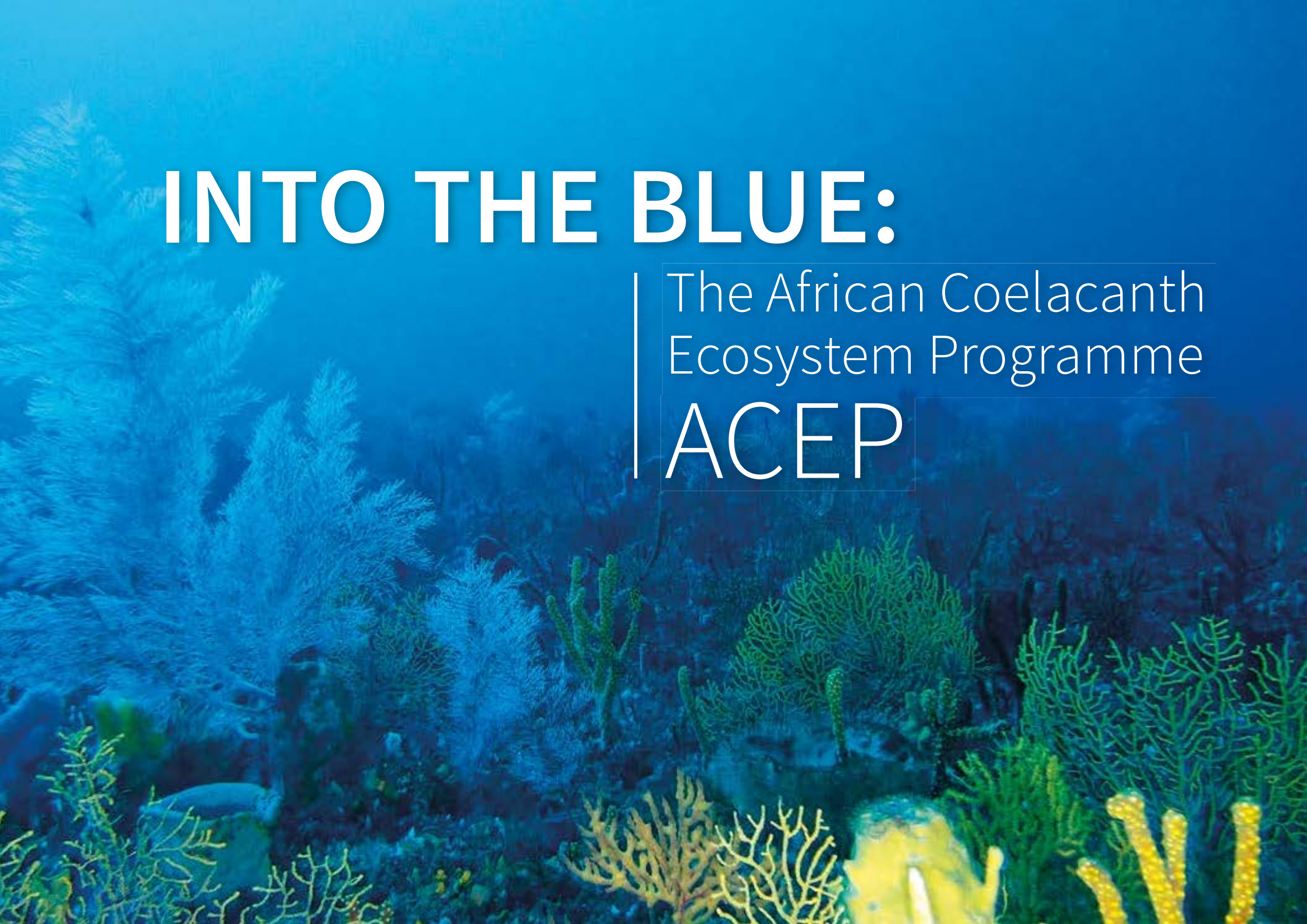

# INTO THE BLUE:

## The African Coelacanth Ecosystem Programme

## ACEP


NRF
National Research Foundation
SAIAB
South African Institute for Aquatic Biodiversity
environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA
NRF
National Research Foundation
RISA
Research and Innovation Support and Advancement
A C E P
OPERATION PHAKISA
planning | implementation | growth
science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA
NRF
National Research Foundation
SAEON
South African Environmental Observation Network
agriculture, forestry & fisheries
Department:
Agriculture, Forestry & Fisheries
REPUBLIC OF SOUTH AFRICA

# CONTENTS

# In support of South Africa's "Blue Economy".

## ACEP'S VISION

Build the capacity to sustain the processes which support life

**Editor:** Penny Haworth
**Picture Editor:** Rose Palmer
**Design:** WalkerDigital, Port Elizabeth
**Print:** CADAR Printers, Port Elizabeth

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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.
The African Coelacanth Ecosystem Programme (ACEP) is a flagship programme of the Department of Science and Technology.

# ENGAGE 01

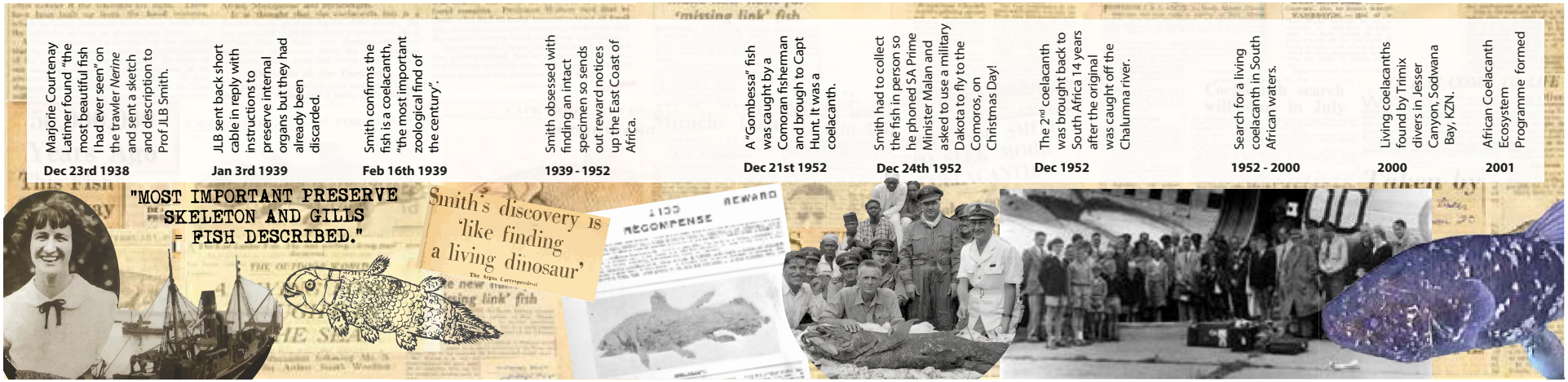
# WHAT IS ACEP?

## ACEP is building on a legacy of marine discovery to ensure a sustainable future

*Executive Overview by Dr Angus Paterson*

In 2000, at the dawn of the new millennium, a living population of coelacanths was found off Sodwana Bay and the African Coelacanth Ecosystem Programme (ACEP) was born. The discovery of this enigmatic fish provided yet another chapter to an amazing South African story that had played out on the world stage between 1938 and 1952. To recap: in 1938 Ms Marjorie Courtenay-Latimer, a young curator at the East London Museum, brought a peculiar fish trawled off the Chalumna River mouth to the attention of Prof JLB Smith, a Chemistry Professor at Rhodes University, who had a deep passion for fish. His realisation that this fish was in fact a species that was thought by scientists to have been extinct for 70 million years resulted in a hunt to find another specimen. This hunt lasted for 14 years until 1952 when a second specimen was found in the Comoros Islands. The story is told by Smith in his bestselling book, *Old Fourlegs – The Story of the Coelacanth.* The discovery and the excitement it created helped towards the establishment in 1968 by Smith's widow and research partner, Professor Margaret Smith, of a world recognised centre of ichthyology (the JLB Smith Institute of Ichthyology) of which Margaret was the first director and which is now the South African Institute for Aquatic Biodiversity (NRF-SAIAB). It inspired numerous foundational academic books such as *Smiths' Sea Fishes,* generations of ichthyologists who have plied their profession all around the world and ultimately the African Coelacanth Ecosystem Programme.

Initiated by the Department of Science & Technology (DST), ACEP is now a major multi-disciplinary east coast research programme funded primarily by the DST but using research equipment and platforms from numerous research agencies including the Department of Environmental Affairs (DEA - Oceans & Coasts), Department of Agriculture, Forestry and Fisheries, South African Environmental Observation Network (NRF-SAEON) and NRF-SAIAB. ACEP is managed by the National Research Foundation through NRF-SAIAB, which is one of its National Facilities.



ACEP aims to ensure that South Africa has in-depth knowledge of our east coast marine and coastal environment and its resources, to ensure sustainable development while benefitting its citizens. This can only be done by undertaking the required research and producing a representative generation of future marine scientists and resource managers which reflects the diverse demography of our country.

## Why is South Africa's east coast so important now?

South Africa is blessed with a number of marine features which make it an area of interest in global marine research. The Agulhas current, one of the major western boundary currents in the world, runs down the length of South Africa's east coast. The Agulhas Current is not only important at a regional scale in terms of climate, but is one of the drivers of the global ocean circulation system. This feature, along with the east coast's high biodiversity and its position at the southern point of the African continent, make it a very important and interesting environment in which to undertake research. These characteristics were identified by the DST as giving South Africa a geographical advantage in the global research arena.

Notwithstanding the pure scientific relevance of the region, sound environmental management of the east coast is of pivotal importance to the wellbeing of the country. From a commercial perspective, the east coast is home to numerous large cities such as Port Elizabeth, East London, Durban and Richards Bay; it supports significant commercial and subsistence fishing activities, major marine tourism operations and a globally significant shipping route, all of which impact upon, but are also reliant on, the coastal and marine environment.

Existing global change impacts of fishing, pollution and freshwater abstraction from estuaries, coastal urban sprawl and coastal degradation, many of which will be exacerbated by climate change, all have to be managed. Research that aids in the sustainable management of the east coast is urgently required along with training the next generation of scientists and environmental managers.

Furthermore, with the recognition that many of the land-based economic activities in South Africa are operating at maximum output or, for example in the

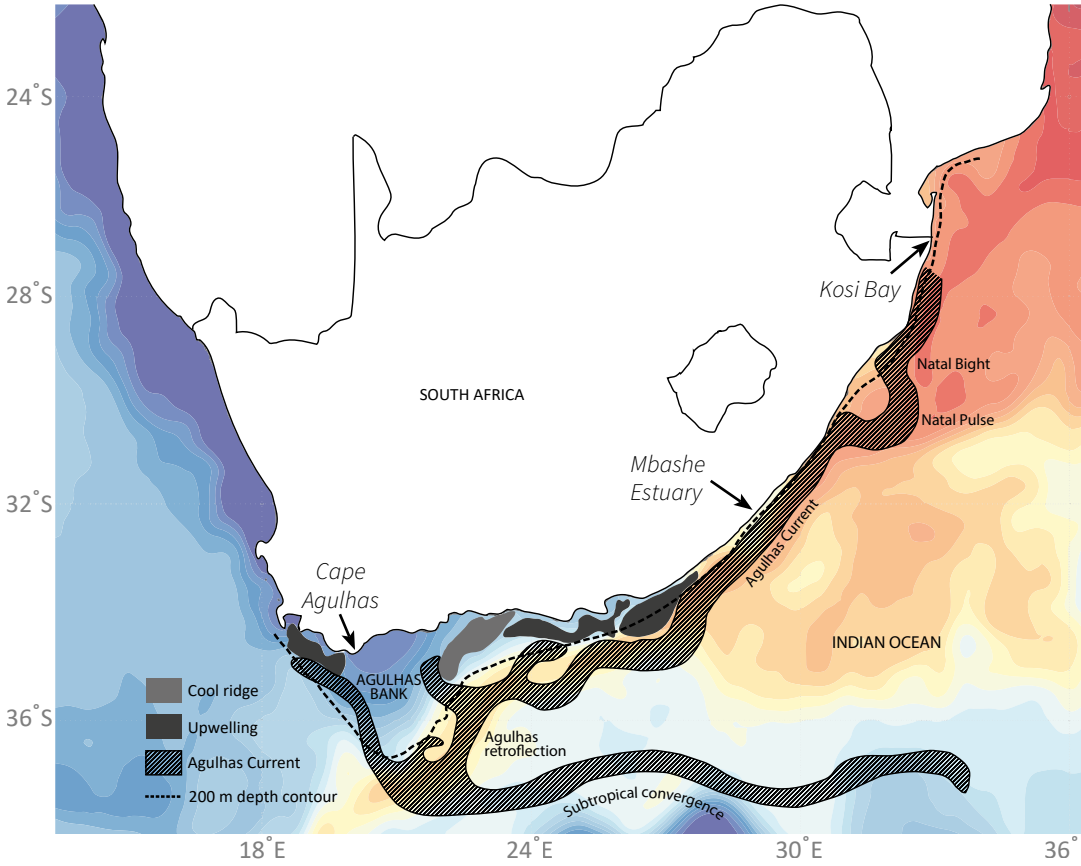



***Figure 1*** *- Map showing the key oceanographic features (UK Met Office 2012) around southern Africa. Modified from McGrath, 2017 and based on information from Roberts (2005) and Lutjeharms (2006). The Agulhas current, one of the major western boundary currents in the world, runs down the length of South Africa's east coast. The east coast has a significant population dispersed along its coastline. A significant number of settlements are concentrated on some 174 estuaries along the east coast and many of the people living there are directly or indirectly reliant on marine resources.*

case of mining, are in decline, there is an increasing need for South Africa to develop the so called “Blue Economy”. South Africa has embarked on Operation Phakisa Oceans which aims to develop a number of key sectors within the marine environment: these include aquaculture/mariculture; marine transport; oil and gas and governance. The development of aquaculture, oil and gas and marine transport will undoubtedly place significant additional pressures on the marine environment and this is where ACEP aims to make a difference.

## Why ACEP?

**ACEP is in place to ensure that:**

- Appropriate research platforms and technologies are available for scientists to undertake the required research to guide South Africa’s decision makers.
- The correct baseline data and understanding of the marine environment are available to decision makers so that decisions are made in the best interest of sustainable and inclusive development.
- The next generation of scientists, policy makers and environmental managers is well trained and, most importantly, is representative of the country as a whole.

## What does ACEP do?

In its current form ACEP comprises four major thrusts which provide the structure of this book:

**ACEP Engages**

Over the last decade, ACEP has adapted to the needs of the country and is now predominantly a programme through which South African researchers can access cutting-edge marine infrastructure such as ships, remote controlled vehicles, coastal craft and buoys, to name a few. Through ACEP, South African scientists are able to continue studies on the coelacanth and, most importantly, the environment along the east coast in which it is found. This research effort is imperative to ensure that relevant and accurate baseline data and understanding of the ecological processes of our east coast are in place to ensure sustainable development.

**ACEP Transforms**

The need to transform the demographics of the scientists undertaking east coast research is of paramount importance to ensure it mirrors the demographics of the country as a whole. The need to create a new generation of black and female scientists is at the core of the current ACEP Programme.

Having a representative (race and gender) scientific workforce is imperative if South Africa’s natural resources are to be effectively managed in the future. The ACEP Phuhlisa Programme is a specific intervention that aims to develop black scientists at historically black universities through providing student bursaries, research funding, technical input, research platforms (such as vessels) and specific life skills courses.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***1.*** *Phuhlisa enabled 70 students on the programme to attend the South African Marine Science Symposium 2017 in Port Elizabeth, to expose them to a broad range of research topics across a variety of themes.*
***2.*** *ACEP Water World at the national science festival, Scifest Africa, targets all ages with emphasis on learners (pp. 19).*
***3.*** *Students learn field work techniques on a Botany project field trip in mangrove swamps. ACEP hands-on field work camps target undergraduates (pp. 16).*
***4-8.*** *The Wildlands Ocean Stewards initiative targets young postgraduates who may wish to continue their research careers through partnering with two of the ACEP Open Call projects, which began with the Biodiversity Surrogacy Project during ACEP Phase 2 and has continued with the Spatial Solutions Project (pp. 22).*
***9-10.*** *ACEP provides access to world class coastal and marine research equipment to scientists from all South African research institutions.*


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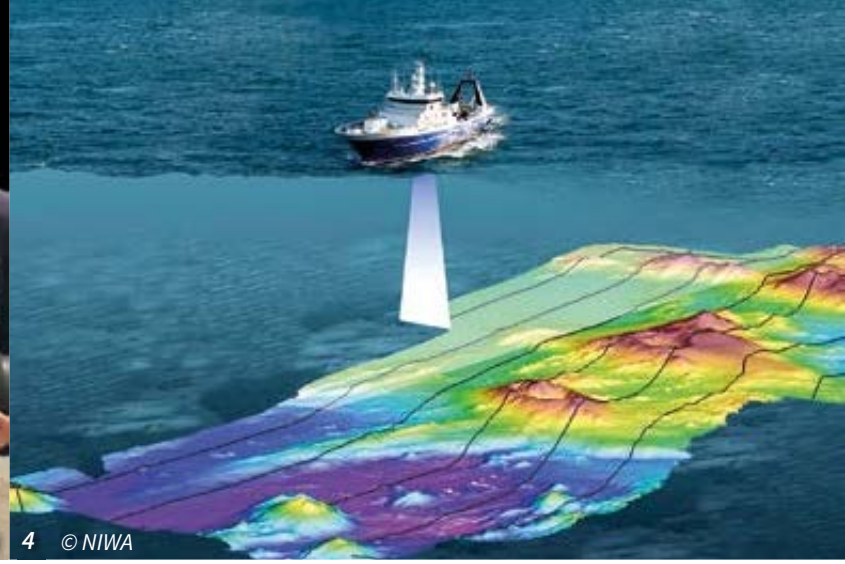
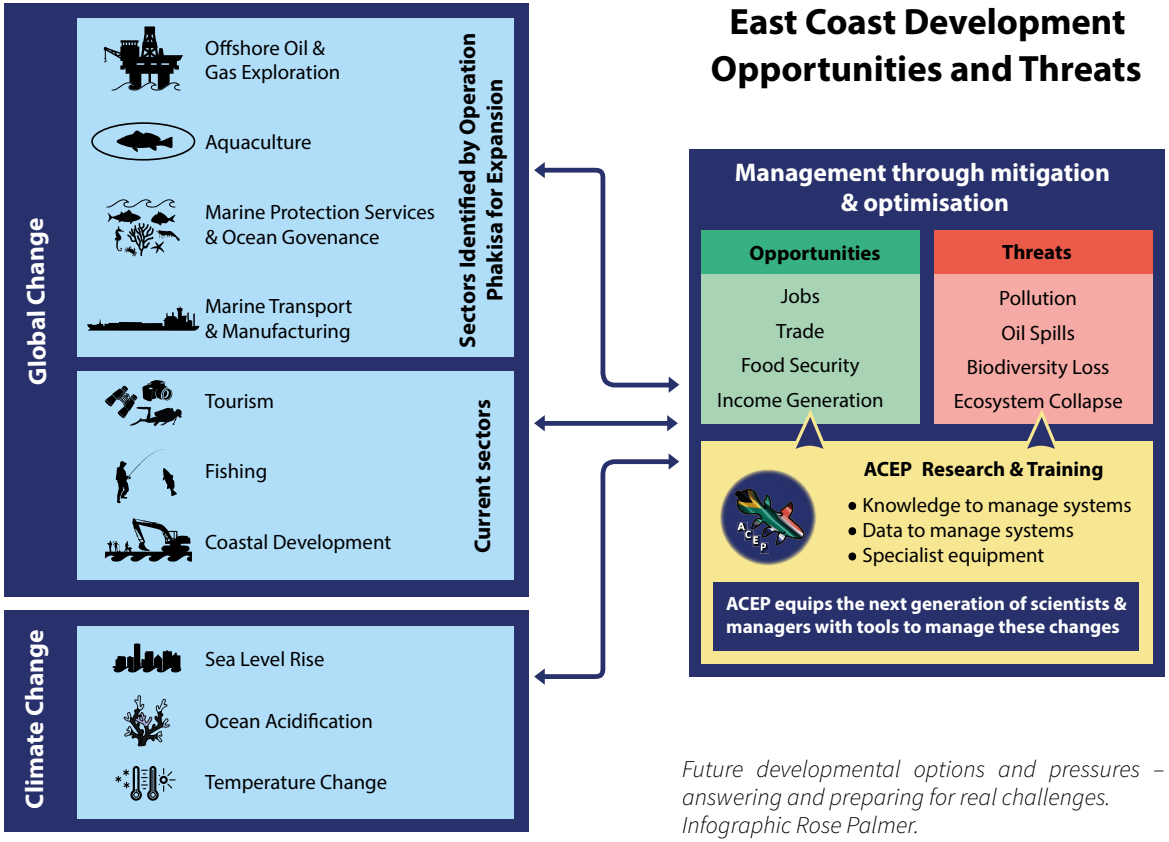


4 © NIWA




*Future developmental options and pressures – answering and preparing for real challenges. Infographic Rose Palmer.*


5

A key component of undertaking science is to engage with the public at large and to introduce the next generation to the wonders of a career in scientific research. ACEP undertakes a number of programmes aimed at different target audiences.

**ACEP Innovates**

World class coastal and marine research equipment is too costly and too technically demanding to be available at all higher education and research institutions. ACEP provides innovative **Marine Research Platforms** which enable scientists from all South African research institutions to apply for competitive access to unique and cutting-edge vessels, equipment and technical support run by the South African Institute for Aquatic Biodiversity, South African Environmental Observation Network and the Department of Environmental Affairs - Oceans & Coasts.

***1-5.*** *ACEP provides access to world class coastal and marine research equipment to scientists from all South African research institutions.*

## MARS Priority Areas

| | |
|---|---|
| **Oceans & Marine Ecosystems under Global Change** | • Understanding modes of ocean variability across temporal & spatial scales<br>• Developing a regional observations network<br>• Developing end-to-end modelling & operational prediction capabilities<br>• Establishing global, regional & coastal system indicators<br>• Delivering robust & useful information to society<br>• Reconstructing past climate changes |
| **Earth Systems Observations** | • Usage of South African space science in Antarctica, as a window into geospace<br>• Understanding the links between ocean-atmospheric physics, ocean iron availability, trace element biogeochemistry & ocean productivity<br>• Understanding large scale ocean circulation & global climate |
| **Ecosystems, Biodiversity & Biodiscovery** | • Understanding scales of biodiversity from molecular to ecosystem<br>• Understanding the connectivity between terrestrial, coastal and marine systems<br>• Understanding natural and anthropogenic drivers of change<br>• Development of capacity in biodiscovery & biotechnology<br>• Marine Spatial Planning and Marine Protected Area Expansion and Optimisation |
| **Innovation & Development** | • Sustainable coastal & ocean development<br>• Oil & gas, fisheries, mining & mariculture<br>• Energy management<br>• Development of technology & vessel design<br>• Development of energy exploration capacity<br>• Development of links to ecotourism<br>• Antarctic waste management |
| **Human Enterprise** | • Geopolitics, international & national law and policy<br>• Usage of the resource & to develop and refine human history & palaeosciences<br>• Antarctic arts, architecture & literature<br>• Social Adaptation & Human Impact |

ACEP

## RESEARCH PLATFORMS


Coastal Craft


Mar-RIP


ATAP


Geophysics


*R/V Algoa*


Sentinel Site


ASCA

## OPEN CALL RESEARCH PROJECTS 2015-2017

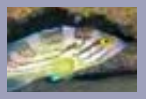

Imida
*Dr S Kerwath*


Deep Secrets
*Dr K Sink*


Agulhas Current
*Dr R Barlow*


Larval Dispersal
*Dr F Porri*


Benthic Biodiversity
*Dr R Dorrington*


Spatial Solutions
*Dr J Harris*

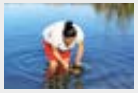
## PHUHLISA


Bursaries


Courses


Infrastructure


Running Costs


Technical Support

## OUTREACH


Ocean Stewards


Scifest Africa


Field Camps


Internship Programme

**ACEP Explores**

Internationally, research managers recognise that competitive access to funding and infrastructure drives innovative, cutting edge and cost effective research. ACEP manages a competitive Open Call through the NRF and usually awards funding to between five and seven projects on a three year cycle. Researchers submit project proposals which are evaluated by their peers both locally and internationally and the best projects are selected.

The research areas called for are guided by the requirements of national and international research strategies to ensure responsible research initiatives that benefit society. In South Africa, examples of such strategic initiatives are the DST's Marine & Antarctic Research Strategy (MARS) 2014 and Operation Phakisa Oceans.

## ACEP Counts

Over the last 16 years ACEP has conducted 13 research cruises, 17 research programmes, trained 232 students and published 160 peer-reviewed research papers.

# TRANSFORM

# 02

# PHUHLISA PROGRAMME

The ACEP Phuhlisa Programme, a strategic DST transformation initiative, aims to assist in building capacity in marine science at historically black universities (HBUs) with the goal of accelerating transformation of the marine science research community. Collaboration between NRF-SAIAB, NRF-SAEON and four HBUs (University of Fort Hare, University of Zululand, University of the Western Cape and Walter Sisulu University), has resulted in a managed programme through which research support is provided by NRF-SAIAB and NRF-SAEON researchers and technicians to facilitate Marine Science research capability at these universities. Disciplines supported include Marine Microbiology, Marine Biochemistry, Marine GIS, Marine Geology and Marine Biology. Inception of the programme was characterised by rapid uptake of these disciplines as a preferred choice of study. Numbers grew rapidly from seven HBU researchers and 12 honours students in 2012 to 21 HBU researchers supervising 72 students in 2017. NRF-SAIAB's Human Capital Development Manager, Mr Garth van Heerden, and his office, provide the professional support needed to drive the programme and ensure that high quality research is maintained.

This strong strategic initiative ensures that black and female South African postgraduates are trained

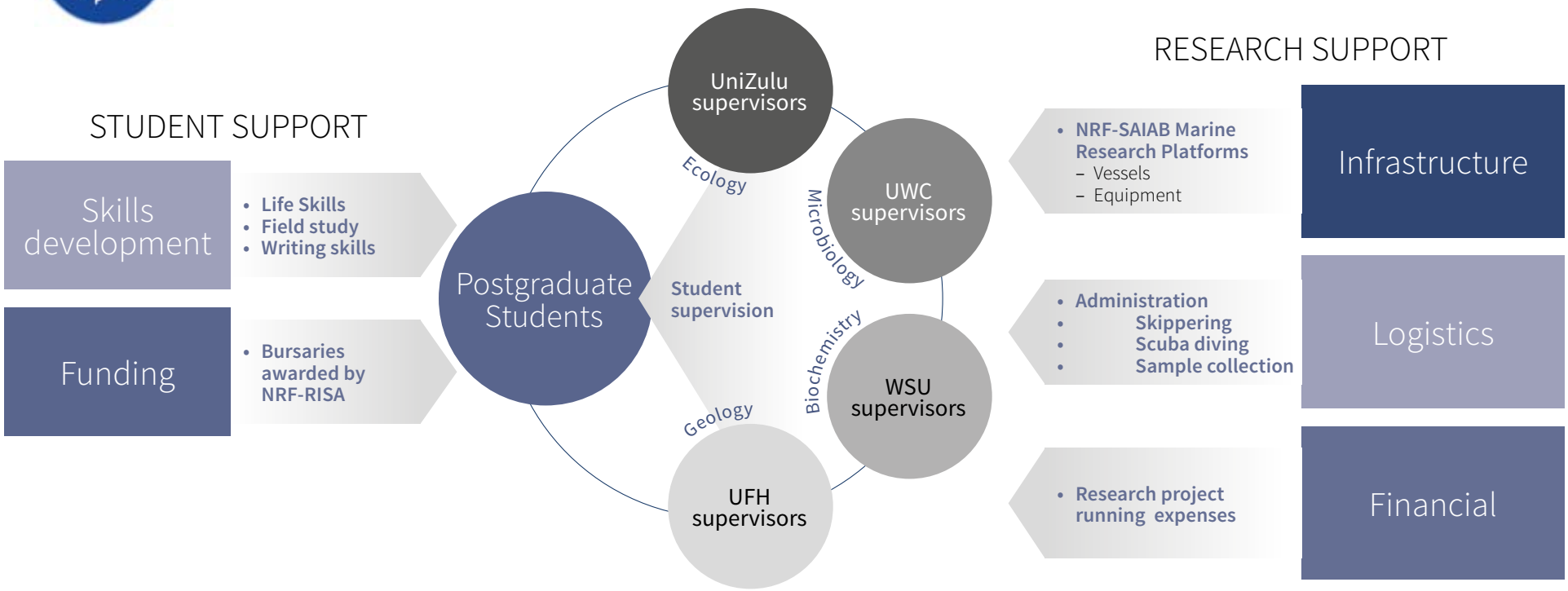
1 2

## RESEARCH PROPOSAL
presentation day at NRF-SAIAB
*March 2017*

*What a start to postgraduate study! Phuhlisa students' project proposals are conceptualised in the first quarter of the academic year. They have the advantage of being required to present their project proposals to an audience of peers and experienced scientists. This allows the students to internalise their projects and to learn that there may be additional things to consider such as the viability of completing their project within the tight time frames of a single academic cycle.*
*The exposure outside the comfort zone of their university allows students to see that they are not alone in their study area, to hear information about other areas of study and to see links between these. It also affords them the opportunity to ask themselves why the research area they are going into is important.*

***1-2.*** *Phakama Nodo, MSc student from Walter Sisulu University is studying fish communities of the Kariega.*

# ACEP Phuhlisa | Human capacity development in MARINE SCIENCE




within the marine sector and that marine science is entrenched more deeply at HBUs. The ACEP call is designed as a split call to facilitate the initiative. One third of the funding is ring-fenced to support marine science researchers at HBUs.

Phuhlisa's foremost function is to capacitate HBU marine science researchers by providing access to National Facility research equipment and expertise:

**Research infrastructure:** Offshore research vessels in Durban, Port Elizabeth and, in the near future, in the Western Cape; skippers; dive teams and submersible ROVs; estuary boats; use of NRF-SAIAB 4X4 vehicles.

**Logistical support:** ACEP assists researchers with administration, skippering, scuba diving and sample collection.

**Financial support:** Financial assistance is provided in the form of running costs for student research projects as well as study bursaries, where required. In this respect due to high number of students, Phuhlisa entered into a strategic partnership with NRF Human and Institutional Capacity Development (HICD) at RISA which has taken over responsibility for the bursary awarding process.

**Academic and professional development:** In order to address the articulation gap between students coming from a disadvantaged background, the Phuhlisa Programme facilitates custom training courses to help students catch up on writing,



***1.*** *Phuhlisa students collecting grab samples on the Bushman's River.*
***2.*** *Students from WSU with supervisor, Thembinkosi Dlaza, (seated extreme left) on a field trip to the Huleka Nature Reserve.*
***3.*** *Lukhanyo Maqhubela locating and identifying solid waste.*
***4.*** *Azizipho Nompozolo recording and categorizing solid waste along the sandy and rocky shore during a field trip to the Hluleka Nature Reserve and Marine Protected Area.*
***5.*** *Dr Niall Vine from the University of Fort Hare with students on the Phuhlisa Programme at the World Aquaculture Conference in Cape Town, during June 2017.*
***6.*** *Phuhlisa students on the* R/V Agulhas II *during a South African National Antarctic Programme (SANAP) Cruise.*

presentation and other skills. Students and their supervisors are provided academic and professional development opportunities including supervisory, scientific and life skills courses like swimming and driving lessons, skipper and diving lessons as well as first aid training.

Critical to the success of the programme is that it follows an HBU researcher-centred approach. We believe that this is where the greatest potential lies for sustained capacity building.

Passion and research excellence is imperative but if South African marine science is to thrive, we must ensure that we have a representative scientific cohort. Dedicated and strategic transformation initiatives such as the Phuhlisa Programme provide the framework within which young scientists can develop their knowledge, understanding and skills in marine research.

Field trips provide an important opportunity for students to apply the knowledge gained from the class room in the environment and to develop the skills with which to recognise and assess human impacts through pollution and other factors. Opportunities to attend conferences in various fields of marine research also serve to broaden students' experience and enable them to develop research networks within their disciplines.

*"Marine science student output has increased dramatically since the initiation of the partnership between WSU and ACEP Phuhlisa, from one Honours student in 2011 to seven Honours and six MSc for 2016."*
Dr TS Dlaza, Department of Biological & Environmental Sciences, Walter Sisulu University

*"The Phuhlisa Programme has contributed to inspiring students who come from poor backgrounds to have a better future and contributes to the growth of young marine scientists who will look after South Africa's Ocean Economy."*
Dr Vincent Nakin, Marine Biology Researcher, Walter Sisulu University

*"…The programme has provided invaluable opportunities and support to both myself and my students. Phuhlisa provides opportunities for our students to engage with internationally renowned scientists, all of whom have encouraged a research culture in the students from our department and a general shift in interest towards marine sciences."*

Ms Tabile Loqo, Department of Biological & Environmental Sciences, Walter Sisulu University

*"The Phuhlisa Programme has made a significant impact on the research output as well as the development of young marine scientists within several departments at the University of Fort Hare. The availability of various equipment such as research boats, environmental monitoring systems, molecular laboratories, archived marine samples, DNA sequencing facility and access to literature has greatly enhanced the quality of the Masters and Doctoral projects. ...a unique opportunity (for staff and students) to start a career in the Marine Sciences and be exposed to multidisciplinary programmes."*

Prof Graeme Bradley, Deputy Dean Research and Internationalization, University of Fort Hare

*"The Phuhlisa Programme has opened up a new world to our Honours and postgraduate students. UWC is proud to be a part of this initiative over the past 18 months and it's delightful to see how staff and students have benefited personally and professionally. Our postgraduate students have been able to network with students in the Eastern Cape and KwaZulu-Natal and staff members have been able to strengthen ties and collaborations across universities."*

Dr Anusha Rajkaran, Department of Biodiversity and Conservation Biology, University of the Western Cape

*"We would like to express a sincere thank you to SAIAB from the students of UWC for having us during the literature review course on 3rd & 4th of June 2017 with Dr Chrissie Boughey. We have learned so much and have been applying the tips taught to us ever since. To Vuyo Ndumela, your efforts in trying to accommodate us, even just by lending an understanding ear, are greatly appreciated."*

Razaan Keur, Calley Chateau, Jillian Fredericks, Lauren Fester, Phangoxolo Sishuba, and Riaaz Mohamed."
Phuhlisa students from the University of the Western Cape.

*"I really enjoyed working with your students and interns on our two writing workshops recently. I can remember a number of years back that the first groups (lovely people) were quite shy and uncertain about what they were doing and why, but over the years, at least from my experience, there have been great changes. Both of these groups had a very good grasp of what they were doing scientifically and were able to critique each other's work very effectively. But more than this, there was a real confidence and assurance about these young people and they were such good fun! I can only speak from my experience but it seems to me that this project is doing great things and helping these young people to develop their talents."*

Dr Les Mitchell, Fellow of the Oxford Centre for Animal Ethics University of Fort Hare Hunterstoun

*"The Phuhlisa programme provided different training and workshops for our postgraduates such as research proposal writing and thesis writing, and even swimming training for marine research students. Moreover, through cooperation with SAIAB and SAEON researchers, our staff and students get useful working experience and skills, and enjoy using some of the facilities and equipment offered by SAIAB and SAEON for research work."*

Prof Ken Liu, Geology Department, University of Fort Hare

# GETTING THEIR HANDS DIRTY!

## ACEP offers world-class training and hands-on field experience to Honours students

An intensive annual 10 day field-based course based at the Mngazana Estuary, just south of Port St Johns, is geared towards providing postgraduates (mostly at the Honours level) with training in several areas of aquatic ecology research. The course provides young postgraduate students from Walter Sisulu University (WSU), the University of Fort Hare (UFH) and the University of the Western Cape (UWC), the opportunity to meet and engage with leading local and international established researchers who run the course and work hand in hand (and mud!) with the students. The students are exposed to experimental design, statistical analysis and various sampling techniques applied to mostly mangrove habitats, but also estuarine and rocky shore habitats in general.

This course is co-ordinated by Dr Francesca Porri (South African Institute for Aquatic Biodiversity, NRF-SAIAB) and led by a team of facilitators from local and international institutions, including the University of Western Cape, Walter Sisulu University, Hong Kong University and the *Technische Universität*, Dresden, Germany. This field course, which has been held annually from 2015-2017, is a great success and serves as a platform for students to collaborate with one another and get a broader understanding of ecological research in aquatic ecosystems.



***1-2.*** *Under the guidance of Dr Paula Pattrick from NRF-SAIAB, students undertake data collection and take measurements within the Mngazana mangrove forest. This is the third largest area of mangroves in South Africa. Photo Francesca Porri.*

***3-5.*** *Dr Stefano Cannicci and Professor Uta Berger actively engage with students in the field.*

**Professor Uta Berger** *(front right)* from the *Technische Universität* Dresden in Germany is a world leader in the field of ecology and computer science, integrating the two disciplines though a modelling approach. While she has a strong expertise in statistical ecology, she specialises in individual based modelling. Her expertise couples well with the focus of the course and the needs of postgraduates from the University of Fort Hare, Walter Sisulu University and University of the Western Cape. Professor Berger's wide experience in training postgraduates from developing countries, together with her regular running of the Summer Schools in individual based modelling is key to the success of the course, especially considering that she has already successfully facilitated and interacted with students from the targeted universities during her previous visits to South Africa over the last four years.

**Dr Stefano Cannicci** *(back)* is a top scientist working on ethology, ecology and taxonomy of decapods and molluscs living in coastal systems with specific focus on mangroves. From his PhD in Kenya, he has taken part in several international projects, working in the mangroves of Kenya, Zanzibar, Mozambique and South Africa. He has very recently relocated from the University of Florence, Italy to Hong Kong holding a professorship within the Swire Institute of Marine Science. Like Prof Berger, he enthusiastically facilitated courses on climate change on coastal systems and mangrove ecology in 2014 and 2015 for students from the universities targeted for this event.

**Dr Francesca Porri** *(front left)* who coordinates this programme says, "I have had the fortune and pleasure of interacting with both of these leading international experts at several levels, from being collaborators within large international research frames, to colleagues and/or facilitators at workshops and/or conferences. Despite their distinguished leadership and global scientific recognition, they are easily approachable and enthusiastically engage with students. It is their passion and dedication that provides the fundamental basis for the success of this course and for inspiring a new generation of scientists."









***1.*** *Data analysis including graph presentation and statistical testing with Prof. Uta Berger.*
***2.*** *An excursion to the mangroves with Dr Anusha Rajkaran from the University of the Western Cape (centre).*
***3, 5 & 7.*** *Students undertaking data collection in the Mngazana mangrove forest.*
***4.*** *A lecture "under the stars", quite literally, following dinner each night, from a guest speaker on various topics.*
***6.*** *Sampling for plankton in the estuary with technical assistance provided by ACEP's Mr Nick Riddin (standing in boat).*
***8.*** *Field trips like this provide great networking opportunities for students and supervisors from different universities.*

*Photos: Francesca Porri and Paula Pattrick*

# ALL-THINGS-AQUATIC

## Water World 'pops up' during Scifest Africa

*Coordinator: Vanessa Rouhani*

NRF-SAIAB has streamlined its science engagement efforts through targeting specific national focus events, such as the annual National Science Festival (Scifest Africa) and the DST's National Science Week, which are coordinated through the Research and Support Divisions.


*Water World on the Lawn at Scifest 2017*

Water World is offered by NRF-SAIAB as an official Scifest Africa venue and funded through ACEP. This "Pop-Up Science Centre" is a huge marquee set up and filled with exhibits showcasing any and all aquatic-related exhibitory at Scifest. Water World provides a public engagement platform for NRF-SAIAB and other research organisations, conservation projects, NGOs and even commercial ventures. A wide range of displays at Water World cover scientific aspects of aquatic biodiversity such as taxonomy, collections, genetic diversity, aquaculture and fisheries, sharks, dolphins, innovative technologies like remote underwater video cameras and ROVs used to study the marine environment, acoustic tracking of aquatic animals and the biocontrol of aliens!

Over the past five years, Water World has also offered lectures, workshops and apprenticeships at NRF-SAIAB, as well as the popular annual estuary excursions. The Water World exhibition venue is free to members of the public and NRF-SAIAB also funds transport for learners and educators from local schools as well as from farm schools in the Sarah Baartman District Municipality.

Water World encourages science promotion, communication and engagement and exposes learners, educators and members of the public to career opportunities in Science, Engineering & Technology.


***1.*** *Steven Mabugana carries out a shark dissection at the KwaZulu-Natal Sharks Board stand. Photo Vanessa Rouhani.*
***2.*** *Zinzisa Somana, DST/NRF intern at SAIAB describes the Water Cycle using simple experiments.*
***3.*** *Ms Qawekazi Mkabile and Mr David Gwapedza of the Institute for Water Research (IWR) explain how aquatic insects can be used as indicators of water quality.*
***4.*** *Learners play an educational fishing game at the Fun with Freshwater Fish stand.*
***5.*** *The Rhodes University Biological Control Research group showcase invasive plants and the biological control agents used to control them.*
***6.*** *"Hands on" during the Work with DNA in a Lab Apprenticeship facilitated by Molecular Laboratory Manager, Taryn Bodill.*
***7.*** *Samella Ngxande of the Rhodes University Biological Control Research Group explains how alien invasive aquatic plants are controlled through the use of biocontrol agents. Photo: Vanessa Rouhani.*
***8.*** *Aquatic invaders and how to combat them – learners look at the tiny aquatic insects used in the biocontrol of alien invasive aquatic plants. Photo Vanessa Rouhani.*
***9.*** *Prof Alan Whitfield, Chief Scientist at SAIAB, leads the annual Estuary Excursion during Water World, highlighting the different types of estuaries and the animals and plants that live in them.*
***10.*** *Learning how to measure micro amounts at the Molecular Biology and Systematics stand. Photo Vanessa Rouhani.*
***11.*** *A touch and feel exhibit at the Freshwater Fish Ecology stand.*
***12.*** *Ferdinand Jacobs shows learners some unusual fish specimens at the ACEP Phuhlisa stand. The Phuhlisa Programme offers intensive one-on-one training to postgraduates. Photo Penny Haworth.*
***13.*** *Learners interacting with WESSA volunteers in a session explaining the evapotranspiration cycle in trees. Photo Eileen Shepherd WESSA.*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# OCEAN STEWARDS

## Inspiring a new generation of marine scientists and conservationists

*Principal Investigator: Jean Harris*

The Wildlands Ocean Stewards Programme aims to catalyse the emergence of a strong new cohort of offshore marine scientists and conservationists. The project was launched in recognition of the threats facing the oceans, and the need for capacity for effective governance and ocean protection. The Ocean Stewards Programme is of key relevance to the Phakisa Ocean Economy presidential initiative to unlock the economic potential of the oceans while ensuring environmental sustainability. By providing young marine science students with a formative experiential journey that gives them unique insights into marine conservation it aims to inspire them to pursue careers in marine science and environmental management. The programme also offers ongoing mentorship and support for future study, providing a channel for students to take further steps towards becoming professionals.


R/V Angra Pequena *is the offshore vessel taking the Wildlands Ocean Stewards and ACEP Spatial Solutions research project team to sea. Photo Jean Harris*

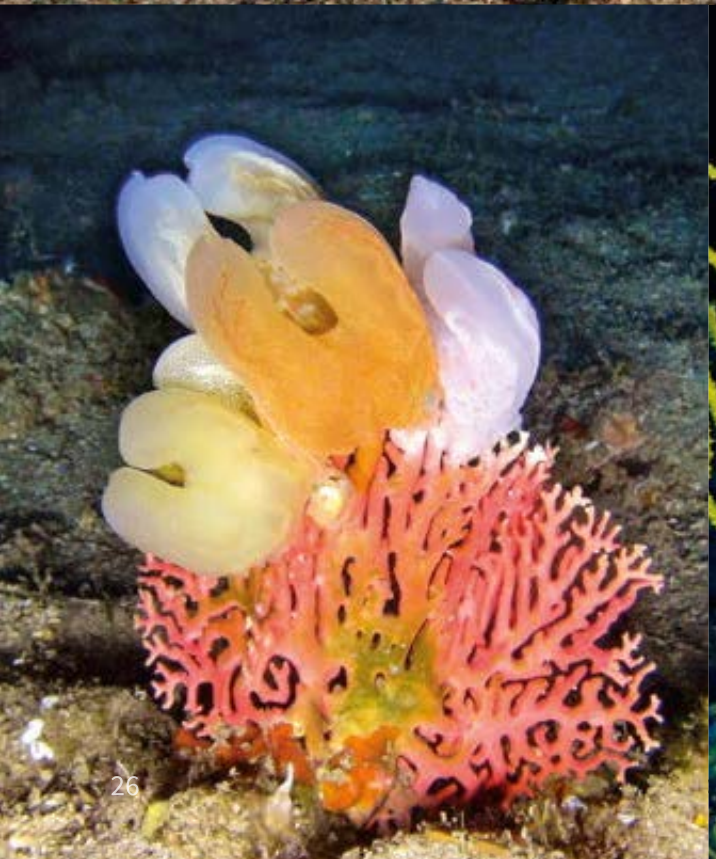
The programme is implemented as a partnership between Wildlands and two of the ACEP east coast projects: Spatial Solutions and Biodiversity Surrogacy. The Ocean Stewards participate in offshore research cruises conducted aboard *R/V Angra Pequena* for these projects. They also interact directly with marine communicators, managers, educators and industry representatives in dedicated learning sessions.

The Ocean Stewards engage in related activities that broaden their understanding of the scope of marine science opportunities, major threats to the marine environment and practical solutions to challenges. These have included attending symposia, coastal clean-up days and Marine Protected Area expansion stakeholder meetings.

***1.*** *The Ocean Stewards Programme has already developed into a fellowship of over 35 students from five universities across the country, networked with a wide range of marine scientists. Photo Fred Kockott.*
***2-3.*** *Central to the Ocean Stewards experience is the opportunity for marine science students to participate in offshore research cruises, working alongside field scientists, during which they are exposed to different sampling techniques and equipment. Photos 2. Shael Harris, 3. Tamsyn Livingstone.*

*ACEP ROV high definition camera captures the beauty of life on the deep reefs. Photo ACEP ROV with Ryan Palmer and Kerry Sink.*


***1-3.*** *Twenty-four final-year undergraduate, eight Honours and six Masters students participated in the ACEP offshore research cruises aboard* R/V Angra Pequena *in 2015 and 2016. An additional sixteen Ocean Stewards joined the project in 2017. Photos 1. Andrew Venter, 2. Fred Kockott, 3. Tamsyn Livingstone.*
***4-5.*** *Central to the Ocean Stewards experience is the opportunity for marine science students to participate in offshore research cruises, working alongside field scientists, during which they are exposed to different sampling techniques and equipment. Photos 4. Jean Harris,5. Nikki Chapman.*



*Ocean Stewards have participated in cruises where the first images of deep reef and soft sediment habitats in the proposed uThukela and Protea Banks MPA were taken with ACEP's Remotely Operated Submersible Vehicle (ROV). Photos ACEP ROV with Ryan Palmer and Kerry Sink.*

# INNOVATE 03

# ACEP MARINE PLATFORMS

As a National Facility, it is NRF-SAIAB's role to provide expensive and unique technical platforms that can be accessed by scientists, specifically in aquatic biodiversity research. NRF-SAIAB manages the ACEP Marine Platform which aims to provide coastal infrastructure that enables research down to 300m for the broader marine science community.

Funded through a multi-departmental partnership, ACEP is a cost-effective, collaborative model which has fostered multi-disciplinary research between more than 15 institutions. With capital outlay and running costs of marine platforms often beyond the reach of Higher Education Institution research programmes, ACEP provides opportunities for regional, national and international partnerships that strengthen South African marine science. The programme optimises good ecosystem-level research drawing together experts from multiple fields.

Innovative ACEP Marine Platforms provide access and technical support, managed through NRF-SAIAB, NRF-SAEON and the Department of Environmental Affairs:

## NRF-SAIAB

- Coastal Fleet: *R/V Phakisa,* a 15m Legacy Cat, stationed in Durban and *R/V uKwabelana*, a 13m LeeCat, stationed in Port Elizabeth.
- Marine Remote Imagery Platform: Seaeye Falcon Remotely Operated Vehicle (ROV) and Stereo-Baited Remote Underwater Video Systems (Stereo-BRUVs).
- Geophysics Platform: Multi-beam Sonar for mapping the seabed to depths of 300m.
- The Acoustic Telemetry Array Platform (ATAP): Acoustic receivers deployed in curtains along the east coast.
- Oceanographic Platform: CTDs, ADCPs, plankton pumps and nets.

## NRF-SAEON

- SAEON Algoa Bay Sentinel Site
- SAEON Agulhas System Climate Array (ASCA)

## DEPARTMENT OF ENVIRONMENTAL AFFAIRS – OCEANS & COASTS

- Defined-period access to the ocean-going research vessel *R/V Algoa*.

*The ACEP ROV being deployed from the* R/V Phakisa


*Left.* R/V uKwabelana *has ample deck space and is fully equipped for overnight trips. She can carry up to 11 scientists and sleep up to five. She operates out of the port of Port Elizabeth, usually between Port Alfred and Cape St. Francis, but is capable of moving along the coast and operating from any commercial harbour on the South African coastline.*

# FLOATING THE BOAT –

## ACEP's Coastal Craft and instrumentation platform

### COASTAL CRAFT

To date this highly successful platform comprises the 13m LeeCat, *R/V uKwabelana*, which is based in the port of Port Elizabeth and the more recently acquired 15m Legacy Cat, *R/V Phakisa*, which is based in Durban. *R/V uKwabelana* operates regularly between Port Alfred and Cape St Francis on a number of research projects which are awarded through the ACEP Open Call, ACEP *Phuhlisa* programme as well as on ad-hoc proposals from the broader marine science community. Regular use is also provided to platform partners such as ATAP and the SAEON Sentinel Site. The vessel is capable of carrying 11 researchers and can sleep five for periods of up to two days at sea, providing an excellent platform for SCUBA diving, ROV work, oceanographic sampling, plankton sampling, fishing, benthic sampling and more.

ACEP's partner platforms include the SAIAB Acoustic Telemetry Array Platform (ATAP), the SAEON Sentinel Site which is serviced on a regular basis by the vessel. This includes servicing the Continuous Monitoring Platform (CMP) equipment in Algoa Bay and St Francis Bay, SAEON Long-Term Ecological Monitoring (LTEM) plankton and oceanography sampling and the ATAP receivers in Algoa Bay.

The proven concept of and high demand for *R/V uKwabelana* in Algoa Bay led to ACEP expanding the Coastal Craft platform with the procurement of a second vessel, *R/V Phakisa,* of which ACEP took ownership in late 2016. *R/V Phakisa* is based in Durban but is capable of operating from other commercial harbours around the coast. To date she has serviced the Imida project for ROV operations off East London and in 2017 took on several small projects in KZN with the aim of testing a variety of different gears in preparation for the ACEP Open Call 2018.

The vessel is highly manoeuvrable and is an extremely effective platform for ROV, BRUV, diving, benthic grabs, multibeam mapping of the sea floor and oceanographic work. A hydraulic winch and A-frame allows for heavier work than is possible from *R/V uKwabelana*. The vessel has similar carrying capacity and can also operate at sea for up to two days.

The ACEP Open Call currently has three projects which subscribe to the Coastal Craft platform. These are Dr Francesca Porri's larval studies (see p. 52), Prof Rosemary Dorrington's biodiversity and pharmaceutical research programme (see p. 44) and Dr Sven Kerwath's Imida project in East London (see p. 50). These

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projects use the vessels for oceanographic work (CTD and ADCP), plankton sampling (plankton pump and bongo nets), benthic surveys and invertebrate collections (ROV), and habitat mapping (jump camera).

The rapid uptake of *R/V Phakisa* and high demand warrants the procurement of a third vessel, which will be ACEP's final step towards a national platform with vessels based in KZN, the Eastern Cape and the Western Cape by 2020.

## INSTRUMENTATION


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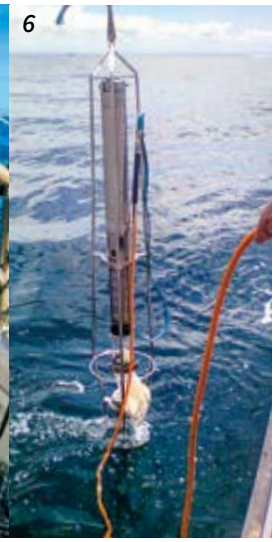
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***1.*** R/V Phakisa *is powered by jet propulsion making her extremely maneuverable, ideal for fine scale ROV operations. She is also equipped to operate a multi-beam sonar for high resolution bathymetry mapping.*
***2.*** *The SAIAB Seaeye Falcon ROV is equipped with an HD Video and 12MP still camera platform. It is ideal for benthic surveys and exploration work, allowing researchers a glimpse at previously inaccessible areas of the South African sub-marine environment to depths of 300m.*
***3.*** *Stereo Baited Remote Underwater Video (S-BRUV) system being deployed. Due to its stereo camera system researchers are not only able to measure abundance of fish, but size distribution too. An extremely valuable tool for fish stock assessments. Photo Steve Benjamin.*
***4-6.*** *Bongo nets, CTD rosettes and plankton pumps are some of the oceanographic equipment accessible to researchers through the ACEP Marine Platform.*

# KEEPING TRACK OF MARINE LIFE –

## The Acoustic Tracking Array Platform (ATAP)

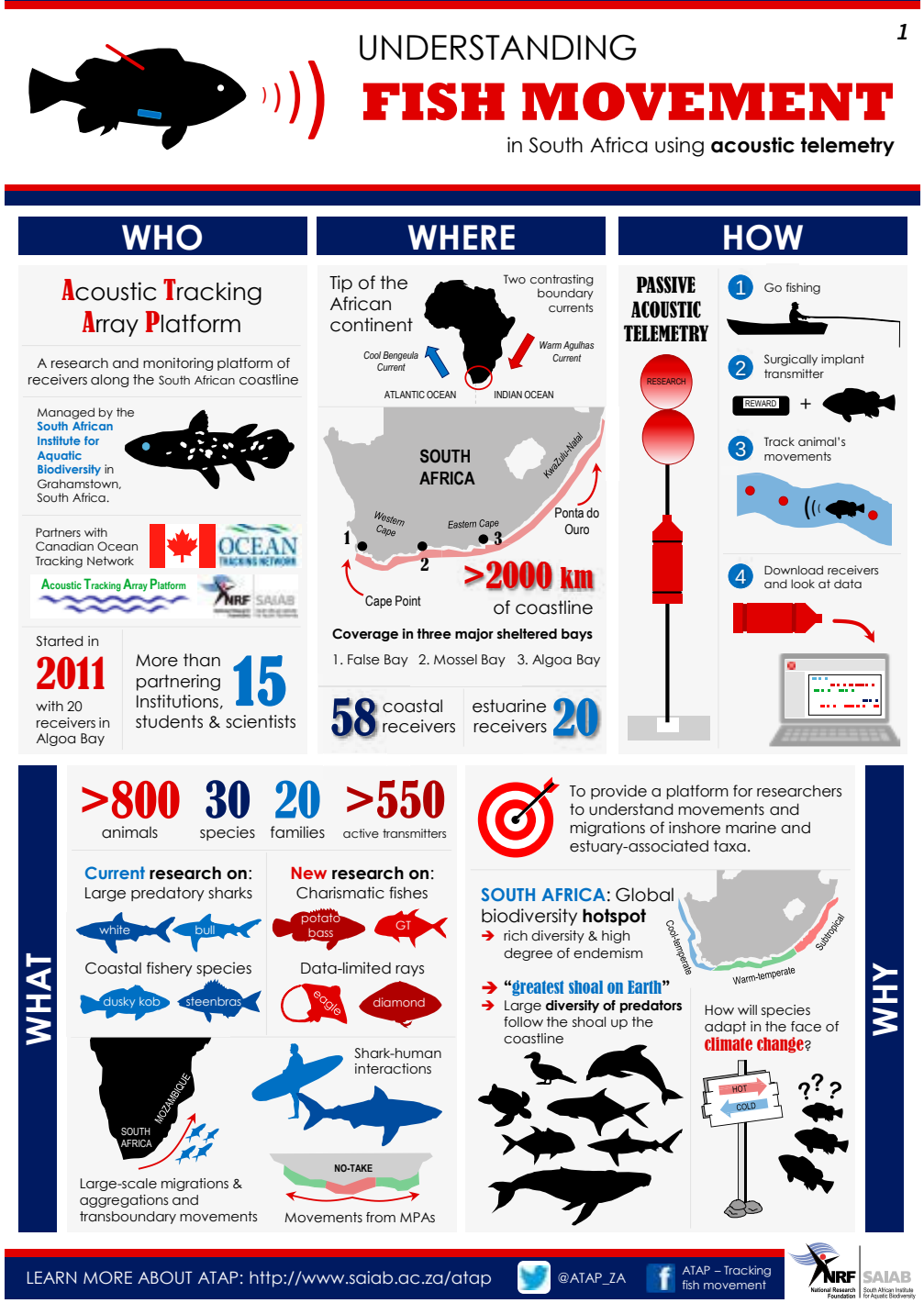
Human activities such as overfishing, pollution and alterations to aquatic habitats have caused many marine species to suffer major population declines. As a result, research is needed to guide conservation and management efforts to ensure the sustainability of species that are of ecological importance, economic value or conservation concern. A critical gap in our understanding of most underwater species is knowing how they distribute themselves through time and space. Information on the movement patterns of animals provides a better understanding of when and where they might be vulnerable and is essential for improved management.

Technological advancements in the field of acoustic telemetry now enable researchers to study marine animal movements and behaviour remotely. The technique involves the surgical implantation of a transmitter into an animal's body cavity. As the animal moves into the detection range of a listening station (acoustic receiver) anchored on the seabed, the receiver will log the unique ID code of the transmitter (tagged animal) together with a record of the date and time. Data collected from multiple receivers deployed over large areas are then pieced together to reveal the whereabouts of tagged animals over time.

The use of this technology has led to the development of several large-scale acoustic receiver networks around the globe (Figure 3, pp. 32). This includes South Africa's Acoustic Tracking Array Platform (ATAP) which consists of approximately 100 acoustic receivers, spanning approximately 2 000 km of coastline from Cape Point to the South Africa–Mozambique border, allowing researchers to track large-scale coastal movements of their tagged animals. More than 700 animals have been tagged to date, including important estuarine and coastal fishery species such as the dusky kob and iconic predators such as the white shark and the Zambezi shark.

This ACEP platform, partly supported by the Save Our Seas Foundation, is a partner of the Canadian-based global Ocean Tracking Network (OTN). NRF-SAIAB staff are responsible for downloading and servicing the receivers, while the data collected are shared with the researchers who initially tagged each animal. Currently more than 30 researchers from 14 different organisations benefit from this platform. The ATAP can be viewed as a long-term monitoring programme that provides an unprecedented opportunity for new discoveries on the secret underwater lives of many different species.

***Divers** inspecting a deployed receiver off Mozambique. Photo Ryan Daly.*






*1. Understanding fish movement in South Africa. Infographic Taryn Murray.*
*2. A large Zambezi shark in a state of tonic immobility ready to be surgically equipped with a longlife acoustic transmitter. Photo Barry Skinstat.*
*3. Global telemetry review image: Global distribution of acoustic telemetry studies showing the South African Acoustic Tracking Array Platform.*


***4.*** *Tagging team preparing to tag a Zambezi shark in Ponta do Ouro. Photo Ryan Daly.*
***5.*** *ATAP technician Willy Kokose servicing acoustic receivers for deployment in coastal waters around South Africa. Photo Paul Cowley.*
***6.*** *ATAP acoustic receivers are also deployed in estuaries and held on the bottom inside concrete mooring blocks. Photo Kyle Smith.*
***7.*** *After interrogation the ATAP receiver and acoustic release float to the surface. Photo Ryan Daly.*
***8.*** *Port Alfred - Siseko Benya (left, ACEP Technician) and Matt Parkinson (right, ATAP Instrument Technician) waiting for ATAP equipment to surface after interrogating the acoustic release mechanism. Photo ATAP.*

# RESEARCHING SUB-TIDAL REEFS

## across the continental shelf of South Africa - Marine Remote Imagery Platform – mar-RIP

Effective management of marine resources relies on robust and current data on the populations of target species and the condition of ecosystems. Ideally the data should be collected using standardized methods which provide useful measurements to describe the distribution of habitats and the structure of populations and communities. While this may seem like a straightforward requirement, research on subtidal reefs in South Africa is challenging. The species distributions, particularly of the fish, are broad, covering expansive latitudinal (e.g. from Cape Point to southern Mozambique) and depth (e.g. 5 – 250 m) ranges. The vast and extreme nature of the environment, characterized by rough sea conditions, strong ocean currents and high pressures in deep water, rigorously tests both sampling equipment and the resolve of marine scientists. ACEP, in collaboration with various partners, has taken up this challenge through the establishment of remote video and photographic sampling units (housed under the mar-RIP) to compliment the coastal crafts platform and facilitate standardized subtidal reef research at a national scale.


*A stereo-BRUV sits perched on a rocky reef with a collection of reef fish typical to the warm-temperate Agulhas Ecoregion of South Africa. Photo Steve Benjamin.*

### ROV unit:

The SAAB Seaeye Falcon 12177 Remotely Operated Vehicle (ROV), which is rated to 300 m, is equipped with an HD video and 12MP stills camera. The platform is ideal for benthic surveys and exploration work, allowing researchers a glimpse at previously inaccessible areas of the South African sub-marine environment.

Over the past seven years the ROV has been used successfully for exploratory work as well as benthic surveys. Operations have been conducted off ACEP's own vessels, *R/V uKwabelana* and *R/V Phakisa*, as well as off third party vessels such as DAFF's *R/V Ellen Khuzwayo* and SeaQuest's *R/V Angra Pequena.*

The ROV platform is well-integrated into the ACEP Open Call projects. Together with researchers, the ACEP technical team have been working hard at honing ROV skills and sampling techniques to produce high-quality, quantifiable data.

The unit is now confident to base student projects around the use of the ROV for data collection and with the capabilities firmly established, the demand on the ROV by researchers is increasing. In the current ACEP Open Call, three of the six projects are making use of the ROV for data collection in KZN and the Eastern Cape.

**Current ROV Projects:**

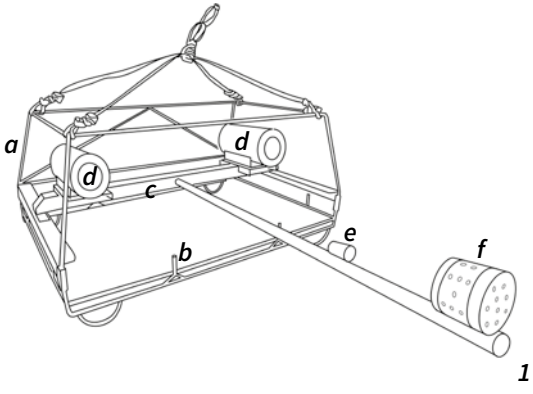
1. **Benthic Biodiversity:** Benthic biodiversity from the Agulhas Bioregion as a source of new pharmaceuticals. Prof Rosemary Dorrington (RU)
2. **Spatial Solutions:** Interdisciplinary spatial solutions for marine conservation planning. Prof Andrew Green (UKZN)
3. **Imida (Frontiers) Project:** Towards conservation planning in the Amathole area of the Eastern Cape. Dr Sven Kerwath (DAFF)

## Stereo-BRUVs unit:

Over the last four years researchers at NRF-SAIAB and NRF-SAEON Elwandle Node, have been applying Baited Remote Underwater Stereo-Video Systems, or stereo-BRUVs, to survey reef fishes on the continental shelf of South Africa. This research has aimed to determine the suitability of stereo-BRUVs for sampling our reef fishes and to further our understanding of their ecology and the impacts of fisheries and management. Stereo-BRUVs are a relatively novel benthic fish sampling technique that are rapidly gaining in popularity around the world due to their ability to effectively sample fish assemblages in a standardized manner, over a very broad depth range and provide accurate measurements of fish size without the need to capture the fish.

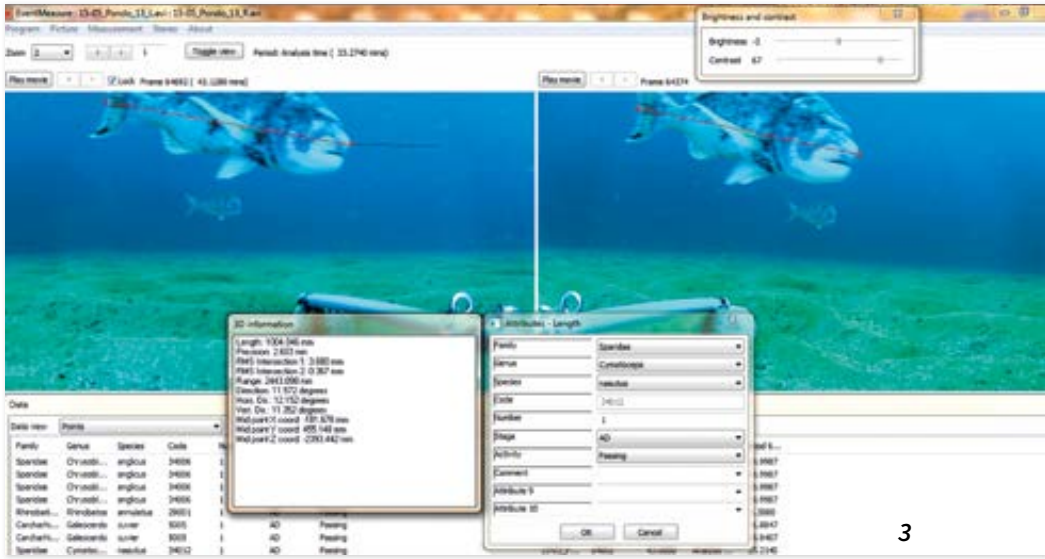
At present the unit consists of nine shallow water stereo-BRUVs (< 50 m depth) and eight deep water stereo-BRUVs (< 150 m depth). While these system have been highly effective at sampling to depths of 150 m, research on the deeper reefs has proven very challenging due to strong currents dragging moorings underwater. With this in mind the unit has invested in the development of two acoustic release stereo-BRUVs that will permit sampling of benthic habitats on the outer edge of South Africa's continental shelf and within the bathyal benthic zone of South Africa's marine environment. These systems use a combination of sacrificial ballast, linked to acoustic releases that when triggered release the ballast, and built in buoyancy to enable the deployment to and retrieval from the sea floor. In this way they do away with the need for mooring ropes and permit deeper water research.

At present, 10 separate projects, spanning the South African coastline between





*Schematic diagram showing **(1)** the design of a stereo-BRUV system and **(2)** an actual system deployed in the Tsitsikamma MPA.*
*Both pictures, **(1)** and **(2)**, illustrate how the stereo-cameras (labeled **d** in picture **1**) are positioned to provide an overlapping field of view centered on the bait canister (labeled **f** in picture **1**).*



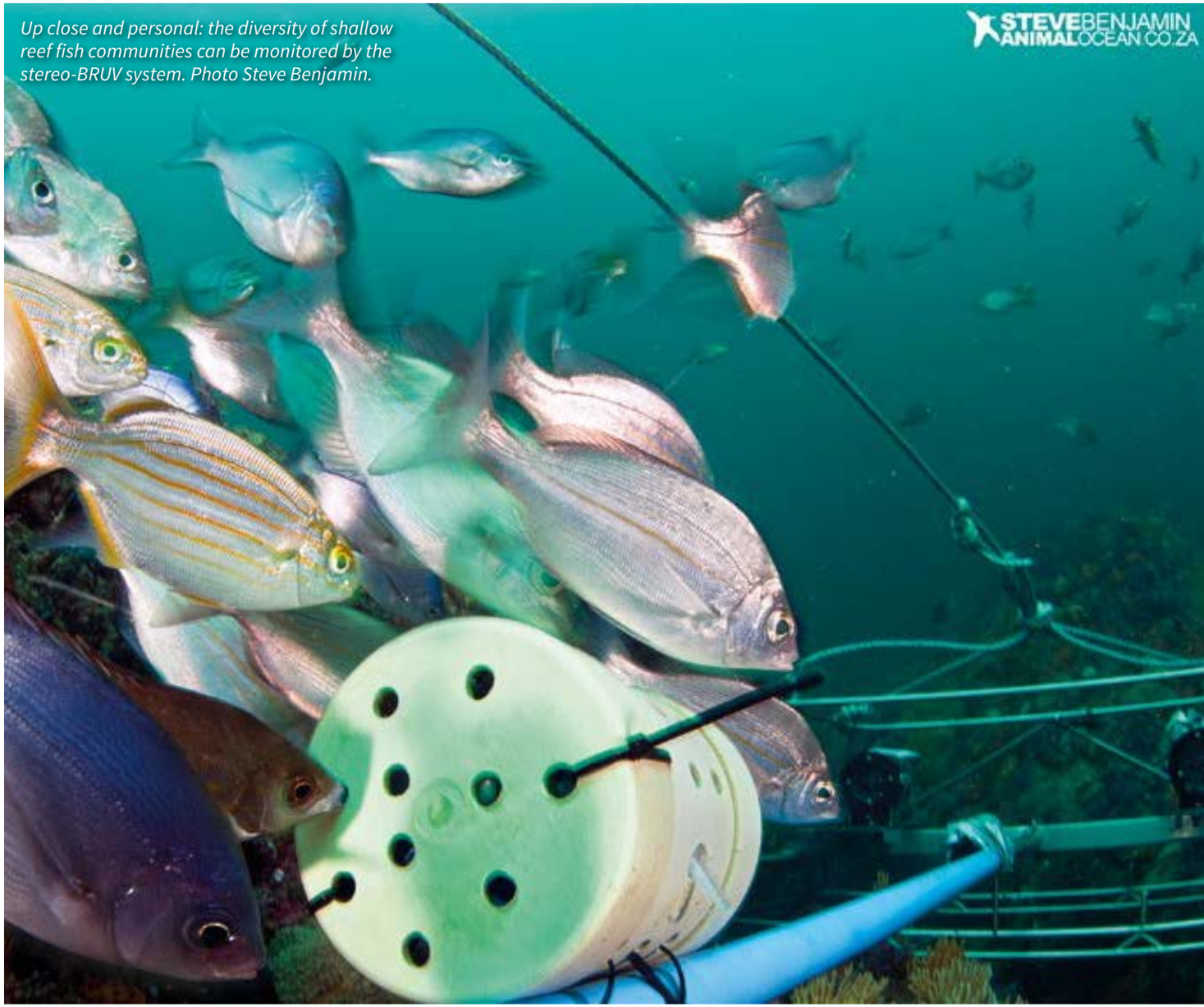

*Picture (**3**) shows how the stereo-videos are processed to obtain length measurements using the camera calibration files.*
*Photo and picture credits 1: Elodie Heyns; 2: Steve Benjamin; 3: compiled by Anthony Bernard.*

Cape Town and iSimangaliso Wetland Park at Sodwana Bay, make use of mar-RIPs stereo-BRUVs. Through their involvement with students, or as collaborators on the different projects, 14 researchers and 16 institutions (13 local, three international) are benefiting from the data collected by the stereo-BRUVs unit. The bulk of these projects employ the *stereo-BRUVs* to address research question on aspects of the spatial ecology and conservation of reef fish in South Africa.

## Additional mar-RIP units

Over the course of 2016 and 2017 the mar-RIP has been expanding to increase its ability to provide infrastructure to the meet the requirements of the subtidal marine research community in South Africa. This has included the purchase of:

- *Remotely Operated Multi-Imaging Drop Cameras* that will enable expanded research on benthic invertebrate communities.
- *Diver Operated Stereo-Video Systems* and *Diver Operated Benthic Camera Systems* to enable in situ surveys of reef ecosystems
- *8.5 m Rigid Hulled Inflatable Boat* to enable research activates utilising the platform's different sampling equipment
- Imagery Repository (150 TB, initial capacity, Network Attached Storage System) and database providing secure long-term storage of imagery data.




*Up close and personal: the diversity of shallow reef fish communities can be monitored by the stereo-BRUV system. Photo Steve Benjamin.*

# NEW DIMENSION FOR MARINE SCIENCE –

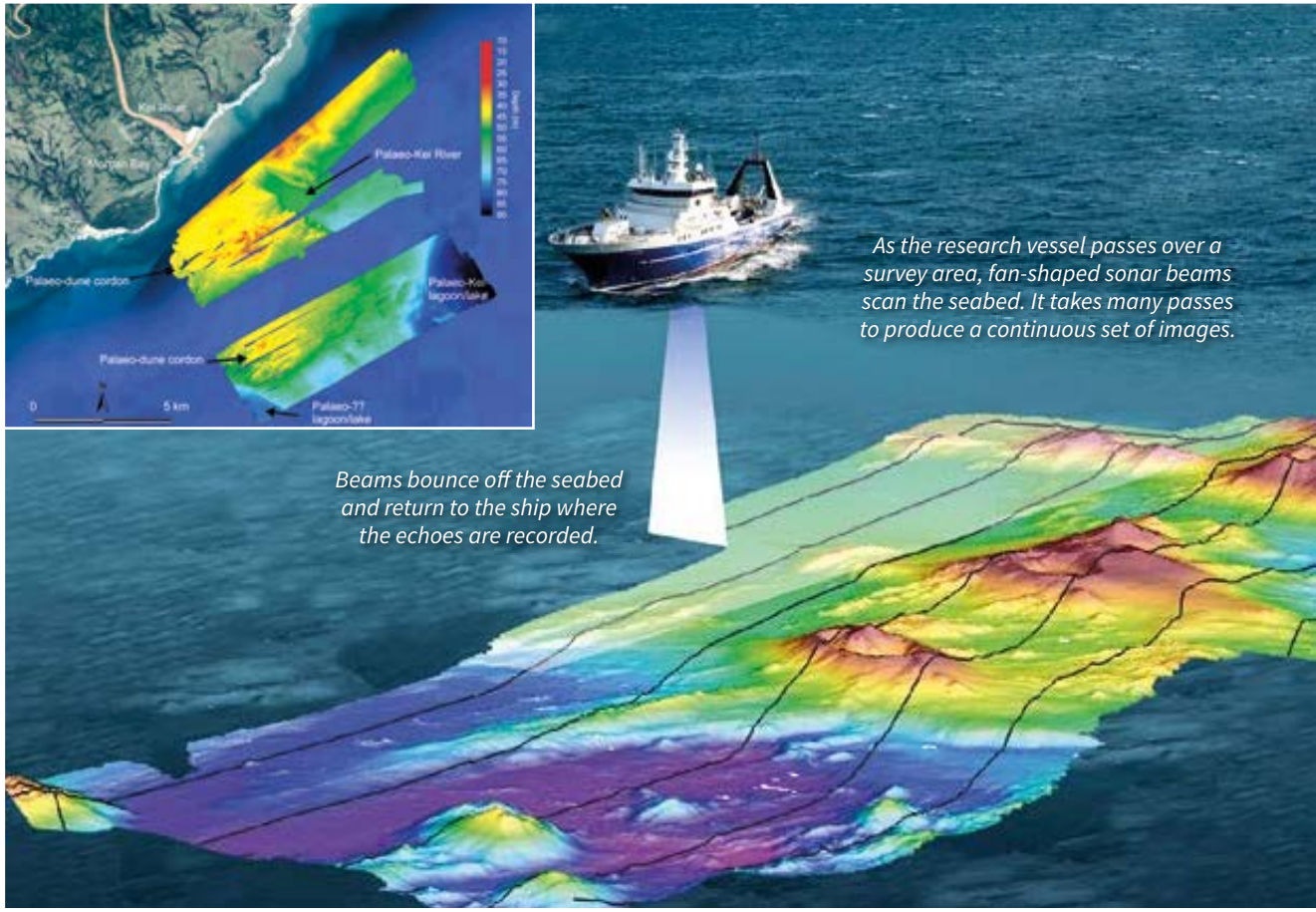
## ACEP Geophysics Platform

ACEP recently acquired the components necessary to make up a marine geophysics platform, which provides a new dimension for marine science. The high-resolution multibeam imagery obtained using the ACEP platform, in conjunction with the UKZN Department of Geology, is able to provide for greater understanding of the layout of the seafloor.

The imagery to date, as shown in the image (right) of the Eastern Cape coast around Kei Mouth and Morgan Bay, has already provided a wealth of knowledge on paleo-estuaries. This links back to the historical coastline of South Africa, where one is able to see historic river pathways and estuarine lagoons and bays at depths of between 30-70m, with paleo-shoreline and lagoons that are about 11 500 years old.

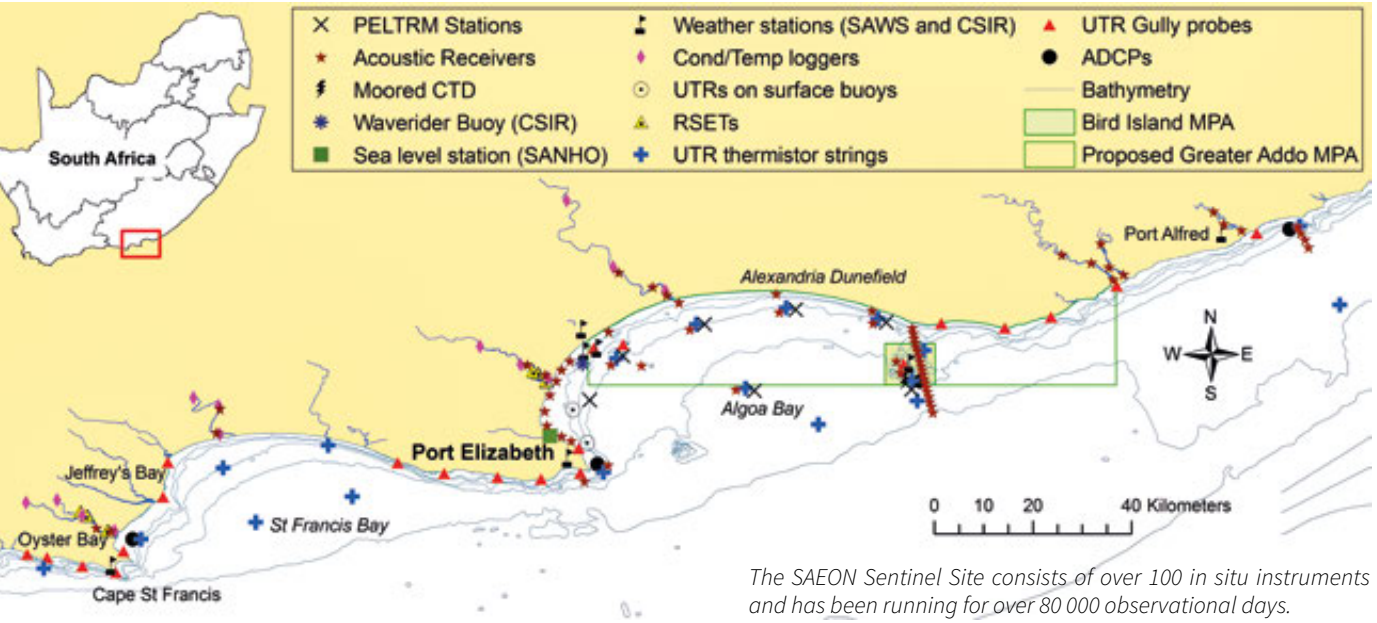
The geological information is then passed on to biologists who are able to determine what community compositions are linked with corresponding habitats in different depth strata.

Understanding the importance of different habitats and their roles in the ecosystem is of critical importance when attempting marine spatial planning. Based on the geology and consequent communities which reside in and around them, areas can be zoned to ensure that highly important habitat types and regions of high levels of rare species can be protected.




*Multibeam sonar involves surveys which cover a transect along the seafloor which is roughly three times the depth of water in which you are working, which makes it far more efficient and higher resolution than a single beam sonar system. This information is then translated into benthic habitat types and sea-bed composition. Graphic reproduced courtesy of NIWA.*

# NRF-SAEON ALGOA BAY SENTINEL SITE –
## a Longterm Coastal Observatory Platform




*The SAEON Sentinel Site consists of over 100 in situ instruments and has been running for over 80 000 observational days.*

The Algoa Bay Sentinel Site is a long-term ecological research (LTER) site of the South African Environmental Observation Network (SAEON) that encompasses the nearshore, coastal and inner continental shelf areas around Algoa Bay, St Francis Bay and Port Alfred on the Eastern Cape coast of South Africa. The Sentinel Site comprises more than 40 permanently moored in situ observatories with over 190 instruments measuring physical variables deployed along this stretch of coast.

The primary objective behind the development of the Algoa Bay Sentinel Site was to create a coastal observatory platform that would span a large enough area to be suitable for scientific enquiry, yet be small enough to remain viable in the longterm relative to the number of people available to run it. Data generated were to be of sufficient quality to monitor, detect and understand environmental change as and when it happens, as well as be of sufficient quality to augment shorter term research programmes typically run by students or researchers from other institutions and universities. Since deploying the first Gully Temperature Probe near Kenton-on-Sea on 23 October 2008, nearly 80 000 combined observation days have been recorded.

Four types of observatories are currently in use to monitor temperature structures (coastal and nearshore), current profiles and variation in other water column properties. They are: Acoustic Doppler Current Profilers (ADCP), Underwater Temperature Recorders (UTR), Gully Temperature Probes (GTP) and Moored SeaBird CTD deployments. In partnership with NRF-SAIAB, NRF-SAEON expanded on their temperature observation network by adding HOBO temperature sensors to Acoustic Telemetry Array Platform (ATAP) mooring transects, launched in collaboration with the Ocean Tracking Network (OTN).

Together NRF-SAEON and the aforementioned partners have developed a coastal network of long-term observatories in Algoa Bay and surrounding coastal waters that is unrivalled in Africa and, potentially, the southern hemisphere.

# NRF-SAEON AGULHAS SYSTEM CLIMATE ARRAY

## established on the east coast of South Africa to monitor inter-ocean exchanges

*By Dr Tammy Morris (ASCA Coordinator – NRF-SAEON)*

The South African Environmental Observation Network (SAEON) was established in 2002 with the Department of Science and Technology (DST) taking the lead, mandating and funding the National Research Foundation (NRF) to establish a network of science institutions, universities, relevant government departments and industrial partners. NRF-SAEON is mandated to undertake three objectives: 1) observe the environment in the long-term, 2) inform the science community, stakeholders, policy and decision-making entities and the general public on relevant scientific results and 3) to educate. Of the six established nodes, the Egagasini Node observes marine-offshore systems, combining data, resources and knowledge from a wide range of partners to understand the oceans, their ecosystems and biodiversity, in terms of an ever-changing climate and thus the impact of climate change on the ocean's resources.

In order to understand global change and the impacts on South Africa, the establishment of sustained measurements of key biomes are essential. Of focus here is a long-term time series within the offshore marine environment of the Agulhas Current,

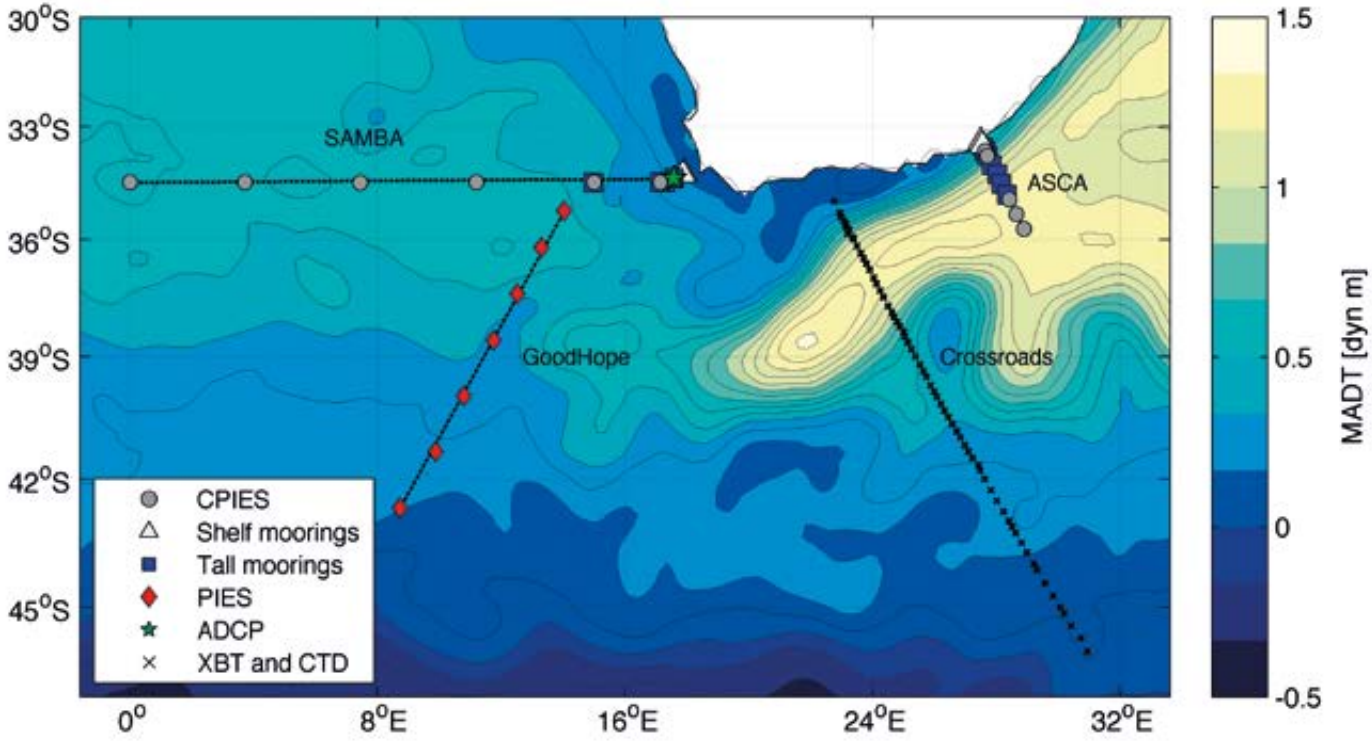



***Figure 1:*** *Schematic and instrument deployments for the large mooring arrays deployed around South Africa (Morris* et al, *2017). The ASCA moorings are a combination of shelf and tall moorings and CPIES deployments, and are shown as a transect across the Agulhas Current.*

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the strongest western boundary current in the Southern Hemisphere. The Agulhas Current directly impacts weather and climate both over Southern Africa and into the Northern Hemisphere through the Atlantic Meridional Overturning Circulation through the transport of heat and salt, and is also itself impacted by global change, and in turn propagates these altered dynamics, creating a feedback loop that is not fully understood (Morris *et al* 2017). In order to monitor and begin understanding the inter-ocean exchanges between the Indian and Atlantic Oceans and the driving mechanisms the Agulhas Current has on the South Atlantic in particular, an integrated system of mooring and monitoring arrays has been successfully deployed around South Africa (Figure 1).

The Agulhas System Climate Array (ASCA – Figure 1: http://asca.dirisa.org/), consisting of seven tall and two shelf moorings with Acoustic Doppler Current Profilers (ADCP), single-point current meters and MicroCats, and five Current- and Pressure-Inverted Echo-Sounders (CPIES), has been established on the east coast of South Africa (34.5° S) to monitor this heat and salt transport. The array was designed to capture the meandering and non-meandering state of the Agulhas

Current, with moorings deployed 200 km offshore, with the additional CPIES deployments extending the array to 300 km offshore. The objective of the array is to determine heat, salt and volume transport along the Agulhas Current over time and to determine the regional and coastal impacts of this powerful western boundary current.

The Array includes instrumentation such as MicroCat sensors to collect essential data on temperature and salinity changes over time. The array of moorings, along with surveys of Conductivity, Temperature and Depth (CTD) stations and ship-borne ADCP transects, has begun to provide a time-series of the Agulhas Current. This provides the baseline on which changes to flow dynamics, volume transport and mesoscale variability can be studied.

It has been suggested that monitoring the Agulhas Current is like "having your finger on the pulse of climate change" hence a comprehensive understanding through sustained detailed observations is a minimum requirement to developing knowledge of a changing planet. Ideally, ASCA would need to be successfully deployed for a minimum of ten years to begin addressing key questions, with the first five years for establishment, to build scientific and technical capacity within South Africa and produce results from the acquired data. ASCA is a multi-institutional programme and provides a platform for South African researchers and students keen to study global change within the Agulhas Current.


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***1-3.*** *ADCP mooring deployment off the* R/V Algoa *in April 2015. Photos Jarred Voorneveld.*
***4.*** *Argo float deployments off the MV* SA Agulhas II *during the SEAmester / ASCA cruise in July 2016. Photos Thomas Mtontsi.*
***5-7.*** *Student training on the MV* SA Agulhas II *during the SEAmester / ASCA cruise in July 2016. Photos Thomas Mtontsi.*

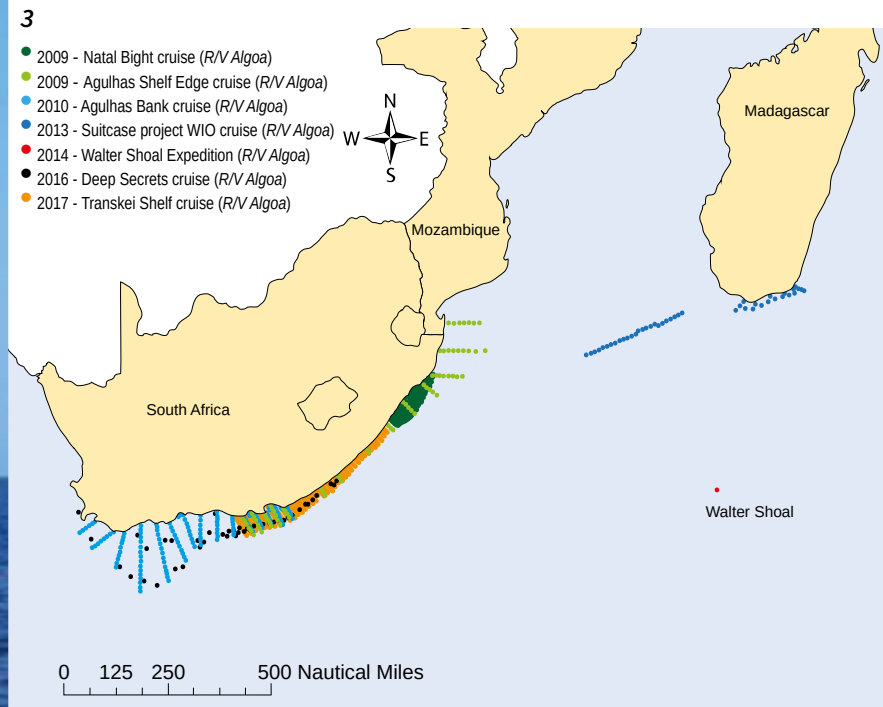
# *R/V ALGOA* – out into the ocean deep

The *R/V Algoa*, owned by the Department of Environmental Affairs (DEA) provides a unique and important platform to ACEP adding a valuable offshore dimension to the programme. While ACEP does have coastal craft these vessels are designed for short inshore trips. Access to the *R/V Algoa* allows scientists to undertake longer cruises of 20 to 30 days in deep water and often far from a port. Over the years, the *R/V Algoa* has provided access to offshore areas such as Agulhas shelf edge, Agulhas Bank, Madagascar and Walter's Shoal for researchers on a number of projects.

The ship also allows for a number of activities that would otherwise be unavailable on a competitive basis. These include: deep water dredges, ski-monkey operation, deep water sediment grabs and cores, multi-net deployment, CTD measurements taken while moving through the water and deep-water CTD casts. Crucially, the *R/V Algoa* is also available to deploy and retrieve large oceanographic moorings.



***1.*** *Conductivity, Temperature, Depth (CTD) profiler being deployed from the* R/V Algoa.
***2.*** *The* R/V Algoa *owned by the Department of Environmental Affairs – a unique and important deep sea marine research platform.*
***3.*** *ACEP Open Call cruises on the* R/V Algoa *from 2009-2017.*



# EXPLORE

04

# BENTHIC BIODIVERSITY

## from the Agulhas Bioregion as a source of new pharmaceuticals

1

*Principal Investigator:*
*Professor Rosemary Dorrington*

More than half of new pharmaceutical drugs on the market or in clinical trials are derived from natural products and their by-products. The majority of these are secondary metabolites, or organic compounds, produced by marine organisms such as sponges and ascidians, algae and bacteria, as a chemical defence against predation and disease-causing pathogens. These small molecules, known as marine natural products, are highly selective and potent inhibitors of their biological targets, making them excellent lead compounds for pharmaceutical development as anti-bacterial, anti-viral and anti-cancer drugs.

This project seeks to explore the potential for the production of novel bioactive small molecules by marine organisms of the biodiversity-rich Agulhas Bioregion off the south-east coast of South Africa. The research aims to extend knowledge of the macro- and microorganism diversity of coastal shelf reef and soft sediment habitats at depths of between 30 m – 100 m.

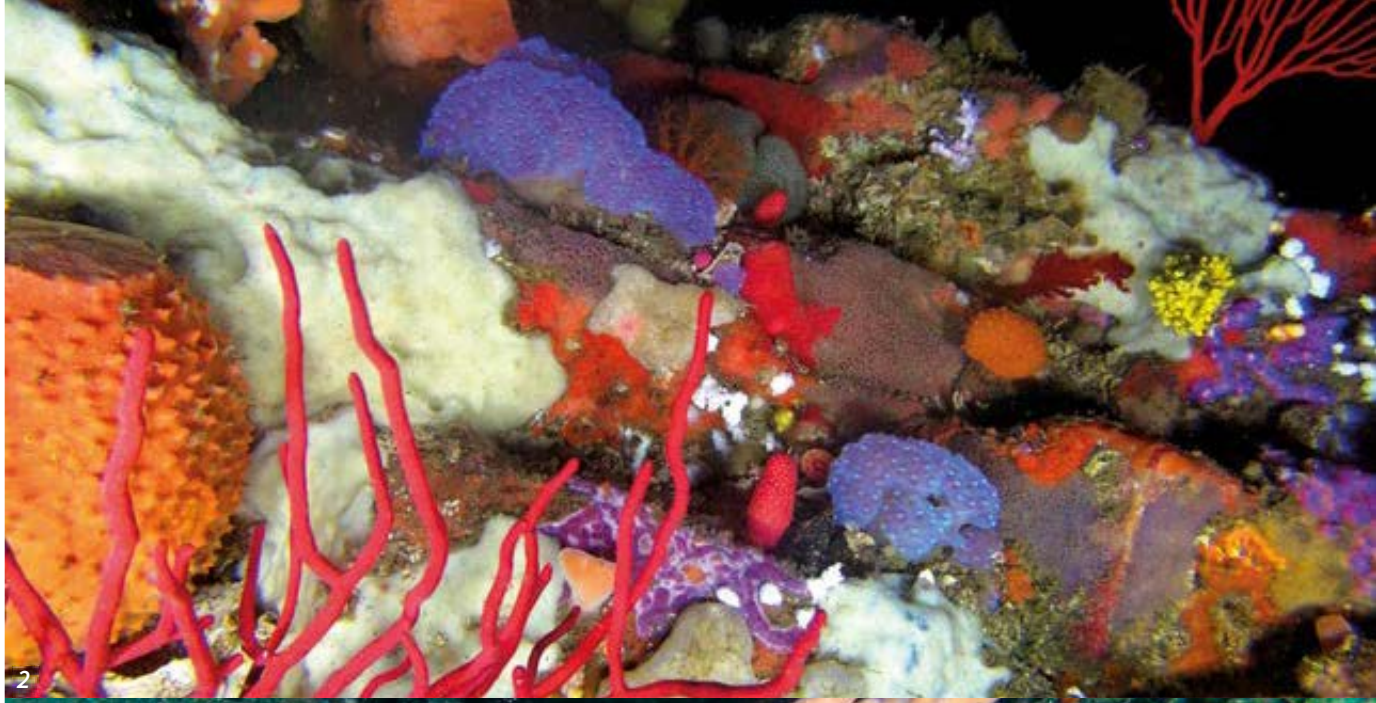
Almost nothing is known about these benthic communities because they are found beyond the reach of SCUBA divers and require specialized remote

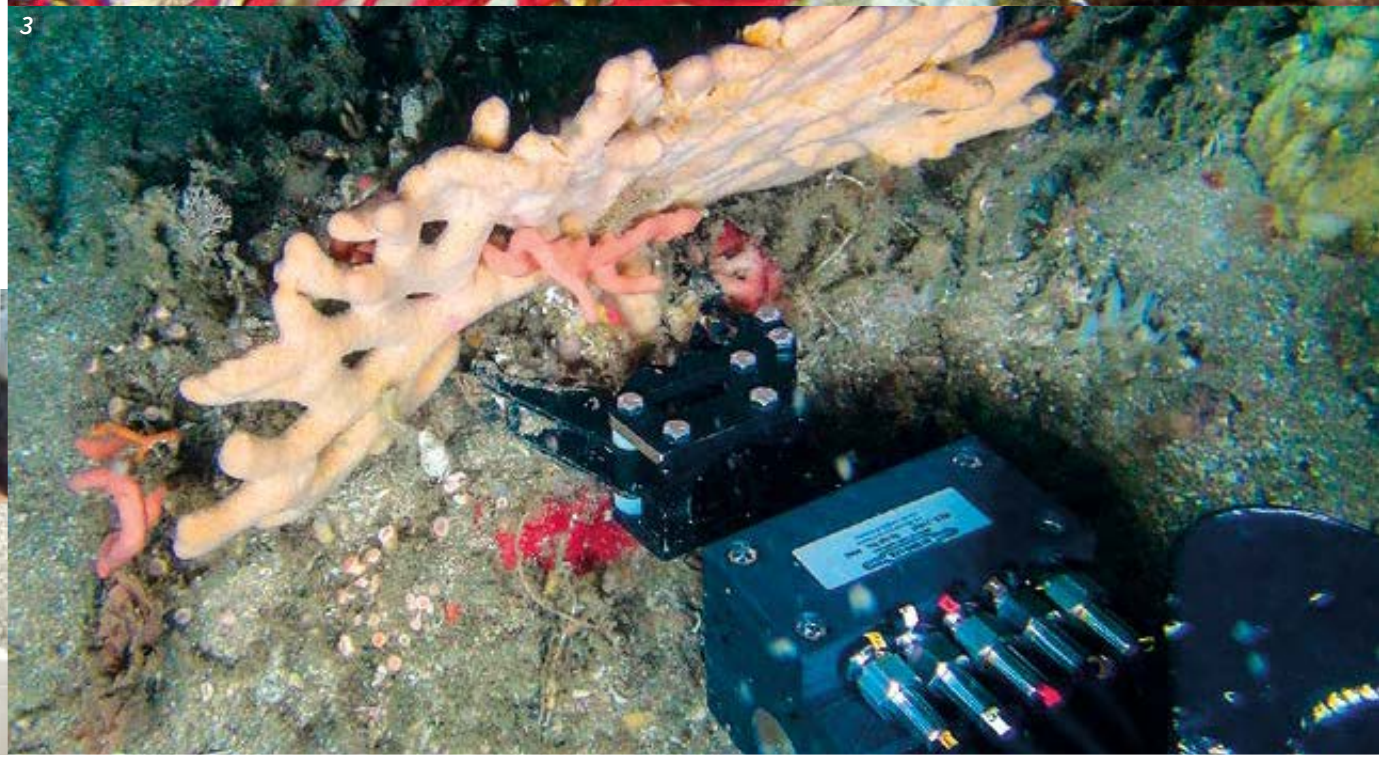
***1.*** *Just below the surface. Colourful reef habitat with long fingered warty sea fans* (Homophyton verrucosum)*, stalked latrunculates (Tsitsikamma pedunculata), a variety of ascidians including the sandy* Polyclinum isipingense *and red ringed yellow* Synoicum globosum *under the silver bodies of fransmadams* (Boopsoidea inornata) *(Evans Peak, Algoa Bay, 35 m).*

***2.*** *Marine Garden of Eden. A kaleidoscope made up of purple ascidian, white, yellow, red and orange soft corals and sea fans, cream, brown and oranges encrusting sponges and a large orange finger sponge and prickly flat headed ball sponge - more than 20 species all together in one frame! (Evans Peak, Algoa Bay, 55 m).*

***3.*** *Collecting a yellow finger sponge specimen by Remote Operating Vehicle (Evans Peak, Algoa Bay, 38 m).*

***4.*** *The Rhodes University Marine Natural Products Research Team: Front (from left to right): Meesbah Jiwaji, Storm Hilliar, Samantha Waterworth, Holisha Moodley, Janet Awando and Rosemary Dorrington. Back: Jarmo Kalinski, Venkatachalam Sidderthan, Eric Isemonger and Mart-Mari de Bruyn.*




operating research equipment to gather data and collect samples. These hurdles can now be overcome by making use of facilities provided by the ACEP and NRF-SAEON research platforms. The study has revealed significant numbers of as yet undescribed invertebrate and tunicate taxa that are associated with complex and diverse microbial communities that have the potential for producing novel bioactive compounds.

*All photographs taken by the ACEP SeaEye Falcon ROV operated remotely from NRF-SAIAB's* R/V uKwabelana.

*Large Basket Star (Riy Banks reef, Algoa Bay, 65m).*

# DEEP SECRETS –

## Shedding light on deepsea ecosystems

*Principal Investigator: Dr Kerry Sink*

The Deep Secrets Project aims to build capacity so that we can research and understand our coast's outer shelf, shelf edge and slope ecosystems and thereby support improved integrated ecosystem-based management across multiple sectors in South Africa. To achieve this, our research objectives focus on understanding the shelf edge geology and oceanography and how this influences benthic and pelagic biodiversity, biogeography, community structure and ecology. The research outputs support evidence-based decision making for the National Biodiversity Assessment, Marine Spatial Planning, Marine Protected Area design (including seven of the Phakisa proposed MPAs), ecosystem-based fisheries management, marine stewardship initiatives and marine sustainable development goals.

A key project component was a month long, offshore Phakisa cruise aboard *R/V Algoa* which involved 13 scientists, technical experts and students from nine

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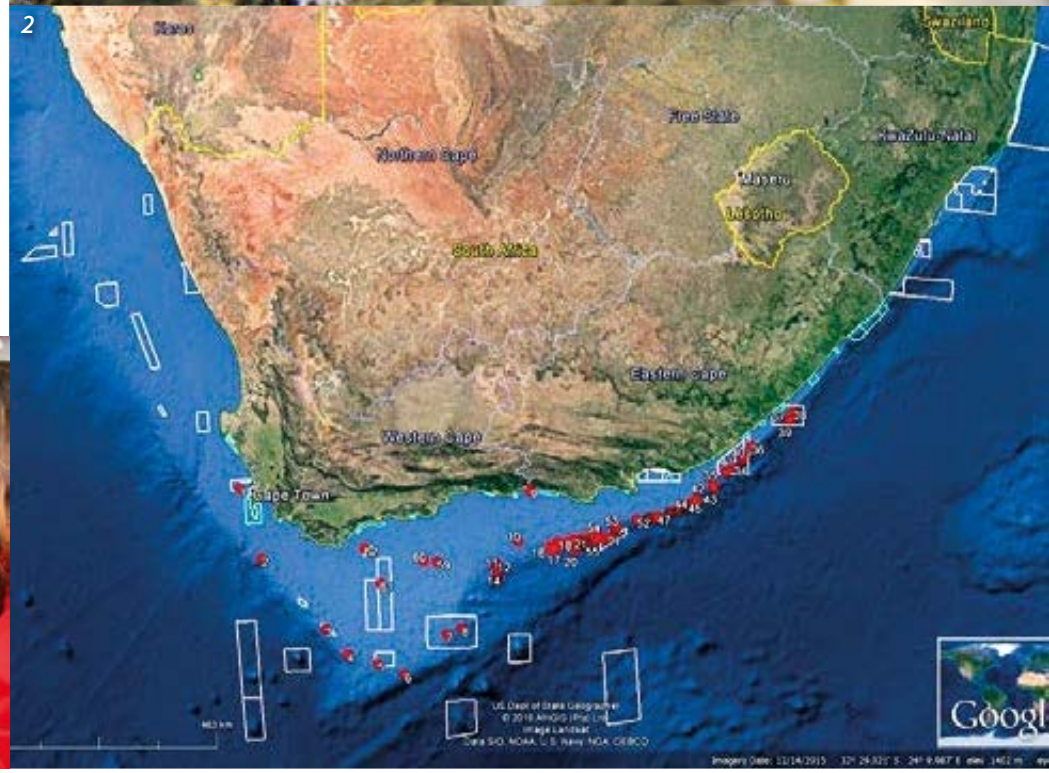
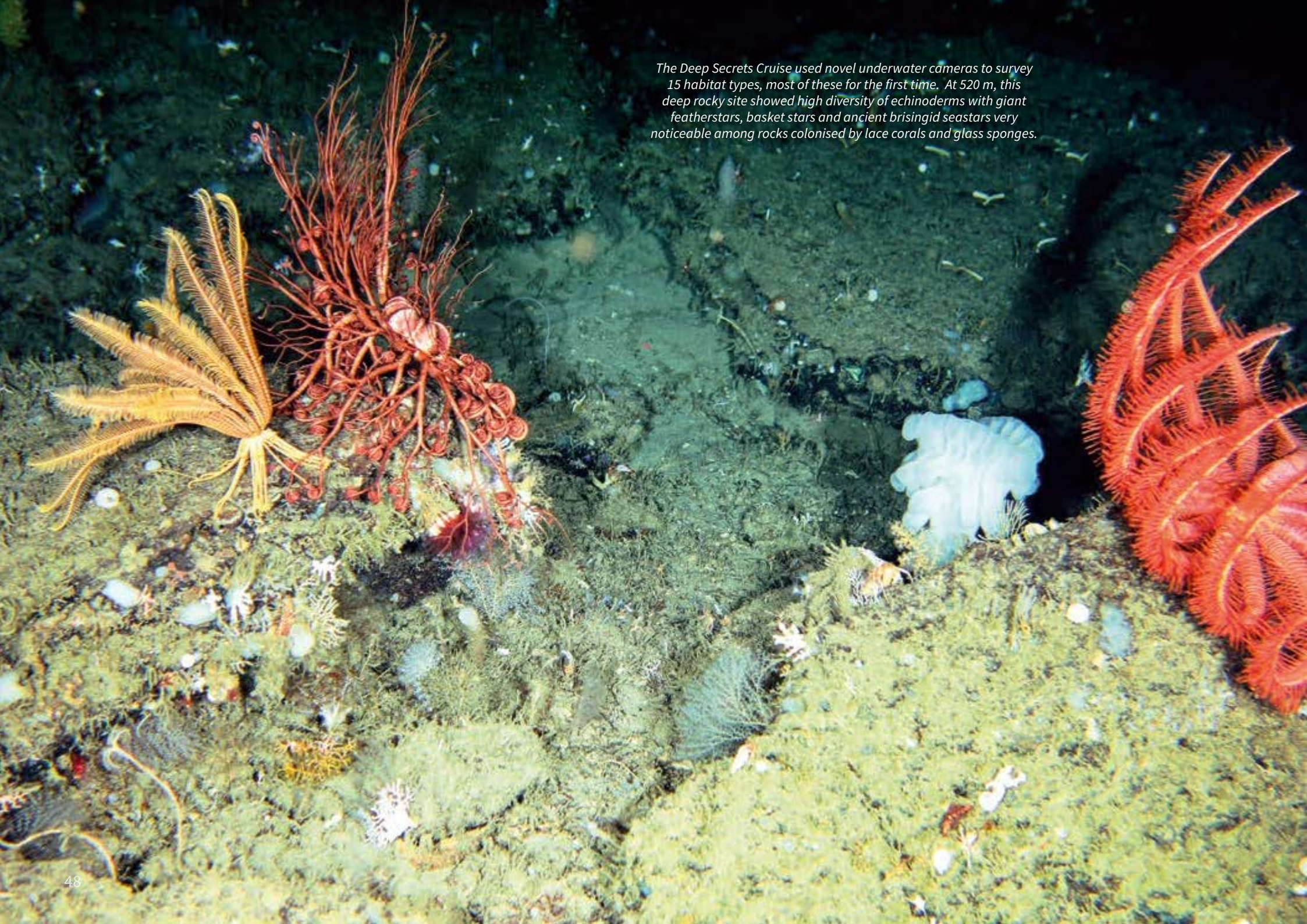



2

3

***1.*** *Secret Reef - One of the first images of the sensitive cold water coral reef in South Africa's deepsea environment.*
***2.*** *Google Earth map with stations and MPAs - The first surveys at seven of the Phakisa proposed Marine Protected Areas (MPAs) will be used to inform the National Habitat map and MPA boundaries, management and decision making in response to stakeholder comments about South Africa's proposed new MPA network.*
***3.*** *Viewing octocorals such as this* Thouarella *species under a microscope revealed associated species such as brittle stars and scale worms in addition to fish eggs and larvae. Genetic barcoding may indicate whether commercially important fisheries species rely on healthy coral habitats as nursery areas.*



*The Deep Secrets Cruise used novel underwater cameras to survey 15 habitat types, most of these for the first time. At 520 m, this deep rocky site showed high diversity of echinoderms with giant featherstars, basket stars and ancient brisingid seastars very noticeable among rocks colonised by lace corals and glass sponges.*

organisations. Sampling 61 stations over more than 1500 km, the team examined 15 habitat types in South Africa's National Marine Ecosystem Classification and Map.

This included the first surveys of many deep-sea habitats. Sand, mud, gravel and rocky ecosystems were sampled and characterised. Additional work was done at key features which included an undocumented rocky ridge off Port Elizabeth, submarine canyons in the Amathole area and coral habitats at Browns Bank on the west coast and between Port Elizabeth and Knysna.

Research highlights included the first survey of deep cold water coral habitats in South Africa, collection of cold water coral samples for taxonomic and genetic research and the deepest biodiversity survey to date at 1035 m off Knysna.

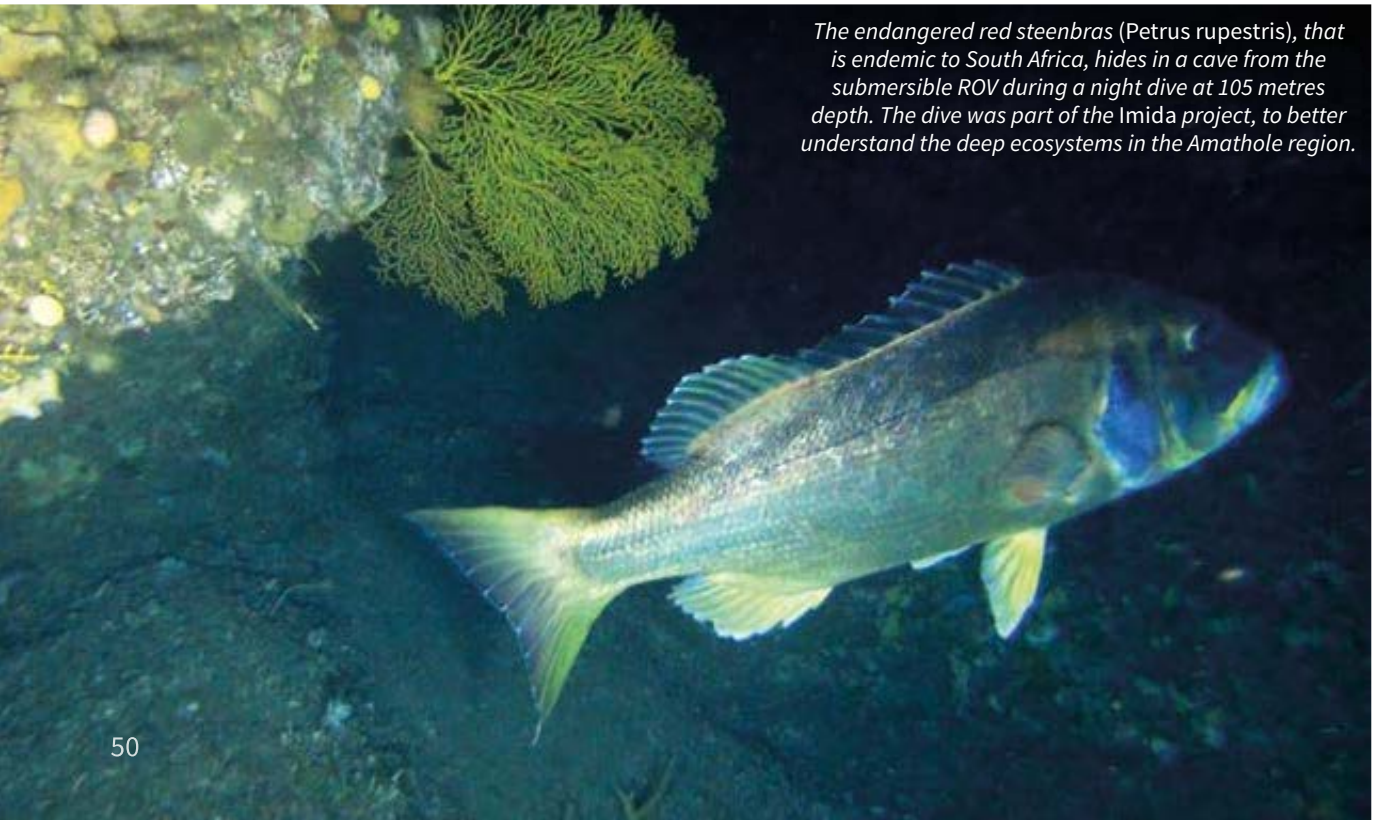
***1.*** *Scientists and technicians from nine organisations collaborated in this multi-disciplinary expedition to deepen ocean understanding in South Africa. Seven students will also use data from the survey in their post graduate studies.*
***2.*** *This project includes studies of the impacts of activities such as trawling on deepsea habitats. This photo shows coral rubble caused by trawling at a depth of more than 500m on the slope off Port Elizabeth.*


# *IMIDA* FRONTIERS PROJECT –

## Researching unique marine habitats in the Amathole region for sustainable management of marine living resources

*Principal Investigator: Sven Kerwath*

Swept by the swift, warm stream of the Agulhas current, the rough and uncompromising seas over the narrow continental shelf between the Great Fish and Kei Rivers have remained a frontier for marine science in South Africa. The first and the shallowest cold water coral records from South Africa both originated from here and the first living coelacanth was captured in this area by a trawler in 1938. The shelf is a hotspot for endemic marine species whose distribution is already showing shifts as a result of climatic changes. The site is also of considerable interest for submarine mining and small-scale fisheries, but the area remains poorly researched and information on bathymetry, geology and ecology is scattered and scarce.



*The endangered red steenbras* (Petrus rupestris)*, that is endemic to South Africa, hides in a cave from the submersible ROV during a night dive at 105 metres depth. The dive was part of the* Imida *project, to better understand the deep ecosystems in the Amathole region.*

In this multidisciplinary ACEP project, *Imida*, we combine geological, oceanographic and ecological studies to investigate and characterise these poorly known marine habitats to feed into marine spatial planning and sustainable management of marine living resources.

Thus far, a multi-beam bathymetric survey has revealed several spectacular geological features, including paleo riverbeds, coastlines and submarine canyons. Dredge surveys yielded more than 1000 specimens of marine invertebrates, many of which are unknown to science. The first dedicated Remotely Operated Vehicle (ROV) survey in the area provided a visual account of previously unknown cold water coral reefs and rhodolith beds, colourful nodules of encrusting marine algae.

The ROV dives discovered several unique habitats that are of importance for a number of ecologically sensitive marine fish and invertebrate species. Based on geological, ecological and oceanographic characteristics, the preliminary findings also suggest that the area could still harbour individuals of the flagship species of this programme, the African coelacanth.

***1.*** *At around the 100m depth zone off East London, there are vast and diverse fields of delicate stylaster hard corals. This group has not been well studied in South Africa and taxonomic work is required.*

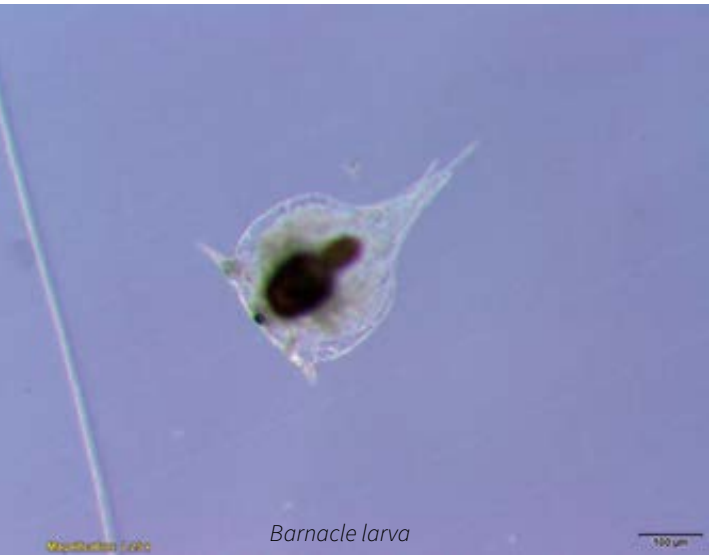
***2.*** Meganthias natalensis, *the gorgeous swallowtail: this is possibly the first photograph of this fish species in the wild.*

***3.*** *Jacopever is a slow growing long lived fish which is taken as bycatch by the hake trawl fishery in South Africa.*

# MICROSCOPIC MARINE WORLD –

## Understanding how plankton can inform inshore fisheries management

*Fish larva*



*Barnacle larva*

*Principal Investigator: Dr Francesca Porri*

The coastal waters along our shores serve as an important habitat for several microscopic marine species. Collectively known as plankton, a drop of seawater can consist of diatoms, protozoans, small crustaceans, and the eggs and larval stages of larger fishes and invertebrates. Many animals are adapted to feed on plankton, especially by filtering the water, such as certain whale and fish species.

The successful development and growth of organisms in their early stages is largely determined by the characteristics of the water in which they are found. If we can describe larval distribution at fine scales in different places along the coast, we can find out important information about their position in the food chain, how widely and where they are found, their survival and how they group together.

To do this, a research project has been undertaken within the NRF-SAEON Algoa Bay Sentinel Site, Eastern Cape. The project has a novel tri-disciplinary link incorporating ecological, oceanographic and molecular techniques to unlock larval transport of invertebrates and fishes.

By integrating physical and biological processes in larval ecology, we can therefore account for dispersal and settlement and ultimately understand how and why the adults occur where they do. This approach provides essential yet challenging information that will further clarify the links between early life stages and adult population sizes and distribution.

The key to understanding what drives the marine coastal populations, is determining the mechanisms and scales of larval connectivity and dispersal. However, how marine larvae are transported in the water column is still poorly understood. This is because of the complex dynamics of the physical environment in which microscopic larvae exist. In the face of global change, eco-physiology studies play a major role in assessing the effect of climate change on the distribution of marine organisms based on an organism's physiological limits.

A central argument to this research is that without the understanding of the role of early life stages in the maintenance of adult populations, most coastal marine resources cannot be safely managed. This project has therefore fundamental potential implications for marine policy and management of coastal inshore fisheries.

## How to sample plankton

***1.*** *Siphelele Dyantyi and Paula Pattrick deploy a plankton pump from the ACEP coastal research vessel,* R/V uKwabelana, *using a motorised winch. PI, Francesca Porri, looks on.*
***2.*** *On deck, the cod end of the plankton pump is rinsed to collect all plankton.*

***3.*** *Bongo nets are towed horizontally through the water column behind the* R/V uKwabelana *to gather plankton suspended in the water column.*
***4.*** *Plankton are collected and preserved onsite for further analysis in the laboratory.*

**1.** *ACEP provides access to the* R/V Algoa *which is managed by Oceans and Coastal Research, Department of Environmental Affairs, Cape Town and from which the oceanographic research on the Transkei shelf was undertaken. Photo Marcel van den Berg.*
**2.** *Bongo nets being deployed off the stern of the* R/V Algoa *for collection of zooplankton and ichthyoplankton samples. Photo Jenny Huggett.*
**3.** *A CTD and water bottle rosette system is deployed for profiling water column conductivity, temperature, depth, oxygen, chlorophyll fluorescence and photosynthetically available radiation, and for collecting seawater samples at selected depths. Photo Marcel van den Berg.*
**4.** *Euphausiids and fish larvae retrieved from a bongo net haul. Photo Tarron Lamont.*

# EDGING ALONG THE TRANSKEI SHELF -

## Influence of the Agulhas Current oceanography on the biodiversity of the Transkei shelf

*Principal Investigator: Ray Barlow*

There is limited knowledge of the distribution of biodiversity on the continental shelf between Algoa Bay and Port Edward. Such knowledge is not only important to assess the effectiveness of existing Marine Protected Areas (MPAs) but is also relevant to the newly proposed expanded Phakisa MPA network. The biodiversity is influenced by the oceanography which is strongly dominated by the fast, warm, southward flowing Agulhas Current. The interaction of the Current with the continental slope topography appears to induce upwelling of cool, nutrient-rich water up the slope and onto the shelf. This mechanism, together with increased plankton productivity, may strongly impact the pelagic and benthic environments on the slope and shelf.

To investigate these processes in more detail, a research cruise was undertaken on the *R/V Algoa* on the Transkei shelf in January 2017 to explain the effect of current flow and associated hydrography on pelagic plankton communities. A series of stations were occupied across the continental shelf and slope for measurements of current flow, hydrographic and bio-optical profiling, seawater sampling for chemical and microscopic analysis, and net hauls for zooplankton and ichthyoplankton.

It is envisaged that this project will, firstly, provide greater insight into the oceanographic environment, and planktonic communities associated with the inshore shelf, slope and oceanic Agulhas Current; secondly, explore cross-shelf connectivity between these domains, including potential biotic inputs into MPAs, and third, explore along-shore flow and biotic connectivity between the southern and northern limits of this under-explored but biodiversity-rich shelf region.

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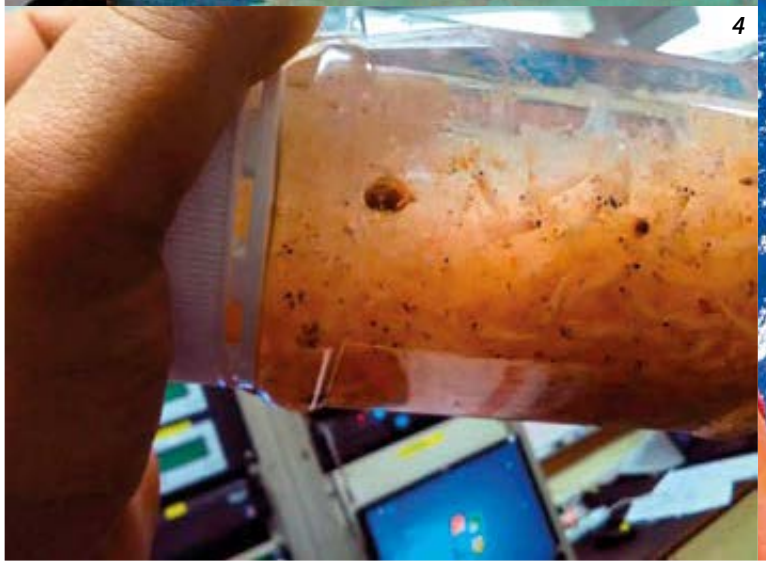

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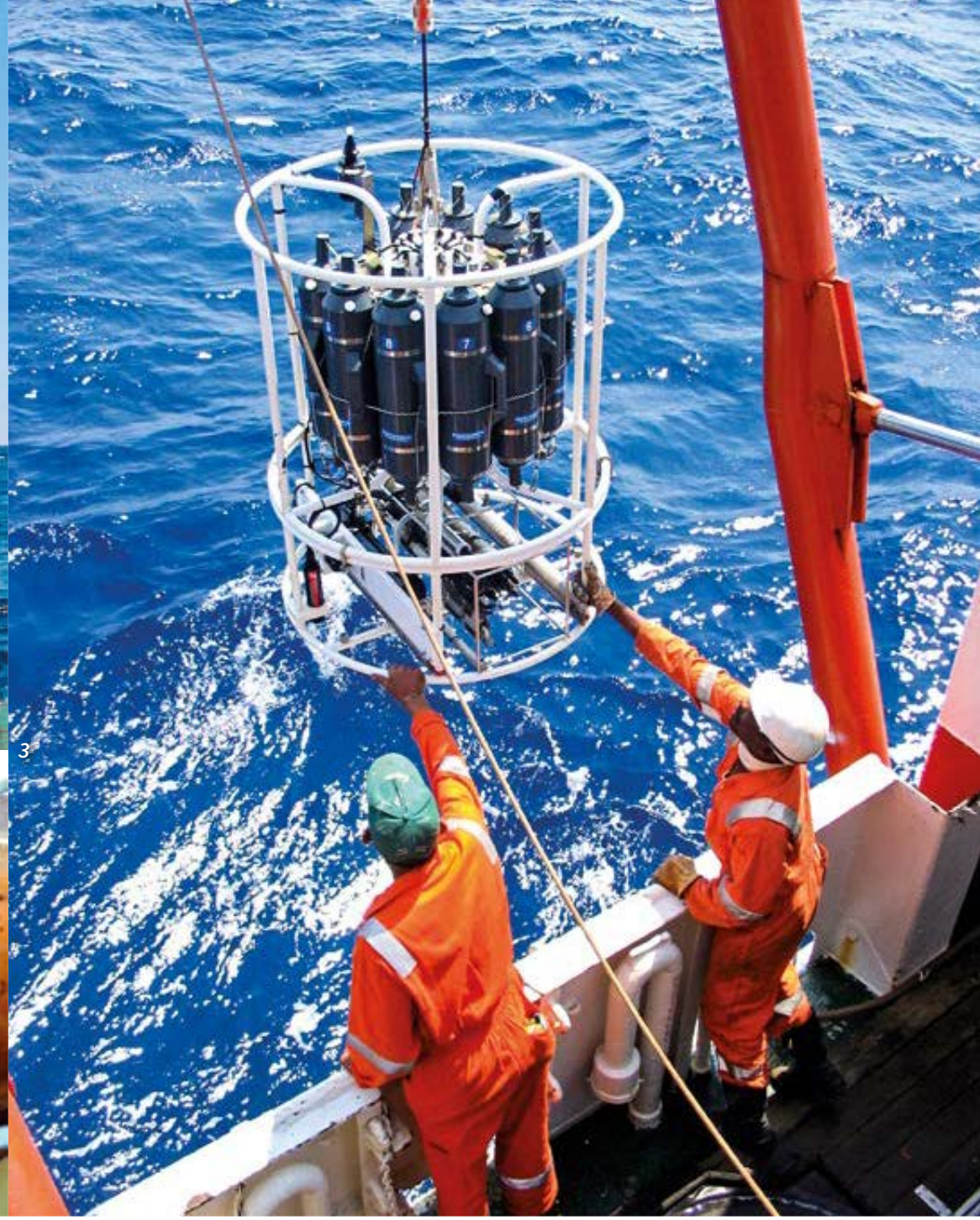

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*During the 2016/17 cruise aboard the research vessel* R/V Angra Pequena *on the Thukela Shelf and between Durban and Richards Bay, 61 Remotely Operated Vehicle (ROV) dives were conducted, and 27 stations were sampled by Baited Remote Underwater Video (BRUV) for fish communities and by Integrated Oblique Plankton tows for fish larval and zooplankton assemblages, with simultaneous water-column oceanography measurements (CTD and ADCP). Photo Tamsyn Livingstone.*

# SPATIAL SOLUTIONS PROJECT

## gathers data for uThukela Banks MPA

*Principal Investigator: Professor Andy Green*

The Spatial Solutions Project focusses on little-studied mesophotic marine ecosystems on the east coast of South Africa which are 30-150m deep. With the advantage of a highly multi-disciplinary team, led by geoscientist Prof Andy Green, this project will match habitat and species distributions to sea floor characteristics and investigate the linkages between oceanography, geomorphology and biodiversity patterns.

The new ACEP multibeam echosounder system will be used to generate the first fine-resolution bathymetry sonar-generated maps, and dynamic oceanographic data "draped" over the topographical landscape, followed by biodiversity data (habitats and species). The ecological data is being obtained by offshore remotely operated vehicle (ROV) benthic surveys for benthic community structure, baited remote underwater video systems (BRUVS) for fish species composition and abundance, integrated oblique plankton tows for fish larvae and zooplankton, and sediment grab sampling. This will result in an integrated categorisation of the continental shelf habitats which can be used in conservation planning as well as to identify areas for additional protected area expansion, and to inform effective management of existing MPAs. The 2016 and 2017 offshore cruises focussed on obtaining baseline data to guide the design and zonation of the globally unique proposed uThukela Banks Marine Protected Area as well as gathering data in the areas between the proposed Aliwal Shoal Expansion and the proposed uThukela MPA.

The unique partnership between this ACEP Project and the related ACEP Biodiversity Surrogacy Project (see pp. 22) with the Wildlands Ocean Stewards Programme (see pp. 22), which was initiated in 2015, has already afforded eight Honours and 24 final-year undergraduate marine science students from five universities their first offshore ship-based research experience. These Ocean Stewards join six Masters-level students who are using data from these projects for their studies. Apart from experience in offshore research methodologies, the project scientists provide the students with on-board sessions covering invertebrate and fish biodiversity, ecosystem classification, data and image management, design of Marine Protected Areas and science communication.








*The ROV surveys, led by Dr Kerry Sink, collected more than 12 000 images during approximately 60 hours of seabed filming with ACEP ROV pilot Ryan Palmer. These will be used to advance benthic ecosystem classification, mapping and description. The observation of a previously unreported tadpole fish (Family Ateleopidae) and a new species of seabat,* Halieutaea *sp. were exciting first discoveries for South Africa. Highlights from the expedition included the first survey of the habitat Natal Gravel Shelf Edge, a new operational depth record of 227m for the team, and the first in-situ sighting of several species such as the armoured gurnard,* Peristedion weber. *Photos: Nicolene Chapman and Shael Harris.*

***1-3.*** *Highlights from fish surveys using BRUVs sampling, led by Dr Bruce Mann and Tamsyn Livingstone, included excellent footage of black musselcracker,* Cymatoceps nasutus, *and seventyfour* Polysteganus undulosus. *The BRUV film footage provided quantitative fish abundance data and has yielded the highest fish diversity data for BRUVs collected in South Africa to date. Together, the ROV and BRUV data gave a preliminary total of 118 fish species from 57 families. Photos Jean Harris and Shael Harris.*

***4-7.*** *Plankton sampling was conducted by MSc student Makalobe Mabotja of University of Zululand, supervised by Dr Shael Harris, yielding interesting records of fish larvae (Photo Tamsyn Livingstone). Samples have revealed a diverse and abundant zooplankton community in the KZN nearshore coastal environment comprised of fish eggs and larvae, jellyfish, copepods, squid larvae, chaetognaths, gastropods, siphonophores, and crab larvae. The larval fish stages of the sand soldier,* Pagellus natalensis, *are particularly abundant in the samples and at certain sites just north of Durban.*

*Larval stage of a cephalopod. (Photo Shael Harris).*

*Sand soldier,* Pagellus natalensis. *(Photo Makalobe Mabotja).*

*Preflexion and postflexion larval stage of spiny flathead,* Hoplichthys *sp. (Photo Shael Harris).*

*Van veen grab sampling done off* R/V Angra Pequena *(1), led by Fiona MacKay, with MSc student Sikhumbuso Maduna. Prior to grab deployment, substrate-type is verified by drop cam. Samples are washed on-board (6), revealing larger fauna such as the crab* Macropthalmus *sp. from the Thukela shelf (2), the ubiquitous giant benthic foram* Schizammina pinnata *(3) and Amphipoda* Byblis *sp. (4) and* Leucothoe *sp. (5) abundant off Durban. These surveys are showing that unconsolidated substrates are very diverse and distinct assemblages are aligned with specific habitats. Also, amongst similar shelf habitats, Durban is a distinct break in infauna distribution. Highlights so far are the 600 taxa that have been sampled and are under verification, several potentially requiring description. Surveys in some areas are a first for biological depiction of the KZN shelf, including in areas included in the proposed Phakisa MPA network. (Photos Fiona MacKay and Jean Harris).*

*Catshark 240m. The red laser dots provide markers with which to measure organism sizes.*

*Deep sea spider crab 220m.*

*Echinoderm extravaganza 215m.*

*Seafans and sponges on a Toti deep reef 69m.*

# ACEP MOVES FORWARD

## A new Open Call period with four new, innovative projects starts in 2018

### 1. Fisheries induced evolution on fish physiology

*Principal Investigator: Dr Warren Potts, Rhodes University*

Although several studies have found evidence for fisheries-induced evolution on the life history and behavioural traits of fishes, none have found any evidence for the selection of physiological traits. However, recent research by a team of young and motivated scientists found clear evidence of fisheries selection on the metabolic rate of an exploited South African linefish. As metabolic rate is closely linked to resilience, this finding suggests that exploited linefish populations may be less resilient to the impacts of climate change than populations that are not so heavily exploited.

To explore this, the team plans to conduct a multidisciplinary project to determine how exploitation influences the physiology of fishes and their resilience to the impacts of climate change. In particular, the team will establish whether selection operates at both physiological and genetic levels and how this knowledge can be applied to Marine Protected Area (MPA) planning.

The project will comprise three subprojects, namely ecophysiology, acoustic telemetry and Baited Remote Underwater Video systems (BRUVs). Research will be laboratory and field-based and make use of the Small Coastal Craft, Acoustic Tracking Array and the Baited Remote Underwater Video platforms. The team will use contemporary research techniques, many of which have not been applied in South Africa.

The project has considerable capacity building and transformation objectives, with a young project team and at least seven postgraduate students participating. The outcomes of the project will have global scientific interest and be very relevant for the development of policy, legislation and, ultimately, adaptation strategies to minimise the impact of climate change on societies that rely on linefish.

### 2. Deep Forests

*Principal Investigator: Dr K Sink, South African National Biodiversity Institute (SANBI)*

The Deep Forests Project, which builds on three previous ACEP projects, focuses on the taxonomy, phylogeny, habitat, ecology and benefits of deep coral and seaweed habitats in South Africa.

Novel aspects include the piloting of a new backscatter-based method in seafloor mapping of submerged Cape Fold Mountains, predictive habitat modelling for coral, first targeted collections of unidentified cnidaria and algae, a microbial and bio-discovery component, testing of new deep water BRUVs and a first analysis of the potential impacts of the inshore trawl fishery.

This multi-disciplinary project aims to build capacity in and contribute to knowledge covering priority marine ecosystems and habitat forming species with a key contribution to local and international barcoding initiatives. The project includes 14 institutions and will establish new research relationships and international collaborations. Results will inform and be accessible through online global and national biodiversity datasets, and be applied in the National Biodiversity Assessment, Marine Spatial Planning (including the delineation of Ecologically and Biologically Significant Areas), and fisheries monitoring and eco-certification.

First offshore research opportunities will be provided for Walter Sisulu University and training is planned in the fields of invertebrate biology, coral

taxonomy, statistical analyses, ecosystem classification and description, cold water coral ecology, scientific writing, grant writing and project management.

In line with the current focus on the blue economy, the project includes a benefits component that examines the potential benefits of focus taxa in terms of traditional use, drug discovery and fisheries ecosystem services.

A documentary will profile research results, emerging marine scientists and form the core of the science engagement strategy.

### **3.** CAPTOR - Connectivity and dispersal between protected areas

*Principal Investigator: Dr Sean Fennessy, Oceanographic Research Institute, South African Association for Marine Biological Research (SAAMBR)*

CAPTOR - Connectivity And disPersal beTween prOtected aReas is an interdisciplinary study linking ocean physics and faunal dispersal in South African east coast MPAs. The CAPTOR project will examine connectivity and dispersal of neritic fauna between South African east coast MPAs and surrounding habitats by integrating information on physical oceanographic processes (currents, eddies, turbulence) and biological processes (reproduction, migration, recruitment) to understand the mechanisms and extent of connectivity. This will provide an additional measure of the effectiveness of existing and proposed MPAs beyond the primary motivation for their existence which to date has been conservation of biodiversity. Their capacity to replenish one another, as well as their surrounding areas - in terms of ecological resilience and/or fisheries benefits – is a potential hedge against increasing pressures on MPAs.

To address this question, the CAPTOR team will use equipment, methods and models which are still new, particularly in the South African context. The project will generate large amounts of new oceanographic and molecular data and information and will refine and develop capacity for the application of cutting-edge models and molecular techniques in a unique biogeographic setting. The relevance of the data will be well communicated in a variety of formats to colleagues, decision-makers and the general public.

### **4.** CANYON CONNECTIONS: The ecological role of submarine canyons on the east coast of South Africa

*Principal Investigator: Prof Amanda Lombard, Nelson Mandela University (NMU)*

Submarine canyons are significant features, intersecting continental shelf edges in many marine regions. There is limited information about canyon ecosystems and biophysical processes. Recent reviews indicate they can be biodiversity hotspots and nodes of higher productivity, and recommend studies on their ecological role, and assessments of the need for enhanced conservation.

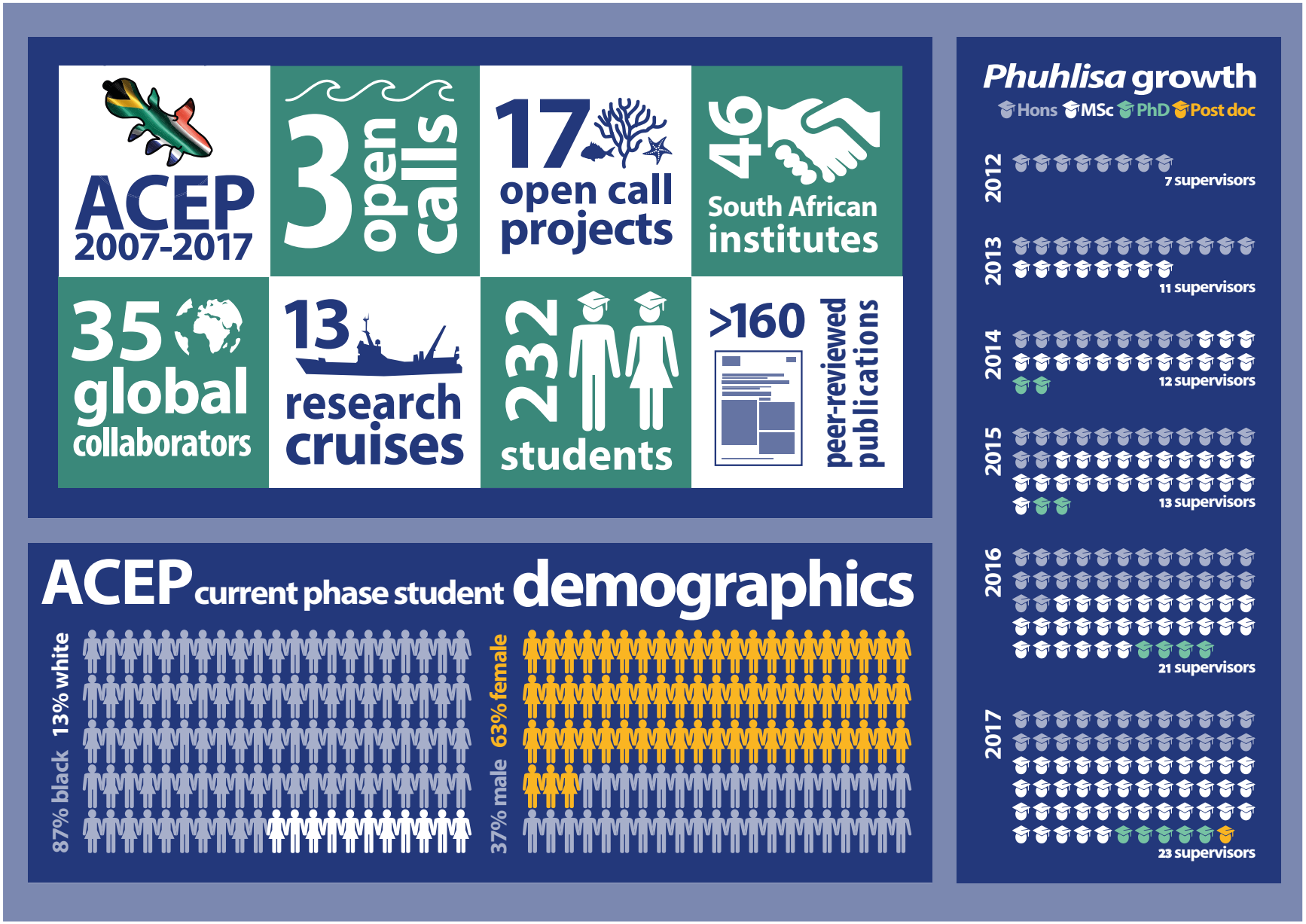
The Canyon Connections project is a novel multi-disciplinary study focussed on canyons on the east coast of South Africa. The project will explore the influence of canyons on distribution of biological communities along the shelf edge, variability amongst and between canyons in different bioregions, and geological and oceanographic processes that underpin observed patterns.

The continental shelf is narrow along this coastline with canyon heads emerging close to the coast. We suggest that they may be ecologically connected to inshore areas and important for sustaining ecosystem goods and services (fisheries and tourism) in adjacent inshore zones. To test this, we will investigate movement of top predatory sharks in coastal areas to offshore canyons, potentially as productive feeding areas due to higher abundance of prey species, in turn linked to higher benthic biomass and plankton productivity.

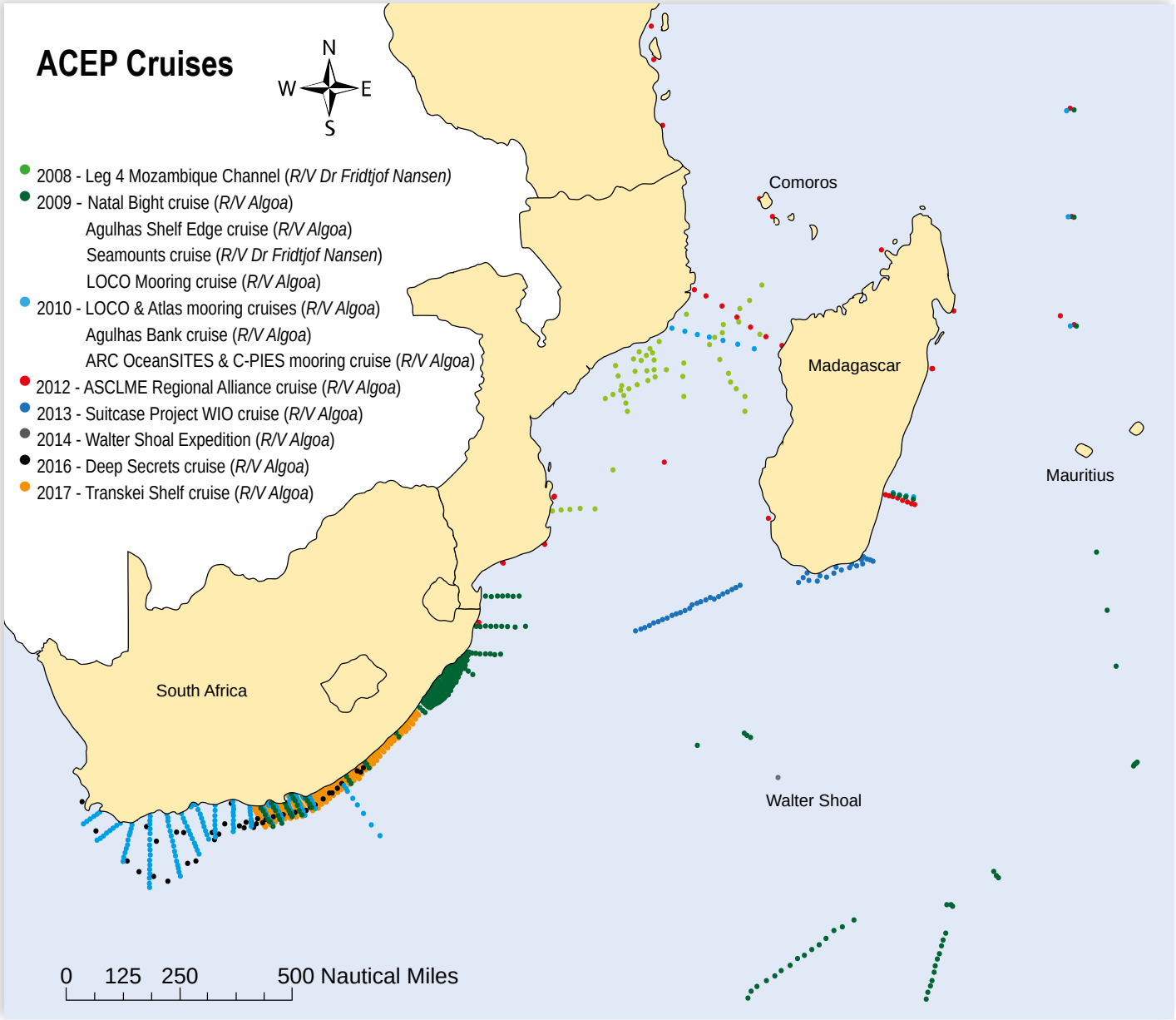
Through an innovative partnership established with the Wildlands Ocean Stewards Programme, the project will make a significant contribution to building marine science capacity. The Ocean Stewards Programme is integrated into all aspects of the project, including field research, post-graduate student support as well as science outreach and conservation awareness.

Fishers place high value on canyon heads for top predators, and the presence of shark aggregations and ecotourism activities inshore of some of them support this conceptual model. Team members are active contributors to the Phakisa Ocean Economy initiative, so there is also strong potential for research results to inform policy for MPA expansion and design.

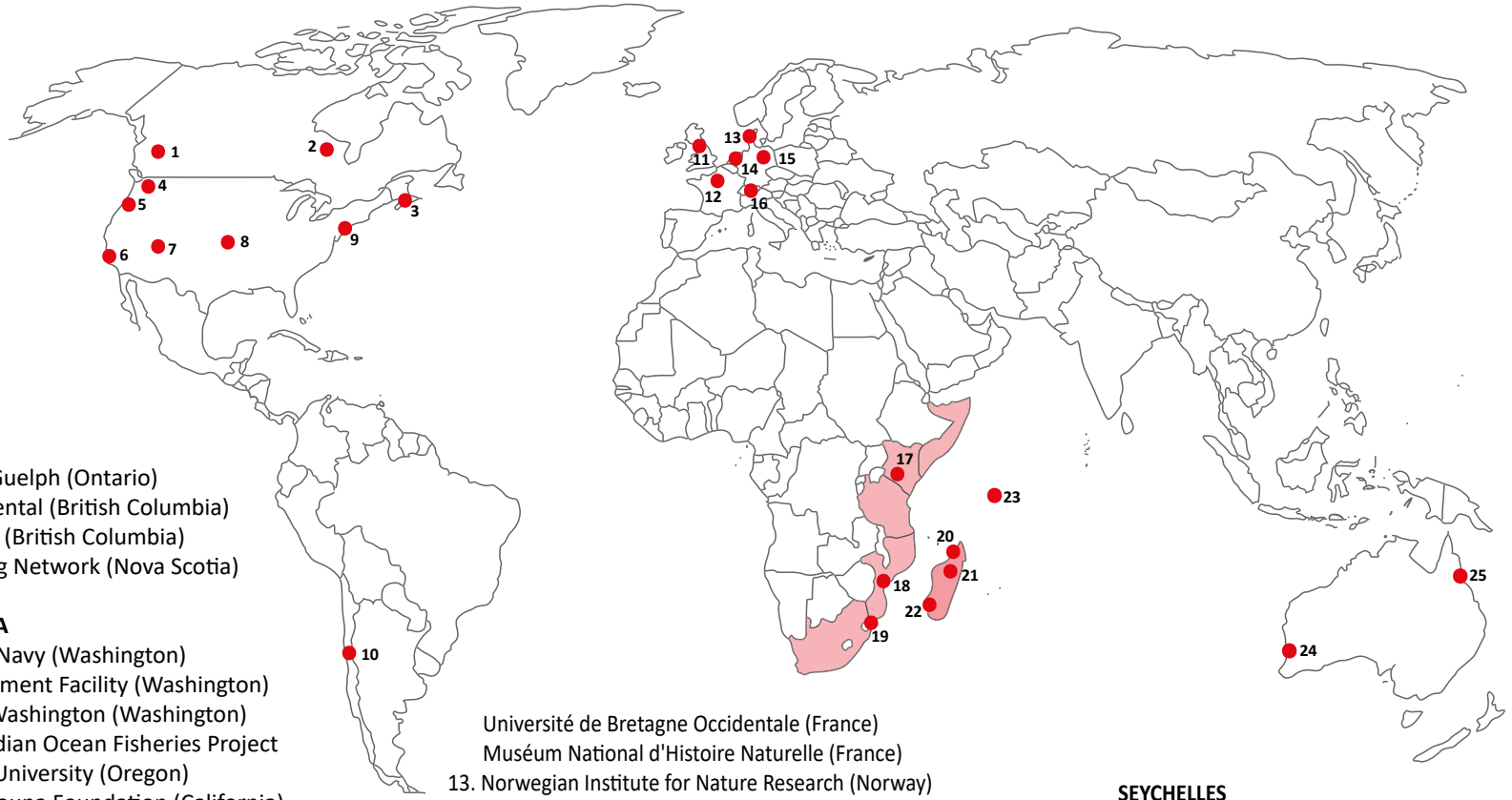
# ACEP COUNTS 05




*Infographic Rose Palmer*


ACEP Cruises
N
W
E
S
2008 - Leg 4 Mozambique Channel (R/V Dr Fridtjof Nansen)
2009 - Natal Bight cruise (R/V Algoa)
Agulhas Shelf Edge cruise (R/V Algoa)
Seamounts cruise (R/V Dr Fridtjof Nansen)
LOCO Mooring cruise (R/V Algoa)
2010 - LOCO & Atlas mooring cruises (R/V Algoa)
Agulhas Bank cruise (R/V Algoa)
ARC OceanSITES & C-PIES mooring cruise (R/V Algoa)
2012 - ASCLME Regional Alliance cruise (R/V Algoa)
2013 - Suitcase Project WIO cruise (R/V Algoa)
2014 - Walter Shoal Expedition (R/V Algoa)
2016 - Deep Secrets cruise (R/V Algoa)
2017 - Transkei Shelf cruise (R/V Algoa)
Comoros
Madagascar
Mauritius
South Africa
Walter Shoal
0 125 250 500 Nautical Miles

# ACEP Global Collaborators




**CANADA**
1. University of Guelph (Ontario)
2. ASL Environmental (British Columbia)
   Hakai Institute (British Columbia)
3. Ocean Tracking Network (Nova Scotia)

**NORTH AMERICA**
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**ASCLME - ACEP COLLABORATING COUNTRIES (2007-2013)**
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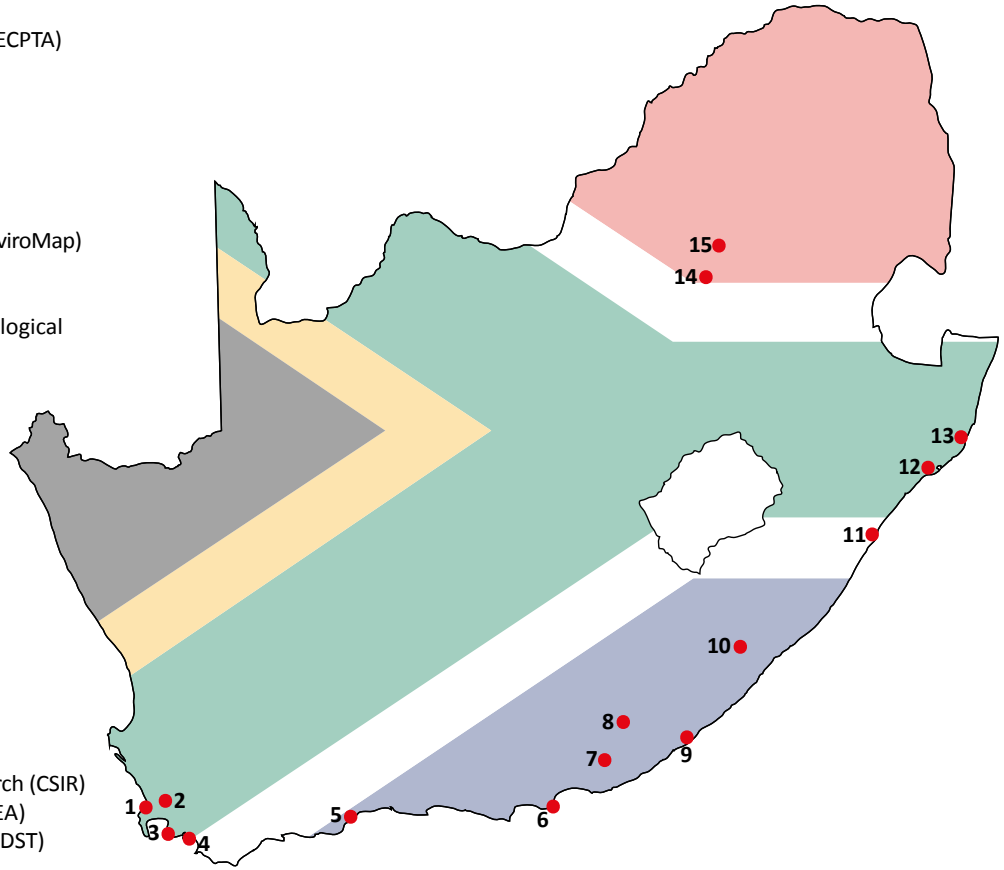

“ACEP aims to ensure that South Africa has in-depth knowledge of our east coast marine and coastal environment and its resources, to ensure sustainable development while benefitting its citizens. This can only be done by undertaking the required research and producing a representative generation of future marine scientists and resource managers which reflects the diverse demography of our country.”

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

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation | RISA Research and Innovation Support and Advancement

ACEP

OPERATION PHAKISA
planning | implementation | growth

science & technology
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REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation | SAEON South African Environmental Observation Network

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