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Inside this issue:

Plunging into new waters: Investigating a novel marine protected area management plan in South Africa

By

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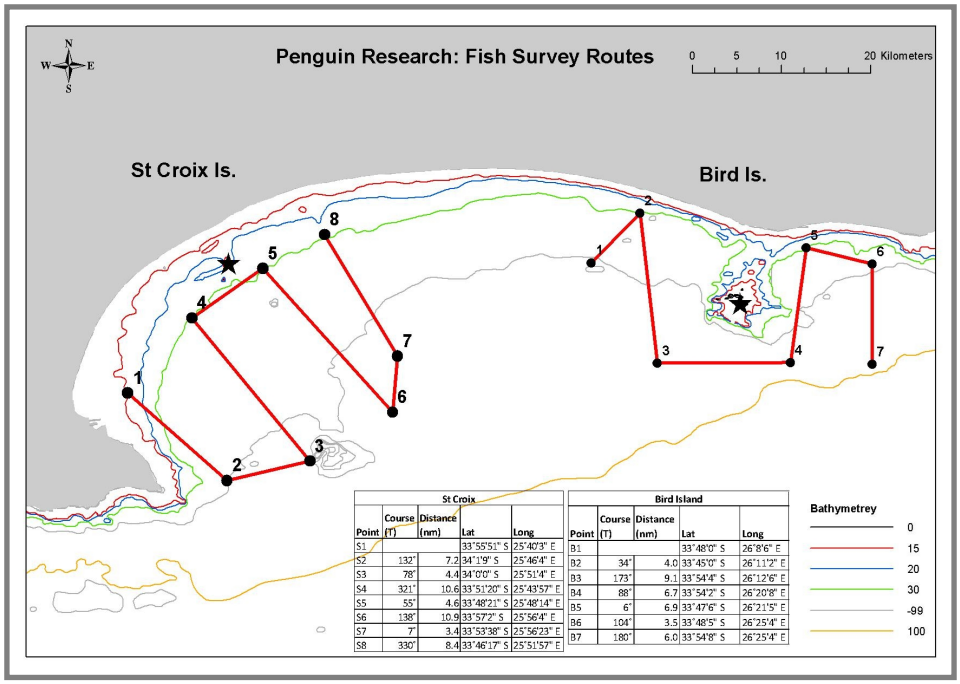
Intensive fishing activities have long had impacts on the marine environment and its inhabitants. The impacts have been studied and highlighted in recent decades; and for broad-scale fishing activities to be sustainable, both the socio-economic needs of communities and health of marine ecosystems need to be considered. Our work is focused on determining how the pelagic fishery in South Africa could be managed to best share resources with other marine life that depend on small pelagic fish.

Algoa Bay's water teeming with life, a bait ball with Cape Gannets, African penguins, Bryde's whales and common dolphins, observed during an acoustic survey.

Fisheries can be managed to limit their environmental impact through harvest controls ranging from catch limits and size limits to closed seasons; or alternatively, with zonation schemes such as marine protected areas (MPAs). No-take zones provide the greatest degree of protection from extractive and destructive activities.

No-take zones are initially designed with particular sizes and shapes. It could, however, be dynamically managed in space or time (e.g. the size or shape can be changed regularly). For example, the New England scallop fishery uses a dynamic management to limit yellowtail flounder bycatch. High-risks areas are identified and updated daily, which allowed the lifting of the closed seasons previously in place, thereby adding $10 million to the fishery each year. We chose Algoa Bay adjacent to Port Elizabeth as a study area in which to test the feasibility of a dynamically-managed no-take zone. Algoa Bay is home to Bird and St Croix Islands, together supporting half of the world's population of endangered African penguins.

African penguins are endemic to Southern Africa and feed primarily on sardines and anchovies, which are also targeted by the pelagic



St Croix

Point	Course (T)	Distance (nm)	Lat	Long
S1			33°55'51" S	25°40'3" E
S2	132°	7.2	34°1'9" S	25°46'4" E
S3	78°	4.4	34°0'0" S	25°51'4" E
S4	321°	10.6	33°51'20" S	25°43'57" E
S5	55°	4.6	33°48'21" S	25°48'14" E
S6	138°	10.9	33°57'2" S	25°56'4" E
S7	7°	3.4	33°53'38" S	25°56'23" E
S8	330°	8.4	33°46'17" S	25°51'57" E

Bird Island

Point	Course (T)	Distance (nm)	Lat	Long
B1			33°48'0" S	26°8'6" E
B2	34°	4.0	33°45'0" S	26°11'2" E
B3	173°	9.1	33°54'4" S	26°12'6" E
B4	88°	6.7	33°54'2" S	26°20'8" E
B5	6°	6.9	33°47'6" S	26°21'5" E
B6	104°	3.5	33°48'5" S	26°25'4" E
B7	180°	6.0	33°54'8" S	26°25'4" E

The acoustic survey routes around Algoa Bay conducted monthly.

fisheries. Penguins' numbers have declined drastically recently, mostly because of reduced prey availability. Oil spills and historical guano and egg harvesting also contributed to their population crash by 90% in the 20th century.

Algoa Bay is also home to an important purse-seine fishery sector in South Africa, supporting the livelihood of many people. Some fishers are aware of the impacts of fishing on the marine environment and contribute to marine conservation initiatives. In this project, we aim to provide a meaningful discussion platform between fishermen and scientists, where knowledge and needs can be voiced. Do fishermen know of possible alternative areas to

Port Elizabeth as seen from the boat.

operate if the area around the penguin colonies islands becomes off-limits? What would be their additional costs, if any? Could they potentially catch more in the alternative areas further away from bird colonies and thus benefit from a new no-take zone? These are important questions and the fishers' opinions are needed for any new management plan to be effective.

Using this platform, we also aim to benefit from the valuable source of knowledge which fishermen possess to help manage the no-take zone. For example, the pelagic fishers know how the moon phase affects where sardine and anchovy will be in the water column and if the easterly wind on a cold afternoon will affect their distribution. These environmental influences are important when designing a management plan.

We are using a Fishfinder, common equipment used by commercial and recreational fishers to track fish in real-time using SONAR, helping to increase their catch but less known is its use to estimate fish abundance. We conduct acoustic surveys along a pre-determined route in Algoa Bay monthly which allows us to estimate and map the relative abundance and distribution of fish throughout much of the bay. We use this information to identify core areas of fish availability seasonally, and then combine this with information on where penguins and fishers are foraging. This information may help in designing the size, shape and location of possible no-take zones that can be shifted in time and space.

The aim of our project at Nelson Mandela University is to determine if a dynamic-managed, adjustable no-take zones in Algoa bay can better protect penguin food sources, to aid penguin population recovery, while taking into consideration fisher economies. If our analyses show that this is indeed a viable option, then the next step will be the development of a management plan to implement the zonation scheme. The project has the potential to inform alternative management practices for other areas in southern Africa where African penguins compete with fishers for food.

A view of Bird Island, one of two islands which support the endangered African penguin in Algoa Bay.

Inspired by the joy of new discoveries—uncovering cryptic coralline algal diversity

By

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The intertidal and shallow rocky subtidal zones are rich in diversity of non-geniculate coralline red algae (seen here as a mosaic of pink, grey and creamy crusts).

Non-geniculate (encrusting, crustose) coralline red algae (Corallinophycidae, Rhodophyta) are widespread in all of the world's oceans, often forming the dominant cover on rocky and other hard substrates. Despite their ubiquity, and despite being amongst the most-studied algal groups in recent years, the coralline algae remain a comparatively poorly understood group of marine algae. This is evidenced by the ongoing debate on their systematics, and a taxonomy that has remained largely in flux.

Coralline algae are generally considered to constitute a 'difficult' taxonomic group. Consequently they are not collected by the vast majority of seaweed biologists and are thus poorly represented in most collections. This is due largely to the fact that they require unique collection (hammer and cold chisel) and special laboratory (dissolving away of the calcium carbonate structure) methods.

Until relatively recently, descriptions of coralline algae were based solely on histological examination of their morphological and anatomical features. This taxonomic procedure has resulted in a large number of species reported to be widely distributed across ocean basins. However, recent molecular analyses, using DNA sequencing, have demonstrated that many reportedly widespread species are really different species passing under the same name. These molecular studies are increasingly showing that species are generally NOT widely distributed across ocean basins and that we have highly underestimated the coralline algal diversity across the globe (possibly by as much as 2-4 times that which is currently recognised by morphological and anatomical features).

The South African rocky intertidal and subtidal habitats are particularly

rich in diversity and abundance of coralline algae, more so than most other reported regions of comparable coastline length. Currently 45 species of non-geniculate coralline red algae, belonging to three orders, three families, seven subfamilies, and 18 genera are recognised to occur intertidally along the South African coast. South Africa has representative species from more than half of the currently recognised extant genera of non-geniculate coralline red algae. One in four species are endemic to the South African coastline and nearly one in three species are endemic to the Southern African region. However, recent molecular evidence has pointed to a large number of cryptic species, suggesting that the true diversity for South Africa is substantially greater than what is currently recognised, and that most species are far more endemic than previously thought.

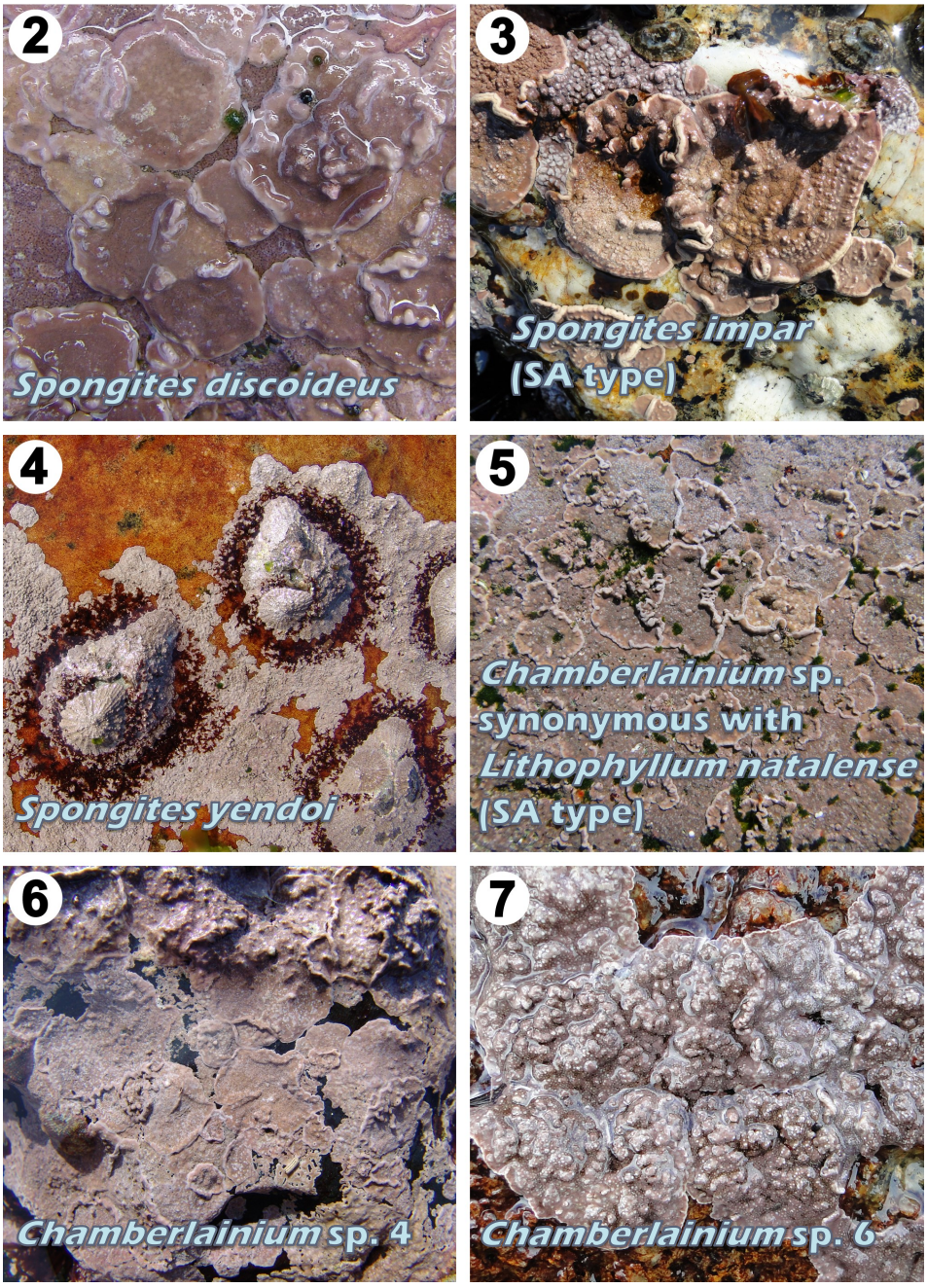


Fig. 2-7. Habit photographs of six different South African species that match the current morphological and anatomical characterisation of the genus *Spongites*, most of which will have to be transferred to *Chamberlainium*.

Species ascribed to the 'cosmopolitan' genus *Spongites* are particularly widespread and common in South Africa (e.g. Figs 2–7). Until recently, all smooth, relatively featureless crusts, conforming to *Spongites* in South Africa, were called *Spongites yendoi* (Foslie) Y.M.Chamberlain. Consequently the species has been reported to be the most abundant intertidally, occurring along the entire South African coast. *Spongites yendoi* was reported to be particularly abundant along the west and south coasts in association with the territorial, gardening limpet *Scutellastra cochlear*, and has been considered to perform an important ecological function (dietary supplement for the limpet) in that association. Although generally a thin featureless species, throughout its geographic range, specimens of

variable morphologies were proposed to result from the absence/presence of sand scour and grazing pressure.

DNA sequence data have shown that South African specimens ascribed to *S. yendoi* not only differ from the type specimen (type locality: Shimoda, Shizuoka Prefecture, Japan), but that additionally as much as six different cryptic species are posing under this name in South Africa (Figs 5–7). Even more interesting is that most of the South African species/specimens, that currently are and would have been ascribed to the genus *Spongites* based on morphology and anatomy, do not align with the generitype species. A new subfamily (Chamberlainoideae) and genus (*Chamberlainium*), in honour of British botanist Dr. Yvonne M. Chamberlain (whose research focused extensively on taxa belonging to the new subfamily), have subsequently been published to (thus far) accommodate species from the Northeast Pacific (Alaska to Monterey, California, USA), South Africa and Taiwan.

Four species (*C. agulhense* [previously *S. agulhensis*], *S. discoideus*[*] [Fig. 2], *S. impar* [Fig. 3], *S. yendoi* [Fig 4]) of non-geniculate coralline red algae are/were assigned to the genus *Spongites* in South Africa. Only two of these (*C. agulhense, S. impar*) have type specimens from South Africa. DNA sequence data have shown that another South African type (*Lithophyllum natalense* Foslie), previously subsumed in *S. yendoi*, will have to be resurrected. In total then South Africa has possibly 10 species of non-geniculate coralline red algae that match the molecular, morphological and anatomical characterisation of *Chamberlainium*, all of which are probably endemic to the region. These findings are currently being prepared for publication and should be adopted by 2019. As a consequence of these recent findings, all species of South African non-geniculate coralline algae will have to be reassessed using DNA sequence data, especially those species that do not have type specimens from South Africa.

The incorporation of DNA sequencing into research is increasingly showing high degrees of cryptic diversity in the coralline algae. The high degree of morphological and anatomical similarity amongst several species of coralline algae has been speculated to be due to either convergent evolution, or to speciation that has yet to reflect as morphological and/or anatomical change. Whatever the case may be, these are exiting times for new discoveries, leaving much opportunities for expanded collaboration and for documenting our little understood biodiversity.

Suggested Reading

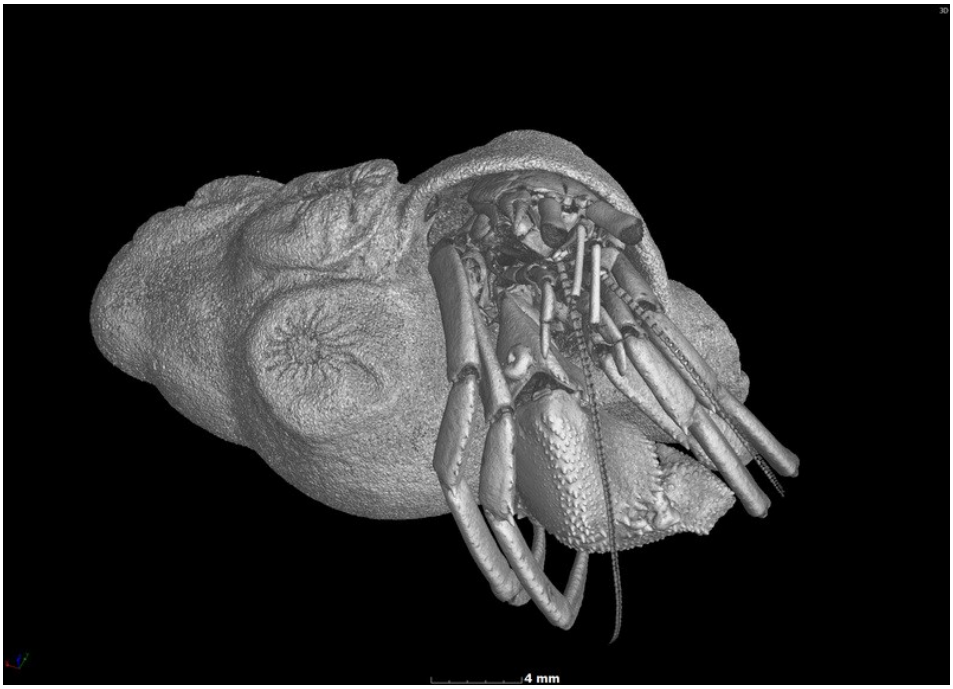
Maneveldt GW, Van der Merwe E & Keats DW. 2016. Updated keys to the non-geniculate coralline red algae (Corallinophycidae, Rhodophyta) of South Africa. *South African Journal of Botany* 106: 158-164.

Caragnano A, Foetisch A, Maneveldt GW, Millet L, Liu L-C, Lin S-M, Rodondi G & Payri CE. 2018. Revision of Corallinaceae (Corallinales, Rhodophyta): Recognizing *Dawsoniolithon* gen. nov., *Parvicellularium* gen. nov. and *Chamberlainoideae* subfam. nov. containing *Chamberlainium* gen nov. and *Pneophyllum*. *Journal of Phycology* 54: 391-409.

[*]Our molecular data is showing that specimens assigned to *S. discoideus* (type locality: Tierra del Fuego, Argentina) in South Africa are not that species and so those specimens will need to be assigned a new name.

Digital avatars new in taxonomers' toolkit

Digital avatars – specimens captured via X-ray 3D micro computed tomography (micro-CT) scanning technology – give taxonomers a new tool to 'dissect' and study rare or delicate specimens on their computer screens, without (or in addition to) museum or natural history collections and artists' replicas.



A digital avatar of a hermit crab using new 3D technology, which gives taxonomers a new tool to 'dissect' and study rare or delicate specimens on their computer screens. Image Jannes Landschoff and Anton du Plessis.

Marine taxonomer and PhD candidate Jannes Landschoff says although the tool will never fully replace physical specimens, it does allow scientists to download interactive, printable scans – or digital avatars – for 3D examination of specimens.

This is an important development for the description of new species and will aid scientific collaboration as researchers can examine the digital sample of the same specimen at different places and times. Actual specimens, many rare and valuable, are difficult to ship around and can be examined by only one person at a time.

Marine biologists at UCT and Stellenbosch University recently used this technology to scan seven hermit crab species. These include one as yet undescribed species as well as two scans of rare species, one from a deep-sea habitat at over 500 metres. Three are species that are new to science and are described in Landschoff's PhD thesis.

A niche market

Landschoff is the lead author of a paper on the technology, featured in *GigaScience*, titled "A micro X-ray computed tomography dataset of South African hermit crabs (Crustacea: Decapoda: Anomura: Paguroidea)". His co-authors are his supervisor, Emeritus Professor Charles Griffiths (Department of Biological Sciences), and Anton du Plessis of Stellenbosch University.

These specimens are held at the Iziko Museum in Cape Town and at the Smithsonian National Museum of Natural History in Washington, DC. But scientists, or even amateurs, who're also interested in having a look can now do so online. The 3D scans and 3D printer files are available from the GigaDB

repository.

Until now, scientists have relied heavily on meticulously drawn illustrations of specimens and their sections. But this is not ideal, says Landschoff.

"Taxonomic biodiversity research is a niche market and a difficult field, and the new technology is important as there are several limitations to hand-drawing specimens, especially complex specimens such as hermit crabs.

"A great artist will produce marvellous illustrations. The main limitation, however, is the artist's skill and the time it takes to produce complicated drawings. When I draw complex structures, for example, of the crab's pincers, a single illustration can take me a week."

Hand-drawn illustrations are also subjective, he adds.

"On the one hand this is a good thing because the artist can highlight certain characteristics they think are important. On the other, this might over-emphasise some things. So, it can result in mistakes. There is also the issue of reproducibility. Each scientific experiment should be reproducible."

Machine-derived images are less vulnerable to bias.

Computing power

In an interview for the *GigaScience* blog, Landschoff says that the power and magnification of X-ray micro-CT also gives a precise picture of surface textures, which are often missing in photographs or manual drawings.

Ironically, hermit crabs are among the most challenging model organisms within Decapoda to use CT scanning on. Many are small, and half of their body – the pleon, which is encased by the scavenged sea shell it lives in – is soft.

"The pleon has many fine-scaled, soft tissue identification characteristics," he adds. "Because CT scanning is based on X-ray detection, these soft structures are difficult to detect. If hermit crabs can be scanned, other groups like Brachyura [normal crabs], which are entirely calcified, would be very visible for scanning."

The new technology does need a lot of computing power and special software, which can make it expensive. While the scanning process is relatively quick and easy, the analysis of the 3D data is time-consuming, as is working on the scan data on the computer, cleaning unwanted scanning artefacts, cutting the specimens open virtually, and so on.

PhD candidate and taxonomer Jannes Landschoff at work in his marine laboratory. Photo Robyn Walker.

As Landschoff says, drawing is cheap and doesn't come with these challenges.

"I require only a pencil, eraser and paper."

A crab in hand

On the other hand, the CT images are very powerful, which makes this a useful tool for education and training. The scans provide a powerful connection to the real thing.

"When I can show a high-resolution rotation movie to an audience instead of a picture of a colourless specimen in a jar of alcohol, that's a huge advantage in making taxonomy more interesting in general," Landschoff explains. "I still believe that having a living specimen at hand is the most fascinating thing for students of biology."

With over 1 100 species and 120 genera of hermit crabs described to date, and with very many species undescribed on museum and laboratory shelves, this digital advance should broaden options and possibilities for greater coverage of specimens.

(Landschoff's new paper in *PlosOne*, due out later this year, describes a new species of hermit crab for the first time, based predominantly on CT scanning.)

Source:

Swingler, H. (2018, April 24). Digital avatars new in taxonomers' toolkit. Retrieved from https://www.news.uct.ac.za/news/research-office/-article/2018-04-24-digital-avatars-new-in-taxonomers-toolkit

Yet another good reason to eat South African hake

By
Claire Attwood
South African Deep-Sea Trawling Industry Association

South African hake comes from a sustainable and well-managed fishery. Now an international study has revealed another good reason for choosing hake over beef and many other forms of animal protein: hake has a low environmental impact.

According to the study – published this week (12 June 2018) in the journal *Frontiers in Ecology and the Environment* – industrial beef production and farmed catfish have the greatest impact on the environment, while small, wild-caught fish and farmed molluscs like oysters, mussels and scallops have the lowest environmental impact.

Hake, pollock and cod were named as wild-caught fish with a relatively low impact.

"What you eat makes a difference to the environment," said Johann Augustyn, secretary of the South African Deep-Sea Trawling Industry Association. "South Africans are fortunate because locally caught hake is sustainable, affordable and versatile and we now know that it compares very favourably to other animal proteins when it comes to the environmental impact of its production."

The environmental cost of animal source foods is authored by United States researchers Ray Hilborn, Jeannette Banobi, Stephen Hall, Teresa Pucylowski and Timothy Walsworth. They believe their study to be the most comprehensive analysis of the environmental impacts of different types of animal protein production.

The study uses four measures as a way to compare environmental impacts across a number of different types of animal food production, including farm-raised seafood (aquaculture), livestock farming and seafood caught in the wild. The four measures are: energy use, greenhouse gas emissions, potential

to contribute excess nutrients – such as fertilizer – to the environment, and the potential to emit substances that contribute to acid rain.

In order to make their comparisons, the researchers used a standard 40 grams of protein –the size of an average hamburger patty and the daily recommended protein serving – and calculated, for example, how much greenhouse gas was produced per 40 grams of protein across all food types, where data were available.

Their analysis revealed animal protein types that had low environmental impacts across all measures. These include farmed shellfish and molluscs, and capture fisheries such as sardines, mackerel and herring. Other capture fish choices with relatively low impact are whitefish like pollock, hake and the cod family. Farmed salmon also performed well.

The researchers found that, when compared to studies of vegetarian and vegan diets, a selective diet of aquaculture and wild capture fisheries has a lower environmental impact than either of the plant-based diets. Mollusc aquaculture – such as oysters, mussels and scallops – actually absorb excess nutrients that are harmful to ecosystems. Capture fisheries consistently scored better than aquaculture or livestock production because no fertilizer is used.

For capture fisheries, fuel used to power fishing vessels is the biggest environmental impact. However, the impact of trawling appears to be related to the abundance of

fish; healthy stocks take less fuel to capture.

"The South African trawl fishery for hake has been certified as sustainable and well managed by the Marine Stewardship Council (MSC) since 2004," said Augustyn. "The MSC is the gold standard of eco-labelling programs for wild-caught fish. On the strength of this latest study, we can confidently say that South African hake is a good environmental choice."

Collaborative approach to help SA fisheries on path to sustainability

By
Angela McQueen
Marine Stewardship Council

Representatives from government, the commercial and small-scale fishing sectors, scientific bodies, NGOs and retail meet as part of the Fish for Good Advisory Group.

Nominated Advisory Group representatives from government, the commercial and small-scale fishing sectors, scientific bodies, NGOs and retail have met to choose South African fisheries that will participate in an exciting new initiative by the Marine Stewardship Council (MSC), setting them on a path towards improvement and sustainability.

The MSC ecolabel and certification program recognises and rewards sustainable fishing practices and is helping create a more sustainable seafood market. The MSC ecolabel on a seafood product means that: 1) It comes from a wild-catch fishery which has been independently certified to the MSC's science-based standard for environmentally sustainable fishing. 2) It's fully traceable to a sustainable source.

Nine South African fisheries were selected for pre-assessment against the MSC Fisheries Standard as part of the Fish for Good project: longline caught yellowfin tuna; pole and line caught albacore tuna; purse seine netted sardine; hand caught east coast rock lobster; the commercial west coast rock lobster fishery; rope grown black mussel; kelp; jig caught squid; and the west coast multispecies line fishery. Beyond pre-assessment, five of these fisheries will be supported through development and implementation of improvement action plans.

In support of the project, Saasa Pheeha, Director: Offshore and

> A first of its kind project in South Africa will bring together stakeholders from across the seafood value chain, to benchmark and improve the sustainability of selected fisheries.

High Seas Fisheries Management, from the Department of Agriculture, Forestry and Fisheries (DAFF) commented, "as custodians of South Africa's fishing resources, DAFF is happy to support initiatives that bring together different role-players in a way that will complement our work towards better fisheries management".

Fish for Good

The Fish for Good project aims to accelerate the building of fisheries sustainability networks in Indonesia, Mexico and South Africa. Initiated by the MSC and funded by the Dutch Postcode Lottery, the four-year project is aimed at guiding fisheries towards more sustainable fishing. The fisheries will use the MSC sustainability criteria as a framework within which to structure improvement activities, opening the potential for future certification.

Mapping and gap analysis based on the MSC Fisheries Standard will be used to identify areas where sustainability improvements can be made. The project will follow a Project Pre-Assessment (PPA) model, focusing on country-specific analysis of fisheries as a way of introducing the MSC program to a range of South African fishers.

Collaboration to drive change

Project Pre-Assessments (PPAs) are an evolving approach being promoted by the MSC. Defined as any project that uses the MSC pre-assessment and other pre-certification tools in a strategic way to engage with multiple fisheries at the same time, a PPA's intended impact extends beyond the immediate project. PPA's aim to involve not only the fisheries and NGO stakeholders, but notably also management authorities, scientific advisory bodies and supply chain companies that are interested in sourcing from these fisheries. Crucially, the project is supported by an Advisory Group who will provide cohesive advice and direction, to ensure real, lasting progress.

On the importance of the Group's role, the nominated chair of the Advisory Group, Professor Kevern Cochrane of Rhodes University, noted, "stakeholders in the fishing sector, whether fishers themselves or supply chain companies, have different priorities and interests. Whilst we can all share the desire for better management of all

Advisory Group members in discussion over fisheries selection.

fisheries, it's important that different voices are given the chance to present their viewpoints so that all can benefit to some extent from the process that the Fish for Good project will introduce."

Commenting on their role in the project, Andrew Gordon, MSC's Southern African Fisheries Manager added, "Since its inception in 1997, the MSC has shown that its fishery certification and eco-labelling program can help drive improvements among fisheries, leading to healthier oceans. Looking forward, the MSC has committed itself to focusing greater effort on the fisheries of the developing world. This work is urgent as fisheries in developing countries are some of the most at risk of overfishing; and yet these fisheries play a critical role both in terms of food security and in providing livelihoods for coastal people".

Minister Molewa returns from a G7 Leaders' Summit focusing on Oceans

The Minister of Environmental Affairs, Dr Edna Molewa, returned from Canada on Tuesday, 12 June 2018, where she accompanied President Cyril Ramaphosa, for the G7 Leaders' Summit Outreach.

The summit's theme: "Healthy, Productive and Resilient Oceans and Seas, Coasts and Communities," addresses many of the opportunities and challenges that are the focus of South Africa's Operation Phakisa: oceans economy. This programme seeks to unlock the economic potential of South Africa's oceans, growing the GDP and creating jobs, while also ensuring healthy, productive and resilient ocean resources.

Minister Molewa accompanied President Ramaphosa and a business delegation from South Africa. President Ramaphosa's participation in the G7 Leaders' Summit Outreach coincides with his drive to attract investment to grow the economy, create jobs and address poverty and inequality in South Africa.

The focus of the G7 Outreach meeting on Healthy, Productive and Resilient Oceans and Seas, Coasts and Communities, is in line with the goals outlined in South Africa's National Development Plan and speaks to the country's efforts to stimulate economic growth and job creation by, amongst others, unlocking the oceans economy through Operation Phakisa.

The six growth areas, with lead departments in each area, have been prioritised to contribute to unlocking the economic potential of South Africa's oceans, based on their potential contribution to economic growth and job-creation, namely:

- Marine Transport and Manufacturing led by the Department of Transport;
- Offshore Oil and Gas Exploration led by the Department of Mineral Resources;
- Aquaculture led by the Department of Agriculture, Forestry and Fisheries;
- Marine Protection Services and Ocean Governance led by the Department of Environmental Affairs;
- Small Harbours Development led by the Department of Public Works (three feet planning mini-Lab to commence in 2018); and
- Coastal and Marine Tourism led by the Department of Tourism.

Minister Edna Molewa accompanied President Cyril Ramaphosa to the G7 Leaders'Summit. Photo: EPA-EFE/NEIL HALL / POOL .

As the world grapples with intractable challenges such as poverty, economic growth, food security and high unemployment rates, the oceans have increasingly come under the spotlight as countries seek economic opportunities in the ocean space to address some of these challenges.

At the same time, there is increasing

recognition that the world's oceans are under severe pressure, especially from human activities. Some of the critical challenges include:

- Marine pollution, in particular plastics (whether land-based or from shipping) and micro plastics;
- Loss of biodiversity;
- Unsustainable fishing practices and overfishing;
- Illegal, Unreported and Unregulated (IUU) fishing;
- Ocean acidification; and
- Mining.

The key challenge therefore is to build and implement programmes that harness the productive potential of ocean resources in a manner that is sustainable. Key to this is the establishment of strong governance and institutional arrangements that facilitate orderly spatial planning and co-ordination of activities within the ocean.

South Africa's Marine Spatial Planning (MSP) Bill, provides a framework for coordinated planning across multiple sectors, ensuring orderly use of the sea space and addressing competing uses, especially in sensitive and vulnerable areas of the environment. The consultations and Public Hearings have been concluded and it is going through the Parliamentary process.

The associated Marine Spatial Planning Framework had been finalised and the development of regional and sub-regional Marine Spatial Management Plans has since been initiated on the South Coast as the first planning area. Valuable research is being undertaken to inform such management plans.

Thus far, the oceans economy has secured investments of about R26.3 billion and created 6 633 jobs since October 2014, mainly in infrastructure development - especially ports, marine manufacturing - mainly boatbuilding, aquaculture, as well scientific and seismic surveys in the oil and gas sector. The empowerment of women, the youth and small, medium and micro enterprises remain a focus in the implementation of initiatives within the oceans economy.

Some of the highlights include the development of a National Guideline towards the Establishment of Coastal Management Lines. This is intended to minimise risks posed by short and long term coastal processes such as storm surges, erosion and sea level rise.

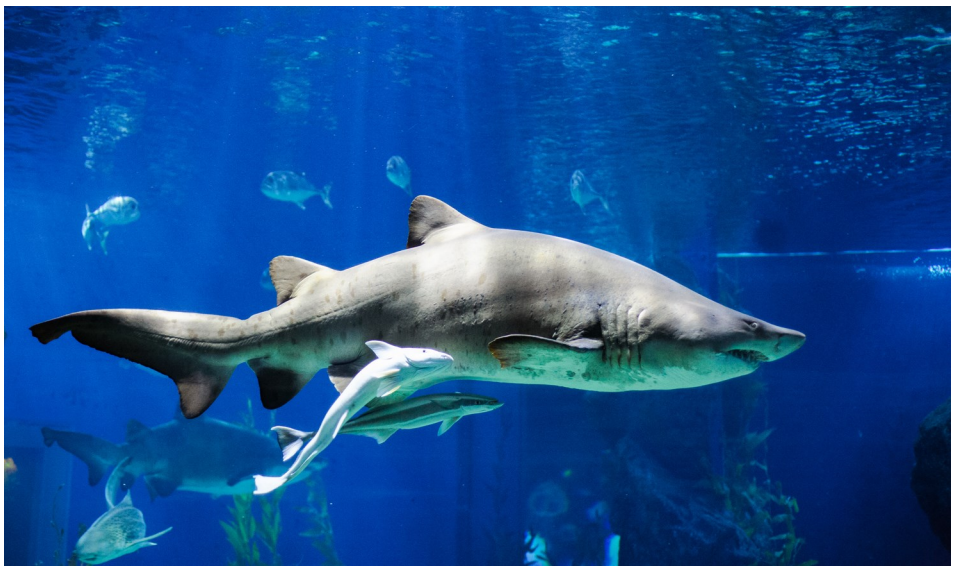
A National Coastal Access Strategy is also under development to provide guidance around access for the public to closed-off beaches. In addition, a review of the strategic plan on dealing with estuaries and a national status quo assessment are being conducted.

Source:

Department of Environmental Affairs [Media release]. (2018, June, 12). Minister Molewa returns from a G7 Leaders' Summit focusing on Oceans. Retrieved from https://www.environment.gov.za/mediarelease/molewa_returnsfromG7leaderssummit

Sharks can have bellybuttons – and other facts about their incredible diversity

The first thing that pops into most people's minds when they think of sharks is of big dumb fish with pointy teeth that are to be greatly feared. But as someone who spends their days studying these creatures, I know just how wrong that image is. For one thing, the diversity of sharks is astounding. The differences between species can even make it seem like some of these animals are barely related.



My new research, carried out with colleagues in the UK and South Africa, shows that significant differences can even exist between male and female members of the same species. Our study of South African great white sharks revealed that females don't always make the switch from eating fish as youngsters to eating seals and other marine mammals when they're older. Instead, our findings suggest that some females may specialise on fish prey and use different habitats to males.

How on Earth did we find this out? We conducted a type of chemical study known as stable isotope analysis on small pieces of muscle that we collected from free-swimming white sharks while on board a cage diving ecotourism boat. This gave us information on what the sharks had been eating and which habitats they had been using for a roughly two-year period – the first time that this analysis has been used on samples from live South African sharks.

What do the results mean? If the females are spending more time in coastal areas than males, they may be more likely to be caught in in-shore fisheries and bather safety nets, as well as being exposed to more pollutants. This issue is already affecting South Africa's white shark population. So better understanding the diversity of shark behaviour could help us improve conservation efforts.

Differences in the way the sexes use resources is called sexual segregation, and is fairly common in sharks. The reasons behind sexual segregation can be complex, sometimes involving different temperature or nutritional requirements or the need for females to give birth in special nursery habitats.

Rough courtship and mating is likely one of the reasons why females grow to larger sizes than males (to be fair, males don't have hands to hold on with, so they use their mouths). Female small spotted catsharks, have been documented avoiding sexual harassment, keeping

away from any romantic (or bitey) encounters with males by hiding out in shallow water caves in the daytime.

Differences between the sexes is just one example of the incredible variety to be found among the sharks. Things get even more diverse when you look at different species. The sizes of the more than 400 species, for example, range from a 20-centimetre dwarf lantern shark to an 18-metre whale shark.

They also come in a surprising variety of shapes, including the flat and ray-like angel shark and the rounded and eel-like frilled shark. Accordingly, their teeth come in a wonderful variety of forms too, from crushing plates used to crunch crabs in smoothhound sharks, to circular blade-like teeth that give cookiecutter sharks their name.

Sharks have a variety of reproductive types too. Some lay eggs (that also come in a bunch of different shapes and sizes depending on the species). Some develop eggs that hatch inside them, producing pups that then develop in the uterus and are born later.

Others give birth similarly to mammals, with a placenta and umbilical chord. The umbilical cord attaches between the pectoral fins and, when the pups are born, they're left with an umbilical scar, effectively a bellybutton, which is visible for a few weeks until it heals up completely. A few shark species have also been found to have "virgin births", reproducing without a sexual partner.

Individual sharks have recently been shown to be just that: individual. In the last few years, the study of shark social interactions and personalities has come to the forefront of shark science. Researchers have found that lemon sharks show a preference for hanging out with familiar individuals. However, just like humans, some sharks are more sociable than others. Port Jackson sharks seem to have best friends that they like to spend time with year after year, and several shark species have been found to to be made up of individuals with different behavioural types, or personalities.

You can even tell individual sharks apart based on their appearance. NASA developed the algorithm that is now used to identify individual whale sharks by their spot patterns (it was originally used to map stars). Each whale shark has a unique pattern that can be identified like a fingerprint, and software is now used to catalogue photographs of individuals to help us monitor their numbers and movement patterns. Several other sharks and rays are now identified by various pattern features. White sharks can be identified by the notches on their dorsal fins, as well as other distinguishing features.

Source:

French, G. (2018, June 12). Sharks can have bellybuttons – and other facts about their incredible diversity. *The Conversation*. Retrieved from https://theconversation.com/sharks-can-have-bellybuttons-and-other-facts-about-their-incredible-diversity-97272#republish

Keeping track of marine life: the Acoustic Tracking Array Platform

By

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South African Institute for Aquatic Biodiversity

Over a decade ago, a small project studying the habitat use and movements of spotted grunter *Pomadasys commersonnii* in the Great Fish Estuary using acoustic telemetry was initiated. Little were we to know that this project would later develop into a programme investigating movements and migrations of a host of estuary-associated species, and ultimately lead to the establishment of a nationwide research platform – the Acoustic Tracking Array Platform.

What is acoustic telemetry?

Acoustic telemetry involves the remote monitoring of tagged individuals using data-logging acoustic receivers, which can either be stationary (passive monitoring) or mobile (active tracking). The receivers work in conjunction with acoustic transmitters which are either surgically inserted into animals (in the case of most fish, sharks and rays) or placed onto animals (penguins and turtles). The receivers then record the unique signals (animal ID code) sent by the transmitters along with the date and time that each signal is received. The spatial and temporal coverage depends on the number of receivers deployed across small or large areas and the battery life (size) of the transmitter. For example, if you have a curtain of receivers placed along the coastline of South Africa, acoustic telemetry allows you to continuously monitor a large-bodied animal's movements around our coastline for up to 10 years.

Why study animal movements?

Animal movements and migrations are key ecological processes and triggered behavioural responses by individuals to move in search of better places to feed, grow, evade predators, survive the cooler winter months or to boost reproduction. Movements of animals can influence how "connected" populations are and can also affect the vulnerability and resilience of a species to both natural and anthropogenic impacts. This, in turn, determines the effectiveness of conservation or management measures aimed to protect certain species. In a world where climate change is happening faster than at a glacial pace, and a world where ever-increasing demands are placed on already dwindling stocks, understanding animal movement

Photo by Ryan Daly

behaviour could be the key to successful conservation and management of a species.

What is the ATAP?

Consider the geographic location of South Africa – it's on the southern tip of the African continent, it has two contrasting boundary currents on either side of the country which give rise to three biogeographic regions, each with varying species diversity and degrees of endemism. This makes our coastline a unique and fascinating natural laboratory in which to study the movement behaviour and migration biology of marine animals. Accordingly, the Acoustic Tracking Array Platform (ATAP) was developed to facilitate the monitoring of aquatic animal movements along the South African coastline. The ATAP, managed by the National Research Foundation–South African Institute for Aquatic Biodiversity (NRF-SAIAB) and other key partners, is a marine research and monitoring platform with more than 100 acoustic receivers moored in estuaries and coastal waters

spanning more than 2 000 km of the South African coastline, from False Bay in the Western Cape to Ponta do Ouro in southern Mozambique. All data collected by the ATAP receiver network are integrated onto a national database, which is then linked to the Canadian-based global Ocean Tracking Network database. The ATAP database provides the mechanism to share detection data with researchers (tag owners). By fostering broader collaborations, we encourage researchers to provide data from private receivers, allowing everyone to fill in potential gaps.

This column aims to keep you updated with the exciting movements of various tagged species along the South African coastline. ATAP currently monitors the movements of 33 species, ranging from important fishery species such as the dusky kob and leervis, to data-limited rays including the diamond and blue stingray, to iconic top predators such as the white and raggedtooth shark. More than 1 000 animals have been equipped with acoustic transmitters and to date, there have been over 8 million detections recorded on the receivers. The ATAP has had almost 900 receiver deployments and currently has 134 active stations. Be sure to keep track of exciting movements with us every SANCOR newsletter!

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