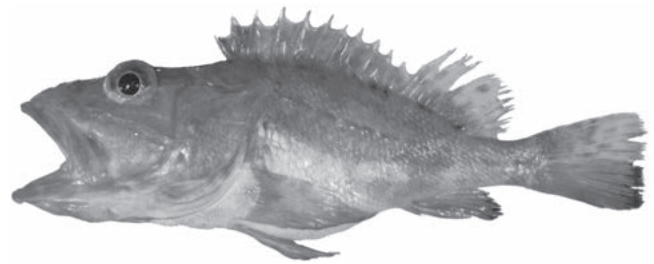
*Pontinus tentacularis* (non Fowler 1938): Baissac 1990; Fricke 1999.

Dorsal fin 13 spines (spines 3 or 4 longest, yet relatively short, <23% SL),  $9\frac{1}{2}$  or  $10\frac{1}{2}$  rays; anal fin 3 spines,  $4\frac{1}{2}$  or  $5\frac{1}{2}$  rays; pectoral fins 15–17 rays. Head and body compressed; snout somewhat elongate, more so with growth. Anterior end of lachrymal rounded, ventral edge with 2 stout, blade-like spines (2nd spine twice length of 1st). Supraocular cirrus usually simple, variably sized and sometimes absent. GR 5–8/1/8–13 = 15–21. LL scales 23–27; LSS 41–50.

Body pinkish or rose-red with indications of yellow; belly pale; when present, supraocular cirrus with black bands. Attains 24 cm SL.



*Pontinus nigerimum*, 16 cm SL holotype, head spination (South Africa). Source: Eschmeyer 1983



*Pontinus nigerimum*, 24 cm TL (N Mozambique). © Alvheim © IMR

**DISTRIBUTION** WIO: Mozambique, South Africa (Sodwana Bay), Madagascar, Réunion, Mauritius, Saya de Malha Bank, Chagos and India.

**REMARKS** The status of this species is problematic. Although Eschmeyer (1983) described *Pontinus nigerimum* as distinct in having a dark, almost uniformly black band low on the supraocular cirrus, the colouration of the cirrus is variable. WIO specimens show a variety of cirrus colour patterns, from entirely dark to banded to nearly pale and unbanded (SA Mandrytsa pers. comm.; this study). Nonetheless, WIO fish assignable to this species have a consistently slightly shorter 1st dorsal-fin spine than do specimens from the western and central Pacific assignable to *P. rhodochrous* (Günther 1872), a senior synonym of *Sebastes hexanema* Günther 1880 and *Nemapontinus tentacularis* Fowler 1938. *Pontinus microcephalus* (Sauvage 1882), found off Japan and Hawaii, has a smaller orbit, especially at large sizes (>20 cm SL), giving the appearance of a larger snout, slightly shorter dorsal-fin spines, and averaging slightly more than one additional pectoral-fin ray, as well as having on average a few more vertical scale rows (44–63) than *Pontinus* specimens from Indonesia, Philippines and Micronesia (vertical scale rows 35–53) or from WIO.

GENUS **Pteroidichthys** Bleeker 1856

Dorsal fin 12 spines,  $9\frac{1}{2}$  rays; anal fin 2 or 3 spines,  $5\frac{1}{2}$  or  $6\frac{1}{2}$  rays, fin long; pectoral fins 14 or 15 rays. Body strongly compressed and deep, ~40% SL; head compressed, relatively large, HL 41–44% SL. Supraocular tentacle long, usually branched in larger specimens. Four species, 2 in WIO.

KEY TO SPECIES

- |    |  |                       |
|----|--|-----------------------|
| 1a | Anal fin 3 spines, rays; supplemental preopercular spine present .....           | <i>P. noronhai</i>    |
| 1b | Anal fin 2 spines, $6\frac{1}{2}$ rays; no supplemental preopercular spine ..... | <i>P. amboinensis</i> |

*Pteroidichthys amboinensis* Bleeker 1856

Ambon scorpionfish

PLATE 104

*Pteroidichthys amboinensis* Bleeker 1856: 34 (Ambon I., Moluccas; and Manado, Sulawesi, Indonesia); Frøiland 1972\*; Dor 1984; Kishimoto in Masuda *et al.* 1984\*; Goren & Dor 1994; Werner & Allen 1998; Mandrytsa 2001; Motomura & Kanade 2015\*; Fricke *et al.* 2015\*.  
*Rhinopias godfreyi* Whitley 1954: 60, Pl. 3, Fig. 2 (Exmouth Gulf, Western Australia).

Median fins elongate; anal fin 2 spines, 6½ rays; pectoral fins reach just past anal-fin origin; all fin rays thin and unbranched (except for 1 unbranched pelvic-fin ray). Mouth upturned at ~45° angle; maxilla broad posteriorly, extends to middle of pupil. Eyes elevated, orbits broadly separated from suborbital bones, particularly anteriorly where it forms a distinct sunken area. Head and body with numerous branched cirri, including on postorbital, parietals, posteriormost lachrymal spine, nostrils, and near and behind lower jaw symphysis; head also with tentacles: supraocular tentacle long and conspicuous, typically with complex branching and fringing. Lachrymal without distinct spines but with blunt, uneven lobes, last largest and supporting prominent skin flap; nasal spine small; 4th suborbital high in postorbital area, relatively elongate, with 2 small spines near middle of bone; preopercle with 4 spines, all small (uppermost spine largest and blunt; 2nd spine barely extends beyond preopercle margin; 3rd spine also blunt, with ridges pointing mostly downward; 4th spine weak with broad base), and supplemental preopercular spine present. No slit behind last hemibranch. GR 2–4/1/5–8 = 9–13. LL scales 19–23; LSS 39–42.

Body colour variable, matching environment: mottled brown, reddish brown or purplish brown, occasionally greenish, and sometimes with yellow on underside; broad dark bar from eye towards subopercle. Attains ~8.5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: northern Red Sea; elsewhere, east coast of India (Chennai), Vietnam, Indonesia (Ambon I.), Taiwan, Ryukyu Is., New Guinea, Australia, Chesterfield Is., New Caledonia and Fiji.

**REMARKS** Remarkably cryptic; found on silt-sand bottom, often with algal debris and coralline habitats, in 7–65 m.

*Pteroidichthys noronhai* (Fowler 1938)

*Pteropelor noronhai* Fowler 1938: 78, Fig. 34 (China Sea, near Hong Kong); Mandrytsa 2001\*, 2002.  
*Pteroidichthys noronhai*: Poss 1999; Motomura *et al.* 2011.

Fin counts as for genus; 3rd and 4th dorsal-fin spines not elongate; anal fin 3 spines (1st spine ~60% length of 2nd; 3rd spine longest), 5½ rays (all branched). Head large, slightly compressed, with well-developed spines. Numerous cutaneous flaps of varying sizes scattered over body, including small flaps and cirri on lower jaw, at posteroventral margin of lachrymal, at preopercular spines, on upper half of pectoral fins, on dorsal and caudal fins, and along body. Supraocular cirrus present, large, sometimes branching near tip. Lachrymal with single spine projecting over premaxilla; suborbital ridge with 4 or 5 well-developed spines (1st on lateral surface of lachrymal, 2nd on 2nd suborbital bone, 3rd and 4th on 3rd suborbital bone); nasals with 2 or 3 spines; preorbital sometimes with multiple points; preopercle with 5 spines (upper 3 spines well-developed, lower 2 spines small), plus supplemental spine at base of uppermost spine; 2 opercle spines. Occipital pit well-developed. Two postorbital bones present and in contact with each other, but separated from stay. Scales on body ctenoid above lateral line and for several horizontal rows below it, those more ventrally pseudocycloid.

Colour in life unknown. Attains 6 cm SL.

**DISTRIBUTION** WIO: Saya de Malha Bank; elsewhere, Vietnam, Philippines, Taiwan, China, Japan, Australia and Vanuatu.

**REMARKS** Found at 50–215 m. Detailed comparison is needed of specimens from Saya de Malha Bank (identified by Mandrytsa 2002) and specimens from the western Pacific.

**GENUS** *Rhinopias* Gill 1905

Dorsal fin 12 spines, 8½–10½ rays; anal fin 3 spines, 5½ rays; pectoral fins 15–18 rays. Head and body compressed, body depth 40–49% SL in adults; head extremely large, HL 44–49% SL; lateral profile of snout concave; eyes elevated. Most head spines weakly developed: lachrymal with weak, poorly defined spines over maxillary; 3rd suborbital forming wide broad stay posteriorly; nasal spines small, if present; no interorbital ridges, sphenotic spine and tympanic spine. Lateral ethmoid separated from vomer. No teeth on palatines. No slit behind last hemibranch. Scales on body small, pseudocycloid, in >60 vertical rows. No swimbladder. Vertebrae 9 + 15 = 24. *Hipposcampa*, *Pteroidichthys* and *Pogonoscorpius* are close relatives. Eight species, 3 in WIO.



**KEY TO SPECIES**

- 1a No black spots or ocelli on dorsal-fin rays; opercle margin scaly, including scales between upper and lower opercular spines; pectoral fins 17–19 (usually 18) rays ..... *R. xenops*
- 1b One or more black spots or ocelli on dorsal-fin rays 6–9; no scales on opercle or between upper and lower opercular spines; pectoral fins 15–17 (usually 16) rays ..... 2
  
- 2a Surface of lower jaw with 9–24 tentacles; numerous elongate cirri and flaps on dorsal-fin spines; supraocular cirrus typically elongate and fringed or multifid; round or oblong pale spots or blotches with dark margins on head, body and fins (spots entirely pallid in preservative) ..... *R. frondosa*
- 2b Lower jaw with 2, short, rounded or tab-like tentacles between mandibular pores 3 and 4; few, if any, cirri on dorsal-fin spines; supraocular cirrus nearly circular or elongate, rarely fringed or multifid; supraocular and posterior lachrymal spines with fleshy tentacles; colouration largely uniform, with scattered tiny white spots ..... *R. eschmeyeri*

***Rhinopias eschmeyeri*** Condé 1977

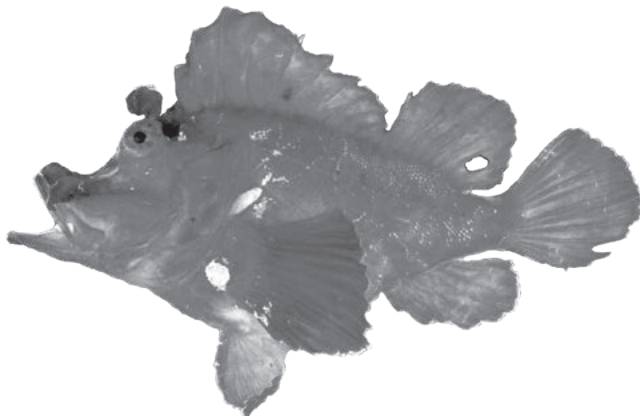
Eschmeyer's scorpionfish

PLATE 105

*Rhinopias eschmeyeri* Condé 1977: 19, Figs. 1–2 (Mahébourg, Mauritius, Mascarenes); Cornic 1987\* [as *eschmeyeri*]; Baissac 1990; Fricke 1999; Wu *et al.* 1999; King & Fraser 2002\*; Motomura & Johnson 2006; Motomura *et al.* 2011.

Dorsal fin 12 spines, 8½ or 9½ rays; pectoral fins 15 rays. Lower jaw with single pair of tentacles; supraocular cirrus often relatively short, spatulate or rounded, with fringe along its lateral margin. Sphenotic with 1–3 weak spines; no supplemental preopercular spine; no scales between upper and lower opercular spines or along opercular margin. GR 5–7/1/12–14 = 18–21. LL scales 22–24; LSS 67–79.

Body colour variable: pinkish, purplish, bluish, brownish or yellowish, relatively uniform (with muted blotches), without significant dark spotting other than a few dark spots largely on dorsal fins. Attains ~17 cm SL.



*Rhinopias eschmeyeri*, 10 cm SL (N Mozambique). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique to South Africa (KwaZulu-Natal), Seychelles, Réunion and Mauritius; elsewhere to Indonesia, Vietnam, Philippines and Australia.

**REMARKS** Found in 3–40 m.

***Rhinopias frondosa*** (Günther 1892)

Weedy scorpionfish

PLATE 105

*Scorpaena frondosa* Günther 1892: 482, Pl. 39 (Mauritius, Mascarenes).

?*Peloropsis frondosa*: Deraniyagala 1952\*.

*Peloropsis frondosa*: Mendis 1954; Munro 1955\*; Fourmanoir & Guézé 1966.

*Rhinopias frondosa*: Whitley 1954; Smith 1957\*, 1966\*; Smith & Smith 1963\*; Kotthaus 1966\*; Maugé 1967; Eschmeyer *et al.* 1973\*; SSF No.

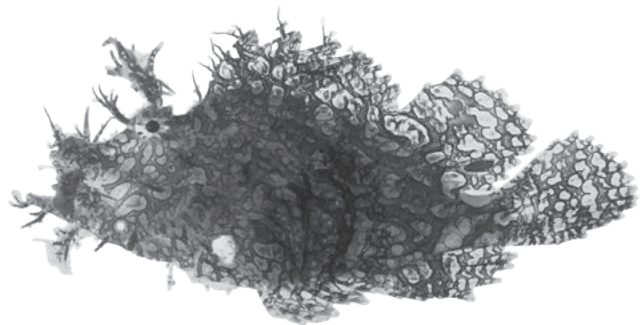
149.20\*; Cornic 1987\*; Baissac 1990; Debelius 1993, 1999; Lieske &

Myers 1994\*; Eichler & Myers 1997; Fricke 1999; Letourneur *et al.* 2004;

McKenna & Allen 2005; Fricke *et al.* 2009; Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; pectoral fins 15 or 16 rays. Head, body and fins covered with elaborate, often branched cirri that give the appearance of algal growth; lower jaw with numerous and often large flaps and tentacles; supraocular cirrus usually elongate and multifid. Sphenotic spine weak; usually no nasal spines in adults; supplemental preopercular spine weak or absent. GR 5–7/1/10–14 = 18–21. LL scales ~22–24; LSS 68–83; no scales between upper and lower opercular spines or along opercle margin.

Head and body reddish brown or olive, covered with generally oblong spots that are dark in the centre and at margin; prominent bright white above 3rd suborbital bone, slightly below and forward of eye; at least 1 dark spot on soft-rayed dorsal fin. Attains ~17 cm SL.



*Rhinopias frondosa*, 5 cm SL (South Africa). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Somalia, Mozambique to South Africa (Park Rynie), Madagascar, Seychelles, Réunion, Mauritius and Sri Lanka; elsewhere to Indonesia, Vietnam, Philippines, southern Japan, Caroline Is. and New Caledonia.

**REMARKS** Found in rocky and coralline habitats, to ~90 m deep.

### *Rhinopias xenops* (Gilbert 1905)

Tattered scorpionfish

PLATE 105

*Peloropsis xenops* Gilbert 1905: 630, Fig. 245 (Auau Channel, between Maui I. and Lanai I., Hawaii).

*Rhinopias xenops*: Whitley 1954; Smith 1966; Eschmeyer *et al.* 1973\*; Eschmeyer & Randall 1975\*; Mandrytsa 2001\*, 2002.

Dorsal fin 12 spines, 9½ or 10½ rays; pectoral fins 18 rays. Nasal, preocular and post-ocular spines pungent; upper and lower opercular spines bifurcate; preopercle with supplemental spine at base of uppermost/largest of 4 small spines. Numerous skin flaps and cirri on body, particularly well-developed along lateral line; supraocular cirrus forms large flap; smaller flaps present on preopercular spines, uppermost pectoral-fin rays, tips of dorsal-fin spines 6–8, and posteroventral margin of lachrymal. GR 5–7/1/11–17 = 17–23. Scales small, pseudocycloid, and present between opercular spines; LL scales 22–25; LSS 59–75.

Body vermilion or orangish red, with olive-green tint dorsally on head and body, and small scattered purplish brown spots, which are also present on upper half of pectoral fins; fins mottled with yellowish white flaps and tentacles, edged with bright yellow; often conspicuous white spots posteriorly on flank; irregular dark spot usually present near middle of spinous dorsal fin, sometimes another at base of 2nd spine. Attains 13 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Seychelles; elsewhere to Taiwan, southern Japan, Coral Sea and Hawaii.

**REMARKS** Known from offshore rocky and coralline areas, to ~110 m deep.

## GENUS *Scorpaena* Linnaeus 1758

Head relatively depressed in most species. Lachrymal with 3 or 4 spines that extend over maxilla in adults; nasal, preorbital, supraorbital, post-orbital, tympanic, sphenotic, parietal, nuchal, upper and lower posttemporal, supracleithral and cleithral spines present. Occiput with pit in most species. No slit behind last hemibranch. Scales ctenoid or pseudocycloid. No swimbladder. This group is heterogeneous, and although several distinct lineages can be identified within it, no synapomorphies that are uniquely diagnostic of the

genus as a whole have as yet been identified. Many species from WIO referred to this genus in older works belong instead to the closely related genus *Parascorpaena* or to the apparently more distantly related genera *Sebastapistes* or *Neomerinthe*. At least 50 species, 1 in WIO.

### *Scorpaena cf. scrofa* Linnaeus 1758

Red bigscale scorpionfish

PLATE 106

*Scorpaena scrofa* Linnaeus 1758: 266 (Mediterranean Sea);

Gilchrist & Thompson 1909; Smith 1957\*; Maugé 1967; Dor 1984;

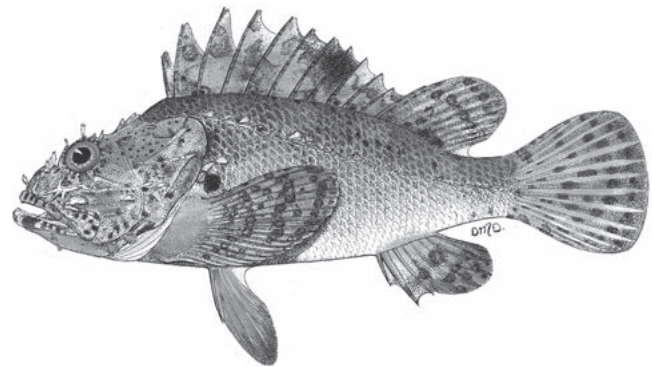
SSF No. 149.21\*; Fischer *et al.* 1990\*; Al Sakaff & Essen 1998;

Mandrytsa 2001; Schneider *et al.* 2005; Voronina & Volkova 2007.

*Scorpaena natalensis* Regan 1906: 5, Pl. 5 (KwaZulu-Natal, South Africa).

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 18–20 rays. Lachrymal with 3 or 4 spines that extend over maxilla in adults (2nd spine at base of larger 1st spine may be absent), usually only 2 spines in juveniles; suborbital ridge with 2–4 spines (1st spine on lateral face of lachrymal often absent; 3rd spine often present as a lump rather than a pungent spine); interorbital area with 2 ridges that end at bases of tympanic spines; preopercle with 5 spines (1st and 2nd subequal). Numerous cirri on lower jaw, a large flap on posteriormost lachrymal spine, and flaps also present on preopercular spines 4 and 5. GR 4 or 5/1/9–11 = 14–17. LL pores immediately behind symphysis of dentaries separate. Scales on dorsum and flanks ctenoid; chest and pectoral-fin bases naked; LL scales 22–25; LSS 41–48.

Body orange-red and mottled, underside of head often with highly contrasting darker brown or deep red markings or spots; large dark blotch usually present near dorsal-fin spines 6–11; anal fin and caudal fin often with darker spots. Attains 66 cm TL (Skaramuca *et al.* 2001) (commonly 30 cm TL).



*Scorpaena cf. scrofa*, 20 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: Yemen, Somalia to South Africa (KwaZulu-Natal) and Saya de Malha Bank.

**REMARKS** Sedentary among rocks and vegetation.

Populations identified as this species in the Mediterranean Sea and North Atlantic (Germany to France) are possibly a distinct species. Records from the Red Sea (Dor 1984) are probably based on a misidentification by Frøiland (1972) (Golani & Bogorodsky 2010; this work). Southern African populations evidently differ in mtDNA base-pair composition from populations in the Mediterranean Sea and North Atlantic (M Mwale, pers. comm.); this has prompted ongoing comparison of their meristics and morphometrics. *Scorpaena natalensis* Regan 1906 will likely prove to be the valid name for specimens from Angola, Namibia and WIO; in this work, however, we follow Smith, Eschmeyer and others, pending completion of a more detailed treatment.

**GENUS** *Scorpaenodes* Bleeker 1857

Dorsal fin with 13 relatively short spines (longest <20% SL); ridges associated with opercular spines relatively weak; no teeth on palatines; scales predominantly ctenoid, except on underside of head and body. Vertebrae 9 + 15 = 24. This taxon is heterogeneous, with various nearshore species and at least two groups of deepwater species (Poss *et al.* 2010). Species assigned to the genus appear to be more closely related to species of Pteroinae than to other members of the Scorpaeninae. Because diagnostic features of adults are often not present in the young, they can be extremely difficult to identify. As yet, no synapomorphies characterise the genus, but the presence of 3 blunt rounded lobes on the ventral surface of the lachrymal (as opposed to distinct spines as seen in most other scorpaenids) and a thickened spinous procurrent ray in the caudal-fin upper lobe may represent such characters. A worldwide study of the genus is needed. Mandrytsa (2001) resurrected *Hypomacrus*, and, although distinctive, it is unclear whether that genus is the sister-group of all other *Scorpaenodes* species or of just some (Poss *et al.* 2010). Twenty-six species, 15 in WIO (most of which extend to the western Pacific).

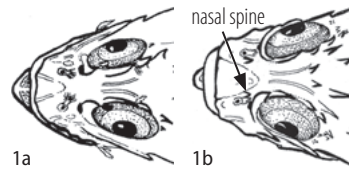
**KEY TO SPECIES**

- 1a No nasal spines in adults; snout elongate, its length 11–15% (usually 12–14%) SL; mouth superior, with upper jaw notably shorter than lower jaw; lower pectoral-fin rays dramatically longer than upper rays, with distinct cleft between upper branched rays (uppermost rays are unbranched) and lower unbranched rays ..... 2

Continued ...

**KEY TO SPECIES**

- 1b Nasal spine present in adults; snout length 9–13% (usually <11%) SL; mouth terminal or nearly so; lower pectoral-fin rays not dramatically longer than upper rays (only slightly in *S. immaculatus* and *S. hirsutus*), with at most a weak cleft between upper branched rays (uppermost rays are unbranched) and lower unbranched rays ..... 3

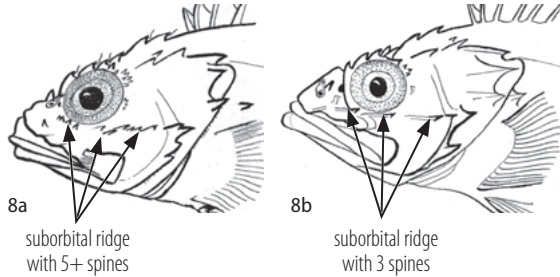


- 2a LSS 38–43 (counted from base of supracleithral spine to end of hypural plate); pectoral fins 16 or 17 (usually 16) rays ..... *S. albaiensis*
- 2b LSS 30–37; pectoral fins 14–17 (usually 15) rays ..... *S. minor*
- 3a LSS 29–58 ..... 4
- 3b LSS 70–73 ..... *S. muciparus*
- 4a Scales on underside of head strongly ctenoid ..... *S. tribulosus*
- 4b Scales on underside of head predominantly pseudocycloid, or scales absent ..... 5
- 5a Large blotch on rear of spinous dorsal fin; pronounced dark triangular mark on pectoral fins ..... *S. varipinnis*
- 5b No large spot or blotch on rear of spinous dorsal fin; no dark triangular mark on pectoral fins ..... 6
- 6a LSS 26–37 (usually ≤30); posterior LL scales sometimes irregular ..... 7
- 6b LSS 38–58; posterior LL scales normal and forming a more or less uninterrupted line ..... 8
- 7a Suborbital ridge with 3 spines along or near dorsal edge of first 3 suborbital bones; no small spine at ventral edge of 2nd suborbital bone; pectoral fins 18–20 rays ..... *S. kelloggi*
- 7b Suborbital ridge with 4 spines along or near dorsal edge of first 3 suborbital bones; small spine on ventral edge of 2nd suborbital bone (below spine on 2nd suborbital); pectoral fins 17 or 18 rays ..... *S. hirsutus*
- 8a Suborbital ridge with ≥5 spines (up to ~15 spines with growth); ctenii on scales strongly pronounced; small skin flaps and cirri on body numerous and often close-set ..... *S. parvipinnis*

Continued ...

## KEY TO SPECIES

- 8b Suborbital ridge with 3 (rarely 4) spines; skin flaps and cirri on body relatively few or entirely absent ..... 9



- 9a Back of buccal cavity dusky ..... *S. investigatoris*  
9b Back of buccal cavity pale ..... 10

- 10a Pronounced dark spot on subopercle ..... *S. evides*  
10b No dark spot on subopercle ..... 11

- 11a Head, body and fins with numerous distinctive white spots; interorbital area weakly scaly; few if any cirri present on head or body ..... *S. corallinus*  
11b Body sometimes with some reddish spots (no white spots); interorbital area relatively densely scaly; cirri or filaments scattered over head and body ..... 12

- 12a Body relatively pale, except for occiput, and without prominent dark saddles ..... 13  
12b Body relatively dark, usually with darker saddles, and sometimes marbled or with weak reticulations ..... 14

- 13a No coronal spines; body uniformly red (pale in preservative, without markings), with small red spots over soft rays, but without brown markings; spots on caudal fin scattered and not arranged in rows; small posteriorly directed spine on anterior margin of dorsal ramus of preopercle above the largest (uppermost) spine; dorsal-fin membranes usually forming small filament immediately behind spine tips ..... *S. immaculatus*  
13b Coronal spines present; scattered minute dark spots over head and body; spots on caudal fin more or less arranged in rows; no small posteriorly directed spine on anterior margin of dorsal ramus of preopercle above the uppermost spine; dorsal-fin membranes not forming small filament immediately behind spine tips ..... *S. steinitzi*

- 14a Opercle usually with prominent (but sometimes poorly defined) dark mark; body more or less darkly marbled or streaked; post-ocular spine usually slightly larger than tympanic spine ..... *S. guamensis*  
14b Opercle seldom much darker than rest of head; body paler and somewhat variegated; post-ocular spine usually subequal to tympanic spine ..... *S. scaber*

*Scorpaenodes albaiensis* (Evermann & Seale 1907)

Long-rayed scorpionfish

PLATE 106

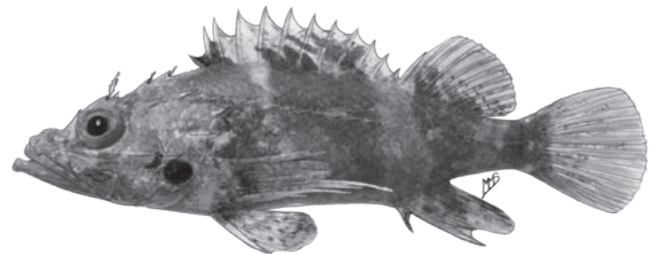
*Hypomacrus albaiensis* Evermann & Seale 1907: 102, Fig. 20 (Bacon, Sorsogon Province, Philippines); Smith 1957\*, 1958; Maugé 1967.

*Hypomacrus africanus* Smith 1958: 177–178 (Zanzibar, Tanzania); Smith 1961; Smith & Smith 1963\* [secondarily preoccupied by *Scorpaenodes africanus* Pfaff 1933].

*Scorpaenodes albaiensis*: SSF No. 149.22\*; Winterbottom *et al.* 1989; Poss & Collette 1990; Randall & Anderson 1993; Winterbottom & Anderson 1997; Pereira 2000; McKenna & Allen 2005 [as *alabaiensis*]; Schneider *et al.* 2005; Motomura *et al.* 2009; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

Dorsal fin 13 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16 or 17 rays, uppermost 1 or 2 rays unbranched and greatly elongate, reaching to above anal-fin origin. Head large, but not deep; snout relatively elongate, with distinct notch in lateral profile just in front of preorbital spine. Nasal spine reduced to small point or entirely absent in larger fish; sometimes 2 weak and blunt spines near midline of lateral occipital commissure. GR 4–6/1/9–13 = 14–20. LL scales 21–25; LSS 36–43.

Body pale, mottled reddish orange, reddish brown or olive-brown, with indications of 4 irregular darker saddles; darker spot on subopercle; white cirri often scattered over body, particularly on dorsum. Attains 8 cm SL.



*Scorpaenodes albaiensis*, 8 cm TL. Source: Smith & Smith 1963



*Scorpaenodes albaiensis*, head spination. Source: Smith 1957



**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Tanzania, Mozambique, Madagascar, Comoros, Seychelles, Chagos and Maldives; elsewhere to Philippines, Ryukyu Is., New Guinea, Great Barrier Reef, Solomon Is., New Caledonia, Vanuatu, Fiji and Tonga.

**REMARKS** Found inshore, on coral reefs, to ~30 m deep.

## *Scorpaenodes corallinus* Smith 1957

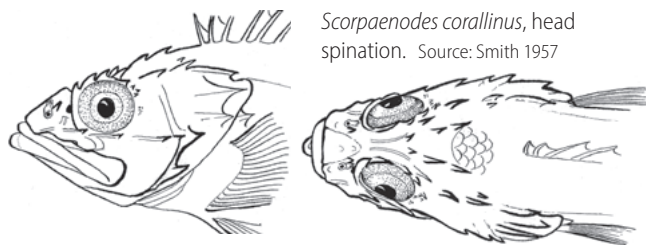
Coral scorpionfish

PLATE 106

*Scorpaenodes corallinus* Smith 1957: 64, Pl. 3e, Fig. 5 (Pinda, Mozambique); Smith 1957\*; Smith & Smith 1963\*; Eschmeyer & Randall 1975; Poss & Collette 1990; Schneider *et al.* 2005.

Dorsal fin 13 spines (spines 4 or 5 relatively long, 14–19% SL), 8½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17 or 18 rays. Body relatively deep, depth 37–40% SL; head pointed; lower jaw projecting, with strong symphyseal knob. Coronal spines present; 2nd suborbital with 1 spine; 3rd suborbital with 2 spines. GR 4–6/1/6 or 7 = 12–14. LL scales 23–25; LSS 39–50; interorbital area weakly scaly.

Body dark reddish brown or red, with numerous small white spots or flecks; anal-fin base reddish brown, with distinct white spots and white bar between darker brown bars on soft-rayed part; pectoral fins orange with white streaks; pelvic fins dark brown with white spots; caudal-fin base reddish brown, rays with somewhat elongate reddish spots, membranes transparent. Attains 10.5 cm SL.



*Scorpaenodes corallinus*, head spination. Source: Smith 1957

**DISTRIBUTION** WIO: Kenya to Mozambique, Aldabra and Seychelles; elsewhere, Hawaii.

## *Scorpaenodes evides* (Jordan & Thompson 1914)

Cheekspot scorpionfish

PLATE 106

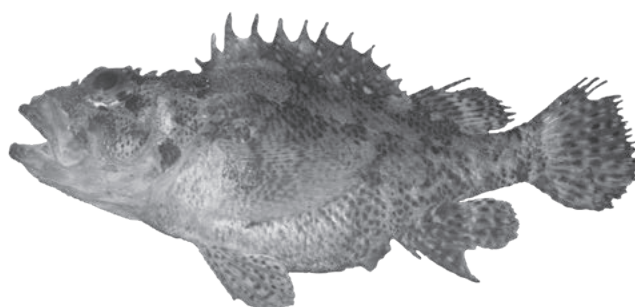
*Thysanichthys evides* Jordan & Thompson 1914: 272, Pl. 32, Fig. 3 (Misaki, Japan); Poss *et al.* 2010\*.

*Scorpaenodes littoralis*: Eschmeyer & Randall 1975\*; Poss & Collette 1990; Randall 1995\*; Almeida *et al.* 2001.

*Scorpaenodes evides*: Motomura *et al.* 2010\*.

Dorsal fin 13 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–19 rays. Interorbital spines usually present, often not well-developed; suborbital ridge with row of 3 spines; coronal spines present or absent; small spines sometimes present between tympanic spines. GR 5–7/1/10–13 = 16–21. Scales on body ctenoid; LL scales 23–26; LSS 34–45; interorbital area heavily scaly.

Head and body with tan to nearly white background, with reddish brown mottling coalescing into weakly defined bars on sides; fins similar but often paler; dark spot sometimes forming an ocellus on subopercle. Attains ~8 cm SL.



*Scorpaenodes evides*, ~6 cm SL (South Africa). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Oman to South Africa (Aliwal Shoal); elsewhere to Indonesia, Taiwan, Japan (Ogasawara Is.), Australia, Kermadec Is., Society Is., Rapa Iti, Marquesas Is. and Hawaii.

**REMARKS** Found on coral reefs, in 1–18 m.

## *Scorpaenodes guamensis* (Quoy & Gaimard 1824)

Guam scorpionfish

PLATE 106

*Scorpaena guamensis* Quoy & Gaimard 1824: 326 (Guam, Mariana Is.).

*Scorpaena rubropunctata* Cuvier (ex Ehrenberg) *in* Cuv. & Val. 1829: 324 (Massawa, Eritrea, Red Sea).

*Scorpaena chilioprista* Rüppell 1838: 107, Pl. 27, Fig. 3 (Massawa, Eritrea, Red Sea); Günther 1860.

*Scorpaena polylepis* Bleeker 1851: 173 (Sumatra, Indonesia).

*Sebastes rubropunctata*: Klunzinger 1870\*; Kossman & Räuber 1877; Borsieri 1904.

*Scorpaena cirrhosa* (*non* Thunberg 1793): Günther 1873 [in part].

*Scorpaenopsis guamensis*: Day 1875 [in part], 1888 [in part], 1889 [in part]; Mendis 1954.

*Sebastichthys strongia* (*non* Cuvier 1829): Day 1875 [in part].

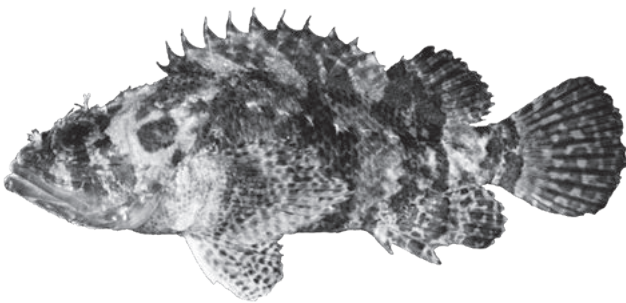
*Sebastes* (*Sebastopsis*) *guamensis*: Klunzinger 1884.

*Scorpaenodes guamensis*: Deraniyagala 1933; Barnard 1947; Smith 1949\*, 1950\*, 1957\*; Munro 1955; Fourmanoir 1957; Smith & Smith 1963\*; Mauge 1967; Jones 1969; Froiland 1972; Baissac 1976, 1990; Harmelin-Vivien 1976; Dor 1984; SSF No. 149.23\*; Letourneur 1991,

1992, 1998; Letourneur *et al.* 1993; Chabanet 1994; Eichler & Lieske 1994\*; Kuitert 1998\*; Almeida *et al.* 1999; Pereira 2000; Mandrytsa 2001; Heemstra *et al.* 2004; McKenna & Allen 2005; Schneider *et al.* 2005; Fricke *et al.* 2009; Golani & Bogorodsky 2010; Motomura *et al.* 2016. *Scorpaenodes corallinus* (non Smith 1957): Frøiland 1972; Dor 1984; Goren & Dor 1994.

Dorsal fin 13 spines,  $8\frac{1}{2}$  or  $9\frac{1}{2}$  rays; anal fin 3 spines,  $4\frac{1}{2}$  or  $5\frac{1}{2}$  rays; pectoral fins 17–19 rays. Interorbital and coronal spines present or absent; suborbital ridge usually with 3 spines: 1st spine sometimes a weak lobe on posterolateral face of lachrymal, small spine on 2nd suborbital, and spine at end of long ridge on 3rd suborbital. GR 5 or 6/1/6–11 = 12–17. LL scales 22–25; LSS 36–50; interorbital area densely scaly.

Body with irregular dark brown and red-brown saddles on paler background; snout pale or mottled white, more so in smaller specimens; opercle usually with dark brown or nearly black eye-sized blotch, sometimes with white or pale margin. Attains 12.5 cm SL.



*Scorpaenodes guamensis*, 7 cm SL (South Africa). © JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Red Sea to South Africa (South Sand Bluff, Eastern Cape), Madagascar, Comoros, Seychelles and Mascarenes; elsewhere to Indonesia, Philippines, Taiwan, southern Japan, Mariana Is., Caroline Is., Marshall Is., Solomon Is., Australia, New Caledonia, Lord Howe I., Vanuatu, Wallis I., Society Is. and Marquesas Is.

**REMARKS** Nocturnal; found in relatively shallow water, to ~30 m deep, typically over dead coral, coral rubble or reef flats.

### *Scorpaenodes hirsutus* (Smith 1957)

Hairy scorpionfish

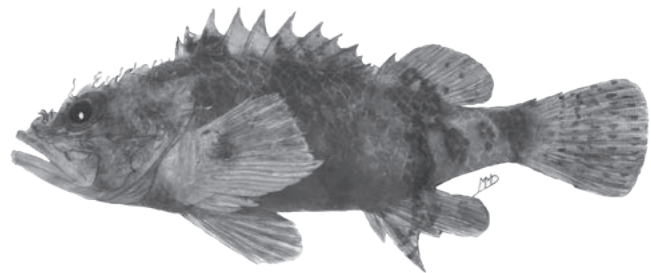
PLATES 106 & 107

*Parascorpaenodes hirsutus* Smith 1957: 63, Pl. 1e, Fig. 5 (Bazaruto I., Mozambique); Smith 1961; Smith & Smith 1963\*.

*Scorpaenodes hirsutus*: Smith 1957\*; Klausowitz & Frøiland 1970; Dor 1984; SSF No. 149.24\*; Winterbottom *et al.* 1989; Baissac 1990; Poss & Collette 1990; Fricke 1999; Pereira 2000; Mandrytsa 2001; McKenna & Allen 2005; Schneider *et al.* 2005; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

Dorsal fin 13 spines,  $7\frac{1}{2}$ – $9\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 15–19 rays. Snout somewhat pointed. Numerous simple cirri on body, especially above lateral line behind head; most head spines with cirrus behind spine base; 2nd suborbital with spine at end of ridge at level of rear margin of pupil on dorsal margin of bone, confluent with lateral spine on lachrymal and usually a smaller spine below and slightly behind it; 3rd suborbital with 2 large spines along ridge confluent with preceding spines. GR 3–6/1/7–10 = 11–17. LL scales 21–25; LSS 27–37.

Body red-orange, with ~4 somewhat dusky or reddish brown irregular saddles; no pronounced markings on subopercle; pectoral-fin bases with dusky red, chevron-shaped or hemispherical blotch; proximal part of pelvic fins with reddish brown mark; anal fin with broad red-orange bar through middle. Attains 7 cm SL.



*Scorpaenodes hirsutus*, 5 cm TL. Source: Smith & Smith 1963

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Mozambique to South Africa (Aliwal Shoal), Comoros, Seychelles, Mauritius, St Brandon Shoals and Chagos; elsewhere to Philippines, Taiwan, Ryukyu Is., Caroline Is., Marshall Is., Australia, New Caledonia, Wallis I., Society Is., Pitcairn Is., Marquesas Is., Line Is. and Hawaii.

**REMARKS** Infrequently seen; found inshore, at 8–54 m.

### *Scorpaenodes immaculatus* Poss & Collette 1990

Immaculate scorpionfish

*Scorpaenodes immaculatus* Poss & Collette 1990: 543, Figs. 1–3 (Walters Shoals); Collette & Parin 1991\*.

Dorsal fin 14 spines,  $8\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 19 rays, rays 2–8 or 9 branched, and uppermost unbranched rays slightly elongate. Maxilla extends below rear margin of orbit. No cirri on body, but many head spines with small simple cirri, longest and most elaborate on supraocular spine; anterior dorsal-fin spines tipped with simple cirri. Interorbital area broad, shallow, with 2 ridges [that of right side ending in spine]; suborbital ridge with distinct spine at rear of 2nd suborbital and another just in front of preopercular

spine; no coronal, sphenotic and upper posttemporal spines; lower posttemporal spine small; front margin of dorsal ramus of preopercle with small spine above the large (1st) spine. GR 5 or 6/1/10. Scales on body ctenoid; underside of head naked; LL scales ~27; LSS ~50.

Body uniformly red, with small red spots on fin rays (no dark markings or black spot on rear of spinous dorsal fin). Preserved specimen uniformly pale. Attains at least 90 mm SL.

**DISTRIBUTION** Known only from the holotype collected from Walters Shoals.

**REMARKS** Found in 40–49 m.

## *Scorpaenodes investigatoris*

Eschmeyer & Rama-Rao 1972

Investigator scorpionfish

*Scorpaenodes varipinnis* (non Smith 1957): Smith 1957 [in part: specimen from off Memba District, Mozambique].

*Scorpaenodes muciparus* (non Alcock 1889): Eschmeyer 1969\*.

*Scorpaenodes investigatoris* Eschmeyer & Rama-Rao 1972: 57 (off Pakistan, Arabian Sea); Poss & Collette 1990; Poss *et al.* 2010; Psomadakis *et al.* 2015\*.

Dorsal fin 13 spines, 9½ or 10½ rays; anal fin 3 spines (2nd spine relatively short, 16–18% SL), 5½ or 6½ rays; pectoral fins 18–20 rays. GR 5 or 6/1/11–13 = 17–20. Cephalic LL pores relatively large. Body scales ctenoid; underside of head with pseudocycloid scales or naked; LL scales 23–25; LSS 39–48.

Head and body rosy dorsally, pinkish or cream ventrally; wide, dark but diffuse bars above lateral line and radiating from eyes; dorsal-fin base with irregular dark brownish red or nearly black spots, and similar but usually smaller dark brown or black spots on soft-rayed dorsal, anal, pelvic and caudal fins; often a large dark spot at rear of spinous dorsal fin; back of buccal cavity dusky. Attains 9 cm SL.

**DISTRIBUTION** WIO: Mozambique, Pakistan and India.

**REMARKS** Known from 57–291 m.

## *Scorpaenodes kelloggi* (Jenkins 1903)

Dwarf scorpionfish

PLATE 107

*Sebastopsis kelloggi* Jenkins 1903: 492, Fig. 37 (Honolulu, Oahu I., Hawaii); Snyder 1904; Smith 1957.

*Scorpaenodes kelloggi*: Eschmeyer & Randall 1975\*; SSF No. 149.25\*; Winterbottom *et al.* 1989; Poss & Collette 1990; Pereira 2000; Fricke *et al.* 2009.

Dorsal fin 13 spines, 8½ rays; anal fin 3 spines, 5½ rays; pectoral fins 18–20 rays. Head with numerous, often relatively long, simple cirri, with smaller cirri below anterior half of spinous dorsal fin and above lateral line. Interorbital spines present or absent; suborbital ridge with row of 3 or 4 spines; no spine on ventrolateral surface of 2nd suborbital; no coronal spines. GR 4–6/1/5–8 = 11–14. LL scales 19–25; LSS 24–39.

Head and body pale brown or greyish, with dusky irregular saddles; pectoral fins with scattered dark spots; caudal fin spotted, usually with pale vertical bar near base. Attains at least 5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Transkei region), Comoros, Seychelles, Réunion, Mauritius, Chagos and Maldives; elsewhere to Philippines, Taiwan, Fiji, Society Is., Marquesas Is. and Hawaii.

**REMARKS** Found among corals, at 6–30 m.

## *Scorpaenodes minor* (Smith 1958)

Minor scorpionfish

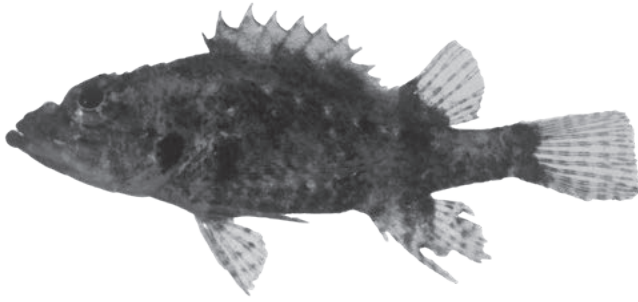
PLATE 107

*Hypomacrus minor* Smith 1958: 178, Pl. 8, Fig. 1 (Bazaruto I., Mozambique); Smith 1961; Smith & Smith 1963\*.

*Scorpaenodes minor*: SSF No. 149.27\*; Poss & Collette 1990; Pereira 2000; Heemstra *et al.* 2004; Letourneur *et al.* 2004; Schneider *et al.* 2005; Motomura *et al.* 2009\*; Poss *et al.* 2010\*.

Dorsal fin 13 spines, 9½ rays; anal fin 3 spines, 4½ or 5½ rays; pectoral fins 14–16 rays. Snout relatively long (11–15% SL), somewhat pointed; lower jaw upturned at ~30–35° angle and extending to tip of premaxilla; paired ascending processes of premaxillae form pronounced knob about half way between snout tip and margin of orbit. Lachrymal with 1 or 2 relatively well-developed cirri on posteroventral margin. Suborbital ridge with pungent spine on 2nd suborbital and continuous with longer ridge of 3rd suborbital which ends in a spine; no nasal spine. GR 4–5/1/7–11 = 11–16. No scales between rear of interorbital area to bases of supraocular spines; LL scales 17–23; LSS 30–37.

Body mostly reddish olive-brown, with irregular pale blotches, including irregular broad bar between dorsal-fin notch and anal fin, and some white spots on belly; dark spot on subopercle; dark or dusky mottling or blotches on spinous dorsal fin. Attains 5 cm SL.



*Scorpaenodes minor*, 3 cm SL (Comoros). © R Winterbottom, ROM

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique, Comoros and Seychelles; elsewhere to Philippines, Taiwan, Ryukyu Is., Australia, New Caledonia, Fiji and Wallis I.

**REMARKS** Found over coral reefs, at ~2–35 m.

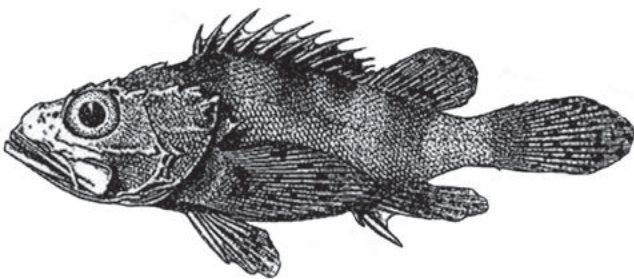
### *Scorpaenodes muciparus* (Alcock 1889)

Cave-headed scorpionfish

*Sebastes muciparus* Alcock 1889: 298, Pl. 22, Fig. 3 (off Gopalpur, India, Bay of Bengal); Alcock 1898\*; Weber 1913; ?Klausewitz & Frøiland 1970. *Scorpaenodes muciparus*: Eschmeyer & Rama-Rao 1972; Poss & Collette 1990; Mandrytsa 2001; Schneider *et al.* 2005; Poss *et al.* 2010\*; Psomadakis *et al.* 2015\*.

Dorsal fin 13 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 18 or 19 rays. Pronounced notch between maxillary bones, into which fits a prominent knob on lower jaw symphysis. Suborbital ridge with 6 spines. Cephalic LL pores large; LL scales ~22; LSS ~70–73.

Body bright red, with dark mottling forming several saddles; dark, nearly black blotch at rear end of dorsal fin; caudal fin with red spots. Attains ~15 cm SL.



*Scorpaenodes muciparus*, 10 cm TL (Bay of Bengal). Source: Alcock 1889

**DISTRIBUTION** Indian Ocean. WIO: Pakistan, and may range to India and Sri Lanka. Primarily known from eastern Indian Ocean: Indonesia (Solor Sea), Gulf of Martaban (Andaman Sea) and Bay of Bengal.

**REMARKS** Rare; found on deep reefs, at ~80–380 m.

Although included by Klausewitz & Frøiland (1970) in a key to species of the Red Sea and WIO, it was not listed as from that locality by Golani & Bogorodsky (2010).

### *Scorpaenodes parvipinnis* (Garrett 1864)

Lowfin scorpionfish

PLATE 107

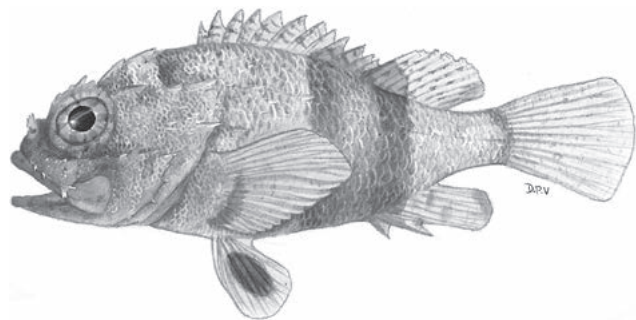
*Scorpaena parvipinnis* Garrett 1864: 105 (Hawaii).

*Scorpaenodes parvipinnis*: Smith 1957\*; Maugé 1967; Jones 1969; Dor 1984; SSF No. 149.28\*; Winterbottom *et al.* 1989; Poss & Collette 1990\*; Kuitert 1998\*; Pereira 2000; McKenna & Allen 2005; Fricke *et al.* 2009; Motomura *et al.* 2010.

*Paronescodes asperrimus* Smith 1958: 177 (La Digue I., Seychelles); Smith & Smith 1963\*.

Dorsal fin 13 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 15–17 rays. Body covered with small skin flaps. Lachrymal with 2 or 3 spines on posterolateral surface; 2nd suborbital with 2–4 spines along ridge continuous with ridge on 3rd suborbital, with 2–6 spines (number of spines increasing with growth); usually no coronal spines; small medial spine (but sometimes paired spines) may be present at rear of interorbital area. GR 4 or 5/1/6–9 = 11–14. LL scales 21–25; LSS 43–49; interorbital area and snout scaly.

Head and rear half of body dark brown or dark red; middle part of body pale, from head to beneath middle of spinous dorsal fin (this area often white in life and most prominent in young); peduncle with dark bar followed by narrower pale bar on caudal-fin base. Attains 9.5 cm SL.



*Scorpaenodes parvipinnis*, 3 cm TL (Tanzania). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Tanzania to South Africa (Aliwal Shoal), Madagascar, Comoros, Seychelles, Mascarenes and Chagos; elsewhere to Indonesia, Taiwan, southern Japan, Caroline Is., Solomon Is., Australia, New Caledonia, Marquesas Is. and Hawaii.

**REMARKS** Found at ~2–50 m, often on inshore reef walls covered with algae and on sponges.



## *Scorpaenodes scaber* (Ramsay & Ogilby 1886)

### Pygmy scorpionfish

*Sebastes scaber* Ramsay & Ogilby 1886: 577 (Shark Reef, Port Jackson, New South Wales, Australia).

*Scorpaenodes scaber*: ?Frøiland 1972; ?Dor 1984; Winterbottom *et al.* 1989\*; Motomura *et al.* 2011.

Dorsal fin 13 spines, 7½–9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–19 rays. Longest dorsal-fin spine 14–18% SL, distinctly greater than orbit diameter; 2nd anal-fin spine relatively long, 17–25% SL. Coronal spines present in most specimens; post-ocular spine and tympanic spine nearly subequal; posteroventral corner of lachrymal ends in weak spine or relatively sharp lobe. GR 5–6/1/10–12 = 17–19. LL scales 37–45; LSS 35–46.

Body somewhat variegated (brown, red brown and pale brown areas); nape and rear part of head typically paler; no pronounced dark blotch on opercle and no spot on subopercle. Attains possibly 12 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Djibouti (one specimen), Kenya to Mozambique and Chagos; elsewhere to Indonesia, Philippines, Japan, Marshall Is., Australia, Lord Howe I., Kermadec Is., Fiji, Tonga, Wallis I., Samoa and Rapa Iti.

**REMARKS** According to Kuitert (1993), it is often found in caves along estuarine and offshore reefs, at 3–30 m. Variation in the development of coronal spines and loss of colouration in preservative makes this species difficult to distinguish from *S. guamensis*, especially smaller individuals. Additional study is needed.

## *Scorpaenodes steinitzi* Klausewitz & Frøiland 1970

### Steinitz's scorpionfish

PLATE 107

*Scorpaenodes steinitzi* Klausewitz & Frøiland 1970: 318, Figs. 1–2 (Eilat, Israel, Gulf of Aqaba, Red Sea); Eschmeyer & Rama-Rao 1972; Frøiland 1972; Dor 1984; Poss & Collette 1990; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

?*Scorpaenodes varipinnis* (non Smith 1957): Klausewitz & Frøiland 1970; Frøiland 1972.

Dorsal fin 13 spines, 9½ (rarely 8½) rays; anal fin 3 spines, 5½ rays; pectoral fins 16–18 (usually 17) rays. Lachrymal with distinct ridge below eye ending in a spine, with ridge continuing over 2nd suborbital, bearing spine, and with long ridge over 3rd suborbital, ending in distinct spine immediately anterior to supplemental preopercular spine;

sometimes small spine at midline of occipital commissure, separating interorbital area from occiput; no coronal spines. GR 4–6/1/8–11 = 14–19 (usually 17 or 18). Scales weakly ctenoid or sometimes emarginate, as in interorbital area, and ctenii best developed on body immediately behind head; LL scales 24 or 25 (often missing); LSS 38–45.

Body pale, covered with minute dark specks; interopercle without distinct markings other than specks. Attains 5.5 cm SL.

**DISTRIBUTION** WIO: northern Red Sea around Sinai Peninsula.

**REMARKS** Found inshore, to ~30 m deep.

## *Scorpaenodes tribulosus* Eschmeyer 1969

### Roughscale scorpionfish

*Scorpaenodes tribulosus* Eschmeyer 1969: 8, Fig. 1c (off Kenya: 02°42' S, 40°53' E); Klausewitz & Frøiland 1970; Eschmeyer & Rama-Rao 1972; Poss & Collette 1990; Poss *et al.* 2010.

Dorsal fin 13 spines, 8½ rays; anal fin 3 spines (2nd spine relatively short, 15–16% SL), 5½ rays; pectoral fins 18 or 19 rays. Body relatively deep, 38–44% SL. Suborbital ridge with 4–8 poorly defined spines. GR 5–7/1/7–10 = 13–16. Scales strongly ctenoid, the ctenii notably longer and more developed than in other *Scorpaenodes* species; underside of head strongly scaly; LL scales 25 or 26; LSS 31–39.

Preserved specimens with faint traces of dusky bars below dorsal fin. Attains at least 4.5 cm SL.

**DISTRIBUTION** WIO: Somalia and Kenya.

## *Scorpaenodes varipinnis* Smith 1957

### Blotchfin scorpionfish

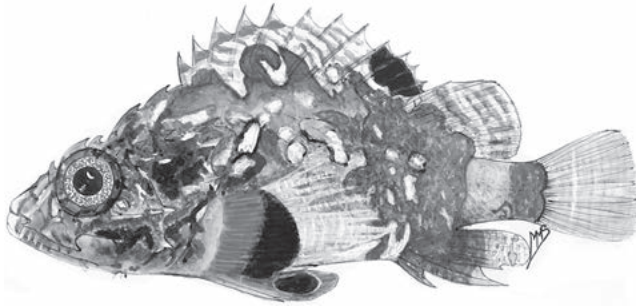
PLATE 107

*Scorpaenodes varipinnis* Smith 1957: 65, Pl. 3d, Fig. 5 (Zanzibar, Tanzania); Smith & Smith 1963\*; Mauge 1967; Dor 1984; SSF No. 149.29\*; Poss & Collette 1990; Kuitert 1998\*; Pereira 2000; McKenna & Allen 2005; Motomura *et al.* 2011.

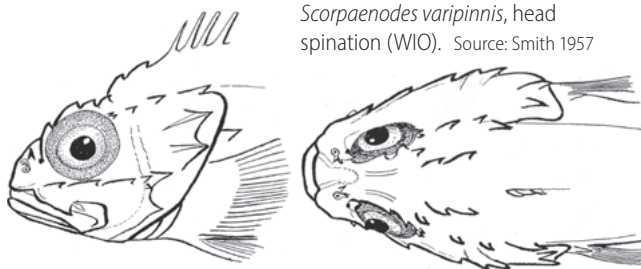
Dorsal fin 13 spines, 7½–9½ rays; anal fin 3 spines, 5½ rays; pectoral fin 17–19 rays. Fifth spine of dorsal fin subequal to eye diameter, 13–14% SL. No coronal spines; preopercle with 2 or 3 distinct spines. GR 3–6/1/6–12 = 12–19. LL scales 22–25; LSS 33–40.

Body predominantly pinkish, with pale orangish brown mottling forming 4 or 5 irregular broad saddles; pectoral fins with dark chevron-shaped blotch; pelvic fins mostly pale, with

scattered small red spots in distal half; dorsal fin with red or reddish brown spots often in somewhat oblique rows. Attains 13 cm TL.



*Scorpaenodes varipinnis*, 3 cm TL (Tanzania). Source: SSF



*Scorpaenodes varipinnis*, head spination (WIO). Source: Smith 1957

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea to South Africa (Morgans Bay, Eastern Cape), Madagascar, Seychelles, Comoros, Mauritius, St Brandon Shoals and Maldives; elsewhere to Philippines, Taiwan, Japan (Ogasawara Is.), Chesterfield Is., New Caledonia and Society Is.

**REMARKS** Found inshore to ~64 m deep; one record possibly as deep as 200 m.

## GENUS *Scorpaenopsis* Heckel 1837

Dorsal fin 12 or 13 spines, 9½ or 10½ rays; anal fin 3 spines, 5 (rarely) or 5½ rays; pectoral fins 16–21 rays. Body robust, depth 2.7–3.2 in SL. Head large, with 3–5 suborbital spines; usually, with a strong antrorse as well as retrorse lachrymal spine; no coronal spines (except in 1 species); elevated median ridge at anterior end of frontal that passes between anterior ends of interorbital ridge of each side. Cirri variously present on head and body. Mouth large, oblique; maxilla extending to middle of orbit or further. Teeth on jaws and vomer in villiform bands; no teeth on palatines. No slit behind last hemibranch. LL pores small, except for those in mandibular series. Scales ctenoid, except pseudocycloid on breast and

abdomen; LL scales 17–24. Body colouration highly variable, usually mimicking surroundings closely, with skin often encrusted with algae. Genus reviewed by Randall & Eschmeyer (2001). Twenty-six species, 14 in WIO.

### KEY TO SPECIES

- |    |   |                     |
|----|---|---------------------|
| 1a | Upper opercular spine single .....  | 8                   |
| 1b | Upper opercular spine bifid or multifid .....   | 2                   |
| 2a | Nape and body immediately behind head highly arched, appearing humpbacked; interorbital area broad, its least width 3.9–4.5 in HL .....   | 3                   |
| 2b | Nape and body immediately behind head not strongly arched; interorbital area relatively narrow, its least width 5.5–8.2 in HL .....   | 6                   |
| 3a | Mouth strongly oblique, at ~60–70° angle with horizontal axis of body; pectoral fins 17–19 (usually 18, rarely 17) rays; posttemporal spine double .....  | <i>S. diabolus</i>  |
| 3b | Mouth oblique, at ~40–50° angle to horizontal axis of body; pectoral fins 16–18 (usually 17, rarely 18) rays; upper posttemporal spine single, blade-like .....   | 4                   |
| 4a | Orbit diameter 1.7–2 in snout length; supraorbital ridge and anterior ridge of lachrymal serrate; pterotic spine, lower posttemporal spine, and spines of 2nd and 3rd suborbital bones developed as serrate ridges; nuchal spine with 1 or 2 supplemental spines; anterior ridge of lachrymal serrate .....   | <i>S. neglecta</i>  |
| 4b | Orbit diameter 1.3–1.5 in snout length; supraorbital ridge and anterior ridge of lachrymal and suborbitals not serrate; lower posttemporal spines simple, not forming serrate ridge; nuchal spine without supplemental spines .....   | 5                   |
| 5a | Narrow, triangular black mark in oral cavity behind upper jaw teeth; nasal spines usually bifid or multifid, with 2–6 points; ascending process of premaxilla relatively broad, its maximum width 1.4–1.8 in orbit diameter; no series of papillae or nodules in interorbital area between supraocular spines; no large black spot (ocellus) on medial surface of pectoral fins .....                     | <i>S. macrochir</i> |
| 5b | No black mark inside oral cavity near front of upper jaw; nasal spines usually single; ascending process of premaxilla narrow, its maximum width 1.8–2.2 in orbit diameter; series of papillae or nodules present, sometimes on low ridge, in interorbital area between supraocular spines; black spot (ocellus) almost size of eye on medial surface of pectoral fin near base of uppermost 5 rays ..... | <i>S. gibbosa</i>   |

Continued ...

## KEY TO SPECIES

- 6a Orbit diameter 1.2–1.7 in snout length; posterior lachrymal spine usually with 2 or 3 points ..... *S. vittapinna*
- 6b Orbit diameter varies from longer than snout to ~1.2 in snout length; posterior lachrymal spine ends in single point ..... **7**
- 7a No suborbital pit below eyes, and no broad space between eye and suborbital ridge; mandibular LL pores at symphysis open medially into deep midventral pit; pectoral fins 16 rays, all unbranched ..... *S. gilchristi*
- 7b Deep, subtriangular suborbital pit present before broad space between eye and suborbital ridge; mandibular LL pores at symphysis opening as 2 separate bilaterally symmetric pores; pectoral fins 16–18 (usually 17) rays ..... *S. cotticeps*
- 8a LSS 59–67; pectoral fins 18–20 rays ..... **9**
- 8b LSS 42–61; pectoral fins 17–21 rays ..... **10**
- 9a Third spine of dorsal fin longest, 2–2.5 in HL; occipital pit shallow or absent; snout relatively long, 2.7–3 in HL; space between opercular spines naked; length of 1st spine of dorsal fin 1.8–2.2 in 2nd spine; supraocular and post-ocular spines broadly joined in adults, with only tip of supraocular spine visible and flared laterally to form shelf over rear half of eye; pectoral fins 18–20 (usually 20) rays ..... *S. oxycephala*
- 9b Fourth or 5th spine of dorsal fin longest, 2.6–3.1 in HL; occipital pit moderately deep; snout relatively short, 3–3.4 in HL; space between opercular spines with scattered small scales; length of 1st spine of dorsal fin 1.7–1.9 in 2nd; supraocular and post-ocular spines not broadly joined; pectoral fins 18 or 19 (usually 18) rays ..... *S. lactomaculata*
- 10a Upper opercular spine broad, with strong median ridge; space between opercular spines with 1 or 2 ridges (may be weak in smaller specimens); first 2 suborbital spines with 1 or more parallel ridges ..... *S. barbata*
- 10b Upper opercular spine relatively narrow, without strong median ridge; space between opercular spines without ridges; suborbital spines without ridges ..... **11**
- 11a Occipital pit deep, quadrangular, in dorsal view its anterior edge straight with a slight ridge; low ridge on each side of occipital pit between tympanic and parietal spines; pectoral fins usually 17 rays ..... *S. venosa*
- 11b Occipital pit neither deep nor quadrangular, in dorsal view its anterior edge curves inwards towards pit, without ridge; no ridge between sides of occipital pit between post-ocular and tympanic spines; pectoral fins 17–19 rays ..... **12**
- 12a Extra spine in front of each tympanic spine, joined by low ridge to post-ocular spine (specimens >6 cm SL); pectoral fins usually 17 (rarely 18) rays; supraocular cirrus of adults small, if present ..... *S. possi*
- 12b No extra spine in front of each tympanic spine; pectoral fins 17–20 rays (rarely 17 rays, except for *S. longispina*); supraocular tentacle of adults prominent, if present ..... **13**
- 13a Ridge above anterior lachrymal spine with sharp edge that angles slightly dorsally, and ends in spine in specimens >9 cm SL; LSS 44–49 ..... *S. ramaraoi*
- 13b Ridge above anterior lachrymal spine relatively smooth, straight, without spine at any size; LSS 48–61 ..... *S. longispina*

## *Scorpaenopsis barbata* (Rüppell 1838)

Bearded scorpionfish

PLATE 108

*Scorpaena barbata* Rüppell 1838: 105, Pl. 27, Fig. 1 (Massawa, Eritrea, Red Sea); Eschmeyer 1998.

*Scorpaena cirrhosa* (non Thunberg 1793): Günther 1860 [in part].

*Scorpaenopsis cirrhosa* (non Thunberg 1793): ?Fowler 1935.

?*Scorpaenopsis* sp.: Randall *et al.* 1978\*.

*Scorpaenopsis barbata*: Dor 1984; Field 2005\*; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

*Scorpaenopsis barbatus*: Randall 1983\*; Al-Baharana 1986\*; Goren & Dor 1994; Randall 1995\*; Carpenter *et al.* 1997\*; Khalaf & Disi 1997\*; Field & Field 1998\*.

*Scorpaena gibbosa* (non Bloch & Schneider 1801): Dor 1984.

*Scorpaenopsis venosa* (non Cuvier 1829): Krupp *et al.* 2000\*.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–19 rays. Snout length 12.5–15.6% SL. Occipital pit moderately or well-developed, somewhat elevated laterally between tympanic and parietal spines; strong median ridge in

anterior third of interorbital area; interorbital ridges strong, separated by wide channel, more than twice width of either ridge, ending at transverse ridge that runs medially from post-ocular spine; opercle with small ridge between 2 spines (ridge weak in smaller specimens); tympanic spine roughly subequal to post-ocular spine. Numerous cirri and skin flaps on head (especially on lower jaw), body (prominent on LL scales), and dorsal and pectoral fins; largest cirrus at tip of large posteroventrally directed lachrymal spine; supraocular cirrus usually present, multifid. GR 4–6/1/7–10 = 12–17. LL scales 21–25; LSS 48–55.

Body yellow or pink above lateral line, with 3 or 4 distinct dark brown bars, and brownish pink to red-pink below lateral line, with small white spots on belly near vent; head variously coloured, usually brownish, with large pale areas on snout and occiput, and dark patch below eyes; chin barbels reddish; spinous dorsal fin often reddish anteriorly, spine tips usually pale; caudal fin with wide mottled bar posteriorly, margin paler and irregularly spotted. Attains 20.5 cm SL.



*Scorpaenopsis barbata*, 7 cm SL (Persian/Arabian Gulf).

© JE Randall, Bishop Museum

**DISTRIBUTION** WIO: Persian/Arabian Gulf, Red Sea, Gulf of Aden, Oman and Somalia.

**REMARKS** Found in shallow waters among rocks and on reefs, often on rubble or sand around coral patches, in 1–29 m.

### *Scorpaenopsis cotticeps* Fowler 1938

Sculpin scorpionfish

PLATE 108

*Scorpaena rosea* (*non* Day 1868): Weber 1913.

*Scorpaenopsis cotticeps* Fowler 1938: 65, Fig. 27 (Tinakata I., Sulu Is., Philippines); Randall & Eschmeyer 2001\*.

*Scorpaenopsis simulata* De Beaufort in De Beaufort & Briggs 1962: 19 (Sulu Is., Philippines).

Dorsal fin 13 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16–18 rays. Snout length 13–16% SL. Suborbital pit present between orbit and suborbital bones. Upper opercular spine ending in 2 or more points. GR 3–5/1/6 or 7 = 10–13. Antermost mandibular LL pores open into large depression that appears to form single median pore; LL scales 17–19; LSS 33–37.

Head and body predominantly orange or reddish orange, darker anteriorly from behind eyes to base of dorsal-fin spines 6–8, and in broad bar extending from middle of soft-rayed dorsal fin to anal-fin base; reddish orange bars on anal, caudal and pectoral fins, and white or cream markings often irregularly present on fins. Attains 6.5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden, Somalia and Seychelles; elsewhere to Philippines, Macclesfield Bank (South China Sea), Taiwan, Japan and Australia.

**REMARKS** Found in 15–70 m.

### *Scorpaenopsis diabolus* (Cuvier 1829)

False stonefish

PLATE 108

*Scorpaena diabolus* Cuvier (ex Duhamel Du Monceau) 1829: 166 [Indo-Pacific].

*Scorpaena multicolor* Kuhl & Van Hasselt in Cuv. & Val. 1829 [name not available].

*Scorpaena gibbosa* (*non* Bloch & Schneider 1801): Klunzinger 1870, 1884; Picaglia 1895.

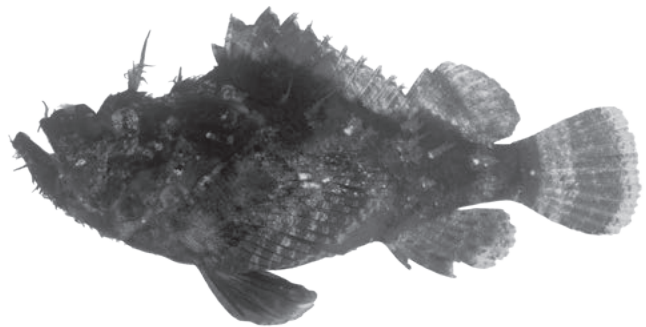
*Scorpaenopsis diabolus*: ?Regan 1908; Randall 1983\*; Dor 1984; SSF No. 149.31\*; Fischer *et al.* 1990\*; Eichler & Lieske 1994\*; Randall 1995\*; Khalaf & Disi 1997\*; Field & Field 1998\*; Pereira 2000; Randall & Eschmeyer 2001; King & Fraser 2002\*; Manilo & Bogorodsky 2003; Field 2005; McKenna & Allen 2005; Schneider *et al.* 2005; Tyler *et al.* 2009; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

*Scorpaenopsis gibbosa* (*non* Bloch & Schneider 1801): Smith 1957 [in part].

*Scorpaenopsis diabolus*: Kuitert 1998\*.

Dorsal fin 12 spines, 9½ or 10½ rays; anal fin 3 spines, 5 or 5½ rays; pectoral fins 17–19 rays. Dorsal profile of body immediately behind head with strong hump, evident even in smaller specimens; snout length 13–15% SL; mouth strongly superior, inclined at ~60–70° angle from horizontal, somewhat less so in smaller specimens, with prominent symphyseal knob; interorbital area broad, width 9–11% SL; deep, nearly triangular suborbital pit at anteroventral margin of orbit. Suborbital ridge with 4–10 spines of irregular size and placement; post-ocular spine with 2–4 points, often forming somewhat serrate ridge; upper posttemporal spine bifid. GR 3–5/1/6–9 = 11–14. LL scales 20–24; LSS 38–47.

Body often with areas of green and blue, and with algae growing on the skin; pectoral-fin axils black with minute white specks, inner surface of fins with bright bands of orange-red, yellow and orange-red, usually an elongate black spot on upper membranes 3–7, and distal margin hyaline. Attains 30 cm TL.



*Scorpaenopsis diabolus*, 14 cm SL (South Africa). © RE Stobbs



**DISTRIBUTION** Indo-Pacific. WIO: Red Sea (Sinai Peninsula), Gulf of Aden, Oman, Kenya to South Africa (Xora River mouth), Madagascar, Comoros, Seychelles, Réunion, Mauritius, St Brandon Shoals, Chagos, Maldives and Sri Lanka; elsewhere to Thailand, Vietnam, Indonesia, Philippines, Taiwan, Japan, New Guinea, New Caledonia, New Zealand, Society Is. and Hawaii.

**REMARKS** Found inshore, at 15–40 m; a report from 70 m (Myers 1999) is erroneous. Venom less potent than that of the true stonefish, *Synanceia verrucosa*, of family Synanceiidae.

*Scorpaenopsis gibbosa* (Bloch & Schneider 1801)

Humpbacked scorpionfish PLATE 108

*Scorpaena gibbosa* Bloch & Schneider 1801: 192, Pl. 44 ('America' [in error; Indo-Pacific]); Sauvage 1891.

*Scorpaena nesogallica* Cuvier in Cuv. & Val. 1829: 315 (Mauritius, Mascarenes); Lesson 1831; Heckel 1837; Günther 1860; Eschmeyer 1998.

*Scorpaena (Scorpaenichthys) gibbosa*: Klunzinger 1870, 1871.

*Scorpaenopsis gibbosa*: Sauvage 1873, 1891; Barnard 1927; Smith 1950 [in part], 1957; Steinitz & Ben-Tuvia 1955; Fourmanoir 1957\*; Smith & Smith 1963\*; Maugé 1967; Jones 1969; Halstead 1970\*; SSF No. 149.32\*; Cornic 1987; Fischer *et al.* 1990\*; Paepke & Fricke 1992; Field & Field 1998; Pereira 2000; Almeida *et al.* 2001; Randall & Eschmeyer 2001\*; Heemstra *et al.* 2004; McKenna & Allen 2005; Motomura & Shinohara 2005\*; Schneider *et al.* 2005.

*Scorpaena axillaris* Bliss 1883: 51 (Mauritius, Mascarenes); Gudger 1929; Smith 1954; Baissac 1968; Randall & Eschmeyer 2002.

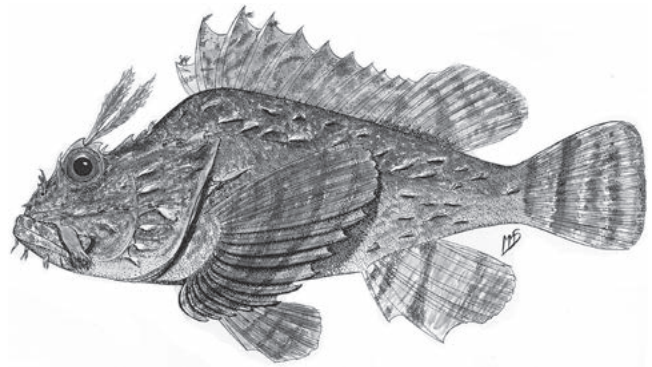
*Scorpaena barbata* (non Rüppell 1838): Dor 1984; Kuronuma & Abe 1986.

*Sebastapistes mauritiana* (non Cuvier 1829): Fricke 1999.

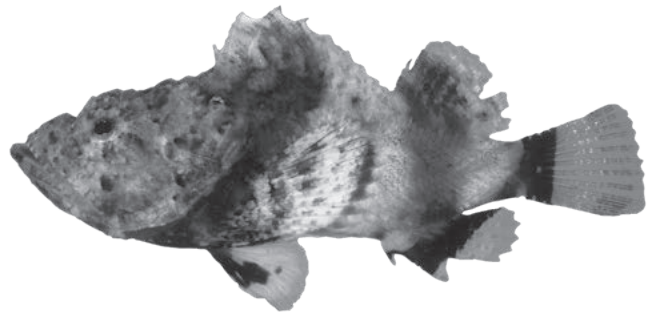
*Scorpaenopsis diabolus* (non Cuvier 1829): Gillibrand *et al.* 2007.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16–18 rays. Snout length 11–13.8% SL; mouth superior, inclined at 40–50° angle from horizontal; interorbital width 8.9–10.4% SL; nearly triangular pit at anteroventral margin of orbit. Occipital pit deep, with low ridges laterally and anteriorly. Suborbital ridge with 4 spines; upper opercular spine double; post-ocular spine with 2–4 points, sometimes forming serrate ridge; upper posttemporal spine single, rather blade-like. GR 4 or 5/1/6–9 = 11–14. LL scales 20–22; LSS 40–44.

Body mottled olive-brown to reddish brown; pectoral-fin axils pale with tiny black spots, fin membranes usually with large black spot between rays 4–5, and black band submarginally over rays 6–9 and intervening membranes; no triangular black mark near upper jaw symphysis. Attains at least 10.5 cm SL.



*Scorpaenopsis gibbosa*, 8 cm TL (S Mozambique). Source: SSF



*Scorpaenopsis gibbosa*, ~4 cm SL (S Mozambique). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: Kenya to South Africa (Eastern Cape), Comoros, Seychelles, Réunion, Mauritius, Rodrigues and Chagos; not known from Red Sea.

**REMARKS** Collected inshore, to ~50 m deep. Reports of this species from outside WIO are probably misidentifications of *S. diabolus*.

*Scorpaenopsis gilchristi* (Smith 1957)

Gilchrist's scorpionfish PLATE 108

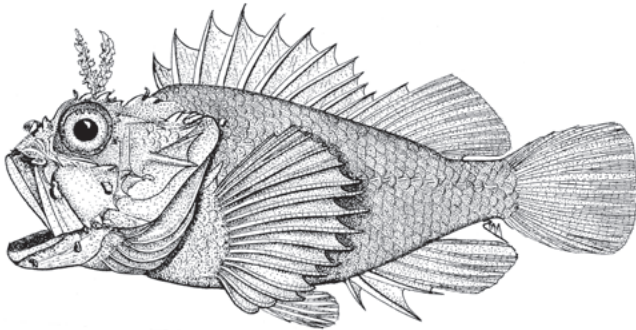
*Dendroscorpaena gilchristi* Smith 1957: 61, Fig. 4 (Thukela River, KwaZulu-Natal, South Africa); Smith 1961.

*Scorpaenopsis gilchristi*: SSF No. 149.33\*; Eschmeyer 1998; Randall & Eschmeyer 2001\*; Voronina & Volkova 2007.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16 rays. Body compressed, not notably humpbacked; snout blunt, relatively short, ~12.8% SL; interorbital area deeply concave, with interorbital ridges elevated posteriorly and with prominent coronal ridges that lack a spine. No suborbital pit. Suborbital ridge with 3 spines; uppermost opercular spine with 2 or 3 points. Supraocular cirrus large, fleshy and fimbriate, usually longer than eye diameter. Teeth at symphysis slightly enlarged.

GR 3/1/8–10 = 13. Mandibular branch of cephalic LL pores (immediately behind lower jaw symphysis) open medially into common pit; LL scales ~22; LSS 34 or 35.

Preserved specimens uniformly pale. Attains at least 6 cm SL.



*Scorpaenopsis gilchristi*, 8 cm TL, holotype (South Africa). Source: Smith 1957

**DISTRIBUTION** WIO: Somalia, South Africa (Kosi River mouth to Presleys Bay) and Saya de Malha Bank.

**REMARKS** Found in 15–75 m.

### *Scorpaenopsis lactomaculata* (Herre 1945)

Whiteblotched scorpionfish

*Scorpaena lactomaculata* Herre 1945: 400 (Mumbai, India).

*Scorpaenopsis lactomaculata*: Carpenter *et al.* 1997\*; Randall & Eschmeyer 2001\*; Manilo & Bogorodsky 2003.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 18 or 19 rays. Snout length 12.6–13% SL. Median interorbital ridge extends nearly to mid-orbit; interorbital ridges each continuous with base of tympanic spines; suborbital ridge with 4 spines; supraocular and post-ocular spines not joined to form single ridge; tympanic spines well-separated and longer than post-ocular spines; upper opercular spine with single point. GR 4 or 5/1/10–12 = 15–18. LL scales 22–24; LSS 59–65.

Body mottled brown or reddish brown, with irregular, broad, dark saddles beneath spinous dorsal fin, and another more or less continuous saddle with dark bars over soft-rayed part of dorsal and anal fins; white spot below eyes; crescent-shaped white markings near base of spinous dorsal-fin membranes, most prominent anteriorly; whitish specks often on rear of spinous and soft-rayed parts of dorsal fin (usually well-developed on latter). Attains 17.5 cm SL.



*Scorpaenopsis lactomaculata* (Persian/Arabian Gulf).

© JE Randall, Bishop Museum

**DISTRIBUTION** WIO: Persian/Arabian Gulf and Oman to India.

**REMARKS** Found inshore.

### *Scorpaenopsis longispina*

Randall & Eschmeyer 2001

Longspined false stonefish

PLATE 108

*Scorpaenopsis longispina* Randall & Eschmeyer 2001: 29, Pl. 4b–c, Fig. 9 (Mauritius, Mascarenes); Heemstra *et al.* 2004.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fin 16–18 rays. Snout length 13–16% SL; mouth moderately upturned at ~30° angle from horizontal; nearly half of orbit above dorsal profile of head; interorbital width narrow; short, well-developed median ridge from between rear edge of nostrils to about anterior quarter of interorbital area; interorbital ridges prominent. Suborbital ridge with 4 spines; tympanic spines longer than post-ocular spines and not connected to other spines by ridges; opercular spines end in single point. Supraocular cirrus usually well-developed. GR 4 or 5/1/8 = 13 or 14. LL scales 22 or 23; LSS 49–53.

Body red to reddish brown, with irregular darker spots on head and body; prominent white or pale spot on peduncle below lateral line. Attains ~9.5 cm SL.

**DISTRIBUTION** WIO: Mozambique, South Africa (Sodwana Bay to Aliwal Shoal), Mauritius and Rodrigues.

**REMARKS** Found in 4–32 m.

## *Scorpaenopsis macrochir* Ogilby 1910

Rough humpbacked scorpionfish

PLATE 108

*Scorpaenopsis macrochir* Ogilby 1910: 29 (Bulwer I., Queensland, Australia); Randall & Eschmeyer 2001\*.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16–18 rays. Body profile humped due to strongly arched vertebral column; snout length 13–16% SL; mouth superior, moderately upturned at ~40–50° from horizontal, and ascending ramus of premaxillae broad. Lower jaw, cheeks, and postorbital area with multifid cirri. Suborbital ridge with 5 spines; nasal spine with 2–6 points; supraocular and post-ocular spines often multifid, with 1 or 2 and 2–4 spines, respectively; upper posttemporal spine single, blade-like; upper opercular spine with 2 points. GR 4–6/1/7–10 = 11–16. Anteriormost mandibular LL pores minute and separate at symphysis; LL scales 20–22; LSS 41–45.

Body colour variable, often golden brown or tan; pectoral fins dusky with dark subterminal band, medial surface near axils pale, with 15–30 brown spots, and remainder of surface dusky (no large dark blotches on medial surface); small triangular black mark inside mouth, on vomer immediately behind space between teeth; some fish with large pale area on or above opercle. Attains 13.5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Mauritius; elsewhere to Thailand, Indonesia, Philippines, Japan, Mariana Is., Caroline Is., New Guinea, Australia, Fiji, Tonga, Wallis I., Samoa, Cook Is., Tuamotu Is. and Marquesas Is.

**REMARKS** Found inshore, depth range unknown.

## *Scorpaenopsis neglecta* Heckel 1837

Yellowfin scorpionfish

PLATE 108

*Scorpaenopsis neglecta* Heckel 1837: 159 ('Sea of East Indies'); Eschmeyer & Randall 1975; Randall & Eschmeyer 2001\*; Voronina & Volkova 2007.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16–18 rays. Snout length 14.6–15.4% SL; mouth superior, at 40–50° angle from horizontal, and ascending processes of premaxillae narrow; deep, nearly triangular pit at anteroventral margin of orbit. Supraocular cirrus small, sometimes nearly imperceptible. Suborbital ridge with 4 spines; supraorbital ridge serrate, with post-ocular spine

forming ridge with 2–4 spinous points; nuchal spine often with multiple points; upper opercular spine with 2 points. GR 4 or 5/1/7–9 = 12–15. LL scales 20–22; LSS 42–45.

Body brown with darker irregular markings; pectoral-fin axils pale with small black spots, medial surface of fins without large dark spots or blotches; narrow triangular black mark inside mouth immediately behind upper jaw symphysis. Attains 14 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Mannar (Krusadai I., India: one specimen); elsewhere, Gulf of Thailand, Vietnam, Indonesia, Philippines, South China Sea, Hong Kong, Taiwan, Japan and western Australia.

**REMARKS** Inhabits relatively shallow water.

## *Scorpaenopsis oxycephala* (Bleeker 1849)

Tasselled scorpionfish

PLATE 109

*Scorpaena oxycephalus* Bleeker 1849: 7 (Jakarta, Java, Indonesia).

*Scorpaenopsis oxycephala*: Sauvage 1873; King & Fraser 2002 [in part]; Zsilavec 2005; Tyler *et al.* 2009.

*Scorpaenopsis venosa* (*non* Cuvier 1829): Smith 1950.

*Scorpaenopsis cirrosa* (*non* Thunberg 1793): ?Munro 1955; Dor 1984.

*Scorpaenopsis oxycephala*: SSF No. 149.34\*; Winterbottom *et al.* 1989;

Eichler & Lieske 1994\*; Field & Field 1998\*; Randall & Eschmeyer 2001\*; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

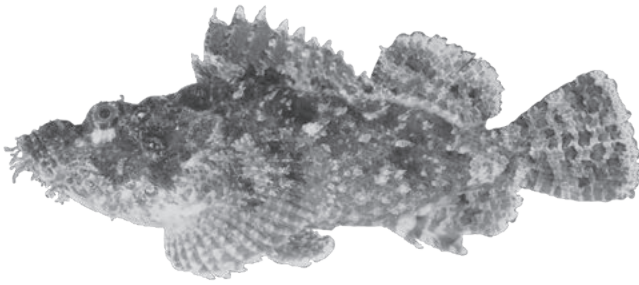
*Scorpaenopsis lactomaculatus* (*non* Herre 1945): Randall 1995\*.

*Scorpaenopsis oxycephalus*: Khalaf & Zajon 2007.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–20 rays. Penultimate dorsal-fin spine relatively long: 1.5–1.9 in length of last spine, or 5.8–7.8% SL; head relatively short, HL 41–43% SL; snout relatively long, 14–16% SL. Occipital pit shallow or absent. Suborbital ridge with 4 spines; no prominent transverse ridge between parietal spines; no scales between opercular spines. GR 4–6/1/9 or 10 = 14–16. LL scales 23 or 24; LSS 59–67.

Body colour variable: usually reddish, pinkish or olive-brown, with darker areas dorsally, and ventrum more or less marbled and often with numerous pale spots; reddish brown or pinkish brown bar from eye broadening over cheek and preopercle; broad, oblique, reddish brown area from anterior dorsal-fin spines onto body; paler, narrower oblique area from posterior dorsal-fin spines onto body; large, merged pale blotches on peduncle; soft-rayed dorsal fin with irregular, somewhat diffuse markings. Attains 35 cm TL.





*Scorpaenopsis oxycephala*, 22 cm SL (Comoros). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf (Bahrain), Oman, Red Sea, Mozambique to South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Réunion, Mauritius and Chagos; elsewhere to Indonesia, Philippines, southern Japan, Palau, Guam, New Guinea, Solomon Is., Australia, Chesterfield Is., New Caledonia, Fiji and Society Is.

**REMARKS** Found on rocky and coral reefs, usually in clear water, at 2–60 m.

### *Scorpaenopsis possi* Randall & Eschmeyer 2001

Poss's scorpionfish

PLATE 109

?*Scorpaenopsis leonina* (non Richardson 1846): Munro 1955.

*Dendroscorpaena cirrhosa* (non Thunberg 1793): Smith 1957\*; Smith & Smith 1963\*; ?Maugé 1967.

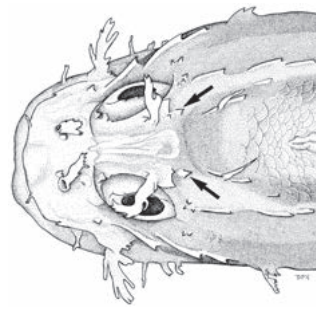
*Scorpaenopsis cirrhosa* (non Thunberg 1793): Jones & Kumaran 1980\*.

*Scorpaenopsis possi* Randall & Eschmeyer 2001: 54, Pls. 7b–d, 12a–c (Pitcairn Is.); McKenna & Allen 2005; Golani & Bogorodsky 2010.

?*Scorpaenopsis oxycephala* (non Bleeker 1849): King & Fraser 2002\*.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17 or 18 rays. Snout length 12–19% SL; mouth oblique, at 35–40° angle from horizontal; interorbital area with short, well-developed median ridge; interorbital ridges prominent and separated at mid-orbit by deep channel ~1.5–2 as deep as width of individual ridges, ridges ending behind anterior end of occipital pit; no strong ridge with sharp tip above anteriormost lachrymal spine. Occipital pit not deep. Suborbital ridge with 4 spines; pre-tympanic spine present in most adults, but often absent in smaller fish (<6 cm SL). GR 4–6/1/10 or 11 = 15–17. LL scales 21–24; LSS 43–50; no scales between opercular spines.

Body colour variable: usually predominantly red, mottled with dark brown, and with dark-edged blue dots; large olive spot on operculum and posteriorly on body; pectoral-fin axils red with dark-edge tan spots. Attains 34 cm SL.



*Scorpaenopsis possi*, 9 cm SL, head (South Africa); arrows indicate spines above tympanic spines. Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Red Sea, Somalia to South Africa (Aliwal Shoal), Comoros, Seychelles, Mauritius, Chagos and Maldives; elsewhere to Christmas I., Indonesia, Philippines, Taiwan, Ryukyu Is., Palau, New Caledonia, Samoa, Society Is. and Pitcairn Is.

**REMARKS** Found on coral reefs and over rocks, to ~60 m deep.

### *Scorpaenopsis ramaraoi* Randall & Eschmeyer 2001

Rama-Rao's scorpionfish

PLATE 109

*Scorpaenopsis ramaraoi* Randall & Eschmeyer 2001: 64, Pls. 8b–d, 12d (off Hikkaduwa, Sri Lanka); Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–19 rays. Snout length 12–13% SL; mouth slightly oblique, at ~20° angle from horizontal. Occipital pit moderately deep. Suborbital ridge with 4 spines; strong ridge above anterior lachrymal spine, angling antiodorsally and ending in a spine; interorbital ridge not elevated on either side to join base of tympanic spines; pre-tympanic spine not present at any body size; upper opercular spine with single point; no scales between opercular spines, but a few above upper opercular spine. GR 4 or 5/1/8–10 = 14 or 15. LL scales 22–24; LSS 45–49.

Body mottled brown or reddish brown on tan background, with numerous scattered white markings over head and fins; darker markings on head and on sides forming weak bars; pinkish ventrally and on distal and ventral parts of pectoral fins and pelvic-fin bases. Attains 16.5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: South Africa (Sodwana Bay), Pakistan, India and Sri Lanka; elsewhere to Thailand, Vietnam, Malaysia, Indonesia, Philippines, Taiwan, southern Japan, Palau, New Guinea and New Caledonia.

**REMARKS** Found to ~60 m deep, on silty sand, rocky or coral bottom.



## *Scorpaenopsis venosa* (Cuvier 1829)

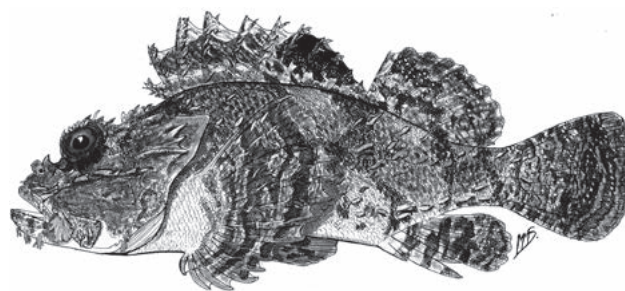
Raggy scorpionfish

PLATE 109

*Scorpaena venosa* Cuvier in Cuv. & Val. 1829: 166 (Puducherry, India).  
*Scorpaena novaeguineae* Cuvier in Cuv. & Val. 1829: 320 (New Guinea).  
*Scorpaena rosea* Day 1868: 703 (Chennai, India); Saunders 1960; Dor 1984.  
*Scorpaenopsis cirrhosa* (non Thunberg 1793): Day 1888, 1889; ?Barnard 1927; Smith 1949 [in part]; Rao *et al.* 2000; Devi & Rao 2003.  
?*Scorpaena cirrhosa* (non Thunberg 1793): Regan 1905.  
*Scorpaena durbanensis* Gilchrist & Thompson 1909: 236 (Durban, KwaZulu-Natal, South Africa); Randall & Eschmeyer 2001\*.  
?*Scorpaenopsis cirrosa* (non Thunberg 1793): Barnard 1927.  
*Scorpaenopsis rosea*: Deraniyagala 1933; Kurian 1953; Mendis 1954; Srinivasan *et al.* 2002.  
?*Scorpaenopsis cirrhosus* (non Thunberg 1793): Munro 1955; ?Jones 1969; Kuronuma & Abe 1986.  
*Scorpaenopsis novaeguineae*: ?Mendis 1954; ?Munro 1955.  
*Dendroscorpaena cirrhosa*: Smith 1957\*, 1961 [in part].  
*Scorpaenopsis venosa*: SSF No. 149.36\*; Fischer *et al.* 1990\*; Eichler & Lieske 1994\*; Randall 1995\*; Carpenter *et al.* 1997; Eschmeyer 1998; Pereira 2000; Randall & Eschmeyer 2001\*; Gell & Whittington 2002; Garpe & Ohman 2003; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004; Letourneur *et al.* 2004; Motomura 2004; Schneider *et al.* 2005; Voronina & Volkova 2007; Tyler *et al.* 2009; Motomura *et al.* 2011.  
*Scorpaenopsis barbata* (non Rüppell 1838): Krupp *et al.* 2000\*.  
*Scorpaenopsis roseus*: Venkatraman 2003.  
*Scorpaenodes roseus*: Ramesh *et al.* 2008.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 15–18 rays. Snout length 13–16% SL; median interorbital ridge well-developed, extending almost to midorbit. Occipital pit broad and deep, its anterior margin straight and at right angles to ridges along lateral margin (rather than inwardly curved as in other *Scorpaenopsis* species). Suborbital ridge with 4 spines; tympanic spines subequal to and medial to post-ocular spines, sometimes with weak ridge between them; upper opercular spine simple, and a few scales between opercular spines. Supraocular cirrus usually present, at least as long as orbit diameter. GR 4–6/1/7–11 = 12–17. LL scales 22–27; LSS 47–53.

Skin often taking on colouration of algae growing on it; body variably relatively uniformly coloured to strongly mottled, usually with much red, reddish pink or predominantly brown, and darker on dorsum, particularly in post-occipital region and beneath spinous dorsal fin; ventrum pale pinkish or pinkish orange. Attains 22 cm SL.



*Scorpaenopsis venosa*, 20 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Kenya to South Africa (Eastern Cape), Madagascar, Comoros, Seychelles, Saya de Malha Bank, India and Sri Lanka; elsewhere to east coast of India, Indonesia, Philippines, Taiwan, Japan, New Guinea, Australia and Vanuatu.

**REMARKS** Usually found in protected bays or lagoons, at 2–70 m.

## *Scorpaenopsis vittapinna*

Randall & Eschmeyer 2001

Bigmouth scorpionfish

PLATE 109

?*Dendroscorpaena cirrhosa* (non Thunberg 1793): Smith & Smith 1963 [in part].

*Scorpaenopsis brevifrons* (non Eschmeyer & Randall 1975): SSF No. 149.30\*; Pereira 2000.

*Scorpaenopsis vittapinna* Randall & Eschmeyer 2001: 71, Pls. 9d, 12g–h (reef off Sodwana Bay, KwaZulu-Natal, South Africa); Golani & Bogorodsky 2010; Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–19 rays. Snout length 14–15% SL; upper jaw reaches to rear margin of orbit; lower jaw with tentacles along outer margin, those at symphysis typically much larger than others. Occipital pit shallow; suborbital pit deep anteriorly, but relatively short, confined to below anterior third of eye. Suborbital ridge with 4 spines (2nd suborbital with 1 spine; 3rd suborbital with 3 spines); small spine on lateral face of lachrymal in line with suborbital ridge; nuchal spine about twice length of parietal spine, with ridge on either side; upper opercular spine with 2–4 points. GR 3–5/1/7 or 8 = 11–14. Ctenoid scales on preopercle behind eye and on opercle between pterotic spine and upper opercular spine; LL scales 19 or 20; LSS 40–44.

Body with complex combination of red, brown, black and grey markings on tan or whitish background; usually diffuse black spot on body below anterior dorsal-fin spines, and large, irregular, red or reddish brown blotches on opercle, anterior part of lateral line and pectoral-fin bases; small red patch behind eyes; oblique reddish bar from dorsal-fin spines 4–7 towards lateral line, and fainter oblique red bar on anterior dorsal-fin rays; pelvic fins whitish proximally, with broad dusky bar on distal third not reaching margin; peduncle usually pale; caudal fin predominantly red or reddish brown, with 2 irregular broad vertical bars. Attains ~6.5 cm SL.



*Scorpaenopsis vittapinna*, 4 cm SL (Seychelles). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO (scattered localities): Gulf of Aqaba, Mozambique, South Africa (KwaZulu-Natal), Comoros, Seychelles, Mauritius and Maldives; elsewhere to Indonesia, Philippines, Taiwan, Japan (Ogasawara Is.), Caroline Is., New Guinea, Chesterfield Is., Fiji, Wallis and Futuna Is., Samoa and Society Is.

**REMARKS** Relatively uncommon; found inshore on reefs and coral rubble, at 2.5–28 m.

## GENUS *Sebastapistes* Gill 1877

Occiput small, slightly or notably rounded, never flat or depressed in adults; supraoccipital commissure confluent with interorbital ridges of both sides posteriorly, or nearly so, to form closed loop posteriorly; when present, spine at posteroventral margin of lachrymal points posteroventrally, sometimes curved but never hooked forward, and sometimes with small anteroventral spine near its base. Usually no slit behind last hemibranch in adults, but present in young and in *S. taeniophrys*. Scales ctenoid on dorsum, becoming pseudocycloid or slightly embedded on ventrum. The limits of this genus are not well-established. Nine or 10 species, 6 in WIO.

### KEY TO SPECIES

- |    |   |                       |
|----|---|-----------------------|
| 1a | No teeth on palatines; LSS 32–34.....   | <i>S. fowleri</i>     |
| 1b | Palatine teeth present; LSS 35–49.....  | 2                     |
| 2a | Coronal spines present.....   | <i>S. mauritiana</i>  |
| 2b | No coronal spines.....  | 3                     |
| 3a | Mandible with distinctive dark transverse bars; maxilla extends to or beyond rear margin of orbit.....  | 4                     |
| 3b | No dark bars on mandible; maxilla extends to between middle of pupil and rear margin of orbit.....  | 5                     |
| 4a | LL scales 11–15; vertical scale rows 31–33; no dark saddle below first 3 dorsal-fin spines.....   | <i>S. taeniophrys</i> |
| 4b | LL scales 18–24; vertical scale rows 35–55; dark saddle below first 3 dorsal-fin spines.....  | <i>S. strongia</i>    |
| 5a | Head and body reddish brown to rose-pink or orangish pink, with numerous small or moderately sized yellow spots or blotches and minute white spots or specks, especially ventrally.....             | <i>S. cyanostigma</i> |
| 5b | Head and body covered with small reddish or reddish brown spots over blotched pale pink or tan background; minute white spots, when present, confined primarily to head and pectoral-fin bases..... | <i>S. tinkhami</i>    |

## *Sebastapistes cyanostigma* (Bleeker 1856)

Yellowspotted scorpionfish

PLATE 109

*Scorpaena cyanostigma* Bleeker 1856: 400 (Kajeli, Buru, Moluccas, Indonesia).

*Scorpaena albobrunnea* Günther 1874: 77 (Palau).

*Scorpaena kowiensis* Smith 1935: 224 (Port Alfred, Eastern Cape, South Africa); Smith 1949 [not figure], 1957.

*Scorpaenopsis albobrunneus*: Marshall 1952.

*Scorpaena aqaba* Fowler & Steinitz 1956: 282, Fig. 25 (Eilat, Israel, Gulf of Aqaba, Red Sea); Böhlke 1984.

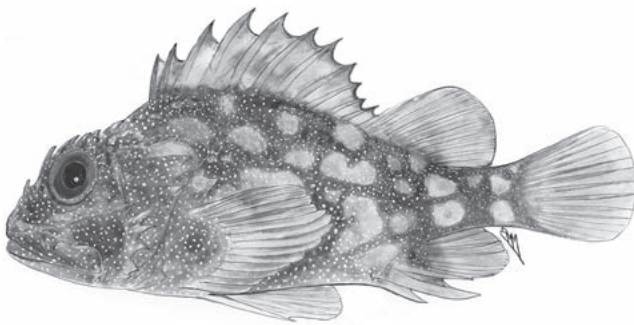
*Sebastapistes kowiensis*: Smith 1957; Smith & Smith 1963\*; Mauge 1967.

*Sebastapistes cyanostigma*: Froiland 1972; Dor 1984; SSF No. 149.37\*; Winterbottom *et al.* 1989; Eichler & Lieske 1994\*; Khalaf & Disi 1997; Pereira 2000; Schneider *et al.* 2005; Tyler *et al.* 2009; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

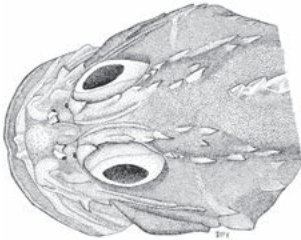
Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 15 or 16 rays. Dorsal fin relatively high, 4th or 5th spines longest. Maxilla extends to level between mid-pupil and rear margin of orbit. Occiput distinctly convex, especially in larger specimens; epidermis over reduced scales in occiput and interorbital area forms minute papillae. Cleithrum usually with 1 or 2 pungent spines; lachrymal with 4 spines extending over

maxilla, and small spine at rear of lateral face; 2nd suborbital with ridge, but no spines; 3rd suborbital with distinct, relatively smooth ridge (stay), ending in short spine in larger specimens (small specimens may lack spine); no coronal spines. GR 5 or 6/1/7–12 = 14–19. Scales on body cycloid, except breast and pectoral-fin bases naked or with reduced and embedded scales; LL scales 24–27; LSS 39–47.

Head, body and fins reddish brown, rose-pink or orangish pink, with prominent irregular yellow spots (more prominent in larger specimens), and numerous white or pale blue specks; blotches in interorbital area often joined to form pale transverse bars; some populations with dusky fins or with spots that are less yellow and more brown. Attains ~7 cm SL.



*Sebastapistes cyanostigma*, 8 cm TL (S Mozambique). Source: SSF



*Sebastapistes cyanostigma*, 45 mm TL, dorsal view of head of holotype of *Scorpaena kowiensis* (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Gulf of Aden, Kenya to South Africa (Eastern Cape), Comoros, Seychelles, Mauritius and Chagos; elsewhere to Indonesia, Taiwan, Japan, Palau, Caroline Is., Marshall Is., New Guinea and New Caledonia.

**REMARKS** Abundant in inshore waters, particularly among stinging corals and on reef flats and areas exposed to relatively strong tidal flux, to ~18 m deep.

### *Sebastapistes fowleri* (Pietschmann 1934)

Dwarf scorpionfish

PLATE 110

*Scorpaena fowleri* Pietschmann 1934: 100 (Makaua, Oahu I., Hawaii).  
*Sebastapistes hassi* Klausewitz 1970: 72, Fig. 1 (Addu Atoll, Maldives).  
*Scorpaenopsis fowleri*: Randall 1973; Winterbottom *et al.* 1989; Randall & Poss 2002\*; Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16 rays. No occipital pit. Cirri or tentacles few and small. Spines on dorsal surface of head ridge-like and retrorse; lachrymal without distinct ventroposteriorly directed spine at rear; parietal spines twice as long as tympanic spine; nasal spine small, if present; no postorbital spines. No teeth on palatines. GR 4–6/1/6–10 = 11–17. Cephalic LL pores relatively large. Scales ctenoid, except reduced or absent on breast; LL scales 19–24; LSS 32–34.

Body red to reddish orange, finely mottled with white spots; dusky saddles at rear of head and on body; pelvic fins often most dusky basally. Attains ~4 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Comoros, Mauritius (including Agaléga Is.), Chagos and Maldives; elsewhere to Indonesia, Philippines, southern Japan, Guam, New Guinea, New Caledonia, Fiji, Gambier Is., Pitcairn Is., Tuamotu Is., Johnston Atoll and Hawaii.

**REMARKS** Matures at ~18–25 mm SL. Found on rubble or mixed rubble-sand, in 3–61 m.

### *Sebastapistes mauritiana* (Cuvier 1829)

Spineblotch scorpionfish

PLATE 110

*Scorpaena mauritiana* Cuvier in Cuv. & Val. 1829: 322 (Mauritius, Mascarenes); Baissac 1968.

*Scorpaena megastoma* Sauvage 1878: 127, Pl. 1, Fig. 7 (Réunion, Mascarenes); Smith 1957.

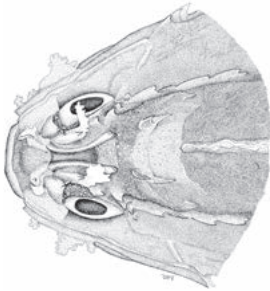
*Scorpaena kowiensis* (non Smith 1935): Smith 1949\*.

*Sebastapistes nuchalis* (non Günther 1874): Smith 1957, 1961; Smith & Smith 1963; Maugé 1967; Jones 1969; Hureau & Litvinenko 1986; Bauchot 1987.

*Sebastapistes mauritiana*: SSF No. 149.38\*; Poss & Duhamel 1991; Pereira 2000; McKenna & Allen 2005; Schneider *et al.* 2005; Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ or 6½ rays; pectoral fins 14–16 rays. Mouth large; maxilla extends to below rear margin of orbit; pores at lower jaw symphysis separate. Nostrils with small cirri; no supraocular tentacle. Occipital pit shallow or absent. Suborbital stay with large, relatively wide spine at rear, usually tipped with small cirrus; lachrymal usually with bifid spine posteriorly; postorbital small, with small blunt spine; upper preopercular spine with supplemental spine positioned above it rather than at its base; strong ridge on lower opercular spine; coronal spines present at end of strong ridges. GR 4–6/1/7–10 = 12–16. Head nearly naked, with pseudocycloid scales at margin of opercle, behind opercular spines; body with ctenoid scales laterally, becoming emarginate or pseudocycloid ventrally; breast fully scaly, scales pseudocycloid and embedded; LL scales 22–25; LSS rows 39–46.

Body marbled reddish brown; chin pale; narrow oblique bars on soft-rayed dorsal fin and anal fin; spinous dorsal fin sometimes with dark spots; pale or white area on anterior part of peduncle. Attains 7.5 cm SL.



*Sebastapistes mauritiana*, 6 cm SL, dorsal view of head (South Africa).  
Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea and Lessepsian migrant to eastern Mediterranean Sea (Egypt and Cyprus), Kenya to South Africa, Madagascar, Seychelles, Réunion and Mauritius; elsewhere to Marshall Is., New Caledonia, Pitcairn Is., Marquesas Is. and Hawaii.

**REMARKS** Usually lives among rocks and coral, to ~12 m deep, often near sandy bottom, where it feeds on crustaceans.

## *Sebastapistes strongia* (Cuvier 1829)

Barchin scorpionfish

PLATE 110

?*Scorpaena asperella* Bennett 1828: 40 (?Hawaii); Smith 1957.

*Scorpaena strongia* Cuvier in Cuv. & Val. 1829: 323 (Kosrae, Caroline Is.); Quoy & Gaimard 1834\*; Günther 1873.

*Sebastes strongensis* Günther 1860: 105 [unjustified emendation].

*Sebastes strongia*: Klunzinger 1870, 1884.

*Scorpaena tristis* Klunzinger 1870: 802 (Al-Qusayr, Egypt, Red Sea); Günther 1874; Smith 1957; Dor 1984.

?*Scorpaena voelzkowi* Jatzow & Lenz 1898: 503, Pl. 34, Fig. 1 (Zanzibar, Tanzania); Smith & Smith 1963\*.

*Kantapus oglinus* Smith 1947: 817 (Inhaca I., Mozambique); Roux-Estève & Fourmanoir 1955; Roux-Estève 1956; Fourmanoir 1957; Russell 1986.

*Sebastapistes strongia*: Munro 1955; Dor 1984; SSF No. 149.39\*; Winterbottom *et al.* 1989; Harris & Cyrus 1995; De Troch *et al.* 1996; Almeida *et al.* 1999; Pereira 2000; Mandrytsa 2001; McKenna & Allen 2005; Schneider *et al.* 2005; Golani & Bogorodsky 2010; Motomura *et al.* 2011.

*Sebastapistes oglinus*: Smith 1957: 55; Maugé 1967; Jones 1969.

*Phenacoscorpius nebulosus* Smith 1958: 177, Pl. 8k (Bazaruto I., Mozambique); Smith 1961; Smith & Smith 1963\*.

*Sebastapistes nuchalis*: ?Jones 1969.

*Sebastapistes tristis*: Frøiland 1972\*.

Dorsal fin 12 (rarely 13) spines, 8½–10½ rays; anal fin 3 spines, 5½ rays; pectoral fins 14 or 15 rays, middle rays sometimes

elongate and membranes relatively deeply incised. Maxilla reaches beyond rear margin of orbit. Supraocular cirrus often long. Interorbital ridges do not end in spines, but make partial loop on occiput joined via curved transverse occipital lateral-line commissure; 2nd suborbital with blunt or pungent spine on lower ridge below eye; 3rd suborbital with blunt spine at rear, and sometimes a spine on ridge anteriorly; supplemental preopercular spine present; ridges associated with opercular spines well-developed, with ridge anterior to lower opercular spine; tympanic spines relatively far apart, lateral and slightly anterior to origins of parietal spines; no coronal spines; parietal spines well-developed, bordering occipital area laterally and originating close to transverse occipital commissure; nuchal spines ~½ length of parietal spines. GR 4 or 5/1/6–10 = 11–15. LL scales 18–24; LSS 35–44.

Body colour cryptic; chin and isthmus with dark brown transverse bars; dark transverse stripe immediately behind parietal spines; dark saddle below first 3 dorsal-fin spines, and sometimes elongate dark blotch between spines 7–10; soft-rayed dorsal fin relatively evenly speckled, sometimes dusky distally. Attains at least 6 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Kenya to South Africa (Aliwal Shoal; rarely to Eastern Cape), Madagascar, Seychelles and Chagos; elsewhere to Indonesia, Philippines, Taiwan, Japan, Mariana Is., Caroline Is., New Caledonia and Cook Is.

**REMARKS** Nocturnal and solitary. Found inshore, over mixed sand and rubble, in shallow lagoons and on reef flats, to ~18 m deep.

## *Sebastapistes taeniophrys* (Fowler 1943)

Tentacle scorpionfish

*Scorpaena taeniophrys* Fowler 1943: 66, Fig. 12 (Cammahana Bay, Luzon I., Philippines); Herre 1951, 1953.

*Sebastapistes taeniophrys*: Motomura 2009; Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 14 or 15 rays, middle rays sometimes elongate and fin membranes relatively deeply incised. Maxilla reaches beyond rear margin of orbit. Supraocular cirrus not longer than eye diameter; 2nd suborbital with blunt or pungent spine on lower ridge below eye; 3rd suborbital with blunt spine at rear, and sometimes with a spine on ridge anteriorly; supplemental preopercular spine present; ridge on upper opercular spine indistinct, ridge on lower opercular spine distinct; tympanic spines relatively far apart, lateral and slightly anterior to origins of parietal spines; no coronal spines; parietal



spines well-developed, bordering occipital area laterally and originating close to transverse occipital commissure. GR 3 or 4/1/7 or 8 = 12. LL scales 11–15; vertical scale rows 31–33.

Preserved specimens with dark brown transverse bars on chin and isthmus, and transverse stripe immediately behind parietal spines; no dark saddle below first 3 dorsal-fin spines. Attains at least 35 mm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Madagascar; elsewhere, Philippines.

**REMARKS** Known only from three tiny specimens, one from Madagascar (Motomura *et al.* 2011). Further comparison of this species with *S. strongia* is needed as additional specimens become available.

### *Sebastapistes tinkhami* (Fowler 1946)

Darkspotted scorpionfish

PLATE 110

*Scorpaena tinkhami* Fowler 1946: 208, Fig. 72 (Aguni Shima, Ryukyu Is., Japan).

*Sebastapistes tinkhami*: SSF No. 149.40\*; Motomura *et al.* 2011.

Dorsal fin 12 spines, 9½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16 rays. Interorbital area with relatively pronounced ridges forming deep groove between them. Lachrymal usually with 4 or 5 prominent spines on lower margin, and base of 2nd spine often with small, usually well-developed, posteroventrally directed spine; 2nd suborbital (below pupil) with double ridge formed by upper and lower spines; 3rd suborbital with 2 spines along double ridge, upper ridge ends in spine followed by continuation of ridge that bears no spine, and lower ridge usually converges slightly with upper ridge, where it ends in a spine near preopercle; no ridge on lower opercular spine; no coronal spines; tympanic spines close-set. GR 4–6/1/9–12 = 14–19. LL scales 24–27; LSS 40–49.

Body usually uniformly covered with numerous dark brown or reddish brown spots (relatively few in some populations) on pinkish or tan background; similar, often duskier spots on dorsal-, anal- and caudal-fin rays; head and breast often with small white spots or specks, sometimes also scattered on flanks and pectoral fins; smaller specimens often with broad dark saddles. Attains 8.5 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: South Africa, Réunion and Mauritius; elsewhere to Christmas I., Indonesia, Taiwan, southern Japan, Wake Atoll, New Caledonia, Vanuatu, Samoa, Society Is., Pitcairn Is. and Marquesas Is.

**REMARKS** Found in 2–30 m.

## GENUS *Taenianotus* Lacepède 1802

Head and body extremely compressed; lateral ethmoid separated from vomer; scales on body greatly reduced and few; no swimbladder. One species.

### *Taenianotus triacanthus* Lacepède 1802

Paperfish

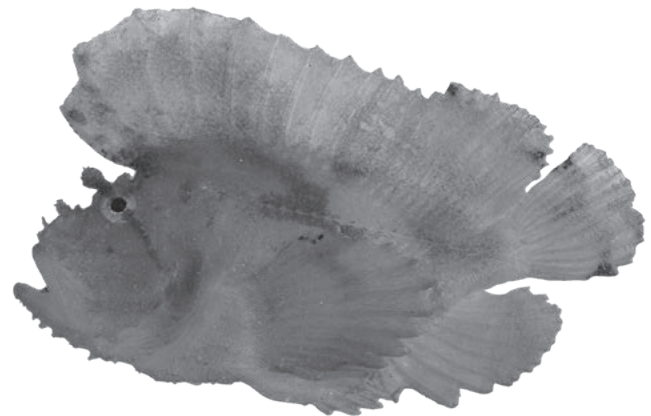
PLATE 110

*Taenianotus triacanthus* Lacepède 1802: 303, 306 [no locality given]; Smith 1953, 1958\*; Smith & Smith 1963\*; Maugé 1967; Eschmeyer & Randall 1975\*; SSF No. 149.41\*; Eichler & Lieske 1994\*; Kuitert 1998\*; Pereira 2000; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; McKenna & Allen 2005; Schneider *et al.* 2005; Motomura *et al.* 2011.

*Taenianotus triacanthus*: Cornic 1987\*.

Diagnosis as for genus. Dorsal fin 12 spines, 9½ or 10½ rays, fin origin over rear margin of orbit, and membrane of soft-rayed portion broadly adnate to peduncle and caudal-fin base; anal fin 3 spines, 5½ or 6½ rays; pectoral fins 13–15 rays. Head and body extremely compressed; mouth upturned at ~40–45° angle from horizontal; eyes elevated; occiput extremely small, nearly absent. Large, broad, frond-like cirrus usually over eyes. Suborbital bones widely separated from ventral margin of orbit. Preopercle with 2 small, indistinct spines. GR 5/1/10–13 = 16–19. Scales greatly reduced, those immediately behind head vestigial and forming small prickles; LL scales 20–24; LSS 27–50, present as scattered prickles, not in well-defined rows posteriorly.

Body colour highly variable: red, pink, tan, yellow, cream, or brown to almost black, commonly with mixtures of these colours. Attains 12 cm TL.



*Taenianotus triacanthus*, 7 cm SL (Rodrigues). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Kenya, Mozambique to South Africa (Park Rynie), Madagascar, Comoros, Seychelles and Mascarenes; elsewhere to southern Japan,

Australia, New Caledonia, Hawaii and Tuamotu Is.; reportedly photographed at Galápagos Is., but a viable population may not occur there.

**REMARKS** Found from near shore to ~135 m deep, on coral reefs and rocky habitats, on sand bottom, and often next to sponges in areas of strong wave action, where it may rock back and forth even in the absence of current. Periodically sheds its skin.

## SUBFAMILY SEBASTINAE

### GENUS *Helicolenus* Goode & Bean 1896

Dorsal fin 11–13 spines, 10½–14½ rays; anal fin 2 or 3 spines, 4½–6½ rays; pectoral fins broad, fan-shaped, with 17–21 rays, uppermost 2 rays simple, middle 8 or 9 rays branched, lower 7 or 8 rays simple and elongate with tendril-like tips free of the fin membrane about half their length. Head and mouth large; head with several spinous ridges. Third infraorbital bone (suborbital 2) forms a somewhat T-shaped stay narrowly attached to preopercle. Preocular, supraocular and post-ocular spines small; tympanic spines far apart; pterotic spine small, sometimes covered by scales; parietal spine longer than nuchal spine; no coronal spine. No slit behind last hemibranch. No swimbladder; peritoneum primarily black. Vertebrae 24 or 25.

At least 9 species, 1 in WIO. *Helicolenus mouchezi* (Sauvage 1875) has been reported from Saint-Paul I. and a volcanic seamount in the Southern Ocean, and may occur at Walters Shoals (Collette & Parin 1991). Populations within the Atlantic Ocean and elsewhere have been assigned to various subspecies (Eschmeyer 1969; Barsukov 1979). Indian Ocean fish appear to be assignable to *Helicolenus dactylopterus angolensis* Barsukov 1979. Molecular studies (Aboim *et al.* 2005) suggest that differences among more northern populations may reflect possible interspecific divergence before the Last Glacial Maximum.

### *Helicolenus dactylopterus* (Delaroche 1809)

Jacopever or blackbelly rosefish

PLATE 103

?*Scorpaena malabarica* Bloch & Schneider 1801: 194 (South America; India).

*Scorpaena dactyloptera* Delaroche 1809: 337 [51], Pl. 22, Fig. 9 (Iviça and Barcelona, Spain, western Mediterranean Sea).

*Sebastes imperialis* Cuvier 1829: 167 (Mediterranean Sea) [unneeded replacement name for *Scorpaena dactyloptera* Delaroche 1809].

*Sebastes maculatus* Cuvier in Cuv. & Val. 1829: 343 (Cape of Good Hope, South Africa); Gilchrist 1902.

*Sebastichthys maculatus*: Sauvage 1891 (Madagascar).

*Helicolenus maculatus*: Barnard 1927; Fowler 1934; Rapson *et al.* 1945;

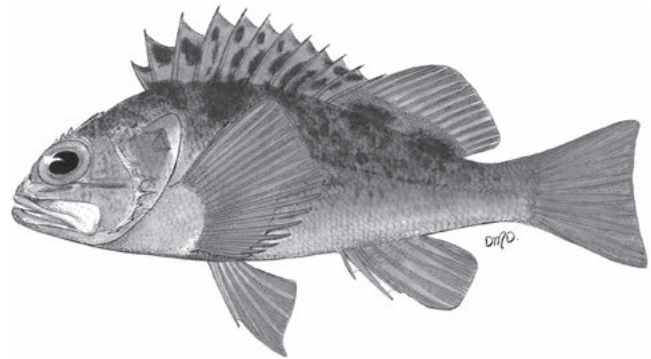
Davies 1949; Smith 1949\*, 1953\*, 1957\*, 1961\*, 1964\*; Barsukov 1973. *Helicolenus dactylopterus*: Eschmeyer 1969\*; SSF No. 149.42\*; Heemstra & Heemstra 2004\*.

*Helicolenus dactylopterus angolensis* Barsukov 1979: 581 [3], Fig. 1 (Atlantic coast of Africa).

*Helicolenus dactylopterus dactylopterus*: Macpherson 1985; David 1987; Eschmeyer & Dempster 1990; Schneider *et al.* 2005.

Dorsal fin 11–13 spines, 11½–14½ rays; anal fin 3 spines, 5½ rays; pectoral fins 17–21 rays. Percentage SL: body depth 30–36%, HL 38–43%, snout length 8–11%, jaw length 19–23%, orbit diameter 13–17%, and interorbital width 3–5%. GR 7–9/1/15–20 = 23–30 (South African specimens: GR 8 or 9/1/19 or 20 = 29 or 30). LL scales ~25; LSS 50–65.

Body pale red or rosy pink, with variable darker saddle-shaped markings on dorsum, last 2 below soft-rayed dorsal fin and often merging to form a Y- or V-shaped mark (juveniles with dark blotch at dorsal-fin base); opercle usually with large, dusky, usually diffuse smudge; buccal cavity bluish black; peritoneum black, fading to brown in preservative. Attains ~33 cm SL (commonly 21 cm SL).



*Helicolenus dactylopterus*, 25 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Western Atlantic (Nova Scotia to Venezuela), eastern Atlantic (Iceland and Norway to Gulf of Guinea; Angola to South Africa), Mediterranean Sea, and Indian Ocean. WIO: South Africa (Cape of Good Hope) to Mozambique, and the John Harrison Ridge (41° S, 42° E); a report from Madagascar (Sauvage 1891) needs confirmation.

**REMARKS** Relatively common; usually inshore, at ~24–700 m, although known to 1 100 m (Allain & Lorange 2000).

#### GLOSSARY

**extrinsic (musculature)** – muscles 'outside' that act on a structure.

**hemibranch** – a gill with filaments only on one side of gill arch.

**pungent** – sharp-pointed.

**tympanic spine** – a spine near the 'ear'.

## FAMILY TETRAROGIDAE

### Waspfishes

Stuart G Poss

Body shape variable, but usually compressed; dorsal fin far forward, origin usually over or in front of eyes, with 8–17 spines; last ray of dorsal and anal fins either divided to base and borne on single pterygiophore (counted as 1½ rays) or not split to base (counted as 1 ray). Lachrymal moveable, with pungent spines; preopercular spines usually 4 or 5, no supplemental preopercle spines at base of uppermost (largest) spine, and no parietal or posttemporal spines. No slit behind last hemibranch. Scales variable; most species with small pseudocycloid scales, some with only vestigial ctenii or weakly ossified, minute, deeply embedded scales, and some entirely devoid of scales other than those on lateral line. Neural arches of first 2 vertebrae articulate with neurocranium.

All species are particularly venomous. Allied to the Apistidae (bearded waspfishes), but share derived features with both the Synanceiidae (stonefishes) and Aploactinidae (velvetfishes) as well as some members of the Scorpaenidae (scorpionfishes). Widespread in Indo-Pacific, except central Pacific; 15 genera and ~40 valid species; 9 genera and 14 or 15 species in WIO.

#### KEY TO GENERA

- 1a First 3 spines of dorsal fin and their connecting membranes separate from remaining spines and membranes ..... *Vespacula*
- 1b Dorsal fin continuous, first 3 spines and membranes not separate from remainder of fin ..... 2
- 2a No scales on body, except LL scales ..... 3
- 2a Body with small, embedded, pseudocycloid scales ..... 5
- 3a Membranes between dorsal-fin spines barely incised; body depth ~24% SL ..... *Coccotropsis*
- 3b Membranes between dorsal-fin spines moderately to deeply incised; body depth >29% SL ..... 4
- 4a Dorsal fin 13 spines, 1st spine small and first 2 spines close-set; pectoral fins 15 rays ..... *Richardsonichthys*
- 4b Dorsal fin 14 or 15 spines; pectoral fins 12 or 13 rays ..... *Ocosia*

Continued ...

#### KEY TO GENERA

- 5a Head and body greatly compressed; dorsal fin tall anteriorly, without incised membranes, its origin in front of eyes ..... *Ablabys*
- 5b Head and body not compressed; dorsal-fin origin above eyes ..... 6
- 6a Membrane between dorsal-fin spines weakly incised; some scales above lateral line immediately behind head, with raised ridge from focus to posterior margin of scale ..... *Tetraroge*
- 6b Membrane between dorsal-fin spines moderately to strongly incised; no scales above lateral line immediately behind head ..... 7
- 7a Pectoral fins 10–12 rays ..... *Paracentropogon*
- 7b Pectoral fins 13–15 rays ..... 8
- 8a Dorsal fin 10 or 11 rays; head large, body depth ~38% SL ..... *Snyderina*
- 8b Dorsal fin 6½ rays; body depth ~35% SL ..... *Neocentropogon*

#### GENUS *Ablabys* Kaup 1873

Head and body strongly compressed. Dorsal-fin origin in front of eyes (except in larvae and juveniles), 1st spine 25–43% length of 2nd spine (1st spine notably shorter in larger specimens), and membranes between most spines weakly or not incised; membrane at posterior end of dorsal fin adnate to caudal fin. Pelvic fins 1 spine, 5 rays. Lachrymal moveable, with 2 subequal, curved, pungent spines. Nasal bone tubular, without spine. Upper jaw relatively short, 7.2–13 in SL. Teeth on vomer and palatines. Body covered with small, partially embedded pseudocycloid scales, fewer scales behind head, and head naked; each scale above lateral line anteriorly with single small point on rear margin, points weakly developed or absent on scales elsewhere on body; scales reduced or absent on breast and pectoral-fin bases. Three species in WIO; 2 of these found in the region only in Sri Lanka but more broadly distributed in the eastern Indian Ocean and western Pacific.

## KEY TO SPECIES

- 1a Dorsal-fin spines 2–5 much longer than succeeding spines, forming rounded crest; anal fin  $4\frac{1}{2}$ – $7\frac{1}{2}$  rays; caudal fin rounded or somewhat elongate, but not tapering to point; dorsal fin and anal fin similar to body colouration..... 2
- 1b Dorsal-fin spines decrease uniformly in height from 2nd spine, sometimes forming concave profile; anal fin  $7\frac{1}{2}$  or  $9\frac{1}{2}$  rays; caudal fin elongate or lanceolate, tapering to relatively sharp point; dorsal fin and anal fin usually black or nearly so and much darker than body..... *A. macracanthus*
- 2a Dorsal fin 16–18 (usually 17) spines,  $6\frac{1}{2}$ – $8\frac{1}{2}$  (usually  $7\frac{1}{2}$ ) rays..... *A. taenianotus*
- 2b Dorsal fin 14 or 15 spines,  $8\frac{1}{2}$  rays..... *A. binotatus*

*Ablabys binotatus* (Peters 1855)

Redskinfinch

PLATE 111

*Apistus binotatus* Peters 1855: 434 (Ibo I., Mozambique).*Tetraroge binotata*: Günther 1860; Playfair 1868; De Brito Capello 1871; Sauvage 1891.*Tetraroge alboguttata* Liénard in Sauvage 1891: 301 (Mauritius, Mascarenes).*Amblyapistus marleyi* Regan 1919: 202, Fig. 5 (Durban, KwaZulu-Natal, South Africa).*Amblyapistus taenianotus* (non Cuvier 1829): Barnard 1927; SFSA No. 1032; Smith 1950; Smith & Smith 1963\*; Baissac 1968.*Amblyapistus binotatus*: Smith 1941, 1949\*, 1965\* [as *binotata*]; Smith 1958\*; Smith & Smith 1963\*; Carcasson 1977.*Ablabys taenianotus* (non Cuvier 1829): Baissac 1976; Eichler & Lieske 1994\*; Fricke 1999; Fricke *et al.* 2009.*Ablabys binotatus*: SSF No. 150.1\*; Paepke & Fricke 1992; Mandrytsa 2001; Randall 2005\*.

Dorsal fin 14 or 15 spines,  $8\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  or  $6\frac{1}{2}$  rays; pectoral fins 11–13 rays; GR 1– $3/1/4$  or 5 = 6–8. Times in SL: body depth 2.8–3.2, predorsal length 5.7–8.1, head depth 2.7–3.3, and jaw length 8.4–13. Head profile inclined  $\sim 80^\circ$  from horizontal; snout more pronounced in small juveniles. Dorsal-fin origin at or just in front of eyes, except in small juveniles; 1st spine short (8–11% in SL), 2nd spine usually longest (2.4–3.4 in SL), and spines 2, 3 or 4 notably longer than succeeding spines; membranes moderately incised between 6th and last spines. LL scales 23–29; LSS 73–91; head naked except for a few scales above opercle. Vertebrae 26–28.

Body relatively uniformly dark brown or reddish brown, with short darker brown horizontal lines on flanks (more

pronounced in smaller fish); distinct, irregular white markings on body (more numerous in smaller specimens), those just above LL scales 7–10 usually most prominent; snout white, particularly in smaller fish; fins usually dusky, also with short irregular lines. Attains 10 cm SL, 13.5 cm TL.

**DISTRIBUTION** WIO: Oman, Tanzania, Mozambique, South Africa, Madagascar, Réunion and Mauritius.

**REMARKS** Commonly found in shallow water among brown algae or under rocks in pools at low tide, to  $\sim 25$  m deep.

*Ablabys macracanthus* (Bleeker 1852)

Spiny waspfish

PLATE 111

*Apistus macracanthus* Bleeker 1852 (Wahai, Seram I., Moluccas, Indonesia).*Ablabys macracanthus*: Randall & Anderson 1993; Kuitert 1998\*; Kuitert & Tonzuka 2001\*; Mandrytsa 2001\*.

Dorsal fin 15 or 16 spines,  $8\frac{1}{2}$ – $10\frac{1}{2}$  rays; anal fin 3 spines,  $7\frac{1}{2}$ – $9\frac{1}{2}$  rays; pectoral fins 11 or 12 rays; GR 1 or  $2/1/4$  or 5 = 6 or 7. In SL: body depth 3.5–5.6, predorsal length 6.8–13, HL 3.1–3.5, and jaw length 11–12.6. Body strongly compressed; head profile concave, head strongly compressed and bulging anteriorly at bases of dorsal-fin spines. Dorsal-fin origin in front of eyes, over anterior nostrils; 1st spine short, 2nd spine extremely long and strongly curved, and remaining spines decreasing relatively uniformly, with spines beyond 6th or 7th about equal in length; fin membranes weakly incised, joined to peduncle and caudal fin posteriorly. Body covered with partially embedded pseudocycloid scales; LL scales 17–22; LSS 66–70. Vertebrae 26–28.

Body usually dark brown, fins darker; juveniles typically with white patch on snout, patch becoming smaller with growth and disappearing entirely in large fish, and white on underside of jaw and chest also less evident in larger fish. Attains at least 7 cm SL, 10 cm TL (possibly much larger).

**DISTRIBUTION** Indo-Pacific. WIO: Maldives and probably Sri Lanka; elsewhere to Andaman Is., Indonesia, Philippines and Taiwan.

**REMARKS** Found on protected sand and shell bottoms and slopes to  $\sim 55$  m deep; juveniles sometimes inhabit sparse seagrass beds. Kuitert & Tonzuka (2001) state this species reaches 20 cm TL, but specimens this large could not be verified.



## *Ablabys taenianotus* (Cuvier 1829)

Cockatoo waspfish

PLATE 111

?*Taenianotus latovittatus* Lacepède 1802: 303 [not Pl. 3] (Mauritius, Mascarenes) [description can be referred to *Malacanthus latovittatus* (Lacepède 1801)].

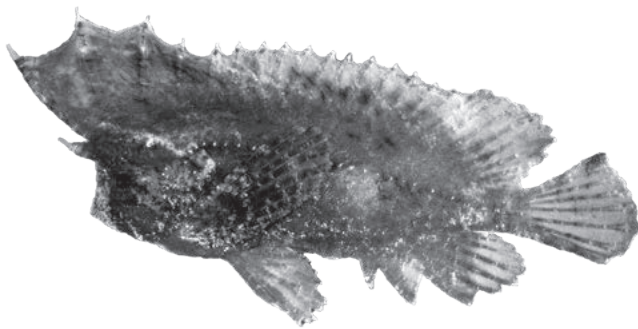
*Apistus taenianotus* Cuvier 1829: 168 (Mauritius, Mascarenes [?]).

*Paracentropogon longispinis* (non Cuvier 1829): Baissac 1990 [unpublished MS referenced by Fricke 1999 in synonymy of *Ablabys taenianotus*].

*Ablabys taenianotus*: Fricke *et al.* 2009.

Dorsal fin 16 or 17 spines,  $6\frac{1}{2}$ – $8\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 11 or 12 rays; GR 1 or 2/1/4–6 = 6–8. Times in SL: body depth 2.2–3.2, predorsal length 4.5–9.6, HL 2.4–3.3, and jaw length 7.2–10.6. Body strongly compressed; head profile inclined  $\sim 70^\circ$  from horizontal. Dorsal-fin origin at front edge of eyes; 1st spine short (7–11 in SL), 2nd spine longest (2.2–3.3 in SL), and 3rd–5th spines longer than succeeding spines; fin membranes weakly incised, attachment to peduncle and caudal-fin base broadly adnate. Body covered with small, partially embedded, pseudocycloid scales; LL scales 21–27; LSS 56–70. Vertebrae 27 or 28.

Head and body pale brown or reddish brown, with tiny dark brown spots or blotches, mostly above lateral line (more elongate and often more or less parallel to lateral line in juveniles); usually pale brown or milky white blotch on sides above level of pectoral fins; dorsal fin dark brown, with irregular patches and spots, particularly on anterior part of spinous dorsal fin; small pale or nearly white spots over spinous dorsal fin; small dark brown spot near middle of soft-rayed dorsal fin. Attains 11 cm SL, 15 cm TL.



*Ablabys taenianotus*, 11 cm SL (Taiwan). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka; elsewhere to Andaman Is., Indonesia, Philippines, Taiwan, Japan, Australia, New Caledonia, Lord Howe I., Norfolk I. and Fiji.

**REMARKS** Infrequently seen, but probably not rare in healthy seagrass habitats; found among seaweeds in rocky or

sand-rubble areas, in both intertidal and littoral habitats, to  $\sim 80$  m deep. Although the original description was said to be of a specimen (but possibly a drawing) taken from Mauritius, this species likely does not occur much further west than India and Sri Lanka. No type specimen is known and, should it exist, may have been collected elsewhere. Though the holotype may have matched what is now regarded as *A. binotatus*, subsequent authors have almost universally used *A. taenianotus* to refer to this species, which is widespread from the Indian subcontinent eastward, and distinct from *A. binotatus*.

## GENUS *Coccotropsis* Barnard 1927

Head and body at most slightly compressed; head and body naked except for LL scales. Dorsal-fin origin above rear edge of eyes. Teeth on vomer, none on palatines. No slit behind last hemibranch. One species.

## *Coccotropsis gymnoderma* (Gilchrist 1906)

Smooth-skin waspfish

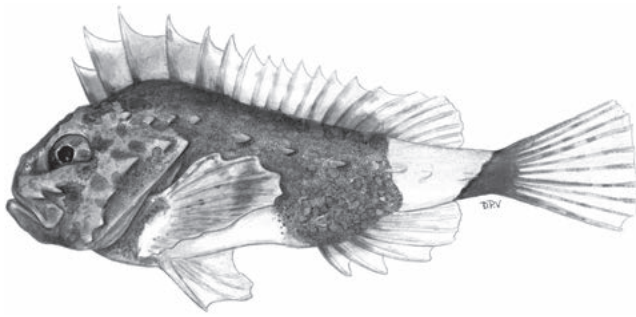
PLATE 111

*Tetraroge gymnoderma* Gilchrist 1906: 147, Pl. 37 (Cape St Blaize and other South African localities).

*Coccotropsis gymnoderma*: Barnard 1927; SFSA No.1931\*; Smith 1958\*; Smith & Smith 1963\*; SSF No. 150.2\*; Mandrytsa 2001; Zsilavec 2005\*.

Dorsal fin 14–16 spines (with prominent venom glands), 5 or  $6\frac{1}{2}$  rays; anal fin 3 spines,  $3\frac{1}{2}$ – $6\frac{1}{2}$  rays; pectoral fins 11 or 12 rays; GR 1–4/0–1/3–8 = 6–13. Lachrymal with 2 moveable pungent spines: 1st spine  $\sim \frac{1}{3}$  size of 2nd spine, which reaches nearly to level of rear margin of pupil; preopercle with 4 pungent spines: uppermost largest, reaching nearly to opercle margin (no other distinct spines on head). LL scales 8–11. Vertebrae 25–27.

Body usually orange or orangish brown with broad darker but diffuse saddles; head mottled brown to deep or bright orange or reddish brown; eyes brown but with gold or yellow margin; snout and lachrymal white or greyish, with variable white and dark speckling; usually brown transverse bar just behind eye, and dark brown or brownish red bar radiating from eyes towards snout; dorsal fin orange or brownish orange, with irregular small brown markings; pectoral fins usually with scattered dark markings on white, tan or greyish membranes; prominent broad white bar across rear of body and peduncle. Attains 4 cm SL, 5.5 cm TL.



*Coccotropsis gymnoderma*, both 3 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: endemic to South Africa from Western Cape (Cape St Blaize) to Eastern Cape (Bird I., Algoa Bay).

**REMARKS** Eggs collected near Cape Point on western side of False Bay, South Africa. Smith & Smith (1963) listed the species as likely in the Seychelles, but had no specimens and thus it is doubtful it occurs there. Found inshore, at ~10–110 m, preferring deeper hard-bottom reefs beyond kelp zones in areas with feather stars *Comanthus wahlbergii* and *Pseudocnella insolens*.

## GENUS *Neocentropogon* Matsubara 1943

Dorsal-fin origin over rear margin of pupil; membranes between dorsal-fin spines moderately or strongly incised. Pelvic fins with 1 spine, 5 rays. Caudal fin relatively rounded. Lachrymal with 2 moveable spines, 2nd spine reaching almost to middle of eye, when medially depressed. Eye diameter 10–17% SL; interorbital width narrow. Teeth on vomer and palatines; 3 pairs of pharyngobranchial tooth plates. Scales small, pseudocycloid, somewhat scattered anteriorly and

difficult to count, but more visible posteriorly; chest and pectoral-fin bases naked. Five species, 2 in WIO, but 1 of these (*Neocentropogon mesedai* Klausewitz 1985) known only from Red Sea from >360 m.

## *Neocentropogon profundus* (Smith 1958)

Southern deepwater waspfish

*Tetraroge longispinis* (non Cuvier 1829): Gudger 1929\*.

*Paracentropogon profundus* Smith 1958: 171, 180, Pl. 7,

Fig. 1 (off Mozambique [stomach contents]); Smith & Smith 1963\* [expected at Seychelles, but no specimens].

*Neocentropogon profundus*: Quérou *et al.* 2011.

Dorsal fin 13 spines, 6½ rays; anal fin 3 spines, 5½ rays; pectoral fins 14 or 15 rays; GR 3 or 4/1/7–10 = 11–15. Pectoral fins 32–37% SL, reaching 2nd–3rd spine of anal fin, lowermost fin rays not free but relatively strongly incised for ~⅓–½ their length. LL scales 20–25. Vertebrae 24 or 25.

Body predominantly bright red, orange-red ventrally; dark specks over dorsum and upper part of head, with few or no specks ventrally; fins darker, more purple, with distal margins of soft-rayed dorsal, pectoral, anal and caudal fins dusky or nearly black. Attains at least 10 cm SL, 12.7 cm TL.



*Neocentropogon profundus*, 7 cm TL, holotype (N Mozambique).

Source: Smith 1958

**DISTRIBUTION** WIO: Mozambique, Réunion, Mauritius and possibly Seychelles.

**REMARKS** Known from 210–366 m; originally described from stomach contents of a jobfish, *Pristipomoides filamentosus* (identified as *P. microlepis* in the paper), caught at ~146 m.

**GENUS** *Ocosia* Jordan & Starks 1904

Dorsal-fin origin above middle of eyes; dorsal fin 14 or 15 spines, 1st spine  $\sim\frac{1}{4}$ – $\frac{1}{2}$  length of 2nd spine (1st spine relatively shorter in larger specimens), membranes between spines moderately or strongly incised. Lachrymal with 2 prominent spines: 1st spine  $\sim\frac{1}{2}$  length of 2nd spine; 1st spine points down and back, 2nd points mostly to rear. Preopercle with prominent uppermost spine, 2nd spine  $\sim\frac{1}{3}$ – $\frac{1}{2}$  length of 1st spine. Teeth on vomer and palatines. Head and body naked except for LL scales. Seven species, 2 in WIO.

**KEY TO SPECIES**

- |    |   |                    |
|----|---|--------------------|
| 1a | Pectoral fins 13 rays; 2nd dorsal-fin spine twice length of 8th spine ..... | <i>O. possi</i>    |
| 1b | Pectoral fins 12 rays; 2nd dorsal-fin spine subequal to 8th spine .....     | <i>O. ramaraoi</i> |

*Ocosia possi* Mandrytsa & Usachev 1990

Poss's waspfish PLATE 111

*Ocosia possi* Mandrytsa & Usachev 1990: 325 [130], Fig. (Saya de Malha Bank); Mandrytsa 1990, 2001.

Dorsal fin 14 spines,  $8\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 12 rays; GR 3 or 4/1/8–11 = 12–16. No small spine on lateral face of lachrymal above 1st spine on ventral margin; no spine on lateral face of 1st suborbital (2nd infraorbital). Dorsal-fin membrane at 4th spine incised  $\sim\frac{1}{3}$  length of spine; 2nd dorsal-fin spine  $\sim 1.5$ – $2.2$  length of 3rd spine,  $\sim 1.8$ – $2.2$  length of 8th spine. LL scales 16–20. Vertebrae 28.

Body pale orange and yellow, with diffuse, irregular, brown mottling and saddles over dorsal part of head, across body immediately behind head, between dorsal and anal fins, and on peduncle and caudal fin; margins of pectoral, soft-rayed dorsal and anal fins reddish. Attains 7.5 cm SL, 9.5 cm TL.

**DISTRIBUTION** Known only from the type specimens collected from Saya de Malha Bank and one specimen from the Mascarene Ridge.

**REMARKS** Taken at 170–230 m (Saya de Malha Bank).

*Ocosia ramaraoi* Poss & Eschmeyer 1975

Rama-Rao's waspfish

*Ocosia ramaraoi* Poss & Eschmeyer 1975: 3, Figs. 2c, 5 (Kollam coast, India); Mandrytsa & Usachev 1990; Mandrytsa 1990, 2001.

Dorsal fin 15 spines,  $8\frac{1}{2}$  or  $9\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 13 rays; GR 3 or 4/1/8–11 = 14–16. No small spine on lateral face of lachrymal above base of 2nd spine; no small spine on lateral face of 1st suborbital (2nd infraorbital). First dorsal-fin spine short, 2nd and 3rd spines longer, but subsequent spines also relatively elongate; membranes near middle of spinous dorsal fin incised for  $\sim\frac{1}{4}$ – $\frac{1}{3}$  length of spines. LL scales 14–18. Vertebrae 28.

Colour in life not known. Attains 9.5 cm SL,  $\sim 12$  cm TL.

**DISTRIBUTION** WIO: Maldives and southwestern India.

**GENUS** *Paracentropogon* Bleeker 1876

Dorsal-fin origin over rear half of eyes, with 8–15 spines,  $6$ – $8\frac{1}{2}$  rays; 1st dorsal-fin spine  $\sim 40$ – $70\%$  length of 2nd spine; membranes between most spines moderately incised. Anal fin 3 spines,  $4\frac{1}{2}$  or  $5\frac{1}{2}$  rays; pectoral fins 10–12 rays; pelvic fins 1 spine, 4 or (rarely) 5 rays. Lachrymal moveable, with 2 spines on ventral margin: 1st spine small, and 2nd spine  $\sim 3$ – $5$  times longer. Body either largely with or without scales, but no scales immediately behind head above lateral line. This genus is in need of revision but possibly has only 2 or 3 species; however, several nominal species are geographically disjunct and exhibit notable differences in colour pattern; 1 species in WIO.

*Paracentropogon longispinis* (Cuvier 1829)

Wispy waspfish PLATE 111

*Apistus longispinis* Cuvier in Cuv. & Val. 1829: 408 (Ambon I., Moluccas, Indonesia).

?*Centropogon indicus* Day 1875: 155, Pl. 38, Fig. 2 (Chennai, India); Day 1889\*.

*Paracentropogon indicus*: Ogilby 1903.

*Paracentropogon longispinis*: Mandrytsa 2001.

Dorsal fin 13–15 spines,  $6$ – $8\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$  rays; pectoral fins 9 or 10 rays; GR 1–5/1/4–7 = 7–13. LL scales 17–24; LSS 60–71. Vertebrae 10 or 11 + 14–16 = 24–26.

Body red to brownish red or dark brown, with large darker blotches and relatively pale areas, and usually covered with scattered small dark or pale spots; pectoral fins often olive-green distally on lateral face; juveniles and small adults with white snout, interorbital area, lower jaw and chest; area of white pigment over chest, lower jaw and snout becoming smaller with growth; specimens from India and Sri Lanka typically more uniformly dark than counterparts to the east. Attains 13 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: India (Tamil Nadu) and Sri Lanka; elsewhere to Thailand, Indonesia, Malaysia, Philippines, Taiwan, China, Australia, New Guinea and Solomon Is.

**REMARKS** Kuitert & Tonozuka (2001) have reported this species as reaching 13 cm TL, but no specimens that large are known. Although specimens from different geographic regions show little meristic or morphometric variation, more study is needed to establish if several distinct regional colour morphs merit recognition as distinct species or subspecies. These have been described as *P. indicus* (Sri Lanka and India), *P. vespa* (Australia), and *P. zonatus* (Philippines). Specimens from the Gulf of Thailand are usually more distinctly blotched.

## GENUS *Richardsonichthys* Smith 1958

Skin smooth, fleshy; lateral line relatively high on body, near or at base of dorsal fin. Dorsal-fin origin on head, just behind middle of pupil; dorsal fin 13 spines, first 2 spines close together, and wide space between 3rd and 4th spines; spine lengths decreasing posteriorly except for last spine: 1st spine relatively short,  $\sim\frac{1}{2}$  length of 2nd spine; 3rd, 4th or rarely 5th spine longest; membranes between spines strongly incised. Pelvic fins 1 spine, 5 rays. One species.

### *Richardsonichthys leucogaster* (Richardson 1848)

Whiteface waspfish

PLATE 111

*Apistes leucogaster* Richardson 1848: 5, Pl. 5, Figs. 1–2 (Sea of China).

*Prosopodasys leucogaster*: Günther 1860; Kner 1868; Playfair 1869; Sauvage 1891; Alcock 1896; Regan 1908.

*Tetraroge leucogaster*: Carcasson 1977.

*Richardsonichthys leucogaster*: Regan 1908; Smith 1958\*; Smith & Smith 1963; Munro 1967\*.

Dorsal fin 8–14 spines,  $6\frac{1}{2}$ – $8\frac{1}{2}$  rays; anal fin 3 spines,  $5\frac{1}{2}$ – $7\frac{1}{2}$  rays; pectoral fins 13–17 rays; GR 2–4/1/5–9 = 8–13. Body somewhat compressed, oblong; head moderate (38–45% SL), profile rounded, with preorbital region inclined  $\sim 47^\circ$  from horizontal, and occipital region strongly depressed. Eyes large, 10–17% SL. Lachrymal moveable, with 2 spines: 1st spine relatively small and directed more or less ventrally just over maxilla, 2nd spine much larger, extends posteriorly and slightly ventroposteriorly to or slightly beyond middle of pupil, but not reaching hind margin. Opercle with rear tip near dorsal-fin base. Upper jaw upturned at  $\sim 40$ – $45^\circ$  from horizontal,

reaching nearly to level of rear margin of pupil. No scales on body, except LL scales 10–17. Vertebrae 24 or 25.

Lower body and dorsal-fin tips usually red-orange, dorsum with reddish brown blotches, but some blotches faint or replaced with diffuse speckling or pale reticulations, and usually whitish band on peduncle; yellow ventrally. Attains 8 cm SL (possibly 10 cm TL: Lieske & Myers 1994).

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Yemen, Mozambique, South Africa (Kosi River mouth), Madagascar and Seychelles; elsewhere to east coast of India, Indonesia, Vietnam, China, Philippines, Ryukyu Is., New Guinea, Australia, Chesterfield Is. and New Caledonia.

**REMARKS** Found nearshore over soft bottom, to  $\sim 78$  m deep (one record of 320 m is questionable).

## GENUS *Snyderina* Jordan & Starks 1901

Head and body vertically compressed, relatively deep, body depth 34–45% SL; head large, 37–50% SL, with strongly inclined snout and predorsal profile. Lachrymal moveable, with 2 spines: anterior spine short, posterior spine long; preopercle with uppermost spine long, 2nd–4th spines very small (no other well-developed spines on head). Skin on lips of both jaws with prominent, short, fleshy tubercles; no barbels or cirri on lower jaw. Teeth on jaws and vomer; palatines with or without weak bands of teeth. Dorsal-fin origin over front edge of eyes; 1st dorsal-fin spine shortest, 3rd spine longest, with subsequent spines decreasing in size, except for last spine; fin membranes moderately incised between spines anteriorly. Pelvic fins 1 spine, 5 rays, fins large and membrane broadly adnate to body. Caudal fin rounded and elongate. Lateral line not high on body. Sides of body covered with minute, embedded, pseudocycloid scales which sometimes bear a small point posteriorly; ventral surface of body largely naked.

Smith (1958) suggested that the 2 nominal species, *Snyderina yamanokami* Jordan & Starks 1901 and *Snyderina guentheri* (Boulenger 1889), are conspecific, but most authors continue to recognise 2 distinct species. Moreover, multivariate analysis shows three distinct statistical populations: one from Indo-Pacific corresponding to *S. yamanokami*, one from Indian subcontinent corresponding to *S. guentheri*, and a third from Mozambique Channel. These populations show colour differences as well, although there is notable variation within populations; whether these correspond to distinct species, subspecies, or less likely reflect geographic variants of a single species, requires further study.



**KEY TO SPECIES OR POPULATIONS**

- 1a Body depth ~45% SL; distance between 5th spine of dorsal fin and pelvic-fin insertions ~47% SL; distance between last dorsal-fin spine and anal-fin origin ~34% SL; posterior dorsal- and anal-fin rays relatively rounded, not attenuate or angular in profile; body with much pink and lavender, and numerous small dark spots scattered relatively uniformly over flanks..... **Mozambique Channel specimens** [see Plate 112]
- 1b Body depth 34–42% SL; distance between 5th spine of dorsal fin and pelvic-fin insertions 34–42% SL; distance between last dorsal-fin spine and anal-fin origin 15–29% SL; posterior dorsal- and anal-fin rays relatively attenuate or angular in profile; body usually with large dark blotches on flanks, a few small black spots with dark purplish red or reddish brown vermiculate markings, and/or broad patches of orange or greenish brown ..... 2
- 2a Body and fins usually with at most a few distinct small vermiculate dark spots (usually <10 spots below lateral line behind head and anterior to anal-fin origin); head and body reddish brown, with round pale spots; fins dusky, with close-set pale spots separated by dark network pattern; pectoral fins usually 13 (rarely 14) rays; postorbital length 22–28% SL; GR 13–18 on 1st arch ..... ***S. guentheri*** [Indian subcontinent]
- 2b Body and fins with dense reddish brown vermiculate markings (usually >10 marks below lateral line behind head and anterior to anal-fin origin); pectoral fins 13–15 (usually 14, rarely 15) rays; postorbital length 20–26% SL; GR 9–15 on 1st arch ..... ***S. yamanokami*** [Indo-Pacific: Indonesia to Japan]

***Snyderina guentheri*** (Boulenger 1889)

Günther's waspfish

PLATE 112

*Tetraroge guentheri* Boulenger 1889: 239, Pl. 25 (Muscat, Oman, Gulf of Oman); Boulenger 1901; Regan 1905.

*Tetraroge guentheri*: Jordan & Starks 1904.

*Snyderina guentheri*: Jordan & Starks 1904; Norman 1939; Smith 1958\*; Smith & Smith 1963\* [expected from Seychelles, but no specimens]; Carcasson 1977; Talwar 1977\*; Mandrytsa 1990 [as *Shydera guentheri*], 2001; Randall 1995\*.

Body relatively compressed anteriorly, more strongly compressed posteriorly; caudal fin rounded, elongate. Dorsal fin 12 or 13 spines, 10½ or 11½ rays; anal fin 3 spines, 5½ to 6½ rays; pectoral fins usually 13 (rarely 14) rays; GR 3 or 4/1/8–13 = 13–18. Lachrymal moveable, with 2 prominent spines: anterior spine smaller, points mostly ventrally but slightly posteriorly, and posterior spine much larger, extends to rear half of pupil, points mostly posteriorly

and slightly ventrally; 2nd infraorbital with weak ridge; 3rd infraorbital with prominent ridge along middle towards large preopercular spine, no spine, but with weaker ridge along upper margin of bone. Interorbital ridges strongly raised in larger specimens and converge posteriorly just in advance of 1st dorsal-fin spine. Uppermost preopercle spine usually points directly back. Mandibular pores moderately large, 4 on each side, anteriormost pores of each side usually fused. Angular bone directed mostly medially, not ventrally. Maxilla extends to under rear of half eye (with mouth closed). LL scales 20–28; LSS 51–79. Vertebrae 26–28 (usually 27).

Body and median fins pale, with many small round orange-red spots; pectoral and pelvic fins grey, with similar spots. Attains 16.5 cm SL, 21.5 cm TL.



*Snyderina guentheri*, 12 cm SL (SW India). KK Bineesh © CMFRI

**DISTRIBUTION** WIO: Gulf of Aden, Gulf of Oman, India (Kerala) and possibly Seychelles; records from Somalia and Mozambique Channel are possibly not this species.

**REMARKS** Found at 49–300 m.

**GENUS** *Tetraroge* Günther 1860

Dorsal fin 8–14 spines, 6½–9½ rays; anal fin 3 spines, 4½ or 5½ rays; pectoral fins 11–13 rays; pelvic fins 1 spine, 5 rays. Dorsal-fin origin in front eyes; 1st dorsal-fin spine 23–44% length of 2nd spine; membranes between spines weakly incised. Teeth on vomer and palatines. Body mostly naked, but with some scattered vestigial pseudocycloid scales, each often evident as little more than a ridge that ends in small point, especially those on body above anterior portion of lateral line. Two species, both reported from Sri Lanka and southern India (Gulf of Mannar), but specimens are needed to confirm these localities.

## KEY TO SPECIES

- 1a One pair of barbels immediately behind lower jaw symphysis; head profile relatively steep and straight ..... *T. barbata*
- 1b No barbels at lower jaw symphysis; head profile rounded and not steep posteriorly ..... *T. niger*

*Tetraroge barbata* (Cuvier 1829)

Bearded roguefish

*Apistus barbatus* Cuvier in Cuv. & Val. 1829: 413 (Bouana River mouth, Java, Indonesia).

*Gymnapistes barbatus*: Swainson 1839.

*Tetraroge barbata*: Ramesh *et al.* 2008.

Dorsal fin 13 spines, 7½ or 8½ rays; anal fin 3 spines, 4½ or 5½ rays; pectoral fins 11–13 rays; GR 2–4/1/5–7 = 8–12. Body depth 31–47% SL; 1st dorsal-fin spine 23–39% length of 2nd spine. Head profile rather steep and relatively straight. Two prominent barbels on each side of lower jaw symphysis. LL scales 14–17. Vertebrae 24–26.

Body usually dark brown, with numerous small black streaks or spots (marbling often more variegated posteriorly in young); smaller specimens with distinct pale vertical bar between 1st dorsal-fin spine and upper edge of eyes; snout and interorbital area of specimens <25 mm almost completely white. Attains 10 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka and Gulf of Mannar; elsewhere to east coast of India (Chennai), Indonesia, Philippines, Ryukyu Is., New Guinea, Australia and New Caledonia.

**REMARKS** Found in coastal tidelands, mangroves, brackish and freshwater streams, and shallow nearshore waters, but its precise bathymetric range is not well documented.

*Tetraroge niger* (Cuvier 1829)

Black smooth stingfish

*Apistus niger* Cuvier in Cuv. & Val. 1829: 415 (Arian Coupang River mouth, Pudukcherry, India).

*Gymnapistes niger*: Swainson 1839.

*Prosopodasys niger*: Günther 1860.

*Prosopodasys nigra*: Sauvage 1878.

*Gymnapistus niger*: Day 1875\*; Johnstone 1903; Munro 1955.

*Tetraroge niger*: De Beaufort 1962\*; Ramesh *et al.* 2008.

Dorsal fin 13 spines, 6½–8½ rays; anal fin 3 spines, 4½ or 5½ rays; pectoral fins 11 or 12 rays; GR 2–5/1/4–12 = 8–17. Body depth 31–44% SL; 1st dorsal-fin spine 29–44% length of 2nd spine. Lachrymal moveable, with 2 spines: 1st short, 2nd relatively long and somewhat bayonet-like. Head profile somewhat rounded and not steep posteriorly. No elongate barbels on lower jaw symphysis. LL scales 13–20. Vertebrae 24 or 25.

Body darkish brown, with some spotting or mottling in some specimens; snout and interorbital area may be pale or white in smaller specimens. Attains 10 cm SL.

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka, and possibly southwestern India; elsewhere to east coast of India, Indonesia, Philippines, Ryukyu Is., New Guinea, Solomon Is. and Fiji.

**REMARKS** Venomous; infrequently seen throughout most of its range. Exhibits some geographic variation in meristic and morphometric measurements over its range. Found in estuaries to ~8 m deep, among mangroves, and often at considerable distances upstream in predominantly freshwater (up to 42 km: Herre 1951).

GENUS *Vespacula* Jordan & Richardson 1910

Dorsal-fin origin behind eyes; first 3 dorsal-fin spines and their membranes widely separate from subsequent spines and membranes, giving appearance of separate anterior finlet. Teeth present on vomer and palatines. Body covered with minute, weak, pseudocycloid scales, except immediately behind head above lateral line. Five or 6 species, 1 or 2 in WIO. *Vespacula bottae* (Sauvage 1878) was described from single specimen said to be from the Red Sea, but never collected subsequently. The Red Sea locality record is probably an error, as the holotype has been shown to be indistinguishable from *V. trachinoides* (Cuvier 1829), a relatively common species from Indo-Pacific. Mandrytsa (2001) subdivided the genus, recognising *Neovespicula* for *V. depressifrons* and *Pseudovespicula* for *V. dracaena*, reserving *Vespacula* solely for *V. trachinoides*. However, Mandrytsa (2001) did not study *V. cypho* and *V. zollingeri*, which are intermediate in several aspects and not readily assignable to the genera proposed by Mandrytsa. Although Mandrytsa may be correct in subdividing lineages within *Vespacula*, a single genus is recognised here, pending a study of all species assignable to *Vespacula*.

## *Vespicola dracaena* (Cuvier 1829)

Brown smooth stingfish

PLATE 112

*Apistus dracaena* Cuvier in Cuv. & Val. 1829: 403 (Malabar coast, India); Bleeker 1852.

*Apistus belangerii* Cuvier in Cuv. & Val. 1829: 412 (Malabar coast, India); Belanger 1834; Günther 1860; Blanc & Hureau 1968 [as *belangerii*].

*Prosopodasys dracaena*: Günther 1860; Day 1865 [as *Proposadasys dracaena*]; Sauvage 1878.

*Tetraroge belangerii*: Day 1865 [as *belangerii*]; Sauvage 1878.

*Gymnapistus dracaena*: Day 1875\*, ?1878, 1889; Johnstone 1904; Mendis 1954.

?*Vespicola dracaene* (*non* Cuvier 1829): Randall 1995\*; Carpenter *et al.* 1997\*.

*Pseudovespicula dracaena*: Mandrytsa 2001.

Body depth 2.5–3.1 in SL. Dorsal fin 12 spines, with broad space between 3rd and 4th spines nearly dividing the fin, and 7 rays; fin origin behind eyes. Anal fin 3 spines, 5 or 6 rays. Caudal fin truncate, slightly rounded when spread. Lachrymal with short ventral spine and large posterior spine extending to below centre of eye; preopercle with large spine in line with suborbital ridge, and a lower 2nd spine, very small and blunt. No scales.

Body pale brown, irregularly blotched with darker brown; broad dark band across interorbital region, continuing as bar below eye, and another band from dorsal-fin origin to eye; dorsal fin pale, with large dark brown blotch in middle (between 6th and 9th spines) and other irregular blotches, especially posteriorly; caudal fin whitish, with small faint dark spots. Attains at least 5 cm SL.

**DISTRIBUTION** Indian Ocean: Persian/Arabian Gulf, Sri Lanka and India (Malabar coast to Chennai).

**REMARKS** Found in estuaries and tidal lagoons, to ~9 m deep, on silty or sandy bottoms with some seagrass. Carpenter *et al.* (1997) reported this species as reaching 7.5 cm TL, but no specimens of that length are known. Specimens from the Persian/Arabian Gulf appear indistinguishable from *V. cypho* (Fowler 1938), a rare species from the Philippines, except in colour pattern, which is unfortunately now faded in the holotype; however, specimens from the Persian/Arabian Gulf can be differentiated in counts and measures and likely represent a distinct species.

## GLOSSARY

**adnate** – joined from having grown together.

**geographically disjunct** – two populations that occur far apart.

**pharyngobranchial tooth plates** – tooth plates on bones in the pharynx (throat) of a fish, behind the gills.

**pseudocycloid scales** – a few species of fishes fail to produce ctenii on their scales, and such 'secondary' cycloid scales are called pseudocycloid.

**pungent** – sharp-pointed.

## FAMILY APLOACTINIDAE

### Velvetfishes

Stuart G Poss

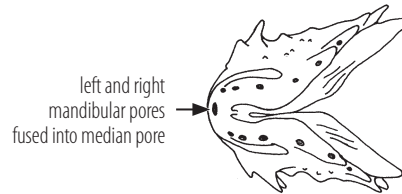
Body shape variable, with some species highly compressed, others notably depressed; head spines usually form knobby lumps rather than spinous points, except in a few species. Dorsal-fin origin far forward on head, with 9–16 spines, 7–16 rays; anal fin 0–5 spines, 6–16 rays; pelvic fins 1 spine, 2 or 3 (rarely 1) rays. Last ray of dorsal fin and anal fin either divided to base (counted as 2 rays) or not divided (counted as 1 ray), all other rays undivided; tips of dorsal-fin spines often blunt, spatulate in some species; dorsal-fin pterygiophores not inserting between 1 or 2 pairs of consecutive neural spines of precaudal vertebrae. Two nostrils on each side; nasal bone tubular, without strong spine. Single infrapharyngobranchial tooth plate; vomerine teeth sometimes reduced or absent; no palatine teeth. Branchiostegal rays usually 5 or 6 (rarely 7); pseudobranch with usually 5–15 primary lamellae; epibranchial of 1st gill arch with uncinat process that diverges from dorsal ramus of epibranchial at ~45° angle; no slit behind rearmost hemibranch. If present, scales small, modified, tack-like, forming spinous points on a nearly circular base; LL scales 8–19. Vertebrae 25–33.

Tiny, benthic, cryptic scorpaenoids, with or without venomous spines. Occur in Indo-Pacific, but only marginally present on central Pacific Plate. Seventeen genera and ~49 species; 3 genera and 7 species in WIO.

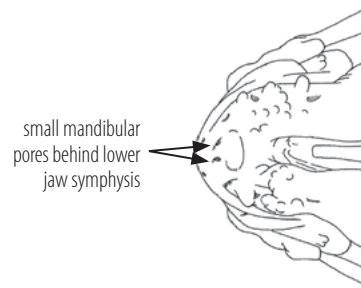
## KEY TO GENERA AND SPECIES

- 1a Gill opening restricted to small slit (gill membranes on both sides fused to skin above isthmus); no fleshy protuberance near front of isthmus [Bathyaploactinae] ..... *Acanthosphex leurynnis*
- 1b Gill membranes free of skin above isthmus; distinct fleshy protuberance near front of isthmus [Aploactininae] ..... 2
- 2a Pelvic fins 1 spine, 3 rays; head and body covered with numerous tack-like scales; spines on lachrymal broad, spatulate; anal-fin spines relatively weak, without conspicuous venom glands ..... 3 [*Cocotropus*]
- 2b Pelvic fins 1 spine, 2 rays; head and body naked except for LL scales; spines on lachrymal relatively pungent; anal-fin spines relatively well-developed, venom glands distinct ..... 6 [*Ptarmus*]
- 3a Mouth upturned at  $>50^\circ$  angle from horizontal (measured from lower edge of upper jaw); dorsal-fin origin over front edge of eyes; no fleshy papilla at rear end of maxilla ..... 4
- 3b Mouth upturned at  $\leq 45^\circ$  angle from horizontal; dorsal-fin origin over middle of eyes; fleshy papilla at rear end of maxilla ..... 5
- 4a Lateral line strongly arched immediately behind head and approaching close to dorsal-fin base (distance between lateral line and fin base  $\sim \frac{1}{2}$  length of dorsal-fin spines); fleshy, papillose anterior tip of isthmus extends well in front of 5th mandibular LL pore; 3rd spine of dorsal fin 19–21% SL; dorsal fin 12 spines, 9 rays; anal fin 2 spines, 7 rays ..... *Cocotropus steinitzi*
- 4b Lateral line arched behind head but not approaching close to dorsal-fin base (distance between lateral line and fin base more than length of dorsal-fin spines); fleshy, papillose anterior tip of isthmus extends slightly behind 5th mandibular LL pore; 3rd spine of dorsal fin 22–24% SL; dorsal fin 12 spines, 8 rays; anal fin 2 spines, 6 rays ..... *Cocotropus roseomaculatus*

- 5a Anal fin 1 spine; mandibular pores of right and left sides immediately behind lower jaw symphysis large and fused into median pore; dorsal fin 9 or 10 rays; pectoral fins 12 or 13 rays ..... *Cocotropus monacanthus*



- 5b Anal fin usually 2 (sometimes 3) spines; mandibular pores immediately behind lower jaw symphysis small and separate; dorsal fin 8 or 9 rays; pectoral fins 13 or 14 rays ..... *Cocotropus roseus*



- 6a Pectoral fins 10 rays; preopercle 1 small spine and 4 or 5 simple cirri; dorsal fin 13 or 14 spines, 8 or 9 rays; body with relatively large irregular pale spots, usually bordered by dark margins; caudal fin with dark blotch and often much yellow ..... *Ptarmus gallus*
- 6b Pectoral fins 9 rays; preopercle with 4 spines; dorsal fin 14–16 spines, 7–9 rays; body without pronounced spots, but with some small, dark streaks; caudal fin relatively uniformly dusky ..... *Ptarmus jubatus*

Drawings sourced from Imamura & Shinohara (2004)

## GENUS *Acanthosphex* Fowler 1938

Body oblong, vertically compressed, with rather loose, fleshy skin, with few scales behind head above lateral line (visible only with magnification). Dorsal fin 11–15 spines (1st spine longest, much stronger than rest), 7–9 rays (last ray usually branched); fin origin over eyes; fin membrane after 3rd spine deeply incised or joined to dorsum to give an effective count of 3 + 6–10 spines. Anal fin 1 or 2 spines, 7–9 rays. Pectoral

fins 9 or 10 rays. Caudal fin rounded, with 14 or 15 rays. Lachrymal moveable, with 2 greatly enlarged, spatulate spines, nearly reaching to base of preopercle spines; preopercle with 4 prominent, blunt, spatulate spines; opercle with extremely weak ridges, no spines; interopercle slender posteriorly, without spines. Branchiostegal membranes fused to isthmus and to skin of pectoral-fin bases, with rear opening restricted to small slit. LL scales 8–11. One species.



## *Acanthosphex leurynnis* (Jordan & Seale 1905)

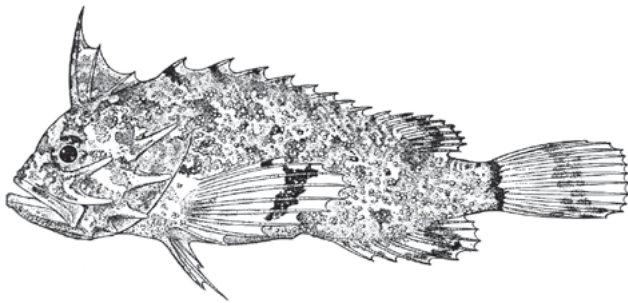
Wasp-spine velvetfish

PLATE 112

*Prosopodasys leurynnis* Jordan & Seale 1905: 525, Fig. 5 (Hong Kong).  
*Acanthosphex leurynnis*: Ramaiyan & Rao 1970; Mandrytsa 2001.

Diagnosis as for genus.

Colour in life described by Ramaiyan & Rao (1970) as body pale with irregular darker mottling, evidently similar to that observed in preservative. However, based on photographs, the upper half of body is dark brown with irregular saddles extending towards ventrum, with ventral part of the body strongly contrasting and distinctly pale, white or cream, as is most of caudal peduncle; white spot at each LL scale; head with dark brown saddle from dorsal-fin origin, across eyes to rear of jaw and over cheeks, but with snout, forehead, preopercle and opercle white, but snout and forehead darkens with increasing size; dorsal fin mostly dark brown, translucent and white distally; pectoral fins and caudal fin mostly white, but with distinct dark brown subterminal markings. Attains ~23 mm SL.



*Acanthosphex leurynnis*, ~2 cm SL, syntype (Hong Kong).  
Source: Jordan & Seale 1905

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka (Trincomalee); elsewhere to east coast of India (Parangipettai), Gulf of Thailand, Indonesia, Philippines, China, Japan, Australia (Arafura Sea) and New Guinea.

**REMARKS** Found to ~60 m deep. Matures at ~16 mm SL.

## GENUS *Cocotropus* Kaup 1858

Head and body vertically compressed, covered with modified tack-like scales, each forming a spinous point. Lachrymal moveable, with 2 prominent blunt spines. Single small postorbital bone. Interorbital ridges nearly parallel or converge slightly posteriorly. Anterior nostril a tube, midway between eye and tip of snout. Preopercle with 4 or 5 blunt spines. Mouth upturned; no palatine teeth. Dorsal fin continuous,

12–14 spines, 7–11 rays, fin origin above eyes, with anterior fin spines longer than those posteriorly; anal fin 1 or 2 (rarely 3) spines, 6–10 rays; pectoral fins rounded, 11–14 rays; pelvic fins 1 spine, 3 rays, fin insertions just before base of lowermost pectoral-fin ray, pelvic-fin membrane not or only slightly adnate to body. Branchiostegal rays 6. Vertebrae 25–28. About 15 species, 4 in WIO.

## *Cocotropus monacanthus* (Gilchrist 1906)

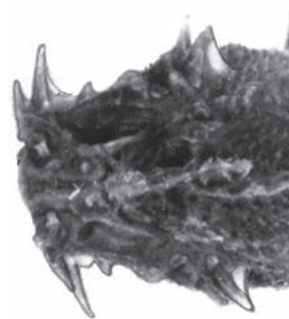
Roughskin velvetfish

PLATE 112

*Tetraroge monacanthus* Gilchrist 1906: 145, Pl. 37 (off False Bluff, KwaZulu-Natal, South Africa); Gilchrist & Thompson 1917.  
*Cocotropus monacanthus*: Barnard 1927; Smith & Smith 1953\*.  
*Cocotropus monacanthus*: SFSA No. 1029\*; Smith 1958\*, 1961\*;  
Shiino 1976; Poss & Eschmeyer 1978; SSF No. 151.1\*.

Dorsal fin 12 or 13 spines, 9 or 10 rays, fin origin over pupil; anal fin 1 spine, 7 or 8 rays; pectoral fins 12 or 13 rays; GR 0 or 1/4–6 = 5–7. Mouth upturned at ~40–45° angle from horizontal; maxilla extends to below level of front margin of eyes; no cirri on maxilla. Ventral surface of lower jaw with numerous papillae and 2 rows of cirri; outer row with 4 cirri; inner row with 3 or 4 cirri on each side. LL scales 10–12. Vertebrae 26 or 27.

Body brick red, head to pectoral-fin base brownish with many small brown spots forming reticulate pattern; pale and darker brown radial bars around eyes; peduncle and caudal fin brownish; dorsal, anal and pectoral fins brick red; anal-fin margin with dark brown spots. Attains ~38 mm SL.



*Cocotropus monacanthus*, 3 cm TL, holotype and dorsal view of head (South Africa). Source: SSF



**DISTRIBUTION** WIO: Comoros, Tanzania (Dar es Salaam) and South Africa (Aliwal Shoal).

**REMARKS** Known from few specimens, collected inshore to ~48 m deep.

### *Cocotropus roseomaculatus*

Imamura & Shinohara 2004

Rose-spotted velvetfish

PLATE 112

*Cocotropus dermacanthus* (non Bleeker 1852): Regan 1908; Smith & Smith 1963 [not figure from Bleeker]; Smith 1958 [not figure].

*Cocotropus roseomaculatus* Imamura & Shinohara 2004: 202, Figs. 1–3 (Kosi Bay, KwaZulu-Natal, South Africa).

Dorsal fin 12 spines, 8 or 9 rays, fin origin over front edge of eyes; anal fin 2 spines, 6 or 7 rays; pectoral fins 13 rays; pelvic fins 1 spine, 3 rays; GR 1 or 2/1/6–8 = 8–10. Lachrymal moveable, with 2 large blunt spines. Mouth superior, inclined ~70° from horizontal; upper jaw reaches vertical at front edge of eyes; no fleshy papilla on rear part of maxillae. Lateral line slightly convex anteriorly; anteriormost pores of mandibular lateral line confluent, opening in single large pore; LL scales 9–11. Vertebrae 26.

Head and body pale, but pink on tip of snout, rear end of maxilla, lachrymal, rear part of dorsal fin and pectoral-fin bases; small pinkish spots near tip of 6th dorsal-fin spine, on base of 3rd dorsal-fin ray, near middle of flanks below 5th or 6th dorsal-fin ray, at ventral margin of peduncle, and another near midline at caudal-fin base. Attains ~40 mm SL.



*Cocotropus roseomaculatus*, 29 mm SL (South Africa).

Source: Imamura & Shinohara 2004; © JSSZ

**DISTRIBUTION** WIO: South Africa (Kosi Bay, KwaZulu-Natal) and Seychelles.

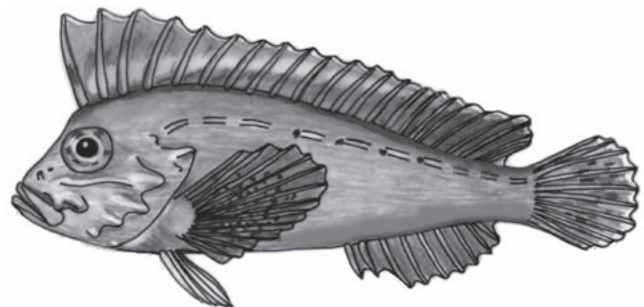
### *Cocotropus roseus* Day 1875

Rosy velvetfish

*Cocotropus roseus* Day 1875: 160, Pl. 38, Fig. 8 (Coromandel coast, India); Klunzinger 1884; Regan 1908; Poss & Eschmeyer 1978; Randall & Anderson 1993.

Dorsal fin 12–14 spines, 8 or 9 rays, fin origin over middle of eyes; anal fin 1–3 spines, 7 or 8 rays; pectoral fins 13 or 14 rays. Head compressed, dorsal profile at ~50° angle from horizontal, and sparsely covered with modified scales. Lachrymal moveable, with 2 prominent blunt spines; 2nd infraorbital with small knob; 3rd infraorbital rugose, without distinct spine, forming low knob in smaller specimens; infraorbital (suborbital) stay broadened posteriorly, firmly attached to preopercle at and between bases of two dorsalmost preopercle spines; no postorbital bone. Vertebrae 26–28.

Described by Day (1875) as fins with pinkish tinge; dorsal-fin margin white, with dull grey band along centre (most distinct posteriorly); anal fin reddish; pectoral fins reddish with many black spots; pelvic fins white; caudal-fin margin white, base with numerous grey spots. Attains ~44 mm SL.



*Cocotropus roseus*, holotype (India). Drawn from Day 1875

**DISTRIBUTION** Indian Ocean. WIO: Maldives, Sri Lanka (Gulf of Mannar); elsewhere, east coast of India.

**REMARKS** Found inshore, at <100 m. Day (1875) noted the species as common along the Coromandel coast of India in summer.

*Cocotropus steinitzi* Eschmeyer & Dor 1978

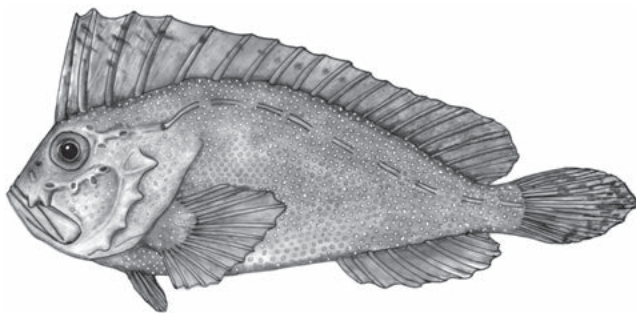
Steinitz's velvetfish

PLATE 113

*Cocotropus steinitzi* Eschmeyer & Dor 1978: 166, Fig. 1 (Eilat, Israel, Gulf of Aqaba, Red Sea); Poss & Eschmeyer 1978; Dor 1984; Johnson 2004; Allen & Erdmann 2012.

Dorsal fin 12 spines, 9 rays; anal fin 2 spines, 7 rays; pectoral fins 12 or 13 rays; GR 1 or 2/1/4–9 = 6–12. Head compressed, covered with modified scales; dorsal profile relatively straight, at ~60° angle from horizontal. Lachrymal moveable, with 2 prominent spines. Mouth superior, at ~50° angle from horizontal, maxilla reaches vertical at middle of eyes. Dorsal-fin origin over front edge of eyes; 1st spine nearly as long as 2nd, 2nd slightly longer than 3rd and subsequent spines, and then spines decreasing slightly in length; no notch between spinous and soft-rayed portions. Lateral line arched upward immediately behind head, continuing high on body below dorsal-fin spines 6–9, but somewhat less so posteriorly; LL scales 9–11. Vertebrae 25.

Colour in life unknown. Holotype with short dark streaks and spots on dorsal fin; anal fin with subterminal band; caudal fin with irregular dark patches or bands, one near middle of fin and broader darker area subterminally. Attains ~36 mm SL.



*Cocotropus steinitzi*, 36 mm SL, holotype (Red Sea).  
Drawn from Eschmeyer & Dor 1978

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aqaba (Red Sea); elsewhere, Andaman Is. and New Guinea.

**REMARKS** Tropical, nearshore.

**GENUS** *Ptarmus* Smith 1947

Head and body extremely vertically compressed; predorsal profile steeply inclined; interorbital width extremely narrow. Mouth slightly upturned. Lachrymal moveable, with 2 small curved pungent spines; 2nd and 3rd infraorbitals narrow, without spines; preopercle spines small; no spine on interopercle.

Dorsal-fin origin at or before front edge of eyes, fin continuous, with 13–15 pungent spines, 1st spine short. Pelvic fins 1 spine, 2 rays. Anal fin with 2 strong spines, each with conspicuous venom gland on either side of midline. Branchiostegal rays 6. Vertebrae 25–30. Two species, both in WIO.

*Ptarmus gallus* (Kossmann & Räuber 1877)

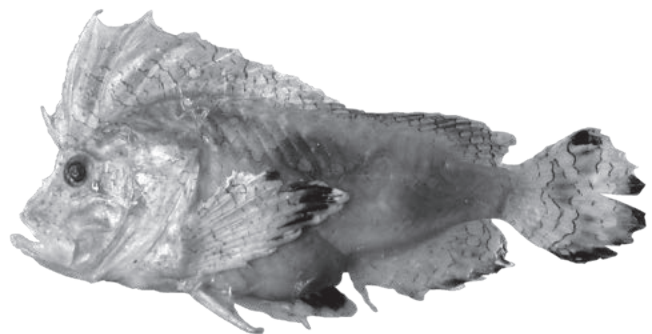
Cock velvetfish

PLATE 113

*Tetraroge gallus* Kossmann & Räuber 1877: 395 (Red Sea); Klausewitz 1964. *Cocotropus gallus*: Klunzinger 1884. *Ptarmus gallus*: Smith 1958; Smith & Smith 1963\*; Frøiland 1972\*; Eichler & Lieske 1994\*; Goren & Dor 1994.

Dorsal fin 13 or 14 spines, 8 or 9 rays; anal fin 2 spines, 4–7 rays; pectoral fins 10 rays; GR 0–3/1/5 = 6–9. Small tuft of short cirri near upper border of ascending process of premaxilla. Preopercle narrow, with single small spine pointing up and back at level of stay (small specimens often show 2 or 3 slight ridges on rear border of preopercle below spine); 4 or 5 simple cirri on preopercle, those ventrally better developed. LL scales 8–11. Vertebrae 25–28.

Colouration changes with size: body sometimes with yellow and often brown or pale brown, with 4 irregular darker brown saddles; ventrum and sometimes peduncle paler, nearly white in small fish; head, body and fins with numerous small pale spots, usually round or oblong, though often irregularly shaped, circled by narrow dark brown rings which accentuate spots (spots usually larger, more numerous, and more irregularly shaped in smaller individuals; more rounded, less numerous, and smaller in larger individuals); dorsal fin often pale distally; caudal fin often yellow, and margin with large, irregular, variously interconnected dark blotches. Attains ~44 mm SL.



*Ptarmus gallus* (Red Sea). © D Golani, HUJ

**DISTRIBUTION** WIO: endemic to Red Sea.

**REMARKS** Venomous. Found inshore, to ~3.5 m deep.



*Ptarmus jubatus* (Smith 1935)

Crested velvetfish

PLATE 113

*Coccotropus jubatus* Smith 1935: 223, Pl. 18, Fig. B (KwaZulu-Natal, South Africa); Smith 1947.

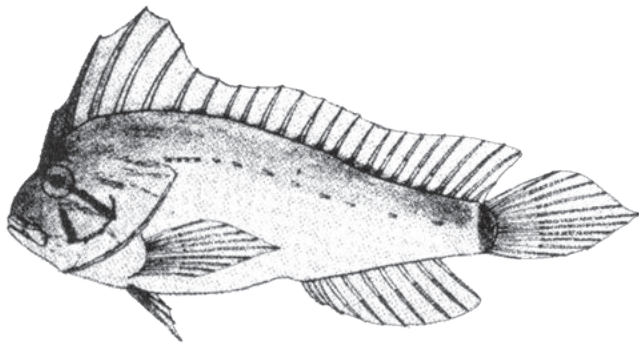
*Ptarmus gallus* (non Kossmann & Rauber 1877): Smith 1958 [in part: *P. jubatus* in synonymy].

*Ptarmus languidus* Smith 1947: 816 (Inhaca I., Maputo Bay, Mozambique).

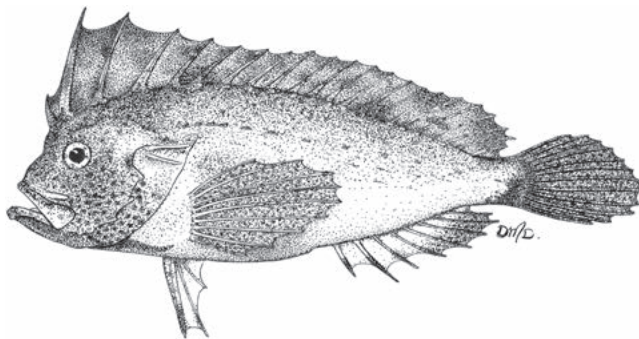
*Ptarmus jubatus*: SFSA No. 1030\*; Smith 1961\*; SSF No. 151.2\*.

Dorsal fin 14–16 spines, 8 or 9 rays; anal fin 2 spines, 6 or 7 rays; pectoral fins 9 rays; GR 0–3/1/4–6 = 5–9. Snout with at most a few cirri. Preopercle narrow, with 4 spines; uppermost spine largest, lowermost 2 spines much smaller, almost rudimentary; no cirri on preopercle. LL scales 8–11. Vertebrae 29 or 30.

Body pale brown to black, darker dorsally and paler ventrally; fins dusker brown than body, especially posteriorly, with pale or white margins; body with numerous dark streaks, better developed on upper part of body; belly and underside of head pale, nearly cream-coloured; white stripe over tip of lower jaw; dorsal fin with thin white margin, and numerous diffuse darker spots posteriorly; anal fin similarly coloured, but more solidly dark posteriorly; pectoral fins and caudal fin and dark brown, with some spotting. Attains ~58 mm SL.



*Ptarmus jubatus*, 6 cm TL (S Mozambique). Source: SSF



*Ptarmus jubatus*, 8 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** WIO: Mozambique (Inhaca I.) and South Africa (KwaZulu-Natal).

**REMARKS** Venomous.

**GLOSSARY**

**infrapharyngobranchial tooth plate** – a tooth plate on bones in the pharynx (throat) of a fish, behind the gills.

**Pacific Plate** – that part of the Pacific Ocean floor bounded by the Aleutian Trench in the north, the trenches that extend from the Okhotsk Peninsula, past Japan, the Mariana Trench, to the Tonga and Kermadec trenches to cut through South Island, New Zealand, to the Antarctic Plate in the south. It is bounded on the east by mid-ocean ridges that extend past Easter Island to Baja California and along the west coast of North America to Alaska. It covers 103.3 million sq. km.

**pseudobranch** – a small, gill-like organ on the inner surface of the operculum; the reduced first gill arch.

**FAMILY CONGIOPODIDAE**

## Horsefishes

Stuart G Poss

Body oblong and strongly compressed; head profile usually concave at snout and then blunt at occiput, with pronounced snout and small mouth. Single nostril on each side of snout; nasal bones firmly attached to cranium. Dorsal fin prominent, continuous, its origin over eyes, and anterior spines elongate; pectoral fins low, subequal to pelvic fins; caudal fin more or less emarginate. Bones of head usually cuirassed, bearing small rugosities or spinules; body with small tack-like scales when present (skin smooth in adults of several species). Branchiostegal rays 5 or 6; gill membranes connected to isthmus, usually restricting gill openings to small slit. Vertebrae 30–39.

Occur in cooler waters of Southern Hemisphere. Three genera and 8 species; 1 genus and 2 species in WIO.

**GENUS *Congiopodus*** Perry 1811

Head large; head and body strongly compressed. Dorsal fin 14–21 spines, 7–10 rays; pectoral fins 9 rays; anal-fin spines weak, difficult to distinguish from segmented rays; caudal fin truncate or weakly forked. Most fin rays branched. Single nasal spine, either strong or reduced or absent in adults.



Preopercle broad, without spine in adults. Distinct slit behind posteriormost hemibranch. Skin of young with small tack-like scales; adults of most species with few or no prickly scales, but with leathery skin. Five species, all confined to cool-temperate waters, 2 in southwestern WIO.

**KEY TO SPECIES**

- 1a LL scales visible; snout with strong nasal spine in juveniles and adults; skin with small prickly scales in juveniles and adults; anal fin 9 or 10 rays ..... *C. spinifer*
- 1b Lateral line obscured in large juveniles and adults, not readily visible except occasionally as minute pores; nasal spine greatly reduced or absent in adults; body smooth in adults, bumpy in juveniles; anal fin 7 or 8 rays ..... *C. torvus*

*Congiopodus spinifer* (Smith 1839)

Spinynose horsefish

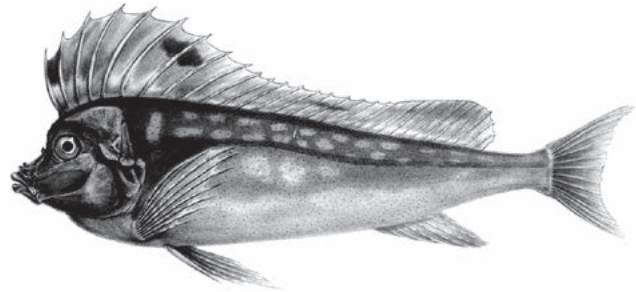
PLATE 113

*Agriopus spinifer* Smith 1839: no page numbers, Pl. 3 (Table Bay, South Africa); Bleeker 1860; Günther 1860; Steindachner 1869\*.  
*Cephalinus granulatus* Gronow in Gray 1854: 161 (South Africa).  
*Congiopodus spinifer*: Gilchrist 1904; Gilchrist & Hunter 1919; Smith 1961; Smith & Smith 1966; Brownell 1979; Washington *et al.* 1984; Olivar & Fortuño 1991\*; Bianchi *et al.* 1993\*; SSF No. 152.1\* [1995]; Heemstra & Heemstra 2004; Zsilavec 2005; Ishii & Imamura 2008.

Dorsal fin 19–21 spines, 11–14 rays, membranes between anterior spines not strongly incised; anal fin 9 or 10 rays; pectoral fins 8 or 9 rays; GR 1–5/1/7–10 = 11–16. Bones of head notably rugose. Lachrymal with 2 raised knobby areas: 1st near anterior tip extending back as a ridge, 2nd along ventral margin, and each usually bearing multiple spinules; dorsally directed pungent spine on lateral face (behind raised ridge and above 2nd knobby area). Nasal spines pungent in specimens of all sizes, and usually slightly curved and directed anterodorsally. Body covered with numerous small tack-like scales; LL scales 18–25, those anteriorly with 2 slightly divergent spines.

Body brown and mottled, paler ventrally; broad pale or yellowish band from eyes to peduncle at level of lateral line, typically yellowish anteriorly behind eyes and cream-coloured posteriorly; the band bordered above by 3–5 irregular dusky saddles below dorsal-fin base, and sometimes bordered below by darker, typically shorter, band of similar width; many specimens with small dark spots scattered over body, some forming distinct ocelli with dark centre surrounded by pale ring; dorsal fin usually with dark spots distally between

spines 1–2, and spines 6–8, and membranes dusky terminally, often with small diffuse spots over posteriormost spines. Attains 45 cm TL.



*Congiopodus spinifer*, 30 cm TL, holotype (South Africa). Source: Smith 1839

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (Pondoland) in WIO.

**REMARKS** Found at ~50–500 m.

*Congiopodus torvus* (Gronow 1772)

Smooth horsefish

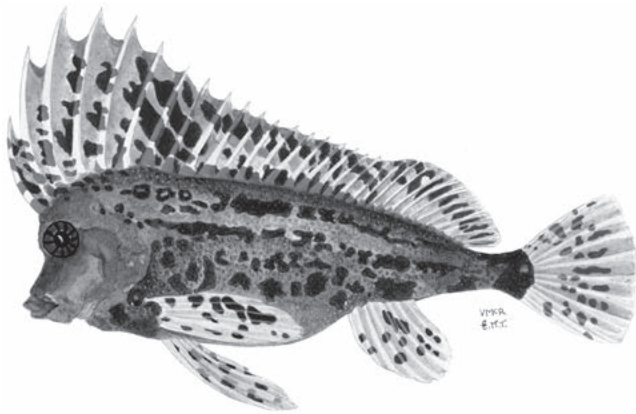
PLATE 113

*Blennius torvus* Gronow 1772: 47, Pl. 3 (Indian Ocean [in error]).  
*?Perca blennoides* Walbaum 1792: 336 [no locality given] [based on Gronovius 1763]; Parenti 2003 [*nomen dubium*].  
*Coryphaena torva*: Bloch & Schneider 1801.  
*Congiopodus percatus* Perry 1811: Pl. 64 [name on plate only].  
*Agriopus unicolor* Burton 1835: 116 (Cape Seas, South Africa).  
*Agriopus torvus*: Cuvier & Valenciennes 1829; Bleeker 1860; Günther 1860.  
*Cephalinus glaber* Gronow in Gray 1854: 159 (Indian Ocean).  
*Agriopus verrucosus* Cuvier in Cuv. & Val. 1829: 387, Pl. 91 (Cape of Good Hope, South Africa) [based on juvenile specimen of *C. torvus*]; Bleeker 1860; Günther 1860; Gilchrist 1903; Tominaga *et al.* 1996.  
*Congiopodus torvus*: Gilchrist 1904; SFSA No. 1060\*; Smith & Smith 1966; Karrer 1973; Lloris 1986\*; SSF No. 152.2\*; Olivar & Fortuño 1991; Bianchi *et al.* 1993\*; Imamura & Yabe 2002; Heemstra & Heemstra 2004\*; Zsilavec 2005.

Dorsal fin 20 or 21 spines, 13–15 rays; anal fin 7 or 8 rays; pectoral fins 9 rays; GR 1 or 2/1/8–11 = 11–13. Head strongly compressed, profile blunt; mouth protractile, relatively pointed. Body compressed, tapering, with narrow peduncle. Dorsal-fin spines long, particularly anteriorly, with spines 2–6 forming elevated crest, and membranes between spines deeply notched. Lateral line present as obscure pores. Skin predominantly smooth in adults, but distinctively bumpy or papillose in juveniles.

Body pale brown, mottled olive-green or dark yellow, with 2 horizontal brown bands: upper band from near base of 5th

dorsal-fin spine to peduncle; lower band from about midflanks behind eyes to peduncle; fins usually mottled darker green, with some irregular but usually oblique pale markings; paired fins somewhat paler proximally. Attains 75 cm TL.



*Congiopodus torvus*, 21 cm TL (South Africa). Source: SSF



*Congiopodus torvus*, 50 cm TL (S Mozambique). Source: SSF

**DISTRIBUTION** Southern Africa: Namibia (deeper reefs) in southeastern Atlantic, to southern Mozambique in WIO.

**REMARKS** Sedentary, usually seen occupying crevices and boulders; found at ~10–300 m.

#### GLOSSARY

**cuirassed** – body armour, with breastplate and backplate fastened together.

**pungent** – sharp-pointed.

**rugosities** – wrinkles and lumps on a surface.

**spinules** – small, spine-like structures.

## FAMILY SETARCHIDAE

### Deepsea bristly scorpionfishes

Stuart G Poss

Body oblong, head large. Bones of cranium relatively weakly ossified, with large openings for lateral line of head; no postorbital bones; no postorbital part of infraorbital branch of head lateral line (*canalis infraorbitalis*); single neuromast in temporal canal (*canalis temporalis*). Last ray of dorsal and anal fins either divided to base (counted as 2 rays) or not divided (counted as 1 ray). Anal-fin spines relatively weakly developed. Unconsolidated caudal-fin skeleton, with hypurals 1–5 autogenous. Scales pseudocycloid, small; lateral line trough-like, covered by thin membranous scales; LSS 43–72.

This small group, found on the upper continental slope, is closely allied to the Scorpaenidae, and some workers have treated it as subfamily Setarchinae. Three genera and 6 species; 1 genus and 2 species in WIO at depths of <200 m. *Setarches guentheri* and *S. longimanus* also occur in WIO, but at depths of >200 m.

### GENUS *Ectreposebastes* Garman 1899

Body relatively deep, 37–52% SL. Dorsal fin 12 spines, 9½–10½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16–20 rays. Lachrymal with anterior spine greatly reduced. Swimbladder rudimentary or absent. Pyloric caeca 5; pyloric caeca and intestine unpigmented, stomach often black. Two named species, but the status of *Ectreposebastes niger* as distinct from *E. imus* is debated. (No specimens of *E. niger* from WIO were examined in preparing this account, although Voronina & Volkova [2007] reported fish identified as *E. niger* from WIO.)

#### KEY TO SPECIES

- |    |                                |                 |
|----|--------------------------------|-----------------|
| 1a | Pectoral fins 18–20 rays ..... | <i>E. imus</i>  |
| 1b | Pectoral fins 16 rays .....    | <i>E. niger</i> |

## *Ectreposebastes imus* Garman 1899

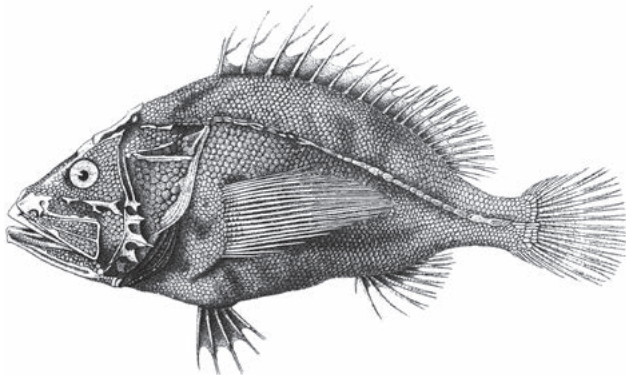
Midwater scorpionfish

PLATE 113

*Ectreposebastes imus* Garman 1899: 53, Pls. 8–9, 71, Fig. 1 (off San Cristóbal I., Galápagos Is.); SSF No. 149 [key only]; Eschmeyer & Collette 1966\*; Mandrytsa 1990, 2001.

Body relatively compressed. Dorsal fin 12 spines, 9½ or 10½ rays; anal fin 3 spines, 5½–7½ rays; pectoral fins 18–20; GR ~6/1/8–10 = 15–17. Percentage SL: body depth 37–52%, HL 46–52%, snout length 13–15%, eye diameter 6–8%, and interorbital width 10–15%. Head spines reduced in larger specimens; lachrymal with 3 spines, front spine reduced; preopercle with 5 spines, 3rd largest, 5th smallest, all about equally spaced. LL scales 21–28; LSS ~43. Vertebrae 24; precaudal vertebrae 9 or 10.

Body of adults black or maroon, juveniles black, with some yellow on pectoral fins and some pink on body; buccal cavity black, with bright orange and red patches in life; pharyngeal teeth orange or red. Attains 18 cm SL, ~22 cm TL.



*Ectreposebastes imus*, type (Galapagos). Source: Garman 1899

**DISTRIBUTION** Circumglobal in tropical to temperate waters of Atlantic and eastern and central Pacific (off Equator Seamount), and in WIO with reports from Kenya and Mozambique.

**REMARKS** Venomous. Benthopelagic, adapted to midwater; found at ~150–2 000 m (usually 500–850 m).

## *Ectreposebastes niger* (Fourmanoir 1971)

*Pontinus niger* Fourmanoir 1971: 42, Fig. 6 (Marquesas Is.).

?*Ectreposebastes imus* (non Garman 1899): Collette & Uyeno 1972\*.

*Ectreposebastes niger*: Paulin 1982\*; Paulin *et al.* 1989; Mandrytsa 1990, 2001; Voronina & Volkova 2007.

Body compressed; peduncle depth 10.6–12.3% SL; pectoral-fin length 43–62% SL. Dorsal fin 11 or 12 spines, 9½ or 10½ rays; anal fin 3 spines, 5½ rays; pectoral fins 16 rays. Head spines on lachrymal and preopercle relatively small. Scales 8 or 9 above lateral line, 21–33 below; vertical scale rows ~55; LL scales ~32. Precaudal vertebrae 8.

Body black. Attains ~14.5 cm SL, ~18 TL.



*Ectreposebastes niger*, 10 cm SL (Japan). Source: Collette & Uyeno 1972

**DISTRIBUTION** Indo-Pacific. WIO: Mozambique and Saya de Malha Bank; elsewhere, Japan and scattered localities in southwestern Pacific, including off New Caledonia and Kermadec Is.

**REMARKS** Occurs on continental slope, to ~1 200 m deep. Although Collette & Uyeno (1972) synonymised this species with *E. imus*, other workers have regarded *E. niger* as distinct; additional research is needed.

## FAMILY SYNANCEIIDAE

## True stonefishes and stingfishes

Stuart G Poss

Relatively grotesque-looking scorpaenoids, usually with greatly depressed head and body typically covered with wart-like protuberances. Dorsal fin continuous, with hypodermic-like dorsal-fin spines, and their associated venom glands often enlarged near spine bases; pectoral fins with or without free rays; last soft ray of dorsal fin and anal fin counted as 1½ when divided to base and carried on a single pterygiophore, or

counted as 1 ray when not split to base. Gill membranes fused to isthmus. Skin with acinar glands; scales greatly reduced or absent. Short neural spines on anteriormost 2 vertebrae.

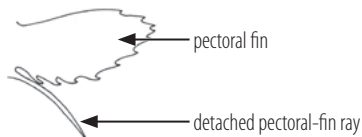
Lie-in-wait suction-feeding predators that camouflage as rocks. Highly dangerous to humans, with venom capable of inflicting excruciating pain and sometimes death. The proteinaceous neurotoxin can be denatured with heat, but immediate medical attention should be sought in the event of a stab wound.

Eight genera and ~35 species; 5 genera and 17 species in WIO.

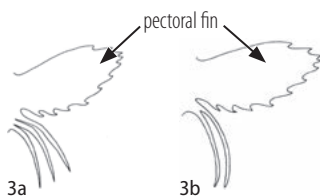
## KEY TO SUBFAMILIES, GENERA AND SPECIES

- 1a Lower 1 to 3 pectoral-fin rays detached from remainder of fin and capable of independent movement (walking and burrowing) ..... 2
- 1b Lower pectoral-fin rays not free from remainder of fin, but continuous and relatively undifferentiated from other fin rays, and thicker ..... 14 [Synanceiinae]

- 2a Lower 2 or 3 pectoral-fin rays detached and free from remainder of fin; most bones of head with distinct knob-like spines, but usually without extensive sculpturing; eyes small to moderate, diameter 4–12% SL; interorbital space relatively wide, 7–12% SL ..... 3 [Choridactylinae]
- 2b Single lower pectoral-fin ray detached and free from remainder of fin; bones of head striated in appearance, with numerous minute spinules, usually arranged in rows, and other sculpturing over surface of all head bones; eyes relatively large, diameter 9–19% SL; interorbital space relatively narrow, 5–10% SL ..... 7 [Minoinae: *Minous*]

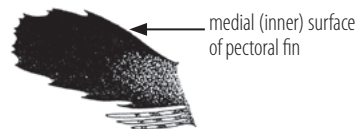


- 3a Lower 3 pectoral-fin rays free from remainder of fin; first 3 spines of dorsal fin not separated from following spines, 3rd spine 22–35% SL; mouth terminal, only slightly oblique ..... 4 [Choridactylus]



- 3b Lower 2 pectoral-fin rays detached from remainder of fin; first 3 spines of dorsal fin well-separated from following spines, but connected to each other by membrane, 3rd spine 16–24% SL; mouth superior and eyes elevated on head ..... 6 [*Inimicus*]

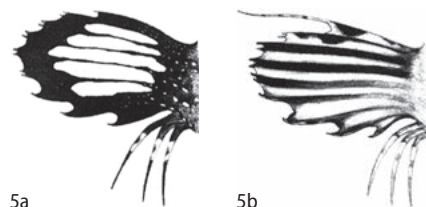
- 4a Body covered with wavy white lines; medial surface of pectoral fins almost uniformly dark brown or black ..... *Choridactylus striatus*



- 4b Body with spots, specks or irregular marks, but no distinct wavy, longitudinal, white lines; medial surface of pectoral fins with either pale brown between fin rays and dark streaks over fin rays, or with numerous white spots on black background ..... 5

- 5a Medial surfaces of pectoral and pelvic fins with many bright white spots on black background; upper pectoral-fin rays not filamentous at any size; dorsal fin 13–15 spines ..... *Choridactylus multibarbus*

- 5b Medial surface of pectoral fins pale brown between fin rays and with dark streaks over fin rays; no spots on pelvic fins; upper pectoral-fin rays filamentous in fish >5 cm SL; dorsal fin 14 or 15 (usually 14) spines ..... *Choridactylus natalensis*

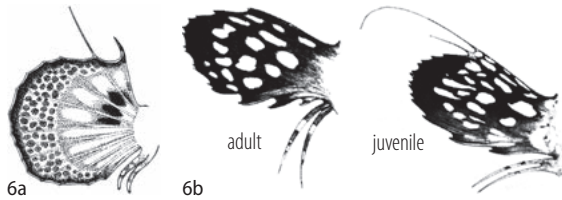


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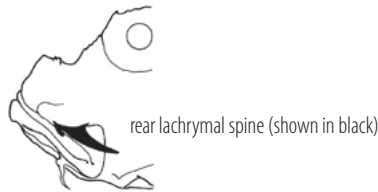


**KEY TO SUBFAMILIES, GENERA AND SPECIES**

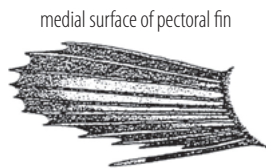
- 6a Eyes extremely elevated, close-set, and broadly joined basally; interorbital space subequal to eye diameter; medial surface of pectoral fins with 1 or 2 large dark blotches dorsomedially near axil, and with many faint and darker, sometimes ocellated, spots in relatively wide subdistal band..... *Inimicus filamentosus*
- 6b Eyes only slightly elevated, widely spaced, and joined only by low ridge of bone; interorbital space usually >1.5 times eye diameter; medial surface of pectoral fins grey-brown, with numerous small dark spots or specks near axil, but no large dark blotches with small spots that may merge to form streaks, and distal margin not dark..... *Inimicus sinensis*



- 7a First spine of dorsal fin subequal to or longer than 2nd spine, its base well-separated from that of 2nd spine..... 8
- 7b First spine of dorsal fin shorter than 2nd spine (and sometimes extremely small and easily overlooked), its base close to that of 2nd spine..... 9
- 8a Medial surface of pectoral fins mostly pale, without distinctive dark brown markings; dorsal fin usually 10–12 spines; rear lachrymal spine somewhat curved..... *Minous monodactylus*



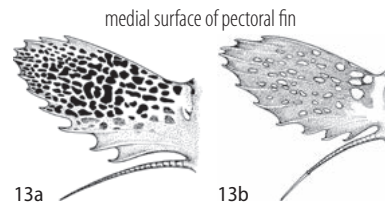
- 8b Medial surface of pectoral fins almost uniformly dark, except for paler area over middle fin membranes; dorsal fin 8 or 9 spines; rear lachrymal spine relatively straight.... *Minous usachevi*



- 9a Pectoral fins >50% SL, reaching end of anal fin or beyond.... 10
- 9b Pectoral fins <46% SL, reaching middle of anal fin..... 11

- 10a Anal fin 2 spines, usually 10 or 11 rays; 3rd or 4th pectoral-fin ray longest; rear lachrymal spine points posteroventrally; dorsalmost preopercular spine does not reach rear margin of opercle; opercle large..... *Minous inermis*
- 10b Anal fin 2 spines, usually 8 or 9 rays; uppermost pectoral-fin ray longest; rear lachrymal spine points anteroventrally; dorsalmost preopercular spine reaches rear margin of opercle or beyond; opercle small..... *Minous longimanus*
- 11a Dorsal fin 7–11 (usually 10½) rays; total anal-fin elements 9–11 (usually 10); posterior lachrymal spine usually less than twice length of anterior spine, both spines with medial axis nearly parallel and pointing mainly ventrally (pointing posteriorly only slightly), and tip of posterior spine barely reaching to end of maxilla..... 12
- 11b Dorsal fin 11–17 rays; total anal-fin elements 11–13; posterior lachrymal spine at least 3 times length of anterior spine, and medial axis of posterior spine noticeably curving posteriorly, its tip reaching nearly to or beyond end of maxilla..... 13

- 12a Dorsal fin 10 or 11 spines, 8–10 rays..... *Minous trachycephalus*
- 12b Dorsal fin 4 or 5 spines, 17 or 17½ rays..... *Minous andriashevi*
- 13a Medial surface of pectoral fins pale, with irregular black spots..... *Minous coccineus*
- 13b Medial surface of pectoral fins with pale spots on dark background..... *Minous dempsterae*



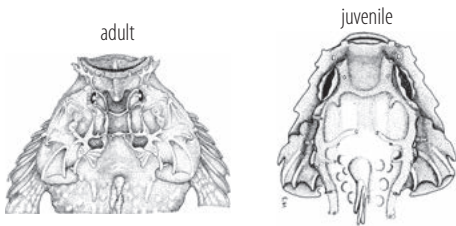
- 14a Dorsal fin ≥16 spines..... 15
- 14b Dorsal fin 10–14 spines..... 17
- 15a Anal fin 2 spines, 11½–13½ rays..... *Trachicephalus uranoscopus* [eastern Indian Ocean to western Pacific]
- 15b Anal fin 3 spines, 4½–6½ rays..... 16
- 16a Pelvic fins 1 spine, 3 rays..... *Pseudosynanceia melanostigma*
- 16b Pelvic fins 1 spine, 4 rays..... *Leptosynanceia asteroblepa* [eastern Indian Ocean to western Pacific]

Pectoral fin drawings sourced from Eschmeyer *et al.* (1979)

Continued ...

## KEY TO SUBFAMILIES, GENERA AND SPECIES

- 17a Pectoral fins  $\leq 12$  rays ..... *Synanceia alula*  
[eastern Indian Ocean to western Pacific]
- 17b Pectoral fins  $\geq 13$  rays ..... 18
- 18a Pectoral fins 14–17 rays, fins primarily vertical, only slightly extending under body; large pit anteroventral to eyes; interorbital space with slight depression; occiput with deep saddle-like or rectangular depression; teeth on vomer ..... 19
- 18b Pectoral fins 18 or 19 (usually 18) rays, fins very broad and curving onto ventral surface of body; small pit anteroventral to eyes; interorbital space wide, 12–20% SL, with deep depression; occiput without deep depression; no teeth on vomer ..... *Synanceia verrucosa*
- 19a Pectoral fins 15–17 (usually 16) rays; interorbital width 7–9% SL, distinct ridge extending transversely and connecting eyes without distinct break near midline of space; occiput forms deep trough behind eyes ..... *Synanceia horrida*
- 19b Pectoral fins 14–16 (usually 14) rays; interorbital width 10–16% SL, deep depression between eyes and in front of weak ridge between eyes, except for small space near midline in smaller individuals; occiput forms rectangular depression in adults ..... *Synanceia nana*

GENUS *Choridactylus* Richardson 1848

## Three-fingered stingfishes

Dorsal fin 12–15 spines; lower 3 pectoral-fin rays free, used for walking over soft bottom. Lachrymal partly moveable, with 2 pungent spines, 2nd spine 2–3 times size of 1st spine. Skin loose, flabby. Head and body nearly naked; scales, if present, notably reduced and deeply embedded in skin, and usually associated with warts or tubercles scattered over body. Acinar skin glands present on body below dorsal fin and above anal fin. Three species, all in WIO, with 2 endemic to the region.

*Choridactylus multibarbus* Richardson 1848

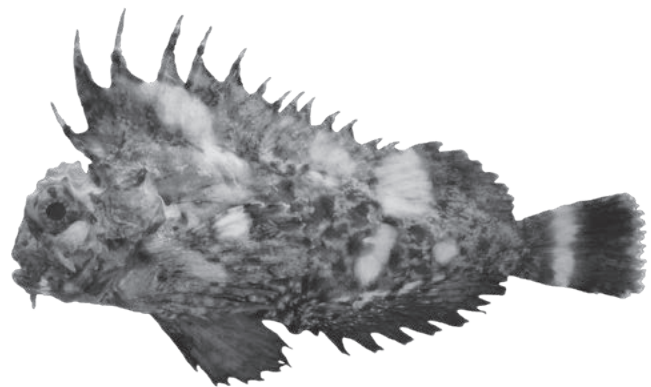
## Orange-banded stingfish

PLATE 114

*Choridactylus multibarbus* Richardson 1848: 8, Pl. 2, Figs. 1–3 (Sea of China); Steindachner 1902; Kyushin *et al.* 1977\*; Eschmeyer *et al.* 1979\*; Dor 1984; SSF No. 149 [genus description]; Randall 1995\*; Carpenter *et al.* 1997; Manilo & Bogorodsky 2003; Bogorodsky *et al.* 2014. *Chorismodactylus multibarbis*: Günther 1860; Boulenger 1889; Steindachner 1903. *Choridactylus multibarbis*: Day 1875\*, 1889\*; Munro 1955; Smith 1958\*; Smith & Smith 1963\*; Mandrytsa 1993; Poss & Mee 1995.

Dorsal fin 12–14 spines,  $8\frac{1}{2}$ – $10\frac{1}{2}$  rays; anal fin 2 spines,  $8\frac{1}{2}$  or  $9\frac{1}{2}$  rays. Uppermost pectoral-fin ray not filamentous at any body size. GR 2 or 3/1/6–8 = 9–11. LL scales 13–15. Vertebrae 26.

Colour variable, usually mottled brown with some yellow and 2 or 3 orange saddles; fins mostly dark brown (sometimes nearly black), and bases of pelvic fins and anal fin covered with bright white spots; medial surface of pectoral fins nearly black, but covered with minute white spots proximally and broad white or yellow streaks more distally between rays. Attains 9 cm SL.



*Choridactylus multibarbus*, 8 cm SL (Red Sea). © SV Bogorodsky

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Gulf of Oman, Persian/Arabian Gulf to India and Sri Lanka (Gulf of Mannar); elsewhere to east coast of India (Chennai), Philippines, Taiwan and China.

**REMARKS** Randall (1995) and Manilo & Bogorodsky (2003) report its depth from shallow water to ~50 m; available records are from 14–38 m. A record from Mauritius (Smith 1958) is in error.

## *Choridactylus natalensis* (Gilchrist 1902)

Three-stick stingfish

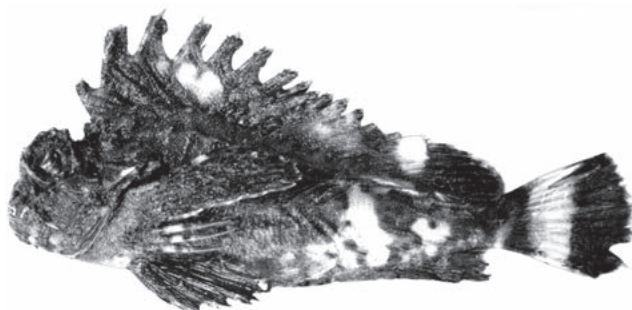
PLATE 114

*Choridactylodes natalensis* Gilchrist 1902: 102, Pl. 5 (off Umhlanga River mouth, KwaZulu-Natal, South Africa); Gilchrist 1904; Gilchrist & Thompson 1917; Von Bonde 1923; Fowler 1925, 1934; SFSA No. 1055\*.

*Choridactylus natalensis*: Barnard 1927\*, 1947\*; Smith 1958\*; Smith & Smith 1963\*; Eschmeyer *et al.* 1979; SSF No. 149.2\*; Mandrytsa 1990, 1993; Poss & Mee 1995.

Dorsal fin 13–15 spines, 7½–10 rays; anal fin 1 or 2 spines, 8½–10½ rays; pectoral fins 9 or 10 + 3 free rays. Uppermost pectoral-fin ray filamentous in adults, extending well past remaining rays. GR 2–4/1/5–9 = 9–14. LL scales 13 or 14.

Body primarily brownish or mottled brown, and sometimes with pink or yellow; medial surface of pectoral fins with dark streaks or stripes over rays, on relatively pale background over membranes; roof of mouth and peritoneum black. Attains 11 cm SL.



*Choridactylus natalensis*, 9 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: Somalia to South Africa (KwaZulu-Natal); not known from Red Sea or Gulf of Aden.

**REMARKS** Found at 22–78 m.

## *Choridactylus striatus* Mandrytsa 1993

Lined stingfish

PLATE 114

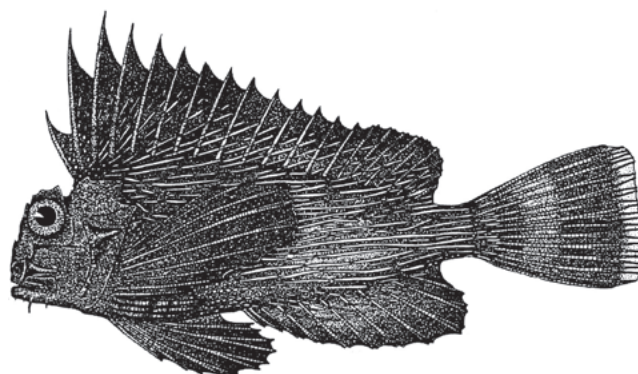
*Choridactylus striatus* Mandrytsa 1993: 137 [136 of English translation], Fig. 1 (Gulf of Aden).

*Choridactylus lineatus* Poss & Mee 1995: 2, Fig. 1 (off Salalah, southern Oman); Randall 1995\*.

Dorsal fin 13 or 14 spines, 9½ or 10½ rays; anal fin 2 spines, 9½ rays; pectoral fins 8 + 3 free rays. GR 2/1/9. LL scales 11–13.

Body brown, covered with numerous, narrow, oblique or longitudinal white streaks; medial surface of pectoral fins with

small white spots over axil, but relatively uniformly dusky distally over most of membranes. Attains 19 cm SL.



*Choridactylus striatus*, 16 cm SL, holotype (Gulf of Aden).

Source: Mandrytsa 1993

**DISTRIBUTION** WIO: Oman, Yemen and Somalia.

**REMARKS** Known from few localities, at 26–64 m.

## GENUS *Inimicus* Jordan & Starks 1904

Ghoulfishes

Mouth large, superior. Eyes elevated on head and joined, or nearly so, by elevated median ridge in interorbital space, with deep and roughly oblong depression anteroventral to each eye. Dorsal fin 15–17 spines, with first 3 spines well-separated from succeeding spines but connected to each other by membrane, 5–9 rays; anal fin 2 spines, 8–13 rays; pectoral fins 12 rays, with lower 2 rays free, detached and independently moveable (used for walking and digging). Vertebrae 27–30. Ten species, 2 in WIO.

## *Inimicus filamentosus* (Cuvier 1829)

Filament-finned stinger

PLATE 114

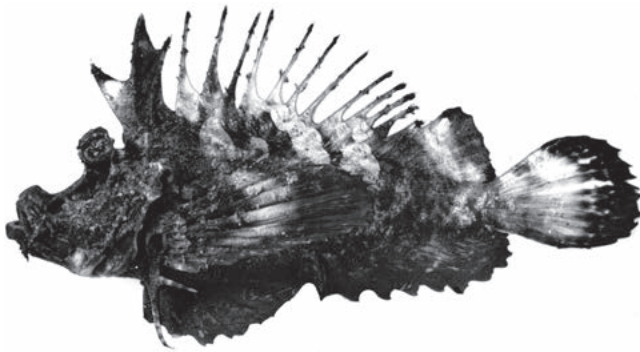
*Pelor filamentosum* Cuvier in Cuv. & Val. 1829: 428, Pl. 94 (Mauritius, Mascarenes); Lesson 1831\*; Cuvier 1834, 1836\*, 1837\*; Kaup 1858; Günther 1860; Playfair & Günther 1867; Peters 1876, 1883; Sauvage 1878, 1891; Bleeker 1879; Blanc & Hureau 1968.

*Pelor filamentosus*: Guichenot 1863; Gill 1905.

*Inimicus filamentosus*: Fowler 1938; Smith 1958\*; Smith & Smith 1963; Dor 1965\*, 1970, 1984; Baissac 1968; Tortonese 1968; Frøiland 1972\*; Eschmeyer *et al.* 1979\*; Poss & Rama-Rao 1984; Randall & Anderson 1993; Khalaf & Disi 1997\*; Eschmeyer 1998; Field & Field 1998\*; Fricke 1999; Letourneur *et al.* 2004; Taquet & Diringer 2007; Fricke *et al.* 2009.

Dorsal fin 15 or 16 spines, 7 or 8 rays; anal fin 2 spines, 9 or 10 rays; pectoral fins 10 + 2 free rays. Percentage SL: HL 36–38%, snout length 18–19%, orbit diameter 6–7%, interorbital width 5–9%, and postorbital length 15–16%. Eyes extremely elevated, close-set, and broadly joined at bases; interorbital width subequal to eye diameter; occiput notably depressed. Dorsal-fin membranes after 4th spine usually  $\frac{1}{4}$ – $\frac{1}{2}$  length of associated spine. Upper 2 pectoral-fin rays filamentous and more elongate than those of rest of fin, 2nd ray longer than uppermost ray. GR  $3/1/4-7 = 8-11$ . LL scales  $\sim 12-14$ . Vertebrae 27.

Body variously mottled, typically with pinkish or red over head and body interspersed with brilliant yellow and numerous black and grey areas, but many specimens more brownish; head usually paler ventrally; dorsal fin often pinkish with broad areas of grey, sometimes black near tips of spines and rays, and elongate black blotch over dorsal-fin rays 2–4 to fin base; pectoral fins dusky proximally, usually with areas of pinkish or yellowish, and with broad grey margin; medial surface of pectoral fins brightly coloured yellow or orangish yellow over proximal two-thirds of fin, with black and white or black and yellow bars merging to solid black over distal third of fin; pelvic fins nearly always black, sometimes with small pale or white spots or markings proximally; caudal fin rose-pink at base, with areas of bright yellow, and black spots distally that merge to solid black margin, but sometimes with small white spots submarginally. Attains at least 18 cm SL (possibly 25 cm TL: Khalaf & Disi 1997).



*Inimicus filamentosus*, 18 cm TL (Tanzania).

**DISTRIBUTION** WIO: Red Sea, East Africa, South Africa, Madagascar, Seychelles, Mascarenes and Maldives.

**REMARKS** Found to  $\sim 55$  m deep. Frequently caught in nets, over sandy or silty bottom, and often encountered by divers.

## *Inimicus sinensis* (Valenciennes 1833)

Spotted ghoull

PLATE 114

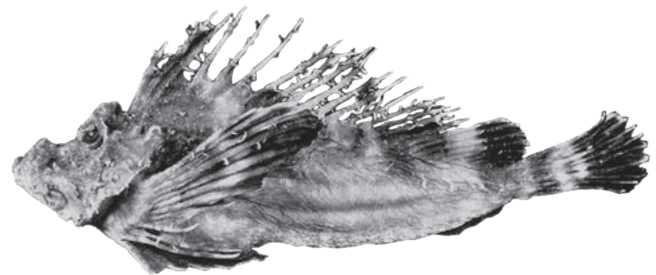
*Pelor sinense* Valenciennes in Cuv. & Val. 1833: 468 (Guangdong, China).

*Inimicus sinense*: Rama-Rao & Badrudeen 1973\*.

*Inimicus sinensis*: Eschmeyer *et al.* 1979\*.

Dorsal fin 17 or 18 spines, 8 or 9 rays; anal fin 2 spines, 11–13 rays; pectoral fins 10 + 2 free rays. Percentage SL: HL 33–40%, snout length 14–18%, orbit diameter 4–6%, interorbital width 7–12%, and postorbital length 13–17%. Eyes strongly elevated and widely spaced, joined by low bony ridge; interorbital space relatively wide, usually  $>1\frac{1}{2}$  orbit diameter. Snout length equal to or longer than postorbital distance (postorbital distance 1–1.5 in snout length). Dorsal-fin membranes after 4th spine  $<\frac{1}{4}$  height of associated spine. Upper 2 pectoral-fin rays not filamentous but relatively elongate in specimens  $>5$  cm SL. GR 2 or  $3/1/4-7 = 7-10$ . Vertebrae 28 or 29.

Body mottled yellowish brown; medial surface of pectoral fins with irregularly sized pale spots, usually on dark background; soft-rayed portion of dorsal fin and caudal fin banded dark brown and whitish. Attains at least 22 cm SL (possibly 26 cm TL: Lieske & Meyers 1994).



*Inimicus sinensis*, 9 cm TL (Hong Kong).

Source: Eschmeyer *et al.* 1979; courtesy of CAS

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka; elsewhere to Indonesia, Vietnam, Philippines, Taiwan, China and Australia.

**REMARKS** Occurs inshore, on sandy bottom near reefs, at 5–90 m.



GENUS *Minous* Cuvier 1829

Stingfishes

Dorsal fin 4–12 spines,  $8\frac{1}{2}$ – $14\frac{1}{2}$  rays; anal fin 1 or 2 spines,  $7\frac{1}{2}$ – $11\frac{1}{2}$  rays; pectoral fins 12 rays, lowermost ray free; pelvic fins 1 spine, 5 rays. All fin rays unbranched; last ray of dorsal and anal fins usually not split to base. Pelvic-fin membrane broadly adnate to body. Head bones covered with rugosities and striations. Lachrymal moveable, with 2 prominent spines, 2nd spine larger than 1st spine; 3rd infraorbital bone broad posteriorly. No teeth on palatines. Lower jaw and upper third of eyes with cirri; no tentacles, flaps or cirri elsewhere on body. No scales other than LL tubed scales. Twelve species, 8 in WIO.

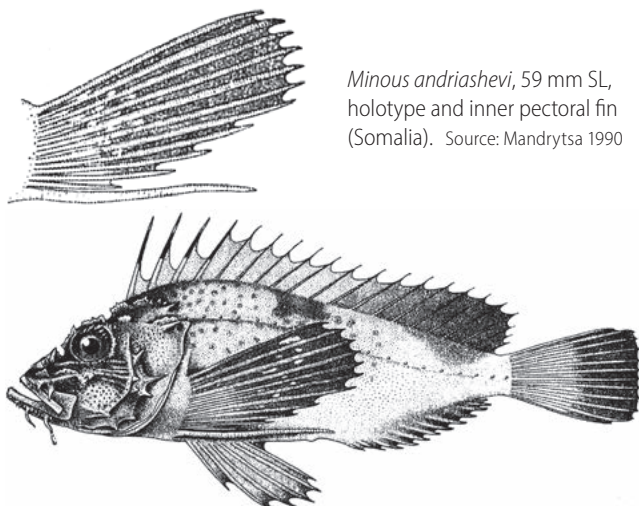
*Minous andriashevi* Mandrytsa 1990

Andriashev's stingfish

*Minous andriashevi* Mandrytsa 1990: 66, Fig. (off Somalia:  $11^{\circ}41'$  S,  $51^{\circ}23'$  E); Mandrytsa 1993, 2001; Manilo & Bogorodsky 2003; Voronina & Volkova 2007.

Dorsal fin 4 or 5 spines, 17 or 18 rays; anal fin 1 or 2 spines, 10 or 11 rays. Percentage SL [holotype]: HL 36%, orbit diameter 10%, snout length 11%, interorbital width 6%, postorbital length 16%, pectoral-fin length 39%, 1st dorsal-fin spine 20%, and 2nd dorsal-fin spine 20%. Posterior spine on lachrymal about twice size of anterior spine. GR 3/1/7 or 8. LL scales 17. Vertebrae 26 or 27.

Body with dark saddle at base of dorsal-fin spines 2–3, another broader saddle above distal quarter of pectoral fins, and weak saddle at base of last dorsal-fin rays, with weak dark spots between saddles; medial surface of pectoral fins dusky, with faint whitish spots on proximal third of fin. Attains 6 cm SL.



*Minous andriashevi*, 59 mm SL, holotype and inner pectoral fin (Somalia). Source: Mandrytsa 1990

**DISTRIBUTION** WIO: Somalia and Mozambique Channel.

**REMARKS** Known to ~90 m deep. Further comparison with *M. trachycephalus* is warranted as additional specimens of this species become available.

*Minous coccineus* Alcock 1890

One-stick stingfish

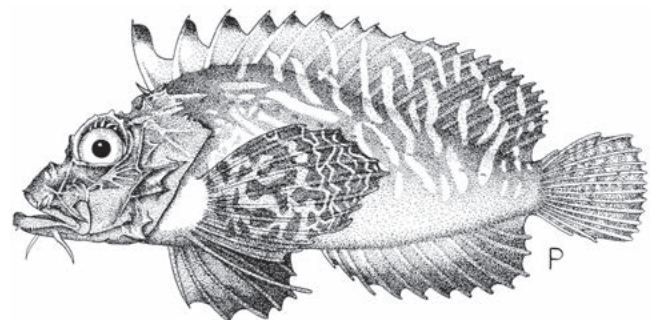
PLATE 115

*Minous coccineus* Alcock 1890: 428 (off Ganjam coast [Odisha], India, Bay of Bengal); Eschmeyer *et al.* 1979\*; Dor 1984; SSF No. 149.3\*; Randall & Von Egmond 1994; Bogorodsky *et al.* 2014.

*Minous trachycephalus* (non Bleeker 1855): Alcock 1896; SFSa No. 1054\*. *Minous superciliosus* Gilchrist & Thompson 1908: 177 (Amatikulu, KwaZulu-Natal, South Africa); Von Bonde 1923; Barnard 1927; Fowler 1934; Smith 1958\*; Smith & Smith 1963\*.

Dorsal fin 10–12 spines (1st  $<\frac{1}{2}$  length of 2nd), 11 or 12 rays; anal fin 2 spines, 9 or 10 rays. Percentage SL: HL 38–43%, orbit diameter 12–15%, snout length 13–15%, interorbital width 9–10%, postorbital length 15–18%, pectoral-fin length 33–42%, 1st dorsal-fin spine 3–7%, and 2nd dorsal-fin spine 14–19%. Dorsal-fin spines sharp and moderately strong. Lachrymal with 2 sharp, somewhat moveable spines extending over maxilla, 1st spine points anteroventrally,  $\sim\frac{1}{2}$  length of 2nd spine, which points posteroventrally. LL scales 18 or 19. Swimbladder present. Vertebrae 26.

Colour variable, usually red or pinkish red with brown or nearly black oblique bars that extend posteroventrally over posterior half of body; dorsum dark brown; underside of head and breast pale, white or nearly so; dorsal fin dark grey or blackish, especially distally, more red or pinkish near base, and anal fin similarly coloured; pectoral fins mostly black, medial surface with distinctive black spots on pale background. Attains 9 cm SL.



*Minous coccineus*, 8 cm TL. Source: SFSa

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Arabian Sea, Tanzania to South Africa (KwaZulu-Natal); elsewhere, Bay of Bengal, Myanmar, Gulf of Thailand, Indonesia and Taiwan.

**REMARKS** Coastal; collected in trawls at 23–81 m. Although expected from Seychelles by Smith & Smith (1963), more recent collecting has cast doubt on its presence there (Randall & Von Egmund 1994).

### *Minous dempsterae*

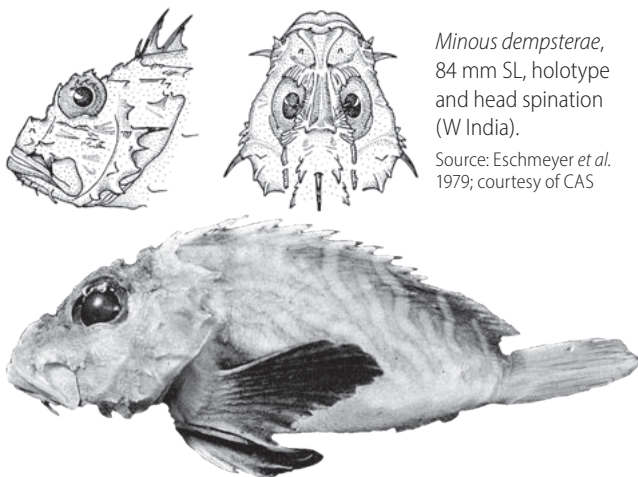
Eschmeyer, Hallacher & Rama-Rao 1979

Obliquebanded stingfish

*Minous dempsterae* Eschmeyer, Hallacher & Rama-Rao 1979: 469, Figs. 1, 2e, 8b, 9 (off west coast of India: 21°11'–08' N, 69°16'–13' E); Böhlke 1984; SSF No. 149 [key only]; Randall 1995\*.

Dorsal fin 10 or 11 spines (1st <½ length of 2nd, and close-set), 11–13 rays; anal fin 2 spines, 9 or 10 rays. Percentage SL: HL 42–47%, orbit diameter 12–13%, snout length 14–16%, interorbital width 9–11%, postorbital length 18–22%, pectoral-fin length 38–44%, 1st dorsal-fin spine 3–6%, and 2nd dorsal-fin spine 13–16%. Pectoral fins reach only to middle of anal fin. Lachrymal with 2 spines, anterior spine points ventrally and slightly posteriorly, <½ length of posterior spine, which is curved and points ventroposteriorly. GR 3–5/1/7–9. Swimbladder present. Vertebrae 25–27.

Body pinkish ventrally, reddish and greyish dorsally, with wavy darker reddish brown or grey lines alternating with paler background and extending from dorsal fin to dorsum and ventral to slightly below lateral line; pectoral fins dark brown or nearly black, except lowermost free ray same as adjacent body colour; medial surface of pectoral fins dusky, with pale spots and pale area near axil. Attains ~9 cm SL.



*Minous dempsterae*, 84 mm SL, holotype and head spination (W India).

Source: Eschmeyer *et al.* 1979; courtesy of CAS

**DISTRIBUTION** WIO: Gulf of Oman (Iran) and Pakistan to India (Mumbai).

**REMARKS** Found at 23–117 m, often on greenish clay, sand or mud bottom.

### *Minous inermis* Alcock 1889

Longfin stingfish

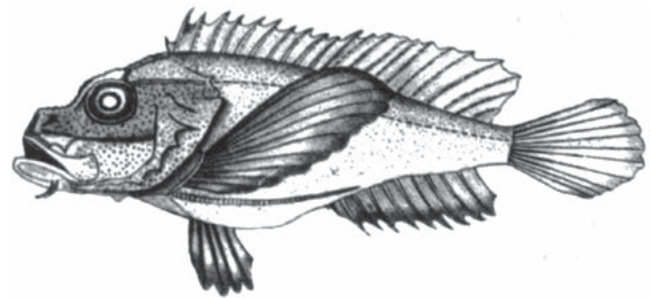
*Minous inermis* Alcock 1889: 299, Pl. 22, Fig. 4 (east of Sacramento Shoal on Godavari coast, India, Bay of Bengal); Alcock 1892, 1894, 1896, 1899; Alcock & Anderson 1898\*; Regan 1905; Norman 1939; Smith 1958\*; Smith & Smith 1963\*; Eschmeyer *et al.* 1979\*; Kotthaus 1979; SSF No. 149 [key only]; Goren & Dor 1994; Randall 1995; Mandrytsa 2001; Manilo & Bogorodsky 2003.

*Minous longipinnis* Lloyd 1909: 162 (Gulf of Oman); Smith 1958\*; Smith & Smith 1963; Menon & Rama-Rao 1975.

*Paraminous inermis*: Fowler 1943.

Dorsal fin 9 or 10 spines (1st ~½ length of 2nd), 12–14 rays; anal fin 2 spines, 8–11 rays. Percentage SL: HL 40–48%, orbit diameter 9–14%, snout length 12–16%, interorbital width 5–9%, postorbital length 15–21%, pectoral-fin length 38–54%, 1st dorsal-fin spine 5–10%, and 2nd dorsal-fin spine 13–19%. Dorsal-fin spines relatively thin and flexible, membranes only weakly incised. Pectoral fins elongate, reaching end of anal fin. Lachrymal with 2 subequal pungent spines; 1st spine points anteroventrally, 2nd spine points ventrally and slightly posteriorly. GR 4/1/9–13 = 14–18. LL scales 16–18. Vertebrae 26 or 27.

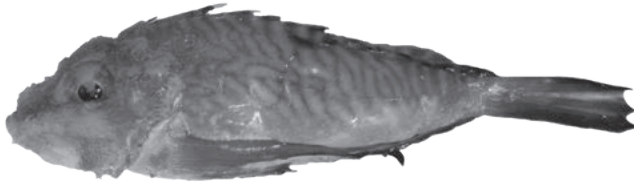
Colour variable, usually without spots in larger adults, but with pale spots on pale-coloured flanks of juveniles and smaller adults; tips of first 5 or 6 dorsal-fin spines with dark flap of skin; pectoral-fin bases pale brown, increasingly darker distally, medial surface of fins pale grey, with white spots at axil; pelvic fins grey with pale spots; caudal fin pale, darker distally. Attains 9 cm SL.



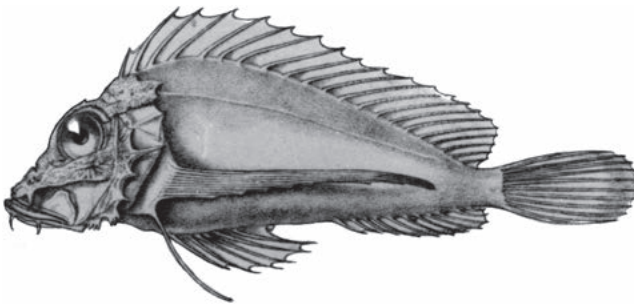
*Minous inermis*, ~7 cm TL, type (Bay of Bengal). Source: Alcock 1889

**DISTRIBUTION** Indian Ocean. WIO: Somalia, Red Sea (Yemen), Gulf of Oman, Pakistan and India; elsewhere to Bay of Bengal, Andaman Sea and Myanmar.

**REMARKS** Found in relatively deep water, on soft bottom, at 37–420 m (most records >120 m).



*Minous longimanus*, ~7 cm TL (Seychelles). © Alvheim © IMR/ASCLME



*Minous longimanus*, type (Saya de Malha Bank). Source: Regan 1908

## *Minous longimanus* Regan 1908

PLATE 115

*Minous longimanus* Regan 1908: 236, Pl. 28, Fig. 2 (Saya de Malha Bank); Smith 1958\*; Smith & Smith 1963\*; SSF No. 149 [key only]; Mandrytsa 1990.

*Minous inermis* (non Alcock 1889): Eschmeyer *et al.* 1979.

Dorsal fin 10 spines (1st spine  $< \frac{1}{2}$  length of 2nd), 10 or 11 rays; anal fin 2 spines, 8 or 9 rays; pectoral fins 11 or 12 rays, lowermost ray free, uppermost 2 rays longest. Percentage SL: HL ~39%, orbit diameter ~12%, snout length ~16%, interorbital width ~9%, postorbital length ~13%, pectoral-fin length ~57%, 1st dorsal-fin spine ~8%, and 2nd dorsal-fin spine ~20%. Caudal fin truncate. Bony surface of head bones extremely rough, with minute spinules and striae. Lachrymal with 2 spines, 1st spine  $\sim \frac{1}{2}$  length of 2nd spine, which points anteroventrally. Opercle relatively small; preopercle with 5 spines: uppermost spine large, extending to or beyond margin of opercle; 2nd spine small, widely spaced from 1st spine; 3rd spine larger than 2nd and pointing primarily ventrally, slightly posteriorly; 2 lowermost spines broad at base, with multiple small points. Snout relatively blunt and longer than orbit diameter; maxilla reaches in front of margin of orbit or slightly beyond. Dorsal margin of orbit with 4 or 5 simple cirri;

ventral surface of lower jaw with 3 or 4 cirri. GR 2 or 3/1/7–9. LL scales 15–18. Vertebrae 11 or 12 + 14 or 15 = 26.

Body reddish orange on dorsum, becoming pinkish white on ventrum; reddish markings on body and fins arranged into oblique narrow bars separated by pale areas, with bars on soft-rayed portion of dorsal fin nearly vertical posteriorly; anal fin greyish or dusky and tipped with black distally; caudal-fin rays darker red or reddish orange, fin membrane relatively pale or translucent, but somewhat darker posteroventrally; pectoral fins reddish, distal markings merging to nearly black, free ray whitish except dusky distally; pelvic fins grey with diffuse darker markings. Attains 7 cm SL.

**DISTRIBUTION** WIO: Seychelles and Saya de Malha Bank.

**REMARKS** Known from 44–125 m.

## *Minous monodactylus* (Bloch & Schneider 1801)

Grey stingfish

PLATE 115

*Scorpaena monodactyla* Bloch & Schneider 1801: 194 [no locality given]; Dor 1984.

*Apistus minous* Cuvier 1829: 168 [footnote] (India).

*Minous woorra* Cuvier *in* Cuv. & Val. 1829: 421.

*Scorpaena biaculeata* Kuhl & Van Hasselt *in* Cuv. & Val. 1829: 424 (Jakarta, Java, Indonesia) [name not available].

*Minous monodactylus*: Cuvier *in* Cuv. & Val. 1829\*; Bleeker 1874;

Day 1875\*; Sauvage 1891; Regan 1905, 1908; Munro 1955\*;

Baissac 1958, 1968; Smith 1958\*; Smith & Smith 1963\*; Eschmeyer *et al.*

1979\*; Dor 1984; SSF No. 149 [key only]; Kuronuma & Abe 1986;

Randall 1995\*; Fricke 1999; Carpenter *et al.* 1997\*.

Dorsal fin 9–11 spines (1st subequal to or longer than 2nd, well-separated), 10 or 11 rays; anal fin 2 spines, 7–10 rays. Percentage SL: HL 36–44%, orbit diameter 10–12%, snout length 13–16%, interorbital width 7–9%, postorbital length 15–19%, pectoral-fin length 36–45%, 1st dorsal-fin spine 7–12%, and 2nd dorsal-fin spine 7–11%. Lachrymal with 2 spines over maxillary, 1st spine points anteroventrally,  $\sim \frac{1}{2}$  length of 2nd spine, which points posteroventrally and has blade-like margin. GR 3 or 4/1/7–11 = 11–16. LL scales 18–20. Vertebrae 25 or 26.

Body grey, pale ventrally; dorsal-fin membranes with oblique pale bars, spine tips black, and soft-rayed portion with large black blotch or spot anteriorly at margin; medial surface of pectoral fins and axil pale, without distinctive spots or markings; lateral surface of pectoral fins, pelvic fins and anal fin black distally; peduncle with dark band just below midline; 2 broad, vertical, dark bars across caudal fin. Attains 11 cm SL.





*Minous monodactylus*, 88 mm SL (India). © JE Randall, Bishop Museum

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan, Persian/Arabian Gulf (Kuwait; Iran), Somalia, Eritrea, Mozambique, Seychelles, Mauritius, Maldives and Sri Lanka; elsewhere to east coast of India, Myanmar, Thailand, Malaysia, Indonesia, Vietnam, Taiwan, China, Japan, Australia and New Caledonia.

**REMARKS** Found inshore, over soft bottom, to ~109 m deep.

### *Minous trachycephalus* (Bleeker 1855)

Striped stingfish

PLATE 115

*Aploactis trachycephalus* Bleeker 1855: 451 (Manado, Sulawesi, Indonesia).

*Minous trachycephalus*: Smith 1950; Frøiland 1972; Eschmeyer *et al.* 1979\*;

Dor 1984; Goren & Dor 1994.

?*Acanthodes fragilis* Fourmanoir & Crosnier 1964: 23, Fig. 14 (Nosy Be, Madagascar) [larvae].

Dorsal fin 10 or 11 spines (1st usually  $< \frac{1}{2}$  length of 2nd, close-set), 8–10 rays; anal fin 1 or 2 spines, 7–9 rays. Dorsal-fin spines moderately strong, but thin and somewhat flexible in smaller specimens. Pectoral fins reach only to middle of anal fin. Lachrymal with 2 spines, neither long; 1st spine points slightly anteroventrally or nearly ventrally; 2nd spine larger and points posteroventrally. Scattered papillae on cheek. GR 2–4/1/6–9 = 9–14. LL scales 15 or 16. Vertebrae 24 or 25.

Body brown dorsally, irregularly separated from orange ventrally; head and snout dark brown, orange below eyes; dorsal fin brown at base, yellow through middle, and orange-brown along margin; pectoral fins brown, with areas of deep yellow. Attains 8 cm SL.



*Minous trachycephalus*, 65 mm SL (Gulf of Thailand).

Source: Eschmeyer *et al.* 1979; courtesy of CAS

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Red Sea, Madagascar (needs confirmation), Maldives, southwestern India and Sri Lanka; elsewhere to Indonesia, Thailand, South China Sea, Philippines, Taiwan, Australia and New Caledonia.

**REMARKS** Found on soft bottom, at 8–82 m.

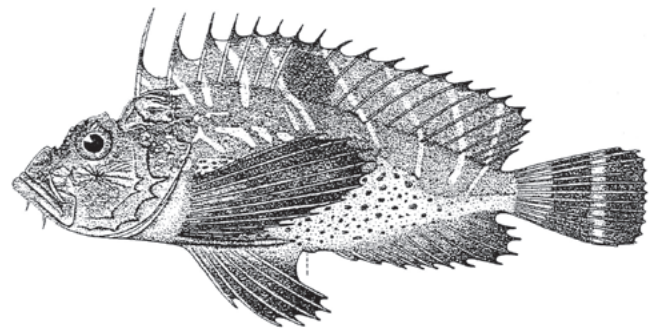
### *Minous usachevi* Mandrytsa 1993

Usachev's stingfish

*Minous usachevi* Mandrytsa 1993: 139 [140 in English translation], Fig. 2 (Gulf of Aden).

Dorsal fin 8 spines, 9 rays; anal fin 2 spines, 9 rays; pectoral fins 11 + 1 free rays. First dorsal-fin spine relatively long, 12–16% SL; 2nd lachrymal spine relatively long, ~3–3.2 length of 1st spine. GR 3/1/10 = 14. LL scales 20. Vertebrae 26.

Preserved specimens pale, with 2 broad, dark, vertical bars on caudal fin (near middle of fin and at margin); no alternating pale and dark stripes or streaks on medial surface of pectoral fins. Attains at least 14 cm SL.



*Minous usachevi*, 138 mm SL, holotype (Gulf of Aden).

Source: Mandrytsa 1993

**DISTRIBUTION** WIO: Gulf of Aden (type locality). Known only from two type specimens collected from Gulf of Aden.

**REMARKS** Taken at 26–33 m.

### GENUS *Pseudosynanceia* Day 1875

Pelvic fins 1 spine, 3 rays. Head size moderate (28–29% SL); mouth strongly upturned. Teeth present on vomer, none on palatines. Skin smooth, without warts, but with acinar glands near bases of dorsal and anal fins. One species.



## *Pseudosynanceia melanostigma* Day 1875

Blackfin stonefish

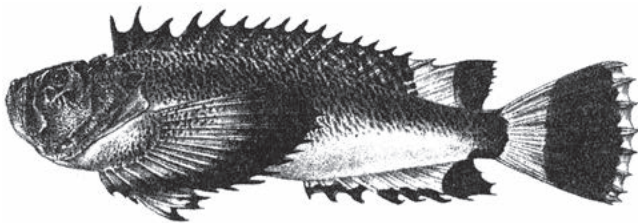
PLATE 115

*Pseudosynanceia melanostigma* Day 1875: 163, Pl. 55, Fig. 6 (Karachi, Sindh, Pakistan); Eschmeyer & Rama-Rao 1973\*; Kuronuma & Abe 1986\*; Randall 1995\*; Carpenter *et al.* 1997.

*Leptosynanceia melanostigma*: Day 1888; Khalaf 1961.

Body relatively elongate; head depressed, without deep pits; mouth superior. Eyes small, on dorsal surface and directed primarily dorsally; interorbital space broad. Dorsal fin 15–17 spines (all spines nearly subequal), 4–6 rays; anal fin 3 spines, 7 or 8 rays; pectoral fins 14 or 15 rays. All fin rays unbranched; last ray of dorsal and anal fins not split to base. Lachrymal with 2 blunt spines that extend over maxilla. Preopercle with 4 prominent spines, uppermost largest; other head spines form weak ridges. Base of dorsal fin (below more posterior spines and rays) with row of 7–9 pores that drain acinar glands; a few pores (1–3) that drain acinar glands above base of anal fin. GR 1–3/1/5 or 6 = 7–9. LL scales 10–15 (evident as pores). Vertebrae 26 or 27.

Head and body brown, grey or nearly black, with dark stippling, especially on dorsum, and pale ventrally; paler yellow markings on fins; anal fin almost uniformly dark brown or black, especially posteriorly; pectoral fins with broad nearly black margin, medial surface yellow, with a few dark specks; pelvic fins pale yellow proximally, nearly black distally, with pale tips; caudal fin with narrow pale margin, broad dark submargin. Attains 18 cm SL.



*Pseudosynanceia melanostigma* (India). Source: Day 1875

**DISTRIBUTION** WIO: Persian/Arabian Gulf to west coast of India.

**REMARKS** Known from over soft muddy bottom, in estuaries and offshore, to ~15 m deep.

**GENUS** *Synanceia* Bloch & Schneider 1801

Stonefishes

Pelvic fins 1 spine, 4 or (usually) 5 rays. Head large, HL 38–43% SL. Head and body with numerous ‘warts’

Minute teeth on jaws and vomer (may be absent on vomer in large specimens of some species); no teeth on palatines. Six species, 3 in WIO.

## *Synanceia horrida* (Linnaeus 1766)

Estuarine stonefish

PLATE 116

*Scorpaena horrida* Linnaeus 1766: 453 (Ambon I., Moluccas, Indonesia); Lacepède 1801; Desmarest 1874.

*Perca alepidota*: Gronow 1772.

*Scorpaena alepidota*: Bloch 1787, 1788.

*Scorpaena horrida*: Bloch 1787.

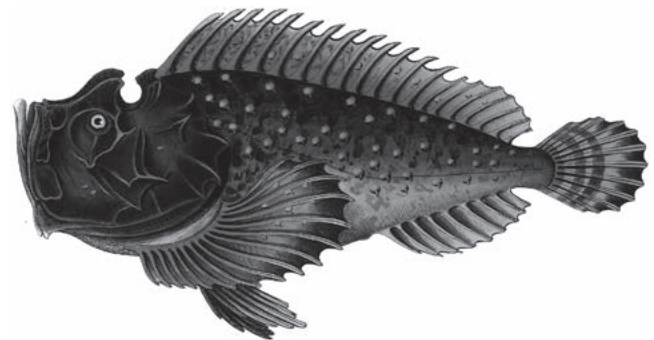
*Synanceia horrida*: Bloch & Schneider 1801; Day 1875; Thorson 1971.

*Scorpaena monstrosa* Gronow in Gray 1854: 117 (Bay of Bengal).

*Synanceia horrida*: Eschmeyer & Rama-Rao 1973\*; Eichler & Lieske 1994\*.

Dorsal fin 8–14 spines, 6½ rays; anal fin 2 or 3 spines, 5½ rays; pectoral fins 15–17 rays. Dorsal-fin spines covered by thickened skin and nearly subequal, but 2nd–4th slightly longest. Anal-fin spines progressively large posteriorly. All fin rays typically branched in larger specimens. Head large and depressed, with deep pits, including deep pits beneath eyes and beneath parietal and nuchal spines. Eyes elevated, joined via a transverse ridge, and postorbital spine forming bony crest at posterodorsal corner of orbit; occiput depressed, forming distinctive deep saddle-like depression behind eyes. Lachrymal with broad, spinous, ventrally directed point, and with lateral ridges that point anteriorly. Preopercle margin with 3 spines, upper 2 subequal, supplemental preopercle spine present as lump at base of uppermost spine; most other head spines indistinct or present as lumps. Body covered with thick skin and warty tubercles, with embedded acinar glands. GR 5 or 6/1/7 or 8. LL scales 10–12. Vertebrae 24.

Body predominantly drab brown, occasionally with scattered bits of cream or yellowish markings, particularly on body warts, soft-rayed portion of dorsal fin, anal-fin rays, and anterior part of peduncle and caudal fin. Attains at least 19 cm SL (Halstead *et al.* [1990] reported specimens of 60 cm TL).



*Synanceia horrida*. Source: Bloch & Schneider 1801

**DISTRIBUTION** Indo-Pacific. WIO: Sri Lanka and possibly Lakshadweep; elsewhere widespread to east coast of India, Thailand, Indonesia, Philippines, China, New Guinea and northern Australia.

**REMARKS** Found in shallow waters, such as in lagoons and estuaries, on coastal reefs, and over sandy or muddy bottom among rubble and rocks. Well-camouflaged and highly venomous.

### *Synanceia nana* Eschmeyer & Rama-Rao 1973

Red Sea stonefish

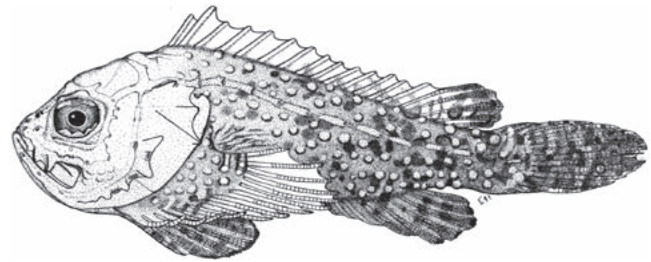
PLATE 115

*Synanceia nana* Eschmeyer & Rama-Rao 1973: 343, Figs. 1–2 (El Himeira, Egypt, Gulf of Aqaba, Red Sea); Dor 1984; Eschmeyer 1986; Randall 1995\*; Carpenter *et al.* 1997.

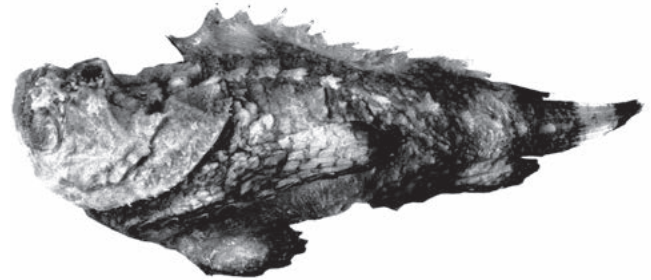
?*Synanceja horrida* (*non* Linnaeus 1766): Bleeker in Pollen & Van Dam 1874; Sauvage 1891.

Dorsal fin 14 or 15 spines (stout, nearly subequal), 5 rays; anal fin 3 spines, 4–6 rays; pectoral fins 14–16 rays. All rays unbranched. Eyes elevated and directed dorsolaterally, with deep depression between; interorbital width 10–16% SL; occiput with rectangular depression in adults, not depressed in small juveniles. Lachrymal with 2 or 3 blunt spines that point ventrally over orbit, posteriormost largest, and anterior 1 or 2 spines forming slight blunt lumps on anterior margin. Preopercle with 4 short spines, uppermost largest, with small supplemental spine; most other head spines poorly developed as blunt lumps or ridges. Minute teeth on jaws and vomer; smaller fish with only a few teeth, ~10 teeth in larger specimens, typically in 2 widely separated clusters. Ventral margin of eye with 3 or 4 fleshy, relatively conical cirri. Body covered with large fleshy warty tubercles that typically bear a minute pore-like duct near their apex; typically fewer and smaller tubercles on breast and belly; head with a few warty tubercles behind eyes and on cheek; flanks medial to pectoral fins relatively devoid of large warty tubercles. All dorsal-fin spines with thick skin covering venom glands. GR 0–2/1/6 or 7. LL scales 9 + 1 to 11 + 1. Vertebrae 24 or 25.

Colour in life evidently variable, brownish and/or reddish; darker on dorsum than on ventrum. Attains at least 10.5 cm SL.



*Synanceia nana*, 9 mm SL, juvenile (S Mozambique).



*Synanceia nana*, 73 mm SL, holotype (Red Sea).

Source: Eschmeyer & Rama-Rao 1973 (by KP Smith); courtesy of CAS

**DISTRIBUTION** WIO: Persian/Arabian Gulf, Red Sea and Mozambique (post-settlement juvenile).

**REMARKS** Found inshore, at 3–10 m. The variable colour may imitate the growth of algae on the skin which further camouflages this already cryptic species. Some records of *S. horrida* may be this species rather than *S. verrucosa* as suggested by Smith (1958).

### *Synanceia verrucosa* Bloch & Schneider 1801

Stonefish

PLATE 116

*Synanceia verrucosa* Bloch & Schneider 1801: 195, Pl. 45 (India);

Rüppell 1838; Günther 1860, 1874; Playfair 1868; Bleeker 1874, 1879\*; Day 1875\*, 1878; Peters 1883; Sauvage 1891; Pfeffer 1893; Gudger 1929; Fourmanoir 1957; Halstead 1970\*; Eschmeyer & Rama-Rao 1973\*; Randall 1983, 1995\*; Dor 1984; SSF No. 149.46\*; Cornic 1987; Winterbottom *et al.* 1989; Fischer *et al.* 1990\*; Eichler & Lieske 1994\*; Goren & Dor 1994; Carpenter *et al.* 1997\*; Khalaf & Disi 1997\*; Winterbottom & Anderson 1997; Field & Field 1998\*; Fricke 1999; Heemstra *et al.* 2004; Heemstra & Heemstra 2004\*; Field 2005; Gillibrand *et al.* 2007.

*Synanceja verrucosa*: Bloch & Schneider 1801; Klunzinger 1870, 1884;

Baird 1872; Günther 1874; Bamber 1915; Smith 1949\*, 1950\*, 1951, 1957, 1958\*; Fourmanoir 1953.

*Scorpaena bicapillata* Shaw 1803: 273 [objective synonym of *Scorpaena bicirrata* Lacepède 1801]; Cuvier in Cuv. & Val. 1829.

*Synanceia brachio* Cuvier in Cuv. & Val. 1829: 447 (Mauritius, Mascarenes; Strong I. and Waigeo, Indonesia); Guichenot 1863.

*Synanceichthys verrucosus*: Smith 1958\*; Smith & Smith 1963; Baissac 1968.

Mouth strongly upturned, capacious; interorbital space broad, with deep depression. Dorsal fin 12–14 spines (spines 3–5 longest, covered with thick skin), 5½–7½ rays; anal fin 3 spines, 5½ or 6½ rays; pectoral fins enormous, with 17–19 broad, branched, fleshy rays. Head with U-shaped pit anteroventral to orbit; pit behind each eye lateral to occiput, deepest ventral to parietal and nuchal ridge; occiput without pit. Lachrymal covered with thick skin, usually with 2 divergent spines that extend over maxilla. Preopercle with 2 or 3 spines, usually without supplemental spine; other head spines indistinct, developed as blunt ridges, or absent. Minute teeth on jaws, none on vomer or palatines. Body with numerous warts, rugosities and bumps; no scales, except some deeply embedded vestigial scales primarily above lateral line just behind head. GR 1–4/1/5–7. LL scales 8–10, visible as pores only. Vertebrae 24.

Body excellently camouflaged, typically covered with algae and small organisms; colour variable, in an irregular pattern that mimics the surrounds almost perfectly, often with mottling of brownish green, yellow, orangish brown or reddish brown. Attains 37 cm SL.



*Synanceia verrucosa*, 37 cm SL (Mauritius). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Indo-Pacific (the most widespread stonefish). WIO: Gulf of Aqaba, Red Sea to South Africa (Eastern Cape), Madagascar, Seychelles, Mascarenes, Chagos, India and Sri Lanka; elsewhere to Indonesia, Philippines, Japan, Marshall Is., New Guinea, Australia, New Caledonia, Society Is. and Tuamotu Is.; not known from Hawaii.

**REMARKS** The most venomous fish. Found inshore, to ~20 m deep; not uncommon in shallow waters of coral reefs, on coral rubble, under ledges and frequently buried in sand. Sedentary ambush predator feeding mostly on fishes.

## GLOSSARY

**acinar glands** – glands formed by a cluster of cells, looking a bit like a raspberry.

**adnate** – joined from having grown together.

## FAMILY APISTIDAE

### Bearded waspfishes

Stuart G Poss

Body elongate, moderately robust, and scaly. Dorsal fin 13–16 spines, 6½–10½ rays; anal fin 3 or 4 spines, 5½–8½ rays; pectoral fins 1 + 9–12 rays; pelvic fins 1 spine, 5 rays. Head large, head bones broad, close-set, rugose, with numerous short projections. Lachrymal bone moveable, with 2 pungent spines: 1st spine small, 2nd spine straight and relatively long (~2.2–5.6 in SL). No pronounced notch separating ascending process of premaxilla from rest of bone. Lateral-line pores of head numerous, small, close-set and broadly scattered. Swimbladder musculature extrinsic in young, intrinsic in adults.

The relationships of this clade have been studied by Matsubara (1943), Ishida (1994), Mandrytsa (2001) and Imamura (2004), but none of the shared derived features used to characterise the family appear to be uniquely derived, all of them appearing in other scorpaenoids. Three monotypic genera: *Apistops*, *Apistus* and *Cheroscorpaena*; 1 species in WIO.

## GENUS *Apistus* Cuvier 1829

Distinguished by lowermost pectoral-fin ray free from remainder of fin; simple, elongate barbel at symphysis of lower jaw, with similar additional pair slightly further back; membrane over 3rd mandibular perforated with numerous small openings (opening not a single large pore); small slit behind last hemibranch. One species.

### *Apistus carinatus* (Bloch & Schneider 1801)

Ocellated waspfish

PLATE 116

*Scorpaena carinata* Bloch in Bloch & Schneider 1801: 193 (Tharangambadi, India).

*Apistus alatus* Cuvier in Cuv. & Val. 1829: 392 (Puducherry, India); Klunzinger 1884; Day 1875.

*Apistus israelitarum* Cuvier (ex Ehrenberg) in Cuv. & Val. 1829 (El Tur, Sinai Peninsula, Egypt, Red Sea); Klunzinger 1870.

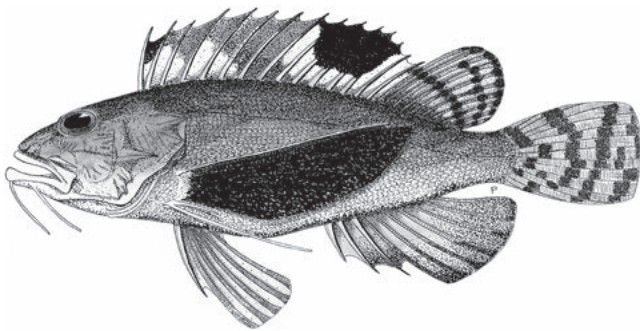


*Apistus faurei* Gilchrist & Thompson 1908: 176 (off Umhlanga River mouth, KwaZulu-Natal, South Africa).

*Apistus carinatus*: Smith 1957; Dor 1984; Kuronuma & Abe 1986; SSF No. 149.1\*; Fischer *et al.* 1990; Carpenter *et al.* 1997; Kapoor *et al.* 2002; Manilo & Bogorodsky 2003; Bogorodsky *et al.* 2014.

Dorsal fin 13–16 spines, 6½–10½ rays; anal fin 3 or 4 spines, 5½–8½ (usually 7½) rays; pectoral fins 1 + 9–12 rays; GR 17–23. Elongate barbel near lower jaw symphysis, typically followed by pair of barbels between 2nd and 3rd mandibular pores. Scales on body usually with pointed posterior margin; LL scales 23–31; LSS 52–66. Vertebrae 26 or 27.

Head and body usually dusky brown or bluish grey, belly pale; pectoral fins typically pale green with yellow spots on upper surface, black or nearly so on lower surface; large black ocellus on dorsal fin, usually between spines 9–12; scattered dark spots on soft-rayed portion of dorsal fin, caudal fin, as well as anal fin (but usually more diffuse and less numerous). Attains 12.5 cm SL, 16.5 cm TL.



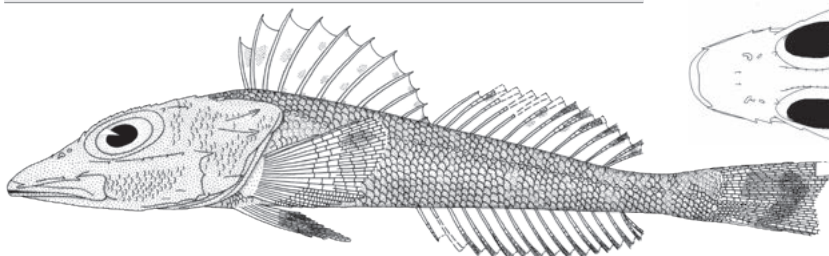
*Apistus carinatus*, 13 cm TL (South Africa). Source: SFSA

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf, Gulf of Oman, Red Sea to South Africa (KwaZulu-Natal), Madagascar and India; elsewhere to east coast of India, South China Sea, southern Japan, New Guinea and Australia.

**REMARKS** Demersal, on continental shelf. The fin spines are extremely venomous. Caught in trawls over soft bottom, to ~60 m deep.

#### GLOSSARY

**hemibranch** – a gill with filaments only on one side of gill arch.



## FAMILY BEMBRIDAE

### Deepwater flatheads

Leslie W Knapp

Body elongate, head slightly depressed; bony ridges on head bearing spines, including a sharp preocular spine; no large bony scutes on body. Jaws subequal or lower jaw slightly shorter than upper jaw. Mouth large; fine teeth on jaws, vomer and palatines. Two narrowly separated dorsal fins: 1st dorsal fin with 9–11 spines; 2nd dorsal fin with 1 spine, 10–11 (usually 11) soft rays; pectoral fins lack free rays; pelvic fins 1 spine, 5 rays, and fins close-set below pectoral-fin bases; anal fin 13–15 rays. Iris lappet not developed; no ocular or interopercle flaps. Branchiostegal rays 7; gill membranes free from isthmus. Lateral line complete; LL pored scales 52–56, pores with single opening to exterior. No swimbladder. Vertebrae 27. Occur in Indo-Pacific, at ~80–350 m. One genus, *Bembras* Cuvier 1829, with 7 species (Imamura *et al.* 2018); 1 species in WIO.

#### GLOSSARY

**iris lappet** – a fleshy flap-like structure in the eye, which can be short and rounded, simple or branched.

### *Bembras adenensis* Imamura & Knapp 1997

#### Aden deepwater flathead

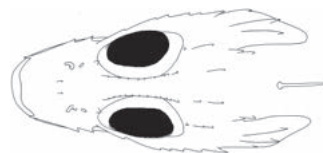
*Bembras adenensis* Imamura & Knapp 1997: 10, Fig. 1 (Gulf of Aden);

Imamura & Knapp 1998; Manilo & Bogorodsky 2003.

*Bembras japonicus*: Knapp 1979\*.

First dorsal fin 11 spines; pectoral fins 19 rays; LL pored scales 54 or 55, anteriormost 4–6 scales with distinct spine; GR 3/10 or 11 = 13 or 14. HL 2.4–2.6 in SL; eye diameter 3.2–3.4 in HL; interorbital width 4.9–5.6 in eye diameter.

Body probably reddish orange in life. Preserved specimens with pale brown dorsum, with a few smaller dark spots, and dorsal fins with series of small brown spots; pectoral fins with small black spot near tip of upper rays; pelvic fins and anal fin pale; caudal fin with broad submarginal black band. Attains 25 cm SL.



*Bembras adenensis*, 15 cm SL, holotype, and dorsal head (Gulf of Aden).

Source: Imamura & Knapp 1997



**DISTRIBUTION** Known only from four specimens from Gulf of Aden.

**REMARKS** Trawled from ~225 m.

## FAMILY PARABEMBRIDAE

### Parabembrids

Leslie W Knapp

Body fusiform, head moderately depressed; dorsal surface of head with spines but no tubercles; rear edge of opercle with 2 sharp points; suborbital ridge with 4–6 spines (1 on preorbital bone, 2 or 3 below eye, 1 or 2 on angle of preopercle); supraorbital ridge coarsely serrate. Two dorsal fins: 1st dorsal fin with 9–11 heteracanth spines, last spine short and hidden by scales; 2nd dorsal fin with 1 long spine, 7 branched rays (last ray split to its base); anal fin 3 spines, 5 branched rays, fin below 2nd dorsal fin; pectoral fins 19–21 rays (none free); pelvic fins 1 spine, 5 branched rays, fin origins in front of lower end of pectoral-fin bases; fin spines with longitudinal ridges and grooves. Minute teeth on jaws, vomer and palatines; rear edge of maxilla fits into groove below suborbital ridge; ascending process of premaxilla autogenous; lower jaw prognathous, teeth at front exposed when mouth is closed. Branchiostegal rays 7, membranes free from isthmus. Lateral line complete; first 3 LL scales each with retrorse spine. Scales large, ctenoid. No swimbladder.

Occur in Indo-Pacific, on outer continental shelf. One genus, *Parabembras* Bleeker 1874, with 2 species; 1 species in WIO. Genus previously included in the family Bembridae.

### *Parabembras robinsoni* Regan 1921

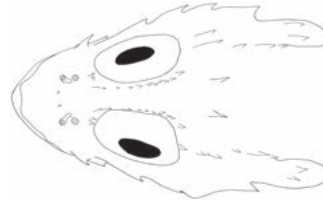
Rosy flathead

PLATE 116

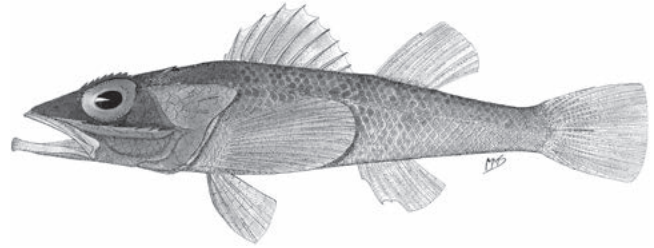
*Parabembras robinsoni* Regan 1921: 418 (off Umvoti River, KwaZulu-Natal, South Africa); SSF No. 154.1\*.

Diagnosis as for family. HL 2.4–2.5 in SL; body depth 5.1–5.2 in SL; eyes large, diameter longer than snout, and close-set, interorbital width ~5 in eye diameter. GR 5–8½/13–17; LL scales 38–41; suborbital ridge with 4 or 5 spines, preceded by large spine on lachrymal, and ridge terminating at preopercle spines; supraorbital ridge coarsely serrate.

Head, body and fins reddish; tips of median-fin rays black; small white V-shaped mark on head. Attains 24 cm TL.



*Parabembras robinsoni*, 16 cm SL, dorsal head (South Africa).  
Source: SSF



*Parabembras robinsoni*, 20 cm TL (South Africa). Source: SSF

**DISTRIBUTION** WIO: Mozambique (Beira) to South Africa (KwaZulu-Natal).

**REMARKS** Trawled from ~200–600 m.

#### GLOSSARY

**autogenous** – independently generated; without external influence.

**heteracanth spines** – asymmetrical dorsal-fin spines, with either the right or left side thickened.

**prognathous jaw** – the lower jaw protruding in front of the upper jaw.

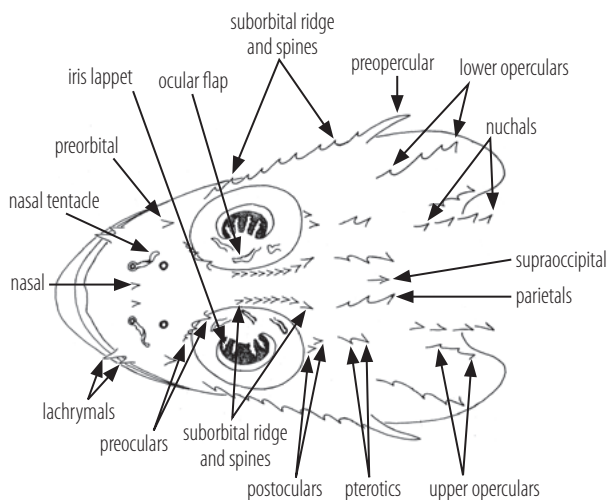
**retrorse (spines)** – pointing or curved backward.

## FAMILY PLATYCEPHALIDAE

## Flatheads

Leslie W Knapp

Body elongate, head moderately to strongly depressed, and bony ridges of head usually bearing spines or serrations. Eyes dorsal, variously constricted by simple or intricate finger-like extensions of the iris. Mouth large, lower jaw slightly projecting, and ascending process of premaxilla a separate ossification. Small villiform or canine teeth on jaws, vomer and palatines of most species, stout canines present in a few. Branchiostegal rays 7; gill membranes free from isthmus; gill rakers few, short or mere rudiments. Two well-separated dorsal fins: 1st dorsal fin 6–10 spines, 1st spine short and scarcely connected to 2nd spine; 2nd dorsal fin and anal fin similar and opposite, each with 10–15 rays (no anal-fin spines), last rays double (split to base but counted as single ray); pelvic fins thoracic, behind pectoral-fin bases, set far apart towards sides of body, with 1 spine, 5 rays; caudal fin truncate or rounded, with 8–12 branched rays. Scales ctenoid dorsally, cycloid ventrally; lateral line complete, most species with small spine or ridge on first few LL scales. Vertebrae 27 (usually 11 + 16, or 12 + 15). Adults usually dark dorsally and pale ventrally, dark mottling of various shades of brown, grey or black, but brighter hues of reddish, purplish or greenish in some. Lateral scale series (LSS) are the oblique scale series running dorsoposteriorly above the lateral line from gill opening to caudal-fin base; diagonal scale count (DSC) is the number of scales downward and backwards from origin of 2nd dorsal fin to lateral line. Gill-raker (GR) counts are of total developed rakers (upper + lower limbs) and do not include rudiments.



Head spine and ridge names. Few species have all the spines shown here, and the lower preopercular spines are not shown in this diagram.

Occur primarily in the Indo-Pacific. Found on the continental shelf, to ~300 m deep (most species at 10–100 m), frequently on mud or sand bottom, but some species are associated with rocky shores or coral reefs. Sedentary, benthic predators that feed on fishes and crustaceans. Some species are excellent food fish, with a few attaining >70 cm TL, and of economic importance particularly in Australia.

Approximately 17 genera and 80 species; 12 genera and possibly 37 species in WIO, at least 16 endemic to the region. The valuable classification of Imamura (1996) is followed here except for retaining the genus *Sorsogona*.

## KEY TO GENERA

1a LL scales 68–82; teeth on vomer in 1 transverse patch; 2nd dorsal fin usually 13 or 14 rays ..... *Platycephalus*

1b LL scales 28–60; teeth on vomer in 2 separate patches; 2nd dorsal fin usually 11 or 12 rays ..... 2

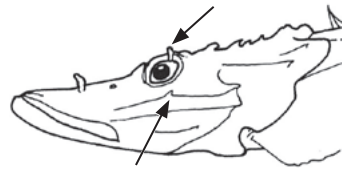
vomerine tooth patches



2a LL scales 28–40 ..... *Onigocia*

2b LL scales 48–60 ..... 3

3a Bony ridges above and below eyes mostly smooth; small spine under rear of eyes; finger-like papilla on upper part of eyes ..... *Papilloculiceps*



3b Bony ridges above and below eyes bearing spines or serrae ..... 4

4a Pectoral fins black with pale central area, rear edge concave; 2nd spine of dorsal fin much shorter than 3rd spine ..... *Kumococius*

4b Pectoral-fin colour not as above, rear edge of fins convex (except concave in *Rogadius welanderi*) ..... 5

5a LSS 54–76, more numerous than LL scales ..... *Cociella*

5b LSS usually 50–54, about equal to number of LL scales ..... 6

Continued ...

**KEY TO GENERA**

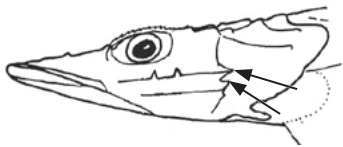
- 6a Almost all LL scales with strong backwardly directed spine, tips of some spines extending well beyond scale margin; LL scale tube with single opening to exterior ..... *Grammoplites*
- 6b LL scales with weak spines anteriorly on body, and without spines on rear third of body (except *Sorsogona portuguesa* with all LL scales bearing 1 or 2 stout spines); LL scale tubes with 2 openings to exterior ..... 7

- 7a Uppermost preopercular spine long, bayonet-like, reaches to or past opercle margin; head rugose, with large exposed bony plates bearing spines or tubercles ..... *Suggrundus*



- 7b Uppermost preopercular spine not reaching opercle margin; head without exposed bony plates but with bony ridges bearing spines or serrae ..... 8

- 8a Upper 2 preopercular spines short, subequal; iris lappet with long finger-like branches ..... *Inegocia*



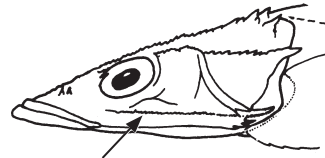
- 8b Uppermost preopercular spine distinctly longer than 2nd spine; iris lappet bilobed, crenate or with short branches ..... 9

- 9a Ridges on head finely serrate (no larger spines); lowermost preopercular spine antrorse (minute in *R. serratus* and *R. welanderi*); lower edge of suborbital bone turned inwards, not readily visible, hence a single horizontal ridge across cheek ..... *Rogadius*



- 9b Lower edge of preopercle without antrorse spine; lower edge of suborbital bone readily visible on outer side of head, hence 2 horizontal ridges across cheek ..... 10

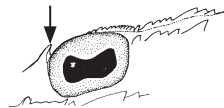
- 10a GR 8–17 on 1st arch (GR 7 in some *Sorsogona tuberculata*); suborbital ridge with many small spines or serrae ..... *Sorsogona*



- 10b GR 5 or 6 (rarely 7) on 1st arch; suborbital ridge with ~6–9 large spines or ~25 small spines ..... 11

- 11a Cheeks with only a few sensory tubules; preorbital spines rarely present; suborbital ridge with ~4–9 larger spines plus numerous fine serrations ..... *Sunagocia*

- 11b Cheeks completely covered with sensory tubules; 1 or more preorbital spines usually present ..... *Thysanophrys*



**GENUS *Cociella*** Whitley 1940

Iris lappet a simple lobe or slightly bilobed; anterior nostrils with elongate flap posteriorly. LL scales 52–55, first 1–19 scales with small spine; LSS 54–91; LL tubes with single opening to exterior. Suborbital ridge with 2 spines: below middle of eye, and below rear edge of eye; 1 preorbital spine; 1 preopercular spine. Five species, 3 in WIO.

**KEY TO SPECIES**

- 1a GR 6 or 7; 2nd dorsal fin and anal fin usually 11 rays; head and dorsum with small dark spots, and 4 or 5 dark saddle blotches on body ..... *C. punctata*

- 1b GR 9–18; 2nd dorsal fin and anal fin usually 12 rays; body often with dark spots dorsally, but usually no dark saddle blotches ..... 2

- 2a GR 9–11; body grey or brown dorsally; caudal fin dusky with small dark spots on upper half, and central rear part of fin yellow to dusky yellow ..... *C. heemstrai*

- 2b GR 12–18; body greyish or brownish dorsally, usually with a few dark spots; caudal-fin background pale, with large dark spots and dark horizontal bars ..... *C. somaliensis*

*Cociella heemstrai* Knapp 1996

Yellowtail flathead

PLATE 117

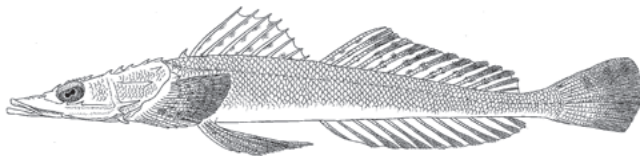
*Platycephalus malabaricus* (non Cuvier 1829): Gilchrist & Thompson 1909.*Platycephalus tentaculatus* (non Rüppell 1838): Fowler 1925.*Platycephalus crocodilus* (non Tilesius 1814): Barnard 1927 [in part];  
Fowler 1934 [in part]; Smith 1950 [in part].*Cociella* sp.: SSF No. 155.2\*; Smale *et al.* 1995\* [otoliths].*Cociella heemstrai* Knapp 1996: 27, Figs. 6–7 (Kenya); Imamura 1996;  
Heemstra *et al.* 2004; Heemstra & Heemstra 2004.

First dorsal fin 1 + 8 or 9 spines; 2nd dorsal fin 11 or 12 rays; anal fin 11–13 rays; pectoral fins 19–22 rays. Interorbital width 1.8–3.4 in orbit diameter; HL 2.8–3.3 in SL. Supraorbital ridge smooth anteriorly, bearing 5–7 spines over rear half of eye; upper preopercular spine reaching nearly to opercle margin; interopercle with narrow, elongate flap. GR 9–11. LL scales 52–55, first 3–19 scales with weak spines.

Head and body greyish or brownish, sometimes with small dark spots; 3 or 4 blackish spots on each interspinous dorsal-fin membrane; each dorsal-fin ray with 3 or 4 black or reddish brown spots; pectoral fins with dark spots; caudal fin dusky with dark blotches near upper margin, often with yellow area near middle or distal half of fin. Attains ~30 cm TL.



*Cociella heemstrai*, 12 cm TL,  
dorsal head (South Africa).  
Source: SSF



*Cociella heemstrai*, 17 cm SL (Kenya).

Source: Knapp 1996; © *Proc. Biol. Soc. Wash.*, Allen Press Publ. Services

**DISTRIBUTION** WIO: Kenya to South Africa (KwaZulu-Natal) and Madagascar.

**REMARKS** Caught with seines in estuaries; trawled to ~280 m deep.

*Cociella punctata* (Cuvier 1829)

Spotted flathead

PLATE 117

*Platycephalus punctatus* Cuvier in Cuv. & Val. 1829: 243 (Trincomalee,

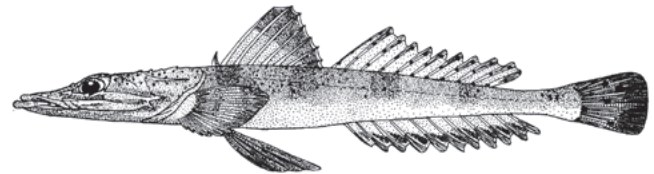
Sri Lanka; Vanikoro I., Solomon Is.); Sauvage 1875\*; Day 1876\*;

Gilchrist &amp; Thompson 1917.

*Platycephalus malabaricus* Cuvier in Cuv. & Val. 1829: 245 (Mahé, India);  
Gilchrist & Thompson 1909.*Platycephalus crocodilus* (non Tilesius 1814): Barnard 1927 [in part];  
Fowler 1934; Smith 1950 [in part]; Fourmanoir 1957; Fourmanoir &  
Guézé 1963; Jones & Kumaran 1980\*; Talwar & Kacker 1984.*Thysanophrys crocodilus* (non Tilesius 1814): Munro 1955\*.*Suggrundus crocodilus* (non Tilesius 1814): Murty 1982\*.*Cociella crocodila* (non Tilesius 1814): Dor 1984; Knapp 1984\*;Bianchi 1985\*; SSF No. 152.2\*; Baranes & Golani 1993\*; De Bruin *et al.*  
1995; Randall 1995\*; Smale *et al.* 1995\* [otolith]; Fricke 1999.*Cociella punctata*: Knapp 1996\*; Manilo & Bogorodsky 2003;  
Heemstra *et al.* 2004; Heemstra & Heemstra 2004.

First dorsal fin 9 or 1 + 8 spines; 2nd dorsal fin 11 or 12 rays; anal fin 11 or 12 rays; pectoral fins 19–22 rays. Interorbital width 1.7–4.4 in orbit diameter; HL 2.6–3.1 in SL. Supraorbital ridge smooth anteriorly, with 10–14 spines posteriorly; suborbital ridge with 1 spine below middle of eye, 1 spine below rear edge of eye, plus 2 spines behind eye; upper preopercular spine reaching about halfway to opercle margin; interopercular flap small. GR 6 or 7. LL scales 52–55, first 1–16 scales bearing weak spine.

Head and body brownish, with 4–6 faint dark bars dorsally on body, but small juveniles with broad dark zone from just behind head to 2nd dorsal-fin origin; numerous small dark spots reaching to below lateral line, more scattered posteriorly; 1st dorsal fin with broad submarginal dark band; 2nd dorsal fin with 2–4 dark spots on each ray; pectoral fins spotted on upper half, with dusky area just below; pelvic fins blackish distally; caudal fin dusky with dark spots or horizontal streaks. Attains ~50 cm TL (commonly 25 cm TL).



*Cociella punctata*, ~42 cm SL. Source: Knapp 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Red Sea to South Africa (KwaZulu-Natal), Madagascar, Comoros, Seychelles, southwestern India and Sri Lanka; elsewhere to Indonesia, Philippines, Taiwan, New Caledonia and Vanuatu.

**REMARKS** Fowler (1934) reported a specimen of 72 cm TL. Taken by seine or ichthyocide in shallow depths and by trawl or traps; found to ~300 m deep.



## *Cociella somaliensis* Knapp 1996

Spot-tail flathead

PLATES 117 & 118

*Cociella somaliensis* Knapp 1996: 29, Fig. 8 (south of Ras Hafun, Somalia); Manilo & Bogorodsky 2003.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 rays; anal fin 11–13 rays; pectoral fins 19–22 rays; caudal fin 11 or 12 rays. Interorbital width 1.3–1.8 in orbit diameter; HL 3.1–3.4 in SL. Supraorbital ridge smooth anteriorly, with 5–7 small spines posteriorly; upper preopercular spine curved slightly upward, reaching to or beyond opercle margin. Interopercular flap narrow, elongate. GR 12–18. LL scales 52–55, first 6–15 scales bearing weak spines.

Body buff dorsally, usually with scattered small dark spots; dorsal fin with large dark spots, and distinct black spots on rays; pectoral fins dusky; caudal fin pale, with bold dark spots and bars. Attains ~35 cm TL.



*Cociella somaliensis*, 22 cm SL, holotype, dorsal view. Source: Knapp 1996 (by SJ Raredon, USNM); © Proc. Biol. Soc. Wash., Allen Press Publ. Services

**DISTRIBUTION** WIO: Somalia, Oman and Pakistan.

**REMARKS** Trawled from 30–49 m.

## GENUS *Grammoplites* Fowler 1904

All or most LL scales with backward-directed spine and all with single opening to exterior; sensory tubes on cheeks not developed. Tubercles either present on head (*G. suppositus*) or absent (*G. knappi*, *G. scaber* and *G. vittatus*); suborbital ridge usually with  $\geq 4$  distinct spines; no ocular and interopercular flaps. Iris lappet simple (rarely slightly bilobed in *G. suppositus*). Four species, 3 in WIO (*G. knappi* Imamura & Amaoka 1994 is found in the eastern Indian Ocean).

### KEY TO SPECIES

- |    |  |                      |
|----|--|----------------------|
| 1a | Posteriormost LL scales usually without spine; upper preopercular spine reaching past opercle margin; anal fin 13 rays; black blotch at rear of 1st dorsal fin ..... | <i>G. suppositus</i> |
| 1b | All LL scales with spine; upper preopercular spine shorter, not reaching opercular edge; anal fin 12 rays .....  | 2                    |

Continued...

### KEY TO SPECIES

- |    |   |                    |
|----|---|--------------------|
| 2a | GR 5 or 6 (rarely 7); interorbital width usually 9–13% HL ..... | <i>G. scaber</i>   |
| 2b | GR 7 or 8; interorbital width 5–10% HL .....                    | <i>G. vittatus</i> |

## *Grammoplites scaber* (Linnaeus 1758)

Rough flathead

PLATE 118

*Cottus scaber* Linnaeus 1758: 265 [probably East Indies]; Bloch 1786.

*Platycephalus scaber*: Bloch & Schneider 1801\*; Sauvage 1873\*; Day 1876\*; Khalaf 1961; George 1970\*; Talwar & Kacker 1984\*.

*Platycephalus neglectus* Troschel 1840: 272 [no locality given].

*Platycephalus americanus* Sauvage 1878: 148, Pl. 2, Fig. 3 ('Potomac River' [Indo-Pacific]).

*Grammoplites scaber*: Fowler 1904; Munro 1955\*; Murty 1982\*;

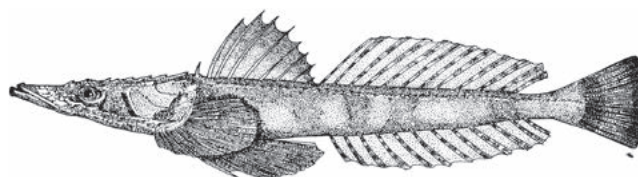
Kuronuma & Abe 1986; De Bruin *et al.* 1995\*; Randall 1995\*;

Carpenter *et al.* 1997\*; Imamura 1997; Knapp 1999\*; Manilo &

Bogorodsky 2003.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 rays; anal fin 12 rays; pectoral fins 19–21 rays. Interorbital width 1.4–6 in orbit diameter; orbit diameter 3.8–5.8 in HL; HL 2.9–3.4 in SL. Supraorbital ridge with ~6–8 spines; 1 preocular spine; suborbital ridge usually with 1 spine in front of eye, 1 spine under middle of eye, 1 spine under rear edge of eye, and 3 or 4 spines behind eye; upper preopercular spine reaches about halfway to opercle margin. GR 6 or 7. LL scales 52–54.

Body brownish dorsally, often with 4 or 5 faint dark saddle bars; 1st dorsal fin with broad submarginal dark band; 2nd dorsal fin, anal fin and pectoral fins with dark spots on rays; caudal fin with submarginal and basal dark band, dark spots near upper edge. Attains 30 cm TL.



*Grammoplites scaber*. Source: Knapp 1999; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Oman to Persian/Arabian Gulf, India and Sri Lanka; elsewhere to Malaysia, Indonesia, Hong Kong and Philippines.

**REMARKS** Trawled from over sand and mud; found to ~55 m deep.

*Grammoplites suppositus* (Troschel 1840)

Spotfin flathead

PLATE 118

*Platycephalus suppositus* Troschel 1840: 269 [Mumbai, India]; Talwar & Kacker 1984\*; Paepke & Fricke 1992.

*Platycephalus maculipinna* Regan 1905: 323, Pl. 1a, Fig. 3 (Muscat, Oman, Gulf of Oman); Blegvad & Løppenthin 1944\*; Dor 1970\*; George 1970\*; Randall *et al.* 1978\*; Sivasubramaniam & Ibrahim 1982\*.

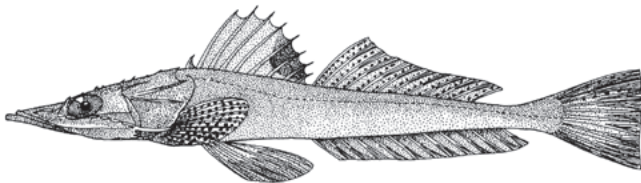
*Grammoplites maculipinna* (*non* Regan 1905): Murty 1982.

*Grammoplites suppositus*: Knapp 1979\*, 1984\*; Dor 1984; Bianchi 1985\*; De Bruin *et al.* 1995\*; Randall 1995\*; Carpenter *et al.* 1997\*; Manilo & Bogorodsky 2003.

*Repotrudis rodericensis* (*non* Cuvier 1829): Kuronuma & Abe 1986.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 or 13 rays; anal fin 13 rays; pectoral fins 21–23 rays. Interorbital width 1.6–2.6 in orbit diameter; orbit diameter 4.3–5.6 in HL; HL 2.8–3.1 in SL. Supraorbital ridge with ~8–12 small serrae; 1 preocular spine; suborbital ridge with 1 spine in front of eye, 1 spine below middle of eye, 1 spine below rear edge of eye, and none behind eye; upper preopercular spine reaching past opercle margin. GR 8–10. LL scales 51–55, the last few scales usually lacking a spine.

Body dark dorsally, pale ventrally; fins more or less dusky; 1st dorsal fin with prominent black blotch posteriorly; dark spots along rays of 2nd dorsal fin, on upper part of pectoral fins, and upper caudal-fin margin. Attains 26 cm TL.



*Grammoplites suppositus*, ~18 cm SL. Source: Knapp 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indian Ocean: Red Sea to Gulf of Oman, Persian/Arabian Gulf, west and east coasts of India and Bay of Bengal.

**REMARKS** Trawled from ~10–90 m.

*Grammoplites vittatus* (Valenciennes 1833)

Pakistan flathead

PLATE 118

*Platycephalus vittatus* Valenciennes *in* Cuv. & Val. 1833: 462 (Malabar coast, India); Sauvage 1878.

*Grammoplites scaber* (*non* Linnaeus 1758): Randall 1995\*; Carpenter *et al.* 1997\*.

*Grammoplites vittatus*: Knapp & Imamura 2014\*.

First dorsal fin 1 + 7 spines and 1 ray, or 1 + 8 spines; 2nd dorsal fin 12 rays; anal fin 12 rays; pectoral fins 19–21 rays; caudal fin 11 or 12 branched rays. Interorbital width 5–10% HL. Preorbital spines 1–3 (usually 3). GR 7 or 8. LL scales 52–54.

Body grey or pale tan dorsally, with 5 or 6 indistinct darker bands; anal-fin margin whitish. Attains at least 17 cm SL.

**DISTRIBUTION** WIO: Persian/Arabian Gulf to Pakistan and southwestern India.

**GENUS** *Inegocia* Jordan & Thompson 1913

Iris lappet with long finger-like branches. LSS about equal to number of LL scales; LL tubes with 2 openings to exterior. Suborbital ridge usually with 1 spine below middle of eye, 1 spine below rear edge of eye, and several more spines behind eye; no preorbital spine; upper 2 preopercular spines short, subequal; base of lower opercular spine extends across opercle as smooth bony ridge. Two species, 1 in WIO.

*Inegocia japonica* (Cuvier 1829)

Japanese flathead

PLATE 119

*Silurus imberbis* Gmelin 1789: 1361 (Japan).

*Platycephalus isacanthus* Cuvier *in* Cuv. & Val. 1829: 246 (Waigeo and Bourou, Indonesia).

*Platycephalus borboniensis* Cuvier *in* Cuv. & Val. 1829: 252 (Réunion, Mascarenes).

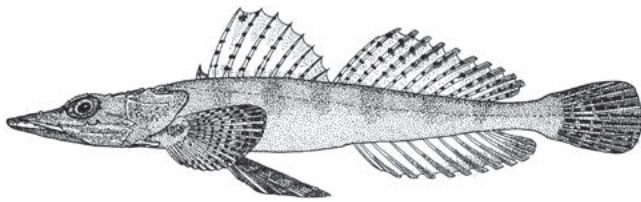
*Platycephalus japonicus* Cuvier (ex Tilesius) *in* Cuv. & Val. 1829: 256 [Nagasaki, Japan] [first available usage of name *Platycephalus japonicus* Tilesius 1814, with reversal of precedence for *Silurus imberbis*].

*Inegocia japonica*: Jordan & Thompson 1913; Knapp 1984\*; De Bruin *et al.* 1995\*; Imamura 1997; Fricke 1999.

*Suggrundus isacanthus*: Murty 1982\*.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11–13 rays; anal fin 11–13 rays; pectoral fins 19–21 rays. HL 2.5–3 in SL; interorbital width 3–4.8 in orbit diameter; orbit diameter 3.9–5.6 in HL. Supraorbital ridge with ~6–8 spines; 1 preocular spine; interopercular flap slender. GR 5 or 6. LL scales 51–54, first 4–10 scales with spine or keel.

Body grey or brown dorsally, with ~6 darker saddles; 1st dorsal fin hyaline, with small brown spots on spines, 2nd dorsal fin with similar spots on rays, and pectoral fins with somewhat larger dark spots; caudal fin pale, with large dark spots, some elongated. Attains ~25 cm TL.



*Inegocia japonica*, ~19 cm SL. Source: Knapp 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Réunion and Sri Lanka; elsewhere to Indonesia, Philippines, southern Japan and northern Australia.

**REMARKS** Trawled from over sand and mud, to ~85 m deep.

**GENUS** *Kumococius* Matsubara & Ochiai 1955

Iris lappet simple or slightly bilobed. Second spine of dorsal fin distinctly shorter than 3rd spine; pectoral fins with concave rear edge; interopercular flap small; upper preopercular spine reaching nearly to opercle margin. LSS about equal to number of LL scales; LL tubes with single opening to exterior. One species.

*Kumococius rodericensis* (Cuvier 1829)

Spiny flathead

PLATE 119

*Platycephalus rodericensis* Cuvier in Cuv. & Val. 1829: 253 (Réunion, Mascarenes).

*Insidiator detrusus* Jordan & Seale 1905: 15, Pl. 10 (Hong Kong).

*Kumococius detrusus*: Matsubara & Ochiai 1955\*; Kuronuma & Abe 1986.

*Platycephalus bengalensis* Rao 1966: 124, Fig. 1 (India, Bay of Bengal); Talwar & Kacker 1984\*.

*Suggrundus bengalensis* (non Rao 1966): Murty 1982\*.

*Suggrundus rodericensis*: Knapp 1984\* [as *rodericensis*];

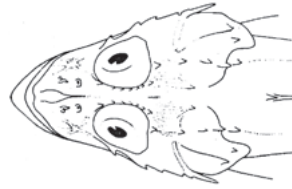
De Bruin *et al.* 1995\*.

*Kumococius rodericensis*: Randall 1995\*, 1999\*; Carpenter *et al.* 1997\*; Imamura 1997; Fricke 1999; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Fricke *et al.* 2009.

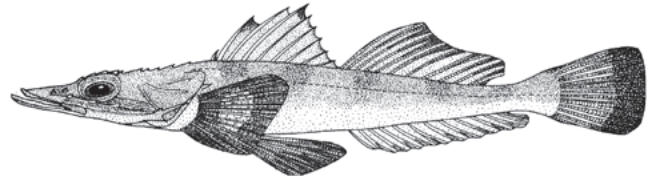
First dorsal fin 9 spines; 2nd dorsal fin 11 rays; anal fin 12 rays; pectoral fins 19 or 20 rays. HL 2.7–3 in SL; interorbital width 3.8–5.3 in orbit diameter; orbit diameter 3.6–4.1 in HL. Single preocular and preorbital spine; supraorbital ridge smooth anteriorly, 4–6 spines posteriorly; suborbital ridge with 1 spine below middle of eye, 1 spine below rear edge of eye, and 2 or 3 spines behind eye. GR 9–11. LL scales 52–55, first 6–28 scales bearing small spine or ridge.

Body brownish dorsally, with scattered minute dark spots, and 4 or 5 dark bars dorsally on some fish; 1st dorsal fin with

dark marginal spot between 2nd and 3rd spines and behind 4th spine; pectoral fins dark with pale area in middle; caudal fin dusky distally. Attains 25 cm TL.



*Kumococius rodericensis*, head, holotype of *Insidiator detrusus*. Source: Jordan & Seale 1905



*Kumococius rodericensis*, ~18 cm SL. Source: Knapp 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Persian/Arabian Gulf to India and Mascarenes; elsewhere to Bay of Bengal, Indonesia, South China Sea, southern Japan and northern Australia.

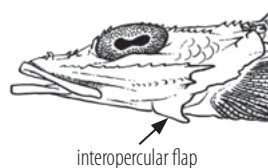
**REMARKS** Trawled from 18–130 m.

**GENUS** *Onigocia* Jordan & Thompson 1913

Body scales large, adherent; LL scales 28–42, about equal to number in LSS, tubes with 2 openings to exterior; single ridge across cheeks (lower edge of suborbital bone turned inwards and not visible); preopercle with 3 spines, uppermost largest, reaching about halfway to opercle margin; pectoral fins rounded. About 9 species, at least 4 in WIO.

**KEY TO SPECIES**

- 1a GR 6–9; interopercular flap cuneal or elongate and contiguous with opercle margin; 1st dorsal fin transparent, with 2 small black spots distally..... *O. bimaculata*

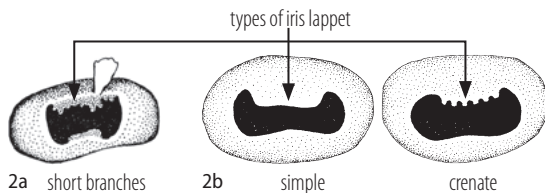


- 1b GR 4–6; no interopercular flap; 1st dorsal fin usually with broad dark submarginal band..... 2

Continued...

## KEY TO SPECIES

- 2a Usually 1 preocular spine; small dermal flap on top of eyes; iris lappet with short branches ..... *O. grandisquama*  
 2b Preocular spines  $\geq 3$ ; no ocular flaps; iris lappet simple or crenate ..... 3



- 3a GR 5 or 6; supraorbital ridge smooth over front of eye; interorbital space narrowest at middle of eye ..... *O. oligolepis*  
 3b GR 4 or 5; supraorbital ridge with spines over front of eye; interorbital space narrowest anterior to middle of eye ..... *O. pedimacula*

*Onigocia bimaculata*

Knapp, Imamura &amp; Sakashita 2000

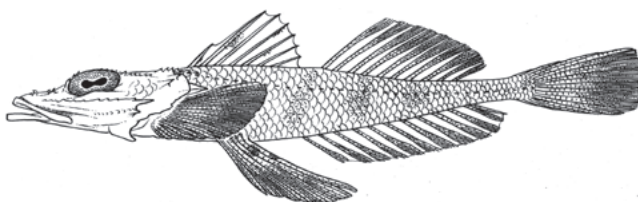
Two-spot flathead

PLATE 119

*Onigocia bimaculata* Knapp, Imamura & Sakashita 2000: 3, Figs. 1–5 (Minna I., Ryukyu Is., Japan).

First dorsal fin 8 or 9 spines; 2nd dorsal fin 10–12 rays; anal fin 10–12 rays; pectoral fins 19–22 rays; caudal fin 4 + 5 branched rays. Interorbital width 0.5–1.9% SL, 7.6–10.5 in orbit diameter; orbit diameter 2.9–3.7 in HL. Preocular spines 3 or 4; supraorbital ridge with 12–14 serrae, of which 4 or 5 are over front half of eye and the rest on the rear part of this ridge; suborbital ridge with ~18–20 small spines. Iris lappet bilobed; interopercular flap cuneal or elongate and continuous with rear margin of opercle. GR 6–9. LL scales 32–39, first 2 or 3 scales with spine.

Body buff dorsally, with 4 or 5 pale brown saddle bars; fins mostly transparent, 1st dorsal fin with 2 black spots distally (between spines 2 and 3, and between spines 3 and 4); 3 transverse rows of dark spots across pelvic fins; caudal fin with faint dark submarginal band, rays with several dark spots. Attains ~7.5 cm TL.



*Onigocia bimaculata*, 6 cm SL (Gulf of Aqaba).

Source: Knapp *et al.* 2000 (by FW Zweifel)

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aqaba, Red Sea, Comoros and Mauritius; elsewhere to Philippines, southern Japan, northeastern Australia, New Caledonia, Fiji and Society Is.

*Onigocia grandisquama* (Regan 1908)

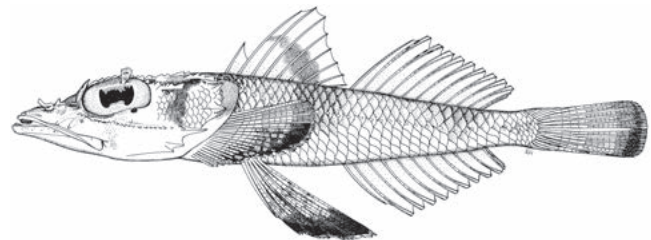
Black-finned flathead

*Platycephalus grandisquamis* Regan 1908: 239 (Amirante Is., Seychelles).

*Onigocia grandisquama*: Imamura & Sakashita 1997\*; Manilo & Bogorodsky 2003; Imamura 2016; Imamura & Shinohara 2019.

First dorsal fin 9 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins 20–22 rays; caudal fin 5 + 5 branched rays. HL 2.2–2.4 in SL; interorbital width 4.1–6.4 in orbit diameter; orbit diameter 3.2–3.6 in HL. Preocular spines 1 or 2; supraorbital ridge smooth anteriorly, 10–12 serrations posteriorly; suborbital ridge with ~14–18 serrae. Iris lappet with short branches; small dermal flap on top of eyes; no interopercular flap. GR 5 or 6. LL scales 31–37, first 3–7 scales with spine; cheek covered with sensory tubules.

Body buff; 1st dorsal fin with faint dusky band distally; pectoral fins with bold black blotch along lower edges; pelvic fins with bold black blotch distally; caudal-fin base with faint, narrow, dark bar and narrow submarginal dark band. Attains possibly ~9 cm TL.



*Onigocia grandisquama*, 6 cm SL (Mauritius).

**DISTRIBUTION** Indo-Pacific. WIO: Somalia, Madagascar, Seychelles, Mauritius and Maldives; elsewhere to Gulf of Thailand, Indonesia, Japan and Australia.

**REMARKS** Trawled from 50–90 m.



## *Onigocia oligolepis* (Regan 1908)

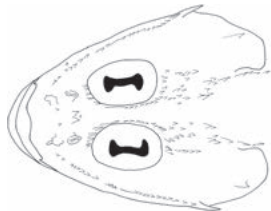
Large-scaled flathead

PLATE 119

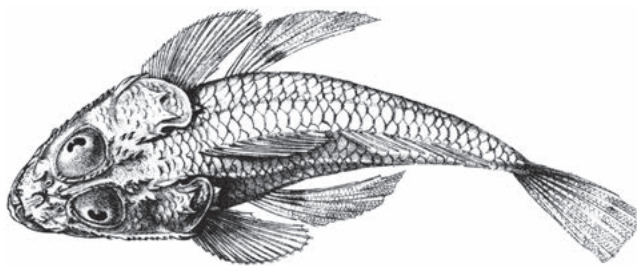
*Platycephalus oligolepis* Regan 1908: 238, Pl. 29, Fig. 4 (St Brandon Shoals).  
*Onigocia oligolepis*: SSF No. 155.4\*; Imamura 1996; Heemstra *et al.* 2004.

Description based on the holotype and 4 specimens tentatively referred to this species: first dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins 21 or 22 rays. HL 2.3–3.7 in SL; interorbital width 5.1–6.8 in orbit diameter. Preocular spines 3 or 4; supraorbital ridge with 5–8 spines; suborbital ridge with ~14–18 spines. Iris lappet simple or bilobed; no interopercular flap. GR 5 or 6. LL scales 31–33, first 3 scales with spine.

Body tan dorsally, with several dark crossbars; central dark spot on each pelvic fin; caudal fin with dusky submarginal band. Attains ~10 cm TL.



*Onigocia oligolepis*, 8 cm SL, dorsal head (South Africa). Source: SSF



*Onigocia oligolepis*, dorsal view (St Brandon Shoals). Source: Regan 1908

**DISTRIBUTION** WIO: Gulf of Aqaba, South Africa (KwaZulu-Natal), St Brandon Shoals, Rodrigues and possibly Tanzania (Zanzibar); records from Australia are a misidentification.

**REMARKS** Trawled from 37–55 m.

## *Onigocia pedimacula* (Regan 1908)

Broadband flathead

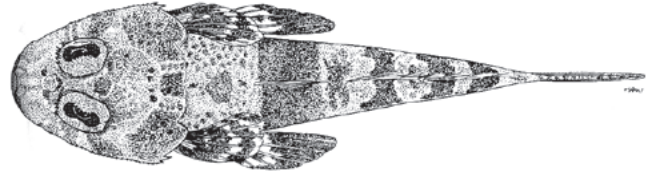
PLATE 120

*Platycephalus spinosus* (non Temminck & Schlegel 1843): Günther 1880.  
*Platycephalus pedimacula* Regan 1908: 238 (Kolumadulu, Maldives).  
*Onigocia pedimacula*: Knapp 1999\*; Manilo & Bogorodsky 2003.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins 20–22 rays; caudal fin 8 branched rays.

Interorbital width 5.4–6.5 in orbit diameter; orbit diameter 3–3.4 in HL. Preocular spines 3–6; preorbital spines 1 or 2; supraorbital ridge with ~8–11 spines; suborbital ridge with 13–18 spines. GR 4 or 5. LL 29–32, first 3 scales with spine.

Body grey or brown dorsally, with broad dark zone below 1st dorsal fin, and 3 or 4 dark bars posteriorly; fins usually with dark spots, and 1st dorsal fin generally dusky; pelvic fins with prominent dark blotch at centre and smaller dark blotch near base. Attains 11 cm TL (commonly 7 cm TL).



*Onigocia pedimacula*, dorsal view. Source: Knapp 1999; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Pakistan to South Africa (KwaZulu-Natal), Rodrigues and Maldives; elsewhere to Indonesia, Philippines, Solomon Is., Australia, New Caledonia and Tonga.

## GENUS *Papilloculiceps* Fowler & Steinitz 1956

Iris lappet with finger-like branches; interopercular flap large; bony ridges of head mostly smooth, suborbital ridge with only 1 spine; 1 preocular spine. LSS greater than number of LL scales. One species, restricted to WIO.

## *Papilloculiceps longiceps* (Cuvier 1829)

Madagascar flathead

PLATES 119 & 120

*Platycephalus longiceps* Cuvier (ex Ehrenberg) in Cuv. & Val. 1829: 255 (Massawa, Eritrea, Red Sea).

*Platycephalus tentaculatus* Rüppell 1838: 104, Pl. 26, Fig. 2 (El Tur, Sinai Peninsula, Egypt, Red Sea); Regan 1908; SFSA No. 1066 [Fig. 1066 taken from Günther is *Cymbacephalus beauforti* (Knapp 1973) from the western Pacific].

*Platycephalus grandidieri* Sauvage 1873: 56 (Madagascar; Zanzibar, Tanzania).

*Platycephalus micracanthus* Sauvage 1873: 60 (Red Sea); Dor 1984.

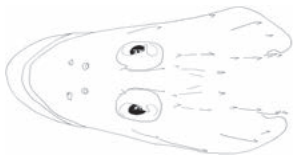
*Platycephalus papilloculus* Fowler 1935: 399, Figs. 32–33 (Durban, KwaZulu-Natal, South Africa).

*Papilloculiceps grandidieri*: Fowler & Steinitz 1956; Dor 1984.

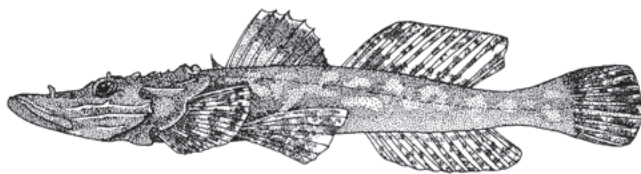
*Papilloculiceps longiceps*: Dor 1984; Knapp 1984\*; Bianchi 1985\*; SSF No. 155.5\*; Golani & Ben-Tuvia 1990\*; Randall 1995\*; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004\*.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins 20–22 rays. Interorbital width 1.7–3 in orbit diameter; orbit diameter 5.4–7.1 in HL; HL 2.7–2.8 in SL. Supraorbital ridge smooth; suborbital ridge with spine below middle of eye; preopercular spines 2, short, subequal. GR 6. LL scales 52–56, first 1 or 2 scales with spine.

Body brownish or greenish dorsally, whitish ventrally; caudal fin with 3 or 4 vertical rows of dark spots, other fins covered with large and small dark spots; 1st dorsal fin dusky posteriorly; anal fin white, with row of black spots along margin. Attains 70 cm TL.



*Papilloculiceps longiceps*, 17 cm SL, dorsal head (Seychelles). Source: SSF



*Papilloculiceps longiceps*, ~49 cm SL. Source: Knapp 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** WIO: Gulf of Oman, Red Sea (Gulf of Suez and Gulf of Aqaba) to South Africa (Aliwal Shoal), Tanzania (Zanzibar), Madagascar and Seychelles; Lessepsian migrant to Mediterranean Sea.

**REMARKS** Found near coral reefs, to ~15 m deep.

## GENUS *Platycephalus* Bloch 1795

Pre-vomerine teeth in single patch; preopercular spines usually 2; LSS more numerous than LL scales; LL scale tubes with single opening to exterior; bony ridges on head mostly smooth. Twenty species, including 2 undescribed (Imamura 2015), mostly from Australia; 1 species in WIO.

### *Platycephalus indicus* (Linnaeus 1758)

Bartail flathead

PLATE 120

*Callionymus indicus* Linnaeus 1758: 250 (Asia [Indo-Pacific]).

*Cottus insidiator* Forsskål 1775: 25, x [Red Sea].

*Platycephalus spathula* Bloch 1795: 97, Pl. 424 (Tharangambadi, India).

*Platycephalus insidiator*: Bloch & Schneider 1801; Regan 1908.

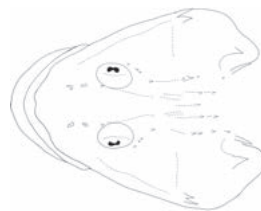
*Platycephalus indicus*: Bleeker 1878; Barnard 1927; Khalaf 1961;

SFSA No. 1063\*; Kreft 1964\*; Kuronuma & Abe 1972\*; Basson *et al.*

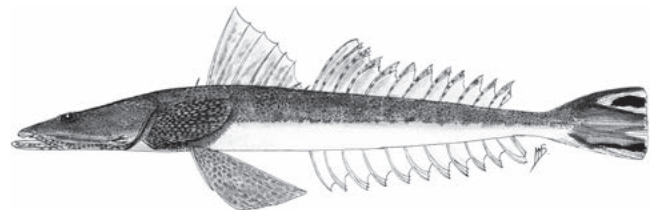
1977\*; Randall *et al.* 1978\*; Van der Elst 1981\*; Murty 1982; Dor 1984; Knapp 1984\*; Bianchi 1985\*; Kuronuma & Abe 1986\*; SSF No. 155.6\*; Golani & Ben-Tuvia 1990; De Bruin *et al.* 1995\*; Randall 1995\*; Smale *et al.* 1995\* [otolith]; Imamura 1997; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*; Imamura 2015.

First dorsal fin 1 + 7 spines; 2nd dorsal fin 1 spine, 13 rays; anal fin 13 rays; pectoral fins 18–20 rays. Interorbital width 0.8–1.9 in orbit diameter; orbit diameter 5.3–8.2 in HL; HL 3.1–3.4 in SL. Preocular spine single, small; 2 preopercular spines, lower spine slightly longer. Iris lappet simple; interopercular flap finger-like. GR 7–10. LL scales 68–83, first 1 or 2 scales with spine or ridge.

Body brownish or greyish dorsally, whitish ventrally; caudal fin white and yellow, with 2 or 3 horizontal black stripes. Attains 100 cm TL.



*Platycephalus indicus*, 19 cm SL, dorsal head (South Africa). Source: SSF



*Platycephalus indicus*, 38 cm SL (South Africa). Source: SSF

**DISTRIBUTION** WIO: Persian/Arabian Gulf, Red Sea (Gulf of Suez), Oman to South Africa (Mossel Bay), Madagascar, Comoros, Seychelles, southern India and Sri Lanka; Lessepsian migrant to Mediterranean Sea; elsewhere to Bangladesh, Indonesia, Philippines, southern Japan.

**REMARKS** Found in estuaries and shallow water, to ~15 m deep.

## GENUS *Rogadius* Jordan & Richardson 1908

Lower edge of preopercle with antrorse spine or tip; bony ridges of head with fine serrae (no large spines); lower edge of suborbital bone turned inwards, not readily visible externally; iris lappet bilobed; no interopercular flap. About 6 species, possibly 4 in WIO.

**KEY TO SPECIES**

- 1a Single preocular spine; pectoral fins with large dark or greyish blotches (lower part of fin may be entirely dark in *R. serratus*) ..... 2
- 1b Two or more preocular spines; pectoral fins mostly blackish or with small dark spots ..... 3
  
- 2a Preocular spine with small accessory spine at base; preopercular antrorse spine tip small or obscure; DSC 8–10; pelvic fins blackish ..... *R. serratus*
- 2b Preocular spine without small spine at base; preopercular antrorse spine large; DSC 6 or 7; paired fins with large dark blotches ..... *R. pristiger*
  
- 3a Preopercle antrorse spine tip small or obscure; pectoral fins blackish, falcate; interpelvic scale count ~19 (number of scales in straight line between pelvic-fin insertions); interorbital width ~8.4 in orbit diameter ..... *R. welanderi*
- 3b Preopercle antrorse spine large, tip readily visible; pectoral fins with small dark spots, fins rounded; interpelvic scale count 11–14; interorbital width 4–6 in orbit diameter ..... *R. fehlmanni*

***Rogadius fehlmanni*** Knapp 2012

Somali flathead

*Rogadius fehlmanni* Knapp 2012: 62, Fig. 1 (off Somalia).

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins 20–22 rays; caudal fin 11 or 12 branched rays. Snout length 7.6–9.8 in SL. Base of lower opercular spine extends anteriorly as ridge, nearly to anterior edge of opercle, bearing few serrae; upper preopercular spine reaches ~¾ distance to opercle margin, with stout accessory spine at base. GR 5–7. LL scales 48–51, first 9–14 scales bearing small spines; interpelvic scales 11–14.

Body brownish or greyish dorsally, with 4 or 5 dark crossbars; faint dark suborbital bar present or absent; 1st dorsal fin dusky with submarginal dark band, and series of small dark spots on spines; 2nd dorsal fin and pectoral fins pale, with small dark spots on rays; pelvic fins dark, with pale area at base; anal fin pale with dusky submarginal band; caudal fin with broad basal dark blotch followed by pale area and 3 or 4 narrow vertical dark bands posteriorly. Attains at least 11 cm SL.

**DISTRIBUTION** WIO: off Somalia.

**REMARKS** Trawled from ~27–39 m.

***Rogadius pristiger*** (Cuvier 1829)

Thorny flathead

PLATE 121

*Platycephalus pristiger* Cuvier in Cuv. & Val. 1829: 260 (New Guinea and Sulawesi, Indonesia); Bleeker 1875–1878\*; Regan 1908; Norman 1939; Dor 1970\*.

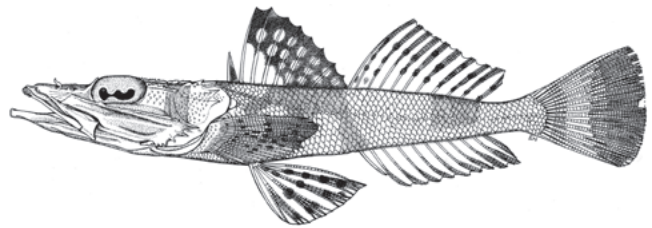
*Platycephalus asper* (non Cuvier 1829): Regan 1908.

*Rogadius pristiger*: Fowler 1928; Murty 1982\*; Kuronuma & Abe 1986; De Bruin *et al.* 1995 [Fig. is *R. asper*, taken from Jordan *et al.* 1913]; Imamura 1996; Kimura *et al.* 2017.

*Rogadius asper* (non Cuvier 1829): Munro 1955 [Fig. is *R. asper*]; Knapp 1979\*, 1984\* [Fig. is *R. asper*]; Dor 1984; Randall 1995\*; Carpenter *et al.* 1997\*; Manilo & Bogorodsky 2003.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 or 12 rays; anal fin 11 or 12 rays; pectoral fins 21–24 rays. Interorbital width 5.4–8.1 in orbit diameter; orbit diameter 3.1–4.1 in HL; HL 2.5–2.6 in SL. Preocular spine single, without small spines at base; preopercular spines 5 or 6 (includes antrorse spine). GR 6–8. LL scales 48–55, first 4–12 scales with small spine.

Body brownish or greyish dorsally, with 4 or 5 darker saddles; 1st dorsal fin dusky, with transverse series of black spots forming submarginal dark band; 2nd dorsal fin with dark spots along rays; pectoral fins with prominent dark spots and white interspaces on upper surface, lower surface dusky with pale margin; pelvic fins dark, with dark spots on upper surface; caudal fin with narrow white basal band, broad submarginal dark band, and narrow white margin. Attains 17 cm TL.



*Rogadius pristiger*, 13 cm SL (Madagascar).

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Oman, Red Sea, Mozambique, Madagascar, Maldives and Sri Lanka; elsewhere to Indonesia, Philippines, Taiwan, northern Australia and New Caledonia.

**REMARKS** Trawled from over sand and mud; found to ~80 m deep.

*Rogadius serratus* (Cuvier 1829)

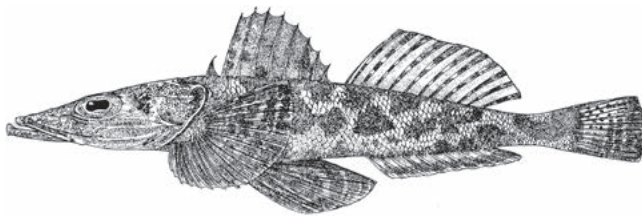
Serrated flathead

PLATE 121

*Platycephalus serratus* Cuvier in Cuv. & Val. 1829: 259 (Trincomalee, Sri Lanka).*Platycephalus subfasciatus* Günther 1887: 551, Pl. 49 (Mauritius, Mascarenes); Regan 1905.*Rogadius serratus*: Knapp 1984; Winterbottom *et al.* 1989\*; De Bruin *et al.* 1995\*; Imamura & Amaoka 1996\*; Manilo & Bogorodsky 2003.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 or 12 rays; anal fin 11 rays; pectoral fins 20–23 rays; caudal fin 12 branched rays. Interorbital width 4.6–7.2 in orbit diameter; orbit diameter 3.2–4.1 in HL; HL 2.4–2.8 in SL. Preocular spine with smaller spine at base; preopercular spines usually 3. GR 5–8. LL scales 50–54, first 1–10 scales bearing small spine.

Body buff dorsally, with 7 or 8 dark crossbars, and series of irregular dark blotches on sides; 1st dorsal fin dusky; 2nd dorsal fin with dark spots on rays; pectoral fins with dark spots on upper surface, lower surface dusky with whitish margin; caudal fin with dark bands at base and near margin, central area pale, with few dark spots near upper margin. Attains 24 cm TL.



*Rogadius serratus*. Source: Knapp 1999; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Somalia, Seychelles, Mauritius, Chagos and Sri Lanka; elsewhere to Thailand, Indonesia, Philippines, northeastern Australia and New Caledonia.

**REMARKS** Occurs over sand around coral reefs, to at least 11 m deep; one specimen trawled from ~45 m.

*Rogadius welanderi* (Schultz 1966)

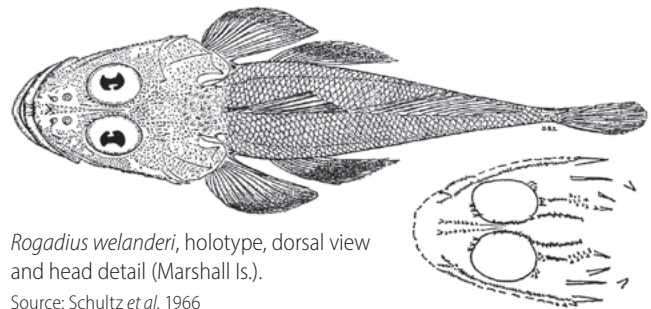
Welander's flathead

*Platycephalus* sp.: Fourmanoir & Guézé 1963.*Wakiyus welanderi* Schultz in Schultz *et al.* 1966: 50, Fig. 144 (lagoon coral head at Rongelap I., Rongelap Atoll, Marshall Is.); Wass 1984.*Sorsogona welanderi*: Gloerfelt-Tarp & Kailola 1984\*.*Rogadius welanderi*: Knapp 1999\*.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins 21 or 22 rays. Interorbital width 8.4–9.6 in

orbit diameter; orbit diameter 3–3.7 in HL; HL 2.4–2.6 in SL. Preocular spines 2–5; preopercular spine 5 (including antrorse spine). GR 7 or 8. LL scales 52–54, first 3–9 scales with small spine.

Body brownish dorsally, with 4 or 5 faint splotchy bars; 1st dorsal fin dark; 2nd dorsal fin transparent with dark spots along rays; anal fin mostly dark, with white margin; pectoral fins with dark spots on upper surface, lower surface dark with white margin; pelvic fins dark with white margin; caudal fin with dark submarginal band or several narrow dark bands. Attains ~20 cm TL.



*Rogadius welanderi*, holotype, dorsal view and head detail (Marshall Is.).

Source: Schultz *et al.* 1966

**DISTRIBUTION** Western Pacific: Indonesia (Ambon I.), Marshall Is. (Rongelap I.), Australia and Samoa; one specimen from Réunion in WIO is provisionally referred to this species.

**REMARKS** Known from coral reefs, to ~40 m deep.

**GENUS** *Sorsogona* Herre 1934

Ventral edge of suborbital bone visible externally, not turned inwards; bony ridges of head with small spines or serrae; base of lower opercular spine with small serrations; preocular spines  $\geq 3$ ; LL tubes with 2 openings to exterior; LSS about equal to number of LL scales. About 6 species, all in WIO.

**KEY TO SPECIES**

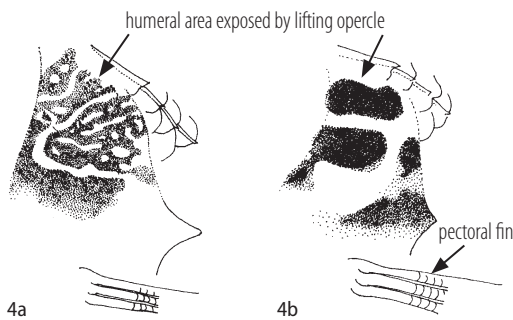
- |    |   |                       |
|----|---|-----------------------|
| 1a | Second dorsal fin and anal fin each with 11 rays; iris lappet crenate.....                                | <i>S. tuberculata</i> |
| 1b | Second dorsal fin and anal fin each with 12 or 13 rays; iris lappet bilobed.....                          | 2                     |
| 2a | All LL scales with 1 or 2 backward-directed spines; lower lip with inner row of finger-like papillae..... | <i>S. portuguesa</i>  |
| 2b | Anterior LL scales with single spine, no spines on posterior LL scales; no papillae on lower lip.....     | 3                     |

Continued...

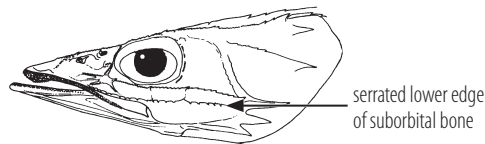


**KEY TO SPECIES**

- 3a Pelvic fins with dark spots; caudal fin with 2–5 vertical dark bands; humeral area under opercle with several dark blotches or swirls on pale background ..... 4
- 3b Pelvic fins and caudal fin uniformly pale or dusky; humeral area pale, with no pattern ..... 5
  
- 4a Pelvic fins with dark spots; caudal fin with 3–5 narrow vertical dark bars; humeral area with dark swirled pattern; DSC 4–6 ..... *S. prionota*
- 4b Pelvic fins without dark spots; caudal fin with dark bar at base, pale central area, and broad dark band on rear half; humeral area with several dark blotches; DSC ~8 ..... *S. humerosa*



- 5a GR 14–18; dorsal fins dusky; lower edge of suborbital bone smooth ..... *S. nigripinna*
- 5b GR 10–13; dorsal fins with dark blotches; lower edge of suborbital bone serrate ..... *S. melanoptera*



***Sorsogona humerosa*** Knapp & Heemstra 2011

White-margined flathead PLATE 121

*Sorsogona humerosa* Knapp & Heemstra 2011: 76, Figs. 1–3 (Mozambique).

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 rays; anal fin 12 rays; pectoral fins 20 or 21 rays; caudal fin 12 branched rays. Interorbital width 3.2–4.8 in orbit diameter; orbit diameter 3.6–4.2 in HL; HL 2.5–2.7 in SL. Preocular margin with 5–7 low spines or ridges; supraorbital and suborbital ridges finely serrate; preopercular spines 3. Iris lappet bilobed. GR 10 or 11. LL scales 51–53, first 12–17 scales with weak spines; DSC ~8.

Body brownish dorsally, with 5 darker crossbands, whitish ventrally; dark brown blotch on head below rear half of eyes;

1st dorsal fin with blackish band along upper half; 2nd dorsal fin more or less transparent with small brown spots on rays; pectoral and pelvic fins with brown spots; pelvic-fin margin and base of spine whitish; anal fin transparent with whitish margin; caudal fin with dark bar at base, pale central area, broad dark band on rear half, and narrow white margin; humeral area below opercle with several large ovate dark blotches. Attains 16 cm SL.



*Sorsogona humerosa*, 10 cm SL (Mozambique). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: Mozambique and Somalia.

**REMARKS** Trawled from 60–97 m.

***Sorsogona melanoptera*** Knapp & Wongratana 1987

Obscure flathead PLATE 122

*Platycephalus tuberculatus*: Day 1876\* [in part]; Blegvad & Løppenthin 1944.

*Platycephalus nigripinnis* (non Regan 1905): Norman 1939.

*Sorsogona* sp.: Knapp 1979\*.

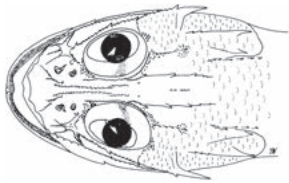
*Sorsogona melanoptera* Knapp & Wongratana 1987: 381, Figs. 1–2 (off

Cochin, India); Randall 1995\*; Manilo & Bogorodsky 2003.

*Rogadius melanopterus*: Imamura & Knapp 1999.

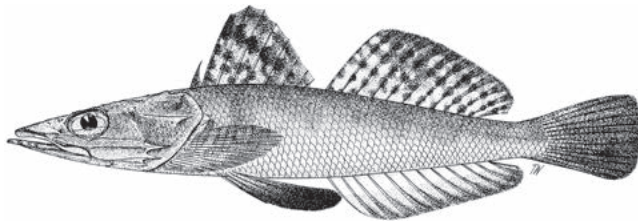
First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 or 13 rays; anal fin 12 rays; pectoral fins 20 or 21 rays; caudal fin 11 branched rays. Interorbital width 2.5–3.7 in orbit diameter; orbit diameter 3.6–4.3 in HL; HL 2.5–3.2 in SL. Preocular margin with modest spine and often 3–6 smaller spines, and usually with 1 or more rows of tubercles in front of marginal spine row; supraorbital and suborbital ridges finely serrate; ventral edge of suborbital with spines and blunt knobs; preopercular spines 3. Iris lappet bilobed. GR 10–12. LL scales 52–55, first 13–34 scales with weak spines.

Body brown dorsally, some with indistinct dark crossbars; 1st dorsal fin dusky, with dark spots along spines; 2nd dorsal fin with dark spots along rays; pectoral fins and anal fin more or less transparent; caudal-fin base pale, dusky distally. Attains ~14 cm TL.



*Sorsogona melanoptera*, 9 cm SL, dorsal head, paratype (W India).

Source: Knapp & Wongratana 1987; © *Proc. Biol. Soc. Wash.*, Allen Press Publ. Services



*Sorsogona melanoptera*, 9 cm SL, holotype (W India).

Source: Knapp & Wongratana 1987; © *Proc. Biol. Soc. Wash.*, Allen Press Publ. Services

**DISTRIBUTION** Indian Ocean: Gulf of Oman to west and east coasts of India and Andaman Sea (southern Thailand).

**REMARKS** Trawled from over sand and mud, at 15–117 m.

### *Sorsogona nigripinna* (Regan 1905)

Blackfin flathead

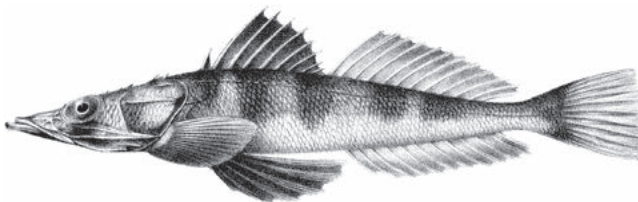
*Platycephalus nigripinnis* Regan 1905: 322, Pl. A, Fig. 2 (Muscat, Oman, Gulf of Oman); Norman 1939.

*Sorsogona nigripinna*: Knapp 1979\*; Randall 1995\* [Fig. from Regan is of *S. prionota*]; Manilo & Bogorodsky 2003.

*Rogadius nigripinnis*: Imamura & Knapp 1999.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 rays; anal fin 12 rays; pectoral fins 20–22 rays. Interorbital width 1.8–2.6 in orbit diameter; orbit diameter 4–5 in HL; HL 2.7–2.9 in SL. Preopercular spines 7–9; supraorbital and suborbital ridges with many fine serrae; preopercular spines 3. Iris lappet bilobed. GR 15–19. LL scales 52–55, first 15–30 scales with small spine or ridge; DSC 8–10.

Body brown dorsally, with 4 or 5 dark crossbars; 1st dorsal fin brown; 2nd dorsal fin with brown submarginal band; caudal fin and paired fins dusky. Attains ~28 cm TL.



*Sorsogona nigripinna*, holotype (Oman). Source: Regan 1905

**DISTRIBUTION** WIO: Somalia and Gulf of Aden to Gulf of Oman.

**REMARKS** Trawled from 21–70 m.

### *Sorsogona portuguesa* (Smith 1953)

South African thorny flathead

*Platycephalus scaber* (non Linnaeus 1758): Gilchrist & Thompson 1908; Barnard 1927; SFSA No. 1069\*; Smith 1950.

*Thysanophrys portuguesus* Smith 1953: 17, Pl. 1, Fig. 3 (Maputo, Mozambique).

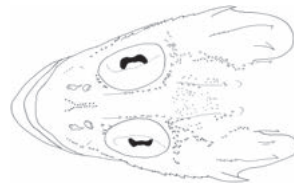
*Grammoplites portuguesus*: Knapp 1984\*; SSF No. 155.3\*.

*Rogadius portuguesus*: Imamura 1996.

*Sorsogona portuguesa*: Knapp & Heemstra 2011.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 or 13 rays; anal fin 12 or 13 rays; pectoral fins 20 or 21 rays. Interorbital width 2.9–5.5 in orbit diameter; orbit diameter 3.5–4.1 in HL; HL 2.2–3.1 in SL. Supraorbital ridge with ~7–12 serrae; preopercular spines 3 or 4; suborbital ridge with many small spines or serrae; upper preopercular spine not reaching opercle margin. Iris lappet bilobed. GR 11–14. LL scales 51–53, all with spine not reaching past scale margin, and some with 2nd small spine on margin.

Body brownish dorsally, and scales pale with brown edges, paler ventrally; 1st dorsal fin dark distally; 2nd dorsal fin and pectoral fins with spots; caudal fin dusky. Attains at least 18 cm TL.



*Sorsogona portuguesa*, 17 cm SL, dorsal head, holotype (S Mozambique). Source: SSF

**DISTRIBUTION** WIO: Mozambique (Pemba) to South Africa (KwaZulu-Natal) and Madagascar.

**REMARKS** Trawled from 20–70 m.

### *Sorsogona prionota* (Sauvage 1873)

Half-spined flathead

PLATE 122

*Platycephalus prionotus* Sauvage 1873: 57 (Red Sea? [possibly Madagascar]).

*Platycephalus townsendi* Regan 1905: 323, Pl. 1a, Fig. 1 (Karachi, Pakistan; Muscat, Oman, Gulf of Oman); Norman 1939.

*Platycephalus heterolepis* Barnard 1927: 77 (Inhaca I., Mozambique).

*Platycephalus* sp.: Haas & Steinitz 1947.

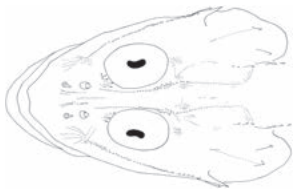
*Platycephalus tuberculatus* (non Cuvier 1829): Smith 1950; Ben-Tuvia & Steinitz 1952.

*Sorsogona prionota*: Knapp 1979\*; Dor 1984; SSF No. 155.7\*; Golani & Ben-Tuvia 1990\*; Randall 1995\*; Smale *et al.* 1995\* [otolith]; Carpenter *et al.* 1997\*; Fricke 1999; Manilo & Bogorodsky 2003; Bogorodsky *et al.* 2014.

*Rogadius prionotus*: Imamura & Knapp 1999.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 rays; anal fin 12 or 13 rays; pectoral fins 19–22 rays. Interorbital width 2.5–4.3 in orbit diameter; orbit diameter 3.7–4.7 in HL; HL 2.7–3.1 in SL. Preocular spine 1, plus 2–5 smaller spines or ridges along orbit margin; supraorbital and suborbital ridges bearing many fine serrations; base of lower opercular spine with fine serrations. Iris lappet simple to bilobed. GR 9–13. LL scales 50–54, first 15–40 scales with small spine or ridge; DSC 4–6.

Body brown dorsally, with 4 or 5 vague dark crossbars; 1st dorsal fin with russet band; 2nd dorsal fin and pectoral and pelvic fins with dark spots; caudal fin with 3–5 narrow vertical dark bars; humeral area beneath operculum dusky purple with pale reticulated lines. Attains ~23 cm TL.



*Sorsogona prionota*, 17 cm SL, dorsal head, holotype of *Platycephalus heterolepis* (S Mozambique).  
Source: SSF

**DISTRIBUTION** WIO: Red Sea (Gulf of Suez) to Gulf of Oman and Pakistan, and to South Africa (St Lucia), Madagascar, Seychelles and Mauritius; recent Lessepsian migrant to Mediterranean Sea.

**REMARKS** Trawled to ~61 m deep.

## *Sorsogona tuberculata* (Cuvier 1829)

Tuberculated flathead

PLATE 122

*Platycephalus tuberculatus* Cuvier in Cuv. & Val. 1829: 258 (Trincomalee, Sri Lanka); Günther 1860; Day 1876\* [in part]; Regan 1908; Blegvad & Løppenthin 1944; Basson *et al.* 1977; Talwar & Kacker 1984.

*Suggrundus tuberculatus*: Munro 1955\*.

*Wakiyus tuberculatus*: Murty 1982\*.

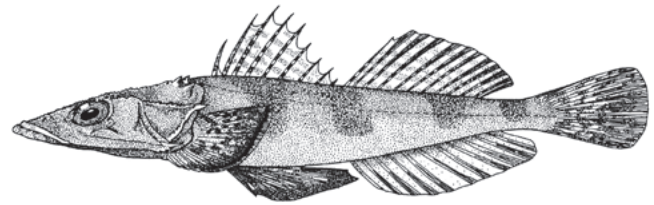
*Sorsogona tuberculata*: Knapp 1984\*; Kuronuma & Abe 1986; De Bruin *et al.* 1995\*; Randall 1995\*; Carpenter *et al.* 1997\*; Manilo & Bogorodsky 2003.

*Rogadius tuberculatus*: Imamura 1996.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 10–12 rays; anal fin 10–12 rays; pectoral fins 19–22 rays. Interorbital width 3–4.7 in orbit diameter; orbit diameter 3.4–4.7 in HL; HL 2.5–2.7 in SL. Preocular spines 2–6; supraorbital and suborbital ridges

bearing serrae or spines (some bicuspid); preopercular spines 4–9. Iris lappet crenate. GR 7–9. LL scales 47–54, first 12–28 scales bearing small spine or ridge; scales in rows above front part of lateral line sometimes bearing a hook or tubercle.

Body pale olive or tan dorsally, with 3 or 4 dark crossbars; 1st dorsal fin with submarginal brown band; 2nd dorsal fin with small brown spots on rays; anal fin white, with a few dark streaks on rear rays; pectoral and pelvic fins with several black spots, margins whitish; caudal fin whitish, with faint brown spots on rays and several indistinct vertical brown bands. Attains 14 cm TL.



*Sorsogona tuberculata*, ~12 cm SL. Source: Knapp 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf and Maldives; elsewhere, east coast of India, Gulf of Thailand, Indonesia, Philippines, western and northern Australia.

**REMARKS** Trawled from over sand and mud, to ~80 m deep.

## GENUS *Suggrundus* Whitley 1930

Head rugose, with exposed bony plates, ridges bearing stout spines or tubercles; suborbital ridge usually with  $\geq 4$  spines; preocular and preorbital spines usually single (*S. cooperi* may have additional small preopercular spines); lower edge of suborbital readily visible, not turned inwards; uppermost preopercular spine long, bayonet-like. Iris lappet bilobed or crenate; interopercular flap present. LL scale tubes with 2 openings to exterior; LSS about equal to number of LL scales. Three species, 2 in WIO.

### KEY TO SPECIES

- |    |  |
|----|--|
| 1a | GR 6 or 7 (usually 7); 2nd dorsal fin and anal fin usually 11 rays; 2nd dorsal fin transparent; pelvic fins with large dark blotches; base of upper preopercular spine with prominent antrorse accessory spine ..... <i>S. cooperi</i>   |
| 1b | GR 7–9 (usually 8); 2nd dorsal fin and anal fin usually 12 rays; 2nd dorsal fin with small brown spots on rays; pelvic fins dusky; base of upper preopercular spine with small spine, not directed forwards ..... <i>S. macracanthus</i> |

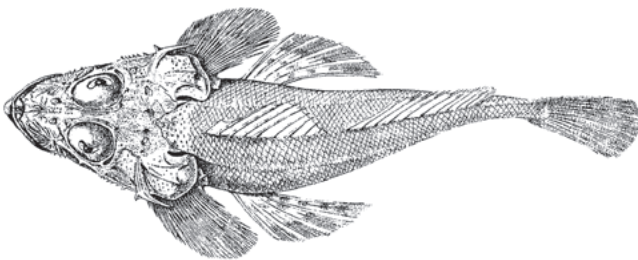
*Suggrundus cooperi* (Regan 1908)

Rough-head flathead

*Platycephalus cooperi* Regan 1908: 238, Pl. 29, Fig. 5 (Seychelles & Chagos Archipelago).*Suggrundus cooperi*: Knapp 1984; Imamura 1996.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 12 rays; anal fin 12 rays; pectoral fins 21–23 rays. Interorbital width 3.7–6.9 in orbit diameter; orbit diameter 3–4.6 in HL; HL 2.4–2.6 in SL. Head rugose, with tubercles and small spine in middle of each bony plate; supraorbital ridge with small spines and serrae; suborbital ridge with many small serrae and 1 or 2 larger spines under eye, and series of stout spinelets behind eye; preopercular spines 3 or 4, uppermost spine usually reaching to opercle margin or beyond. Iris lappet bilobed. GR 6 or 7. LL scales 51–54, first 6–10 scales with small spine or ridge.

Body buff or grey dorsally; 1st dorsal fin with broad, clear basal area, narrower submarginal dark band, and separate small black blotch behind 1st spine; 2nd dorsal fin dusky; pectoral and pelvic fins with dark blotches; anal fin usually whitish; caudal fin with dusky basal band, pale central area and dusky submarginal band. Attains 30 cm TL.

*Suggrundus cooperi*, type, dorsal view (WIO). Source: Regan 1908

**DISTRIBUTION** WIO: Amirante Is. (Seychelles), and Mascarene Ridge from Mahé to St Brandon Shoals.

**REMARKS** Trawled from 36–70 m.

*Suggrundus macracanthus* (Bleeker 1869)

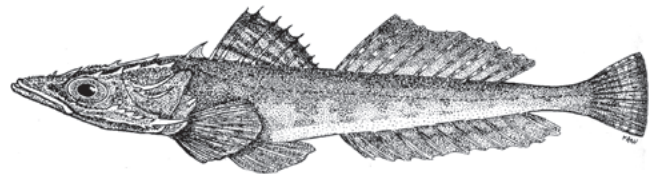
Large-spined flathead

PLATE 123

*Platycephalus macracanthus* Bleeker 1869: 253, Pl. (Ambon I., Moluccas, Indonesia); Day 1876\*.*Platycephalus sundaicus* Bleeker 1878: no page number, Pl. 419, Fig. 4 (Sumatra and Java, Indonesia); Bleeker 1879\*.*Suggrundus macracanthus*: Munro 1955\*; Knapp 1984; De Bruin *et al.* 1995\*; Imamura 1996.*Suggrundus rodericensis* (*non* Cuvier 1829): Murty 1982\*.*Platycephalus rodericensis* (*non* Cuvier 1829): Talwar & Kacker 1984.*Repotrudis rodericensis* (*non* Cuvier 1829): Kuronuma & Abe 1986.

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 or 12 rays; anal fin 12 or 13 rays; pectoral fins 20–23 rays. Interorbital width 2.8–4.1 in orbit diameter; orbit diameter 3.9–4.4 in HL; HL 2.5–3.1 in SL. Supraorbital ridge smooth over front third of eye, with ~9 minute spines posteriorly; suborbital ridge bearing stout spines; preopercular spines 3, uppermost long, bayonet-like, reaching to or past opercle margin. Iris lappet crenate or bilobed. GR 7–10. LL scales 50–55, first 13–33 scales with small spine or ridge.

Body brownish dorsally, with ~7 dark crossbars, pale ventrally; 1st dorsal fin dusky with dark horizontal streaks; 2nd dorsal fin transparent with small brown spots on rays; anal fin transparent, with a few dark streaks on rear rays; pectoral fins with dark spots on upper surface, greyish on lower surface; pelvic fins greyish; caudal fin brownish. Attains 26 cm TL (commonly 18 cm TL).

*Suggrundus macracanthus*. Source: Knapp 1999; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: southern India and Sri Lanka; elsewhere to Gulf of Thailand, Indonesia, Philippines, Taiwan and Australia.

**REMARKS** Trawled from over sand and mud, to ~132 m deep.

**GENUS** *Sunagocia* Imamura 2003

Lateral-line scales 50–54, first 1–3 scales with small spine; LSS about equal to number of LL scales; sensory tubes on cheeks few; preocular spine single or 3–5; suborbital ridge with ~4–9 larger spines and ≥20 fine serrations; iris lappet with short branches. Five species, 4 in WIO (plus 1 unidentified species; Plate 124).



## KEY TO SPECIES

- 1a Row of papillae on upper part of eyes, middle papilla elongate; extensive mottling of large blotches on lower sides ..... *S. carbunculus*
- 1b No papillae on upper part of eyes; mottling on lower sides, if present, small specks ..... 2
- 2a Preocular spine 1; anal fin 12 rays; GR 6 or 7; suborbital ridge with ~4–9 larger spines ..... 3
- 2b Preocular spines 3; anal fin 11 rays; GR 6; suborbital ridge with ~15–20 small serrations ..... *S. omanensis*
- 3a Lips with row of small papillae; 2nd dorsal fin usually 11 rays ..... *S. otaitensis*
- 3b No papillae on lips; 2nd dorsal fin usually 12 rays ..... *S. arenicola*

## *Sunagocia arenicola* (Schultz 1966)

Sand flathead

PLATE 123

*Thysanophrys arenicola* Schultz in Schultz *et al.* 1966: 6, Pl. 130b–c, Fig. 148

(lagoon reef at Naen I., Rongelap Atoll, Marshall Is.); SSF No. 155.8\*; Winterbottom *et al.* 1989\*; Smale *et al.* 1995\* [otolith]; Knapp 1999\*.

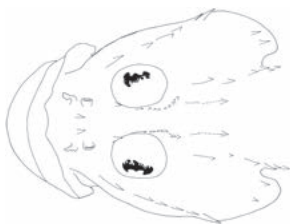
*Eurycephalus arenicola*: Imamura 1996\*; Manilo & Bogorodsky 2003;

Heemstra *et al.* 2004.

*Sunagocia arenicola*: Imamura 2003\*.

First dorsal fin 1 + 8 or 9 spines; 2nd dorsal fin 11 or 12 rays; anal fin 11–13 rays; pectoral fins 19–21 rays. Interorbital width 1.9–3.8 in orbit diameter; orbit diameter 3.5–4.7 in HL; HL 2.5–3.3 in SL. Preocular spine 1; no preorbital spine; supraorbital ridge smooth over front half of eye, ~7 spines posteriorly; suborbital ridge with  $\geq 4$  spines; upper preopercular spine at most reaching halfway to opercle margin; no interopercular flap. GR 5–7. LL scales 51–54, first 1–3 scales bearing small spine.

Body pale brown or greyish dorsally, finely mottled with brown and white; fins with small brown flecks. Attains ~23 cm TL.



*Sunagocia arenicola*, 14 cm SL, dorsal head (South Africa).

Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden to South Africa (Sodwana Bay), Comoros, Seychelles, Rodrigues and Chagos; elsewhere to Philippines, Taiwan, southern Japan, Marshall Is., New Guinea, Australia, New Caledonia and Fiji.

**REMARKS** Found on sandy areas near rocks and coral reefs; buries in the sand for camouflage.

## *Sunagocia carbunculus* (Valenciennes 1833)

Carbuncle flathead

*Platycephalus carbunculus* Valenciennes in Cuv. & Val. 1833: 461 (Mumbai, India); Cantor 1849.

*Platycephalus bobosok* Bleeker 1853: 461 (Jakarta, Java, Indonesia).

*Platycephalus cantori* Bleeker 1879: 26 (India; Penang I., Malaysia; Moluccas, Indonesia).

*Thysanophrys carbunculus*: De Bruin *et al.* 1995\*; Knapp 1999\*.

*Eurycephalus carbunculus*: Imamura 1996; Knapp & Imamura 1997\*; Manilo & Bogorodsky 2003.

*Sunagocia carbunculus*: Imamura 2003; Knapp & Randall 2013.

First dorsal fin 1 + 7 or 8 spines; 2nd dorsal fin 11 rays; anal fin 12 rays; pectoral fins 18–20 rays. Preorbital spine 1; nasal spines 2; ethmoid spines 2. Interorbital width 4.6–7.3 in orbit diameter; orbit diameter 3.4–4.1 in HL; HL 2.7–3.6 in SL. GR 6 or 7. LL scales 50–54, first 2–30 scales bearing weak spine; DSC 7–10.

Body greenish or brownish dorsally, with 4 or 5 dark crossbars and series of dark blotches along lower sides; 1st dorsal fin with broad submarginal dark band; 2nd dorsal fin and pectoral and pelvic fins with dark spots or blotches; caudal fin with several vertical dark bars. Attains ~18 cm TL.

**DISTRIBUTION** Indo-Pacific. WIO: possibly India (Mumbai); elsewhere, Gulf of Thailand, Malaysia (Penang I.), Singapore and Indonesia.

**REMARKS** The locality of the holotype is in doubt; recent and extensive collecting in WIO has not yielded any specimens of this species, and it may well not occur in the region.

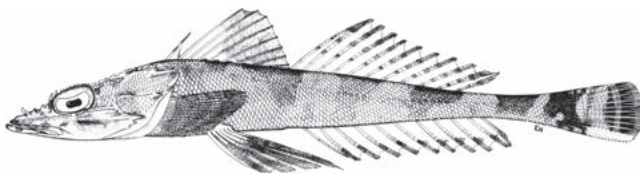
*Sunagocia omanensis* Knapp & Randall 2013

Omani flathead

*Sunagocia omanensis* Knapp & Randall 2013: 98, Figs. 1–2 (Sawda I., Khuriya Muriya Is., Oman).

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins 20 or 21 rays. Interorbital width 4.4–4.6 in snout length. Preocular spines 3; pair of nasal spines; ethmoid spines on midline forming unique rosette, with 5 or 6 tips from a common base; base of lower opercular spine with 5 or 6 serrations. GR 6. LL scales 53, first 3 scales with spines; DSC 12.

Body pale tan, with 5 or 6 dark saddles, most extending to below midsides; 1st dorsal fin with broad submarginal dark band; anal fin with submarginal dark band; pectoral fins with 3 or 4 dark bands; pelvic fins with dark blotches; caudal fin with broad dark blotch at base, centre pale, and 2 dark bands at margin. Attains at least 13 cm TL.

*Sunagocia omanensis*, 12 cm SL (Oman). Source: Knapp & Randall 2013**DISTRIBUTION** WIO: Oman.**REMARKS** Type specimens collected from sand and rubble bottom, at ~21 m.*Sunagocia otaitensis* (Cuvier 1829)

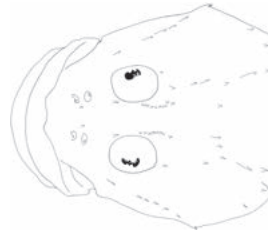
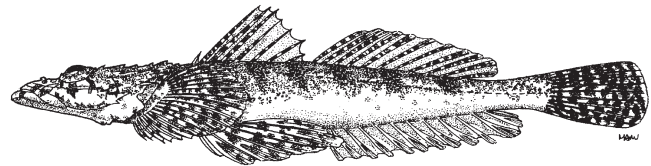
Fringelip flathead

PLATE 123

*Cottus otaitensis* Cuvier (ex Parkinson) in Cuv. & Val. 1829: 242 (Tahiti, Society Is.).*Platycephalus malayanus* Bleeker 1854: 498 (Padang, Sumatra, Indonesia); Jones & Kumaran 1980\*.*Thysanophrys otaitensis*: SSF No. 155.11\*; Winterbottom *et al.* 1989\*; Randall & Anderson 1993; Fricke 1999.*Eurycephalus otaitensis*: Imamura 1996.*Sunagocia otaitensis*: Imamura 2003\*.

First dorsal fin 1 + 8 or 9 spines; 2nd dorsal fin 11 or 12 rays; anal fin 11–13 rays; pectoral fins 20–22 rays. Interorbital width 1.6–4.4 in orbit diameter; orbit diameter 3–5 in HL; HL 2.6–3.3 in SL. Development of spines on head similar to that of *S. arenicola*. GR 5–7. LL scales 51–54, first 1–3 scales with spines.

Body pale brown dorsally, finely mottled with darker brown and white blotches, sometimes with 4 or 5 indistinct dark crossbars; fins with brown flecks. Attains 25 cm TL.

*Sunagocia otaitensis*, 20 cm SL, dorsal head (South Africa). Source: SSF*Sunagocia otaitensis*. Source: Knapp 1999; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific (widespread). WIO: Mozambique to South Africa (KwaZulu-Natal), Madagascar, Comoros, Mascarenes, Chagos, Maldives and Sri Lanka; elsewhere to Indonesia, southern Japan, Marshall Is., Australia, New Caledonia, Tahiti and Pitcairn Is.

**REMARKS** Found on sand near coral reefs, to ~15 m deep.**GENUS** *Thysanophrys* Ogilby 1898

LSS about equal to number of LL scales; cheeks completely covered with well-developed sensory tubes; iris lappet with long or short branches, crenate in some; preocular spine 1; preorbital spines 1 or more; suborbital ridge with  $\geq 4$  distinct spines (except no spines in *T. cirronasa* (Richardson 1848) from Australia). About 9 species, at least 7 in WIO (*T. papillaris* Imamura & Knapp 1999, known from the Andaman Sea, South China Sea and Australia, is also included in the key).

**KEY TO SPECIES**

1a	Single papilla on upper part of eye.....	2
1b	No papilla on upper part of eye.....	3
2a	Papilla on upper part of eye finger-like; anal fin 13 (rarely 12) rays; preorbital spines 2–4 (rarely 1).....	<i>T. celebica</i>
2b	Papilla on upper part of eye tiny and wart-like; anal fin 12 rays; preorbital spine single.....	<i>T. papillaris</i> [eastern Indian Ocean]
3a	DSC (diagonal scale count downwards and backwards from origin of 2nd dorsal fin to lateral line) 9–12.....	7
3b	DSC 4–8.....	4
4a	DSC 4 or 5.....	5
4b	DSC 6–8.....	6
5a	DSC 5; 1st dorsal fin 1 + 8 spines; GR 6; snout length 2.8–3.3 in HL.....	<i>T. springeri</i>
5b	DSC 4 or 5; 1st dorsal fin 1 + 7 spines; GR 5 or 6; snout length 3.7–4 in HL.....	<i>T. tricaudata</i>
6a	Nasal spines with elongate base, half height of preocular spine; iris lappet with short branches with bifid tips; snout length ~2.8–3.3 in HL.....	<i>T. chiltonae</i>
6b	Nasal spines taller, no elongate base, subequal to height of preocular spine; iris lappet crenate; snout length ~3.2–3.5 in HL.....	<i>T. randalli</i>
7a	Preocular spine single; suborbital ridge bearing 6–9 larger spines.....	<i>T. longirostris</i>
7b	Preocular spines 6; suborbital ridge with ~25 small spines.....	<i>T. rarita</i>

***Thysanophrys celebica*** (Bleeker 1855)

Sulawesi flathead

PLATE 124

*Platycephalus celebicus* Bleeker 1855: 450 (Manado, Sulawesi, Indonesia).

*Platycephalus pristis* Peters 1855: 433 (Mozambique); Barnard 1927;

Smith 1950; Dor 1984.

*Platycephalus heterolepis* (non Barnard 1927): Fowler 1934.

*Grammoplites pristis*: Fowler 1935\*.

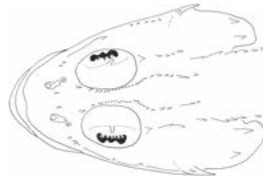
*Thysanophrys carbunculus*: Murty 1982.

*Thysanophrys celebica*: SSF No. 155.9\*; Randall *et al.* 1994; Randall 1995\*; Carpenter *et al.* 1997\*; Knapp 1999\*, 2013; Manilo & Bogorodsky 2003.

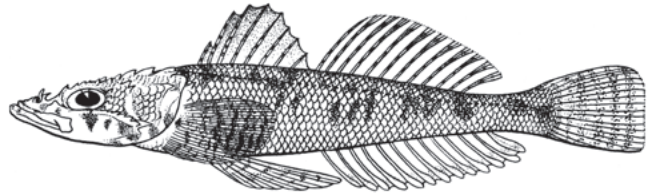
First dorsal fin 1 + 7 or 8 spines; 2nd dorsal fin 11 or 12 rays; anal fin 13 (rarely 12) rays; pectoral fins 19 or 20 rays. Interorbital width 3.6–8.3 in orbit diameter; orbit diameter

1–1.1 in snout length; HL 2.2–3.1 in SL. Single finger-like papilla on upper part of eye. Preorbital spines 2–4 (rarely 1). GR 5–7. LL scales 50–53, first 2–10 scales with weak spine.

Body greyish or brownish dorsally, with 3 or 4 darker crossbars; pectoral and pelvic fins with dark blotches or bands; 1 or 2 dark subocular bars. Attains ~20 cm TL.



*Thysanophrys celebica*, 11 cm SL, dorsal head (Tanzania). Source: SSF



*Thysanophrys celebica*, 16 cm TL. Source: Fowler 1935

**DISTRIBUTION** Indo-Pacific. WIO: Persian/Arabian Gulf to South Africa and to Sri Lanka; elsewhere to east coast of India, Indonesia, Philippines, Taiwan, Australia and Solomon Is.

**REMARKS** Usually taken in <20 m, but trawled to ~43 m deep.

***Thysanophrys chiltonae*** Schultz 1966

Longsnout flathead

PLATE 124

*Thysanophrys chiltonae* Schultz in Schultz *et al.* 1966: 57, Figs. 146–147

(coral head near lagoon at Rongelap I., Rongelap Atoll, Marshall Is.);

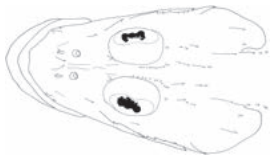
SSF No. 155.10\*; Randall & Anderson 1993; De Bruin *et al.* 1995\*;

Randall 1995\*; Fricke 1999; Manilo & Bogorodsky 2003;

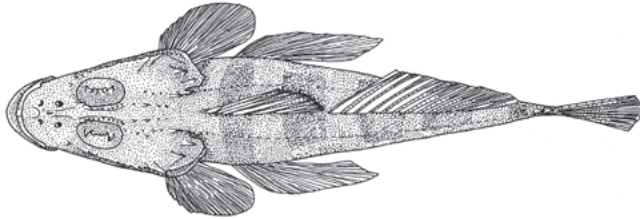
Fricke *et al.* 2009.

First dorsal fin 1 + 7 or 8 spines; 2nd dorsal fin 11 rays; anal fin 12 rays; pectoral fins 19–21 rays. Interorbital width 3.6–5.3 in eye diameter; orbit diameter 1.3–1.7 in snout length; HL 2.4–2.9 in SL. Preorbital spines 1 or 2; nasal spines with elongate base. Iris lappet with short branches with bifid tips. GR 6 or 7. LL scales 52–55, first 2 or 3 scales with spine.

Body grey or tan dorsally, with white mottling and 5–7 brown crossbars. Attains 25 cm TL.



*Thysanophrys chiltonae*, 13 cm SL, dorsal head (South Africa). Source: SSF



*Thysanophrys chiltonae*, dorsal view. Source: Knapp 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** Indo-Pacific. WIO: Oman, Mozambique to South Africa (Sodwana Bay), Madagascar, Comoros, Seychelles, Mauritius, Maldives and Sri Lanka; elsewhere to Indonesia, Philippines, Taiwan, Ryukyu Is., Marshall Is., Mariana Is., Australia, New Caledonia and Marquesas Is.

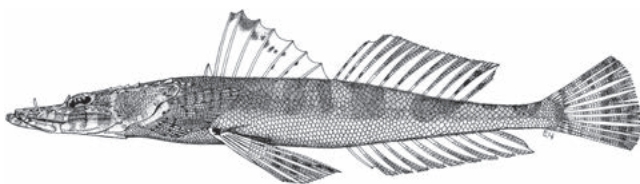
**REMARKS** Erroneously reported as being found at Rodrigues by Knapp (1984) and Heemstra *et al.* (2004).

### *Thysanophrys longirostris* (Shao & Chen 1987)

Deepwater flathead

*Suggrundus longirostris* Shao & Chen 1987: 83, Figs. 1a, 17–18 (Daxi, Taiwan).  
*Thysanophrys longirostris*: Imamura 1996; Matsuura *et al.* 2001.

Preocular spine 1; suborbital ridge with 6–9 larger spines. Specimens with DSC 9–11 from South Africa, Comoros and Mauritius are tentatively regarded as this species, although its status remains unclear and it may prove to be a deeper-water form of *T. chiltonae*: the two species appear very similar in colour pattern and counts, except for number of scale rows between 2nd dorsal-fin origin and lateral line. Attains ~22 cm TL.



*Thysanophrys longirostris*, 19 cm SL, paratype (Taiwan).

**DISTRIBUTION** Indo-Pacific. WIO: South Africa, Comoros and Mauritius; elsewhere, Christmas I., Indonesia (Sulawesi), Philippines, Taiwan, South China Sea, Palau and Marquesas Is.

### *Thysanophrys randalli* Knapp 2013

Snub-snouted flathead

*Platycephalus* sp.: Wass 1984.

*Thysanophrys randalli* Knapp 2013: 128, Figs. 1–2 (Mauritius, Mascarenes).

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 12 rays; pectoral fins 20 or 21 rays; pelvic fins 1 spine, 4 + 1 rays; caudal fin 10 branched rays. Eye diameter 1.1–1.4 in snout length; snout length 3–3.6 in HL. Preorbital spines 1 or 2. Iris lappet crenate. GR 6 or 7. LL scales 52–54, first 2 or 3 bearing small spines; DSC 6 or 7.

Body brownish dorsally, with faint bands crossing back; series of irregular small dark blotches along lower sides; 1st dorsal fin with small dark spots on rays and larger dark blotch along upper margin of first 4 rays; 2nd dorsal fin with small dark spots on rays and faint dark blotch at rear margin; pectoral and pelvic fins dark with few darker blotches; anal fin mostly transparent; caudal fin with dark band at base, followed by clear band, and rear half of fin dusky with numerous small dark spots. Attains 12 cm TL.



*Thysanophrys randalli*, 9 cm SL, holotype (Mauritius). Source: Knapp 2013

**DISTRIBUTION** WIO: Mascarenes and Seychelles (Amirante Is.); possibly widely distributed in Indo-Pacific.

**REMARKS** Collected at ~4–28 m.

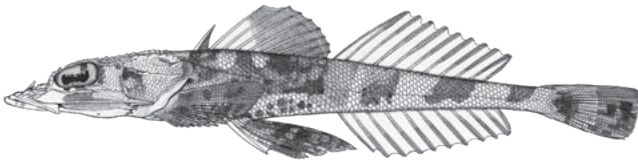
### *Thysanophrys rarita* Knapp 2013

*Thysanophrys rarita* Knapp 2013: 130, Figs. 3–5 (Somalia).

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 11 rays; pectoral fins ~21 rays (2 unbranched + 11 branched + 8 unbranched); pelvic fins 1 spine, 4 + 1 rays; caudal fin 10 branched rays. Snout length 3.5 in HL. Preorbital spines 6; suborbital ridge with ~25 small spines. GR 7. LL scales 54, first 11 bearing small spines; DSC 10.

Body with 6 dark crossbars, extending far down sides, and series of small dark spots on lower side below 1st dorsal fin; rear two-thirds of 1st dorsal fin with broad marginal dark band; 2nd dorsal fin and anal fin transparent; pectoral and pelvic fins with dark blotches; caudal fin with dark blotch at base, and several small dark blotches along margin. Attains at least 15 cm TL.





*Thysanophrys rarita*, 13 cm SL, holotype (Somalia). Source: Knapp 2013

**DISTRIBUTION** Known only from the holotype from Somalia.

**REMARKS** Trawled from ~22 m.

### *Thysanophrys springeri* Knapp 2013

Red Sea flathead

PLATE 125

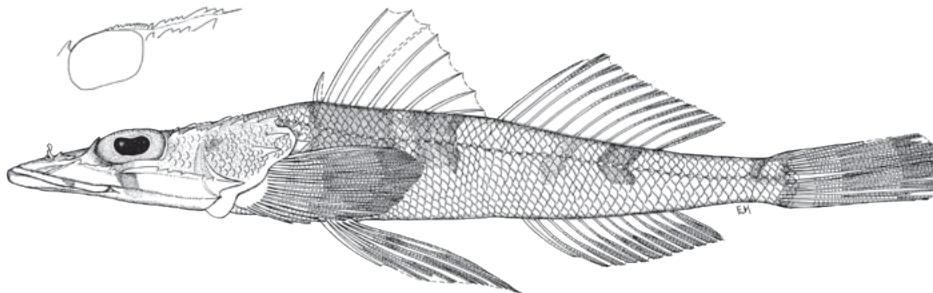
*Thysanophrys springeri* Knapp 2013: 131, Figs. 6–7 (Melita Bay, Eritrea, Red Sea).

First dorsal fin 1 + 8 spines; 2nd dorsal fin 11 rays; anal fin 12 rays; pectoral fins 19 rays (one specimen with 20 rays); pelvic fins 1 spine, 5 rays; caudal fin 10 branched rays. Snout length 2.8–3.1 in HL. Preorbital spines 1–4 (usually 3). Iris lappet with short branches. GR 6. LL scales 50–53, first 3 scales with small spines; DSC 5.

Body tan dorsally, pale ventrally; dorsum crossed by 2 broad dark bands at 1st dorsal fin, fainter dark band under middle of 2nd dorsal fin, and bolder dark band under rear of 2nd dorsal fin; 2nd dorsal fin and anal fin pectoral fins with black margin; pectoral-fin rays pale proximally, distal two-thirds dark; pelvic fins mostly dark; caudal fin with dark band at base, fainter band crossing middle, and broad dark band along margin. Attains ~12.5 cm TL.

**DISTRIBUTION** WIO: Red Sea and Gulf of Aden (Gulf of Tadjoura, off Djibouti).

**REMARKS** Known from 4–21 m.



*Thysanophrys springeri*, 9 cm SL, holotype, and detail of supraorbital and postocular spination (Eritrea). Source: Knapp 2013

### *Thysanophrys tricaudata* Knapp 2013

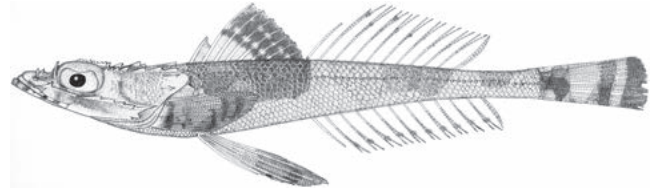
Sri Lankan flathead

*Thysanophrys armata*: Debelius 1993\*.

*Thysanophrys tricaudata* Knapp 2013: 133, Figs. 8–9 (Hikkaduwa, Sri Lanka).

First dorsal fin 1 + 7 spines; 2nd dorsal fin 11 rays; anal fin 12 rays; pectoral fins 19 or 20 rays; pelvic fins 1 spine, 5 rays; caudal fin 9 branched rays. Snout length 3.6–3.9 in HL. Preorbital spines 1. GR 5 or 6. LL scales 51 or 52, anteriormost scale bearing small spine; DSC 4 or 5.

Body grey dorsally, pale ventrally; 1st dorsal fin with submarginal dark band with pale spots in 2 series; caudal fin with 3 bold vertical dark bars with whitish areas between; pectoral fins with ~4 dark bands; pelvic fins with 3 indistinct dark bands. Attains at least 16 cm TL.



*Thysanophrys tricaudata*, 9 cm SL, holotype (Sri Lanka). Source: Knapp 2013

**DISTRIBUTION** WIO: southwestern Sri Lanka.

**REMARKS** Type specimens collected at 15–20 m.

#### GLOSSARY

**crenate** – having a margin shaped into small, rounded scallops.  
**cuneal** – wedge-shaped.

## FAMILY HOPLICHTHYIDAE

### Spiny flatheads

Leslie W Knapp

Head and body depressed; body elongate, tapering posteriorly. Dorsal surface of head with numerous serrate spines, denticulate ridges, and minute bony tubercles; rear edge of opercle with 2 sharp points; preopercle fused with other head bones, the ventral terminus with large retrorse spine; supraorbital ridge serrate. No scales on body, but lateral-line scales modified to form row of large spiny scutes along sides, from head to tail, each scale bearing a large, blade-like, curved, retrorse spine, plus a few smaller spinelets at each spine's base. Mouth terminal, jaws subequal; posterior end of maxilla enlarged, spatulate, mostly hidden in groove under lachrymal; minute, sharp, conical teeth on jaws, vomer and palatines. Two separate dorsal fins: 1st dorsal fin with 6 slender, fragile spines; 2nd dorsal fin with 14 or 15 slender, segmented, branched and mostly isolated rays, last ray split to its base, and dorsal-fin rays of males filamentous; anal fin with 1 short spine, 16 slender branched rays; fin membranes of median fins thin and fragile. Pelvic fins with 1 slender flexible spine, 5 branched rays, fin origins on chest, well before lower end of pectoral-fin base. Pectoral-fin tips reach past anus; upper 12 rays joined by membrane, lower 3 rays free. Caudal fin 10 branched rays, plus 2 unbranched rays above and below. Branchiostegal rays 7, membranes joined to front of isthmus. No swimbladder; peritoneum dusky, with scattered small black spots.

One genus, *Hoplichthys* Cuvier 1829, with ~10 species in Indo-Pacific; 1 species in WIO.

#### *Hoplichthys acanthopleurus* Regan 1908

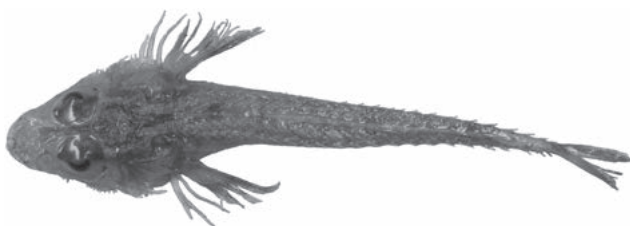
Ultra-spiny flathead

PLATE 125

*Hoplichthys acanthopleurus* Regan 1908: 239, Pl. 28, Fig. 5 (Saya de Malha Bank); SFSA No. 1061\*; SSF No. 156.1\*; Adam *et al.* 1998.

Second dorsal fin 14 or 15 rays; anal fin 1 spine, 16–18 rays; pectoral fins 12 or 13 rays. Body depth ~15 in SL; HL ~3.3 in SL; eye diameter 3.7–3.8 in HL; interorbital width ~6.7 in eye diameter. Jaws subequal; maxilla expanded posteriorly. GR 1/12, plus cluster of 3 rakers at angle of 1st arch. LL scutes 27 or 28.

Head and body pale yellowish buff dorsally, white ventrally; fin rays pale orange distally. Attains 18 cm TL.



*Hoplichthys acanthopleurus*, 18 cm TL (Mozambique). © Alvhheim © IMR

**DISTRIBUTION** WIO: Mozambique, South Africa (KwaZulu-Natal), Madagascar, Seychelles, Saya de Malha Bank and Maldives.

**REMARKS** Trawled from 70–300 m.

#### GLOSSARY

**lachrymal** – the anteriormost bone below the eye.

**scutes** – modified (thickened) bony scales with a keel or spiny point.

## FAMILY DACTYLOPTERIDAE

### Helmet gurnards

Phillip C Heemstra

Body oblong, tapering posteriorly; head large and blunt, with bones fused to form a bony helmet; preopercle spine very long; scapulae exposed, expanded backwards and ending in sharp spine. Mouth small, subterminal; jaws with villiform teeth, no teeth on palate. First dorsal fin with 1 or 2 isolated spines (anteriormost spine elongate) set well in front of main spinous portion of fin, followed by 5 slender spines joined by membrane; 2nd dorsal fin larger, with soft rays; anal fin 6 rays, fin similar to and opposite 2nd dorsal fin; pectoral fins enormous, reaching past 2nd dorsal fin; pelvic fins 1 spine, 4 rays; caudal fin concave. Body covered with scute-like scales; 3 or 4 hemi-circular disc-like scutes along ventrolateral part of peduncle. Lateral line not apparent.

Although these benthic fishes are often called 'flying gurnards' they cannot glide out of the water. The greatly enlarged pectoral fins have led to the erroneous impression that dactylopterids are able to behave like true flyingfishes (family Exocoetidae). Unlike flyingfishes, helmet gurnards are heavy and the pectoral fins weak, supported only by soft flexible rays. Dactylopterids probably spread their pectoral fins in defensive displays to startle predators and to appear larger; these large and colourful fins may also play a role in courtship, feeding behaviour, and possibly species recognition. Likewise, the greatly enlarged fins of most gurnards (family Triglidae) and of some scorpionfishes (family Scorpaenidae) are probably used in similar ways. Feed on molluscs, benthic crustaceans and fishes.

Two genera and 7 species; 1 genus and 2 or 3 species in WIO. *Dactylopterus volitans* (Linnaeus 1758) of the monotypic genus *Dactylopterus* Lacepède 1801 is confined to the Atlantic Ocean.

GENUS *Dactyloptena* Jordan & Richardson 1908

Diagnosis as for family. Six species, 2 or 3 in WIO. One specimen of *Dactyloptena gilberti* Snyder 1909 was reported from the Red Sea by Bogorodsky *et al.* 2014, but no specimens of *D. gilberti* have been examined to confirm this distribution.

KEY TO SPECIES

- 1a Two free dorsal-fin spines: 1st spine just behind head, 2nd spine midway between 1st and main portion of spinous dorsal fin ..... *D. orientalis*
- 1b One free dorsal-fin spine, just behind head, followed by wide gap to main portion of spinous dorsal fin ..... *D. peterseni*

*Dactyloptena orientalis* (Cuvier 1829)

Oriental helmet gurnard PLATE 126

*Dactylopterus orientalis* Cuvier (ex Russell) 1829: 162 (Coromandel coast, India); Cuvier & Valenciennes 1829\*.

*Dactyloptena orientalis*: SFSA No. 1076\*; SSF No. 159.1\*; Manilo & Bogorodsky 2003; Heemstra *et al.* 2004; Heemstra & Heemstra 2004; Fricke *et al.* 2009; Bogorodsky *et al.* 2014.

First dorsal fin 2 free + 5 spines; 2nd dorsal fin 9 rays; anal fin 6 or 7 rays; pectoral fins 32–35 rays, anterior 5 rays partly free (used as feelers to find prey and walk along the bottom).

Head and body reddish brown dorsally, white ventrally; 1st spine of dorsal fin black; pectoral fins spotted yellowish brown and pale blue-grey; pelvic-fin rays and anal fin pale blue; caudal fin with reddish margin and 2 vertical series of reddish yellow spots; iris red in adults, white in juveniles. Attains 56 cm TL, ~1.5 kg.



*Dactyloptena orientalis*, 11 cm TL (Mozambique). © Alvheim © IMR

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, Persian/Arabian Gulf to India and Sri Lanka, Oman to South Africa (Mossel Bay), Madagascar, Comoros, Aldabra, Seychelles and Réunion; elsewhere to east coast of India, Indonesia, Japan, Australia, Marquesas Is. and Hawaii.

**REMARKS** Most common helmet gurnard in WIO, and most widespread member of family. Lives on sand, gravel and coral-rubble bottoms, from 20–144+ m; well-camouflaged. Prejuveniles (3–6 cm SL) often taken near surface at night with a light.

*Dactyloptena peterseni* (Nyström 1887)

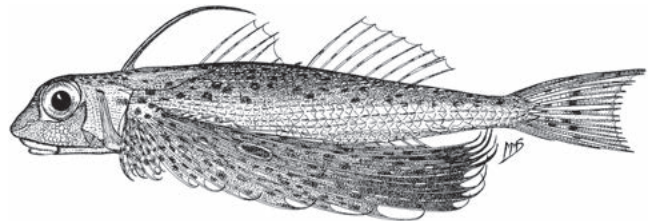
Rufous helmet gurnard PLATE 126

*Dactylopterus peterseni* Nyström 1887: 24 (Nagasaki, Japan).

*Dactyloptena peterseni*: Smith 1953; Smith & Smith 1966\*; Baranes & Golani 1993\*; Heemstra & Heemstra 2004\*; Fricke *et al.* 2009.

First dorsal fin 1 free spine + 5 spines; 2nd dorsal fin 9 rays; anal fin 6 rays; pectoral fins 32–34 rays.

Head, body and fins reddish orange, covered with yellowish and brownish green spots; paler ventrally; dark swathe along middle 5 pectoral-fin rays; small disc-like scutes of peduncle white. Attains 37 cm TL.



*Dactyloptena peterseni*, 20 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Red Sea, northern Mozambique to South Africa (Algoa Bay), Madagascar, St Lazarus Bank, Comoros, Réunion, Saya de Malha Bank and India; elsewhere to Ogasawara Is. (Japan), Saipan, Arafura Sea and northern Australia.

**REMARKS** Found over sandy or gravel bottoms in coastal areas. Adults trawled from 43–510 m.

GLOSSARY

- scapula** – a bone of the pectoral girdle.
- scute-like scales** – scutes are modified (thickened) bony scales with a keel or spiny point.

## FAMILY TRIGLIDAE

## Gurnards

William J Richards

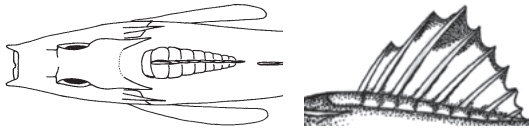
Body elongate; head large and bony with many ridges and spines but without barbels; snout usually ending in pair of projections (rostral processes), often with one or more pairs of short to moderate spines (terminology for rostral process follows Richards & Yato 2014). Mouth terminal to slightly inferior; villiform teeth present in both jaws. Two separate dorsal fins: 1st dorsal fin 7–11 spines, 2nd dorsal fin 11–18 rays; anal fin 10–17 rays; pectoral fins short to long, 3 lowermost rays free, detached from upper rays. Body with small scales, no bony scutes. Swimbladder bilobed in most species, and capable of sound production. Colouration variable: silvery to red or black or dusky, belly always paler; some species with prominent dark saddles; 1st dorsal fin often with black or red spot or blotch; pectoral fins usually with bands, spots or blotches, and often quite colourful with blue, green, black and/or white features.

Small- to medium-sized (to ~75 cm TL), on continental and insular shelves of tropical and warm-temperate seas, commonly to ~200 m deep, but several species occur at much deeper depths. Benthic, on sandy, muddy, rubble or reef-type bottoms, using their free pectoral-fin rays for support and as feelers to search for food. Most species are not the object of any special fishery but are often collected in bottom-trawl catches; although most species are considered trash fish, some larger ones are used as food as the flesh is tasty and firm.

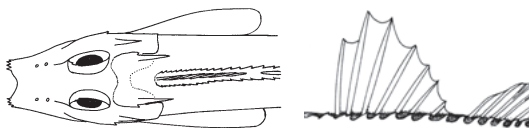
Eight genera and ~125 species; 3 genera and at least 15 species in WIO at depths of <200 m.

## KEY TO GENERA

- 1a Broad, flattened, bony plates on body along sides of 1st dorsal fin only (no spines or plates along 2nd dorsal-fin base); lateral line not bifurcate on caudal fin ..... *Pterygotrigla*



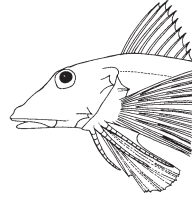
- 1b Small bony plates with spines along sides of 1st and 2nd dorsal fins; lateral line bifurcate on caudal fin ..... 2



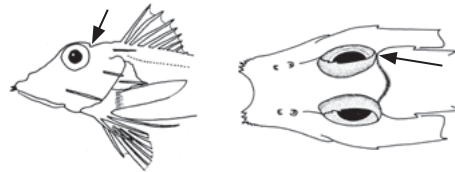
Continued ...

## KEY TO GENERA

- 2a LL scales >70; no groove behind eyes ..... *Chelidonichthys*



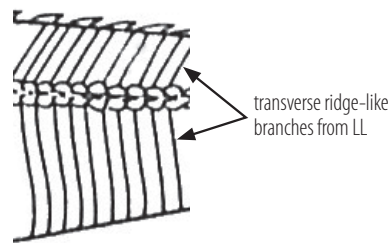
- 2b LL scales <70; prominent groove behind eyes ..... *Lepidotrigla*

GENUS *Chelidonichthys* Kaup 1873

Both dorsal-fin bases with small bony plates (expanded pterygiophores) bearing strong lateral spines; no groove behind eyes; LL scales usually >70; lateral line bifurcate on caudal fin. Eight species, 4 in WIO.

## KEY TO SPECIES OR SUBSPECIES

- 1a Lateral-line canal normal, without extensive branches ..... 2  
1b Lateral-line canal with many branches extending transversely over sides of body ..... *C. lastoviza africanus*



- 2a Second dorsal fin + anal fin with total 29–33 rays; breast naked ..... 3  
2b Second dorsal fin + anal fin with total 34–36 rays; breast scaly ..... *C. queketti*  
3a Lower GR 13–18; eyes small, interorbital width 0.5–1.7 in eye diameter ..... *C. capensis*  
3b Lower GR 8–10; eyes large, interorbital width 1.5–2.2 in eye diameter ..... *C. kumu*



## *Chelidonichthys capensis* (Cuvier 1829)

Cape gurnard

PLATE 127

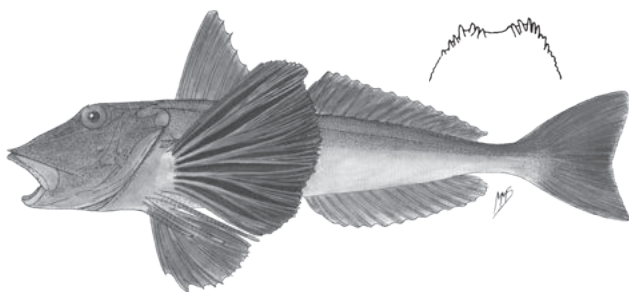
*Trigla peronii* Cuvier in Cuv. & Val. 1829: 53 (Indian Ocean); Blanc & Hureau 1968.

*Trigla capensis* Cuvier in Cuv. & Val. 1829: 55 (Cape of Good Hope, South Africa); Smith 1949\*; Blanc & Hureau 1968.

*Chelidonichthys capensis*: Richards 1968\*, 1984\*; Heemstra 1982; SSF No. 157.1\*; Heemstra & Heemstra 2004\*.

First dorsal fin 8–10 spines; 2nd dorsal fin 15–17 rays; anal fin 14–16 rays; pectoral fins 10 or 11 + 3 rays. Percentage SL: pectoral-fin length 35–40% (fins reach anal fin), HL 21–33%, eye diameter 7–8%, and interorbital width 5.3–6.7%. Rostral spines short, not projecting. GR 15–19 + rudiments. Scales small and embedded; LL scales 63–73; 19–21 scale rows above lateral line and 47 or 48 rows below. Vertebrae 12 or 13 + 21 = 33 or 34.

Body and median fins reddish orange, pale ventrally; pectoral fins dark green with faint reddish margin, intense black blotch on inner surface and several tiny white spots mainly on blackish border, and separate lower rays reddish. Attains 75 cm TL.



*Chelidonichthys capensis*, 60 cm TL; 22 cm SL, dorsal view of rostral process (both South Africa). Source: SSF

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa and Mozambique (Maputo Bay) in WIO.

**REMARKS** Found at 10–390 m. Excellent food fish and valuable commercial fish caught by trawlers. Records of *C. hirundo* (Linnaeus 1758) (= *C. lucerna*) from Walvis Bay, Namibia, by Smith (1949) are probably referable to *C. capensis*. *Trigla peronii* has also been considered a synonym of *C. kumu* (Cuvier 1829), and is represented by 7 syntypes. All specimens with GR 14–16 and eye diameter 7.5–8.3% SL, exceeding the interorbital widths of 5.2–6% SL (specimens 7–16.5 cm SL). In 4 small syntypes (2.6–4.3 cm SL), the eye diameter (9.5–12.1% SL) still exceeds the interorbital width

(8.1–10.2% SL), as there are clear proportional differences with size. *Chelidonichthys capensis* is represented by 4 syntypes: two poorly preserved heads and two mounted dried skins. The two heads each have GR 17, and eye diameters exceeding the interorbital widths. The two skins are large specimens (~40–50 cm SL); the gill rakers are no longer extant, but the eye diameters are much less than the interorbital widths. To preserve nomenclatural stability, the larger of the syntype heads (catalogued MNHN 6938) is designated as the lectotype of *C. capensis*, which is recognised as the valid name for this species, and *Trigla peronii* Cuvier is placed in synonymy.

## *Chelidonichthys kumu* (Cuvier 1829)

Bluefin gurnard

PLATE 127

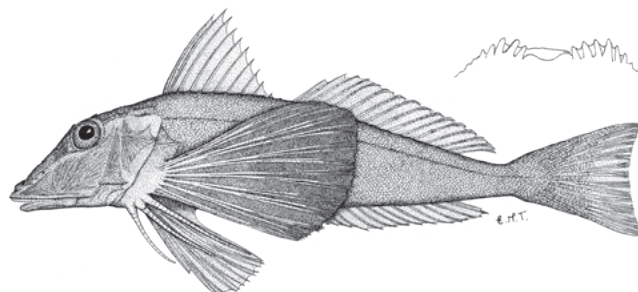
*Trigla kumu* Cuvier in Cuv. & Val. (ex Lesson) 1829: 50 (New Zealand); Lesson 1830: 214\*; Smith 1949; Blanc & Hureau 1968.

*Trigla amoena* Castelnau 1873: 131 (Fremantle, Western Australia); Smith 1949\*; Blanc & Hureau 1968.

*Chelidonichthys kumu*: Ochiai & Okada 1966; Heemstra 1982; Richards 1984\*; SSF No. 157.2\*; Heemstra & Heemstra 2004.

First dorsal fin 8–10 spines; 2nd dorsal fin 14–17 rays; anal fin 14–16 rays; pectoral fins 10 or 11 + 3 rays. Percentage SL: HL 30–34%, pectoral-fin length 30–43%, eye diameter 6.8–9.6%, and interorbital width 3.7–5.4%. Rostral spines short, not projecting. GR 8–10 + rudiments. LL scales 70–75. Vertebrae 34 or 35.

Body reddish orange dorsally, lower flanks pale; median fins reddish orange; pectoral fins olive-green with bright blue margin, and inner surface with large black blotch with white or pale blue spots. Attains 60 cm TL.



*Chelidonichthys kumu*, 22 cm TL; 14 cm SL, dorsal view of rostral process (both South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific (antitropical). WIO: Mozambique (Maputo Bay) to South Africa (False Bay); elsewhere, Australia and New Zealand (abundant), Lord Howe I. and Hawaii.

**REMARKS** Found in rivers and offshore, to ~200 m deep. Records from the China Sea and Japan are likely a different species, *C. spinosus* (McClelland 1843). A thorough study throughout its range and comparisons with *C. spinosus* and the European *C. lucerna* (Linnaeus 1758) is warranted. Recent biochemical data indicate that *C. kumu* from Australia is not the same as *C. kumu* from Africa (PR Last, pers. comm.).

## *Chelidonichthys lastoviza africanus*

(Smith 1934)

African gurnard

PLATE 127

*Trigla (Trigloporus) africana* Smith 1934: 334, Pl. 23 (Port Alfred, Eastern Cape, South Africa).

*Chelidonichthys africanus*: SFSA No. 1085\*.

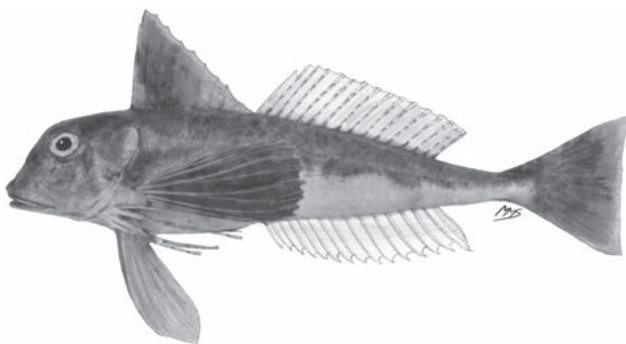
*Trigloporus lastoviza*: Richards & Saksena 1980.

*Chelidonichthys (Trigloporus) lastoviza*: Richards 1984\*.

*Trigloporus lastoviza africanus*: Heemstra 1982; SSF No. 157.7\*.

First dorsal fin 10 or 11 spines; 2nd dorsal fin and anal fin each with 15–17 rays; pectoral fins 10 + 3 rays. Percentage SL: HL 24–26%, pectoral-fin length 32–45% SL, eye diameter 6.7–8.6% SL, and interorbital width 4.3–4.7%. Rostral spines short, not projecting. GR 7 or 8. Body covered with heavy ctenoid scales, arranged in distinct transverse rows; LL scales 71–75. Vertebrae 35 (rarely 33 or 34).

Body pale with irregular reddish brown markings; front of head reddish; dorsal fins and anal fin with bands of reddish marks; pectoral fins pale blue with bright blue margin, blue spots distally, red spots proximally, and membrane between rays red; caudal fin orange-red. Attains 40 cm TL.



*Chelidonichthys lastoviza africanus*, 23 cm TL (South Africa). Source: SFSA

**DISTRIBUTION** Atlantic Ocean (Norway to Azores and Morocco to Angola), Mediterranean Sea and Indian Ocean. WIO: Mozambique (Maputo Bay) to South Africa (St Sebastian Bay).

**REMARKS** Found at 35–150 m.

## *Chelidonichthys queketti* (Regan 1904)

Lesser gurnard

PLATE 128

*Trigla queketti* Regan 1904: 128 (KwaZulu-Natal, South Africa); Smith 1949\*.

*Chelidonichthys queketti*: Smith 1934; Richards 1968, 1984\*; Heemstra 1982, 1986; SSF No. 157.3\*; Heemstra & Heemstra 2004.

First dorsal fin 9 or 10 spines; 2nd dorsal fin 17–19 rays; anal fin 17 or 18 rays; pectoral fins 10 or 11 + 3 rays. Percentage SL: pectoral-fin length 29–31% (fins reach anal fin), HL 27–31%, eye diameter 7.9–8.5%, and interorbital width 5.3–5.7%. GR 10–13 + rudiments. Body scales small; breast scaly; LL scales 68–76; 10–12 scale rows above lateral line and 26–38 rows below. Rostral spines short, outer spine longest and inner spine covered with skin. Vertebrae 13 + 23 = 36.

Body generally reddish orange and lower flanks pale or silvery, but lower flanks and 2nd dorsal fin yellowish in some individuals. Attains 35 cm TL.



*Chelidonichthys queketti*, 20 cm SL; dorsal view of rostral process (both South Africa). PC Heemstra © NRF-SAIAB

**DISTRIBUTION** Southern Africa: Namibia (Walvis Bay) in southeastern Atlantic, to South Africa (KwaZulu-Natal) in WIO.

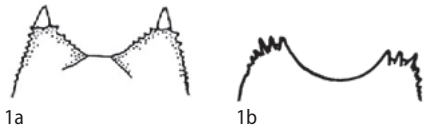
**REMARKS** Found from shore to ~212 m deep.

## GENUS *Lepidotrigla* Günther 1860

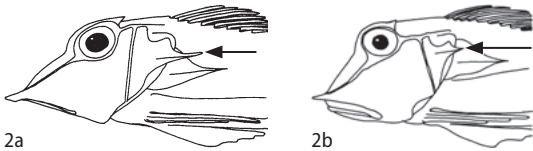
Scales large, LL scales usually <70; grooves behind eyes; plates along bases of 1st and 2nd dorsal fins with spines. Generally small-sized (<20 cm SL); coastal, in temperate to tropical waters of the eastern Atlantic and Indo-Pacific. The most speciose triglid genus; ~60 nominal forms and several undescribed species, with at least 9 species in WIO (Richards 1992).

**KEY TO SPECIES**

- 1a Rostral process with prominent blade-like spine which is much larger than other rostral spines ..... 2
- 1b Rostral process with several prominent spines, largest not much larger than other spines ..... 6



- 2a Opercle spine long, extends to upper margin of cleithral-spine base ..... *L. sayademalha*
- 2b Opercle spine short, barely extends behind of rear margin of opercle ..... 3

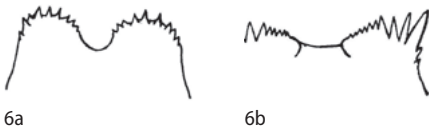


- 3a Belly not fully scaled ..... *L. bentuviai*
- 3b Belly fully scaled ..... 4

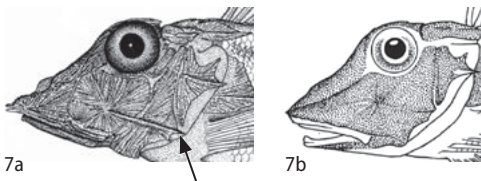
- 4a Scales very loosely attached, in uneven, indistinct rows ..... *L. longipinnis*
- 4b Scales firmly attached, in even, distinct rows ..... 5

- 5a Scale rows below lateral line 10–14 (usually 12); interorbital width 4.8–8.9% SL; HL 38.2–43.1% SL ..... *L. omanensis*
- 5b Scale rows below lateral line 15–19 (usually 18); interorbital width 4.8–8.2% SL; HL 31.5–41.7% SL ..... *L. bispinosa*

- 6a Rostral process curved, with no prominent spines ..... 7
- 6b Rostral process with several prominent spines ..... 8



- 7a Preopercle ridge strong ..... *L. multispinosa*
- 7b Preopercle ridge weak or absent ..... *L. alcocki*



- 8a Scale rows below lateral line 19–21 ..... *L. spiloptera*
- 8b Scale rows below lateral line 12–16 ..... *L. faurei*

*Lepidotrigla alcocki* Regan 1908

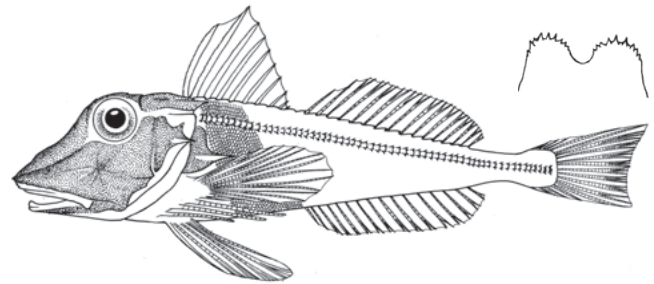
Alcock's gurnard

PLATE 128

*Lepidotrigla alcocki* Regan 1908: 240, Pl. 28, Fig. 4 (Saya de Malha Bank); Richards & Saksena 1977; Richards 1984\*, 1992; Del Cerro & Lloris 1997.

First dorsal fin 9 or 10 spines; 2nd dorsal fin 15 or 16 rays; anal fin 15–17 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 27–35%, HL 28–33%, eye diameter 7.9–10.5%, and interorbital width 3.9–5.5%. Rostral process projecting as curved process with no prominent spines (type M). Preopercle ridge weak. Scales weakly attached; nape and belly fully scaled (nape incorrectly reported as scaleless in Richards & Saksena 1977); breast and interpelvic area naked; LL scales 62–68; scale rows below lateral line 17–35 (usually 22–25). Vertebrae 32 or 33.

Head and upper body reddish; 1st dorsal fin with red blotch between 4th and 6th spines (no black spot); 2nd dorsal fin with pale submarginal band. Attains at least 14 cm SL.



*Lepidotrigla alcocki*, ~7 cm SL, and dorsal view of rostral process.

Source: Richards 1984; © Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; reproduced with permission

**DISTRIBUTION** WIO: Saya de Malha Bank.

**REMARKS** Known from 126–260 m. A subspecies, *L. alcocki vaubani*, is known from New Caledonia.

*Lepidotrigla bentuviai* Richards & Saksena 1977

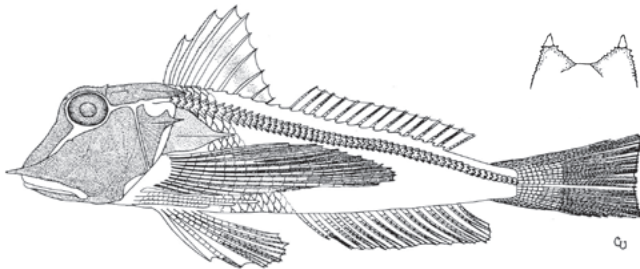
Ben-Tuvia's gurnard

*Lepidotrigla bentuviai* Richards & Saksena 1977: 213, Fig. 3 (Somalia); Richards 1984\*, 1992; Del Cerro & Lloris 1997; Manilo & Bogorodsky 2003.

First dorsal fin 8 or 9 spines; 2nd dorsal fin 14 or 15 rays; anal fin 13–15 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 42–59%, HL 33–36%, eye diameter 6.5–8.9%, and interorbital width 6.9–8.2%. Rostral process

with prominent blade-like projection (type P). Body scales firmly attached, in precise rows; nape scaly; belly partially scaled; breast and interpelvic area naked; LL scales 55–58; 14 scale rows below lateral line. Vertebrae 29–31.

Body probably reddish orange in life; grey area on 1st dorsal fin, but no distinct black blotch; inner side of pectoral fins with dark area, lower rays pale. Attains 12 cm SL.



*Lepidotrigla bentuviai*, 11 cm SL, holotype and dorsal view of rostral process (Red Sea). Source: Richards & Saksena 1977

**DISTRIBUTION** WIO: Red Sea, Gulf of Aden and Arabian Sea.

**REMARKS** Found at ~20–300 m.

### *Lepidotrigla bispinosa* Steindachner 1898

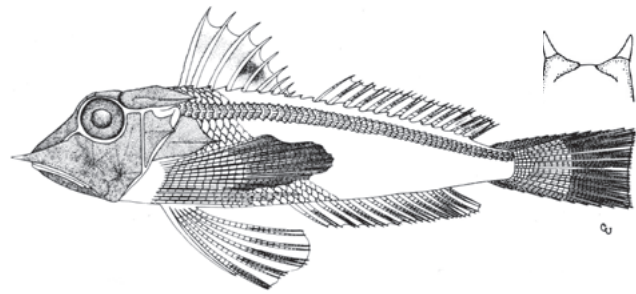
Bullhorn gurnard

PLATE 128

*Lepidotrigla bispinosa* Steindachner 1898: 199 (Gulf of Suez, Egypt, Red Sea); Steindachner 1899\*; Richards & Saksena 1977\*; Richards 1984\*, 1992; Barnes & Golani 1993; Randall 1995\*; Manilo & Bogorodsky 2003.  
*Lepidotrigla omanensis* (*non* Regan 1905): Blegvad & Løppenthin 1944.  
*Lepidotrigla* sp.: Kuronuma & Abe 1986.

First dorsal fin 8–10 spines; 2nd dorsal fin and anal fin each with 13–15 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 32–44%, HL 32–37%, eye diameter 7.1–11.5%, and interorbital width 5–7%. Rostral process with prominent blade-like spine (type P). No preopercle ridge. Scales firmly attached; nape and belly scaly; breast and interpelvic area naked; LL scales 53–60; 15–19 scale rows below lateral line. Vertebrae 29–32.

Head reddish, upper body and flanks pinkish, breast and belly white; median fins mostly whitish; 1st dorsal fin with large red spot on margin at 5th–8th spines. Attains 16 cm SL.



*Lepidotrigla bispinosa*, 7 cm SL, and dorsal view of rostral process (Red Sea). Source: Richards & Saksena 1977

**DISTRIBUTION** WIO: Red Sea, Somalia to Oman, Persian/Arabian Gulf, Iran and Pakistan to northern India.

**REMARKS** Found at 9–115 m.

### *Lepidotrigla faurei* Gilchrist & Thompson 1914

Prickly gurnard

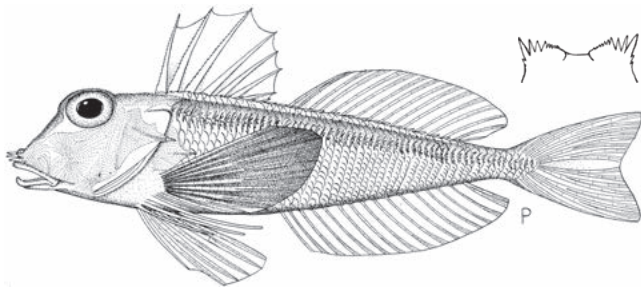
PLATE 128

*Lepidotrigla faurei* Gilchrist & Thompson 1914: 75 (off Thukela River mouth, KwaZulu-Natal, South Africa); Smith 1934\*, 1949\*; Richards & Saksena 1977\*; Richards 1984\*, 1992; SSF No. 157.4\*; Randall 1995\*; Krupp *et al.* 2000; Manilo & Bogorodsky 2003.  
*Lepidotrigla natalensis* Gilchrist & Thompson 1914: 76 (Thukela River mouth, KwaZulu-Natal, South Africa); Barnard 1914; Smith 1934\*, 1949\*.  
*Lepidotrigla stigmapteron* Fowler 1934: 487, Fig. 46 (Durban, KwaZulu-Natal, South Africa); Smith 1949.  
*Lepidotrigla omanensis* (*non* Regan 1905): Kuronuma & Abe 1986.

First dorsal fin 8–10 spines; 2nd dorsal fin and anal fin each with 15–17 rays; pectoral fins 31–34 rays. Percentage SL: pectoral-fin length 31–47% (clinally variable), HL 29–39%, eye diameter 7.9–11.7%, and interorbital width 4.7–7.1%. Rostral process with several prominent spines (type L). No preopercle ridge. Scales weakly attached; nape and belly fully scaled; breast and interpelvic area naked, but a few specimens with scales on breast; LL scales 56–64; 12–16 scale rows below lateral line.

Head and upper body pale orangish pink; lower flanks, breast, and belly paler but not white. Attains 18 cm TL.





*Lepidotrigla faurei*, 13 cm SL, and dorsal view of rostral process (South Africa). Source: SSF

**DISTRIBUTION** WIO: Persian/Arabian Gulf, Oman to Pakistan and India, and East Africa to South Africa (KwaZulu-Natal); not known from Red Sea.

**REMARKS** Occurs on continental and island shelves, at 50–175 m.

### *Lepidotrigla longipinnis* Alcock 1890

Long-finned gurnard

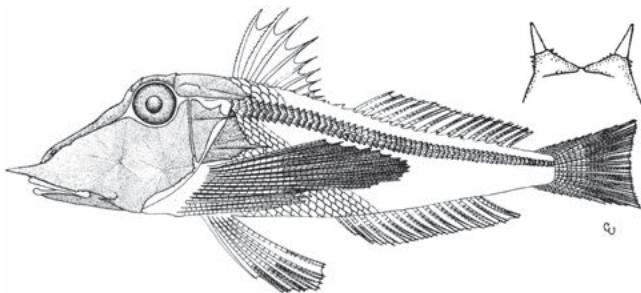
PLATE 129

*Lepidotrigla spiloptera longipinnis* Alcock 1890: 429 (Ganjam coast, India, Bay of Bengal); Alcock 1900\*; Menon & Yazdani 1968; Manilo & Bogorodsky 2003.

*Lepidotrigla riggsi* Richards & Saksena 1977: 215 (Ganjam coast, India, Bay of Bengal) [incorrectly replaced, thought to be preoccupied by *Lepidotrigla longipinnis* [actually *longispinis*] Steindachner & Döderlein 1887]; Richards 1984\*, 1992; Manilo & Bogorodsky 2003.

First dorsal fin 8 or 9 spines; 2nd dorsal fin and anal fin each with 14 or 15 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 35–51%, HL 35–45%, eye diameter 7.5–12.4%, and interorbital width 5.6–7.6%. Rostral process with prominent blade-like spine (type P). No preopercle ridge. Scales weakly attached; nape and belly fully scaled; breast and interpelvic area naked; LL scales 59–62; 16 or 17 scale rows below lateral line. Vertebrae 30 or 31.

Body reddish, lower flanks pale, but not distinctly white; no black blotch on dorsal fin. Maximum size unknown.



*Lepidotrigla longipinnis*, 10 cm SL, and dorsal view of rostral process (India). Source: Richards & Saksena 1977

**DISTRIBUTION** Indian Ocean. WIO: Arabian Sea; elsewhere, Bay of Bengal and Andaman Is.

**REMARKS** Types collected at ~33 m; known to ~96 m.

### *Lepidotrigla multispinosa* Smith 1934

Spiny gurnard

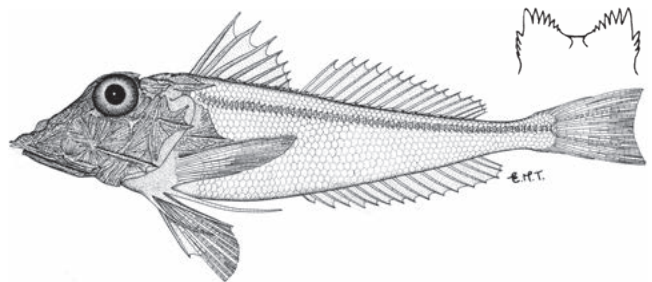
PLATE 129

*Lepidotrigla multispinosus* Smith 1934: 326, Pls. 17, 20 (southeastern South Africa); Norman 1939; Smith 1949\*; De Beaufort 1962; Richards & Saksena 1977\*; Heemstra 1982; Richards 1984\*.

*Lepidotrigla multispinosa*: SFSA No. 1079\*; SSF No. 157.5\*; Richards 1992; Manilo & Bogorodsky 2003.

First dorsal fin 8 or 9 spines; 2nd dorsal fin 16 rays; anal fin 15–17 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 25–29%, HL 33–35%, eye diameter 10–12%, and interorbital width 6–7%. Rostral process projecting as curved process, with no prominent spines (type M). Preopercle ridge strong. Body scales weakly attached; nape and belly fully scaled; breast and interpelvic area naked; LL scales 61–64; 14 or 15 scale rows below lateral line. Vertebrae 32 or 33.

Body reddish; no black mark on 1st dorsal fin; inner surface of pectoral fins dark. Attains 16 cm TL.



*Lepidotrigla multispinosa*, 12 cm SL, and dorsal view of rostral process (South Africa). Source: SSF

**DISTRIBUTION** WIO: Somalia to South Africa (KwaZulu-Natal) and southwestern Madagascar.

**REMARKS** Known from 230–335 m.

### *Lepidotrigla omanensis* Regan 1905

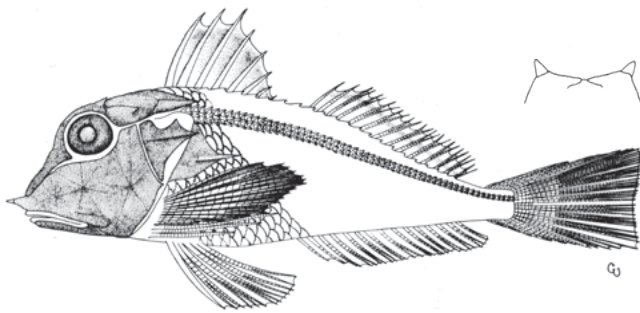
Oman gurnard

PLATE 129

*Lepidotrigla omanensis* Regan 1905: 324, Pl. 2b, Fig. 2 (Gulf of Oman); Norman 1939; Blegvad & Løppenthin 1944 [misidentification and incorrect synonymisation of *L. bispinosa* and *L. omanensis*]; Richards & Saksena 1977\*; Richards 1984\*, 1992; Randall 1995\*; Manilo & Bogorodsky 2003.

First dorsal fin 8 or 9 spines; 2nd dorsal fin and anal fin each with 13–15 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 32–45%, HL 39–43%, eye diameter 8–12%, and interorbital width 7–9%. Rostral process with prominent blade-like projection (type P). Body scales firmly attached; nape and belly fully scaled; breast and interpelvic area naked; LL scales 53–58; 10–14 scale rows below lateral line. Vertebrae 30 or 31.

Body reddish; 1st dorsal-fin membrane with black blotch; inner surface of pectoral fins black, separate lower rays pale. Attains 13.5 cm TL.



*Lepidotrigla omanensis*, 11 cm SL, and dorsal view of rostral process (Oman). Source: Richards & Saksena 1977

**DISTRIBUTION** WIO: Arabian Sea, from Gulf of Aden to Gulf of Oman, Pakistan and India; not known from Red Sea and Persian/Arabian Gulf; elsewhere, Myanmar.

**REMARKS** Found at 56–335 m.

### *Lepidotrigla sayademalha* Richards 1992

Saya de Malha gurnard

PLATE 129

*Lepidotrigla sayademalha* Richards 1992: 47, Figs. 2–3 (Saya de Malha Bank).

First dorsal fin 8 or 9 spines; 2nd dorsal fin 13–15 rays; anal fin 13 or 14 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 43–52%, HL 32–37%, eye diameter 9–10%, and interorbital width 6.5–8%. Rostral process with prominent blade-like projection (type P). Opercle spine long, extending to upper margin of cleithral-spine base. GR on ceratobranchial 6–8, short. Body scales weakly attached; nape and belly scaly; breast and interpelvic area naked; LL scales 55–60; 23–25 scale rows below lateral line. Vertebrae 11 + 19 = 30.

Body pale red or pink; 1st dorsal fin with dark red blotch (no black blotch); inner surface of pectoral fins black with pale margin. Attains at least 10.5 cm SL.



*Lepidotrigla sayademalha*, 7 cm SL, paratype and dorsal view of rostral process (Saya de Malha Bank). E Heemstra © NRF-SAIAB

**DISTRIBUTION** WIO: Saya de Malha Bank.

**REMARKS** Known from 50–115 m.

### *Lepidotrigla spiloptera* Günther 1880

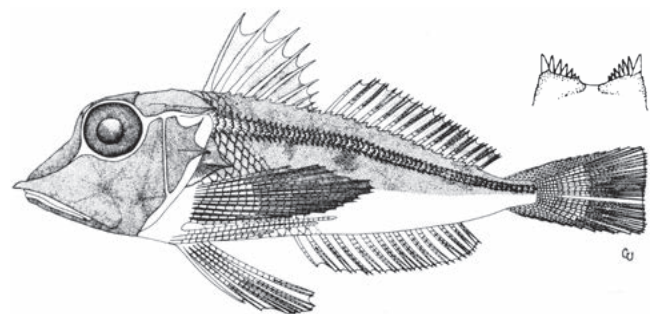
Spotwing gurnard

PLATE 129

*Lepidotrigla spiloptera* Günther 1880: 42, Pl. 18c (Kai Is., Indonesia, Arafura Sea); Weber 1913; Norman 1939; De Beaufort 1962\*; Richards & Saksena 1977\*; Richards 1984\*, 1992; Baranes & Golani 1993; Randall 1995\*; Manilo & Bogorodsky 2003.

First dorsal fin 8 or 9 spines; 2nd dorsal fin 15 or 16 rays; anal fin 14–16 rays; pectoral fins 11 + 3 rays. Percentage SL: pectoral-fin length 31–39%, HL 33–40%, eye diameter 8.5–11.8%, and interorbital width 6–7.7%. Rostral process projecting slightly, with several spines, the lateral spine largest and medial spines smallest (type L). No preopercle ridge. Scales weakly attached; nape and belly fully scaled; breast and interpelvic area naked; LL scales 60–65; 15–21 scale rows below lateral line. Vertebrae 31.

Head and upper body reddish orange; lower flanks, breast and belly distinctly white; 1st dorsal fin with red spot between 4th and 6th spines; 2nd dorsal fin and caudal fin pinkish; inner surface of pectoral fins dusky; pelvic fins and anal fin white. Attains 11.5 cm SL.



*Lepidotrigla spiloptera*, 7 cm SL, and dorsal view of rostral process (Red Sea). Source: Richards & Saksena 1977

**DISTRIBUTION** Indian Ocean. WIO: Persian/Arabian Gulf, Gulf of Aqaba, Red Sea, Pakistan, Somalia and Tanzania (Zanzibar); elsewhere, Bay of Bengal, Indonesia, Australia, and possibly Philippines and Japan.

**REMARKS** Found at 76–256 m. Records from the Philippines and Japan may represent another species (Richards & Saksena 1977). Del Cerro & Lloris (1997) compared *L. alcocki vaubani* with *L. spiloptera* and noted differences and similarities, but tentatively placed the *L. spiloptera* of several authors in the synonymy of *L. alcocki*.

**GENUS** *Pterygotrigla* Waite 1899

Expanded bony plates on body along 1st dorsal-fin base only; LL scales small; lateral line not bifurcate on caudal fin. Most species found deeper than 200 m and are rare. At least 20 species, 7 in WIO, but only 2 at depths of <200 m.

**KEY TO SPECIES**

- |    |   |                   |
|----|---|-------------------|
| 1a | Pectoral fins with 11 or 12 rays connected by membrane.....       | <i>P. arabica</i> |
| 1b | Pectoral fins with 13 (rarely 14) rays connected by membrane..... | <i>P. amaokai</i> |

*Pterygotrigla (Otohime) amaokai*

Richards, Yato & Last 2003

Amaoka's gurnard

PLATE 129

*Pterygotrigla (Otohime) amaokai* Richards, Yato & Last 2003: 3, Fig. 1e, Pl. 1 (Saya de Malha Bank).

First dorsal fin 7 or 8 spines; 2nd dorsal fin and anal fin each with 12 rays; pectoral fins 13 or 14 + 3 rays. Pectoral-fin length 35–44% SL, longest free ray 32–36% SL. No definite cleithral spine: rudiment of spine medial to opercle spine. GR 0 or 1/10–13; epibranchial GR 0 or 1; ceratobranchial GR 10–13, short, 2–3% SL. Breast usually scaly, rarely naked; belly scaly; pre-pectoral and interpelvic areas naked; LL scales 63–69. Vertebrae 27 (rarely 26).

Body reddish; 1st dorsal fin with red spot (no black spot), black blotch near base and dark membranes. Attains ~14 cm SL.



*Pterygotrigla (Otohime) amaokai*, 10 cm SL, paratype (Saya de Malha Bank). © HUMZ

**DISTRIBUTION** WIO: Saya de Malha Bank, and one record from off Kenya.

**REMARKS** Known from 156–187 m.

*Pterygotrigla (Otohime) arabica*

(Boulenger 1888)

Arabian gurnard

PLATE 130

*Trigla arabica* Boulenger 1888: 663 (Muscat, Oman, Gulf of Oman); Day 1888; Boulenger 1889; Steindachner 1902.

*Pterygotrigla picta* (non Günther 1880): Samuel 1963.

*Prionotus alepis*: Menon & Yazdani 1968; Richards & Saksena 1974.

*Pterygotrigla hemisticta*: Richards & Saksena 1974; Richards 1984\*, 1999; Randall 1995.

*Pterygotrigla arabica*: Baranes & Golani 1993\*; Manilo & Bogorodsky 2003; Richards *et al.* 2003 [in part].

First dorsal fin 7–10 spines; 2nd dorsal fin 11–13 rays; anal fin 11 or 12 rays; pectoral fins 12 + 3 rays. Cleithral spine present; opercular spine long, extending behind cleithrum; rostral spine short; no nasal spine or antrorse rostral spine. GR 1 or 2/10–15. Breast scaly or naked; LL scales 53 or 54. Vertebrae 11 or 12 + 15–17 = 27 or 28.

Body pinkish red, dorsum with distinct, irregular black spots; 1st dorsal fin with black blotch on membranes between spines 3–5; inner surface of pectoral fins black, without white spots. Attains ~20 cm SL.



*Pterygotrigla (Otohime) arabica*, holotype (Oman). Source: Boulenger 1889

**DISTRIBUTION** Indian Ocean. WIO: Persian/Arabian Gulf, Gulf of Oman, Pakistan to southwestern India (Kerala); elsewhere, Bay of Bengal.

**REMARKS** Found at 26–210 m.

#### GLOSSARY

**rostral process** – a beak-like structure on the rostrum or ‘nose’.

## FAMILY PERISTEDIIDAE

### Armoured gurnards

Toshio Kawai and William J Richards

Head and body ventrally flattened; body elongate, encased in bony plates or scutes; head large, bony, with many ridges and spines; snout ending in pair of flattened rostral projections, often with one or more pairs of short to moderate spines on dorsal surface; series of barbels on lower jaw. Mouth inferior; villiform teeth present or absent in upper jaw, always absent on lower jaw; no pre-vomerine or palatine teeth. Dorsal fin divided, with 6–9 spines and 13–23 rays; anal fin 11–23 rays (no spines); pectoral fins with most rays or at least 2 lowermost rays free, detached from rest of fin rays, which are joined by membrane; pelvic fins far apart, with 1 spine, 5 rays; caudal fin 9 or 10 branched rays. Gill membranes fused to isthmus. Swimbladder present. Body variably coloured reddish orange, some species with dark spots, and belly typically paler; dorsal

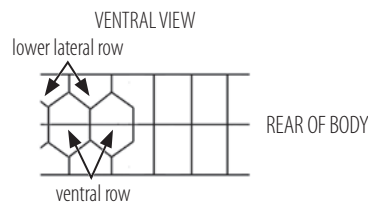
fin often with black membrane anteriorly; pectoral fins often with bands.

Measurements of standard length (SL), head length (HL), and snout length are, respectively, from front of upper jaw: to caudal-fin base, to rear edge of subopercle, and to front edge of bony orbit; orbit diameter is the horizontal diameter of the bony orbit; interorbital width is the least bony width between orbits; pectoral-fin length is from the base of the uppermost joined fin rays to tip of longest ray; pelvic-fin length is from origin of the pelvic-fin spine to tip of longest ray. The method for counting bony plates (all plates in each row) and the terminology for barbels follow Yatou & Okamura (1985).

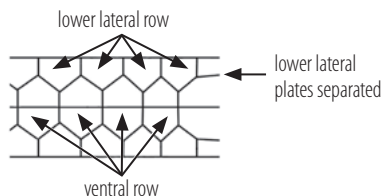
Small- to medium-sized (to ~62 cm SL), worldwide in tropical to warm-temperate seas. Benthic, on continental shelves and slopes, to ~900 m deep. Inhabit sandy or muddy substrates, rubble or reef-type bottoms, using the free rays of their pectoral fins for support and as feelers searching for food. Not targeted by fisheries, but occasionally taken in bottom trawls; most species are considered trash fish. Six genera and ~45 species; 4 genera and 8 species in WIO, but only 2 genera and 2 species at depths of <200 m.

#### KEY TO SPECIES

- 1a Dorsal fin 20–23 rays; anal fin 20–22 rays; rear part of bony plates in lower lateral row sutured on both sides ..... *Peristedion weberi*



- 1b Dorsal fin 13–17 rays; anal fin 14–17 rays; rear part of bony plates in lower lateral row separated ..... *Satyrichthys laticeps*





GENUS *Peristedion* Lacepède 1801

No teeth in upper jaw teeth; lateral margins of head smooth; rear part of bony plates in lower lateral row sutured on both sides. About 24 species worldwide, 1 in WIO.

*Peristedion weberi* Smith 1934

PLATE 130

*Peristedion weberi* Smith 1934: 329, Pl. 21 (off Maputo Bay, Mozambique); SFSA No. 1075\*; Miller 1974; Heemstra 1982; SSF No. 158.1\*; Manilo & Bogorodsky 2003; Kawai 2008, 2016.

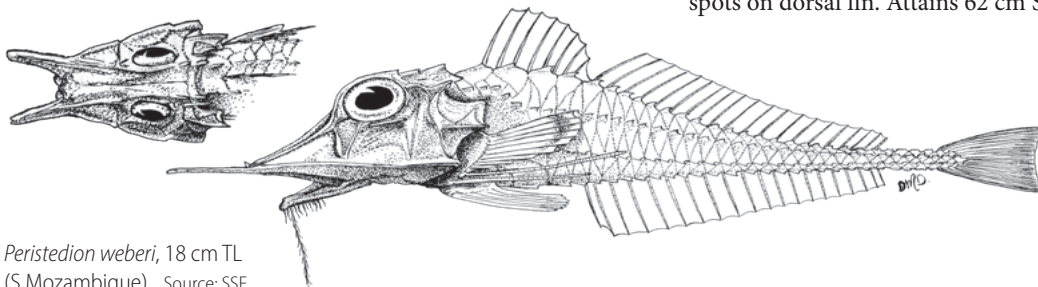
*Peristedion gracile* (*non* Goode & Bean 1896): Gilchrist & Von Bonde 1924; Barnard 1927.

Dorsal fin 8 spines, 20–23 rays; anal fin 20–22 rays; pectoral fins 11 or 12 + 2 rays; pelvic fins 1 spine, 5 rays; GR 5 or 6/20–23 = 25–29. Lip barbels in 3 groups: anterior pair of groups with 3 filaments in each, and posteriormost group with 12–22 filaments in total. Chin barbels in 5 or 6 groups, with 14–22 filaments in total; filamentous barbel relatively short, terminating at end of 1st mandibular ridge. Rostral projections slender, parallel to or slightly divergent from one another, proportion of their length increasing with size (31–37% HL); HL 43–53% SL; interorbital width 20–25% HL. Bony plates: 29–33 in dorsal row; 33–35 in upper lateral row, with bicuspid spines on 8–12 posteriormost plates; 25–27 in lower lateral row, last 2 plates sutured on both sides; 21–23 + 2 in ventral row; and usually 3 before anus.

Preserved specimens with grey body, mottled darker above; prominent black blotch at pectoral-fin tips, dusky mark above pectoral-fin axil, joined rays with grey margin, dark mark near end of joined rays and another near fin base; soft dorsal-fin margin black; peritoneum lightly pigmented. Attains 16 cm SL.

**DISTRIBUTION** WIO: Somalia to South Africa (KwaZulu-Natal).

**REMARKS** Found at 177–665 m.



*Peristedion weberi*, 18 cm TL (S Mozambique). Source: SSF

GENUS *Satyrichthys* Kaup 1873

No teeth in upper jaw; lateral margins of head smooth; rear part of bony plates in lower lateral row separated (not sutured); barbels on lower jaw not branched, except for posteriormost lip and chin barbels (some species lack chin barbels); dorsal-fin rays <20. Seven species, in Indo-Pacific, 1 in WIO.

*Satyrichthys laticeps* (Schlegel 1852)

PLATE 130

*Peristedion laticeps* Schlegel 1852: 43, Pl. 1 (Ambon I., Moluccas, Indonesia).

*Peristethus* sp. Haly 1886: 166 (Sri Lanka).

*Peristethus halei* Day (ex Haly) 1888: 791 (Galle, Sri Lanka) [description quoted from Haly].

*Peristedion adeni* Lloyd 1907: 8 (Gulf of Aden); Regan 1921; Gilchrist 1922; Fowler 1925, 1934; Barnard 1927, 1955; Smith 1934; Norman 1939; SFSA No. 1074\*; Smith & Smith 1963; Menon & Yazdani 1968.

*Peristedion pothumaluva* Deraniyagala 1936: 221, Figs. 2–3 (Moratuwa, west coast of Sri Lanka); Munro 1955; Samuel 1963.

*Satyrichthys piercei* Fowler 1938: 125, Fig. 60 (China Sea); Richards 1999, 2000.

*Satyrichthys adeni*: Miller 1974; Heemstra 1986; SSF No. 158.2\*; Richards 1999, 2000; Manilo & Bogorodsky 2003; Heemstra & Heemstra 2004\*; Kawai 2008; Kawai & Tashiro 2008; Ali *et al.* 2009; Yamada & Yagishita 2013.

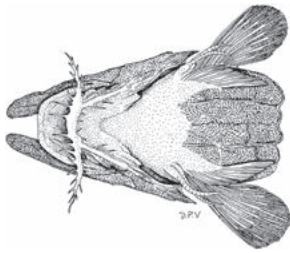
*Satyrichthys magnus* Yatou *in* Okamura 1985: 591, Pl. 366 (Okinawa Trough); Richards 1999, 2000; Yamada 2002; Kawai 2008.

*Satyrichthys laticeps*: Kawai 2013, 2014; Kawai *et al.* 2017.

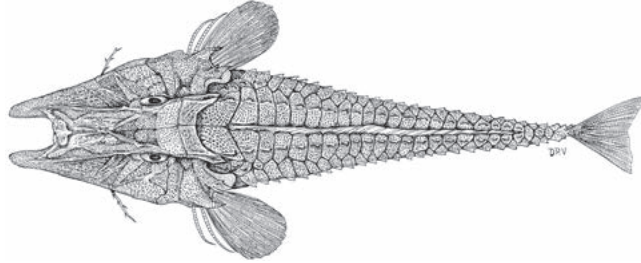
*Satyrichthys kikingeri* Pogoreutz, Vitecek & Ahnelt 2013: 153, Figs. 2–3 (Rasdhooh Atoll, Maldives [floating at surface]).

Dorsal fin usually 7 spines, 13–17 rays; anal fin 14–17 rays; pectoral fins 12–15 + 2 rays; pelvic fins 1 spine, 5 rays; GR 4–6/15–22 = 21–27. Lip barbels usually 4, posteriormost filamentous barbel with 9–16 filaments; chin barbels usually 3; filamentous barbel moderately long, terminating past rear end of mandible and before posterior edge of preopercular ridge; filaments single, usually opposite each other. Bony plates: 23–27 in dorsal row; 29–32 in upper lateral row, with bicuspid spines on 4–11 posteriormost plates; 16–22 in lower lateral row; 19–22 in ventral row; and 2 before anus.

Body and fins reddish orange, paler ventrally; no dusky spots on dorsal fin. Attains 62 cm SL.



*Satyrichthys laticeps*, 48 cm TL, ventral head (South Africa). Source: SSF



*Satyrichthys laticeps*, 15 cm TL (South Africa). Source: SSF

**DISTRIBUTION** Indo-Pacific. WIO: Gulf of Aden, Mozambique (Maputo Bay) to South Africa (Mossel Bay), Saya de Malha Bank, Maldives and Sri Lanka; elsewhere to Andaman Sea, Indonesia, Taiwan, Sulu Sea, East China Sea and Japan.

**REMARKS** Found at 58–300 m.

## FAMILY LIPARIDAE

### Snailfishes

M Eric Anderson

Body fusiform, stout anteriorly, tail long and laterally compressed. Head short and rounded to moderately elongated and ovoid; 1 or 2 pairs of nostrils. Dorsal and anal fins long, low; dorsal fin sometimes with anterior notch. Pectoral fins often with ventral notch, with rays in ventral lobe exerted in most species. Pelvic fins absent or modified into a sucking disc (much like that of clingfishes, family Gobiesocidae). Caudal fin small, but distinct. No fin spines. Scales absent or modified into minute, tack-like structures termed 'thumbtack prickles.' Dentition often species-specific: teeth simple and lanceolate to compact and trilobed, arranged in varying rows. Gill slit usually above pectoral fin; gill rakers rudimentary or mere pads. Anus close behind pelvic disc, far from anal-fin origin. Pyloric caeca on left side of body, finger-like, and usually <20.

Twenty genera and ~200 species. Sometimes considered a subfamily of family Cyclopteridae. Of no commercial interest; the largest snailfish attains ~50 cm TL. Most snailfishes inhabit the deep sea; species of *Liparis* occur in tidepools to ~650 m

(*L. bathyartcticus*), in the Arctic and cold-temperate Northern Hemisphere, with the exception of 1 species which inhabits shallow waters of the Red Sea. This species has been considered either a label-switching error or, if a valid record, an example of extreme evolutionary adaptation. However, Fishelson (1993) clearly recalls the collection of this single specimen, thus it is not an erroneous record, but is apparently a *Liparis* living in a habitat that experiences temperatures around 25 °C in summer.

## GENUS *Liparis* Scopoli 1777

Lower pectoral-fin rays exerted, under throat; 2 pairs of nostrils; teeth usually trilobed; branchiostegal rays 6; pseudobranch present. About 70 species, plus several undescribed species, in Arctic, North Pacific, North Atlantic and at least 1 in Red Sea. A single specimen reported from Chile (*Liparis antarcticus* Putnam 1874) may be an erroneous record (Andriashev & Stein 1998). A recent generic review by Chernova (2008) placed the species described below as *incertae sedis* in *Liparis*, whereas here it is placed in subgenus *Neoliparis* Steindachner 1876.

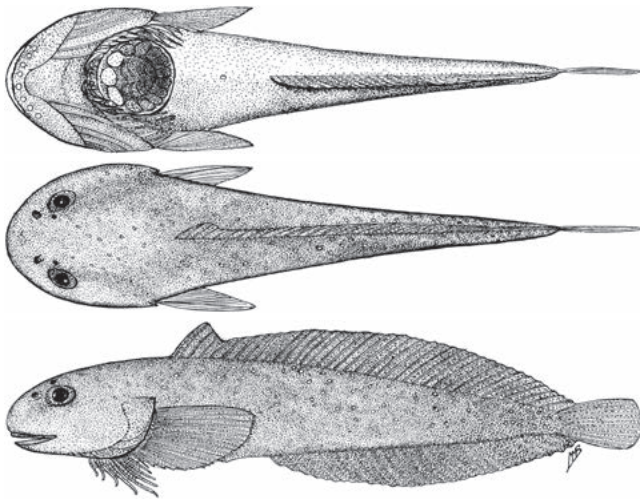
### *Liparis (Neoliparis) fishelsoni* Smith 1967

Red Sea snailfish

*Liparis fishelsoni* Smith 1967: 107, Fig. (Dahlak Archipelago, Eritrea, Red Sea); Fishelson 1993; Anderson 1994; Chernova 2008.

Holotype: dorsal fin 38 rays, fin origin just behind vertical through upper end of pectoral-fin base, and fin with shallow anterior notch; anal fin 30 rays; pectoral fins 23 + 9 rays; caudal fin 12 rays. Head bulbous, snout rounded; few scattered prickles on head, nape, and body just above pectoral fins; 2 pairs of nostrils, anteriormost tubular, located just before eyes. Opercle with narrow, upturned process at upper rear margin. Teeth trilobed, in bands. Branchiostegal rays 6; gill rakers undeveloped, 1st gill arch with sharp edge bearing 25 spinules giving arch the appearance of being minutely serrated; gill slit extending ventrally to opposite 4th pectoral-fin ray. Anus midway between rear edge of pelvic disc and anal-fin origin. Percentage SL: body depth 19%, HL 27%, head width 25%, eye diameter 8%, snout length 7%, pectoral-fin length 18%, pelvic disc width 12%, and pelvic disc length 14% (these morphometrics differ somewhat from those given in the original description, as the caudal fin and last 1 or 2 vertebrae of the holotype are missing, and the snout tip is slightly crushed). Vertebrae 12 + 28.

Preserved specimen uniformly brown, darker above. Adult size unknown.



*Liparis (Neoliparis) fishelsoni*, 23 mm TL, holotype; ventral, dorsal and lateral views (Red Sea). Source: Smith 1967

**DISTRIBUTION** WIO: southern Red Sea.

**REMARKS** Apparently the only warm-water snailfish.

Known only from the holotype (23-mm-TL juvenile), trawled at 25–30 m in the type locality and sent to JLB Smith in a damaged condition. Smith (1968) compared this species with *Liparis bristolensis* (Burke 1912) which Chernova (2008) placed in subgenus *Liparis* Scopoli 1777. On the basis of characters given in Chernova's key to species of subgenus *Neoliparis*, *L. fishelsoni* seems to fit into the '*L. grebnitzkii*' group, although Smith did not dissect the small specimen to report its sex or number of pyloric caeca. The '*L. grebnitzkii*' group includes the similar northwestern Atlantic *Liparis inquilinus* Able 1973, possibly a sister-species.

#### GLOSSARY

**pseudobranch** – a small, gill-like organ on the inner surface of the operculum; the reduced first gill arch.