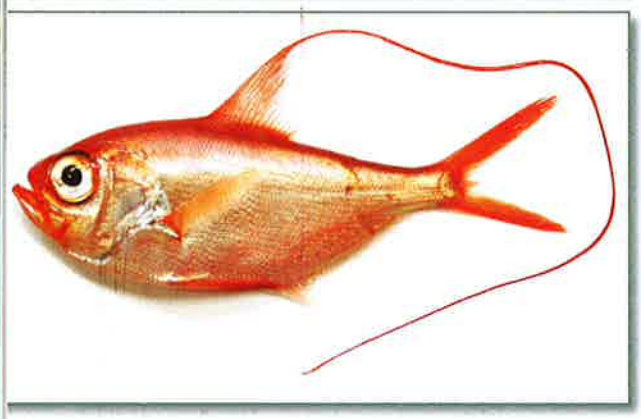
Understanding the ocean floor

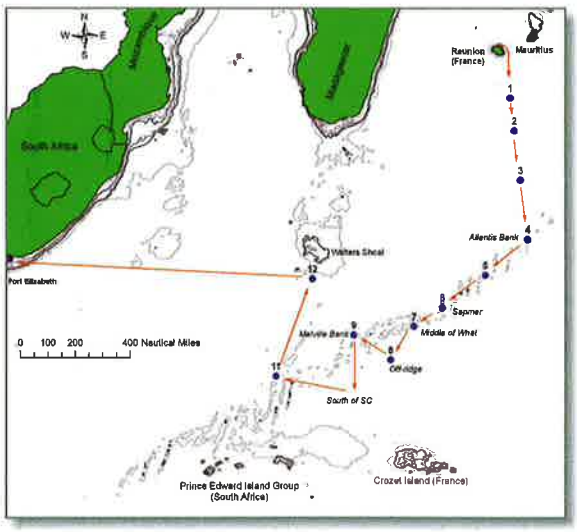
A number of young South African scientists participated in a pioneering survey of the seamounts of the Indian Ocean that was carried out on the research ship *Dr Fridtjof Nansen* late last year. By **Sarah Gotheil** and **Claire Attwood**.

Above: The only octopus caught during the 40-day cruise was this unidentified species, caught on Walter's Shoal near Port Elizabeth. A surprising diversity of squids were caught, however and it is believed that some will be new to science. Image: Sarah Gotheil



Top left: A phyllosoma or rock lobster larva. Many seamounts host a large number of larvae because they seem to trap them. The transparency of the larva helps it to hide from predators. Image: Oddgeir Alvheim

Left: Beryx splendens *(Splendid Alfonsino), a deep-sea fish of commercial interest, which is typically caught at a depth of between 400 and 800 m.* Image: Oddgeir Alvheim



The research vessel Dr Fridtjof Nansen *left on 12 November from Réunion Island, and travelled 6 000 miles in 40 days to study five seamounts on the southwest Indian Ocean Ridge, and one seamount further north on Walters Shoal, south of Madagascar, before docking in Port Elizabeth, South Africa on 18 December.*

These young South African scientists worked side-by-side with a team of the world's leading experts and returned to South Africa with a rich collection of data and specimens, and a new understanding of seamount ecosystems. Seamounts are undersea mountains rising from the ocean floor. They are found in all the oceans of the world and are known to play an important role in ocean food webs.

The six-week survey of the seamounts of the Indian Ocean was organised by the International Union for Conservation of Nature (IUCN), in partnership with several other organisations, including the Agulhas and Somali Current Large Marine Ecosystems (ASCLME) Project and the African Coelacanth Ecosystem Programme. Both these multilateral programmes are based in South Africa and through their involvement in funding and organising the cruise, a handful of South Africans were asked to participate in the survey.

The overall goal of the survey was to improve knowledge of seamounts across the southwest Indian Ocean ridge. In pursuit of this goal, the team of scientists travelled 6 000 miles and returned to Port Elizabeth with nearly 7 000 specimens, ranging from two metre-long fish to tiny crustacean larvae.

The species collection includes an impressive variety of fish, shrimps, squids and gelatinous marine creatures. Many more samples of phytoplankton and zooplankton – representing the base of the ocean food chain – were also collected. Two seabird and marine mammal observers recorded thousands of seabirds from as many as 36 species, and 26 marine mammals over the course of the 40-day cruise. Two of them, majestic humpback whales, even offered the team a wonderful 30-minute display of breaching and spy hopping, only metres from the research ship.

'I am extremely pleased with the data that we have collected and the number of species that we have encountered', said Dr Alex David Rogers, chief scientist on the cruise and senior research fellow at the Zoological Society of London.

'The diversity of species that we sampled is higher than I would have expected. Some species have been recorded for the first time in the region, and we hope to have found some species new to science. It was also very interesting to discover that the six seamounts we surveyed are

The research ship, Dr Fridtjof Nansen, *provided a platform for a team of international scientists to survey the seamounts of the southwest Indian Ocean.* Image: Charine Collins

very different from each other, and I believe our findings will certainly improve our global knowledge of seamount ecosystems'.

A scientific workshop will soon be arranged to identify all the species collected, but the analysis of the thousands of samples collected on the voyage is expected to take many more years.

The results of the seamounts survey will not only have a scientific application, they will also help to improve conservation and management of Indian Ocean marine resources.

One of the primary goals of the survey is to confirm the conservation benefits of protecting seamount features on the ridge. This will inform future management of deep-sea ecosystems in the high seas on a global scale. □

Alex Rogers is a senior research fellow at the Zoological Society of London and was chief scientist on the seamounts research cruise.

Sarah Gotheil is programme officer with the IUCN's global marine programme.

Claire Attwood is a freelance journalist based in Cape Town. She works as media consultant to the Agulhas and Somali Current Large Marine Ecosystem (ASCLME) Project.

A feast for snot flower worms?

Are there any marine creatures with the wonderfully descriptive name of 'snot flower worm' living on the seamounts of the Indian Ocean?

This is the question that biologist Dr Kirsty Kemp, of the Zoological Society of London, is trying to find out. To tempt the little critters to reveal themselves, Dr Kemp delivered a few delectable whale bones and mango tree branches to the seabed of Atlantis and Coral seamounts. The bones and branches were attached to a transponder so that they can be located in 2011, when a second survey of the seamounts of the southern Indian Ocean is scheduled to take place.

Biologists know that whale carcasses are important mini ecosystems on the bottom of the sea. Each decomposition phase attracts different predators – the carcass mostly attracts bigger animals, while the bones are left to worms, bacteria and other tiny creatures. The unique community that colonises whale carcasses (and sometimes wood) is dominated by polychaete worms.

Dr Kemp is particularly interested in snot flower worms because they have been described in the Pacific Ocean, the North Atlantic and the North Sea but, so far, none have been described in the Indian Ocean.

Why are they called a snot flower worms?

'In water it looks like a flower, but out of water it looks like snot!', she says.

The snot flower worm

Why study seamounts?

By Alex David Rogers

Most of the deep sea is inhabited by a very sparse, but diverse, community of animals.

This is because most of them rely on particles of food raining down from the sea surface where photosynthesis takes place. As this food – known as marine snow – sinks, it gets consumed and only a small part reaches the seafloor.

Seamounts are different because some of them harbour striking communities of fish and other animals living on the seabed. They also appear to be hotspots for ocean predators such as sharks, tuna, whales, seabirds and seals.

One of the reasons we are studying the South West Indian Ocean Ridge is that the seamounts along it occur at a variety of depths and in different currents and provide us with a range of environments to try and understand what makes seamounts biological hotspots.

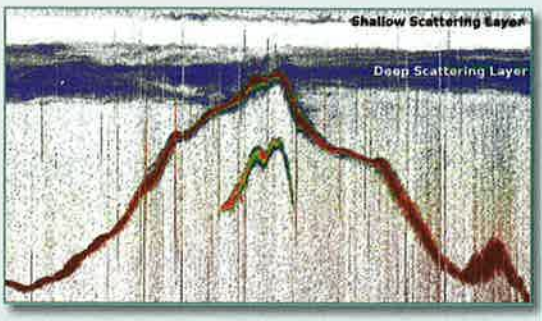
The other reason for studying seamounts is that fishers target seamounts for their abundant fish populations, including orange roughy, oreos and cardinal fish.

When exploitation of seamounts began there was very limited knowledge about the biology of the fish stocks that were being targeted. It turned out that many seamount fish stocks were extremely vulnerable to overfishing because they live for more than 100 years, grow extremely slowly and are very late to mature and reproduce. But, because many stocks were located in the high seas, where there was no control on fishing effort, they crashed very rapidly.

In addition, it was discovered that bottom trawling was highly destructive to seabed communities, which were formed by animals like corals on seamounts. Some of these have now been aged to more than 4 000 years old (although typical ages are tens to hundreds of years old), and are unlikely to recover from the impacts of fishing.

Thus we aim to identify why commercial stocks of fish are found on the South West Indian Ocean Ridge (and therefore elsewhere); how important the seamounts are to other marine life, including birds and whales; and to make our findings available to the fishing industry and managers of fisheries in the region, to help develop ecosystem-based precautionary management of high-seas seamount fisheries.

In 2011 we will return to the Indian Ocean to investigate whether vulnerable marine ecosystems, such as coral reefs, occur on the ridge.



A seamount echogram. The thick blue layer at the summit of the seamount represents the deep scattering layer (DSL). The DSL reflects sound and is visible on echosounders. The world's largest daily migration occurs in the DSL when animals rise to the sea surface at night to feed and then sink back into the dark depths by day to avoid being eaten themselves.

A life on the ocean wave

Riaan with the multinet.

Often working at night and in rough weather, the scientific team on the Dr Fridtjof Nansen collected and preserved almost 7 000 specimens.

An unusual looking fish, this Bean's sawtoothed eel was caught at 500 m.

Caught at 500 m was this deep-sea angler fish, also known as a 'sea toad'. Image: Sarah Gotheil

Riaan Cedras was one of five South African scientists who participated in the survey of the seamounts of the southern Indian Ocean and writes about his experiences on the *Dr Fridtjof Nansen*, where he worked side-by-side with some of the leading marine scientists in the world.

On 11 November 2009 the engines of the *Nansen* started up and the international team of scientists on board prepared for departure from Réunion Island where our 40-day survey of the seamounts of the southwest Indian ocean was to begin.

As is the case on many scientific cruises, our plans were immediately complicated by equipment – or rather the lack of it. The British zooplankton team, which I had joined, was faced with a dilemma because the Methot net they had planned to use for sampling plankton was not on board the *Nansen*, but stuck at Heathrow Airport in London! This meant that a new zooplankton sampling protocol has to be drawn up from scratch.

Having sampled zooplankton from the *Nansen* in 2008, I was familiar with the ship's Multi-net and was able to share my experiences with the zooplankton team. I told them about its capabilities and limitations and some of the problems that might arise when we used the Multi-net. I think one of our biggest challenges was that the British team had planned to split zooplankton samples. This was difficult to do at sea and we needed a Folsom plankton splitter to split the samples accurately. We didn't have one on board, but I was able to build one and when I tested it, it worked very well, splitting the samples into two equal halves. I have to admit those guys were very impressed. It made me feel important throughout the cruise because I realised that there was nothing that the team would not ask me to help with.

One of the expedition's most exciting finds was this barrel eye fish which has huge eyes within a large, dome-shaped transparent or translucent head.

On the other hand, as I collected my own samples, there was always help at hand. I also watched in amazement at how genetic material was collected from each fish. The fish from each trawl were collected and placed in ice-cold water, which kept the DNA frozen and prevented it from denaturing. Furthermore, fascinating pictures were taken by Sarah Gotheil and Oddgeir Alvheim, by placing beautiful specimens such as cephalopod larvae into a fish tank filled with cold water to create buoyancy for the animal. As the animals slowly sank in the tank, the photographers snapped away.

While we were on board, the crew kept us informed about weather conditions, such as strong winds and rough seas. These were a common occurrence over the 40-day cruise, but we were compensated with spectacular sights of whales jumping and seabirds diving.

Daily scientific meetings inspired me and taught me how to go about running a scientific cruise one day when I'm chief scientist. Alex Rogers, who was chief scientist on this cruise, was very time conscious, making sure that scientists were sampling and working when they were required to. No sloppy behaviour was tolerated and I learnt about the importance of working as a team.

A great deal of effort was put into organising and funding this survey of the seamounts of the south western Indian ocean and I am looking forward to participating in future workshops and publications related to the survey. □

Riaan Cedras recently completed his Masters' degree in Zoology at the University of the Western Cape. He will soon begin studying for a PhD that will identify and document plankton abundance and structure in the western Indian Ocean.