NRF National Research Foundation | SAIAB South African Institute for Aquatic Biodiversity

# NRF-SAIAB

## ANNUAL RESEARCH REPORT 2023

Compiled and edited by Penny Haworth and Vanessa Rouhani
Proofread by Helen Holleman
Designed and set by WalkerDigital, Gqeberha
Printed by CADAR Printers, Gqeberha

ISBN 978-1-0672249-5-0
ISSN 978-1-0672249-6-7

Cover photo front by Siphamandla Mceleli, Zinzi Sinazo Somana and Margaret Bartkowiak.
*From left to right: Siphamandla Mceleli and Zinzi Sinazo Somana, both SANBI Curation Technicians, along with Margaret Bartkowiak, NSCF Museum Specimen Photographer, pose with the largest type specimen of the deepwater stingray or giant stingray,* Urotrygon daviesi *in the NRF-SAIAB Collection Facility.*
Cover photo back by Russell Chalmers


The South African Institute for Aquatic Biodiversity (SAIAB) is a National Facility of the National Research Foundation, established in terms of Act 23 of 1998.
NRF-SAIAB is a Schedule 3A Public Entity of Government responsible for conducting research and promoting technological advances and innovation in both freshwater and marine environments in southern Africa.

# Research Overview 2023

*Dr Albert Chakona, Chief Scientist (right) and Nkosinathi Mazungula, Collections Manager (left), sampling at Riviersonderend. (Photo credit: Jeremy Shelton, Freshwater Research Centre).*


**DR ALBERT CHAKONA**

*Chief Scientist and Acting MD: NRF-SAIAB*


The NRF values, mission and priorities emphasize the importance of re-imagining research through the principles of knowledge advancement, innovation, multi- and trans-disciplinarity, Open Science, Responsible Research Advancement (RRA) and institutional commitment. Researchers, postgraduates, Postdoctoral Research Fellows and Honorary Research Associates at NRF-SAIAB pursue such ideals in order to respond and adapt to the evolving curiosity and societal-driven needs and challenges in the aquatic realm.

Such high-calibre, expansive, transformative, exploratory and impactful research is made possible largely by NRF-SAIAB's unique research infrastructure platforms which are available to the broader research community in the National System of Innovation (NSI). During 2023, 209 individuals and 52 organisations made use of the NRF-SAIAB Platforms.

NRF-SAIAB engages dynamically and responsively with universities and local and national government bodies to address pressing environmental issues. These issues require the integration of evidence-based science with management, enabling NRF-SAIAB to provide scientific advice that policy makers can use to formulate national environmental policies. NRF-SAIAB's involvement extends to various areas of national concern, including socio-economic development, water security issues, ecosystem degradation and the influence of climate change on food security. Team science remains a key pillar of NRF-SAIAB's research endeavour, with strong collaborations established and ongoing with national and international partners.

NRF-SAIAB fosters a healthy and productive research culture by prioritising commitment to inclusion, real-world impact, and open scholarship practices which are reflected in the mentorship style embraced by NRF-SAIAB's research staff as they prepare the next generation of scientists. Postgraduates supervised through NRF-SAIAB are passionately trained to strive for excellence and develop the ability to adapt and respond to future professional pursuits. The extended impact of NRF-SAIAB in terms of science advancement, promotion of excellence, transformation and reach, is further highlighted through the ongoing development of the ACEP Phuhlisa Joint Marine Laboratories Programme at Historically Disadvantaged Institutions (HDIs). The next phase is expansion into Joint Freshwater Laboratories.

Networked and collaborative science remains a key pillar of NRF-SAIAB's research endeavour. Its growing cohort of Honorary Research Associates (HRAs) maintain this ethos as established national and international partners.

A steady publication output by NRF-SAIAB continued in 2023, with a total of 132 Web of Science indexed, peer-reviewed scientific papers published during this period. Additionally, there was an active participation in conferences and symposia with 34 presentations given during this year.

The 2023 Annual Research Report provides a taste of the hugely diverse action research undertaken by a dedicated cohort of scientists responding to global challenges while working towards ensuring the sustainability of Africa's freshwater and marine ecosystems. The report is structured to showcase NRF-SAIAB's globally competitive research and integration of innovative ways to engage meaningfully with communities through inclusion of communication specialists as partners on transdisciplinary and multi-institutional research projects to advance dissemination of scientific information through diverse communications media.

Such pioneering projects include the Indigenous Marine Innovations for sustainable Environments and Economies (IMIsEE) project that combines innovative green eco-engineering approaches with indigenous cultural practices to address the negative effects of coastal armouring on biodiversity, and the REFRESH Project which is renewing data and filling knowledge gaps for freshwater species of South Africa to inform species and ecosystem conservation.

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# INNOVATE, DISCOVER

## Promote Globally Competitive Research & Innovation

*Albert Chakona, Nkosinathi Mazungula (NRF-SAIAB) and Jeremy Shelton (Freshwater Research Centre) sampling for freshwater fish at Riviersonderend in the Western Cape.*

# Freshwater fish research informing evidence-based decision making for conservation and sustainable development

**DR ALBERT CHAKONA**
*CHIEF SCIENTIST*

**TEAM MEMBERS** Albert Chakona, Mandla Magoro, Pedro Bragança, Roger Bills, Lubabalo Mofu, Lizaan de Necker, Paul Skelton, Yonela Sithole, Tholoana Ntokoane, Martinus Scheepers, Tadiwa Mutizwa, Marliese Truter

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**COLLABORATIONS** RU, SANBI, DFFE, CapeNature, Ezemvelo KZN Wildlife, Wits University, University of the Free State, Gorongosa National Park, Natural History Museum of Zimbabwe, University of Zimbabwe, Lake Kariba Research Station, Lurio University, RMCA Belgium, Cornell University, ZSM – Germany, University of Basel

Freshwater fishes are among the most highly threatened taxa on the planet.

The 2018 National Biodiversity Assessment (NBA 2018) highlights freshwater fishes as being among the most highly threatened taxa on the planet. On the African continent, freshwater fishes are mainly threatened by habitat and water quality degradation, as well as the spread of alien invasive freshwater species. Management of non-native invasive species is complicated by species that are economically valuable but can also cause harm to biodiversity, such as largemouth bass and trout. As a result, both national and provincial South African Government authorities must constantly find a balance between freshwater fish conservation and development priorities, such as aquaculture, and make decisions that are guided by reliable scientific evidence. Therefore it is imperative that the diversity and distribution patterns of our freshwater fishes are assessed and documented. These types of assessments produce baseline data, which can be used to formulate conservation strategies and to help guide sustainable development.

NRF-SAIAB projects are addressing important data gaps and questions related to freshwater fish biodiversity within the African continent.

The NRF-SAIAB Freshwater Research Unit is currently involved in various projects aimed at addressing important data gaps and questions related to freshwater fish biodiversity within the African continent. These include: the NRF Foundational Biodiversity Information Programme (FBIP)-funded REFRESH Project, in collaboration with researchers from various academic and research institutions; the Waterberg Project, which seeks to compile an up-to-date inventory of freshwater fish species within the Waterberg District of Limpopo Province, with a special emphasis on the Waterberg freshwater ecoregion; the tilapia project, in collaboration with the South African National Biodiversity Institute (SANBI), the Department of Forestry, Fisheries & Environment (DFFE) and the provincial conservation authority, Ezemvelo KZN Wildlife.

These projects will benefit both natural ecosystems and society through guiding sustainable aquaculture development and contributing towards achieving various goals and targets aligned to national and international protocols such as South Africa's NDP 2030, the African Union's Agenda 2063, and the United Nations' Sustainable Development Goals (SDGs).

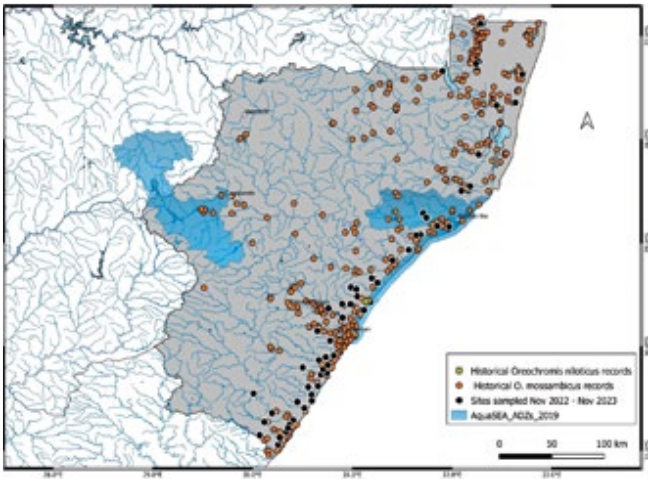
## Multiple stakeholders converge to co-create data to guide science-based decision making.

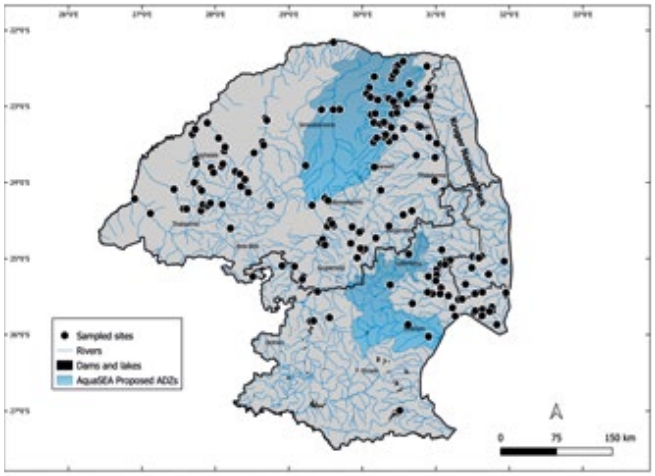
The freshwater fish biodiversity research undertaken by the REFRESH and the Waterberg projects provides data which can be used in the ongoing development of management tools, such as the National Freshwater Ecosystem Priority Areas (NFEPAs) mapping programme and the IUCN Red List of Threatened Species. Currently, the NRF-SAIAB Freshwater Research Unit has collected 1299 tissue samples and 1302 vouchers, produced 165 COI barcodes and is in the process of describing several new freshwater fish species. The work is ongoing and there are plans to collect more data and samples from key areas in southern Africa. Two PhDs graduated in 2023 from projects directly linked to the broader REFRESH project, contributing towards human capacity development and transformation, with two more PhD candidates due to graduate in 2024.

The tilapia project focuses on assessing the current distribution of alien invasive Nile tilapia, *Oreochromis niloticus*, and native Mozambique tilapia, *O. mossambicus,* across the KwaZulu-Natal Province, expanding on similar work which has recently been concluded in the Limpopo and Mpumalanga Provinces. The project team, Prof. Albert Chakona, Dr Mandla Magoro, Dr Lubabalo Mofu and Prof. Wilbert Kadye, undertook comprehensive surveys, sampling 64 localities between November 2022 and November 2023. These surveys yielded 798 voucher specimens and 635 tissue samples which are interlinked in a comprehensive database. Morphological examination of the collected specimens indicates that Nile tilapia and suspected hybrids are not as widely distributed as previously

*Lubabalo Mofu sampling for tilapia and other freshwater fish species in the Tongati River, KwaZulu-Natal.*

*The Msunduzi River near Ehlabosini, KwaZulu-Natal.*




***Above Map:*** *Showing historical records of* Oreochromis mossambicus *and* O. niloticus *as well as localities that were sampled for the present study in the KwaZulu-Natal Province. Also shown are the Strategic Aquaculture Development areas (blue) identifed during the 2019 Strategic Environmental Assessment for Aquaculture Development in South Africa.*

perceived, with Nile tilapia being detected at only two sites located within one river system. These findings will be published in a policy brief to be submitted to all interested and affected parties, including SANBI and the DFFE.

## Distribution mapping is a tool that can be used in the sustainable development of the aquaculture sector.

This study demonstrates the successful convergence of multiple stakeholders (academia, government, industry and societal partners) in a process of co-creation of data to guide science-based decision-making. Overall, the mapping exercise and associated data (covering the Limpopo, Mpumalanga and KwaZulu-Natal provinces) represent a tool that should be used in the sustainable development of the tilapia aquaculture sector. The data from this project can be used to help guide the permitting of aquaculture activities by feeding into an Integrated Environmental Management (IEM) decision-making process that drives sustainable development through considering economic, social, ecological, and redress factors.

**MEASURES OF SUCCESS:**

- Specimens catalogued and deposited in the National Fish Collection (NFC) = 2100
- Tissue samples deposited into the NRF-SAIAB BioBank = 1934
- Fish images uploaded into Specify = 700

**CONFERENCE PRESENTATIONS:**

- Seven (7) presentations at the *Southern African Society of Aquatic Scientists (SASAqS) Congress* 2023.
- Eleven (11) presentations at the *7th International Conference of the Pan African Fish and Fisheries Association (PAFFA)* held in the Republic of the Congo.
- One (1) presentation at the *11th Indo-Pacific Fish Conference* held in New Zealand.

***Top:*** *The shaded blue areas indicate the proposed Strategic Aquaculture Development areas identified during the 2019 Strategic Environmental Assessment for Aquaculture Development in South Africa.*
***Middle:*** *Upstream view of the Klein Brak River, Western Cape.*
***Bottom:*** *Attendees of the PAFFA conference hosted in Brazzaville, Republic of Congo, 18–22 September 2023. From left to right: T. Mutizwa, M. Scheepers, A. Chakona, G. Jaime, Y. Sithole, P. Bragança.*

# Towards the conservation of South Africa's hidden diversity: freshwater parasites and their vectors

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**COLLABORATIONS** NRF-SAIAB, University of the Free State, University of Limpopo, SANBI, CapeNature

Our freshwater aquatic environments and the fish diversity they hold are of particular interest for conservation. However, the most recent National Biodiversity Assessment (2018) confirmed that, despite conservation efforts, these species continue to be threatened, and increased efforts are needed to protect and conserve remaining populations and their ecosystems which support cultural, social and economic aspects that, in turn, generate income through eco-tourism and international collaborations that contribute to the continued development of biodiversity knowledge and expertise.

## Aquatic parasites are largely understudied, under-protected and mostly ignored.

Aquatic parasites are a largely understudied group of organisms that are under-protected and mostly ignored during most biodiversity studies. However, they form important ecosystem links between trophic levels, facilitate energy flow and contribute to biomass. The study of aquatic parasites that live in and on freshwater fish and snails helps increase conservation efforts and discovery in South Africa's understudied aquatic biodiversity.

Parasites can also act as control agents for host populations or defend against disease; they can be used to track host invasion and introduction events and, recently, aquatic parasites of fish have been identified as accumulation indicators for metal pollutants in aquatic ecosystems. All this forms part of a suite of characteristics that make parasites a useful tool through which to promote conservation of South Africa's microscopic diversity as well as of their hosts and sensitive ecosystems.

## Serious health risks associated with bilharzia caused by parasitic trematodes have not been well studied in South Africa.

In 2023 our team undertook research on freshwater snails as vectors of freshwater fish parasites as well as of neglected tropical diseases, such as schistosomiasis (bilharzia) caused by parasitic trematodes. The most recent evaluation of the distribution of the freshwater snail vectors that transmit schistosomiasis in South Africa was completed between the 1950s and 1980s. In the face of notable environmental and climatic changes, and the presence of invasive snails such as the quilted melania, *Tarebia granifera*, changes in the distribution of freshwater snail vectors and their disease risk is largely unknown. Although bilharzia affects at least 4.5 million people annually, in communities from high-risk infection areas in South Africa, it is not well understood. Furthermore, knowledge of the communities related to infection, prevention or treatment and the serious health risks associated with the disease have not been well studied in South Africa, especially in the Limpopo Province.

## Research on freshwater parasites will assist in the development of strategies for the prevention and elimination of bilharzia.

The research reported here assists in identifying innovative approaches to conserve habitats (in this case the fish hosts) and potentially increase economic benefits through a multi-species conservation approach. Information used to identify National Freshwater Ecosystem Priority Areas (NFEPAs) was last published ten years ago and parasitic species of freshwater fishes were not included in the assessment. The present research aims to update and compile species data, create a catalogue, and use DNA barcoding to study the biodiversity of freshwater fish parasites of South Africa. By mobilising and updating historical and current knowledge, prioritising poorly explored and critical habitats, and recommending long-term monitoring and informed conservation strategies, this project aligns with South Africa's biodiversity management and species conservation criteria at a global scale. Data catalogues and protection status are crucial elements to optimise the conservation of macro- and microfauna in the freshwater ecosystems of South Africa. This research helps to facilitate assessment of species extinction risks, enabling informed conservation decisions to mitigate the impacts, and to promote education about South Africa's biodiversity and ecological heritage.

The research on snail vectors also aims to determine whether changes have occurred in the distribution ranges, if invasive species are suitable vectors for spreading neglected tropical diseases, and how climate change may alter the distribution and risk of exposure to South Africans. The research will provide updated freshwater snail and bivalve data from surveys of freshwater snails from the late 1950s to 2010. This information will shed light on the impacts of invasive snail species on native aquatic biota and the conservation status of the native freshwater snail species as well as the potential schistosomiasis risk areas. Various models were implemented

to illustrate the historic distribution of freshwater snails and how predicted climate change may alter distribution of native freshwater snail species and associated parasites. Findings will impact public policy and, potentially, health services by assisting in the development of prevention and elimination strategies.

All research on parasitic species conservation and disease vector distribution falls under the umbrella of the multi-institutional research project known as REFRESH, funded by the NRF, and a snail vector project funded by the Water Research Commission (WRC) of South Africa.

**MEASURES OF SUCCESS**

- Over the course of the project, training in data collecting, processing and interpretation has been provided to early career researchers and students (Honours, MSc and PhD) equipping them with the necessary skills to conduct and disseminate research findings (Figure 1a, b). Findings from the projects have been shared through conferences across different disciplines and through informative publications, reaching broad audiences. Capacity development is ongoing with students participating in the data collection and processing for the remainder of the project.
- Two community outreach events focussing on creating awareness among young learners were successfully hosted for schistosomiasis in the Ha-Nesengani community (Figure 2a, b) and on the biology and ecology of fish and their parasites to local learners in Potchefstroom (Figure 2c).
- An online news article on Snail Day can be seen at article: https://news.nwu.ac.za/snail-day-raises-awareness-schistosomiasis-and-river-health
- In 2023 a total of nine peer-reviewed publications were published in internationally recognised journals, with Altmetrics scores of between 3 and 9, and all within journals ranked in the 25th percentile of the discipline.
- One of the highlights of 2023 was the submission of the final report of the snail project entitled Current status and future predicted distribution of bilharzia-transmitting snails under climate change and implications for vector-borne diseases in South Africa. The report was submitted to and approved by the WRC for publication in 2024.







**1** *NRF-SAIAB PhD candidate, Nichole Donough studying live cercariae shed from snails for morphological identification* ***(1a)****. These microscopic life stages of digenean parasites use fish as a second intermediate host. Species are distinguished by their overall morphology, with the tail morphology being the most conspicuous difference. Pictured here is a furcocercariae with its distinct forked tail* ***(1b)****.*

**2** *Snail Awareness Day in April 2023; a community outreach in Ha-Nesengani, Limpopo. NRF-SAIAB & NWU Postdoctoral Research Fellows, Dr Lizaan de Necker teaching learners about the snail vectors of schistosomiasis* ***(2a)*** *and Dr Marliese Truter showing the microscopic life stages* ***(2b)*** *found in water bodies. Learners looking at parasitic species of South Africa's fishes during the annual Fish Day community outreach in Potchefstroom during August 2023* ***(2c)****.*

**3** *Snail Awareness Day - Limpopo school learners participated in educational games and activities hosted by the NWU Water Research Group, the University of Limpopo, and Nature-I-Am on Snail Awareness Day.*

# Ocean sustainability science in the Anthropocene:
## a collective weaving of indigenous and scientific solutions

**PROF. FRANCESCA PORRI**
*SENIOR SCIENTIST*

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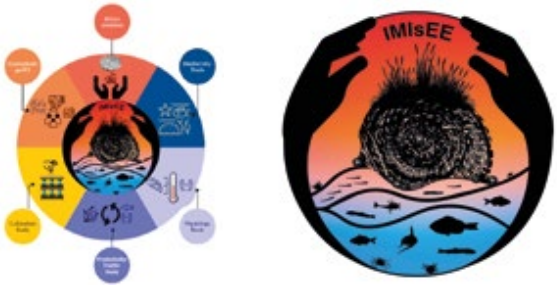
**COLLABORATIONS** RU, Keiskamma Trust, TNPA, NRF-SAEON, NMU, UCT, SU, NIOZ

Weaving scientific inquiry with innovative community co-creation and environmental stewardship, IMIsEE is a transdisciplinary enterprise which sets a precedent for collaborative approaches to address complex environmental challenges and sustainable science and development.

Most of the research conducted by COST in 2023 centred on the Indigenous Marine Innovations for sustainable Environments and Economies (IMIsEE) project. This trans-disciplinary research initiative uniquely combines innovative green eco-engineering approaches with indigenous cultural practices to address the negative effects of coastal armouring on biodiversity. By enhancing the ecological value of coastal habitats, focusing on early-stage usage, functionality, and biodiversity, the overarching goal of this research is to revitalise urban coastlines. By placing indigenous knowledge at the centre of science and innovation co-production, this project, which integrates action research on degraded habitats, stands not only as a pioneering endeavour in South Africa, but is also unique within a burgeoning field globally.




*Indigenous Marine Innovations for Sustainable Environments and Economies (IMIsEE): Trans-disciplinarity in action.*

Nature-based interventions ("working with Nature") are increasingly recognised as vital tools for rehabilitating fragmented and urbanised coastal ecosystems sustainably by emphasising the symbiotic relationship between human populations and natural environments. Overall, the impact of this research extends beyond academia, resonating with broader societal concerns and aspirations for a more sustainable and resilient future.

In 2023, the team of young scientists comprising the four PhD candidates of the IMIsEE project, Ms Mpanza, Mr Dyantyi, Mr Ndaba, Ms Mxo, together with the two Postdoctoral Research Fellows, Dr Mbandzi and Dr van der Walt, with the support of three interns, embarked on extensive monthly fieldwork across various sites including urban TNPA sites, such as the Port of Ngqura and Port of Port Elizabeth, the Port of St Francis, Royal Port Alfred Marina, and neighbouring natural sites. Their efforts were pivotal in collecting the bulk of data for the IMIsEE project that is working to understand

*The IMIsEE team and Transnet colleagues sampling at the Port of Ngqura. From left to right: Nobuhle Mpanza (PhD candidate), Yonelisa Gxumayo (Transnet intern), Kerry-Ann van der Walt (Postdoctoral Research Fellow), Francesca Porri, Sandisiwe Tyekela (Transnet intern). Seated: Siphelele Dyantyi (PhD candidate).*

*The IMIsEE team sampling on the shore. From left to right: Jabulani Ndaba (PhD candidate), Francesca Porri, Nobuhle Mpanza (PhD candidate), Vuyolwethu Mxo (PhD candidate), Nokubonga Mbandzi-Phorego (Postdoctoral Research Fellow), Siphelele Dyantyi (PhD candidate).*

and find innovative solutions to environmental challenges linked to coastal urbanisation.

This team of action scientists facilitated the monthly deployment and monitoring of two nature-based structure designs using jute and Cyperus textilis, known in isiXhosa as imizi.

Ms Mpanza spearheaded the collection of early-stage biodiversity data, while Mr Dyantyi collected data for his thesis on complexity, physiology of early life stage invertebrates, and soundscape components, comparing natural and urban rocky shores.

Dr van der Walt initiated a project assessing fish and invertebrate assemblages on the *imizi* nature-based structures using non-invasive RUV cameras, while Dr Mbandzi investigated metal contamination on sediments, seawater, algae, and invertebrates, highlighting species-specific bioaccumulation and the potential of coastal invertebrates to enhance water quality in urbanised coastal areas.

The significance of this research extends beyond scientific inquiry to societal implications. The potential for overuse of the plant for possible upscaling of the IMIsEE project prompted Ms Mxo's PhD research to delve into the feasibility of domesticating the *imizi* plant, its potential for community-based cultivation, and the formulation of a sustainable propagation index. Ms Mxo's investigation into the domestication and sustainable cultivation of a key plant species reflects a deliberate commitment to environmentally responsible research practices that acknowledges the delicate balance between the use of resources and their conservation. This component of the research not only enriches scientific understanding, but also lays the groundwork for sustainable resource management strategies that prioritise both ecological integrity and community well-being.

The collaborative co-creation of the nature-based *imizi* structures, in partnership with the indigenous local community from the Keiskamma Trust in Hamburg, embodies weaving principles of inclusivity, scientific and indigenous knowledge.

This initiative not only fosters community empowerment, but also exemplifies the potential for synergistic transdisciplinary partnerships in addressing environmental challenges.

One key evaluation focus is on the material's suitability for the establishment of natural coastal assemblages. In the realm of scientific discoveries, Mr Ndaba's PhD research on the short-term succession of diatom biofilm formation on the plant material revealed the bioremediation potential of nature-based structures, offering a proactive solution to mitigating metal pollution in coastal ecosystems. These findings suggest the potential practical implications that these nature-based structures possess for environmental management, resilience, and restoration efforts.

**MEASURES OF SUCCESS**

- In 2023, a notable creative output was the *Harmony of Science and Art – Sound Postcard Exhibition* at the Amazwi Museum of Literature. Led by eco-musicologist Prof. Boudina McConnachie and her team at Rhodes University, the exhibition featured sonic postcards which are MP4 files that blend soundscapes with visuals. These innovative creations, combining recorded environmental and human sounds, not only express the project's reflections, but also serve as powerful tools for storytelling and conservation awareness.

*Vuyo Mxo and team gathering* imizi *reeds.* Cyperus textilis *is a sedge in the family Cyperaceae. It is endemic to southern parts of South Africa where it grows near rivers and other water reservoirs.* Cyperus textilis *is used to make baskets, sleeping mats, rolled twine and other woven articles.*


*Harmony of Science & Art Exhibition.*

# Shallow water seascape connectivity

**PROF. NICOLA JAMES**
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**STUDENTS AND INTERNS** Thembani Mkhize (PhD), Melissa Pollard (PhD), Mihle Gayiza (MSc), Sivuyisiwe Cwebe (MSc), Shadly Easton (BSc Hons), Liyabona Sofuthe (BSc Hons)

**COLLABORATIONS** RU, UWC, NMU, NRF-SAEON, Swedish University of Agricultural Sciences

## Identifying, valuing and quantifying impacts of human activity on habitats within seascapes is critical if these habitats are to be constructively managed and conserved.

Coastal habitats provide a number of important ecosystem services, such as the provision of nursery and feeding areas for fishes, filtering of sediment and contaminants, as well as refuge from the effects of climate change. However, habitat degradation, alteration and loss of structural complexity seriously threaten coastal habitats, with impacts associated with climate change (such as habitat and species loss) placing additional pressure on these important systems.

Identifying and valuing habitats within seascapes, as well as quantifying impacts is critical if these habitats are to be constructively managed and/or conserved. The Seascape Ecology Group at NRF-SAIAB strives to understand multi-scale linkages between seascape structure, function and change to better support sustainable ocean development, biodiversity protection and help to understand the consequences of human activity on ecosystem services.

Focussing on shallow nearshore and estuarine environments, the group maps and models seascape spatial structure; studies the impact of climate change in seascapes, with a focus on seagrass, seaweed and associated organisms, as well as climate change resilience and mitigation; and assesses connectivity of fish within seascapes and between shallow nursery seascapes. By better understanding these linkages and impacts, the group aims to contribute knowledge that can ultimately inform effective management and conservation strategies for these important coastal habitats and associated fishery species.

## Seagrass and estuaries are highly productive, core nursery areas.

With the increasing demand on marine resources, there is a dire need to determine the socio-ecological importance of the coastal region so that appropriate management and conservation measures can be prioritised. Continued urbanisation, agriculture and the critical need for fresh water impose numerous anthropogenic pressures on the natural environment and resource health and productivity. Identifying highly productive areas (especially nursery areas) provides managers with the evidence-based resources needed to target and protect or restore these areas.

In order for research to impact on understanding, learning and participation, the Seascape Ecology Group aims to align its research with international and national strategies such as the Marine Research Plan and the UN Decade of Ocean Science for Sustainable Development and to include various stakeholders and societal groups by disseminating knowledge and encouraging participation.

*Prof. Nicola James (NRF-SAIAB) and Thembani Mkhize (PhD candidate) exploring the St Francis shallow-water seascape.*


*Seascape team members: Prof. Anusha Rajkaran, Thembani Mkhize (PhD candidate), Prof. Nicola James (NRF-SAIAB) and Shadly Easton (Hons student) sampling in the Kromme Estuary.*


*Thembani Mkhize (PhD candidate), Prof. Nicola James (NRF-SAIAB) and Dr Carla Edworthy (NRF-SAIAB) exploring the St Francis shallow-water seascape.*

This is done by generating both tangible scientific outputs (papers, book chapters and presentations) and meaningful engagement through public and social media platforms.

In 2023, five papers and one book chapter were published, highlighting the importance of both seagrass and estuaries as core nursery areas, and the threats facing these productive habitats through climate and global change. Research was presented at the Fisheries Society of the British Isles annual symposium *Fish habitat ecology in a changing climate* in the United Kingdom (three presentations), as well as at the 5th National Global Change conference, showcasing comprehensive local and international coverage.

In addition to academic contributions, the group strives to inform and engage with stakeholders and societal groups on topics and issues related to coastal habitats and their management. PI Prof. Nicola James was invited to talk on estuaries and climate change at the Nelson Mandela University Coastal and Marine Research Annual Symposium, *Optimising Marine and Coastal Research for Global Sustainability,* and at the Western Cape Estuaries Task Team quarterly meeting. She also authored a Briefing Note on seascape ecology entitled *Seascape - importance and translation into management.* A briefing note aims to provide a concise outcome-based synopsis of recent research or expert opinion that may inform decision making and activities by authorities, NGOs and NPOs.

PDP Postdoctoral Research Fellow, Dr Carla Edworthy, represented South Africa at a workshop on communicating on Ocean Acidification hosted by the International Atomic Energy Agency in Costa Rica. The group maintains social media platforms (e.g. X (previously Twitter) and Instagram: @SeascapeEcolSA) and a research webpage (https://seascapeecologysa.wixsite.com/seascape-ecology-res) to disseminate research to stakeholders and society. These groups include industry stakeholders, such as the linefish community, marine spatial planners, and resource/environmental managers and educators who will directly benefit from the research outputs, as well as local communities and the general public. These means of engagement aim to develop societal awareness and understanding of the importance of conserving coastal habitats and encourage participation in research and conservation activities.

The research undertaken by the Seascape Ecology Group is multi-disciplinary and underpinned by the use of innovative research platforms, such as acoustic telemetry, acoustic imaging technology, downscaled sRUVs (remote underwater stereo video systems) for use in nearshore environments, and amino acid habitat-specific isotope analysis to unravel patterns in the highly dynamic, shallow estuarine and nearshore environment.

In order to impact understanding, learning and participation, transformation and capacity development are important key elements of this research, with strong representation by female scientists, young early-career researchers, and black researchers.

Postgraduate students and Postdoctoral Research Fellows are trained in the fields of seascape ecology and climate change through collaborative supervision on innovative research projects. Indicators of this impact for 2023 include the graduation of one PhD candidate (Lauren Bailey), one MSc student (Andrew Meiklejohn) and the completion of two BSc Honours dissertations (Shadly Easton and Liyabona Sofuthe), with research encompassing climate change and seascape ecology.

# Seafloor Ecology and Sustainability (SEaS)

**DR ANTHONY BERNARD**
*INSTRUMENT SCIENTIST AND MARIP MANAGER*

**TEAM MEMBERS** Elodie Heyns-Veale, Kaylee Smit, Roxanne Juby, Aseeqah Davids

**STUDENTS AND INTERNS** Mpilonhle Nyawo (PhD), Angus van Wyk (PhD), Thembelihle Dube (MSc), Jade Vermeulen (MSc), Enya Munting (MSc), Melissa Abrahams (MSc), Matsobane Malebatja (HSRC intern)

**COLLABORATIONS** RU, Wild Oceans, Wildlife Conservation Society, SANBI, NMU, ORI, Namibia Nature Foundation, NEKTON Foundation, University of Seychelles

The SEaS Group aims to mainstream underwater observation-based research to support effective management of seafloor ecosystems.

This research aims to advance the sustainable management of seafloor ecosystems in five thematic areas: improving sampling methodologies and research capacity; creating foundational knowledge; understanding how global change and management decisions influence ecosystem components and structure; determining societal opportunities and costs associated with management actions, and supporting policy and decision making. This research builds on the foundation provided by the Marine Remote Imagery Platform (MARIP).

Seafloor ecosystems are highly valued by a diverse range of stakeholders for their provisioning, cultural, supporting and regulatory services. In many instances, economic incentives and competing interests have led to unsustainable activities and conflict amongst stakeholders and between stakeholders and management. Improving knowledge of the ecology, impacts of global change and the social-ecological systems is fundamental to support sustainability and effective management.

Society has a strong interconnectedness and reliance on the ecological services provided by seafloor ecosystems. However, rapidly growing coastal populations, improved accessibility, climate change and industrialisation undermine the functioning of these ecosystems. Research and outcomes that advance sustainability need to be prioritised to ensure that we can continue to benefit from seafloor ecological services.

The SEaS research group relies on underwater cameras to conduct research on benthic and demersal fishes, and considerable effort is invested into strengthening the capabilities and knowledge base for these sampling tools. Our current focus is the development

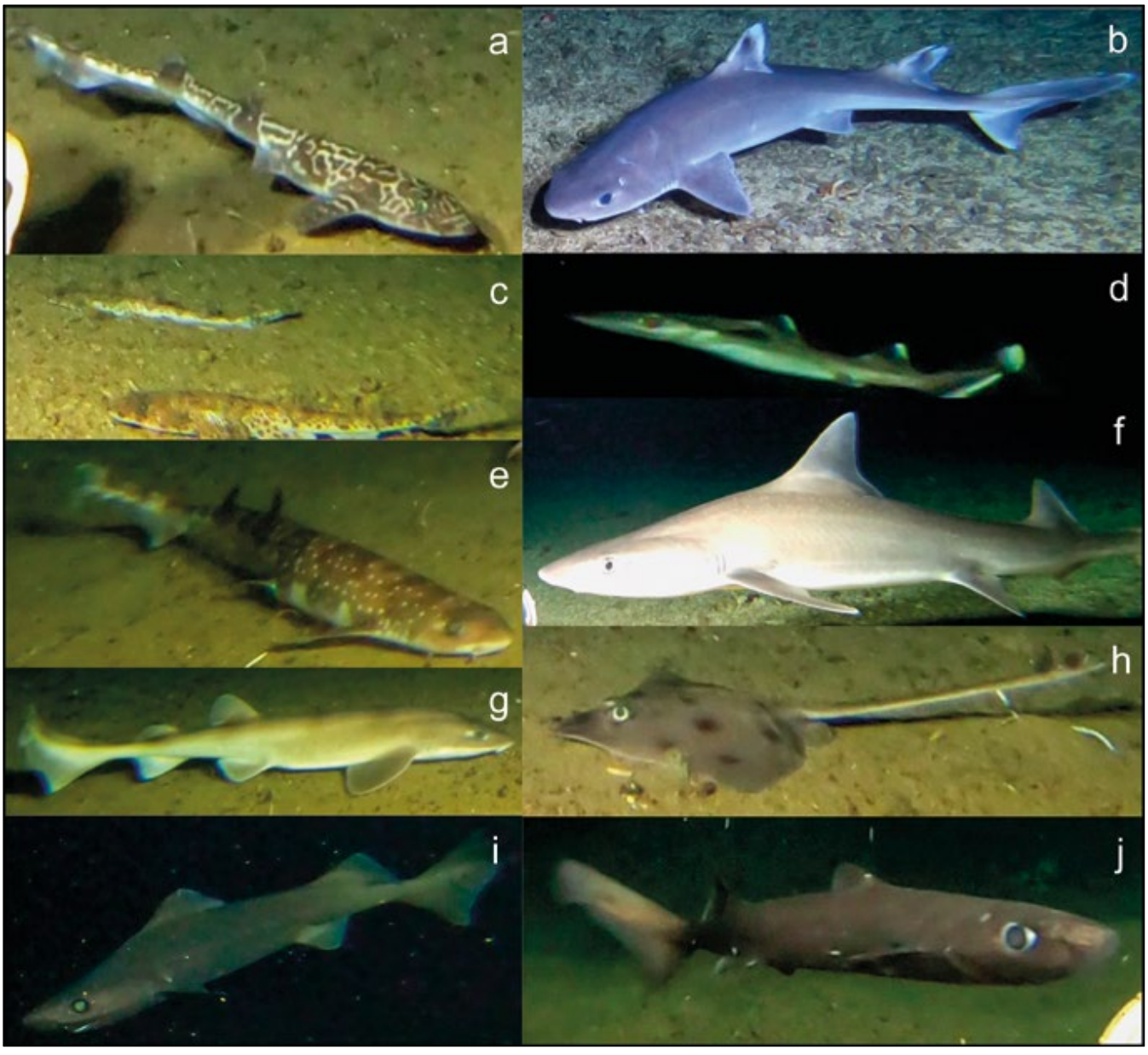
*Images of fish recorded on the mesophotic reefs in the restricted zone of the uThukela Banks MPA during the ACEP SMART-Zone project.*

of deep-sea baited stereo video landers, sampling protocols and analytical procedures to maximise data value.

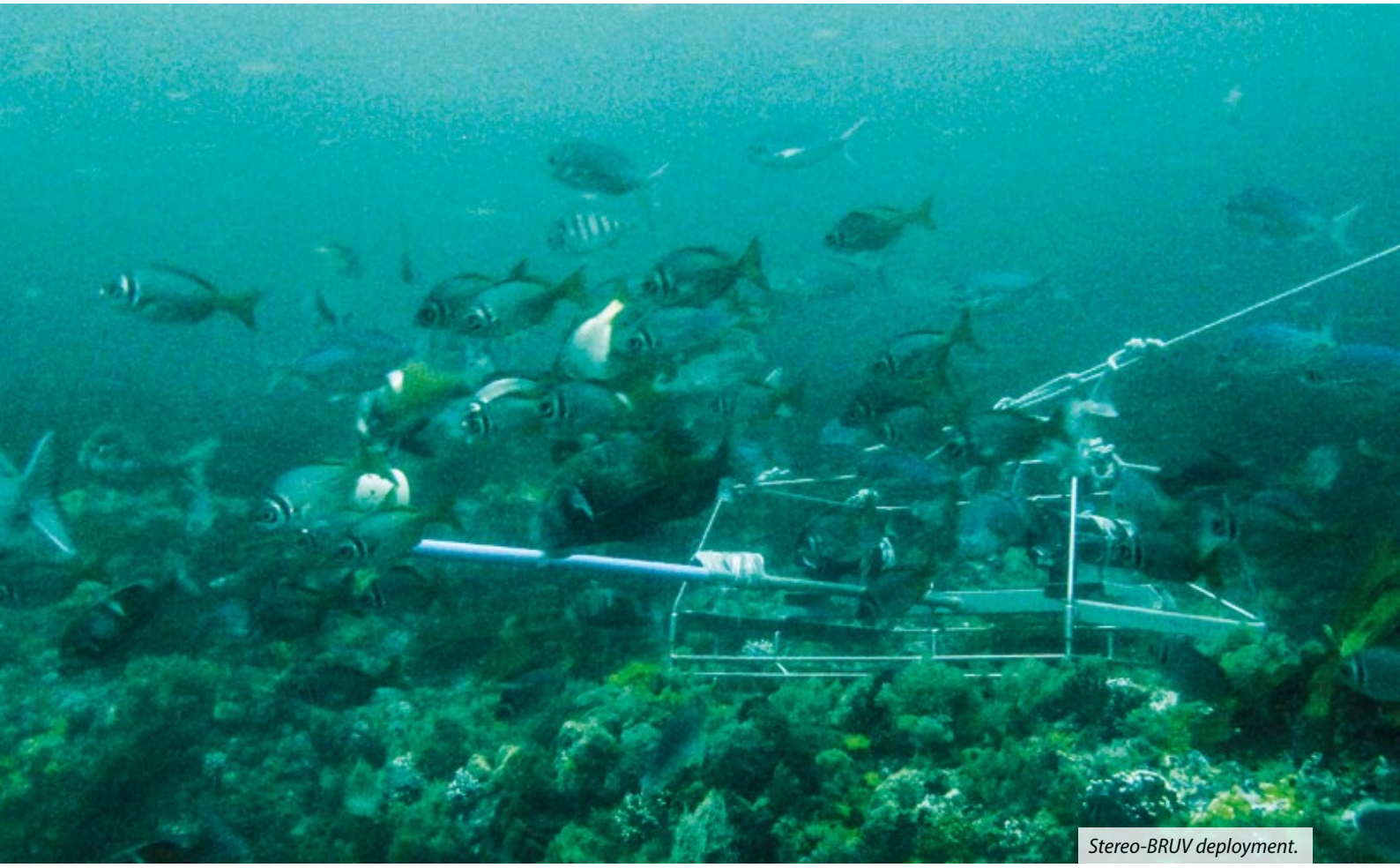
Despite exceptionally challenging sea conditions, SEaS successfully collected underwater video footage between depths of 200 and 1000 m directly below the Agulhas Current.

In 2023, during the ACEP deep-sea research capacity-building cruise, we were able to test the equipment on the shelf edge and slope environments offshore of East London. We successfully collected footage between depths of 200 and 1000 m directly beneath the Agulhas Current, which was ranging between two and five knots, creating exceptionally challenging sea conditions. However, the operations protocols worked flawlessly, and the landers collected valuable information, including range extensions for multiple species and some of the first in situ observations for others.

The research community is a key stakeholder when considering the sustainable development of seafloor ecosystems because knowledge exchange, capacity development and collaboration can advance research activities and impact. We currently have two projects, one funded by the National Research Foundation and the other by the Scientific Committee for Oceanic Research, which aim to strengthen the community of practice, collaboration, knowledge mobilisation and improve capacity to conduct standardised and robust research using underwater observation-based sampling techniques.




*Images of the shark species identified from the lander footage collected between 200 and 1000m depth offshore East London during a capacity building cruise. The species are: (a)* Holohalaelurus regani, *(b)* Cirrhigaleus asper, *(c)* Holohalaelurus punctatus, *(d)* Deania spp., *(e)* Scyliorhinus capensis, *(f)* Mustelus palumbes, *(g)* Cephaloscyllium sufflans, *(h)* Cruriraja parcomaculata, *(i)* Centrophorus granulosus, *(j)* Etmopterus pusillus.



*Stereo-BRUV deployment.*

## Marine spatial and adaptive management requires relevant ecological datasets.

Marine spatial and adaptive management, which forms the basis for the sustainable development of the oceans, requires relevant ecological datasets to develop plans and then track ecological responses in space and time once the management plan is established. Research carried out within our group contributed to a number of projects and scientific publications with direct benefits for management.

The scientific papers covered topics such as identifying indicators for measuring reef ecosystem condition, developing spatial management plans for elasmobranchs, providing frameworks for Marine Spatial Planning (MSP) and tracking global deficits in reef shark populations. We continued our work in the uThukela Banks marine protected area (MPA) and the KwaZulu-Natal coastline where we aim to improve our understanding of the effect of the MPA network on linefish species and elasmobranchs, and the commercial linefishers from the region. This feeds into the ACEP SMART Zone project and the Blue Action Fund uThukela Banks management support project led by Nelson Mandela University and Wild Oceans.

In 2023 surveys of new offshore reefs (40–200 m depth) within and to the north of the uThukela Banks MPA were completed. This data will allow us to develop a feasible long-term monitoring programme to support the MPA management and, when combined with existing datasets from the region, will allow us to measure the overall ecological response to the KZN MPA network.

## Human social systems are interconnected with and inseparable from marine ecosystems.

It is becoming apparent that sustainability challenges can benefit from a social-ecological systems approach. In 2022, data on the perceptions of commercial linefishers regarding the ecological, social, and governance impacts of MPAs and their management were collected for KZN and this was analysed by an MSc student in 2023. These data will help us understand the sustainability and management issues, and better measure the effectiveness of the KZN MPA network by incorporating social-ecological perspectives.

**REPRESENTATION ON COMMITTEES/PANELS/ WORKING GROUPS -**

- GOOS BioEco Panel Member
- National Marine Biodiversity Working Group
- National Marine Ecosystem Committee
- National Line and Netfish Scientific Working Group
- Co-Chair on SCOR Working Group 164: CoNCENSUS

# Assessment of fish assemblages using environmental DNA (eDNA)

**DR GWYNNETH MATCHER**
*INSTRUMENT SCIENTIST AND AGRP MANAGER*

**TEAM MEMBERS** Gwynneth Matcher, Anthony Bernard, Kerry Sink, Ryan Palmer

**STUDENTS AND INTERNS** Mpilo Nyawo (PhD), Jody Oliver (PhD)

**COLLABORATIONS** SANBI

The use of eDNA is a rapidly growing approach worldwide for non-invasive evaluations of fish biodiversity.

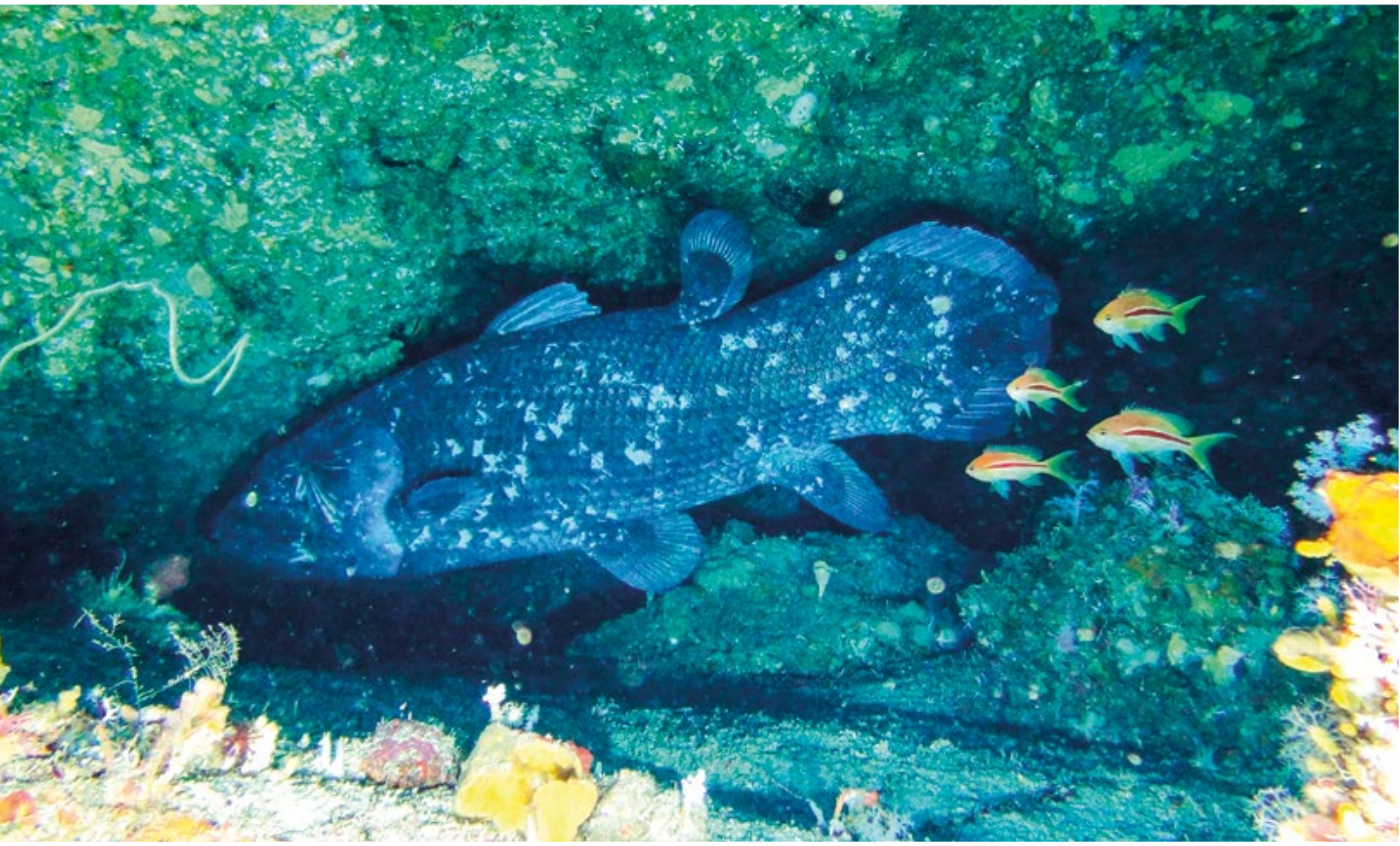
Marine ecosystems are under severe pressure to meet resource demands from human populations. Furthermore, global climate change and impacts from human disturbances are placing additional physiological stress on marine organisms. Improved understanding of the biodiversity and habitat use of fish assemblages is essential for the effective management of our marine environment and the accurate understanding of the impact of human use of marine resources.

To mitigate these growing threats, assessment of vulnerable ecosystems needs to be non-destructive and non-invasive. This can now be achieved thanks to advances in molecular research, decreased costs of next-generation sequencing, and the targeted use of environmental DNA (eDNA).

eDNA refers to DNA that is shed by target species into their surrounding environment.

eDNA can be extracted from abiotic environmental samples such as water, soil, and air. In the marine environment, eDNA provides a valuable complement to already existing survey and biodiversity assessment methods, such as baited remote underwater stereo video systems (BRUVs).

The research conducted by NRF-SAIAB in 2023 focused on the



*eDNA coelacanth population assessment is part of the ACEP Deep Connections Project. This coelacanth was photographed at Mzumbe (south-eastern coast of South Africa) by NRF-SAIAB's ROV piloted by Ryan Palmer.*

use of eDNA to assess fish biodiversity in shallow reefs within and outside of marine protected areas (MPAs) and the assessment of understudied deep canyon (100-200 m) fish assemblages.

Research focused on three research topics: (a) the use of eDNA to assess fish biodiversity in shallow reefs within and outside of MPAs along the Garden Route (Tsitsikamma and Nature's Valley), in Algoa Bay, and along the Wild Coast (Mdumbi and Dwesa Cwebe) in order to assess the efficacy of the MPAs as a refuge for aquatic biota; (b) assessment of the currently limited studies on deep canyon (100-200 m) fish assemblages; (c) the use of eDNA to detect and determine the distribution range of the iconic coelacanth *(Latimeria chalumnae)*.

## MPAs function as a haven for fish species, protecting them from overfishing.

Overfishing of species before they reach reproductive maturity is a primary cause of extinction. Like game reserves, MPAs are areas of the ocean that are set aside and managed for conservation purposes; they are a crucial tool for the conservation of marine biodiversity and maintenance of ecosystem services. Protecting fishes from overfishing, MPAs provide a haven for fish species by providing protected areas for them to breed. The protected area also functions as a nursery habitat to allow fish to reach maturity. This safeguards marine biodiversity, prevents extinction events, preserves genetic diversity and maintains healthy marine ecosystems.

MPAs are also beneficial to the fishing industry as they provide a source of fish larvae and larger adult fish which migrate out of the MPAs and replenish fish stocks. The MPAs have an additional impact in the tourism industries which support local economies and communities.

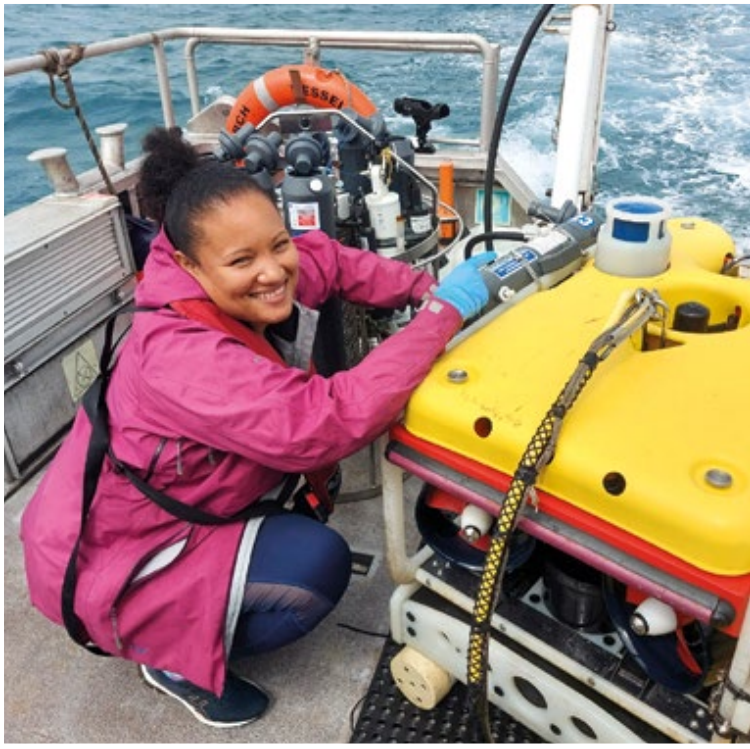
## eDNA provides a useful complementary tool to BRUVs and can detect species that do not swim into the view of the camera.

Deep canyons (> 100 m below the sea) are home to a wide range of marine fish; however, they are often overlooked in biodiversity assessments, and little is known of these deep-sea environments off the coast of South Africa. Deep canyons are important fishing grounds for commercial and subsistence fisheries. By studying the diversity of fish in these habitats, scientists can identify key species and habitats that are important for fisheries, as well as potential threats to these fish species, including overfishing and habitat destruction.

Owing to their deep-sea nature, these canyons are less sensitive to the effects of climate change and may function as a sanctuary for fish species sensitive to the effects of sea warming and acidification. To date, research on deep canyons has typically been conducted by remote underwater vehicle (ROV) (which is limited by the fish species which are located directly in the view of the camera), or trawl studies which, while informative, are destructive methods of biodiversity assessments as they involve the death of the collected specimens.

eDNA presents an attractive complement to these two methods in that it is non-destructive, and it can include all species present in the water body. Research undertaken in 2023 involved collecting water samples from several deep-water canyons off the east coast of South Africa. eDNA studies, in conjunction with BRUV assessments inside and outside of MPAs in three distinct regions of the South African coastline, have been completed. Genetic material has been extracted from these water samples; sequence analysis to determine the identity of the fish species present in the deep canyons is currently underway.

The final stages of the analyses are currently underway. Preliminary data show that the eDNA methods are able to detect >75% of the fish species observed with BRUV assessments with 45 additional species detected by eDNA that were not observed by the BRUV camera.



*Jody Oliver (PhD candidate) collecting water from a niskin bottle attached to the ROV for eDNA filtration and subsequent analysis in the laboratory as part of the ACEP Deep Connections Project.*

The coelacanth is a prehistoric fish that was thought to be extinct until its rediscovery in 1938. It is listed as a critically endangered species owing to its low population size and restricted distribution. The coelacanth is extremely rare and has been found only in Indonesia and along the eastern coastline of southern Africa. Studying the coelacanth can help inform conservation efforts to protect this species. However, coelacanths are usually found in very deep water (>100 m) which makes studying this iconic species extremely difficult. Little is known of their distribution range outside of the visual sightings conducted by ROV camera footage.

eDNA studies conducted in 2023 have successfully detected the presence of coelacanths within a canyon known to support coelacanths as well as at a site where coelacanths have not previously been observed or reported. These findings verify the validity of eDNA as an approach to discern the distribution range of this elusive and iconic fish. Additional samples have been taken from various sites along the South African coastline to determine the true extent of the distribution range of the coelacanth.

# Little fish, big insights: learning more about mullet species

**DR TARYN MURRAY**
*INSTRUMENT SCIENTIST and ATAP MANAGER*

**TEAM MEMBERS** Taryn Murray, Amber-Robyn Childs, Matt Parkinson, Tor Næsje

**STUDENTS AND INTERNS** Dinah Mukhari (PhD), Bantony Ziko (PhD)

**COLLABORATIONS** RU, Norwegian Institute for Nature Research

Estuaries support large numbers of juvenile and adult fishes, providing fishery opportunities for people living near them.

Estuaries are bodies of water where the sea and river meet, characterised by fluctuating water temperature, salinity and turbidity. Over the past 20 years, acoustic telemetry has been used to investigate the behaviour and vulnerability of important estuary-dependent fishery species, giving us unprecedented insights into their movement patterns. In addition to overexploitation, an additional, and no longer unseen, threat to these fishes is a changing climate.

Because fish are unable to control their body temperatures, they are at the mercy of fluctuating water temperatures, and understanding the thermal limits of a species provides insights that we need to predict future changes. Over the past two years, the ATAP team has been assessing the movements of five mullet species tagged in the Kowie Estuary, Eastern Cape. Mullet have been identified as possible indicators of global warming, and 2023 was an opportune year to further study the influence that fluctuating temperatures may have on their movements by conducting thermal tolerance laboratory experiments.

This research has a direct socio-economic impact because mullet are so important in estuarine fisheries, and the data collected can be used to better manage the impact on these species both now and in the future.

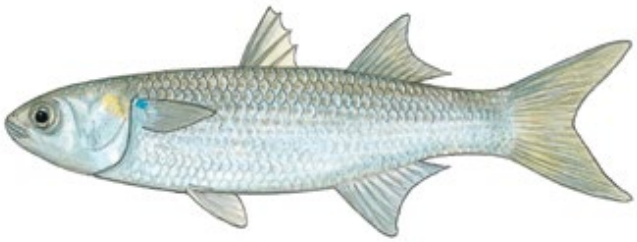
Acoustic telemetry, the most popular method used to study the movements of aquatic animals across the globe, has allowed researchers to gain incredible insights into the movements of animals, including residency, home range, multiple habitat connectivity, and migratory movements, among others.

Smaller fish species are arguably more important than larger species in estuarine systems, often contributing most in terms of abundance.

While larger-bodied species tend to be the species of choice when it comes to telemetry studies, their smaller-bodied counterparts are arguably more important in estuarine systems, often contributing most in terms of abundance.

These include species from the Mugilidae family. During 2023, 56 mullet from five species – bluespot *Moolgarda seheli*, flathead *Mugil cephalus*, grooved *Chelon dumerili*, southern *Liza richardsonii* and striped *Liza tricuspidens* – were acoustically tagged and their movements monitored in the Kowie Estuary, Eastern Cape by an array of 26 acoustic receivers.

***Above:*** *A small flathead mullet recovering after being tagged on the opercula with a visible implant fluorescent elastomer tag for identification during video analysis.*
***Below:*** *Flathead mullet* (Mugil cephalus) *- illustration by Elaine Heemstra from* Coastal Fishes of Southern Africa *(2004) by Phil and Elaine Heemstra.*



Together, these fish have accumulated almost 1.8 million detections. This is significant and is the largest estuary dataset collected over a one-year period since the initiation of estuary acoustic telemetry in 2003. Preliminary results suggest environmental niche partitioning, with each species using a certain stretch of the estuary. Results of the detections were presented at the Southern African Society of Aquatic Scientists (SASAqS) Annual Conference in June 2023.

Some individuals have displayed habitat connectivity, moving

between the estuary and the adjacent marine environment. Several tags have 'gone quiet' suggesting the fish have died, either because of predation (by fish or bird) or fishing. Death through fishing was recently confirmed when a buyer who bought a mullet from a Durban fish market was surprised to find a tag when working the animal. This highlights the level of exploitation of fishes that have been tagged in the Kowie Estuary, with undoubtedly more animals having been recaptured but not reported.

## Mullet species are also an ideal family to use as an environmental indicator of global warming and a changing climate.

While the acoustic telemetry data reveal unprecedented information on mullet movement behaviour, an additional and complementary method is also being employed to learn more about these small-bodied animals. Mullet species were proposed as the ideal family to use as an environmental indicator of global warming and a changing climate; previous work has suggested strong links between water temperature and the distribution and abundance of mullet species in estuaries. To test this, additional mullet from the Kowie Estuary were caught and transported to the NRF-SAIAB's Aquatic Ecophysiology Research Laboratory at Rhodes University in Makhanda, where after an acclimation period, thermal tolerance experiments were run. The experiments were run to determine the maximum and minimum temperatures the chosen mullet species – flathead and grooved – could handle before showing signs of stress. While both species were tolerant of huge fluctuations in temperature, the thermal range (i.e., difference between minimum and maximum temperatures) of the flathead mullet was considerably greater than that of grooved mullet, highlighting how each species will adapt slightly differently to anticipated changes in water temperature.

*PhD candidates Dinah Mukhari and Bantony Ziko prepping fish for thermal tolerance experiments.*

## This project is about so much more than the fish.

This project, while directly contributing to sustainable use of marine resources (SDG 14: Life Below Water) and sustainable consumption patterns (SDG 2: Zero hunger, SDG 12: Responsible Consumption and Production), is also developing human capacity through the specific training of two PhD candidates, Dinah Mukhari and Bantony Ziko. Through this project, they have developed skills associated with acoustic telemetry and fish husbandry, conducted successful thermal tolerance experiments, gained skippering experience, have been awarded an equipment-related training and travel research grant, and will be presenting their findings at an international conference in 2024, showing that this project is about so much more than just the fish. Furthering her training, ATAP Manager, Dr Taryn Murray, was awarded an equipment-related travel and training grant for a training opportunity with Dr Audrey Darnaude in Montpellier, France at the French National Centre for Scientific Research (CNRS). An additional output was Murray, T.M. 2023. Final Report and Executive Summary for SANOCEAN Project No. 287015 *Benchmarking knowledge-based adaptive management of estuarine fisheries in South Africa for sustainable development*. ISBN: 978-82-426-5110-5

***Top:*** *Supervisors Dr Taryn Murray and Prof. Amber-Robyn Childs with PhD candidate, Dinah Mukhari.*
***Above:*** *PhD candidates Dinah Mukhari and Bantony Ziko assisting with the rolling over of acoustic receivers in the Kowie Estuary.*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# ENGAGE

## Engaged Research

# ENGAGED RESEARCH

## Marine and freshwater research projects are instrumental in communicating science

**LUCKY DLAMINI**
*COMMUNICATIONS AND STAKEHOLDER RELATIONS MANAGER*

NRF-SAIAB's research staff and students play a crucial role in spearheading various science engagement initiatives. Online engagement platforms, social media channels, and virtual hosting capabilities have exponentially expanded NRF-SAIAB's reach. These efforts include participation in environmental awareness days and collaborations with other organisations, all aimed at enhancing science awareness and interest, using mediums of communication that are accessible by the general public. Furthermore, NRF-SAIAB's scientists actively contribute to online and social media interactions, sharing their research and work-related insights. Through our newly launched website, the Institute effectively communicates news and events to engage with the general public.

Targeting public audiences, NRF-SAIAB's Seminar Series and Student Symposium further stimulate interaction, promoting the exchange of information on aquatic biodiversity research. Initiatives like Summer Schools and the School Learner Internship Programme continue to inspire a new generation of scientists and raise awareness about the importance of aquatic ecosystems.

The Institute strategically coordinates science communication and engagement efforts through two NRF-funded research projects, namely the Indigenous Marine Innovations for Sustainable Environments and Economies (IMIsEE) project and the REFRESH project. Both these multi-institutional, collaborative projects had a successful year engaging with communities and communicating their findings. Incorporating communication practitioners as research partners on these projects has been instrumental in enhancing NRF-SAIAB's science engagement and communication in both marine and freshwater research domains.

> IMIsEE Project combines experiential learning, hands-on activities, and interactions with industry experts to foster curiosity among leaners.

The Indigenous Marine Innovations for Sustainable Environments and Economies (IMIsEE) project welcomes enthusiastic learners from various Makhanda high schools as part of the NRF-SAIAB and RU DIFS Science Internship Programme. The aim of the programme, which was initiated by NRF-SAIAB's Prof. Francesca Porri (IMIsEE Project PI) and has run for over 10 years, is to expose learners to different science disciplines so that they can make more informed decisions about their future careers.

In 2023, the two-day interaction took place on 10 and 12 July. The programme, facilitated by IMIsEE's research students and Postdoctoral Research Fellows, gave learners the chance to engage in practical activities and meet PhD candidates and researchers. This experience offered valuable insights into the importance of biodiversity, nature-based ecological engineering, and the integration of indigenous knowledge in scientific endeavours. The Science Internship Programme is highly beneficial for high school learners, combining experiential learning, hands-on activities and interactions with industry experts to foster curiosity.

In collaboration with the Royal Alfred Marina in Port Alfred, on 5 September, the IMIsEE and Coastal and Ocean Sciences Team


*Harmony of Science and Art - Sound Postcard Exhibition poster and invitation to the exhibition held at the Amazwi Museum of Literature. This exhibition blended creativity and sustainability.*

*Integrating scientific inquiry with artistic expression, the IMIsEE project celebrates the rich cultural heritage intertwined with South Africa's coastal landscapes.*

***Above & right:*** *Science Internship Programme: Empowering Young Minds: NRF-SAIAB's Science Internship Programme, led by Prof. Francesca Porri, sparks curiosity and career exploration among Makhanda high schoolers. From hands-on activities to engaging with experts, the programme ignites passion for biodiversity and indigenous knowledge integration. Pictured is Dr Lubabalo Mofu leading the learners through an interactive practical activity.*

(COST) hosted a session for 20 high school learners from Kuyasa Combined School, featuring presentations, an exhibition, and a quiz, making scientific knowledge accessible and fostering environmental curiosity among young minds.

As part of National Marine Week 2023, NRF-SAIAB partnered with the Johan Carinus Art Centre and Victoria Girls' High School in Makhanda to organise a Plastic Pollution Art Exhibition, showcasing Grade 8 learners' creative responses to marine conservation challenges. The exhibition, launched in October, highlighted the urgent need for action against plastic pollution. Professor Porri, IMIsEE PI and Senior Scientist, delivered an impactful address at the exhibition, inspiring the audience to act against plastic pollution, urging them to reduce their plastic usage and to reuse plastics rather than disposing of them. The Plastic Pollution Art Exhibition served as a powerful platform to engage the community and drive home the urgency of marine conservation.

In November, the IMIsEE project presented a unique exhibition at the Amazwi South African Museum of Literature, blending science, art, and sound to address coastal challenges creatively. Organised jointly with the Rhodes University Department of Music and Musicology, the *Harmony of Science and Art* – Sound Postcard Exhibition was part of the NRF-SAIAB Annual Student Symposium and showcased the project's innovative approach to sustainability and cultural preservation.

With ongoing research and community-based activities, the IMIsEE project seeks to expand its impact. Anticipated outputs include international presentations, exhibitions, and performances, aiming to amplify its message of sustainability of coastal resources and cultural preservation. By integrating scientific inquiry with artistic expression, the IMIsEE project exemplifies the power of transdisciplinary collaboration. Through initiatives like the *Harmony of Science and Art exhibition,* it endeavours to not only address environmental challenges exclusively through science but also to celebrate the rich cultural heritage intertwined with South Africa's coastal landscapes.

***Top:*** *Engagement with Port Alfred High School Learners: NRF-SAIAB collaboration with Port Alfred High School, the Royal Alfred Marina, IMIsEE, and COST brought science to life for 20 Kuyasa Combined School learners. Through engaging presentations, exhibitions, and a quiz, they sparked curiosity and environmental awareness. Pictured is IMIsEE Postdoctoral Research Fellow, Dr Kerry-Ann van der Walt and NRF-SAIAB/WWF-SA intern, Thulisile Nkomo fostering environmental curiosity among young minds from Kuyasa Combined School, Port Alfred.*
***Above:*** *NRF-SAIAB/DSI-HSRC Intern, Vusumzi Tsipa communicating about an innovative and sustainable farming method that combines aquaculture (fish farming) with hydroponics (soilless plant cultivation) called aquaponics. In this system, fish and plants work together in a mutually beneficial manner.*

*The art exhibition, held in NRF-SAIAB's lecture room on the 10 October 2023, showcased the creative talents of the Grade 8 learners, who harnessed their artistic skills to communicate the devastating effects of plastic pollution in our oceans. The learners' artworks were made from recycled materials, emphasising the importance of reducing, reusing, and recycling plastic. Senior Scientist Prof. Francesca Porri reviewing and engaging with one of the learner's artwork.*

These IMIsEE initiatives have demonstrated the power of interdisciplinary collaboration and innovative approaches in promoting science engagement and environmental awareness.

## REFRESH Project informs species and ecosystem conservation efforts.

The REFRESH Project is actively involved in enhancing data and addressing knowledge gaps regarding freshwater species in South Africa, with a focus on informing species and ecosystem conservation efforts. Alongside these scientific endeavours, the REFRESH project team has been deeply engaged in science communication activities. Notably, members of the team from North-West University (NWU) have contributed significantly to the Unit of Environmental Sciences and Management newsletter.

At the Southern African Society of Aquatic Scientists (SASAqS) Congress, the REFRESH team showcased a strong presence through various presentations that emphasised the project's goals and achievements. Their contributions underscored the collaborative nature of the project, demonstrating partnerships with universities, research centres and governmental bodies. These collaborations emphasise the importance of engaging multiple stakeholders to address climate uncertainties effectively. By leveraging diverse expertise and resources, the REFRESH project adopts a holistic approach to research and management within aquatic sciences. The NRF-SAIAB researchers and collaborators continue to show unwavering dedication to scientific excellence, the pursuit of sustainable aquatic ecosystems, and engaging with the public and various stakeholders.

Participation in international conferences, such as the *7th International Conference of the Pan African Fish and Fisheries Association* (PAFFA), further solidified the REFRESH project's global impact.


*REFRESH Project - Southern African Society of Aquatic Scientists (SASAqS) NRF-SAIAB Researchers and Partners on the REFRESH Project at the SASAqS Congress showcasing the project's impactful contributions in aquatic sciences, at the Lord Charles Hotel Conference & Functions Venue.*

*7th International Conference of the Pan-African Fish and Fisheries Association (PAFFA). From Left to right: Dr Albert Chakona, Dr Tadiwa Mutizwa, Graça Mandava Jaime and Christian Mukweze Mulelenu, part of the NRF-funded REFRESH project at the PAFFA Conference in Brazzaville, Republic of Congo. Tadiwa, Graça and Mukweze were all awarded prizes for their presentations.*

Seven NRF-SAIAB researchers provided oral presentations of their work, and two poster presentations were on display for the duration of the conference. Three outstanding NRF-SAIAB members, Tadiwa Mutizwa (Zimbabwe), Graça Mandava Jaime (Mozambique) and Christian Mukweze Mulelenu (Democratic Republic of Congo) emerged as student-award recipients for their exceptional presentations, highlighting the excellence of NRF-SAIAB's research work and impact on the study of *African Fish and Fisheries: Diversity, Conservation and Sustainable Management*. The REFRESH team looks ahead with renewed determination, poised to continue its mission to document and safeguard Africa's aquatic biodiversity, using global platforms such as this to communicate this work.

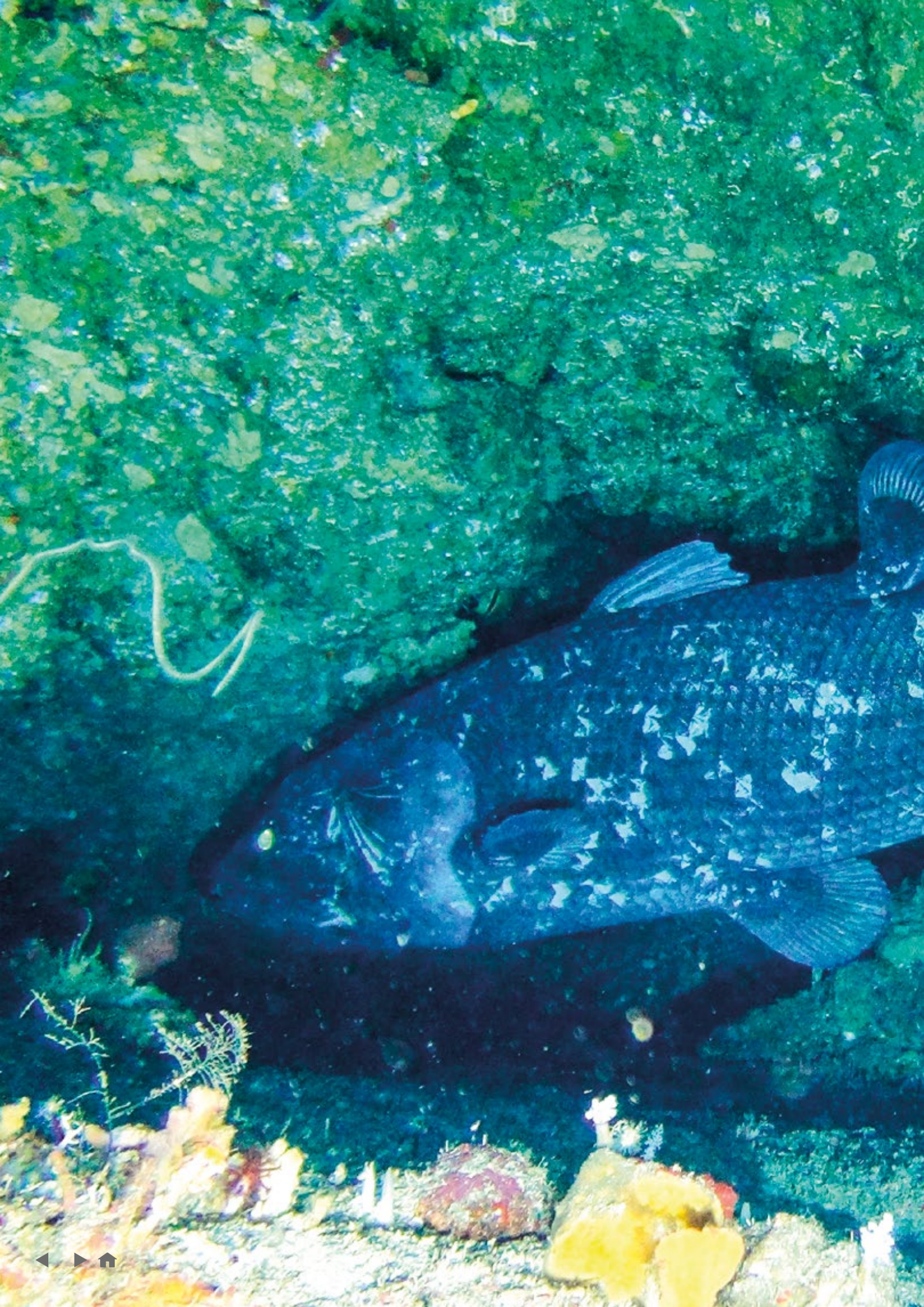
NRF-SAIAB consistently demonstrates its commitment to bridging the gap between the scientific community and the broader public.

Notably, in 2023, NRF-SAIAB received recognition through its award for the Second Best Exhibition at the Working World Exhibition, where the Institute engaged with 6800 learners, providing them with interactive experiences and exposure to scientific specimens from the National Fish Collection (NFC).

The Eskom Expo for Young Scientists served as a platform for Postdoctoral Research Fellows to mentor learners on practical science projects involving scientific investigations. Alutha Botha, a student at Nombulelo Senior Secondary School in Makhanda, benefited from mentorship by Dr Phakama Nodo, a Postdoctoral Research Fellow at NRF-SAIAB, in collaboration with NRF-SAEON. Following his success at the Eskom Expo for Young Scientists Regional Science Fair, where he received a gold award and a Rhodes University Bursary, Alutha represented Makhanda and the province at the *Eskom Expo International Science Fair* in the environmental science category. He competed against learners from all nine provinces and other international participants, earning a Bronze Medal. Alutha's research project, titled *Exploring Habitat Use by Juvenile Fishes in Algoa Bay, South Africa Using Remote Underwater Videos,* will be presented at the Regeneron International Science and Engineering Fair in Los Angeles, California, USA, scheduled from 11–17 May 2024.

NRF-SAIAB enables public access to its research and science infrastructure, conducting tours for diverse audiences, from schools to environmental training centres and the general public. NRF-SAIAB engages individuals of all ages and backgrounds in the wonders of aquatic life. Visitors have the opportunity to explore cutting-edge research on marine and freshwater species, witness live demonstrations of scientific techniques, and participate in hands-on activities that promote environmental stewardship.

***Right, top to bottom:*** *NRF-SAIAB's participation in the Working World Exhibition (WWE) was pivotal for providing career guidance to learners and offering an interactive experience with science specimens. Meeting young scientists in the making and showcasing research students as role models added value. The WWE platform effectively reached and equipped South Africa's school-leaving youth, earning NRF-SAIAB recognition with awards for the best stand along with the other NRF Facilities. The expo drew 12,963 visitors, including school groups, teachers, and the general public.*



# EXPLORE

## Platform Provision & Infrastructure Development


RV Observer *supports marine and coastal research in the Eastern Cape.*

# AFRICAN COELACANTH ECOSYSTEM PROGRAMME (ACEP) – MARINE PLATFORM

## Supporting the sustainable development of the Blue Economy

**RYAN PALMER**
*MARINE PLATFORM MANAGER*

**PLATFORM USERS**
RU, SANBI, NMU, UCT

**METRICS** Vessel days in 2023 – 124
Researchers gaining access to ACEP Platforms – 84
Peer-reviewed publications acknowledging ACEP – 33
Postgraduate students – 45
Public engagements and awareness events – 4

A key facet of ACEP is the provision of research infrastructure to the National System of Innovation.

The African Coelacanth Ecosystem Programme (ACEP) is a flagship programme of the Department of Science and Innovation (DSI) implemented by NRF-SAIAB. ACEP partners with the Department of Forestry, Fisheries and Environment (DFFE), the South African Environmental Observation Network (SAEON), the Shallow Marine and Coastal Research Infrastructure (SMCRI) and NRF-SAIAB, and has been directly aligned with the Global Change Grand Challenge, NRF Vision 2015, the Marine and Antarctic Research Strategy 2016, and the 2030 Agenda for Sustainable Development.

"The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs) which are an urgent call for action by all countries – developed and developing – in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests." – United Nations

The previous phase of ACEP linked in with Operation Phakisa Ocean Cruises and represents a key contribution by the DSI and NRF

*Students on board* RV Observer.


RV Observer.

*ACEP manages and operates a fleet of three coastal research vessels. The* RV Observer *operates out of Gqeberha and supports marine and coastal research in the Eastern Cape to build capacity in offshore marine sciences, particularly developing a critical mass of skilled personnel and addressing equity imbalances.*

to Operation Phakisa. The ACEP projects are integral to achieving the strategic objectives identified by other government departments, such as the DFFE. ACEP is currently in its 2021–2023 cycle. Research priorities drew from the National Biodiversity Assessment 2019, in addition to the above-mentioned strategy documents.

ACEP is aligned with the NRF's Strategic Goals in promoting internationally competitive research as the basis for a knowledge economy; growing a representative science and technology workforce in South Africa; providing cutting-edge research, technology and innovation platforms; operating world-class evaluation and grant-making systems; and contributing to a vibrant national innovation system.

With a strong focus on student training and scientific output in areas that are relevant to society, ACEP contributes to several Global Goals for Sustainable Development and fills an important role in South Africa's National System of Innovation (NSI).

The objectives of the ACEP programme are to:

- Integrate the physical and biological sciences to understand the processes that govern the South West Indian Ocean (SWIO) ecosystem functioning.
- Understand biological processes and the impact of climate and global change.
- Determine species richness, biodiversity and biogeography of the SWIO.
- Provide recommendations for the SWIO conservation, management strategies and long-term sustainability.
- Build capacity in offshore marine sciences, particularly developing a critical mass of skilled personnel and addressing equity imbalances.
- Build capacity in Marine Sciences at Historically Disadvantaged Institutions.
- Provide public awareness and understanding of marine science.
- Generate knowledge and build integrated and shared marine information systems including a Geographic Information System (GIS).
- Promote ACEP as a platform for national, regional and international partnership.
- Support the sustainable development of the Blue Economy.

ACEP is a competitive open-research programme that links researchers with equipment or expertise not normally available at Higher Education Institutions (HEIs). It is run on a three-year rolling funding cycle, the previous cycle having run from 2018–2020, and the current cycle run from 2021–2023. A competitive call for support in 2024–2026 has been reviewed and five new projects are being supported for 2024–2026.

**CURRENT OPEN CALL PROJECTS**

**Agulhas Bank Connections (Dr Natasha Karenyi – UCT):** The multi-disciplinary Agulhas Bank Connections (ABC) project aims to improve our understanding of land-sea connectivity, social-natural connectivity, biodiversity of muddy ecosystems, ecological processes and population connectivity across the Agulhas Bank. Further, ABC aims to incorporate these elements into ecosystem mapping, assessment and spatial management. The project also addresses the common public misconception that water flowing from the river into the ocean is wasted. Rivers carry sediments to the estuaries and the ocean, thus sustaining marine mud ecosystems which are essential for commercial fish species, such as hake and sole.

**SmartZone MPA (Prof. Amanda Lombard – NMU):** Using the new uThukela Marine Protected Areas (MPA) as a case study, this multi-disciplinary project uses a rare time-sensitive opportunity to gain a social-ecological baseline essential to assess the achievement of MPA objectives in the future. We will generate data to underpin an


*Above Left:* *Jody Oliver, Thabo Mbuyazi and Sinothando Shibe tend the ROV tether during the ACEP Deep Connections project.*
*Above:* *Marine Technician, Thabo Mbuyazi with a sponge collected during the ACEP Deep Connections project.*
*Left:* *SeaPeople workshop.*
*Photo credit: ACEP Deep Connections.*

evidence-based approach to adaptive management of the MPA in a 'SMART' framework. This framework defines **S**pecific objectives for the MPA; develops **M**easurable success indicators; sets **A**chievable goals given limited resources for management; ensures monitoring findings are **R**elevant for biodiversity and people; and provides Time-bound outputs.

**Deep Connections (Prof. Kerry Sink – SANBI):** The Deep Connections Project is a multi-disciplinary and multi-institutional project that aims to build knowledge on genetic, physical, and socio-cultural connectivity to improve biodiversity monitoring, spatial assessment and prioritisation. This will be achieved by piloting novel approaches across the biodiversity value chain. The project is making the science easily accessible through theatre, children's stories, an exhibit, and social learning to foster an emotional connection to the ocean whilst increasing socio-cultural exchange and advancing research on human dimensions of marine protected areas (MPAs).

**SALPA Project (Prof. Warren Potts – Rhodes University):** Fish are facing increasing threats from the combined impacts of climate change and exploitation. The South African Linefish Physiology Assessment (SALPA) research group has recently shown that exploitation removes high performance physiological phenotypes (HPPP) from populations, which has a negative impact on fish populations during thermal extremes. This finding suggests that exploited populations may be at greater risk in a changing environment and highlights the potential value of marine protected areas (MPAs) in maintaining and exporting HPPPs to promote population resilience. However, before we proclaim MPAs as the panacea for population resilience, we need to better understand the mechanisms driving the observed patterns and whether our findings apply beyond a single species and a single MPA.

**ENGAGEMENT ACTIVITIES**

- ACEP Deep Connections video released on World Oceans Day - https://www.youtube.com/watch?v=2fgANwAFm9I
- Community engagement at WildOceans Resource Hub. Presentation title: *What we are doing in the iSiMangaliso Wetland Park Marine Protected Area?* 14 June 2023
- Career Talks with Grade 11 and 12 pupils at Queenstown Girls High School, 18 August 2023
- ACEP Summer School in Port Alfred in December 2023 attended by 10 undergraduate students.

# MARINE REMOTE IMAGERY PLATFORM (MARIP)

## New technologies for observing life on the deep-sea floor

**DR ANTHONY BERNARD**
*INSTRUMENT SCIENTIST & MARIP MANAGER*

**PLATFORM USERS**

MMF, MMRI, NEKTON Foundation Oxford, NMU, NNF, RU, SANBI, UCT, University of the Seychelles, WCS, WILDOCEANS

**METRICS**

Stereo-BRUVs samples collected = 250
ROV dives completed = 81
Species observations uploaded = 15 000
Projects supported = 15
Fieldtrips conducted = 6
Students supported = >30

Advanced underwater imaging equipment enables exploratory and quantitative surveys from shallow subtidal marine ecosystems down to a depth of 1500 m.

In underwater environments, responsible research on the status, structure and functioning of ecosystems and living resources is challenging and limited by access to suitable technologies. However, this research is essential to support sustainable use and effective management of important ecosystem services. The Marine Remote Imagery Platform (MARIP) addresses this problem by providing researchers from South Africa and the broader region access to advanced underwater imaging equipment that can be used to conduct exploratory and quantitative surveys of benthic, demersal and pelagic marine biota from the shallow subtidal down to a depth of 1500 m.

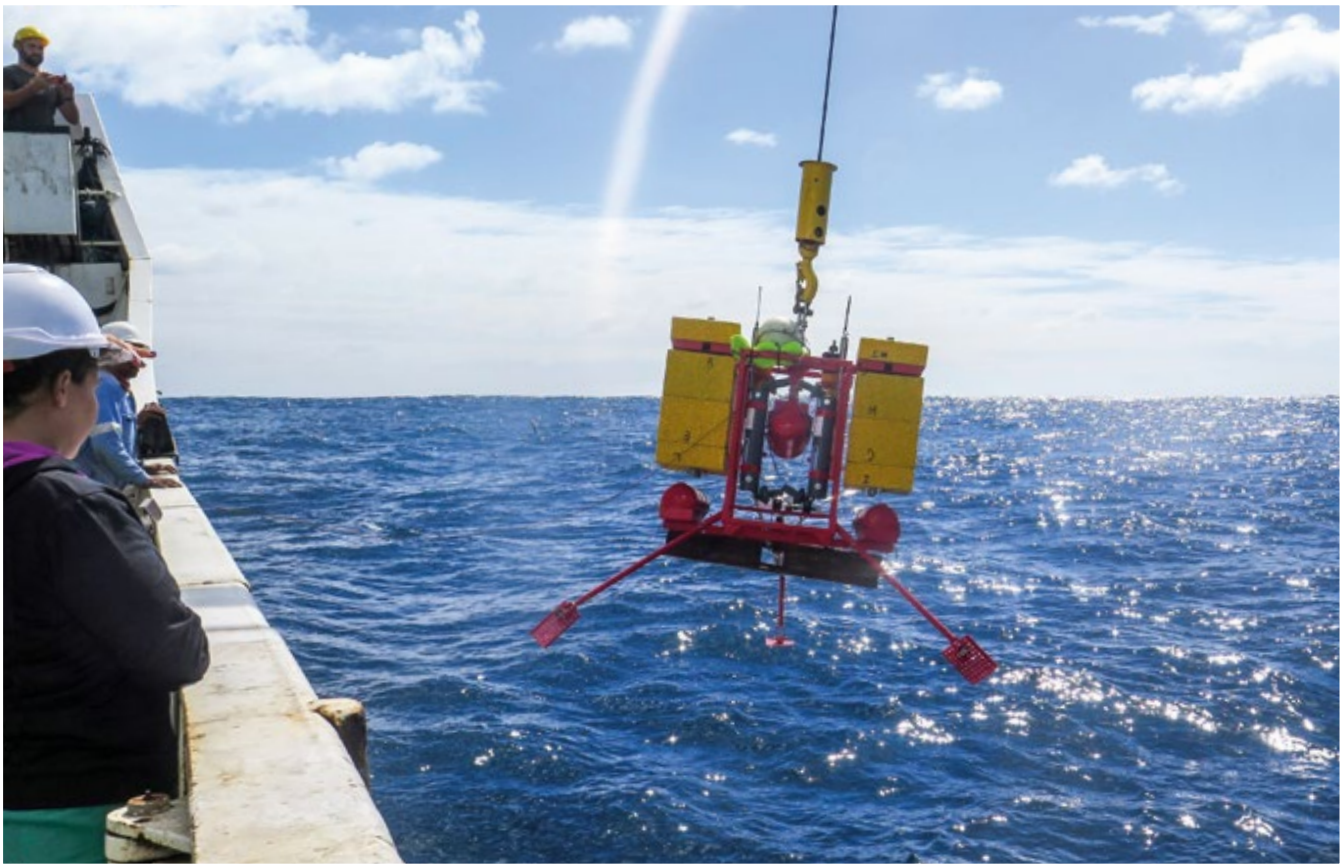
Infrastructure provided by MARIP includes a ROV, multi-imaging drop cameras, and a broad variety of stereo-video camera systems, including tethered and untethered stereo-BRUVs, pelagic stereo-BRUVs and a diver-operated stereo-video system. These are ideally suited to be operated off NRF-SAIAB's coastal craft which enable research up to 40 nautical miles (NM) off South Africa's coastline. The platform includes a comprehensive suite of computing systems for processing the imagery data, a large-scale imagery management facility for data management and sharing, and trained video analysts to facilitate annotation and data analysis.

MARIP is the largest research platform of its kind in southern Africa.

MARIP provides our scientists unprecedented access to research opportunities to enable research that advances knowledge generation and supports sustainable management.

The platform provides equipment, expertise and data to support a variety of research projects, management processes, training events and media outputs. Priority support is given to projects that are funded through the African Coelacanth Ecosystem Programme (ACEP) that is managed by NRF-SAIAB. In addition to the ACEP projects, MARIP supports a large number of local and interna-


*The Marine Remote Imagery Platform Research Group launching the NRF-SAIABs research vessel,* Hispidus, *to conduct baited remote underwater stereo-video (stereo-BRUV) surveys in the Tsitsikamma National Marine Protected Area. This expedition is a key component of their ongoing long-term monitoring project, aimed at understanding the marine ecosystem and contributing to its conservation.*

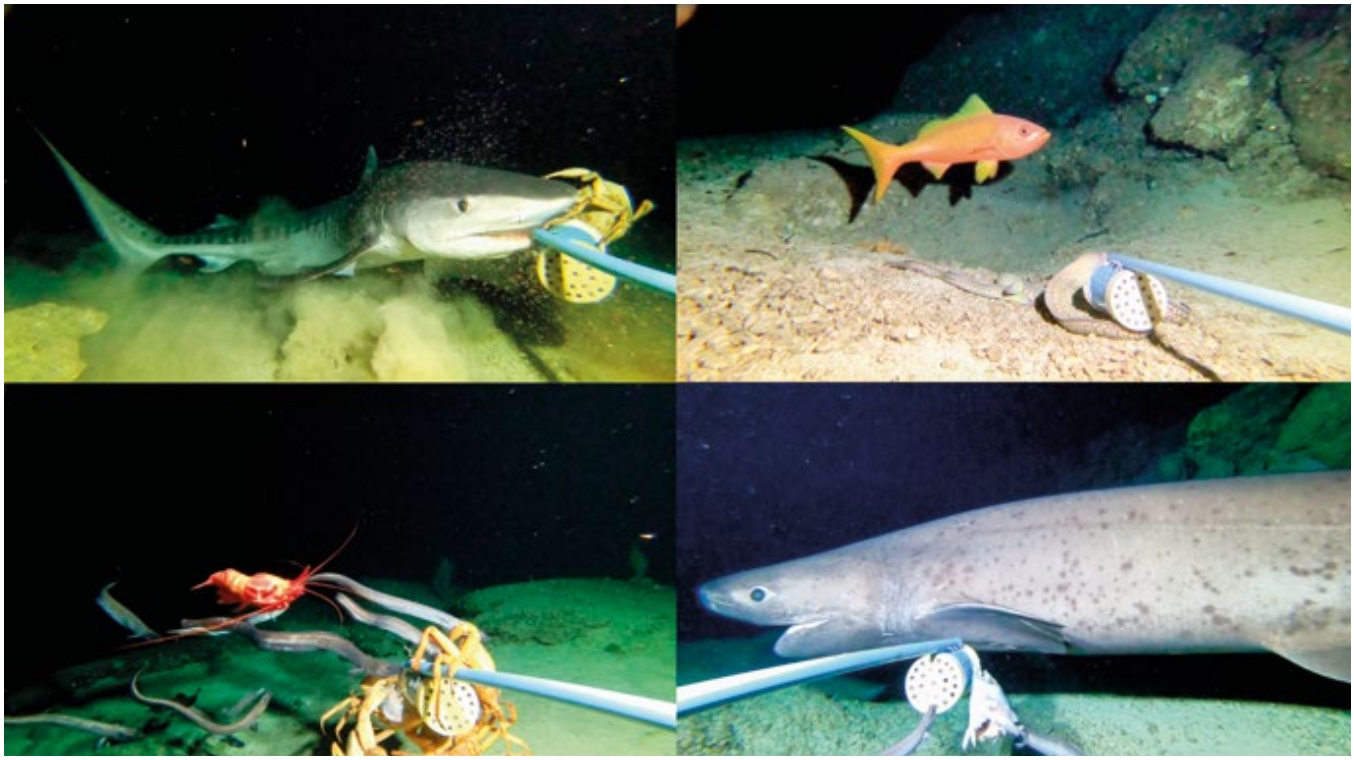


***Above:*** *NRF-SAIAB students prepare to deploy a stereo-BRUV to survey the demersal fish assemblages off the South African coastline.*
***Left:*** *The baited camera lander in action. Here the crew of the* RV Ellen Khuzwayo *prepare the system for deployment (top), and seabirds congregate around the lander floating on the surface after a successful deployment (bottom).*

tional, independent projects.

In 2023, MARIP supported research activities carried out by two of the four ACEP projects. The Deep Connections (PI: Kerry Sink) project aims to support sustainable management by advancing spatial planning capabilities and strengthening the marine social ecological systems. The SMART Zone project (PI: Mandy Lombard) is focused on the new uThukela marine protected area (MPA) and aims to support and strengthen the MPA's management by providing social-ecological baseline data. In 2023, the MARIP ROV conducted ecosystem mapping surveys and specimen collections for the Deep Connections project. Furthermore, the deep-sea lander platform was used to collect baited stereo-video and eDNA samples from the sponge gardens found between 150 and 200 m depth in the iSimangaliso Wetland Park to compare the day and night-time species assemblages. Baseline demersal fish and benthic invertebrate assessments were carried out for the SMART Zone project with the ROV and stereo-BRUVs in the uThukela Banks MPA.

MARIP is used extensively by NRF-SAIAB scientists within two broad applied disciplines: methodologies and environmental management. Methodological research aims to better understand the costs and benefits of different research methods and undertake optimisation to improve their effectiveness. This research directly benefits the research community by providing better tools to answer important questions, and knowledge to strengthen confidence around findings and recommendations for decision-making.



***Above left and right:*** *Fish and invertebrates attracted to the baited camera lander during surveys undertaken in the Maldives.*
***Right:*** *A ragged tooth shark inspects the bait on a stereo-BRUV. Ragged tooth sharks were commonly recorded on the mesophotic reef ecosystems in the restricted zone of the uThukela Banks MPA.*

Environmental management research carried out by NRF-SAIAB with MARIP infrastructure focusses on advancing our understanding of the structure, functioning and distribution of marine communities and ecosystems, the effects of anthropogenic pressures and climate change and how current management measures are mitigating these pressures. Noteworthy methodological research carried out in 2023 included an on-going project to optimise protocols and better understand the potential of Environmental DNA (eDNA) as a tool to monitor demersal and benthic fish assemblages across South Africa's continental shelf, relative to the more established baited remote underwater stereo-video systems (stereo-BRUVs). New research began testing the full capabilities of MARIP's landers as a way to collect stereo-BRUV samples from South Africa's slope ecosystems. The new research project aims to conduct standardised research at multiple locations within tropical and temperate Africa to develop optimised sampling protocols to support standardised national and regional research activities.

MARIP provides research support to numerous independent South African and international research projects on an annual basis. The extent of the support varies based on the specific project needs, from basic training and equipment provision to full logistical and research support to address research questions. MARIP also provides access to existing datasets, video analysts to assist with the processing of imagery samples, and long-term support to securely manage imagery samples.

In South Africa, MARIP has been providing research support to the WILDOCEANS NGO on numerous of their marine projects that aim to support and improve the management of the iSimangaliso Wetland Park and uThukela Banks MPAs, and research support on elasmobranchs. Technical support was provided to a number of NRF-SAIAB scientists conducting research on the physiological limitations of marine fishes, and nature-based solutions to coastal habitat destruction.

Regionally, MARIP provided research support to the Namibian Nature Foundation, Wildlife Conservation Society, Marine Megafauna Foundation, Maldives Marine Research Institute and the University of the Seychelles.

**PRINCIPAL INVESTIGATORS AND ORGANISATIONS**

**ACEP:** Kerry Sink (SANBI), Natasha Karenyi (UCT), Warren Potts (RU), Mandy Lombard (NMU)

**NRF-SAIAB:** Anthony Bernard, Gwynneth Matcher, Nikki James, Francesca Porri

**Other:** Jean Harris (WILDOCEANS), Rhett Bennet (WCS), Ruth Leeney (NNF), Anna Flam (MMF), Lucy Woodall (NEKTON Foundation, Oxford), Rosemary Dorrington (RU), Amber Childs (RU), Stuart Laing (University of the Seychelles)

*A hawksbill turtle returns to the sea after being rehabilitated and equipped with an acoustic tag. (Photo credit: Two Oceans Aquarium)*

# ACOUSTIC TRACKING ARRAY PLATFORM (ATAP)

## Monitoring marine movers (and stayers)

**DR TARYN MURRAY**
*INSTRUMENT SCIENTIST & ATAP MANAGER*

**PLATFORM USERS**

BCRE, CPUT, East London Museum, Marine Dynamics, Namibian Nature Foundation, NMU, Norwegian Institute for Nature Research, ORI, Reel Science Co., RU, Shark Spotters, NRF-SAIAB, SANParks, South African Shark Conservancy, TOA, UCT, UKZN, uShaka Marine World, Wildlife Conservation Society, WILDTRUST

**Metrics**

Fixed array stations managed and operational (NRF-SAIAB only) = 92
Fixed array stations managed and operational (all ATAP) = 289
Animals tagged in 2023 = 98
Species being tracked = 45
Researchers (and institutions) benefitting = 46
Students using ATAP = 13
Data reports = 40

**Altmetrics**

Publications acknowledging ATAP = 10
Public/online presentations = 3
Conferences attended = 2
Online articles mentioning ATAP = 9
Facebook, X and Instagram followers (in total) = 4321

Using acoustic telemetry to study the movements and migrations of aquatic species, ATAP has recorded more than 19 million detections, since 2011.

The ATAP is an established research infrastructure comprising a nationwide network of acoustic receivers. This is a collaborative platform through which researchers use acoustic telemetry to study the movements and migrations of aquatic species. The receivers record the signals released by the tags, allowing researchers to piece together the movements of individual tag-and-release animals, providing information on the species in general; these data are freely available to the tag owners.

Since it was officially established in October 2011, the ATAP has recorded more than 19 million detections, representing a significant amount of movement data on important fishery and charismatic species. Although initially slow to be taken into consideration, movement data are finally beginning to be included in the development of conservation plans and formal changes in legislation, including the development of a systematic conservation plan for sharks and rays, and a change in legislation in the Maputo National Park for a sought-after gamefish species. Not only do these data improve our understanding of animal movements, but by increasing protection of important fishery species, these data indirectly, and also positively, impact society and the economy through the provision of fish and income generated through their sale.

## A nationwide network of acoustic receivers provides information on the movements of various fishes, sharks, rays, skates and turtles.

As a collaborative nationwide network of acoustic receivers, the ATAP provides information on the movements of various fishes, sharks, rays, skates and turtles which enables researchers to learn more about their residency (do they stay in one place?), site affinity (do they return to familiar places?), home range size (how big is the area in which they live?), seasonal migratory behaviour (where do they go and do they come back?) and habitat connectivity (between which environments do they move?). In its current format, this large-scale array design allows researchers to address several key questions pertaining to animal movement – information which is essential for the development of effective management measures, including movements in relation to MPA boundaries, transboundary movements and a host of ecological aspects, such as spawning aggregation dynamics and predator-prey interactions.

## Contributing data towards the development of conservation plans and management regulations that support SDGs.

During 2023, the ATAP collected data for and provided logistical assistance to several different projects involving personnel from universities, research organisations, management, and non-profit organisations. These projects ranged from monitoring the movements of the endemic blue stingrays, *Dasyatis chrysonota*, in the Knysna Estuary (PI: Dr Chantel Elston, in collaboration with RU and SANParks), to the spatial ecology of elasmobranchs in False Bay (PI: Dr Alison Kock, in collaboration with SANParks, Shark Spotters and Two Oceans Aquarium - TOA), to learning more about the coastal movements of rehabilitated turtles (in collaboration with TOA Turtle Conservation Centre, Bayworld Centre for Research and Education (BCRE), East London Museum and uShaka Marine World), to understanding longshore movements of the Critically Endangered whitespotted wedgefish, *Rhynchobatus djiddensis,* (PI: Dr Bruce Mann, in collaboration with ORI, Wildlife Conservation Society (WCS) and NRF-SAIAB) and common eagle rays (PI: Dr Michelle Soekoe, in collaboration with Reel Science Co., RU, NRF-SAIAB, SANParks and UP).

The goal of all these projects is to contribute data towards the development of conservation plans and management regulations, which in turn will work towards a) sustainable use of marine resources (SDG 14: Life Below Water), b) improving food security with sustainable consumption patterns (SDG 2: Zero Hunger and SDG 12: Responsible Consumption and Production, respectively), and c) poverty alleviation (SDG 1: No Poverty). At least 40 data reports were compiled, and we also saw a considerable increase in the number of scientific publications (n = 10), which has significantly increased our understanding of the movements of several important fishery species.

## Training new movers and shakers - ATAP actively develops human capacity.

The ATAP also actively aims to develop human capacity, with an emphasis on training students from HBUs and involving female researchers (SDG 4: Quality Education and SDG 5: Gender Equality, respectively) by working with, and providing support to, scientists from at least 20 organisations. Additionally, the ATAP, together with MARIP, hosted its annual Summer School, held in Port Alfred in the Eastern Cape in December 2023. Ten undergraduate and postgraduate students from all over South Africa took part in this five-day school, which included two days of active fieldwork where students were exposed to acoustic telemetry methodology. This year's participants were from at least five of South Africa's nine provinces, with their current studies ranging from oceanography to computer science. Always limited to 10 participants only, this was also the largest female contingent to date (90%), which is something of which to be proud. The ATAP also contributed, and continues to contribute, data towards several student projects, with three students graduating with their MSc (Vuyolwethu Mxo) and PhDs (Dr Alison Towner, Dr Ralph Watson) in 2023.

*A lesser guitarfish caught in False Bay, Western Cape, is surgically equipped with an acoustic transmitter. (Photo credit: Shark Spotters - Two Oceans Aquarium).*

**PROJECTS SUPPORTED BY ATAP**

**PIs** – Dr Chantel Elston, Dr Alison Kock, Talitha Noble, Ruth Wright, Malini Pather, Dr Ruth Leeney, Dr Michelle Soekoe, Dr Taryn Murray, Dr Tor Næsje, Dr Jean Harris, Dr Ryan Daly, Dr Bruce Mann, Dr Enrico Gennari, Guy Paulet

**Blue stingrays in the Knysna Estuary** – Dr Chantel Elston (PI, NRF-SAIAB), Kyle Smith (SANParks), Prof. Amber-Robyn Childs (RU), Dr Taryn Murray (NRF-SAIAB), Dr Matthew Parkinson (NRF-SAIAB)

**Simply stingrays** – Dr Chantel Elston (PI, NRF-SAIAB), Dr Taryn Murray (NRF-SAIAB), Dr Matt Parkinson (NRF-SAIAB), Dr Bruce Mann (ORI and RU), Dr JD Filmalter (NRF-SAIAB), Toby Rogers (Sharks Spotters and UCT)

**False Bay elasmobranchs** – Dr Alison Kock (PI, SANParks), Dr Judy Mann-Lang (TOA), Sarah Waries (Shark Spotters), Toby Rogers (Shark Spotters), Dr Nathalie Viljoen (TOA), Calley Chateau-Cyster (TOA), Tinus Beukes (TOA), Dr Taryn Murray (NRF-SAIAB)

**Turtle rehabilitation project** – Talitha Noble (TOA), Ruth Wright (BCRE), John Werth (BCRE), Malini Panther (uShaka Marine World)

**Namibian Islands MPA Elasmobranchs** – Dr Ruth Leeney (PI, Namibian Nature Foundation)

**Student projects** – Vuyolwethu Mxo (RU), Alison Towner (RU and SAIMI), Dinah Mukhari (RU), Bantony Ziko (RU), Ralph Watson (RU and Marine Dynamics), Emy Cottrant (SASC and UCT), Toby Rogers (Shark Spotters and UCT), Kevin Spiby (TOA and CPUT), Guy Logan (UKZN)

**SAFER Lab and Save Our Seas Foundation eagle rays** – Dr Michelle Soekoe (PI, Reel Science Co.), Prof. Amber-Robyn Childs (RU), Prof. Warren Potts (RU), Dr Alexander Winkler (RU and NRF-SAIAB), Dr Rhett Bennett (WCS), Dr Bruce Mann (ORI and RU), Dr Taryn Murray (NRF-SAIAB), Dr Matt Parkinson (NRF-SAIAB)

**Estuarine fisheries** – Dr Taryn Murray (South African PI, NRF-SAIAB), Dr Tor Næsje (Norwegian PI, Norwegian Institute for Nature Research), Dr JD Filmalter (NRF-SAIAB), Dr Nina Rivers (NMU), Dr Bernadette Snow (Scottish Association for Marine Science and NMU), Dr Mia Strand (NMU), Sipesihle Booi (NMU), Prof. Syden Mishi (NMU), Loyolah Nonyane (NMU), Dr Aidan Wood (NMU)

**Monitoring sharks and rays along the South African coastline** – Dr Jean Harries (PI, WILDTRUST), Jennifer Olbers (WILDTRUST), Geremy Cliff (WILDTRUST), Nina Beaulieu (WILDTRUST), Dr Ryan Daly (ORI)

**Soupfin and spotted gully shark movements along the south-west coast** – Guy Paulet (SASC), Natalia Drobniewska (SASC), Emy Cottrant (SASC and UCT)

**Whitespotted wedgefish** – Dr Bruce Mann (PI, ORI and RU), Dr Rhett Bennett (WCS), Dr Ryan Daly (ORI), Dr Taryn Murray (NRF-SAIAB), Gareth Jordaan (ORI)

**Smooth hammerheads and smoothhound sharks** – Dr Enrico Gennari (PI, Oceans Research Institute)

**DEFINITIONS**

**Acoustic transmitter:** A small tag placed either into (internally tagged) or onto (externally tagged) an animal, which then emits a sound signal which is recorded by acoustic receivers.

**Acoustic receiver:** A piece of equipment which is placed into a water body which then records the signal released from an acoustic transmitter which has been placed either into (internally tagged) or onto (externally tagged) an animal. The receiver records the date, time and unique ID code of the transmitter.

**Elasmobranch:** A term used to describe any cartilaginous fish, including sharks, skates and rays.


*Dr Taryn Murray (right), Shaza Qalela (far left) and Kiara Ranjt (left) collectively try to locate the position of an acoustically tagged mullet, recording water quality parameters at the same time.*

# AQUATIC ECOPHYSIOLOGY RESEARCH PLATFORM (AERP)

## Addressing impacts of change on the resilience of coastal resources

**DR LUBABALO MOFU**
*SCIENTIST & AERP CO-ORDINATOR*

**PLATFORM USERS**

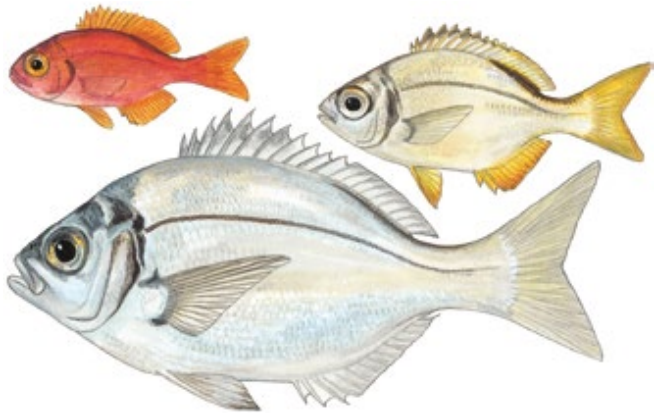
National Research Institute for Sustainable Development - IRD
Rhodes University
University of Southampton
University of Pretoria

**TEAM MEMBERS**

SAFER lab: Warren Potts, Amber Childs, Nicola James, Cuen Muller
COST: Francesca Porri, Kerry Ann van der Walt
Rhodes University (Entomology Department): Ryan Wasserman, Trishan Naidoo

**STUDENTS AND INTERNS**

SAFER lab: Lauren Bailey, Nonhle Mlotshwa, Caitlin Allison, Bradley Van Heerden, Dinah Mukhari, Bantony Ziko, Samkele Ngcefa, Christian Hempel
COST: Siphelele Dyantyi



Boopsoidea inornata - *Fransmadam, showing life stages of juvenile to adult. Small juveniles reddish orange; larger juveniles silvery with yellow-orange fins. Adults (attain 30 cm) bronzy silver and rear edge of operculum black. Illustrations NRF-SAIAB by Elaine Heemstra from* Coastal Fishes of Southern Africa *(2004) by Phil and Elaine Heemstra.*

Most aquatic organisms are ectotherms, dependent on external sources of body heat, and their physiological processes are governed by their external environment. The research undertaken by members of the Southern African Fisheries Ecology Research laboratory (SAFER lab) and the Coast and Ocean Science Team (COST), has increased our understanding of the impacts of climate change, ocean acidification, and urbanisation on the physiology of marine organisms. Student mentorship has upskilled and built human capacity in this field.

The SAFER lab focusses on understanding the behaviour of marine organisms in order to implement effective conservation and management strategies, while the COST team aims to co-develop nature-based eco-engineered structures with various stakeholders with the purpose of enhancing the quality of urban habitats for invertebrate and fish larvae through studies on the physiological fitness of early life stages of invertebrates.

The users of the AERP have generated a substantial body of research used for marine resource management and conservation.

In 2023, AERP research focused on two primary areas: firstly, an exploration of the metabolic physiology of Fransmadam, *Boopsoidea inornata* (Castelnau, 1861) and, secondly, an investigation into the physiological fitness of early life stages of invertebrates.

Fish behaviour is shaped by several factors, ranging from environmental conditions to internal physiological processes. One of these processes, thermal metabolic physiology, plays a crucial role in regulating fish behaviour by influencing metabolic rates,

*Bradley van Heerden is a Rhodes University MSc student supervised by Prof. Warren Potts. His project is investigating whether thermal metabolic physiology information can predict fish behaviour as observed on baited remote underwater video. This photo shows a Fransmadam (*Boopsoidea inornata*) in an intermittent-flow respirometer.*

energy allocation, and thermoregulatory responses. By examining the link between thermal metabolic physiology and behaviour, we can gain insights into how marine organisms interact with their environment and make informed predictions about their responses to environmental changes. The overall aim is to compare the aerobic performance (standard metabolic rate (SMR), maximum metabolic rate (MMR), aerobic scope (AS)) of Fransmadam across a thermal range, to behavioural metrics from the wild. Physiological experiments were conducted on Fransmadam collected from Cape St Francis. So far, the results show that temperature has a significant effect on aerobic scope, with peak performance around 17 ºC and the highest variability at 20 ºC.

*Bradley van Heerden fin-chasing a fish in the sump before placing it back into the respirometer to estimate maximum metabolic rate (MMR).*

**ENGAGEMENT**

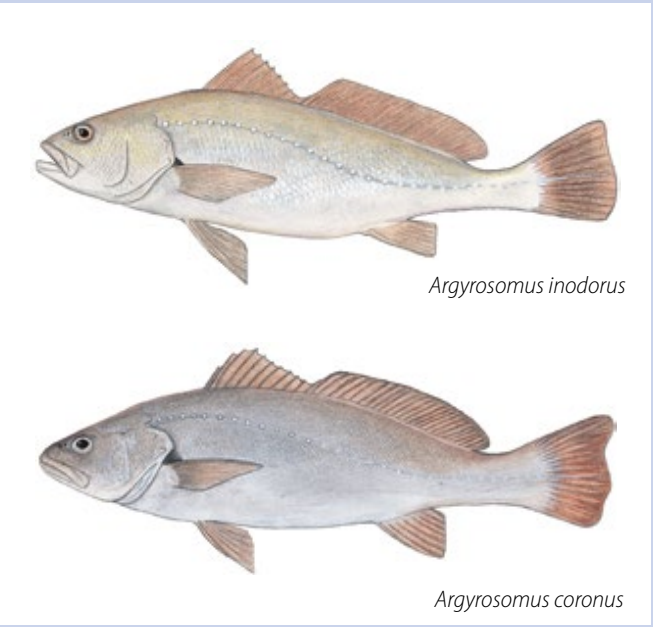
The Aquatic Ecophysiology Research Platform conducted tours of the facilities, providing visitors with a chance to learn about the research conducted and its significance. Tours were conducted for 34 students from Walter Sisulu University; scholars attending a school learner internship run by the RU Department of Ichthyology and Fisheries Science; an African Continent delegation; Grade 10 learners from St Andrews College in Makhanda.

Research published in 2023 from studies focusing on the northern Namibian coast found that the rapid warming in coastal waters has considerable impacts. Such an example is the distribution of dusky kob, *Argyrosomus coronus* (Griffiths & Heemstra, 1995), previously listed as extending from False Bay to southern Mozambique (Heemstra and Heemstra, 2004) which now overlaps and hybridises with the closely related silver kob, *A. inodorus*, the distribution of which extends from Namibia to the Kei River (ibid)]

In addition, a study on the acute metabolic responses of Mediterranean mussel, *Mytilus galloprovincialis* (Lamarck, 1819), and brown mussel, *Perna perna* (Linnaeus, 758), showed a similar degree of phenotypic or developmental plasticity between the two species in response to the thermal environment.

Research undertaken by COST covers coastal environments, encompassing rocky shores and estuaries that are productive habitats that facilitate important ecological functions that help maintain populations of marine organisms. Coastal urbanisation, however, can have negative impacts on the marine environment; examples include habitat fragmentation, decreased habitat complexity, and changes in ambient sound profiles that affect the overall biological community. As such, understanding the behaviour and the effect of urbanisation is important for implementing effective conservation and management strategies, especially as our oceans face more threats.

In the context of coastal urbanisation, the focus of this study is to co-develop, with various stakeholders, nature-based eco-engineered structures to potentially enhance the quality of urban habitats for invertebrate and fish larvae. This focus will be achieved by assessing the physiological fitness of early stages of invertebrates, characterising the ambient soundscape, and determining the structural complexity of the nature-based structures and drawing comparisons between coastal urban (Port of Ngqura and Port of Port Elizabeth) and natural areas (Cannon Rocks and Kini Bay).



*Argyrosomus inodorus*

*Argyrosomus coronus*

*Illustrations NRF-SAIAB by Elaine Heemstra from* Coastal Fishes of Southern Africa *(2004) by Phil and Elaine Heemstra.*

# AQUATIC GENOMICS RESEARCH PLATFORM (AGRP)

## Next-Generation Sequencing unlocking next generation solutions

**DR GWYNNETH MATCHER**
*INSTRUMENT SCIENTIST & AGRP MANAGER*

**PLATFORM USERS**

Albany Museum, Bavarian State Collection of Zoology, Makerere University, National Fisheries Resource Research Institute, NMU, NWU, ORI, RU, NRF-SAIAB, NRF-SAEON, UFH, UJ, UKZN, UNISA, UNIZULU

**METRICS**

Users = 104
Capillary sequences generated = 2110
NGS metabarcoding libraries sequenced (Illumina) = 772
Whole genome sequence datasets generated (Nanopore) = 12
Whole genome draft assemblies completed = 10
Transcriptomic sequence datasets (Nanopore) = 12
Training workshops hosted at NRF-SAIAB = 6

The AGRP is strongly positioned through its link to the National Fish Collection, National Aquatic Biodiversity Biobank and to active researchers in the aquatic biosphere. The platform provides infrastructure, access to specialised equipment, and workspace for researchers in the field of aquatic genomics.

The application of genomics can support improvements in government decision-making, industry and communities, in key strategic areas. The AGRP provides national genomics infrastructure for aquatic research, prioritising and supporting research that leads to sustainable use of aquatic resources, as well as human health and wellbeing, specifically linking to global Sustainable Development Goal 14.

Research undertaken using the AGRP includes both freshwater and marine sectors and leveraging research related to aquaculture, aquaponics, bioprospecting for pharmaceuticals, biodiversity, barcoding, ecology and genome studies.

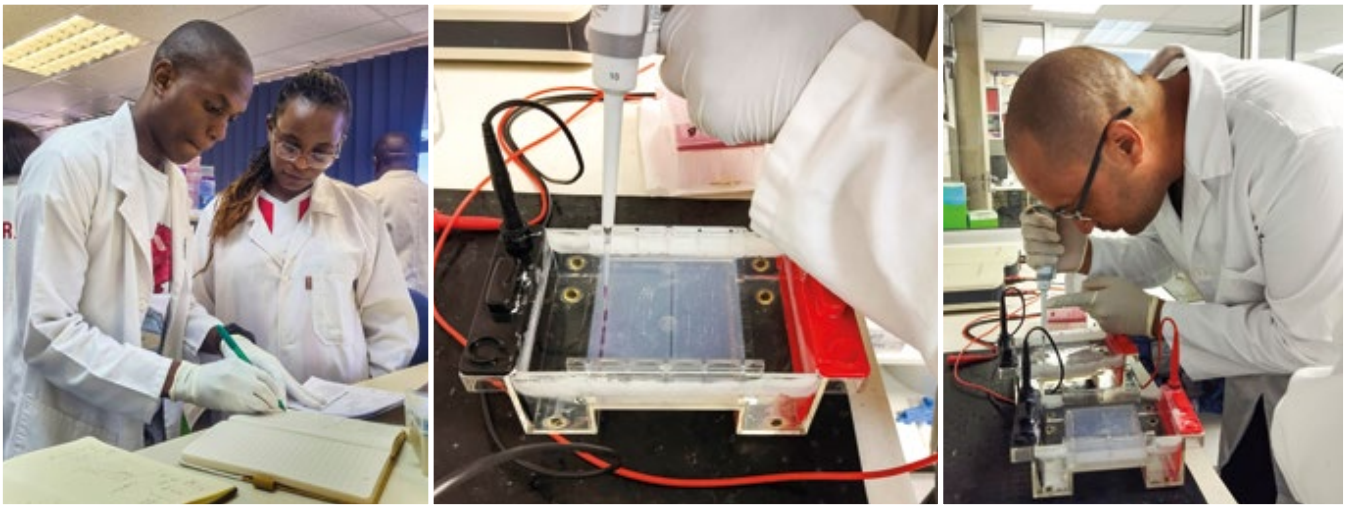
The AGRP facilitates access for South African researchers to equipment and training that would otherwise be unaffordable.

The AGRP is fully furnished with laboratory equipment for capabilities that extend from DNA extraction through to Sanger sequencing, as well as next-generation sequencing (Illumina (MiSeq) and Oxford Nanopore (Mk1Cand P2Solo). High-performance computational hardware in the form of a server with 2TB RAM is available which enables analysis of the large datasets generated by next-generation sequencing. Primarily, the server has been used for the assembly of genomes from metagenomics data and metabarcoding.

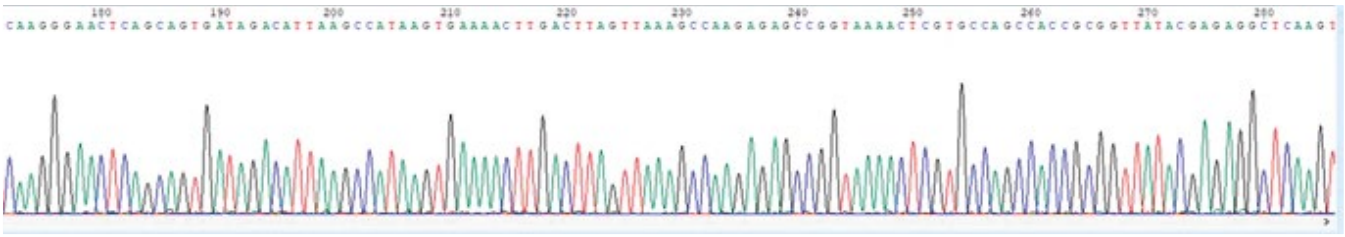
Operating on a cost-recovery basis, the AGRP facilitates access for South African researchers to equipment and training that would otherwise be unaffordable, thereby strongly impacting the advancement of aquatic research in the country while maintaining high standards in the training and upskilling of emerging young researchers.

Genomics research projects that focus on aquaculture and aquaponics can help to address food security challenges.

Research projects undertaken in 2023 using the AGRP resources and infrastructure range from fundamental research through to more applied topics. This, in turn, has high societal impact as the research conducted contributes to the understanding and conser-



*Research activities conducted at AGRP* ***Left:*** *Interaction between researchers and discussion of research methodologies.* ***Middle:*** *Quantifying purified genomic DNA using a Nanodrop 2000 Spectrophotometer.* ***Right:*** *Loading DNA generated by PCR (i.e. DNA amplification) on an agarose gel which will be subjected to electrophoresis.*



*An example of a Sanger Sequencer chromatogram. DNA sequence analysis on a 3500 Genetic Analyzer using fluorescently labelled nucleotides (A, T, G and C) yields data indicating the gentic sequence or code of the DNA being analysed. The nucleotide A (Adenine) is depicted in green, T (Thymine) is depicted in red, G (Guanine) in black and C (Cytosine) in blue.*

vation of aquatic ecosystems which are vital to ensure their sustainable use as food resources, for recreation, tourism and biodiversity. Additionally, the genomics research projects conducted in AGRP that focus on aquaculture and aquaponics can help to address food security challenges in South Africa and beyond.

Characterisation and barcoding of the rich aquatic biodiversity in South African waters (both freshwater and marine) is central to our understanding of ecosystem functioning and health, thereby facilitating informed management of our resources which, in turn, can maximise sustainable economic use of these resources at the same time as maintaining ecological functionality and biodiversity.

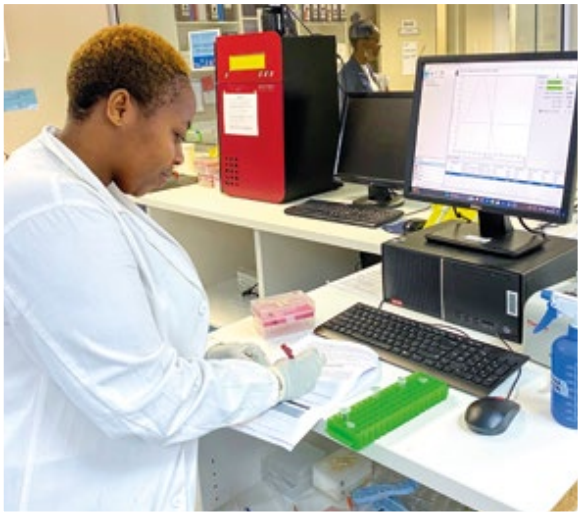
Research carried out in 2023 that accessed the AGRP includes (but is not limited to) characterisation of the microbiomes of farmed sea cucumbers, yellowtail fish eggs, estuarine oysters; inventories for biodiversity assessments and monitoring; potential for bacterial removal of phenolics from wastewater; assessment of genetic diversity in farmed Nile Tilapia; antibiotic resistance profiles of bacteria; and bioprospecting.

Next-Gen sequencing technologies could reveal novel bioactive compounds in microorganisms and marine invertebrates that have the potential to be applied in the biopharmaceutical and drug discovery industry.

Micro-organisms and marine invertebrates are an extremely rich source of novel bioactive compounds with potential impact on human health for applications in the biopharmaceutical and drug discovery industry for the treatment of antibiotic-resistant pathogens, TB, cancer, HIV, and more. Many of these compounds are synthesised by micro-organisms that cannot be cultured, thus, to discover and harness these potentially life-saving novel compounds, the metabolic pathways need to be revealed using next generation sequencing technologies such as those used within the AGRP.

The platform is also an invaluable teaching resource, contributing to national imperatives through developing understanding and learning, and upskilling of people in this field of science. Staff provide technical support to all platform users, allowing those with little or no practical experience to gain the skills needed to answer their research questions, obtain their qualifications (in the case of MSc and PhD candidates) and/or to pursue a career in the field of molecular biology. In 2023, the platform was used by 104 students and staff and included researchers from 15 institutions.

The platform also hosted workshops on Fundamentals of Molecular Biology, qPCR, R and Bioinformatics, Fragment Analysis (3500 Genetic Analyser), Next-generation sequencing methodologies and Bacterial metabarcoding data analysis. This included hands-on practical experience as well as in-depth theoretical grounding. Individual one-on-one training was also supplied for the diverse genomics techniques that are used by researchers in the AGRP laboratory.



*Assessment of the concentration and quality of genomic DNA being conducted on a Nanodrop Spectrophotometer.*

*2024 Fundamentals to Molecular Biology Workshop, funded by Diplomics and hosted by the Aquatics Genomics Research Platform at NRF-SAIAB.*

# COLLECTIONS PLATFORM

## A diverse assortment of biological specimens that provides myriad opportunities for researchers from Africa and beyond

**NKOSINATHI MAZUNGULA**
*COLLECTIONS MANAGER*

**ROBER BILLS**
SENIOR CURATOR

**TEAM MEMBERS**

Nkosinathi Mazungula, Roger Bills, Amanda Gura, Mzwandile Dwani, Zinzi Sinazo Somana, Nonkoliso Mgibantaka, Vuyani Hanisi, Seshnee Reddy, Phumza Malibongwe Ndaleni, Siphamandla Mceleli, Willem Coetzer

**PLATFORM USERS**

Albany Museum Department of Freshwater Invertebrates, Amathole Museum, Bayworld Museum, Aquatic Ecosystems Services Fisheries and Environmental Consulting, Botswana Wild Bird Trust, RU DIFS, East London Museum, Ecotone Freshwater Consultants, FAO, Norwegian Institute for Marine Research, iZiko Museums of South Africa, National Geographic Okavango Wilderness Project, NWU, NRF-SAEON, NRF-SAIAB, Pennsylvania State University (PSU) USA, Stellenbosch University, UFS, Russian Academy of Sciences, University of Liège Belgium

**METRICS**

Specimens catalogued and deposited in the NFC = 2537 fish, 207 frogs, 429 invertebrates. Total = 3173
Tissue samples catalogued and deposited in the Biobank = 2003
Specimen loans for research = 7742
Tissue sample gifts for research = 1415
Queries (affecting NRF-SAIAB dataset) executed via the GBIF Data Portal = 5538
High-quality images produced for the Type Catalogue = ~800

*The largest type specimen (SAIAB 7861) photographed to date for the type catalogue.*

The Collections Platform at NRF-SAIAB, home to the National Fish Collection (NFC) alongside the National Aquatic Biodiversity Biobank, stands out in the southern hemisphere not only for its extensive wet collection, but also for its substantial repository of southern African fish specimens. With a diverse assortment that includes amphibians, tunicates, cephalopods, and diatoms, the Collection is constantly expanding. This growth translates into myriad opportunities for students, interns, scholars, and researchers from Africa and beyond to significantly advance their research endeavours.

As a vital component of the Natural Science Collection Facility (NSCF) and Biodiversity Biobanks South Africa (BBSA), the NFC plays a pivotal role in advancing scientific objectives. By ensuring secure and accessible housing for collections, facilitating data availability for research and management purposes, conducting research to address critical national and global issues, providing essential identification services to various stakeholders, and leveraging collections for broader societal benefits such as education and citizen science initiatives, the platform contributes substantially to scientific progress and fosters a deeper understanding of South Africa's rich biodiversity. Through these efforts, the platform not only inspires the next generation of scientists but also underscores the importance of preserving and using natural science collections for the betterment of society.

The platform welcomes tours of the collection, offering students, researchers, and the public a chance to explore diversity, conservation initiatives, and the significance of natural science collections. Additionally, the platform extends an invitation to researchers worldwide to collaborate and work within its state-of-the-art facility.

NRF-SAIAB actively promotes global partnerships, providing researchers with a unique opportunity to access its comprehensive resources and expertise.

Accurate species identification is crucial for fisheries and environmental research and management, making NRF-SAIAB's facilities indispensable for such endeavours.

- Prof. Jay Stauffer from Penn State University (PSU) spent three weeks at the platform, focusing on the uncatalogued Lake Malawi cichlid collection at NRF-SAIAB. Arrangements are being made to relocate the 1/3 PSU cichlid collection to the NRF-SAIAB.
- Dr Mpho Ramoejane, formerly a PhD candidate at NRF-SAIAB and now a Lecturer in Zoology and Undergraduate Coordinator at the University of the Free State, visited the platform to pursue further research on the taxonomy and diversity of South African mudfishes (Labeos). This work is part of a collaborative effort with Prof. Albert Chakona aimed at the taxonomic revision of the group.
- Mr Craig Rennie, formerly an MSc student at NRF-SAIAB and currently employed at Aquatic Ecosystems Services Fisheries and Environmental Consulting, visited the platform to sort and identify a donation of ichthyofaunal collection from the Kafue Basin in Zambia. This collection has since been integrated into the NFC.

*NRF-SAIAB Biobank staff Amanda Gura and Seshnee Reddy preparing a tissue gift request for researchers to conduct DNA analysis.*

*Nonkoliso Mgibantaka, Collection Officer, shelving specimens in the Collection.*

- Ms Arcénia Chivale from Gorongoza National Park in Mozambique visited NRF-SAIAB to acquire expertise in fish sampling techniques (electrofishing) and collection management that will contribute to the establishment of a new and comprehensive fish collection at the Park.
- Dr Dave Ebert (USA) – Chondrichthyan Curator, spent a week examining specimens from the recent cruise off the coast of Mozambique and Tanzania.
- Prof. Franz Uiblein from Norway dedicated two weeks to examining and updating NRF-SAIAB goat fishes (Mullidae), initiating the preparation of a manuscript tentatively titled, *New Western Indian Ocean Fishes Records,* which includes the redescriptions of *Parupeneus diagonalis*. This collaborative effort would include Dr Anthony Barnard and Dr Yonela Sithole from NRF-SAIAB, Mr Patroba Matiku from the Tanzania Fisheries Research Institute (TAFIRI), and Tuan Anh Hoang from Vietnam National Museum of Nature (VNMN).
- Dr Marek Lipinski (Cape Town) spent two weeks visiting the platform to examine and update the cephalopod collection.
- Dr Peter Psomadakis from the Food and Agriculture Organization of the United Nations (FAO), along with Dr Sarah Viana (Shark and Ray Taxonomist, Iziko) and Mark Lisher, Collections Manager at the Iziko Museum of South Africa, visited the platform to identify and select previously undescribed species. These species will be featured in the upcoming capacity-building workshop titled, *EAF-Nansen Programme Post-Survey Workshop on Fish Taxonomy Research,* scheduled to take place at NRF-SAIAB from 27 May to 7 June 2024. The workshop aims to enhance the expertise of scientists from Mozambique, Tanzania, and Kenya in conducting fish taxonomic research and publishing scientific findings as primary authors.
- Dr Shirley Parker-Nance from NRF-SAEON, accompanied by her intern Yonela Mahamba, organised and relocated the benthic invertebrate collection to the recently installed mobile shelving.
- Mr Roger Bills, Senior Curator at NRF-SAIAB, collaborated with Mozambican colleagues, engaging in on-site practical training to enhance their skills in data collection techniques and the identification of fish species. This valuable experience took place in Gorongosa National Park and the Maputo Natural History Museum.
- Nonkoliso Mgibantaka, Collections Officer at NRF-SAIAB, visited Mzuzu University in Malawi as part of the COTRA/admin staff exchange initiative, whose purpose is to develop collaborative relationships, exchange ideas and training in fisheries in aquaculture in east, central and southern Africa.

The National Aquatic Biodiversity Biobank of NRF-SAIAB was awarded funding from DIPLOMICS for method development: Assessment of optimal long and short-term tissue storage protocols yielding maximal high molecular weight genomic DNA.

*Tour of NRF-SAIAB's Collection Facility for children from a local Makhanda school.*

*NRF-SAIAB, in collaboration with Rhodes University's Department of Ichthyology and Fisheries Science (DIFS), hosted a pop-up science exhibition for Makhanda residents outside the institution on Somerset Street on Friday, 04 August 2023. The exhibition was part of the Institute's initiative for National Science Week under the theme, "Transforming lives through evidence-based science". The exhibition attracted a diverse audience from pre-school learners, young adults, parents to senior citizens. (The photographs were taken by Rhodes University Journalism and Media Studies student, Brent Smith, as part of his photography course photo story assignment).*

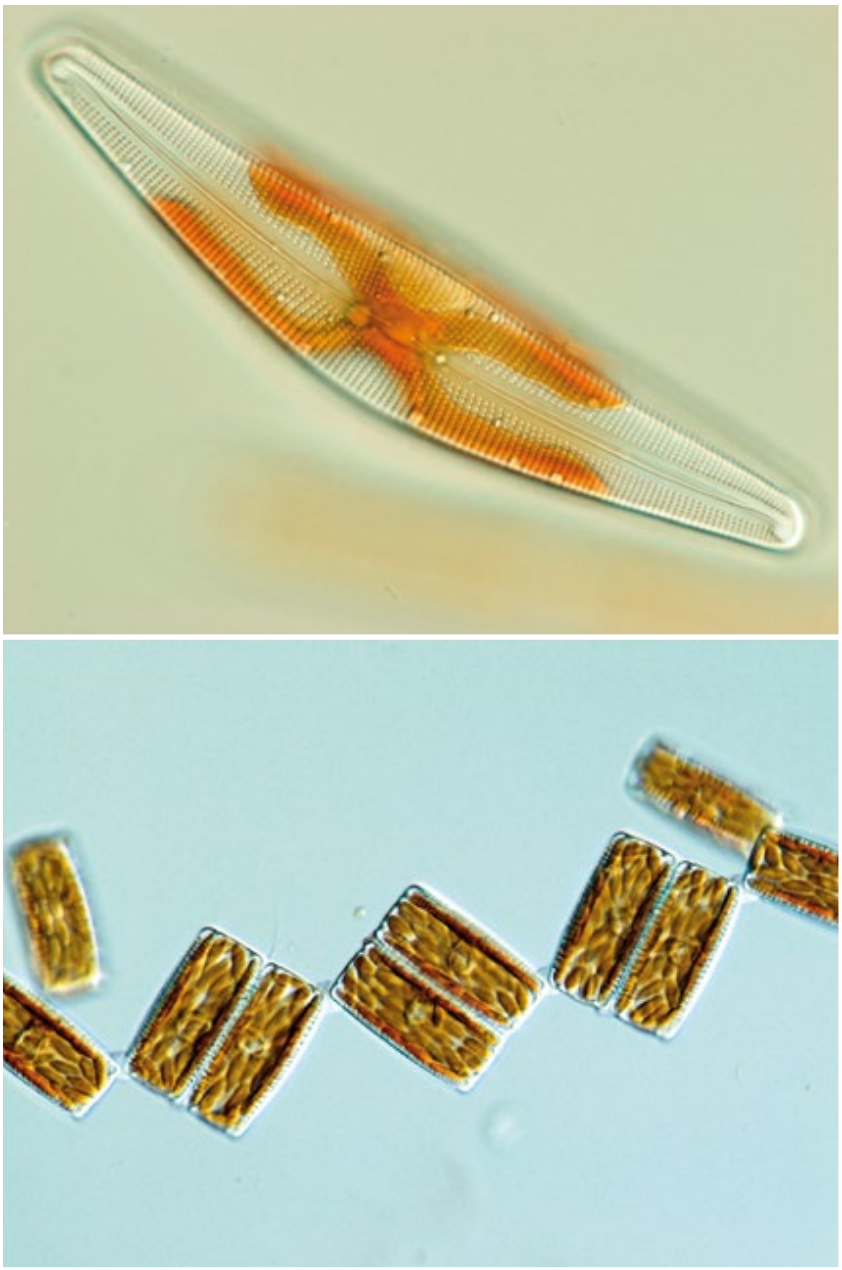


# The National Diatom Collection

## A long-term record of water quality and changes through the decades

**PROF. JONATHAN TAYLOR**
*NORTH-WEST UNIVERSITY*
*HONORARY CURATOR SA NATIONAL DIATOM COLLECTION*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

The NRF-SAIAB South African National Diatom Collection (SANDC) is an internationally recognised herbarium housing diatom slides and samples collected in southern and central Africa. The collection houses over 20 000 discrete diatom samples and contains material dating from the late 1940s to the present.



***Top:*** Cymbella aspera *living cell, commonly found in good quality fresh waters.*
***Bottom:*** Diatoma vulgaris *living cells (chain-forming colony), commonly found in waters with increased nutrient content and are a good indicator of eutrophication.*

Diatoms are single-celled algae which construct their cell walls from silica. This very robust cell wall is resistant to decay, making the diatom easy to collect, preserve and examine. Each diatom community is unique, shaped by the quality of the water in which they grow, thus they are excellent and commonly used indicators of environmental pollution and impact. For this reason, SANDC can provide a long-term record of water quality and changes through the decades.

The SANDC continues to accession specimens, loan specimens and train students. During 2023 just under 500 discrete diatom samples were added to the collection. These samples were interrogated to provide insights into water quality at the sites in question and, once accessioned, provide a permanent record of both the diatom community composition at that site, and the reigning water quality at the time of sampling. These samples were used for research in two broad fields: environmental monitoring, and diatom species discovery and taxonomy.

Papers published in 2023 were mostly in the first category, exploring the use of diatoms to indicate water quality in groundwater sources (from samples collected from wells and boreholes) as well as investigating the health of individual cells as indicators of pollutants, such as herbicides and pesticides. A review was completed of the possible role diatoms may play in indicating the impact on the aquatic ecosystem of various pharmaceuticals carried in urban and industrial effluent.

Towards the end of 2023, the collection hosted Mr Ernest Seretse who was completing an Honours project on diatoms as indicators of water quality in the Molopo River. He received training on preparing and identifying diatoms and was also assisted with statistical analysis. He has since graduated with a BSc Hons from the North-West University Mahikeng Campus.

With funding provided by the NRF-SAIAB, Prof. Jonathan Taylor (NRF-SAIAB Research Associate) visited Belgium for the European Diatom Meeting and presented two posters on new diatom taxa from central Africa. After the conference he stayed on for a research visit to the Meise Botanical Garden in Brussels which houses a very large collection of diatom samples from central Africa. The visit was hosted by Dr Christine Cocquyt, a long-time collaborator with Jonathan Taylor and a leading authority on African tropical diatom species. The visit resulted in the description of several diatoms as new to science.

# Understanding South African frogs, reptiles, their parasites and related cultural practices

**PROF. LOUIS DU PREEZ**
*NORTH-WEST UNIVERSITY*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**TEAM MEMBERS**
Louis du Preez, Fortunate Phaka

**STUDENTS & INTERNS**
Arno van Niekerk, Tiaan Brink, Joretha du Buisson

**COLLABORATIONS**
University of Perpignan, France - Olivier Verneau; Auburn University, Alabama, USA – Stephen Bullard; Belem University, Brazil – Marcus Dominguis; Hasselt University Belgium – Maarten Vanhove


*A comprehensive book on polystomatid flatworm parasites of the world by Louis du Preez, Willem Landman and Olivier Verneau entitled,* Polystomatid Flatworms: State of Knowledge and Future Trends *was published by Springer Publishers.*

## Wildlife-based cultural practice research improves understanding of human activities that impact wildlife.

South Africa's traditional cultures have practices that rely on frogs and reptiles and investigating these practices improves knowledge about them as they are part of human activities that impact wildlife both negatively and positively. An increased understanding of cultural practices that rely on wildlife improves conservation by contributing to social and conservation objectives. Protective practices can also improve conservation by making it contextually appropriate and socially inclusive.

Research seeking to improve conservation is especially important for this project's focal group, amphibians and reptiles, which have 41% and 21% of their species, respectively, declared globally threatened (IUCN, 2023, The IUCN Red List of Threatened Species Version 2022-2). Wildlife-based cultural practice research improves understanding of human activities that impact wildlife (negatively and positively); such understanding of biodiversity's interactions with cultural diversity can increase the effectiveness of conservation planning and improve the balance between social and conservation objectives.

Consideration of cultural practices contributes to Sustainable Development Goals 11, 15 and 16 by promoting conservation planning that is inclusive of previously excluded members of society while also documenting and incidentally protecting cultural practices (United Nations, 2015).

Culturally inclusive biodiversity conservation is also in line with the Global Biodiversity Framework (Target 17) which promotes consideration of cultural practices in decision-making (Convention on Biological Diversity 2021). Outputs of research focussed on cultural practices inform science-based integrative conservation that is suited for wildlife conservation in culturally diverse landscapes.

In 2023 the research team undertook successful surveys in the Eastern Cape Province, KwaZulu-Natal (KZN) and Namibia. Student Tiaan Brink was based at Nature's Valley where he documented the diversity of amphibians and their calls and studied the local community's cultural perceptions about amphibians from a conservation perspective. He also managed to record new populations of the threatened Knysna Leaf-folding Frog. In KZN, student Arno van Niekerk studied the threatened Kloof Frog. He focused largely on parental care in this species and analysed large volumes of volunteer monitoring data. In Namibia we discovered a new bullfrog called Beytell's Bullfrog. This discovery caused a fair amount of excitement in social and printed media.

Joretha du Buisson, an intern funded by NRF-SAIAB, is in charge of curation of the frog collection at NWU, maintaining the Specify database, curating the frog tissue collection as well as the frog parasite collection. Her services are of critical importance for the productivity of our research group.

*A new species of African bullfrog called Beytell's Bullfrog,* Pyxicephalus beytelli, *is the fourth species of bullfrog identified in Southern Africa. It is the largest frog species discovered in more than 100 years.*

# Cephalopods

## Key ecological players in global ecosystems

**DR MAREK LIPINSKI**
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*
*HONORARY CURATOR: CEPHALOPODS*

**TEAM MEMBERS**
Marek Lipinski, Rob Leslie

**COLLABORATIONS**
Natural History Museum London; NHM Copenhagen; Humboldt Universitat Berlin

Biodiversity is the key word in the modern reality (as is climate change). This is true not only for specialists dealing with worrying developments on the ground, but also for the general public. The unavoidable base for both groups is the reference collection of 'voucher specimens' - types and other systematics-related individuals and preparations made from them, like otoliths, statoliths, beaks, radulas and others, photographs, and 'genetic vouchers' - small pieces of tissue used for genetic studies, like the simplest barcoding.

### Systematics is a crucial start for all areas of biodiversity study.

Systematics is now the least popular aspect of biology, but it is a critical starting point for all other areas of study: ecology, genetics, physiology and so on. Without proper species recognition, which can sometimes become rather complicated, these other disciplines cannot proceed.

The cephalopod collection at NRF-SAIAB was started in 2013, when large cephalopod collections were acquired and transported from Cape Town to Makhanda/Grahamstown by Dr Marek Lipinski and Roger Bills. This initial collection was supplemented by further collections from RV *Dr Fridtjof Nansen* research projects. The cephalopod project has brought an extensive cephalopod collection to NRF-SAIAB. Cephalopod specimens were collected through the former Sea Fisheries Research Institute (Cape Town) and later by various international projects based on the research of RV *Dr Fridtjof Nansen* in various areas of the world, mainly around southern Africa.

### The main aim and direction of the NRF-SAIAB cephalopod project is to collect properly identified voucher specimens and assist in assessing the ecological importance of identified species.

Some cephalopod species are key ecological players in many ecosystems across the globe. They also support fisheries. The same is true for southern African waters. Both ecological and industrial aspects are researched annually by Fisheries Research of the DFFE by undertaking, *inter alia*, demersal and pelagic surveys along South African coasts. During these surveys, catches are identified to species level and quantified. Proper identification of all components is crucially important. Cephalopods from other distant regions serve as a training basis for identification skills in this systematic group.

The NRF-SAIAB cephalopod collection is being worked in two main directions: first, is the identification of specimens to species level, followed by an accession process. Second, is the publication of research papers based upon the identified and accessioned material. Several hundred specimens have already been identified and accessioned. During a working session in November 2022, 87 samples, 31 species, 130 identifications were completed. During Dr Lipinski's visit to NRF-SAIAB at the end of 2023, 150 samples were processed, and 48 species identified among 170 individual cephalopods examined. There were possible new genera and species in that material, from the families Onychoteuthidae and Ancistrocheiridae, and possibly from deep water Octopoda. The bulk of the material was from the RV *Dr Fridtjof Nansen* cruise 2009, with 410 in the Indian Ocean.

*Dr Marek Lipinski, Honorary Curator of the NRF-SAIAB Cephalopod Collection processing samples during his visit to SAIAB in November 2023.*

Figure 1: Sepia roeleveldi *Lipinski, 2020.*

Previous research (published) on the Sepiidae (see Figure 1) was recognised in Lupse et al. 2023 Cuttlefishes (Cephalopoda, Sepiidae): The bare bones – an hypothesis of relationships. *Marine Biology* 170: 93, doi.org/10.1007/s00227-023-04195-3] and a new genus in the family confirmed on the basis of genetic identifications and analysis (*Digitosepia* Lipinski, 2020).

# MARGARET SMITH LIBRARY
## A vibrant knowledge hub

*Students using library spaces.*

**MADITABA MELTAF**
*SENIOR LIBRARIAN*

**PLATFORM USERS**

Rhodes University Library; RU DIFS; SANBI; SANParks; CapeNature

**COLLABORATIONS**

Fisheries Library, Department of Primary Industries and Regional Development, Western Australia; Kenya Marine and Fisheries Research Institute, (KFMRI) Centre of Excellence in Marine and Fisheries Research; Zoological Institute, University of Basel, Switzerland; National Institute of Water & Atmospheric Research Ltd (NIWA), New Zealand; Training and Information Division, Aquaculture Department, Southeast Asian Fisheries Development Center (SEAFDEC), Philippines.

Books circulated = 823
Articles supplied = 514
New books purchased = 93
Web of Science (WOS) peer-reviewed publications = 132
Peer-reviewed publications with Rhodes University = 77

The Margaret Smith Library is a specialised platform which provides valuable resources shared with the Rhodes University Library. As part of the Rhodes University community, postgraduate students hosted at NRF-SAIAB have the same level of access to the University E-learning Resources as students registered with the university. With its specialised literature collection focused on ichthyology, aquaculture and fisheries, the Margaret Smith Library serves as the primary library for the Rhodes University Department of Ichthyology and Fisheries Science (DIFS).

The library prioritises relevance when building and updating its collection to ensure that it meets the specific needs of its primary users, replenishing its stock with up-to-date and recommended material. Users include DIFS and NRF-SAIAB staff, students, Honorary Research Associates and international specialists. During 2023, the library was able to purchase new books to the value of over R42 000.00; most titles purchased were suggested by researchers at NRF-SAIAB and DIFS academics and students. This user-centric approach ensures continued high circulation of books and excellent user-satisfaction surveys at the end of each calendar year. The library is also actively engaged in digitisation projects to ensure that literature produced by NRF-SAIAB researchers, our heritage collections, fish images, scientific illustrations and archival material are increasingly accessible.

The Margaret Smith Library is an active hub for research, training, and teaching.

The Senior Librarian, Ms Maditaba Meltaf, organises annual training sessions for NRF-SAIAB interns and students as well as for undergraduates and postgraduates at DIFS and the broader Rhodes University community. Additionally, training is done on an ad hoc basis on request. Visiting students from the University of Fort Hare (UFH) Zoology Department had a tour of the physical library and a guided tour of the digital library at https://ru.za.libguides.com/saiablibrary/home

In March 2023, the Margaret Smith Library was allocated an intern from the SANBI Groen-Sebenza Internship Project. Ms Siyathemba Mnguni has a Bachelor's Degree in Library and Information Studies and a Diploma in Archival Studies from UFH, which makes her a very valuable asset for the Margaret Smith Library.

Siyathemba is leading the Margaret Smith Library Archives project. For years our archives have been in disarray. Now, under

the guidance of Roger Bills, Senior Curator, the archives have new shelving donated from the NRF-SAIAB Collection, and the working area in the archives is much improved and more spacious, with boxes and files better organised. Archival boxes are being labelled and the data recorded. The next step will be to compile detailed descriptions of the box contents. While organising the archives is still not complete, we are happy to have come this far.

## Digitization and Open Access remain central pillars of the Margaret Smith Library

In line with NRF's strategy to improve science impact, digitisation and Open Access remain central pillars of the Margaret Smith Library to help increase dissemination, access to and the use of information hosted by this platform. Author, Prof. Tom Hecht, gave permission for the Senior Librarian to digitise and upload his book entitled *Aquaculture in South Africa: history, status, and prospects* to an Open Access Platform under CreativeCommons Licensing. The book is now freely available to download at the Biodiversity Heritage Library (BHL) - https://www.biodiversitylibrary.org/bibliography/208377

In 2023, the Margaret Smith Library reported on 132 Web of Science indexed peer-reviewed papers published with NRF-SAIAB as the affiliation address. These papers included early views but excluded retracted and corrected results. NRF-SAIAB researchers have embraced taking the Open Access publishing route and of the 132 publications on WOS, 86 papers are in Open Access journals.

The Margaret Smith Library also provided Rhodes University with a list of 77 peer-reviewed, subsidy-earning publications for submission to the Department of Higher Education and Training (DHET).

Future digitisation projects include digitising *Ichthyological Bulletins* by JLB Smith and edited by MM Smith (Volume 1: 1-20; Volume 2: 21-32) and uploading the five volumes of *The Coastal Fishes of the Western Indian Ocean* by Heemstra, P. et al (2022) to the BHL repository.

The Margaret Smith Library is a member of IAMSLIC – the International Association of Aquatic and Marine Science Libraries and Information Centres. Membership of this consortium paved the way for our high rate of user satisfaction for literature support. Our library users are happy to timeously receive literature that is not easily available locally. This service enables library members to share articles and book chapters which closes the no-access gap.

Contributing to community engagement, Ms Maditaba Meltaf is a Sesotho narrator for audiobooks at the South African Library for the Blind, and Siyathemba Mnguni volunteers her time once a week to assist with running the Good Shepard Primary School Library.

*BEFORE: Old shelving with narrow working space in the archives.*

*Ms Siyathemba Mnguni (intern) organising the archives.*

*AFTER: New shelving with improved working space.*

# TRANSFORM

## Human Capital Development

# ACEP Phuhlisa Human Capital Development Programme and DSI/NRF-SAIAB Joint Marine Laboratories Programme

**GARTH VAN HEERDEN**
*TRANSFORMATION MANAGER*

**PLATFORM USERS**
UFH, UNIZUL, UWC, WSU

**METRICS**
Students receiving support through ACEP Phuhlisa = 56
Supervisors = 19
HDIs represented = 4
Joint Marine Laboratories = 4

## The ACEP Phuhlisa Programme stands as a pivotal initiative in the transformation landscape of the Department of Science and Innovation

The Phuhlisa Programme's primary objective is to bolster the capacity of Historically Disadvantaged Institutions (HDIs) in Marine Science to expedite the transformation process within the marine science research community. Through a collaborative effort involving NRF-SAIAB, the University of Fort Hare (UFH), the University of Zululand (UNIZUL), the University of the Western Cape (UWC), and Walter Sisulu University (WSU), a structured programme has been established. This programme channels support from NRF-SAIAB to marine science researchers, to augment research capabilities across these universities.

An integral aspect of this initiative is the focus on nurturing black and female South African postgraduates within the marine sector and consolidating the presence of marine science within HDIs. Spearheaded by Mr Garth van Heerden, NRF-SAIAB's Transformation Manager, dedicated professional support is provided to propel the programme forward, ensuring the maintenance of high-quality research standards.

## Strategic allocation of funds enables HDIs to tap into NRF National Facility research platforms and expertise.

The ACEP Call has been specifically designed to serve this purpose, with a split funding approach. While two-thirds of the funding caters to an open research call, the remaining third is specifically allocated to bolster marine science researchers and their students at HDIs. This strategic allocation enables these institutions to tap into NRF National Facility research platforms and expertise, typically accessible only to scientists at historically white or research-intensive universities. These resources encompass a wide array of assets, including offshore research vessels, specialised vehicles, dive teams, and ROVs.

Financial support is extended to student research projects in the form of running costs and study bursaries, ensuring that financial constraints do not impede academic progress. Moreover, recognising the need to bridge the gap for students from disadvantaged backgrounds, the Phuhlisa Programme organises tailored training courses focussed on developing essential skills, like writing and presentation.

## The holistic development of students and supervisors remains a cornerstone of the programme

Academic and professional enhancement opportunities are provided, ranging from supervisory and scientific training to practical life skills such as swimming, driving, and first aid. Central to the efficacy of the programme is its HDI researcher-centred approach. This philosophy underscores the belief that the greatest potential for capacity building lies within this demographic. While passion and research excellence are paramount, true progress in South African marine science necessitates a diverse and representative scientific community. Thus, initiatives like the Phuhlisa Programme play a pivotal role in fostering strategic and dedicated transformation efforts.

## Bringing excellence closer to communities – Joint Marine Laboratories Platform (JMLP).

The next phase of the Phuhlisa Programme has focused on establishing the DSI/NRF-SAIAB Joint Marine Laboratories Programme (JMLP) at the four historically disadvantaged university campuses. The aim is to merge the expertise of four partner universities with that of NRF-SAIAB and its extensive network, creating a collaborative platform. These laboratories offer researchers and students from partner institutions access to advanced infrastructure and equipment, fostering continuous growth, enhancing research quality, and making societal impacts.

The JMLP is designed to tackle crucial marine, social, and economic challenges in South Africa, including the development of technical skills necessary for managing these shared research platforms.

**UFH – BIODIVERSITY JOINT MARINE LABORATORY – CANCER AND DIABETES RESEARCH ON RED ALGAE**

Prof. Graeme Bradley has initiated a tissue culture laboratory and installed Ultra-High Pressure Liquid Chromatography (UPLC) for novel compound research. The JML has provided an opportunity for students, hands-on training in UPLC and learning how to work on and maintain the system. Consumables for UPLC and for cancer research have been provided by JMLP funding.

*Students gather red algae samples to take back to the laboratory.*

Students have been able to run their samples on the system and use the experimental data to gather evidence on the anti-cancer activity of bioactive compounds extracted from red algae. The funding has also assisted in lab refurbishment.

Additionally, Prof. Niall Vine operates the Fort Hare Aquaculture Research Unit (FHARU) the NRF-JML funded facility based at Kingfish Enterprises, a mariculture research unit, based in East London. The opportunities created by partnering with Phuhlisa extend beyond the capabilities of what can be offered on the UFH Alice campus thereby increasing the university's ability to build capacity in the marine sciences.

***Above:*** *Through the Phuhlisa Programme, Dr Carla Edworthy (NRF-SAIAB) offered an Honours project investigating the potential impact of ocean acidification on urchin larval development. The experiment was conducted at the SAEON Elwandle laboratories, using state-of-the-art equipment and funded by the ACEP-Phuhlisa programme. Co-supervised by Dr Niall Vine (UFH), Liyabona Sofuthe was trained in basic animal husbandry, aspects of experimental design and microscopy. Here Liyabona Sofuthe takes a sample of her urchin larvae to check at under the microscope.*

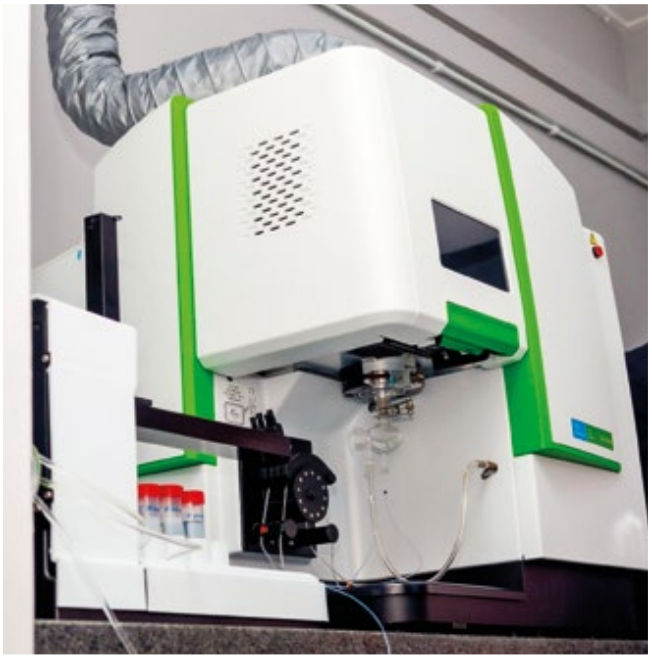
**UWC – MICROPLASTICS AND COASTAL RESEARCH (MCR) JOINT MARINE LABORATORY**

Prof. Anusha Rajkaran has established a clean laboratory, equipped with instrumentation, including a Fourier Transform Infrared Spectrometer machine. This lab, which was inaugurated in April 2023, is set up to extract, enumerate, and describe microplastic samples collected from sediment, water and fauna. It comprises flow cabinets, filtration apparatus with pumps, sieves, a microscope, and the flagship item: a Bruker LUMOS II compact standalone FT-IR imaging microscope which is used to determine the polymers of macro- and microplastics. The MCR JML is fundamental to the research on microplastics: without the equipment and funding provided, it would be difficult to undertake the analysis in a low contamination environment and it would be costly to send samples away for analysis. The laboratory also enables the training of students and contributes to increasing human capacity and transformation.

***Left:*** *In the laboratory, a student prepares sediment for sediment particle size analysis under a fume hood.*
***Below:*** *Evaluation of carbon stocks and associated threats at Berg River Estuary. Kezi Dreyer (MSc candidate) measuring height of vegetation samples.*
***Bottom:*** *Dr Jaime Johnson collects water samples at the Nahoon Estuary in East London to quantify heavy metals in urbanised estuaries.*

**UNIZULU – MARINE AND COASTAL ECOTOXICOLOGY JOINT MARINE LABORATORY**

Dr Ntuthuko Masikane is enhancing the laboratory to address ecotoxicology issues, including anti-foulants, outfalls, land-based pollution, and port management. The laboratory, equipped with Total Oxygen and Carbon/Total Nitrogen (TOC/TN) analysers and an Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES), was launched on December 5, 2023. The ICP-OES equipment is vital in assessing metals in the aquatic environment compartments such as water and sediment, as well as in animal tissues, thus allowing us to determine bioaccumulation. Metal assessment in aquatic ecosystems is becoming a standard procedure in determining the state of pollution in an ecosystem.



***Three images to the left:*** *The ICP-OES equipment and TOC analyser used to assess bioaccumulation of metals in water, sediment and animal tissues.* ***Above:*** *Lungelo Nsibande (PhD candidate) collecting sediment samples in Algoa Bay as part of his project assessing the macrozoobenthos community structure and sediment health status of Algoa and Cape St Francis bays in Eastern Cape.*

**WSU – RURAL COASTAL SUSTAINABILITY JOINT MARINE LABORATORY**

Dr Thembinkosi Dlaza is the Principal Investigator. Once it has been officially launched on 24 January 2024, this laboratory will conduct research on aquaculture for food security, species taxonomy, reproduction, and physiology, as well as tissue damage and stress responses. The JMLP has provided funding for three high-resolution, camera-fitted microscopes (i.e., dissecting, inverted and upright) to enable researchers to identify invertebrates and seaweeds to species

level while capturing evidence on camera. During 2023, the JML was further capacitated with a Toyota Landcruiser 4x4 double-cab vehicle and a boat for sampling in estuaries and coastal areas

Histology equipment (semi-automatic microtome and embedding station), a tissue-drying stackable oven, a spectrophotometer, and centrifuge with interchangeable rotor chambers to perform tissue analysis studies were also procured through JMLP funding. These acquisitions will expand the scope of research at WSU such that lab-based simulation experimental studies will be conducted instead of relying solely on field observations or depending on external laboratories.


*Dr Thembinkosi Steven Dlaza with the new Toyota Landcruiser 4x4 vehicle and boat for the WSU JML.*

*WSU Honours students, Aphedulwe Twabu (sitting) and Asemahle Tikilili (standing) taking depth measurements of a rock pool before collecting data on sea anemones.*

*The NRF-SAIAB, in collaboration with DIPLOMICS, hosted a training workshop aimed at upskilling researchers interested in entering the field of molecular biology or refreshing previously obtained skills. The five-day training workshop ran from 20 to 24 February at NRF-SAIAB's Aquatic Genomics Research Platform laboratory. The workshop was attended by 10 diverse researchers from the University of Zululand, the University of Fort Hare, and some participants from NRF-SAIAB. It was facilitated by NRF-SAIAB's Instrument Scientist, Dr. Gwyneth Matcher, who introduced or reintroduced the participants to the theory and practical learning in the field of molecular biology and its associated methods.*


An NRF – FBIP biodiversity
inventory project
to fill knowledge gaps in
South Africa's freshwater systems.
Refresh
Funded by the DSI
Managed by the NRF-SAIAB
in collaboration
with SANBI
science & innovation
NRF
SAIAB
SANBI

# NETWORK

## Strategic Engagement & Global Collaboration

*Women fishing with traditional reed baskets in the main stem of the Luswishi River.*

# Fish diversity survey of the Kafue River, Zambia -
## A glimpse into one of Southern Africa's least studied rivers.

**DR RUSSELL CHALMERS**
*AQUATIC ECOSYSTEMS SERVICES*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**TEAM MEMBERS**

Dr Russell Chalmers, Naomi Richardson, Craig Rennie, Dr Bruce Ellender, Denis Tweddle, Prof. Peter Teske, Dr Arsalan Emami-Khoyi and Prof. Cyprian Katongo.

**COLLABORATIONS**

TNC, AES, Zambian Department of Fisheries, Department of National Parks and Wildlife Zambia, African Parks, GKLL, Mushingashi Conservancy; UJ, UNZA, NRF-SAIAB.

Large-scale mining, deforestation for agriculture and charcoal production, and unsustainable fisheries techniques threaten fisheries resources on the Kafue River.

The Kafue River in central Zambia provides critical services to the ecosystems and local human communities it supports. One primary service is fisheries, sustained by high species diversity and productivity, which provides an important contribution to household protein provision, livelihood opportunities and local economies. Large-scale mining, deforestation for agriculture and charcoal production, and unsustainable fisheries techniques threaten the resources.

In recognition of these threats, The Nature Conservancy (TNC) is implementing the Kafue Sustainable Fisheries Programme (KSFP) to safeguard freshwater resources and the fisheries they support for ecosystem health, biodiversity protection, livelihood security, and nutrition. The KSFP follows a science-based approach to inform the development of robust fish and fisheries conservation and management initiatives, a critical aspect of this being understanding the diversity and distribution of fishes across the Greater Kafue Ecosystem (GKE).

Historically, few ichthyological surveys have been undertaken in the Kafue, resulting in a significant knowledge gap in the region. This lack of information on ichthyofaunal biodiversity, coupled with the complex geological history and evolution of the Kafue Basin, means there is uncertainty about the species distribution within

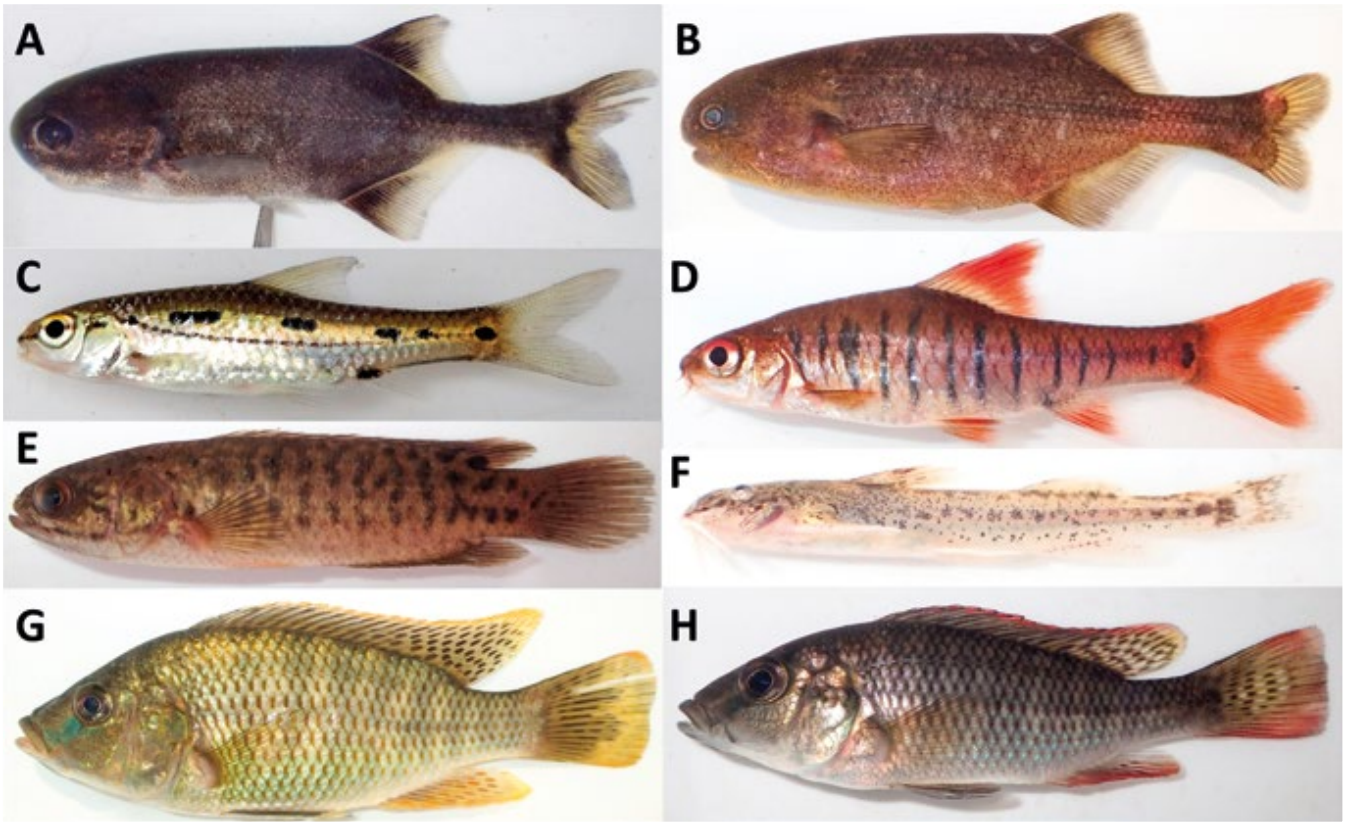
the Basin, which hampers conservation planning and fisheries management. The study's aim was to document the fish diversity and collect voucher specimens with genetic material and live colour photographs across the GKE. The field survey targeted the mainstem Kafue and four major tributaries (Luswishi, Lunga, Lufupa and Nanzhilla Rivers). The primary objective is to develop a genetic barcoding reference library for the catchment to feed into environmental DNA (eDNA) studies and ultimately inform a larger spatial aquatic conservation plan.

## Addressing the knowledge gap to find nature-based solutions to societal challenges.

To address this knowledge gap, an intensive field survey was undertaken in the GKE led by Dr Russell Chalmers (NRF-SAIAB-RA) and Craig Rennie with assistance from the University of Zambia under the guidance of Prof. Cyprian Katongo. Comprehensive multi-habitat, multi-gear sampling was undertaken at 20 central localities across the GKE between October and December 2023. A total of 73 confirmed species were captured during the survey with an additional 13 forms of further taxonomic interest based on morphometric and meristic characteristics.

The fauna of the Kafue resembles that of the Upper Zambezi. However, many species require further genetic comparison between catchments. Nine hundred and eighteen (918) genetic samples and 2349 voucher specimens were lodged at the National Fish Collection at NRF-SAIAB, allowing global access to new material from a poorly studied catchment. The eDNA reference library is currently being developed in collaboration with Prof. Peter Teske and Dr Arsalan Emami-Khoyi and their team of regional and global collaborators. While the main focus of this project is generating eDNA sequences for the Kafue River, local and international taxonomists will have access to the curated voucher specimens and accompanying genetic material to better understand species diversity within species groups of interest in the region. These interest groups include cyprinids *(Enteromius and Labeobarbus)*, mormyrids *(Petrocephalus and Pollimyrus)*, mochokids *(Chiloglanis and Synodontis)*, amphiliids *(Zaireichthys)* and cichlids *(Pharyngochromis and Sargochromis)*. All these groups contain hidden species diversity in the Kafue and neighbouring river systems. Additionally, the study has developed a preliminary photographic species identification guide for the Kafue River, which will be updated as genetic and taxonomic studies progress.

All the information gathered from the present study feeds into large-scale conservation planning in the Kafue Basin, striving to achieve sustainable development targets like the United Nations Sustainable Development Goals and finding nature-based solutions to societal challenges. Through evidence-based policy decisions, management can improve food security, livelihoods, conservation and resource management. Protecting freshwater resources is critical to ensure healthy communities in a balanced ecosystem.




*An example of fish species sampled in the Kafue.* **A:** Petrocephalus sp. *'dark oval spot';* **B:** Pollimyrus cf. castelnaui; **C:** Enteromius greenwoodi; **D:** Enteromius fasciolatus; **E:** Ctenopoma multispine; **F:** Zaireichthys kafuensis; **G:** Sargochromis greenwoodi; **H:** Pharyngochromis acuticeps *'Lunga'.*

# Plastics in the environment

**DR TATENDA DALU**
*AQUATIC SYSTEMS RESEARCH GROUP,*
*UNIVERSITY OF MPUMALANGA (UMP)*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**TEAM MEMBERS**
Dr Farai Dondofema, Dr Mwazvita TB Dalu, Dr Linton F Munyai, Dr Lubabalo Mofu

**COLLABORATIONS**
Dr Ross N. Cuthbert (Queens University Belfast), Prof. Naicheng Wu (Ningbo University), Dr Collins Oduro (Ningbo University), Prof. Franco Teixeira de Mello (Universidad de la República-Uruguay)

**STUDENTS**
Ayanda Xozmuti (BSc Hons), Samkelisiwe T Themba (MSc), Nelisiwe Ngomane (MSc), Nombuso N Themba (PhD), Ronald Mashamba (PhD), Masimini S Nkosi (PhD)

## African rivers are completely understudied in the context of microplastic contamination.

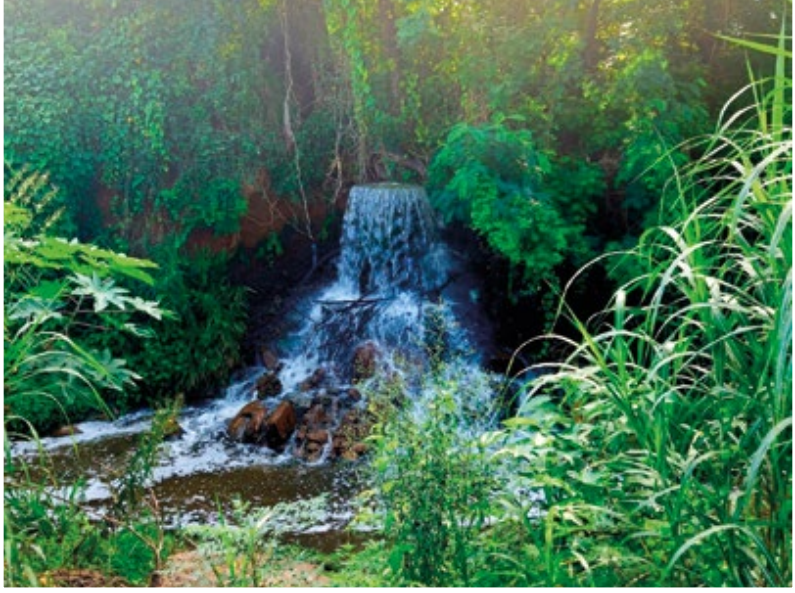
Plastics are synthetic polymers that underpin many human activities, and often end up polluting aquatic environments owing to improper waste management, poor human practice and accidental loss. Their durability results in the accumulation of plastic waste throughout ecosystems globally, and their slow breakdown often produces successively smaller pieces, so-called microplastics.

Microplastics act as points of accumulation for many dissolved chemicals, concentrating harmful and persistent organic pollutants onto their surface. Furthermore, harmful additives from plastics are suspected to leach out into the environment or organisms and may have adverse effects such as endocrine disruption. While the implications of microplastic pollutants in aquatic ecosystems have yet to be fully realised, they have been associated with detrimental effects for certain biota as a result of laboratory-induced ingestion.

Marine environments are the focus of most microplastic investigations; only recently has investigation been extended to include freshwater systems. In turn, relatively few studies have examined aquatic-terrestrial microplastic linkages. African rivers, however, are completely understudied for microplastic contamination.

## An integrated ecosystem approach to identify species that can serve as river quality and health indicators.

Water resources provide priceless ecosystem services to biodiversity and humans. Similar to global trends, across South Africa water resources are increasingly threatened by growing human populations and development. Thus, the maintenance of water availability and quality, whilst sustaining crucial biodiversity, remains a major concern on national and international scales.



*Sewer water overflow from an unattended sinkhole along the tributary of the Crocodile River. This is one of the major sources of microplastics in aquatic ecosystems.*

In recent years, the burgeoning impacts of microplastics on ecosystems have been realised, yet effects in the Global South and between ecosystem types remain under-examined. This project will help contextualise the fundamental plastic distribution between and within aquatic and terrestrial environments that are ecologically linked by assessing contributions of allochthonous plastic within two different river systems with different catchment activities.

Further, by examining microplastics in relation to trophic subsidies (invertebrates and fish), the economic impact of plastics on ecosystems will be quantified. Plastic transfers between ecosystems are likely to vary significantly through space and time owing to changes in human and physicochemical variables. By approaching the problem at a landscape scale, this project will also enable us to understand how biological, human and physicochemical features influence within-system processes and environmental transfers of microplastics. Thus, by determining the way in which landscapes are connected, we will build an improved understanding of the values of these connections in preserving the biodiversity structure of South African rivers and adjacent/connected ecosystems, as well as the potential consequences of human activities. Such an integrated approach can additionally identify species that can serve as river quality and health indicators

Overall, the ecosystem approach employed in this study will enable novel understandings of microplastic reciprocal transfers occurring between different pathways.

*Samkelisiwe Themba (MSc student) holding the invasive bass,* Micropterus spp. *caught in Nandoni Reservoir for a microplastic study.*

# Ecology and systematics of three freshwater fish species in three countries – North America, Namibia and Malawi

**PROF. JAY STAUFFER**
*PENN STATE UNIVERSITY*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**TEAM MEMBERS**
Jay Stauffer, Sara Meuller

**COLLABORATIONS**
Pennsylvania Fish and Boat Commission, USFWS, Wild Resource Conservation Fund

I have extensively studied the current status of the Chesapeake Logperch, which is endemic to the Susquehanna and Potomac rivers in Pennsylvania and Maryland, USA. The Chesapeake Logperch has been extirpated from the Potomac River. The studies described below attempt to expand its distribution in the Susquehanna River as they were in the early 20th century. If we can re-establish these populations, the US Fish and Wildlife Service (USFWS) will not list it as endangered, which will benefit many activities in the lower Susquehanna River Basin.

Our discovery of a new species of fish in Namibia adds to our understanding of the diversity and biogeography of Namibian fishes.

We are continuing our studies of the diversity of fishes from Lake Malawi and native charr, *Salvelinus* spp. in North America.

## Studies like these are essential for the implementation of management practices to conserve freshwater fishes.

I completed the first phase of the status of the Chesapeake Logperch in the lower Susquehanna River. Scientists from the Pennsylvania Fish and Boat Commission, my graduate students, and I transplanted some 700 fish from the lower Susquehanna River to above the Holtwood Dam. We monitored these fish and were able to collect a few recaptures.

In addition to transplanted fish, we cultured over 1000 individuals and released them above Holtwood Dam. To verify if cultured fish were able to breed, some of the cultured fish were kept, and they bred in our tanks, as expected. We still do not know if most of these fish vacate the smaller tributaries and live in the main channel and then migrate into the tributaries when they mature to spawn. We have approached the USFWS and are hopeful that they will continue to fund these studies.

I secured funds from the Wild Resource Conservation Fund to determine the temperature preference of adult and juvenile Chesapeake Logperch. The initial request for proposal (RFP) was to determine the upper incipient lethal temperature of these fish. I proposed determining the temperature preference at different acclimation temperatures and then calculating the final preferred temperature. Previous work with other species of fishes demonstrated that the final preferred temperature is within 0.5° C of the incipient lethal temperature, so I proposed that we use the final preferred temperature as a surrogate for the lethal temperature and so avoid sacrificing individuals of this endangered species.

*Jay Stauffer on the 'Zodiac' inflatable.*

## New species continue to emerge

My colleagues and I completed a morphological comparison of the Chesapeake Logperch with other logperches that inhabit Pennsylvania and verified that it is a unique species, most closely related to the Northern Logperch, *Percina caprodes semifasciata*.

I discovered a new species of fish that lives in the freshwater pools in the Namibian deserts that are filled with aquatic plants and algae. At night these fish come to the surface and gulp air in order to survive. By 09h00 hours, the plants produce enough dissolved oxygen in the pools, enabling the fish to rely solely on their gills to breathe.

My colleagues and I described geographically variable elongate species, *Pseudotropheus likomae* from Lake Malawi.

My student, Sara Mueller, and I have shown that what was previously identified as the Brook Trout, *Salvelinus fontinalis*, in Pennsylvania is a different species. We compared it to the neotype of the Brook Trout that I designated from Long Island, NY. The prepared manuscript will be submitted in 2024.

# Collaborative taxonomic and phylogenetic studies investigate the conservation status, diversity and population biology of a variety of African freshwater fishes

**DR ULRICH SCHLIEWEN**
*CURATOR OF ICHTHYOLOGY/ HEAD OF MOLECULAR LAB SNSB – Zoologische Staatssammlung München*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**TEAM MEMBERS**
Ulrich Schliewen, Fredric Schedel, Pedro Bragança, Fattah Zarei, Yonela Sithole, Gwynneth Matcher, Tholoana Ntokoane, Francois Jacobs, Jessica Glass, Jody Olivier, Albert Chakona

**INTERNS**
Xiluva Mathebula
Nkululeko Zuma

### 1) STATUS OF THE SOUTHERN AFRICAN ENDEMIC GOBIID CROILIA MOSSAMBICA (TELEOSTEI: GOBIIDAE)

The taxonomic and phylogenetic placement of the rarely collected burrowing gobiid, *Croilia mossambica* Smith, 1955 is currently being investigated using DNA-based and morphological tools. We successfully sequenced the complete mitogenome of one juvenile specimen collected during a research field trip in cooperation with Albert Chakona and Pedro Bragança in 2021 (Figure 1). Preliminary phylogenetic analyses strongly suggest a placement of *Croilia mossambica* in the so-called *Kraemeria-lineage* (sensu Agorreta *et al*., 2013) together with other burrowing gobies of the genera *Kraemeria, Schismatogobius,* and particularly, *Parkraemeria*. The latter genus was already suggested to be phylogenetically close to *Croilia* by Suzuki and Senou (2013) based on meristic, squamation, colouration and overall body shape. Based on the mitogenome data, additional nuclear locus data from genome skimming of the whole genome sequences (WGS) and on morphological comparisons with *Parkraemeria*, we will finally redescribe *Croilia mossambica*.

### 2) USING THE POOLSEQ-APPROACH TO ASSESS THE CONSERVATION STATUS OF *OREOCHROMIS MOSSAMBICUS (PETERS, 1852)*

Invasion of non-native Nile tilapia *(Oreochromis niloticus)* threatens a South African tilapia species of economic importance, *O. mossambicus* (Peters, 1852), because both species frequently hybridize. Phenotypic distinction of pure *Oreochromis mossambicus* and those introgressed by non-native introduced species is, however, challenging because hybrids cannot be unambiguously identified morphologically. In order to assess the conservation (=purity) status of South African populations of *O. mossambicus*, we successfully initiated a modern and cost-efficient next-generation-population-genomic sequencing project based on whole genome sequencing in order to establish a sustainable and long-term monitoring tool, potentially applicable not only to *O. mossambicus*. The proof-of-concept project applies pooled analysis of Whole Genome Sequences of pooled population size samples ("PoolSeq") in order to assess the introgression status of *O. mossambicus* populations each represented by twenty pooled individuals and tested for genomic components of other Tilapia species, that is, *O. niloticus*, *O. macrochir* and *O. andersonii*. The methods component was suggested by the research associate and further developed in cooperation with Albert Chakona, Pedro Bragança, Fredric Schedel and Gwynneth Matcher.

Croilia mossambica.

Bioinformatics analysis will be supported by Jessica Glass at the University of Alaska Fairbanks.

**3) A NEW LIST OF MINIATURE AFRICAN FRESHWATER FISHES**

Despite representing a huge fraction of the global vertebrate diversity, miniature fishes, that is, fishes that do not grow larger than approx. 2.6 cm of standard length and reproduce below 2.0 cm, very little is known about their diversity. Led by Pedro Bragança, a new list of African freshwater miniature fishes was produced and published in cooperation with Ulrich Schliewen. This work will serve as a benchmark list for future studies, including conservation studies, of often highly threatened miniature fishes. We also collaborated on a global list of freshwater, brackish water and marine miniature fishes.

**4) DIVERSITY OF THE GOBIID GENUS *GLOSSOGOBIUS* IN SOUTHERN AFRICA**

South Africa is home to at least one putatively endemic *Glossogobius* species, *G. callidus* Smith, 1937, and several additional taxa, including the recently revalidated *G. tenuiformis* Fowler, 1934 (Al Jufaili *et al*. 2022). The DNA-data produced by NRF-SAIAB had previously shown that several mitochondrial DNA-lineages are present along the fresh and brackish waters of the southern African coasts (Maake *et al*., 2013), but their taxonomic status has remained as yet unscrutinised, particularly since it has become evident that the global *Glossogobius*-diversity is difficult to assess without extensive comparative data and that morphological diagnostic criteria are difficult to establish for unambiguous species identification (Hammer *et al*. 2021). Dr Schliewen has revitalised the southern African *Glossogobius* research project, which will be led by a recently appointed Postdoctoral Research Fellow at NRF-SAIAB (Fattah Zarei) and PDP Fellow (Yonela Sithole).

Glossogobius *sp. from KZN.*

**5) POPULATION BIOLOGY OF THE CRITICALLY ENDANGERED *TILAPIA GUINASANA TREWAVAS, 1936***

*Tilapia guinasana* is a critically endangered cichlid fish endemic to a single tiny sinkhole of 50 m diameter and approximately 200 m deep, in Lake Guinas in Namibia. The fish evolved into a unique and fascinating polychromatic species after a founder population became isolated in the Guinas sinkhole. The former NRF-SAIAB-based Ribbink *et al*. (1991) SCUBA-dived in Lake Guinas in the autumn of 1988 and spring of 1989 and recorded the occurrence and composition of breeding pairs based on six different colour morphs down to a depth of 37 m.

The species is threatened by extraction of groundwater for farming and the potential for introducing allochthonous cichlids (Bills, 2007), but according to IUCN (accessed April 15, 2024), its conservation status needs to be updated. Despite its globally unique polymorphism and sinkhole-related biology, very little is known about the ecology, behaviour and the nature of polymorphism of this species.

Greenwood *et al*. (1992) redescribed the species based on type material and the material deposited at NRF-SAIAB by Ribbink *et al*., but they had not analysed correlations of morphometry and colouration. Nxomani *et al*. (1999) provided the only available population genetic study using the Randomly Amplified Polymorphic DNA (RAPD) fingerprinting method (outdated today because of methodological difficulties for producing reproducible results) on each of four specimens of colour morphs and one of a fifth colour morph. Based on this limited sample and Ribbink *et al*.'s (1991) observations of a limited but nevertheless distinctive degree of colour-morph assortative mating, the RAPD study indicated a slight degree of reproductive isolation between at least some colour morphs.

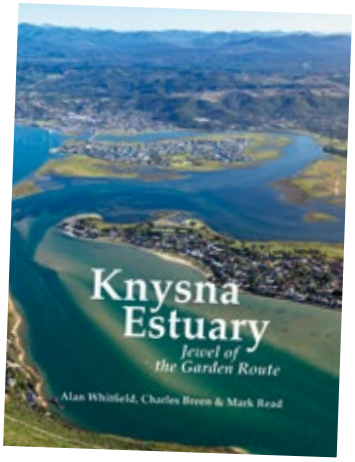
On several occasions *Tilapia guinasana* specimens have been used to establish *ex situ* populations in and outside of Namibia. Greenwood *et al*. (1992) reported that specimens were translocated to another sinkhole, Lake Otjikoto, already in 1922, and some (but not all) subsequent visitors to that lake confirmed the presence of the species in that sinkhole (Greenwood *et al*., 1992; Schraml, 2005). Skelton (2001) further reported that the species was transplanted to several nearby farm dams. Schraml (2005) photographed specimens in 2002 at the London Zoo, in 2000 in a cichlid exhibition in Cleveland (Ohio/USA), and in 1993 in the Artis Aquarium (Amsterdam/Netherlands; possibly derived from a stock imported in the early 1960s to the Netherlands – see van den Nieuwenhuizen, 1963). Furthermore, Stellenbosch University Botanical Gardens used to keep and breed different colour variants, but this captive population is now extinguished (D. Bellstedt (US), pers. comm.). The Berlin Zoo (Germany) keeps live specimens comprising at least two colour morphs.

Currently Dr Schliewen is in the process of applying, in cooperation with Albert Chakona, Fredric Schedel, European Zoos and Francois Jacobs, for funding to re-assess the population biology of this globally unique cichlid endemic in a few localities in northern Namibia. Field trips to determine the ecology, vertical distribution, and genetic characterisation of the *in situ* situation and the *ex situ* populations are of paramount importance for any conservation initiatives for this highly threatened cichlid.

*Light-coloured morph of* Tilapia guinasana *specimen RUSI 27334 collected by NRF-SAIAB.*

# Knysna Estuary: Jewel of the Garden Route

## Ecology and long-term conservation of the Knysna Estuary




**PROF. ALAN WHITFIELD**
*NRF-SAIAB CHIEF SCIENTIST EMERITUS*

**TEAM MEMBERS** Alan Whitfield, Mark Read, Charles Breen

**COLLABORATIONS**
NRF-SAIAB, Knysna Basin Project

The Knysna Estuary is the most important of South Africa's 290 estuaries in terms of conservation importance.

The Knysna Estuary is the only natural estuarine bay on the subcontinent, with both Durban Bay and Richards Bay having been significantly altered from their natural state. The Knysna Estuary is also the most important of South Africa's 290 estuaries in terms of conservation importance. With a deep mouth and strong marine and freshwater influences, rich and diverse plant, invertebrate, fish and bird communities now occupy the system.

Mark Read, a long-time resident of Knysna came up with the idea for a comprehensive book on the ecology and long-term conservation of the Knysna Estuary, and he contacted Charles Breen of the Knysna Basin Project to find a suitable editor to drive such a product. Charles approached Alan Whitfield who then invited scientists in various fields with a strong knowledge and direct research experience of the Knysna Estuary to contribute to the book. Alan was the primary editor, and it took two years to bring the project to fruition. The book is dedicated to the late Prof. Brian Allanson, a past Chair of the Knysna Basin Project, and past Head of Department of Zoology & Entomology at Rhodes University.

Some of the questions that are addressed by the book include – How has the Knysna Estuary evolved into what we see today? Why is the Knysna Estuary so rich in plant, invertebrate and fish species? Which animals, including humans, occupied the area thousands of years ago? How might the estuary be changing over time, especially in this era of global climate change? How should we manage our interventions to ensure that the estuary retains its value to society? And what is the way forward to ensure a healthy and fully functional system? These are the sort of questions that motivated the writing of this book, which comprises 12 chapters, all richly illustrated with photographs and pictorial images pertaining to the presented information.

**Chapter 1** – Brief introduction to the Knysna Estuary outlining why this book is important for conservation/management efforts in the area, and a summary of some of the natural wonders that relate to the estuary and its environs. Authors: Prof. Alan Whitfield and Prof. Charles Breen.

**Chapter 2** – Early climates, botanical changes and our ancient links to the Garden Route, with particular emphasis on the Palaeoclimate and history of human occupation in the Knysna/Garden Route area. Authors: Prof. Naomi Cleghorn and Prof. Sarah Wurz.

**Chapter 3** – Footprints cast in stone, which is an account of the Pleistocene tracks of humans, elephants, antelopes, giraffe, crocodiles, rodents and birds from the Knysna to Wilderness coastal zone. Authors: Dr Charles Helm, Dr Hayley Cawthra, Prof. Jan de Vynck, Mark Dixon, Dr Willo Stear, Guy Thesen and Dr Fred van Berkel.

**Chapter 4** – Evolution of the Knysna Estuary, with a particular emphasis on an assessment of the changing Knysna Estuary over the last 100 000 years, caused mainly by sea level changes during this period. Authors: Prof. Andrew Cooper and Prof. Andrew Green.

**Chapter 5** – Meeting place of river and sea that focuses on the tidal regime, hydrodynamic features and nutrient characteristics of the modern Knysna Estuary. Authors: Prof. John Largier and Dr Lucienne Human.

**Chapter 6** – The role of plant habitats in the functioning of the Knysna Estuary, with a focus on phytoplankton, benthic algae, eelgrass beds and saltmarshes. Authors: Dr Johan Wasserman, Prof. Janine Adams and Dr Lucienne Human.

**Chapter 7** – Invertebrates of the Knysna Estuary, emphasising the invertebrate species of eelgrass beds and intertidal sand and mudflats, but also covering zooplankton in the system. Authors: Prof. Richard Barnes, Prof. Alan Hodgson and Prof. Tris Wooldridge.

**Chapter 8** – Fishes of the Knysna Estuary, with a focus on the nursery function of the estuary for fishes as well as the life cycles of selected angling species and the iconic Knysna seahorse. Authors: Prof. Alan Whitfield, Dr Louw Claassens and Kyle Smith.

**Chapter 9** – Birds of the Knysna Estuary, highlighting the different categories of birds using the estuary, both resident species and migratory waders. Authors: Dr David Allan, Dr Ian Russell, Prof. Jane Turpie, Lorna Watt and Pat Nurse.

**Chapter 10** – Global change, connectivity and the Knysna Estuary, with an emphasis on global warming and sea level rise and what this means for the biotic integrity, connectivity, ecology and people of the estuary. Authors: Dr Nicola James, Dr Lara van Niekerk and Dr Steve Lamberth.

**Chapter 11** – Understanding and managing Knysna Estuary as a complex social-ecological system that emphasises incomplete understanding, inherent uncertainty and unpredictable change – and the implications of managing and governing such systems. Authors: Dr Dirk Roux, Dr Stef Freitag, Dr Ian Russel and Megan Taplin.

**Chapter 12** – The way forward provides a summary of major points from the preceding chapters, as well as additional ideas from the authors. Authors: Prof. Charles Breen and Prof. Alan Whitfield.

The primary aim of the book throughout is to enable and encourage readers to appreciate life within the estuary, understand its structure and functioning, as well as to empower people to communicate its value and conservation importance from an informed position. To increase the impact and transfer of information to all, an electronic version of the book can be freely downloaded from the Knysna Basin Project website (www.knysnabasinproject.co.za).

# Where have all the white sharks gone?

## Concern growing over the stability of white shark population in South Africa

**DR ENRICO GENNARI**
*OCEANS RESEARCH INSTITUTE*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*
*RU-DIFS HONORARY RESEARCH ASSOCIATE*

**TEAM MEMBERS**
Enrico Gennari, Neil Hammerschlag, Sara Andreotti, Chris Fallows, Monique Fallows, Matias Braccini

The collaboration between Dr Enrico Gennari and NRF-SAIAB has provided very important results.

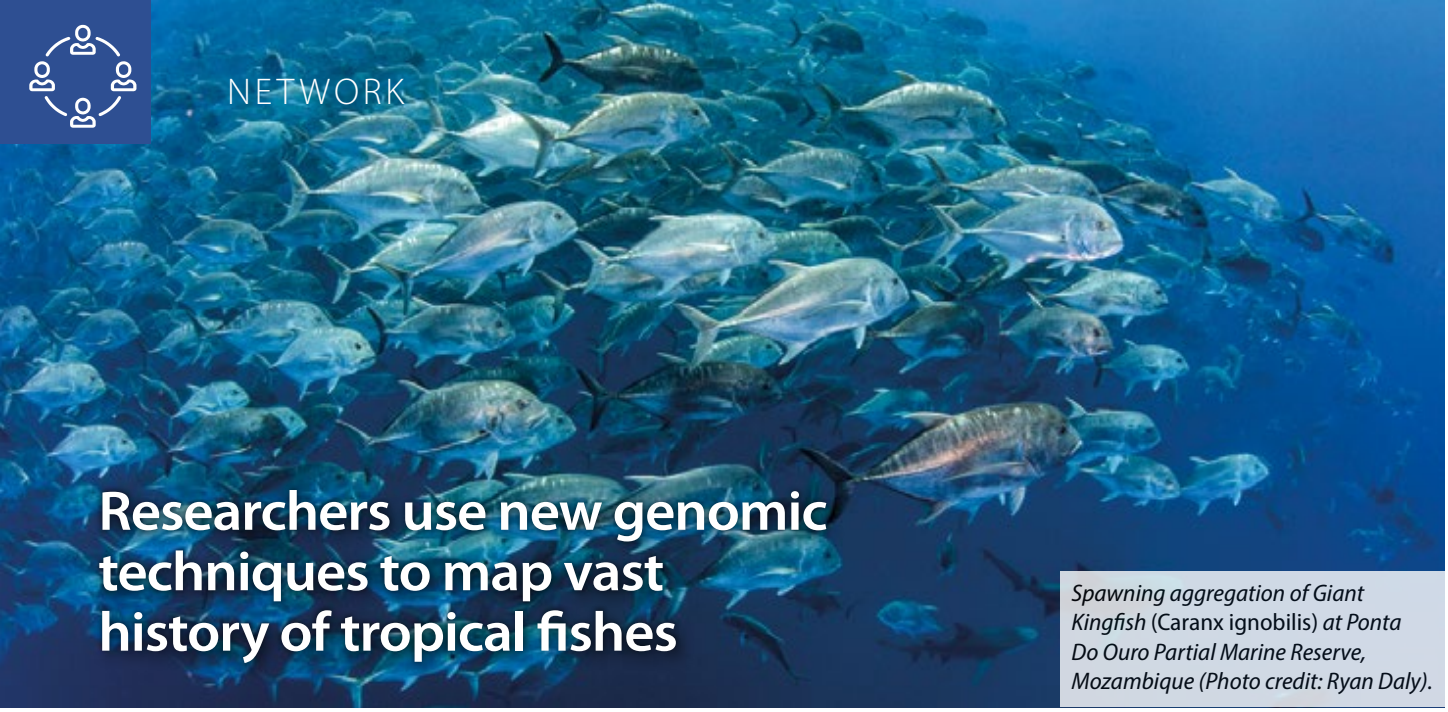
Dr Enrico Gennari has tagged 21 white sharks with internal acoustic transmitters (10-year life span) since 2019.

The relevance of this research can be better understood when looking at the preliminary results of the tagging study, where 18 of the 21 white sharks have already disappeared since the start of the programme: not detected in South Africa or in any other country within the South West Indian Ocean, nor in Australia, creating grave concerns over the real effectiveness of the legal protection of white sharks in South Africa. The loss of nearly 90% of the tracked white sharks in less than four years is worrying. If these white sharks were relocating east, they should have been detected moving to the Eastern Cape or elsewhere along the curtain of receivers that comprise the Acoustic Tracking Array Platform (ATAP) managed by NRF-SAIAB. This distressing result urged Dr Gennari to include satellite tagging in his tagging protocol in order to monitor in real time the movement of the tagged white sharks across the open ocean. Tagging expeditions are planned to start by the end of April 2024.

***Above:*** *Our research on the physiology of white sharks has shown they are quite resistant and resilient to capture stress, yet the secret of the success of a tagging expedition resides in the synergy and experience of the tagging team. (Photo credit: Oceans Research Institute).*
***Below:*** *Catching a white shark requires an experienced team, a good, approved protocol, the right equipment, and a modified vessel. (Photo credit: Oceans Research Institute).*

Dr Gennari presented his work on the thermal eco-physiology of the white shark as well as on the white shark tagging programme at the White Sharks Global conference, an international conference focused on white sharks that takes place every 10-15 years. The attendance at the conference in Port Lincoln (Australia) was sponsored by NRF-SAIAB.

Dr Gennari and his team published a recent paper disputing a study that alleges the white shark population in South Africa is stable.



# Researchers use new genomic techniques to map vast history of tropical fishes

*Spawning aggregation of Giant Kingfish* (Caranx ignobilis) *at Ponta Do Ouro Partial Marine Reserve, Mozambique (Photo credit: Ryan Daly).*

**PROF. JESSICA GLASS**
*UNIVERSITY OF ALASKA FAIRBANKS*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**TEAM MEMBERS**
Sheena Talma, Ryan Daly, Peter Cowman, Brant Faircloth, Thomas Near, Richard Harrington

**STUDENTS**
Martinus Scheepers

**COLLABORATORS**
University of Seychelles, Yale University, Louisiana State University, James Cook University, University of Oxford

## 56-million-year-old family tree details when various carangoid species emerged and how they are related

In 2023 our international research team published an unprecedented 'tree of life' for a group of more than 150 related tropical fishes, a project that uncovered clues about how distinct species were likely able to evolve over millions of years. It was published in the November 2023 issue of the *Journal Proceedings of the Royal Society B.*

Dr Jessica Glass started this project while she was a PhD candidate at Yale University on a visiting fellowship to NRF-SAIAB funded by the National Science Foundation and USAID. She completed the project while a Postdoctoral candidate at NRF-SAIAB and an Assistant Professor at the University of Alaska Fairbanks in the College of Fisheries and Ocean Sciences. Dr Glass spent nearly a decade collecting and analysing DNA data from carangiform fishes, a diverse group that includes species like kingfish, scads, marlins, billfish, remoras and mahi mahis.

Along with samples from living species, we also used fossils of carangoid species. The effort resulted in the most comprehensive time-calibrated phylogeny (reconstruction of the tree of life) of these fishes to date. We used a novel genomic sequencing technique called ultraconserved elements, which are parts of the genome that remain static, or 'conserved', as species evolve. Through the analysis of about 900 genes, we were able to map out a 56-million-year-old family tree that detailed when various carangoid species emerged and how they are related.

## Species of carangoids are critically important for recreational, subsistence, commercial and small-scale fisheries across the Atlantic, Indian and Pacific Oceans

Our ability to reconstruct the evolutionary history of carangoids over 56 million years is an important finding. Understanding how past climatic events have shaped their evolution can inform us about how these species were able to survive over millions of years of climatic changes. Moreover, we identified several genera where the current taxonomy needs to be re-assessed because it does not match the true evolutionary history, which is important for creating more accurate species identification guidebooks used in the field by scientists and fishers.

As resource managers consider the future of many fish species, a longer perspective could help them understand what makes them resilient or vulnerable to change.

No other study has developed such a comprehensive time-calibrated phylogeny for this many species of carangiforms before. We also included a deeper look at 41 sister species among carangoid fishes, most of which diverged into separate species 2 million to 5 million years ago. More than 70% of those species shared the same ranges, which is usually more conducive to genetic intermixing than maintaining distinct evolutionary lineages. However, we also found that sister species often existed at different water depths, suggesting that ecological differences allowed these species to evolve in overlapping but separate environments.

The above work was conducted in conjunction with fishery stakeholders, including commercial fly fishing operators, local collaborators, federal and state agencies, museum collections, and academic partners.

This research is complementary to ongoing genomics work in the Seychelles using DNA metabarcoding to detect species of juvenile and larval fish, in conjunction with project partners at SAIAB and the University of Seychelles Blue Economy Research Institute.

*Workshop participants enjoying the fieldwork component of the baited remote underwater video system (BRUVs) training session. Stuart Laing from the Blue Economy Research Institute at the University of Seychelles led the fieldwork training. Participants were from Seychelles, Comoros and Kenya.*

# Building capacity and improving knowledge mobilisation for baited remote underwater video (BRUV) research in South Africa and Seychelles: a collaboration with SEaS and MARIP

**DR KAYLEE SMIT**
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**STUDENTS**
Annia Marengo (Hons, University of Seychelles)

**COLLABORATIONS**
MARIP, SANBI, NMU, UCT, WildTrust, BERI-University of Seychelles, DTU Aqua, Denmark, NIWA

## Using MARIP to bolster management and conservation efforts for coral reef ecosystems and fisheries resources.

My research and collaboration with NRF-SAIAB encompass several themes, mostly associated with baited remote underwater video systems (BRUVs) research; this includes fieldwork support, data management and curation, imagery data analysis and synthesis, report/publication writing, knowledge mobilisation and capacity building.

The first aim is to publish outstanding research chapters from my PhD, co-supervised by Dr Anthony Bernard. Additionally, the aim is to align research objectives and activities with those of my current Postdoctoral Research Fellowship at Nelson Mandela University (NMU), which is conducting a synthesis of previous African Coelacanth Ecosystem Project (ACEP) projects in KwaZulu-Natal. These projects used various remote imagery technologies provided by the Marine Remote Imagery Platform (MARIP). By collaborating on this work, we aim to enhance the management and curation of BRUVs data collected from these projects, integrating them into a regional BRUVs database for broader research applications across KZN and South Africa. Lastly, while based in Seychelles and working with Stuart Laing from the Blue Economy Research Institute (BERI) at the University of Seychelles (UniSey), we are developing local capacity to conduct BRUVs research at a national level. This initiative will use MARIP to bolster management and conservation efforts for coral reef ecosystems and fisheries resources.

## Balancing sustainable management with the demands of local communities

relies on robust scientific knowledge for effective decision-making.

Coral and rocky reef ecosystems in the Western Indian Ocean (WIO) are vital, supporting millions through critical resources and ecosystem services, with fish and benthic population health directly impacting livelihood security. The challenge is balancing sustainable management with the demands of local communities, which relies on the delivery of robust scientific knowledge for effective decision-making. The use of BRUVs has emerged as an effective tool for surveying a diverse range of fish and invertebrate species, accessing deeper ecosystems beyond safe diving limits, and improving sampling efficiency.

Despite widespread use and a high degree of standardisation among research hubs, challenges remain in mobilising knowledge from BRUVs data owing to delays in video annotation and limited engagement among end-users. Video annotation is time-consuming and requires specialised software and skilled expertise, leading to delays in data availability and reduced management relevance. Despite efforts to increase regional capacity, a shortage of skilled practitioners persists, leaving significant data unprocessed or unreported. Issues like data accessibility, doubts over methodology validity, poor data management, and the absence of formalised reporting obstruct the use of annotated data in decision-making, limiting its potential to inform regional marine assessments.

In efforts to disseminate knowledge, I have published my PhD research in international peer-reviewed journals and presented findings at various national and international conferences. Notably, a paper titled "Identifying suitable indicators to measure ecological condition of rocky reef ecosystems in South Africa" was published in *Ecological Indicators*, with two others in progress. Other collaborative efforts included presenting part of my PhD data at the GeoHab Conference in Reunion through a partnership with the Geophysics Mapping Platform and the Council for Geoscience. Lastly, supported by NMU and NRF-SAIAB, I presented at the 11th Indo-Pacific Fish Conference and the Australian Society for Fish Biology, on "The contribution of fish data to the last decade of conservation planning in South Africa". I then spent time in Hamilton to establish an important research collaboration with the National Institute for Water and Atmospheric Research (NIWA). This collaboration aims to enhance the utility of South African BRUVs data for species distribution modelling and biodiversity assessments.

I received funding from the Scientific Council for Oceanic Research (SCOR) as a visiting research scholar, leading training workshops in Seychelles to promote improved marine monitoring and the application of stereo-BRUVs. Two four-day workshops were held over two weeks, training a total of 23 people spanning 10 organisations, including key NGOs; the Ministry of Agriculture, Climate Change and Environment; the University of Seychelles, and other private organisations.

Our latest SAIAB-BERI-UniSey joint Critical Ecosystem Partnership Fund (CEPF)-funded project kicked off in July 2023. By filling important knowledge gaps and building capacity to expand marine monitoring initiatives, this project aims to improve an understanding of the status and distribution of coral reefs and threatened species in selected Marine Protected Areas (MPAs), to improve MPA management. This project will also increase awareness and education that will support management by engaging with key stakeholders and civil society organisations. Under this project, a third capacity building workshop was held, mainly directed at students from UniSey, and others who were not able to attend previous workshops. Additionally, we had four international participants who travelled from Comoros (University of Comoros) and Kenya (Coastal Oceans Research and Development in the Indian Ocean - CORDIO), thus expanding our reach into other countries from WIO.

*Workshop participants learning how to identify fish and use the EventMeasure (SeaGIS) software that is used to analyse BRUVs videos.*

**MEASURES OF SUCCESS**

- Peer-reviewed publications: 1
- Conference presentations: 2
- Training workshops conducted: 3
- BRUVs fieldtrips: 2 (iSimangaliso Wetland Park, South Africa; Denis Island, Seychelles)

**Education and outreach activities:** 2 (1 presentation for the Mabibi community at the Mabibi Resource Hub (WildTrust); 1 presentation for the Sodwana Bay SCUBA diving community at Coral Divers)

**International workshop attended:** The International Seabed Authority (ISA), in collaboration with the Ministry of Earth Sciences and the National Institute of Ocean Technology of India, convened a workshop on the development of a regional environmental management plan (REMP) for the Area of the Indian Ocean, with a focus on the Mid-Ocean Ridges and Central Indian Ocean Basin, 1–5 May 2023, in Chennai, India.

**Networks/working groups:**

- The Interdisciplinary Early Career Network (IMECaN)
- The Network for Woman in Marine Sciences (WiMS)
- Global Change Emerging Researcher Network (GCERN)
- Collaborator on SCOR Working Group 164: CoNCENSUS

# Natural products in drug discovery – hunting for chemical biodiversity and antimicrobial activity in macrofauna endemic to South Africa

**PROF. ROSEMARY DORRINGTON**
*DSI/NRF SARChI PROFESSOR*
*MARINE NATURAL PRODCUTS RESEARCH - RHODES UNIVERSITY*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

*Report by Roxanne Leigh Higgitt*
*Research Manager MNP Research Group*

**TEAM MEMBERS**

Prof. Rosemary Dorrington, Roxanne Higgitt, Michelle Isaacs, Busi Goba, Dr Jarmo Kalinksi, Dr Tarryn Swart, Dr Idris Njanje, Dr Getahun Gurmessa, Dr Ross-Lynne Gibb, Luthando Madonsela, Dele Abdissa, Wakisa Kipandula, Gaberiella Solomons, Hugan West, Tumi Tsele, Asisipho Dloboyi, Lesedi Setsiba, Natasha Murape.

**Collaborations**

Prof. Mathew Upton – University of Plymouth, Prof. Rachel Sipler – Bigelow Laboratory for Ocean Sciences, Prof. Paul Race – Newcastle University, Dr Shirley Parker-Nance – NRF-SAEON, Prof. Tommy Bornman – NRF-SAEON, Prof. Mandi Lombard – NMU, Prof. Clint Veale – UCT, Prof. Marilize Le Roes-Hill – CPUT, Prof. Karin Jacobs – SU, Kerry McPhail – Oregon State University, Daniel Petras – University of Tübingen, Dr Xavier Siwe-Noundou – Sefako Makgatho Health Sciences University

The Marine Natural Products (MNPs) research group at Rhodes University explores the potential of bioactive small molecules as molecular probes for drug development across the broad field of marine biodiversity.

Research activities include mapping benthic macrofauna diversity in the Agulhas Bioregion; assembling taxonomically identified, curated collections of invertebrates, tunicates and their associated microbiota; generating and screening natural products extract libraries for antimicrobial, anticancer and antiviral activity, and developing multi-"omics" approaches to isolate novel bioactive MNPs.

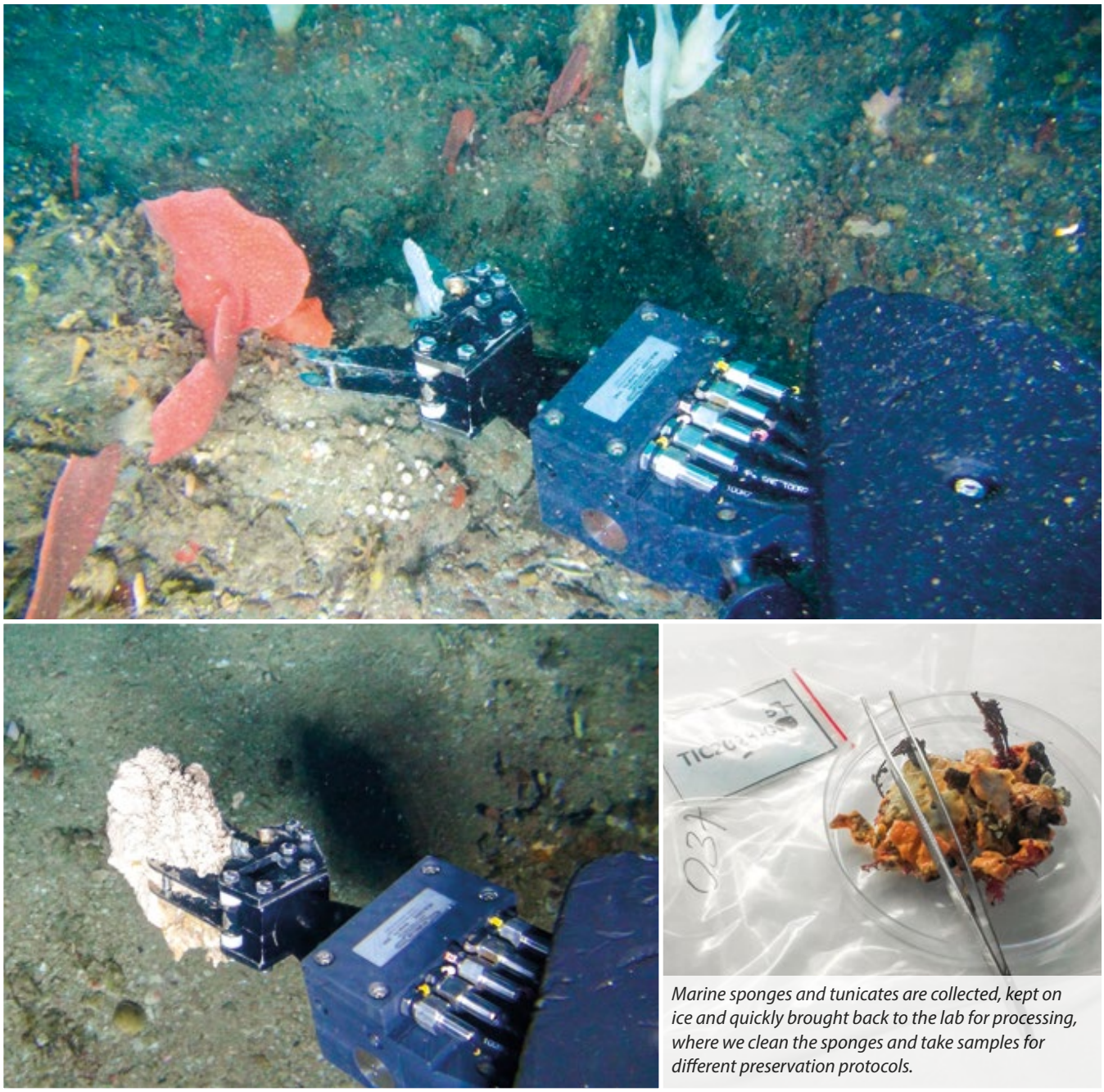
While the focus is on drug discovery, the team is also keen to understand how and why these bioactive secondary metabolites are produced, their response to a changing environment, and how to better understand ecosystem functioning. This is done through a systems approach, integrating genomics and metabolomics with physical and biological oceanography data to identify physical and biological drivers of aquatic ecosystem functioning.

Work done on a small subset of the ACEP collection provides compelling evidence that marine natural products from macrofauna endemic to the South African coastline are a rich source of new classes of antimicrobial compounds.

*Dr Idris Njanje, with Prof. Rosemary Dorrington, celebrates the award of his PhD at the RU Graduation 2023.*

In 2023, the Marine Natural Products research group celebrated the doctorate graduation of Idris Njanje. Dr Njanje's research addresses the critical need for new classes of antibiotics to combat drug-resistant infections. He focused on the antimicrobial potential of marine natural products, screening chemical extract libraries derived from indigenous marine sponges. His research resulted in the isolation of compounds with promising antibiotic activity that are now being further validated. Here Dr Njanje, with Prof. Rosemary Dorrington, celebrates the award of his PhD at the RU Graduation 2023.

Continuing to look for a novel source of new classes of antimicrobial compounds, the MNP team focused on developing an efficient biodiscovery pipeline to explore the chemical diversity of endemic macrofauna inhabiting the South African coastline. The discovery pipeline has been designed to derive maximum benefit from often limited biomass, enabling taxonomic identification and genomics analysis of the specimen and its associated microbiome, as well as bioactivity assessment and metabolomics analysis of small-scale chemical extracts. The bioassay platform provides *in vivo* screening for antimicrobial activity against selected bacterial pathogens and cytotoxicity to mammalian HeLa cells, as well as *in vitro* screening for inhibitors of three key enzymes established as potential drug targets. Metabolomic analysis provides an overview of the secondary metabolites present in the collected specimens, allowing dereplication of species, while highlighting variability of secondary



*Marine sponges and tunicates are collected, kept on ice and quickly brought back to the lab for processing, where we clean the sponges and take samples for different preservation protocols.*

metabolites produced by closely related species.

A total of 189 specimens representing 40 sponge, octocoral and ascidian families (with more than 25% of specimens likely as yet undescribed) were collected by remote-operated vehicle (ROV) at depths of 25–80 m off the South African coastline, the majority of which are endemic to Algoa Bay. An analysis of 16S rRNA gene metabarcoding data shows highly diverse microbial communities associated with the sponge specimens in the collection.

The overall antibacterial hit rate for screening crude chemical extracts of macrofauna specimens was 18.46%, of which the most hits were against *Staphylococcus aureus*, followed by *Acinetobacter baumannii*, *Escherichia coli* and *Pseudomonas aeruginosa*, and *in vitro* enzyme assays returned 22 extracts that inhibited key enzyme activities.

Molecular networking identified 12,456 LC-MS/MS features that were resolved into 917 clusters (i.e., compound classes) that could be correlated with biological activity, supporting the notion that chemical diversity correlates with the taxonomic diversity of the ACEP collection. We have prioritised five clusters with promising antimicrobial activity for future preparative work, which includes compounds belonging to four compound classes, namely bifunctional sphingolipids (sponge genus *Oceanapia*), variabilin furanosesterterpenes (sponge genera *Psammocinia* and *Sarcotragus*), topsentin bisindole alkaloids (sponge genus *Topsentia*), and pyrroloiminoquinones (sponge genus *Tsitsikamma*).

Future focus will be on re-collecting prioritised species with identified antimicrobial activity, as well as collecting specimens, conducting bioassays and collecting associated metabolomics data that will support further antimicrobial and other drug discovery efforts.

# Survey records possible new species and new geographical records for Mozambique

**PROF. PETER PSOMADAKIS**
*FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)*
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

Between 24 May and 24 June 2023, the EAF-Nansen Programme conducted a scientific cruise on the research vessel *Dr Fridtjof Nansen* to obtain data on fisheries resources, marine biodiversity, marine debris and microplastics, and oceanography of the exclusive economic zone (EEZ) of Mozambique.

The Nansen Mozambique cruise encompassed 120 stations from different subregions of Mozambique (86 in southern Mozambique, 31 in the central region, and three in the north) and recorded a total of 561 fish taxa, comprising 505 bony fishes, 28 elasmobranchs, 27 sharks and 1 chimaera.

Among the 561 fish taxa documented, there were several taxonomically relevant specimens, such as potential new species and new geographical records for Mozambique. The potential new species belong to both cartilaginous and bony fish genera and will be further examined for confirmation during a dedicated post-survey workshop planned by the EAF-Nansen Programme in 2024. This is scheduled to take place at NRF-SAIAB. The workshop aims to strengthen the capacity of scientists from the region to carry out taxonomic research and publish scientific articles as lead authors.

In addition, activities onboard resolved a long-standing taxonomic question regarding the identity of *Polysteganus* species occurring in Mozambique. Survey data showed that the dominant *Polysteganus* occurring along the southern and central Mozambique coast is *P. lineopunctatus* and not *P. coeruleopunctatus*, as previously assumed.


*Fish specimens after processing at MMNH. (Photo credit: Emile Ammann).*

**METRICS**
De Abreu, D., Sitoe, J., Pinto, A., & Psomadakis, P. 2023. Survey records possible new species and new geographical records for Mozambique, *WIOMSA Newsbrief* 33(3), 22–23, 2023

*Fish specimens collected for implementing the MMNH and NRF-SAIAB collections and for post-survey taxonomy studies. (Photo credit: FAO/EAF-Nansen Programme/PN Psomadakis).*

*Basic Taxonomy and Identification of Marine Fish and Macroinvertebrates workshop, held from 9-19 May 2023 at Eduardo Mondlane University, Maputo, Mozambique.*

*Peter delivering lectures.*

*Practical session in progress.*

*Showcasing of the* Coastal Fishes of the Western Indian Ocean.

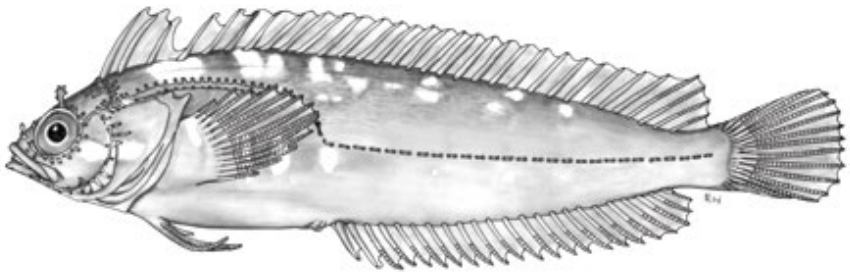
*Mozambique Nansen Survey, conducted from 24 May to 24 June 2023 - Peter taking a tissue sample from a stingray before releasing it back into the wild.*

# Diversity, interrelationships and distribution patterns of blennies and klipfish of the Western Indian Ocean: 20 years of exploration

**WOUTER HOLLEMAN**
*NRF-SAIAB HONORARY RESEARCH ASSOCIATE*

**COLLABORATIONS**
Station of Naturalists, Senckenberg Naturmuseum, Australian Museum; Kochi University

For over 20 years I have been involved primarily in exploring the diversity, interrelationships and distribution patterns of the Tripterygiidae (three-fin blennies) and Clinidae (klipfish) of the Western Indian Ocean.



Springeratus polyporatus *from Mauritius.*

Springeratus xanthosoma *from Bali.*

Springeratus halei *from Sri Lanka.*

**Tripterygiidae** – Work on this family has focused mainly on the species diversity in the Socotra Archipelago, in collaboration with Sergey Bogorodsky of the Station of Naturalists in Omsk, Russia, and Uwe Zajonz of the Senckenberg Naturmuseum in Frankfurt, Germany. Uwe Zajonz has carried out extensive work on the biogeography of the archipelago, and the study on the Tripterygiidae is to include a preliminary assessment of the biogeography of the family in the Western Indian Ocean. This would be the first study of the biogeography of species of this family to be done.

**Clinidae** – The Clinidae, with more than 40 species, is the most speciose family in South African waters, and all species are endemic. There are a further 30+ endemic species in south Australian waters. One genus, *Springeratus*, however, is widely distributed, with a species known from south-west India and Sri Lanka, another from Mauritius and Reunion, an undescribed species from New Caledonia and the coast of southern Queensland, and a fourth distributed from southern Japan, Taiwan, the Philippines and to Bali and the south coast of Java, from where it was originally described.

In 2013, Doug Hoese of the Australian Museum and I presented a preliminary assessment of the species of the genus *Springeratus* at the *9th Indo-Pacific Fish Conference* in Okinawa. The project was shelved as a result of my involvement in the compilation of the *Coastal Fishes of the Western Indian Ocean*, published at the end of 2022.

Distribution of some clinid species could be determined by ocean currents.

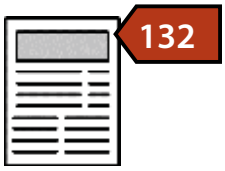
Indo-Pacific clinids are viviparous and the larvae have a very short pelagic tenure before settling into a benthic existence. There is evidence that, because of their short larval tenure, the distribution of some clinid species is determined by ocean currents, which is hypothesised for *Springeratus* species. This is to be explored in a paper currently in preparation, with Doug Hoese and Hiromitsu Endo of Kochi University in Japan.

# APPENDICES

*(Photo credit: Helen Walne)*

# APPENDIX A: NRF-SAIAB IN NUMBERS

## Science and Society



Scientific publications

Popular articles

Public presentations

Books

## Internationalisation


Conferences

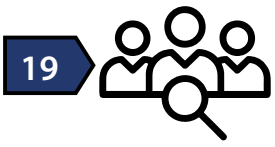

Collaborations
(from submitted reports)


Agreements

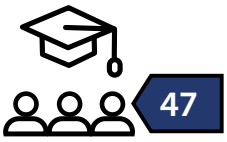
| | | | |
|---|---|---|---|
| Local | 22 | 51 | 73 |
| Global | 12 | 69 | 10 |

## Human Capital

Employees

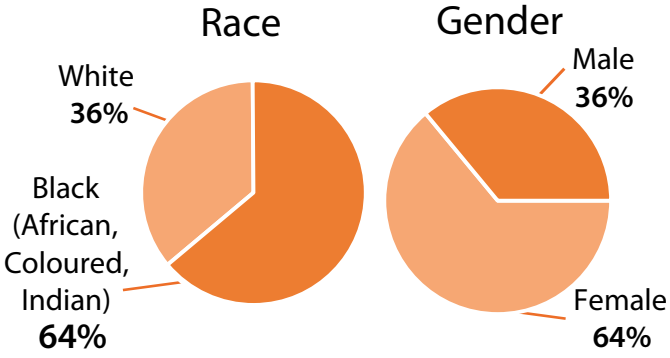


Researchers

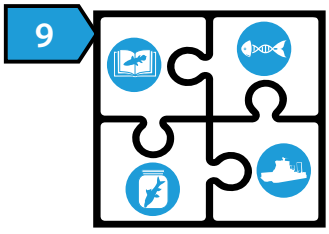


Students

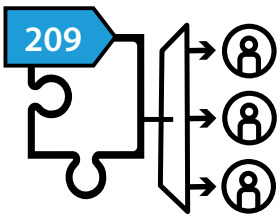
## Student demographics




## Platforms



Platforms



Platform users

## Social Media

X followers
(Previously
Twitter)

Instagram
followers

Facebook followers

Website users

YouTube
subscribers

# APPENDIX B: NRF-SAIAB RESEARCH OUTPUTS 2023

## Thomson Reuters Web of Science Index (formerly ISI) Publications by NRF-SAIAB Scientists, Honorary Research Associates and Postgraduate Students


Abwe, E., Snoeks, J., Manda, B.K., Mutambala, P.K., Kalumba, L.N., Bragança, P.H.N., Kipanga, K., Mulelenu, C.M., Kasongo, M., Kayaba, M.K.I., Manda, A.C. & Vreven, E J.W.M.N. 2023. *Checklist of the Fishes of the Kundelungu National Park (Upper Congo Basin, DR Congo): Species Diversity and Endemicity of a Poorly Known Ichthyofauna.* Diversity-Basel 15(2), 259–296

Albano, P.S., Fallows, C., Fallows, M., Williams, L.H., Murray, T., Sedgwick, O. & Hammerschlag, N. 2023. Acoustic tracking of a threatened juvenile shark species, the smooth hammerhead (Sphyrna zygaena), reveals vulnerability to exploitation at the boundary of a marine reserve. *Frontiers in Marine Science* 10, DOI: 10.3389/fmars.2023.1082049

Ayob, N., Burger, R.P., Belelie, M.D., Nkosi, N.C., Havenga, H., de Necker, L. & Cilliers, DP. 2023. Modelling the historical distribution of schistosomiasis-transmitting snails in South Africa using ecological niche models. *PLoS One* 18(11), art. no. e0295149

Baptista, N.L., Pinto, P.V., Keates, C., Lobón-Rovira, J., Edwards, S. & Rödel, M-O. 2023. Two new *Poyntonophrynus* species (Anura: Bufonidae) highlight the importance of Angolan centers of endemism. *Vertebrate Zoology* 73, 991–1031

Barletta, M., Melo, R.C.B. & Whitfield, A.K. 2023. Past and present conservation of South American estuaries. *Estuarine Coastal and Shelf Science* 295, art.no. 108542.

Bernt, M.J., Neto, D.D., Swartz, E. & Stiassny, M.L.J. 2023. Rediscovery and range extension for *Platyclarias machadoi* Poll, 1977 (Siluriformes, Clariidae) in the Kwanza River, Angola. *Check List* 19(4), 541–548

Bowlby, H.D., Dicken, M.L., Towner, A.V., Waries, S. Rogers, T. & Kock, A. 2023. Decline or shifting distribution? A first regional trend assessment for white sharks *(Carcharodon carcharias)* in South Africa. *Ecological Indicators* 154, DOI: 10.1016/jecolind.2023.110720

Campos, D.S., Oliveira, R.F., de Oliveira Viera, L., Bragança, P. Nunes, J., Guimarães, E.C. & Ottoni, F.P. 2023. Revisiting the debate: documenting biodiversity in the age of digital and artificially generated images. *Web Ecology*, 23, 135–144, https://DOI.org/10.5194/we-23-135-2023

Cerrilla, C., Flemming, L., Griffiths, C., Impson, D., Jordaan, M. Kajee, M., Paxton, B., van der Walt, J.A.,Whitehead, T.O. & Shelton, J.M. 2023. Using a head-start conservation intervention to boost spawning numbers of the endangered Clanwilliam sandfish. *Conservation Science and Practice* 6(1), DOI:10.1111/csp2.13065

Chakandinakira, A.T., Madzivanzira, T.C., Mashonga, S., Muzvondiwa, J.V., Ndlovu, N. & South, J. 2023. Socioeconomic impacts of Australian redclaw crayfish, *Cherax quadricarinatus*, in Lake Kariba. *Biological Invasions* 25(9), 2801–2812

Claassens, L., Phillips, B., Ebert, D., Delaney, D., Henning, B., Nestor, V., Ililau, A. & Giddens, J. 2023. First records of the Pacific sleeper shark, *Somniosus* cf. *pacificus* in the western tropical Pacific. *Journal of Fish Biology* 103(5), 1214–1220

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Cottrant, E., Drobniewska, N.J.,Johnson, T., Underhill, L.G., Murray, T.S., Hammerschlag, N., Albano, P., Elston, C., McCord, M., Cowley, P., Fallows, C. & Paulet, T.G. 2023. Network analysis of the endemic spotted gully shark *Triakis megalopterus* reveals spatial vulnerability to exploitation in the Western Cape, South Africa. *African Journal of Marine Science* 45(4), DOI:10.2989/1814232X.2023.2271959

Daly, R., Venables, S.K., Rogers, T., Filmalter, J.D., Hempson, T.N., Murray, T.S., Hussey, N.E., Marques da Silva, I., Pereira, M.A.M, Mann, B.Q. , Nharreluga, B.A.S. & Cowley, P.D. 2023. Persistent transboundary movements of threatened sharks highlight the importance of cooperative management for effective conservation. *Marine Ecology Progress Series* 720: 117–131

Day, J.J., Steell, E.M., Vigliotta, T.R., Withey, L.A., Bills, R., Friel, J.P., Genner, M.J. & Stiassny, M.L.J. 2023. Exceptional levels of species discovery ameliorate inferences of the biogeography and diversification of an Afrotropical catfish family. *Molecular Phylogenetics and Evolution* 182, DOI: 10.1016/j.ympev.2023.107754

de Bragança, P.H.N., van der Zee, J., Lobel, P.S. & Schliewen, U. 2023. Osteology and redescription of the miniature lampeye species of *Congopanchax* Poll, 1971 with an overview of miniature African freshwater fishes. *Spixiana* 46(1), 91–118

De Lange, F., Netherlands, E.C. & Du Preez, L.H. 2023. Call repertoire of *Ptychadena uzungwensis* (Anura: Ptychadenidae) to complement molecular and morphological identification of the species from the Soutpansberg, South Africa. *African Journal of Herpetology* 72(1), 33–46

de Necker, L., Dyamond, K., Greenfield, R., van Vuren, J. & Malherbe, W. 2023. Aquatic invertebrate community structure and functions within a Ramsar wetland of a premier conservation area in South Africa. *Ecological Indicators* 148(4), DOI: 10.1016/j.ecolind.2023.110135

Devloo-Delva, F., Burridge, C.P., (Daly, R.), Feutry, P. 2023. From rivers to ocean basins: The role of ocean barriers and philopatry in the genetic structuring of a cosmopolitan coastal predator. *Ecology and Evolution* 13(2), DOI: 10.1002/ece3.9837

Dixon, R.B., Murray, T.S., Mann, B.Q., Cowley, P.D. & Jordaan, G.L. 2023. Movement patterns of the iconic giant trevally, *Caranx ignobilis*, from southern Africa, determined using tag-recapture data. *Fisheries Research* 263, DOI: 10.1016/j.fisheries.2023.106693

Ebert, D.A., Garcias, A.C., Fahmi, Pestana, A.G., Hernandez, S., Leurs, G. & Simeon, B.M. 2023. Searching for lost sharks: extinct or alive? *Oryx* 57(4), 419–420

Elston, C., Murray, T.S., Parkinson, M., Filmalter, J.D. & Cowley, P.D. 2023. Female Diamond Rays, *Gymnura natalensis*, and Bull Rays, *Aetomylaeus bovinus*, Display Seasonal Philopatry to South African Estuaries. *Estuaries and Coasts* 46 (7), 1880–1894

Emami-Khoyi, A., Jooste, C.M., Wasserman, R.J., Dalu, T., Raath-Krüger, M.J., Jansen van Vuuren, B. & Teske, P.R. 2023. Persistent effects of historical sea levels on the population structure of a temporary wetland copepod. *Freshwater Biology* 68(8), 1442–1452

Faure-Beaulieu, N., Lombard, A.T., (Daly, R.), (Kock, A., Mann, B.Q.,

Murray, T.S.), (Gennari, E.), (Bernard, A.T.F., Cowley, P.D.), (Elston, C.) & Harris, J. 2023. A systematic conservation plan identifying critical areas for improved chondrichthyan protection in South Africa. *Biological Conservation* 284, DOI: 10.1016/j.biocon.2023.110163

Ferreira, J.A., Alberts, J.A., Smith, G., Bernard, A.T.F., Pereira, M.J. & De Vos, L. 2023. Seasonal changes characterise the shark and ray assemblages in a subtropical shallow sandy habitat in the iSimangaliso Wetland Park, South Africa. *PeerJ* DOI:10.7717/peerj15636

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Gon, O., Maclaine, J., Collins, M.A., Matcher, G. & Pogonoski, J.J. 2023. The type series of *Poromitra crassiceps* (Pisces, Melamphaidae) with lectotype designation. *Zootaxa* 5389(4), DOI: https://doi.org/10.11646/zootaxa.5389.4.5

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Holmes, M., Campbell, E.E., Taylor, J.C. & de Wit, M. 2023. Analysis of freshwater diatom deformities in the Karoo, South Africa. *African Journal of Aquatic Science* 48(4), 374-392

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Kajee, M., Henry, D.A.W., Dallas, H., Griffiths, C.L., Pegg, J., van der Colff, D., Impson, D., Chakona, A., Raimondo, D., Job, N., Paxton, B., Jordaan, M., Bills, I.R., Roux, F., Zengeya, T., Hoffman, A., Rovers-Moore, N.A. & Shelton, J.M. 2023. How the Freshwater Biodiversity Information System (FBIS) is supporting national freshwater fish conservation decisions in South Africa. *Frontiers in Environmental Science* 11, DOI:10.3389/fenvs.2023.1122223

Kalumba, L.N., Abwe, E., Schedel, F.D.B., Manda, A.C., Schliwen, U.K. & Vreven, E.J.W.M.N. 2023. Two New Shellear Species (Gonorhynchiformes: Kneriidae), from the Luansa River (Upper Congo Basin): Hidden Diversity Revealed by Integrative Taxonomy. *Diversity* DOI:10.3390/d15101044

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Klein, J.D., Maduna, S.N., Dicken, M.L., da Silva, C., Soekoe, M., McCord, M.E., Potts, W.M., Hagen, S.B. & Bester-van der Merwe, A.E. 2023. Local adaptation with gene flow in a highly dispersive shark. *Evolutionary Applications* 17(1), art. no. e13628

Kock, A., Glanville, H.C., Law, A.C., Stanton, T., Carter, L.J. & Taylor, J.C. 2023. Emerging challenges of the impacts of pharmaceuticals on aquatic ecosystems: A diatom perspective. *Science of the Total Environment* 878, DOI: 10.1016/j.scitotenv.2023.162939

Kock, A., Pheiffer, W., Wepener, V., Smit, N.J. & Taylor, J.C. 2022. Using Confocal Microscopy and Pigment Analyses to Detect Adverse Insecticide Effects in non-target Freshwater Diatom species-a proof-of-concept Using *Nitzschia palea*. *Bulletin of Environmental Contamination and Toxicology* 110 (6), DOI: 10.1007/s00128-023-03741-5

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Lubitz, N., Daly, R., Filmalter, J.D., Sheaves, M., Cowley, P.D., Naesje, T.F. & Barnett, A. 2023. Context drives movement patterns in a mobile marine predator. *Movement Ecology* 11(1), DOI: 10.1186/s40462-023-00390-5

Lynch, A.J., Cooke, S.J., (Tweddle, D.), & Jähnig, S.C. 2023. People need freshwater biodiversity. *Wiley Interdisciplinary Reviews – Water* 10(3), DOI: 10.1002/wat2.1633

Madzivanzira, T.C., Chakandinakira, A.T., Mungenge, C.P., O'Brien, G.C., Dalu, T. & South, J. 2023. Get it before it gets to my catch: misdirection traps to mitigate against socioeconomic impacts associated with crayfish invasion. *Management of Biological Invasions* 14(1), DOI:10.3391/mbi.2023.14.2.10

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Truter, M., Erasmus, A., Malherbe, K., Smit, N. J. 2023. A REFRESHing journey to update knowledge on aquatic parasite species in South Africa. *NWU ENVIRA Newsletter*, Autumn Edition, p. 22–23, https://natural-sciences.nwu.ac.za/sites/natural-sciences.nwu.ac.za/files/files/uesm/ENVIRA/Autumn2023/ENVIRA-Autumn-Edition-2023.pdf

Truter, M., Erasmus, A., Malherbe, K., Smit, N. J. 2023. A REFRESHing journey to update knowledge on aquatic parasite species in South Africa. SAIAB News & Events, A REFRESHing journey to update knowledge on aquatic parasite species in South Africa – South African Institute for Aquatic Biodiversity (saiab.ac.za)

Truter, M. 2023. Accolades: Water Research Group students – cleaning cupboard at SASAqS student Awards. *NWU UESM ENVIRA Quarterly Newsletter* (Spring Edition, p. 11), ENVIRA_Spring_Edition_2023.pdf (nwu.ac.za)

Truter, M. 2023. News Flash – Research Articles: In Action – Conservation Plan for Parasites! *NWU UESM ENVIRA Quarterly Newsletter* (Spring Edition, p. 33–34), ENVIRA_Spring_Edition_2023.pdf (nwu.ac.za)

Truter, M. 2023. Reflection: 9th International Symposium on Monogenea. *NWU UESM ENVIRA Quarterly Newsletter* (Summer edition, p. 31)

Wanda, T. and Dlamini, L. 2023. Quarterly featured research article: Highlighting the value of using multibeam bathymetry in marine spatial planning within the uThukela Banks Marine Protected Area, South Africa. November 2023

## ENGAGED RESEARCH VIDEO PRODUCTIONS

NRF-SAIAB celebrates Youth Day: Enya Munting: https://www.youtube.com/watch?v=2385oTFAI3Q&ab_channel=SouthAfricanInstituteforAquaticBiodiversity

NRF-SAIAB celebrates Youth Day: Matsobane Malebatja: https://www.youtube.com/watch?v=on8vka3-2mc&ab_channel=SouthAfricanInstituteforAquaticBiodiversity

NRF-SAIAB celebrates Youth Day: Dr Nokubonga Mbandzi: https://www.youtube.com/watch?v=3chIZpcksEo&ab_channel=SouthAfricanInstituteforAquaticBiodiversity

NRF-SAIAB celebrates Youth Day: Xiluva Mathebula: https://www.youtube.com/watch?v=ng7K6Q4Krgk&ab_channel=SouthAfricanInstituteforAquaticBiodiversity

NRF-SAIAB celebrates Youth Day: Nobuhle Mpanza: https://www.youtube.com/watch?v=6ivKC8f9wrE&t=7s&ab_channel=SouthAfricanInstituteforAquaticBiodiversity

Introduction to Aquaponics: https://www.youtube.com/watch?v=hXJRx7ypqxs&ab_channel=SouthAfricanInstituteforAquaticBiodiversity

Summer School 2023: Siyamthanda Ndinisa: https://www.youtube.com/watch?v=dxBHwz3LgcM&t=6s&ab_channel=SouthAfricanInstituteforAquaticBiodiversity

## REELS/ SHORT VIDEO FORMATS

NRF-SAIAB, in collaboration with the Royal Alfred Marina, hosted 20 high school learners from Port Alfred https://www.instagram.com/reel/Cw0IqDcqxjs/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA

Smith Memorial https://www.facebook.com/reel/971362810621106

Graduation Reel https://www.facebook.com/reel/1009480953637899

Student Symposium https://www.facebook.com/reel/1560229424382005

Summer School 1st Reel https://www.facebook.com/reel/804430928117958

Summer School 2nd Reel https://www.facebook.com/reel/320121920884420

IMIsEE Sound Postcard Launch https://www.facebook.com/reel/1373199889973296

Working World Exhibition https://www.facebook.com/reel/7077350315654144

## CONFERENCE AND SYMPOSIUM PRESENTATIONS

Dube T., Bernard A., De Vos L., Harris J., 2023. `Building the foundation for efficient monitoring of the mesophotic reef fishes to support management of the uThukela Banks marine protected area', paper presented at the *Conservation Symposium, Biodiversity Economy:* WildCoast Sun, Port Edward, 05-10 November 2023

Dube T., Bernard A., De Vos L., 2023. `Building the foundation for efficient monitoring of the mesophotic reef fishes to support management of the uThukela Banks marine protected area', paper presented at the *Graduate Student Network SAEON Indibano Conference, Mountain meets seas: Exploring environmental Interactions*, Cape Town, 22-27 October 2023

Edworthy, C., James, NC. 2023. 'Monitoring pH variability in important coastal habitats in South Africa: implications for coastal nurseries and associated species'. *OA Week 2023*, online symposium. November 2023

Edworthy, C., James, N.C., Potts, W.M. & Dupont, S. 2023. 'Combining monitoring and eco-physiology to understand the response of a coastal fish to ocean acidification'. *Fisheries Society of the British Isles (FSBI) symposium*, Colchester, United Kingdom. July 2023

Edworthy, C., Potts, W.M., Dupont, S., Duncan, M.I., Bornman, T.G. & James, N.C. 2023. 'A baseline assessment of coastal pH variability in South Africa and insights for future ocean acidification research'. *5th National Global Change Conference.* January 2023

Elston, C., Murray, T., Parkinson, M., Filmalter, J.D., Cowley, P.D. 2023. 'From small fry to the big leagues: a national telemetry array

reveals novel fine- and large-scale insights into the movements of rays'. *International Conference on Fish Telemetry*. June 2023

Elston, C., Murray, T., Parkinson, M., Cowley, P.D. 2023. 'Rays in South African estuaries: a separate ecotype?' *South African Shark and Ray Symposium*. October 2023

Elston, C., Murray, T. 2023. 'The Keurbooms Estuary: a potential nursery for juvenile common eagle rays Myliobatis aquila'. *South African Shark and Ray Symposium*. October 2023

Erasmus, A., Truter, M., Malherbe, W., Smit, N.J., Hadfield, K.A. 2023. 'Proposing a user-friendly parasite database for collections'. *South African Society of Aquatic Scientists conference*. Lord Charles Hotel, Somerset West. 25–29 June 2023.

Fikiye, P.P., Smit, N.J., Van As, L.L., Truter, M., Hadfield, K.A. 2023. 'First integrated taxonomy study for characterization of gill copepod *Ergasilus mirabilis* Oldewage & Van As, 1987 (Ergasilidae: Cyclopoid)'. *51st Parasitological Society of Southern Africa Annual Conference*, Muldersdrift, 17–20 September 2023.

Gallop, J., Truter, M., Smit, N.J. 2023. 'Exploring helminth parasitic diversity in South African estuarine fish: a case study of the full moony, *Monodactylus falciformis* Lacépède, 1801'. *51st Parasitological Society of Southern Africa Annual Conference*, Muldersdrift, 17–20 September 2023

Gibb, R.A., de Vos, D.K.L, Venkatachalam, S., Bizani, M., Bornman, T.G. & Dorrington, R.A. 2023. 'Microbial community variability in the Agulhas Current system; a snapshot study'. *Phycological Society of South Africa* (PSSA)

Glass, J.R., Belle, K., Berke, G., Bodin, N., Burt, A.J., Duncan, M.I., Morgan, S.K., Pillay, P. and Talma, S. 2023. Evaluating the feasibility of sustainable seafood labelling programmes in Small Island Developing States: a pilot study in Seychelles. *11th Indo-Pacific Fish Conference*. Auckland, New Zealand.

James, N.C., Jacobs, A., Gayiza, M., Pollard, M., Human, L., Rishworth, G., Steyn, P-P., Bernard, A., Childs, A-R, Murray, T. 2023. 'Nursery role of red algae dominated reef in temperate Algoa Bay, South Africa'. *Fisheries Society of the British Isles 2023 Annual Symposium*. 24–28 July 2023, University of Essex, UK.

Le Roux, C., Cook, C., Netherlands, E.C., Truter, M., Smit, N.J. 2023. 'Molecular and morphological characterisation of four species of fish parasitic *Trypanosoma* Gruby, 143 from the South Coast of South Africa'. *51st Annual meeting of the Parasitological Society of Southern Africa,* 17–20 September 2023, Muldersdrift, South Africa

Le Roux, C., Courtney, C., Netherlands, E., Truter, M., Smit, N.J. 2023. 'Molecular and morphological characterization of four species of fish parasitic Trypanosoma Gruby, 1843 from the South Coast of South Africa'. *51st Parasitological Society of Southern Africa Annual Conference*, Muldersdrift, 17–20 September 2023

Le Roux, M.H., Smit, N.J. & L. de Necker. 2023. 'The distribution of aquatic molluscs and associated trematodes within the Limpopo Lowveld ecoregion, South Africa'. *South African Society of Aquatic Scientists Conference*. Lord Charles Hotel, Somerset West. 25–29 June 2023

Le Roux, C., Truter, M., Smit, N.J., Cook, C. 2023. 'Morphological and molecular characterization of four new species of Trypanosoma from fishes of the south coast of South Africa'. *5th Annual SAIAB Student Symposium*, Makhanda, South Africa, 24 November 2023

Magoro M.L., Paterson A.W., Mofu L., Bragança P.H.N., Bills I.R., James N.P.E., Woodford D.J., Kadye W.T., Nelukalo K., Khosa D., Hoffman A., Rodgers S.M., Petersen R.M., Manyama P., Rahlao S.J., Pereira V., van der Waal B.C.W., Chakona A. 2023. 'The current distribution of non-native Nile tilapia Oreochromis niloticus (Linnaeus 1758) in the Limpopo and Mpumalanga Provinces: Implications for the conservation of native Mozambique tilapia *O. mossambicus* (Peters 1852)'. *Southern African Society of Aquatic Scientists*, Somerset West, South Africa

Malebatja, M.B., Bernard, A.T.F., Nyawo, M.A.J. (2023). 'Using Fisheries Independent Data from MPAs To Support Effective Management of Threatened Fish Species'. *The Conservation Symposium 2023: Natural Resource Management: Protected Area Management And Effectiveness*, Port Edward, Eastern Cape, South Africa

Masilo, T., Hadfield, K.A., Luus-Powell, W.J., Smit, W.J., Smit, N.J., Truter, M. 2023. 'A first insight into the application of the historical ecology of parasitism on the parasitological communities of *Labeobarbus marequensis* in the Letaba River, South Africa'. *51st Annual meeting of the Parasitological Society of Southern Africa*, 17–20 September 2023, Muldersdrift, South Africa

Masilo, T., Truter, M., Smit, N.J., Hadfield, K.A. 2023. 'A first insight into the parasitic communities of Labeobarbus marequensis within the Letaba River, in South Africa: a baseline to determine the historical ecology of parasitism'. *5th Annual SAIAB Student Symposium*, Makhanda, South Africa, 24 November 2023

Munting, E.M, Bernard, A.T.F., Cockburn, J., & Mann, B. Q. 2023. 'The multidimensional impacts of Marine Protected Areas in KwaZulu-Natal on the Commercial Linefishing Sector'. *The Conservation Symposium*, South Africa.

Murray, T.S., Elston, C., Parkinson, M.C., Cowley, P.D. & Daly, R. 2023. 'Do Marine Protected Areas really protect mobile aquatic animals?' *6th International Conference on Fish Telemetry*, Sète, France. June 2023

Porri, F., Pattrick, P., Human, L., McConnachie, B., Puccinelli, E., Betani, V., Howse, M., Mvubu, C., Cotiyane-Pondo, P., Ndaba, J., Dyantyi, S., Mpanza,N., Mxo, V.R., Mbandzi, N., Moyo, V., Mathebula, P., Dlamini, L., Ncapai, L., Tyekela, S., Riddin, T., Adams, J.B., van der Walt, K-A., Wynberg, R. 2023. 'Changing narratives for sustainable solutions in coastal ecological engineering: a transdisciplinary partnership through science, arts, indigenous knowledge and industry'. Darwin, Australia, 26–30 September 2023

Přikrylová, I., Truter, M., Smit, N.J., Kičinjaová, M.L., Raphahlelo, M.E., Luus-Powell, W.J. 2023. 'Decade of exploration: Extraordinary and ordinary findings in the diversity of monogenean parasites of freshwater fishes in South Africa'. *40th Zoological Society of Southern Africa Biennial Conference*, Champagne Sports Resort, 25–29 September 2023

Sithole, Y., Muscschoot, T, Huyghe, S., Chakona, A., Vreven, E. 2023. 'A new species of *Paraucheonoglanis* (Siluriformes: Auchenoglanididae) from the Upper Lualaba River (Upper Congo), with further evidence of hidden species diversity within the genu's'. *21st International FishBase and SeaLifeBase Symposium*, Belgium (Online), September 2023

Sithole, Y., Vreven, E.J.W.M.N., Bragança, P., Musschoot, T., Chakona, A. 2023. 'Nine species in one: Molecular and morphological evidence of hidden species diversity in the Zambezi grunter (Siluriformes, Auchenoglanididae) in southern and south-central Africa'. *Southern African Society of Aquatic Scientists Congress* (SASAqS), Somerset West, June 2023

Sithole, Y., Vreven, E.J.W.M.N., Bragança, P., Musschoot, T., Chakona, A. 2023. 'Uncovering hidden diversity within *Parauchenoglanis* (Siluriformes, Auchenoglanididae) in central and southern Africa

with description of ten new species'. *7th Pan-African Fish and Fisheries Association*, Congo. September 2023

Smit, K.S., Bernard, A.T.F., Harris, J., Lombard, A.T., Palmer, R., Sink, S. & Haupt, P. 2023. 'The contribution of fish data to the last decade of conservation planning in South Africa'. *Indo-Pacific Fish Conference and the Australian Society for Fish Biology*, 20–24 November 2023, Auckland, New Zealand

Truter, M., Hadfield, K.A., Chakona, A. & Smit, N.J. 2023. 'A first for parasite conservation in South Africa: The case of threatened freshwater fishes in the Cape Fold Region'. *British Society for Parasitology Spring Meeting,* Edinburgh, Scotland from 11–14 April 2023

Truter, M., Přikrylová, I., Hadfield, K.A., Chakona, A., Smit, N.J. 2023. 'Parasite Conservation: A first application to threatened freshwater fishes in the Cape Fold ecoregion, South Africa'. *SASAqS Annual Conference*, Lord Charles Hotel, Somerset West, 25–28 June 2023

Truter, M., Přikrylová, I., Smit, N.J. 2023. 'Novel species and records of monogeneans parasites on the gills of three threatened cyprinids from the Cape Fold Ecoregion, South Africa'. *9th International Symposium on Monogenea*, Lucknow, India, 8–11 October 2023

van der Walt, K., Reddy, S., Pattrick, P. & Porri, F. 2023. 'Tiny titans? Evaluating resiliency and functional connectivity of early life stages of Brachyuran species within a southern African urban coastal system in a changing climate'. *International Symposium on Human Impacts on Marine Functional Connectivity* (SEA-UNICORN, ICES, CIEM), Sesimbra, Portugal. May 2023

Van Wyk, A.J., Bernard, A.T.F., & Lombard, A.T. 2023. 'Understanding the interoperability and complementarity of disparate fish visual census techniques and optimising data value for stakeholders'. *The Conservation Symposium*, South Africa.

### SEMINAR AND WORKSHOP PRESENTATIONS

Bernard, A.TF. 2023. 'Advancing the underwater visual census field of research to address multiscale sustainability challenges' (Presenter in the *Global challenges to local solutions panel at the Sustainability, Research and Innovation 2023* – Africa Satellite Event; Gqeberha, 20-22 June 2023)

Bernard, A.T.F. 2023. Presented on the SAIAB protocols for BRUVs and stereo-BRUVs research and data management. *SANParks Biodiversity data management workshop*. Tokai, Cape Town, 17 October 2023

Bernard, A.T.F. 2023. Presented on the SAIAB biodiversity data management protocols and biological indicators useful for MPA reporting. *SANParks Biodiversity data management workshop.* Tokai, Cape Town, 18 October 2023

Bernard, A.T.F. 2023. 'Deep sea research in South Africa'. Guest Lecture, Rhodes University, *Zoology 302 Marine Biology*. September 2023

de Necker, L. 2023. 'Schistosomiasis distribution and what people know: A South African perspective'. *Seminar for KU Leuven staff and students.* KU Leuven, Leuven, Belgium. 16 June 2023

Elston, C. 2023. 'Citizen science for shark conservation: ELMO Africa'. *Seminar for IOI-SA Ocean Academy Programme hosted by the Two Oceans Aquarium Foundation*. 16 November 2023

James, N.C. 2023. 'Climate Change effects on estuaries and associated fish'. *Management of estuaries in South Africa*. 14–18 August, Nelson Mandela University

James, N.C. 2023. 'Research at the South African Institute for Aquatic Biodiversity'. *Chinese (BRICS) and Nelson Mandela University ministerial science meeting* August 2023

Mbandzi, N. & van der Walt, K-A. 2023. 'Scientific Writing'. *Workshop, SAIAB*, Makhanda, 02–04 August 2023

Porri, F. 2023. 'Global challenges to local solutions: how FAIR data, transdisciplinarity and innovation are sustainably shaping the marine research, management, communities and narratives of South Africa'. Convenor of the panel at the *Sustainability, Research and Innovation 2023 – Africa Satellite Event*; Gqeberha, 20-22 June 2023)

### PUBLIC PRESENTATIONS

Ebert, D. 2023. 'Searching for lost sharks'. *SAIAB Seminar Series*, Makhanda. 2 November 2023

Elston, C. 2023.' Stingrays of the Garden Route'. *Plett Ocean Festival*. July 2023

Gon, O. 2023. 'The South African SIB Expedition to Antarctica'. *Probis Club*, Makhanda. 6 June 2023

James, N.C. 2023. 'Climate Change effects on estuaries and associated fish'. *Cape Nature Western Cape Estuaries Management Task team*. 27 November 2023, Online

Mbandzi, N. 2023. 'Using bioindicator organisms to understand chemical pollution in intertidal systems'. *SAIAB Seminar Series*, Makhanda. 8 June 2023

Mbandzi, N. 2023. 'Blue Flag Environmental Awareness and Education Programme'. *Royal Port Alfred*. 5 September 2023

Mpanza, N. 2023. 'REHAB FOR SHORES: Enhancing coastal functionality and biodiversity through nature-based solutions'. *Victoria Girls High School*. 27 July 2023

Murray, T.S. 2023. 'Do Marine Protected Areas really project mobile aquatic animals?' *SAIAB Seminar Series*, Makhanda. 13 July 2023

Murray, T.S. 'Unlocking the secret movements of aquatic animals using the ATAP'. *Unlocking Nature series, Leadership for Conservation in Africa*. 17 August 2023

Murray, T. 2023. 'Benchmarking knowledge-based adaptive management of estuarine fisheries in South Africa for sustainable development'. *SAIAB Seminar Series*, Makhanda. 19 October 2023

Truter, M., Yong, R.Q. 2023. 'Parasites of Fish'. *NWU Water Research Group Fish Day Outreach.* Lekwena Wildlife Estate, Potchefstroom, 26 August 2023

Welch, RJ. 2023. 'Life after Leeds'. Leeds University. May 2023

van der Walt, K. 2023. 'Tiny Titans? Evaluating the resiliency and functional connectivity of Brachyuran early life stages within a southern African urban coastal system in a changing climate'. *SAIAB Seminar Series*. 2 August 2023

# APPENDIX C: NRF-SAIAB RESEARCH DIVISION 2023

## RESEARCH AND MANAGEMENT STAFF 2023

| NAME | POSITION |
|---|---|
| Dr A.W. Paterson, PhD (Rhodes University) | Managing Director; Acting NRF-DCEO |
| Prof. P.D. Cowley, PhD (Rhodes University) | Principal Scientist |
| Prof. A. Chakona, PhD (Rhodes University) | Chief Scientist; Acting NRF-SAIAB MD |
| Prof. N.C. James, PhD (Rhodes University) | Senior Scientist |
| Prof. F. Porri, PhD (Rhodes University) | Senior Scientist |
| Dr A.T.F. Bernard, PhD (Rhodes University) | Instrument Scientist |
| Dr G Matcher, PhD (Rhodes University) | AGRP Instrument Scientist |
| Dr T.S. Murray PhD (Rhodes University) | ATAP Instrument Scientist |
| Dr E.A. Wiles, PhD (University of KwaZulu-Natal) | Geophysics Instrument Scientist |
| Dr M. Magoro, PhD (Rhodes University) | Instrument Scientist, Freshwater Field Ecologist |
| Dr L. Mofu, PhD (Rhodes University) | Instrument Scientist, Freshwater Field & Lab Ecologist |
| Dr W. Coetzer, PhD (University of KwaZulu-Natal) | Biodiversity Information Manager |
| Mr I.R. Bills, MSc (Rhodes University) | Senior Curator |
| Mr D.N. Mazungula, MSc (Rhodes University) | Collections Manager |
| Ms S. Reddy, MSc (Rhodes University) | Ecophysiology Laboratory Co-ordinator |
| Mr R. Palmer, MSc (Rhodes University) | ACEP Technical & Scientific Manager |
| Mr T. Eriksen, BSc (UNISA) | ACEP Marine Technician |
| Mr K. Smith | ACEP Marine Technician |
| Mr M. Parkinson PhD (Rhodes University) | ATAP Instrument Technician |
| Mr F. Jacobs | Marine Field Assistant |
| Mr T. Mbuyazi | Coastal Craft Deckhand |
| Mr Lishini Kokose | General Assistant |
| Mrs V.T.J. Rouhani, MSc (Rhodes University) | Research Support Administrator |

## POSTDOCTORAL SCIENTISTS

| NAME | PRIMARY STUDY AREA | INSTITUTE COLLABORATOR |
|---|---|---|
| Dr P. de Bragança | Freshwater taxonomy | Prof. A. Chakona |
| Dr L. de Necker | Freshwater ecology | Prof. A. Chakona |
| Dr C. Edworthy | Ecology, eco-physiology, climate change | Prof. N. James |
| Dr C. Elston | Fish movement studies | Dr T. Murray |
| Dr R-L. Gibb | Algal bloom studies in estuarine ecosystems | Dr G. Matcher |
| Dr N. Mbandzi | Coastal ecology | Prof. F. Porri |
| Dr P. Ndaleni | Ecology | R. Bills |
| Dr P. Nodo | Coastal and estuarine ecology | Prof. N. James |
| Dr F. Phaka | Conservation and ecology (frogs, reptiles) | Prof. A. Chakona |
| Dr Y. Sithole | Taxonomy & systematics | Prof. A. Chakona |
| Dr M. Truter | Invasions and freshwater ecology | Prof. A. Chakona |
| Dr K-A. van der Walt | Larval ecology | Prof. F. Porri |
| Dr R. Welch | Coastal and estuarine ecology | Prof. N. James |

## HONORARY RESEARCH ASSOCIATES

| NAME | STATUS |
|---|---|
| Dr E. Anderson, PhD (College of William & Mary) | Curator Emeritus |
| Dr R. Bennett, PhD (Rhodes University) | Honorary Research Associate |
| Dr G. Bradley, PhD (University of Port Elizabeth) | Honorary Research Associate |
| Dr M. Bruton, PhD (Rhodes University) | Honorary Research Associate |
| Dr R. Chalmers, PhD (Rhodes University) | Honorary Research Associate |
| Prof. A. Channing, PhD (Natal University) | Honorary Research Associate |

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|---|---|
| Prof. A-R. Childs, PhD (Rhodes University) | Honorary Research Associate |
| Mr W. Conradie, MSc (North-West University) | Honorary Research Associate |
| Dr R. Cuthbert, PhD (Queen's University of Belfast/University of Reading) | Honorary Research Associate |
| Dr T. Dalu, PhD (Rhodes University) | Honorary Research Associate |
| Dr R. Daly, PhD (Rhodes University) | Honorary Research Associate |
| Dr T. Dlaza, PhD (University of Cape Town) | Honorary Research Associate |
| Prof. R. Dorrington, PhD (University of Cape Town) | Honorary Research Associate |
| Prof. L. du Preez, PhD (University of the Free State) | Honorary Research Associate |
| Dr D. Ebert, PhD (Rhodes University) | Honorary Research Associate |
| Dr B. Ellender, PhD (Rhodes University) | Honorary Research Associate |
| Dr J. Filmalter, PhD (Rhodes University) | Honorary Research Associate |
| Dr E. Gennari, PhD (Rhodes University) | Honorary Research Associate |
| Dr J. Glass, PhD (Yale University) | Honorary Research associate |
| Mr O. Gon, MSc (University of Jerusalem) | Curator Emeritus |
| Dr G. Gouws, PhD (University of Stellenbosch) | Honorary Research Associate |
| Dr J. Hargrove, PhD (University of Florida) | Honorary Research Associate |
| Mrs E. Heemstra, Dip. Ed. (University of Rhodesia) | Honorary Research Associate |
| Dr E. Heyns-Veale, PhD (Rhodes University) | Honorary Research Associate |
| Dr J. Hill, PhD (Rhodes University) | Honorary Research Associate |
| Mr W. Holleman, MSc (Rhodes University) | Honorary Research Associate |
| Dr J. Jackson, PhD (University of British Columbia) | Honorary Research Associate |
| Dr M. Jackson, PhD (Queen Mary University of London) | Honorary Research Associate |
| Dr F. Jacobs, PhD (University of KwaZulu-Natal) | Honorary Research Associate |
| Dr H. James, PhD (Rhodes University) | Honorary Research Associate |
| Dr M. Jordaan, PhD (Stellenbosch University) | Honorary Research Associate |
| Dr W. Kadye, PhD (Rhodes University) | Honorary Research Associate |
| Dr C. Keates, PhD (Rhodes University) | Honorary Research Associate |
| Dr D. Khosa, PhD (Rhodes University) | Honorary Research Associate |
| Mr D. King, Pr Eng (Ewell Technical College) | Honorary Research Associate |
| Dr A. Kock, PhD (University of Cape Town) | Honorary Research Associate |
| Dr M. Lipinski, DSc (University of Lodz) | Honorary Research Associate |
| Dr N. Mandrak, PhD (University of Toronto) | Honorary Research Associate |
| Dr S. Marr, PhD (University of Cape Town) | Honorary Research Associate |
| Dr M. Martin, PhD (Australian Maritime College/University of Tasmania) | Honorary Research Associate |
| Dr N. Masikane, PhD (University of KwaZulu-Natal) | Honorary Research Associate |
| Dr T. Miya, PhD (Rhodes University) | Honorary Research Associate |
| Dr T. Næsje, DSc (University of Trondheim) | Honorary Research Associate |
| Dr T. Naidoo, PhD (University of KwaZulu-Natal) | Honorary Research Associate |
| Dr S. Parker-Nance, PhD (Nelson Mandela University) | Honorary Research Associate |
| Dr R. Peel, PhD (Rhodes University) | Honorary Research Associate |
| Dr J. Pegg, PhD (Bournemouth University) | Honorary Research Associate |
| Dr W. Potts, PhD (Rhodes University) | Honorary Research Associate |
| Dr P. Psomadakis, PhD (Polytechnic University of Marche) | Honorary Research Associate |
| Dr E. Puccinelli, PhD (Rhodes University) | Honorary Research Associate |
| Dr A .Rajkaran, PhD (Nelson Mandela Metropolitan University) | Honorary Research Associate |
| Dr U. Schliewen, PhD (Ludwigs-Maximilians-University) | Honorary Research associate |
| Prof. P. Skelton, PhD (Rhodes University) | Managing Director Emeritus |
| Dr M. Smale, PhD (Rhodes University) | Honorary Research Associate |
| Dr K. Smit, PhD (Nelson Mandela University) | Honorary Research Associate |
| Dr N. Smit, PhD (University of the Free State) | Honorary Research Associate |
| Dr J. South, PhD (Queens University Belfast) | Honorary Research Associate |
| Dr J. Stauffer, PhD (Blackburg State University) | Honorary Research Associate |
| Prof. N. Strydom, PhD (Rhodes University) | Honorary Research Associate |
| Dr M. Tagliarolo, PhD (Université de Bretagne Occidentale) | Honorary Research Associate |
| Dr G. Taylor, PhD (Rhodes University) | Honorary Research Associate |
| Dr J. Taylor, PhD (North-West University) | Honorary Research Associate |
| Mr D. Tweddle, BSc (University of Wales) | Honorary Research Associate |
| Dr F. Uiblein, PhD (University of Vienna) | Honorary Research Associate |

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|---|---|
| Dr S. Viana, PhD (University of São Paulo) | Honorary Research Associate |
| Dr N. Vine, PhD (Rhodes University) | Honorary Research Associate |
| Dr L. Vorsatz, PhD (Rhodes University) | Honorary Research Associate |
| Dr E. Vreven, PhD (KU Leuven) | Honorary Research Associate |
| Dr R. Wasserman, PhD (Rhodes University) | Honorary Research Associate |
| Prof. A. Whitfield, PhD (University of Natal) DSc (Rhodes University) | Chief Scientist Emeritus |
| Dr E. Wiles, PhD (University of KwaZulu-Natal) | Honorary Research Associate |
| Dr D. Woodford, PhD (University of Canterbury) | Honorary Research Associate |

### NRF-SAIAB SUPERVISED STUDENTS GRADUATED - 2023

| NAME | DEGREE | HIGHER EDUCATION INSTITUTION | INSTITUTE SUPERVISOR/CO-SUPERVISOR |
|---|---|---|---|
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# APPENDIX D: Abbreviations, Acronyms and Definitions

| | |
|---|---|
| ABC | Agulhas Bank Connections |
| ACEP | African Coelacanth Ecosystem Programme |
| AERP | Aquatic Ecophysiology Research Platform |
| AES | Aquatic Ecosystem Services |
| AGRP | Aquatic Genomics Research Platform |
| AS | Aerobic Scope |
| ATAP | Acoustic Tracking Array Platform |
| BBSA | Biodiversity Biobanks South Africa |
| BCRE | Bayworld Centre for Research and Education |
| BERI | Blue Economy Research Institute |
| BHL | Biodiversity Heritage Library |
| BRUVs | Baited Remote Underwater Video systems |
| BSCM | *Basilica Santuario del Carmine Maggiore* (Naples, Italy) |
| CEPF | Critical Ecosystem Partnership Fund |
| CNRS | *Centre national de la recherche scientifique* (National Centre for Scientific Research) |
| CoNCENSUS | Coastal and Nearshore CENSUS Techniques |
| CORDIO | Coastal Oceans Research and Development in the Indian Ocean |
| COST | Coastal and Ocean Sciences Team |
| CPUT | Cape Peninsula University of Technology |
| DFFE | Department of Forestry, Fisheries and Environment |
| DHET | Department of Higher Education and Training |
| DIFS | Department of Ichthyology and Fisheries Science |
| DSI | Department of Science and Innovation |
| DTU | Technical University of Denmark |
| DTU Aqua | National Institute of Aquatic Resources, Technical University of Denmark |
| eDNA | Environmental DNA |
| EEZ | Exclusive Economic Zone |
| FAO | Food and Agriculture Organization of the United Nations |
| FBIP | Foundational Biodiversity Information Programme |
| FHARU | Fort Hare Aquaculture Research Unit |
| GIS | Geographic Information System |
| GKLL | Greater Kafue Landscape Limited |
| GOOS BioEco | Global Ocean Observing System, Biology and Ecosystems |
| HBUs | Historically Black Universities |
| HDIs | Historically Disadvantaged Institutions |
| HEI | Higher Education Institution |
| HPPP | High Performance Physiological Phenotypes |
| HRA | Honorary Research Associate |

| | |
|---|---|
| HSRC | Human Sciences Research Council |
| IAMSLIC | International Association of Aquatic and Marine Science Libraries and Information Centres |
| ICP-OES | Inductively Coupled Plasma - Optical Emission Spectrometry |
| IEM | Integrated Environmental Management |
| IMIsEE | Indigenous Marine Innovations for sustainable Environments and Economies |
| IMR | Institute for Marine Research - Norway |
| IRD | *Institut de Recherche pour le Développement* (French National Research Institute for Sustainable Development) |
| ISA | International Seabed Authority |
| IUCN | International Union for Conservation of Nature |
| JMLP | Joint Marine Laboratories Programme |
| KMFRI | Kenya Marine and Fisheries Research Institute |
| KPI | Key Performance Indicator |
| KSFP | Kafue Sustainable Fisheries Programme |
| KZN | KwaZulu-Natal |
| MARIP | Marine Remote Imagery Platform |
| MCR | Microplastics and Coastal Research |
| MMF | Marine Megafauna Foundation |
| MMNH | Maputo Museum of Natural History |
| MMR | Maximum Metabolic Rate |
| MMRI | Maldives Marine Research Institute |
| MNPs | Marine Natural Products |
| MOA | Memorandum of Agreement |
| MOU | Memorandum of Understanding |
| MPA | Marine Protected Area |
| MSP | Marine Spatial Planning |
| NBA | National Biodiversity Act |
| NDP 2030 | National Development Plan 2030 |
| NEKTON | A not-for-profit research foundation, working with the University of Oxford and wider range of partners to accelerate scientific exploration and protection of the oceans |
| NFC | National Fish Collection |
| NFEPAs | National Freshwater Ecosystem Priority Areas |
| NGO | Non-governmental Organisation |
| NGS | Next-generation sequencing |
| NHM | Natural History Museum |
| NIOZ | *Nederlands Instituut voor Onderzoek der Zee* (Royal Netherlands Institute for Sea Research) |
| NIWA | National Institute for Water and Atmospheric Research |
| NM | Nautical Miles |
| NMU | Nelson Mandela University |
| NNF | Namibian Nature Foundation |
| NP | Natural Product |
| NRF | National Research Foundation |
| NSCF | Natural Science Collection Facility |
| NSI | National System of Innovation |
| NWU | North-West University |
| NY | New York |
| ORI | Oceanographic Research Institute |
| OTC/TN | Total Oxygen and Carbon/Total Nitrogen |
| PAFFA | Pan African Fish and Fisheries Association |
| PDP | Professional Development Programme |
| PI | Principal Investigator |
| PSU | Pennsylvania (Penn) State University, USA |
| RAPD | Randomly amplified polymorphic DNA |
| REFRESH | Renewing data and filling knowledge gaps for freshwater species of South Africa to inform species and ecosystem conservation |
| REMP | Regional Environmental Management Plan |
| RFP | Request for Proposal |
| RMCA | Royal Museum for Central Africa |
| ROV | Remotely Operated Vehicle |
| RRA | Responsible Research Advancement |
| RU | Rhodes University |
| SAEON | South African Environmental Observation Network |
| SAFER | Southern African Fisheries Ecology Research |
| SAIMI | South African International Maritime Institute |
| SALPA | South African Linefish Physiology Assessment |
| SANBI | South African National Biodiversity Institute |
| SANDC | South African National Diatom Collection |
| SANParks | South African National Parks |
| SASAqS | Southern African Society of Aquatic Scientists |
| SASC | South African Shark Conservancy |
| SCOR | Scientific Committee for Oceanic Research |
| SDG | Sustainable Development Goal |
| SEaS | Seafloor Ecology and Sustainability |
| SMART | Specific Measurable Achievable Relevant Time-based |
| SMCRI | Shallow Marine and Coastal Research Infrastructure |
| SMR | Standard Metabolic Rate |
| SNSB | *Zoologische Staatssammlung München* (Bavarian State Collection of Zoology) |
| sRUVs | Remote underwater stereo video systems |
| stereo-BRUVs | Baited remote underwater stereo-video systems |
| SU | Stellenbosch University |
| SWIO | South West Indian Ocean |
| TAFIRI | Tanzania Fisheries Research Institute |
| TNC | The Nature Conservancy |
| TNPA | Transnet National Ports Authority |
| TOA | Two Oceans Aquarium |
| TOC/TN | Total Oxygen and Carbon/Total Nitrogen |
| UCT | University of Cape Town |
| UFH | University of Fort Hare |
| UFS | University of the Free Sate |
| UJ | University of Johannesburg |
| UKZN | University of KwaZulu-Natal |
| UMP | University of Mpumalanga |
| UNISA | University of South Africa |
| UniSey | University of Seychelles |
| UNIVEN | University of Venda |
| UNIZULU | University of Zululand |
| UNZA | University of Zambia |
| UPLC | Ultra-High Pressure Liquid Chromatography |
| USA | United Sates of America |
| USFWS | United States Fish and Wildlife Service |
| UWC | University of the Western Cape |
| VNMN | Vietnam National Museum of Nature |
| WCS | Wildlife Conservation Society |
| WGS | Whole Genome Sequences |
| WOS | Web of Science |
| WRC | Water Research Commission |

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