NORAD-FAO PROGRAMME
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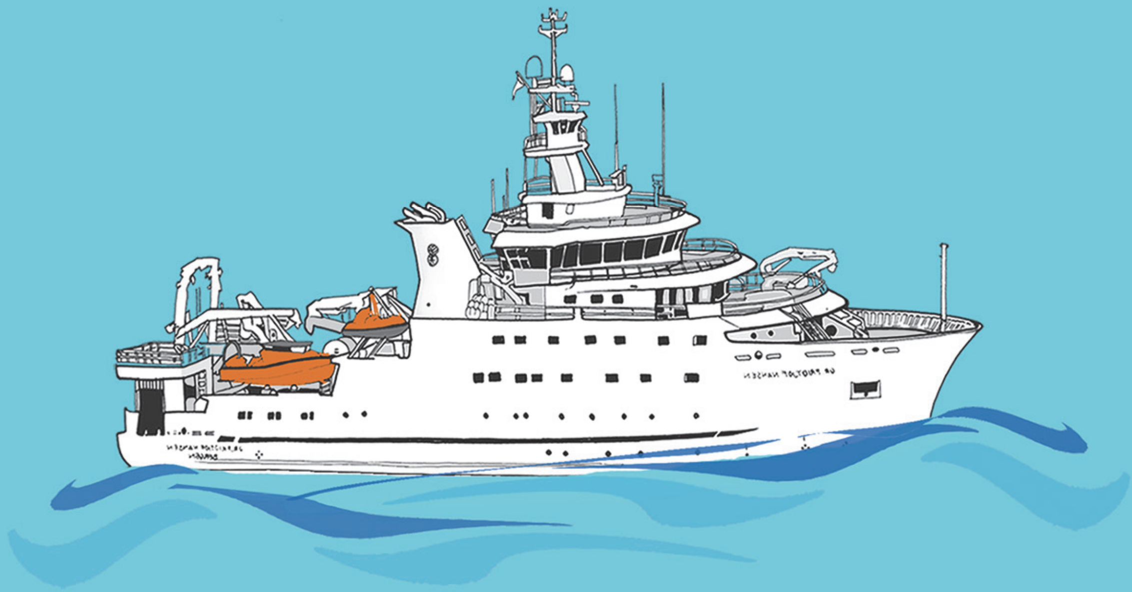
CRUISE REPORTS *DR FRIDTJOF NANSEN*
EAF-Nansen/CR/2019/1



INVESTIGATION OF VULNERABLE MARINE ECOSYSTEMS (VMES), FISHERIES RESOURCES AND BIODIVERSITY OF SELECTED SEAMOUNT COMPLEXES OF THE CONVENTION AREA OF THE SOUTH EAST ATLANTIC FISHERIES ORGANISATION (SEAFO)

24 January – 24 February 2019

South East Atlantic Fisheries Organisation
Swakopmund, Namibia

Institute of Marine Research
Bergen, Norway

THE EAF-NANSEN PROGRAMME (2017–2021)

The EAF-Nansen Programme "Supporting the Application of the Ecosystem Approach to Fisheries Management considering Climate and Pollution Impacts" supports partner countries and regional organizations in Africa and the Bay of Bengal improving their capacity for the sustainable management of their fisheries and other uses of marine and coastal resources through the implementation of the Ecosystem Approach to Fisheries (EAF), taking into consideration the impacts of the climate and pollution.

The Programme is executed by the Food and Agriculture Organization of the United Nations (FAO) in close collaboration with the Institute of Marine Research (IMR) of Bergen, Norway, and funded by the Norwegian Agency for Development Cooperation (Norad). This Programme is the current phase (2017–2021) of the Nansen Programme which started in 1975.

The aim of the Programme is that sustainable fisheries improve food and nutrition security for people in partner countries. It builds on three pillars, Science, Fisheries Management, and Capacity Development, and supports partner countries to produce relevant and timely evidence-based advice for management, to manage fisheries according to the EAF principles and to further develop their human and organizational capacity to manage fisheries sustainably. In line with the EAF principles, the Programme adopts a broad scope, taking into consideration a wide range of impacts of human activities and natural processes on marine resources and ecosystems including fisheries, pollution, climate variability and change.

A new state of the art research vessel, the *Dr Fridtjof Nansen*, is an integral part of the Programme. A comprehensive science plan, covering a broad selection of research areas, and directed at producing knowledge for informing policy and management decisions, guides the Programme's scientific work.

The Programme works in partnership with countries, regional organizations, other UN agencies as well as other partner projects and institutions.

LE PROGRAMME EAF-NANSEN (2017-2021)

Le programme EAF-Nansen « Soutenir l'application de l'approche écosystémique pour la gestion des pêches compte tenu des impacts du climat et de la pollution » appui les pays partenaires et les organisations régionales en Afrique et dans le golfe du Bengale pour améliorer leur capacité de gestion durable de leurs pêcheries et d'autres usages de la mer ainsi que les ressources côtières, grâce à la mise en œuvre de l'Approche écosystémique des pêches (AEP), en tenant compte des impacts du climat et de la pollution.

Le programme est exécuté par l'Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO) en étroite collaboration avec l'Institut de recherche marine (IMR) de Bergen, en Norvège, et financé par l'Agence norvégienne de coopération au développement (Norad). Ce programme est la phase actuelle (2017-2021) du programme Nansen qui a débuté en 1975.

L'objectif du programme est que la pêche durable améliore la sécurité alimentaire et nutritionnelle des populations des pays partenaires. Il s'appuie sur trois piliers, la science, la gestion des pêches et le développement des capacités, et aide les pays partenaires à produire des avis pertinents et opportuns fondés sur des données factuelles pour la gestion, à gérer les pêcheries conformément aux principes de l'AEP et à développer davantage leur capacité humaine et organisationnelle à gérer durablement les pêches. Conformément aux principes de l'AEP, le programme adopte une large vision, prenant en considération un large éventail d'impacts des activités humaines et des processus naturels sur les ressources et les écosystèmes marins, y compris la pêche, la pollution, la variabilité et le changement climatique.

Un nouveau navire de recherche de pointe, le *Dr Fridtjof Nansen*, fait partie intégrante du programme. Un plan scientifique complet, couvrant un large éventail de domaines de recherche et visant à produire des connaissances pour éclairer les décisions de politique et de gestion, guide les travaux scientifiques du programme.

Le programme travaille en partenariat avec des pays, des organisations régionales, d'autres agences des Nations Unies ainsi que d'autres projets et institutions partenaires.

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CRUISE REPORTS *DR FRIDTJOF NANSEN*

INVESTIGATION OF VULNERABLE MARINE ECOSYSTEMS (VMES), FISHERIES RESOURCES AND BIODIVERSITY OF SELECTED SEAMOUNT COMPLEXES IN THE CONVENTION AREA OF THE SOUTH EAST ATLANTIC FISHERIES ORGANISATION (SEAFO)

24 January - 24 February 2019

by

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Institute of Marine Research
Bergen, 2020

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EXECUTIVE SUMMARY

In January-February 2019 the R/V *Dr Fridtjof Nansen* conducted a 29-day survey to seamounts in the Discovery Seamount complex in Sub-Area D of the SEAFO Convention Convention Area. The cruise was part of a scientific study conducted by an international team of scientists, most of whom represented the SEAFO Contracting Parties. The overall objective of the study was to conduct basic mapping and identification of vulnerable marine ecosystems (VMEs) and fisheries resources on selected seamounts and seamount complexes in the SEAFO Convention Area. Some of the areas studied are currently closed to fishing whereas others are being or have been fished for Patagonian toothfish.

The study area covered seven main seamounts known as the Discovery Seamounts. Five of these were investigated during this cruise, including Discovery, Shannon, Herdman, Tablemount and Schwabenland seamounts. Unfortunately, bad weather prevented studies on seamounts in the area further south-west (Western Seamounts).

The report presents first results on bathymetry, VME-indicator organism presence, and mesopelagic communities from the seamounts and along the transit between Cape Town and Discovery Seamounts. The seabed was surveyed at depths between 400 and 1800 m, with ROV at 14 locations. VME-indicator organism (gorgonians, black corals, lace corals, solitary stone corals and sponges) were observed at all locations, with varying taxonomic compositions and dominance.

The highest densities were observed at Tablemount and Discovery seamount. Most common were Isidiidae and Primnoidae octocorals, but lace corals, sponges, and crinoids were also locally abundant. In general, the abundance of VME indicator species was low at the summit of the seamounts, high near the edges, and moderate on the slopes of the sides of the seamounts. The highest VME abundance was observed at st 13, at the northern part of Discovery Seamount.

Colonial scleractinians were not observed at any location. The megafauna was diverse, and more than 200 taxa were observed in the field. In addition to the VME taxa mentioned above several taxa, such as balanoid and scalpellid cirripeds, dominated locally. No evidence of human footprint was observed, but extensive grazing on bamboo corals (*Keratoisis sp.*) by an un-identified sea urchin (Echinidea) was observed at one location at depths between 850 m and 960 m.

CHAPTER 1. INTRODUCTION

1.1 Background

The overall framework and rationale for the surveys carried out by the R/V *Dr Fridtjof Nansen* as contributions to the EAF-Nansen Programme are described in the EAF-Nansen Science Plan which has three main pillars and 11 research themes. Within this framework, the survey aimed to explore and map benthic habitats and biota, and study fish resources on selected seamounts of the SEAFO Convention Area. These efforts are contributions to Themes 7 and 11.

SEAFO as a regional fisheries management organization (RFMO) endeavours to calls expressed in the United Nations General Assembly (UNGA) resolution 61/105 (and later) by implementing conservation measures in accordance with the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO 2009, http://www.fao.org/docrep/011/i0816t/i0816t00.htm), that includes the definition of Vulnerable Marine Ecosystems.

FAO defines a vulnerable marine ecosystem (VME) as "groups of species, communities, or habitats that may be vulnerable to impacts from fishing activities", that is, the likelihood that a community or habitat will experience substantial alteration to a significant adverse impact, which compromises the structure or function of ecosystem. VMEs are usually formed by coral and sponge communities, which are characterized by a maturation at relatively old age, slow growth rates, long life expectancies, and low or unpredictable recruitment. Thus, these habitats should be reviewed for application of protective measures. Seamounts are often associated with fragile biological communities and with high levels of endemism, thus they are considered VMEs. However, it is necessary to study case-by-case because the range of physical and chemical environments and biological communities are very different.

In the 2015 cruise report (FAO, 2015), the planned trajectory of the cruise included seamounts across a wide area, but due to unfavorable weather, an important fishing area for toothfish, i.e. the Discovery Seamount complex had to be abandoned. In its meeting in 2015, the Scientific Committee expressed appreciation of the efforts in the 2015 cruise, but at the same time formulated priorities for new cruises, should opportunities arise. In the report from the 2015 Scientific Committee (SC), the following priority was expressed:

Chapter 21.11 The SC considered alternative study areas for future scientific cruises, if opportunities arise. It was agreed to prioritize two such areas within the CA, both including existing fishing areas and fishing closures. The two areas are:

a) Discovery and West Seamount complexes in Sub-Area D, including Closures #12 and 14. [#14 and 15 changed numbers to 6 and 7].

b) Existing fishing areas and Closure #1 in SEAFO Division A1, if possible, all closures and existing fishing areas in Sub-Area A.

The survey was planned following recommendations by the SEAFO Scientific Committee that had set priorities for work in understudied areas and had welcomed the possibility of the R/V *Dr Fridtjof Nansen* to carry out this study. It should be noted that despite a few surveys have been conducted earlier in this area, including in 2015 by the R/V *Dr Fridtjof Nansen*, it remains a challenge to SEAFO that ecosystems and biodiversity in the vast areas beyond national jurisdictions in the Southeast Atlantic are severely understudied. This report deals with the first results on the study of epifaunal and infaunal invertebrates collected on the Discovery Seamounts Complex area.

1.2 Study area

The areas planned to be sampled were selected seamounts and seamount complexes of the Southeast Atlantic (Figure 1), as well as mid-water stations along the transit between CT and the seamounts. Except two locations in South African EEZ, along the transit line, all study locations were in the area beyond national jurisdiction (ABNJ) within the Convention Area of the Southeast Atlantic Fisheries Organization (SEAFO, www.seafo.org). Unfortunately, bad weather restricted the available time during the survey, and it was decided to drop plans of reaching the West Seamount area. Discovery Seamounts are a chain of seamounts in the Southern Atlantic Ocean, which include the Discovery Seamount. The seamounts were formed between 41 and 35 million years ago.

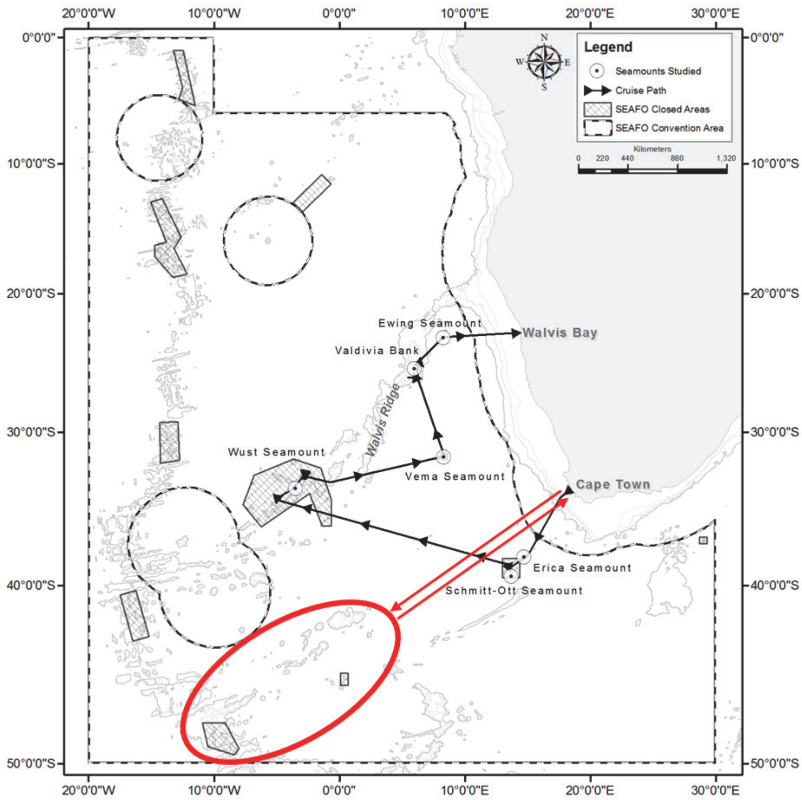


Figure 1. The Convention Area of SEAFO (area within hatched border) and the area to be studied on the 2019 cruise (encircled in red). The survey trajectory of a previous DFN cruise to SEAFO seamounts, in 2015, is also included (black line from Cape Town to Walvis Bay). Hatched areas within the SEAFO CA are closed to fishing to protect VMEs.

1.3 Objectives

The overriding goal of the 2019 cruise was to further develop the databases and collections to benefit regional science and enhance the global understanding of the Southeast Atlantic ecosystems. More concrete objectives were, as in 2015, to analyse occurrence and abundance of benthopelagic fish and sessile epibenthos, including indicators of VMEs, in selected 'existing fishing areas' and areas closed to fishing within the SEAFO Convention Area.

In addition to further mapping of VME taxa and fisheries resources - utilizing the enhanced capabilities of the new vessel - en route recording of mesopelagics, seabirds, and mammals, as well as the standard EAF-Nansen sampling regional biological and chemical oceanographic data, microplastics and litter etc. would also be undertaken. More specifically the survey would:

- Carry out detailed and accurate mapping of geomorphology, benthic habitats and benthos on upper slopes and summits of the seamounts where VMEs may be most likely to occur. The maximum VAMS sampling depth will be 2 000 m.
- Record occurrence and collect biological samples of main fish resources in the study area (Patagonian toothfish and accompanying species).
- Record occurrence of large epipelagic fish (tuna and tuna-like species, sharks), mammals, turtles and seabirds.
- Collect data on the physical, chemical and biological oceanography in the study area
- Record occurrence of marine debris and microplastics.
- During passage between Cape Town and the study areas, and between seamount summits, conduct acoustic recording of mesopelagic scattering layers.

1.4 Participation

Twenty scientific staff from six countries (Angola, Brazil, Namibia, Norway, South Africa, and Spain) participated in the survey (Table 1).

Table 1. List of survey participants.

	Participants	*Background*	*Institution*	*Country*
1	Buhl Mortensen, Pål	Principal scientist	IMR	Norway
2	Ensrud, Tor Magne	Technician	IMR	Norway
3	Olsen, Magne	Technician	IMR	Norway
4	Vågenes, Jan Arne	Acoustic engineer	IMR	Norway
5	Landa, Geir	Acoustic engineer	IMR	Norway
6	Larsen, Sindre Nygaard	Acoustics engineer	IMR	Norway
7	Roberto Sarralde	Fish and invertebrate biologist	IEO	Spain
8	Shivute, La-Toya	Fishery biologist	NatMIRC	Namibia
9	Tshimwadi, Fillipus	Student	NatMIRC	Namibia
10	Machado, Tiago	Fishery and crustacean biologist	NatMIRC	Namibia

	Participants	*Background*	*Institution*	*Country*
11	Arve Pedersen	Multibeam prosessering	BK Marine	Norway
12	Granville Louw	Fishery biologist (co cruise leader)	DAFF	South Africa
13	Alvarez Perez, Jose Angel	Fish and invertebrate biologist	Uni. of Vale do Itajaí	Brasil
14	Ramil, Fran	Fish and invertebrate biologist	Uni. of Vigo	Spain
15	Castillo, Sara	Fish and invertebrate biologist	Uni. of Vigo	Spain
16	Vena, Kanyisile	Chemical oceanography	DEA	South Africa
17	Mpafa, Zininzi	Dissolved Oxygen, DIC	DEA	South Africa
18	Botha, Thomas	Benthic Taxonomic identification	UCT	RSA
19	Gumede, Nosipho	Top predators	DEA	South Africa
20	Nsaku, Domingas	Fishery biologist	INIP	Angola

1.5 Narrative

The R/V *Dr Fridtjof Nansen* departed from Cape Town on 25 January, at 18:00 hrs. The departure was delayed due to repair of gyro and testing of the VAMS. Transit to the survey area, the Discovery Seamount area, was used for cruise preparation meetings held in the auditorium onboard. The weather during steaming was good. The first survey station took place on 29 January, 22:00 hrs. Within the seamount area, the VAMS was deployed 18 times, five of which were aborted due to technical problems or too rough weather conditions. VAMS operation was restricted to daytime, and night shifts were allocated to bathymetric mapping with Multibeam Echosounder (MBE). The vessel was outside coverage of normal communication (Internet and telephone) from 26 January to 22 February and only communication via Iridium was possible. The weather was rough as expected, and restricted survey operations for a total of about two days. At its strongest, the wind speed was around 35 knots. The VAMS needed service during the survey and was not operational for two days. Survey of the seamount area finished on 15 February in the southern part of the survey area (Herdman Seamount). After transiting to the outer end of the transect between the seamount area and Cape Town, sampling of the mesopelagic communities started on late evening of 16 February. Six locations were sampled with pelagic trawl between the seamount area and the South African EEZ. In addition, two hauls were taken between the seamounts. Permission for sampling within the SA EEZ was not obtained in time. R/V *Dr Fridtjof Nansen* headed back to Cape Town early morning of 21 February. The vessel returned to Cape Town in the evening of 24 February. The survey was successfully completed despite challenging weather conditions and a valuable collection of biological specimens was delivered to the Iziko Museum in Cape Town, now being a source for further studies of taxonomy and systematics.

1.6 Survey Design

The survey aimed to sample the Discovery and West seamount complexes (Figures 2 and 3) as well as adjacent waters, in accordance with an agreed survey plan. The plan included video transects and sampling locations on the seamount, selected after studying the detailed topography from multibeam maps produced onboard. In addition, some sampling was conducted along the survey line between Cape Town and the study area.

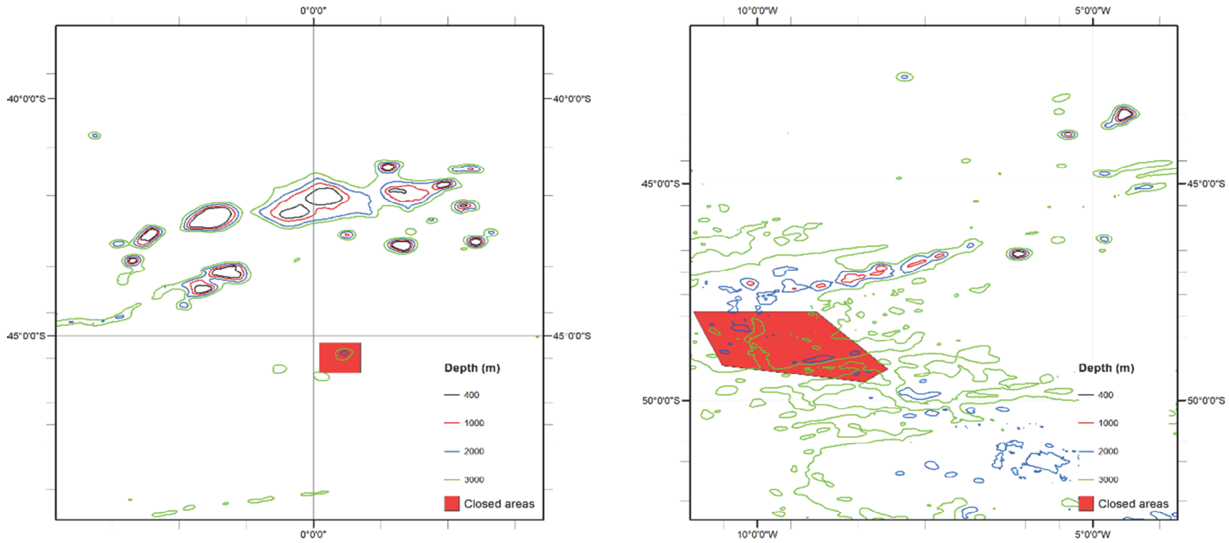


Figure 2. Subareas of the SEAFO CA selected for detailed studies: Discovery Seamounts (left), and West Seamounts (right). Special target areas are the fishing closures shown in red. Depth contours are from GEBCO and may be imprecise.

The multibeam mapping, video surveys and sampling started at the Shannon Seamount after following the southern transit line from Cape Town. Figure 3 shows the survey track of the cruise, and the northern transit line marks the return transit.

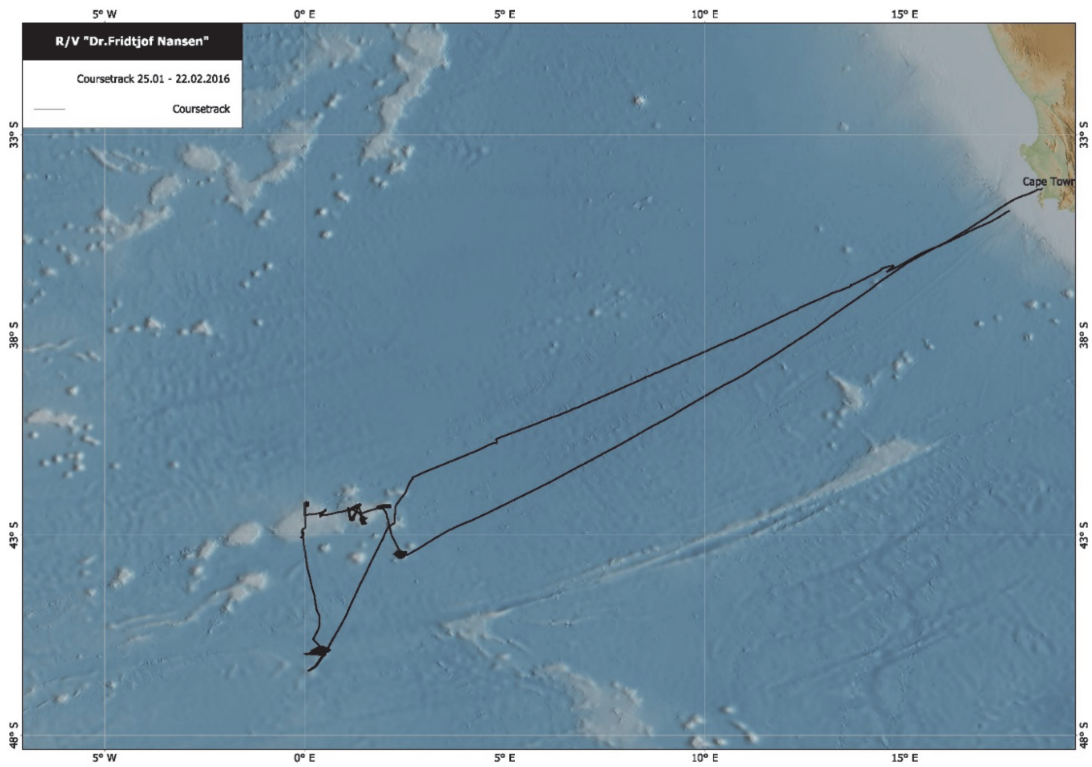


Figure 3. The survey track for R/V *Dr Fridtjof Nansen* during cruise # 2019401. The northern transit line marks the return transit.

CHAPTER 2. METHODS

Standard sampling procedures as conducted on all EAF-Nansen cruises were carried out at the study sites and during transit back to Cape Town from the Discovery Seamounts. These efforts will contribute to regional studies of physical and chemical oceanography including pH and alkalinity, records of primary productivity, food safety assessments, and the occurrence of microplastics and marine debris.

2.1 Meteorology, physical and chemical oceanography

The environmental setting of the biota is poorly known, and the aim was to characterize the physical and chemical properties, as well as pelagic primary productivity, of the waters in the survey area. The approach was to record physico-chemical environmental conditions (temperature, salinity, oxygen, chlorophyll, nutrients pH and alkalinity) along a transect from Cape Town to the Discovery Seamounts and at the seamounts.

Weather station

Wind direction and speed, air temperature, air pressure, and relative humidity are logged automatically every 60s with an DNMI Meteorology weather station.

CTD

One full-depth CTD cast was made before every VAMS transect. CTD stations were also taken along the passages between CT and the study area when recording/sampling mesopelagic scattering layers. Vertical profiles of temperature, salinity, fluorescence, and oxygen were obtained by the Seabird 911 down to a depth of 1 500m. Niskin water samplers (10 l) attached to the CTD-rosette were used to collect water at predefined depths. Water samples (20 ml) for nutrient analyses (nitrate, nitrite, silicate and phosphate) were taken from the Niskin water-bottles at 500 m, 400 m, 300 m, 200 m and 100 m.

Thermosalinograph

The SBE 21 Seacat thermosalinograph ran continuously during the survey obtaining samples of sea surface (at 4 m depth) salinity and relative temperature every 10 seconds. An attached in-line C3 Turner Design Submersible Fluorometer measured turbidity and chlorophyll-a levels.

Current speed and direction measurements (ADCP)

Two-hull-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments ran continuously during the survey. The frequency of the VMADCP are 75 and 150 kHz. The system is run in narrow band mode and data were averaged in 8 m vertical bins and stored on files for post survey processing.

pH and total alkalinity sampling and measurements

Water samples from the Niskin samplers (250 ml) were taken in borosilicate glass bottles using silicone tubing to reduce air contamination (similar as for oxygen samples) for spectrophotometric pH measurements in the water column (vertical resolution). Samples were collected at 500 m, 400 m, 300 m, 200 m and 100 m. pH was determined spectrophotometrically using a Diode array spectrophotometer and a pH sensitive indicator, the sulphonephtalein dye, m-cresol purple in 2 mM solution. Prior to analysis the samples were temperated to room temperature. Samples were measured in a 1-cm quartz cuvette directly after the sample analysis. Total alkalinity (AT) was determined using potentiometric titration with 0.1 N hydrochloric acid in an open cell. The accuracy was checked against Certified Reference Material (CRM) supplied by Scripps Inst of Oceanography (San Diego, USA)

2.2 Primary production and phytoplankton

Chlorophyll-*a* was sampled from the Niskin-samples (see above) associated with CTD casts.

For chlorophyll-*a* and phaeopigment measurements, water was collected (263 ml) at the standardized depths. The water was filtered using a 0.7µm filtration system (Munktell fiberglass filters Grade: MGF, vacuum 400 mm Hg) and stored at 20°C until analysis on shore by the Institute of Marine Research. The assay was performed by extraction with 90% acetone followed by centrifugation, and the measurements were taken with a fluorometer (model 10 AU, Turner Designs Inc., Sunnyvale, Ca., USA).

2.3 Microplastic

A manta trawl (designed and manufactured by Marcus Eriksen, 5 Gyres Institute) with a rectangular opening of 19 cm (height) × 61 cm (width) and net mesh size of 335 µm was used to collect microplastic at locations along the transit between the seamounts and Cape Town and at selected seamounts combined with CTD stations. The Manta trawl was towed at 2-3 knots (1-1.5 m/s) for 15 min.

2.4 Zooplancton

Oblique tows with a multinet (Midi 180 µm), were performed with 5 nets, separated into 200 m depth bins. Flow, depth and duration were recorded. Each plankton sample was divided into two equally large parts using a *Motoda plankton splitter*. One part was sized fractioned (2 000 um, 1 000 um and 180 um) and dried on aluminium dishes for biomass estimation. The other part was fixed in seawater with 4% final borax buffered formaldehyde solution for subsequent species identification on land. All data was punched in the plankton database.

2.5 Biological fish sampling

The target fish resource in the study area is Patagonian toothfish. Reported bycatches in the targeted longline fishery for toothfish include grenadiers (Macrouridae) and a few other fishes. Demersal fish were recorded during VAMS transects and, aimed to be captured with pelagic and demersal trawls. Unfortunately, it was not possible to use demersal trawl on the seamounts.

Pelagic trawl was used for target identification during the acoustic recording. The catch was sorted to lowest possible taxonomical level and subsamples taken to measure number and weight by species. Length measurements were taken for all pelagic and demersal species with an Electronic Fish Meter (SCANTROL) connected to a customized data acquisition system (Nansis). The total length of each fish was recorded to the nearest 1 cm below (rounding down to nearest cm). Voucher specimens of all fish taxa were preserved for subsequent deposition in the museum collection.

2.6 Acoustic recording of scattering layers and seamount-associated shoals

During passage between Cape Town and the seamount area, and between seamount summits, acoustic recording of mesopelagic scattering layers was conducted. As required, sampling for identification was conducted with midwater trawls.

A SIMRAD EK80 Scientific Split Beam Echo Sounders with transducers for 18, 38, 70, 120, 200 and 333 kHz mounted in drop keel was used. Datalogging was done to a max depth of 1 500 m at maximum pingrate ($1 \sim s^{-1}$, dependent on depth/ sample range).

2.7 Visual observation of large epipelagic fish (tuna and tuna-like species, sharks), mammals, turtles and seabirds

Large pelagic fish and airbreathing animals such as mammals and birds were recorded when sighted and facilities will be made available to record sightings.

2.8 Debris (litter on the surface and seabed)

This is a standard task on all DFN surveys and will be carried out by recording observations of surface litter as well as litter occurring in trawl samples and on videos at the seabed.

2.9 Bathymetry

Prior to the cruise, coarse maps of the bathymetry and substrates were generated from previous surveys and global bathymetries. The multibeam echosounder available on R/V *Dr Fridtjof Nansen* facilitate more detailed and accurate mapping that will be useful as baselines for further scientific studies and assessments. The approach was to use multibeam to map geomorphology in selected subareas and along pre-determined transects. Bathymetry was mapped using the Kongsberg EM 302, which is a multibeam echosounder with deep range. The multibeam activity was performed during nighttime.

2.10 Benthic habitats and benthos

Video recording of the seabed

Habitats were characterized following standard procedures using the ROV (Remotely Operated Vehicle) of the VAMS (Video-Assisted Multi Sampler) (Figure 4) and its HD video cameras. The VAMS was used both in parked mode and in towed-mode. During towed mode the VAMS was attempted to follow as much as possible straight pre-determined transects.

Benthic communities were characterized from the video records. Initial identification of megabenthos was carried out onboard the vessel, to be followed-up by later land-based post-processing.

Figure 4. VAMS (Video-assisted Multi Sampler), used for observation and collection of benthos and habitats during the survey.

For analyses of fish and cephalopods, each video profile was first observed continuously and stopped when fish or cephalopod were visualized. Morphotypes (defined by codes) were assigned to the recorded individuals, posteriorly classified into Orders and Classes. Classification in Families, Genera and Species levels were further attempted using taxonomic guides (e.g. Cohen *et al*., 1990; Nielsen *et al*., 1999 and others) and image catalogs available from different sources (e.g. OER's Benthic Deepwater Animal Identification Guide – https://oceanexplorer.noaa.gov/okeanos/animal_guide/animal_guide.html and others). After a reexamination/ redefinition of morphotypes, a second analysis of the video profiles was conducted for corrections and complementation of the records data file. In addition to time of visualization and morphotype, each record was added dive information including geographic position (Latitude, Longitude) and depth. This data file was further transformed into a 'morphotype x video' profile matrix which allowed basic exploratory analysis on morphotype richness and abundance. Video profiles were grouped by seamount and by depth strata: shallow (<500 m depth), moderately deep (500 – 1 000 m) and deep (>1 000 m). Because sampling effort was variable among seamounts and depth strata, relative abundance and richness were analyzed considering records divided by observation time and expressed in individuals per minute and morphotypes per minute, respectively.

Sediment and macrofauna sampling

The VAMS was used to collect grab samples and HD videos for benthos studies. The VAMS has five hydraulically operated grabs mounted at the bottom of the ROV garage (Figure 4).

Benthos studies were focused on upper slopes and summits of the seamounts where VMEs were more likely to occur. The maximum VAMS sampling depth is 2 000 m.

A total of 13 valid VAMS stations were accomplished between 400 and 1 800 m depth. The seamounts sampled during this survey were Shannon Seamount (one station), Tablemount (seven stations), Discovery Seamount (four stations) and Herdman Seamount (one station). At each sampling station, the data corresponding to the gear, code, date, zone and position (time, coordinates and depth), were recorded.

All samples obtained with the VAMS were sieved through a tower sieves with mesh sizes 5 and 1 mm. For each fraction, the fauna was sorted out of the sediments and identified on board to the lowest possible taxonomical level. In addition, imaging of almost all identified specimens were performed with a digital camera mounted on a stereomicroscope.

Finally, a representative collection of the material identified on board was fixed and preserved in 70% alcohol or 4% formaldehyde solutions for a more exhaustive taxonomic study in the future.

CHAPTER 3. RESULTS

Table 2 gives an overview of the sampling effort.

Table 2. Brief overview of sampling effort.

N	SAMPLING TYPE
31	CTD profiles
31	Station for nutrients, alkalinity, and chlorophyll
4	Multinet hauls for plankton
13	Grab locations
275 hr	Bird observations during day time
275 hr	Mammal observations during day time
10	Pelagic trawl hauls for mesopelagic fish and invertebrates
3648 km^2	Multibeam from four seamounts and areas in between
14	VAMS dives

3.1 Bathymetry

Multibeam bathymetry was recorded from parts of seven seamounts (Figure 5). In total, an area of 3 648 km^2 was mapped. Most complete coverage was obtained from Shannon and Herdman seamounts.

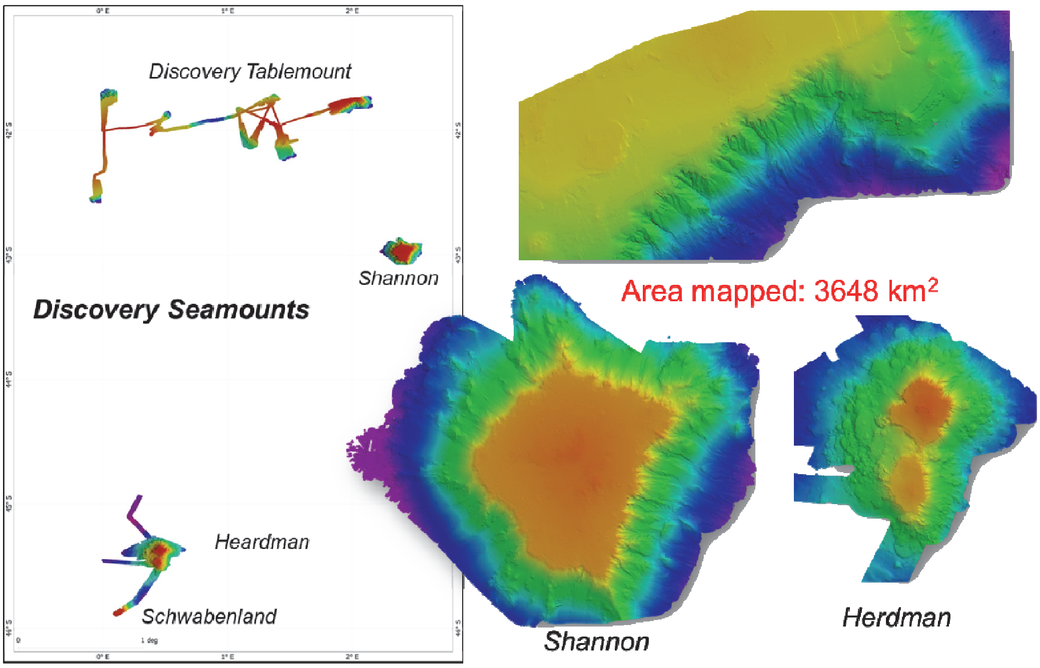


Figure 5. Overview of areas mapped with multibeam echosounder by R/V *Dr Fridtjof Nansen*.

3.2 Oceanography

A total of 31 CTD casts were taken (Table 2). CTD profiles from the different locations are shown in sections of the report presenting results from the different survey areas. The temperature and salinity profiles over the seamounts indicated that the southern seamount, Schwabenland was influenced by a different watermass than those further north. For all northern seamounts there was a distinct salinity maximum at depths between 200 m and 300 m, and a steep temperature drop from surface down to ca 500 m depth. Below 500 the temperature decreased slowly from 5 °C to 3 °C. Over the Schwabenland Seamount the temperature and salinity profile were quite different, with steady increasing salinity with depth. Here, cold water occurred shallower than at the northern seamounts.

3.3 Video observations

The seabed was surveyed at depths between 400 and 1800 m, with the VAMS ROV at 15 locations. Unfortunately, five dives were aborted due to technical problems. Therefore, only 13 locations were properly surveyed with VAMS. I total 27.5 hours video was recorded (Table 3). Positions for these are shown in Figure 6 and Table 5.

VME indicators

VME-indicator organism (gorgonians, black corals, lace corals, solitary stone corals, seapens and sponges) were observed at all locations, with varying taxonomic compositions and dominance (Table 4). VME indicators were most common and with local high densities at the eastern and western side of Tablemount and at the north part of Discovery (Table 3 and 4). Examples of video frame grabs of different corals are shown in Figures 7 – 11. The number of VME taxa were weakly and insignificantly correlated with the duration and distance of the video observations. This implies that the video lines should be comparable with respect to number of VME indicator species per ROV dive. Two different representations of VME occurrence are provided in Table 3 and 4. Table 3 indicate types of VME indicators that were observed with high densities (high no of colonies per area). Table 4 presents number of occasions where occurrence of VME indicators were commented in the field log, without necessarily a high density.

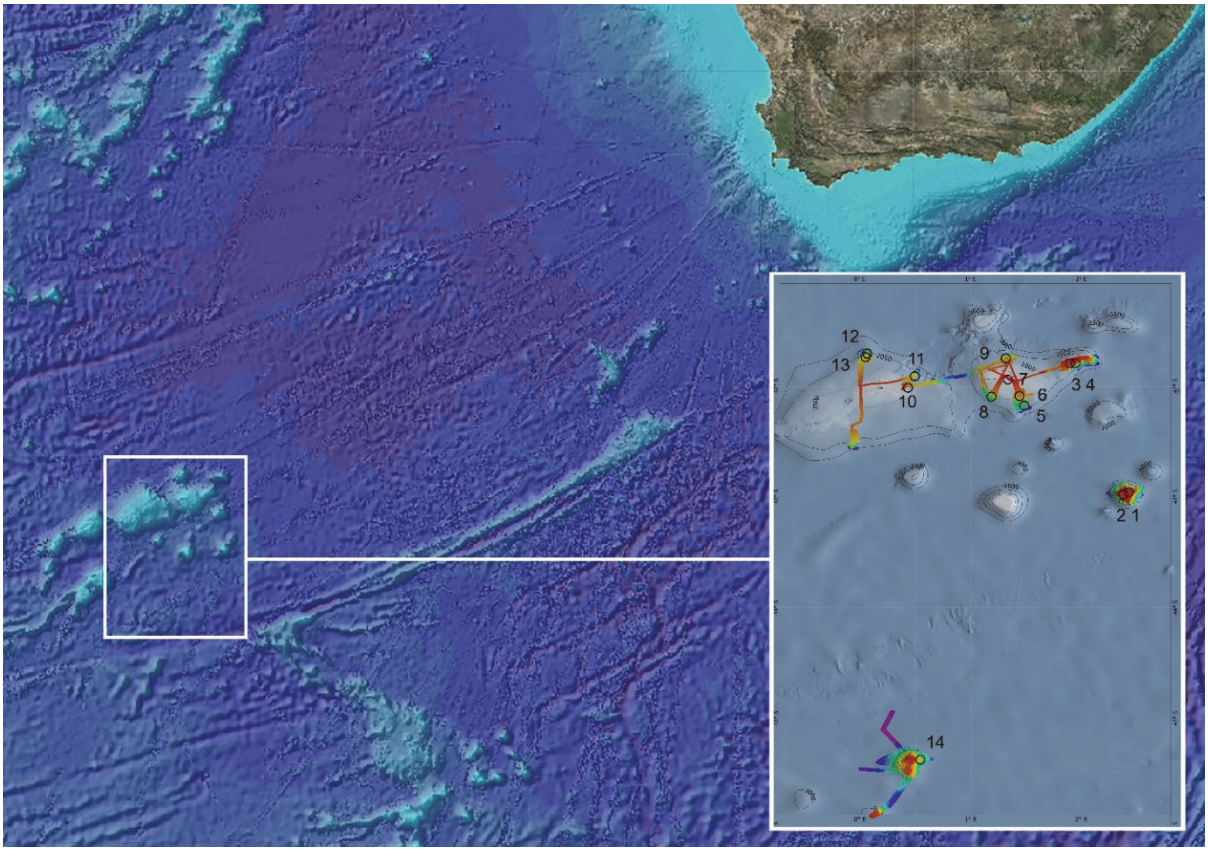


Figure 6. Location of the Discovery Seamount area, with a detail map inserted showing multibeam-mapped areas in colours and locations for the VAMS dives with station numbers.

All seamounts visited had VME indicators (mainly Isidiidae and Primnoidae corals, but lace corals, sponges, and crinoids were also locally abundant). Figures 7 to 9 show examples of different cold-water corals observed with the VAMS. Colonial scleractinians were not observed at any location. Most of the VME indicators where not possible to identify to species level during the cruise. Further examination of videoes and stills by cold-water coral experts would increase the number of VME records with confident identification. The megafauna was diverse, and more than 200 taxa were observed in the field. In addition to the VME taxa mentioned above several taxa, such as balanoid and scalpellid cirripeds, dominated locally.

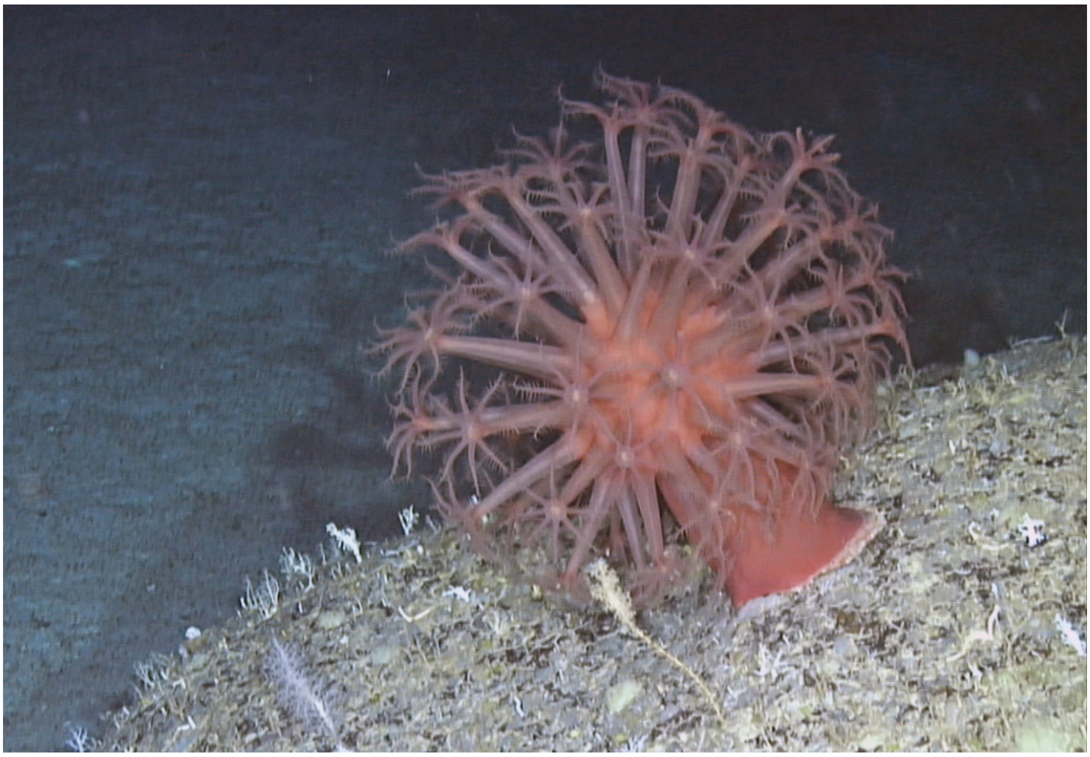


Figure 7. A soft coral of the genus *Anthomastus*, at dive 2_2.

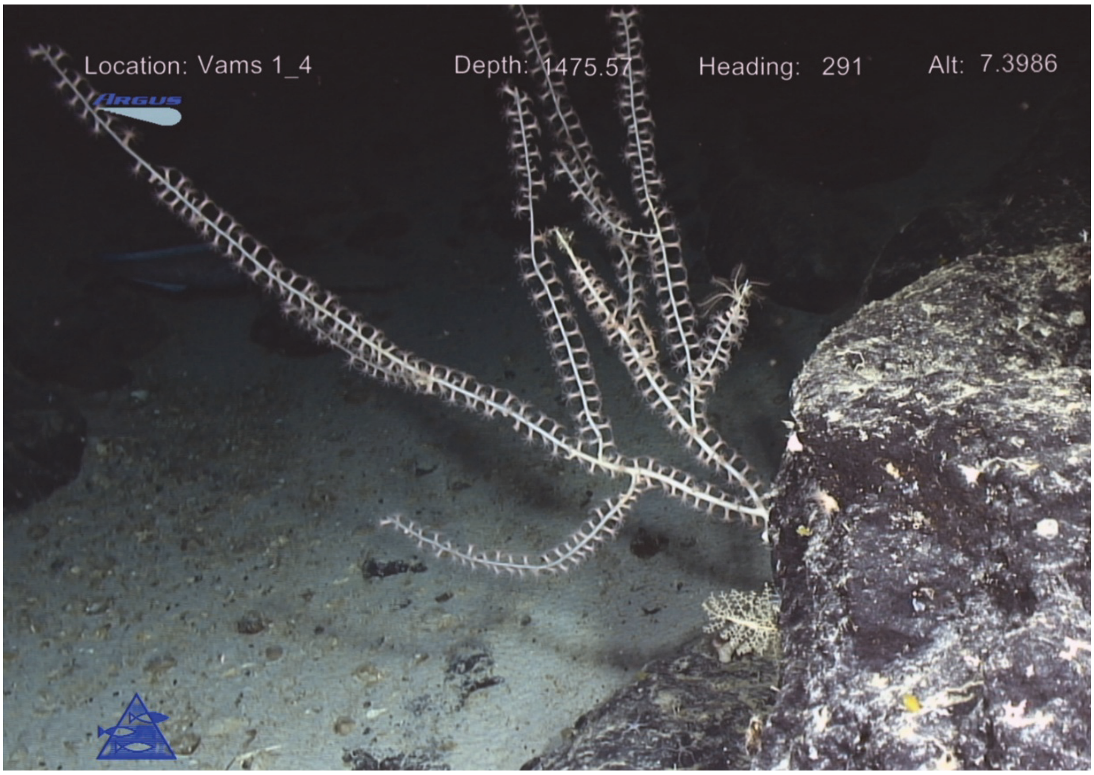


Figure 8. Bamboo coral, *Keratoisis sp.* at dice 1_4.

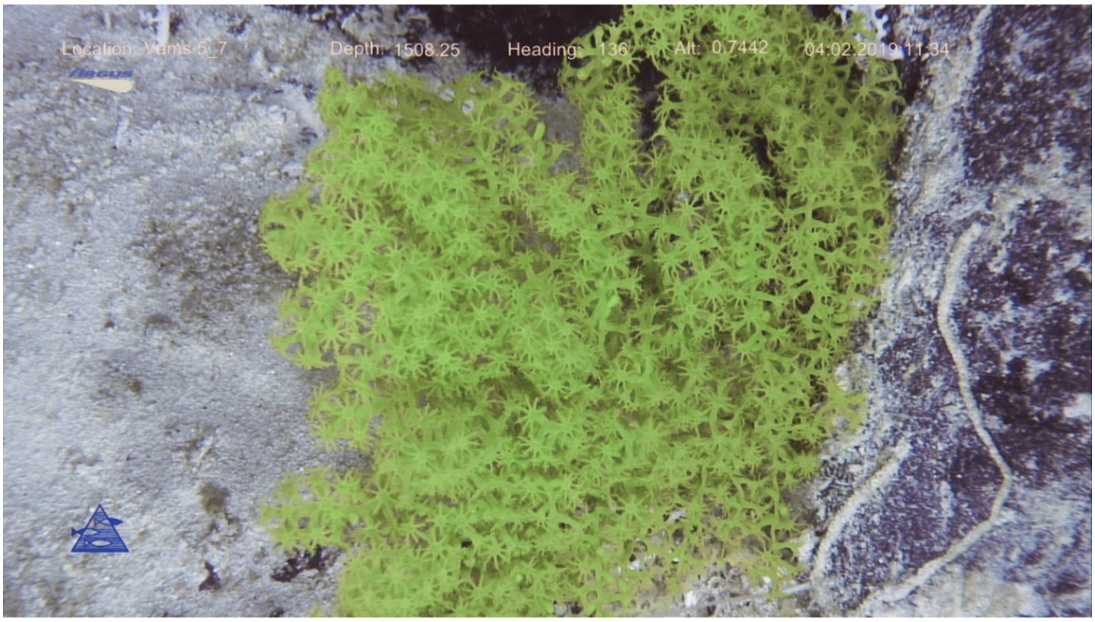


Figure 9. An unidentified yellow-green coral at dive 5_7.

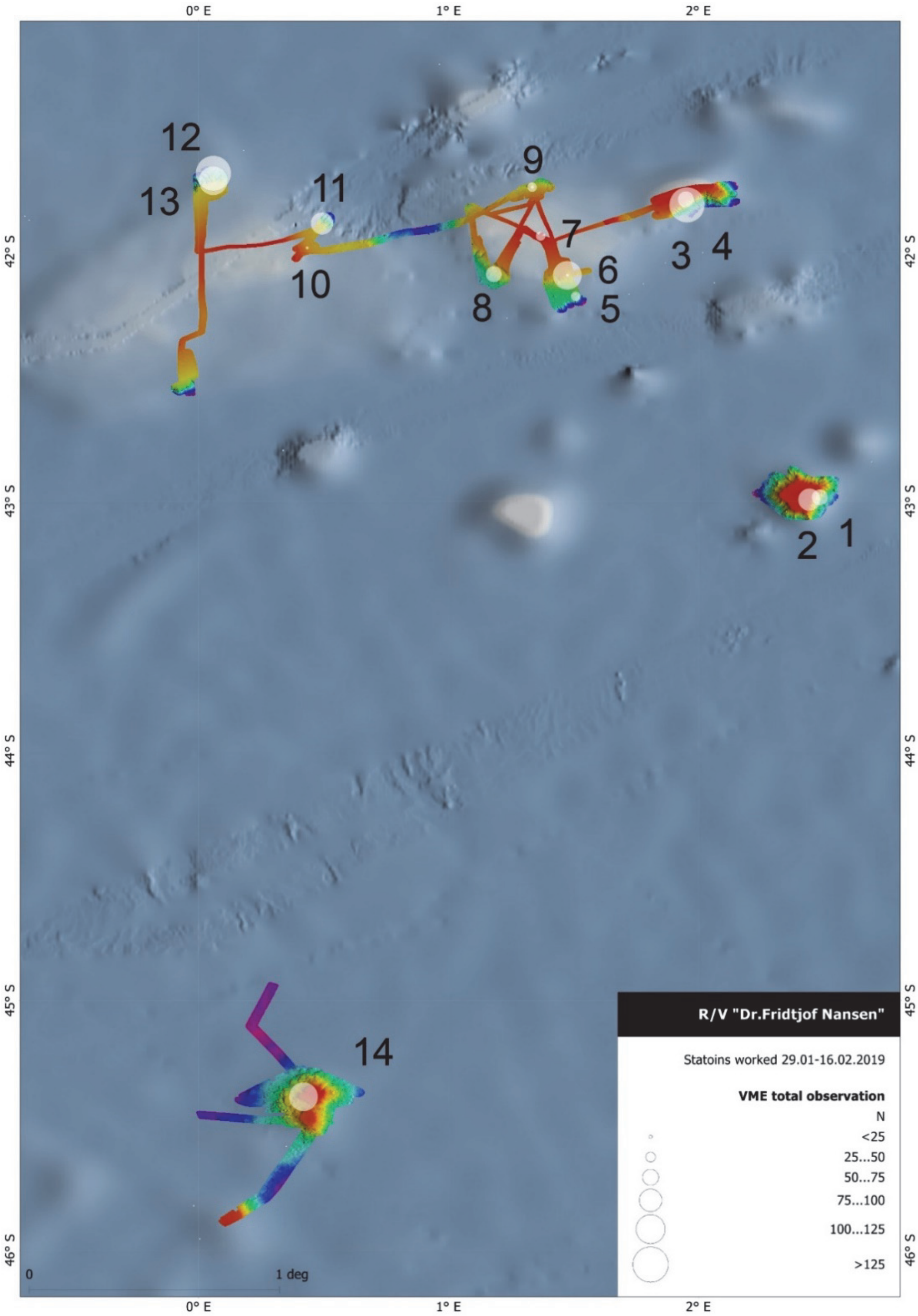


Figure 10. Relative abundance (observations per video line) of VME indicator species, with station numbers provided.

VME indicator species were found at all stations but were most abundant at st. 4 and 11-14 (Figures 10 and 11, Table 3). Standardised against time (number of VME indicators per 1 hour of observation) there was a pattern of low VME indicator abundance at the summit of the seamounts, high abundance around the edges, and moderate on the slopes of the sides of the seamounts (Figure 11). The highest VME abundance was observed at st 13 (Figure 12), at the northern part of Discovery Seamount, and the second highest abundance was found at st 4 (Figure 13), at the eastern part of Tablemount seamount.

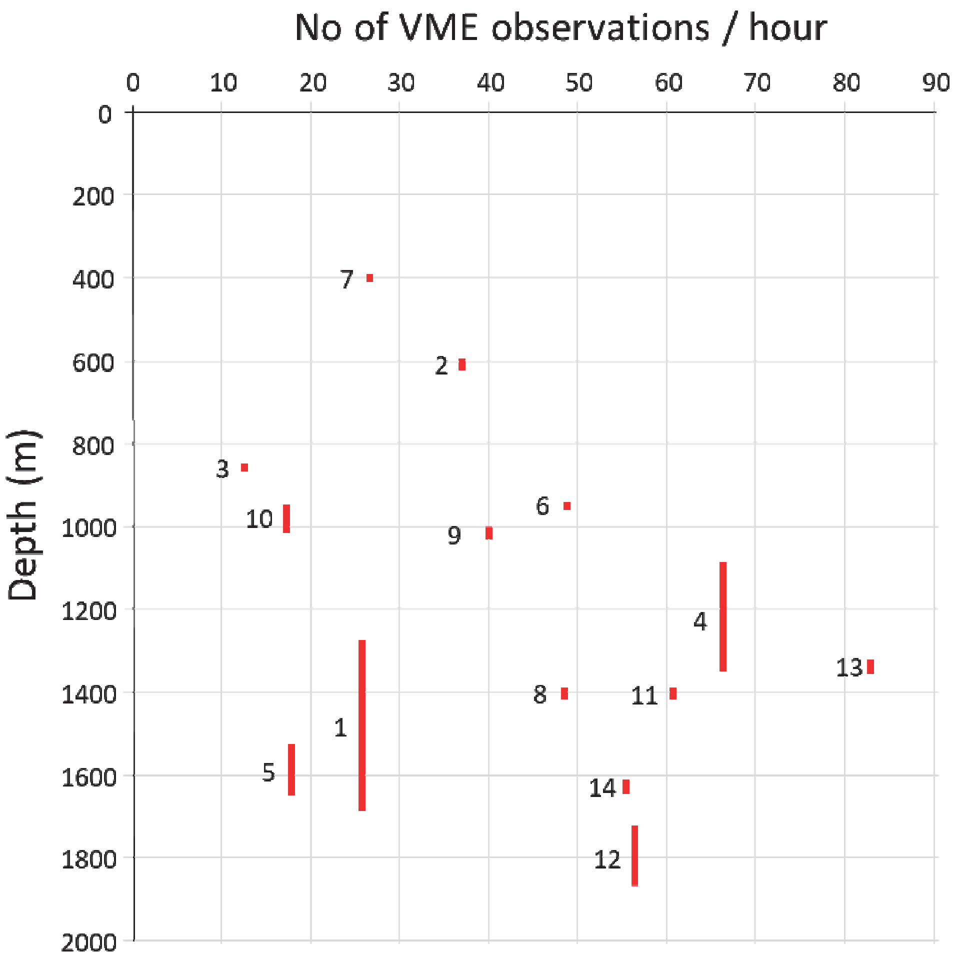


Figure 11. Number of VME observations per hour of video observation. Station number are indicated along with the vertical range of each individual video transect.

The composition of VME indicator species differed between the stations, and along the video lines, related to depth, type of marine landscape, and sediment type. Below we present the relative composition and distribution for all video lines.

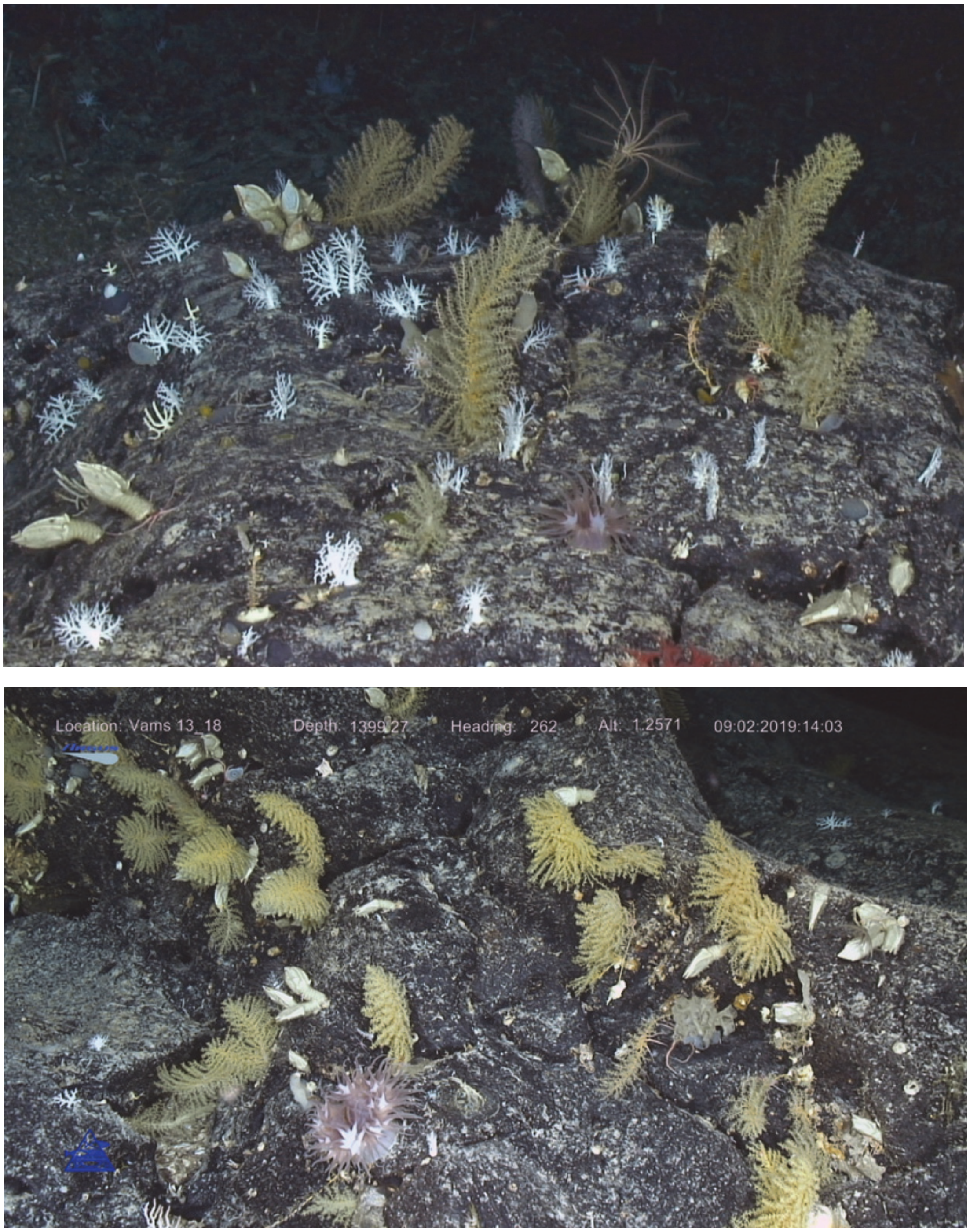
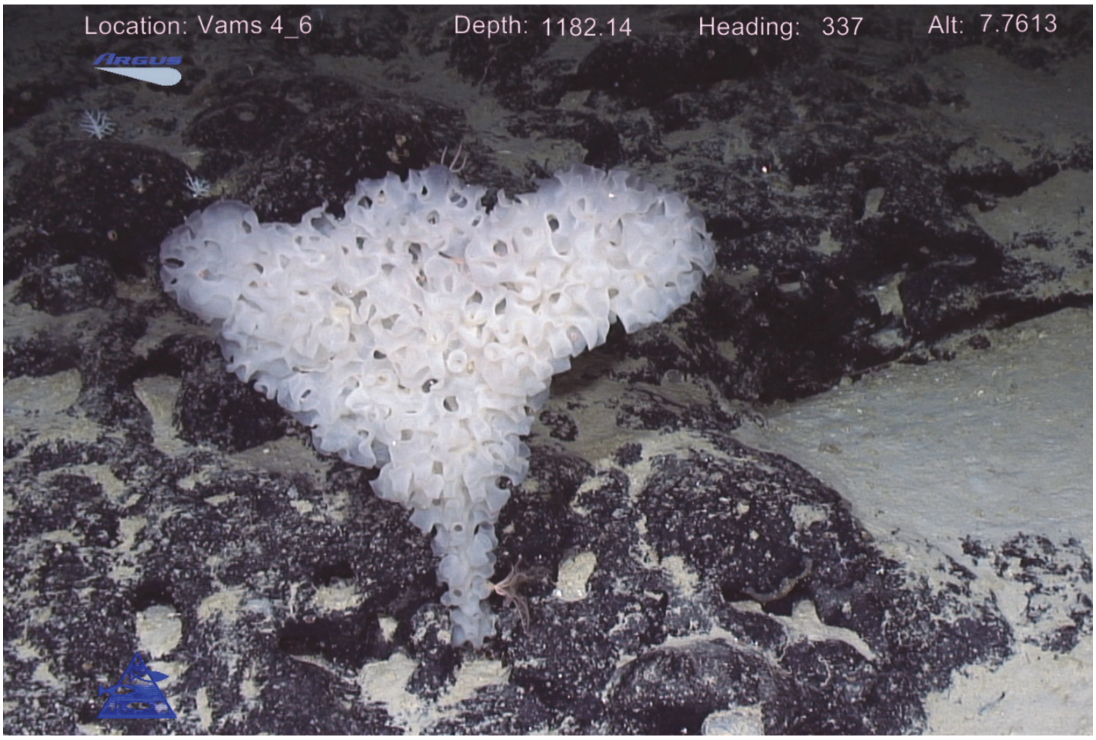


Figure 12. Examples of local high abundance of primnoid gorgonians and the Conopora stylasterid at st 13 (northern part of Discovery Seamount), 1 400 m depth. In the pictures we also see scalpellid, gooseneck barnackles, a feather star and an anemone.



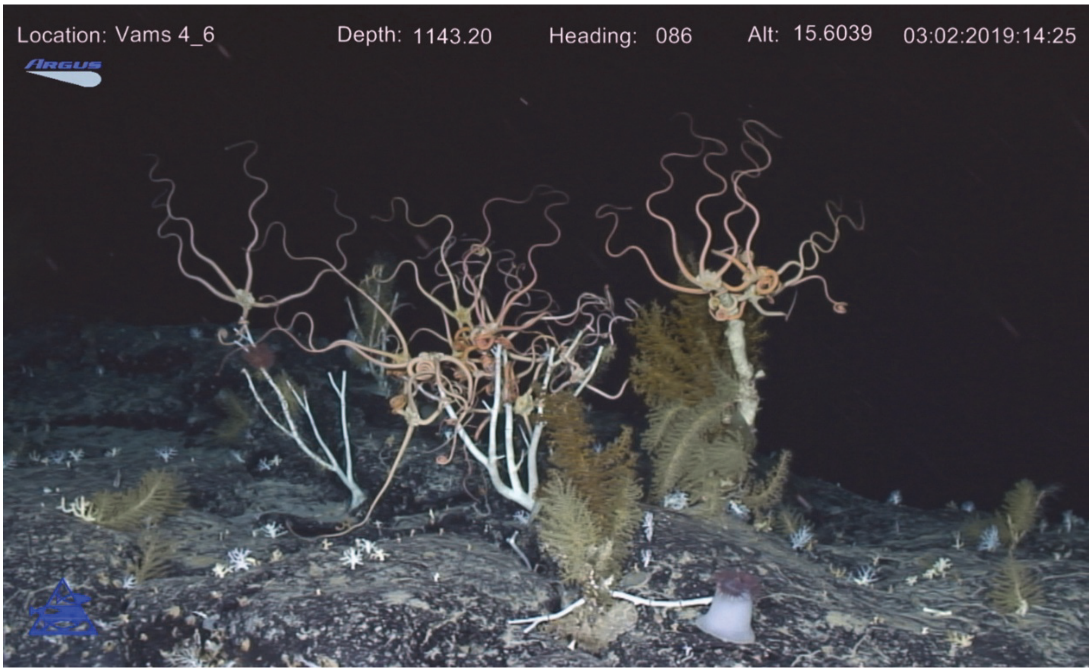


Figure 13. Examples of VME indicators at st 4 (eastern part of Tablemount seamount), 1 140 m depth. In the upper picture we see an unidentified glass sponge, and in the lower; primnoid gorgonians, bamboo coral skeletons with brittlestars, small Conopora and an anemone.

Shannon Seamount

On Shannon Seamount VME indicators were observed 58 times at the deep station (st 1), and 82 times at the shallow st. 2 (Figures 14 and 15). Standardised against time 26 and 37 VME indicators were observed per hour for st 1 and 2 respectively (Figure 11). Sponges, gorgonians and alcyonaceans were most common at st 2 while gorgonians and actiniarians were most common among the observed VME indicators at st 1 (Figure15).

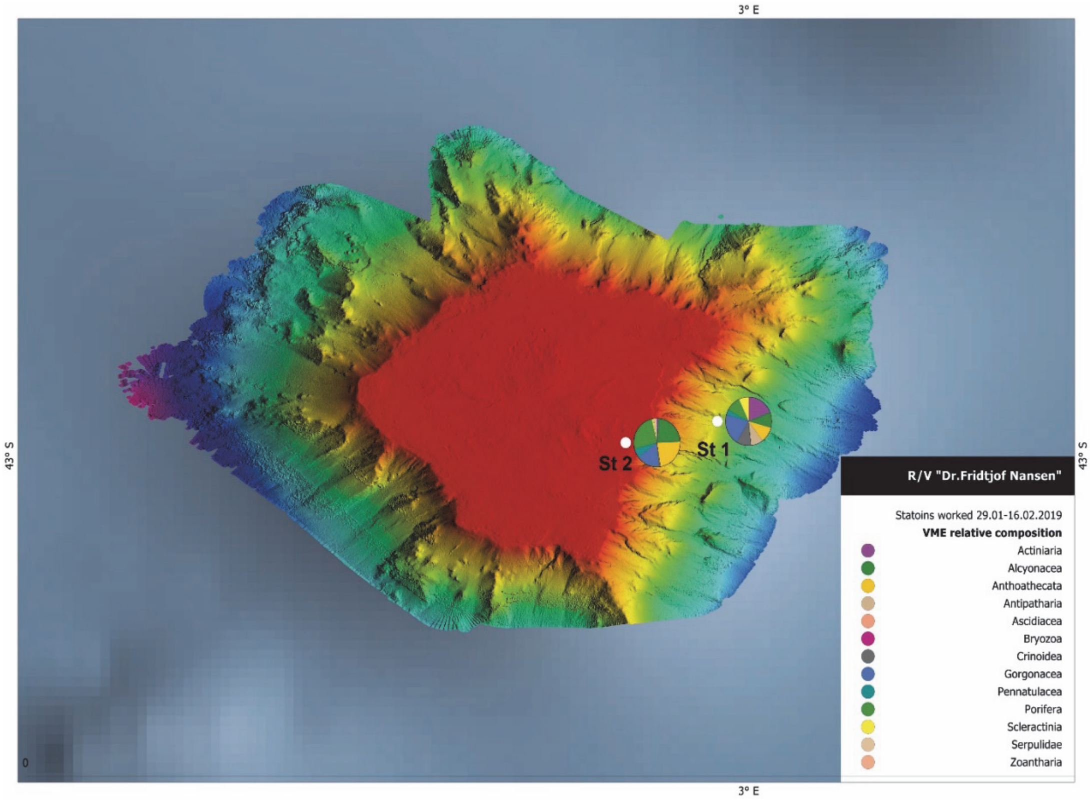


Figure 14. Relative composition of VME indicator species at st. 1 and 2, on Shannon Seamount.

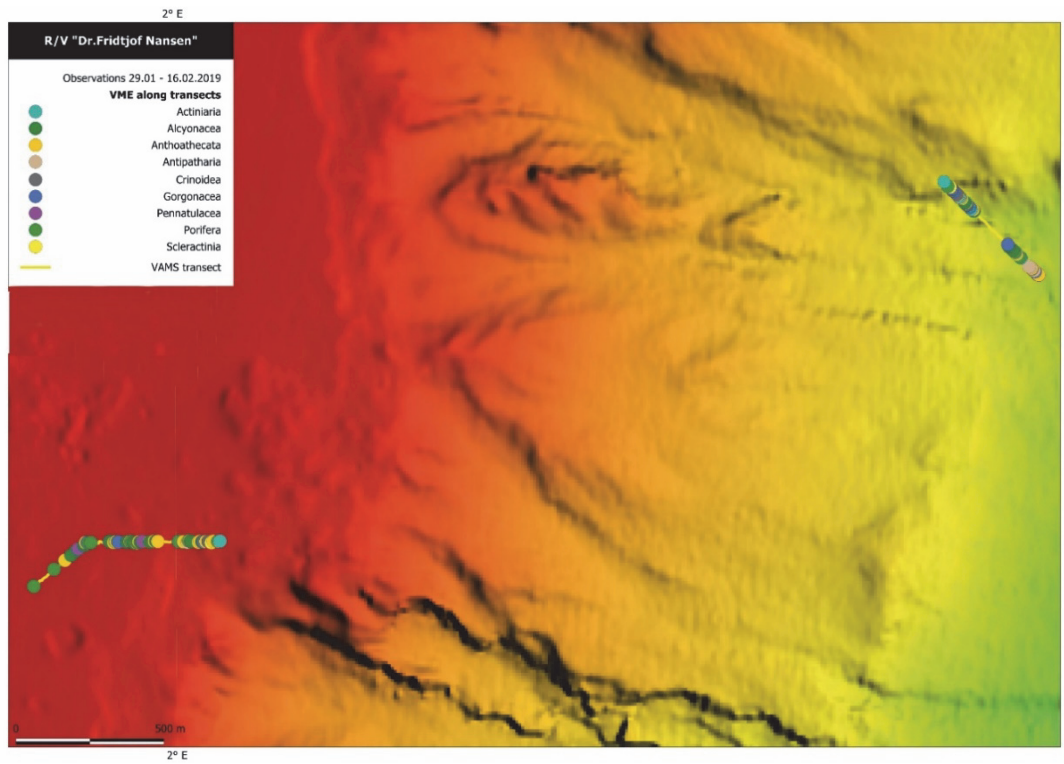


Figure 15. Observations of VME indicators at st 1 (deepest, eastern) and st 2 (shallower, western) on Shannon Seamount.

Tablemount Seamount

East on Tablemount Seamount sponges and gorgonians were most common at the shallow station (st 3), while gorgonians and stylasterids (Anthoathecata) were most common on the deep station (st 4) (Figure 16). In total VME indicators were observed 156 times at st 4 (66 VME ind/h), while only 59 times at st 3 (12 VME ind/h) (Figures 11, 17 and 18). The ROV inspection at st 3 was a stationary dive with only observations within a radius of 20 m. Thus, the map (Figure 17) does not present a realistic picture of the distribution of the VME indicators.

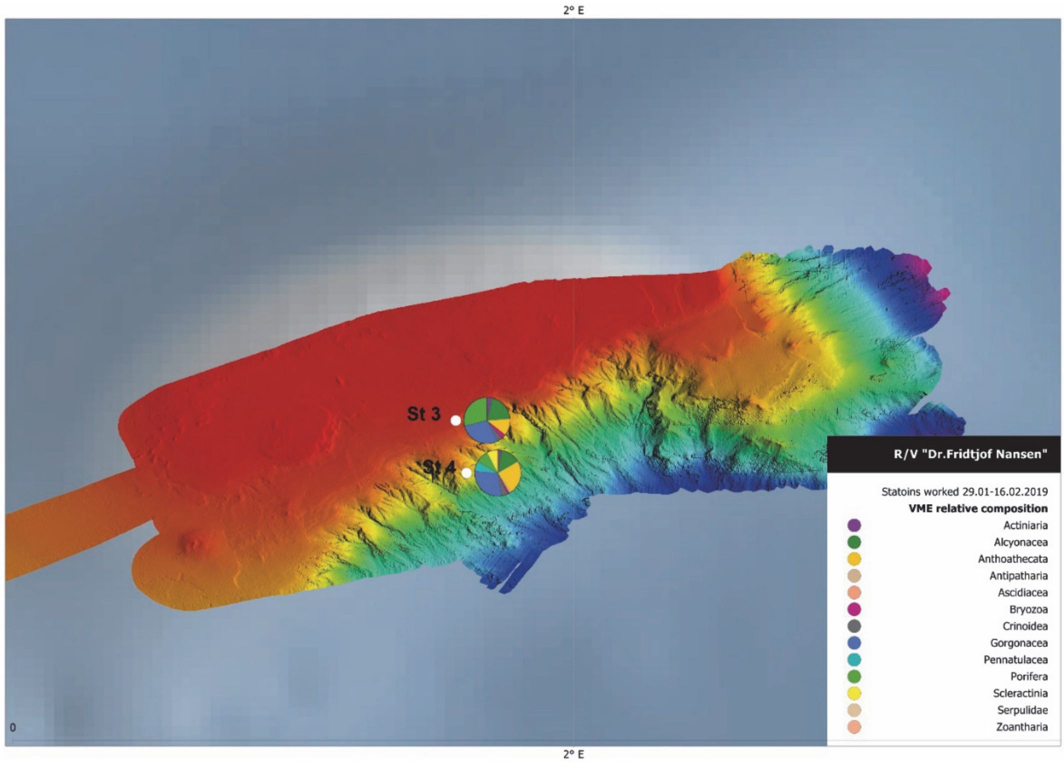


Figure 16. Relative composition of VME indicator species at st. 3 and 4, on eastern part of Tablemount Seamount.

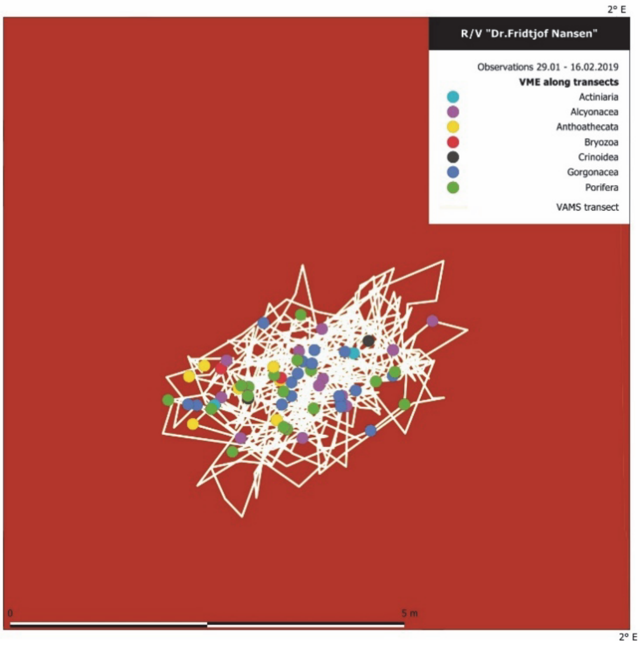


Figure 17. Observations of VME indicators locally around the parked VAMS at st 3. This was a stationary dive where the white line represents the noise in the underwater positioning of the garage of the VAMS. Thus, this is not a realistic representation of the distribution of the VME indicators.

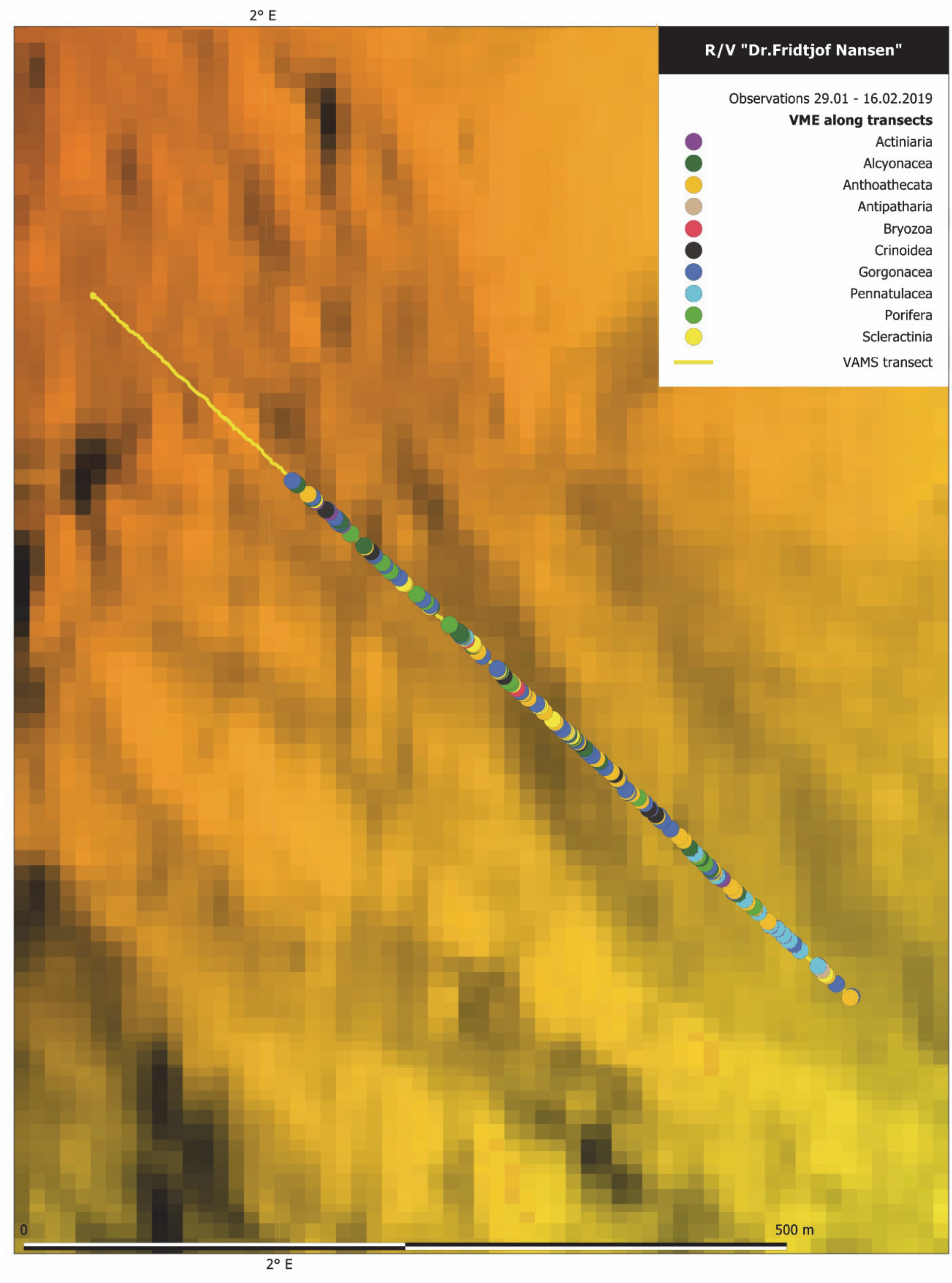


Figure 18. Observations of VME indicators along the video line at st 4. The end of the line (upper left) are positions of theVAMS up in the water, without seabed observations.

West on Tablemount Seamount stylasterids (Anthoathecata) were most common at the shallowest station (st 7), while gorgonians and crinoids were most common on the intermediate deep stations (st 6, 8 and 9) (Figures 17 to 22). Gorgonians and sponges were most common on the deepest station (st 5) (Figure 19). Station 6, 8, and 9 on the slope of the seamount had moderate abundance of VME indicators (40-50 VME ind/h, Figure 11), whereas st 7 at the summit had a low abundance (27 VME ind/h).

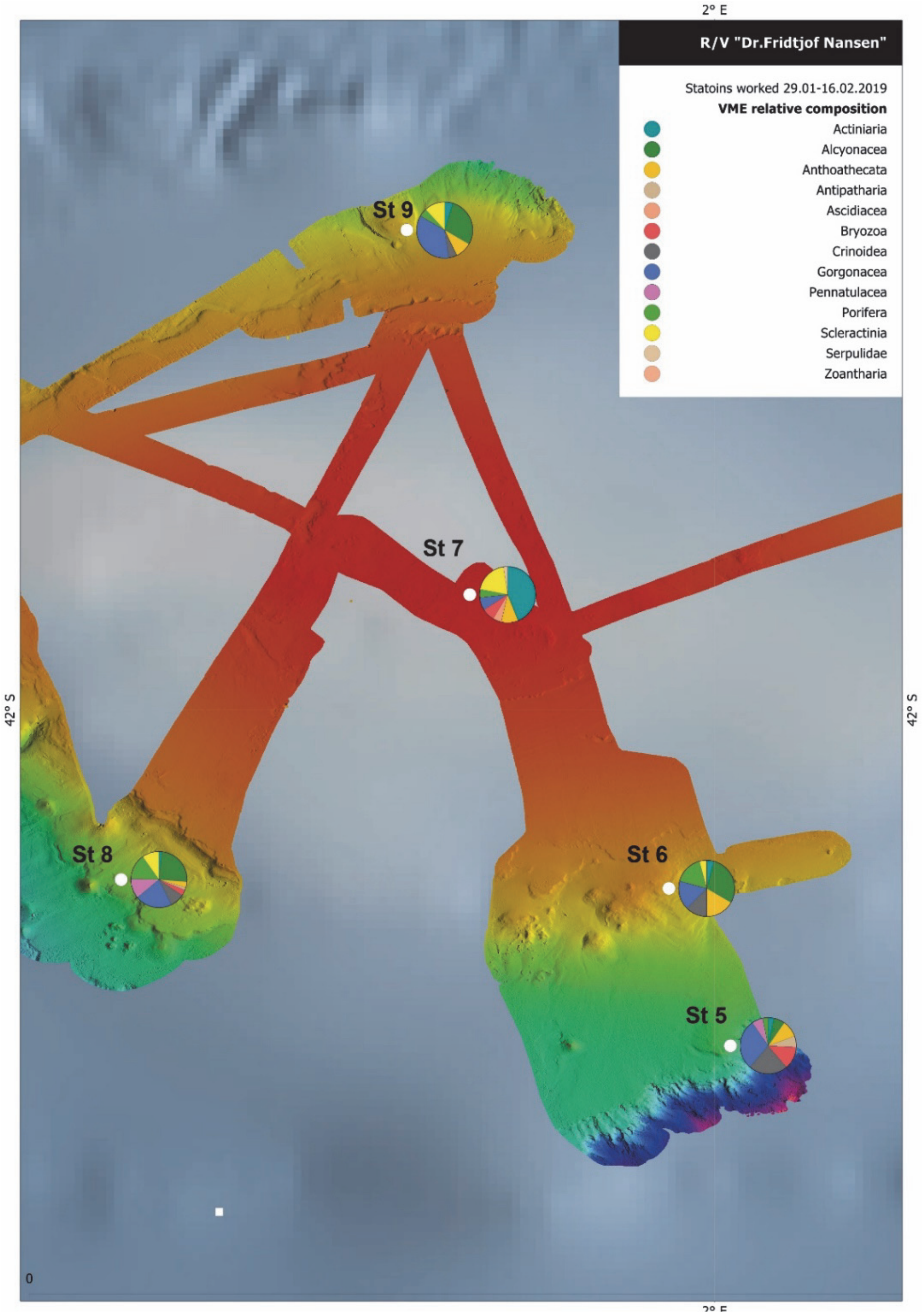


Figure 19. Relative composition of VME indicator species at st. 5-9, on the western part of Tablemount Seamount.

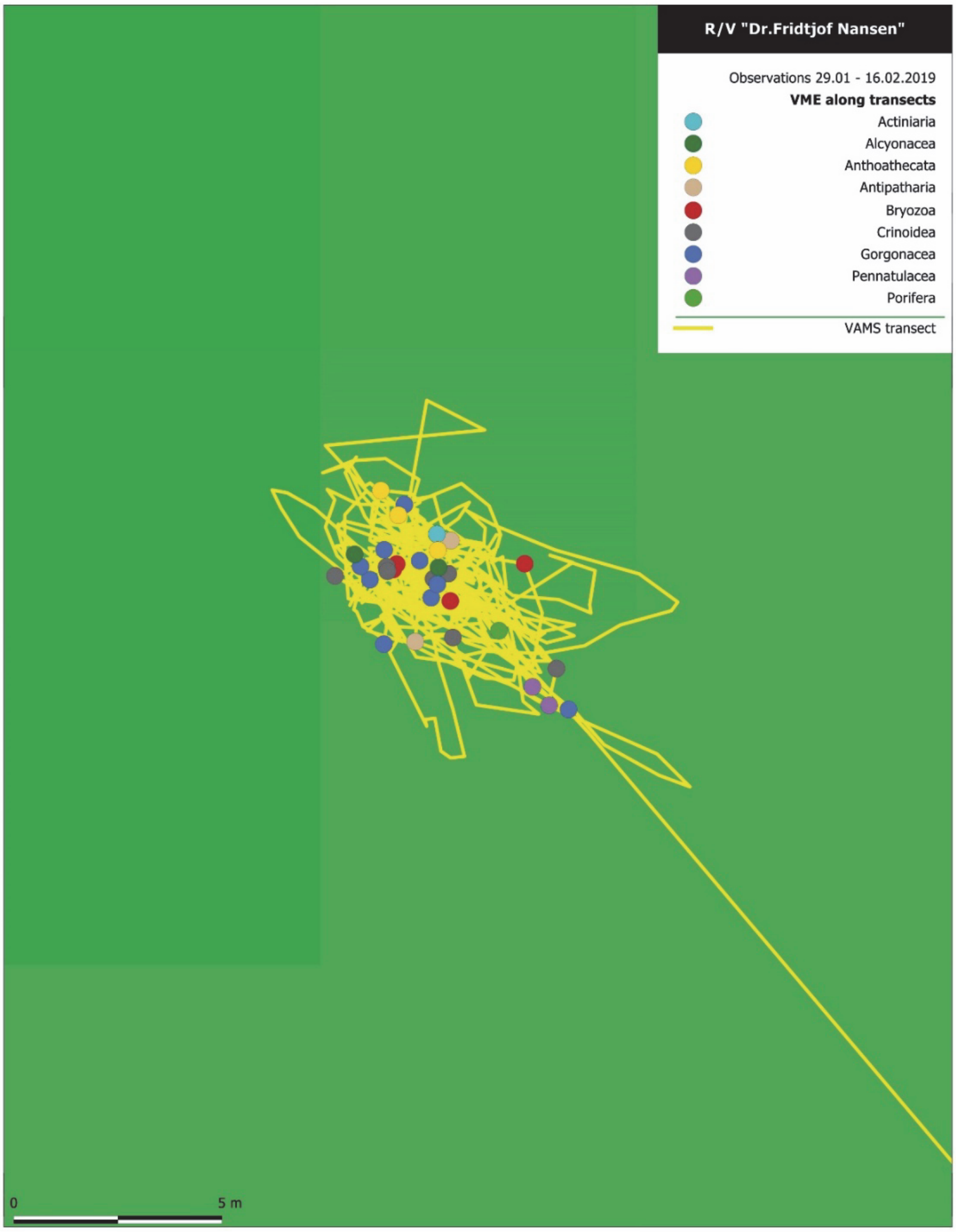


Figure 20. Observations of VME indicators locally around the parked VAMS at st 5, at a shelf on the slope of the seamount. This was a stationary dive where the yellow line represents the noise in the underwater positioning of the garage of the VAMS. Thus, this is not a realistic representation of the distribution of the VME indicators.

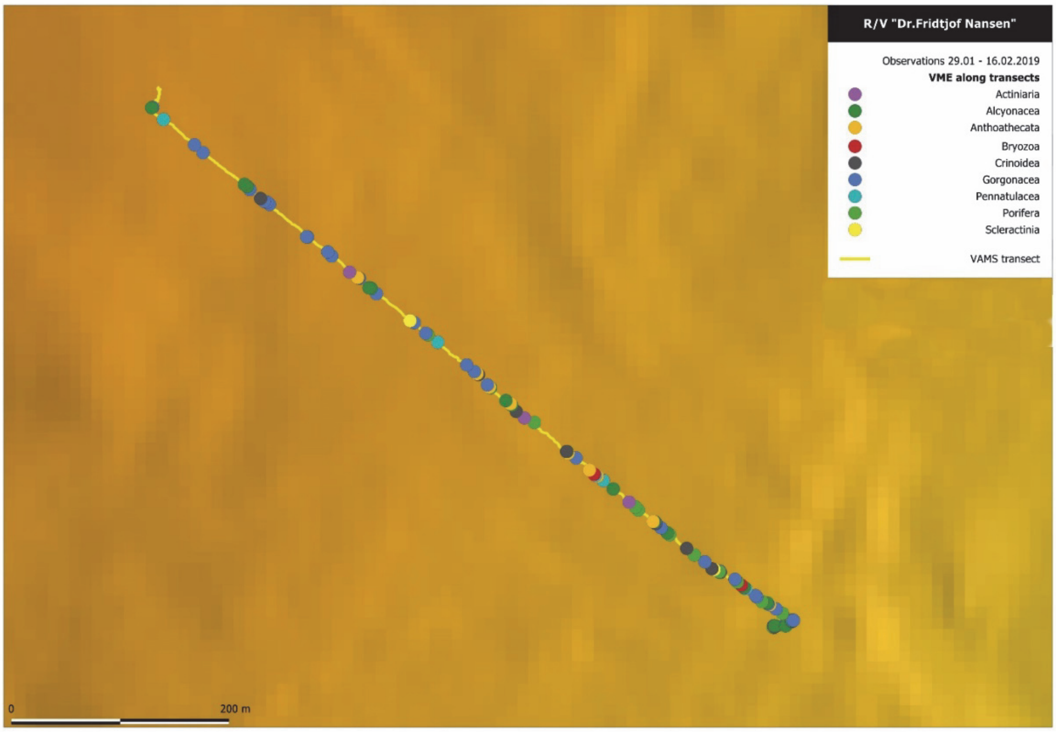


Figure 21. Observations of VME indicators along the video line at st 6, located at the slope of the seamount.

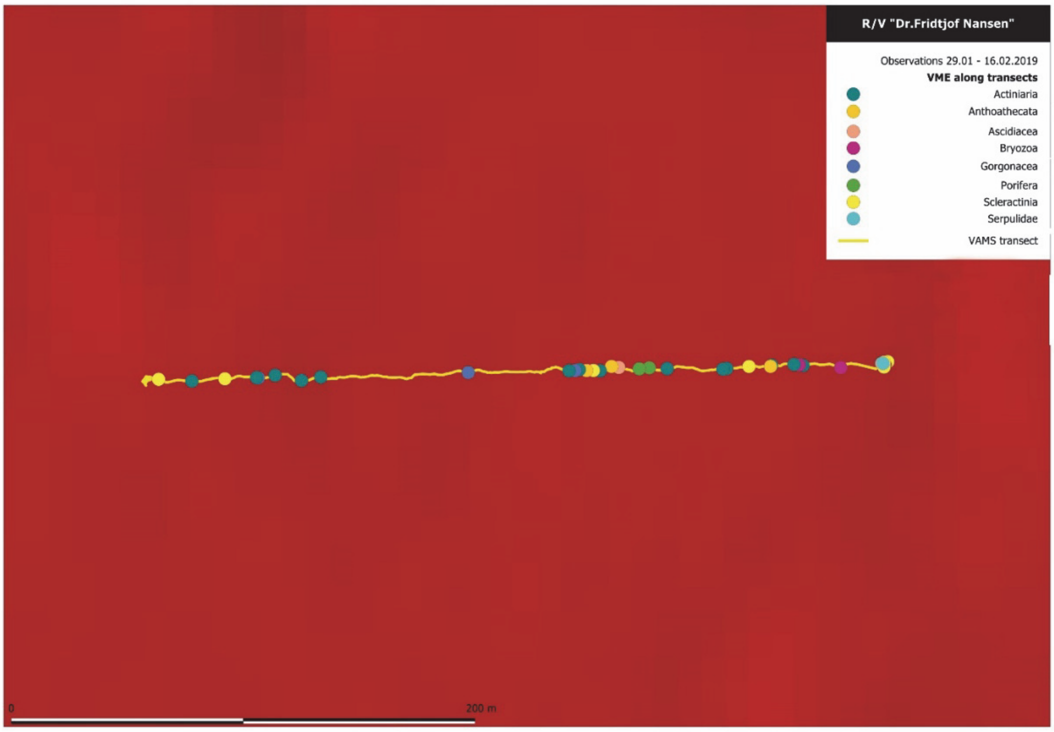


Figure 22. Observations of VME indicators along the video line at st 7, at the summit of the seamount.

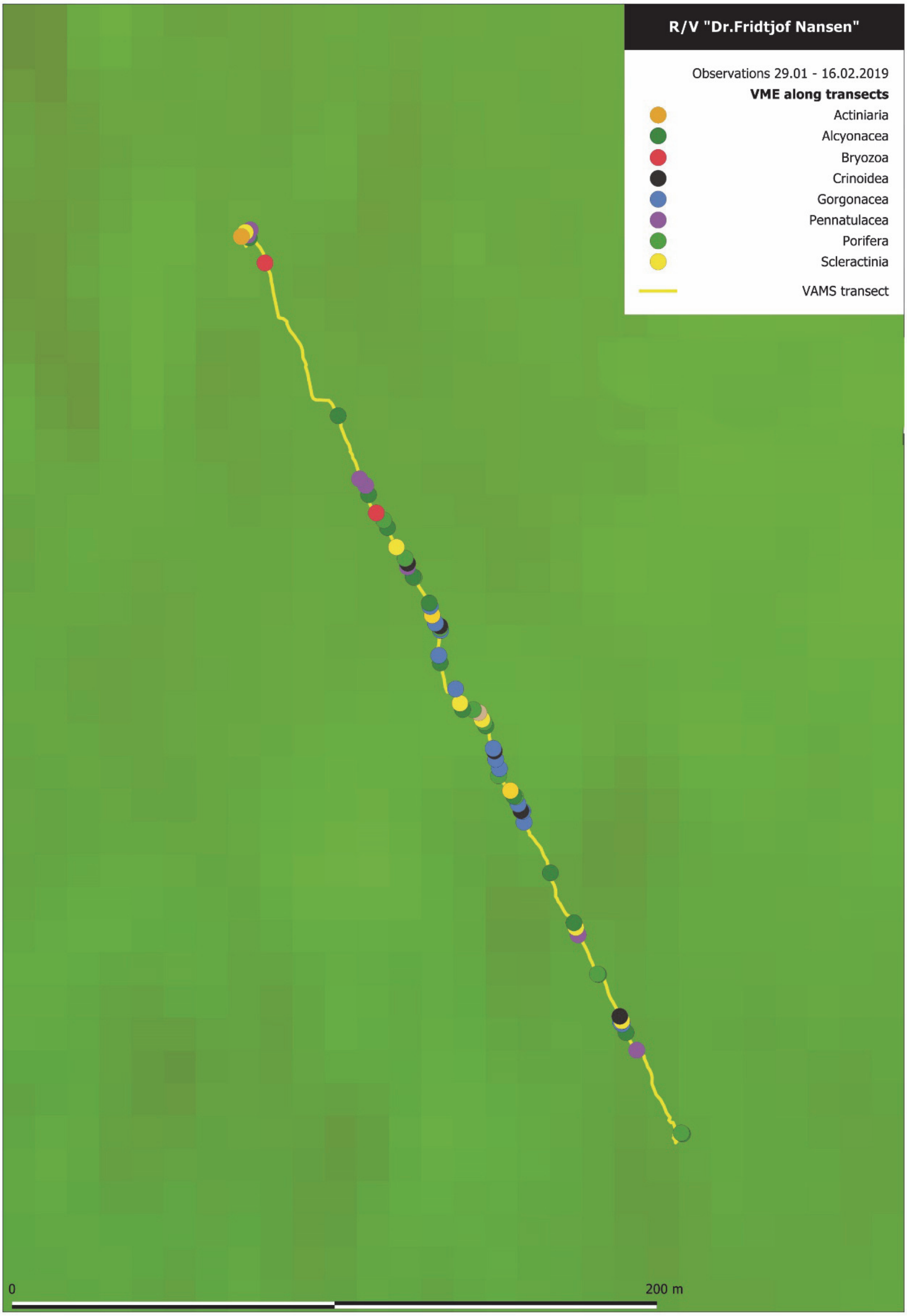


Figure 23. Observations of VME indicators along the video line at st 8, at the slope of the seamount.

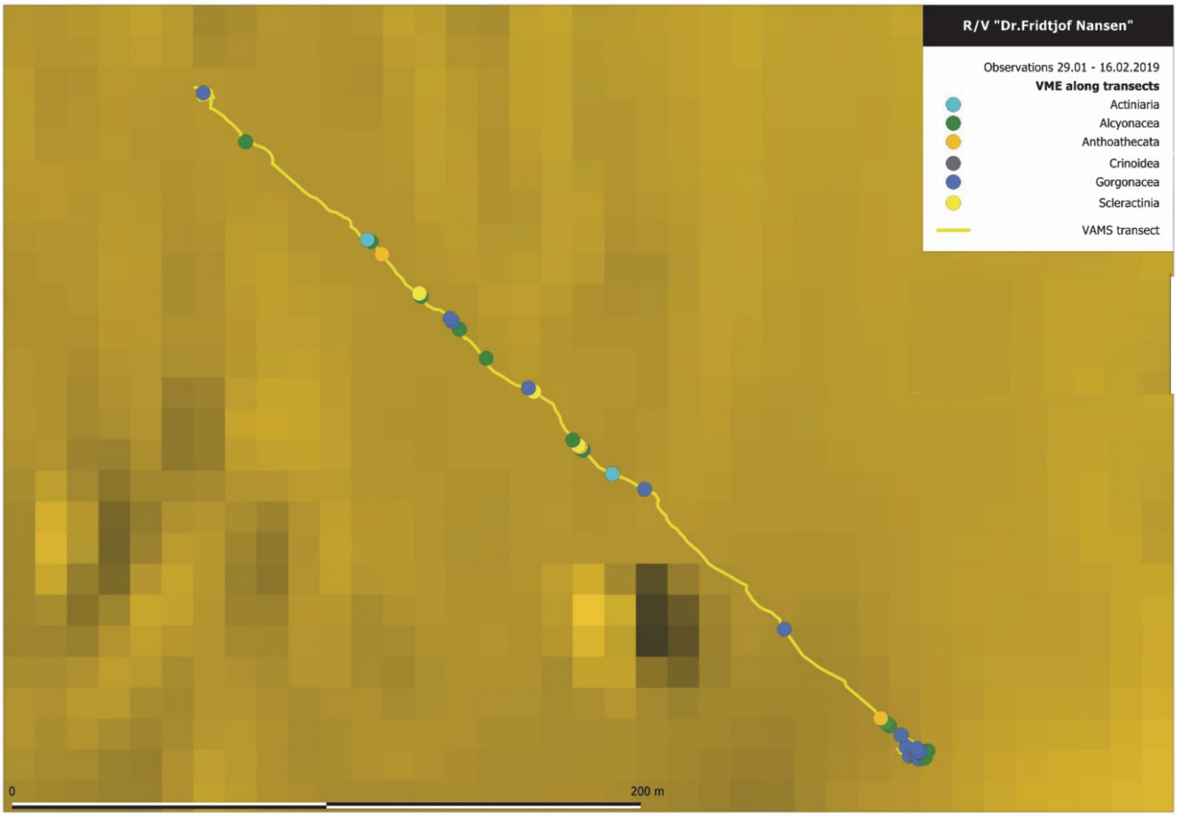


Figure 24. Observations of VME indicators along the video line at st 9, at the slope of the seamount.

Discovery Seamount

At st 10 and 11, east on Discovery Seamount, the deepest station (11) gorgonians and crinoids were most common, whereas at the shallower station (10) solitary scleractinians and actiniarians were most common (Figure 22). Station 11 on the slope of the seamopunt, had a high VME abundance (60 VME ind/h), whereas st 10 had a low abundance (17 VME ind/h) (Figure 11). This difference is clearly indicated by comparing two video transects (Figures 26 and 27).

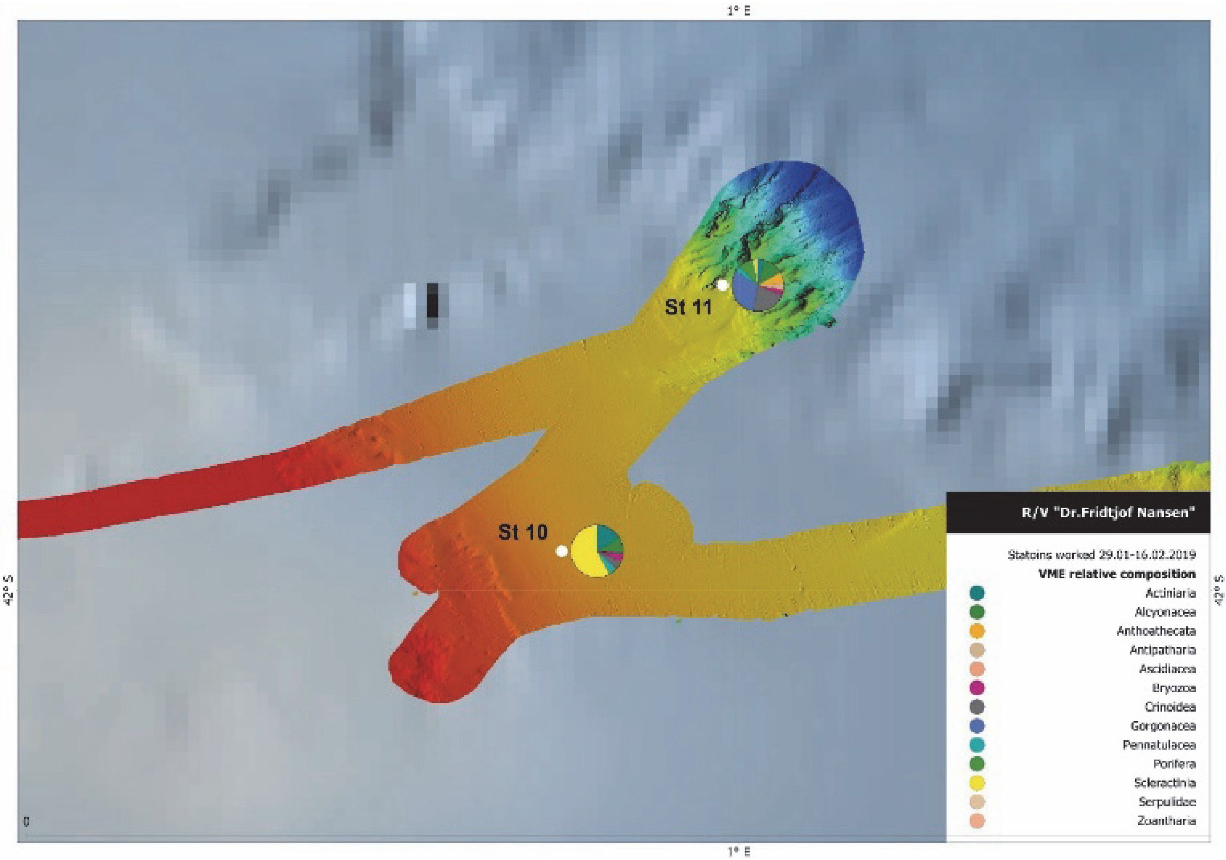


Figure 25. Relative composition of VME indicator species at st. 10 and 11, east on Discovery Seamount.

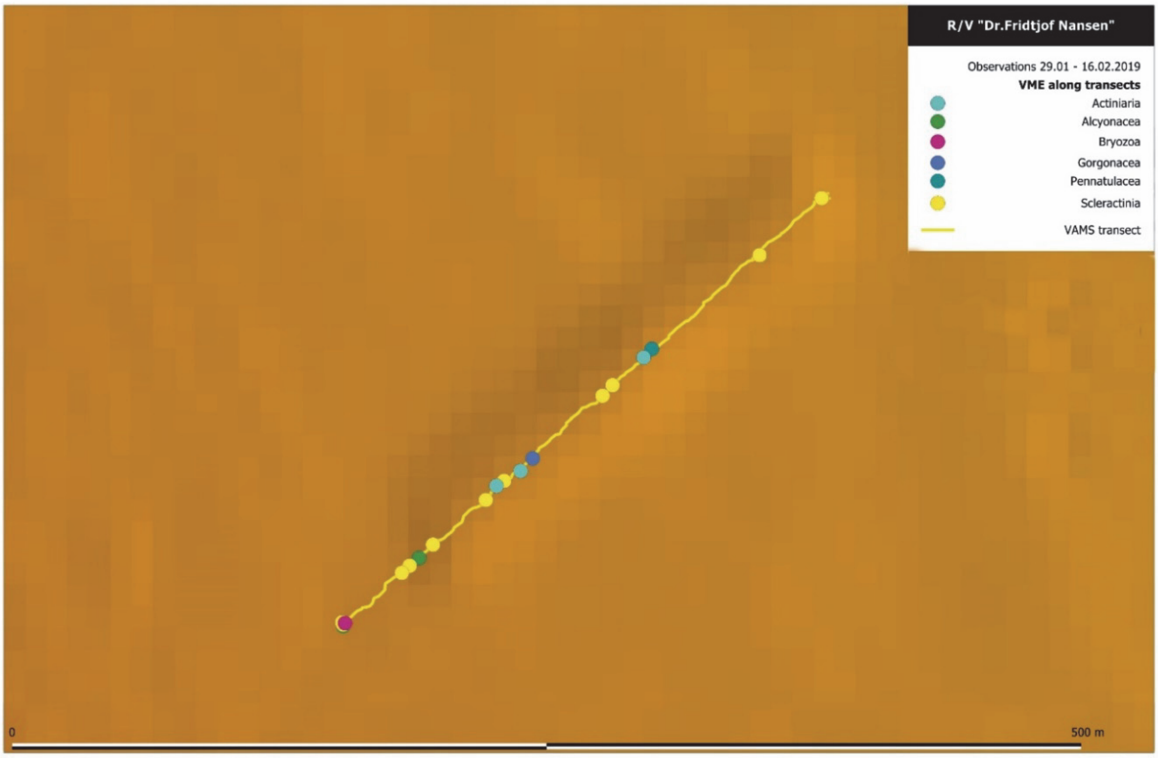


Figure 26. Observations of VME indicators at st 10.

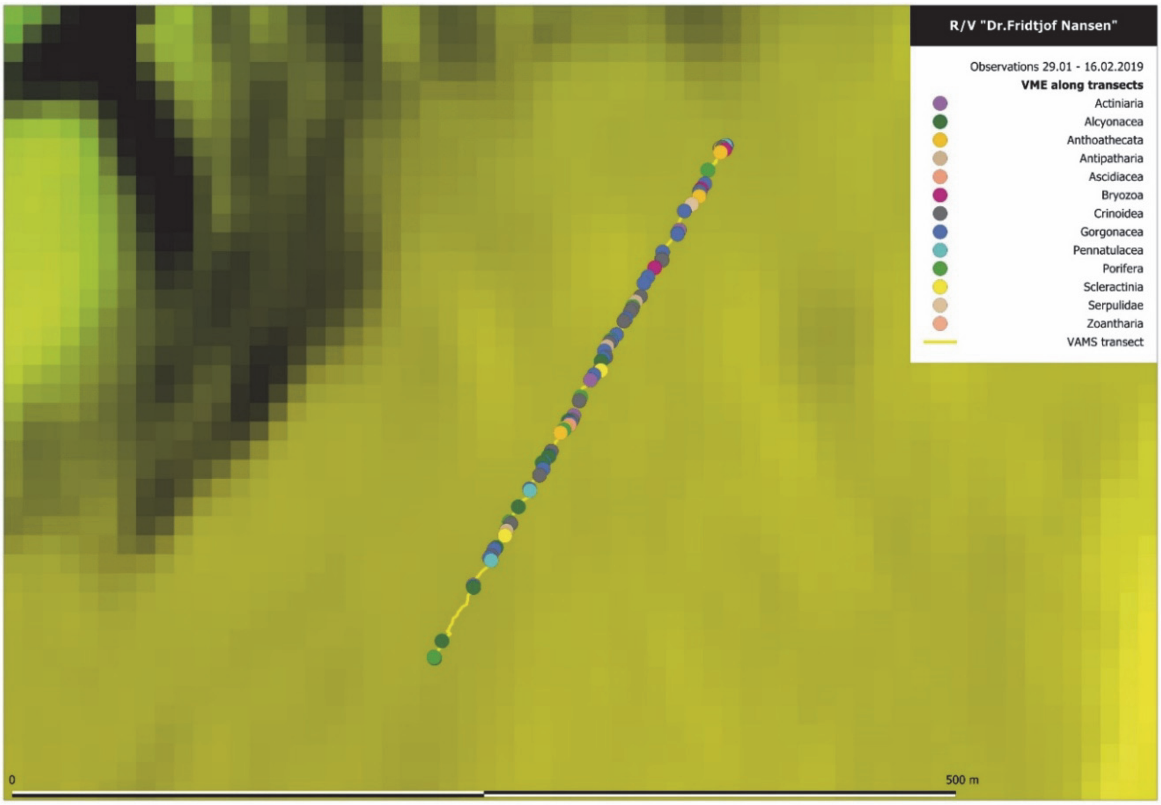


Figure 27. Observations of VME indicators at st 11.

North on Discovery Seamount sponges and gorgonians were relatively common at both the shallow and the deep stations (Figures 28 and 29). At the shallowest (st 13) alcyonians were also common, whereas at the deepest (st 12) crinoids were common also. St 13, on the edge of the seamount, had the highest VME indicator abundance of all stations (83 VME ind/h) (Figure 11), whereas st 12 further down at the slope of the seamount had a moderate abundance (56 VME ind/h).

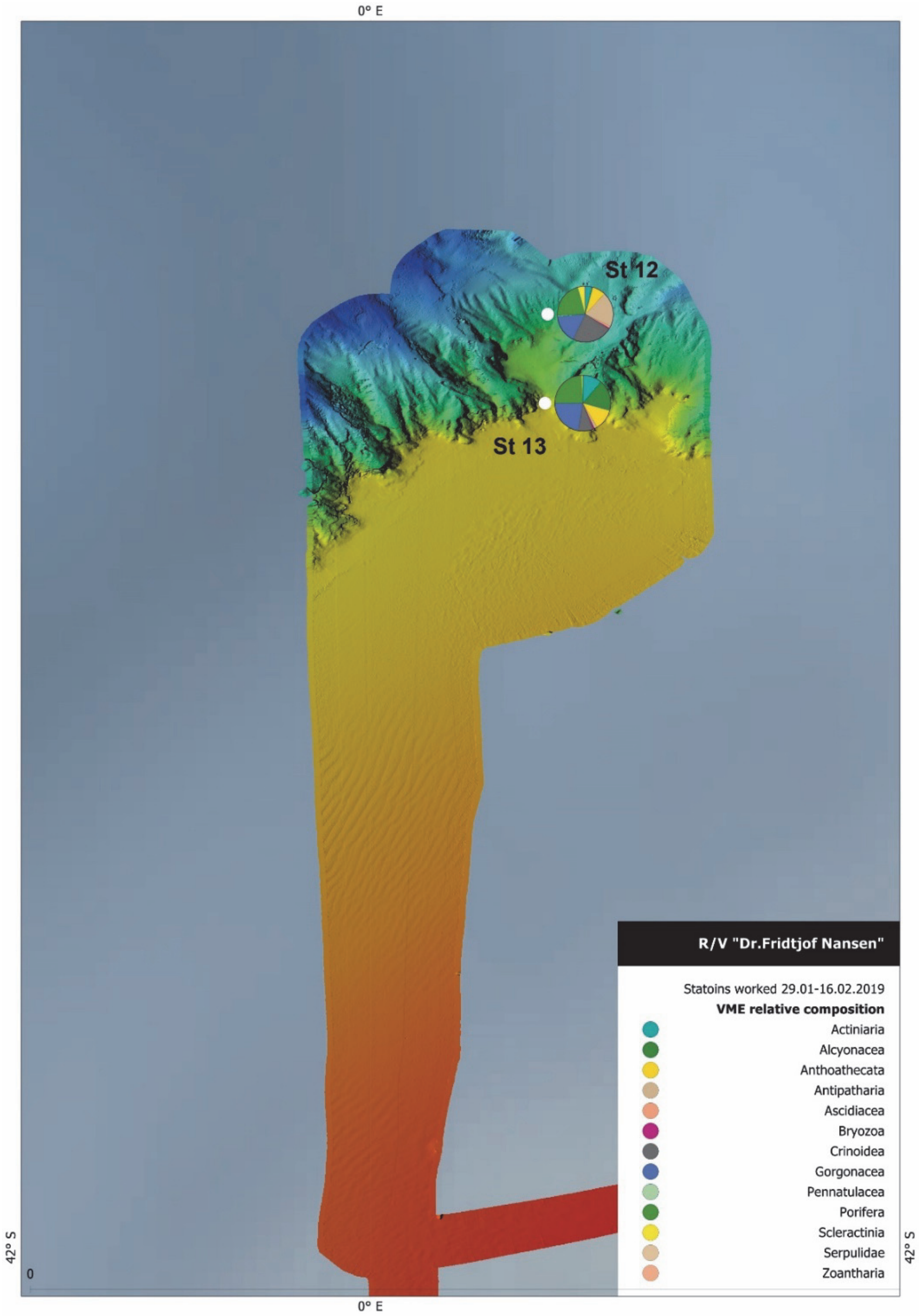


Figure 28. Relative composition of VME indicator species at st. 12 and 13, north on Discovery Seamount.

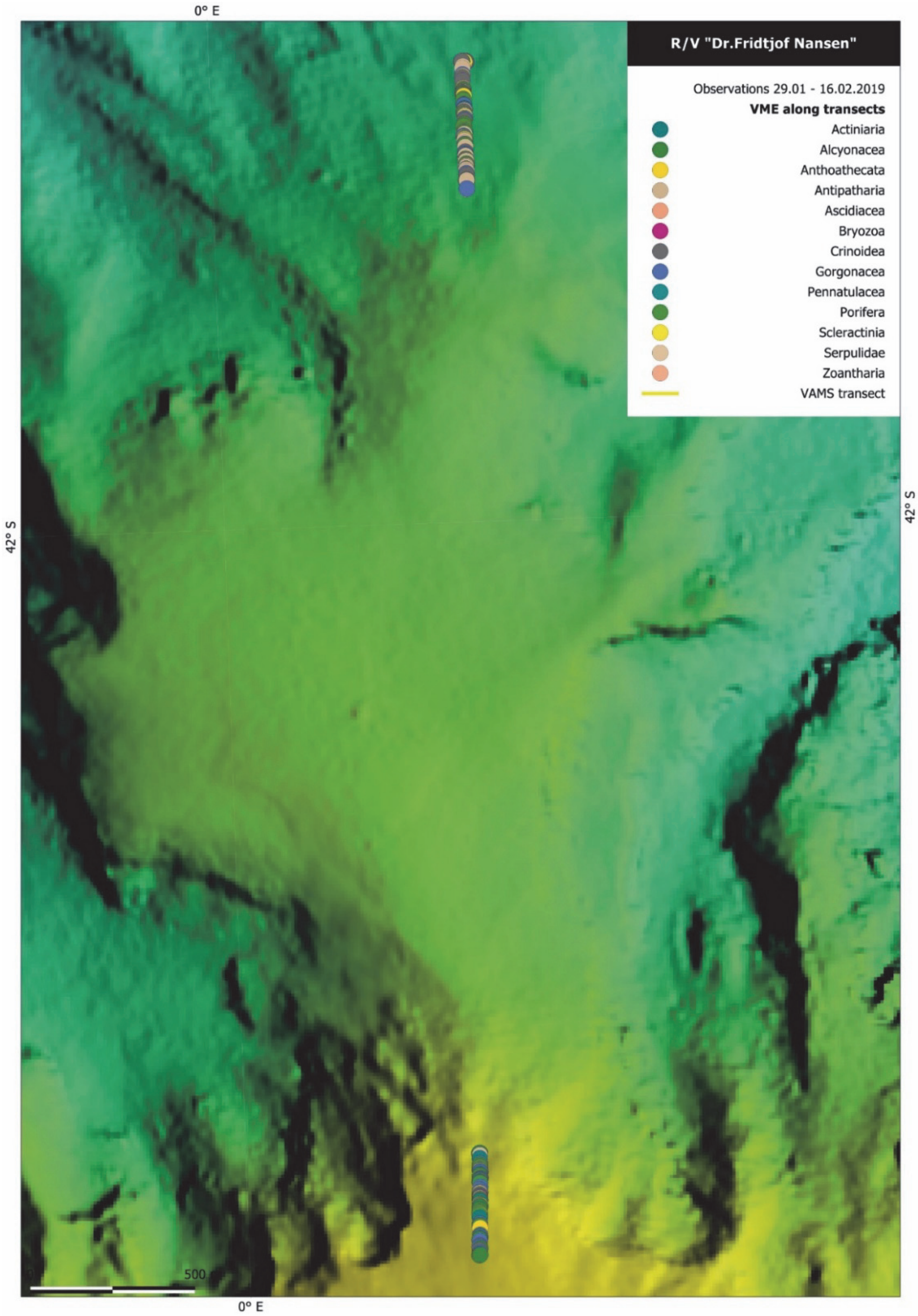


Figure 29. Observations of VME indicators at st 12 (north), st 13 (south), on the northern part of Discovery Seamount.

Herdman Seamount

On st 14, on the summit of Herdman Seamount, sponges, gorgonians and crinoids were most common among the observed VME indicators (Figures 30 and 31). The abundance of VME indicators was moderate (56 VME ind/h).

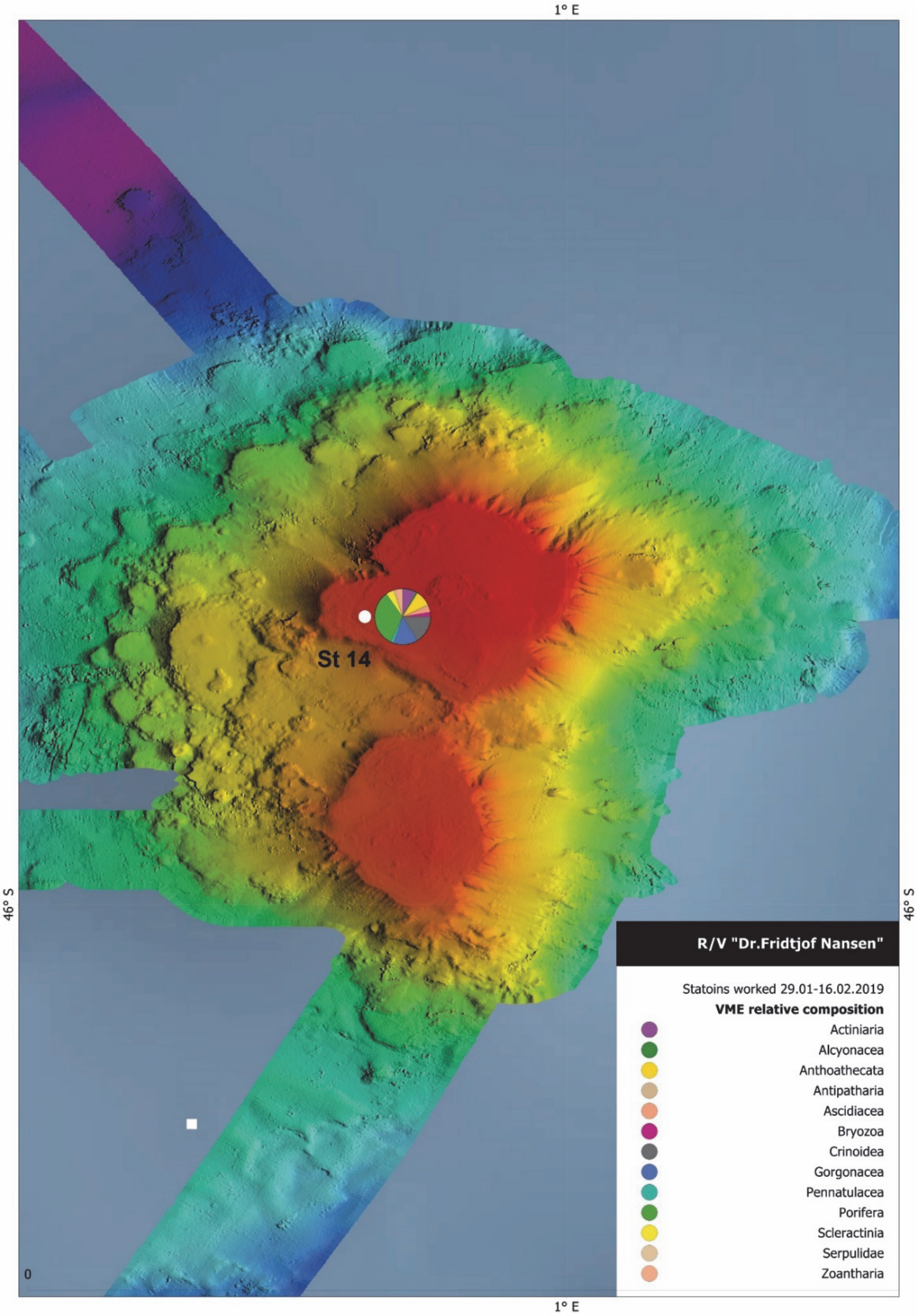


Figure 30. Relative composition of VME indicator species at st. 14, on Herdman Seamount.

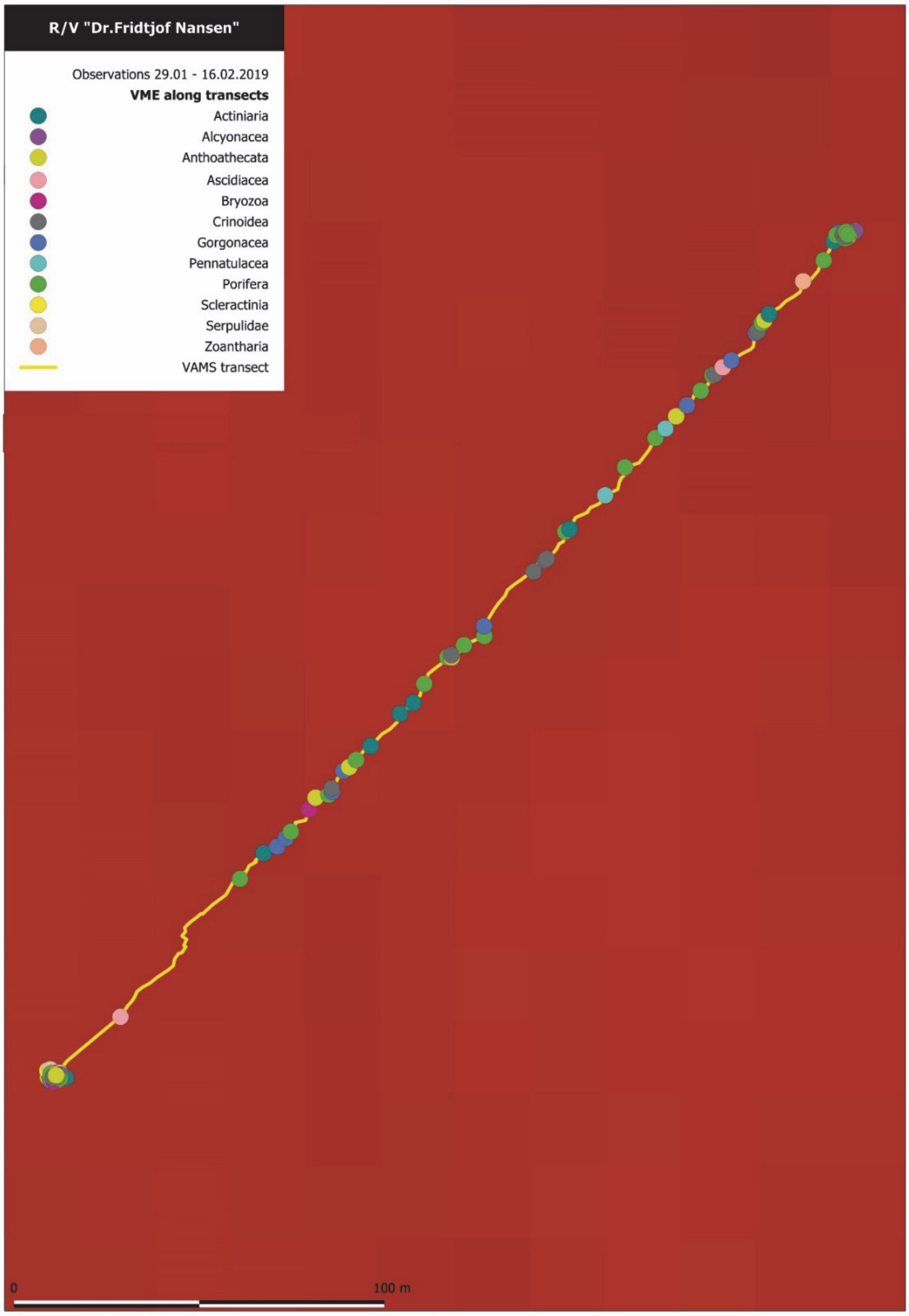


Figure 31. Observations of VME indicators at st 14 on Herdman Seamount.

Table 3. Brief overview of dives with VAMS (Video-Assisted Multisampler), with occurrence of dense patches of VME indicators.

			Time (hh:mm)					
St_Dive	**Seamount area**	**Date**	**Start**	**Stop**	**Duration**	**Depth (m)**	**Comment**	**Dominating VME indicators**
1_1	Shannon	30-Jan			00:00	1550	Aborted	
2_2	Shannon	31-Jan	10:59	11:12	00:12	596	Aborted	
2_3	Shannon	31-Jan	12:28	14:40	02:12	613-596		Stylasterids
1_4	Shannon	1-Feb	07:05	09:18	02:13	1679-1285		
3_5	Tablemnt. E	3-Feb	08:52	10:18	01:26	868-862		Stylasterids
4_6	Tablemnt. E	3-Feb	12:51	15:12	02:21	1350-1094		Crinoids, Primnoid corals, Stylasterids
5_7	Tablemnt. W	4-Feb	11:02	12:46	01:43	1651-1526		Primnoid corals
6_8	Tablemnt. W	5-Feb	12:17	14:49	02:31	957-948		Stylasterids
6_9	Tablemnt. W	5-Feb	07:34	09:17	01:43	558	Aborted	
6_10	Tablemnt. W	5-Feb	09:18	09:24	00:05	961-854		*Keratoisis* corals, Primnoid corals,
7_11	Tablemnt. W	6-Feb	08:03	09:34	01:31	401-394		
8_12	Tablemnt. W	6-Feb	15:53	17:11	01:17	1416-1390		Primnoid corals
9_13	Tablemnt. W	7-Feb	12:15	12:23	00:08	1015	Aborted	
9_14	Tablemnt. W	7-Feb	14:18	15:28	01:09	1027-1014		Primnoid corals
10_15	Discovery E	8-Feb	10:21	11:27	01:06	1000-962		
11_16	Discovery E	8-Feb	14:12	15:40	01:28	1411-1394		
12_17	Discovery N	9-Feb	09:12	12:02	02:49	1865-1726		Crinoids, Yellow-green corals
13_18	Discovery N	9-Feb	13:50	15:14	01:24	1358-1326		Sponges, Stylasterids
14_19	Herdman	15-Feb	04:51	06:51	02:00	1640-1616		Sponges, Crinoids
15_20	Herdman	15-Feb	12:25	12:43	00:17	1468-1456	Aborted	
					27:35	394-1865		

Four video lines had more than 90 observations of VME indicators (Table 4). At the eastern side of Tablemount seamount (dive 4_6) stalked crinoids (sea lilies), Primnoid corals (Gorgonacea), Stylasterids (lace corals) was relatively abundant, and common along the videoline. At the western side of Tablemount seamount (dive 6_10) *Keratoisis* sp. (bamboo coral), and Primnoid coral were common and abundant. At the northern side of Discovery seamount several VME types were common and abundant. Along dive 12_17 crinoids and an unidentified yellow-green gorgonian were abundant, and black coral were common all along the way. On the video line 13_18 sponges and lace corals were abundant.

Further analyses are needed to identify the species better for many of the VME indicators, and a more detailed analyses of the video records would provide better information about densities of the indicators.

Table 4. Number of records (observations noted in the field), and number of VME indicator taxa per valid (not aborted) video-line.

	VAMS video line no														
Taxon	1-4	2-3	3-5	4-6	5-7	6-8	6-10	7-11	8-12	9-14	10-15	11-16	12-17	13-18	14-19
Xenophyophora															
Xenophyophora	2						1		2			1			
Sponges															
Hexactinellida	3	2	1	3			6	2	2			5	20	2	5
Axinellidae			7			1	4						4	8	6
Demospongia	2		1	1		1	1								3
Porifera	2	19	8	11	1	2	5		8	2		3	11	13	20
Porifera big		1												5	3
Soft corals															
Anthomastus	4	18	12	19	1	5	13		8	5	2	8	1	20	1
Nephtheidae				3	1	1	6		6	3		3		1	
Octocorallia	2	1				1			1	4					
Sea fans and whips															
Antipatharia	5			2	2				1			3	32	2	1
Chrysogorgidae															1
Gorgonacea	7	11	5	25	3	3	2	12	1			15	11	5	1
Isididae	4			9	3		5	1	6	3	1	5	10	7	1
Keratoisis	1		1	1	1		19		3	4		1			1
Primnoidae		1	2	1			1			1		1			5
Thouarella spp		1	9	9	2	1	10	2	3	7		6	5	14	7
Seapens															
Pennatulacea	3	5	1	11	2		6		8		1	3	1		3
Stone corals															
Scleractinia solitary	4	1		12		1	2	8	6	5	11	2	6	1	5
Lace corals															
Stylasteridae	6	19	7	37	3	4	10	4	2	4		6	12	14	10
Crinoids															
Crinoidea stalked				4	3				1			3	22		10
No of VME records	45	79	54	148	22	20	91	29	58	38	15	65	135	92	83
No of VME taxa	13	11	11	15	11	10	15	6	15	10	4	15	12	12	17

Table 5. Chronological list of positions for VAMS and pelagic trawl sampling station.

Date	Station	Gear	Latitude	Longitude
30.01.2019	1-1	VAMS	42°59.10 S	02°29.14 W
31.01.2019	2-2	VAMS	42°59.65 S	02°26.64 W
31.01.2019	2-3	VAMS	42°59.60 S	02°26.86 W
01.02.2019	1-4	VAMS	42°59.01 S	02°29.02 W
03.02.2019	3-5	VAMS	41°47.48 S	01°56.99 W
03.02.2019	4-6	VAMS	41°48.68 S	01°57.07 W
04.02.2019	5-7	VAMS	42°10.80 S	01°30.51 W
05.02.2019	1	Pel trawl	42°05.27 S	01°30.13 E
05.02.2019	6-10	VAMS	42°05.62 S	01°28.35 W
05.02.2019	6-8	VAMS	42°05.74 S	01°28.52 W
05.02.2019	6-9	VAMS	42°05.74 S	01°28.52 W
06.02.2019	2	Pel trawl	42°05.83 S	01°10.94 E
06.02.2019	7-11	VAMS	41°56.28 S	01°21.98 W
06.02.2019	8-12	VAMS	42°05.36 S	01°10.83 W
07.02.2019	9-13	VAMS	41°44.55 S	01°20.08 W
07.02.2019	9-14	VAMS	41°44.47 S	01°19.98 W
08.02.2019	10-15	VAMS	41°59.20 S	00°25.99 W
08.02.2019	11-16	VAMS	41°53.35 S	00°29.57 W
09.02.2019	12-17	VAMS	41°41.38 S	00°03.55 W
09.02.2019	13-18	VAMS	41°43.12 S	00°03.51 W
10.02.2019	3	Pel trawl	42°31.75 S	00°03.72 W
15.02.2019	4	Pel trawl	45°22.40 S	00°28.11 E
15.02.2019	14-19	VAMS	45°23.06 S	00°25.27 W
15.02.2019	15-20	VAMS	45°22.67 S	00°27.78 W
16.02.2019	5	Pel trawl	41°07.97 S	02°39.44 E
17.02.2019	6	Pel trawl	40°11.50 S	04°44.39 E
18.02.2019	7	Pel trawl	39°21.47 S	06°40.80 E
18.02.2019	8	Pel trawl	38°28.31 S	08°43.06 E
20.02.2019	9	Pel trawl	36°17.39 S	13°37.40 E
21.02.2019	10	Pel trawl	35°51.39 S	14°24.72 E

No evidence of human footprint was observed, but extensive grazing on bamboo corals (*Keratoisis sp*.) by a sea urchin (Echinidea) was observed at one location at depths between 850 and 960m (Figure 32). This urchin is likely *Dermechinus horridus africanus* Döderlein 1906. Most of the observed colonies had naked skeleton areas lacking tissue and polyps. 31% of the colonies contained urchins, some of them with more than 20 individual urchins. Such massive grazing on cold-water corals has never been observed earlier. The impact of urchins was observed over the stretch of the 200 m long video transect, with broken, partly live colonies and dead skeleton fragments locally aggregated by the seabed topography (Figure 33). It was not possible to tell whether this is a natural, and possibly cyclic phenomenon or caused by an external pressure. Given the longevity and slow growth of the corals, the ongoing grazing must represent a short event.

Figure 32. Sea urchins grazing on *Keratoisis* corals at dive 6_10. Colonies with 7-20 individual urchins were common.

Figure 33. Seemingly old skeletal debris of *Keratoisis* skeleton (to the left), and spines of sea urchins (close-up to the right), at dive 6_10. The red soft coral in the picture to the left is an unidentified *Anthomastus*.

Benthopelagic fish and cephalopods

Benthopelagic fish and cephalopods were frequent components of benthic ecosystems explored by VAMS in seamounts of the South East Atlantic Fisheries Organization (SEAFO) Convention Area. A total of 374 fish and 21 cephalopods were visualized in 16 video profiles (including one short aborted dive) analyzed (total time = 27.5 hours). Fish were classified in 33 morphotypes represeting 8 orders and 12 families (Table 6). Two morphotypes could not be assigned to any taxa. Five cephalopod morphotypes were differentiated in the videos, classified in two Orders and four families. One morphotype could not be assigned to Family level. Most fish morphotypes were classified in the families Macrouridae (15) and Moridae (5).

Table 6. Fish and cephalopods visualized along 16 video profiles obtained in the Convention Area of the South East Atlantic Fisheries Organization (SEAFO). Classification in Genus and Species level is tentative and based only in external visible characters.

Class	Order	Family	Species	Morphotype code
Caphalopoda	Oegopsida	Onychoteuthidae	*Onykia ingens*	CT1
		Histioteuthide	*Histioteuthis atlantica*	CT5
		Indet.	*Indet.*	CT4
	Octopoda	Octopodidae	Indet.	CT2
		Opistoteuthidae	*Opistoteuthis agassizi*	CT3
Holocephalii	Chimaeriformes	Chimaeridae	*Hydrolagus sp.*	FT1
Actinopterygii	Notacanthiformes	Notacanthidae	Indet.	FT7
	Anguilliformes	Synaphobranchidae	Indet.	FT20
			Indet.	FT21
	Zeiformes	Oreosomatidae	Indet.	FT22
	Gadiformes	Macrouridae	*Coelorinchus sp.*	FT4
			Indet.	FT8
			Indet.	FT10
			Indet.	FT13
			Indet.	FT14
			Indet.	FT15
			Indet.	FT18
			Indet.	FT24

Class	Order	Family	Species	Morphotype code
			Indet.	FT27
			Coelorinchus sp.	FT6
			Coryphaenoides sp.	FT26
			Indet.	FT30
			Indet.	FT32
			Indet.	FT34
			Cynomacrurus piriei	FT31
		Moridae	*Lepidion sp.*	FT3
			Laemonema sp.	FT12
			Antimora rostrata	FT9
			Guttigadus sp.	FT7
			Indet.	FT17
	Ophidiiformes	Ophidiidae	Indet.	FT25
		Bythitidae	*Cataetyx sp.*	FT2
	Scorpaeniformes	Liparidae	*Paraliparis cf. copei*	FT11
	Perciformes	Zoarcidae	*Melanostigma sp.*	FT5
		Bramidae	*Brama sp.*	FT33
		Epigonidae	*Epigonus cf. telescopus*	FT28
	Indet.	Indet.	Indet.	FT19
	Indet.	Indet.	Indet.	FT29

Macrouridae and Moridae occurred in nearly 40% of the analyzed video profiles (13), followed by Zoarcidae (21%). These were also the most numerically abundant groups; Moridae alone included 65.8% of all fish records (240 records), followed by Macrouridae (20.3%, 74 records) and Zoarcidae (7.9%, 29 records). Particularly abundant morphotypes were morids FT12 (possibly genus *Laemonema*), FT7 (possibly *Guttigadus* sp.), FT3 (*Lepidion* sp.), macrourid FT13 and zoarcid FT5, *Melanostigma* (Figure 34). The remaining 22 fish records were distributed among 10 different families (Figure 34). Cephalopod families, and morphotypes, occurred in five different video profiles. Records were generally scarce in the videos except for VAMS 2 and 3 where *Onykia ingens* (Oegopsida, Onychoteuthidae) was relatively abundant.

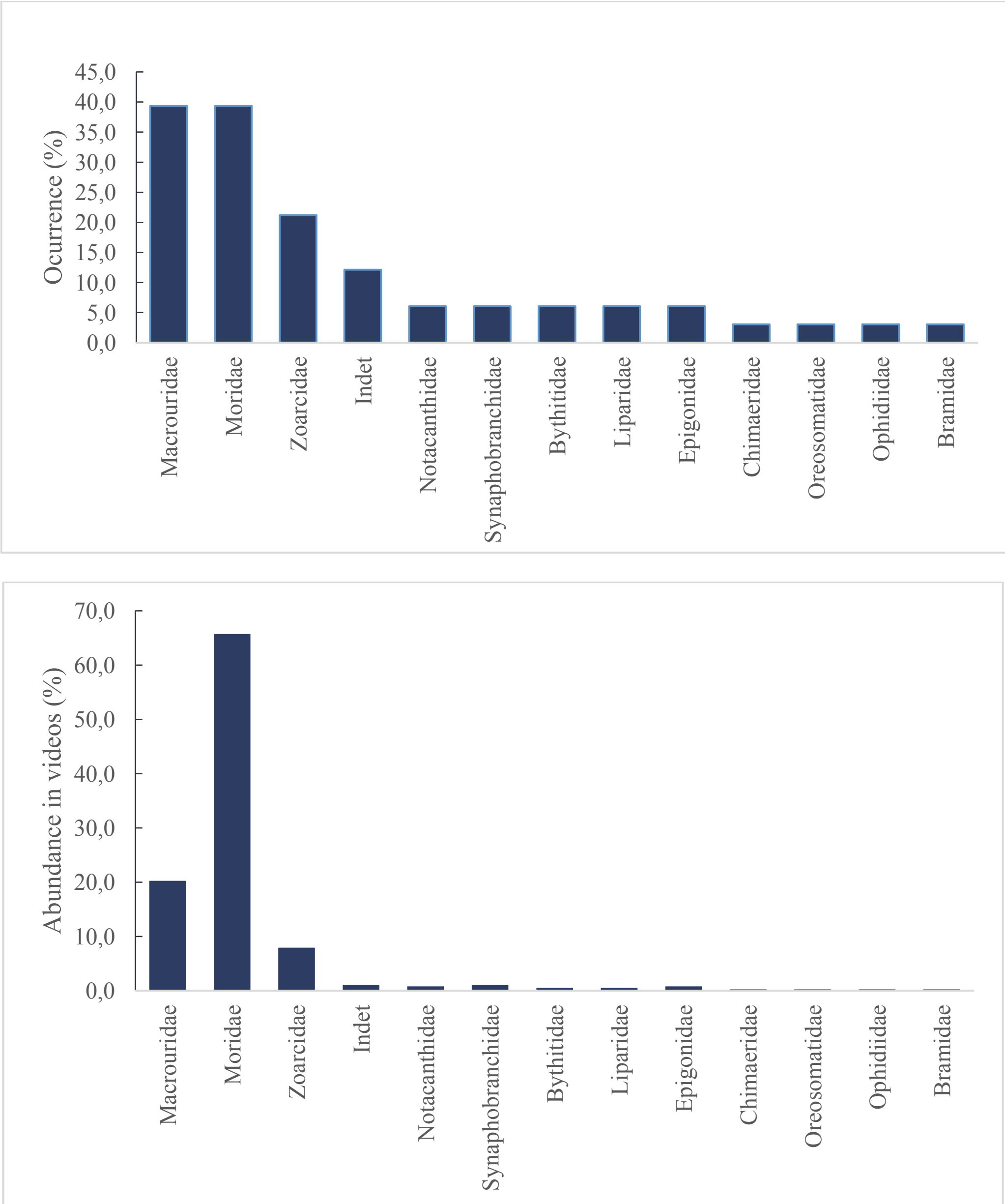


Figure 34. Occurrence of fish families in 16 video profiles obtained the Convention Area of the South East Atlantic Fisheries Organization (SEAFO). Upper panel, frequency (%) of occurrence in the video profiles. Lower panel, frequency of families in the total number of fish count in the videos (n = 374).

Fish morphotype richness and relative abundance increased with observation time (Table 7). Relative abundance was higher in Tablemount video profiles (0.38 fish per minute), followed by Shannon seamount (0.13 fish per minute). Fish records were very scarce in video profiles obtained in Discovery and Herdman seamounts. Morphotype richness, however, varied little between seamounts (0.3 – 0.4 morphotype per minute) (Figure 35).

Table 7. Summary of fish and cephalopods records visualized along 16 video profiles obtained in four seamounts within the Convention Area of the South East Atlantic Fisheries Organization (SEAFO).

	Shannon	Tablemount	Discovery	Herdman
Number of VAMS profiles	3	8	4	1
Observation time (minutes)	291.0	833.2	408.3	120.7
Number of Cephalopod Morphotypes	1	5	0	0
Number of Fish Morphotypes	9	22	11	5
Number of Cephalopods	11	10	0	0
Number of Fish	28	304	32	10

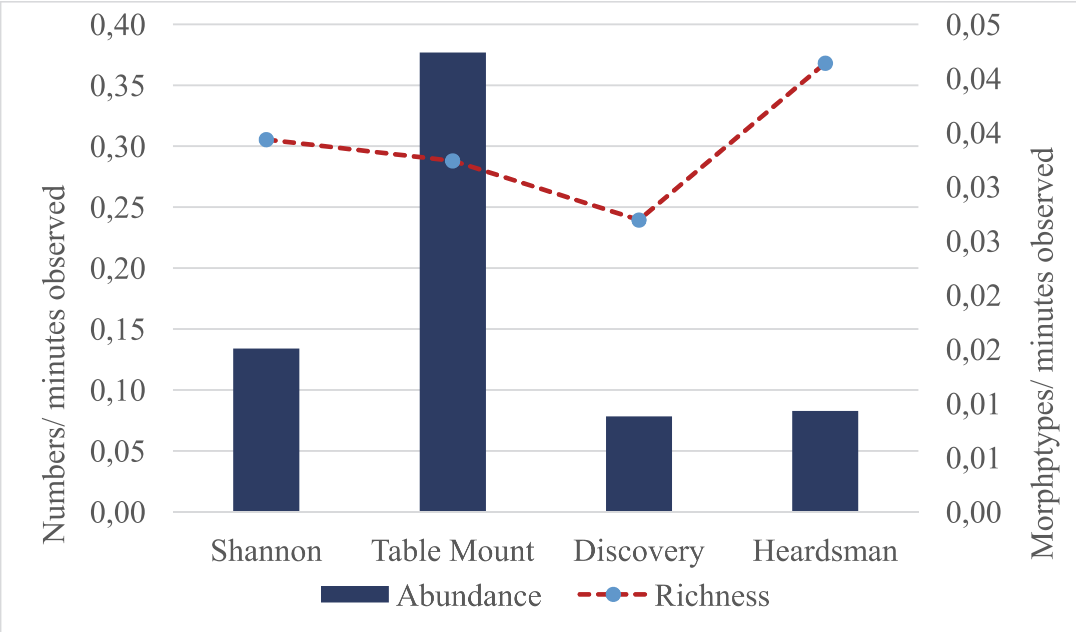


Figure 35. Richness and relative abundance of cephalopod and fish morphotypes visualized along 16 video profiles obtained in the Convention Area of the South East Atlantic Fisheries Organization (SEAFO).

General remarks:

- Video exploration revealed a relatively diverse fish fauna, typical of seamounts, with vast dominance of Gadiforms, particularly families Moridae and Macrouridae.
- Records generally included small-sized species and only one commercial species was recorded, *Antimora rostrata*, in only two occasions.
- Abundance was greater in the Tablemount seamounts, but richness, considering differences in observation time, was similar among the seamounts explored.
- Within seamounts, fish tended to be more abundant in shallower areas. Morphotype richness however differed little between depth strata. In the explored seamounts, fish

fauna composition differed greatly among depth strata (Beta-diversity), suggesting that there may be important habitat specialization and depth along with habitat heterogeneity, may drive community structure.

- These generalizations may be affected by different sampling efforts and dive strategies conducted in the different areas.

References

Cohen, D.M.; Inada.T.; Iwamoto, T.; Scialabba, N. 1990. FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis. No. 125, Vol. 10. Rome, FAO. 1990. 442 p.

Nielsen, J.G.; Cohen, D.M.; Markle, D.F.; Robins, C.R. 1999. FAO species catalogue. Volume 18. Ophidiiform fishes of the world (Order Ophidiiformes). An annotated and illustrated catalogue of pearlfishes, cusk-eels, brotulas and other ophidiiform fishes known to date. FAO Fisheries Synopsis. No. 125, Vol. 18. Rome, FAO. 1999. 178p., 136 figs

Spatial patterns of species distribution

The video transects were divided into 72 segments of approximately 100 m length based on positions of the VAMS garage. Observed taxa were represented with a relative abundance (rare, common, or abundant) based on the observation logs. These field data were applied in a Detrended Correspondence Analyses (DCA) and Cluster Analyses (based on Bray Curtis similarity indexes) (Figure 36).

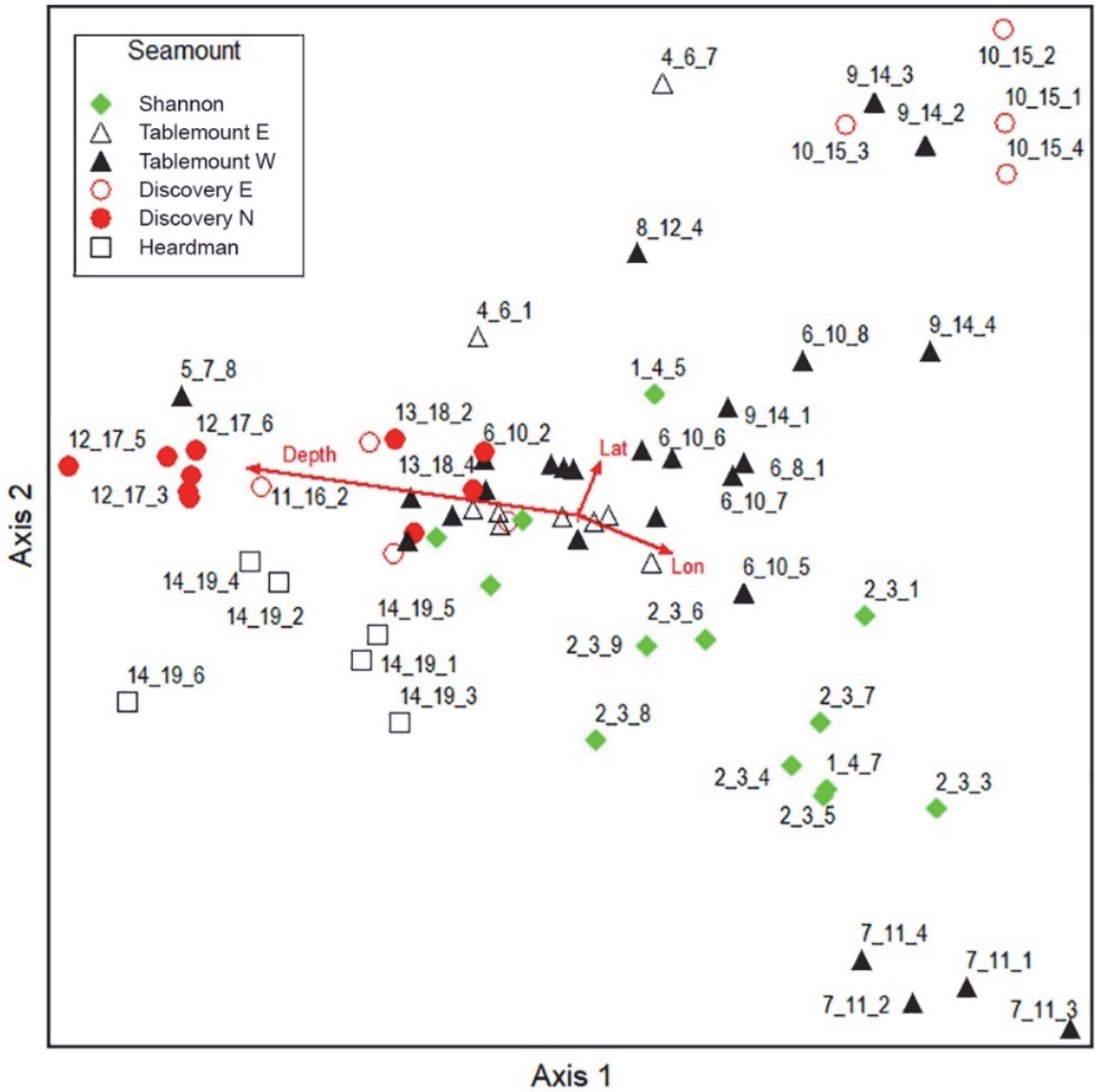


Figure 36. DCA plot based on relative abundance of fish and invertebrates in video samples (100 m long sequences). The arrows indicate the correlation between species composition and explanatory factors. Video samples are given as station no, dive no and video sequence no.

Seamount name and substrate type were used as categorical variable in the analyses, while depth, latitude and longitude were used as numerical explanatory variables. The six seamounts clustered in groups both in the DCA plots (Figure 36) and in the cluster dendrograms (Figure 37). Depth was a strong explanatory variable with a correlation coefficient (Pearson and Kendall Correlations with Ordination Axes) of 0.66 with the first axis.

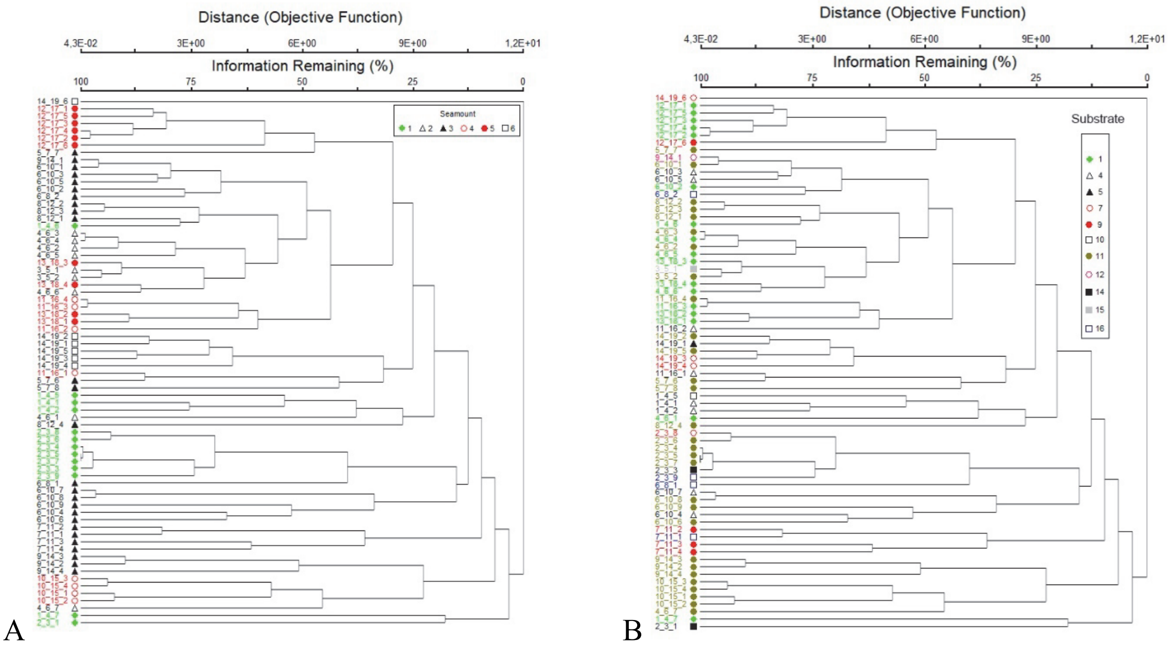


Figure 37. Cluster dendrogram for video samples based on Bray Curtis similarity. A) with symbols representing the different seamounts, and B) symbols representing different dominating substrate types. Substrates: 1) Bedrock, 4) Bedrock with sand, 5) Bedrock with shell fragments, 7) Boulders , 9) Gravel, 10) Gravelly sand, 11) Sand, 12) Sand with bedrock, 14) Sand with cobbles, 15) Sand with patches of bedrock, 16) Sandy gravel.

The cluster analysis separated the video samples into two groups of seamounts, with one group mainly consisting of video sequences from bedrock (Figure 37 B). These video sequences were also typical deeper than the other main group, represented by video sequences from various substrate types occurring shallower.

3.4 Macrofauna in grab samples

At the 13 VAMS stations, a total of 665 infaunal specimens, belonging to 34 higher taxa, were collected. Overall, benthic specific richness was approximately 157 species with average richness of 19.9 species by station. The highest occurrence was recorded for Polychaeta, collected at all stations, followed Ophiuroidea (10 stations, 76.9%), Amphipoda (9 stations, 69.2%) and Porifera (8 stations, 61.5%) (Figure 38). Polychaeta was also the most diverse group, with 37 species, followed by Ophiuroidea (21 species), Hydrozoa (17 species), Porifera (14 species) and Prosobranchia and Bryozoa with 9 species each one (Figure 39). These results may change slightly when the taxonomic study is concluded.

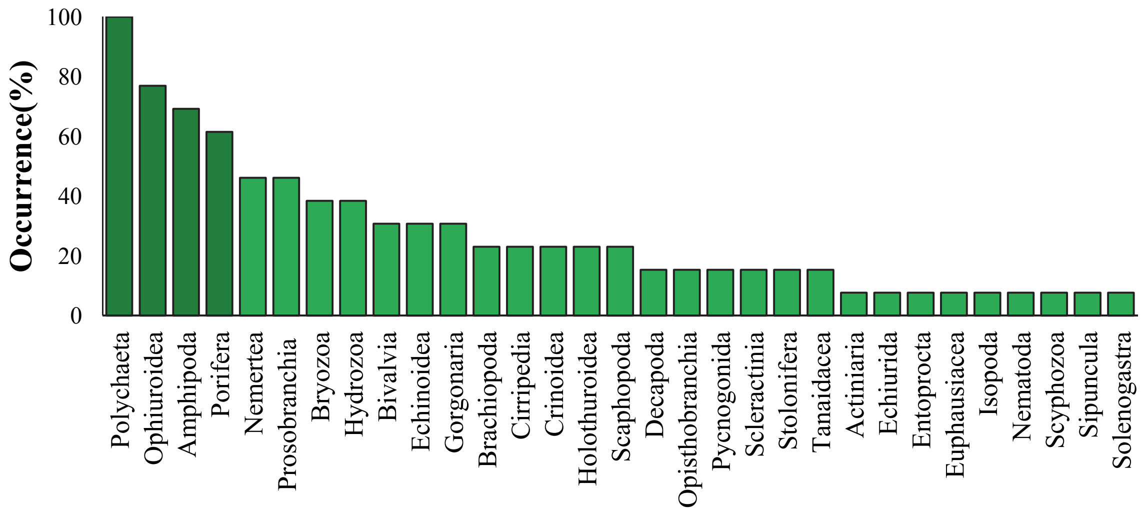


Figure 38. Occurrence of the 34 main-taxa (% of stations) collected with grab.

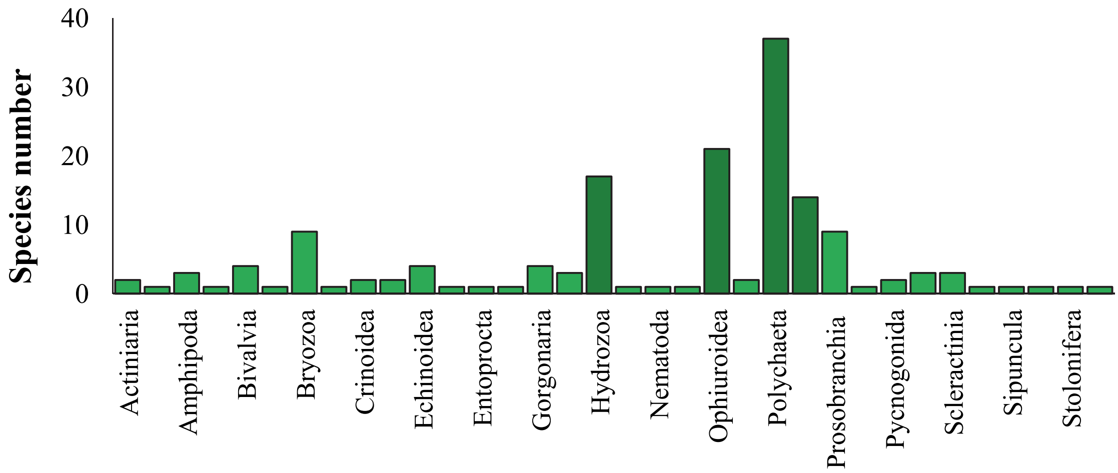


Figure 39. Species richness (S) for the 34 main-taxa collected with grab.

The two most diverse groups were also the most abundant, accounting 27% and 18% of the total abundance for Polychaeta and Ophiuroidea respectively. Amphipoda with 17%, was the third taxa in abundance (Figure 40).

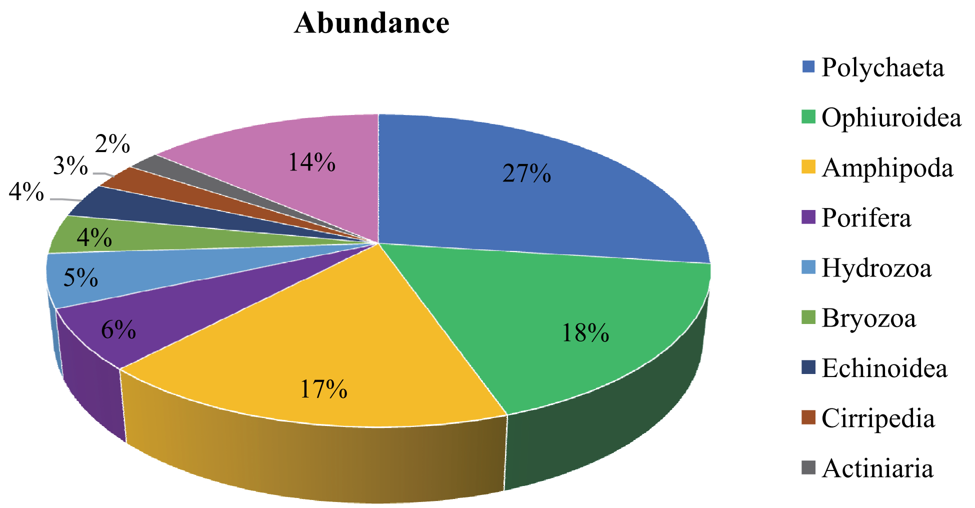


Figure 40. Composition of relative abundance by main-taxa (%) of benthic fauna collected with grab.

3.5 Pelagic trawls

A total of 10 pelagic trawls have been performed during the survey on Discovery Seamounts Complex including the transects done in the transit back to Cape Town (Figure 39). Locations of the trawls are shown in Figure 41. Trawls 1 to 4 were above the seamounts in a narrower depth range (350-525 m) than the stations 5 to 10 that were made along the transect from the SEAFO surveyed area and Cape Town at depths between 0 to1000m. Two taxa were predominant in the catch, Crustaceans from the Euphausiidae family (krill) and Fishes from the Myctophidae family (lanternfishes). 127 species of fish, 85 crustacean, 41 cephalopods as well as other invertebrates in the catch show a high mesopelagic biodiversity in these areas. Biodiversity is higher in the Transit stations compared to that above the seamounts, likely due to the broader depth range of the trawls in the Transit stations.

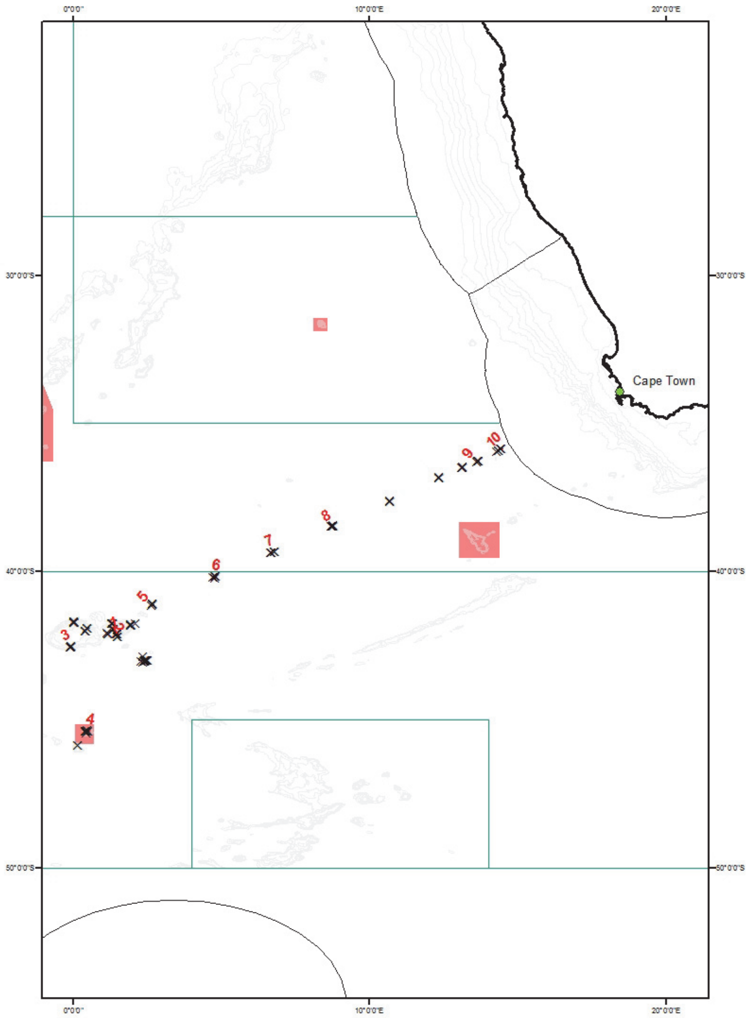


Figure 41. Location of the pelagic trawls (numbered in red).

ll catches have been sampled and the first results on the analysis of the pelagic trawl catches collected during the survey is presented here.

Two taxa were predominant both in number and weight during the pelagic trawls namely Crustaceans from the Euphausiidae family (krill) and Fishes from the Myctophidae family (lanternfishes) (Figure 42).

Figure 42. Krill (left) and lanternfishes (right) were the most abundant taxa in pelagic trawls.

Table 8 and Figure 43 show the statistics of the catches for main taxa groups. The maximum catch was of crustaceans (more than 50 kg in one station) and fishes (more than 40 kg). The mean catch per station is highlighted in red.

Table 8. Statistics of catches (kg) per station for the main taxa groups.

Cephalopoda	Crustacea	Fish	other invert.
Min. : 0.980	Min. : 0.1550	Min. : 1.360	Min. :0.170
1st Qu.: 3.608	1st Qu.: 0.5152	1st Qu.: 8.465	1st Qu.:1.015
Median : 4.731	Median : 1.7307	Median :15.125	Median :1.343
Mean : 5.810	Mean : 9.2762	Mean :15.947	Mean :2.498
3rd Qu.: 9.115	3rd Qu.:12.7462	3rd Qu.:19.930	3rd Qu.:2.810
Max. :11.850	Max. :51.4200	Max. :41.960	Max. :9.510

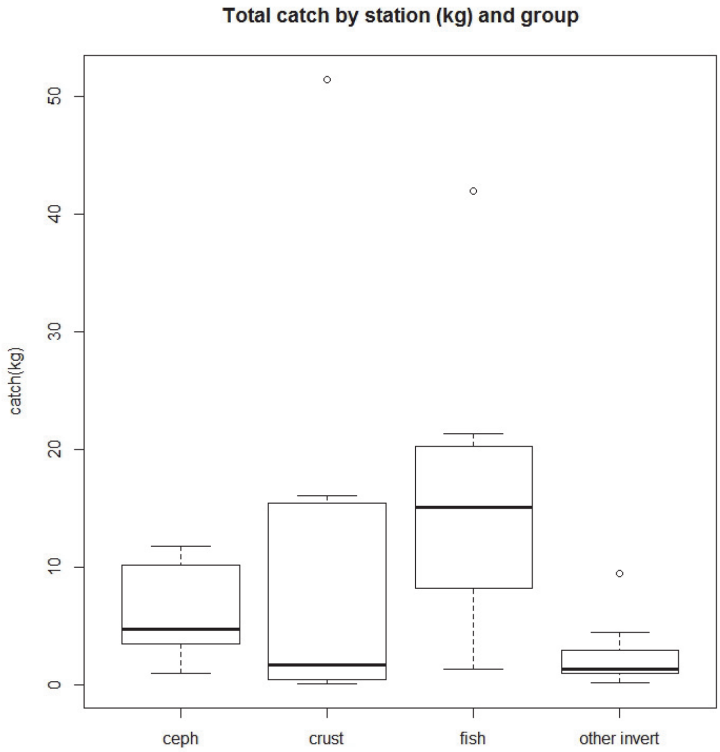


Figure 43. Boxplot of the catch statistics for the different main taxa groups.

While fish was the most abundant group in the catch in weight (48% of the catch), followed by 28, 17 and 7% from crustaceans, cephalopods and other invertebrates respectively (Figure 44), crustaceans were dominant (mainly krill species) in the catch in terms of number of individuals, reaching more than 93% of the total number. Fish and other invertebrates contributed approximately 3% and cephalopods less than 1% in number of individuals.

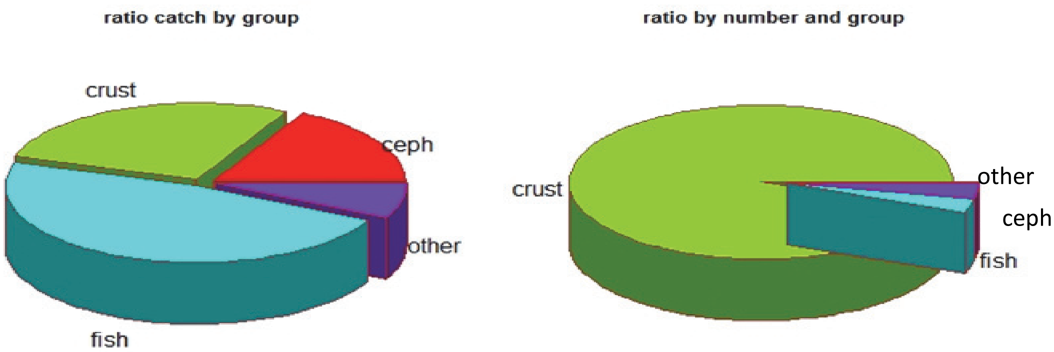


Figure 44. Relative abundance composition by main-group by weight (left) and number (right)

All species in the catch, and their wet weight are shown in alphabetical order by station, Fishes (Table 9), Crustaceans (Table 10), Cephalopods (Table 11) and other invertebrates (Table 12). The size of the dots indicates the species weight at each station.

127 fish species were present in the catch. *Photichthys argenteus* (Figure 45) from the family Photichtydae was the most widely distributed species, being present in 9 out of 10 stations, followed by *Vinciguerria* sp. (7 stations), *Sternoptyx pseudobscura* (6 stations), *Malacosteus niger* (6 stations) and *Electrona* sp. (6 stations)

From the 85 species of crustaceans in the catch, the Amphipoda *Phronima sedentaria* had the maximum frequency of occurrence, being present at all stations. It was followed in frquency by two Decapoda species *Oplophorus novaezeelandiae* (9 stations) and *Acanthephyra pelagic* (7 stations) and the Amphipoda, *Themisto gaudichaudii* (7 stations).

From the 41 species of cephalopods in the catch, the squid of the family Lycotheuthidae, *Lycoteuthis lorigera* was present in 9 out of the 10 stations followed by *Histioteuthis atlantica* (6 stations), *Todarodes angolensis* (6 stations) *and Octopoteuthis sicula* (5 stations).

For other invertebrates is worth noting the presence of jellyfishes at all stations and Tunicates from the family Pyrosomatidae (3 stations) and the mollusc *Cavolinia tridentata f. australis* (3 stations).

Greater biodiversity is found at the stations sampled during the transect while transiting to Cape Town, likely due to the wider depth range of the pelagic trawls, between the surface and 1 000 m deep. For this reason, it is not possible to describe the distribution of the species by depth strata at these stations.

Three species of krill, namely *Nematoscelis megalops*, *Euphausia similis* and *Euphausia spinifera* were the most abundant by far both in number and in wet-weight and predominantly in the sets made over the seamount.

The squid *Lycoteuthis lorigera* was the most abundant cephalopod in the catch taking into account the number of individuals, while *Todarodes angolensis* was most abundant in weight.

Both lanternfishes, *Gymnoscopelus* sp. and *Diaphus mollis* (Myctophidae) were the most abundant in number of individuals while *Brama brama* and *Diaphus hundsoni* in wet-weight.

Figure 45. *Photichtys argenteus*.

Table 9. Wet-weight (kg) of fish species per station.

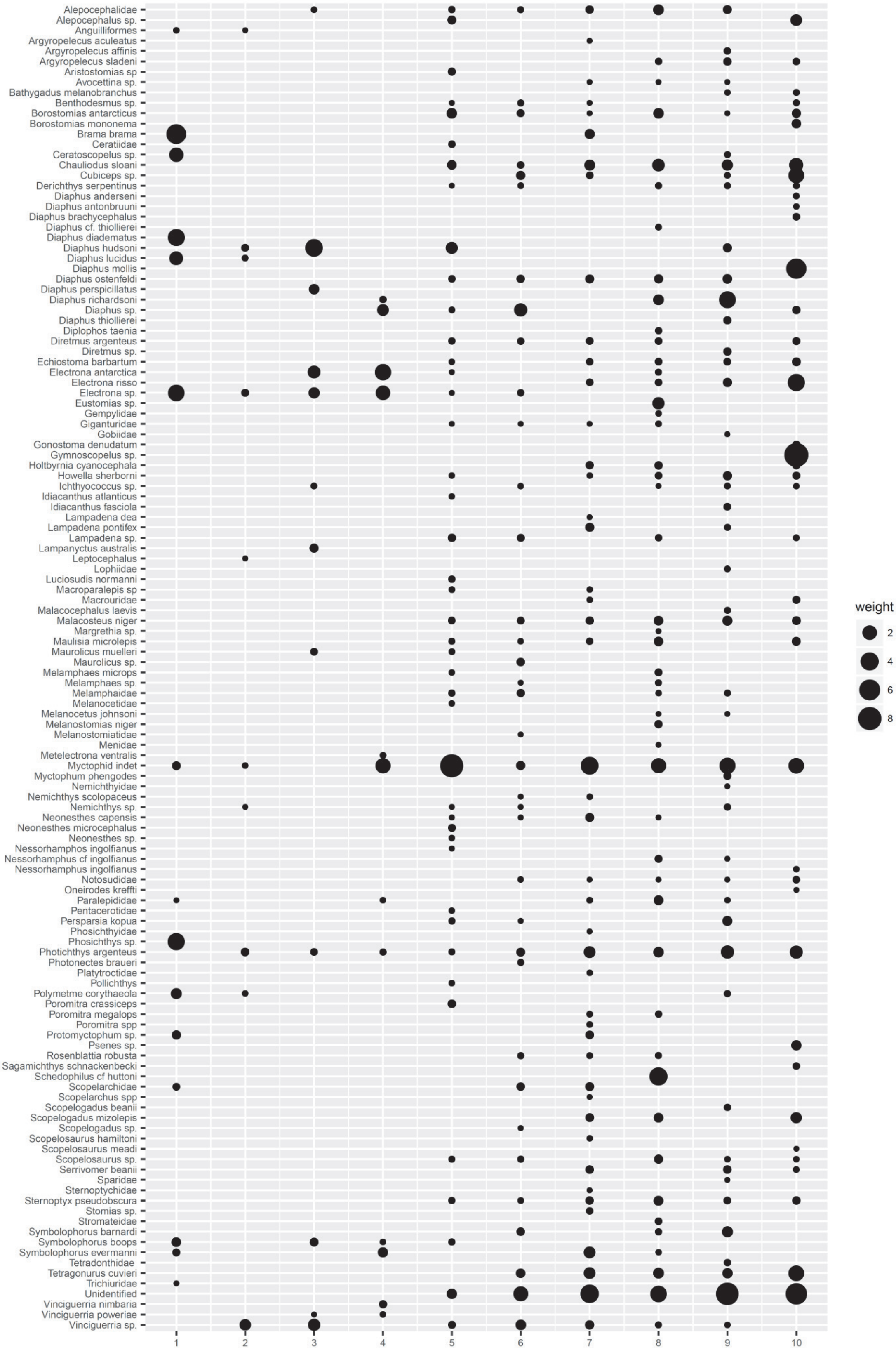


Table 10. Wet-weight (kg) of crustaceans species per station.

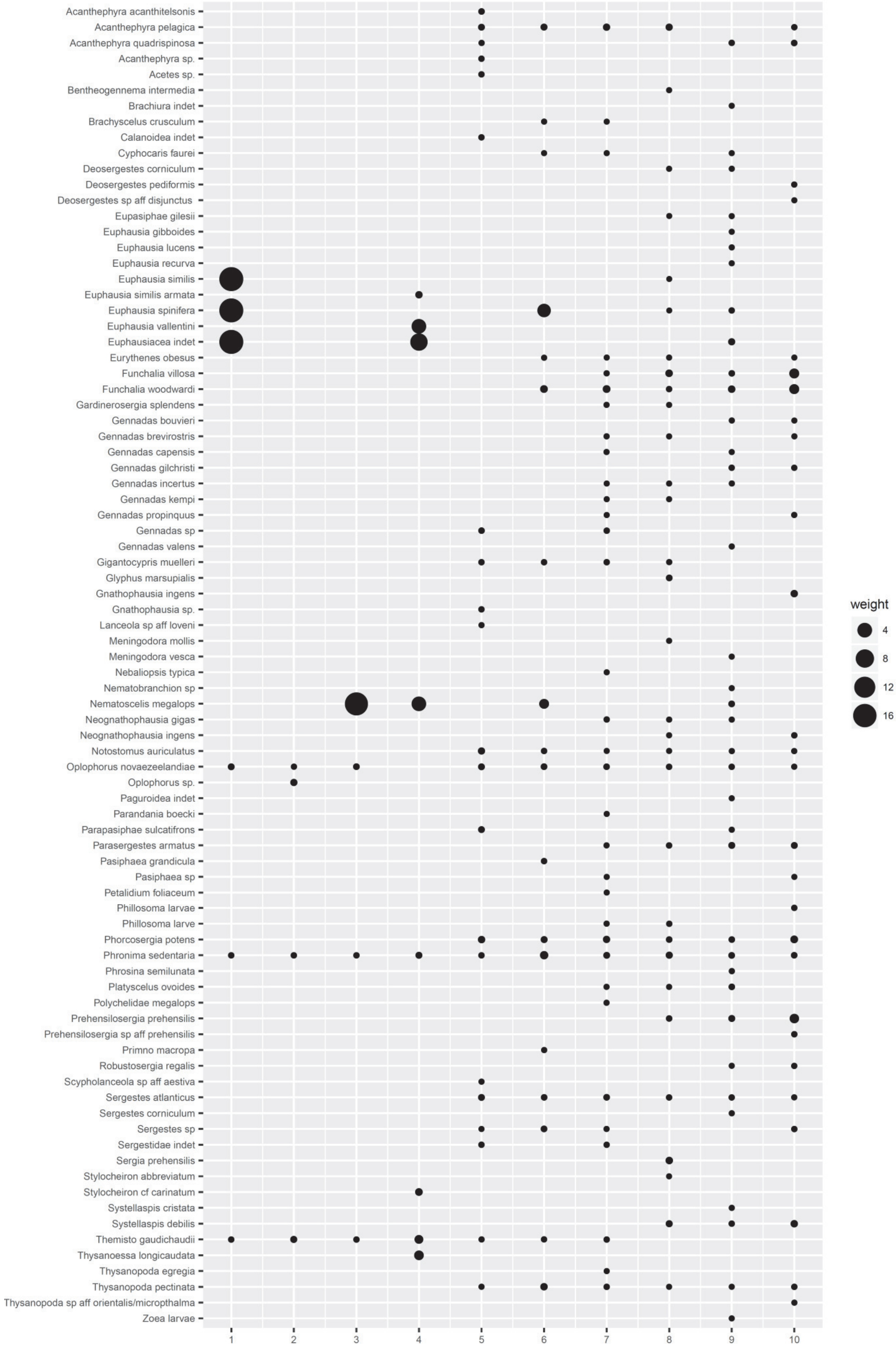


Table 11. Wet-weight (kg) of cephalopods species per station

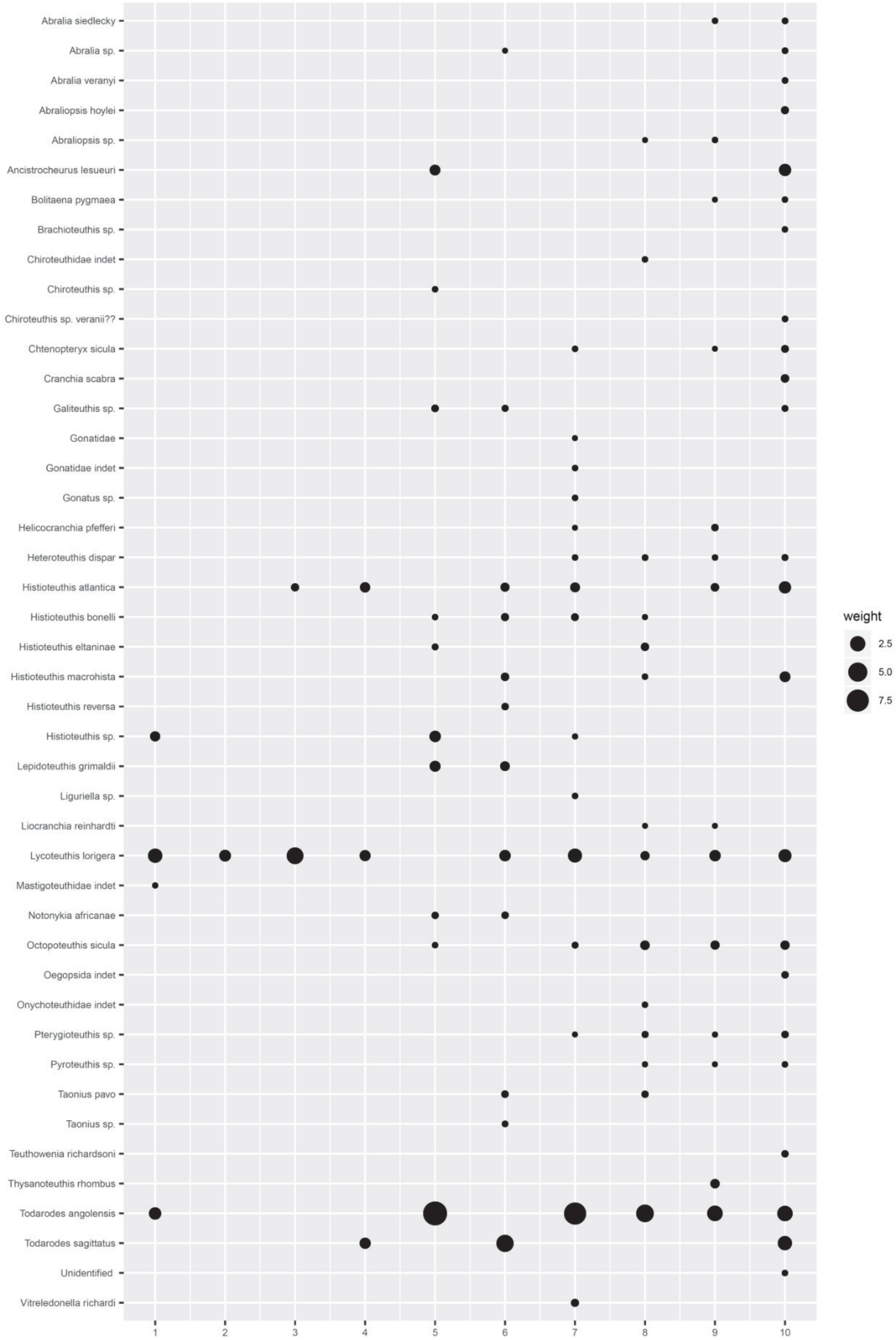
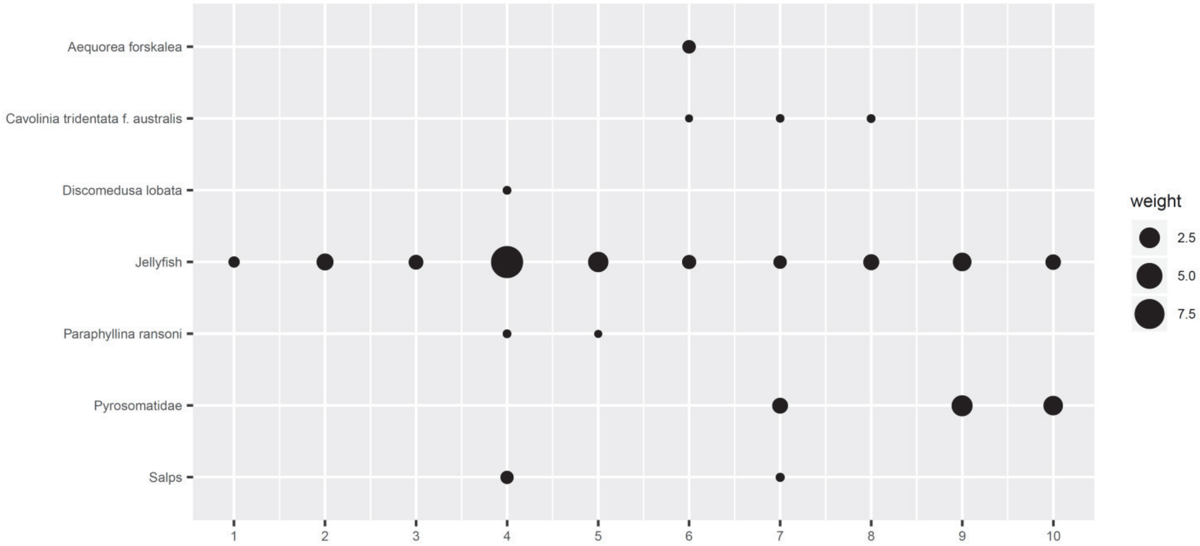


Table 12. Wet-weight (kg) of other invertebrate species per station.



ANNEX I. OBSERVATIONS FROM INDIVIDUAL STUDY LOCATIONS

Shannon Seamount

Bathymetry

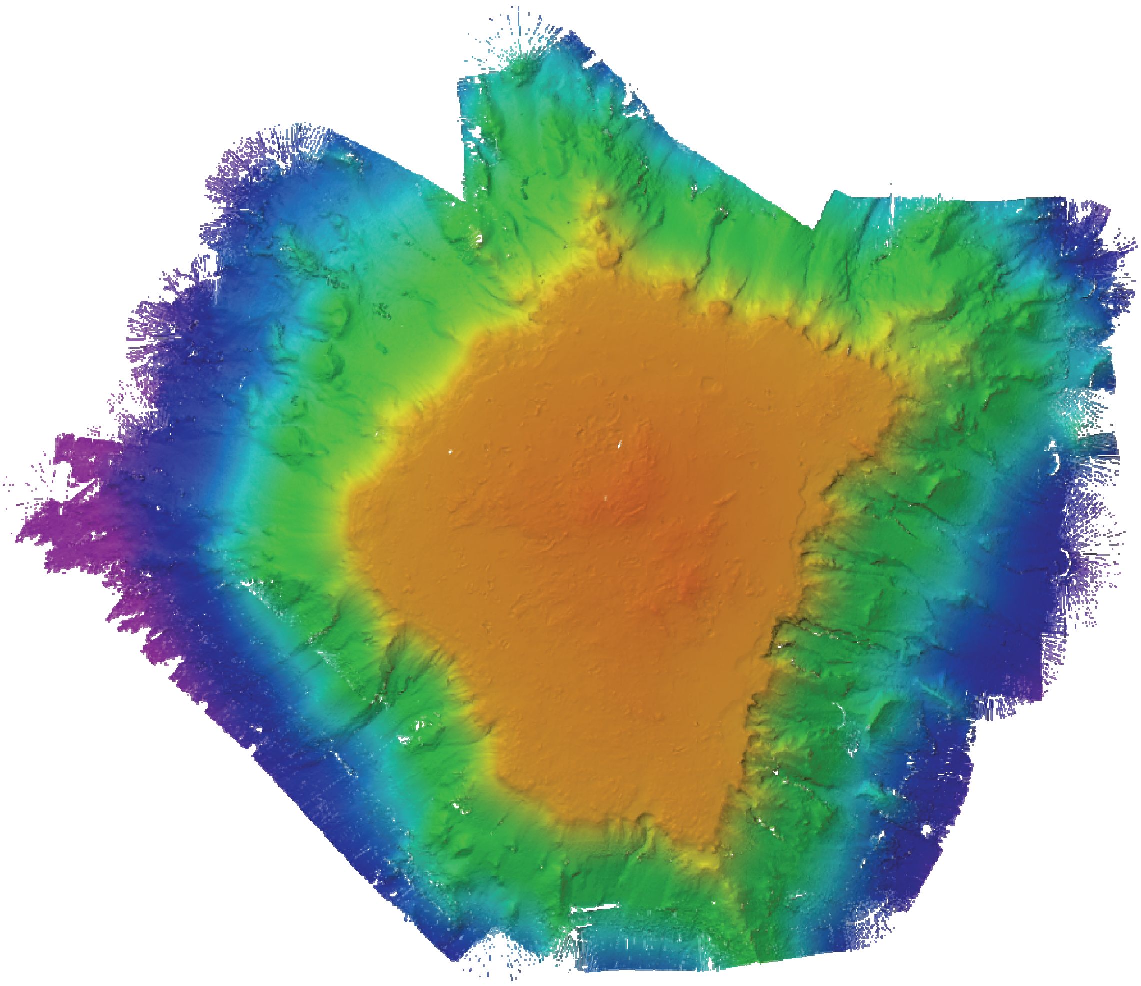
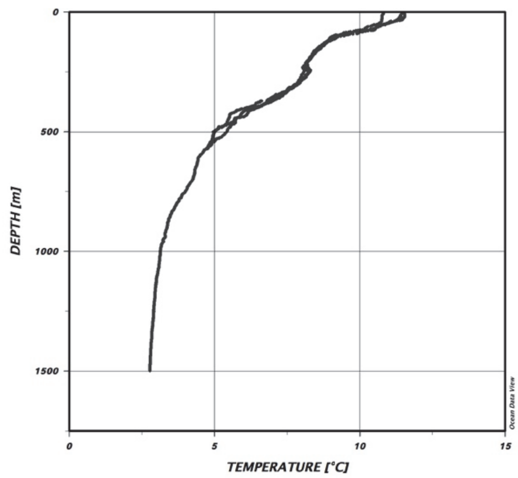
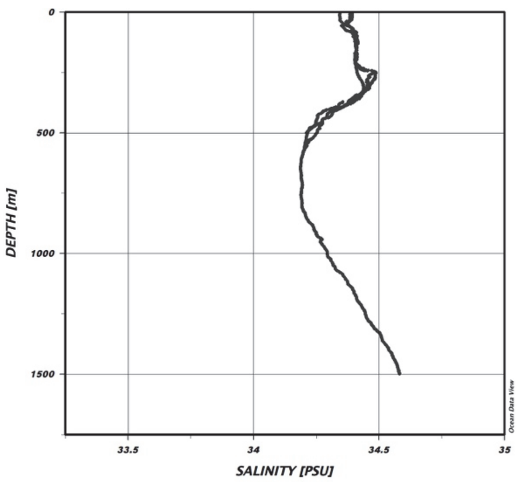


Figure I.1. Multibeam map of Shannon Seamount in box D1.

Water column profile





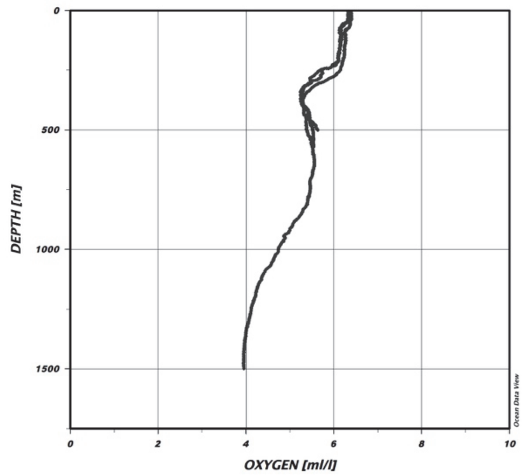


Figure I.2. Water column profile of the Shannon seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) up to 1 500 m depth.

Macrofauna

On this seamount, only one station was samples, located at zone D1, at 606 m depth.

At this site, only 15 specimens belonging to 12 different species included in 6 high-range taxa were recorded. Polychaeta was the most specious and abundant taxon, represented by 5 species and 8 individuals (53% of total catch), followed by Porifera with 3 exemplars belonging to 3 species of Demospongiae. Remaining taxa include Nemertea, Scaphopoda, Euphausiacea and Amphipoda, each one with one species and one individual (Figures I.3 and I.4). The presence of Euphausiacea in this sample should be considered as an accidental capture, because it is a pelagic group, not represented within benthic infaunal communities.

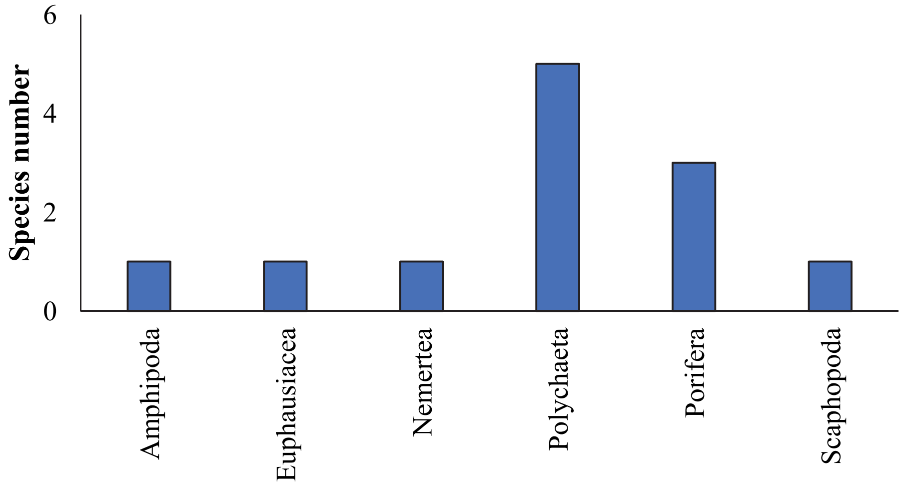


Figure I.3. Specific richness (S) for the 6 main-taxa collected in Shannon seamount during SEAFO survey.

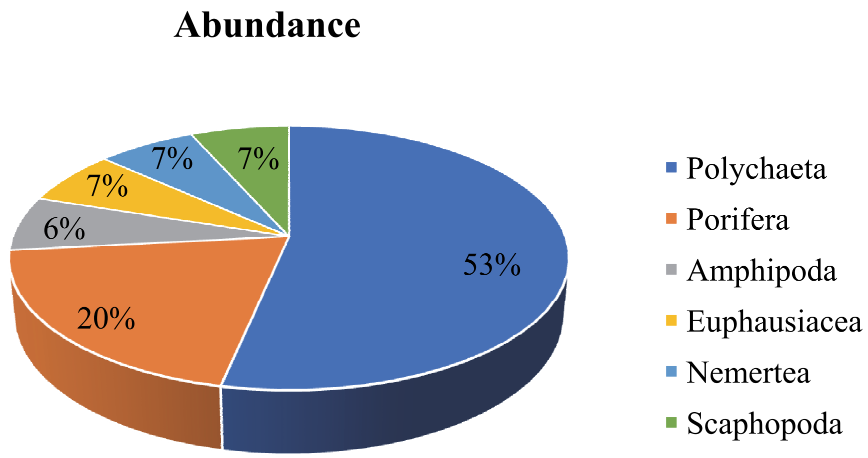


Figure I.4. Composition of relative abundance by main-taxa (%) of invertebrates collected in Shannon seamount based on number of individuals.

A list of species is given in Table I.1, and Figure I.5 shows some pictures of the fauna collected at this station.

Table I.1. List of species collected from Shannon seamount.

Phylum PORIFERA

- Demospongiae indet1
- Demospongiae indet4
- Demospongiae indet5

Phylum ARTHROPODA

- Order AMPHIPODA
  - *Primno macropa*
- Order EUPHAUSIACEA
  - *Thysanopoda obtusifrons*

Phylum ANNELIDA

- *Chloeia inermis*
- *Notomastus* cf. *latericeus*
- *Poecilochaetus* sp aff *fulgoris*
- Polychaeta indet4
- Syllidae indet

Phylum MOLLUSCA

- *Dentalium* sp1

Phylum NEMERTEA

- Nemertea indet

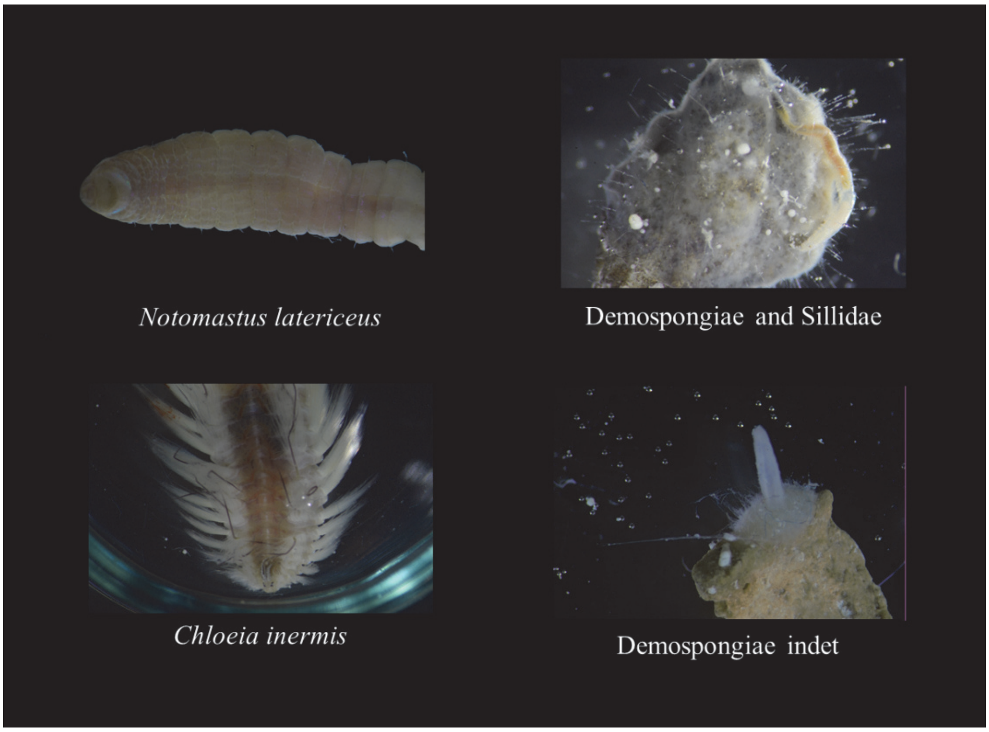


Figure I.5. Pictures of most representative taxa collected in Shannon seamount.

Fish and Cephalopods observed in video images

Three video profiles were conducted by VAMS in the Shannon Seamount, two of them on moderately deep (596 – 606 m) and one in deep areas (1 383 – 1 535 m). The former included 31 fish and cephalopod records within 5 morphotypes (including 2 unidentified fish) (Table I.2). Particularly abundant were the squid *Onykia ingens* (CT1) and the macrourid FT13 (Figure I.6). Six morphotypes were identified in the deep video profiles. Richness, in morphotypes per minute, was similar in moderately deep (0.03 ind./minute) and deep (0.04 ind./minute) areas. Relative abundance was higher in moderately deep (0.19 ind./minute) than in deep (0.06 ind./minute) areas. One morphotype was recorded in both summit and flank video profiles, the morid *Lepidion* sp. (FT3) (Table I.2).

Table I.2. Fish and cephalopods visualized along 4 video profiles obtained in the Shannon Seamount, Convention Area of the South East Atlantic Fisheries Organization (SEAFO), grouped by depth strata. Numbers represent individual records, numbers in brackets are individuals per minute of observation.

			500-1 000m	>1 000m
Onychoteuthidae	CT1	*Onykia ingens*	11 (0.07)	0 (0.00)
Notacanthidae	FT70	Indet.	0 (0.00)	1 (0.01)
Macrouridae	FT13	Indet.	12 (0.07)	0 (0.01)
	FT24	Indet.	0 (0.00)	1 (0.01)
	FT26	*Coryphaenoides sp.*	0 (0.00)	2 (0.02)
Moridae	FT3	*Lepidion sp.*	1 (0.01)	2 (0.02)
	FT12	*Laemonema sp.*	5 (0.03)	0 (0.00)
	FT7	*Guttigadus sp.*	0 (0.00)	1 (0.01)
Ophidiidae	FT25	Indet.	0 (0.00)	1 (0.01)
Total			31 (0.19)	8 (0.06)

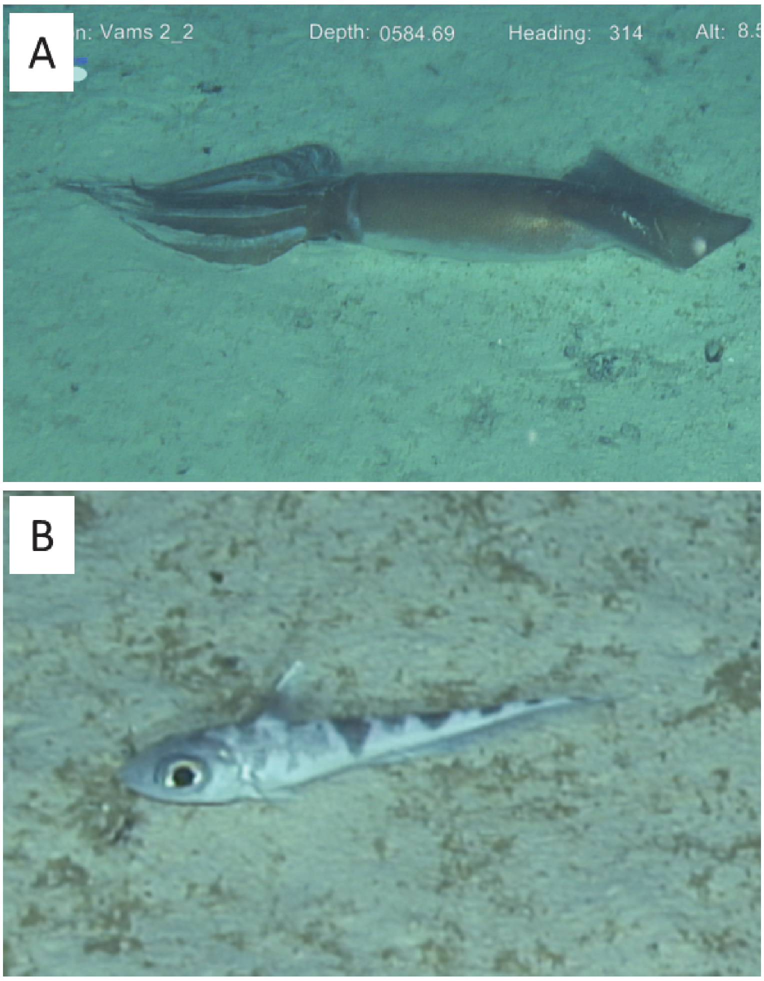


Figure I.6. Fish cephalopods commonly observed in Shannon Seamount, Convention Area of the South East Atlantic Fisheries Organization (SEAFO). A, *Onykia ingens* (CT1); B, Macrourid FT13.

Tablemount Seamount

Bathymetry

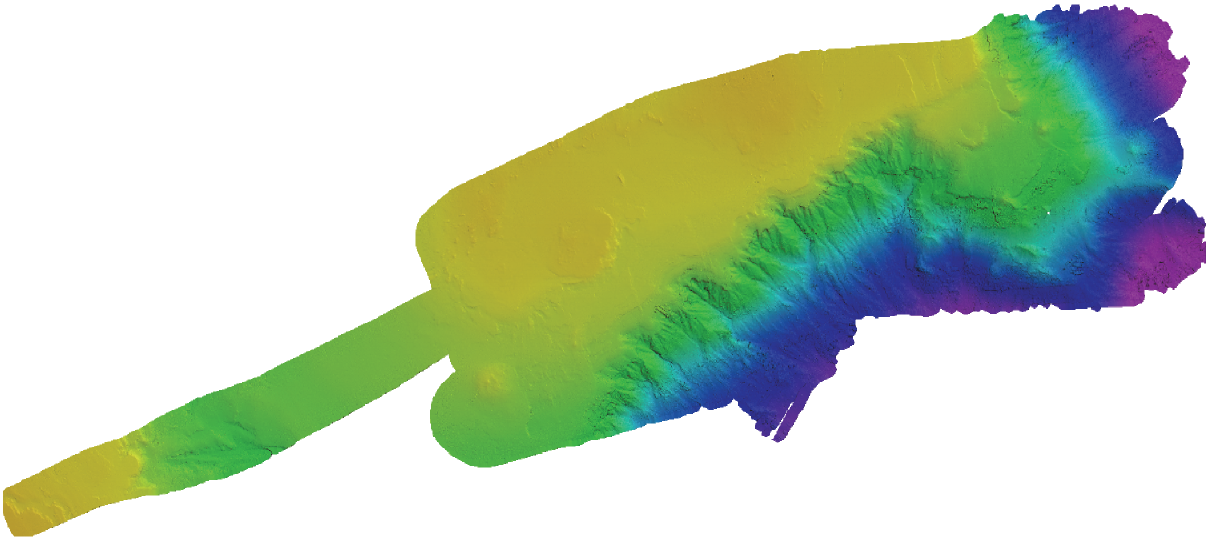


Figure I.7. Multibeam map of south-eastern part of Table mount Seamount.

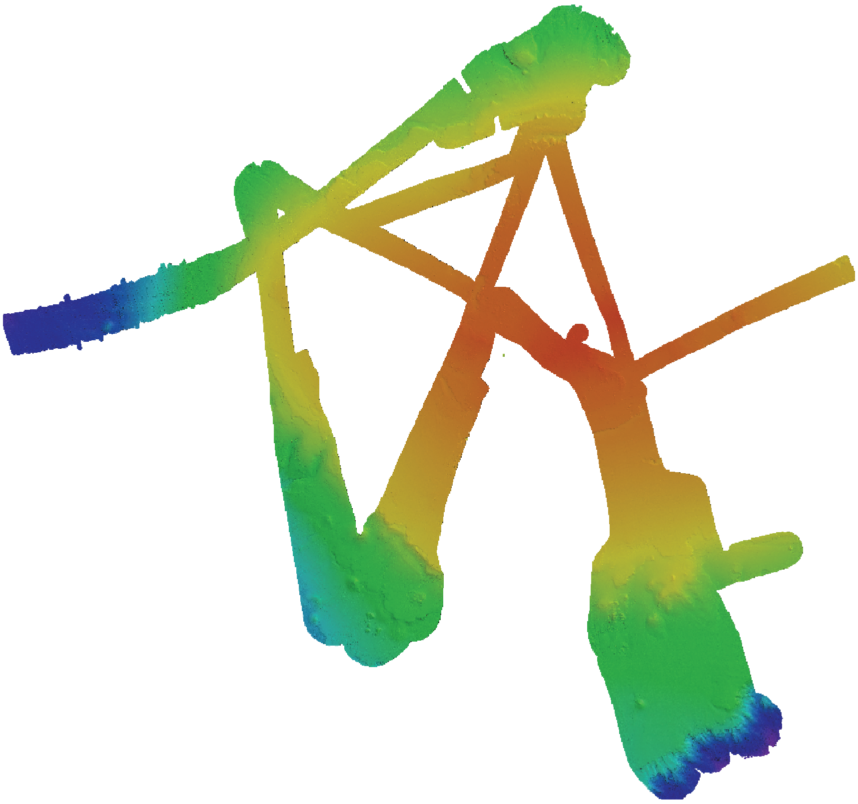
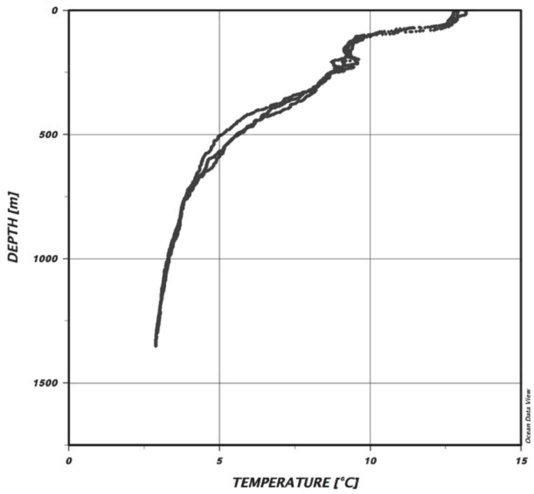
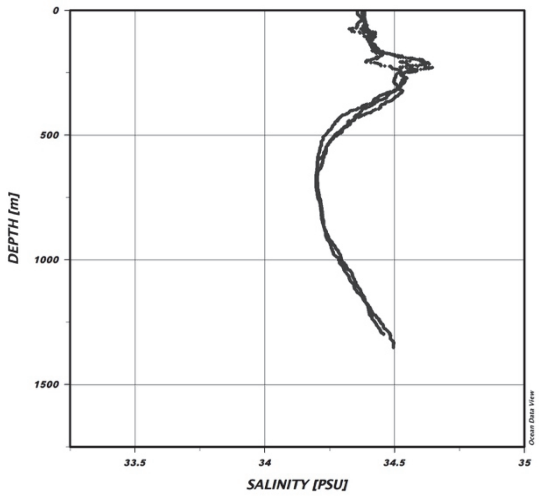


Figure I.8. Multibeam map of western part of Table mount Seamount, western side.

Water column profiles





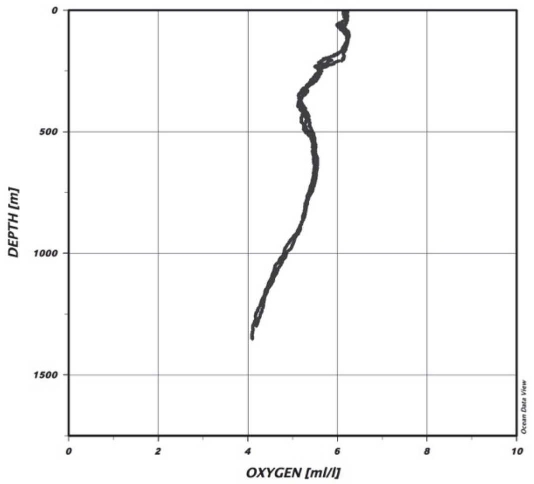
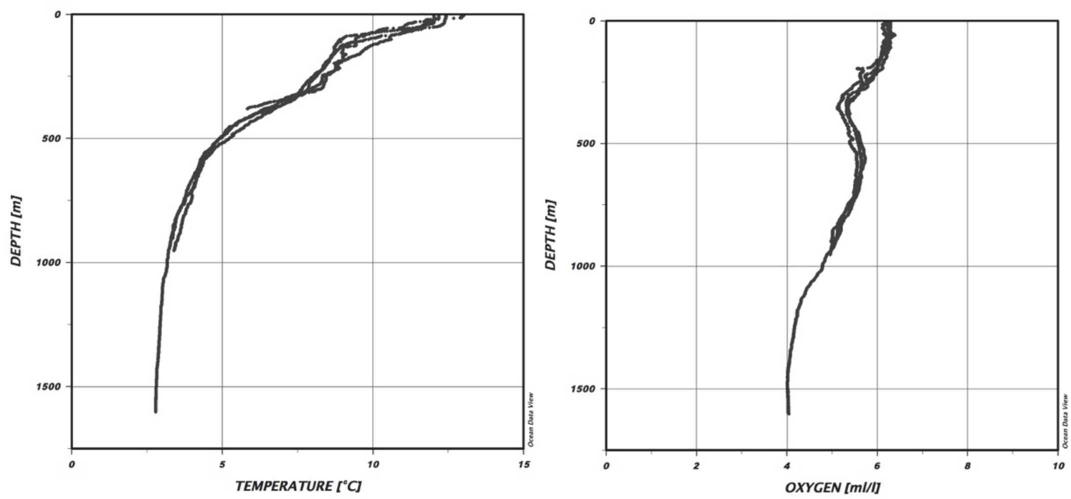


Figure I.9. Water column profile of the Tablemount East seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.



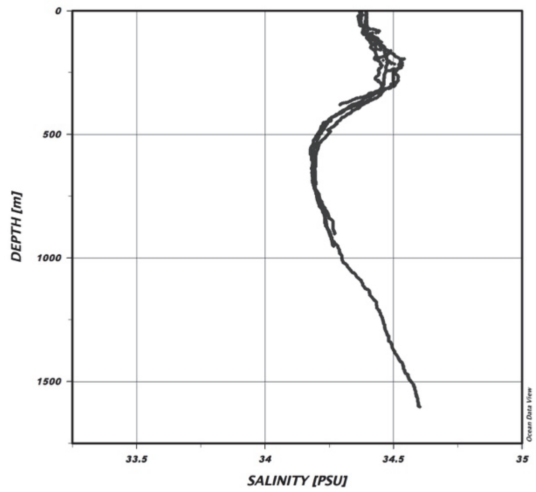


Figure I.10. Water column profile of the Tablemount West seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.

<u>Macrofauna</u>

In this seamount area, 7 stations at depths from 399 m to 1 540 m depth were sampled with the VAMS, collecting a total of 454 specimens belonging to 25 main taxa. The specific richness on this seamount was 104 species, with an average richness of 14.9 species per station. Polychaeta was collected at all sampling stations. Other taxa with high occurrence within Tablemount were Ophiuroidea (71%), Amphipoda (57%) and Bivalvia (57%) (Figure I.11). The most diverse group was Polychaeta with 29 species, followed by Ophiuroidea with 17 species and Hydrozoa with 10 species (Figure I.12). The abundance was also dominated by Polychaeta (27%) and Ophiuroidea (22%), but Amphipoda, was represented only by four species, accounting for 17% of the total (Figure I.13).

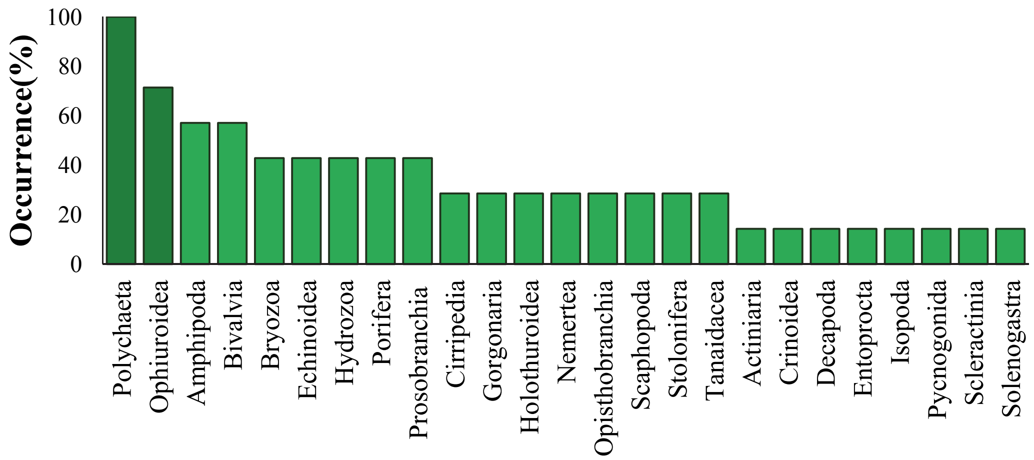


Figure I.11. Occurrence of the 25 main-taxa (% of stations) collected in Tablemount during the SEAFO survey.

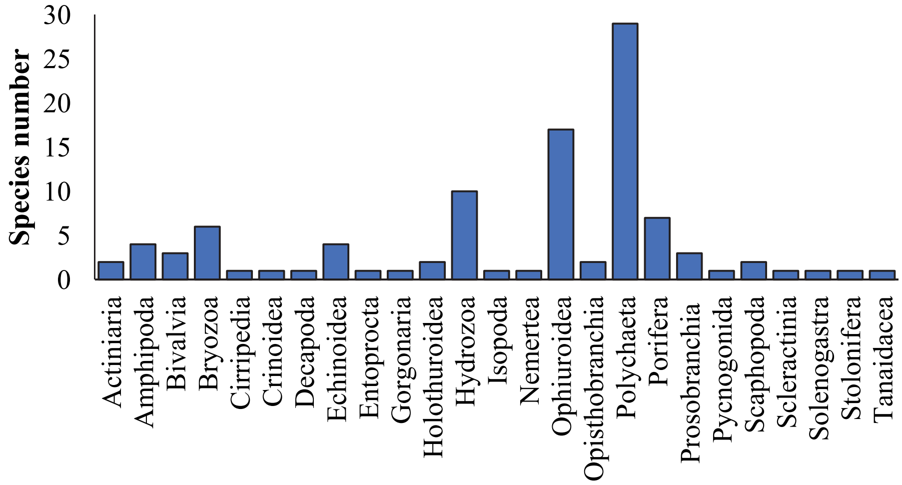


Figure I.12. Specific richness (S) for the 25 main-taxa collected in Tablemount seamount during SEAFO survey.

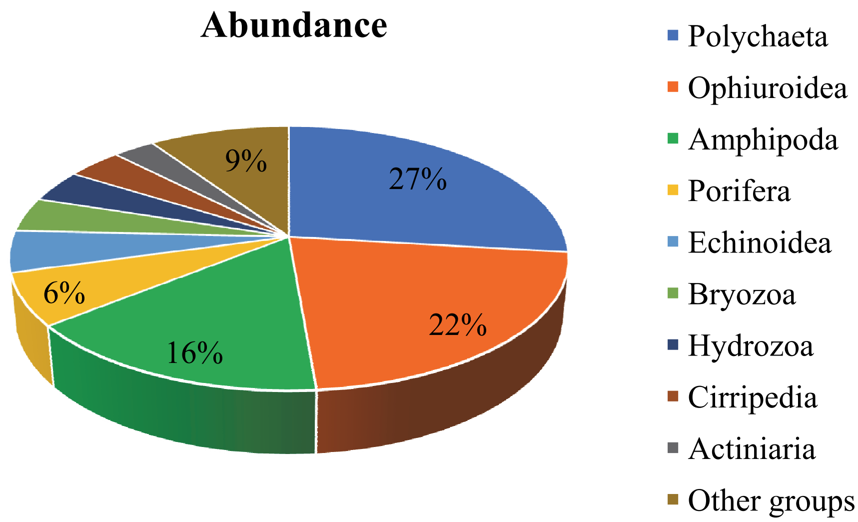


Figure I.13. Composition of relative abundance by main-taxa (%) of invertebrates collected in Tablemount seamount during SEAFO survey.

Table I.3 shows the species richness and abundance per station. The stations with both highest species richness and abundance were VAMS7_11 (49 species; 168 specimens) located in zone D4 at 399 m depth, and VAMS3_5 (40 species; 177 specimens) located in zone D3 at 867 m depth. The stations VAMS6_10, VAMS8_12, VAMS9_14 had intermediate values (15 – 19 specimens), and VAMS4_6 together with VAMS5-7 had the lowest number of species at this this seamount (9 and 6 species respectively).

Table I.3. Macrofaunal species richness and abundance (number of individulas) per station on Tablemount seamount.

Station	Seamount	Zone	Depth (m)	VME habitat	Richness	Abundance
VAMS3_5	Tablemount	D3	867	Stylasterid garden	40	177
VAMS4_6	Tablemount	D3	1095	Crinoidea, Primnoid, Stylasterid garden	9	13
VAMS5_7	Tablemount	D4	1540	Primnoid garden	6	11
VAMS6_10	Tablemount	D4	854	Primnoid, Keratoisis garden	19	34
VAMS7_11	Tablemount	D4	399		49	168
VAMS8_12	Tablemount	D4	1397	Stylasterid garden	15	20
VAMS9_14	Tablemount	D4	986	Primnoid garden	15	28

Main-taxa composition in relative abundance (%) per station is presented in Figure I.14. In four stations (VAMS4_6, VAMS5_7, VAMS8_12, VAMS9_14), Polychaeta clearly dominated in relative abundance (60% - 79%), at VAMS3_5 Ophiuroidea was the most dominant group (38%), while at VAMS7_11 the dominance was shared by Porifera and Hydrozoa in VAMS6_10 and by Ophiuroidea and Polychaeta.

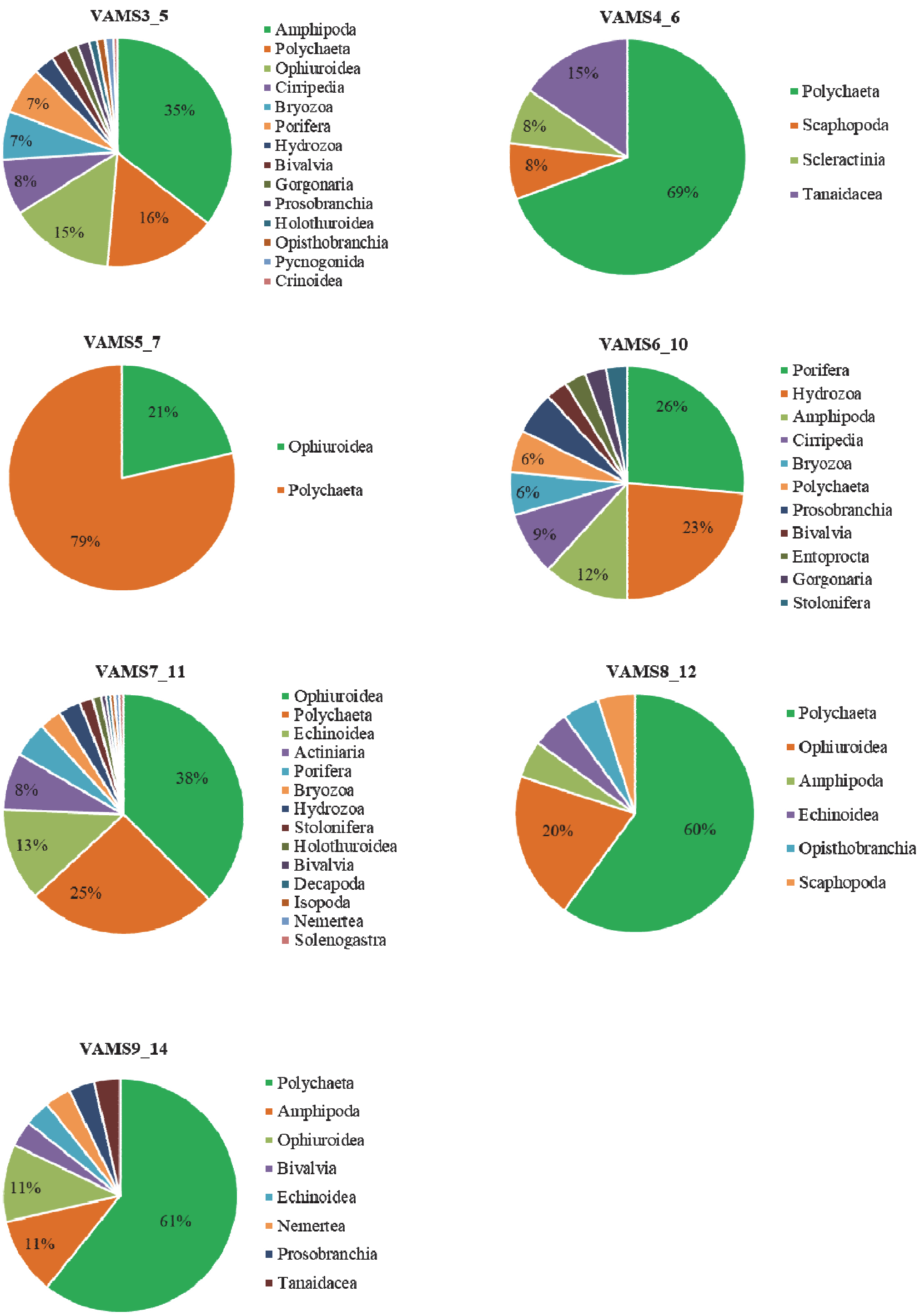


Figure I.14. Composition of main-taxa of benthic invertebrates in relative abundance (%) per station at Tablemount seamount.

The bathymetric distribution of abundance and specific richness showed a similar pattern on this seamount, with a clear decrease from the shallowest station (399 m) to the deepest one (1 540 m) (Figure I.15).

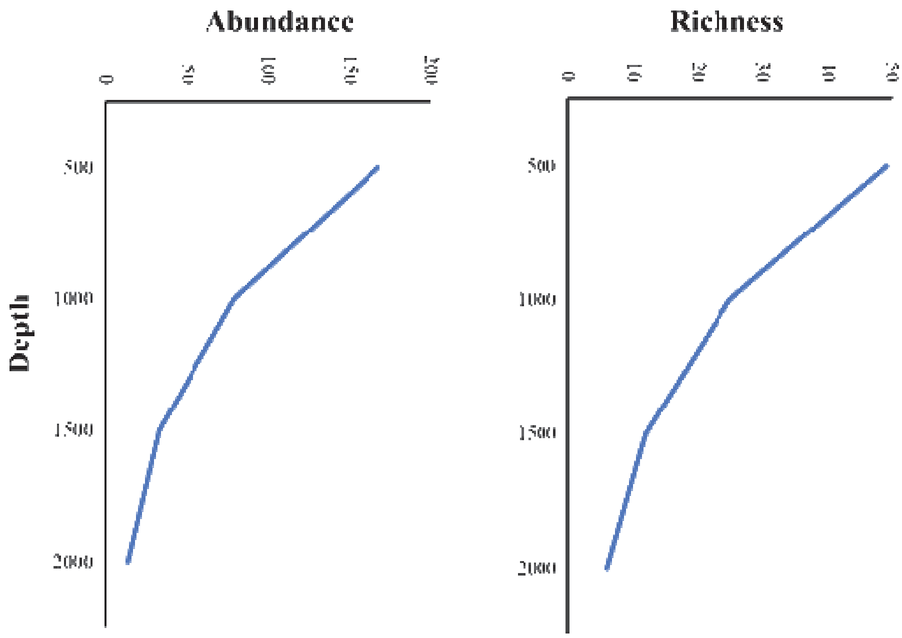


Figure I.15. Bathymetric distribution by 500 m depth interval of abundance and specific richness (S) of benthic invertebrates collected in Tablemount seamount.

A list of species collected at this seamount is provided in Table I.4 and Figure I.16 shows pictures with examples of the fauna collected at this location.

Table I.4. List of species collected at Tablemount seamount.

Phylum PORIFERA

- Calcarea indet
- Demospongiae indet1
- Demospongiae indet2
- Demospongiae indet4
- Demospongiae indet6
- Demospongiae indet8
- Hexactinellida indet1

Phylum CNIDARIA

- Order ACTINIARIA
  - Actiniaria indet
  - *Peachia* sp
- Order HYDROZOA
  - *Cirrholovenia tetranema*
  - *Conopora* A sp
  - *Cyclocanna producta*
  - *Errina* sp
  - *Filellum* sp
  - *Halecium* cf *dichotomun*
  - *Halecium* sp
  - *Kirchenpaueria pinnata*
  - *Obelia bidentata*
  - Stylasteridae indet
- Order ALCYONACEA
  - *Thouarella (Thouarella)* sp1
  - Stolonifera indet
- Order SCLERACTINIA
  - *Anthemiphillia* sp

Phylum BRYOZOA

- Bryozoa indet
- Bryozoa indet1
- Bryozoa indet4
- Bryozoa indet5
- Bryozoa indet6
- *Nordgaardia* sp

Phylum NEMERTEA

- Nemertea indet

Phylum ENTOPROCTA

- *Pedicellina* sp

Phylum ANNELIDA

- Class Polychaeta
  - Ampharetidae indet
  - *Aricidea* sp
  - *Chloeia inermis*
  - Cirratulidae indet
  - *Eunice* sp
  - Eunicidae indet
  - *Euphrosine* sp
  - *Glycera* sp
  - Maldanidae indet
  - *Nephtys* sp
  - *Nothria conchylega*
  - Opheliidae indet
  - *Orbinia* sp
  - Orbinidae indet
  - Pectinaria sp

Phylum ECHINODERMATA

- Class CRINOIDEA
  - Crinoidea indet
- Class ECHINOIDEA
  - Echinidae indet
  - *Echinus* sp
  - Neolampadidae indet
  - *Tropholampas loveni*
- Class HOLOTHUROIDEA
  - Chiridotinae indet
  - *Psolus* sp
- Class OPHIUROIDEA
  - Ampharetidae indet
  - *Amphiura* sp1
  - *Amphiura* sp2
  - *Amphiura* sp aff *abyssorum*
  - *Ophiacantha* sp aff *lineata*

Poecilochaetus sp
Poecilochaetus sp aff *fulgoris*
Polinoidae indet
Polychaeta indet1
Polychaeta indet2
Polychaeta indet3
Polychaeta indet6
Polynoidae indet5
Serpulidae indet
Spionidae indet
Spirorbidae indet
Syllidae indet
Terebellidae indet
Tharyx sp

Ophiacanthidae indet
Ophiactis abyssicola
Ophiomusa sp aff *africana*
Ophiomusium sp
Ophiomyxa sp aff *serpentaria*
Ophiopsila sp
Ophioscolex sp aff *glacialis*
Ophiura (Ophiura) sp aff *mundata*
Ophiura (*Ophiuroglypha) irrorata concreta*
Ophiura (Ophiuroglypha) sp aff *irrorata*
Ophiura sp
Ophiuroidea indet

Phylum MOLLUSCA
Class BIVALVIA
Bivalvia indet
Cuspidariidae indet
Limidae indet
Class GASTROPODA
Subclass CAENOGASTROPODA
Haloceratidae indet
Naticidae indet
Prosobranchia indet5
Prosobranchia indet6
Triphoridae indet
Subclass HETEROBRANCHIA
Opisthobranchia indet
Scaphander sp
Class SCAPHOPODA
Dentalium sp2
Scaphopoda indet
Class SOLENOGASTRES
Solenogastres indet

Phylum ARTHROPODA
Class PYCNOGONIDA
Achelia sp
InfraClass CIRRIPEDIA
Scalpellidae indet
Order AMPHIPODA
Amphipoda indet
Gammaridea indet
Melitidae indet
Primno macropa
Order DECAPODA
Paguroidea indet
Order ISOPODA
Isopoda indet
Order TANAIDACEA
Tanaidacea indet

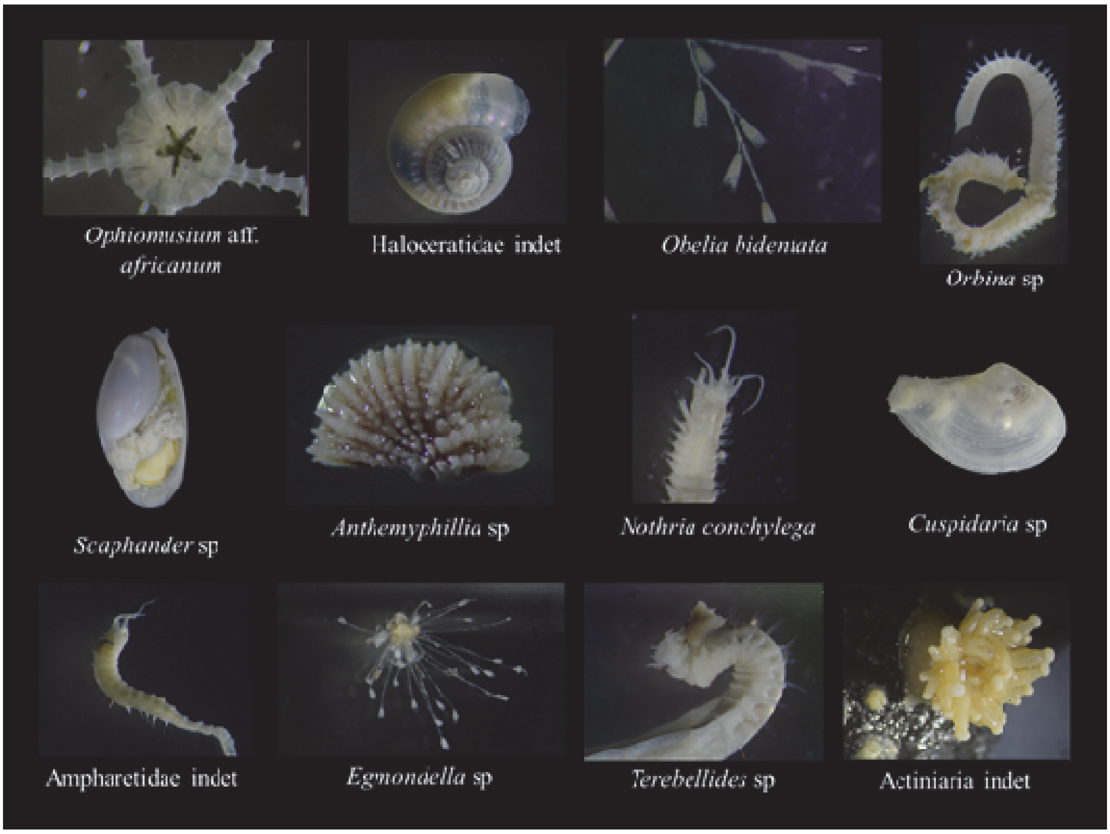


Figure I.16. Pictures of some representative taxa collected from Tablemount seamount.

Fish and Cephalopods observed in video images

Eight video profiles were obtained during VAMS operations in shallow (<500 m, 1), moderately deep (500 – 1 000 m, 3) and deep (>1 000 m, 4) areas. Two cephalopods and 140 fish were recorded in the shallow video profile, within three morphotypes (Table I.5). The most abundant was the morid FT12 (*Laemonema* sp.), followed by the macrourid *Coelorinchus* sp. FT13 (Figure I.17). In moderately deep areas, 2 cephalopods and 29 fish were recorded, within 10 morphotypes. Particularly abundant was the zoarcid fish *Melanostigma* sp. (FT5). In the deep dives, 129 fish and 6 cephalopods were recorded within 13 and 2 morphotypes, respectively. The morid *Guttigadus* sp. (FT7) was the most abundant in the video profiles. The three depth strata explored exhibited similar richness, approximately 0.03 morphotypes per minute. Fish and cephalopods were most abundant in the shallow area (1.6 ind./minute), and less abundant in the moderately deep area (0.03 ind./minute). No morphotypes were recorded in all three depth strata. Morphotypes of the shallow strata were not observed in the other depth strata. Five, in a total of 20 morphotypes, were observed in both moderately deep and deep strata (Table I.5).

Table I.5. Fish and cephalopods visualized along 8 video profiles obtained in the Table Mount Seamount, Convention Area of the South East Atlantic Fisheries Organization (SEAFO), grouped by depth strata. Numbers represent individual records, numbers in brackets are individuals per minute of observation.

			<500	500-1 000	>1 000
Histioteuthide	CT5	*Histioteuthis atlantica*	0 (0.000)	1 (0.003)	0 (0.000)
	CT4	Indet.	0 (0.000)	0 (0.000)	3 (0.008)
Octopodidae	CT2	Indet.	2 (0.022)	0 (0.000)	0 (0.000)
Opistoteuthidae	CT3	*Opistoteuthis agassizi*	0 (0.000)	0 (0.000)	1 (0.003)
Synaphobranchidae	FT20	Indet.	0 (0.000)	0 (0.000)	2 (0.005)
Oreosomatidae	FT22	Indet.	0 (0.000)	0 (0.000)	1 (0.003)
Macrouridae	FT4	*Coelorinchus* sp.	0 (0.000)	4 (0.012)	2 (0.005)
	FT8	Indet.	0 (0.000)	0 (0.000)	5 (0.013)
	FT10	Indet.	0 (0.000)	0 (0.000)	1 (0.003)
	FT13	Indet.	27 (0.302)	0 (0.000)	0 (0.000)
	FT14	Indet.	0 (0.000)	1 (0.003)	0 (0.000)
	FT15	Indet.	0 (0.000)	1 (0.003)	0 (0.005)
	FT18	Indet.	0 (0.000)	1 (0.003)	0 (0.0050
	FT24	Indet.	0 (0.000)	1 (0.003)	0 (0.000)
	FT6	*Coelorinchus* sp.	0 (0.000)	0 (0.000)	1 (0.003)
	FT30	Indet.	0 (0.000)	0 (0.000)	1 (0.003)
Moridae	FT3	*Lepidion* sp.	0 (0.000)	3 (0.009)	14 (0.035)
	FT12	*Laemonema* sp.	113 (1.265)	0 (0.000)	0 (0.000)
	FT9	*Antimora rostrata*	0 (0.000)	1 (0.003)	1 (0.003)
	FT7	*Guttigadus* sp.	0	0	91

			<500	500-1 000	>1 000
			(0.000)	(0.000)	(0.228)
Liparidae	FT11	*Paraliparis cf. copei*	0	1	1
			(0.000)	(0.003)	(0.003)
Zoarcidae	FT5	*Melanostigma* sp.	0	15	5
			(0.000)	(0.043)	(0.013)
Epigonidae	FT28	*Epigonus cf. telescopus*	0	0	2
			(0.000)	(0.000)	(0.005)
Total			142	31	135
			(1.590)	(0.090)	(0.339)

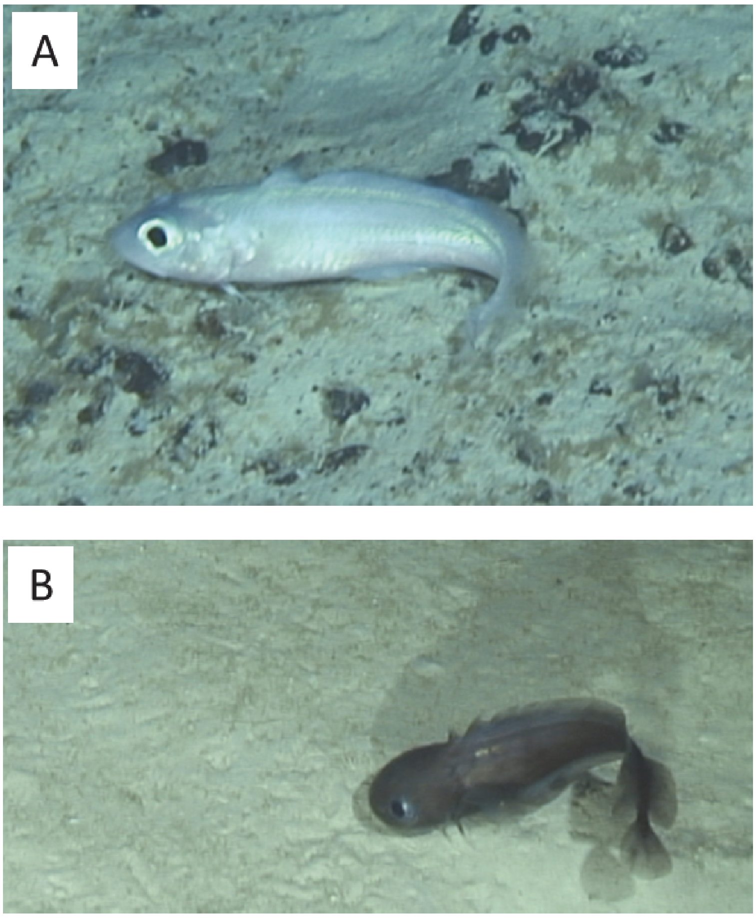


Figure I.17. Fish cephalopods commonly observed in Table Mount Seamounts, Convention Area of the South East Atlantic Fisheries Organization (SEAFO). A, *Laemonema* sp. (FT12); B, *Guttigadus* sp. FT7.

Pelagic trawl (D4-Stations 1 and 2)

The depth range of the two stations were: St1: 500-525 m and St2: 350-400 m.

Krill species were dominant in the catches at the two stations sampled over this seamount, reaching almost the 99% of the catch in number of individuals, but only 65% in weight. In Figure I.18 the catch per species and group obtained in these two stations is shown. The red dot represents the mean catch value.

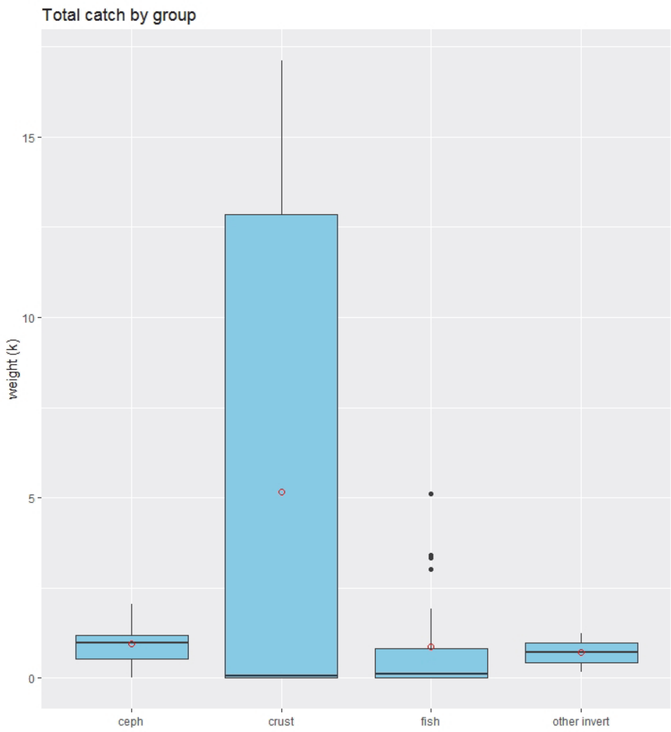


Figure I.18. Boxplot of the catch (kg) for main taxonomic groups at the Tablemount seamount.

The total number of specimens per species obtained at these stations for fishes (Table I.6), crustaceans (Table I.7), cephalopods (Table I.8) and other invertebrates (Table I.9) are ordered by Family. The 19 fish species identified belonged to 9 families, of which 8 are Myctophidae and 4 Phosichthydae. Most abundant in number of individuals was the Myctophid *Diaphus diadematus* while the Myctophid *Electrona* sp. the most abundant in weight.

The most abundant Krill species were *Euphausia spinifera* and *E. similis*. All the 4 cephalopod species in the catch belonged to different families. The squid *Lycoteuthis lorigera* was the most commonly caught cephalopod taking into account both number of individuals and weight.

Table I.6. Total number of fish specimens per species over the Tablemount seamount.

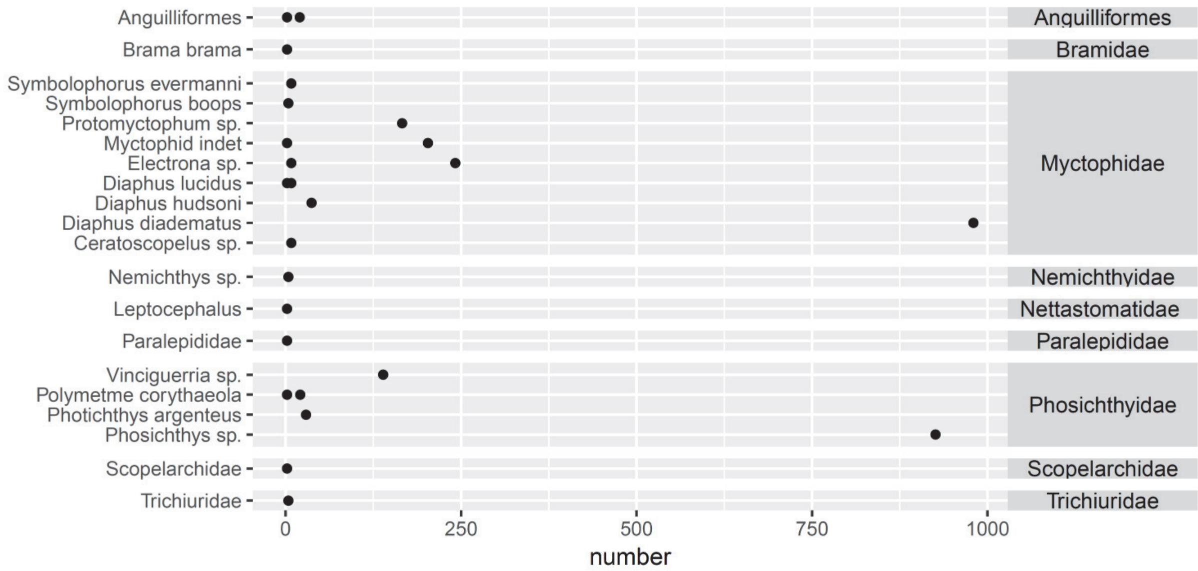


Table I.7. Total number of crustacean specimens per species over the Tablemount seamount.

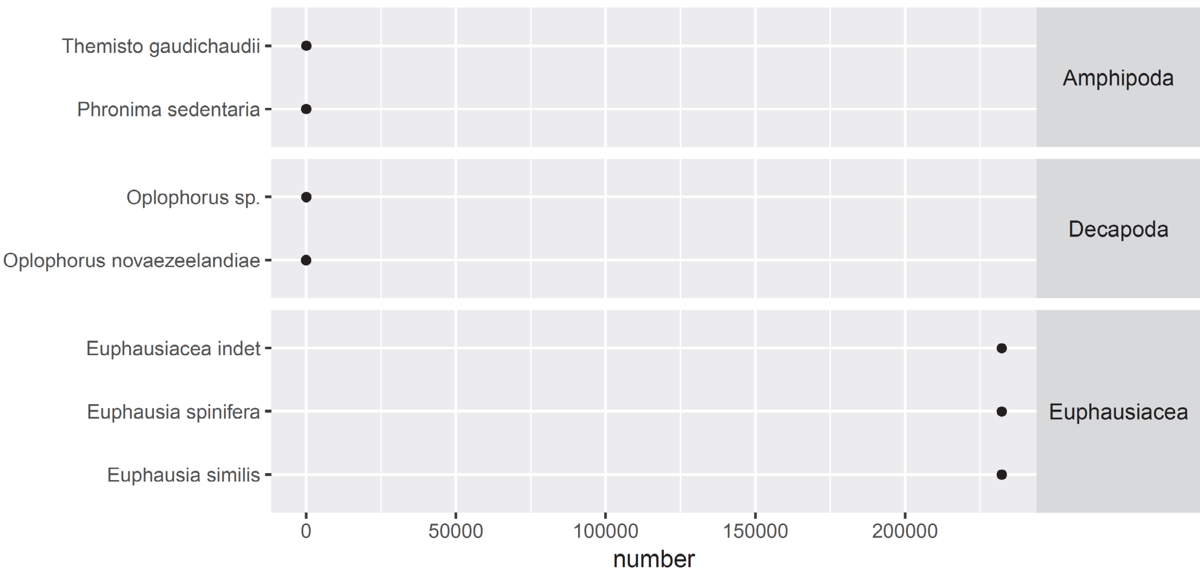


Table I.8. Total number of cephalopod specimens per species over the Tablemount seamount.

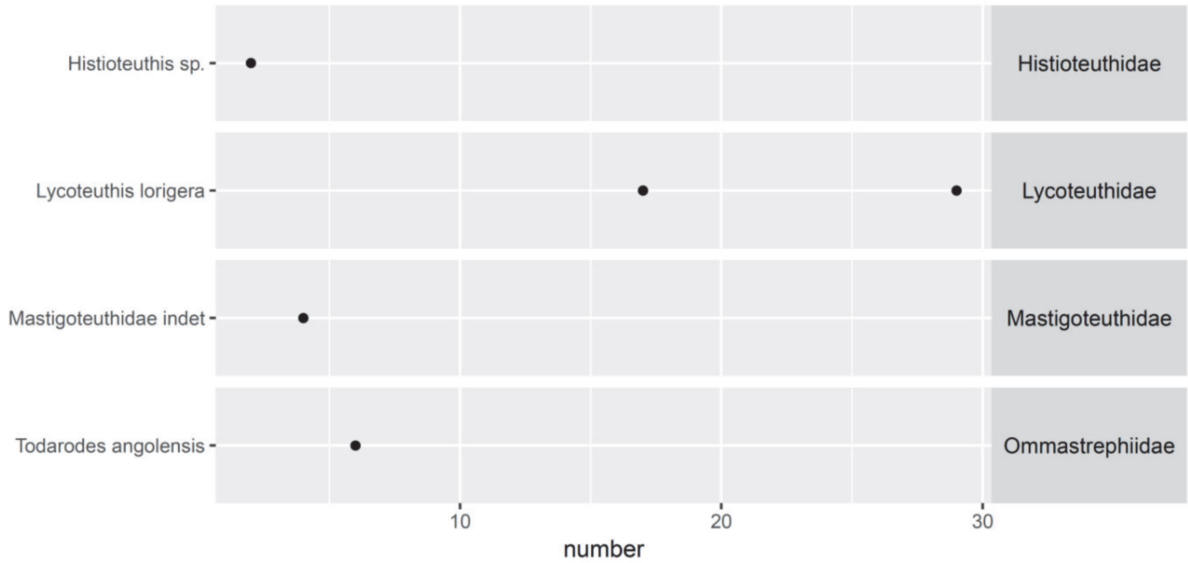
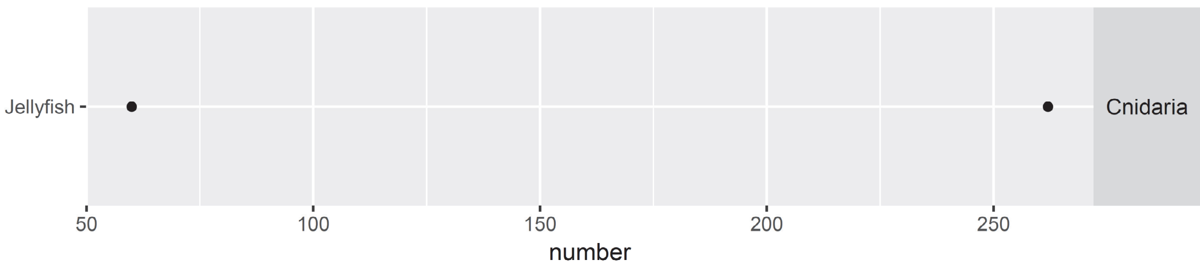


Table I.9. Total number of specimens of other invertebrates (Cnidaria) per species over the Tablemount seamount.



Discovery Seamount

Bathymetry

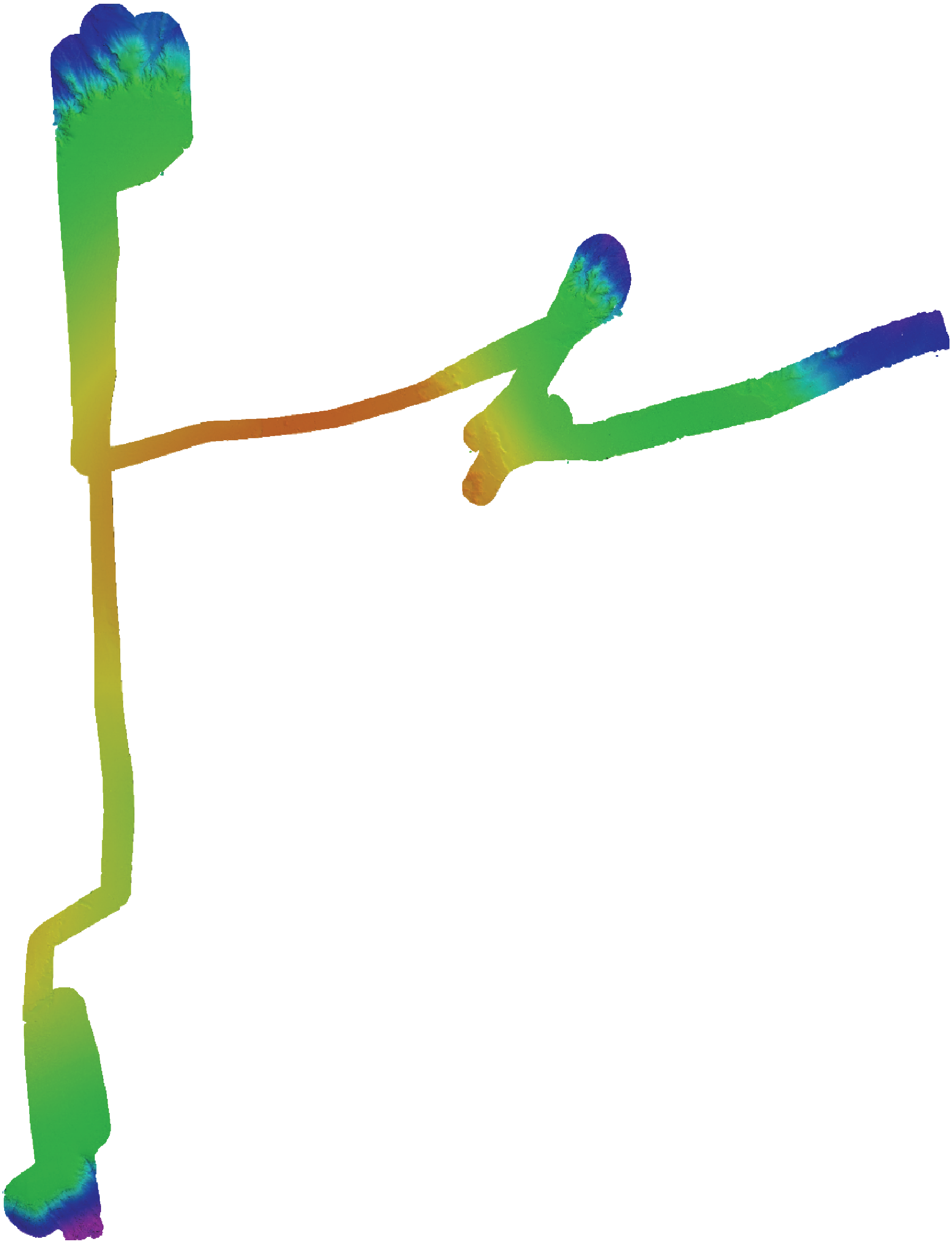


Figure I.19. Multibeam map of Discovery Seamount.

Water column profiles

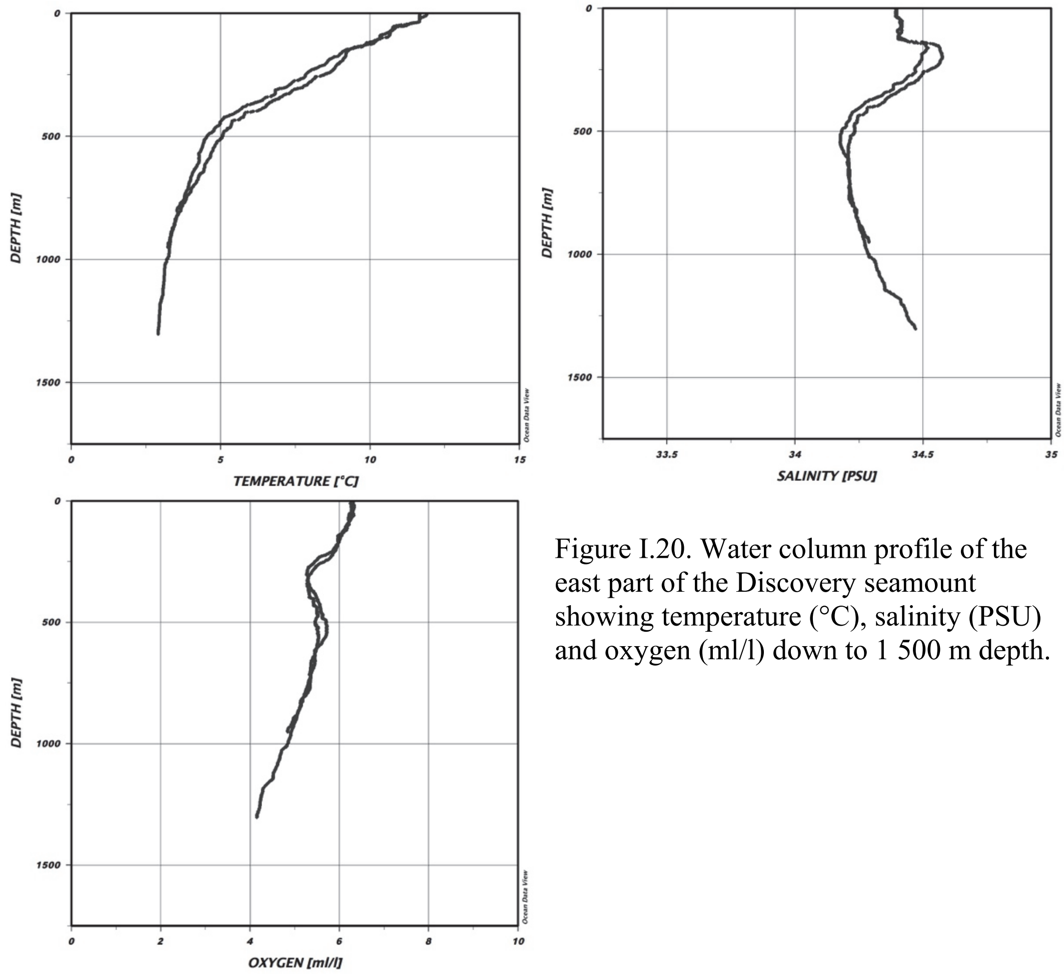
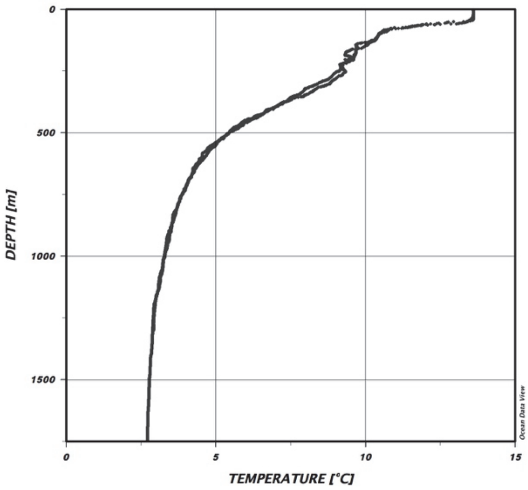
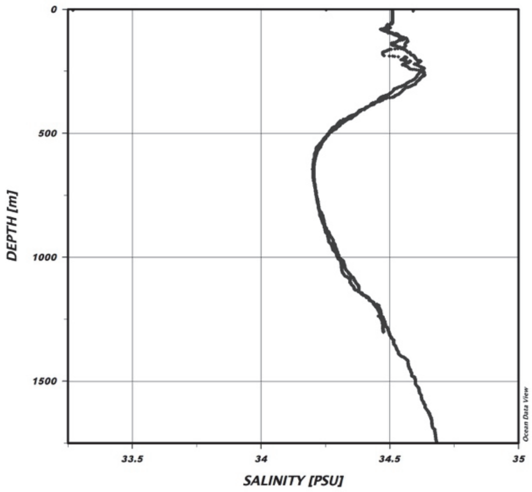


Figure I.20. Water column profile of the east part of the Discovery seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.





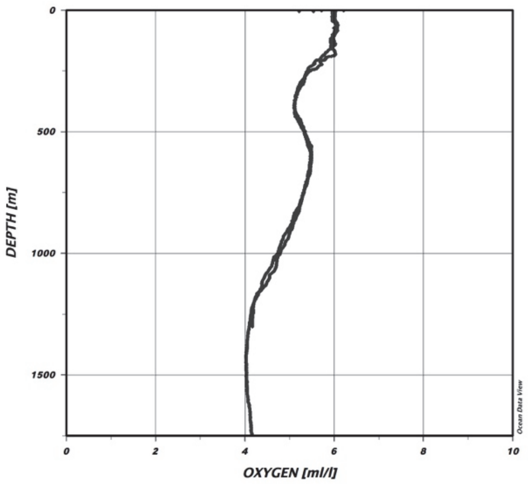
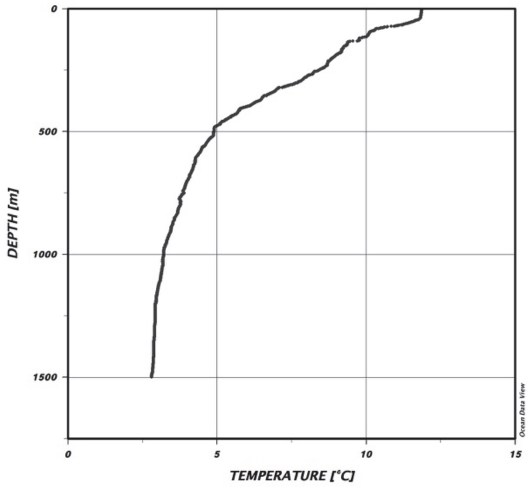


Figure I.21. Water column profile of the North part of the Discovery seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.



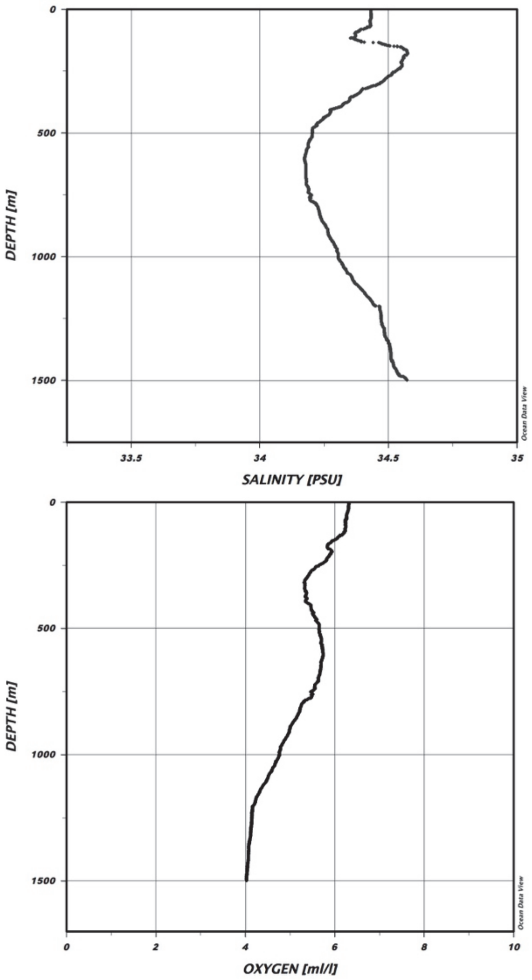


Figure I.22. Water column profile of the South part of the Discovery seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.

<u>Macrofauna</u>

At the Discovery seamount 4 stations were sampled, located at depths between 968 to 1 726 m. A total of 156 specimens belonging to 17 main taxa were collected. The total number of species was 54, with an average richness of 13.5 species per station. At this seamount, Polychaeta, Amphipoda and Ophiuroidea were recorded at all stations. Other taxa occurred at 25-50% of the stations (Figure I.23). Polychaeta was the most diverse group with 12 species, followed by Ophiuroidea with 7 species. Porifera, Prosobranchia and Bryozoa accounted for 5 species each (Figure I.24). The dominance in number of individuals was shared by Amphipoda (27%) and Polychaeta (26%), followed by Hydrozoa (12%). For the remaining taxa, abundance was less than 10%. (Figure I.25).

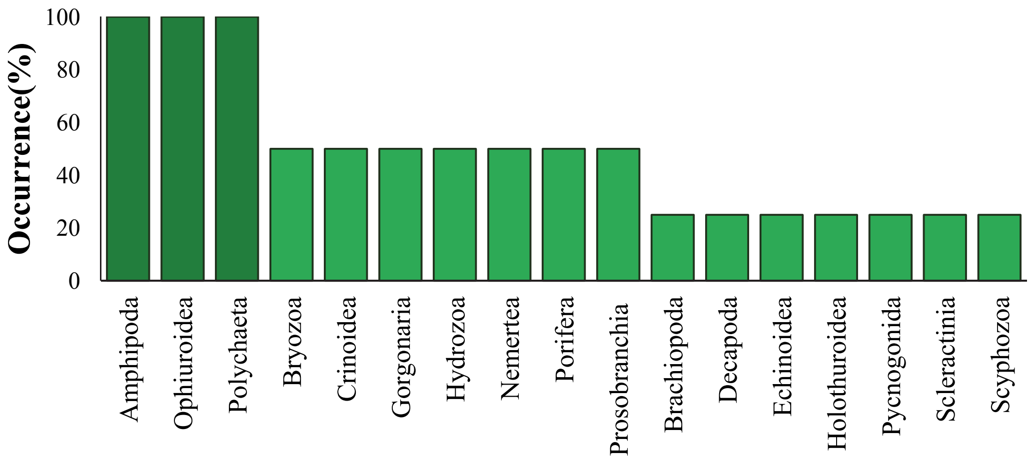


Figure I.23. Frequency of occurrence of the 17 main-taxa (% of stations) collected with grab at Discovery seamount.

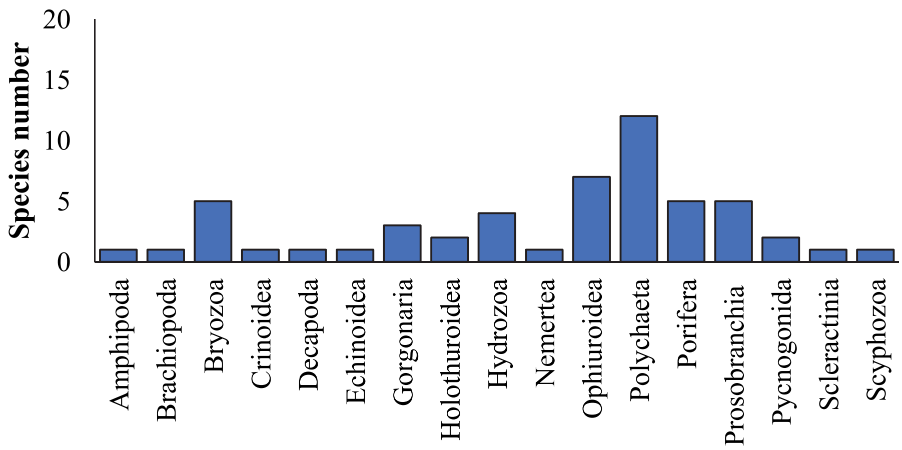


Figure I.24. Species richness (S) for the 17 main-taxa collected at Discovery Seamount.

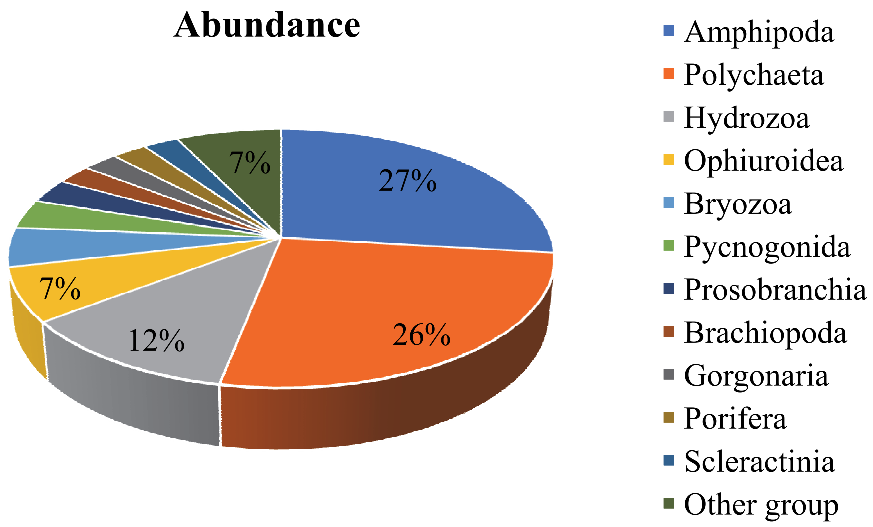


Figure I.25. Relative abundance of main invertebrate taxa (%) collected at Discovery Seamount.

Table I.10 shows the specific richness and abundance per station. The station with both highest specific richness and abundance was VAMS12_17 (32 species; 107 specimens) located on zone D6 at 1 726 m depth. Remaining stations, (VAMS10_15; VAMS11_16; VAMS13_16), also located in zone D6 and from 968 to 1 394 m depth, showed lower values, oscillating from 9 to 18 species and from 11 to 28 specimens.

Table I.10. Specific richness and abundance (in number) per station at Discovery seamount.

Station	Seamount	Zone	Depth (m)	VME habitat	Richness	Abundance
VAMS10_15	Discovery	D6	968		18	28
VAMS11_16	Discovery	D6	1394		10	19
VAMS12_17	Discovery	D6	1726	Crinoidea, Yellow green coral garden	32	107
VAMS13_18	Discovery	D6	1331	Sponge forest, Stylasterid garden	9	11

Main-taxa composition in numerical abundance (%) by station is presented in Figure I.26. In stations VAMS10_15 and VAMS11_16 Polychaeta was the dominant group (57% - 37%), in VAMS12_17 dominate Amphipoda (38%), and in VAMS13_18 dominance was shared by Gorgonaria, Polychaeta and Ophiuroidea (18% each one).

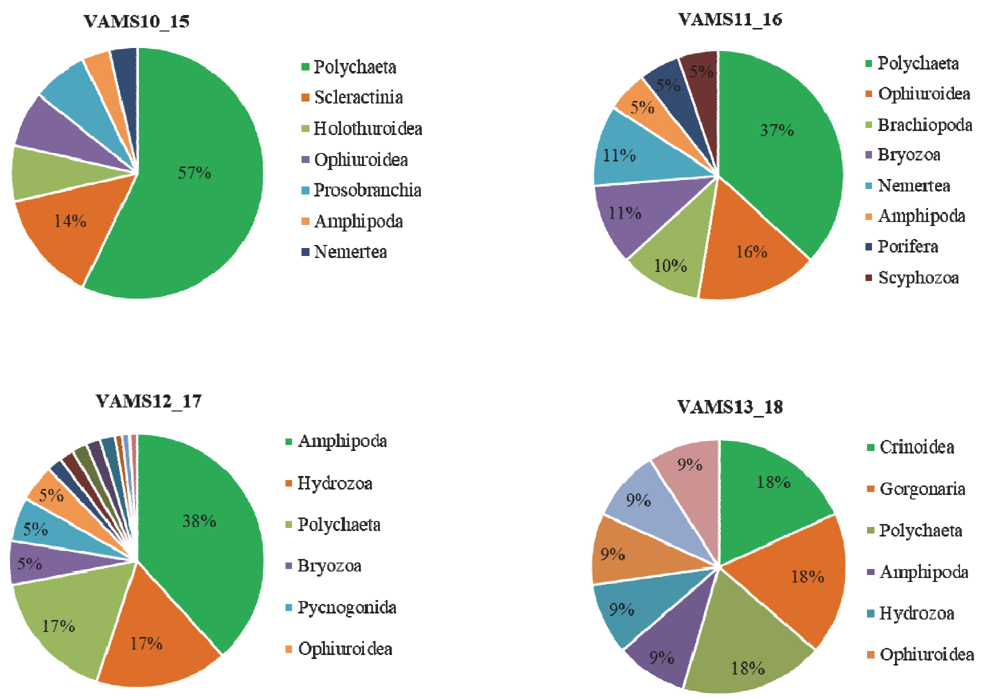


Figure I.26. Relative abundance (%) of main invertebrate taxa per station at Discovery seamount.

The bathymetric distribution of abundance and species richness showed a similar pattern but, on this seamount, the highest values for both variables were found at the deepest station (1 726 m) (Figure I.27).

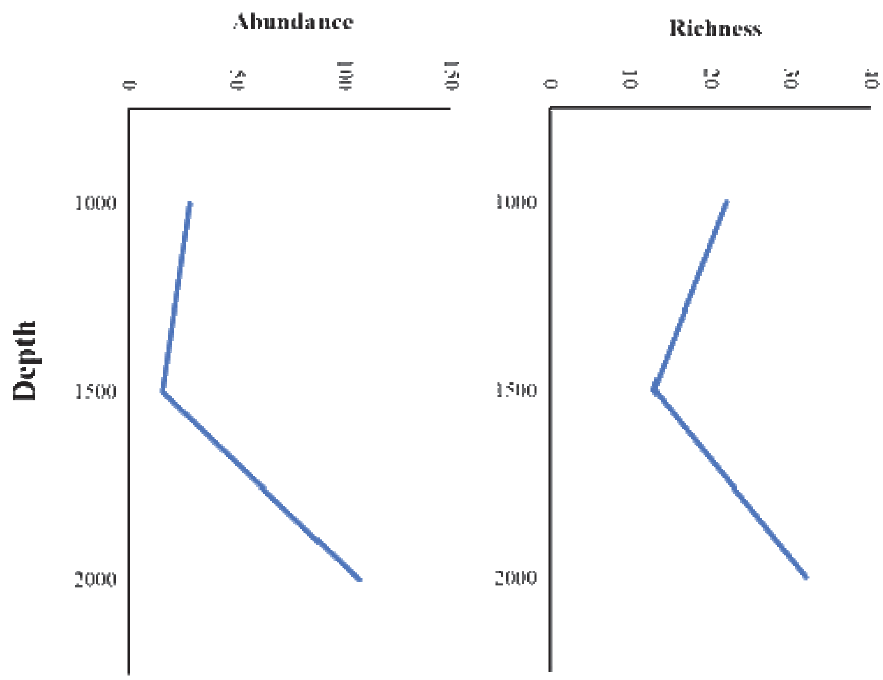


Figure I.27. Bathymetric distribution of benthic invertebrate abundance and species richness (species number) in 500 m depth intervals on Discovery Seamount.

A list of species collected at this seamount is provided in Table I.11, and Figure I.28 shows some pictures with examples of the fauna.

Table I.11. List of species collected from Discovery seamount.

Phylum PORIFERA

- Calcarea indet
- Demospongiae indet7
- Hexactinellida indet1
- Myxillidae indet

Phylum ECHINODERMATA

- Class CRINOIDEA
  - Comatulidae indet
- Class ECHINOIDEA
  - *Tropholampas loveni*
- Class HOLOTHUROIDEA
  - *Chiridotinae indet*
  - *Mesothuria sp*
- Class OPHIUROIDEA
  - *Amphiura* sp
  - Ophiacanthidae indet
  - *Ophiomusa* sp aff *africana*
  - *Ophioplinthaca* sp aff *carduus*
  - *Ophioscolex* sp aff *purpureus*
  - *Ophiura* sp
  - Ophiuroidea indet

Phylum CNIDARIA

- Order ALCYONACEA
  - Gorgonaria indet
  - *Thouarella (Thouarella)* sp1
  - *Thouarella (Thouarella)* sp2
- Order HYDROZOA
  - *Conopora* A sp
  - Lafoeidae indet
  - *Leuckartiara octona*
  - Stylasteridae indet
- Order SCLERACTINIA
  - *Flabellum* sp

Phylum BRYOZOA

- Bryozoa indet
- Bryozoa indet1
- Bryozoa indet2
- Bryozoa indet3
- Scrupocellaria sp

Phylum ANNELIDA

- Class Polychaeta
  - Ampharetidae indet
  - *Aricidea* sp
  - *Eulalia* sp
  - *Glycera* sp
  - *Nephtys* sp
  - Orbinidae indet
  - *Poecilochaetus* sp aff *fulgoris*
  - Polinoidae indet
  - Polychaeta indet7
  - Spionidae indet
  - Spionidae indet1
  - Spionidae indet2

Phylum MOLLUSCA

- Class GASTROPODA
  - Subclass CAENOGASTROPODA
    - Naticidae indet
    - Prosobranchia indet1
    - Prosobranchia indet2
    - Prosobranchia indet3
    - Prosobranchia indet4

Phylum ARTHROPODA

Class PYCNOGONIDA

Achelia sp

Nymphon sp aff procerum

InfraClass CIRRIPEDIA

Scalpellidae indet

Order AMPHIPODA

Amphipoda indet

Melitidae indet

Order DECAPODA

Munida sp

Phylum BRACHIOPODA

Brachiopoda indet

Phylum NEMERTEA

Nemertea indet

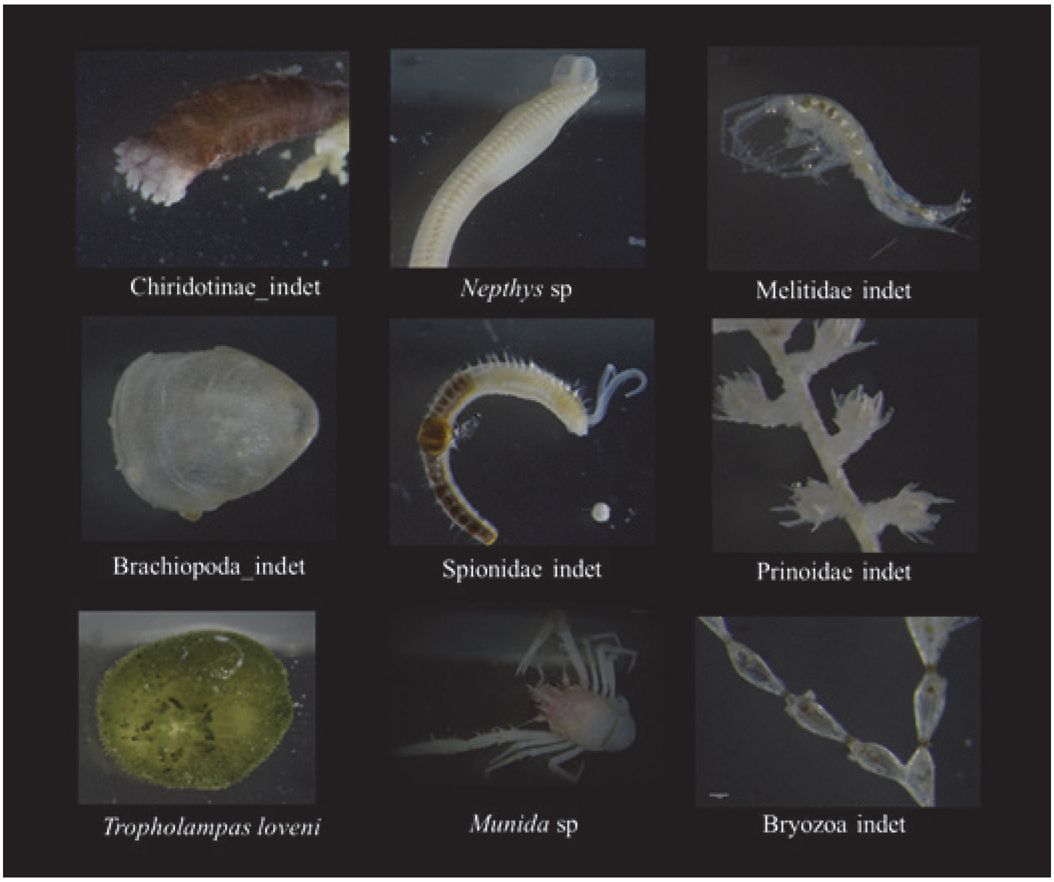


Figure I.28. Examples of taxa collected at Discovery seamount.

Fish and Cephalopods observed in video images

Four video profiles were conducted in Discovery Seamount, one in moderately deep areas (968 m – 999 m) and three in deep areas (1 329 m – 1 853 m). The former included 19 fish records within 5 morphotypes (Table I.12). The zoarcid Melanostigma sp. (FT5) and the macrourid Coelorinchus sp. (FT4) were the most commonly observed (Figure I.29). Deep video profiles included 13 fish records within 8 morphotypes. Fish more abundant (0.28

inds./minute) an more diverse (0.07 morphotypes/miute) in moderately deep areas, and less abundant (0.04 inds./minute) and diverse (0.02 morphotypes/minute) in deep areas. One morphptype, *Cataetyx* sp. (FT2, Family Bithitidae) occurred in both depth strata (Table I.12).

Table I.12. Fish and cephalopods visualized along 4 video profiles obtained in the Discovery Seamounts, Convention Area of the South East Atlantic Fisheries Organization (SEAFO), grouped by depth strata. Numbers represent individual records, numbers in brackets are individuals per minute of observation.

			500-1 000	>1 000
Chimaeridae	FT1	*Hydrolagus sp.*	0 (0.000)	1 (0.003)
Synaphobranchidae	FT21	indet.	2 (0.003)	0 (0.000)
Macrouridae	FT4	*Coelorinchus sp.*	6 (0.089)	0 (0.000)
	FT27	indet.	0 (0.000)	1 (0.003)
	FT32	indet.	0 (0.000)	4 (0.003)
Moridae	FT3	*Lepidion sp.*	0 (0.000)	2 (0.006)
Bythitidae	FT2	*Cataetyx sp.*	1 (0.015)	1 (0.003)
Zoarcidae	FT5	*Melanostigma sp.*	9 (0.134)	0 (0.000)
Bramidae	FT33	*Brama sp.*	0 (0.000)	1 (0.003)
Epigonidae	FT28	*Epigonus cf. telescopus*	0 (0.000)	1 (0.003)
Indet1	FT19	indet.	1 (0.015)	2 (0.006)
Total			19	13
			(0.283)	(0.038)

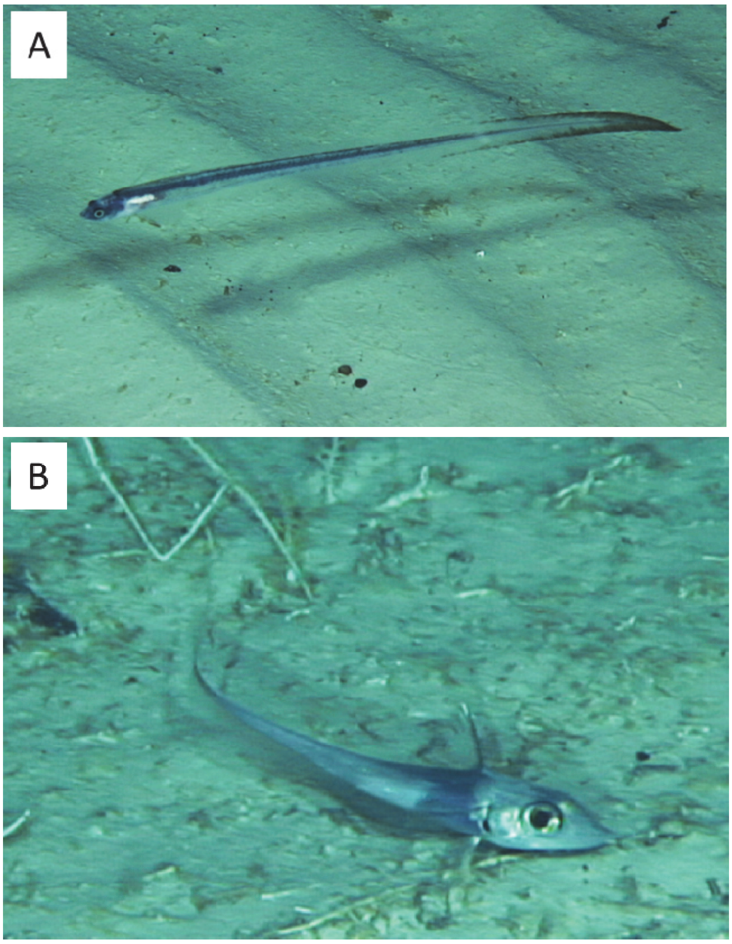


Figure I.29. Fish cephalopods commonly observed in Discovery Seamounts, Convention Area of the South East Atlantic Fisheries Organization (SEAFO). A, *Melanostigma* sp. (CT1); B, *Coelorinchus* sp. FT4.

Pelagic trawl – St 3

This location was sampled with pelagic trawl between 450 m and 525 m depth.

Krill species were dominant in the catches reaching almost the 99% of the catch in number of individuals, and 55% in weight (Figure I.30). In the figure below is shown the catch by species and group. The red dot represents the mean catch value.

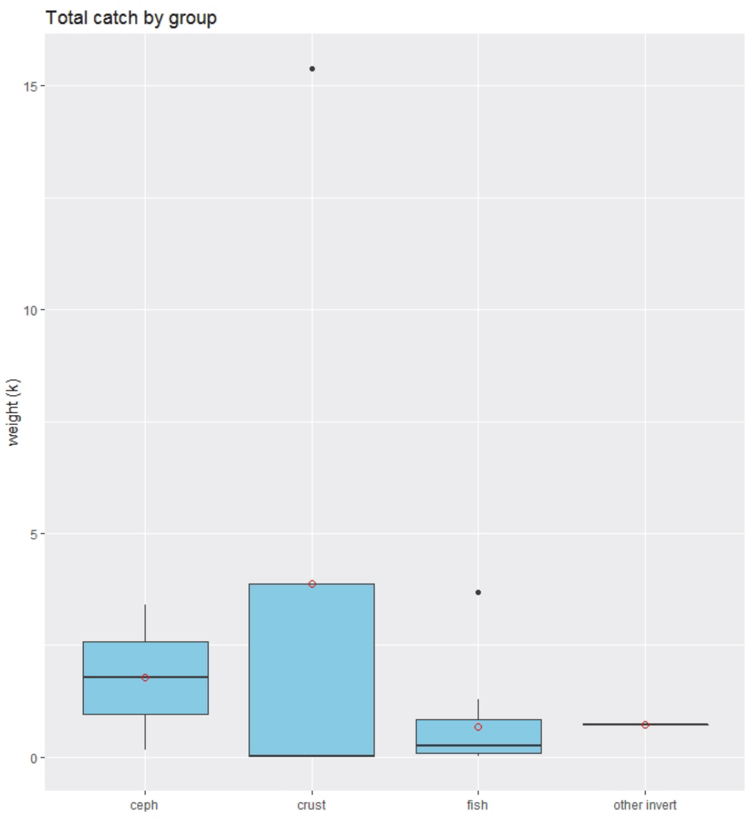


Figure I.30. Boxplot of the species catch (kg) per group in the Discovery seamount.

Total number of specimens per species from this station is shown in Table I.13-I.21 for main taxonomic groups (fish, crustaceans, cephalopods, and other invertebrates), ordered by Family. The most abundant Krill species was *Nematoscelis megalops* with a catch of 15 kg and more than 250 000 in number. The number of individuals of the three remaining species of crustaceans was less than 30 specimens (0.03kg).

From the 12 species of fishes identified belonging to 4 families, 6 were Myctophidae and 4 Phosichthydae. The most abundant in number was the Myctophid *Diaphus hudsoni,* while the Myctophid *Electrona* sp was the most abundant in weight. Only 2 species of cephalopods belonging to different families were present in the catch. The squid *Lycoteuthis lorigera* was the most abundant.

Table I.13. Number of fish specimens per species over the Discovery seamount.

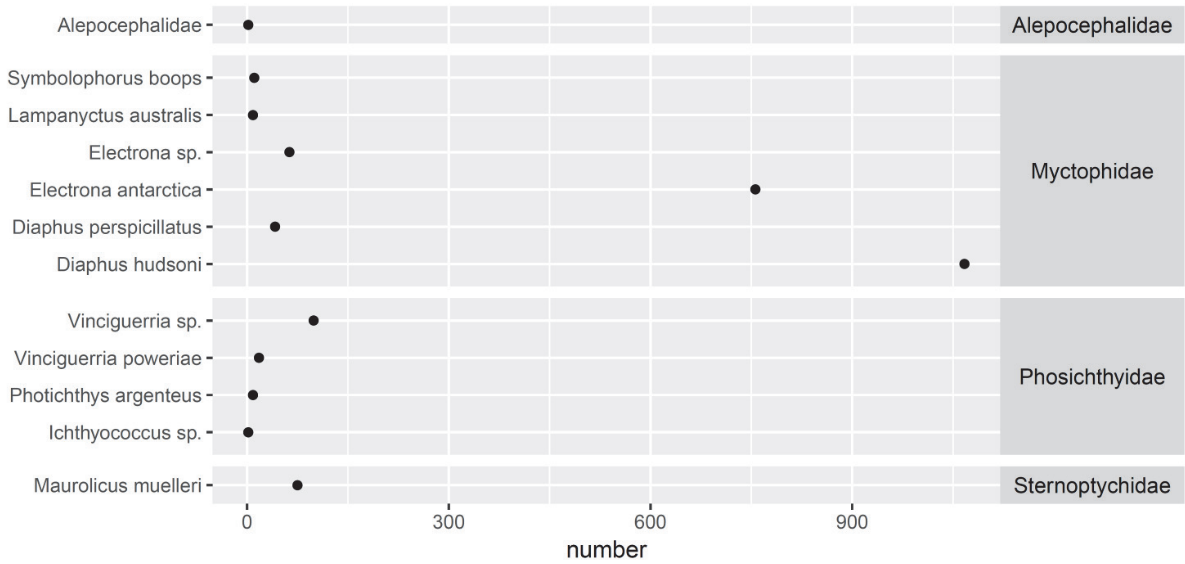


Table I.14. Total number of crustacean specimens by species in the Discovery seamount.

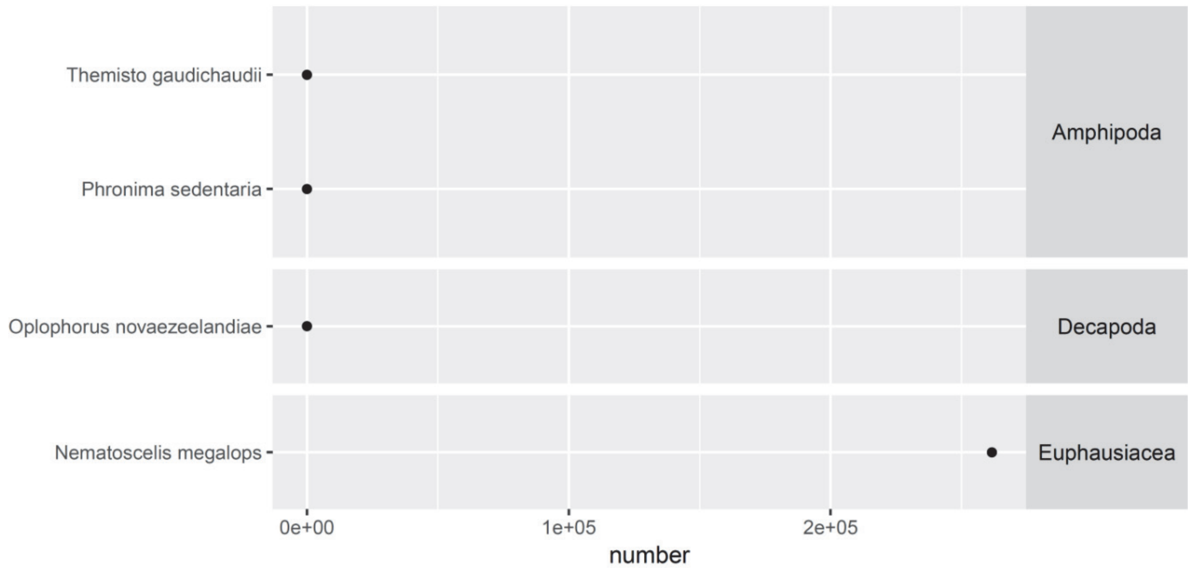


Table I.15. Number of cephalopod specimens per species over the Discovery seamount.

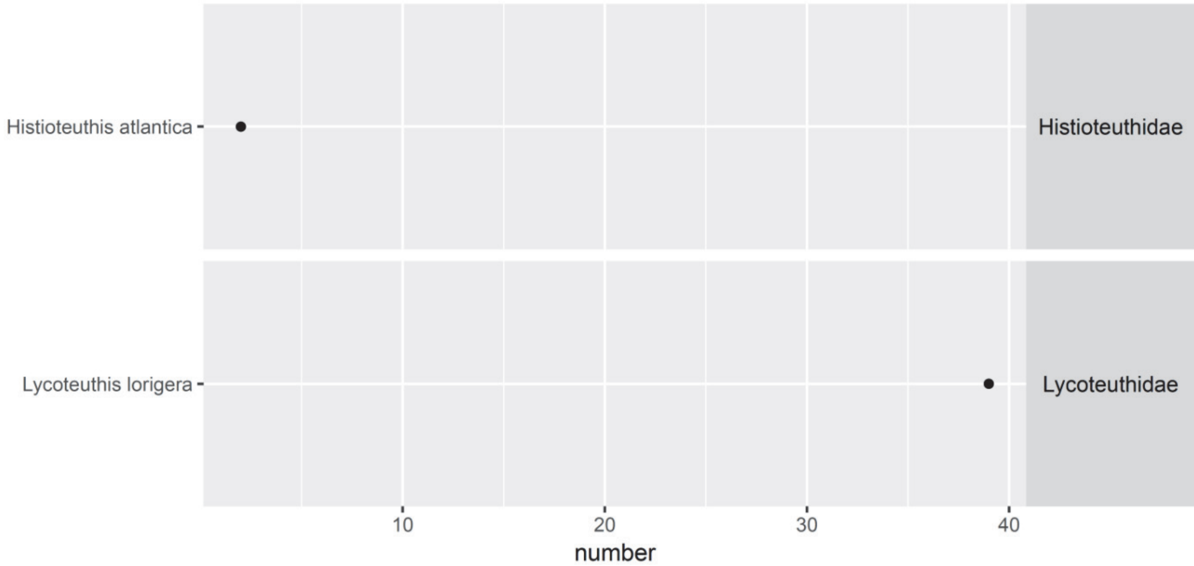


Table I.16. Number of other invertebrates (Cnidaria) over the Discovery seamount.

Herdman Seamount

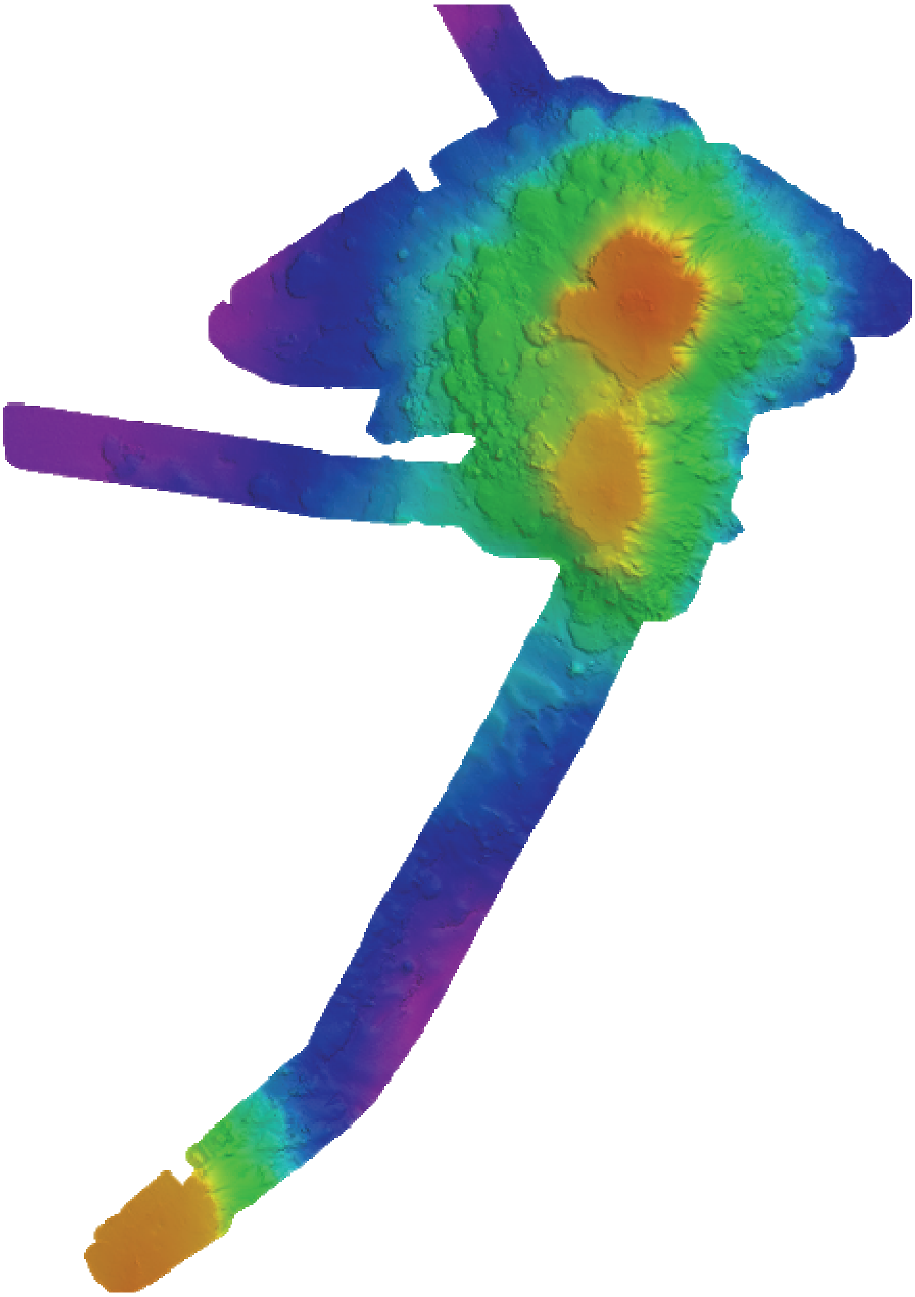
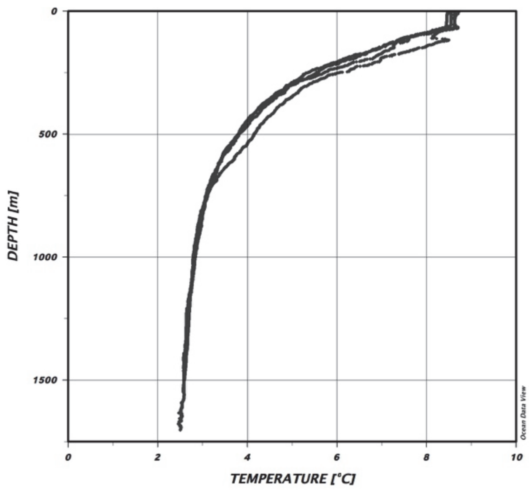
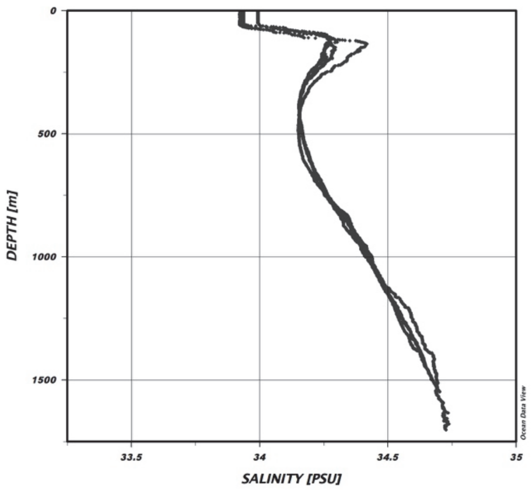


Figure I.31. Multibeam map over the Herdman seamount and northeastern corner of Schwabenland Seamount (at the bottom).

Water column profile





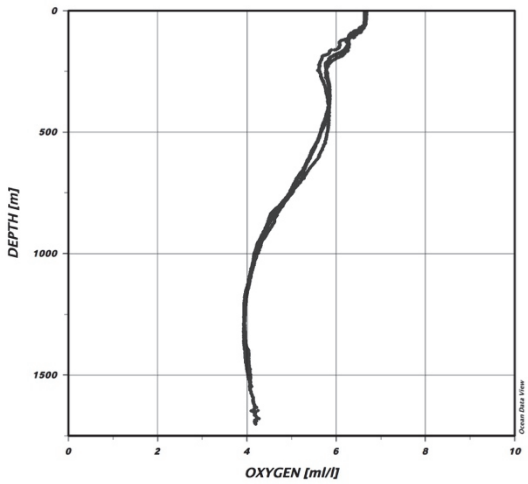


Figure I.32. Water column profile of the Herdman seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.

Fish and Cephalopods observed in video images

One video profile represented deep areas of this seamount (1 636 m). It included 10 fish records within five morphotypes (Table I.18). *Lepidion* sp. (FT3, Family Moridae) was the most frequently observed. Relative abundance and richness were low in this area (0.08 ind./minute; 0.04 morphotypes/minute).

Table I.18. Fish and cephalopods visualized along 1 video profile obtained in the Herdman Seamount, Convention Area of the South East Atlantic Fisheries Organization (SEAFO), grouped by depth strata. Numbers represent individual records, numbers in brackets are individuals per minute of observation.

			>1 000
Notacanthidae	FT70	Indet.	2 (0.017)
Macrouridae	FT31	*Cynomacrurus piriei*	1 (0.008)
	FT34	indet.	1 (0.008)
Moridae	FT3	*Lepidion* sp.	5 (0.041)
	FT9	*Antimora rostrata*	1 (0.008)
Total			10 (0.083)

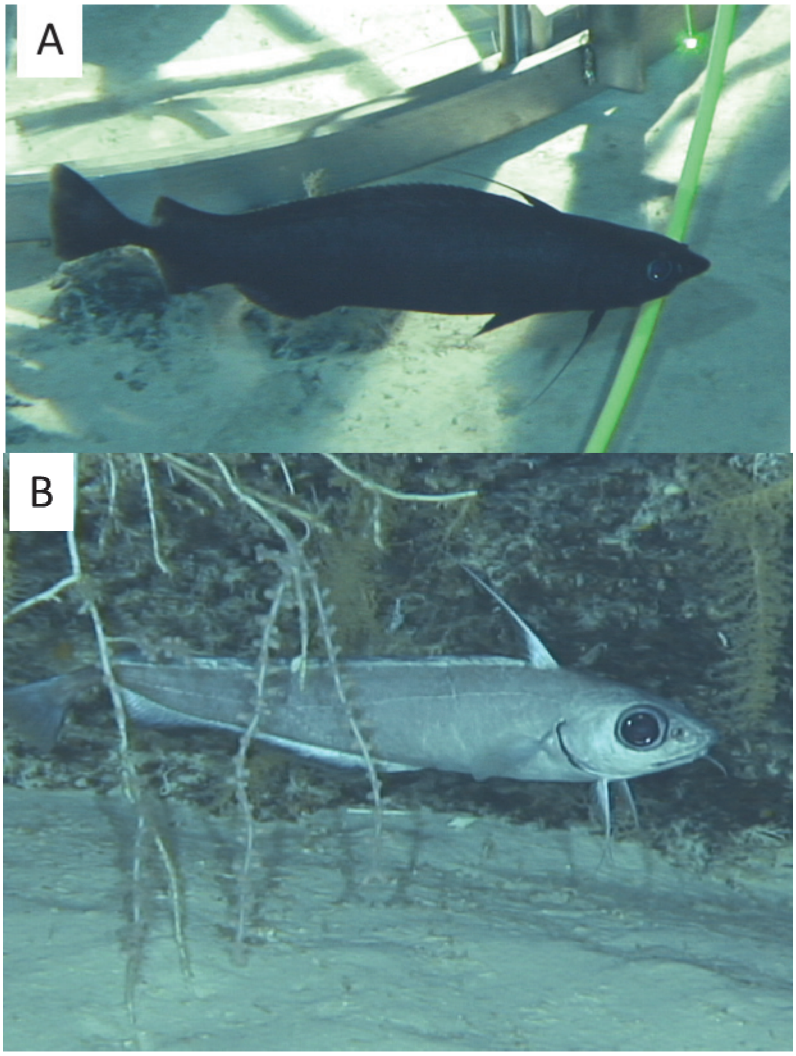


Figure I.33. Fish cephalopods observed in Herdman Seamount, Convention Area of the South East Atlantic Fisheries Organization (SEAFO). A, *Antimora rostrata* (FT9); B, *Lepidion* sp. FT3.

Pelagic trawl - St 4

The depth range of this sample was 500-520 m.

Big quantities of jellyfish were caught above this seamount, reaching more than 9 kg in weight and more than 43 000 individuals (Figure I.34). Crustaceans were the second most abundant group in the catch, followed by fish and cephalopods.

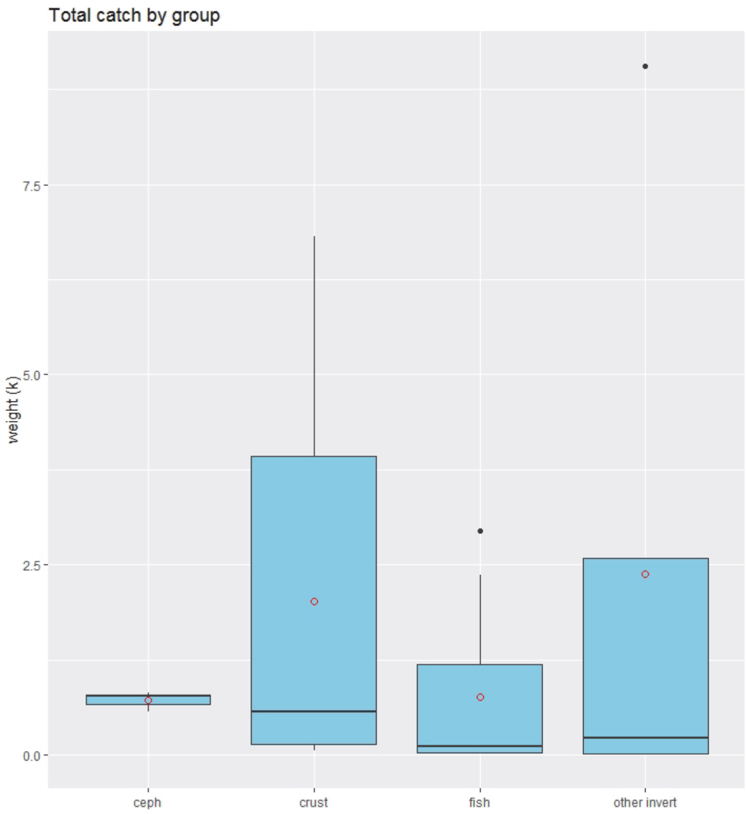


Figure I.34. Boxplot of the species catch (kg) for main taxonomic groups at the Herdman seamount.

The number of specimens per species for different main taxonomic groups, at this station are given in Table I.19-I.22 ordered by Family. Of the 12 fish species collected belonging to 3 families, 8 were Myctophidae and 3 Phosichthydae. The most abundant both in number and weight was the Myctophid *Electrona Antarctica* although one species of an indeterminate myctophid was also very abundant. The most abundant Krill species were *Euphausia valentini* and *Euphausia* indet. 6 different species from the family Euphausiidae were found together with 2 species of Amphipods. No decapods were found in the catch. It was only 3 species of cephalopods in the catch, each belonging to different familes. The squid *Lycoteuthis lorigera* was the most abundant cephalopod in the catch. More invertebrates were found above this seamount than in the previous ones.

Table I.19. Number of fish specimens per species at Herdman seamount.

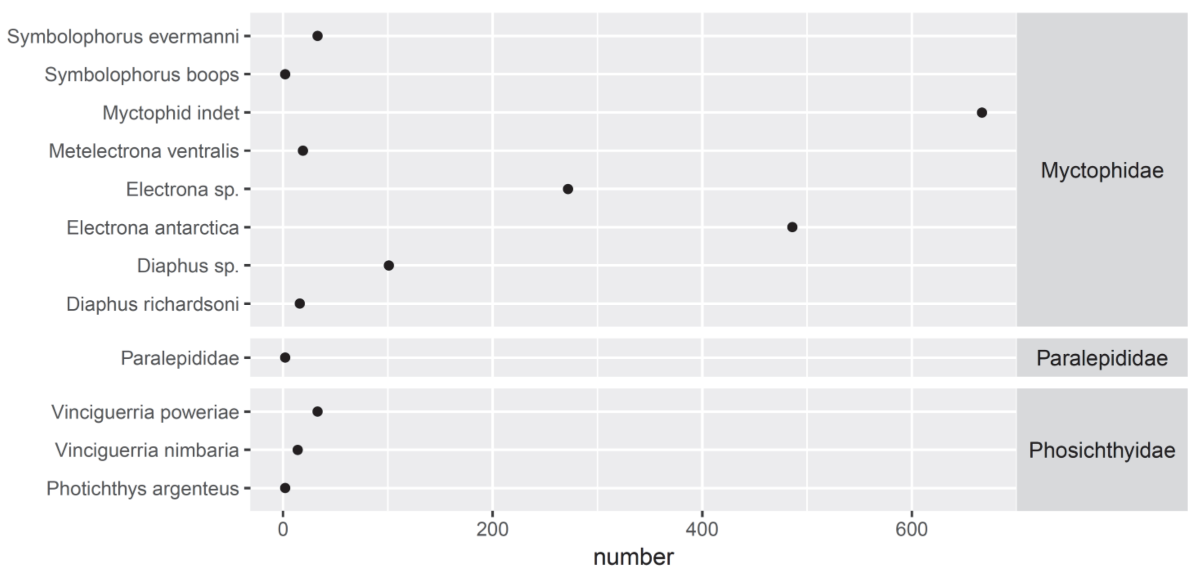


Table I.20. Number of crustacean specimens per species at Herdman seamount.

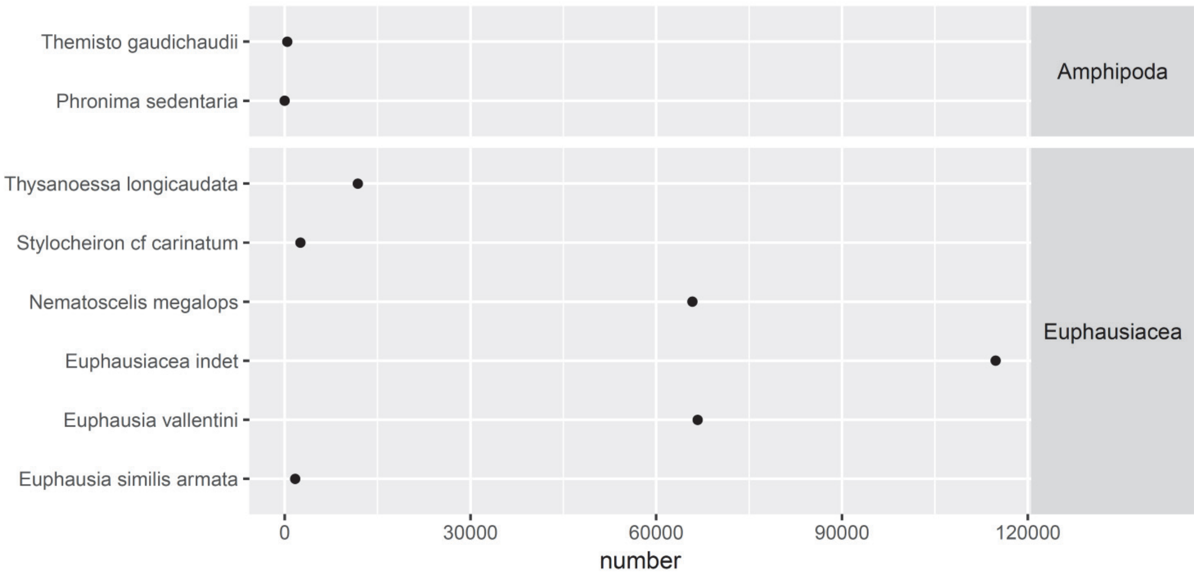


Table I.21. Number of cephalopod specimens per species at Herdman seamount.

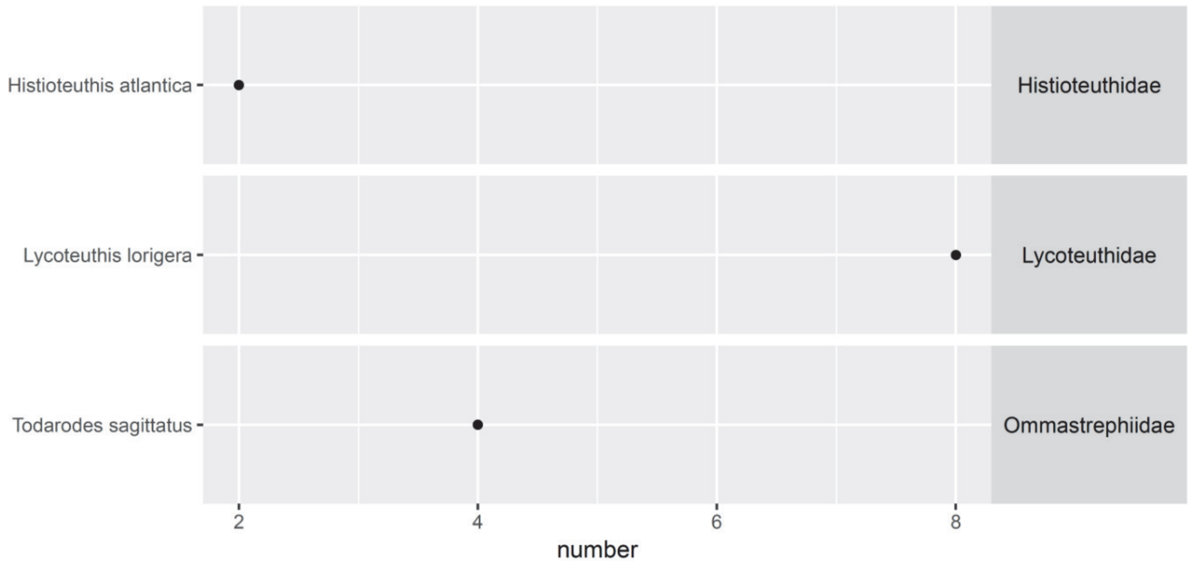
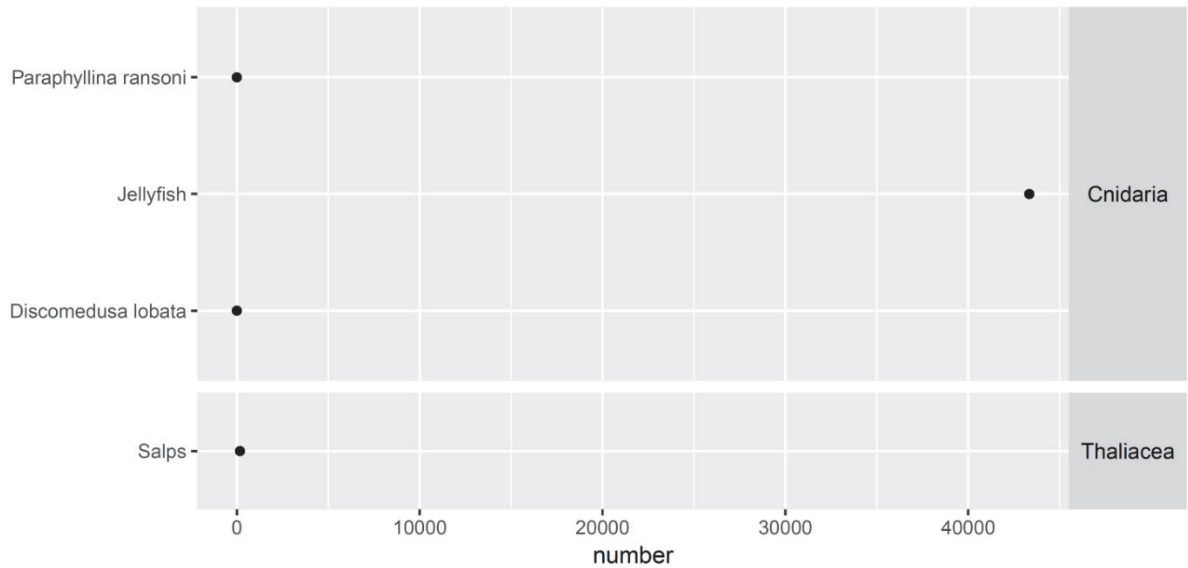


Table I.22. Number of specimens per species of other invertebrates at Herdman seamount.



<u>Macrofauna</u>

On this seamount, only one station, located on zone C3 at 1 620 m depth, was sampled.

31 specimens belonging to 18 different species including 7 high-level taxa were collected. At this station, Polychaeta (7 species, 8 specimens), Ophiuroidea (4 species, 7 specimens) and Porifera (3 species, 6 specimens) were the dominant taxa (Figures I.35 and I.36).

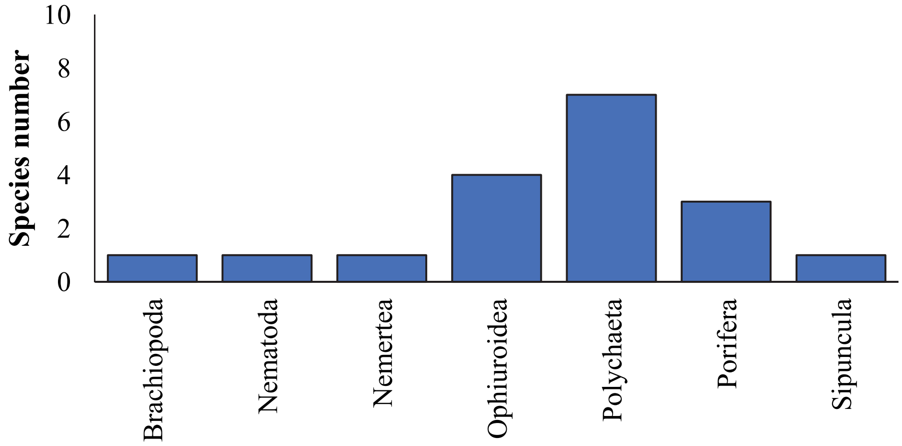


Figure I.35. Specific richness (S) for the 7 main-taxa collected at Herdman seamount.

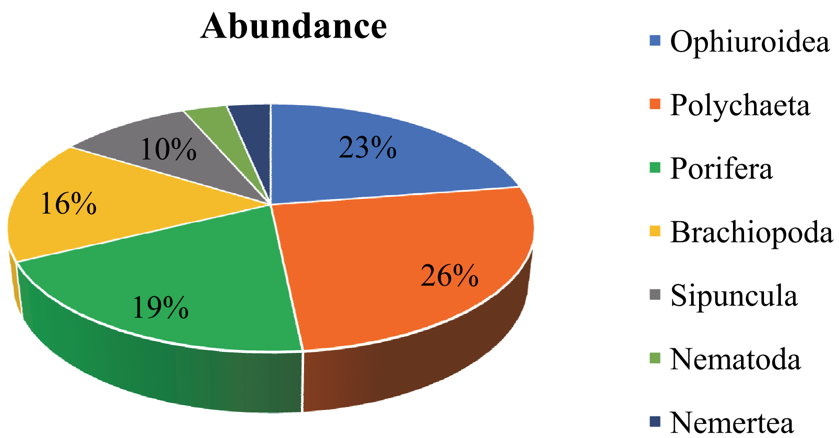


Figure I.36. Composition of relative abundance (%) for main-invertebrate taxa collected at Herdman seamount.

The list of species is reported in Table I.23, and the Figure I.37 shows some pictures with examples of the fauna collected at Herdman seamount.

Table I.23. List of species collected at Herdman seamount.

Phylum PORIFERA

Demospongiae indet5
Hexactinellida indet1
Hexactinellida indet2

Phylum BRACHIPODA

Brachiopoda indet

Phylum ANNELIDA

Class Polychaeta

Ampharetidae indet
Amphinomidae indet
Eulalia sp
Eunice sp
Glycera sp
Maldanidae indet
Echiura indet

Phylum NEMERTEA

Nemertea indet

Phylum NEMATODA

Nematoda indet

Phylum ECHINODERMATA

Class OPHIUROIDEA

Amphiuridae indet
Ophiomusium sp
Ophioscolex sp
Ophiuroidea indet

Phylum SIPUNCULA

Sipuncula indet

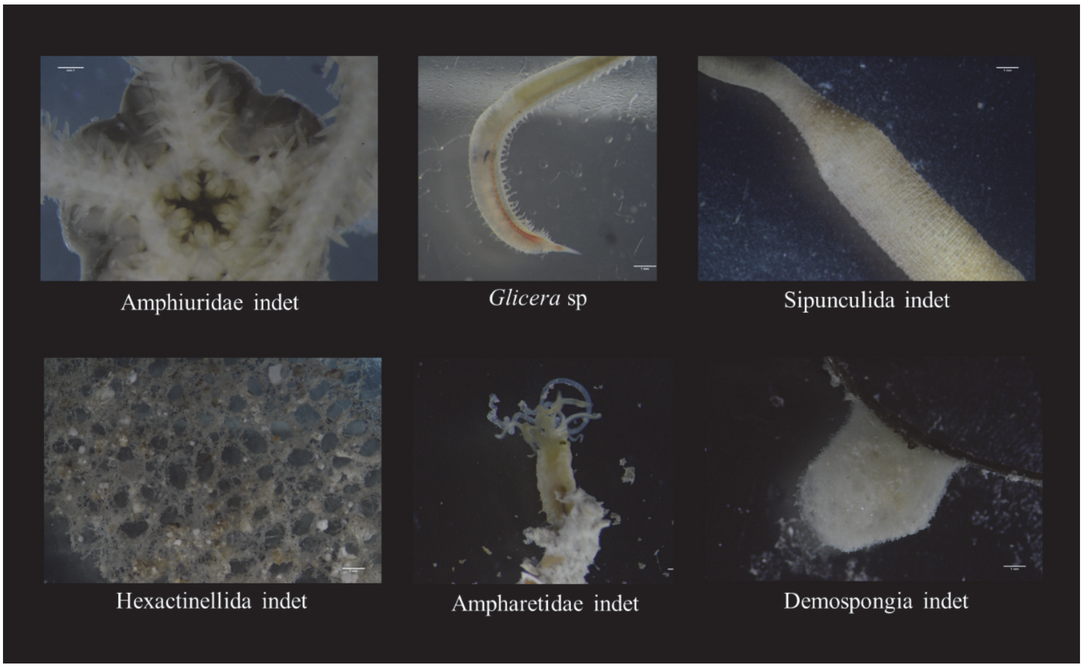


Figure I.37. Pictures of some taxa collected from Herdman seamount.

Schwabenland Seamount

<u>Water column profile</u>

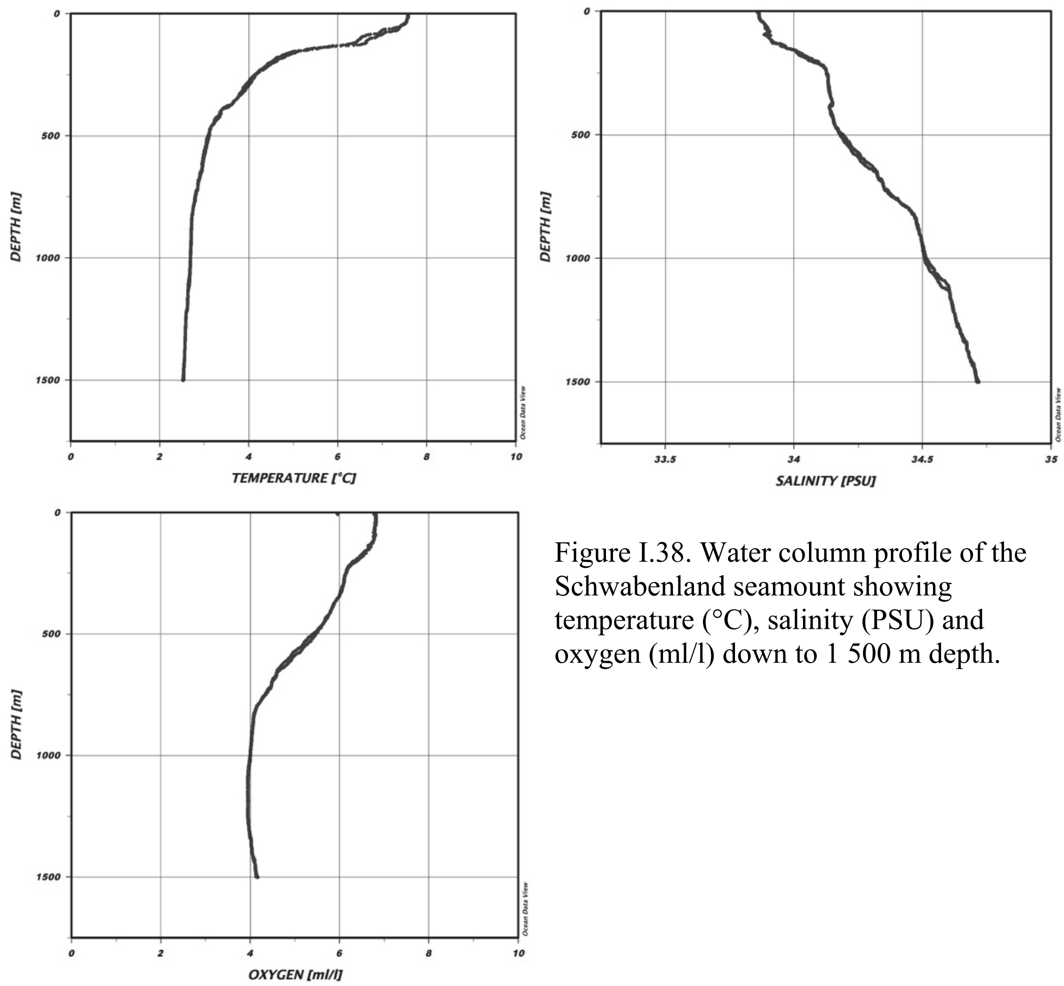
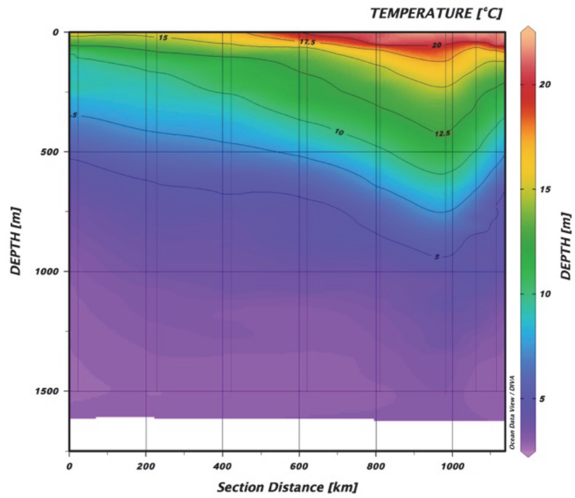
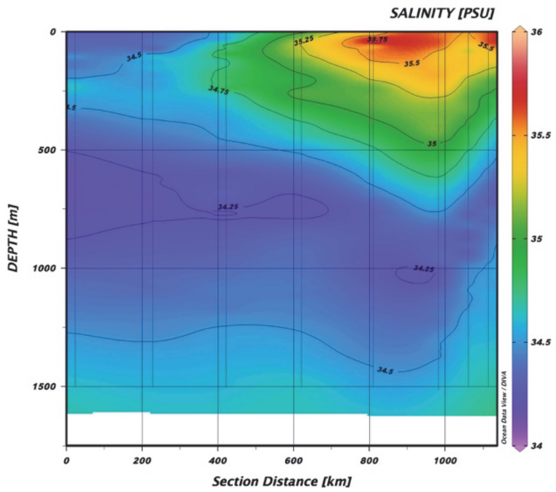


Figure I.38. Water column profile of the Schwabenland seamount showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.

ANNEX II. TRANSECT FROM DISCOVERY SEAMOUNTS TO CAPE TOWN

<u>Oceanography</u>





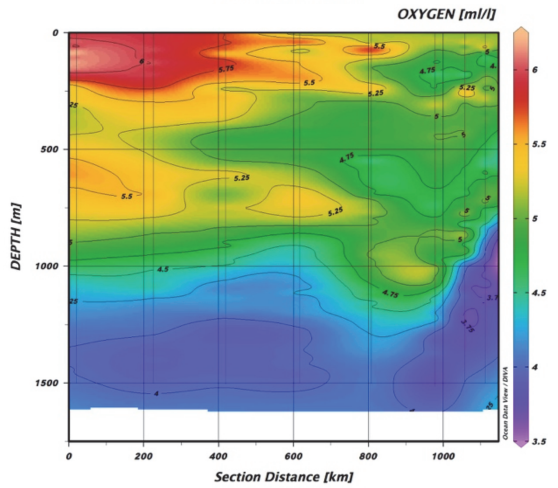


Figure II.1. Vertical section of the water column profile of the transect from the Discovery seamounts towards South Africa showing temperature (°C), salinity (PSU) and oxygen (ml/l) down to 1 500 m depth.

<u>Pelagic trawls (St 5 to 10)</u>

The depth range of the pelagic trawls was 0-1 000 m. The biodiversity of the "Transit" stations, along the transect back to Cape Town from the seamount area was much higher than at the stations with samples over the seamounts, likely due to the broader depth range of the pelagic trawls, starting at the surface and reaching down to 1 000 m depth.

It is worth noting that there was not a clear dominance of any group over another, due to the higher mean catch of other invertebrates per station.

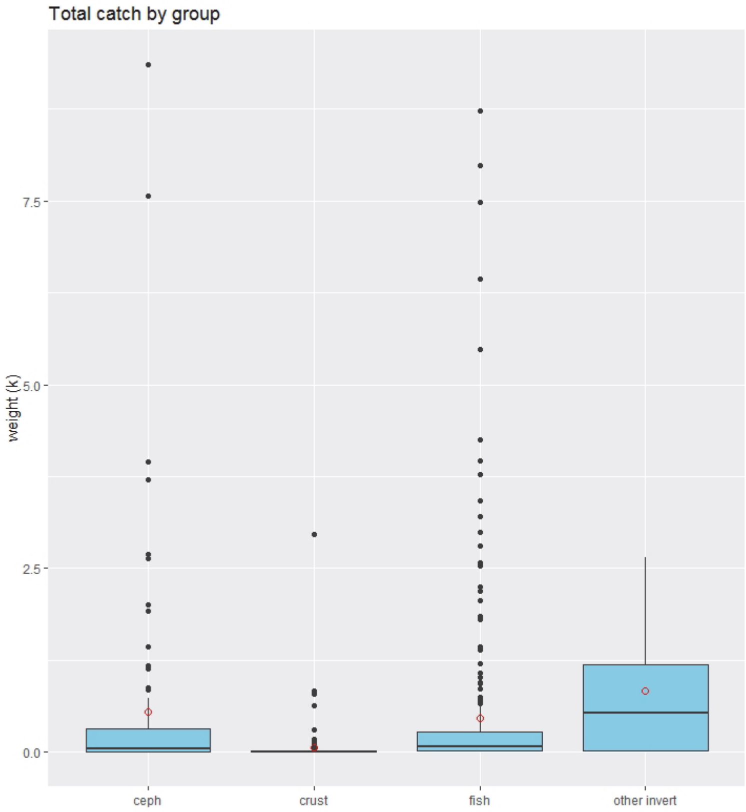


Figure II.2. Boxplot of the species catch (kg) for main taxonomic groups along the Transit stations.

The total number of specimens per species collected at these stations for are shown in Tables II.1-II.6, ordered by Family. Two species of crustaceans were the most abundant in weight: the krill *Euphausia spinifera* and the decapod *Funchalia villosa*. The same species of krill was the most abundant species in number, but the second most numerous was the decapod *Nematoscelis megalops*. 13 different species of Euphausiidae were identified as well as 65 species of other crustaceans belonging to 6 different taxa. 120 fish species were found, belonging to 41 families, of which 25 are Myctophidae and 14 barbeled dragonfishes from the family Stomiidae. The Myctophids *Gymnoscopelus* sp. and *Diaphus mollis* were the most abundant both in number and weight in the catch.

40 different species of cephalopods were identified, belonging to 16 families. The Angolan flying squid, *Todarodes angolensis* was the most abundant cephalopod in weight while the squid *Lycoteuthis lorigera* in number. More invertebrates were found in these stations than the sets performed above the seamounts. Thaliaceans from the family Pyrosomatidae and Cnidarian jellyfishes were the most abundant within this group.

Table II.1. Number of Myctophidae fish specimens per species along the Transit stations.

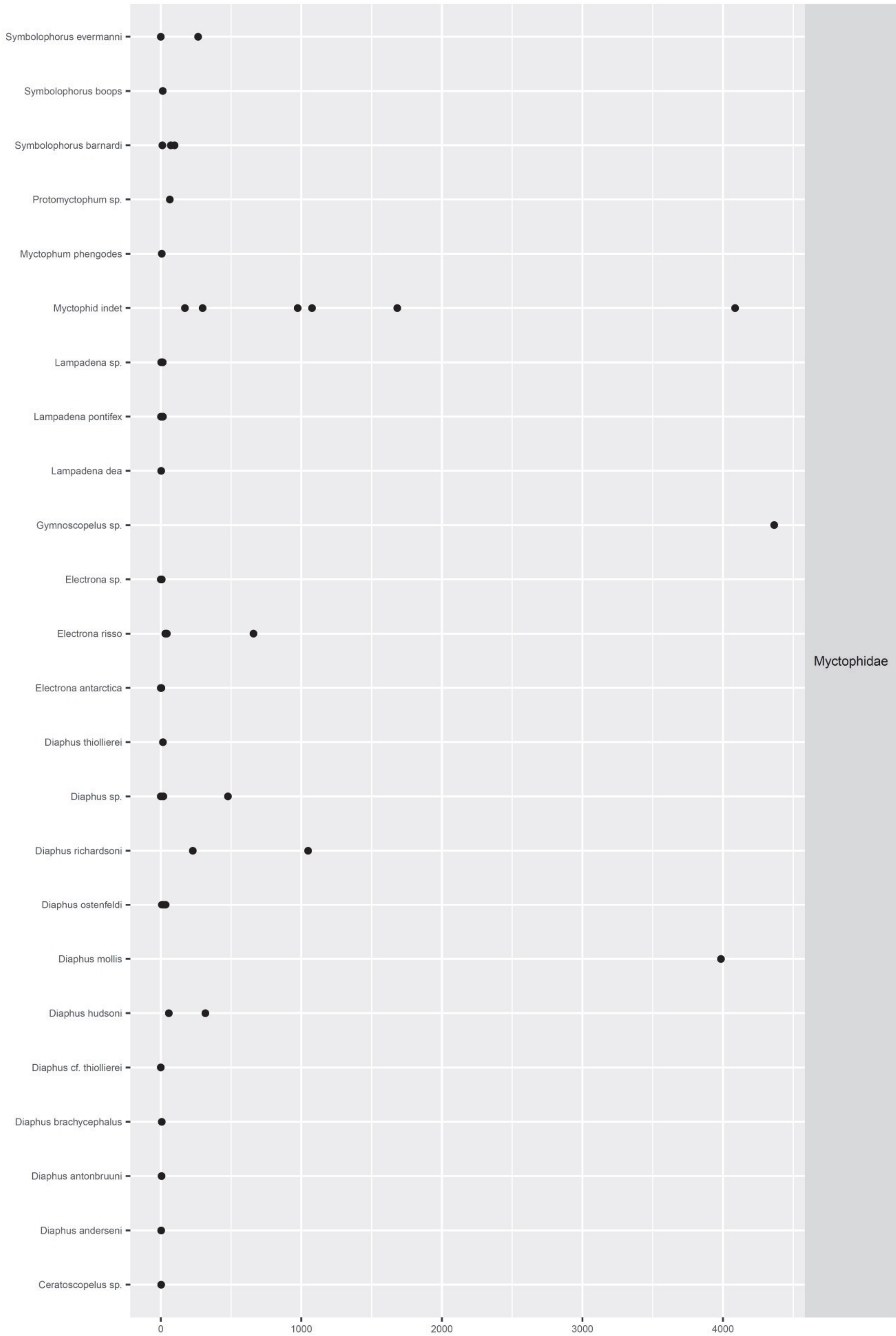


Table II.2. Number of non-Myctophidae specimens per species at the Transit stations.

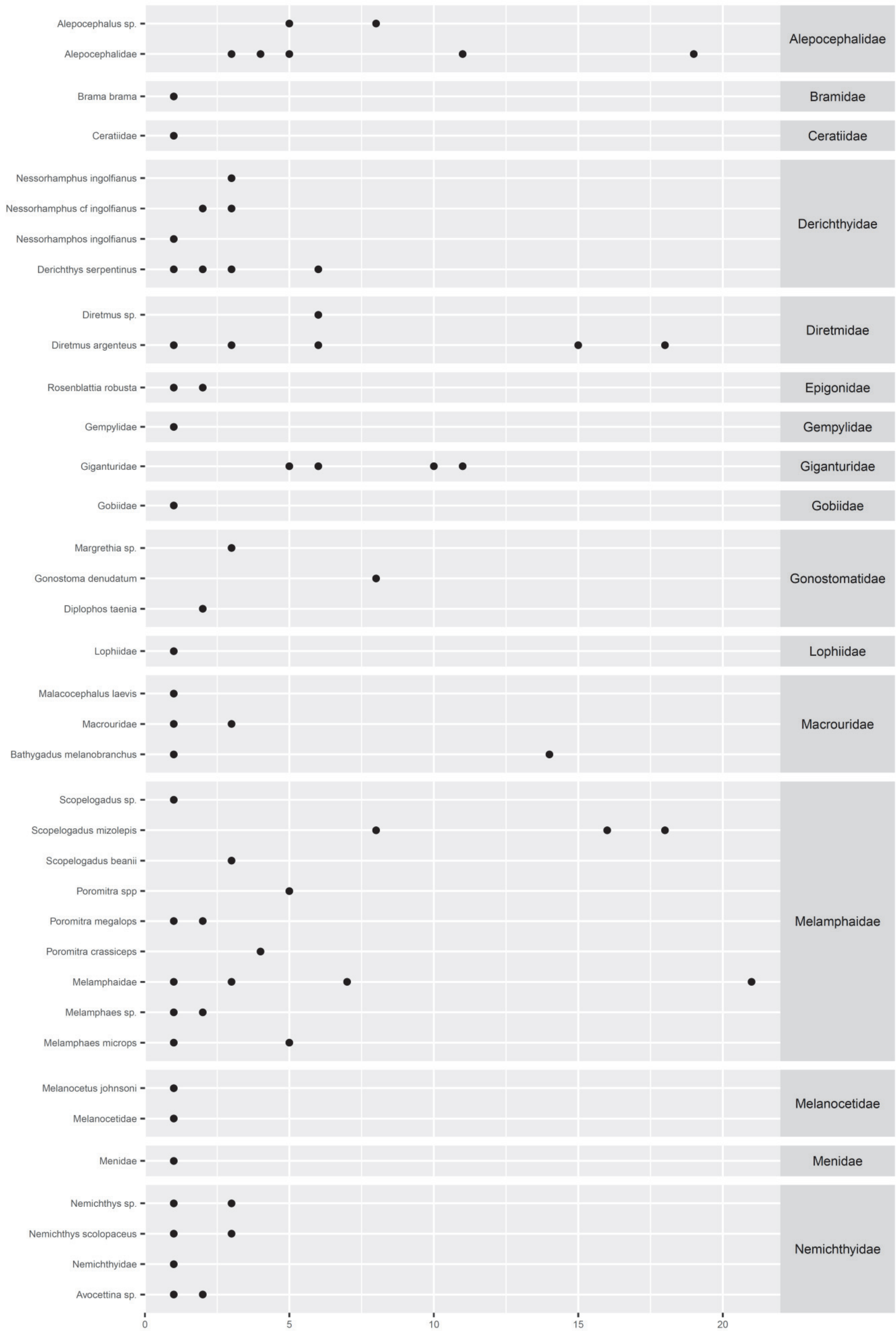


Table II.2. continued. Number of non-Myctophidae specimens per species at the Transit stations.

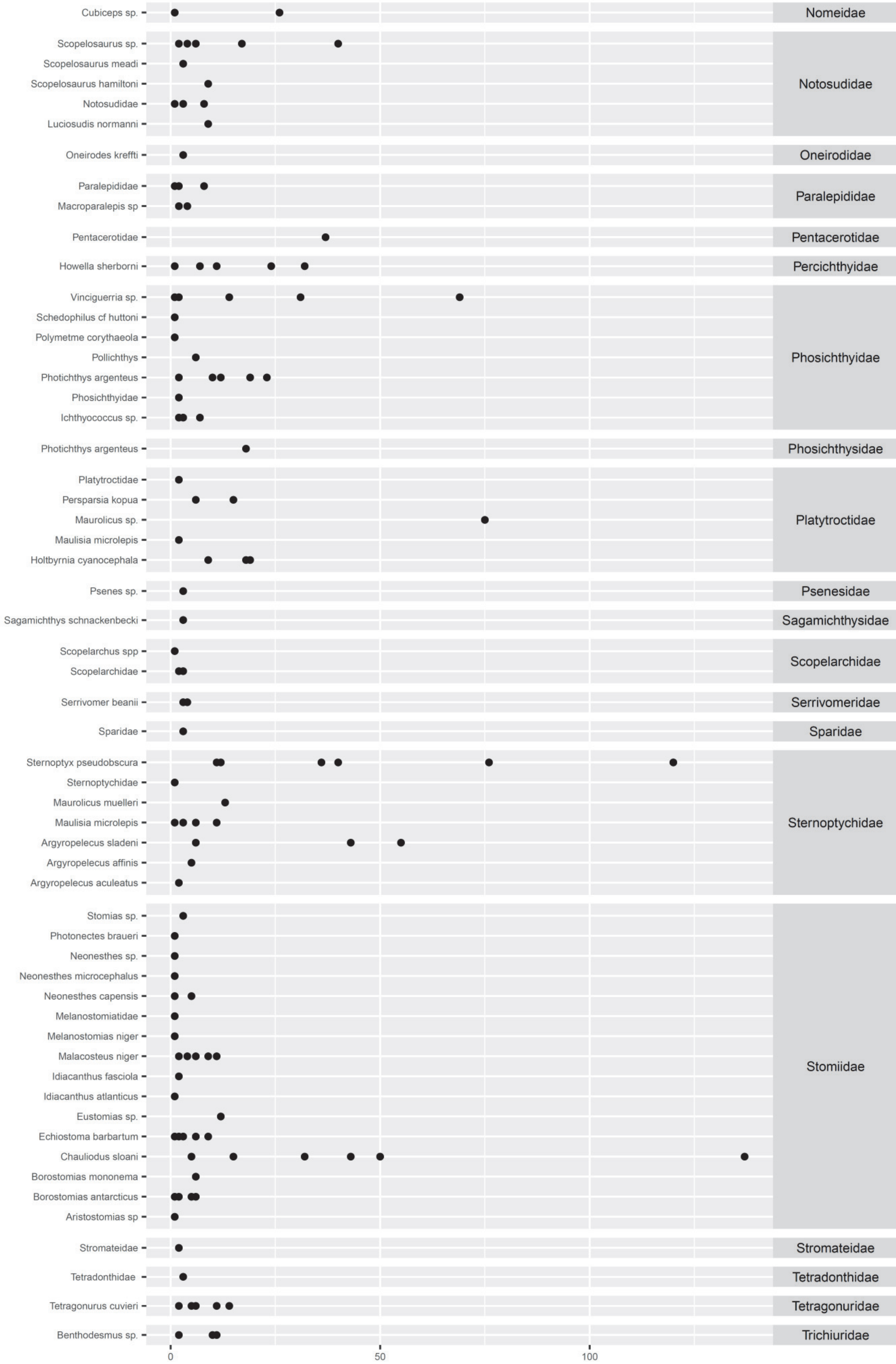


Table II.3. Number of Euphausiacea (Family Euphasiidae) specimens per species at the Transit stations.

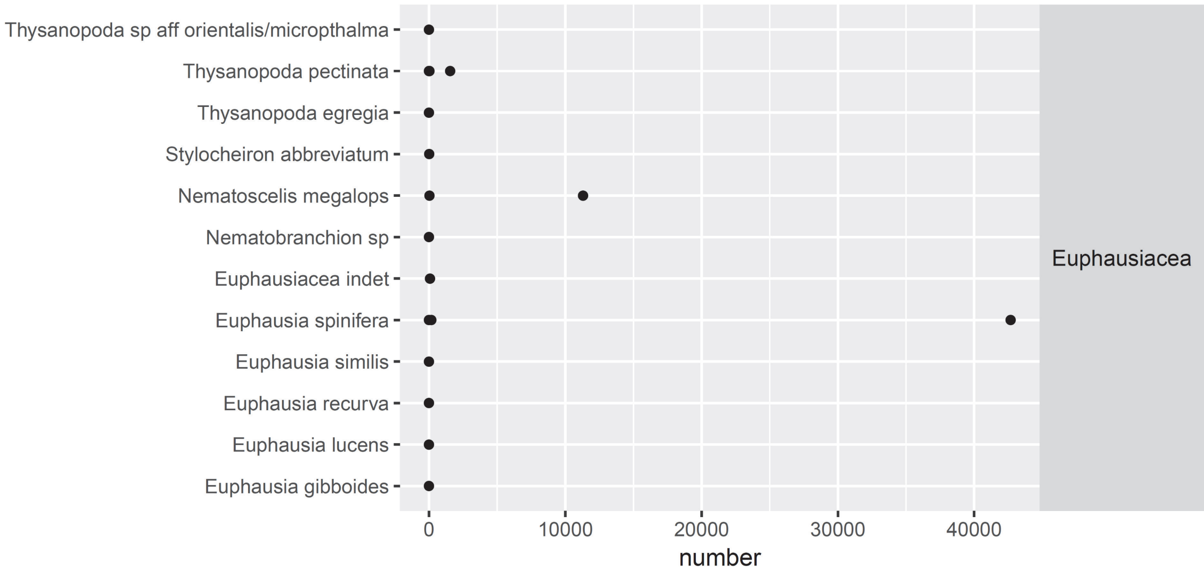


Table II.4. Number of specimens of crustaceans other than Euphausiacea per species at the Transit stations.

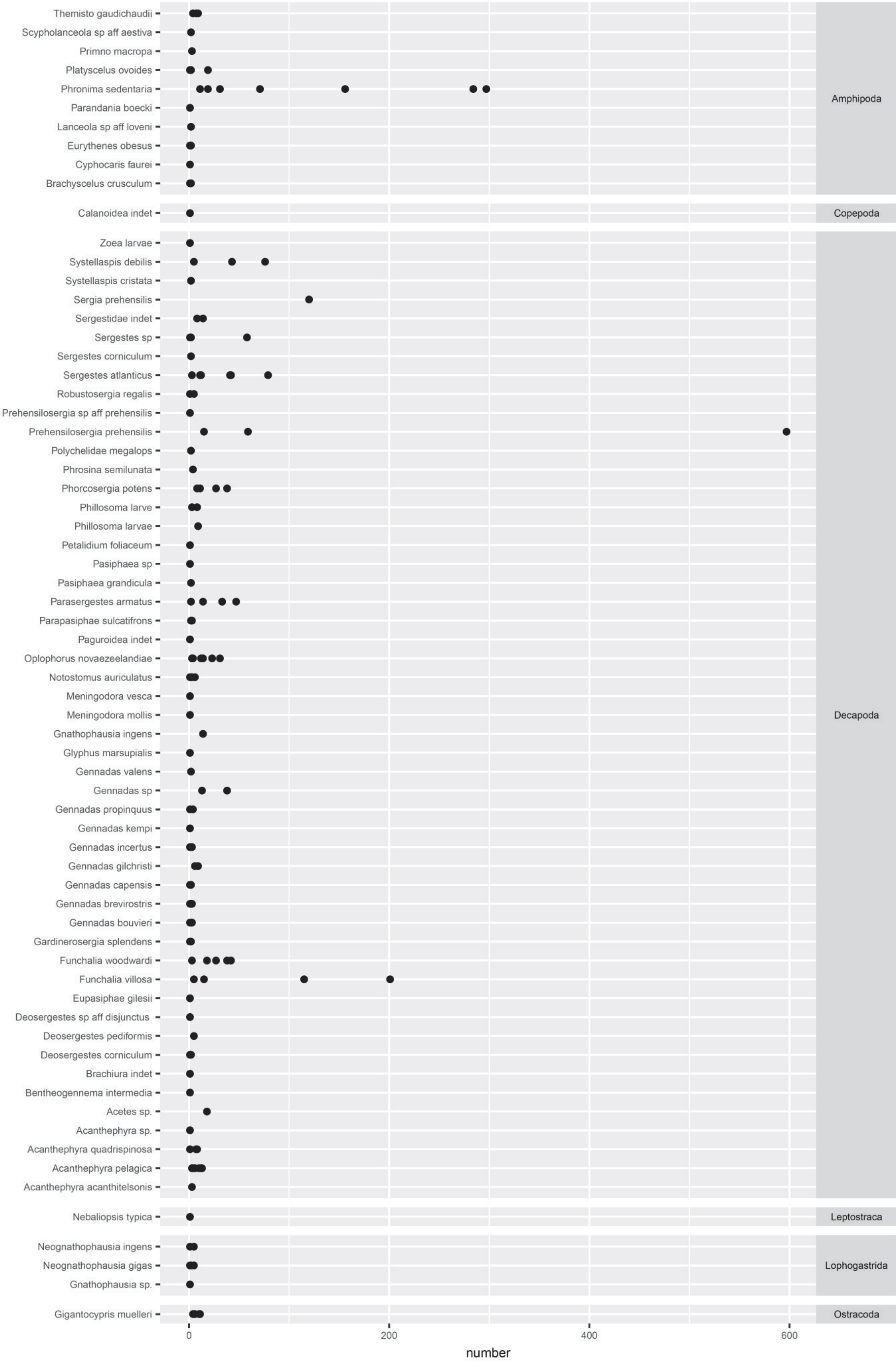


Table II.5. Number of Cephalopod specimens per species at the Transit stations.

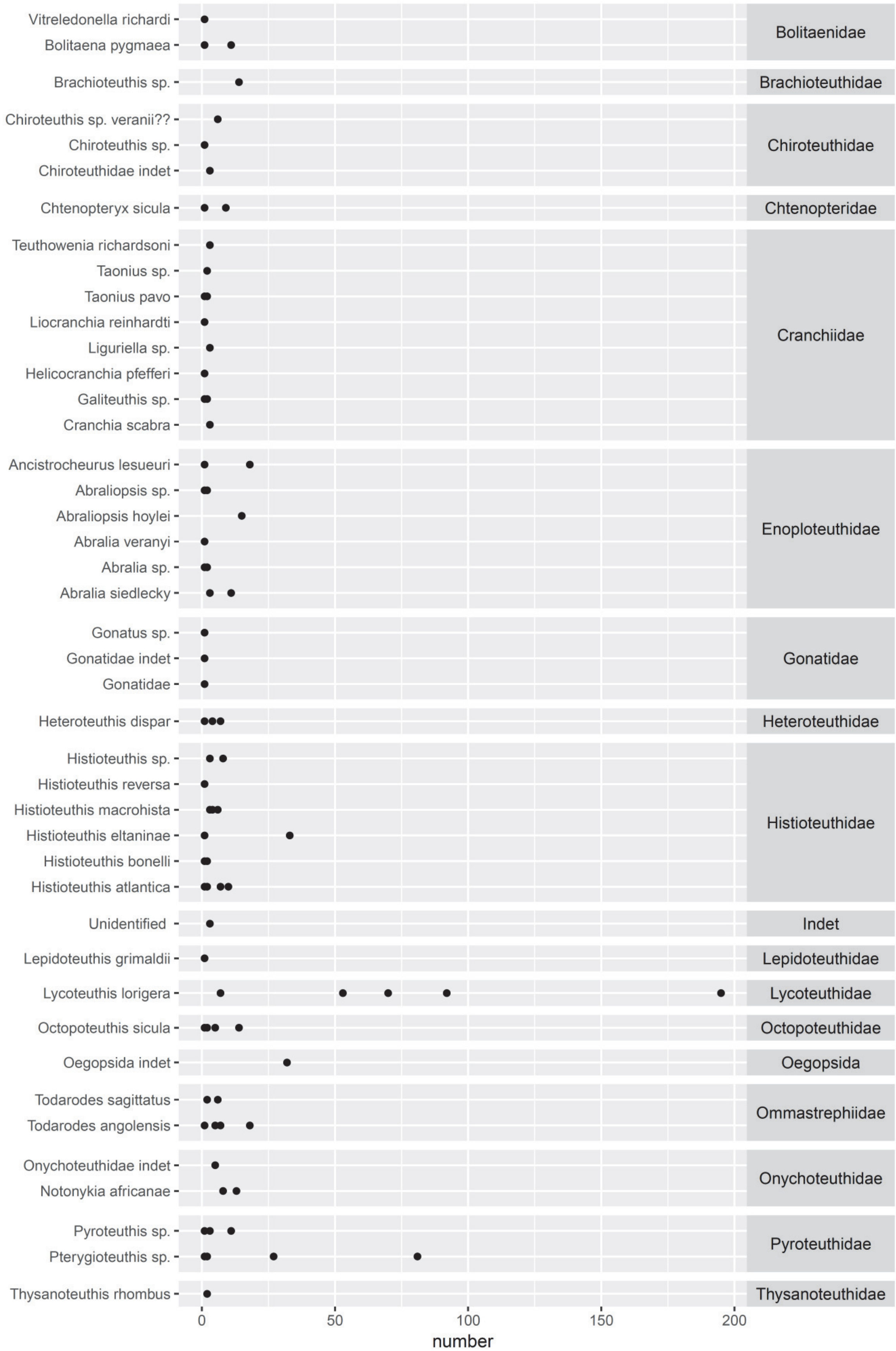
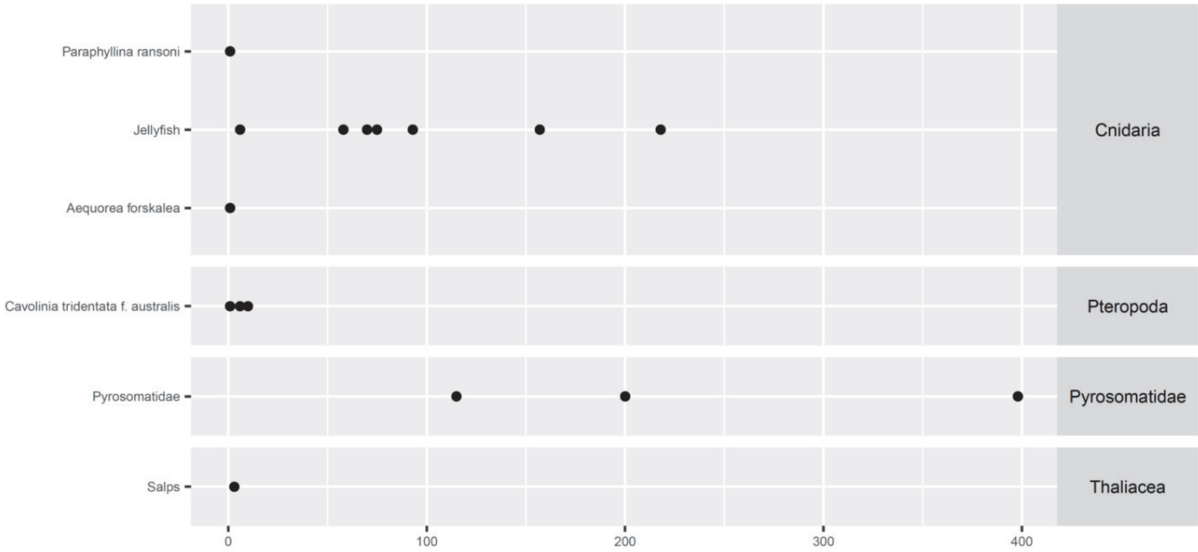


Table II.6. Number of specimens per species for other invertebrates at the Transit stations.



ANNEX III. TAXA OBSERVED ON THE SEABED

	Station#												
Taxa	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Actiniaria	10		1	4	1	1	7			3	2	4	5
Actiniaria big							1						
Actiniaria buried													1
actinophycia		1											
Amphilaphys			2										
Amphipoda			1		1								
Amphiura cf											1		
Antimora			1					1					
Antipatharia	3			2	2			1			3	32	2
Antipatharia long	2												
Antipatharia small	1												
Antomastus	4	18	12	19	1	18		7	5	2	8	1	20
Antoptilum	1												
Ascaergos octopoda							1						
Ascidiacea												1	
Ascidiacea colonial							1						
Ascidiacea colonial cf												1	
Ascidiacea colonial transparent							1						
Ascidiacea solitary											1		
Asconema like		1					1					1	
asterix							1						
Asteroidea	2	5		1		2	8		1		2	4	1
Asteroidea big							1						
Asteroidea sp2											1		
Balanoidea												9	2
Bivalvia						2							
Bivalvia buried siphon and shell visible										1			
Bivalvia cf	1												
Brachiopoda		1					6						
Bramidae													1
Brisingidae							1					1	
Bryozoa				6		2					3	6	
Bryozoa anascophora					1	3		1			1	3	1
Bryozoa anascophora bush					1		4	1		1			
Bryozoa branched				2									
Bryozoa bush tiny branches											1		
Bryozoa cyclostomata			1		1	1					1	1	1
Bryozoa cyclostomata bush					1								
Bryozoa cyclostomata net								1					
Bryozoa feather					1								
Bryozoa gymnolematidae						1							

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13
Bryozoa small bush			1										
Caryophyllia sp				2									
Caryophyllidae							1						
Ceramaster cf		2				5				2		1	4
Ceriantharia						3	1		2		2	2	2
Ceriantharia cf							1						
Ceriantharia in tube								1					
Chaceon		2	1	4		1			3				
Chimaera											1		
Chondrocladia	1			1									
Chondrocladia cf	1												
Cidaridae					2	3					2	3	2
Collosendeidae							1						1
Comatulidae	6	1	2	3	2	15		4	2		15	15	9
Comatulidae five arms											1		1
Comatulidae five arms dark					2								
Crinoidea stalked				4	2			1			3	22	
Crinoidea stalked white arms					1								
Decapoda		1											
demospongia						1							
desmophyllum or actiniaria	1												
Echinoidae regularia	2	4	1	1		13		2				6	1
echinoidae regularis small												1	
echinoidea long spines	1												
Echinoidea regularia						2							
Echinoidea small regularia												1	1
echinothurid								1					
echinothurid echinoid								1					
Edwardsidae							8						
Eel-like			2	3		7			2	4			
encrusting grey	1												1
Enipmiaster										1			
enipniaster eximia					1								
estinasterius		1											
estinastris		1											
estirasteria		1											
Euryalida													1
Euryalidae	1			3	2	3		3	1		2	8	1
Fish	1	1		11				1		1	1		
Fish black						1							
Fish small			1	1									
Fish small black											1		
Fish small thin									1				
Flabellum										9			
Foraminifera agglutinated				2	1								
Formosoma echinoid												1	

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13
Funiculina		2											
Galatheidae			1	1	1	1		1	1		2		1
gastropod						1							
gastropoda small											1		
Geodia like						1							
Gonostomatidae						1							
Gorgonacea	6	12	2	24	1	2		1			1	5	1
Gorgonacea elongated	1			1									
Gorgonacea elongated monoaxial			3										
Gorgonacea small white			1										
Gorgonacea small yellow			1										
Gorgonacea stolonifera							3						
Gorgonacea unbranched											1		
Gorgonacea yellow											2		
Gorgonacea yellow green				2		1					11	6	4
Gorgonacephalus						1	2						
Gorgonocephalidae						1	9						
halepocephalida like													1
halosauridae	1												
halosauridae like											1		
Heaxctinellida on coral													1
henricia							2						
Henricia like							2	1					
hexacorals	1												
Hexactinellida	3		1	2		3	1	1			3	5	
Hexactinellida cone				1							1	4	1
Hexactinellida coral covering								1					
Hexactinellida Farrea like						1						1	
Hexactinellida stalked												2	
Hexactinellida stalked sp2												1	
Hexactinnelida sp1											1		
holothurian swimming				1		1							
Holothuroidae lilla						1							
Holothuroidea	3	1		16		3	7	1	1		5	1	7
holothuroidea paroriza										1			
holothuroidea black						1							
Holothuroidea Mesothuria like							1				1		
Holothuroidea sp1						1							
Hormatidae													5
Hydrozoa				1	1	2	1	1			3		
Hydrozoa bush								1					
Hydrozoa cf		2											
hydrozoa colony						1							
hydrozoa zig zag							1						
Isididae	3			9	3	5	2	6	3	1	5	5	6
Isididae monoaxial												5	1

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13
Isidide large								1					
javinia cf							1						
Keratoisis	1		1	1		16		1	3		1		
Keratoisis like					1	1		1	2				
Kolga like				6	1						1		
laetmogone						1							
laetmogone lilla						2							
lafoidae											1		
Liparidae						2		1	8				
Liparidae like									1				
Liponema							1						1
liponema lilla											1		
Lithodidae	1	2				2							
Macruridae	5	35	4	1		10	11	1	5	5		2	3
Macruridae small						1							
mesothuria like							4						
Moridae	1	2		7	1	11	19	2	3		2		1
Moroteuthis									3				
munida		1										1	
munnopsidae					1								
murida		1											
muridae		1											
Mycale like			1										
Nephtheidae				3	1	7		6	3		3		1
nudibranchiata											1		
octocoral	1	1				1							
Octocoral purple									4				
Octocorallia	1												
Octocorallia three polyps								1					
octopodidae							2						
ophiacanthida							1						
ophididae	1						3						
ophiomysium cf								2					
Ophiotrix							6						
ophiura				2									
ophiura cf					1								
Ophiuroidea	8		5	19	4	2	7	5	3		6	4	13
ophiuroidea big					1			1					
ophiuroidea Ophiomysium								1					
Ophiuroidea small				1									
ophiuroidea white								1					
ophiuroidea without spines							1						
opistobranchia			1								1		
Opistotheutis								1					
oreosomatide				1									
Paguridae				1	1			1			1		1

Taxa	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Paguridae with epizoanthus									4	4			
paramola		1											
paramora		1											
paromola		1											
pectinidae											1		
pennatula				1		3		1					
Pennatulacea	2			3	1					1	1		
Pennatulacea cf			1										
Pennatularia				7	1	3		7			2	1	
Pergament tube								1					
Pergament tubes							4						
Phakelia			7			5							5
Phakellia big													1
Phakellia cf												1	
phakellia like												2	1
Phakellia like yellow													1
phenicurinae		1											
phicurinae		1											
phinopanacia		1											
polychaet cloeia inermis										1			
polychaet tube terebellid or ampharetidae										1			
polychaet tube terebellidae									1				
polychaeta chloeia inermis										1			
Polychaeta errantia		1											
polychaeta sedentaria		1											
polychaeta sedentary small							1						
polychaeta tube					1								
polychaeta tube erect			1										
polychaeta tubes											1		
Polychatea		1				1							
Polychatea errantia		1											
Polycheta hyalinoecious tube					1								
Porania like						1							
Porifera	2	17	3	15	1	5		8	2		1	8	13
Porifera big													2
Porifera big white													1
Porifera big with holes													1
Porifera branched			1										
Porifera cantarelle like						2							
Porifera elongated				1									
Porifera encrusting						2	1						
Porifera encrusting brown						1							
Porifera encrusting orange			1	1		1							
Porifera encrusting red							1						
Porifera encrusting transparent			1										
Porifera encrusting yellow cf	1												

Taxa	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Porifera fan												1	
Porifera funnel shaped			1										
Porifera orange						1							
Porifera small											2	2	
porifera small sp2												1	
Porifera small transparent			1										
porifera small varia			1										
Porifera yellow			1			1							
Primnoidae		1	6	8		11	1	3	8		5	5	14
Primnoidae cf					1								
Primnoidae elongated yelow						1							
primnoidae small					1								
Primnoidae small yellow			1										
Primnoidae unbranched											1		
Primnoidae yellow											1		
Prosobranchiata					1				1	1			
Psolidae							1						
Regadrella												6	
Sabellida													6
Scalpellidae			1		1	1		3			8	1	13
Scleractinia				5								2	
Scleractinia solitary	4	1		5		3	6	5	5	1	2	4	1
Scleractinia solitary freeliving								1		1			
sea cucumber/ zigoturia		1											
Serpulidae		2					1				1	1	
sertularella					1						1		2
sertularella robusta					1								
sertularella sponge big													1
sestail		1											
Shrimp	11		3	25	2	3		12	5	12	4	17	7
Solasteridae								1					
squid		2	1			1							
Stylasteridae	6	16	7	37	3	14	4	2	5		6	12	12
Stylasteridae big													1
Synaphobranchidae				2						1			
Terebellidae			1				2						
Tremaster like					1							2	
Tubularidae												1	
Xenophyophora	2					1		2			1		
Zoarcidae				1						1			
zoarcidae cf										1			
Sum taxa	39	43	41	50	44	69	49	50	29	24	60	52	53

ANNEX IV. OBSERVATIONS OF SCATTERING LAYERS

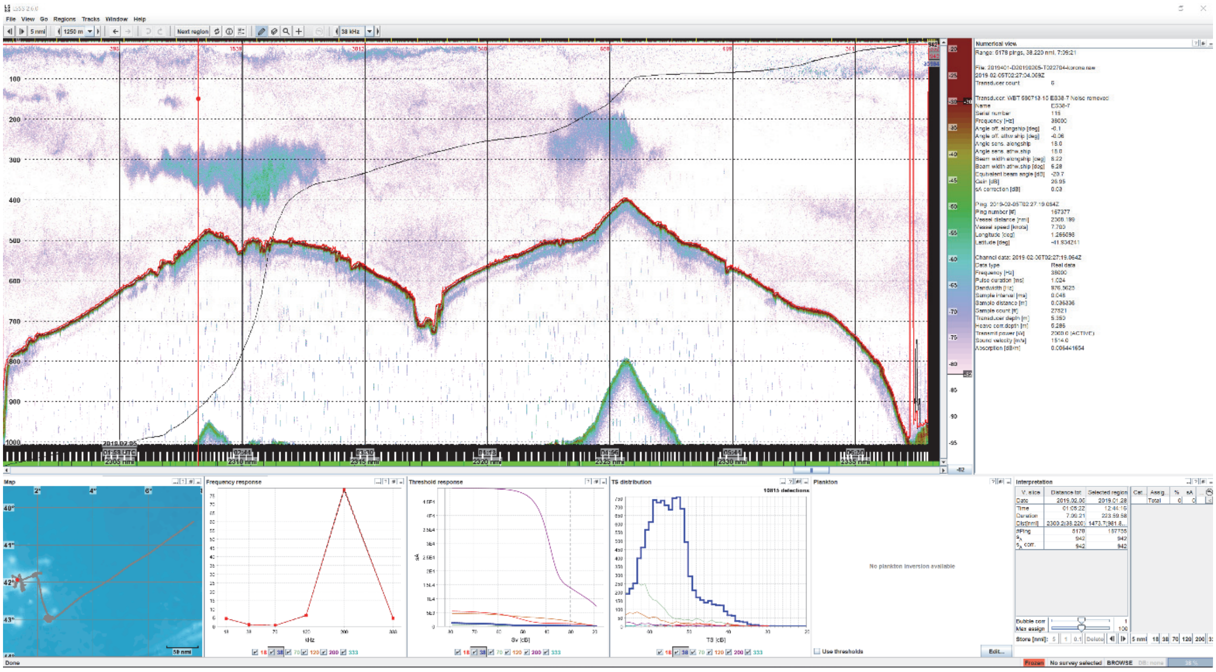


Figure IV.1. Echogram, with inserted map that indicated the location. The position, time and etc correspond to the ping locked that is shown in the picture (red line with a dot).

Only data from 5th February is displayed.

ANNEX V. OBSERVATIONS OF MARINE TOP PREDATORS (MARINE MAMMALS & SEA BIRDS)




Observer: Nosipho Gumede
Principle Investigator and Corresponding author:
Mduduzi Seakamela (smseakamela@environment.gov.za)

Introduction

Top predators play a vital role in our ecosystems in terms of controlling and avoiding over-population of species. As they are consumers of trophic level, on top of the food chain due to their large body size and abundance they are considered the main influence in the structuring and functioning of ecosystems. And they also serve as a good indicators of species found in a particular area/ecosystem and their abundance. They make it relevant to study and predict ecological consequences of an ecosystem. With regards to the marine top predators, which are difficult and hard to define their role in the aquatic ecosystems, as they are complex and expensive to conduct research on them. Although, it is learned that their presence, abundance and distribution in the ecosystem shape the structure and functioning of the aquatic ecosystems and make us aware of species found in the aquatic ecosystems. Presence of marine top predators can give brief description of what can be found in the aquatic ecosystem and the nature of the ecosystem.

Marine mammals (Whales & Dolphins) are fully-adapted to live their entire lives in waters, as their biology and diet is mainly built for the survival in water only. Their diversity and distribution differ, depending on the waters they are in and their preference for survival. The depth, temperature and oceanographic nature of waters has an influence in the distribution of marine mammals, as they do not just reside randomly in certain areas. Although, it difficult to tell why these marine mammals are present in certain waters and absent in others. As the marine mammals can be found in warm water, cold water, deep waters and at times shallow waters, also this maybe depending on the resources available for them to survive. Others can be found throughout the waters such as killer whales, whereas others such as humpback whales are seasonal movers, as they migrate every breeding season and they are mostly found in coastal areas. And one would sight sperm whales mostly in deep waters.

Whereas, sea birds are well-adapted in both land and water. Mainly they feed on prey found at sea, which makes them good indicators of distribution and abundance of fish diversity in that particular areas they are sighted in. And they can also act as indicators of any changes that might be occurring in the marine ecosystems.

Seamounts as submarine mountains are homes to small deep- sea animals such as corals & sponges, and rare sighting of big animals has been observed, as the mountains can rise up to 1000 m from the sea floor but does not reach or go above the sea surface. Some animals especially the big ones, cannot move around and search for food for their survival due to the seamounts. Sometimes seamounts areas can be a virtual desert due to only deep-sea animals tend to survive the ecosystem by attaching themselves on the rocks of the submarine mountains. As the ecosystem is known for a frequent and strong current that upwell planktonic food for the survival of deep-sea animals.

Aim

The aim of the survey was to investigate the distribution, diversity and abundance of marine top predators in the Seamounts ecosystem of the Southeast Atlantic Ocean, Cape Town (South Africa).

Objectives

- To develop the databases, collections to benefit regional science and enhance the global understanding of marine top predators encountered in the Seamounts of Southeast Atlantic Ocean ecosystems
- To understand if Seamounts ecosystems can be a habitat for marine top predators (Sea birds & Marine mammals).

Observation protocol

The observations started on the 26th January - 22nd February 2019, and they were done on daily basis from the observation Nest above the wheel-house, and in bad weather days, the observations were done from the bridge. Active observations were only conducted from 07:00 to 18:00 daily. The weather conditions were monitored and recorded every hour on the weather form, every day. Effort was also recorded at the beginning & end of observations each day, with other activities occurring in between the observations were recorded on the effort form. And in conditions when we had strong winds of 20 knots and above, the observations were recorded off-effort due to poor conditions of sightings especially marine mammals, which is difficult to spot with whitecaps, foam and spray that can easily be mistaken for a slash/blow/breaching of the animal or miss of the animal. A GPS coordinates were also recorded every hour with the weather conditions and on the effort form for any changes or activities occurring during the survey.

Mammals observations were done 180° to the forward section of the moving vessel. Equipment used were the angle board, to estimate the angle which the animal was sighted from the vessel, binoculars and a camera of 200mm lens were used to take pictures for species identification. GPS coordinates, for the position at which the animal was sighted, estimation of distance from the ship to the animal, time of the sighting and number of individuals were recorded on the sighting form. Only sightings of whales and dolphins were recorded.

With bird's observations, they were done at 180°to the forward section of the moving vessel only, when the vessel was stationary, there was no recording of birds. All sightings recorded were within 300m from the vessel and bird that came from the back of the vessel were not recorded. Binoculars and a camera of 200mm lens were used for the identification of the bird's species. And birds were recorded at the time seen, position sighted at and number of individuals in a note book. The birds following the vessel were not recorded.

All searching was carried out in passing mode and no diversion to the animal was attempted.

Results

Marine Mammals sighted

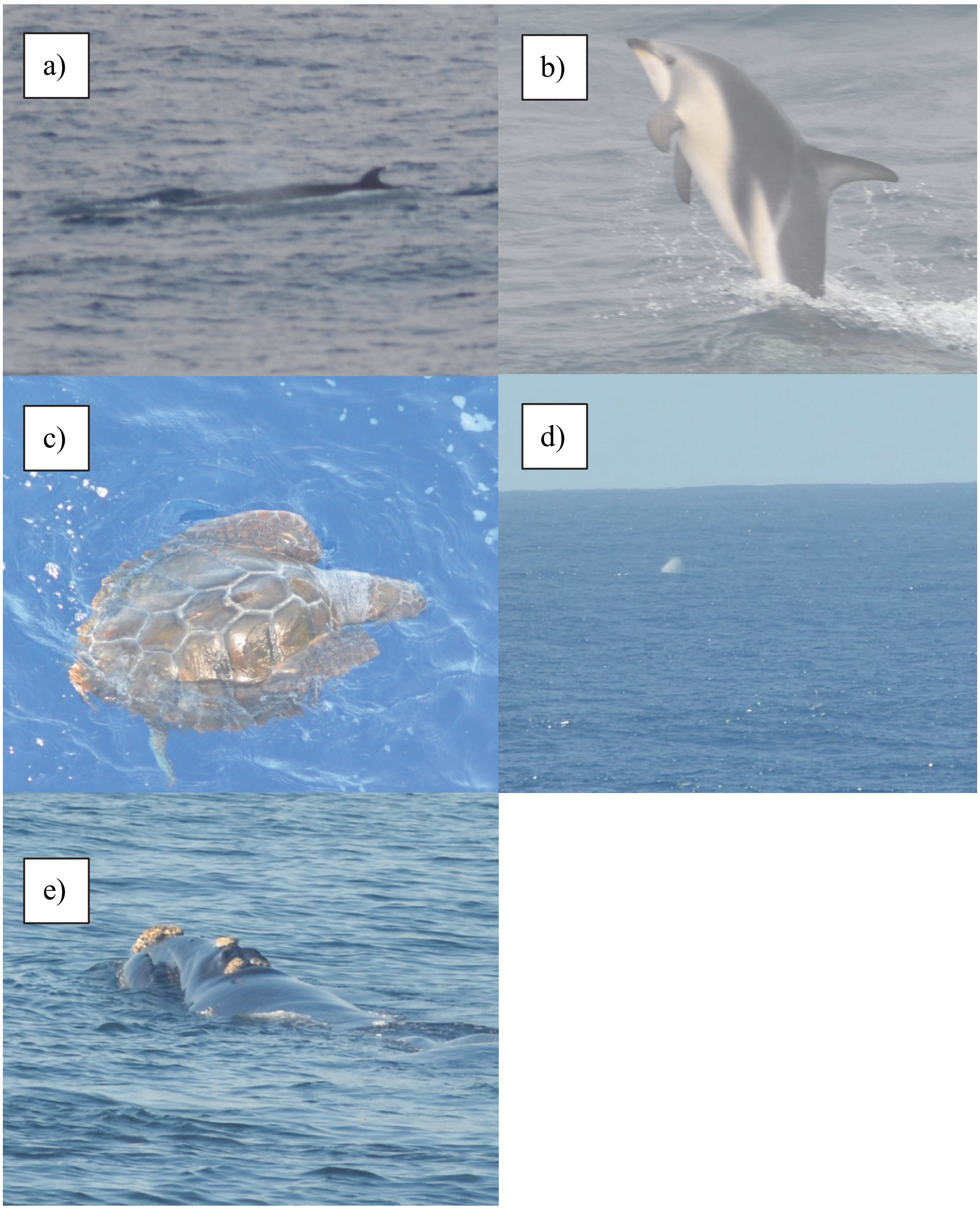


Figure V.1. a) Minke whale, b) Dusky dolphin, c) Hawksbill Turtle, d) Sperm whale and e) Southern-right whale.

The Marine mammals sighted were the Bryde whale (*Balaenoptera edeni*), Dusky Dolphins (*Lagenorhynchus obscurus*), Sperm whale (*Physeter macrocephalus*), Southern-right whale (*Eubalaena australis*) and a Hawksbill turtle (*Eretmochelys imbricata*). With dusky dolphins having the highest number of individuals sighted, and the Bryde whale and the turtle having the least sighting. As shown in the Figure V.2 and V.3 below.

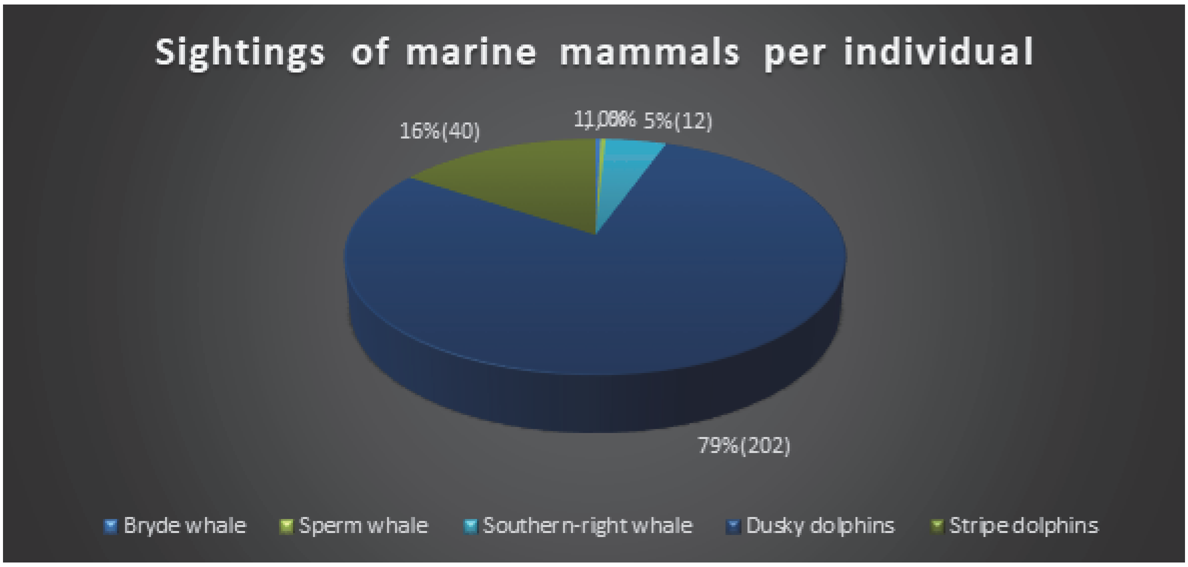


Figure V.2. Sighting of marine mammals.

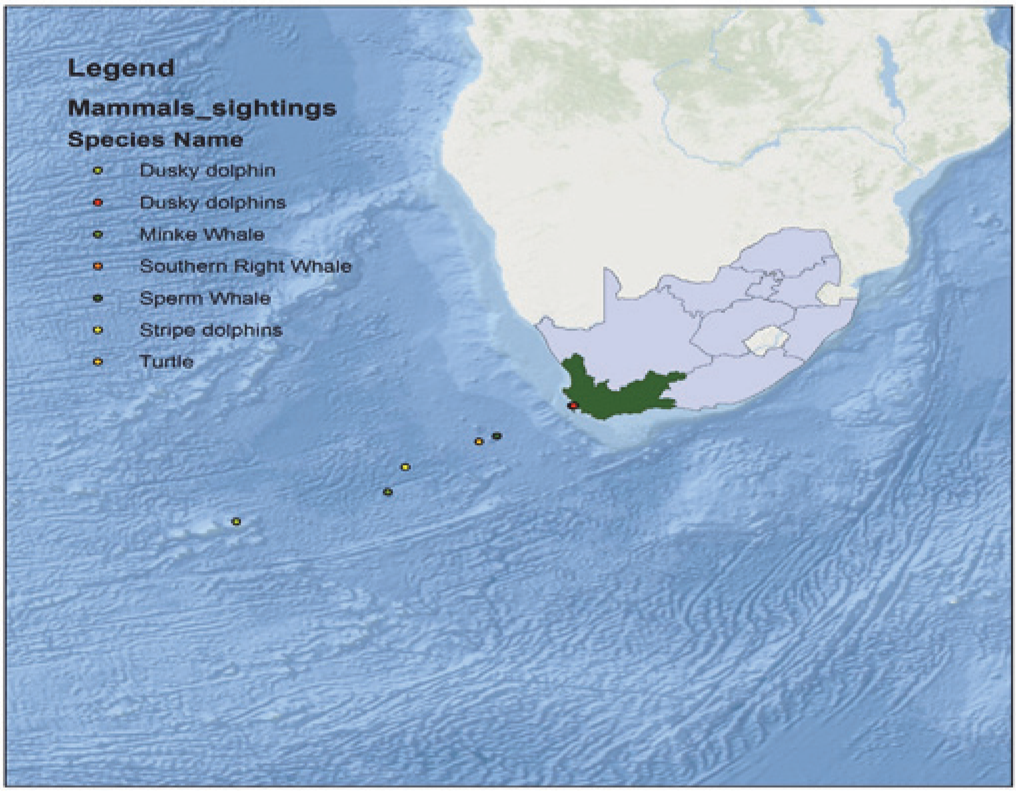


Figure V.3. Map with positions of the mammal sightings.

Sea birds

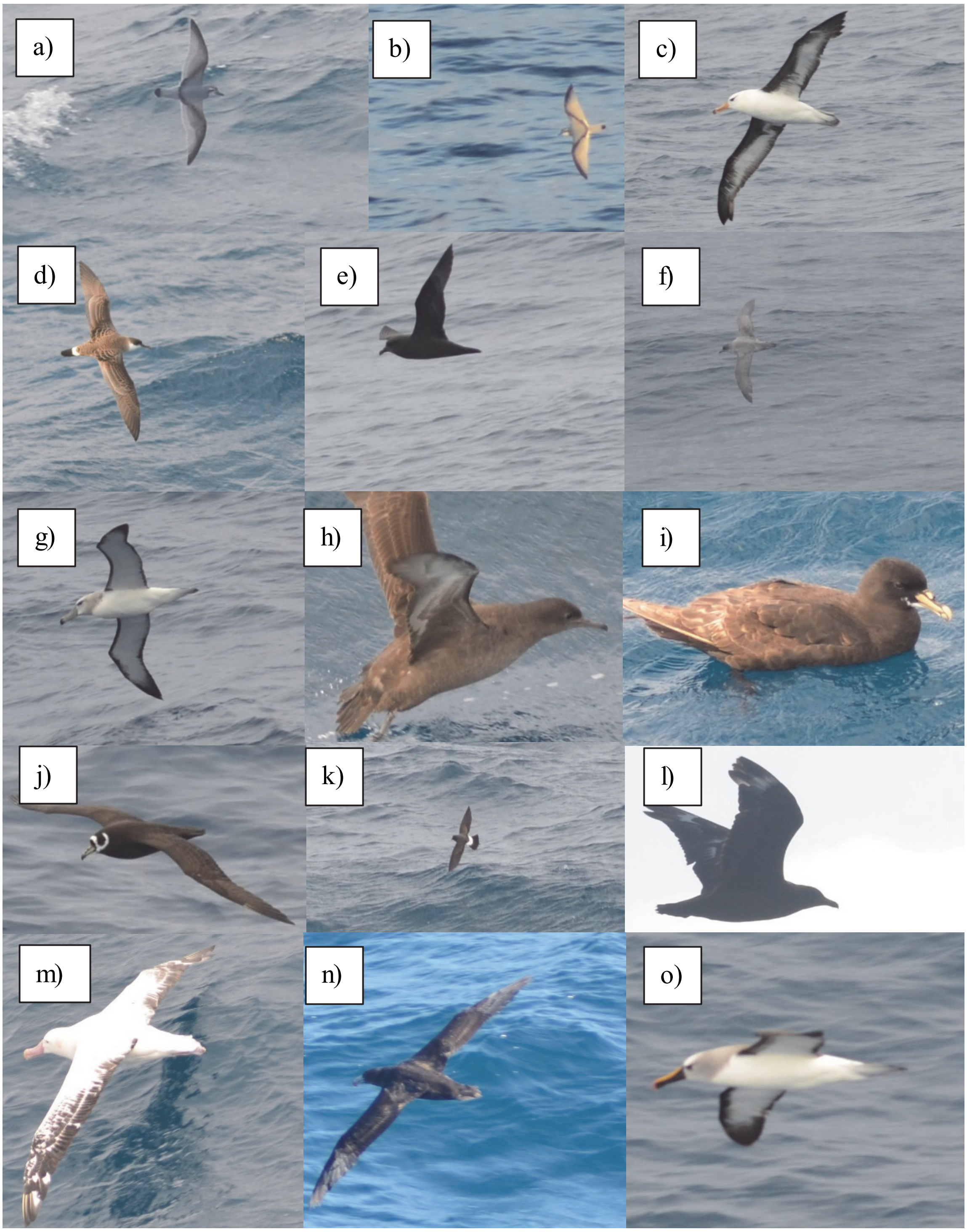


Figure V.4. a) Antarctic Prion, b) Prion, c) Black-browed Albatross, d) Great Shearwater, e) Great-winged Petrel, f) Grey Petrel, g) Shy Albatross, h) Sooty Shearwater, i) Southern giant Petrel, j) Spectacled Petrel, k) Storm Petrel, l) Sub-Antarctic Skua, m) Wandering Albatross, n) White-chinned Petrel, O) Yellow-nosed Albatross.

The Sea birds species sighted are as follows, African Penguin (*Spheniscus demersus*), Antarctic Prion (*Pachyptila desolata*), Arctic Tern (*Sterna Paradisaea*), Black-browed Albatross (*Thalassarche melanophrys*), Cape Gannet (*Morus capensis*), Great Shearwater (*Puffinus gravis*), Great-winged Petrel (*Pterodroma macroptera*), Grey Petrel (*Procellaria cinerea*), Kelp Gull (*Larus dominicanus*), Shy Albatross (*Thalassarche cauta*), Sooty Shearwater (*Puffinus griseus*), Southern giant Petrel (*Macronectes giganteus*), Spectacled Petrel (*Procellaria conspicillata*), Storm Petrel White-bellied (*Fregetta grallaria*), Sub-Antarctic Skua (*Catharacta antarctica*), Wandering Albatross (*Diomedea exulans*), White-chinned Petrel (*Procellaria aequinoctialis*) and Yellow-nosed Albatross (*Thalassarche chlororhynchos*). Rare sightings of African penguins far offshore, with Great Shearwater being the most sighted sea bird and having the Blue & Grey Petrel being the least sighted sea birds. The sighting of the sea birds species per individual are shown in the Figure V.5 below.

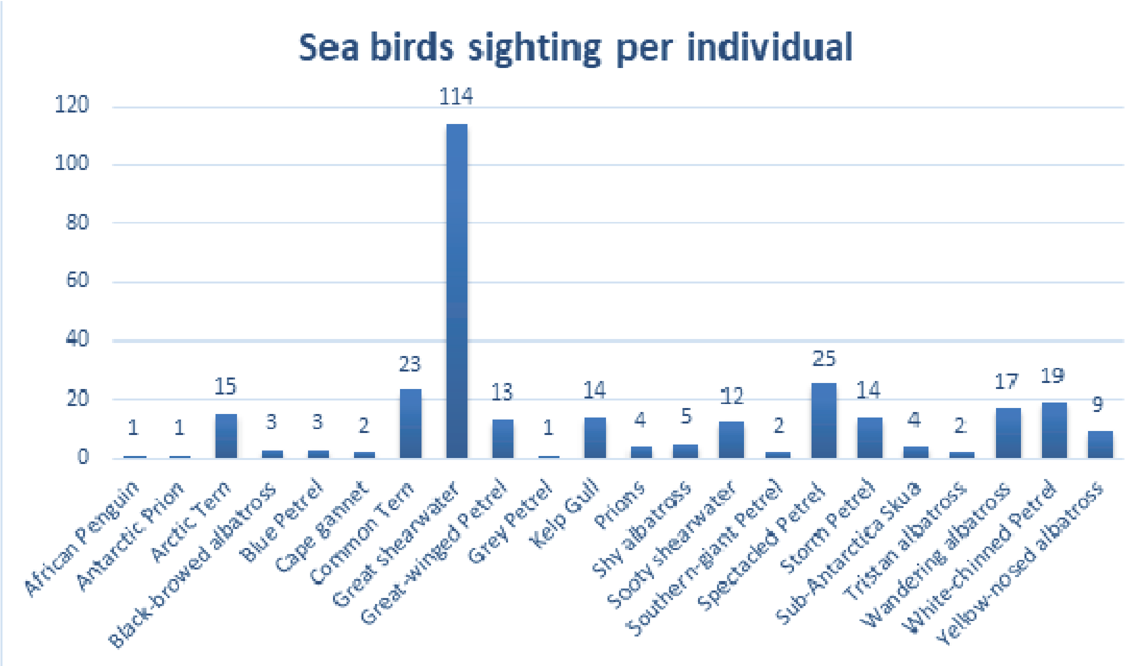


Figure V.5. Sea birds species sighted per individual.

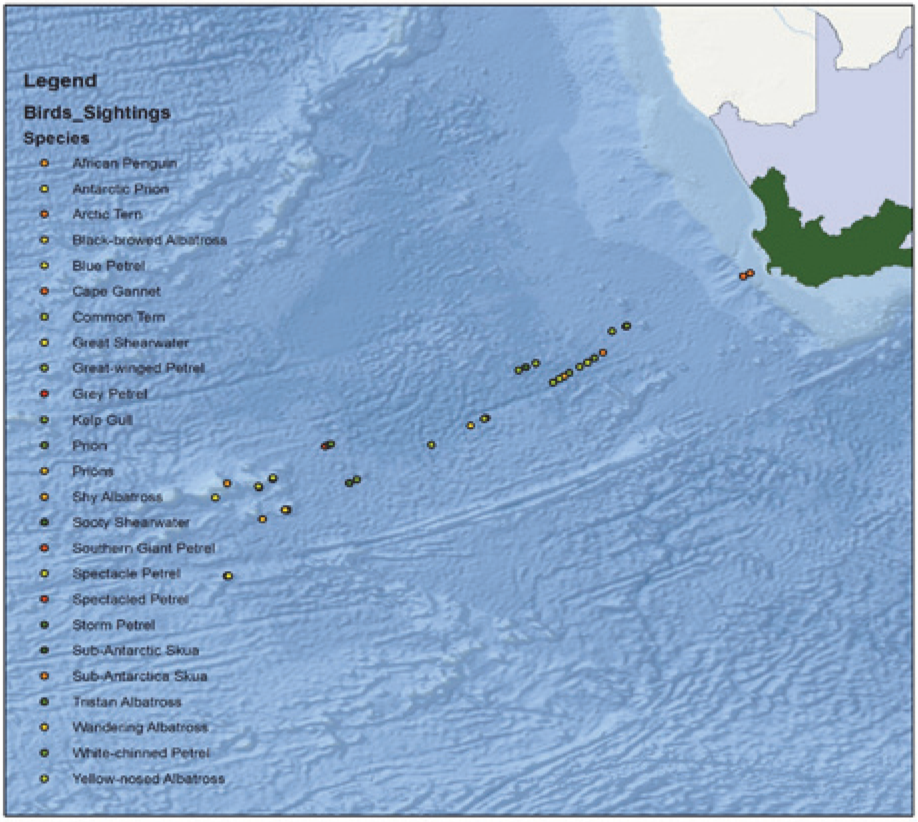


Figure V.6. A map that show the positions which sea birds were sighted.

All results presented here are raw data as collected. No attempt was made to process the data through an analysis software.

<u>Summary of the Survey</u>

There were 6 sightings of marine mammals 15 whales of 3 different species and 242 estimated dolphins with 1 species confirmed and two sightings of dolphins the species were not confirmed, making an overall estimation of 257 individuals of cetacean sighted. There were 306 sea birds sighted of 21 Sea-birds species, and also a turtle was sighted. We also witness unfavourable weather conditions almost the whole duration of the survey, with an average of 19.4 Knots of wind-speed and sea state of 5, which had moderate longer waves, some foam and spray. The sea-surface temperature average was 13.1°C, with an average sightability of 3 (moderate sightability). And lastly, we had an average swell of 2 meters. Although, these weather conditions are not a true reflection of what was experienced, but an average of the weather conditions experienced in the duration of the survey. The opportunistic survey did not turn out the way it was expected, as we were expecting rare and a lot of marine mammal's sightings, but it was the opposite. We suggest that the results of the survey may be due seamounts ecosystem or the time of the year/season that the survey was conducted. Maybe marine mammals do not reside in seamounts due to the nature and structuring of the area, and unavailability of food resources. And lastly, it might be the time of the year that the survey was conducted, the marine mammals might have migrated to other areas.

Recommendations for observation facility improvements

For the observation Nest tower

- Tie-down points above the desk for securing things on the desk,
- Shelving for storage of over equipment (Clip-board, Radio, GPS),
- Screen with trip plan running on it and communication with the bridge to know when CTD, net sampling or trawls are happening, so that we can also record on our effort form,
- A paper-towel dispenser or a sponge to clean windows in the morning before observations start,
- To conduct the survey again in the same transect line but in a different season or different time of a year