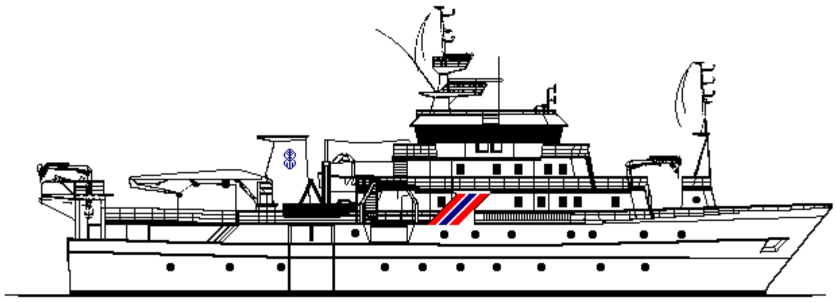
Cruise Report "Dr. Fritjof Nansen"



MARINE ENVIRONMENTAL SURVEY of bottom fauna, selected physical and chemical compounds and fisheries survey in the Joint Development Zone between Nigeria and Saõ Tomé & Principe.

December 2012

By

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Table of Contents

Analysis and reporting 4

Chapter 1 Introduction 6

1.2 Summary 6

1.3 The cruise schedule 10

Chapter 2 MATERIALS AND METHODS 11

2.1 Survey area and sampling design. 11

2.2 Remote sensing observations. 14

2.3 Hydrographic sampling 14

2.4 Sediment sampling and sample treatment 15

2.4.1 Colour, grain size and Total Organic Matter (TOM) 17

2.4.2 Oil Hydrocarbons Analysis 19

2.4.3 Metal Analysis 22

2.4.4 Biological Analyses of the benthic fauna. 24

2.5 Plankton samples 26

Chapter 3 Results 33

3.1 Oceanography 33

3.1.1 The vertical structure of the water column in The JDZ region. 33

3.1.2 The Equatorial Undercurrent 37

3.1.3 Currents 38

3.1.4 Short term variations 39

3.1.5Changes in the T-S structure, 2011-2012. 40

3.1.6 Acoustic backscatter 41

3.1.7 Day- Nighttime distribution of DSL at 18 and 38 kHz 41

3.1.8 A morning migration event xx.12.2012 41

3.1.9 Daytime backscatter around Principe, xx.12.2012 41

3.2 Plankton 41

3.2.1 Chlorophyll concentrations in the Gulf of Guinea during May 2011 41

3.2.2 Zooplankton 44

3.3 Fish 81

Tuna resources in Nigeria and Sao Tome é Principe (Joint Development Authority) 81

Discussion 90

Recommendations 105

3.4 Environmental monitoring 107

3.4.1 Sediment sampling area in JDZ. 107

3.4.2 Sediment characteristics 109

3.4.3 Chemistry JDZ 2012 115

3.4.4 Biology 135

Chapter 4 Appendix 1 157

Chapter 5 Appendix 2 159

Table A10 Sediment samples 203

Chapter 1 Introduction

The area covered by the Joint Development Zone is located in one of the least studied regions of the global oceans. There are virtually no scientifically validated data on plankton
and fish in this region.
In recent years oil exploration activities in cooperation with international oil companies have started in this area. Based on the fact that knowledge about the area is limited and there is need for a control and regulation regime, the Joint Development Authority's (JDA) decided to carry out marine recourses surveys. The Nigeria – São Tomé Joint Development Zone (JDZ) is an area with great expectations regarding both living and non living resources. The concept of development cooperation in the overlapping zone between the two countries is an interesting and progressive approach on resource management in a disputed area with a potential benefit of both countries.
In accordance with the Joint Development Authority's (JDA) intent to carry out marine recourses surveys in this area both the warm and the cold season. The Research Vessel "Dr Fridtjof Nansen" conducted the first survey in the warm season in May 2011. This was followed up by a 25 days survey in the same area in the cold season in December 2012. It was important to collect data from both the warm and the cold season to get a better understanding of the oceanography and the physical conditions which form the basis for primary production, fish migration and spawning. The Surveys showed that the oceanographic conditions of the JDZ were favourable to tuna and the observed large numbers of juveniles could indicate JDZ being a migratory route, a spawning and a feeding ground for tuna and tuna-like fishes.The objective of the surveys was to investigate the living and non living resources in the zone and to provide information about the JDZ in order to manage the recourses in a prosperous manner.
The depths in JDZ vary from 1500-4000 meters. These great depths represent a challenge when a sampling program water column and benthos should be designed. The newly developed "Video-grab", designed for collection of sediment samples, hydrographic measurements and observation with high resolution cameras was successfully used. The biological samples were analysed partly by the University of Łodz in Poland in close cooperation with the Institute for Marine Research in Bergen, Norway ("IMR"). The selected chemical parameters according to the OSPAR- guidelines were analysed by Eurofins, Moss – Norway. The information from the reference stations will serve as an environmental baseline for this area.
Training local participants from Nigeria and Säo Tome has been an important part of the project. A group of 4 experts/administrators from JDZ visited Norway in August for a 2 weeks Fisheries Management Course given by the Institute of Marine Research and the Directorate of Fisheries.
A workshop on Maritime policing – Security and Development of Non Hydrocarbon Resources in Nigeria – Sao Tome And Principe was hold in Saõ Tomé e Principe in May 2014.

Thanks to the financial support from The Norwegian Embassy in Abuja the 2 surveys in the Joint Development zone could be realized. The Embassy has covered 70%of the costs. And The Joint Development Authority has covered 30% of the costs. In addition FAO has made the research vessel Dr. Fridtjof Nansen available at a subsidased rate for both the 2011 and 2012 surveys.

1.2 Summary

The survey of marine resources in the cold season in the Joint Development Zone took place in Descember 2012. This was a follow up of the Cruise in the warm season in the same area in May

2011. The observational program was designed according to the objectives stated in the survey permit issued by the Joint Development Zone Authority (Appendix I). The collected data cover a wide range of ecosystem characteristics ranging from oceanographic conditions via sediments and benthic habitats using the new "Videograb" through plankton and fish composition onto satellite imagery.

The survey region, the Joint Development Zone, is located in the eastern region of the Gulf of Guinea extending approximately between the latitude 1°30' and 3°North. This latitude range plays a special role to the dynamics of the ocean currents because it straddles a boundary between the region of the strictly westward flowing currents near the equator and the region dominated by the circulation and eddies controlled by the earth rotation to the north of 2°N.

With respect to the vertical habitat, the survey effort was concentrated on the two regions: on the upper part of the water column, restricted to the uppermost 500 m and on the seabed of the deep ocean in the depth range of 1531-2655 m.

The investigations in the upper column included satellite altimetry and ocean colour studies, oceanographic measurements, zooplankton and mesopelagic fish monitoring. The results from these investigations are detailed in Chapter 3 and the principal findings are summarized below.

The salinity within the top 200 m displays a significant variability. In the top layer it changes from less than 32 psu on Line 1 to over 33.5 on Line 7. This is to be expected, as Line 1 is in the northeastern corner of the JDZ, which borders the source of fresh water pool in the Bay of Bonny.

The same distribution reveals a presence of the salinity maximum, located in the depth range of 50-70 m. This salinity maximum strengthens towards the west, especially along the southern rim of the survey grid where it exceeds 36 psu. This is an intriguing result as such high salinities are linked to the core of the Equatorial Undercurrent (EUC), whereas the EUC has never been reported to occur in the latitude range of the JDZ.

The dissolved oxygen sections exhibit a similar location of the oxygen minimum zones (OMZ) across Lines 1-7. The OMZ is firmly located at the depth 350 m and has the minimum DO < 1.4 ml l^{-1}. In contrast, in the top layer, the range of the well-oxidized layer (DO > 4.5 ml l^{-1}) is not uniform. The oxycline descends and becomes strongest from the northeast (Line 1) towards the south west (Line 7). This tendency in the oxycline is concomitant with the drop in the fluorescence level within the deep chlorophyll maximum (DCM), observed between Line 1 and 7. This suggests for an increased respiration and decomposition rates in the north-eastern corner of the JDZ. This is in turn is related to secondary production rates and migration and foraging patterns of mesopelagic fish, presumably higher there.

Zooplankton distribution: The highest plankton densities were associated with the Deep Chlorophyll Maximum (DCM), located just below the thermocline. Copepods made up a relatively high proportion of the total catch.

Environmental monitoring

The sediment sampling in 2012 consisted of 10 stations in the Joint Development Zone between Nigeria and Saõ Tomé & Principe.
The investigation included sediment sampling for analysis of grain size, chemical content and benthic fauna. The sampling was executed according to the OSPAR Guidelines for sediment monitoring in offshore oil production areas included necessary changes based on the experiences from the 2011 survey. The guidelines/standards used were developed for and used in relatively shallow waters (< 750m, ISO 16665, 2005) in the north Atlantic mainly and it is not specially adapted to deep water investigations. Kropp (2004) addresses several factors to consider related to environmental monitoring on deep-water habitats.
The ecosystem investigated was a deepwater system in a tropical area which was quite different from what we are used to work with on the Norwegian shelf. These systems are not very well understood because relatively few investigations have been made in deep waters compared to the numerous investigations in shallow waters upon the shelf.
The sampling and conservation of the samples were carried out by scientists from Nigeria, Saõ Tomé, Poland, and South Africa under the supervision of the IMR - Norway:
7 stations were positioned at previous drilling sites while 3 were undisturbed and therefore regarded as reference stations. The reference stations from 2011 and 2012 were used to calculate background levels for the chemical parameters. The results from the biological analysis at the reference stations were used for comparison with the drilling sites. Data collected on the cruise suggested a physically stable environment in terms of hydrological data and grain size distribution.

CTD profiles were deployed at selected sediment sampling stations. The determined parameters included temperature, conductivity and dissolved oxygen. These measurements showed a stable environment in terms of salinity and dissolved oxygen.

Due to the lack of findings in 2011 the samples where not analysed for PCB in 2012. The concentrations of heavy metals were mostly within the low range, with the exception of Barium on Melanza 1X, Oki 1X and Obo 2W. Hydrocarbon levels were low at all stations except for Melanza 1X, Oki 1X and Obo 2W.
The findings from the chemical and biological analysis suggest that the 3 drillsites with elevated levels of contamination should be investigated further to determine the geographical extent of the contamination and the biological impact caused by it.

Benthic Fauna

In general both the abundance and the biomass of macrofauna will decrease with increasing water depth, the biomass more than the number of specimens. This means that the macrofauna in deep waters are generally smaller than that in relatively shallow habitats. (Rex et. al. 2006) Few species and specimens were detected in these deep site stations in 2011. This might have been due to sample treatment, temperature gradients, and patchiness of distribution or unsuited sample equipment. Based on these observations the mesh size of the sieves was reduced to 0.3 millimeter and cold water was available for washing the samples.
The 2011 survey proved useful to uncover the need for adoptions to the standard guidelines in use, and to develop reliable tools and methods for environmental assessment in deepwater habitats based on biological data.
In the summary we stated that:

The deepwater fauna is of a more delicate character than we are used to from shallow waters. The size of the animals and the temperature gradient are two important factors to considerate while sampling. The 2011 survey showed us that the benthic fauna needs to be investigated further and adoptions needed to be made both with regards to sampling equipment and sample treatment onboard. As a consequence of this an RSW plant (refrigerated sea water) as well as new 0,3mm sieves was in place for the 2012 Survey. Altogether, the results from both 2011 and 2012 indicate a benthic environment of good quality and the chemical analysis will be well suited as background material for future comparisons. In some of the drilling locations there are significant footprints from the oil drilling activities. This is seen both chemical and biological analysis, in addition the bacterial mats are seen on top of the drillcuttings deposited on the bottom. The cuttings seem to be distributed in narrow stripes from the well-head and can be followed a few hundred meters from there: The ROV observations from the seafloor gives valuable information about the environmental status and makes it possible to collect samples from both polluted and not polluted areas. It is also be an important tool in the search and investigations for unknown recourses.

Fish composition and distribution:

The purpose of the trawling was to get an overview of the biodiversity of pelagic fish in the area.

The area shows a great variety of small pelagic fish species, more than 150 species were identified, most of them represented in small quantities. During the 2011 survey, 9 observations of tuna shoals were made in the area. One shoal was observed around the vessel feedingon squids and small fishes. In 2012 during the cold season none of the big tuna specis were observed in shoales. However some of the smaller tuna species were observed and caught with fishing rods from our vessel. Larvea and juvenile tuna were caught in the newston net and multi net

The results indicate that the small pelagic recourses found in the area do not form a basis for commercial fisheries.

Fish stocks in open oceans are generally not very dense. This was confirmed by the trial fishing with pelagic trawl done on targets seen on the echo sounder in various depths from surface to about 400 m depth. The abundance was difficult to estimate due to seasonal variations creating westward mowing eddies that effected the distribution of the mesopelagic assemblages.

The total catches were generally small; the largest catch was 131 kg/trawl hour. Jellyfish was often a major part of the smaller catches. Mesopelagic fish was also commonly found.

Knowledge about the area in terms of hydrographical data and water currents will contribute to the comprehension of migrating fish stocks in the area and ease the efforts to make more accurate estimates of the fishing resources. The statistical data for tuna landings for the area are inadequate (ICCAT statistics 2012 Annex 6), but the data available suggests that shoals of Skipjack, Yellowfin and Bigeye migrate through the area. The abundance of fast moving and migratory big tuna species are difficult to estimate, but none of the species mentioned above are listed as overexploited. Based on this test licences should be issued keeping in mind that the management of sustainable fisheries is based on viable statistical data.

Overall the 2012 survey has provided valuable information that will enable us to understand more of the oceanographic, chemical and biological processes in the area. The newly developed Videograb has also provided large amounts of video and still pictures from the benthos including live fish observations in both undisturbed control areas and in the areas were oildrilling has taken place. The “Videograb” is also greatly inproving the sampling of sediments in these deep areas.

Competence building

Competence building was an important part of all the cruise activities and all the cruise participants were practically engaged in collecting benthic samples and analysing fish samples onboard. All the scheduled samples were collected and the planned survey area was covered. (Appendix I and II)

Recommendations

Since it is difficult to estimate the tuna stocks from a survey with the research vessel Dr. Fridtjof Nansen, we recommend a limited test fishery to be started in the area. One or two purse seine vessels equipped for tuna fisheries and with possibility to use floating attractive devices (FAD) should be given license to start test fisheries in this area. If possible it would give even better information if you also could give test license to one or two long line vessels. The vessel needs to have specialists/inspectors onboard to control the catches. It is important to register the amount of different species, to measure length and weight and to take samples of stomach content, collect otolitts for age and growth information. Gonads will give information about maturation and reproductively.

1.3 The cruise schedule

The scientists from Nigeria and Saõ Tome arrived 25th of November and the ship sailed from Tema Harbour to the Joint Development Zone on the 26th of November.
The Ship reached the sampling area in the JDZ on the 28th, Starting the environmental part of the cruise with benthic sampling and CTD stations. We were able to obtain all the planned samples.
On the 6th of Desember we sailed to Saõ Tomé for an official visit and or change of crew. The ship returned to the sampling program on 07th Desember
The sampling program was finished on the 17th after which we started cruising back to Cape Town, South Africa where the equipment and the samples was set ashore.

Cruise participants and the official delegation visiting the Dr Fridtjof Nansen on the first visit to Saõ Tomé.

Chapter 2 MATERIALS AND METHODS

2.1 Survey area and sampling design.

The mapping of marine living resources and their habitats in the Joint Development Zone started with the survey in the warm season in 2011, see survey map I figure 2.1. The mapping continued in 2012 with a survey in the cold season, see survey map in figure 2.2.

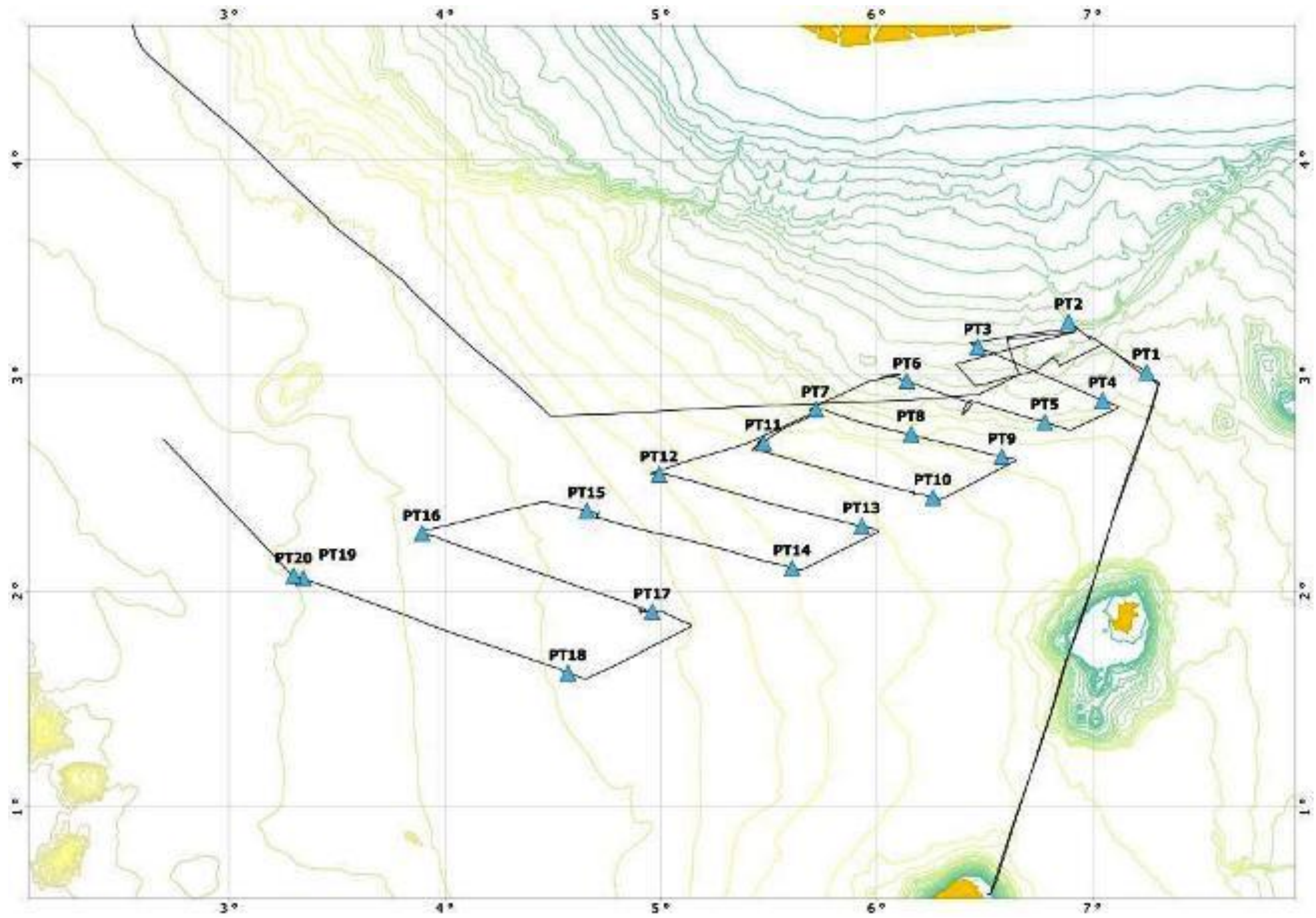


Figure 2.1 Map of sampling route trough the Joint Development Zone from the 2011 survey.

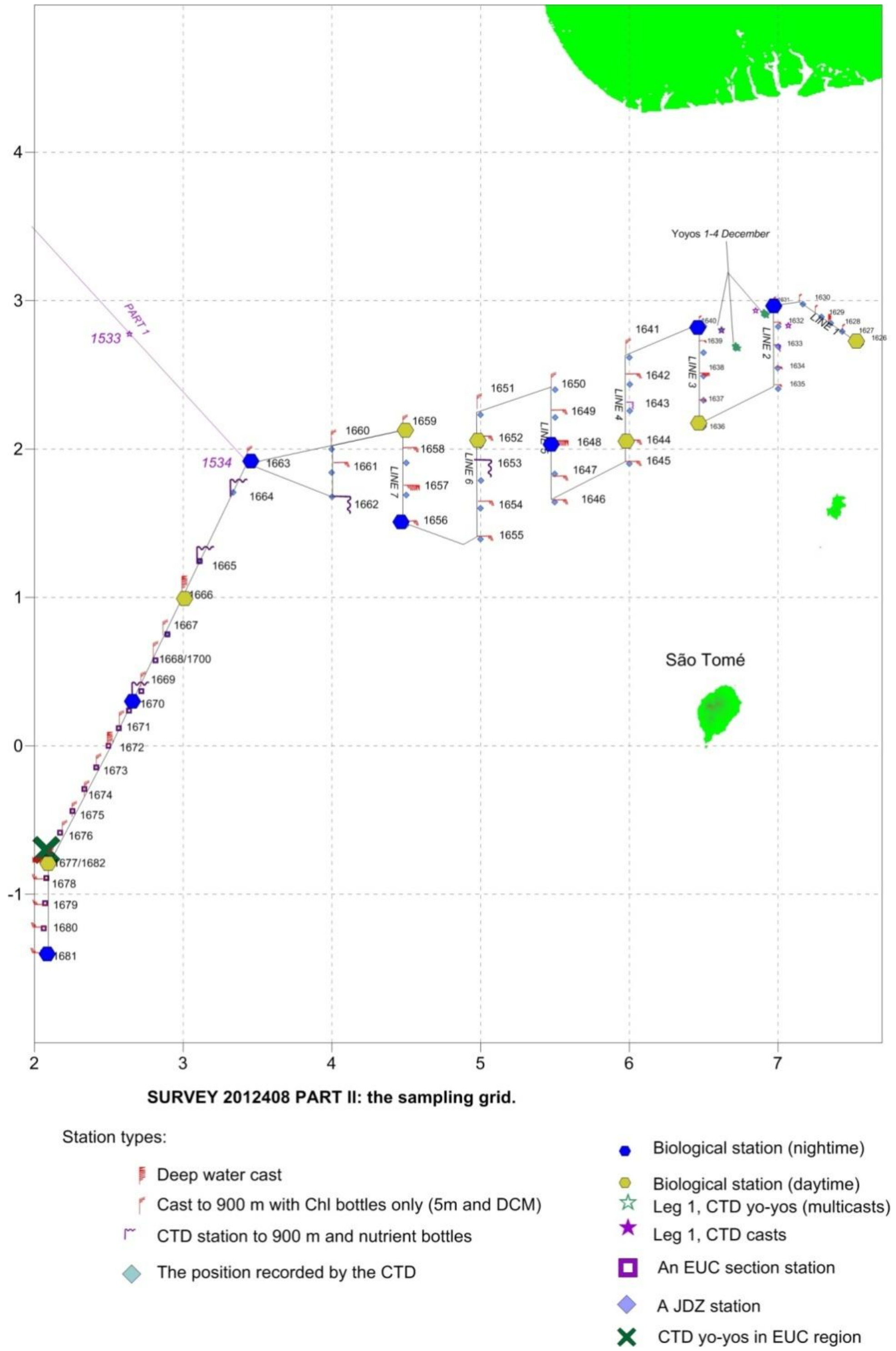


Figure 2.2 Map of sampling route trough the Joint Development Zone from the 2012 survey.

Fisheries.To achieve the goals in point 2, 9 grab sites were sampled in the Joint Development Zone between Nigeria and Saõ Tomé e Principe. The sampling sites consisted of 4 reference sites and 5 stations near previous drilling sites. A $0.1m^2$ Van Veen grab was used for the sampling. A map of sampling stations is presented in Appendix.

The sediment sampling was executed in accordance with the OSPAR guidelines for sediment monitoring in offshore oil production areas.

2.2 Remote sensing observations.

Large-scale circulation features in the survey region from 2011 were detected from satellite altimetry. Two global products were used: merged absolute dynamic topography maps (Madt) and maps of geostrophic currents at the sea surface. The spatial resolution of these maps was 0.33 degree. The data were obtained AVISO (http://www.aviso.oceanobs.com).

Daily satellite maps of chlorophyll distribution were obtained from NASA (http://oceancolor.gsfc.nasa.gov). The Gulf of Guinea was poorly covered on these maps during the survey period because of cloud cover. To improve the spatial coverage, a single composite map was created that included data from all survey days. The spatial resolution on this map was 4 km.

2.3 Hydrographic sampling

CTD profiles were deployed at selected sediment sampling stations. A Seabird 911 CTD Plus was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. The profiles were taken down to a few metres above the sea floor.

The SBE 21 Seacat thermosalinograph was running continuously during the survey, collecting data for salinity and relative temperature at 5 m depth every 10 seconds. An attached in-line Turner Design SCUFA Fluorometer was used to supplement these data with the underway measurements of Chlorophyll-a levels [RFU].

Meteorological data including wind direction and speed, air temperature and sea surface temperature (SST) were automatically logged into the system using a WIMDA meteorological station and averaged by every nautical mile distance sailed.

Current profiles in the water column

The water currents were measured with the vessel-mounted 156 kHz Ocean Surveyor Acoustic Doppler Current Profiler (ADCP), manufactured by the Teledyne RD Instruments, operating in the narrow band mode. The ping rate between individual transmissions was 4 sec on average; the transmissions were triggered externally from the EK60 echo sounder. The currents were measured down to 300 meters with the 8 meter vertical resolution.

The navigational reference data were measured with the SeaPath 2000 system, which combines inertial technology (gyroscopes and accelerometers) with the differential GPS, resulting in precise navigation data at the same sampling rates as the ADCP.

The misalignment angle correction was performed using the standard ADCP calibration procedure (Pollard and Read, 1989). An offset of about 0.8 degree with respect to the value used internally in the instrument's software was found and all data were accordingly corrected.

2.4 Sediment sampling and sample treatment

The sediment samples were collected by scientists from Nigeria and Saõ Tomé & Principe under the supervision of experienced Norwegian scientists that instructed and assisted them with the sampling. The sampling was performed in accordance to the Norwegian guidelines"Aktivitetsforskriften", OSPAR guidelines and International Standards (ISO 5667-19 and ISO 16665).
The positioning of *Dr. Fridtjof Nansen* was done by Differential Global Positioning System (DGPS). The sediment samples were collected using Van Veen grabs with an opening of 0.1 m^2 for bethic fauna. Three grabs vere mounted on the newly developed sampler refferd to as the video grab. Two of these were double chambered grabs. The total volume of the grab was 21 litres for benthic fauna.
Eight grab samples were collected at each grab station. Five samples were used for biological analysis and three were used for chemical analysis.
The volume of each sample was first measured, then samples for biological analysis were sieved through three sieves of 5 mm, 1 mm and a 0,3 mm mesh size, the latter two placed in a water bath. To avoid problems with the temperature gradient cooled seawater was used to wash the samples. The material retained in the sieves were placed in 500-1000 ml plastic containers and fixed with 4% formaldehyde in seawater, borax was added to avoid acidity. Some samples were fixed on ethanol. Each sample was labelled for identification using the station ID, sample no., date etc. and stored on board in transport containers.

Three samples were used for chemical analysis (metals and oil hydrocarbons) and grain size analysis. Chemical samples were taken from 0-1 cm of the samples surface, and the samples for grain size were taken from 0-6 cm separated into three sections 0-2 cm, 2-4 cm and 4-6 cm.
The sediment samples for hydrocarbons analyses were taken with a specially designed metal spatula, to avoid contamination the samples for metal analyses were collected with plastic spoons. The spoons were washed with seawater before and between sampling. The samples for chemical analysis were packed in pre labelled Rilsan plastic bags and immediately frozen to prevent evaporation of labile compounds. The samples were kept frozen for further analysis in the onshore laboratory. Samples for TOM and grain size analyses were taken from the upper 0-5 cm layer of the sediment and put in separate plastic bags, labelled and immediately frozen.

The samples for chemical analyses, were stored onboard in the freezer room onboard Nansen, and later shipped frozen to Norway from the port of Cape Town. These samples were later transported to Eurofins Environmental Laboratory AS located in Moss Norway.

The biological samples were transported from the Port of Cape Town to IMR in Bergen for storage and shipment to the taxonomical lab at the University of Łódź where the species analyses were performed. .

2.4.1 Colour, grain size and Total Organic Matter (TOM)

The colour of the sediment was determined using a revised Munsell® Soil Colour Chart System year 2000 (GretagMacbeth, New Windsor, NY, USA). A mixture consisting of sediment from the upper 0-6 cm divided into three fractions (0-2 cm, 2-4 cm and 4-6 cm) of three separate grab samples was used for the grain size analysis at each sampling site.

The particle size was analysed in the laboratory by dissolving the sediment samples in water and then sieving it through a 0,063 mm sieve. Particles larger than 0,063 mm, was then dry sieved trough Endecott sieves. The sieves had square holes with mesh sizes found in table 2.2. For two of the samples the < 0,063 mm fraction was analysed with pipette analysis. The analysis was performed at SAM Marine.
The median diameter and sorting (Table 2.2) were calculated with the formulas below (Buchanan (1984) and Folk & Ward (1957)), and the program GradiStat version 4.01 (Blott & Pye 2001).

Particle diameter: x = Φ-value ($\Phi=-\log_2 x$)

Median particle diameter: Md Φ = Φ50.

Mean diameter $M_z = \dfrac{\Phi(16)+\Phi(50)+\Phi(84)}{3}$

Sorting: SD $\Phi = \dfrac{\Phi(84)-\Phi(16)}{4} + \dfrac{\Phi(95)-\Phi(5)}{6{,}6}$

Table 2.2. The mesh sizes of the sieves used for grain size analysis.

Size of the sieve (mm)	Phi class Φ	Description
16	-4	Gravel
16-8	-3	Gravel
8-4	-2	Gravel
4-2	-1	Gravel
2-1	0	Sand
1-0,5	1	Sand
0,5-0,25	2	Sand
0,25-0,0125	3	Sand
0,0125-0,063	4	Sand
< 0,063		Pelite

TOM

The total organic matter (TOM) was determined as the weight loss in a 2-3 gram dried sample (dried at 105° C for about 20 hours) after 2 hours of combustion at 480° C.

2.4.2 Oil Hydrocarbons Analysis

- Principle

The petroleum hydrocarbon content was determined by GC/FID analysis of the extracts obtained as outlined in Intergovernmental Oceanographic Commission, Manuals & Guides no 11, UNESCO (1982).

The petroleum hydrocarbons were isolated from the sediment sample by saponification with methanolic potassium hydroxide for two hours, followed by extraction with pentane. The pentane phase is reduced using a Rotavapor and is subsequently purified by solid phase extraction. The petroleum hydrocarbon components were eluted (extracted) from the solid phase column with pentane followed by dichloromethane. The extract was reduced using a heating jacket and analyzed using Gas Chromatography with Flame Ionisation Detection (GC/FID). The analyses of PAHs and Decalines were performed by Gas Chromatography with Mass Selective Detection operating in the Single Ion Monitoring mode (GC/MS SIM).

- Procedure

The sediment sample was homogenized by stirring and subsequently centrifuged at 2300 rpm for 5 minutes to remove excess water. The amount of dry matter in the centrifuged sample was determined by the differencial weight of a small part (about 10 g) of the sample before and after drying at 105°C for 16 hours.

- Soxtec extraction

The saponification was carried out using a Soxtec System equipped with glass cups and cellulose thimbles at 150°C. In order to reduce the background level of hydrocarbons in the blank samples, the empty cellulose thimbles were boiled for 1 hour in methanol prior to its use.

About 20 g of the sample was placed in the cellulose thimble and boiled for 1 hour (in the "boiling position" in 50 ml of a solution of potassium hydroxide in methanol (30 g/L). Before boiling, 1.0 ml of a mixture of internal standards is added to the extraction cups. The thimble was lifted to the "rinsing position" for 1 hour while the refluxing methanol extracted hydrocarbons from the sample. For every 20 samples, reference samples of HDF 200 (base oil in drilling fluid; for THC, olefins and decalines) and HS-4B (Harbour Marine Sediment Reference Material; for PAH and NPD) are extracted, purified and analysed according to this method for monitoring the accuracy of the method.

- Pentane extraction

The methanol extract was collected in a Duran bottle. After cooling, 25 ml of pentane was added and the bottle shaken for 10 minutes. The pentane phase was separated from the methanol phase and collected in a conical flask. Another 25 ml of pentane was added to the methanol, shaken, separated and added to the first pentane phase. The pentane was reduced to 1 ml using a Rotavapor with a water bath at 30°C.

- Solid phase clean up

The final clean up was carried out using 200 mg florisil solid phase columns. The columns were conditioned prior to use. The sample was then added to the column which was eluted with 2x2 ml pentane and 2 ml dichloromethane. The elute was reduced to dryness using a heating jacket at 40°C. The residue was redissolved in 1 ml of dichloromethane and analyzed by GC/FID (THC) and GC/MS-SIM (PAH, NPD).

Quantification of components

- THC

The content of THC was quantified in the nC_{12}-nC_{35} boiling point range by using external and internal standards. The external standard was a solution of n-alkanes in dichloromethane (5 mg/L of each component; Restek # 57257). This external standard was also used to establish the retention time window. The internal standards (bromobenzene, *o*-terphenyl and squalane; all 5 mg/L) were added to the sample before boiling as well as to the external standard. The average THC value from blank samples was subtracted before the final quantification of the THC content of the sample. A chromatogram illustrate the presence of specific compounds within the samples (Figure 2.1) while the analytical conditions of the GC/FID system are presented in Table 2.3.

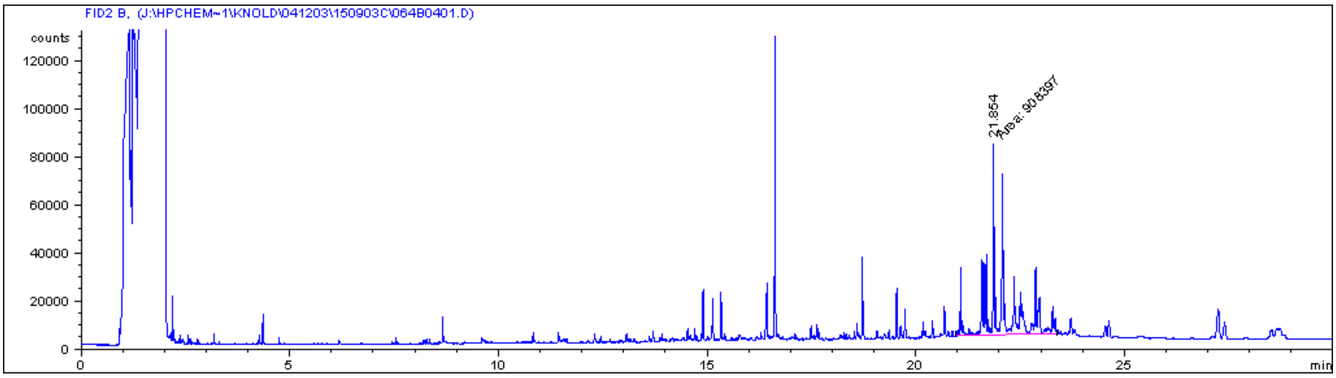


Figure 2.1. Chromatogram showing the subtracted phytosterol fraction of sediment sample.

Table 2.3. GC/FID conditions

GC system	Hewlett-Packard 5890 Series II Gas Chromatograph with split/splitless injector, Flame Ionisation Detector
Column	Agilent DB-5, length: 25 m, ID: 0,2 mm, film: 0,33 µm
Injector temperature	290°C
Detector temperature	300°C
Temperature program	35°C (3 min) - 15°C/min - 315°C (9,5 min)
Carrier gas	H_2, 1,4 ml/min

Injection	1 μL, splitless

- PAH and NPD

The PAHs/NPDs analysis was performed by GC/MS operating in the SIM (single ion monitoring) mode. The analytical conditions of the GC/MS system are shown in Table 2.4.

Table 2.4. GC/MS conditions

GC system	Agilent Technologies 6890N Network GC System
MS	Agilent 5973 Network Mass Selective Detector
Column	Agilent DB-5ms, length: 30 m, ID: 0,25 mm, film: 0,25 μm
Injector temperature	300°C
Temperature program	60°C (2 min) - 12°C/min - 300°C (8 min)
Carrier gas	He, 1,0 ml/min
Injection	1 μl, splitless, purge flow: 40 ml/min in 1 min

The amounts of PAHs and NPDs were quantified using internal deuterium marked standards and calibration curves made from 3 levels of standards containing the 16 EPA PAHs and selected NPDs (Table 2.5). The internal standards were added to the sample before boiling as well as to the external standard. The 16 standard EPA PAHs were obtained in PAH cocktail ampoules from Ehrensdorfer (20952500 PAH Mix 25) and Chemservice (PP-HC6JM). A NPD cocktail containing 1 compound representing each of the NPD clusters was obtained from Chiron (NPD Cocktail 3, S-4046). The NPD compounds in the cocktail were: Dibenzothiophene, 4-methyldibenzothiophene, 2,8-dimethyldibenzothiophene, 2,4,7-trimethyldibenzothiophene, naphthalene, 2-methylnaphthalene, 2,3-dimethylnaphthalene, 2,3,6-trimethylnaphtalene, phenanthrene, 2-methylphenanthrene, 1,6-dimethylphenanthrene and 1,2,8-trimethylphenanthrene. Table 2.3.3 shows target ion, qualifier ion, and the corresponding internal standard for each PAH compound and NPD cluster. Before the final quantification was carried out, the corresponding average concentration of blank samples was subtracted.

Table 2.5 Analyzed PAH compounds and NPD clusters

Compound / cluster	Target ion m/z	Qualifier ion m/z	Corresponding internal standard
Naphthalene	128	102	Naphthalene-d8
C1-naphthalene	142	141	Naphthalene-d8
C2-naphthalene	156	141	Acenaphthylene-d10
Acenaphthylene	152	151	Acenaphthylene-d10
Acenaphthene	153	154	Acenaphthylene-d10
C3-naphthalene	170	155	Acenaphthylene-d10
Flourene	166	165	Acenaphthylene-d10
Dibenzothiophene	139	168	Acenaphthylene-d10
Phenanthrene	178	176	Phenanthrene-d10
Anthracene	178	176	Phenanthrene-d10
C1-dibenzothiophene	198	-	Phenanthrene-d10
C1-phenanthrene	192	191	Phenanthrene-d10
C2-dibenzothiophene	212	-	Phenanthrene-d10
C2-phenanthrene	206	191	Phenanthrene-d10
Fluoranthene	202	101	Fluoranthene-d10
C3-dibenzothiophene	226	-	Fluoranthene-d10
Pyrene	202	101	Pyrene-d10
C3-phenanthrene/antracene	220	-	Pyrene-d10
Benzanthracene	228	114	Pyrene-d10
Chrysene/triphenylene	228	114	Pyrene-d10
Benz[bjk]fluoranthenes	252	250	Benz[a]pyrene-d12
Benz[a]pyrene	252	250	Benz[a]pyrene-d12
Indeno(1,2,3-cd)pyrene	276	274	Benz[a]pyrene-d12
Dibenzo[a,h]anthracene	278	-	Benz[a]pyrene-d12
Benzo(ghi)perylene	276	274	Benzo(ghi)perylene-d12
Internal standards			
Naphthalene-d8	136		
Acenaphthylene-d10	160		
Phenanthrene-d10	188		
Fluoranthene-d10	212		
Pyrene-d10	212		
Benz[a]pyrene-d12	264		
Benzo(ghi)perylene-d12	288		

2.4.3 Metal Analysis

Principle

The metal content is determined by Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES) except mercury which was determined by Cold Vapour Atomic Emission Spectrometry (CVAAS) after drying, sieving and digestion.

Procedure

The sediment samples were dried at 105°C or 40°C for samples containing mercury. The sample was sieved through a 0.5 mm sieve and the fraction <0.5 mm was digested with nitric acid in accordance with NS4770.

Digestion by nitric acid

Digestion was performed in an autoclave. About 1g of sample was weighed into a sterile PP test tube with 4 ml of nitric acid. The samples were then autoclaved at 120°C for 30 min. After digestion, the samples were filtered and diluted to 50 ml.

Metal analysis by ICP-AES

The metals, except mercury, were analysed by a Varian Vista-PRO ICP-AES method. The analytical conditions are found in Table 2.6.

Table 2.6 ICP-AES analytical conditions

Element	Wavelength	Power (kW)	Background correction
Ba	233.527	1.35	Fitted
Cd	228.802	1.35	One point, left
Cr	267.716	1.35	Fitted
Cu	324.754	1.35	Fitted
Pb	220.353	1.35	Fitted
Zn	213.857	1.35	Fitted

Mercury Analysis by CVAAS

Mercury was analyzed using the mercury analyser instrument, Cetac M6000-A. The mercury in the solution was reduced by $SnCl_2$ to its elementary form Hg^0. Elementary mercury is volatile and was separated from the solution in a gas liquid separator by an argon carrier gas. The absorption at 254 nm was measured to determine the concentration of mercury.

Reference materials

CRM015-050 metals on sediment and CRM031-040 metals on soil (Resource Technology Corporation) was use as a reference.

Table 2.7 Detection levels and measurement uncertainties (MU)

Group	Parameter	Method	LOQ (mg/kg)	Mu (%)
metals	Arsene(As)	EN ISO 11885	0,5	20 %
	Lead (Pb)	EN ISO 11885	0,3	20 %
	Copper (Cu)	EN ISO 11885	0,05	20 %
	Chrome(Cr)	EN ISO 11885	0,05	30 %
	Mercury(Hg)	NS 4768	0,001	20 %
	Nikkel (Ni)	EN ISO 11885	0,2	20 %
	Zink (Zn)	EN ISO 11885	0,05	20 %
	Barium (Ba)	EN ISO 11885	0,05	20 %

	Cadmium (Cd)	EN ISO 17294-2	0,01	40 %
PCB's	PCB single elements	ISO/DIS 16703-Mod	0,0005	40 %
	PCB 7 (sum)	ISO/DIS 16703-Mod	0,005 (0,0035*)	40 %
NPD's	NPD E single elements	Annon. 1982 -intern KG.58	0,0005	40 %
	NPD's Sum (10)	Annon. 1982 -intern KG.58	0,01 (0,005*)	40 %
PAH's	PAH single elements (15)	Annon. 1982 -intern KG.58	0,0005	40 %
	PAH 16 EPA (Sum)	Annon. 1982 -intern KG.58	0,01 (0,0075*)	40 %
THC's	THC (C12-C35)	Annon. 1982 -intern KG.58	1	40 %

2.4.4 Biological Analyses of the benthic fauna.

Prior to sorting and species identification, each sample was washed through a 0,3 mm sieve to remove formalin. Specimens were then sorted out under a dissecting microscope, split into taxonomic groups and fixed on small tubes containing ethanol. The specimens were then identified and enumerated before being returned to the fixation fluid.

A complete species list is presented in the appendix. Only the bottom fauna (benthos) was used for further analyses which included:

Total number of species

Total number of specimens standardised to 0.5 m² of sea floor

The ten most abundant species at each site (species name, number of specimens and percent of total number of specimens)

Cumulative species / area graph, for reference sites only (5 samples)

Species diversity as “Shannon Wiener index” on a $\log_2$ base (Shannon & Weaver 1963).

Evenness as Pielous’s “J” (Pielou 1966)

J´ has a value between <0 and 1 where 1 is the point where the specimens are distributed evenly between the species.

Cluster analysis based on “Bray-Curtis dissimilarity index” (Bray & Curtis 1957), followed by “group average sorting” on 4th root transformed data.

Ordination by “multidimensional scaling”

All data was analysed using the data program PRIMER, from Plymouth Marine Laboratory in England.

- Univariate analyses:

The mathematical bases for the diversity indices are outlined by (Shannon & Weaver 1949) It is calculated as follows:

$$H' = -\sum_{i=1}^{R} p_i \log p_i$$

Evenness is an estimate of how the individuals are distributed among the species. It varies between 0 and 1, with a value close to 0 if all individuals belong to one or a couple of species and a value closer to 1 if all the individuals are equally distributed between the species. It is calculated as follows:

$J' = \frac{H'}{H'_{\max}}$ were $H'_{\max}$ is the maximum value of H', equal to:

$$H_{\max} = -\sum_{i=1}^{S} \frac{1}{S} \ln \frac{1}{S} = \ln S.$$

The species-area curve is produced by the program EstimateS from The University of Conneticut. (For more information about the method see Colwell & al 2004).

- Log-normal curve

An indication of the environmental condition is gained by using geometrical classes. Geometrical classes are the relations between the species and the number of individuals. For example, species which are represented by one individual, 2-3 individuals, 4-7 individuals among others are defined as geometrical class I, class II, and class III respectively. Geometrical classes are plotted against number of species for each station. Good environmental conditions are indicated by the presence of many species with few individuals and few species with many individuals. Impoverished environmental conditions are indicated by the presence of only a few species with very many individuals. For further information, see Gray & Mirza (1979) and Pearson & al. 1983.

- Multivariate analyses

Multivariate analyses were done to compare the actual species composition at the sites. Two different types of multivariate analyses where executed, a classification (cluster analysis) and an ordination (non-metric multidimensional scaling). The species abundance data were double square root transformed prior to analysis to reduce the effect of the most abundant species and to include more of the rare species. The calculation was done using the program PRIMER from Plymouth Marine Laboratory in England.

- Cluster analysis: The cluster analysis is a hierarchical agglomerative clustering of stations with the most similar species composition grouped together first at a high similarity level and then grouping the other stations at lower and lower similarity levels together, until all stations are grouped in a single cluster. The comparisons of the fauna at each station were based on Bray-Curtis similarity index (BRAY & CURTIS, 1957), while the linking of the groups is based on group average sorting of the similarity indices.

- Ordination procedure (MDS)

The non-metric multidimensional scaling (MDS) groups the stations with the most similar fauna. This analysis presents the results such that the distance between the stations on the plot reflects the similarity in fauna. Thus the MDS can be used to support the cluster analysis results. More importantly the MDS reveals any existing continuum or gradient in the sampled fauna. The MDS analysis is based on the same similarity matrix as the cluster analysis and the calculation was done using the PRIMER program.

2.5 Plankton samples

OBJECTIVES:

To collect, estimate, grossly identify and preserve samples of the biological productivity in the waters adjacent to the islands of Sao Tome and Principe (see Fig. 1), using Multinet, Multisampler and Methot net rigged as neuston (Figs 2-4);

To link these estimates (as above) to oceanographic and hydroacoustic signals from the area and in that way, provide tentative explanations for this productivity;

To capture juveniles of tuna, preserve them for the genetic IDs, and use the available information from the literature and results of this cruise (as above, to provide background) to delineate regions of high tuna productivity, and if possible, highlight elements of the tuna life cycle(s).

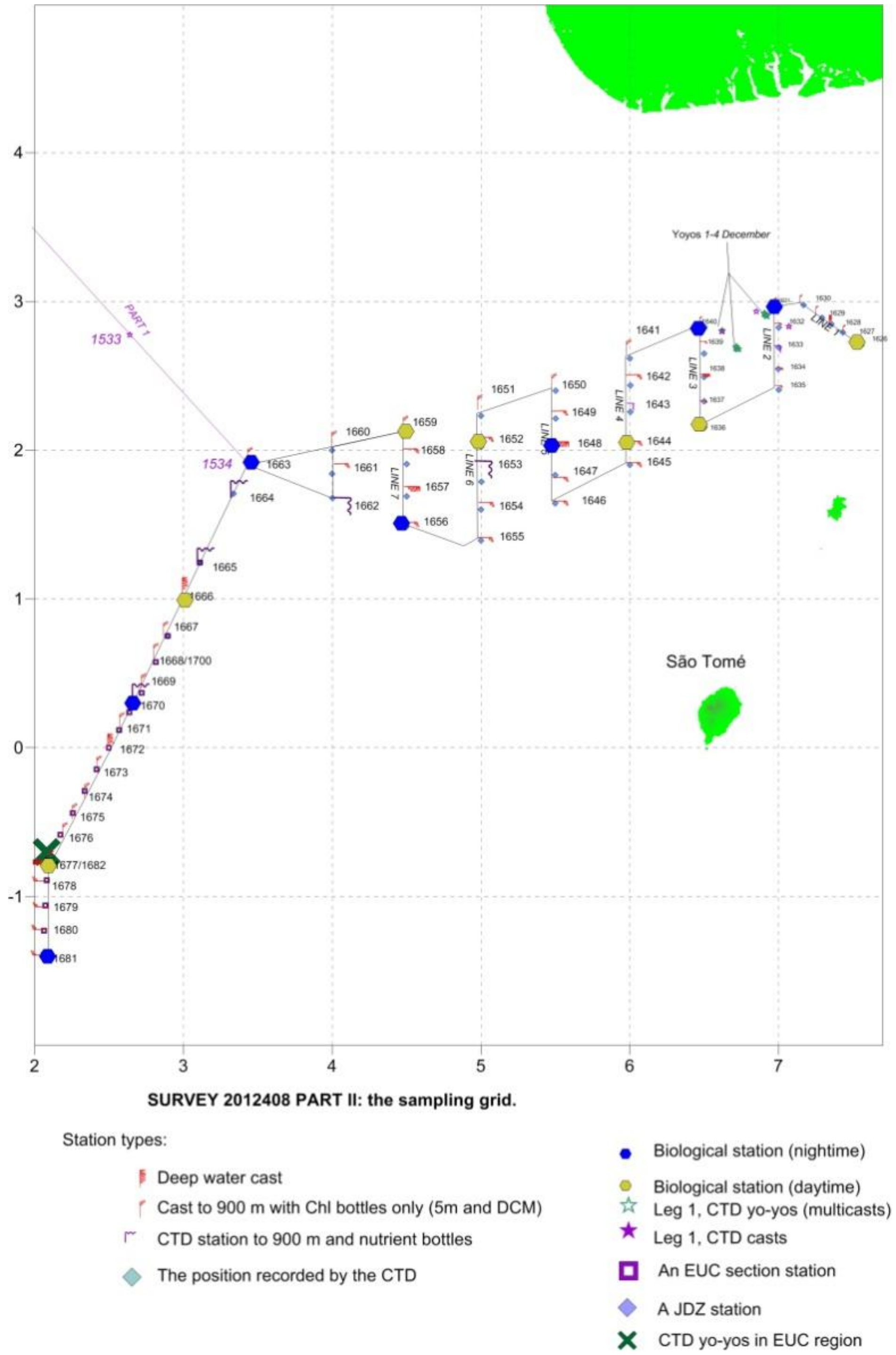


Fig. 1: Region of research and positions of sampling stations.

Fig. 2: Samplers used during the cruise: Multinet (upper left), Multisampler (upper right) and Methot rigged as neuston net.

Fig. 2: Samplers used during the cruise: Multinet (upper left), Multisampler (upper right) and Methot rigged as neuston net.

All objectives as listed above were achieved admirably, mainly due to diligent work of all involved. Work proceeded in shifts 12h each and was labour-intensive, typical station lasting to up 5h.
Summarily, 154 samples were collected (some divided into the sub-sets) on 47 sites and 24 stations, 14 during the second part of the cruise (site is defined here as each sampling position which may be within certain radius from designated CTDO station). Full results have to be processed, particularly to provide full links of oceanography & hydroacoustics with biological results, and also full identification of organisms collected will require an aid of systematic laboratory with required level of knowledge.

The latter will be provided by the Plankton ID and Sorting Centre in Szczecin, Poland, and also by University of Stellenbosch, South Africa (for tuna juveniles).
However, some preliminary biological results can be highlighted here, as follows.

Gear	Stations	samples	Parameters	
CTD	171		Sal, temp, dens, Oxy, Chla. Nutrients.	
Multinet	24	120	Zoo plankton	
Multisampler	9	27	Mesopelagic	
Oter sampler	3	3	Ictoplankton	
Newston net	10	10	Ictoplankton	
Videograb	10	45/ 27	Benthos bio, chemistry	

Table 2.xx Overview of different gears used in this investigation.

Dominating trends in uncorrected, preliminary values of biomass, are represented on Fig. 3. From these preliminary data, the following conclusions can be drawn:
Pelagic environment investigated is dominated by salps, which make up a bulk of catches of all gears used. Their maximum abundance was recorded in the middle of the investigated area (stations 1652 during the day and 1656 during the night). Their abundance may mark a latitudinal division of investigated region into two parts along approximately 5^{o}E. However, this requires much more thorough sampling effort to be confirmed;
Multinet results indicate the gradual decrease of the biomass of the small plankton in the south-westward direction. These changes may be compensated by the change in the catch composition and a turnover rate, as abundance of copepods increases markedly in the same direction. These hints however require more thorough processing of data and their more in-depth interpretation to be confirmed.
Oceanography and hydroacoustic data and their interpretation tie well with biological observations, providing cohesive (but preliminary) picture. These data are presented separately in this report.
Tuna juveniles of similar size are distributed throughout the investigated area. Their mean size was 30-31 mm. They still have to be identified to species. Their maximum number (N=30) was recorded on one station (1682) during the day in depth of 35 m, which indicates the importance of this particular area for future investigations. This result was obtained using Multisampler gear, which then proves to be an effective sampler for this type of studies. Depth of 35 m is unusual, as most tuna-oriented sampling programs use large

neuston nets, hauled near the surface. This finding is also an important element in the planning of next surveys.

Finding tuna juveniles in the relatively large number in the region of eastward warm current, associated with upwelling just south to it, suggests a feeding mechanism into the tuna-rich waters around the Sao Tome and Principe islands.

Zooplankton samples were collected on 24 stations using Multinet (Hydrobios GmbH Kiel, Germany) Samples were collected with the opening was 50*50 cm, with a mesh size of 180 µm. The flow was measured with an internal flow meter and dept was recorded in real time by pressure sensors.

5 depth intervals were sampled on each station: 0-25m, 25-50m, 50-75m, 75-100 and 100-200m. The multinet was deployed and retrieved at a speed of ~ 1.5 m per second and was towed obliquely behind the vessel. The vertical deviation on the wire was kept at less than 30º. The plankton net was flushed each time with seawater to collect plankton from the net itself inside the cup, while the net was still hanging outside the railing. Furthermore, the area above the cup was flushed on deck to secure that the whole plankton sample was properly collected. The cup was detached from the net inside a bucket, to avoid losing part of the plankton sample. The sample from each (multi)net was divided into two half's using a Motoda plankton splitter. This split fraction was preserved with borax-buffered formalin resulting in a final 4% formalin concentration in a 100 ml plastic bottle for later taxonomic analysis on shore

The samples were preserved on eighter 70% ethanol or 4 % formaldehyde pre buffered with borax. The material was analysed for species identification at the national marine fisheries research institute in Szczecin.

The other half of the sample was sequentially sieved through three filters to obtain the plankton biomasses representing the size-fractions >2000 µm (large), 2000-1000 µm (middle), and 1000-180 µm (small). The biomass samples were stored on pre weighed aluminium dishes, and dried at ~70 °C for 24 h. After drying, the samples were stored frozen at -18°C for subsequent weighing of biomass dry weight on shore (after a second time of drying).

Samples for nutrient analyses (nitrate, nitrite, phosphate and silicate) were taken from the Niskin water-bottles on the CTD, representing the depths from the bottom to surface. The water-samples (20 ml, scintillation vials PE) were added 2 ml chloroform and stored dark onboard at 4°C and analysed by the IMR laboratory in Bergen.

For calculation of chlorophyll *a* and phaeopigment concentrations, water-samples (263 ml) were collected from the water-bottles representing the depths above, below and as close as possible to the fluorescence maximum measured by the Mk III Aquatracka fluorometer. The Mk III Aquatracka fluorometer measures *in situ* fluorescence on a relative scale and can be related to the absolute chlorophyll concentrations obtained from the analyses of the samples collected from the water-bottles. The water-samples were filtered on Munktell glass fiber filters (GF/C, 25 mm diameter) using a custom-made filtration system. The filters were then stored dark at -18°C in for subsequent analysis on shore.

2.6 Pelagic trawling

9 trawl hauls made using the pelagic trawl equipped with depth sensors and the multisampler with three nets were taken from from surface to about 400m depth.

Fishing gear

The vessel has three different sized four-panel 'Åkrahamn' pelagic trawls and one 'Gisund super bottom trawl'. The two smallest pelagic trawls were used during the survey. The smallest pelagic trawl has 10-12 m vertical opening under normal operation, whereas the intermediate sized trawl has 15-18 m opening.

Trawling was conducted for species identification only and no restraining rope was therefore used during the survey.

The SCANBAS system was used during all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their distance. The pelagic trawls are equipped with a trawl eye that provides information about the trawl opening and the distance of the footrope to the bottom. A pressure sensor is used to show the depth on the headline.

The sampling stations are listed in annex 4 for the trawl samples and in table 3.3.22.

Innerlinings????

2.7 Hydrographical and Meteorological and sampling

CTD profiles

CTD stations were taken on 171 predefined stations. A Seabird 911 CTD was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC.

Attached to the CTD was also a Chelsea flourometer of the type Mk III Aquatracka. It measures chlorophyll A in micrograms per litre with an uncertainty of 3%. Factory slope and offset was 0.921 and -0.02.

The CTD positions are listed in table nr.4 in the annex.III

Thermosalinograph

The SBE 21 Seacat thermosalinograph was running routinely during the survey, obtaining samples of sea surface salinity and relative temperature and fluorescence (5 m depth) every 10 sec. An attached in-line Turner Design SCUFA Fluorometer was continuously measuring Chlorophyll levels [RFU] at -5m below the sea surface while underway during the entire cruise. The instrument was configured with a bright blue photodiode, a 420 NM Excitation filter and a 680 NM Emission filter. It was calibrated against the secondary orange standard dye. The maximum output was equivalent to 5Volt = 100%. It had a linear temperature compensation of 2.14%/°C.

Meteorological observations
Wind direction and speed, air temperature, global radiation and sea surface temperature (5 m depth) were logged automatically every nautical mile on an Aanderaa meteorological station.

2.8 Quality Control

Eurofins Analyse AS/Ltd is an accredited chemistry laboratory and performed the chemical analysis in accordance with the criteria of Norwegian Accreditation under accreditation- number Test043. The benthic samples were collected under supervision of Tor Ensrud from IMR. The samples were sendt to the Univerity of Lodz in Poland where Polish scientists sorted and determined the taxa/species. Analyses of geological samples were performed by Eurofins AS who is accreditated for this analysis. the geological samples were also subject to quality control according to Eurofins internal routines. Any deviations from the sampling procedures were noted in the sampling journal.

2.9 Storage of samples

The biological samples are currently stored at the University of Lodz in Poland. We would like however to establish routines for conservation and storage of this material for the future, and to build a reference collection for scientific and educational purposes.

Chapter 3 Results

3.1 Oceanography

3.1.1 The vertical structure of the water column in The JDZ region.

A sampling grid consisting of eight parallel latitudinal hydrographic lines was occupied to cover the JDZ. Each line had its end-point stations located at the northern and southern JDZ boundaries. The number of station per line varied from 3 to 5. The lines were worked up from the east towards the west (Figure 1?). The total time spent to cover this survey grid was 9 days, yielding a quasi-synoptic snapshot of the oceanographic variability.

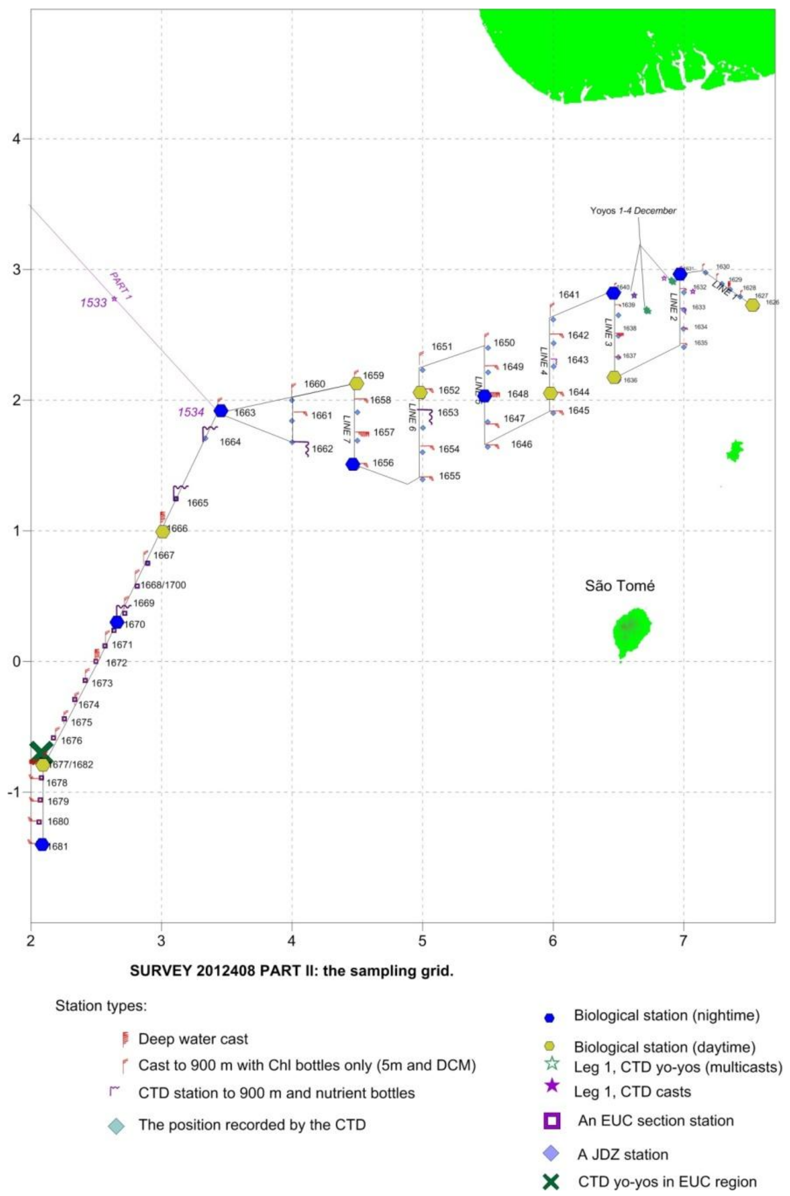


Figure 0-1 The survey grid over the JDZ and EUC region in December 2012

In this section, we focus on the results from the first seven lines - those that consisted 4 or 5 sampling stations between their north and end points. Figure 0-2 to 0-5, depict the resulting distributions. To capture spatial patterns, you are advised to view these figures in connection with the survey map (Figure 0-1).

The results from the seven hydrographic lines always in the same sequence: beginning with the easternmost Line 1, shown in the far left panel; through Lines 2 to 6 shown towards the right in the same order as they were collected; towards the westernmost Line 7, depicted in the far right panel. The direction of the continuous distributions shown within a panel is north-south.

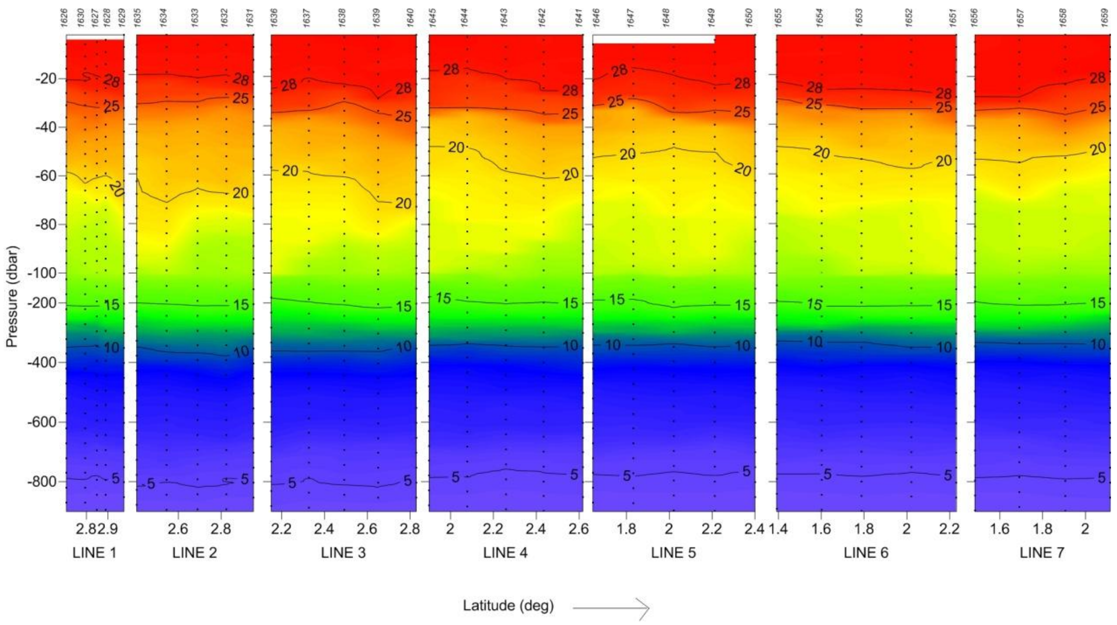


Figure 0-2 Distribution of temperature across the seven hydrographic lines occupied in the JDZ in December 2012. The bottom axis describes latitude along each line; the top axis depicts the station numbers (see Figure 0-1for the geo-reference); the left axis is pressure in decibars. Note that that the vertical depth scale is broken at 300 m into the surface and midwater regions, shown using a separate depth spacing.

The temperature distribution (Figure 0-2) exhibits a uniform thermal structure across the JDZ. The top 20 m layer is dominated by Tropical Water, characterized by temperature greater then 28°C across all hydrographic lines. The temperature drops below 25°C in the depth range between 25 and 30 m, marking the location of the main thermocline. Below this thermocline, temperature decreases monotonically down to 800 meters.

In contrast, salinity within the top 200 m displays a significant variability, (Figure 0-3). In the top layer it changes from less then 32 psu on Line 1 to over 33.5 on Line 7. This is to be expected, as Line 1 is in the northeastern corner of the JDZ, which borders the source of fresh water pool in the Bay of Bonny.

The same distribution reveals a presence of the salinity maximum, located in the depth range of 50-70 m. This salinity maximum strengthens towards the west, especially along the southern rim of the survey grid where it exceeds 36 psu. This is an intriguing result as such high salinities are linked to the core of the Equatorial Undercurrent (EUC), whereas the EUC has never been reported to occur in the latitude range of the JDZ.

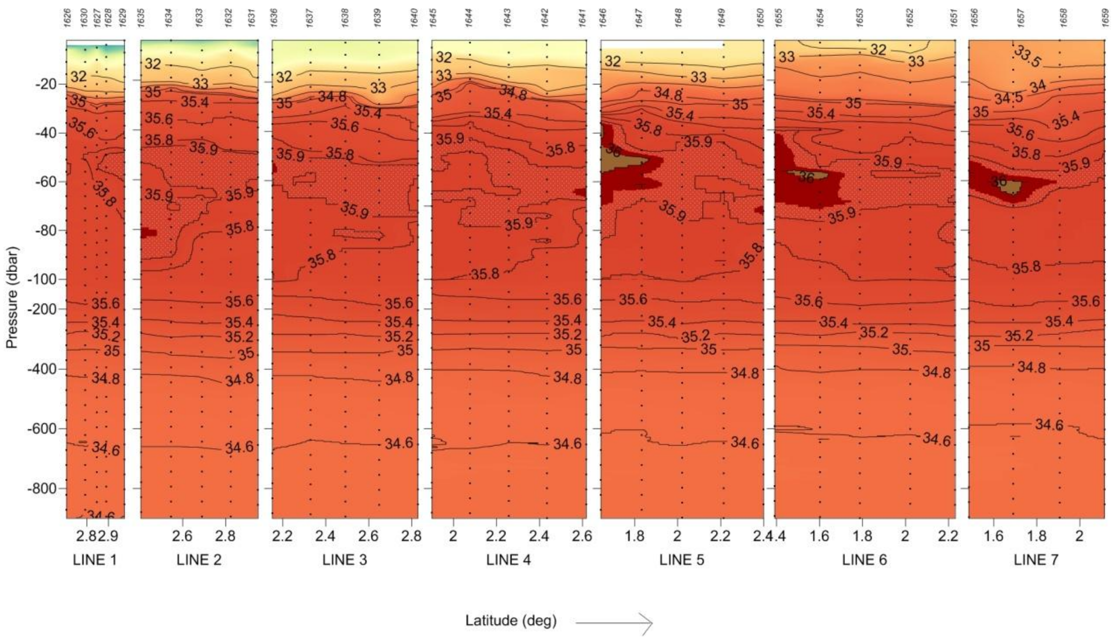


Figure 0-3: Distribution of salinity across the seven hydrographic lines occupied in the JDZ in December 2012. Salinity uses practical salinity units. See Figure 0-2 for more description.

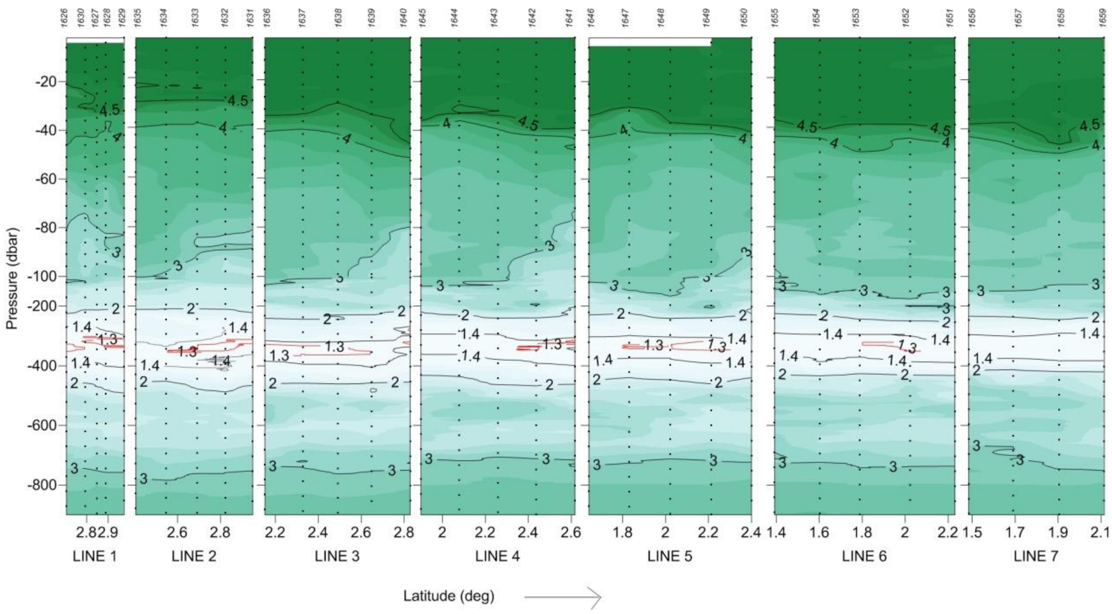


Figure 0-4 Distribution of dissolved ocygen across the seven hydrographic lines occupied in the JDZ in December 2012. DO given in ml l^{-1}. See Figure 0-2 for more description.

Sadly, the question whether the high salinity we observed within the JDZ derives from the EUC cannot be fully resolved with our data, as are missing such a station coverage immediately south of the JDZ. Despite of the time availability, it was not possible to include such stations, as the vessel had no license to extend the survey grid beyond the JDZ, into the EEZ of Saõ Tome. The only survey grid that we could examine was located on the international waters, to the west of JDZ (Figure 0-1).

Those data yield an interesting result of its own (see the next section), bout did provide data to resolve the discussed question.

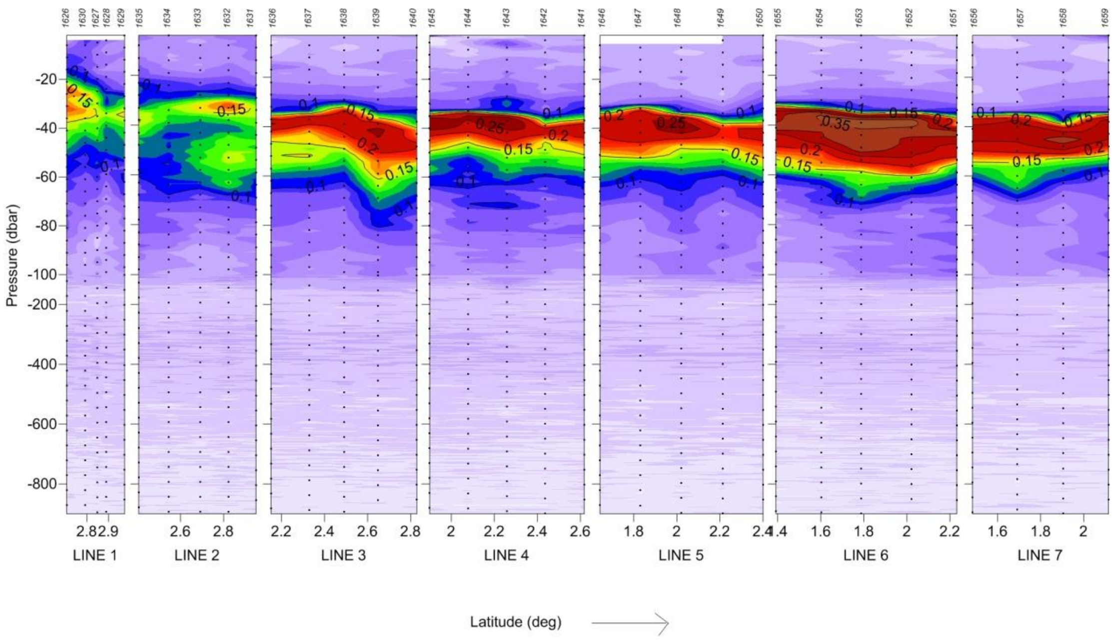


Figure 0-5 Distribution of fluorescence across the seven hydrographic lines occupied in the JDZ in December 2012. Fluorescence in relative units. See Figure 0-2 for more description.

The dissolved oxygen sections (Figure 2c) exhibit a similar location of the oxygen minimum zones (OMZ) across Lines 1-7. The OMZ is firmly located at the depth 350 m and has the minimum DO < 1.4 ml l^{-1}. In contrast, in the top layer, the range of the well-oxidized layer (DO > 4.5 ml l^{-1}) is not uniform. The oxycline descends and becomes strongest from the northeast (Line 1) towards the south west (Line 7). This tendency in the oxycline is concomitant with the drop in the fluorescence level within the deep chlorophyll maximum (DCM), observed between Line 1 and 7 (Figure 2d). This suggests for an increased respiration and decomposition rates in the north-eastern corner of the JDZ. This is in turn is related to secondary production rates and migration and foraging patterns of mesopelagic fish, presumably higher there.

3.1.2 The Equatorial Undercurrent

The crossing of the equatorial region occurred west of the Saõ Tome and Ambon EEZs. (Figure 0-1). Figure 1.1 depicts the resulting cross-section of temperature and salinity. Both section indicate for a systematic uplift of the pycnocline from the north to south across the equator. The location of the Equatorial Undercurrent (EUC) is clearly manifested by the salinity core, S > 36 psu, in the depth range of 50-60 m. The core is clearly shifted towards the southern hemisphere. To the north of the equator, it extends to about 0°40’N - clearly outside of the southern extent of the JDZ. However, the observation reported here was made to the west of the JDC. In the context of the collected data, it cannot be excluded a scenario, in which the EUC as it heads further east, retroflects on approach to Saõ Tome, and part of its high salinity core, perhaps trapped by an eddy, reappears within the JDZ, as observed in Figure 0-3.

This full understanding of the connection between the EUC and JDZ, however, requires further studies, as indicated in the preceding section, using a survey grid that extends from the JDZ region down to the equator.

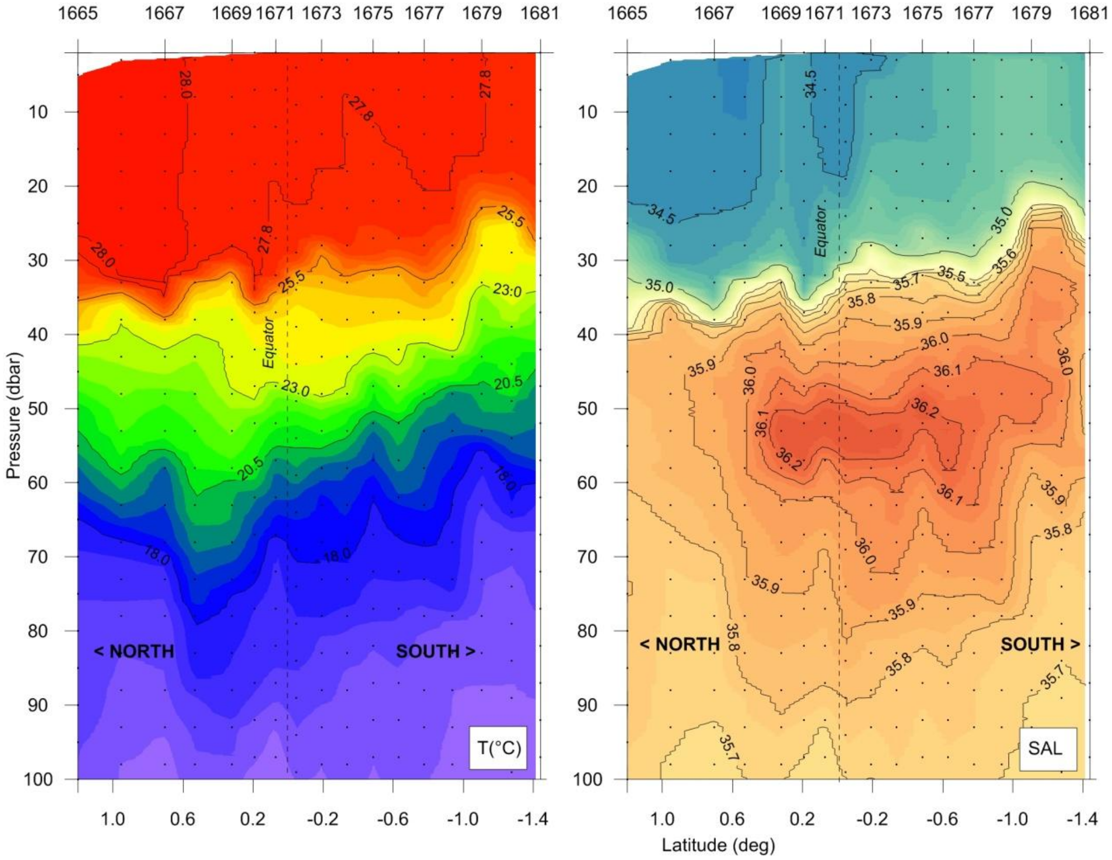


Figure 1.1 Temperature and salinity cross-sections across the equator , stas. 1665-1861. The bottom axis describes latitude; the negative latitude values denote the southern hemisphere.

3.1.3 Currents

The RV Dr. Fridtjof Nansen is equipped with a150 kHz Ocean Surveyor Acoustic Current Profiler to measure continuous current profiles underway. That unit was not operational during the survey because the transducer was damaged. Notwithstanding we recorded data using that dysfunctional unit and were able to extract from it some still valid data. In particular, the currents between 40-60 meters appeared to be of an acceptable quality. Figure 1.2 depicts their distribution. The strongest currents are associated with the EUC core, which flows just south of the equator. In the same depth range, the current over the JDZ is significantly slower (10-15 cm vs. 70cm). The figure also suggests, that the subsurface current bifurcates within the JDZ with one branch turning westward and the other eastward. Unlike in May 2011, the strong current in the Principe-Saõ Tome Channel was not observed in December 2012.

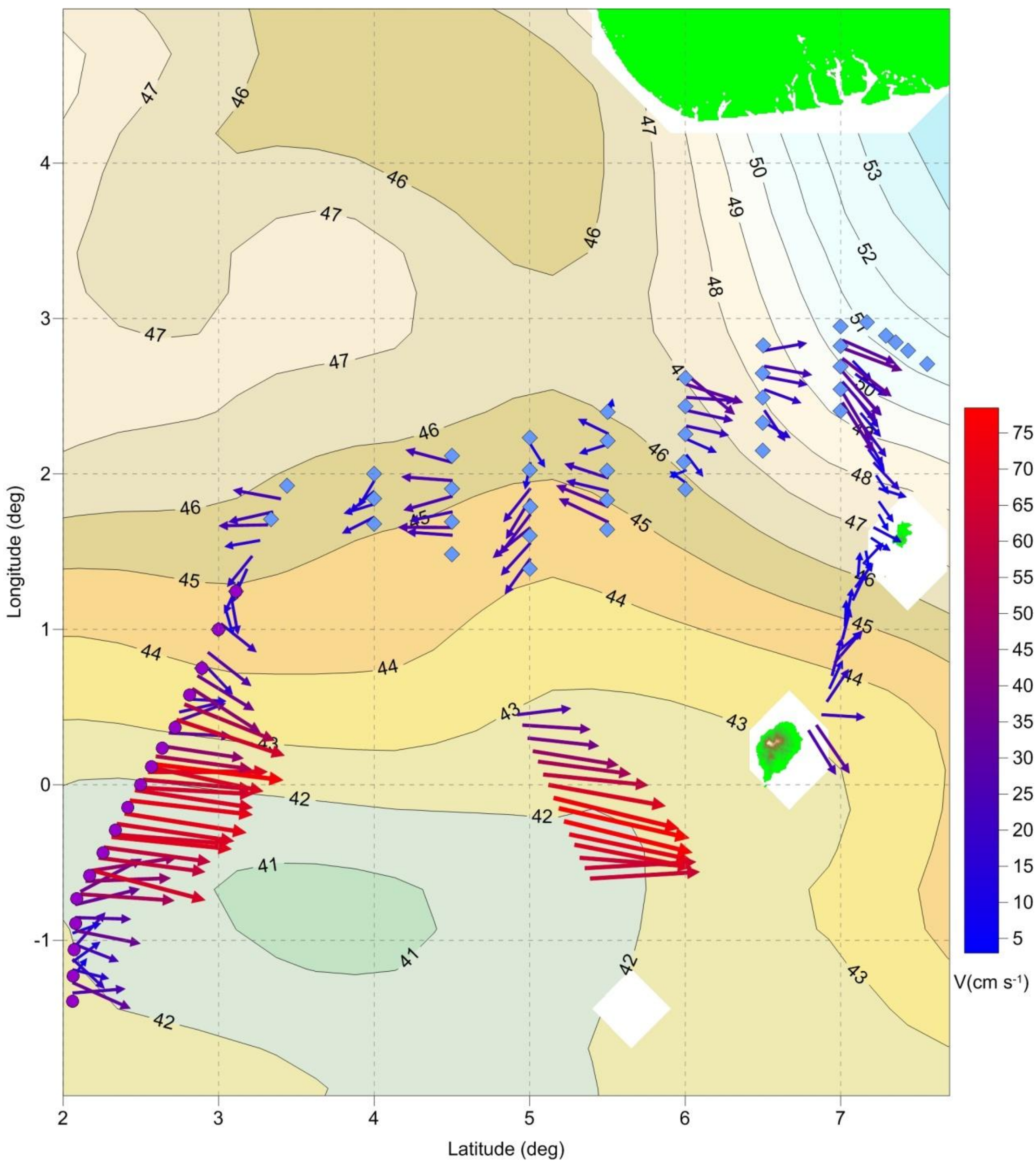


Figure 1.2 Distribution of current at depth 48-56 m recorded by the vessel-mounted ADCP on the RV Dr. Fridtjof Nansen in November-December 2012. The size of the vectors proportional to the velocity. Additionally, the vectors are color coded; the color scale is shown to the left. Distribution of sea surface height during the firs of December shown in the background.

3.1.4 Short term variations

Benthic studies and video-grab dives were preformed at pre-planned geographical locations and during daytime. That has left some idle ship time during nighttime, which could be used for special studies. We used this time to preform multiple CTD casts in order to resolve the short time variability. The result was rather surprising. All four experiments preformed between December 1 and 4th, indicated for an existence of a depth-synchronous (barotropic) change across the water column. Figure 1.3 demonstrates the result from the experiment preformed on December 2-nd between 1 and 7 hours UCT. The anomalies were computed by subtracting individual CTD casts from the mean profile for the entire experiment period. The temperature anomalies (top left) exhibit a cooling phase of a fluctuation from a warm to a cold state with a period of approximately 6 hours. This suggest for a full 12 hour-cycle of the fluctuations, thus related to a semi-diurnal tide. The particularly strong fluctuations are observed in the thermocline region where peak-to-peak difference exceeds 2°C. The similar half-cycle of the semi-diurnal fluctuation is observed on the salinity (top-right) and density (bottom-left) distributions, although below the top layer these fluctuations have very low-amplitudes. However, on the dissolved oxygen distribution (bottom-left), some depth layers are clearly excluded from the semi-diurnal fluctuations. The cause of this requires a further study. One explanation is that the DO levels are mediated by the respiration of mesopelagic biota and therefore does not strictly follow the semi-diurnal physical cycle of fluctuations.

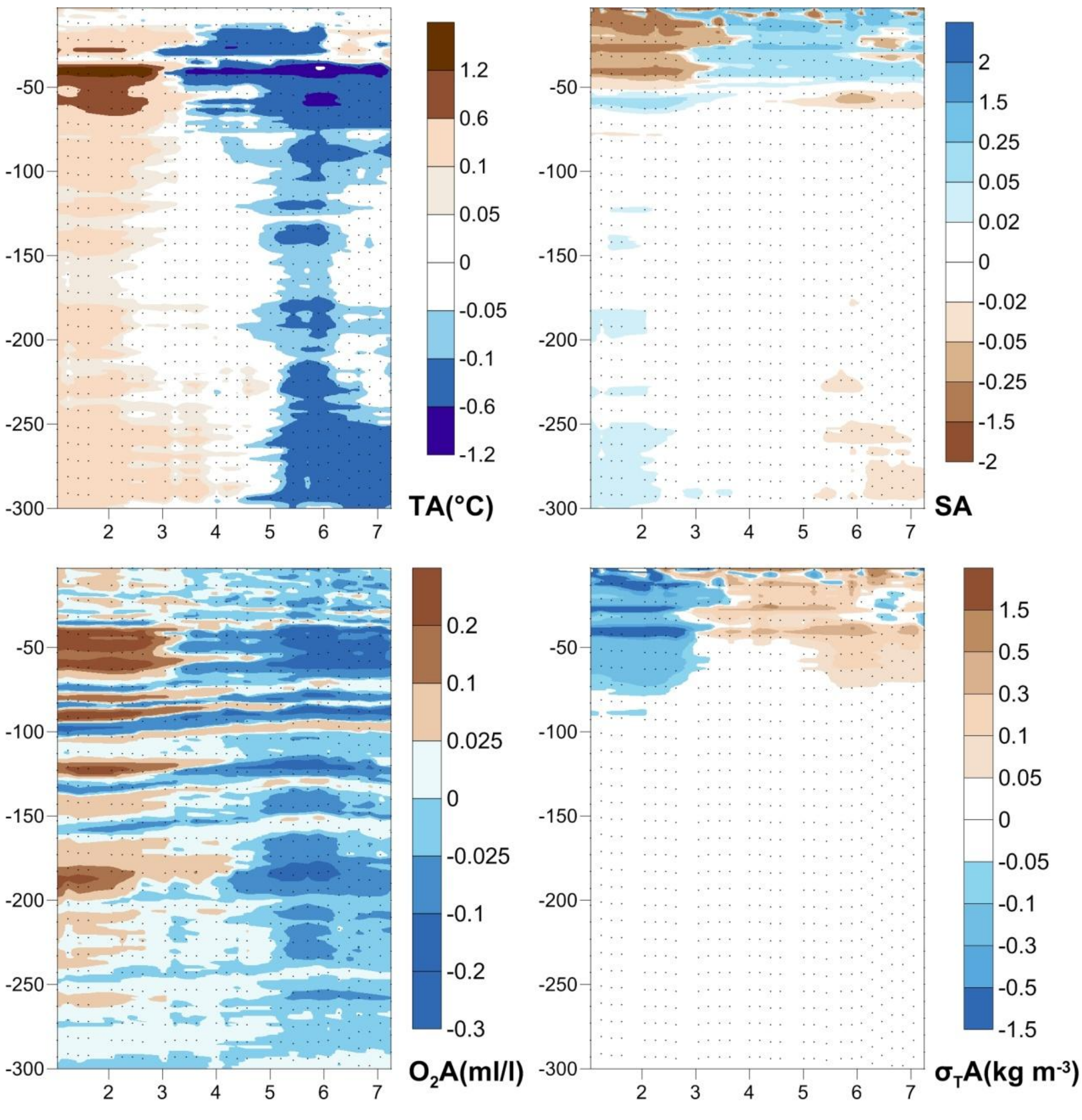
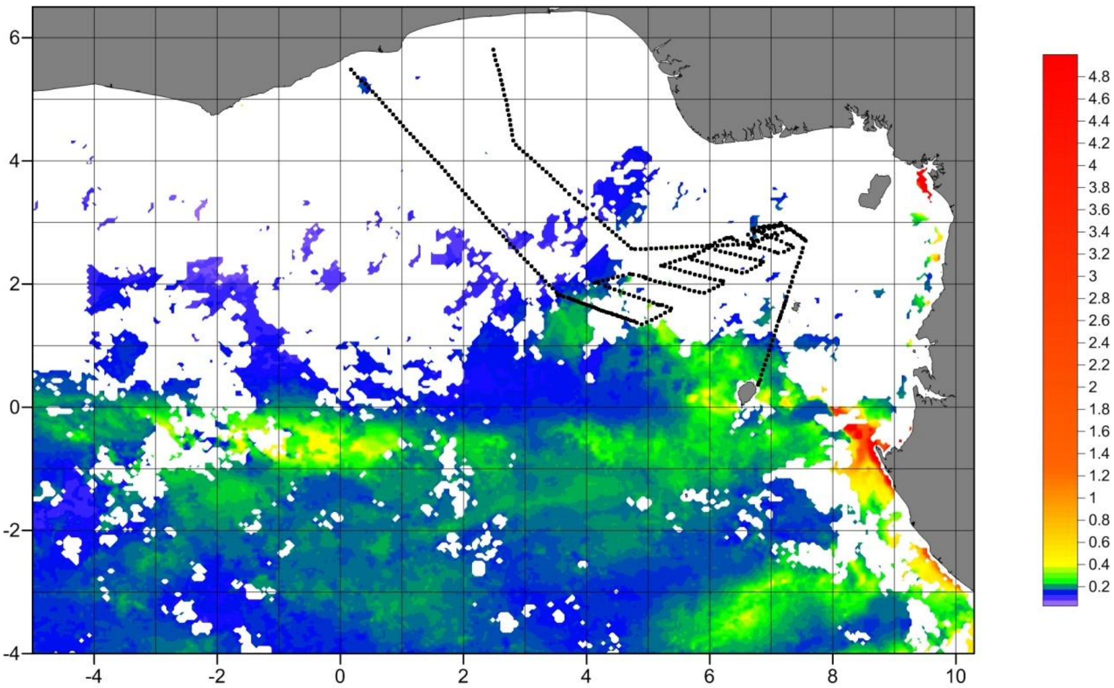


Figure 1.3. Anomalies of temperature (top-left), salinity (top-right) dissolved oxygen (bottom-left) and potential density (bottom-right) from multiple CTD casts preformed on December 2-nd from midnight to 7 a.m. at the location marked in Figure 0-1 as "yoyos 2-4 dec". The color scales shown to the left of each figure. The time in hours shown along the bottom axes.

3.1.5Changes in the T-S structure, 2011-2012.



To be finished soon

3.1.6 Acoustic backscatter

3.1.7 Day- Nighttime distribution of DSL at 18 and 38 kHz

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3.1.8 A morning migration event xx.12.2012

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3.1.9 Daytime backscatter around Principe, xx.12.2012

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3.2 Plankton

3.2.1 Chlorophyll concentrations in the Gulf of Guinea during May 2011

Figure 3.1.10 shows the Chlorophyll *a* map over the Gulf of Guinea, which was made by merging all cloud-free daily images available during the survey period. The is principally no valid data to the north of the equator, and this may be attributed to the permanently cloudy conditions associated with the seasonal position of the Intertropical Convergence Zone (ITCZ) over the tropics. According to the existing data, the highest chlorophyll concentrations (Chl a> 2 mg m^{-3}) are near the coast of Africa. The continuous band of high pigment concentration seen along the coast of Gabon (0°-2°S) is apparently associated to coastal upwelling. The isolated spot of high pigment concentration off Duala Bay, Cameroon, may be attributed high nutrient loads from river runoff in the Bight of Bonny. The observed spot was likely to be much larger in nature, but because of the cloud cover only a portion of it is visible on the map.

Figure 3.1.10 Composite map of the chlorophyll (mg Chl m^{-3}); distribution between May 9 and 31 2011. The map composed from the daily 4 km chlorophyll maps provided the MODIS Aqua mission (http://oceancolor.gsfc.nasa.gov/). The chlorophyll concentrations according to the color scale to the right of the figure. Regions with no data are white. The dotted lines denote the survey tracks of Dr. Fridtjof Nansen in May 2011.

The chlorophyll concentrations in the open basin of the Gulf are notably lower from the coastal region. The band of comparatively high Chl *a* concentrations (0.2-0.4 mg Chl m^{-3}) is nevertheless observed just south of the equator. This band may be associated to effects of the EUC and equatorial upwelling. Figure 3.1.10 indicates that in the vicinity of São Tome this band expands to the northern hemisphere. This is consistent with our observations indicating the presence of the EUC to the north off São Tome.

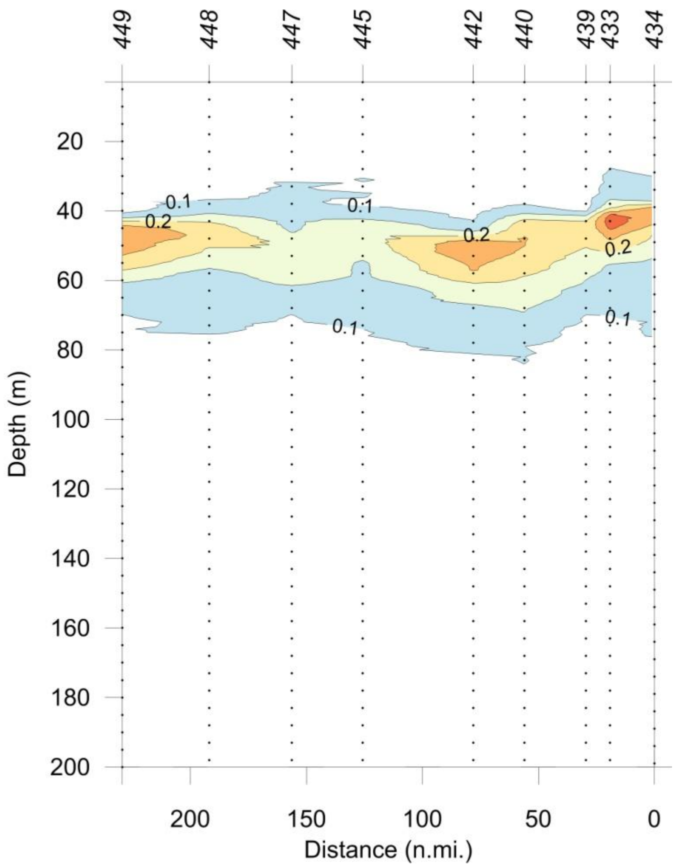


Figure 3.1.11 Fluorescence distribution along the Joint Development zone hydrographic line (see Section 3.1.1.2 for information about this transect). Fluorescence units are relative.

Figure 3.1.10 exhibits very low surface chlorophyll concentrations (<0.1 mg Chl m^{-3}) in the northern half of the Gulf, including the Joint Development Zone. This is corroborated by the shipboard fluorescence observations. Figure 3.1.11 shows the fluorescence distribution along the same hydrographic line, which was described in Section 3-4. The upper layer is devoid of primary productivity while high pigment concentrations prevail below the thermocline, in a depth range of

40-70 m. This is the typical productivity pattern for a tropical ocean where the stratification is too strong to permit transfer of nutrients to the surface layer, but the sunlight penetrates deep enough to permit photosynthesis to occur in the nutrient-rich deep waters below the thermocline depth.

3.2.2 Zooplankton

(MN= multinet, MS= multisampler, NS= Methot rigged as Newston, O= Oter.)

Date	time	st nr	STD st	Gear	Depth	day/night
29-11-2012	03.24-04.27	PL_1	1534	MN	0-280	night
29-11-2012	08.59-09.24	2 Neuston		O	0	day
30-11-2012	20.20-20.50	3 Neuston		O	0	night
30-11-2012	21.07-21.51	PL_2	1536	MN	0-300	night
1-12-2012	01.05-02.07	PL_3	1537	MN	0-30	night
1-12-2012	08.00-08.49	PL_4		MN	0-300	day
1-12-2012	16.56-17.41	PL_5	1562	MN	0-350	day
1-12-2012		PT_1		O	0	night
1/2-12-2012	23.50-00.34	PL_6		MN	0-300	night
2-12-2012	22.24-23.28	PL_7		MN	0-450	night
3-12-2012	07.44-08.32	PL_8		MN	0-450	day
3-12-2012	23.14-00.19	PL_9		MN	0-450	night
4-12-2012	06.28-07.24	PL_10		MN	0-450	day
8-12-2012	13.27-14.17	PL_11	1626	MN	0-450	day
8-12-2012	14.32-16.15	PT_5-7		MS	0-390	day
8/9-12-2012	23.52-00.49	PL_12	1631	MN	0-400	night
9-12-2012	02.42-02.57	PL_13		NS	0	night
9-12-2012	12.09-13.24	PL_14	1636	MN	0-450	day
9-12-2012	14.54-15.43	PT_8-10		MS	0-410	day
10-12-2012	00.47-01.47	PL_15	1640	MN	0-400	night
10-12-2012	13.45-14.23	PL_16	1644	MN	0-450	day
11-12-2012	03.30-03.44	PT_11		NS	0	night
11-12-2012	00.49-02.18	PL_17	1648	MN	0-435	night
11-12-2012	13.18-13.59	PL_18	1652	MN	0-450	day
11-12-2012	14.21-15.07	PT_12-14		MS	0-380	day
11.12.2012		PT_15		NS	0	day
12-12-2012	02.22-03.32	PL_19	1656	MN	0-450	night
12-12-2012	03.48-04.30	PT_16-18		MS	0-250	night
12-2-2012		PT_19		NS	0	night
12-12-2012	12.09-12.46	PL_20	1659	MN	0-450	day
12-12-2012	13.07-13.53	PT_20-22		MS	0-370	day
12-12-2012	14.37-15.07	PT_23		NS	0	day
13-12-2012	02.42-03.27	PL_21	1663	MN	0-450	night
13-13-2012	03.44-03.59	PT_24		NS	0	night
13-12-2012	15.16-16.00	PT_25-27		MS	0-380	day
13-12-2012	14.07-14.49	PL_22	1666	MN	0-450	day
13-12-2012	16.39-17.10	PT_28		NS	0	day
14-12-2012	00.42-01.37	PL_23	1670	MN	0-450	night
14-12-2012	02.00-02.42	PT_29-31		MS	0-270	night
14-12-2012	03.25-03.56	PT_32		NS	0	night
15-12-2012	01.46-02.40	PL_24	1681	MN	0-450	night
15-12-2012	03.01-03.42	PT_33-35		MS	0-250	night
15-12-2012	04.21-04.50	PT_36		NS	0	night
15-12-2012	14.16-15.01	PT_37-39		MS	0-380	day
15-12-2012	13.02-13.57	PL_25	1682	MN	0-450	day
15-12-2012	15.41-16.11	PT_40		NS	0	day

Systematic account: zooplankton

Over 100 different zooplankton categories were identified and quantified (including various developmental stages). It is virtually impossible to give a detailed account of all these IDs and their biological meaning. To illustrate this quantification, herewith are three pages of the ID sheet from the station 13, where zooplankton was particularly abundant (see Fig. 19). Of note is the fact that very small but important non-calanoid copepods (such as Oithona and Oncaea) were retained and counted. It is only fairly recently that the role of these copepods in the marine ecosystems has been recognized (e.g. Gallienne and Robins, 2001).

Table. 1. Multinet 2011: raw data, lists of quantified systematic categories

Systematic account: fish larvae and juveniles

Fish larvae and juveniles were not identified in 2011 material from Multinet. Adult fish from the trawls were discussed in the Report from that cruise (Serigstad et al., 2012) and will not be repeated here.

Larval fishes from the Multinet 2012, multisampler and neuston consisted of three categories: myctophids (genera Hygophum, Diogenichthys, Lampanyctus, Myctophum, Diaphus, Benthosema, Notolychnus (N. valdiviae), Notoscopelus, Lampadena, Ceratoscopelus, Electrona, Centrobranchus, Electrona, Lepidophanes and Bolinichthys), mesopelagics and other (lists of genera and/or families given below).

The list of mesopelagics consisted of the following: Gonostomatidae, Sternoptychidae, Chiasmodontidae, Photichthyidae (Vinciguerria spp.), Melamphaeidae, Astronesthidae, Ceratoidei, Paralepididae, Argentinidae, Scopelarchidae, Stomiiformes, Acropomatidae, Melanostomiidae, Nettastomatidae, Opchhtithidae, Synodontidae, Epigonidae, Notosudidae, Bathylagidae, Searsiidae, Melanonidae, Opisthoproctidae, Malacosteidae, Nemichthyidae. Most common was Vinciguerria spp. (Photichthyidae).

“Other” list includes Bregmaceros, Cubiceps, Gobiidae, Trichiuridae, Balistidae, Congridae, Gadiformes, Exocetidae, Hemiramphidae, Ahlia egmontis (key worm eel), Coryphaena, Ariomma, Opishognathidae, Auxis, Anquilliformes, Callionymidae, Psenes, Acanthurus, Caranx, Percoidei (possibly Pomacentridae, damselfishes), Syacium, Trichiuridae, Bothus, Scorpenidae, Atherinidae, Carapus, Sphyraena, Monolene, Ostraciidae, Caristidae, Pleuronectiformes, Serranidae, Tetraodontidae,

Bramiidae, Moriidae, Cantherines pullus (balistid-like coral reef fish), Letharchus velifer (American sailed snake eel), Pomatomus, Brotula, Apogon and Selene. Genetically identified fishes included tunas (Katsuwonus pelamis, Auxis rochei and Euthynnus alletteratus), bigeye scad (Selar crumenophthalmus) and Lutjanus jocu (dog snapper). Illustrations of some of these fishes are given below.
Fig. 19.

Fig. 19. Myctophid Myctophum sp. Photo: Oddgeir Alvheim

Fig. 20. Vinciguerria sp., most common mesopelagic fish during the 2012 survey

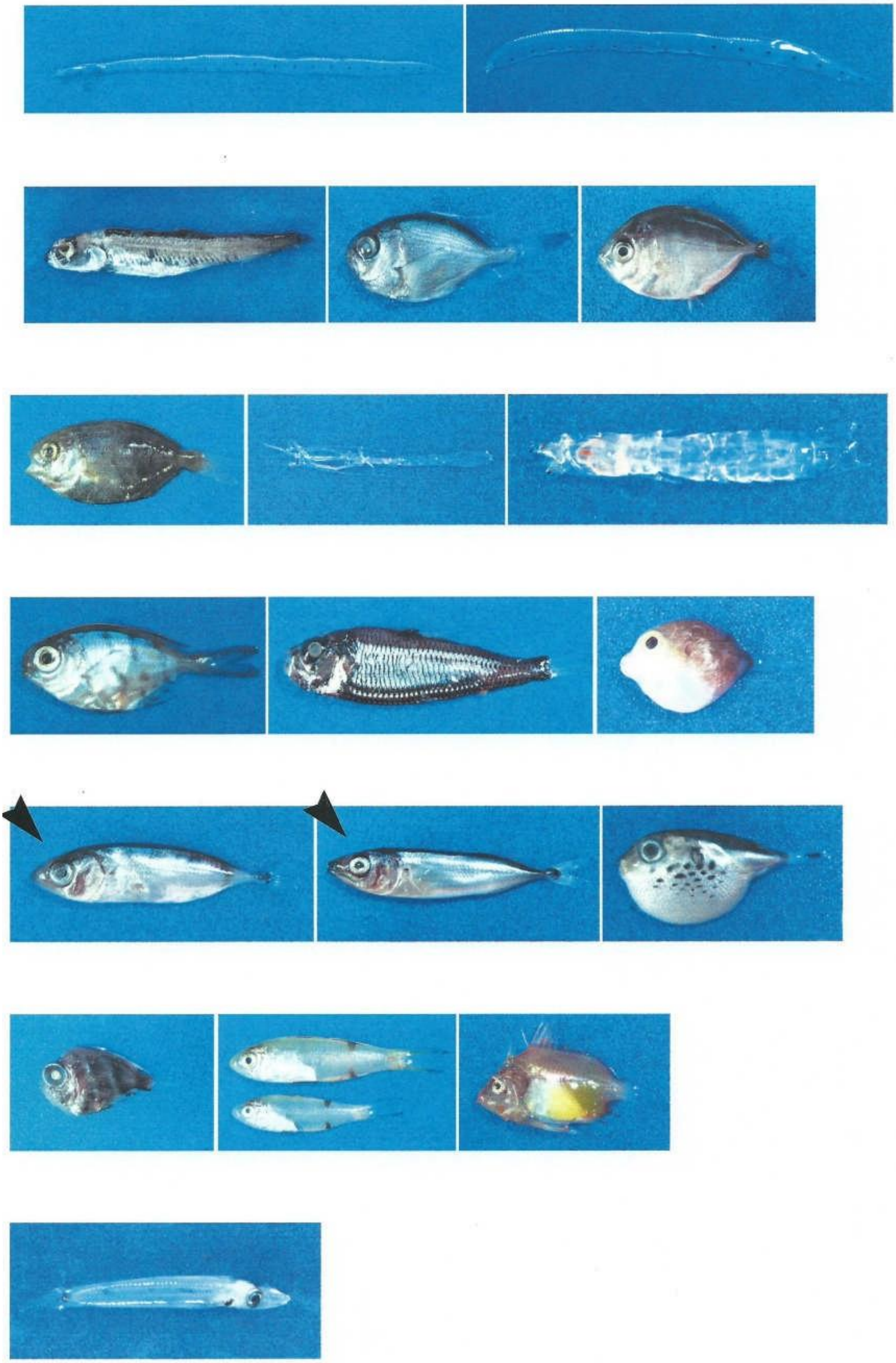
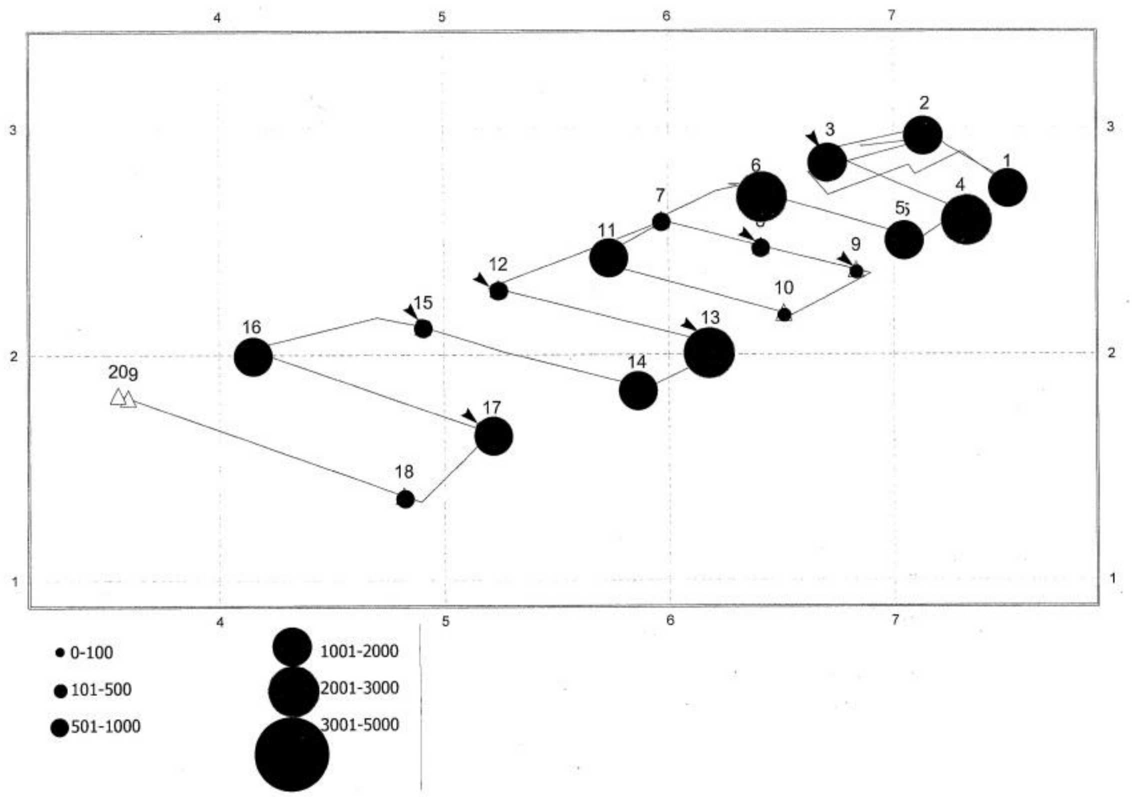


Fig. 21. Examples of fish from all three gears during the 2012 survey. Tuna marked by arrows. Photo: Oddgeir Alvheim.

Multinet, May 2011: zooplankton distribution and abundance

It is a common knowledge that zooplankton migrates at night as a part of the Scattering Layer of the open ocean. However, this migration is not always a dominant factor determining the abundance level. The dominant force seems to be the play of water quality (nutrients, oxygen, salinity, temperature, sediment and transparency to light), density, movement and dynamics of living components (through the non-trophic influence and predator-prey relationships on all levels). So, an interpretation of plankton abundance, distribution and dynamics becomes complex, and results in patterned patchiness which may be different on different depth levels. Given below, there is an account of such patchiness in the JDZ in May 2011.

Fig. 22.



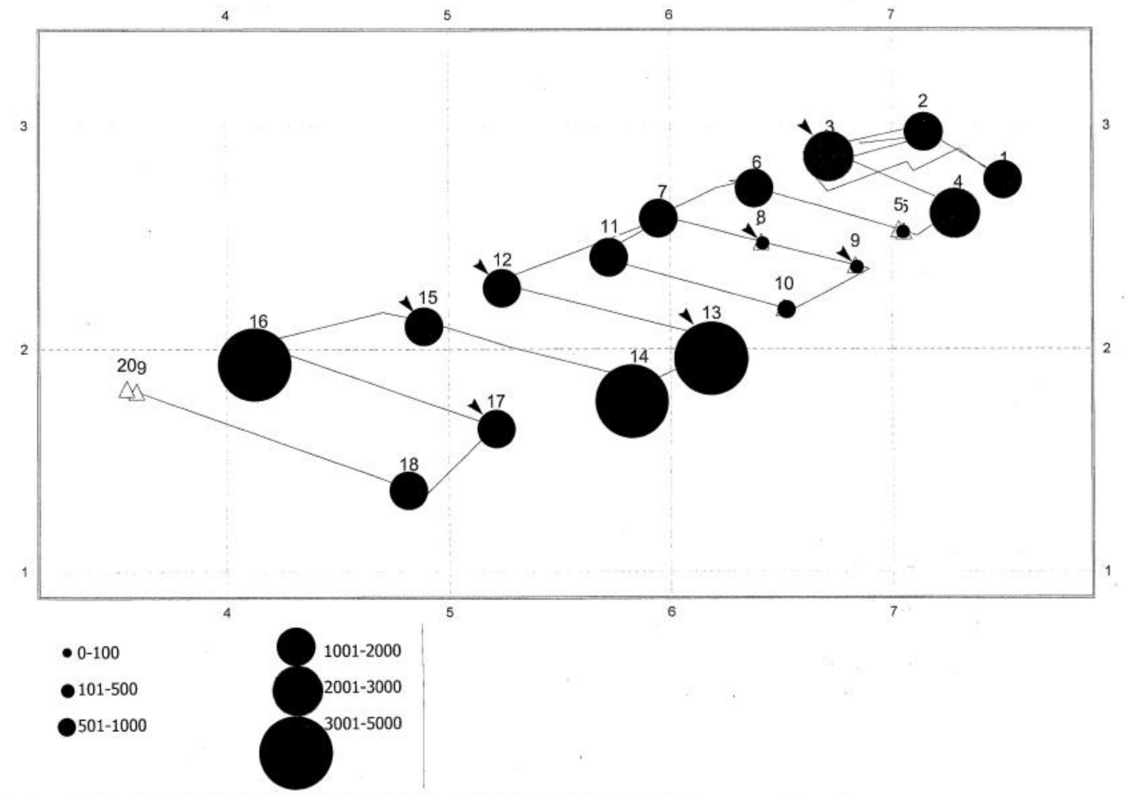
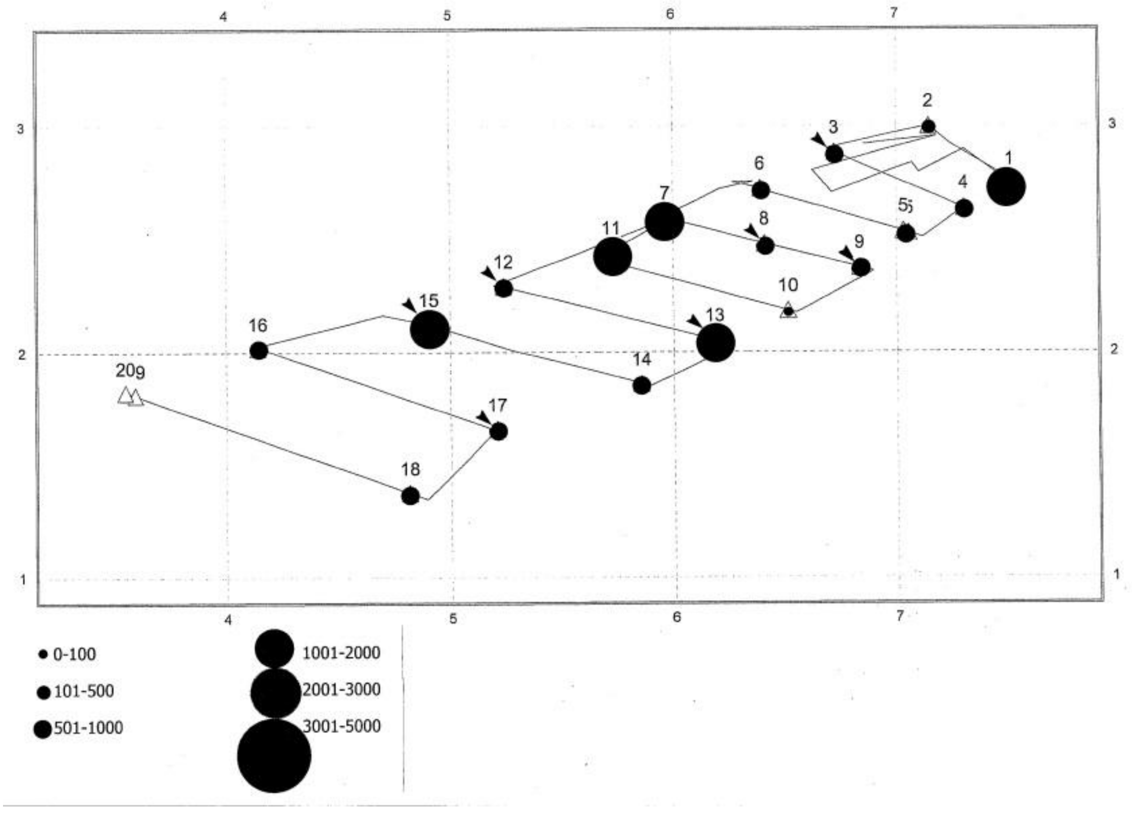
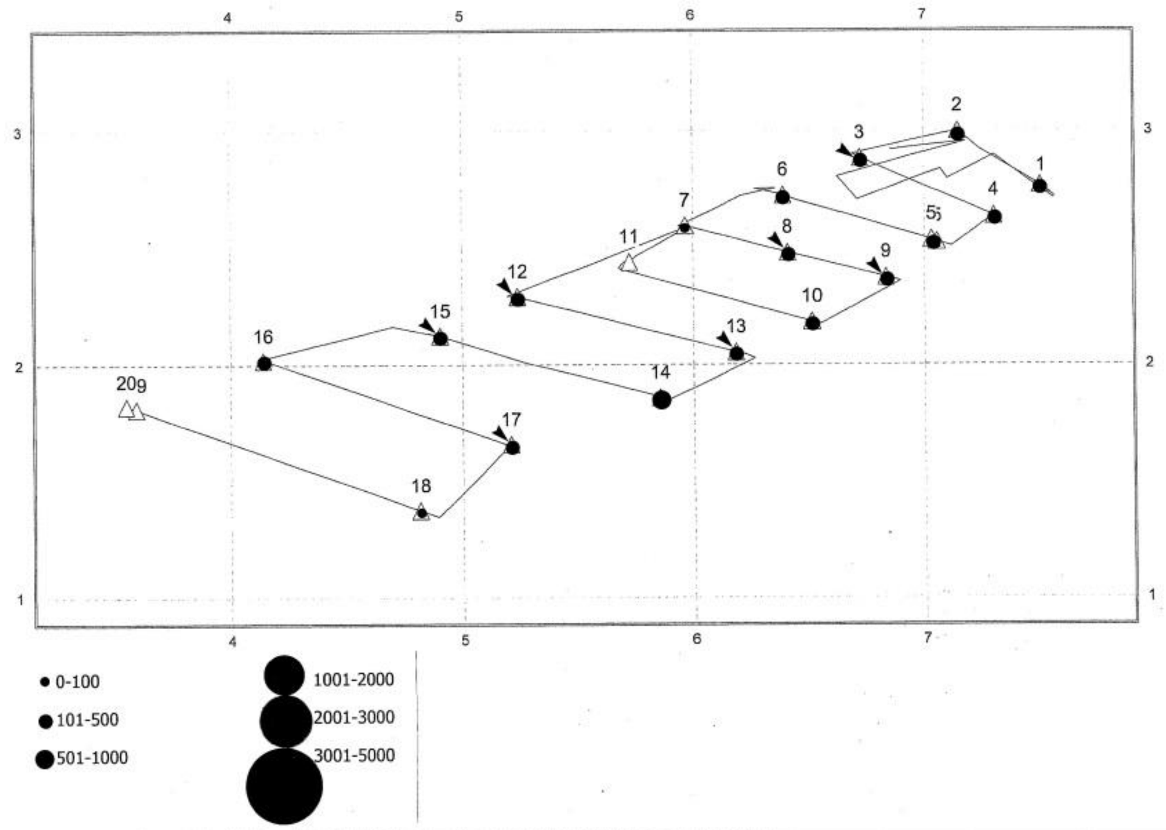


Fig. 22. Total number of individuals in JDZ plankton, May 2011. Upper, 0-25 m; lower, 25-50 m. Arrows indicate the night stations.





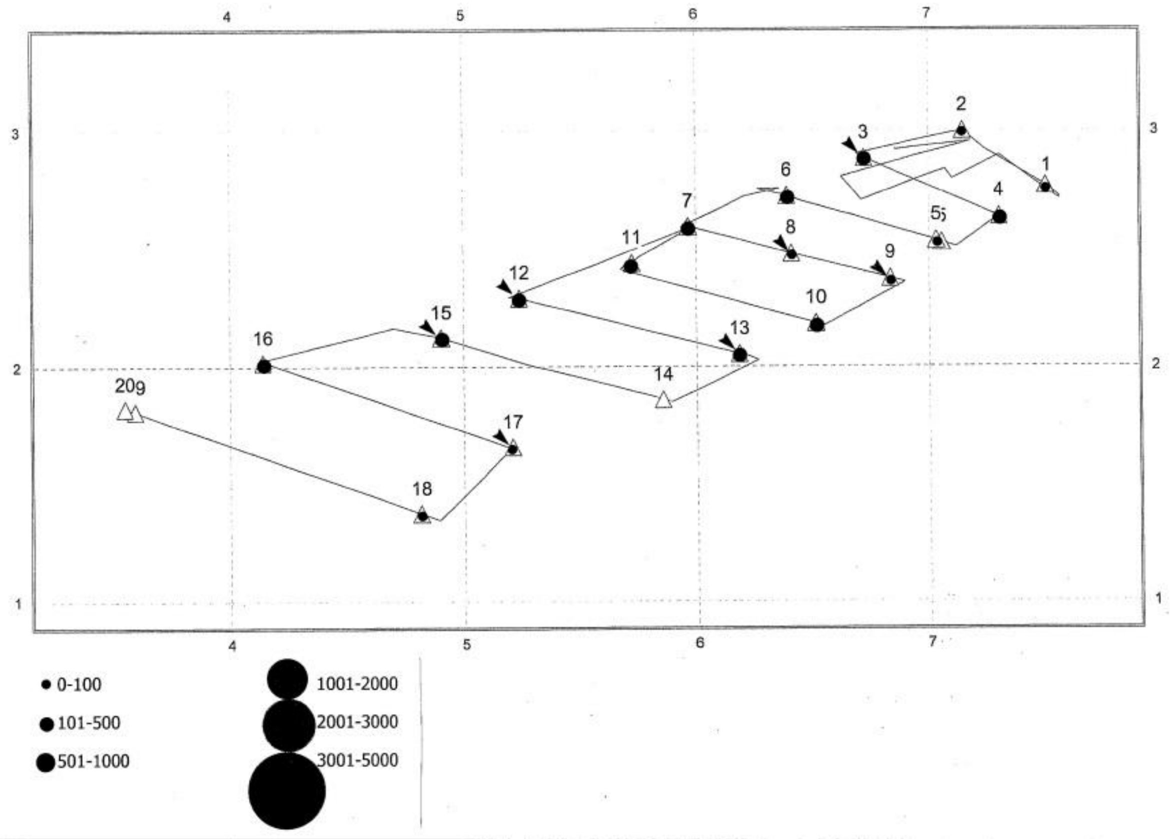


Fig. 23. Total number of individuals in JDZ plankton, May 2011. Upper, 50-75 m; middle, 75-100 m; lower, 100-200 m. Arrows indicate the night stations.

These figures indicate the following patterns for further research:
 In tropical region of GOM, abundance of zooplankton (mainly copepods) measured in individuals decreases with depth;
 Zooplankton in JDZ is most abundant around thermocline (approximately 40m), day and night; day-night migrations are easily obscured by other powerful factors.
 Where zooplankton is abundant, patchiness is the greatest; zooplankton abundance becomes uniform deeper than 75 m.
These patterns do not inform at all about the dynamics of the studied system. They inform however about the priority depth for the all linked biological research. This depth is around the thermocline (25-50 m) according to selected depth ranges. Therefore, this depth range was selected for in-depth analysis. From the most abundant Copepoda (Oithona, Oncaea, Calocalanus, Clausocalanus, Ctenocalanus, Temora, Undinula, Farranula, Coryceus, Nannocalanus, Paracalanus, Lubbockia, Candacia, Lucicutia and others), several were selected to illustrate most important patterns of abundance and distribution in the target zone of 20-50 m. Other two invertebrate groups were also selected (Appendicularians Oikopleura and Firtillaria, and Ostracoda). Results are shown below.

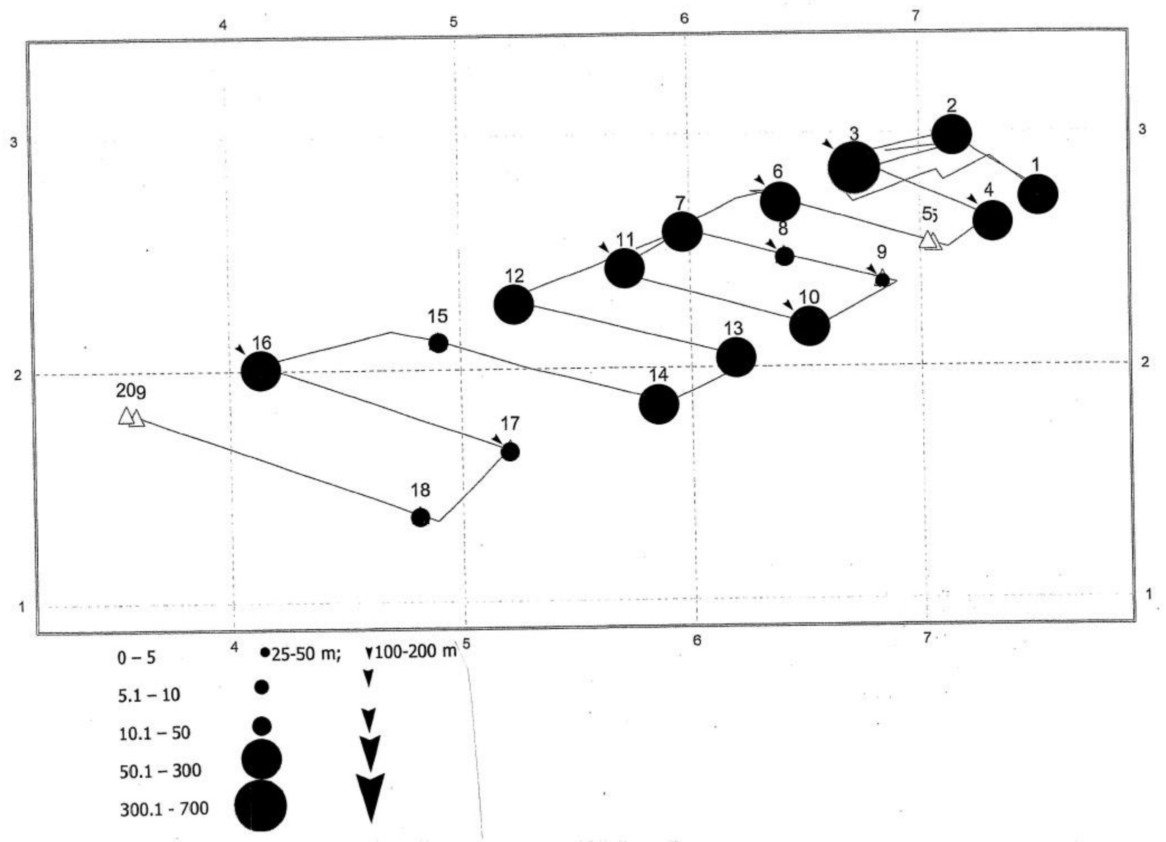


Fig. 24. Distribution and abundance of Temora sp. (Copepoda) in the JDZ in two depth layers (Multinet, number of individuals in 1 m3).

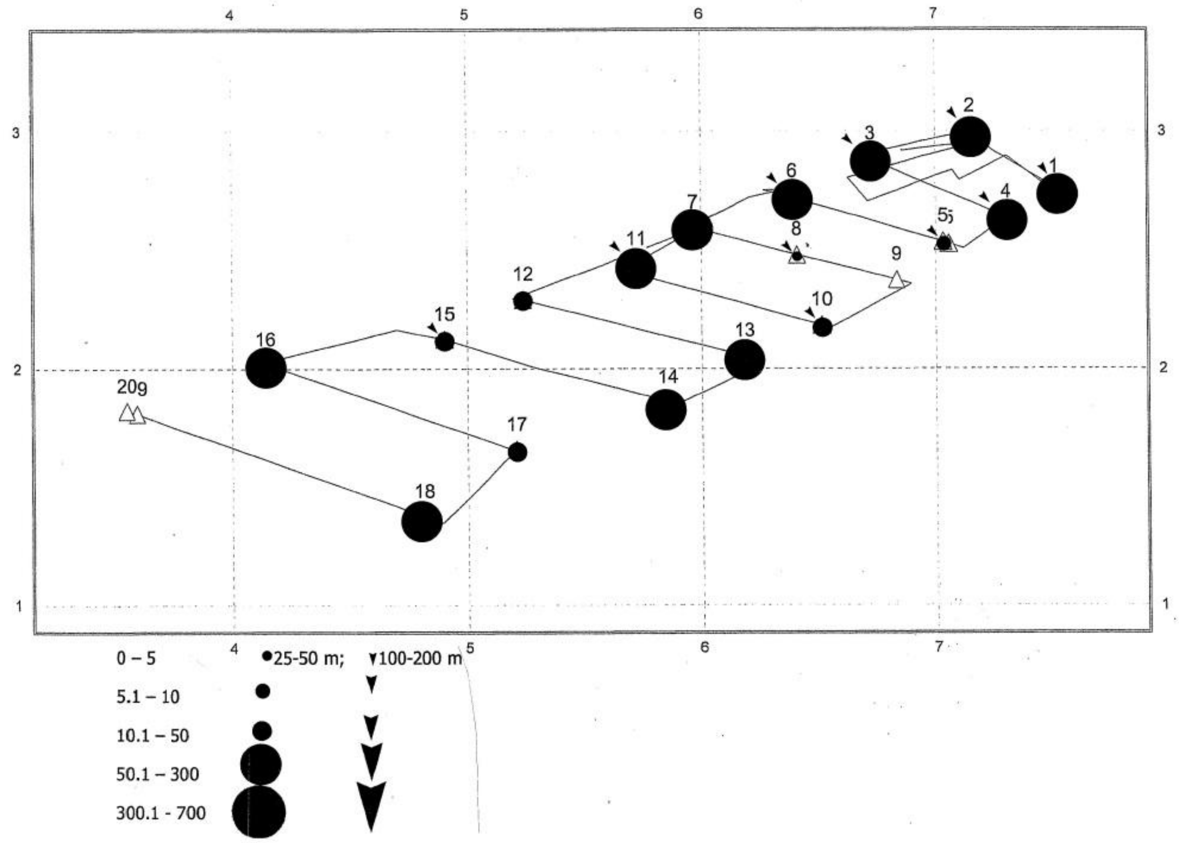


Fig. 25. Distribution and abundance of Oikopleura sp. (Appendicularia) in the JDZ in two depth layers (Multinet, number of individuals in 1 m3).

As it can be seen, there is no particular geographic pattern in the distribution of these two groups of organisms, except that they are usually abundant in the upper layer regardless of the day/night patterns, and scarce in the deep layer.

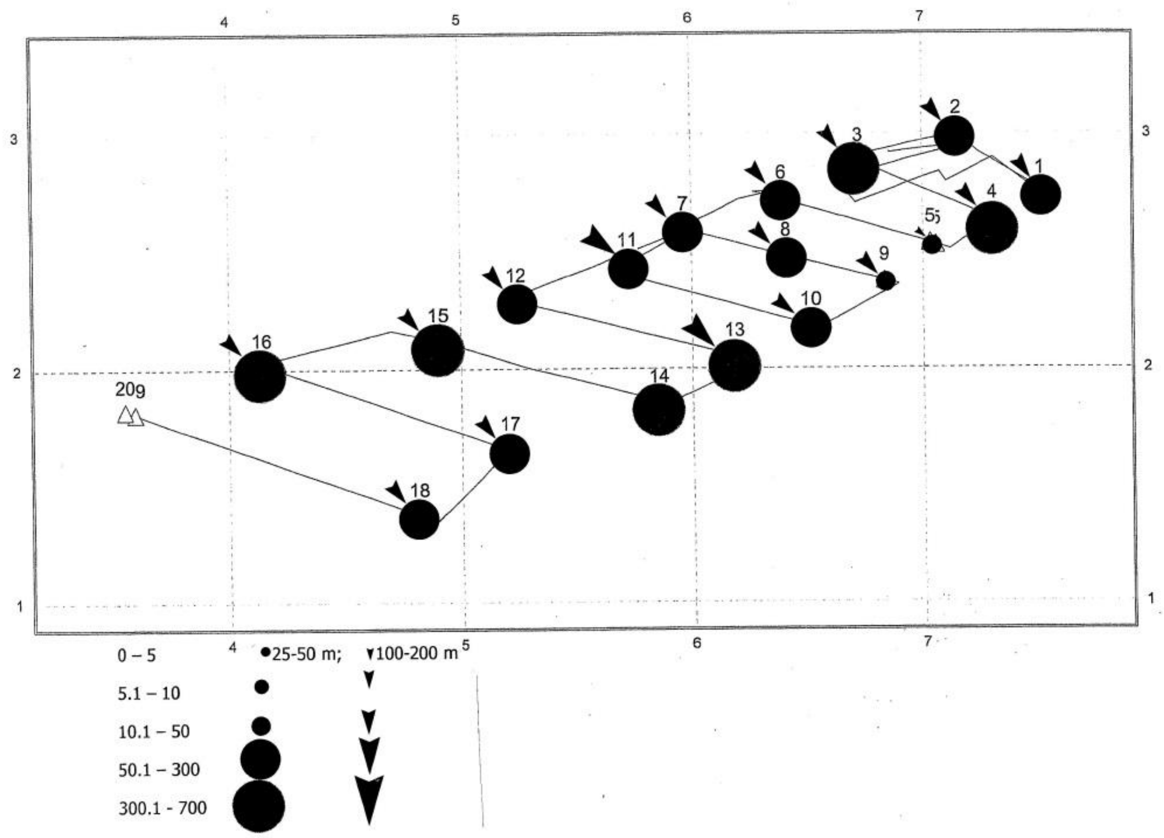


Fig. 26. Distribution and abundance of Oncaea sp. (Copepoda) in the JDZ in two depth layers (Multinet, number of individuals in 1 m3).

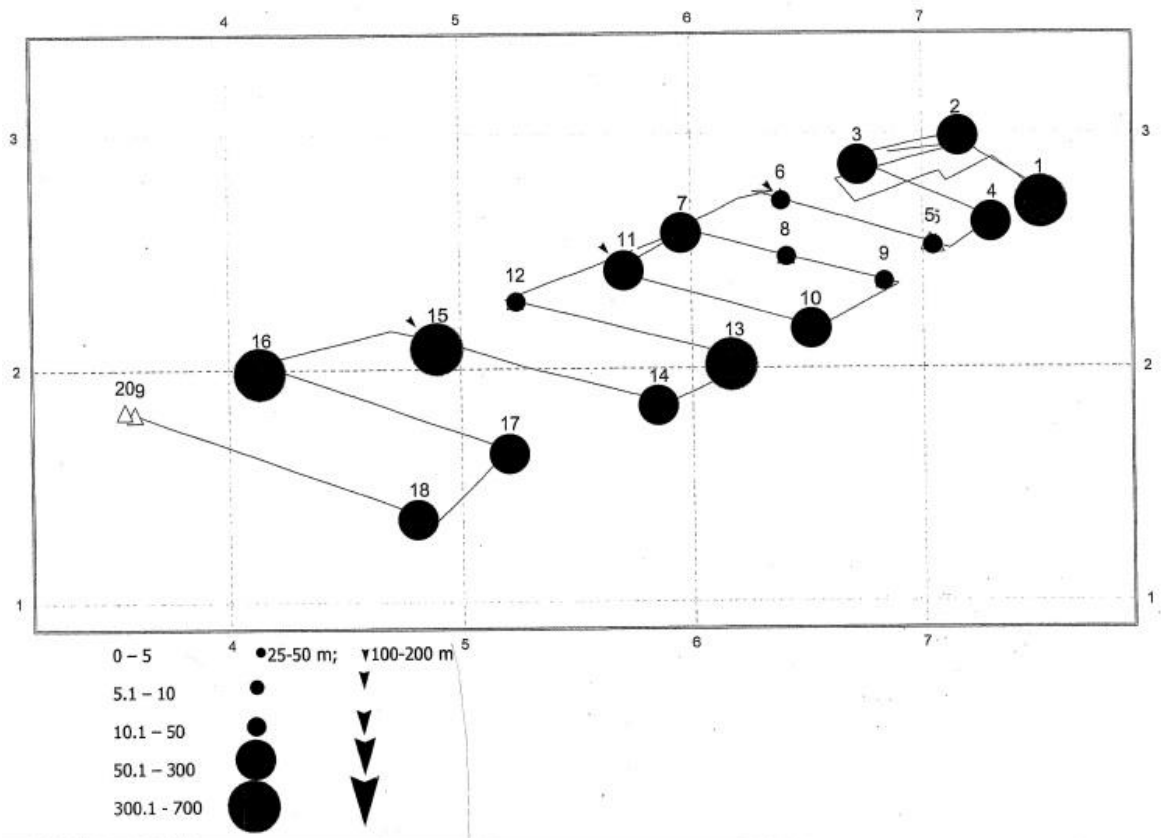


Fig. 27. Distribution and abundance of Nannocalanus sp. (Copepoda) in the JDZ in two depth layers (Multinet, number of individuals in 1 m3).

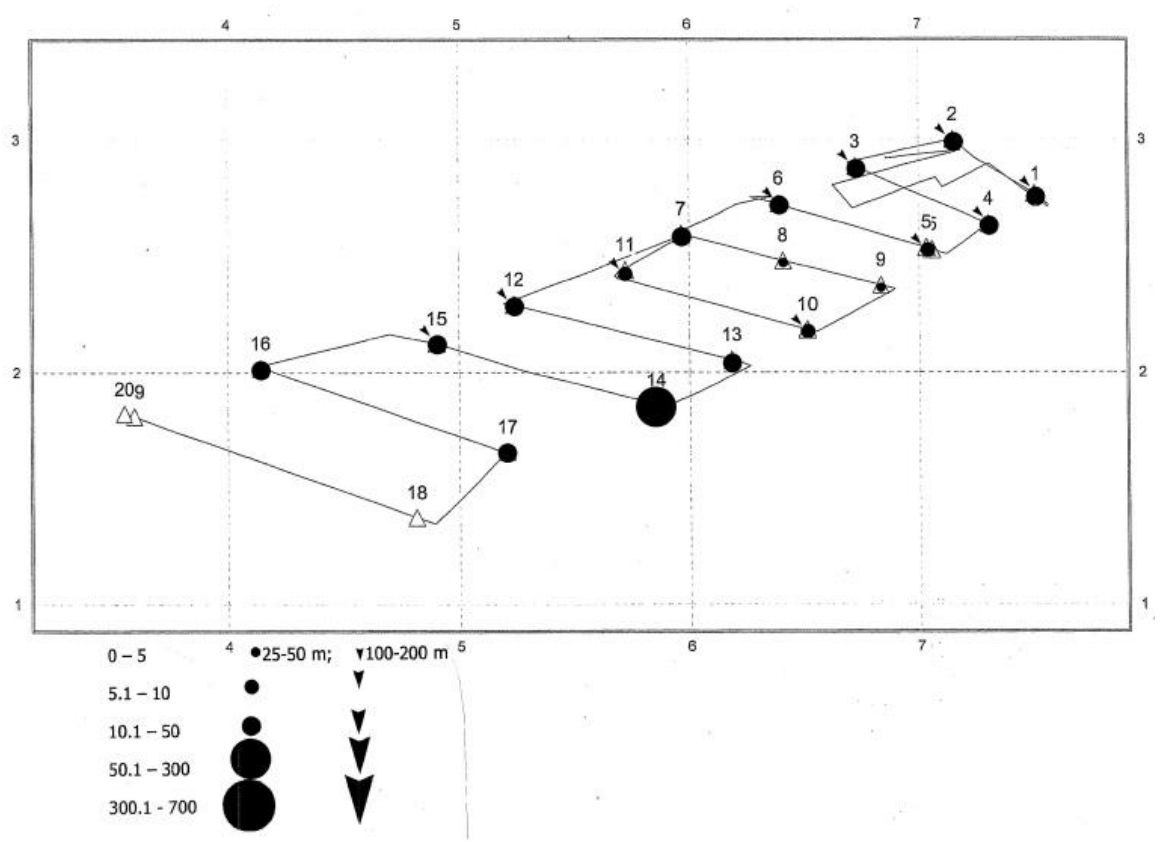


Fig. 28. Distribution and abundance of Fritillaria sp. (Appendicularia) in the JDZ in two depth layers (Multinet, number of individuals in 1 m3).

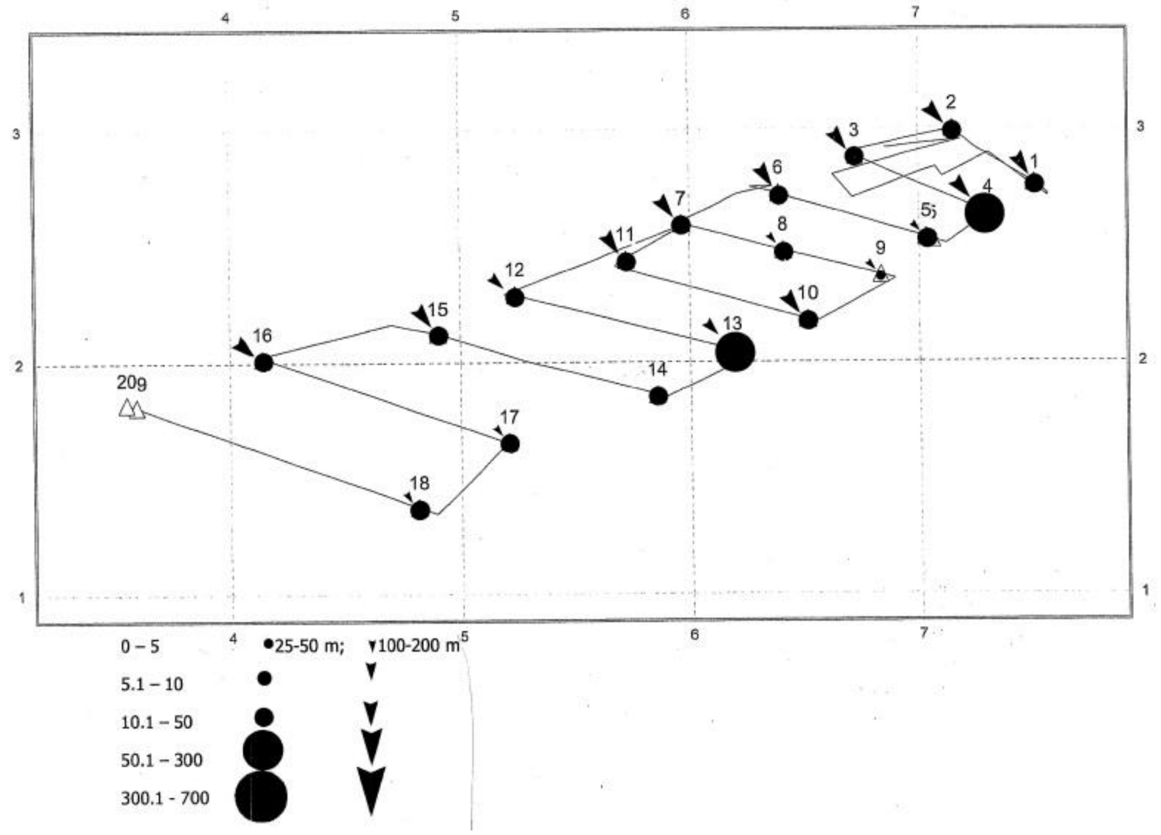
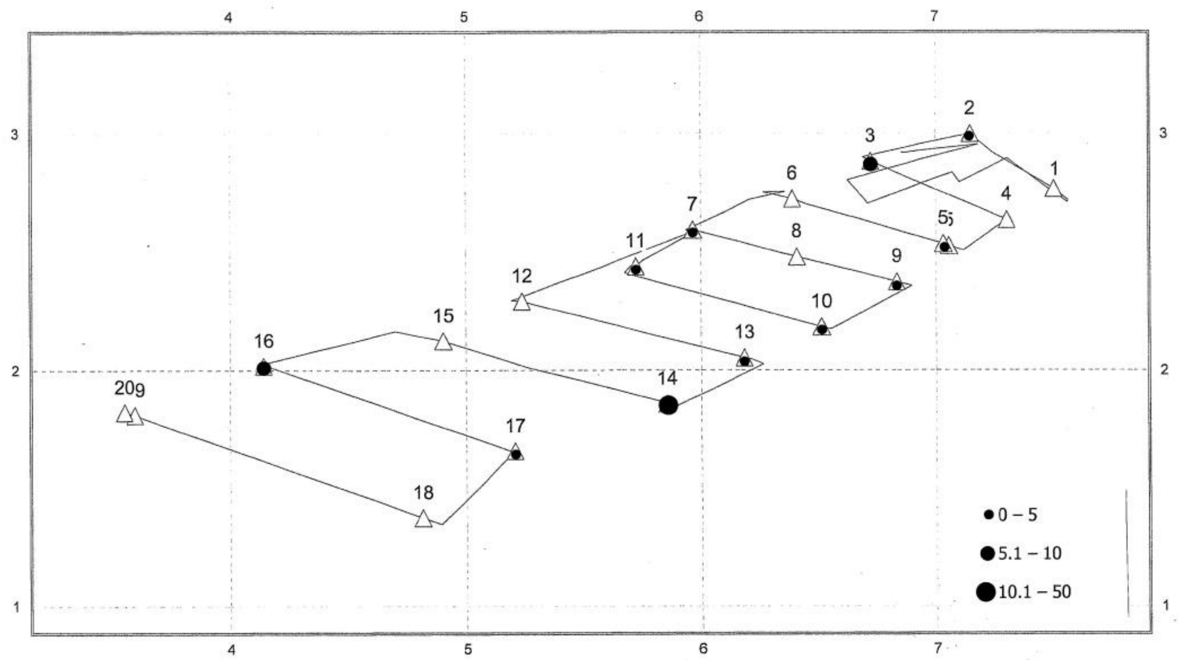


Fig. 29. Distribution and abundance of Ostracoda in the JDZ in two depth layers (Multinet, number of individuals in 1 m3).



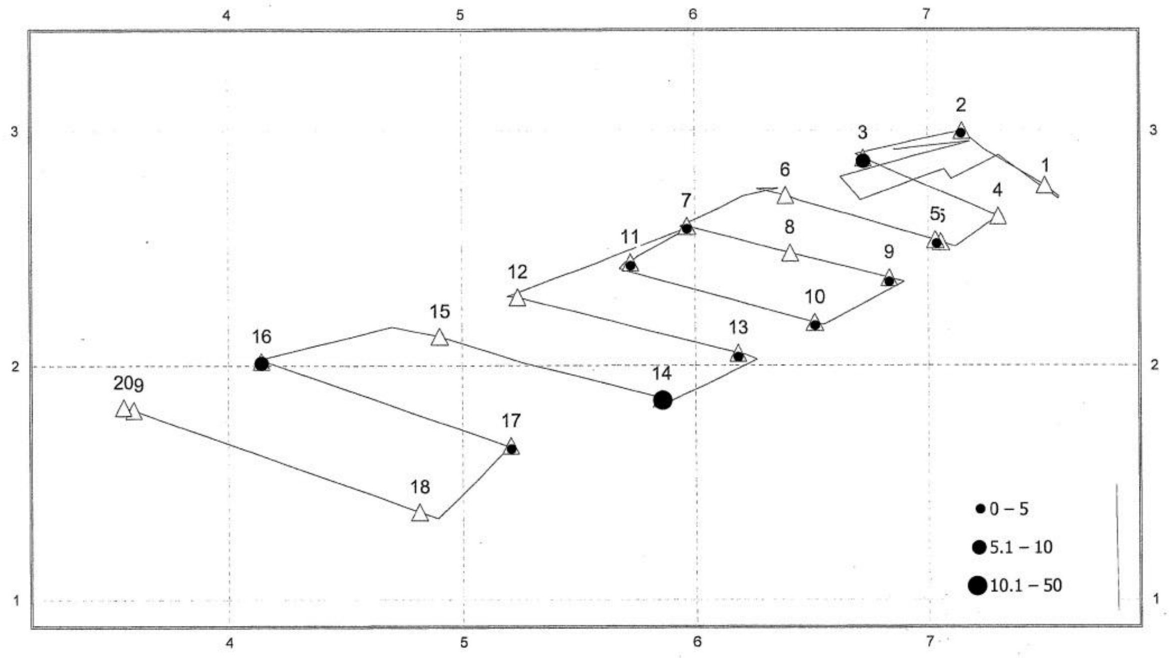


Fig. 30. Distribution and abundance of fish larvae in the JDZ in two depth layers (Multinet, number of individuals in 1 m3). Upper: 0-25 m; lower: 25-50 m.

In contrast to Temora and Oikopleura, group containing Oncaea, Nannocalanus, Fritillaria and Ostracoda shows distinct patterns in their distribution. In all, stations 4, 13/14, and in Oncaea & Nannocalanus also stations 15/16 show increased abundance in 25-50 m layer. Whilst Oncaea (together with Oithona, most abundant copepod during 2011 survey) shows strong presence in 100-200 layer, even during the night (station #3 and 13), Nannocalanus and Fritillaria distinctly prefer upper layers. Ostracoda, like Oncaea, keep strong presence in the deep. Fish larvae are not particularly abundant; largest numbers were found on a day station #14 and on a night station #13.

Detailed account of the numbers encountered are given in tables below.

Table 2. Multinet 2011 results: all organisms added up.

Multinet 2011	Dominant categories (number of individuals per 1 m3)							Copepods
Station	Oncaea		Clausocal		Nannocal		Temora	
Depth m	25-50	100-200	25-50	100-200	25-50	100-200	25-50	100-200
1	148.4	11.4	491.6	6.9	29.1	0	81.4	0
2	276.5	15	145.9	5	0	0	84.5	0
3N	355.9	15.6	227.9	3.8	0	0	405.8	0.3
4	433.8	27.8	224	20.1	42.7	0	206.2	2.4
5	48.8	5	16.4	2.2	0.4	0	0	0
6	222.2	15.5	19.6	3.3	8.9	0.2	154.7	0.5
7	292.2	37.6	161.4	5.6	50.1	0	153	0
8N	62.7	16.1	21.9	0.9	2.1	0	11.4	0.1
9N	44.9	12.1	14.8	1.4	0	0	[illegible]	[illegible]

[illegible]		[illegible]	12.1	14.8	1.4	0	0	9.8	0.1
	10	235.2	30.4	107.2	4.2	3.5	0	65.7	0.7
	11	259.1	63.3	184.2	25.3	0	0.7	115.5	2.8
12N		138.4	27.6	36.6	3.7	0	0	67.9	0
13N		549.3	137.8	314.7	18	85.3	0	165.3	0
	14	688.8	no data	249.9	no data	30.5	no data	243.8	no data
15N		328.3	21.7	444.5	2.6	13.8	0.3	48.4	0
	16	357	33.6	592.8	3.6	67.4	0	67.4	0.4
17N		174.8	17.1	187.1	1.1	22.1	0	27.1	0.3
	18	72.9	16.4	181.3	1.4	53.3	0	12.4	0

N - night stations

Table 4. Multinet 2011. Selected genera of other important zooplankton apart from copepods

Multinet 2011		Dominant categories (number of individuals per 1 m3)						Others
Station		Ostracoda		Oikopleura		Fritillaria		
Depth m		25-50	100-200	25-50	100-200	25-50	100-200	
	1	11.6	15.4	101.8	0.3	26.2	0.2	
	2	23	18.7	97.3	0.6	25.6	0.5	
3N		31.2	27	243.5	1	25	0.3	
	4	56.9	15.7	106.7	4.4	42.7	0.6	
	5	37.9	3.4	5.9	0.6	7.2	0.1	
	6	16	14.9	101.3	0.9	19.6	0.6	
	7	16.7	23.7	133.6	0	19.5	0	
8N		10.1	2.5	4.2	0.1	2.1	0	
9N		0.8	3.6	0	0	1.6	0	
	10	12.1	19.4	13.8	0.5	5.2	0.9	
	11	37.5	26	84.3	1.4	6.2	5.6	
12N		26.1	7.9	15.7	0	39.2	0.1	
13N		53.3	9	64	0	10.7	0	
	14	18.3	no data	219.4	no data	85.3	no data	
15N		25.9	11	20.8	0.3	17.3	0.2	
	16	33.7	12	256	0	40.4	0	
17N		24.6	0.9	19.7	0	14.8	0	
	18	26.7	2	106.7	0	0	0	

N - night stations

Table 5. Multinet 2011. Fish larvae as an important component of the zooplankton

Multinet 2011 Dominant categories (numbers of individuals per 1 m3) Fish larvae

Station	Depth m 0-25	25-50	50-75	75-100	100-200
1	0	8.7	0	0	0
2	1.8	7.7	0.9	1.2	1
3N	5.5	3.1	0	0	0.3
4	0	3.6	0	0.6	0.3
5	2.3	0.4	0	0	0.1
6	0	5.3	1.6	0	1.4
7	1.6	0	2.7	0.3	0
8N	0	0	3.1	0.6	0.2
9N	0.9	0.4	1.3	0	0
10	0.4	0	0	2.6	0.2
11	2.1	0	0	0.4	1.4
12N	0	7.8	0	0.5	0
13N	4	10.7	2.5	0	0.8
14	40.5	0	2.6	2.8	no data
15N	0	1.7	2.9	0.2	0.3
16	8	0	5.5	2.1	0.7
17N	2.8	0	5.8	0.8	0
18	0	3.6	0	0	0

N - night stations

Multinet, Multisampler, Neuston 2012: preliminary results

Multinet 2012 results (ID and abundance) are not as yet available. Only a general, makeshift picture, prepared during the cruise, is available:

For the 2012408 Survey Report
By Bjørn A. Krafft

Results

Samples for nutrient, chlorophyll and phaeopigment analysis still awaits to be analysed, due to poor personnel capacity at our chemistry lab.

The general trend of plankton biomass sampled during the cruise was that it decreased with increasing depth (Figure 1). The largest zooplankton biomass concentrations were found at stations between 2-3°N and 6-7°E (Figure 2). Of the total biomass, the largest zooplankton plankton contributed with 60%, the middle sized zooplankton with 18% and the small zooplankton with 22%. The average station biomass for the large, middle and small size fractions were 0-007±0.017 (SD) g/m^3 (range 0-0.104 g/m^3), 0.002±0.003 (SD) g/m^3 (range 0-0.013 g/m^3) and 0.002±0.003(SD) g/m^3 (range 0-0.017 g/m^3), respectively. Large zooplankton was most common in the upper water layers (see Figure 1-7).

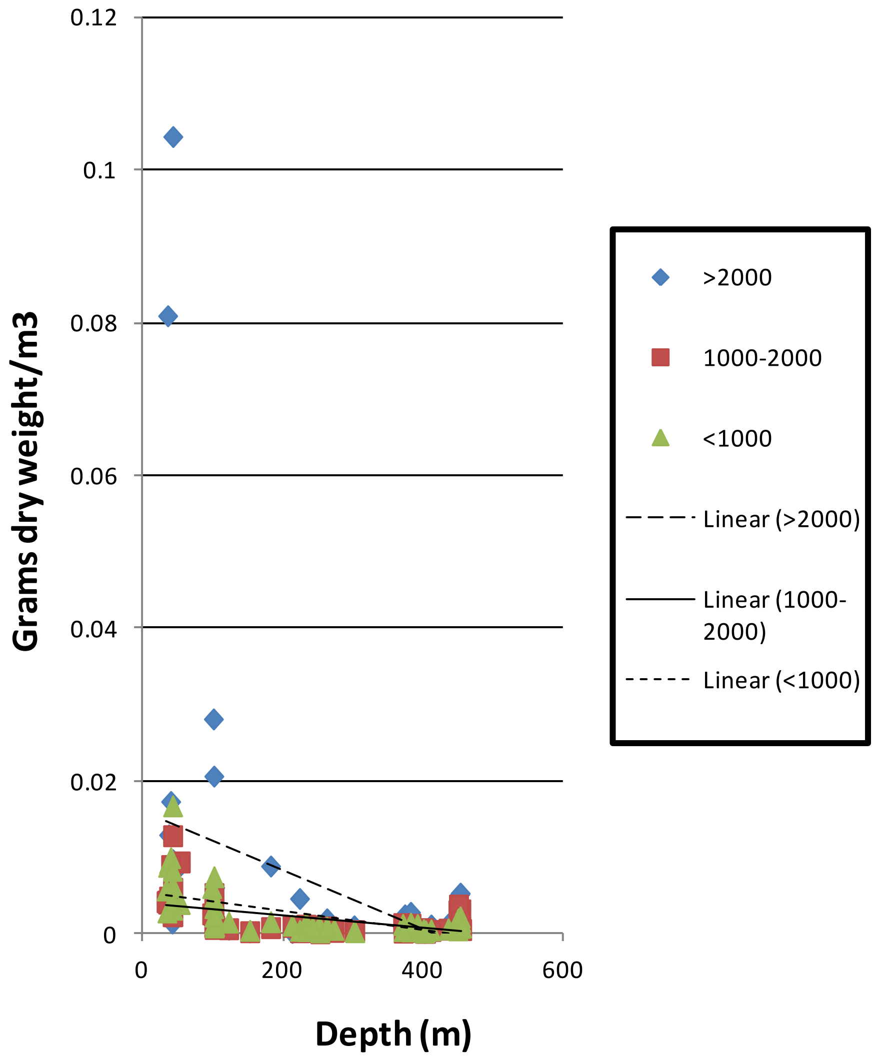


Figure 1. Zooplankton biomass representing the size fractions >2000µm, 2000-1000µm and 1000-180µm, sampled with a Hydro-Bios Multinet at different depth strata.

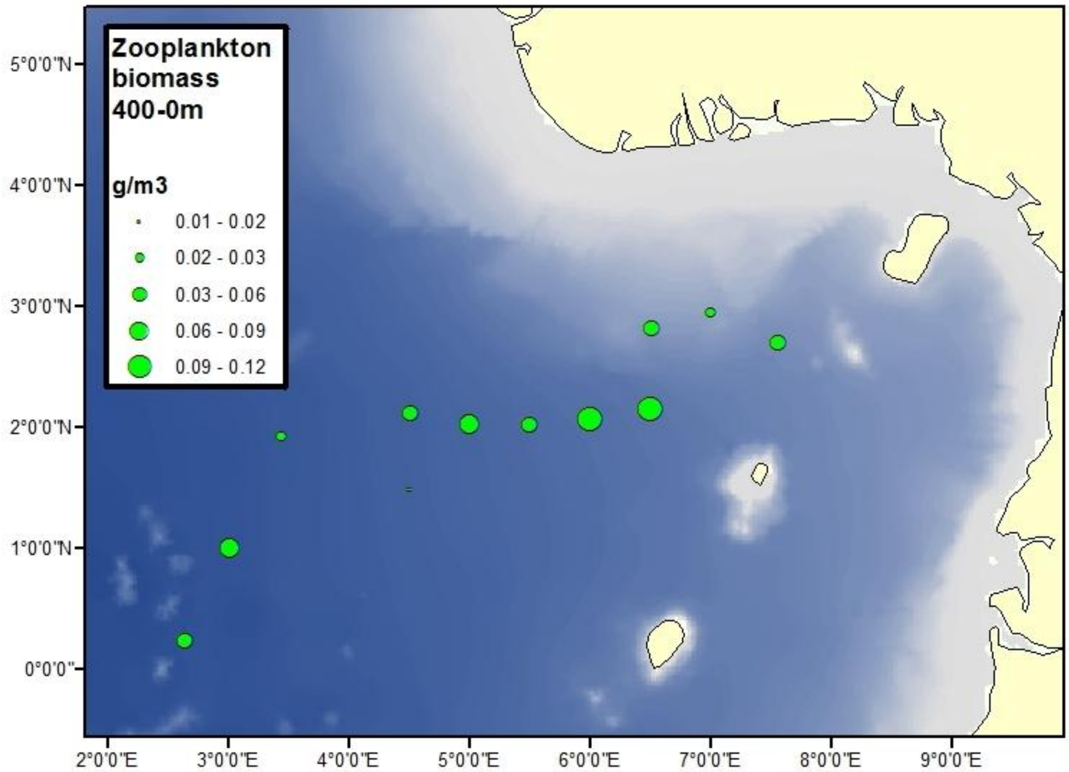


Figure2. Total zooplanktonbiomass from the 400-0m water column.

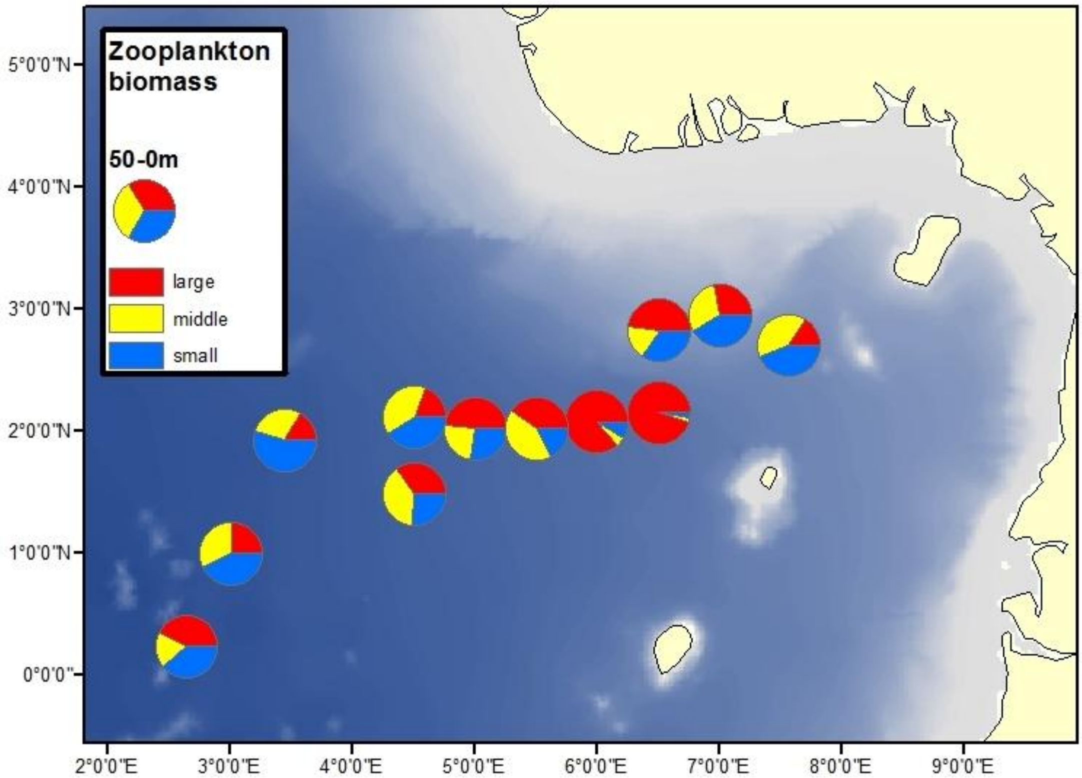


Figure 3. Large (>2000µm), middle (2000-1000µm) and small (1000-180 µm) zooplankton sampled from the 50-0m depths.

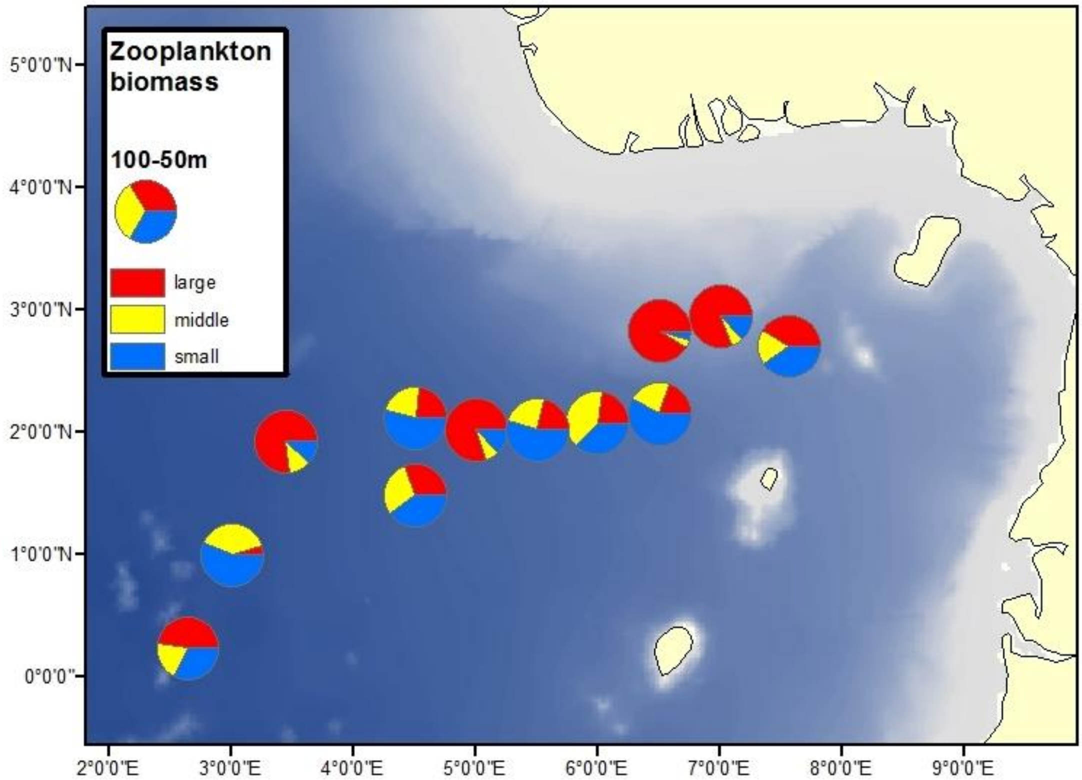


Figure 4. Large (>2000µm), middle (2000-1000µm) and small (1000-180 µm) zooplankton sampled from the 100-50m depths.

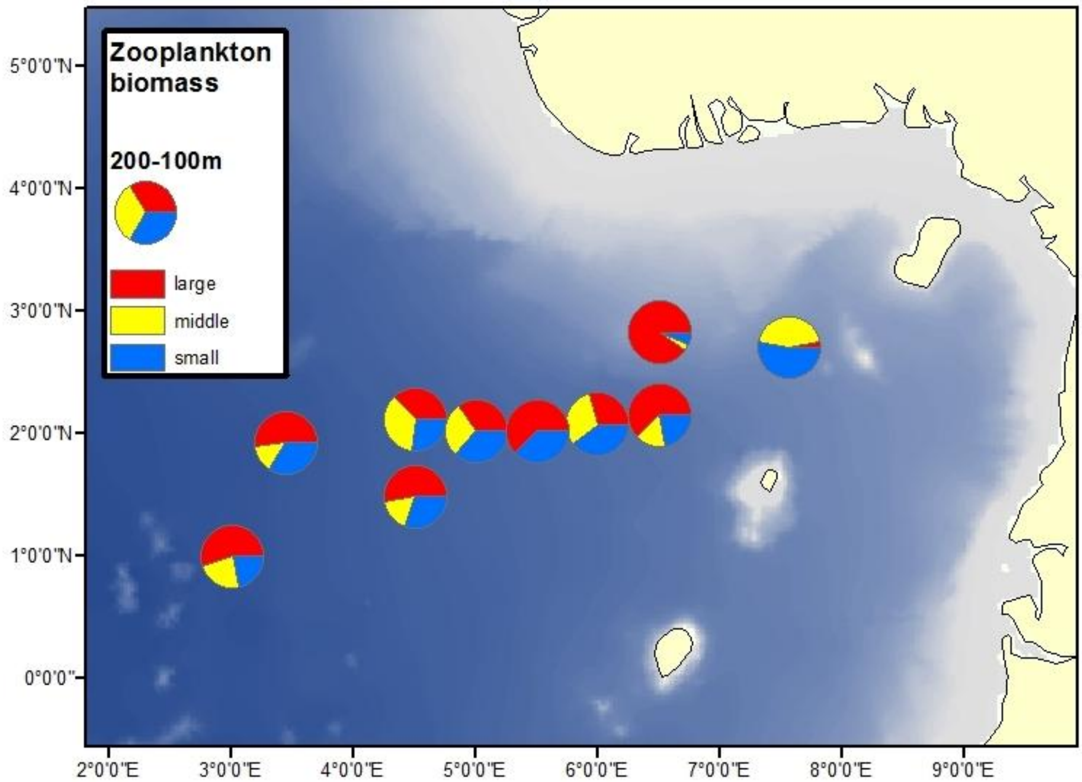


Figure 5. Large (>2000µm), middle (2000-1000µm) and small (1000-180 µm) zooplankton sampled from the 200-100m depths.

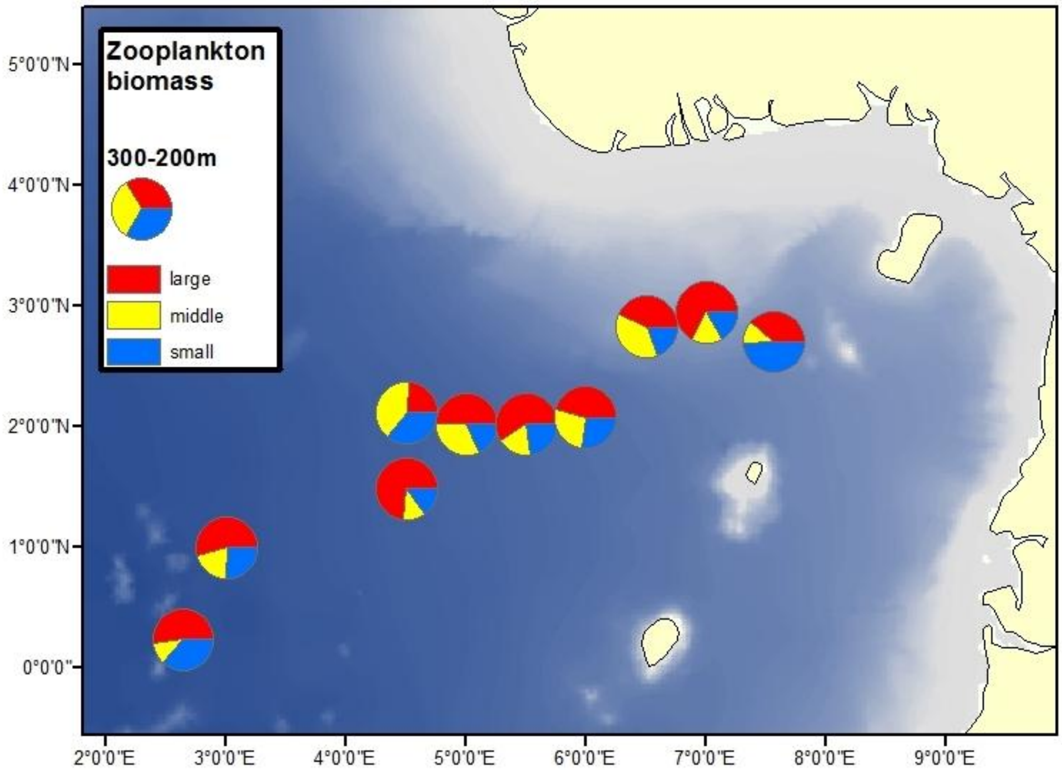


Figure 6. Large (>2000µm), middle (2000-1000µm) and small (1000-180 µm) zooplankton sampled from the 300-200m depths.

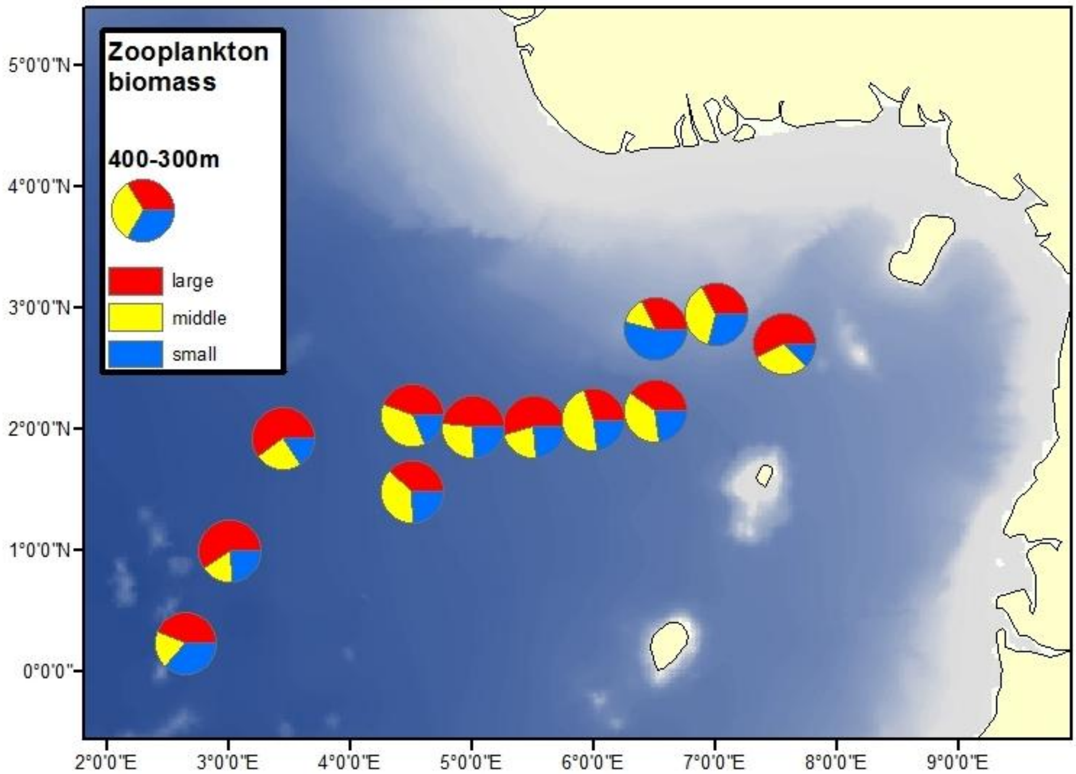


Figure 7. Large (>2000µm), middle (2000-1000µm) and small (1000-180 µm) zooplankton sampled from the 400-300m depths.

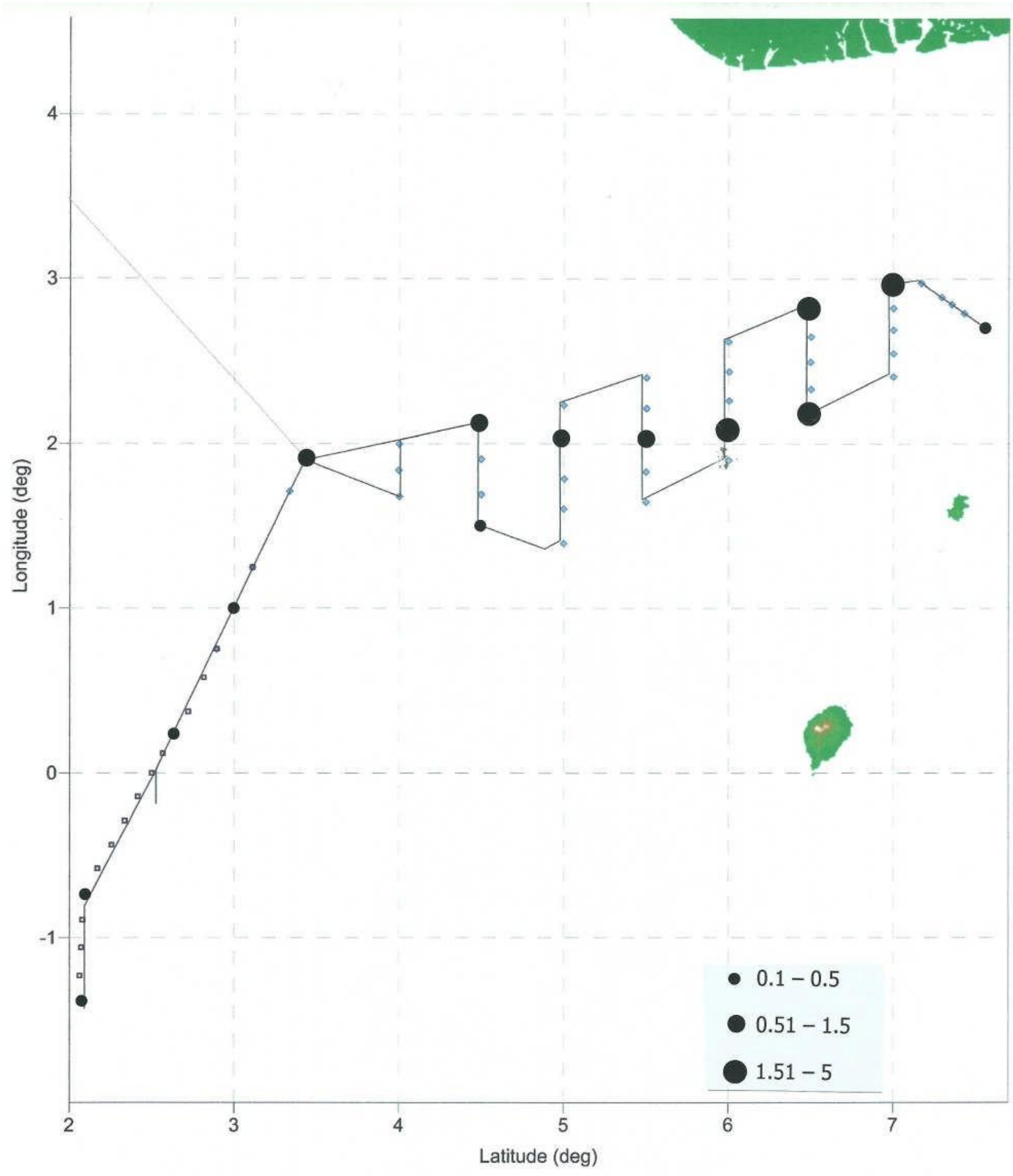


Fig. 31. Multinet 2012. Zooplankton in g/m3

These data are not very informative as they are not directly comparable with 2011 data, expressed in the numbers of individuals and not biomass. The detailed account (like for 2011) is necessary, to statistically compare both results remembering however, that they were collected in different seasons (May vs. December; see Introduction for the coverage of these differences). There are however, fish larvae data available. They indicate that both myctophid and mesopelagic larvae are mostly concentrated in the north of the investigated region (with the minor center southwest), unlike almost all other researched components of the ecosystem. These larvae are very small (3-6 mm TL on average) and this suggests that the reproduction of these organisms may take place more towards land mass. It is interesting then to ascertain if abundance of juveniles and adults stays in the same region.

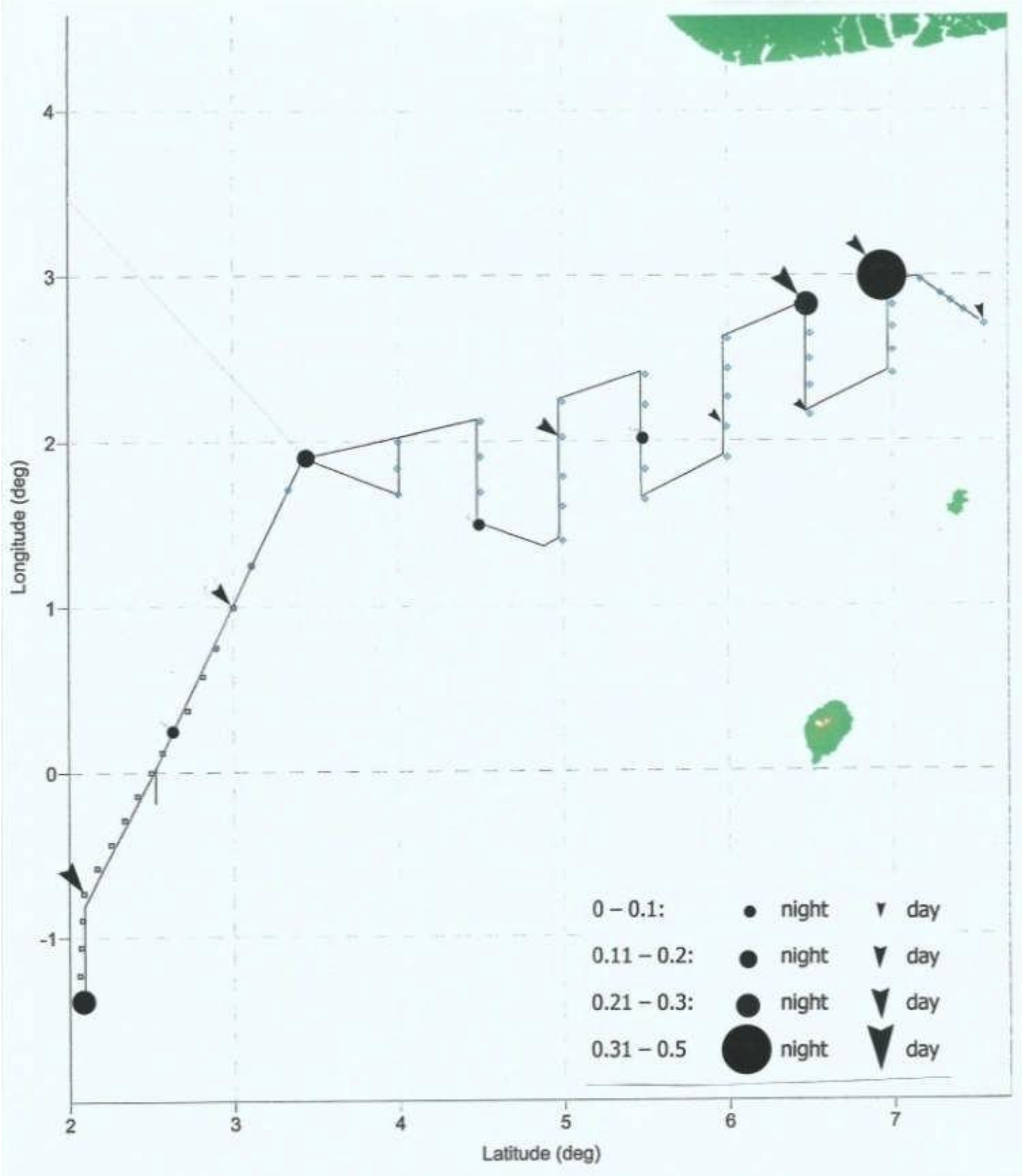


Fig. 32. Multinet 2012. Myctophid larval abundance (individuals) per 1 m3

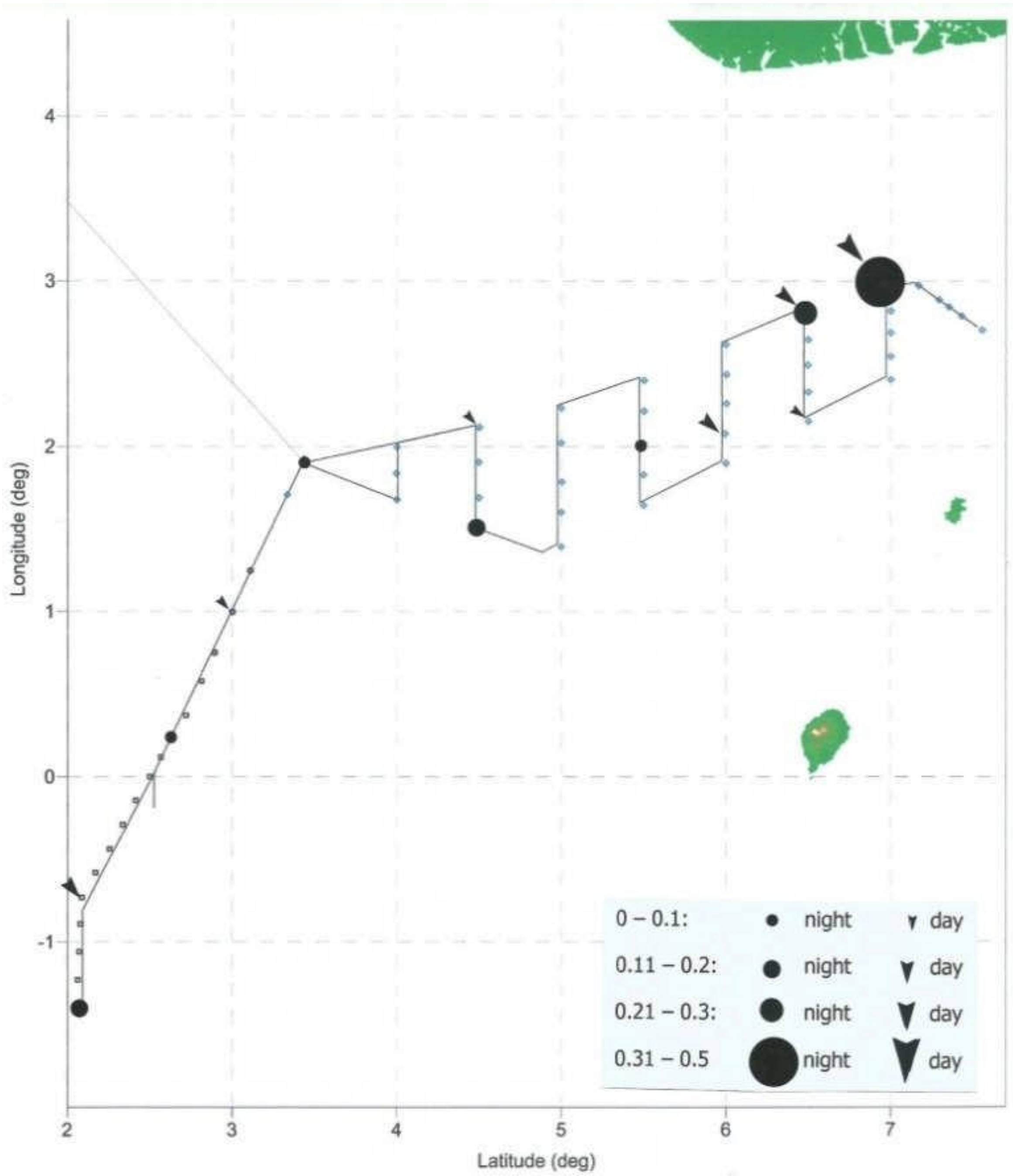


Fig. 33. Multinet 2012. Myctophid larval abundance (individuals) per 1 m3

Herewith is the full account of the collected data.

Table. 6. Fish larvae in Multinet 2012.

Fish larvae in Multinet 2012 (number of individuals in 1 m3)

Date	Station	Depth m	Time	Myctophids	Mesopelagics
29/XI	1663	1-70	night	0.006	0.006
		71-102	night	0.149	0.021
13/XII	1663	0-42	night	0.103	0.034
		42-102	night	0.076	0.091
		103-273	night	0.023	0.009
		402-453	night	0	0.029
30/XI	1640	0-50	night	0.172	0.273
		50-100	night	0.451	0.173
		100-150	night	0	0.075
		200-299	night	0	0.013
01/XII	1640	0-67	night	0.25	0.202
		67-151	night	0	0.005
		151-234	night	0.279	0.177
01/XII	1640	0-40	day	0.169	0.169
		40-100	day	0.042	0.07
		100-200	day	0.003	0.017
04/XII	1640	0-40	day	0.232	0.196
		40-100	day	0.134	0.076
		100-250	day	0.008	0.027
10/XII	1640	0-37	night	0.089	0.107
		37-101	night	0.022	0.029
01/XII	1631	0-30	day	0.2	0.286
		35-101	day	0.182	0.141
		102-182	day	0.066	0.138
		252-351	day	0.013	0
02/XII	1631	0-32	night	0.342	0.368
		33-53	night	0.276	0.345
		53-102	night	0.022	0.033
		181-299	night	0	0.007
02/XII	1631	0-40	night	0.17	0.277
		40-81	night	0.079	0.048
		81-190	night	0.005	0.011
03/XII	1631	0-40	day	0.535	0.372
		40-200	day	0.071	0.04
		300-400	day	0.008	0.024
09/XII	1631	2-33	night	0.083	0.111
		33-182	night	0.011	0.039
		182-301	night	0	0.011
03/XII	1640	0-42	night	0.08	0.04
		42-101	night	0.343	0.242
		102-250	night	0.005	0.021
		250-400	night	0	0.006
08/XII	1626	0-43	day	0.051	0
		43-102	day	0	0.1
		213-392	day	0.005	0.048
09/XII	1636	0-43	day	0.048	0.097
		43-122	day	0.029	0.035
		122-252	day	0.008	0.019

CTN of Table

		253-411	day	0.002	0.011
		411-450	day	0.023	0.045
10/XII	1644	0-35	day	0.038	0.154
		35-102	day	0.083	0.062
		233-383	day	0	0.017
11/XII	1652	0-40	day	0.161	0
		40-101	day	0.035	0.105
11/XII	1648	0-53	night	0.021	0.085
12/XII	1656	0-34	night	0.065	0.152
		34-101	night	0.064	0.021
		102-233	night	0	0.014
		233-374	night	0	0.008
		374-450	night	0.009	0.026
12/XII	1659	0-43	day	0	0.029
		98-242	day	0.014	0
		371-450	day	0.077	0.103
13/XII	1666	0-42	day	0.138	0.069
		43-101	day	0	0.077
		101-263	day	0	0.01
14/XII	1670	3-42	night	0.064	0.043
		42-101	night	0.086	0.074
15/XII	1681	0-30	night	0.265	0.176
		30-102	night	0.034	0.118
15/XII	1682	0-36	day	0.256	0.14
		37-102	day	0	0.082
		103-191	day	0	0.011
		292-382	day	0	0.025

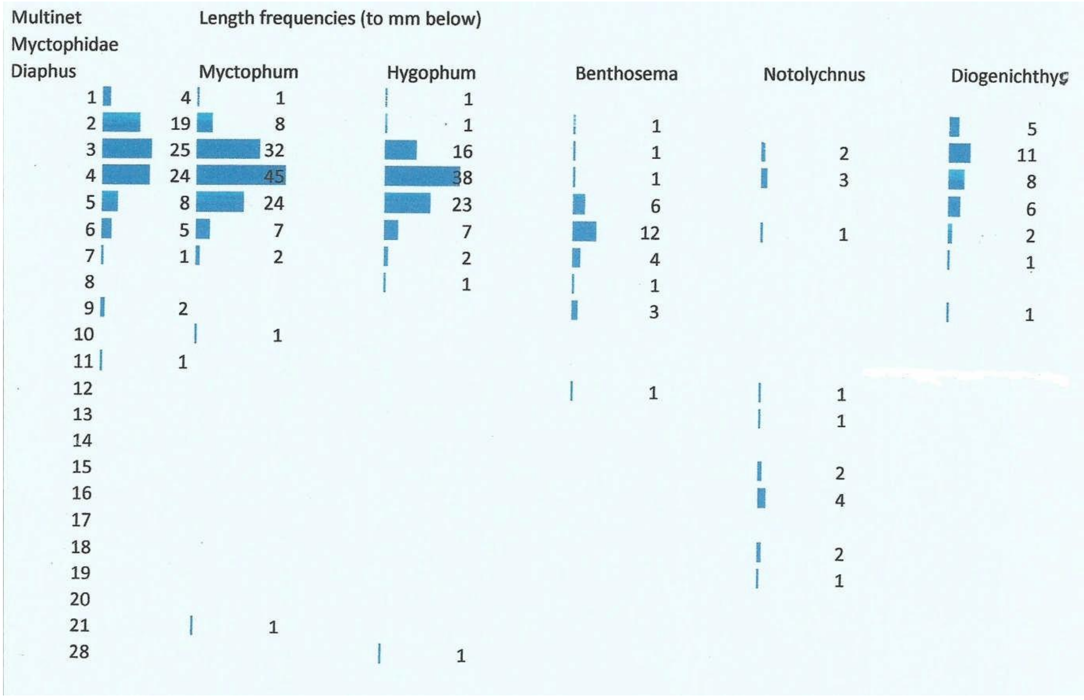


Fig. 34. Multinet 2012. Length frequencies of most common larvae of Myctophidae.

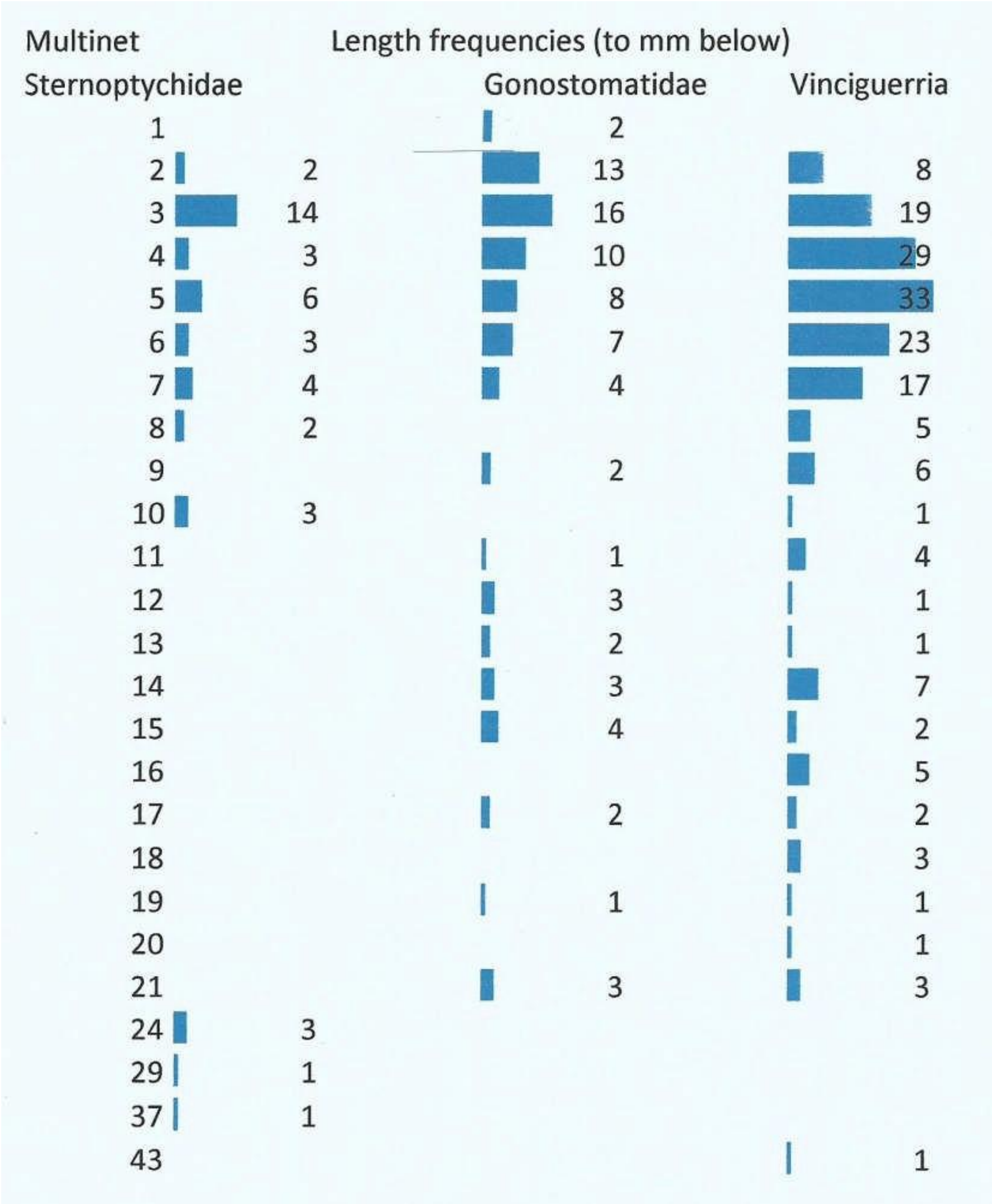


Fig. 35. Multinet 2012. Length frequencies of the most common mesopelagic fish larvae.

Results of the Multinet are further highlighted and extended by the Multisampler and Neuston results. As it is often the case, general account of catches are not very informative because they are dominated by one-two components of lesser interest (salps, jellyfish).

Table 7. Neuston results, 2012 cruise.

Nuston 2012 results (nights only)

Date	Station	Catch kg/hour	Main component
30/XII	1640	0.34	Euphausiiaceae
01/XII	1631	0.04	Myctophidae
09/XII	1631	0.1	Pelagic mollusks
11/XII	1648	0.06	Salps
11/XII	1652	0.06	Salps
12/XII	1656	0.01	Salps
12/XII	1659	0.09	Salps
13/XII	1663	0.31	Salps
13/XII	1666	0.26	Salps
14/XII	1670	36.13	Salps
15/XII	1681	0.95	Salps
15/XII	1677/1682	0.01	Leptocephalus

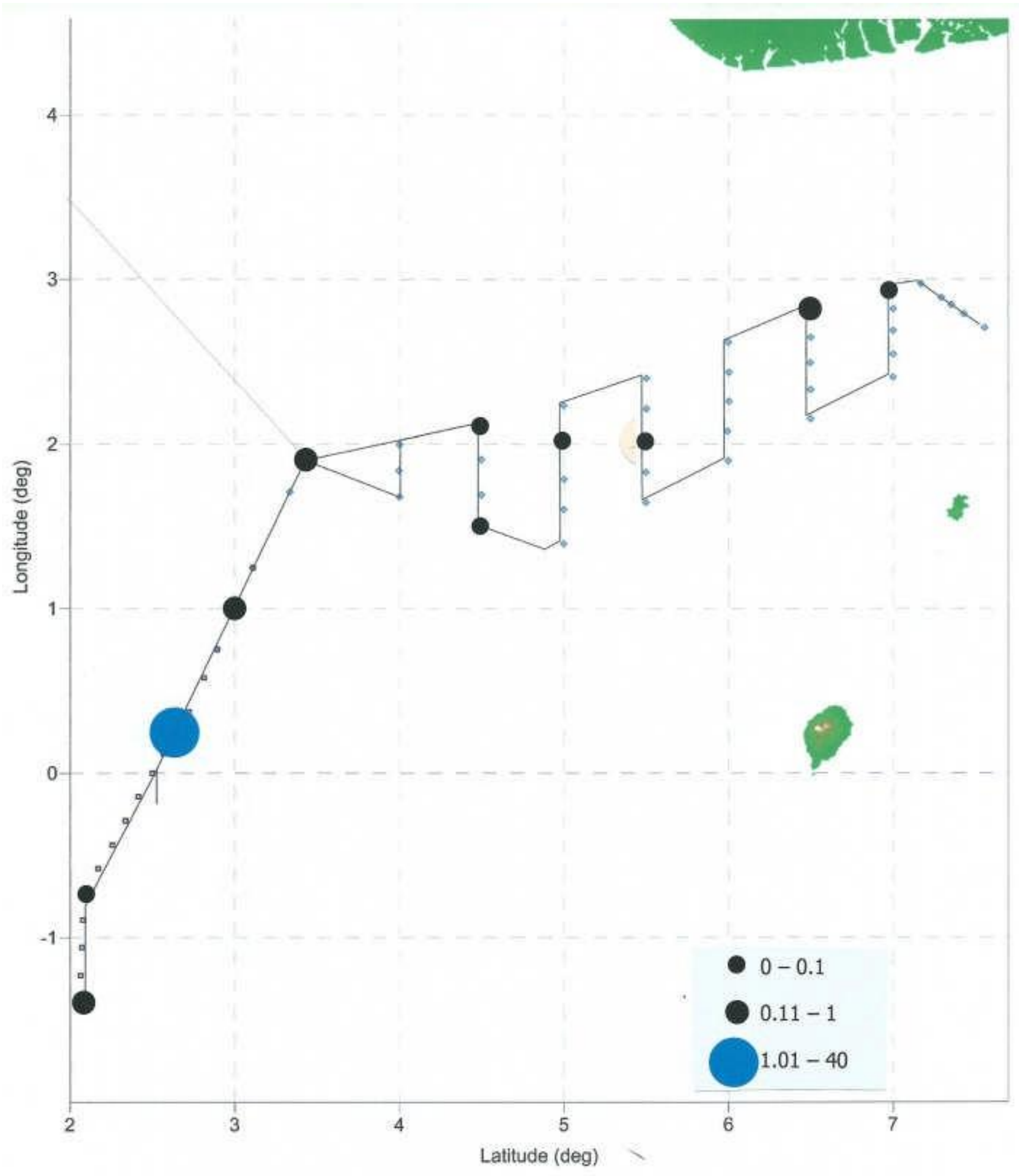


Fig. 36. Results of Neuston catches: distribution and abundance (kg/hour). Surface.
Table 8. Results of Multisampler catches in three depth layers.

Multisampler 2012 results

Date	Time	Station	Depth m	kg/hour	Myc No	Meso No	Dominant
08/XII	day	1626	40	0.59	7	20	Salps, Jellyfish
			210	0.19	0	70	Salps, Jellyfish
			390	0.36	22	13	Salps, Jellyfish
09/XII	day	1636	40	4.43	15	11	Salps, Jellyfish
			250	0.46	17	40	Salps, Jellyfish
			410	8.36	370	115	Salps, Jellyfish
10/XII	day	1644	not done				
11/XII	day	1652	40	86.95	0	173	Salps, Jellyfish
			250	0.86	0	25	Salps, Jellyfish
			380	31.6	243	231	Salps, Jellyfish
12/XII	day	1659	40	4.28	12	42	Salps, Jellyfish
			240	1.3	165	18	Salps, Jellyfish
			370	17.62	268	152	Salps, Jellyfish
13/XII	day	1666	40	6.66	6	12	Salps, Jellyfish
			260	0.8	105	0	Salps, Jellyfish
			380	0.82	271	101	Salps, Jellyfish
15/XII	day	1677/1682	35	5.74	0	18	Ariomma, Salps
			290	0.12	0	6	Ariomma, Salps
			380	4.9	349	6	Ariomma, Salps

1631, 1640, 1648, 1663 night stations: not done due to malfunction of the gear

12/XII	night	1656	30	131.83	2948	326	Salps, Myctophids
			40	48.93	3143	119	Salps, Myctophids
			250	1.43	143	71	Salps, Myctophids
14/XII	night	1670	40	27.81	2548	3886	Salps
			100	0.91	152	42	Salps
			270	0.03	12	3	Salps
15/XII	night	1681	20	28.18	701	30	Salps, Myctophids
			50	8.53	1711	2859	Salps, Myctophids
			250	4.66	224	218	Sapls, Myctophids

Myc No = number of individuals (Myctophidae)
Meso No = number of individuals (Mesopelagics)
Average weight of one myctophid is 4 g, and mesopelagic 3 g. Max weight per hour: 12.6 kg of myctophids and 11.7 kg of mesopelagics.

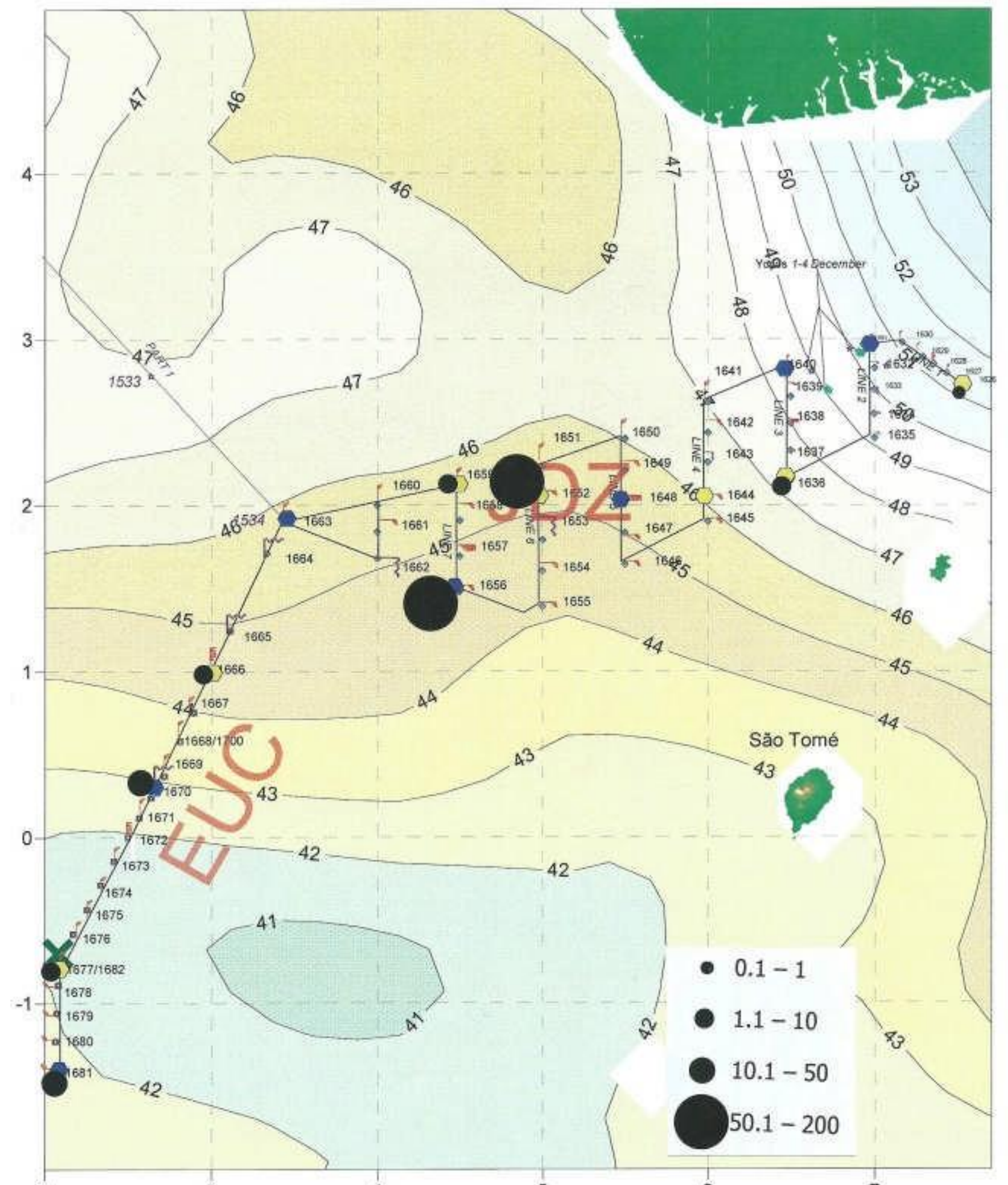


Fig. 37. Multisampler results: distribution and abundance (kg/hour)

Results concerning myctophids and mesopelagics (Table 8, Figs 38-39) expressed as number of individuals per hour, provide an answer about locations of main concentrations of their juveniles and adults.

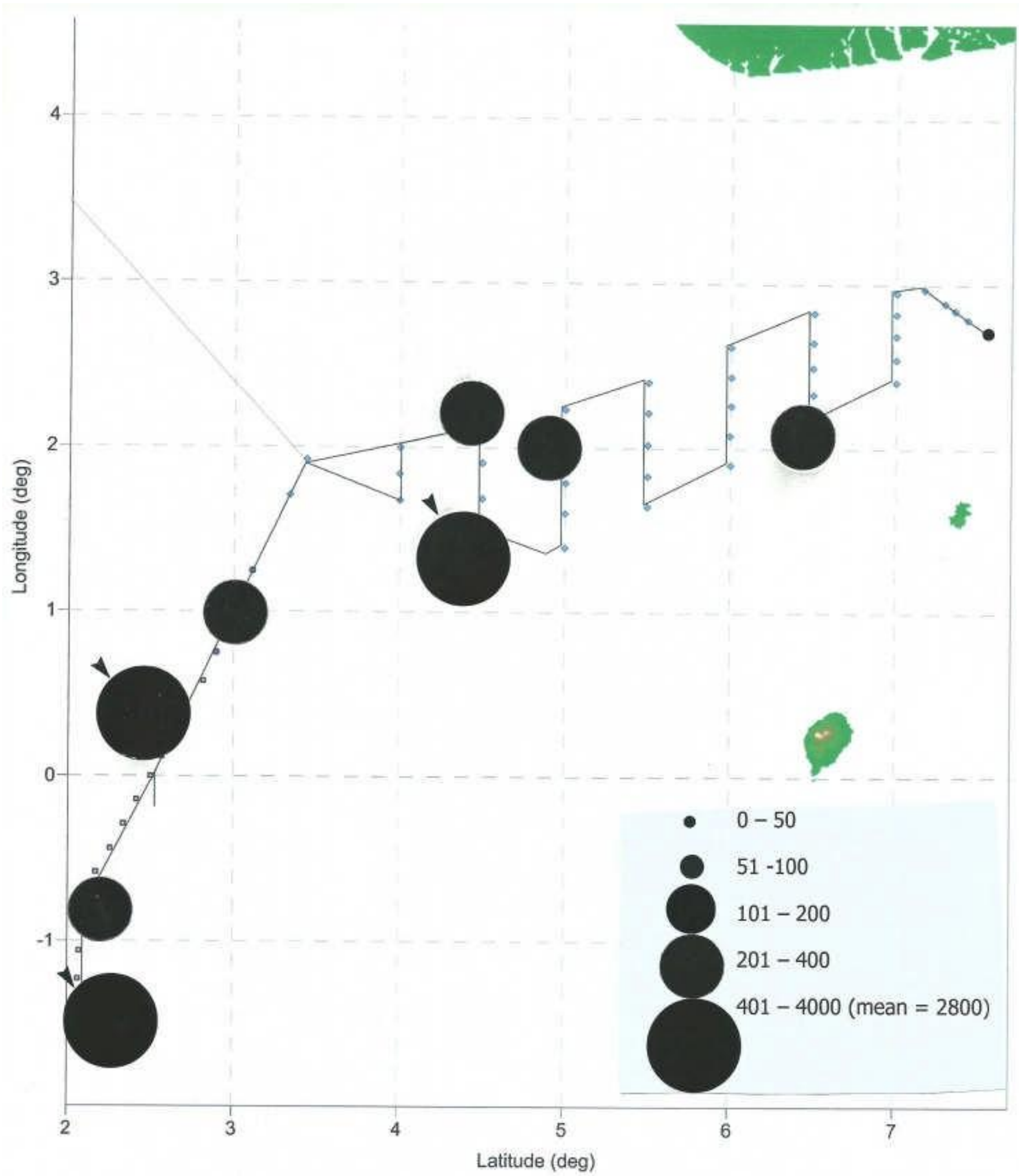


Fig. 38. Multisampler results for myctophids (Myctophidae): main concentrations and abundance (individuals per hour). Arrows indicate stations done at night.

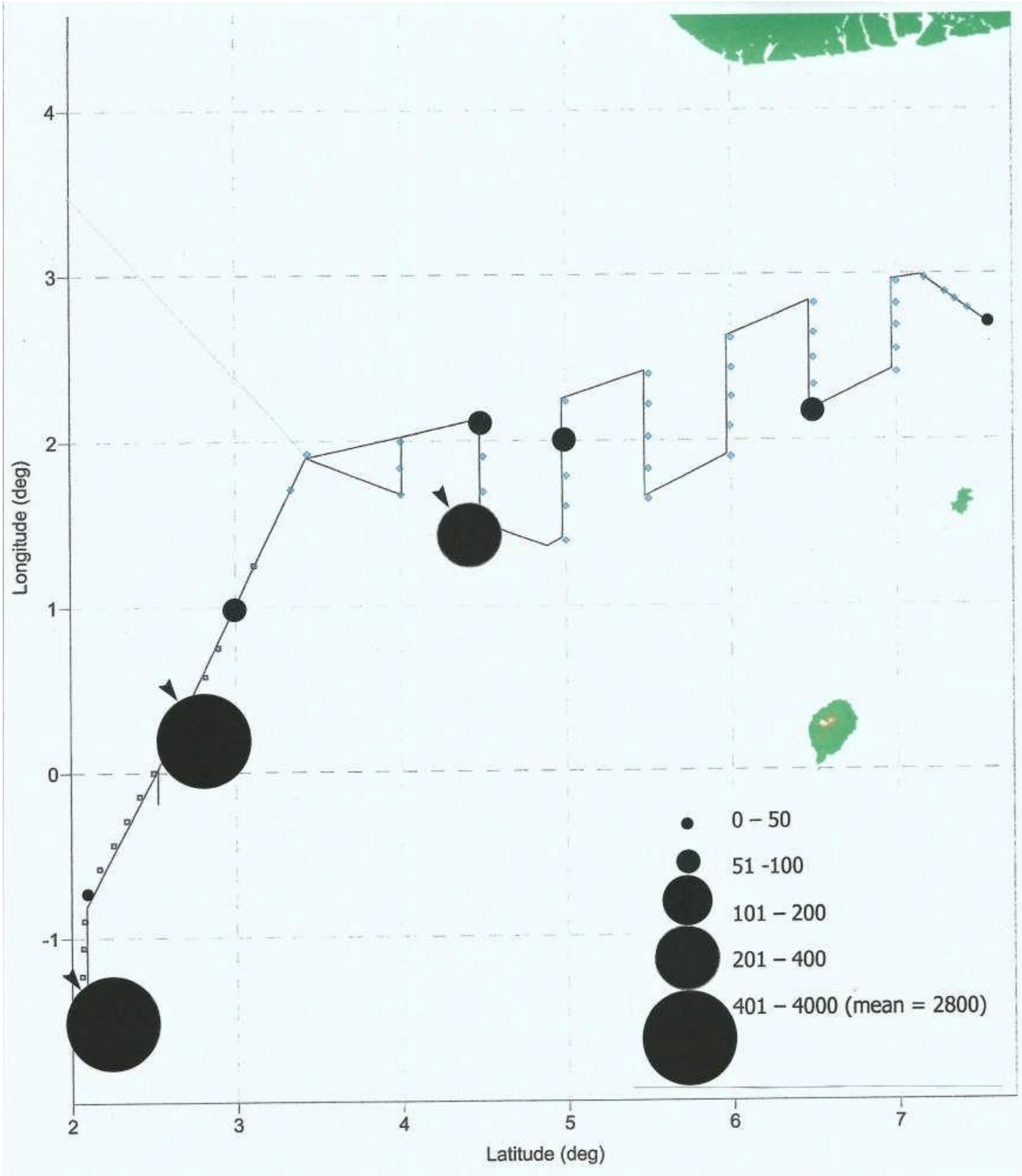


Fig. 39. Multisampler results for mesopelagic fish: main concentrations and abundance (individuals per hour). Arrows indicate stations done at night.

From these results it is clear that larvae of myctophids and mesopelagics are distributed differently than juveniles and adults (please compare Figs 32-33 with Figs 38-39). It may mark an ontogenetic migration of these animals, but it also may mark predation patterns in different areas. Also, material caught in Multinet is much smaller than that of the Multisampler; small number of executed stations and stratification effect may mask true differences and similarities. This is why, among other reasons, to do elaborate statistics on a scant data results more often than not in the wrong conclusions, and subsequently, wrong research directions. To differentiate between the cause and effect, and account for possible explanations, additional and rather broad biological research in the field is necessary.

Table 8 provides data which underline the level of dispersal and a small biomass of the catch: only 12.6 kg per hour of Myctophidae and 11.7 kg of mesopelagic fishes at best. On average, this catch was much smaller. To make a profitable catch for fish meal, specially designed large pelagic trawl would be required, which would be towed by two vessels (like in fish meal operations on Baltic Sea). Even then catches may be too small. Further experiments of concentrating fish using powerful lights may be conducted but this enormously lifts the costs, probably beyond any profitability. Also, further research concerning length frequency distribution is necessary as collected data present juvenile and stretched LFs (Fig. 40AB,41).

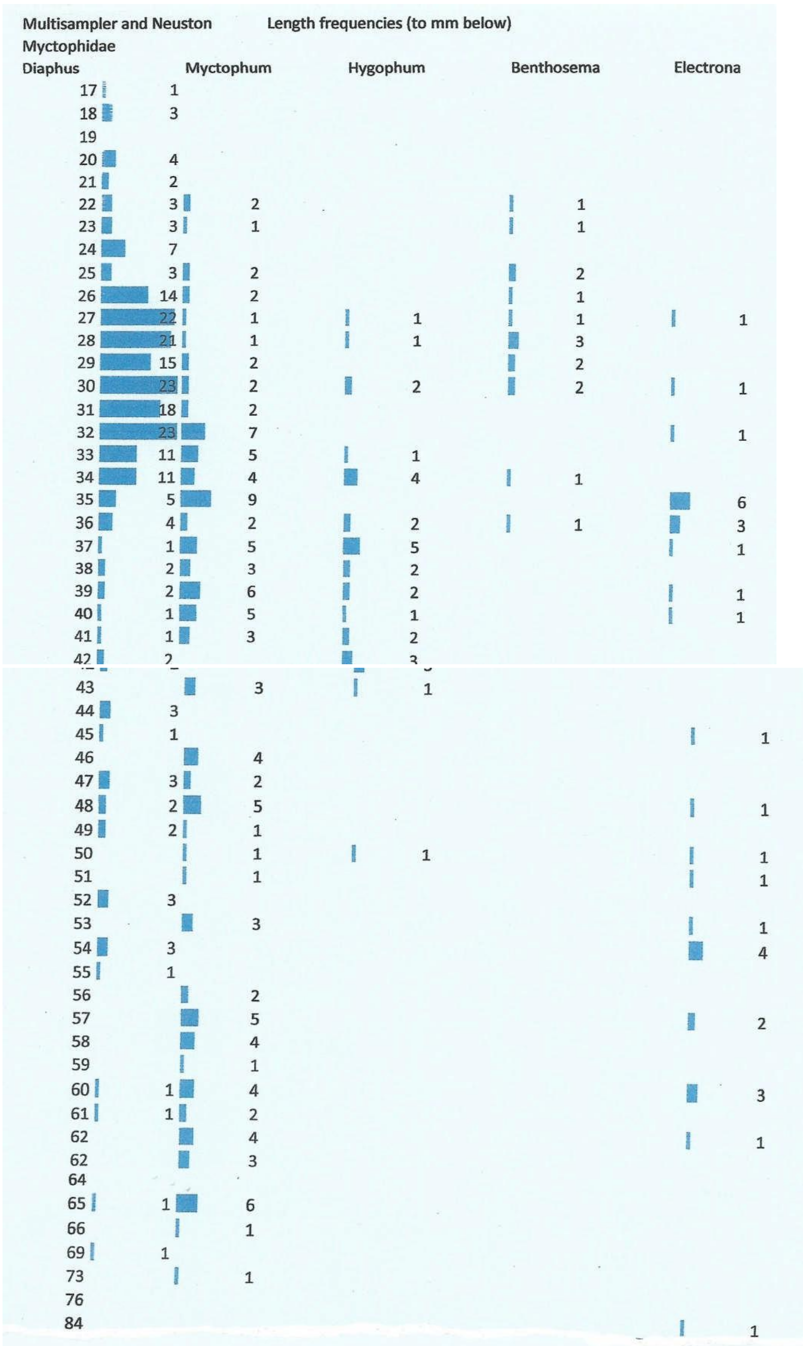


Fig. 40A. Length frequencies of Myctophidae caught in the Multisampler, 2012 (in mm below)

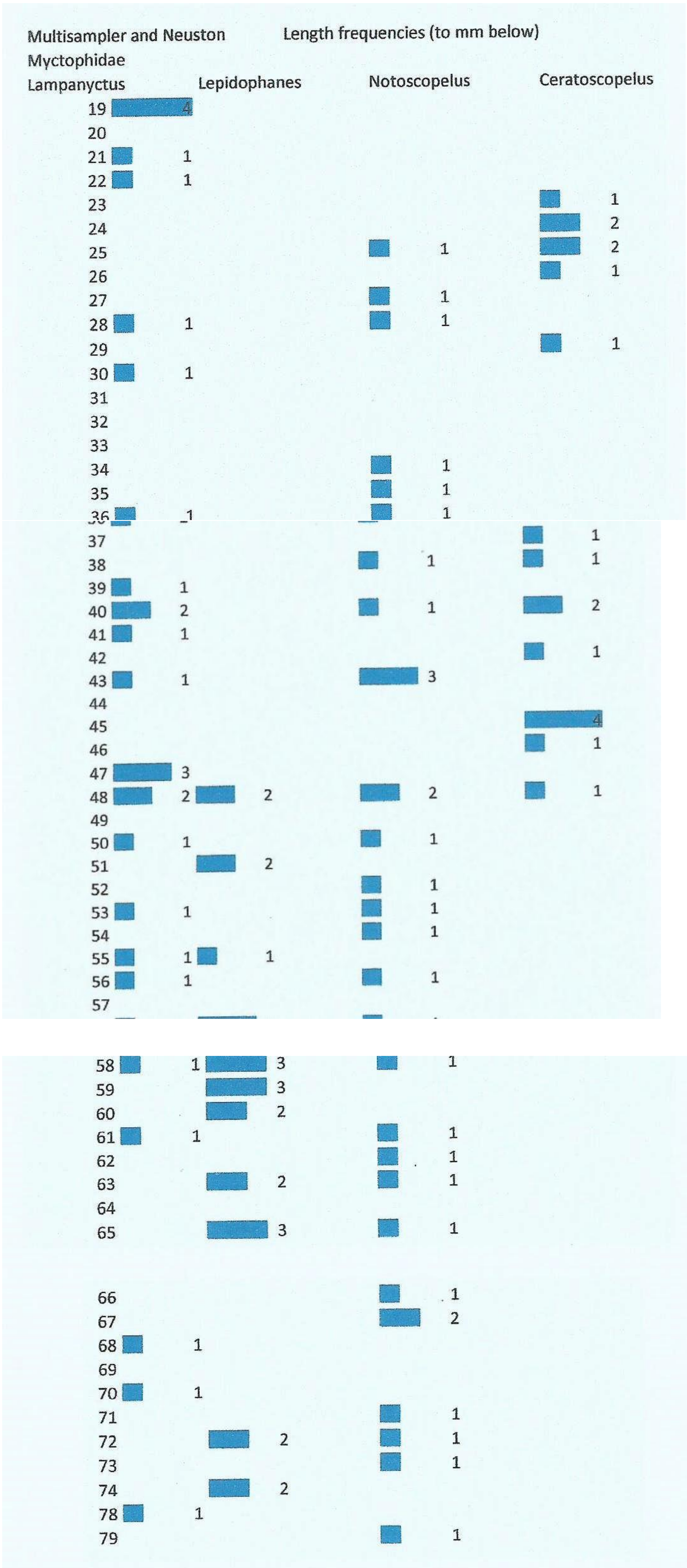


Fig. 40B. Length frequencies of Myctophidae caught in the Multisampler, 2012 (in mm below).

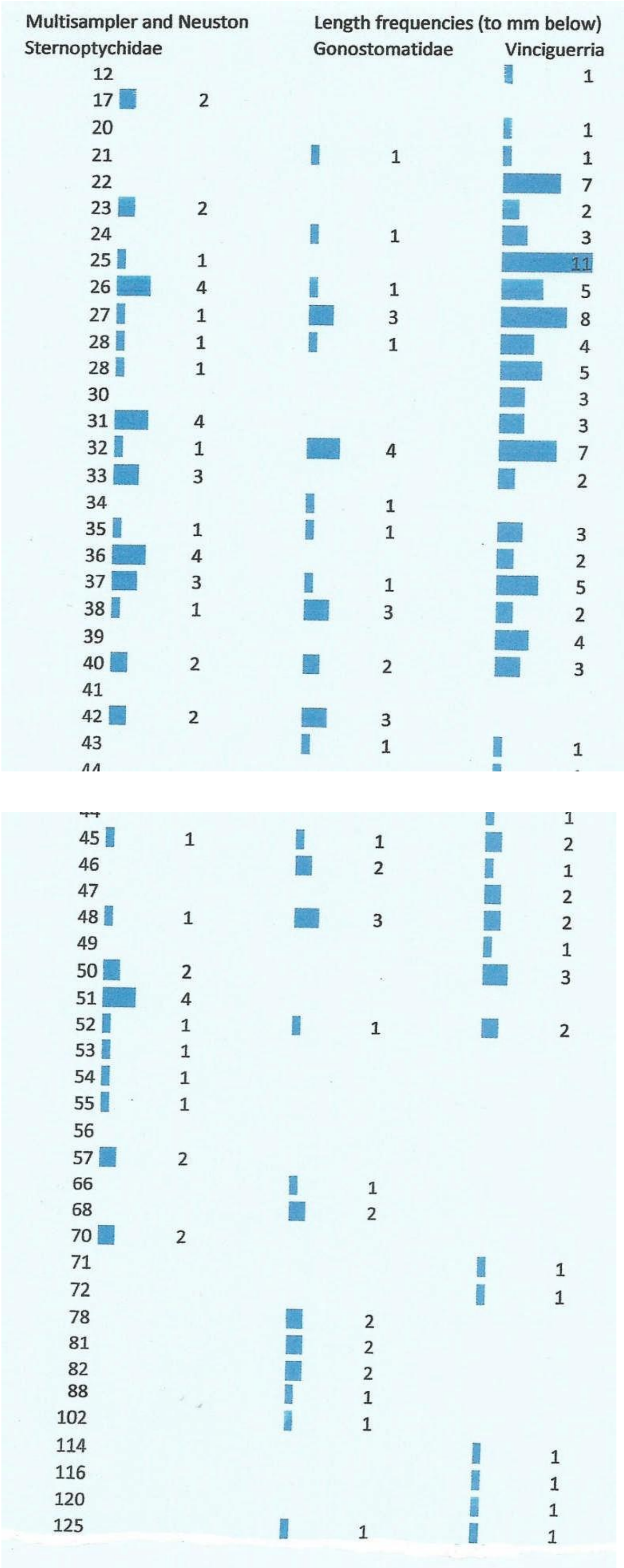


Fig. 41. Length frequencies of most common mesopelagics caught in the Multisampler, 2012 (in mm below). For further information on the most abundant mesopelagic (Vinciguerria), see Olivar and Fortuno, 1991 p. 96-99.

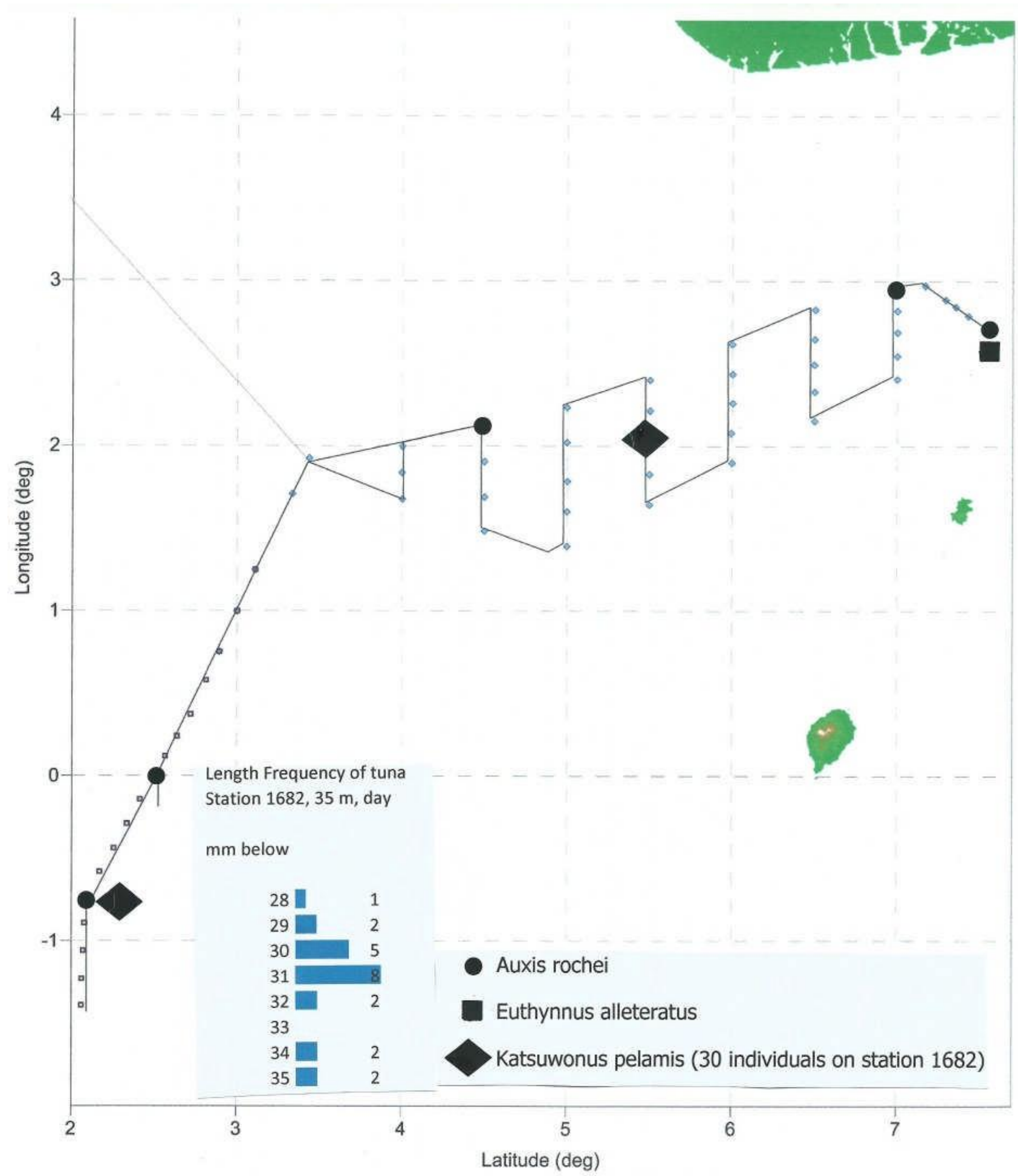


Fig. 42. Catches of juvenile tuna in the area of operations, 2012.

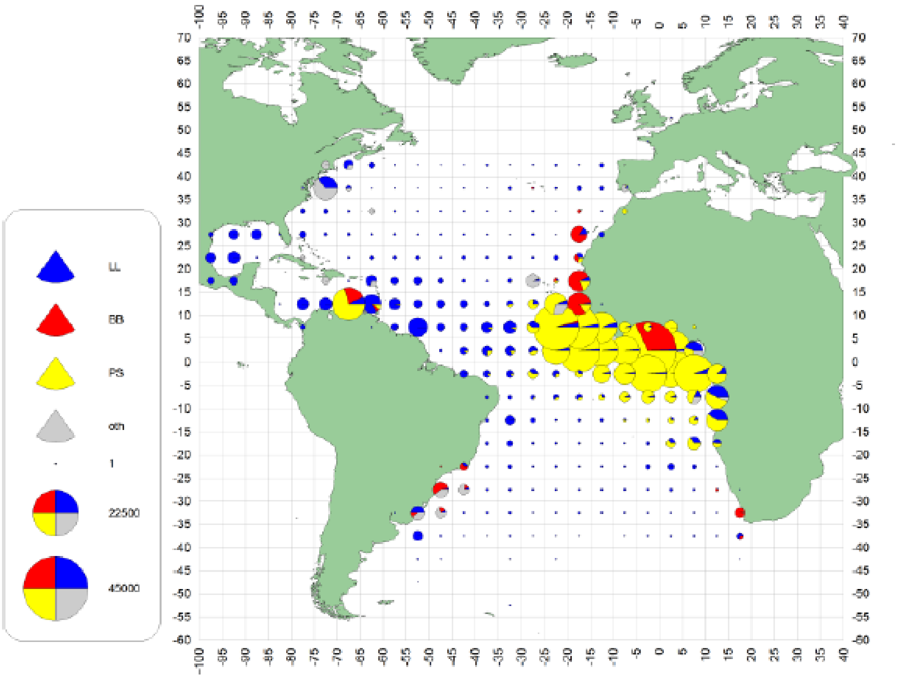
Fig. 42 illustrates distribution of three tuna species juveniles encountered during the survey. These findings follow the same patchiness pattern visible in zooplankton and other fish larvae & juveniles. There were single findings of bullet tuna (Auxis rochei) except station 1682 where two were found, single little tunny Euthynnus alletteratus at station 1626, and skipjack tuna found at 1682 (30 individuals, 31 mm length on average) and at 1648 (single individual, at night on the surface).

3.3 Fish

Tuna resources in Nigeria and Sao Tome é Principe (Joint Development Authority)

Tuna resources are mapped within the convention area of the International Commission for the Conservation of Atlantic Tunas (ICCAT)
Nigeria became an official member of ICCAT in 2007, while in São Tomé Principe has been an official member of ICCAT since 1983. NeitherNigeria or São Tomé é Principe has delivered annual report on fisheries and statistics to ICCAT's scientific committee SCRs. The two countries do not participate in research meetings of ICCAT. São Tomé and Principe in contrast to Nigeria submitted to ICCAT catch statistics on the various tuna species found and harvested in their waters.
There is a general tendency that the commercial fishery for various tuna species in ICCAT's Convention area in São Tomé é Principe has increased during the past 5-10 years, while we know very little when it comes to fishing activity and catches of different tuna species in Nigeria.

Yellowfin tuna
Yellowfin tuna (yellowfin tuna) are fished throughout the tropical Atlantic Ocean between 40 ° N and 45 ° S with surface gear (purse seine, live bait and line) (Figure 1). It was reported catches between 160 and 169 tons of yellowfin tuna for Sao Tome é Principe, while Nigeria as far as we know have not been assigned any quota of yellowfin tuna and they have not reported any catch.

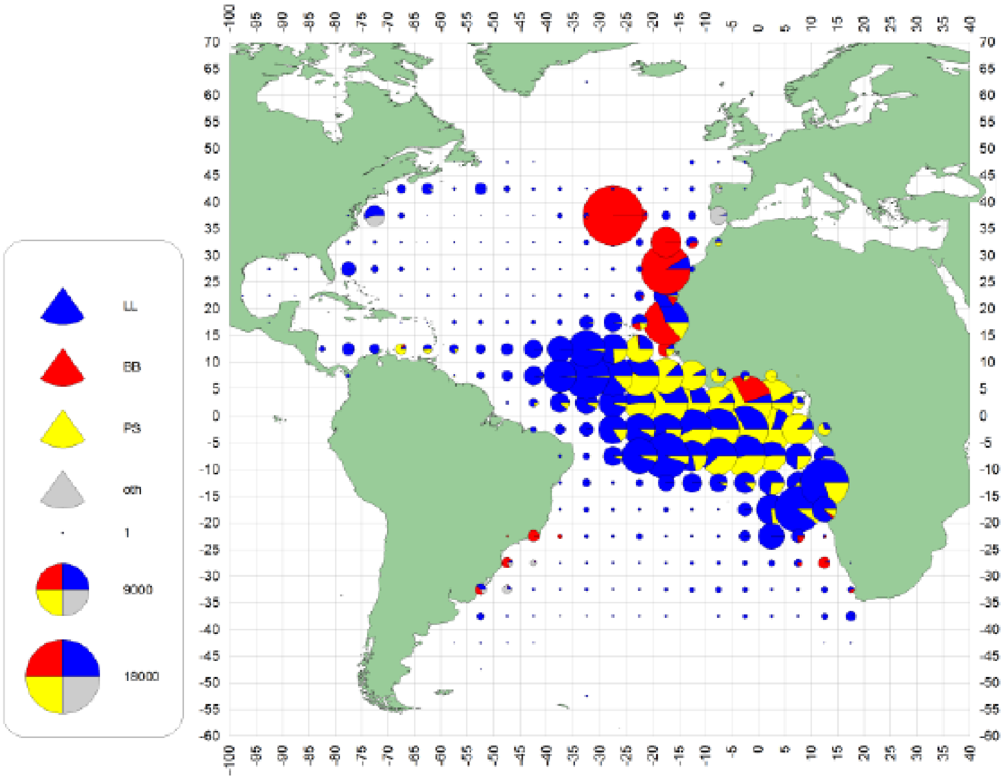


f. YFT(2010-12)

Figure 3.3.24 Geographical distribution of yellowfin tuna catches in the South Atlantic Ocean for the period 2010-2012. The main fishing methods was line, live bait, purse and seine.

Bigeye tuna
Bigeye tuna is widely distributed throughout the tropical and subtropical waters of the Atlantic Ocean, Indian Ocean and the Pacific. The geographical distribution is limited by 55-60 ° N and 45-50 °

S (Figure 2). From São Tomé é Principe catches of 92-97 tons were reported for the period 2008-2010 for bigeye tuna. Nigeria did not report any catches of bigeye tuna in this period.

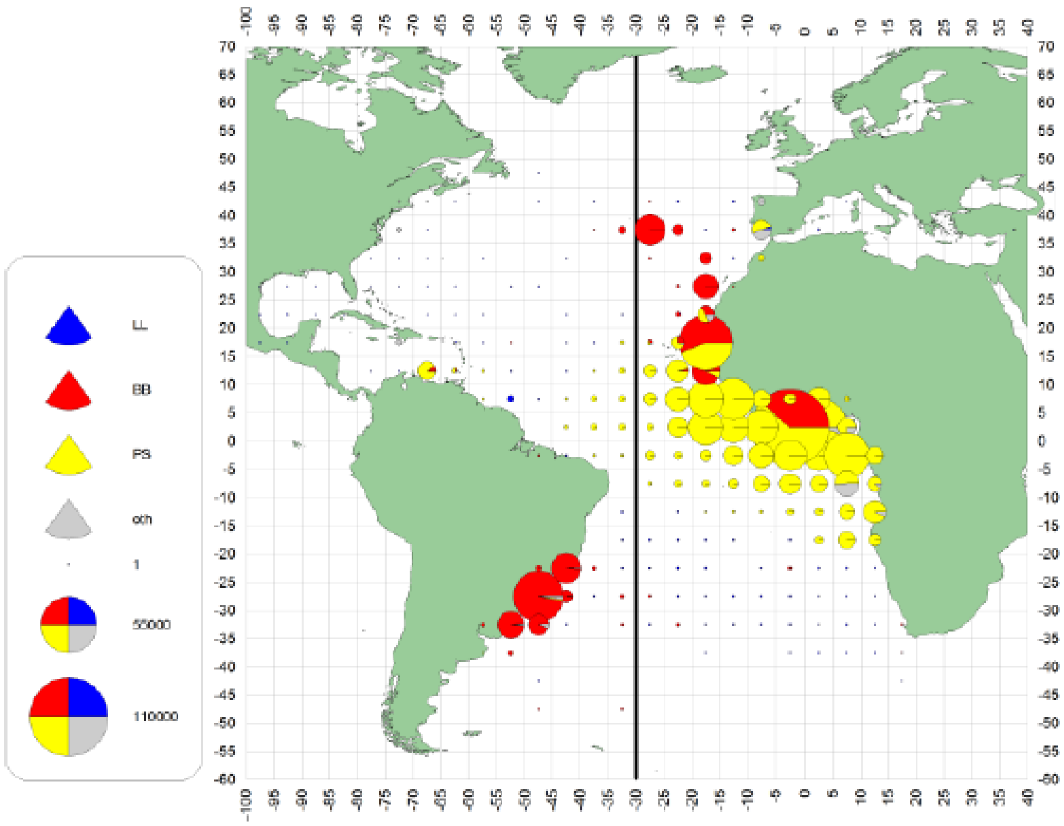


f. BET(2010-12)

Figure 3.3.25 Geographic distribution of bigeye tuna catches by major fishing gear from 2010-2012.

Skipjack tuna

Skipjack tuna is a cosmopolitan species found in shoals in tropical and subtropical waters of the Atlantic Ocean, Indian Ocean and Pacific Ocean. The geographical distribution is limited by 55-60 ° N and 45-50 ° S (Figure 3). The reported catches of skipjack tuna were between 229 and 241 tons from 2008-2010 in São Tomé in Principe. Nigeria has not reported any catch of skipjack tuna to ICCAT.



f. SKJ(2010-12)

Figure 3.3.26 The distribution of skipjack tuna catches of various equipments for the period 2010-2012.

Albacore

Albacore is a cosmopolitan species that is found in tropical and subtropical waters of the Atlantic Ocean, Indian Ocean and Pacific Ocean. The geographical limits are 55-60 ° N and 45-50 ° S (Figure 4). Neither Nigeria or São Tomé é Principe have reported catches of albacore.

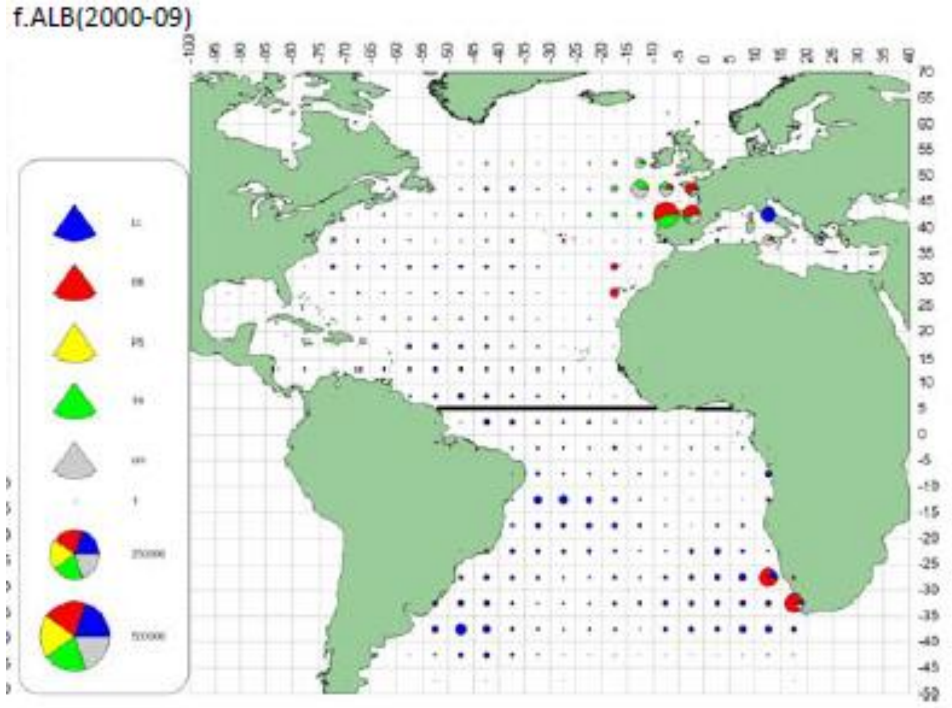


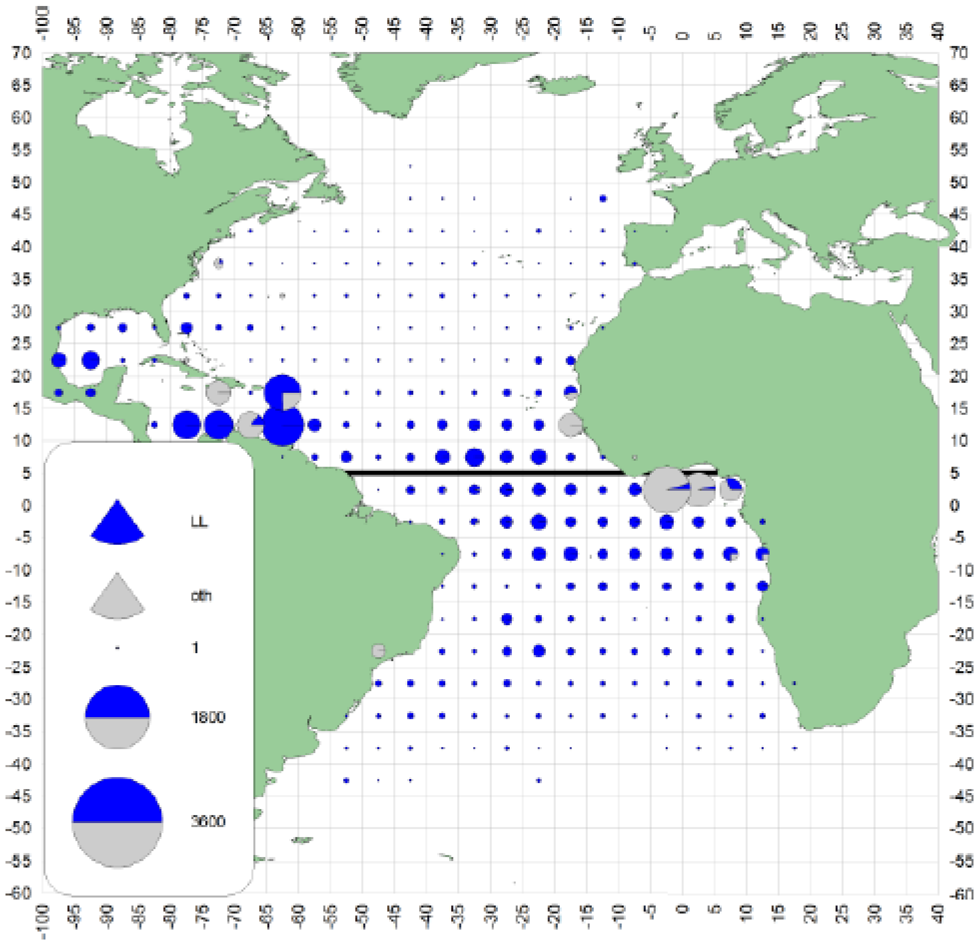
Figure 3.3.27 Distribution of catches of albacore for the period 2000-2009.

Bluefin tuna

Neither Nigeria or São Tomé é Principe in quotas or catch bluefin tuna mostly due to the fact that the countries mainly located outside the coverage area.

Blue marlin

Blue marlin are widely distributed in the sub-tropical and tropical waters in the Atlantic, and sometimes it's also more temperate Atlantic waters. White marlin are widely distributed in the sub-tropical and tropical waters in the Atlantic and found occasionally in temperate waters of the Atlantic and in the Mediterranean. The geographical distribution is between 50 ° N and 45 ° S (Figure 5).

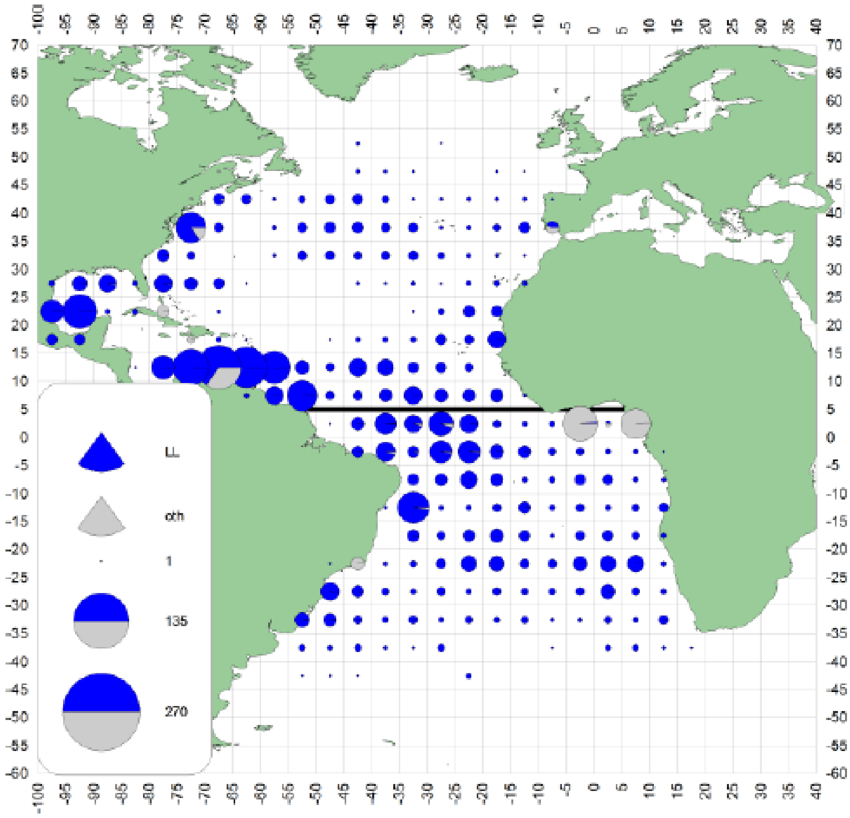


. BUM(2010-12)

Figure 3.3.28 Geographical distribution of blue marlin catches between 2010-2012.

White marlin

White marlin has a geographical distribution between 55 ° N and 45 ° S. São Tomé é Principe reported catches between 68 and 72 tons of blue marlin and 38-40 tonnes of white marlin between 2008 and 2010. Nigeria has not reported any catches of white and blue marlin to ICCAT.

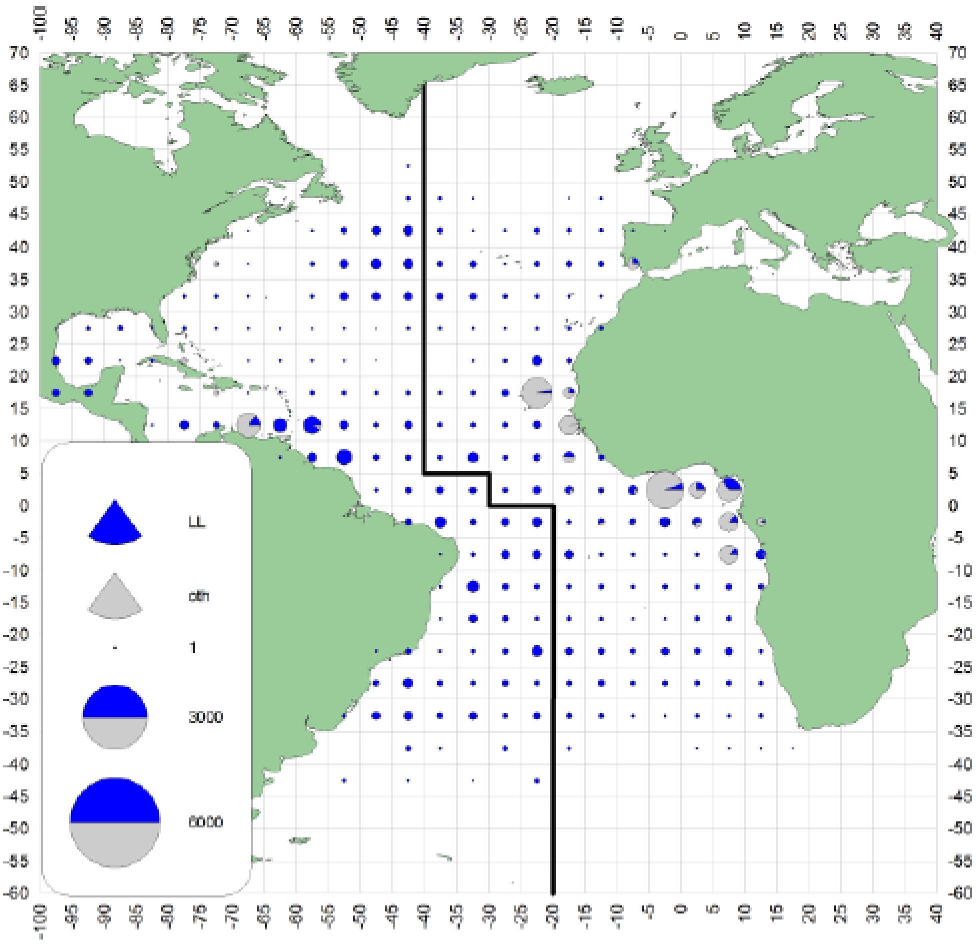


f. WHM(2010-12)

Figure 3.3.29 Geographical distribution of white marlin catches between 2010-2012.

Sailfish

Sailfish has a distribution that goes around the globe in tropical waters. In the Atlantic Ocean, the species is widely distributed in tropical and sub-tropical waters of the Mediterranean. The geographic distribution limits based on commercial catches ranging from 40 ° N to 40 ° S. São Tomé é Principe reported catches of between 114 and 121 tons of sailfish from 2008-2010. Nigeria has not reported any catches of sailfish to ICCAT.

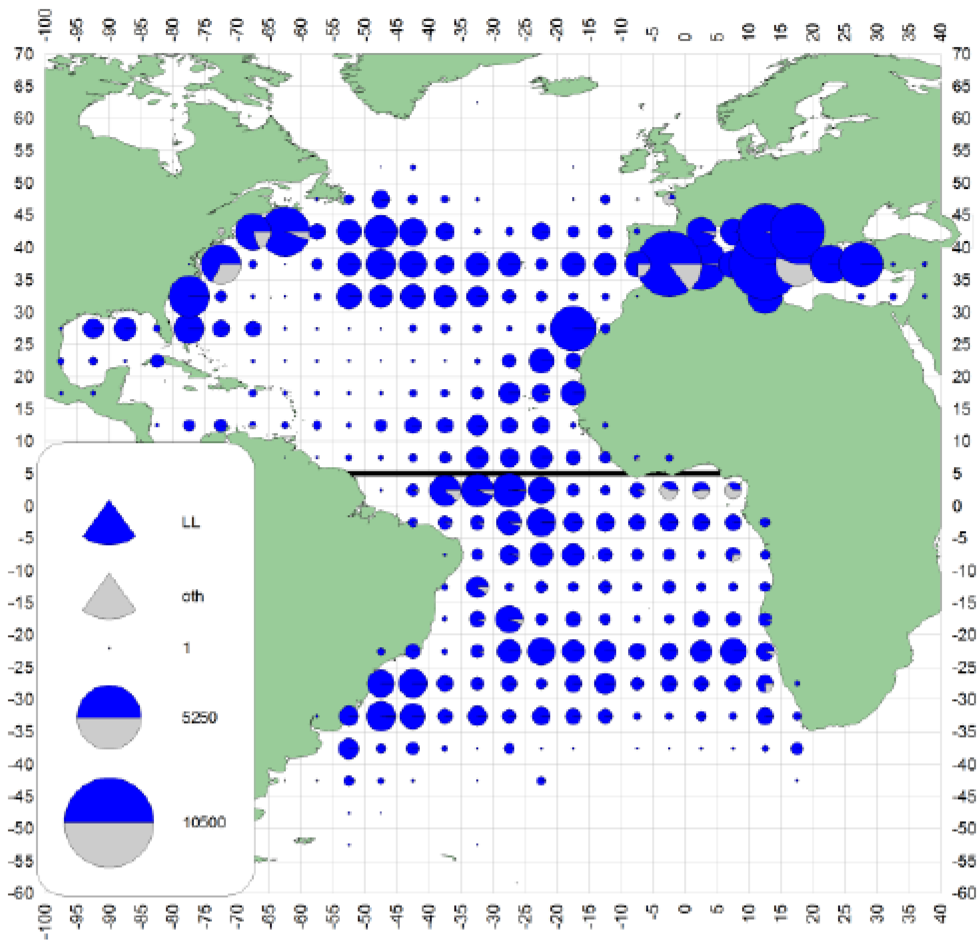


f. SAI(2010-12)

Figure 3.3.30 Distribution of reported catches of sailfish for the period 2010-2012.

Atlantic swordfish

Atlantic swordfish is a cosmopolitan species found in tropical and sub-tropical waters between 45 ° N and 45 ° S (Figure 8). São Tomé é Principe reported catches between 183 and 193 tonnes of Atlantic swordfish between 2008 and 2010. Nigeria has not reported any catches of Atlantic swordfish at ICCAT.



f. SWO(2010-12)

Figure 3.3.31 Geographical distribution of Atlantic swordfish catches between 2010-2012.

Small tuna species
São Tomé é Principe has for many years reported catches of small tuna species to ICCAT. Nigeria has not reported any catches of small tuna species to ICCAT.

Frigate tuna
Frigate tuna has a worldwide distribution in tropical and sub-tropical waters. It is distributed between 45 ° N and 35 ° S in the Atlantic Ocean. Between 275-290 tons of frigate tuna were reported caught by São Tomé and Principe in the period 2008-2010.

Atlantic black skipjack
Atlantic black skipjack is distributed on both sides of the tropical and sub-tropical Atlantic Ocean, including the Mediterranean, Caribbean and Gulf of Mexico. Between 183-193 tonnes of Atlantic black skipjack were reported caught by São Tomé and Principe in the period 2008-2010.

West African Spanish Mackerel
Between 91-96 tons were reported captured by West African Spanish mackerel in São Tomé and Principe in the period 2008-2010.

Wahoo
Between 135-241 tons Wahoo were reported caught in São Tomé é Principe in the period 2008-2010.

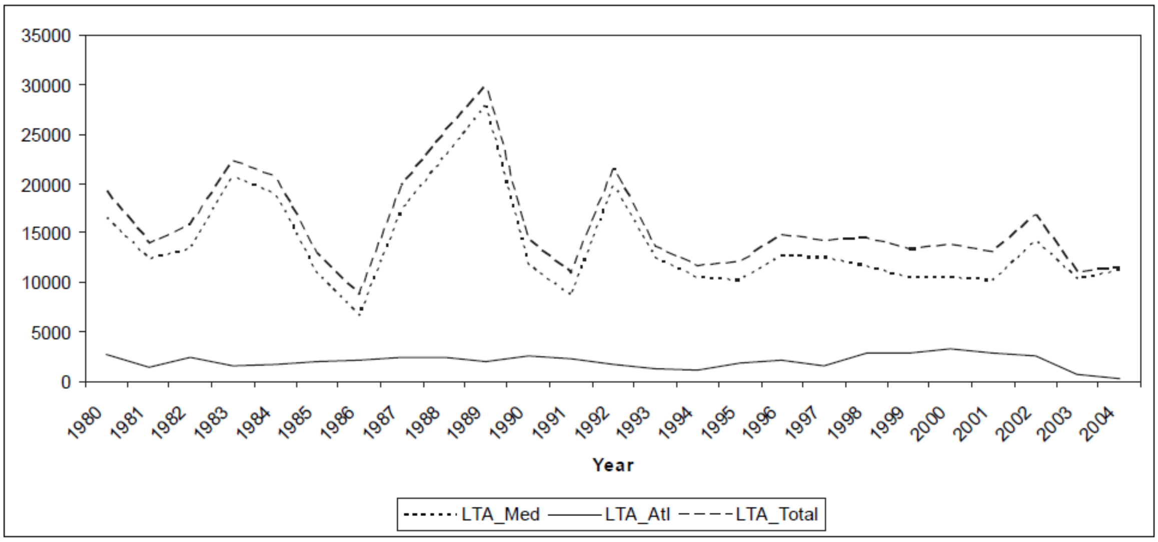


Figure 3.3.32 shows the distribution and migratory pattern of Yellowfin Tuna in the South Atlantic. Notice the high concentration of larvae and mature fish in the Gulf of Guinea in the first quarter of the year.

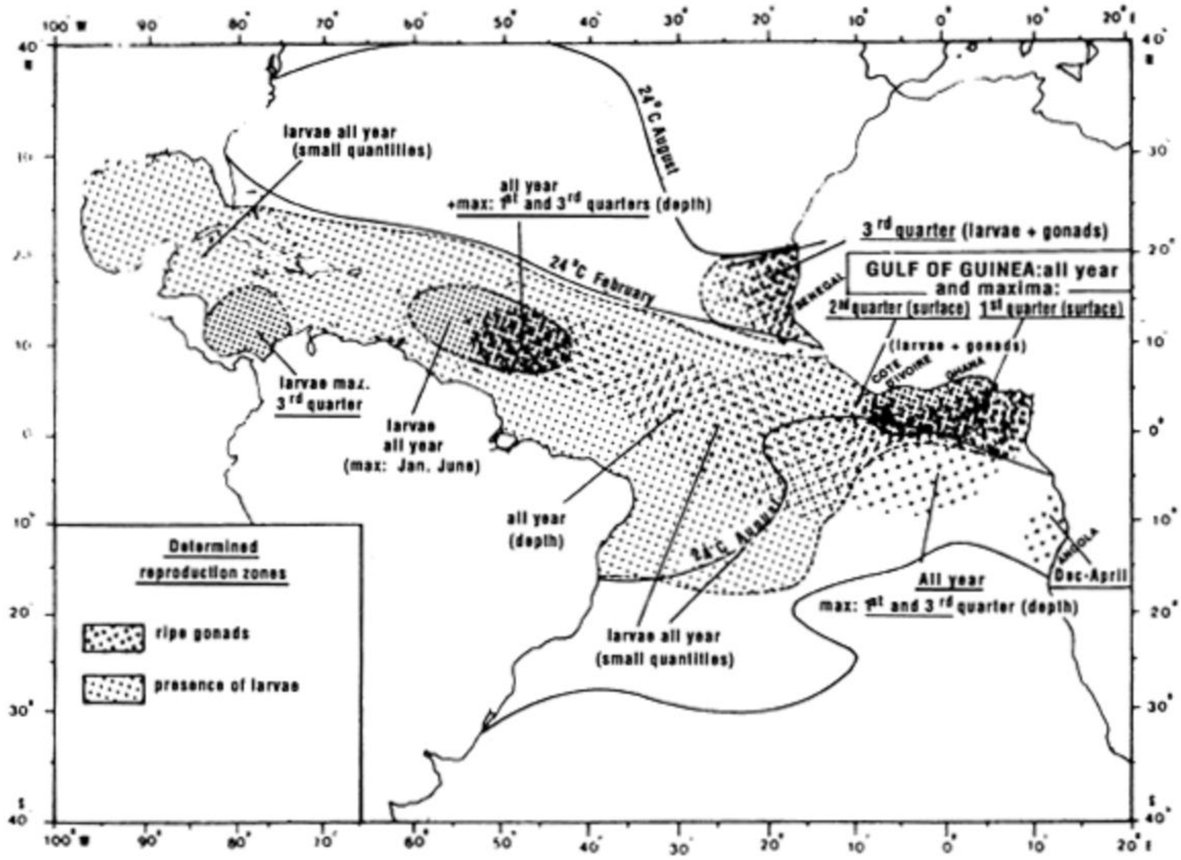


Figure 3.3.22. Pattern of the spatio-temporal distribution of yellowfin reproduction in the Atlantic.

Discussion

The Guinea Current Large Marine Ecosystem Project (2010), in part entitled "Zooplankton Survey in the GCLME" has argued that temperature was found to be the main driving force behind all encountered variability and patterns.
Yaqub (2000) also pointed out that temperature and oxygen were the main factor controlling copepods abundance in Ghanaian coastal waters and the fact that copepod zooplankton has been on the decreasing side since the eighties. GCLME Project also pointed out that zooplankton abundance appeared to be seasonal, high during upwelling periods (July-September, when temperatures are lower) and small in the warmer periods (March-June, when temperatures are at maximum).
Species diversity was found to be low in upwelling seasons with species such as the Calanoides carinatus dominating among the copepods. This species in a normal sample at the peak (August) of the cold (upwelling) season could constitute a significant proportion by number (60-80%) of the zooplankton (Houghton and Mensah, 1978). However, its low numbers may indicate an increase in temperature in the Gulf of Guinea. A study on climatic trend with particular reference to temperature in the Gulf of Guinea by Koranteng and McClade, 2002 has revealed this persistent increase in temperature which they attributed to climate change and global warming. Calanoides carinatus abundantly occurs in temperatures below 23°C and any increase could cause the disappearance of the species, and development like this could affect community structure during the upwelling period (Wiafe,2002).
Temora stylifera ,Eucalanus crassus and E. pileatus dominated the samples collected during GCLME Project irrespective of their location, season and the year and could be concluded that these species are tolerant of wide range of environmental conditions and could do well in most environments. However, they are most abundant during the warm periods. Bainbridge, 1972 and Vervoot, 1965 agreed that Temora stylifera is widely distributed in the world oceans and occurs along the whole of African coast. As a result of the global warming these species, especially T. stylifera, could take over even during upwelling periods, thereby causing a shift in the community structure as well as in the diet of important commercial species of fish. Results of the Dr Fridtjof Nansen plankton survey in 2012 gave a very different account of the zooplankton IDs, distribution and abundance to that of GCLME Project. This is partially because GCLME Project has dealt with more inshore waters, towards Ghanaian coast, where upwelling influence may be strong. Calanus carinatus was entirely absent from JDZ Project results. Various species of Temora (e.g. T. stylifera) were present in 25-50 m layer, but as in GCLME Project, there was notable lack of patterns. In contrast, non-calanoid Oithona and Oncaea (Fig. 43; distribution and abundance illustrated in the report) as well as Nannocalanus showed distinct patterns in their horizontal and vertical abundance.

Fig. 43. Copepod Oncaea venusta.

These copepods are of very small size and their role in the marine ecosystems was recognized only fairly recently (Bottger-Schnack, 1996; Gallienne and Robins, 2001; Oliveira Dias et al, 2010). As indicated by Piontkovski et al., 2003, their role stems from the fact that higher turnover rates (and hence production per area) are inverse function of size (Fig. 44).

Fig. 44.

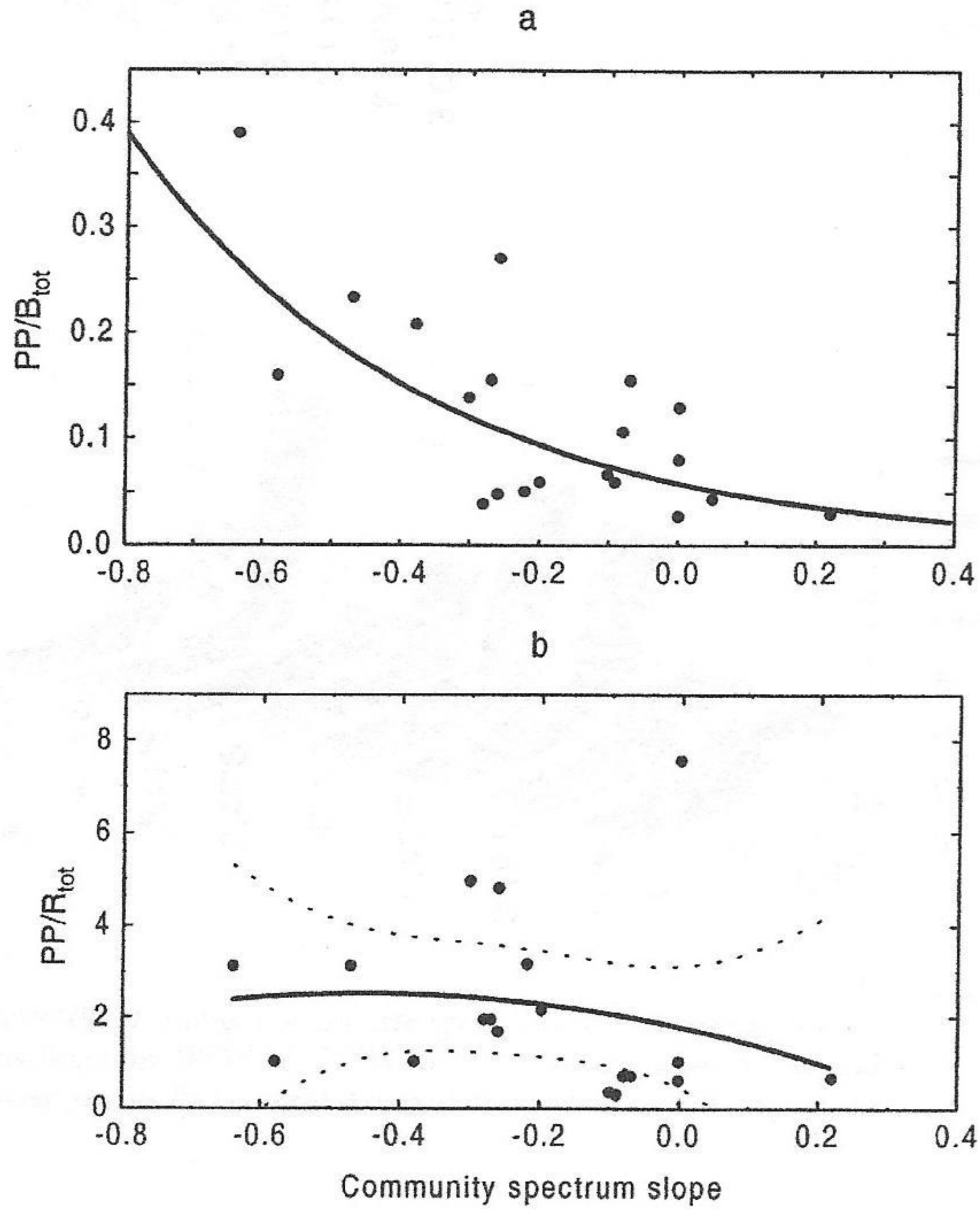


Fig. 44. Turnover rate (a) and the balance between production and community metabolism (b) as functions of a community spectrum slope. PP = primary production; B_{tot} = total biomass; R_{tot} = total metabolism.

Piontkovski et al. (2003) for eastern tropical Atlantic and Oliveira Dias et al. (2010) for subtropical Brazilian waters found similar zooplankton spectra to these reported here. However, it is difficult to make a detailed comparison with the published data, as zooplankton of the JDZ area and its relation to the natural resources (exploited and not exploited, such as mesopelagics) is much less explored that zooplankton of the northern part of the Gulf (related to Sardinella aurita and its fishery; Binet and Marchal, 1993; Wiafe et al., 2008). Also, interpretations of simple presence-absence,

as well as relative abundances, should take into consideration instantaneous predation pressures leading to hypothesis explaining diel migrations of some zooplankton species (Yamaguchi et al., 2004), but also possibly explaining sudden changes in their distribution and abundance.
The same concerns apply to patterns described here for myctophids and mesopelagics, with an additional factor: net avoidance on all gear levels (Kaartvedt et al., 2012).

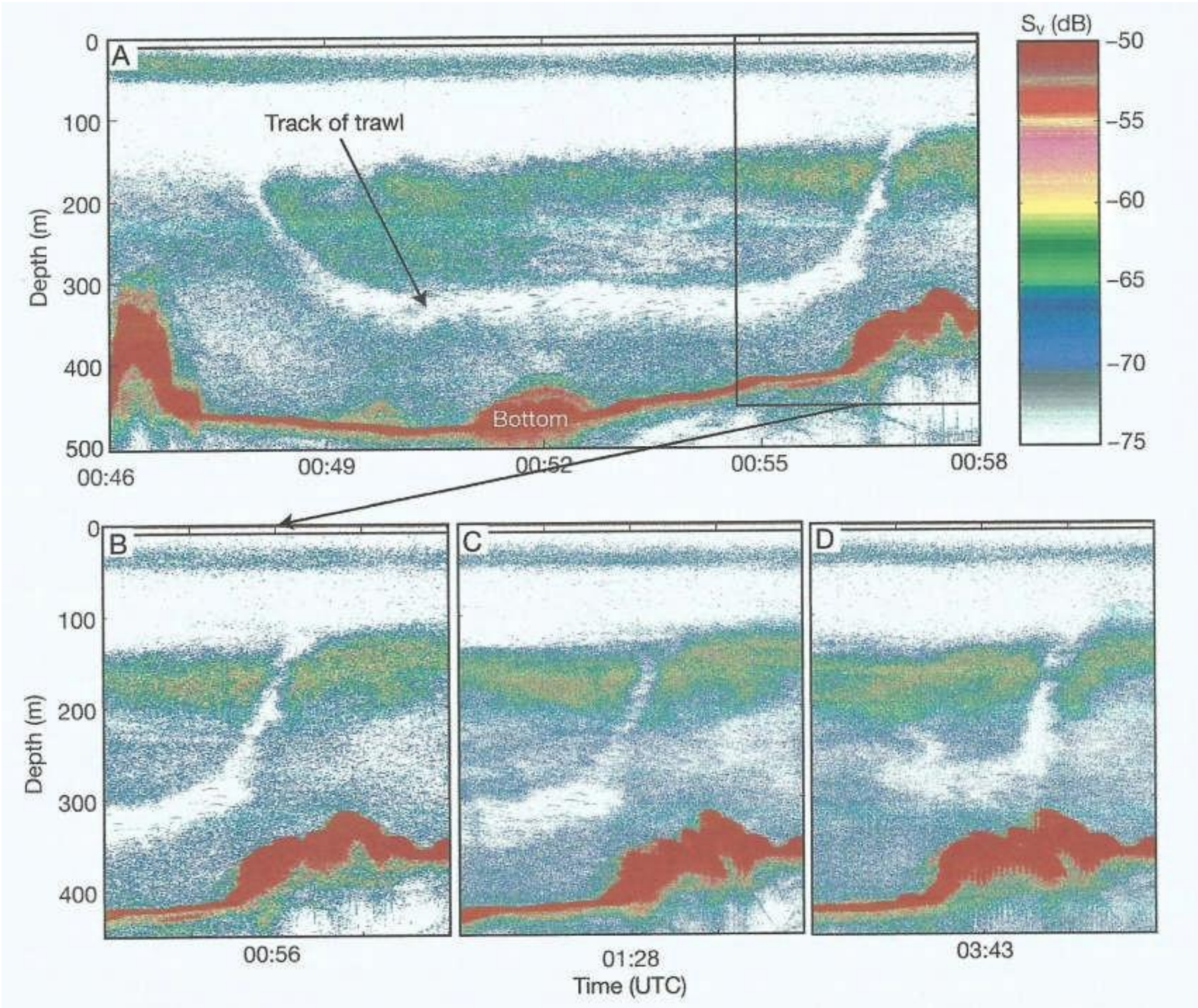


Fig. 45. Avoidance of trawl. A. Echogram recorded when the path of a preceding trawl tow was traversed; signature with low backscatter depicts the track of the trawl. B-D. Persistence of the void created by the trawl (deployed at ~23h30). The trawl had free throughflow and was not sampling on its way down (B-D), so the void in the acoustic record cannot be explained by removal of fish by the gear. Color scale refers to volume backscattering strength (S_V), with brownish-red as the strongest echoes. From Kaartvedt et al., 2012.
Therefore the results of 2012 Multisampler and Neuston based results and their interpretation (see results) should be treated with caution, and be followed by further research. Piontkovski et al. (2003) for a proper statistical treatment of their data have required 81 stations with full account for physical, chemical and biological measurements on each station (executed from July to September). Similar effort will

be required for an improvement to present preliminary suggestions. These suggestions are as follows.

Zooplankton was abundant but typically patchy, concentrated both day and night in the thermocline related zone (20-50 m). This is the main zone of future investigations as it provides ample food for next trophic levels, right to the top. Zooplankton has shown to be more abundant in the southern and south-western part of the JDZ in May 2011, but this pattern needs to be investigated in more detail (especially in other seasons).
Myctophid and mesopelagic larvae tend to occur in greater numbers in the northeast of the JDZ, but juveniles and adults strongly so in the south-western part of the region. They concentrate more at night at 20-50 m of water; however, this resource shows such level of dispersal that their exploitation in JDZ would not be profitable at this stage. Also, it must be borne in mind that this is the main food for large predators in the marine food chain (Marchal et al., 1993). It is feared that simultaneous exploitation at the base and at the top of the trophic pyramid may not be sustainably possible. These preliminary findings require further research on a broader time- and space base.
During the course of research, tuna juveniles were found across the researched area. Most of them (32 individuals) were found on one station during the day at depth of 35 m. However, results were too scant to draw any conclusions besides reporting their presence, number and size. Tuna-specific research is recommended for JDZ. On the basis of the literature review and ongoing international efforts, this is potentially most promising course of fisheries-related development for the region. Older papers on tuna fisheries in the Gulf of Guinea are interesting because they are suitable for comparisons with the most recent data (e.g. Beardsley, 1969; Postel, 1969).

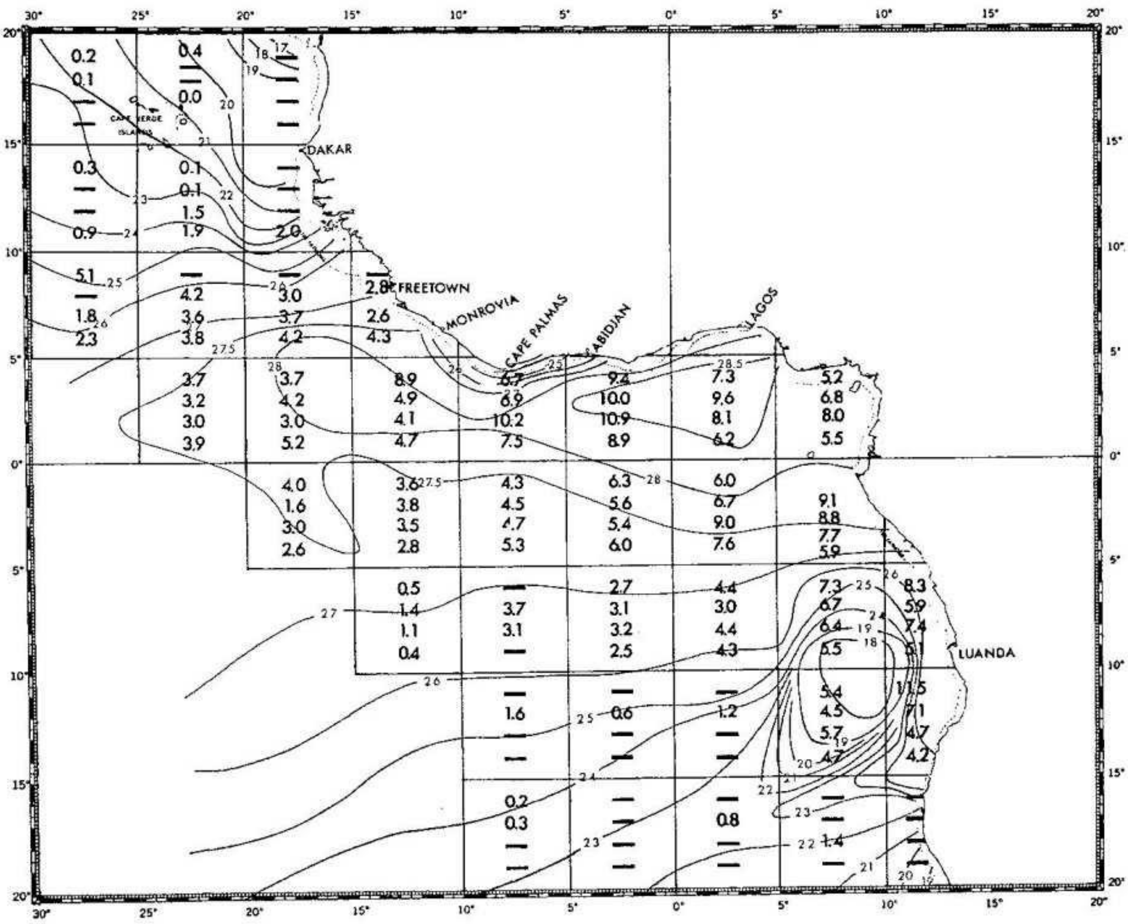
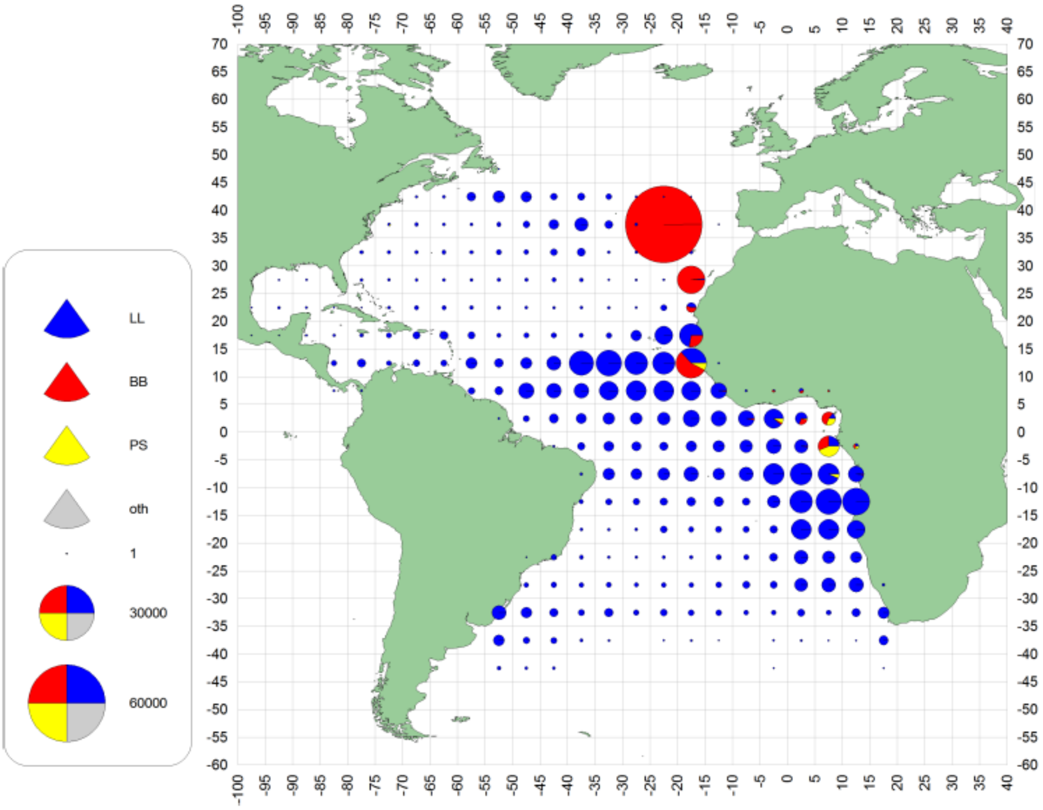
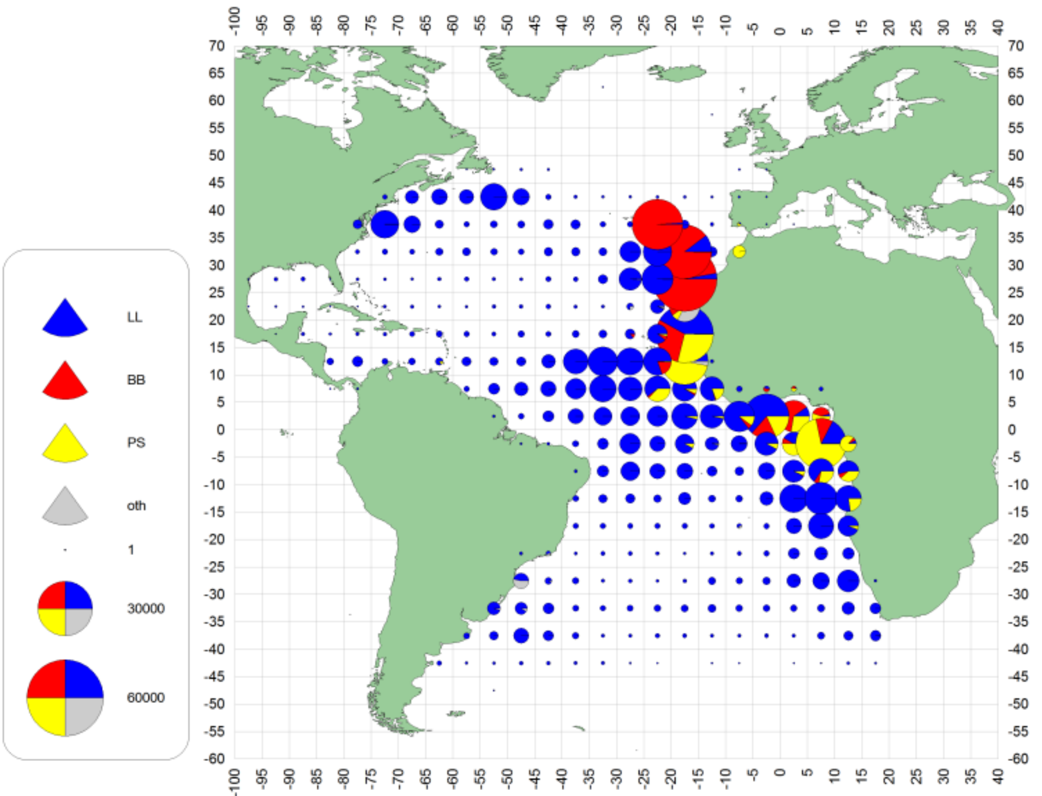


Fig. 46. Average monthly catch rates of yellowfin tuna (No/100 hooks) by the Japanese long-line fishery in the Gulf of Guinea by 5o of latitude and 5o of longitude Jan.-April 1957-1964. Dash – no fishing. The average catch rate for January is at the top of the column. The isotherms indicate temperature at 20 m Jan.-April. According to the Nigerian Institute of Oceanography and Marine Research in Lagos, prospect of developing further tuna fishery in the area lies around 20,000 tonnes per year. USAID West Africa website lists even higher figure of 55,000 tonnes per year.

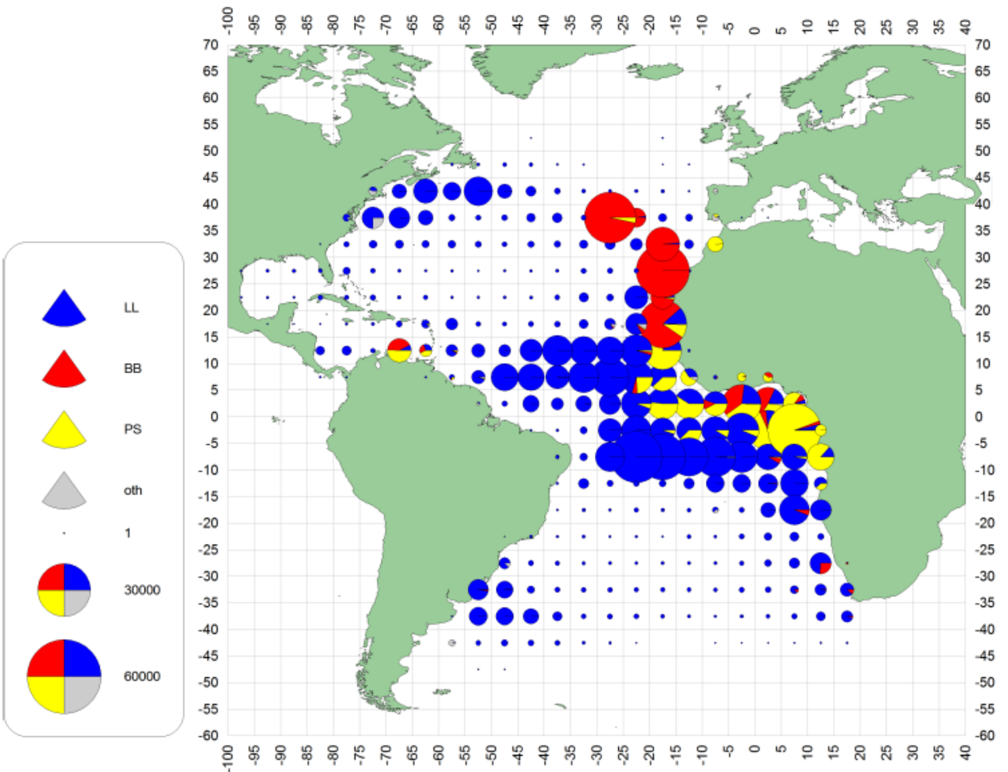
Literature and data about tuna fisheries is very large, there is no shortage of information and advice. ICCAT website provides catch records (as above) and pictorial guides about abundance & distribution per region and throughout the year.



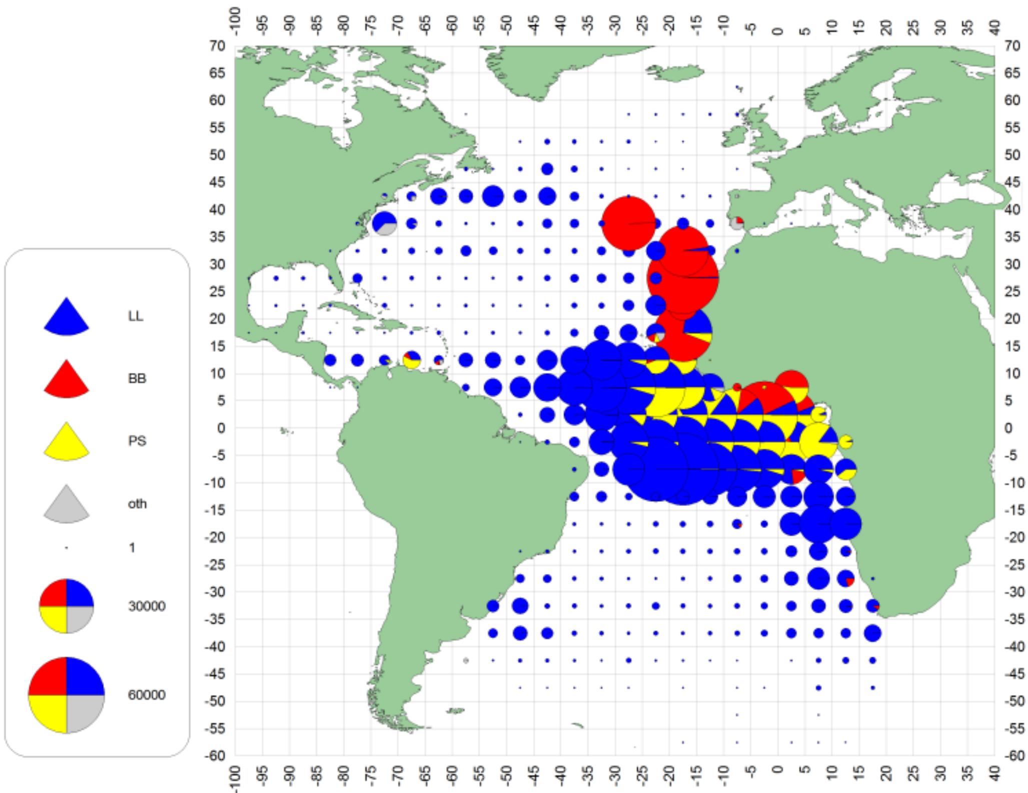
a. BET(1960-69)



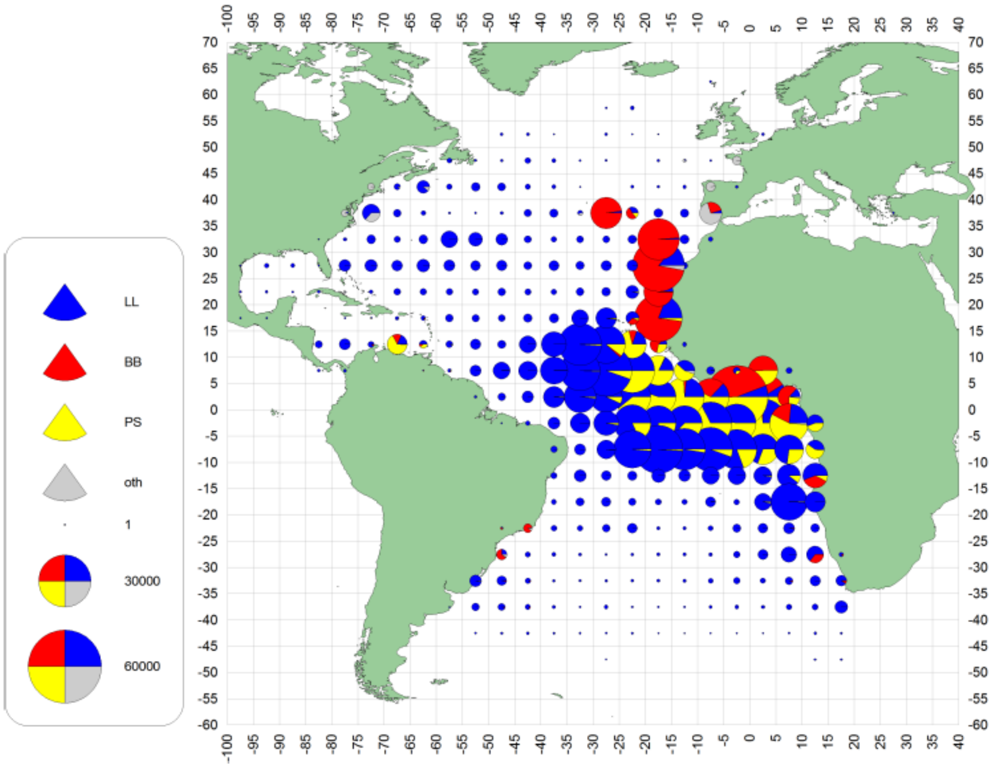
b. BET(1970-79)



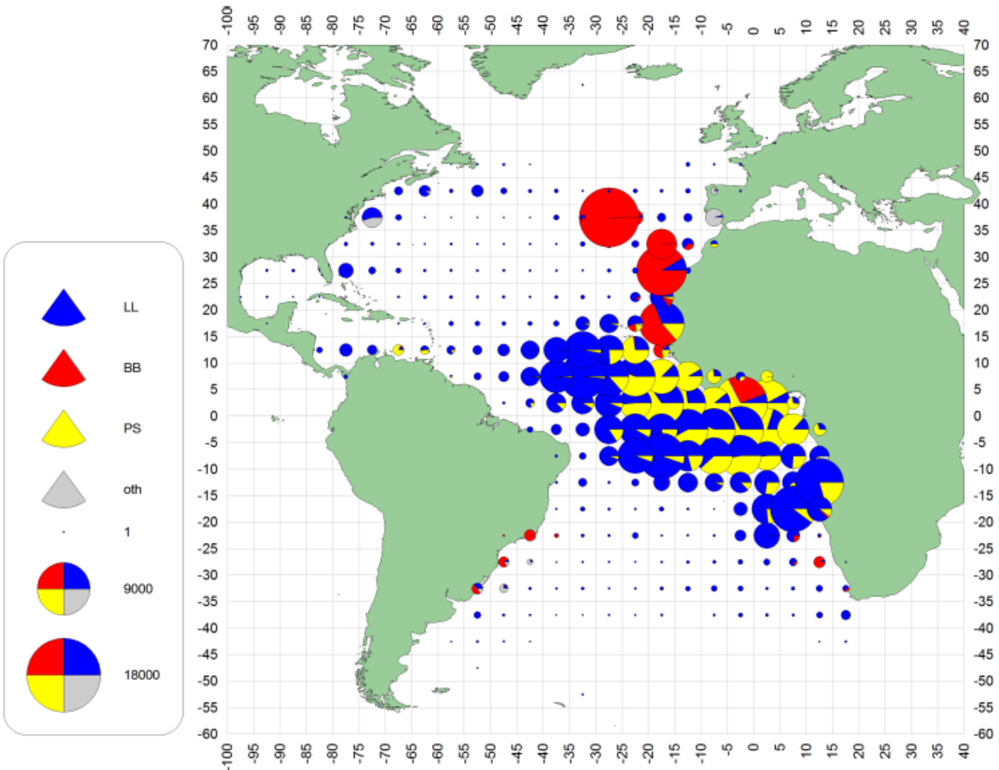
c. BET(1980-89)



d. BET(1990-99)



e. BET (2000-09)



f. BET(2010-12)

Figures 51[a-f] Geographical distribution of BET catch (t) by major gears and decade

Fig. 47. An example of ICCAT information about tuna (for a bigeye).

There is a number of examples how to conduct tuna related research (e.g. Oceana MarViva Project for Bluefin Tuna: http://oceana.org/es/node/458; Ageykum et al., 2012; Pecoraro, 2012).

Pecoraro (2012) has conducted a survey entitled “Catch and by-catch analyses of tropical tuna fishery in the Gulf of Guinea from 2010 to 2012” (University of Bologna, Italy), on a French purse seiner M/V Via Avenir. His results are shown below.

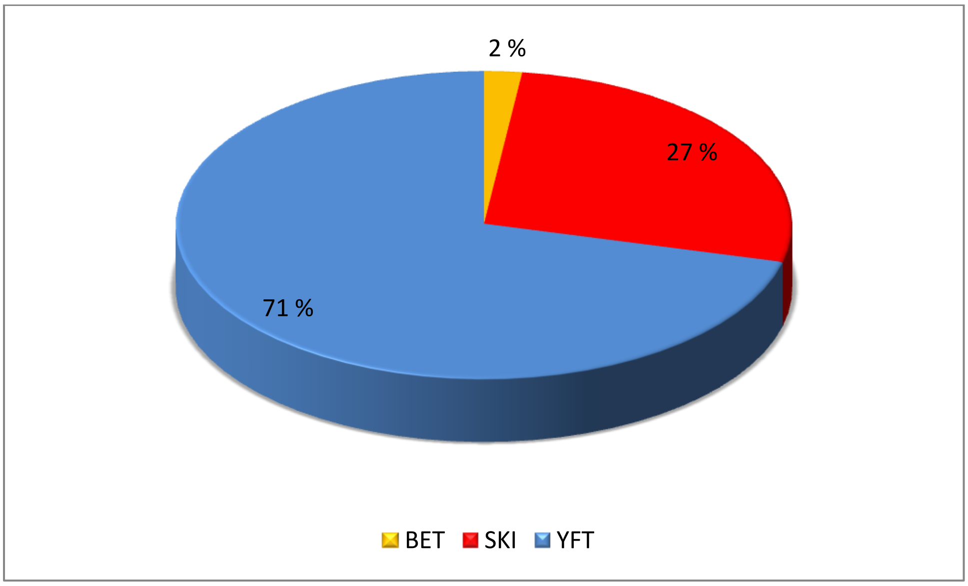


Fig. 48. Results of catches in percent of a single purse seiner in the Gulf of Guinea, from 16 fishing trips (482 sets), years 2011-2012, in total >8,000 tonnes of tuna.

YFT=Thunnus albacores Yellowfin tuna; SKI=Katsuwonus pelamis Skipjack tuna; BET=Thunnus obesus Bigeye tuna. From

Pecoraro (2012).

Tab. 3.3.24 Common tuna species in the area. (FAO 1981)

Common name	Latin name	Size Max + common	Feed	Distribution
Bigeye tuna	Tunnus obesus	197 cm 180 kg 180 cm	Fishes, cephalopods and crustaceans	Oceanic 0-400m
Yellowfin tuna	Tunnus albacares	195 cm 150 cm	Fishes, cephalopods and crustaceans	oceanic
Albacore	Tunnus Alalunga	120cm 100 cm	Mainly fishes squids and crustaceans	oceanic
Skipjack tuna	Katsuwonus pelamis	100 cm 80 cm	Fish, cepalopods and crustceans.	
West african spanish macrel	Scomberomorus tritor	98 cm 50 cm	Small fishes like sardins and anchovies	
Atlantic bonito	Sarda sarda	85 cm/5kg max 50 cm/2kg	Fish: small clupeoids, gadoides and mackrels.	Inshore waters near the surface
Frigate and bullet tuna	Auxis thazard	Max 58/ cm 1,7 kg 25-40 cm		An epipelagic, neritic as well as oceanic species.
Atlantic Black Skipjack (Fulu fulu*.)	Euthynnus alletteratus	max 90cm 7kg 85 cm		
Wahoo	***Acanthocybium solandri***	170 cm 250cm/ 83 kg		Oceanic 0-12m

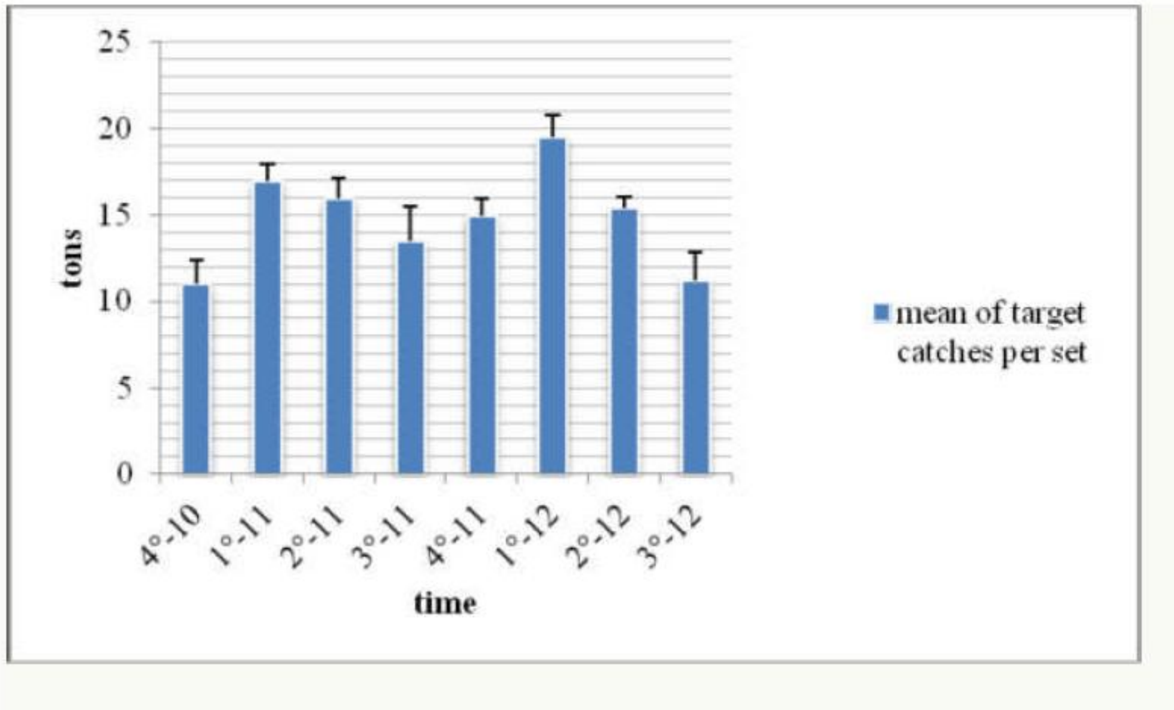


Fig. 49. Mean and standard error of the total tuna catches per set. Time refers to quarters of 2011 and 2012. From Pecoraro (2012).
Fig. 50. Juveniles of Thunnus albacares and adults of Euthynnus alletteratus. From Pecoraro (2012).

Fig. 50. Katsuwonus pelamis Skipjack tuna.

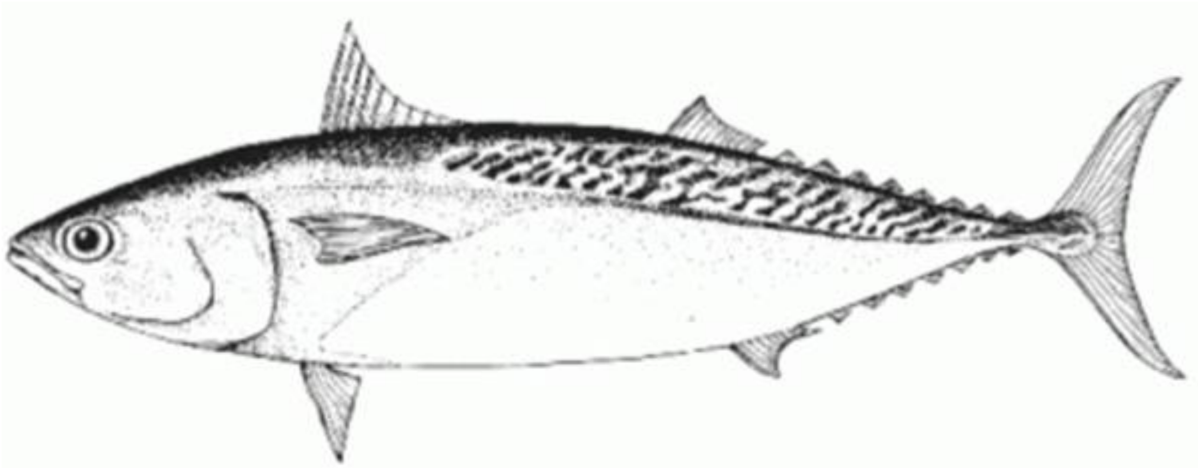
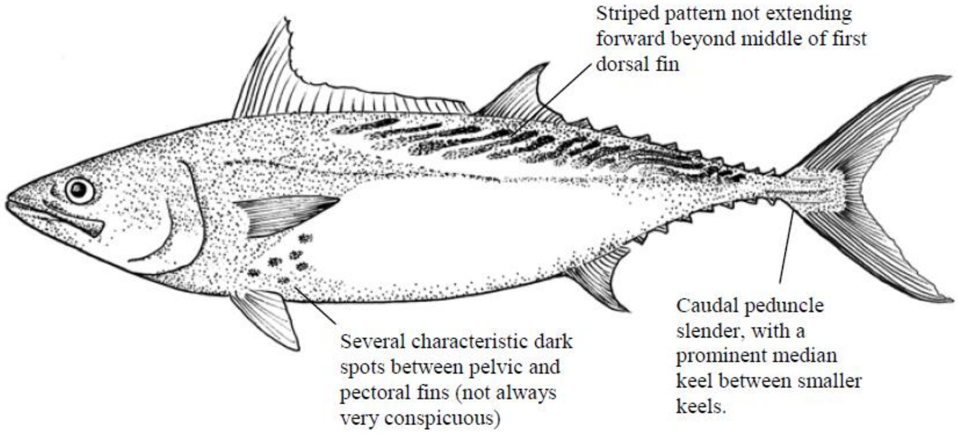


Fig. 51. Auxis thazard, Frigate tuna (or A. rochei). (From FAO).

Fig. 52. Euthynnus affinis. From Pecoraro (2012). Indian ocean ?????

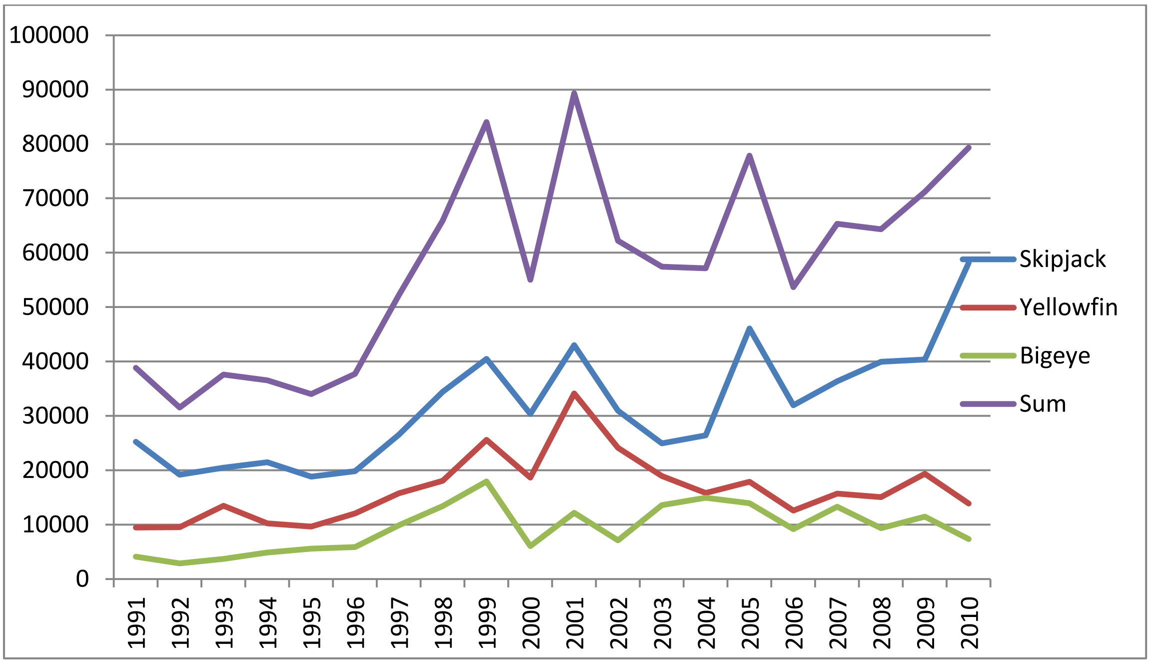
Fig 54 Thunnus albacares



Atlantic Black Skipjack *Euthynnus alletteratus (FAO)*

Fig 54 Thunnus obesus

Wahoo ***Acanthocybium solandri***



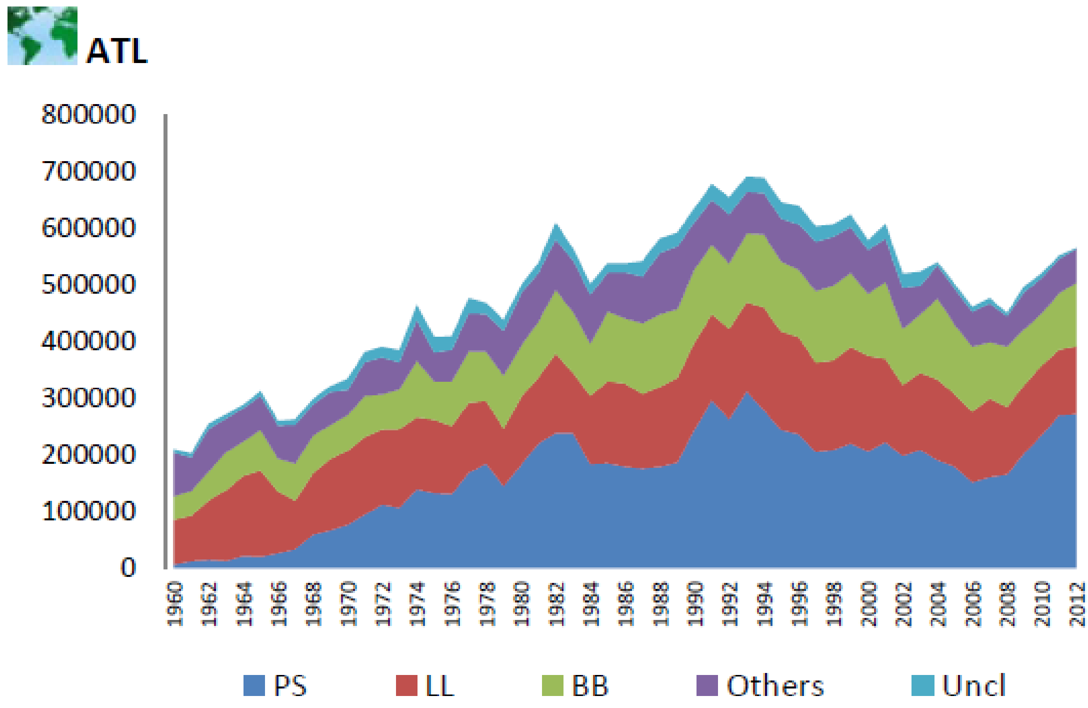


Figure 6 Cumulative catch of all tunas by major gear (ATL)

Fig. 56. A. Catches of tuna in the Gulf of Guinea (Cote D'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Equatorial Guinea, Gabon, Sắo Tomé e Principe). B. Gears used in the fishery. PS= purse seine; BB=baitboat; LL=longline; OTH=others.

Recommendations

Since it is difficult to estimate the tuna stocks from a survey with the research vessel Dr. Fridtjof Nansen, we recommend a limited test fishery to be started in the area. One or two purse seine vessels equipped for tuna fisheries and with possibility to use floating attractive devices (FAD) should be given license to start test fisheries in this area. If possible it would give even better information if you also could give test license to one or two long line vessels. The vessel needs to have specialists/inspectors onboard to control the catches. It is important to register the amount of different species, to measure length and weight and to take samples of stomach content, collect otolitts for age and growth information. Gonads will give information about maturation and reproductively.

From the Pecoraro's Thesis and several other reviews, it is suggested that the most prospective development of tuna fisheries for JDZ, would be to target skipjack (Katsuwonus pelamis) and smaller tuna species (Euthynnus, Auxis). There is relatively less competition for them, they are fast-growing and least endangered by commercial activities. Yet, they are in high demand for a local market, especially in Abidjan. They are abundant throughout the year and can be fished using purse seines combined with FADs (Fish Aggregating Devices). The latter requires some research however: Greenpeace has asked for banning FAD's because of the sheer numbers deployed (each Spanish boat: around 1000 FAD's; each French boat: 100 FAD's per trip) and their potential role in the "silent murder" (similar to that by driftnets), also tuna juveniles.

Acknowledgements

Author of this report, Marek R. Lipinski, thanks all involved in the JDZ Project for their input and collaboration: Dr Bjorn Serigstad, Tor Ensrud, Oddgeir Alvheim, Marek Ostrowski (all from Institute of Marine Research, Bergen, Norway), all colleagues from Nigeria and Sấo Tomé & Principe (especially Mr. Chindo Uche-Okeke and Virginia Godinho) and all colleagues from Poland (Sea Fisheries Institute in Gdynia and Szczecin and University of Lodz, especially Ms. Wanda Kalandyk). Prof. Conrad Matthee (University of Stellenbosch) is thanked for genetic identification of tuna individuals.

Disclaimer

This report, apart from the materials & methods, results and discussion which are entirely original, used freely text and illustrations available in the public domain. Authors of these materials are thanked most sincerely for their contribution. In the Introduction, materials of the following Authors were used:

George Wiafe: Guinea Current Large Marine Ecosystem Project (Report), and his presentation at 4th Zooplankton Symposium in Hiroshima, Japan, 2007;

Olegario Tiny: His PP presentation;

Wolfgang Schneider: Field Guide to the Commercial Marine Resources of the Gulf of Guinea, FAO;

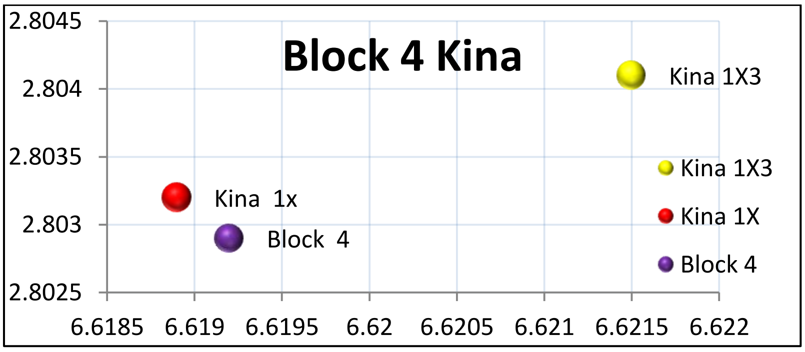
Jubilee Unit Area Project (Report), Environmental Resources Management, Tullow Ghana Ltd.;

J. Tanga Biang, The Joint Development Zone between Nigeria and Sấo Tomé e Principe, etc. New York 2010.

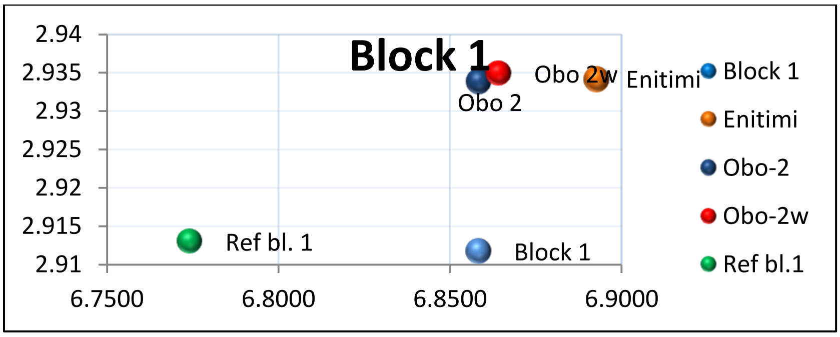
3.4 Environmental monitoring

3.4.1 Sediment sampling area in JDZ.

Map 3.4.2 benthos stations 2011 and 2012



Detajled map of Block 4.



Detajled map of Block 1.

Grab station	Date	Latitude WGS 84	Longditude WGS 84	Depth (m)	Sediment colour description
Enitimi	1/12-12	6,8928 6,8940	2,9341 2,9334	1662/1662	7,5 3/1 Very dark grey.
Kina 1X	30/11-12	6,6189 6,6195	2,8032 2,8035	1981	Gley 1 3/10 Y very dark greenish grey.
Kina 1X3**	1/12-12 3/12-12			1992	10 YR 3/2 Very dark greyish brown.
Melanza 1X	1/12-12	6,6626	2,8266	1923	XXX
Obo-2**	2/12-12	6,8585	2,9338	1696	7,5 YR 3/1 Dark grey.
Obo-2w*	2/12-12	6,8642	2,9349	1685	7,5 YR 3/1 Dark grey. + dark mud from drillings.
Oki 1X	4/12-12	6,7064 6,7063	2,7019 2,7019	2065	10YR 3/2 Very dark greyish brown.
RB4	3/12-12	6,5449 6,5455	2,8444 2,8443	1909/10	5Y 3/1 Very dark grey.
Ref 1	30/11-12	7,0689 7,0692	2,8345 2,8345	1531/1529	7,5 YR 2,5/1 Black. 2,5 Y 3/2 Very dark greenish brown.
Ref bl.1	2/12-12	6,7742 6,7733	2,9130 2,9126	1800	10 YR 3/1 Very dark grey.

Table 3.4.1 Date, position and depth of benthic sampling sites.

3.4.2 Sediment characteristics

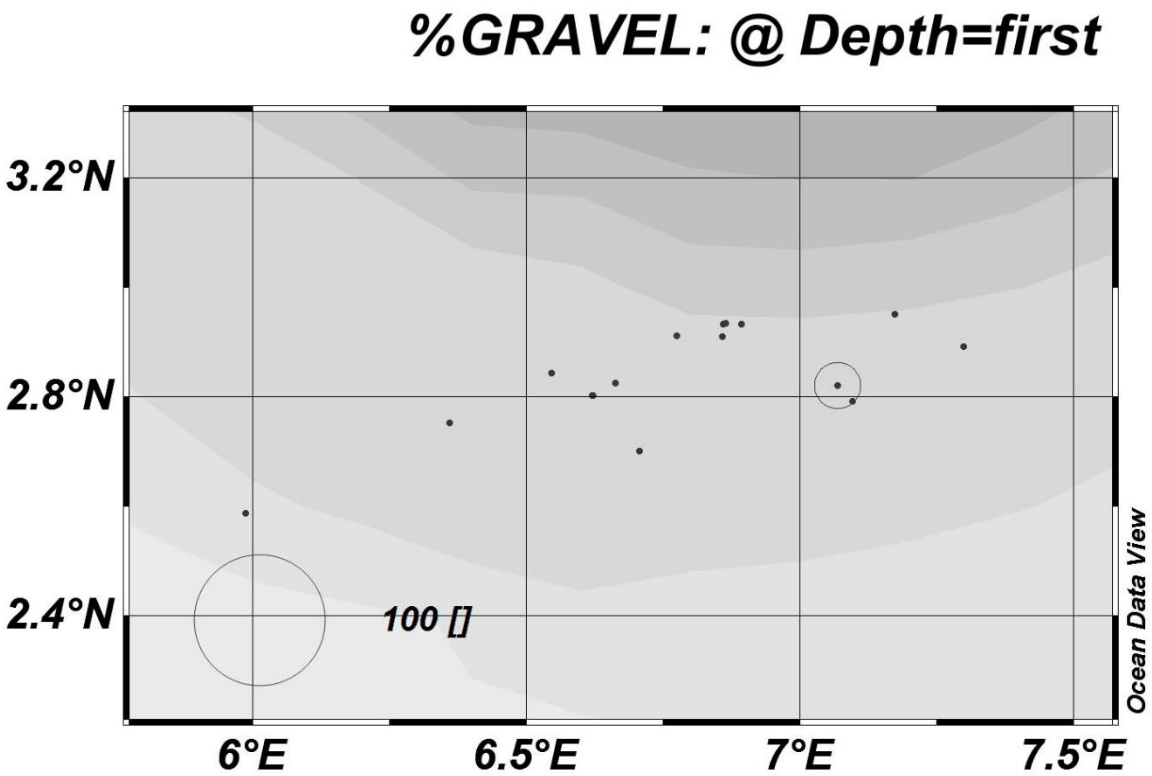
The seabed in the investigated area from 2012 was dominated by fine sediments (pelite) and small to medium amounts of fine sand similar to what we found in 2011. Stations Ref 1 (2011), Ref 1.1, 1.2 and Ref bl. 1 had relatively coarse sediment containing up to 56% sand, Ref 1,1.1 and 1.2 also contained some gravel, Ref 1 was left in 2011 due to difficulties getting samples, In 2012 we sampled two nearby stations Ref 1.1 and 1.2. The content of total organic matter (TOM) was between 7,9 and 15,5 % in 2012 (7,5 and 12,3% in 2011). (Tab. 3.2.2) Some of the lowest TOM values were found on the stations with the highest content of sand and gravel Ref 1,1.1 and 1.2, indicating stronger currents and a lover rate of sedimentationin that particular area. The content of sand in the samples varied from 2,4 % (Obo 2w) – 56,3 % (Ref 1.1)(Tab 3.2.1). The literature (Rex & Etter 2010) indicates that there is a link between the composition of the fine fraction of the sediment (>63µm) and the species living in it. This seems to play an important role as the animals get relatively smaller with increasing dept; unfortunately there was no budget to investigate this any further. The colour of the sediment varied from very dark grey to dark olive brown in the top 2 centimetre layer and on 5 sites sampled there was a clear stratification in terms of colour in 2011 (Appendix 3.2.1) we observed the same in 2012 and on the heavily contaminated Melanza 1X we observed a bacteria mat with the HD camera on top of the oil based drill cuttings. No foul odours were registered from any of the samples in 2011 indicating satisfactory oxygen conditions in the seabed. In the 2012 samples we could detect an oily smell from the Obo- 2W and the Melanza 1X.

Picture 3.4.2.1 Collection of geological samples and determination of the colour with the Munsell soil chart. (Photo T. Ensrud)

Total organic matter (TOM), and the amount (%) of gravel, sand, pelite, median (Φ), sorting, skewness, kurtosis and mean from the sediment samples are presented in Table 3.2.1

Table 3.4.2.1 Total organic matter and sediment grain size at in twenty stations from 2011 and 2012 (Bold). The size of pelite particles are < 0.063 mm. The circled area in the map illustrates the relative amount of the different parameters at each station. The result for TOM from st. Ref 4. (2011) is missing.

STATION	% GRAVEL:	% SAND:	% MUD:	Tom%	D_{50} (f):	SORTING	SKEWNESS	KURTOSIS	MEAN
RB4	0.0%	6.5%	93.5%	15,3%	5.859	2.684	0.081	0.880	17.23
Kina 1X	0.0%	6.3%	93.7%	13,6%	5.864	2.783	0.112	0.950	17.17
Kina 1X3	0.0%	24.1%	75.9%	15,3%	5.362	5.007	0.306	1.109	33.47
Melanza 1X	0.0%	16.4%	83.6%	11,6%	5.606	3.104	0.102	0.921	20.62
Oki 1X	0.0%	8.5%	91.5%	15,5%	5.811	2.820	0.103	0.929	17.81
Ref bl.1	0.0%	31.8%	68.2%	13,2%	5.065	5.501	0.269	0.771	41.65
Obo-2	0.0%	2.4%	97.6%	13,3%	5.949	2.375	-0.008	0.726	16.19
Obo-2w	0.0%	15.5%	84.5%	7,91%	5.631	2.851	0.042	0.806	20.18
Enitimi	0.0%	8.3%	91.7%	14,7%	5.816	2.819	0.104	0.933	17.75
Ref 1.1	3.1%	56.3%	40.6%	8,50%	2.877	5.750	-0.254	0.799	90.63
Ref 1.2	2.9%	31.1%	66.1%	9,31%	4.970	4.831	0.184	0.938	35.49
Block 1	0.0%	3.8%	96.2%	11,13%	5.920	2.412	-0.004	0.732	16.52
Block 2	0.0%	2.7%	97.3%	11,67%	5.942	2.384	-0.007	0.728	16.27
Block 3	0.0%	9.4%	90.6%	7,53%	5.791	3.061	0.151	1.056	18.06
Block 4	0.0%	5.0%	95.0%	11,33%	5.894	2.445	-0.001	0.737	16.82
Block 4 Oki 1X	0.0%	7.4%	92.6%	12,00%	5.839	2.833	0.116	0.961	17.47
Ref 1	12.3%	38.3%	49.4%	9,57%	3.918	8.826	0.203	0.831	90.27
Ref 2	0.0%	7.2%	92.8%	11,53%	5.843	2.847	0.121	0.973	17.43
Ref 3	0.0%	3.0%	97.0%	12,33%	5.936	2.392	-0.006	0.729	16.34
Ref 4	0.1%	17.6%	82.3%		5.568	3.491	0.173	1.011	22.45



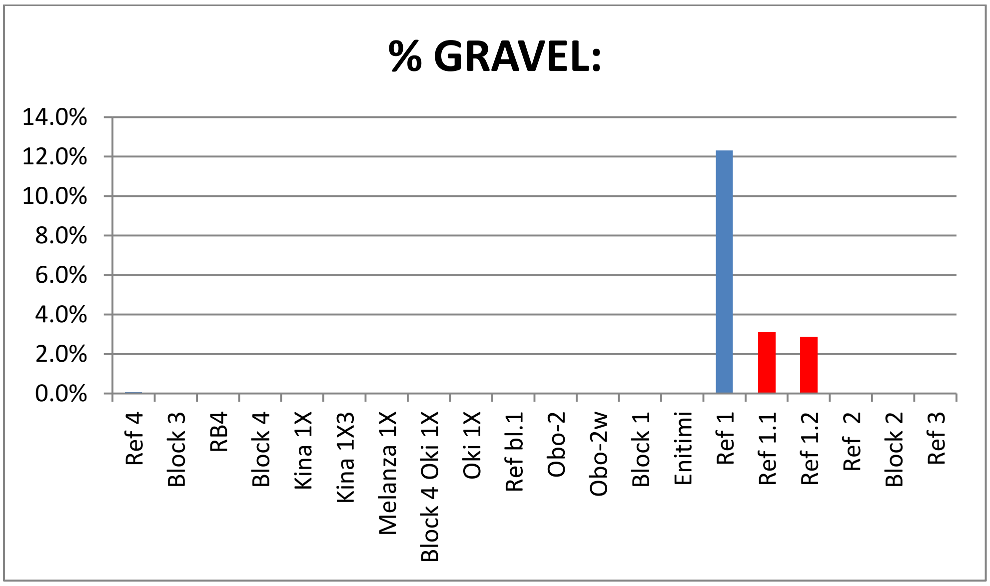
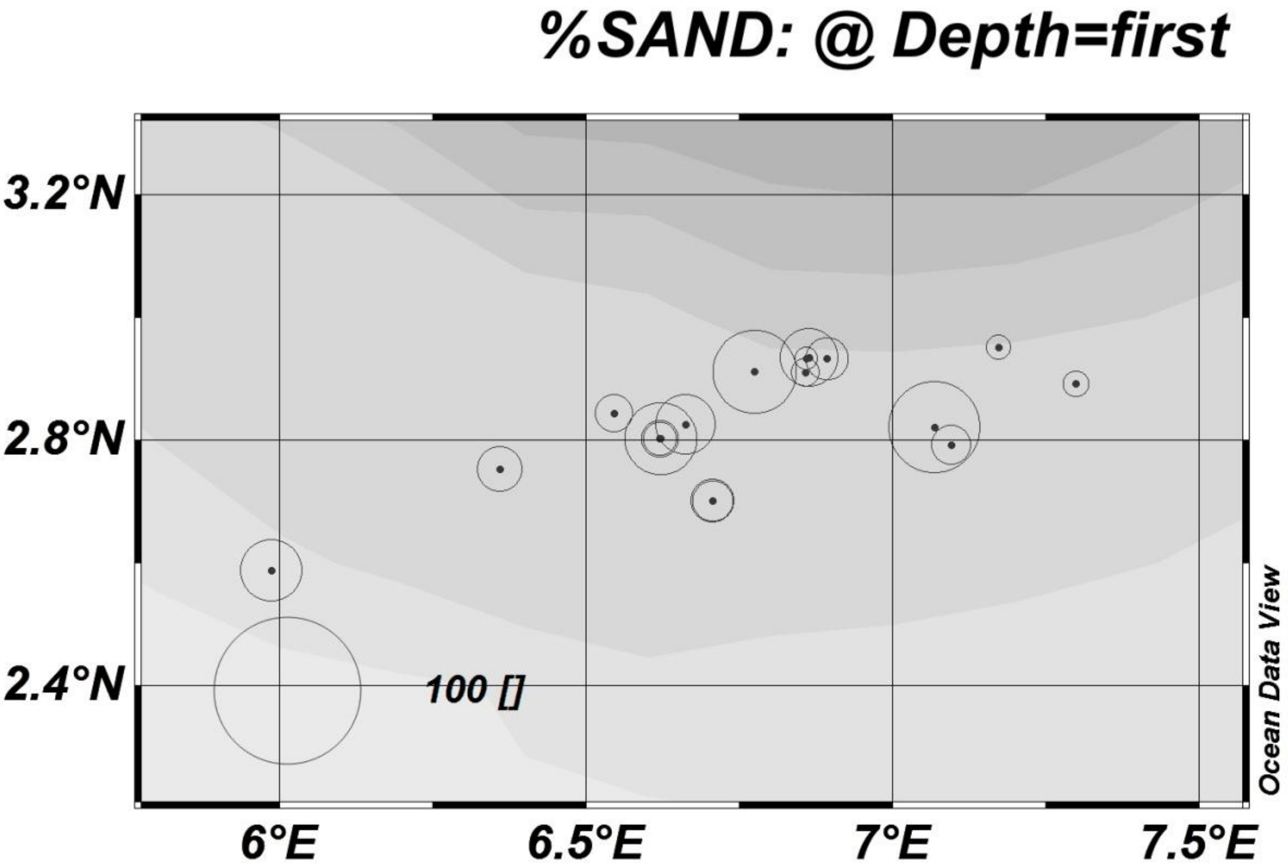


Fig. 3.2.2.1 and 3.2.2.2 The content of gravel on all stations, sediment depths 0-4 cm. 2011 blue, 2012, red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3.2°N
2.8°N
2.4°N
100 []
6°E
6.5°E
7°E
7.5°E
Ocean Data View

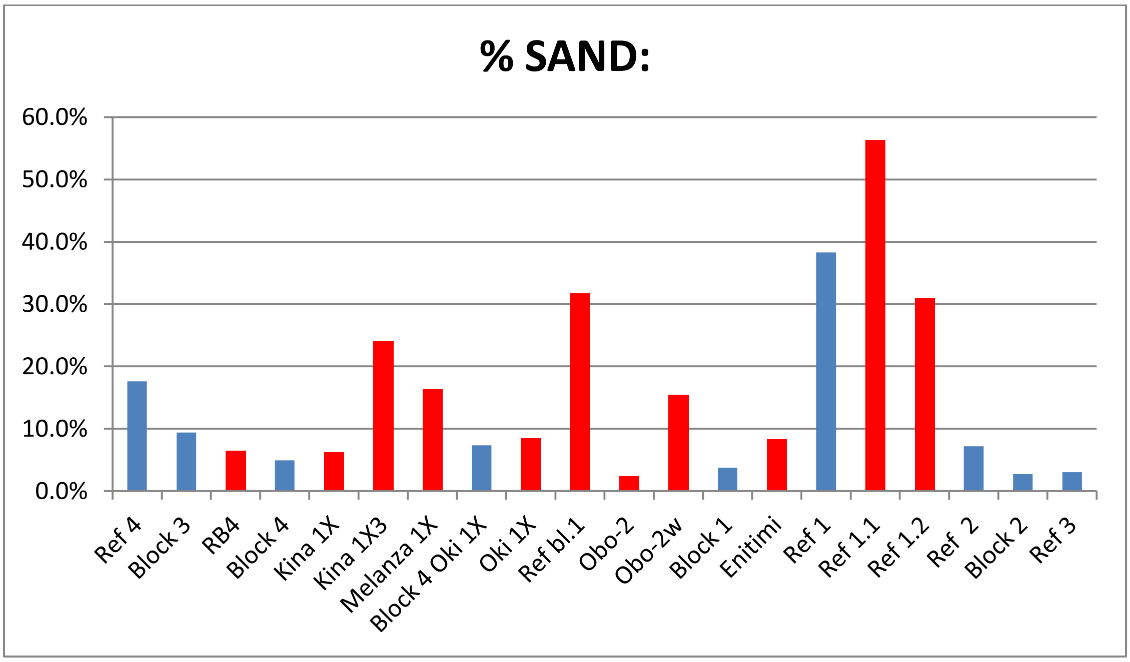
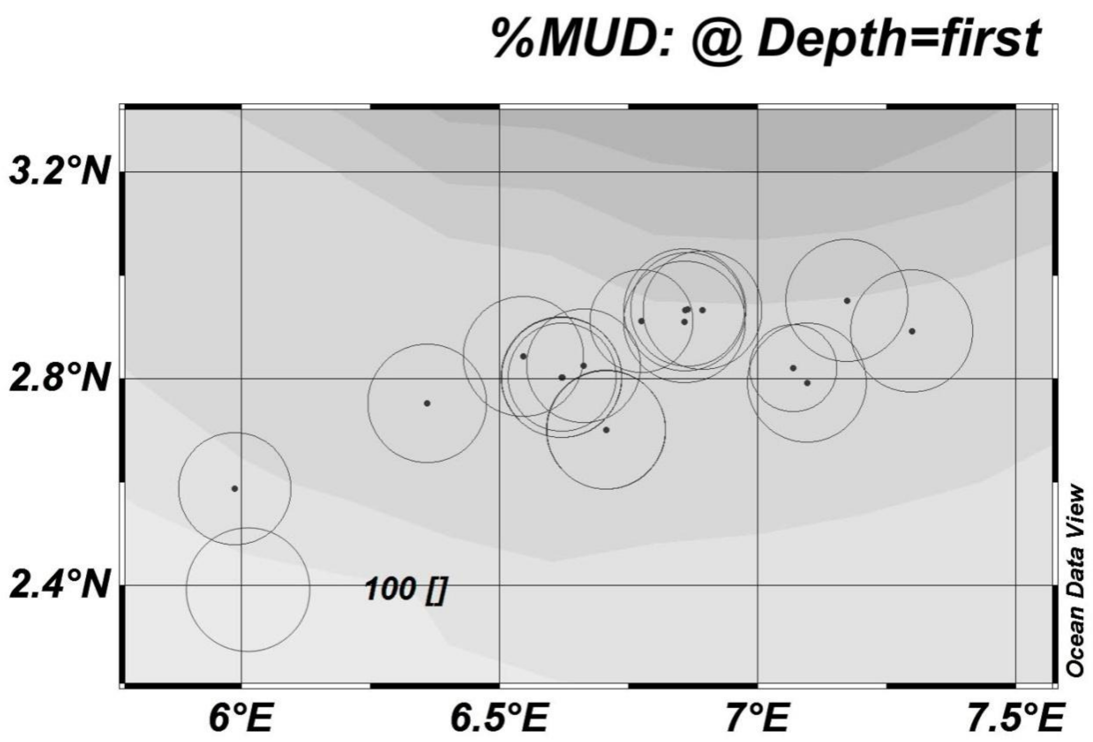

% SAND:
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Ref 4
Block 3
RB4
Block 4
Kina 1X
Kina 1X3
Melanza 1X
Block 4 Oki 1X
Oki 1X
Ref bl.1
Obo-2
Obo-2w
Block 1
Enitimi
Ref 1
Ref 1.1
Ref 1.2
Ref 2
Block 2
Ref 3

Fig. 3.4.2.3 and 3.4.2.4 The content of sand on all stations, sediment depths 0-4 cm. 2011 blue, 2012, red.



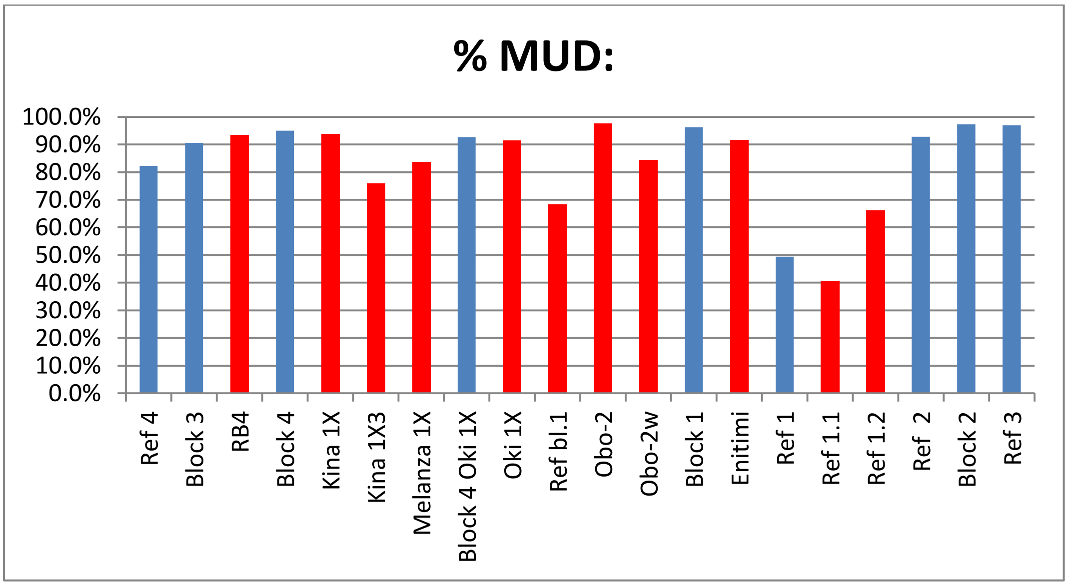
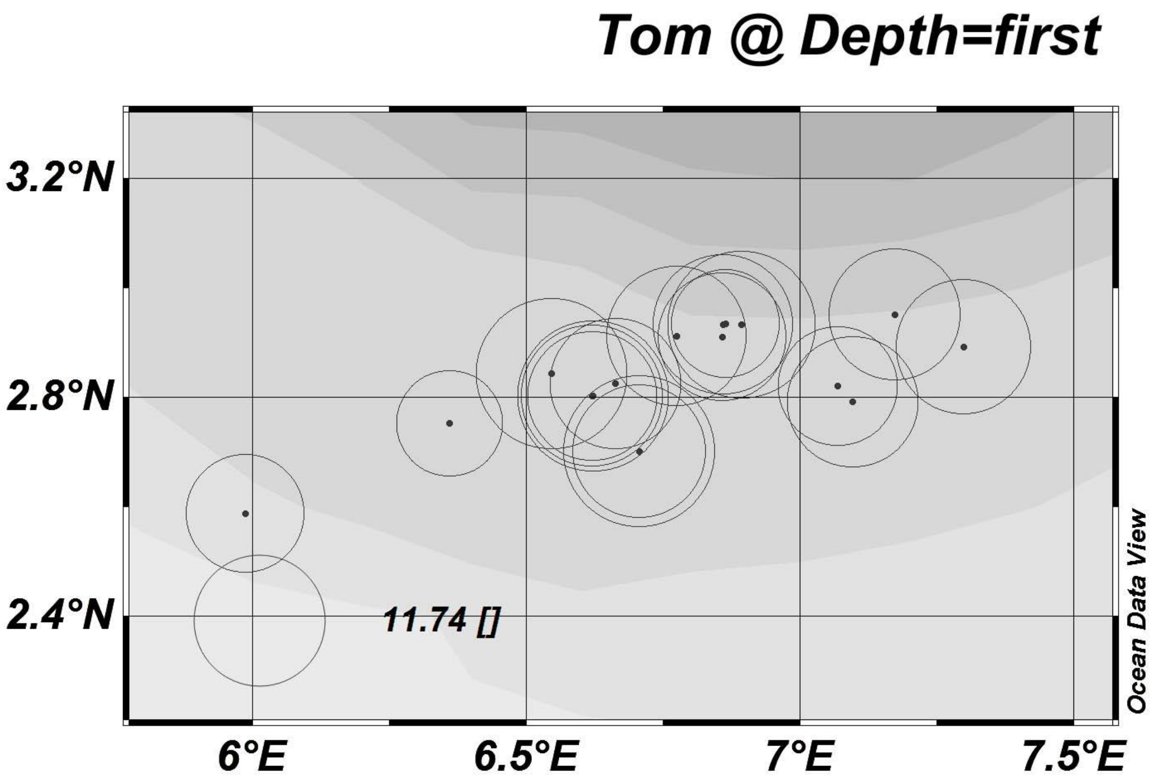


Fig. 3.2.2.5 and 3.2.2.6 The content of mud on all stations, sediment depths 0-4 cm. 2011 blue, 2012, red.



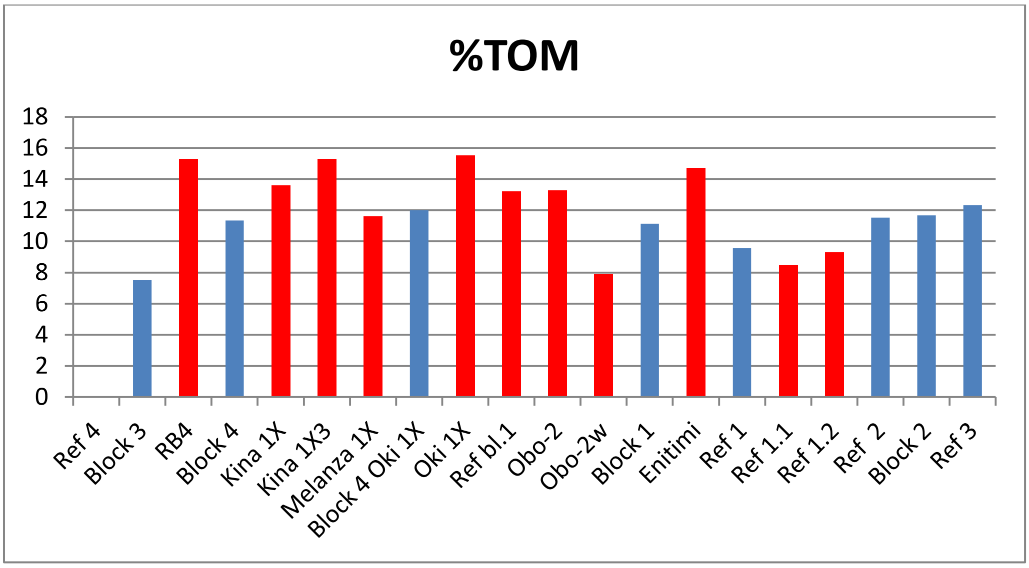


Fig. 3.4.2.7 and 3.4.2.8 The content of mud on all stations, sediment depths 0-4 cm. 2011 blue, 2012, red.

3.4.3 Chemistry JDZ 2012

Picture 3.4.3.1 Collecting samples for chemical analysis.

PCB

No PCB values from the 2011 samples were seen above the detection limit of 0.5 µg/kg dry weight. PCB production was banned by the United States Congress in 1979 and by the Stockholm Convention on Persistent Organic Pollutants in 2001 (Unep chemicals 1999).The dataset for 2011 is presented in the Appendix. Due to the lack of findings in 2011 no further analysis was undertaken in 2012.

Metals

Table 3.2.3.2 summarizes the results of metal analysis. The complete data set including replicates is given in the Appendix (3.2, table 3.2.3).

Setting fixed levels for metal contamination in an area without extensive background data is a difficult task to undertake. The fluctuations caused by geology, sediment composition, volcanic and seismic activity in deep water benthos allows for considerable variation in observed levels and the assembly of organisms inhabiting these habitats.

We have therefore used the calculated LSC for the assumed pristine reference stations as indicator of the background levels, but also comparing the figures to established European standards.

The bottom sediment samples were analysed for the following heavy metals: Arsene (As), Cadmium (Cd), Copper (Cu), Barium (Ba), Mercury (Hg), Chromium (Cr), Lead (Pb), Nickel (Ni) and Zink (Zn) 53 samples has been analysed (figure 3.2.3.1-3.23.16).

The concentrations of heavy metals were low for Arsene Chromium, Zink and Cadmium compared to European standards. High levels of Barium were found on Block 4 Oki 1X in 2011 and on Melanza 1X, Oki 1x and Obo 2w in 2012. The mean value from Block 4 Oki 1X was 1813 mg/kg dry weight and the highest value about 3200 mg/kg. This is between 5 and 9 times the average LSC (Level of significant contamination) value for Barium. For Melanza

1x (2012) the average was 1567 mg/kg and the highest value 2800 mg/kg. Oki 1X showed an average of 727 and a peak of 1400 mg/kg. On Block 2 Barium was slightly elevated compared to the LSC calculations.
One single measurement of lead was higher than the background concentrations (BC) set by Ospar and ten measurements of copper. The highest level of Copper (51mg/kg) was found on Melanza 1x (2012). However for Copper, 4 measurements from the reference stations show levels above background levels set by Ospar, that being said only two samples was higher than the calculated LSC. Overall, measurements were low for these parameters.
For Mercury 52 measurements showed values above BC set by Ospar. Two of the measure ments on Oki 1X bl. 4 from 2011 shows values slightly above LSC. However the LSC is well below the BC set by Klif for sediments from Norwegian waters, so the levels are to be considered low and well below any levels believed to cause biological effects.
For Nickel the LSC was set well over the Ospar BC. It is also well above what's believed to cause biological effects in the Klif manual. According to the Klif manual the LSC for Nickel is to be characterised as moderately polluted. The levels however on most of the reference stations are above Ospar BC, on 4 stations the average is also above the level thought to cause biological effects. The values are however relatively stable and we believe the reference stations reflect the true background levels for this area.
(Bakke et al 2007)

Table 3.4.3.1 Level of significant contamination (LSC), determined from the metal analysis from the reference stations from 2011 and 2012.

		(mg/kg)	Arsen	Barium	lead	Copper	Chromium	Mercury	Nickel	Zink	Cadmium
Station	Depth	Sample	(As)	(Ba)	(Pb)	(Cu)	(Cr)	(Hg)	(Ni)	(Zn)	(Cd)
Ref 1	1537	1	4.7	210	8.9	18	22	0.075	33	54	0.11
		2	4.1	180	7.2	12	20	0.075	29	41	0.1
		3	4.2	210	7.4	13	21	0.066	31	44	0.085
Ref 2	1925	1	1.9	300	9.4	19	28	0.087	38	57	0.24
		2	1.5	300	8.9	18	28	0.094	35	58	0.11
		3	1.9	290	9.1	18	28	0.092	40	58	0.14
Ref 3	1912	1	1.9	290	9.7	19	29	0.092	32	59	0.23
		2	2.6	320	12.0	20	32	0.078	73	65	0.2
		3	2.6	300	11.0	19	32	0.087	52	66	0.14
Ref 4	2665	1	3.1	320	7.2	24	22	0.075	57	61	0.14
		2	3.8	320	7.2	25	22	0.082	66	67	0.18
		3	2.8	280	6.0	21	19	0.071	42	51	0.086
RB4	1909	1	2.1	310	9.3	16	21	0.071	37	39	0.17
		2	2.6	350	9.7	17	22	0.07	46	40	0.14
		3	2.4	330	10.0	16	20	0.098	42	40	0.2
Ref 1	1545	1	3.2	150	7.1	10	14	0.038	18	23	0.1
		2	3.1	160	6.8	8	16	0.037	21	23	0.088
		3	3.3	160	6.5	8	14	0.038	20	20	0.12
Ref bl.1	1800	1	4.7	320	12.0	17	22	0.099	49	41	0.18
		2	4.6	320	11.0	17	22	0.092	50	42	0.17
		3	4.8	350	12.0	18	22	0.09	58	45	0.2
Av			3.1	275	9.0	17	23	0.077	41	47	0.15
Stdev			1.1	66	1.9	5	5	0.019	15	14	0.05
LSC >			5.1	396	12.5	25	32	0.111	68	73	0.24

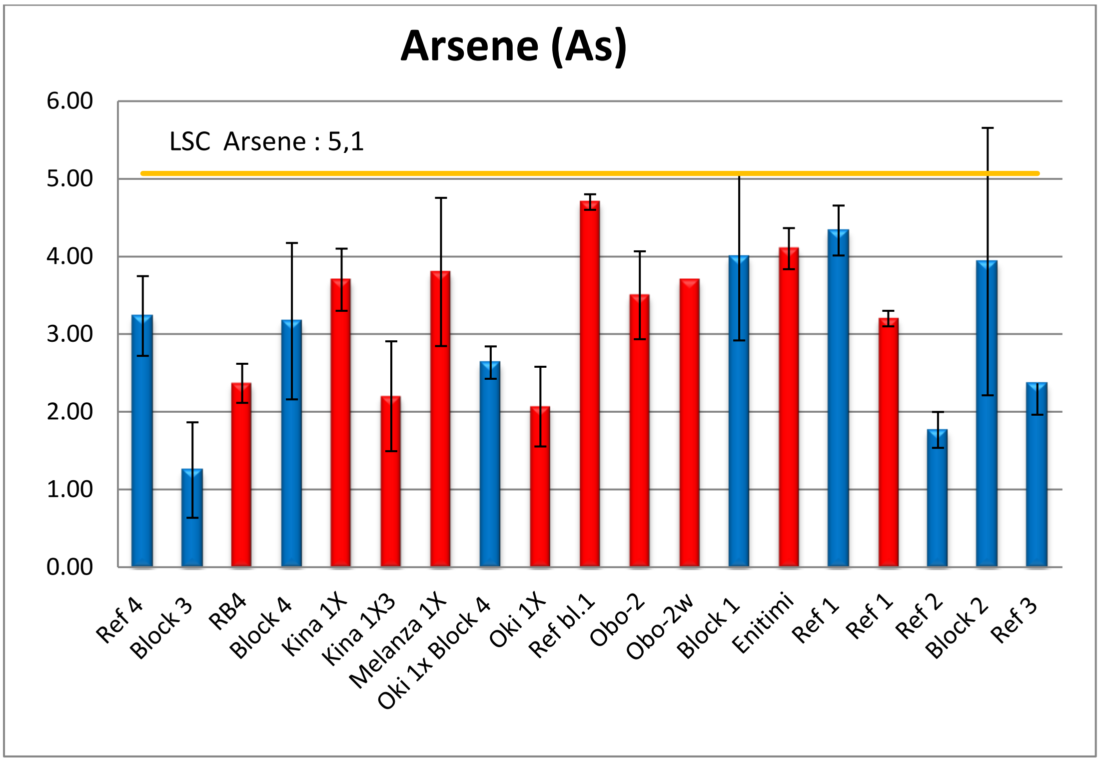
Table 3.4.3.2 Average concentrations and standard deviations from three parallel samples (mg/kg dry weight) of metal at nine stations. Values higher than LSC from all four reference stations are highlighted in the table. The samples were collected in May 2011. Bold is 2012 stations.

		Arsene (As)		Barium (Ba)		Lead (Pb)		Copper (Cu)		Chromium (Cr)		Mercury (Hg)		Nickel (Ni)		Zink (Zn)		Cadmium (Cd)	
Station	Depth	AV	STDV	AV	STDV	AV	STDV	AV	STDV	AV	STDV	AV	STDV	AV	STDV	AV	STDV	AV	STDV
Oki 1X	2062	2.07	0.51	726.7	585.3	10.10	0.85	16.00	0.00	19.33	0.58	0.072	0.003	41.33	8.14	39.00	1.00	0.23	0.01
Ref 1	1545	3.20	0.10	156.7	5.8	6.80	0.30	8.53	1.01	14.67	1.15	0.038	0.001	19.67	1.53	22.00	1.73	0.10	0.02
Enitimi	1674	4.10	0.26	306.7	20.8	11.33	0.58	15.67	1.15	22.67	1.15	0.097	0.010	47.00	2.65	40.00	1.73	0.17	0.01
Kina 1X	1999	3.70	0.40	283.3	5.8	11.33	1.15	18.00	1.00	22.67	0.58	0.062	0.014	38.67	3.79	44.33	2.08	0.23	0.03
Kina 1X3	1992	2.20	0.71	330.0	14.1	9.40	0.00	16.00	0.00	20.50	0.71	0.069	0.002	37.00	2.83	40.50	0.71	0.23	0.01
Melanza 1X	1922	3.80	0.95	1566	1250	32.33	34.44	29.67	18.50	18.33	5.51	0.074	0.019	35.33	19.66	48.67	7.02	0.21	0.04
Obo-2	1696	3.50	0.57	305.0	7.1	11.50	0.71	16.00	1.41	23.00	1.41	0.075	0.004	45.00	4.24	41.00	2.83	0.15	0.02
Obo-2w	1685	3.70		1100.0		16.00		10.00		16.00		0.062		12.00		26.00		0.08	
RB4	1909	2.37	0.25	330.0	20.0	9.67	0.35	16.33	0.58	21.00	1.00	0.080	0.016	41.67	4.51	39.67	0.58	0.17	0.03
Ref bl.1	1800	4.70	0.10	330.0	17.3	11.67	0.58	17.33	0.58	22.00	0.00	0.094	0.005	52.33	4.93	42.67	2.08	0.18	0.02
Block 1	1730	4.00	1.08	350.0	55.7	12.00	1.73	20.33	2.08	30.33	2.52	0.09	0.01	82.67	30.02	65.33	6.66	0.17	0.08
Block 2	1660	3.93	1.72	410.0	155.2	11.00	1.73	18.00	1.73	31.33	1.53	0.09	0.00	56.33	30.44	63.67	7.23	0.11	0.08
Block 3	1892	1.25	0.61	266.7	61.1	5.83	2.12	13.37	5.45	22.67	4.16	0.05	0.03	34.67	11.85	46.67	13.80	0.12	0.05
Block 4	1976	3.17	1.01	300.0	10.0	9.90	0.10	19.33	0.58	25.33	0.58	0.10	0.01	48.33	1.53	61.00	2.00	0.24	0.04
Oki 1x Bl. 4	2062	2.63	0.21	1813	1293	10.97	2.63	19.33	1.53	23.33	0.58	0.10	0.01	50.67	4.62	58.33	3.21	0.23	0.03
Ref 1	1537	4.33	0.32	200.0	17.3	7.83	0.93	14.33	3.21	21.00	1.00	0.07	0.01	31.00	2.00	46.33	6.81	0.10	0.01
Ref 2	1925	1.77	0.23	296.7	5.8	9.13	0.25	18.33	0.58	28.00	0.00	0.09	0.00	37.67	2.52	57.67	0.58	0.16	0.07
Ref 3	1912	2.37	0.40	303.3	15.3	10.90	1.15	19.33	0.58	31.00	1.73	0.09	0.01	52.33	20.50	63.33	3.79	0.19	0.05
Ref 4	2665	3.23	0.51	306.7	23.1	6.80	0.69	23.33	2.08	21.00	1.73	0.08	0.01	55.00	12.12	59.67	8.08	0.14	0.05

Table 3.4.3.3 Classification table for metals.

Parameter	Arsen (As)		Barium (Ba)		Lead (Pb)		Copper (Cu)		Chromium (Cr)		Mercury (Hg)		Nickel (Ni)		Zink (Zn)		Cadmium (Cd)	
	Bc	Bac	Bc	Bac	Bc	Bac	Bc	Bac	Bc	Bac	Bc	Bac	Bc	Bac	Bc	Bac	Bc	Bac
KLIF	<20				<30		<35		<70		0,15		<30		<150		<0,25	
OSPAR	<15	<25			<25	<38	<20	<27	<60	<81	<0,05	<0,07	<30	<36	<90	<122	<0,25	<0,31
LSC 2011/12	5,1		396		12,5		25		32		0,11		68		73		0,24	
No toxic eff. *	<52				<83		<51/1		<560		<0,63		<46/**21**		<360		<2,6	
Highest measurement	5,3		3200		72		51		33		0,11		100		65		0,27	
Singles over Bc Klif/ospar/LSC	0/0/1		x/x/11		1/1/7		1/10/2		0/0/2		0/52/2		46/46/4		0/0/0		5/19/8	

*upper limit for good conditions with no toxic effects according to KLIF TA 2229/2007.
BC= background concentrations. LSC=Level of significant contamination.



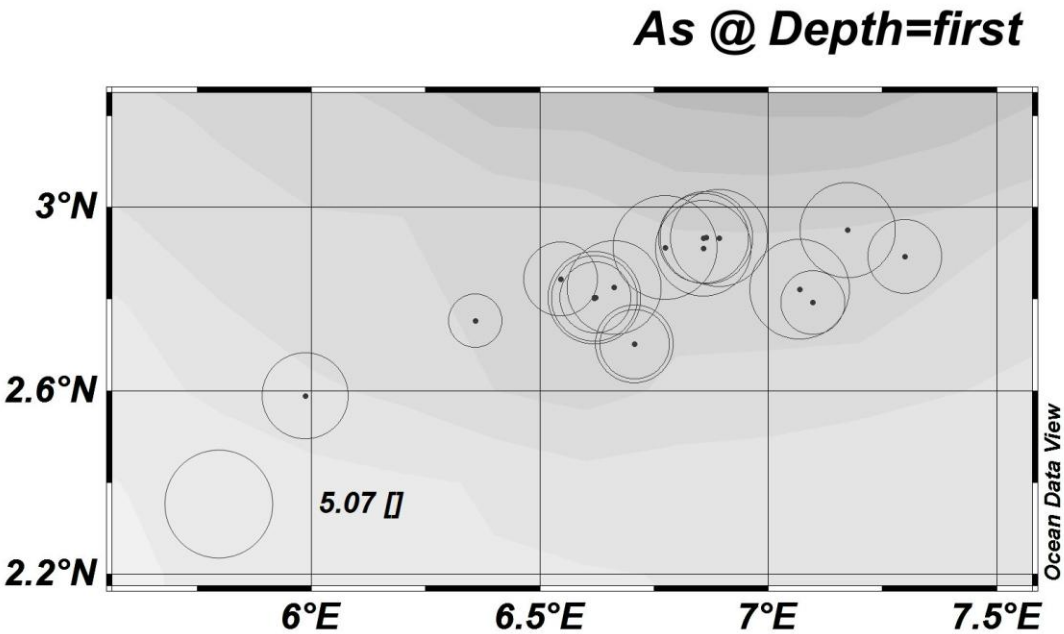
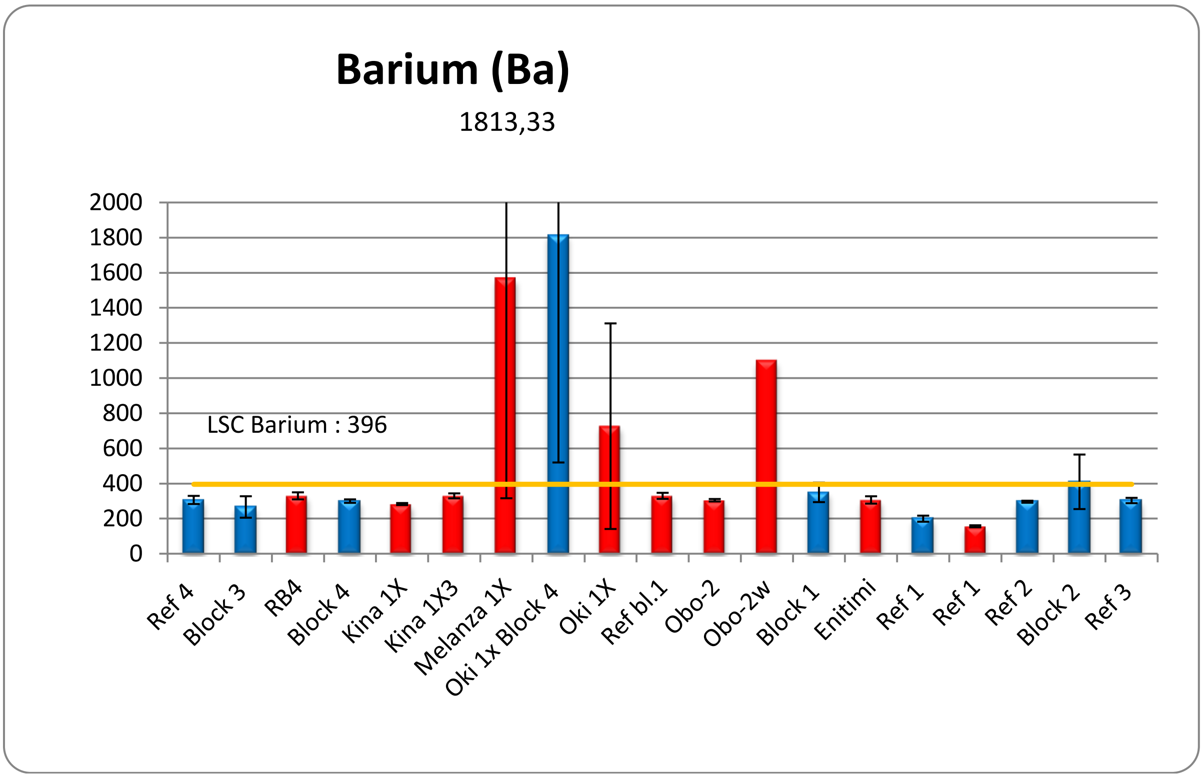


Fig. 3.4.3.1 and 3.2.3.2 Distribution of Arsene (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Arsene on each station.



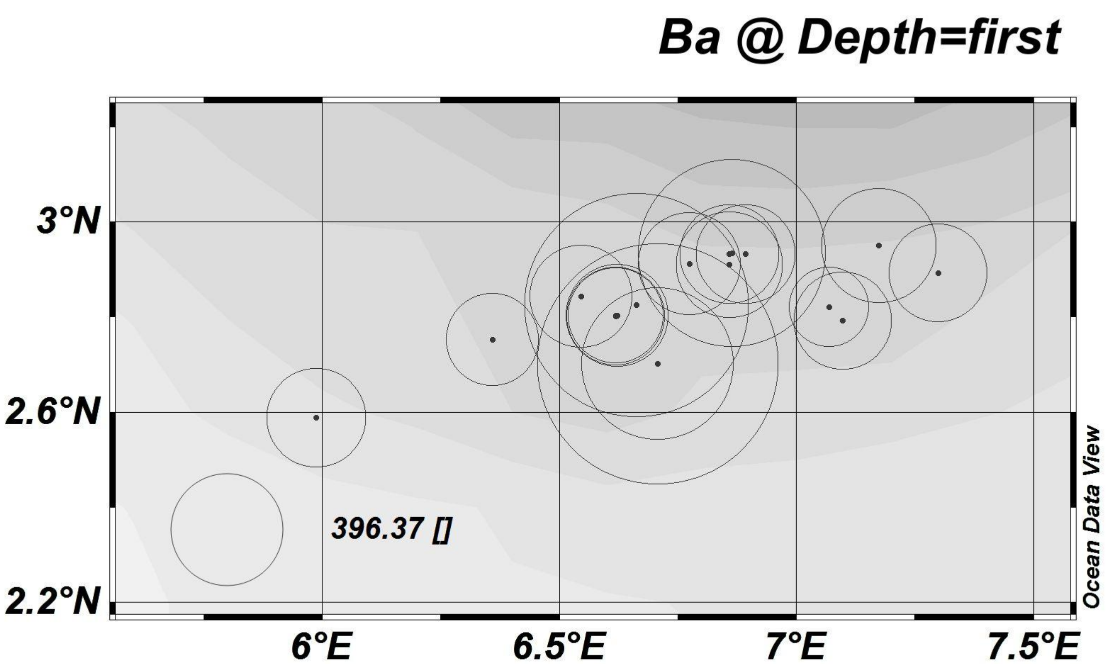
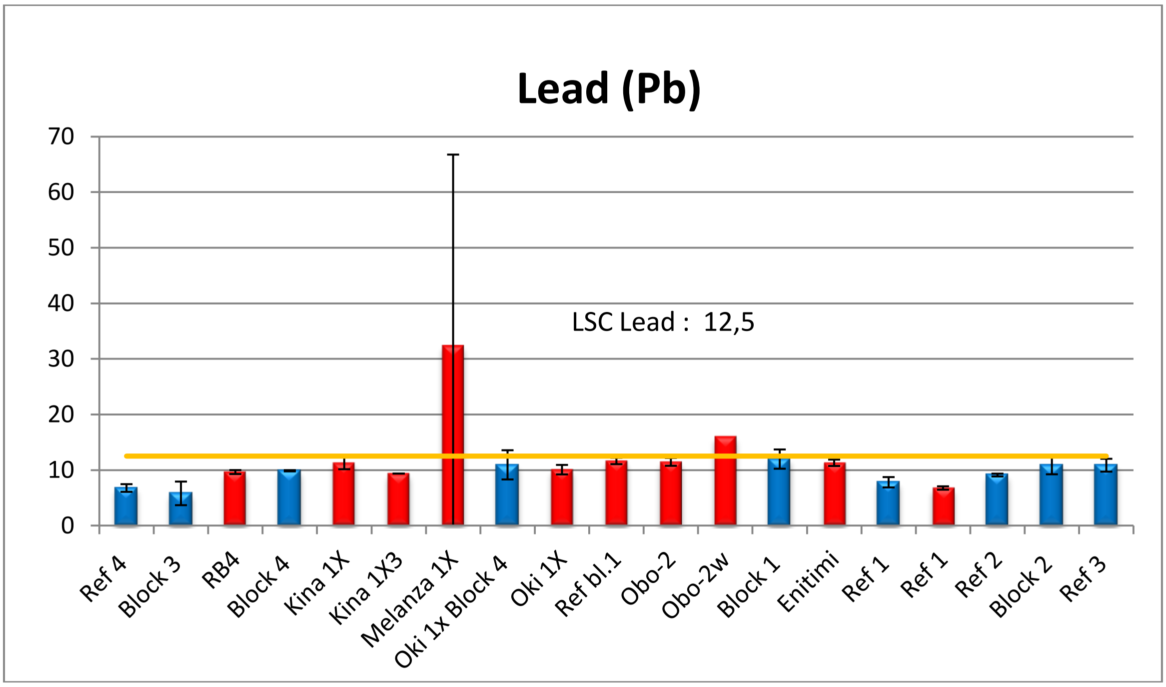


Fig. 3.4.3.3 and 3.4.3.4 Distribution of Barium (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Barium on each station.



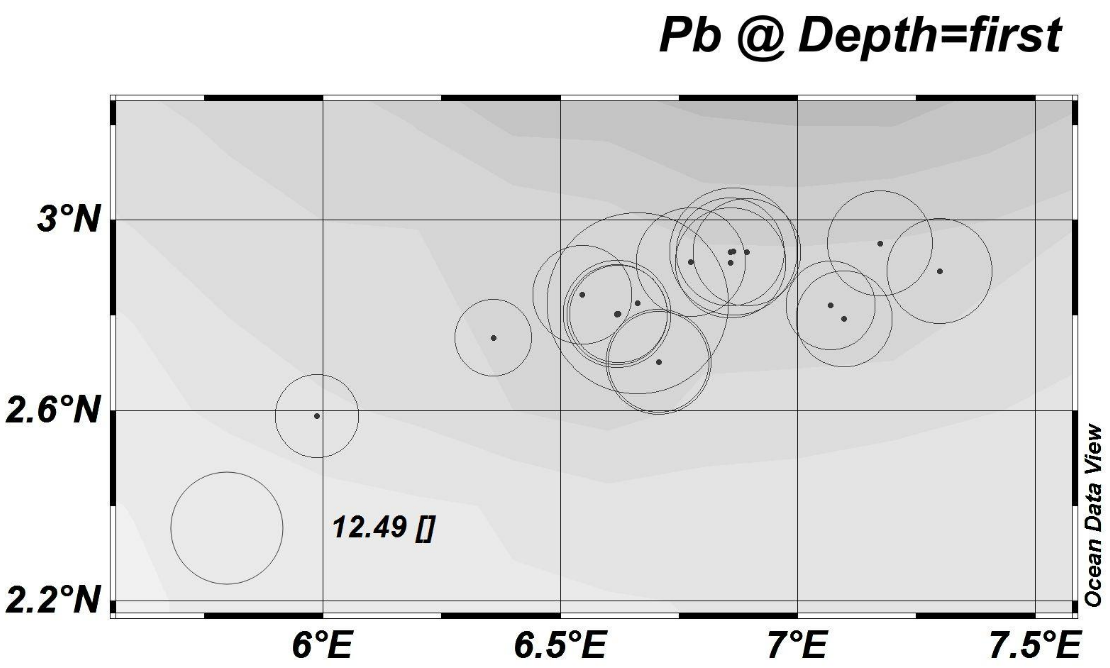
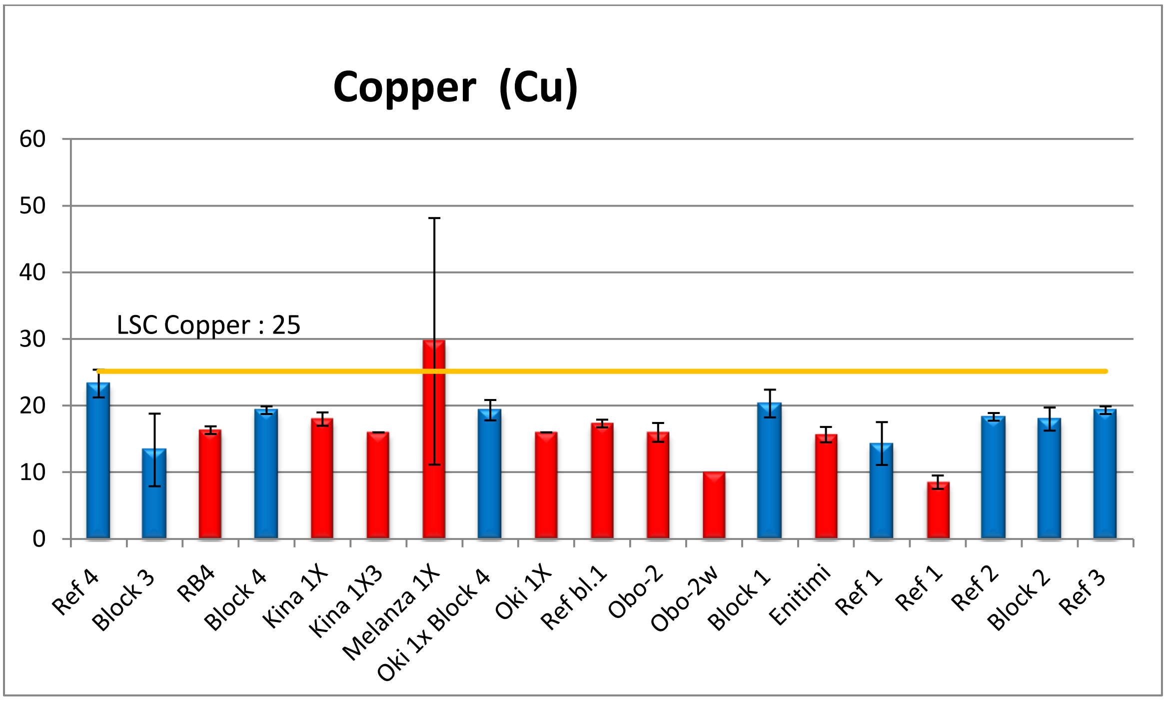


Fig. 3.4.3.5 and 3.4.3.6 Distribution of Lead(average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Lead on each station.



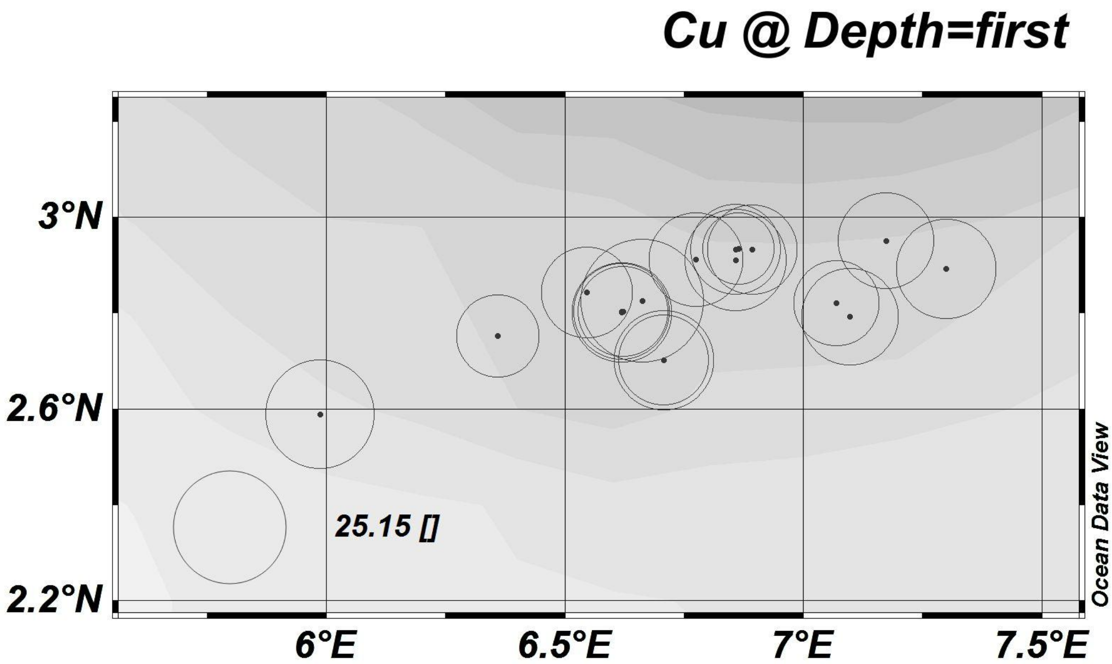
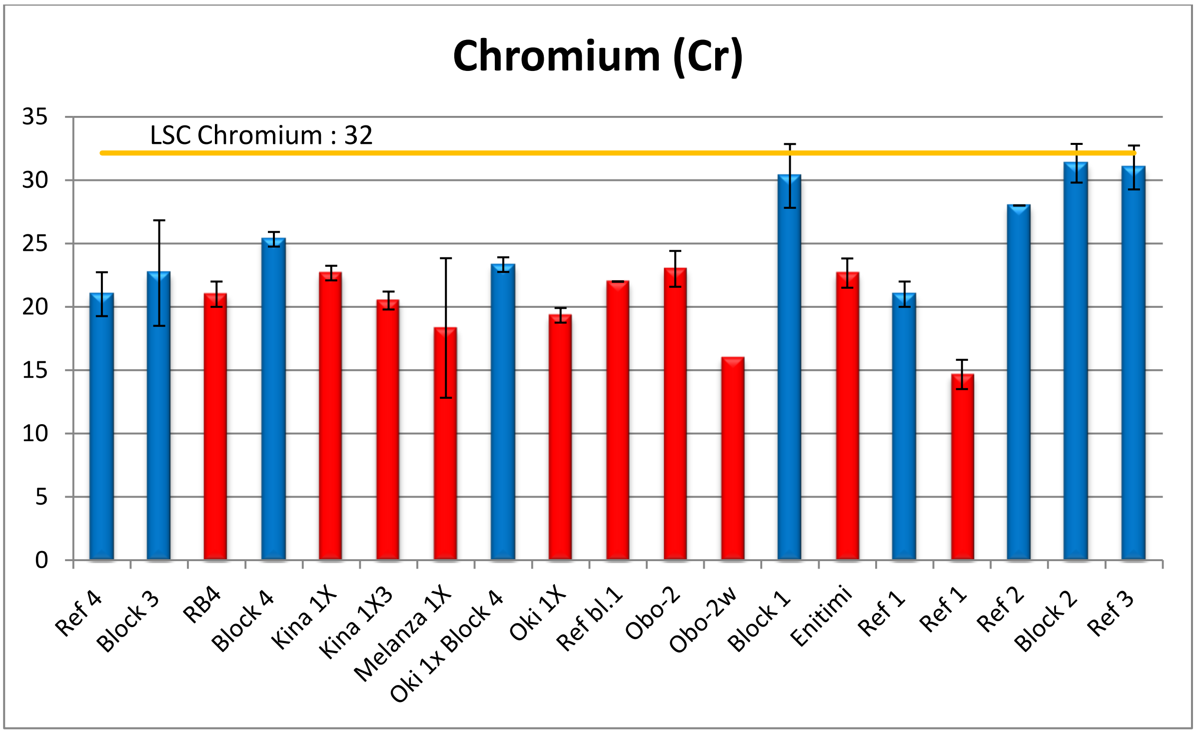


Fig. 3.4.3.7 and 3.4.3.8 Distribution of Copper (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Copper on each station.



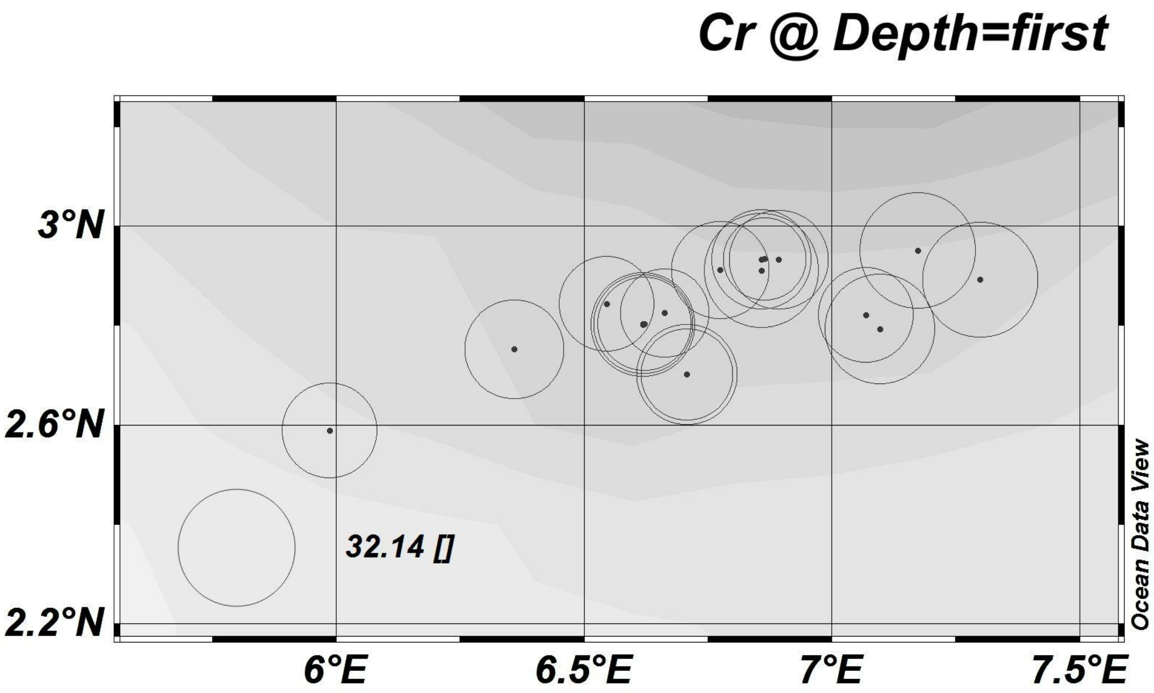
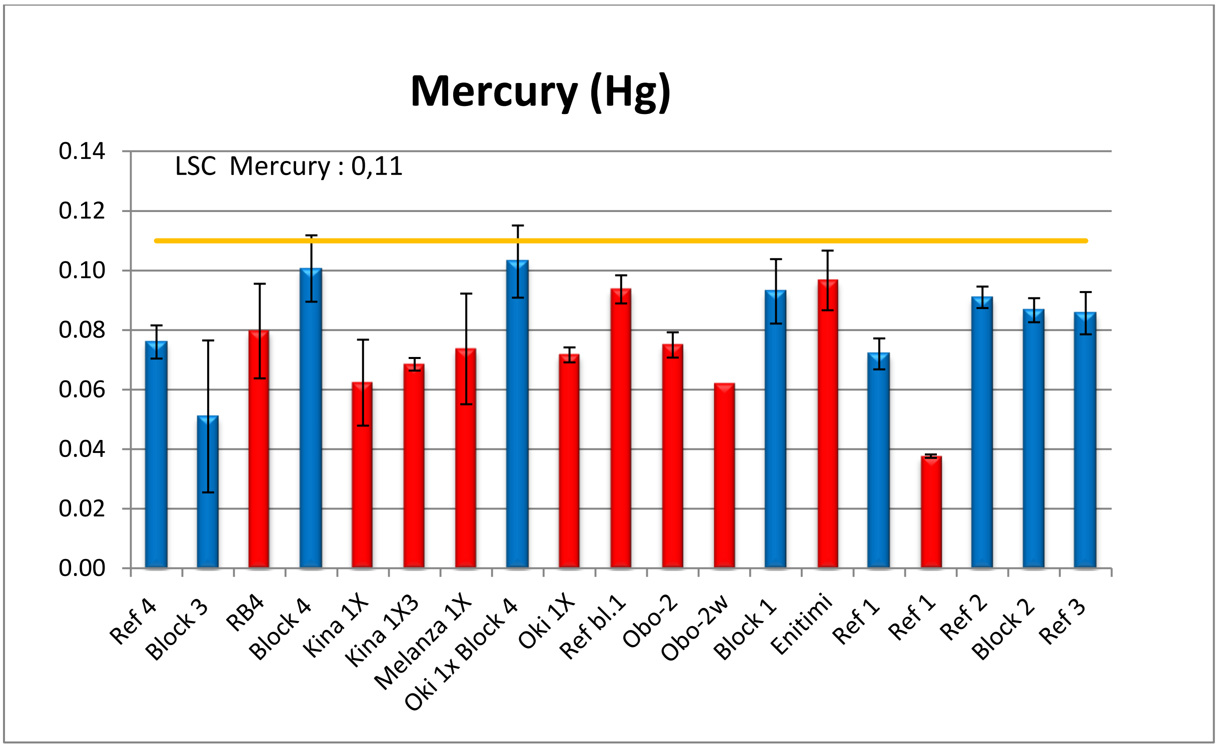


Fig. 3.4.3.9 and 3.4.3.10 Distribution of Chromium (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Chromium on each station.



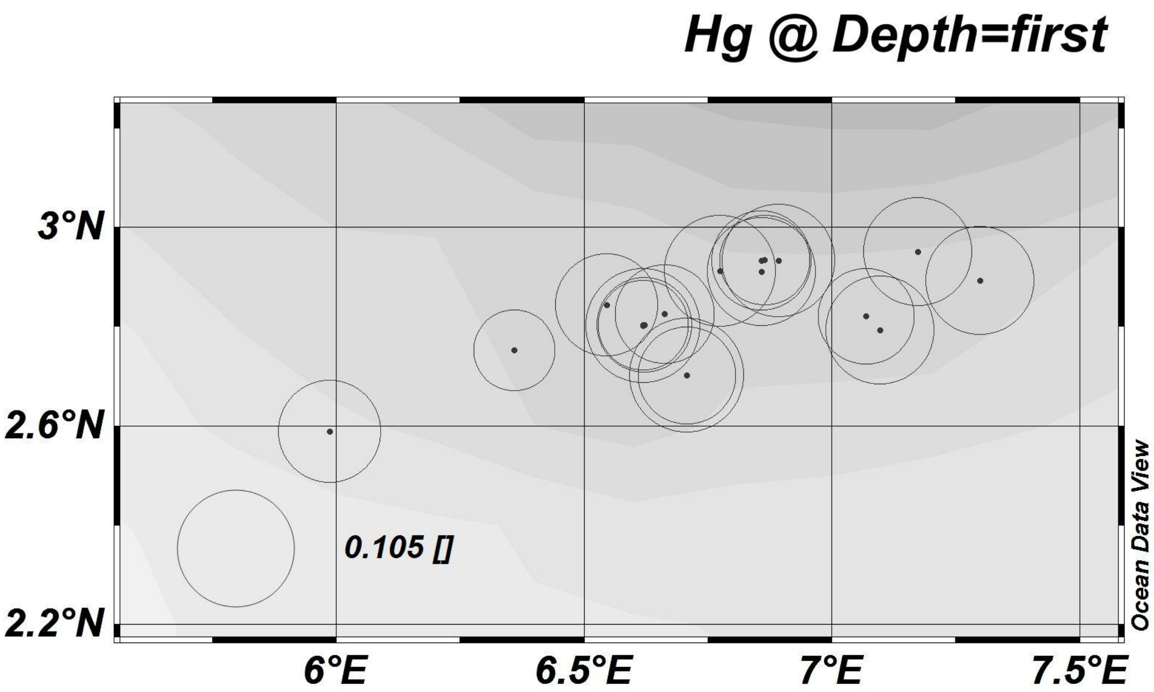
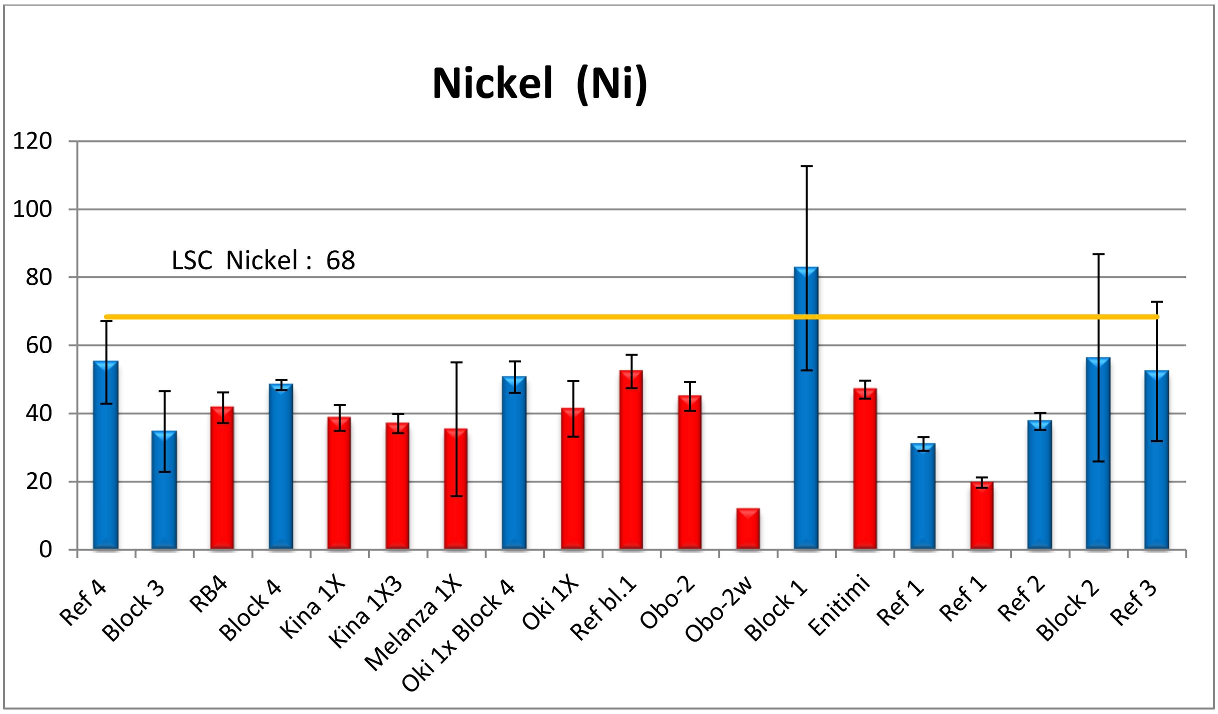


Fig. 3.4.3.11 and 3.4.3.12 Distribution of Mercury (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Mercury on each station.



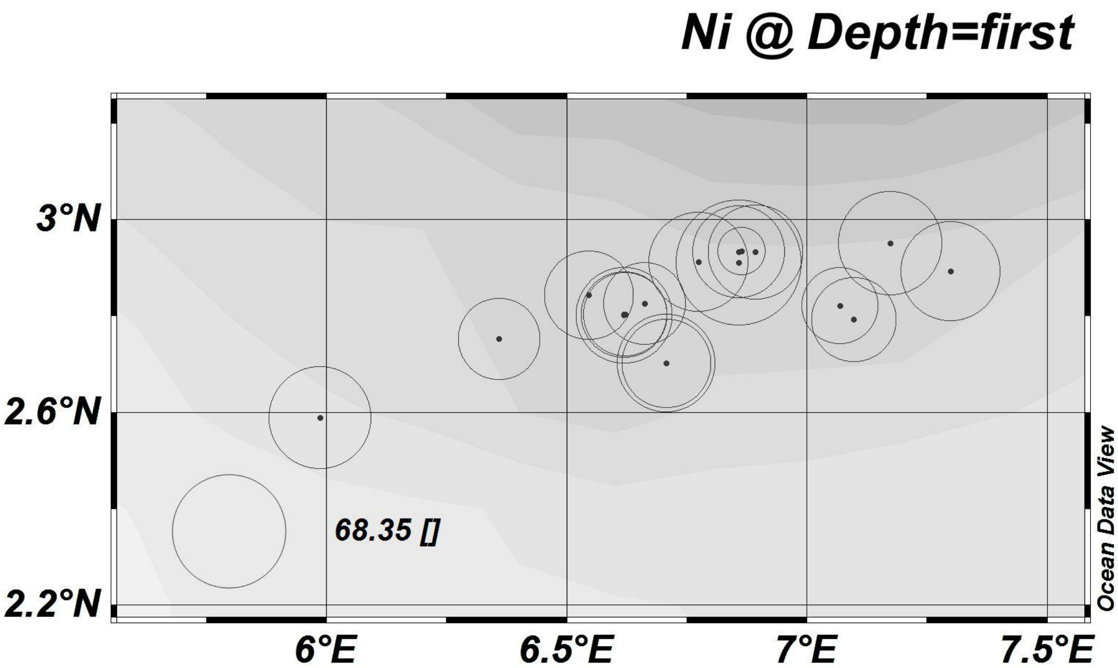


Fig. 3.4.3.11 and 3.4.3.12 Distribution of Nickel (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Nickel on each station.

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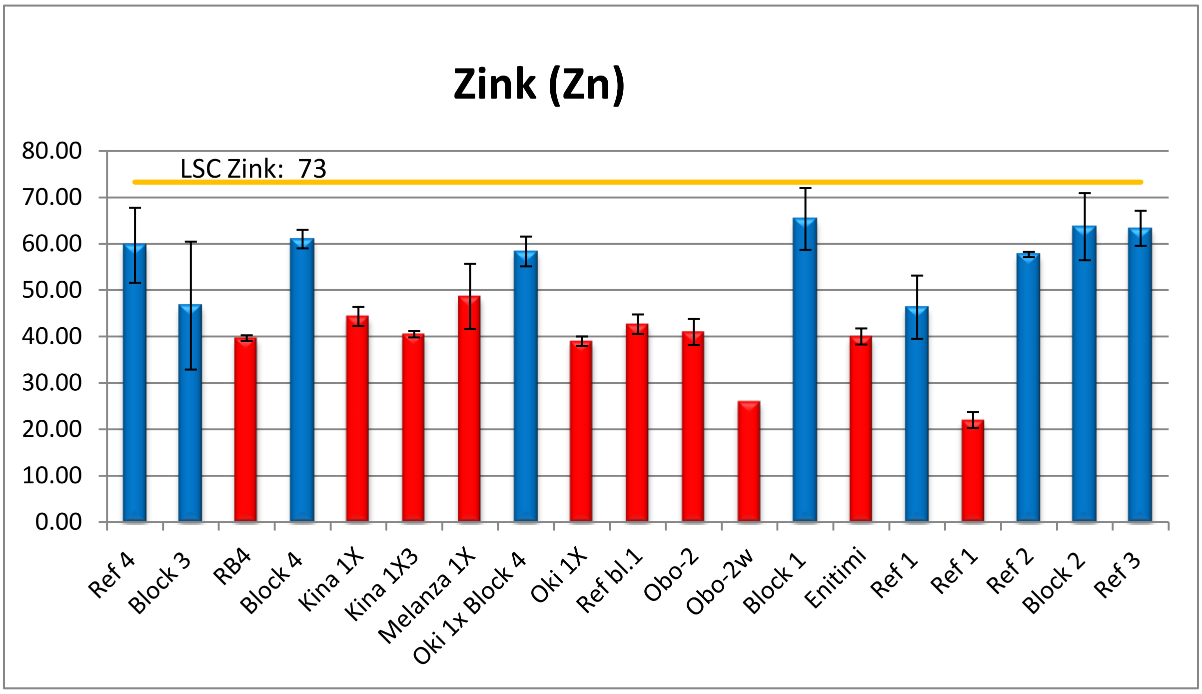


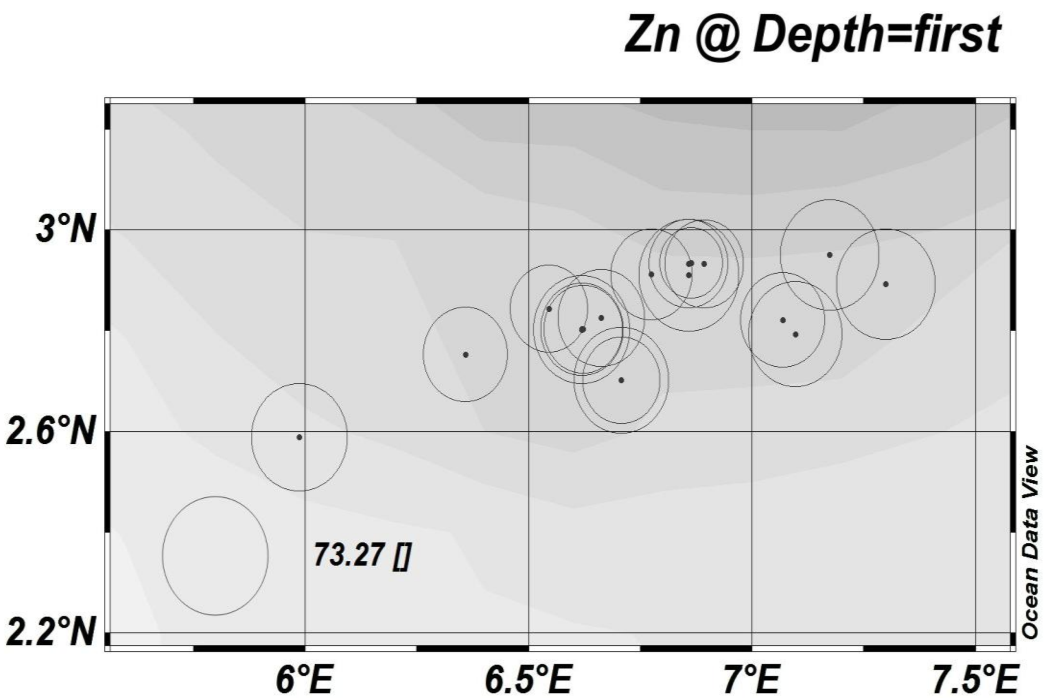
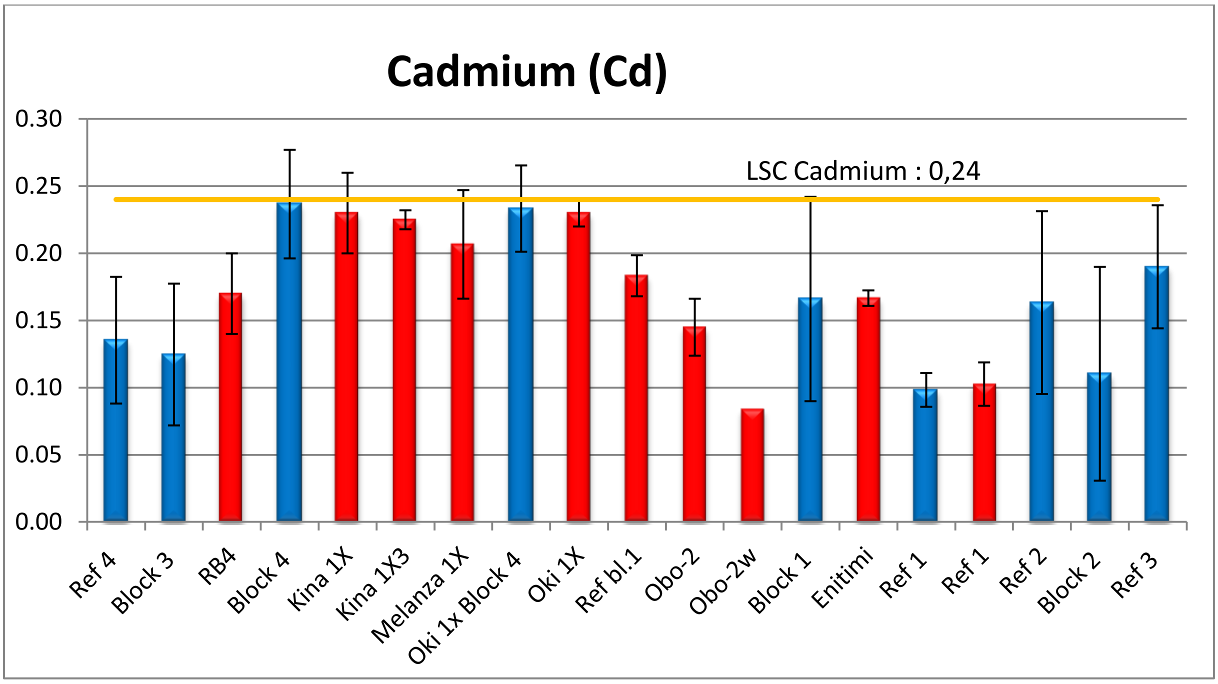


Fig. 3.4.3.13 and 3.4.3.14 Distribution of Zink (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)

The size of the circles illustrates the relative content of Zink on each station.



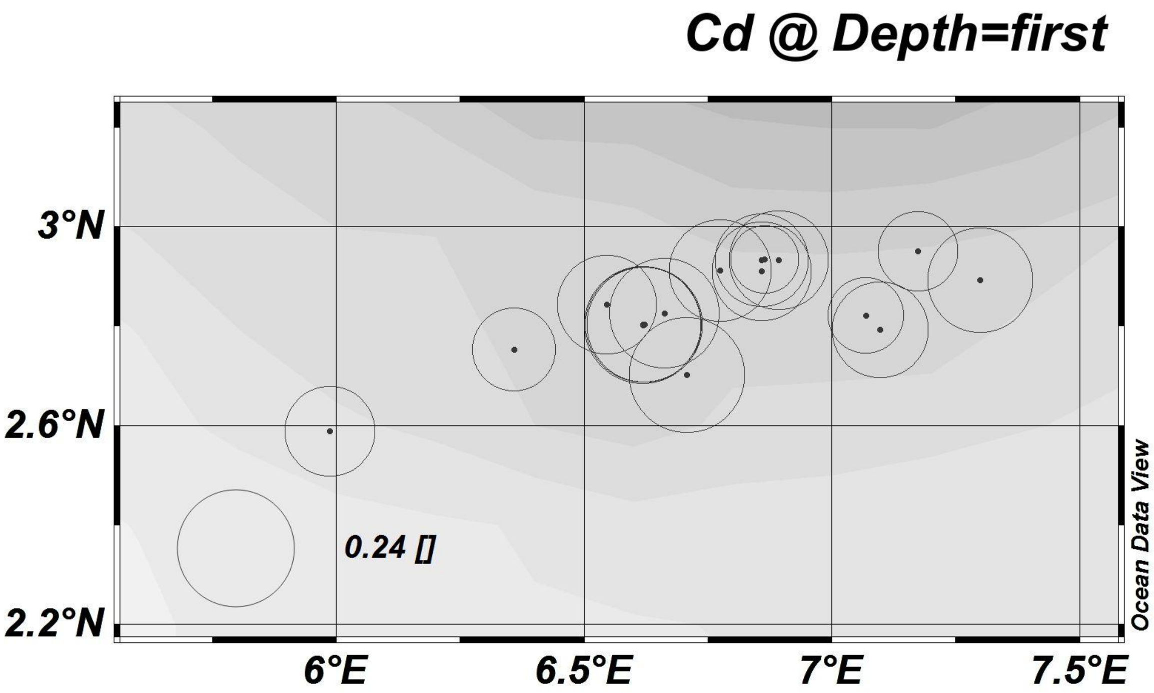


Fig. 3.4.3.15 and 3.4.3.16 Distribution of Cadmium (average and stdev) at the 19 samling sites. The blue collums are the stations sampled in 2011 and the red ones are from 2012. The yellow line is the calculated LSC (level of significant contamination) calculated from 21 reference stations samples. (mg/kg dry matter)
The size of the circles illustrates the relative content of Cadmium on each station.

Hydrocarbons

Table 3.4.3.4 summarises the results of the hydrocarbon analysis. The complete data set including replicates is presented in the Appendix (3.2 Tab. 3.4.5-3.2.6).

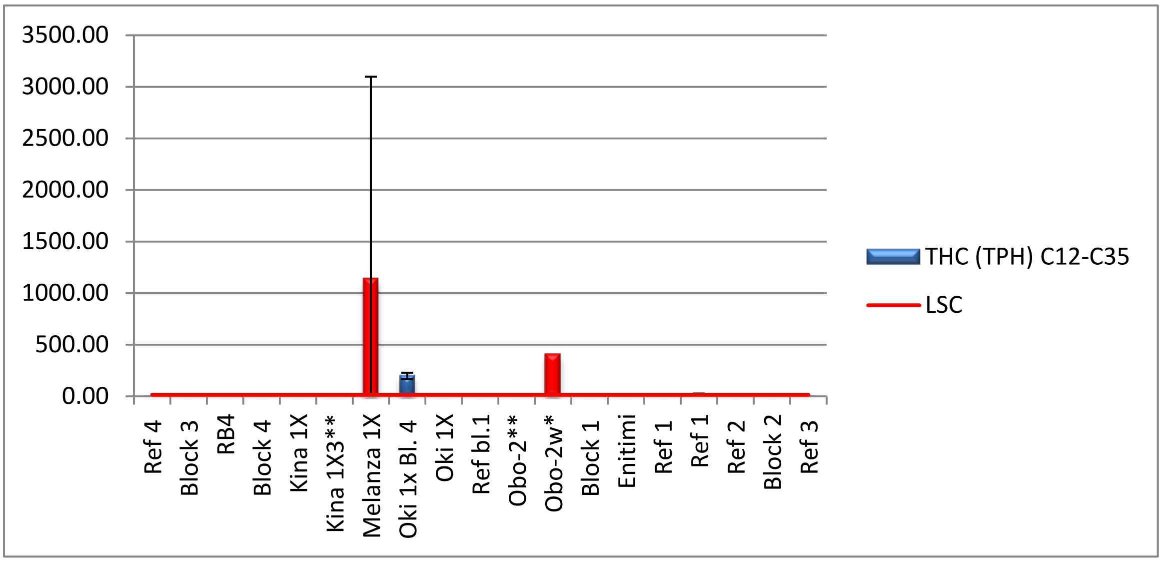
The concentrations of hydrocarbons, THC were low at most sites, the average of the referece stations in the area was 2,85 mg/kg. (Including one relatively high value) (Table 3.2.3.5). Values for most of the other sites were also low in THC. The exception for THC was found at Oki 1 X, Melanza 1X and Obo-2w showing 196.7, 1135.33 and 400.00 mg/kg respectivly. This is about 70 to 400 times the average of the reference stations (2,85 mg/kg). For comparison average values from region II (150-200 km of the coastline)(2009) on the Norwegian shelf had backround levels of 4 mg on average (0,1-9,8 mg/kg) the Norwegian Mareano project had 5,5mg/kg average (2,2-7,4 mg/kg) in Norland and Troms (the Mareano project has stations closer to the coast line). All compounds of PAH (polyaromatic hydrocarbons) were below the detection limits in 2011 and NPD's (naphthalene, phenanthrene and dibenzothiophene) were only seen in one sample from Block 2 and in the samples from Block 4 Oki 1 X. For the 2012 samples PAH levels are relatively high on Obo-2w and slightly elevated on Oki-1x. Compared to numbers from region II the average for NPD on the reference stations was 0,0027 in JDZ and 0,008 in region II. Taking level of industrialisation and distance to shore into account this seems to be a reasonable and expected background level. Due to some variation among the samples the calculated LSC is set to 0,0115.
The NPD's indicating antropogenic sources of hydrocarbons shows very high levels on Obo-2w, high levels on Malenza-1x and an elevated level on Kina 1x compared to the LSC for the area.

Table 3.4.3.4 Average concentrations and standard deviations of THC (C12-35), PAH16, NPD's and PCB (mg/kg dw) at the nineteen samling stations 2011 and 2012.

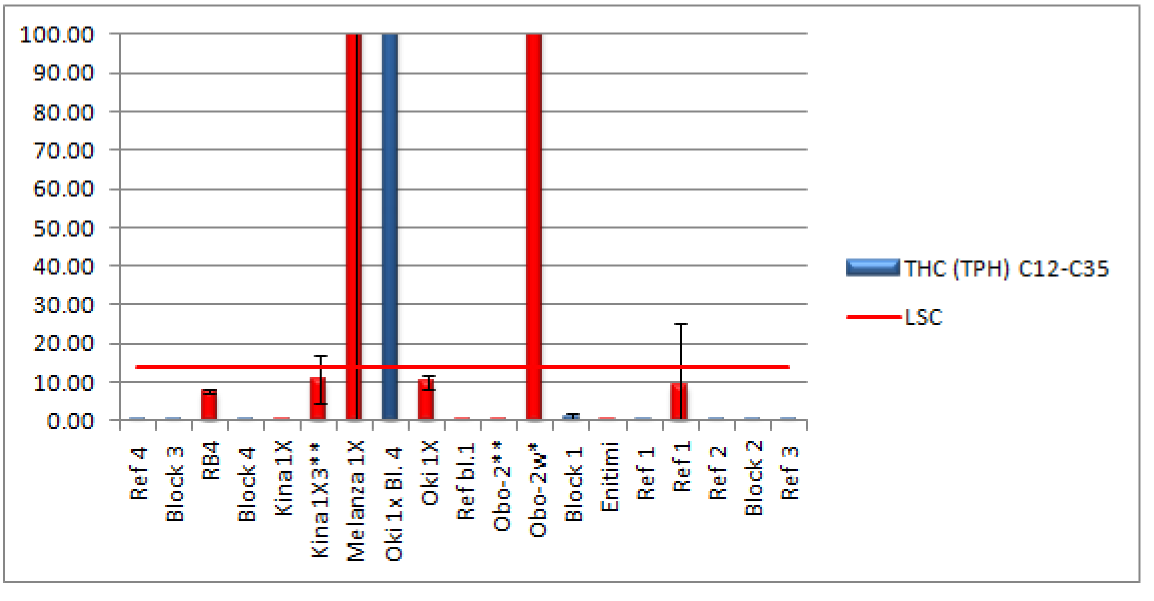
Station	Depth	THC (TPH) C12-C35 (mg/kg dw)		NPD's (mg/kg dw)		PAH 16 EPA (sum) (mg/kg dw)		PCB (7) Sum) (mg/kg dw)	
		Av	Stdev	Av	Stdev	Av	Stdev	Av	Stdev
(11) Block 1	1730m	1.07	0.98	nd		0.014	0.006	nd	
Block 2	1660m	<1		<0,001		0.018	0.004	nd	
Block 3	1892m	<1		nd		<0,01		nd	
Block 4	1976m	<1		nd		0.016	0.005	nd	
Oki 1x Bl. 4	2062m	196.7	30.6	0.006	0.007	0.017	0.004	nd	
Ref 1	1537m	<1		nd		0.011	0.001	nd	
Ref 2	1925m	<1		nd		0.015	0.004	nd	
Ref 3	1912m	<1		nd		0.017	0.002	nd	
Ref 4	2665m	<1		nd		0.011	0.001	nd	
(12) Enitimi	1674	<1		0.0042	0.0012	0.030	0.002	-	
Kina 1X	1999	<1		0.0260	0.0020	0.027	0.003	-	
Kina 1X3**	1992	10.7	6.1	0.0078	0.0007	0.021	0.002	-	
Melanza 1X	1922	1135.33	1961.26	0.2363	0.3669	0.018	0.008	-	
Obo-2**	1696	<1	0.00	0.0061	0.0002	0.024	0.001	-	
Obo-2w*	1685	400.00		1.1000		0.100		-	
Oki 1X	2062	10.17	1.76	0.0025	0.0006	0.025	0.004	-	
RB4	1909	7.77	0.51	0.0049	0.0008	0.028	0.003	-	
Ref 1	1545	9.33	16.17	0.0004	0.0006	0.009	0.003	-	
Ref bl.1	1800	<1	0.00	0.0133	0.0006	0.046	0.006	-	

Table **3.4.3.5** Level of significant contamination, calculated from the hydrocarbon data from the reference stations. Values marked with * is calculated from 0,5*detection limit.

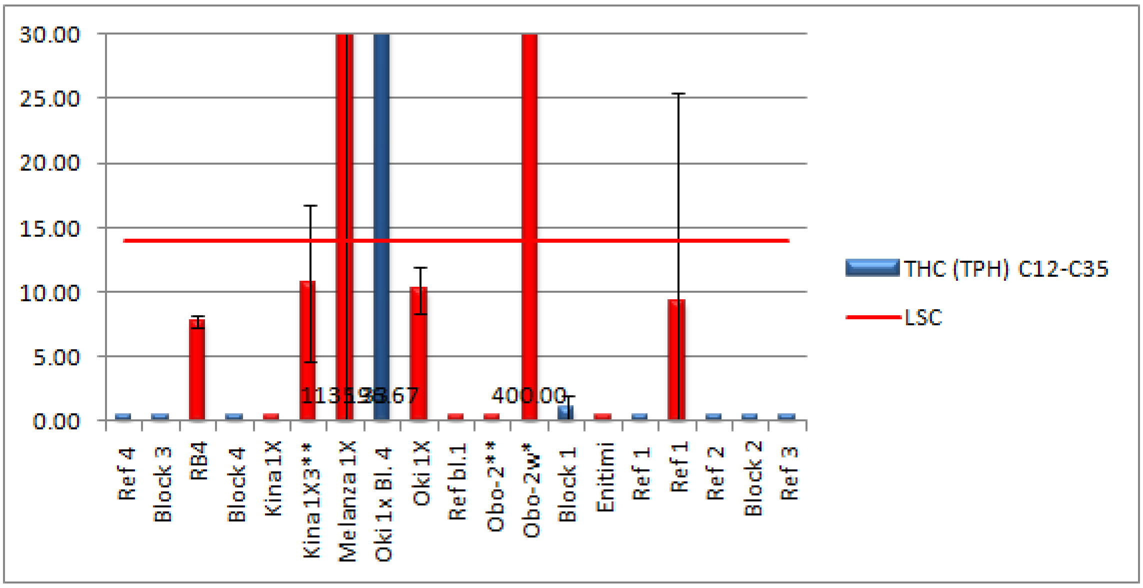
			mg/kg dry matter		
Station	Depth	Sample	NPDs	PAH 16 EPA	TPH C12-C35
Ref 1 (11)	1537m	1	0.00	0.0113	0.50
		2	0.00	0.0063	0.50
		3	0.00	0.0103	0.50
Ref 2 (11)	1925m	1	0.00	0.0151	0.50
		2	0.00	0.0192	0.50
		3	0.00	0.0123	0.50
Ref 3 (11)	1912m	1	0.00	0.0194	0.50
		2	0.00	0.0149	0.50
		3	0.00	0.0183	0.50
Ref 4 (11)	2665m	1	0.00	0.0104	0.50
		2	0.00	0.0113	0.50
		3	0.00	0.0122	0.50
RB4 (12)	1909	1	0.0055	0.02432	8.2
		2	0.004	0.0282	7.9
		3	0.0052	0.0298	7.2
Ref 1 (12)	1545	1	0.0011	0.0133	28
		2	0	0.00796	0.50
		3	0	0.00686	0.50
Ref bl.1 (12)	1800	1	0.013	0.04055	0.50
		2	0.014	0.05211	0.50
		3	0.013	0.04387	0.50
		Av	0.0027	0.0194	2.85
		Stdev	0.0048	0.0128	6.32
		LSC	0.0115	0.0429	14.47



3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Ref 4
Block 3
RB4
Block 4
Kina 1X
Kina 1X3**
Melanza 1X
Oki 1x Bl. 4
Oki 1X
Ref bl.1
Obo-2**
Obo-2w*
Block 1
Enitimi
Ref 1
Ref 1
Ref 2
Block 2
Ref 3
THC (TPH) C12-C35
LSC



100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Ref 4
Block 3
RB4
Block 4
Kina 1X
Kina 1X3**
Melanza 1X
Oki 1x Bl. 4
Oki 1X
Ref bl.1
Obo-2**
Obo-2w*
Block 1
Enitimi
Ref 1
Ref 1
Ref 2
Block 2
Ref 3
THC (TPH) C12-C35
LSC



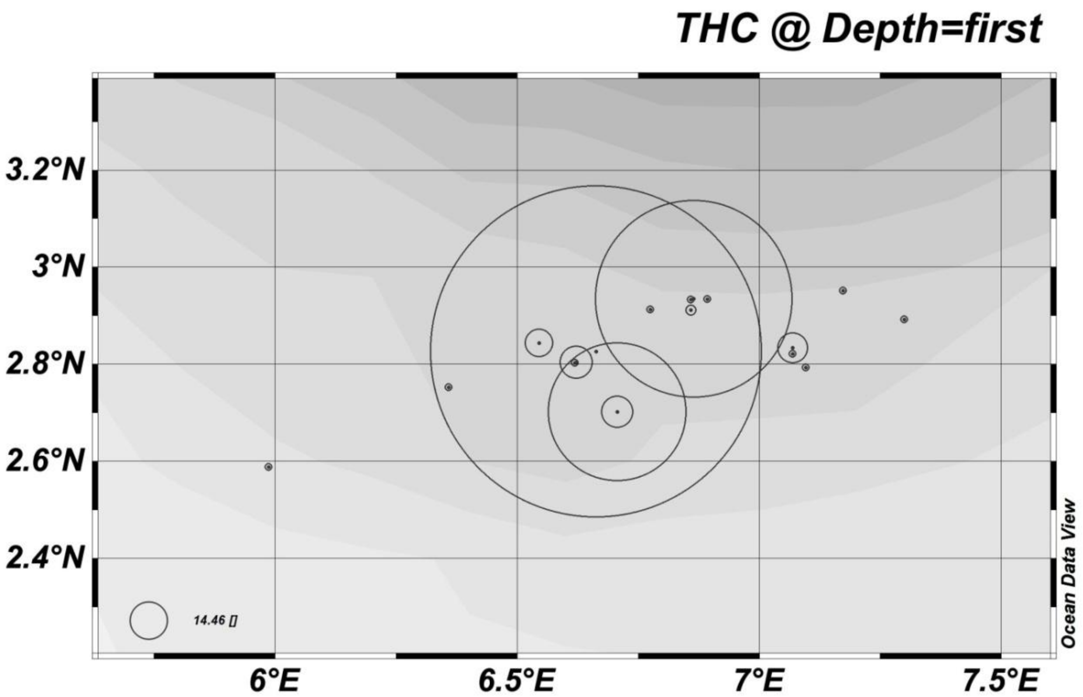
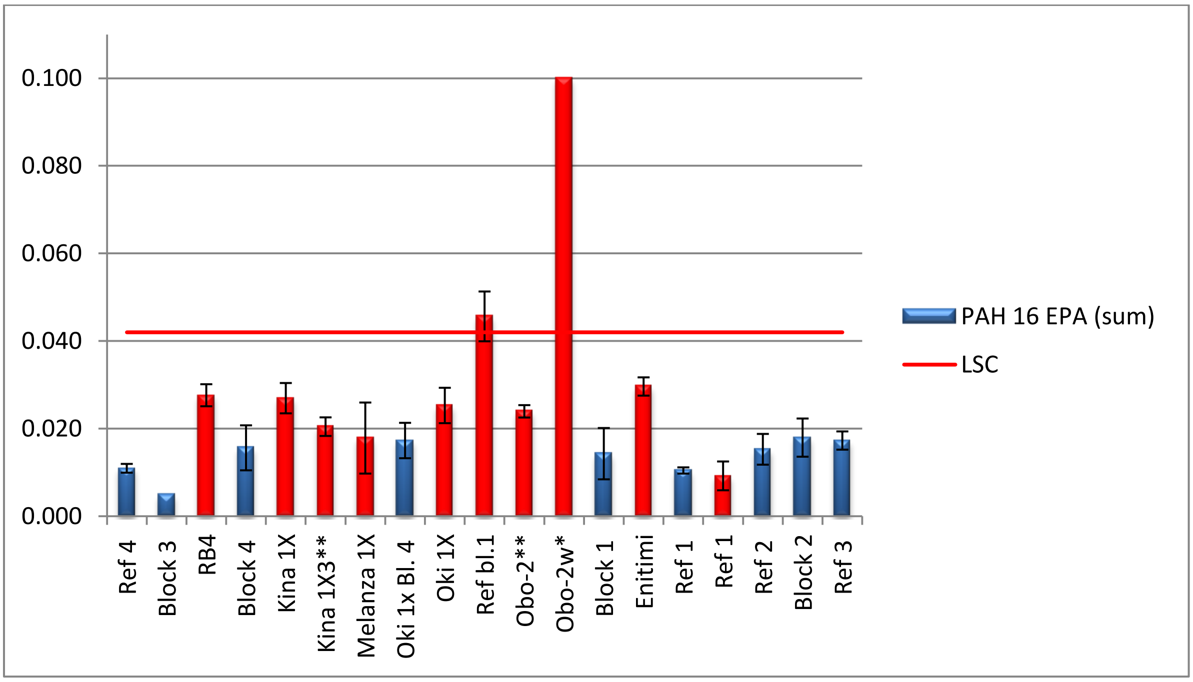


Fig. 3.4.3.17 THC. Distribution of THC (average and standard deviation) Data lower than the detection limit are presented as half the detection limit in the column chart's. The size of the circles illustrates the relative content of THC on each station.



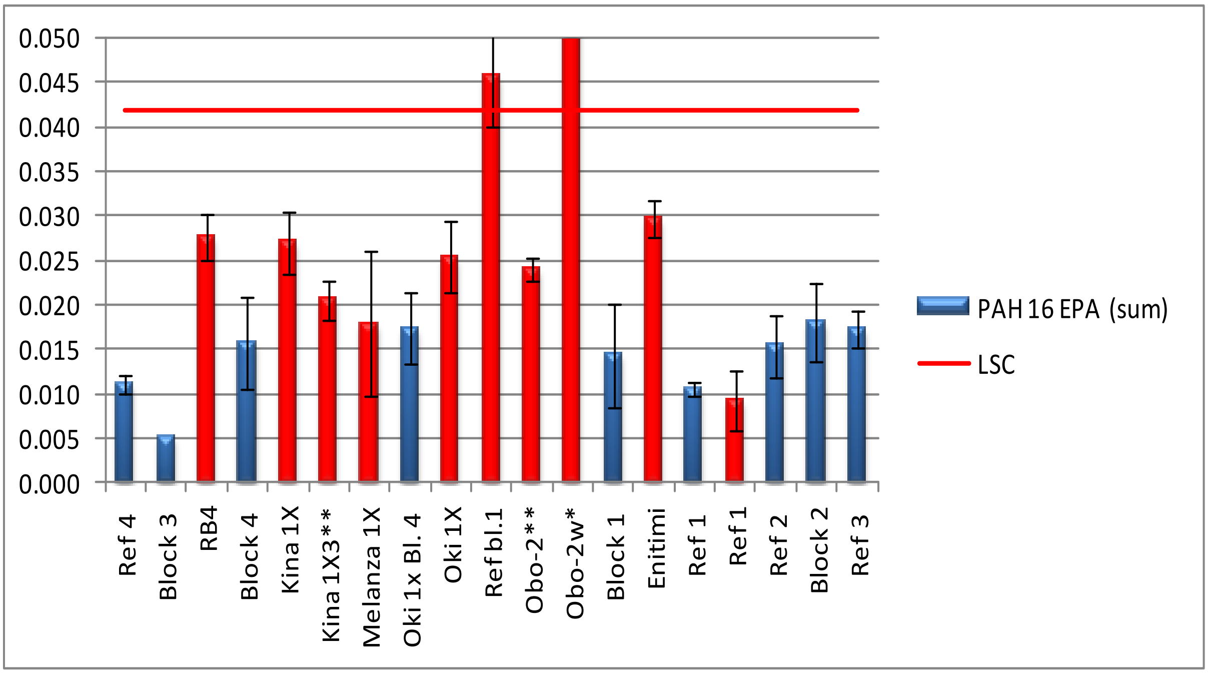


Fig. 3.4.3.18 Distribution of the 16 EPA PAH (average and standard deviation) at the nine samling stations. Data lower than the detection limit are presented as half the detection limit.

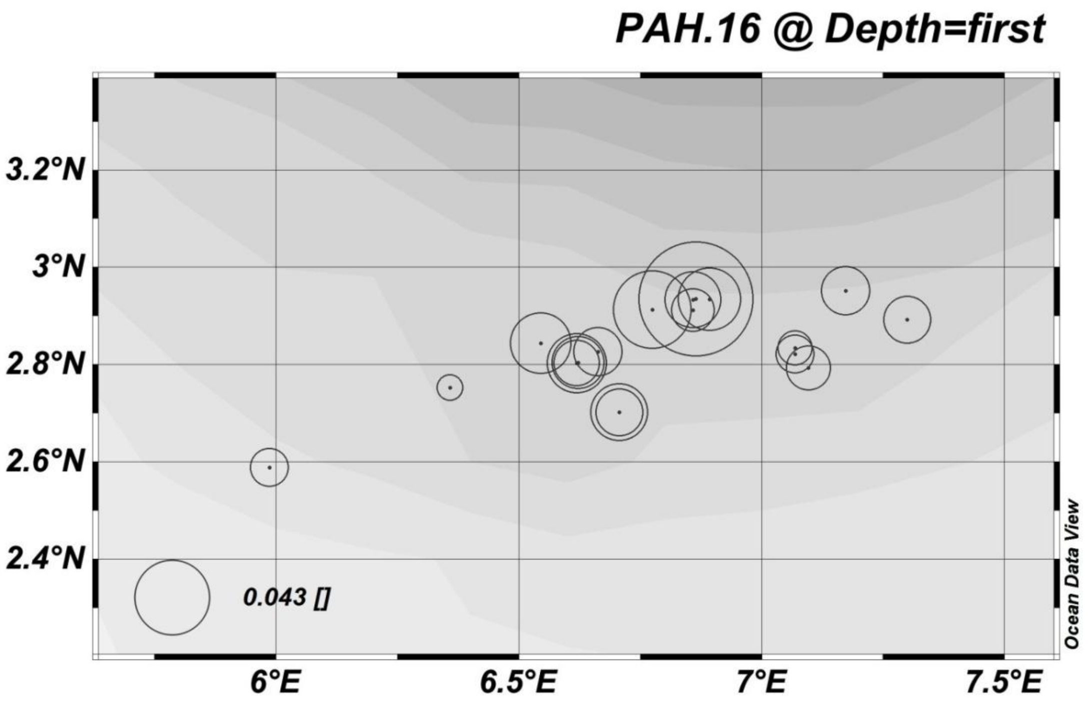
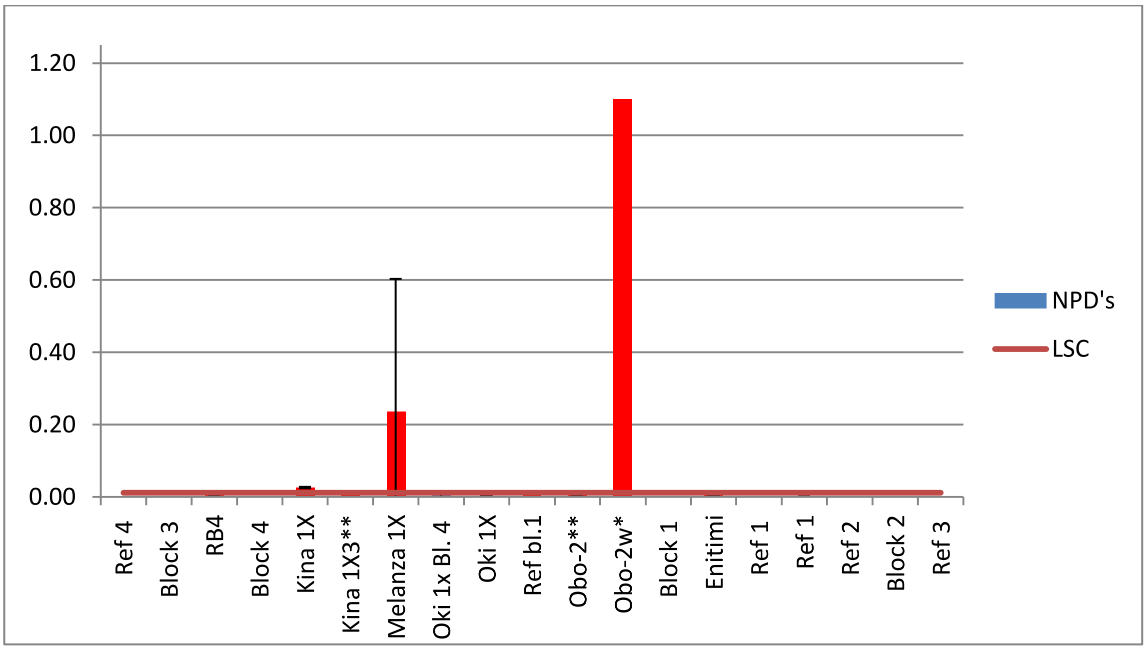
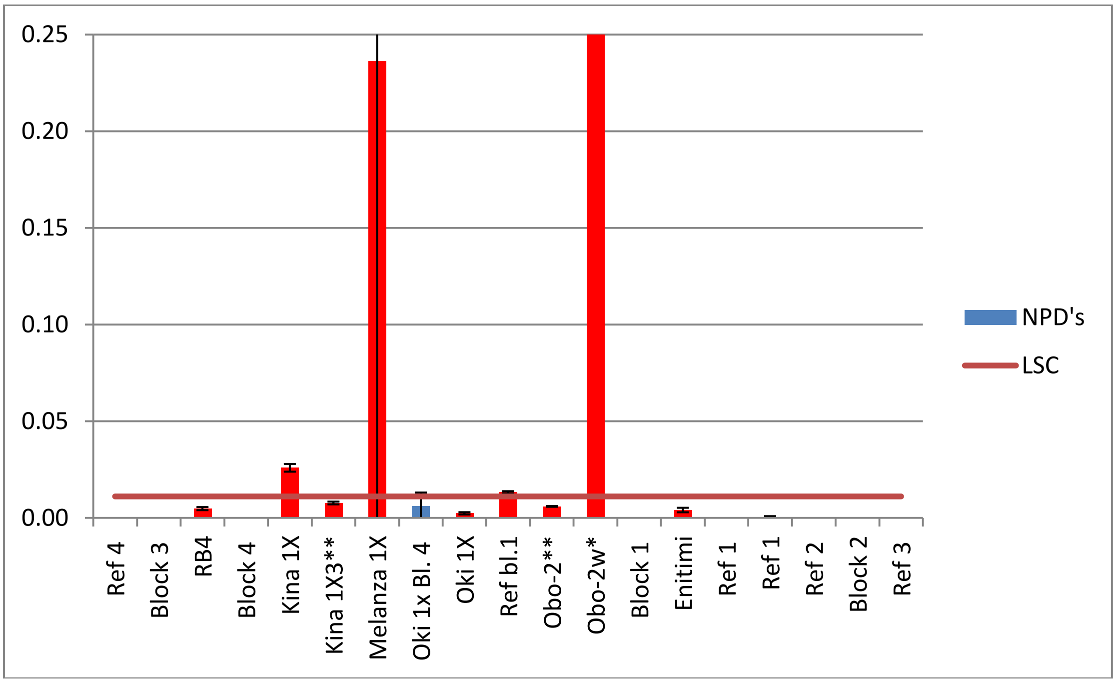


Fig. 3.4.3.18 PAH EPA16. Distribution of PAH's (average and standard deviation) Data lower than the detection limit are presented as half the detection limit in the column chart's. The size of the circles illustrates the relative content of PAH's at each station.





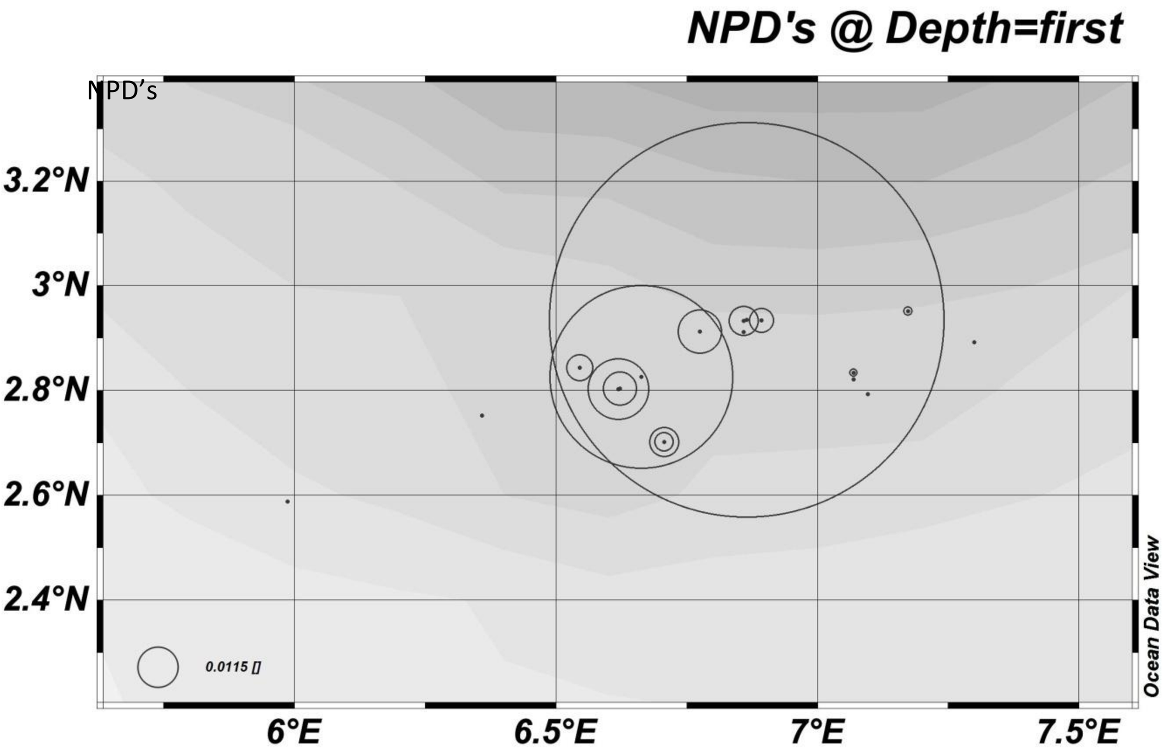


Fig. 3.4.3.19 NPD's. Distribution of NPD's (sum Naphtalene C1,C2,C3, Phenanthren C1,C2,C3 and Dibenzothiophene C1,C2,C3) (average and standard deviation) Data lower than the detection limit are presented as half the detection limit in the column chart's. The size of the circles illustrates the relative content of NPD's at each station.

3.4.4 Biology

Benthic sampling. (Photo T. Ensrud)

Benthic fauna was sampled from nine stations with a depth gradient from 1537 to 2665m in 2011 and 1531- 2065 m in 2012. Compared to the 2011 samples two important changes was made to the 2012 setup. The changes were made taking into account that both the abundance and the biomass of macrofauna decreases with water depth on a logarithmic scale, the biomass more than the number of specimens. This means that the macro fauna in deep waters are generally smaller than that in relatively shallow habitats. (Rex et. al. 2006)

The first change was a reduced mesh size of the sieves from 0,5 to 0,3 mm. The 0,3 mm was chosen because it provides a stronger net for the sieves. The term macrofauna is defined by the mesh size of the sieves used to separate the animals from the sediment. In deep sea studies, 0,3 mm is curretnly used in American programs and 0,25 mm in European programs. These two mesh sizes provide almost identical estimates for abundance, biomass and diversity estimates. Compared to the 250µm the 500 µm sieve is estimated to retain about 59% of the macro faunal specimens and 86% of the species in the sample. But in terms of diversity the Shannon index shows a variable response with finer sieves finer than 500 µm. (Gage et al. 2002).

The second change was related to the temperature gradient in the deep water compared to surface water.

The temperature in the deep water associated with the benthic stations varied between 2,76 ^{0}C and 4,08 ^{0}C, while the temperature of the surface water was around 29-30 ^{0}C. The washing water for the samples used in 2011 was taken form the fire outlet with a temperature ranging from 32 to about 42 ^{0}C if the water flow was closed between stations.

To reduce this temperature gradient an RSW (refrigerated sea water plant was purchased and mounted on the winch deck.

This setup provided washing water in a temperature range of 5-10 ^{0}C, improving the quality of fauna samples significantly.

The salinity was stable between 34,88 and 34,96 ‰, the amount of oxygen was between 5,11 and 5,39 ml/l. The hydrographical data is presented in Table 3.5.4.1.
Seven of the sampling stations from 2012 were located around old oil exploration wells, the other three were sampled as reference stations.

Table 3.4.4.8 hydrographical data from the benthic stations.

Station	depth	B.station	temp.	sal.	ox. ml/l	Sat %
1535	1503	Ref 1	4.24	34,94	3.3	
1536	1977	Kina 1x	3,70	34,97	3,3	
1562	1710	Melanza				
1591	1703	Enitimi				
1592	1706	Obo 2				
1625	1731	Ref 1	4,25	34,94	3,3	

A summary of number of individuals and taxa within the main taxonomic groups is presented in Table 3.2.9. Annelida was the main taxonomic group in the material, contributing with 60,3 % of the total amount of individuals from the sampling area. The second largest taxonomical group was crustaceans contributing 22,7 % of the individuals, the third group, mollusca accounted for 11,7 % of the individuals. There were 34 taxa's of annelids, 21 % of the taxas found. 101 taxa's of Arthropoda or 62,3 % of the total, the Molluscs accounted for 19 taxa's (11,7 %). From the reference stations the numbers were Annelida 14,5 %, crustacea 51,7 % and mollusca 23,5 %.
From the three most contaminated stations Melanza, Obo 2 and Obo 2w the numbers were Annelida 86,5 %, crustacea 7,0 % and mollusca 5,8 %.
Comparing these three to data from deep water studies from the east coast of the United States conducted in the 1950-1960 this distribution is clearly skeewed. (Theroux & Wigley. 1998) The number of individuals and species, diversity and evenness is presented in Table 3.2.10, 3.5.4.3 and Figure 3.2.29-3.2.36. 3.3.5.4 The complete species list of the benthic animals is available in the Appendix. (Annex 5 Tab. 5.9)
There is an expectance of high diversity and evenness in these deep water habitats, meaning a relatively high number of species represented by few specimens. (see the definition in materials and methods) The expected value for evenness (J) should be in the range 0,75-0,85 (Rex & Etter 2010). The figures in this investigation ranges from 0,43-0,96 with an average of 0,91 from the reference stations and 0,74 from the drilling stations. According to Gage et.al. (2002) 0,5mm sieves gives slightly higher values for evenness (J) compared to 0,3 or 0,25mm mesh size. The evenness index singles out Obo-2w (0,50) and Block 4 Obo-2w (0,43) because of their drop in evenness compared to the other stations. This drop seems to be atypical for homogenous deep water environments and indicates a significant disturbance in the benthic community as seen in the distribution among the main groups.
The ten most abundant species/groups for each site are presented in Table 3.5.4.3.2.11-3.2.19. The distribution of taxa between geometrical classes is presented in Table: 3.5.43.2.20 and plotted in fig. 3.5.3.2.37. The plot indicates a normal distribution of numbers and species for the reference stations and half of the drilling sites. The stations Obo 2, Obo-2w and Melanza stands out from the rest of the material having a high abundance of polychaets, 965 out of 1132 from the whole material distributed

on three main families Capitellidae Spionidae and Cirratulidae. The distribution in the geometric classes plot is a clear sign of disturbance on these particular stations.

Results of the multivariate analyses on diversity are given in the dendrogram (Figure 3.2.393.5.411) and the MDS plot (Figure 3.5.43.2.4012). In the cluster analyses, all sampling sites were linked together at approximately 22 % similarity (root transformation).

The dendrogram groups the stations into three assemblies:

1th assembly: Ref 1 bl -1, RB-4,OKI 1X and Enitimi groups together at 35 %.

2nd Assembly: Kina 1x and Kina 1x3 groups together at 55 %.

3rd Assembly: Melanza, Obo-2 and Obo-2w groups together at 43 %.

Ref -1 is separated from the rest of the stations having a different fauna composition consisting of fewer specimens and taxa but having high scores in the diversity and evenness indexes. This station has a coarse sediment with more sand and some gravel and lower TOM.

The coarser sediment seems to provide habitat for a different fauna limited by relatively lower access to available carbon.

The MSD plot separates Melanza and the Obo stations from the rest of the stations.

The PCA analysis in fig. 3.5.43.2.41/42 suggests that contamination with THC and NPD's are the main to explain the differences in the fauna composition from seen in the MDS plot in figure 3.5.43.2.40. The rate of accumulation of species in Figure 3.2.38 indicates that more replicates are desired to have full use of the biological samples in estimating the impact of oil exploration.

The samples also varied more than expected between the replicates on each station.

We could see the same variation in the 2011 material*. In 2012 we addressed those speculations changing the mesh size of the sieves and having refrigerated seawater to wash the samples. In addition we also had video footage of the sampled stations.

The video stream revealed a bacterial mat covering the most contaminated parts of the sampling area. Upon the bacterial mat there was an abundance of polychaeta feeding on the bacterial layer utilizing the bacterial decomposition of the hydrocarbons in the mud as a food recourse. We believe that this observation is consistent with the results of the chemical and biological analysis of the material.

*There are two possible explanations for this:

The relatively coarse 0,5mm sieves used in this investigation is estimated to hold approximately 59% of the specimens and 86% of the species held by a 0.25 or 0.30mm sieve. (Gage et.al. 2002) In addition, there will also be variations with different fauna composition to this estimate.

The other explanation is the lack of cold water to wash the samples. The surface water holds about 28-30 ˚C and when water supply was cut off between stations and samples, it might have reached 50-60 ˚C while the water temperature at the bottom held 2-4 ˚C. This migh have caused some animals to simply "boil" away. No log was made of these events and incidents happened throughout the cruise, so backtracking the problem is impossible at this stage. The polyhaetas and especially the malanidae are thought to be vulnerable to this.

Table. 1 Number of individuals of higher taxa.

Taxon	No. of ind.	Taxon	No. of ind.
CRUSTACEA	426	ECHINODERMATA	5
Amphipoda	21	Asteroidea	1
Cumacea	10	Echinoidea	1
Isopoda	90	Ophiuroidea	3
Ostracoda	211	NEMERTEA	1
Tanaidacea	94	SIPUNCULA	6
MOLLUSCA	219	NEMATODA	86
Bivalvia	206	POLYCHAETA	1132
Gastropoda	3	Tunicata	1
Caudofoveata	8		
Scaphopoda	2	Total	1876

Table 3.4.9 a-d Number of individuals and taxa of the main taxonomic groups for all stations, ref. stations and drilling stations sampled in 2012.

JDZ 2012 all stations				
Large taxonomic groups	N.o.specimens	%	N.o.Species	%
MOLLUSCA	219	11.67	19	11.73
ANNELIDA	1132	60.34	34	20.99
CRUSTACEA	426	22.71	101	62.35
SIPUNCULA	6	0.32	1	0.62
ECHINODERMATA	5	0.27	4	2.47
NEMERTEA	1	0.05	1	0.62
NEMATODA	86	4.58	1	0.62
Tunicata	1	0.05	1	0.62
Total	1876	100	162	100

JDZ 2012 Ref. stations				
Large taxonomic groups	N.o.specimens	%	N.o.Species	%
MOLLUSCA	81	23.55	14	13.86
ANNELIDA	50	14.53	18	17.82
CRUSTACEA	178	51.74	66	65.35
SIPUNCULA	3	0.87	1	0.99
ECHINODERMATA	3	0.87	1	0.99
NEMERTEA	0	0.00	0	0.00
NEMATODA	29	8.43	1	0.99
Tunicata	0	0.00	0	0.00
Total	344	100	101	100

JDZ 2012 drill stations Large taxonomic groups	N.o.specimens	%	N.o.Species	%
MOLLUSCA	138	9.01	18	14.88
ANNELIDA	1082	70.63	27	22.31
CRUSTACEA	248	16.19	71	58.68
SIPUNCULA	3	0.20	1	0.83
ECHINODERMATA	2	0.13	1	0.83
NEMERTEA	1	0.07	1	0.83
NEMATODA	57	3.72	1	0.83
Tunicata	1	0.07	1	0.83
Total	1532	100	121	100

JDZ 2012 Obo,Malenza Large taxonomic groups	N.o.specimens	%	N.o.Species	%
MOLLUSCA	65	5.83	12	16.67
ANNELIDA	965	86.55	23	31.94
CRUSTACEA	78	7.00	33	45.83
SIPUNCULA	1	0.09	1	1.39
ECHINODERMATA	0	0.00	0	0.00
NEMERTEA	1	0.09	1	1.39
NEMATODA	4	0.36	1	1.39
Tunicata	1	0.09	1	1.39
Total	1115	100	72	100

Table 3.4.10 Number of, species (S), individuals(N), Es(100), diversity (H'(Log2)), evenness (J) and max. diversity (H'max) for each station in the JDZ zone in 2012.

	S	N	D	Es(100)	H'(Log2)	H' max	J'
RB-4	54	148	10.61	43.66	5.11	5.75	0.89
Ref-bl-1	53	127	10.73	46.06	5.05	5.73	0.88
Ref-1	39	60	9.28	39.00	5.02	5.29	0.95
OKIIX	51	153	9.94	40.95	4.84	5.67	0.85
KIN-IX-3	29	47	7.27	29.00	4.61	4.86	0.95
KIN-IX	39	105	8.17	37.90	4.58	5.29	0.87
ENI	37	112	7.63	34.70	4.45	5.21	0.86
OBO-2	40	231	7.17	25.66	3.94	5.32	0.74
OBO-2W	25	241	4.38	15.03	2.33	4.64	0.50
Mal	34	633	5.12	12.17	2.19	5.09	0.43

Station	Crustacea	Mollusca	Polychaeta	Nematoda	Misc
	N	N	N	N	N
RB-4	80	33	17	18	0
Ref-bl-1	66	31	19	9	2
Ref-1	32	8	14	2	4
OKIIX	73	16	38	24	2
KIN-IX-3	22	4	16	5	0
KIN-IX	39	17	41	7	1
ENI	36	36	22	17	1
OBO-2	26	35	166	3	2
OBO-2W	16	17	207	1	0
Mal	27	13	592	0	1
All stat. N	417	210	1132	86	13
Station	Crustacea	Mollusca	Polychaeta	Nematoda	Misc
	%	%	%	%	%
RB-4	54.1	22.3	11.5	12.2	0.0
Ref-bl-1	52.0	24.4	15.0	7.1	1.6
Ref-1	53.3	13.3	23.3	3.3	6.7
OKIIX	47.7	10.5	24.8	15.7	1.3
KIN-IX-3	46.8	8.5	34.0	10.6	0.0
KIN-IX	37.1	16.2	39.0	6.7	1.0
ENI	32.1	32.1	19.6	15.2	0.9
OBO-2	11.2	15.1	71.6	1.3	0.9
OBO-2W	6.6	7.1	85.9	0.4	0.0
Mal	4.3	2.1	93.5	0.0	0.2
All stat. %	22.4	11.3	60.9	4.6	0.7

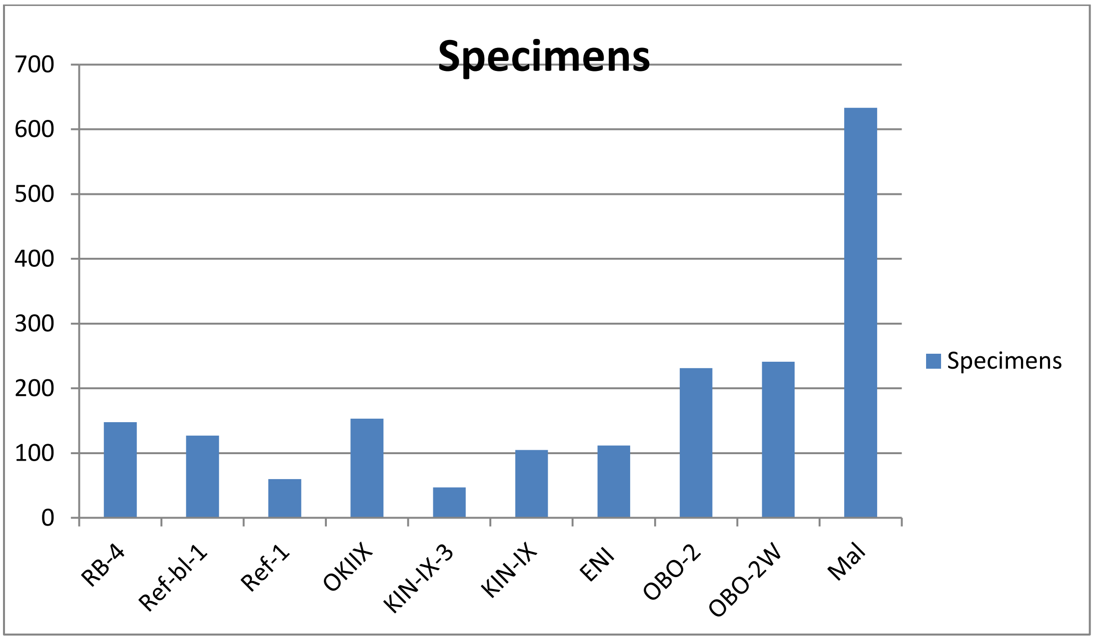
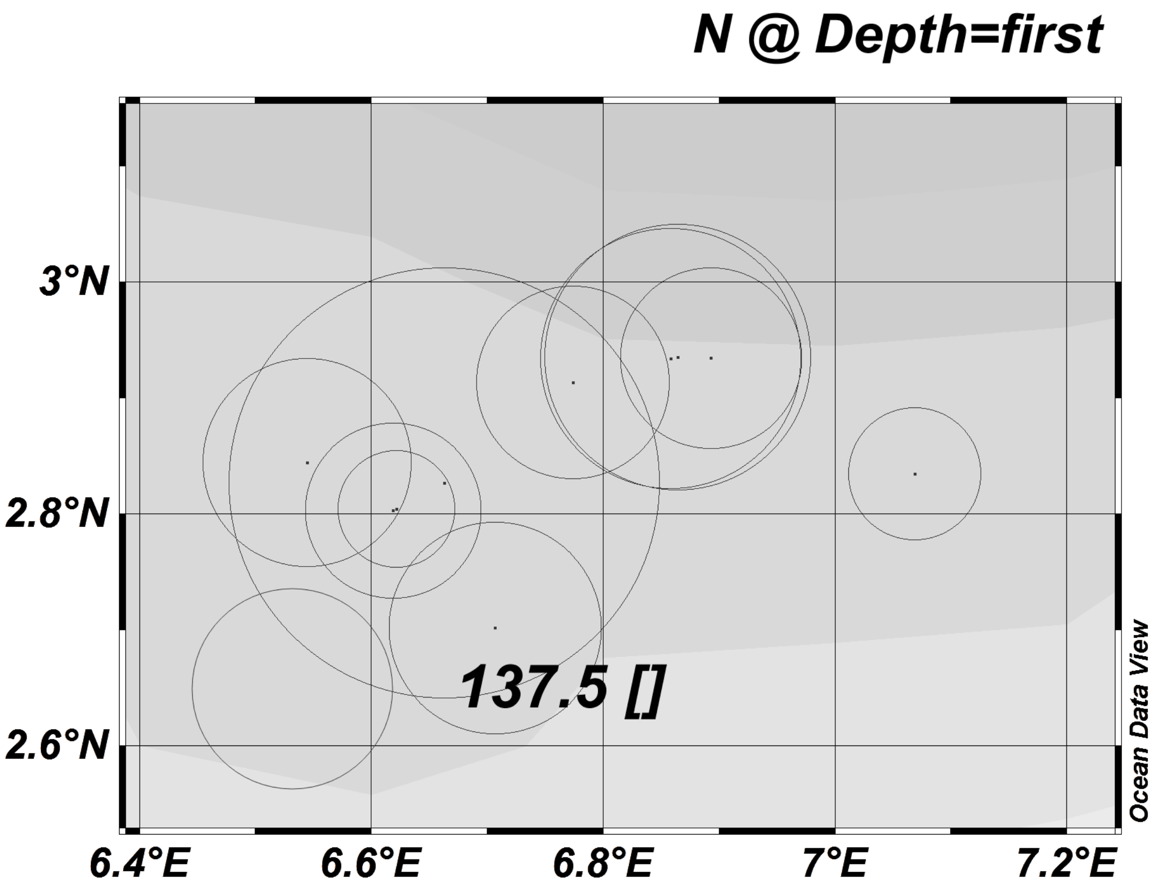
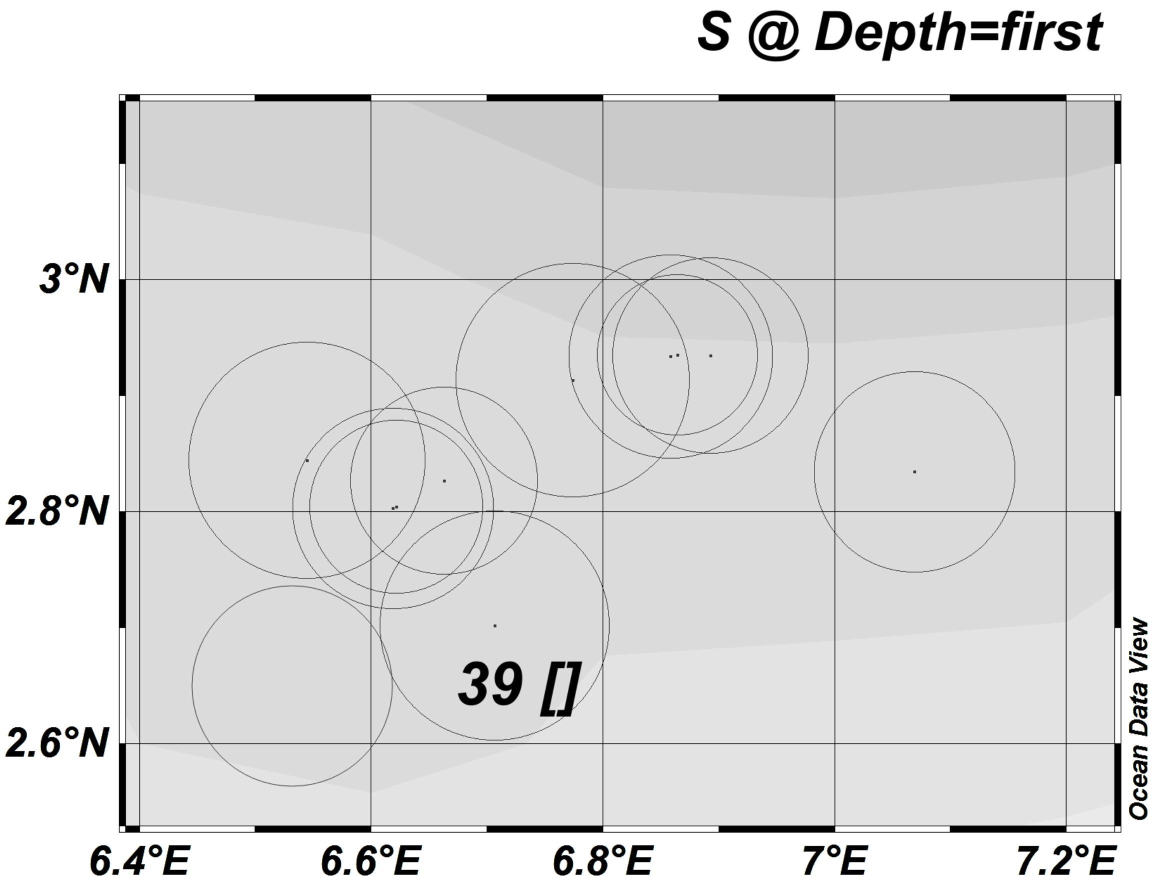


Fig. 3.2.29 Number of specimens at each station.

Fig. 3.2.30 Number of specimens. The size of the circles illustrates the relative number of specimens at each station.





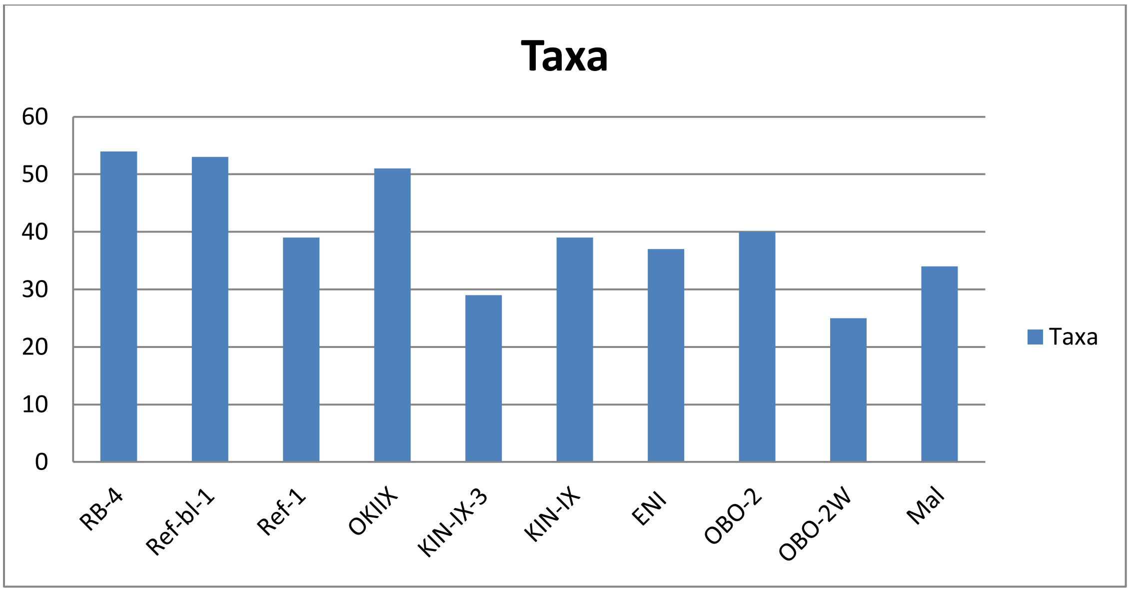
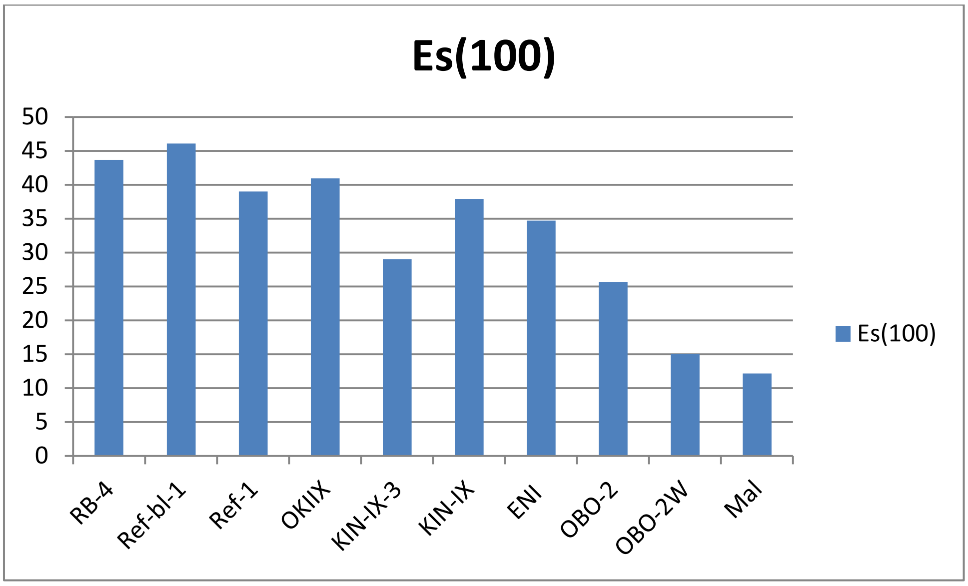


Fig. 3.2.31 Number of Taxa at each station.

Fig. 3.2.32 Number of taxa. The size of the circles illustrates the relative number of taxa found at each station.



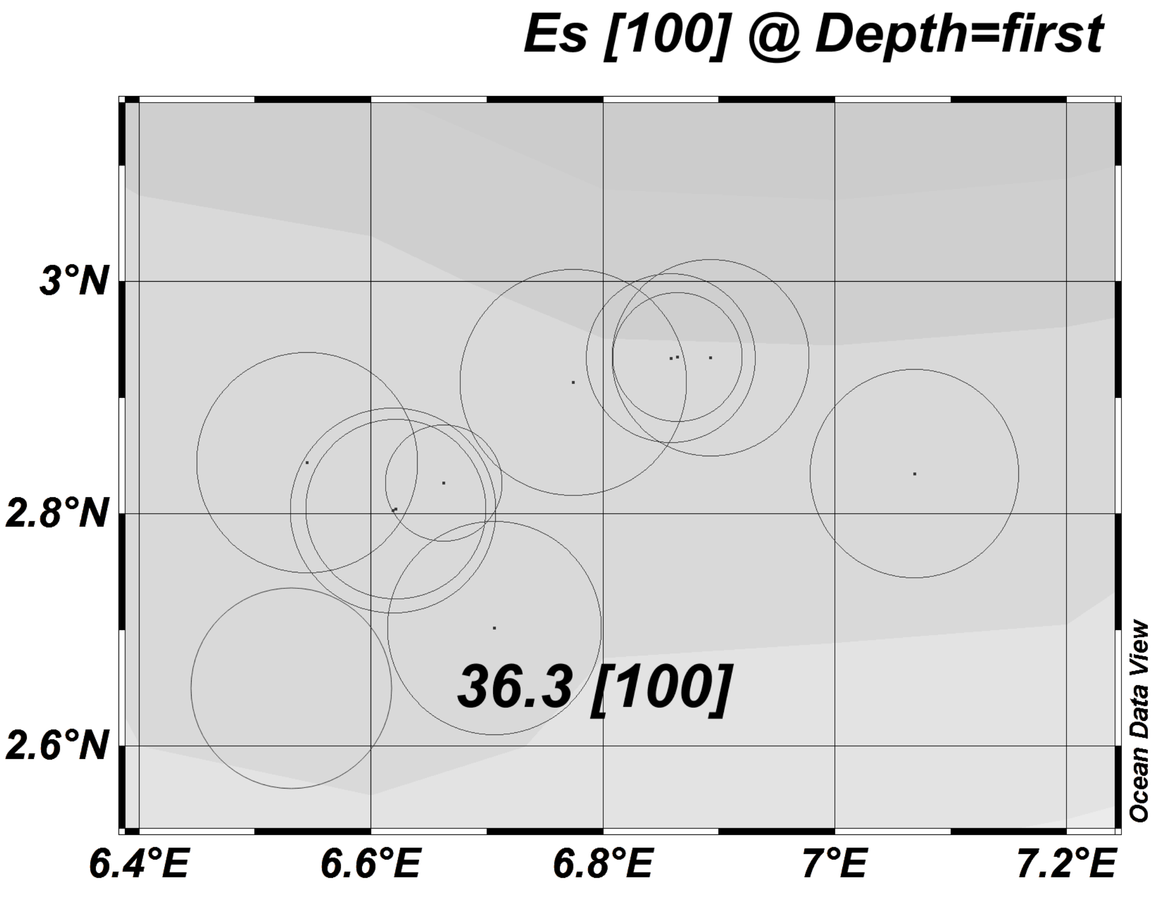
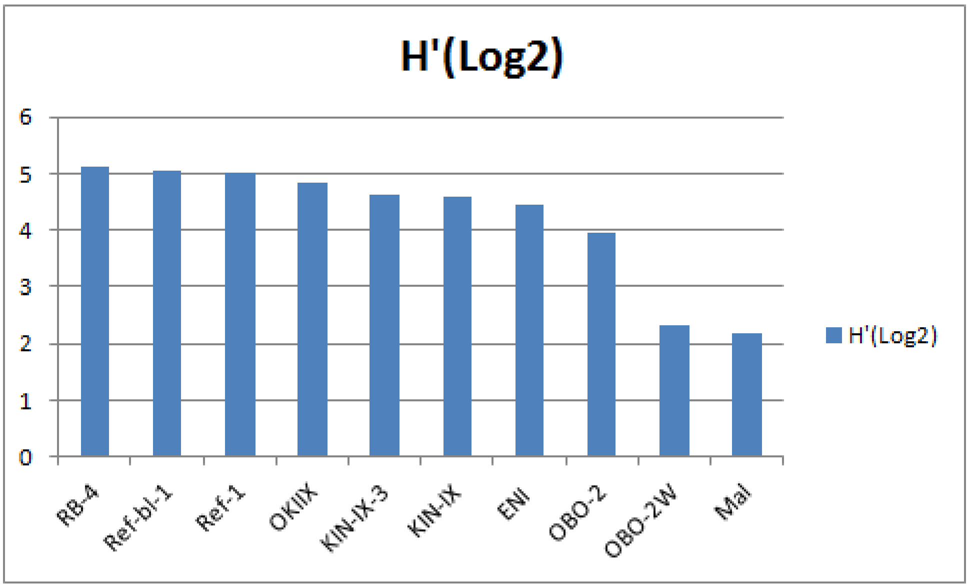
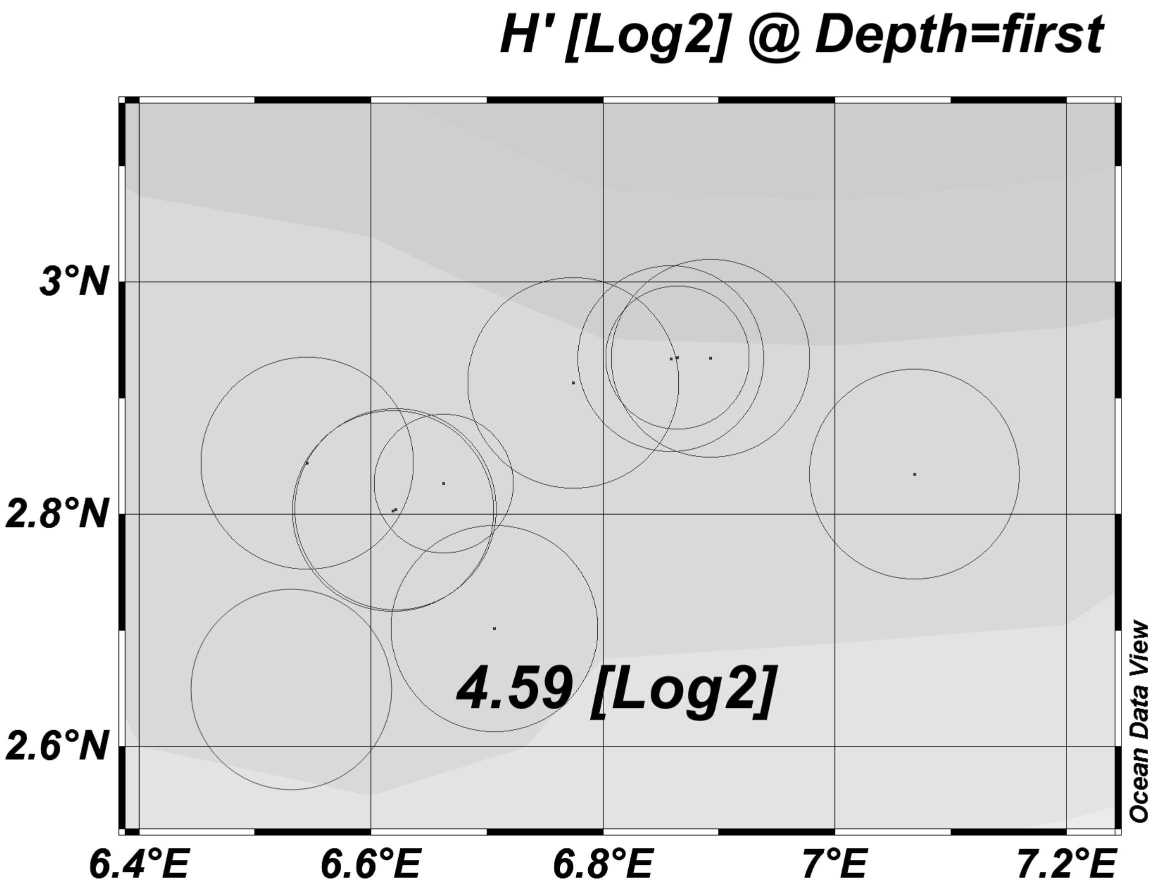
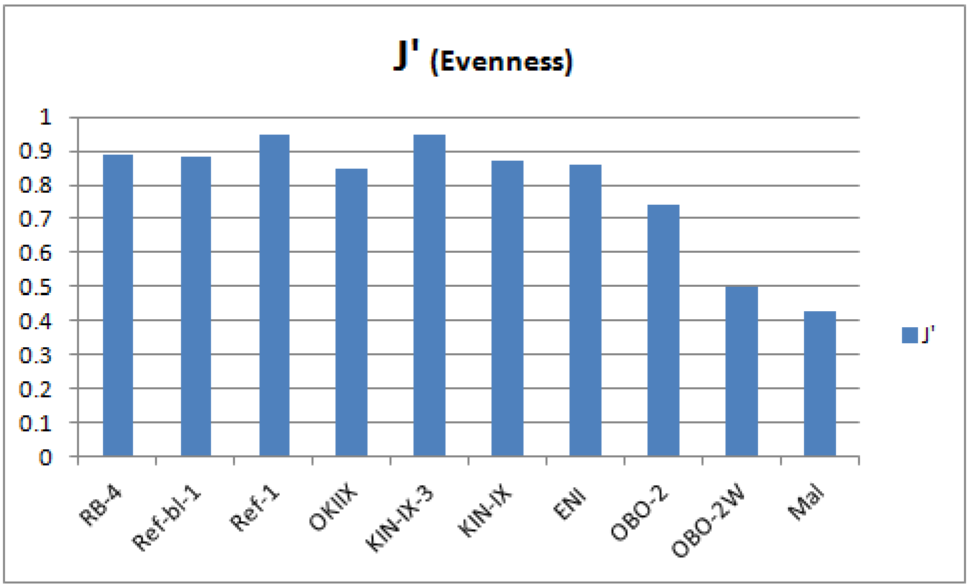


Fig. 3.2.33 Diversity (H') and Hmax for each station


H'(Log2)
6
5
4
3
2
1
0
RB-4
Ref-bl-1
Ref-1
OKIIX
KIN-IX-3
KIN-IX
ENI
OBO-2
OBO-2W
Mal
H'(Log2)


H' [Log2] @ Depth=first
3°N
2.8°N
2.6°N
4.59 [Log2]
Ocean Data View
6.4°E
6.6°E
6.8°E
7°E
7.2°E



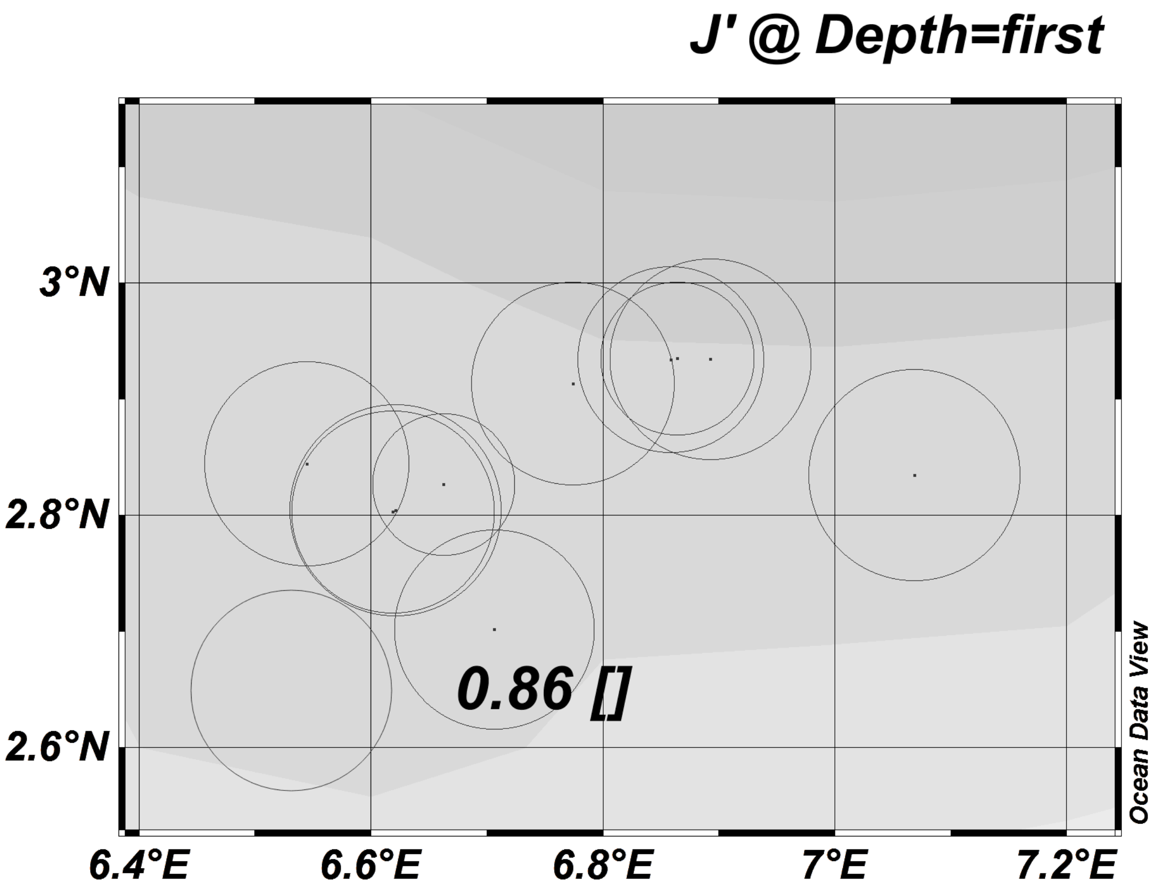


Fig. 3.2.34 The size of the circles illustrates the relative diversity at each station.

Station	RB-4			
Depth	1909 m			
Phylum	Taxa	N	% dist	% cumm
	Nematoda	18	12.2	12.2
Isopoda	Desmosomatidae	12	8.1	20.3
Biv.	Yoldiella sp.	10	6.8	27.0
Biv.	Nuculana sp.	9	6.1	33.1
Pol.	Spionidae	7	4.7	37.8
Ost.	Podocopa gen. sp. 20	7	4.7	42.6
Ost.	Podocopa gen. sp. 7	6	4.1	46.6
Ost.	Podocopa gen. sp. 3	5	3.4	50.0
Biv.	Nuculoidea gen. sp.	4	2.7	52.7
Pol.	Paraonidae	4	2.7	55.4
	Tot species	54		
	Tot specimens	148		

Station	Ref bl 1.			
Depth	1800 m			
Phylum	Taxa	N	% dist	% cumm
Biv.	Nuculoidea gen. sp.	21	16.5	16.5
	Nematoda	9	7.1	23.6
Isopoda	Desmosomatidae	9	7.1	30.7
Pol.	Spionidae	6	4.7	35.4
Pol.	Paraonidae	6	4.7	40.2
Ost.	Podocopa gen. sp. 7	6	4.7	44.9
Amph.	Phoxocephalinae sp.1	4	3.1	48.0
Tanai.	Sphyrapus"melleous"	3	2.4	50.4
Pol.	Exogoninae gen. sp.	3	2.4	52.8
Biv.	Yoldiella sp.	3	2.4	55.1
Tanai.	Cristatotanais sp.1	3	2.4	57.5
	Tot species	53		
	Tot specimens	127		

Station	Ref-1			
Depth	1545 m			
Phylum	Taxa	N	% dist	% cumm
Pol.	Spionidae	7	11.7	11.7
Isopoda	Desmosomatidae	4	6.7	18.3
Tanai.	Collettea sp.4	3	5.0	23.3
Tanai.	Parafilitanais?	3	5.0	28.3
Biv.	Nuculoidea gen. sp.	2	3.3	31.7
	Nematoda	2	3.3	35.0
Ost.	Podocopa gen. sp. 20	2	3.3	38.3
Ost.	Podocopa gen. sp. 21	2	3.3	41.7
Isopoda	Asellota	2	3.3	45.0
Tanai.	Collettea sp.1	2	3.3	48.3
Gast.	Cocculina sp.	2	3.3	51.7
Ophi.	Amphiura atlantica	2	3.3	55.0
	Tot species	39		
	Tot specimens	60		

Station	OKI-IX			
Depth	2062 m			
Phylum	Taxa	N	% dist	% cumm
	Nematoda	24	15.7	15.7
Isopoda	Desmosomatidae	19	12.4	28.1
Pol.	Spionidae	15	9.8	37.9
Ost.	Podocopa gen. sp. 7	8	5.2	43.1
Isopoda	Asellota	5	3.3	46.4
Tanai.	Cristatotanais sp.1	5	3.3	49.7
Pol.	Nereidae gen. sp.1	4	2.6	52.3
	Caudofoveata	4	2.6	54.9
Biv.	Nuculoidea gen. sp.	3	2.0	56.9
Tanai.	Tanaidacea (demaged specimens)	3	2.0	58.8
Biv.	Abra sp.	3	2.0	60.8
Pol.	Cirratulidae	3	2.0	62.7
Pol.	Paraonidae	3	2.0	64.7
Tanai.	Paranarthrura sp.1	3	2.0	66.7
Biv.	Brevinucula sp.	3	2.0	68.6
	Tot species	51		
	Tot specimens	153	100.0	

Station	KIN-IX-3			
Depth	1992 m			
Phylum	Taxa	N	% dist	% cumm
	Nematoda	5	10.6	10.6
Pol.	Spionidae	4	8.5	19.1
Ost.	Podocopa gen. sp. 6	4	8.5	27.7
Pol.	Opheliidae	3	6.4	34.0
Ost.	Podocopa gen. sp. 7	2	4.3	38.3
Pol.	Cirratulidae	2	4.3	42.6
Ost.	Podocopa gen. sp. 8	2	4.3	46.8
Biv.	Bathyarca sp.	2	4.3	51.1
Pol.	Ampharetidae gen. sp.	2	4.3	55.3
Ost.	Podocopa gen. sp. 12	2	4.3	59.6
	Tot species	29		
	Tot specimens	47	100.0	

Station	KIN-IX			
Depth	1999 m			
Phylum	Taxa	N	% dist	% cumm
Pol.	Spionidae	18	17.1	17.1
Ost.	Podocopa gen. sp. 7	12	11.4	28.6
	Nematoda	7	6.7	35.2
Pol.	Opheliidae	6	5.7	41.0
Ost.	Podocopa gen. sp. 2	6	5.7	46.7
Pol.	Paraonidae	5	4.8	51.4
Biv.	Nuculana sp.	5	4.8	56.2
Ost.	Podocopa gen. sp. 6	4	3.8	60.0
Pol.	Cirratulidae	3	2.9	62.9
Isopda	Desmosomatidae	3	2.9	65.7
Biv.	Brevinucula sp.	3	2.9	68.6
	Tot species	39		
	Tot specimens	105	100.0	

Station	Enitimi			
Depth	1674 m			
Phylum	Taxa	N	% dist	% cumm
	Nematoda	17	15.2	15.2
Biv.	Nuculoidea gen. sp.	14	12.5	27.7
Biv.	Nucula sp.	11	9.8	37.5
Biv.	Kelliella sp.	8	7.1	44.6
Pol.	Cirratulidae	8	7.1	51.8
Isopoda	Desmosomatidae	5	4.5	56.3
Pol.	Spionidae	4	3.6	59.8
Pol.	Paraonidae	4	3.6	63.4
Ost.	Podocopa gen. sp. 7	3	2.7	66.1
Ost.	Podocopa gen. sp. 13	3	2.7	68.8
Tanai.	Tanaidacea gen. sp. 1	3	2.7	71.4
Pol.	Exogoninae	3	2.7	74.1
	Tot species	37		
	Tot specimens	112		

Station	OBO-2			
Depth	1696 m			
Phylum	Taxa	N	% dist	% cumm
Pol.	Spionidae	58	25.0	25.0
Pol.	Capitellidae (mostly Capitella)	31	13.4	38.4
Pol.	Spionidae gen sp.1	30	12.9	51.3
Biv.	Nuculoidea gen. sp.	15	6.5	57.8
Pol.	Dorvilleidae	14	6.0	63.8
Pol.	Hesionidae gen. sp.	12	5.2	69.0
Biv.	Kelliella sp.	9	3.9	72.8
Pol.	Cirratulidae	7	3.0	75.9
Isopoda	Asellota	6	2.6	78.4
Ost.	Podocopa gen. sp. 8	4	1.7	80.2
Biv.	Nuculana sp.	4	1.7	81.9
Pol.	Paraonidae	4	1.7	83.6
	Tot species	41		
	Tot specimens	232		

Station	OBO-2W			
Depth	1685 m			
Phylum	Taxa	N	% dist	% cumm
Pol.	Spionidae	139	57.7	57.7
Pol.	Spionidae gen sp.1	37	15.4	73.0
Pol.	Capitellidae (mostly Capitella)	25	10.4	83.4
Biv.	Nuculoidea gen. sp.	6	2.5	85.9
Biv.	Nucula sp.	5	2.1	88.0
Ost.	Podocopa gen. sp. 13	4	1.7	89.6
Pol.	Hesionidae gen. sp.	3	1.2	90.9
Pol.	Dorvilleidae	2	0.8	91.7
Biv.	Yoldiella sp.	2	0.8	92.5
Ost.	Podocopa gen. sp. 5	2	0.8	93.4
Ost.	Podocopa gen. sp. 28	2	0.8	94.2
	Tot species	25		
	Tot specimens	241		

Station	Malenza			
Depth	1922 m			
Phylum	Taxa	N	% dist	% cumm
Pol.	Capitellidae (mostly Capitella)	377	59.6	59.6
Pol.	Cirratulidae	101	16.0	75.5
Pol.	Spionidae	59	9.3	84.8
Pol.	Spionidae gen sp.1	32	5.1	89.9
Pol.	Ampharetidae gen. sp.	9	1.4	91.3
Ost.	Podocopa gen. sp. 7	8	1.3	92.6
Pol.	Hesionidae gen. sp.	6	0.9	93.5
Ost.	Podocopa gen. sp. 14	4	0.6	94.2
Ost.	Podocopa gen. sp. 8	3	0.5	94.6
Ost.	Podocopa gen. sp. 11	3	0.5	95.1
Biv.	Kelliella sp.	3	0.5	95.6
Biv.	Yoldiella sp.	3	0.5	96.1
	Tot species	34		
	Tot specimens	633	96.1	

Station	All			
Depth				
Phylum	Taxa	N	% dist	% cumm
Pol.	Capitellidae (mostly Capitella)	437	23.5	23.5
Pol.	Spionidae	317	17.1	40.6
Pol.	Cirratulidae	126	6.8	47.4
Pol.	Spionidae gen sp.1	99	5.3	52.7
	Nematoda	86	4.6	57.3
Biv.	Nuculoidea gen. sp.	67	3.6	60.9
Isopoda	Desmosomatidae	54	2.9	63.8
Ost.	Podocopa gen. sp. 7	48	2.6	66.4
Pol.	Paraonidae	26	1.4	67.8
Biv.	Kelliella sp.	25	1.3	69.2
	Tot species			
	Tot specimens	1858	100.0	

Fig. 3.2.36 The size of the circles illustrates the relative evenness at each station.

Table 3.2.11 - 3.2.19 the ten most abundant taxa from each station.

Class	N	Mal S	RB-4 S	ENI S	Ref-bl-1 S	Ref-1 S	OBO-2 S	OBO-2W S	OKI-IX S	KIN-IX-3 S	KIN-IX S
I	1	19	27	21	30	27	22	14	24	19	23
II	2-3	7	16	8	16	10	6	5	19	7	8
III	4-7	2	6	3	4	2	5	3	4	3	6
IV	8-15	2	4	4	2	0	5	0	2	0	1
V	16-31	0	1	1	1	0	2	1	2	0	1
VI	32-63	2	0	0	0	0	1	1	0	0	0
VII	64-127	1	0	0	0	0	0	0	0	0	0
VIII	128-255	0	0	0	0	0	0	1	0	0	0
IX	256-511	1	0	0	0	0	0	0	0	0	0
X	512-1023	0	0	0	0	0	0	0	0	0	0
XI	1024-2047	0	0	0	0	0	0	0	0	0	0

Table 3.2.20**.** Distribution of taxa in geometric groups for the 2012 stations.

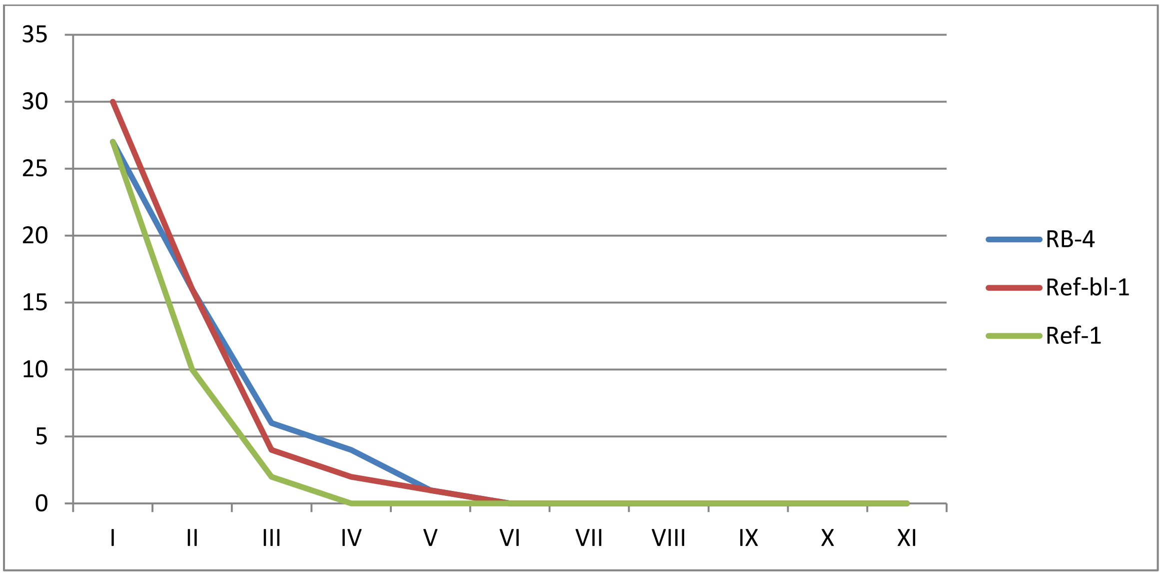
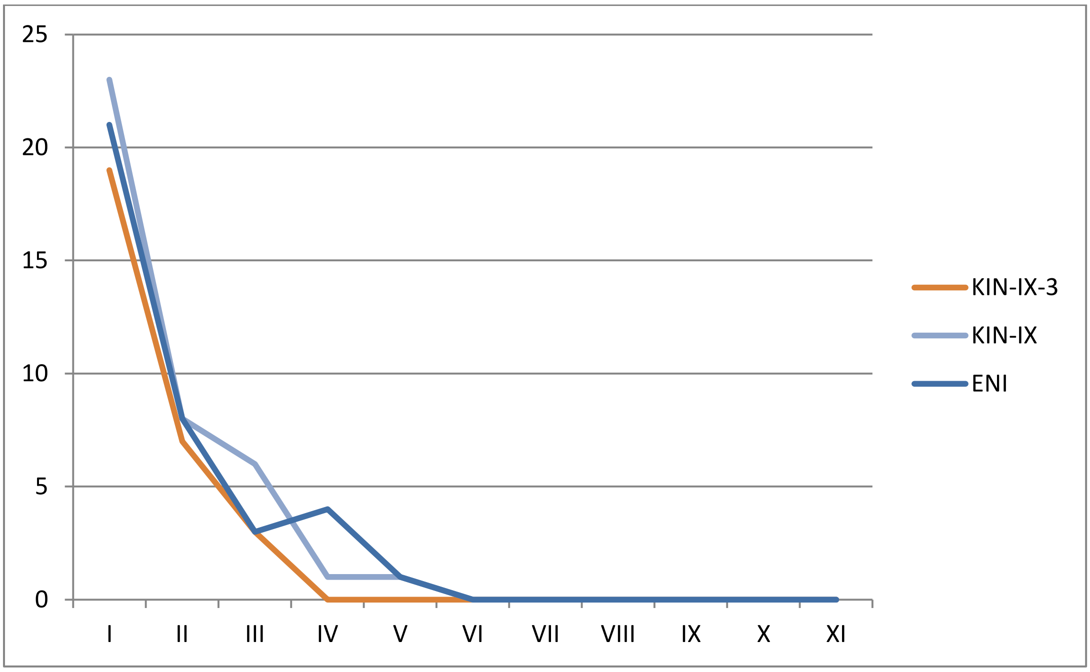
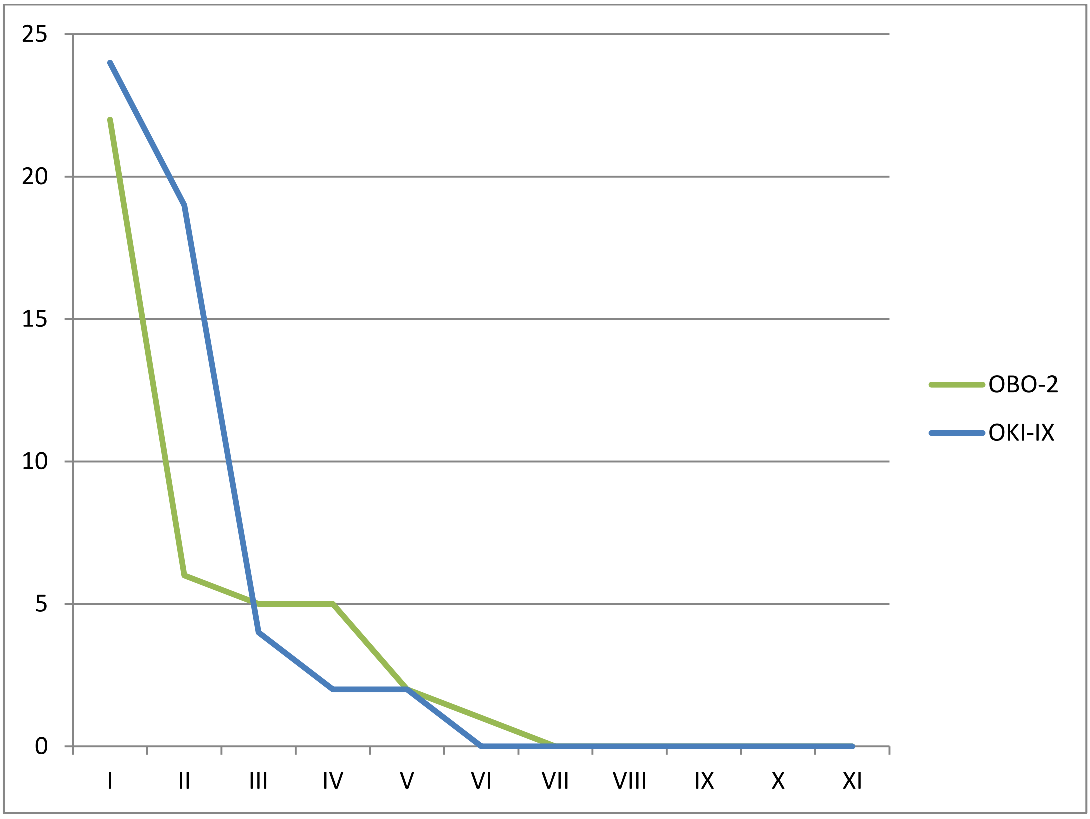


Fig. 5. Distribution of taxa in geometric groups for the 2012 ref. stations.


25
20
15
10
5
0
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
KIN-IX-3
KIN-IX
ENI


25
20
15
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I
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VIII
IX
X
XI
OBO-2
OKI-IX

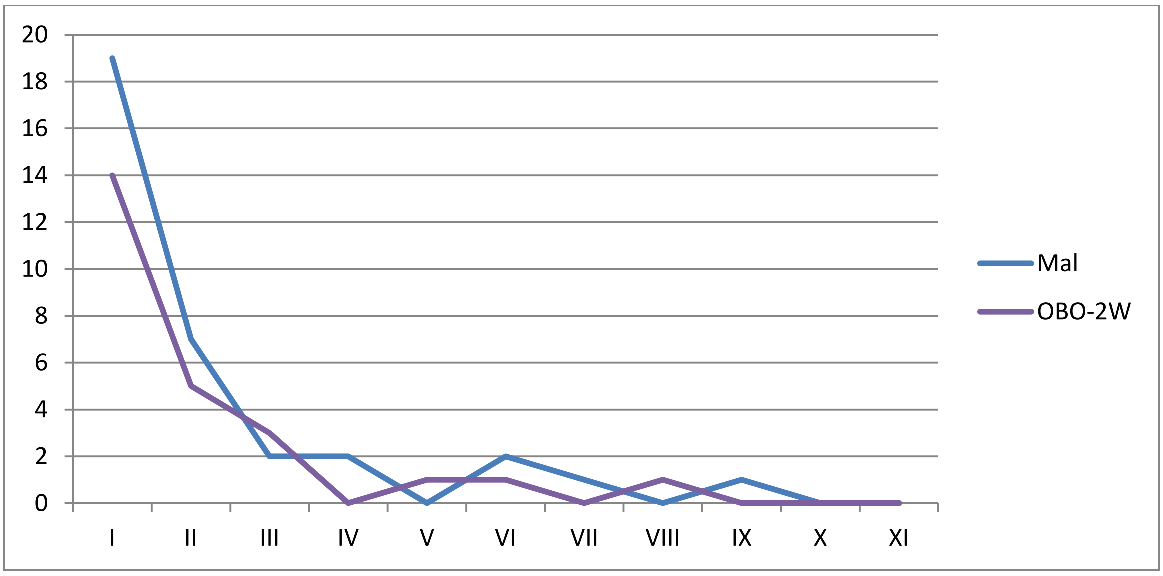

Fig. 6 Distribution of taxa in geometric groups for the stations with the highest levels of THC found in the 2012 material.

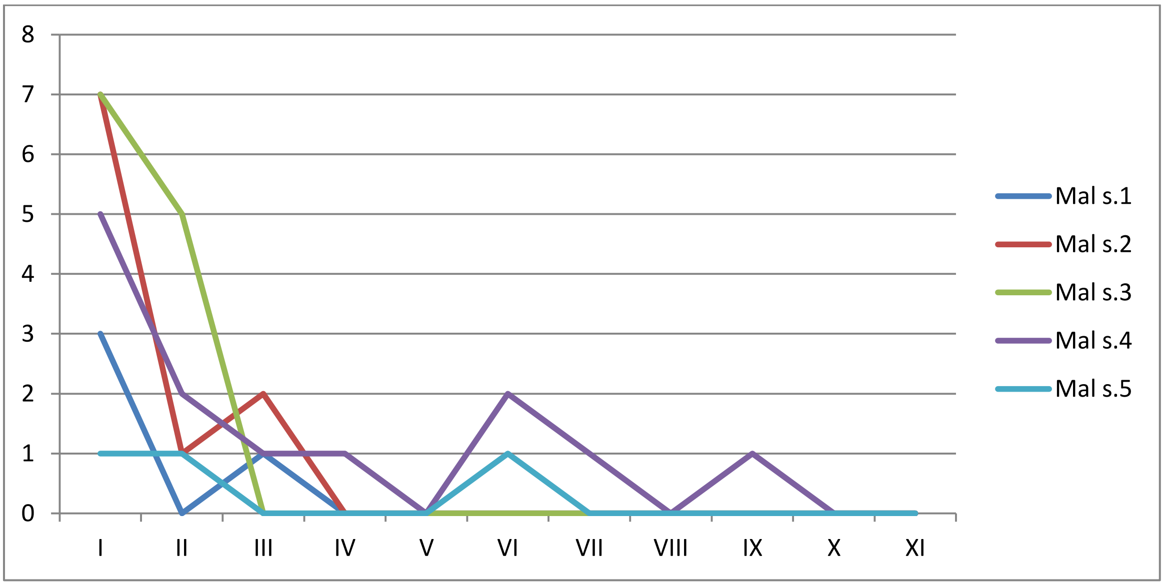

Fig. 7 Distribution of taxa in geometric groups for station Malenza with the highest levels of THC found in the 2012 material. Each graph representing one sample.

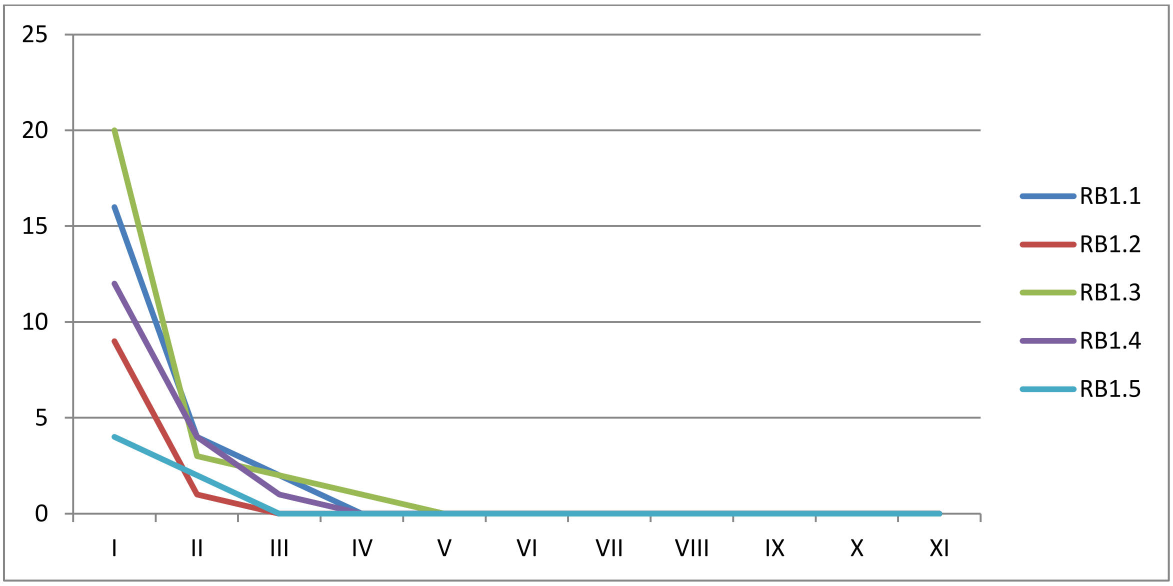

Fig. 8 Distribution of taxa in geometric groups for station RB 1 one of the undisturbed stations in the 2012 material. Each graph representing one sample.

Fig. 3.2.37 continued. Distribution of taxa in geometric groups for the 2012 stations.

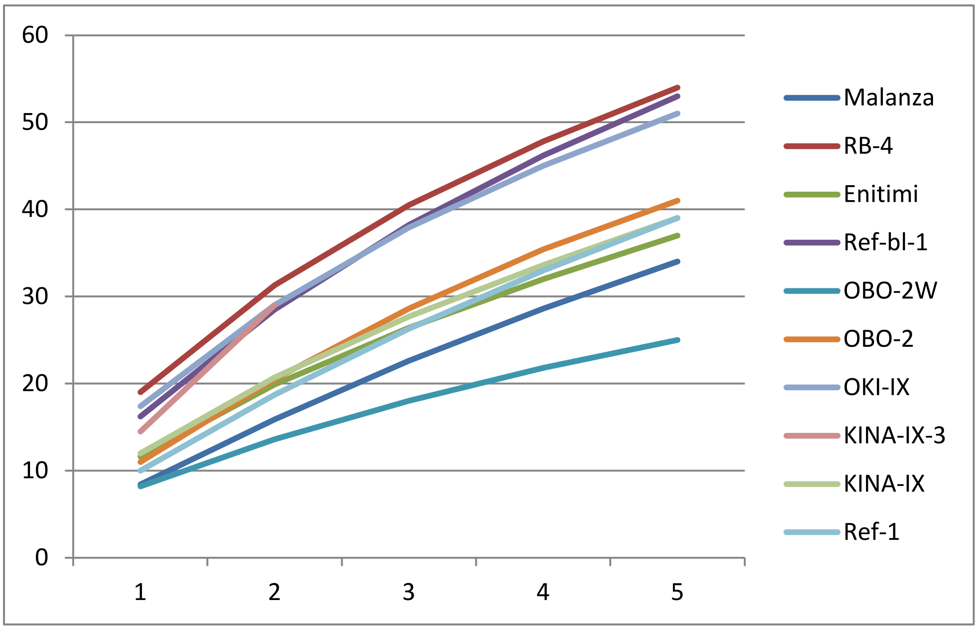

Fig. 3.2.38 accumulating species per sample.

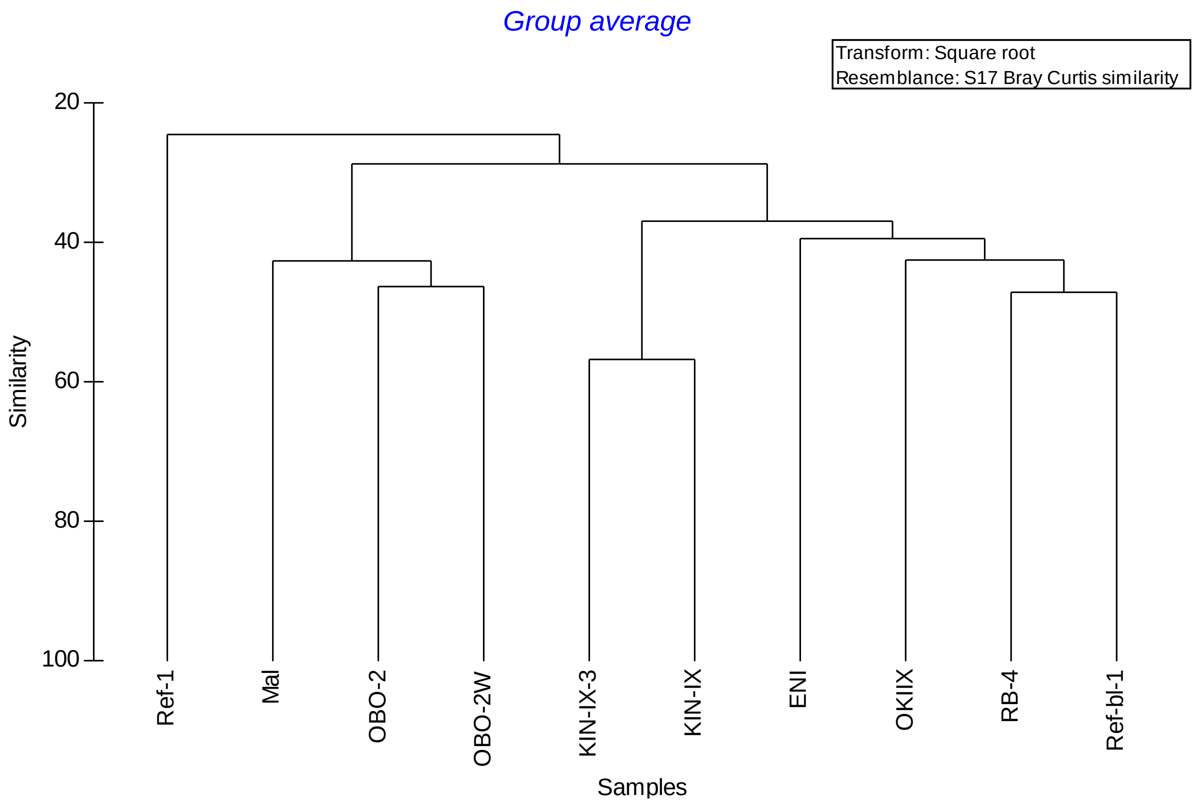

Fig. 3.2.39 Dendrogram showing the similarity between fauna from sampling stations from 2012.

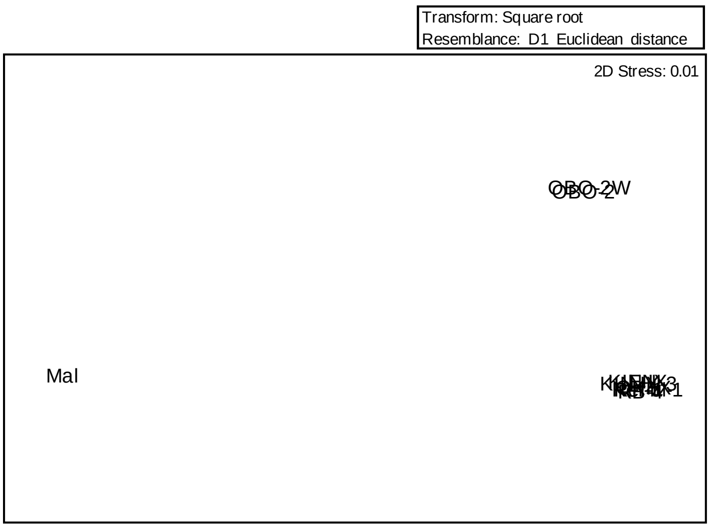

Fig. 3.2.40 A two-dimensional plot of the MDS analyses of the 2011 stations. The data was root transformed. Melanza, Obo-2 and Obo-2w clearly differs from the rest of the sampling sites.

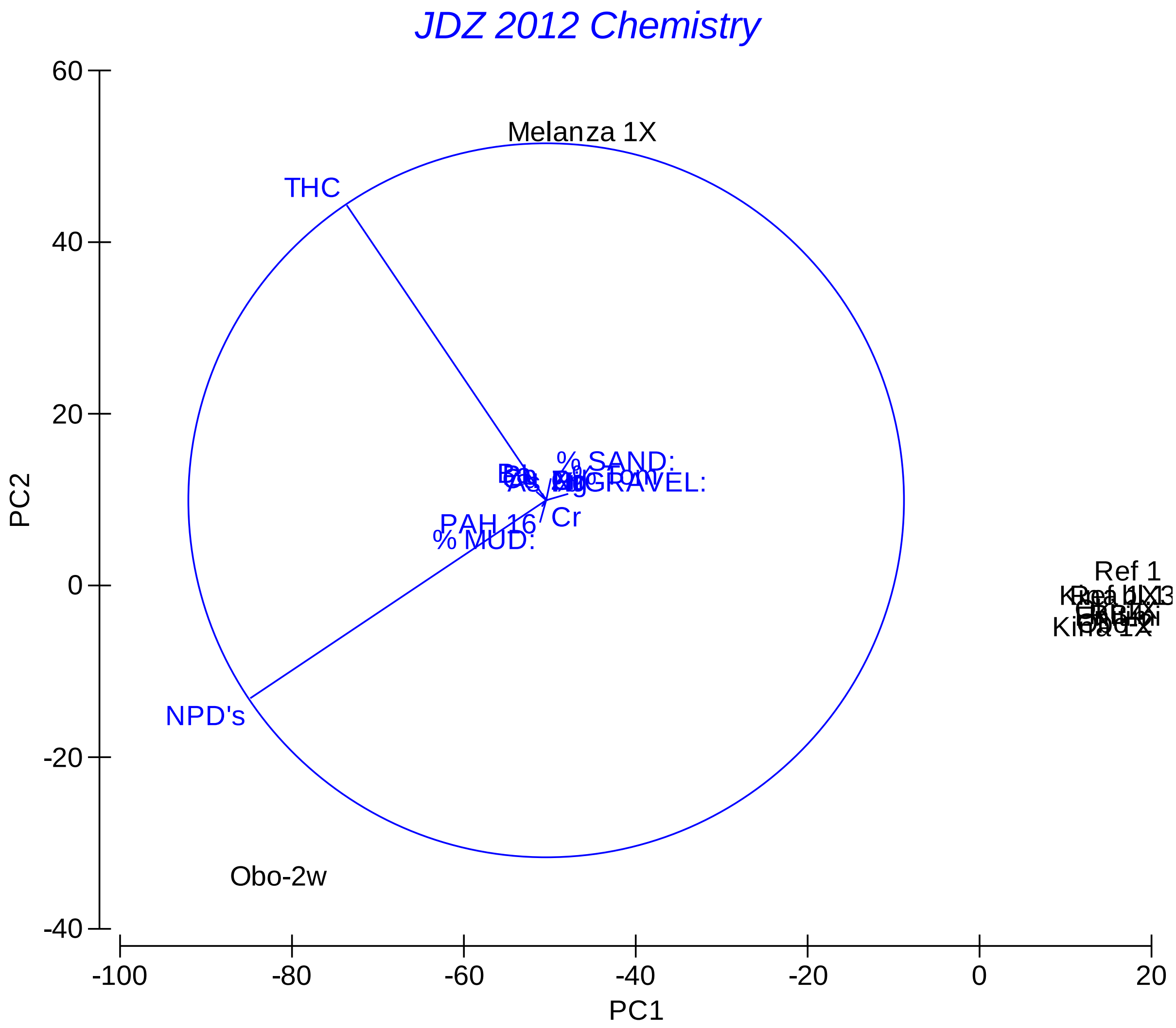

Fig. 3.2.41 PCA analyses of the environmental parameters from the investigated stations. The x-axis explains 52,3 % of the variation in faunal distribution, while 29,7 % is explained by the y-axis This accounts for 82% of the variation in the dataset used .

Figure 3.2.42 PCA analyses of the environmental parameters from the investigated stations. The x-axis explains 52,1 % of the variation in faunal distribution, while 19,6 % is explained by the y-axis. This accounts for 71,7% of the variation in the dataset used.

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Chapter 4 Appendix 1

Permit for operation in JDZ

NIGERIA-SAO TOME & PRINCIPE
JOINT DEVELOPMENT AUTHORITY

OFFICE OF THE CHAIRMAN OF THE BOARD

Ref: 3/NHR/JDA/30/08 **Date: 27th September, 2012**

Your Excellency,
Ambassador Ree Rolf
Royal Norwegian Embassy
54, T.Y. Danjuma Street
Asokoro
Abuja, Nigeria.

Attention: Mr.Tanum Tor Oivind

Your Excellency,

REQUEST FOR APPROVAL AND IMPLEMENTATION OF THE ATTACHED NIGERIA-SAO TOME & PRINCIPE JOINT DEVELOPMENT AUTHORITY (JDA) AND INSTITUTE OF MARINE RESEARCH (IMR), BERGEN, NORWAY, JOINTLY AGREED 2012 MARINE RESEARCH SURVEY OF THE JOINT DEVELOPMENT ZONE (JDZ) BUDGET

The Nigeria-Sao Tome and Principe Joint Development Authority (JDA) presents its compliments to the Royal Norwegian Embassy.

2. JDA and IMR hereby jointly request the approval and implementation of the 2012 Marine Resources Survey of the JDZ budget amounting to NOK 6, 826,175.10 ($1,193,421.80 equivalent at NOK 5.75 to $1) detailed breakdown attached.

3. JDA is aware of the increase in the project budget but after taking into consideration the importance of capacity building needs of the JDA in the areas of fisheries management and biological and chemical sample analysis, it is hoped that the budget will be considered and approved as submitted to ensure that JDA enjoys the short and long term benefits of capacity building programs.

4. Subsequently, JDA will provide the names and profiles of its nominees for the above mentioned trainings while IMR will provide the training programs.

5. While the JDA is committed to funding 30% of the project cost, it is important to mention that the Food and Agriculture Organization (FAO) granted JDA the use of Research Vessel, *Dr. Fridtjof Nansen* at a subsidized rate.

Plot 117 Aminu Kano Cres. **Tel: 07098212073** **DN-09-27-12-30-08c**
Wuse II, Abuja
Nigeria

6. While thanking the Royal Norwegian Embassy, Abuja and the Royal Norwegian Government for your assistance and support, we look forward to your kind consideration and approval of the JDA-IMR jointly agreed budget of NOK 6,862, 175.10 (equivalent, $1,636,900.02) for the 2012 Marine Resources Survey of the JDZ (copy attached) to be funded, 70% by the Royal Norwegian Embassy, Abuja and 30% by JDA.

7. Please accept the assurances of our highest regards.

COLLINS KALABARE
Executive Director
Monitoring & Inspection/
Ag. Chairman of the Board

OLEGARIO TINY
Executive Director
Non-Hydrocarbon Resources/
Ag. Secretary Board and Council

Chapter 5 Appendix 2

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-11-27	21:09	0.1947	5.445	759	HD1530	H	
2012-11-28	4:33	1.0077	4.5604	3752	HD1531	H	
2012-11-28	12:30	1.841	3.652	4281	HD1532	H	
2012-11-28	19:55	2.6376	2.7765	4321	HD1533	H	
2012-11-29	4:37	3.4365	1.9245	4255	HD1534	H	
2012-11-30	6:11	7.0689	2.834	1553	HD1535	H	
2012-11-30	18:56	6.6205	2.8004	1985	HD1536	H	
2012-12-01	2:39	6.6192	2.8036	1981	HD1537	H	
2012-12-01	2:52	6.6198	2.8039	1981	HD1538	H	
2012-12-01	3:03	6.6202	2.8047	1980	HD1539	H	
2012-12-01	3:14	6.6206	2.8049	1978	HD1540	H	Yo-yo
2012-12-01	3:25	6.6207	2.8046	1980	HD1541	H	
2012-12-01	3:36	6.6205	2.8055	1979	HD1542	H	
2012-12-01	3:47	6.6205	2.8056	1979	HD1543	H	
2012-12-01	3:57	6.6203	2.8053	1979	HD1544	H	
2012-12-01	4:09	6.6206	2.8055	1979	HD1545	H	
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2012-12-01	4:33	6.6203	2.8046	1981	HD1547	H	
2012-12-01	4:47	6.6207	2.8054	1979	HD1548	H	
2012-12-01	4:58	6.6205	2.8049	1979	HD1549	H	
2012-12-01	5:09	6.6202	2.8045	1982	HD1550	H	
2012-12-01	5:20	6.6201	2.8037	1981	HD1551	H	
2012-12-01	5:31	6.6203	2.8041	1980	HD1552	H	
2012-12-01	5:42	6.6199	2.8035	1981	HD1553	H	
2012-12-01	5:53	6.6197	2.8039	1981	HD1554	H	
2012-12-01	6:04	6.6199	2.8042	1981	HD1555	H	
2012-12-01	6:15	6.6207	2.8035	1981	HD1556	H	
2012-12-01	6:27	6.6207	2.8027	1981	HD1557	H	
2012-12-01	6:38	6.6204	2.8019	1982	HD1558	H	
2012-12-01	6:50	6.6196	2.8023	1981	HD1559	H	
2012-12-01	7:01	6.6193	2.8022	1982	HD1560	H	
2012-12-01	7:12	6.6191	2.8025	1981	HD1561	H	
2012-12-01	16:30	6.8492	2.932	1710	HD1562	H	
2012-12-02	1:00	6.901	2.9185	1705	HD1563	H	
2012-12-02	1:13	6.9027	2.9186	1704	HD1564	H	
2012-12-02	1:25	6.9037	2.9195	1701	HD1565	H	
2012-12-02	1:36	6.9048	2.921	1700	HD1566	H	
2012-12-02	2:00	6.9056	2.921	1700	HD1567	H	
2012-12-02	2:14	6.9059	2.9216	1701	HD1568	H	
2012-12-02	2:25	6.9062	2.9222	1702	HD1569	H	
2012-12-02	2:36	6.9067	2.9218	1702	HD1570	H	
2012-12-02	3:00	6.9059	2.9173	1706	HD1571	H	
2012-12-02	3:13	6.9064	2.9172	1707	HD1572	H	

Table A1.a CTD stations.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-12-02	3:25	6.906	2.9164	1709	HD1573	H	
2012-12-02	3:37	6.9061	2.9164	1709	HD1574	H	
2012-12-02	3:58	6.9068	2.9175	1706	HD1575	H	
2012-12-02	4:10	6.9074	2.9175	1706	HD1576	H	
2012-12-02	4:21	6.908	2.9175	1705	HD1577	H	
2012-12-02	4:31	6.9083	2.9174	1705	HD1578	H	
2012-12-02	4:58	6.9092	2.9172	1706	HD1579	H	
2012-12-02	5:11	6.9096	2.9169	1706	HD1580	H	
2012-12-02	5:23	6.9102	2.9166	1705	HD1581	H	
2012-12-02	5:24	6.9103	2.9166	1705	HD1582	H	
2012-12-02	5:38	6.9111	2.9159	1706	HD1583	H	
2012-12-02	5:53	6.9118	2.9151	1707	HD1584	H	
2012-12-02	6:04	6.912	2.9144	1709	HD1585	H	
2012-12-02	6:15	6.9116	2.9157	1706	HD1586	H	
2012-12-02	6:26	6.912	2.9152	1707	HD1587	H	
2012-12-02	6:38	6.9119	2.9156	1706	HD1588	H	
2012-12-02	6:49	6.9104	2.9162	1705	HD1589	H	
2012-12-02	7:01	6.9097	2.917	1705	HD1590	H	
2012-12-02	7:13	6.9108	2.9167	1703	HD1591	H	
2012-12-03	0:46	6.9092	2.9158	1706	HD1592	H	
2012-12-03	1:07	6.909	2.9158	1706	HD1593	H	
2012-12-03	1:25	6.9094	2.9159	1706	HD1594	H	
2012-12-03	1:43	6.9108	2.915	1706	HD1595	H	
2012-12-03	2:02	6.9112	2.9149	1707	HD1596	H	
2012-12-03	2:36	6.9129	2.9125	1712	HD1597	H	
2012-12-03	2:53	6.9137	2.9109	1716	HD1598	H	
2012-12-03	3:12	6.9149	2.9097	1719	HD1599	H	
2012-12-03	3:29	6.9153	2.9104	1716	HD1600	H	
2012-12-03	3:58	6.9172	2.9101	1720	HD1601	H	
2012-12-03	4:21	6.9195	2.9096	1719	HD1602	H	
2012-12-03	4:40	6.9219	2.9083	1719	HD1603	H	
2012-12-03	4:58	6.9227	2.9061	1723	HD1604	H	
2012-12-03	5:15	6.9226	2.9041	1727	HD1605	H	
2012-12-03	5:33	6.9215	2.9028	1731	HD1606	H	
2012-12-03	5:50	6.9239	2.9038	1727	HD1607	H	
2012-12-03	6:06	6.9224	2.9026	1731	HD1608	H	
2012-12-03	6:24	6.9209	2.9022	1733	HD1609	H	
2012-12-03	6:42	6.9203	2.9029	1731	HD1610	H	
2012-12-04	1:00	6.7129	2.699	2074	HD1611	H	
2012-12-04	1:17	6.714	2.6981	2088	HD1612	H	

Table A1.b CTD stations.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-12-04	1:35	6.717	2.6978	2115	HD1613	H	
2012-12-04	1:52	6.72	2.6971	2116	HD1614	H	
2012-12-04	2:37	6.7159	2.6951	2107	HD1615	H	
2012-12-04	3:00	6.7126	2.6926	2101	HD1616	H	
2012-12-04	3:18	6.7104	2.6906	2133	HD1617	H	
2012-12-04	3:35	6.7124	2.6898	2125	HD1618	H	
2012-12-04	4:05	6.7161	2.6871	2146	HD1619	H	
2012-12-04	4:21	6.7178	2.6851	2153	HD1620	H	
2012-12-04	4:38	6.7198	2.6836	2160	HD1621	H	
2012-12-04	4:55	6.7223	2.6826	2166	HD1622	H	
2012-12-04	5:13	6.7251	2.6812	2170	HD1623	H	
2012-12-04	5:31	6.7273	2.6797	2174	HD1624	H	
2012-12-04	20:57	7.069	2.8337	1525	HD1625	H	
2012-12-08	12:40	7.5565	2.7063	2344	HD1626	H	Line 1
2012-12-08	16:41	7.4331	2.7927	2309	HD1627	H	
2012-12-08	17:52	7.355	2.8467	2086	HD1628	H	
2012-12-08	19:44	7.2919	2.8896	1880	HD1629	H	
2012-12-08	21:21	7.168	2.9752	1623	HD1630	H	
2012-12-08	23:07	7.0004	2.9505	1637	HD1631	H	Line2
2012-12-09	2:42	6.9997	2.8235	1762	HD1632	H	
2012-12-09	4:17	6.9997	2.69	2109	HD1633	H	
2012-12-09	5:54	6.9984	2.5467	2709	HD1634	H	
2012-12-09	7:32	7	2.406	2769	HD1635	H	
2012-12-09	11:28	6.4998	2.1517	3053	HD1636	H	Line 3
2012-12-09	17:43	6.4988	2.3284	2957	HD1637	H	
2012-12-09	19:53	6.4981	2.491	2581	HD1638	H	
2012-12-09	22:22	6.4988	2.6493	2270	HD1639	H	
2012-12-10	0:00	6.5006	2.8271	1941	HD1640	H	
2012-12-10	5:23	6.0011	2.6169	2620	HD1641	H	Line 4
2012-12-10	7:34	6.0019	2.4361	3099	HD1642	H	
2012-12-10	10:23	6.0025	2.258	3248	HD1643	H	
2012-12-10	12:59	5.9934	2.0778	3317	HD1644	H	
2012-12-10	15:32	6.0009	1.9001	3338	HD1645	H	
2012-12-10	19:28	5.4997	1.6436	3537	HD1646	H	Line 5
2012-12-10	21:13	5.4994	1.8312	3552	HD1647	H	
2012-12-10	22:54	5.4996	2.0205	3516	HD1648	H	
2012-12-11	4:10	5.5013	2.2114	3384	HD1649	H	
2012-12-11	5:51	5.5011	2.3992	3264	HD1650	H	

Table A1.c CTD stations.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-12-11	10:06	4.9995	2.2317	3603	HD1651	H	Line6
2012-12-11	12:05	4.9999	2.0234	3660	HD1652	H	
2012-12-11	16:23	5.0001	1.8125	3682	HD1653	H	
2012-12-11	19:54	4.9998	1.6021	3687	HD1654	H	
2012-12-11	21:55	4.9998	1.3923	3721	HD1655	H	
2012-12-12	1:43	4.5008	1.4837	3835	HD1656	H	Line7
2012-12-12	6:18	4.5	1.691	3850	HD1657	H	
2012-12-12	9:39	4.5	1.9063	3844	HD1658	H	
2012-12-12	11:24	4.5002	2.1151	3822	HD1659	H	
2012-12-12	17:59	4.0006	2.0005	4006	HD1660	H	Line8
2012-12-12	19:46	4	1.8415	4000	HD1661	H	
2012-12-12	21:33	4.0003	1.6797	4058	HD1662	H	
2012-12-13	1:55	3.4391	1.9247	4178	HD1663	H	Last line
2012-12-13	5:26	3.3366	1.7108	4216	HD1664	H	
2012-12-13	9:36	3.1123	1.2469	4270	HD1665	H	
2012-12-13	11:58	2.9999	0.9997	4325	HD1666	H	
2012-12-13	18:23	2.8932	0.7513	4329	HD1667	H	
2012-12-13	20:12	2.8148	0.5777	4341	HD1668	H	
2012-12-13	22:24	2.7195	0.3685	4407	HD1669	H	
2012-12-14	0:00	2.6379	0.2378	4421	HD1670	H	
2012-12-14	4:26	2.5682	0.1192	4435	HD1671	H	
2012-12-14	6:01	2.4999	0.0001	4414	HD1672	H	Ekvator
2012-12-14	11:30	2.4167	-0.144	4443	HD1673	H	
2012-12-14	13:08	2.335	-0.2897	4456	HD1674	H	
2012-12-14	14:47	2.2548	-0.4377	4470	HD1675	H	
2012-12-14	16:21	2.1722	-0.5835	1589	HD1676	H	
2012-12-14	17:52	2.0892	-0.7308	3457	HD1677	H	
2012-12-14	20:02	2.0804	-0.8909	4600	HD1678	H	
2012-12-14	21:36	2.0719	-1.0599	4499	HD1679	H	
2012-12-14	23:29	2.0635	-1.2297	4592	HD1680	H	
2012-12-15	1:09	2.0607	-1.3932	4556	HD1681	H	
2012-12-15	11:04	2.0884	-0.7312	3461	HD1682	H	
2012-12-15	16:35	2.0799	-0.7005	3471	HD1683	H	
2012-12-15	16:47	2.0804	-0.7013	3453	HD1684	H	
2012-12-15	16:53	2.0801	-0.7012	3453	HD1685	H	
2012-12-15	17:00	2.0795	-0.7012	3458	HD1686	H	
2012-12-15	17:07	2.0794	-0.7013	3459	HD1687	H	
2012-12-15	17:13	2.0793	-0.7016	3479	HD1688	H	
2012-12-15	17:20	2.0789	-0.7019	3496	HD1689	H	
2012-12-15	17:27	2.0781	-0.7021	3511	HD1690	H	

Table A1.d CTD stations.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-12-15	17:44	2.0758	-0.7023	3514	HD1691	H	
2012-12-15	17:44	2.0758	-0.7024	3514	HD1692	H	
2012-12-15	17:51	2.0755	-0.7028	3524	HD1693	H	
2012-12-15	17:57	2.0751	-0.7034	3535	HD1694	H	
2012-12-15	18:04	2.0745	-0.704	3549	HD1695	H	
2012-12-15	18:11	2.0738	-0.7051	3569	HD1696	H	
2012-12-15	18:19	2.0717	-0.7043	3574	HD1697	H	
2012-12-15	18:27	2.0697	-0.7042	3591	HD1698	H	
2012-12-15	18:35	2.0679	-0.7046	3664	HD1699	H	
2012-12-16	4:17	2.8142	0.5769	4343	HD1700	H	

Table A1.e CTD stations.

Parameter	**Bio 1**	**Bio 2**	**Bio 3**	**Bio 4**	**Bio 5**	**Bio 6**	**Bio 7**	**Bio 8**	**Bio 9**	**Bio 10**	**Bio 11**	**Bio 12**	**Bio 13**	**Bio 14**
CTD	HD 1626	HD 1631	HD 1636	HD 1640	HD 1644	HD 1648	HD 1652,3	HD 1656	HD 1659	HD 1663	HD 1666	HD 1670	HD 1677,81	HD 1682
Multinet	PL 11	PL 12	PL 14	PL 15	PL 16	PL 17	PL 18	PL 19	PL 20	PL 21	PL 22	PL 23	PL 24	PL 25
Multisampler	PT 5-7		PT 8-10				PT 12-14	PT 16-18	PT 20-22		PT 25-27	PT 29-31	PT 33-35	PT 37-39
Newston net		PL 13				PT 11	PT 15	PT 19	PT23	PT 24	PT 28	PT 32	PT 36	PT 40
Nutrients	HD 1628	HD 1632	HD 1638	HD 1638	HD 1643	HD 1648	HD 1653	HD 1657	HD 1657		HD 1666	HD 1670	HD 1681	HD 1677
Zoopl. Biomass														
Chl.a. filter	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Table A 2 overview bio stations.

STA	Bio	DATE	TIME	LON	LAT	DEPTH	Depth range	Nets	Tot vol m3
PL1		2012-11-29	3:24	3.4091	1.9662	4253	280-1	5	5234
PL2		2012-11-30	21:05	6.6527	2.8404	1918	300-0	5	5524
PL3		2012-12-01	0:59	6.6336	2.8207	1954	300-0	5	4455
PL4		1/12/12	8:01	6.6122	2.8131	1975	250-0	5	6265
PL5		1/12/12	16:56	6.8511	2.9389	1691	351-0	5	5821
PL6		2012-12-01	23:50	6.8960	2.8830	1771	300-0	5	6158
PL7		2012-12-02	22:24	6.8972	2.9333	1661	454-0	5	5299
PL8		2012-12-03	7:44	6.8984	2.9317	1666	453-0	5	1684
PL9		2012-12-03	23:14	6.7100	2.7151	2016	453-0	5	8159
PL10		2012-12-04	6:28	6.7087	2.7172	2007	452-0	5	5979
PL11	Bio 1	2012-12-08	13:27	7.5511	2.7077	2349	452-0	5	3936
PL12	Bio 2	2012-12-08	23:52	7.0003	2.9450	1644	401-2	4	4494
PL13	Bio 2	2012-12-09	2:06	6.9910	2.8751	1745			
PL14	Bio 3	2012-12-09	12:10	6.4995	2.1591	3051	450-0	5	9348
PL15	Bio 4	2012-12-10	0:48	6.4971	2.8338	1907	400-0	5	6877
PL16	Bio 5	2012-12-10	13:46	5.9961	2.0750	3315	453-0	5	2757
PL17	Bio 6	2012-12-11	0:50	5.5014	2.0295	3505	436-0	5	11579
PL18	Bio 7	2012-12-11	13:17	4.9994	2.0070	3663	453-0	5	3515
PL19	Bio 8	2012-12-12	2:20	4.4980	1.4875	3837	450-0	5	8855
PL20	Bio 9	2012-12-12	12:07	4.4998	2.1120	3821	450-0	5	770
PL21	Bio 10	2012-12-13	2:43	3.4388	1.9201	4176	453-0	5	4298
PL22	Bio 11	2012-12-13	14:06	3.0007	0.9819	4327	400-0	5	3954
PL23	Bio 12	2012-12-14	0:41	2.6366	0.2348	4421	455-3	4	4316
PL24	Bio 13	2012-12-15	1:45	2.0559	-1.3915	4558	452-0	5	4539
PL25	Bio 14	2012-12-15	13:01	2.0927	-0.7239	3415	453-0	5	5401

Table A 3 Multinet stations.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-11-29	8:14	3.6189	1.9182	4256	PT1	P	Newston
2012-11-29	8:54	3.6670	1.8928	4200	PT2	P	Newston
2012-11-30	20:20	6.6220	2.8024	1981	PT3	S	Newston
2012-11-30	20:50	6.6510	2.8366	1922	PT3	E	Newston
2012-12-01	23:07	6.8965	2.9315	1668	PT4	S	Newston
2012-12-01	23:37	6.8954	2.8851	1769	PT4	E	Newston

Table A 4 Oter net stations.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-12-11	3:30:06	5.5005	2.1396	3436	PT11	S	Methot

2012-12-11	3:44:55	5.4984	2.1496	3430	PT11	E	
2012-12-11	17:11:18	4.9982	1.7992	3683	PT15	S	methot
2012-12-11	18:00:09	5.0033	1.7891	3755	PT15	E	
2012-12-12	5:10:47	4.4995	1.6198	3832	PT19	S	Methot
2012-12-12	5:39:49	4.4901	1.6174	3849	PT19	E	
2012-12-12	14:37:24	4.4047	2.0945	3866	PT23	S	Methot
2012-12-12	15:07:54	4.4107	2.1017	3863	PT23	E	
2012-12-13	3:44:51	3.4247	1.8906	4246	PT24	S	Methot
2012-12-13	3:59:28	3.4212	1.8841	4247	PT24	E	
2012-12-13	16:39:56	2.9723	0.8973	4324	PT28	S	Methot
2012-12-13	17:10:18	2.9581	0.8930	4324	PT28	E	
2012-12-15	4:21:31	2.0498	-1.2941	4539	PT36	S	Methot
2012-12-15	4:50:44	2.0585	-1.2880	4597	PT36	E	
2012-12-15	15:41:15	2.0786	-0.6433	2341	PT40	S	Methot
2012-12-15	16:11:04	2.0759	-0.6592	2647	PT40	E	

Table A 4 Newston net samples for ichtoplankton on suface.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-12-01	8:01	6.6122	2.8131	1975	PL4	P	Multisampler
2012-12-01	16:56	6.8511	2.9389	1691	PL5	P	Bio 1
2012-12-08	14:32	7.5267	2.7279	2357	PT5	S	
2012-12-08	15:44	7.474	2.7654	2350	PT5	E	
2012-12-08	15:44	7.4737	2.7655	2347	PT6	S	
2012-12-08	15:54	7.4667	2.7704	2340	PT6	E	
2012-12-08	16:06	7.4604	2.7747	2335	PT7	S	
2012-12-08	16:15	7.4537	2.7794	2324	PT7	E	
2012-12-09	14:54	6.4943	2.2654	2990	PT8	S	Bio 3
2012-12-09	15:10	6.4954	2.2798	2986	PT8	E	
2012-12-09	15:11	6.4954	2.2799	2986	PT9	S	
2012-12-09	15:21	6.4957	2.2875	2982	PT9	E	
2012-12-09	15:33	6.4965	2.2973	2980	PT10	S	
2012-12-09	15:43	6.4971	2.3056	2984	PT10	E	
2012-12-11	14:21	5.002	1.9748	3672	PT12	S	Bio 7
2012-12-11	14:31	5.0012	1.9667	3673	PT12	E	
2012-12-11	14:42	5.0001	1.9578	3677	PT13	S	
2012-12-11	14:52	4.9997	1.9495	3679	PT13	E	
2012-12-11	14:58	4.9999	1.9441	3679	PT14	S	
2012-12-11	15:07	5.0003	1.9362	3679	PT14	E	
2012-12-12	3:48	4.499	1.546	3834	PT16	S	Bio 8
2012-12-12	3:59	4.4991	1.5541	3850	PT16	E	
2012-12-12	4:00	4.4992	1.5555	3859	PT17	S	
2012-12-12	4:10	4.4993	1.5626	3882	PT17	E	
2012-12-12	4:20	4.4997	1.5714	3860	PT18	S	
2012-12-12	4:30	4.4998	1.5792	3832	PT18	E	
2012-12-12	13:07	4.4791	2.0916	3835	PT20	S	Bio 9
2012-12-12	13:17	4.4712	2.0914	3836	PT20	E	
2012-12-12	13:25	4.4636	2.09	3839	PT21	S	
2012-12-12	13:35	4.4567	2.0903	3846	PT21	E	
2012-12-12	13:43	4.4498	2.0896	3846	PT22	S	
2012-12-12	13:53	4.4423	2.0903	3848	PT22	E	
2012-12-13	15:16	2.9859	0.9451	4326	PT25	S	Bio 11
2012-12-13	15:26	2.9829	0.9376	4325	PT25	E	
2012-12-13	15:34	2.9796	0.9301	4323	PT26	S	
2012-12-13	15:44	2.9768	0.9231	4322	PT26	E	
2012-12-13	15:50	2.9743	0.9176	4324	PT27	S	

Table A 5 Multisampler stations.

DATE	TIME	LON	LAT	DEPTH	STA	EVENT	REMARK
2012-12-13	16:00	2.9714	0.9109	4323	PT27	E	Bio 11 Multisampler
2012-12-14	2:00	2.6128	0.2025	4424	PT29	S	Bio 12
2012-12-14	2:10	2.6065	0.1979	4425	PT29	E	
2012-12-14	2:14	2.6043	0.1961	4425	PT30	S	
2012-12-14	2:23	2.5985	0.1904	4426	PT30	E	
2012-12-14	2:31	2.594	0.1856	4427	PT31	S	
2012-12-14	2:42	2.5879	0.1797	4430	PT31	E	
2012-12-14	3:25	2.579	0.1709	4434	PT32	S	
2012-12-14	3:56	2.5972	0.1659	4428	PT32	E	
2012-12-15	3:01	2.054	-1.3491	4474	PT33	S	Bio 13
2012-12-15	3:11	2.0542	-1.3411	4397	PT33	E	
2012-12-15	3:13	2.0544	-1.3391	4395	PT34	S	
2012-12-15	3:24	2.0549	-1.3302	4392	PT34	E	
2012-12-15	3:32	2.0563	-1.3221	4376	PT35	S	
2012-12-15	3:42	2.057	-1.3138	4380	PT35	E	
2012-12-15	14:16	2.0945	-0.6786	2917	PT37	S	Bio 14
2012-12-15	14:26	2.094	-0.6703	2833	PT37	E	
2012-12-15	14:36	2.0945	-0.6598	2514	PT38	S	
2012-12-15	14:46	2.0944	-0.6521	2340	PT38	E	
2012-12-15	14:51	2.0945	-0.6481	2098	PT39	S	
2012-12-15	15:01	2.0943	-0.6407	1944	PT39	E	

Table A 6 Multisampler stations.

Plankton samples, metadata multinet

Cruise: 2012408
Station: **PL1**
Position: N 1 57,97 E 3 24,55
Depth: 4253
Operator: J.A.V

Data Start: 11-29-2012 03:24:47
Data End: 11-29-2012 04:27:08
Cast: Oblique

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
03:40:36	1	279.4	0	0.1	0.1	100.00	
03:46:48	1	275.8	84	0.8	0.9	88.89	
03:46:49	2	276.0	0	0.8	0.9	88.89	
03:54:02	2	255.1	1141	1.0	1.0	100.00	
03:54:03	3	255.1	0	1.1	1.0	110.00	
04:09:03	3	101.7	3647	1.2	1.2	100.00	
04:09:04	4	101.6	0	1.4	1.3	107.69	
04:18:04	4	70.8	194	1.5	1.3	115.38	
04:18:05	5	70.6	0	1.6	1.4	114.29	
04:26:59	5	1.1	168	1.4	1.6	87.50	

Station: PL 2
Cast: Oblique
Position: N 2 50.42 E 6 39.20
Depth: 1960
Operator: fw

Data Start: 11-30-2012 21:07:14
Data End: 11-30-2012 21:51:50

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
21:22:49	1	299.2	0	1.4	1.2	116.67	
21:30:48	1	200.4	2224	2.0	1.8	111.11	
21:30:49	2	200.4	0	1.8	1.7	105.88	
21:37:39	2	150.4	1734	1.8	1.7	105.88	
21:37:40	3	150.2	0	1.7	1.6	106.25	
21:42:49	3	100.4	1334	1.8	1.6	112.50	
21:42:50	4	100.3	0	1.7	1.6	106.25	
21:47:46	4	50.3	133	1.8	1.8	100.00	
21:47:47	5	50.1	0	1.9	1.8	105.56	
21:51:38	5	0.2	99	1.6	1.5	106.67	

Station: PL3
Cast: Oblique
Position: N 2 49,24 E 6 38,01
Depth: 1954
Operator: JAV

Data Start: 12-01-2012 01:05:27
Data End: 12-01-2012 02:07:48

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
01:19:29	1	300.9	0	0.6	0.6	100.00	
01:26:06	1	297.4	88	1.0	0.9	111.11	
01:26:07	2	297.4	0	0.9	0.9	100.00	
01:36:07	2	234.4	1844	1.0	0.9	111.11	
01:36:08	3	234.3	0	1.1	1.0	110.00	
01:47:18	3	151.5	2155	1.0	1.0	100.00	
01:47:19	4	151.6	0	1.0	1.0	100.00	
01:58:09	4	66.7	200	0.9	0.9	100.00	
01:58:10	5	66.6	0	1.0	0.9	111.11	
02:07:36	5	0.6	168	2.1	2.0	105.00	

Station: PL4
Cast: Oblique
Position: N 2 48.79 E 6 36.73
Depth: 1970
Operator: fw

Data Start: 12-01-2012 08:00:47
Data End: 12-01-2012 08:49:07

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
08:21:12	1	299.3	0	1.0	0.2	500.00	
08:25:46	1	250.6	1316	2.1	1.9	110.53	
08:25:47	2	250.4	0	2.1	1.9	110.53	
08:31:40	2	200.4	1724	2.1	1.9	110.53	
08:31:41	3	200.1	0	2.1	2.1	100.00	
08:41:44	3	100.1	3011	2.0	2.1	95.24	
08:41:45	4	99.9	0	2.0	2.1	95.24	
08:46:38	4	40.4	143	2.0	2.1	95.24	
08:46:39	5	40.2	0	2.1	2.1	100.00	
08:49:00	5	0.1	71	1.5	1.7	88.24	

Station:	PL5
Cast:	Oblique
Position:	N 2 56,33 E 6 51,07
Depth:	1710
Operator:	JAV

Data Start: 12-01-2012 16:56:33
Data End: 12-01-2012 17:41:46

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
17:14:40	1	351.0	0	1.3	0.4	325.00	
17:22:13	1	251.8	1598	1.4	1.6	87.50	
17:22:14	2	251.5	0	1.6	1.6	100.00	
17:29:15	2	182.5	1665	1.3	1.3	100.00	
17:29:16	3	182.3	0	1.4	1.3	107.69	
17:35:47	3	101.6	1526	1.2	1.4	85.71	
17:35:48	4	101.4	0	1.4	1.4	100.00	
17:40:06	4	34.7	997	1.5	1.6	93.75	
17:40:07	5	34.6	0	1.2	1.4	85.71	
17:41:44	5	0.1	35	1.4	1.1	127.27	

Station:	PL6
Cast:	Oblique
Position:	N 2 52.98 E 6 53.76
Depth:	1770
Operator:	fw

Data Start: 12-01-2012 23:50:04
Data End: 12-02-2012 00:34:07

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
00:07:38	1	298.8	0	0.7	0.1	700.00	
00:18:59	1	181.3	2843	1.6	1.6	100.00	
00:19:00	2	181.3	0	1.6	1.6	100.00	
00:27:15	2	102.5	2065	1.7	1.5	113.33	
00:27:16	3	102.2	0	1.8	1.5	120.00	
00:30:58	3	52.6	916	1.6	1.5	106.67	
00:30:59	4	52.3	0	1.6	1.6	100.00	
00:32:19	4	32.6	296	1.3	1.2	108.33	
00:32:20	5	32.4	0	1.2	1.2	100.00	
00:34:07	5	0.4	38	0.8	0.9	88.89	

Station: PL7
Cast: Oblique
Position: N 2 56.00 E 6 53.83
Depth: 1662
Operator: fw

Data Start: 12-02-2012 22:24:22
Data End: 12-02-2012 23:28:41

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
22:48:16	1	453.6	0	0.8	0.8	100.00	
22:51:16	1	399.4	53	1.4	1.4	100.00	
22:51:17	2	399.0	0	1.5	1.5	100.00	
23:08:06	2	190.6	4196	2.2	1.8	122.22	
23:08:07	3	190.2	0	2.1	2.0	105.00	
23:23:21	3	81.2	370	1.4	1.4	100.00	
23:23:22	4	81.0	0	1.5	1.4	107.14	
23:26:15	4	40.3	633	1.6	1.4	114.29	
23:26:16	5	39.9	0	1.7	1.6	106.25	
23:28:33	5	0.2	47	1.4	1.0	140.00	

Station: PL8
Cast: Oblique
Position: N 2 55,90 E 6 53,90
Depth: 1667
Operator: fw

Data Start: 12-03-2012 07:44:28
Data End: 12-03-2012 08:32:15

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
08:03:17	1	452.7	0	0.8	0.7	114.29	
08:06:01	1	399.7	37	1.0	1.0	100.00	
08:06:02	2	399.6	0	0.9	1.0	90.00	
08:13:33	2	300.4	1274	1.2	1.1	109.09	
08:13:34	3	300.3	0	1.0	1.0	100.00	
08:19:08	3	200.0	106	1.0	1.2	83.33	
08:19:09	4	199.9	0	1.1	1.2	91.67	
08:29:54	4	40.5	224	1.3	1.3	100.00	
08:29:55	5	40.3	0	1.4	1.3	107.69	
08:32:09	5	0.2	43	1.1	1.3	84.62	

Station: PL9
Cast: Oblique
Position: N 2 42.91 E 6 42.60
Depth: 2021
Operator: fw

Data Start: 12-03-2012 23:14:53
Data End: 12-04-2012 00:19:29

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
23:36:57	1	453.1	0	0.4	0.5	80.00	
23:39:37	1	400.7	43	0.9	1.0	90.00	
23:39:38	2	400.2	0	1.4	1.3	107.69	
23:54:49	2	250.5	3195	1.4	1.4	100.00	
23:54:50	3	250.5	0	1.3	1.3	100.00	
00:12:13	3	101.6	3876	1.1	1.2	91.67	
00:12:14	4	101.4	0	1.4	1.3	107.69	
00:16:52	4	42.5	995	1.2	1.3	92.31	
00:16:53	5	42.2	0	1.3	1.3	100.00	
00:19:25	5	0.6	50	0.8	0.8	100.00	

Station: PL10
Cast: Oblique
Position: N 2 43.03 E 6 42.52
Depth: 2008
Operator: fw

Data Start: 12-04-2012 06:28:03
Data End: 12-04-2012 07:24:27

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
06:48:06	1	451.7	0	0.8	0.8	100.00	
06:50:10	1	398.4	34	1.8	1.6	112.50	
06:50:11	2	397.9	0	1.3	1.6	81.25	
06:59:49	2	249.7	2087	1.4	1.5	93.33	
06:59:50	3	249.7	0	1.4	1.3	107.69	
07:15:57	3	100.3	3683	1.6	1.4	114.29	
07:15:58	4	100.1	0	1.7	1.6	106.25	
07:21:32	4	40.7	119	1.2	1.2	100.00	
07:21:33	5	40.3	0	1.6	1.4	114.29	
07:24:20	5	0.1	56	1.0	1.6	62.50	

Station:	PL11		Data Start: 12-08-2012 13:27:26
Cast:		Oblique	Data End: 12-08-2012 14:17:15
Position:	N 2 42,6 E7 33,07		
Depth:		2349	
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
13:49:36	1	452.2	0	0.8	0.4	200.00	
13:52:56	1	391.9	48	0.9	1.1	81.82	
13:52:57	2	391.6	0	1.0	1.1	90.91	
14:04:50	2	213.2	2102	1.2	1.1	109.09	
14:04:51	3	212.8	0	1.2	1.1	109.09	
14:11:40	3	102.1	1141	0.7	1.0	70.00	
14:11:41	4	102.1	0	0.6	1.0	60.00	
14:14:59	4	42.6	606	1.4	1.3	107.69	
14:15:00	5	42.4	0	1.2	1.2	100.00	
14:17:12	5	0.3	39	0.9	0.8	112.50	

Station:	PL12		Data Start: 12-08-2012 23:52:36
Cast:		Oblique	Data End: 12-09-2012 00:49:36
Position:	N 2 56.7 E 7 0.02		
Depth:		1644	
Operator:	fw		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
00:15:32	1	400.5	0	0.9	0.8	112.50	
00:22:50	1	301.5	1445	1.6	1.4	114.29	
00:22:51	2	301.3	0	1.6	1.4	114.29	
00:35:11	2	182.4	2724	1.6	1.5	106.67	
00:35:12	3	182.2	0	1.6	1.5	106.67	
00:47:21	3	33.4	279	1.5	1.5	100.00	
00:47:22	4	33.1	0	1.6	1.5	106.67	
00:49:11	4	1.6	36	1.6	1.4	114.29	
00:49:12	5	1.1	01	1.5	1.4	107.14	
00:49:13	5	0.9	09	1.3	1.3	100.00	

Station:	PL14		Data Start: 12-09-2012 12:09:45
Cast:		Oblique	Data End: 12-09-2012 13:24:52
Position:	N 2 9.54 E6 29.97		
Depth:		3051	
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
12:39:16	1	449.6	0	0.7	0.2	350.00	
12:41:28	1	411.4	44	1.6	1.6	100.00	
12:41:29	2	411.1	0	1.6	1.7	94.12	
13:02:48	2	252.6	5446	2.0	1.7	117.65	
13:02:49	3	252.4	0	2.0	1.8	111.11	
13:15:55	3	122.5	3625	1.8	1.7	105.88	
13:15:56	4	122.3	0	1.8	1.8	100.00	
13:22:04	4	43.0	171	1.8	1.8	100.00	
13:22:05	5	42.7	0	1.7	1.8	94.44	
13:24:40	5	0.2	62	0.8	1.0	80.00	

Station:	PL15		Data Start: 12-10-2012 00:47:55
Cast:		Oblique	Data End: 12-10-2012 01:47:48
Position:	N 2 50.03 E6 29.83		
Depth:		1941	
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
01:10:18	1	403.3	0	1.0	0.9	111.11	
01:17:21	1	302.3	1453	1.3	1.3	100.00	
01:17:22	2	302.3	0	1.4	1.4	100.00	
01:26:32	2	223.7	2157	1.5	1.5	100.00	
01:26:33	3	223.5	0	1.7	1.6	106.25	
01:39:51	3	101.3	3073	1.6	1.6	100.00	
01:39:52	4	101.2	0	1.4	1.5	93.33	
01:45:31	4	37.0	138	1.8	1.7	105.88	
01:45:32	5	36.7	0	1.8	1.8	100.00	
01:47:45	5	0.2	56	1.2	1.3	92.31	

Station:	PL16		Data Start: 12-10-2012 13:45:59
Cast:		Oblique	Data End: 12-10-2012 14:23:25
Position:	N 2 4.50 E5 59.76		
Depth:		3315	
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
14:01:27	1	453.7	0	0.7	0.1	700.00	
14:04:11	1	382.8	33	0.5	1.0	50.00	
14:04:12	2	382.6	0	0.5	0.9	55.56	
14:11:48	2	232.7	1157	0.8	1.0	80.00	
14:11:49	3	232.6	0	0.8	0.9	88.89	
14:18:45	3	101.6	1056	0.9	1.0	90.00	
14:18:46	4	101.2	0	1.0	1.0	100.00	
14:21:51	4	35.5	485	1.2	1.2	100.00	
14:21:52	5	35.3	0	1.0	1.1	90.91	
14:23:24	5	0.1	26	1.3	1.4	92.86	

Station:	PL17		Data Start: 12-11-2012 00:49:18
Cast:		Oblique	Data End: 12-11-2012 02:18:19
Position:	N 2 1.77 E5 30.08		
Depth:		3505	
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
01:19:52	1	435.6	0	0.3	0.2	150.00	
01:25:43	1	382.4	1484	1.8	1.6	112.50	
01:25:44	2	382.3	0	1.8	1.6	112.50	
01:47:40	2	252.8	5668	1.6	1.6	100.00	
01:47:41	3	252.6	0	1.7	1.6	106.25	
02:02:25	3	152.5	4015	1.8	1.8	100.00	
02:02:26	4	152.4	0	1.9	1.8	105.56	
02:14:15	4	53.6	318	1.7	1.6	106.25	
02:14:16	5	53.3	0	1.6	1.6	100.00	
02:18:13	5	0.0	94	1.2	1.2	100.00	

Station:	PL18		Data Start: 12-11-2012 13:18:30
Cast:	Oblique		Data End: 12-11-2012 13:59:58
Position:	N 2 0.42 E 4 59.96		
Depth:	3663		
Operator:	J.A.V		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
13:34:26	1	452.9	1	0.8	0.3	266.67	
13:37:29	1	381.6	44	1.0	1.2	83.33	
13:37:30	2	381.6	0	0.8	1.0	80.00	
13:45:45	2	251.4	1474	1.1	1.1	100.00	
13:45:46	3	251.3	0	0.9	1.0	90.00	
13:54:49	3	100.8	1388	0.7	1.0	70.00	
13:54:50	4	100.6	0	0.8	0.9	88.89	
13:58:08	4	39.8	578	1.0	1.1	90.91	
13:58:09	5	39.6	0	1.0	1.0	100.00	
13:59:57	5	0.0	31	1.8	1.8	100.00	

Station:	PL19		Data Start: 12-12-2012 02:22:22
Cast:	Oblique		Data End: 12-12-2012 03:32:07
Position:	N 1 29.25 E4 29.88		
Depth:	3837		
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
02:50:00	1	449.4	0	0.9	0.3	300.00	
02:55:00	1	373.7	1167	1.6	1.4	114.29	
02:55:01	2	373.6	0	1.5	1.4	107.14	
03:11:05	2	233.3	3913	1.6	1.6	100.00	
03:11:06	3	233.2	0	1.6	1.5	106.67	
03:24:46	3	101.8	3588	1.8	1.6	112.50	
03:24:47	4	101.4	0	2.1	1.8	116.67	
03:30:02	4	34.4	141	1.4	1.6	87.50	
03:30:03	5	34.3	0	1.6	1.6	100.00	
03:32:01	5	0.3	46	1.4	1.2	116.67	

Station: PL20
Cast: Oblique
Position: N 2 6.72 E 4 29.98
Depth: 3821
Operator: JAV

Data Start: 12-12-2012 12:09:08
Data End: 12-12-2012 12:46:52

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
12:24:56	1	450.4	0	0.5	0.3	166.67	
12:28:04	1	371.0	39	1.5	1.4	107.14	
12:28:05	2	370.7	0	1.0	1.2	83.33	
12:33:44	2	242.0	104	1.4	1.4	100.00	
12:33:45	3	241.9	0	1.0	1.2	83.33	
12:42:15	3	98.5	145	0.8	0.9	88.89	
12:42:16	4	98.2	0	0.9	0.9	100.00	
12:45:00	4	42.8	448	0.8	1.1	72.73	
12:45:01	5	42.6	0	0.8	1.0	80.00	
12:46:52	5	0.0	34	1.6	1.6	100.00	

Station: PL21
Cast: Oblique
Position: N 1 55.21 E 3 26.33
Depth: 4178
Operator: JAV

Data Start: 12-13-2012 02:42:50
Data End: 12-13-2012 03:27:58

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
03:00:57	1	453.0	0	0.6	0.5	120.00	
03:03:24	1	402.0	34	1.0	1.1	90.91	
03:03:25	2	401.7	0	1.1	1.0	110.00	
03:10:47	2	272.5	1345	1.4	1.4	100.00	
03:10:48	3	272.6	0	1.0	1.2	83.33	
03:22:26	3	102.8	2228	1.2	1.2	100.00	
03:22:27	4	102.4	0	1.6	1.4	114.29	
03:26:04	4	42.2	662	1.4	1.4	100.00	
03:26:05	5	41.7	0	1.2	1.4	85.71	
03:27:55	5	0.1	29	1.3	1.6	81.25	

Station:	PL22		Data Start: 12-13-2012 14:07:02
Cast:	Oblique		Data End: 12-13-2012 14:49:38
Position:	N 0 58.92 E3 0.04		
Depth:	4327		
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
14:27:05	1	452.8	0	0.8	0.7	114.29	
14:29:45	1	381.8	45	1.2	1.4	85.71	
14:29:46	2	381.9	0	0.8	1.2	66.67	
14:35:57	2	262.7	1257	1.8	1.8	100.00	
14:35:58	3	262.4	0	1.6	1.7	94.12	
14:45:27	3	101.5	2095	1.4	1.5	93.33	
14:45:28	4	101.4	0	1.2	1.3	92.31	
14:48:05	4	42.8	528	1.3	1.4	92.86	
14:48:06	5	42.4	0	1.2	1.3	92.31	
14:49:37	5	0.4	29	1.3	1.4	92.86	

Station:	PL23		Data Start: 12-14-2012 00:42:56
Cast:	Oblique		Data End: 12-14-2012 01:37:47
Position:	N 0 14.09 E 2 38.20		
Depth:	4421		
Operator:	JAV		

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
01:04:43	1	454.9	0	0.5	0.6	83.33	
01:09:10	1	371.8	63	1.3	1.2	108.33	
01:09:11	2	371.5	0	1.0	1.1	90.91	
01:31:03	2	101.5	4125	1.2	1.1	109.09	
01:31:04	3	101.5	0	1.1	1.1	100.00	
01:34:54	3	42.0	81	1.6	1.8	88.89	
01:34:55	4	42.1	0	1.4	1.5	93.33	
01:37:13	4	3.0	47	1.1	1.3	84.62	

Station:	PL24	Data Start: 12-15-2012 01:46:40	
Cast:	Oblique	Data End: 12-15-2012 02:40:02	
Position:	S 1 23.49 E 2 3.35	Comment No.: 2	
Depth:	4558	Communication Error at 12-15-2012 02:04:58	
Operator:	JAV	Re-connected at 12-15-2012 02:05:01	

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
02:06:51	1	452.3	0	0.8	0.7	114.29	
02:11:57	1	359.3	84	1.1	1.2	91.67	
02:11:58	2	359.0	0	1.2	1.2	100.00	
02:20:58	2	252.3	1823	1.4	1.2	116.67	
02:20:59	3	252.2	0	1.4	1.2	116.67	
02:33:01	3	101.9	2479	1.6	1.6	100.00	
02:33:02	4	101.7	0	1.4	1.6	87.50	
02:38:24	4	30.4	119	1.2	1.3	92.31	
02:38:25	5	30.2	0	1.2	1.3	92.31	
02:39:59	5	0.1	34	1.7	1.5	113.33	

Station:	PL25	Data Start: 12-15-2012 13:02:42
Cast:	Oblique	Data End: 12-15-2012 13:57:12
Position:	S 0 43.44 E2 5.56	
Depth:	3415	
Operator:	JAV	

Time [hh:mm:ss]	Net []	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]	Comments [Index]
13:24:13	1	452.9	0	0.8	0.3	266.67	
13:27:19	1	382.1	54	1.6	1.6	100.00	
13:27:20	2	381.8	0	1.5	1.5	100.00	
13:34:24	2	291.6	1586	1.8	1.6	112.50	
13:34:25	3	291.5	0	1.4	1.4	100.00	
13:50:41	3	102.8	3608	1.4	1.3	107.69	
13:50:42	4	102.5	0	1.6	1.5	106.67	
13:55:17	4	36.7	110	1.6	1.5	106.67	
13:55:18	5	36.3	0	1.6	1.5	106.67	
13:57:12	5	0.4	43	1.0	1.2	83.33	

Metadata Trawl stations

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:    1
DATE  :11/29/12            GEAR TYPE: PT NO:  1  POSITION:Lat   N 3°40.67
        start    stop    duration                        Lon   E 1°54.00
TIME  :08:14:31 08:34:31  30.0 (min)          Purpose   : 1
LOG   : 8615.02  8619.02   4.0                Region    : 3200
FDEPTH:        0        0                     Gear cond.: 0
BDEPTH:        0        0                     Validity  : 0
Towing dir:    0°     Wire out   : 100  m     Speed     : 8.0 kn
Sorted    :    0      Total catch: 0.00       Catch/hour: 0.00

   SPECIES                                   CATCH/HOUR    % OF TOT. C   SAMP
                                          weight   numbers
                                       __________       ________

R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:    2
DATE  :11/29/12            GEAR TYPE: PT NO:  1  POSITION:Lat   N 3°41.00
        start    stop    duration                        Lon   E 1°54.00
TIME  :08:54:00 09:24:00  30.0 (min)          Purpose   : 0
LOG   : 8618.45  8620.95   2.5                Region    : 3200
FDEPTH:        0        0                     Gear cond.: 0
BDEPTH:        0        0                     Validity  : 0
Towing dir:    0°     Wire out   : 100  m     Speed     : 5.0 kn
Sorted    :    0      Total catch: 0.01       Catch/hour: 0.01

   SPECIES                                   CATCH/HOUR    % OF TOT. C   SAMP
                                          weight   numbers
   Amphipods                                 0.00        40       0.00
   Not found                                 0.00         4       0.00
   Not found                                 0.00       120       0.00
   Mugil cephalus, juvenile                  0.00         2       0.00
   Unidentified larvae                       0.00        22       0.00
                                       __________       ________

R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:    3
DATE  :11/30/12            GEAR TYPE: PT NO:  1  POSITION:Lat   N 2°48.14
        start    stop    duration                        Lon   E 6°37.32
TIME  :20:20:00 20:50:46  30.8 (min)          Purpose   : 1
LOG   : 8864.53  8867.19   2.7                Region    : 3200
FDEPTH:       50        1                     Gear cond.: 0
BDEPTH:     1981     1922                     Validity  : 0
Towing dir:    0°     Wire out   : 0    m     Speed     : 5.2 kn
Sorted    :    0      Total catch: 0.17       Catch/hour: 0.34

   SPECIES                                   CATCH/HOUR    % OF TOT. C   SAMP
                                          weight   numbers
   Amphipods                                 0.03         0       0.00
   Leptocephalus                             0.01         2       0.00
   Not found                                 0.02         0       0.00
   Symbolophorus sp.                         0.02         2       0.00
   MYCTOPHIDAE                               0.02         4       0.00
   MYSIDACEA                                 0.23         0       0.00
   Miscellaneous                             0.01         0       0.00
                                       __________       ________
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:    4
DATE  :12/01/12            GEAR TYPE: PT NO:  1  POSITION:Lat   N 2°55.89
        start    stop    duration                        Lon   E 6°53.79
TIME  :23:07:43 23:37:12  29.5 (min)          Purpose   : 1
LOG   : 8904.31  8907.08   2.8                Region    : 3200
FDEPTH:        1        1                     Gear cond.: 0
BDEPTH:     1668     1769                     Validity  : 0
Towing dir:    0°     Wire out   : 0    m     Speed     : 5.6 kn
Sorted    :    0      Total catch: 0.02       Catch/hour: 0.04

   SPECIES                                   CATCH/HOUR    % OF TOT. C   SAMP
                                          weight   numbers
   Amphipods                                 0.01         0       0.00
   Not found                                 0.01         0       0.00
   MYCTOPHIDAE                               0.01         0       0.00
   Unidentified larvae                       0.01         0       0.00
   Miscellaneous                             0.01         0       0.00
```

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:    5
DATE  :12/08/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 2°43.67
         start    stop    duration                     Lon   E 7°31.60
TIME  :14:32:49 15:44:05  71.3 (min)          Purpose   : 1
LOG   : 9375.06  9378.92   3.9                Region    : 3200
FDEPTH:     390      390                      Gear cond.: 0
BDEPTH:    2357     2350                      Validity  : 0
Towing dir:   0°     Wire out   : 0    m      Speed     : 3.3 kn
Sorted    :   0      Total catch: 0.43        Catch/hour: 0.36
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Euphausiacea	0.01	15	0.00	
Not found	0.01	2	0.00	
J E L L Y F I S H	0.21	19	0.00	
MYCTOPHIDAE	0.03	23	0.00	
S H R I M P S	0.00	1	0.00	
Argyropelecus affinis	0.02	8	0.00	
Sternoptyx sp.	0.00	2	0.00	
Not found	0.08	6	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:    6
DATE  :12/08/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 2°45.93
         start    stop    duration                     Lon   E 7°28.42
TIME  :15:44:41 15:54:17  9.6  (min)          Purpose   : 1
LOG   : 9378.94  9379.45   0.5                Region    : 3200
FDEPTH:     210      210                      Gear cond.: 0
BDEPTH:    2347     2340                      Validity  : 0
Towing dir:   0°     Wire out   : 0    m      Speed     : 3.2 kn
Sorted    :   0      Total catch: 0.03        Catch/hour: 0.19
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Leptocephalus	0.04	12	0.00	
C R A B S	0.00	6	0.00	
Not found	0.03	12	0.00	
Vinciguerria sp.	0.02	25	0.00	
SALPS	0.09	88	0.00	
Argyropelecus affinis	0.01	12	0.00	0
Sternoptyx sp.	0.01	19	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:    7
DATE  :12/08/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 2°46.48
         start    stop    duration                     Lon   E 7°27.62
TIME  :16:06:23 16:15:57  9.6  (min)          Purpose   : 1
LOG   : 9379.91  9380.40   0.5                Region    : 3200
FDEPTH:      40       40                      Gear cond.: 0
BDEPTH:    2335     2324                      Validity  : 0
Towing dir:   0°     Wire out   : 120  m      Speed     : 3.0 kn
Sorted    :   0      Total catch: 0.09        Catch/hour: 0.59
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
BOTHIDAE, juvenile	0.00	6	0.00	
Naucrates ductor	0.00	6	0.00	
Selene dorsalis	0.01	19	0.00	
Trachurus sp., juvenile	0.01	19	0.00	
Cirripedia	0.01	6	0.00	
C R A B S	0.01	19	0.00	
JELLYFISH	0.11	19	0.00	
Diaphus sp.	0.01	6	0.00	
SALPS	0.40	1979	0.00	
Liocranchia reinhardti	0.04	75	0.00	
TETRAODONTIDAE	0.01	6	0.00	
Unid. juvenile fishes	0.01	25	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 8
DATE :12/09/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 2°15.92
start stop duration Lon E 6°29.66
TIME :14:54:41 15:10:59 16.3 (min) Purpose : 1
LOG : 9489.43 9490.29 0.9 Region : 3200
FDEPTH: 40 40 Gear cond.: 0
BDEPTH: 2990 2986 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 3.2 kn
Sorted : 1 Total catch: 1.20 Catch/hour: 4.43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	4.22	14061	95.26	
Not found	0.07	7	1.66	0
Cranchia scabra	0.06	18	1.41	
MYCTOPHIDAE	0.03	22	0.75	
J E L L Y F I S H	0.03	4	0.58	
Abralia sp.	0.01	4	0.17	
C R U S T A C E A N S	0.01	66	0.17	
Amphipods	0.00	11	0.00	
TETRAODONTIDAE	0.00	4	0.00	
Leptocephalus	0.00	4	0.00	
Selene dorsalis	0.00	7	0.00	
CARANGIDAE, juvenile	0.00	15	0.00	
FISH LARVAE	0.00	4	0.00	
FISH LARVAE	0.00	4	0.00	0
Ornithoteuthis antillarum, juvenile	0.00	7	0.00	
Total	4.43		100.00	

R/V Dr. Fridtjof Nansen
SURVEY:2012408 STATION: 9
DATE :12/09/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 2°16.79
start stop duration Lon E 6°29.72
TIME :15:11:10 15:21:10 10.0 (min) Purpose : 1
LOG : 9490.30 9490.75 0.5 Region : 3200
FDEPTH: 250 250 Gear cond.: 0
BDEPTH: 2986 2982 Validity : 0
Towing dir: 0° Wire out : 505 m Speed : 2.7 kn
Sorted : 0 Total catch: 0.08 Catch/hour: 0.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Amphipods	0.00	6	0.00	
Leptocephalus	0.00	6	0.00	
Not found	0.00	6	0.00	
C R U S T A C E A N S	0.01	18	0.00	0
J E L L Y F I S H	0.00	6	0.00	
Not found	0.03	6	0.00	0
Electrona risso	0.01	12	0.00	
MYCTOPHIDAE	0.00	6	0.00	
PARALEPIDIDAE	0.04	6	0.00	
Vinciguerria sp.	0.01	24	0.00	
Not found	0.00	42	0.00	
Not found	0.15	0	0.00	0
SALPS	0.20	552	0.00	
Argyropelecus affinis	0.01	6	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 10
DATE :12/09/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 2°17.84
start stop duration Lon E 6°29.79
TIME :15:33:34 15:43:30 9.9 (min) Purpose : 1
LOG : 9491.33 9491.82 0.5 Region : 3200
FDEPTH: 410 410 Gear cond.: 0
BDEPTH: 2980 2984 Validity : 0
Towing dir: 0° Wire out : 825 m Speed : 3.0 kn
Sorted : 1 Total catch: 1.38 Catch/hour: 8.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Not found	6.16	0	73.75	
MYCTOPHIDAE	0.65	369	7.74	
Not found	0.60	30	7.23	
Argyropelecus affinis	0.28	187	3.40	
Gonostoma elongatum	0.18	18	2.17	
Not found	0.10	30	1.23	
Euphausiacea	0.07	187	0.80	
Not found	0.06	121	0.72	0
Gymnoscopelus sp.	0.05	12	0.65	
Xenodermichthys copei	0.04	6	0.51	
Sternoptyx sp.	0.03	30	0.36	
Stoloteuthis sp.	0.03	6	0.36	
Not found	0.03	6	0.36	
Electrona risso	0.02	6	0.29	
Not found	0.02	18	0.22	0
Diretmus argenteus	0.02	6	0.22	
C R A B S, juvenile	0.00	6	0.00	
Total	8.36		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 11
DATE :12/11/12 GEAR TYPE: PT NO: 3 POSITION:Lat N 2°8.37
start stop duration Lon E 5°30.03
TIME :03:30:06 03:44:55 14.8 (min) Purpose : 1
LOG : 9672.63 9673.23 0.6 Region : 3200
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 3436 3430 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 2.5 kn
Sorted : 0 Total catch: 0.01 Catch/hour: 0.06

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Leptocephalus	0.00	4	0.00	
Not found	0.00	4	0.00	
BOTHIDAE, juvenile	0.00	4	0.00	
CARANGIDAE, juvenile	0.00	4	0.00	
Euphausiacea	0.01	65	0.00	
Not found	0.00	4	0.00	
FISH LARVAE	0.00	4	0.00	
Phyllosoma	0.00	4	0.00	
SALPS	0.04	223	0.00	
Not found	0.00	4	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 12
DATE :12/11/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 1°58.49
start stop duration Lon E 5°0.12
TIME :14:21:53 14:31:37 9.7 (min) Purpose : 1
LOG : 9736.88 9737.36 0.5 Region : 3200
FDEPTH: 40 40 Gear cond.: 0
BDEPTH: 3672 3673 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 3.0 kn
Sorted : 14 Total catch: 14.10 Catch/hour: 86.95

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	85.10	0	97.87	
Not found	0.78	0	0.90	
Ariomma sp., juvenile	0.59	592	0.68	
C E P H A L O P O D A	0.23	166	0.27	
Leptocephalus	0.07	99	0.09	
Liguriella sp.	0.07	49	0.08	
TETRAODONTIDAE, juvenile	0.03	86	0.04	
Unid. squids and crustaceans, juvenile	0.01	6	0.01	
Selene dorsalis	0.01	18	0.01	
Desdemonia sp.	0.01	6	0.01	
Not found	0.01	18	0.01	
Nealotus tripes, juvenile	0.01	6	0.01	
Holocentrus sp., juvenile	0.01	6	0.01	
OPHICHTHIDAE, juvenile	0.01	12	0.01	
Cranchia scabra	0.01	6	0.01	
Acanthurus monroviae, juvenile	0.01	12	0.01	
Liocranchia reinhardti	0.00	6	0.00	
GEMPYLIDAE, juvenile	0.00	6	0.00	
Not found	0.00	6	0.00	
Ornithoteuthis antillarum	0.00	0	0.00	
Total	86.95		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 13
DATE :12/11/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 1°57.47
start stop duration Lon E 5°0.00
TIME :14:42:17 14:52:07 9.8 (min) Purpose : 1
LOG : 9737.90 9738.39 0.5 Region : 3200
FDEPTH: 250 250 Gear cond.: 0
BDEPTH: 3677 3679 Validity : 0
Towing dir: 0° Wire out : 490 m Speed : 3.0 kn
Sorted : 0 Total catch: 0.14 Catch/hour: 0.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Amphipods	0.00	6	0.00	
Euphausiacea	0.01	18	0.00	
C R U S T A C E A N S	0.01	67	0.00	
Vinciguerria sp.	0.01	12	0.00	
Not found	0.40	0	0.00	
SALPS	0.40	0	0.00	
Megalocranchia sp.	0.02	6	0.00	
Sternoptyx sp., juvenile	0.01	6	0.00	
TETRAODONTIDAE, juvenile	0.01	6	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 14
DATE :12/11/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 1°56.65
start stop duration Lon E 5°0.00
TIME :14:58:19 14:07:56 9.6 (min) Purpose : 1
LOG : 9738.72 9739.19 0.5 Region : 3200
FDEPTH: 380 380 Gear cond.: 0
BDEPTH: 3679 3679 Validity : 0
Towing dir: 0° Wire out : 750 m Speed : 3.0 kn
Sorted : 5 Total catch: 5.07 Catch/hour: 31.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	30.12	0	95.32	
J E L L Y F I S H	0.78	0	2.47	
Argyropelecus affinis	0.19	44	0.59	
Argyropelecus gigas	0.12	56	0.37	
Electrona risso	0.09	19	0.30	
Diretmus argenteus, juvenile	0.09	25	0.28	
MYCTOPHIDAE	0.08	168	0.26	
Not found	0.04	31	0.14	
Megalocranchia sp.	0.02	6	0.06	
Not found	0.02	6	0.06	
S H R I M P S	0.02	19	0.06	
Liocranchia reinhardti	0.02	6	0.06	
Not found	0.01	6	0.04	
Euphausiacea	0.00	31	0.00	
Total	31.60		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   15
DATE  :12/11/12            GEAR TYPE: PT NO:  3  POSITION:Lat   N 1°47.95
         start    stop    duration                      Lon   E 4°59.89
TIME  :17:11:18 17:41:00  30.0 (min)           Purpose   : 1
LOG   : 9748.04  9749.10   1.1                 Region    : 3200
FDEPTH:       0        0                       Gear cond.: 0
BDEPTH:    3683     3755                       Validity  : 0
Towing dir:   0°     Wire out   : 0    m       Speed     : 2.5 kn
Sorted    :   0      Total catch: 0.03         Catch/hour: 0.06
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
BALISTIDAE	0.00	2	0.00	
Molluscs	0.00	0	0.00	
BOTHIDAE, juvenile	0.00	2	0.00	
Not found	0.00	2	0.00	
Hemicaranx bicolor	0.01	20	0.00	
Euphausiacea	0.00	10	0.00	
Holocentrus sp., juvenile	0.00	4	0.00	
Phyllosoma	0.00	4	0.00	
Not found	0.00	6	0.00	
SALPS	0.05	0	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   16
DATE  :12/12/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 1°32.80
         start    stop    duration                      Lon   E 1°33.20
TIME  :03:48:56 03:59:12  10.3 (min)           Purpose   : 1
LOG   : 9809.88  9810.36   0.5                 Region    : 3200
FDEPTH:      30       30                       Gear cond.: 0
BDEPTH:    3834     3850                       Validity  : 0
Towing dir:   0°     Wire out   : 90   m       Speed     : 2.8 kn
Sorted    :  23      Total catch: 22.63        Catch/hour: 131.83
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	106.02	0	80.42	
Not found	18.06	0	13.70	0
Brama brama, juvenile	2.27	17	1.72	
Euphausiacea	1.94	9699	1.47	
MYCTOPHIDAE	1.19	996	0.91	
Ommastrephes bartrami	0.66	6	0.50	
J E L L Y F I S H	0.63	17	0.48	
Nealotus tripes	0.26	12	0.20	
Leptocephalus	0.23	82	0.18	
Cubiceps gracilis	0.15	6	0.11	
Cranchia scabra	0.10	248	0.08	
Ommastrephes bartrami, juvenile	0.08	12	0.06	
Selene dorsalis	0.06	41	0.04	
Psenes sp.	0.06	12	0.04	
Liguriella sp.	0.03	41	0.02	
Onychoteuthis sp.	0.02	17	0.02	
Diplophos taenia	0.02	41	0.01	
Ariomma sp.	0.02	17	0.01	
S H R I M P S	0.01	12	0.01	
Pyroteuthis sp.	0.01	6	0.01	
Unidentified larvae	0.00	12	0.00	
BOTHIDAE, juvenile	0.00	6	0.00	
TETRAODONTIDAE	0.00	6	0.00	
Unidentified larvae	0.00	12	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   17
DATE  :12/12/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 1°33.30
         start    stop    duration                     Lon   E 4°30.00
TIME  :04:00:48 04:10:22  9.6  (min)          Purpose   : 1
LOG   : 9810.44  9810.86   0.4                Region    : 3200
FDEPTH:      40       40                      Gear cond.: 0
BDEPTH:    3859     3882                      Validity  : 0
Towing dir:   0°     Wire out   : 110  m      Speed     : 2.6 kn
Sorted    :   8      Total catch: 7.83        Catch/hour: 48.93
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Not found	38.75	244	79.20	39
Not found	7.78	0	15.90	
MYCTOPHIDAE	1.81	2013	3.70	
Cubiceps gracilis	0.19	6	0.38	
Nealotus tripes	0.15	6	0.31	
Pyroteuthis sp.	0.04	44	0.09	
Onychoteuthis sp.	0.04	31	0.09	
Leptocephalus	0.04	6	0.08	
Euphausiacea	0.03	138	0.06	
Unidentified larvae	0.02	94	0.04	
S H R I M P S	0.02	19	0.04	
Ariomma sp., juvenile	0.02	19	0.04	
BOTHIDAE, juvenile	0.01	6	0.01	
Selene dorsalis, juvenile	0.01	6	0.01	
Liocranchia reinhardti	0.01	6	0.01	
Diplophos taenia	0.01	12	0.01	
TETRAODONTIDAE, juvenile	0.01	19	0.01	
Megalocranchia sp.	0.00	6	0.00	
Not found	0.00	6	0.00	
Octopoteuthis sp.	0.00	6	0.00	
Total	48.93		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   18
DATE  :12/12/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 1°34.30
         start    stop    duration                     Lon   E 4°30.00
TIME  :04:20:04 04:30:08  10.1 (min)          Purpose   : 0
LOG   : 9811.38  9811.85   0.5                Region    : 1
FDEPTH:     250      250                      Gear cond.: 0
BDEPTH:    3860     3832                      Validity  : 0
Towing dir:   0°     Wire out   : 550  m      Speed     : 2.8 kn
Sorted    :   0      Total catch: 0.24        Catch/hour: 1.43
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Amphipods	0.00	12	0.00	
Selene dorsalis, juvenile	0.01	6	0.00	
Euphausiacea	0.01	24	0.00	
Not found	0.05	12	0.00	
Electrona risso	0.00	6	0.00	
Gymnoscopelus sp.	0.17	12	0.00	
MYCTOPHIDAE	0.29	184	0.00	
Aristostomias lunifer	0.13	6	0.00	
Avocettina sp.	0.04	6	0.00	
Not found	0.42	119	0.00	
Sergia sp.	0.19	119	0.00	
S H R I M P S	0.02	18	0.00	
Megalocranchia sp.	0.01	6	0.00	
Argyropelecus gigas	0.04	24	0.00	
Polyipnus polli	0.02	30	0.00	
Unidentified black fish	0.04	12	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 19
DATE :12/12/12 GEAR TYPE: PT NO: 3 POSITION:Lat N 1°37.20
start stop duration Lon E 4°30.00
TIME :05:10:47 05:39:49 29.0 (min) Purpose : 1
LOG : 9814.27 9815.43 1.2 Region : 3200
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 3832 3849 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 2.4 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Molluscs	0.00	0	0.00	
BOTHIDAE, juvenile	0.00	2	0.00	
Not found	0.00	0	0.00	
SALPS	0.00	0	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 20
DATE :12/12/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 2°5.49
start stop duration Lon E 4°28.74
TIME :13:07:27 13:17:22 9.9 (min) Purpose : 1
LOG : 9849.88 9850.36 0.5 Region : 3200
FDEPTH: 40 40 Gear cond.: 0
BDEPTH: 3835 3836 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 2.9 kn
Sorted : 1 Total catch: 0.71 Catch/hour: 4.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	2.48	0	57.91	
Not found	1.57	0	36.72	
Ornithoteuthis antillarum, juvenile	0.06	73	1.41	
Selene dorsalis, juvenile	0.05	30	1.13	
Cranchia scabra	0.05	12	1.13	
Not found	0.01	6	0.28	
Euphausiacea	0.01	91	0.28	
MYCTOPHIDAE	0.01	24	0.28	
Not found	0.01	6	0.28	
Abraliopsis sp.	0.01	6	0.14	
TETRAODONTIDAE	0.01	12	0.14	
Unidentified juv fish	0.01	12	0.14	
Leptocephalus	0.01	6	0.14	
Diplophos taenia, juvenile	0.00	6	0.00	
Not found	0.00	6	0.00	
Not found	0.00	6	0.00	
Not found	0.00	18	0.00	
Total	4.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 21
DATE :12/12/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 2°5.40
start stop duration Lon E 4°27.81
TIME :13:25:22 13:35:28 10.1 (min) Purpose : 1
LOG : 9850.83 9851.25 0.4 Region : 3200
FDEPTH: 240 240 Gear cond.: 0
BDEPTH: 3839 3846 Validity : 0
Towing dir: 0° Wire out : 500 m Speed : 2.5 kn
Sorted : 0 Total catch: 0.22 Catch/hour: 1.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Acanthurus monroviae, juvenile	0.00	6	0.00	
Selene dorsalis, juvenile	0.02	12	0.00	
Euphausiacea	0.01	48	0.00	
C R U S T A C E A N S	0.00	12	0.00	
MYCTOPHIDAE	0.74	778	0.00	
SALPS	0.50	0	0.00	
Megalocranchia sp.	0.01	6	0.00	
Stoloteuthis sp.	0.02	6	0.00	
TETRAODONTIDAE, juvenile	0.00	6	0.00	
Not found	0.00	6	0.00	
Not found	0.01	6	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 22
DATE :12/12/12 GEAR TYPE: PT NO: 2 POSITION:Lat N 2°5.37
Lon E 4°26.99

	start	stop	duration		
TIME	:13:43:10	13:53:00	9.8 (min)	Purpose	: 1
LOG	: 9851.66	9852.12	0.5	Region	: 3200
FDEPTH:	370	370		Gear cond.:	0
BDEPTH:	3846	3848		Validity	: 0
Towing dir:	0°	Wire out	: 750 m	Speed	: 2.8 kn
Sorted :	3	Total catch:	2.89	Catch/hour:	17.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	9.40	0	53.34	
SALPS	5.68	0	32.21	
Not found	0.86	0	4.88	
Argyropelecus affinis	0.53	208	3.01	
Diretmus argenteus	0.26	43	1.49	
MYCTOPHIDAE	0.24	85	1.39	
Electrona risso	0.22	43	1.25	
Not found	0.20	31	1.11	
Not found	0.15	12	0.87	
Argyropelecus gigas	0.03	6	0.17	
Vinciguerria sp.	0.02	12	0.14	
Megalocranchia sp.	0.01	6	0.07	
Ornithoteuthis antillarum, juvenile	0.01	12	0.03	
Polyipnus polli	0.01	12	0.03	
Holocentrus sp., juvenile	0.00	6	0.00	
Euphausiacea	0.00	31	0.00	
Total	17.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 23
DATE :12/12/12 GEAR TYPE: PT NO: 3 POSITION:Lat N 2°5.67
Lon E 4°24.28

	start	stop	duration		
TIME	:14:37:24	15:07:54	30.5 (min)	Purpose	: 1
LOG	: 9854.98	9856.30	1.3	Region	: 3200
FDEPTH:	0	0		Gear cond.:	0
BDEPTH:	3866	3863		Validity	: 0
Towing dir:	0°	Wire out	: 0 m	Speed	: 2.6 kn
Sorted :	0	Total catch:	0.05	Catch/hour:	0.09

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
BOTHIDAE, juvenile	0.00	2	0.00	
Nealotus tripes, juvenile	0.00	37	0.00	
J E L L Y F I S H	0.00	0	0.00	
Not found	0.01	0	0.00	
SALPS	0.07	0	0.00	
UNIDENTIFIED FISH	0.00	2	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 24
DATE :12/13/12 GEAR TYPE: PT NO: 3 POSITION:Lat N 1°53.43
Lon E 3°25.48

	start	stop	duration		
TIME	:03:44:51	03:59:28	14.6 (min)	Purpose	: 1
LOG	: 9941.76	9942.23	0.5	Region	: 3200
FDEPTH:	0	0		Gear cond.:	0
BDEPTH:	4246	4247		Validity	: 0
Towing dir:	0°	Wire out	: 0 m	Speed	: 1.9 kn
Sorted :	0	Total catch:	0.08	Catch/hour:	0.31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Leptocephalus	0.00	4	0.00	
Molluscs	0.00	4	0.00	
CARANGIDAE	0.00	4	0.00	
Euphausiacea	0.04	0	0.00	
Diplophos taenia	0.02	8	0.00	
Mugil cephalus	0.00	4	0.00	
Not found	0.02	0	0.00	
SALPS	0.21	0	0.00	
S H R I M P S	0.02	0	0.00	
Unidentified larvae	0.00	4	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   25
DATE  :12/13/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 0°56.71
         start    stop    duration                     Lon   E 2°59.16
TIME  :15:16:21 15:26:28  10.1 (min)          Purpose   : 1
LOG   :     5.67     6.15   0.5               Region    : 3200
FDEPTH:      40       40                      Gear cond.: 0
BDEPTH:    4326     4325                      Validity  : 0
Towing dir:   0°     Wire out   : 0    m      Speed     : 2.8 kn
Sorted    :   1      Total catch: 1.12        Catch/hour: 6.66
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Not found	5.57	350	83.63	
Not found	0.79	0	11.92	
J E L L Y F I S H	0.20	12	3.02	
Brama brama, juvenile	0.02	18	0.27	
Not found	0.01	12	0.18	
Psenes sp., juvenile	0.01	6	0.18	
Argyropelecus gigas	0.01	6	0.18	
Lagocephalus lagocephalus, juvenile	0.01	12	0.18	
Unid. squids and crustaceans	0.01	6	0.09	
Not found	0.01	6	0.09	
TETRAODONTIDAE, juvenile	0.01	30	0.09	
CENTROLOPHIDAE, juvenile	0.01	6	0.09	
Electrona risso	0.01	6	0.09	
Amphipods	0.00	18	0.00	
BOTHIDAE, juvenile	0.00	6	0.00	
Euphausiacea	0.00	30	0.00	
Cranchia scabra	0.00	6	0.00	
Not found	0.00	6	0.00	
Total	6.66		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   26
DATE  :12/13/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 0°55.80
         start    stop    duration                     Lon   E 2°58.78
TIME  :15:34:23 15:44:26  10.1 (min)          Purpose   : 1
LOG   :     6.64     7.08   0.5               Region    : 3200
FDEPTH:     260      260                      Gear cond.: 0
BDEPTH:    4323     4322                      Validity  : 0
Towing dir:   0°     Wire out   : 0    m      Speed     : 2.7 kn
Sorted    :   0      Total catch: 0.13        Catch/hour: 0.80
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	0.04	6	0.00	
Electrona risso	0.14	101	0.00	
SALPS	0.58	263	0.00	
Liocranchia reinhardti	0.00	6	0.00	
Megalocranchia sp.	0.00	6	0.00	
Argyropelecus gigas	0.01	6	0.00	
Not found	0.03	6	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   27
DATE  :12/13/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 0°55.06
         start    stop    duration                     Lon   E 2°58.46
TIME  :15:50:38 16:00:27  9.8  (min)          Purpose   : 1
LOG   :     7.45     7.89   0.4               Region    : 3200
FDEPTH:     380      380                      Gear cond.: 0
BDEPTH:    4324     4323                      Validity  : 0
Towing dir:   0°     Wire out   : 550  m      Speed     : 2.7 kn
Sorted    :   0      Total catch: 0.13        Catch/hour: 0.82
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Euphausiacea	0.02	92	0.00	
J E L L Y F I S H	0.39	61	0.00	
Diaphus sp.	0.02	6	0.00	
Electrona risso	0.04	6	0.00	
MYCTOPHIDAE	0.15	251	0.00	
Vinciguerria sp.	0.01	18	0.00	
SALPS	2.11	470	0.00	
Argyropelecus affinis	0.20	43	0.00	
Argyropelecus gigas	0.04	24	0.00	
Unidentified black fish	0.01	12	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   28
DATE  :12/13/12            GEAR TYPE: PT NO:  3  POSITION:Lat   N 0°53.84
         start    stop    duration                      Lon   E 2°58.34
TIME  :16:39:56 17:10:18  30.4 (min)           Purpose   : 1
LOG   :    8.91    10.12   1.2                 Region    : 3200
FDEPTH:       0        0                       Gear cond.: 0
BDEPTH:    4324     4324                       Validity  : 0
Towing dir:   0°     Wire out   : 0    m       Speed     : 2.4 kn
Sorted    :   0      Total catch: 0.13         Catch/hour: 0.26
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Hemicaranx bicolor, juvenile	0.00	2	0.00	
Nealotus tripes, juvenile	0.00	2	0.00	
J E L L Y F I S H	0.04	6	0.00	
Not found	0.02	0	0.00	
SALPS	0.19	0	0.00	
Not found	0.01	12	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   29
DATE  :12/14/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 0°12.15
         start    stop    duration                      Lon   E 2°36.77
TIME  :02:00:36 02:10:22  9.8  (min)           Purpose   : 1
LOG   :   58.11    58.57   0.5                 Region    : 3200
FDEPTH:      40       40                       Gear cond.: 0
BDEPTH:    4424     4425                       Validity  : 0
Towing dir:   0°     Wire out   : 0    m       Speed     : 2.8 kn
Sorted    :   5      Total catch: 4.53         Catch/hour: 27.81
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Not found	16.64	332	59.85	
Euphausiacea	3.44	0	12.37	
Cubiceps gracilis	2.70	135	9.72	1
Vinciguerria sp.	1.09	3623	3.91	
MYCTOPHIDAE	1.03	2063	3.71	
Mollusc eggs	0.94	0	3.38	
Ornithoteuthis antillarum	0.75	344	2.69	
Not found	0.58	282	2.08	
Liocranchia reinhardti	0.11	166	0.40	
Leptocephalus	0.10	37	0.35	
Nealotus tripes	0.08	6	0.29	
Abraliopsis sp.	0.05	43	0.18	
Psenes sp.	0.05	6	0.18	
Pyroteuthis sp.	0.04	55	0.15	
Argonauta sp.	0.04	6	0.15	
Onychoteuthis banksi	0.04	6	0.13	
Malacosteus sp.	0.03	6	0.11	
Liguriella sp.	0.02	18	0.09	
Lepidopus caudatus	0.02	6	0.07	
ASTRONESTHIDAE	0.02	6	0.07	
S H R I M P S	0.01	12	0.04	
Gonostoma sp.	0.01	6	0.02	
Not found	0.01	6	0.02	
Lagocephalus lagocephalus	0.01	31	0.02	
TETRAODONTIDAE, juvenile	0.01	6	0.02	
Cranchia scabra	0.00	6	0.00	
BOTHIDAE, juvenile	0.00	6	0.00	
Total	27.81		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   30
DATE  :12/14/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 0°11.77
         start    stop    duration                     Lon   E 2°36.25
TIME  :02:14:11 02:23:54  9.7  (min)          Purpose   : 1
LOG   :   58.74    59.23   0.5                Region    : 3200
FDEPTH:     100      100                      Gear cond.: 0
BDEPTH:    4425     4426                      Validity  : 0
Towing dir:   0°     Wire out   : 250  m      Speed     : 3.0 kn
Sorted    :   0      Total catch: 0.15        Catch/hour: 0.91
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Amphipods	0.00	6	0.00	
Ariomma sp.	0.00	6	0.00	
BATHYLAGIDAE	0.01	6	0.00	
Bregmaceros sp.	0.00	12	0.00	
Euphausiacea	0.08	401	0.00	
C R U S T A C E A N S	0.00	12	0.00	
Gonostoma sp.	0.01	6	0.00	
Gymnoscopelus sp.	0.04	19	0.00	
MYCTOPHIDAE	0.12	136	0.00	
Malacosteus sp.	0.01	6	0.00	
PARALEPIDIDAE	0.01	6	0.00	
Vinciguerria sp.	0.02	80	0.00	
Not found	0.57	0	0.00	
S H R I M P S	0.01	19	0.00	
Shrimps, small, non comm.	0.01	31	0.00	
Pyroteuthis sp.	0.02	31	0.00	
Unidentified black fish	0.01	19	0.00	
Unidentified larvae	0.01	6	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   31
DATE  :12/14/12            GEAR TYPE: PT NO:  2  POSITION:Lat   N 0°11.13
         start    stop    duration                     Lon   E 2°35.64
TIME  :02:31:05 02:42:21  11.3 (min)          Purpose   : 1
LOG   :   59.62    60.12   0.5                Region    : 3200
FDEPTH:     270      270                      Gear cond.: 0
BDEPTH:    4427     4430                      Validity  : 0
Towing dir:   0°     Wire out   : 600  m      Speed     : 2.7 kn
Sorted    :   0      Total catch: 0.01        Catch/hour: 0.03
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Euphausiacea	0.01	80	0.00	
MYCTOPHIDAE	0.01	21	0.00	
PARALEPIDIDAE	0.01	5	0.00	
SALPS	0.00	5	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   32
DATE  :12/14/12            GEAR TYPE: PT NO:  3  POSITION:Lat   N 0°10.25
         start    stop    duration                     Lon   E 2°34.74
TIME  :03:25:22 03:56:31  31.2 (min)          Purpose   : 1
LOG   :   61.31    62.53   1.2                Region    : 3200
FDEPTH:       0        0                      Gear cond.: 0
BDEPTH:    4434     4428                      Validity  : 0
Towing dir:   0°     Wire out   : 0    m      Speed     : 2.4 kn
Sorted    :  19      Total catch: 18.76       Catch/hour: 36.13
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Not found	36.12	0	99.96	
Not found	0.01	2	0.03	
Hemicaranx bicolor, juvenile	0.00	2	0.01	
Not found	0.00	4	0.01	
Ariomma sp., juvenile	0.00	2	0.00	
Total	36.13		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 33
DATE :12/15/12 GEAR TYPE: PT NO: 2 POSITION:Lat S 1°20.94
start stop duration Lon E 2°3.24
TIME :03:01:32 03:11:27 9.9 (min) Purpose : 1
LOG : 175.20 175.68 0.5 Region : 3200
FDEPTH: 20 20 Gear cond.: 0
BDEPTH: 4474 4397 Validity : 0
Towing dir: 0° Wire out : 80 m Speed : 2.9 kn
Sorted : 5 Total catch: 4.66 Catch/hour: 28.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Not found	13.97	429	49.58	
Euphausiacea	6.35	31754	22.54	
Not found	5.20	496	18.46	
Ornithoteuthis antillarum	0.82	260	2.90	
Cubiceps gracilis	0.51	18	1.82	
MYCTOPHIDAE	0.50	1675	1.78	
Liocranchia reinhardti	0.36	520	1.29	
Not found	0.25	0	0.88	
Nealotus tripes	0.11	6	0.41	
Leptocephalus	0.07	24	0.24	
Liguriella sp.	0.01	12	0.04	
Pyroteuthis sp.	0.01	12	0.04	
Not found	0.01	6	0.02	
SCOMBRIDAE, juvenile	0.00	6	0.00	
Bregmaceros sp., juvenile	0.00	6	0.00	
Total	28.18		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012408 STATION: 34
DATE :12/15/12 GEAR TYPE: PT NO: 2 POSITION:Lat S 1°20.34
start stop duration Lon E 2°3.27
TIME :03:13:40 03:24:50 11.2 (min) Purpose : 1
LOG : 175.80 176.33 0.5 Region : 3200
FDEPTH: 50 50 Gear cond.: 0
BDEPTH: 4395 4392 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 2.8 kn
Sorted : 2 Total catch: 1.59 Catch/hour: 8.53

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	2.07	1885	24.31	
Vinciguerria sp.	1.86	3099	21.79	
Not found	1.51	27	17.76	
Not found	0.84	0	9.82	
Liocranchia reinhardti	0.61	167	7.18	
Nealotus tripes	0.40	21	4.72	
Mollusc eggs	0.34	0	3.97	
Leptocephalus	0.32	27	3.72	
Not found	0.26	140	3.02	
Ornithoteuthis antillarum	0.10	70	1.20	
Euphausiacea	0.07	349	0.82	
Cranchia scabra	0.03	11	0.31	
Lagocephalus lagocephalus, juvenile	0.02	27	0.25	
Onychoteuthis banksi	0.02	5	0.25	
Pyroteuthis sp.	0.02	21	0.25	
Liguriella sp.	0.02	11	0.19	
Diplophos taenia	0.02	11	0.19	
C R U S T A C E A N S	0.02	5	0.19	
Not found	0.01	27	0.13	
Holocentrus sp., juvenile	0.01	5	0.13	
TETRAODONTIDAE	0.01	5	0.06	
Shrimps, small, non comm.	0.01	5	0.06	
BOTHIDAE, juvenile	0.01	16	0.06	
Not found	0.01	5	0.06	
Brama brama, juvenile	0.00	5	0.00	
Malacosteus sp.	0.00	5	0.00	
Total	8.57		100.44	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   35
DATE  :12/15/12           GEAR TYPE: PT NO:  2  POSITION:Lat   S 1°19.32
        start    stop    duration                          Lon   E 2°3.38
TIME  :03:32:53 03:42:51  10.0 (min)           Purpose   : 1
LOG   :  176.82   177.31   0.5                 Region    : 3200
FDEPTH:     250      250                       Gear cond.: 0
BDEPTH:    4376     4380                       Validity  : 0
Towing dir:   0°     Wire out   : 600  m       Speed     : 3.0 kn
Sorted    :   1      Total catch: 0.77         Catch/hour: 4.66
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Not found	0.98	24	21.06	
TRACHIPTERIDAE	0.73	6	15.76	
Not found	0.73	241	15.63	
MYCTOPHIDAE	0.64	259	13.82	
GEMPYLIDAE	0.32	12	6.85	
S H R I M P S	0.30	181	6.46	
Not found	0.16	18	3.36	
Histioteuthis meleagroteuthis	0.16	6	3.36	
Malacosteus sp.	0.13	12	2.71	
Argyropelecus gigas	0.11	90	2.45	
Not found	0.07	12	1.42	
Euphausiacea	0.06	66	1.29	
Gonostoma elongatum	0.05	6	1.16	
Liguriella sp.	0.05	18	1.03	
Vitreledonella richardi	0.03	6	0.65	
Grammicolepis brachiusculus	0.03	6	0.65	
Not found	0.02	12	0.52	
Vinciguerria sp.	0.02	24	0.52	
Liocranchia reinhardti	0.02	6	0.39	
BATHYLAGIDAE	0.02	6	0.39	
Diplophos taenia	0.01	6	0.26	
Unidentified black fish	0.01	6	0.26	
Total	4.66		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   36
DATE  :12/15/12           GEAR TYPE: PT NO:  3  POSITION:Lat   S 1°17.65
        start    stop    duration                          Lon   E 2°2.99
TIME  :04:21:31 04:50:44  29.2 (min)           Purpose   : 1
LOG   :  178.69   179.48   0.8                 Region    : 3200
FDEPTH:       0        0                       Gear cond.: 0
BDEPTH:    4539     4597                       Validity  : 0
Towing dir:   0°     Wire out   : 0    m       Speed     : 1.6 kn
Sorted    :   0      Total catch: 0.46         Catch/hour: 0.95
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Amphipods	0.00	0	0.00	
Leptocephalus	0.01	6	0.00	
CENTROLOPHIDAE, juvenile	0.00	2	0.00	
Euphausiacea	0.00	0	0.00	
Not found	0.06	0	0.00	
Not found	0.89	41	0.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   37
DATE  :12/15/12           GEAR TYPE: PT NO:  2  POSITION:Lat   S 0°40.71
        start    stop    duration                          Lon   E 2°5.67
TIME  :14:16:16 14:26:19  10.1 (min)           Purpose   : 1
LOG   :  219.20   219.69   0.5                 Region    : 3200
FDEPTH:      35       35                       Gear cond.: 0
BDEPTH:    2917     2833                       Validity  : 0
Towing dir:   0°     Wire out   : 90   m       Speed     : 3.0 kn
Sorted    :   1      Total catch: 0.96         Catch/hour: 5.74
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Ariomma sp.	5.07	12687	88.36	
Ornithoteuthis antillarum, juvenile	0.39	370	6.86	
Not found	0.12	179	2.08	2
Leptocephalus	0.05	30	0.94	
Lagocephalus lagocephalus	0.04	96	0.62	
CENTROLOPHIDAE, juvenile	0.04	18	0.62	
C R U S T A C E A N S	0.01	6	0.21	
TETRAODONTIDAE	0.01	12	0.10	
Centrolophidae - juvenile	0.01	12	0.10	
Nemichthys sp.	0.01	6	0.10	
MONACANTHIDAE	0.00	6	0.00	
Total	5.74		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   38
DATE  :12/15/12           GEAR TYPE: PT NO:  2  POSITION:Lat   S 0°39.59
        start    stop    duration                      Lon   E 2°5.67
TIME  :14:36:40 14:46:54  10.2 (min)          Purpose   : 1
LOG   :  220.31   220.77   0.5                Region    : 3200
FDEPTH:     290      290                      Gear cond.: 0
BDEPTH:    2514     2340                      Validity  : 0
Towing dir:   0°     Wire out   : 800  m      Speed     : 2.7 kn
Sorted    :   0      Total catch: 0.02        Catch/hour: 0.12
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
J E L L Y F I S H	0.09	6	0.00	
Vinciguerria sp.	0.01	6	0.00	
SALPS	0.02	6	0.00	
Not found	0.00	6	0.00	3

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   39
DATE  :12/15/12           GEAR TYPE: PT NO:  2  POSITION:Lat   S 0°38.88
        start    stop    duration                      Lon   E 2°5.67
TIME  :14:51:25 15:01:12  9.8  (min)          Purpose   : 1
LOG   :  221.01   221.45   0.4                Region    : 3200
FDEPTH:     380      380                      Gear cond.: 0
BDEPTH:    2098     1944                      Validity  : 0
Towing dir:   0°     Wire out   : 750  m      Speed     : 2.7 kn
Sorted    :   1      Total catch: 0.80        Catch/hour: 4.90
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Not found	3.68	0	75.09	
Argyropelecus affinis	0.26	67	5.38	
J E L L Y F I S H	0.25	31	5.13	
MYCTOPHIDAE	0.18	368	3.75	
Argyropelecus gigas	0.18	74	3.63	
Electrona risso	0.16	31	3.25	
Vinciguerria sp.	0.06	43	1.13	
Diaphus sp.	0.03	12	0.63	
Not found	0.03	6	0.63	
Polyipnus polli	0.02	12	0.50	
Not found	0.01	6	0.25	
Vinciguerria sp., juvenile	0.01	6	0.13	
Euphausiacea	0.01	37	0.13	
Not found	0.01	6	0.13	
Shrimps, small, non comm.	0.01	6	0.13	
Sternoptyx sp.	0.01	6	0.13	
Not found	0.00	6	0.00	
Total	4.90		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2012408        STATION:   40
DATE  :12/15/12           GEAR TYPE: PT NO:  3  POSITION:Lat   S 0°38.60
        start    stop    duration                      Lon   E 2°4.72
TIME  :15:41:15 16:11:04  29.8 (min)          Purpose   : 1
LOG   :  222.62   223.89   1.3                Region    : 3200
FDEPTH:       0        0                      Gear cond.: 0
BDEPTH:    2341     2647                      Validity  : 0
Towing dir:   0°     Wire out   : 0    m      Speed     : 2.5 kn
Sorted    :   0      Total catch: 0.01        Catch/hour: 0.01
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Amphipods	0.00	2	0.00	
Leptocephalus	0.01	18	0.00	
CENTROLOPHIDAE	0.00	2	0.00	
Euphausiacea	0.00	2	0.00	
C R A B S, juvenile	0.00	2	0.00	
OCTOPODIDAE, juvenile	0.00	4	0.00	

Gear type 1 : Otter sampler

Gear type 2 : Pelagic trawl with multisampler

Gear type 3 : Metot net rigged as Newston net with 2*2 m^2 opening.

Superstation											BIO 1	BIO 2	BIO 3	BIO 4	BIO 5	BIO 6	BIO 7	BIO 8	BIO 9	BIO 10	BIO 11	BIO 12	BIO 13	BIO 14
Multinet	Pl.1	Pl.2	Pl. 3	Pl. 4	Pl.5	Pl.6	Pl.7	Pl.8	Pl. 9	Pl. 10	Pl. 11	Pl.12	Pl. 14	Pl. 15	Pl.16	Pl.17	Pl.18	Pl.19	Pl. 20	Pl.21	Pl.22	Pl.23	Pl. 24	Pl. 25
Tot. Vol. m3	5234	5524	4455	6265	5821	6158	5299	1684	8159	5979	3936	4494	9348	6877	2757	11579	3515	8855	770	4298	3954	4316	4539	5401
Depth	280-1	300-0	300-0	250-0	351-0	300-0	454-0	453-0	453-0	452-0	452-0	401-2	450-0	400-0	453-0	436-0	453-0	450-0	450-0	453-0	400-0	455-3	452-0	453-0
Acropomatidae	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ahlia egmontis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Anguilliformes	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argentinidae	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Argentinioidei?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Argyropelecus spp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Ariomma spp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Astronesthidae	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atherinidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auxis spp.	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Balistidae	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bembrops spp.	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benthosema spp.	0	12	0	1	0	1	0	2	6	3	1	1	1	1	0	1	0	1	0	0	0	0	0	0
Bothidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Bothus spp.	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bregmaceros spp.	1	1	2	3	0	0	2	0	4	2	1	1	7	2	3	0	1	3	0	0	0	0	0	0
Callionymidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carapus spp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centrobranchus spp.	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratioidei	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratoscopelus spp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	4	0
Chauliodus spp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chiasmodontidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Congridae	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coryphaena spp.	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Cubiceps spp.	2	2	0	3	2	0	1	1	0	2	0	2	0	1	1	1	0	4	1	4	0	1	0	1
Cyclothone spp.	1	0	0	0	0	0	0	1	2	0	1	0	1	0	1	5	0	4	0	1	0	0	2	6
Diaphus spp.	1	8	3	5	14	6	6	10	1	6	1	0	1	3	1	0	1	2	0	6	3	1	7	9
Diogenichthys spp.	2	5	9	1	2	1	2	3	4	4	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Diplophos spp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diplospinus multistriatus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Disintegrated larvae	4	19	60	10	12	18	2	2	7	20	12	1	3	1	2	2	0	10	7	4	1	2	14	7
Epigonidae	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gadiformes	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gempylus serpens	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gobiidae	5	2	1	0	0	2	4	2	0	2	2	0	0	2	1	1	0	0	0	2	0	0	0	0
Gonostoma spp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gonostomatidae	1	14	25	3	7	2	0	4	16	18	2	4	12	2	1	0	2	7	2	2	4	2	1	1
Howella spp.	0	2	0	0	0	0	0	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0
Hygophum spp.	13	13	29	5	7	2	2	8	9	2	0	0	5	0	3	0	2	3	2	4	0	5	0	0
Ichthyococcus spp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lampadena spp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lampanyctus spp.	1	0	1	0	0	0	1	3	0	1	0	0	0	0	0	1	1	0	0	0	1	2	1	0
Maurolicus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Melamphaeidae	0	1	3	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melamphaes spp.	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melanostomias spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Melanostomiidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myctophidae	6	5	29	0	1	0	2	2	3	5	0	2	2	2	0	1	1	2	0	0	0	0	0	1
Myctophum spp.	12	30	28	7	11	12	2	10	14	10	0	0	2	2	0	0	2	4	3	3	0	2	1	1
Nettastomatidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Notolychnus spp.	0	4	3	0	0	1	0	1	4	0	0	2	1	0	0	0	0	1	0	0	0	0	0	0
Notolychnus valdiviae	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notoscopelus spp.	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophichthidae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Opisthognathidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A7a. Ictioplankton from multinet

Superstation Bio.											BIO 1	BIO 2	BIO 3	BIO 4	BIO 5	BIO 6	BIO 7	BIO 8	BIO 9	BIO 10	BIO 11	BIO 12	BIO 13	BIO 14
Multinet	**Pl.1**	**Pl.2**	**Pl. 3**	**Pl. 4**	**Pl.5**	**Pl.6**	**Pl.7**	**Pl.8**	**Pl. 9**	**Pl. 10**	**Pl. 11**	**Pl.12**	**Pl. 14**	**Pl. 15**	**Pl.16**	**Pl.17**	**Pl.18**	**Pl.19**	**Pl. 20**	**Pl.21**	**Pl.22**	**Pl.23**	**Pl. 24**	**Pl. 25**
Tot. Vol. m3	**5234**	**5524**	**4455**	**6265**	**5821**	**6158**	**5299**	**1684**	**8159**	**5979**	**3936**	**4494**	**9348**	**6877**	**2757**	**11579**	**3515**	**8855**	**770**	**4298**	**3954**	**4316**	**4539**	**5401**
Depth	280-1	300-0	300-0	250-0	351-0	300-0	454-0	453-0	453-0	452-0	452-0	401-2	450-0	400-0	453-0	436-0	453-0	450-0	450-0	453-0	400-0	455-3	452-0	453-0
Paralepididae	0	4	3	1	2	6	5	4	0	3	0	1	0	0	0	1	0	1	0	0	0	1	0	0
Percoidei	0	0	0	0	0	0	3	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Percoidei (Pomacentridae?)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phosichthyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Pleuronectiformes	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Polichthys spp.	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Psenes spp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Scopelarchidae	0	0	2	3	1	0	4	0	0	0	0	1	2	0	0	0	0	2	3	0	0	0	2	0
Scopeloberyx spp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scopelogadus spp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Scorpaenidae	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphyraena spp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Sternoptychidae	2	5	0	0	13	2	1	0	3	3	4	0	0	2	2	0	2	0	0	6	1	0	1	1
Sternoptyx spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Stomiatidae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stomiidae	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Stomiiformes	0	0	1	0	2	0	0	0	2	0	0	0	0	3	0	0	2	1	0	0	1	0	0	0
Sudis spp.	0	2	0	1	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Syacium spp.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synagrops spp.	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synodontidae	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichiuridae	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified larvae	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Valenciennellus spp.	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinciguerria spp.	1	28	33	14	17	17	9	17	6	3	0	9	9	4	4	5	0	5	0	1	4	4	17	16

Table A7b. Ictioplankton from multinet continued.

Superstation				Bio 1	Bio 7	Bio 9	Bio 11	Bio 12	Bio 14
Species/ station	**Pt. 1-2**	**Pt. 3**	**Pt. 4**	**Pt. 11**	**PT. 15**	**Pt.23**	**Pt.28**	**Pt. 32**	**pt. 40**
Acanthurus spp.			1						
Acropomatidae				1					
Ahlia egmontis		5		1					
Ahlia spp.					1				
Anguilliformes				1					
Astronesthes spp.									
Auxis spp.									
Benthosema spp.									
Bothidae				1					
Bothus spp.				9					
Caranx spp.			1						
Caranx spp.				1			1	1	
Congridae					1				7
Coryphaena spp.	1								
Cubiceps spp.								1	
Cyclothone spp.					2				
Diaphus spp.									
Disintegrated larvae				1					
Exocoetidae	10								
Gempylus serpens						19	1		
Gonostomatidae									
Hemiramphidae	4								
Lampanyctus spp.									
Letharchus velifer									1
Melanostomiidae									
Monolene spp.				1	1	2			
Muraenidae									
Myctophidae									
Myctophum spp.		3	1		2				
Myrophis spp.					1				
Notoscopelus spp.									
Oligoplites spp.						1			
Ophichthidae									
Ophichthus spp.			1	6					
Ostraciidae				1					
Psenes spp.							6		1
Scopelogadus spp.	1								
Scorpaenidae				1					
Selene spp.					1				
Tetragonuridae								2	
Thunnus spp.						1			
Vinciguerria spp.					1				

Table A8a Ichtoplankton from Newston net.

Superstation				**Bio 1**	**Bio 3**	**Bio 6**	**Bio 7**	**Bio 7**	**Bio 8**	**Bio 9**	**Bio 10**	**Bio 11**	**Bio 12**	**Bio 13**	**Bio 14**
Station	PT 2	PT 3	PT 4	PT 5-7	PT 8-10	PT 11	PT 12-14	PT 15	PT 16-18,19	PT 20-22,23	PT 24	PT 25-27,28	PT 29-31,32	PT 33-35,36	PT 37-39,40
Depth m	0	50	1	0-390	40-410	0	40-380	0	0-250	0-370	0	0-380	0-270	0-250	0-380
Acanthurus monroviae				0	0		2		0	1		0	0	0	0
Xenodermichthys copei				0	1		0		0	0		0	0	0	0
Leptocephalus		1		2	2	1	16		15	1	1	0	6	12	14
Leptocephalus pigmented				0	0	1	0		0	0		1	0	0	0
Ariomma sp, juv.				0	0		96		6	0		0	2	0	2125
ASTRONESTHIDAE				0	0		0		0	0		0	1	0	0
BATHYLAGIDAE				0	0		0		0	0		0	1	1	0
BALISTIDAE				0	0		0	1	0	0		0	0	0	0
BOTHIDAE				1	0	1	0	1	3	1		1	1	3	0
Brama brama				0	0		0		3	0		3	0	1	0
Bregmaceros sp,				0	0		0		0	0		0	2	1	0
Munida larvae	2			0	0		0	1	0	0		0	0	5	1
CARANGIDAE				0	4	1	0		0	0	1	0	0	0	0
Hemicaranx bicolor				0	0		0	10	0	0		1	1	0	0
Naucrates ductor				1	0		0		0	0		0	0	0	0
Selene dorsalis				3	2		3		9	7		0	0	0	0
Trachurus sp,				3	0		0		0	0		0	0	0	0
CENTROLOPHIDAE				0	0		0		0	0		1	0	1	4
Centrolophidae - juvenile				0	0		0		0	0		0	0	0	2
Ctenophora				0	0		0		0	0		0	0	26	0
Diretmus argenteus				0	1		4		0	7		0	0	0	0
FISH LARVAE				0	2	1	0		0	0		0	0	0	0
GEMPYLIDAE				0	0		1		0	0		0	0	2	0
Nealotus tripes				0	0		1		3	19		1	1	5	0
Diplophos taenia				0	0		0		9	1	2	0	0	3	0
Gonostoma sp,				0	0		0		0	0		0	2	0	0
Gonostoma elongatum				0	3		0		0	0		0	0	1	0
Gonostoma elongatum				2	0		5		2	2		0	0	0	0
Grammicolepis brachiusculus				0	0		0		0	0		0	0	1	0
Holocentrus sp,				0	0		1	2	0	1		0	0	1	0
Phyllosoma				0	0	1	0	2	0	0		0	0	0	0
Aristostomias lunifer				0	0		0		1	0		0	0	0	0
Malacosteus sp,				0	0		0		0	0		0	2	3	0
Microstoma sp,				0	2		0		0	0		0	0	0	0
MONACANTHIDAE				0	0		0		0	0		0	0	0	1

Tab A9 a Taxa composition on mesopelagics from Trawls.

Superstation				Bio 1	Bio 3	Bio 6	Bio 7	Bio 7	Bio 8	Bio 9	Bio 10	Bio 11	Bio 12	Bio 13	Bio 14
Station	PT 2	PT 3	PT 4	PT 5-7	PT 8-10	PT 11	PT 12-14	PT 15	PT 16-18,19	PT 20-22,23	PT 24	PT 25-27,28	PT 29-31,32	PT 33-35,36	PT 37-39,40
Depth m	0	50	1	0-390	40-410	0	40-380	0	0-250	0-370	0	0-380	0-270	0-250	0-380
Mugil cephalus	1			0	0		0		0	0	1	0	0	0	0
MYCTOPHIDAE		2	0	27	68		27		524	149		41	362	671	60
Diaphus sp,				1	0		0		0	0		1	0	0	2
Electrona risso				0	3		3		1	7		19	0	0	5
Gymnoscopelus sp,				0	2		0		2	0		0	3	0	0
Symbolophorus sp,		1		0	0		0		0	0		0	0	0	0
Avocettina sp,				0	0		0		1	0		0	0	0	0
Nemichthys sp,				0	0		0		0	0		0	0	0	1
Cubiceps gracilis				0	0		0		2	0		0	22	3	0
Psenes sp,				0	0		0		2	0		1	1	0	0
OPHICHTHIDAE				0	0		2		0	0		0	0	0	0
Opistoproctus sp,				2	0		1		0	0		0	0	2	1
PARALEPIDIDAE				0	1		0		0	0		0	2	0	0
Ichthyococcus ovatus				0	0		1		0	0		0	0	0	1
Vinciguerria sp,				4	4		2		0	2		3	603	581	9
Sagitta				0	0		0	3	0	0	0	0	0	0	0
SCOMBRIDAE				0	0		0		0	0		0	0	1	0
Tuna post larvae				0	0	1	0		0	0		0	1	0	31
Argyropelecus affinis				12	32		7		0	34		7	0	0	11
Argyropelecus gigas				0	0		9		4	1		6	0	15	12
Polyipnus polli				0	0		0		5	2		0	0	0	2
Sternoptyx sp,				5	5		1		0	0		0	0	0	1
Chauliodus sloani				7	5		0		0	5		1	0	1	1
Tetragonurus sp,				0	0		0		0	0		0	2	0	0
TETRAODONTIDAE				1	1		15		4	3		5	1	1	2
Lagocephalus lagocephalus				0	0		0		0	0		2	5	5	16
TRACHIPTERIDAE				0	0		0		0	0		0	0	1	0
Desdemonia sp,				0	0		1		0	0		0	0	0	0
Lepidopus caudatus				0	0		0		0	0		0	1	0	0
UNIDENTIFIED FISH				0	0		0		0	1		0	0	0	0
Unid, juvenile fishes				4	0		0		0	0		0	0	0	0
Unidentified black fish				0	0		0		2	0		2	3	1	0
Unidentified juv fish				0	0		0		0	2		0	0	0	0
Unid fish pink spiny				0	0		1		0	0		1	0	0	0
Unid fish dark back				0	0		1		0	0		0	0	0	0

Tab A9 b Taxa composition on mesopelagics from Trawls.

Superstation				Bio 1	Bio 3	Bio 6	Bio 7	Bio 7	Bio 8	Bio 9	Bio 10	Bio 11	Bio 12	Bio 13	Bio 14

Station	PT 2	PT 3	PT 4	PT 5-7	PT 8-10	PT 11	PT 12-14	PT 15	PT 16-18,19	PT 20-22,23	PT 24	PT 25-27,28	PT 29-31,32	PT 33-35,36	PT 37-39,40
Depth m	0	50	1	0-390	40-410	0	40-380	0	0-250	0-370	0	0-380	0-270	0-250	0-380
Unid fish pink small				0	0		3		1	2		1	0	0	0
Unid fish				0	0		0		0	2		0	0	0	0
Unide fish deep body striped				0	0		0		0	1		0	0	0	0
Unid fish spot near dorsal/ana				0	0		0		0	0		2	0	1	0
Unidentified fish oval				0	0		0		0	0		6	0	0	0
Unidentified black fish				0	0		0		0	0		0	0	3	0
Unidentified larvae				0	0		0		2	0		0	0	0	0
Unidentified larvae				0	0		0		17	0		0	0	0	0
Unidentified larvae	11		0	0	0		0		0	0	1	0	1	0	0
Unidentified mix		0	0	0	0		0		0	0		0	0	0	0
C R U S T A C E A N S				0	21		11		0	2		0	2	1	1
Cirripedia				1	0		0		0	0		0	0	0	0
Copepods	60			0	0		0		0	0		0	0	0	0
Euphausiacea				18	31	16	8	5	1691	28	0	20	80	5326	7
Squilla larvae				0	0	1	0		0	0		0	0	0	0
Squilla unidentified				0	0		0		0	1		0	0	0	0
Copepoda		0	0	0	0		0		0	0		0	0	0	0
C R A B S				4	1		0		0	0		0	0	0	1
Crab larvae				0	1		0		0	0		0	0	0	0
S H R I M P S				1	0		3		8	0	0	0	5	30	0
Shrimps, small, non comm,				0	0		0		0	0		0	5	1	1
Amphipods	20	0	0	0	4		1		2	0		3	1	0	1
Sergia sp,				0	0		0		20	0		0	0	0	0
MYSIDACEA		0		0	0		0		0	0		0	0	0	0
Unidentified crustacean				0	0		0		0	3		0	0	0	0
Mollusc eggs				0	0		0		0	0		0	0	0	0
Molluscs				0	0		0	0	0	0	1	0	0	0	0
C E P H A L O P O D A				0	0		27		0	0		0	0	0	0
Argonauta sp,				0	0		0		0	0		0	1	0	0
Cranchia scabra				0	5		1		43	2		1	1	2	0
Liocranchia reinhardti				12	0		2		1	0		1	27	118	0
Liguriella sp,				0	0		8		7	0		0	3	7	0
Megalocranchia sp,				0	0		2		2	2		1	0	0	0
Abraliopsis sp,				0	0		0		0	1		0	7	0	0
Abralia sp,				0	1		0		0	0		0	0	0	0

Tab A9 c Taxa composition on mesopelagics from Trawls.

Superstation				Bio 1	Bio 3	Bio 6	Bio 7	Bio 7	Bio 8	Bio 9	Bio 10	Bio 11	Bio 12	Bio 13	Bio 14
Station	PT 2	PT 3	PT 4	PT 5-7	PT 8-10	PT 11	PT 12-14	PT 15	PT 16-18,19	PT 20-22,23	PT 24	PT 25-27,28	PT 29-31,32	PT 33-35,36	PT 37-39,40
Depth m	0	50	1	0-390	40-410	0	40-380	0	0-250	0-370	0	0-380	0-270	0-250	0-380
Pyroteuthis sp,				0	0		0		8	0		0	14	6	0
Histioteuthis meleagroteuthis				0	0		0		0	0		0	0	1	0
OCTOPODIDAE				0	0		0		0	0		0	0	0	2
Ommastrephes bartrami				0	0		0		3	0		0	0	0	0
Ornithoteuthis antillarum				0	2		0		0	14		0	56	56	62
Onychoteuthis sp,				0	0		0		8	0		0	0	0	0
Onychoteuthis banksi				0	0		0		0	0		0	1	1	0
Octopoteuthis sp,				0	0		0		1	0		0	0	0	0
Stoloteuthis sp,				0	1		0		0	1		0	0	0	0
Vitreledonella richardi				0	0		0		0	0		0	0	1	0
SALPS				329	3912	55	0	0	0	0	0	121	1	0	1
Salps - large				0	8		0		39	0		59	54	100	0
Salps - small				0	20		0		20	0		0	47	0	0
Salp with crustacean				0	0		0		0	0		0	0	0	0
Salps and medusa				0	0		0		0	0		0	0	0	0
J E L L Y F I S H				23	2		0		3	0		16	0	0	6
Medusae black				0	0		0		0	0		0	0	2	0

Table A9 d Taxa composition on mesopelagics from Trawls.

Table A10 Sediment samples SAMPLING JOURNAL Sign. in: Page nr: 1 of 11

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Position		Depth (m) 1531 m
		Longitude	Latitude	
Ref 1	30/11-12	7,0689	2,8345	Positioning control:

Weather: cloudy	Wind: calm	Wave height (m):
Time Start: 09:48	Time Finish: 12:30	Duration: 2 hr 40 min
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Rocks and fine sand			
Color: 7,5 YR 2,5/1 black	Odor: none		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc:	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ				Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	1			1		1				1									1		
2	1			1		1				1							1		3		
3																					

Sample nr	Vol. (cm)	No bottles bio.	Remarks:	Grabnr.	Extra weights
4	15	2		2	
5	14	3	Top layer for chemical analysis	1	
6	15	1	Top layer for chemical analysis	3	
7			• Continued page 11		

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Longitude	Position	Latitude	Depth (m) 1981/1981 m (2dives)
		6,6189		2,8032	
Kina 1x	30/11-12	6,6195		2,8035	Positioning control:

Weather: Overcast	Wind: light breeze	Wave height (m): 0,5m
Time Start: 13:48	Time Finish: 19:00 (appr.)	Duration: 5 hr 12 min
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Clay			
Color: Gley 1 3/10Y very dark greenish grey (Light grey from video grab.)	Odor: none		
Observation of animals: Sea urchins, sea cucumbers, ophiouridea and fish	No. rejected samples:		
Observation of oil, waste etc: Drill cuttings	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ		foraminifer a		Toc Nor/ JDZ		Remarks :	DNA Bact. Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	11	1		1		1				1		foraminifera							1		N
2	11	1		1		1				1		and bacteria					1		3		N
3	4	1	1	1	1	1		1		1		Sectioned	1	1	1				1		N

Sample	Vol. (cm)	bottles bio.	Remarks: drill cuttings	Gnr.	Extra weights
4	14,5*	4		2	
5	11*	3	1 bag of drill cuttings for chemistry	1	
6	11*	3		3	
7	Full ?	5		2	
8	full	5		3	

Sign. outSAMPLING JOURNAL Sign. in: Page nr: 3 of 11

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.: Malanza 1X	Date:	Longitude	Position	Latitude	Depth (m) 1923 m
		6,6626		2,8266	
Mal 1X	**1/12-12**				**Positioning control:**

Weather: ovecast	Wind:	Wave height (m):
Time Start: 10:58	**Time Finish: 15:00 (appr.)**	**Duration: 4 hr 2 min**
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Ref pictures			
Color: ?	**Odor: some**		
Observation of animals: white crabs, octopus, crabs, polychaeta and sea cucumber.	**No. rejected samples:**		
Observation of oil, waste etc: Bacteria mat on bottom.	**Empty:**	**Stone:**	**Open:**

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ		foraminifera		Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	**full**	1		1		1				1		2 first							**3**		**N**
2	**4**	1		1		1				1		sectioned					1		**1**		**N**
3	**5**	1	1	1	1	1		1		1			1						**3**		**n**

Sample	Vol. (cm)	bottles bio.	Remarks: Wellhead visible on the eccosounder, ca. 30m distance.	Grabnr.	Extra weights
4	**Full**	**5**		**2**	
5	5	**2**		**3**	
6	4	**3**		**1**	
7	Full	**4**	**Mud with layer of bacteria and polychaeta on top of sediment.**	**2**	
8	5	**5**	**Bacteria feeding on mud ? Polychaeta feeding on bacteria ?**	**1**	

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SAMPLING JOURNAL **Sign. in:** **Page nr: 4 of 11**

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Longitude	Position	Latitude	Depth (m) 1662/1662 m
Enitimi		6,8928		2,9341	(2 dives)
Enit	**1-2/12-12**	**6,8940**		**2,9334**	**Positioning control:**

Weather: Partly overcast	Wind: Light air	Wave height (m):
Time Start: 18:00 and 09:11	**Time Finish: 21:30 and 11:00**	**Duration: 3,5 hr and 1 hr 49 min (appr.)**

Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)

Type of bottom sediment: Clay with softer mud layer on top.			
Color: 7,5 3/1 very dark grey	**Odor: none**		
Observation of animals:	**No. rejected samples:**		
Observation of oil, waste etc:	**Empty:**	**Stone:**	**Open:**

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ				Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	**7**	1		1		1				1									**1**		
2	**9,5**	1		1		1				1							1		**3**		
3	**3,5**	1	1	1	1	1				1			1	1	1				**1**		

Sample	Vol. (cm)	bottles bio.	Remarks: * from bottom to top of sediment.	Grabnr.	Extra weights
4	**6,5**	**3**		**2**	
5	9,5	**3**		**1**	
6	9,5	**2**		**3**	
7	full	**4**		**2**	
8	3,5	**4**		**1**	

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SAMPLING JOURNAL **Sign. in:** **Page nr: 5 of 11**

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Position		Depth 1696 m
		Longitude	Latitude	
Obo-2	2/12-12	6,8585	2,9338	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 11:00	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Clay with mud on top			
Color: Dark gray 7,5 YR 3/1	Odor: none		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc:	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ				Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	6,5	1		1		1				1									1		
2	6,5	1		1		1				1							1		3		
3																					

Sample nr	Vol. (cm)	No bottles bio.	Remarks:	Grabnr.	Extra weights
4	Full	3	Left after one dive, well 300 meter away at St. Obo-2W (p.6)	2	
5	6,5	3		1	
6	6,5	2		3	
7					
8					

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SAMPLING JOURNAL Sign. in: Page nr: 6 of 11

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Longitude	Position	Latitude	Depth: 1685 m
		6,8642		2,9349	
Obo-2W	2/12-12	6,8642		2,9349	Positioning control:

Weather: Overcast	Wind: light breeze	Wave height (m):
Time Start:	Time Finish:	Duration: 3 hr 59 min
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: clay with mud on top			
Color: 7,5 YR 3/1 Dark gray + dark mud from drilling	Odor: Yes some oil odor		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: some oily mud in the sample	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ		foraminifera		Toc Nor/ JDZ		Remarks :	DNA Bact Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	Full	1		1		1				1									1		N
2	Full	1		1		1				1							1		3		N
3	full	1	1	1	1	1		1	Sect	1			1	1	1				1		Y

Sample	Vol. (cm)	bottles bio.	Remarks:	Grabnr.	Extra weights
4	Full	2		2	
5	Full	3	Some residues of drilling fluids.	3	
6	Full	1		2	
7	Full ?	2		1	
8	Full ?	2		3	

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SAMPLING JOURNAL Sign. in: Page nr: 7 of 11

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Longitude	Position	Latitude	Depth (m) 1791 / 1790 m
		6,7742		2,9130	(2 dives)
Ref. Bl. 1	2-3/12-12	6,7733		2,9126	Positioning control:

Weather: Overcast	Wind: Light breeze	Wave height (m):
Time Start: 19:11	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Clay with muddy top layer			
Color: 10 YR 3/1 Very dark grey	Odor: none		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc:	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ				Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	4	1		1		1				1									3		N
2	9,5	1		1		1				1							1		1		N
3	6	1	1	1	1	1				1									1/ 1		N

Sample	Vol. (cm)	bottles bio.	Remarks:	Grabnr.	Extra weights
4	11	2		2	
5	4	2		3	
6	9,5	1		1	
7	Full	3		2	
8	6	1		1	

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SAMPLING JOURNAL Sign. in: Page nr: 8 of 11

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Position		Depth (m) 1979 m
		Longitude	Latitude	
Kina 1X3	3/12-12	6,6215	2,8041	Positioning control:

Weather: Overcast	Wind:	Wave height (m):
Time Start: 15:45	Time Finish: 18:00	Duration: 2 hr 15 min
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Viscous mud and some clay			
Color: 10 YR 3/2 Very dark grayish brown	Odor: none		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ		Foraminifera		Toc Nor/ JDZ		Remarks :	DNA Bact. Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	11	1		1		1				1									1		N
2	11	1		1		1		1		1			1	1	1		1		3		N
3																					

Sample	Vol. (cm)	bottles bio.	Remarks:	Grabnr.	Extra weights
4	10	3		2	
5	11	1		3	
6					
7					
8					

Sign. out:

SAMPLING JOURNAL Sign. in: Page nr: 9 of

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Longitude	Position	Latitude	Depth (m) 1909 / 1910 m (2 dives)
		6,5449		2,8444	
RB.4	3.12.12	6,5455		2,8443	Positioning control:

Weather: Overcast with some rain	Wind:	Wave height (m):
Time Start: 18:00	Time Finish: 23:00	Duration: 5 hr
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Mud			
Color: 5Y 3/1 Very dark grey	Odor: none		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ		Foraminifera		Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	4	1		1		1				1									1		N
2	9	1		1		1				1							1		3		N
3	9	1	1	1	1	1	1	1		1			1	1	1				1		N

Sample	Vol. (cm)	bottles bio.	Remarks:	Grabnr.	Extra weights
4	7	2		2	
5	4	3		1	
6	4	2		3	
7	4	2		2	
8	9	3	Sample 2 and 8 from the same grab.	3	

Sign. out:

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Longitude	Position	Latitude	Depth (m) 2065 / 2065 m (2 dives)
		6,7064		2,7019	
Oki- 1X	4.12.12	6,7063		2,7019	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 10:30	Time Finish: 16:00	Duration: 5,5 hr
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment:			
Color: 10 YR 3/2 Very dark grayish brown	Odor: none		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc:	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ				Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1	4,5	1		1		1				1									1		N
2	?	1		1		1				1							1		3		N
3		1	1	1	1	1				1									3		N

Sample	Vol. (cm)	bottles bio.	Remarks:	Grabnr.	Extra weights
4	3	5		2	
5	9	3		1	
6	12	3		3	
7	11	4		2	
8	9	4		1	

Sign. out:

SAMPLING JOURNAL **Sign. in:** **Page nr: 11 of 11**

Vessel: RV Dr. Fritjof Nansen	Area: JDZ	Project code:	Survey nr: 2012408

Grab station nr.:	Date:	Position		Depth (m)
		Longitude	Latitude	1529
Ref 1	4.12.12	7,0692	2,8342	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish: 21:20	Duration:
Sample equipment used (name, bite area, weight): 0,1m² Van Veen Grab Serigstad Sampler, 0,3 mm (square holes) 0,5 and 5 mm sieves (Round holes)		

Type of bottom sediment: Sandy with mud			
Color: 2,5 Y 3/2 very dark greenish brown	Odor: none		
Observation of animals: Oligochaeta	No. rejected samples:		
Observation of oil, waste etc:	Empty:	Stone:	Open:

Sample nr.	Volume (cm)	THC Nor / JDZ		Metals Nor / JDZ		PCB Nor/ JDZ		Foraminifera		Toc Nor/ JDZ		Remarks :	DNA Nor			granulometry geo.			G. nr	Ex. w	Br. Surf
													0-2	2-4	4-6	Sek.	Nor	JDZ			
1																					
2																					
3	8	1		1		1		1		1			1				1		3		N

Sample	Vol. (cm)	bottles bio.	Remarks:	Grabnr.	Extra weights
4					
5					
6					
7	6,5	8		2	
8	12	9		1	

Sign.out:

Table. A 11 Level of quantification and measurement uncertenties.

Group	Parameter	Method	LOQ (mg/kg)	Mu (%)
metals	Arsene(As)	EN ISO 11885	0,5	20 %
	Lead (Pb)	EN ISO 11885	0,3	20 %
	Copper (Cu)	EN ISO 11885	0,05	20 %
	Chrome(Cr)	EN ISO 11885	0,05	30 %
	Mercury(Hg)	NS 4768	0,001	20 %
	Nikkel (Ni)	EN ISO 11885	0,2	20 %
	Zink (Zn)	EN ISO 11885	0,05	20 %
	Barium (Ba)	EN ISO 11885	0,05	20 %
	Cadmium (Cd)	EN ISO 17294-2	0,01	40 %
PCB's	PCB single elements	ISO/DIS 16703-Mod	0,0005	40 %
	PCB 7 (sum)	ISO/DIS 16703-Mod	0,005 (0,0035*)	40 %
NPD's	NPD E single elements	Annon. 1982 -intern KG.58	0,0005	40 %
	NPD's Sum (10)	Annon. 1982 -intern KG.58	0,01 (0,005*)	40 %
PAH's	PAH single elements (15)	Annon. 1982 -intern KG.58	0,0005	40 %
	PAH 16 EPA (Sum)	Annon. 1982 -intern KG.58	0,01 (0,0075*)	40 %
THC's	THC (C12-C35)	Annon. 1982 -intern KG.58	1	40 %

Table. A 12 grain size distribution.

Station:	RB4	Kina 1X	Kina 1X3	Melanza 1X	Oki 1X	Ref bl.1	Obo-2	Obo-2w	Enitimi	Ref 1.1	Ref 1.2
Initial S Weight:	133.82	29.47	30.21	138.23	60.92	47.61	125.37	83.8	97.06	89.78	63.85
Aperture (microns)											
4000								0.02		0.06	0.19
2000			0.01							2.72	1.64
1000	0.12		0.57	0.1	0.04	0.16		0.09	0.32	2.66	0.8
500	2.04	0.17	1.55	1.07	0.3	5.13	0.02		0.45	7.06	2.18
250	2.04	0.77	2.37	2.93	1.41	3.69	0.65	0.41	2.58	19.99	2.15
125	2.07	0.64	1.8	7.44	1.58	4.4	0.9	2.66	1.85	14.14	7.25
63	2.2	0.22	0.94	10.9	1.76	1.69	1.2	9.67	2.71	6.65	7.38
	125.35	27.67	22.97	115.79	55.83	32.54	122.6	70.95	89.15	36.5	42.26

Table. A 13 metal analysis and tab. 5.5 THC.

Station	Sample	Barium Ba	Mercury Hg	Cadmium Cd	Copper Cu	Lead Pb	Crome Cr	Zink Zn)	Arsene As	Nickel Ni
Enitimi	1	300	0.089	0.17	15	11	22	39	3.9	45
1674 m	2	330	0.108	0.17	17	12	24	42	4.4	50
	3	290	0.093	0.16	15	11	22	39	4	46
Kina 1X	1	280	0.054	0.23	17	10	22	42	3.3	37
1999 m	2	290	0.079	0.26	19	12	23	46	3.7	43
	3	280	0.054	0.2	18	12	23	45	4.1	36
Kina 1X3	1	320	0.067	0.23	16	9.4	21	41	1.7	39
1992 m	2	340	0.070	0.22	16	9.4	20	40	2.7	35
Melanza 1X	1	1,600	0.079	0.17	18	10	21	42	2.9	43
1922 m	2	2,800	0.089	0.2	20	15	22	48	3.7	50
	3	300	0.053	0.25	**51**	**72**	12	56	4.8	13
Obo-2	1	300	0.072	0.16	15	11	22	39	3.1	42
1696 m	2	310	0.078	0.13	17	12	24	43	3.9	48
Obo-2w	3	1,100	0.062	0.084	10	16	16	26	3.7	12
1685 m										
Oki 1X	1	440	0.069	0.22	16	10	20	39	2.2	45
2062 m	2	1,400	0.074	0.24	16	11	19	40	2.5	47
	3	340	0.072	0.23	16	9.3	19	38	1.5	32
RB4	1	310	0.071	0.17	16	9.3	21	39	2.1	37
1909 m	2	350	0.070	0.14	17	9.7	22	40	2.6	46
	3	330	0.098	0.2	16	10	20	40	2.4	42
Ref 1	1	150	0.038	0.1	9.6	7.1	14	23	3.2	18
1545 m	2	160	0.037	0.088	8.4	6.8	16	23	3.1	21
	3	160	0.038	0.12	7.6	6.5	14	20	3.3	20
Ref bl.1	1	320	0.099	0.18	17	12	22	41	4.7	49
1800 m	2	320	0.092	0.17	17	11	22	42	4.6	50
	3	350	0.090	0.2	18	12	22	45	4.8	**58**

Table. A 14. NPD and THC

Station Depth	Sample	C1 Dibenzotiofen	C1-Fenantren /Antracen	C1 Naftalen	C2 Dibenzotiofen	C2-Fenantren /Antracen	C2 Naftalen	C3 Dibenzotiofen	C3-Fenantren /Antracen	C3 Naftalen	Dibenzotiofen	NPD Sum	THC C12-C35
Enitimi	1	<0,0005	<0,0005	0.0036	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0036	<1
1674 m	2	<0,0005	<0,0005	0.0055	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0055	<1
	3	<0,0005	<0,0005	0.0034	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0034	<1
Kina 1X	1	<0,0005	0.0006	0.021	<0,0005	0.0014	0.0034	<0,0005	0.00092	<0,0005	<0,0005	0.028	<1
1999 m	2	<0,0005	0.00053	0.018	<0,0005	0.0021	0.0028	<0,0005	0.00071	<0,0005	<0,0005	0.024	<1
	3	<0,0005	<0,0005	0.02	<0,0005	0.0013	0.0049	<0,0005	<0,0005	<0,0005	<0,0005	0.026	<1
Kina 1X3	1	<0,0005	<0,0005	0.0073	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0073	15
1992 m	2	<0,0005	<0,0005	0.0083	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0083	6.4
Melanza 1X	1	<0,0005	<0,0005	0.018	<0,0005	<0,0005	0.006	<0,0005	<0,0005	<0,0005	<0,0005	0.024	<1
1922 m	2	<0,0005	0.00084	0.017	<0,0005	0.0022	0.0042	<0,0005	0.0014	<0,0005	<0,0005	0.025	6
	3	0.0084	0.034	0.1	0.019	0.061	0.39	0.0083	0.03	<0,05	<0,05	0.66	3400
Obo-2	1	<0,0005	0.0014	0.0013	<0,0005	0.0019	<0,0005	<0,0005	0.0016	<0,0005	<0,0005	0.0062	<1
1696 m	2	<0,0005	0.0014	0.0021	<0,0005	0.0014	<0,0005	<0,0005	0.0011	<0,0005	<0,0005	0.0059	<1
Obo-2w	3	0.023	0.11	0.02	0.054	0.28	0.17	0.052	0.3	0.075	<0,005	1.1	400
1685 m													
Oki 1X	1	<0,0005	<0,0005	0.0024	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0024	8.5
2062 m	2	<0,0005	<0,0005	0.0019	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0019	10
	3	<0,0005	<0,0005	0.0031	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0031	12
RB4	1	<0,0005	<0,0005	0.0055	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0055	8.2
1909 m	2	<0,0005	<0,0005	0.004	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.004	7.9
	3	<0,0005	<0,0005	0.0052	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0052	7.2
Ref 1	1	<0,0005	<0,0005	0.0011	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.0011	28
1545 m	2	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	nd	<1
	3	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	nd	<1
Ref bl.1	1	<0,0005	<0,0005	0.013	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.013	<1
1800 m	2	<0,0005	<0,0005	0.014	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.014	<1
	3	<0,0005	<0,0005	0.013	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	<0,0005	0.013	<1

Table. 3.2.6 PAH.

Station Depth	Sample	Acenaften	Acenaftylen	Antracen	Benzo [a]antracen	Benzo [a]pyren	Benzo [b,j,k] fluoranten	Benzo[ghi] perylen	Dibenzo [a,h] antracen	Fenantren	Fluoranten	Fluoren	Indeno [1,2,3-cd]pyren	Krysen	Naftalen	Pyren	Sum PAH (16) EPA
Enitimi	1	<0,0005	0.0039	<0,0005	<0,0005	<0,0005	0.0019	<0,0005	<0,0005	0.003	0.0038	<0,0005	<0,0005	0.0016	0.013	0.0021	0.029
1674 m	2	<0,0005	0.0043	<0,0005	<0,0005	<0,0005	0.0021	<0,0005	<0,0005	0.0034	0.0042	<0,0005	<0,0005	0.0018	0.014	0.0022	0.032
	3	<0,0005	0.0035	<0,0005	<0,0005	<0,0005	0.0016	<0,0005	<0,0005	0.0029	0.0031	<0,0005	<0,0005	0.0013	0.013	0.0017	0.028
Kina 1X	1	<0,0005	0.0035	<0,0005	<0,0005	<0,0005	0.0015	<0,0005	<0,0005	0.0029	0.0033	<0,0005	<0,0005	0.0012	0.015	0.0027	0.031
1999 m	2	<0,0005	0.0026	<0,0005	<0,0005	<0,0005	0.0013	<0,0005	<0,0005	0.0023	0.0024	<0,0005	<0,0005	0.0012	0.013	0.0023	0.025
	3	<0,0005	0.0024	<0,0005	<0,0005	<0,0005	0.001	<0,0005	<0,0005	0.0021	0.0024	<0,0005	<0,0005	0.0008	0.014	0.0022	0.025
Kina 1X3	1	<0,0005	0.0025	<0,0005	<0,0005	<0,0005	0.0006	<0,0005	<0,0005	0.0016	0.0016	<0,0005	<0,0005	0.0005	0.0098	0.0019	0.019
1992 m	2	<0,0005	0.0027	<0,0005	<0,0005	<0,0005	0.00054	<0,0005	<0,0005	0.0021	0.0025	<0,0005	<0,0005	0.0008	0.01	0.0029	0.022
Melanza 1X	1	<0,0005	0.0028	<0,0005	<0,0005	<0,0005	0.0011	<0,0005	<0,0005	0.0023	0.0021	<0,0005	<0,0005	0.001	0.013	0.002	0.024
1922 m	2	<0,0005	0.0023	<0,0005	<0,0005	<0,0005	0.001	<0,0005	<0,0005	0.0021	0.0023	<0,0005	<0,0005	0.0011	0.011	0.0014	0.021
	3	<0,05	<0,05	<0,005	<0,005	0.0013	0.0045	0.0014	<0,0005	<0,005	<0,005	<0,05	0.0015	<0,005	<0,05	<0,005	0.0087
Obo-2	1	<0,0005	0.0025	<0,0005	<0,0005	<0,0005	0.0012	<0,0005	<0,0005	0.0038	0.003	<0,0005	<0,0005	0.001	0.0085	0.0029	0.023
1696 m	2	<0,0005	0.0033	<0,0005	<0,0005	<0,0005	0.0014	<0,0005	<0,0005	0.0032	0.0033	<0,0005	<0,0005	0.0013	0.01	0.0029	0.025
Obo-2w	3	<0,005	<0,005	0.0022	0.016	0.0048	0.0073	0.0035	0.0012	0.017	0.0046	<0,005	0.0019	0.026	<0,005	0.018	0.1
1685 m																	
Oki 1X	1	<0,0005	0.0031	<0,0005	<0,0005	<0,0005	0.0011	<0,0005	<0,0005	0.0023	0.0027	<0,0005	<0,0005	0.0011	0.0097	0.0014	0.021
2062 m	2	<0,0005	0.0044	<0,0005	<0,0005	<0,0005	0.0011	<0,0005	<0,0005	0.0019	0.0029	<0,0005	<0,0005	0.0009	0.013	0.0016	0.026
	3	<0,0005	0.0042	<0,0005	<0,0005	<0,0005	0.00097	<0,0005	<0,0005	0.0028	0.0031	<0,0005	<0,0005	0.001	0.013	0.0033	0.029
RB4	1	<0,0005	0.0029	<0,0005	<0,0005	<0,0005	0.0014	<0,0005	<0,0005	0.002	0.0025	<0,0005	<0,0005	0.0009	0.012	0.0026	0.025
1909 m	2	<0,0005	0.0038	<0,0005	<0,0005	<0,0005	0.0013	<0,0005	<0,0005	0.0026	0.0029	<0,0005	<0,0005	0.0011	0.013	0.0035	0.028
	3	<0,0005	0.0046	<0,0005	<0,0005	<0,0005	0.0016	<0,0005	<0,0005	0.0031	0.0035	<0,0005	<0,0005	0.0013	0.013	0.0027	0.03
Ref 1	1	<0,0005	0.0016	<0,0005	<0,0005	<0,0005	0.0012	<0,0005	<0,0005	0.0014	0.0021	<0,0005	<0,0005	0.0008	0.0054	0.0008	0.013
1545 m	2	<0,0005	0.001	<0,0005	<0,0005	<0,0005	0.00068	<0,0005	<0,0005	0.00091	0.0015	<0,0005	<0,0005	0.0006	0.0033	<0,0005	0.008
	3	<0,0005	0.0011	<0,0005	<0,0005	<0,0005	0.00055	<0,0005	<0,0005	0.0011	0.0016	0.00072	<0,0005	0.0006	0.00057	0.00063	0.0068
Ref bl.1	1	<0,0005	0.0045	0.00055	<0,0005	<0,0005	0.0024	<0,0005	<0,0005	0.0035	0.0046	<0,0005	<0,0005	0.0019	0.021	0.0021	0.041
1800 m	2	0.00051	0.0071	0.00065	<0,0005	<0,0005	0.0028	<0,0005	<0,0005	0.0046	0.0059	0.00065	<0,0005	0.0026	0.024	0.0033	0.052
	3	<0,0005	0.007	0.00077	<0,0005	<0,0005	0.0015	<0,0005	<0,0005	0.0034	0.0039	0.0006	<0,0005	0.0016	0.023	0.0021	0.044

	Mal					RB-4					ENI				
	4	5	6	7	8	4	5	6	7	8	4	5	6	7	8
Crustacea Ostracoda															
Podocopa gen. sp. 1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0
Podocopa gen. sp. 2	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0
Podocopa gen. sp. 3	0	0	0	0	0	0	1	2	1	1	0	0	0	0	0
Podocopa gen. sp. 4	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0
Podocopa gen. sp. 5	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 6	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Podocopa gen. sp. 7	4	4	0	0	0	2	1	1	1	1	1	0	0	2	0
Podocopa gen. sp. 8	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0
Podocopa gen. sp. 9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Podocopa gen. sp. 11	0	1	2	0	0	0	0	0	1	1	0	0	0	0	0
Podocopa gen. sp. 12	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 13	0	0	1	0	0	0	2	0	0	0	0	2	0	0	1
Podocopa gen. sp. 14	1	0	3	0	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 18	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 20	0	1	0	0	0	1	0	0	6	0	1	0	0	0	0
Podocopa gen. sp. 21	0	0	0	0	0	1	2	0	0	0	0	0	1	0	0
Podocopa gen. sp. 22	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Podocopa gen. sp. 23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 24	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Podocopa gen. sp. 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 32	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 34	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Podocopa gen. sp. 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myodocopa gen. sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumacea															
Lampropidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Epileucon sp. 1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Cumella? sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bodotriinae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Campylaspis? sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Epileucon? sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumacea sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nannastacidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epileucon? sp. 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Mal					RB-4					ENI				
	4	5	6	7	8	4	5	6	7	8	4	5	6	7	8
Tanaidacea															
Agatotanais ingolfi?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Akanthophoreus sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Akanthophoreus sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cristatotanais sp.1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Leviapseudes sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megathotanais cf loerzae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meromonakantha sp.1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Neotanais	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Parafilitanais?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paragathotanais sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranarthrura sp.1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Paranarthrura sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranarthrura sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranarthrura sp.4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Pseudotanais sp.1	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0
Pseudotanais sp.2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Pseudotanais sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphyrapus sp.2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Sphyrapus"melleous"	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Tanaella? sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaella? sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaella sp.3	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Tanaidacea gen. sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Tanaidacea gen. sp. 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Tanaidacea gen. sp. 7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Tanaidacea gen. sp. 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Tanaidacea (damaged spec.)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Amphipoda															
Caprellidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Corophiidea indet.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erichthonius group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harpiniinae sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lysianassidae sp.1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Lysianassidae sp.2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pardaliscidae sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pardaliscidae sp.2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Phoxocephalinae sp.1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Ampipoda (damaged spec.)	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0
Isopoda															
Anthuridea	0	0	1	0	0	3	0	0	0	0	0	0	0	0	0
Asellota	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0

	Mal					RB-4					ENI				
	4	5	6	7	8	4	5	6	7	8	4	5	6	7	8
Bathygnathia sp.1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathygnathia sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Desmosomatidae	0	0	0	0	0	6	3	0	2	1	0	4	1	0	0
Hyssuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca Gastropoda															
Cocculina sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudomalaxis sp.,juv.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Bivalvia															
Abra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathyarca sp.	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Brevinucula sp.	0	0	1	0	0	0	5	5	0	0	0	0	0	0	0
Costanuculana sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuspidaria sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dacrydium sp.	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0
Delectopecten sp.juv.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelliella sp.	0	0	3	0	0	1	1	0	1	0	3	3	1	0	1
Limopsis sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Lyonsiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nuculana sp.	0	0	0	2	0	0	5	2	0	2	0	0	1	0	0
Nucula sp.	0	0	0	0	0	0	0	0	0	1	4	0	7	0	0
Nuculoidea gen. sp.	0	1	0	0	0	1	0	2	1	0	0	5	0	6	3
Yoldiella sp.	0	0	3	0	0	4	3	0	3	0	0	0	0	0	0
Yoldiidae juv.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scaphopoda	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Caudofoveata	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Annelida polychaeta															
Ampharetidae gen. sp.	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0
Capitellidae (mostly Capitella)	0	0	0	**336**	41	0	0	0	0	0	0	1	0	0	0
cf Notomastus	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Cirratulidae	0	0	0	**99**	2	0	2	0	0	0	0	6	1	1	0
Cossuridae gen. sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Dorvilleidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euphrosinidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exogoninae	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Exogoninae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Flabelligeridae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycera sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Goniadidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesionidae gen. sp.	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Magelona sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nereidae gen. sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Nereidae gen. sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Onuphidae gen. sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Opheliidae	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Ow eniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraonidae	0	0	0	0	0	2	0	1	0	1	1	0	1	1	1
Sabellidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaerodoridae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spionidae	0	7	2	**50**	0	3	2	0	2	0	1	0	1	0	2
Spionidae gen sp.1	0	0	0	**32**	0	0	0	0	0	0	0	0	0	0	0
Terebellidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

	Mal					RB-4					ENI				
	4	5	6	7	8	4	5	6	7	8	4	5	6	7	8
Polychaeta gen. sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Aciculata gen. sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aciculata gen. sp.2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Aciculata gen. sp.3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Nematoda	0	0	0	0	0	7	2	1	4	4	3	2	2	10	0
Nemertea	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Sipuncula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asteroidea															
Goniasteridae gen. sp. (Juv.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoidea															
Echinoidea gen. sp. (Juv.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ophiuroidea															
Amphiura atlantica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophiuroidea gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunicata															
Ascidiacea gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Ref-bl-1					Ref-1					OBO-2				
	4	5	6	7	8	4	5	4	5	6	4	5	6	7	8
Crustacea Ostracoda															
Podocopa gen. sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Podocopa gen. sp. 7	1	1	2	2	0	0	0	0	0	0	2	0	0	0	0
Podocopa gen. sp. 8	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0
Podocopa gen. sp. 9	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 10	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 11	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Podocopa gen. sp. 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Podocopa gen. sp. 14	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 16	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Podocopa gen. sp. 17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Podocopa gen. sp. 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 19	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 20	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0
Podocopa gen. sp. 21	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 22	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 31	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 32	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 33	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 37	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 38	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Podocopa gen. sp. 39	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Myodocopa gen. sp. 1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Cumacea															
Lampropidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epileucon sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumella? sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Bodotriinae gen. sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Campylaspis? sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epileucon? sp. 2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Cumacea sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nannastacidae gen. sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Epileucon? sp. 3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Ref-bl-1					Ref-1					OBO-2				
	4	5	6	7	8	4	5	4	5	6	4	5	6	7	8
Tanaidacea															
Agatotanais ingolfi?	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Akanthophoreus sp.1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Akanthophoreus sp.2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Collettea sp.1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Collettea sp.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.4	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0
Cristatotanais sp.1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Leviapseudes sp.1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Megathotanais cf loerzae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meromonakantha sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neotanais	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0
Parafilitanais?	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Paragathotanais sp.1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Paranarthrura sp.1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Paranarthrura sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranarthrura sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranarthrura sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudotanais sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudotanais sp.2	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0
Pseudotanais sp.3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Sphyrapus sp.2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
Sphyrapus"melleous"	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0
Tanaella? sp.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaella? sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaella sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 3	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Tanaidacea gen. sp. 4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Tanaidacea gen. sp. 5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 8	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea (damaged spec.)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Amphipoda															
Caprellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidea indet.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Erichthonius group	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Harpiniinae sp.1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Lysianassidae sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lysianassidae sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pardaliscidae sp.1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Pardaliscidae sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoxocephalinae sp.1	1	0	0	1	2	0	0	1	0	0	0	0	0	0	0
Ampipoda (damaged spec.)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda															
Anthuridea	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Asellota	0	0	1	0	0	0	0	2	0	0	5	1	0	0	0

	Ref-bl-1					Ref-1					OBO-2				
	4	5	6	7	8	4	5	4	5	6	4	5	6	7	8
Bathygnathia sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathygnathia sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Desmosomatidae	3	0	2	4	0	2	0	2	0	0	8	0	2	0	0
Hyssuridae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mollusca Gastropoda															
Cocculina sp.	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
Pseudomalaxis sp.,juv.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia															
Abra sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Bathyarca sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brevinucula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costanuculana sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuspidaria sp.	0	0	1	0	0	0	0	0	0	0	1	2	0	0	0
Dacrydium sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Delectopecten sp.juv.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelliella sp.	0	0	0	0	0	1	0	0	0	0	8	1	0	0	0
Limopsis sp.	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Lyonsiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nuculana sp.	0	0	0	0	0	1	0	0	0	0	2	2	0	0	0
Nucula sp.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Nuculoidea gen. sp.	6	1	13	1	0	1	0	0	0	1	5	10	0	0	0
Yoldiella sp.	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0
Yoldiidae juv.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Scaphopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caudofoveata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida polychaeta															
Ampharetidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitellidae (mostly Capitella)	0	0	0	0	0	0	0	0	0	0	0	0	0	13	18
cf Notomastus	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Cirratulidae	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5
Cossuridae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Dorvilleidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
Euphrosinidae gen. sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Exogoninae	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Exogoninae gen. sp.	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0
Flabelligeridae gen. sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Glycera sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Goniadidae gen. sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesionidae gen. sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	12
Magelona sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Nereidae gen. sp.1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Nereidae gen. sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Onuphidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opheliidae	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0
Oweniidae	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Paraonidae	0	1	4	1	0	0	0	0	0	0	1	0	3	0	0
Sabellidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaerodoridae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spionidae	4	0	2	0	0	4	2	1	0	0	0	0	0	27	31

Spionidae gen sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
Terebellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Ref-bl-1					Ref-1					OBO-2				
	4	5	6	7	8	4	5	4	5	6	4	5	6	7	8
Polychaeta gen. sp.1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Polychaeta gen. sp.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aciculata gen. sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Aciculata gen. sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aciculata gen. sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	2	3	4	0	0	1	1	0	0	0	1	0	2	0	0
Nemertea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0
Asteroidea															
Goniasteridae gen. sp. (Juv.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoidea															
Echinoidea gen. sp. (Juv.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophiuroidea															
Amphiura atlantica	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Ophiuroidea gen. sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Tunicata															
Ascidiacea gen. sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

	OBO-2W	OKI-IX	KIN-IX-3	KIN-IX

	4	5	6	7	8	4	5	6	7	8	4	5	4	5	6	7	8
Crustacea Ostracoda																	
Podocopa gen. sp. 1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Podocopa gen. sp. 2	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	3	2
Podocopa gen. sp. 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Podocopa gen. sp. 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 5	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 6	0	0	0	0	0	0	0	0	0	0	4	0	0	3	0	0	1
Podocopa gen. sp. 7	1	0	0	0	0	1	6	1	0	0	2	0	0	6	2	4	0
Podocopa gen. sp. 8	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	1
Podocopa gen. sp. 9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 10	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Podocopa gen. sp. 11	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 12	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
Podocopa gen. sp. 13	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 14	0	0	0	0	0	0	0	0	2	0	1	0	0	0	1	1	0
Podocopa gen. sp. 15	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Podocopa gen. sp. 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 18	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0
Podocopa gen. sp. 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 21	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
Podocopa gen. sp. 22	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
Podocopa gen. sp. 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 24	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 25	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 26	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Podocopa gen. sp. 27	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Podocopa gen. sp. 28	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 29	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 34	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 35	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 36	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Podocopa gen. sp. 37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocopa gen. sp. 39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myodocopa gen. sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumacea																	
Lampropidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epileucon sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumella? sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bodotriinae gen. sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Campylaspis? sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epileucon? sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumacea sp. 1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Nannastacidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epileucon? sp. 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	OBO-2W					OKI-IX					KIN-IX-3		KIN-IX				

	4	5	6	7	8	4	5	6	7	8	4	5	4	5	6	7	8
Akanthophoreus sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Akanthophoreus sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Collettea sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collettea sp.3	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Collettea sp.4	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Cristatotanais sp.1	0	0	0	0	0	2	0	2	1	0	0	0	0	0	0	0	0
Leviapseudes sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megathotanais cf loerzae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Meromonakantha sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neotanais	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parafilitanais?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paragathotanais sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranarthrura sp.1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
Paranarthrura sp.2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Paranarthrura sp.3	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Paranarthrura sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudotanais sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudotanais sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudotanais sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphyrapus sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphyrapus "melleus"	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Tanaella? sp.1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tanaella? sp.2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Tanaella sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 5	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Tanaidacea gen. sp. 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea gen. sp. 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanaidacea (damaged spec.)	0	0	0	0	1	2	0	0	0	1	1	0	1	0	0	0	0
Amphipoda																	
Caprellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidea indet.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Erichthonius group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harpiniinae sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lysianassidae sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lysianassidae sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pardaliscidae sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pardaliscidae sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoxocephalinae sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampipoda (damaged spec.)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda																	
Anthuridea	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Asellota	0	0	0	0	0	0	1	4	0	0	0	0	1	0	0	0	0

	OBO-2W					OKI-IX					KIN-IX-3		KIN-IX				
	4	5	6	7		4	5	6	7		4	5	6	7		4	5
Bathygnathia sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathygnathia sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Desmosomatidae	0	0	0	0	0	7	3	3	6	0	1	0	3	0	0	0	0
Hyssuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca Gastropoda																	
Cocculina sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudomalaxis sp.,juv.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia																	
Abra sp.	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1
Bathyarca sp.	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
Brevinucula sp.	0	0	0	0	0	1	0	1	0	1	1	0	1	0	0	0	2
Costanuculana sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Cuspidaria sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dacrydium sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Delectopecten sp.juv.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelliella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Limopsis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Lyonsiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Nuculana sp.	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	3
Nucula sp.	1	0	0	0	4	0	0	0	2	0	0	0	0	1	0	0	0
Nuculoidea gen. sp.	0	0	5	1	0	1	0	1	0	1	1	0	0	0	0	0	0
Yoldiella sp.	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Yoldiidae juv.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scaphopoda	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Caudofoveata	0	0	0	0	0	1	1	0	2	0	0	0	1	0	0	0	0
Annelida polychaeta																	
Ampharetidae gen. sp.	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0
Capitellidae (mostly Capitella)	2	0	2	3	18	1	0	0	0	0	1	0	0	1	0	0	0
cf Notomastus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Cirratulidae	0	0	0	0	0	3	0	0	0	0	2	0	2	1	0	0	0
Cossuridae gen. sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Dorvilleidae	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0
Euphrosinidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exogoninae	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Exogoninae gen. sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Flabelligeridae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goniadidae gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesionidae gen. sp.	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	2	0
Magelona sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nereidae gen. sp.1	0	0	0	0	0	0	1	0	2	1	1	0	0	2	0	0	0
Nereidae gen. sp.2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Onuphidae gen. sp.	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0
Opheliidae	0	0	0	0	0	1	0	0	1	0	3	0	3	1	0	2	0
Oweniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraonidae	0	0	0	0	0	0	0	0	2	1	0	0	0	0	2	1	2
Sabellidae gen. sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sphaerodoridae gen. sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Spionidae	42	18	8	27	44	5	1	2	3	4	4	0	3	5	2	2	6
Spionidae gen sp.1	11	0	2	10	14	0	0	0	0	0	0	0	0	0	0	0	0
Terebellidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

	OBO-2W					OKI-IX					KIN-IX-3		KIN-IX				
	4	5	6	7	8	4	5	6	7	8	4	5	4	5	6	7	8
Polychaeta gen. sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta gen. sp.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aciculata gen. sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aciculata gen. sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aciculata gen. sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	0	0	0	0	1	10	3	2	6	3	5	0	3	2	0	2	0
Nemertea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Asteroidea																	
Goniasteridae gen. sp. (Juv.)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Echinoidea																	
Echinoidea gen. sp. (Juv.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophiuroidea																	
Amphiura atlantica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophiuroidea gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunicata																	
Ascidiacea gen. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex VII Instruments and fishing gear

The Simrad EK-500, 38 kHz scientific echosounder was used for abundance estimation during the survey, in addition data from the 18 kHz, 120 kHz and 200 kHz transducers where logged for possible future multi frequency target estimation. The Bergen Echo Integrator system (BEI) were logging the echogram raw data from the sounder and used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data were stored to tape, and a backup of the database of scrutinized data, stored. The details of the settings of the echosounders were as follows:

Transceiver 1 menu

Transducer depth	5.5	m
Absorption coeff.	10	dB/km

Pulse length mediu

m (1ms) Bandwidth	wide
Max power	2000 Watt
2-way beam angle	-21.0 dB
SV transducer gain	27.17dB
TS transducer gain	29.96
Angle sensitivity	21.9
3 dB beamwidth along.	7.3
3 dB beamwidth athw.	7.0
Alongship offset	0.05
Athwardship offset	0.04

Transceiver 2 menu

Transducer depth	5.5 m
Absorption coeff.	38 dB/km
Pulse length	long (1ms)
Bandwidth	narrow
Max power	1000 Watt
2-way beam angle	-20.6 dB
SV transducer gain	25.96B
TS transducer gain	25.95dB
Angle sensitivity	21.0
3 dB beamwidth along.	7.4
3 dB beamwidth athw.	7.2
Alongship offset	0.24
Athwardship offset	0.04

Transceiver 3 menu

Transducer depth	5.5 m
Absorption coeff.	3 dB/km
Pulse length	short (0.7ms)
Bandwidth	wide
Max power	2000 Watt
2-way beam angle	-17.2 dB
SV transducer gain	23.75dB
TS transducer gain	23.36B
Angle sensitivity	13.9
3 dB beamwidth along.	10.8
3 dB beamwidth athw.	10.8
Alongship offset	0.06
Athwardship offset	-004

Transceiver 4 menu

Transducer depth	5.5 m
Absorption coeff.	53 dB/km
Pulse length	long (0.6ms)
Bandwidth	narrow
Max power	1000 Watt
2-way beam angle	-20.5 dB
SV transducer gain	24.18dB
TS transducer gain	24.80B
Angle sensitivity	0.0
3 dB beamwidth along.	0.0°
3 dB beamwidth athw.	0.0°
Alongship offset -	0.00°
Athwardship offset	0.00°

Display menu

Echogram	1
Bottom range	10 m
Bottom range start	10 m
TVG	20 log R
Sv colour min -	65 dB
TS Colour minimum	-65 dB

Printer- menu

Range	0-50, 0-100, 0-150, 0-250 or 0-500 m
TVG	20 log R
Sv colour min	-67 dB

Bottom detection menu

Minimum level	-40 dB

Calibration

A calibration of the acoustic instruments was conducted during the a survey on 14 September 2009.