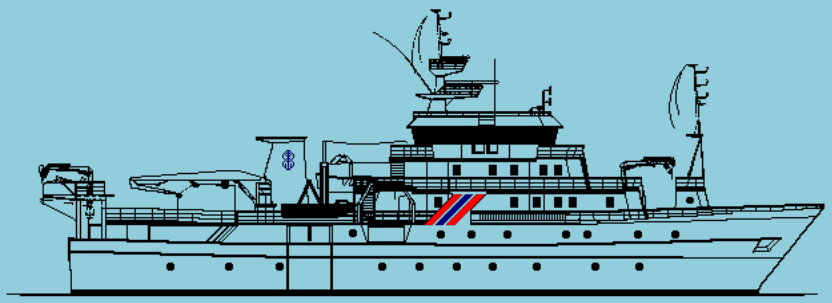

SURVEY OF THE MESOPELAGIC FISH AND ENVIRONMENT IN THE BAY OF BENGAL

Cruise report No 8/2013

22 October – 03 November 2013

National Aquatic Resources Research and Development Agency
Colombo, Sri Lanka

Institute of Marine Research
Bergen , Norway

Bergen 2014

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 œuvre 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 œuvre et le suivi des progrès de la mise en œuvre de plans d'aménagement des ressources marines conformes à l'approche écosystémique des pêches.

CRUISE REPORTS 'DR FRIDTJOF NANSEN'

SURVEY OF THE MESOPELAGIC FISH AND ENVIRONMENT IN THE BAY OF BENGAL

22 October – 03 November 2013

by

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2014

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CHAPTER 1 INTRODUCTION

1.1 Objective of the cruise

The main objectives of the survey were to study the distribution of mesopelagic fish and plankton in international waters, in an area east of Sri Lanka EEZ. The Oxygen minimum zone in deep water and the behaviour of fish resources like the mesopelagic fish in relation to this minimum and other oceanographic features were questions of main interest.

- To map the distribution and estimate the biomass of mesopelagic fish
- To map the hydrographic regime by doing five transects
- To map the distribution of plankton

1.2 Participation

Members of the scientific teams were:

National Aquatic Resources Research and Development Agency, Sri Lanka:
Arulananthan K, Jinadasa, S.U.P., Priyadarshani W.N.C., Maldeniya R.R.P., Gammanpila M., Harischandra K.A.D.T., Indika K.W. and Rathnasuriya M.I.G.

Institute of Marine Research, Norway:
Reidar TORESEN, Diana ZAERA-PEREZ, Thor KLEVJER, Tor Magne ENSRUD, Ole Sverre FOSSHEIM and Håkon Matre LANGØEN

1.3 Narrative

The course tracks with the fishing and hydrographical stations are shown in Figure 1 a-c.

The vessel left Colombo on the 23rd October in the morning. The survey was carried out in international waters in the Bay of Bengal and started about 200 NM east of Trincomalee. Five parallel transects, west – east, 150 NM long, 60 NM apart were carried out. Trawling were carried out on registrations of pelagic fish and mesopelagic fish. The vessel returned to Colombo in the morning, on the 3rd of November.

CHAPTER 2 SAMPLING AND ESTIMATION METHODS

2.1 Hydrographical sampling

Survey effort

Alltogether 1200 NM were sailed during the survey. For sampling of data, 38 CTD stations, 10 plankton stations and 22 pelagic trawl stations were carried out. Details on survey effort is given in the text table.

	Oceanographic			Biological										
	CTD	Oxygen	Salinity	Phytoplankton	Zooplankton		Micro zoplankton	Nutrients	Chlorophyll	Chlorophyll mix	Length frequency	Biology	Pelagic trawls	NM
					Multinet (180 µ)	WP2 (180µ)	Juday (90µ)							
Day	22										14		12	
Night	16										17	1	10	
TOTAL	38	209	23	10	10	10	10	306	207	34	31	1	22	1015

CTD

A Seabird 911+ CTD probe was used to obtain vertical profiles of the temperature, salinity and oxygen. Real time logging was carried out using the PC based Seabird Seasave software. CTD casts were conducted at five transects, 150 NM long, 60 NM apart. The casts were stopped at 1000 meters. Additional CTD stations were added on some of the trawl stations.

Attached to the CTD was also a Chelsea fluorometer of the type Mk III Aquatrack. It measures fluorescence, which can be converted to chlorophyll A in microgram per litre with an uncertainty of 3%. Factory slope and offset was 0.921 and -0.02.

Thermosalinograph

The SBE 21 Seacat thermosalinograph was running routinely during the survey, obtaining samples of sea surface salinity (in PSU) 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 5 m 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

Note that the calibration status of both fluorescence sensors (CTD + Thermosalinograph) is uncertain, and values should be treated as relative values.

Current speed and direction measurements (ADCP)

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

Meteorological data were logged by the Norwegian Meteorological Institute's (DNMI) meteorological station on board, included air temperature, humidity, air pressure, wind direction and speed, and sea surface temperature (SST). All data were averaged by unit distance sailed (1 nautical mile, NM).

2.2 Biological sampling

Plankton sampling

Phytoplankton

Phytoplankton was sampled through 2 different gears, water was directly drawn from the Niskin bottles on the CTD-frame, and by means of a phytoplankton net, mesh size 10 µm, sampled vertically from 50 to 0 m. The net samples are qualitative, and are meant to catch both frequent and rare species, to give an overview over species present in the areas. The mixed bottle samples are quantitative, and should be used to estimate densities of important species in the area. These samples were taken by mixing 20 ml of water from each of the predefined depths (0-10-30-50 meter in shallow samples, and 75-100-125-150 m in the deep samples). If samples are well-mixed (turn bottles prior to analysis), one can easily calculate densities by counting all occurrences of a species in a defined volume. The mixed bottle samples are fixated in Lugol, whereas the phytoplankton net samples are fixated in formaldehyde. NARA will be responsible for the processing of the fixated zooplankton samples.

Zooplankton

Zooplankton samples were collected with Juday nets (90 µm mesh size, vertically sampled from 200 – 0 m), WP2 nets (180 µm mesh size, vertically sampled from 200 – 0 m) and the Multinet system (405 µm (should have been 180 µm, but wrong nets were used. Nets used are in general not marked, but one of them is marked with 405, so this mesh size is assumed) mesh size, vertically sampled from 900 – 0 m, the vertical range split into 5 intervals per Multinet, 900-500, 500-200, 200-100,100-50, 50-0). Half of each sample from each of these nets was fixated in 4% borax buffered formaldehyde, and should be used for estimating densities of taxonomically resolved groups (see below). The other half of each sample was fractionated according to size, dried, and will be used for estimating biomasses of different size fraction of zooplankton. Weighing of the biomass samples will be performed at IMR.

Fish sampling

A brief description of the fishing gear is provided in Annex II. All trawl catches were sampled for species composition by weights and numbers. Records of catch rates are given in Annex I. Total length (TL) frequencies in mm were taken for: *Diaphus effulgens*, *Vinciguerria* sp. and *Myctophidae*.

Stomach samples of mesopelagic fish were collected at three trawl stations as shown in the text table:

Details of samples:

	Trawl station	Trawl station	Trawl station
Station	19	20	21
No. Sample	45	35	27
Sample containers	107 Plastic small bottles One plastic box		

Methodology of sample collection and preservation:

- *Diaphus eflfugeus* were measured to the nearest 1 mm standard length (SL).
- All fish were weighed and stomach dissected out by cutting it at the posterior end at the esophagus and at the pyloric valve.
- The weighed guts were preserved in 90% alcohol.
- The following will be estimated ;

  Fullness

  Stomach content up to lowest possible taxa

All data on fishing stations and fish length sampling were made available to the participants on diskettes.

The complete records of fishing stations are shown in Annex I.
An overview of plankton samples are shown in Annex IV.

2.3 Acoustic sampling

Acoustic equipment

Acoustic data were recorded using a Simrad ER60 scientific echo sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38, 120 and 200 kHz. The survey was started without *a priori* calibration.

Acoustic data were logged and post-processed using the latest acoustic data post-processing software, the Large Scale Survey System (LSSS) Version 1.25. The technical specifications and operational settings of the echo sounder used during the survey are given in Annex II.

Allocation of acoustic energy to species group

The acoustic data were scrutinized using the LSSS version 1.6.1. Scatters were displayed at 38 kHz. The 1 nautical miles (NM) area backscattering coefficient s_A (m^2/NM^2) was allocated to a predefined set of species groups on the basis established echogram features. Acoustic groups and respective species are listed in Table 3. Ground truthing and estimation of mean length and weight were accomplished by means of targeted pelagic trawling.

The following target groups were used:

1) mesopelagic fish,
2) other pelagic carangids and associated species
3) other clupeids

Estimation of abundances indices

The target strength (TS) function used to convert mean area backscattering coefficient s_A (m^2/NM^2) at 38 kHz to number of fish (Ona 2014) corresponds to:

$$TS = 20 \log L - 71 \text{ (dB)} \quad (1)$$

or

$$C_F = \frac{10^{7.1}}{4\pi} \cdot L^{-2} \quad (2)$$

Or on a much simpler form:

$$CF = \frac{1.001821 \cdot 10^6}{\bar{L}^2}$$

where C_F is the conversion factor from acoustic density to fish biomass and L is the mean total fish length.

The biomass was calculated by multiplying the number of fish by the mean weight at that length.

In order to split and convert the allocated s_A – values (m^2/NM^2) to fish densities (numbers per length group per NM^2), the following formula is generally used:

$$\rho_i = S_A \cdot \frac{p_i}{\sum_{i=1}^{n} \frac{p_i}{C_{F_i}}}$$

where

Δ_i = density of fish in length group *i*

S_A = mean integrator value

p_i = proportion of fish in length group *i*

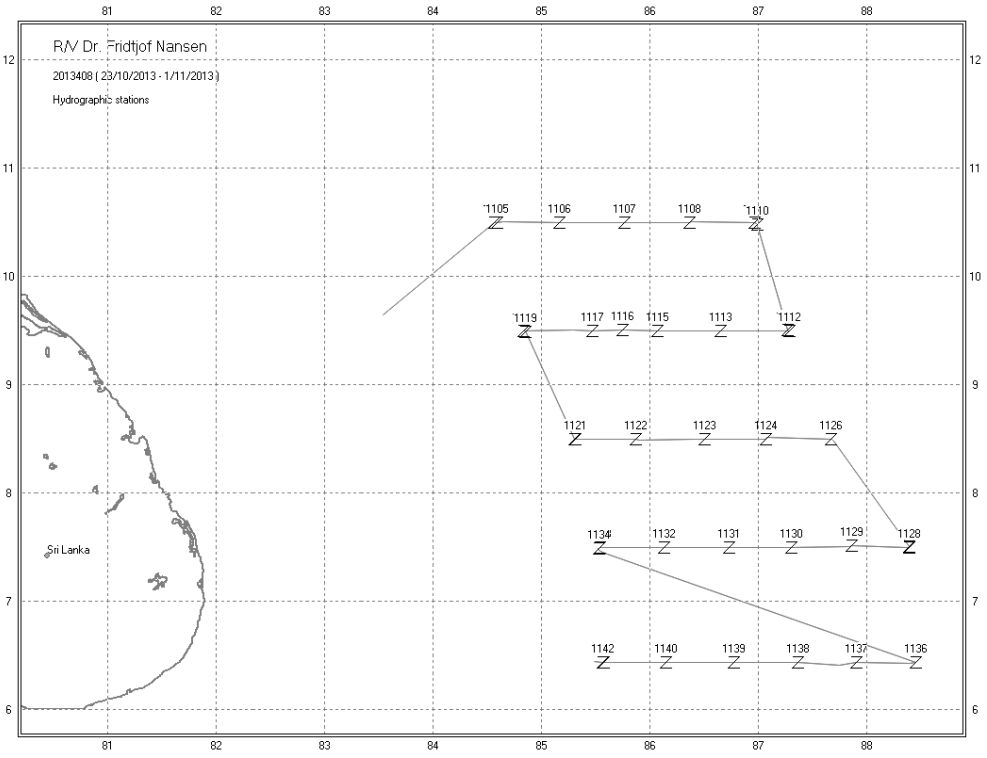
$\sum_{i=1}^{n} \frac{p_i}{C_{Fi}}$ = the relative back scattering cross section (m^2) of the length frequency sample of the target species, and

C_{fi} = reciprocal back scattering cross section (σ_{bs}^{-1}) of a fish in length group *i*.

The above equations show that the conversion from s_A-values to number of fish is dependent on the length composition of the fish. It is therefore important to get representative length distributions from the stock in the whole distribution area. However, in the surveyed area there was a mixture of many species of mesopelagic fishes, and the data are too inaccurate to make separate estimates of the abundance of each of them. Therefore, in this survey, one mean length of mesopelagic fish (4 cm) was chosen for the purpose of converting the Sa-values to abundance of fish.

The density estimates area converted to total estimates in the surveyed area when the size of the area is known. The numbers are converted to biomass using the weight at length. The weight of mesopelagic fish at 4 cm was measured to be ~ 1 gr, and this value was used in the calculations of biomass.

a)



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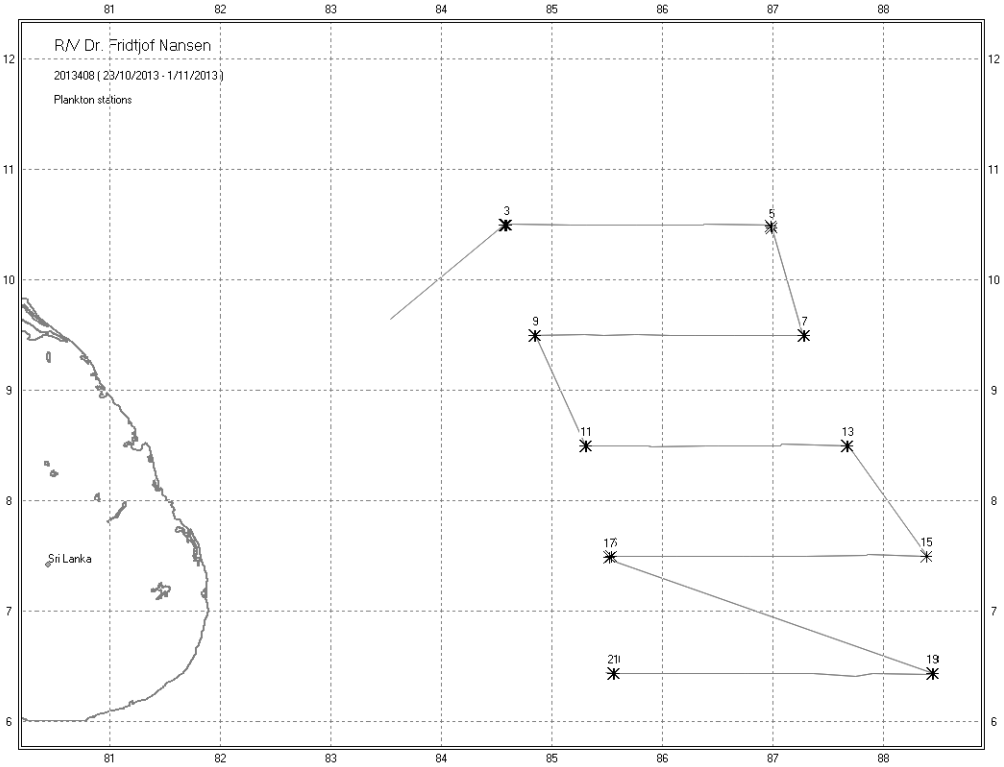

c)

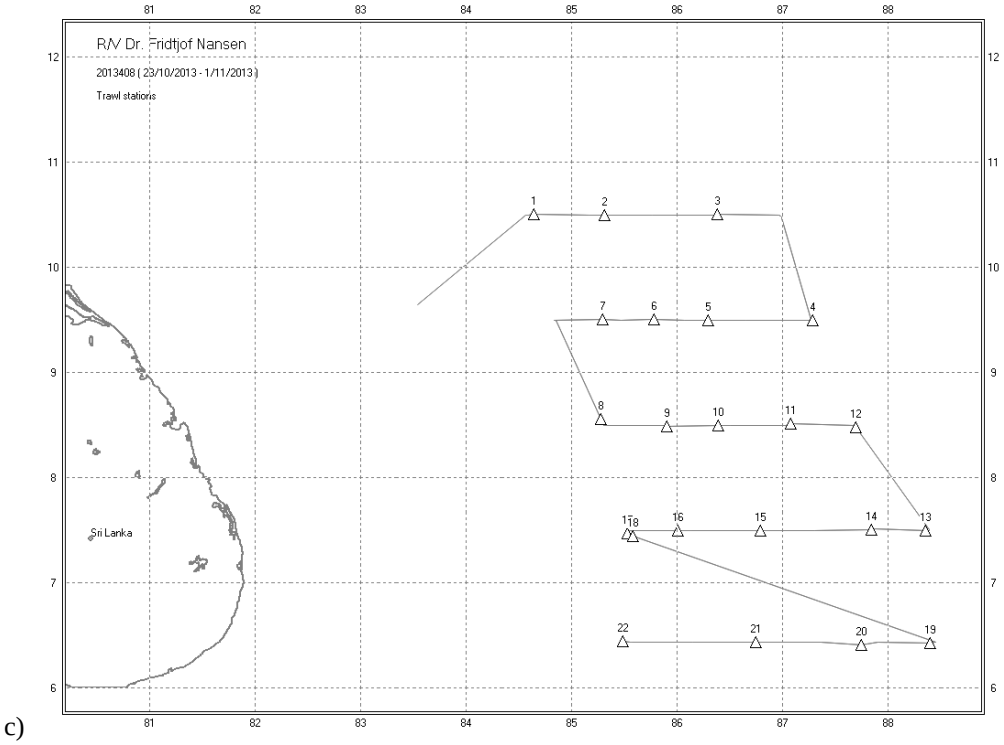

Figure 1,a – c. Course tracks with a) CTD stations, b) plankton stations, and c) fishing stations

CHAPTER 3 SURVEY RESULTS

3.1 Hydrography

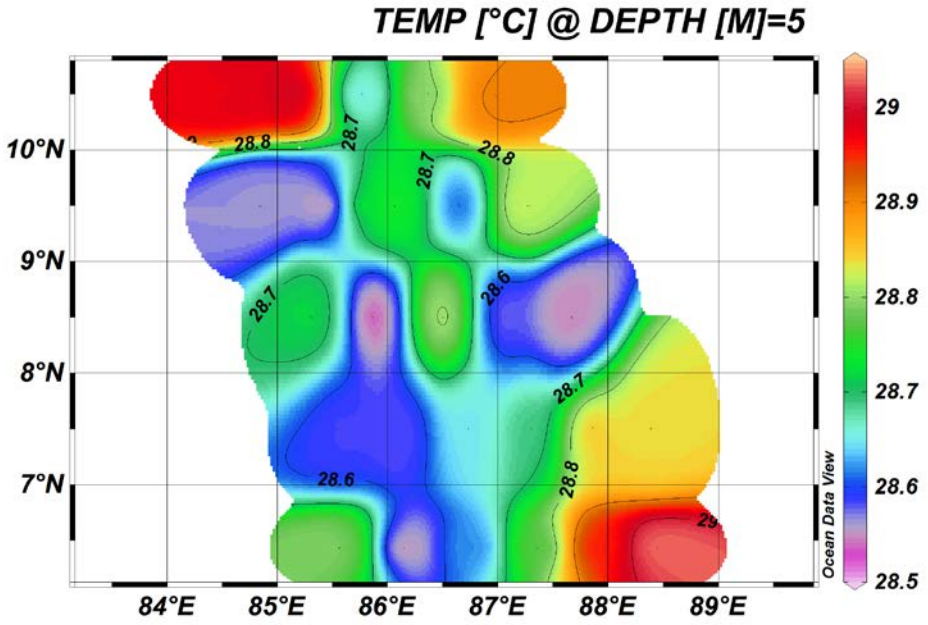

Figure 2a. Surface temperature (5 m depth) in the surveyed area.

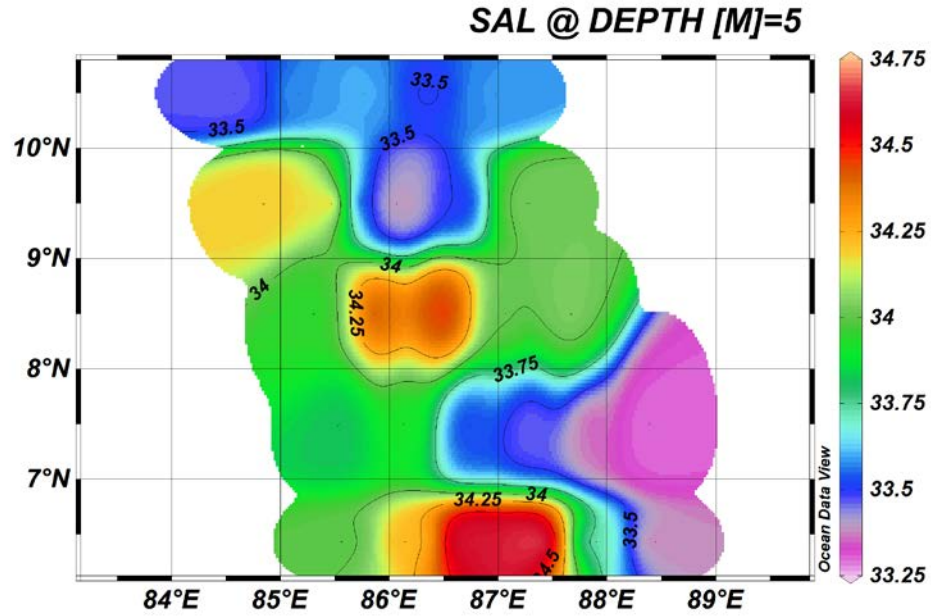

Figure 2b. Surface salinity (5 m depth) along the cruise line.

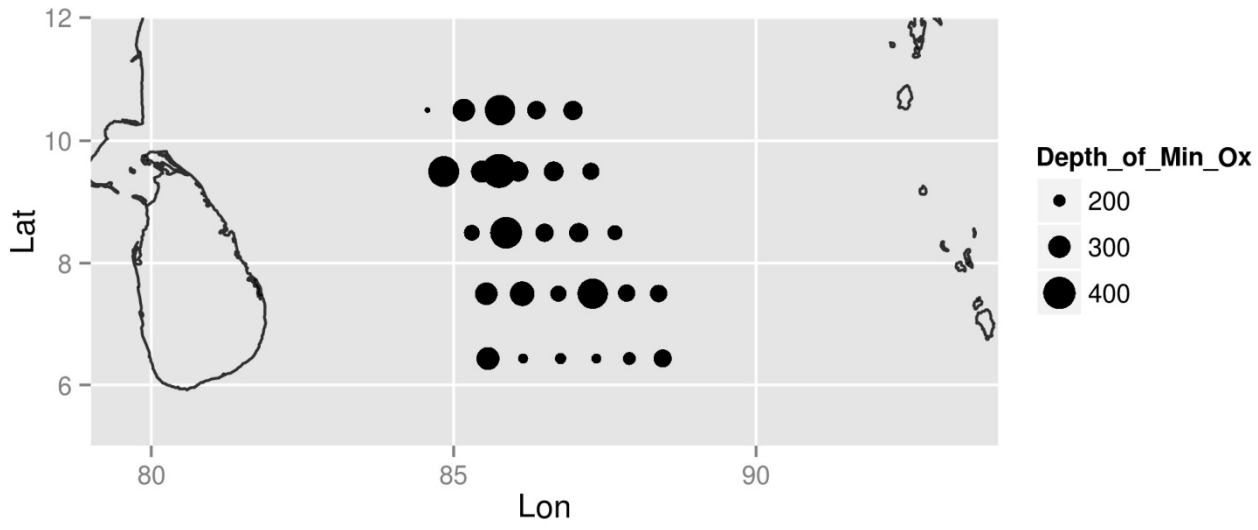

Figure 3. Depth of minimum oxygen.

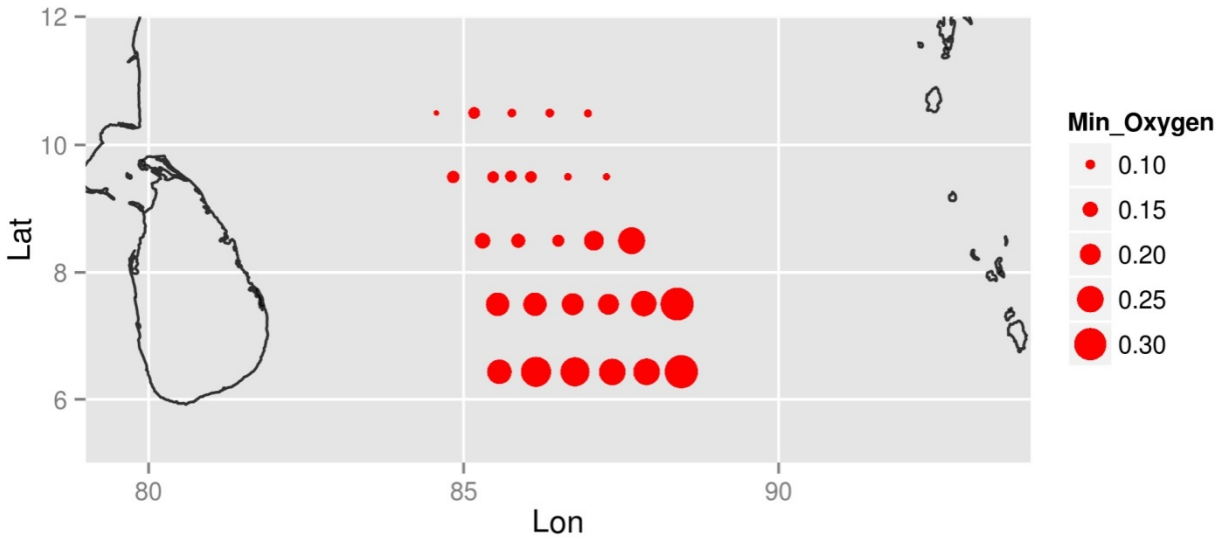

Figure 4. Minimum oxygen levels, levels in ml l^{-1} based on CTD sensor.

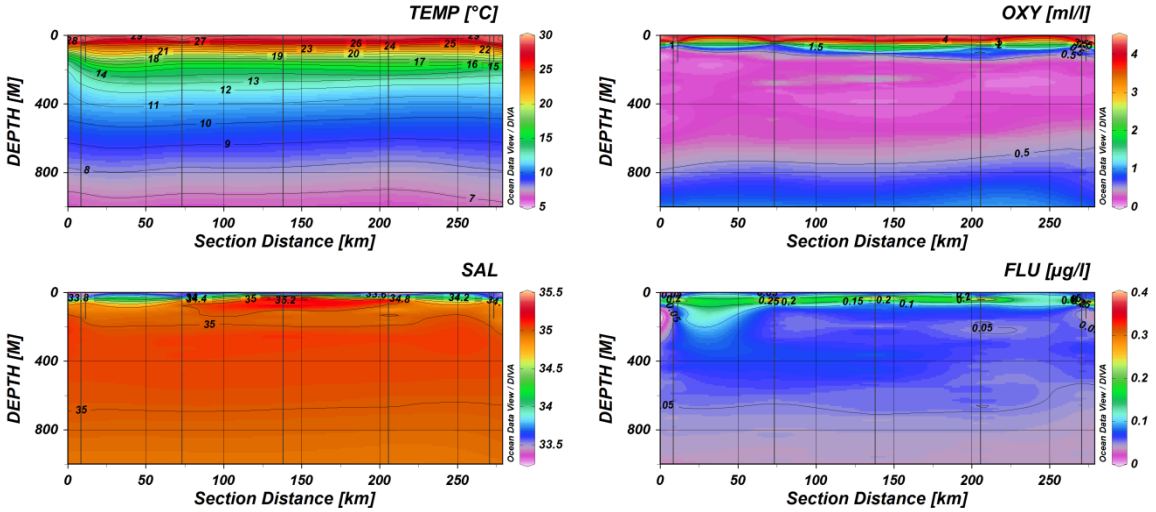

Figure 5 a, Temperature, salinity, oxygen and fluorescence along **Section 1**.

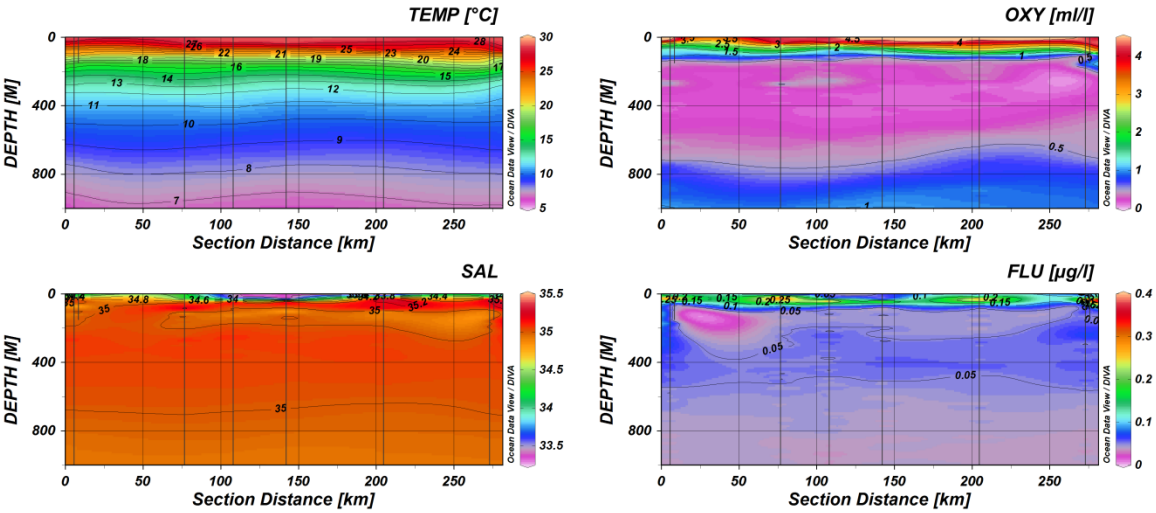

Figure 5 b, Temperature, salinity, oxygen and fluorescence along **Section 2**.

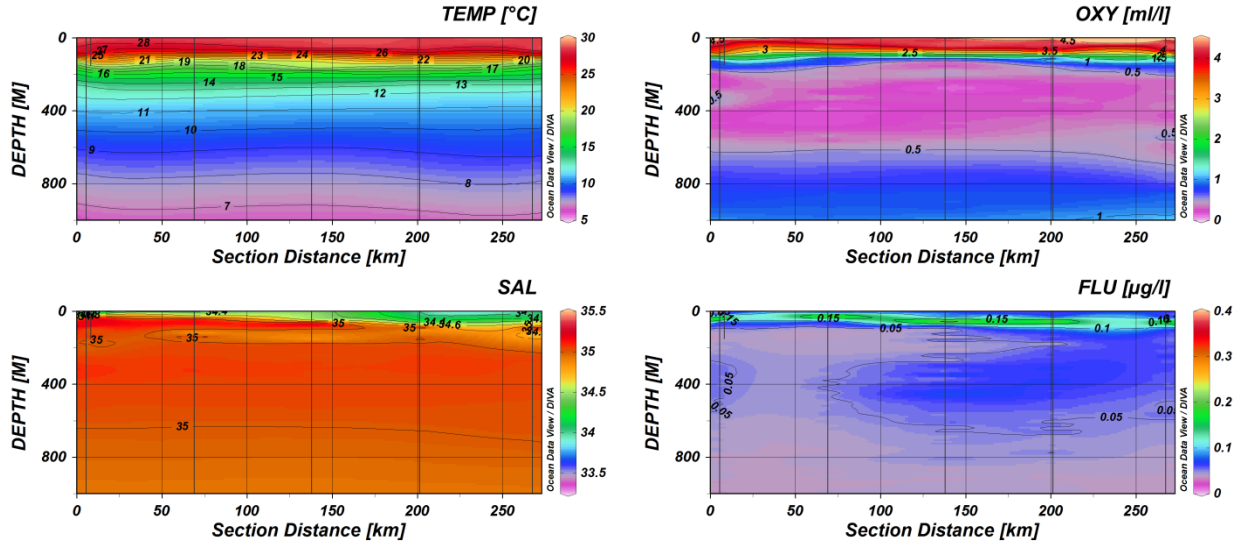

Figure 5 c, Temperature, salinity, oxygen and fluorescence along **Section 3**.

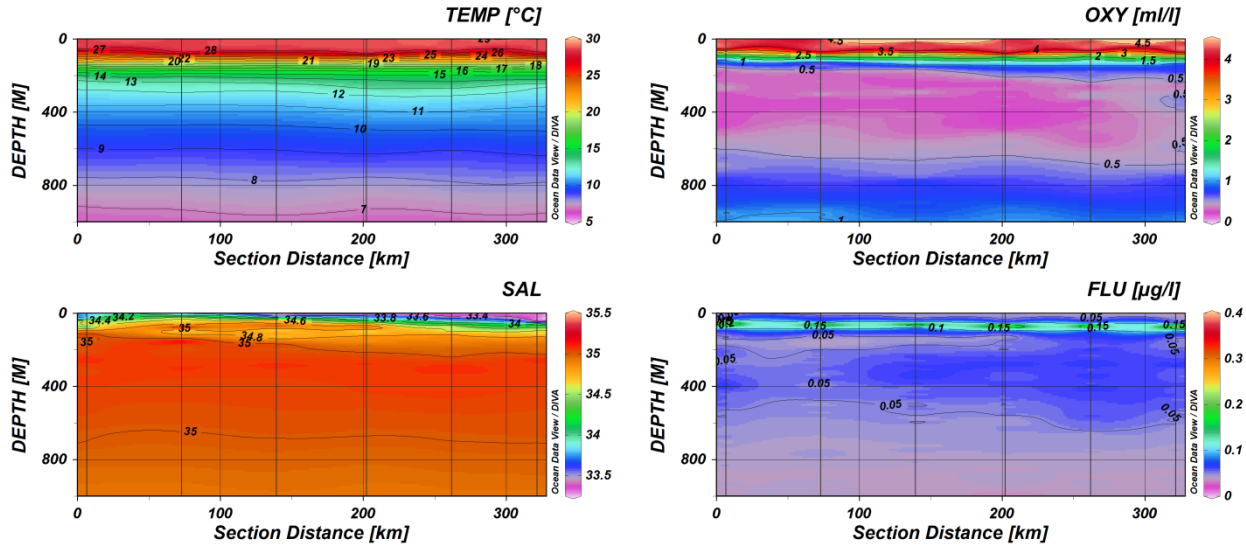

Figure 5 d, Temperature, salinity, oxygen and fluorescence along **Section 4**.

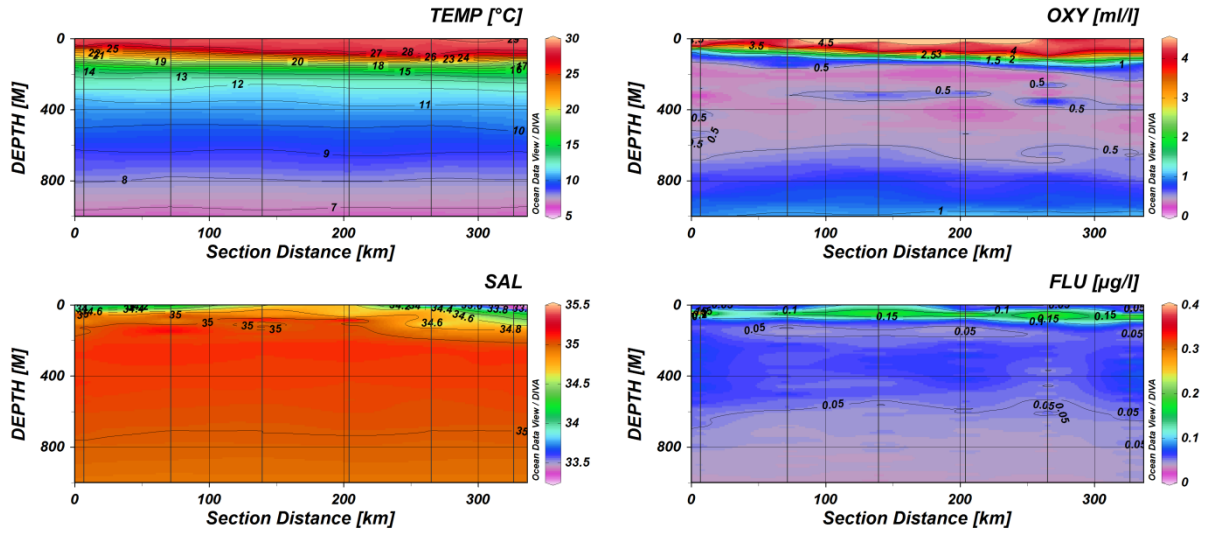

Figure 5 e, Temperature, salinity, oxygen and fluorescence along **Section 5**.

Surface temperature ranged from 27,6 to 29,6 ^{o}C, Figure 2a and Figure 5a-e, while surface salinity ranged from 33,3 to 35,5 ^{o}/oo, Figure 2b and Figure 5a-e. The minimum oxygen levels were detected in the different CTD casts, and the depths of the local minima plotted against position (Fig. 3), as were the minimum values detected (Fig. 4). Minimum oxygen levels were found in the depth range 133 to 418 m (Table 1 and Figure 5 a-e), and there may have been a slight tendency for the local oxygen minima to occur deeper in the northwestern casts (Fig. 3 and Figure 5a-e), overall the mean depth of minimum oxygen was ~275 m. There was however a clear pattern in the distribution of the lowest minimum oxygen values (Fig. 4), with the lowest values appearing in the north (Figure 5a).

Cast	Date	Lat	Lon	Depth of Min Oxygen	Min Oxygen Value (ml l^{-1})	Depth of Max Chlf.	Max Chlf. (µg l^{-1})	Mean Chlf. 15-150 (µg l^{-1})
1104	2013-10-25 05:35	10.5002	84.5672	133	0.06	45	0.25	0.08
1106	2013-10-25 13:08	10.5002	85.1677	303	0.12	44	0.32	0.08
1107	2013-10-25 17:47	10.4990	85.7665	381	0.09	35	0.26	0.08
1108	2013-10-25 21:49	10.4990	86.3673	262	0.09	41	0.26	0.08
1109	2013-10-26 02:57	10.4937	86.9728	271	0.09	55	0.28	0.08
1111	2013-10-26 11:50	9.5020	87.2680	249	0.08	33	0.29	0.08
1113	2013-10-26 19:22	9.5002	86.6530	275	0.08	32	0.25	0.08
1114	2013-10-27 00:09	9.4988	86.0680	279	0.12	44	0.19	0.06
1116	2013-10-27 03:47	9.5088	85.7498	418	0.12	43	0.25	0.08
1117	2013-10-27 06:08	9.4972	85.4680	298	0.12	28	0.28	0.10
1118	2013-10-27 11:41	9.4980	84.8355	386	0.12	30	0.28	0.08
1120	2013-10-27 21:41	8.4978	85.3007	236	0.15	43	0.17	0.08
1122	2013-10-28 03:51	8.4982	85.8673	395	0.14	28	0.19	0.06
1123	2013-10-28 09:48	8.4988	86.5025	260	0.12	58	0.21	0.07
1124	2013-10-28 13:47	8.4993	87.0677	270	0.19	55	0.20	0.08
1125	2013-10-28 18:34	8.4990	87.6668	228	0.25	59	0.17	0.07
1127	2013-10-29 05:18	7.5025	88.3888	252	0.31	74	0.21	0.08
1129	2013-10-29 12:13	7.5098	87.8595	251	0.24	69	0.18	0.07
1130	2013-10-29 16:49	7.4993	87.2992	381	0.20	72	0.19	0.07
1131	2013-10-29 21:19	7.5002	86.7315	240	0.21	66	0.16	0.07
1132	2013-10-30 01:13	7.4988	86.1318	323	0.22	65	0.16	0.07
1133	2013-10-30 06:13	7.4988	85.5398	303	0.22	54	0.22	0.08
1135	2013-10-31 05:00	6.4363	88.4550	259	0.31	62	0.18	0.07
1137	2013-10-31 11:56	6.4343	87.9038	207	0.25	57	0.20	0.09
1138	2013-10-31 17:26	6.4327	87.3595	177	0.25	53	0.20	0.07
1139	2013-10-31 21:28	6.4342	86.7677	189	0.27	49	0.18	0.08
1140	2013-10-01 02:18	6.4340	86.1483	178	0.28	49	0.18	0.07

Table 1. Depth and values for oxygen minima and fluorescence maxima from the different deep CTD casts.

3.2 Plankton

Phytoplankton

Phytoplankton constitutes the base of the marine pelagic food chain, and is therefore the basis for production at all higher trophic levels. To assess phytoplankton and estimate primary

production we sampled phytoplankton using a combination of nets, water samples and filtering of water samples, as well as measurements of fluorescence both underway and on the CTD. Apart from the measurements of fluorescence, these samples are time and labor-intensive to work up, and results for phytoplankton were not ready by the time of writing of this report.

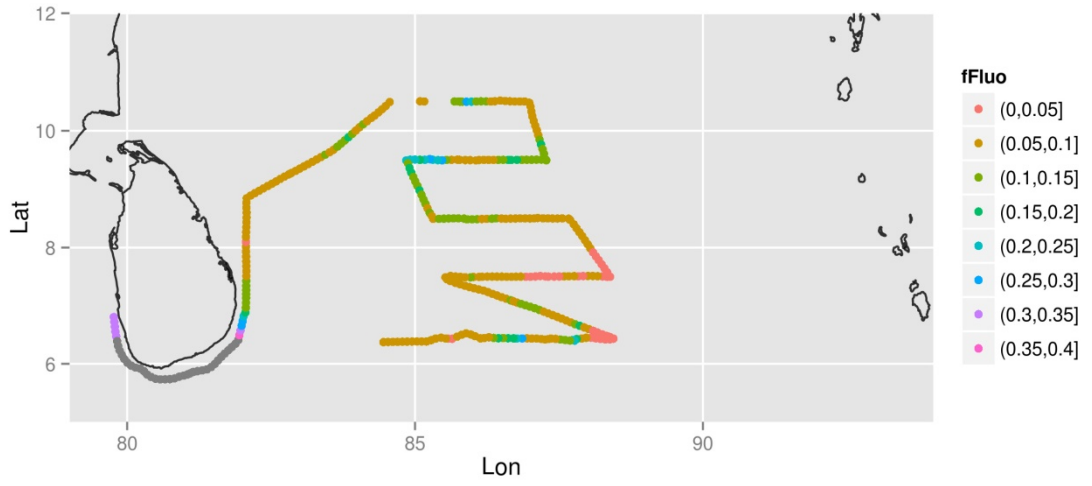

Figure 5. Fluorescence at 5 m depth along the cruise line.

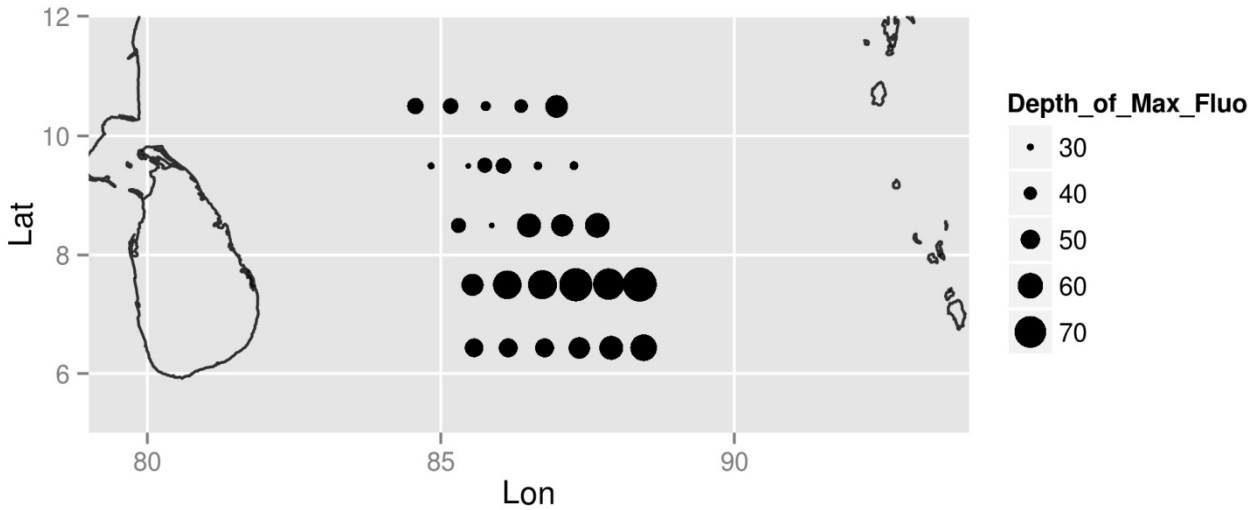

Figure 6. Depth of max fluorescence.

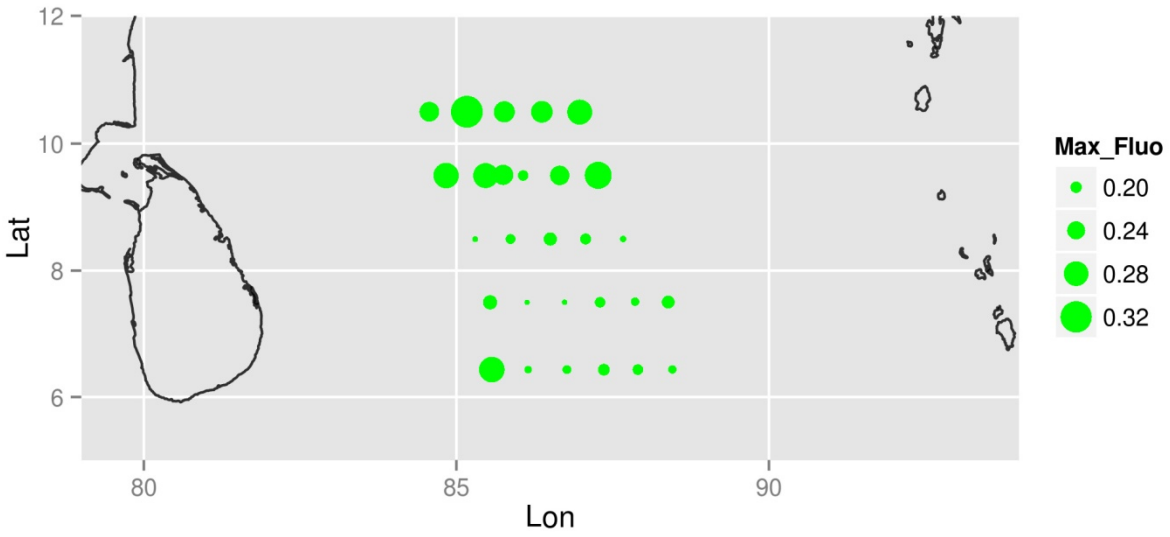

Figure 7. Maximum fluorescence.

Underway data from the thermosalinograph showed low fluorescence values in the area of the survey, with registered values only rarely exceeding the equivalent of 0.15 µg l^{-1} chlorophyll, but some variation was evident (Fig. 5). The CTD casts revealed that fluorescence maxima were found in the depth range 28 to 74 meters, with deeper maxima being more frequent in the southern area (Fig. 6). Values found in the local maxima were also low, the highest fluorescence values were found in the "shallower" maxima in the north, with few values exceeding the equivalent of 0.30 µg l^{-1} chlorophyll. It should be noted that prior to verification by the chlorophyll values from the filtered samples, the values obtained from the electronic sensors should be treated as uncalibrated.

Zooplankton

Zooplankton composition and abundance is important in its' own right, but in this dataset it carries additional importance as the main food of the larger pelagic organisms, for instance fish. In order to assess the abundances of zooplankton, several types of nets were deployed at selected stations. Two types of net hauls were used to sample zooplankton, vertical net hauls of "simple nets" (Juday (90 µm), WP2 (180 µm)) were used to give an estimate of total zooplankton in the upper 200 m, while the deployments of the more advanced Multinet

system (405 µm) gives depth-stratified samples down to a total depth of 1000 m, and can be used to assess also the vertical distribution of mesozooplankton. The samples from the net systems are time and labor-intensive to work up, and results for zooplankton were not ready by the time of writing of this report. An overview of samples of zooplankton is given in Annex V.

3.3 Mesopelagic fish

The biomass of mesopelagic fish was estimated to be **3 million tonnes**. The fish was evenly distributed in the surveyed area, Figure 8, of 40 000 km^2, and the mean S_A-value in the whole area was 1509.

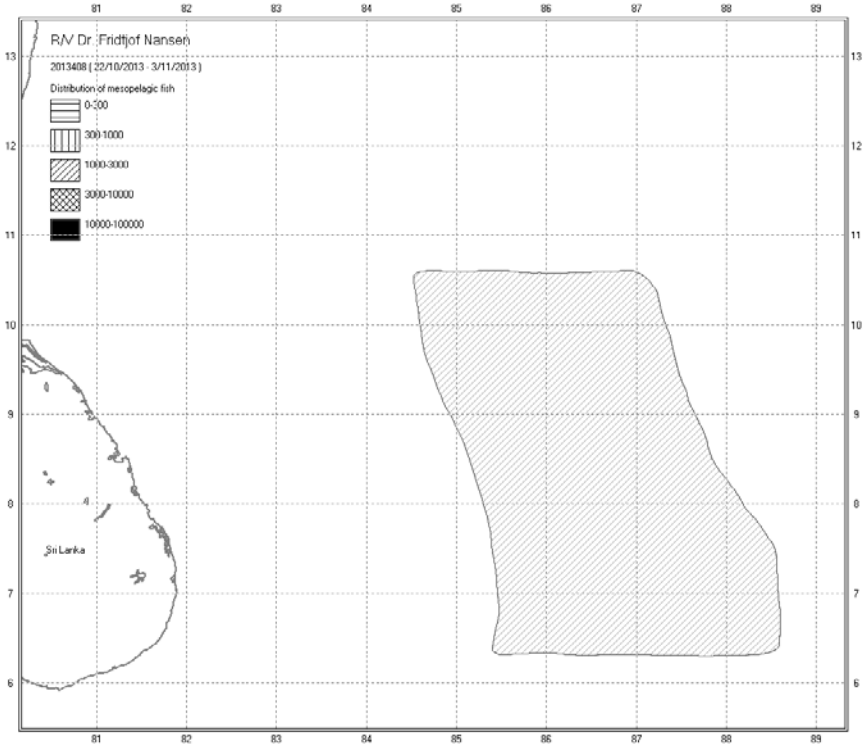

Figure 8. Distribution of mesopelagic fish.

Myctophids was by far the largest group (family) of species in the large group defined as mesopelagic fish during this survey.

Length frequencies of three main species or groups thereof (*Myctophidae*, *Diaphus effulgens* (which belongs to the *Myctophidae*) and *Vinciguerria* sp.) are presented in Annex III. The sizes of these fish were about 30 – 50 mm.

Catch rates of mesopelagic fish, cephalopods, shrimps and crustacean, by day and night, are presented in Annex IV. The catch rates were much higher by night than by day.

The mesopelagic fish undertook large vertical migrations during the day. At daytime the fish was distributed in 3-400 meters, in the oxygen minimum layer, while during nighttime, the fish was mostly distributed in the upper 100 meters. The daytime S_A – values was higher than the night values which indicate that the fish not only rise towards the surface during night, but also disperse and probably has some avoidance reaction to the research vessel.

The mesopelagic fishes are phyletically diverse, but fish belonging to *Myctophidae* family are frequently an important component, and often make up a sizeable fraction of the biomass. In addition fish belonging to the *Gonostomatidae* and the *Phosichtyidae* (such as *Vinciguerria sp.*) families can be numerically important, and it is believed that, looking at numbers, fish belonging to the genus *Cyclothone* is the world's most "common" fish.

The mesopelagic fishes are loosely defined as fishes that have their main daytime depth of residence in the mesopelagic zone. The mesopelagic zone is usually found to be in the depth range 200-1000 m, but is technically defined as pelagic waters in the depth range where daytime light penetrates, but is too low for primary production to occur. The mesopelagic fishes are made up of, mostly, relatively small fishes, most of the time occurring in relatively low densities, but since the volume of their biotope, given by a large horizontal as well as vertical dimension (200-1000m), is enormous, it follows that the world biomass of this "group" is enormous. Gjøsæther and Kawaguchi (1980) estimated the worldwide biomass at around 1000 million tons, but more recent work has suggested that this is likely to be a very conservative estimate (Kaartvedt et al. 2012). In the Indo-Pacific region a good deal of work

on the abundance, distribution and ecology of this group has been performed in the vicinity of the Arabian Sea, which houses the world's highest densities of mesopelagic fish (Gjøsæter and Kawaguchi (1980)).

The level of direct commercial exploitation of mesopelagic fishes is presently low, though they have been suggested as the target of commercial fisheries (Gjøsæter 1984). However, mesopelagic fish feature prominently in the diet of many commercially important species, such as tunas, billfishes, and many of the commercially exploited demersal deep-water species. In addition mesopelagic fish are important in the diet of dolphins and other toothed whales, seals and marine birds. Some of these species gain access to mesopelagic fish by foraging in the mesopelagic zone themselves, but some, like billfishes and tunas have high oxygen requirements, and may be excluded from foraging at mesopelagic depths (Prince & Goodyear 2006) in areas with midwater oxygen minimum zones. These species then forage on mesopelagic fishes during night, when the mesopelagic fishes typically venture close to the surface in order to themselves feed on plankton.

Since the mesopelagic fish migrate from their daytime residence depths in deep waters to surface near waters in order to feed, they are an important vector for transport of carbon out from the epipelagic zone. While their numbers (and possibly biomass) typically are lower than that of migrating meso- and macrozooplankton, their migration amplitudes are typically larger, implying that the transported carbon is injected deeper in the water column. At present the ecology of mesopelagic fish are too poorly known to be able to properly assess their importance in the global carbon pump.

Fish biodiversity

Biodiversity is the variety of living organisms in all their forms and defined in terms of genetic diversity, species diversity and ecosystem diversity and the interrelations between genes, species and ecosystems. The scope of this chapter is more modest as we will to try to highlight the main trends found. Since this is a mesopelagic survey we will try to have closer look in the dial vertical migration of the different species present in this group.

The survey had a total of 22 fishing stations, 12 performed during day time and 10 during night time. A total of 89 telesots species, belonging to 52 teleost fish families were recorded; 6 species of crustaceans and 16 species of cephalopods, though not all specimens could be identified to the species level.

For analyses purposes, the fishing stations have been divided according to the light hours in day and night time stations. Being day stations those taken between 0600 and 1800, and night stations between 1800 and 0600 hours.

The total and mean values of biomass and abundance, together with the number of species and fishing stations, by time of the day, are shown in Table 1. Figure 9 shows that the number of species in the trawl catches is higher during day time than at night.

STATION	Number of fishing stations	Total Biomass (kg/30 m)	Mean Biomass (Kg/30 m)	Total abundance (number/30 m)	Mean abundance (number/30 m)	Number of species
Day	12	133.02	0.57	89704	382	235
Night	10	416.10	2.62	455705	2866	159

Table 1. Number of fishing stations, total biomass (kg/h), mean biomass by station (kg/h), total abundance (number/h), mean abundance by station (number/h) and number of species for the day and night stations.

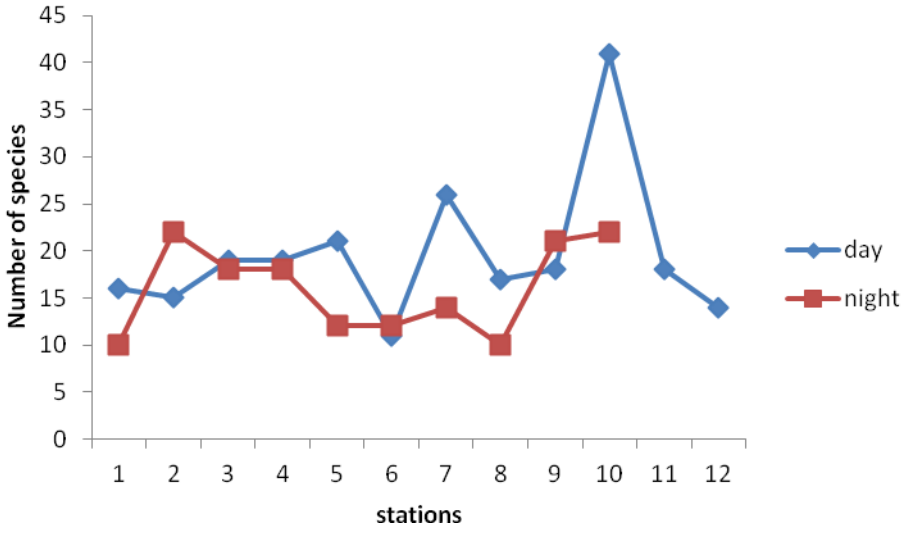

Figure 9. Number of species by stations.

LADCP processing for mesopelagic biota

High frequency acoustic instruments are capable of mapping the distribution of zooplankton, but unfortunately the higher the frequency, the lower the effective range. As a consequence, the frequencies needed to resolve mesozooplankton have a short effective range, and hull-mounted transducers are incapable (unless resonance is involved) of mapping the mesozooplankton at mesopelagic depths. The LADCP deployed during the cruise is an instrument designed to measure currents speeds acoustically, but since it transmits sound and records the received backscattering levels it can also be used as a simple echosounder. Its' transmit frequency is high enough (300 kHz) to be able to map at least larger forms of zooplankton, and since it is lowered together with the CTD package the restricted range of the echosounder is not a major impediment to observing zooplankton at mesopelagic depths, and this type of gear has previously been used to study zooplankton at mesopelagic depths (Postel et al. 2007, Klevjer et al. 2012).

Using a modified version of software provided by Marek Ostrowski (IMR), backscatter amplitude counts, a measure of backscattered energy, were extracted from the LADCP files,

and further processed. Compared to conventional scientific echosounders, ADCP's are difficult to calibrate, so in order to generate meaningful measurements LADCP amplitude data were extracted from a fixed range bin (range bin 2) and averaged over the 4 LADCP beams from the downwards looking LADCP. The results should be comparable between casts and for different depths, and provide a relative measure of the backscatter. Range bin 2 extends from ca. 12.5 to 14.5 meters away from the CTD rig, and previous studies have demonstrated that deep-living fishes actively avoid lowered gear, so it is believed that most of the backscatter is caused by plankton.

Preliminary results show, like for the hull-mounted echosounder, clear patterns of DVM, with acoustic backscatter relocating upwards in the water column during nighttime (Fig. 10). Unlike the hull-mounted echosounders, the results however indicate that a sizeable proportion of the backscatter remains at depth also during night, and also within the depth ranges with low oxygen levels (Fig. 10). A recurring feature in the profiles is a reduced level of backscatter in the region ~150 to 250 m, suggesting low zooplankton biomasses at these depths. Furthermore the results indicate that both day and night there is a gradual, but strong, reduction in backscatter below ca. 600 meters, the implication is again that the biomass of zooplankton may follow the same trend. Finally, below ca. 500-600 meter, there appears to be little difference in day and night backscattering levels, suggesting that DVM of zooplankton is mostly restricted to depths shallower than this (Fig. 10).

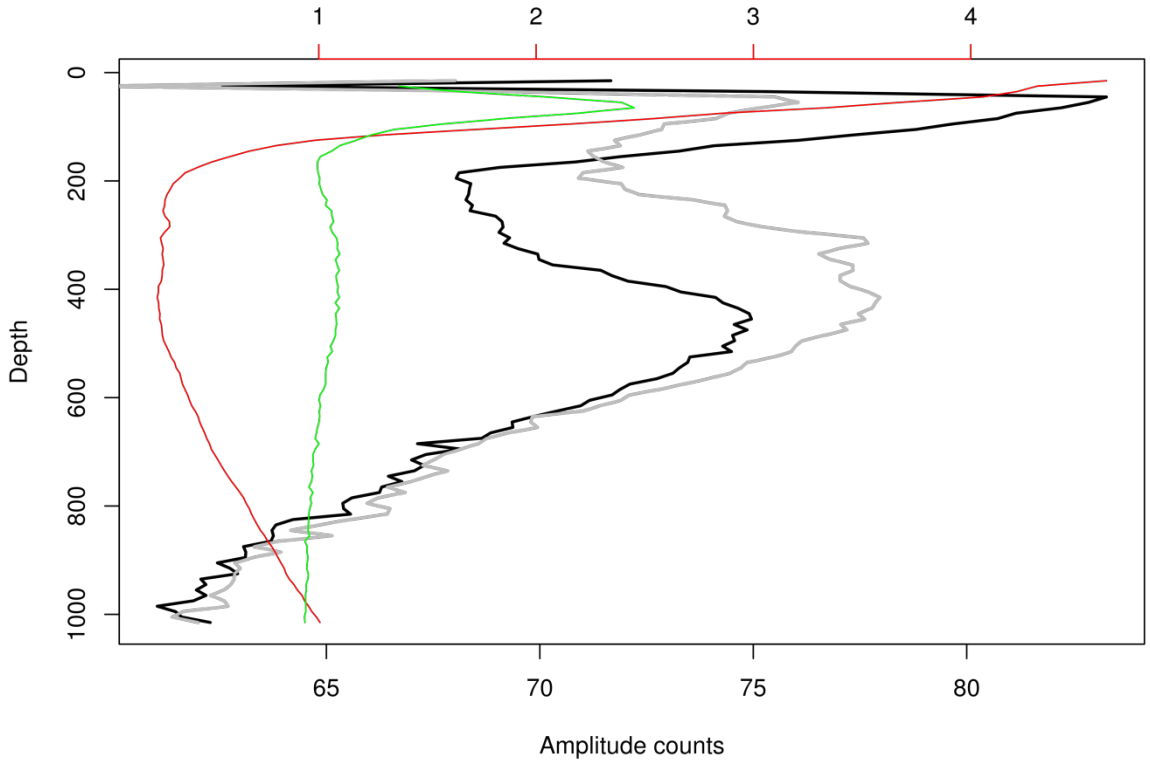

Figure 10. LADCP backscatter profiles. Thick black line is average nighttime amplitude count (averaged 10 m vertical over all nighttime casts), thick grey line is average daytime amplitude count in 10 m vertical bins (averaged over all daytime casts). Red and green line is average oxygen and fluorescence profiles, averaged over all CTD casts.

CHAPTER 4 SUMMARY OF RESULTS

Hydrography

The sea surface temperature in the surveyed area was quite warm, ranging between 27,6 and 29,6^{o}C.

A clear minimum of oxygen was found in a depth range of around 100 meters in intermediate layers in all the surveyed area. The depth of this minimum varied from about 200 – 400 meters.

Plankton

A high number of zooplankton samples were collected during the survey, and these samples will be analysed within 2 mnds.

Fish

The survey covered the high seas of the Bay of Bengal. Altogether 22 pelagic trawl stations were carried out, mainly to identify species composition of mesopelagic fish. The dominating species were of the family *myctophidae*.

An acoustic estimate of the biomass shows that there is mesopelagic fish in the area (40 000 NM^{2}) of about 3 million tonnes.

References:

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Kaartvedt, S., Staby, S., Aksnes, D.L. (2012). Efficient trawl avoidance by mesopelagic fishes causes large underestimation of their biomass. Mar. Ecol. Prog. Ser. 456: 1-6

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ANNEX I. FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 1
DATE :25/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
10°30.42
start stop duration Lon E
84°38.38
TIME :09:15:05 10:09:35 54.5 (min) Purpose : 1
LOG : 6123.37 6126.37 3.0 Region : 10800
FDEPTH: 250 300 Gear cond.: 0
BDEPTH: 3536 3533 Validity : 0
Towing dir: 0° Wire out : 700 m Speed : 3.3 kn
Sorted : 18 Total catch: 17.65 Catch/hour: 19.43

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	MYCTOPHIDAE	16.03	12725	82.49
	Diaphus effulgens	2.08	3095	10.71
1	Leptocephalus	0.65	145	3.34
	J E L L Y F I S H	0.46	0	2.38
	PORTUNIDAE	0.09	2	0.45
	Chauliodus sloani	0.06	17	0.28
	Cubiceps sp.	0.02	19	0.11
	C E P H A L O P O D A	0.02	24	0.11
	EMMELICHTHYIDAE	0.02	29	0.11
	Argyropelecus sp.	0.00	1	0.00
	TRICHIURIDAE	0.00	1	0.00
	C R U S T A C E A N S	0.00	18	0.00
	BOTHIDAE	0.00	7	0.00
	ARIOMMIDAE	0.00	1	0.00
	NEMICHTHYIDAE	0.00	1	0.00
	OREOSOMATIDAE	0.00	1	0.00
	Total	19.43		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 2
DATE :25/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
10°29.95
start stop duration Lon E
85°18.77
TIME :02:36:56 03:07:20 30.4 (min) Purpose : 1
LOG : 6163.93 6165.88 1.9 Region : 10800
FDEPTH: 30 40 Gear cond.: 0
BDEPTH: 3489 3483 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.9 kn
Sorted : 15 Total catch: 65.84 Catch/hour: 129.99

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	Ommastrephes sp.	101.88	190	78.37
	Euphausiacea	16.90	45631	13.00
	MYCTOPHIDAE	8.85	5591	6.80
2	Regalecus sp.	1.42	2	1.09
	PORTUNIDAE	0.47	16	0.36
	GONOSTOMATIDAE	0.16	16	0.12
	Onychoteuthis banksi	0.16	205	0.12
	Nemichthys sp.	0.16	16	0.12
	SEPIOLIDAE	0.00	79	0.00
	Bregmaceros sp.	0.00	47	0.00
	Total	129.99		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 3
DATE :25/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
10°30.10
start stop duration Lon E
86°22.94
TIME :10:33:42 11:04:28 30.8 (min) Purpose : 1
LOG : 6227.81 6229.52 1.7 Region : 10800
FDEPTH: 35 42 Gear cond.: 0
BDEPTH: 3471 3470 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.3 kn
Sorted : 0 Total catch: 28.28 Catch/hour: 55.14

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	Vinciguerria sp.	25.43	64099	46.11
3	C R U S T A C E A N S	11.64	0	21.11
	MYCTOPHIDAE	7.41	8045	13.44
4	Ommastrephes sp.	2.38	0	4.31
	EMMELICHTHYIDAE	2.11	2106	3.82
	Katsuwonus pelamis	1.93	4	3.50
	Auxis thazard thazard	1.75	0	3.18
	Cubiceps sp.	0.88	60	1.59
	Euthynnus affinis	0.80	2	1.45
	Onychoteuthis banksi	0.31	18	0.57
	Leptocephalus	0.18	0	0.32
	NEMICHTHYIDAE	0.12	6	0.21
	PORTUNIDAE	0.06	2	0.11
	Diaphus effulgens	0.06	6	0.11
	Decapterus macarellus	0.04	6	0.07
	Stemosudis elongatus	0.04	6	0.07
	SCOMBROLABRACIDAE	0.02	2	0.04
	TRACHICHTHYIDAE	0.00	2	0.00
	OREOSOMATIDAE	0.00	6	0.00
	Paramonacanthus nipponensis	0.00	2	0.00
	Chauliodus sloani	0.00	105	0.00
	BOTHIDAE	0.00	10	0.00
	Total	55.14		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 4
DATE :26/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
9°29.71
start stop duration Lon E
87°17.01
TIME :03:02:34 03:37:50 35.3 (min) Purpose : 1
LOG : 6329.20 6331.31 2.1 Region : 10800
FDEPTH: 20 30 Gear cond.: 0
BDEPTH: 3546 3554 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 3.6 kn
Sorted : 2 Total catch: 32.30 Catch/hour: 54.95

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	Diaphus effulgens	36.03	40772	65.57
6	Euphausiacea	5.05	19031	9.20
	Onychoteuthis banksi	4.71	4479	8.58
	Cubiceps sp.	2.69	202	4.89
	Doryteuthis sp.	2.69	100	4.89
	Vinciguerria sp.	1.34	1987	2.45
5	Chauliodus sloani	1.00	539	1.83
	Psenes sp.	0.51	5	0.93
	LOBOTIDAE	0.51	2	0.93
	Leptocephalus	0.32	471	0.59
	Regalecus sp.	0.09	2	0.15
	BOTHIDAE	0.00	34	0.00
	OREOSOMATIDAE	0.00	68	0.00
	J E L L Y F I S H	0.00	34	0.00
	Bregmaceros sp.	0.00	134	0.00
	EMMELICHTHYIDAE	0.00	68	0.00
	Stemosudis elongatus	0.00	34	0.00
	CRANCHIIDAE	0.00	68	0.00
	Total	54.95		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 5
DATE :26/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
9°30.07
start stop duration Lon E
86°17.57
TIME :10:15:25 10:45:32 30.1 (min) Purpose : 1
LOG : 6388.89 6390.59 1.7 Region : 10800
FDEPTH: 56 74 Gear cond.: 0
BDEPTH: 3583 3580 Validity : 0
Towing dir: 0° Wire out : 200 m Speed : 3.4 kn
Sorted : 8 Total catch: 18.66 Catch/hour: 37.16

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	Diaphus effulgens	14.22	118598	38.26
10	PORTUNIDAE	10.75	40	28.94
	Squid unidentified	4.30	0	11.58
	Euphausiacea	2.87	0	7.72
	Onychoteuthis banksi	1.91	143	5.14
	Cubiceps sp.	1.04	56	2.79
8	TRICHIURIDAE	0.64	1599	1.71
9	Leptocephalus	0.32	0	0.86
	Bregmaceros sp.	0.32	687	0.86
7	Neoepinnula orientalis	0.32	16	0.86
	Chauliodus sloani	0.16	80	0.43
	SCOMBROLABRACIDAE	0.16	16	0.43
	OREOSOMATIDAE	0.16	191	0.43
	EMMELICHTHYIDAE	0.00	48	0.00
	BOTHIDAE	0.00	48	0.00
	XIPHIIDAE	0.00	16	0.00
	Stemosudis elongatus	0.00	32	0.00
	Regalecus sp.	0.00	16	0.00
	Total	37.16		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 6
DATE :27/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
9°30.12
start stop duration Lon E
85°46.77
TIME :03:00:52 03:29:42 28.8 (min) Purpose : 1
LOG : 6420.44 6422.04 1.6 Region : 10800
FDEPTH: 20 30 Gear cond.: 0
BDEPTH: 3631 3635 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 3.3 kn
Sorted : 1 Total catch: 0.69 Catch/hour: 1.44

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	Leptocephalus	0.81	256	56.52
	PORTUNIDAE	0.42	17	28.99
	Onychoteuthis banksi	0.19	169	13.04
	TETRAODONTIDAE	0.02	52	1.45
	EMMELICHTHYIDAE	0.00	2	0.00
	Fistularia sp.	0.00	6	0.00
	J E L L Y F I S H	0.00	2	0.00
	MONACANTHIDAE	0.00	10	0.00
	OREOSOMATIDAE	0.00	10	0.00
	OSTRACIIDAE	0.00	2	0.00
	Polynemus indicus	0.00	2	0.00
	URANOSCOPIDAE	0.00	2	0.00
	BOTHIDAE	0.00	8	0.00
	Bregmaceros sp.	0.00	15	0.00
	Carangoides ferdau	0.00	4	0.00
	Total	1.44		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 7
DATE :27/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
9°30.42
start stop duration Lon E
85°17.81
TIME :08:03:06 08:34:59 31.9 (min) Purpose : 1
LOG : 6451.21 6452.94 1.7 Region : 10800
FDEPTH: 320 432 Gear cond.: 0
BDEPTH: 3609 3605 Validity : 0
Towing dir: 0° Wire out : 1000 m Speed : 3.2 kn
Sorted : 6 Total catch: 5.99 Catch/hour: 11.27

	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
SAMP				
	Ommastrephes sp.	2.71	2	24.05
	Chauliodus sloani	2.41	254	21.38
	J E L L Y F I S H	1.94	0	17.20
	Diaphus effulgens	1.56	2130	13.86
12	Euphausiacea	0.68	0	6.01
	Leptocephalus	0.55	0	4.84
	Argyropelecus sp.	0.30	32	2.67
	Loligo sp.	0.28	2	2.51
	Parapandalus sp.	0.27	0	2.39
	Benthodesmus sp.	0.26	6	2.34
	EVERMANNELLIDAE	0.09	30	0.84
	Onychoteuthis banksi	0.06	55	0.50
	Vinciguerria sp.	0.05	117	0.47
11	CRANCHIIDAE	0.04	8	0.33
	Lampanyctus sp.	0.04	2	0.32
	Myctophum sp.	0.02	36	0.17
	STOMIIDAE	0.02	15	0.13
	MELAMPHAIDAE	0.00	100	0.00
	Ichthyococcus sp	0.00	2	0.00
	Total	11.27		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 8
DATE :27/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
8°33.69
start stop duration Lon E
85°16.52
TIME :08:38:31 09:08:35 30.1 (min) Purpose : 1
LOG : 6543.44 6545.08 1.6 Region : 10800
FDEPTH: 37 37 Gear cond.: 0
BDEPTH: 3707 3713 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.3 kn
Sorted : 1 Total catch: 7.12 Catch/hour: 14.22

	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
SAMP				
	J E L L Y F I S H	8.85	0	62.21
	MYCTOPHIDAE	1.90	6861	13.34
13	C E P H A L O P O D A	1.34	0	9.41
	PORTUNIDAE	0.90	22	6.32
	Leptocephalus	0.58	0	4.07
	Ommastrephes sp.	0.40	2	2.81
	Onychoteuthis banksi	0.16	14	1.12
	Shrimps, small, non comm.	0.04	42	0.29
	Cubiceps sp.	0.04	2	0.28
	CHAULIODONTIDAE	0.02	2	0.14
	Vinciguerria sp.	0.00	42	0.00
	GONOSTOMATIDAE	0.00	2	0.00
	Total	14.22		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 9
DATE :28/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
8°29.05
start stop duration Lon E
85°54.31
TIME :04:56:46 05:30:02 33.3 (min) Purpose : 1
LOG : 6585.96 6587.68 1.7 Region : 10800
FDEPTH: 310 340 Gear cond.: 0
BDEPTH: 3670 3675 Validity : 0
Towing dir: 0° Wire out : 700 m Speed : 3.1 kn
Sorted : 3 Total catch: 2.93 Catch/hour: 5.28

	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
SAMP				
	J E L L Y F I S H	2.47	0	46.76
	PORTUNIDAE	0.85	23	16.04
	MYCTOPHIDAE	0.58	592	10.92
14	Onychoteuthis banksi	0.56	0	10.58
	Euphausiacea	0.27	0	5.12
	Leptocephalus	0.27	72	5.12
	Psenes sp.	0.14	2	2.73
	Vinciguerria sp.	0.11	271	2.05
15	Argyropelecus sp.	0.04	2	0.68
	Ichthyococcus sp	0.00	25	0.00
	Fistularia sp.	0.00	4	0.00
	Carangoides ferdau	0.00	2	0.00
	Decapterus macarellus	0.00	9	0.00
	Gnathanodon speciosus	0.00	2	0.00
	Diretmoides sp.	0.00	2	0.00
	EVERMANNELLIDAE	0.00	4	0.00
	AMARSIPIDAE	0.00	2	0.00
	OREOSOMATIDAE	0.00	4	0.00
	Stemosudis elongatus	0.00	2	0.00
	Total	5.28		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 10
DATE :28/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
8°29.84
start stop duration Lon E
86°23.34
TIME :08:29:00 09:00:12 31.2 (min) Purpose : 1
LOG : 6614.66 6616.60 1.9 Region : 10800
FDEPTH: 350 335 Gear cond.: 0
BDEPTH: 3685 3682 Validity : 0
Towing dir: 0° Wire out : 950 m Speed : 3.7 kn
Sorted : 2 Total catch: 2.05 Catch/hour: 3.94

	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
SAMP				
	J E L L Y F I S H	0.96	0	24.39
	Chauliodus sloani	0.87	192	21.95
	MYCTOPHIDAE	0.54	542	13.66
16	Parapandalus sp.	0.38	337	9.76
	Onychoteuthis banksi	0.27	256	6.83
	Argyropelecus sp.	0.21	102	5.37
	Leptocephalus	0.21	62	5.37
	Euphausiacea	0.15	0	3.90
	SALPS	0.13	12	3.41
	EVERMANNELLIDAE	0.08	17	1.95
	PORTUNIDAE	0.08	2	1.95
	Vinciguerria sp.	0.04	58	0.98
	Melamphaes sp	0.02	56	0.49
	Champsodon sp.	0.00	2	0.00
	Decapterus macarellus	0.00	2	0.00
	BOTHIDAE	0.00	12	0.00
	MELANOSTOMIATIDAE	0.00	2	0.00
	Sternoptyx diaphana	0.00	2	0.00
	OREOSOMATIDAE	0.00	2	0.00
	Stemosudis elongatus	0.00	2	0.00
	Ichthyococcus sp	0.00	4	0.00
	Total	3.94		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 11
DATE :28/10/13 GEAR TYPE: PT NO: 4 POSITION:Lat N
8°30.64
start stop duration Lon E
87°4.50
TIME :02:39:11 03:08:11 29.0 (min) Purpose : 1
LOG : 6656.96 6658.93 2.0 Region : 10800
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 3660 3657 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 4.1 kn
Sorted : 1 Total catch: 19.64 Catch/hour: 40.64

	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
SAMP				
	Diaphus effulgens	22.16	7990	54.54
17	Ommastrephes bartrami	7.08	263	17.41
	Leptocephalus	4.52	0	11.12
	Cubiceps sp.	3.29	161	8.09
	MYCTOPHIDAE	2.58	8992	6.35
18	Brama sp.	0.48	8	1.17
	Parapandalus sp.	0.43	215	1.06
	Gempylus serpens	0.10	2	0.25
	SALPS	0.00	21	0.00
	BOTHIDAE	0.00	194	0.00
	Onychoteuthis banksi	0.00	64	0.00
	Total	40.64		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 12
DATE :28/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
8°28.57
start stop duration Lon E
87°41.43
TIME :09:42:28 10:12:31 30.1 (min) Purpose : 1
LOG : 6695.40 6697.29 1.9 Region : 10800
FDEPTH: 54 64 Gear cond.: 0
BDEPTH: 3618 3608 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 3.8 kn
Sorted : 1 Total catch: 5.63 Catch/hour: 11.25

	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
SAMP				
	MYCTOPHIDAE	5.61	6749	49.84
19	C R U S T A C E A N S	3.46	0	30.80
	SALPS	0.58	2	5.15
	Cubiceps sp.	0.52	28	4.61
	Squid unidentified	0.46	46	4.08
	Leptocephalus	0.25	0	2.18
	Onychoteuthis banksi	0.21	0	1.90
	Unidentified larvae	0.12	2	1.06
	BOTHIDAE	0.02	54	0.21
	G A S T R O P O D S	0.01	10	0.09
	OREOSOMATIDAE	0.00	22	0.00
	AMARSIPIDAE	0.00	10	0.00
	Total	11.24		99.93

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 13
DATE :29/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
7°29.65
start stop duration Lon E
88°21.58
TIME :08:33:00 09:06:18 33.3 (min) Purpose : 1
LOG : 6770.66 6772.66 2.0 Region : 10800
FDEPTH: 420 405 Gear cond.: 0
BDEPTH: 3713 3714 Validity : 0
Towing dir: 0° Wire out : 1000 m Speed : 3.6 kn
Sorted : 2 Total catch: 2.09 Catch/hour: 3.77

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	J E L L Y F I S H	0.94	0	24.88
	Argyropelecus gigas	0.61	187	16.27
	MYCTOPHIDAE	0.59	431	15.79
20	SALPS	0.59	323	15.79
	Onychoteuthis banksi	0.32	337	8.61
	Euphausiacea	0.20	0	5.26
	Histioteuthis sp.	0.18	2	4.78
	Parapandalus sp.	0.13	94	3.35
	EVERMANNELLIDAE	0.09	22	2.39
	Chauliodus sloani	0.09	31	2.39
	Pterygioteuthis giardi	0.02	2	0.48
	Vinciguerria sp.	0.00	22	0.00
	GONATIDAE	0.00	2	0.00
	ONYCHOTEUTHIDAE	0.00	2	0.00
	Leptocephalus	0.00	2	0.00
	Sternoptyx diaphana	0.00	7	0.00
	Decapterus macarellus	0.00	2	0.00
	CERATIIDAE	0.00	4	0.00
	Diretmoides sp.	0.00	2	0.00
	Fistularia sp.	0.00	4	0.00
	Diplophos sp.	0.00	2	0.00
	Melamphaes sp	0.00	11	0.00
	Hygophum hygomii	0.00	9	0.00
	OREOSOMATIDAE	0.00	7	0.00
	Stemosudis elongatus	0.00	2	0.00
	Ichthyococcus sp	0.00	4	0.00
	Total	3.77		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 14
DATE :29/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
7°30.38
start stop duration Lon E
87°50.29
TIME :01:01:45 01:33:00 31.3 (min) Purpose : 1
LOG : 6802.10 6804.22 2.1 Region : 10800
FDEPTH: 20 25 Gear cond.: 0
BDEPTH: 3726 3728 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 4.1 kn
Sorted : 2 Total catch: 8.00 Catch/hour: 15.35

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	MYCTOPHIDAE	6.34	19836	41.27
21	Euphausiacea	6.03	36227	39.27
	Ommastrephes bartrami	1.27	21	8.25
	Cubiceps sp.	0.92	44	6.00
	Leptocephalus	0.44	0	2.88
	Zu sp.	0.21	10	1.38
	Onychoteuthis banksi	0.15	486	0.95
	Nemichthys sp.	0.00	2	0.00
	Fistularia sp.	0.00	15	0.00
	Pterygioteuthis giardi	0.00	44	0.00
	Chauliodus sloani	0.00	60	0.00
	Sternoptyx diaphana	0.00	15	0.00
	Oxyporhamphus sp.	0.00	60	0.00
	Bregmaceros sp.	0.00	15	0.00
	Total	15.35		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 15
DATE :29/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
7°30.06
start stop duration Lon E
86°47.17
TIME :08:28:37 09:00:22 31.7 (min) Purpose : 1
LOG : 6865.25 6866.98 1.7 Region : 10800
FDEPTH: 52 56 Gear cond.: 0
BDEPTH: 3764 3766 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.3 kn
Sorted : 6 Total catch: 27.15 Catch/hour: 51.33

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	Onychoteuthis banksi	17.59	0	34.28
	Euphausiacea	14.45	0	28.16
	MYCTOPHIDAE	10.29	13940	20.06
23	Squid unidentified	4.08	0	7.96
	Cubiceps sp.	2.79	153	5.44
22	Jelly squid	1.27	0	2.47
	Leptocephalus	0.46	0	0.89
	Bregmaceros sp.	0.24	121	0.47
	Stemosudis elongatus	0.07	96	0.14
	Gonostoma sp.	0.07	217	0.14
	Total	51.33		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 16
DATE :30/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
7°29.55
start stop duration Lon E
86°0.50
TIME :02:51:42 03:22:01 30.3 (min) Purpose : 1
LOG : 6913.77 6915.42 1.6 Region : 10800
FDEPTH: 250 270 Gear cond.: 0
BDEPTH: 3793 3794 Validity : 0
Towing dir: 0° Wire out : 600 m Speed : 3.3 kn
Sorted : 1 Total catch: 5.62 Catch/hour: 11.13

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	J E L L Y F I S H	4.34	0	38.99
	Vinciguerria sp.	3.11	7975	27.94
24	MYCTOPHIDAE	1.91	2664	17.13
25	Onychoteuthis banksi	0.90	984	8.11
	Cubiceps sp.	0.42	22	3.74
	Loligo singhalensis	0.40	8	3.56
	Stemosudis elongatus	0.04	8	0.36
	Leptocephalus	0.02	20	0.18
	OCTOPOTEUTHIDAE	0.00	2	0.00
	Argyropelecus sp.	0.00	30	0.00
	Decapterus macarellus	0.00	20	0.00
	Fistularia sp.	0.00	10	0.00
	Thyrsitoides sp.	0.00	10	0.00
	GONOSTOMATIDAE	0.00	30	0.00
	Hygophum hygomii	0.00	69	0.00
	Nemichthys sp.	0.00	20	0.00
	ONYCHOTEUTHIDAE	0.00	2	0.00
	Total	11.13		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 17
DATE :30/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
7°28.28
start stop duration Lon E
85°31.77
TIME :09:23:17 09:56:33 33.3 (min) Purpose : 1
LOG : 6945.87 6947.80 1.9 Region : 10800
FDEPTH: 340 360 Gear cond.: 0
BDEPTH: 3787 3786 Validity : 0
Towing dir: 0° Wire out : 800 m Speed : 3.5 kn
Sorted : 3 Total catch: 3.26 Catch/hour: 5.88

SAMP	SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
	C R U S T A C E A N S	1.62	3663	27.61
	Chauliodus sloani	1.28	179	21.78
	J E L L Y F I S H	0.69	0	11.66
	Parapandalus sp.	0.67	725	11.35
	MYCTOPHIDAE	0.58	788	9.82
26	SALPS	0.36	0	6.13
	Argyropelecus gigas	0.32	97	5.52
	Onychoteuthis banksi	0.13	99	2.15
	EVERMANNELLIDAE	0.07	32	1.23
	Leptocephalus	0.05	14	0.92
	Stemosudis elongatus	0.05	4	0.92
	Photichthys sp	0.02	7	0.31
	Melamphaes sp	0.02	11	0.31
	Astronesthes sp.	0.02	4	0.31
	SCOMBRIDAE	0.00	2	0.00
	ARGENTINIDAE	0.00	2	0.00
	Nemichthys sp.	0.00	2	0.00
	BOTHIDAE	0.00	2	0.00
	Total	5.88		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 18
DATE :30/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
7°26.43
start stop duration Lon E
85°35.00
TIME :10:37:06 11:07:55 30.8 (min) Purpose : 1
LOG : 6949.61 6950.51 0.9 Region : 10800
FDEPTH: 460 500 Gear cond.: 0
BDEPTH: 3782 3781 Validity : 0
Towing dir: 0° Wire out : 900 m Speed : 1.7 kn
Sorted : 8 Total catch: 8.11 Catch/hour: 15.79

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
Chauliodus sloani	4.34	709	27.50
Diplophos sp.	2.10	86	13.32
SALPS	1.41	0	8.93
Histioteuthis sp.	1.17	27	7.40
Zu sp.	1.11	2	7.03
MYCTOPHIDAE	0.62	982	3.90
27 Parapandalus sp.	0.60	434	3.82
PYROSOMIDAE	0.60	0	3.82
Lepidopus sp.	0.47	14	2.96
Argyropelecus sp.	0.43	94	2.71
Euphausiacea	0.35	0	2.22
BATHYCLUPEIDAE	0.31	2	1.97
SERRIVOMERIDAE	0.25	19	1.60
EVERMANNELLIDAE	0.25	33	1.60
OPISTHOPROCTIDAE	0.25	2	1.60
ARISTEIDAE	0.19	111	1.23
Astronesthes sp.	0.18	14	1.11
Hygophum hygomii	0.16	37	0.99
Lampanyctus sp.	0.16	12	0.99
Shrimps, small, non comm.	0.15	0	0.97
Medusae black	0.14	19	0.86
Gymnoscopelus sp.	0.10	2	0.62
MELAMPHAIDAE	0.08	6	0.49
Caristius sp	0.08	2	0.49
Ahliesaurus berryi	0.08	6	0.49
Lampadena luminosa	0.04	2	0.25
Leptostomias gladiator	0.04	14	0.25
Malacosteus niger	0.04	6	0.25
Leptocephalus	0.04	12	0.25
Onychoteuthis banksi	0.03	25	0.21
STOMIIDAE	0.01	8	0.05
Vinciguerria sp.	0.01	25	0.05
REGALECIDAE	0.01	8	0.05
Loligo singhalensis	0.00	18	0.00
Onychoteuthis banksi	0.00	8	0.00
Xenodermichthys sp	0.00	4	0.00
Photichthys sp.	0.00	4	0.00
Scopeloberyx sp.	0.00	6	0.00
MELANOSTOMIATIDAE	0.00	4	0.00
Nemichthys sp.	0.00	2	0.00
Histioteuthis sp.	0.00	2	0.00
Total	15.79		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 19
DATE :31/10/13 GEAR TYPE: PT NO: 1 POSITION:Lat N
6°25.73
start stop duration Lon E
88°24.20
TIME :08:24:30 08:55:00 30.5 (min) Purpose : 1
LOG : 7136.16 7138.00 1.8 Region : 10800
FDEPTH: 400 388 Gear cond.: 0
BDEPTH: 3859 3860 Validity : 0
Towing dir: 0° Wire out : 1100 m Speed : 3.6 kn
Sorted : 4 Total catch: 3.51 Catch/hour: 6.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
Chauliodus sloani	3.46	234	50.14
J E L L Y F I S H	1.48	0	21.37
SALPS	0.69	77	9.97
Euphausiacea	0.33	991	4.84
Argyropelecus gigas	0.33	79	4.84
Diaphus effulgens	0.31	476	4.56
28 Parapandalus sp.	0.14	157	1.99
Stemosudis elongatus	0.06	4	0.85
Leptocephalus	0.04	10	0.57
Onychoteuthis banksi	0.02	22	0.28
EVERMANNELLIDAE	0.02	10	0.28
Photichthys sp.	0.02	6	0.28
SCOMBRIDAE	0.00	12	0.00
Hygophum hygomii	0.00	12	0.00
OREOSOMATIDAE	0.00	2	0.00
Sternoptyx diaphana	0.00	2	0.00
Ichthyococcus sp	0.00	8	0.00
Vinciguerria sp.	0.00	24	0.00
Total	6.90		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 20
DATE :31/10/13 GEAR TYPE: PT NO: 2 POSITION:Lat N
6°24.64
start stop duration Lon E
87°44.83
TIME :01:59:19 02:34:38 35.3 (min) Purpose : 1
LOG : 7178.65 7180.77 2.1 Region : 10800
FDEPTH: 45 55 Gear cond.: 0
BDEPTH: 3825 3927 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.6 kn
Sorted : 2 Total catch: 11.65 Catch/hour: 19.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
MYCTOPHIDAE	12.78	7918	64.53
29 C R U S T A C E A N S	3.08	19424	15.58
Cubiceps sp.	1.17	73	5.93
CRANCHIIDAE	0.95	17	4.81
Onychoteuthis banksi	0.59	632	2.96
OMMASTREPHIDAE	0.37	17	1.89
Ichthyococcus sp	0.29	117	1.48
LYCOTEUTHIDAE	0.25	3	1.29
Zu sp.	0.17	3	0.86
Chauliodus sloani	0.07	12	0.34
Stemosudis elongatus	0.05	15	0.26
Photichthys sp.	0.02	7	0.09
CHIROTEUTHIDAE	0.00	29	0.00
Nemichthys sp.	0.00	15	0.00
Idiacanthus sp.	0.00	15	0.00
HEMIRAMPHIDAE	0.00	3	0.00
Bregmaceros sp.	0.00	133	0.00
Sternoptyx diaphana	0.00	15	0.00
Stomias sp.	0.00	15	0.00
Leptocephalus	0.00	117	0.00
Astronesthes sp.	0.00	15	0.00
Total	19.80		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 21
DATE :31/10/13 GEAR TYPE: PT NO: 2 POSITION:Lat N
6°26.32
start stop duration Lon E
86°45.04
TIME :10:16:06 10:46:18 30.2 (min) Purpose : 1
LOG : 7244.30 7246.03 1.7 Region : 10800
FDEPTH: 65 73 Gear cond.: 0
BDEPTH: 3866 3869 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.4 kn
Sorted : 13 Total catch: 13.55 Catch/hour: 26.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
MYCTOPHIDAE	16.96	23166	62.99
30 C R U S T A C E A N S	5.53	0	20.54
OMMASTREPHIDAE	1.34	632	4.96
Hygophum hygomii	0.70	632	2.61
Gempylus serpens	0.50	2	1.84
Leptocephalus	0.47	127	1.76
CRANCHIIDAE	0.38	4	1.40
Cubiceps sp.	0.34	38	1.25
Onychoteuthis banksi	0.24	0	0.89
Sternoptyx diaphana	0.19	850	0.70
Tetragonurus sp.	0.06	2	0.22
Stemosudis elongatus	0.06	16	0.22
PORTUNIDAE	0.06	2	0.22
Vinciguerria sp.	0.04	185	0.13
Bregmaceros sp.	0.03	77	0.10
SCOMBROLABRACIDAE	0.02	2	0.07
Paramonacanthus nipponensis	0.01	75	0.04
Canthigaster sp.	0.01	75	0.04
Gnathanodon speciosus	0.01	40	0.02
Epinephelus sp.	0.00	2	0.00
Nemichthys sp.	0.00	6	0.00
BOTHIDAE	0.00	6	0.00
Total	26.92		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013408 STATION: 22
DATE :01/11/13 GEAR TYPE: PT NO: 2 POSITION:Lat N
6°26.80
start stop duration Lon E
85°29.03
TIME :11:35:18 12:05:58 30.7 (min) Purpose : 1
LOG : 7323.74 7325.32 1.6 Region : 10800
FDEPTH: 150 250 Gear cond.: 0
BDEPTH: 3887 3891 Validity : 0
Towing dir: 0° Wire out : 450 m Speed : 3.1 kn
Sorted : 2 Total catch: 3.86 Catch/hour: 7.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C
MYCTOPHIDAE	2.91	6730	38.56
31 Euphausiacea	2.18	18072	28.92
SALPS	1.08	106	14.25
Onychoteuthis banksi	0.52	479	6.87
J E L L Y F I S H	0.49	0	6.48
Leptocephalus	0.22	22	2.85
Sepioteuthis sp.	0.14	2	1.81
Nemichthys sp.	0.02	20	0.26
Vinciguerria sp.	0.00	94	0.00
BOTHIDAE	0.00	10	0.00
Argyropelecus sp.	0.00	125	0.00
EVERMANNELLIDAE	0.00	41	0.00
Sternoptyx diaphana	0.00	84	0.00
Chauliodus sp.	0.00	10	0.00
Total	7.55		100.00

ANNEX II Instruments and fishing gear used

Fishing gear

The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super bottom trawl". During the present survey the pelagic trawls were used with a small meshed inner net.

The SCANMAR system was used on 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 the trawl was equipped with a trawl eye that provides information about the trawl opening. A catch sensor on the cod-end indicated the size of the catch.

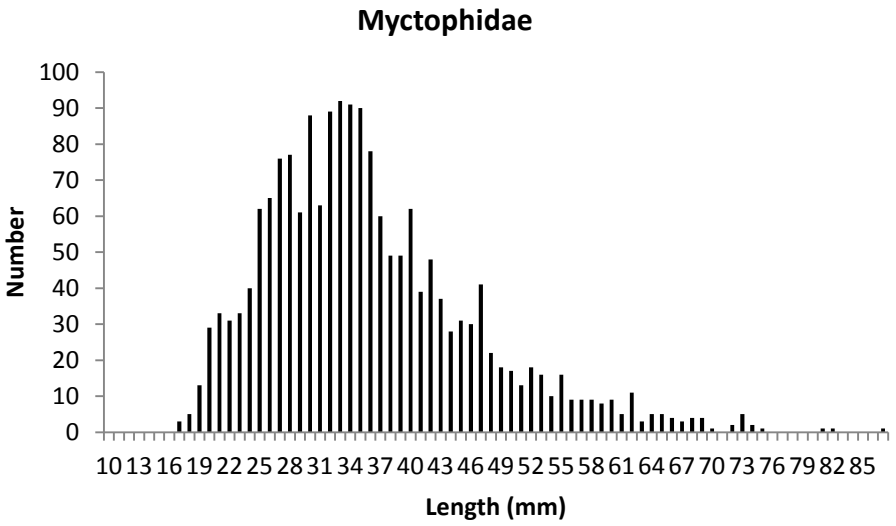
Acoustic instruments

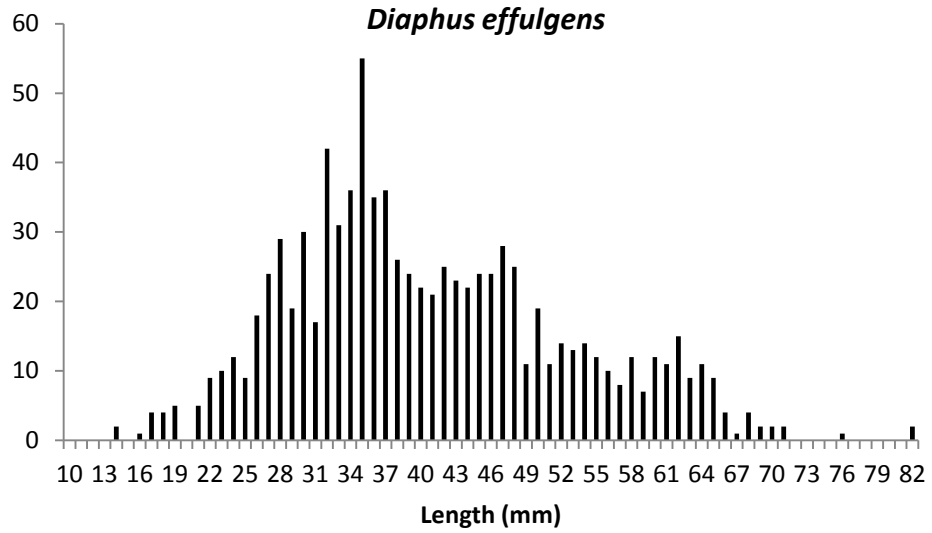
The Simrad ER-60/18, 38, 120 and 200 kHz scientific sounder was run during the survey only for observation of fish and bottom conditions. No scrutinizing of the recordings was done. Last standard sphere calibrations was checked on the 07.07.2013 in Baía dos Elefantes using Cu-64, Cu-60, WC-38.1 add WC-38.1 spheres for 18, 38, 120 and 200 kHz, respectively. The details of the settings for the 38 kHz echo sounder were as follows:

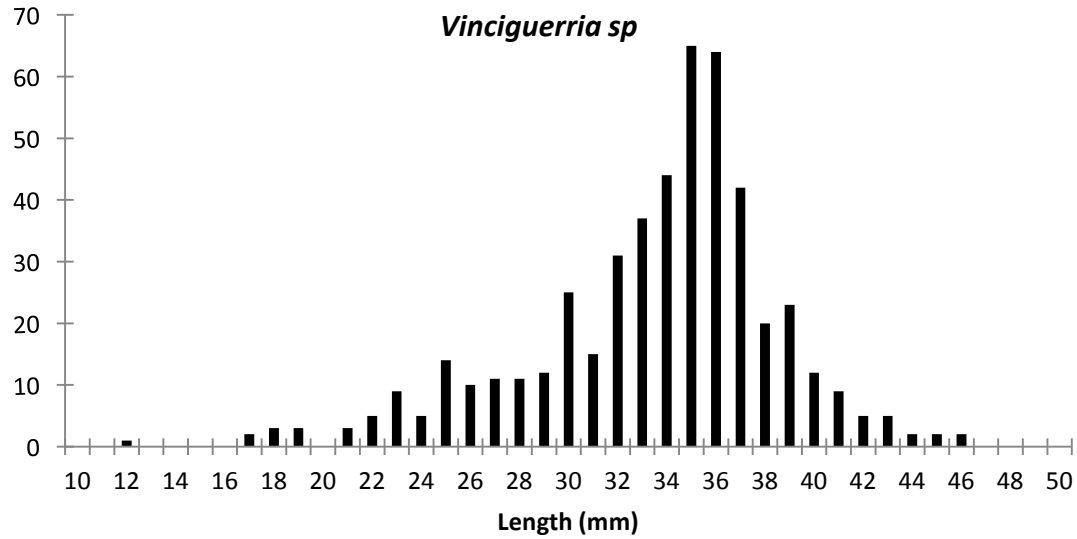
Transceiver-2 menu (38 kHz)	
Transducer depth	5.50 m
Absorbtion coeff.	9.6 dB/km
Pulse duration	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2-way beam angle	-20,6dB
gain	25,13 dB
SA correction	-0.55 dB
Angle sensitivity	21.9
3 dB beamwidth	7.01º along ship
	6.98º athwardship
Alongship offset	0.12º
Athwardship offset	0.02º

Bottom detection menu Minimum level -43 dB

ANNEX III LENGTH FREQUENCY DISTRIBUTION






Vinciguerria sp
70
60
50
40
30
20
10
0
10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Length (mm)

ANNEX IV CATCH RATES

Families included in the different groups:

Mesopelagic = Myctophidae - Pothichthydae - Chauliodontidae - Gonostomatidae

Crustaceans = Crustaceans (does not include neither shrimps nor crabs)

Cephalopods = Squids

Shrimps = Shrimps

DAY TIME

Station	Gear depth	Mesopelagic	Crustacea	Cephalopods	Shrimps	Others	Total
1	275.0	16.50		0.02		1.13	17.65
6	25.0			0.09		0.60	0.69
7	376.0	2.17	0.36	1.64	0.14	1.68	5.99
9	325.0	0.38	0.15	0.31		2.09	2.93
10	342.5	0.75	0.08	0.14	0.20	0.88	2.05
11	10.0	11.96		3.42	0.21	4.05	19.64
13	412.5	0.38	0.11	0.29	0.07	1.24	2.09
16	260.0	2.53		0.66		2.43	5.62
17	350.0	1.04	0.90	0.07	0.37	0.88	3.26
18	480.0	3.86	0.18	0.62	0.49	2.96	8.11
19	394.0	1.93	0.17	0.01	0.07	1.33	3.51
22	200.0	1.49	1.12	0.34		0.92	3.86
Mean	287.5	3.6	0.26	0.63	0.13	1.68	6.28
Std dev		5.18	0.37	0.99	0.16	1.03	6.12
%Catch		57.02	4.07	10.08	2.06	26.79	100.00

NIGHT TIME

Station	Gear depth	Mesopelagic	Crustacea	Cephalopods	Shrimps	Others	Total
2	35.0	4.56	8.56	51.68		1.04	65.84
3	38.5	16.87	5.97	1.38		4.06	28.28
4	25.0	22.56	2.97	4.35		2.42	32.30
5	65.0	7.22	1.44	3.12		6.88	18.66
8	37.0	0.96		0.95	0.02	5.19	7.12
12	59.0	2.81	1.74	0.34		0.75	5.63
14	22.5	3.30	3.14	0.74		0.82	8.00
15	54.0	5.48	7.65	12.14		1.89	27.15
20	50.0	7.74	1.82	1.28		0.82	11.65
21	69.0	8.91	2.78	0.98		0.88	13.55
Mean	45.5	8.04	3.61	7.69		2.47	21.82
Std dev		6.74	2.83	15.85	0.01	2.18	18.16
%Catch		36.86	16.53	35.27	0.01	11.34	100.00

Annex IV Samples of plankton collected during the survey

Station	Date	Lat	Lon	DN	Net name	Mesh size	Depth end	Depth start	Vol. filtered	Responsible biomass samples	Responsible enumeration preserved samples	Responsible taxonomy preserved samples
1104	2013-10-25 06:00:00	10.5002	84.5672	Day	WP2	180	0	200	50	IMR	NARA	NARA
1104	2013-10-25 06:15:00	10.5002	84.5672	Day	Juday	90	0	200	20	IMR	NARA	NARA
1104	2013-10-25 06:45:00	10.5002	84.5672	Day	Phyto	10	0	50	5	-	-	NARA
1105	2013-10-25 07:45:00	10.4968	84.5858	Day	Multi net	405	500	900	100	IMR	NARA	NARA
1105	2013-10-25 08:10:00	10.4968	84.5858	Day	Multi net	405	200	500	75	IMR	NARA	NARA
1105	2013-10-25 08:27:00	10.4968	84.5858	Day	Multi net	405	100	200	25	IMR	NARA	NARA
1105	2013-10-25 08:35:00	10.4968	84.5858	Day	Multi net	405	50	100	12.5	IMR	NARA	NARA
1105	2013-10-25 08:37:00	10.4968	84.5858	Day	Multi net	405	0	50	12.5	IMR	NARA	NARA
1110	2013-10-26 04:30:00	10.4765	86.9875	Day	WP2	180	0	200	50	IMR	NARA	NARA
1110	2013-10-26 04:40:00	10.4765	86.9875	Day	Juday	90	0	200	20	IMR	NARA	NARA
1110	2013-10-26 04:50:00	10.4765	86.9875	Day	Phyto	10	0	50	5	-	-	NARA
1110	2013-10-26 05:01:00	10.4765	86.9875	Day	Multi net	405	502	805	75.75	IMR	NARA	NARA
1110	2013-10-26 05:25:00	10.4765	86.9875	Day	Multi net	405	203	501	74.5	IMR	NARA	NARA
1110	2013-10-26 05:40:00	10.4765	86.9875	Day	Multi net	405	101	201	25	IMR	NARA	NARA
1110	2013-10-26 05:48:00	10.4765	86.9875	Day	Multi net	405	0	54	13.5	IMR	NARA	NARA
1110	2013-10-26 05:49:00	10.4765	86.9875	Day	Multi net	405	54	101	11.75	IMR	NARA	NARA
1111	2013-10-26 12:30:00	9.5020	87.2680	Night	WP2	180	0	200	50	IMR	NARA	NARA
1111	2013-10-26 12:45:00	9.5020	87.2680	Night	Phyto	10	0	50	5	-	-	NARA
1111	2013-10-26 13:00:00	9.5020	87.2680	Night	Juday	90	0	200	20	IMR	NARA	NARA
1112	2013-10-26 14:13:00	9.4963	87.2837	Night	Multi net	405	498	997	124.75	IMR	NARA	NARA
1112	2013-10-26 14:29:00	9.4963	87.2837	Night	Multi net	405	202	497	73.75	IMR	NARA	NARA
1112	2013-10-26 14:38:00	9.4963	87.2837	Night	Multi net	405	97	201	26	IMR	NARA	NARA
1112	2013-10-26 14:41:00	9.4963	87.2837	Night	Multi net	405	52	96	11	IMR	NARA	NARA
1112	2013-10-26 14:43:00	9.4963	87.2837	Night	Multi net	405	0	51	12.75	IMR	NARA	NARA
1118	2013-10-27 12:10:00	9.4980	84.8355	Night	Juday	90	0	200	20	IMR	NARA	NARA
1118	2013-10-27 12:35:00	9.4980	84.8355	Night	WP2	180	0	200	50	IMR	NARA	NARA

Station	Date	Lat	Lon	DN	Net name	Mesh size	Depth end	Depth start	Vol. filtered	Responsible biomass samples	Responsible enumeration preserved samples	Responsible taxonomy preserved samples
1118	2013-10-27 12:50:00	9.4980	84.8355	Night	Phyto	10	0	50	5	-	-	NARA
1118	2013-10-27 13:52:00	9.4980	84.8355	Night	Multi net	405	501	1002	125.25	IMR	NARA	NARA
1118	2013-10-27 14:12:00	9.4980	84.8355	Night	Multi net	405	201	501	75	IMR	NARA	NARA
1118	2013-10-27 14:23:00	9.4980	84.8355	Night	Multi net	405	101	201	25	IMR	NARA	NARA
1118	2013-10-27 14:29:00	9.4980	84.8355	Night	Multi net	405	53	101	12	IMR	NARA	NARA
1118	2013-10-27 14:32:00	9.4980	84.8355	Night	Multi net	405	0	53	13.25	IMR	NARA	NARA
1120	2013-10-27 22:00:00	8.4978	85.3007	Night	WP2	180	0	200	50	IMR	NARA	NARA
1120	2013-10-27 22:20:00	8.4978	85.3007	Night	Juday	90	0	200	20	IMR	NARA	NARA
1120	2013-10-27 22:40:00	8.4978	85.3007	Night	Phyto	10	0	50	5	-	-	NARA
1121	2013-10-27 23:59:00	8.4940	85.3105	Night	Multi net	405	499	902	100.75	IMR	NARA	NARA
1121	2013-10-28 00:10:00	8.4940	85.3105	Day	Multi net	405	202	499	74.25	IMR	NARA	NARA
1121	2013-10-28 00:29:00	8.4940	85.3105	Day	Multi net	405	102	202	25	IMR	NARA	NARA
1121	2013-10-28 00:34:00	8.4940	85.3105	Day	Multi net	405	52	102	12.5	IMR	NARA	NARA
1121	2013-10-28 00:36:00	8.4940	85.3105	Day	Multi net	405	0	52	13	IMR	NARA	NARA
1125	2013-10-28 18:50:00	8.4990	87.6668	Night	Phyto	10	0	50	5	-	-	NARA
1125	2013-10-28 19:00:00	8.4990	87.6668	Night	Juday	90	0	200	20	IMR	NARA	NARA
1125	2013-10-28 19:20:00	8.4990	87.6668	Night	WP2	180	0	200	50	IMR	NARA	NARA
1126	2013-10-28 20:32:00	8.4942	87.6727	Night	Multi net	405	501	900	99.75	IMR	NARA	NARA
1126	2013-10-28 20:57:00	8.4942	87.6727	Night	Multi net	405	201	501	75	IMR	NARA	NARA
1126	2013-10-28 21:15:00	8.4942	87.6727	Night	Multi net	405	102	201	24.75	IMR	NARA	NARA
1126	2013-10-28 21:20:00	8.4942	87.6727	Night	Multi net	405	51	101	12.5	IMR	NARA	NARA
1126	2013-10-28 21:23:00	8.4942	87.6727	Night	Multi net	405	0	51	12.75	IMR	NARA	NARA
1128	2013-10-29 05:40:00	7.4980	88.3883	Day	Phyto	10	0	50	5	-	-	NARA
1128	2013-10-29 05:50:00	7.4980	88.3883	Day	WP2	180	0	200	50	IMR	NARA	NARA
1128	2013-10-29 06:10:00	7.4980	88.3883	Day	Juday	90	0	200	20	IMR	NARA	NARA
1128	2013-10-29 07:06:00	7.4980	88.3883	Day	Multi net	405	500	903	100.75	IMR	NARA	NARA
1128	2013-10-29 07:30:00	7.4980	88.3883	Day	Multi net	405	203	501	74.5	IMR	NARA	NARA
1128	2013-10-29 07:49:00	7.4980	88.3883	Day	Multi net	405	100	203	25.75	IMR	NARA	NARA
1128	2013-10-29 07:56:00	7.4980	88.3883	Day	Multi net	405	52	99	11.75	IMR	NARA	NARA

1128	2013-10-29 07:59:00	7.4980	88.3883	Day	Multi net	405	0	52	13	IMR	NARA	NARA
1133	2013-10-30 06:30:00	7.4988	85.5398	Day	Juday	90	0	200	20	IMR	NARA	NARA
1133	2013-10-30 06:50:00	7.4988	85.5398	Day	WP2	180	0	200	50	IMR	NARA	NARA
Station	Date	Lat	Lon	DN	Net name	Mesh size	Depth end	Depth start	Vol. filtered	Responsible biomass samples	Responsible enumeration preserved samples	Responsible taxonomy preserved samples
1133	2013-10-30 07:10:00	7.4988	85.5398	Day	Phyto	10	0	50	5	-	-	NARA
1134	2013-10-30 08:10:00	7.4878	85.5247	Day	Multi net	405	502	905	100.75	IMR	NARA	NARA
1134	2013-10-30 08:33:00	7.4878	85.5247	Day	Multi net	405	202	502	75	IMR	NARA	NARA
1134	2013-10-30 08:50:00	7.4878	85.5247	Day	Multi net	405	101	201	25	IMR	NARA	NARA
1134	2013-10-30 08:55:00	7.4878	85.5247	Day	Multi net	405	52	101	12.25	IMR	NARA	NARA
1134	2013-10-30 08:57:00	7.4878	85.5247	Day	Multi net	405	0	52	13	IMR	NARA	NARA
1135	2013-10-31 05:30:00	6.4363	88.4550	Day	Juday	90	0	200	20	IMR	NARA	NARA
1135	2013-10-31 05:50:00	6.4363	88.4550	Day	WP2	180	0	200	50	IMR	NARA	NARA
1135	2013-10-31 06:10:00	6.4363	88.4550	Day	Phyto	10	0	50	5	-	-	NARA
1136	2013-10-31 07:01:00	6.4468	88.4468	Day	Multi net	405	501	903	100.5	IMR	NARA	NARA
1136	2013-10-31 07:28:00	6.4468	88.4468	Day	Multi net	405	202	501	74.75	IMR	NARA	NARA
1136	2013-10-31 07:45:00	6.4468	88.4468	Day	Multi net	405	102	202	25	IMR	NARA	NARA
1136	2013-10-31 07:51:00	6.4468	88.4468	Day	Multi net	405	51	102	12.75	IMR	NARA	NARA
1136	2013-10-31 07:54:00	6.4468	88.4468	Day	Multi net	405	0	51	12.75	IMR	NARA	NARA
1142	2013-11-01 07:10:00	6.4345	85.5593	Day	Juday	90	0	200	20	IMR	NARA	NARA
1142	2013-11-01 07:30:00	6.4345	85.5593	Day	WP2	180	0	200	50	IMR	NARA	NARA
1142	2013-11-01 07:50:00	6.4345	85.5593	Day	Phyto	10	0	50	5	-	-	NARA
1142	2013-11-01 09:56:00	6.4345	85.5593	Day	Multi net	405	501.2	870.1	92.225	IMR	NARA	NARA
1142	2013-11-01 10:18:00	6.4345	85.5593	Day	Multi net	405	200	501	75.25	IMR	NARA	NARA
1142	2013-11-01 10:34:00	6.4345	85.5593	Day	Multi net	405	101	199	24.5	IMR	NARA	NARA
1142	2013-11-01 10:40:00	6.4345	85.5593	Day	Multi net	405	28	101	18.25	IMR	NARA	NARA
1142	2013-11-01 10:44:00	6.4345	85.5593	Day	Multi net	405	0	27	6.75	IMR	NARA	NARA