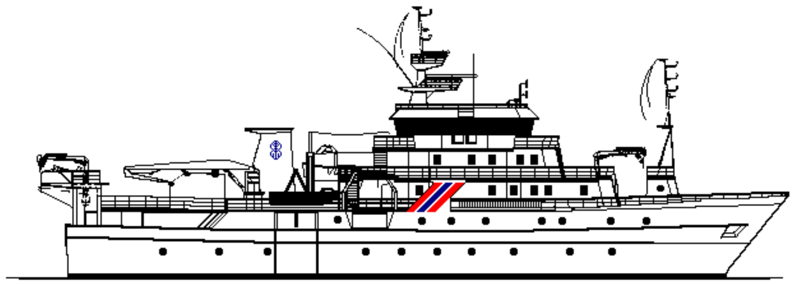
PRELIMINARY

Cruise Report "Dr. Fritjof Nansen"



Southern Indian Ocean Seamounts
(IUCN/ UNDP/ ASCLME/ NERC /EAF Nansen Project 2009 Cruise 410)
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By

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1.0 The South West Indian Ocean

1.1 Regional fisheries management arrangements

The Indian Ocean is the world's third largest ocean, stretching 9600km from the Bay of Bengal to Antarctica and 7600km from Africa to Australia (Demopoulos *et al*., 2003). It is a globally important region for marine capture fisheries, representing more than 10% of global catches according to the latest FAO figures (FAO, 2009). Within this region, the western Indian Ocean is notable for recent increases in fish catches (FAO, 2009). However, it is also the region of the world where the highest proportions of exploited fish stocks are of unknown or uncertain status (Kimani *et al*., 2009), reflecting problems of fisheries management and ocean governance in the region. Artisanal fisheries in the Indian Ocean are critical for the livelihoods and food security of the populations of coastal states in the region, particularly island nations such as the Seychelles. The offshore fisheries of the western Indian Ocean are rich but countries within the region have been unable to develop the infrastructure to exploit these fisheries. As a result they have allowed the distant water fishing fleets of developed countries to access fish resources through multilateral or bilateral agreements (Kimani *et al*., 2009). This situation is promoted by the subsidies received by foreign distant-water fleets which give them a competitive advantage over local fishing fleets (Kimani *et al*., 2009).

At present there are two main agreements that exist for the Southern Indian Ocean, the Southwest Indian Ocean Fisheries Commission (SWIOFC; see Fig. 1), which was opened in 2004 to promote sustainable utilization of marine living resources. This agreement was signed by Comoros, France, Kenya, Madagascar, Mauritius, Mozambique, the Seychelles, Somalia, and Tanzania. SWIOFC is focused on shallow-water fisheries but some states are investigating new fisheries for deep-water species within their EEZs (e.g. Mauritius or Mauritian dependencies on the Nazareth and St Brandon Banks; SWIOFC, 2009). In 2006, the South Indian Ocean Fisheries Agreement (SIOFA see Fig. 2) was opened and signatories so far include Australia, the Comoros, France, Kenya, Madagascar, Mozambique, Mauritius, New Zealand, Seychelles and the European Community. However, the latter agreement, which forms the basis of a regional RFMO, has not yet entered into force. This delay in the implementation of the SIOFA agreement caused sufficient concern amongst several of the deep-water fishing companies in the area that in 2006 they formed an association to promote technical, research and conservation activities to furnish a future RFMO with data required for management of deep-water fisheries in the region (Shotton, 2006). This association is known as the Southern Indian Ocean Deepwater Fisher's Association (SIODFA).

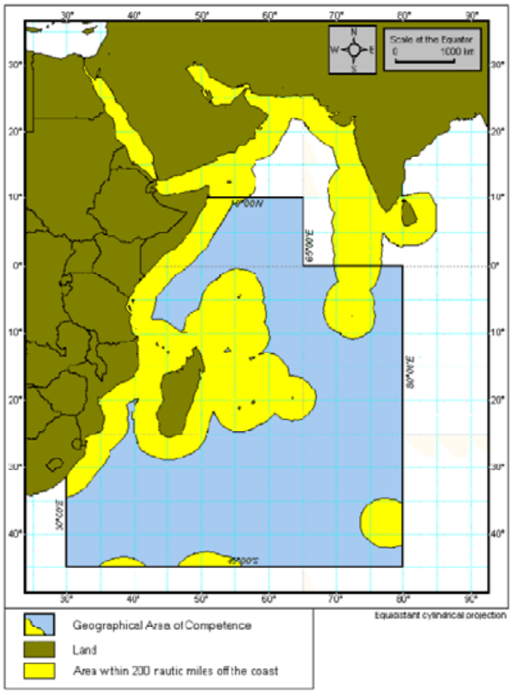

Figure 1.1 SWIOFC proposed area of competence (SWIOFC, 2005)

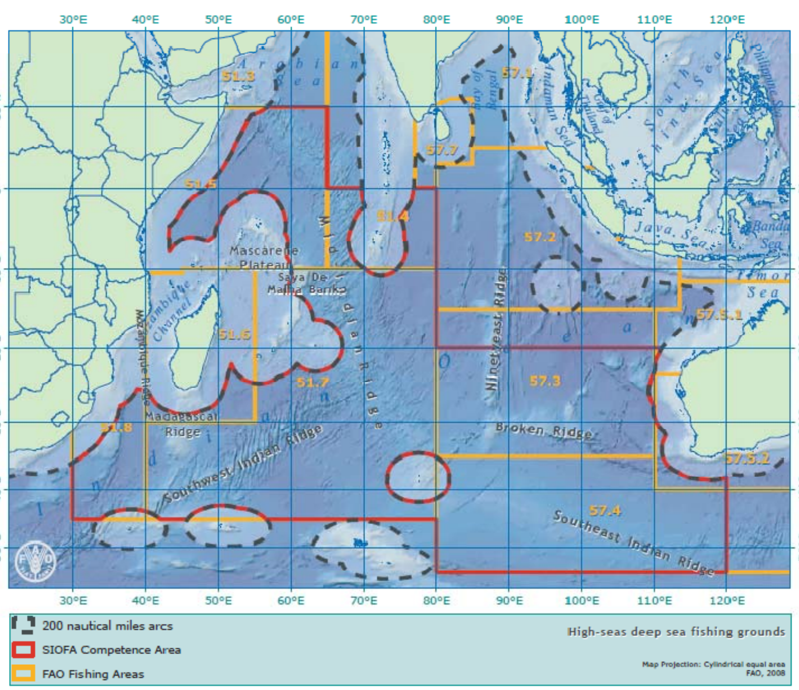

Figure 1.2 Proposed SIOFA area of competence (Bensch *et al*., 2008).

1.2 Fisheries for deep-sea species in the South West Indian Ocean

The development of deep-sea fisheries in the high seas regions of the Indian Ocean were undertaken by distant-water fleets of developed countries, particularly the USSR. In the early 1970s, the Soviet distant water fishing fleet was the largest in the world (Romanov, 2003). Exploratory fishing on the South West Indian Ocean Ridge, the Mozambique Ridge and the Madagascar Ridge began in the 1970s by the Soviet fleet, and associated research institutions, with commercial trawling began in the early 1980s (Romanov, 2003; Clark *et al*., 2007). These fisheries targeted redbait (*Emmelichthys nitidus*) and rubyfish (*Plagiogeneion rubiginosus*) with catches peaking about 1980 and then decreasing to the mid 1980s (Clark *et al*., 2007). Fishing then switched to alfonsino (*Beryx splendens*) in the 1990s as new seamounts were exploited. Some exploratory trawling was also carried out on the Madagascar Ridge and South West Indian Ocean Ridge by French vessels in the 1970s and 1980s, particularly targeting Walter's Shoals and Sapmer Bank (Collette & Parin, 1991).

In the late 1990s, a new fishery developed on the South West Indian Ocean Ridge with trawlers targeting deep-water species such as orange roughy (*Hoplostethus atlanticus*), black cardinal fish (*Epigonus telescopus*), southern boarfish (*Pseudopentaceros richardsoni*), oreo (Oreosomatidae) and alfonsino (Clark *et al*., 2007). This fishery rapidly expanded, with estimated catches of orange roughy being in the region of 10,000t, but the fishery rapidly collapsed. Fishing then shifted to the Madagascar Plateau, Mozambique Ridge and Mid-Indian Ocean Ridge, targeting alfonsino and rubyfish (Clark *et al*., 2007).

Fishing continues along the South West Indian Ocean Ridge mainly targeting orange roughy and alfonsino. Recent fishing has also taken place on the Broken Ridge (eastern Indian Ocean), 90 East Ridge, possibly the Central Indian Ridge, the Mozambique Ridge and Plateau and Walter's Shoal (western Indian Ocean), where a deep-water fishery for lobster (*Palinurus barbarae*) has developed (Bensch *et al*., 2008). The banks around Mauritius within the EEZ and high seas portions of the Saya da Malha Bank have been targeted by fisheries for *Lutjanus* spp., and lethrinid fish (SWIOFC, 2009). There are also reports of unregulated fishing using gillnets in areas of the Southern Indian Ocean such as Walter's Shoal, which target sharks (Shotton, 2006). SIODFA report that their vessels undertake approximately 2000 deep-water trawl tows per year in the entire Indian Ocean. By-catch of fish from SIODFA fishing operations in the region are reported to be small, especially when fishing below 500m depth (Shotton, 2006). As with New Zealand vessels operating in the southern Pacific Ocean, tow times have been reported to be typically short in the region, with a duration of 10-15 minutes (Shotton, 2006), reflecting the highly targeted nature of roughy and alfonsino fisheries on seamounts.

Currently, there is little or no information available for the assessment of the impacts of deep-sea fishing on high seas areas of the Indian Ocean on populations of target or by-catch species. Reporting of data are complicated by issues of commercial confidentiality in fisheries where individual stocks may be located across a wide area (e.g. the South West Indian Ocean Ridge), and there is no regional fisheries management body in force to regulate fishing. At present, new fisheries are developing in the region with no apparent assessment of resource size or appropriate exploitation levels to ensure sustainability of fisheries. SIODFA have reported that they are collecting data on both fishing operations and catches (tow by tow data) as well as other biological information on target species to feed into a future arrangement (SIOFA) when it is implemented (Shotton, 2006).

1.3 Protection of benthic marine ecosystems

At present the only initiative protecting vulnerable marine ecosystems in the high seas region of the Indian Ocean is the unilateral declaration by SIODFA of Benthic Protected Areas (BPAs). The companies that belong to SIODFA have voluntarily closed these areas to bottom fishing or mid-water trawling (Shotton, 2006). The BPAs were selected on the basis of a number of criteria including:

- Representivity of seabed type (e.g. seamount, slope edge etc.)
- Fishing history
- Level of pre-existing knowledge on an area of geology, bathymetry and biology
- Protection of benthic communities
- Protection of areas of special scientific interest (e.g. geological features of Atlantis Bank)

On these criteria, ten areas were protected in the Indian Ocean on the basis of the knowledge gathered by the members of the association from various sources, as well as the research and data gathered during fishing operations by vessel masters. These sites include a number of seamount, knoll, ridge and other topographic features that in some cases are known or suspected to host VMEs, as well as populations of commercial and non-commercial fish species (see Fig. 3).

1.4 The Seamounts Project

At present little is understood about the representivity of the BPAs or whether they offer protection from bottom fishing, as non-members of SIODFA are under no legal obligation to avoid fishing these areas. It was against this background, as well as wider issues of management of fisheries in waters beyond national jurisdiction that stimulated the current project and cruise. Also, unlike other oceans of the world, the Indian Ocean was explored relatively little during the "heroic age" of deep-sea exploration. It was only during the Indian Ocean Expedition of 1962-1965 that deep-sea areas were extensively sampled. Since that time deep-sea research in the Indian Ocean has largely focused on the Arabian Sea, and in general the deep-sea ecosystems of the rest of the region remain poorly explored (Banse, 1994; Ingole & Koslow, 2005). The fauna inhabiting seamounts in the Indian Ocean are particularly poorly known and there is an urgent requirement to explore these ecosystems to complete the picture of the biodiversity and productivity associated with the Indian Ocean (Demopoulos *et al*., 2003). Until now the main source of information on the biology of these seamounts have been scientific / fisheries reports of past Soviet expeditions related to exploratory fishing which are focused on fish populating the ridges of the Indian Ocean (Romanov, 2003).

The International Union for the Conservation of Nature (IUCN), the United Nations Development Programme (UNDP), the Aghulas and Somali Current Large Marine Ecosystem Project (ASCLME), the Norwegian Agency for Development Cooperation (NORAD), the Natural Environment Research Council (NERC) and the Zoological Society of London have collaborated to develop a research programme focused on the high seas ecosystems and management of fisheries of the South West Indian Ocean, particularly the South West Indian Ocean Ridge. This project is aimed at addressing a number of scientific questions but all are focused on contributing to ecosystem-based management of fisheries on the high seas of the Southern Indian Ocean. The questions specifically are:

- What are the benthic communities of southern Indian Ocean seamounts like, how diverse are they (global importance, biogeography)?
- What is driving the seamount fisheries (energy supply to the seamount ecosystems)?
- Are predictions of coral diversity on seamounts in the southern Indian Ocean based on habitat suitability modelling using global datasets accurate?
- What are the impacts of the past and current deep-sea fishing activities?

- Will the areas voluntarily set aside as BPAs by the trawling industry make a significant contribution to conservation of vulnerable seabed communities?
- Could the BPAs actually benefit fishing?
- Which seamounts should be fully protected due to their high ecological value, and which others can remain open to bottom fishing subject to regulations to prevent significant adverse impacts to marine biodiversity?

To answer these questions, two cruises were funded. The first, supported by NORAD's EAF-Nansen Project on their vessel, the *Fridtjof Nansen*, funded as part of a UNDP/IUCN project funded by the Global Environment Facility (GEF) [1] and the ASCLME project, is a cruise aimed at understanding the pelagic biology and physical oceanographic setting of the seamounts on the South West Indian Ocean Ridge. In addition, it would also provide a platform for the observation of the avifauna of the region as well as distribution of cetaceans around the seamounts, knowledge of which were pointed out as being data deficient in the region for the purposes of management (Shotton, 2006). The second cruise, funded by NERC and to be undertaken on a NERC vessel, will deploy a remotely operated vehicle to explore and sample the benthic biodiversity of seamounts of the South West Indian Ocean Ridge.

Here we report on the results of the first cruise, Fridtjof Nansen Cruise 2009 410, which explored 6 seamounts, five distributed along the South West Indian Ocean Ridge running from north to south including, Atlantis Bank (BPA), Sapmer Seamount, Middle of What Seamount, Melville Bank and Coral Seamount (BPA). The final seamount investigated, lies on the Madagascar Ridge, north of Walter's Shoal, a large submarine plateau, part of which is also protected as a BPA by SIODFA. Thus, these seamounts were located on two isolated groups of ridge features. The seamounts of the South West Indian Ocean ridge also differed in physical settings, both through having different summit depths but also by being divided, between Melville Bank and Coral Seamount, by the Sub-Tropical front, recognised as a major potential biogeographic barrier. The main methods of investigation included systematic acoustic survey, sampling of pelagic fauna using a combination of bongo nets, multisampling nets and trawls, oceanographic measurements using CTD casts and measurements of chlorophyll and phytoplankton biodiversity.

[1] Applying an ecosystem-based approach to fisheries management: focus on seamounts in the Southern Indian Ocean; GEF Project ID 3657

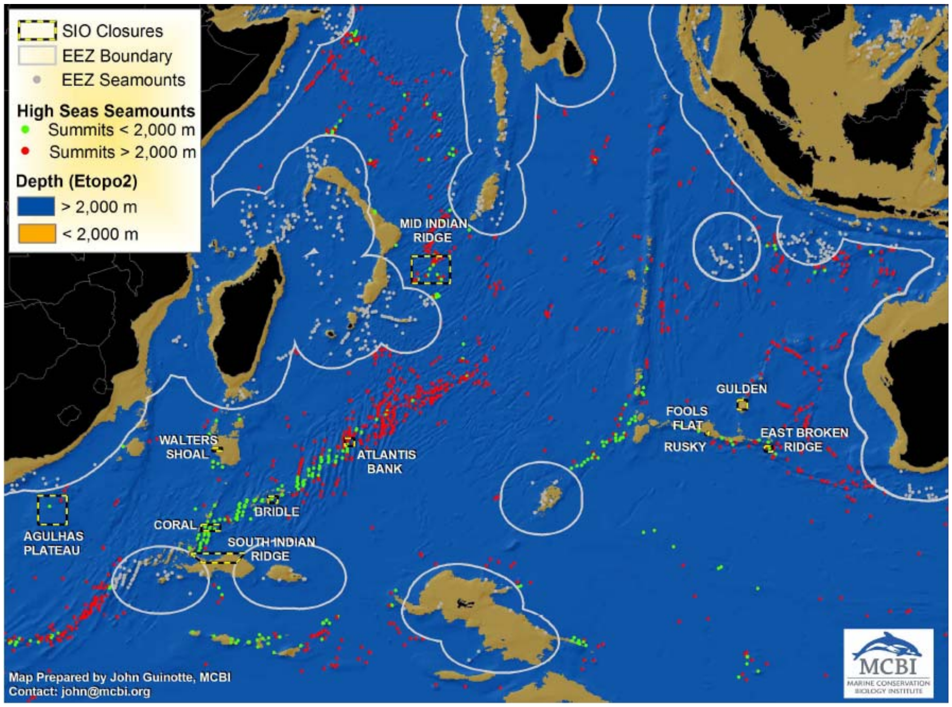

Figure 1.3 Map of the Indian Ocean showing high seas areas, seamounts <2000m summit depth (green dots), seamounts >2000m depth (red dots) and BPAs (MCBI, 2009).

1.5 The Environmental Setting of the Madabascar and South West Indian Ocean Ridges

1.5.1 Geology

The South West Indian Ocean Ridge separates the African and Antarctic Plates and has an ultra-slow spreading rate (full rate of 16mm per year; Sauter *et al*., 2002). It extends approximately 1200 miles from the Rodriguez Triple Junction to the Prince Edward Islands, and varies from 200-300 miles wide (Romanov, 2003). The ridge is characterised by a very deep (>5000m in places) and rough mid-axial valley and is cut by a series of north – south running transform faults (Münch *et al*., 2001), such as the Atlantis II and Novara transform faults that lie either side of Atlantis Bank (Coogan *et al*., 2004). Near Prince Edward Island the ridge splits into two, one branch continuing as the South West Indian Ocean Ridge and joining with the Mid-Atlantic Ridge, the other forming the African-Antarctic Ridge.

The Madagascar Ridge extends southwards from the microcontinent of Madagascar for about 700 miles. The minimum depth is about 15m on the summit of Walter's Shoals which is located roughly 400 nautical miles (nm; approx. 720 km) south of Madagascar and 600 nautical miles east of South

Africa, and have an estimated area of 400 km^2 shallower than the 500 m depth isobath (Groeneveld *et al*., 2006). This large and shallow seamount is covered, at its shallowest depths, with rhodoliths formed predominantly by the calcareous algae *Mesophyllum syrphetodes* and *Tenarea tessellata* (Collette & Parin, 1991), and coral (Romanov, 2003). The slopes of the Shoals are reported to be steep. Other seamounts along the Madagascar Ridge are reported to have summit depths between 84m to 1100m (Romanov, 2003).

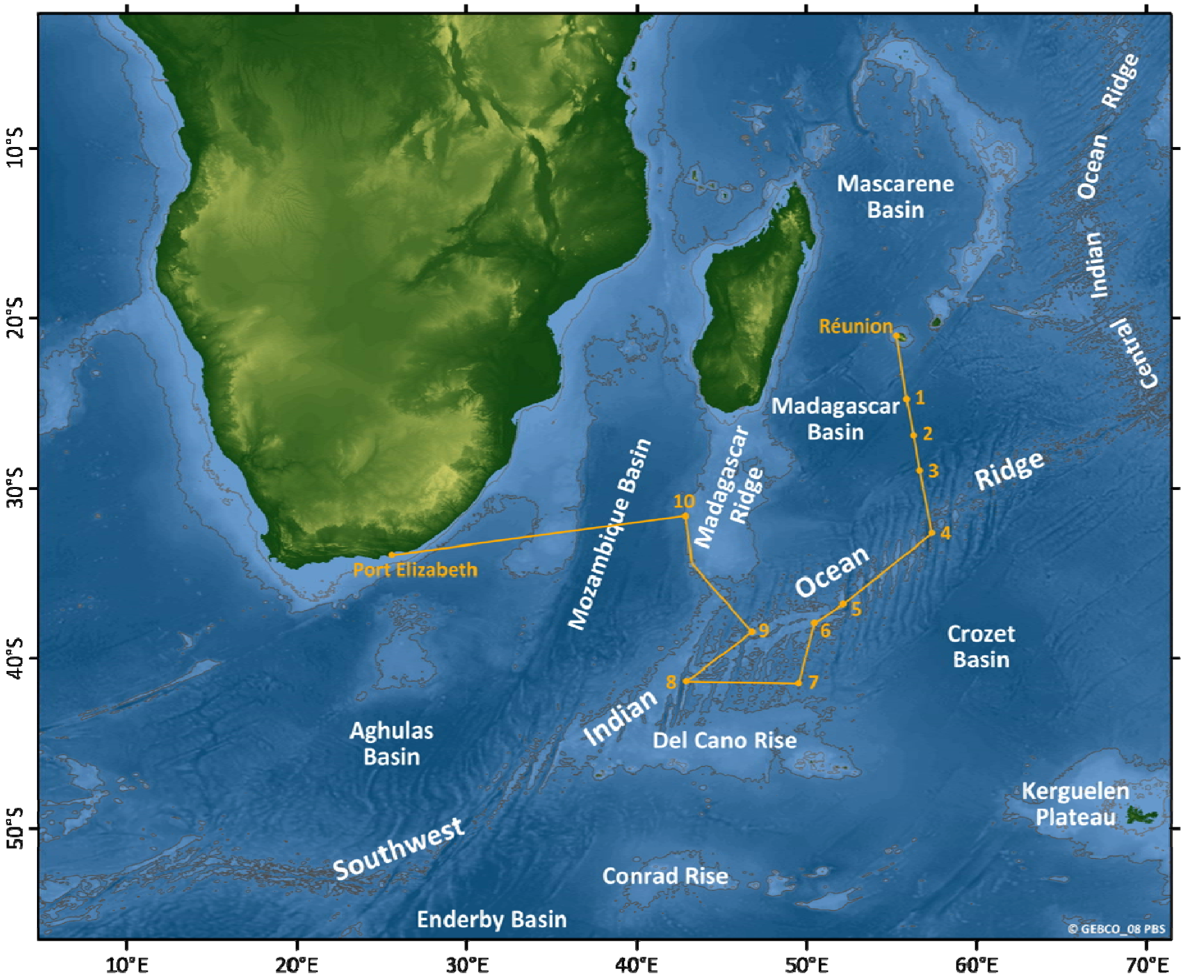

Figure 1.4 South West Indian Ocean Seamounts Cruise; cruise route and stations: 1. CTD station. 2. Off Ridge Station. 3. CTD Station. 4. Atlantis Bank. 5. Sapmer Bank. 6. Middle of What Seamount. 7. Off-Ridge cold-water station. 8. Coral Seamount. 9. Melville Bank. 10. Un-named Seamount Walter's Shoal.

The South West Indian Ocean ridge has been subject to numerous geological investigations and was key to the discovery that ultraslow spreading ridges were distinct from slow and fast spreading ridges (Dick *et al*., 2003). One result of this is that rather than being formed of volcanic rock parts of the ridge comprises large areas where mantle has been extruded onto the seafloor. Atlantis Bank, in particular, has been subject to intensive geological study and has been the subject of many scientific publications. However, the biological observations on this seamount have been confined to comments that Atlantis Bank was host to large populations of lobsters, crabs, sharks, sea fans, siphonophores and other “critters” (Dick, 1998). Side scan sonar imaging of the ridge has identified a number of different types of geological formations. These include flat-topped volcanoes, hummocky terrains (<500 m diameter sub-circular mounds) formed by flows of pillow lavas, and smooth flat areas formed of smooth lava flows or lava ponds, all of which may or may not be draped with sediment (Sauter *et al*., 2002). Such terrains are likely to provide a variety of attachment surfaces and niches for benthic fauna.

Hydrothermal vents were first observed on the Central Indian Ocean Ridge in 2000 (Hashimoto *et al.*, 2001; Van Dover *et al.*, 2001). This site comprised a fauna with affinities to western Pacific hydrothermal vent fields but with the addition of shrimps, *Rimicaris karei*, closely related to the visually dominant species at some Atlantic hydrothermal vents, *Rimicaris exoculata* (Watabe & Hashimoto, 2002; Komai *et al.*, 2007; Komai & Segonzac, 2008). Vent plumes were first identified along the South West Indian Ocean Ridge in 1997 (German *et al*., 1998) but the first vent has only just been discovered using an autonomous underwater vehicle (Tao *et al*., 2007). The vent field is located close to the Middle of What Seamount at a depth of ~2800 m, includes black smokers, sulphide edifices and a fauna comprising stalked barnacles, anemones and gastropods. A proposal to explore this vent field as part of the second NERC funded cruise to the Indian Ocean is currently in submission (John Copley, National Oceanography Centre, University of Southampton).

1.5.2 Oceanography

The water circulation of the upper layers of the southern Indian Ocean is dominated by a Sub-Tropical Anticyclonic Gyre which is mainly located in the western half of the ocean (Demopolous *et al*., 2003; Sultan *et al*., 2007). The eastern extension of the gyre is mainly blocked by the South-East Indian Ocean Ridge, although some water penetrates further east to be blocked by the Ninety-East Ridge. Topographic constraints exerted by the Madagascar and South West Indian Ocean Ridges forces the separation of three small anticyclonic cells within the Sub-Tropical Anticyclonic Gyre, two to the east of the Madagascar Ridge and one between the Madagascar Ridge and South Africa (Sultan *et al*., 2007). The western boundary of the Sub-Tropical Anticyclonic Gyre is associated with a strong southward transport of water (~55Sv) associated with the Aghulas Current.

This current retroflects eastwards as the Aghulas Return Current between 16^{o} and 20^{o}E to become the Aghulas Return Current (Lutjeharms & Van Ballegooyen, 1988). Through the region of the present investigation, the southern boundary of the Aghulas Return Current is marked by the Aghulas Front which lies to the north of the Sub-Tropical Front, to the south of which lies the Antarctic Circumpolar Current (ACC; Read *et al*., 2000). The Aghulas Front has the steepest density gradient of any in the Southern Ocean, is narrow, with an average width of only 96km, has a temperature of 21^{o}C – 15.7^{o}C, is optically clear and nutrient impoverished and is limited to about 40^{o}S (Read *et al*., 2000). The Aghulas Front can compress closely to the Sub-Tropical Front so the two are difficult to distinguish (Read & Pollard, 1993). The proximity of the Aghulas Return Current and the Sub-Tropical Front can lead to extreme temperature gradients (up to 1^{o}C per km; Read *et al*., 2000).

The Sub-Tropical Front forms the poleward boundary of warm salty water from the South Atlantic sub-tropical gyre (Read *et al*., 2000). It has a mean latitude of 41^{o}40'S (Lutjeharms & Valentine, 1984), although its north-south position varies considerably. It is associated with a marked gradient in temperature, of up to 7^{o}C and salinity of up to 0.5‰ (Lutjeharms, 1985; Whitworth & Nowlin, 1987; Lutjeharms *et al*., 1993). It is a surface feature associated with the upper 300m of the water column and its position and shape are influenced by bottom topography (Weeks & Shillington, 1996).

Below the surface water layers, in the regions to the north of the front (all but Coral Seamount and occasionally Melville Bank), Sub-Antarctic Mode Water is located in the thermocline. This water is ventilated in the Southern Ocean, north of the Sub-Antarctic Front, and is associated with a maximum in oxygen. It moves with the subtropical gyre (McDonagh *et al*., 2008). This water mass is found down to about 500m depth, in the vicinity of the South West Indian Ocean Ridge. Below it occurs Antarctic Intermediate Water, which is also ventilated in the Southern Ocean, but is identified by a salinity minimum (McDonagh *et al*., 2008). This water reaches to about 1500m around the South West Indian Ocean Ridge. Underlying this water mass is Upper Deep Water which comprises mainly Indian deep water. It flows south and forms part of the Indian Ocean overturning circulation. It exhibits an oxygen minimum, and high levels of inorganic nutrients (McDonagh *et al*., 2008), and penetrates to about 2000m depth.

The deep-water circulation of the region is quite different to the shallow circulation. Between 2000 and 3,500m depth, modified North Atlantic Deep Water (NADW) flows into the Indian Ocean

(McDonagh *et al*., 2008) along the African continental slope, up through the Mozambique Channel and also around the southern South West Indian Ocean Ridge and Del Cano Rise (Van Aken *et al*., 2004). In the north western part of the region the NADW flows up along the eastern slope of the Madagascar Ridge and then on over the Madagascar Ridge at about 35^{o}S. An additional flow comes through the South West Indian Ocean Ridge via the Discovery Fracture Zone in the south (Van Aken *et al*., 2004). This water eventually forms Circumpolar Deep Water (McDonagh *et al*., 2008).

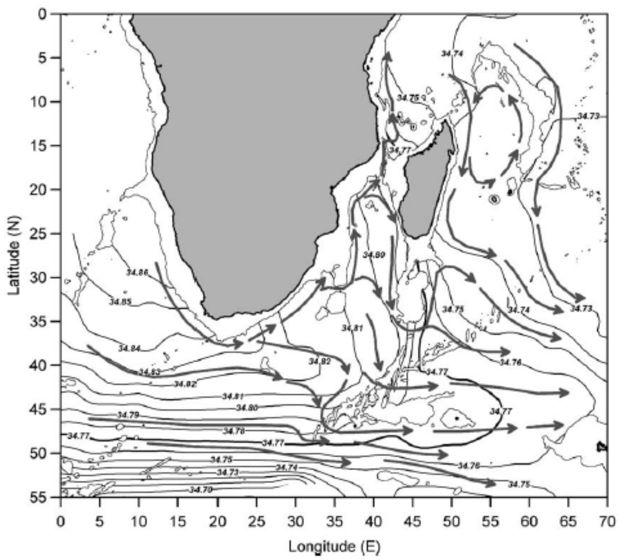

Figure 4. Deep-circulation in the SW Indian Ocean at 2000 – 3,500m depth (Van Aken *et al*., 2004).

Deeper still, the flow of Antarctic Bottom Water into the Indian Ocean is controlled by the South West Indian Ocean Ridge. The main flow, from the Enderby Basin in to the Aghulas Basin, is over a saddle in the ridge between 20^{o} and 30^{o}E, probably via deep channels (>4,000m depth) in the ridge (Boswell & Smythe-Wright, 2002). This water continues to flow northwards between the gap between the Aghulas Plateau and South West Indian Ocean Ridge and then onto the Mozambique Channel. Another branch crosses the ridge at 35-36^{o}S through the Prince Edward Fracture Zone whilst a third branch passes along the southern flank of the Del Cano Rise (Boswell & Smythe-Wright, 2002).

Overall, the South West Indian Ocean Ridge is set within an area where the Aghulas Return Current, the Sub-Tropical Front and the Sub-Antarctic Front, further to the south, create one of the most energetic and important hydrographic regions of the world (Read *et al*., 2000). The seamounts of the ridge lie within an area of complex biogeochemistry, phytoplankton composition and productivity associated with the transition from sub-tropical conditions to sub-Antarctic (Bathmann *et al*., 2000). The Sub-Tropical/Sub-Antarctic Front front is also thought to represent a major biogeographic boundary in the Southern Indian Ocean dividing two distinct faunal provinces (Vierros *et al*., 2009). In deeper water, the South West Indian Ocean Ridge acts as a major physical barrier to the flow of deep water masses and separates areas of deep-sea floor on the Enderby Abyssal Plain, the Aghulas Basin and the Crozet Basin.

1.5.3 Prior knowledge on the biology of the Madagascar and South West Indian Ocean Ridges

Despite being an area of downwelling, the sub-tropical convergence within the region has been associated with elevated concentrations of phytoplankton and zooplankton compared to the seas to the north and south (Froneman *et al*., 1998) and has been identified as a region important in carbon sequestration in the oceans (Llido *et al*., 2005). At the front peak chlorophyll concentrations of >1µg l^{-1} have been recorded with microphytoplankton making up a significant proportion (~10%) to total chlorophyll. Outside this region, with the exception of the sub-Antarctic Front, chlorophyll concentrations have been measured at <0.9µg l^{-1} and the phytoplankton assemblages may be dominated by nano- and picophytoplankton (Froneman *et al*., 1998). It is thought that the accumulation of phytoplankton cells at the front, stability of the water column and availability of nutrients, especially iron may all contribute to elevated chlorophyll measurements (Lutjeharms *et al*., 1985; Weeks & Shillington, 1996; Froneman *et al*., 1998). The enhanced primary productivity of the sub-tropical convergence zone occurs in intermittent pulses in spring and summer (Llido *et al*., 2005). Likewise, species diversity of microphytoplankton may also peak at the sub-tropical convergence as a result of mixing of species from different water masses and unique biochemical conditions which lead to a unique planktonic community that is poorly characterised, especially in regions away from continents (Froneman *et al*., 1998; Barange *et al*., 1998; Longhurst, 1998; Richoux & Froneman, 2009). Recent stable-isotope studies have also demonstrated that planktonic foodwebs undergo significant changes across the sub-tropical covergence in response to differing availability of phytoplankton and smaller zooplankton size classes (Richoux & Froneman, 2009). Thus, the seamount along the South West Indian Ridge are likely to be in contrasting productivity regimes depending on their proximity to the sub-tropical convergence and the sub-Antarctic front. Advection of surface production to the benthos of seamounts will depend on the depth of the seamount summit and the current regimes around seamounts (Rowden *et al*., 2005; White *et al*., 2007).

The recent Global Open Oceans and Deep Seabed report classified the pelagic ecosystems of the South West Indian Ocean into several different regions: The Indian Ocean Gyre, The Aghulas

Current, The Sub-Tropical Covergence and the Sub-Antarctic Region (Vierros *et al*., 2009). This biogeographic analysis was focused on the upper 200m of the water column and it was unknown how much it was likely to reflect the distribution of deeper pelagic communities, although it was felt that patterns would diverge from that at the surface with increasing depth (Vierros *et al*., 2009). The same classification identified the lower bathyal benthic fauna of the South West Indian Ocean Ridge as all falling into one biogeographic area, The Indian Ocean, the southern limit of which coincided with the Antarctic Convergence (Vierros *et al*., 2009). At present there are few data available to test this proposed scheme of biogeography.

Data on the diversity of biological communities of the southern Indian Ocean are sparse. More studies have been undertaken on Walter's Shoal, probably because the region is closer to land than the South West Indian Ocean Ridge and because of interests in commercial fisheries in the region. The shoal was sampled during the Indian Ocean expedition in 1964 by the *R/V Anton Bruun* and subsequently by the *Vityaz*. These collections included a new endemic sub-species of crinoid, *Comanthus wahlbergi tenuibrachia* (Clark, 1972), prevalent in the shallow-waters of the shoal (Collette & Parin, 1991), and several crustaceans including an endemic species of alpheid shrimp (*Alpheus waltervadi*; Kensley, 1981) and an endemic isopod, *Jaeropsis waltervadi* (Kensley, 1975). Recently, an endemic species of rock lobster, *Palinurus barbarae*, has been described from the shoals following the landing of the species from commercial fishing vessels (Groeneveld *et al*., 2006). Collette and Parin (1991) described the fish fauna from ~400m depth to the surface on the shoal (summit depth approx. 15m) and identified 20 species of which several were potentially endemic undescribed species, several were widespread temperate or sub-tropical species and several were Indo-Pacific reef associated species. Biogeographic affinities of elements of the shallow fish fauna with Gough Island, Tristan da Cunha and St Pauls and Amsterdam Islands (West Wind Drift Islands) were identified, particularly in the occurrence of species such as *Helicolenus mouchezi*, *Trachurus longimannus* and *Serranus novemcinctus* (Collette & Parin, 1991). Others are found in Australia and New Zealand (*Acantholatris monodactylus*, *Lepidoperca coatsii*, *Nelabrichthys ornatus*). *Helicolenus mouchezi* and possibly several other species from Walter's Shoal also occur on the South West Indian Ocean Ridge. The implication here is that the Sub-Tropical Anticyclonic Gyre and Antarctic Circumpolar Current and/or other westerly flowing currents have assisted in transoceanic dispersal of these species, with islands and seamounts acting as stepping stones. Russian exploration of the Madagascar Ridge in the search of fisheries resources identified: dories (Oreosomatidae), sharks, *Alepocephalus* sp., *Beryx* sp., Macrouridae, Moridae, *Plagiogeneion* *rubiginosum*, *Polyprion americanus*, *Polyprion oxygeneios*, *Pseudopentaceros richardsoni*, scabbard fish, Scorpaenidae, *Trachurus longimannus*, tuna, Uranoscopidae.

Vereshchaka (1995) summarised several investigations on the macroplankton occurring on slopes and seamounts in the Indian Ocean. The paper lists a large number of taxa as occurring on Walter's Shoal including: Mysidacea - *Gnathophausia ingens*, *G. gracilis*, *Siriella thompsoni*, *Euchaetomera typica*, *E. glythidophthalmica*, *Metamblyops macrops*; Euphausiacea – *Thysanopoda monacantha*, *T. tricuspidata*, *T. aequalis*, *T. obtusifrons*, *T. pectinata*, *T. orientalis*, *T. egregia*, *Nematobrachion flexipes*, *N. boopis*, *Euphausia recurva*, *E. diomedeae*, *E. mutica*, *E.similis*, *E. spinifera*, *E. hemigibba*, *E. paragibba*, *E. pseudogibba*, *Thysanoessa gregaria*, *Nematoscelis megalops*, *N. microps*, *N. atlantica*, *N. gracilis*, *N. tenella*, *Stylocheiron carinatum*, *S. affine*, *S. suhmi*, *S. longicorne*, *S. elongatum*, *S. abbreviatum*, *S. maximum*; Decapoda – *Funchalia villosa*, *Gennadas parvus*, *G. propinquus*, *G. scutatus*, *G. bouvieri*, *G. incertas*, *G. tinnayrei*, *G. gilchristi*, *Sergestes corniculum*, *S. disjunctus*, *S. atlanticus*, *S. sargassi*, *S. pectinatus*, *S. armatus*, *S. orientalis*, *Sergia prehensilis*, *Sergia scintillans*, *Sergia splendens*, *Sergia grandis*, *Sergia laminata*, *Lucifer typus*, *Pasiphaea natalensis*, *Acanthephyra quadrispinosa*, *Notostomus elegans*, *Oplophorus spinosus*, *O. Novaezelandiaea*, *Systellaspis debilis*, *S. guillei*, *Stylopandalus richardi*; Larvae – *Penaeus* sp., *Solenocera* sp., *Gennadas* sp., *Sergestes* sp., *Acanthephyra* sp., Palaemoninae, Pontoniinae, Pandalidae, Nematocarcinidae, *Lysmata* sp., *Alpheus* sp., *Pontophilus* sp., *Stenopus* sp., *Panulirus* sp., *Jasus* sp., *Scyllarides* sp., Paguridae, *Galathea* sp., *Callianassa* sp., *Homola* sp., Dromiidae, *Albunea* sp., Cancridae, Majidae, Calappidae, Brachyura, *Amphionides reynaudi*. These animals fall into two distinct group, species that were associated mainly with the water column and decrease in numbers towards the seabed, and those that are associated with the seabed. The latter group fall into several categories including: animals that are found near the seabed at night but disappear by day, presumably because they migrate to benthic habitats during daylight hours; animals found well above the seabed by day and descend to the seabed by day; larval animals which are found mainly over areas of seabed inhabited by adults (Vereshchaka, 1995).

Investigations of high seas areas of Indian Ocean for fish resources were undertaken by Soviet research vessels and exploratory fishing vessels from the 1960s to 1998. Whilst detailed information is not available data on the fish species present on the South West Indian Ocean Ridge has been published. The following species were identified as being present: *Alepocephalus* spp., *Antimora rostrata*, *Beryx splendens*, *Beryx decadactylus*, *Centrolophus niger*, Chauliodontidae, *Dissostichus eleginoides*, *Electrona carlsbergi*, *Epigonus* spp., Gonostomatidae, *Helicolenus* *mouchezi*, *Hyperoglyphe antarctica*, *Lepidopus caudatus*, *Macrourus carinatus*, Myctophidae, *Nemadactylus macropterus*, *Neocyttus rhomboidalis*, *Notothenia squamifrons*, *Plageogeneion rubiginosum*, *Polyprion americanus*, *Polyprion oxygeneios*, *Promethichthys prometheus*, *Pseudopentaceros richardsoni*, rays, *Ruvettus pretiosus* , *Schedophilus huttoni*, *Schedophilus maculatus*, *Schedophilus velaini*, sharks, *Trachurus longimannus* (Romanov, 2003). A more extensive species list is given in Romanov (2003) but this list is for all the seamounts sampled in the Indian Ocean from 1969-1998. It was noted that seamounts on the South West Indian Ocean Ridge showed a marked variation in the fish present. For example, pelagic armourhead, *Pseudopentaceros richardsoni*, was only caught in commercial quantities on Seamount 690 (Romanov, 2003), which corresponds in position to Atlantis Seamount. The species has also been found on Sapmer Seamount (López-Abellán *et al*., 2008). Some of the species listed are exclusively Antarctic / Sub-Antarctic and so probably occur further south than the seamounts sampled on the present expedition.

As, with invertebrates and fish, knowledge of the distribution of aquatic predators, including cetaceans and birds in the region are sparse. There have been sightings of concentrations of humpback whales in the vicinity of Walter's Shoal (e.g. Collette & Parin, 1991; Shotton, 2006), suggesting that it may be an important migratory area between high latitude feeding grounds and low latitude breeding grounds off Madagascar (Findley, 2009). There are reports of pilot whales, humpback whales and sperm whales in the areas of deep-water fishing in the Southern Indian Ocean although it is not clear where these were (Shotton, 2006).

Shotton (2006) report that sightings of birds are rare in the areas of fishing and these were rarely seen north of 35^{o}S. White chinned petrels (*Procellaria aequinoctialis*) had been reported as occurring in areas of deep-water fishing and cape pigeons (*Daption capense*) and sooty shearwaters (*Puffinus griseus*) were reported as being observed from fishing vessels (Shotton, 2006). Bird observations taken from a cruise between La Réunion, Crozet, Kerguelen, St. Paul, Amsterdam Islands, and Perth, Western Australia identified 51 species of birds from over 15,000 sightings (Hyrenbach *et al*., 2007). During this cruise the density of birds increased significantly across the sub tropical convergence from 2.4 birds km^{-2} in sub-tropical waters to 23.8 birds km^{-2} in sub-Antarctic waters. The taxonomic composition of birds also differed markedly in the 3 areas with prions (*Pachyptila* spp.) accounting for 57% of all sub-Antarctic birds, wedge-tailed shearwaters (*Puffinus pacificus*) accounting for 46% of all subtropical birds, and Indian Ocean yellow-nosed albatross (*Thallasarche carteri*) accounting for 32% of all birds in the sub-tropical convergence zone (Hyrenbach *et al*., 2007). Given that this cruise transited part of the South West Indian Ocean Ridge it would seem likely that significant numbers of seabirds are present in the vicinity of the seamounts, particularly in the more southerly areas.

2.0 Cruise track and daily events

2.1 Cruise track

The cruise track was aimed at taking physical and biological observations and samples along the South West Indian Ocean Ridge, targeting five seamounts, two of which were SIODFA voluntary benthic protected areas, the others of which had been previously targeted by fishing (see Fig. 1.4). In addition two off-seamount stations were included in the survey as control sites. Two CTD sections were taken across the Sub-Tropical Convergence to analyse the physical structure and changes in phytoplankton communities across the front. Six days of contingency time were included in the schedule for bad weather, although if these were not taken a further station would be included at Walter's Shoal, a site of special interest for bird observations. Oceanographic observations at these sites were to include CTD transects across seamounts to analyse the structure of the water column and a 24 hour CTD yo-yo to observe the influence of tides on the water masses immediately around each seamount. CTD work was complemented where possible with ADCP measurements. At each station an acoustic grid of 12 hours was surveyed to analyse the relative biomass and movements of the deep-scattering layers and fish shoals on and off seamounts. Biological sampling included samples taken to analyse chlorophyll, phytoplankton samples and micro- and mesozooplankton samples taken with phytoplankton, bongo and multinets. Targeted trawling of the deep-scattering layers and fish shoals was undertaken using the aakra trawl.

Six seamounts were surveyed during the cruise as a result of only losing one day in total to poor weather, although conditions at several points in the cruise were marginal for work. The sites were Atlantis Bank, Sapmer Bank, Middle of What Seamount, Coral Seamount and Melville Bank, on the South West Indian Ocean Ridge, and an un-named seamount to the north of Walter's Shoal on the Madagascar Ridge. The total distance by sea covered during the cruise was close to 5000 nm. For details of sampling activities see relevant chapters.

Date	Station	Event	Sample	Day/night
12/11/2009		Leave Reunion		Night
13/11/2009	1 24°48'S, 55°49.3'E	1	CTD – 1500m	Day
	1	2	Phytoplankton net	Day
14/11/2009	2 26°56.6'S, 56°14.4'E	Acoustic survey	-	Day
	2	1	CTD	Day
	2	2	Phytoplankton net	Day
	2	3	Multinet	Day
	2	4	Multinet	Day
	2	5	Bongo	Day
	2	6	Bongo	Day
	2	7	Aakra trawl 600-300m	
	2	8	Multinet	Night
	2	9	Multinet	Night
	2	10	Bongo	Night
	2	11	Bongo	Night
	2	12	Bongo	Night
	2	13	Bongo	Night
15/11/2009	2	Acoustic survey	-	Day
	2	14	Aakra trawl 800m	Day
	2	15	Bongo	Day
	2	16	Bongo	Day
	2	17	Bongo	Day
16/11/2009	3 29°S, 56°34.5'E	1	CTD	Day
	3	2	Phytoplankton net	Day
17/11/2009	4 Atlantis Bank 32°40'S, 57°20'E	Acoustic survey	-	Day
	4	1	CTD	Day
	4	2	Phytoplankton net	Day
	4	3	Multinet	Day
	4	4	Aakra trawl 700-500m	Day
	4	5	Aakra trawl 400-100m	Day
	4	6	CTD Yo-Yo	Day
	4	7	Phytoplankton net	Day
	4	8	CTD Yo-Yo	Night
	4	9	Phytoplankton net	Night
18/11/2009	4	10	CTD Yo-Yo	Day
	4	11	Phytoplankton net	Day
	4	12	CTD Yo-Yo	Day
	4	13	Phytoplankton net	Day
	4	Whale bone drop	-	Day
	4	14	Bongo	Night
	4	15	Bongo	Night
	4	16	Bongo	Night
	4	17	Multinet	Night
	4	18	Aakra trawl 700m	Night
19/11/2009	4	19	Aakra trawl 400m	Night
	4	20	Multinet	Night
	4	21	Multinet	Night
	4	22	Small aakra trawl	Dawn
	4	Acoustic survey	-	Day
	4	23	Multinet	Day
	4	24	Multinet	Day
	4	25	Bongo	Day
	4	26	Bongo	Day
	4	27	Bongo	Day
	4	28	CTD	Day
	4	29	Phytoplankton net	Day
	4	30	CTD	Night

	4	31	Phytoplankton net	Night
	4	32	CTD	Night
	4	33	Phytoplankton net	Night
	4	34	CTD	Night
	4	35	Phytoplankton net	Night
	4	36	CTD	Night
	4	37	Phytoplankton net	Night
20/11/2009	Steam	(CTD station lost due to bad weather)		
21/11/2009	Steam			
22/11/2009	5 Sapmer Seamount 36^{o}50'S, 52^{o}6.6'E	1	CTD	Night
	5	2	Phytoplankton net	Night
	5	3	Bongo	Night
	5	4	Bongo	Night
	5	5	Bongo	Night
	5	6	Multinet	Night
	5	7	Multinet	Night
	5	Acoustic survey	-	Day
	5	8	Aakra trawl	Day
	5	9	Aakra trawl	Day
	5	10	Multinet	Day
	5	11	Multinet	Day
	5	12	Multinet	Day
	5	13	CTD Yo-Yo	Day
	5	14	Phytoplankton net	Day
	5	15	CTD Yo-Yo	Night
	5	16	Phytoplankton net	Night
23/11/2009	5	17	CTD Yo-Yo	Night
	5	18	Phytoplankton net	Night
	5	19	CTD Yo-Yo	Day
	5	20	Phytoplankton net	Day
	5	21	CTD Yo-Yo	Day
	5	22	Phytoplankton net	Day
	5	23	Aakra trawl 750m	Night
	5	24	Aakra trawl 400m	Night
24/11/2009	5	25	Small aakra trawl 250m	Night
	5	26	Small aakra trawl 750m	Dawn
	5	Acoustic survey	-	Day
	5	27	Multinet	Day
	5	28	CTD	Day
	5	29	Phytoplankton net	Day
	5	30	CTD	Day
	5	31	Phytoplankton net	Day
	5	32	CTD	Day
	5	33	Phytoplankton net	Day
	5	34	CTD	Night
	5	35	Phytoplankton net	Night
	5	36	CTD	Night
	5	37	Phytoplankton net	Night
	5	38	Multinet	Night
	5	39	Bongo	Night
25/11/2009	5	40	Bongo	Night
	5	41	Bongo	Night
	6 Middle of What SM 37^{o}57.6'S, 50^{o}25.2'E	Acoustic survey	-	Day
	6	1	CTD	Day
	6	2	Phytoplankton net	Day
	6	3	Multinet	Day
	6	4	Multinet	Day
	6	5	Multinet	Night
	6	6	Multinet	Night
	6	7	Multinet	Night

	6	8	Bongo	Night
	6	9	Bongo	Night
	6	10	Bongo	Night
26/11/2009	6	11	Aakra trawl 700-500m	Night
	6	12	Aakra trawl 400-200m	Night
	6	13	Aakra trawl 950m	Night/Dawn
	6	14	CTD	Day
	6	15	Phytoplankton net	Day
	6	16	CTD	Day
	6	17	Phytoplankton net	Day
	6	18	CTD	Night
	6	19	Phytoplankton net	Night
27/11/2009	6	20	CTD	Night
	6	21	Phytoplankton net	Night
	6	Acoustic survey	-	Day
	6	22	Bongo	Day
	6	23	Bongo	Day
	6	24	Multinet	Day
	6	25	Aakra trawl 700-500m	Day
	6	26	Aakra trawl 400-200m	Day
	6	27	Bongo	Day
	6	28	CTD	Night
	6	29	CTD	Night
	6	30	CTD	Night
28/11/2009	6	31	CTD	Night
	6	32	CTD	Night
	6	33	CTD	Night
	39oS		CTD Section	
	39o15'S		CTD Section	
	39o30'S		CTD Section	
	39o45'S		CTD Section	
	40oS		CTD Section	
	40o15'S		CTD Section	
	40o30'S		CTD Section	
	40o45'S		CTD Section	
	41oS		CTD Section	
	41o15'S		CTD Section	
29/11/2009	7 Off-Ridge Site 41°30'S, 49°30'E	1	CTD	Day
	7	2	Phytoplankton net	Day
	7	3	Multinet	Day
	7	4	Multinet	Day
	7	5	Multinet	Day
	7	6	Bongo	Day
	7	7	Bongo	Night
	7	8	Bongo	Night
	7	9	Bongo	Night
	7	10	Multinet	Night
	7	11	Multinet	Night
30/11/2009	7	12	Multinet	Night
	7	13	Aakra trawl 700-500m	Night
	7	14	Aakra trawl 400-200m	Night
	7	Acoustic survey	-	Day
	7	15	Aakra trawl 700-500m	Day
	7	16	Aakra trawl 400-50m	Day
	7	17	Bongo	Day
	7	18	Bongo	Day
1/12/2009	Steam			

2/12/2009	8 Coral Seamount 41°23.82'S,42°52.86'E	1	CTD	Night
	8	2	Phytoplankton net	Night
	8	3	Multinet	Night
	8	4	Multinet	Night
	8	5	Multinet	Night
	8	Acoustic survey	-	Day
	8	6	Multinet	Day
	8	7	Multinet	Day
	8	8	Multinet	Day
	8	9	Bongo	Day
	8	10	Bongo	Day
	8	11	Bongo	Day
	8	12	Aakra trawl 900-600m	Day
	8	13	Aakra trawl 600-300m	Day
	8	14	Bongo	Night
	8	15	Bongo	Night
	8	16	Bongo	Night
3/12/2009	8	17	Aakra trawl 900-600m	Night
	8	18	Aakra trawl 600-300m	Night
	8	19	Small Aakra trawl 300m	Dawn
	8	20	CTD Yo-Yo	Day
	8	21	Phytoplankton net	Day
	8	22	CTD Yo-Yo	Day
	8	23	Phytoplankton net	Day
	8	24	CTD Yo-Yo	Night
	8	25	Phytoplankton net	Night
4/12/2009	8	26	CTD Yo-Yo	Night
	8	27	Phytoplankton net	Night
	8	Acoustic survey	-	Day
	8	Whale moorings	-	Day
	8	28	CTD	Day
	8	29	Phytoplankton net	Day
	8	30	CTD	Day
	8	31	Phytoplankton net	Day
	8	32	CTD	Day
	8	33	Phytoplankton net	Day
	8	34	CTD	Night
	8	35	Phytoplankton net	Night
	8	36	CTD	Night
	8	37	Phytoplankton net	Night
	41°12.85'S 43°00.05'E		CTD Section	Night
	40°59.95'S 43°12.34'E		CTD Section	Night
5/12/2009	40°48.02'S 43°35.03'E		CTD Section	Day
	40°36.09'S 43°51.98'E		CTD Section	Day
	40°12.13'S 44°25.63'E		CTD Section	Day
	40°00.03'S 44°41.85'E		CTD Section	Day
	39°48.06'S 44°58.37'E		CTD Section	Night
	39°36.00'S 45°15.04'E		CTD Section	Night
6/12/2009	39°23.97'S 45°31.16'E		CTD Section	Night
	39°11.96'S 45°47.40'E		CTD Section	Night
	38°55.99'S 46°03.53'E		CTD Section	Day
	38°44.95'S 46°22.97'E		CTD Section	Day
	9 Melville Bank 38° 28.8'S, 46°46.2'E	1	CTD	Day
	9	2	Phytoplankton net	Day
	9	3	CTD	Night
	9	4	Phytoplankton net	Night
	9	5	CTD	Night
	9	6	Phytoplankton net	Night

7/12/2009	9	7	CTD	Night
	9	8	Phytoplankton net	Night
	9	9	CTD	Night
	9	10	Phytoplankton net	Night
	9	11	CTD	Day
	9	12	Phytoplankton net	Day
	9	13	CTD	Day
	9	14	Phytoplankton net	Day
	9	Acoustic survey	-	Day
	9	Acoustic survey	-	Day (incomplete)
	9	15	Aakra trawl 900m	Night
8/12/2009	9	16	Aakra trawl 700m	Night
	9	17	Multinet	Night
	9	18	Multinet	Night
	9	19	Multinet	Night
	9	20	Small aakra trawl 300m	Dawn
	9	21	Multinet	Day
	9	22	Multinet	Day
	9	23	Multinet	Day
	9	24	Bongo	Day
	9	25	Bongo	Day
	9	26	Bongo	Day
	9	27	Aakra trawl 900m	Day
	9	28	Aakra trawl 700m	Day
	9	29	Small aakra trawl 500-600m	Day
	9	30	Bongo	Night
	9	31	Bongo	Night
	9	32	Bongo	Night
	9	33	CTD	Night
	9	34	Phytoplankton net	Night
	9	35	CTD	Night
	9	36	Phytoplankton net	Night
	9	37	CTD	Night
	9	38	Phytoplankton net	Night
9/12/2009	9	39	CTD	Night
	9	40	Phytoplankton net	Night
	9	41	CTD	Night
	9	42	Phytoplankton net	Night
	9	43	CTD	Night
	9	44	Phytoplankton net	Night
	9	45	CTD	Day
	9	46	Phytoplankton net	Day
	9	Acoustic survey	-	Day
	9	47	CTD Yo-Yo	Day
	9	48	Phytoplankton net	Day
	9	49	CTD Yo-Yo	Night
	9	50	Phytoplankton net	Night
10/11/2009	9	51	CTD Yo-Yo	Night
	9	52	Phytoplankton net	Night
	9	53	CTD Yo-Yo	Day
	9	54	Phytoplankton net	Day
12/11/2009	10 Un-named seamount 31o37.48'S 42o50.22'E	Acoustic survey	-	Day
	10	1	CTD	Day
	10	2	Phytoplankton net	Day
	10	3	Multinet	Day
	10	4	Multinet	Night
	10	5	Multinet	Night
	10	6	Multinet	Night
	10	7	Bongo	Night

	10	8	Bongo	Night
	10	9	Bongo	Night
13/12/2009	10	10	Aakra trawl 1100m-900m	Night
	10	11	Aakra trawl 700m-400m	Night
	10	12	Aakra trawl 300m – 0m	Dawn
	10	Acoustic survey	-	Day
	10	13	Multinet	Day
	10	14	Multinet	Day
	10	15	Bongo	Day
	10	16	Bongo	Day
	10	17	Bongo	Day
	10	18	Aakra trawl 1100m-900m	Day
	10	19	Aakra trawl 700-400m	Day
	10	20	CTD Yo-Yo	Day
	10	21	Phytoplankton net	Day
	10	22	CTD Yo-Yo	Night
	10	23	Phytoplankton net	Night
14/12/2009	10	24	CTD Yo-Yo	Night
	10	25	Phytoplankton net	Night
	10	26	CTD Yo-Yo	Day
	10	27	Phytoplankton net	Day
	10	28	CTD Yo-Yo	Day
	10	29	Phytoplankton net	Day
	10	30	CTD transect	Night
	10	31	Phytoplankton net	Night
15/12/2009	10	32	CTD transect	Night
	10	33	CTD transect	Night
	10	34	CTD transect	Night
	10	35	CTD transect	Night
	10	36	CTD transect	Night
	10	37	CTD transect	Day
	10	38	CTD transect	Day
	11 Underway station	1	CTD	Day
	11	2	Phytoplankton net	Day

Table 2.1 Southern Indian Ocean Seamounts Cruise 2009-410 daily event log.

3.0 Multibeam bathymetry of the investigated seamounts

3.1 The seabed mapping system

Surveys of seamount bathymetry were undertaken using a SIMRAD EM710 70 – 100 kHz multibeam echosounder (Kongsberg Maritime AS, Horten, Norway). This is a high-resolution seabed mapping system which, on the R/V Nansen is logged onto the Olex navigation system. The minimum acquisition depth is from less than 3 m below its transducers, and the maximum acquisition depth is approximately 2000 m, somewhat dependant upon array size. Across track coverage (swath width) is up to 5.5 times water depth, to a maximum of more than 2000 m and the depth resolution is 1cm (Kongsberg Maritime). The transmit fan is divided into three sectors to maximize range capability, but also to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping, and uses distinct frequencies or waveforms. All acoustic instruments used during the cruise were triggered by the 38kHz signal from the SIMRAD EK60. Timing of each instrument can be finely adjusted on the vessel to avoid interference between instruments if the vessel is, for example, operating in shallow water. The model on the R/V Nansen is a 1x2^{o} model which generates 128beams/200 soundings per ping.

Following collection of raw data for each seamount, data was filtered to remove obvious bad pings (echos that are much higher or lower than background).

3.2 Bathymetry of the seamounts

3.2.1 Atlantis Bank

Atlantis Bank is a tectonic guyot that comprises a section of the Earth's mantle that has been pushed up above the crust onto the seabed. Unlike most flat-topped seamounts, therefore, it does not have a volcanic origin but is tectonic (Dick, 1998). It consists mainly of gabbro, which was uncovered through low-angle detachment faulting about 9.5 – 13 MYA (Coogan *et al*., 2004). About 9.5 million years ago Atlantis Bank formed an island, about 25km^2 in area but subsided slowly into deep waters and now the summit lies at 700m depth. As a result, large areas are covered in limestone and the remains of rippled fossil beaches, boulders, wave-cut platforms, sea stacks and fossilized clams, gastropods and other marine animals are visible on the seamount surface (Dick, 1998). The seamount lies on the flank of the Atlantis II Fracture Zone and rises on one side from 5000m depth (Dick, 1998).

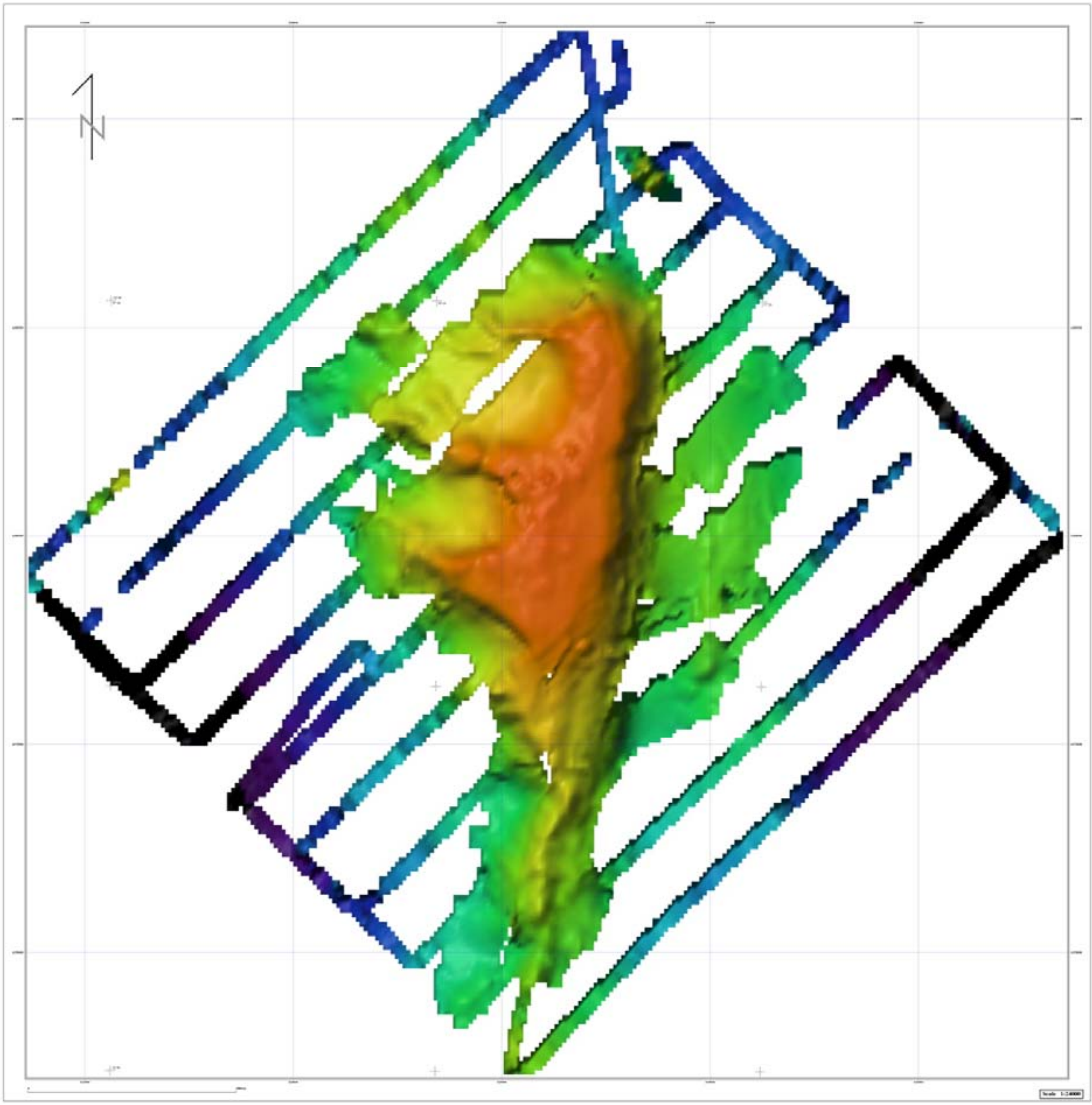

Figure 3.1 Atlantis Bank. Multibeam bathymetry of the seamount.

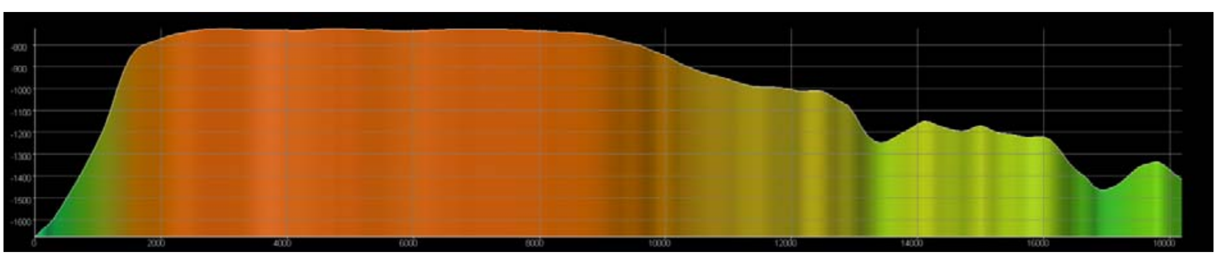

Figure 3.2 Atlantis Bank. Profile along longest axis.

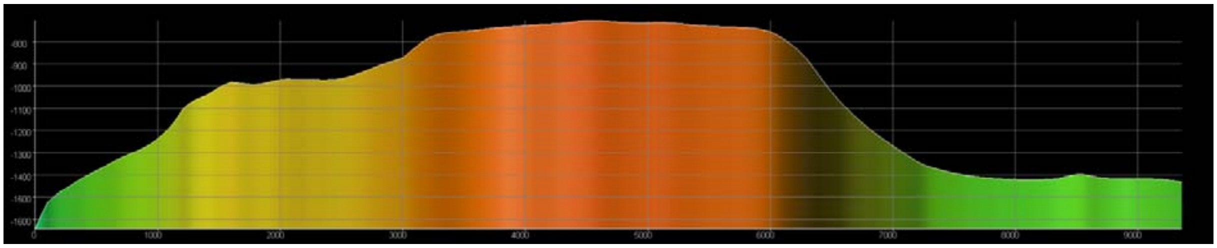

Figure 3.3 Atlantis Bank. Profile across seamount.

There are very limited scientific data on Atlantis Bank, known as Seamount 690 to Soviet scientists (Romanov, 2003). Geological investigations have reported lobsters, crabs, sharks, sea fans, siphonophores, sponges and other benthic organisms on the seamount (Dick, 1998). A single paper on ROV investigations reported the presence of crow shark (*Etmopterus pusillus*), orange roughy (*Hoplostethus atlanticus*) and warty oreo (*Allocyttus verrucosus*) all of which exhibited specific depths distributions (Lindsey *et al*., 2000). Other species observed included several putative species of bellows fish (*Centriscops* spp.), cutthroat eels (*Synaphobranchus* spp), rattail fish (*Coryphaenoides* spp., and possibly *Hymenocephalus* or *Ventrifossa*), attenuated spider fish (*Bathypterois atricolor*), a chimaera, tadpole whiptail (*Squalogadus modificatus*), a halosaur (*Alvodrandia* spp.), a morid cod (*Lepidion capensis*), several perciform fish (Haemulidae) and false cat sharks (*Pseudotriakis microdon*; Lindsey *et al*., 2000). Several benthopelagic or benthic shrimps were observed including *Hepomadus* sp., *Nematocarcinus* spp., and c.f. *Acanthephyra*, as well as sergestids and swarms of euphausiids above the seamount (Lindsey *et al*., 2000). Cirrate octopuses and squid were also observed as well as a pelagic holothurian. One of the photographs in the paper shows bellows fish in amongst black coral and octocorals colonies (Lindsey *et al*., 2000).

Shotton (2006) report that the rugged nature of Atlantis Bank makes it very difficult to trawl, although some trawlable areas exist and up to 60 trawls have been take by SIODFA vessels. They also state that catches of alfonsino were taken from the bank (Shotton, 2006). Soviet vessels seem to have caught significant numbers of pelagic armourhead on Atlantis Bank and nowhere else on the South West Indian Ocean Ridge (Romanov, 2003).

As can be seen from Figs. 3.1-3.3 Atlantis Bank is a north to south trending seamount, > 18km in length and >10km wide, with two distinct "scoops" out of the western side. These correspond to fossil lagoons separated by headlands and oolitic limestone, that may form in lagoons has been found on Atlantis Bank (Dick, 1998). We speculate that these "scoops" may correspond to collapse features on the western side of the seamount associated with mass wasting. The summit depth is approximately 700m, whilst the base lies at 5000m depth (Dick, 1998). The central area of the summit is characterised by the presence of fossil sea stacks, clearly visible on the multibeam map constructed during the present cruise.

3.2.2. Sapmer Bank

There are few specific data associated with Sapmer Bank. The bank has been subject to exploratory fishing by French and Spainish fishing vessels (Collette & Parin, 1991; López-Abellán *et al*., 2008) and is still subject to a fishery by SIODFA vessels. Some samples of pelagic armourhead (*Pseudopentaceros richardsoni*) have been taken from this locality and used for ageing studies (López-Abellán *et al*., 2008). The seamount trends roughly northeast to southwest and, like Atlantis Bank, lies on the edge of a fracture zone. It has a highly irregular shape and very rough topography that seems to be associated with significant mass-wasting in the form of obvious slide features, particularly along the southern face of the seamount, but also along the north. The seamount summit lies at a shallowest depth of approximately 300m, and the entire feature is > 12km in length across its longest axis. There are no available data on the geology of Sapmer Bank.

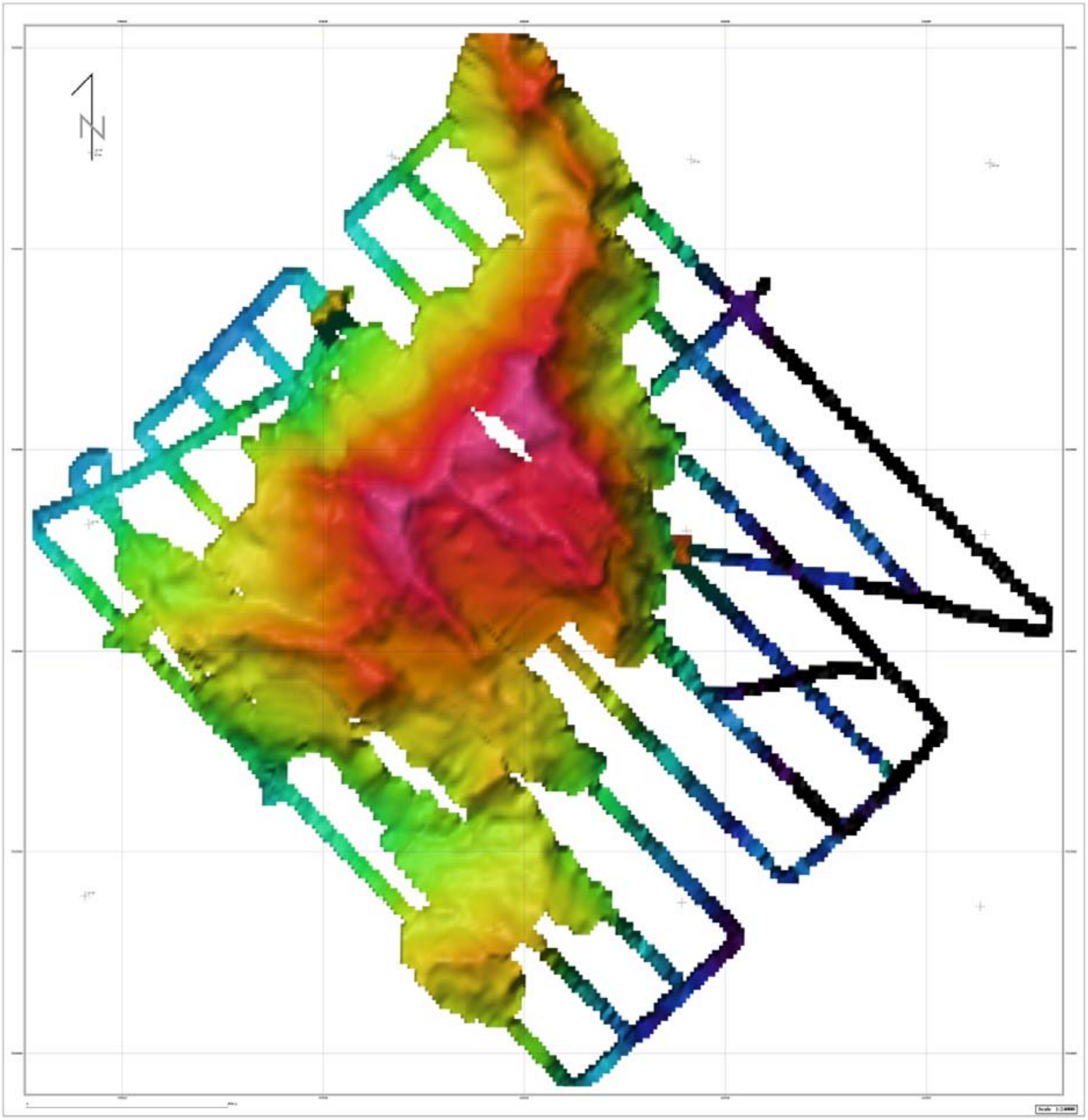

Figure 3.4 Sapmer Seamount. Multibeam bathymetry of the seamount.

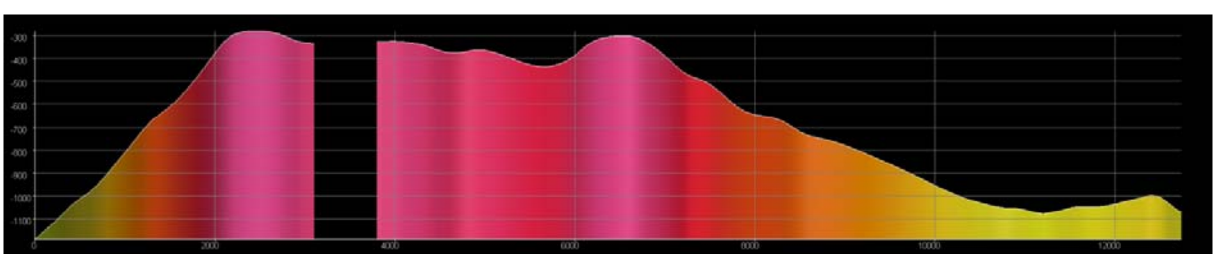

Figure 3.5 Sapmer Seamount. Profile along longest axis.

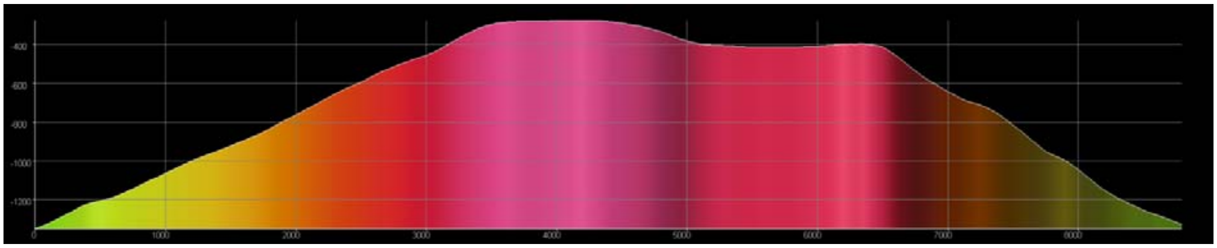

Figure 3.6 Sapmer Seamount. Profile across seamount.

3.2.3. “Middle of What” Seamount

There are no specific data on Middle of What Seamount. It is a deep feature with an ellipsoid shape, longer in the east to west direction than north to south. The seamount has a distinct ridgeline running along the northern face, almost appearing to follow a fault line, where it reaches its shallowest depths of approximately 970m at the summit. Surrounding the seamount, particularly to the west are small sub-conical features that may be volcanic in origin. The seamount is more than 12km in length along its longest axis. Contact with the seabed by the pelagic trawl deployed on the present cruise indicates that this seamount is likely to host a significant cold-water coral reef feature associated with the northern, ridge-like summit edge.

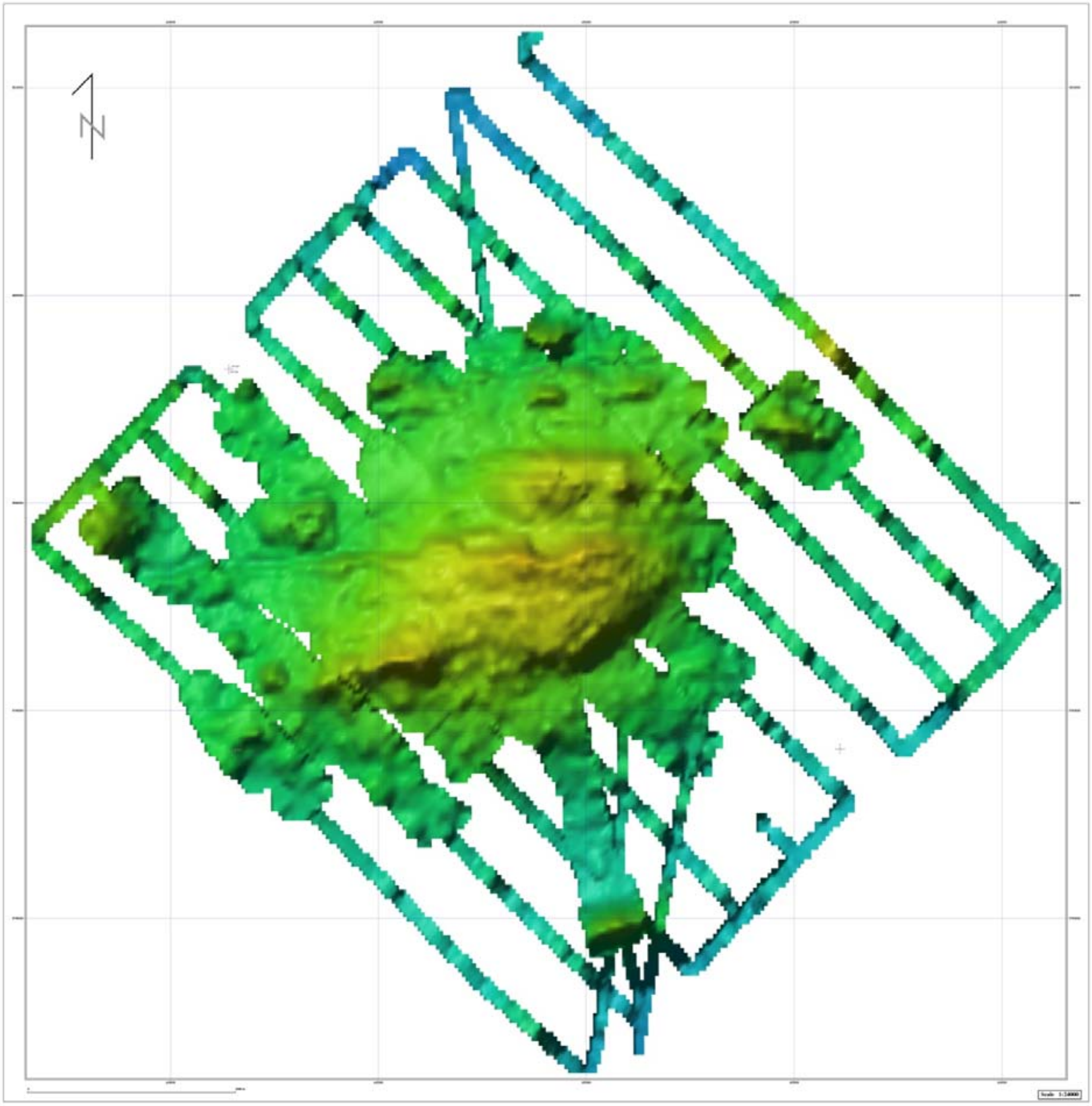

Figure 3.7 Middle of What Seamount. Multibeam bathymetry of seamount.

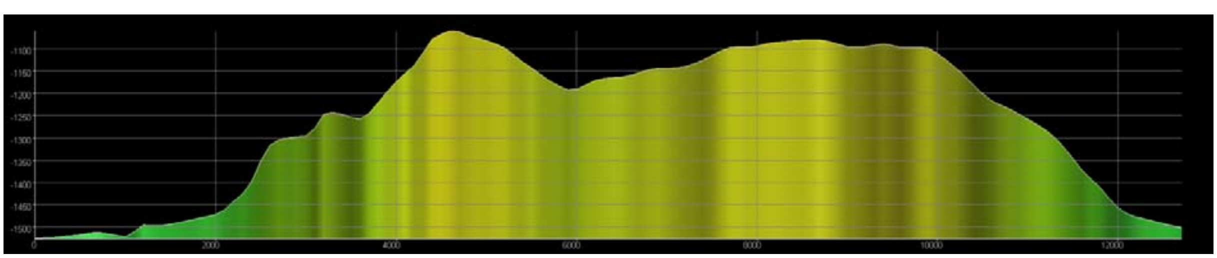

Figure 3.8 Middle of What Seamount. Profile along longest axis.

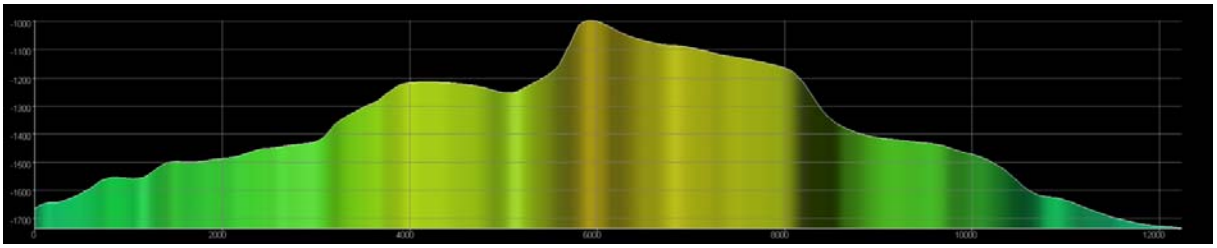

Figure 3.9 Middle of What Seamount. Profile across seamount.

3.2.4 Coral Seamount

This seamount lies to the eastern side of a transform fault and has been reported to host extensive coral communities (Shotton, 2006). For this reason, Coral Seamount has been declared a voluntary Benthic Protected Area (BPA) by SIODFA. Unlike all the other seamounts investigated during the cruise, Coral lies to the south of the sub-tropical convergence. The seamount forms part of a series of ridge-like elevations along the eastern side of a deep fracture zone and lies approximately north east east to south west west, with a length of >18km at its longest axis and a minimum depth of approximately 120m. The central area of the summit has a particularly block-like morphology with a wide area of flat summit.

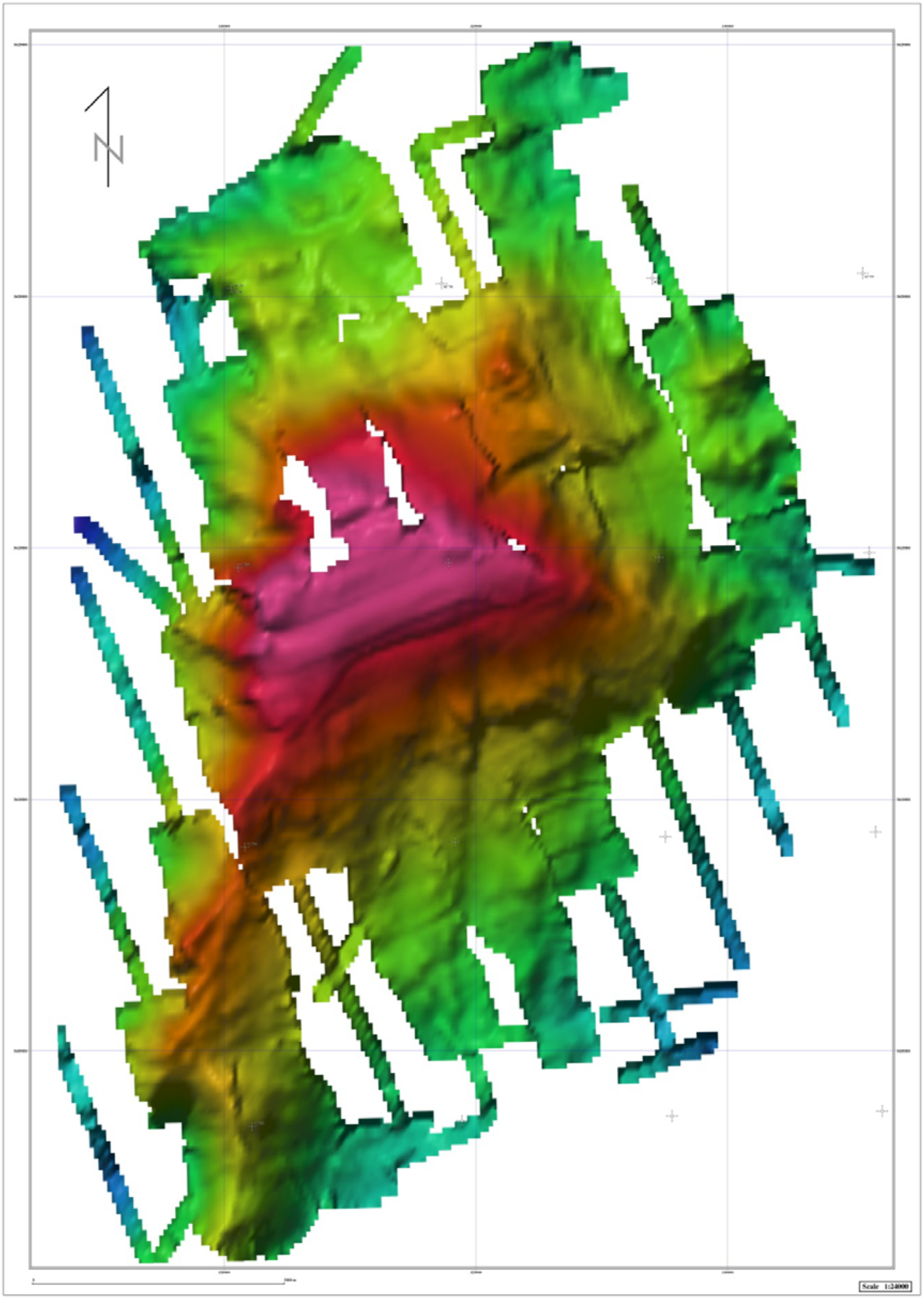

Figure 3.10 Coral Seamount. Multibeam bathymetry of the seamount.

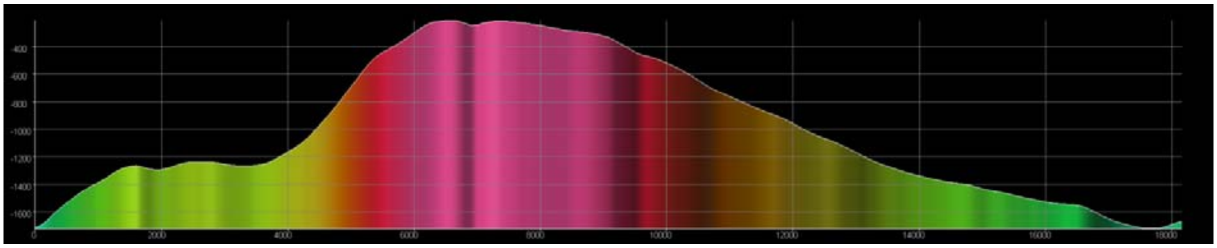

Figure 3.11 Coral Seamount. Profile along longest axis of seamount.

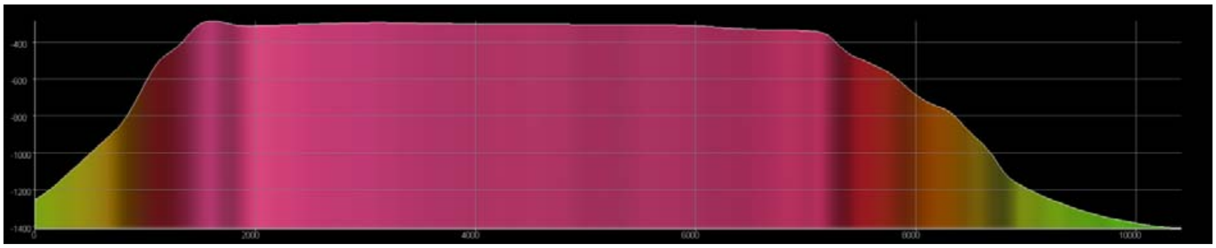

Figure 3.12 Coral Seamount. Profile across seamount.

3.2.5. Melville Bank

Melville Bank lies just to the north of the sub-tropical convergence and is influenced by meanders and eddies associated with the front. It possibly corresponds to seamount 102 fished by Soviet fleets (Romanov, 2003) and is the shallowest seamount on the South West Indian Ocean Ridge with a summit depth of about 90m (Gershanovich & Dubinets, 1991). Melville Bank has been fished by the Soviet fleet and has been heavily fished between the depths of 750 – 1000m and as deep as 1500m depth (Shotton, 2006).

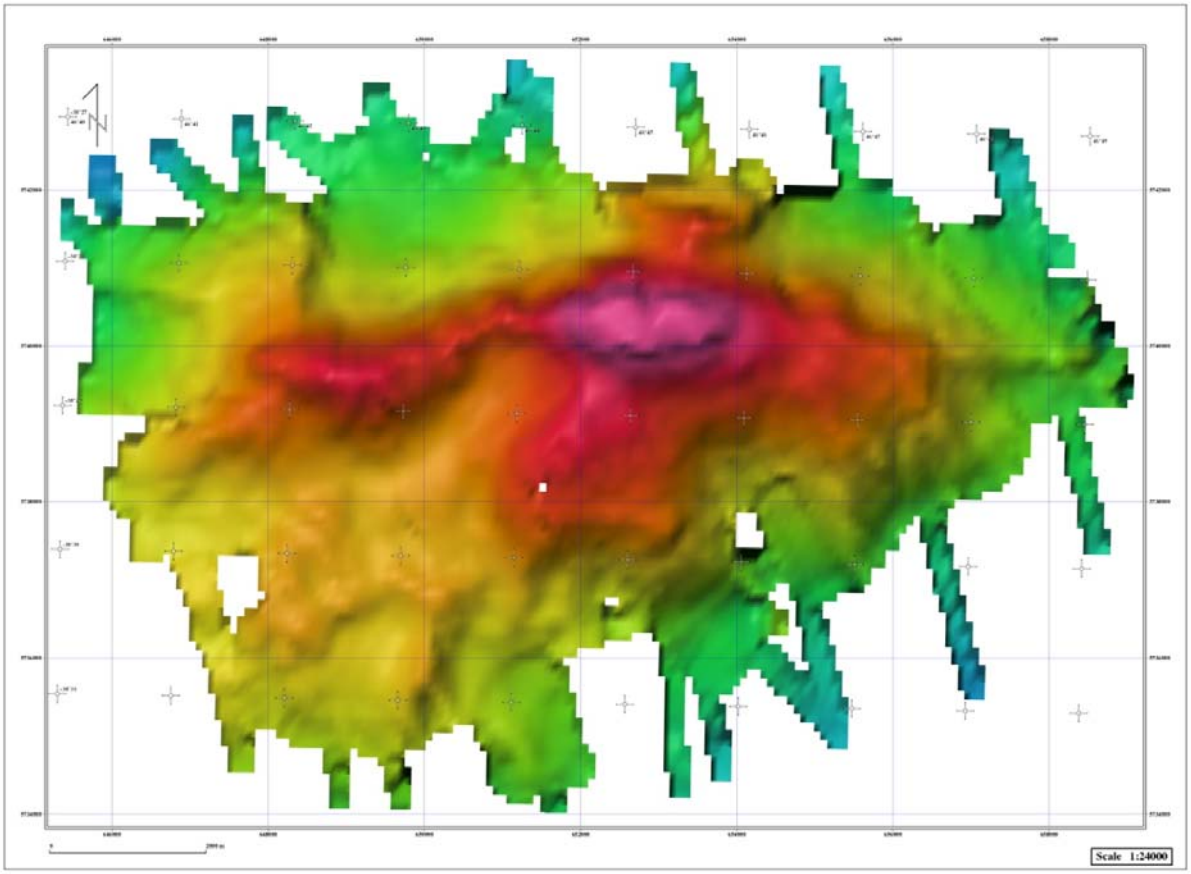

Figure 3.13 Melville Bank. Multibeam bathymetry of the seamount.

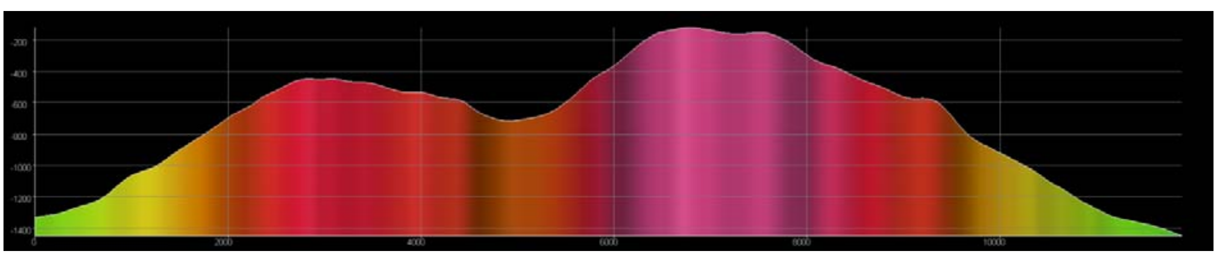

Figure 3.14 Melville Bank. Profile along longest axis of seamount.

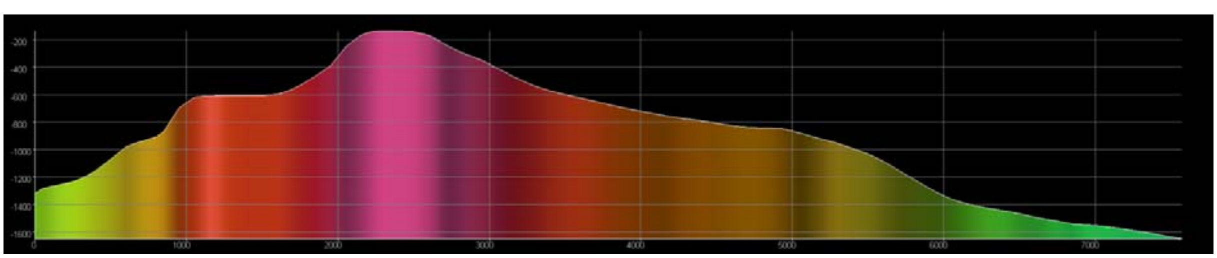

Figure 3.15 Melville Bank. Profile across the seamount.

Melville Bank trends roughly east to west with two distinct peaks, summit depths ~90m and ~550m. The seamount is about 12km along its longest axis.

3.2.6 Unnamed Seamount, Madagascar Ridge

This seamount was predicted to have a summit depth of approximately 700m from Gebco. Instead a sub-conical seamount was located with a summit depth of approximately 1300m. The seamount showed a much more regular outline in shape than those located on the South West Indian Ocean Ridge and is circular and approximately dome-shaped in profile. It is a large feature of more than 16km in diameter.

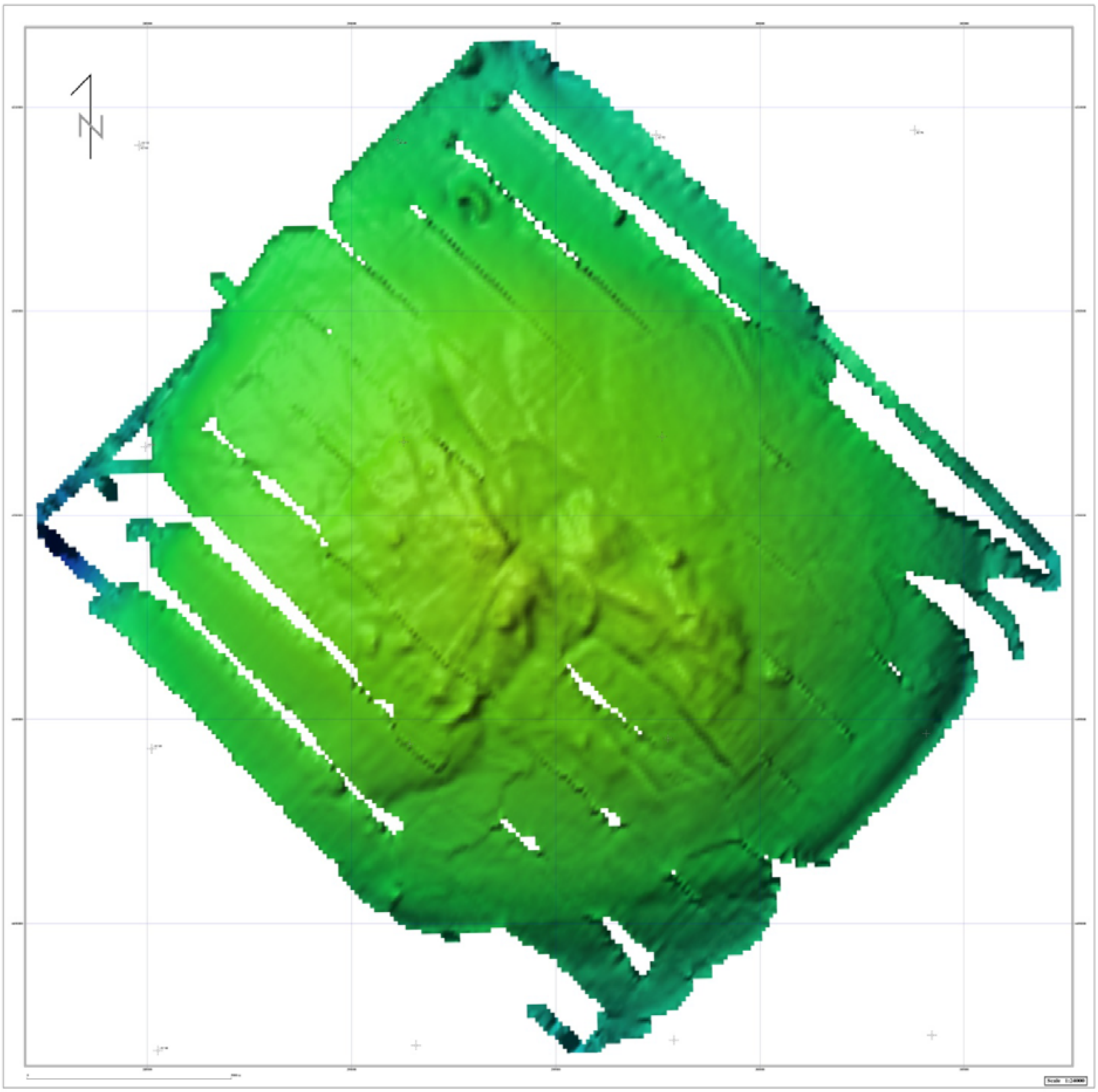

Figure 3.16 Un-named seamount, Madagascar Ridge. Multibeam bathymetry.

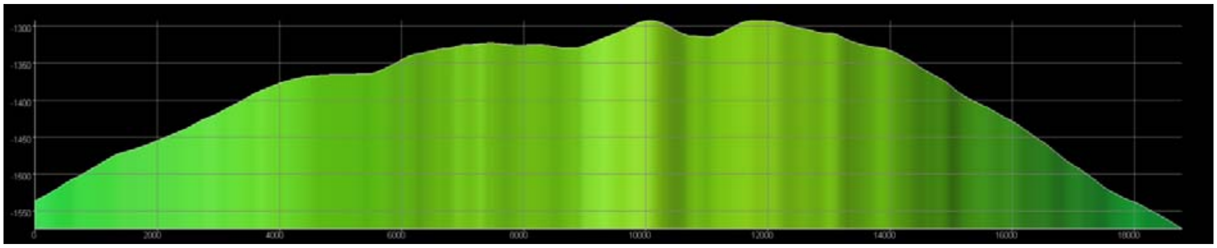

Figure 3.17 Unnamed seamount, Madagascar Ridge. Profile across seamount.

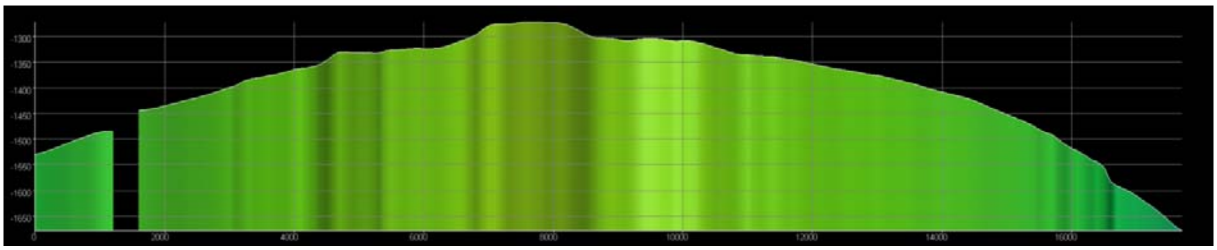

Figure 3.18 Unnamed seamount, Madagascar Ridge. Profile across seamount.

4.0 Physical Oceanography

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4.1 Objectives

There were two objectives to the physical oceanography component of the cruise:
i) to establish the boundaries of the Agulhas-Somali Current Large Marine Ecosystem (ASCLME),

ii) to ascertain the influence of seamounts on the pelagic ecosystem and to investigate the interaction between seamounts and the water column in terms of physical oceanography.

4.2 Plan

To achieve the objectives two different components were planned. The first was to collect CTD and lowered acoustic Doppler current profiler (LADCP) profiles at intervals throughout the cruise, to investigate the large (gyre) scale water mass properties and circulation. These were to be supplemented by one or two (depending on time) close spaced (better than 30nm) CTD + LADCP sections across the Agulhas Return Current and Subtropical Convergence (STC), to investigate the highly dynamic southern boundary of the ASCLME.

The second component centred on the seamounts. Thus at each seamount, a 24-hour CTD yoyo at or near the crest, would provide details of the tidal cycle, inertial oscillations, internal waves and any short-term periodic flow, while a short full-depth CTD transect across the seamount would measure background density gradients and water mass properties. In addition, the vessel mounted ADCP would be run throughout the acoustic grid survey to provide a map of the surface currents over each seamount.

In addition to data collected during the cruise, access to real-time AVISO merged altimeter sea surface height and absolute surface velocities was requested. These provided a low resolution (1/3rd degree) map of the circulation of the region, and proved invaluable in planning the location of sections and “off seamount” surveys. Satellite chlorophyll data were obtained in weekly composite maps from the MODIS satellite.

4.3 Equipment

The plan depended on good CTD and lowered ADCP profiles, vessel mounted ADCP and shipboard position. Additional information was obtained from thermosalinograph and meteorological instruments.

CTD

Conductivity, temperature and pressure data were collected using a SeaBird Electronics SBE 911+ CTD and deck unit, together with an SBE 43 dissolved oxygen sensor and Chelsea Instruments Aquatracka Mk III fluorometer. A 12-way rosette holding twelve 5-litre Niskin bottles was used to collect water samples.

CTD 911+ SBE CTD and deck unit
CTD serial no 09P8109-0316
Deck unit serial no 11P8109-0305
Pressure sensor serial no 53966
Temperature sensor serial no 4143
Conductivity sensor serial no 2037
SBE43 dissolved oxygen sensor
Replaced on cast with serial number 431277
Chelsea instruments Aquatracka Mk III serial number 88/2615/119
12-way rosette with 12 5-litre bottles (various of these were lost during the cruise and were replaced by older bottles)

The system worked well throughout the cruise and a total of 423 stations were sampled.
A number of Niskin bottles were lost during bad weather and had to be replaced. The first six bottles were lost on station 1273 and only 9 bottles were available for station 1274 until more could be assembled from spare parts. After this time bottles 11 and 12 regularly leaked or failed to close
The oxygen sensor broke down on station 1397 and a replacement installed for station 1398
To protect against worn cable, the cable was coiled around the top of the CTD frame several times during the cruise. The CTD termination was re-made after station 1490.

Lowered ADCP

The Lowered ADCP was a problem, which began before the cruise started, when the full-specification instrument requested of IMR could not be transferred to the Nansen. Two alternatives were obtained, a Teledyne RDI Quartermaster Workhorse from IMR, which was rated to 1500 m and a Teledyne RDI Sentinel “moored” ADCP from NOC. The latter used an old potting compound with the known problem of breaking up with cyclic pressurising. This meant that the instrument could only be used on a limited number of CTD profiles.

Unfortunately and unknown to those on board, the IMR Quartermaster Workhorse was supplied to the ship with a separate battery pack that was rated only to 200m. When the system was deployed to 1500m at the first CTD station the battery pack was destroyed. No alternative was available so this instrument could no longer be used. The Sentinel ADCP was deployed on the next two CTD stations and worked well until the first crossing of the STC. At this point it seemed to be suffering from excess internal moisture and was taken out of use. In fact, this was probably the result of condensation from being used in colder temperatures. However, it was also discovered that the holding bar of the CTD frame had been severely bent under the weight of the LADCP and since no alternative method of deploying the LADCP could be found, it could no longer be used. Stations with lowered ADCP data were as follows:

1215, 1216 – between Reunion and Atlantis
1342,1343,1344,1345,1346 – Sapmer transect
1384,1385,1386,1387,1388,1389 – Middle of What transect
1390,1391,1392,1393,1394,1395,1396,1397 – STC/SAF transect

Underway Measurements

Surface measurements of temperature, salinity and fluorescence were made using a Seabird SBE 21 SeaCat thermosalinograph. Data were presented as 1 minute averages in the daily cnv files. Meteorological measurements were provided, although no air pressure was recorded in the 1 minute tracklog_data file. The other underway measurement that would have been useful was incoming irradiance or PAR (photosynthetic irradiance). Apparently this instrument was recently removed from the meteorological system.

Vessel Mounted ADCP

The Nansens' hull mounted acoustic Doppler current profiler is an RDI Ocean Surveyor 150 kHz model, system serial number 1533 and transducer 3067 running vmDAS version 1.44 with 30° beam angle. Transmissions were synchronised with the other acoustic equipment on board (EM710, EK60), such that the ADCP had to wait for the 38 kHz transducer of the EK60 to ping, before it transmitted. This led to a lower data rate than the instrument is capable of, and some degradation of data was expected. However, there was little evidence of this and the instrument provided good data over the top 300-400 m of the water column for most of the cruise.

The instrument was configured with one hundred 8m bins, 8m blank beyond transmit and zero transducer depth. Bin depths were corrected during processing using the RDI formula
Central depth of first bin = blank distance (WF) + 0.5 * (bin size + xmt length + lag)
Where the blank distance = 10 m, bin size = 8 m, xmt length = 8 m and lag = 0.74 m. Together with the vessel's draft of 5.5 m, an estimated first bin depth of 24 m was applied.

Individual pings were internally corrected for ship's heading using the 1 second NMEA input from the Seatex Seapath 200. Data were averaged internally over 3 minutes (STA) and 20 minutes (LTA). During the cruise, the 3-minute averages were read into pstar, corrected for ship's velocity and plotted for the acoustic grids, CTD yoyo's and transects.

No calibration for misalignment angle was attempted during the cruise. The first acoustic survey (event 2) provided coherent data (ie no divergence between the lines of the grid) indicating that any misalignment angle must be small, however, this is something that should be assessed post-cruise.

The Seatex Seapath 200 (S/N 2261) provides real-time heading, attitude, position and velocity. These are obtained by integrating the signals from an inertial measurement unit (MRU 5) and two GPS antennae. The Seatex MRU 5 incorporates 3-axis sensors to measure linear acceleration and angular rate and the output is processed in the Seapath processing unit using a Kalman filter to produce roll, pitch, heave and velocity measurements. Roll, pitch and heading were passed to the vessel's ADCP in NMEA format.

While the instruments on board worked well, there were a number of observations conspicuous by their absence. There was no par or solar radiation sensor on board. Air pressure was not recorded in the tracklog file, although it appeared on the monitor. No thermometers could be found to check the temperature of the lab for the salinometer.

4.4 Data processing and calibration

CTD data were heavily processed before being made available to scientists. The processing path consisted of conversion from binary to ascii format (datcnv), wild edit (calculating mean and standard deviation on blocks of 2 scans on the first pass and 20 scans on the second pass), correction for the cell's thermal mass (cellTM using default parameters), low pass filtered (conductivity, oxygen and fluorescence over 0.03 and pressure over 0.15), pressure reversals or slowdowns were removed with loopedit (minimum velocity 0.25). The data were then averaged to 1 dbar (binavg) and salinity and density calculated (derive).

While the resulting data were clean, the data had been averaged to 1db, so time was no longer available in the file, except as a start time. Time needs to be maintained as a variable, so that the data can be merged with other data sets. Conductivity had been dropped, although this is usually used for salinity calibrations and further derived parameters. The up-casts were deleted, and yet these would have provided useful additional information during the yoyos. Also, it was not possible to follow the usual convention of obtaining the station position at the bottom of the cast. Instead, the start position had to be used. Curiously temperature was calculated using the International Practical Temperature scale of 1968, instead of using the International Temperature Scale of 1990, whereas temperature from the thermosalinograph was calculated using the ITS90. This anomaly, and the missing parameters, mean that the CTD data need to be re-processed to be comparable with other modern data sets and before other variables, such as potential temperature, are derived.
CTD data were read into pstar, but no further processing was attempted. Data were gridded and contoured for the transects and yo-yos. Bottle files were also read into pstar and combined with salinity values determined from the salinometer (see below). The difference between CTD and bottle samples suggest that a correction of between 0.01 – 0.02 to salinity is necessary. Dissolved oxygen measurements using Winkler titration suggested that the SBE43 oxygen sensor had a significant offset.

Salinity calibration

A total of 272 samples were drawn and analysed for salinity. A Guildline Portasal, Portable Salinometer model 8410, serial number 60 652, sited in the main lab, was used for analysis. At the beginning of the cruise the cell was soaked and cleaned with a soap solution before thorough rinsing with distilled water, and the sealing bung and sampling tube were replaced. There were a number of issues with salinity analysis.

Sample bottles were 100 ml green glass with porcelain stopper and rubber rings sealed with a clip spring. The springs were worn and some were heavily corroded, several broke during use and it was not clear how effective a seal the rubber rings provided.

Prior to the cruise, it was understood that there was standard seawater on board, however on arrival, it was discovered that this was not the case and there was not enough time to get any couriered to the ship. Thus just one bottle of standard seawater, provided by ECOMAR (Reunion), was available. This was completely inadequate for a cruise of this duration and intensity of CTD work. Usually, we estimate usage of one bottle per day of CTD time, rounded up to the nearest ten (for this cruise, I would have expected to use up to 20 bottles and would have brought 30 bottles of standard seawater to allow for breakage).

Three bottles of standard seawater were couriered from NOC to the agent in Port Elizabeth and a carefully selected set of samples were analysed on board after the ship had docked.
The one bottle of standard seawater (P144) was used to standardize the salinometer at the beginning of the first session (28 November).

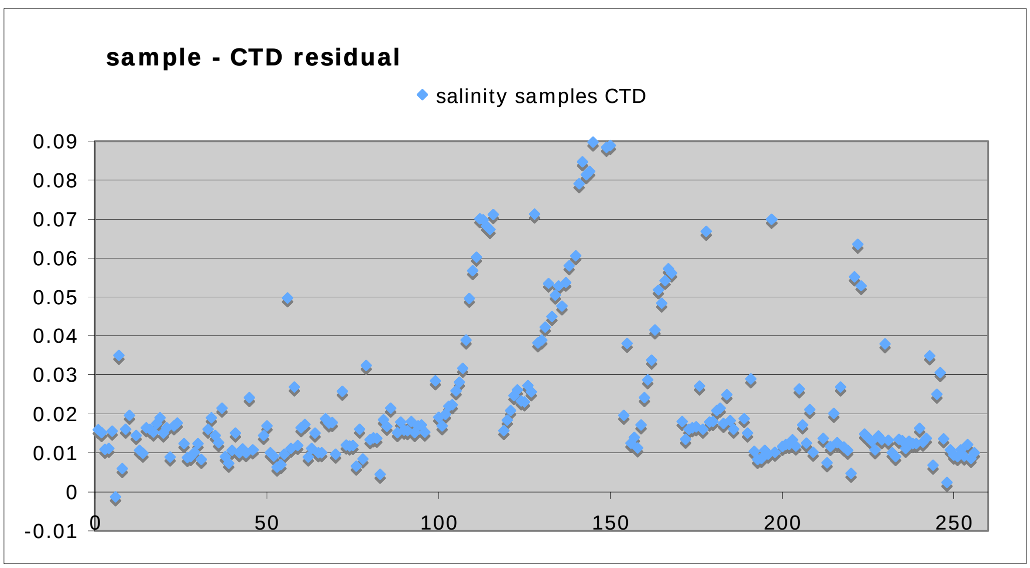
A “substandard” was collected from 2000 m depth on the first cast and measurements of this were made at the beginning and end of every salinometer session. However the values increased during the cruise, presumably due to evaporation through perished sealing rings, so were useless for identifying any drift in the salinometer. It did, however, prove useful in alerting the analyst to anomalous behaviour in the salinometer.

It seems likely that other bottles also allowed evaporation of the sample and some samples were stored for up to a week before analysis. There is no way of quantifying the extent of this problem. However, the majority of samples had sufficient pressure to “pop” the top when the catch was released (from thermal expansion), suggesting that a good seal had been made. Therefore evaporation is not considered to be a major problem (compared to all the other issues encountered).
Two problems with the salinometer made salinity analysis difficult. In calm conditions during the acoustic grid surveys, the salinometer made sudden jumps to higher ratios when measuring the conductivity of a sample, which were obviously wrong. These coincided with rapid (“destroyer” or

"handbrake") turns made at grid points. The same behaviour occurred in rough seas, when the ship experienced sudden or violent movement (pitching, heaving or rolling). This made it inadvisable to use the salinometer during bad weather.

A ship's motion is generally much reduced when hove-to, therefore an attempt was made to use the salinometer during CTD work. However, it was quickly found that this didn't work either. There was a lot of activity in and between the labs, the CTD hatch was open and there were noticeable fluctuations in temperature and drafts around the lab. The salinometer gave such unstable readings that it was impossible to determine a correct value for the samples.

The behaviour of the salinometer is shown in the plot of salinity residuals (bottle salinity – CTD salinity). A sequence of steadily increasing residuals beginning at samples 100, 119 and 156 coincide with three separate analysis sessions. The first two took place during rough weather, the third took place while the vessel was hove-to working CTD stations. There is no reason to think that the CTD conductivity sensor was misbehaving at this time.



These behaviours have been experienced before in other salinometers and are not unique to this one. However, on a cruise that experienced days of bad weather, it was difficult to find periods of suitable, calm, quiet conditions for salinity analysis. When the analysis took place in good conditions, the salinometer worked well giving good, stable measurements of conductivity ratio.
A total of 272 samples were analysed including 10 pairs of duplicates. A further 12 pairs of duplicates were drawn for analysis at the end of the cruise. Mean differences between the 10 pairs of cruise duplicates was -0.0002 ± 0.003, although this masks three "bad" pairs (difference greater than ±0.005) and seven "good" duplicates (difference better than ±0.002) .

The data suggest that a correction to CTD salinity of order 0.01 is necessary, however, calibration is usually applied to conductivity before calculation of salinity. Conductivity was not available in the CTD files, so a full assessment of the calibration required will be done post-cruise.

4.5 Results.

Plots of parameters measured underway by the meterological and thermosalinograph instruments showed the extent of the gale force winds and bad weather experienced during the cruise. Air bubbles in the thermosalinograph caused noise in the salinity data and the instrument had to be turned off during particularly bad weather.

Sea surface height images were received on a daily basis (data were obtained in real-time from AVISO, http://www.aviso.oceanobs.com/). Images presented here were selected to represent each seamount survey. The image for 7 December also includes approximate positions of the two STF crossings.

Reunion to Atlantis

1214 – station 1

1215 – station 2 (off-seamount survey)

1216 – station 3

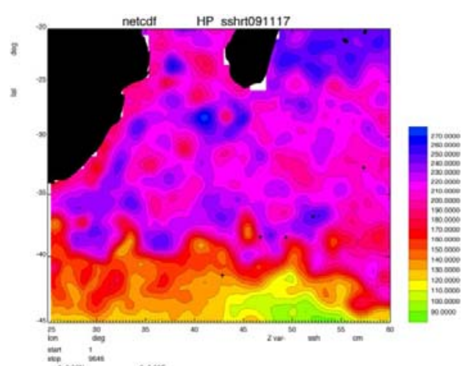
Atlantis

1217 – Atlantis seamount biological station

1218 – 1268 Atlantis yoyo. 51 profiles, depth 740m, 32° 42.735'S, 57° 16.326'E

1269 – 1274 Atlantis transect. 6 profiles

Mean temperature, salinity and density of the top 200 m on the transect: 16.559°C ±1.464, 35.505 ±0.069, 25.998 kg m^{-3} ±0.294.



Sea surface height from 17 November.

Although Atlantis reached about 70 m below the sea surface at its highest point most of the plateau was about 750 m deep. The yoyo was worked near the centre of the plateau and showed evidence of tidal periodicity in the bottom 350 m of the water column.

Sapmer

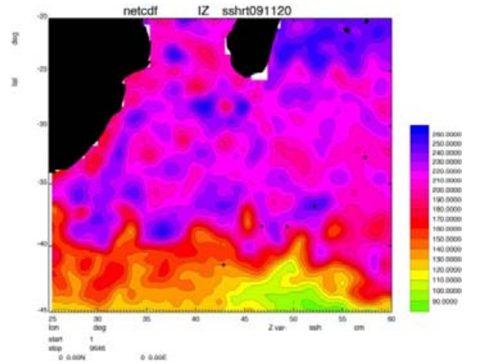
1275 - Sapmer seamount biological station

1276 – 1340 Sapmer yoyo. 65 profiles in 512 m on SW edge of seamount, above the fracture zone

36° 50.589'S 52° 8.522'E

1341 – 1346 Sapmer transect

Mean temperature, salinity and density of the top 200 m on the transect: 15.820°C ±0.069, 35.452 ±0.002, 26.207 kg m^{-3} ±0.014.



Sea surface height from 20 November.

Gale force winds were encountered throughout the two day steam from Atlantis to Sapmer. Conditions improved during the Sapmer survey. The upper layer was well mixed down to 350-400 m, with almost no vertical gradient in salinity and only 0.3°C change in temperature. The yoyo was worked at the eastern end of the summit plateau in about 500 m of water, above the steep drop into the fracture zone. There was considerably more structure in the bottom 100 m of the water column than in the top 300 m and this was organised into two periods approximating to tidal cycles, in which colder water appeared at the base of the water column then disappeared again. Surface currents were weak averaging approx 20 cm/s to the east.

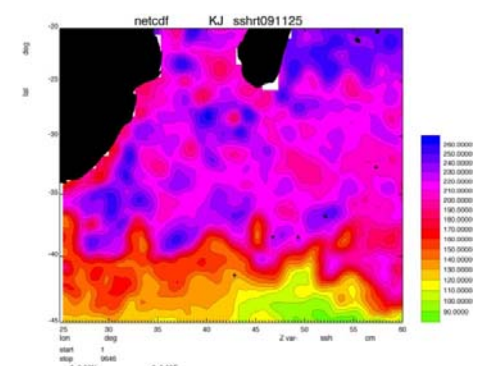
Middle of What

1347 – Middle of What biological station

1348 – 1383 Middle of What yoyo, 36 profiles in 990 m 37° 57.415'S 50° 24.828'E

1384 – 1389 Middle of What transect

Mean temperature, salinity and density of the top 200 m: 16.604°C ±0.522, 35.548 ±0.032, 26.028 kg m^{-3} ±0.098.



Sea surface height from 25 November.

Middle of What was one of the deeper features examined, at its highest elevation reaching no closer than 1000 m to the sea surface. The CTD yoyo was worked close to the summit on the northern edge of the plateau, at the northern drop off into the central rift valley. Surface currents showed weak eastwards flow of about 25 cm/s. The only evidence of tidal signals was a small temperature difference at the seabed in the bottom 100 m of the yoyo.

STC/SAF crossing

1390 – 1400 STC/SAF crossing (15 nm spacing)

Eleven stations were worked at approximately 15 nm spacing across the STC to a depth of 2000 m. The oxygen sensor broke down on station 1397 and was replaced for station 1398. The LADCP was removed at the end of station 1396. Results showed a double frontal feature with strong eastward currents throughout the section.

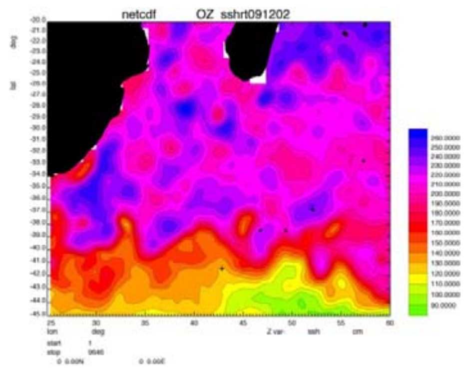
Coral

1401 - Coral seamount biological station

1402 – 1489 Coral yoyo, 89 profiles in 425 m, 41° 25.360'S 42° 50.695'E

1490 – 1495 Coral transect

Mean temperature, salinity and density of the top 200 m during the transect: 10.014°C ±0.654, 34.561 ±0.132, 26.605 kg m^{-3} ±0.145.



Sea surface height from 2 December.

Coral was the only seamount of the survey that was south of the STC and therefore sited in different water masses, providing a colder and fresher environment than the other seamounts studied. It was a shallow seamount, at its highest point reaching about 100 m below the sea surface. The CTD yoyo was worked on the western side, on the edge of the summit plateau, in about 400 m of water above the drop off into the fracture zone. The seamount survey took place at almost full moon, spring tides. The first cast worked in 954m of water, but the topography was too steep to judge safely the CTD depth relative to the bottom, so the vessel was repositioned at end of first cast to a small flattened area in about 425 m depth of water. Tidal effects were visible throughout the water column over the 24 hour period of the yoyo. Water column ADCP measurements suggested bottom intensification and rapid changes in strength and direction of the currents. Surface currents showed a variable easterly flow. The effects of the tide were strongest at the sea bed, but extended upwards to the sea surface, including affecting the phytoplankton layer. The base of the fluorescence maximum was elevated over columns of cold water, rising from about 100 m to less than 40 m depth. This appeared to be associated with changes in the concentration of fluorescence from >1 µg/l (uncalibrated) as the isolines rose to <0.5 µg/l as the isolines relaxed downwards

STC crossing

1496 – 1508 STF crossing (18 nm spacing)

The second crossing of the STC consisted of 13 CTD stations worked to 2000 m approximately 18 nm apart, but included the last station of the Coral transect and the first station of the Melville transect. Frontal gradients were more gentle than the first crossing and only a single frontal feature was observed.

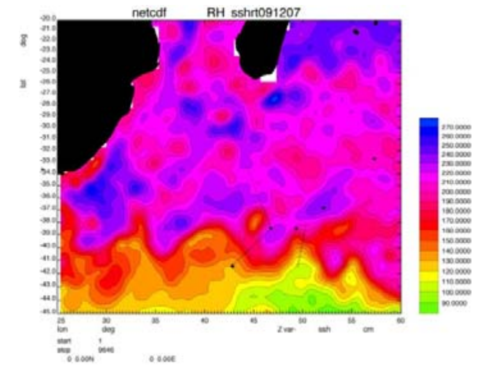
Melville

1509 – 1515 Melville transect (south-north)

1516 – 1525 Melville transect 2 (east-west)

1526 - 1600 Melville yoyo 75 profiles in 520 m at 38° 28.271’S 46° 43.922’E

Mean temperature and salinity of the top 200 m during the two transects: 16.281°C ±0.445, 35.540 ±0.034, 26.098 kg m^{-3} ±0.079.



Sea surface height from 7 December, this figure also shows approximate positions of the two CTD sections across the STF.

Melville was elongated west to east on the southern edge of the central rift of the SW Indian ridge. The shallowest area was about 100 m, with a second elevation to the west of about 400 m. The CTD yoyo was worked on the western shoulder of the shallowest part of the seamount, just above a col about 600m deep. The initial north-south transect was worked in very bad weather and the ship drifted up to half a mile during stations. A second transect was worked later, from east to west.

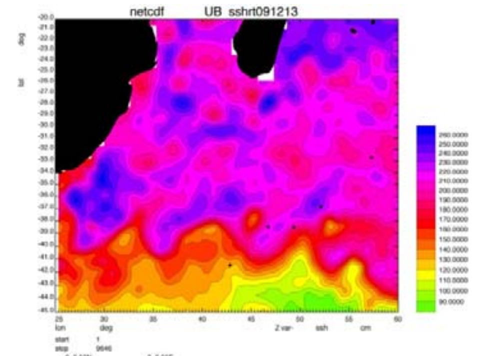
Walters’ Shoals Seamount

1601 – Walters’ Shoals biological station

1602 – 1628 Walters’ Shoals yoyo 27 profiles in 1280 m at the centre of the seamount 31° 37.352’S 42° 49.180’E

1629 - 1635 Walter’s Shoals transect

Mean temperature, salinity and density of the top 200 m during the transect: 18.298°C ±1.683, 35.567 ±0.027, 25.621 kg m^{-3} ±0.408



Sea surface height from 13 December.

A small seamount to the northwest of the area called Walters' Shoals was chosen for the last survey site. The seamount proved to be much deeper than either GEBCO or Sandwell and Smith topography predicted (1200 m instead of 700 m). It was also atypical in having a domed structure rather than a plateau. The yoyo was sited at the shallowest point, at the centre of the dome and the transect worked from southeast to northwest through that central point. There was no obvious evidence of a tidal signal, and instead of upwelling in the bottom boundary layer there appeared to be lateral mixing. Surface currents showed a southwestward flow.

4.6 Conclusions

Overall this was a successful cruise collecting a remarkably extensive data set for the weather conditions. Two close spaced CTD sections were worked across the STF and SAF, the first with some LADCP data, fulfilling objective one. CTD yoyos and transects were completed at 6 seamounts for objective two. Results from the seamounts were mixed, but showed evidence of tidal motions, amplification of tidal currents, internal waves and mixing. It was clear that such features had a direct impact on the deep scattering layers observed in the EK60 acoustic data. Less frequent, but perhaps more striking was the effect on phytoplankton, as indicated by fluorescence. Such effects will be investigated further post-cruise.

5.0 Phytoplankton, nutrients and POM

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Samples for phytoplankton, nutrients and POM were collected at the 110 environmental stations indicated in Figure 5.1. Details of the samples collected at each depth of every station are given in Appendix A. At each environmental station, the SBE 911plus CTD (Sea-Bird Electronics Inc.) was dipped to the bottom or to a maximum depth of 2000 m. The Deep Chlorophyll Maximum (DCM) or Fluorescence Maximum (F-Max) and bottle sample depths were identified on the downcast and Niskin bottles were triggered on the upcast. Fluorescence was measured by an AQUAtracka III (Chelsea Technologies Group Ltd). Two Niskin bottles were triggered at F-max for POM and phytoplankton purposes.

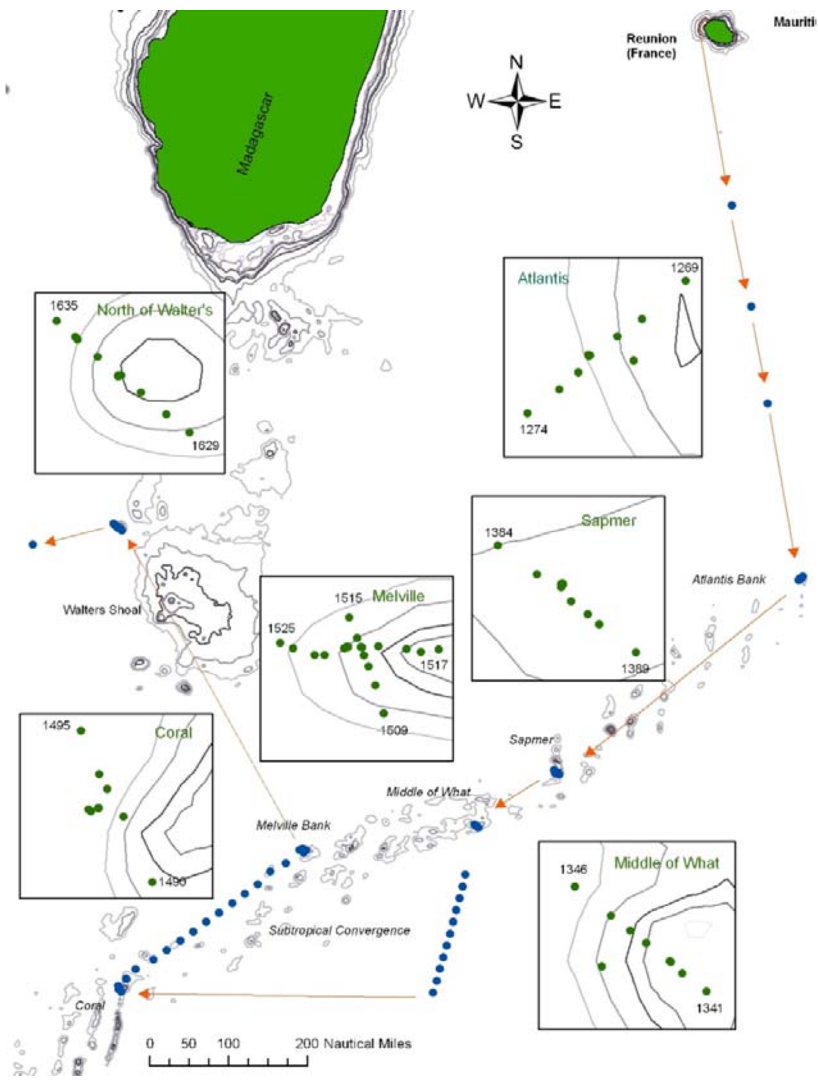


__Figure 5.1.__ Station positions sampled for phytoplankton, nutrients and POM.

5.1 Phytoplankton

5.1.1 Materials and methods

Water was collected from five potential depths (depths determined from the sheet provided by acoustics):

1. Surface
2. Below Surface (termed Shallow – normally 20 m)
3. Below Surface and above Fmax (termed Deep – normally around 40 – 50 m)
4. Fmax (can be anywhere from surface to >100 m)
5. Below Fmax (next station below Fmax that has a visibly lower fluorescence)

Samples were collected for size fractionated chl-a, phytoplankton identification, nutrients and particulate organic matter (POM).

Chlorophyll-a *analyses:*

Half a litre (500 ml) of water from each of the five (or less depending on the depth of F-max) depths were filtered through a Sartorius filter tower cascade set-up with the following filter paper:

a. Top: 20 µm Nylon Net Millipore filter to collect microphytoplankton
b. Middle: 2 µm Macherey-Nagel filter to collect nanophytoplankton
c. Bottom: 0.7 µm GF/F Whatman filter to collect picophytoplankton

The filter paper were sealed in tin foil, labeled and placed in a -20°C freezer for later analyses.

Phytoplankton identification

A litre of water were collected from the surface and the highest F-max Niskin bottle, preserved with 2% Lugols (20 ml) (Karayanni *et al.* 2004) and stored for later analyses. The samples were always added to the fixative so that the preserved cells experienced the minimum target fixative concentration at all times.

80 µm ring net for phytoplankton identification

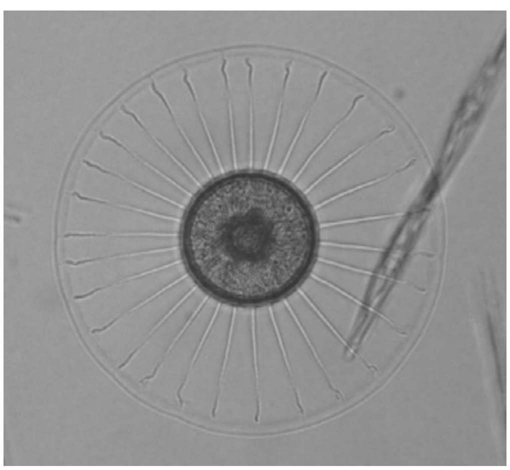
An 80 µm ring net was deployed vertically to below the F-max and winched up to the surface at 0.5 $m.s^{-1}$. The contents of the cod-end were washed into a 250 ml honey jar containing 2% Lugols solution and stored for later analyses. Slides from selected stations (1275, 1342, 1348, 1394 and 1601) were made and examined using a Leitz light microscope. Light micrographs of dominant species/taxa were made using a DCM 310 digital camera (3 megapixels) for microscopes.

Identification of all taxa to the lowest taxonomic level will be done at the Nelson Mandela Metropolitan University (NMMU) and SAIAB using Light and Scanning Electron Microscopy.

5.1.2. Preliminary results

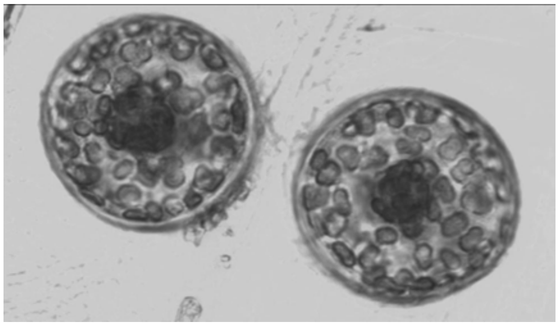
Chl-*a* will be extracted and read on a Turner Designs 10AU Fluorometer in the phytoplankton laboratory of the South African Institute for Aquatic Biodiversity, South Africa. Comparisons will also be done between Fluorometer, HPLC and Spectrophotometer results.

Diatoms formed the dominant phytoplankton group south of 36°S. The stations north of Sapmer Seamount (including Atlantis Seamount) was characterized by low fluorescence and a relatively deep (80 – 100 m) Deep Chlorophyll Maximum (DCM) typical of oligotrophic tropical and subtropical water. The dominant diatoms included the chain forming species belonging to the genus *Pseudonitzschia*, *Chaetocerus*, *Fragilariopsis*, *Melosira* and *Thalassiosira*; large centrics, such as *Planktoniella* and *Coscinodiscus*; and others, including the large *Rhizosolenia* spp. and several *dinoflagellate* species belonging to genus *Ceratium*. The highest fluorescence was measured in the surface waters between the Subtropical Front and the Subantarctic Front around 40°S. In the Subantarctic water the important high latitude flagellate, *Phaeocystis* sp. (probably P. *antarctica*), made its appearance in large numbers, although diatoms remained the dominant group. The light micrographs below show some of the dominant diatoms recorded during the cruise.

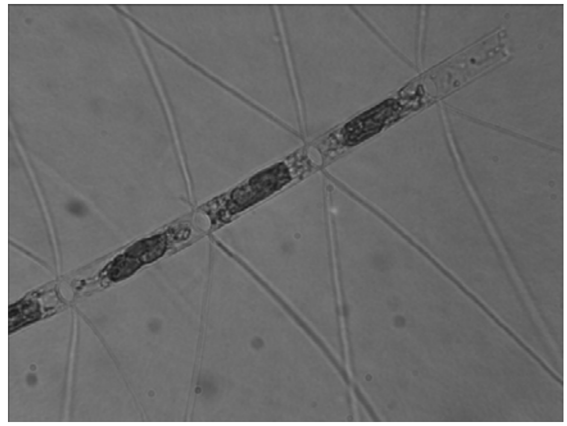


Planktoniella sp.

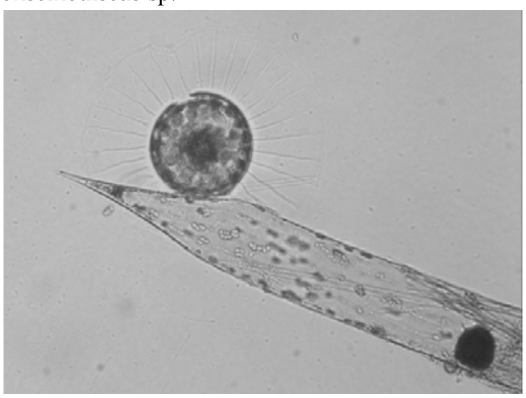
Pseudonitzschia sp.



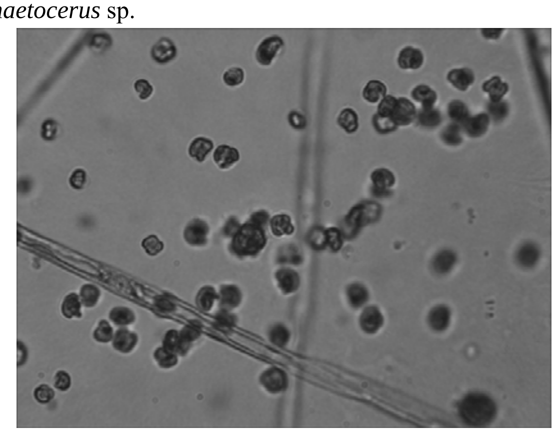
Conscinodiscus sp.



Chaetocerus sp.



Rhizosolenia sp.



Phaeocystis cf. antarctica

5.2 Nutrients

5.2.1. Materials and methods

Water samples were collected from all the depths (except for the duplicate F-max bottle) where the Niskin bottles were triggered. Acid washed 50 ml "urine jars" were rinsed twice with water directly from Niskin and filled ¾ full (5 – 10 ml space were left to allow expansion during freezing). Bottles were labelled and placed in a -20°C freezer for later in South Africa.

5.2.2. Preliminary results

The nutrients will be analysed in Dr. Howard Waldron's laboratory in the Department of Oceanography at the University of Cape Town. The nutrient data should be available early in 2010. To access the data please contact Dr Tom Bornman at t.bornman@saiab.ac.za.

5.3 Particulate Organic Matter (POM)

5.3.1. Materials and methods

POM samples were collected from the surface and F-max at each environmental station. Five litres of water were collected from the surface with the aid of a bucket and from the duplicate F-max Niskin bottle and pre-screened through a 64 µm sieve to remove zooplankton. The sieved water was filtered onto a pre-combusted GFF filter under slight vacuum. GFF filters were then dried at 50^{o}C for 24 hrs and stored in sterile opaque blue containers for later analyses.

5.3.2. Preliminary results

The POM and isotope samples will be analysed by Dr. Sven Kaehler from IsoEnvironmental at Rhodes University. For more info contact: s.kaehler@ru.ac.za or visit http://www.isoenviron.co.za/

6.0 Mesozooplankton and micronekton sampling

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6.1 Summary

During the 2009 410 Seamount cruise (12/11.09-19/12.09) on the Research Vessel *Dr Fridtjof Nansen* we successfully collect net samples from the epipelagic realm on top of, and in the vicinity of six seamounts along the South West Indian Ocean Ridge and Walter's shoal south of Madagascar. Samples were collected in order to describe the pelagic community and to estimate the effects of seamounts on the species composition and the biomass of the pelagic realm, thus complementing and providing a fishery management framework for the area. The preliminary methods and results from the epipelagic mesozooplankton caught with plankton nets and the pelagic crustacean catch (from the Aakra trawl) are presented here. With our sampling completed we are confident that we are able to meet our original goals. Our activities shed light on the biogeography of a remote and poorly surveyed part of the ocean.

6.2 Materials and methods

6.2.1 Pelagic Sampling

Observations of the epipelagic realm were collected using scientific plankton nets. The Multinet (50×50 cm mouth opening, 180 µm mesh size, Fig.6.1 and 6.2) was fished obliquely and enabled us to collect and describe samples from 5 depths strata (Falkenhaug 2007; Hosia *et al*. 2008; Wenneck *et al*. 2008). While the ship was steaming at 0.3-0.5 m.s^{-1} the Multinet was lowered to a maximum of 200 m. Nets were then triggered at the selected depth intervals. Net changing was controlled by downwire link from a Net Command Unit. The volume of water filtered was measured by a Hydro Bios Electronic Flowmeters situated internally and externally on the net frame and was between 8 and 200 m^3 per net. Full deployment metrics are included in Appendix B. Nominal depths intervals alternated between two sets of standards deployments: Stratified/Biogeographic and Fmax (see section 6.2.2 and 6.2.3 for respective sampling protocols).

A dual Bongo net (mesh size 500 µm and 375 µm, cod-end mesh size 500 µm and 500 µm respectively) was towed obliquely from 200 m to the surface (see Fig. 6.3 for deployment). A HYDRO-BIOS flow-meter was mounted in the mouth of the net frame to allow the volume of water filtered to be determined. A record was kept of the time of deployment and recovery, and of flow-meter readings before and after each haul. The Bongo nets were fitted with Scanmar sensors to acoustically determine the depth of the gear (Fig.6.4). The Bongo nets were retrieved over 30 min (up 10m every 1 min).

Multinet and Bongo net hauls were deployed to get 3 replicates during day and night-time (see Table 2.1). Upon recovery all nets were hosed down with seawater to ensure that all zooplankton cumulated in the cod-ends.

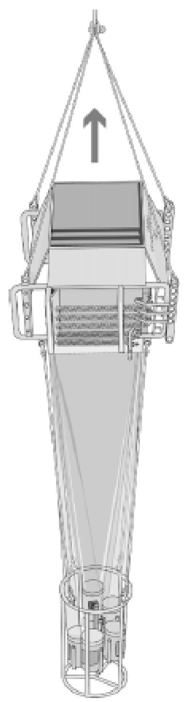

Figure 6.1 Diagram of the multinet used on the 2009 SWIO cruise on the Dr Fritdjof Nansen *Source* HYDRO-BIOS Apparatebau GmbH. For our purpose the cod-end frame depicted was removed so that the cod-ends could be towed freely.

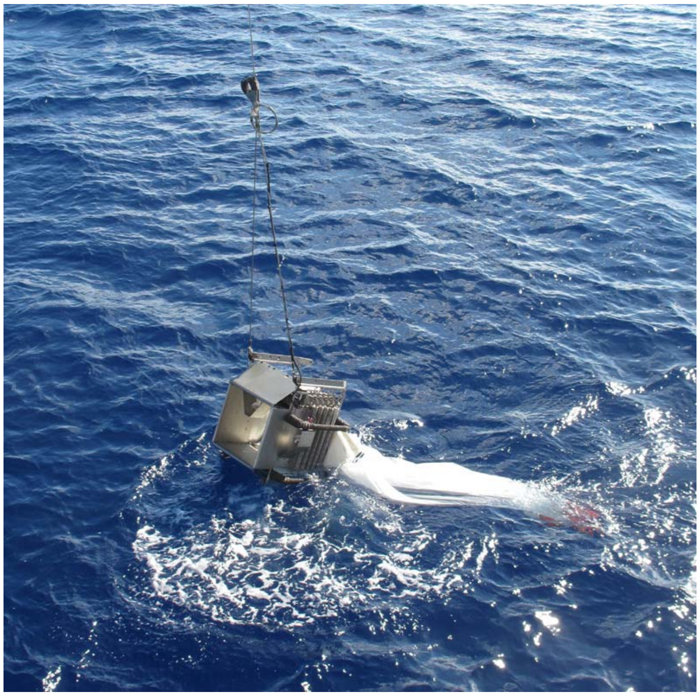

Figure 6.2 Deployment of the HYDRO-BIOS multinet of the starboard side of the *Dr Fridtjof Nansen*.

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Figure 6.3 Night time deployment of Bongo nets with SCANMAR sensors (red) of the starboard side of the ship.

6.2.2 Multinet protocol (Stratified)

For biogeographical studies the nominal stratified ranges were 250-200, 200-150, 150-100, 100-50 and 50-0 m. Single stratified hauls were conducted at all stations during day and night time to avoid diel vertical migration bias (see table # for list of deployments and Appendix B for full list of flow meter readings/deployment times and location). Upon recovery of the multinet samples were retrieved from the cod-ends and split into two fractions using a folsom splitter. One fraction was preserved on 95% ethanol for genetic analysis and the other was preserved on 4% borax buffered formaldehyde. We visually inspected multinet samples for diversity and bio-volume estimates.

6.2.3 Multinet protocol (Fmax)

The fluorescence profile from the CTD dip was used to determine the exact depths at which the nets were triggered, which were as follows: two above f-max, one through f-max, two below f-max. Upon recovery samples were retrieved in a 180µm sieve a fixed on 4% buffered formaldehyde. Sample jars were placed in a black Addis plastic box for 24 hours. After 24 hours, the approximate volume of zooplankton in each sample was recorded using a ruler (in mm) and the data were entered into a log. The main types of zooplankton observed in each sample was identified and recorded in a log. Thereafter, the samples were placed back into the black Addis boxes for storage and for further laboratory analysis.

6.2.4 Oblique bongo protocol

Three Bongo net hauls were conducted at day and night at each station to avoid diel vertical migration bias (sea table of activity for list of Bongo net deployments and Appendix B for full list of flow meter readings/deployment times). For one net out of three, the 375 µm net was carefully washed through 1mm and 64 µm sieves. Thereafter each zooplankton size-fractioned sample was placed into a blue opaque vile and dried in an oven at 50^{o}C. The sample from the 500 µm net was washed into a 180 ml honey jar and immediately preserved in 4% buffered formaldehyde. The 500 µm sample will be analysed for fish larvae by Dr Nadine Strydom at the Nelson Mandela Metropolitan University.

For the second net the 500 and 350 µm nets were washed through 1mm and 64 µm sieves and were immediately preserved in 10 seawater formaldehyde. In the final net the 500 µm net codend were removed and the mesozooplankton was preserved in formalin for subsequent taxonomical analysis. Samples from the 375 μm net cod-end were removed and preserved on ethanol for subsequent genetic analysis of species diversity.

6.2.5 Aakratrawl Crustaceans

For full details of fishing procedure and sorting protocols see section 7.0. Crustaceans were removed from the catches and voucher specimens were kept for photography and fixed on 4% buffered formaldehyde and later transferred to 70% ethanol. Crustaceans were sorted to taxa and identified to species level when possible, using keys and microscopes. Fractions of the dominant crustaceans species (n>20) were preserved for phylo- and population genetic analysis and where kept on ethanol. At stations 7, 8, 9 and 10 individuals of the dominant groups (4<n<10) were frozen and kept at -20°C for stable isotopes and fatty acid analysis.

6.3 Results

6.3.1 Mesozooplankton

The catches showed high temporal, spatial and temporal variability in quantity and taxon presence. The 500 μm net yielded consistently greater catches than the 375 μm net. The Bongo net generally caught animals of a greater size range than the multinet. A complete picture of the biogeography will emerge following more thorough post-cruise analysis. The highest catch of mesozooplankton was caught in the depth range scoping the highest fluorescence reading (*f*-max, see section 5). Information on the presence and absence of main zooplankton identified are shown in Table 1, from which it can be seen that most stations were dominated by copepods, euphausiids, chaetognaths and amphipods. Typically oceanic taxa (pteropods, thaliaceans) were present at the far south and Subtropical front stations. Settled volumes for zooplankton were fairly similar across the sampled stations but lowest at the off seamount station (Station 2) and Atlantis bank (Station 4). The greatest number of euphausiids was caught during the net deployments at night. A large collection of Salps and deeper-living crustaceans were caught off Walter's Shoal (e.g *Systellaspis debillis*).

Table 6.1 Present and absent averages for each zooplankton taxon in the water column, at each sampling station for day and night, using the f-max multinet protocol.

	Station2		**Atlantis bank**		**Sapmer Bank**		**Middle of What**		**Subtropical front**		**Coral**		**Mellville bank**		**Walter shoal**	
Date (date-month-year)	14/11/2009		18/11/2009		24/11/2009		25-27/11/2009		29/11/2009		02/12/2009		08/12/2009		12-13/12/2009	
Latitude	S 26 56 47		S 32 45 23		S 36 52 03		S 37 57 97		S 41 28 96		S 41 24 66		S 21 29 39		S 31 40.82	
Longitude	E 56 14 56		E 57 18 09		E 52 13 91		E 50 23 99		E 49 33 40		E 42 56 10		E 46 48 05		E 42 52.88	
Maximum depth (m)	5055		1169		4100		1179		3566		725		1172		1495	
Max. sampling depth (m)	200		200		200		200		200		200		200		200	
Number of hauls	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Day/Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Copepoda	1	1	0.7	0.7	1	1	1	1	1	1	0.9	1	1	0.9	1	1
Euphausiacea	0.6	0.8	0.6	0.8	0.5	0.9	0.7	1	0.7	1	0.6	1	0.9	0.8	1	0.4
Amphipoda	0.4	0.2	0.5	0.5	0.9	0.9	0.9	1	0.9	1	0.6	0.6	1	0.6	0.8	1
Chaetognatha	1	0.8	0.7	0.9	1	1	0.9	0.9	1	0.7	0.9	1	1	0.8	0.9	1
Hydromedusae	0.2	0.6	0	0.1	0.1	0.4	0.3	0	0	0.1	0	0	0.3	0.2	0.1	0.6
Siphonophorae	0	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0	0.1	0	0.1	0.6	0.2	0.6	0.6
Fish larvae	0.2	0.4	0.3	0.5	0.6	0.6	0.3	0.5	0.4	0.6	0.2	0.6	0.2	0.4	0.6	0.4
Ostracoda	0.6	1	0.3	0.8	0.1	0.3	0.3	0.6	0.5	0.7	0	0.8	0.1	0.2	0.1	0
Polychaete larvae	0	0	0.2	0.5	0.4	0.3	0.3	0.2	0	0	0	0	0	0	0.1	0.1
Mysidacea	0	0	0.2	0.5	0.1	0.2	0.2	0.1	0	0	0	0.1	0.2	0	0	0.2
Doliolida	0	0	0.1	0.1	0.2	0.1	0.1	0.2	0	0	0	0	0.3	0.1	0	0.2
Heteropoda	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1	0
Salpida	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.6	0.2	0	0.6	0.5
Pteropoda	0	0	0.1	0.2	0	0.8	0.4	0.5	0.1	0.1	0	0	0	0.2	0.3	0
Gastropod larvae	0	0	0	0	0.3	0.3	0.3	0.5	0.1	0.2	0	0.2	0.2	0.4	0.2	0
Cephalopod larvae	0	0	0	0	0.2	0	0.1	0	0	0	0	0	0.1	0	0.1	0
Larval decapods	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0

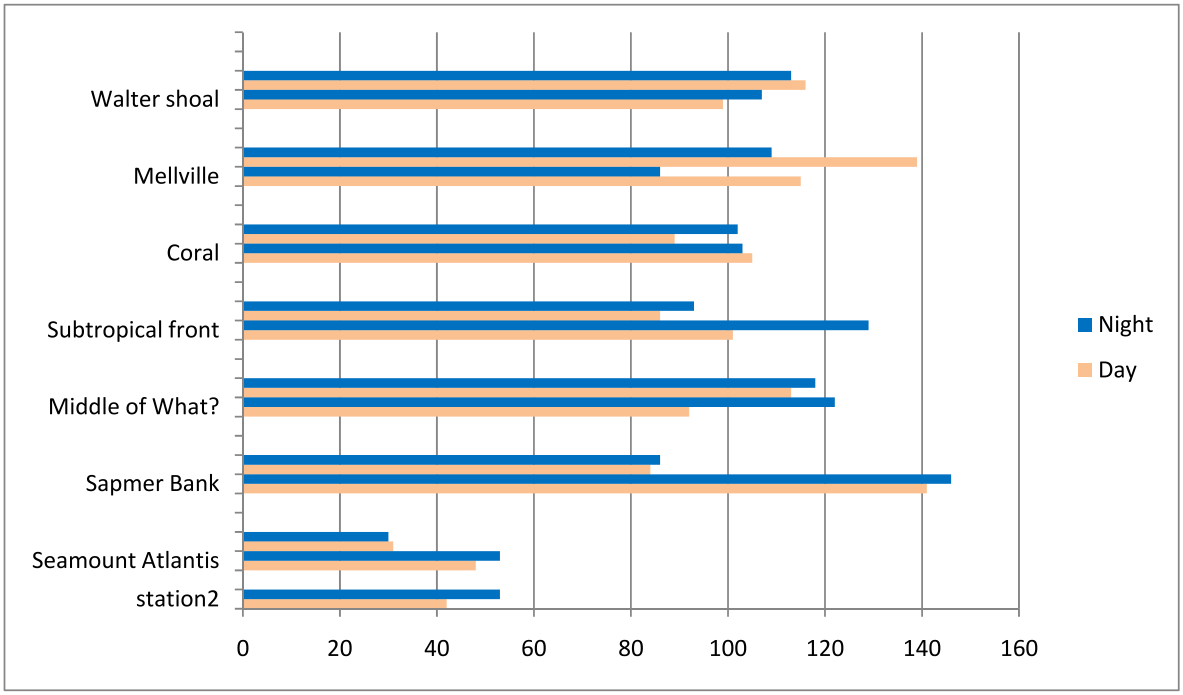

Figure 6.4 Total settled volumes (mm) of zooplankton in the water column, at each sampling station for day and night, using the f-max multinet protocol.

6.3.2 Aakra trawl Crustaceans

Crustaceans from the Aakratrawl were removed from the samples and identified to the nearest taxa. We identified 16 species of decapods, 22 species of amphipods, 18 species of euphausiids, 1 species of Ostracoda and 3 species of lophogastridea (Table 3). Due to the semi-quantitative nature of the sampling the numerical abundance of each species caught in each trawl is omitted from this report but can be found in Appendix A. The crustacean diversity was highest in the deep trawls. Lowest diversity and abundance of crustaceans was caught at station 2. Amphipod diversity was highest over seamounts. Euphausiid diversity was highest in the vicinity and south of the subtropical front.

Decapoda	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Acanthephyra								X
Acanthephyra sp.								X
Acanthephyra sp.	X	X	X	X	X	X	X	X
Funchalia villosa	X	X	X	X		X	X	X
Gennadas sp.			X	X	X	X	X	
Meningodora mollis				X				
Notostomus				X		X	X	
Oplophorus	X	X	X	X	X	X	X	X
Parapasiphae								X
Pasiphaea chacei		X	X	X	X	X	X	X
Pasiphaea sp								X
Pasiphaea				X		X	X	
Pasiphaea sp								X
Sergestes sp	X	X	X	X	X	X	X	X
Sergia sp	X	X	X	X	X	X	X	X
Systellaspis debilis	X	X	X	X			X	X
Amphipoda								
Orchomenella sp						X		
Trischizostoma sp						X		
Andaniexis australis		X						
Hyperia crassa					X	X		
Phronima		X	X	X	X	X	X	X
Phrosina semiluna		X	X	X	X			X
Orchomenella						X		
Oxycephalus clausi		X						
Scina sp		X	X	X	X		X	X
Eupronae sp	X	X		X			X	X
Eurythenes obesus					X	X		
Platyscelus ovoides			X	X			X	X
Platyscelus		X		X				
Streetsia	X	X	X	X			X	X
Synopia sp			X	X				
Bathystegocephalus			X		X	X		X
Brachyscelus sp			X	X				
Cyphocaris						X	X	
Cyphocaris richardi					X	X		X
Cystisoma longipes		X	X	X				X
Danaella					X	X		
Themisto					X	X		
Euphauseacea								

Thysanopoda							X	
Thysanopoda						X	X	
Thysanopoda		X						
Thysanopoda	X							
Thysanopoda		X		X				X
Thysanopoda					X			
Thysanopoda		X	X	X			X	X
Thysanopoda sp.					X			
Euphausia					X			
Euphausia					X	X		
Euphausia sp		X	X	X				
Euphausia spinifera			X	X				
Euphausiacea sp.		X						
Stylocheiron		X	X	X	X	X	X	X
Nematobrachion		X	X					
Nematoscelis					X	X		
Nematoscelis sp.							X	
Euphausia mutica							X	X
Ostracoda								
Gigantocypris					X	X		X
Lophogastrida								
Gnathophausia		X	X	X		X	X	X
Gnathophausia				X		X		
Gnathophausia								X

Table 6.2 Species presence/absence as caught in the Aakratrawl during the 2009 seamount expedition on the RV Dr Fridtjof Nansen. See introduction section 2.0 for station location

6.4 Sampling limitations

Although the multinets were in good quality at the beginning of the cruise considerable efforts were allocated to fixing holes and tears near the canvas end. These were created throughout our sampling activity, mainly due to contact with the other cod-ends and the cod-end frames. We suggest that new nets are provided, and that the cod-end frame design is modified so that the nets are better protected from tears. Two alternating sets of cod-ends were used during repetitive deployments; one of these sets was loose fitting, and on two occasions the content of the cod-end was lost before it could be recovered. We suggest that this second, inadequate set is replaced.

Bongo nets were in poor quality at the start of the cruise and should be replaced. The discrepancy between the cod-end mesh size and the net mesh size mean that the while the two nets sampled the same size fractions of zooplankton (i.e. both cod-ends were 500μm), these two samples should not be considered replicates or pseudoreplicates for the sake of statistical analyses.

The aakra trawl is primarily designed for catching larger and faster moving species (Wenneck *et al*. 2008). As such a lot of the delicate and fragile specimens were damaged upon capture and many individuals will not be identifiable to species levels. Some particularly soft-bodied taxa (such as mysids) will probably not lend themselves to identification due to this constraint. The trawl was originally fitted with a multisampler cod-end, which would have enabled the catching of samples from 3 discrete depths. The multisampler failed during the second deployment and was deemed U/S for the remainder of the cruise. The subsequent use of a non-closing cod-end means that it will be difficult to estimate the upper limit of the vertical distribution of the species caught.

6.5 Research intentions/discussion

The mesozooplankton samples we have collected using the multinet are consistent and of high quality. The multinet is internationally recognized as a qualitative and quantitative sampling device, and will fill a cap in the already wide-spanning biooceanographic coverage of mesozooplankton in the Indian Ocean (Zeitzschel and Gerlach 1973). The multinet formaldehyde fraction will be used for ground-truthing the high frequency acoustic backscatter and integrating pelagic biomass, and for the biogeographical studies of mesozooplankton.

The formaldehyde fraction of the cod-end (500 μm) will complement the biogeography study and will be used to assess mesoplanktic biodiversity, as this greater mesh size probably catches a larger size-fraction of the mesozooplankton taxa due to the smaller bow-wave.

The ethanol fraction of the multinet and the dual bongo (375 μm) will enable a genetic analysis of larval stages and population genetics/dispersal patterns of mesozooplankton. Results from the larval barcoding will be coupled with the investigation of benthic fauna data from 2011 ROV cruise on the *RSS James Cook* (JC) and should help identify cryptic stages of species with poorly understood lifecycles.

The crustacean species presence/absence data from the Aakratrawl will be used to undertake a study of the biogeography of the South West Indian Ocean Ridge. Although almost certainly the micronektic catches from the Aakratrawl are not quantitative, the depth sampled with the aakratrawl are unprecedented in this area and the crustacean 'bycatch' will provide a valuable record for the

South West Indian Ocean Ridge. Moreover there are, to the authors' knowledge, no previously published records of the mesopelagic crustacean fauna from our study sectors (with the exception of Walter's shoal) and many of our species records will involve range extensions (i.e. *Gnathophausia gracilis, Oplophorus novaezealandiaea*) and new records all together. Scientific macrozooplankton sampling has previously been conducted on Walter's shoal and includes published species lists (Vereshchaka 1994). As such some of our data will lend itself to comparative studies. Length measurement will be conducted on portion of the crustacean catch deemed quantitative (i.e. *Acanthephyra* sp, *Pasiphaeia* sp etc), and the data will be used estimate micronekton biomass in conjunction with acoustic measurements, see Holliday (1992) and Greenlaw (1979). The overall species presence/absence data will be used in a cluster analysis, which should provide information on the species composition and the horizontal, and vertical extend of micronekton assemblages. The ethanol fraction will be used for phylo/population genetic analysis. Certain cosmopolitan species, such as *Systellaspis debilis* are particularly suited for the latter. The crustaceans kept for the purpose of Stable Isotopes analyses will be used in the construction of a bentho-pelagic foodweb, again coupled with samples collected on the 2011 JC cruise.

7.0 Micronekton and nekton sampling

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7.1 Summary

A total of 40 trawls were undertaken between 14/11/09 and 14/12/09 along the South West Indian Ocean Ridge and Walter's shoal region to the south of Madagascar. 20 of these were in warm subtropical water between -26.93ºS, 42.81 ºE and -37.96ºS, 57.29 ºE. The remaining 20 trawls were undertaken in colder water between -38.46ºS, 42.74ºE and -41.56ºS, 49.54ºE. 32 trawls were at seamount sites; 8 were off-seamount sites. Trawling was largely undertaken between 300 and 900m. A single trawl was undertaken at 50m and two had a slightly deeper recorded depth of 1100m. Two day and night replicates were undertaken at each station and targeted the deep scattering layer and the shallow scattering layer. Dawn trawls were usually targeted at summit-associated aggregations and were undertaken opportunistically at 4 stations. Trawls were categorised by station and event number, and by corresponding Nansen Trawl Numbers (a sequential count of successive trawls). These categorisations are outlined in Table 7.1.

A total of 6962 samples were labeled, fixed and stored. 4842 of these samples were frozen, 1725 fixed in 95% ethanol and 370 fixed in 4% formalin. 382 subsamples of fish tissue were taken for genetic analysis by the South African Institute of Aquatic Biodiversity and a further~ 1000 samples of tissue from fish and invertebrates were collected by ZSL (AD Rogers). 9 samples were discarded after weighing/measuring and subsampling (largely scyphomedusa and salp samples) and 1 porifera sample was dried. Storage mode was not noted for 12 samples. A single sample (# 4822) was lost during bad weather in transit.

Table 7.1. Nansen trawl numbers and corresponding station and event codes for all Ǻkra trawls. d= day, n=night, dw=dawn. Max depth is the maximum depth recorded during the duration of each trawl.

Nansen trawl number	Station	Event	Max depth (m)	Start Lat (deg)	Start Long (deg)	Stop Lat (deg)	Stop Long (deg)	Day/Night/Dawn	Date
1	2	7	600	-26.931	56.189	-26.939	56.230	d	14/11/2009
2	2	7	300	-26.941	56.237	-26.947	56.279	d	14/11/2009
3	2	7	50	-26.947	56.282	-26.953	56.324	d	14/11/2009
4	2	14	800	-26.986	56.243	-26.930	56.180	d	15/11/2009
5	4	4	700	-32.725	57.297	-32.715	57.241	d	17/11/2009
6	4	5	400	-32.725	57.297	-32.722	57.233	d	17/11/2009
7	4	18	700	-32.727	57.297	-32.726	57.262	n	18/11/2009
8	4	19	400	-32.722	57.274	-32.726	57.324	n	18/11/2009
9	4	22	740	-32.737	57.288	-32.693	57.297	dw	19/11/2009
10	5	8	750	-36.856	52.054	-36.819	52.062	d	22/11/2009
11	5	9	400	-36.827	52.061	-36.868	52.053	d	22/11/2009
12	5	23	720	-36.842	52.056	-36.805	52.062	n	23/11/2009
13	5	24	400	-36.816	52.075	-36.787	52.118	n	23/11/2009
14	5	25	500	-36.788	52.121	-36.788	52.121	n	23/11/2009
15	5	26	750	-36.861	52.051	-36.807	52.066	dw	24/11/2009
16	6	11	700	-37.955	50.377	-37.951	50.431	n	25/11/2009
17	6	12	400	-37.953	50.421	-37.955	50.373	n	25/11/2009
18	6	13	930	-37.957	50.409	-37.958	50.440	n	26/11/2009
19	6	25	700	-37.956	50.403	-37.959	50.426	d	27/11/2009
20	6	26	420	-37.958	50.423	-37.958	50.405	d	27/11/2009
21	7	13	700	-41.480	49.534	-41.518	49.493	n	29/11/2009
22	7	14	400	-41.510	49.504	-41.475	49.542	n	29/11/2009
23	7	15	700	-41.571	49.450	-41.550	49.471	d	30/11/2009
24	7	16	400	-41.557	49.476	-41.568	49.456	d	30/11/2009
25	8	12	900	-41.427	42.928	-41.415	42.953	d	02/12/2009
26	8	13	600	-41.411	42.942	-41.418	42.913	d	02/12/2009
27	8	17	900	-41.426	42.930	-41.436	42.880	n	02/12/2009
28	8	18	643	-41.419	42.903	-41.400	42.944	n	02/12/2009
29	8	19	270	-41.412	42.870	-41.402	42.905	dw	03/12/2009
30	9	15	860	-38.504	46.759	-38.517	46.699	n	07/12/2009
31	9	16	480	-38.478	46.780	-38.495	46.730	n	07/12/2009
32	9	20	320	-38.475	46.771	-38.473	46.737	dw	08/12/2009
33	9	27	850	-38.505	46.760	-38.515	46.711	d	08/12/2009
34	9	28	430	-38.493	46.743	-38.474	46.791	d	08/12/2009
35	9	29	560	-38.465	46.749	-38.475	46.701	d	08/12/2009
36	10	9	700	-31.641	42.833	-31.624	42.840	n	12/12/2009
37	10	10	1100	-31.589	42.860	-31.581	42.885	n	12/12/2009
38	10	11	300	-31.596	42.880	-31.605	42.859	n	13/12/2009
39	10	18	1100	-31.648	42.813	-31.663	42.803	d	14/12/2009
40	10	29	700	-31.645	42.813	-31.627	42.828	d	14/12/2009

7.2 Methods

7.2.1 Ǻkra trawl fishing

Two pelagic Ǻkratrawls were used for fishing. The larger net, a Flytetrål 152 MSK x 3200mm, with a 20m net mouth opening, was used for most trawls (Figure 7.1a). The smaller net, with a 10m net mouth opening, was used for faster trawl attempts targeting what were believed to be aggregations of larger fish mainly at dawn.

Both nets were fitted to a 24mm trawl wire which was payed out to 2.5 x the target fishing depth. Both nets used two Tuberin combi trawl doors of 1750kg each. Trawling was undertaken between 2 and 3 knots vessel speed.

The Ǻkra trawl net was fitted with a multisampler for the first deployment (figure 1b). The first three trawls undertaken at Station 2 (all labeled as Event 7) were made using this apparatus. Damage to the multisampler which occurred during recovery of this first trawl meant that it could not be used in successive trawls. Though specific sampling depths were targeted during all trawls the net mouth remained open for the duration of fishing. Incidental catches made during deployment to and recovery from the target depths could therefore not be avoided. This catch was minimised by a quick recovery speed once the nets had been hauled from the target fishing depth.

Figure 7.1 (a) Recovery of the large Ǻkratrawl. (b) The damaged multisampler on deck.

7.2.2. Ǻkra trawl catch-processing

Prior to each trawl ice-trays for sorting, and sample labels were prepared. Each label has a unique number. Note that labels were not used in a consecutive order and there were labels remaining after sampling was completed meaning that not all numbers are represented in the database.

Upon arrival on deck the cod end was immediately emptied into large plastic tubs. Particularly large or interesting samples and samples in very good-condition were removed for photography and the rest of the catch emptied into large trays of ice. A small amount of seawater was added to each tray to prevent the samples freezing to the ice. The catch was largely sorted into fish, cephalopod, crustacean, gelatinous zooplankton, and other abundant invertebrate groups.

Fish which could not be immediately identified were photographed and stored in formalin. If a second specimen was available it was stored in ethanol for later genetic analysis. Juvenile and larval stages of fish and crustaceans were preserved in ethanol. All other fish were identified, measured for total length and standard length and frozen in individual zip-lock bags. Very large fish were stored in black bin liners. Additional head length and pre-anal fin length measurements were taken for grenadiers. All large fish were weighed. Labels were fixed to large fish by tying on a loop of string through the mouth and gill slits. Labels were tied around the mantle-arm join or around an individual arm of large cephalopods. All other frozen samples were stored in individual zip lock bags with labels inserted. Formalin and ethanol-stored samples were contained in individual buckets, jars or bottles, with labels inserted.

Crustaceans were identified and species diversity was recorded before weighing and fixing in bulk. All other invertebrates were sorted into broad categories and weighed and fixed in bulk. Fractions of every group were fixed in formalin and ethanol, respectively, and an attempt was made to ensure that representatives of every putative species were included in either fraction.

For the first 26 trawls (up to and including trawl 26: station 8, event 13) myctophids were individually labeled and frozen after measuring. From trawl 27 (station 8, event 17) onwards myctophids were individually measured but stored together in one container of ethanol with one sample number per trawl. This decision was made based on a shortage of small bags and time constraints during trawl processing. Between 50 and 200 myctophids (in addition to those measured) were taken from each catch and stored in ethanol for later genetic work. Note that the measured myctophids are undoubtedly biased towards the larger individuals in each catch.

Small tissue samples were taken from behind the dorsal fin of a subsample of 382 fish by SAIAB (see database for details) and stored in ethanol for genetic analysis. Further samples of tissue of both fish and invertebrates were collected by ZSL for phylogenetics and population genetics studies (see Appendix C). Tissue samples from the mantle or arms were collected from large cephalopods and stored in ethanol for genetic analysis. Crustacean and some cephalopod samples were frozen for stable isotope analysis from trawls 23-25, 31, 35, 37, and 38.

Trawls 12 (station 5, event 23), 29 (station 8, event 19) and 40 (station 10, event 29) were recorded in their entirety. All other trawls have a “rest of catch” component labeled, weighed, and split between formalin and ethanol storage. This component is the sieved mixed remains of the catch which were not sorted due to time or logistical constraints. This portion typically represented 0.5 – 1.5 kg of the total catch for each trawl.

7.3 Results

7.3.1 Fish identifications

In total, 60 fish identifications were made to species level, representing 41 families (Table 7.2).

Fish Identification	Authority	Family	Common name
Alepisaurus brevirostris	Gibbs 1960	Alepisauridae	Shortnose lancetfish
Argyropelecus aculeatus		Sternoptychidae	Hatchetfishes
Argyropelecus affinis		Sternoptychidae	Hatchetfishes
Argyropelecus gigas		Sternoptychidae	Hatchetfishes
Argyropelecus hemigymnus		Sternoptychidae	Hatchetfishes
Astronesthes indicus		Astronesthidae	Snaggletooths
Astronesthes martensii		Astronesthidae	Snaggletooths
Beryx decadactylus		Berycidae	Berycids
Beryx splendens		Berycidae	Berycids
Borostomias antarcticus		Astronesthidae	Snaggletooths
Brama orcini		Bramidae	Pomfrets
Bregmaceros macclellandi	Thompson 1840	Bregmacerotidae	Codlets
Chauliodis sloani	Schneider 1901	Chauliodontidae	Viperfishes
Chauliodontidae		Chauliodontidae	Viperfishes
Chiasmodon niger	Johnson 1863	Chiasmodontidae	Swallowers
Cryptopsaras couesii	Gill 1883	Ceratiidae	Seadevils
Diplophos taenia	Gunther 1873	Gonostomatidae	Bristlemouths
Diretmus argenteus	Johnson 1863	Diretmidae	Diretmids
Emmelichthys nitidus	Richardson 1845	Emmelichthyidae	Rovers
Etmopterus brachyurus	Smith and Radcliffe 1912	Squalidae	Dogfishes
Etmopterus pusillus	Lowe 1839	Squalidae	Dogfishes
Evermannella cf indica	Brauer 1906	Evermannellidae	Sabretoothed fishes
Gonostoma elongatum	Gunther 1878	Gonostomatidae	Bristlemouths
Halargyreus johnsonii	Gunther 1862	Moridae	Deepsea cods
Howella sherborni	Norman 1930	Acropomatidae	Lanternbellies
Idiacanthus atlanticus	Brauer 1906	Idiacanthidae	Sawtail-fishes
Lepidopus caudatus	Euphrasen 1788	Trichiuridae	Frostfishes
Luciosudis normani	Fraser-Brunner 1931	Notosudidae	Notosudids
Margrethia cf obtusirostra	Jespersen and Taaning 1919	Gonostomatidae	Bristlemouths
Maurolicus muelleri	Gmelin 1788	Sternoptychidae	Hatchetfishes
Melanocetus johnsoni	Gunther 1864	Melanocetidae	Devil-anglers
Melanostomias barbatombeani	Parr 1927	Melanostomiidae	Scaleless dragonfishes
Mesobius antipodum	Hubbs and Iwamoto 1977	Macrouridae	Grenadiers
Myctophum selenops	Taaning 1928	Mytophidae	Lanternfishes
Nansenia cf macrolepis	Gilchrist 1922	Argentinidae	Argentines
Nealotus tripes	Johnson 1865	Gempylidae	Snake mackerels
Nemichthys curvirostris	Stromman 1896	Nemichthyidae	Snipe eels
Nemichthys scolopocerus	Richardson 1848	Nemichthyidae	Snipe eels
Neocyttus rhomboidalis	Gilchrist 1906	Oreosomatidae	Oreos
Nessorham ingolfianus	Schmidt 1912	Derichthyidae	Longneck eels
Odontomacrurus murrayi	Norman 1939	Macrouridae	Grenadiers
Odontostomops narmalops			
Opisthoproctus grimaldii	Zugmayer 1911	Opisthoproctidae	Barreleyes
Persparsia cf kopua	Phillips 1942	Platytroctidae	Tubeshoulders
Photicthys argenteus	Hutton 1872	Phosichthyidae	Lightfishes
Prometichthys prometheus	Cuvier 1832	Gempylidae	Snake mackerels
Pseudoicichthys australis	Haedrich 1966	Stromateidae	Ruffs
Pseudoicichthys cf australis	Haedrich 1966	Stromateidae	Ruffs
Pseudopentaceros richardsoni	Smith 1844	Pentacerotidae	Armourheads
Ranzania laevis	Pennant 1776	Molidae	Ocean sunfishes
Rondeletia loricata	Abe and Hotta 1963	Rondeletiidae	Redmouth whalefishes
Rossenblattia robusta	Mead and De Falla 1965	Apogonidae	Cardinal fishes
Scopelarchoides cf signifer	Johnson 1974	Scopelarchidae	Pearleyes
Scopelosaurus hamintoni	Waite 1916	Notosudidae	Notosudids
Sternoptyx obscura	Garman 1899	Sternoptychidae	Hatchetfishes
Stomias boa boa	Risso 1810	Stomiidae	Scaly dragonfishes
Trachipterus trachypterus	Gmelin 1789	Trachipteridae	Ribbonfishes
Trachurus delagoa	Nekrasov 1970	Carangidae	Kingfishes
Vinciguerria nimbaria	Jordan and Williams 1896	Phosichthyidae	Lightfishes
Xenodermichthys coupei	Gill 1884	Alepocephalidae	Slickheads

Table 7.2 Species-level identifications and corresponding authority, family, and common names.

41 further fish identifications were made to genus or family level, representing 34 families (Table 7.3).

Fish Identification	Family	Common name
Alepocephalus	Alepocephalidae	Slickheads
Argentinida	Argentinidae	Argentines
Astronesthes sp	Astronesthidae	Snaggletooths
Astronesthidae	Astronesthidae	Snaggletooths
Atherinidae sp	Atherinidae	Silversides
Batophilus sp	Melanostomiidae	Scaleless dragonfishes
Beryx sp	Berycidae	Berycids
Bregmaceros sp	Bregmacerotidae	Codlets
Brotulotaenia sp	Ohpidiidae	Cuskeels
Centrolophida	Stromateidae	Ruffs
Chauliodontidae	Chauliodontidae	Viperfishes
Chiasmodontidae	Chiasmodontidae	Swallowers
Cubiceps sp	Nomeidae	Driftfishes
Diastobranchus	Synaphobranchidae	Cutthroat eels
Diretmoides sp	Diretmidae	Diretmids
Epigonus sp	Apogonidae	Cardinal fishes
Evermannella sp	Evermannellidae	Sabretoothed fishes
Gempylidae	Gempylidae	Snake mackerels
Gonostoma sp	Gonostomatidae	Bristlemouths
Gramicolepididae	Gramicolepididae	Tinselfishes
Hatchetfish	Sternoptychidae	Hatchetfishes
Holcomycteronus sp	Ophidiidae	Cuskeels
Hyperoglyphe sp	Stromateidae	Ruffs
Idiacanthus sp	Idiacanthidae	Sawtail-fishes
Linophrynidae	Linophrynidae	Dwarf anglers
Margrethia sp	Gonostomatidae	Bristlemouths
Melanostomias sp	Melanostomiidae	Scaleless dragonfishes
Myctophid	Mytophidae	Lanternfishes
Nemichthidae	Nemichthyidae	Snipe eels
Nemichthys sp	Nemichthyidae	Snipe eels
Notolepis sp	Paralepididae	Barracudinas
Ophididae	Ohpidiidae	Cuskeels
Paraliparis	Liparididae	Snailfishes
Persparsia sp	Platytroctidae	Tubeshoulders
Scorpaenid	Scorpaenidae	Scorpionfishes
Stomiidae	Stomiidae	Scaly dragonfishes
Tetragonurus sp	Tetragonuridae	Squaretails
Trachiurus	Carangidae	Kingfishes
Trichiuridae	Trichiuridae	Frostfishes
Vinciguerria sp	Phosichthyidae	Lightfishes
Winteria sp	Opisthoproctidae	Barreleyes

Table 7.3. Genus and family-level identifications with corresponding common names.

Two other fish categories are listed in the database: “unidentified” and “Telescope eye fish”. A large portion of the fish categorised as “unidentified” were from the first 3 trawls when the catch was sorted and stored before we were able to identify individual samples. These will be identified at a later date and are likely to include many of the species also identified from later trawls. A small number of fish in each remaining trawl could not be immediately identified and were categorised as "unidentified". Identification of these will also be attempted at a later date and will undoubtedly add to the total species list outline in Table 2. The category "Telescope eye fish" was used to distinguish a specific fish which appeared in several catches but which could not be satisfactorily identified. This species will be carefully examined at a later date.

7.3.2 Species presence-absence

The representation of each fish family in the 40 trawls undertaken is outlined in Table 7.4. There was a particularly diverse catch at Walter's Shoal probably reflecting the proximity of the large area of shallow water in this region associated with Walter's Shoals Seamount itself.

Though larval fish are not included in Table 7.4, it is worth noting that a large number of juvenile scabbardfish (Trichuiridae) were caught at the off-ridge site just after the vessel entered colder waters (Station 7). The cardinal fishes (*Rossenblattia robusta*) were also only found at this site. Larval fish were fixed in ethanol and formalin for later examination and it is not possible to quantify them at this stage.

Station	2				4 - Atlantis Bank					5 - Sapmer Seamount						6 - Middle of What					7 - Off-ridge site				8 - Coral Seamount					9 - Melville Bank						10 - Watson's Shoal				
Event	7	7	7	14	4	5	18	19	22	8	9	23	24	25	26	11	12	13	25	26	13	14	15	16	12	13	17	18	19	15	16	20	27	28	29	9	10	11	18	29
Day/Night/Dawn	d	d	d	d	d	d	n	n	dw	d	d	n	n	n	dw	n	n	n/dw	d	d	n	n	d	d	d	d	n	n	dw	n	n	dw	d	d	d	n	n	n	d	d
Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Acropomatidae																x	x																x							
Alepisauridae									x																														x	
Alepocephalidae							x						x				x																						x	
Apogonidae																					x						x										x			
Argentinidae																	x																			x				
Astronesthidae				x			x	x					x				x	x			x				x	x	x						x							x
Atherinidae												x																												
Berycidae							x	x	x						x																x									
Bramidae																																				x			x	
Bregmacerotidae													x			x																				x			x	
Carangidae																			x				x																	
Ceratiidae																																							x	
Chauliodontidae								x	x	x					x	x	x	x	x	x	x				x	x	x	x		x	x		x		x	x	x	x	x	x
Chiasmodontidae													x				x				x	x											x	x						
Derichthyidae									x																		x										x			
Diretmidae				x			x		x	x		x	x		x				x								x			x			x			x	x		x	x
Emmelichthyidae																															x									
Evermannellidae														x			x																							
Gempylidae												x					x				x																	x		
Gonostomatidae																	x	x	x	x			x		x			x								x	x	x	x	x
Gramicolepididae																									x															
Idiacanthidae																									x		x									x		x		x
Linophrynidae																		x																					x	
Liparididae				x							x		x	x		x					x	x													x		x			
Macrouridae																x					x				x	x	x	x									x			
Melanocetidae																	x	x																						
Melanostomiidae				x			x			x		x			x	x				x					x		x						x			x	x		x	x
Molidae	x	x	x																																					
Moridae																									x															
Mytophidae			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Nemichthyidae				x						x			x	x	x	x		x	x														x				x		x	x
Nomeidae				x							x																									x				
Notosudidae							x						x				x	x				x			x				x		x		x			x				
Ohpidiidae																		x				x																		
Opisthoproctidae										x						x	x			x											x	x		x	x	x			x	x
Oreosomatidae																		x																						
Paralepididae																																							x	
Pentacerotidae									x																															
Phosichthyidae				x			x			x	x	x			x	x			x	x	x		x		x	x	x	x			x		x	x	x	x	x		x	x
Platytroctidae									x							x						x			x	x	x	x		x			x							
Rondeletiidae																																					x			
Scopelarchidae																														x							x			
Scorpaenidae																																				x				
Squalidae									x						x												x													
Sternoptychidae		x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x					x	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Stomiidae									x												x	x	x		x	x	x													
Stromateidae									x														x	x		x			x							x				
Synaphobranchidae																																				x				
Tetragonuridae																																				x		x		
Trachipteridae							x																																	
Trichiuridae													x								x	x															x			
Unidentified	x	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x			x	x		x		x	x	x	x	x	x
(Telescope eye fish)																					x																x			

Table 7.4. Family-level presence and absence records for each event undertaken at each station. d=day, n=night, dw=dawn.

7.3.3 Invertebrates

The Åkra-trawl sampled a broad spectrum of invertebrate, spanning a size range from makrozooplankton to metre-long cephalopods. Results for crustaceans are discussed in detail in chapter 6. For lack of specialist taxonomic knowledge and time constraints all other invertebrate taxa remain to be identified during post-cruise analysis. Apart from Crustaceans, cephalopods and gelata were the most abundant groups (Figure 2).

Cephalopod diversity appeared very high north of the subtropical front, including several species from the Sepiida, Chranchiidae, Enoploteuthidae, Histioteuthidae and Chtenopterygidae. South of the front diversity appeared to be lower. Octopodids were rare, at present we are only aware of two specimens (#5353 and #5722).

The vast majority of gelatinous specimens were severely damaged by the net, hindering identification of most specimens. Hydromedusae and Siphonophores usually made up a significant proportion of the gelatinous fraction. Among scyphozoans *Atolla sp.* and *Peryphylla sp.* were common. Salps were very abundant south of the front and at Walters Shoal. At least four species of pyrosomes were collected.

Chaetognaths were abundant on most stations. Heteropods and Pteropods were taken in small numbers on most stations.

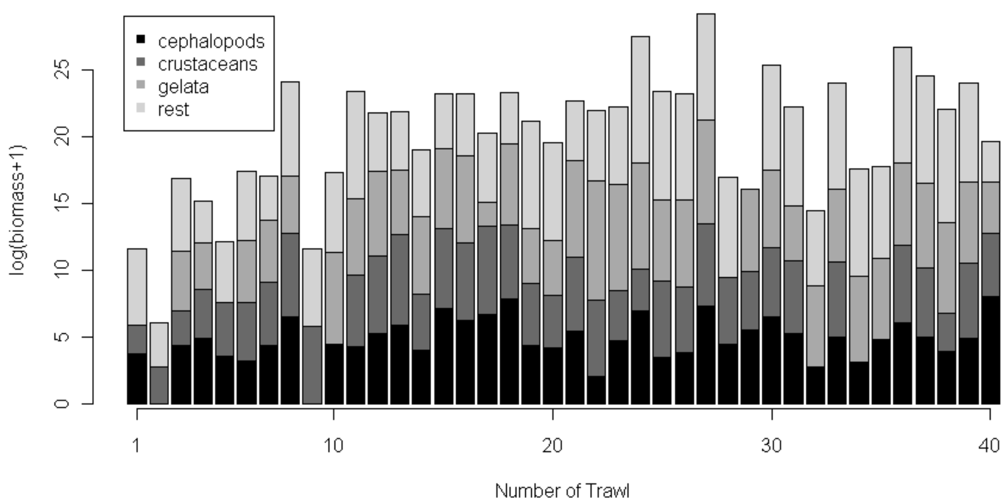

Figure 7.2 log-transformed invertebrate biomass for all trawls. The “rest” category includes the remaining invertebrates as well as the “rest of catch” lots which usually contained a number of small fishes. The category gelata includes coelenterates and pelagic tunicates.

7.4 Discussion

The trawls described here represent the largest targeted pelagic survey undertaken in this region, to the author’s knowledge. The data-overview presented here is obviously a very preliminary account of the catch composition and a fraction of the analysis which will be undertaken on this dataset. Samples will be stored at The South African Institute for Aquatic Biodiversity (SAIAB) until a workshop can be arranged later in 2010 for further analysis to be undertaken. These samples will also contribute directly to the biodiversity assessments of African marine fishes being undertaken by SAIAB. This is a DNA barcoding project which is an attempt to assist with the identification of taxonomically unclear taxa, marine fishes of the Indian Ocean (WIO). The Fish Barcode of Life (FISH-BoL) project is a global initiative devoted to developing DNA barcoding as a global standard for the identification of biological species through the coordinated assembly of a standardised reference DNA sequence library for all fish species that is derived from voucher specimens with authoritative taxonomic identifications. The gene region that has been selected as the standard barcode for almost all animal groups is a 648 base-pair region in the mitochondrial Cytochrome Oxidase I gene (“COI”). The COI region has been shown to be highly effective in identifying birds, butterflies, fish, flies and many other animal groups. High-quality DNA barcode records of identified organisms are all available on-line with images, and geospatial coordinates of specimens. The database also includes information on species distributions, nomenclature and authoritative taxonomic information. The benefits of barcoding fishes include facilitating species identification for all potential users, including taxonomists; highlighting specimens that represent a range expansion of known species; flagging previously unrecognised species; and perhaps most importantly, enabling identifications where traditional methods are not applicable. The barcode sequence data remains in the private domain (authority of project collaborators) until published and submitted to the public domain and GENBANK. The long-term goal of this project is to generate species lists and DNA barcode data for all fish species in Africa. The outcomes of this project will include improved species lists of the fish diversity of all surveyed areas, significantly enhancing knowledge of the taxonomic status, and conservation of fish.

8.0 Acoustic Sampling of Zooplankton, Micronekton and Fish

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8.1 Summary

Acoustic samples of the pelagic realm were successfully collected at every seamount station and the two off-ridge control sites. Samples were collected using a calibrated EK-60 scientific echosounder (Simrad, Norway). A balanced line transect survey design will enable inter-site statistical comparisons of acoustic backscatter and potentially of pelagic biomass.

All acoustic survey grids were also sampled using a variety of nets, this will enable ground-truthing of acoustic data and elucidate the composition of scattering layers in the survey area.

As the echosounders were recording continuously throughout the survey further acoustic samples were collected during all other scientific operations and transit.

8.2 Introduction

A substantial proportion of zooplankton and mikronekton biomass migrates daily between the surface and deeper layers. This diurnal vertical migration is thought to be driven by predation pressures, with organisms ascending to shallower depths during night-time to feed and descending to aphotic depths at dawn to avoid visual predators. Shallow topography can block the descent of these animals, exposing them to predators and/or concentrating them on the summits and flanks of of submarine banks and seamounts.

This "topographic blockage mechanisms" was first observed with sonar technology by Isaacs and Schwartzlose (1965). Despite the rapid technological advancement in echosounder technology since, most seamount investigations to date have relied on net sampling. Only few acoustical studies of the interactions between biological scatterers and abrupt topographies have been made, mostly restricted to shallow seamounts (e.g. Genin *et al*. 1994, Wilson and Boehlert 2004, Valle-Levinson *et al*. 2004).

To our knowledge this survey is the first attempt to study the interactions between mesopelagic seamounts and associated scattering layers, as well as the first study to apply multi-frequency techniques to seamount ecosystems.

8.3 Materials and Methods

8.3.1 Acoustic equipment and data processing

Acoustic data were collected using a calibrated split-beam scientific echosounder Simrad EK60 (Kongsberg Maritime AS, Horten, Norway) operating at 18, 38, 120 and 200 kHz. The transducer array was mounted on the drop keel of *Dr. Fridtjof Nansen* at a deployed depth of 8.0 m. The EK60 was operated in synchronisation with a vessel mounted ADCP and a bottom-mapping multibeam echosounder, with the EK60 38 kHz transducer setting the master ping rate. Pings were transmitted with a pulse duration of 1024 ms.

Acoustic signals were digitised and processed with Simrad ER60 software (Kongsberg Maritime AS, Horten, Norway) and logged in a raw format for post processing. Acoustic data quality was monitored in real-time using the ER60 software and near real-time using Echoview software (Myriax Pty Ltd. Hobart, Tasmania, Australia).

Post processing will follow the recommendations of Korneliussen et al. (2008) and established PERG in-house procedures:

> Integrated elementary distance acoustic sampling intervals (EDSUs, 500 m along transect distances and 20 m depth horizons) will be calculated on a common spatial grid for all frequencies. This particular grid resolution minimises errors caused by the spatial separation of transducers and the frequency-specific acoustic beam dimensions.
>
> Time varied gain noise will be removed using the technique described by Watkins and Brierley (1996). Spurious acoustic returns (including noise spikes and dropped pings) will be identified using PERG in-house data post-processing algorithms that have been implemented in the Echoview acoustic processing software.
>
> Combining net and acoustic samples will enable us to estimate pelagic biomass by solving the “inverse problem” (see Greenlaw, 1979; Holliday 1992). Current research at PERG involves

usage of the SIMFAMI multi-frequency inversion algorithm to identify pelagic community composition, and estimate size distributions and biomass (SIMFAMI 2005).

8.3.2 Echosounder Calibration

Transducer parameters were estimated by calibration following the procedures of Foote *et al* 1987. The most recent calibration was conducted by the *Nansen's* technical staff on 14th June 2009 at Baia dos Elefantes, Angola (13°13'S 12°44'E) at a bottom depth of 32 m (T. Mørk, personal communication).

A copper calibration sphere (diameter 64 mm) was used for the 18 kHz sounder, a copper sphere (diameter 60 mm) was used for the 38 kHz sounder and a tungsten carbide sphere (diameter 38.1 mm) was used for the 120 and 200 kHz sounders. Theoretical target strengths for those spheres were adjusted to the speed of sound as calculated from local water temperature and salinity (c=1518 m/s). Parameter estimates are given in Tables 8.1 to 8.4.

Table 8.1 Calibration parameter estimates for the 18 kHz echosounder

Reference Target (CU-64):			
TS	-34.27 dB	Min. Distance	18.00 m
TS Deviation	5.0 dB	Max. Distance	23.00 m
Transducer: ES18-11 Serial No. 593			
Frequency	18000 Hz	Beamtype	Split
Gain	20.76 dB	Two Way Beam Angle	-17.0 dB
Athw. Angle Sens.	13.90	Along. Angle Sens.	13.90
Athw. Beam Angle	11.19 deg	Along. Beam Angle	11.23 deg
Athw. Offset Angle	0.04 deg	Along. Offset Angl	0.10 deg
SaCorrection	-0.62 dB	Depth	0.00 m
Transceiver: GPT 18 kHz 00907205973e 1-1 ES18-11			
Pulse Duration	1.024 ms	Sample Interval	0.194 m
Power	2000 W	Receiver Bandwidth	1.57 kHz
Sounder Type:			
EK60 Version 2.2.0			
TS Detection:			
Min. Value	-50.0 dB	Min. Spacing	100 %
Max. Beam Comp.	6.0 dB	Min. Echolength	80 %
Max. Phase Dev.	8.0	Max. Echolength	180 %
Environment:			
Absorption Coeff.	2.2 dB/km	Sound Velocity	1518.0 m/s

Beam Model results:

Transducer Gain =	22.87 dB	SaCorrection =	-0.65 dB
Athw. Beam Angle =	10.98 deg	Along. Beam Angle =	11.06 deg
Athw. Offset Angle =	0.02 deg	Along. Offset Angle=	0.08 deg

Data deviation from beam model:

RMS = 0.16 dB

Max = 0.34 dB No. = 253 Athw. = -5.3 deg Along = 5.3 deg

Min = -0.59 dB No. = 379 Athw. = -1.9 deg Along = -7.2 deg

Data deviation from polynomial model:

RMS = 0.09 dB

Max = 0.21 dB No. = 263 Athw. = 0.3 deg Along = 6.1 deg

Min = -0.29 dB No. = 379 Athw. = -1.9 deg Along = -7.2 deg

Table 8.2 Calibration parameter estimates for the 38 kHz echosounder

Reference Target (CU-60):			
TS	-33.60 dB	Min. Distance	18.00 m
TS Deviation	5.0 dB	Max. Distance	23.00 m
Transducer: ES38B Serial No. 489			
Frequency	38000 Hz	Beamtype	Split
Gain	25.82 dB	Two Way Beam Angle	-20.6 dB
Athw. Angle Sens.	21.90	Along. Angle Sens.	21.90
Athw. Beam Angle	6.99 deg	Along. Beam Angle	6.95 deg
Athw. Offset Angle	0.04 deg	Along. Offset Angl	0.11 deg
SaCorrection	-0.53 dB	Depth	0.00 m
Transceiver: GPT 38 kHz 009072057b8a 2-1 ES38B			
Pulse Duration	1.024 ms	Sample Interval	0.194 m
Power	2000 W	Receiver Bandwidth	2.43 kHz
Sounder Type:			
EK60 Version 2.2.0			
TS Detection:			
Min. Value	-50.0 dB	Min. Spacing	100 %
Max. Beam Comp.	6.0 dB	Min. Echolength	80 %
Max. Phase Dev.	8.0	Max. Echolength	180 %
Environment:			
Absorption Coeff.	8.5 dB/km	Sound Velocity	1518.0 m/s

Beam Model results:

Transducer Gain =	25.90 dB	SaCorrection =	-0.57 dB
Athw. Beam Angle =	7.06 deg	Along. Beam Angle =	7.05 deg
Athw. Offset Angle =	0.05 deg	Along. Offset Angle=	0.11 deg

Data deviation from beam model:

RMS = 0.14 dB

Max = 0.34 dB No. = 113 Athw. = 3.7 deg Along = 1.9 deg

Min = -1.32 dB No. = 25 Athw. = -3.2 deg Along = -1.8 deg

Data deviation from polynomial model:

RMS = 0.10 dB

Max = 0.26 dB No. = 23 Athw. = 4.3 deg Along = 0.0 deg

Min = -1.41 dB No. = 25 Athw. = -3.2 deg Along = -1.8 deg

Table 8.3 Calibration parameter estimates for the 120 kHz echosounder

Reference Target (WC-38.1):			
TS	-39.70 dB	Min. Distance	19.00 m
TS Deviation	5.0 dB	Max. Distance	22.00 m
Transducer: ES120-7 Serial No. 587			
Frequency	120000 Hz	Beamtype	Split
Gain	25.27 dB	Two Way Beam Angle	-20.8 dB
Athw. Angle Sens.	21.00	Along. Angle Sens.	21.00
Athw. Beam Angle	8.93 deg	Along. Beam Angle	8.96 deg
Athw. Offset Angle	0.04 deg	Along. Offset Angl	0.02 deg
SaCorrection	-0.33 dB	Depth	0.00 m
Transceiver: GPT 120 kHz 009072059721 1-1 ES120-7			
Pulse Duration	1.024 ms	Sample Interval	0.194 m
Power	250 W	Receiver Bandwidth	3.03 kHz
Sounder Type:			
EK60 Version 2.2.0			
TS Detection:			
Min. Value	-50.0 dB	Min. Spacing	100 %
Max. Beam Comp.	6.0 dB	Min. Echolength	80 %
Max. Phase Dev.	8.0	Max. Echolength	180 %
Environment:			
Absorption Coeff.	45.3 dB/km	Sound Velocity	1518.0 m/s

Beam Model results:

Transducer Gain =	25.44 dB	SaCorrection =	-0.30 dB
Athw. Beam Angle =	7.20 deg	Along. Beam Angle =	7.22 deg
Athw. Offset Angle =	0.05 deg	Along. Offset Angle=	-0.04 deg

Data deviation from beam model:

RMS = 0.22 dB

Max = 0.57 dB No. = 157 Athw. = -3.6 deg Along = 5.3 deg

Min = -0.62 dB No. = 146 Athw. = 0.6 deg Along = 4.5 deg

Data deviation from polynomial model:

RMS = 0.20 dB

Max = 0.53 dB No. = 123 Athw. = -1.8 deg Along = 3.8 deg

Min = -0.53 dB No. = 292 Athw. = -3.5 deg Along = -2.6 deg

Table 8.4 Calibration parameter estimates for the 200 kHz echosounder

Reference Target (WC-38.1):			
TS	-38.85 dB	Min. Distance	19.00 m
TS Deviation	5.0 dB	Max. Distance	22.00 m
Transducer: ES200-7 Serial No. 492			
Frequency	200000 Hz	Beamtype	Split
Gain	25.38 dB	Two Way Beam Angle	-20.7 dB
Athw. Angle Sens.	23.00	Along. Angle Sens.	23.00
Athw. Beam Angle	6.55 deg	Along. Beam Angle	6.59 deg
Athw. Offset Angle	0.21 deg	Along. Offset Angl	0.11 deg
SaCorrection	-0.27 dB	Depth	0.00 m
Transceiver: GPT 200 kHz 009072057b8e 2-1 ES200-7			
Pulse Duration	1.024 ms	Sample Interval	0.194 m
Power	120 W	Receiver Bandwidth	3.09 kHz
Sounder Type:			
EK60 Version 2.2.0			
TS Detection:			
Min. Value	-50.0 dB	Min. Spacing	100 %
Max. Beam Comp.	6.0 dB	Min. Echolength	80 %
Max. Phase Dev.	8.0	Max. Echolength	180 %
Environment:			
Absorption Coeff.	69.1 dB/km	Sound Velocity	1518.0 m/s

Beam Model results:

Transducer Gain =	24.93 dB	SaCorrection =	-0.29 dB
Athw. Beam Angle =	6.23 deg	Along. Beam Angle =	6.64 deg
Athw. Offset Angle =	0.36 deg	Along. Offset Angle=	-0.10 deg

Data deviation from beam model:

RMS = 0.74 dB

Max = 2.32 dB No. = 65 Athw. = -3.1 deg Along = 2.8 deg

Min = -2.06 dB No. = 347 Athw. = -3.6 deg Along = -2.4 deg

Data deviation from polynomial model:

RMS = 0.62 dB

Max = 1.55 dB No. = 15 Athw. = -3.5 deg Along = 0.7 deg

Min = -1.86 dB No. = 312 Athw. = 4.2 deg Along = -1.4 deg

8.3.4 Survey Strategy

On full environmental stations acoustic data were observed along ten line transects with a systematic survey design (length = 10 n.miles, inter-transect spacing = 1 n.mile). Transect orientation was chosen as a compromise between minimised vessel pitch and bubble entrainment on one hand and maximised seamount coverage on the other. The centre points of the survey grids were chosen arbitrarily within the above constraints.

Acoustic grids were usually separated into two parallel, interlaced grids of 5 transects with a 2nm spacing, both parts of the complete grids were usually surveyed within 48 hours. Acoustic grids were surveyed during daytime only, usually from sunrise to mid-day.

Apart from dedicated acoustic transect surveys, the EK60 was running and logging data throughout the cruise, providing underway data as well as acoustic data (albeit of low quality) during fishing operations and CTD deployments. From these data we hope to elucidate the characteristics of the diel vertical migration.

8.4 Summary of Activities

Time constraints and weather conditions did not allow the scheme described above to be followed at all stations. As a result some transects were surveyed in the afternoon. At Station 09 (Melville Bank) a part of the acoustic grid was resurveyed to account for poor data quality caused by adverse weather conditions during the first part of the acoustic survey. An overview of all acoustic transects is given in Table 8.5.

Table 8.5 Summary of acoustic transect surveys

Station	Date	Start/End of survey (GMT)		Orientation (degrees)	Transects	Transect length (nautical miles)
02 Off-Ridge North	14/11	03:30	09:26	315	5	10
	15/11	01:59	07:53	315	5	10
04 Atlantis Bank	17/11	01:40	07:40	315	5	10
	19/11	02:45	08:40	315	5	10
05 Sapmer Bank	22/11	01:22	07:23	315	5	10.5
	24/11	03:25	09:30	315	5	10.5
06 Middle of What	25/11	06:56	12:54	315	5	10
	27/11	04:05	10:01	315	5	10
07 Off-Ridge South	30/11	01:00	11:38	350	10	10
08 Coral	2/12	02:08	08:04	340	5	10
	4/12	03:54	09:44	340	5	10
09 Melville Bank	7/12	03:47	16:15	345	9	10
	9/12	02:53	08:43	345	5	10
10 Walters NW	12/12	10:16	15:58	315	5	10
	13/12	02:45	08:23	315	5	10

8.5 Preliminary results

Visual inspection of echograms showed distinct differences in scattering features between acoustic-frequencies and between sites. While the off-ridge control sites showed a stable layer structure, the scattering layers (SL) around and over seamount summits were often perturbed. An overview of interactions between the topography, seamount associated aggregations and the scattering layers is presented in Table 8.6.

Perturbations were apparently caused by both biological (i.e. feeding aggregations of fish and other scatterers, see Figure 8.1) and physical processes (Figure 8.2). Observations of the diel vertical migration were made during steaming and other sampling activities. An example is shown in Figure 8.3.

Table 8.6: Characteristics of scattering layers (SL) and their interactions with seamounts and seamount associated aggregations. ++ strong effect observed, + effect observed, o further analysis required, - no effect observed

Station	summit or bottom depth	summit intercepts main SL	summit intercepts deeper SL	summit associated aggregations	aggregations intercepting SL	perturbations of layer structure
02 Off-Ridge North		-	-	-	-	-
04 Atlantis Bank		+	+	+	+	+
05 Sapmer Bank		+	+	+	+	++
06 Middle of What		-	+	o	o	+
07 Off-Ridge South		-	-	-	-	-
08 Coral		+	+	+	+	++
09 Melville Bank		+	+	o	o	+
10 Walters NW		-	-	-	-	-

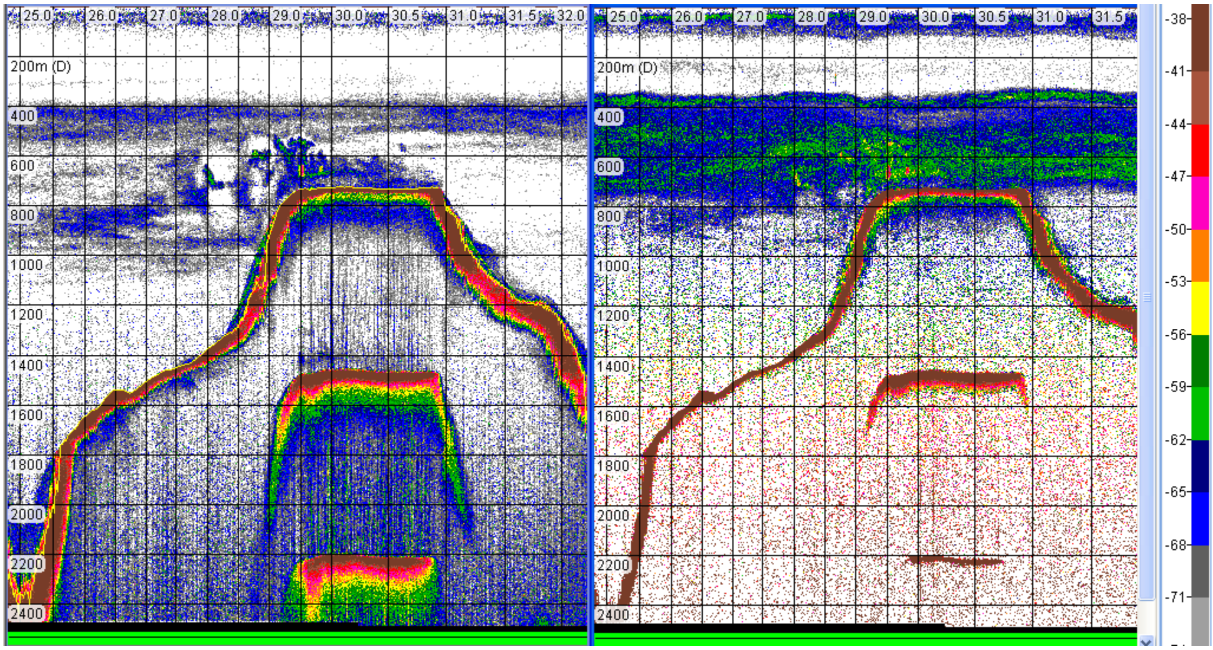

Figure 8.1 18 and 38 kHz echograms depicting the summit of Atlantis Bank and associated aggregations as they intercept the main deep-scattering layer. Grid spacing 0.5 nm horizontally and 200m vertically.

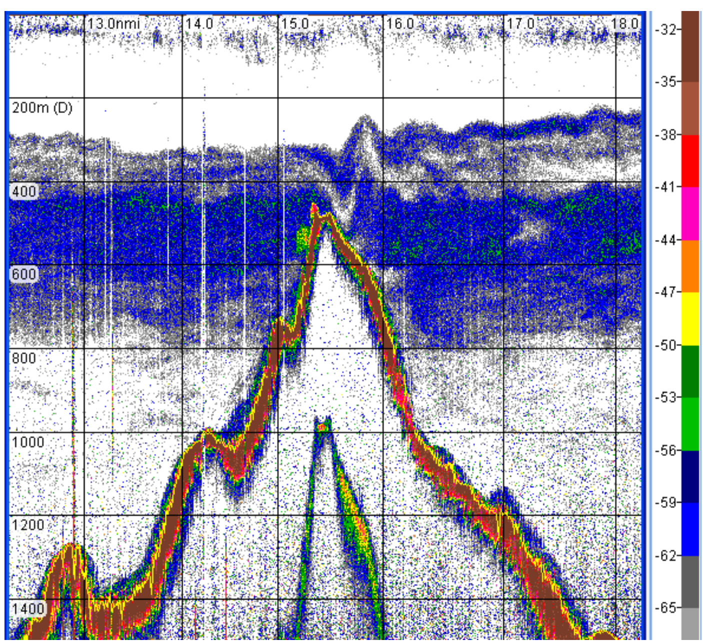

Figure 8.2 38 kHz echogram showing physical perturbation of the main scattering layer at an unnamed seamount. Grid spacing 1nm horizontally and 200m vertically.

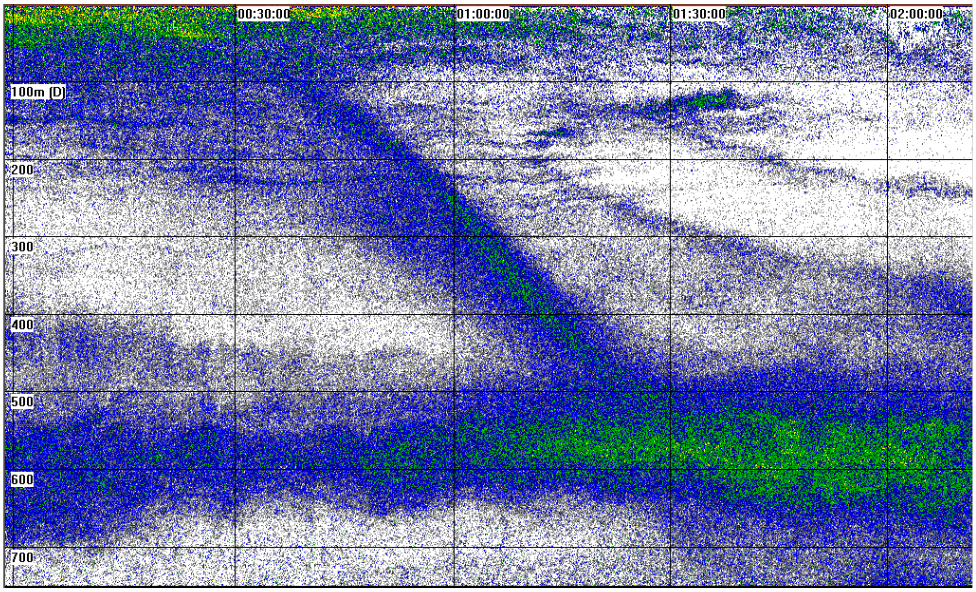

Figure 8.3 38 kHz echogram showing the downward vertical movement of biological scatterers. Grid spacing 30 minutes horizontally and 100m vertically.

8.6 Discussion

Given the exploratory nature of the current survey, the acoustic sampling was limited to the systematic transect surveys as described above. Dedicated surveys to investigate seamount-specific effects on a comprehensive spatio-temporal scale, e.g. downstream patchiness of scattering layers (Genin *et al.* 1994) or small scale bio-physical coupling (Wilson and Boehlert 2004), were not possible within the time constraints. However, a detailed analysis of the transect data may reveal evidence for these effects.

From the data we have collected during this survey we may be able to estimate the pelagic biomass at six seamounts and two off-ridge control sites. Limitations in the net sampling and the time mismatch between acoustic surveys and net/trawl deployments will, however, make this difficult. Specifically, quantitative net data is available for mesozooplankton in the shallow scattering layers only (0-250m, see Chapter 6 for details). Macrozooplankton, micronekton and fish were sampled with the Aakra trawl, however, this gear is neither quantitative nor able to sample the top 50-100 m of the water column. Interpretation of the acoustic data will therefore have to rely on inverse modeling (SIMFAMI 2005) and previously published data on scattering layers (e.g. Benoit-Bird 2009)

The vertical motions of pelagic organisms may be elucidated by comparison of day and night time net and trawl samples. The acoustic data for these movements is, however, often limited, as other sampling activities usually created acoustical or electrical noise, thus significantly deprecating data quality. Due to a lack of a surface irradiance sensor, an important environmental variable to explain variations in the vertical structure of scattering layers could not be measured.

9.0 Seabird and cetacean observations

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9.1 Background

The "seabird team" of the lab ECOMAR have been studying seabird ecology and conservation in the western Indian Ocean for 10 years. One of the goals of our research is to better understand the interaction between the marine environment and the ecology, behaviour and population dynamics of seabirds. We are also very interested in developing methodologies to use seabirds as indicators of marine hotspots and potential marine protected areas (MPAs) in the deep blue ocean. We use two main complementary methods to study seabirds at sea: individual tracking [remote sensing and satellite telemetry, using Argos transmitters and more recently archival tags, and at sea surveys during oceanic cruises. The opportunity to participate to the seamounts cruise co-organised by IUCN and ASCLME was really interesting for several reasons. First it allowed us to census seabirds at places where we have not been before. In particular, the transition zone between typical tropical seabird assemblages and typical sub-Antarctic assemblages around the subtropical convergence was very interesting to study. It was also a wonderful opportunity to investigate at sea the seabird assemblages and behaviour attracted by or associated with seamounts. We already knew (thanks to our tracking results) that seamounts (especially the Walter's Shoals) were important for seabirds so it was really a unique opportunity to study such behaviour "in situ". This project is part of a regional programme on seabirds as indicators of potential Marine Protected Areas, co-funded by a Pew Fellow Award in Marine Conservation, the Fondation Française pour la Recherche sur la Biodiversité, and the French Ministry for Overseas Territories.

9.2 Seabirds and Seamounts

Seamounts have been recently recognized as highly important for fisheries, biodiversity and conservation as they support often isolated but rich underwater ecosystems (Pitcher *et al.*, 2007). They tend to concentrate water currents and they can have their own localised tides, eddies and upwellings (where cold, nutrient-rich, deep water moves up along the steep sides of the seamount) and they are often called "oceanic oases (Boehlert and Genin, 1987; Genin, 2004; Pitcher *et al*., 2007). Aggregations of zooplankton, micronekton and fish are common over shelf breaks or seamounts (Boehlert and Genin, 1987; Genin, 2004) and have also been documented for krill and copepods in the southern ocean (Macaulay et al., 1984; Pauly et al., 2000; Barange, 1994). While the importance of seamounts for bottom fishes is very well documented (Boehlert an Sasaki, 1988; Koslow *et al*., 2000; Morato *et al*., 2006), their importance to visiting pelagic organisms has been poorly examined. In the marine environment, top predators such as seabirds are known to concentrate their foraging effort in specific oceanic features where productivity is elevated or prey concentrated (Kareiva and Odell, 1987). Tropical waters are known to be less productive with an unpredictable prey distribution. These relatively unproductive oceanic regions support far ranging upper-trophic predators that forage on widely dispersed resources and frequently exploit prey concentrated at the periphery of mesoscale eddies (Nel *et al*., 2001; Weimerskirch *et al*., 2004). Many previous studies showed that seabird distributions are clearly influenced by mesoscale hydrographic features (Hunt and Schneider 1987). In particular, many species forage and aggregate at hydrographic fronts and mesoscale eddies (Haney and McGillivary, 1985; Abrams and Lutjeharms, 1986; Haney, 1986; Nel *et al*., 2001; Weimerskirch *et al*., 2004; Hyrenbach *et al*., 2007). It is also known that water depth influences seabird distributions (Schneider, 1997; Louzao *et al*., 2006; Jaquemet *et al*., 2004; Hyrenbach *et al*., 2007), because high topographic features as seamounts, shoals or ridges can create local enrichment. Recently, Morato *et al*. (2008) showed an important seamount effect on aggregating visitors as seabirds or tunas. Cory's shearwater *Calonectris diomedea*, yellow-legged gull *Larus cachinnans atlantis*, Madeiran storm petrel *Oceanodroma castro* (Monteiro *et al*., 1996), Cassin's auklet *Ptychoramphus aleuticus* (Yen *et al*., 2004, 2005) and black-footed albatross *Diomedea nigripes* (Haney *et al*., 1995) have also been observed above seamount summits, where they feed on zooplankton, small fish and small cephalopods. But this has been based on sparse records and warrants further examination. To our knowledge, in the Indian Ocean, nobody has studied the direct effects of the southwest Indian Ocean ridges and seamounts on the seabird's distribution. However, this area is known to support many sub-Antarctic seabird species, but also tropical species like (*Petrodroma baraui)* (Stahl and Bartle, 1991) that consistently use these areas from 2000 km distance to their breeding colonies (Pinet unpublish. data). The objectives of this cruise are to characterize the potential influence of the South West Indian Ocean Ridge and seamounts, on the seabird's at-sea distribution. At the same time, taken into account that (1) seabird species are often associated with topographic and dynamic oceanographic habitat features, and (2) seamounts are known to be exploited or over exploited by fisheries since several decades ago, an urgent understanding of these wildlife-habitat associations is critical for evaluating the feasibility and design of pelagic MPAs (Hooker and Gowans, 1999; Hyrenbach and Dayton, 2000; Louzao *et al.*, 2006).

9.3 Materials and methods

9.3.1 Study area

We investigated seabird-seamount associations from tropical to sub-Antarctic waters of the southern Indian Ocean during a 40d cruise (November-December 2009) from Reunion Island to Port Elizabeth (South Africa) (Fig. 9.1). This trip encompasses an important part of the Southwest Indian Ocean Ridge and different hydrographic fronts. Five major frontal systems occur within the study area (Fig. 9.1) and are known to support distinct seabird assemblages (Hyrenbach *et al.*, 2007). Frontal systems structure seabird communities by delimiting species distributions and by enhancing local aggregations due to enhanced prey availability and concentration.

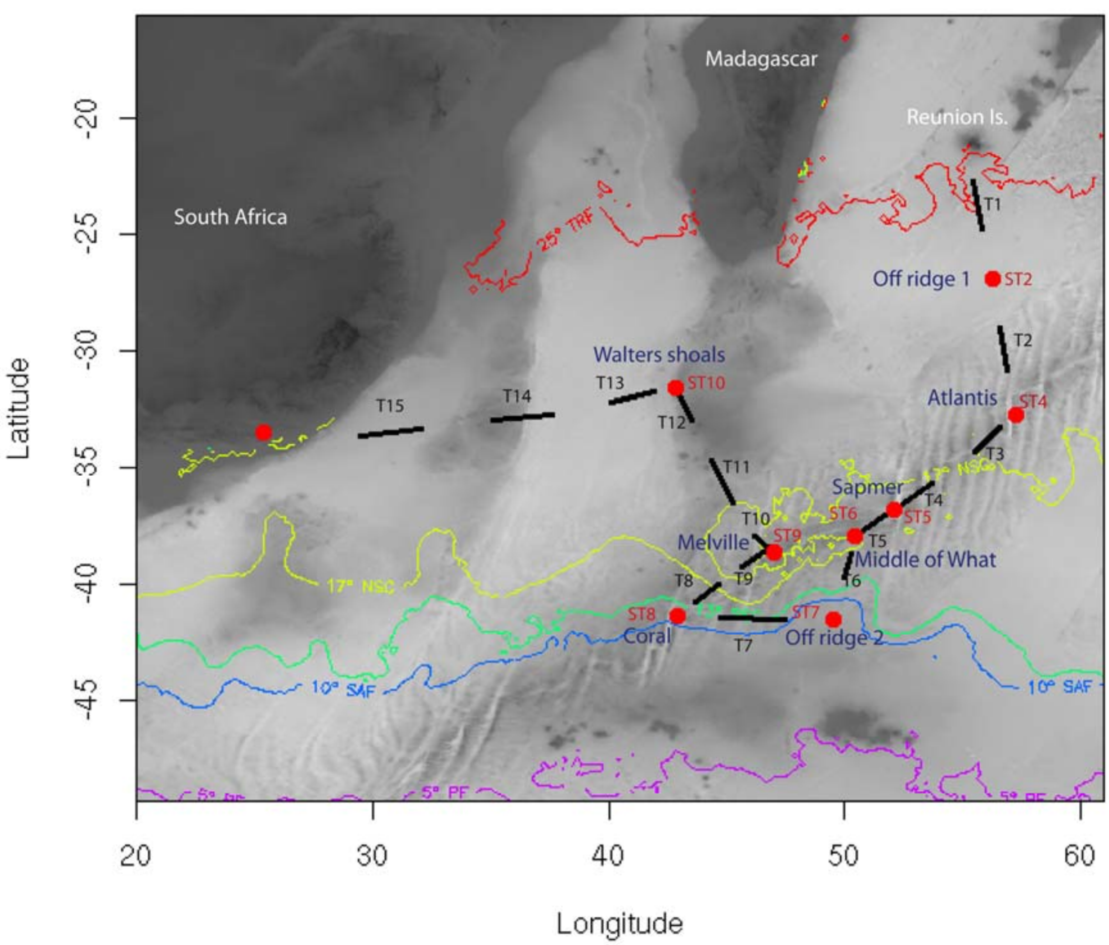

Figure 9.1 Map of the study area showing the location of the survey transects (black lines: T1-T15)

and stations (red dots: S2, S4-S10). The insert depicts the contours of sea surface temperature (SST) from satellite altimetry (November, 2009)), indicative of the localisation of the main fronts (TRF: tropical front; NSC: northern extent of the Subtropical Convergence; SSC: southern extent of the Subtropical Convergence; SAF: Sub-Antarctic Front; PF: Polar Front).

9.3.2 Seabird and mammals surveys

During the whole mission, two observers (EB, PP) surveyed marine birds and mammals. Observations were made from the unenclosed bridge of the vessel Dr Fridtjof Nansen during daylight hours while the vessel cruised at speeds around 10 knots. Following the transect methods (Tasker et al., 1984), a 300-m strip-width transect band was used, with the two observers surveying each sides of the vessel (i.e., 600-m band). Censuses were continuous, all individuals or groups being identified at the lowest possible taxonomic level. The observer on watch estimates the number of seabirds in the flock, all taxa combined. If more than one taxon was present, percent composition of each species in the flock was also estimated. The behaviour of each bird (sitting, flying, feeding, ship following) and the presence of surface-dwelling fishes or mammals were recorded. Photography were also taken during each transect in order to help determination. Also, when the ship was stopped, many observations were made opportunistically in order to complete the seabird sightings but were not taken into account for the density analysis (presence only).

During this cruise, 2 census were down:

1) Classical transects between stations (see Table 9.1 Transect surveyed)
2) On seamounts, four transects (10 nautical miles each) were selected along the 10 radials made for acoustic survey representing 24 km^2 surveying per station (see Table 9.1 Seamounts surveyed)

9.4 Preliminary results

9.4.1 Survey track

Our cruise track spanned subtropical to sub-Antarctic waters, and crossed 3 frontal systems (Fig. 9.1). We did 8 transects in the Tropical waters, 5 in the subtropical convergence and 1 crossing the southern subtropical convergence. The stations were also localized at different sea surface temperatures (S2= 22°C; S4= 18°C, S5-S6-S9= 16°C S7=8°C; S8=10°C) (Table 9.1). The environmental parameters (Wind, sea surface temperature, depth) were recorded and will be used for further analysis. For this first analysis, we aggregated the station survey on the basis of their SST characteristics, and qualified (presence/absence) seabird community structure within three large-scale biographic domains (Table 1): the subtropical convergence (STC), subtropical waters to the north (TR), and sub-Antarctic waters to the south (SA) (Kostianoy *et al*., 2004)

Table 9.1 Indicators of ocean temperature in different biogeographic domains across the southern Indian Ocean and the position of each transect and seamounts surveyed during this cruise. (See Figure 9.1 for station's location)

	Tropical (TR)	***Subtropical convergence (STC)***	***Sub-Antarctic (SA)***
SST range (°C)	>*17*	13-17	<13
Transect surveys			
Number	8	6	1
Survey effort (km²)	950	550	140
Seamount surveys			
Stations (24 km²/station)	S2, S4, S10	S5, S6, S9	S7, S8

9.4.2 Seabird observations

We surveyed 2630 km (1640km²) of around 6000 km cruise track over 150 hours, sighted a high number of seabirds (we have not the exact number yet) belonging to 36 taxa (Table 2). For this report, we will just present few qualitative results (presence/absence) of seabird's assemblage along seamounts.

Table 9.2 Summary of seabird taxa recorded during the whole Seamounts cruise (12 November to 18 December, 2009). Four feeding guilds are considered: surface-feeders (SF), divers (DI), plungers (PL), scavenger (SC), and kleptoparasites (KL). Status is based on IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. www.iucnredlist.org. Downloaded on **16 December 2009**.EN: Endangered; NT: Near threatened; VU: Vulnerable; LC: least Concern. Species observed on station are bolded.

ENG NAME	SCIENTIFIC NAME	FEED.	IUCN STATUS
Procellariiformes			
Barau's Petrel	***Pterodroma baraui***	***SF***	***EN***
White-Chinned Petrel	***Procellaria aequinoctialis***	***SF, DI***	***VU***
Grey Petrel	*Procellaria cinerea*	*SF*	*NT*
Pintado Petrel	***Daption capense***	***SF***	***LC***
Blue Petrel	*Halobaena caerulea*	*SF*	*LC*
Atlantic petrel	***Pterodroma incerta***	***SF***	***EN***
Great-Winged Petrel	***Pterodroma macroptera***	***SF***	***LC***
Soft-Plumaged Petrel	***Pterodroma mollis***	***SF***	***LC***
White-Headed Petrel	***Pterodroma lessonii***	***SF***	***LC***
Wilson's Storm-Petrel	***Oceanites oceanicus***	***SF***	***LC***
Black-bellied Storm-Petrel	***Fregatta tropica***	***SF***	***LC***
White-bellied Strom-Petrel	***Fregatta grallaria***	***SF***	***LC***
Northern Giant-Petrel	***Macronectes halli***	***SF, SC***	***LC***
Southern Giant-Petrel	***Macronectes giganteus***	***SF, SC***	***LC***
Light-Mantled Albatross	*Phoebetria palpebrata*	*SF*	*NT*
Sooty Albatross	***Phoebetria fusca***	***SF***	***EN***
Shy Albatross	***Thalassarche cauta***	***SF***	***NT***
Grey-Headed Albatross	***Thalassarche chrysostoma***	***SF***	***VU***
Black-Browed Albatross	***Thalassarche melanophrys***	***SF***	***EN***
Indian Yellow-Nosed Albatross	***Thalassarche carteri***	***SF***	***EN***
Wandering Albatross	***Diomedea exulans***	***SF***	***VU***
Northern Royal Albatross	***Diomedea sanfordi***	***SF***	***EN***
Wedge-tailed Shearwater	*Puffinus pacificus*	*SF, DI*	*LC*
Tropical Shearwater	***Puffinus bailloni***	***SF, DI***	***LC***
Sooty Shearwater	***Puffinus griseus***	***SF***	***NT***
Cory's shearwater	*Calonectris diomedea*	*SF, DI*	*LC*
Flesh-footed shearwater	*Puffinus carneipes*	*SF*	*LC*
Antarctic Fulmar	***Fulmarus glacialoides***	***SF***	***LC***
Fairy Prion	***Pachyptila turtur***	***SF***	***LC***
Broad-billed Prion	***Pachyptila vittata***	***SF***	***LC***
Slender-Billed prion	***Pachyptila belcheri***	***SF***	***LC***
Antartic Prion	***Pachyptila desolata***	***SF***	***LC***
Pelecaniformes			
White-tailed tropicbird	*Phaethon lepturus*	*PL*	*LC*
Charadriiformes			
Great skua	***Catharacta skua lonbergii***	***KL, SC***	***LC***
Roseate tern	*Sterna dougalli*	*PL*	*LC*
Sooty tern	*Sterna fuscata*	*PL*	*LC*
Arctic tern	*Sterna paradisaea*	*PL*	*LC*

9.4.3 Seabirds distribution

Higher species richness (18-20) occurred in cool (SST<10°C) sub-Antarctic waters, and intermediate (10-13) in Subtropical Convergence (13°C >SST <17°C). Seabird's diversity declined north of the northern Subtropical Convergence and tropical stations (>17°C) supported lower specie's number (2-10) (Fig. 9.2). We documented the highest species richness (20) close to the sub-Antarctic front on the Coral seamount (41.39°S, 42.88°E).

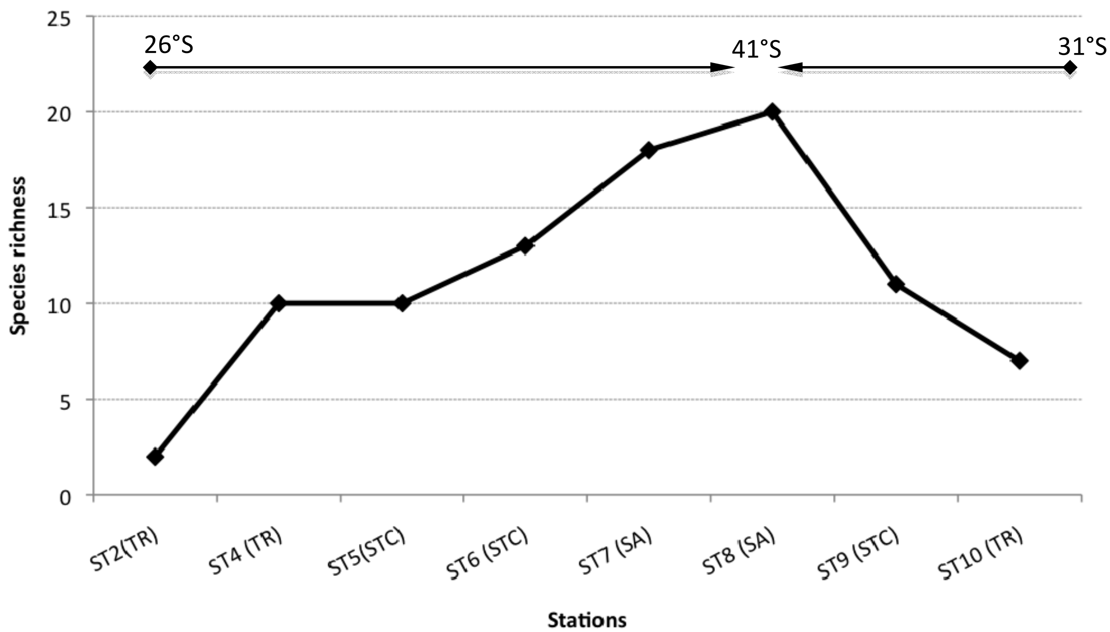

Figure 9.2 Species richness per stations (ST2, ST4-ST10). Base on the 24km² surveyed per station. (TR: Tropical; STC: subtropical convergence; SA: sub-Antarctic)

9.4.4 Seabird assemblage

Seabird assemblage varied also substantially across the study area (Fig. 9.3). The species assemblages in sub-Antarctic, subtropical and tropical waters seem distinct. These preliminary results suggest that the avifauna of the southern Indian Ocean is structured by large-scale gradients in physical and biological properties. Cooler sub-Antarctic waters of higher ocean productivity and phytoplankton standing stocks supported an order of magnitude higher seabird diversity, than lower productivity subtropical waters.

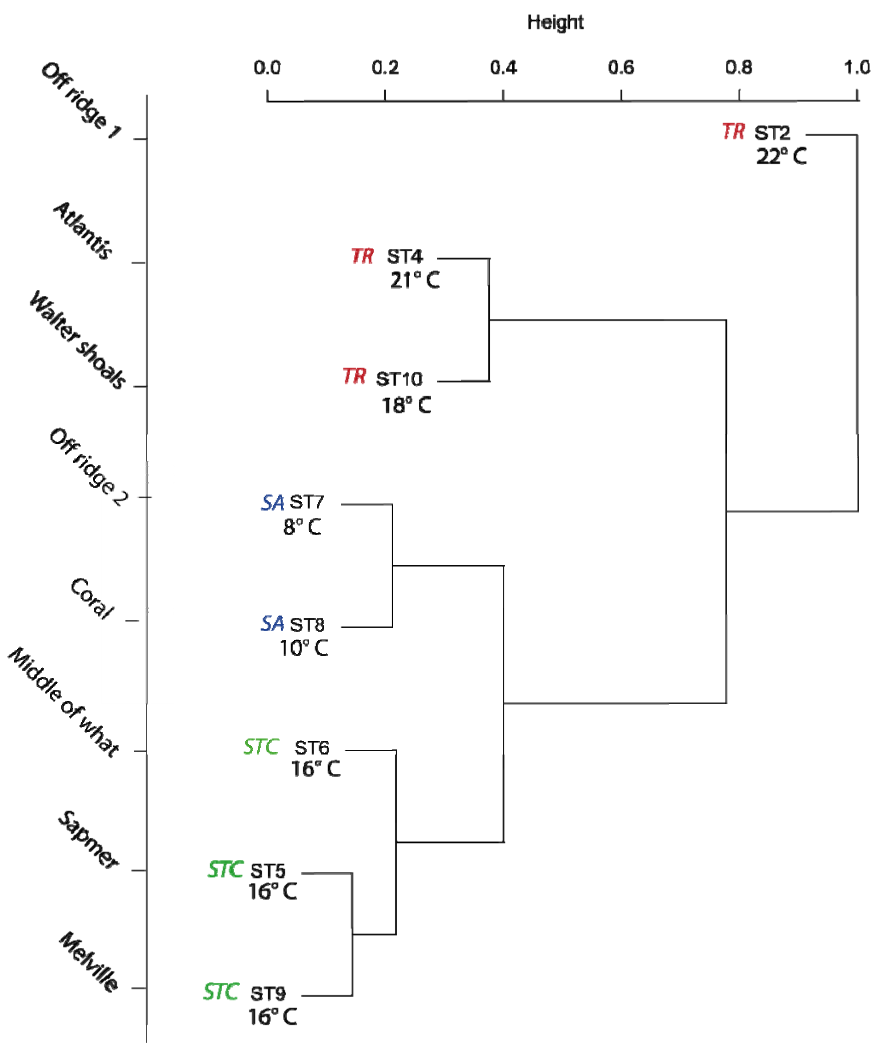

Figure 9.3 Results of cluster analysis of seabird community (presence/absence) structure along 8 stations (ST2, ST4-ST10). (See Table 9.1 for codes and Figure 9.1 for seamount's location).

This result is consistent with past at-sea surveys, which have documented higher bird densities in sub-Antarctic waters than in less productive subtropical and tropical regions (Griffiths *et al.*, 1982; Stahl *et al.*, 1985; Hyrenbach *et al.*, 2007).

9.5 Mammals observations

Each mammal observed during the survey was recorded. However, marine mammals are very difficult to identify and we were not specialists. Photos were taken and were sent to specialists for identification. During this mission, we recorded 25 mammals that we classified in 5 sighting-categories (Table 9.3). We recorded nine whales in subtropical convergence (STC, Table 3) and 15 in Tropical waters (TR, Table 3).

Table 9.3 Summary of marine mammals recorded during the Seamounts cruise (12 November to 19 December, 2009). (TR: Tropical; STC: subtropical convergence; SA: sub-Antarctic)

Date	Sighting-Categories	Observation	Photo	Water	Species
26/11/09	1 Sperm whales	Blow, fine	No	STC	*Physeter macrocephalus*
26/11/09	5 Humpback whales	Blow, fine	Yes	STC	*Megaptera novaeangliae*
27/11/09	2 Humpback whales	Blow, fine	Yes	STC	*Megaptera novaeangliae*
30/11/09	1 Unidentified seal	Body	Yes	SA	
10/12/09	1 Unidentified whale	Blow	No	STC	
11/12/09	6 Humpback whales	Blow, fine	Yes	TR	*Megaptera novaeangliae*
11/12/09	1 Unidentified whale	Blow, fine	Yes	TR	Probably Fin whale?
12/12/09	1 Unidentified whale	Blow	No	TR	
13/12/09	1 Unidentified whale	Blow, fine	Yes	TR	Probably Blue whale?
13 /12/09	3 Short-Finned pilot whales	Blow, fine	Yes	TR	*Globicephala macrorhynchus*
15/12/09	1 Unidentified whale	Blow	No	TR	
17/12/09	2 Unidentified whales	Blow	No	TR	
17/12/09	1 Sperm whales	Blow	No	TR	*Physeter macrocephalus*
TOTAL	***26 mammals recorded***				

9.6 Preliminary discussion

The degree of aggregation and the habitat associations of far-ranging seabirds greatly influence their susceptibility to anthropogenic threats, such as longline by-catch and oil spills, and the potential use of marine protected areas (MPAs) to mitigate those threats. Seabirds are particularly susceptible to anthropogenic impacts at certain time periods (e.g., breeding season) and localities (e.g., foraging grounds) when/where they aggregate in dense concentrations. Similarly, the feasibility and effectiveness of specific management practices depend on both the spatial extent and the degree of aggregation of the protected species and the threats in question. It is of course too early to interpret these results because we have to complete the data processing and the statistical analysis. Analysis will include in particular the comparison of seabird assemblages and seabird density during “en route” transects (off the seamounts) and during “acoustic transects” (on seamounts), to investigate the potential aggregative effects of seamounts. At first glance, it seems that seabird diversity and density was very high at seamounts, especially near the sub-Antarctic front. We can also notice the very high proportion of endangered, near threatened and vulnerable species (see Table 9.2) at these seamounts. All these species are of conservation concern because they are attracted by industrial fishing boats and are a by-catch of fishing gears, particularly long lines. Although the problem is been reduced now, thanks to international agreements on mitigation measures (no fishing during daylight), most species are still highly vulnerable and should be protected at sea. For these reasons our results will probably support the idea of implementing high-seas MPAs in some of the seamounts that we prospected.

10.0 Indian Ocean Whalebone Moorings

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10.1 . Summary

Recent studies have shown that two important sources of highly-localised and enriched organic matter in the deep sea are the sunken carcasses of dead whales and large pieces of wood which have been washed out to sea (becoming waterlogged and eventually sinking) or from shipwrecks (e.g. Dando et al., 1992; Smith & Baco, 2003; Glover *et al*., 2005). These large inputs of organic matter can support a highly specialised microbial and invertebrate fauna. Hydrogen sulphide is created at a localised scale through the anaerobic decomposition of the soft tissue and bone lipids by the bacteria that colonise the bones and wood. This creates environmental conditions similar to those found at hydrothermal vents and cold seeps. The unique invertebrate community characteristic of all these chemosynthetic environments is dominated by polychaete worms. Whilst hydrothermal vents and cold seeps are both created by geological forces, whale and wood fall ecosystems are of biogenic origin, and are more ameanable to experimental manipulation. In particular, these habitats can be created in a chosen location by sinking large parcels of wood or bone.

During this 2009-410 Seamount cruise, two moorings, each carrying a package of minke, fin and sperm whale bones and a package of mango wood logs, were deployed to two seamount sites from the Research Vessel Dr Fridtjof Nansen. Mooring 1 was deployed north of the frontal zone in the warm water of Atlantis Bank. Mooring 2 was deployed in the colder water south of the frontal zone, on Coral Seamount. These moorings will remain in place until recovery by ROV in late 2011

To date virtually no studies of chemosynthetic ecosystems have been carried out in this the Indian Ocean and these deployments represent the first bone and wood packages experimentally implanted in this region. It is expected that the bones will be colonised by as yet undescribed specialist organisms. Inclusion of these worms into a growing phylogenetic analysis will shed light on both the evolutionary history of these worms and also the larger ecosystem level processes of larval dispersal and transport across ocean basins, and colonisation processes in the deep sea environment

10.2 . Methods

10.2.1 Bone collection

Whale bones were collected opportunistically over several years prior to the cruise, by the author, Thomas Dahlgren of Goteborg University, Sweden, and Adrian Glover of the Natural History Museum, London. A scapula and several vertebrae were collected from a minke whale which stranded and died on Veddö Island, Sweden in December 2006. This carcass was in a very dessicated state when bones were collected from it. Four sperm whale vertebra were collected by chance in the trawl net of a vessel undertaking benthic fishing off the Swedish west coast. These have been mostly used for other whalebone deployments but half of one vertebra remained and was included in these Indian Ocean bone packages. The remaining bones (all ribs) were collected by Rob Deaville of the Institute of Zoology, London, from a Humpback whale and a Northern bottlenose whale, both stranded on the southern coast of the UK. Details are as follows:

- Three ribs from a juvenile male Humpback whale (*Megaptera novaeangliae*), found stranded near the Dartford Bridge, London, UK, on 12/09/09.
- Two ribs from a juvenile female Northern bottlenose whale (*Hyperoodon ampullatus*), found stranded at Bournemouth, UK, on 21/09/09.
- One scapula and 3 vertebrae from a juvenile Minke whale (*Balaenoptera acutorostrata*), found stranded on Veddö Island, Sweden, in December 2006.
- Half a vertebra from a Sperm whale (*Physeter macrocephalus*), found stranded on Veddö Island, Sweden, in December 2006.

The Institute of Zoology is licensed to possess and transport these specimens under Annex B of the Conservation Regulations 1994 issued by The Wildlife Licensing Unit, Natural England.

Logs of mango wood were collected from a local source in the departure port in Reunion. They came from a recently cut tree and remained moist from lying in a damp garden for approximately two weeks after cutting.

10.2.2 Mooring setup and design

The moorings were adapted from a design originally proposed by Alan Jamieson of Oceanlab, University of Aberdeen. The basic mooring is comprised of a large ballast (150kg concrete-filled tires in this case), connected to a 15m double mooring line with a 20mm rope. This rope is the weak point in the mooring but is necessary as the ROV will cut the mooring at this point during recovery. The double mooring line is in turn shackeled to a string of 8 floats (Figure 1). Floats are 1200m rated and give a total buoyancy of 20kg. A Sonardyne Transponder Type 7832 and compatible with ISIS ROV Homer system, is fitted to the mooring line. A mesh net was added around the ballast block. This net is fixed directly to the mooring line and is intended to act as a safety catch should the steel fittings of the ballast prove unreliable and corrode during the two year deployment period.

All bones were individually drilled and fitted with loops of 8mm polypropylene line. They were then sewed into a course net bags with the loops of polypropylene line protruding through the mesh. These lines were spliced onto a single lifting ring which in turn is connected directly to the ballast (not to the mooring line) by a single 14mm polypropylene line. A separate parcel was prepared in the same way for wood.

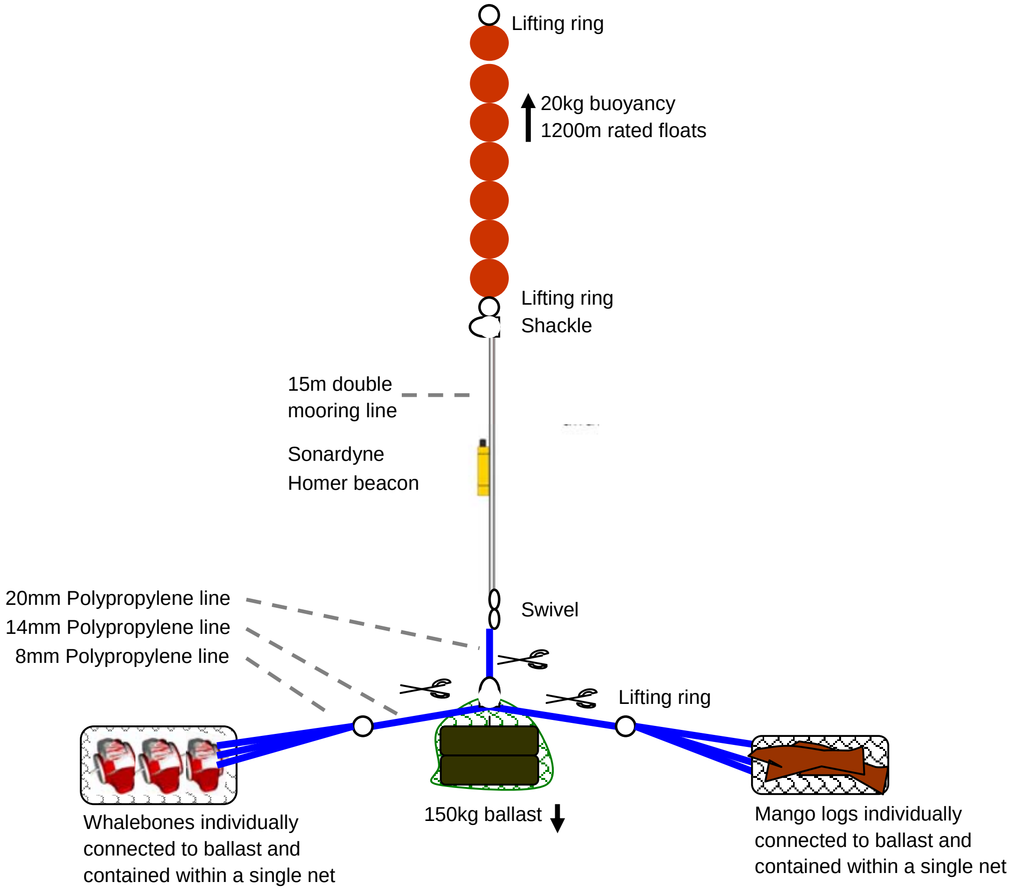

Figure 10.1 Mooring setup. The scissor symbol designates where the ROV should cut during recovery. See details later in the text.

10.2 3. Bone and wood package preparation

Figure 10.2 – Mooring preparation. (a -b) Bones were drilled and fitted with individual loops of line. They were then sewn up into mesh bags. (c-d) Wood was prepared in the same way. (e-f) These lines were fitted to lifting rings (visible in the right of image f) which were attached directly to the ballast.

10.2.4 Deployment details

Mooring 1

Date 18/11/09

Time 15.22 UTC

Latitude 32º42.71'S

Longitude 57º16.31E

Depth

Wood:

Mango log	4.4kg
Mango log	4.8kg
Mango log	10.9kg
Wood subtotal:	**19.1kg**

Bones:

Sperm whale 1/2vertebra	12.65kg
Minke whale vertebra	1.05kg
Humpback and northern bottlenose whale ribs	4.15kg
Bones subtotal:	**17.85kg**

Beacon:	1.2kg
Mooring line (estimated):	
Bouys:	

Total payload in air:	**36.95kg**
Ballast:	**150.00kg**

Est wood bouyancy

Est bone bouyancy

Buoy bouyancy 20kg

Est total payload in water:

Figure 10.3 Deployment details for Mooring 1.

Mooring 2

Date 04/12/09

Time 15.24UTC

Latitude 41º22.381S

Longitude 42º54.636E

Depth

<u>Wood:</u>

Mango log	4.5kg
Mango log	2.15kg
Mango log	6.15kg
Mango log	5.3kg
Wood subtotal:	**18.10kg**

<u>Bones:</u>

Minke whale vertebra	3.60kg
Minke whale vertebra	1.20kg
Minke vertebra cap 0.20kg	
Humpback and northern bottlenose whale ribs	4.15kg
Humpback and northern bottlenose whale ribs	4.50kg
Bones subtotal:	**13.65kg**

Beacon:	1.2kg
Mooring line (estimated):	
Bouys:	

Total payload in air:

Ballast: 150.00kg

Est wood bouyancy

Est bone bouyancy

Buoy bouyancy 20kg **Est total payload in water:**	

Figure 10.4 Deployment details for Mooring 2.

10.2.4 Deployment procedure

The deployment sites were chosen after multibeam surveys of the areas were completed. Flat or shallow-sloping areas were chosen. The bottom sediment of these seamount sites appears fairly hard, though more detail than that is not available at this point.

Figure 10.5. The moorings were deployed by the ship's crane over the side of the ship.

10.3 Discussion

10.3.1 . Recovery procedure and recommendations

Recovery will be undertaken from the James Cook cruise XXX in 2011 using the ISIS ROV. The packages should be filmed in detail prior to any disturbance of the site by the ROV. The bone and wood packages should then be recovered by cutting the individual 14mm polypropylene lines which attach them directly to the ballast.

The mooring package can be retrieved by securing it with one manipulator, and cutting it free from the ballast below the SS swivel. It may be possible to then attach the mooring to the ISIS elevator system using the two lifting rings.

Once on deck the bone and wood parcels should be immediately transferred to dark seawater containers and examination and sampling for associated fauna should be undertaken as early as possible after recovery.

10.3.2 . Analysis

Though the diversity of hydrothermal vent-associated polychaetes is well documented, we have poor knowledge of woodfall and whalefall polychaete assemblages, even at the level of basic identifications. Worms collected from these moorings upon recovery will add to an ongoing phylogenetic analysis of these geni and greater clarify the evolutionary history (evolutionary relatedness) of these organisms, and the processes underlying their dispersal and distribution on a global scale.

11. 0 Communications activities

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11.1 Initial activities

The major communications work around the cruise started at the beginning of November, with a "media advisory" sent out to international media. Although it did not receive high media attention in quantitative terms, the qualitative outcomes were immense, as it opened up the opportunity to publish a weekly seamount diary on BBC Earth News website. The "Die Burger Newspaper" of Cape Town also contacted IUCN's communications department following the advisory, and Scuba news advertised the cruise on their website.

A reception day was organized on November 10 for 4 classes of St-Denis, the local media and the local authorities to visit the vessel and meet with the scientists. A special media advisory in French had been sent out to the media in Reunion. The media presence was successful, and we regretted that the Director of Maritime Affairs was not able to join in the end. Two out of the three newspapers of the island turned up, as well as the local television. The articles (in French) are available on the cruise blog and the seamounts project website. The school kids seem to have appreciated their tour on the Nansen, and wrote about their experience in the December edition of the school journal (available on the blog). 56 promotional t-shirts were designed, with a seabird in the front and the 9 logos of the organisations associated with the cruise in the back. They were distributed to all cruise participants to be worn during the reception day.

A cruise launch webstory went up on November 12, the day of departure, on the homepages of IUCN, IUCN Global Marine Programme and the seamounts project.

11.2 Cruise blog (http://seamounts2009.blogspot.com/)

The cruise blog, set up in September, was used as the main communications tool to report on the life and work on the vessel, as well as to introduce the cruise participants. Posts were published on a daily basis since the first day of work on Reunion island (November 8).
Several websites created a link to the blog, including IUCN Global Marine Programme, ASCLME and the EAF-Nansen project.

A statistics tool was introduced on November 26 to analyse the success of the blog (using www.statcounter.com):

		Page Loads	Unique Visitors	First Time Visitors	Returning Visitors
Total		**2272**	**1351**	**959**	**392**
Average		*103*	*61*	*44*	*18*
Day	Date	Page Loads	Unique Visitors	First Time Visitors	Returning Visitors
Thursday	26th November 2009	61	36	36	0
Friday	27th November 2009	108	61	51	10
Saturday	28th November 2009	99	55	40	15
Sunday	29th November 2009	121	58	42	16
Monday	30th November 2009	110	68	51	17
Tuesday	1st December 2009	125	72	54	18
Wednesday	2nd December 2009	172	104	90	14
Thursday	3rd December 2009	120	87	69	18
Friday	4th December 2009	85	55	33	22
Saturday	5th December 2009	74	44	22	22
Sunday	6th December 2009	83	59	30	29
Monday	7th December 2009	99	67	46	21
Tuesday	8th December 2009	123	74	54	20
Wednesday	9th December 2009	86	48	21	27
Thursday	10th December 2009	108	47	29	18
Friday	11th December 2009	191	103	81	22
Saturday	12th December 2009	89	53	37	16
Sunday	13th December 2009	75	52	35	17
Monday	14th December 2009	127	80	59	21
Tuesday	15th December 2009	97	55	36	19
Wednesday	16th December 2009	93	56	35	21
Thursday	17th December 2009	27	17	8	9

Table 11.1 Visitors to the cruise blog

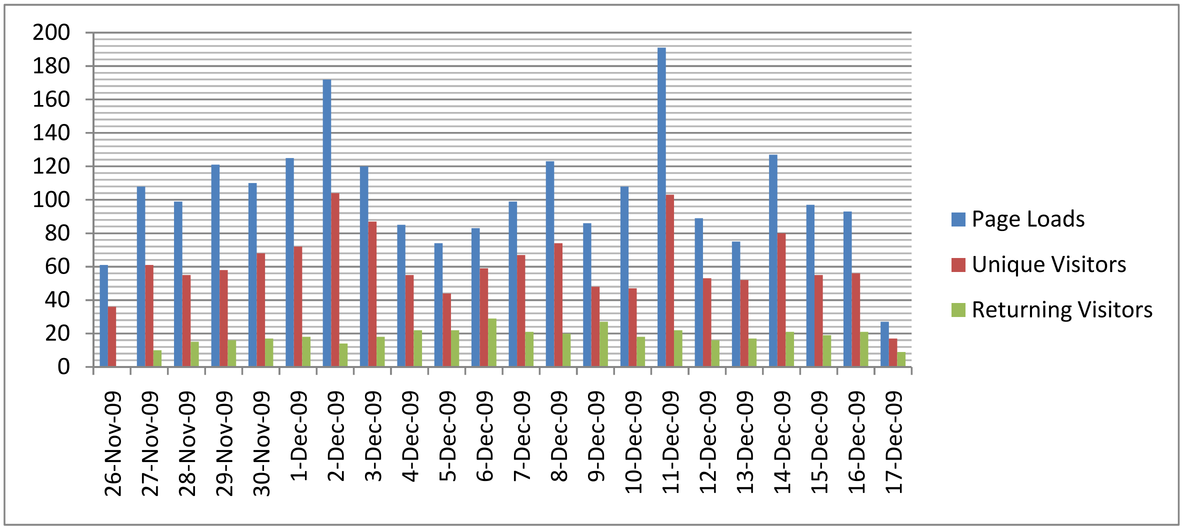

Figure 11.1 Visitors records for the cruise website.

Returning Visitors - Based purely on a cookie, if this person is returning to your website for another visit an hour or more later
First Time Visitors - Based purely on a cookie, if this person has no cookie then this is considered their first time at your website.
Unique Visitor - Based purely on a cookie, this is the total of the returning visitors and first time visitors - all your visitors.
Page Load - The number of times your page has been visited[2].

Although not 100% accurate, it gives a good idea of the success of the blog. On average, there have been about 60 visitors per day. A notable increase in the number of visitors can be observed on the day following a story on BBC Earth News (December 2 and December 11).

[2] Notes from Statcounter

Country | State/Region | City | ISP

	Num	Perc.	Country Name
▼	257	51.40%	Norway
▼	59	11.80%	United Kingdom
▼	57	11.40%	Switzerland
▼	20	4.00%	France
▼	17	3.40%	Germany
▼	15	3.00%	South Africa
▼	13	2.60%	Netherlands
▼	12	2.40%	Sweden
▼	9	1.80%	New Zealand
▼	9	1.80%	United States
▼	5	1.00%	Brazil
▼	4	0.80%	Italy
▼	4	0.80%	Reunion
▼	4	0.80%	India
▼	3	0.60%	Spain
▼	2	0.40%	Ireland
▼	2	0.40%	Canada
▼	2	0.40%	Mozambique
▼	1	0.20%	Iran, Islamic Republic Of
▼	1	0.20%	Indonesia
▼	1	0.20%	Morocco
▼	1	0.20%	Singapore
▼	1	0.20%	Ukraine
▼	1	0.20%	Thailand

Figure 11.2 The countries where the blog was most popular include (based on 500 logs only!):

11.3 Google Earth & ProtectPlanetOcean

Through an arrangement with Google Earth and ProtectPlanetOcean (a marine protected areas portal set up by the IUCN World Commission on Protected Areas-Marine in collaboration with Google Earth, and launched at the 2008 IUCN Congress), the geolocated daily posts of the blog were featured on www.protectplanetocean.org and on the expeditions layer of Google Earth, thereby potentially accessible to millions of people.

11.4 BBC Earth News (http://news.bbc.co.uk/earth/hi/earth_news/newsid_8363000/8363108.stm)

We have had a special "seamount diary" featured on BBC Earth News website, updated on a weekly basis and accompanied each time with a picture gallery. This represented an unparalleled opportunity to publicise the cruise and the work onboard. BBC Earth News is said to attract 1.3 million visitors a day. Links to the diary also appeared on BBC Science and Nature website.
The updates were made on November 17, November 24, December 1, December 10 and the last one planned on December 21.

The pictures on BBC Earth News led to Oddgeir Alvheim's picture of a hatchetfish to be featured on Fox News as the best science photo of the week, on 18 November.

11.5 Photography

Photographs of the life, the work and the people onboard were taken, as well as many pictures of seabirds and marine species. They will be used for several purposes, including illustrations (articles, reports, Powerpoints, etc.), species identification sheets, a possible future pictorial book and displays.

The photographs of marine species include about 300 pictures, representing over 200 species.

11.6 On the web

A quick, non exhaustive, research on Google shows the fame of the seamounts cruise (mostly gained through BBC):

http://www.propeller.com/story/2009/12/02/revaeling-the-strange-lifeforms-of-the-deep-indian-ocean-seamounts/
http://www.widgetbox.com/network/politics/post/seamount-diary-december-2009/2538023
http://esciencenews.com/dictionary/seamount
http://www.ubervu.com/conversations/news.bbc.co.uk/earth/hi/earth_news/newsid_8363000/8363307.stm
http://www.news.scubatravel.co.uk/2009/11/iucn-to-unveil-mysteries-of-deep.html
http://www.academici.com/news/2355054/seamount_diary_december_2009.html
http://businessdailyreview.com/teasers/think/seamount-diary-in-pictures.html
http://www.elertgadget.com/elertlibrary/News/Media/seamount_diary_november_2009_189171.htm
http://www.silobreaker.com/seamount-diary-december-2009-5_2262785120257703981
http://www.heralddeparis.com/seamount-diary-november-2009/64361
http://www.developpementdurablelejournal.com/spip.php?page=article_esd&id_article=5671
http://bx.businessweek.com/africa-energy/seamount-diary-december-2009/13558019725529782489-95d6303fd27ff405b818050401261828/

12.0 Final Comments

12.1 Conclusions

The Southern Indian Ocean seamounts expedition achieved many of its sampling objectives. The data gathered are likely to form a significant contribution to knowledge in the following areas:

- Hydrographic structure of the Sub-Tropical Convergence zone
- Patterns of chlorophyll concentration, nutrient chemistry and phytoplankton diversity from the oligotrophic Sub-Tropical Anticyclonic Gyre system through the Sub-Tropical Front to Sub-Antarctic waters
- Small scale current topography interactions around seamounts with differing summit heights, including evidence of tidally driven concentration and / or mixing of water and phytoplankton and influence on the distribution of zooplankton
- Trapping of multiple deep-scattering layers of zooplankton and predation by resident seamount predators
- Evidence supporting proposed biogeographic zones within the southern Indian Ocean
- Evidence of the significance of both water masses and the presence of elevated topography on seabird distributions
- Connectivity of populations of pelagic organisms across the South West Indian Ocean Ridge

The extremely large number of specimens gathered during this expedition (see Chapters 6,7) means that a large post-cruise effort will be required in order to extract the maximum information from the cruise. These data will be most significant when combined across the disciplines of oceanography, biogeochemistry, botany and zoology represented on the cruise by the scientists. Additional benefits of the cruise included:

- Training of regional scientists
- Training of international Ph.D. students
- Public awareness and education
- Increased networking of regional scientists with the international research community

12.2 Sampling limitations and other comments on cruise organisation

Specific comments relating to the limitations of sampling equipment are noted under specific chapters. We would point out that one particularly area of sampling deficiency for this cruise was in the area of macrozooplankton / micronekton which would have been covered by the METHOT net.

This equipment was not delivered on time for the cruise on the Dr Fridtjof Nansen and we would recommend it is made available for future cruises of this nature.

When operating in remote locations single-points of failure for cruise equipment become critical and it should be noted that a full range of spares was not available for the multiple trawl net when it was damaged during its first two deployments. Thus maintenance of an up-to-date spares list for crusie equipment is vitally important for future operations within the limitations of operations in the region.

Organisation of the cruise would have benefited by a tick list for equipment for the vessel made available to scientists at least 6-12 months ahead of the cruise date. Such a tick list would enable equipment requirements to be identified a long way ahead of the cruise departure to avoid last moment losses of equipment through failure of deliveries which in the region can be slow. It should also be noted that basic consumables such as salinity standards for the salinometer and consumables for the oxygen electrode should be maintained in good supply on the vessel or scientists should be notified that they have to supply their own materials for such equipment well in advance of the cruise. These instruments, which are critical to modern oceanographers, should be kept at a high level of maintenance and service.

Finally we would note that the laboratories on the Dr Fridtjof Nansen is small and so it is essential that scientific crews leave the laboratories in a clean and tidy state prior to leaving the ship. If necessary the officers of the vessel should undertake an inspection of the laboratories prior to departure of scientists so that the laboratories are prepared for follow-on cruises.

12.3 Acknowledgements

Dr Alex Rogers would like to acknowledge the technical scientists, crew and officers of the R/V Dr Fridtjof Nansen for the superb and seemless operation of the vessel throughout the Southern Indian Ocean Seamounts expedition in what were sometimes less than ideal weather conditions. Special thanks are also due to Dr A. Hoines for his excellent and valuable advice on operation of the vessel and other matters during the cruise. Without the excellent, professional and good-humoured service provided by everyone on the vessel we would not have achieved a fraction of what was actually done during the cruise. We point out that the EAF Nansen Project is a huge asset to environmental science and management of the oceans within the region and sincerely hope that the programme continues into the future.

Finally, this project would not have been possible without funding from the Global Environment Facility project Applying an ecosystem-based approach to fisheries management: focus on seamounts in the Southern Indian Ocean, with supporting funding from the UNDP Aghulas Somali Current Large Marine Ecosystem project (ASCLME), the Natural Environment Research Council, U.K., the NORAD programme which funds the EAF-Nansen project and FAO who administer the programme. We also acknowledge the contributions in terms of data made by SIODFA (Graham Patchell and Ross Shotton). AD Rogers and K Kemp also acknowledge the Leverhulme Trust and Zoological Society of London for funding during the present cruise.

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Appendix A: List of CTD stations and depths sampled for phytoplankton, nutrients and POM

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
1	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	1	1500	y					
2	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	2	1502						
3	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	3	1249	y					
4	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	4	999						DNC
5	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	5	676	y					
6	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	6	497	y					
7	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	7	211	y	y				
8	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	8	86		y	y	5 L		
9	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	9	86	y			5 L		
10	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	10	44	y	y				
11	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	11	25	y	y				
12	1214	2009/11/13	24 48.12 S	055 49.41 E	14:15	Off-mount	12	1.7	y	y	y	2 x 5 L	100 m	Isotopes 2 x 5 L Surface Bucket
13	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	1	2003	y					
14	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	2	2001						Duplicate
15	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	3	1499	y					
16	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	4	997	y					
17	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	5	498	y					
18	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	6	299	y					
19	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	7	124	y	y				
20	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	8	98						Duplicate
21	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	9	98	y	y	y	5 L		
22	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	10	50	y	y				
23	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	11	23	y	y				
24	1215	2009/11/14	26 56.49 S	056 14.32 E	10:08	Off-mount	12	3	y	y	y	2 x 5 L	110 m	
25	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	1	2003						Duplicate
26	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	2	2003	y					
27	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	3	1498	y					
28	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	4	999	y					
29	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	5	749	y					
30	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	6	400	y					
31	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	7	143	y	y				
32	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	8	104	y	y	y	5 L		
33	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	9	104						Duplicate
34	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	10	49	y	y				
35	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	11	25	y	y				
36	1216	2009/11/16	29 00.06 S	056 34.57 E	02:18	Off-mount	12	3	y	y	y	2 x 5 L	110 m	
37	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	1	700	y					
38	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	2	649	y					
39	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	3	499	y					
40	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	4	199	y	y				
41	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	5	89				5 L		Duplicate
42	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	6	83				5 L		Duplicate
43	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	7	79	y	y	y			
44	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	8	49	y	y				
45	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	9	24	y	y				
46	1217	2009/11/17	32 42.87 S	057 17.84 E	08:24	Atlantis	10	2	y	y	y	2 x 5 L	150 m	Isotopes 2 x 5 L Surface Bucket
47	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	1	737	y					
48	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	2	501	y					
49	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	3	250	y					
50	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	4	149	y	y				
51	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	5	103	y	y	y	5 L		
52	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	6	105				5 L		Duplicate
53	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	7	49	y	y				
54	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	8	25	y	y				
55	1225	2009/11/17	32 42.68 S	057 16.29 E	18:58	Atlantis CTD Yo-Yo	9	0.4	y	y	y	2 x 5 L	110 m	Isotopes 2 x 5 L Surface Bucket
56	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	1	730	y					
57	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	2	697	y					
58	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	3	548	y					
59	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	4	351	y					
60	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	5	197	y	y				
61	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	6	80						Duplicate
62	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	7	79	y	y	y	5 L		
63	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	8	56	y	y		5 L		
64	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	9	20	y	y				
65	1239	2009/11/18	32 42.71 S	057 16.26 E	01:26	Atlantis CTD Yo-Yo	10	4	y	y	y	2 x 5 L	85 m	Isotopes 2 x 5 L Surface Bucket
66	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	1	738	y					
67	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	2	499	y					
68	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	3	298	y					
69	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	4	151	y	y				
70	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	5	98	y					
71	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	6	72	y	y	y			
72	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	7	76				2 x 5 L		Duplicate
73	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	8	49	y	y				
74	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	9	25	y	y				
75	1251	2009/11/18	32 42.68 S	057 16.30 E	07:39	Atlantis CTD Yo-Yo	10	0.4	y	y	y	2 x 5 L	80 m	Isotopes 2 x 5 L Surface Bucket
76	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	1	739	y					
77	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	2	502	y					
78	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	3	249	y	y				
79	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	4	102	y			5 L		Duplicate
80	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	5	74						
81	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	6	74	y	y	y			
82	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	7	75				5 L		Duplicate
83	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	8	51	y	y				
84	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	9	26	y	y				
85	1268	2009/11/18	32 42.67 S	057 16.24 E	14:28	Atlantis CTD Yo-Yo	10	3	y	y	y	2 x 5 L	110 m	Isotopes 2 x 5 L Surface Bucket
86	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	1	1638	y					
87	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	2	1500	y					
88	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	3	1250	y					
89	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	4	999	y					
90	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	5	750	y					
91	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	6	400	y					
92	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	7	150	y	y				
93	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	8	90				5 L		Duplicate
94	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	9	90	y	y	y			
95	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	10	49	y	y				
96	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	11	25	y	y				
97	1269	2009/11/19	32 40.06 S	057 19.66 E	13:07	Atlantis Transect	12	2.36	y	y	y	5 L	110 m	Isotopes 1 x 5 L Surface Bucket

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
98	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	1	878	y					
99	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	2	750	y					
100	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	3	499	y					
101	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	4	250	y					
102	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	5	150	y	y				
103	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	6	86						Duplicate
104	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	7	86	y	y	y	5 L		
105	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	8	50	y	y				
106	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	9	25	y	y				
107	1270	2009/11/19	32 41.40 S	057 18.13 E	15:03	Atlantis Transect	10	2.2	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket
108	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	1	712	y					
109	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	2	500	y					
110	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	3	248	y					
111	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	4	151	y	y				
112	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	5	86	y	y	y			
113	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	6	85				5 L		Duplicate
114	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	7	52	y	y				
115	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	8	24	y	y				
116	1271	2009/11/19	32 42.01 S	057 17.26 E	16:19	Atlantis Transect	9	2.2	y	y	y	5 L		Isotopes 1 x 5 L Surface Bucket
117	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	1	715	y					
118	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	2	501	y					
119	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	3	250	y					
120	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	4	150	y	y				
121	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	5	99						Duplicate
122	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	6	100	y	y	y	5 L		
123	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	7	50	y	y				
124	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	8	22	y	y				
125	1272	2009/11/19	32 43.28 S	057 15.89 E	17:19	Atlantis Transect	9	1.2	y	y	y	5 L	110 m	Isotopes 1 x 5 L Surface Bucket
126	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	1	See notes						Niskin Bottle Lost
127	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	2	999	y					
128	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	3	750	y					
129	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	4	See notes						Niskin Bottle Lost
130	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	5	247	y					
131	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	6	See notes						Niskin Bottle Lost
132	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	7	See notes						Niskin Bottle Lost
133	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	8	97	y	y	y	2.5 L		
134	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	9	51	y	y		2.5 L		
135	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	10	See notes						Niskin Bottle Lost
136	1273	2009/11/19	32 43.88 S	057 15.22 E	18:18	Atlantis Transect	11	urface buck	y	y	y	5 L	110 m	Surface Bucket, Isotopes 1 x 5 L Surface Bucket
137	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	1	2051	y					
138	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	2	1498	y					
139	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	3	999	y					
140	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	4	498	y					
141	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	5	148	y	y				
142	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	6	100	y			5 L		
143	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	7	99						DNC
144	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	8	49	y	y	y			
145	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	9	23	y	y				
146	1274	2009/11/19	32 44.72 S	057 14.11 E	19:35	Atlantis Transect	10	urface buck	y		y	5 L	110 m	Isotopes 1 x 5 L Surface Bucket, codend lost
147	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	1	542	y					
148	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	2	485	y					
149	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	3	248	y					
150	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	4	99	y	y				
151	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	5	49	y	y				
152	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	6	9						Duplicate
153	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	7	9						DNC
154	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	8	1.9	y	y	y		100 m	Phyto ID 2 x 1 L
155	1275	2009/11/21	36 50.87 S	052 04.88 E	20:27	Sapmer	9	1.9				2 x 5 L		Duplicate, Isotopes 1 x 5 L Surface Bucket,
156	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	1	510	y					
157	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	2	399	y					
158	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	3	300	y					
159	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	4	199	y	y				
160	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	5	100	y					
161	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	6	70	y					
162	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	7	36	y	y	y			
163	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	8	36				5 L		Duplicate
164	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	9	25	y	y				
165	1276	2009/11/22	36 50.59 S	052 08.48 E	15:02	Sapmer CTD Yo-Yo	10	2	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
166	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	1	508	y					
167	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	2	400	y					
168	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	3	301	y					
169	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	4	200	y	y				
170	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	5	100	y					
171	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	6	49	y					
172	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	7	25	y	y	y	2.5 L		
173	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	8	25				2.5 L		Duplicate
174	1287	2009/11/22	36 50.60 S	052 08.51 E	19:45	Sapmer CTD Yo-Yo	9	1.2	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
175	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	1	509	y					
176	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	2	399	y					
177	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	3	299	y					
178	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	4	198	y	y				
179	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	5	99	y					
180	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	6	45						Duplicate
181	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	7	46	y			5 L		
182	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	8	23						DNC
183	1305	2009/11/23	36 50.63 S	052 08.53 E	02:42	Sapmer CTD Yo-Yo	9	3	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
184	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	1	511	y					
185	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	2	402	y					
186	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	3	300	y					
187	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	4	198	y	y (250 ml)				Filtered 250 ml for Chl a
188	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	5	101	y					
189	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	6	50	y	y	y	5 L		
190	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	7	28	y	y				
191	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	8	29						Duplicate
192	1322	2009/11/23	36 50.60 S	052 08.52 E	08:36	Sapmer CTD Yo-Yo	9	5	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
193	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	1	508	y					
194	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	2	400	y					
195	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	3	298	y					
196	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	4	200	y	y				
197	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	5	98	y					
198	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	6	47	y					
199	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	7	29				2.5 L		Duplicate
200	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	8	20	y	y	y	2.5 L		
201	1340	2009/11/23	36 50.58 S	052 08.50 E	14:37	Sapmer CTD Yo-Yo	9	2.3	y	y	y	3.5 L	100 m	Isotopes
202	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	1	1985	y					
203	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	2	1501	y					
204	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	3	998	y					
205	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	4	747	y					
206	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	5	448	y					
207	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	6	250	y					
208	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	7	98	y	y				
209	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	8	73	y					
210	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	9	44						
211	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	10	44	y			5 L		
212	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	11	24	y	y	y			
213	1341	2009/11/24	36 52.18 S	052 10.42 E	10:43	Sapmer Transect	12	1.9	y			5 L	loved to 134	DNC, Isotopes 1 x 5 L Surface Bucket
214	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	1	879	y					
215	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	2	749	y					
216	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	3	498	y					
217	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	4	350	y					
218	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	5	198	y	y				
219	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	6	100	y					
220	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	7	49	y			2.5 L		
221	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	8	25						DNC
222	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	9	25	y	y	y	2.5 L		
223	1342	2009/11/24	36 51.23 S	052 09.13 E	12:31	Sapmer Transect	10	1	y	y	y	5 L	2 x 100 m	Isotopes 1 x 5 L Surface Bucket,
224	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	1	441	y					
225	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	2	349	y					
226	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	3	199	y	y				
227	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	4	97	y					
228	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	5	49	y					
229	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	6	31	y	y	y	5 L		
230	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	7	30						
231	1343	2009/11/24	36 49.63 S	052 07.24 E	13:42	Sapmer Transect	8	0.7	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
232	1344	2009/11/24	36 48.96 S	052 06.39 E	14:24	Sapmer Transect	1	326	y					
233	1344	2009/11/24	36 48.96 S	052 06.39 E	14:24	Sapmer Transect	2	196	y	y				
234	1344	2009/11/24	36 48.96 S	052 06.39 E	14:24	Sapmer Transect	3	100	y					
235	1344	2009/11/24	36 48.96 S	052 06.39 E	14:24	Sapmer Transect	4	50	y	y	y			
236	1344	2009/11/24	36 48.96 S	052 06.39 E	14:24	Sapmer Transect	5	49				5 L		Duplicate
237	1344	2009/11/24	36 48.96 S	052 06.39 E	14:24	Sapmer Transect	6	18	y	y	y			
238	1344	2009/11/24	36 48.96 S	052 06.39 E	14:24	Sapmer Transect	7	3.3	y			5 L	100 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
239	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	1	960	y					
240	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	2	749	y					
241	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	3	501	y					
242	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	4	347	y					
243	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	5	202	y	y				
244	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	6	102	y					
245	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	7	51	y	y	y			
246	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	8	50				5 L		Duplicate
247	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	9	26	y	y				
248	1345	2009/11/24	36 48.17 S	052 05.37 E	15:03	Sapmer Transect	10	0.2	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
249	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	1	2002	y					
250	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	2	1499	y					
251	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	3	1001	y					
252	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	4	749	y					
253	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	5	500	y					
254	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	6	251	y	y				
255	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	7	150	y					
256	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	8	100	y			5 L		
257	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	9	40						Duplicate
258	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	10	41	y	y	y			
259	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	11	24	y	y				
260	1346	2009/11/24	36 46.63 S	052 03.46 E	16:08	Sapmer Transect	12	3.2	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
261	1347	2009/11/25	37 57.56 S	050 24.79 E	13:41	Middle of What	1	301	y					
262	1347	2009/11/25	37 57.56 S	050 24.79 E	13:41	Middle of What	2	150	y					
263	1347	2009/11/25	37 57.56 S	050 24.79 E	13:41	Middle of What	3	97	y	y				
264	1347	2009/11/25	37 57.56 S	050 24.79 E	13:41	Middle of What	4	52	y					
265	1347	2009/11/25	37 57.56 S	050 24.79 E	13:41	Middle of What	5	9						Duplicate
266	1347	2009/11/25	37 57.56 S	050 24.79 E	13:41	Middle of What	6	10	y	y	y			
267	1347	2009/11/25	37 57.56 S	050 24.79 E	13:41	Middle of What	7	1.8	y	y	y		50 m	No Isotopes collected
268	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	1	960	y					
269	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	2	750	y					
270	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	3	500	y					
271	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	4	250	y					
272	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	5	100	y	y				
273	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	6	49	y					
274	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	7	49						Duplicate
275	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	8	30	y					
276	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	9	31				5 L		Duplicate
277	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	10	15	y	y	y			
278	1348	2009/11/26	37 57.42 S	050 24.83 E	02:49	MOW Yo-Yo	11	3	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
279	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	1	962	y					
280	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	2	750	y					
281	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	3	500	y					
282	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	4	249	y	y				
283	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	5	101	y					
284	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	6	49	y					
285	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	7	40				5 L		Duplicate
286	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	8	41	y	y	y			
287	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	9	19	y	y				
288	1356	2009/11/26	37 57.43 S	050 24.80 E	08:17	MOW Yo-Yo	10	3.3	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
289	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	1	960	y					
290	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	2	749	y					
291	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	3	499	y					
292	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	4	249	y					
293	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	5	149	y	y				
294	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	6	100	y					
295	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	7	50	y					
296	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	8	28	y	y	y	5 L		
297	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	9	29						Duplicate
298	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	10	15	y	y				
299	1363	2009/11/26	37 57.45 S	050 24.84 E	14:44	MOW Yo-Yo	11	1.7	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
300	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	1	970	y					
301	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	2	748	y					
302	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	3	499	y					
303	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	4	249	y					
304	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	5	149	y					
305	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	6	100	y	y				
306	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	7	49	y	y	y	5 L		
307	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	8	32						Duplicate
308	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	9	32	y	y				
309	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	10	15	y	y	y			
310	1372	2009/11/27	37 57.41 S	050 24.86 E	20:20	MOW Yo-Yo	11	4	y			5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
311	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	1	960	y					
312	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	2	749	y					
313	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	3	499	y					
314	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	4	250	y					
315	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	5	100	y					
316	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	6	50	y	y				
317	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	7	30	y	y	y	5 L		
318	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	8	15						Duplicate
319	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	9	15	y	y				
320	1383	2009/11/27	37 57.44 S	050 24.87 E	02:39	MOW Yo-Yo	10	2.7	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
321	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	1	1481	y					
322	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	2	999	y					
323	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	3	750	y					
324	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	4	501	y					
325	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	5	349	y					
326	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	6	179	y					
327	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	7	141	y	y				
328	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	8	80	y					
329	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	9	40				5 L		Duplicate
330	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	10	40	y	y	y			
331	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	11	19	y	y	y			
332	1384	2009/11/27	37 55.98 S	050 22.42 E	16:23	MOW Transect	12	3.7	y			5 L	ind too stron	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
333	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	1	1214	y					
334	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	2	999	y					
335	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	3	750	y					
336	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	4	500	y					
337	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	5	351	y					
338	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	6	170	y					
339	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	7	129	y	y				
340	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	8	79	y					
341	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	9	39				4 L		Duplicate
342	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	10	39	y					
343	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	11	20	y	y	y			
344	1385	2009/11/27	37 57.07 S	050 23.88 E	17:41	MOW Transect	12	2	y	y	y	5 L	ind too stron	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
345	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	1	1071	y					
346	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	2	749	y					
347	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	3	500	y					
348	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	4	350	y					
349	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	5	178	y					
350	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	6	105	y					
351	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	7	80	y	y				
352	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	8	39				5 L		Duplicate
353	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	9	40	y	y	y			
354	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	10	20	y	y				
355	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	11	2	y	y	y	5 L		Isotopes 1 x 5 L Surface Bucket,
356	1386	2009/11/27	37 58.09 S	050 25.16 E	18:42	MOW Transect	12	1	y				Wind too stron	Duplicate
357	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	1	1171	y					
358	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	2	1000	y					
359	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	3	749	y					
360	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	4	500	y					
361	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	5	350	y					
362	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	6	176	y					
363	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	7	110	y					
364	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	8	80	y	y				
365	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	9	40				5 L		Duplicate
366	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	10	40	y	y	y			
367	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	11	20	y	y				
368	1387	2009/11/27	37 58.57 S	050 25.79 E	19:44	MOW Transect	12	1.1	y	y	y	5 L	ind too stron	Isotopes 1 x 5 L Surface Bucket,
369	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	1	1449	y					
370	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	2	1000	y					
371	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	3	749	y					
372	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	4	499	y					
373	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	5	250	y					
374	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	6	132	y	y				
375	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	7	89	y					
376	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	8	48						DNC
377	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	9	48	y			5 L		
378	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	10	19	y	y	y			
379	1388	2009/11/27	37 58.95 S	050 26.22 E	20:40	MOW Transect	11	1.9	y	y	y	5 L	ind too stron	Isotopes 1 x 5 L Surface Bucket,
380	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	1	1676	y					
381	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	2	1299	y					
382	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	3	1000	y					
383	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	4	751	y					
384	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	5	500	y					
385	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	6	348	y					
386	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	7	269	y					
387	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	8	108	y	y				
388	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	9	54	y	y	y	5 L		
389	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	10	55						Duplicate
390	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	11	19	y	y				
391	1389	2009/11/27	38 00.01 S	050 27.60 E	22:02	MOW Transect	12	2.9	y	y	y	3.5 L	ind too stron	DNC used Surface Bucket, Isotopes 1 x 3.5 L Surfa
392	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	1	2001	y					
393	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	2	1499	y					
394	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	3	1248	y					
395	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	4	1000	y					
396	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	5	749	y					
397	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	6	499						DNC
398	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	7	248						DNC
399	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	8	101	y	y				
400	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	9	49	y					
401	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	10	7				5 L		Duplicate
402	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	11	6	y	y	y			
403	1390	2009/11/28	38 59.84 S	050 10.95 E	05:30	SCZ1	12	0.1	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
404	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	1	2002	y					
405	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	2	1499	y					
406	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	3	1249	y					
407	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	4	998	y					
408	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	5	747	y					
409	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	6	498	y					
410	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	7	350	y					
411	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	8	101	y	y				
412	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	9	48	y					
413	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	10	20				5 L		Duplicate
414	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	11	21	y	y	y			
415	1391	2009/11/28	39 15.02 S	050 07.48 E	08:37	SCZ1	12	2	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
416	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	1	2001	y					
417	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	2	1498	y					
418	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	3	1250	y					
419	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	4	1000	y					
420	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	5	750	y					
421	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	6	499	y					
422	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	7	297	y					
423	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	8	101	y	y				
424	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	9	52	y					
425	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	10	41				5 L		Duplicate
426	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	11	41	y	y	y			
427	1392	2009/11/28	39 30.13 S	050 03.45 E	11:40	SCZ1	12	2.2	y	y	y	5 L	80 m	Isotopes 1 x 5 L Surface Bucket,
428	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	1	2002	y					
429	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	2	1501	y					
430	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	3	1251	y					
431	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	4	1000	y					
432	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	5	749	y					
433	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	6	500	y					
434	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	7	200	y					
435	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	8	100	y	y				
436	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	9	70	y					
437	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	10	13	y	y	y	5 L		
438	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	11	14						Duplicate
439	1393	2009/11/28	39 45.01 S	049 59.56 E	14:51	SCZ1	12	1.4	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
440	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	1	2001	y					
441	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	2	1498	y					
442	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	3	1250	y					
443	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	4	999	y					
444	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	5	751	y					
445	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	6	499						DNC
446	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	7	199	y					
447	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	8	100	y					
448	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	9	71	y	y				
449	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	10	17				5 L		Duplicate
450	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	11	16	y	y	y			
451	1394	2009/11/28	40 00.02 S	049 55.58 E	18:00	SCZ1	12	2.9	y		y	5 L	50 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
452	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	1	2001	y					
453	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	2	1499	y					
454	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	3	1251	y					
455	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	4	999	y					
456	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	5	749	y					
457	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	6	499						DNC
458	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	7	199	y					
459	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	8	149	y					
460	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	9	79	y	y				
461	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	10	41	y	y	y	5 L		
462	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	11	1.5	y	y				
463	1395	2009/11/28	40 15.09 S	049 51.62 E	20:51	SCZ1	12	0.8		?	y	5 L	50 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
464	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	1	2002	y					
465	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	2	1498	y					
466	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	3	1250	y					
467	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	4	1000	y					
468	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	5	748	y					
469	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	6	499	y					
470	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	7	199	y					
471	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	8	100	y	y				
472	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	9	52	y					
473	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	10	26	y	y	y	5 L		
474	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	11	26						Duplicate
475	1396	2009/11/28	40 30.10 S	049 47.45 E	23:55	SCZ1	12	1.4	y	y	y	5 L	50 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
476	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	1	2004	y					
477	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	2	1500	y					
478	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	3	1249	y					
479	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	4	999	y					
480	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	5	750	y					
481	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	6	497	y					
482	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	7	200	y					
483	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	8	101	y	y				
484	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	9	38	y					
485	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	10	38				5 L		Duplicate
486	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	11	19	y	(250 m	y			
487	1397	2009/11/29	40 44.96 S	049 43.14 E	03:05	SCZ1	12	1.7	y	(250 m	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
488	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	1	2002	y					
489	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	2	1498	y					
490	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	3	1247	y					
491	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	4	999	y					
492	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	5	750	y					
493	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	6	497	y					
494	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	7	198	y					
495	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	8	149	y	y				
496	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	9	90	y	y	y	5 L		
497	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	10	89						Duplicate
498	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	11	30	y	y				
499	1398	2009/11/29	40 59.65 S	049 38.82 E	06:01	SCZ1	12	0.7	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
500	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	1	2001	y					
501	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	2	1496	y					
502	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	3	1247	y					
503	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	4	999	y					
504	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	5	747	y					
505	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	6	500	y					
506	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	7	250	y	y				
507	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	8	96	y					
508	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	9	95				5 L		Duplicate
509	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	10	50	y	y	y			
510	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	11	11	y	y				
511	1399	2009/11/29	41 14.83 S	049 34.53 E	09:05	SCZ1	12	1.7	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
512	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	1	2001	y					
513	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	2	1496	y					
514	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	3	1249	y					
515	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	4	998	y					
516	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	5	748	y					
517	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	6	500	y					
518	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	7	249	y	y				
519	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	8	99	y					
520	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	9	63	y	y	y	5 L		
521	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	10	48	y	y				
522	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	11	24	y	y				
523	1400	2009/11/29	41 30.00 S	049 30.04 E	12:11	SCZ1	12	0.6	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
524	1401	2009/12/01	41 25.44 S	042 50.82 E	22:45	Coral	1	303	y					
525	1401	2009/12/01	41 25.44 S	042 50.82 E	22:45	Coral	2	200	y					
526	1401	2009/12/01	41 25.44 S	042 50.82 E	22:45	Coral	3	98	y	y				
527	1401	2009/12/01	41 25.44 S	042 50.82 E	22:45	Coral	4	39						Duplicate
528	1401	2009/12/01	41 25.44 S	042 50.82 E	22:45	Coral	5	39	y			5 L		
529	1401	2009/12/01	41 25.44 S	042 50.82 E	22:45	Coral	6	20	y	y	y			
530	1401	2009/12/01	41 25.44 S	042 50.82 E	22:45	Coral	7	2.7	y	y	y	5 L	80 m	Isotopes 1 x 5 L Surface Bucket,
531	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	1	802	y					
532	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	2	600	y					
533	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	3	399	y					
534	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	4	201	y					
535	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	5	118	y	y				
536	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	6	80	y					
537	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	7	40	y					
538	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	8	15	y	y	y	5 L		
539	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	9	15						Duplicate
540	1402	2009/12/03	41 25.35 S	042 50.69 E	02:58	Coral Yo-Yo	10	0.56	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
541	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	1	407	y					
542	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	2	300	y					
543	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	3	200	y					
544	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	4	100	y	y				
545	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	5	68	y					
546	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	6	29	y	y	y			
547	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	7	26				5 L		Duplicate
548	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	8	15	y	y				
549	1422	2009/12/03	41 25.27 S	042 51.24 E	08:41	Coral Yo-Yo	9	3.2	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
550	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	1	405	y					
551	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	2	298	y					
552	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	3	199	y					
553	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	4	101	y	y				
554	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	5	51	y					
555	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	6	19				5 L		Duplicate
556	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	7	19	y	y	y			
557	1443	2009/12/03	41 25.27 S	042 51.19 E	14:34	Coral Yo-Yo	8	1.9	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
558	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	1	400	y					
559	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	2	302	y					
560	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	3	200	y					
561	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	4	98	y					
562	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	5	50	y	y				
563	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	6	14	y			5 L		Duplicate
564	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	7	13		y	y			
565	1466	2009/12/03	41 25.29 S	042 51.21 E	20:45	Coral Yo-Yo	8	1.3	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
566	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	1	402	y					
567	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	2	343	y					
568	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	3	199	y					
569	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	4	150	y					
570	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	5	81	y	y				
571	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	6	29	y	y				
572	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	7	14				5 L		Duplicate
573	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	8	14	y		y			
574	1488	2009/12/04	41 25.27 S	042 51.21 E	02:19	Coral Yo-Yo	9	2.7	y	y	y	5 L	80 m	Isotopes 1 x 5 L Surface Bucket,
575	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	1	1557	y					
576	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	2	1248	y					
577	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	3	1002	y					
578	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	4	752	y					
579	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	5	497	y					
580	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	6	398	y					
581	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	7	101	y	y				
582	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	8	52	y					
583	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	9	31				5 L		Duplicate
584	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	10	31	y	y	y			
585	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	11	14	y	y				
586	1490	2009/12/04	41 29.13 S	042 54.01 E	10:29	Coral Transect	12	2.3	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
587	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	1	566	y					
588	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	2	499	y					
589	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	3	247	y					
590	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	4	99	y	y				
591	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	5	47	y			5 L		
592	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	6	23						Duplicate
593	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	7	24	y	y	y			
594	1492	2009/12/04	41 25.71 S	042 52.51 E	14:21	Coral Transect	8	2.7	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
595	1493	2009/12/04	41 24.28 S	042 51.67 E	15:47	Coral Transect	1	191	y					
596	1493	2009/12/04	41 24.28 S	042 51.67 E	15:47	Coral Transect	2	150	y					
597	1493	2009/12/04	41 24.28 S	042 51.67 E	15:47	Coral Transect	3	101	y	y				
598	1493	2009/12/04	41 24.28 S	042 51.67 E	15:47	Coral Transect	4	50	y			2.5 L		
599	1493	2009/12/04	41 24.28 S	042 51.67 E	15:47	Coral Transect	5	29	y	y	y			
600	1493	2009/12/04	41 24.28 S	042 51.67 E	15:47	Coral Transect	6	28				2.5 L		Duplicate
601	1493	2009/12/04	41 24.28 S	042 51.67 E	15:47	Coral Transect	7	3.6	y	y	y	5 L	80 m	Isotopes 1 x 5 L Surface Bucket,

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
602	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	1	902	y					
603	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	2	799	y					
604	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	3	600	y					
605	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	4	400	y					
606	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	5	200	y					
607	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	6	101	y	y				
608	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	7	50	y					
609	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	8	18				5 L		Duplicate
610	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	9	18	y	y	y			
611	1494	2009/12/04	41 23.50 S	042 51.26 E	16:21	Coral Transect	10	0.9	y	y	y	5 L	Wind too stron	Isotopes 1 x 5 L Surface Bucket,
612	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	1	1870	y					
613	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	2	1501	y					
614	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	3	999	y					
615	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	4	754	y					
616	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	5	502	y					
617	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	6	297	y					
618	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	7	179	y					
619	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	8	79	y	y (250 ml)				
620	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	9	50				5 L		Duplicate
621	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	10	51	y					
622	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	11	25	y	y	y			
623	1495	2009/12/04	41 21.23 S	042 50.30 E	17:23	Coral Transect	12	5.5	y	y	y	5 L	Wind too stron	Isotopes 1 x 5 L Surface Bucket,
624	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	1	1573	y					
625	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	2	1251	y					
626	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	3	1000	y					
627	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	4	801	y					
628	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	5	601	y					
629	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	6	400	y					
630	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	7	200	y					
631	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	8	89	y	y				
632	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	9	30				5 L		Duplicate
633	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	10	29	y	y	y			
634	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	11	13	y	y				
635	1496	2009/12/04	41 12.18 S	043 00.05 E	19:40	SCZ2	12	4.1	y	y	y	5 L	Wind too stron	Isotopes 1 x 5 L Surface Bucket,
636	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	1	2003	y					
637	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	2	1499	y					
638	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	3	1246	y					
639	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	4	1001	y					
640	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	5	750	y					
641	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	6	501	y					
642	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	7	249	y					
643	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	8	99	y	y				
644	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	9	49	y					
645	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	10	18				5 L		Duplicate
646	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	11	17	y	y	y			
647	1497	2009/12/04	40 59.95 S	043 12.34 E	22:31	SCZ2	12	3.65	y	y	y	5 L	Wind too stron	Isotopes 1 x 5 L Surface Bucket,
648	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	1	2003	y					
649	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	2	1493	y					
650	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	3	1249	y					
651	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	4	994	y					
652	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	5	752	y					
653	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	6	498	y					
654	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	7	248	y					
655	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	8	99	y	y				
656	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	9	49	y	y				
657	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	10	19	y			5 L		
658	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	11	20						Duplicate
659	1498	2009/12/05	40 48.02 S	043 35.03 E	01:36	SCZ2	12	3.7	y	y	2 x 1 L	5 L	Wind too stron	Isotopes 1 x 5 L Surface Bucket,
660	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	1	2002	y					
661	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	2	1500	y					
662	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	3	1251	y					
663	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	4	1000	y					
664	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	5	748	y					
665	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	6	498	y					
666	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	7	252	y					
667	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	8	99	y	y				
668	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	9	49	y	y				
669	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	10	29	y	y	y	5 L		
670	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	11	29						Duplicate
671	1499	2009/12/05	40 36.09 S	043 51.98 E	04:49	SCZ2	12	4	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
672	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	1	2001	y					
673	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	2	1500	y					
674	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	3	1248	y					
675	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	4	1001	y					
676	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	5	750	y					
677	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	6	499	y					
678	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	7	250	y					
679	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	8	90	y	y				
680	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	9	49	y					
681	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	10	30				5 L		Duplicate
682	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	11	29	y	y	y			
683	1500	2009/12/05	40 23.98 S	044 08.93 E	08:16	SCZ2	12	1.8	y	y	y	5 L	80 m	Isotopes 1 x 5 L Surface Bucket,
684	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	1	2003	y					
685	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	2	1499	y					
686	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	3	1249	y					
687	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	4	999	y					
688	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	5	748	y					
689	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	6	499	y					
690	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	7	249	y					
691	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	8	99	y	y				
692	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	9	38				5 L		Duplicate
693	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	10	39	y	y	y			
694	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	11	20	y	y				
695	1501	2009/12/05	40 12.13 S	044 25.63 E	11:30	SCZ2	12	1.8	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
696	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	1	2004	y					
697	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	2	1500	y					
698	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	3	1249	y					
699	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	4	998	y					
700	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	5	748	y					
701	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	6	499	y					
702	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	7	250	y					
703	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	8	147	y	y				
704	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	9	49				5 L		Duplicate
705	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	10	50	y	y				
706	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	11	19	y	y	y			
707	1502	2009/12/05	40 00.03 S	044 41.85 E	14:48	SCZ2	12	6.7	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
708	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	1	2001	y					
709	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	2	1500	y					
710	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	3	1249	y					
711	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	4	997	y					
712	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	5	750	y					
713	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	6	498	y					
714	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	7	249	y	y				
715	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	8	99						DNC
716	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	9	50						Duplicate
717	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	10	49	y	y	y	5 L		
718	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	11	20	y	y				
719	1503	2009/12/05	39 48.06 S	044 58.37 E	18:03	SCZ2	12	0.3	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
720	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	1	2003	y					
721	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	2	1500	y					
722	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	3	1249	y					
723	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	4	998	y					
724	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	5	748	y					
725	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	6	499	y					
726	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	7	251	y					
727	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	8	100	y	y				
728	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	9	49				5 L		Duplicate
729	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	10	50	y	y	y			
730	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	11	19	y	y				
731	1504	2009/12/05	39 36.00 S	045 15.04 E	21:18	SCZ2	12	2.06	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
732	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	1	2002	y					
733	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	2	1499	y					
734	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	3	1249	y					
735	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	4	999	y					
736	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	5	750	y					
737	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	6	498	y					
738	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	7	248	y					
739	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	8	100	y	y				
740	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	9	50	y	y				
741	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	10	28	y			5 L		
742	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	11	14	y					
743	1505	2009/12/06	39 23.97 S	045 31.16 E	00:48	SCZ2	12	2.1	y	y	2 x 1 L	5 L	100 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
744	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	1	2000	y					
745	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	2	1499	y					
746	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	3	1250	y					
747	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	4	1000	y					
748	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	5	750	y					
749	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	6	500	y					
750	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	7	249	y					
751	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	8	179	y	y				
752	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	9	100	y	y				
753	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	10	48	y			5 L		
754	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	11	26	y	y	y			
755	1506	2009/12/06	39 11.96 S	045 47.40 E	04:02	SCZ2	12	1.1	y	y	y	5 L	100 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
756	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	1	2002	y					
757	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	2	1500	y					
758	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	3	1250	y					
759	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	4	999	y					
760	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	5	748	y					
761	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	6	500	y					
762	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	7	250	y					
763	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	8	169	y	y				
764	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	9	73	y	y		5 L		
765	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	10	25						Duplicate
766	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	11	24	y	y	y			
767	1507	2009/12/06	38 55.99 S	046 03.53 E	07:23	SCZ2	12	6	y	y	y	5 L	100 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
768	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	1	2003	y					
769	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	2	1497	y					
770	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	3	1250	y					
771	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	4	1000	y					
772	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	5	751	y					
773	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	6	501	y					
774	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	7	251	y					
775	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	8	148	y	y				
776	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	9	76	y	y	y	5 L		
777	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	10	41	y	y				
778	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	11	19	y	y				
779	1508	2009/12/06	38 44.95 S	046 22.97 E	10:55	SCZ2	12	2.5	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
780	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	1	1862	y					
781	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	2	1500	y					
782	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	3	1250	y					
783	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	4	1000	y					
784	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	5	748	y					
785	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	6	499	y					
786	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	7	249	y					
787	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	8	149	y					
788	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	9	70	y	y				
789	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	10	33						
790	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	11	34	y	y	y	5 L		
791	1509	2009/12/06	38 31.56 S	046 45.74 E	14:56	Melville Transect	12	4	y	y	y	5 L	100 m	DNC used Surface Bucket, Isotopes 1 x 5 L Surfac
792	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	1	1063	y					
793	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	2	749	y					
794	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	3	498	y					
795	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	4	251	y					
796	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	5	101	y	y				
797	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	6	50	y					
798	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	7	29	y	y	y	5 L		
799	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	8	14						Duplicate
800	1510	2009/12/06	38 30.17 S	046 45.32 E	16:28	Melville Transect	9	1.7	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
801	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	1	512	y					
802	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	2	397	y					
803	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	3	218	y					
804	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	4	191	y					
805	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	5	149	y					
806	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	6	100	y	y				
807	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	7	49	y					
808	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	8	28	y	y	y	5 L		
809	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	9	14						Duplicate
810	1511	2009/12/06	38 29.23 S	046 44.98 E	17:47	Melville Transect	10	2.7	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
811	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	1	361	y					
812	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	2	247	y					
813	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	3	198	y					
814	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	4	129	y					
815	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	5	100	y	y				
816	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	6	49	y	y	y			
817	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	7	30	y			5 L		
818	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	8	16						Duplicate
819	1512	2009/12/06	38 28.68 S	046 44.75 E	18:57	Melville Transect	9	1.4	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
820	1513	2009/12/06	38 28.29 S	046 44.67 E	19:59	Melville Transect	1	101	y	y				
821	1513	2009/12/06	38 28.29 S	046 44.67 E	19:59	Melville Transect	2	80	y					
822	1513	2009/12/06	38 28.29 S	046 44.67 E	19:59	Melville Transect	3	49	y			5 L		
823	1513	2009/12/06	38 28.29 S	046 44.67 E	19:59	Melville Transect	4	23	y	y	y			
824	1513	2009/12/06	38 28.29 S	046 44.67 E	19:59	Melville Transect	5	2	y	y	y	5 L	50 m	Isotopes 1 x 5 L Surface Bucket,
825	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	1	852	y					
826	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	2	743	y					
827	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	3	500	y					
828	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	4	201	y					
829	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	5	99	y					
830	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	6	69	y	y				
831	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	7	29	y	y		5 L		
832	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	8	15						
833	1514	2009/12/06	38 27.83 S	046 44.42 E	20:39	Melville Transect	9	2.4	y	y	2 x 1 L	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
834	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	1	1681	y					
835	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	2	1498	y					
836	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	3	1249	y					
837	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	4	998	y					
838	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	5	747	y					
839	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	6	497	y					
840	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	7	252	y					
841	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	8	101	y					
842	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	9	71	y	y				
843	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	10	29	y			5 L		
844	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	11	14	y	y	y			
845	1515	2009/12/06	38 26.81 S	046 44.03 E	21:50	Melville Transect	12	0.9	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
846	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	1	1258	y					
847	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	2	1258	y					
848	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	3	1000	y					
849	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	4	747	y					
850	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	5	499	y					
851	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	6	249	y					
852	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	7	197	y					
853	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	8	125						DNC
854	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	9	98	y	y				
855	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	10	59	y			5 L		
856	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	11	30	y	y	y			
857	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	12	30						DNC
858	1516	2009/12/08	38 28.38 S	046 48.45 E	18:52	Melville Transect 2	Surf	0	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket,
859	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	1	751	y					
860	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	2	500	y					
861	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	3	259	y					
862	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	4	140	y					
863	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	5	109	y	y				
864	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	6	81	y	y	y			
865	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	7	49	y			5 L		
866	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	8	31	y	y				
867	1517	2009/12/08	38 28.51 S	046 47.57 E	19:57	Melville Transect 2	9	0	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket, Surface bucket
868	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	1	550	y					
869	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	2	399	y					
870	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	3	250	y					
871	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	4	140	y					
872	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	5	99	y	y				
873	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	6	69	y			2.5 L		
874	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	7	50	y	y	y			
875	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	8	24	y			2.5 L		
876	1518	2009/12/08	38 28.36 S	046 46.85 E	20:42	Melville Transect 2	9	2.6	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket
877	1519	2009/12/08	38 28.24 S	046 45.47 E	21:34	Melville Transect 2	1	106	y					
878	1519	2009/12/08	38 28.24 S	046 45.47 E	21:34	Melville Transect 2	2	68	y	y				
879	1519	2009/12/08	38 28.24 S	046 45.47 E	21:34	Melville Transect 2	3	50	y					
880	1519	2009/12/08	38 28.24 S	046 45.47 E	21:34	Melville Transect 2	4	24	y	y	y	2.5 L		
881	1519	2009/12/08	38 28.24 S	046 45.47 E	21:34	Melville Transect 2	5	0.1	y	y	y	7.5 l	80 m	Isotopes 1 x 5 L Surface Bucket
882	1520	2009/12/08	38 28.27 S	046 44.60 E	22:02	Melville Transect 2	1	109	y	y				
883	1520	2009/12/08	38 28.27 S	046 44.60 E	22:02	Melville Transect 2	2	69	y					
884	1520	2009/12/08	38 28.27 S	046 44.60 E	22:02	Melville Transect 2	3	51	y			5 L		
885	1520	2009/12/08	38 28.27 S	046 44.60 E	22:02	Melville Transect 2	4	25	y	y	y			
886	1520	2009/12/08	38 28.27 S	046 44.60 E	22:02	Melville Transect 2	5	1.6	y	y	y	5 L	80 m	Isotopes 1 x 5 L Surface Bucket
887	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	1	550	y					
888	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	2	500	y					
889	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	3	250	y					
890	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	4	201	y					
891	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	5	124	y					
892	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	6	100	y	y				
893	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	7	68	y					
894	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	8	50	y			5 L		
895	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	9	29	y	y	y			
896	1521	2009/12/08	38 28.33 S	046 43.78 E	22:33	Melville Transect 2	10	2.59	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket
897	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	1	420	y					
898	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	2	249	y					
899	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	3	200	y					
900	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	4	122	y					
901	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	5	99	y					
902	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	6	71	y					
903	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	7	48	y			5 L		
904	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	8	20	y	y	y			
905	1522	2009/12/08	38 28.67 S	046 42.80 E	23:16	Melville Transect 2	9	0.9	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket
906	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	1	430	y					
907	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	2	249	y					
908	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	3	195	y					
909	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	4	124	y					
910	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	5	100	y	y				
911	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	6	59	y					
912	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	7	37	y			5 L		
913	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	8	20	y	y	y			
914	1523	2009/12/08	38 28.66 S	046 42.32 E	23:53	Melville Transect 2	9	2.4	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket
915	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	1	1052	y					
916	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	2	749	y					
917	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	3	501	y					
918	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	4	251	y					
919	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	5	201	y					
920	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	6	126	y					
921	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	7	100	y					
922	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	8	71	y	y				
923	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	9	52	y			5 L		
924	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	10	21	y	y	y			
925	1524	2009/12/09	38 28.33 S	046 41.25 E	00:37	Melville Transect 2	11	1.12	y	y	y	5 L	100 m	Isotopes 1 x 5 L Surface Bucket
926	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	1	1350	y					
927	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	2	996	y					
928	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	3	749	y					
929	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	4	248	y					
930	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	5	199	y					
931	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	6	121	y					
932	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	7	98	y					
933	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	8	70	y	y				
934	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	9	48	y					
935	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	10	17	y	y				
936	1525	2009/12/09	38 28.07 S	046 40.60 E	01:39	Melville Transect 2	11	1	y	y	2 x 1 L	2 x 5 L	100 m	DNC used Surface Bucket, Isotopes 2 x 5 L Surfac
937	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	1	505	y					
938	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	2	399	y					
939	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	3	300	y					
940	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	4	249	y					
941	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	5	173	y					
942	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	6	100	y	y				
943	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	7	60	y					
944	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	8	40	y	y	y	5 L		
945	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	9	40						Duplicate
946	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	10	18	y	y				
947	1526	2009/12/09	38 28.26 S	046 43.92 E	09:54	Melville Yo-Yo	11	1.6	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
948	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	1	507	y					
949	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	2	400	y					
950	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	3	300	y					
951	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	4	249	y					
952	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	5	201	y					
953	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	6	104	y	y				
954	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	7	40				5 L		Duplicate
955	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	8	40	y	y	y			
956	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	9	20	y	y				
957	1545	2009/12/09	38 28.26 S	046 43.93 E	15:54	Melville Yo-Yo	10	2.2	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
958	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	1	510	y					
959	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	2	400	y					
960	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	3	299	y					
961	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	4	250	y					
962	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	5	150	y					
963	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	6	80	y	y				
964	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	7	30	y	y	y	5 L		Duplicate
965	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	8	30						
966	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	9	14	y	y				
967	1563	2009/12/09	38 28.28 S	046 43.91 E	21:38	Melville Yo-Yo	10	1.9	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
968	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	1	500	y					
969	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	2	401	y					
970	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	3	299	y					
971	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	4	249	y					
972	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	5	150	y					
973	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	6	89	y	y				
974	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	7	39				5 L		Duplicate
975	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	8	40	y	y	y			
976	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	9	19	y	y				
977	1582	2009/12/10	38 28.28 S	046 43.96 E	03:39	Melville Yo-Yo	10	1.6	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
978	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	1	507	y					
979	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	2	399	y					
980	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	3	301	y					
981	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	4	250	y					
982	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	5	150	y	y				
983	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	6	99	y					
984	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	7	50	y	y				
985	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	8	10				5 L		Duplicate
986	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	9	9	y	y	y			
987	1600	2009/12/10	38 28.26 S	046 43.94 E	09:34	Melville Yo-Yo	10	1	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
988	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	1	301	y					
989	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	2	200	y					
990	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	3	139	y					
991	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	4	119	y	y				
992	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	5	86	y	y	y	5 L		
993	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	6	86						Duplicate
994	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	7	49	y	y				
995	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	8	34	y	y				
996	1601	2009/12/12	31 34.33 S	042 45.78 E	16:24	WS	9	2.7	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
997	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	1	1252	y					
998	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	2	998	y					
999	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	3	749	y					
1000	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	4	500	y					
1001	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	5	249	y					
1002	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	6	120	y	y				
1003	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	7	77	y	y	y	5 L		
1004	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	8	77						Duplicate
1005	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	9	48	y	y				
1006	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	10	19	y	y				
1007	1602	2009/12/13	31 37.34 S	042 49.17 E	13:06	WS Yo-Yo	11	1.7	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
1008	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	1	1249	y					
1009	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	2	999	y					
1010	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	3	749	y					
1011	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	4	500	y					
1012	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	5	250	y					
1013	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	6	119	y	y				
1014	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	7	69				5 L		Duplicate
1015	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	8	69	y	y	y			
1016	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	9	49	y	y				
1017	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	10	20	y	y				
1018	1611	2009/12/13	31 37.34 S	042 49.19 E	20:08	WS Yo-Yo	11	1.5	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
1019	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	1	1256	y					
1020	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	2	998	y					
1021	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	3	751	y					
1022	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	4	499	y					
1023	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	5	249	y					
1024	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	6	120	y	y				
1025	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	7	69	y	y	y	2.5 L		
1026	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	8	70						DNC
1027	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	9	50	y	y		2.5 L		
1028	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	10	19	y	y				
1029	1618	2009/12/14	31 37.42 S	042 49.13 E	01:49	WS Yo-Yo	11	1.5	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
1030	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	1	1251	y					
1031	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	2	1000	y					
1032	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	3	751	y					
1033	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	4	501	y					
1034	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	5	252	y					
1035	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	6	130	y	y				
1036	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	7	81				5 L		Duplicate
1037	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	8	79	y	y	y			
1038	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	9	49	y	y				
1039	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	10	20	y	y				
1040	1624	2009/12/14	31 37.33 S	042 49.39 E	07:19	WS Yo-Yo	11	2.8	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
1041	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	1	1257	y					
1042	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	2	1000	y					
1043	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	3	751	y					
1044	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	4	499	y					
1045	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	5	299	y					
1046	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	6	149	y	y				
1047	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	7	70	y					
1048	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	8	70				5 L		Duplicate
1049	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	9	50	y	y	y			
1050	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	10	21	y	y				
1051	1628	2009/12/14	31 37.37 S	042 49.17 E	11:37	WS Yo-Yo	11	2.3	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
1052	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	1	1702	y					
1053	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	2	1499	y					
1054	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	3	999	y					
1055	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	4	750	y					
1056	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	5	499	y					
1057	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	6	259	y					
1058	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	7	119	y	y				
1059	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	8	77				5 L		Duplicate
1060	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	9	75	y	y	y			
1061	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	10	49	y	y				
1062	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	11	19	y	y				
1063	1629	2009/12/14	31 41.82 S	042 54.72 E	16:49	WS Transect	12	2.2	y	y	y	5 L	100 m	Isotopes 1x 5 L Surface Bucket
1064	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	1	1444	y					
1065	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	2	998	y					
1066	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	3	748	y					
1067	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	4	499	y					
1068	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	5	302	y					
1069	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	6	200	y					
1070	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	7	117	y	y				
1071	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	8	78				5 L		Duplicate
1072	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	9	79	y	y	y			
1073	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	10	51	y	y				
1074	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	11	18	y	y				
1075	1630	2009/12/14	31 40.40 S	042 52.90 E	18:28	WS Transect	12	1.4	y	y	y	5 L	Cod-end los	Isotopes 1x 5 L Surface Bucket
1076	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	1	1330	y					
1077	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	2	1000	y					
1078	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	3	751	y					
1079	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	4	499	y					
1080	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	5	297	y					
1081	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	6	199	y					
1082	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	7	100	y	y				
1083	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	8	75	y	y	y	5 L		
1084	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	9	74						Duplicate
1085	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	10	49	y	y				
1086	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	11	19	y	y				
1087	1631	2009/12/14	31 38.69 S	042 50.93 E	19:48	WS Transect	12	1.5	y	y	y	5 L	Broken	Isotopes 1x 5 L Surface Bucket
1088	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	1	1261	y					
1089	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	2	999	y					
1090	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	3	750	y					
1091	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	4	501	y					
1092	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	5	298	y					
1093	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	6	199	y					
1094	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	7	101	y	y				
1095	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	8	75				5 L		Duplicate
1096	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	9	75	y	y	y			
1097	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	10	49	y	y				
1098	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	11	20	y	y				
1099	1632	2009/12/14	31 37.35 S	042 49.15 E	20:53	WS Transect	12	1.35	y	y	y	5 L	Broken	Isotopes 1x 5 L Surface Bucket

No.	Station	Date	Latitude	Longitude	Time	Event	Bottle	Depths	Nutrients	Chl-a	Phyto ID	POM	Phyto-Net	Notes
1100	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	1	1354	y					
1101	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	2	1000	y					
1102	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	3	749	y					
1103	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	4	500	y					
1104	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	5	299	y					
1105	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	6	200	y					
1106	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	7	98	y	y				
1107	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	8	79				5 L		Duplicate
1108	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	9	80	y	y	y			
1109	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	10	48	y	y				
1110	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	11	18	y	y				
1111	1633	2009/12/14	31 35.90 S	042 47.53 E	21:53	WS Transect	12	2.6	y	y	y	5 L	Broken	Isotopes 1x 5 L Surface Bucket
1112	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	1	1469	y					
1113	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	2	997	y					
1114	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	3	750	y					
1115	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	4	499	y					
1116	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	5	300	y					
1117	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	6	197	y	y				
1118	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	7	101						DNC
1119	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	8	64	y	y		5 L		
1120	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	9	64			y			Duplicate
1121	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	10	50	y	y				
1122	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	11	20	y	y				
1123	1634	2009/12/14	31 34.53 S	042 45.96 E	21:53	WS Transect	12	1.1	y	y	y	5 L	Broken	DNC used surface bucket, isotopes 1 x 5 L from su
1124	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	1	1887	y					
1125	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	2	1499	y					
1126	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	3	1000	y					
1127	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	4	747	y					
1128	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	5	499	y					
1129	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	6	252	y					
1130	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	7	100	y	y				
1131	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	8	76				5 L		Duplicate
1132	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	9	76	y	y	y			
1133	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	10	49	y	y				
1134	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	11	18	y	y				
1135	1635	2009/12/15	31 33.07 S	042 44.32 E	00:07	WS Transect	12	1.7	y	y	y	5 L	Broken	Isotopes 1x 5 L Surface Bucket
1136	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	1	302	y					
1137	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	2	302						
1138	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	3	302						
1139	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	4	302						
1140	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	5	302						
1141	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	6	302						
1142	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	7	152	y	y				
1143	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	8	84	y	y	y			
1144	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	9	83						
1145	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	10	61	y	y				
1146	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	11	19	y	y				
1147	1636	2009/12/15	31 59.36 S	041 01.75 E	10:04	Underway to PE	12	2.2	y	y	y	None	100 m	

Appendix B Multinet and bongo net metadata

B1 Multinet metrics

Date	station	Position	Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:27:50	1	250.1	0	0.3	0.3	100	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:30:20	1	202.9	8	0.2	0.2	100	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:30:21	2	202.6	0	0.1	0.3	33.33	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:34:47	2	151.8	54	0.7	0.3	233.33	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:34:48	3	151.6	0	0.8	0.2	400	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:42:51	3	101.6	224	2.1	1.8	116.67	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:42:52	4	101.3	0	2.1	1.9	110.53	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:46:26	4	50.6	101	1.8	1.7	105.88	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:46:27	5	50.3	0	2	1.8	111.11	
11-14-2009 11:06:26	PL3	S 26 56 20 E 56 18 84	11:49:23	5	1.5	69	1.6	0.9	177.78	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:18:58	1	199.3	0	0.2	0.2	100	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:21:49	1	151.3	15	0.1	0.3	33.33	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:21:50	2	151.3	0	0.1	0.1	100	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:27:55	2	101.8	123	1	1.1	90.91	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:27:56	3	101.9	0	1.1	0.8	137.5	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:33:30	3	50.7	151	1.5	1.7	88.24	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:33:31	4	51	0	1.2	1.4	85.71	
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:35:24	4	25.6	50	1.7	1.6	106.25	
11-14-2009	PL4	S 26 56 47 E 56 14	12:35:25	5	25.6	0	1.5	1.5	100	

12:03:31		56							
11-14-2009 12:03:31	PL4	S 26 56 47 E 56 14 56	12:37:03	5	0.6	42	1.4	0.8	175
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:39:13	1	252	0	0.2	0.3	66.67
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:48:31	1	202.8	61	0.8	0.1	800
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:48:32	2	202.1	0	0.7	0.3	233.33
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:53:20	2	147.8	90	1.1	1.3	84.62
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:53:21	3	147.1	0	1.1	1.3	84.62
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:56:03	3	100.2	65	1.6	1.6	0
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:56:04	4	100.2	0	1.4	1.4	100
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:59:55	4	50.6	98	1.8	1.7	105.88
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	19:59:56	5	50.6	0	1.6	1.6	100
11-14-2009 19:22:14	PL7	S 26 56 66 E 56 17 78	20:03:14	5	1.9	75	1	0.7	142.86
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:26:11	1	201.2	0	0.2	0.3	66.67
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:29:04	1	151.9	10	0.8	0.1	800
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:29:05	2	151.9	0	0.8	0.2	400
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:34:14	2	101.4	66	1.2	0.1	1200
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:34:15	3	101.4	0	1.3	0.2	650
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:40:30	3	51.4	155	1.2	1.3	92.31
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:40:31	4	51.3	0	1.2	1.2	100

11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:42:18	4	25.2	41	1.8	1.6	112.5
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:42:19	5	24.6	0	1.8	1.6	112.5
11-14-2009 20:13:48	PL8	S 26 56 00 E 56 16 29	20:43:37	5	0.6	27	1.2	1.3	92.31
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:30:15	1	199.9	0	0.5	0.2	250
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:33:07	1	151.9	33	1.1	0.3	366.67
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:33:08	2	151.2	0	1	0.2	500
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:38:32	2	101.1	121	1.2	1.4	85.71
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:38:33	3	101.3	0	1	1.2	83.33
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:43:46	3	51.9	121	1.2	1.3	92.31
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:43:47	4	52.2	0	1	1.1	90.91
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:45:55	4	25.8	44	1.2	1.3	92.31
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:45:56	5	26.1	0	0.8	1	80
11-17-2009 08:21:45	PL18	S 32 43 00 E 57 17 49	08:47:49	5	1.3	50	1.4	1.4	100
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:17:51	1	201.2	0	0.5	0.7	71.43
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:22:08	1	151.1	78	1.2	1.1	109.09
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:22:09	2	151.1	0	1.4	1.1	127.27
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:27:35	2	100.3	112	1.2	1	120
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:27:36	3	100.2	0	1.4	0.9	155.56
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:33:04	3	51.2	108	0.2	0.5	40

11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:33:05	4	51.3	0	0.7	0.7	100
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:35:21	4	24.9	32	0.8	0.8	100
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:35:22	5	24.6	0	1.2	0.9	133.33
11-18-2009 17:10:04	PL26	S 32 44.87 E 57 16.29	17:37:56	5	1	45	0.5	0.8	62.5
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	21:40:16	1	250.6	0	0.3	0.1	300
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	21:44:34	1	200.7	72	1.5	1.3	115.38
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	21:44:35	2	200.5	0	1.3	1.1	118.18
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	21:48:54	2	150.1	86	1.4	1.3	107.69
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	21:48:55	3	150.4	0	0.8	1	80
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	21:56:18	3	100.1	150	1.7	1.6	106.25
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	21:56:19	4	99.8	0	1.8	1.6	112.5
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	22:01:49	4	50	151	2	1.7	117.65
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	22:01:50	5	49.7	0	1.8	1.7	105.88
11-18-2009 21:28:08	PL27	S 32 43 86 E 57 19 78	22:06:27	5	2.1	125	1	1.2	83.33
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:35:48	1	199.4	0	1.4	0.8	175
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:38:27	1	150.4	53	1.2	1.1	109.09
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:38:28	2	150.1	0	1.4	1	140
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:43:05	2	100	90	0.3	0.2	150
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:43:06	3	100.3	0	0.8	0.5	160

11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:50:33	3	50.8	187	1.2	1.4	85.71
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:50:34	4	50.9	0	1.2	1.2	100
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:52:52	4	24.8	51	1.4	1.5	93.33
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:52:53	5	24.9	0	1.1	1.2	91.67
11-18-2009 22:25:01	PL28	S 32 44 68 E 57 17 29	22:54:52	5	0.4	44	1	1	100
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:26:30	1	251.3	0	0.8	0.1	800
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:30:06	1	200.6	56	0.9	0.2	450
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:30:07	2	200.7	0	1	0.2	500
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:36:39	2	149.2	142	1.5	1.4	107.14
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:36:40	3	148.5	0	1.8	1.7	105.88
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:41:53	3	100.1	122	1.2	1.4	85.71
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:41:54	4	100.3	0	1	1.1	90.91
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:45:30	4	50.7	87	1.6	1.6	100
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:45:31	5	50.8	0	1.3	1.4	92.86
11-19-2009 08:06:30	PL29	S 32 45 38 E 57 16 38	08:48:23	5	0	60	1.6	0.9	177.78
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:17:13	1	201.3	0	0.5	0.1	500
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:21:56	1	150.8	86	0.9	1	90
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:21:57	2	151.1	0	0.8	0.8	100
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:27:09	2	100.5	94	0.5	0.9	55.56

11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:27:10	3	101	0	0.3	0.5	60
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:31:35	3	50.8	93	1.3	1.4	92.86
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:31:36	4	50.2	0	1.8	1.5	120
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:33:39	4	25.1	51	1.6	1.6	100
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:33:40	5	25	0	1.4	1.4	100
11-19-2009 09:08:11	PL30	S 32 45 23 E 57 18 09	09:35:20	5	0.1	40	1.6	1.4	114.29
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:16:10	1	200	0	0.7	0.1	700
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:19:47	1	150.2	71	1	1	100
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:19:48	2	149.8	0	1	1	100
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:27:07	2	101.9	155	1	1.1	90.91
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:27:08	3	101.4	0	1.5	1.2	125
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:32:26	3	50.5	112	1	1	100
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:32:27	4	50.5	0	1.2	1	120
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:34:32	4	25.1	39	0.8	1.2	66.67
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:34:33	5	25.4	0	0.5	0.9	55.56
11-21-2009 22:07:19	PL44	S 36 48 42 E 52 07 79	22:36:21	5	1.1	39	1.6	1.4	114.29
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	22:57:13	1	248.4	0	0.5	0.4	125
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:00:43	1	200.1	71	1.8	1.6	112.5
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:00:44	2	199.6	0	1.8	1.6	112.5

11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:05:36	2	151.1	104	0.6	1.1	54.55
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:05:37	3	150.7	0	1.2	1.3	92.31
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:09:05	3	100.2	79	2.1	1.4	150
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:09:06	4	99.5	0	2.2	1.7	129.41
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:12:31	4	50.5	83	1.6	1.4	114.29
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:12:32	5	50.1	0	1.8	1.5	120
11-21-2009 22:45:41	PL45	S 36 49 59 E 52 08 80	23:15:19	5	0.2	62	1.8	2	90
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:27:08	1	199.6	0	1.9	1.5	126.67
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:29:42	1	149.8	38	1.4	0.3	466.67
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:29:43	2	149.6	0	1	0.3	333.33
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:34:58	2	100.3	108	1.7	1.4	121.43
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:34:59	3	100.1	0	1.5	1.5	100
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:40:20	3	50.3	107	0.8	1.5	53.33
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:40:21	4	50	0	1	1.6	62.5
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:42:19	4	25.8	39	1	1	100
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:42:20	5	25.6	0	1.1	1	110
11-22-2009 11:19:19	PL46	S 36 52 38 E 5203 27	11:44:07	5	1.2	39	1.3	1.2	108.33
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:05:50	1	250.9	0	0.9	0.8	112.5
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:08:34	1	200.2	49	0.2	0.3	66.67

11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:08:35	2	199.7	0	0.4	0.5	80
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:14:33	2	150.1	122	1.6	1.5	106.67
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:14:34	3	150.2	0	1.2	1.3	92.31
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:21:14	3	100.8	140	1.4	1.2	116.67
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:21:15	4	100.5	0	1.6	1.3	123.08
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:26:11	4	50.4	101	1.3	1.2	108.33
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:26:12	5	50.5	0	1.2	1	120
11-22-2009 11:54:53	PL47	S 36 51.13 E 52 03.39	12:29:58	5	0.9	78	1	1.3	76.92
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	12:55:23	1	251.7	0	1	1.1	90.91
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	12:58:47	1	199.8	53	0.5	0.8	62.5
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	12:58:48	2	199.7	0	0.3	0.6	50
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	13:03:05	2	159.7	88	1.7	1.4	121.43
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	13:03:06	3	159.5	0	1.6	1.4	114.29
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	13:05:06	3	140	47	1.4	1.3	107.69
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	13:05:07	4	140	0	1.5	1.4	107.14
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	13:13:40	4	49.9	209	1.7	1.5	113.33
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	13:13:41	5	49.4	0	1.9	1.6	118.75
11-22-2009 12:43:40	PL48	S 36 49.09 E 52 03.74	13:17:54	5	0	86	1	1.3	76.92
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	08:52:28	1	201	0	1.2	0.3	400

11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	08:59:20	1	150.2	147	1	1.4	71.43
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	08:59:21	2	150.5	0	1.2	1.3	92.31
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	09:06:49	2	101.4	222	1.3	1.6	81.25
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	09:06:50	3	101.6	0	1.2	1.5	80
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	09:13:35	3	49.7	221	1.9	2.2	86.36
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	09:13:36	4	49.5	0	2.1	1.9	110.53
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	09:15:53	4	25.4	75	2.1	2.3	91.3
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	09:15:54	5	25.2	0	2	1.9	105.26
11-24-2009 08:39:12	PL54	S 36 52 03 E 52 13 91	09:17:36	5	0.5	58	2.1	2.3	91.3
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:06:28	1	200.1	0	1.4	1.1	127.27
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:09:46	1	149.1	53	1	1.2	83.33
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:09:47	2	149	0	1.2	1.1	109.09
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:14:00	2	100.3	83	1.4	1.2	116.67
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:14:01	3	100.3	0	1.3	1.2	108.33
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:18:08	3	50.3	85	0.8	1	80
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:18:09	4	50.5	0	1	0.9	111.11
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:19:51	4	24	35	1.2	1.6	75
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:19:52	5	24	0	1	1.2	83.33
11-24-2009 17:00:29	PL61	S 36 48.62 E 52 05.16	17:22:59	5	0.2	62	1.6	1.4	114.29

11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:18:01	1	200.9	0	0.8	0	0
11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:25:16	2	99.8	100	1.4	1.6	87.5
11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:25:17	3	99.6	0	1.4	1.4	100
11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:29:23	3	50.5	94	1.4	1.6	87.5
11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:29:24	4	50.8	0	1	1.2	83.33
11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:31:10	4	25.8	43	1.4	1.2	116.67
11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:31:11	5	25.3	0	1.8	1.5	120
11-25-2009 13:08:51	PL66	S 37 57 52 E 50 24 85	13:32:35	5	0.1	33	1.8	1.2	150
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	13:53:35	1	249.3	0	0.3	0	0
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	13:56:13	1	200.6	47	0.8	1	80
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	13:56:14	2	200.7	0	0.8	0.7	114.29
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	14:01:37	2	149.7	141	1.8	1.6	112.5
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	14:01:38	3	149.5	0	2	1.7	117.65
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	14:05:26	3	99.9	109	2.3	2.1	109.52
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	14:05:27	4	99.9	0	1.7	1.8	94.44
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	14:08:38	4	49.5	89	2.1	2.1	100
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	14:08:39	5	49.5	0	1.6	1.7	94.12
11-25-2009 13:41:02	PL67	S 37 56 74 E 50 23 36	14:12:33	5	0.7	93	1.8	1.6	112.5
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:32:29	1	201.3	0	0.3	0.3	100

11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:36:06	1	151.5	64	0.6	0.5	120
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:36:07	2	151.3	0	0.8	0.7	114.29
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:41:44	2	99.4	128	2.1	1.6	131.25
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:41:45	3	99.1	0	1.8	1.7	105.88
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:46:15	3	50.2	102	1.6	1.4	114.29
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:46:16	4	49.8	0	1.7	1.4	121.43
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:48:19	4	24.6	44	1.2	1.4	85.71
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:48:20	5	24.8	0	1	1.2	83.33
11-25-2009 14:21:48	PL68	S 37 56.33 E 50 22.39	14:51:14	5	2	64	1	1.2	83.33
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:25:03	1	201.2	0	0.8	0.6	133.33
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:28:14	1	148.7	58	1.4	0.9	155.56
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:28:15	2	148.4	0	1	0.8	125
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:33:11	2	99.6	106	1.6	1.4	114.29
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:33:12	3	99.2	0	1.6	1.5	106.67
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:37:00	3	48.8	87	1.7	1.7	100
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:37:01	4	48.8	0	1.3	1.5	86.67
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:40:07	4	25.2	60	1.1	1	110
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:40:08	5	25.4	0	1	0.8	125
11-25-2009 15:17:43	PL69	S 37 58.23 E 50 24.60	15:43:36	5	0.1	71	1.6	1.4	114.29

11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:03:10	1	250.3	0	1.1	1	110
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:07:45	1	200.7	75	0.9	1	90
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:07:46	2	200.9	0	1.1	1	110
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:13:19	2	150.7	132	1.4	1.4	100
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:13:20	3	150.4	0	1.8	1.4	128.57
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:17:03	3	99.8	91	1.4	1.3	107.69
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:17:04	4	100.1	0	0.9	1	90
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:21:33	4	49.7	102	1.6	1.6	100
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:21:34	5	49.6	0	1.4	1.4	100
11-25-2009 15:51:35	PL70	S 37 57.04 E 50 24.42	16:24:59	5	0.4	82	1.8	1.8	100
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:40:38	1	199.5	0	0.8	0.3	266.67
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:44:38	1	150.2	60	0.5	0.7	71.43
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:44:39	2	150	0	1.2	1	120
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:49:14	2	99.9	95	1.6	1.4	114.29
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:49:15	3	99.5	0	1.6	1.4	114.29
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:52:42	3	49.4	75	1.5	1.4	107.14
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:52:43	4	48.8	0	1.9	1.6	118.75
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:55:04	4	25.3	48	0.8	1	80
11-25-2009 16:33:20	PL71	S 37 55.87 E 50 23.47	16:55:05	5	25.2	0	1	1	100
11-25-2009	PL71	S 37 55.87 E 50	16:56:51	5	0.7	38	0.7	1	70

16:33:20		23.47							
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:13:51	1	200	0	1	0.8	125
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:17:46	1	150.2	62	1	0.8	125
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:17:47	2	150.2	0	1	0.8	125
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:23:51	2	100.6	109	1.2	1.1	109.09
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:23:52	3	100.4	0	1.3	1.2	108.33
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:28:14	3	51	90	1.2	1.4	85.71
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:28:15	4	51.1	0	1	1.2	83.33
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:30:33	4	25.9	55	1.3	1.3	100
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:30:34	5	25.3	0	2.1	1.6	131.25
11-27-2009 11:05:54	PL82	S 37 57 97 E 50 23 99	11:31:59	5	1.2	39	1.4	0.3	466.67
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:40:08	1	199.4	0	0.6	0.3	200
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:41:53	1	149.4	31	1.2	0.3	400
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:41:54	2	149.2	0	1	0.2	500
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:44:55	2	100.4	70	1.3	1.4	92.86
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:44:56	3	100.6	0	1.1	1.2	91.67
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:47:49	3	49.9	63	1.6	1.3	123.08
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:47:50	4	49.4	0	1.6	1.4	114.29
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:48:53	4	25	21	1.5	1.4	107.14

11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:48:54	5	24	0	2.1	1.7	123.53
11-29-2009 12:30:50	PL95	S 41 29 65 E 49 30 46	12:49:54	5	0.4	24	1.4	1.4	100
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:11:49	1	250.7	0	0.2	0.1	200
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:14:53	1	200.4	45	1.1	0.9	122.22
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:14:54	2	199.8	0	1.4	1	140
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:18:27	2	150.3	56	1	1	100
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:18:28	3	150.1	0	1.2	1	120
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:21:52	3	100.6	64	1.4	1.2	116.67
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:21:53	4	100.3	0	1.5	1.3	115.38
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:25:33	4	49.6	72	1.8	1.5	120
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:25:34	5	49	0	1.8	1.6	112.5
11-29-2009 13:00:41	PL96	S 41 29 36 E 49 31 66	13:29:16	5	0.9	71	0.6	1.2	50
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	13:51:09	1	200.3	0	0.3	0.3	100
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	13:54:45	1	150.2	62	1.4	1.2	116.67
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	13:54:46	2	150.3	0	1	1	100
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	13:58:30	2	100.2	80	1.4	1.8	77.78
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	13:58:31	3	100.5	0	1	1.3	76.92
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	14:02:33	3	49.9	95	0.9	1.1	81.82
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	14:02:34	4	49.7	0	1.1	1.1	100

11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	14:04:23	4	25	40	0.8	1	80
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	14:04:24	5	25	0	1	1	100
11-29-2009 13:39:43	PL97	S 41 28 96 E 49 33 40	14:06:32	5	0	44	1.4	1	140
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:20:31	1	200.5	0	0.5	0.3	166.67
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:27:09	1	120.3	109	1.2	1.2	100
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:27:10	2	120.3	0	1	1	100
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:30:37	2	81.1	58	1.2	1	120
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:30:38	3	80.4	0	1.6	1.3	123.08
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:34:14	3	51.4	65	0.9	0.9	100
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:34:15	4	51.7	0	1	0.8	125
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:38:44	4	25.9	82	0.5	0.9	55.56
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:38:45	5	25.8	0	1	0.9	111.11
11-29-2009 17:13:43	PL102	S 41 31.01 E49 27.19	17:42:23	5	0	63	0.5	1.3	38.46
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	17:59:28	1	251.1	0	1.1	0.8	137.5
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:03:52	1	200.3	67	1.1	1	110
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:03:53	2	200.1	0	1.1	1	110
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:09:42	2	151.2	100	0.9	1	90
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:09:43	3	151.5	0	0.9	0.9	100
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:14:13	3	100.2	85	1.4	1.4	100

11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:14:14	4	100	0	1.4	1.4	100
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:18:43	4	50	94	0.8	1.1	72.73
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:18:44	5	50.2	0	0.8	1	80
11-29-2009 17:52:10	PL103	S 41 30.63 E 49 28.57	18:22:02	5	0	63	1.5	1.4	107.14
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	18:44:46	1	202.5	0	1.4	1.2	116.67
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	18:54:11	1	80.4	138	1	1.1	90.91
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	18:54:12	2	80.3	0	1.1	1.1	100
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	18:56:24	2	50	45	1.3	1.2	108.33
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	18:56:25	3	49.8	0	1.4	1.2	116.67
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	18:59:50	3	25	65	1.2	1.2	100
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	18:59:51	4	25	0	1.2	1	120
11-29-2009 18:42:38	PL104	S 41 30.00 E 49 30.85	19:02:48	4	0.8	46	0.9	0.8	112.5
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:37:59	1	200.7	0	0.2	0.1	200
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:41:44	1	150.6	75	1.6	1.5	106.67
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:41:45	2	150.7	0	1.3	1.4	92.86
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:46:08	2	100.9	97	1.2	1.2	100
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:46:09	3	100.5	0	1.4	1.2	116.67
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:49:25	3	50.7	66	0.8	1	80
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:49:26	4	50.6	0	0.8	1	80

12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:50:38	4	24.9	23	1.2	1.4	85.71
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:50:39	5	24.8	0	1.1	1.2	91.67
12-01-2009 22:23:58	PL108	S 41 26 98 E 42 51 47	22:51:37	5	0	24	1.6	1.6	100
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:17:51	1	250.5	0	0.1	0.2	50
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:24:46	1	200.3	129	0.3	0.5	60
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:24:47	2	200.4	0	1	1	100
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:31:06	2	149.5	169	2.1	2.3	91.3
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:31:07	3	149.4	0	1.8	2	90
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:35:18	3	100.5	119	1.6	1.8	88.89
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:35:19	4	100.6	0	1.4	1.5	93.33
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:39:07	4	50.2	99	1.2	1.4	85.71
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:39:08	5	50.1	0	1.2	1.3	92.31
12-01-2009 22:58:17	PL109	S 41 25 27 E 42 54 21	23:42:18	5	1.9	78	1.4	0.5	280
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:04:10	1	200.4	0	1	0.7	142.86
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:06:42	1	149.8	56	1.2	1.2	100
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:06:43	2	149.8	0	1.2	1.2	100
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:11:21	2	100.8	111	1.5	1.7	88.24
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:11:22	3	100.8	0	1.4	1.5	93.33
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:16:19	3	50.2	129	1.2	1.4	85.71

12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:16:20	4	50.4	0	1	1.2	83.33
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:18:02	4	24.5	42	1.7	1.8	94.44
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:18:03	5	24.4	0	1.6	1.6	100
12-01-2009 23:52:55	PL110	S 41 24 66 E 42 56 10	00:19:18	5	0.7	31	1.3	0.4	325
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	21:54:41	1	200.7	0	0.5	0.3	166.67
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:00:32	1	148.8	113	0.1	0.5	20
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:00:33	2	148.7	0	0.1	0.3	33.33
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:07:27	2	99.9	172	1	1.1	90.91
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:07:28	3	99.6	0	1.4	1.2	116.67
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:11:55	3	50.9	105	1.4	1.3	107.69
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:11:56	4	50.8	0	1.4	1.2	116.67
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:13:49	4	25.3	46	1.5	1.4	107.14
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:13:50	5	25.4	0	1.1	1.2	91.67
12-07-2009 21:39:41	PL146	S 38 30 55 E 46 43 48	22:15:18	5	0.7	37	1	1.4	71.43
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	22:49:08	1	250.6	0	0.7	0.3	233.33
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	22:55:34	1	200.7	126	0.5	0.5	100
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	22:55:35	2	200.5	0	1.2	1	120
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	23:03:12	2	150.4	198	1.8	1.8	100
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	23:03:13	3	150.8	0	1.2	1.4	85.71

12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	23:08:32	3	99.3	125	2.2	2.3	95.65
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	23:08:33	4	99	0	1.7	2	85
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	23:12:09	4	50.7	86	1	1.1	90.91
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	23:12:10	5	50	0	1.8	1.4	128.57
12-07-2009 22:24:54	PL147	S 38 29 01 E 46 45 43	23:15:50	5	1.7	87	0.6	1.2	50
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	23:44:11	1	200.4	0	0.3	0.4	75
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	23:48:29	1	150.1	65	0.2	0.6	33.33
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	23:48:30	2	150.3	0	0.5	0.7	71.43
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	23:53:22	2	101.5	82	0.5	0.8	62.5
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	23:53:23	3	101.9	0	0.6	0.7	85.71
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	23:58:03	3	50.1	84	0.8	1.2	66.67
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	23:58:04	4	51.3	0	1	1.2	83.33
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	00:00:17	4	25.4	47	1	1.1	90.91
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	00:00:18	5	26.3	0	0.9	1	90
12-07-2009 23:30:31	PL148	S 21 29 39 E 46 48 05	00:02:05	5	0.2	38	1.8	1.8	100
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:16:06	1	201.3	0	1.2	1.1	109.09
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:21:35	1	149.5	96	1.4	1.6	87.5
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:21:36	2	149.4	0	1.2	1.4	85.71
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:26:36	2	100.1	128	2	2.1	95.24

12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:26:37	3	99.8	0	2	2.1	95.24
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:30:55	3	51.4	111	1	1.4	71.43
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:30:56	4	51.8	0	1	1.2	83.33
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:33:02	4	25.5	53	1.2	1.5	80
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:33:03	5	25.9	0	0.8	1.1	72.73
12-08-2009 02:07:04	PL149	S 38 29.44 E 46 44.85	02:34:42	5	0.2	43	1.7	1.4	121.43
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	02:55:05	1	251.6	0	1	0.9	111.11
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	02:58:31	1	200.4	53	0.1	0.1	100
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	02:58:32	2	200.8	0	0.1	0.1	100
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	03:03:33	2	149.2	116	1.8	2	90
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	03:03:34	3	149.5	0	1.2	1.6	75
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	03:09:01	3	98.9	137	2.3	2.4	95.83
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	03:09:02	4	98.8	0	1.8	2.1	85.71
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	03:12:50	4	50.8	100	1.3	1.4	92.86
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	03:12:51	5	50.6	0	1.6	1.4	114.29
12-08-2009 02:51:40	PL150	S 38 28.81 E 46 46.18	03:15:45	5	1.3	78	1.8	1.9	94.74
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	03:51:47	1	199.8	0	1.2	1.1	109.09
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	03:54:51	1	149.5	53	0.3	0.8	37.5
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	03:54:52	2	149.4	0	0.6	1	60

12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	03:59:53	2	101.4	123	1.2	1.3	92.31
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	03:59:54	3	101.5	0	1.3	1.3	100
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	04:04:03	3	50.3	116	1.4	1.4	100
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	04:04:04	4	50	0	1.7	1.5	113.33
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	04:06:36	4	25.1	65	1.1	1.2	91.67
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	04:06:37	5	25.7	0	0.8	1.1	72.73
12-08-2009 03:46:27	PL151	S 38 29.62 E 46 44.75	04:09:26	5	1.5	70	1.3	1.8	72.22
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:11:13	1	199.7	0	1.5	1.3	115.38
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:15:40	1	151	69	1	1	100
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:15:41	2	151	0	1.2	1	120
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:21:36	2	100	128	1.3	1.2	108.33
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:21:37	3	99.9	0	1.4	1.2	116.67
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:26:04	3	49.2	99	1.4	1.6	87.5
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:26:05	4	49.3	0	1	1.2	83.33
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:27:45	4	24.5	36	1.7	1.6	106.25
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:27:46	5	24.4	0	1.2	1.3	92.31
12/12/2009 18:04	PL177	S 31 38.67 E 42 50.61	18:30:07	5	1.2	45	1	1	100
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	18:47:06	1	250.8	0	1.1	1	110
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	18:50:05	1	200.1	41	0.1	0.2	50

12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	18:50:06	2	199.6	0	0.1	0.5	20
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	18:55:29	2	150.3	120	1.4	1.5	93.33
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	18:55:30	3	150.3	0	1.3	1.4	92.86
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	19:00:20	3	99.5	106	1.6	1.6	100
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	19:00:21	4	99.6	0	1.1	1.3	84.62
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	19:04:13	4	49.7	82	1.2	1.2	100
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	19:04:14	5	49.5	0	1.4	1.1	127.27
12/12/2009 18:37	PL178	S 31 39.79 E 42 51.76	19:07:06	5	0.5	60	1.2	1	120
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:21:14	1	199.9	0	0.2	0.1	200
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:24:40	1	149.1	53	1.1	1.2	91.67
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:24:41	2	148.8	0	1.2	1.2	100
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:28:26	2	100.5	72	0.9	1.1	81.82
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:28:27	3	100.3	0	1	1	100
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:32:44	3	51.2	85	1	0.9	111.11
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:32:45	4	50.9	0	1.3	1	130
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:34:47	4	24.7	45	1.6	1.6	100
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:34:48	5	24.5	0	1.4	1.4	100
12/12/2009 19:14	PL179	S 31 40.82 E 42 52.88	19:36:24	5	0.1	40	0.8	0.3	266.67
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:32:40	1	200.3	0	1	0.4	250

12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:35:27	1	150.2	48	0.8	1	80
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:35:28	2	150.2	0	0.6	0.8	75
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:40:01	2	100.2	94	1.5	1.2	125
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:40:02	3	99.9	0	1.6	1.3	123.08
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:44:07	3	49.6	84	1.9	1.7	111.76
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:44:08	4	49.1	0	1.8	1.8	100
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:45:59	4	24.9	38	0.8	1.2	66.67
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:46:00	5	25.1	0	0.7	0.9	77.78
12-13-2009 07:26:03	PL180	S 31 36.25 E 42 43.47	07:47:28	5	0.2	31	1.5	1.5	100
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:10:29	1	250.2	0	0.3	5	6
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:14:07	1	200.6	57	1.3	0.8	162.5
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:14:08	2	200.3	0	1.4	0.9	155.56
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:21:24	2	150.4	152	1.3	1.2	108.33
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:21:25	3	150.3	0	1.4	1.2	116.67
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:27:45	3	100.6	137	1.4	1.2	116.67
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:27:46	4	100.5	0	1.4	1.2	116.67
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:33:42	4	50.7	125	1.4	1	140
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:33:43	5	50.5	0	1.4	1.1	127.27
12-13-2009 07:54:01	PL181	S 31 36 23 E 42 45 30	08:38:10	5	0.9	98	1	1	100

B2 Multinet samples

Cruise	LOCATION	EVENT	Sample Number	#	Trawl type	PRESERVATION genetics	Note
2009410	ST2	3	PL3NET1	695	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET1	681	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET2	292	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET2	278	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET3	646	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET3	644	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET4	630	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET4	643	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET5	629	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	3	PL3NET5	682	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET1	600	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET1	014	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET2	013	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET2	590	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET3	604	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET3	622	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET4	635	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET4	640	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET5	626	MULTINET	FORMALDEHYDE	TOO SMALL TO QUANTIFY
2009410	ST2	8	PL7NET5	639	MULTINET	ETHANOL	TOO SMALL TO QUANTIFY
2009410	ST2	9	PL8NET1	539	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	9	PL8NET2	553	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	9	PL8NET3	540	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	9	PL8NET4	575	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	9	PL8NET5	642	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	4	PL4NET1	627	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	4	PL4NET2	641	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	4	PL4NET3	647	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	4	PL4NET4	661	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST2	4	PL4NET5	648	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4	20	PL27NET1	736	MULTINET	ETHANOL	
2009410	ST4	20	PL27NET1	175	MULTINET	FORMALDEHYDE	

2009410	ST4	20	PL27NET2	735	MULTINET	ETHANOL	
2009410	ST4	20	PL27NET2	161	MULTINET	FORMALDEHYDE	
2009410	ST4	20	PL27NET3	749	MULTINET	ETHANOL	
2009410	ST4	20	PL27NET3	166	MULTINET	FORMALDEHYDE	
2009410	ST4	20	PL27NET4	111	MULTINET	ETHANOL	
2009410	ST4	20	PL27NET4	121	MULTINET	FORMALDEHYDE	
2009410	ST4	20	PL27NET5	58	MULTINET	ETHANOL	
2009410	ST4	20	PL27NET5	750	MULTINET	FORMALDEHYDE	
2009410	ST4	21	PL28NET1	1429	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4	21	PL28NET2	1611	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4	21	PL28NET3	1485	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4	21	PL28NET4	1457	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4	21	PL28NET5	1414	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4		PL29NET1	1345	MULTINET	FORMALDEHYDE	
2009410	ST4		PL29NET1	1373	MULTINET	ETHANOL	
2009410	ST4		PL29NET2	1699	MULTINET	FORMALDEHYDE	
2009410	ST4		PL29NET3	1622	MULTINET	FORMALDEHYDE	
2009410	ST4		PL29NET4	1366	MULTINET	FORMALDEHYDE	
2009410	ST4		PL29NET5	1450	MULTINET	FORMALDEHYDE	
2009410	ST4		PL29NET2	1433	MULTINET	ETHANOL	
2009410	ST4		PL29NET3	1787	MULTINET	ETHANOL	
2009410	ST4		PL29NET4	1650	MULTINET	ETHANOL	
2009410	ST4		PL29NET5	1333	MULTINET	ETHANOL	
2009410	ST4		PL30NET1	1427	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4		PL30NET2	1729	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4		PL30NET3	1455	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4		PL30NET4	1789	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST4		PL30NET5	1785	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST5	6	PL45NET1	1813	MULTINET	FORMALDEHYDE	
2009410	ST5	6	PL45NET1	1847	MULTINET	ETHANOL	
2009410	ST5	6	PL45NET2	1831	MULTINET	FORMALDEHYDE	
2009410	ST5	6	PL45NET2	1871	MULTINET	ETHANOL	
2009410	ST5	6	PL45NET3	1899	MULTINET	FORMALDEHYDE	
2009410	ST5	6	PL45NET3	1811	MULTINET	ETHANOL	
2009410	ST5	6	PL45NET3	1843	MULTINET	FORMALDEHYDE	
2009410	ST5	6	PL45NET4	1841	MULTINET	ETHANOL	

2009410	ST5	6	PL45NET4	1843	MULTINET	FORMALDEHYDE
2009410	ST5	6	PL45NET5	1815	MULTINET	FORMALDEHYDE
2009410	ST5	6	PL45NET5	1869	MULTINET	ETHANOL
2009410	ST5	10	PL47NET1	1365	MULTINET	ETHANOL
2009410	ST5	10	PL47NET1	1337	MULTINET	FORMALDEHYDE
2009410	ST5	10	PL47NET2	1393	MULTINET	FORMALDEHYDE
2009410	ST5	10	PL47NET2	1421	MULTINET	ETHANOL
2009410	ST5	10	PL47NET3	1332	MULTINET	ETHANOL
2009410	ST5	10	PL47NET3	1449	MULTINET	FORMALDEHYDE
2009410	ST5	10	PL47NET4	1360	MULTINET	FORMALDEHYDE
2009410	ST5	10	PL47NET4	1388	MULTINET	ETHANOL
2009410	ST5	10	PL47NET5	1444	MULTINET	FORMALDEHYDE
2009410	ST5	10	PL47NET5	1416	MULTINET	ETHANOL
2009410	ST5	11	PL48NET1	1900	MULTINET	FORMALDEHYDE
2009410	ST5	11	PL48NET1	2079	MULTINET	ETHANOL
2009410	ST5	11	PL48NET2	1876	MULTINET	FORMALDEHYDE
2009410	ST5	11	PL48NET2	1870	MULTINET	ETHANOL
2009410	ST5	11	PL48NET3	1951	MULTINET	FORMALDEHYDE
2009410	ST5	11	PL48NET3	1814	MULTINET	ETHANOL
2009410	ST5	11	PL48NET4	1842	MULTINET	ETHANOL
2009410	ST5	11	PL48NET4	2094	MULTINET	FORMALDEHYDE
2009410	ST5	11	PL48NET5	2007	MULTINET	FORMALDEHYDE
2009410	ST5	11	PL48NET5	1923	MULTINET	ETHANOL
2009410	ST6	4	PL67NET1	2879	MULTINET	ETHANOL
2009410	ST6	4	PL67NET1	3053	MULTINET	FORMALDEHYDE
2009410	ST6	4	PL67NET2	2880	MULTINET	ETHANOL
2009410	ST6	4	PL67NET2	2912	MULTINET	FORMALDEHYDE
2009410	ST6	4	PL67NET3	2908	MULTINET	ETHANOL
2009410	ST6	4	PL67NET3	2884	MULTINET	FORMALDEHYDE
2009410	ST6	4	PL67NET4	2957	MULTINET	ETHANOL
2009410	ST6	4	PL67NET4	2934	MULTINET	FORMALDEHYDE
2009410	ST6	4	PL67NET5	2936	MULTINET	ETHANOL
2009410	ST6	4	PL67NET5	2940	MULTINET	FORMALDEHYDE
2009410	ST6	7	PL70NET1	2759	MULTINET	ETHANOL
2009410	ST6	7	PL70NET1	2830	MULTINET	FORMALDEHYDE
2009410	ST6	7	PL70NET2	2761	MULTINET	ETHANOL

2009410	ST6	7	PL70NET2	2787	MULTINET	FORMALDEHYDE
2009410	ST6	7	PL70NET3	2789	MULTINET	FORMALDEHYDE
2009410	ST6	7	PL70NET3	2817	MULTINET	ETHANOL
2009410	ST6	7	PL70NET4	2843	MULTINET	FORMALDEHYDE
2009410	ST6	7	PL70NET4	2815	MULTINET	ETHANOL
2009410	ST6	7	PL70NET5	2844	MULTINET	FORMALDEHYDE
2009410	ST6	7	PL70NET5	2831	MULTINET	ETHANOL
2009410	ST7	4	PL96NET1	2844	MULTINET	ETHANOL
2009410	ST7	4	PL96NET1	2865	MULTINET	FORMALDEHYDE
2009410	ST7	4	PL96NET2	2791	MULTINET	ETHANOL
2009410	ST7	4	PL96NET2	2893	MULTINET	FORMALDEHYDE
2009410	ST7	4	PL96NET3	3985	MULTINET	ETHANOL
2009410	ST7	4	PL96NET3	4069	MULTINET	FORMALDEHYDE
2009410	ST7	4	PL96NET4	4013	MULTINET	ETHANOL
2009410	ST7	4	PL96NET4	3929	MULTINET	FORMALDEHYDE
2009410	ST7	4	PL96NET5	2819	MULTINET	ETHANOL
2009410	ST7	4	PL96NET5	4041	MULTINET	FORMALDEHYDE
2009410	ST7	9	PL103NET1	2917	MULTINET	FORMALDEHYDE
2009410	ST7	9	PL103NET1	2916	MULTINET	ETHANOL
2009410	ST7	9	PL103NET2	2944	MULTINET	ETHANOL
2009410	ST7	9	PL103NET2	2861	MULTINET	FORMALDEHYDE
2009410	ST7	9	PL103NET3	2889	MULTINET	ETHANOL
2009410	ST7	9	PL103NET3	2121	MULTINET	FORMALDEHYDE
2009410	ST7	9	PL103NET4	2647	MULTINET	FORMALDEHYDE
2009410	ST7	9	PL103NET4	2675	MULTINET	ETHANOL
2009410	ST7	9	PL103NET5	3733	MULTINET	ETHANOL
2009410	ST7	9	PL103NET5	3054	MULTINET	FORMALDEHYDE
2009410	ST8	4	PL109NET1	4626	MULTINET	ETHANOL
2009410	ST8	4	PL109NET1	4471	MULTINET	FORMALDEHYDE
2009410	ST8	4	PL109NET2	4568	MULTINET	ETHANOL
2009410	ST8	4	PL109NET2	4199	MULTINET	FORMALDEHYDE
2009410	ST8	4	PL109NET3	4691	MULTINET	ETHANOL
2009410	ST8	4	PL109NET3	4653	MULTINET	FORMALDEHYDE
2009410	ST8	4	PL109NET4	4577	MULTINET	ETHANOL
2009410	ST8	4	PL109NET4	4703	MULTINET	FORMALDEHYDE
2009410	ST8	4	PL109NET5	4094	MULTINET	FORMALDEHYDE

2009410	ST8	4	PL109NET5	3721	MULTINET	ETHANOL	
2009410			PL44NET1	2001	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL44NET2	1931	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL44NET3	1089	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL44NET4	1959	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL44NET5	2082	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL46NET1	2029	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL46NET2	1917	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL46NET3	1973	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL46NET4	1945	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL46NET5	1895	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST8	7	PL112NET1	4387	MULTINET	ETHANOL	
2009410	ST8	7	PL112NET1	4230	MULTINET	FORMALDEHYDE	
2009410	ST8	7	PL112NET2	4202	MULTINET	FORMALDEHYDE	
2009410	ST8	7	PL112NET2	4174	MULTINET	ETHANOL	
2009410	ST8	7	PL112NET3	4146	MULTINET	ETHANOL	
2009410	ST8	7	PL112NET3	4227	MULTINET	FORMALDEHYDE	
2009410	ST8	7	PL112NET4	4118	MULTINET	FORMALDEHYDE	
2009410	ST8	7	PL112NET4	4521	MULTINET	ETHANOL	
2009410	ST8	7	PL112NET5	4549	MULTINET	ETHANOL	
2009410	ST8	7	PL112NET5	4531	MULTINET	FORMALDEHYDE	
2009410			PL54NET1	2964	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL54NET2	2929	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL54NET3	2962	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL54NET4	2901	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL54NET5	2881	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL61NET1	2876	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL61NET2	2904	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL61NET3	2932	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL61NET4	2960	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL61NET5	2878	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL66NET1	2473	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL66NET2	2476	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL66NET3	2504	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL66NET4	2532	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL66NET5	2478	MULTINET	FORMALDEHYDE	FULL SAMPLE

2009410			PL68NET1	2501	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL68NET2	2537	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL68NET3	2502	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL68NET4	2509	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL68NET5	2530	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL69NET1	2518	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL69NET2	2534	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL69NET3	2506	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL69NET4	2841	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL69NET5	2490	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL71NET1	2748	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL71NET2	2760	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL71NET3	2749	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL71NET4	2474	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL71NET5	2546	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL82NET1	2883	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL82NET2	2911	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL82NET3	2811	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL82NET4	2784	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410			PL82NET5	2812	MULTINET	FORMALDEHYDE	FULL SAMPLE
2009410	ST9	18	PL147NET1	3056	MULTINET	ETHANOL	
2009410	ST9	18	PL147NET1	2973	MULTINET	FORMALDEHYDE	
2009410	ST9	18	PL147NET2	3001	MULTINET	FORMALDEHYDE	
2009410	ST9	18	PL147NET2	3029	MULTINET	ETHANOL	
2009410	ST9	18	PL147NET3	3057	MULTINET	ETHANOL	
2009410	ST9	18	PL147NET3	2974	MULTINET	FORMALDEHYDE	
2009410	ST9	18	PL147NET4	N/A	N/A	N/A	DUDD
2009410	ST9	18	PL147NET4	N/A	N/A	N/A	DUDD
2009410	ST9	18	PL147NET5	5952	MULTINET	ETHANOL	
2009410	ST9	18	PL147NET5	5924	MULTINET	FORMALDEHYDE	
2009410	ST9	22	PL150NET1	4857	MULTINET	ETHANOL	
2009410	ST9	22	PL150NET1	4711	MULTINET	FORMALDEHYDE	
2009410	ST9	22	PL150NET2	4217	MULTINET	FORMALDEHYDE	
2009410	ST9	22	PL150NET2	2859	MULTINET	ETHANOL	
2009410	ST9	22	PL150NET3	4620	MULTINET	ETHANOL	
2009410	ST9	22	PL150NET3	4418	MULTINET	FORMALDEHYDE	

2009410	ST9	22	PL150NET4	4180	MULTINET	ETHANOL
2009410	ST9	22	PL150NET4	4208	MULTINET	FORMALDEHYDE
2009410	ST9	22	PL150NET5	4965	MULTINET	ETHANOL
2009410	ST9	22	PL150NET5	4590	MULTINET	FORMALDEHYDE
2009410	ST10	7	PL178NET1	6081	MULTINET	FORMALDEHYDE
2009410	ST10	7	PL178NET1	4702	MULTINET	ETHANOL
2009410	ST10	7	PL178NET2	6317	MULTINET	FORMALDEHYDE
2009410	ST10	7	PL178NET2	6184	MULTINET	ETHANOL
2009410	ST10	7	PL178NET3	6092	MULTINET	FORMALDEHYDE
2009410	ST10	7	PL178NET3	6064	MULTINET	ETHANOL
2009410	ST10	7	PL178NET4	6036	MULTINET	FORMALDEHYDE
2009410	ST10	7	PL178NET4	6355	MULTINET	ETHANOL
2009410	ST10	7	PL178NET5	4336	MULTINET	FORMALDEHYDE
2009410	ST10	7	PL178NET5	4684	MULTINET	ETHANOL
2009410	ST10	12	PL181NET1	1806	MULTINET	ETHANOL
2009410	ST10	12	PL181NET1	1981	MULTINET	FORMALDEHYDE
2009410	ST10	12	PL181NET2	2009	MULTINET	ETHANOL
2009410	ST10	12	PL181NET2	2037	MULTINET	FORMALDEHYDE
2009410	ST10	12	PL181NET3	2041	MULTINET	ETHANOL
2009410	ST10	12	PL181NET3	2013	MULTINET	FORMALDEHYDE
2009410	ST10	12	PL181NET4	1985	MULTINET	ETHANOL
2009410	ST10	12	PL181NET4	1980	MULTINET	FORMALDEHYDE
2009410	ST10	12	PL181NET5	2008	MULTINET	ETHANOL
2009410	ST10	12	PL181NET5	2011	MULTINET	FORMALDEHYDE

B3 Bongo net samples

LOCATION	#	TAXA	DATE	STARTHAUL (LOCAL)	STOPHAUL	START FLOW METER	STOP FLOW METER	PRESERVATION	MESH (μ)	WEIGHT (kg)
ST2		BULK	2009.11.14	18:42		20632		ETHANOL	375	-
ST2	615	BULK	2009.11.14	18:42		94937		FORMALDEHYDE	500	-
ST2	660	BULK	2009.11.14	18:07	18:33	DUDD	20632	ETHANOL	375	
ST2	621	BULK	2009.11.14	18:07	18:33		94937	FORMALDEHYDE	500	0.0194
ST2	633	HETEROPOD	2009.11.14	18:07	18:33		94937	FORMALDEHYDE	500	
ST2	619	EUPHAUSID	2009.11.14	18:07	18:33		94938	FORMALDEHYDE	500	
ST2	203	BULK	2009.11.15	01:53	02:27	27173	31981	ETHANOL	375	
ST2	608	BULK	2009.11.15	01:53	02:27	4174	11066	FORMALDEHYDE	500	
ST2	666	BULK	2009.11.15	02:41	03:19	31981	39100	ETHANOL	375	
ST2	652	BULK	2009.11.15	02:41	03:19	11066	20426	FORMALDEHYDE	500	
ST2	651	BULK	2009.11.15	03:28	04:05	20426	28857	ETHANOL	375	
ST2	664	BULK	2009.11.15	03:28	04:05	39100	45318	FORMALDEHYDE	500	
ST2	663	BULK	2009.11.15	04:12	04:55	28857	38198	ETHANOL	375	
ST2	649	BULK	2009.11.15	04:12	04:55	45138	51886	FORMALDEHYDE	500	
ST2	655	BULK	2009.11.15	16:22	16:50	38198	44362	ETHANOL	375	
ST2	672	BULK	2009.11.15	16:22	16:50	51886	56512	FORMALDEHYDE	500	
ST2	688	BULK	2009.11.15	16:57	17:30	56512	60587	ETHANOL	375	
ST2	657	BULK	2009.11.15	16:57	17:30	44362	51595	FORMALDEHYDE	500	
ST4	689	BULK	2009.11.18	19:55	20:27	64534	68229	ETHANOL	375	
ST4	690	BULK	2009.11.18	19:55	20:27	58277	62663	FORMALDEHYDE	500	
ST4	676	BULK	2009.11.18	21:00	21:32	68229	72171	ETHANOL	375	
ST4	675	BULK	2009.11.18	21:00	21:32	62663	68013	FORMALDEHYDE	500	
ST4	691	BULK	2009.11.18	21:35	22:05	68013	74378	FORMALDEHYDE	500	tommy
ST4	1422	BULK	2009.11.19	14:40	15:10	76659	80193	ETHANOL	375	
ST4	1617	BULK	2009.11.19	14:40	15:10	74379	78863	FORMALDEHYDE	500	
ST4	1761	BULK	2009.11.19	15:15	15:50	80193	89507	ETHANOL	375	
ST4	1338	BULK	2009.11.19	15:15	15:50	78863	86932	FORMALDEHYDE	500	
ST4	1399	BULK	2009.11.19	16:00	16:32	86932	92643	FORMALDEHYDE	500	tommy
ST5	1867	BULK	2009.11.22	01:16	01:51	93085	4181	FORMALDEHYDE	500	tommy
ST5	None	BULK	2009.11.22	01:16	01:51	89756	94331	dried	375	tommy
ST5	1817	BULK	2009.11.22	01:55	02:32	4181	15624	FORMALDEHYDE	500	
ST5	1873	BULK	2009.11.22	01:55	02:32	94331	97123	ETHANOL	375	
ST5	1901	BULK	2009.11.22	02:35	03:05	15624	21624	FORMALDEHYDE	500	

ST5	1845	BULK	2009.11.22	02:35	03:05	97123	99376	ETHANOL	375	
	2785	BULK	2009.11.24	21:30	22:10	21631	30210	FORMALDEHYDE	500	tommy
	None	BULK	2009.11.24	21:30	22:10	99376	2332	dried	375	tommy
	2902	BULK	2009.11.24	22:10	2240	2332	4676	ETHANOL	375	
	2933	BULK	2009.11.24	22:10	2240	30210	36789	FORMALDEHYDE	500	
	2906	BULK	2009.11.24	22:40	2315	4676	6605	ETHANOL	375	
	2961	BULK	2009.11.24	22:40	2315	36789	43943	FORMALDEHYDE	500	
	2815	BULK	2009.11.25	21:05	21:35	43943	51325	FORMALDEHYDE	500	tommy
	None	BULK	2009.11.25	21:05	21:35	6605	8602	dried	375	tommy
	2840	BULK	2009.11.25	21:35	22:02	8602	10812	ETHANOL	375	
	2832	BULK	2009.11.25	21:35	22:02	51325	56864	FORMALDEHYDE	500	
	2776	BULK	2009.11.25	22:02	22:32	10812	12980	ETHANOL	375	
	2788	BULK	2009.11.25	22:02	22:32	56864	76619	FORMALDEHYDE	500	
	2499	BULK	2009.11.27	13:51	14:23	61994	70072	FORMALDEHYDE	500	
	2527	BULK	2009.11.27	13:51	14:23	12980	15968	ETHANOL	375	
	2528	BULK	2009.11.27	14:23	14:58	70072	79781	FORMALDEHYDE	500	tommy
	None	BULK	2009.11.27	14:23	14:58	15968	19170	dried	375	tommy
	2867	BULK	2009.11.27	18:10	18:45	79781	85554	FORMALDEHYDE	500	
	2895	BULK	2009.11.27	18:10	18:45	19170	21681	ETHANOL	375	
	3899	BULK	2009.11.29	18:10	18:47	21681	24603	ETHANOL	375	
	3313	BULK	2009.11.29	18:10	18:47	85554	94101	FORMALDEHYDE	500	
	3975	BULK	2009.11.29	19:55	20:25	28559	32205	ETHANOL	375	
	3947	BULK	2009.11.29	19:55	20:25	3533	11434	FORMALDEHYDE	500	
	4059	BULK	2009.11.29	20:30	21:02	32205	36270	ETHANOL	375	
	4003	BULK	2009.11.29	20:30	21:02	11434	20321	FORMALDEHYDE	500	
	2918	BULK	2009.11.30	17:55	18:25	38289	41038	ETHANOL	375	
	2690	BULK	2009.11.30	17:55	18:25	26670	32467	FORMALDEHYDE	500	
	4657	BULK	2009.12.02	13:25	13:55	41030	44887	ETHANOL	375	
	4713	BULK	2009.12.02	13:25	13:55	32480	39906	FORMALDEHYDE	500	
	4901	BULK	2009.12.02	13:59	14:22	39906	45372	FORMALDEHYDE	500	
	4629	BULK	2009.12.02	13:59	14:22	44887	47272	ETHANOL	375	
	4077	BULK	2009.12.02	14:23	14:58	45372	51749	FORMALDEHYDE	500	tommy
	None	BULK	2009.12.02	14:23	14:58	47272	50845	dried	375	tommy
	6005	BULK	2009.12.02	19:50	20:21	51749	59814	FORMALDEHYDE	500	
	5979	BULK	2009.12.02	19:50	20:21	50845	54545	ETHANOL	375	
	5923	BULK	2009.12.02	20:30	20:55	59814	68056	FORMALDEHYDE	500	

	5951	BULK	2009.12.02	20:30	20:55	54545	58277	ETHANOL	375	
	5977	BULK	2009.12.02	21:03	21:40	68057	77744	FORMALDEHYDE	500	tommy
	None	BULK	2009.12.02	21:03	21:40	58277	62808	dried	375	tommy
	5801	BULK	2009.12.08	08:15	08:45	62589	67488	ETHANOL	375	
	5824	BULK	2009.12.08	08:15	08:45	77815	86942	FORMALDEHYDE	500	
	5745	BULK	2009.12.08	08:50	09:36	67488	71620	ETHANOL	375	
	5773	BULK	2009.12.08	08:50	09:36	86942	97309	FORMALDEHYDE	500	
	5972	BULK	2009.12.08	19:50	20:25	75355	79195	ETHANOL	375	
	5832	BULK	2009.12.08	19:50	20:25	5050	15138	FORMALDEHYDE	500	
	6000	BULK	2009.12.08	20:30	21:05	79195	82645	ETHANOL	375	
	5916	BULK	2009.12.08	20:30	21:05	15138	2573	FORMALDEHYDE	500	
ST10	4683	BULK	2009.12.12	20:42	21:25	44838	55394	FORMALDEHYDE	500	
ST10	6205	BULK	2009.12.12	20:42	21:25	90844	95956	ETHANOL	375	
ST10	5864	BULK	2009.12.12	21:27	21:56	55394	63385	FORMALDEHYDE	500	
ST10	6183	BULK	2009.12.12	21:27	21:56	95956	99326	ETHANOL	375	
	4847	BULK	2009.12.13	13:20	14:10	99326	3968	ETHANOL	375	
	4765	BULK	2009.12.13	13:20	14:10	63385	74341	FORMALDEHYDE	500	
	4277	BULK	2009.12.13	14:12	14:57	3968	8254	ETHANOL	375	
	4875	BULK	2009.12.13	14:12	14:57	74341	84309	FORMALDEHYDE	500	

Appendix C Zoological Society of London Genetics Samples by Sample box (numbers indicate sample number)

1 **5618**	**2** **6250**	**3** **6276**	**4** **5188**	**5** **5132**	**6** **5074**	**7** **5046**	**8** **6043**	**9** **5590**
10 **6375**	**11** **5216**	**12** **5417**	**13** **6332**	**14** **5160**	**15** **5480**	**16** **5166**	**17** **5018**	**18** **6304**
19 **5487**	**20** **4359**	**21** **4417**	**22** **4912**	**23** **4081**	**24** **5722**	**25** **5668**	**26** **5263**	**27** **4775**
28 **4791**	**29** **5620**	**30** **6082**	**31** **5543**	**32** **5123**	**33** **5151**	**34** **5207**	**35** **5233**	**36** **5749**
37 **4249**	**38** **5259**	**39** **5156**	**40** **5699**	**41** **5162**	**42** **5095**	**43** **5340**	**44** **5179**	**45** **4552**
46 **4288**	**47** **4400**	**48** **4184**	**49** **4263**	**50** **4553**	**51** **4267**	**52** **4494**	**53** **4173**	**54** **4472**
55 **4100**	**56** **4187**	**57** **4895**	**58** **4911**	**59** **4524**	**60**	**61**	**62**	**63**
64	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter A Samples Station 7 Event 15

1 **5719**	**2** **6295**	**3** **6314**	**4** **5793**	**5** **5775**	**6** **5741**	**7** **5716**	**8** **6208**	**9** **5016**
10 **5796**	**11** **5196**	**12** **5824**	**13** **5770**	**14** **5737**	**15** **5683**	**16** **5714**	**17** **4623**	**18** **5102**
19 **5315**	**20** **5686**	**21** **5657**	**22** **6342**	**23** **6272**	**24** **5685**	**25** **5787**	**26** **5765**	**27** **5826**
28 **5492**	**29** **5742**	**30** **5821**	**31** **5744**	**32** **6258**	**33** **5713**	**34** **5655**	**35** **6129**	**36** **6112**
37 **5128**	**38** **5044**	**39** **4805**	**40** **4293**	**41** **5269**	**42** **5408**	**43** **5676**	**44** **6298**	**45** **4838**
46 **5404**	**47** **5473**	**48** **5803**	**49** **4321**	**50** **5241**	**51** **5772**	**52** **5646**	**53** **4435**	**54** **5415**
55 **5783**	**56** **6322**	**57** **6145**	**58** **5348**	**59** **5325**	**60** **5379**	**61** **5376**	**62** **5297**	**63** **6268**
64 **5482**	**65** **5454**	**66** **5738**	**67** **5008**	**68** **5789**	**69** **5758**	**70** **5817**	**71** **6107**	**72** **5374**
73 **5451**	**74** **6398**	**75** **5510**	**76** **6059**	**77** **6160**	**78** **4403**	**79** **5334**	**80** **6188**	**81** **4851**

Box Letter B Samples

1 **1479**	**2** **1507**	**3** **1533**	**4** **1571**	**5** **1459**	**6** **1503**	**7** **1324**	**8** **1589**	**9** **1475**
10 **1435**	**11** **1463**	**12** **1491**	**13** **1431**	**14** **1591**	**15** **1358**	**16** **1543**	**17** **1477**	**18** **1561**
19 **1330**	**20** **1487**	**21** **1471**	**22** **1505**	**23** **1668**	**24** **236**	**25 Sta 4 Ev 22** **Isididae**	**26** **5830**	**27**
28	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
37	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
46	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**
55	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
64	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter C Samples Station 4 Event 22

1 **5679**	**2** **4398**	**3** **1969**	**4** **4780**	**5** **6357**	**6** **6396**	**7** **5651**	**8** **5120**	**9** **5798**
10 **5183**	**11** **6159**	**12** **1911**	**13** **4725**	**14** **6372**	**15** **6008**	**16** **6040**	**17** **6265**	**18** **5345**
19 **5280**	**20** **5240**	**21** **4831**	**22** **4337**	**23** **6053**	**24** **5866**	**25** **6266**	**26** **6237**	**27** **5242**
28 **5363**	**29** **6132**	**30** **4866**	**31** **2146**	**32** **6101**	**33** **5980**	**34** **6294**	**35** **6293**	**36** **5413**
37 **4752**	**38** **5280**	**39** **4309**	**40** **6369**	**41** **4307**	**42** **6233**	**43** **6240**	**44** **5270**	**45** **5894**
46 **4103**	**47** **5223**	**48** **5521**	**49** **6290**	**50** **5755**	**51** **6358**	**52** **5391**	**53** **5950**	**54** **5295**
55 **4447**	**56** **5308**	**57** **3002**	**58** **6318**	**59** **4821**	**60** **6015**	**61** **6386**	**62** **5922**	**63** **5819**
64 **4478**	**65** **5319**	**66** **4123**	**67** **4872**	**68** **6344**	**69** **6125**	**70** **6320**	**71** **6006**	**72** **6173**
73 **4370**	**74** **5002**	**75** **5056**	**76** **5844**	**77** **5839**	**78** **6108**	**79** **6201**	**80** **5946**	**81** **5350**

Box Letter D Samples

1 **4283**	**2** **4998**	**3** **4869**	**4** **4195**	**5** **4742**	**6** **5462**	**7** **5700**	**8** **4405**	**9** **4712**
10 **4884**	**11** **5000**	**12** **4770**	**13** **4792**	**14** **4301**	**15** **4139**	**16** **2115**	**17 Sta8 Ev17** **Mesobius**	**18** **5953**
19 **5639**	**20** **5640**	**21** **5464**	**22** **5612**	**23** **5472**	**24** **5500**	**25** **5528**	**26** **4974**	**27** **4424**
28 **5585**	**29** **5557**	**30** **5672**	**31** **5728**	**32** **5735**	**33** **5763**	**34** **5756**	**35** **5784**	**36** **5812**
37 **4933**	**38** **4905**	**39** **4082**	**40** **5800**	**41** **5641**	**42** **5529**	**43** **5613**	**44** **5475**	**45** **5307**
46 **5996**	**47** **5448**	**48** **5925**	**49** **4994**	**50**	**51**	**52**	**53**	**54**
55	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
64	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter E Samples Station 8 Event 17

1 **3769**	**2** **3903**	**3** **3744**	**4** **3858**	**5** **3855**	**6** **3832**	**7** **3066**	**8** **3907**	**9** **3730**
10 **3770**	**11** **3906**	**12** **3016**	**13** **3010**	**14** **3877**	**15** **3745**	**16** **3061**	**17** **3782**	**18** **3720**
19 **3913**	**20** **3431**	**21** **3794**	**22** **3875**	**23** **3766**	**24** **3883**	**25** **3950**	**26** **3401**	**27** **3266**
28 **3473**	**29** **3434**	**30** **3375**	**31** **3250**	**32** **3247**	**33** **3281**	**34** **3325**	**35** **3262**	**36** **3998**
37 **3199**	**38** **3227**	**39** **3398**	**40** **4045**	**41** **3686**	**42** **3305**	**43** **3478**	**44** **3333**	**45** **3120**
46 **3087**	**47** **3345**	**48** **3261**	**49** **3084**	**50** **3499**	**51** **3527**	**52** **2119**	**53** **2065**	**54** **2093**
55 **3209**	**56** **2872**	**57** **3533**	**58** **3488**	**59** **3168**	**60** **2143**	**61** **2978**	**62** **3193**	**63** **3312**
64 **3828**	**65Unlabelled** **St6 Ev13**	**66** **2012**	**67** **3520**	**68**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter F Samples Station 6 Events 11,12,13

1 **232**	**2** **232**	**3** **232**	**4** **232**	**5** **232**	**6** **232**	**7** **232**	**8** **232**	**9** **232**
10 **232**	**11** **232**	**12** **232**	**13** **232**	**14** **232**	**15** **232**	**16** **232**	**17** **232**	**18** **232**
19 **232**	**20** **232**	**21** **232**	**22** **232**	**23** **232**	**24** **232**	**25** **232**	**26** **232**	**27** **232**
28 **232**	**29** **232**	**30** **232**	**31** **232**	**32** **232**	**33** **232**	**34** **232**	**35** **232**	**36** **232**
37 **232**	**38** **232**	**39** **232**	**40** **232**	**41** **232**	**42** **232**	**43** **232**	**44** **232**	**45** **232**
46 **232**	**47** **232**	**48** **232**	**49** **232**	**50** **232**	**51** **232**	**52** **232**	**53** **232**	**54** **232**
55 **232**	**56** **232**	**57** **232**	**58** **232**	**59** **232**	**60** **232**	**61** **232**	**62** **232**	**63** **232**
64 **232**	**65** **232**	**66** **232**	**67** **232**	**68** **232**	**69** **232**	**70** **232**	**71** **232**	**72** **232**
73 **232**	**74** **232**	**75** **232**	**76** **232**	**77** **232**	**78** **232**	**79** **232**	**80** **232**	**81** **232**

Box Letter G Samples *Cyclothone*

1 **3267**	**2** **3615**	**3** **2736**	**4** **3136**	**5** **3160**	**6** **3612**	**7** **3556**	**8** **3147**	**9** **3180**
10 **3192**	**11** **3528**	**12** **4072**	**13** **2909**	**14** **3235**	**15** **3113**	**16** **3059**	**17** **2869**	**18** **3122**
19 **3150**	**20** **4067**	**21** **3311**	**22** **3347**	**23** **3628**	**24** **3182**	**25** **3207**	**26** **4024**	**27** **3121**
28 **3245**	**29** **3255**	**30** **3129**	**31** **3099**	**32** **3127**	**33** **3142**	**34** **4063**	**35** **2903**	**36** **2668**
37 **3497**	**38** **4057**	**39** **3512**	**40** **3761**	**41** **3901**	**42** **3708**	**43** **3540**	**44** **3568**	**45** **2661**
46 **3566**	**47** **3253**	**48** **3710**	**49** **3654**	**50** **3601**	**51** **3669**	**52** **2640**	**53** **2696**	**54** **4001**
55 **3667**	**56** **2663**	**57** **2635**	**58** **4488**	**59** **3620**	**60** **4023**	**61** **3841**	**62** **3871**	**63** **3819**
64 **3680**	**65** **3835**	**66** **3188**	**67** **3204**	**68**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter H Samples Station 6 Events 25,26 Station 7 Events 13,14

1 **1990**	**2** **1678**	**3** **1420**	**4** **2126**	**5** **2066**	**6** **1336**	**7** **1509**	**8 Sta 5 Ev 8** **Egg**	**9 Sta 5 Ev 8** **Zoea**
10 **2275**	**11** **2172**	**12** **2200**	**13** **2226**	**14** **2202**	**15** **2230**	**16** **2224**	**17** **2311**	**18 Sta 5 Ev9** **Polychaete**
19 **2207**	**20** **2221**	**21** **2161**	**22** **2088**	**23** **1909**	**24** **2311**	**25** **2198**	**26** **2304**	**27** **2205**
28 **2339**	**29** **2235**	**30** **2258**	**31** **2165**	**32** **2144**	**33** **2278**	**34** **2283**	**35** **1670**	**36** **2197**
37 **2294**	**38** **2024**	**39** **1961**	**40** **1976**	**41** **1989**	**42** **2186**	**43** **2351**	**44** **2255**	**45** **2342**
46 **2448**	**47** **1920**	**48** **2407**	**49** **2424**	**50** **1446**	**51** **2000**	**52** **1950**	**53** **2023**	**54** **3391**
55 **3447**	**56** **2016**	**57** **1997**	**58** **2150**	**59** **1967**	**60** **2101**	**61** **2153**	**62** **2154**	**63** **2059**
64 **3363**	**65** **1790**	**66** **1352**	**67**	**68**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter I Samples Station 5 Events 8, 9, 23, 24, 26

1 **329**	**2** **1234**	**3** **306**	**4** **398**	**5** **222**	**6** **694**	**7** **679**	**8** **677**	**9** **92**
10 **943**	**11** **56**	**12** **463**	**13** **407**	**14** **1256**	**15** **1254**	**16** **208**	**17** **90**	**18** **86**
19 **388**	**20** **48**	**21** **1248**	**22** **411**	**23** **249**	**24** **941**	**25** **1303**	**26** **75**	**27** **277**
28 **901**	**29** **899**	**30** **211**	**31** **89**	**32** **62**	**33** **54**	**34** **1238**	**35** **1266**	**36** **291**
37 **258**	**38** **244**	**39** **1002**	**40** **91**	**41** **1226**	**42** **494**	**43** **267**	**44** **235**	**45** **343**
46 **2643**	**47 Sta 7 Ev14** **Periphyllia**	**48** **2698**	**49** **2726**	**50** **609**	**51** **226**	**52** **1276**	**53** **1221**	**54** **1272**
55 **1304**	**56** **1259**	**57** **1319**	**58** **971**	**59** **742**	**60** **281**	**61** **751**	**62** **446**	**63** **1294**
64 **212**	**65** **1249**	**66** **599**	**67** **756**	**68**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter J

Samples Station 4 Events 4,19; Station 7 Event 14

1 **2090**	**2** **2095**	**3** **1965**	**4** **2089**	**5** **2117**	**6** **2149**	**7** **2129**	**8** **2027**	**9** **5998**
10 **2118**	**11** **2122**	**12** **2061**	**13** **2091**	**14** **1971**	**15** **1993**	**16** **1937**	**17** **2064**	**18** **2120**
19 **5878**	**20** **5990**	**21** **5934**	**22** **1958**	**23** **2147**	**24** **2092**	**25** **2025**	**26** **1984**	**27** **4419**
28 **4278**	**29** **5849**	**30** **5961**	**31** **4841**	**32** **2042**	**33** **2087**	**34** **4413**	**35** **5855**	**36** **4953**
37 **5893**	**38** **5887**	**39** **5929**	**40** **4167**	**41** **5850**	**42** **4786**	**43** **4223**	**44** **4652**	**45** **4680**
46 **5865**	**47** **4111**	**48** **4736**	**49** **4385**	**50** **4981**	**51** **1995**	**52** **1928**	**53** **2014**	**54** **1986**
55 **1956**	**56** **5909**	**57** **5993**	**58** **5937**	**59** **4255**	**60** **4110**	**61** **4368**	**62** **1941**	**63** **2125**
64 **5994**	**65** **5965**	**66** **5881**	**67** **2044**	**68** **2151**	**69** **2123**	**70** **2021**	**71** **1999**	**72** **2145**
73 **2062**	**74** **2148**	**75** **2040**	**76** **1913**	**77** **1930**	**78**	**79**	**80**	**81**

Box Letter K

Samples Station 8 Events 12, 13, 17

1 **10**	**2** **1311**	**3** **1311**	**4** **1311**	**5** **1311**	**6** **1311**	**7** **1311**	**8** **1311**	**9** **1311**
10 **1311**	**11** **1311**	**12** **1311**	**13** **1311**	**14** **1311**	**15** **1311**	**16** **1311**	**17** **1311**	**18** **1311**
19 **1311**	**20** **650**	**21** **650**	**22** **650**	**23** **650**	**24** **650**	**25** **650**	**26** **650**	**27** **650**
28 **650**	**29** **650**	**30** **650**	**31** **650**	**32** **792**	**33** **650**	**34** **650**	**35** **650**	**36** **833**
37 **474**	**38** **435**	**39** **473**	**40** **419**	**41** **484**	**42** **376**	**43** **440**	**44** **460**	**45** **378**
46 **475**	**47** **365**	**48** **420**	**49** **462**	**50** **429**	**51** **373**	**52** **910**	**53** **371**	**54** **433**
55 **443**	**56** **36**	**57** **421**	**58** **366**	**59** **370**	**60** **459**	**61** **444**	**62** **532**	**63** **461**
64 **447**	**65** **426**	**66** **372**	**67** **472**	**68** **20**	**69**	**70**	**71**	**72**
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**

Box Letter L

Samples Station 2 Net 1 Event 14; station 4 Event 4