NZ IPY-CAML Voyage 2008

28 FEB – 2 MAR Ice and more ice John Mitchell

Having left the inner Ross Sea, we passed through the ever-thickening ice barrier between the open water in the polynya to the south and the open ocean to the northeast. In the ice barrier, we had to push through ribbons of thick pack ice with relatively open ‘leads’ that were filled with grease ice and newly formed soft pancake ice. Although our progress was slow at times, it was only about 24 hours before we arrived at our first seamount site, dubbed South Scott Seamount.

As Scott South seamount had never been surveyed or mapped before, we began by mapping enough of the area with the multibeam system to be able to plan our sampling programme of benthic sled and DTIS camera transects. Although the ice cover was quite thick, we had enough open water to proceed with sampling. Overnight and the next morning was very calm, providing all on board beautiful views of the ever-changing sea ice. Unfortunately, it also meant that the seawater, which was sitting at -1.8°C, started to form new ice rapidly. We quickly finished sampling and moved off to more open waters and our next station, to sample at a depth of 3350 m on the abyssal plain.

Fig. 1. *Tangaroa* proceeding through close pack ice towards an open lead in the distance.

Fig.2.Working on South Scott Seamount. DTIS wire cutting through thin new ice.

Now that we’re in more open waters on the edge of the ice pack, we hope to see more in the way of Antarctic wildlife. Adelie penguins have been seen in isolated groups on ice floes, but not in great numbers. Whale sightings have been uncommon, but at the abyssal station in more open ocean waters we were treated to a very rare sighting: a pair of blue whales.

Fig.3. Adelie penguins on a newly formed ice floe.
(Photos 1-4: John Mitchell)

Fig.4. Pair of blue whales passing close by the *Tangaroa* – half a mile away.

SCIENCE REPORT

The shape of the deep (John Mitchell & Arne Pallentin)

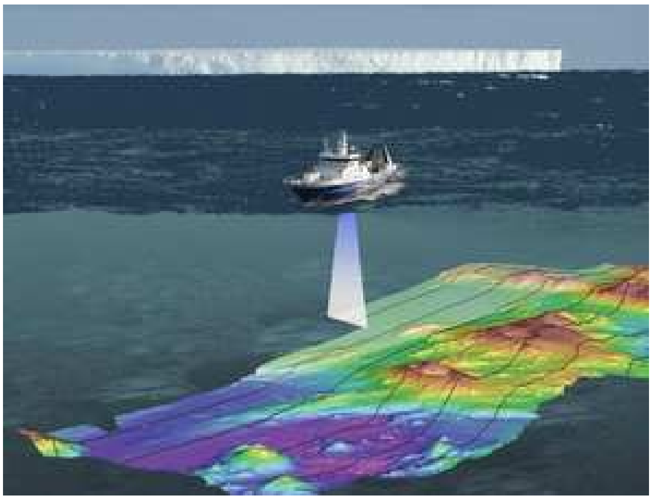


Fig. 5. Diagrammatic representation of the *Tangaroa* multibeaming the seabed of Ross Sea (Image: Erika Mackay, modified John Mitchell).

Mounted on *Tangaroa's* hull, the EM-300 multibeam echosounder maps the seafloor using a fan of 135 acoustic beams, providing 100% coverage of the seabed out to a maximum swath width of five kilometres (Fig.5). The swath-map surveys show far greater detail and accuracy about the bathymetry and topography of the seabed than the methods that use single-beam sounders (Fig.6). The increased beam width of the multibeam system over a single beam sounder also greatly reduces the time to survey a given area.

As most of the Ross Sea has not been mapped in this way, the multibeam is an important tool to provide 3D context for gear deployment at sample stations. This is most evident when sampling steep or rugged features such as seamounts.

Most major seamounts in the Ross Sea have been poorly mapped to date, using information from satellites and data from the occasional vessel which sounds across them opportunistically or when fishing.

For the NZ IPY-CAML project the multibeam is being used at each sample station to measure seabed depth and roughness and to map features such as bottom type, iceberg scouring, seamounts, as well as identify suitable ground for sampling.

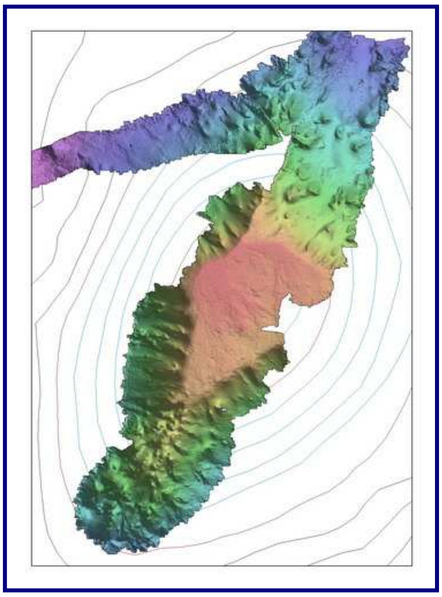


Fig. 6. Sun illuminated image of South Scott Seamount. Pre-survey depth contours shown in background.

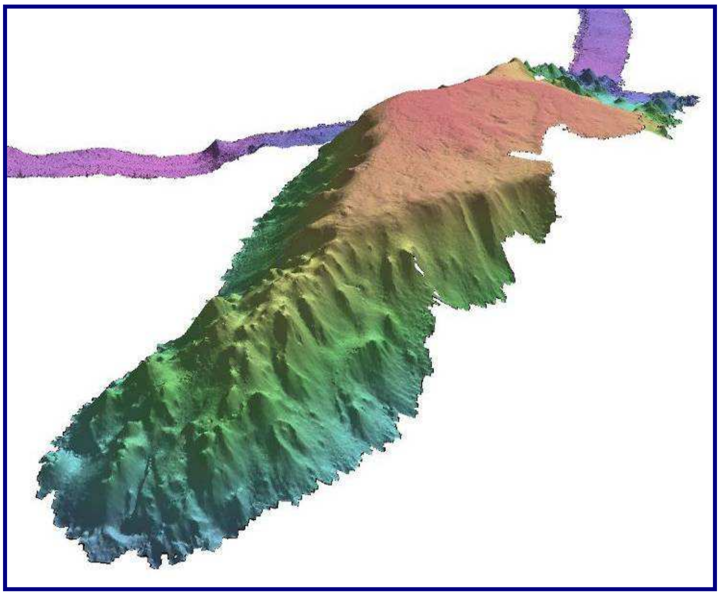


Fig.7. Three dimensional perspective view of South Scott Seamount viewed from the southwest. Colour range: 400-3500 m (Images: Arne Pallentin)

Some rare fish finds (Andrew Stewart, Museum of New Zealand – Te Papa Tongarewa)

We're half-way through the expedition and have so far collected 69 fish species from the Ross Sea, including some rare specimens and even some that have never been seen before.

Among the more common species of mesopelagic fishes – lanternfish, deep-sea smelt, and barracudinas – taken in the mid-water tows, has been a single specimen of a rare lanternfish, the slender pearleye, *Benthalbella elongata* (Fig. 8). The fish was caught at a depth of more than 1300 m at 72ºS, making it one of the southern-most specimens ever collected for the species. At only 240 mm long the slender pearleye seems small (although 240 mm is quite large for the species) yet it is a well adapted predator armed with an impressive array of hooked and barbed teeth in both jaws. If that weren't enough, the tongue also has a single row of teeth in a rip-saw band. To assist prey capture, the slender pearleye's large eyes look upward and forward. This layout gives the fish binocular vision, enabling it to accurately judge distances to its prey. Meals can be hours or even days apart, so it is important not to miss! Lanternfish live in the twilight zone, and have a characteristic a cup-like structure at the base of their eyes – the 'lantern' that gives the family its common name. This acts to enhance and re-focus light going into the eye acting like night vision goggles.

Fig. 8. The slender pearleye (*Benthalbella elongata*) a midwater predator (Photo: Peter Marriott).

Plunderfishes (Family Artedidraconidae) have also been caught occasionally. These pug-headed fishes are endemic to the Southern Ocean, where 25 species are known. They're characterised by the barbel on the tip of the chin and flattened curved hook-like spines on the gill cover (Fig. 9). On this survey, we've been able to confirm that the specimens we have caught are a valid species and we have recorded their fresh colour for the first time. We also collected tissue samples for on-going taxonomic work on the evolution of this group of fishes.

Fig. 9. The plunderfish (*Pogonophryne marmorata*) a benthic predator (Photo: Peter Marriott).

The deepest tow at 2300 m depth also caught four specimens of Scott’s dragonfish, *Bathydraco scotiae*, a first for this expedition.

Fig. 10. Dragonfish, *Bathydraco scotiae* (Photo: Peter Marriott)

Mystery invertebrate identification remains to be solved (Kareen Schnabel)

At our first site deeper than 2000 m, (station C18) in the northern Ross Sea, the DTIS camera recorded a number of unusual-looking quite large gelatinous invertebrates (Fig. 11). The animals are nearly transparent, in excess of half a metre in length, and are anchored into the soft sediment with a flexible stem. Based on the images, our best guess is that these are a type of predatory tunicate (sea squirt), a deep-sea adaptation of the otherwise passive filter-feeding mode of the sea squirt commonly found in shallow waters. Unfortunately, our hopes of getting a closer look at these creatures were dashed, as no specimens were caught in the benthic sleds used to sample the seabed after the camera deployment.

Fig. 11. Mystery animal of the deep. Possibly a predatory tunicate, photographed by DTIS camera system at a depth of 2200 m. A small isopod crustacean is using it as a perch. (Photo: Dave Bowden/DTIS)

NZ IPY-CAML Voyage 2008

3 - 5 MAR Seamounts and open water

John Mitchell

Now we are out of the inner Ross Sea the focus of the voyage has changed to sampling seamounts (underwater mountains) and the abyss (seafloor in the deep ocean 2000–4000 m). We're surveying a series of seamounts, concentrating on the Scott complex around Scott Island north of the Ross Sea, at about 68 ºS, 180º followed by the Admiralty chain further to the west. Even further west are the Balleny Islands and associated seamounts, which will not be visited this trip as they have already been sampled during previous *Tangaroa* voyages. The composition of the fauna has gradually changed and reduced in quantity (but not quality) as we have moved north and is now 'transitional' i.e., is a mixture containing fauna typical of both the Ross Sea and the Southern Ocean.

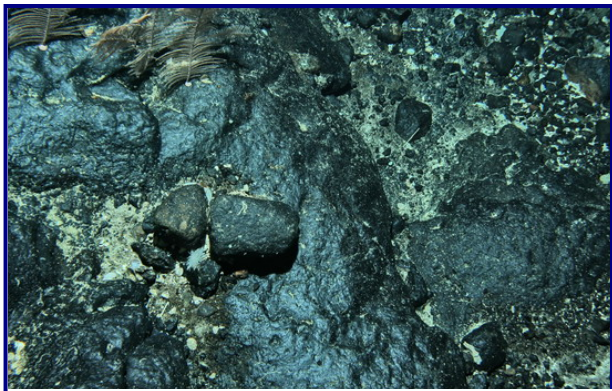


Fig. 1. DTIS image from Scott Seamount showing a seafloor lava flow and glacial 'drop stones' (stones carried by glaciers and icebergs and dropped to the seafloor upon melting).

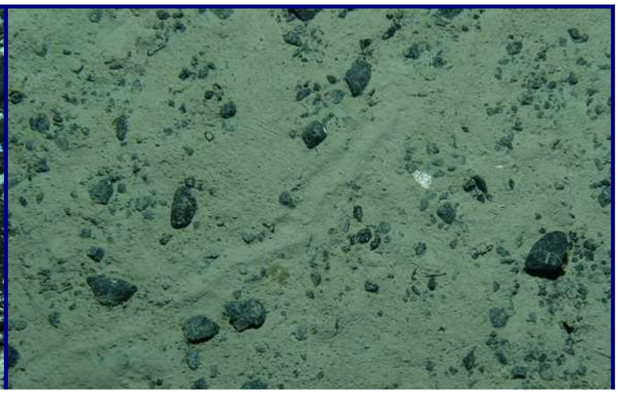


Fig. 2. DTIS image of the seabed at a depth of 3325 m, showing a predominantly muddy seabed with numerous drop stones and animal tracks. (Photos 1 & 2: Dave Bowden/DTIS)

Running closely in parallel to our sampling programme is an extensive outreach programme which includes educational blogs for both New Zealand and International web sites, and the filming of the voyage with the aim of producing a documentary of our scientific journey. Max Quinn (Natural History NZ), assisted by Stacey Mulgrew (MFish), can be seen at all times of the day and night capturing the voyage activities on film or interviewing us.

Fig. 3. Filmmaker Max at work, filming a trawl station and the recovery of the DTIS camera. (Photos 3 & 4: John Mitchell)

Fig. 4. The documentary team filming *Tangaroa*, working in heavy ice.

SCIENCE REPORT

Denizens of the deep: daggertooth and stareater:
(Andrew Stewart – Museum of New Zealand, Te Papa Tongarewa)

We have caught two striking but very different predatory fishes in the midwater trawl net this week: the formidable daggertooth and the stareater.

At 71°S, the half-grown, 50 cm long daggertooth specimen (Fig. 5 & 6) is one of the southernmost daggertooth specimens ever caught. The unusual forward-curved teeth in the upper jaw of this species help it to immobilise its prey. When the daggertooth clamps down on its prey (usually small fish) it then pulls backwards and the teeth cut deep into its victim, often severing the spine and paralysing it. Because this specimen is in such good condition, we were able to record not only the iridescent body colour, but also the brilliant sapphire blue of the eye. Sadly, these colours fade rapidly on death and are not visible in museum collections.

Fig. 5. Andrew Stewart holding a freshly caught daggertooth and close-up of its jaw (Photos: Richard O'Driscoll)

Fig. 6. Daggertooth set up for specimen photography (Photo: Peter Marriott)

The stareater is another midwater predator. Smaller and more fragile than the daggerfish it is believed to capture its prey by luring small fishes into striking range with its red luminous chin barbel. The delicate fins and skin on this specimen were abraded by the net, but all important key features remained. These include the row of light organs along the belly (seen as black dots on Fig. 7); the mouth with its long, slender, curved teeth; and the lure. This 21 cm long specimen is about as big as this species gets. Scientists are unsure as to exactly how many species of stareater there are.

Fig. 7. Stareater showing the sharp curved teeth and red luminous lure (Photo: Peter Marriott)

Linking DTIS and specimen images yields new insights
(David Bowden – NIWA, and Stefano Schiaparelli – Italian National Antarctic Museum)

Images of invertebrates captured by NIWA's Deep Towed Imaging System can help with the identification of specimens collected by physical sampling methods. Used in conjunction with specimen images, they can also reveal a whole lot more about the communities that live on the seafloor.

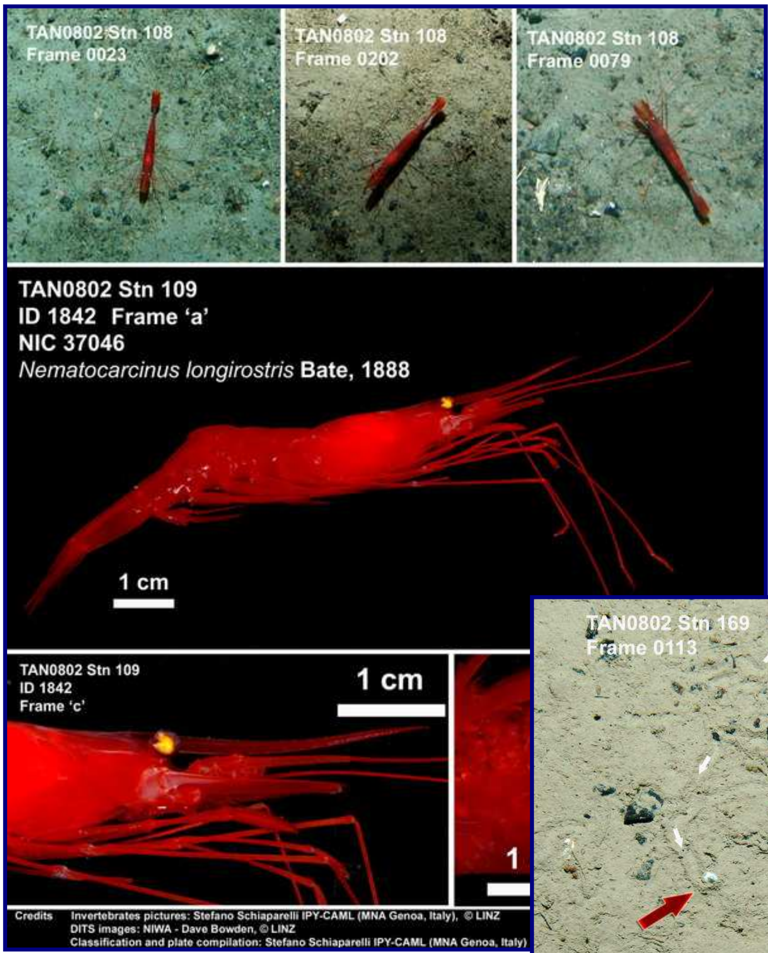
For marine biologists, scientific field expeditions provide a great opportunity to study freshly caught specimens while they retain their natural colouration and form. Biological material collected during a voyage is preserved, usually in formalin or ethanol, for later identification of known species and naming of those not previously described. In most cases the colours of the organisms fade rapidly after fixing them in these chemicals. For invertebrate groups such as anemones that lack skeletal structures, even their 3-D structure and morphology may be unclear once they are hauled up on deck. Consequently, fresh caught and preserved specimens may bear little resemblance to their live appearance, and give little indication of how the animals are organised on the seabed.

Onboard *Tangaroa*, we routinely photograph live specimens under controlled conditions in the laboratory. These images record consistent standards of detail required for accurate taxonomic identification. These images are also used to confirm the identity of organisms captured on film during seabed video transects with the deepwater camera system.

Our aim is to be able to use DTIS video transects to assess the diversity of benthic (bottom-dwelling) organisms and estimate species abundances with minimum impact on the seabed. If we can do this reliably, we will be able to reduce our dependance on more destructive sampling tools, such as trawls and sleds. Another bonus from using a sampling tool like the DTIS is to learn about the spatial relationships and structural organisation of organisms on the seabed. To achieve this, we use sled and trawl sample data to 'ground-truth' the identifications made from photographic transects. By photographing captured specimens in the lab and linking these to images of the undisturbed seabed taken by DTIS, we're developing a reference library of benthic fauna. This library allows us to first assess the match between what's seen in the photographic transects and what's caught by the trawls and sleds.

Further analysis of the video and still images will then allow us to calculate accurate abundances for conspicuous species and to describe a range of ecological factors that could not be determined from the trawl and sled samples alone. This includes studying the direct links between physical aspects of the seabed (e.g. substrate type) and the patterns of animal distribution seen on camera.

In the first example here (Fig. 8), consecutive deployments of the DTIS and the bottom trawl enable species-level identification of the shrimp *Nematocarcinus longirostrus* seen in DTIS images. The next example (Fig. 9) illustrates how *in situ* images of organisms on the seabed can improve ecological understanding. The literature on deep-sea lepetellid gastropods (a type of limpet) reports that all known species are sedentary and live on hard substrates . However, in the DTIS images, ground-truthed by trawl-caught specimens (Fig. 9), the limpets can be seen clearly grazing on soft mud and from the tracks that they have left, it appears that they actively avoid rocks.



There is far more detail captured in the images we are taking than we can analyse during the voyage, but these examples demonstrate how the combination of seabed images and detailed specimen images can yield new insights into the ecology of the Ross Sea benthic fauna.

Fig. 8. Laboratory images of live specimens caught from sleds or trawls (bottom) allow accurate ground-truthing of specimens visible in seabed images (top) (Photos: Dave Bowden/DTIS – top; Stefano Schiaparelli, bottom).

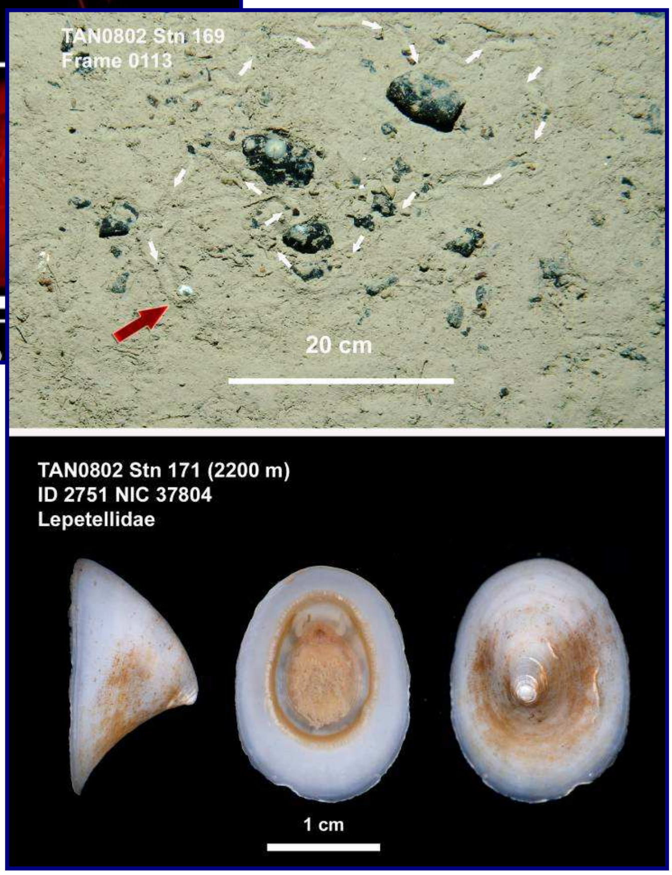


Fig. 9. Top: Deep-sea limpet (red arrow) at 2250 m depth grazing on soft mud. White arrows show its track across the mud (Photo: Dave Bowden/DTIS). Bottom: Laboratory images of limpet specimens (Photo: Stefano Schiaparelli).