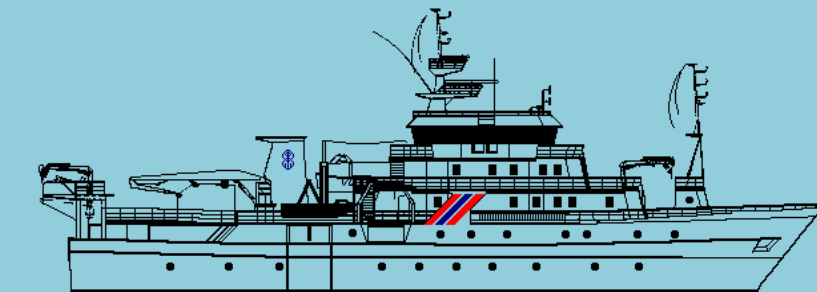


## Cruise Report "Dr. Fritjof Nansen"



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

**May 2011**

By

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*Bergen November 2011*



## **THE EAF-NANSEN PROJECT**

FAO started the implementation of the project "Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries (EAF-Nansen GCP/INT/003/NOR)" in December 2006 with funding from the Norwegian Agency for Development Cooperation (Norad). The EAF-Nansen project is a follow-up to earlier projects/programmes in a partnership involving FAO, Norad and the Institute of Marine Research (IMR), Bergen, Norway on assessment and management of marine fishery resources in developing countries. The project works in partnership with governments and also GEF-supported Large Marine Ecosystem (LME) projects and other projects that have the potential to contribute to some components of the EAF-Nansen project.

The EAF-Nansen project offers an opportunity to coastal countries in sub-Saharan Africa, working in partnership with the project, to receive technical support from FAO for the development of national and regional frameworks for the implementation of Ecosystem Approach to Fisheries management and to acquire additional knowledge on their marine ecosystems for their use in planning and monitoring. The project contributes to building the capacity of national fisheries management administrations in ecological risk assessment methods to identify critical management issues and in the preparation, operationalization and tracking the progress of implementation of fisheries management plans consistent with the ecosystem approach to fisheries.

## **LE PROJET EAF-NANSEN**

La FAO a initié la mise en oeuvre du projet "Renforcement de la base des connaissances pour mettre en oeuvre une approche écosystémique des pêcheries marines dans les pays en développement (EAF-Nansen GCP/INT/003/NOR)" en décembre 2006. Le projet est financé par de l'Agence norvégienne de coopération pour le développement (Norad). Le projet EAF-Nansen fait suite aux précédents projets/ programmes dans le cadre du partenariat entre la FAO, Norad et l'Institut de recherche marine (IMR) de Bergen en Norvège, sur l'évaluation et l'aménagement des ressources halieutiques dans les pays en développement. Le projet est mis en oeuvre en partenariat avec les gouvernements et en collaboration avec les projets grands écosystèmes marins (GEM) soutenus par le Fonds pour l'Environnement Mondial (FEM) et d'autres projets régionaux qui ont le potentiel de contribuer à certains éléments du projet EAF-Nansen.

Le projet EAF-Nansen offre l'opportunité aux pays côtiers de l'Afrique subsaharienne partenaires de recevoir un appui technique de la FAO pour le développement de cadres nationaux et régionaux visant une approche écosystémique de l'aménagement des pêches et la possibilité d'acquérir des connaissances complémentaires sur leurs écosystèmes marins. Ces éléments seront utilisés pour la planification et le suivi des pêcheries et de leurs écosystèmes. Le projet contribue à renforcer les capacités des administrations nationales responsables de l'aménagement des pêches en introduisant des méthodes d'évaluation des risques écologiques pour identifier les questions d'aménagement d'importance majeure ainsi que la préparation, la mise en oeuvre et le suivi des progrès de la mise en oeuvre de plans d'aménagement des ressources marines conformes à l'approche écosystémique des pêches.

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## Summary

The objective of the cruise was to establish an environmental baseline prior to oil exploration, reveal valuable and vulnerable areas for protection and to obtain information about the living marine resources in this area. The area covered by the Joint Development Zone is one of the least studied regions of the global ocean. The most recent direct oceanographic observations are from the 1980s (e.g. Verstraete 1992). There are virtually no scientifically validated data on plankton and fish in this region. The RV Dr. Fridtjof Nansen was perhaps the first research vessel to visit this region during the last 25-30 years. While the bulk of data is still subject analysis, new patterns became to emerge. The westward flowing Equatorial Current was clearly observed in the JDZ area while the core of the eastward Equatorial Current was identified just north of Sao Tome. Acoustic observations made within the JDZ revealed at least three major group of mesopelagic assemblages, characterized by distinct diel vertical migration patterns. The analysis of samples and trawl data related to those observations, as well as of the benthic data, is currently an ongoing effort. When completed, the results from the 2011 survey with the RV Dr. F. Nansen will provide the first ever snapshot containing baseline data on physics and ecosystem of this area. One important aspect found in the data analysed thus far is a realisation of risks involved in establishing an oil exploration zone in a close vicinity of the core of the persistently eastward flowing Equatorial Undercurrent.

### ***Participants on the cruise***

From JDA Sao Thome & Nigeria:

Louiz Gamboa  
Akanbi Williams  
Virginia Godinho  
Samuel Iwu  
Jose Lopes  
Ibrahim Buba  
Eugenio Nascimento  
Chindo Uche-Okeke  
Ndubuisi Ajuonu

From IMR

Bjørn Serigstad (Cruise leader) (IMR)  
Magne Olsen  
Tore Mørk  
Jarle Kristiansen  
Marek Ostrowski

Tor Magne Ensrud  
Frøydis Lygre

(Uni Research AS):  
(University of Bergen)

We would like to thank the officers and the crew On Board Dr. Fridtjof Nansen.

### **Worked area**

The scientists from Nigeria and Saõ Tome arrived 8<sup>th</sup> of May and the ship sailed from Tema Harbour to the Joint Development Zone on the 10<sup>th</sup> of May by sailing from Tema Harbour in Ghana.

The Ship reached the sampling area in the JDZ on the 12<sup>th</sup>, Starting the environmental part of the cruise with benthic sampling and CTD stations. er we were able to obtain all the the planned samples

On the 16<sup>th</sup> of May we sailed to Sao Thome for an official visit.

On the 17<sup>th</sup> a delegation consisting of 4 ministers accompanied by top officials from Saõ Tome , JDA and the local press visited the RV DR. Fridtjof Nansen. After the visit scientists and some of crew vent ashore to se the island.

In the evening about 20:00 hr the ship went back to sea for the fisheries and plankton part of the cruise The last two benthic stations were also sampled. The sampling program was finished on the 25<sup>th</sup> after witch we started cruising back to Tema Harbour. The ship ported in Tema harbour on the 27<sup>th</sup> and the equipment and the samples was set ashore.



Cruise participants and the official delegation visiting the vessel on May 17<sup>th</sup>

### **Introduction**

The Nigeria – São Tomé Joint Development Zone (JDZ) is an interesting area regarding both living and non living resources. The concept of a Joint Development in the overlapping zone between the two countries seems to be an interesting and good agreement for exploring and exploiting a disputed area, to the benefit of both parties..

The area covered by the Joint Development Zone is one of the least studied regions of the global ocean. The most recent direct oceanographic observations are from the 1980s (e.g. Verstraete 1992). There are virtually no scientifically validated data on plankton and fish in this region. The JDZ is located at the eastern limb of the equatorial current system. The eastward flowing Equatorial Undercurrent on passing Sao Tome splits in to two branches. The northern branch reverts off the Cameroonian coast to feed the westward flowing Equatorial Current. The boundaries between these two major and opposing current systems are likely to be located within the JDZ study area, but there are not data to verify this claim. The RV Dr. Fridtjof Nansen was perhaps the first research vessel to visit this region during the last 25-30 years. While the bulk of data is still subject analysis, new patterns became to emerge. The westward flowing Equatorial Current was clearly observed in the JDZ area while the core of the eastward Equatorial Current was identified just north of Sao Tome. Acoustic observations made within the JDZ revealed at least three major group of mesopelagic assemblages, characterized by distinct diel vertical migration patterns. The core of the Equatorial Undercurrent was associated with enhanced backscatter levels, what indicates for its possible importance in transporting biota from the Central Atlantic towards the African Coast. The analysis of samples and trawl data related to those observations, as well as of the benthic data, is currently an ongoing effort. When completed, the results from the 2011 survey with the RV Dr. F. Nansen will provide the first ever snapshot containing baseline data on physics and ecosystem of this area. However, this region is subjected to strong variability, forced both by local changes (e.g. ITCZ) and remote teleconnections from the Western Atlantic. The planned surveys will help in understanding the causes and effects of this forcing on the seasonal and interannual variability, both for the physical environment and the marine and benthic ecosystem within the JDZ.

This cruise was the first approach to establishment of an environmental monitoring plan for the Nigeria – São Tomé and Príncipe Joint Development zone with special focus on possible pollution from the expanding offshore petroleum industry.

Competence building is an important part of this activity and all the cruise participants was practically engaged in the sample collection and analysis onboard. All the planned samples were collected and the planned survey area was covered. (Annex I and II) Unfortunately we had some problems with the ROV when it was deployed to 1700 meters and we did not get the photo documentation of the sampling sits.

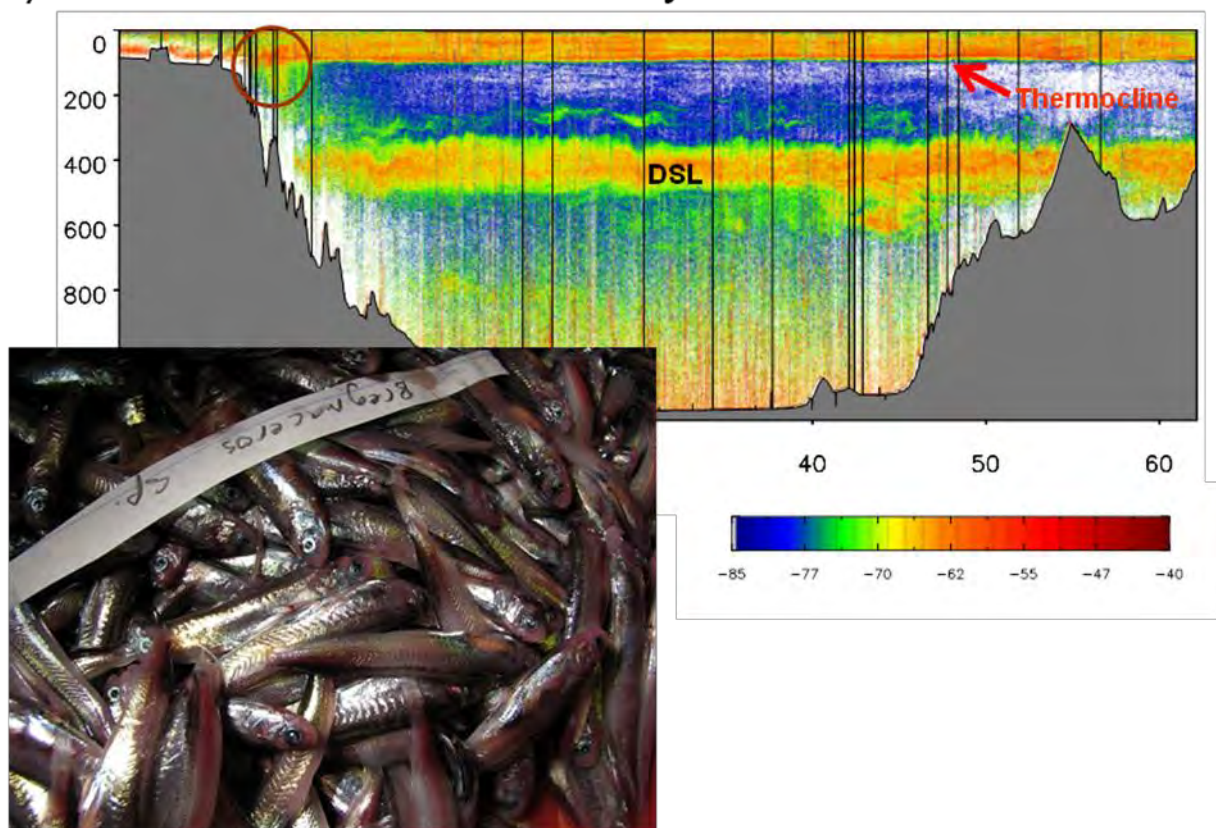
## **Materials and methods.**

### ***Acoustic sampling***

A SIMRAD EK-60 Echosounder was used with the settings as shown in Annex II. The Large Scale Survey System (LSSS) was used for analysis and allocation of the integrated  $s_A$ -values to the individual specified target groups by 5 NM intervals. The allocation of values to target groups was based on a combination of a visual scrutiny of the pattern as deduced from echo diagrams, the LSSS analysis, and the catch compositions. LSSS analysis will be finished in mid December and included in the final report

# Remote sensing of the ocean using acoustics

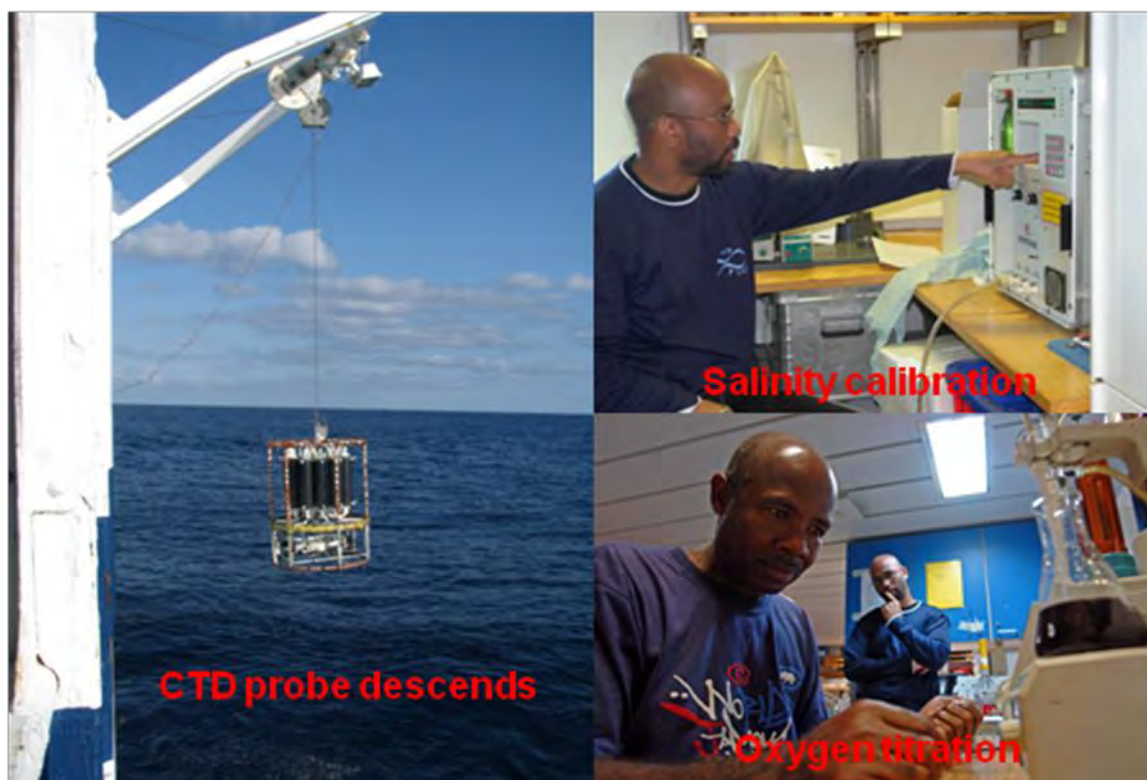
## 2) Acoustic observations of marine ecosystems



*Bregmaceros* sp. a small meso-pelagic fish



# Oceanographic investigations



## ***Meteorological and hydrographical sampling***

### **CTD profiles**

CTD stations were taken on 17 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 fluorometer 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.



### **Current speed and direction measurement**

A vessel-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments was run continuously during the survey in broadband mode shallower than about 400 m and in narrow band mode in deeper waters. The frequency of the VMADCP is 150 kHz, and data were averaged and stored in 3 m or 4 m vertical bins. All data were stored on files for post survey processing.

### **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.

### ***Benthic sampling***



Washing benthic samples

### **The Ospar Standard.**

OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the North-East Atlantic

Ospar also include Contracting Parties due to their location within the catchments of the rivers leading to the North-East Atlantic. The OSPAR Commission works under the umbrella of customary international law as codified by the 1982 United Nations Convention on the Law of the Seas (UNCLOS).

Overall, the work of the OSPAR Commission is guided by the ecosystem approach to an integrated management of human activities in the marine environment. This is supported by a general obligation of Contracting Parties to apply:

1. The precautionary principle;
2. The polluter pays principle;
3. Best available techniques (BAT) and best environmental practice (BEP), including clean technology.

### **Standard methodology for environmental surveys and reporting.**

Since the spread of pollutants in the marine environment marine does not recognise state borders it is of great importance to implement uniform standards for the whole region.

The Joint Assessment and Monitoring Programme (JAMP) sets out the basis on which the OSPAR Contracting Parties will work together in fulfilling the obligations set in Ospar.

For offshore oil exploration the OSPAR Guidelines for Monitoring the Environmental Impact of Offshore Oil and Gas Activities is one of the tools used in JAMP.

The programme also includes:

The Harmonised Offshore Chemical Notification Format (HOCNF) which applies to all chemicals used in connection with offshore exploration & production activities in the OSPAR maritime area.

Norwegian experiences.

The Norwegian programme for environmental monitoring of offshore oil exploration started in the early 1980's. Since then the environmental standard on Norwegian oil fields has taken a turn to the better. Implementing new and better environmental standards, technologies and working procedures has allowed the industry to grow without increasing the overall environmental pressure at the same pace.

It has also created a considerable basis of knowledge about the marine environment. This has given the administration reliable tools to manage the environmental effects of the industry in a sustainable way.

As a result of the industries improved environmental standards new and more vulnerable areas of the coast has been considered for oil exploration.

We have used OSPAR Guidelines on precious environmental cruises when sampling sediments both in Angola and Ghana and our experience is that this can be a good basis for a standard monitoring guide also in the South-West Atlantic

### **Practical operations onboard**

The scientists were divided into two shifts. The standard procedures for sampling and cruise activity were introduced to each shift and a copy of the standard procedures (internal standards SAM) was distributed.

The sampling was started on Block 1 12/5-11 at 18:50. under supervision.

The benthic stations are listed in Table 1 and the sampling journal in table 5 in the annex III.

## **Samples collected from each station.**

### **Biology:**

5 samples for biodiversity were washed through a 5mm and a 0,5 mm sieve as careful as possible, fixed on 8% formaldehyde and buffered with borax.

The biological samples are sorted to 0,5mm mesh size and the species are determined by taxonomists to describe the benthic fauna found in the area before the impact of oil exploration, diversity indexes are made for statistical analysis and comparison with future investigations to determine the effect of industrial impact.

The biological parameters are important to determine any disturbance in the ecosystem and will trigger further investigations into the cause of such changes.

During the project we aim to fine tune the use of benthic fauna indexes by collecting relevant literature and organising an international workshop based on the material from the survey.

Based on the results of this work reference collections should be made available for local scientists and the issue of storage facilities should be addressed as this is the basis of building the capacity to handle these issues in the future.

Materials from future investigations will also be used as a part of a training programme teaching technicians to process biological samples.

### **Chemistry.**

The chemical samples are analysed at Eurofins to determine the contents of pollutants related to oil exploration to establish baseline values.

3 samples from each station to be analysed for Heavy metals (Ba, As, Pb, Cd, Cu, Cr, Hg, Ni, Zn), Hydrocarbons (THC, PAH 16, NPD), PCB7 and TOM (Total Organic Matter) In accordance with Ospar, and 16 Chlorinated pesticides.

### **Geology:**

1 collective sample from the three samples for chemical analysis 0-5cm into the sediment. The particle size will be analysed in the laboratory by dissolving the sediment in water and then sieving it through a 0,063 mm sieve. Particles larger than 0,063 mm will then be dry sieved through Endecott sieves. The sieves have square holes with mesh sizes found in table 2.2. The analysis will be performed at SAM.

The median diameter and sorting (Table 2.2) are then calculated with the formulas below (Buchanan (1984) and Folk & Ward (1957)) and the program GradiStat version 4.01 (Blott & Pye 2001).



Samples for chemical analysis.

## Geological analysis



Determining colour with the soil chart.

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 of three separate grab samples was separated into 3 subsamples 0-2cm, 2-4cm, 4-6cm collected for grain size analysis at each sampling site.

The particle size are analysed in the laboratory by dissolving the sediment in water and then sieving it through a 0,063 mm sieve. Particles larger than 0,063 mm, is then dry sieved trough Endecott sieves. The sieves have square holes with mesh sizes found in table 2.2. The analysis is performed at SAM.

### Equipment for benthic sampling

Three, 0,1m<sup>2</sup> Van Veen grabs with adjustable weights and 1mm mesh size plate in the lids.

One Van Veen grab with double chambers (0,1m<sup>2</sup> for biology and a smaller chamber for chemistry) used on the second part of the cruise

Two 0,025 Van Veen grabs used for the shoreline sampling.

Four sieves with 1mm mesh size and round holes approved for correct mesh size.

One 5 mm mesh size sieve with round holes.

Two 0,5 mm mesh size sieves with round holes.

One new washing table to land the grab samples with drawers for the sieves.

Rilsan bags for chemical samples. Transparent bags for the biological and geological samples.

Formaldehyde, borax (Di sodium tetra Borat dekahydrat) and ethanol for fixing of samples.

Cruise journal.

Remote controlled grab sampler with a mini ROV, video and photo equipment. For testing.

## ***Plankton samples***

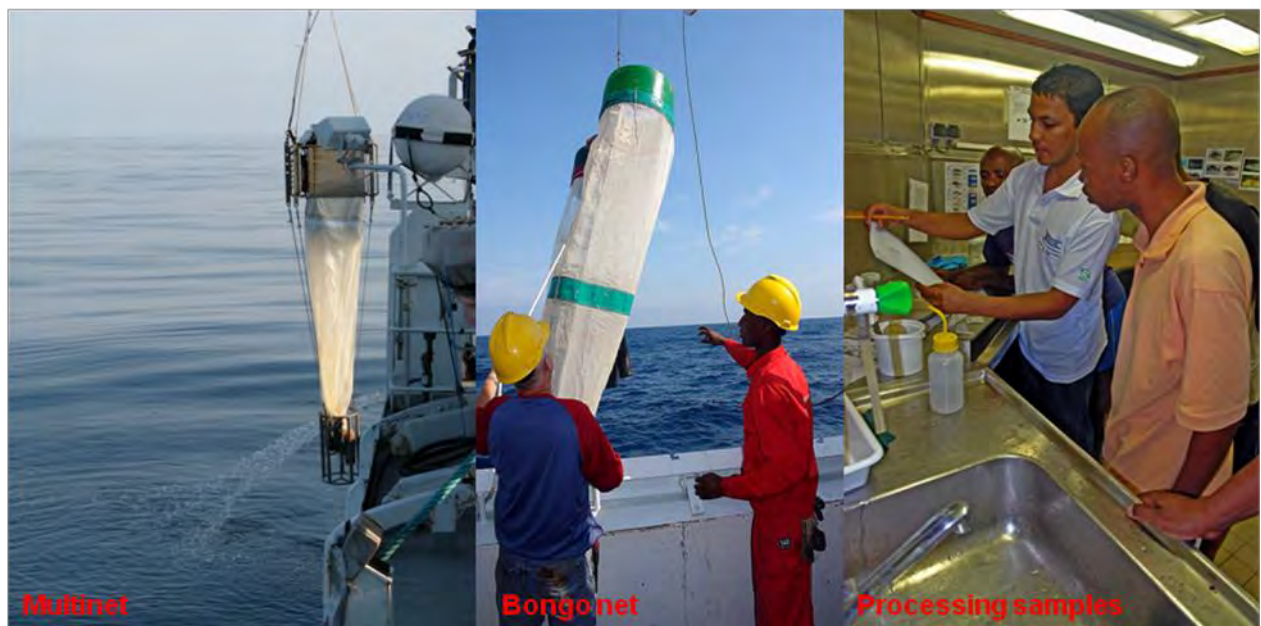
Zooplankton samples were collected on 18 stations using Multinet (Hydrobios GmbH Kiel, Germany) Samples were collected with A WP-2 plankton nets, 56 cm in diameter, with a mesh size of 180 µm. Depth was recorded in real time by pressure sensors.

5 depth intervals were sampled on each station: 0-25m, 25-50m, 50-75m, 75-100 and 100-200m. The hauling speed was 0.5 m/s. The vertical deviation on the wire was kept at less than 30°. 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 samples were preserved on 4 % formaldehyde buffered with borax and brought to Norway for identification.

The plankton analysis is in progress and the results are expected by the end of December 2011

## **Plankton studies**



See annex 4 Plankton samples.

## ***Pelagic trawling.***

20 trawl hauls with pelagic trawl with depth sensors were taken from 18.5 to 25.5-2011 from sea surface to about 400m depth determined by

### **Fishing gear**

The vessel has three different sized four-panel 'Åkrahavn' pelagic trawls and one 'Gisund super bottom trawl'. The two smallest pelagic trawls and the demersal trawl 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.

The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m<sup>2</sup> and weigh 2000 kg. The door spreading is about 50 m when using restraining rope. 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 and a height sensor is fitted on the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

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 the annex III in table 2.

Further analysis of the trawl sampling will be finalized by mid December and presented in the final report

## ***Seabed mapping***

The multibeam equipment (Simrad 720) onboard Dr. Fridtjof Nansen has a capacity of bathymetric mapping down to 1500 meters. And could not be used in JDZ, in more shallow areas in Saõ Tome and Nigerian waters it is a fantastic tool for bathymetric mapping of the sampling areas.

## ***HSE***

Before the work on board started there were an initial security briefing by the 1st Officer. Each team was guided through the use of Safety equipment, emergency exits and muster stations onboard.

There were also a SIA (safe job analysis) before the sampling started.

While working on deck helmets, protective shoes, safety goggles and gloves was used.

The work onboard was carried out in a safe manner and there were no incidents onboard during the cruise period.



## Weather

The sea was calm during the whole cruise period and the temperature was stable at about 32°C. Due to the onset of the rainy season there was some rain and thunder.



## Maps of the sampling area.

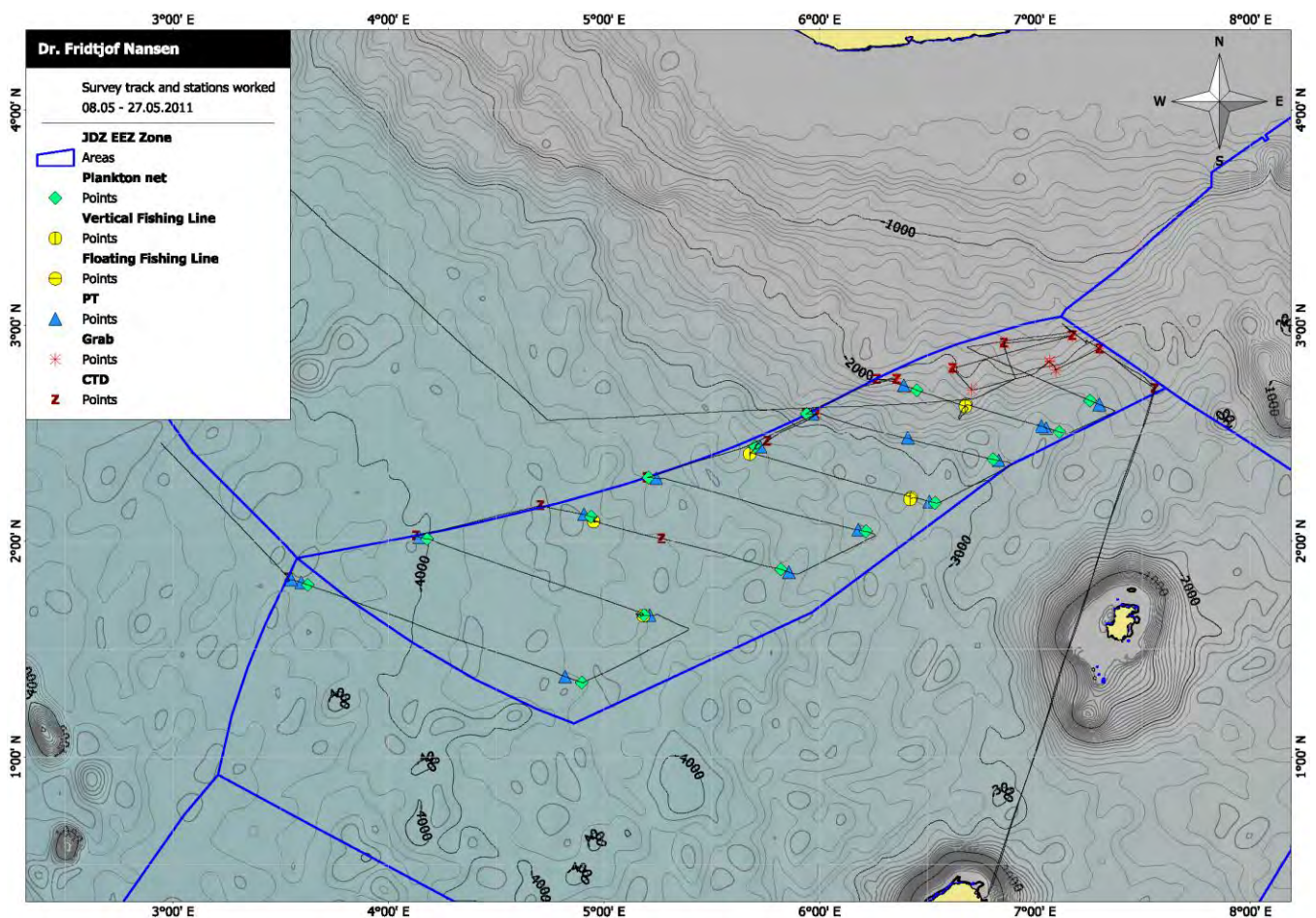


Fig 1. Map showing the sampled area from 2011.

# Results

## Oceanography

During the survey, a total of 17 hydrographic stations were occupied. At the 9 stations, CTD casts were extended to the bottom while at the remaining stations only the upper portion of the water column was covered, down to the 500 m depth. The bulk hydrographic stations were arranged along a straight-line section running along the eastern edge of the survey grid from northeast towards southwest (Fig. 1). A typical distance between the stations along that section was 35 nautical miles.

The properties of the water masses based on the data collected at deep-water stations are depicted on the T-S diagram in Fig. 2.

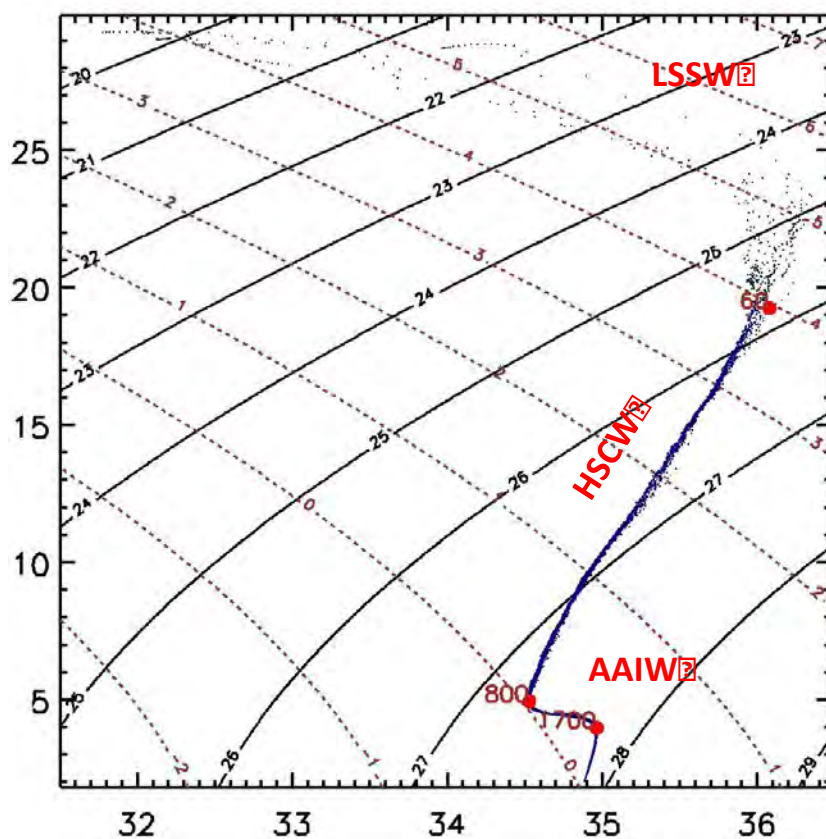


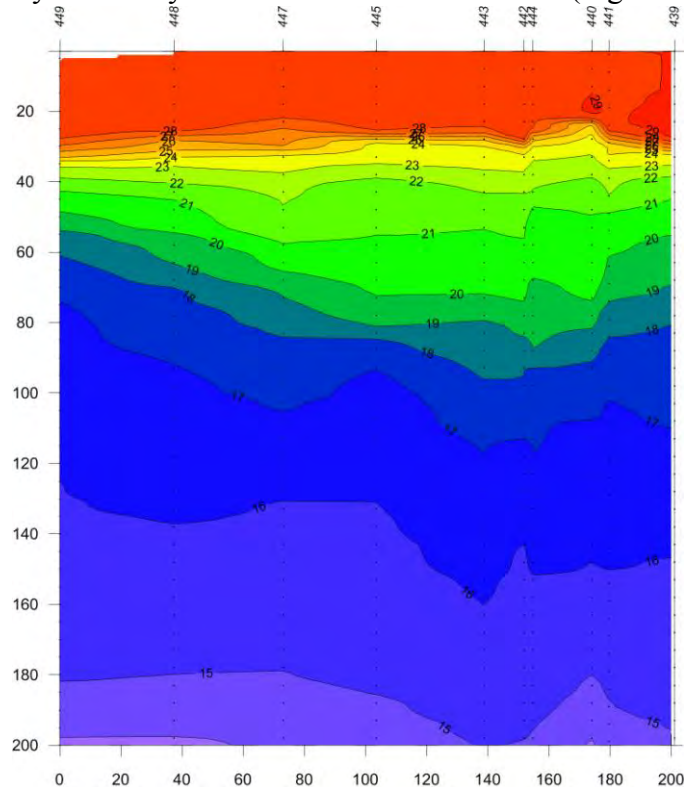
Fig. 2 Temperature-Salinity (T-S) diagram based on deep-water stations occupied during the survey. The horizontal and vertical axes denote salinity and temperature, respectively. The constant density lines are black and continuous while those of the constant spiciness are brown and broken. Water masses: LSSW – Low Salinity Surface Water, HSCW – High Salinity Central Water and AAIW Antarctic Intermediate Water. The red dots and associated labels denote depth marks.

In the upper

150 m of the water column the T-S relationship varied strongly between the stations, resulting in the strong scatter in the upper part of the diagram. This area of the diagram, corresponding to the top layer of the water column, was dominated by Low Salinity Surface Water (LSSW), originated from the river runoff and local excess of precipitation over evaporation in the Gulf of Guinea. Although the temperature and salinity increased gradually with depth, this water mass maintained almost fixed spiciness signature of  $5 \text{ kg m}^{-3}$ . The salinity maximum occurred in the depth range 50-60 m. Its emergence marked a transition from LSSW to underlying it High Salinity Central Water (HSCW). The HSCW layer occupied the depth range of 60 – 800 m. This water mass is a major source of nutrients in the Gulf of Guinea. It originates at the sea surface in the subtropics and on its way towards the equator it subducts below the lighter tropical water. Between 800 and 1700 m, the

T-S curve orientation changed to manifest a distinct layer, characterized by a constant temperature and varying salinity, associated to Antarctic Intermediate Water Mass (AAIW). This water mass originates to the south of the Southern Polar Front and propagates towards the equator below HSCW.

The hydrographic section (Fig. 1) extended over the distance of 230 nautical miles. All CTD casts below resulted in practically the same profiles in the depth range below 200 m. Above the 200 m; there was a gradual warming and freshening of the water column from the open towards coastal ocean. The change on the temperature and salinity distributions was not uniform. The warming trend occurred mainly in the upper part of the HSCW layer located just below the thermocline in the depth range of 35-100 m. In the top layer, the temperature oscillated between 28.3 and 29.3°C, but was relatively uniformly distributed across the section (Figure 3).

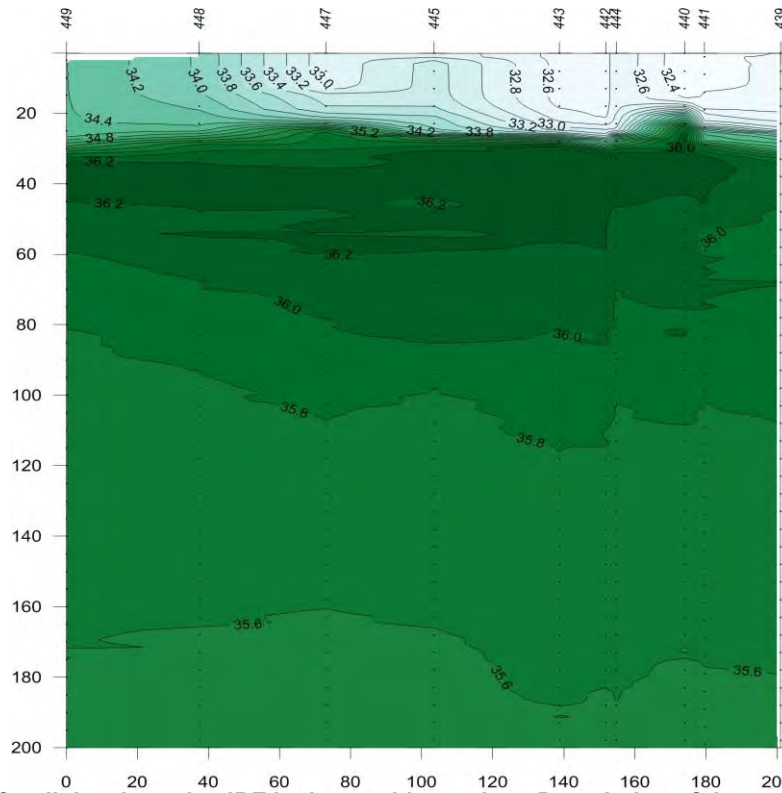


**Fig. 3** Distribution of temperature in the top 200 m along the JDZ hydrographic section. Horizontal and vertical axes denote distance in nautical miles and depth in meters, respectively. The CTD station number shown in the top of the figure. The southwestward (open ocean) corner of the section is to the left (see Fig. 1 for the locations of the stations).

The  
top  
25  
m

of the water column on the salinity distribution (Fig. 4) were dominated by low salinity water originated within the Gulf of Guinea basin and along its lateral boundaries due to copious tropical precipitation and river runoff. There is a clear trend of a decreasing salinity in this layer from 34.2 at the oceanic boundary to less than 32.2 towards the Bay of Biafra. A very sharp halocline separates this low-salinity water from the salinity maximum,  $S > 36.2$ , associated to HSCW. This layer thickens from the open ocean towards the center of the section, suggesting that the inner Gulf of Guinea is likely to be the region of the highest sub-thermocline salinities in the Tropical Eastern Atlantic.

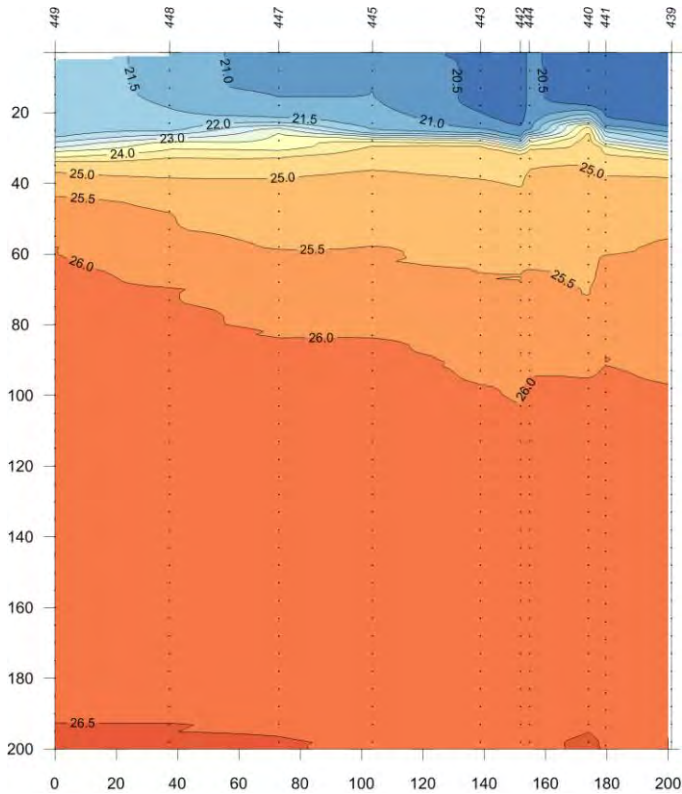




**Fig. 4 Distribution of salinity along the JDZ hydrographic section. Description of the axes and location as in Fig. 3.**

The

warming and freshening of the water column towards the inner Gulf of Guinea towards its continental boundaries, as indicated by data collected along the JDZ section in Fig. 3 and 4, results in formation of the coastal ocean area that is lighter from the surrounding ocean. The potential density distribution (Fig. 5) illustrates this. The lowest density characterizes the water column at the north-eastern extremity of the section, located nearest to the Nigerian coast (see Fig 1.). The pool of the lighter is not confined to the surface layer, since as the north-eastward depression of isopycnals still observed at about 120 m. This isopycnal pattern would be favourable to cyclonic circulation, thus to north-westward ('into the page') flows across the JDZ section.

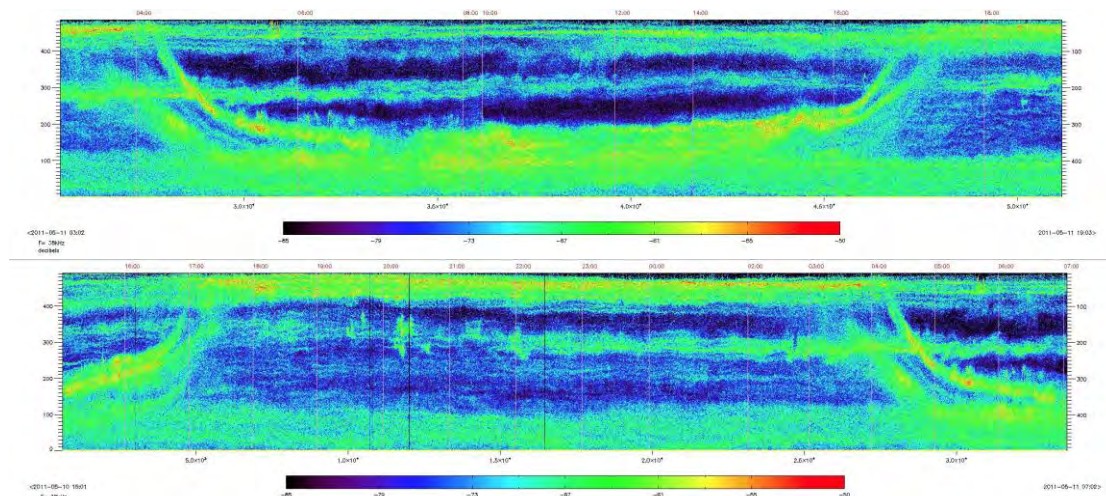


**Fig. 5 Distribution of potential density along the JDZ hydrographic section. Description of the axes and location as in Fig. 3.**

The ADCP-derived currents were recorded continuously underway during this survey. From data collected along the survey tracks a continuous distribution has been obtained using statistical interpolation. Fig. 6 demonstrates the current distribution across the JDC Polygon at the depth of 60 m overlaying the salinity map at 5 m depth, derived from the thermosalinograph recorded concurrently to the ADCP. A weak southerly flow ( $V < 10 \text{ cm sec}^{-1}$ ) dominates the north-eastern sector of the survey polygon. Further south the flow is strong,  $40 \text{ cm sec}^{-1}$ , and its direction changes direction to westward. This results in the emergence of the flow component perpendicular to the JDZ hydrographic section, in agreement with the direction of the geostrophy-induced flows suggested by the density distribution in Fig. 5.

## Acoustics

Multi-frequency acoustics at 18, 38, 120 and 200 kHz in conjunction with net sampling was used to study the composition and migratory behavior of mesopelagic fauna. While the results of net-samples are still under processing, the acoustic imagery has already provided some clues partitions on the main biota groups with respect to their diurnal behavior. Figure 7 shows acoustic imagery that compares the migratory patterns between day and night on the northern flank of the JDZ. As evidenced by the position of the scattering layers there are four major migratory behaviors: (a) animals staying in the top 50-70 m of the water column during day and night, (b) diel vertical migrants (DVM), consisting of animals that stay in the depth range of 250-350 during daytime and migrate to feed in the top layer during nighttime, (c) non-migratory animals that maintain the same depth range within the 200 m depth, both during the day and night, and (4) non-migratory fauna located below 400 meters.



**Fig. 7 Comparison of acoustic images at 38 kHz exhibiting vertical migration patterns in the JDZ during day (top) and night (bottom). The time of the day is described in the top of each figure; the depth is shown along the right margin. Volume backscattering strength (SV) is color coded in decibels; the respective color scale is shown below the figures. The left and bottom descriptions denote sample number in the vertical and horizontal plane, respectively.**

Interestingly, these partitions of migratory behaviors were coupled to the hydrographic structure in the water column (shown in Fig. 8). The non-migratory biota (a) was found exclusively in the relatively warm and fresh tropical surface water (TSW) above the thermocline. The diel vertical migrants (b) resided below the oxygen minimum layer zone (OMZ, Fig.8) during nighttime, crossed the OMZ rapidly on their upward migration at dusk (16:00-17:00 UTC), remained in the top TSW layer during nighttime and descended to the depths below 350 m at dawn (04:00-05:20 UTC). The non-migratory scattering layers (c) and (d) kept their position within their respective depth ranges both during day and night. Note that the position of layer (c) was closely maintained immediately above the OMZ.



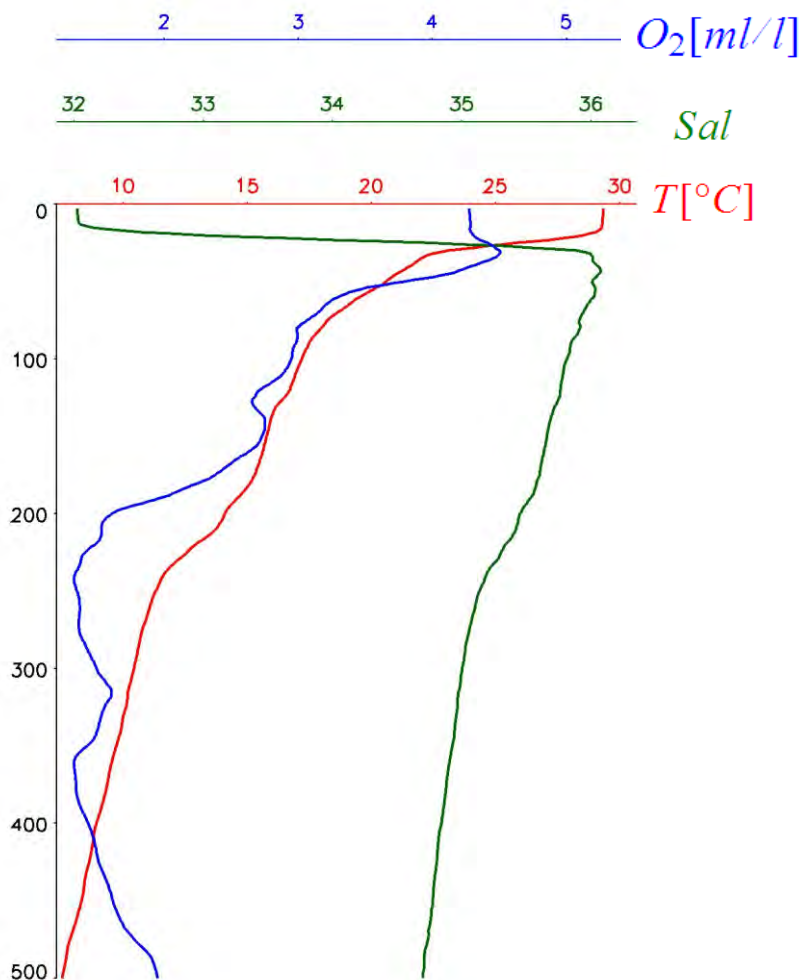


Fig. 8 Mean vertical profiles of temperature salinity and oxygen concentration averaged over data from all hydrographic stations occupied in the JDZ zone. The upper layer is dominated by Tropical Surface Water (TSW) characterized by low salinity,  $S < 33$ , and high temperature,  $T > 29^{\circ}\text{C}$ . The layer between 250 and 300 m is the oxygen minimum zone (OMZ) where  $\text{O}_2 < 1.5 \text{ ml l}^{-1}$ .

### ***Towards understanding the major environmental gradients and their consequences to oil spill disaster mitigation.***

The JDZ lies in the region of the equatorial current system. Those currents, unlike the current system at higher latitudes, have a persistent strong on- or offshore components. Having the future oil exploration in perspective, it is important to avoid locations of the oil platforms within regions of prevailing onshore flows. Such a location would have resulted with a major disaster to the coastal zone, had an oil spill occurred. In an attempt to avoid such miscalculated decisions at the prospection design stage it is therefore necessary to understand the major current patterns in the region. Although, some general knowledge on the flow patterns in the Gulf of Guinea may be learned from historical references, these old investigations are lacking both the spatial and timescale resolution necessary to support the engineering decisions.

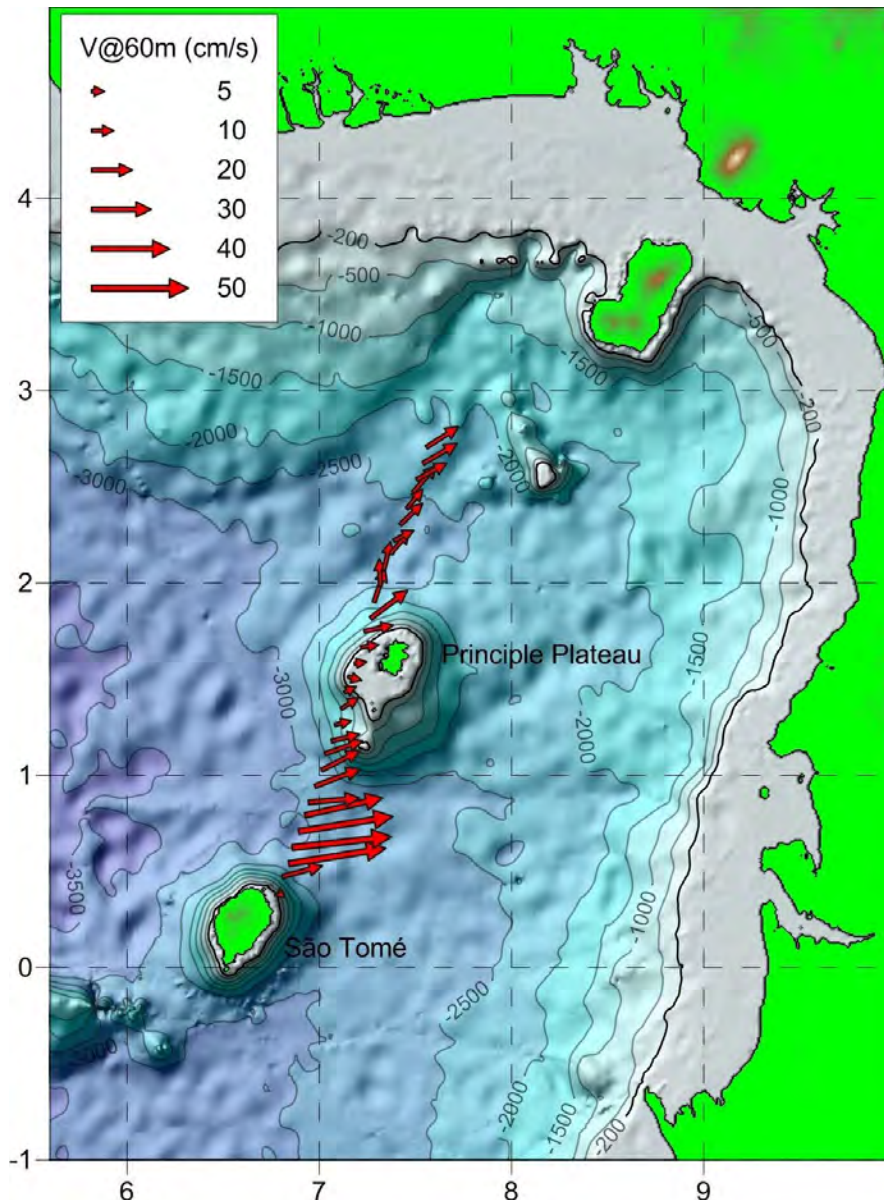
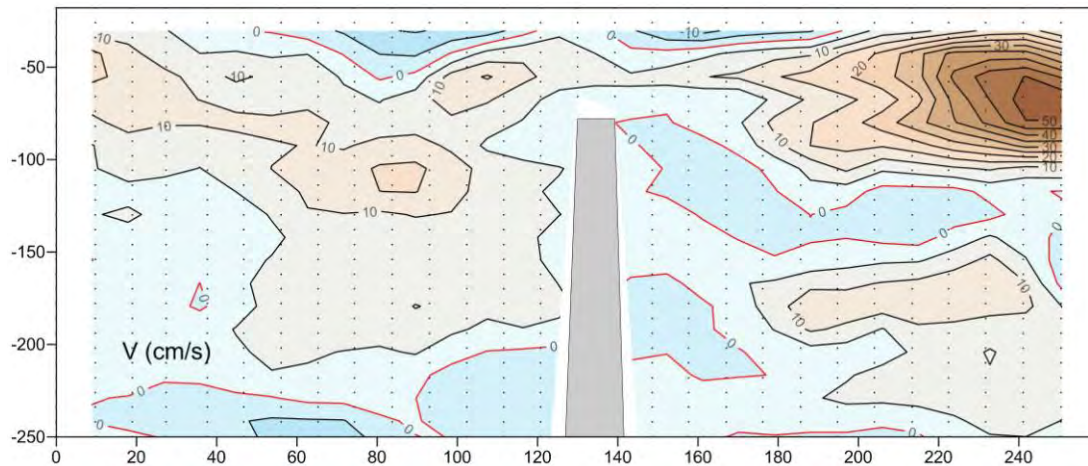


Fig. 9 Map of the current at 60 m depth recorded along the RV Dr. Fridtjof Nansen track towards Sao Tome on May 16 2011. The current magnitude scale shown in the top left corner.

During the 2011 survey, no major eastward currents were observed within the pre-allocated JDZ polygon. The dominant flow was everywhere within this region oriented westward (Figure 6). However, additional underway data recorded during the vessel's transit to Sao Tome, indicated clearly that the region of a strong eastward current was located uncomfortably close to the JDZ. Figure 9 shows the current recorded during this crossing. Note the eastward flow acceleration in the Principe – Sao Tome Channel. It manifests the core of Equatorial Undercurrent, which in the observed instance was found deflected just north of Sao Tome. Figure 10 demonstrates the vertical structure of this current. The flow is subsurface intensified with the maximum speed at the 70 m depth. The core of this flow is relatively narrow – between 30 and 40 km. The observed position of this core is, however, not fixed. From historical observations the core of the Equatorial Undercurrent has been found at various positions within a 1-degree of latitude on both sides of the Equator, but the available data are scarce. The departures of this core into the zone defined as the JDZ cannot be fully ruled out on the basis of the available data. An emergence of this current within this zone, once the oil prospection has been established would have inherently increased the risk of shoreward transport of an oil spill.



**Fig. 10** Vertical section of the eastward current component along the track of RV Dr. F. Nansen shown in Fig. 9. The positive values denote the eastward flow. The horizontal and vertical axes denote the distance sailed in km and depth in meters, respectively. The grey structure in the center of the figure matches the location of Principe along this track.

While this may seem as the speculation at the present state of our knowledge, we propose that it should be one of the main roles of the future surveys with the RV Dr. F. Nansen to obtain sufficient data to understand the variability of the core of meandering Equatorial Current and to establish if this variability can increase the risk of shorewaz.



# Annex I Permit for operation in JDZ



## NIGERIA-SAO TOME & PRINCIPE JOINT DEVELOPMENT AUTHORITY

*OFFICE OF THE CHAIRMAN OF THE BOARD*

Ref: 3/NHR/JDA/621/05

13<sup>th</sup> May, 2011

Dr. Bjorn Serigstad  
Cruise Leader  
'Dr. Fridtjof Nansen'  
Institute of Marine Research

**RE: MARINE RESOURCES SURVEY OF THE NIGERIA – SAO TOME AND  
PRINCIPE JOINT DEVELOPMENT ZONE (JDZ):  
PERMIT FOR COLLECTION OF SAMPLES – FISHERIES AND  
ENVIRONMENTAL MONITORING SURVEY IN THE NIGERIA-SAO TOME AND  
PRINCIPE JOINT DEVELOPMENT ZONE (JDZ)**

### 1.0 Introduction

The Nigeria-Sao Tome and Principe Joint Development Authority (JDA) intends to carry out a Marine Resources Survey of the Nigeria-Sao Tome and Principe Joint development Zone (JDZ) in collaboration with the Institute of Marine Research (IMR) Bergen, Norway and the Food and Agriculture Organization (FAO) in JDZ Waters with the research vessel 'Dr Fridtjof Nansen' from 9<sup>th</sup> to 27<sup>th</sup> May, 2011.

This Survey Permit is issued authorizing Cruise Leader of 'Dr Fridtjof Nansen' to undertake a Marine Resources Survey of the JDZ to collect samples and data.

### 2.0 Objectives

The objectives of the survey are to:

1. Establish what fisheries and sediment resources exist in the JDZ and their commercial value.
2. Perform environmental monitoring of the areas of the JDZ where petroleum activities have occurred with incidences recorded.
3. Conduct an assessment of fish, zooplankton and phytoplankton biodiversity in the JDZ.
4. Carry out an oceanographic and bathymetric mapping to improve knowledge and achieve data for map production; as well as an assessment of fish biodiversity in the JDZ.

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Wuse II, Abuja  
Nigeria

Tels: 09-524 1063  
Fax: 09-524 1052

DN-05-11-11-621-05c

### 3.0 Survey Area

The sampling will be performed according to OSPAR guidelines for sediment monitoring on offshore production area. The survey will involve the following activities:

- Collection of sediment samples for biological and chemical analysis
- Collection of oceanography information
- Use of Multi-beam echo-sounder to collect data for bathymetric mapping
- Deployment of Remote Operating Vehicle for data collection
- Surface and mid-water trawling to collect data on fish and fisheries resources in the JDZ

### 4.0 Outputs of the Survey


Outputs will be:

- A preliminary cruise report containing preliminary results and analysis including maps, graphs and other summaries
- A final cruise report within four (4) months from completion of the survey documenting activities of the survey,
- A complete electronic copy of the various data, etc collected during the survey.

5.0 This permit is issued strictly in line with the MOU signed between JDA and IMR and the MOU signed between JDA and FAO. All samples and data collected are strictly for the purpose of research relating to the JDZ Survey. Such samples and data shall remain confidential and shall not be commercialised.

6.0 While thanking you for all your support to the JDA, we look forward to a successful survey of the JDZ.

Matching



**Collins Kalabare**  
Executive Director  
Monitoring & Inspection/  
Acting Chairman of the Board



**Olegario Tiny**  
Executive Director  
Non-Hydro Carbon Resources &  
Acting Secretary of the Board/JMC

Cc: The Honourable Minister of Foreign Affairs II &  
Leader, Nigeria JMC Delegation

The Honourable Minister of Foreign Affairs &  
Leader, DRSTP JMC Delegation

Kristin Waeringsaasen  
Royal Norwegian Embassy, Abuja, Nigeria  
Kwame Koranteng  
FAO, Headquarters, Rome, Italy

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Fax: 09-524 1052

DN-05-13-11-621-05c

## **Annex II Terms of reference**

**R/V Dr. Fridtjof Nansen, Environmental baseline cruise to the Nigeria- Saõ Tome, Joint Development Zone (JDZ) 9<sup>th</sup> to 27th May 2011.**

### **Survey area**

The survey will take place in the JDZ area see enclosed map

### **Scientific approach**

- 1 Fisheries research using acoustic equipment and pelagic trawls. Floating vertical lines will be used to obtain samples of fish species that are difficult to catch by trawl. For deep water species there will be tests with traps/pots. HD pictures and videos...**
- 2 Hydrographical measurements using CTD with water bottles and sensors for salinity, temperature, Oxygen and fluorescence (chlorophyll). ADCP current meter. Thermosalinograph for surface temperature and salinity measurements. Geodetic GPS for tidal measurements.**
- 3 Plankton research using multi net that can collect zooplankton from different water depth. Water samples for nutrient analysis will be collected.**
- 4 Benthic sampling, videos and high resolution pictures of the seafloor down to 2300 meters depth. Samples collected will be analysed according to the OSPAR guidelines for monitoring of pollution from offshore petroleum industry. The same guidelines are used for monitoring in Norwegian, Angolan and Ghanaian waters**

Biological samples will be analysed for biodiversity (OSPAR)

Chemical samples will be analysed for:

Oil hydrocarbons THC and NPD (OSPAR)

Heavy Metals (OSPAR)

PCB

DDT and other pesticides that can follow the same preparation

- 5 Geological analysis: Grain size and distribution of sediments**
- 6 In addition to the samples for the above listed analysis, interesting objects may be collected by ROV from the seafloor for more detailed studies on board or in the laboratory.**

### **Work plan**

ROV and sediment sampling stations 1600- 2300 meters depth

**Estimated time 8 days**

Acoustic survey along 8-9 lines with approximately 15 nautical miles distance.

Can be reduced by using 30 nautical miles distance, to save time for other activities



2 trawl stations on each line totally 16 trawl stations

**Estimated time 4 days**

16 sampling stations for zooplankton

**1 day**

16 sampling stations for phytoplankton

**1 day**

16 sampling stations CTD (may require special design)

**1 day**

Fishing with vertical lines and other equipment for large pelagic fish 8 sampling sites

**Estimated time 2 days**

Sailing from Tema to JDZ

**1 day**

Sailing from JDZ to Tema

**1 day**

**Totally 19 days**

Sampling and analysis will be according to the OSPAR guidelines for sediment monitoring in offshore production area. The samples will be preserved for Chemical, Biological and Geochemical analysis.

### **Competence building**

Competence building is an important part of this activity. There will be onboard training in sample collection and analysis. The samples will be collected in duplicate (chemical samples). One set for analysis at international laboratories with accreditation and one set for analysis at local laboratories.

### **Objectives:**

To perform Environmental Baseline studies according to the OSPAR Monitoring Guidelines in JDZ.

Competence building and training for local staff representing the Joint Development Authority.



Green dots sediment sampling by “Video grab”

Red dots trawl, plankton and hydrographic sampling

Black lines: Fisheries Acoustics

## Annex III      Stations, positions and water depth

Table 1, 2 and 3. Stations, positions and water depth. Benthos, plankton, hydrography and trawling.

Table 1 grab stations.

Grab station	Date	Lattitude WGS84	Longitude WGS84	Depth (m)	Sediment description
Block 1	12.5.2011	2.91174 N	6.8583 E	1730 m	Clay 10 YR 3/1 Very dark grey
Block 2	13.5.2011	2.9520 N	7.1731 E	1660 m	2.5 Y 3/1 Very dark grey
Block 4	13.5.2011	2.8029 N	6.6192 E	1976 m	2,5 Y Very dark grey. Sub surface : Gley 1 10Y 3/1 very dark greenish grey
Block 4 Oki 1x	14.5.2011	2.7025 N	6.7066 E	2062 m	Mud surface : 2.5 Y 3/3 dark olive brown. Clay : Gley 1 10Y 2.5/1 greenish black
GR 5	14.05.2011	2.8346 N	7.0682 E	1543	
Ref 1	15.5.2011	2.8318 N	7.0686 E	1537 m	Clay 10 Y 4/1 Dark grey
Ref 2	15.5.2011	2.27931 N	7.0962 E	1925 m	Clay 5Y 3/1 very dark grey
Ref 3	16.5.2011	2.8930 N	7.2988 E	1912 m	Mud surface: 2,5Y 3/2 very dark greyish brown. Clay: Gley 1 10Y 2,5/1 Greyish black.
Block 3	19.5.2011	2.7530 N	6.3580 E	1892 m	Mud surface: 10YR 3/3 Dark brown. Clay: 5GY 2,5/1 Greenish black
Ref 4	21.5.2011	2.5887 N	5.9864 E	2665 m	Mud surface: 10YR 3/2 very dark greyish brown. Clay: Gley 1 10Y 3/1 Very dark Greenish grey

Table 2 pelagic trawl.

Station	Date	Start point		Trawl depth	Depth
		Longitude	Latitude		
PT 1	18.05.2011	7.5007	2.7648		2342 m
PT 2	18.05.2011	7.1402	2.9986		1533 m
PT 3	19.05.2011	7.7192	2.8816		1818 m
PT 4	19.05.2011	7.2980	2.6345		2494 m
PT 5	19.05.2011	7.0518	2.5247		2712 m
PT 6	19.05.2011	6.3914	2.7229		2142 m
PT 7	20.05.2011	5.9675	2.5917		2609 m
PT 8	20.05.2011	6.4098	2.4788		2641 m
PT 9	21.05.2011	6.8315	2.3742		2862 m
PT 10	21.05.2011	6.5104	2.1841		3035 m
PT 11	21.05.2011	5.7260	2.4385		3160 m
PT 12	22.05.2011	5.2427	2.2919		3469 m
PT 13	23.05.2011	6.1809	2.0528		3246 m
PT 14	23.05.2011	5.8583	1.8567		3404 m
PT 15	23.05.2011	4.9066	2.1241		3683 m
PT 16	24.05.2011	4.1433	2.0181		3964 m
PT 17	24.05.2011	5.2111	1.6562		3621 m
PT 18	25.05.2011	4.8190	1.3723		3756 m
PT 19	25.05.2011	3.5941	1.8088		4138 m
PT 20	25.05.2011	3.5488	1.8214		4147 m

Table 3 plankton stations.

Date	Plankton station	Latitude WGS84	Longitude WGS84	Depth (m)
18.05.2011	Pl.1	N 2.42.53	E 7.33.37	2337 m
18.05.2011	Pl.2	N 2.5989	E 17.1402	1548 m
19.05.2011	Pl.3	N 02 53.78	E 006 41.32	1780 m (1817m)
19.05.2011	Pl.4	N 2.3910	E 6.4464	2501 m
19.05.2011	Pl.5	N 2.3735	E 7.702	2681 m
19.05.2011	Pl.6	N 2.3753	E 6.4066	2221 m
20.05.2011	Pl.7	N 02 35,39	E 005 56,47	2508 m
21.05.2011	Pl.8	N 02 22,77	E 006 48,38	2862 m
21.05.2011	Pl.9	N 02 10,64	E 006 32,17	3032 m
21.05.2011	Pl.10	N 02 26,34	E 005 42,05	3163 m
22.05.2011	Pl.11	N 02 17,70	E005 12,35	3496 m
23.05.2011	Pl.12	N 02 2,77	E 006 12,90	3229 m
23.05.2011	Pl.13	N 01 52,18	E 005 49,31	3410 m
23.05.2011	Pl.14	N 02 06,80	E 004 56,39	3662 m
24.05.2011	Pl.15	N 02 00,65	E 004 10,77	3954 m
24.05.2011	Pl.16	N 01 39,42	E 005 11,13	3636 m
24.05.2011	Pl.17	N 1 20.61	E 4 54.10	3743 m
25.05.2011	Pl.18	N 1 47.82	E 3 37.63	4132 m

Table 4 CTD stations in the JDZ zone.

Station	Date	Longitude	Latitude	Depth
HD433 (Block 1)	12.05.2011	6.8551	2.9202	1761 m
HD434 (Block 2)	13.05.2011	7.1726	2.9528	1659 m
HD435 (Block 4)	13.05.2011	6.6184	2.8022	1977 m
HD436 (Ref 3)	16.05.2011	7.2993	2.8932	1911 m
HD437 (PL 1)	16.05.2011	7.5561	2.7088	2339 m
HD438	18.05.2011	7.2337	2.9205	1787 m
HD439 ( PL 3)	19.05.2011	6.6841	2.8987	1780 m
HD440	19.05.2011	6.2654	2.7508	2008 m
HD441 (Block 3)	20.05.2011	6.3581	2.7525	1929 m
HD442 (PL 7)	20.05.2011	5.9379	2.5902	2510 m
HD443	21.05.2011	5.7575	2.4643	3125 m
HD444 (Ref 4)	22.05.2011	5.9861	2.5899	2666 m
HD445 (PL11)	22.05.2011	5.1977	2.2948	3495 m
HD446	23.05.2011	5.2667	2.0121	3569 m
HD447	23.05.2011	4.7039	2.1657	3726 m
HD448	23.05.2011	4.1280	2.0238	3968 m
HD449 (PT 20)	25.05.2011	3.5351	1.8296	4151 m

## Annex IV      Sampling journal

**Table 5. SAMPLING JOURNAL**

Sign. in:

Page nr: 1 of 10

Vessel: <b>RV Dr. Fritjof Nansen</b>	Area: <b>JDZ</b>	Project code: <b>80 55 69</b>	Survey nr: <b>2011405 JDZ</b>
--------------------------------------	------------------	----------------------------------	-------------------------------

Grab station nr.:	Date:	Position		Depth (m)
		Latitude	Longitude	1730 m
<b>Block 1</b>	<b>12/5-11</b>	<b>2.9174 N</b>	<b>6.8583 E</b>	Positioning control

Weather:	Wind:	Wave height (m):
Time Start: <b>18:50</b>	Time Finish: <b>06:20</b>	Duration: <b>11 hr 30 min</b>
Sample equipment used (name, bite area, weight): <b>0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes).</b>		

Type of bottom sediment: <b>Clay</b>		
Color: <b>10 YR 3/1 Very dark grey</b>		Odor:
Observation of animals:		<b>No. rejected samples: 3</b>
Observation of oil, waste etc:		Empty: 3      Stone:      Open:

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex . w	Br. Surf
								0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>Full</b>	x	x	x	x	x	Broken surface					1-3	La		x
<b>2</b>	<b>Full</b>	x	x	x	x	x	Broken surface						La		x
<b>3</b>	<b>Full</b>	x	x	x	x	x	Broken surface						La		x

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>Full</b>			<b>1</b>		<b>La</b>	<b>X</b>
<b>5</b>	<b>Full</b>			<b>1</b>		<b>La</b>	<b>X</b>
<b>6</b>	<b>Full</b>			<b>1</b>		<b>La</b>	<b>X</b>
<b>7</b>	<b>Full</b>			<b>1</b>		<b>La</b>	<b>X</b>
<b>8</b>	<b>Full</b>			<b>1</b>		<b>La</b>	<b>1 pair off</b>

Sign. out:



**SAMPLING JOURNAL**

**Sign. in:**

**Page nr: 2 of 10**

<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>1660 m</b>
		Latitude	Longitude	
<b>Block 2</b>	<b>13/5-11</b>	<b>2.9520 N</b>	<b>7.1731 E</b>	<b>Positioning control</b>

<b>Weather: Rainy sunny from 14:00</b>	<b>Wind:</b>	<b>Wave height (m):</b>
<b>Time Start: 09:17</b>	<b>Time Finish: 16:40</b>	<b>Duration: 7 hr 23 min</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes).</b>		

<b>Type of bottom sediment: Clay</b>		
<b>Color: 2.5 Y 3/1 Very dark grey</b>		<b>Odor:</b>
<b>Observation of animals:</b>		<b>No. rejected samples:</b>
<b>Observation of oil, waste etc:</b>		Empty: 1    Stone:    Open: 1

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex . w	Br. Surf
								0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>Full</b>	X	X	X	X	X					1-3	<b>La</b>		<b>X</b>	
<b>2</b>	<b>full</b>	X	X	X	X	X						<b>Sa</b>		<b>X</b>	
<b>3</b>	<b>Full</b>	X	X	X	X	X						<b>Sa</b>		<b>X</b>	

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>Full</b>		<b>2</b>	<b>2</b>		<b>La</b>	
<b>5</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>Sa</b>	
<b>6</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>Sa</b>	
<b>7</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>Sa</b>	
<b>8</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>Sa</b>	

**Sign. out:**

**SAMPLING JOURNAL**

**Sign. in:**

**Page nr: 3 of 10**

<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>1976 m</b>
		Latitude	Longitude	
<b>Block 4</b>	<b>13/5-11</b>	<b>2.8029 N</b>	<b>6.6192 E</b>	<b>Positioning control</b>

<b>Weather:</b>	<b>Wind:</b>	<b>Wave height (m):</b>
<b>Time Start: 21:22</b>	<b>Time Finish: 09:10</b>	<b>Duration: 11 hr 48 min</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes) Short arm grab and duo grab.</b>		

<b>Type of bottom sediment: Clay</b>		
<b>Color: Surfase : 2,5 Y Very dark grey. Sub surface : Gley 1 10Y 3/1 very dark greenish grey</b>		<b>Odor:</b>
<b>Observation of animals:</b>		<b>No. rejected samples: 3</b>
<b>Observation of oil, waste etc:</b>		Empty: 1    Stone:    Open: 1

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
								0-2	2-4	4-6	Sek	Nor			
<b>1</b>	<b>Full</b>	X	X	X	X	X						1-3	<b>Sa</b>	<b>J</b>	<b>N</b>
<b>2</b>	<b>4</b>	X	X	X	X	X							<b>Duo</b>	<b>J</b>	<b>N</b>
<b>3</b>	<b>2,5</b>	X	X	X	X	X							<b>Sa</b>		<b>N</b>

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>5,5</b>			<b>2</b>		<b>Duo</b>	
<b>5</b>	<b>7</b>			<b>1</b>		<b>Sa</b>	
<b>6</b>	<b>Full</b>			<b>2</b>		<b>Sa</b>	
<b>7</b>	<b>1,5</b>			<b>3</b>		<b>Sa</b>	
<b>8</b>	<b>2</b>			<b>2</b>		<b>Sa</b>	

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<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>2062 m</b>
		Latitude	Longitude	
<b>Block 4 Oki 1x</b>	<b>14/5-11</b>	<b>2.7025 N</b>	<b>6.7066 E</b>	<b>Positioning control</b>

<b>Weather:</b>	<b>Wind:</b>	<b>Wave height (m):</b>
<b>Time Start: 10:00</b>	<b>Time Finish:</b>	<b>Duration:</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes) Short arm.</b>		

<b>Type of bottom sediment: clay with brownish muddy surface.</b>		
<b>Color: Surface : 2.5 Y 3/3 dark olive brown. Clay : Gley 1 10Y 2.5/1 greenish black</b>		<b>Odor:</b>
<b>Observation of animals: Sipuncula</b>		<b>No. rejected samples: 3</b>
<b>Observation of oil, waste etc:</b>		Empty: 2    Stone:    Open:1

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
								0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>6</b>	X	X	X	X	X					0-5 cm	1-3	Sa	Y	N
<b>2</b>	<b>2,5</b>	X	X	X	X	X							Sa	Y	N
<b>3</b>	<b>6</b>	X	X	X	X	X							Duo	Y	N

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>6</b>		<b>2</b>	<b>2</b>		<b>Duo</b>	
<b>5</b>	<b>1,5</b>		<b>2</b>	<b>2</b>		<b>Sa</b>	<b>Y</b>
<b>6</b>	<b>3</b>		<b>2</b>	<b>2</b>		<b>Sa</b>	<b>Y</b>
<b>7</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>Sa</b>	<b>Y</b>
<b>8</b>	<b>6</b>		<b>2</b>	<b>2</b>		<b>Sa</b>	<b>Y</b>

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<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>1543 m</b>
		Latitude	Longitude	
<b>Ref 1</b>	<b>14/5-11</b>	<b>2.8346 N</b>	<b>7.0682 E</b>	<b>Positioning control</b>

<b>Weather:</b>	<b>Wind:</b>	<b>Wave height (m):</b>
<b>Time Start: 22:06</b>	<b>Time Finish: 11:15</b>	<b>Duration:</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes).</b>		

<b>Type of bottom sediment:</b>		
<b>Color:</b>	<b>Odor:</b>	
<b>Observation of animals:</b>	<b>No. rejected samples: 3</b>	
<b>Observation of oil, waste etc:</b>	<b>Empty: 1</b>	<b>Open: 2</b>

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
								0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>5</b>	X	X	X	X	X					1-2	Sa		N	
<b>2</b>	<b>11</b>	X	X	X	X	X						Sa			
<b>3</b>															

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>					<b>Left station after 3 attempts to fill the grab moved to</b>		
<b>5</b>					<b>Softer bottom.</b>		
<b>6</b>							
<b>7</b>							
<b>8</b>							

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<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>1537m</b>
		Latitude	Longitude	
<b>Ref 1</b>	<b>15/5-11</b>	<b>2.8318 N</b>	<b>7.0686 E</b>	<b>Positioning control</b>

<b>Weather:</b>	<b>Wind:</b>	<b>Wave height (m):</b>
<b>Time Start: 03:34</b>	<b>Time Finish: 11:15</b>	<b>Duration:</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes).</b>		

<b>Type of bottom sediment: Clay</b>		
<b>Color: 10 Y 4/1 Dark grey</b>	<b>Odor:</b>	
<b>Observation of animals:</b>	<b>No. rejected samples: 3</b>	
<b>Observation of oil, waste etc:</b>	<b>Empty: 2</b>	<b>Stone:      Open:1</b>

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
								0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>11</b>										<b>0-5 cm</b>	<b>1-3</b>	<b>La</b>	<b>Y</b>	<b>N</b>
<b>2</b>	<b>6</b>												<b>La</b>	<b>Y</b>	<b>N</b>
<b>3</b>	<b>Full</b>												<b>La</b>	<b>Y</b>	<b>N</b>

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>Full</b>	<b>2</b>	<b>1</b>	<b>3</b>		<b>La</b>	<b>Y</b>
<b>5</b>	<b>Full</b>	<b>2</b>	<b>2</b>	<b>4</b>		<b>La</b>	<b>Y</b>
<b>6</b>	<b>Full</b>	<b>2</b>	<b>3</b>	<b>5</b>		<b>La</b>	<b>Y</b>
<b>7</b>	<b>Full</b>	<b>1</b>	<b>3</b>	<b>4</b>		<b>La</b>	<b>Y</b>
<b>8</b>	<b>Full</b>	<b>2</b>	<b>3</b>	<b>5</b>		<b>La</b>	<b>Y</b>

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<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>1925m</b>
		Latitude	Longitude	
<b>Ref 2</b>	<b>15/5-11</b>	<b>2.7931</b>	<b>7.0962</b>	<b>Positioning control</b>

<b>Weather: Rain/ thunder</b>	<b>Wind: Windy</b>	<b>Wave height (m): 2-3 m</b>
<b>Time Start: 11:23</b>	<b>Time Finish: 23:50</b>	<b>Duration:</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes) Short arm.</b>		

<b>Type of bottom sediment: 5Y 3/1 very dark grey</b>		
<b>Color:</b>	<b>Odor:</b>	
<b>Observation of animals:</b>	<b>No. rejected samples:</b>	
<b>Observation of oil, waste etc:</b>	Empty: 3	Stone:      Open: 2

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
								0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>10</b>	X	X	X	X	X					0-5 cm	1-3	La		N
<b>2</b>	<b>9</b>	X	X	X	X	X							La		N
<b>3</b>	<b>Full</b>	X	X	X	X	X							La		Y

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>9</b>			<b>1</b>		<b>La</b>	<b>Y</b>
<b>5</b>	<b>12</b>			<b>1</b>		<b>La</b>	<b>Y</b>
<b>6</b>	<b>Full</b>			<b>2</b>		<b>La</b>	<b>Y</b>
<b>7</b>	<b>Full</b>			<b>2</b>		<b>La</b>	<b>Y</b>
<b>8</b>	<b>Full</b>	<b>1</b>	<b>1</b>	<b>2</b>		<b>La</b>	<b>Y</b>

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<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>1912m</b>
		Latitude	Longitude	
<b>Ref 3</b>	<b>16/5-11</b>	<b>2.8930</b>	<b>7.2988</b>	<b>Positioning control</b>

<b>Weather: Cloudy</b>	<b>Wind: Light breeze</b>	<b>Wave height (m):</b>
<b>Time Start: 01:06</b>	<b>Time Finish:</b>	<b>Duration:</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes) Short arm.</b>		

<b>Type of bottom sediment: Clay with brownish surface</b>		
<b>Color: Surface: 2,5Y 3/2 Very dark greyish brown Clay: Gley 1 10Y 2,5/1 greyish black</b>		<b>Odor:</b>
<b>Observation of animals:</b>		<b>No. rejected samples:</b>
<b>Observation of oil, waste etc:</b>		Empty:      Stone:      Open: <b>1</b>

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Remarks :	DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
								0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>9</b>	X	X	X	X	X					0-5	1-3	La	N	Y
<b>2</b>		X	X	X	X	X							La	Y	Y
<b>3</b>		X	X	X	X	X							La	Y	Y

y

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>La</b>	<b>Y 4/4</b>
<b>5</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>La</b>	<b>Y 4/4</b>
<b>6</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>La</b>	<b>Y 24</b>
<b>7</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>La</b>	<b>No</b>
<b>8</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>La</b>	<b>Y 2/4</b>

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<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>1892 m</b>
		Latitude	Longitude	
<b>Block 3</b>	<b>19/5-11</b>	<b>2.7530</b>	<b>6.3580</b>	<b>Positioning control</b>

<b>Weather:</b>	<b>Wind: light air</b>	<b>Wave height (m): 1m</b>
<b>Time Start: 22:20</b>	<b>Time Finish: 12:20</b>	<b>Duration: 14 hr</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes) Short arm.</b>		

<b>Type of bottom sediment: Clay with fine brownish sediment.</b>		
<b>Color: surface : 10YR 3/3 Dark brown Clay : 5GY 2,5/1 greenish black</b>		<b>Odor:</b>
<b>Observation of animals:</b>		<b>No. rejected samples:</b>
<b>Observation of oil, waste etc:</b>		Empty: 2    Stone:    Open: 3

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Micro palentologi			DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
							0-2	2-4	4-6	0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>Full</b>	X	X	X	X	X	X	X	X	X	X	X	<b>0-2</b>	<b>1-3</b>	<b>La</b>	<b>Y</b>	<b>Y</b>
<b>2</b>	<b>1</b>	X	X	X	X	X	X	X	X	X	X	X	<b>2-4</b>	<b>1-3</b>	<b>Sa</b>	<b>Y</b>	<b>Y</b>
<b>3</b>	<b>Full</b>	X	X	X	X	X	X	X	X	X	X	X	<b>4-6</b>	<b>1-3</b>	<b>Sa</b>	<b>Y</b>	<b>Y</b>

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>Full</b>		<b>2</b>	<b>2</b>		<b>Sa</b>	<b>Y</b>
<b>5</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>Sa</b>	<b>Y</b>
<b>6</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>Sa</b>	<b>Y</b>
<b>7</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>La</b>	<b>Y</b>
<b>8</b>	<b>Full</b>		<b>1</b>	<b>1</b>		<b>La</b>	<b>Y</b>

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<b>Vessel: RV Dr. Fritjof Nansen</b>	<b>Area: JDZ</b>	<b>Project code: 80 55 69</b>	<b>Survey nr: 2011405 JDZ</b>
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Grab station nr.:	Date:	Position		Depth (m) <b>2665m</b>
		Latitude	Longitude	
<b>Ref 4</b>	<b>21/5-11</b>	<b>2.5887</b>	<b>5.9864</b>	<b>Positioning control</b>

<b>Weather:</b>	<b>Wind:</b>	<b>Wave height (m):</b>
<b>Time Start: 21:16</b>	<b>Time Finish:</b>	<b>Duration:</b>
<b>Sample equipment used (name, bite area, weight): 0,1m<sup>2</sup> Van Veen Grab and 1mm sieve (round holes) Short arm.</b>		

<b>Type of bottom sediment: Clay with brownish top layer</b>		
<b>Color: Top : 10 YR 3/2 very dark greyish brown Clay : Gley 1 10Y 3/1 very dark greenish grey</b>		<b>Odor:</b>
<b>Observation of animals:</b>		<b>No. rejected samples:</b>
<b>Observation of oil, waste etc:</b>	<b>Empty:</b>	<b>Stone: Open:</b>

Sample nr.	Volume (cm)	THC	Metals	PCB	Pesticides	Toc	Micro palentologi			DNA Nor			granulometry geo.		G. nr	Ex. w	Br. Surf
							0-2	2-4	4-6	0-2	2-4	4-6	Sek.	Nor			
<b>1</b>	<b>Full</b>	X	X	X	X	X											
<b>2</b>	<b>Full</b>	X	X	X	X	X											
<b>3</b>	<b>Full</b>	X	X	X	X	X											

Sample nr	Vol. (cm)	No bottles bio. 1mm	No bottles bio. 0,5mm	Total bottles	Remarks:	Grabnr.	Extra weights
<b>4</b>	<b>Full</b>						
<b>5</b>	<b>Full</b>						
<b>6</b>	<b>Full</b>						
<b>7</b>	<b>Full</b>						
<b>8</b>	<b>Full</b>						

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## Annex IV      Plankton samples

Ship:            Dr. Fridtjof Nansen  
 Cruise:        2011405  
 Station: 1  
 Cast:  
 Position: N 2.42.53 E 7.33.37  
 Depth:        2337  
 Operator: FW

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
10:56:07	1	203.3	0	1.0	1.0	100.00
11:02:12	1	100.3	100	1.0	1.0	100.00
11:02:13	2	100.0	0	0.8	1.0	80.00
11:04:27	2	75.2	48	1.3	0.1	1300.00
11:04:28	3	75.1	0	1.2	0.1	1200.00
11:07:10	3	51.6	71	1.4	1.5	93.33
11:07:11	4	51.4	0	1.6	1.4	114.29
11:09:00	4	25.6	44	1.0	1.1	90.91
11:09:01	5	25.1	0	1.5	1.3	115.38
11:10:26	5	0.0	31	2.0	2.0	100.00

Ship:            Dr. Fridtjof Nansen  
 Cruise:        2011405  
 Station: 2  
 Cast:  
 Position: N 2.5989 E17.1402  
 Depth:        1546  
 Operator: Fw

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
19:47:09	1	201.6	0	0.8	1.0	80.00
19:53:34	1	101.3	99	1.2	1.0	120.00
19:53:35	2	101.0	0	0.7	0.9	77.78
19:56:01	2	74.7	52	1.6	1.1	145.45
19:56:02	3	74.5	0	1.4	0.9	155.56
19:58:55	3	50.8	68	1.1	1.2	91.67
19:58:56	4	50.4	0	1.6	1.4	114.29
20:01:04	4	24.2	50	1.6	1.4	114.29
20:01:05	5	24.0	0	1.4	1.2	116.67
20:02:45	5	0.0	35	1.2	0.6	200.00

Ship:            Dr. Fridtjof Nansen

Cruise: 2011405  
 Station: 3  
 Cast:  
 Position: N 02 53.78 E 006 41.32  
 Depth: 1780  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
01:40:51	1	201.7	0	0.2	0,1	200.00
01:49:53	1	96.2	185	1.6	1,8	88.89
01:49:54	2	96.1	0	1.4	1,6	87.50
01:51:42	2	76.8	37	1.3	0,8	162.50
01:51:43	3	76.5	0	1.5	1,0	150.00
01:54:35	3	50.4	68	2.1	1,6	131.25
01:54:36	4	50.1	0	1.8	1,7	105.88
01:56:31	4	25.8	41	1.2	1,3	92.31
01:56:32	5	25.7	0	1.2	1,2	100.00
01:58:11	5	0.3	35	1.8	1,3	138.46

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: 4  
 Cast:  
 Position: N 2.3910 E 6.4464  
 Depth: 2500  
 Operator: FW

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
06:43:40	1	202.3	0	0.8	0.6	133.33
06:50:34	1	101.3	108	1.0	0.7	142.86
06:50:35	2	101.0	0	1.1	0.7	157.14
06:53:26	2	75.9	57	1.2	0.8	150.00
06:53:27	3	75.8	0	1.2	0.7	171.43
06:55:56	3	50.1	47	1.4	1.2	116.67
06:55:57	4	49.8	0	1.3	1.2	108.33
06:57:46	4	25.7	36	1.4	1.6	87.50
06:57:47	5	25.7	0	1.2	1.4	85.71
06:59:53	5	0.4	47	1.0	0.8	125.00



Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: 5  
 Cast:  
 Position: N 2.3735 E 7.702  
 Depth: 2678  
 Operator: fw

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
10:40:15	1	202.7	0	0.8	0.6	133.33
10:46:35	1	100.3	113	0.8	1.0	80.00
10:46:36	2	100.0	0	0.5	0.8	62.50
10:49:07	2	76.0	57	1.4	1.6	87.50
10:49:08	3	75.9	0	1.2	1.5	80.00
10:50:53	3	50.5	41	1.4	1.3	107.69
10:50:54	4	50.1	0	1.7	1.4	121.43
10:52:40	4	25.1	38	1.4	1.2	116.67
10:52:41	5	24.8	0	1.4	1.2	116.67
10:53:58	5	0.4	28	1.4	1.6	87.50

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: 6  
 Cast:  
 Position: N 2.3753 E 6.4066  
 Depth: 2221  
 Operator: FW

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
19:17:46	1	203.6	0	0.5	0.7	71.43
19:24:27	1	100.7	102	1.2	1.0	120.00
19:24:28	2	100.7	0	1.0	0.9	111.11
19:26:52	2	76.8	47	1.4	1.4	100.00
19:26:53	3	76.5	0	1.2	1.3	92.31
19:28:57	3	50.8	41	1.0	0.9	111.11
19:28:58	4	50.6	0	1.2	1.0	120.00
19:30:53	4	26.2	36	1.4	1.1	127.27
19:30:54	5	25.9	0	1.4	1.1	127.27
19:32:40	5	0.3	35	1.6	1.4	114.29

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL7  
 Cast:  
 Position: N 02 35,39 E 005 56,47  
 Depth: 2508  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
16:45:51	1	201.8	0	0.3	0.1	300.00
16:52:37	1	102.6	97	1.2	1.0	120.00
16:52:38	2	102.5	0	1.4	1.0	140.00
16:55:20	2	76.7	57	0.8	0.2	400.00
16:55:21	3	76.3	0	1.5	0.9	166.67
16:57:39	3	50.4	48	1.4	1.4	100.00
16:57:40	4	50.6	0	1.0	1.2	83.33
16:59:39	4	25.5	46	1.8	1.8	100.00
16:59:40	5	25.5	0	1.6	1.6	100.00
17:01:26	5	0.0	41	1.2	1.2	100.00

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL8  
 Cast:  
 Position: N 02 22,77 E 006 48,38  
 Depth: 2860m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
00:22:40	1	200.9	0	0.1	0.3	33.33
00:29:42	1	100.7	106	0.9	0.8	112.50
00:29:43	2	100.6	0	1.2	0.9	133.33
00:32:14	2	75.2	51	1.3	1.3	100.00
00:32:15	3	75.2	0	1.2	1.2	100.00
00:33:56	3	50.0	31	1.6	1.3	123.08
00:33:57	4	49.7	0	1.4	1.2	116.67
00:35:44	4	25.4	38	1.7	1.4	121.43
00:35:45	5	24.9	0	1.9	1.6	118.75
00:37:28	5	0.9	38	1.2	1.2	100.00

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL9  
 Cast:  
 Position: N 02 10,64 E 006 32,17  
 Depth: 3031m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
04:39:43	1	201.2	0	0.2	0.1	200.00
04:48:00	1	100.7	129	0.5	0.4	125.00
04:48:01	2	100.5	0	1.1	0.7	157.14
04:51:32	2	75.3	68	1.2	1.4	85.71
04:51:33	3	75.3	0	1.1	1.2	91.67
04:54:21	3	50.3	51	1.2	1.1	109.09
04:54:22	4	50.5	0	0.8	0.9	88.89
04:56:58	4	25.0	41	1.0	0.8	125.00
04:56:59	5	25.1	0	0.7	0.7	100.00
04:59:02	5	0.3	35	1.1	1.0	100.00

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL10  
 Cast:  
 Position: N 02 26,34 E 005 42,05  
 Depth: 3163m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
17:32:53	1	200.1	0	1.2	1.0	120.00
17:42:04	1	101.2	137	0.7	1.0	70.00
17:42:05	2	101.3	0	0.8	0.8	100.00
17:45:28	2	74.9	73	1.5	1.3	115.38
17:45:29	3	74.7	0	1.6	1.4	114.29
17:47:29	3	50.1	39	1.5	1.4	107.14
17:47:30	4	49.9	0	1.2	1.2	100.00
17:49:23	4	25.4	37	1.6	1.2	133.33
17:49:24	5	25.1	0	1.8	1.4	128.57
17:51:06	5	0.0	43	2.1	1.8	116.67

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL11  
 Cast:  
 Position: N 02 17,70 E005 12,35  
 Depth: 3494m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
16:49:28	1	199.9	0	0.5	0.1	500.00
16:55:28	1	100.1	91	1.6	1.4	114.29
16:55:29	2	99.9	0	1.4	1.4	100.00
16:57:38	2	75.6	37	1.3	1.2	108.33
16:57:39	3	75.2	0	1.3	1.2	108.33
16:59:29	3	50.4	37	1.7	1.5	113.33
16:59:30	4	50.0	0	1.6	1.5	106.67
17:01:12	4	25.1	41	1.9	1.8	105.56
17:01:13	5	24.9	0	1.6	1.6	100.00
17:02:47	5	0.1	31	1.0	1.1	90.91

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL12  
 Cast:  
 Position: N 02 2,77 E 006 12,90  
 Depth: 3228m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
01:12:32	1	200.3	0	1.1	0.8	137.50
01:19:21	1	100.2	109	0.1	0.2	50.00
01:19:22	2	100.2	0	0.1	0.1	100.00
01:22:20	2	75.6	66	1.6	1.6	100.00
01:22:21	3	75.5	0	1.4	1.5	93.33
01:24:12	3	50.1	40	1.5	1.4	107.14
01:24:13	4	50.1	0	1.2	1.2	100.00
01:26:23	4	25.1	49	1.7	1.5	113.33
01:26:24	5	24.9	0	1.6	1.6	114.29
01:28:13	5	0.1	42	1.4	0.8	175.00

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL13  
 Cast:  
 Position: N 01 52,18 E 005 49,31  
 Depth: 3410m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
05:26:18	1	199.7	0	0.2	0.1	200.00
05:33:08	1	100.4	78	1.2	1.0	120.00
05:33:09	2	100.3	0	1.0	1.0	100.00
05:35:44	2	75.7	60	1.2	1.3	92.31
05:35:45	3	75.4	0	1.4	1.3	107.69
05:37:07	3	50.3	26	1.4	1.2	116.67
05:37:08	4	49.9	0	1.5	1.2	125.00
05:38:23	4	25.5	24	1.4	1.4	100.00
05:38:24	5	25.5	0	1.1	1.2	91.67
05:39:47	5	0.2	32	1.1	1.4	78.57

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL14  
 Cast:  
 Position: N 02 06,80 E 004 56,39  
 Depth: 3663m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
16:05:51	1	200.6	0	0.9	0.5	180.00
16:12:48	1	99.9	0	1.4	1.3	107.69
16:12:49	2	99.8	0	1.1	1.1	100.00
16:15:05	2	75.3	45	1.2	1.2	100.00
16:15:06	3	75.2	0	1.0	1.1	90.91
16:16:49	3	50.2	25	1.0	0.8	125.00
16:16:50	4	50.1	0	0.8	0.8	100.00
16:18:25	4	24.7	21	1.0	0.8	125.00
16:18:26	5	24.5	0	0.8	0.8	100.00
16:19:53	5	0.4	30	1.5	1.5	100.00

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL15  
 Cast:  
 Position: N 02 00,65 E 004 10,77  
 Depth: 3954m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
02:07:37	1	199.9	0	0.1	0.3	33.33
02:14:20	1	100.6	92	1.2	1.1	109.09
02:14:21	2	100.6	0	1.2	1.1	109.09
02:17:12	2	75.5	65	1.6	1.2	133.33
02:17:13	3	75.3	0	1.5	1.2	125.00
02:20:28	3	51.0	88	1.7	1.8	94.44
02:20:29	4	50.9	0	1.8	1.6	112.50
02:23:00	4	25.2	74	1.8	1.7	105.88
02:23:01	5	25.1	0	1.6	1.6	100.00
02:24:41	5	0.1	36	1.4	1.2	116.67

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: PL16  
 Cast:  
 Position: N 01 39,42 E 005 11,13  
 Depth: 3636m  
 Operator: JK

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m³]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
16:32:43	1	199.1	0	0.4	0.4	100.00
16:38:59	1	100.7	88	0.8	0.8	100.00
16:39:00	2	100.5	0	1.0	0.8	125.00
16:40:48	2	75.4	31	1.2	1.3	92.31
16:40:49	3	75.7	0	0.7	1.0	70.00
16:42:22	3	50.4	29	1.2	1.2	100.00
16:42:23	4	50.3	0	1.4	1.2	116.67
16:44:20	4	25.4	38	1.1	1.0	110.00
16:44:21	5	25.1	0	1.3	1.1	118.18
16:45:57	5	0.3	32	1.2	1.3	92.31



Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: 17  
 Cast:  
 Position: N 1 20.61 E 4 54.10  
 Depth: 3745  
 Operator: fw

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
23:25:16	1	202.3	0	0.8	0.4	200.00
23:32:32	1	100.6	99	0.6	0.8	75.00
23:32:33	2	100.6	0	0.9	0.7	128.57
23:35:29	2	75.5	61	1.2	0.8	150.00
23:35:30	3	75.3	0	1.3	0.8	162.50
23:38:05	3	50.5	55	1.2	1.1	109.09
23:38:06	4	50.0	0	1.5	1.2	125.00
23:39:54	4	24.0	26	1.1	1.1	100.00
23:39:55	5	24.3	0	0.5	0.8	62.50
23:41:10	5	0.2	23	1.5	1.2	125.00

Ship: Dr. Fridtjof Nansen  
 Cruise: 2011405  
 Station: 18  
 Cast:  
 Position: N 1 47.82 E 3 37.63  
 Depth: 4131  
 Operator: fw

Time[hh:mm:ss]	Net	Pressure [dbar]	Volume [m <sup>3</sup> ]	Flow in [m/s]	Flow out [m/s]	Flow ratio [%]
08:05:04	1	205.7	0	1.0	1.0	100.00
08:11:35	1	100.6	90	0.6	0.9	66.67
08:11:36	2	100.6	0	0.7	0.8	87.50
08:14:08	2	72.8	54	1.4	1.5	93.33
08:14:09	3	72.5	0	1.4	1.4	100.00
08:15:46	3	50.2	29	0.7	0.8	87.50
08:15:47	4	50.3	0	0.7	0.8	87.50
08:17:21	4	24.7	18	0.3	0.7	42.86
08:17:22	5	24.3	0	0.8	0.8	100.00
08:18:45	5	0.2	27	0.9	1.0	90.00

# Annex VI Records of fishing stations

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 1  
 DATE :18/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°45.89  
 start stop duration Lon E 7°30.04  
 TIME :12:23:19 12:53:23 30.1 (min) Purpose : 1  
 LOG : 6256.94 6258.54 1.6 Region : 3200  
 FDEPTH: 370 381 Gear cond.: 0  
 BDEPTH: 2342 2332 Validity : 0  
 Towing dir: 0° Wire out : 940 m Speed : 3.2 kn  
 Sorted : 0 Total catch: 1.18 Catch/hour: 2.36

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 3  
 DATE :19/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°52.89  
 start stop duration Lon E 6°43.15  
 TIME :02:17:47 02:48:15 30.5 (min) Purpose : 1  
 LOG : 6327.63 6329.33 1.7 Region : 3200  
 FDEPTH: 51 52 Gear cond.: 0  
 BDEPTH: 1818 1840 Validity : 0  
 Towing dir: 0° Wire out : 150 m Speed : 3.3 kn  
 Sorted : 0 Total catch: 7.69 Catch/hour: 15.15

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Acanthusus sp. juvenile	0.74	228	31.28	
J E L L Y F I S H	0.58	134	24.51	
Argyroleucus aculeatus	0.34	138	14.37	
Bonapartia pedaliota	0.24	116	10.14	
Leptocephalus	0.14	24	5.93	
MYCTOPHIDAE	0.10	100	4.23	
Polyipnus polli	0.06	42	2.54	
C E P H A L O P O D A	0.05	30	2.20	
Selene dorsalis	0.04	66	1.69	
Ichthyococcus sp	0.02	4	0.85	
OMMASTREPHIDAE	0.01	6	0.36	
MELANOSTOMIATIDAE	0.01	22	0.27	
Alloteuthis africana	0.01	2	0.27	
Unidentified crustacean	0.01	18	0.24	
MALACOSTEIDAE	0.00	10	0.18	
Xenolepidichthys dagleishi	0.00	6	0.15	
Photonectes braueri	0.00	2	0.13	0
Shrimps, small, non comm.	0.00	20	0.10	
Phosichthyidae sp.	0.00	8	0.09	
NOMEIDAE	0.00	2	0.08	
Scorpaena sp.	0.00	4	0.08	
TRICHIURIDAE	0.00	4	0.08	
Sphoeroides marmoratus	0.00	2	0.08	
Unidentified crustacean	0.00	18	0.05	
SQUILLIDAE	0.00	6	0.04	
Photonectes braueri	0.00	2	0.04	
Lestidiops sp.	0.00	4	0.03	
BOTHIDAE	0.00	2	0.02	
Acanthusus sp. juvenile	0.00	4	0.02	0
Total	2.36		100.03	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L L Y F I S H	9.31	128	61.49	
MYCTOPHIDAE	3.13	6575	20.67	
Cubiceps sp.	0.83	55	5.46	
Gymnoscopelus sp.	0.35	122	2.34	
Leptocephalus	0.33	224	2.21	
Diaphus sp.	0.22	144	1.43	
Photichthys sp	0.20	299	1.30	
Shrimps, small, non comm.	0.16	1292	1.04	
Selene dorsalis	0.16	201	1.04	
Lestidium sp.	0.12	73	0.78	
Symbolophorus sp.	0.10	69	0.65	
Enoplateuthis sp.	0.10	85	0.65	
Lampanyctodes sp.	0.04	51	0.26	
TRICHIURIDAE	0.03	83	0.20	
BOTHIDAE	0.02	83	0.16	
UNIDENTIFIED FISH	0.02	18	0.13	
Stomias sp.	0.02	65	0.13	
Unidentified crustacean	0.00	69	0.03	
Holocentrus sp.	0.00	10	0.03	
Peristedion sp.	0.00	2	0.01	
Priacanthus sp.	0.00	14	0.00	
SQUILLIDAE	0.00	8	0.00	
Unidentified crustacean	0.00	6	0.00	
Total	15.15		100.01	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 4  
 DATE :19/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°38.07  
 start stop duration Lon E 7°17.88  
 TIME :07:29:43 08:01:01 31.3 (min) Purpose : 1  
 LOG : 6365.35 6367.17 1.8 Region : 3200  
 FDEPTH: 350 335 Gear cond.: 0  
 BDEPTH: 2494 2496 Validity : 0  
 Towing dir: 0° Wire out : 860 m Speed : 3.5 kn  
 Sorted : 0 Total catch: 1.34 Catch/hour: 2.56

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 2  
 DATE :18/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°59.91  
 start stop duration Lon E 7°8.41  
 TIME :20:28:36 20:58:39 30.1 (min) Purpose : 1  
 LOG : 6290.20 6292.02 1.8 Region : 3200  
 FDEPTH: 35 35 Gear cond.: 0  
 BDEPTH: 1533 1613 Validity : 0  
 Towing dir: 0° Wire out : 130 m Speed : 3.6 kn  
 Sorted : 0 Total catch: 2.88 Catch/hour: 5.75

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Xenolepidichthys dagleishi	0.63	127	24.70	
Gonostoma denudata	0.47	159	18.50	
Argyroleucus affinis	0.38	19	14.97	
J E L L Y F I S H	0.21	40	8.23	
Leptocephalus	0.14	44	5.39	
Ommastrephes bartrami	0.12	104	4.75	
Electrona risso	0.12	15	4.49	
CRANCHIIDAE	0.11	25	4.45	
MYCTOPHIDAE	0.06	123	2.29	
Polyipnus polli	0.06	35	2.25	
Diaphus sp.	0.03	15	1.32	
Sea cucumbers	0.03	2	1.20	
Chauliodus sp.	0.03	8	1.00	
PHOTICHTHYIDAE	0.02	54	0.79	
Sternoptyx sp.	0.02	15	0.75	
Ichthyococcus sp	0.02	12	0.75	
Gonostoma elongatum	0.02	56	0.62	
TRICHIURIDAE	0.01	13	0.43	
Cyrtopsis roseus	0.01	2	0.40	
IDIACANTHIDAE	0.01	13	0.37	
Chaunax sp.	0.01	2	0.36	
Selene dorsalis	0.01	17	0.36	
Lestidiops sp.	0.01	6	0.31	
BOTHIDAE	0.01	2	0.30	
Xenolepidichthys dagleishi	0.01	4	0.22	0
C R U S T A C E A N S	0.01	8	0.22	
Scorpaena sp.	0.01	4	0.21	
Scopelarchoides signifer	0.00	2	0.15	
Shrimps, small, non comm.	0.00	8	0.10	
UNIDENTIFIED FISH	0.00	2	0.09	
Holocentrus ascensionis	0.00	2	0.01	
Total	2.56		100.00	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Diaphus sp.	1.62	463	28.13	
J E L L Y F I S H	1.24	24	21.53	
Sea cucumber	0.94	20	16.32	
Cubiceps sp.	0.60	46	10.42	
Leptocephalus	0.40	66	6.94	
MYCTOPHIDAE	0.22	276	3.82	
Ommastrephes bartrami	0.18	2	3.13	
Gymnoscopelus sp.	0.14	32	2.43	
OMMASTREPHIDAE	0.14	86	2.43	
Promethichthys prometheus	0.08	10	1.39	
CRANCHIIDAE	0.06	2	1.04	
Selene dorsalis	0.06	86	1.04	
Not found	0.04	32	0.69	
Phosichthyidae sp.	0.02	80	0.35	
Lestidiops sp.	0.01	6	0.17	
TRICHIURIDAE	0.01	20	0.09	
Shrimps, small, non comm.	0.00	26	0.07	
Eustomias sp.	0.00	2	0.00	
Total	5.75		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 5  
 DATE :19/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°32.02  
 start stop duration Purpose : 1  
 LOG : 6389.72 6391.24 1.5 Region : 3200  
 FDEPTH: 360 380 Gear cond.: 0  
 BDEPTH: 2712 2712 Validity : 0  
 Towing dir: 0° Wire out : 850 m Speed : 2.4 kn  
 Sorted : 0 Total catch: 1.11 Catch/hour: 2.21

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L L Y F I S H	0.62	158	28.01	
Argyropelecus aculeatus	0.40	92	18.07	
Gonostoma denudata	0.36	140	16.26	
Argyropelecus affinis	0.34	98	15.36	
PHOTICHTHYIDAE	0.10	116	4.52	
Electrona risso	0.05	8	2.26	
Diaphus sp.	0.05	24	2.26	
Polyipnus spinosus	0.05	36	2.24	
CRANCHIIDAE	0.04	12	1.84	
Leptocephalus	0.04	8	1.81	
MYCTOPHIDAE	0.03	62	1.36	
Selene dorsalis	0.02	56	0.75	
OMMASTREPHIDAE	0.02	10	0.72	
Chauliodus sloani	0.02	6	0.72	
GONOSTOMATIDAE	0.01	2	0.49	
Gonostoma sp.	0.01	36	0.39	
Sternoptyx sp.	0.01	4	0.36	
Directmus argenteus	0.01	2	0.33	
Opistoproctus grimaldi	0.01	2	0.33	
SEPIOLIDAE	0.01	2	0.27	
BOTHIDAE	0.01	14	0.27	
Ichthyococcus sp	0.01	6	0.25	
Copepods	0.00	2	0.18	
Unidentified juv fish	0.00	16	0.18	
Astronesthes sp.	0.00	4	0.16	
Unidentified crustacean	0.00	8	0.13	
IDIACANTHIDAE	0.00	6	0.10	
NOMEIDAE	0.00	2	0.10	
Scorpaenid sp.	0.00	4	0.07	
Shrimps, small, non comm.	0.00	16	0.06	
C R U S T A C E A N S	0.00	4	0.05	
Scorpaena sp.	0.00	4	0.04	
FISH LARVAE	0.00	2	0.03	
Scorpaenid - long pec	0.00	2	0.02	
Squillidae	0.00	2	0.01	
Total	2.21		100.01	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 6  
 DATE :19/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°43.38  
 start stop duration Purpose : 1  
 LOG : 6446.41 6448.29 1.9 Region : 3200  
 FDEPTH: 35 35 Gear cond.: 0  
 BDEPTH: 2142 2073 Validity : 0  
 Towing dir: 0° Wire out : 130 m Speed : 3.8 kn  
 Sorted : 0 Total catch: 12.45 Catch/hour: 24.89

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
JELLYFISH	15.30	232	61.47	
Diaphus sp.	2.12	608	8.52	
PHOTICHTHYIDAE	1.75	3690	7.04	
MYCTOPHIDAE	1.43	2674	5.74	
Leachia atlantica	1.04	88	4.18	
OMMASTREPHIDAE	0.59	418	2.36	
Gymnoscopelus sp.	0.48	98	1.93	
Leptocephalus	0.42	358	1.70	
Cubiceps sp.	0.38	18	1.53	
Symblophorus sp.	0.32	332	1.30	
Ommastrephes bartrami	0.19	182	0.77	
UNIDENTIFIED FISH	0.16	278	0.65	0
Jelly	0.14	102	0.57	
Selene dorsalis	0.13	198	0.53	
Benthosoma sp.	0.12	82	0.49	
Illex coindetii	0.08	16	0.32	
Shrimps, small, non comm.	0.05	346	0.20	
PARALEPIDIDAE	0.04	14	0.16	
TRICHIURIDAE	0.04	92	0.15	
Gonostoma sp.	0.02	1468	0.08	
Acanthusus sp. juvenile	0.02	24	0.08	
Lestidium sp.	0.02	90	0.07	
Leachia atlantica	0.01	4	0.05	0
Holocentrus ascensionis	0.01	24	0.02	
DIRETMIDAE	0.00	62	0.02	
BOTHIDAE	0.00	8	0.01	
Nemichthys scolopaceus	0.00	2	0.01	
Total	24.88		99.94	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 7  
 DATE :20/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°35.50  
 start stop duration Purpose : 1  
 LOG : 6496.89 6498.49 1.6 Region : 3200  
 FDEPTH: 40 40 Gear cond.: 0  
 BDEPTH: 2609 2714 Validity : 0  
 Towing dir: 0° Wire out : 130 m Speed : 3.1 kn  
 Sorted : 0 Total catch: 2.50 Catch/hour: 4.85

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
JELLYFISH	3.69	21	76.09	
Jelly	0.78	258	16.02	
C R U S T A C E A N S	0.15	1251	3.02	
Sternoptyx sp.	0.08	153	1.63	
Leptocephalus	0.06	21	1.22	
Selene dorsalis	0.02	82	0.47	
Lestidium sp.	0.02	31	0.40	
Ommastrephes bartrami	0.02	8	0.34	
Acanthusus sp. juvenile	0.01	17	0.26	
UNIDENTIFIED FISH	0.00	2	0.10	
Leachia atlantica	0.00	6	0.10	
BOTHIDAE	0.00	8	0.06	
TRICHIURIDAE	0.00	4	0.06	
Leachia atlantica	0.00	16	0.06	0
UNIDENTIFIED FISH	0.00	8	0.06	
FISH LARVAE	0.00	4	0.04	
PHOTICHTHYIDAE	0.00	6	0.02	
NOMEIDAE	0.00	4	0.02	
ISOPODS	0.00	2	0.01	
Sphyaena sp.	0.00	2	0.01	
Total	4.85		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 8  
 DATE :20/05/2011 GEAR TYPE: PT NO: 4 POSITION:Lat N 2°28.73  
 start stop duration Purpose : 1  
 LOG : 6524.45 6526.08 1.6 Region : 3200  
 FDEPTH: 0 0 Gear cond.: 0  
 BDEPTH: 2641 2704 Validity : 0  
 Towing dir: 0° Wire out : 110 m Speed : 3.2 kn  
 Sorted : 0 Total catch: 15.82 Catch/hour: 30.62

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Cubiceps sp.	23.88	815	78.01	0
MYCTOPHIDAE	2.61	275	8.51	
OMMASTREPHIDAE	1.09	815	3.55	
Ommastrephes bartrami	1.01	60	3.29	
Neolates tripes	0.63	33	2.05	
Leptocephalus	0.62	54	2.02	
Decapterus macarellus	0.23	2	0.75	
Brama brama	0.16	2	0.53	
Gonostoma sp.	0.11	325	0.34	
HEMIRAMPHIDAE	0.08	2	0.27	
BOTHIDAE	0.05	184	0.18	
UNIDENTIFIED FISH	0.05	120	0.18	
Shrimps, small, non comm.	0.04	283	0.14	
Diaphus sp.	0.02	66	0.06	
CARANGIDAE	0.02	87	0.05	
Acanthusus sp. juvenile	0.01	87	0.03	
UNIDENTIFIED FISH	0.01	434	0.03	
Caranx sp.	0.00	12	0.01	
Total	30.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 9  
 DATE :21/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°22.45  
 start stop duration Purpose : 1  
 LOG : 6550.64 6552.24 1.6 Region : 3200  
 FDEPTH: 48 56 Gear cond.: 0  
 BDEPTH: 2857 2853 Validity : 0  
 Towing dir: 0° Wire out : 140 m Speed : 3.1 kn  
 Sorted : 0 Total catch: 2.01 Catch/hour: 3.94

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
MYCTOPHIDAE	2.67	5342	67.76	
Leptocephalus	0.31	393	7.97	
PHOTICHTHYIDAE	0.18	389	4.48	
Shrimps, small, non comm.	0.10	393	2.49	
Ommastrephes bartrami	0.08	24	1.99	
Gonostoma sp.	0.08	275	1.99	
PARALEPIDIDAE	0.08	45	1.99	
Selene dorsalis	0.06	157	1.49	
Cubiceps sp.	0.06	2	1.49	
Unidentified crustacean	0.05	613	1.38	
Gymnoscopelus sp.	0.05	53	1.18	
TRICHIURIDAE	0.04	33	1.00	
Acanthusus sp. juvenile	0.04	165	1.00	0
UNIDENTIFIED FISH	0.04	96	1.00	
Diaphus sp.	0.04	26	1.00	
C R U S T A C E A N S	0.02	2060	0.60	
BOTHIDAE	0.01	39	0.30	
Acanthusus sp. juvenile	0.01	37	0.27	
Eustomias sp.	0.01	2	0.26	
Holocentrus ascensionis	0.01	20	0.17	
Decapterus sp.	0.00	6	0.04	
Carangoid 'deep' juvenile	0.00	4	0.02	
Antigonia 'deep'	0.00	10	0.02	
EUPHASIDAE *	0.00	27	0.02	0
Hippocampus sp.	0.00	2	0.01	
SQUILLIDAE	0.00	10	0.01	
FRIACANTHIDAE	0.00	2	0.01	
Nemichthys scolopaceus	0.00	2	0.00	
Hemicarax sp.	0.00	2	0.00	
Total	3.94		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 10  
 DATE :21/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°11.04  
 start stop duration Lon E 6°30.62  
 TIME :05:13:40 05:43:58 30.3 (min) Purpose : 1  
 LOG : 6581.05 6582.77 1.7 Region : 3200  
 FDEPTH: 30 52 Gear cond.: 0  
 BDEPTH: 3035 3046 Validity : 0  
 Towing dir: 0° Wire out : 120 m Speed : 3.4 kn  
 Sorted : 0 Total catch: 0.48 Catch/hour: 0.95

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 12  
 DATE :22/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°17.52  
 start stop duration Lon E 5°14.56  
 TIME :17:32:45 18:03:06 30.4 (min) Purpose : 1  
 LOG : 6729.24 6730.67 1.4 Region : 3200  
 FDEPTH: 380 382 Gear cond.: 0  
 BDEPTH: 3469 3463 Validity : 0  
 Towing dir: 0° Wire out : 750 m Speed : 2.8 kn  
 Sorted : 0 Total catch: 5.28 Catch/hour: 10.44

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Acanthusus sp. juvenile	0.00	6	0.00	
Leptocephalus	0.04	32	0.00	
BOTHIDAE	0.00	18	0.00	
Antigonia 'deep'	0.00	12	0.00	
Selene dorsalis	0.01	40	0.00	
C R U S T A C E A N S	0.02	190	0.00	
FISH LARVAE	0.00	4	0.00	
Gempylus sp.	0.26	2	0.00	
Gonostoma sp.	0.01	48	0.00	
Holocentrus ascensionis	0.00	4	0.00	
ISOPODS	0.00	8	0.00	
J E L L Y F I S H	0.12	640	0.00	
MYCTOPHIDAE	0.14	352	0.00	
NOMEIDAE	0.00	2	0.00	
Lestidium sp.	0.05	16	0.00	
PHOTICHTHYIDAE	0.05	168	0.00	
Scorpaena sp.	0.00	4	0.00	
Shrimps, small, non comm.	0.00	16	0.00	
OMMASTREPHIDAE	0.20	30	0.00	
Sternoptyx sp.	0.02	22	0.00	
Lepidopus sp.	0.01	14	0.00	
UNIDENTIFIED FISH	0.00	6	0.00	
Unidentified larvae	0.00	6	0.00	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Jelly	2.79	465	26.71	
Desmodema polystictum	2.59	2	24.82	
Argyropelecus aculeatus	0.47	125	4.55	
Chauliodus sloani	0.42	53	3.98	
Argyropelecus affinis	0.34	117	3.22	
Acanthephyra sp.	0.30	202	2.84	
J E L L Y F I S H	0.30	10	2.84	
Gonostoma denudata	0.28	32	2.65	
Symbolophorus sp.	0.26	51	2.46	
Cubiceps sp.	0.26	10	2.46	
Benthoosema sp.	0.20	83	1.89	
Melanostomias niger	0.20	6	1.89	
GONOSTOMATIDAE	0.20	34	1.89	
BATHYLAGIDAE	0.19	10	1.80	
Stomias boa boa	0.14	8	1.33	
Scopeloberyx sp.	0.14	99	1.33	
C E P H A L O P O D A	0.12	8	1.14	
Isistius brasiliensis	0.12	2	1.14	
DICERATIIDAE	0.12	4	1.14	
HISTIOTEUTHIDAE	0.10	4	0.95	
Neonesthes	0.08	2	0.76	
PENAEIDAE	0.08	16	0.76	
Leptocephalus	0.06	14	0.57	
MACROURIDAE	0.06	2	0.57	
MALACOSTEIDAE	0.04	2	0.38	
Glyphocrangon sp.	0.04	16	0.38	
Anoplogaster cornuta	0.04	2	0.38	
MELAMPHIDAE	0.04	6	0.38	
REGALECIDAE	0.04	2	0.38	
Astronesthes sp.	0.04	2	0.38	
MYCTOPHIDAE	0.04	77	0.38	
Electrona risso	0.04	6	0.36	
Caristius sp.	0.03	2	0.28	
PARALEPIDIDAE	0.03	10	0.27	
Lampyanctus sp.	0.02	4	0.23	
Electrona sp.	0.02	6	0.21	
CERATIIDAE	0.02	2	0.19	
Microstoma microstoma	0.02	2	0.19	
Small squids	0.02	2	0.19	
SCORPAENIDAE	0.02	2	0.16	
Scopelopsis multipunctatus	0.02	2	0.15	
Xenolepidichthys dagleishi	0.01	6	0.12	
Howella sherrboni	0.01	4	0.11	
Melamphaes sp.	0.01	18	0.11	
Diretmus argenteus	0.01	6	0.10	
MELANOSTOMIATIDAE	0.01	2	0.10	
Small squids unident.	0.01	2	0.10	
Polyipnus polli	0.01	6	0.09	
OMMASTREPHIDAE	0.01	4	0.09	
Ichthyococcus sp.	0.01	4	0.07	
Kali normani	0.01	2	0.07	
Euphausiacea	0.01	18	0.06	
Sternoptyx sp.	0.01	16	0.06	
TRICHIURIDAE	0.01	2	0.05	
Selene dorsalis	0.01	18	0.05	
Diaphus sp.	0.00	4	0.04	
Diplophos taenia	0.00	4	0.04	
PHOTICHTHYIDAE	0.00	16	0.04	
PRIACANTHIDAE	0.00	6	0.04	
BOTHIDAE	0.00	8	0.03	
Scorpaena sp.	0.00	2	0.02	
ISOPODS	0.00	4	0.02	
Gonostoma sp.	0.00	4	0.02	
Total	10.44	100.00		

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 11  
 DATE :21/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°26.31  
 start stop duration Lon E 5°43.56  
 TIME :18:20:00 18:52:32 32.5 (min) Purpose : 1  
 LOG : 6648.49 6650.31 1.8 Region : 3200  
 FDEPTH: 185 190 Gear cond.: 0  
 BDEPTH: 3160 3127 Validity : 0  
 Towing dir: 0° Wire out : 500 m Speed : 3.4 kn  
 Sorted : 0 Total catch: 1.85 Catch/hour: 3.42

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 13  
 DATE :23/05/2011 GEAR TYPE: PT NO: 4 POSITION:Lat N 2°3.17  
 start stop duration Lon E 6°10.85  
 TIME :00:15:56 00:45:58 30.0 (min) Purpose : 1  
 LOG : 6787.50 6788.98 1.5 Region : 3200  
 FDEPTH: 0 0 Gear cond.: 0  
 BDEPTH: 3246 3238 Validity : 0  
 Towing dir: 0° Wire out : 100 m Speed : 2.9 kn  
 Sorted : 0 Total catch: 49.84 Catch/hour: 99.58

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L L Y F I S H	0.52	103	15.12	
Aristaeomorpha sp.	0.48	240	14.04	
MYCTOPHIDAE	0.35	1051	10.26	
Benthoosema sp.	0.24	96	7.02	
Leptocephalus	0.17	22	4.86	
BATHYLAGIDAE	0.15	26	4.32	
OMMASTREPHIDAE	0.13	90	3.78	
Diaphus sp.	0.11	24	3.24	
Gymnoscopelus sp.	0.11	33	3.24	
Gonostoma denudata	0.09	22	2.70	
Astronesthes sp.	0.09	11	2.70	
Xenolepidichthys dagleishi	0.09	53	2.70	
Cubiceps sp.	0.07	24	2.16	
Bajacaliforni magalops	0.07	7	2.16	
Photonectes sp.	0.07	13	2.16	
EUPHASIDAE *	0.06	280	1.62	
Cubiceps sp.	0.06	6	1.62	0
CHIASMONTIDAE	0.06	2	1.62	
Chauliodus sloani	0.06	9	1.62	
PHOTICHTHYIDAE	0.05	120	1.35	
HISTIOTEUTHIDAE	0.04	2	1.08	
Lestidium sp.	0.04	9	1.08	
Argyropelecus aculeatus	0.04	26	1.08	
GONOSTOMATIDAE	0.04	9	1.08	
Symbolophorus sp.	0.04	15	1.08	
MELANOSTOMIATIDAE	0.04	2	1.08	
Sternoptyx sp.	0.02	37	0.54	
Histioteuthis sp.	0.02	2	0.54	
Zenion sp.	0.02	31	0.45	
Caristius sp.	0.01	7	0.44	0
MALACOSTEIDAE	0.01	4	0.39	
FISH LARVAE	0.01	6	0.38	
SCORPAENIDAE	0.01	2	0.34	
Scorpaena sp.	0.01	9	0.31	
MELAMPHIDAE	0.01	6	0.28	
Acanthusus sp. juvenile	0.01	13	0.24	
Stomias boa boa	0.01	4	0.17	
Selene dorsalis	0.01	18	0.15	
ASTRONESTHIDAE	0.01	9	0.15	
Melamphaes sp.	0.00	4	0.15	
ORHIDIIDAE	0.00	2	0.12	
Unidentified larvae	0.00	6	0.11	
Dicrolene sp.	0.00	2	0.11	
ISOPODS	0.00	7	0.10	
Gonostoma sp.	0.00	9	0.08	
TRICHIURIDAE	0.00	4	0.05	
Cyrtopsis roseus	0.00	2	0.05	
PRIACANTHIDAE	0.00	6	0.03	
BOTHIDAE	0.00	4	0.03	
Antigonia 'deep'	0.00	2	0.00	
Total	3.42	99.97		

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Cubiceps sp.	97.50	3528	97.91	
Illex coindetii	1.22	30	1.22	
Todaropsis eblanae	0.64	20	0.64	
MELANOSTOMIATIDAE	0.08	4	0.08	
Paradiplospinus gracilis	0.08	4	0.08	
GONOSTOMATIDAE	0.02	2	0.02	
Scomber sp.	0.01	2	0.01	
Symbolophorus sp.	0.01	2	0.01	
Unidentified juv fish	0.01	2	0.01	
Trachurus sp.	0.00	10	0.00	
Oxyporhamphus m. micropterus	0.00	4	0.00	
Astronesthes sp.	0.00	2	0.00	0
HEMIRAMPHIDAE	0.00	2	0.00	
Acanthusus sp. juvenile	0.00	2	0.00	
Total	99.57	99.99		

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 14  
 DATE :23/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 1°51.40  
 start stop duration Lon E 5°51.50  
 TIME :04:37:56 05:07:28 29.5 (min) Purpose : 1  
 LOG : 6820.06 6821.89 1.8 Region : 3200  
 FDEPTH: 22 30 Gear cond.: 0  
 BDEPTH: 3404 3409 Validity : 0  
 Towing dir: 0° Wire out : 90 m Speed : 3.7 kn  
 Sorted : 0 Total catch: 1.71 Catch/hour: 3.47

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Cubiceps sp.	2.50	96	72.10	
J E L Y F I S H	0.49	61	14.07	
Leptocephalus	0.14	148	4.10	
MYCTOPHIDAE	0.08	179	2.43	
KRILL *	0.05	323	1.58	
Unidentified crustacean	0.04	301	1.13	
Todaropsis eblanae	0.03	2	0.99	
ATHERINIDAE	0.03	73	0.73	0
PHOTICHTHYIDAE	0.02	173	0.64	
SQUILLIDAE	0.01	63	0.40	
Symbolophorus sp.	0.01	4	0.33	
BOTHIDAE	0.01	43	0.28	
Leachia atlantica	0.01	6	0.26	0
Leachia atlantica	0.01	179	0.26	
OMMASTREPHIDAE	0.01	6	0.24	
ATHERINIDAE	0.00	49	0.13	
Trachurus sp.	0.00	10	0.12	
Sphyræna sp.	0.00	8	0.07	
Unidentified larvae	0.00	6	0.03	
Selene dorsalis	0.00	6	0.02	
UNIDENTIFIED FISH	0.00	4	0.02	
Carangoid 'deep' juvenile	0.00	4	0.02	
ISOPODS	0.00	2	0.01	
Total	3.47		99.96	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 15  
 DATE :23/05/2011 GEAR TYPE: PT NO: 2 POSITION:Lat N 2°7.45  
 start stop duration Lon E 4°54.40  
 TIME :16:44:10 17:16:04 31.9 (min) Purpose : 1  
 LOG : 6887.39 6889.88 2.5 Region : 3200  
 FDEPTH: 35 45 Gear cond.: 0  
 BDEPTH: 3683 3689 Validity : 0  
 Towing dir: 0° Wire out : 150 m Speed : 4.7 kn  
 Sorted : 0 Total catch: 0.36 Catch/hour: 0.67

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Acanthusus sp. juvenile	0.03	30	0.00	
Leptocephalus	0.06	30	0.00	
BOTHIDAE	0.00	4	0.00	
Brama orcinii	0.01	2	0.00	
Antigonia 'deep'	0.00	4	0.00	
CARANGIDAE	0.00	2	0.00	
Caranx sp.	0.01	11	0.00	
Selene dorsalis	0.06	113	0.00	
C R U S T A C E A N S	0.00	2	0.00	
Unidentified crustacean	0.00	30	0.00	
E C H I N O D E R M A T A	0.00	4	0.00	
FISH LARVAE	0.00	2	0.00	
Gempylus sp.	0.00	2	0.00	
ISOPODS	0.01	23	0.00	
J E L Y F I S H	0.38	88	0.00	
KRILL *	0.00	2	0.00	
Pervagor sp	0.00	2	0.00	0
Cubiceps sp.	0.03	21	0.00	
Psenes sp.	0.02	9	0.00	
PHOTICHTHYIDAE	0.00	2	0.00	
Friacanthus juvenile	0.01	9	0.00	
Scorpaena sp.	0.00	2	0.00	
Scorpaena sp.	0.00	2	0.00	0
Sphyræna sp.	0.00	2	0.00	
CRANCHIIDAE	0.01	4	0.00	
Leachia atlantica	0.00	2	0.00	
OMMASTREPHIDAE	0.01	4	0.00	
Sternoptyx sp.	0.00	2	0.00	
TETRAODONTIDAE	0.00	6	0.00	
TRICHIURIDAE	0.00	4	0.00	
Unidentified fish	0.00	4	0.00	
Unid. juvenile fishes	0.00	6	0.00	
Unidentified fish	0.00	6	0.00	
UNIDENTIFIED FISH	0.01	6	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 16  
 DATE :24/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 2°1.08  
 start stop duration Lon E 4°8.60  
 TIME :01:10:28 01:41:31 31.1 (min) Purpose : 1  
 LOG : 6937.72 6939.30 1.6 Region : 3200  
 FDEPTH: 32 30 Gear cond.: 0  
 BDEPTH: 3964 3957 Validity : 0  
 Towing dir: 0° Wire out : 100 m Speed : 3.1 kn  
 Sorted : 0 Total catch: 6.66 Catch/hour: 12.87

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Cubiceps sp.	4.52	172	35.12	
Neolates tripes	3.52	300	27.32	
MYCTOPHIDAE	2.03	1842	15.76	
J E L Y F I S H	1.08	19	8.41	
Shrimps, small, non comm.	0.43	454	3.30	
Psenes arafurensis	0.25	2	1.95	
Diaphus sp.	0.23	164	1.80	
Gymnoscopelus sp.	0.19	70	1.50	
Leptocephalus	0.17	52	1.35	
Ommastrephes sp.	0.12	6	0.90	
OMMASTREPHIDAE	0.08	199	0.60	
Illex coindetii	0.06	25	0.45	
Psenes arafurensis	0.04	199	0.30	0
Histioteuthis sp.	0.04	37	0.30	
PARALEPIDIDAE	0.02	23	0.15	
Scombridae sp - Juvenile	0.02	54	0.15	
Holocentrus ascensionis	0.02	71	0.15	
Unidentified crustacean	0.02	166	0.15	
UNIDENTIFIED FISH	0.01	14	0.09	
Carangoid 'deep' juvenile	0.01	60	0.08	
BOTHIDAE	0.01	41	0.06	
Leachia atlantica	0.01	17	0.04	
NOMEIDAE	0.00	8	0.04	
Gonostoma sp.	0.00	23	0.03	
Unidentified crustacean	0.00	58	0.03	
Caranx sp.	0.00	4	0.02	
Unidentified juv fish	0.00	10	0.01	
ISOPOD	0.00	2	0.00	
SQUILLIDAE	0.00	2	0.00	
Alectis alexandrinus	0.00	2	0.00	
Total	12.88		100.09	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 17  
 DATE :24/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 1°39.37  
 start stop duration Lon E 5°12.67  
 TIME :17:09:52 17:40:57 31.1 (min) Purpose : 1  
 LOG : 7016.40 7017.79 1.4 Region : 3200  
 FDEPTH: 390 410 Gear cond.: 0  
 BDEPTH: 3621 3614 Validity : 0  
 Towing dir: 0° Wire out : 710 m Speed : 2.7 kn  
 Sorted : 0 Total catch: 3.67 Catch/hour: 7.09

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L Y F I S H	2.39	369	33.75	
Argyropelecus affinis	0.62	207	8.71	
Chauliodus sloani	0.58	89	8.17	
HISTIOTEUTHIDAE	0.39	12	5.44	
Symbolophorus sp.	0.31	14	4.44	
Leptocephalus	0.27	21	3.81	
Acanthephyra sp.	0.27	369	3.81	
Benthosema sp.	0.24	19	3.35	
Argyropelecus aculeatus	0.21	37	2.99	
MYCTOPHIDAE	0.20	251	2.84	
Ommastrephes sp.	0.19	4	2.72	
Lampadena sp.	0.17	2	2.45	0
MALACOSTEIDAE	0.17	12	2.45	
Brama orcinii	0.15	2	2.18	
Electrona risso	0.14	21	1.91	
Stomias boa boa	0.08	31	1.09	
REGALECIDAE	0.08	17	1.09	
Diretmus argenteus	0.07	12	0.93	
Melanostomias sp.	0.06	4	0.82	
Diaphus hudsoni	0.06	2	0.82	
Gonostoma atlanticum	0.06	15	0.82	0
Diaphus sp.	0.06	12	0.82	
Scopeloberyx sp.	0.05	42	0.68	
EUPHASIDAE *	0.04	108	0.54	
Gonostoma denudata	0.04	6	0.54	
ANOSTOMATIDAE	0.04	15	0.54	
Astronesthes sp.	0.02	6	0.23	
Xenolepidichthys dagleishi	0.02	6	0.22	
Polyipnus polli	0.01	10	0.20	
Scopelarchoides cf danae	0.01	2	0.17	
ALEPOCEPHALIDAE	0.01	2	0.16	
MELANOSTOMIATIDAE	0.01	2	0.16	
Sternoptyx sp.	0.01	17	0.16	0
Lestidium sp.	0.01	4	0.11	
OMMASTREPHIDAE	0.01	10	0.10	
SCOPELARCHIDAE	0.01	4	0.10	
PENAEIDAE	0.01	2	0.10	
Gymnoscopelus sp.	0.01	2	0.10	
Diplophos taenia	0.01	8	0.10	
PHOTICHTHYIDAE	0.00	25	0.07	
NOMEIDAE	0.00	2	0.06	
ARGENTINIDAE	0.00	2	0.05	
Macrostomias longibarbat	0.00	2	0.04	
TETRAODONTIDAE	0.00	4	0.03	
Ichthyococcus sp	0.00	2	0.03	
Gonostoma sp.	0.00	6	0.03	
Scorpaena sp.	0.00	2	0.03	
Acanthusus sp. juvenile	0.00	6	0.02	
Holocentrus ascensionis	0.00	2	0.01	
Zenion sp.	0.00	2	0.01	
Antigonia 'deep'	0.00	2	0.01	
SCOREPENIDAE	0.00	2	0.01	
CARANGIDAE	0.00	4	0.01	
Total	7.09		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 18  
 DATE :25/05/2011 GEAR TYPE: PT NO: 4 POSITION:Lat N 1°22.34  
 start stop duration Lon E 4°49.14  
 TIME :00:17:50 00:47:52 30.0 (min) Purpose : 1  
 LOG : 7068.45 7070.23 1.8 Region : 3200  
 FDEPTH: 10 10 Gear cond.: 0  
 BDEPTH: 3756 3761 Validity : 0  
 Towing dir: 0° Wire out : 90 m Speed : 3.6 km  
 Sorted : 0 Total catch: 91.33 Catch/hour: 182.47

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Cubiceps sp.	176.32	6737	96.63	
Neolates tripes	1.80	86	0.99	
Electrona sp	1.35	1518	0.74	
Illex coindetii	1.00	16	0.55	
Centrolophus sp.	0.80	20	0.44	
OMMASTREPHIDAE	0.80	226	0.44	
Leptocephalus	0.15	16	0.08	
Paradiplosinus gracilis	0.10	6	0.05	
Shrimps, small, non comm.	0.10	669	0.05	
CARANGIDAE	0.05	120	0.03	
Scombridae sp - Juvenile	0.05	30	0.03	
Holocentrus ascensionis	0.02	6	0.01	
BOTHIDAE	0.01	60	0.01	
Unidentified crustacean	0.01	80	0.01	
Nemichthys sp.	0.00	6	0.00	
Carangoid 'deep' juvenile	0.00	6	0.00	
UNIDENTIFIED FISH	0.00	6	0.00	
Unidentified juv fish	0.00	6	0.00	
Caranx sp.	0.00	6	0.00	
Total	182.57		100.05	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 19  
 DATE :25/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 1°48.53  
 start stop duration Lon E 3°35.65  
 TIME :08:41:27 09:09:11 27.7 (min) Purpose : 1  
 LOG : 7146.66 7147.66 1.0 Region : 3200  
 FDEPTH: 340 350 Gear cond.: 0  
 BDEPTH: 4138 4142 Validity : 0  
 Towing dir: 0° Wire out : 700 m Speed : 2.2 km  
 Sorted : 0 Total catch: 1.39 Catch/hour: 3.01

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Cubiceps sp.	0.65	24	21.55	
Gonostoma denudata	0.39	84	12.93	
Electrona risso	0.28	43	9.34	
Leptocephalus	0.26	35	8.62	
J E L Y F I S H	0.22	43	7.18	
OMMASTREPHIDAE	0.19	48	6.47	
Gonostoma atlanticum	0.17	43	5.75	
GONOSTOMATIDAE	0.15	93	5.03	
MYCTOPHIDAE	0.15	379	5.03	
Electrona sp	0.11	89	3.59	
HISTIOBUTHIDAE	0.09	15	2.87	
Ichthyococcus sp	0.06	17	2.16	
Chaulioides sloani	0.04	2	1.44	
Opistoproctus grimaldi	0.04	11	1.44	
Polyipnus polli	0.04	37	1.28	
Diaphus sp.	0.04	13	1.26	
CRANCHIIDAE	0.03	11	0.98	
PHOTICHTHYIDAE	0.02	71	0.51	
Xenolepidichthys dagleishi	0.01	2	0.40	
Shrimps, small, non comm.	0.01	48	0.35	
Scopelarchoides cf danae	0.01	2	0.32	
Unidentified crustacean	0.01	13	0.23	
Microstoma microstoma	0.01	2	0.22	
Gonostoma sp.	0.00	19	0.17	
Rossia sp.	0.00	2	0.14	
REGALCIDAE	0.00	9	0.14	
Scopelarchoides sp	0.00	2	0.12	
OPHIIDAE	0.00	2	0.10	
Selene dorsalis	0.00	9	0.06	
BOTHIDAE	0.00	6	0.05	
TRICHIURIDAE	0.00	2	0.05	
C R U S T A C E A N S	0.00	4	0.04	0
Acanthus sp. juvenile	0.00	4	0.04	
NEMICHTHYIDAE	0.00	2	0.03	
Fistularia sp.	0.00	2	0.02	
Isopod	0.00	2	0.02	
SCOPELARCHIDAE	0.00	2	0.02	0
FISH LARVAE	0.00	2	0.01	
Scorpaena sp.	0.00	2	0.01	
NOMEIDAE	0.00	2	0.01	
Total	3.01		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011405 STATION: 20  
 DATE :25/05/2011 GEAR TYPE: PT NO: 1 POSITION:Lat N 1°49.28  
 start stop duration Lon E 3°32.93  
 TIME :09:47:56 10:20:22 32.4 (min) Purpose : 1  
 LOG : 7149.60 7151.52 1.9 Region : 3200  
 FDEPTH: 40 50 Gear cond.: 0  
 BDEPTH: 4147 4156 Validity : 0  
 Towing dir: 0° Wire out : 130 m Speed : 3.6 km  
 Sorted : 0 Total catch: 0.85 Catch/hour: 1.58

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
JELLYFISH	1.02	135	64.48	
Leptocephalus	0.24	41	15.24	
Jelly	0.15	592	9.38	
OMMASTREPHIDAE	0.05	41	3.42	
Selene dorsalis	0.04	72	2.26	
C R U S T A C E A N S	0.03	124	1.89	
TRICHIURIDAE	0.01	11	0.80	
BOTHIDAE	0.01	22	0.49	
Trachurus sp.	0.01	13	0.48	
UNIDENTIFIED FISH	0.01	2	0.39	
SCORPAENIDAE	0.01	2	0.34	
Cubiceps sp.	0.00	4	0.16	
Caranx sp.	0.00	6	0.15	
ARGONAUTIDAE	0.00	2	0.14	
Scorpaenid sp.	0.00	4	0.14	
NOMEIDAE	0.00	4	0.08	
Priacanthus sp.	0.00	4	0.08	
ZEIDAE	0.00	4	0.05	
GEMPYLIDAE	0.00	4	0.05	
Total	1.58		100.	



## 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 were 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
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Transducer depth	5.5 m
Absorption coeff.	10 dB/km
Pulse length	medium (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
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### Calibration

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