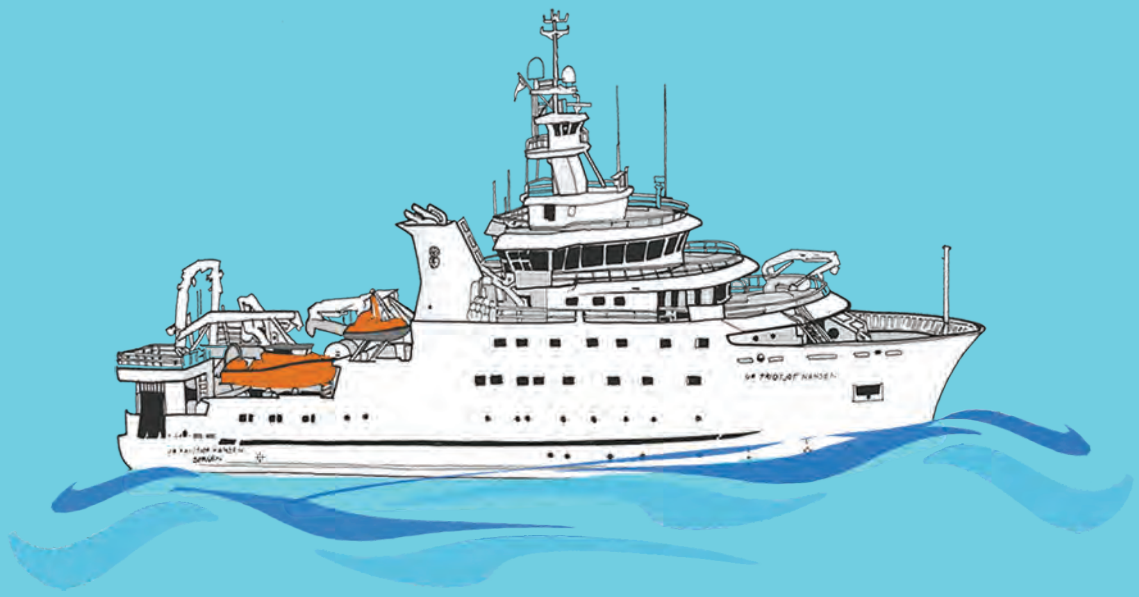
NORAD-FAO PROGRAMME
GCP/GLO/690/NOR

CRUISE REPORTS *DR FRIDTJOF NANSEN*
EAF-Nansen/CR/2018/8



SURVEY OF REGIONAL RESOURCES AND ECOSYSTEM OF THE BAY OF BENGAL

Sri Lanka

24 June – 16 July 2018

National Aquatic Resources Research and Development Agency, Sri Lanka

Department of Botany, University of Kelaniya, Sri Lanka

Institute of Marine Research
Bergen, Norway

The EAF-Nansen Programme

The EAF-Nansen Programme "Supporting the application of the Ecosystem Approach to Fisheries Management considering climate and pollution impacts" (GCP/GLO/690/NOR) aims to further strengthen the knowledge base and the overall institutional capacity for the implementation of the Ecosystem Approach to Fisheries (EAF) in developing countries, with additional attention to the impact of climate variability and change, pollution and other anthropogenic stressors.

The programme, that started implementation in May 2017, builds on earlier phases, and is governed by an agreement between the Food and Agriculture Organization of the United Nations (FAO), the Institute of Marine Research (IMR), Norway and the Norwegian Agency for Development Cooperation (Norad). The three pillars of the new programme are: Science, Fisheries management, and Capacity development. A new state of the art research vessel, *Dr Fridtjof Nansen* is an integral part of the programme. A science plan, covering 11 research themes, guides the programme scientific work.

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

Le Programme EAF-Nansen

Le Programme EAF-Nansen "Appuyer la mise en œuvre de l'approche écosystémique de la gestion des pêches en tenant compte des impacts du climat et de la pollution" (GCP/GLO/690/NOR), vise à renforcer la base de connaissances et la capacité institutionnelle pour la mise en œuvre de l'approche écosystémique des pêches (AEP) dans les pays en développement, en accordant une attention particulière aux effets de la variabilité et du changement climatique, de la pollution et d'autres facteurs de stress anthropiques.

Le programme, qui a débuté en mai 2017, s'appuie sur les phases précédentes et est régi par un protocole d'accord entre l'Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO), l'Institut de recherche marine (IMR) de Norvège et l'Agence norvégienne de Coopération au développement (Norad). Les trois piliers du nouveau programme sont : la science, l'aménagement de la pêche et le développement des capacités. Un navire de recherche à la pointe de la technologie, le nouveau *Dr Fridtjof Nansen*, fait partie intégrante du programme. Un plan scientifique, couvrant 11 thèmes de recherche, guide les travaux scientifiques du programme.

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

Krakstad, J.-O., Jayasinghe, P., Totland, A., Dalpadado, P., Søiland, H., Cervantes, D., Gunasekara, S., Liyanage, U., Haputhantri, S., Rathnasuriya, I., Wimalasiri, U., Weerakoon, A., Nirbadha, S., Harischandra, A., Wanigatunga, R., Kithsiri, P. 2018. Survey of regional resources and ecosystem of the Bay of Bengal, 24 June – 16 July 2018. NORAD-FAO PROGRAMME GCP/GLO/690/NOR, CRUISE REPORTS *DR FRIDTJOF NANSEN*, EAF-Nansen/CR/2018/8.

CRUISE REPORTS *DR FRIDTJOF NANSEN*

SURVEY OF REGIONAL RESOURCES AND ECOSYSTEM OF THE BAY OF BENGAL

Sri Lanka

24 June-16 July 2018

by

Jens-Otto Krakstad[1], Prabath Jayasinghe[2], Atle Totland[1], Padmini Dalpadado[1], Henrik Søiland[1], David Cervantes[1], Sudheera Gunasekara[2], Upul Liyanage[2], Sisira Haputhantri[2], Ishara Rathnasuriya[2], Udeshika Wimalasiri[2], Ashoke Weerakoon[2], Srimantha Nirbadha[2], Akila Harischandra[2], Rasika Wanigatunga[3], Palitha Kithsiri[2]

[1] Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen, Norway
[2] National Aquatic Resources Research and Development Agency (NARA), Sri Lanka
[3] Department of Botany, University of Kelaniya, Sri Lanka

Institute of Marine Research
Bergen, 2020

CONTENTS

EXECUTIVE SUMMARY

This survey was part of a synoptic coverage of the Bay of Bengal marine resources and ecosystems conducted by the research vessel (R/V) *Dr Fridtjof Nansen* under the framework of the EAF-Nansen Programme (2017-2021). Survey objectives represented a wide scope of research areas linked to the EAF-Nansen Science Plan and encompassing marine resources, pollution and climate. Therefore, in addition to providing key information on the abundance and distribution of main pelagic stocks, the survey programme was designed to also support longer term research projects under the EAF-Nansen science plan.

This report documents the scientific scope of the survey within Sri Lanka EEZ, the sampling methods used and provides preliminary results while the broader set of results is expected to come as part of the activites under the EAF-Nansen Science Plan and will be published separately.

The ecosystem survey was successfully carried out and provided a wealth of new data on the marine shelf and slope ecosystem off Sri Lanka. Data collected during the survey included physical and chemical oceanography, plastic pollution, plankton distribution and abundance, pelagic and demersal fish biomass, distribution and diversity, and distribution of marine mammals. Standard acoustic and swept area fish stock assessment methods were used to estimate the distribution, abundance and biomass of the pelagic and demersal fish stocks in the region.

Waters off the east coast of Sri Lanka are characterised by a 50-100 m thick surface layer with high temperature and low salinity, except for the southern coast where signs of upwelling were present. Observations during the survey were considered as typical for the season.

In agreement with the oceanographic picture, highest concentrations of zooplankton biomass were recorded in the South Coast of Sri Lanka. The zooplankton species diversity was highest in the South West and North West regions. With regard to ichthyoplankton distribution, an important indicator of fish nursery areas, the highest average number of fish larvae was observed in the South East region.

Microplastics were found all around Sri Lanka, and the vast majority belonged to the “secondary” category, indicating that the packaging material, industrial applications and fishing gear are major sources. The highest concentrations were found in the North Western region off Sri Lanka. This region was highly polluted with microplastics, compared to other regions, while the northeast coast and the south coast showed the lowest number of microplastic particles in the samples.

The total biomass of clupeiformes, i.e sardines and anchovies (Clupeidae, Dussumieriidae and Engraulididae) was 21 000 tonnes, of this more than 18 000 tonnes were found in the South West coast region (off Negombo). Biomass of the Pel2 group (Carangidae, Scombridae, Barracuda and Hairtails) was estimated at 101 000 tonnes, with the highest abundance found along the south and west coast.

Demersal fish biomass, based on the swept-area method, was 53 000 tonnes excluding jellyfish, garbage, coral debris and sponges that came up with the trawl. Looking at the biomass on the shelf (20-100 m depth) in the different regions the North West coast gave the lowest biomass estimate (967 tonnes). The highest biomass in the coastal zone was found on the shelf off Batticaloa in the South East region with an estimate of 8173 tonnes, the South West coast had the second highest biomass estimate on the shelf with biomass of 7894 tonnes. The biomass of jellyfish was 15 600 tonnes with a majority (14 200 tonnes) from the shelf off Batticaloa in the East region.

The present survey provided the opportunity for the first marine mammal systematic observation carried out in Sri Lanka covering the whole coastal areas within a season. During the survey, five species of cetaceans were recorded. Blue whale *Balaenoptera musculus* is the most commonly observed (72% of total observations) and showed a wide distribution with a record of 151 (best) individuals. Since there were very low sightings of blue whales in the East of Sri Lanka, the current survey results indicated that during the southwest monsoon period the blue whales in Sri Lanka are found mainly in the southwestern part of the country. Importantly, the highest blue whale aggregations were recorded on the dense shipping lane from Dondra to Galle in the South coast of Sri Lanka.

CHAPTER 1. INTRODUCTION

This survey was planned as part of a synoptic coverage of the Bay of Bengal marine resources and ecosystems to be conducted by the R/V *Dr Fridtjof Nansen* in 2018 as part of the EAF-Nansen Programme (2017-2021). In connection with this phase of the Programme, a Science Plan has been developed that addresses 11 different topics within three main lines of research related to resources, impacts of oil/mining activities and pollution on resources and ecosystems and climate change. Therefore, in addition to providing key information on the abundance and distribution of main pelagic stocks, the survey programme was designed to also support the research projects under the science plan. Within this framework, the survey scope and objectives for the Bay of Bengal were discussed and agreed to during a regional meeting held in Colombo (Sri Lanka) in August 2017.

The desirability of a survey in Sri Lanka waters was also put forward to Norad and IMR in connection with the existing bilateral cooperation in fisheries.

1.1 The survey area

The area surveyed in 2018 by the R/V *Dr Fridtjof Nansen* includes the continental shelf and upper slope of East Africa (continental) (Leg 1), the Mascarene Bank (Leg 2) and parts of the Bay of Bengal region (Leg 3). Transfer of the vessel between the different legs was used as an opportunity to carry out studies of specific oceanographic features and of the mesopelagic communities. The continental shelves and upper slope areas of Sri Lanka, Bangladesh, Myanmar and Thailand were covered as part of Leg 3. Figure 1 provides an overview of the surveys undertaken as part of Leg 3.

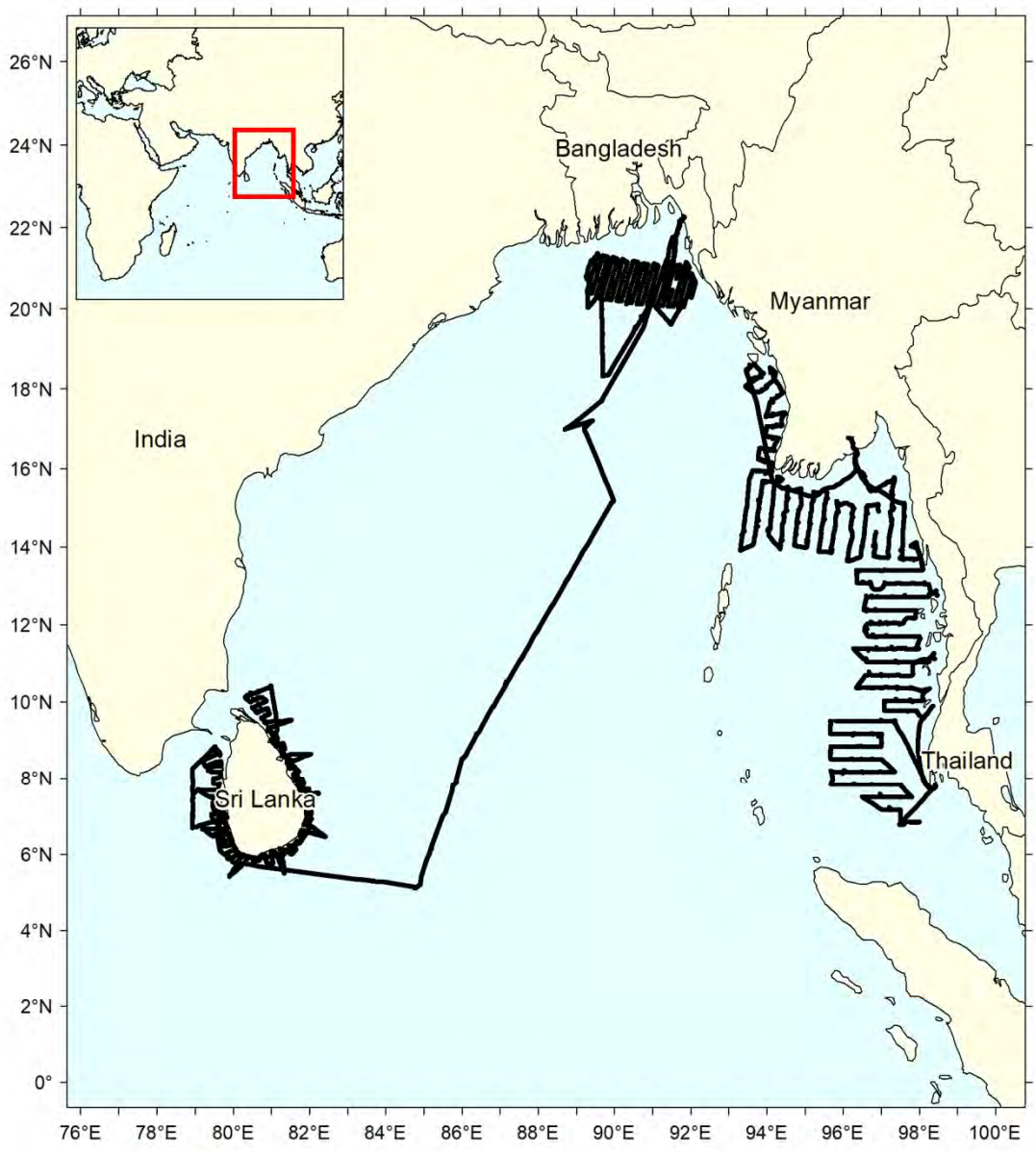


Figure 1. The survey plan for the R/V *Dr Fridtjof Nansen* during leg 3.

The survey 3.1 started in Colombo (Sri Lanka) on 24 June 2018 and covered the continental shelf and upper slope of Sri Lanka until 16 July. After completion of the survey off Sri Lanka, the vessel moved northwards to complete oceanographic sampling in the international waters of the Bay of Bengal. In Bangladesh, the main emphasis was on pelagic resources, while in Myanmar on the distribution of eggs and larvae. Off Thailand, the priority was the deep waters of the Andaman Sea.

This report describes the ecosystem survey along the coast of Sri Lanka (Leg 3.1, Figure 2) covering hydrographic conditions, phytoplankton, zooplankton and ichthyoplankton, an abundance of pelagic and demersal resources, biodiversity from trawl catches, pollution (microplastics, food safety and nutritional value of fish), the occurrence of top predators. Additional analysis of data collected will take place as part of the work under the EAF-Nansen Science Plan.

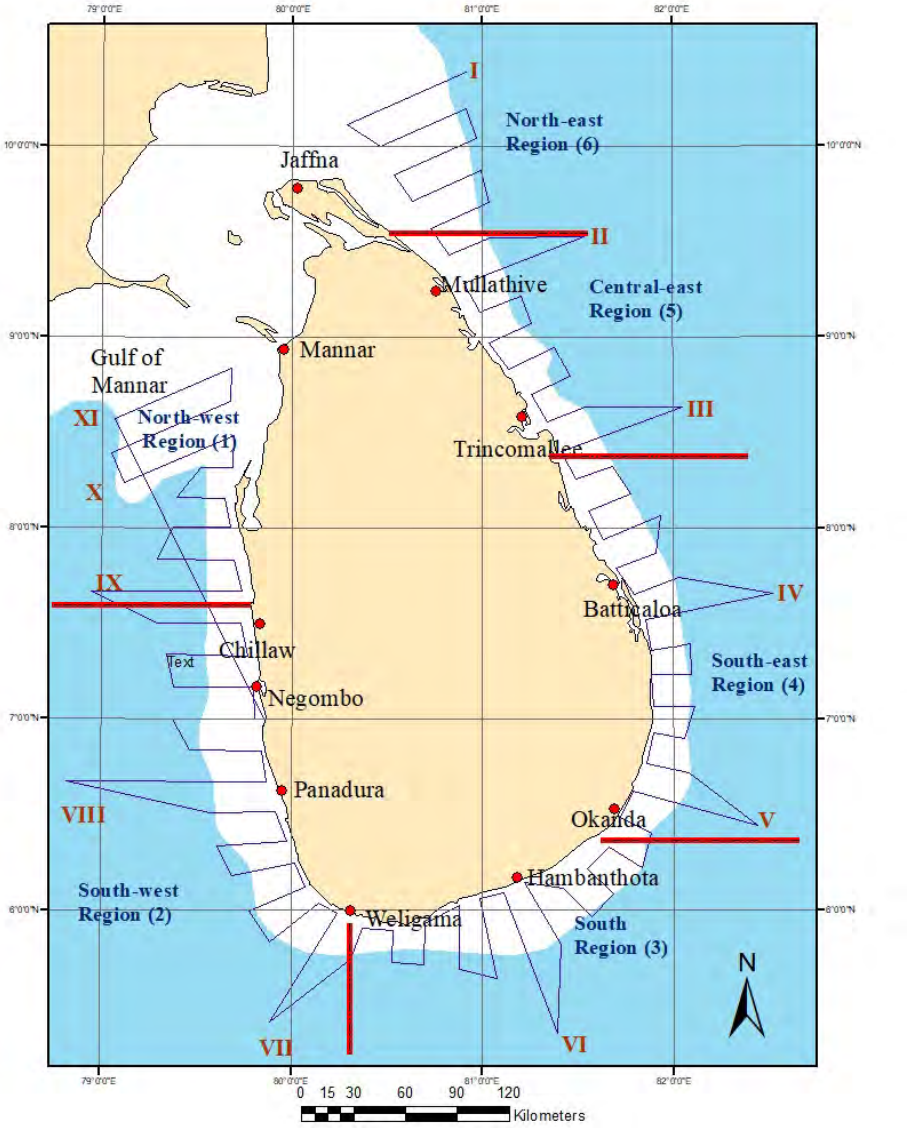


Figure 2. R/V *Dr Fridtjof Nansen* Survey Programme 2018, Leg 3.1. Note: Survey regions (1-6) were designed according to the *Dr Fridtjof Nansen* surveys carried out in 1978 - 1980 in Sri Lanka. Roman numbers I-XI describes the numbering of the ecosystem transects carried out.

1.2 Survey objectives

Hydrography:

- To map the hydrographic/environmental conditions in the survey area (temperature, salinity, oxygen, chlorophyll, nutrients and pH values).

Phytoplankton, zooplankton, ichthyoplankton and jellyfish:

- To establish as far as possible, the distribution, abundance and composition of phytoplankton and zooplankton (including jellyfish), and species composition of fish eggs and larvae.

Pelagic and demersal fish stocks:

- To obtain information on abundance, distribution (also by size) of the main pelagic fish species, and also considering the pelagic sub-groups PEL 1(clupeids, engraulids) and PEL2 (carangids, scombrids, barracudas, hairtail), using acoustic methods in a systematic grid survey strategy and conducting targeted trawling.
- To obtain information on abundance, distribution (also by size) of the main demersal fish species, crustaceans and squids, using a swept-area method with bottom trawls.
- To collect information on the biodiversity of fish from trawl catches
- To collect information on maturity stages, for the main pelagic fish, demersal fish, crustaceans and squids.
- To collect samples for genetic analysis for selected species.
- To collect stomach samples for analysis of contents (diet) including microplastics.

Mesopelagic fish:

- To identify the main species of mesopelagic fish in coastal waters around Sri Lanka.

Contaminants:

- To collect samples of fish species consumed locally, the most abundant/less exploited depth water fish species and other indicator species, for analysis of contaminant levels and nutrient values.

Top predators:

To record occurrence of sea birds and marine mammals along the cruise track.

1.3 Participation

A total of 29 scientists and technicians from Sri Lanka and Norway participated in the survey. The full list of participants and their affiliations are given in Table 1.

Table 1. List of participants, their role and affiliation during the survey off Sri Lanka.

PARTICIPANT	ROLE	AFILIATION
Jens-Otto Krakstad	Cruise Leader	IMR
Prabath Jayasinghe	Local Cruise Leader	NARA
Atle Totland	Scientist- Acoustics	IMR
Padmini Dalpadado	Scientist- Plankton Biology	IMR
Henrik Søiland	Scientist- Oceanography	IMR
Edel Erdal	Scientist- Food Safety	IMR
Amalie Moxness	Scientist- Food Safety	IMR
Olaf Sørås	Acoustic Engineer	IMR
Hege Rognaldsen	Acoustic Engineer	IMR
Tom Williams	Technician -Fish Lab	IMR
Erik Odland	Technician -Fish Lab	IMR
Sisira Haputhantri	Scientist -Fisheries Biology	NARA
Vasantha Pahalawattarachchi	Scientist- Water Chemistry	NARA
Ajith Kumara	Scientist - Fisheries Biology	NARA
Ramani Shirantha	Scientist - Plankton Biology	NARA
Upul Liyanage	Scientist -Marine mammal/ Sea bird Biology	NARA
Sujeewa Athukoorala	Scientist- Fisheries Biology (Acoustics)	NARA
Akila Harischandra	Scientist- Physical Oceanography	NARA
Ishara Rathnasuriya	Scientist- Ichthyoplankton Biology	NARA
Srimantha Nirbadha	Scientist- Water Chemistry	NARA
Sudheera Gunasekara	Scientist - Fisheries Biology (Acoustics)	NARA
Kasun Dalpathadu	Scientist - Fisheries Biology	NARA
Thilanka Madhushanka	Scientist - Plankton Biology	NARA
Thejani Balawardhana	Scientist - Fisheries Biology	NARA
Udeshika Wimalasiri	Scientist – Zooplankton Biology	NARA
Thiruchenduran Somasundaran	Scientist- Food Safety	NARA
Ashoka Weerakoon	Scientist- Microplastic Analysis	NARA
Duminda Withanaarachchi	Scientist – Plankton Biology	DFAR
Nalin Herath	On board Observer/Scientist– Fisheries Biology	NAVY

List of institution abbreviations:

IMR – Institute of Marine Research, Bergen, Norway
NARA – National Aquatic Resources Research and Development Agency, Sri Lanka
DFAR – Department of Fisheries and Aquatic Resources, Sri Lanka
NAVY – Sri Lanka Navy

1.4 Narrative

The research vessel *Dr Fridtjof Nansen* arrived in Colombo, Sri Lanka on 21 June 2018 after completion of Leg 2.2 crossing the southern Indian Ocean from Port Luis, Mauritius. On the 22nd morning, the National Aquatic Resources Research and Development Agency (NARA) of Sri Lanka welcomed the vessel. On the 23rd, the vessel was open to the public including university students, staff of NARA and the Ministry of Fisheries and other interested visitors. The Sri Lankan scientists embarked at 16:00 hrs of the same day. The vessel departed from

Colombo on 24 June at 08:00 local time in the morning and sailed towards the north-east coast of Sri Lanka on the border with India.

The first sampling station took place in the morning of 26 June at 04:00 local time (UTC +5.5h). The vessel continued the survey southwards and around Sri Lanka and reached the northeastern region on in the early morning of 14 July. The vessel then proceeded on an offshore acoustic and hydrographic transect to search for pelagic fish in offshore waters off the west coast and to get more data on water mass circulation in that area. A request from the NAVY to map the bottom topography in an area off Colombo port was received during the survey. After confirmation by NARA and realising that time was available for this work, a small bathymetric survey was carried out on in the morning of 15 July. The survey ended at around 14:00 hrs the same day with the vessel sailed to Colombo.

1.5 Survey effort

The design of the standard survey and the sampling followed the agreed design described in the sailing order for Leg 1.3. This implied a systematic survey track consisting of pseudo-parallel acoustic transect lines perpendicular to the coastline, from 20 m to 1500 m depth, equally spaced approximately 10 nautical miles apart. Every degree latitude an ecosystem transects were carried out with detailed hydrographic sampling with CTD, and phytoplankton and zooplankton sampling stations at predefined bathymetric depths (Annex I).

Besides acoustic sampling for pelagic fish biomass estimation, the survey design also allowed a continuous recording of data from the multibeam bottom mapping echo sounder EM302, thermosalinograph and weather station. The bottom penetrating echo sounder was used on selected locations along the ecosystem transects.

Bottom trawling for biomass estimation of demersal fish and crustaceans was undertaken at three different depth-strata on each transect or when bottom conditions allowed, between 20-50 m, 50-100 m and between 100-1000 m depth. Due to the steepness of the shelf, the number of trawl station beyond 100 m was low and no biomass estimate could be carried out for this depth range.

Hydrographic variables were measured at every bottom trawl station and at “ecosystem” sections perpendicular to the coastline about every 60 nm. At these transects, in addition to CTD sampling, an elaborate sampling program was conducted including for plankton, egg and larvae and water collected for chemical analysis.

Table 2 summarises the survey effort in each sub-area, while Table 3 shows the area covered and effort per strata as used in the swept area analyses. Table 4 shows the areas of the acoustic stratused during the survey. The cruise tracks with bottom-trawls, pelagic trawls, plankton and hydrographic stations can be found in Figure 3.

Table 2. Survey effort per region with the in number of sampling stations. Number of CTD, Phyto - phytoplankton nets, WP2 – zooplankton nets, Multi – Multinet mammoth for eggs and larvae, Manta – nets for plastic particles in the surface, BT-bottom trawl and PT- Pelagic trawl hauls.

Regions	**North East**	**Central East**	**South East**	**South**	**South West**	**North West**	**Offshore West**
Date	25- 28/6	28-30/6	30/6 - 3/7	4- 6/7	6-10/7	10-14/7	14- 15/7
Distance (NM)	299.5	337.1	469.1	312.8	912.6	422.1	81.7
Transect	5	8	13	9	11	9	1
BT	12	10	18	11	13	5	0
PT	2	1	2	2	7	3	2
CTD	21	20	28	18	22	18	8
Phyto	3	6	4	3	6	1	0
WP2	5	10	10	5	10	3	4
Multi	3	5	5	3	4	2	2
Manta	3	6	6	3	6	2	2
Pump sample*	7	7	9	7	7	7	4

Table 3. Survey effort, with the number of valid trawl hauls for swept-area analysis (by region and depth strata).

Region	**Effort**	**Depth strata (m)**	
		20-100	**100-500**
1 North West	N trawl hauls	3	2
	Sampling intensity (A/N)	51	131
	Area (NM^2)	153	261
2 South West	N trawl hauls	13	-
	Sampling intensity (A/N)	81	-
	Area (NM^2)	1047	203
3 South	N trawl hauls	10	1
	Sampling intensity (A/N)	65	241
	Area (NM^2)	653	241
4 South East	N trawl hauls	18	-
	Sampling intensity (A/N)	44	-
	Area (NM^2)	795	207
5 Central East	N trawl hauls	10	-
	Sampling intensity (A/N)	35	-
	Area (NM^2)	345	191
6 North East	Trawlhauls	9	2
	Sampling intensity (A/N)	75	221
	Area (NM^2)	677	442

Table 4. Stratum and areas surveyed acoustically along the coast of Sri Lanka. The positions (Decimal degrees) relates to the corners of the strata. These were further subdivided into two depth strata at the 500 m isobaths.

Stratum	Area (nm^2)	Start Lat	start Lon	End Lat	End Lon
NW_shallow	1114.4	Not covered			
I_NW_20-500 m	414.0	8.943	79.925	7.287	79.831
I_NW_500-1000 m	805.4				
SW_shallow	203.8	Not covered			
II_SW_20-500 m	1248.6	7.287	79.831	5.935	80.499
II_SW_500-1000 m	278.9				
S_shallow	166.3	Not covered			
III_S_20-500 m	871.4	5.935	80.499	6.334	81.519
III_S_500-1000 m	135.2				
SE_shallow	445.6	Not covered			
IV_SE_20-500 m	928.4	6.334	81.519	8.333	81.398
IV_SE_500-1000 m	157.0				
CE_shallow	332.0	Not covered			
V_CE_20-500 m	521.1	8.333	81.398	9.503	80.560
V_CE_500-1000 m	119.1				
NE_shallow	605.9	Not covered			
VI_NE_20-500 m	1100.7	9.503	80.560	9.777	79.934
VI_NE_500-1000 m	149.9				

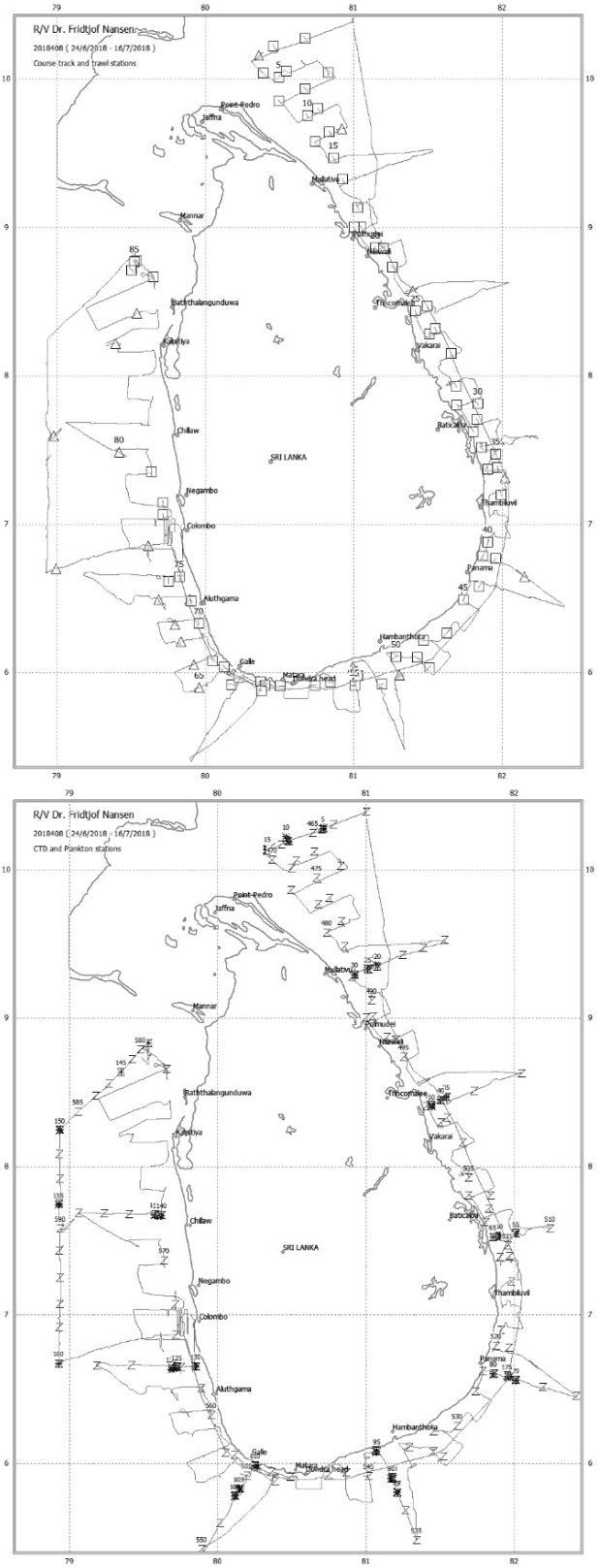


Figure 3. Cruise track and trawl stations (left) and CTD and plankton stations (right).

CHAPTER 2. METHODS

2.1 Underway sampling

Meteorological data recording

Meteorological data are normally logged continuously from the AANDERAA Smartguard meteorological station and included wind direction and speed, air pressure, relative humidity, air temperature and solar radiation. All data were logged to the Nansis tracklog system averaged every 60 sec. The wind speed and directions observed along the ship track is reported in this report.

Thermosalinograph

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

Current speed and direction measurements (ADCP)

Two hull-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments ran during the survey. The frequency of the VMADCP are 75 and 150 kHz. At the start of the cruise the system was run in narrowband mode and set to estimate the current in 8 and 16 m vertical bins at 150 and 75 kHz. Due to very shallow shelf regions surveyed, the settings for the 150 kHz were changed to the broadband mode with 4 m vertical bins. Thus, from late July 2, the 150 KHz was run with increased vertical resolution and shallower penetration. The depth range covered by these instruments was variable, depending on sound scattering conditions, and settings. The 150 kHz ADCP ranged from 20-400 m in narrowband and 12-200 m in broadband mode settings. The 75 kHz reached 650-800 m. The heading data to convert the current recorded in the ship-referenced coordinates to the absolute zonal and meridional components were obtained from the vessel's differential GPS system, Seapath.

The ADCP data were postprocessed using the CODAS system (https://currents.soest.hawaii.edu/docs/adcp_doc/) producing 180s ensembles. The two data sets were interpolated to a combined data set, with shallow values (<105 m) with weight 1 for the 150 kHz data and deep data (>155 m) with weight 1 for the 75 kHz data, and linear interpolation between these depths.

The ADCP velocity vectors from the main sections are plotted on a map at 100 m intervals down to 600 m depth, Figures 9-12.

2.2 Fixed hydrographic station sampling

A series of biological and oceanographic sampling was undertaken every 60 NM, i.e. along every 6th acoustic transect (Transects 1, 5, 9 and so on). Samples were taken at a water depth of between 25 and 30m, at the 100 m depth, at 500 m depth and at the outer end of the transects, i.e. at 1000 m bottom depth. These stations were referred to as "super-stations". In addition, further CTD stations were sampled at all bottom trawl stations.

The samples collected on these transects are shown in Figure 4 and in Annex I.

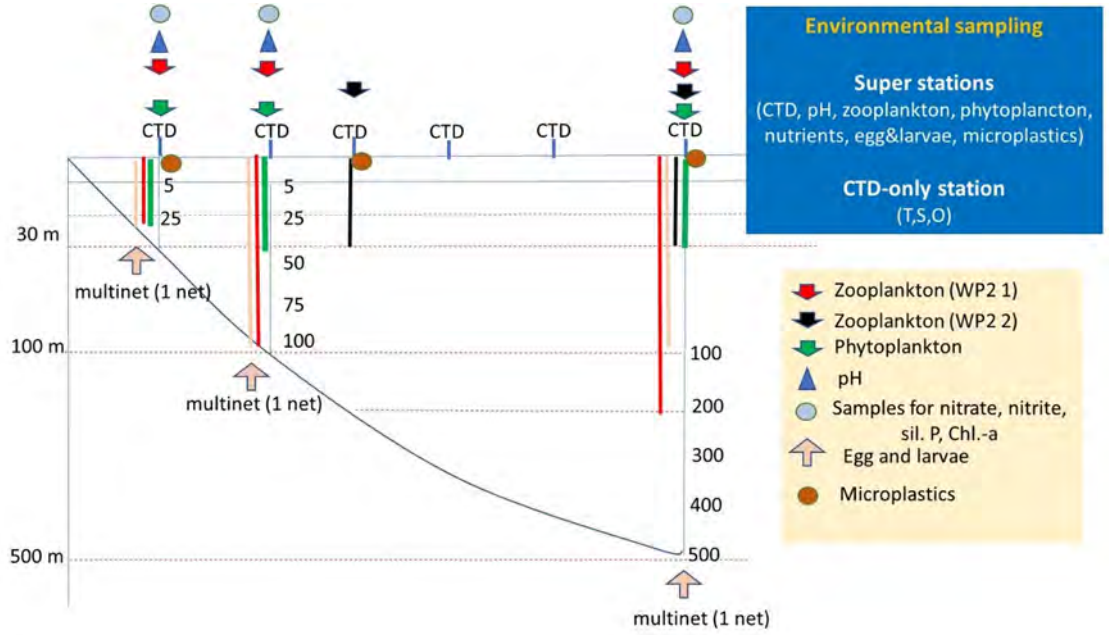


Figure 4. Sampling diagram showing the depth and the equipment used at the super stations transects, from the inshore (left side) towards the deep 500 m stations (right side).

2.3 CTD sensors – temperature, salinity, oxygen and fluorescence

Vertical temperature and salinity profiles were obtained by a Seabird 911 CTD, while in situ concentrations of dissolved oxygen were measured using a CTD-mounted SBE 43 oxygen sensor. Real-time logging and plotting were performed using the Seabird Seasave software installed on a PC. Attached to the CTD was also an uncalibrated Chelsea Mk III Aquatracka fluorimeter, which measures in situ fluorescence on a relative scale and a Photosynthetic Active Radiation (PAR) sensor, measuring downwelling irradiance (in micromole photons m-2).

The salinity sensor on the CTD was validated using a Portasal salinometer from Osil (mod. 8410A) on board the vessel and the oxygen sensor was validated using Winkler titration (Grasshoff *et al*. 1983).

Salinity validation against the water bottles was carried out at maximum observation depth on all deep stations, giving 30 samples for analysis. The salinity samples were measured with the Portasal salinometer unit installed onboard. The water bottles after the collection were left for more than 24 hours in the vessel's CTD Lab to acquire the same room temperature. The measurement of each water bottle was repeated 2 times for each water bottle and was the absolute difference between the two samples was less than 0.001. The median and mean of the difference between the CTD and water bottles were 0.008 and 0.003, respectively, and a standard deviation of 0.011. Indicating a high CTD salinity. Given the high variability in the difference between the CTD and Salinometer values, no correction was carried out, even though the median difference is on the high side.

Ocean acidification parameters (pH and alkalinity)

The Nansen is currently equipped with a CTD rosette holding up to 12 ten litre Niskin bottles that are used to collect water samples from pre-defined depths. The standard sampling depths were defined to cover the depth range observed with the CTD for nutrients and the top 200 m for chlorophyll on all CTD stations in the transects. These samples were used to determine chlorophyll, pH, alkalinity and for nutrient analyses (nitrate, nitrite, silicate and phosphate) as described below.

Seawater samples (250 ml) from the CTD-mounted Niskin-bottles were collected in borosilicate glass bottles using silicone tubing to reduce air exchange. Both pH and alkalinity were analysed on board the vessel. pH was determined spectrophotometrically using a diode array spectrophotometer and a pH sensitive indicator, m-cresol purple in 2 mM solution, as described by Clayton and Byrne, 1993; Chierici *et al*., 1999. Alkalinity was measured by titration with acid (0.05M HCl) and changes in pH were measured with an electrode (potential in mV) using tiamo software. The data provide information on the marine carbonate system and parameters for ocean acidification.

Nutrient samples

Seawater samples (20 ml) for nutrient analyses (nitrate, nitrite, silicate and phosphate) were collected from the Niskin water-bottles. The seawater samples were stored in 20 ml polyethylene vials, conserved with 0.2 ml chloroform, and kept cool and dark in a refrigerator (Hagebø and Rey, 1984). The analyses will be made on shore by IMR, using a modified Alpkem AutoAnalyzer C (O I Analytical, USA) and following standard procedures (Strickland and Parsons, 1972). The seawater samples were stored in 20 ml polyethylene vials, conserved with 0.2 ml chloroform, and kept cool and dark in a refrigerator (Hagebø and Rey, 1984). The analyses were made at the Institute of Marine Research (Bergen, Norway), using a modified Alpkem AutoAnalyzer C (O I Analytical, USA) and following standard procedures (Strickland and Parsons, 1972). Extra standards were added during the analysis to cover the whole measurement range. During the laboratory's quality control of the data, some outlying values that were obviously wrong were excluded. The quality control included evaluation of the ratios between the different nutrients.

Phytoplankton sampling

Water samples from selected depths from the CTD were filtered using a 0.7µm filtration system (Munktell glass-fibre filters Grade: MGF, vacuum 200 mm Hg). Filters were stored at -20°C for subsequent chlorophyll-a analysis. The assay was performed by extraction with 90% acetone followed by centrifugation, and the measurements using a fluorometer (model 10 AU, Turner Designs Inc., Sunnyvale, Ca., USA), according to Welshmeyer (1994) and Jeffrey and Humphrey (1975).

Qualitative phytoplankton samples were collected at super-stations as described above. At each super-station, qualitative phytoplankton samples were collected with a net (35 cm in diameter and mesh-size of 10 µm, hauled vertically at a speed of 0.1 ms-1 from the depth of 30 m to the surface (from ca. 5 m above bottom at the 30 m stations). Quantitative analysis of

phytoplankton was done by counting the individual species in triplicates under the compound light microscope (Biological microscope, MEIJI, Japan) using a counting chamber

Zooplankton sampling

Mesozooplankton was collected with a WP2-net along the super-station hydrographic transects at stations positioned at bottom-depths of approximately 30 m, 100 m and 1000 m. The WP2-net (56 cm diameter, mesh size 180 µm, (Fraser 1966, Anonymous 1968) was hauled vertically at a speed of ~0.5 ms-1 at each station. At the shallowest and intermediately deep stations (bottom-depths of 30 m and 100 m, respectively) the sampling strata were from near-bottom to the surface (deepest sampling depths of ~25 and 90 m, respectively). At the stations with bottom-depth of ~1000 m or greater, the sampling stratum was from the depth of 200 m to the surface.

Furthermore, a second sample with the WP2 net was collected from the upper 30 m at the stations with bottom depths of 100 m and 500 m. The purpose of these additional samples was to enable a direct comparison of the zooplankton composition and concentrations in the uppermost layer of the water column along the bottom-depth gradient. Each zooplankton sample was divided into two equal parts using a Motoda plankton splitter (Motoda 1959). The first part of the sample was size-fractioned successively by using three sieves with the decreasing mesh-sizes of 2000 µm, 1000 µmand 180 µm. 60 ºC for 24 h. The content on each screen is briefly rinsed with fresh water to remove salt and transferred to pre-weighed Aluminium trays before it was dried at 60 ºC for 24 h and frozen on board. These samples will be dried once more and weighed on shore after the cruise at IMR for estimation of biomasses for the different size-groups. The second part of the sample was preserved in seawater with a final solution of 4% formaldehyde buffered with borax for subsequent species identification and quantification, at NARA.

The manta trawl (333µm) was towed at the surface for 15 mins to collect neuston and samples for microplastics analysis. All net samples were preserved in 70% ethanol.

Fish-eggs and larvae

Fish eggs and larvae were collected using Multinet Mammoth (1 m^2) net with a mesh size of 300 µm, the samples were taken obliquely from ~25 - 0 m at 30 m bottom depth, and 100 - 0 m at greater depths using a single net. The samples were rinsed from the net and collected in to the cod-end and fish larvae visible with "the naked eye" were removed from the total sample photographed and transferred individually to Eppendorf tubes in 96% ethanol. Furthermore, fish eggs and larvae were examined under the binocular. The images of fish larvae and eggs were taken using the image analysis system, and the selected individuals were carefully transferred to Eppendorf tubes with 96% Ethanol for DNA barcode identification analysis at IMR, Norway. The rest of the sample was divided into two halves, with one portion in 4% formalin (borax as a buffer) and the other half in 96% ethanol. The formalin half was used for taxonomic identification of fish larvae and the half of the sample in ethanol is for genetic analyses.

Microplastics and debris

Microplastics are small pieces of plastic marine debris defined as less than 5 mm long. Microplastics were collected along the hydrographic transects at all super-stations. At each station, the surface layer was sampled with a Manta-trawl, with a rectangular opening of 19 cm × 61 cm (HxW), mesh-size 333 µm and two wings to keep it balanced and at the surface during the tow. Trawls were hauled horizontally at the surface at a speed of ~1.5 ms-1 for 15 minutes. The counts of a manual flowmeter attached in the lower part of the trawl opening were recorded at the start and end of each trawl. Trawling was performed some meters away from the vessel of the starboard side, about mid-ship, attempting to avoid the wake of the vessel.

Once the Manta-trawl was back on the ship, the samples were washed in filtered sea-water over a sieve with a mesh-size 180 µm. Microplastic particles were sorted from the sample under a stereo-microscope, and the sorted sample was then checked once more to reduce the risk of overlooking the smallest plastic particles. All assumed plastic items were then placed on a gridded petri dish for examination under the stereo-microscope, photographed and, to the extent possible, also measured and described (e.g. length, shape, type and colour). Each sample was checked against two blank containers (controls); (1) sea water sample and (2) fresh water sample, and a container with known contaminants accumulate in the control samples to reduce the risk of contamination and to remove possible contaminants from samples.

The sorted microplastics were washed with freshwater and dried in pre-weighed aluminium-trays in a drying cabinet at 30 ºC. The trays were packed in aluminium foil and stored in room-temperature until transport to the laboratory of IMR for further analysis in the context of Theme 6 of the EAF-Nansen Science Plan. After removing the plastics, the remaining part of the samples - mainly plankton material - was preserved in 70% ethanol for studies of neuston and sent to IMR. Furthermore, a total of 26 pumped water samples were collected for the analysis of microplastics, following the same procedure for Manta-trawl samples and stored in 70% Ethanol. Additional water samples from CTD were collected for similar analysis.

2.4 Sediment sampling

Sediment from bottom trawls: stainless steel cylinders were mounted on the footrope of the trawl to collect bottom sediment samples at every trawl station. The samples were collected from the cylinder when the trawl was on deck and stored in Rizan plastic bags and preserved for further analyses of sedimentological and chemical compositions. In addition, macrobenthos that trapped in the steel cylinders were identified and counted.

2.5 Bottom mapping echo sounder

The EM 710 and EM 302 multibeam echo sounders are both belonging to a high to the very high-resolution seabed mapping system. The EM 302 is hull mounted whereas the EM 710 is mounted on the drop keel. The operational depths of the EM 710 are 3 to 2000 m and of the EM302 are 10 to 7000 m. Across track coverage (swath width) is up to 5.5 times water depth

and may be limited by the operator either in angle or in swath width without reducing the number of beams. The operating frequencies are between 70 to 100 kHz. There are 128 beams with dynamic focusing employed in the near field. The transmitting fan is divided into three sectors to maximize range capability and to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping and use distinct frequencies or waveforms. The along-track beam width is 1 degree. Ping rate is set according to depth. The receiving beam width is 2 degrees. Sound profiles were set manually in the system according to the area of operation. The EM710 was not operational for most of the survey. Data from the EM302 w logged to the onboard Olex plotting system and to raw data files.

During the survey, swath coverage and depth range settings were adjusted accordingly to optimize the mapping. The measured sound speed profile was also inputted in the system when CTD measurements were carried out. Tide correction was not done.

The recorded data were viewed on Seafloor Information System (SIS), Kongsberg real-time software designed to be the user interface and the real-time data processing system for its hydrographic instruments, and on Olex, the onboard navigation planning system.

A Kongsberg SBP 300 Sub Bottom Profiler was also operational. This is an optional extension of the EM 302. The outer limits for the start and stop frequencies of the FM pulse are 2.5 kHz and 6.5 kHz. It has a very narrow beam and penetrates well trough sediment layers. It was run in selected areas during the survey.

2.6 Food safety

Whole fish, fillet and different organs from various fish that are regularly consumed in the Bay of Bengal were sampled during this survey and preserved. Some the samples will be analysed for a wide variety of nutrients and contaminants at IMR, Bergen as part of the EAF-Nansen Science Plan Theme 8. In addition, several fish samples were obtained to analyse in Sri Lanka for radioactivity, nutrition and contaminants.

2.7 Top predator observations

Observations of marine mammals and seabirds were carried out during daylight hours from 6:00 to 18:00 (with breaks) at the observation platform of the vessel situated 21.5 m above sea level. Observations were not carried out during oceanographic and fisheries sampling stations and no track changes were done to bring the vessel closer to observed targets. Observations were made by a single observer covering an angle of 180° from port to starboard up to 10 km maximum distance from the vessel. Scanning for animals was performed with a naked eye. A handheld Nikon (7X50) reticular binocular with compass (marine binocular) was used to locate and observe the orientation of the animal/ pod comparative to the vessel. If a group was spread in an area, distance was determined to the middle position of the pod from the observer. Sightings were recorded on a Garmin etrex 20 GPS. Species-level identification of the cetaceans was carried out through the careful

observation of specific features of the body, size, behaviour, shape, colour pattern and height of the blow.

Sea birds were identified using their body size, colour pattern when roosting and flying, and shape. For further identification or to confirm the species, photos of the sightings were taken using a digital camera (Nikon D 500 with 70-300 m telephoto lens attached) and standard catalogues (Carwardine, *et al*., 2006; Marchant *et al*., 1991) were used to identify the animals whenever necessary.

Species identified, their behaviour and pod size (minimum, best and maximum) were recorded on a standardized sighting form. Additional data such as local time, the position of the ship, position and orientation of the animal (s) relative to the ship (bearing and reticule) were also noted. Since the weather conditions effect on the visibility, parameters such as sea state, swell height, wind speed, wind direction, swell direction, glare, cloud cover, rainfall and visibility were also recorded during every half an hour. All the observations were made while favourable visibility and the sea conditions (Beaufort value less than 5) are available.

2.8 Biological trawl sampling

Biological sampling of the fish was carried out using pelagic and bottom trawls. In shallow water (<30 m) or at night when pelagic fish was close to the surface, the pelagic trawl with floats or bottom trawl with floats were used for sampling. A more detailed description of instruments and fishing gear is given Annex II.

All catches were sampled for composition by weight and numbers of each species caught. Species identification followed FAO species identification sheets for Fishery purposes, Fishing Area 51 (Fisher *et al*. 1984), FAO species identification guide for Fishery purposes, Western Central Pacific (Carpenter, K.E and Niem, V.H 1988), FAO Species Identification Guide for Fishery Purposes. The Marine Fishery Resources of Sri Lanka (De Bruin *et al*. 1994) and Smith's Sea Fishes (Smith *et al*. 1988) in addition to several online databases especially the Eschmeyer database (Eschmeyer 2018), WoRMS database (WoRMS Ed. Board 2018) and FishBase (Froese and Pauly 2018).

For the selected target species length (total length to the nearest cm), weight (to the nearest 0,5 g), sex, gonad maturity stage (according to the table in Annex III), and stomach fullness (according to the table in Annex III) were recorded. When the size distribution of the target species in the catch was seemingly narrow (similarly sized individuals), a total of 50 individuals were length measured. The length and weight measurements were used to estimate the length-weight relationship and together with length frequency distributions applied in biomass calculations. In addition, samples for genetic analysis, and frozen samples for morphometric analysis (25-30 fish) were also taken.

The priority groups used for this survey can be found in ANNEX V, while the complete records of fishing stations and catches are shown in AnnexIII. A list of biological scales used for maturity and stomach fulness is given in Annex IV.

2.9 Jellyfish collection and preservation

Jellyfish caught as part of the trawl haul were identified to the lowest taxonomic level possible, counted and weighed. Jellyfish specimens that were in good condition were photographed (top and bottom sections), before being processed and preserved for future analysis. A small piece of the oral arm tissue, as well as one gonad, was removed and preserved in 96% ethanol (EtOH) and stored at -20°C. Tissue samples stored in EtOH were collected for genetic studies, aimed at determining species and population structure, as well as establishing regional and global connectivity. The rest of the specimen was preserved in 10% formalin. These samples formed part of a greater morphological identification and taxonomic study as part of Theme 3 of the EAF-Nansen Science plan.

2.10 Acoustic sampling

Sonar data

A Simrad SH90 Sonar recorded data continuously during the survey for post-processing after the survey. The sonar was set to a frequency of 26 kHz, in FM Normal mode. The sonar was operated using bow up/180° operation mode with the bearing of the vertical beams 90°, perpendicular to the vessel direction with a range of 450 m and with the horizontal beams set to 450 m with a tilt angle of 3 deg. The filters built into the sonar software to improve the school representation (i.e. AGC, RCG and ping to ping) were set to default values except for the Noise filter, which was turned off.

The settings including range and tilt were kept the same during the survey except during trawling operations where the sonar was at times used actively to focus on targets.

No other sonars were used during the survey.

Echo sounder

Acoustic data were recorded using a Simrad EK80 Scientific Split Beam Echo Sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38, 70, 120, 200 and 333 kHz. The last calibration was conducted in Bergen on the 23 January 2017. Annex I give the details of the acoustic settings used during the survey.

Allocation of acoustic energy to species group

Acoustic data were logged and post-processed on board using the latest acoustic data post-processing software, the Large-Scale Survey System (LSSS) Version 2.0.

Scatters were displayed at 38 kHz. The mean 5 nautical miles (nm) area backscattering coefficient $s_A(m^2/NM^2)$ was allocated to a predefined set of species groups on the basis of established echogram features and stored as mean values per 1 nautical mile (nm). Allocation of acoustic densities to species groups and respective species are listed in Table 5. Ground truthing and estimation of mean length and weight were accomplished by means of targeted pelagic and demersal trawling. In cases where the integrated echo contained more than one category of fish, the mean s_A-value allocated to each category was in the same ratio as their contribution to the abundance in trawls in that area. Table 5 also lists the target species and groups used for analysis.

Table 5. Allocation of acoustic densities to species groups.

Group	Taxon	Species
Pelagic species group 1 (Pel1)	Clupeidae	*Amblygaster clupeoides* *Amblygaster sirm* *Dussumieria acuta* *Escualosa thoracata* *Herklotsichthys quadrimaculatus* *Hilsa kelee* *Nematalosa nasus* *Sardinella albella* *Sardinella fimbriata* *Sardinella gibbosa* *Sardinella longiceps*
	Engraulididae	*Thryssa mystax* *Thryssa setirostris*
	Chirocentridae	*Chirocentrus* spp.
Pelagic species group 2 (Pel2)	Carangidae	*Carangoides armatus* *Carangoides fulvoguttatus* *Carangoides gymnostethus* *Carangoides malabaricus* *Caranx heberi* *Caranx ignobilis* *Caranx sexfasciatus* *Decapterus macarellus* *Decapterus macrosoma* *Decapterus russelli*
	Scombridae	*Acanthocybium solandri* *Auxis* spp. *Euthunnus affinis* *Katsuwonus pelamis* *Rastrelliger kanagurta* *Scomberomorus* spp. *Thunnus* spp.
	Sphyraenidae	*Sphyraena* spp.
	Trichiuridae	*Benthodesmus elongatus* *Lepidopus caudatus* *Trichiurus lepturus*
Main demersal groups	Ariidae Balistidae Lethrinidae Lutjanidae Serranidae	
Mesopelagics	Myctophidae Other mesopelagic fish	
Plankton	Calanoidae	*Calanus* spp.
	Euphausiidae	*Meganyctiphanes* spp.
	Other plankton	

The acoustic backscatter was scrutinized daily and allocated to the various groups. The SV threshold used when sardinellas occurred to filter out other species and plankton was -45 dB. In regions where the plankton layer was extremely dense an even lower threshold had to be used. For Pelagic I, Pelagic II and "other pelagic species" -50 dB was used. To identify mesopelagic layers a threshold of -60 dB was used. Biomass estimates can only be estimated for those acoustic groups in which length and weight were recorded (see Table 5).

2.11 Estimation of biomass

The target strength (TS) function used to convert mean area backscattering coefficient s_A (m2/NM2) at 38 kHz to number of fish corresponds to:

$$TS = 20 \log L - 72 \text{ (dB)} \quad (1)$$

or

$$CF = \frac{10^{7.2}}{4\pi} \cdot \overline{L}^{-2} \quad (2)$$

and in the simplest form

$$CF = \frac{1.2612 \cdot 10^{6}}{\overline{L}^{2}} \quad (3)$$

where CF is the conversion factor from acoustic density to fish biomass and $\overline{L}^2$ is the mean of squared fish lengths. This target strength function was originally established for North Sea herring but has later been attributed to clupeids in general (Foote *et al*., 1986; Foote, 1987).

No specific target strength relations presently are available for the species at hand, and equation (3) has therefore been applied consequently for all targeted species in this time series. The biomass was calculated by multiplying the number of fish by the expected length at weight, estimated by regression of the log-length (total) against total weight. Separate length-weight relationships were worked for each region, pooling all data within each region.

The boundaries of encountered fish aggregations (post strata) were determined by means of contouring within the inner and outer zero-value limits of the transect lines. The strata contours were digitised using Nansis Maptool Version 2.1.4. Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories:

1: $0 < s_A < 300$;

2: $300 \leq s_A < 1000$;

3: $1000 \leq s_A < 3000$;

The basis for contouring is averages of 1 NM s_A values along transects. Other sources of bias of concern are the shallow distribution pattern (above integration limit), vessel avoidance behaviour (Misund and Aglen, 1992) and inshore distribution (depths < 20 m). All estimates should consequently be considered as relative indices of abundance.

The total number of fish was estimated as:

$$\rho_i = \frac{< s_A > t_{i,j} \cdot u_i}{\sum_i \frac{u_i}{C_{Fi}}} \cdot A_s \quad = \quad \frac{10^{7.2} \cdot t_{i,j} \cdot u_i \cdot < s_A > \cdot A_s}{4\pi \sum_i u_i \cdot (L_i + 0.5)^2} \qquad (4)$$

where: ρ_i = estimated number of fish in length group i

$<s_A>$ = mean recorded area backscattering coefficient (m2/NM2)

ti,j = proportion of species j in length group i

ui = proportion of sampled fish in length group i

As = horizontal area of stratum s

CFi = conversion factor for length group i

Li = length group i (nearest full cm below total length)

Li+0.5 = mean length in Li.

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 was therefore important to get representative length distributions from the key species groups in the whole distribution area. However, due to the combination of low s_A value recorded, high species richness with lack of a clear dominance of any single pelagic species and few PEL1 and PEL2 species recorded in the bottom trawl catch a set average fish length (as mentioned above) was used to substitute the length distribution part of the formula and biomass was only calculated for species groups and not for individual species in Sri Lanka.

For a stratum representing a distribution of a target group, the following basic data are needed for the estimation of abundance;

1. The average sA-value for the region,
2. The surface area (usually square nautical miles, NM^2), and
3. A representative length distribution of the fish in the region (a set average in this case).

The target groups used during the survey can be found in Table 5 while the complete records of fishing stations and catches are shown in Annex I.

2.12 Swept area biomass calculations

In the bottom trawl survey, stock biomasses were estimated by the swept-area method with catch per haul as the index of abundance (see Strømme 1992). In most hauls the trawling time (with the gear at the bottom) was around 30 min. The area swept by the trawl net within 30 minutes trawl time was 0.015 NM² and it corresponds to an average horizontal trawl opening of 18.5 m efficient net width, towing at 3.0 knots. Diagrams of the bottom trawl used are shown in Annex VI. The general formula to estimate biomass B, using this method is:

$$B = \frac{A}{a} \cdot \frac{\overline{X}}{q} \qquad (6)$$

A is the total area surveyed, a is the swept area of the net per haul, $\overline{X}$ is the average catch per haul (the index of abundance) and q (trawl catchability) is the proportion of fish in the path of the net that are actually caught. The density of the resource is estimated as biomass per unit area. In a stratified survey of k non-overlapping strata, if the mean catch per haul in stratum i and its variance are denoted by $\overline{X}_i$ and s_i^2 respectively, then an unbiased estimate of the population mean $\overline{X}$ is the stratified mean $\overline{X}$ st , which is given by:

$$\overline{X}_{st} = \frac{1}{N}\sum_{i=1}^{k} N_i \overline{X_i} = \sum_{i=1}^{k} W_i \overline{X_i} \qquad (7)$$

where $W_i = \frac{Ni}{N} = \frac{A_i}{A}$ is the statistical weighting factor expressed as relative size of the ith stratum with Ai the area of the ith stratum and A the total area surveyed). The variance of the stratified mean is given by

$$\text{var}(\overline{X}\,\text{st}) = \sum_{i=1}^{k} w_i^2 \,\text{var}\,\overline{X}_i = \sum_{i=1}^{k} w_i^2 \frac{s_i^2}{n_i} \qquad (8)$$

where n_i is number of hauls in the ith stratum and n is the total number of hauls in the survey. Table 3 shows the areas used in the swept-area method to estimate biomass for the different regions. A stratified semi-random design was used with depth and area as stratification factors. Estimated total biomass by species/group was obtained by summing estimates for each depth stratum.

For conversion of catch rates (kg/h) to fish densities (t/NM²), the effective fishing area was considered as the product of the wing spread and the haul length, or distance over the bottom, as measured by means of the SCANMAR® equipment based on GPS readings. The area swept for each haul was thus 18.5 m (traditionally applied wing spread for the “Nansen” bottom trawl) times the distance trawled, raised to NM²/hour. The catchability coefficient (q), i.e. the fraction of the fish encountered by the 18.5 m horizontal opening of the trawl that was actually caught, was assumed equal to 1, which leads to an estimation of the biomass which allows for comparison with previous surveys. Catchability may vary depending on the type of gear used and the type of species (e.g. gears with bobbins are less efficient for species such as

flat fishes and octopus, as compared to gears without bobbins and with footrope touching the bottom). For this reason, biomass estimates are to be considered indices of abundance and not absolute values. Mean fish densities by species and strata, were calculated by the swept-area module in Nansis.

CHAPTER 3. RESULTS

3.1 Oceanography

Background

Sri Lanka is situated at the northern Indian Ocean (IO) southwest to the Indian sub-continent. Northern IO has two marginal seas 1. Bay of Bengal (BoB) and 2. Arabian Sea (AS) which are situated either side of Sri Lanka. BoB and AS have significantly different hydrographical features. The area where Sri Lanka has located acts like a conduit which favour the water mass exchange between these two marginal seas. BoB receives a huge riverine discharge and excess precipitation and produces an annual net freshwater surplus (Rao and Sivakumar, 2003). As a result, sea surface salinity (SSS) is consistently very low in the northern BoB (typically < 32) (Chaitanya *et al*. 2014). Also, the ocean surface of the BoB is much warmer (28^oC) than the adjacent AS (26^oC) because of the prevailing strong surface winds and surface cooling by evaporation in AS. The AS experiences net evaporation and inflow of high-salinity water masses from the Red Sea and Persian Gulf, produce an annual net salt surplus, thus the SSS in AS is comparably high (36.5) (Chatterjee *et al*. 2012). Different water properties of these two water bodies are exchanged by the seasonal wind-driven currents along the periphery of Sri Lanka.

Circulation in these two marginal seas is strongly forced by the seasonal monsoonal winds. IO has two major monsoons as South West Monsoon (SWM, May to September) and North East Monsoon (NEM, November to February). Between there are two inter-monsoon periods (IM). During SWM, strong (wind speed 10-15 ms^{-1}) southwesterly winds blow over the IO by bringing high precipitation to the ocean and adjacent land mass in the Indian region. In contrast, the NEM brings relatively weaker winds ($<10ms^{-1}$) and less rain to the IO and lands. These seasonally changing winds force the wind-driven Ekman flows and geostrophic flows which ultimately create the seasonal circulation patterns in the IO, BoB and AS. Circulation and water mass exchange between BoB and AS is happening along the periphery of Sri Lanka, thus creating extensive seasonal ocean circulation dynamic and very different water mass characteristics on the east, south and west coast.

Wind speed and directions

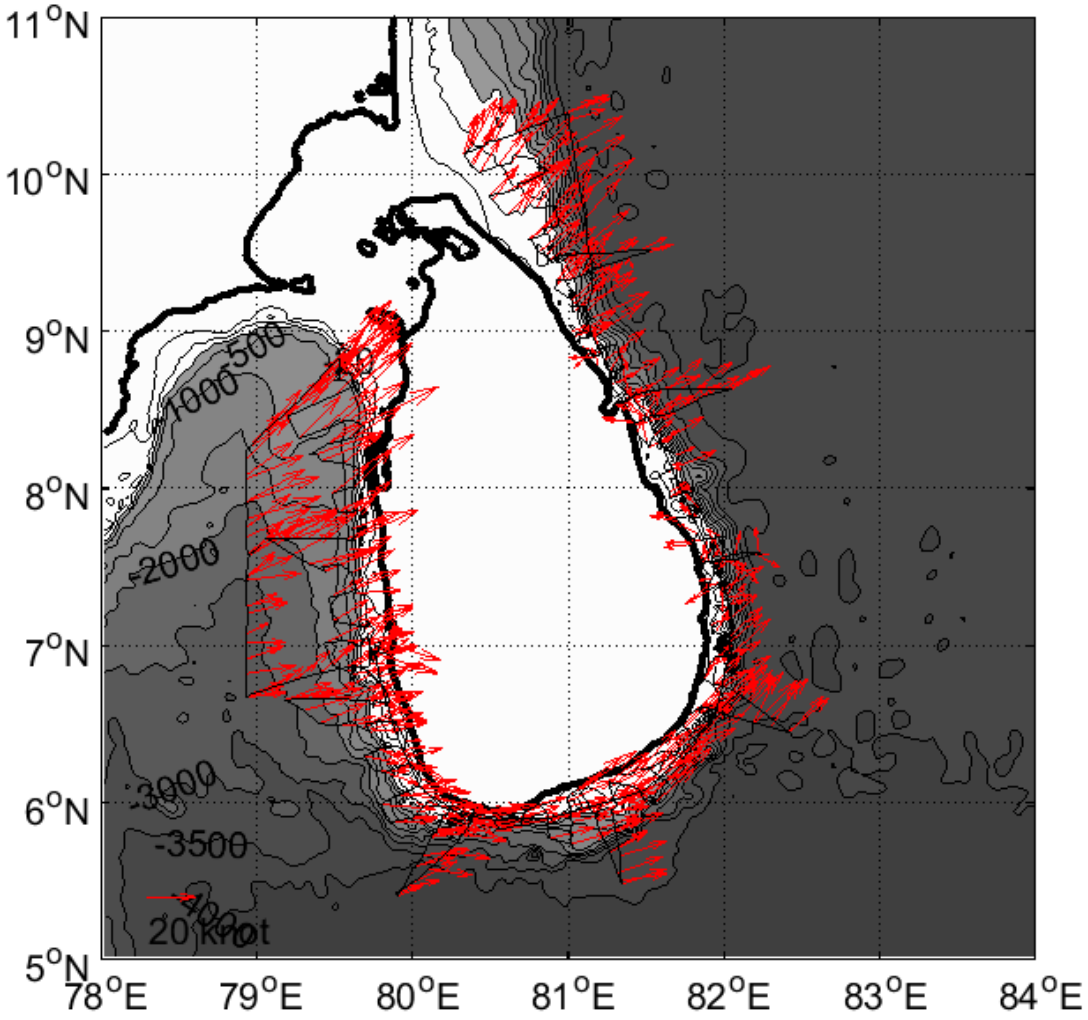


Figure 5. Wind directions and wind speed in the survey area indicated by direction and length of arrows.

During the whole cruise period the SWM prevailed (Figure 5). The west coast of Sri Lanka had stronger wind bursts than the east coast because the east coast to a large extent is shaded by the central mountain range, as illustrated. The wind pattern was otherwise consistent all across the survey area.

Horizontal distribution of oceanographic parameters

Sea Surface Temperature (SST) distribution demarcate the survey area into three zones, the warm eastern part, the intermediate southern part and the cooler western zone (Figure 6). Usually, BoB is warmer (>28^{O}C) than the Arabian Sea (AS) at the west of Sri Lanka. The BoB region experience a fresh water inflow from the great Indian rivers (Godavari, Ganges, Irrawaddy etc.) which create a shallow mixed layer. Thus, the mixing is limited to a shallow area making the incoming solar radiation distribute within that shallow layer. Incoming solar

radiation is more than enough to heat up the shallow upper ocean area, eventually making a warmer sea surface at BoB.

In contrast, the SST distribution in the western survey area is much cooler than in the east. The west coast experiences the touch of cooler AS water. Generally, AS is cooler than the BoB. AS does not experience any fresh water input as in BoB, thus have a deeper mixed layer (>50 m). So, the incoming solar energy dissipates to a great depth and the mixing process makes the surface area cooler. The evaporation rate is high in AS, as the prevailed strong South West Monsoon (SWM) winds, thus the latent heat loss can create cooler sea surface on the western side of Sri Lanka.

Profound cooler SST signal along the south coast is a clue for the southern coastal upwelling. During the SWM period, strong winds create offshore Ekman flow and carry surface water away from the coast, creating upwelling which brings cooler, dense and nutrient enriched water to surface. The southern coastal upwelling is an important phenomenon which is accountable for the improved ocean primary productivity.

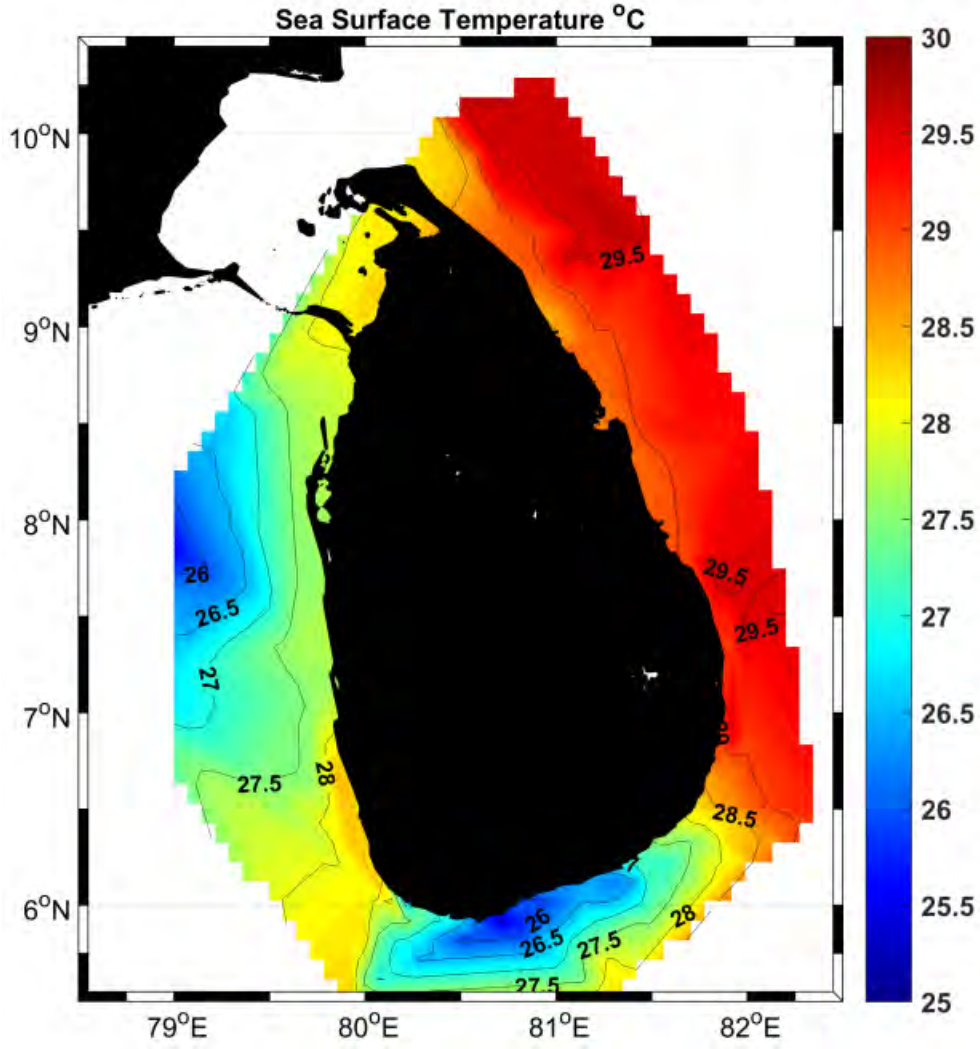


Figure 6. Temperature at ocean surface (4 m) along the survey area.

As with the temperature distribution, sea surface salinity (SSS) also expressed a marked geographical distribution. A fresher (~33.7) ocean surface at the east coast, a saline (34.8-35.0) ocean surface at west and northwest coast coasts and an intermediate (~34.5) level salinity distribution at the southern coast can be observed (Figure 7).

Eastern ocean area of Sri Lanka is much more prone to fresh water mixing than the west side. Freshwater mixing in the BoB is mostly accountable for the observed relative freshness in the eastern side of the survey area. In contrast, AS is not having such a prominent fresh water inflow as in BoB, thus experience a saline environment throughout the year. Therefore, the recorded salinity at the sea surface was relatively higher (~35 PSU) in the western side of the survey area.

At the southern tip of Sri Lanka, an intermediate SSS was observed. This area is a transitional area for ocean currents which passes seasonally either way. This survey was carried out in SWM period, thus a strong current (South Monsoon Current) passes from AS to BoB touching the southern tip of Sri Lanka. It carries more saline water from AS towards the BoB. At the southern part of Sri Lanka, high saline AS waters and low saline BoB waters are mixing laterally, thus an intermediate SSS (~34.5) and an east-west SSS gradient could be observed during the survey period.

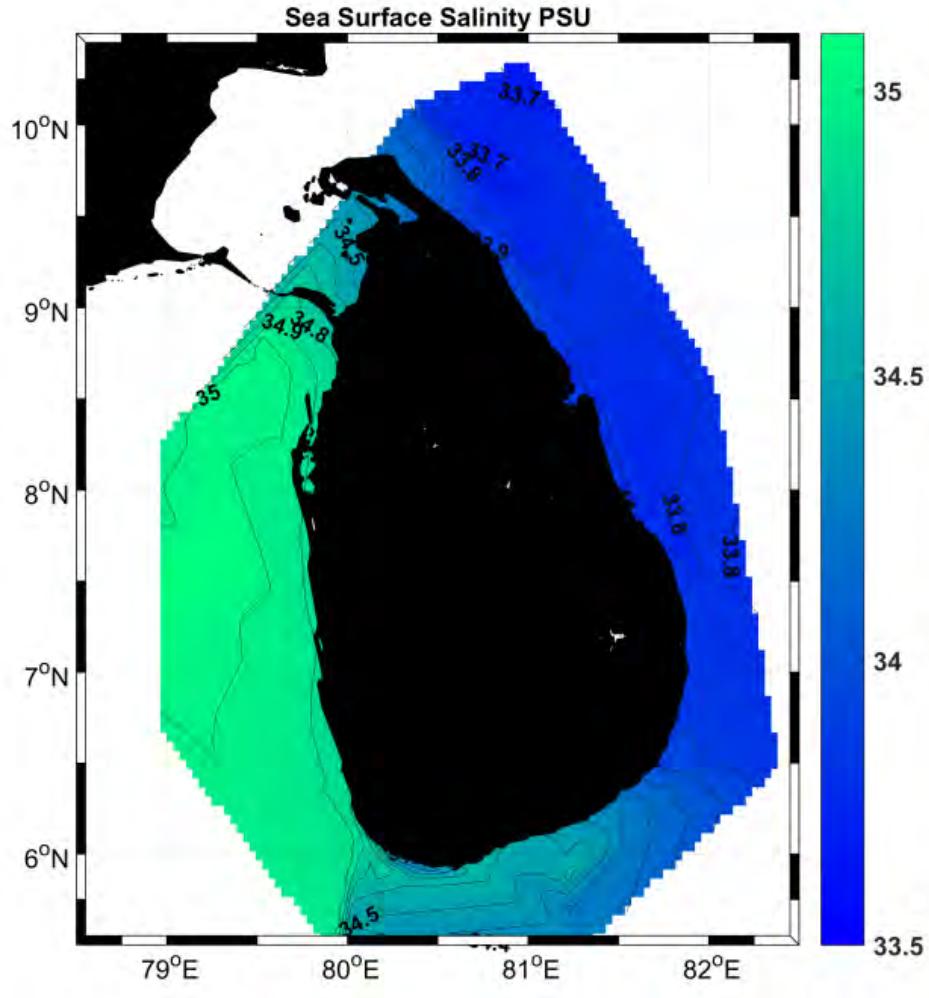


Figure 7. Salinity at ocean surface (4m) along the survey area.

Chlorophyll concentration depicts the productivity of an area. According to Figure 8, the east coast is less productive (>0.5 ug/l) than the west coast. A significant chlorophyll increment could be observed in two places (south coast and the far offshore western area). They could be attributed to the southern upwelling zone and a potential offshore upwelling eddy. This southern upwelling and offshore upwelling eddy spotted two surface cooling area as observed in Figure 6.

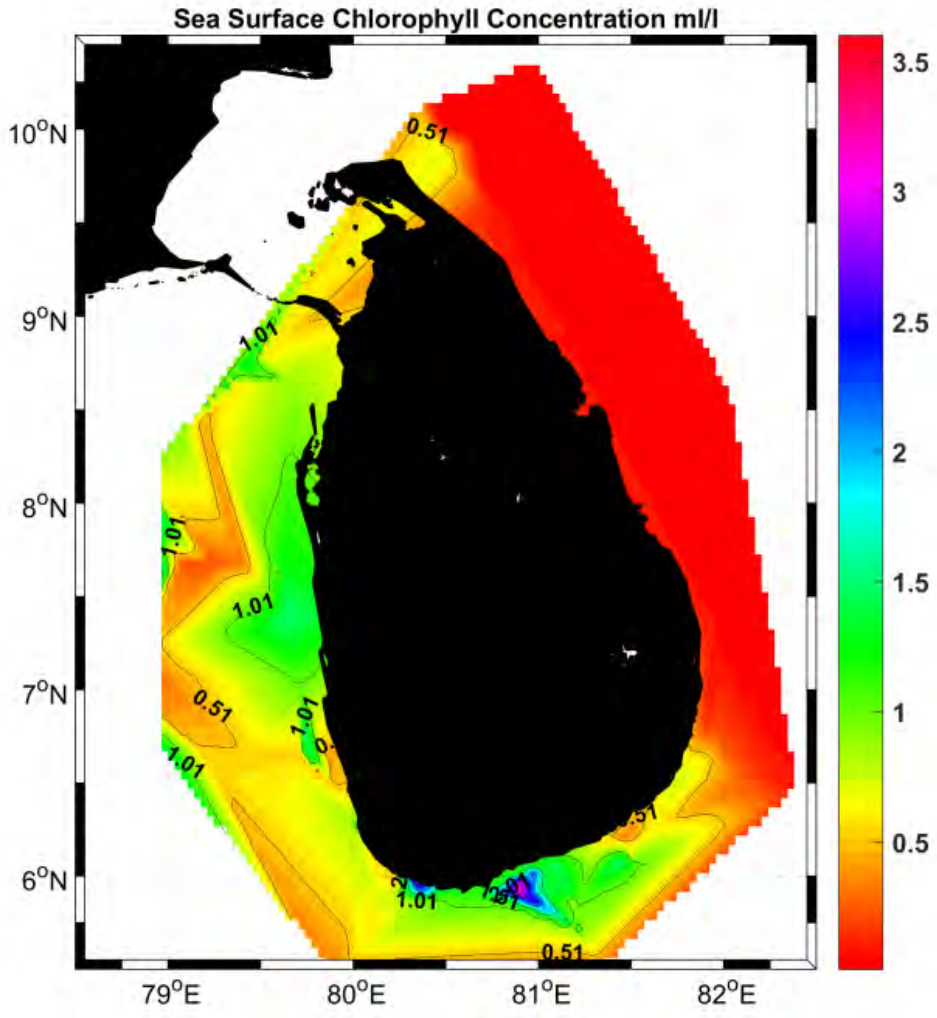


Figure 8. Chlorophyll concentration at the ocean surface (4m) along the survey area.

ADCP results

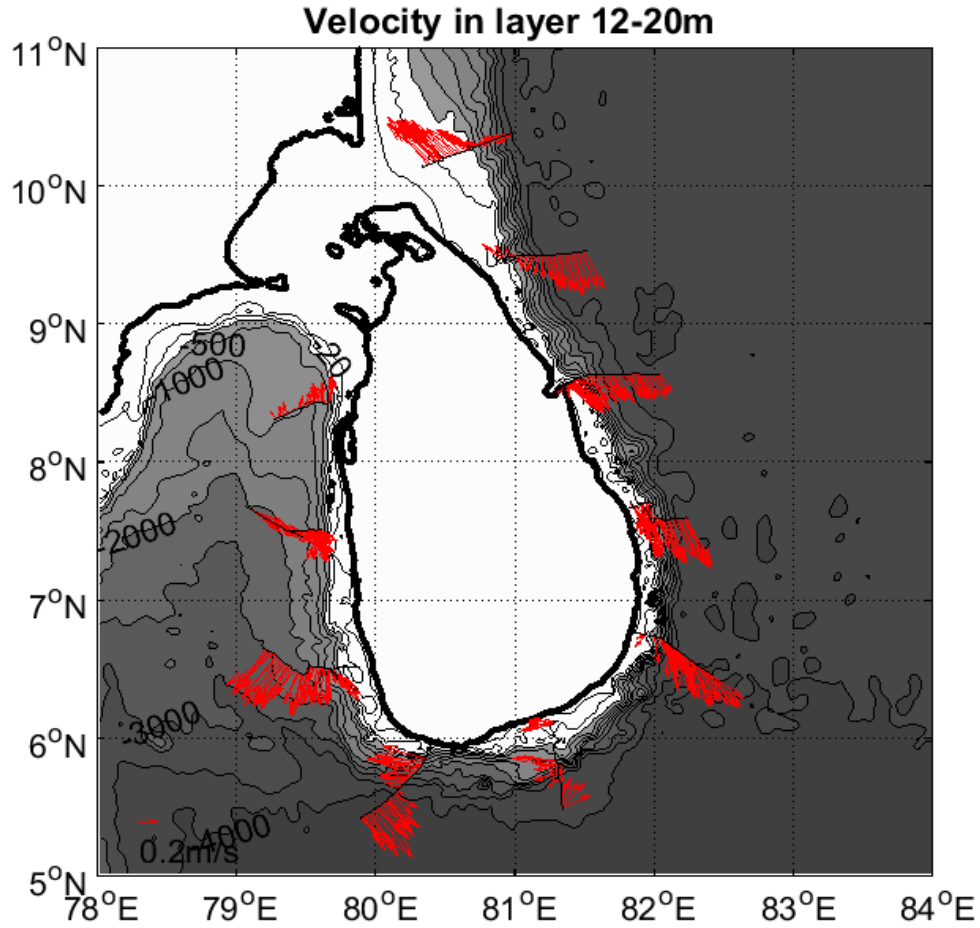


Figure 9. Near surface (12-20 m) ocean current velocities. Note scale vector in the lower left corner of the map.

At the first survey line (at the northeast of Sri Lanka), surface flow along the continental shelf was northward, whilst the offshore current was southward. During the SWM, the EICC which flows along the Indian coast reverse its direction to flow northward. This pattern is clearly depicted in Figure 9. However, the offshore flow of the first cross section is southward. Then onwards the surface current at the other cross-sections flows southward, resolving the suggestion which the counterpart of the EICC at the east coast of Sri Lanka flows southward during SWM. The section at the southern and southeaster coast of Sri Lanka has offshore eastward current and near shore westward current. The offshore eastward current could be the strong SMC which flows eastward along southern Sri Lanka, however, the nearshore westward current could be attributed to the EICC further. The surface flow depicted in western sections expressed an offshore ward surface flow, which could be described as the flow of WICC. It was noticeable that the flow at the further North West cross section flows northward. It could be suggested that the WICC hits the west coast and bifurcate into two parts and one flows offshore and other portion flows northward.

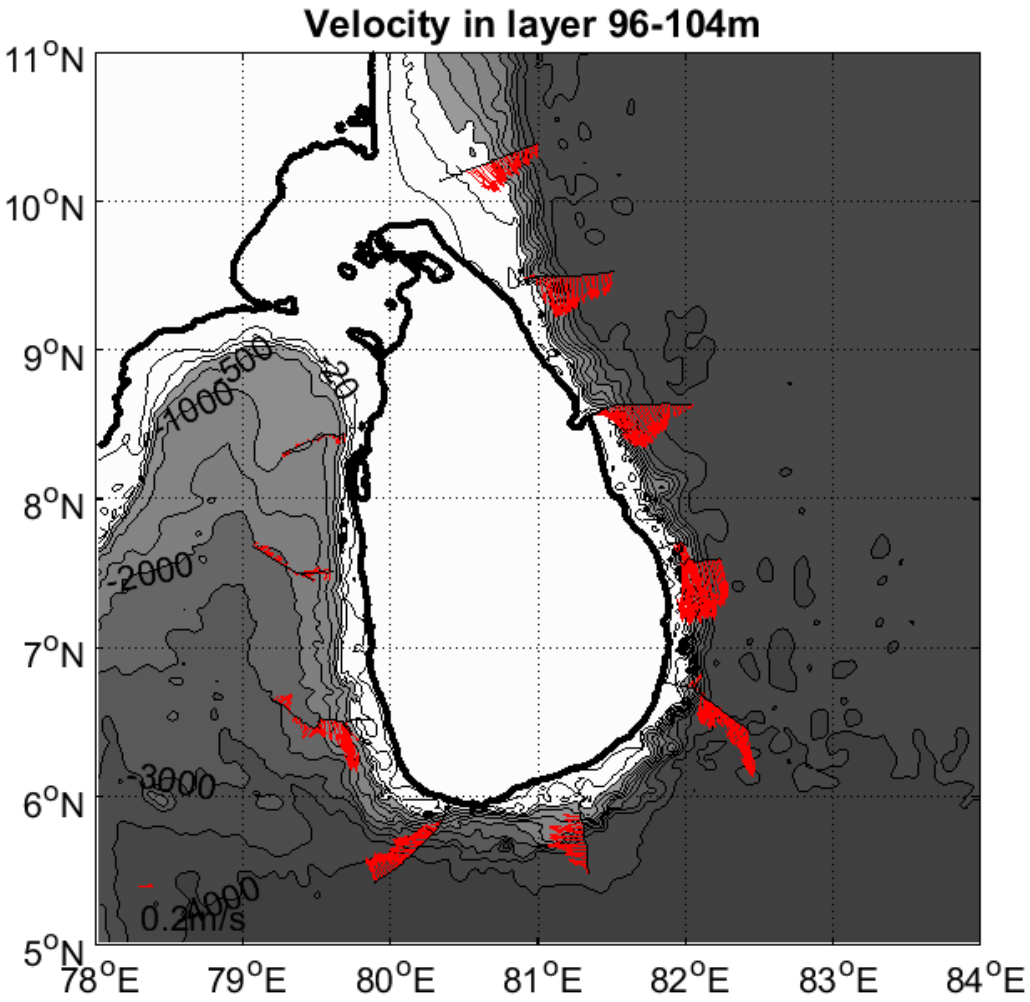


Figure 10. Ocean current velocities at 100 m. Note scale vector in the lower left corner of the map.

Surface flow at the 100 m was mostly the same as the flow at surface column (Figure 10). Generally, most of the wind-driven circulation could be extended up to 100 m depth until the wind forcing is power enough to move the upper water column. However, as depicted in Figure 11 the flow at 300 m was not the same as the flow at the surface or at 100 m.

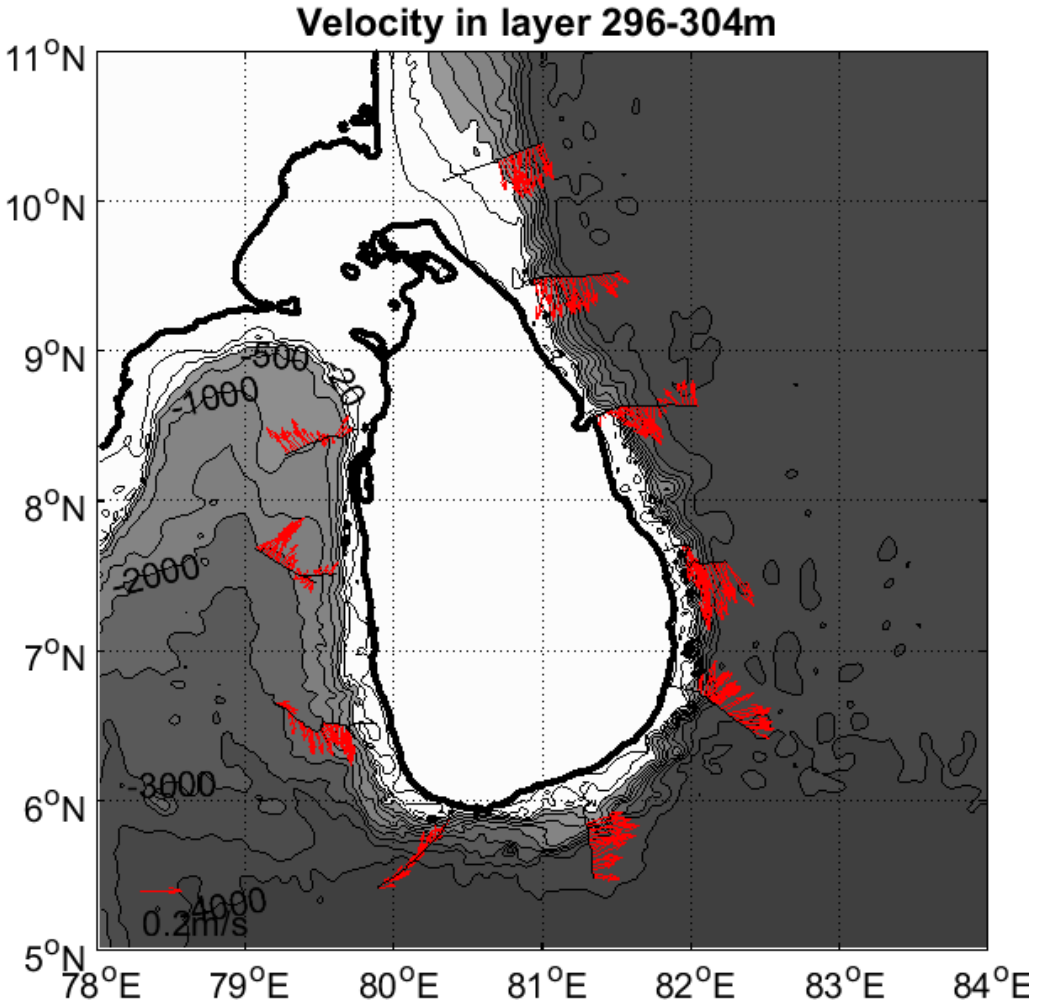


Figure 11. Ocean current velocities at 300 m. Note scale vector in the lower left corner of the map.

The survey lines at southeast, south and southwest area clearly indicated a westward flow across the area. The speed of this flow reached its maximum at the southern part of Sri Lanka. Generally, SMC which carries high saline and dense AS water towards the BoB. As this water mass is high dense than the BoB water, it sinks down and flows as an undercurrent. This subsurface flow of SMC flow westward along the southern coast of Sri Lanka and enters to BoB as indicated in the southeast cross-section. All cross sections at east coast show a southward flow, which the subsurface flow of EICC. However, the subsurface flow at the west coast showed a complex and jumbled pattern. The flow at the bottom survey line at the west coast showed a southward flow, whilst the flow at other two survey lines showed a northward flow (Figure 11).

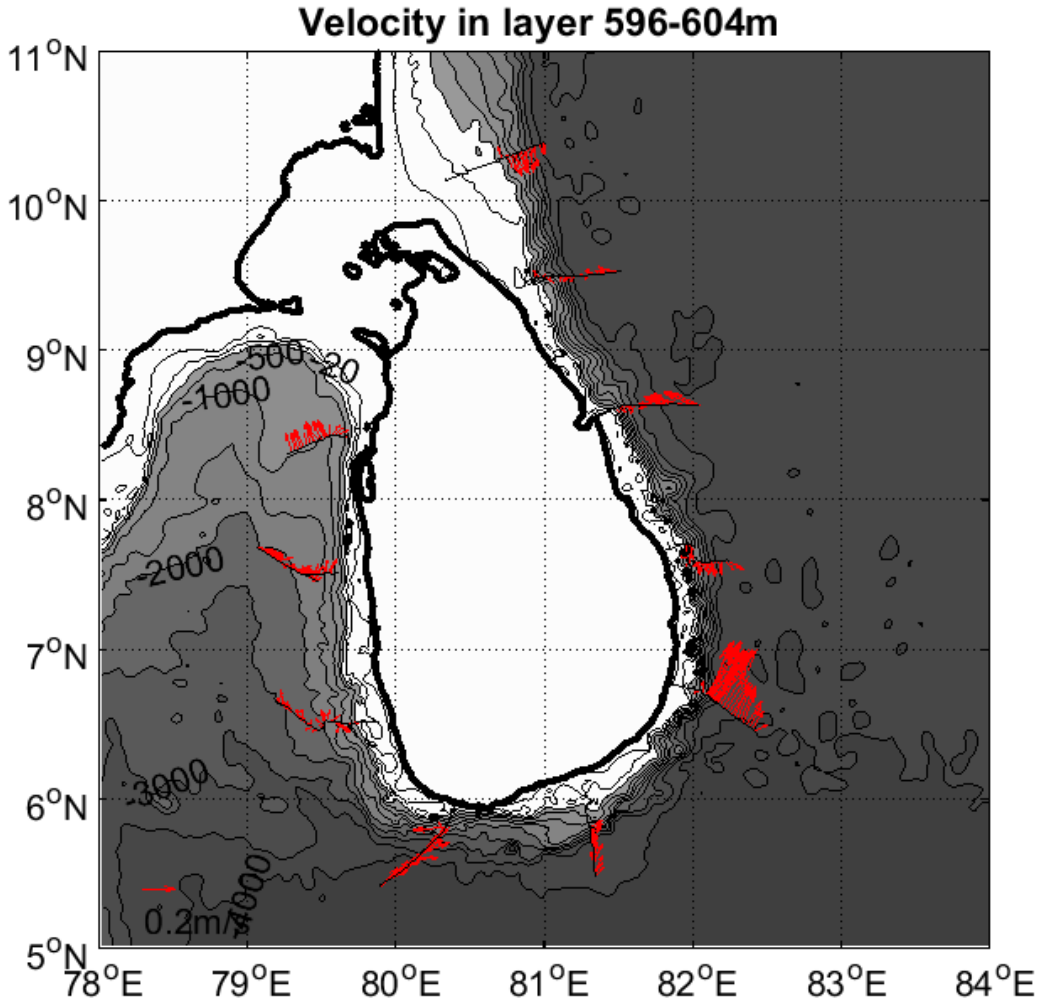


Figure 12. Ocean current velocities at 600 m. Note scale vector in the lower left corner of the map.

The flow at the 600 m was relatively slower (20 cm/s) than the upper ocean area (Figure 12). The flow at the east coast was northward (reversed) and very slow (<10 cm/s). The flow at the southwest, south and southeast area was westward, which depicted the inflow of relatively high saline water to BoB area. The flow at the west coast was almost northward and slow.

CTD Cross Sections

Ten hydrographic transects were occupied along the coast of Sri Lanka. Hydrographic sensors were used to collect data for conductivity, temperature, pressure, salinity, oxygen, and fluorescence. During each transect, water was collected from various depths (Annex I) for pH, alkalinity, nutrients (nitrite, nitrate, phosphate, silicate), and chlorophyll-a. On selected stations and depths, water was also collected for dissolved oxygen and salinity analyses for CTD sensor calibration.

Sections 1-4 on the east coast have the very similar vertical and horizontal structure (section 1 and 4 are shown in Figure 13 and 14, respectively). There is a warm (>29.0°C), low salinity (<34.0) layer that is about 50 m thick. This low-density layer is well originated (>4.0 ml/l). However, at 100 m depth, the oxygen concentrations drop below 0.5 4.0 ml/l. In the pycnocline, a maximum in fluorescence is observed. The fluorescence values are small,

except for at the shelf and at the shelf break where the vertical maximum in fluorescence is moderate. Section 5 has a similar structure as sections 1-4.

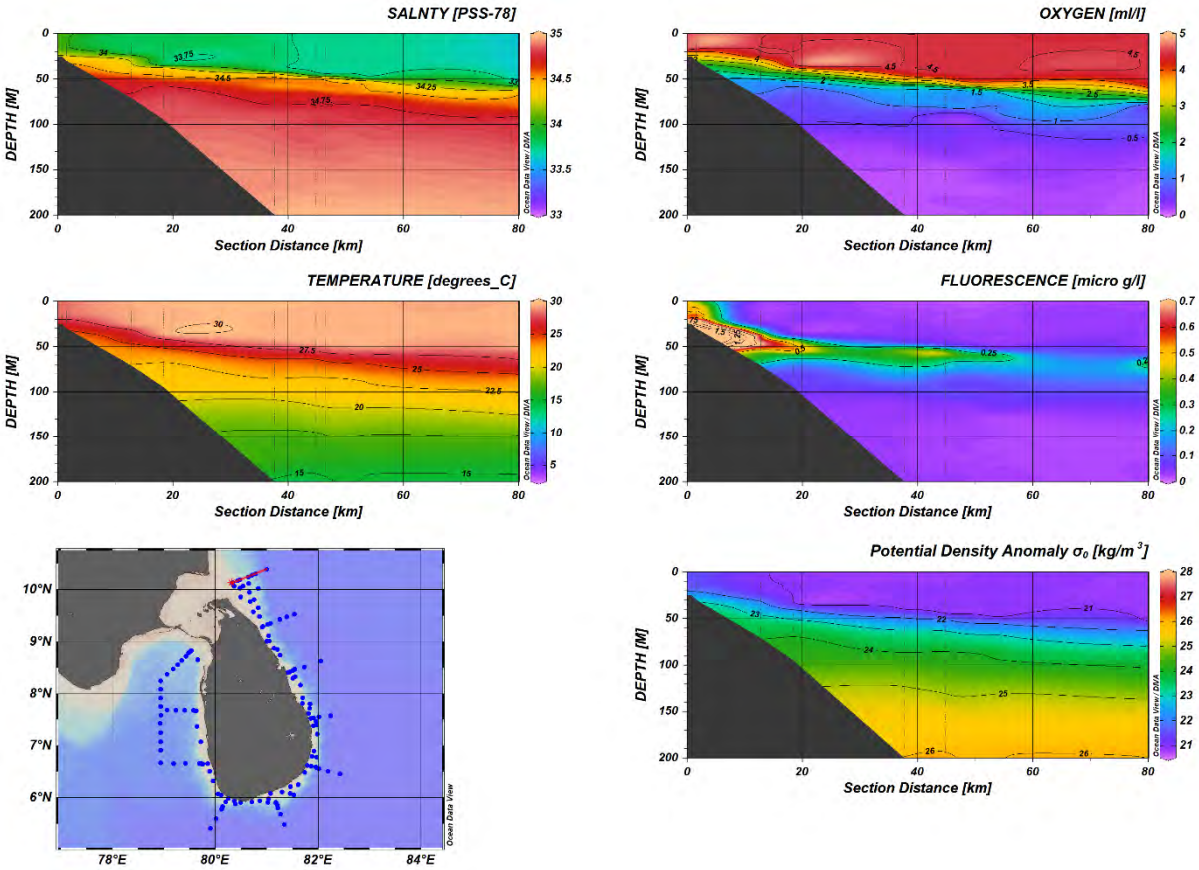


Figure 13. Hydrographic section 1.

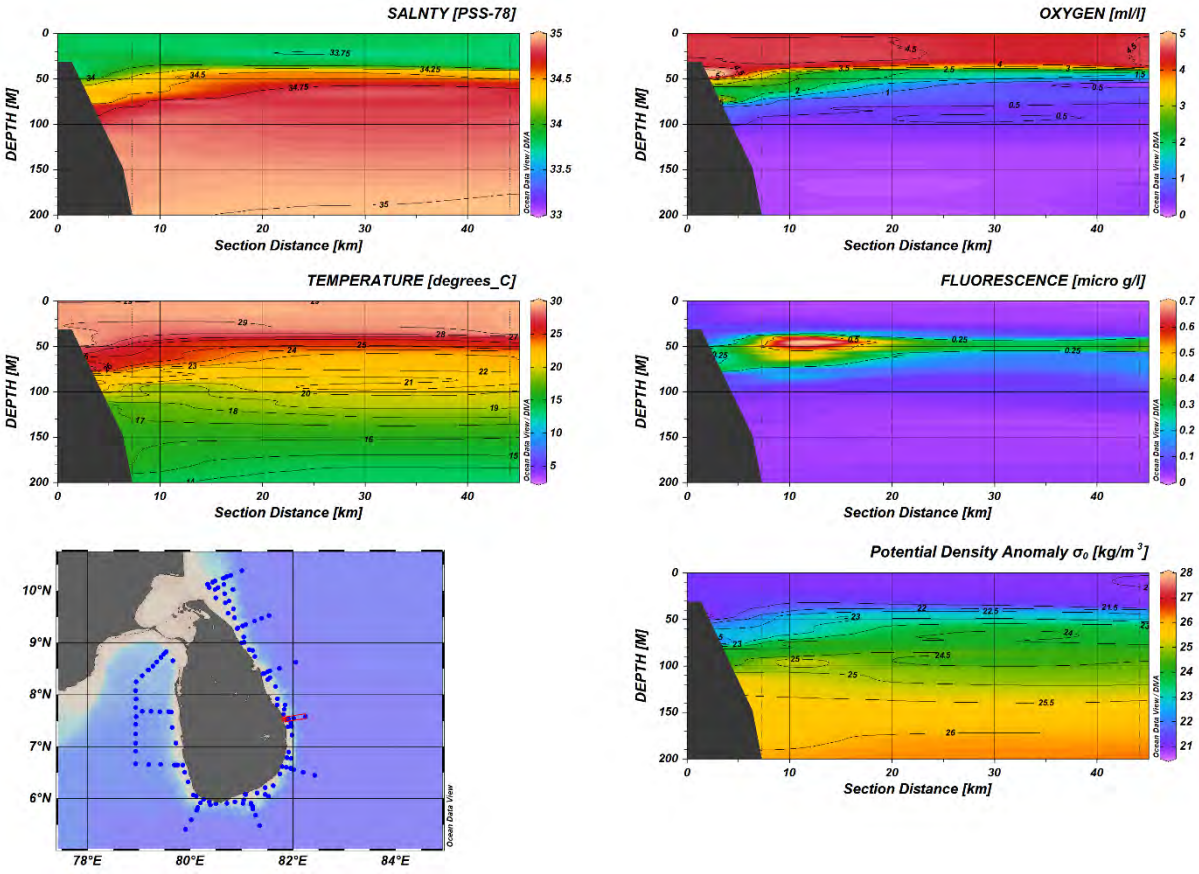


Figure 14. Hydrographic section 4.

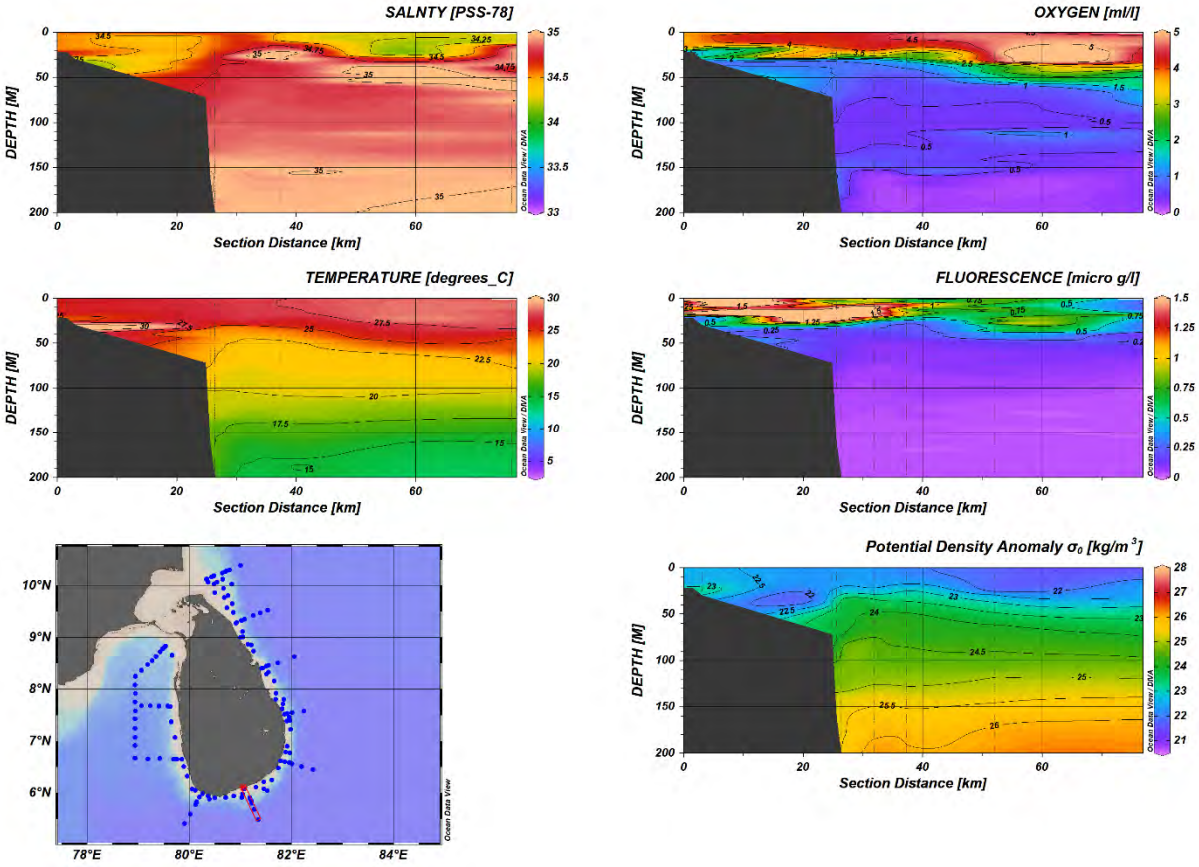


Figure 15. Hydrographic section 6.

A very different horizontal and vertical structure is observed in section 6 (Figure 15) on the southern coast of Sri Lanka. The structure indicates that there is active upwelling with isosurfaces of temperature, salinity and density with bulging upwards over the continental slope. Cooler and more saline water is brought to the surface and on to the shelf. The high fluorescence values in the surface water also show that there is a supply of nutrients from below maintaining primary production. Upwelling is also taking place on section 7 with cooler and higher salinity water observed on the shelf.

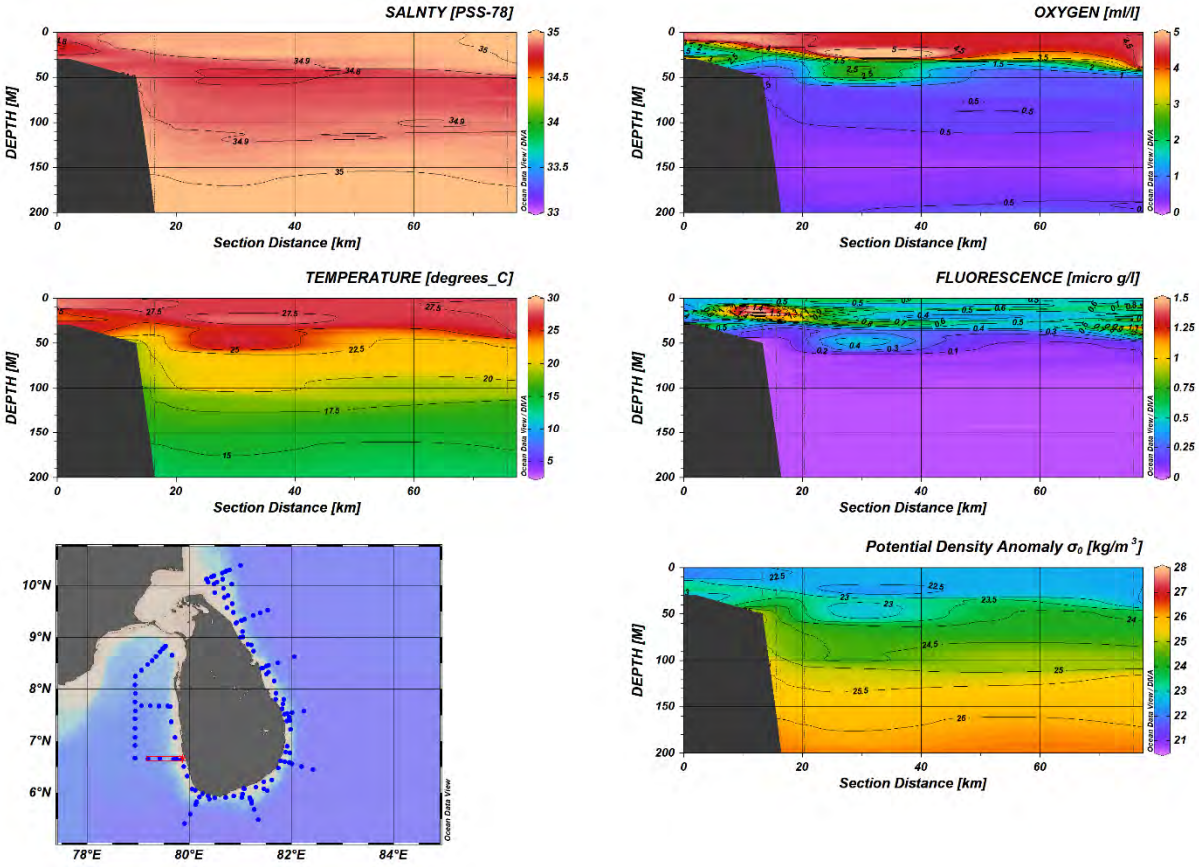


Figure 16. Hydrographic section 8.

In sections 8 and 10 on the west coast shown in Figures 16 and 17, there is no low salinity surface layer. The surface salinity is just below 35.0 whereas on the east coast surface salinities below 34.0 were observed. The structure indicates that there is active upwelling with isosurfaces of temperature, salinity and density with bulging upwards over the continental slope. However, also further offshore there seems to be wind-driven mixing, resulting in cooler patches and patches of higher fluorescence values.

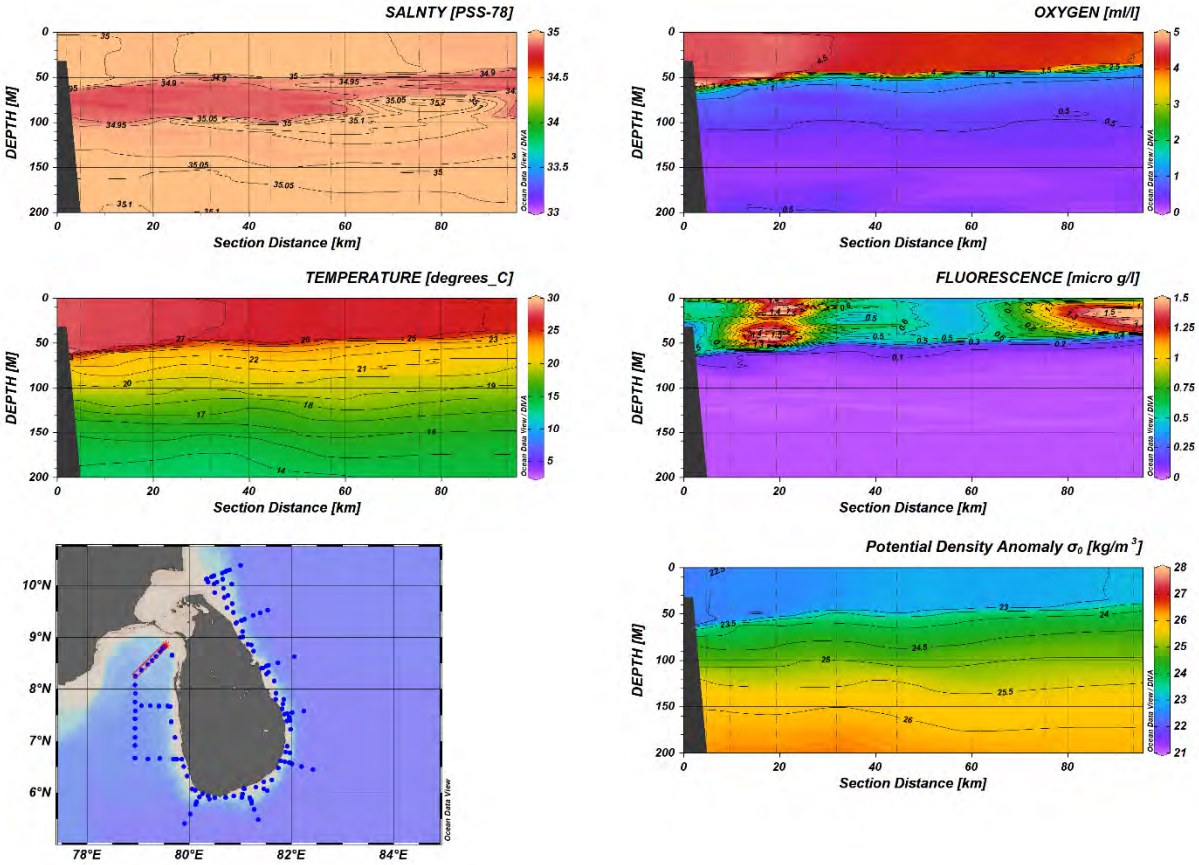


Figure 17. Hydrographic section 10.

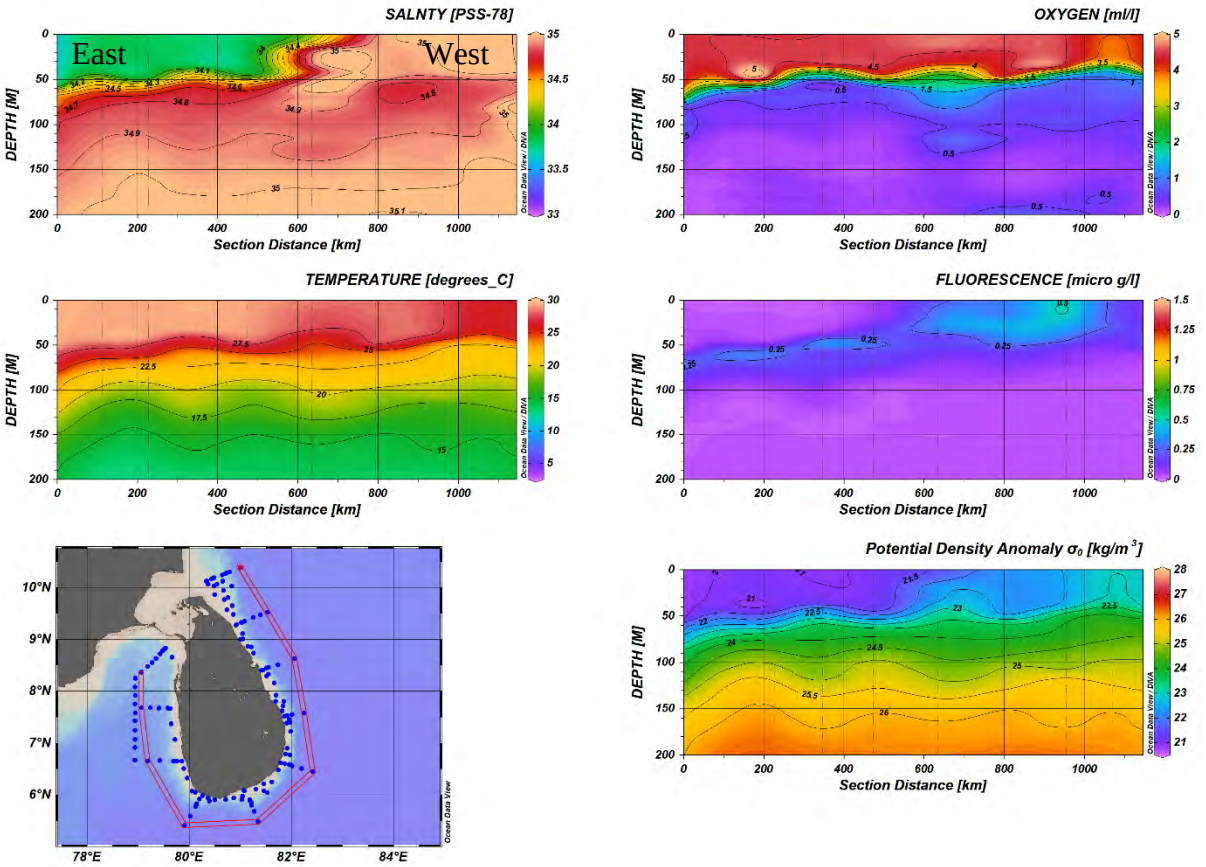


Figure 18. Hydrographic section around Sri Lanka, the top 200 m. Outer station on each section has been picked and distance runs from section 1 in the north east.

To illustrate the horizontal gradients observed around Sri Lanka, a section consisting of the outer stations in each of the cross-shelf sections are shown in Figures 18 and 19. The station spacing is very large, but it illustrates the low salinity and low-density water observed in the top 50 m to the east of Sri Lanka, that is not present to the west of Sri Lanka.

In the deep water, the gradients are not as prominent, except for in oxygen (Figure 19). On the stations to the east of Sri Lanka, a thick layer of extremely low oxygen (minimum values around 0.1 ml/l) water is observed from 100 m depth down to 7-800 m depth. To the south of Sri Lanka, the very low oxygen values are restricted to a thinner layer, and the values are only reaching 1.0 ml/l at intermediate depths. Also, in the northwest low oxygen values are observed down to 8-900 m, but not as low as the values to the west. In Figure 20 the oxygen concentrations on all stations in the sections are plotted as functions of salinity and coloured coded for three different regions, east, south and west of Sri Lanka. This figure shows that the oxygen values below the warm surface layer are low on all stations, but the stations to the east show extremely low values for temperatures between 10 and 20 °C. Figures 18 and 19, show that at great depth and low temperatures the oxygen values are above 3.0 ml/l, all around Sri Lanka.

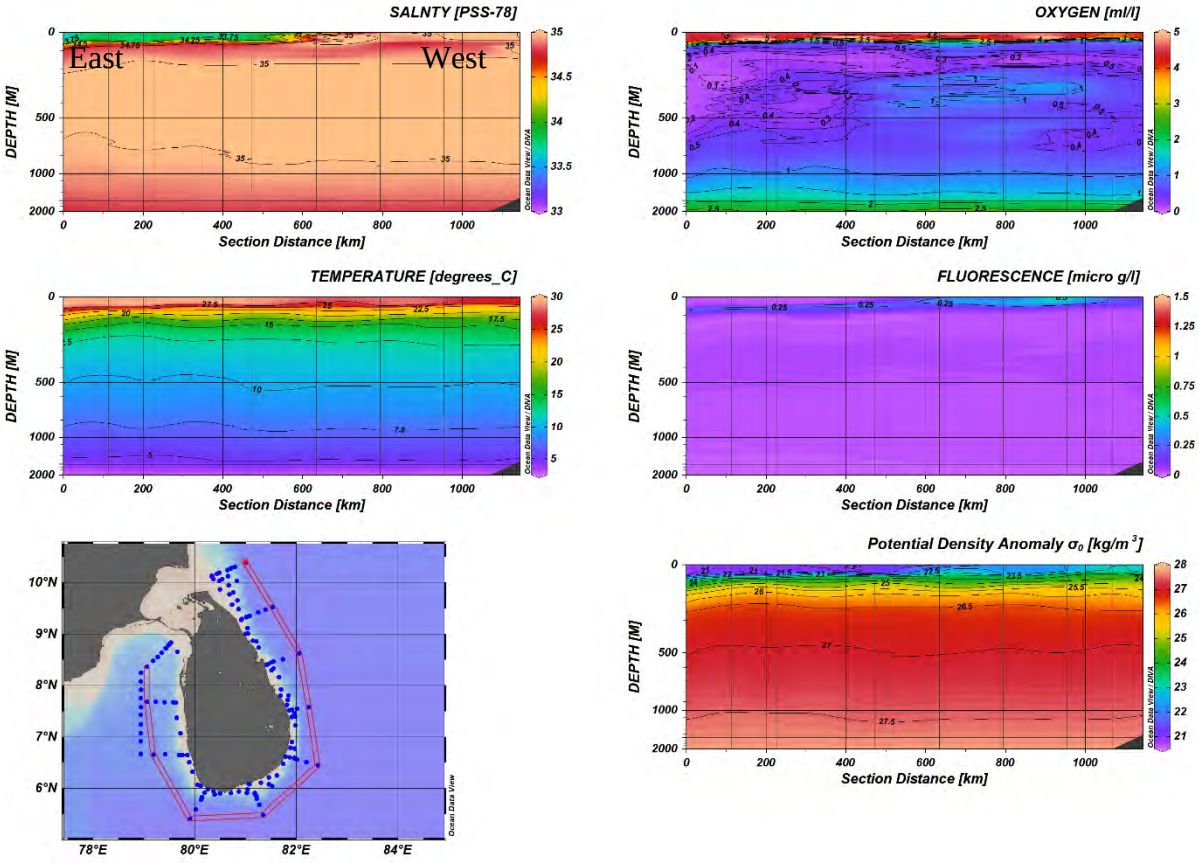


Figure 19. Deep hydrographic section around Sri Lanka. Outer station on each section has been picked and distance runs from section 1 in the north east. Note the stretched vertical scale.

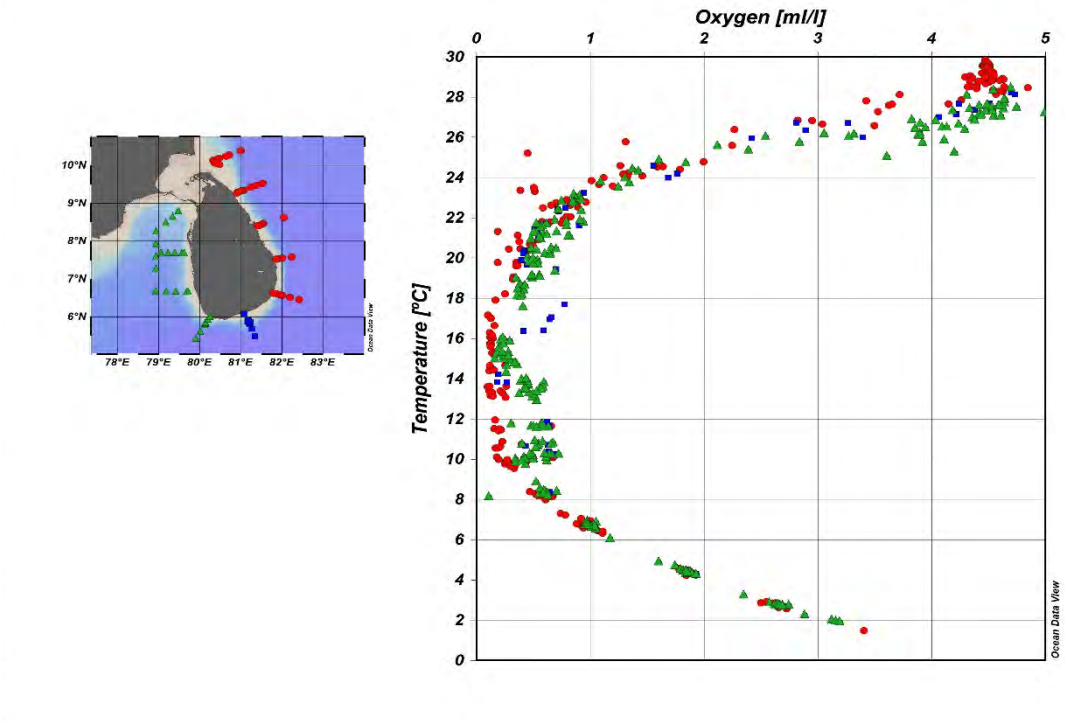


Figure 20. Temperature-oxygen relationship diagram for the sections in the east (red dots), west (green triangles) and south (blue squares).

Plots are produced with Ocean Data View with DIVA gridding interpolation (Ocean Data View, Schlitzer, R., http: odv.awi.de, 2017).

Water Chemistry (pH, total alkalinity and nutrients)

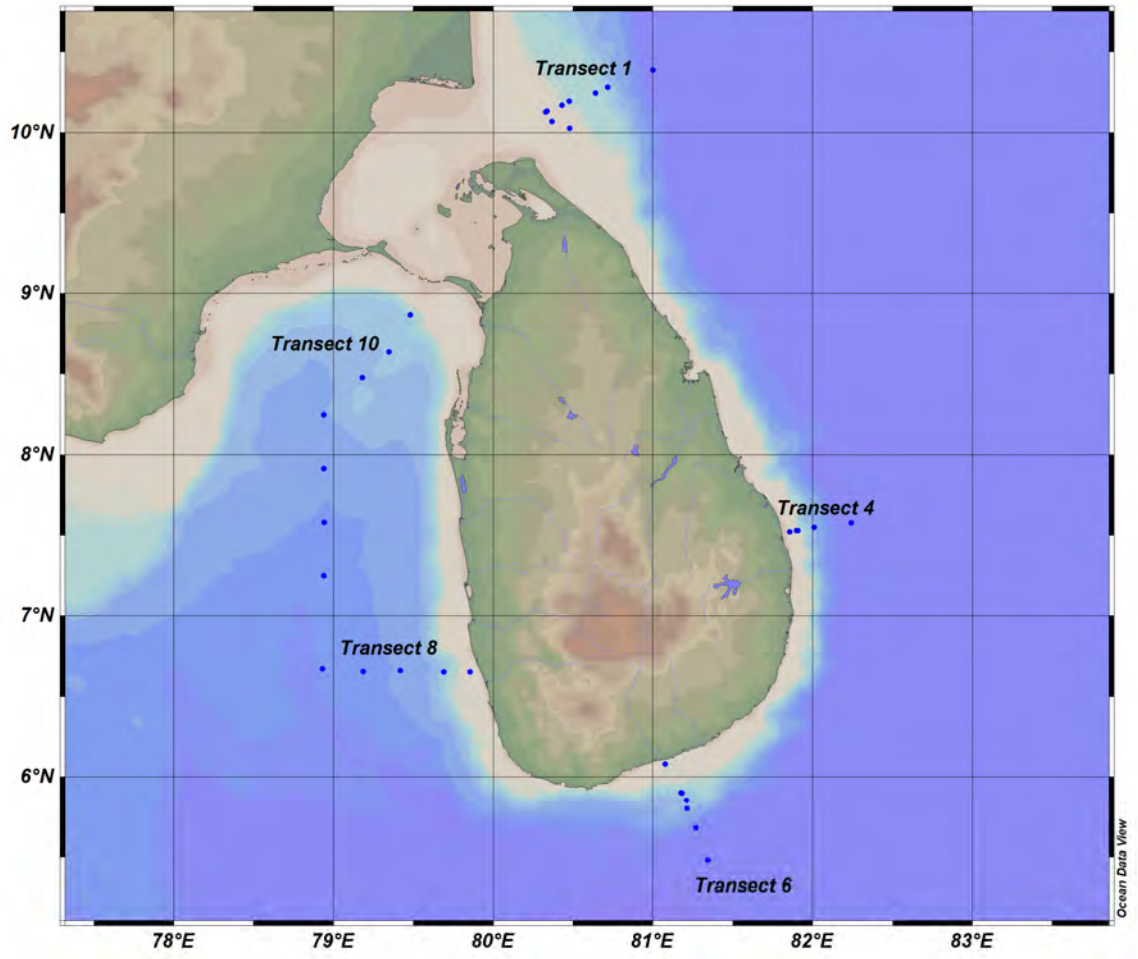


Figure 21. Transects for water chemistry studies.

Five transects were sampled for chemical measurements: Transect 1 on the northern coast outside the Palk Strait, Transect 4 on the eastern coast, Transect 6 on the southern coast, Transect 8 on the western coast, Transect 10 on the north-western coast in the Gulf of Mannar (Figure 21).

Outside the Palk Strait from Transect 1 and into Transect 2, pH levels remain relatively high near the surface reaching levels above 8.1 (Figures 22 and 23). Both transects show decreases in pH below 7.5 near 100 m and remain that way except for slight pH increases beyond 1000 m in Transect 1. The pH increase near the ocean floor, this is a trend that remains consistent around Sri Lanka as also total alkalinity levels are increased near the ocean floor (close to or above 2400 µmol/kg depending on the transect depth). Total alkalinity measurements at the surface of Transects 1 and 2 are the lowest observed around Sri Lanka reaching levels below 2250 µmol/kg. Transects 1, 4 and 6 show the greatest levels of mixing near the coast for the carbon measurements, whereas (Figures 22, 23 and 24) Transects 8 and 10 in the Gulf of Mannar have more defined measurement levels as they move away from the coast (Figures 25 and 26)

As for nutrients (nitrite, nitrate, phosphate, silicate), indications of upwelling can be observed around all of Sri Lanka, and most evident on Transect 6 (southern coast-Figure 24) and slightly less so on Transects 4 and 8 (eastern and western coasts-Figures 23 and 25). Transect 6 shows greater mixing out until 20 m – 30 m offshore and as deep as 300 – 400 m (Figure 24). The upwelling observed in Transects 4 and 8 are much closer to the shore < 10 m (Transect 4-Figure 22) and < 20 m (Transect 8-Figure 25) and most easily observed in the nitrite levels. In addition, it is important to point out that the highest nitrite levels observed around Sri Lanka are near the coast of Transect 8 reaching levels of 1.5 µmol/l while the rest of the nutrient parameters remain relatively stable. Transect 1 shows the highest volume of high-level nitrate (> 40µmol/l) and phosphate (> 3 µmol/l) beginning near 250 m and continuing down to 3000 m. Silicate also reaches a high in this northern region (> 125 µmol/l) but only near the bottom depths. The Gulf of Mannar region depicts relatively low nutrient levels throughout the water column, which may be a result of deep waters throughout the transect and little to no observed upwelling.

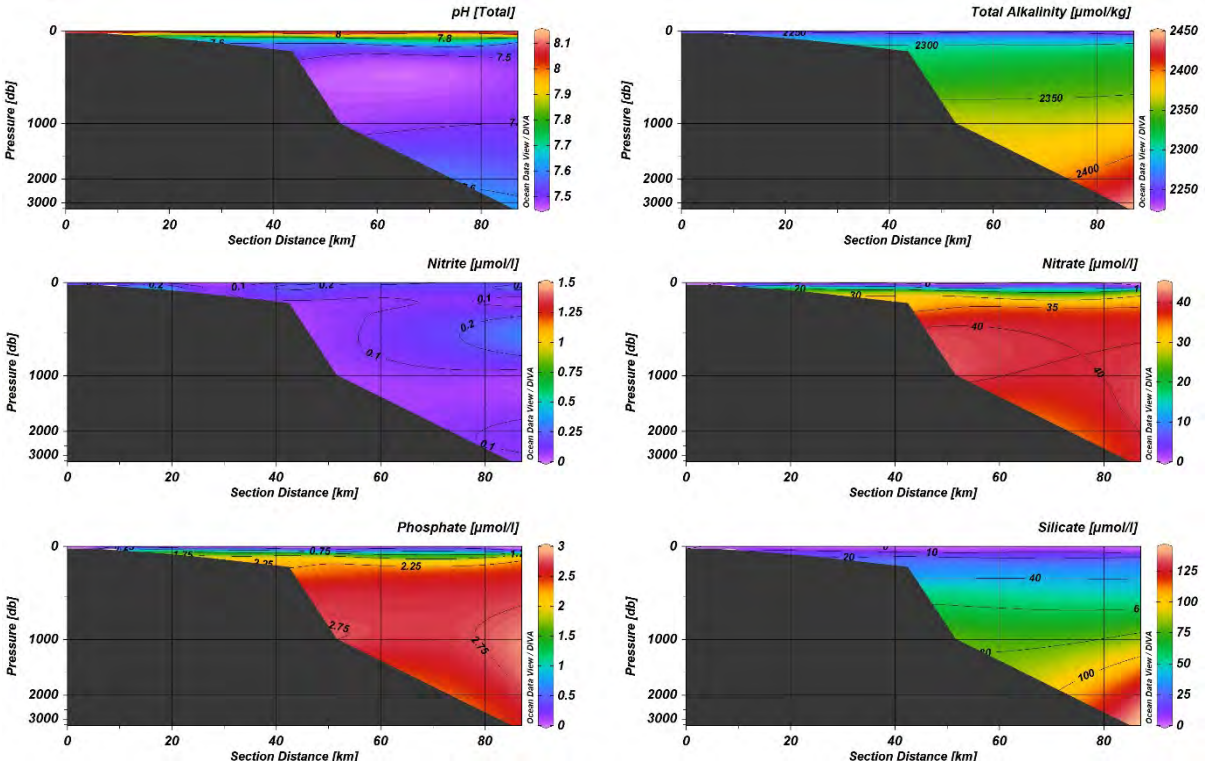


Figure 22. Water Chemistry in Transect 1.

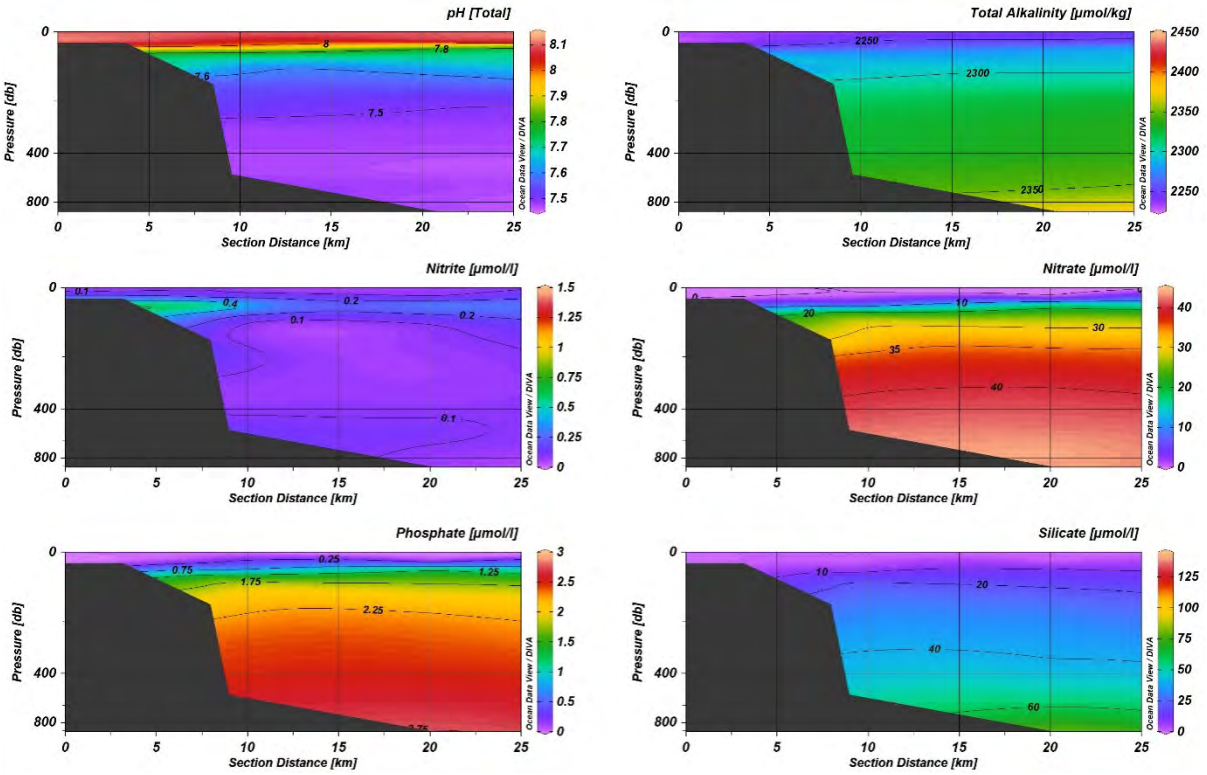


Figure 23. Water Chemistry in Transect 4.

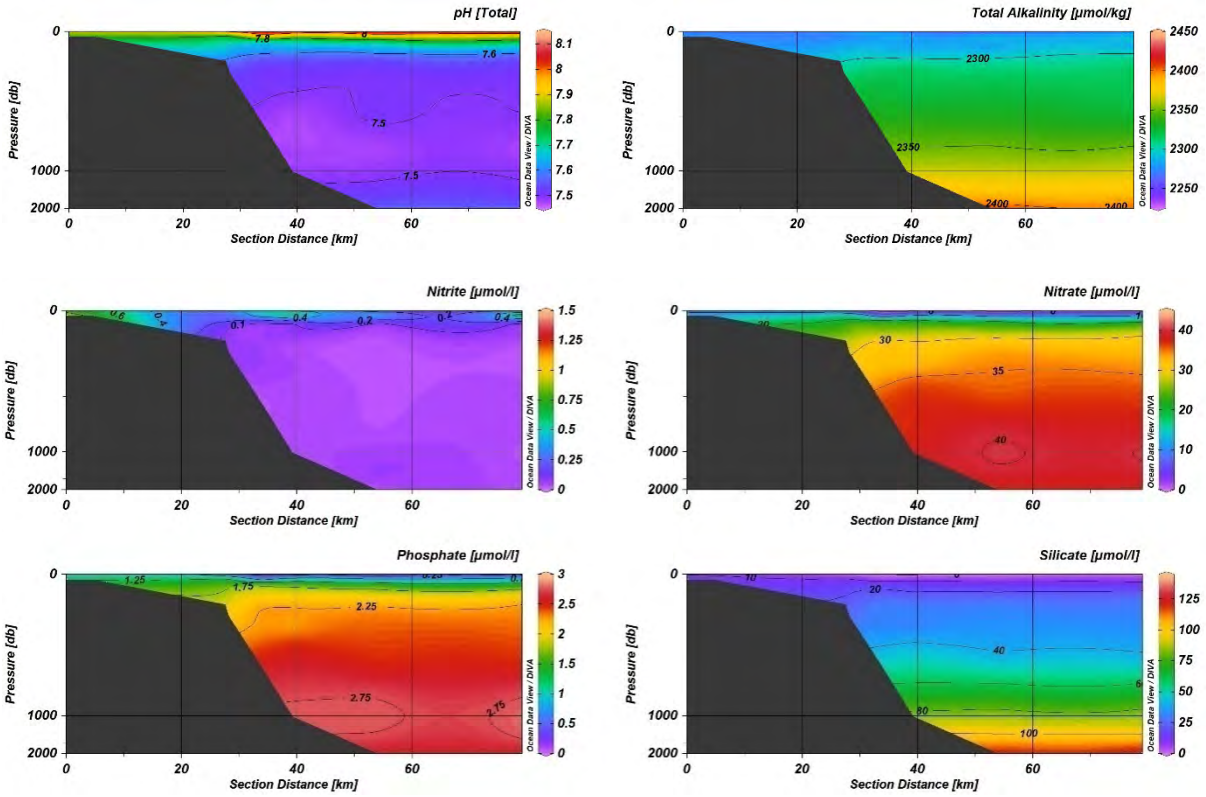


Figure 24. Water Chemistry in Transect 6.

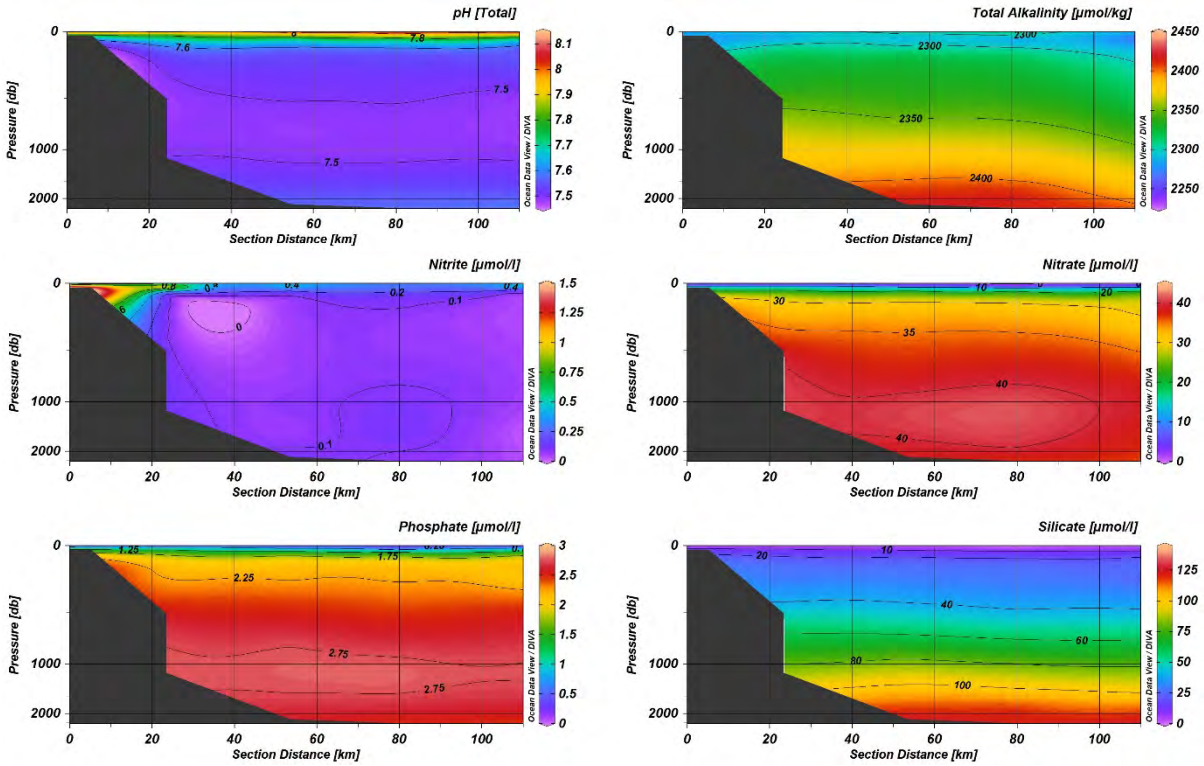


Figure 25. Water Chemistry in Transect 8.

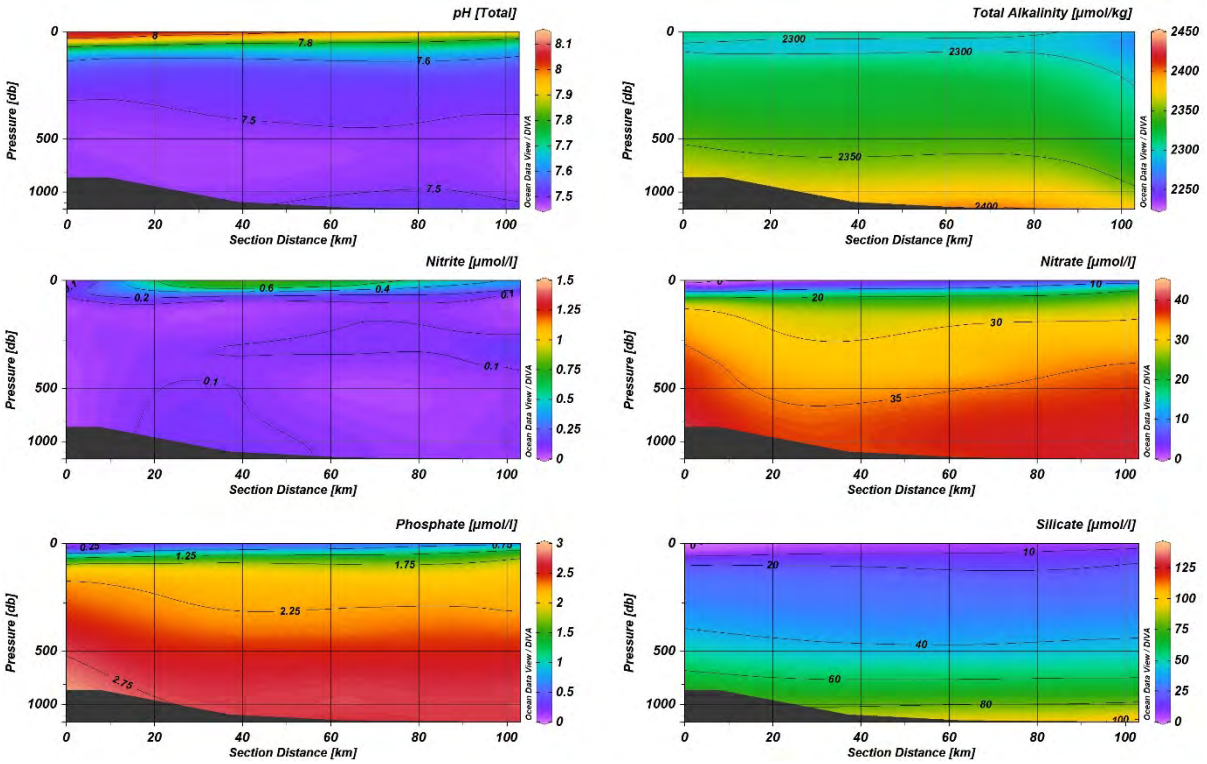


Figure 26. Water Chemistry in Transect 10.

Chlorophyll a and Phaeopigment

Due to a sensitivity adjustment on the Turner Designs 10AU Fluorometer for in-lab water sample analysis to a setting ill-fitting for Sri Lanka, the onboard values from the collected water samples should not be used for chlorophyll a and phaeopigment concentration determination at this time. However, the AquaTracka III Fluorometer attached to the CTD can be used for chlorophyll a concentration determination. Annex X shows the comparison of the chlorophyll a measurement from the Turner 10 AU Fluorometer and the AquaTracka III Fluorometer. All plots from the independent analyses are very similar. However, the incorrect sensitivity setting on the Turner 10AU Fluorometer is clearly visible in the incorrect higher chlorophyll a values. One could theoretically calibrate the Turner 10 AU values with the AquaTracka values but the AquaTracka Fluorometer has not been calibrated since 2013 and using it as a calibration method is unadvisable. The Nansen instrument team has indicated that all sensors have been sent back to the manufacturer for calibration.

3.2 Plankton and microplastic sampling

Phytoplankton

Phytoplankton abundance

High phytoplankton counts were observed in the South and North West part of the area (Table 6, Figure 27). Lowest phytoplankton abundance was recorded in the Central East region of Sri Lanka (43.8 X 10^3 cells/ml). Sample sites owing higher concentrations of phytoplankton were 527, 542, 566 and phytoplankton concentration (cells/ml) at each site were 146,119 ^{3},101 X 10^3 respectively.

Rhizosolenia, Proboscia and *Pseudo-nitzschia* species were dominant in almost all the samples (Figure 28). *Ceratium longipes* and *Oscillatoria* sp. were recorded as dominant in sample number 500 and 513 respectively.

Table 6. Phytoplankton abundance (cells/ml) of different regions of Sri Lankan water.

Depth (m)	Survey region	Name of the region	No. of stations in the region	Phytoplankton count (cells/ml) (X 10^3)
0-30	1	North West	1	85.00
	2	South West	6	72.33
	3	South	3	84.66
	4	South East	4	64.00
	5	Central East	5	43.80
	6	North East	3	61.33

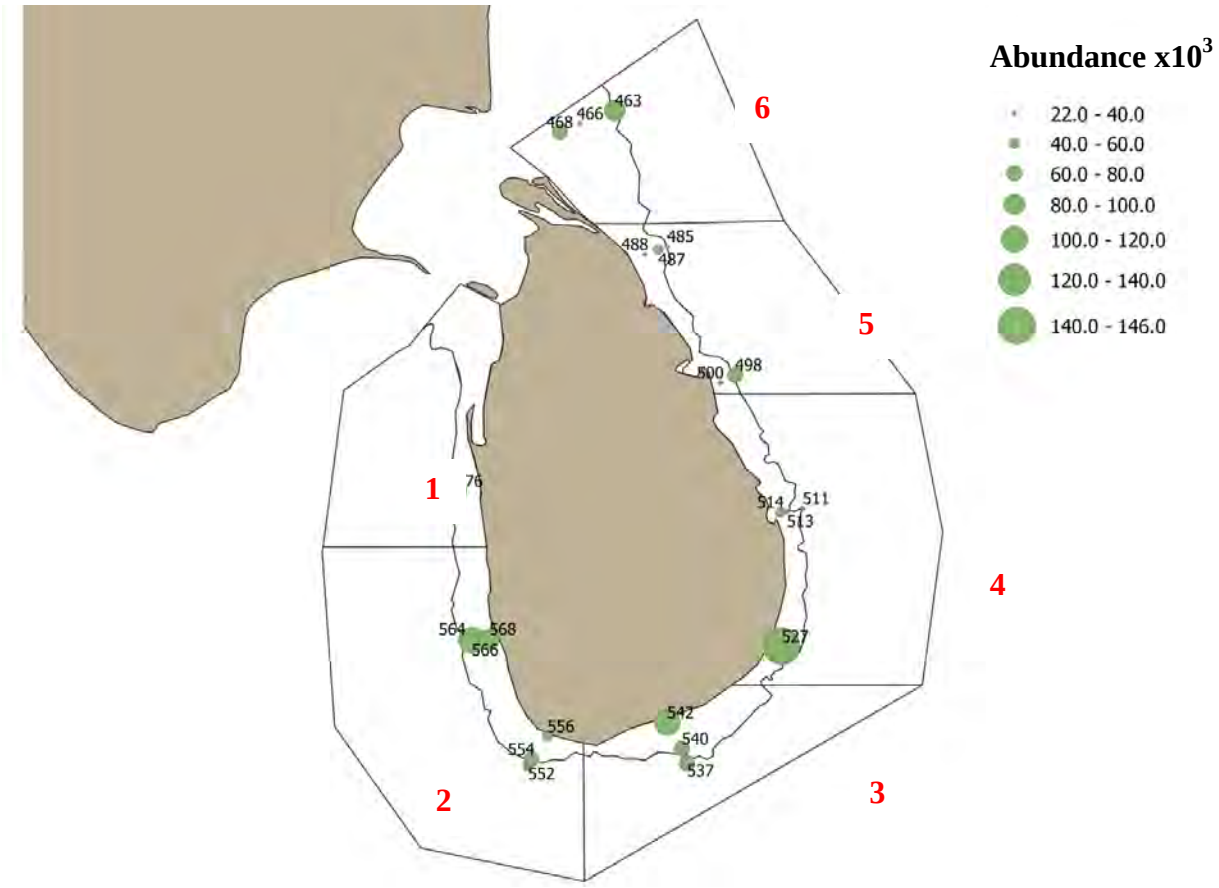
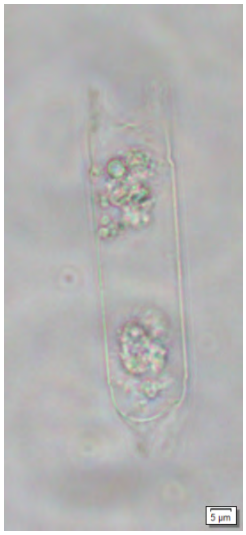
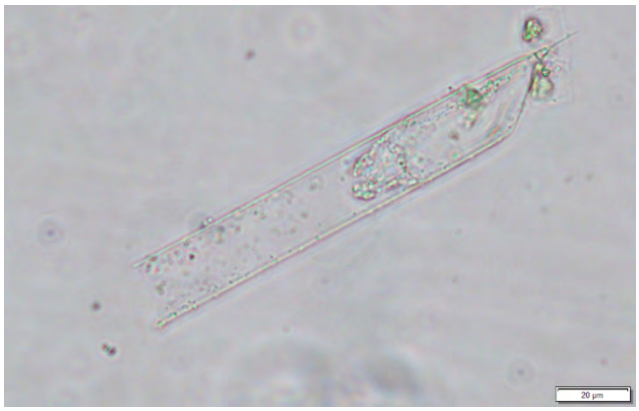


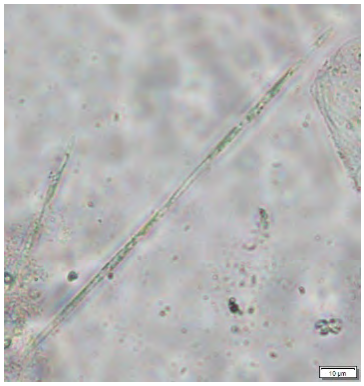
Figure 27. Phytoplankton abundance distribution map around Sri Lanka.



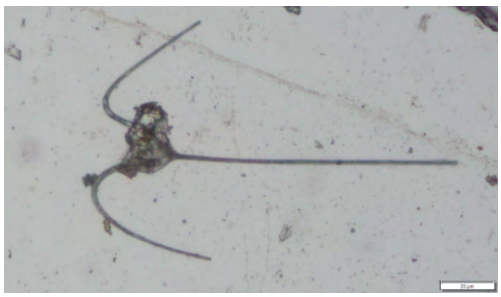
Rhizosolenia sp



Proboscia sp



Pseudo-nitzschia sp



Ceratium longipes

Oscillatoria sp

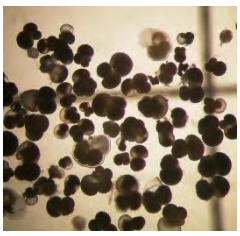
Figure 28. Dominant phytoplankton species.

Zooplankton

In general, phytoplankton and zooplankton abundance were high in the southern region while biomass levels were low along the east coast. Both South West and North West regions showed high zooplankton biomass with high species diversity. *Acrocalanus* sp., chaetognaths, siphonophores were abundant in all samples. Foraminifera were abundant in South East, Central East and North East regions in all samples. Some zooplankton species found during the survey are shown in Figure 29.

Acrocalanus sp.

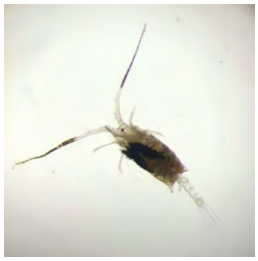
Eucalanus sp.



Globigerina spp.

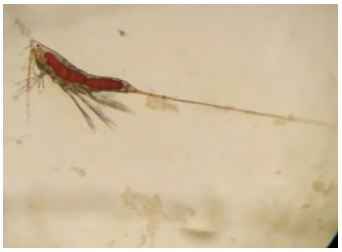
Krill

Euchaeta sp.



Candacia sp.

Pontella plumata



Macrosetella sp.

Figure 29. Some of the zooplankton species collected during the survey.

Zooplankton Biomass

The zooplankton biomass showed huge variations around Sri Lankan waters. In general, high levels of zooplankton biomass were recorded in the South and South-West regions while on the East Coast the biomass was comparatively low. Furthermore, for all depths, the lowest and highest zooplankton biomass were recorded in the North East coast (0.8467 gm^{-2} dry wt.) and the in the South Coast of Sri Lanka (2.7046 gm^{-2} dry wt.), respectively as indicated in Table 7. Figures 30-32 show biomass distribution at different depths in Sri Lankan waters during the survey. Larger individuals (2000µm fraction) were observed mainly in the shallow waters of the Central East, South West, in shelf and deeper waters of South East and South and deep waters of North West (Table 7). In addition, the contribution of smaller zooplankton to the total biomass (180-1000µm) was generally high in all the regions, however, spatial variations were observed. The WP2 net generally tends to underestimate the larger organisms such as euphausiids (krill) due to avoidance. The overall total zooplankton biomass results indicated that the North East, Central East, South East and North West regions had low productivity while the South, South West and North West regions were more productive.

Zooplankton taxonomic identification activities are ongoing at NARA and will be reported in a supplementary issue in 2019.

Table 7. Zooplankton biomass (gm^{-2} dry wt.and gm^{-3} dry wt.) at different depths in Sri Lankan waters.

Depth(m)	Region	Region name	No. of stations in the Region	>2000µm gm-2 dry wt.	1000-2000µm gm-2 dry wt.	180-1000µm gm-2 dry wt.	Total gm-2 dry wt.	>2000µm gm-3 dry wt.	1000-2000µm gm-3 dry wt.	180-1000µm gm-3 dry wt.	Total gm-3 dry wt.
0-30	1	North West	6	0.2483	0.3897	0.6295	1.2675	0.0083	0.0130	0.0210	0.0422
	2	South West	7	0.1235	0.3473	1.3159	1.7867	0.0041	0.0116	0.0439	0.0596
	3	South	3	0.2426	0.3776	0.7352	1.3554	0.0081	0.0126	0.0245	0.0452
	4	South East	6	0.6248	0.1617	0.4889	1.2754	0.0208	0.0054	0.0163	0.0425
	5	Central East	6	0.0016	0.1913	0.2957	0.4886	0.0001	0.0064	0.0099	0.0163
	6	North East	3	0.0000	0.2272	0.2563	0.4835	0.0000	0.0076	0.0085	0.0161
0-100	2	South West	2	0.4824	0.3816	1.3856	2.2496	0.0048	0.0038	0.0139	0.0225
	3	South	1	0.3472	0.3184	1.7904	2.4560	0.0035	0.0032	0.0179	0.0246
	4	South East	2	0.3428	0.4556	1.4048	2.2032	0.0034	0.0046	0.0140	0.0220
	5	Central East	2	0.2268	0.1356	0.7656	1.1280	0.0023	0.0014	0.0077	0.0113
	6	North East	1	0.0000	0.7952	0.4064	1.2016	0.0000	0.0080	0.0041	0.0120
0-200	1	North West	4	0.4170	0.8832	0.8884	2.1886	0.0021	0.0044	0.0044	0.0109
	2	South West	3	0.0000	1.9517	2.1176	4.0693	0.0007	0.0098	0.0106	0.0211
	3	South	1	0.0000	1.7016	2.6008	4.3024	0.0000	0.0085	0.0130	0.0215
	4	South East	2	0.5068	0.2412	0.9168	1.6648	0.0025	0.0012	0.0046	0.0083
	5	Central East	1	0.0000	0.4640	0.9712	1.4352	0.0000	0.0023	0.0049	0.0072
	6	North East	1	0.0000	0.3512	0.5040	0.8552	0.0000	0.0018	0.0025	0.0043

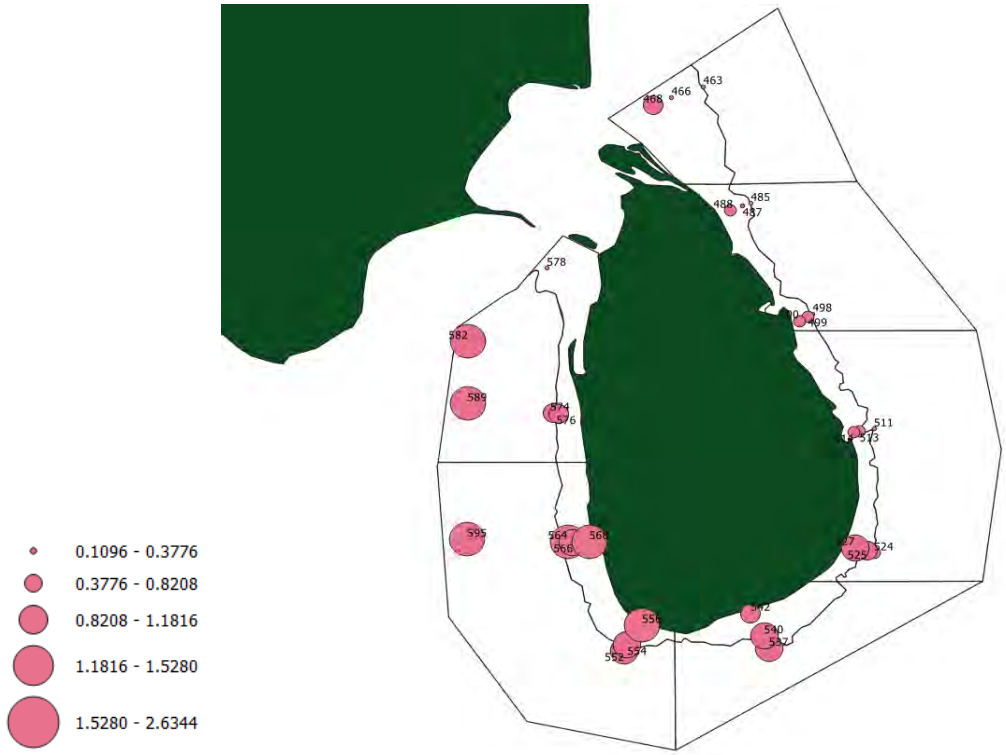


Figure 30. 0-30 m Zooplankton biomass distribution map around Sri Lanka.

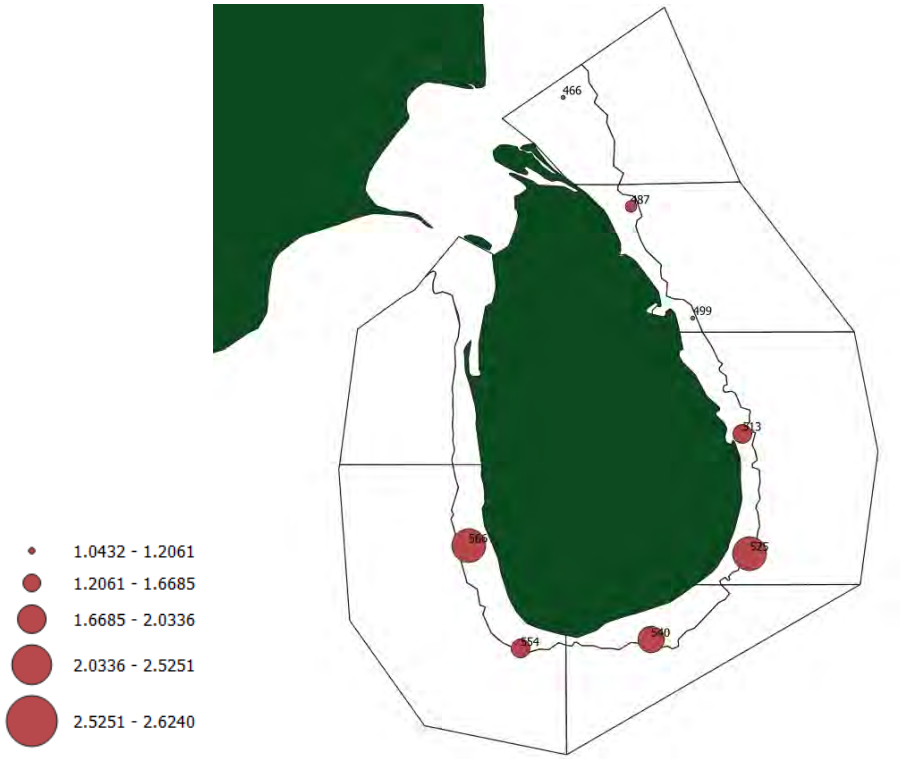


Figure 31. 0-100 m Zooplankton biomass distribution map around Sri Lanka.

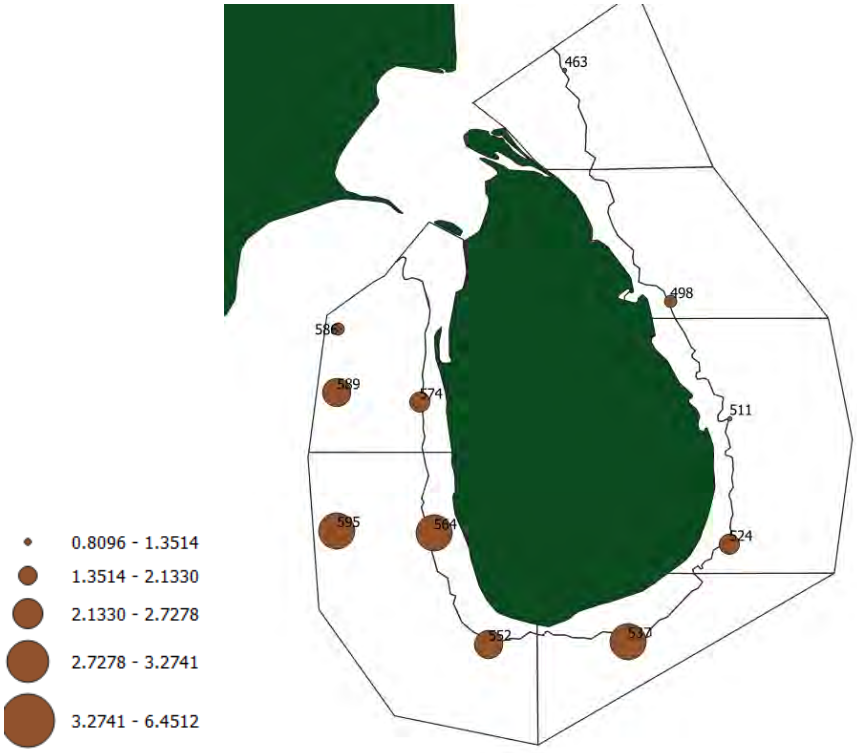


Figure 32. 0-200 m Zooplankton biomass distribution map around Sri Lanka.

Ichthyoplankton

Fish eggs and fish larvae

Fish larvae abundances collected from Manta trawl during the survey period, 24 June to 16 July 2018 are given in Table 8 and Figure 33.

Table 8. Summary of average density of fish larvae and dominant families in different regions from Multinet Mammoth catches.

Area / Region	**Average no of fish larvae per 1000m^3**	**Dominant families**
North East	103	Engraulidae, Bregmacerotidae, Myctophidae
Central East	604	Lutjanidae, Engraulidae, Scombridae, Carangidae
South East	1183	Carangidae, Lutjanidae, Blennidae
South	189	Lutjanidae, Labridae, Scombridae
South West	552	Myctophidae, Bothidae, Engraulidae, Scombridae, Coryphynidae
North West	192	Myctophidae, Lutjanidae, Carangidae

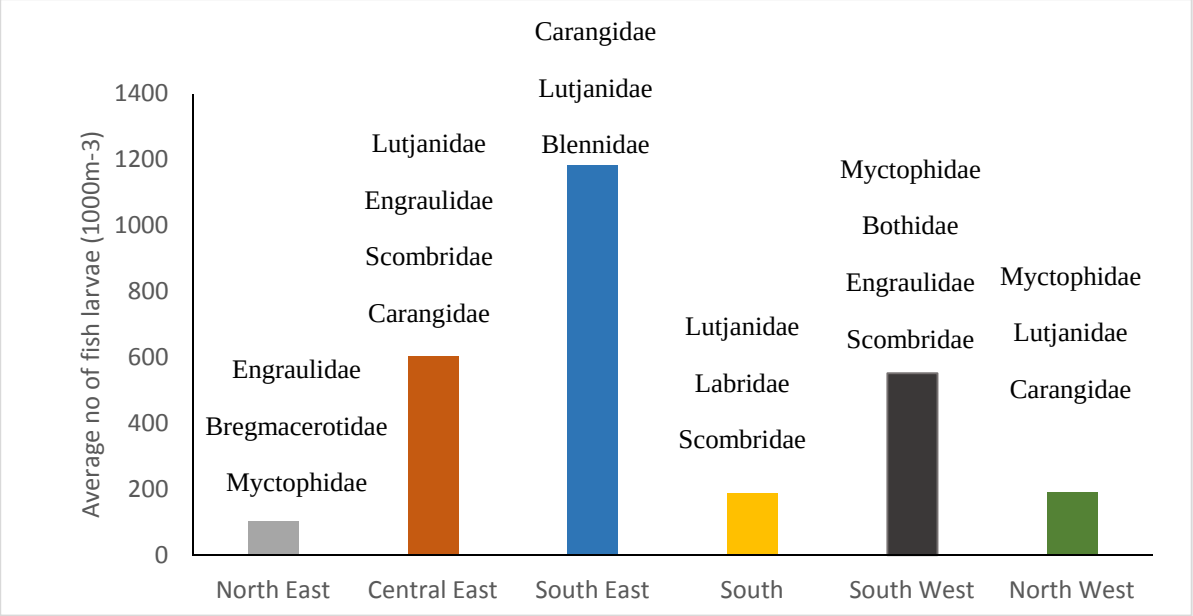


Figure 33. Abundant families observed in different regions in Sri Lankan waters.

Results from the Multinet Mammoth catches showed that dominant fish larvae in Sri Lankan waters belonged to the families Engraulidae, Carangidae, Lutjanidae, Scombridae, Labridae and Myctophidae (Table 8, Figure 34). The highest average number of fish larvae was observed in the South East region (1183 fish larvae 1000 m^{-3}) followed by Central East region (604 fish larvae/ 1000 m^{-3}) and South West region. Lowest average number of fish larvae was observed in the North-east region with 103 fish larvae 1000 m^{-3} (Table 8 Figure 34). Four shelf regions showed a higher average number of fish larvae compare to the deep-sea areas i.e. Central East, South East, South West and North West except North East and South regions. The highest species diversity was observed in the South West region whereas the lowest was in the North East region.

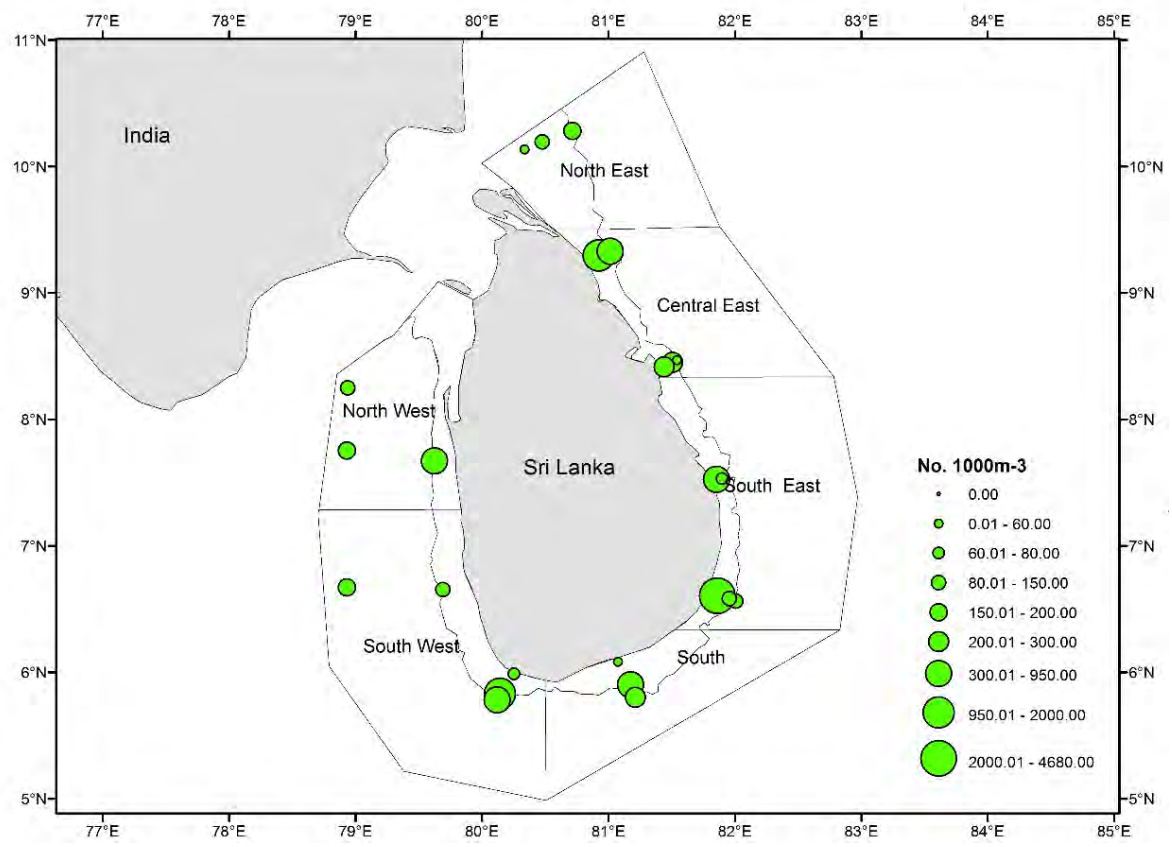
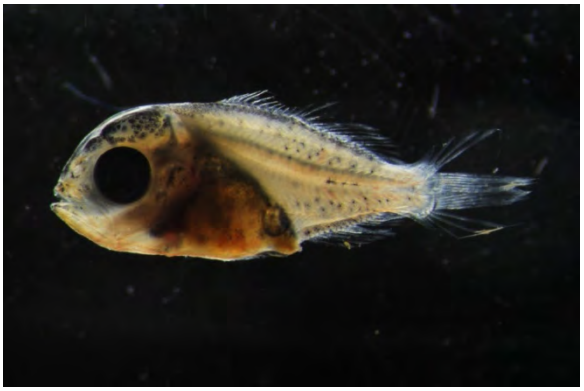


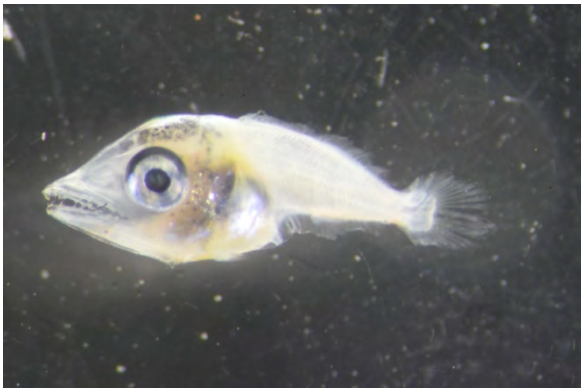
Figure 34. Abundance of fish larvae around Sri Lankan (No. 1000^{-3}).

The North East region mainly consisted of pelagic and mesopelagic fish families i.e. Engraulidae, Bregmacerotidae and Myctophidae. The Central East was mainly dominated by both pelagic and demersal families (Lutjanidae, Engraulidae, Scombridae and Carangidae). In the South East and South regions, though both pelagic and demersal families were observed, the demersal families dominated i.e. Lutjanidae, Blennidae and Labridae. In the South West and North West regions, mesopelagic Myctophids dominated (Figure 33).

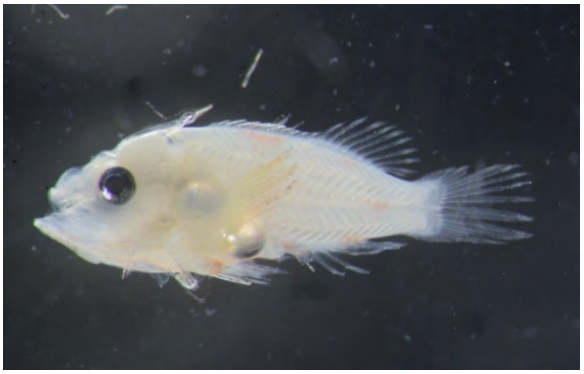
Some of the fish larvae and fish eggs sampled were shown in Figures 35 and 36 respectively. Detailed taxonomic identification of ichthyoplankton activities are ongoing at NARA and will be reported in a supplementary issue in 2019.



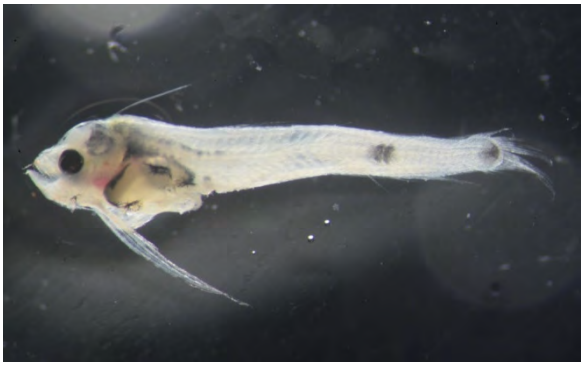
Family: Nomeidae, *Cubiceps* spp. Postflexion (7.2 mm), North East Region



Family: Scombridae, *Auxis* spp. (6.2 mm), North East Region



Family: Lethrinidae Postflexion (7.5 mm), Central East Region

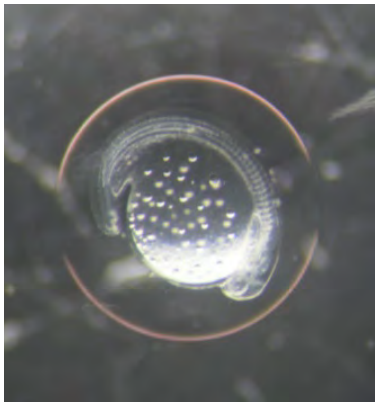


Family: Bregmacerotidae Postflexion (9 mm), North East Region

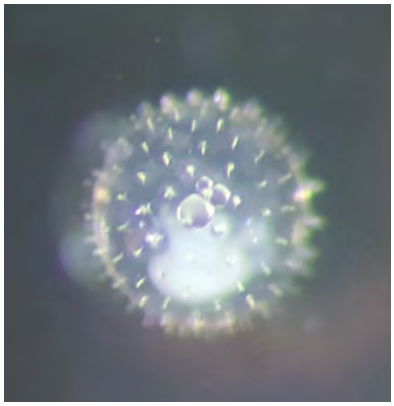
Family: Lutjanidae, *Lutjanus* spp. Postflexion (16.2 mm), Central East Region

Family: Bothidae Postflexion (18 mm), Central East Region

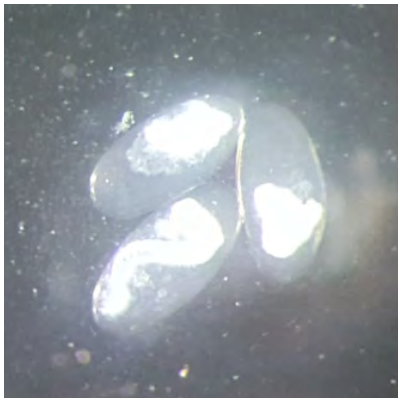
Figure 35. Some fish larvae collected during the survey.



Family: Diodontidae



Family: Myctophidae



Family:Engraulidae

Figure 36. Some fish eggs collected during the survey.

Microplastics and Debris

These samples were analysed regional-wise. Pumped samples are being analysed similar to the Manta trawl samples, where FTIR-ATR analysis was performed for selected samples. The summary of sample collection and analysis for Manta-trawl, Pumped and CTD water samples were given in Tables 9 and 10 respectively.

Table 9. Summary of collection and analysis of Manta-trawl samples.

Region	No. of Stations	No. of Samples Collected	No. of Samples Analysed (Visual)	No. of Samples to be analysed (Visual)	No. of Samples to be analysed (Chemical)
North East	3	3	3	0	3
Central East	6	5	5	0	5
South East	6	6	6	0	6
South	3	3	1	2	3
South West	6	6	4	2	6
North West	5	5	2	3	5

Table 10. Summary of collection and analysis of Pumped water samples[a] and CTD water samples [b].

Region	No. of Stations	No. of Samples Collected	No. of Samples Analysed (Visual)	No. of Samples to be analysed (Visual)	No. of Samples to be analysed (Chemical)
North East	07 (5^a+2^b)	07 (5^a+2^b)	03 (3^a+0^b)	04 (2^a+2^b)	04 (2^a+2^b)
Central East	11 (6^a+5^b)	11 (6^a+5^b)	03 (3^a+0^b)	08 (3^a+5^b)	08 (3^a+5^b)
South East	11 (6^a+5^b)	11 (6^a+5^b)	03 (3^a+0^b)	08 (3^a+5^b)	08 (3^a+5^b)
South	11 (7^a+5^b)	11 (7^a+5^b)	04 (4^a+0^b)	08 (3^a+5^b)	08 (3^a+5^b)
South West	13 (7^a+6^b)	13 (7^a+6^b)	04 (4^a+0^b)	09 (3^a+6^b)	09 (3^a+6^b)
North West	14 (7^a+7^b)	14 (7^a+7^b)	03 (3^a+0^b)	11 (4^a+7^b)	11 (4^a+7^b)

Abundance and Size of Microplastics

Preliminary results show that the waters in the west coast in general, are more polluted with micro-plastics compared to the East coast, especially due to the high abundance of microplastics observed in the North West (0.85 particles/ m^3), On the East coast, the Central East is slightly more polluted with microplastics (0.27 particles/ m^3), compared to the North East (0.18 particles/ m^3) and South East coast (0.25 particles/ m^3). The number of microplastic particles found in the limited number of stations analysed in the South was low (0.12 particles/ m^3) compared to other regions (Figure 37). The overall average abundance of micro-plastics in Sri Lankan waters was estimated to 0.31 particles/m^3 of surface water during the survey.

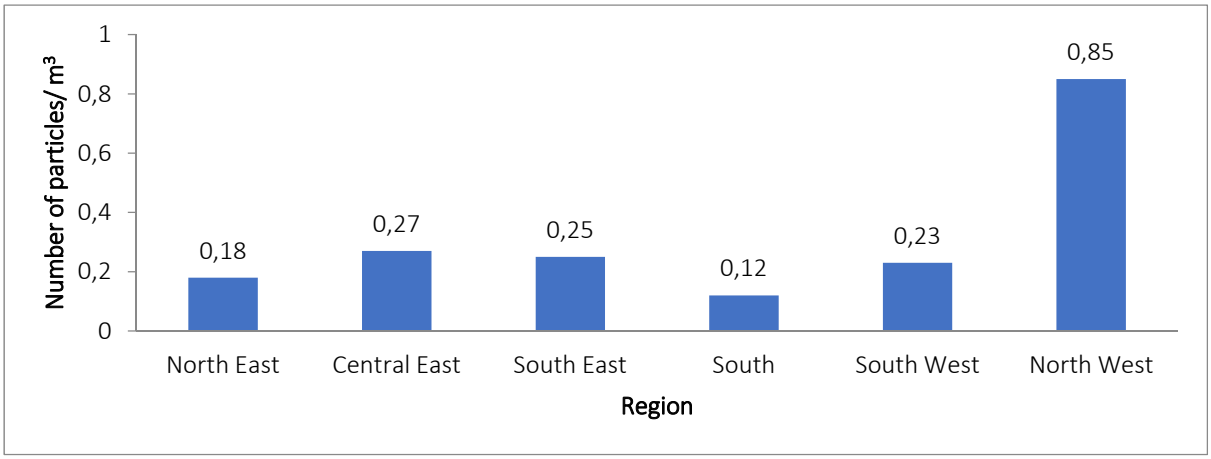


Figure 37. Microplastic abundance in regions (number of particles/m^3 of surface water).

Categorical Distribution of Microplastics

In reference to all six regions, the majority of microplastic particles found in surface waters were fragments, followed by thread-like microplastics, foams, thin fibres and films. A high number of fragments were recorded from the Central East and the North West (Figure 38).

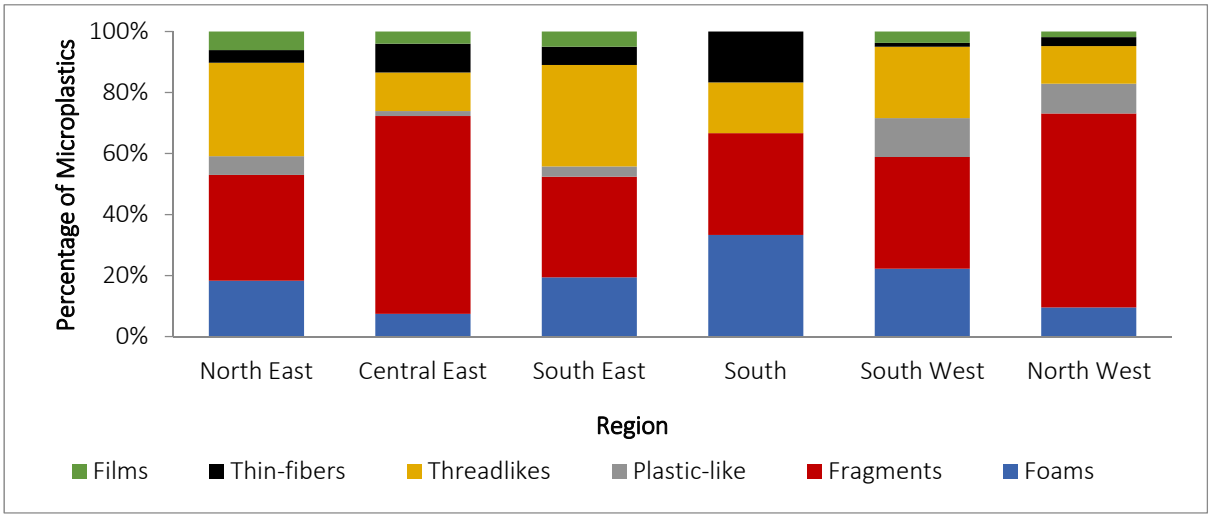


Figure 38. Different categories of microplastics found in the six regions off Sri Lanka.

As shown in Figure 39, the vast majority, over 60% of the microplastic particles, were fragments whereas thread-like microplastics and foams accounted to 16% and 11% of the total assessed during the survey. Thin fibers accounted for 8% of the samples, where films were the leased found category (4%). In addition, categorical distribution of microplastics among regions described as a number of particles/ m3 of surface water was given in Table 11.

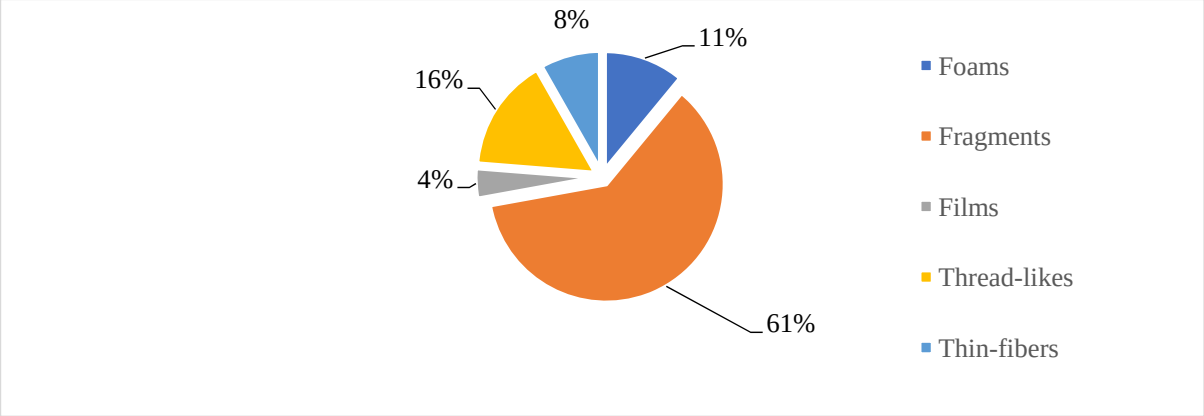


Figure 39. Abundance of different categories of microplastics.

Table 11. Categorical distribution of microplastics among regions described as the number of particles/ m^3 of surface water.

Category	North East	Central East	South East	South	South West	North West
Foams	0.04	0.02	0.05	0.03	0.05	0.08
Fragments	0.07	0.17	0.08	0.03	0.08	0.54
Plastic-likes	0.01	0.00	0.01	0.00	0.03	0.08
Thread-likes	0.06	0.03	0.08	0.02	0.05	0.10
Thin-fibers	0.01	0.03	0.01	0.02	0.00	0.02
Films	0.01	0.01	0.01	0.00	0.01	0.02

Colour composition of Microplastic Particles

In all six regions, the majority of microplastic particles were blue in colour, whereas white, green, transparent and brown plastic particles are abundant in large quantities in different regions (Figure 40).

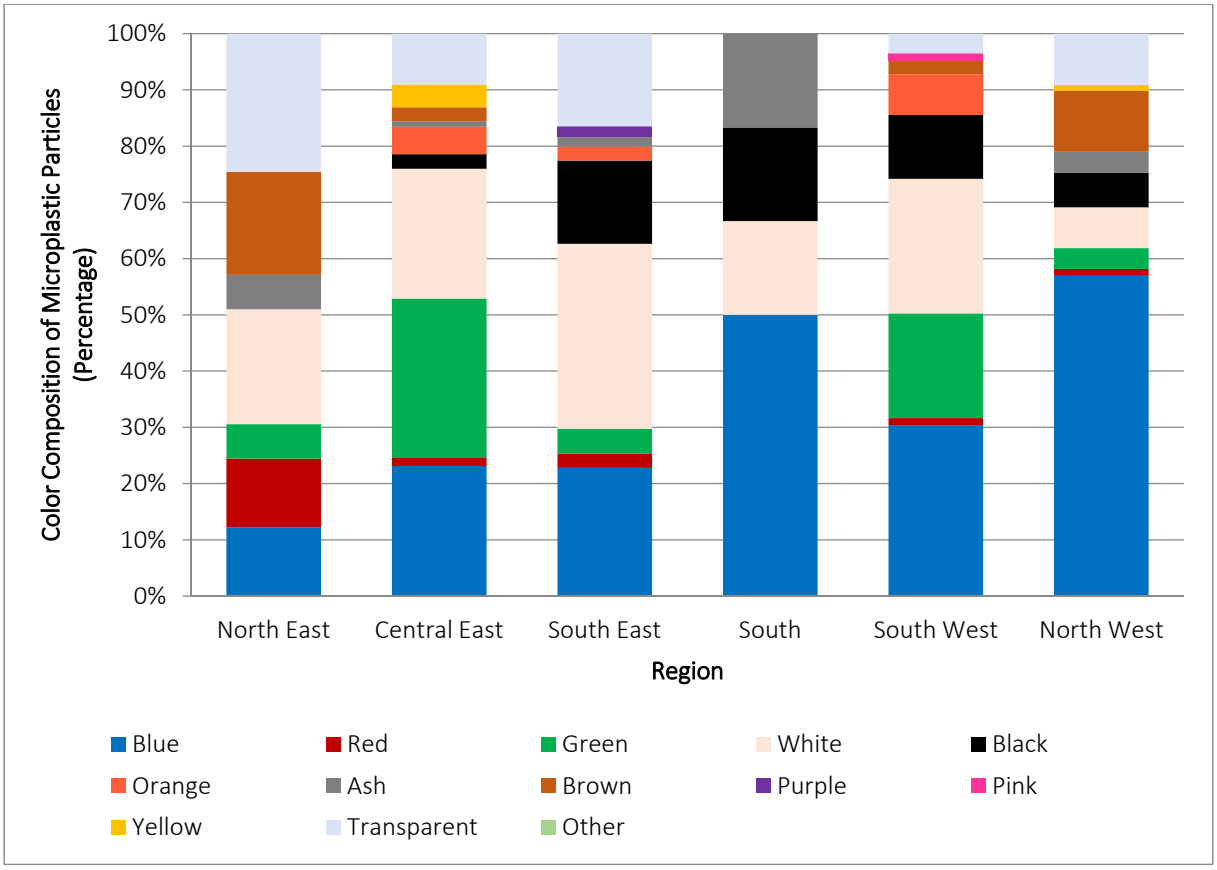


Figure 40. Colour composition of Microplastic Particles in the six regions.

The estimated abundances of different coloured microplastics found in the survey are listed below (Table 12).

Table 12. Estimated abundances (Number of particles/ m^3 of surface water)of different coloured microplastics found during the survey.

Colour	North East	Central East	South East	South	South West	North West
Green	0.01	0.08	0.01	0.00	0.04	0.03
Blue	0.02	0.06	0.06	0.05	0.07	0.48
Red	0.02	0.00	0.01	0.00	0.00	0.01
Yellow	0.00	0.01	0.00	0.00	0.00	0.01
White	0.04	0.06	0.08	0.02	0.05	0.06
Black	0.00	0.01	0.04	0.02	0.02	0.05
Ash	0.01	0.00	0.00	0.02	0.00	0.03
Brown	0.04	0.01	0.00	0.00	0.01	0.09
Orange	0.00	0.01	0.01	0.00	0.02	0.00
Purple	0.00	0.00	0.00	0.00	0.00	0.00
Pink	0.00	0.00	0.00	0.00	0.00	0.00
Transparent	0.05	0.02	0.04	0.00	0.01	0.08
Other	0.00	0.00	0.00	0.00	0.00	0.00

Physical Size of Microplastics

The average size of micro-plastic particles was 1.23±1.18 mm. This reveals the vast diversity in size of microplastic particles (Figure 41). There were microplastics smaller than 0.1 mm and the majority among those smallest particles belonged to filaments, many thread-like and thin fiber microplastics were lengthier but small in width. The majority of microplastics were 0-0.5 mm in width and 0-4.1 mm in length. Notably, there were tiny microplastics longer than 28 mm.

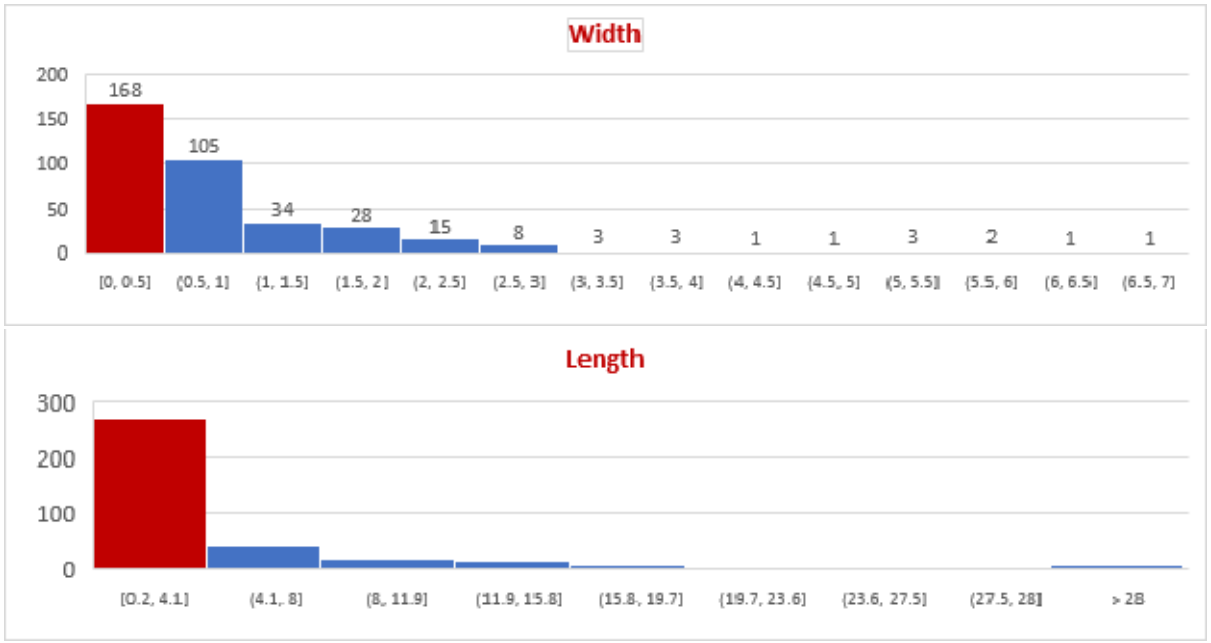


Figure 41. Width and length of microplastics found during the survey.

Surface Properties of microplastics

Most of the microplastics (62.67%) had rough surfaces at the time of observation (Figure 42). Many fragments and foams contained rough surfaces while many particles in the form of films contained a smooth and shiny surface. Thin fibers and thread-like microplastics varied in this characteristic, and this surface property may vary with their origin.

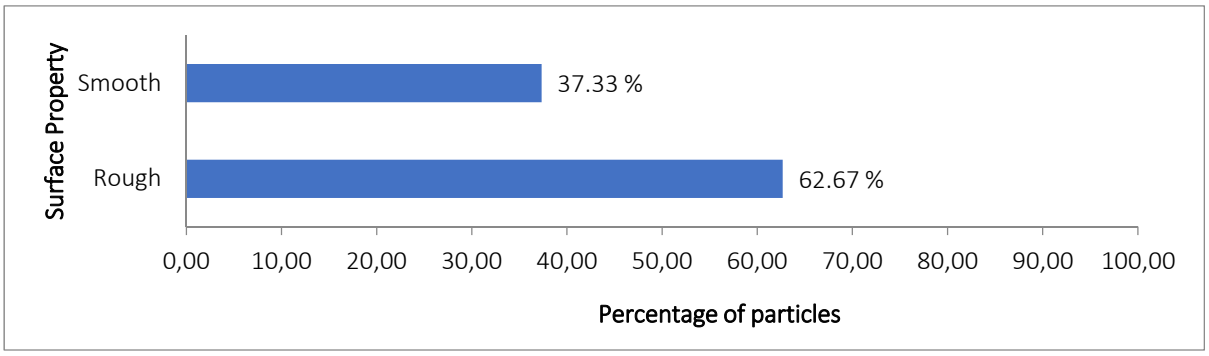


Figure 42. Surface properties of microplastic particles.

Hardness of Microplastic Particles

Most of the microplastic particles contained a hard structure originating from the debris of hard plastics (Figure 43). A nearly equal proportion (49.6%) comprised of soft structured plastics, and are debris of soft plastics or the plastic particles that have been partially degraded into fragile structures.

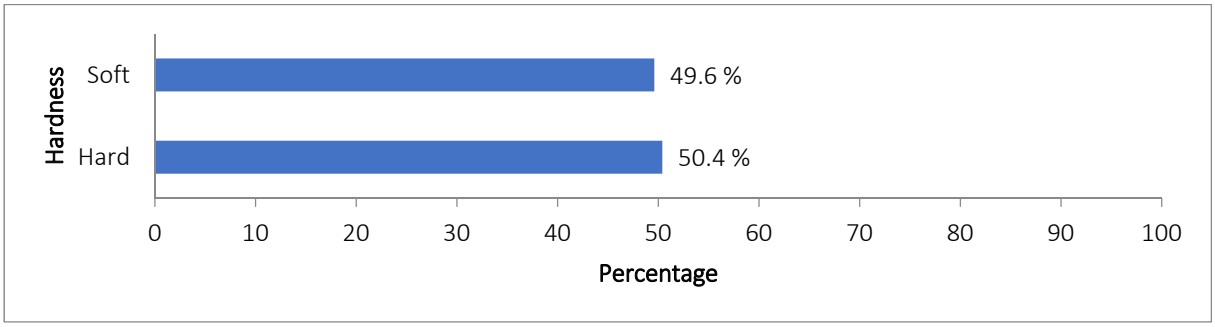


Figure 43. Hardness of microplastic particles.

Geometric Shapes of Microplastic Particles

The majority of plastic particles were irregularly shaped (74.13%), whereas filament type was the second most abundant shape. Some few particles were triangular and round in shape with an abundance of 1.07% and 0.27% respectively (Figure 44). Plastic particles with other geometrical shapes were not found in the samples analyzed.

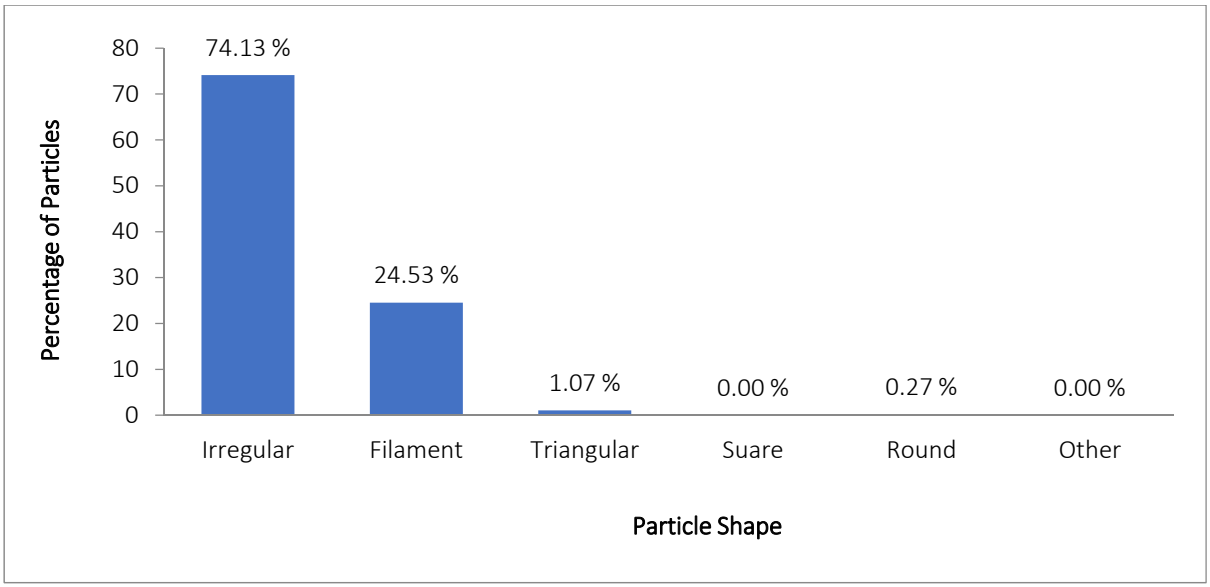


Figure 44. Geometric shapes of microplastic particles.

Most of the plastic particles were three dimensional in their geometric shapes. A few images of samples obtained from different stations are shown below (Figures 45- 48).

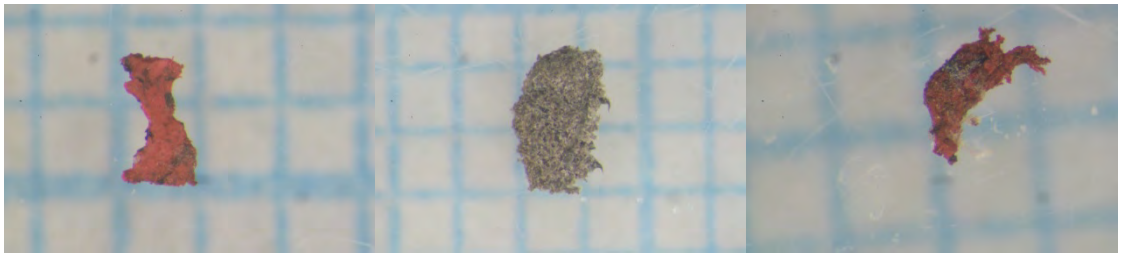


Figure 45. Microplastic fragments with different characteristics; surface properties, structures and sizes.

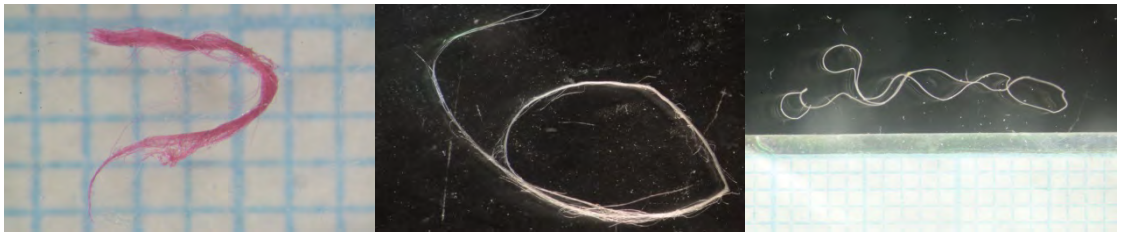


Figure 46. Thread-like microplastics and thin fibers with different characteristics.

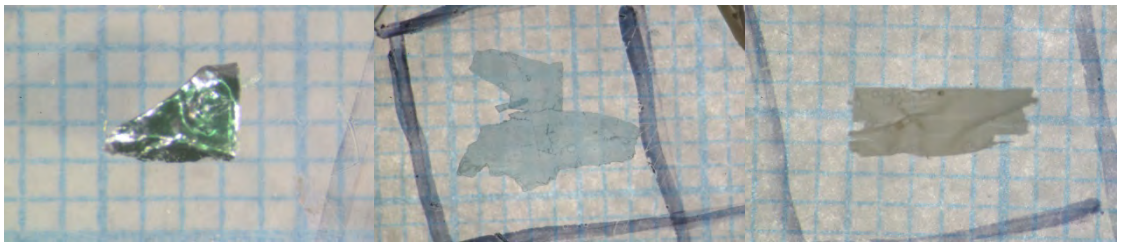


Figure 47. Microplastic films with different characteristics

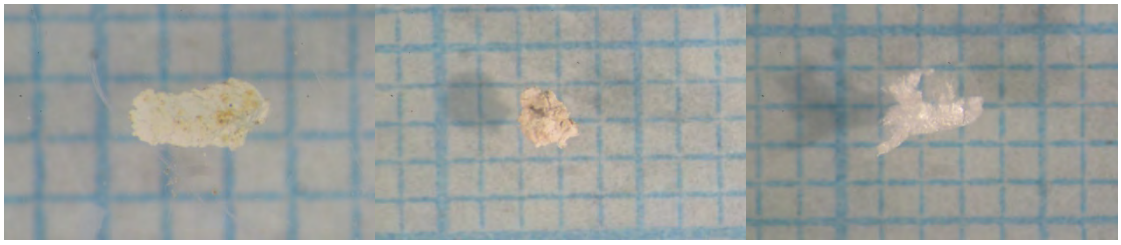


Figure 48. Microplastic foams with different characteristics

Microplastics in Pumped Water Samples

A total of 20 out of 38 pumped water samples were analyzed where both physical and chemical characteristics were studied. Similar to the samples collected from Manta trawl sampling, the pump samples contained plastic particles with an array of properties (Figure 49).

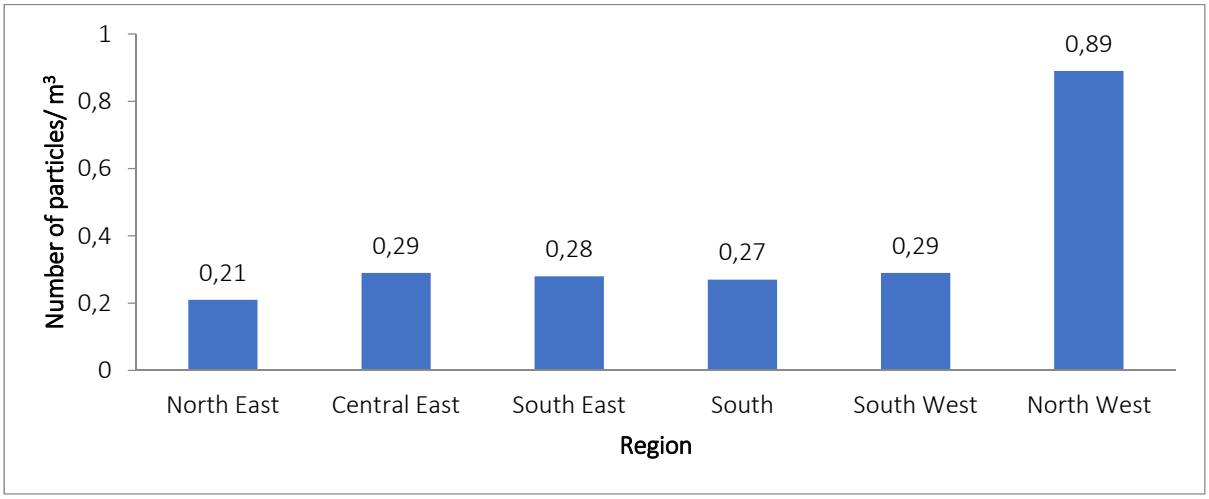


Figure 49. Abundance of microplastics in pumped water samples collected from the six regions.

The data from the water pump compared well to the Manta trawl samples. The pollution levels revealed by pumped water samples in different regions were comparable, and also the water pump samples show that the North Western region off Sri Lanka are highly polluted with microplastics, compared to other regions.

Chemical Composition of Microplastics

The chemical composition of microplastic particles selected from the pumped water samples were subjected to a FTIR-ATR analysis. Accordingly, the polymer and plastic categories were roughly estimated. The preliminary results revealed that the samples at a majority, contains polypropylene, polyethylene, polystyrene and nylon. PETE and HDPE types were notable in the results, and the virgin pellets (primary plastics) were least observed in all samples (Figure 50). This indicates that the majority of microplastics were originated from secondary plastics, and the results indicate that the majority of microplastics are from packaging materials, industry used material and fishing gear.

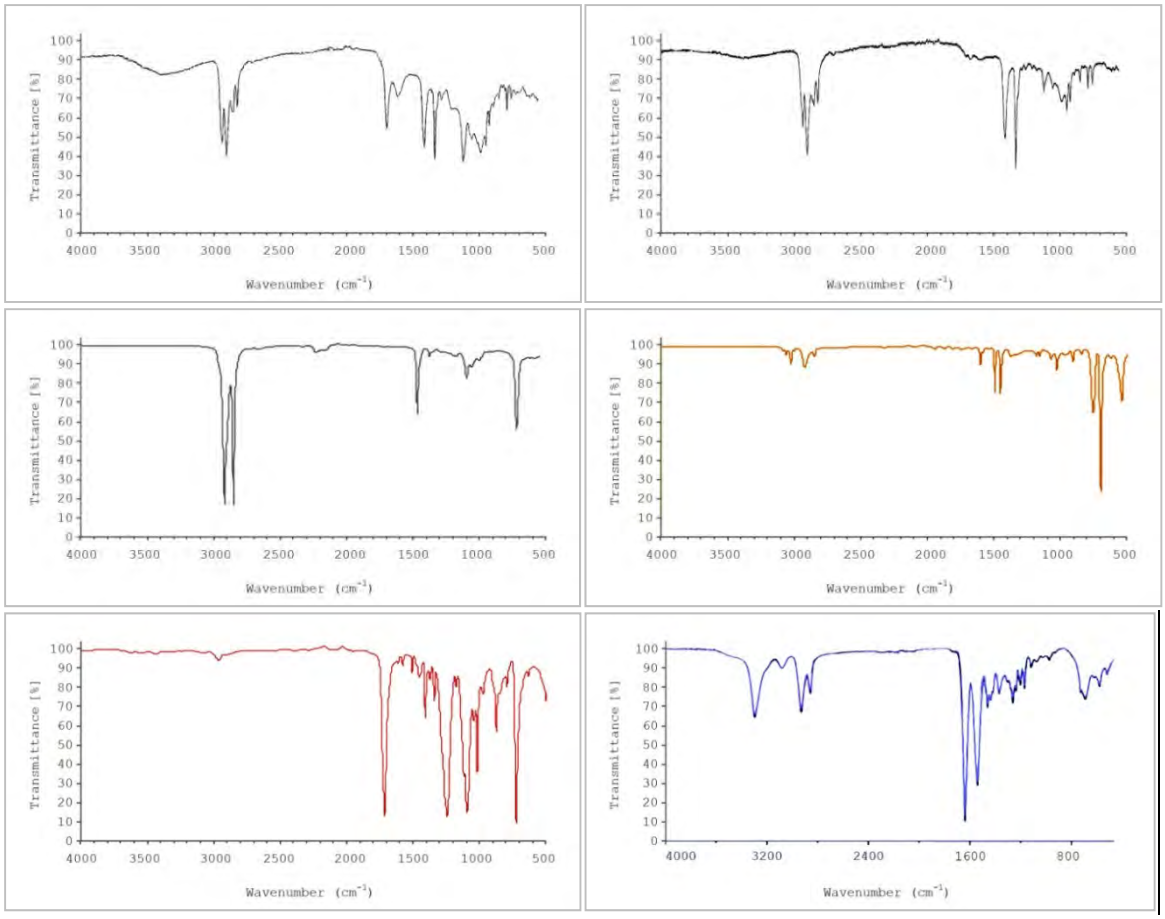


Figure 50. FTIR-ATR Spectra of Secelted microplastics from pumped water samples.

Sediment samples

Sediments were collected from most demersal trawls for habitat characterisation. 84 sediment samples are being analyzed at NARA. During the study benthos and the granular properties (percentage of grain size) are examined. Once analysed, the information will contribute to the description of seafloor habitats in the area. The data will be analysed in Sri Lanka in 2019 and will be reported separately.

Bottom Mapping

Continuous recording of the seafloor depth was made whilst underway and during a special study in the port area off Colombo. Data will be analysed in Sri Lanka in 2019, and will be reported separately.

Nutrition and food safety

Fisheries are almost invisible in strategies to achieve SDG2, and nutrition and food security are not the primary focus in SDG14. Fisheries, however, support people either directly or indirectly through food and income and the unique nutrient content of fish plays a significant role in combating the triple burden of hunger, micronutrient deficiencies and non-communicable diseases. Nevertheless, the qualities of fish are not recognized in the global food security discourse, and fish is strikingly missing from strategies for nutrient deficiency

reduction. Having relevant, reliable and up-to-date food composition data are the basis for assessing nutrient intake, nutrient requirements and food-based dietary guidelines.

Samples of whole fish, fillet and liver of various fish species were sampled and prepared for analysis by filleting, homogenising and freeze-drying. The samples will be analysed for selected nutrients and metals. Samples will be stored pending budget for analyses for other nutrients and contaminants. Table 13 shows the number of samples taken for the different kinds of analyses of fish for food safety and nutrition. The analyses will be carried out at the Institute of Marine Research in Bergen, Norway. Typical analyses will include:

1) Nutrients: energy, water content, total fat, proteins, ash, fatty acids, cholesterol, vitamins (D, A, B12,), iodine, selenium and other minerals. Samples will be stored pending budget for analysis of amino acids and other vitamins.
2) Contaminants: heavy metals to start withand samples will be stored pending budget for analysis of inorganic arsenic, methyl mercury, PCB, dioxins, furans, PBDE, pesticides, and PAH.

Table 13. Number of samples taken for the different kinds of analyses of fish for food safety and nutrition for a) big fish and b) small fish

a)

DATE	SPECIES	NUMBER OF FISH	JOURNAL NR.	TISSUE	FREECE DRIED SAMPLES	STATION NR.	START POSITION	END POSITION	COUNTRY
28.06.2018	*Carangaides fulroguttatus*	25	2018-76/1-25	Fillet and liver	5	14	9.58, 80.74	9.59, 80.0	Sri Lanka
29.06.2018	*Diagramma Pictun*	25	2018-75/1-25	Fillet and liver	30	19	9, 81	8.98, 81	Sri Lanka
01.07.2018	*Lethrinus Olivaceus*	25	2018-78/1-25	Fillet and liver	30	33	7.71, 81.83	7.68, 81.8	Sri Lanka
04.07.2018	*Lutjanus Argentimaculatus*	12	2018-77/1-12	Fillet and liver	12	46	6.27, 81.63	6.29, 81.6	Sri Lanka
07.07.2018	*Nemipterus Bipunctatus*	25	2018-74/1-25	Fillet and liver	5	61	5.97, 80.23	5.96, 80.3	Sri Lanka
07.07.2018	*Lutjanus Lutjanus*	25	2018-80/1-25	Fillet and liver	30	63	5.88, 80.38	5.88, 80.4	Sri Lnka
07.07.2018	*Lutjanus Lunulatus*	25	2018-166/1-25	Fillet and liver	25	63	5.88, 80.38	5.88, 80.4	Sri Lanka
09.07.2018	*Selar Crumenophtthalamus*	23	2018-167/1-25	Filet, filet with skin and liver	5	73	6.49, 79.69	6.44, 79.7	Sri Lanka
10.07.2018	*Sphyrena Jello*	24	2018-168/1-25	Fillet and liver	29	78	7.15, 79.71	7.12, 79.7	Sri Lanka

b)

DATE	SPECIES	NUMBER OF FISH	JOURNAL NR.	TISSUE	FREECE DRIED SAMPLES	STATION NR.	START POSITION	END POSITION	COUNTRY
27.06.2018	*Decapterus Macrosoma*	150	2018-916/1-6	Whole fish and fillet with skin and bones	6	8	9.94, 80.67	9.92, 80.7	Sri Lanka
28.06.2018	*Leiognathus Bindus*	150	2018-917/1-6	Whole fish and fillet with skin and bones	6	15	9.47, 80.86	9.45, 80.9	Sri Lanka
29.06.2018	*Stolephorus Indicus*	150	2018-918/1-6	Whole fish and fillet with skin and bones	6	17	9.13, 81.03	9.15, 81	Sri Lanka
29.06.2018	*Leiognathus Bindus*	150	2018-919/1-6	Whole fish and fillet with skin and bones	6	18	9, 81.05	8.98, 81.1	Sri Lanka
02.07.2018	*Leiognathus Dussumieri*	150	2018-920/1-6	Whole fish and fillet with skin and bones	6	41	6.79, 81.87	6.77, 81.9	Sri Lanka
04.07.2018	*Sillago Ingenuua*	150	2018-921/1-6	Whole fish and fillet with skin and bones	6	46	6.27, 81.63	6.29, 81.6	Sri Lanka
05.07.2018	*Decapterus Macrosoma*	150	2018-922/1-6	Whole fish and fillet with skin and bones	6	53	6.04, 80.99	6.04, 81	Sri Lanka
05.07.2018	*Rastrelliger Kanagurta*	150	2018-923/1-6	Whole fish and fillet with skin and bones	6	53	6.04, 80.99	6.04,81	Sri Lanka
10.07.2018	*Leiognathus Elongatus*	150	2018-924/1-6	Whole fish and fillet with skin and bones	6	77	7.06, 7.71	7.03, 79,7	Sri Lanka
10.07.2018	*Amblygaster Sirim*	150	2018-925/1-6	Whole fish and fillet with skin and bones	6	78	7.15, 79.71	7.12, 79.71	Sri Lanka
11.07.2018	*Encrasicholina Devisi*	300	2018-926/1-6	Whole fish and fillet with skin and bones	6	78	7.15, 79.71	7.12, 79.71	Sri Lanka
12.07.2018	*Auxis Thazard*	150	2018-927/1-6	Whole fish and fillet with skin and bones	6	80	7.49, 79.42	7.46, 79.5	Sri Lanka

3.3 Top predator observations

During the sighting survey from 24 June to 13 July, five species of cetaceans were identified (Table 14). Of the seven larger cetacean species which have been previously recorded in waters of Sri Lanka, only two species of Bryde's whales and blue whales were recorded during the current survey. From the sightings blue whales contributed to 72 percent (n=57) of the total sighting and total number of individuals 151 (best) (Figure 51) Current survey results revealed that during the southwest monsoon period more or less the whole blue whale population in Sri Lanka has migrated to the southwestern part of the country due to food availability in the upwelling area. However, coastal waters of the east coast in Trincomalee is a famous cetacean ground in Sri Lanka, especially for the blue whales, but during the current survey no sightings were made in the east coast region. The highest number of sightings were recorded between Dondra head in the southernmost part to the Kaluthara in the west coast (Figure 52). During the survey large pods of blue whales were recorded in the West and North-western region (Figure 52) These north-western observations were the first recorded in the region. Furthermore, the highest blue whale aggregations were recorded in the south region (from Dondra head to Galle area) which is the busiest shipping area in Sri Lanka. Blue whales may therefore be more vulnerable in this region to ship strikes during the southwest monsoon period. Past records revealed that blue whale stranding's and accidents in the south coast are much higher than that of the other monsoon and locations of the country (Priyadarshana *et al*.,2016).

Table 14. Summarised list of observations with estimated numbers of observations. Min = Minimum number of animals observed, Best = Best estimate of Animals, Max = Maximum numbers of observations.

Species		**No of sightings**	**No of individuals**		
Local name	Scientific name		Min.	Best	Max.
Blue whale	*Balaenoptera musculus*	57	132	151	155
Bryde's whale	*Balaenoptera edeni*	2	2	2	2
Melon-headed whale	*Preponocephala electra*	1	20	25	28
Short-finned pilot whale	*Globicephala macrorhynchus*	3	42	50	62
Spinner dolphin	*Stenella longirostris*	3	39	43	55
Unidentified baleen whale		6	8	8	8
Unidentified whale		2	21	23	30
Unidentified dolphin		5	90	100	120

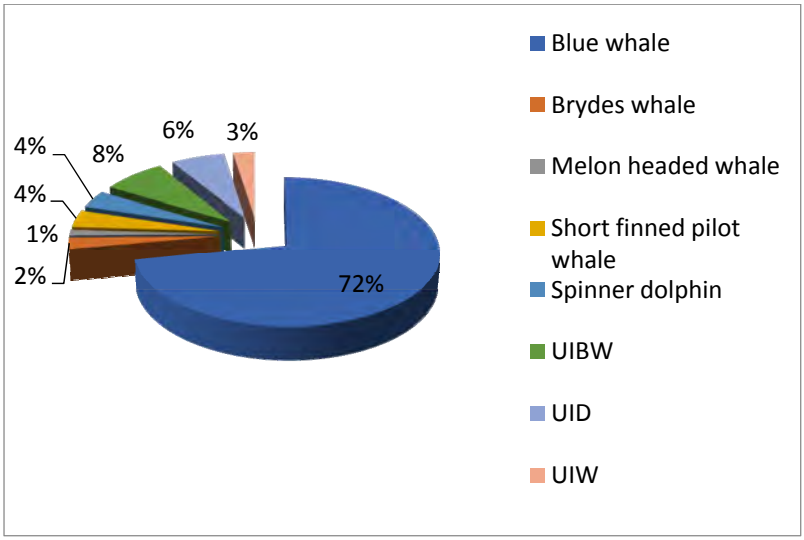


Figure 51. Percentage of different marine mammal sightings.

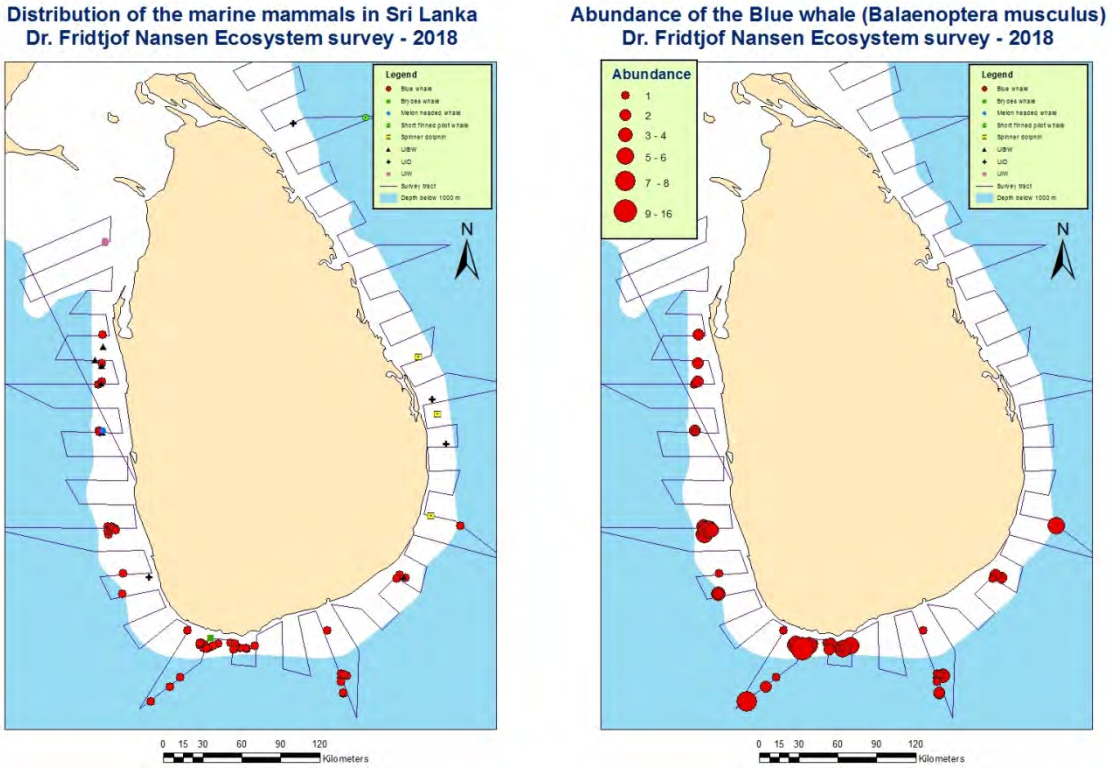


Figure 52. Distribution of the marine mammals around the waters of Sri Lanka during the southwest monsoon 2018. UIW-Un identified whale, UID-Un identified dolpin, UIBW-Un identified baleen whale.

3.4 Acoustic abundance and distribution

The hydroacoustic survey covered the shelf and slope from roughly 20 m depth to 600 m depth from the coast to 1500 m bottom depth. Continuous acoustic recordings and analyses were carried out throughout the survey. Acoustic distribution and abundance were estimated

for two species groups during the survey. These were Pelagic 1 (Pel1) and Pelagic 2 (Pel2). The Pel1 group of species consists of pelagic fish of the families Clupeidae, Dussumieriidae and Engraulididae, while the Pel2 species consist of the families Carangidae, Scombridae, Barracuda and Hairtails. Table 5 gives an overview of the most common species belonging to each of these groups. The Pel1 species are typically separated from the Pel2 species based on the presence of the two groups in the trawl catches and based on the acoustic signal as seen during the scrutinizing process, e.g. the fact that the Clupeidae and Engraulididae has a much stronger backscattering signal and a stronger schooling behaviour then the Carangidae and other Pel2 species. The length used for estimating the biomass index for the two taxonomic groups was 14 cm for Pel1 and 30 cm for Pel2 and the individual weights applied was 25 g and 250 g, respectively.

Summary of backscattered s_A values and biomass estimates for the two species categories can be found in Tables 15 and 16 respectively.

Pel1

The distribution of clupeoids in the southern region of Sri Lanka was generally very low. A few encounters of Pel1 species was made along the east coast, but the biomass was negligible. The fish found in this region was mainly a mix of several *Amblygaster* species and some engraulids. Most of the biomass was found in one distribution area off Negombo. In this area several clupeoid species co-existed, the *Sardinella gibbosa*, *S. albella*, *Amblygaster sirm*, *A. clupeoides*, *A. leiogaster*, and several anchovy species; *Encrasicholina devisi*, *Stolephorus commersonii*, *Stolephorus indicus*, (Figure 53). The total acoustic abundance index (biomass in tonnes)was estimated based on the average total length of 14 cm (Table 15) and individual weight of 25 g. The biomass of Pel1 was estimated to be 21 000 tonnes. Of this, more than 18 000 tonnes were found off Negombo. Length frequencies of the most commonly caught species can be found in Annex III.

Pel2

Most of the Pel2 group of fish was found between 20 and 100 m depth in a more or less continues band along the coast. The highest abundances were found along the south and west coast. (Figure 54, Table 16). The densities were generally low. A total acoustic abundance index of 101 000 tonnes was estimated based on a set (average) total length of 30 cm and individual weight of 250 g (Table 16). The most frequently found Pel2 species found off Sri Lanka was the Carangid species *Decapterus macrosoma*, *Decapterus russelli* and *Selar crumenophthalmus*. Length frequencies of the most commonly caught species can be found in Annex III.

Table 15. The acoustic estimate of Pel1 species along the coast of Sri Lanka.

Region	**North East**	**Central East**	**South East**	**South East**	**South East**	**South East**	**South**	**South West**	
Nansis contour area	1	2	3	4	5	6	7	8	Total:
Area (nm^2)	1.5	10.6	4.4	1.3	0.3	0.4	4.7	198.8	222.0
$<s_A>$:	1072	27	384	513	282	196	2164	534	646
Biomass:	270	50	300	100	15	12	1 700	18 300	21 000

Table 16. The acoustic estimate of Pel2 species along the coast of Sri Lanka.

Region	**North East**	**Central East**	**Central East / South East**	**South East**	**South East**	**South**	**South West**	**South West/ North West**	**North West**	
Nansis contour area	1	2	3	4	5	6	7	8	9	Total:
Area (nm^2)	234	234	350	164	483	735	1068	566	638	4473
$<s_A>$:	60	33	40	22	14	77	76	89	60	52
Biomass:	5 000	3 000	5 000	1 000	3 000	21 000	30 000	19 000	14 000	101 000

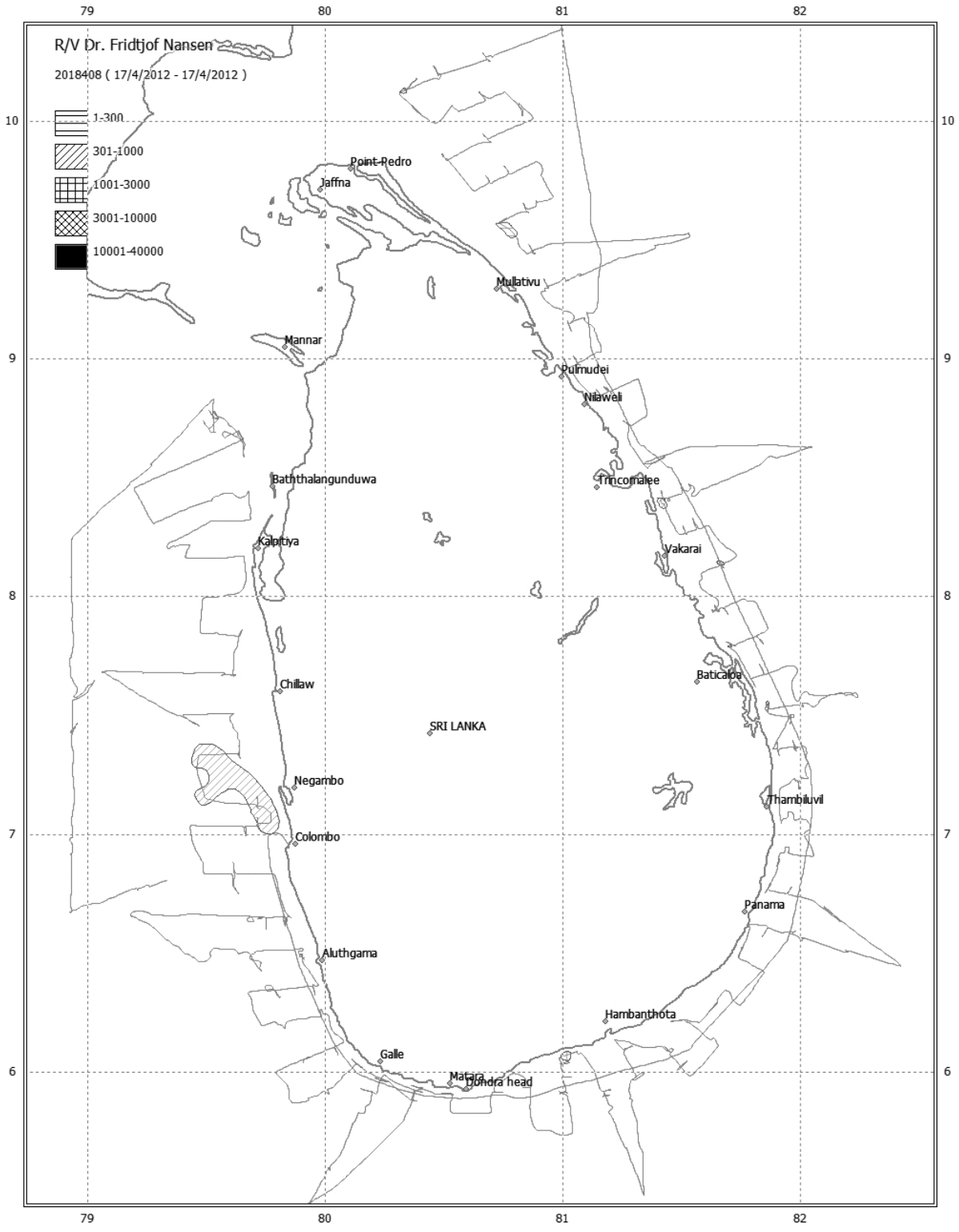


Figure 53. Distribution of acoustic backscattering of Pell species.

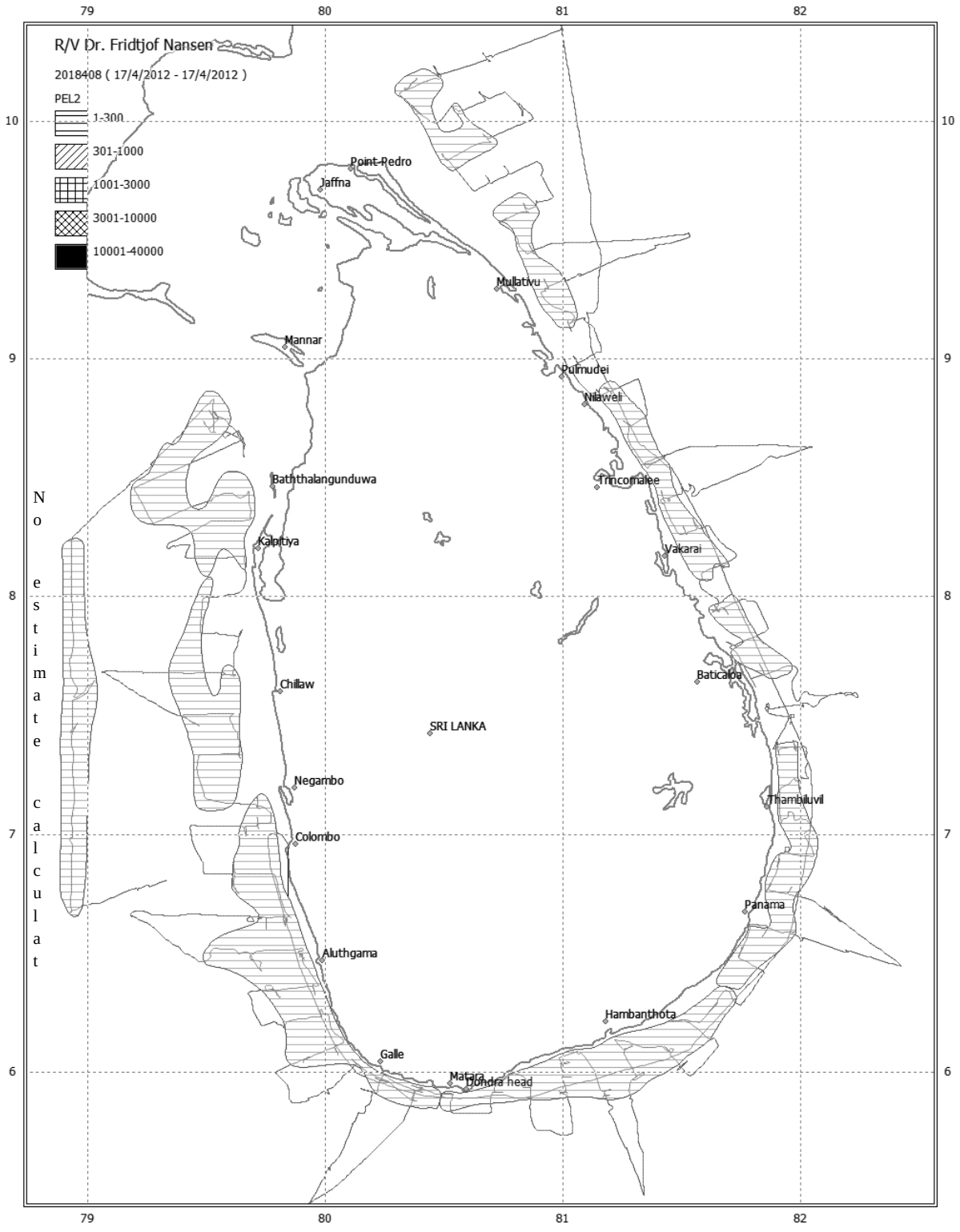


Figure 54. Distribution of acoustic backscattering of Pel2 species.

3.5 Swept area abundance and distribution

The bottom trawl survey covered six regions around Sri Lanka, within these regions the shelf and slope were covered mainly between 20 m to 100 m bottom depth. Catch rates in kg/h are presented per region and depth strata for main taxonomic groups together with the proportional distribution of main taxonomic and functional groups per region, Figures 55 - 65).

Three depth strata were defined prior to the survey; 20 - 50 m depth (inner shelf), 50 - 100 m depth (outer shelf) (combined to one shelf strata for the biomass estimation) and 100 - 500 m depth (slope) and 500-1000 m. Trawling deeper than 100 m turned out to be impossible due to the steepness of the slope. Furthermore, several coral and sponge habitats could not be sampled. The trawl positions are mapped in Figure 1. Station information and catch by species are presented in Annex III.

Analyses of catch rates

Depth ranges of 20-50 m and 50-100 m were used for all regions except for Pedro Bank and North West region where the depth range of 100-500 m was also used. Among the six regions the highest catch rates were recorded for the depth 20-50 m in the South East (1224 kg/h). The lowest catch rate for 20-50 m depths (143 kg/h) was found in the North East. In the depth region between 50-100 m highest catches were found on the south coast (408 kg/h) while lowest catches were found on the southwest coast (181 kg/h). The following paragraphs explain the catch rates of each region in detail.

North East

A total number of 11 valid trawl stations were conducted on the Pedro Bank including five stations at the depths of 20-50 m, five stations at the depth range of 50-100 m and only two stations were conducted at the deep waters of 100-500 m.

Inner shelf (20-50 m)

The average trawling depth and total catch rate in the depth range 20-50 m were 30.3 m and 142.6 kg/h respectively. The most dominant groups of species found in this depth range were rays (20.1 kg/h), Carangidae (15.1 kg/h), Lethrinidae (10.8 kg/h), Lutjanidae (7.9 kg/h), Diodontidae (7.8 kg/h), Acanthuridae (7.6 kg/h), Monacanthidae (6.3 kg/h), Caesionidae (5.9 kg/h) and Nemipteridae (5.1 kg/h). In addition, Tetraodontidae, Haemulidae, Mullidae, Apogonidae, Synodontidae, Balistidae, Ambassidae and Priacanthidae were also found in the trawl catches (4.0-1.0 kg/h). Other fish groups such as Fistulariidae, Sphyraenidae, Bothidae, soles, Sharks, Scorpaenidae, Ostraciidae, Scombridae, Dactylopteridae, Clupeidae, Derichthydae and Trichuridae were recorded occasionally, but in minor amounts (< 1.0 kg/h). Other than the finfish groups, non-finfish groups i.e. cephalopods (5.7 kg/h), coelenterates (jellyfish- 5.7 kg/h), shrimps, Echinodermata and lobsters contributed to the trawl catches. The sessile organisms such as corals and poriferans were rarely observed. Besides all these organisms, reptiles (sea snakes, 1.5 kg/h) were also caught in this depth region.

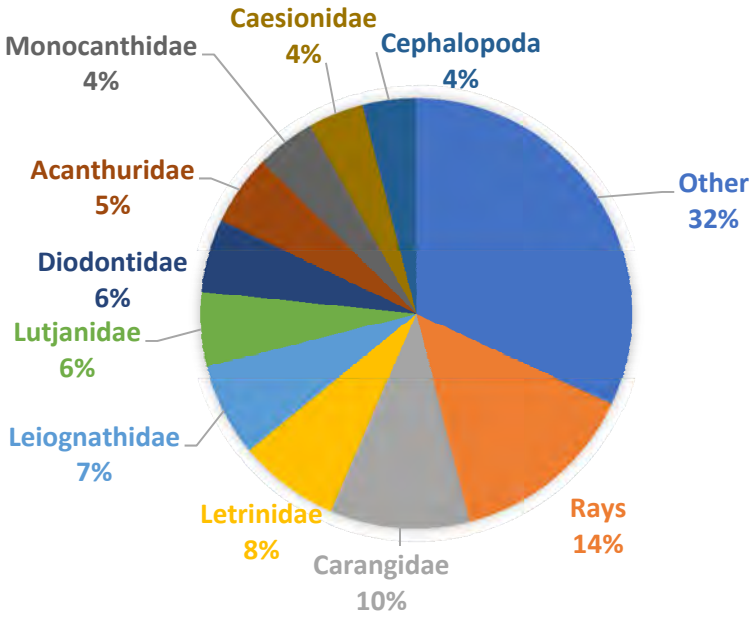


Figure 55. Distribution of catch rates (kg/h) in the North East 20-50 m.

Outer shelf (50 – 100 m)

The average depth of trawling within the 50-100 m range was 74.5 m and the average total catch rate was 312.5 kg/h, a higher value compared to the shallow area. Most of the species groups recorded in this depth range were the same as those in the 20-50 m range but with different densities. Nemipteridae and Carangidae were the most common families in this depth showing catch rates of 109.9 and 53.9 kg/h respectively. In addition, other finfish groups such as Acanthuridae (22.9 kg/h), Lethrinidae (22.4 kg/h), Lutjanidae (22.3 kg/h), Haemulidae (8.0 kg/h), Synodontidae (6.6 kg/h) and Diodontidae (6.4 kg/h) were found commonly. The finfish groups found in smaller quantities were Dactylopteridae, Caesionidae, Leiognathidae, Monacanthidae, Priacanthidae and rays (1.0-2.0 kg/h). Furthermore, Mullidae, Ostraciidae, Tetraodontidae, Trichuridae, Fistulariidae, Bothidae, Cynoglossidae, Ophidiidae and Triglidae (< 1.0 kg/h) were detected occasionally in some stations. Considering the non-finfish groups, Cephalopods (30.0 kg/h) were common while jellyfish (7.6 kg/h) also showed relatively high catch rates. Other groups like Echinodermata and shrimps showed low catch rates. Poriferans and sea snakes were also found irregularly.

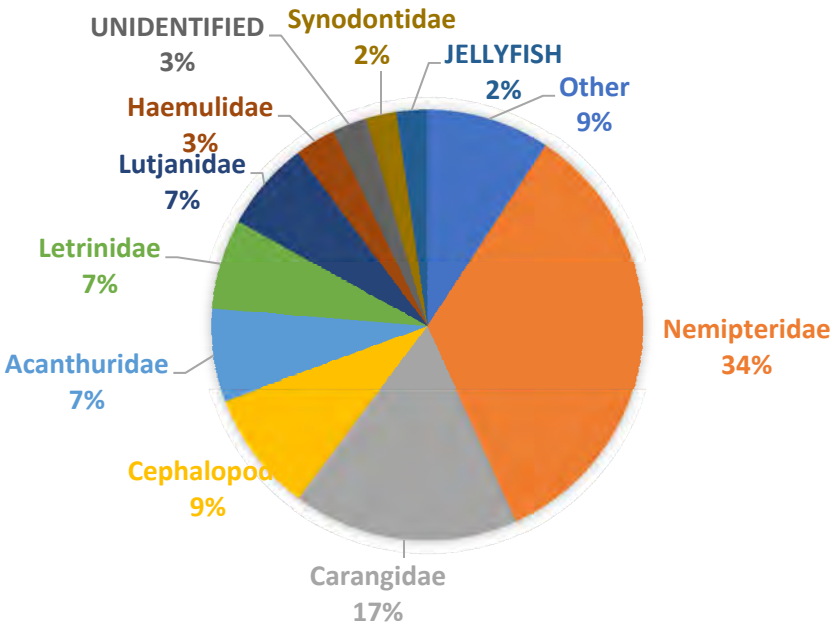


Figure 56. Distribution of catch rates (kg/h) in the North East 50-100 m.

Slope (100 – 200 m)

Only two trawl hauls were carried out in deeper waters (200-500 m) on the Pedro Bank. One of these had a high catch rate while the other catch was low. The average value was 1010.5 kg/h. However, the species composition was generally of uncommercial species. The families recorded in this depth range were somewhat different from other depths, counting Trachichthyidae (738.4 kg/h) as the dominant group.

Central East

Ten valid trawl stations were conducted in the central east region including six stations in the depth range of 20-50 m and another four between 50-100 m depth. In this region, a higher percentage of commercially important species was recorded.

Inner shelf (20 – 50 m)

The average fishing depth and total catch rate between 20-50 m depth were 35.3 m and 524.91 kg/h respectively. In this depth range, relatively good catches of important demersal species groups were found. Among the catches those of Haemulidae (93.8 kg/h) and Leiognathidae (89.2 kg/h) were noteworthy. Moreover, Gerreidae (40.3 kg/h), Carangidae (34.3 kg/h), rays (32.3 kg/h), Caesionidae (23.7 kg/h), Acanthuridae (22.2 kg/h), Mullidae (16.6 kg/h), Lethrinidae (15.0 kg/h) and Nemipteridae (10.2 kg/h) were frequent in the catches. The Monacanthidae, Balistidae, Diodontidae, Fistulariidae, Clupeidae, Serranidae, Ostraciidae, Lutjanidae, Sphyraenidae, Ariidae, Tetraodontidae and Synodontidae had catch rates between 2.0-10.0 kg/h. Additionally, some finfish groups occurred infrequently or had

low catch rates (<2.0 kg/h). These were Scombridae, Scaridae, Ambassidae, Bothidae, Cynoglossidae, Polynemidae and Engraulidae. Apart from the finfish, jellyfish (3.5 kg/h), cephalopods (2.6 kg/h), echinoderms, lobsters and shrimps were also recorded. In this depth range higher amount of poriferans (74.3 kg/h) and a few sea snakes (1.3 kg/h) were also caught.

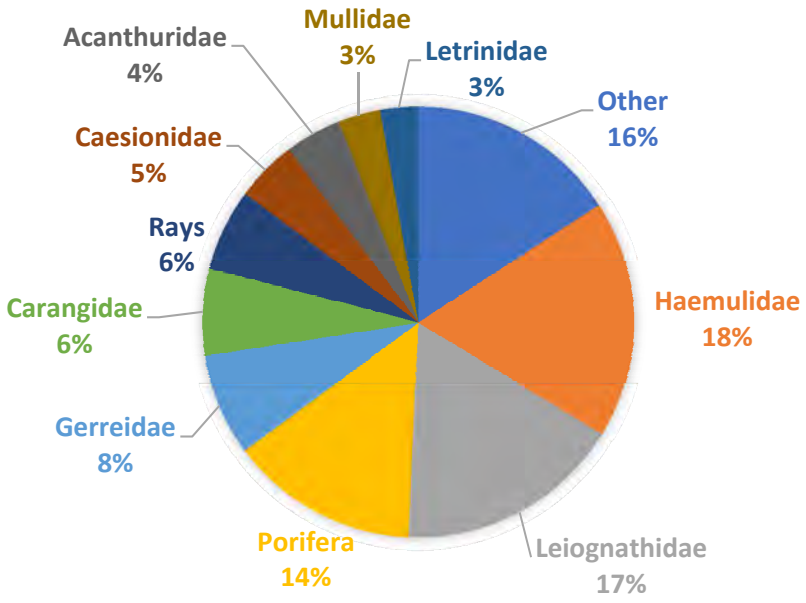


Figure 57. Distribution of catch rates (kg/h) in the Central East 20-50 m.

Outer shelf (50 – 100 m)

In the depth range between 50-100 m in the Central East region, the average total catch rate was lower than in the shallower zone (230.8 kg/h). However, most of the fish found in this depth region were commercially important. Among them, Lutjanidae (96.7 kg/h) and Carangidae (33.1 kg/h) were the dominant families followed by Leiognathidae, Haemulidae, Serranidae, rays, Acanthuridae, Monacanthidae, Caesionidae, Nemipteridae, Diodontidae, Engraulidae, Mullidae, Lethrinidae and Priacanthidae which showed the catch rates between 2.0-10.0 kg/h. Fish groups such as Ariidae, Ostraciidae, Scombridae, Fistulariidae, Tetraodontidae, Synodontidae and Trichuridae were also found occasionally in minor amounts (0.5-2.0 kg/h).

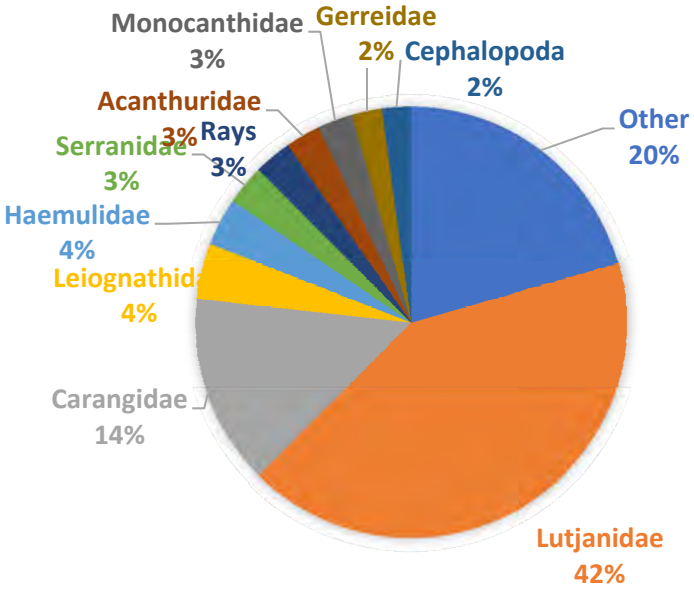


Figure 58. Distribution of catch rates (kg/h) in the Central East 50-100 m.

South East

A total number of 18 valid trawl stations were conducted along the shelf off Batticaloa. Each depth zone (0-50 and 50-100 m) had nine trawl stations.

Inner shelf (20 – 50 m)

The average total catch rate between 20-50 m depth was 1224.5 kg/h. Even though this was recorded as the highest catch rate experienced along the east coast, it was caused by a huge catch of jellyfish in trawl Station 40. Consequently, jellyfish was recorded as the most dominant species group in this depth having an average catch rate of 825.8 kg/h. Other than the jellyfish, poriferans also showed a high catch rate (74.9 kg/h). The most abundant finfish families were Leiognathidae (44.3 kg/h), Diodontidae (32.0 kg/h),rays (29.0 kg/h), Acanthuridae (28.8 kg/h), Carangidae (24.7 kg/h), Lethrinidae(18.6 kg/h) and Ostraciidae (10.0 kg/h) followed by other families which showed lower catch rates, 3.0-10.0 kg/h, Lutjanidae, Haemulidae, Scaridae, Mullidae, Tetraodontidae, Monacanthidae, Balistidae, Sphyraenidae and Nemipteridae. Other families that showed low abundance (1.0- 3.0 kg/h) were Synodontidae, Ariidae, Serranidae, Sciaenidae, Scombridae, Gerreidae and Engraulidae. Furthermore, Fistulariidae, Caesionidae, Ambassidae, Clupeidae, Sillaginidae, Bothidae, soles, Trichuridae and Polynemidae were found sporadically with very low catch rates (<1.0 kg/h). Additionally, the contribution of cephalopods to the total catch was 4.9 kg/h while shrimps and lobsters were found in small amounts (<1.0 kg/h). Sea snakes were listed in almost every station showing a catch rate of 1.7 kg/h.

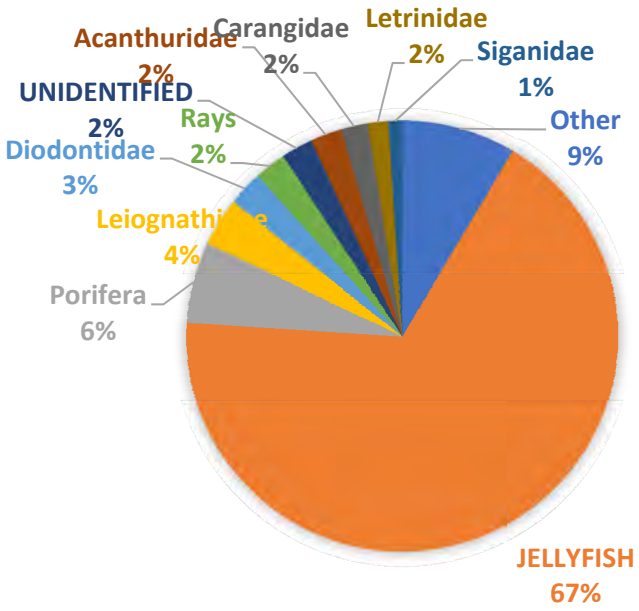


Figure 59. Distribution of catch rates (kg/h) in the South East 20-50 m.

Outer shelf (50 – 100 m)

The average total catch rate for depth range 50-100 m was 859.8 kg/h. However, this value was inflated by an extraordinary catch of dead coral rubbles (527.7 kg/h). Excluding this, the total catch in this depth region was 332 kg/h. The most dominant family was Acanthuridae (82.0 kg/h) followed by important commercial families such as Lutjanidae (42.0 kg/h), Lethrinidae (35.8 kg/h), Carangidae (24.6 kg/h), Serranidae (24.3 kg/h), Scaridae (17.6 kg/h), Haemulidae (14.2 kg/h) Caesionidae (9.2 kg/h) and Nemipteridae (4.0 kg/h). Further, Balistidae, Monacanthidae, Gerreidae, Ostraciidae, Sphyraenidae, Priacanthidae, Synodontidae, Diodontidae, Mullidae and Ambassidae were relatively common but in low abundance (1.0-4.0 kg/h). Other than the above, some families (Dactylopteridae, Fistulariidae, rays, Clupeidae, Apogonidae, Leiognathidae, Scombridae, Scorpaenidae, Tetraodontidae, Muraenesocidae, Myctophidae) were detected infrequently and in small abundance (<1.0 kg/h). Among the non-fish groups, the catch rates of Cephalopoda (18.6 kg/h) and Poriferans (17.6 kg/h) were quite considerable. Besides that, the catch rates of jellyfishes and sea snakes were 3.4 kg/h and 1.2 kg/h respectively.

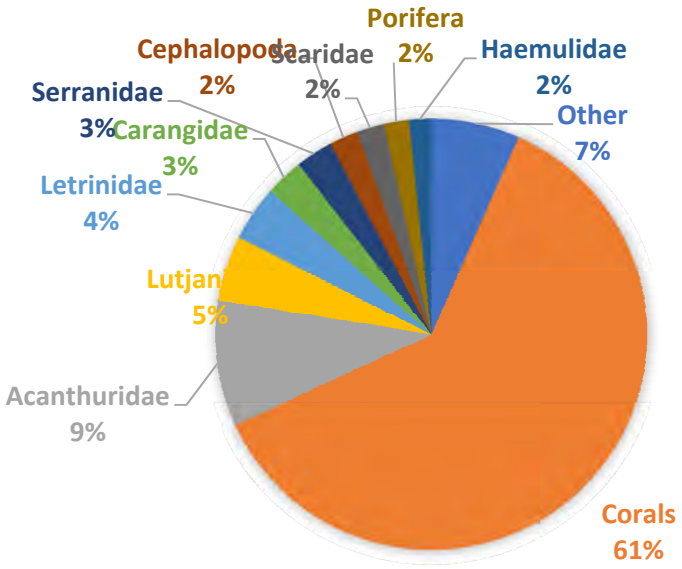


Figure 60. Distribution of catch rates (kg/h) in the South East 50-100 m.

South

A total number of 12 valid trawl stations were conducted along the Hambantota bank, including four stations in the 20-50 m depth interval, seven in the 50-100 m depth zone, and one deeper than 100 m.

Inner shelf (20 – 50 m)

The average trawling depth and total catch rate at the depth of 20-50 m were 37.7 m and 438.5 kg/h respectively. The region showed a high diversity with a high number of species and families occurring in the catches. Synodontidae were the most dominant (76.3 kg/h) finfish group in this depth range while rays (63.7 kg/h), Acanthuridae (37.0 kg/h), Lethrinidae (35.7 kg/h), Ambassidae (35.2 kg/h), Balistidae (25.1 kg/h), Lutjanidae (22.0 kg/h), Carangidae (20.0 kg/h) and Diodontidae (11.6 kg/h) were highly abundant. Furthermore, families such as Nemipteridae (8.5 kg/h), Caesionidae (7.2 kg/h), Sillaginidae (5.2 kg/h), Serranidae (5.1 kg/h), were also common in the trawl catches. Also, sharks, Bothidae, Soleidae, Ostraciidae, Fistulariidae, Priacanthidae and Mullidae were caught commonly but in smaller quantities (1.0-5.0 kg/h). The abundance of cephalopods and jellyfish were also quite high accounting for catch rates of 63.7 kg/h and 14.9 (kg/h) respectively. Apart from all the groups mentioned above, another 15 groups occurred in the region but in low abundance (< 1.0 kg/h).

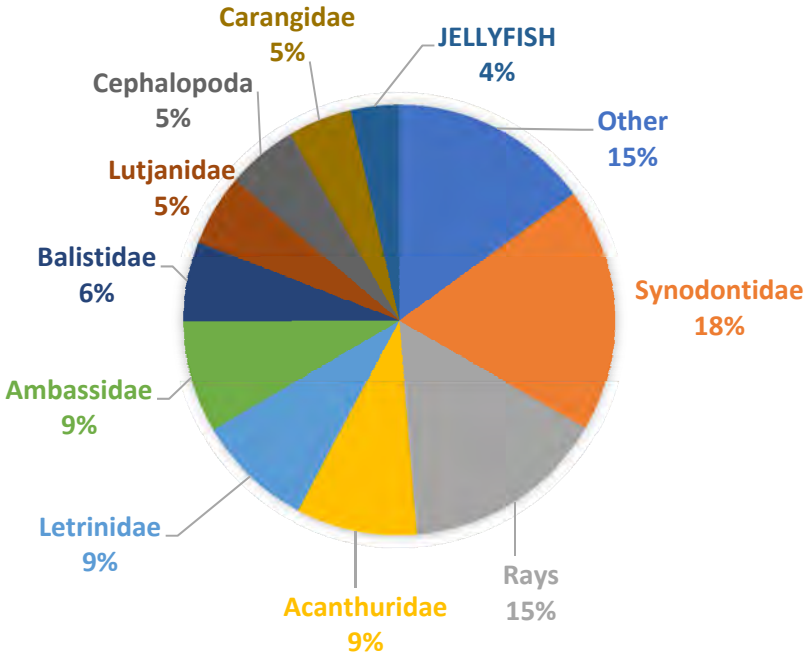


Figure 61. Distribution of catch rates (kg/h) in the South 20-50 m.

Outer shelf (50 – 100 m)

The average total catch rate for the depth range between 50-100 m was 408.4 kg/h. Fish families, Lutjanidae (52.0 kg/h), Ambassidae (47.7 kg/h) and Synodontidae (46.7 kg/h) were the most abundant followed by Serranidae (22.3 kg/h), Balistidae (18.5 kg/h), Haemulidae (15.5 kg/h), Acanthuridae (14.4 kg/h) and Lethrinidae (12.5 kg/h). In addition, the contribution of Carangidae, rays, Caesionidae, Sphyraenidae, Nemipteridae, Monacanthidae, Leiognathidae, Bothidae, Soleidae, Tetraodontidae, Diodontidae and Priacanthidae were found with catch rates between 1.0 - 10.0 kg/h. The catch rates of cephalopods and Porifera were 37.7 kg/h and 26.7 kg/h respectively. Shrimps (2.4 kg/h) and lobsters (1.5 kg/h) were also recorded in some stations. Like in the 20-50 m depth range, many families were present in trawl catches with average catch rates below 1.0 kg/h.

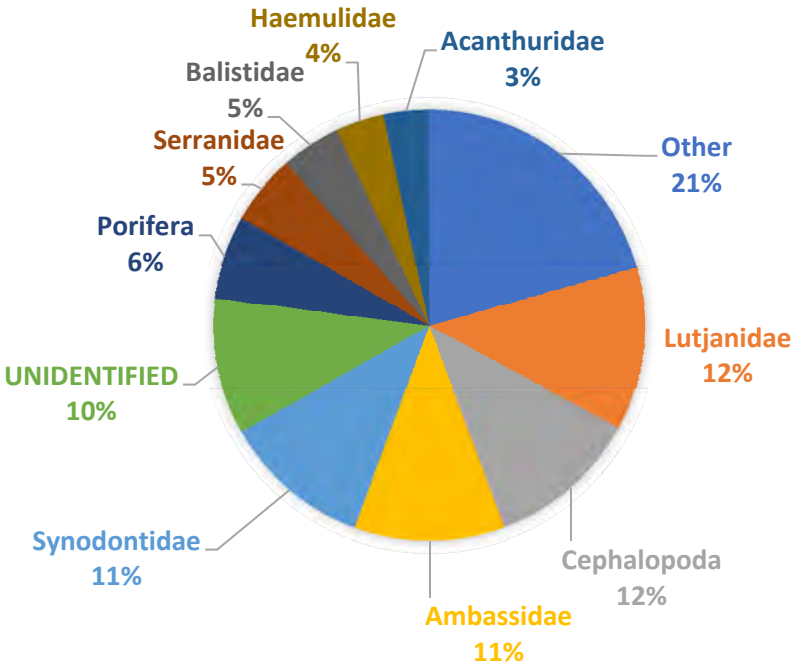


Figure 62. Distribution of catch rates (kg/h) in the South 50-100 m.

>100 m depth

Only one trawl station was found in this depth region, the bottom depth was 274 m and the total catch was 1249 kg/h. Sharks were the most dominant species group in this haul, with catch of 410 kg/h. Several unidentified species will be identified after the survey.

South West

Thirteen valid trawl stations were operated in the south west coast. Among them four stations were operated in the 20-50 m depth range while nine trawl stations were conducted in the depth range of 50-100 m.

Inner shelf (20 – 50 m)

The average depth of gear operation was 39.8 m for the 20-50 m depth region. The total catch rate was 412.7 kg/h. Jellyfish was the most dominant (455.2 kg/h) followed by Scombridae (38.2 kg/h), Carangidae (33.7 kg/h) and Scaridae (26.5 kg/h). The higher catch rates for jellyfish, Scombridae and Scaridae were occurred due to a high catch in one trawl station (Station 78). Rays (26.4 kg/h), Acanthuridae (25.7 kg/h), Sphyraenidae (24.5 kg/h), Leiognathid (13.7 kg/h), Balistidae (12.8 kg/h) and Diodontidae (11.3 kg/h) were also common. Further, Lethrinidae (8.6 kg/h), Serranidae (7.5 kg/h), Gerridae (7.1 kg/h), Tetraodontidae (5.8 kg/h), Haemulidae (5.5 kg/h), Nemipteridae (4.5 kg/h), Ostraciidae (4.4 kg/h), Clupeidae (4.0 kg/h) and Engraulidae (3.1 kg/h) were also present. Next, fish belonging to the families Ambassidae, Lutjanidae, Fistulariidae and Sciaenidae were recorded

with an abundance of 1.0-3.0 kg/h. Furthermore, another 10 fish families were recorded showing catch rates of <1.0 kg/h. In this depth range a considerable number of Cephalopods (18.5 kg/h) and Poriferans (11.1) were also reported.

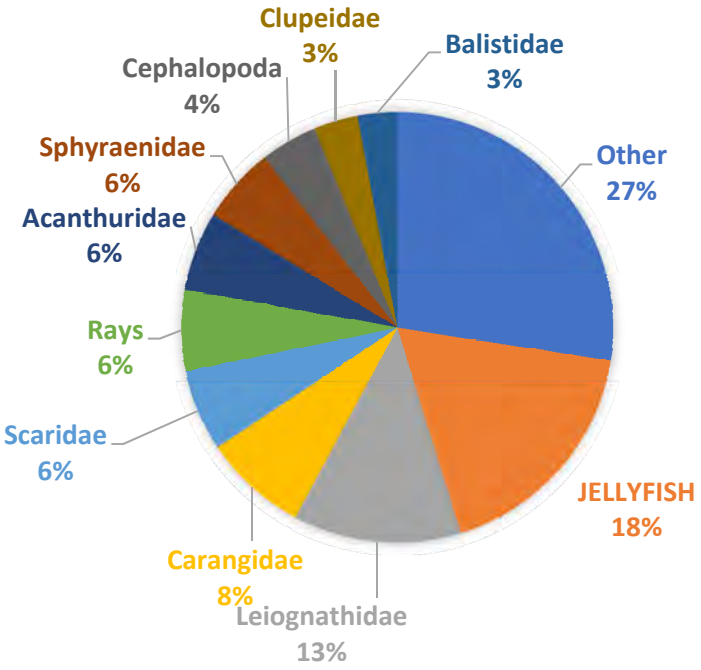


Figure 63. Distribution of catch rates (kg/h) in the South West 20-50 m.

Outer shelf (50 – 100 m)

The average trawling depth and total catch rate were 59.8 m and 180.7 kg/h respectively. Cephalopods (31.5 kg/h) were the most abundant species group in this depth zone. Among the fish, Gerridae (29.5), Lutjanidae (13.9), Balistidae (13.2 kg/h), Carangidae (12.0 kg/h), Serranidae (9.9 kg/h), Nemipteridae (9.0 kg/h) were also abundant. Fish families such as Acanthuridae, Fistulariidae, Mullidae, Priacanthidae, Bothidae, Soleidae, Sphyraenidae and Tetraodontidae contributed to the catch by 1.0-8.0 kg/h. In addition to these 15 fish families were present but with low abundance (0-1.0 kg/h). Poriferans (2.9 kg/h) and jellyfish (1.8 kg/h) were also found in the catches. Relatively high densities of land-based waste recorded in this region (3.6 kg/h).

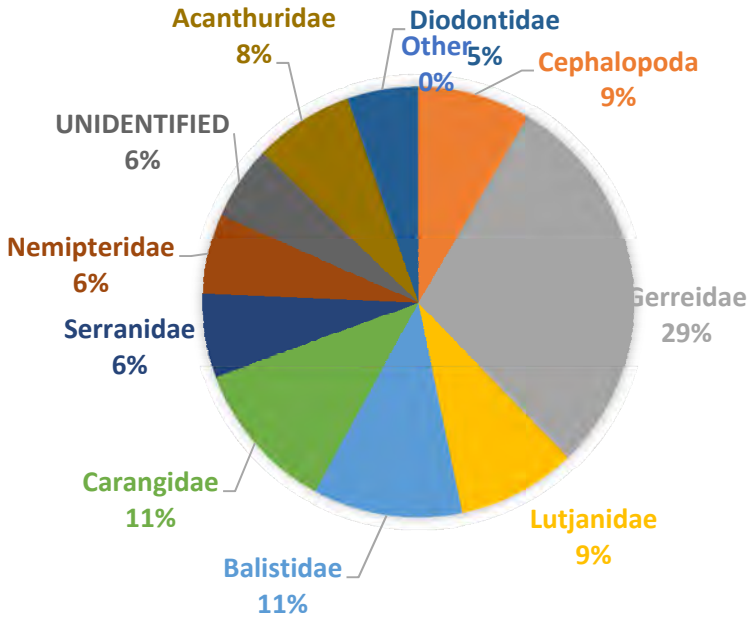


Figure 64. Distribution of catch rates (kg/h) in the South West 50-100 m.

North West

The number of total valid trawl hauls were limited to five in this area due to the very narrow continental shelf and roughed and steep bottom unfavorable for trawling. Therefore, trawl operations were carried out as follows; two in the depth range of 20-50 m, one operation in the 50-100 m depth zone and two in the deep waters (200-500 m).

Inner shelf (20 – 50 m)

The average depth of trawling and the total catch rate were 30.3 m and 374.7 kg/h respectively. However, Poriferans (sponges) contributed with a maximum catch rate of 153.9 kg/h. Among the finfish, Balistidae showed the highest abundance (42.7 kg/h) followed by Lethrinidae (24.7 kg/h), Acanthuridae (18.6 kg/h), Lutjanidae (17.9 kg/h), Diodontidae (12.7 kg/h), Ostraciidae (10.4 kg/h), Serranidae (8.1 kg/h), Gerreidae (7.3 kg/h) and Tetraodontidae (7.3 kg/h). Likewise, Mullidae (5.8 kg/h), rays (5.0 kg/h), Fistulariidae (4.8 kg/h), Caesionidae (4.3 kg/h), Monacanthidae (3.2 kg/h), Ambassidae (3.0 kg/h), Carangidae (2.3 kg/h), Nemipteridae (1.6 kg/h), and Scorpaenidae (0.5 kg/h) were also relatively common in the trawl catches. Importantly, cephalopods showed a high catch rate of 21.0 kg/h. In addition, Echinodermata, Jellyfish and Brachyurans were found with lower densities (<1.0 kg/h).

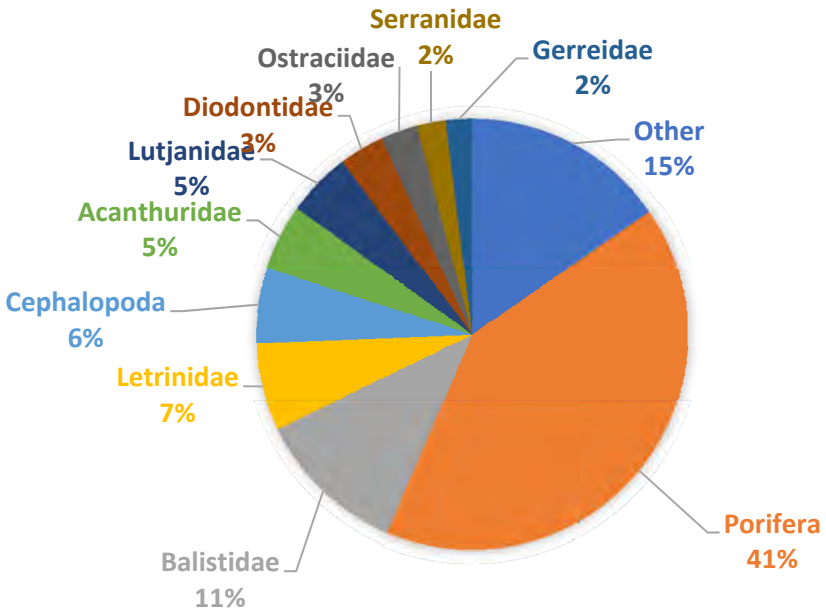


Figure 65. Distribution of catch rates (kg/h) in the North West 20-50 m.

Outer shelf (50 – 100 m)

The gear depth and total catch (1 haul) in this area were 70.5 m and 246.1 kg/h respectively. Cephalopoda was the dominant group (69.0 kg/h) in this depth zone. Considering finfish, Monacanthidae (34.5 kg/h), Serranidae (29.3 kg/h), Acanthuridae (10.6 kg/h), Lethrinidae (6.2 kg/h) and Balistidae (5.8 kg/h) were the most abundant.

>100 m

The average depth of trawling was 339.0 m. The average total catch rate was 528.3 kg/h. Sharks (48.8 kg/h) and shrimps (43.8 kg/h) dominated in the catches followed by Congridae (33.56 kg/h), Gempylidae (32.1 kg/h), Myctophidae (18.3 kg/h), Ophidiidae (13.5 kg/h), Rays (12.9 kg/h), Priacanthidae (11.5 kg/h), Peristediidae (9.9 kg/h) and Chlorophthalmidae (5.3 kg/h). In addition to these families, Macrouridae, Triglidae, Trachichthyidae and Trichuridae (< 4.0 kg/h) were common. Deep water invertebrate groups such as Cephalopods, Jellyfish, Lobsters, Brachyurans and Poriferans were also found with lower densities.

Table 17. The average catch in tonnes/nm^2 of main groups found per region/depth strata and the estimated swept area biomass of these groups. The column "Total fish" describes the total fish biomass caught per region. The main taxonomic families and other important groups are listed.

Survey: Sri Lanka	Depth	N stations	Area		Gear depth	Total Fish	Total	Other	WASTE	Corals	Porifera	UNIDENTIFIED	JELLYFISH
North West Coast	20 - 100	3	152.9	tonnes /nm2	43.7		9.4	0.4	0.0	0.0	3.0	0.4	0.0
				Mean biomass		967	1438.2	56.7	0.7	7.0	464.8	63.1	0.1
North West Coast	>100	2	261.1	tonnes /nm2	339.0		16.6	1.2	0.0		0.0	7.8	0.1
				Mean biomass		4326	4344.7	304.4	2.9	0.0	4.0	2039.1	17.1
South West coast	20 - 100	13	1047.2	tonnes /nm2	52.1		8.7	0.3	0.1	0.0	0.2	0.2	1.0
				Mean biomass		7894	9061.0	348.2	93.3	39.2	179.2	242.4	1042.3
Hambantota banks	20 - 100	10	652.9	tonnes /nm2	56.1		11.4	0.3	0.0	0.1	0.6	1.0	0.2
				Mean biomass		6901	7469.8	190.4	0.5	69.7	372.8	645.8	127.1
East coast, shelf off Batticaloa	20 - 100	18	795.1	tonnes /nm2	45.7		37.9	0.6	0.0	8.4	1.3	0.6	17.9
				Mean biomass		8173	30120.6	478.7	15.6	6705.9	1059.9	472.7	14197.8
North East coast	20 - 100	10	345.0	tonnes /nm2	46.5		13.0	0.1	0.0	0.0	1.4	0.1	0.1
				Mean biomass		4003	4498.6	32.3	13.1	0.7	481.0	34.8	27.3
Pedro Bank	20 - 100	9	676.6	tonnes /nm2	49.9		6.9	0.2	0.0	0.0	0.0	0.2	0.2
				Mean biomass		4485	4642.3	117.1	0.8	3.9	7.6	120.8	146.3
Pedro Bank	>100	2	441.6	tonnes /nm2	345.5		36.7	1.2				5.1	
				Mean biomass		16210	16210.4	537.5	0.0	0.0	0.0	2264.2	0.0
		67	**Total**	Mean biomass		**52959**	**77785.5**	**2065.2**	**126.9**	**6826.3**	**2569.3**	**5883.0**	**15558.0**

Trachichthyidae	Acanthuridae	Lutjanidae	Carangidae	Cephalopoda	Rays	Letrinidae	Leiognathidae	Nemipteridae	Sharks	Haemulidae	Shrimps	Serranidae	Gerreidae	Balistidae	Diodontidae
	0.5	0.3	0.0	1.1	0.1	0.5		0.0				0.5	0.2	0.8	**0.2**
0.0	69.0	49.7	6.4	171.3	13.6	78.3	0.0	7.0	0.0	0.0	0.0	71.0	23.0	127.2	**34.9**
0.0				0.1	0.4				1.5		1.3				
12.6	0.0	0.0	0.0	18.1	108.3	0.0	0.0	0.0	392.0	0.0	347.3	0.0	0.0	0.0	**0.0**
	0.5	0.3	0.7	0.8	0.5	0.2	0.2	0.2	0.0	0.1	0.0	0.3	0.6	0.4	**0.2**
0.0	492.0	325.3	712.1	860.6	474.7	198.8	186.4	253.7	10.1	76.8	2.5	323.5	634.1	421.2	**231.4**
	0.7	1.3	0.4	1.0	0.8	0.6	0.1	0.2	0.0	0.3	0.1	0.5	0.0	0.5	**0.1**
0.0	438.5	873.2	251.0	657.6	523.9	418.8	32.6	99.3	17.5	216.2	34.3	328.9	7.2	296.9	**95.3**
	1.7	0.8	0.9	0.4	0.4	0.9	0.8	0.1	0.0	0.4	0.0	0.4	0.1	0.1	**0.5**
0.0	1347.9	667.7	682.7	300.7	348.1	732.1	615.9	87.8	4.2	288.6	2.1	319.4	62.3	103.1	**428.3**
	0.5	1.5	1.1	0.1	0.7	0.3	1.9	0.3		1.9	0.0	0.2	0.8	0.1	**0.2**
0.0	172.0	507.9	375.2	39.2	238.7	106.0	645.6	88.9	0.0	643.2	3.2	59.3	290.4	42.9	**58.2**
	0.5	0.4	1.0	0.5	0.4	0.5	0.2	1.6	0.0	0.2	0.0		0.0	0.0	**0.2**
0.0	324.9	296.7	665.3	360.7	241.9	342.3	127.3	1061.3	3.4	120.2	24.7	0.0	0.1	16.4	**158.7**
27.0			0.0		0.1				0.3		0.1				
11935.0	0.0	0.0	2.3	0.0	25.7	0.0	0.0	0.0	113.0	0.0	52.3	0.0	0.0	0.0	**0.0**
11947.7	**2844.3**	**2720.5**	**2695.0**	**2408.2**	**1975.0**	**1876.2**	**1607.9**	**1598.0**	**540.2**	**1345.0**	**466.4**	**1102.1**	**1017.0**	**1007.7**	**1006.8**

Table 17 continued

Chlorophthalmidae	Synodontidae	Congridae	Gempylidae	Ambassidae	Scaridae	Scombridae	Sphyraenidae	Caesionidae	Myctophidae	Priacanthidae	Monacanthidae	Mullidae
				0.1			0.0	0.1		0.0	0.4	0.1
0.0	0.0	0.0	0.0	7.9	0.0	0.0	5.2	15.6	0.0	3.5	66.6	17.0
0.2		1.1	1.0						0.6	0.4		
44.2	0.0	274.8	265.6	0.0	0.0	0.0	0.0	0.0	151.5	96.6	0.0	0.0
	0.1			0.0	0.3	0.5	0.3	0.0		0.1	0.0	0.1
0.0	90.9	0.0	0.0	32.4	345.0	497.3	337.8	12.1	0.0	52.7	18.6	52.9
	1.0			1.0		0.0	0.1	0.1	0.0	0.0	0.1	0.0
0.0	662.5	0.0	0.0	670.2	0.0	7.5	87.0	89.1	1.5	27.4	52.6	9.5
	0.1			0.0	0.4	0.0	0.1	0.2	0.0	0.0	0.1	0.1
0.0	52.6	0.0	0.0	17.3	307.8	25.8	66.3	120.2	0.2	19.2	106.3	106.5
	0.0			0.0	0.0	0.0	0.1	0.4		0.0	0.2	0.4
0.0	17.2	0.0	0.0	2.6	2.8	14.9	37.1	152.1	0.0	9.8	75.7	125.4
0.0	0.1			0.0		0.0	0.0	0.1		0.0	0.1	0.0
11.0	83.8	0.0	0.0	15.2	0.0	1.8	7.6	86.9	0.0	20.2	86.7	32.9
1.8			0.0									
813.6	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
868.9	**907.0**	**274.8**	**267.2**	**745.6**	**655.7**	**547.3**	**541.0**	**476.0**	**153.3**	**229.4**	**406.6**	**344.2**

Biomass index

For the calculation of the biomass index, a calculation of the areas of the different depth strata and regions covered by the survey was made (Table 17).

The biomass estimates of the various demersal groups of fish and invertebrates can be found in Table 17 while a summary can be found in Figure 66. The individual species groups are not covered further in the text as a description of the most common groups (in kg/h) has been presented above. Pelagic species groups are not reported as these are considered not to be sampled representatively in the bottom trawl catches.

The total swept area biomass (t) estimated from the survey was 53 000 tonnes excluding jellyfish, garbage, coral debris and sponges that were also caught in the trawl. Looking at the biomass on the shelf (20-100 m depth) in the different regions, the North West coast gave the lowest biomass estimate of all 6 regions of Sri Lanka with an estimate of 967 tonnes. The highest biomass was observed in the coastal zone on the shelf off Batticaloa in the South Eastern region with an estimate of 8173 tonnes, the South West coast had the second highest biomass estimate on the shelf with biomass of 7894 tonnes. On the South coast, the Hambantota banks, the biomass was 6901 tonnes. On the Central East coast, 4003 tonnes were recorded while in the far North East on the Pedro Bank biomass of 4485 tonnes was estimated. In deeper waters, at depths greater than 100 m, trawling was very challenging due to the steepness of the slope. Only two regions where trawlable, the North West Coast and the Pedro Bank, and also in these regions only a few trawls were carried out. The biomass (although very uncertain estimates due to the low number of trawl stations) were 4326 tonnes and 16210 tonnes. However, the slope regions were characterised with low oxygen (hypoxic) water and the catch consisted mainly of non-commercial species.

Jellyfish (excluded from Figure 66) was relatively abundant in some areas, especially on the East coast, on the shelf off Batticaloa. These species are found throughout the water column and are caught by the trawl on the way down and up from the bottom (in addition to what is caught on the bottom). The total estimate of jellyfish was 15 600 tonnes, of this the majority (14 200 tonnes) was found on the shelf off Batticaloa.

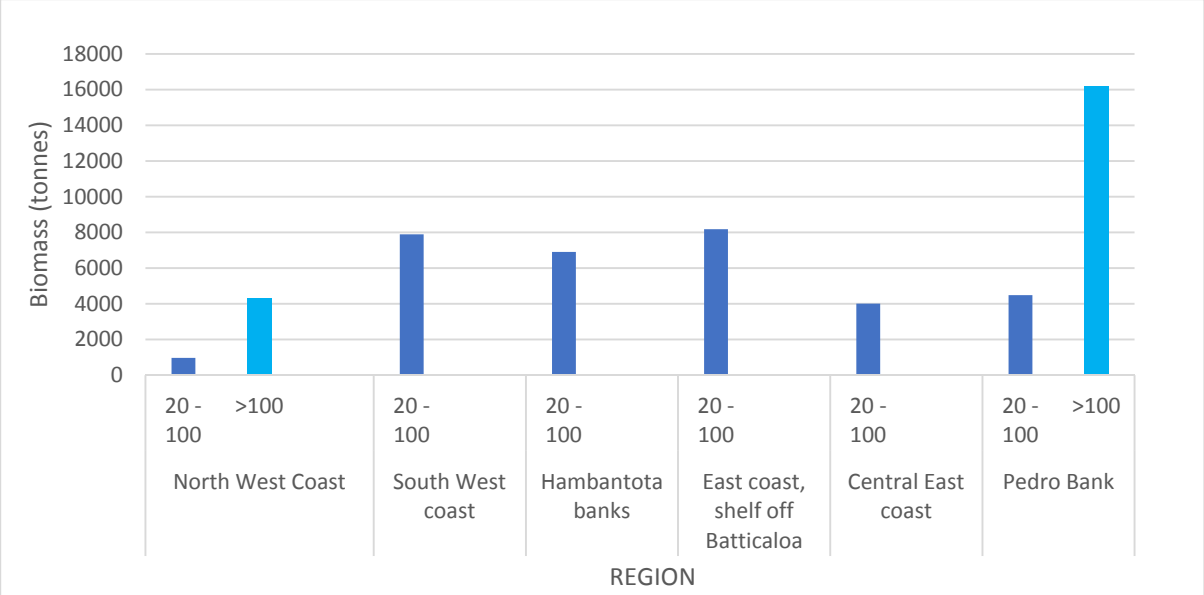


Figure 66. Swept area biomass estimates by the main regions. Note that all jellyfish, garbage, coral debris and sponges caught with the bottom trawl are not included in the estimates (see text).

3.6 Taxonomy

During the survey fish and invertebrate species, identification was made to the lowest taxonomic level possible by experienced taxonomists as described in the method section. The area investigated is poorly described in terms of taxonomy and a number of species were not possible to identify to species level. All material was identified to the lowest possible taxon. Several samples from the trawl catches have been sent to SAIAB, South Africa and will be distributed to international taxonomists for identifications. Preliminary results indicate that the survey has identified between 2 and 5 new fish species for science.

High-resolution pictures were taken of uncommon species of both fish and some invertebrates for the photo database onboard *Dr Fridtjof Nansen* and for help in identification by specialists. A total of 593 different species were recorded during the survey (preliminary data, including material identified only to a higher taxonomic level). A number of these have yet to be identified. The largest taxonomic group was the bony fish with >400 different species recorded belonging to >100 different families, followed by, 21 different rays and13 different shark species. Table 18 describes the number of taxonomic families recorded in bottom trawling and Figure 67 explains the number of species recorded in each region according to depth strata.

The results from these will be published separately after the survey. It is too early to conclude regarding the number of new records observed for Sri Lanka. However, it is the reason to believe that several species found during the survey are new to science while others have been registered around Sri Lanka for the first time.

Table 18: Number of taxonomic families recorded in bottom trawls in the different regions. NW- Northwest, SW- Southwest, S- South, SE – Southeast, CE – Central East and NE Northeast.

Survey	NW	SW	S	SE	CE	NE
2018408	41	74	67	76	63	66

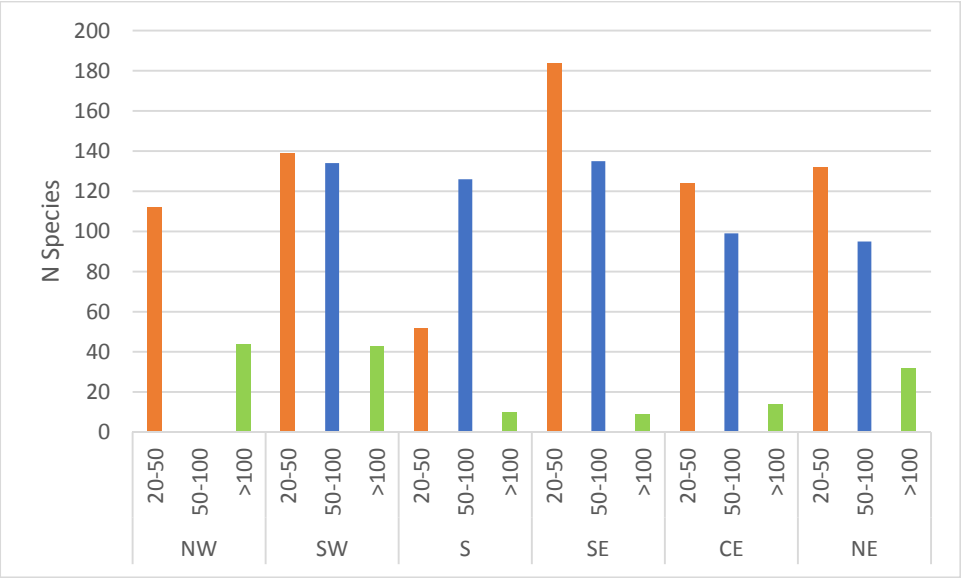


Figure 67. Number of species recorded during the 2018 survey in the different regions. NW-Northwest, SW- Southwest, S-South, SW-Southeast, CE-Central East and NE-Northeast.

The South East region has shown the highest diversity as compared to the other regions, confirming earlier records.

3.7 Genetics

Fin clips of 30 individuals of each fish species (listed in the priority list for genetic analysis, Annex IV) in each region were preserved individually with 95% Ethanol in Eppendorf vials for genetic analysis. In addition, samples were taken from species to confirm the identity at species level. All genetic samples will be analysed in the laboratory at NARA and the results will be presented separately from this report.

3.8 Plastic waste from trawl catches

A high percentage of the trawl catches in Sri Lanka contained various forms of waste during the survey (Figure 68). Two sources of waste were frequent, plastic waste and fishing gear (especially different types of line gear).

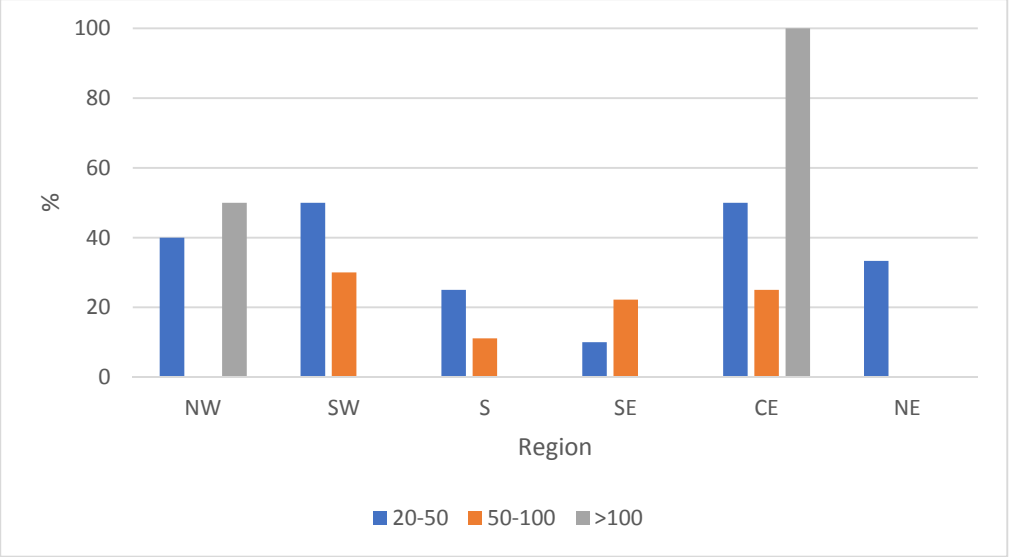


Figure 68. Percentage stations with waste recorded per region and depth stratum. NW-North West, SW- South West, S-South, SE-South East, CE-Central East and NE-North East.

There was a tendency of higher proportions of waste in the depth region 20-50 m, and in the central east and south western regions. In both these regions abandoned fishing gears were frequent in the catches.

CHAPTER 4. SUMMARY OF SURVEY RESULTS

The ecosystem survey was successfully carried out and provided a wealth of new data on the marine shelf and slope ecosystem off Sri Lanka. Data collected during the survey included physical and chemical oceanography, plastic pollution, plankton distribution and abundance, pelagic and demersal fish biomass, distribution and diversity, and distribution of marine mammals around Sri Lanka. Standard acoustic and swept area fish stock assessment methods were used to estimate the distribution, abundance and biomass of the pelagic and demersal fish stocks in the region. Some of the analyses will require additional work and will be reported separately from this report. Research activities are also planned as part of the EAF-Nansen Science Plan and the data and samples collected in Sri Lanka will be analysed and published in that context.

4.1 Oceanography, plankton and microplastics

Oceanography

Waters off the east coast of Sri Lanka are characterised by a 50-100 m thick surface layer with high temperature and low salinity. This low-density layer prevents vertical mixing. Off the southern coast there is active upwelling over the slope. Off the southwest coast there is also indications of some upwelling, and in addition lower stratification and strong winds allow wind mixing bringing up waters from below the pycnocline. Below the pycnocline, warm saline water with low oxygen concentrations is observed in the whole survey area, with higher salinity observed immediately below the upper low-density layer to the east of Sri Lanka, this layer is not present off the west coast.

The circulation around Sri Lanka is quite complex. Our observations from the survey are typical for the season. On the east coast, a northward directed flow is observed in the far northern part of the survey area while from 9°30’N the surface current is directed southwards following the shelf and bending westwards along the southern coast of Sri Lanka. Further offshore in the southern region, an oppositely directed current can be observed bringing AO water into the BOB. On the southwestern shelf, the flow is toward the south, turning offshore and westward with the water masses coming from the east. In the northwestern part of the coast, the direction of the current was again northward directed pushing water masses into the Gulf of Mannar and the Palk Strait. Figure 69 shows a schematic overview of the surface currents as observed during the survey.

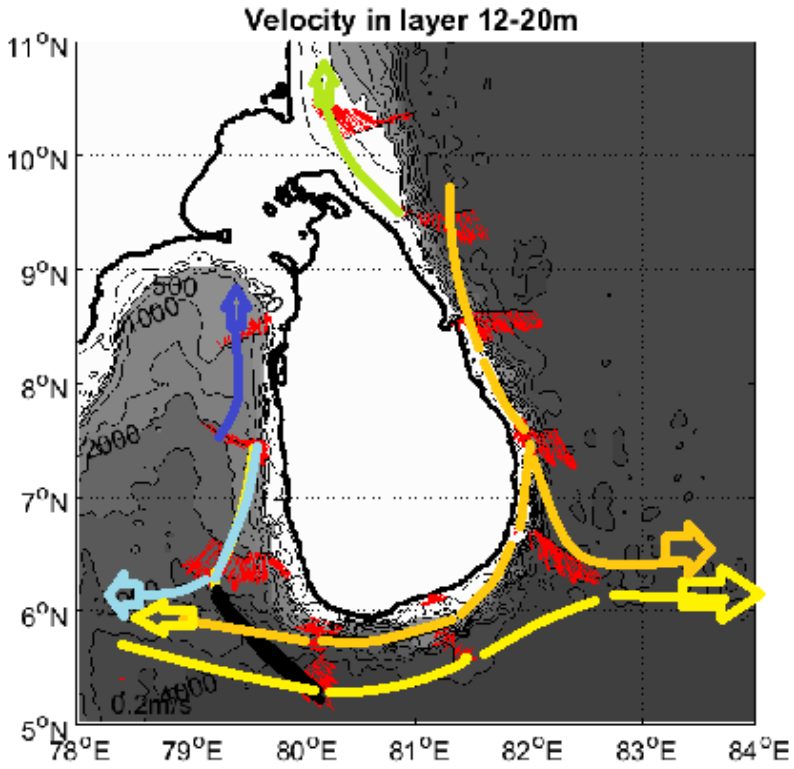


Figure 69. Schematic description of the near-surface currents as observed during the survey.

Plankton

Integrated data overall depths showed the lowest zooplankton biomass was recorded in the North East coast while the highest biomass was observed in the South Coast of Sri Lanka. The zooplankton species diversity was highest in the South West and North West regions. With regard to ichthyoplankton distribution, an important indicator of fish nursery areas. The highest average number of fish larvae was observed in the South East region while the lowest average number of fish larvae was recorded in the North East coast.

Microplastic

The results reveal that the waters around Sri Lanka are contaminated with microplastics, and the vast majority of microplastics found are in the secondary category, indicating that the packaging material, industrial applications and fishing gear are major sources. The survey covered one season of the year, and the results as such are a snapshot. Microplastic particles were found throughout the survey area on all sampling stations. The highest concentrations were found in the North Western region off Sri Lanka. This region was highly polluted with microplastics, compared to other regions, while the northeast coast and the south coast showed the lowest number of microplastic particles in the samples.

4.2 Biomass estimates

Pelagic estimates

Acoustic biomass estimates were calculated for Clupeidae, Dussumieriidae and Engraulididae (PEL1), while the PEL2 species consisted of the families Carangidae, Scombridae, Barracuda and Hairtails. The total PEL1 biomass of Sri Lanka was 21 000 tonnes, of this more than 18 000 tonnes were found in the South West coast region (off Negombo) Clupeoids were the most important group. Of the Pel2 group, total estimated biomass was of 101 000 tonnes with the highest abundance found along the south and west coast. Different Carangid species dominated. The numbers should be considered as relative indices and reflect the standing stock in the area surveyed by the vessel. There are indications that some pelagic fish was distributed outside the area surveyed close to the coast and far offshore.

Demersal estimates

The total swept area biomass (t) estimated from the survey was 53 000 tonnes excluding jellyfish, garbage, coral debris and sponges that came up with the trawl. Looking at the biomass on the shelf (20-100 m depth) in the different regions the North West coast gave the lowest biomass estimate of Sri Lanka with an estimate of 967 tonnes. The highest biomass in the coastal zone was found on the shelf off Batticaloa in the South East region with an estimate of 8173 tonnes, the South West coast had the second highest biomass estimate on the shelf with biomass of 7894 tonnes. On the South coast, the Hambantota banks, the biomass was 6901 tonnes. On the Central East coast, 4003 tonnes were recorded while in the far North East on the Pedro Bank biomass of 4485 tonnes was estimated. The biomass of jellyfish was 15 600 tonnes with a majority (14 200 tonnes) from the shelf off Batticaloa in the East region.

Marine Mammals

The present survey provides the opportunity for the first marine mammal observation carried out in Sri Lanka covering the whole coastal areas within a season. During the survey, five species of cetaceans were recorded. Blue whale *Balaenoptera musculus* is the most commonly observed (72% of total observations) and showed a wide distribution with a record of 151 (best) individuals. Since there were very low sightings of blue whales in the East of Sri Lanka, the current survey results indicated that during the southwest monsoon period the blue whales in Sri Lanka are found mainly in the southwestern part of the country. Importantly, the highest blue whale aggregations were recorded on the dense shipping lane from Dondra to Galle in the South coast of Sri Lanka.

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ANNEX I. DESCRIPTION OF SAMPLING AT HYDROGRAFIC TRANSECTS

CTD Station

20 m

***30 m**

75 m

***100 m**

200 m

500 m

***1000 m**

3000 m or transect end

***Superstations at:**

30 m bottom depth

100 m bottom depth

1000 m bottom depth

Bottle depths at ecosystem transects

Btl #	30 m depth	100 m depth	200 m depth	500 m depth	1000 m depth	>1000 m depth
1	25	100	200	500	1000	near bottom
2	5	75	150	400	750	2000
3		50	100	300	500	1500
4		25	75	200	400	1000
5		5	50	150	300	500
6			25	100	200	200
7			5	75	150	150
8				50	100	100
9				25	75	75
10				5	50	50
11					25	25
12					5	5

Some stations have been excluded regularly at 500 and / or 200 m and sometimes 75 m due to the very steep shelf that causes the stations to be to close together

On superstations

CTD to bottom or to 2000 m, release bottles at standard depths

Phytoplankton net to 30 m (or 25 m at inner station) - maks haul speed 0,1 m s, not in bad weather!

WP2 to 25 m (inner station), 100 m – maks haul speed 0,5 ms

WP2 to 30m, at the 100 m and 1000 m station – maks haul speed 0,5 ms

WP2 to 100m, at the 100 m and 1000 m station – maks haul speed 0,5 ms

Multinet Mamuth to 100 m– maks speed 1,5 m s

Manta trawl at surface for 15 minutes - maks speed 1-1,5 m s, not in bad weather! (usually simultaneous with multinet)

ANNEX II. DESCRIPTION OF ACOUSTIC INSTRUMENTS AND FISHING GEAR

Acoustic instruments

The Simrad EK80/18, 38, 70,120, 200 and 333 kHz scientific sounder was run during the survey. Scrutinizing was done in LSSS using the data from the 38-kHz transducer. Last standard sphere calibrations were checked on the 23.01.2017 in Sandviksflaket, Bergen, Norway using Cu64 for the 18 kHz, Cu60 for the 38 kHz, WC38.1 for the 70, 120 and 200 kHz, and the WC22 for the 333 kHz. The details of the settings for the 38-kHz echo sounder were as follows:

Transceiver2 menu (38 kHz)	
Transducer depth	5 8 m
Absorption coeff.	8.3 dB/km
Pulse duration	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2way beam angle	20,6dB
gain	26,95 dB
SA correction	0.03 dB
Angle sensitivity	21.9
3 dB beamwidth	6.22º along ship
	6.28 athwart ship
Alongship offset	0.10º
Athwardship offset	0.06º

Bottom detection menu Minimum level 50 Db

Fishing gear

The vessel has one small four-panel Åkrahamn pelagic trawl, one MultPelt 624 trawl (Figure II.1, new in 2017) and one ‘Gisund super bottom trawl’. The multpelt trawl was not used during the survey due to a problem on the winch system. The smallest pelagic trawl has 8 to 12 m vertical opening under normal operation, whereas the MultPelt 624 trawl has 25 to 35 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 m2 and weigh 2000 kg. The door spreading is about 45 m when using restraining rope. Trawling was conducted for species identification only and no restraining rope was therefore used during the survey.

The SCANMAR 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 inter distance and angle, while a height sensor is fitted on the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

All the 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.

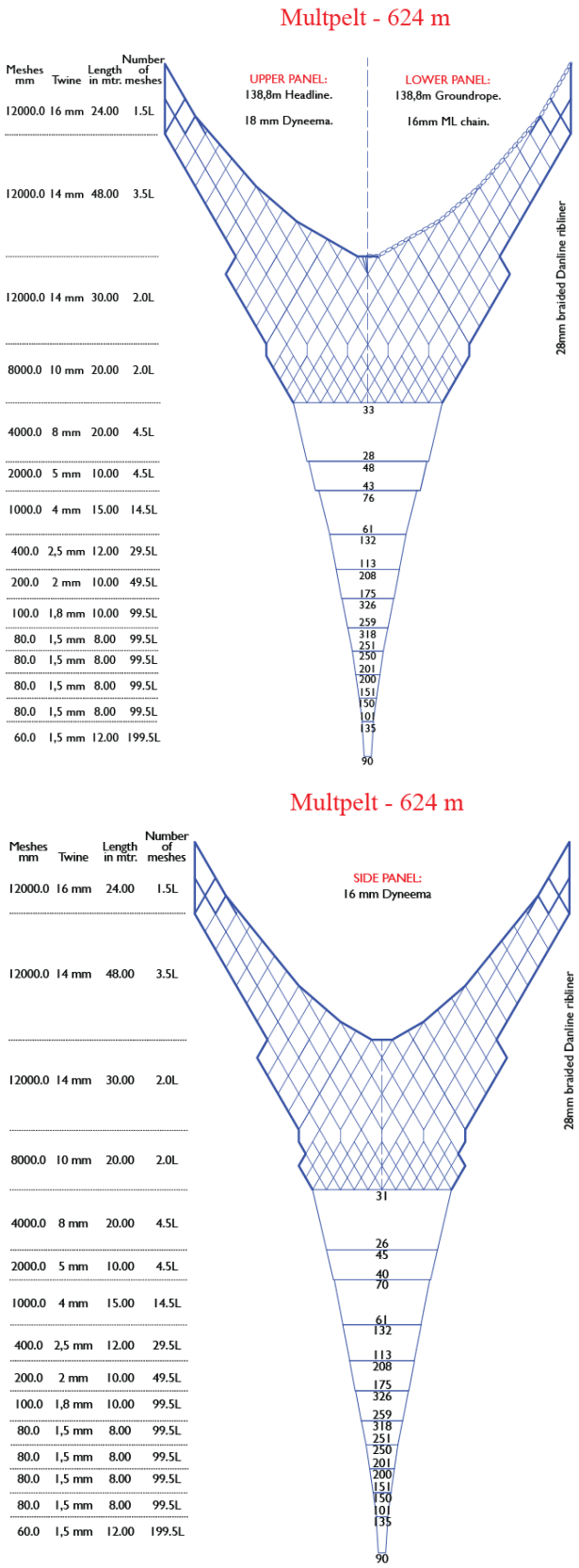
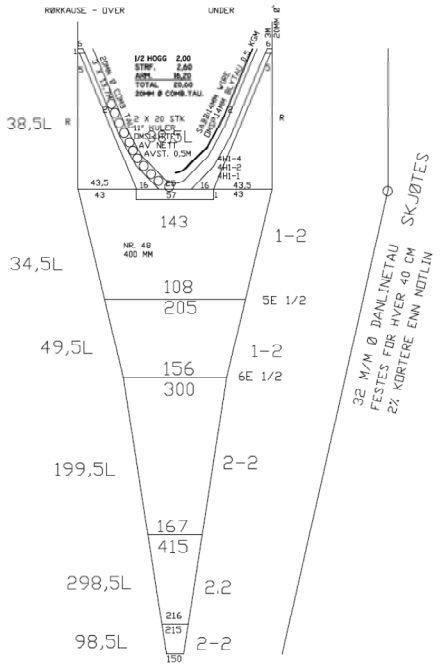


Figure II.1. Schematic drawing of the MultPelt 624.

LITEN PELAGISK ÅKRATRÅL

HEL MASKER M/M	TRÅD NR.	LENGDE I METER	MASKER I EVING
400	64	38,5	4
400	48	14	4
200	32	10,0	4
100	24	20,0	4
38	12	11,4	4
38	18	3,76	4



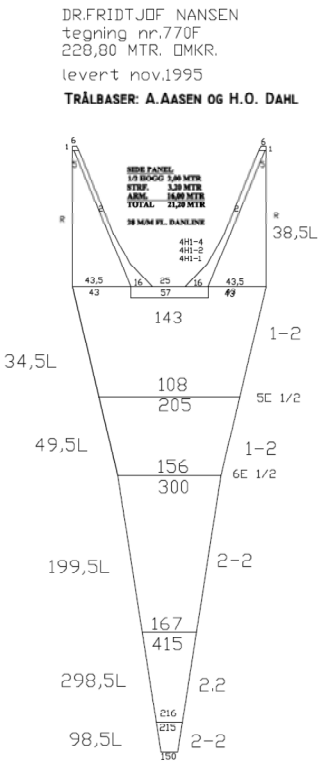


Figure II.2. Schematic drawing of the small pelagic Akratrawl.

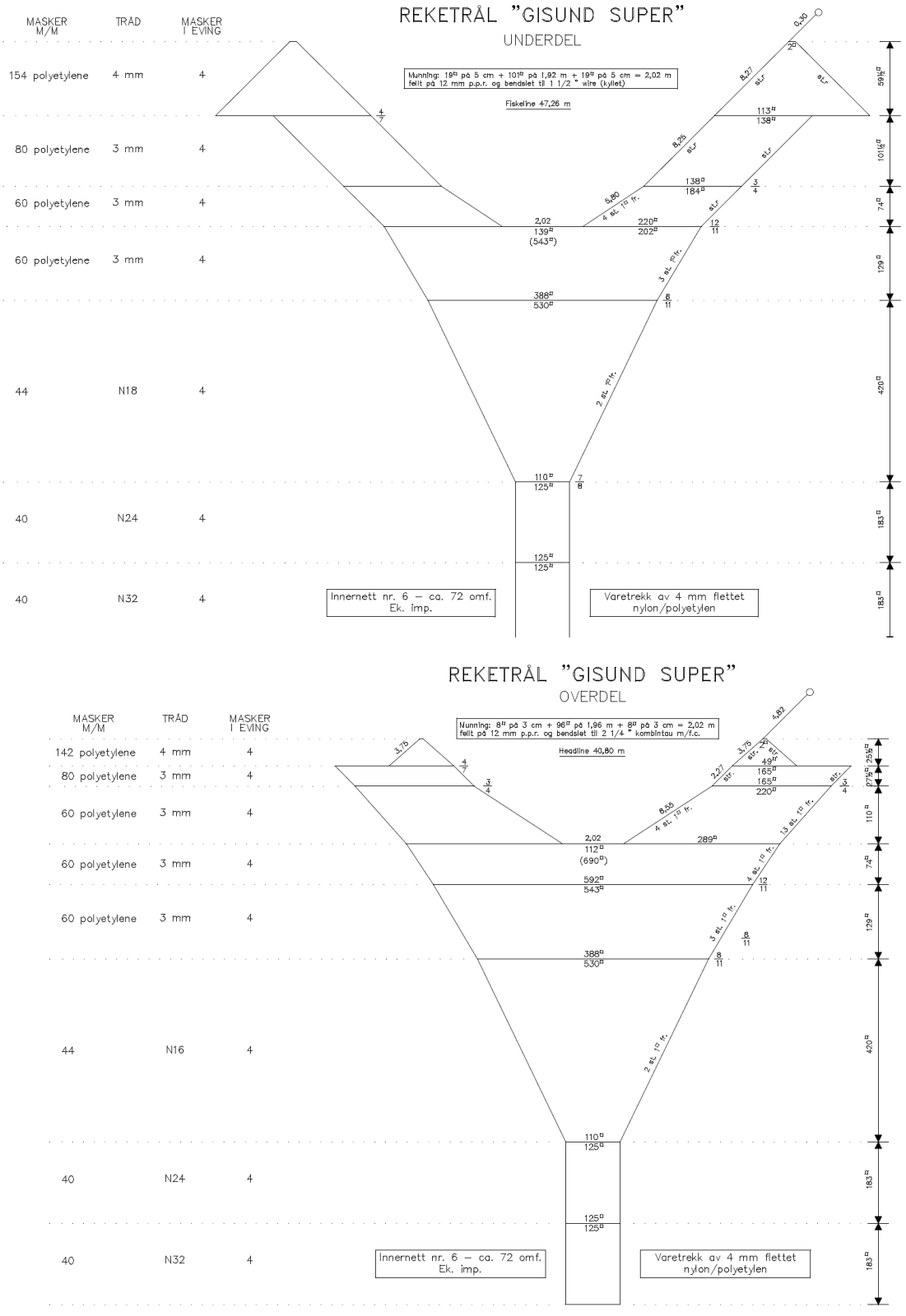


Figure II.3. Schematic drawing of the Super Gisund bottom trawl.

ANNEX III. RECORDS OF FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 1
DATE :26/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 10°16.45
start stop duration Lon E 80°40.37
TIME :08:36:34 09:06:44 30.2 (min) Purpose : 3
LOG : 1772.19 1773.68 1.5 Region : 10860
FDEPTH: 250 250 Gear cond.: 0
BDEPTH: 250 250 Validity : 1
Towing dir: 0° Wire out : 630 m Speed : 3.0 kn
Sorted : 36 Total catch: 90.59 Catch/hour: 180.23

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Chlorophthalmus agassizi	109.97	11107	61.02	
CENTROLOPHIDAE	17.93	497	9.95	
Unidentified	17.51	3724	9.72	
Eridacnis radcliffei	15.28	847	8.48	
Shrimps unidentified	7.07	1223	3.92	
Bembrops caudimaculata	4.21	94	2.34	
Unidentified	2.34	72	1.30	0
Leptocephalus	1.82	255	1.01	
Aristaeopsis sp.	0.83	72	0.46	
BOTHIDAE	0.78	56	0.43	
Lepidotrigula rigssi	0.73	14	0.40	
Decapterus macrosoma	0.31	4	0.17	1
Crabs - hairy	0.26	4	0.14	
Periophthalmus sp.	0.21	20	0.11	
Neoepinnula sp.	0.21	10	0.11	
Congresox talabonoides	0.16	10	0.09	
Cynoglossus bilineatus	0.16	4	0.09	
Congresox talabon	0.16	4	0.09	
Chascanopsetta lugubris	0.10	4	0.06	
Chaunax sp.	0.05	4	0.03	
Hephthocara simum	0.05	4	0.03	
OPHIDIIDAE	0.05	8	0.03	
Mursia sp.	0.05	4	0.03	
Squillidae	0.01	4	0.00	
DROMIIDAE	0.00	2	0.00	
Total	180.23		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 2
DATE :26/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 10°13.35
start stop duration Lon E 80°27.67
TIME :12:15:05 12:46:30 30.2 (min) Purpose : 3
LOG : 1791.55 1793.08 1.5 Region : 10860
FDEPTH: 98 95 Gear cond.: 0
BDEPTH: 98 95 Validity : 1
Towing dir: 0° Wire out : 639 m Speed : 3.0 kn
Sorted : 27 Total catch: 60.35 Catch/hour: 119.90

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Loligo duvaucelii	82.66	4071	68.94	3
Decapterus macrosoma	8.45	221	7.05	2
Miscellaneous	5.67	0	4.73	
Chlorophthalmus agassizi	4.45	52	3.71	
Nemipterus randalli	4.23	75	3.53	
Bohadschia marmorata	4.19	8	3.49	
SYNODONTIDAE	2.67	66	2.23	
Priacanthus hamrur	2.62	42	2.19	
Unidentified	1.97	4	1.64	
S H R I M P S	0.86	0	0.72	
CENTROLOPHIDAE	0.44	8	0.36	
Eupleurogrammus glossodon	0.36	79	0.30	
Trachinocephalus myops	0.22	8	0.18	
Centriscus scutatus	0.19	52	0.16	
Octopus membranaceus	0.17	4	0.15	
Unidentified	0.15	4	0.12	
Unidentified black fish	0.12	4	0.10	
Unidentified	0.11	18	0.09	
E C H I N O D E R M A T A	0.10	0	0.08	
Bembrops caudimacula	0.09	4	0.07	
POMACENTRIDAE	0.06	4	0.05	
Squillidae	0.04	4	0.04	
OPHIDIIDAE	0.04	4	0.04	
Lepidotrigula rigssi	0.03	18	0.02	
Total	119.89		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 3
DATE :26/06/18 GEAR TYPE: PT NO: 4 POSITION:Lat N 10°9.57
start stop duration Lon E 80°21.69
TIME :16:21:28 16:51:41 30.2 (min) Purpose : 1
LOG : 1807.40 1808.66 1.3 Region : 10860
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 48 54 Validity : 3
Towing dir: 0° Wire out : 130 m Speed : 2.5 kn
Sorted : 1 Total catch: 0.95 Catch/hour: 1.88

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Chirocentrus dorab	0.83	6	44.35	4
Loligo duvaucelii	0.50	18	26.40	5
Selar crumenophthalmus	0.39	10	20.91	
Dipterygonotus balteatus	0.16	2	8.34	
Total	1.88		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 4
DATE :26/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 10°2.47
start stop duration Lon E 80°23.43
TIME :19:15:28 19:48:40 33.2 (min) Purpose : 3
LOG : 1824.26 1825.95 1.7 Region : 10860
FDEPTH: 26 24 Gear cond.: 0
BDEPTH: 26 24 Validity : 2
Towing dir: 0° Wire out : 140 m Speed : 3.1 kn
Sorted : 41 Total catch: 81.23 Catch/hour: 146.80

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Diodon hystrix	21.33	18	14.53	
Lethrinus crocineus	16.47	934	11.22	
Discodoris spp.	14.26	31	9.71	
Neotrygon caeruleopunctata	9.54	11	6.50	
Miscellaneous	6.80	0	4.63	
Dipterygonotus balteatus	6.80	721	4.63	
Pterocaesio tessellata	5.84	721	3.98	
E C H I N O D E R M A T A	5.37	9	3.66	
Acanthurus sp.	5.24	2	3.57	
Sepia pharaonis	4.03	5	2.75	
Chromis sp.	3.60	647	2.45	
Loligo sp.	3.19	392	2.17	0
Gelidiella spp.	2.97	0	2.03	
J E L L Y F I S H	2.93	11	1.99	
Rhinobatos annulatus	2.86	2	1.95	
Ambassis gymnocephalus	2.55	1063	1.74	
Ambassis urotaenia	2.55	1063	1.74	
Upeneus japonicus	2.44	266	1.66	
Arothron immaculatus	2.31	2	1.58	
Loligo duvaucelii	2.13	20	1.45	
Sphyraena acutipinnis	2.02	13	1.38	
Thenus orientalis	2.02	7	1.38	
Lutjanus lutjanus	1.97	94	1.34	
Astrotia stokesii	1.66	5	1.13	
Pterocaesio tile	1.49	137	1.01	
Paragaleus sp.	1.27	31	0.87	
Metapenaeopsis spp.	1.27	902	0.87	
Ambassis sp.	1.06	351	0.72	
TETRAODONTIDAE	1.06	31	0.72	
Sponges	1.03	0	0.70	
Decapterus macrosoma	0.96	20	0.65	0
Lutjanus quinquelineatus	0.85	9	0.58	
Scombridae sp - Juvenile**	0.74	296	0.51	
Loligo sp.	0.74	9	0.51	
Lethrinus harak	0.74	14	0.50	
Plectorhinchus lineatus	0.42	20	0.29	
Unidentified Sea Plant	0.42	0	0.29	
Priacanthus hamrur	0.42	20	0.29	
Lethrinus olivaceus	0.32	20	0.22	
Pseudorhombus elevatus	0.32	31	0.22	
Unidentified	0.31	20	0.21	
Fistularia commersonii	0.27	5	0.18	
Unidentified juv fish	0.27	340	0.18	
Alectis indica	0.23	4	0.16	
Arothron immaculatus	0.21	9	0.14	0
Siganus canaliculatus	0.21	20	0.14	
Padina spp.	0.21	0	0.14	
Aluterus sp.	0.21	20	0.14	
Euprymna berryi	0.21	9	0.14	
Thenus orientalis	0.21	9	0.14	0
Decapterus macrosoma	0.16	4	0.11	
Sphyraena forsteri	0.11	2	0.07	
Hydrophis sp.	0.07	2	0.05	
Lepturacanthus savala	0.04	0	0.03	
Fishing gears	0.03	0	0.02	
Halimeda spp.	0.01	0	0.01	
SCORPAENIDAE	0.01	9	0.01	
Sepia sp	0.00	63	0.00	
Total	146.80		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 5
DATE :26/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 10°0.71
start stop duration Lon E 80°29.86
TIME :21:45:54 22:16:27 30.6 (min) Purpose : 3
LOG : 1836.20 1837.70 1.5 Region : 10860
FDEPTH: 40 40 Gear cond.: 0
BDEPTH: 45 45 Validity : 2
Towing dir: 0° Wire out : 150 m Speed : 3.0 kn
Sorted : 80 Total catch: 79.75 Catch/hour: 156.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Naso annulatus	24.08	31	15.37	
Diagramma pictum	15.83	12	10.11	
Lethrinus conchyliatus	13.91	43	8.88	
Jellyfish	11.19	0	7.15	
Diodon holocanthus	10.06	2	6.42	
Acanthurus mata	8.52	6	5.44	
Dipterygonotus balteatus	6.76	0	4.31	
Neotrygon sp.	5.26	8	3.36	
Mulloidichthys sp.	5.11	55	3.26	
Miscellaneous	4.56	0	2.91	
Lutjanus lutjanus	4.52	84	2.88	
Scolopsis bimaculata	4.44	65	2.83	
Ostorhinchus aureus	3.95	0	2.52	
Abalistes stellatus	3.89	2	2.48	
APOGONIDAE	3.85	0	2.46	
PEMPHERIDAE	3.46	0	2.21	
Priacanthus hamrur	2.91	6	1.86	
Lutjanus quinquelineatus	2.71	0	1.73	
Penaeus japonicus	2.52	0	1.61	
Lethrinus lentjan	2.26	8	1.44	6
Stegastes sp.	1.76	0	1.13	
Aluterus sp.	1.76	0	1.13	
Equulites elongatus	1.71	118	1.09	
Soft corals	1.46	0	0.93	0
Chaetodon gardineri	1.36	6	0.87	
Gastrophysis sceleratus	1.12	0	0.71	
Aluterus monoceros	0.99	2	0.63	
Arothron stellatus	0.94	4	0.60	
Pterois sp.	0.91	18	0.58	
Lethrinus crocineus	0.60	2	0.38	
Alectis ciliaris	0.44	2	0.28	12
Sea cucumber	0.39	4	0.25	
Synodus jaculum	0.36	41	0.23	
Dactyloptena orientalis	0.36	8	0.23	
Astrotia stokesii	0.35	2	0.23	
Unidentified demersal fish	0.34	27	0.21	
Pterocaesio tessellata	0.26	31	0.17	
Trachinocephalus myops	0.26	16	0.16	
Fistularia petimba	0.24	14	0.16	
Cookeolus japonicus	0.16	2	0.10	
Lethrinus nebulosus	0.13	2	0.08	
Apolemichthys xanthotis	0.12	6	0.08	
Heniochus acuminatus	0.12	6	0.08	
S H A R K S	0.10	10	0.07	
Penaeus sp.	0.08	2	0.05	
Narcine lingula	0.07	2	0.04	
Scolopsis sp.	0.07	2	0.04	
Soft corals	0.06	4	0.04	
Plotosus lineatus	0.05	12	0.03	
Gerres acinaces	0.05	2	0.03	
Ostracion sp.	0.04	2	0.03	
Thenus orientalis	0.04	2	0.03	
TETRAODONTIDAE	0.04	4	0.02	
Unidentified crab	0.03	16	0.02	
S H R I M P S	0.03	0	0.02	
SCORPAENIDAE	0.02	16	0.01	
Balistoides sp.	0.01	2	0.01	
Ostorhinchus sp.	0.01	6	0.01	
Ctenochaetus sp.	0.01	2	0.00	
Total	156.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 6
DATE :26/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 10°3.29
start stop duration Lon E 80°32.65
TIME :23:35:59 00:01:21 25.4 (min) Purpose : 3
LOG : 1847.28 1848.53 1.3 Region : 10860
FDEPTH: 80 82 Gear cond.: 0
BDEPTH: 80 82 Validity : 3
Towing dir: 0° Wire out : 193 m Speed : 3.0 kn
Sorted : 0 Total catch: 48.82 Catch/hour: 115.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diagramma pictum	8.59	9	7.44	
Nemipterus japonicus	8.58	374	7.43	
Decapterus macrosoma	8.52	310	7.37	14
Bothus sp.	8.19	7	7.09	0
Parapercis sp.	6.66	270	5.76	
Sargocentron rubrum	6.19	47	5.36	
Sphyraena acutipinnis	5.06	237	4.38	
Rhinobatos lionotus	4.14	5	3.58	
Synodus indicus	3.93	215	3.40	
Pseudorhombus sp.	1.69	52	1.46	
Bothus sp.	1.36	102	1.18	
Octopus sp.	1.16	9	1.01	
Priacanthus sp.	1.05	38	0.91	
Amphioctopus aegina	0.90	28	0.78	
PRIACANTHIDAE	0.87	57	0.75	
Scolopsis bimaculata	0.79	5	0.68	
Lepidotrigula rigssi	0.70	57	0.61	
Dipterygonotus balteatus	0.65	111	0.56	
Tetrosomus gibbosus	0.61	5	0.53	
NARCINIDAE	0.54	14	0.47	
Parupeneus forsskali	0.49	5	0.42	
Unidentified	0.33	52	0.28	
Ostorhinchus aureus	0.30	43	0.26	
Cociella crocodila	0.28	43	0.24	
Fistularia petimba	0.11	19	0.09	
Thenus orientalis	0.10	5	0.09	
Peristedion riversandersoni	0.08	9	0.07	
Ambassis sp.	0.05	33	0.05	
Padina spp.	0.05	5	0.05	
Leiognathus berbis	0.05	5	0.04	
Samaris sp.	0.04	9	0.03	
Paramonacanthus choirocephalus	0.02	5	0.02	
Equulites elongatus	0.01	5	0.01	
Total	72.06		62.39	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 7
DATE :27/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 10°2.67
start stop duration Lon E 80°49.58
TIME :04:13:00 04:42:25 29.4 (min) Purpose : 3
LOG : 1875.05 1876.38 1.3 Region : 10860
FDEPTH: 446 436 Gear cond.: 0
BDEPTH: 446 436 Validity : 1
Towing dir: 0° Wire out : 940 m Speed : 2.7 kn
Sorted : 77 Total catch: 902.92 Catch/hour: 1840.82

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Hoplostethus sp.	1476.80	30210	80.23	
Unidentified	194.10	1686	10.54	0
Unidentified	45.57	1350	2.48	
Sargocentron rubrum	35.44	167	1.93	
Goniasteridae indet 1	32.07	9452	1.74	
Congresox talabon	20.25	167	1.10	
Unidentified crabs	11.92	167	0.65	
Unidentified crabs	10.13	336	0.55	
BYTIIDAE	4.57	16	0.25	
Hippolytidae	3.37	1855	0.18	
Neotrygon caeruleopunctata	3.18	2	0.17	
Puerulus sewelli	2.14	20	0.12	
Chaunax sp.	0.47	4	0.03	
Polymixia sp.	0.37	2	0.02	
Unidentified	0.29	4	0.02	
Pseudotriacanthus strigilifer	0.16	6	0.01	
Total	1840.82		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 8
DATE :27/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°56.25
start stop duration Lon E 80°40.31
TIME :07:43:04 08:13:45 30.7 (min) Purpose : 3
LOG : 1897.47 1899.16 1.7 Region : 10860
FDEPTH: 85 86 Gear cond.: 0
BDEPTH: 85 86 Validity : 1
Towing dir: 0° Wire out : 260 m Speed : 3.3 kn
Sorted : 49 Total catch: 382.23 Catch/hour: 747.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Nemipterus japonicus	434.72	13543	58.17	
Decapterus macrosoma	110.84	3597	14.83	17
Decapterus russelli	92.23	2123	12.34	18
Aphareus rutilans	87.91	12147	11.76	
Loligo sp.	8.97	381	1.20	15
Diodon sp.	7.15	16	0.96	
CARIDEA	2.33	66	0.31	
Priacanthus hamrur	1.66	49	0.22	
Sepia prashadi	0.33	16	0.04	
Unidentified lobster	0.17	16	0.02	16
Sand doller	0.17	16	0.02	
Fistularia petimba	0.17	33	0.02	
Equulites elongatus	0.17	16	0.02	
Cynoglossus sp.	0.17	16	0.02	
Pseudotriacanthus strigilifer	0.15	66	0.02	
Synodus dermatogenys	0.15	100	0.02	
Total	747.27		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 9
DATE :27/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°51.25
start stop duration Lon E 80°29.73
TIME :11:02:14 11:29:07 26.9 (min) Purpose : 3
LOG : 1914.72 1916.17 1.5 Region : 10860
FDEPTH: 20 21 Gear cond.: 0
BDEPTH: 20 21 Validity : 1
Towing dir: 0° Wire out : 120 m Speed : 3.3 kn
Sorted : 37 Total catch: 37.19 Catch/hour: 83.01

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aprion virescens	28.19	7	33.96	
Uroteuthis singhalensis	5.45	103	6.57	10
Arothron stellatus	4.91	2	5.92	
Nemipterus furcosus	4.82	63	5.81	
Loligo duvaucelii	4.73	85	5.69	11
Arothron hispidus	4.31	2	5.19	
Aluterus monoceros	4.15	2	5.00	
Astrotia stokesii	3.08	9	3.71	
Selaroides leptolepis	2.97	382	3.58	
Dipterygonotus balteatus	2.97	507	3.58	
Diodon holocanthus	2.17	4	2.61	
Ablennes hians	2.12	2	2.55	13
Diodon hystrix	2.05	2	2.47	
Decapterus russelli	1.98	65	2.38	9
Pterocaesio chrysozona	1.96	350	2.37	
Miscellaneous	1.56	0	1.88	
Echeneis naucrates	1.00	4	1.21	
Sepia pharaonis	0.92	4	1.10	
Decapterus macrosoma	0.86	20	1.04	8
Fistularia petimba	0.80	7	0.97	
Equulites elongatus	0.65	212	0.78	
POMACENTRIDAE	0.60	109	0.73	
E C H I N O D E R M A T A	0.36	2	0.43	
Scolopsis bimaculata	0.22	2	0.27	
Amblygaster sirm	0.08	4	0.10	7
Carangoides sp.	0.02	2	0.03	
Gymnocranius elongatus	0.02	2	0.03	
Lutjanus lutjanus	0.02	2	0.03	
Opisthopterus sp.	0.02	27	0.03	
Gnathanodon sp.	0.00	2	0.00	
Eduarctus martensii	0.00	2	0.00	
Total	83.01		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 10
DATE :27/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°45.35
start stop duration Lon E 80°41.30
TIME :14:08:24 14:28:34 20.2 (min) Purpose : 3
LOG : 1934.29 1935.33 1.0 Region : 10860
FDEPTH: 43 38 Gear cond.: 0
BDEPTH: 43 38 Validity : 2
Towing dir: 0° Wire out : 180 m Speed : 3.1 kn
Sorted : 36 Total catch: 36.37 Catch/hour: 108.24

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Aluterus monoceros	22.95	9	21.20	
JELLYFISH	14.29	0	13.20	
Lethrinus nebulosus	13.39	3	12.37	
Neotrygon caeruleopunctata	5.24	6	4.84	
Sepia sp.	4.32	36	3.99	
Trachinocephalus myops	3.13	0	2.89	
Dipterygonotus balteatus	2.92	0	2.69	0
Nemipterus furcosus	2.92	65	2.69	0
Ablennes hians	2.80	0	2.58	
S H R I M P S	2.80	0	2.58	
Chromis sp.	2.80	0	2.58	
Nemipterus furcosus	2.77	113	2.56	
Abalistes stellatus	2.68	0	2.47	
Pempheris sp.	2.62	0	2.42	
Lethrinus lentjan	2.62	3	2.42	
Lethrinus rubrioperculatus	2.38	12	2.20	
Diodon liturosus	2.29	3	2.12	
Parupeneus forsskali	2.14	42	1.98	
Loligo sp.	1.64	18	1.51	
Seriola sp.	1.55	3	1.43	
Scolopsis bimaculata	1.43	24	1.32	
Lutjanus quinquelineatus	1.34	15	1.24	
Lethrinus sp.	1.25	74	1.15	
DIODONTIDAE	1.19	45	1.10	
Stegastes sp.	1.19	0	1.10	
Aluterus sp.	1.16	0	1.07	0
Hydrophis atriceps	0.65	3	0.60	
Aluterus sp.	0.45	24	0.41	
Miscellaneous	0.36	0	0.33	
Fishing gears	0.30	0	0.27	
Ostorhinchus sp.	0.30	36	0.27	
Fistularia petimba	0.18	6	0.16	
Dipterygonotus balteatus	0.18	9	0.16	
Synodus sp.	0.06	3	0.05	
Total	108.24		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 11
DATE :27/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°48.18
start stop duration Lon E 80°45.60
TIME :15:52:35 16:22:38 30.1 (min) Purpose : 3
LOG : 1943.69 1945.36 1.7 Region : 10860
FDEPTH: 59 60 Gear cond.: 0
BDEPTH: 59 60 Validity : 2
Towing dir: 0° Wire out : 180 m Speed : 3.3 kn
Sorted : 55 Total catch: 55.44 Catch/hour: 110.69

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Gymnocranius grandoculis	29.71	88	26.84	
Lethrinus olivaceus	26.74	90	24.15	21
Coral mix	19.23	0	17.37	
Plectorhinchus ceylonensis	6.31	4	5.70	
Lethrinus nebulosus	4.63	8	4.18	22
Aluterus monoceros	4.43	22	4.00	
Rhinobatos lionotus	3.25	2	2.94	
Sponges	2.28	0	2.06	
Equulites elongatus	1.52	100	1.37	
Lethrinus lentjan	1.18	2	1.06	23
Lutjanus lunulatus	1.04	4	0.94	
Heniochus acuminatus	1.02	4	0.92	
Petersius sp.	1.02	4	0.92	
Hydrophis spiralis	0.96	4	0.87	
Dactyloptena orientalis	0.80	2	0.72	
Diodon holocanthus	0.76	2	0.69	
Upeneus moluccensis	0.72	16	0.65	
Decapterus macrosoma	0.70	20	0.63	25
Sepia pharaonis	0.56	2	0.51	24
Ostracion meleagris	0.54	2	0.49	
Dipterygonotus balteatus	0.44	82	0.40	
Unidentified	0.44	100	0.40	
Unidentified Sea Plant	0.42	0	0.38	
Synodus dermatogenys	0.36	14	0.32	
Starfish	0.34	14	0.31	
Lutjanus quinquelineatus	0.28	2	0.25	
Naso sp.	0.26	2	0.23	
Chromis sp.	0.12	16	0.11	
Nemipterus sp.	0.10	2	0.09	
Unidentified squids and crustaceans	0.10	32	0.09	
Loligo sp.	0.08	2	0.07	
J E L L Y F I S H	0.08	4	0.07	
Lethrinus microdon	0.08	2	0.07	
Unidentified	0.06	10	0.05	
Canthigaster sp.	0.06	12	0.05	
Priacanthus hamrur	0.04	10	0.04	
Fistularia petimba	0.04	2	0.04	
Myripristis botche	0.02	2	0.02	
Total	110.69		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 12
DATE :27/06/18 GEAR TYPE: PT NO: 4 POSITION:Lat N 9°39.91
start stop duration Lon E 80°55.28
TIME :19:08:30 19:38:45 30.3 (min) Purpose : 1
LOG : 1966.01 1967.53 1.5 Region : 10860
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 0 0 Validity : 3
Towing dir: 0° Wire out : 150 m Speed : 3.0 kn
Sorted : 2 Total catch: 2.35 Catch/hour: 4.67

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Loligo sp.	4.51	198	96.60	20
Loligo sp.	0.08	4	1.70	19
Unidentified	0.08	48	1.70	
Total	4.67		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 13
DATE :27/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°38.66
start stop duration Lon E 80°50.22
TIME :21:01:17 21:32:01 30.7 (min) Purpose : 3
LOG : 1974.83 1976.37 1.5 Region : 10860
FDEPTH: 56 57 Gear cond.: 0
BDEPTH: 56 57 Validity : 2
Towing dir: 0° Wire out : 180 m Speed : 3.0 kn
Sorted : 21 Total catch: 139.40 Catch/hour: 272.10

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Naso brevirostris	82.08	37	30.16	
J E L L Y F I S H	30.23	254	11.11	
Plectorhinchus ceylonensis	25.78	12	9.48	
Synodus indicus	20.92	689	7.69	
Lethrinus nebulosus	19.69	37	7.24	28
Loligo sp.	19.40	638	7.13	29
Diodon sp.	17.74	12	6.52	
Naso tuberosus	9.17	25	3.37	
Dactyloptena orientalis	8.16	12	3.00	
Lethrinus microdon	7.40	12	2.72	
Sepia pharaonis	6.50	12	2.39	
Dipterygonotus balteatus	4.59	816	1.69	
Unidentified	4.08	638	1.50	
Holothuria spinifera	3.83	12	1.41	
Equulites elongatus	3.44	638	1.26	
Decapterus macrosoma	3.44	127	1.26	30
Synodus dermatogenys	2.17	217	0.80	
Unidentified	1.13	740	0.42	
Pterocaesio chrysozona	0.76	37	0.28	
Upeneus moluccensis	0.37	25	0.14	
TETRAODONTIDAE	0.37	12	0.14	
Nemipterus bipunctatus	0.37	12	0.14	
Unidentified crabs	0.12	51	0.04	
Rogadius serratus	0.12	12	0.04	
Parabothus polylepis	0.12	12	0.04	
Euprymna berryi	0.06	12	0.02	
Shrimps unidentified	0.06	267	0.02	
Total	272.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 14
DATE :27/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°34.75
start stop duration Lon E 80°44.42
TIME :23:07:24 23:27:34 20.2 (min) Purpose : 3
LOG : 1985.75 1986.84 1.1 Region : 10860
FDEPTH: 24 27 Gear cond.: 0
BDEPTH: 24 27 Validity : 2
Towing dir: 0° Wire out : 125 m Speed : 3.3 kn
Sorted : 73 Total catch: 73.18 Catch/hour: 217.70

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Maculabatis gerrardi	77.34	6	35.53	
Equulites elongatus	47.48	0	21.81	
Carangoides fulvoguttatus	44.26	265	20.33	
Selaroides leptolepis	16.06	0	7.38	
Nemipterus furcosus	5.59	0	2.57	
Trachinocephalus myops	3.51	0	1.61	
Nemipterus nemurus	3.19	68	1.47	
Upeneus moluccensis	2.69	0	1.23	
Gastrophysis sceleratus	2.61	0	1.20	
Decapterus macrosoma	2.49	104	1.15	26
Astrotia sp.	1.43	3	0.66	
Decapterus russelli	1.22	42	0.56	27
Miscellaneous	1.04	0	0.48	
Loligo duvaucelii	1.03	12	0.47	
Sphyraena forsteri	1.02	6	0.47	
Crossorhombus azureus	0.78	62	0.36	
Tetrosomus gibbosus	0.73	3	0.34	
Unidentified sea snake	0.65	3	0.30	
Caranx ignobilis	0.65	6	0.30	
Priacanthus hamrur	0.43	71	0.20	
URCHINS	0.43	3	0.20	
Dipterygonotus balteatus	0.42	0	0.19	
Carangoides sp.	0.41	3	0.19	
Unidentified	0.41	0	0.19	
Bothus pantherinus	0.32	9	0.14	
Sepia prashadi	0.23	3	0.10	
Carangoides oblongus	0.22	3	0.10	
Portunus sanguinolento	0.21	0	0.10	
Fistularia petimba	0.19	6	0.09	
Penaeus sp.	0.19	0	0.09	
Synodus sp.	0.19	15	0.09	
Ostorhinchus sp.	0.10	0	0.04	
Ostorhinchus aureus	0.05	9	0.02	
Unidentified	0.05	15	0.02	
Pseudorhombus elevatus	0.03	3	0.02	
Ambassis sp.	0.03	9	0.01	
Unidentified	0.00	0	0.00	
Total	217.70		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 15
DATE :28/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°28.22
start stop duration Lon E 80°51.85
TIME :02:11:15 02:40:54 29.6 (min) Purpose : 3
LOG : 2004.60 2006.12 1.5 Region : 10850
FDEPTH: 40 47 Gear cond.: 0
BDEPTH: 40 47 Validity : 1
Towing dir: 0° Wire out : 150 m Speed : 3.1 kn
Sorted : 34 Total catch: 245.56 Catch/hour: 497.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Photopectoralis bindus	220.59	24508	44.38	
Leiognathus lineolatus	113.29	35401	22.79	
Gazza minuta	50.30	3223	10.12	
Selar crumenophthalmus	25.86	597	5.20	
Upeneus moluccensis	24.98	1247	5.02	
J E L L Y F I S H	20.23	281	4.07	
Pentaprion longimanus	12.49	879	2.51	
Pomadasys kaakan	8.64	4	1.74	
Saurida micropectoralis	6.51	105	1.31	
Pristipomoides multidens	3.87	34	0.78	
Loligo sp.	2.64	334	0.53	32
Hydrophis spiralis	2.63	4	0.53	
Loligo duvaucelii	1.76	16	0.35	31
Thenus orientalis	1.17	6	0.24	
Nemipterus nematophorus	0.70	34	0.14	
Fistularia petimba	0.35	16	0.07	
Secutor insidiator	0.35	16	0.07	
Portunus sanguinolento	0.20	2	0.04	
Unidentified Bivalve	0.17	34	0.04	
Equulites elongatus	0.17	16	0.04	
Atropus atropos	0.17	16	0.04	
Total	497.08		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 16
DATE :28/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°19.65
start stop duration Lon E 80°55.50
TIME :19:36:56 20:07:26 30.5 (min) Purpose : 3
LOG : 2092.18 2093.75 1.6 Region : 10850
FDEPTH: 37 38 Gear cond.: 0
BDEPTH: 37 38 Validity : 2
Towing dir: 0° Wire out : 180 m Speed : 3.1 kn
Sorted : 34 Total catch: 223.64 Catch/hour: 440.10

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pentaprion longimanus	116.10	6175	26.38	
Leiognathus berbis	106.28	16605	24.15	
Selaroides leptolepis	47.52	1745	10.80	
Upeneus sulphureus	30.08	801	6.83	
Upeneus moluccensis	27.07	882	6.15	
Gazza achlamys	17.04	299	3.87	
Carangoides coeruleopinnatus	14.44	79	3.28	
Carangoides talamparoides	13.03	159	2.96	
Netuma thalassina	12.91	8	2.93	
Amblygaster clupeoides	9.62	279	2.19	33
Nemipterus japonicus	9.42	340	2.14	
Pomadasys argyreus	8.46	8	1.92	
Nemipterus bipunctatus	6.62	279	1.50	
Photopectoralis bindus	6.42	561	1.46	
PECTINIDAE	5.82	460	1.32	
Fistularia petimba	2.40	59	0.55	
Saurida nebulosa	1.80	20	0.41	
Psettodes erumei	1.59	2	0.36	
Ichthyscopus lebeck	0.80	20	0.18	
Polydactylus plebeius	0.69	2	0.16	
Loligo duvaucelii	0.60	20	0.14	34
Pseudorhombus elevatus	0.60	20	0.14	
Platichthys sp.	0.40	39	0.09	
Thenus orientalis	0.37	2	0.08	
Total	440.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 17
DATE :29/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°7.93
start stop duration Lon E 81°1.73
TIME :00:03:55 00:27:51 23.9 (min) Purpose : 3
LOG : 2113.76 2115.02 1.3 Region : 10850
FDEPTH: 52 51 Gear cond.: 0
BDEPTH: 52 51 Validity : 2
Towing dir: 0° Wire out : 170 m Speed : 3.2 kn
Sorted : 50 Total catch: 49.61 Catch/hour: 124.33

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Leiognathus lineolatus	22.86	4571	18.38	
Sphyraena forsteri	18.26	145	14.69	50
Stolephorus indicus	17.54	639	14.11	55
Alectis indica	10.43	3	8.39	46
Gerres acinaces	8.62	0	6.93	
Upeneus taeniopterus	7.12	251	5.72	
Psettodes erumei	5.91	8	4.76	
Netuma thalassina	5.66	5	4.56	
Alectis ciliaris	5.16	8	4.15	47
Scomberomorus commerson	4.21	3	3.39	52
Loligo duvaucelii	3.38	108	2.72	54
Lethrinus lentjan	2.61	3	2.10	
J E L L Y F I S H	2.11	18	1.69	49
Priacanthus hamrur	1.75	3	1.41	
Trichiurus lepturus	1.50	5	1.21	
Carangoides gymnostethus	1.21	5	0.97	53
Carangoides chrysophrys	1.10	3	0.89	
Lutjanus russellii	1.05	3	0.85	
Saurida undosquamis	0.95	8	0.77	
Megalaspis cordyla	0.95	3	0.77	
Selaroides leptolepis	0.65	28	0.52	
Nemipterus bipunctatus	0.25	10	0.20	
Lactoria fornasini	0.25	3	0.20	
Pseudorhombus arsius	0.23	5	0.18	
Nemipterus nematophorus	0.20	10	0.16	
Photopectoralis bindus	0.18	13	0.14	
PLEURONECTIDAE	0.08	13	0.06	
Amblygaster sirm	0.05	3	0.04	48
APOGONIDAE	0.05	10	0.04	
Total	124.33		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 18
DATE :29/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°0.15
start stop duration Lon E 81°3.03
TIME :04:29:12 05:00:02 30.8 (min) Purpose : 3
LOG : 2141.28 2142.89 1.6 Region : 10850
FDEPTH: 40 44 Gear cond.: 0
BDEPTH: 40 44 Validity : 1
Towing dir: 0° Wire out : 150 m Speed : 3.1 kn
Sorted : 84 Total catch: 84.27 Catch/hour: 163.94

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pentaprion longimanus	84.18	7652	51.35	
Carangoides malabaricus	11.68	58	7.13	35
Aluterus monoceros	10.82	6	6.60	
Photopectoralis bindus	6.87	745	4.19	
Carangoides coeruleopinnatus	6.79	4	4.14	
Fistularia petimba	5.18	84	3.16	
Leiognathus berbis	4.67	543	2.85	
Alectis ciliaris	4.11	2	2.50	
Saurida tumbil	3.74	18	2.28	
Loligo duvaucelii	3.60	99	2.20	36
Nemipterus bipunctatus	2.55	23	1.55	
Leiognathus fasciatus ***	2.10	12	1.28	
Psettodes erumei	2.00	2	1.22	
Fishing gears	1.71	4	1.04	
Sepia pharaonis	1.69	2	1.03	37
Netuma thalassina	1.60	2	0.97	
Gerres filamentosus	1.58	10	0.96	
Hydrophis cyanocinctus	1.21	2	0.74	
Carangoides sp.	1.19	6	0.72	
Hydrophis fasciatus	1.09	2	0.66	
PECTINIDAE	0.88	51	0.53	
Hydrophis ornatus	0.74	2	0.45	
Pseudorhombus elevatus	0.68	6	0.42	
Uraspis helvola	0.66	2	0.40	
Carangoides hedlandensis	0.58	2	0.36	
Saurida nebulosa	0.47	19	0.28	
Stolephorus indicus	0.43	18	0.26	
J E L L Y F I S H	0.37	4	0.23	
Tetrosomus gibbosus	0.33	2	0.20	
Upeneus moluccensis	0.27	10	0.17	
Pterois antennata	0.08	2	0.05	
Sepia sp	0.06	2	0.04	38
Sphyraena jello	0.06	2	0.04	
Centriscus scutatus	0.00	2	0.00	
Total	163.94		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 19
DATE :29/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 9°0.15
start stop duration Lon E 81°0.14
TIME :06:29:54 07:00:05 30.2 (min) Purpose : 3
LOG : 2150.86 2152.46 1.6 Region : 10850
FDEPTH: 21 20 Gear cond.: 0
BDEPTH: 21 20 Validity : 1
Towing dir: 0° Wire out : 140 m Speed : 3.2 kn
Sorted : 364 Total catch: 400.94 Catch/hour: 796.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diagramma pictum	487.59	314	61.19	
Neotrygon caeruleopunctata	78.66	64	9.87	
Acanthurus mata	36.97	42	4.64	
Pterocaesio chrysozona	26.85	2441	3.37	
Fistularia petimba	21.07	282	2.64	
Balistoides viridescens	19.62	6	2.46	
Scolopsis bimaculata	18.84	163	2.36	
Gnathanodon speciosus	16.18	6	2.03	
Aluterus scriptus	10.93	12	1.37	
Pentaprion longimanus	7.24	328	0.91	
Equulites elongatus	6.64	1010	0.83	
Alectis sp.	6.04	4	0.76	
Lethrinus nebulosus	4.99	2	0.63	44
Nemipterus bipunctatus	4.95	70	0.62	
Tetrosomus gibbosus	4.63	20	0.58	
Siganus javus	4.17	2	0.52	
Aluterus monoceros	4.15	4	0.52	
Atule mate	3.81	16	0.48	43
Epinephelus undulosus	3.58	2	0.45	40
Carangoides sp.	3.43	20	0.43	
Triacanthus biaculeatus	3.37	20	0.42	
Lagocephalus sceleratus	3.35	18	0.42	
Diodon sp.	2.80	2	0.35	
Lutjanus argentimaculatus	2.66	2	0.33	45
Mulloidichthys vanicolensis	2.44	24	0.31	
Parupeneus indicus	2.11	8	0.26	
Fishing gears	1.71	0	0.21	
Lethrinus lentjan	1.42	4	0.18	39
Carangoides hedlandensis	1.42	4	0.18	
Sepia sp	1.25	16	0.16	
Ambassis sp.	1.09	473	0.14	
Abalistes stellatus	0.91	2	0.11	
Saurida tumbil	0.87	4	0.11	
Selaroides leptolepis	0.54	4	0.07	
Hydrophis sp.	0.48	2	0.06	
Zanclus cornutus	0.06	2	0.01	
Total	796.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 20
DATE :29/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°51.81
start stop duration Lon E 81°8.77
TIME :09:02:18 09:30:28 28.2 (min) Purpose : 3
LOG : 2168.03 2169.59 1.6 Region : 10850
FDEPTH: 41 44 Gear cond.: 0
BDEPTH: 41 44 Validity : 1
Towing dir: 0° Wire out : 165 m Speed : 3.3 kn
Sorted : 197 Total catch: 197.32 Catch/hour: 420.43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Neotrygon caeruleopunctata	98.27	47	23.37	
Sponges	78.07	0	18.57	
Diagramma pictum	58.02	17	13.80	56
Aluterus monoceros	20.07	11	4.77	60
Acanthurus mata	19.92	11	4.74	57
Lethrinus nebulosus	15.02	4	3.57	65
Alectis indica	12.78	4	3.04	58
Lethrinus microdon	12.63	6	3.01	62
Epinephelus undulosus	10.91	2	2.59	59
Miscellaneous	10.87	0	2.58	
Lutjanus argentimaculatus	10.65	4	2.53	66
Lactoria fornasini	10.23	9	2.43	
Epinephelus coioides	10.06	2	2.39	63
Pentaprion longimanus	7.03	0	1.67	
Megalaspis cordyla	5.20	6	1.24	
Dipterygonotus balteatus	5.16	5156	1.23	
ECHINOMETRIDAE	4.43	2	1.05	
Carangoides oblongus	4.22	19	1.00	
Fistularia petimba	3.58	60	0.85	
Fishing gears	3.20	0	0.76	
Carangoides chrysophrys	2.09	2	0.50	
Loligo duvaucelii	1.96	62	0.47	
TETRAODONTIDAE	1.79	9	0.43	
Gerres oblongus	1.58	4	0.38	
Triacanthus biaculeatus	1.28	11	0.30	
Lethrinus nebulosus	1.28	2	0.30	0
Lethrinus obsoletus	1.26	2	0.30	
Hydrophis sp.	1.07	2	0.25	
Aluterus scriptus	0.96	2	0.23	
Carangoides malabaricus	0.90	4	0.21	
Aurigequula longispina	0.87	4	0.21	
Carangoides hedlandensis	0.85	2	0.20	
Nemipterus furcosus	0.75	11	0.18	
Antipatharia	0.68	0	0.16	
Gerres filamentosus	0.53	2	0.13	
Scolopsis bimaculata	0.49	6	0.12	
Nemipterus bipunctatus	0.47	6	0.11	
J E L L Y F I S H	0.38	2	0.09	
B I V A L V E S	0.34	0	0.08	
Sepia sp	0.32	2	0.08	
Heniochus acuminatus	0.21	2	0.05	
Upeneus moluccensis	0.04	4	0.01	
Choerodon robustus	0.02	2	0.01	
Total	420.43		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 21
DATE :29/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°51.57
start stop duration Lon E 81°11.99
TIME :10:52:12 11:21:21 29.2 (min) Purpose : 3
LOG : 2177.55 2179.13 1.6 Region : 10850
FDEPTH: 55 53 Gear cond.: 0
BDEPTH: 55 53 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.2 kn
Sorted : 133 Total catch: 133.22 Catch/hour: 274.11

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lutjanus rivulatus	71.58	8	26.12	71
Carangoides oblongus	60.04	126	21.90	
Plectorhinchus schotaf	29.44	6	10.74	
Epinephelus sp.	26.34	6	9.61	
Aluterus monoceros	24.28	45	8.86	
Gerres acinaces	12.26	33	4.47	
Lutjanus erythropterus	10.31	4	3.76	70
Lethrinus olivaceus	9.43	12	3.44	67
Alectis ciliaris	7.57	4	2.76	68
Sepia sp	4.69	16	1.71	
Plectorhinchus ceylonensis	3.58	2	1.31	
OSTRACIIDAE	2.59	4	0.95	
Parupeneus forsskali	1.93	23	0.71	
Epinephelus longispinis	1.43	4	0.52	69
TETRAODONTIDAE	1.23	4	0.45	
Scarus ghobban	1.09	2	0.40	
Choerodon robustus	1.07	2	0.39	
Arothron hispidus	0.86	2	0.32	
Fistularia petimba	0.86	14	0.32	
Ostracion rhinorhynchus	0.82	2	0.30	
Scolopsis bimaculata	0.78	4	0.29	0
Triacanthus biaculeatus	0.41	4	0.15	
Loligo sp.	0.29	12	0.11	
Sphyraena obtusata	0.29	4	0.11	
Sponges	0.25	4	0.09	
Tetrosomus gibbosus	0.25	2	0.09	
Chelonodon patoca	0.21	2	0.08	
Lutjanus quinquelineatus	0.12	2	0.05	
Scolopsis bimaculata	0.08	2	0.03	
Total	274.11		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 22
DATE :29/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°44.09
start stop duration Lon E 81°15.69
TIME :14:44:01 14:54:57 10.9 (min) Purpose : 3
LOG : 2207.01 2207.49 0.5 Region : 10850
FDEPTH: 73 74 Gear cond.: 0
BDEPTH: 73 74 Validity : 2
Towing dir: 0° Wire out : 200 m Speed : 2.6 kn
Sorted : 85 Total catch: 85.26 Catch/hour: 467.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aphareus furca	233.53	2449	49.99	
Lutjanus vitta	59.07	625	12.64	
Caranx ignobilis	27.12	5	5.81	73
Naso brevirostris	24.33	33	5.21	
Narcine atzi	14.85	44	3.18	
Equulites elongatus	14.79	3068	3.17	
Lutjanus quinquelineatus	11.23	153	2.40	
Narcine sp.	10.47	38	2.24	
Unidentified fish	9.86	849	2.11	
Nemipterus japonicus	7.67	148	1.64	
Carangoides sp.	7.67	16	1.64	
Unidentified fish	6.58	1233	1.41	
Priacanthus hamrur	5.42	16	1.16	
Sepia sp	4.71	16	1.01	
Fishing gears	4.66	0	1.00	
Upeneus moluccensis	3.67	88	0.79	
PENAEIDAE	2.47	1562	0.53	
Sepia pharaonis	2.41	5	0.52	72
Cyclichthys orbicularis	2.36	11	0.50	
Parascolopsis eriomma	1.59	55	0.34	
Nemipterus zysron	1.26	38	0.27	
Sunagocia carbunculus	1.15	33	0.25	
Scolopsis vosmeri	0.99	11	0.21	
Pterois sp.	0.93	33	0.20	
Scolopsis bimaculata	0.88	11	0.19	
Ambassis sp.	0.82	192	0.18	
Decapterus russelli	0.82	5	0.18	
Dipterygonotus balteatus	0.82	329	0.18	
Neotrygon caeruleopunctata	0.77	5	0.16	
Sphyraena obtusata	0.66	11	0.14	
Leiognathus berbis	0.55	55	0.12	
Fistularia petimba	0.44	5	0.09	
Synodus indicus	0.33	49	0.07	
Pseudorhombus sp.	0.33	5	0.07	
Hirundichthys speculiger	0.27	5	0.06	
Monomitopus conjugator	0.27	22	0.06	
PORTUNIDAE	0.27	27	0.06	
Unidentified fish	0.27	82	0.06	
Saurida nebulosa	0.22	11	0.05	
Trachinocephalus myops	0.16	5	0.04	
Bothus pantherinus	0.16	11	0.04	
Halieutaea stellata	0.16	16	0.04	
Muraenesox cinereus	0.11	5	0.02	
Pseudorhombus elevatus	0.05	5	0.01	
Total	467.18		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 23
DATE :29/06/18 GEAR TYPE: PT NO: 2 POSITION:Lat N 8°34.45
start stop duration Lon E 81°24.07
TIME :17:28:11 17:48:25 20.2 (min) Purpose : 1
LOG : 2225.13 2226.45 1.3 Region : 10850
FDEPTH: 100 110 Gear cond.: 0
BDEPTH: 521 550 Validity : 3
Towing dir: 0° Wire out : 320 m Speed : 3.9 kn
Sorted : 7 Total catch: 23.00 Catch/hour: 68.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
PANDALIDAE	60.61	58849	88.79	
S H R I M P S	3.40	8300	4.99	
GONATIDAE	3.39	1585	4.97	
CONGRIDAE	0.48	196	0.71	
Puerulus sewelli	0.12	65	0.18	
Unidentified larvae**	0.09	0	0.13	
Chauliodus sloani	0.06	9	0.08	
LOLIGINIDAE	0.06	83	0.08	
Waste General	0.01	0	0.01	
Metapenaeus elegans	0.01	9	0.01	
Bothidae - juvenile	0.01	9	0.01	
PORIFERA (Sponges)	0.00	9	0.01	
PALINURIDAE	0.00	18	0.01	
Phosichthys argenteus	0.00	9	0.00	
Benthosema sp.	0.00	9	0.00	
Unidentified larvae	0.00	9	0.00	
Total	68.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 24
DATE :30/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°28.29
start stop duration Lon E 81°29.73
TIME :09:26:02 09:55:54 29.9 (min) Purpose : 3
LOG : 2320.86 2322.45 1.6 Region : 10850
FDEPTH: 77 70 Gear cond.: 0
BDEPTH: 77 70 Validity : 1
Towing dir: 0° Wire out : 195 m Speed : 3.2 kn
Sorted : 29 Total catch: 28.86 Catch/hour: 57.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sponges	15.59	2	26.89	
Diodon holocanthus	15.35	10	26.48	
Caranx melampygus	9.52	2	16.43	74
Sepia pharaonis	3.43	2	5.93	75
Nemipterus peronii	3.09	189	5.34	
Fistularia petimba	2.33	8	4.02	
J E L L Y F I S H	1.39	0	2.39	
Tetrosomus gibbosus	1.17	6	2.01	
Hydrophis sp.	1.04	6	1.80	
Nemipterus randalli	1.04	38	1.80	
Sepia sp	0.98	20	1.70	79
Polyodontognathus caerulescens	0.96	2	1.66	
Mixed debries	0.80	0	1.39	
Priacanthus hamrur	0.70	2	1.21	
Synodus indicus	0.32	28	0.55	
Parascolopsis inermis	0.18	14	0.31	
SEAWEED	0.04	0	0.07	
Halieutichthys sp.	0.01	2	0.01	
Decapterus macrosoma	0.00	2	0.01	
Total	57.96		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 25
DATE :30/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°26.22
start stop duration Lon E 81°24.89
TIME :12:07:52 12:56:52 49.0 (min) Purpose : 3
LOG : 2332.76 2335.46 2.7 Region : 10850
FDEPTH: 27 25 Gear cond.: 0
BDEPTH: 27 25 Validity : 1
Towing dir: 0° Wire out : 125 m Speed : 3.3 kn
Sorted : 14 Total catch: 678.14 Catch/hour: 830.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
PORIFERA (Sponges)	367.42	2	44.24	
Dipterygonotus balteatus	111.76	42985	13.46	
Acanthurus dussumieri	73.02	81	8.79	
Lethrinus olivaceus	45.09	114	5.43	78
Amblygaster sirm	26.60	6653	3.20	82
Balistoides viridescens	18.52	9	2.23	
Diodon holocanthus	17.64	36	2.12	
Neotrygon caeruleopunctata	17.07	9	2.06	
Decapterus russelli	16.39	3035	1.97	81
Diodon hystrix	16.36	9	1.97	
Sphyraena forsteri	15.24	73	1.83	
Scolopsis bimaculata	14.50	136	1.75	
Gerres acinaces	11.17	0	1.34	
Scomberomorus commerson	8.33	2	1.00	77
Parupeneus indicus	7.96	28	0.96	
Gymnocranius griseus	7.64	33	0.92	
Arothron stellatus	6.52	1	0.78	
Epinephelus sp.	4.19	1	0.50	
Fistularia petimba	4.19	18	0.50	
Carangoides chrysophrys	4.09	15	0.49	
Tetrosomus gibbosus	4.07	18	0.49	
Upeneus moluccensis	3.48	15	0.42	
Naso annulatus	3.11	1	0.37	
Lutjanus malabaricus	2.79	2	0.34	
Siganus lineatus	2.65	5	0.32	
Nemipterus furcosus	2.13	27	0.26	
Sepia sp.	1.89	7	0.23	
Scarus ghobban	1.62	1	0.19	
Arothron sp.	1.59	2	0.19	
Rastrelliger kanagurta	1.54	223	0.19	80
Alectis ciliaris	1.48	1	0.18	76
Unidentified	1.43	2	0.17	
Thenus orientalis	1.30	4	0.16	
Upeneus sp.	1.22	1	0.15	
OSTRACIIDAE	1.22	1	0.15	
Abalistes stellatus	1.22	2	0.15	
Heniochus singularis	0.96	11	0.12	
Heniochus acuminatus	0.86	11	0.10	
TETRAODONTIDAE	0.72	1	0.09	
Hydrophis fasciatus	0.47	7	0.06	
Hydrophis cyanocinctus	0.34	1	0.04	
Ambassis sp.	0.32	64	0.04	
Actinopyga miliaris	0.20	1	0.02	
Pomacentrus indicus	0.18	4	0.02	
SEAWEED	0.06	1	0.01	
Unidentified	0.00	0	0.00	0
Total	830.54		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 26
DATE :30/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°17.01
start stop duration Lon E 81°30.63
TIME :15:18:27 15:39:13 20.8 (min) Purpose : 3
LOG : 2351.94 2352.96 1.0 Region : 10840
FDEPTH: 39 38 Gear cond.: 0
BDEPTH: 39 38 Validity : 2
Towing dir: 0° Wire out : 135 m Speed : 3.0 kn
Sorted : 102 Total catch: 102.03 Catch/hour: 294.61

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Unidentified fish	60.00	0	20.37	
Diodon hystrix	41.98	17	14.25	
Lutjanus quinquelineatus	30.81	257	10.46	
Tetrosomus gibbosus	27.66	121	9.39	
Diodon holocanthus	25.99	38	8.82	
Neotrygon caeruleopunctata	23.21	23	7.88	
Gymnocranius grandoculis	12.42	107	4.21	
Lutjanus lutjanus	11.46	179	3.89	83
OSTRACIIDAE	8.11	69	2.75	
Sepia pharaonis	6.12	6	2.08	86
Lethrinus lentjan	5.83	17	1.98	84
Sphyraena obtusata	5.77	20	1.96	
Abalistes stellatus	4.94	3	1.68	89
Selar crumenophthalmus	4.33	55	1.47	
Loligo sp.	4.30	87	1.46	87
Upeneus moluccensis	3.46	69	1.18	
Nemipterus peronii	3.26	90	1.11	
Thenus orientalis	3.23	17	1.10	
Lagocephalus lunaris	2.02	55	0.69	
Cyclichthys orbicularis	1.99	6	0.68	
Sphyraena forsteri	1.27	6	0.43	
Synodus indicus	1.07	49	0.36	
Sepia sp	1.06	20	0.36	90
Decapterus russelli	0.84	12	0.28	85
Synodus dermatogenys	0.81	52	0.27	
Lactoria cornuta	0.72	3	0.25	
Plectorhinchus lineatus	0.66	9	0.23	
Chromis sp.	0.38	26	0.13	
Fistularia petimba	0.14	3	0.05	
Sphyraena jello	0.14	20	0.05	
Scyllaridae	0.12	29	0.04	
Rastrelliger kanagurta	0.12	9	0.04	
Chelonodon patoca	0.12	12	0.04	
Dascyllus trimaculatus	0.09	3	0.03	
Aluterus monoceros	0.09	6	0.03	
Gymnocranius elongatus	0.06	9	0.02	
Synodus variegatus	0.01	3	0.00	
Total	294.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 27
DATE :30/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°19.16
start stop duration Lon E 81°33.03
TIME :17:02:14 17:22:33 20.3 (min) Purpose : 3
LOG : 2360.77 2361.82 1.1 Region : 10840
FDEPTH: 60 58 Gear cond.: 0
BDEPTH: 60 58 Validity : 2
Towing dir: 0° Wire out : 165 m Speed : 3.1 kn
Sorted : 130 Total catch: 144.97 Catch/hour: 428.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Naso tuberosus	152.58	154	35.63	91
Epinephelus coioides	62.45	6	14.58	
Miscellaneous	61.21	0	14.29	
Lutjanus lutjanus	41.08	467	9.59	93
Epinephelus malabaricus	18.49	3	4.32	114
Plectorhinchus sp.	12.41	6	2.90	
Lutjanus argentimaculatus	11.07	6	2.58	111
Scolopsis bimaculata	10.62	124	2.48	
Lutjanus rivulatus	9.90	3	2.31	
Ambassis ambassis	6.79	89	1.59	
Priacanthus hamrur	6.26	15	1.46	
Aphareus furca	5.26	198	1.23	
Tetrosomus gibbosus	4.75	27	1.11	
Upeneus moluccensis	3.25	127	0.76	
Acanthurus mata	3.01	6	0.70	
Plectorhinchus ceylonensis	2.78	3	0.65	
Lutjanus quinquelineatus	2.72	35	0.63	
Lethrinus olivaceus	2.66	3	0.62	112
Lethrinus nebulosus	2.49	3	0.58	113
Lethrinus olivaceus	2.38	12	0.55	92
Lutjanus lutjanus	2.01	9	0.47	
Nemipterus randalli	0.84	27	0.20	
Synodus dermatogenys	0.70	154	0.16	
Chaetodon sp.	0.56	12	0.13	
Saurida tumbil	0.56	12	0.13	
Synodus indicus	0.56	68	0.13	
Dipterygonotus balteatus	0.28	334	0.06	
Synodus variegatus	0.28	41	0.06	
Congresox talabon	0.14	12	0.03	
Callionymus sp.	0.14	27	0.03	
Chelonodon sp.	0.07	12	0.02	
Total	428.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 28
DATE :30/06/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 8°9.10
start stop duration Lon E 81°39.42
TIME :20:15:08 20:45:29 30.3 (min) Purpose : 3
LOG : 2384.07 2385.79 1.7 Region : 10840
FDEPTH: 67 65 Gear cond.: 0
BDEPTH: 67 65 Validity : 2
Towing dir: 0° Wire out : 170 m Speed : 3.4 kn
Sorted : 31 Total catch: 31.26 Catch/hour: 61.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lutjanus vitta	17.45	273	28.22	
Sphyraena jello	11.95	2	19.32	94
Naso annulatus	5.10	4	8.25	
Miscellaneous	3.46	0	5.60	
Miscellaneous	3.42	0	5.53	0
Cookeolus japonicus	3.03	18	4.89	
Lutjanus quinquelineatus	2.77	49	4.48	
Nemipterus furcosus	2.10	109	3.39	
Sepia sp	2.02	12	3.26	
Decapterus russelli	1.53	18	2.48	96
Diodon hystrix	1.46	2	2.37	
Nemipterus zysron	1.31	194	2.11	
Abalistes stellatus	1.30	4	2.10	
Ostorhinchus aureus	1.17	182	1.89	
Dactyloptena orientalis	1.03	2	1.66	
Neotrygon caeruleopunctata	0.85	4	1.38	
Synodus dermatogenys	0.40	49	0.64	
Tetrosomus gibbosus	0.28	2	0.45	
Krill	0.28	0	0.45	
Ambassis sp.	0.20	30	0.32	
Benthosema sp.	0.20	0	0.32	
S H R I M P S	0.20	42	0.32	
Alectis ciliaris	0.14	2	0.23	95
Pseudorhombus elevatus	0.12	14	0.19	
Trachinocephalus myops	0.08	10	0.12	
Pempheris sp.	0.02	14	0.03	
Total	61.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 29
DATE :01/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°55.95
start stop duration Lon E 81°41.44
TIME :01:23:26 01:43:58 20.5 (min) Purpose : 3
LOG : 2418.87 2419.90 1.0 Region : 10840
FDEPTH: 58 57 Gear cond.: 0
BDEPTH: 58 57 Validity : 1
Towing dir: 0° Wire out : 180 m Speed : 3.0 kn
Sorted : 73 Total catch: 167.41 Catch/hour: 489.02

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Decapterus russelli	167.13	33158	34.18	100
Loligo duvaucelii	49.58	1650	10.14	97
Diagramma pictum	46.74	15	9.56	108
Gymnocranius grandoculis	44.69	23	9.14	
Lutjanus rivulatus	44.34	9	9.07	109
Epinephelus malabaricus	28.63	3	5.85	
Epinephelus coioides	21.50	3	4.40	
Nemipterus furcosus	19.43	196	3.97	
Aluterus monoceros	16.71	9	3.42	
Decapterus macrosoma	16.65	745	3.40	99
Hydrophis cyanocinctus	6.78	6	1.39	
Dipterygonotus balteatus	6.54	2430	1.34	
Lutjanus malabaricus	6.02	3	1.23	107
Dactyloptena orientalis	4.38	6	0.90	
Amblygaster sirm	3.40	800	0.70	98
Miscellaneous	1.70	0	0.35	
SCOMBRIDAE	1.46	438	0.30	
Hydrophis ornatus	0.99	3	0.20	
Sphyraena forsteri	0.73	123	0.15	
Ambassis urotaenia	0.73	631	0.15	
J E L L Y F I S H	0.48	23	0.10	
Fistularia petimba	0.24	23	0.05	
Priacanthus hamrur	0.17	23	0.03	
Total	489.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 30
DATE :01/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°48.75
start stop duration Lon E 81°50.18
TIME :05:54:58 06:24:30 29.5 (min) Purpose : 3
LOG : 2444.01 2445.36 1.4 Region : 10840
FDEPTH: 61 59 Gear cond.: 0
BDEPTH: 61 59 Validity : 1
Towing dir: 0° Wire out : 180 m Speed : 2.7 kn
Sorted : 513 Total catch: 513.25 Catch/hour: 1042.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Coral - small	756.33	0	72.53	
Acanthurus mata	64.29	22	6.17	
Lutjanus rivulatus	61.08	12	5.86	104
Scarus rivulatus	52.44	14	5.03	102
Scarus rubroviolaceus	23.26	4	2.23	103
Naso tuberosus	20.44	16	1.96	106
Lutjanus rivulatus	20.24	4	1.94	
Lethrinus olivaceus	11.91	6	1.14	
Caranx ignobilis	8.66	2	0.83	101
Pseudobalistes fuscus	7.46	4	0.72	
Pomacanthus semicirculatus	6.91	4	0.66	
Heniochus acuminatus	3.25	14	0.31	
Abalistes stellatus	2.50	4	0.24	
Cyclichthys orbicularis	1.54	2	0.15	
Sufflamen fraenatum	1.10	2	0.11	
Sepia pharaonis	0.83	2	0.08	105
Sponges	0.22	2	0.02	
Crinoidea	0.10	4	0.01	
ASTEROIDEA	0.10	4	0.01	
SEAWEED	0.10	0	0.01	
Unidentified	0.04	0	0.00	
Unidentified fish	0.04	2	0.00	
Total	1042.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 31
DATE :01/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°48.38
start stop duration Lon E 81°41.66
TIME :07:55:30 08:25:50 30.3 (min) Purpose : 3
LOG : 2454.40 2456.14 1.7 Region : 10840
FDEPTH: 40 43 Gear cond.: 0
BDEPTH: 40 43 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.4 kn
Sorted : 396 Total catch: 395.71 Catch/hour: 782.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Unidentified fish	195.81	65	25.01	
Acanthurus mata	176.42	164	22.54	119
Pastinachus sp	72.15	2	9.22	
Scarus rubroviolaceus	54.92	10	7.02	
Naso tuberosus	53.73	30	6.86	122
Gnathanodon speciosus	40.30	12	5.15	123
Mixed debries	31.18	0	3.98	
Plectorhinchus gibbosus	19.62	6	2.51	
Diagramma pictum	18.27	10	2.33	121
Chelonodon sp.	15.69	8	2.00	
Starfish	14.64	10	1.87	
Aluterus monoceros	14.28	12	1.82	120
Epinephelus undulosus	11.12	2	1.42	125
Cyclichthys orbicularis	10.37	6	1.32	
Loligo sp.	8.11	148	1.04	
Aluterus scriptus	8.03	8	1.03	
Diodon holocanthus	7.91	8	1.01	
Lutjanus argentimaculatus	5.80	4	0.74	126
Balistoides viridescens	4.37	2	0.56	
Sepia pharaonis	3.50	8	0.45	
Seriolina nigrofasciata	3.20	2	0.41	
Hydrophis atriceps	3.13	16	0.40	
Ostracion cubicus	1.94	2	0.25	
Alectis ciliaris	1.62	6	0.21	
Tetrosomus gibbosus	1.44	6	0.18	
PORIFERA (Sponges)	1.43	0	0.18	
Gerres filamentosus	1.38	6	0.18	
Fistularia commersonii	1.29	8	0.16	
Thenus orientalis	0.44	2	0.06	
Sphyraena forsteri	0.38	2	0.05	
Polyodontognathus caerulescens	0.24	4	0.03	
Fistularia petimba	0.10	2	0.01	
Total	782.81		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 32
DATE :01/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°37.58
start stop duration Lon E 81°48.35
TIME :10:23:13 10:53:16 30.0 (min) Purpose : 3
LOG : 2471.24 2472.89 1.6 Region : 10840
FDEPTH: 24 24 Gear cond.: 0
BDEPTH: 24 24 Validity : 1
Towing dir: 0° Wire out : 120 m Speed : 3.3 kn
Sorted : 301 Total catch: 301.17 Catch/hour: 601.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sponges	423.44	0	70.39	
Diodon holocanthus	26.56	16	4.42	
Neotrygon caeruleopunctata	26.32	20	4.38	
Lethrinus olivaceus	22.25	92	3.70	115
Aluterus monoceros	18.89	12	3.14	
Chilomycterus reticulatus	13.38	24	2.22	
Jellyfish	10.51	28	1.75	
Balistoides viridescens	10.23	4	1.70	
Scolopsis bimaculata	7.67	74	1.28	
Sepia sp	6.55	12	1.09	
Chelonodon sp.	5.59	8	0.93	
Balistoides sp.	4.89	2	0.81	
Naso annulatus	4.47	2	0.74	
Aluterus sp.	4.23	136	0.70	
Ostracion rhinorhynchus	3.08	4	0.51	
Parupeneus forsskali	2.40	8	0.40	
Miscellaneous	2.24	0	0.37	
TETRAODONTIDAE	1.96	2	0.33	
Pseudobalistes sp.	1.92	2	0.32	
Hydrophis ornatus	1.32	4	0.22	
Gerres acinaces	1.32	6	0.22	
Fistularia petimba	1.08	6	0.18	
Scolopsis aurata	0.48	4	0.08	
Loligo duvaucelii	0.20	2	0.03	
Tetrosomus gibbosus	0.20	2	0.03	
Cephalopholis sonnerati	0.16	2	0.03	116
Pterois antennata	0.14	6	0.02	
Chaetodon gardineri	0.06	2	0.01	
Total	601.54		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 33
DATE :01/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°42.34
start stop duration Lon E 81°49.84
TIME :12:07:51 12:37:20 29.5 (min) Purpose : 3
LOG : 2480.33 2481.88 1.6 Region : 10840
FDEPTH: 57 57 Gear cond.: 0
BDEPTH: 57 57 Validity : 1
Towing dir: 0° Wire out : 165 m Speed : 3.1 kn
Sorted : 146 Total catch: 252.36 Catch/hour: 513.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sepia sp	77.23	334	15.04	
Dipterygonotus balteatus	75.72	16461	14.74	
Acanthurus mata	68.87	55	13.41	
Lethrinus olivaceus	56.54	47	11.01	128
Diagramma pictum	34.48	14	6.71	
J E L L Y F I S H	28.69	0	5.59	
Lutjanus argentimaculatus	20.19	8	3.93	
Lutjanus argentimaculatus	18.58	8	3.62	117
Naso annulatus	15.06	8	2.93	
Aluterus monoceros	14.78	8	2.88	
Lutjanus rivulatus	12.82	2	2.50	
Gerres longirostris	11.64	41	2.27	
Miscellaneous	10.14	0	1.97	
Epinephelus sp.	8.59	2	1.67	
Ostracion meleagris	7.49	8	1.46	
Metal waste	7.45	2	1.45	
Caranx ignobilis	6.96	2	1.36	
Selar crumenophthalmus	6.51	31	1.27	
Lethrinus nebulosus	4.62	2	0.90	118
Fistularia petimba	4.53	10	0.88	
Loligo duvaucelii	3.67	183	0.71	
Abalistes stellaris	3.58	6	0.70	
Parupeneus forsskali	2.65	49	0.52	
Decapterus russelli	2.16	145	0.42	127
Neotrygon caeruleopunctata	1.95	4	0.38	
Ambassis sp.	1.94	0	0.38	
Rhinobatos annulatus	1.59	2	0.31	
Priacanthus hamrur	1.14	2	0.22	
Sphyraena forsteri	0.92	4	0.18	
MONACANTHIDAE	0.81	4	0.16	
Nemipterus furcosus	0.65	10	0.13	
Scolopsis bimaculata	0.65	10	0.13	
Tetrosomus gibbosus	0.41	2	0.08	
Hydrophis cyanocinctus	0.28	2	0.06	
Odonus niger	0.11	10	0.02	
Cephalopholis sonnerati	0.11	10	0.02	
POMACANTHIDAE	0.11	10	0.02	
Total	513.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 34
DATE :02/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°31.18
start stop duration Lon E 81°51.75
TIME :03:06:09 03:34:18 28.2 (min) Purpose : 3
LOG : 2553.98 2555.36 1.4 Region : 10840
FDEPTH: 35 35 Gear cond.: 0
BDEPTH: 35 35 Validity : 1
Towing dir: 0° Wire out : 130 m Speed : 2.9 kn
Sorted : 88 Total catch: 88.21 Catch/hour: 187.95

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diodon holocanthus	68.10	83	36.23	
Chilomycterus reticulatus	25.53	15	13.58	
J E L L Y F I S H	21.56	0	11.47	
Ostracion rhinorhynchus	10.82	13	5.76	
Ostracion cubicus	8.99	11	4.78	
Xestospongia sp.	8.86	0	4.72	
Caranx ignobilis	7.27	40	3.87	135
Tetrosomus gibbosus	6.86	21	3.65	
Carangoides gymnostethus	5.75	11	3.06	
Lactoria cornuta	4.82	9	2.56	
Sepia sp	2.86	21	1.52	
Gerres acinaces	2.60	15	1.38	0
Arothron hispidus	2.58	2	1.37	
Abalistes stellatus	2.51	2	1.34	
Miscellaneous	2.22	0	1.18	
Hydrophis cyanocinctus	1.53	6	0.82	
Rhynchostracion nasus	1.36	2	0.73	
Arothron stellatus	1.11	2	0.59	
Decapterus macrosoma	1.00	371	0.53	137
Equulites elongatus	0.53	181	0.28	
Nemipterus furcosus	0.30	26	0.16	
Decapterus russelli	0.30	68	0.16	136
Dipterygonotus balteatus	0.19	47	0.10	
Carangoides sp.	0.13	13	0.07	
Psettodes belcheri	0.04	2	0.02	
Scolopsis aurata	0.04	2	0.02	
Hydrophis sp.	0.04	2	0.02	
Pycnogonid	0.02	4	0.01	
Scolopsis bimaculata	0.02	2	0.01	
SEAWEED	0.00	0	0.00	
Total	187.95		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 35
DATE :02/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°28.44
start stop duration Lon E 81°57.42
TIME :05:33:49 06:05:00 31.2 (min) Purpose : 3
LOG : 2569.89 2571.32 1.4 Region : 10840
FDEPTH: 69 73 Gear cond.: 0
BDEPTH: 69 73 Validity : 1
Towing dir: 0° Wire out : 190 m Speed : 2.7 kn
Sorted : 30 Total catch: 30.04 Catch/hour: 57.82

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lethrinus olivaceus	25.47	40	44.05	130
Abalistes stellatus	6.79	8	11.75	
Mixed debries	5.00	0	8.66	
Chilomycterus sp.	4.02	4	6.96	
Dactyloptena orientalis	3.27	6	5.66	
Sepia pharaonis	3.00	13	5.19	129
Fishing gears	2.91	0	5.03	
Gymnocranius elongatus	2.37	13	4.10	
Ostracion sp.	1.92	2	3.33	
Pterois miles	0.92	4	1.60	
J E L L Y F I S H	0.77	4	1.33	
Priacanthus hamrur	0.46	2	0.80	
Hydrophis cyanocinctus	0.42	2	0.73	
Unidentified	0.31	10	0.53	
Coral	0.10	8	0.17	
PORIFERA (Sponges)	0.02	2	0.03	
Scolopsis aurata	0.02	2	0.03	
Starfish	0.02	8	0.03	
Unidentified fish	0.01	2	0.02	
Total	57.82		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 36
DATE :02/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°22.34
start stop duration Lon E 81°54.08
TIME :07:56:03 08:38:22 42.3 (min) Purpose : 3
LOG : 2585.40 2587.90 2.5 Region : 10840
FDEPTH: 29 30 Gear cond.: 0
BDEPTH: 29 30 Validity : 1
Towing dir: 0° Wire out : 145 m Speed : 3.6 kn
Sorted : 341 Total catch: 341.27 Catch/hour: 484.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Xestospongia sp.	240.37	0	49.66	
Himantura leoparda	120.57	1	24.91	
Diodon sp.	50.67	61	10.47	
Scarus rubroviolaceus	10.87	1	2.24	
Naso tuberosus	9.15	4	1.89	131
Chelonodon sp.	7.45	7	1.54	
Ostracion cubicus	6.87	6	1.42	
Mixed debries	6.68	0	1.38	
Naso sp.	6.61	3	1.37	
Acanthurus xanthopterus	3.69	1	0.76	
Diagramma pictum	3.65	1	0.75	134
Arothron sp.	3.63	1	0.75	
Sepia pharaonis	2.50	7	0.52	132
Lethrinus olivaceus	1.82	62	0.38	
J E L L Y F I S H	1.80	3	0.37	
Abalistes stellatus	1.76	1	0.36	
Tetrosomus gibbosus	0.82	3	0.17	
Gymnocranius elongatus	0.78	3	0.16	
Nemipterus zysron	0.77	48	0.16	
Lactoria cornuta	0.74	1	0.15	
Fistularia commersonii	0.64	4	0.13	
Gnathanodon speciosus	0.55	1	0.11	
Sufflamen fraenatum	0.47	3	0.10	
Polyodontognathus caerulescens	0.43	1	0.09	
Hydrophis sp.	0.37	1	0.08	
Scolopsis bimaculata	0.11	1	0.02	
Equulites elongatus	0.09	41	0.02	
Soft corals	0.07	4	0.01	
Chaetodon sp.	0.07	1	0.01	
Loligo sp.	0.03	1	0.01	133
Chromis sp.	0.03	6	0.01	
Unidentified fish	0.01	1	0.00	
SCOMBRIDAE	0.01	4	0.00	
Starfish	0.01	4	0.00	
Siganus sp.	0.01	1	0.00	
Decapterus russelli	0.01	3	0.00	
BALISTIDAE	0.01	1	0.00	
Total	484.08		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 37
DATE :02/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°23.00
start stop duration Lon E 81°58.18
TIME :10:08:57 10:34:00 25.1 (min) Purpose : 3
LOG : 2598.66 2600.17 1.5 Region : 10840
FDEPTH: 52 53 Gear cond.: 0
BDEPTH: 52 53 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.6 kn
Sorted : 234 Total catch: 233.65 Catch/hour: 559.42

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Xestospongia sp.	137.31	0	24.54	
Scarus rubroviolaceus	83.08	14	14.85	
Lethrinus olivaceus	57.76	81	10.32	145
Naso sp.	54.49	29	9.74	
Epinephelus malabaricus	54.11	2	9.67	138
Lutjanus rivulatus	45.99	7	8.22	142
Naso tuberosus	41.88	22	7.49	140
Abalistes stellatus	11.44	12	2.05	
Acanthurus mata	10.77	7	1.93	141
Lutjanus argentimaculatus	10.18	2	1.82	147
Epinephelus undulosus	10.01	2	1.79	144
Naso unicornis	7.47	5	1.34	
Pomacanthus semicirculatus	5.39	2	0.96	
Acanthurus dussumieri	5.34	2	0.95	
Alectis indica	4.62	2	0.83	139
Diodon sp.	4.55	5	0.81	
Lethrinus nebulosus	3.47	2	0.62	146
Bohadschia marmorata	2.97	2	0.53	
Sepia pharaonis	2.94	10	0.53	143
Arothron sp	2.56	2	0.46	
Fistularia commersonii	1.20	12	0.21	
Lactoria cornuta	0.98	2	0.18	
Sponges	0.48	0	0.09	
Hydrophis sp.	0.43	2	0.08	
Total	559.43		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 38
DATE :02/07/18 GEAR TYPE: PT NO: 8 POSITION:Lat N 7°18.99
start stop duration Lon E 82°1.37
TIME :11:45:23 12:23:06 37.7 (min) Purpose : 1
LOG : 2608.07 2611.93 3.9 Region : 10840
FDEPTH: 30 60 Gear cond.: 0
BDEPTH: 330 337 Validity : 3
Towing dir: 0° Wire out : 300 m Speed : 6.1 kn
Sorted : 3 Total catch: 8.15 Catch/hour: 12.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
EGGS	5.95	0	45.91	
Loligo sp.	2.69	1918	20.76	
SCOMBRIDAE	1.78	716	13.71	
Decapterus russelli	0.67	1550	5.13	
Stegastes sp.	0.57	536	4.39	
Ambassis sp.	0.54	584	4.15	
J E L L Y F I S H	0.36	10	2.77	
CONGRIDAE	0.18	68	1.42	
Unid. juvenile fishes	0.09	18	0.69	
Unidentified	0.09	18	0.69	
Unidentified	0.01	18	0.07	
Unidentified	0.01	10	0.07	
S H R I M P S	0.01	10	0.07	
BALISTIDAE	0.01	10	0.07	
Unidentified	0.01	89	0.07	
Total	12.96		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 39
DATE :02/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 7°11.97
start stop duration Lon E 81°59.54
TIME :13:35:24 14:05:28 30.1 (min) Purpose : 3
LOG : 2619.05 2620.67 1.6 Region : 10840
FDEPTH: 55 55 Gear cond.: 0
BDEPTH: 55 55 Validity : 2
Towing dir: 0° Wire out : 170 m Speed : 3.2 kn
Sorted :2257 Total catch: 2256.60 Catch/hour: 4505.69

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Coral - mixed	3993.34	0	88.63	
Naso annulatus	226.24	168	5.02	
Lethrinus olivaceus	105.18	162	2.33	148
Acanthurus mata	36.34	44	0.81	
Lutjanus rivulatus	28.19	4	0.63	
Gerres acinaces	20.19	52	0.45	
Diagramma pictum	11.78	6	0.26	
Sepia sp	9.06	40	0.20	
Naso tonganus	8.97	4	0.20	
Naso tuberosus	8.29	4	0.18	
Epinephelus sp.	7.51	2	0.17	
Miscellaneous	7.39	0	0.16	
Sponges	7.39	0	0.16	
Lutjanus vitta	6.91	48	0.15	
Lutjanus quinquelineatus	6.07	80	0.13	
Pristipomoides sieboldii	5.07	30	0.11	
Epinephelus malabaricus	4.86	8	0.11	149
Carangoides coeruleopinnatus	1.96	6	0.04	
Bohadschia spp.	1.68	6	0.04	
Ostorhinchus aureus	1.48	142	0.03	
Starfish	1.42	24	0.03	
Actinopyga echinites	1.22	8	0.03	
Heniochus acuminatus	1.18	6	0.03	
Cookeolus sp.	1.16	4	0.03	
J E L L Y F I S H	0.86	2	0.02	
Tetrosomus gibbosus	0.54	2	0.01	
Parupeneus macronemus	0.28	6	0.01	
Hydrophis cyanocinctus	0.24	2	0.01	
Sargocentron diadema	0.22	2	0.00	
Fistularia petimba	0.20	2	0.00	
ANGUILLIDAE	0.20	2	0.00	
Dactyloptena orientalis	0.16	2	0.00	
URCHINS	0.12	6	0.00	
S H R I M P S	0.02	8	0.00	
Total	4505.70		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 40
DATE :02/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°52.75
start stop duration Lon E 81°54.21
TIME :20:56:27 21:16:59 20.5 (min) Purpose : 3
LOG : 2673.16 2673.95 0.8 Region : 10840
FDEPTH: 23 25 Gear cond.: 7
BDEPTH: 23 25 Validity : 2
Towing dir: 0° Wire out : 130 m Speed : 2.3 kn
Sorted : 137 Total catch: 2603.74 Catch/hour: 7605.85

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	7302.82	0	96.02	
Lethrinus nebulosus	84.30	41	1.11	152
Caranx ignobilis	77.12	9	1.01	
Siganus javus	63.68	61	0.84	
Lutjanus rivulatus	23.08	3	0.30	151
Lethrinus lentjan	18.75	23	0.25	153
Neotrygon caeruleopunctata	7.51	3	0.10	
Diodon hystrix	6.11	3	0.08	
Lethrinus microdon	5.61	6	0.07	
Diodon holocanthus	4.82	6	0.06	
Lactoria cornuta	3.18	6	0.04	
Selaroides leptolepis	2.45	114	0.03	
Sillago ingenuua	1.72	53	0.02	
Pentaprion longimanus	1.31	70	0.02	
Hydrophis sp.	1.17	3	0.02	
Pseudorhombus elevatus	0.73	6	0.01	
Loligo duvaucelii	0.47	9	0.01	154
Sardinella gibbosa	0.44	18	0.01	150
Nibea maculata	0.41	3	0.01	
Thryssa encrasicholoides	0.38	18	0.00	
Starfish	0.38	18	0.00	
Gazza achlamys	0.35	20	0.00	
Synodus indicus	0.32	6	0.00	
Nemipterus zysron	0.32	3	0.00	
Stolephorus indicus	0.23	23	0.00	
Sphyraena obtusata	0.20	9	0.00	
Pterocaesio chrysozona	0.18	6	0.00	
Pomadasys maculatus	0.15	3	0.00	
Unidentified	0.07	3	0.00	
Grammoplites suppositus	0.06	3	0.00	
Equulites elongatus	0.06	23	0.00	
Carangoides sp.	0.06	3	0.00	
Dipterygonotus balteatus	0.06	9	0.00	
Ambassis sp.	0.03	15	0.00	
Hippocampus kuda	0.03	3	0.00	
Caesio caerulaurea	0.03	3	0.00	
Elops machnata	0.01	9	0.00	
Total	7608.60		100.04	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 41
DATE :02/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°47.21
start stop duration Lon E 81°52.32
TIME :23:44:41 00:05:08 20.4 (min) Purpose : 3
LOG : 2687.55 2688.52 1.0 Region : 10840
FDEPTH: 35 35 Gear cond.: 0
BDEPTH: 35 35 Validity : 2
Towing dir: 0° Wire out : 140 m Speed : 2.8 kn
Sorted : 24 Total catch: 208.61 Catch/hour: 612.05

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Leiognathus dussumieri	348.35	14335	56.91	161
Siganus javus	49.15	29	8.03	
Upeneus moluccensis	45.79	1039	7.48	
Selaroides leptolepis	37.55	1006	6.14	
Secutor insidiator	22.59	672	3.69	
Pomadasys argyreus	17.10	519	2.79	
Carangoides malabaricus	16.49	91	2.69	
Selar crumenophthalmus	10.38	214	1.70	
Saurida tumbil	8.55	29	1.40	
Scomberomorus sp.	7.98	3	1.30	
Sphyraena forsteri	6.70	91	1.09	
Johnius carutta	5.19	91	0.85	
Ctenochaetus striatus	4.75	3	0.78	
Megalaspis cordyla	4.40	9	0.72	
Terapon jarbua	4.27	62	0.70	
Gerres erythrourus	4.27	62	0.70	
Chilomycterus reticulatus	3.46	3	0.57	
Ephippus orbis	2.44	29	0.40	
Lapemis curtus	2.41	6	0.39	
Thryssa encrasicholoides	2.07	1526	0.34	
Nibea maculata	1.62	50	0.27	
Equulites leuciscus	1.22	62	0.20	
Hydrophis sp.	1.00	6	0.16	
Nemipterus furcosus	0.92	62	0.15	
Hydrophis spiralis	0.88	3	0.14	
Portunus sanguinolento	0.82	6	0.13	
Pentaprion longimanus	0.61	244	0.10	
Loligo duvaucelii	0.31	62	0.05	
Fishing gears	0.31	0	0.05	
Plotosus lineatus	0.15	29	0.02	
Sepia sp	0.15	29	0.02	
Balistididae juvenile	0.15	29	0.02	
Total	612.04		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 42
DATE :03/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°46.16
start stop duration Lon E 81°57.31
TIME :01:30:10 01:50:18 20.1 (min) Purpose : 3
LOG : 2696.59 2697.55 0.9 Region : 10840
FDEPTH: 55 53 Gear cond.: 0
BDEPTH: 55 53 Validity : 1
Towing dir: 0° Wire out : 165 m Speed : 2.8 kn
Sorted : 22 Total catch: 22.42 Catch/hour: 66.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pomadasys maculatus	19.67	405	29.44	
Sepia sp	13.71	72	20.52	
Saurida nebulosa	9.45	250	14.14	
Loligo duvaucelii	4.71	95	7.05	158
Upeneus sulphureus	3.22	75	4.82	
Sand doller	2.98	250	4.46	
Seriola rivoliana	2.09	3	3.12	
Leiognathus dussumieri	1.52	75	2.27	
Cookeolus boops	1.34	12	2.01	
Carangoides malabaricus	1.31	12	1.96	156
Hydrophis sp.	1.28	3	1.92	
Terapon jarbua	0.80	6	1.20	
Tetrosomus gibbosus	0.63	3	0.94	
Mixed debries	0.54	0	0.80	
Selar crumenophthalmus	0.54	24	0.80	
Selaroides leptolepis	0.42	9	0.62	
Decapterus russelli	0.42	45	0.62	157
Lagocephalus sp.	0.39	6	0.58	
URCHINS	0.33	57	0.49	
Upeneus bensasi	0.33	27	0.49	
Gerres sp.	0.33	69	0.49	
Sphyraena obtusata	0.27	3	0.40	155
Nemipterus peronii	0.24	3	0.36	
Secutor insidiator	0.12	6	0.18	
J E L L Y F I S H	0.12	9	0.18	
Selaroides leptolepis	0.09	3	0.13	0
Total	66.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 43
DATE :03/07/18 GEAR TYPE: PT NO: 8 POSITION:Lat N 6°38.82
start stop duration Lon E 82°9.25
TIME :04:01:40 05:01:30 59.8 (min) Purpose : 1
LOG : 2714.13 2718.13 4.0 Region : 10840
FDEPTH: 30 60 Gear cond.: 0
BDEPTH: 0 0 Validity : 3
Towing dir: 0° Wire out : 280 m Speed : 4.0 kn
Sorted : 1 Total catch: 7.08 Catch/hour: 7.10

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Unidentified	4.92	9468	69.31	
NEMIPTERIDAE	0.62	190	8.74	
Unidentified	0.45	895	6.30	
Leptocephalus	0.34	111	4.72	
CARANGIDAE	0.23	293	3.30	
Loligo sp.	0.15	173	2.15	
Unidentified	0.15	0	2.12	
SCOMBRIDAE	0.12	105	1.72	
Unidentified	0.05	27	0.71	
BALISTIDAE	0.03	22	0.47	
TETRAODONTIDAE	0.02	16	0.23	
Unidentified	0.01	16	0.16	
PRIACANTHIDAE	0.01	5	0.07	
Unidentified	0.00	10	0.03	
Total	7.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 44
DATE :03/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°34.88
start stop duration Lon E 81°50.73
TIME :19:02:54 19:33:06 30.2 (min) Purpose : 3
LOG : 2787.50 2789.27 1.8 Region : 10840
FDEPTH: 39 37 Gear cond.: 0
BDEPTH: 39 37 Validity : 2
Towing dir: 0° Wire out : 130 m Speed : 3.5 kn
Sorted : 44 Total catch: 53.11 Catch/hour: 105.51

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lutjanus lutjanus	12.00	2	11.37	165
Nemipterus furcosus	11.84	93	11.22	
J E L L Y F I S H	11.64	0	11.03	
Lethrinus nebulosus	11.17	4	10.58	164
Pseudobalistes fuscus	8.66	6	8.21	
Epinephelus undulosus	7.67	2	7.27	163
Chelonodon sp.	5.17	2	4.90	
Neotrygon caeruleopunctata	4.73	2	4.48	
Plectorhinchus ceylonensis	4.61	2	4.37	162
Dipterygonotus balteatus	2.70	1351	2.56	
Ambassis sp.	2.67	570	2.53	
Rhizoprionodon acutus	2.66	2	2.52	
Synodus dermatogenys	2.13	2162	2.02	
Arothron hispidus	1.91	2	1.81	
Sepia pharaonis	1.43	8	1.36	166
Gymnocranius griseus	1.43	2	1.36	
Scolopsis bimaculata	1.27	10	1.21	
Sepia sp	1.07	32	1.02	167
Lactoria cornuta	0.99	2	0.94	
Sphyraena forsteri	0.87	10	0.83	
Ostracion sp.	0.83	2	0.79	
Diodon holocanthus	0.79	2	0.75	
Thryssa baelama	0.79	81	0.75	
Synodus indicus	0.74	95	0.70	
Upeneus bensasi	0.70	97	0.66	
Sphyraena jello	0.68	2	0.64	
Tetrosomus gibbosus	0.60	2	0.56	
Loligo sp.	0.48	157	0.46	
Ilisha africana	0.40	14	0.38	
Mixed debries	0.36	0	0.34	
Octopus sp.	0.33	54	0.31	
Gymnocranius elongatus	0.29	28	0.28	
Decapterus macrosoma	0.28	52	0.26	
Unidentified larvae	0.20	628	0.19	
Lagocephalus lunaris	0.20	10	0.19	
Thryssa setirostris	0.20	24	0.19	
S H R I M P S	0.18	280	0.18	
Unidentified fish	0.17	364	0.17	
Nemipterus zysron	0.16	4	0.15	
Pentaprion longimanus	0.16	6	0.15	
Nemipterus sp.	0.13	14	0.12	0
Unidentified fish	0.13	306	0.12	
Chromis cadenati	0.12	36	0.11	
Thryssa vitrirostris	0.12	10	0.11	
Caranx sp.	0.09	72	0.08	
Unidentified crab	0.09	44	0.08	
Synodus variegatus	0.08	16	0.08	
Ambassis sp.	0.08	16	0.08	0
SEAWEED	0.06	0	0.05	
Alectis sp.	0.06	44	0.05	
Equulites elongatus	0.06	44	0.05	0
Hydrophis sp.	0.04	2	0.04	
Synodus jaculum	0.04	2	0.04	
Equulites elongatus	0.04	8	0.04	
juvenile stingray	0.04	2	0.04	
Sphyraena obtusata	0.04	2	0.04	
Aluterus monoceros	0.03	4	0.03	
Total	106.42		100.87	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 45
DATE :03/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°29.67
start stop duration Lon E 81°44.46
TIME :21:39:09 22:09:14 30.1 (min) Purpose : 3
LOG : 2803.92 2805.57 1.7 Region : 10840
FDEPTH: 23 28 Gear cond.: 0
BDEPTH: 23 28 Validity : 2
Towing dir: 0° Wire out : 130 m Speed : 3.3 kn
Sorted : 173 Total catch: 173.30 Catch/hour: 345.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Terapon jarbua	99.53	1203	28.79	
Jellyfish	77.37	353	22.38	160
Plicofollis dussumieri	19.50	18	5.64	169
Sphyraena jello	16.99	2	4.92	186
Equulites leuciscus	14.36	997	4.15	
Pomadasys argyreus	12.17	279	3.52	
Leiognathus equulus	11.05	134	3.20	
Saurida tumbil	10.05	467	2.91	0
Mulloidichthys vanicolensis	8.94	413	2.59	
Strophidon sathete	6.06	2	1.75	
JELLYFISH	5.98	16	1.73	159
Otolithes cuvieri	5.94	24	1.72	
Lagocephalus spadiceus	5.83	40	1.69	
Gymnura poecilura	5.66	2	1.64	
Lethrinus nebulosus	5.59	2	1.62	168
Scomberomorus koreanus	5.03	18	1.46	173
Otolithes cuvieri	3.95	2064	1.14	0
Portunus sanguinolento	3.95	108	1.14	
Ephippus orbis	3.75	36	1.08	
Sepia sp	3.59	162	1.04	
Scomberomorus commerson	3.23	0	0.94	172
Monodactylus sp.	2.87	162	0.83	
Hydrophis sp.	2.19	4	0.63	
Portunus sanguinolento	1.80	72	0.52	0
Loligo duvaucelii	1.44	54	0.42	
Alectis ciliaris	1.08	54	0.31	171
Sphyraena obtusata	1.08	54	0.31	174
Sardinella gibbosa	1.08	54	0.31	170
Narcine timlei	0.88	4	0.25	
Ilisha sp.	0.80	2	0.23	
S H R I M P S	0.72	108	0.21	
Lepturacanthus savala	0.52	10	0.15	
Neotrygon caeruleopunctata	0.36	2	0.10	
Carcharhinus sorrah	0.36	2	0.10	187
Polydactylus sexfilis	0.36	18	0.10	
Selaroides leptolepis	0.36	36	0.10	
Carcharhinus sp.	0.29	18	0.08	
Saurida tumbil	0.28	2	0.08	
Penaeus monodon	0.28	2	0.08	
Hydrophis fasciatus	0.24	2	0.07	
Penaeus indicus	0.16	10	0.05	
Total	345.68		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 46
DATE :04/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°16.04
start stop duration Lon E 81°37.64
TIME :02:57:13 03:26:12 29.0 (min) Purpose : 3
LOG : 2841.51 2843.19 1.7 Region : 10830
FDEPTH: 53 48 Gear cond.: 0
BDEPTH: 53 48 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.5 kn
Sorted : 198 Total catch: 288.62 Catch/hour: 597.15

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Epinephelus coioides	82.06	8	13.74	182
Ambassis sp.	62.42	0	10.45	
Lethrinus nebulosus	60.29	21	10.10	178
Sepia sp	53.40	103	8.94	
Decapterus macrosoma	47.50	0	7.96	
Lutjanus erythropterus	38.15	25	6.39	185
Lutjanus rivulatus	31.41	0	5.26	
Diagramma pictum	27.56	6	4.62	
Abalistes stellatus	24.83	21	4.16	
Loligo duvaucelii	24.28	4179	4.07	184
Gymnocranius grandoculis	22.26	4	3.73	181
Epinephelus undulosus	17.88	4	2.99	183
Saurida nebulosa	14.91	261	2.50	
Neotrygon caeruleopunctata	13.08	6	2.19	
Nemipterus bipunctatus	11.09	139	1.86	
Panulirus ornatus	9.10	2	1.52	180
Arothron stellatus	7.90	2	1.32	
Rachycentron canadum	7.24	2	1.21	
Rhynchostracion sp.	5.67	6	0.95	
J E L L Y F I S H	5.42	37	0.91	
Lagocephalus lunaris	4.16	712	0.70	
Netuma thalassina	3.85	2	0.64	0
Pentaprion longimanus	3.81	190	0.64	
Sphyraena sp.	3.12	538	0.52	
Dipterygonotus balteatus	2.77	867	0.46	
Lethrinus lentjan	2.28	4	0.38	179
Leiognathus splendens	1.74	139	0.29	
Pterocaesio chrysozona	1.73	329	0.29	
Equulites elongatus	1.39	1266	0.23	
Pomacentrus pavo	1.03	190	0.17	
Netuma thalassina	1.03	17	0.17	
Lapemis curtus	0.99	2	0.17	
Thenus orientalis	0.74	2	0.12	
Carangoides ferdau	0.69	52	0.12	
Nemipterus furcosus	0.41	2	0.07	
Hydrophis ornatus	0.33	2	0.06	0
Hydrophis ornatus	0.33	2	0.06	
Scolopsis bimaculata	0.29	2	0.05	
Plotosus lineatus	0.08	17	0.01	
Total	597.24		100.01	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 47
DATE :04/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°12.99
start stop duration Lon E 81°28.26
TIME :05:48:00 06:17:55 29.9 (min) Purpose : 3
LOG : 2859.01 2860.68 1.7 Region : 10830
FDEPTH: 28 29 Gear cond.: 0
BDEPTH: 28 29 Validity : 1
Towing dir: 0° Wire out : 130 m Speed : 3.4 kn
Sorted : 38 Total catch: 83.30 Catch/hour: 167.11

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	50.99	475	30.51	
Cyclichthys orbicularis	24.25	14	14.51	
Sillago ingenuua	21.29	518	12.74	
Unidentified	18.64	2796	11.16	
Diodon holocanthus	9.48	6	5.67	
Selaroides leptolepis	9.16	291	5.48	
Carcharhinus falciformis	8.99	4	5.38	175
Loligo sp.	5.10	207	3.05	
Abalistes stellatus	4.53	4	2.71	
Sepia pharaonis	3.12	6	1.87	
Sphyraena jello	2.53	58	1.51	
Oreosoma atlanticum	2.33	4	1.39	
Tetrosomus gibbosus	1.52	4	0.91	
Carangoides sp.	0.95	70	0.57	
Sepia sp	0.87	22	0.52	
Sphyraena forsteri	0.87	34	0.52	
Decapterus russelli	0.83	48	0.50	177
Rastrelliger kanagurta	0.55	10	0.33	176
Hydrophis sp.	0.48	2	0.29	
Sea snakes	0.24	2	0.14	
Dipterygonotus balteatus	0.24	0	0.14	
Amblygaster sirm	0.08	4	0.05	
Starfish	0.08	4	0.05	
Total	167.11		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 48
DATE :04/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°1.95
start stop duration Lon E 81°30.54
TIME :10:16:54 10:47:10 30.3 (min) Purpose : 3
LOG : 2890.60 2892.14 1.5 Region : 10830
FDEPTH: 268 280 Gear cond.: 0
BDEPTH: 268 280 Validity : 1
Towing dir: 0° Wire out : 640 m Speed : 3.1 kn
Sorted : 326 Total catch: 630.17 Catch/hour: 1249.10

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Centrophorus granulosus	404.96	87	32.42	196
Unidentified fish	342.52	8737	27.42	
Peristedion sp.	163.09	254	13.06	206
Unidentified	112.39	4460	9.00	
Unidentified	39.60	373	3.17	
Unidentified	36.79	1952	2.95	
Unidentified	35.32	1758	2.83	
Benthosema sp.	32.11	2755	2.57	
Unidentified fish	17.66	1713	1.41	
Little brown blotch	17.66	26	1.41	
Deep sea shrimps	10.70	2517	0.86	
Chlorophthalmus agassizi	7.61	345	0.61	
Unidentified fish	7.49	54	0.60	
Centrophorus sp.	5.11	2	0.41	
OPHICHTHIDAE	4.28	26	0.34	
Unidentified	3.45	2	0.28	
Unidentified squids and crustaceans	1.74	2	0.14	
Unidentified	1.72	79	0.14	
Unidentified crab	1.61	161	0.13	
Gephyroberyx darwini	1.51	2	0.12	
Unidentified	1.07	54	0.09	0
Unidentified 'longsnout'	0.54	54	0.04	
Squid unidentified	0.08	2	0.01	
Unidentified black fish	0.04	4	0.00	
Unidentified	0.04	4	0.00	
Total	1249.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 49
DATE :04/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°6.25
start stop duration Lon E 81°25.81
TIME :12:26:19 12:51:31 25.2 (min) Purpose : 3
LOG : 2903.10 2904.48 1.4 Region : 10830
FDEPTH: 60 61 Gear cond.: 0
BDEPTH: 60 61 Validity : 1
Towing dir: 0° Wire out : 180 m Speed : 3.3 kn
Sorted : 159 Total catch: 252.31 Catch/hour: 600.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lutjanus rivulatus	147.56	21	24.57	200
Ambassis sp.	78.17	15634	13.02	
Lutjanus lutjanus	56.38	1121	9.39	205
Lutjanus argentimaculatus	52.69	12	8.78	203
Sphyraena obtusata	37.47	1442	6.24	199
Loligo sp.	36.52	816	6.08	
Aethaloperca rogaa	34.41	10	5.73	201
Naso annulatus	33.80	12	5.63	
Acanthurus dussumieri	29.37	29	4.89	
Abalistes stellatus	19.22	17	3.20	
Dipterygonotus balteatus	11.53	1802	1.92	
Lutjanus erythropterus	9.09	5	1.51	202
Diagramma pictum	7.52	2	1.25	
Sepia sp	6.41	31	1.07	
Acanthurus dussumieri	6.05	12	1.01	0
Lutjanus lutjanus	5.85	117	0.98	
Loligo sp.	5.24	100	0.87	198
Decapterus macrosoma	4.81	95	0.80	204
Cookeolus japonicus	4.48	2	0.75	
Neotrygon caeruleopunctata	3.38	2	0.56	
Sarda orientalis	3.24	2	0.54	
Selar crumenophthalmus	2.88	31	0.48	
Nemipterus bipunctatus	1.28	64	0.21	
J E L L Y F I S H	1.28	17	0.21	
Pempheris sp.	0.96	159	0.16	
Hydrophis sp.	0.67	2	0.11	
Plastic	0.24	2	0.04	
Total	600.50		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 50
DATE :04/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 6°6.51
start stop duration Lon E 81°17.15
TIME :16:21:50 16:44:19 22.5 (min) Purpose : 3
LOG : 2926.80 2928.03 1.2 Region : 10830
FDEPTH: 49 51 Gear cond.: 0
BDEPTH: 49 51 Validity : 2
Towing dir: 0° Wire out : 180 m Speed : 3.3 kn
Sorted : 42 Total catch: 270.48 Catch/hour: 721.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Saurida nebulosa	257.99	5931	35.75	
Ambassis sp.	137.60	98284	19.07	
Abalistes stellatus	77.64	72	10.76	
Loligo sp.	59.08	912	8.19	189
Synodus indicus	32.43	1523	4.49	
Dipterygonotus balteatus	28.01	6003	3.88	
Neotrygon caeruleopunctata	26.63	19	3.69	
Naso tuberosus	14.83	8	2.06	351
Nemipterus bipunctatus	14.74	269	2.04	
S H R I M P S	12.29	8775	1.70	
Pseudorhombus sp.	8.60	859	1.19	
Synodus dermatogenys	8.35	392	1.16	
Sargocentron rubrum	5.90	24	0.82	
Sepia pharaonis	5.65	24	0.78	190
Diodon holocanthus	5.31	13	0.74	
Decapterus russelli	3.93	539	0.54	
Upeneus bensasi	2.95	245	0.41	
Diodon sp.	2.93	5	0.41	
Paramonacanthus nipponensis	2.21	195	0.31	
Sepia sp	1.96	48	0.27	191
Unidentified	1.52	3	0.21	
Equulites elongatus	1.47	662	0.20	
Fistularia petimba	1.47	293	0.20	
Carangoides sp.	1.47	96	0.20	
Siganus canaliculatus	1.47	24	0.20	
Thysanophrys chiltonae	0.98	24	0.14	
Cociella crocodila	0.98	72	0.14	
Ichthyscopus lebeck	0.49	24	0.07	
Pterocaesio chrysozona	0.49	48	0.07	
DACTYLOPTERIDAE	0.49	123	0.07	
Lutjanus lutjanus	0.49	72	0.07	
Congresox talabon	0.49	48	0.07	
TETRAODONTIDAE	0.44	72	0.06	
Chromis sp.	0.17	24	0.02	
Eduarctus martensii	0.12	24	0.02	
Total	721.60		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 51
DATE :04/07/18 GEAR TYPE: PT NO: 4 POSITION:Lat N 5°59.01
start stop duration Lon E 81°18.63
TIME :18:51:49 19:22:25 30.6 (min) Purpose : 1
LOG : 2943.84 2945.60 1.8 Region : 10830
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 71 63 Validity : 3
Towing dir: 0° Wire out : 145 m Speed : 3.4 kn
Sorted : 10 Total catch: 10.34 Catch/hour: 20.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Selar crumenophthalmus	10.25	286	50.56	
Dipterygonotus balteatus	5.69	682	28.04	
Loligo sp.	3.02	192	14.89	195
Decapterus macrosoma	0.84	18	4.16	194
Auxis sp.	0.33	6	1.64	192
Decapterus russelli	0.11	6	0.56	193
Diodon sp.	0.01	2	0.06	
Octopus sp.	0.01	4	0.05	
Sufflamen sp.	0.01	10	0.05	
Total	20.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 52
DATE :05/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°55.35
start stop duration Lon E 81°11.44
TIME :09:58:36 10:27:02 28.4 (min) Purpose : 3
LOG : 3014.28 3015.83 1.6 Region : 10830
FDEPTH: 68 68 Gear cond.: 0
BDEPTH: 68 68 Validity : 1
Towing dir: 0° Wire out : 190 m Speed : 3.3 kn
Sorted : 133 Total catch: 276.73 Catch/hour: 584.01

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Miscellaneous	295.74	0	50.64	
Sponges	186.77	0	31.98	
Loligo sp.	42.43	2121	7.27	210
Epinephelus undulosus	18.23	4	3.12	207
Acanthurus mata	13.97	21	2.39	
Diagramma pictum	8.02	2	1.37	208
Lutjanus argentimaculatus	4.41	2	0.76	211
Acroteriobatus variegatus	3.10	2	0.53	
Naso tuberosus	2.85	4	0.49	
Gymnocranius griseus	2.53	6	0.43	
Sargocentron rubrum	1.52	6	0.26	
Aphareus rutilans	1.14	11	0.20	
Nemipterus zysron	0.63	11	0.11	
Sepia pharaonis	0.61	27	0.11	209
Fistularia petimba	0.40	2	0.07	
Chaetodon gardineri	0.34	6	0.06	
Lutjanus lutjanus	0.32	2	0.05	
Odonus niger	0.27	2	0.05	
Unidentified	0.23	6	0.04	
Scolopsis bimaculata	0.15	2	0.03	
Apolemichthys xanthotis	0.15	4	0.03	
Lutjanus bengalensis	0.13	2	0.02	
Synodus dermatogenys	0.06	2	0.01	
Total	584.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 53
DATE :05/07/18 GEAR TYPE: PT NO: 1 POSITION:Lat N 6°2.30
start stop duration Lon E 80°59.69
TIME :13:49:01 14:07:11 18.2 (min) Purpose : 1
LOG : 3036.76 3037.92 1.2 Region : 10830
FDEPTH: 15 25 Gear cond.: 0
BDEPTH: 39 45 Validity : 3
Towing dir: 0° Wire out : 90 m Speed : 3.8 kn
Sorted : 26 Total catch: 172.42 Catch/hour: 569.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Rastrelliger kanagurta	278.06	11643	48.81	213
Decapterus macrosoma	234.30	31659	41.13	214
Dipterygonotus balteatus	26.52	5002	4.66	
Herklotsichthys quadrimaculat.	12.38	1213	2.17	212
Thryssa encrasicholoides	11.05	463	1.94	
J E L L Y F I S H	2.65	0	0.47	
Lutjanus vitta	1.10	20	0.19	
Aluterus monoceros	0.88	86	0.15	
Ablennes hians	0.76	3	0.13	
Ambassis sp.	0.44	198	0.08	
Alectis ciliaris	0.44	43	0.08	
Loligo sp.	0.44	198	0.08	
Sepia sp	0.22	86	0.04	
Plastic	0.22	20	0.04	
Sphyraena obtusata	0.22	66	0.04	
Total	569.68		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 54
DATE :05/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°58.83
start stop duration Lon E 81°1.59
TIME :15:35:55 15:57:05 21.2 (min) Purpose : 3
LOG : 3047.08 3048.25 1.2 Region : 10830
FDEPTH: 61 61 Gear cond.: 0
BDEPTH: 61 61 Validity : 2
Towing dir: 0° Wire out : 185 m Speed : 3.3 kn
Sorted : 16 Total catch: 46.34 Catch/hour: 131.35

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pomadasys argyreus	33.81	2486	25.74	
Pempheris sp.	27.41	34257	20.87	
Paramonacanthus sp.	17.87	4470	13.61	
Neotrygon caeruleopunctata	6.07	3	4.62	
Saurida tumbil	5.96	380	4.54	
Loligo duvaucelii	4.91	142	3.74	218
Aethaloperca rogaa	4.08	3	3.11	
Miscellaneous	3.57	0	2.72	0
Abalistes stellatus	3.46	3	2.63	
Saurida undosquamis	2.68	357	2.04	0
S H R I M P S	2.38	1400	1.81	
Equulites elongatus	2.38	626	1.81	0
Cookeolus sp.	2.38	9	1.81	
Nemipterus bipunctatus	2.23	1	1.70	
Ostorhinchus aureus	2.09	298	1.59	
Unidentified crab	1.79	774	1.36	0
Sepia sp	1.62	119	1.23	
Unidentified crustacean	1.50	37	1.14	
Pomadasys argyreus	1.49	179	1.14	0
Equulites elongatus	1.04	156	0.79	
Ambassis sp.	0.60	119	0.45	0
Fistularia petimba	0.45	14	0.34	
Diodon holocanthus	0.40	3	0.30	
Saurida undosquamis	0.30	14	0.23	
Loligo sp.	0.30	60	0.23	
ANGUILLIDAE	0.15	23	0.11	
Stolephorus waitei	0.15	9	0.11	
Bothus pantherinus	0.15	23	0.11	
Unidentified crab	0.07	9	0.06	
Bothus pantherinus	0.03	31	0.02	0
Lutjanus vitta	0.01	9	0.01	
Ambassis sp.	0.01	9	0.01	
Total	131.35		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 55
DATE :05/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°54.90
start stop duration Lon E 81°0.43
TIME :17:48:19 18:08:59 20.7 (min) Purpose : 3
LOG : 3058.31 3059.39 1.1 Region : 10830
FDEPTH: 73 74 Gear cond.: 0
BDEPTH: 73 74 Validity : 2
Towing dir: 0° Wire out : 195 m Speed : 3.1 kn
Sorted : 10 Total catch: 9.82 Catch/hour: 28.51

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Equulites elongatus	8.21	1399	28.81	
Abalistes stellatus	4.09	3	14.35	
Paramonacanthus nipponensis	2.18	604	7.64	
Sargocentron rubrum	2.15	9	7.53	
Priacanthus hamrur	2.03	6	7.13	
Rhinobatos annulatus	1.83	9	6.41	
Octopus sp.	1.09	29	3.83	
Gonichthys sp.	0.73	232	2.55	
Mixed debries	0.70	0	2.44	
Unidentified	0.52	6	1.83	
S H R I M P S	0.52	2525	1.81	
Nemipterus bipunctatus	0.46	6	1.63	
Nemipterus randalli	0.44	9	1.53	
Trachinocephalus myops	0.32	17	1.12	
Synodus dermatogenys	0.29	15	1.02	
Loligo sp.	0.28	17	1.00	215
Ambassis sp.	0.26	136	0.92	
Unidentified	0.23	38	0.81	
Selar crumenophthalmus	0.23	6	0.81	
Sepia sp	0.20	6	0.71	217
Parascolopsis eriomma	0.20	3	0.71	
Sufflamen sp.	0.17	29	0.61	
Strophidon sathete	0.15	6	0.53	
Fistularia petimba	0.15	3	0.51	
Unidentified crab	0.15	136	0.51	
Nemipterus furcosus	0.15	12	0.51	
Unidentified	0.12	3	0.41	
Starfish	0.09	38	0.31	
Parabothus polylepis	0.09	12	0.31	
Parapercis sp.	0.09	3	0.31	
Nemipterus zysron	0.09	3	0.31	
Sepia pharaonis	0.07	6	0.24	216
Decapterus russelli	0.06	3	0.20	
CALLIONYMIDAE	0.06	3	0.20	
PARALEPIDIDAE	0.03	6	0.10	
Unidentified	0.03	46	0.10	
Pterois antennata	0.03	3	0.10	
Rogadius pristiger	0.03	3	0.10	
TETRAODONTIDAE	0.01	3	0.03	
OGCOCEPHALIDAE	0.01	3	0.02	
Total	28.51		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 56
DATE :05/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°56.14
start stop duration Lon E 80°50.57
TIME :22:18:43 22:38:56 20.2 (min) Purpose : 3
LOG : 3095.28 3096.32 1.0 Region : 10830
FDEPTH: 65 64 Gear cond.: 0
BDEPTH: 65 64 Validity : 2
Towing dir: 0° Wire out : 170 m Speed : 3.1 kn
Sorted : 37 Total catch: 66.22 Catch/hour: 196.59

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Ambassis sp.	54.64	78056	27.79	
Soft corals	31.57	0	16.06	
Diagramma pictum	30.28	9	15.40	
Lutjanus lutjanus	15.38	148	7.82	219
Loligo sp.	13.96	297	7.10	221
Sepia pharaonis	4.99	18	2.54	220
Nemipterus zysron	4.19	68	2.13	
Neotrygon caeruleopunctata	3.80	9	1.93	
Sargocentron rubrum	3.06	15	1.56	
Pseudorhombus sp.	3.03	59	1.54	
Paramonacanthus nipponensis	3.03	0	1.54	
Synodus dermatogenys	3.03	95	1.54	
Scolopsis bimaculata	2.70	15	1.37	
Pempheris sp.	2.43	546	1.24	
DASYATIDAE	2.08	3	1.06	
Cyclichthys orbicularis	1.90	12	0.97	
S H R I M P S	1.82	1576	0.93	
Krill	1.82	1820	0.93	
Ostorhinchus aureus	1.82	181	0.93	
Priacanthus hamrur	1.43	3	0.72	
Bothus pantherinus	1.21	238	0.62	
Plotosus lineatus	1.21	484	0.62	
Lutjanus madras	0.89	48	0.45	
Parapercis pulchella	0.74	24	0.38	
Coral - mixed	0.61	59	0.31	
Unidentified	0.61	59	0.31	
Unidentified crab	0.61	59	0.31	
Sepia sp	0.61	303	0.31	
Upeneus bensasi	0.56	9	0.29	
Nemipterus bipunctatus	0.50	6	0.26	
Scolopsis vosmeri	0.48	6	0.24	
Saurida undosquamis	0.48	24	0.24	
Scorpaena sp.	0.30	3	0.15	
Ichthyscopus lebeck	0.24	3	0.12	
Trachinocephalus myops	0.21	3	0.11	
Rhinobatos annandalei	0.18	3	0.09	
Rogadius serratus	0.12	3	0.06	
Nemipterus randalli	0.09	3	0.05	
Total	196.59		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 57
DATE :06/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°54.97
start stop duration Lon E 80°44.55
TIME :01:31:49 01:55:04 23.2 (min) Purpose : 3
LOG : 3112.34 3114.27 1.9 Region : 10830
FDEPTH: 64 64 Gear cond.: 0
BDEPTH: 64 64 Validity : 1
Towing dir: 0° Wire out : 185 m Speed : 0.0 kn
Sorted : 48 Total catch: 47.53 Catch/hour: 122.71

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sepia sp	44.30	132	36.10	
Loligo duvaucelii	33.15	485	27.01	222
Nemipterus bipunctatus	10.59	173	8.63	
Cookeolus sp.	5.01	21	4.08	
Saurida tumbil	4.75	103	3.87	
Neotrygon caeruleopunctata	4.75	3	3.87	
Nemipterus tambuloides	4.13	93	3.37	
Ambassis sp.	3.30	4131	2.69	
Abalistes stellatus	2.79	3	2.27	
Decapterus macrosoma	1.86	3	1.51	224
Trachinocephalus myops	1.60	23	1.30	
MONACANTHIDAE	1.50	287	1.22	
Sargocentron diadema	1.08	5	0.88	
Lutjanus lutjanus	0.72	8	0.59	223
Fistularia petimba	0.72	18	0.59	
Starfish	0.62	103	0.50	
Lagocephalus spadiceus	0.57	10	0.46	
Lepturacanthus savala	0.52	5	0.42	
Bothus pantherinus	0.34	8	0.27	
Miscellaneous	0.23	5	0.19	
Soft corals	0.18	0	0.15	
Total	122.71		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 58
DATE :06/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°54.63
start stop duration Lon E 80°30.28
TIME :05:06:39 05:27:46 21.1 (min) Purpose : 3
LOG : 3138.53 3139.82 1.3 Region : 10830
FDEPTH: 40 41 Gear cond.: 0
BDEPTH: 40 41 Validity : 1
Towing dir: 0° Wire out : 130 m Speed : 3.7 kn
Sorted : 251 Total catch: 261.38 Catch/hour: 742.57

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Himantura gerrardi	201.99	9	27.20	
Acanthurus mata	133.41	65	17.97	230
Lethrinus olivaceus	131.70	31	17.74	225
Lutjanus erythropterus	83.58	51	11.26	226
Carangoides fulvoguttatus	38.75	230	5.22	229
Drepane punctata	17.05	9	2.30	
Epinephelus undulosus	16.70	3	2.25	234
Neotrygon caeruleopunctata	16.19	9	2.18	
Abalistes stellatus	15.45	14	2.08	
Carangoides fulvoguttatus	14.46	14	1.95	236
Rachycentron canadum	8.52	3	1.15	
J E L L Y F I S H	8.44	62	1.14	
Sepia pharaonis	6.94	11	0.94	232
Acroteriobatus variegatus	5.34	6	0.72	
Fistularia petimba	4.89	85	0.66	
Diodon holocanthus	4.60	9	0.62	
Lethrinus lentjan	4.38	6	0.59	227
Tetrosomus gibbosus	4.32	17	0.58	
Lethrinus mahsena	3.95	6	0.53	228
Elagatis bipinnulata	3.95	6	0.53	
Loligo sp.	3.68	523	0.50	233
Decapterus macrosoma	3.68	838	0.50	
Lutjanus argentimaculatus	3.10	3	0.42	235
Lethrinus nebulosus	2.87	3	0.39	
Parupeneus indicus	1.34	3	0.18	
Iniistius pavo	1.05	3	0.14	
Alectis ciliaris	0.97	17	0.13	231
Soft corals	0.79	0	0.11	
Pterois sp.	0.23	3	0.03	
Starfish	0.16	51	0.02	
Nemipterus bipunctatus	0.11	3	0.02	
Total	742.57		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 59
DATE :06/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°56.45
start stop duration Lon E 80°22.52
TIME :07:29:41 08:01:30 31.8 (min) Purpose : 3
LOG : 3152.84 3154.50 1.7 Region : 10820
FDEPTH: 44 39 Gear cond.: 6
BDEPTH: 44 39 Validity : 1
Towing dir: 0° Wire out : 155 m Speed : 3.1 kn
Sorted : 76 Total catch: 91.89 Catch/hour: 173.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Neotrygon caeruleopunctata	56.95	40	32.86	
Loligo sp.	32.58	14810	18.80	
Carangoides malabaricus	26.85	81	15.50	240
Sepia pharaonis	18.05	47	10.42	237
Diodon sp.	4.86	2	2.81	
Nemipterus bipunctatus	4.51	30	2.60	
J E L L Y F I S H	3.75	2	2.17	239
Fistularia petimba	3.60	68	2.08	
Decapterus macrosoma	3.02	45	1.74	238
Acroteriobatus variegatus	2.64	2	1.52	
Diodon hystrix	2.56	2	1.48	
Abalistes stellatus	2.21	2	1.27	
Arothron sp.	2.17	2	1.25	
Priacanthus hamrur	1.77	6	1.02	
Seriolina nigrofasciata	1.77	2	1.02	
Psettodes erumei	1.70	2	0.98	
J E L L Y F I S H	1.51	0	0.87	0
Tetrosomus gibbosus	1.24	6	0.72	
Saurida nebulosa	0.60	2	0.35	
PEMPHERIDAE	0.32	9	0.18	
Fistularia petimba	0.30	15	0.17	0
Lutjanus lutjanus	0.17	2	0.10	
Trachinocephalus myops	0.08	2	0.04	
Parabothus polylepis	0.06	2	0.03	
Total	173.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 60
DATE :07/07/18 GEAR TYPE: BT NO: 1 POSITION:Lat N 5°55.24
start stop duration Lon E 80°10.77
TIME :01:50:32 02:14:06 23.6 (min) Purpose : 3
LOG : 3245.91 3247.32 1.4 Region : 10820
FDEPTH: 78 75 Gear cond.: 0
BDEPTH: 78 75 Validity : 1
Towing dir: 0° Wire out : 230 m Speed : 3.6 kn
Sorted : 85 Total catch: 86.09 Catch/hour: 219.14

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Acanthurus mata	53.76	48	24.53	
Epinephelus undulosus	31.62	8	14.43	
Loligo duvaucelii	30.50	1087	13.92	253
Miscellaneous	23.62	0	10.78	
Lutjanus rivulatus	22.04	3	10.06	
Lutjanus erythropterus	11.53	8	5.26	241
Sepia sp	7.94	46	3.62	
Sponges	7.13	0	3.25	
Lethrinus ornatus	5.01	36	2.29	243
Lutjanus sp.	4.02	15	1.84	
Lutjanus lutjanus	4.02	20	1.84	244
Nemipterus randalli	2.47	33	1.13	
Epinephelus areolatus	2.34	8	1.07	242
Gerres acinaces	1.91	5	0.87	
Abalistes stellatus	1.58	3	0.72	
Cookeolus sp.	1.27	10	0.58	
Diodon holocanthus	1.27	8	0.58	
Fistularia petimba	1.02	18	0.46	
J E L L Y F I S H	0.87	64	0.39	
Starfish	0.81	193	0.37	
Soft corals	0.78	0	0.36	
Nemipterus bipunctatus	0.66	10	0.30	
Trachinocephalus myops	0.59	23	0.27	
Parupeneus cinnabaricus	0.53	5	0.24	
Scolopsis sp.	0.53	8	0.24	
Synodus jaculum	0.28	8	0.13	
Atule mate	0.25	8	0.12	245
MONACANTHIDAE	0.25	31	0.12	
Acanthocepola indica	0.18	3	0.08	
Upeneus sp.	0.15	8	0.07	
Ophiuroidae	0.15	10	0.07	
Equulites elongatus	0.03	5	0.01	
Total	219.14		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 61
DATE :07/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 5°58.16
start stop duration Lon E 80°13.57
TIME :03:25:09 03:56:06 30.9 (min) Purpose : 3
LOG : 3254.84 3256.68 1.9 Region : 10820
FDEPTH: 59 56 Gear cond.: 0
BDEPTH: 59 56 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.6 kn
Sorted : 137 Total catch: 136.95 Catch/hour: 265.57

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Abalistes stellatus	81.37	97	30.64	
Sepia sp	58.84	268	22.15	
Epinephelus undulosus	28.93	6	10.89	
Neotrygon caeruleopunctata	22.84	12	8.60	
Loligo sp.	12.37	419	4.66	250
Miscellaneous	11.95	0	4.50	
Priacanthus hamrur	10.20	33	3.84	
Nemipterus bipunctatus	4.63	64	1.75	
Saurida nebulosa	4.05	149	1.53	
Sphyraena obtusata	3.49	138	1.31	
Argyrops spinifer	3.12	4	1.18	
Fistularia petimba	2.87	111	1.08	
Lutjanus argentimaculatus	2.11	2	0.80	251
Upeneus moluccensis	1.86	16	0.70	
Nemipterus zysron	1.65	16	0.62	
J E L L Y F I S H	1.57	12	0.59	252
Narcine atzi	1.45	2	0.55	
Parupeneus indicus	1.36	4	0.51	
Tetrosomus gibbosus	1.24	6	0.47	
Grammatobothus polyophthalmus	0.95	39	0.36	
Lagocephalus lunaris	0.91	41	0.34	
Cyclichthys orbicularis	0.89	4	0.34	
Soft corals	0.85	0	0.32	
Gymnocranius griseus	0.83	2	0.31	
Unidentified fish	0.81	0	0.31	
Sponges	0.58	0	0.22	
Ambassis sp.	0.54	301	0.20	
Unidentified crab	0.43	68	0.16	
Scolopsis bimaculata	0.43	2	0.16	
Saurida tumbil	0.39	2	0.15	
Diodon holocanthus	0.37	2	0.14	
Gymnothorax punctatus	0.33	2	0.12	
Fishing gears	0.31	0	0.12	
Epinephelus areolatus	0.21	2	0.08	
Carangoides sp.	0.17	2	0.07	
POMACANTHIDAE	0.14	8	0.05	
Chaetodon gardineri	0.14	2	0.05	
Unidentified crab	0.10	12	0.04	0
Trachinocephalus myops	0.10	4	0.04	
Rogadius pristiger	0.10	6	0.04	
Alectis indica	0.06	2	0.02	
Unidentified crab	0.01	2	0.00	0
Total	265.57		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 62
DATE :07/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 5°55.03
start stop duration Lon E 80°24.12
TIME :06:20:18 06:51:49 31.5 (min) Purpose : 3
LOG : 3272.46 3274.11 1.6 Region : 10820
FDEPTH: 63 60 Gear cond.: 0
BDEPTH: 63 60 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.1 kn
Sorted : 49 Total catch: 49.30 Catch/hour: 93.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sepia pharaonis	42.44	116	45.19	246
Cyclichthys orbicularis	19.35	920	20.61	
J E L L Y F I S H	6.32	0	6.73	
Rhinobatos annandalei	5.35	4	5.70	
Pseudorhombus elevatus	3.12	1101	3.33	
Eupleurogrammus glossodon	2.08	2	2.21	
Nemipterus bipunctatus	1.90	38	2.03	
Fistularia petimba	1.68	2	1.78	
Mixed debries	1.52	0	1.62	
Abalistes stellatus	1.47	2	1.56	
Tetrosomus gibbosus	1.41	8	1.50	
Loligo sp.	1.41	46	1.50	249
Fistularia petimba	0.91	82	0.97	0
Starfish	0.80	200	0.85	
Priacanthus hamrur	0.72	2	0.77	
Urchin	0.72	67	0.77	
Sphyraena jello	0.61	34	0.65	
Dactyloptena orientalis	0.50	2	0.53	
J E L L Y F I S H	0.34	2	0.37	248
Nemipterus zysron	0.30	8	0.32	
Sorsogona tuberculata	0.23	11	0.24	
Saurida nebulosa	0.21	2	0.22	
Sand doller	0.15	19	0.16	
Soft corals	0.11	0	0.12	
Unidentified crab	0.11	17	0.12	
Unidentified fish	0.04	6	0.04	
Paramonacanthus nipponensis	0.04	8	0.04	
J E L L Y F I S H	0.04	2	0.04	247
Total	93.90		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 63
DATE :07/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 5°52.86
start stop duration Lon E 80°22.69
TIME :08:01:51 08:25:19 23.5 (min) Purpose : 3
LOG : 3279.82 3281.02 1.2 Region : 10820
FDEPTH: 72 64 Gear cond.: 0
BDEPTH: 72 64 Validity : 1
Towing dir: 0° Wire out : 175 m Speed : 3.1 kn
Sorted : 44 Total catch: 43.71 Catch/hour: 111.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lutjanus lutjanus	28.64	97	25.62	261
Epinephelus undulosus	25.37	8	22.69	262
Lutjanus lunulatus	24.14	97	21.60	348
Loligo sp.	12.46	455	11.14	260
Sepia sp	5.49	15	4.91	259
Iago omanensis	3.79	3	3.39	
Fistularia petimba	2.20	36	1.97	
Starfish	1.53	384	1.37	
Narcine atzi	1.33	3	1.19	
Acanthurus mata	1.28	3	1.14	
Lutjanus argentimaculatus	1.28	3	1.14	263
URCHINS	1.07	59	0.96	
Cyclichthys orbicularis	0.97	3	0.87	
Soft corals	0.77	0	0.69	
Mixed debries	0.66	0	0.59	
J E L L Y F I S H	0.41	59	0.37	
Unidentified crab	0.10	31	0.09	
Pseudorhombus triocellatus	0.08	3	0.07	
POMACENTRIDAE	0.05	5	0.05	
Unidentified fish	0.05	41	0.05	
Ichthyscopus lebeck	0.05	3	0.05	
Sphyraena jello	0.03	5	0.02	
Rogadius pristiger	0.03	3	0.02	
Paramonacanthus nipponensis	0.02	3	0.01	
Total	111.80		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 64
DATE :07/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 6°2.43
start stop duration Lon E 80°7.62
TIME :11:19:36 11:49:21 29.8 (min) Purpose : 3
LOG : 3300.70 3302.46 1.8 Region : 10820
FDEPTH: 55 52 Gear cond.: 0
BDEPTH: 55 52 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.5 kn
Sorted : 63 Total catch: 145.75 Catch/hour: 293.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pentaprion longimanus	213.02	6950	72.50	
Plastic	32.26	20	10.98	
Carangoides malabaricus	15.36	8	5.23	
Loligo duvaucelii	9.33	185	3.18	258
Cookeolus sp.	6.13	14	2.09	
Arothron stellatus	5.79	2	1.97	
Sphyraena jello	1.36	141	0.46	254
Saurida tumbil	1.13	2	0.38	
Bothus pantherinus	1.13	46	0.38	
Saurida tumbil	1.13	38	0.38	0
Decapterus russelli	1.13	93	0.38	257
Pterois sp.	1.01	4	0.34	
Lutjanus lutjanus	0.98	4	0.33	256
Unidentified crab	0.85	10	0.29	
Nemipterus randalli	0.75	10	0.25	
Fistularia petimba	0.75	10	0.25	
Alectis ciliaris	0.73	10	0.25	255
Tetrosomus gibbosus	0.48	2	0.16	
Acanthurus - juvenile	0.19	18	0.06	
Unidentified fish	0.19	28	0.06	
Penaeus monodon	0.16	2	0.05	
Fishing gears	0.00	2	0.00	
Total	293.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 65
DATE :07/07/18 GEAR TYPE: PT NO: 1 POSITION:Lat N 5°53.95
start stop duration Lon E 79°57.60
TIME :14:14:59 14:48:56 34.0 (min) Purpose : 1
LOG : 3321.00 3321.91 0.9 Region : 10820
FDEPTH: 30 30 Gear cond.: 0
BDEPTH: 0 0 Validity : 3
Towing dir: 0° Wire out : 95 m Speed : 1.6 kn
Sorted : 38 Total catch: 97.70 Catch/hour: 172.61

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
S H R I M P S	125.51	100410	72.71	
Promethichthys prometheus	28.71	2049	16.63	
Cyclichthys orbicularis	5.05	562	2.92	
Unidentified squids and crustaceans	2.52	0	1.46	
Gonichthys sp.	2.52	1007	1.46	
Unidentified fish	2.33	87	1.35	
Selar crumenophthalmus	2.13	9	1.24	
Trachipterus sp.	2.05	4	1.19	
BALISTIDAE	0.78	106	0.45	
Krill	0.39	9673	0.22	
Avocettina sp.	0.19	67	0.11	
Unidentified	0.10	87	0.06	
Paramonacanthus nipponensis	0.10	9	0.06	
DACTYLOPTERIDAE	0.08	28	0.04	
Astronesthes sp.	0.05	9	0.03	
Loligo duvaucelii	0.05	9	0.03	
PALINURIDAE	0.03	18	0.02	
Sudis sp.	0.03	18	0.02	
Unidentified fish	0.02	9	0.01	
Total	172.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 66
DATE :07/07/18 GEAR TYPE: PT NO: 4 POSITION:Lat N 6°3.39
start stop duration Lon E 79°55.33
TIME :18:07:10 18:26:14 19.1 (min) Purpose : 1
LOG : 3347.69 3348.61 0.9 Region : 10820
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 65 65 Validity : 3
Towing dir: 0° Wire out : 120 m Speed : 2.9 kn
Sorted : 19 Total catch: 75.80 Catch/hour: 238.72

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Auxis thazard	143.10	3250	59.94	266
Loligo sp.	74.38	98	31.16	265
Loligo duvaucelii	10.11	145	4.24	264
Decapterus macrosoma	8.00	110	3.35	268
Selar crumenophthalmus	1.97	47	0.82	
Decapterus russelli	0.74	22	0.31	267
PORTUNIDAE	0.22	9	0.09	
Paramonacanthus nipponensis	0.09	22	0.04	
Chilomycterus sp.	0.06	9	0.03	
Sufflamen sp.	0.06	9	0.03	
Total	238.72		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 67
DATE :07/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 6°4.83
start stop duration Lon E 80°3.11
TIME :20:16:57 20:41:19 24.4 (min) Purpose : 3
LOG : 3361.09 3362.20 1.1 Region : 10820
FDEPTH: 71 71 Gear cond.: 0
BDEPTH: 71 71 Validity : 2
Towing dir: 0° Wire out : 175 m Speed : 2.7 kn
Sorted : 26 Total catch: 25.78 Catch/hour: 63.45

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Nemipterus zysron	10.93	204	17.22	
Sepia pharaonis	9.06	20	14.27	270
Nemipterus bipunctatus	5.71	103	9.00	
Sargocentron rubrum	5.41	30	8.53	
Octopus sp.	2.90	17	4.58	
Paramonacanthus nipponensis	2.78	2503	4.38	
Diodon holocanthus	2.31	15	3.65	
Saurida nebulosa	2.26	49	3.57	
Fistularia petimba	2.26	81	3.57	
Neotrygon caeruleopunctata	2.26	2	3.57	
Psettodes erumei	1.97	2	3.10	
Sepia latimanus	1.92	54	3.03	
Ambassis sp.	1.72	861	2.72	
Tetrosomus gibbosus	1.43	10	2.25	
Unidentified crab	1.35	0	2.13	
J E L L Y F I S H	1.13	111	1.78	
Squillidae	0.98	25	1.55	
Pseudorhombus elevatus	0.84	94	1.32	
S H R I M P S	0.69	861	1.09	
Parapercis sp.	0.64	25	1.01	
Loligo duvaucelii	0.54	20	0.85	269
LAGANIDAE	0.44	81	0.70	
Pentaprion longimanus	0.39	15	0.62	
Rogadius pristiger	0.39	22	0.62	
Unidentified	0.34	1199	0.54	
Priacanthus hamrur	0.34	30	0.54	0
Miscellaneous	0.32	0	0.50	
Equulites elongatus	0.30	86	0.47	
Lagocephalus lunaris	0.30	10	0.47	
Priacanthus hamrur	0.25	7	0.39	
Starfish	0.25	34	0.39	
Ostorhinchus fasciatus	0.20	15	0.31	
Decapterus russelli	0.20	25	0.31	
Congresox talabon	0.10	2	0.16	
Upeneus bensasi	0.10	7	0.16	
PETROSIIDAE	0.10	0	0.16	
Zebrias quagga	0.06	2	0.10	
OPHICHTHIDAE	0.05	2	0.08	
Congresox sp.	0.05	5	0.08	
Unidentified	0.05	2	0.08	
Unidentified	0.05	2	0.08	
Monomitopus conjugator	0.05	5	0.08	
Cynoglossus sp.	0.02	2	0.03	
Total	63.45		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 68
DATE :08/07/18 GEAR TYPE: PT NO: 4 POSITION:Lat N 6°12.59
start stop duration Lon E 79°50.31
TIME :00:18:40 00:39:05 20.4 (min) Purpose : 1
LOG : 3388.27 3389.34 1.1 Region : 10820
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 84 325 Validity : 3
Towing dir: 0° Wire out : 130 m Speed : 3.1 kn
Sorted : 20 Total catch: 19.81 Catch/hour: 58.24

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Acanthocybium solandri	20.23	3	34.73	
Auxis thazard	13.64	317	23.42	273
Acanthurus - juvenile	9.00	2999	15.45	
Decapterus macarellus	5.26	212	9.04	271
Loligo sp.	4.88	479	8.38	272
J E L L Y F I S H	2.70	0	4.64	
Diodon hystrix	0.59	62	1.01	
Balistididae juvenile	0.47	97	0.81	
Unidentified crab	0.35	26	0.61	
NEMICHTHYIDAE	0.24	59	0.40	
Chaetodon sp.	0.24	62	0.40	
Leptocephalus	0.24	6	0.40	
Pomacentrus sp.	0.18	12	0.30	
Fistularia commersonii	0.06	29	0.10	
Cookeolus japonicus	0.06	12	0.10	
MONACANTHIDAE	0.06	15	0.10	
DACTYLOPTERIDAE	0.06	3	0.10	
Trichiurus sp.	0.00	3	0.01	
Total	58.24		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 69
DATE :08/07/18 GEAR TYPE: PT NO: 8 POSITION:Lat N 6°19.49
start stop duration Lon E 79°47.87
TIME :04:17:22 05:00:27 43.1 (min) Purpose : 1
LOG : 3416.75 3420.01 3.3 Region : 10820
FDEPTH: 20 50 Gear cond.: 0
BDEPTH: 100 180 Validity : 3
Towing dir: 0° Wire out : 300 m Speed : 4.5 kn
Sorted : 8 Total catch: 7.54 Catch/hour: 10.51

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Acanthurus mata	8.08	6	76.89	
EGGS	1.64	0	15.64	
JUVENILE FISHES	0.36	135	3.45	
Fistularia commersonii	0.17	60	1.59	
J E L L Y F I S H	0.17	0	1.59	
Pomacanthus sp.	0.06	6	0.53	
Diodon hystrix	0.03	8	0.27	
Chaetodon sp.	0.00	1	0.01	
BALISTIDAE	0.00	1	0.01	
Cookeolus japonicus	0.00	1	0.01	
Total	10.51		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 70
DATE :08/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 6°20.09
start stop duration Lon E 79°57.36
TIME :07:34:43 08:00:48 26.1 (min) Purpose : 3
LOG : 3436.92 3438.30 1.4 Region : 10820
FDEPTH: 50 50 Gear cond.: 0
BDEPTH: 50 50 Validity : 1
Towing dir: 0° Wire out : 150 m Speed : 3.2 kn
Sorted : 36 Total catch: 35.85 Catch/hour: 82.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pentaprion longimanus	38.05	2593	46.14	
Sepia pharaonis	7.36	23	8.93	277
Loligo sp.	6.14	205	7.45	279
Nemipterus bipunctatus	5.02	46	6.08	
Parabothus polylepis	4.37	205	5.30	
Carangoides malabaricus	3.59	14	4.35	280
Sphyraena forsteri	2.99	53	3.63	
Decapterus russelli	2.90	518	3.51	
Aurigequula longispina	2.30	35	2.79	
Fistularia petimba	1.47	41	1.79	
Saurida tumbil	1.24	12	1.51	
Paramonacanthus nipponensis	1.01	216	1.23	
Tetrosomus gibbosus	0.87	5	1.06	
Mixed debries	0.83	0	1.00	
Priacanthus hamrur	0.83	5	1.00	
Nemipterus japonicus	0.74	5	0.89	
Unidentified crab	0.60	223	0.73	
Octopus sp.	0.41	5	0.50	
Sepia latimanus	0.39	7	0.47	278
Sargocentron rubrum	0.32	2	0.39	
J E L L Y F I S H	0.25	21	0.31	
Sand doller	0.23	76	0.28	
Alectis ciliaris	0.18	5	0.22	281
Starfish	0.18	37	0.22	
OGCOCEPHALIDAE	0.09	2	0.11	
Selar crumenophthalmus	0.05	7	0.06	
S H R I M P S	0.05	12	0.06	
Total	82.47		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 71
DATE :08/07/18 GEAR TYPE: PT NO: 4 POSITION:Lat N 6°29.49
start stop duration Lon E 79°53.68
TIME :09:50:33 10:44:31 54.0 (min) Purpose : 1
LOG : 3450.09 3453.62 3.5 Region : 10820
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 42 38 Validity : 3
Towing dir: 0° Wire out : 130 m Speed : 3.9 kn
Sorted : 10 Total catch: 9.60 Catch/hour: 10.67

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Jellyfish	8.69	0 81.48	
Acanthurus - juvenile	0.56	278 5.21	
Loligo sp.	0.41	41 3.86	274
J E L L Y F I S H	0.36	1 3.33	275
JELLYFISH	0.33	1 3.13	276
Gnathanodon speciosus	0.08	8 0.73	
Equulites elongatus	0.07	63 0.63	
Paramonacanthus nipponensis	0.04	7 0.42	
Carangoides sp.	0.03	1 0.31	
Sphyraena sp.	0.02	8 0.21	
Fistularia petimba	0.02	4 0.21	
Decapterus russelli	0.02	10 0.21	
BALISTIDAE	0.02	7 0.21	
Cyclichthys orbicularis	0.01	1 0.05	
Lagocephalus lunaris	0.00	2 0.02	
Arnoglossus tapeinosoma	0.00	4 0.00	
Total	10.67	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 72
DATE :08/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 6°28.95
start stop duration Lon E 79°54.27
TIME :11:22:39 11:52:55 30.3 (min) Purpose : 3
LOG : 3455.85 3457.43 1.6 Region : 10820
FDEPTH: 38 43 Gear cond.: 0
BDEPTH: 38 43 Validity : 1
Towing dir: 0° Wire out : 130 m Speed : 3.1 kn
Sorted : 102 Total catch: 102.11 Catch/hour: 202.41

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Neotrygon caeruleopunctata	56.25	22 27.79	
Epinephelus coioides	36.67	2 18.12	290
Lethrinus nebulosus	30.78	18 15.21	294
Diagramma pictum	11.42	4 5.64	
Gnathanodon speciosus	9.04	2 4.47	291
Caranx ignobilis	8.89	8 4.39	292
Acroteriobatus variegatus	6.07	4 3.00	
Nemipterus furcosus	5.03	71 2.49	
Ambassis sp.	5.00	1921 2.47	
Diodon holocanthus	3.57	4 1.76	
Acanthurus mata	3.17	2 1.57	
Loligo duvaucelii	2.23	24 1.10	287
Drepane africana	2.22	10 1.10	
Abalistes stellatus	1.94	2 0.96	
Carangoides sp.	1.88	4 0.93	
Diodon hystrix	1.74	2 0.86	
Pentaprion longimanus	1.39	89 0.69	
Saurida tumbil	1.31	6 0.65	
Sphyraena jello	1.23	236 0.61	
Echeneis naucrates	1.15	6 0.57	
Scomberomorus guttatus	1.03	2 0.51	289
Arothron immaculatus	0.99	2 0.49	
Arothron hispidus	0.99	2 0.49	
J E L L Y F I S H	0.95	0 0.47	
Lactoria cornuta	0.75	2 0.37	
Carangoides chrysophrys	0.73	18 0.36	295
Caesio xanthonota	0.71	123 0.35	
Bothus pantherinus	0.67	30 0.33	
Plastic	0.52	0 0.25	
Selaroides leptolepis	0.48	30 0.24	
Gerres acinaces	0.44	6 0.22	
Stolephorus indicus	0.44	18 0.22	
Tetrosomus gibbosus	0.36	2 0.18	
E C H I N O D E R M A T A	0.36	30 0.18	
Fistularia petimba	0.36	8 0.18	
Dipterygonotus balteatus	0.32	105 0.16	
Sepia acuelata	0.32	6 0.16	
Sargocentron diadema	0.20	2 0.10	
Miscellaneous	0.20	0 0.10	
Pterocaesio pisang	0.16	24 0.08	
MONACANTHIDAE	0.12	24 0.06	
Ostorhinchus fasciatus	0.12	18 0.06	
Sponges	0.08	0 0.04	
Mulloidichthys vanicolensis	0.08	4 0.04	
Decapterus macrosoma	0.05	8 0.02	288
Equulites elongatus	0.04	6 0.02	
Total	202.41	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 73
DATE :08/07/18 GEAR TYPE: PT NO: 5 POSITION:Lat N 6°29.58
start stop duration Lon E 79°41.19
TIME :14:52:12 15:51:37 59.4 (min) Purpose : 1
LOG : 3473.47 3478.83 5.4 Region : 10820
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 463 277 Validity : 3
Towing dir: 0° Wire out : 280 m Speed : 5.4 kn
Sorted : 771 Total catch: 1575.69 Catch/hour: 1591.07

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Caranx ignobilis	562.21	60 35.34	282
Selar crumenophthalmus	421.68	6728 26.50	285
Auxis thazard	125.29	2210 7.87	286
Sufflamen sp.	122.63	20438 7.71	
Sphyraena jello	88.90	12 5.59	283
Mobula mobular	81.99	2 5.15	
DIODONTIDAE	57.19	7798 3.59	
Gonichthys sp.	52.35	11229 3.29	
Miscellaneous	33.44	0 2.10	
Unidentified fish	15.99	2999 1.01	
Euthynnus affinis	11.05	6 0.69	284
Unidentified fish	7.75	267 0.49	
Pteroplatytrygon violacea	4.73	1 0.30	
Promethichthys sp	3.39	218 0.21	
Lagocephalus gloveri	0.73	73 0.05	
Priacanthus hamrur	0.73	121 0.05	
DACTYLOPTERIDAE	0.48	170 0.03	
Paramonacanthus nipponensis	0.29	48 0.02	
S H R I M P S	0.19	194 0.01	
Sudis sp.	0.05	24 0.00	
Total	1591.07	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 74
DATE :09/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 6°36.96
start stop duration Lon E 79°45.05
TIME :10:49:07 11:19:38 30.5 (min) Purpose : 3
LOG : 3570.33 3571.95 1.6 Region : 10820
FDEPTH: 50 50 Gear cond.: 0
BDEPTH: 50 50 Validity : 1
Towing dir: 0° Wire out : 150 m Speed : 3.2 kn
Sorted : 51 Total catch: 51.34 Catch/hour: 100.90

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Diodon sp.	36.36	29 36.03	
Sepia pharaonis	27.47	55 27.23	296
Sponges - spiky	15.25	0 15.11	
Abalistes stellatus	10.89	10 10.79	
Lethrinus mahsena	3.30	161 3.27	297
Arothron sp.	3.07	6 3.04	
Pterois antennata	1.14	4 1.13	
Carangoides sp.	0.67	2 0.66	
JELLYFISH	0.51	0 0.51	
E C H I N O D E R M A T A	0.43	0 0.43	
Nemipterus randalli	0.35	6 0.35	
MONACANTHIDAE	0.24	43 0.23	
Saurida tumbil	0.24	4 0.23	
ACANTHURIDAE	0.20	51 0.19	
Plastic	0.16	0 0.16	
Trachinocephalus myops	0.16	4 0.16	
Miscellaneous	0.12	0 0.12	
Unidentified crab	0.08	8 0.08	
Cookeolus sp.	0.08	10 0.08	
Bothus sp.	0.04	2 0.04	
Sepia sp	0.04	4 0.04	
Labroides dimidiatus	0.04	6 0.04	
Diodon hystrix	0.04	4 0.04	
Caesio xanthonota	0.04	4 0.04	
Total	100.90	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 75
DATE :09/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 6°38.87
start stop duration Lon E 79°49.51
TIME :13:02:15 13:31:59 29.7 (min) Purpose : 3
LOG : 3582.45 3584.09 1.6 Region : 10820
FDEPTH: 50 51 Gear cond.: 0
BDEPTH: 50 51 Validity : 2
Towing dir: 0° Wire out : 150 m Speed : 3.3 kn
Sorted : 196 Total catch: 196.31 Catch/hour: 396.06

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Selar crumenophthalmus	78.96	708 19.94	298
Nemipterus bipunctatus	44.81	686 11.31	
Sepia sp	44.12	196 11.14	
Lutjanus lutjanus	26.22	478 6.62	
Lethrinus ornatus	24.51	208 6.19	299
Miscellaneous	23.77	0 6.00	
BALISTIDAE	23.28	3638 5.88	
Saurida tumbil	22.55	331 5.69	
Pentaprion longimanus	15.44	650 3.90	
Upeneus sp.	14.71	478 3.71	
Unidentified crab	12.50	48 3.16	
Naso annulatus	11.62	8 2.93	
Fistularia petimba	10.05	184 2.54	
Psettodes belcheri	6.29	4 1.59	
J E L L Y F I S H	4.66	73 1.18	
Bothus pantherinus	4.41	171 1.11	
Rogadius pristiger	4.41	208 1.11	
Decapterus macrosoma	4.17	48 1.05	300
PORIFERA (Sponges)	3.19	0 0.80	
Ostorhinchus aureus	2.94	438 0.74	
Sphyraena forsteri	2.45	36 0.62	
Sepia acuelata	2.21	48 0.56	
Sea snakes	2.06	2 0.52	
Parupeneus forsskali	1.71	12 0.43	
Sargocentron diadema	1.22	12 0.31	
SNAKE	1.21	2 0.31	
Equulites elongatus	0.98	748 0.25	
Cookeolus japonicus	0.49	24 0.12	
Epinephelus coioides	0.49	24 0.12	
SEAWEED	0.24	0 0.06	
Unidentified fish	0.24	48 0.06	
Halichoeres sp.	0.12	12 0.03	
Plotosus lineatus	0.01	12 0.00	
Total	396.06	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 76
DATE :09/07/18 GEAR TYPE: PT NO: 5 POSITION:Lat N 6°51.30
start stop duration Lon E 79°37.04
TIME :18:13:51 19:14:39 60.8 (min) Purpose : 3
LOG : 3614.89 3619.27 4.4 Region : 10820
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 119 528 Validity : 3
Towing dir: 0° Wire out : 300 m Speed : 4.3 kn
Sorted : 142 Total catch: 886.42 Catch/hour: 874.76

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Selar crumenophthalmus	484.84	3352	55.43	301
Unidentified squid	120.45	252	13.77	
Gonichthys sp.	107.59	299887	12.30	
Unidentified fish	28.25	1195	3.23	
Unidentified	28.25	14125	3.23	
S H R I M P S	23.61	13041	2.70	
Loligo parts	18.68	0	2.14	0
Synagrops japonicus	9.78	651	1.12	
Astronesthes sp.	8.40	928	0.96	
Loligo sp.	8.05	201	0.92	302
Unidentified squid	6.52	163	0.75	0
Sufflamen sp.	5.43	977	0.62	
Sudis sp.	4.62	492	0.53	
Mixed debries	4.50	0	0.51	
Loligo sp.	4.35	814	0.50	0
Unidentified fish	3.14	561	0.36	
Unidentified fish	2.19	109	0.25	
Diodon sp.	2.17	271	0.25	
PORTUNIDAE	2.17	109	0.25	
Lepturacanthus sp.	0.85	2	0.10	
Nemichthys sp.	0.27	164	0.03	
Fistularia sp.	0.27	217	0.03	
Hippocampus sp.	0.22	54	0.02	
Auxis thazard	0.08	1	0.01	
Gempylus sp.	0.05	54	0.01	
Unidentified	0.01	1	0.00	
Total	874.75		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 77
DATE :10/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 7°3.85
start stop duration Lon E 79°42.88
TIME :02:02:05 02:31:40 29.6 (min) Purpose : 3
LOG : 3671.81 3673.59 1.8 Region : 10820
FDEPTH: 32 33 Gear cond.: 0
BDEPTH: 32 33 Validity : 1
Towing dir: 0° Wire out : 120 m Speed : 3.6 kn
Sorted : 58 Total catch: 207.59 Catch/hour: 420.94

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sponges	51.26	0	12.18	
Equulites elongatus	49.23	7026	11.70	
Naso annulatus	34.11	16	8.10	
Neotrygon caeruleopunctata	27.46	22	6.52	
Selar crumenophthalmus	26.91	1819	6.39	307
Abalistes stellatus	22.83	22	5.42	
Scomberoides commersonianus	18.27	4	4.34	
Acanthurus mata	16.83	8	4.00	
Soft corals	14.80	0	3.52	
Balistoides viridescens	14.48	10	3.44	
Platax sp.	12.29	2	2.92	
Diagramma pictum	10.87	4	2.58	
Sepia sp	9.85	12	2.34	
TETRAODONTIDAE	9.59	1054	2.28	
Tripterodon orbis	9.41	4	2.24	
Diodon hystrix	8.76	18	2.08	
Scolopsis bimaculata	7.66	103	1.82	
Gnathanodon speciosus	7.54	2	1.79	
Loligo sp.	6.29	444	1.49	
Miscellaneous	4.74	0	1.13	
Ostracion cubicus	4.06	6	0.96	
Carangoides sp.	3.71	474	0.88	
Lactoria cornuta	3.61	10	0.86	
Diodon holocanthus	3.45	2	0.82	
Tetrosomus gibbosus	3.20	12	0.76	
Fishing gears	3.20	8	0.76	
Sphyraena forsteri	3.04	10	0.72	
Aluterus scriptus	2.80	2	0.66	
Acroteriobatus variegatus	2.62	2	0.62	
Lethrinus nebulosus	2.51	2	0.60	
Lutjanus erythropterus	2.43	2	0.58	306
Dipterygonotus balteatus	2.37	740	0.56	
Arothron hispidus	2.27	2	0.54	
Fistularia petimba	1.91	24	0.45	
Pterocaesio chrysozona	1.64	231	0.39	
Scolopsis sp.	1.48	30	0.35	
Hydrophis ornatus	1.42	6	0.34	
SNAKE	1.30	2	0.31	
Parupeneus indicus	1.30	10	0.31	
Nemipterus bipunctatus	1.14	12	0.27	
Lethrinus olivaceus	1.09	2	0.26	303
Lagocephalus lunaris	0.93	30	0.22	
Ambassis sp.	0.83	474	0.20	
Arothron immaculatus	0.81	2	0.19	
Thenus orientalis	0.65	2	0.15	
Amblygaster sirm	0.63	30	0.15	304
Unidentified	0.51	191	0.12	
C R A B S	0.49	2	0.12	
Echeneis naucrates	0.34	22	0.08	
Selaroides leptolepis	0.30	10	0.07	
Upeneus sp.	0.30	6	0.07	
Cookeolus sp.	0.30	10	0.07	
Sphyraena forsteri	0.30	114	0.07	0
Amblygaster leiogaster	0.28	2	0.07	305
Lagocephalus spadiceus	0.20	4	0.05	
Cephalopholis sp.	0.20	6	0.05	
Trachinocephalus myops	0.10	6	0.02	
POMACENTRIDAE	0.01	6	0.00	
Total	420.94		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 78
DATE :10/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 7°8.78
start stop duration Lon E 79°42.90
TIME :04:50:10 05:19:12 29.0 (min) Purpose : 3
LOG : 3689.46 3691.26 1.8 Region : 10820
FDEPTH: 24 25 Gear cond.: 0
BDEPTH: 24 25 Validity : 1
Towing dir: 0° Wire out : 120 m Speed : 3.7 kn
Sorted : 568 Total catch: 887.93 Catch/hour: 1834.57

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
J E L L Y F I S H	455.21	0	24.81	
Scomberomorus commerson	228.35	74	12.45	323
SCARIDAE	144.30	37	7.87	
Sphyraena jello	139.13	50	7.58	320
Photopectoralis bindus	122.73	13149	6.69	
Acanthurus mata	99.79	145	5.44	309
Amblygaster sirm	65.45	6136	3.57	308
Drepane punctata	56.49	101	3.08	
Leiognathus berbis	55.79	7151	3.04	
Gazza minuta	55.04	2948	3.00	
Tripterodon orbis	49.50	23	2.70	
Stolephorus commersonii	32.73	7012	1.78	
Secutor insidiator	26.03	3550	1.42	
Carangoides coeruleopinnatus	23.19	14	1.26	315
Carangoides fulvoguttatus	19.59	29	1.07	318
Miscellaneous	18.60	0	1.01	0
Balistoides viridescens	15.83	8	0.86	
Stolephorus commersonii	15.62	3682	0.85	0
Scarus rubroviolaceus	15.00	4	0.82	
Alectis indica	14.17	10	0.77	322
Arothron immaculatus	13.80	25	0.75	
Lethrinus nebulosus	13.22	4	0.72	316
Carangoides coeruleopinnatus	11.82	54	0.64	
Sardinella gibbosa	10.34	1713	0.56	329
Plectorhinchus gibbosus	9.88	4	0.54	311
Abalistes stellatus	8.39	8	0.46	
Epinephelus malabaricus	8.35	2	0.45	319
Leiognathus lineolatus	8.18	1264	0.45	
LEIOGNATHIDAE	8.18	149	0.45	
Tetrosomus gibbosus	7.69	35	0.42	
Otolithes ruber	6.98	14	0.38	
Gnathanodon speciosus	6.94	2	0.38	
Lutjanus argentimaculatus	5.58	4	0.30	313
Amblygaster clupeoides	5.58	37	0.30	
Diodon hystrix	5.33	4	0.29	
Ambassis urotaenia	5.21	2417	0.28	
Fishing gears	4.83	0	0.26	
Atule mate	4.71	21	0.26	314
Sardinella albella	3.79	669	0.21	
Aetomylaeus nichofii	3.43	2	0.19	
Miscellaneous	3.10	0	0.17	
Ostracion cubicus	2.77	4	0.15	
Carangoides hedlandensis	2.48	6	0.14	
Caranx ignobilis	2.44	2	0.13	321
Neotrygon caeruleopunctata	2.36	2	0.13	
Gerres acinaces	1.80	4	0.10	
Pterois miles	1.65	4	0.09	
Triacanthus sp.	1.55	6	0.08	
Lactoria cornuta	1.45	4	0.08	
Diodon holocanthus	1.32	4	0.07	
Gerres oblongus	1.03	4	0.06	
Saurida nebulosa	0.95	4	0.05	
Gymnura poecilura	0.70	2	0.04	
Selar crumenophthalmus	0.66	4	0.04	312
Abudefduf bengalensis	0.66	37	0.04	
Ostracion sp.	0.58	2	0.03	
Selaroides leptolepis	0.56	35	0.03	
Lethrinus lentjan	0.54	2	0.03	317
Diagramma pictum	0.53	2	0.03	310
Stolephorus indicus	0.50	31	0.03	
Sphyraena forsteri	0.50	2	0.03	
Nemipterus bipunctatus	0.45	2	0.02	
Scolopsis bimaculata	0.33	2	0.02	
Priacanthus hamrur	0.29	2	0.02	
Hydrophis sp.	0.25	2	0.01	
Ilisha sp.	0.25	10	0.01	
Pomadasys maculatus	0.12	2	0.01	
Total	1834.57		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 79
DATE :10/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 7°21.24
start stop duration Lon E 79°38.33
TIME :10:49:57 11:16:18 26.4 (min) Purpose : 3
LOG : 3731.93 3733.55 1.6 Region : 10810
FDEPTH: 26 25 Gear cond.: 0
BDEPTH: 26 25 Validity : 1
Towing dir: 0° Wire out : 120 m Speed : 3.7 kn
Sorted : 258 Total catch: 257.76 Catch/hour: 586.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sponges	273.14	0	46.56	
Balistoides viridescens	50.49	0	8.60	
Lethrinus olivaceus	32.32	23	5.51	325
Lutjanus erythropterus	19.39	14	3.31	326
Lactoria cornuta	16.66	43	2.84	
Naso annulatus	16.53	16	2.82	0
Gerres sp.	14.61	16	2.49	
Canthidermis maculata	14.11	14	2.41	
Lutjanus rivulatus	13.43	2	2.29	
Acanthurus mata	10.56	14	1.80	
Abalistes stellatus	10.33	11	1.76	
Cyclichthys orbicularis	9.61	7	1.64	
Diodon holocanthus	9.33	25	1.59	
Fistularia petimba	8.92	61	1.52	
Epinephelus undulosus	8.83	2	1.51	
Parupeneus indicus	8.65	25	1.47	
Neotrygon caeruleopunctata	7.24	7	1.23	
Naso annulatus	5.37	11	0.92	
Arothron hispidus	5.33	9	0.91	
Diodon hystrix	5.14	7	0.88	
Gymnocranius griseus	5.10	5	0.87	
Sepia sp	4.96	2	0.85	
Arothron immaculatus	4.92	9	0.84	
Naso unicornis	4.69	2	0.80	
Lethrinus ornatus	4.60	11	0.78	324
Ulua mentalis	4.46	7	0.76	
Arothron immaculatus	4.28	11	0.73	0
Pomacanthus imperator	4.14	7	0.71	
Aprion virescens	2.64	5	0.45	
Scolopsis bimaculata	2.59	23	0.44	
Ostracion cubicus	1.87	7	0.32	
Pterois antennata	0.96	2	0.16	
Heniochus acuminatus	0.86	16	0.15	
Rhynchostracion nasus	0.64	2	0.11	
Total	586.71		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 80
DATE :10/07/18 GEAR TYPE: PT NO: 5 POSITION:Lat N 7°29.13
start stop duration Lon E 79°25.28
TIME :15:27:34 16:00:20 32.8 (min) Purpose : 1
LOG : 3761.56 3763.79 2.2 Region : 10810
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 0 0 Validity : 3
Towing dir: 0° Wire out : 300 m Speed : 4.1 kn
Sorted : 83 Total catch: 2381.00 Catch/hour: 4359.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Auxis thazard	2363.64	48040	54.22	327
Chirocentrus dorab	1473.85	32040	33.81	
Cubiceps sp.	190.82	15144	4.38	
Unidentified crab	75.91	5165	1.74	
Loligo sp.	48.49	262	1.11	
Miscellaneous	45.33	0	1.04	
Unidentified fish	42.17	11713	0.97	
Desmodema polystictum	32.68	104	0.75	
Promethichthys prometheus	32.68	1159	0.75	
Euthynnus affinis	24.25	211	0.56	
Brama dussumieri	8.43	51	0.19	
Unidentified fish	8.43	315	0.19	
Diodon hystrix	6.32	685	0.15	
Decapterus macarellus	5.27	104	0.12	
CARANGIDAE	1.05	51	0.02	
ACANTHURIDAE	0.07	26	0.00	
S H R I M P S	0.05	157	0.00	
Pelamis platura	0.04	2	0.00	
Total	4359.50		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 81
DATE :11/07/18 GEAR TYPE: PT NO: 5 POSITION:Lat N 8°13.16
start stop duration Lon E 79°23.85
TIME :15:36:53 16:22:21 45.5 (min) Purpose : 3
LOG : 3902.63 3906.12 3.5 Region : 10810
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 0 0 Validity : 3
Towing dir: 0° Wire out : 300 m Speed : 4.6 kn
Sorted : 57 Total catch: 262.54 Catch/hour: 346.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Unidentified fish	179.99	13845	51.95	
Katsuwonus pelamis	38.72	13	11.18	330
TRIACANTHIDAE	30.77	3846	8.88	
Unidentified	22.64	769	6.54	
Unidentified squid	19.16	73	5.53	
Loligo sp.	11.03	232	3.18	
Gonichthys sp.	10.74	8951	3.10	
Brama dussumieri	6.10	44	1.76	
Unidentified fish	5.52	15	1.59	
Caretta caretta	4.41	1	1.27	
Echeneis naucrates	2.77	3	0.80	
Unidentified fish	2.03	29	0.59	
S H R I M P S	2.03	464	0.59	
Promethichthys prometheus	1.45	87	0.42	
Decapterus macrosoma	1.45	29	0.42	332
Selar crumenophthalmus	1.16	44	0.34	
Abudefduf sp.	1.16	102	0.34	
Cyclichthys orbicularis	0.87	87	0.25	
CONGRIDAE	0.87	203	0.25	
Desmodema polystictum	0.77	1	0.22	
Plastic	0.58	15	0.17	
Megalaspis cordyla	0.58	29	0.17	
Small squids unident.	0.58	406	0.17	
Sphyraena barracuda	0.48	1	0.14	
Sudis sp.	0.29	29	0.08	
Euthynnus affinis	0.26	3	0.08	331
Paracanthurus sp.	0.03	15	0.01	
Total	346.44		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 82
DATE :11/07/18 GEAR TYPE: PT NO: 4 POSITION:Lat N 8°25.28
start stop duration Lon E 79°32.42
TIME :21:27:01 21:51:22 24.4 (min) Purpose : 3
LOG : 3947.42 3948.64 1.2 Region : 10810
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 0 0 Validity : 3
Towing dir: 0° Wire out : 130 m Speed : 3.0 kn
Sorted : 0 Total catch: 0.03 Catch/hour: 0.07

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
PORTUNIDAE	0.03	2	42.86	
Diogenichthys sp.	0.01	2	21.43	
MYCTOPHIDAE	0.01	12	14.29	
Diaphus sp.	0.00	7	7.14	
Loligo sp.	0.00	2	7.14	
PASIPHAEIDAE	0.00	10	3.57	
PASIPHAEIDAE	0.00	5	3.57	0
Total	0.07		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 83
DATE :12/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 8°40.19
start stop duration Lon E 79°39.08
TIME :04:59:08 05:23:18 24.2 (min) Purpose : 3
LOG : 4011.41 4012.95 1.5 Region : 10810
FDEPTH: 32 38 Gear cond.: 0
BDEPTH: 32 38 Validity : 1
Towing dir: 0° Wire out : 130 m Speed : 3.8 kn
Sorted : 66 Total catch: 65.57 Catch/hour: 162.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sepia pharaonis	36.10	27	22.18	333
Sponges	34.75	0	21.35	
Mixed debries	29.79	0	18.30	
Dipterygonotus balteatus	8.54	2135	5.25	
Epinephelus undulosus	7.35	2	4.51	336
Aluterus monoceros	6.45	5	3.97	
Ambassis sp.	5.96	685	3.66	
Lethrinus olivaceus	5.91	10	3.63	335
Balistes sp.	5.56	2	3.42	
Abalistes stellatus	4.87	5	2.99	
Parupeneus indicus	2.83	7	1.74	
Neotrygon caeruleopunctata	2.73	2	1.68	
Iniistius pavo	2.09	12	1.28	
Ostracion sp.	1.59	2	0.98	
Lethrinus conchyliatus	1.09	2	0.67	
Loligo sp.	0.93	84	0.57	334
Chromis sp.	0.89	89	0.55	
Diodon holocanthus	0.79	2	0.49	
Fistularia commersonii	0.70	15	0.43	
Scolopsis bimaculata	0.55	17	0.34	
Fishing gears	0.50	0	0.31	
Lethrinus olivaceus	0.45	169	0.27	0
Cyclichthys orbicularis	0.45	2	0.27	
Holothuria (Halodeima) atra	0.30	10	0.18	
Lutjanus lutjanus	0.30	22	0.18	
Pterocaesio chrysozona	0.20	17	0.12	
Halichoeres zeylonicus	0.15	5	0.09	
URCHINS	0.15	7	0.09	
Upeneus moluccensis	0.15	17	0.09	
Sand doller	0.10	12	0.06	
Carangoides sp.	0.10	7	0.06	
Parupeneus rubescens	0.06	2	0.04	
Soft corals	0.05	0	0.03	
Starfish	0.05	10	0.03	
J E L L Y F I S H	0.05	7	0.03	
Pterois sp.	0.05	2	0.03	
Selar crumenophthalmus	0.05	17	0.03	
Labroides dimidiatus	0.04	10	0.02	
Aluterus sp.	0.03	2	0.02	
Aprion virescens	0.03	2	0.02	
PEGASIDAE	0.03	5	0.02	
Labridae sp.	0.02	2	0.01	
INACHIDAE	0.01	2	0.01	
Total	162.76		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 84
DATE :12/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 8°46.62
start stop duration Lon E 79°32.02
TIME :10:31:01 10:52:46 21.8 (min) Purpose : 3
LOG : 4050.86 4051.97 1.1 Region : 10810
FDEPTH: 81 60 Gear cond.: 0
BDEPTH: 81 60 Validity : 1
Towing dir: 0° Wire out : 160 m Speed : 3.0 kn
Sorted : 89 Total catch: 89.30 Catch/hour: 246.24

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sepia pharaonis	69.04	33	28.04	344
Miscellaneous	37.09	0	15.06	
Aluterus monoceros	33.75	41	13.71	
Sponges	24.49	0	9.94	
Epinephelus malabaricus	19.25	8	7.82	345
Epinephelus undulosus	8.49	3	3.45	341
Acanthurus mata	8.27	8	3.36	342
Balistoides viridescens	5.85	3	2.37	
Lethrinus olivaceus	5.21	3	2.12	337
Soft corals	4.14	0	1.68	
Starfish	3.14	3	1.28	
Sphyraena forsteri	3.14	8	1.28	343
Pomacanthus imperator	2.98	6	1.21	
Fistularia commersonii	2.81	14	1.14	
Naso tuberosus	2.32	3	0.94	
Priacanthus hamrur	2.10	6	0.85	
Dipterygonotus balteatus	2.10	350	0.85	
Hydrophis sp.	1.76	3	0.72	
Gerres sp.	1.65	3	0.67	
Epinephelus coioides	1.65	3	0.67	338
Parascolopsis eriomma	1.16	33	0.47	
Lethrinus ornatus	1.10	3	0.45	340
Aluterus scriptus	1.05	6	0.43	
Miscellaneous	0.77	0	0.31	0
Mulloidichthys sp.	0.39	11	0.16	
Pelamis platura	0.33	3	0.13	
E C H I N O D E R M A T A	0.22	33	0.09	
Chaetodon gardineri	0.22	3	0.09	
Parupeneus macronemus	0.22	8	0.09	
Scolopsis bimaculata	0.22	3	0.09	
Scolopsis xenochrous	0.22	6	0.09	
Pterocaesio pisang	0.22	33	0.09	0
Anthias sp.**	0.22	22	0.09	
Nudibranch sp	0.17	22	0.07	
Lutjanus lutjanus	0.17	3	0.07	339
Ostorhinchus fasciatus	0.17	33	0.07	
TETRAODONTIDAE	0.06	8	0.02	
Pterocaesio pisang	0.03	6	0.01	
Fistularia commersonii	0.03	3	0.01	0
Aspidontus taeniatus	0.03	6	0.01	
SEAWEED	0.03	3	0.01	
Plastic	0.00	3	0.00	
Plotosus lineatus	0.00	6	0.00	
Acanthurus - juvenile	0.00	6	0.00	
Holothuria sp.	0.00	0	0.00	
Total	246.24		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 85
DATE :12/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 8°46.19
start stop duration Lon E 79°31.34
TIME :12:14:12 12:45:16 31.1 (min) Purpose : 3
LOG : 4057.30 4058.91 1.6 Region : 10810
FDEPTH: 270 257 Gear cond.: 0
BDEPTH: 270 257 Validity : 1
Towing dir: 0° Wire out : 650 m Speed : 3.1 kn
Sorted : 20 Total catch: 413.82 Catch/hour: 799.39

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Unidentified	476.10	47610	59.56	
Promethichthys prometheus	53.39	564	6.68	
Ariosoma sp.	47.29	902	5.92	
Bythaelurus hispidus	45.13	489	5.64	
MYCTOPHIDAE	30.83	3854	3.86	
S H R I M P S	28.59	6496	3.58	
Plesiobatis daviesi	25.81	2	3.23	346
Cookeolus japonicus	16.17	301	2.02	0
Chirocentrus dorab	15.05	37	1.88	
Cubiceps gracilis	12.03	1617	1.51	
Chlorophthalmus agassizi	10.53	1880	1.32	
Peristedion cataphractum	10.53	37	1.32	0
Cookeolus japonicus	6.84	8	0.86	
Lepidotrigla sp.	5.27	639	0.66	
Peristedion cataphractum	3.36	6	0.42	
Gephyroberyx darwini	3.01	112	0.38	
Miscellaneous	3.01	0	0.38	
PEMPHERIDAE	2.26	75	0.28	
Heptranchias perlo	1.51	2	0.19	347
'Undidentified crab'	0.75	75	0.09	
Plastic	0.70	2	0.09	
Halieutaea sp.	0.42	2	0.05	
Chelidonichthys queketti	0.39	37	0.05	
Physiculus sp.	0.31	2	0.04	
Puerulus sewelli	0.08	2	0.01	
Unidentified crab	0.04	6	0.00	
Total	799.39		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 86
DATE :12/07/18 GEAR TYPE: BT NO: 0 POSITION:Lat N 8°42.84
start stop duration Lon E 79°30.21
TIME :14:23:02 14:53:16 30.2 (min) Purpose : 3
LOG : 4067.93 4069.64 1.7 Region : 10810
FDEPTH: 406 423 Gear cond.: 0
BDEPTH: 406 423 Validity : 3
Towing dir: 0° Wire out : 1070 m Speed : 3.4 kn
Sorted : 49 Total catch: 129.56 Catch/hour: 257.15

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Neoscopelus sp.	34.50	548	13.41	
Shrimps unidentified	32.79	2469	12.75	
Neoharriotta sp.	27.87	4	10.84	
OPHIDIIDAE	26.91	171	10.47	
Deep sea shrimps	23.60	1764	9.18	
Centrophorus sp.	23.14	26	9.00	
Conger cinereus	19.59	14	7.62	
Promethichthys prometheus	10.80	26	4.20	
Polymixia sp.	8.36	77	3.25	
Peristedion sp.	6.01	40	2.34	
Hygophum sp.	5.76	391	2.24	
Miscellaneous	5.50	0	2.14	0
Coelorinchus sp.	4.70	157	1.83	
J E L L Y F I S H	4.45	0	1.73	
OCTOPODIDAE	4.19	131	1.63	
NEPHROPIDAE	3.65	379	1.42	
Eugonatonotidae	2.62	26	1.02	
Unidentified	1.57	26	0.61	
MAJIDAE	1.57	14	0.61	
Nezumia sp.	1.31	65	0.51	
Trachyrincus sp.	1.17	52	0.46	
Cyttopsis sp.	1.07	8	0.42	
Argyropelecus aculeatus	1.05	391	0.41	
Bembrops caudimacula	1.05	26	0.41	
Sponges	1.05	419	0.41	
TRICHIURIDAE	0.79	208	0.31	
Loligo sp.	0.52	183	0.20	
Trichiurus lepturus	0.52	14	0.20	
Chaunax sp.	0.28	2	0.11	
Uroconger sp.	0.26	26	0.10	
POLYCHAELIDAE	0.26	26	0.10	
Unidentified	0.18	40	0.07	
Small shrimps	0.08	705	0.03	
Total	257.15		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 87
DATE :13/07/18 GEAR TYPE: PT NO: 5 POSITION:Lat N 7°35.69
start stop duration Lon E 78°58.73
TIME :18:18:10 19:04:00 45.8 (min) Purpose : 3
LOG : 4172.76 4175.80 3.0 Region : 10800
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 0 0 Validity : 3
Towing dir: 0° Wire out : 300 m Speed : 4.0 kn
Sorted : 60 Total catch: 252.95 Catch/hour: 331.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Unidentified squids and crustaceans	61.30	0	18.51	
Katsuwonus pelamis	54.83	18	16.56	349
Miscellaneous	49.54	0	14.96	
Brama dussumieri	33.72	211	10.18	
Unidentified fish	30.65	1820	9.26	
Trachipterus sp.	27.62	55	8.34	
Auxis thazard	23.75	287	7.17	
Neoepinnula orientalis	11.11	326	3.36	
Euthynnus affinis	10.73	58	3.24	
PORTUNIDAE	7.66	402	2.31	
Decapterus macarellus	4.98	115	1.50	
Unidentified fish	4.60	42	1.39	
Loligo sp.	3.06	230	0.93	
BALISTIDAE	1.53	306	0.46	
Promethichthys prometheus	1.53	77	0.46	
Acanthurus - juvenile	1.15	517	0.35	
Naucrates ductor	0.45	1	0.13	
S H R I M P S	0.44	191	0.13	
Sphyraena forsteri	0.41	1	0.12	350
Sufflamen sp.	0.38	96	0.12	
Unidentified fish	0.38	632	0.12	
Leptocephalus	0.38	38	0.12	
TRICHIURIDAE	0.34	422	0.10	
Gnathanodon speciosus	0.13	20	0.04	
Diodon sp.	0.12	20	0.03	
Nemichthys sp.	0.12	38	0.03	
Sudis sp.	0.12	195	0.03	
Priacanthus hamrur	0.11	20	0.03	
Total	331.16		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2018408 STATION: 88
DATE :14/07/18 GEAR TYPE: PT NO: 8 POSITION:Lat N 6°42.17
start stop duration Lon E 78°59.67
TIME :13:48:43 14:21:15 32.5 (min) Purpose : 3
LOG : 4250.35 4252.62 2.3 Region : 10800
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 0 0 Validity : 2
Towing dir: 0° Wire out : 290 m Speed : 4.2 kn
Sorted : 21 Total catch: 692.67 Catch/hour: 1277.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Balistididae juvenile	678.13	109374	53.09	
Xiphias gladius	174.43	4	13.66	352
Unidentified crab	156.73	10313	12.27	
Squid unidentified	80.04	444	6.27	
BALISTIDAE	71.16	19763	5.57	
Unidentified	41.14	2001	3.22	
Auxis thazard	33.91	444	2.65	353
Myctophid sp. A	21.13	12424	1.65	
CONGRIDAE	6.67	667	0.52	
CARANGIDAE	5.00	555	0.39	
Unidentified	5.00	166	0.39	
Brama dussumieri	1.66	55	0.13	
EGGS	1.11	0	0.09	
Myctiphid 'fully scaled'	0.55	55	0.04	
GEMPYLIDAE	0.55	55	0.04	
Total	1277.20		100.00	

ANNEX IV. BIOLOGY SCALES

Sexual maturity

Stage	State	Description
I	Immature	Ovary and testis about 1/3rd length of the body cavity. Ovaries pinkish, translucent, testis whitish. Ova are not visible to naked eye.
II	Maturing virgin and recovering spent	Ovary and testis about ½ length of the body cavity. Ovary pinkish, translucent, testis whitish, symmetrical. Ova are not visible to naked eye.
III	Ripening	Ovary and testis is about 2/3rds length of the body cavity. Ovary pinkish yellow colour with a granular appearance, testis whitish to creamy. No transparent or translucent ova visible.
IV	Ripe	Ovary and testis from 2/3rds to full length of the body cavity. Ovary orange-pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova are visible. Testis whitish-creamy, soft.
V	Spent	Ovary and testis shrunken to about ½ length of the body cavity. Walls loose. Ovary may contain remnants of disintegrating opaque and ripe Ova, darkened or translucent. Testis bloodshot and flabby

Stomach content

Scale	Designation	Description
0	Empty	Stomach empty except for water.
1	Very little content	The stomach is almost empty. Only traces of small organisms can be found.
2	Some content	Stomach not completely full and not dilated.
3	Stomach full	Stomach full, but not bloated/dilated.
4	Bloated/dilated	The stomach is visibly expanded and tight. Content can be observed from the outside.

ANNEX V. ph, ALKALINITY AND ARAGONITE SATURATION STATE

Water samples were collected from the whole water column at the stations on most of the transects. These were analyzed on board for pH and alkalinity, and the nutrients will later be analyzed in onshore laboratories. Preliminary calculations are shown here, final results can only be calculated when nutrient concentrations are known. These variables will be used to characterize the inorganic carbon components of the waters, which also show the status of ocean acidification.

Deepwater has low pH because of high content of CO2, which is produced by the degradation of sinking organic material. The upwelling water along the shelf, consequently had low pH values, and pH decreased gradually with depth.

Alkalinity is more related to the salinity of the waters, and a layer was found around 50m depth, consisting of warm high saline water with lower alkalinity than the surrounding waters.

Saturation state of calcium carbonates is an indicator used for monitoring development of ocean acidification in seawater. A saturation state value below one for a calcium carbonate mineral, means the water is under-saturated for the mineral. Under-saturation predicts that over time the mineral will dissolve. Aragonite saturation state was well above one in the waters studied, but in the below 250m depth the values were rather low, as is expected in upwelling waters. For some marine organisms that construct shells of aragonite, saturation state below 2 has been shown to slow down the process of shell formation.

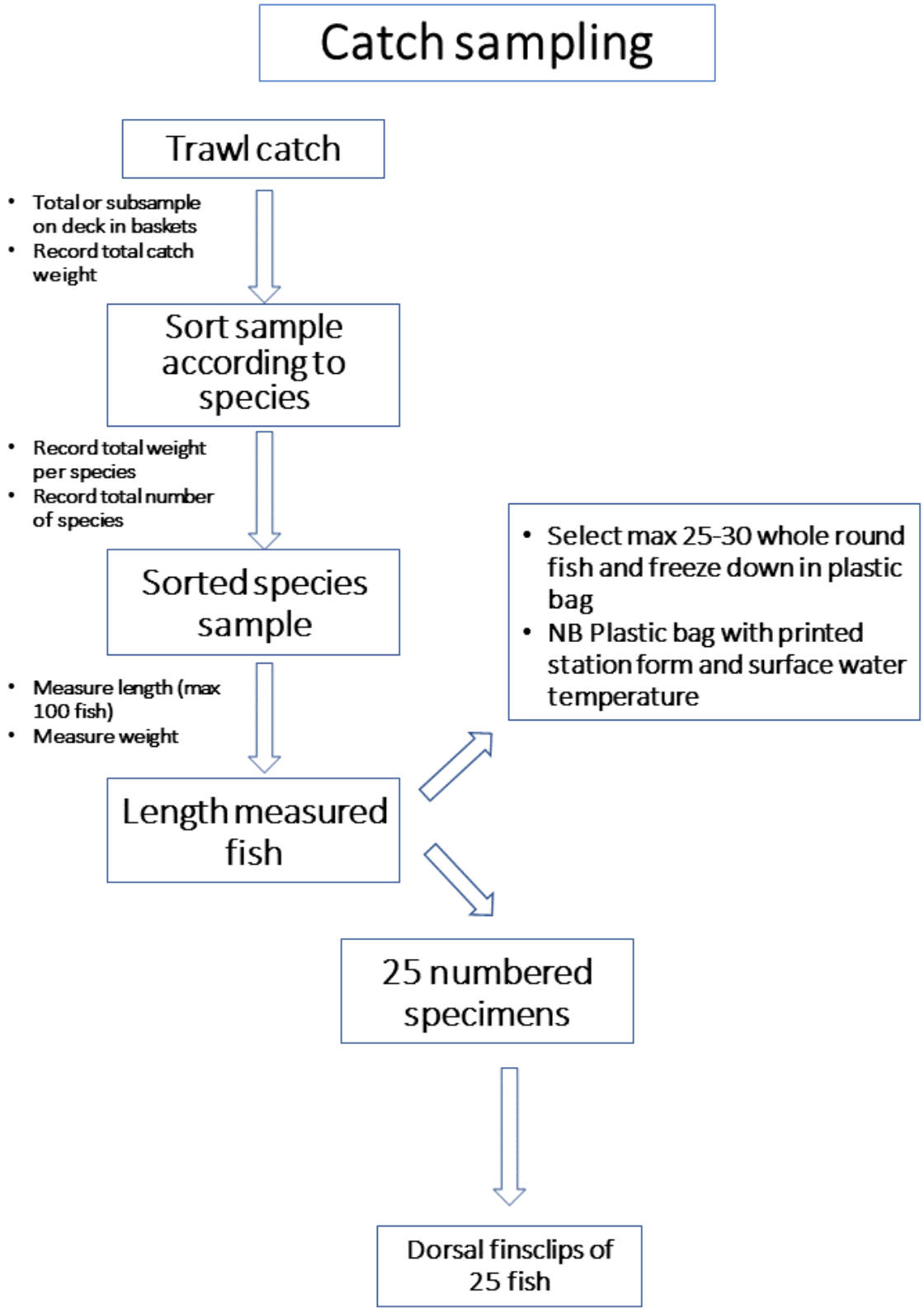
ANNEX VI. PRIORITY SPECIES AND BIOLOGICAL SAMPLES COLLECTED

Main species and their priority analysis.

Main Groups	Main Families	Typical Species	Length and weight	Sex and maturation	Stomach	Genetics	Contaminants
Demersal	Ariidae(sea cat fishes)	*Arius dussumeiri*	x	x			
	Balistidae(Triggerfishes, durgons)	*Canthidermis maculatus*	x	x			
	Carangidae(Jacks, Trevellies, Scads, Queenfishes, Runners, Pampnos)	*Alectis ciliaris*	x	x	x		
		Alectis indicus	x	x	x		
		Alepes djedaba	x	x			
		Alepes melanoptera	x	x			
		Atule mate	x	x			
	Lethrinidae	*Lethrinus lentjan*	x	x	x	x	
		Lethrinus mahsena	x	x	x		
		Lethrinus nebulosus	x	x	x	x	
		Lethrinus olivaceus	x	x	x		
		Lethrinus ornatus	x	x	x		
		Lethrinus rubrioperculatus	x	x	x		
	Lutjanidae	*Lutjanus bohar*	x	x	x		
		Lutjanus argentimaculatus	x	x	x		
		Lutjanus ehrenbergii	x	x	x		
		Lutjanus erythropterus	x	x	x		
		Lutjanus fulviflamma	x	x	x		
		Lutjanus gibbus	x	x	x		
		Lutjanus lutjanus	x	x	x		
	Serranidae	*Cephalopholis sonnerati*	x	x	x	x	x
		Epinephelus areolatus	x	x	x		x
		Epinephelus lanceolatus	x	x	x		x
		Epinephelus longispinis	x	x	x		x
		Epinephelus malabaricus	x	x	x	x	x
		Epinephelus undulosus	x	x	x		x
Pelagic	Carangidae(Jacks, Trevellies, Scads, Queenfishes, Runners, Pampnos)	*Carangoides armatus*	x	x			
		Carangoides fulvoguttatus	x	x			
		Carangoides gymnostethus	x	x			
		Carangoides malabaricus	x	x			
		Caranx heberi	x	x			
		Caranx ignobilis	x	x			
		Caranx sexfasciatus	x	x	x	x	
		Decapterus macarellus	x	x	x	x	
		Decapterus macrosoma	x	x	x	x	
		Decapterus russelli	x	x	x	x	
	Chirocentridae(Wolf herrings)	*Chirocentrus dorab*	x	x	x		
		Chirocentrus nudus	x	x	x		
	Clupeidae(Herrings, shads, gizzard shads, sardins, sardinellas, sprats, menhadens)	*Amblygaster clupeoides*	x	x	x	x	
		Amblygaster sirm	x	x	x	x	
		Dussumieria acuta	x	x			
		Escualosa thoracata	x	x			
		Herklotsichthys quadrimaculatus	x	x	x	x	
		Hilsa kelee	x	x	x	x	
		Nematalosa nasus	x	x			
		Sardinella albella	x	x	x	x	
		Sardinella fimbriata	x	x			
		Sardinella gibbosa	x	x	x	x	
		Sardinella longiceps	x	x	x	x	
	Engraulididae(Anchovies)	*Thryssa mystax*	x	x	x		
		Thryssa setirostris	x	x	x		
	Scombroidae(Albacores, bonitos, kawakawas, mackerals, seerfishes,	*Acanthocybium solandri*	x	x			x
		Auxis rochei	x	x			x
		Auxis thazard	x	x			x

Main Groups	Main Families	Typical Species	Length and weight	Sex and maturation	Stomach	Genetics	Contaminants
	tunas, wahoos)	*Euthunnus affinis*	x	x			x
		Katsuwonus pelamis	x	x			x
		Rastrelliger kanagurta	x	x			x
		Scomberomorus commerson	x	x			x
		Scomberomorus guttatus	x	x			x
		Scomberomorus koreanus	x	x			x
		Thunnus albacares	x	x			x
		Thunnus obesus	x	x			x
		Thunnus tonggol	x	x			x
	Sphyraenidae(Barracudas)	*Sphyraena barracuda*	x	x	x		
		Sphyraena obtusata	x	x	x		
		Sphyraena jello	x	x	x		
Rays	Rhinobatidae	*Rhinobatos sp.*	x	x			
	Dasyatidae	*Dasyatis kuhlii*	x	x			
		Dasyatis zugei	x	x			
		Himantura sp.	x	x			
	Myliobatididae	*Aetobatus sp.*	x	x			
		Rhinoptera sp.	x	x			
	Gymnuridae	*Gymnura sp.*	x	x			
Scates	Rajidae		x	x			
Crabs	Portunidae	*Portunus pelagicus*	x	x			
		Portunus sanguinolentus	x	x			
Lobsters	Palinuridae	*Panulirus homarus*	x	x			
		Panulirus longipes	x	x			
		Panulirus ornatus	x	x			
		Panulirus penicillatus	x	x			
		Panulirus polyphagus	x	x			
		Panulirus versicolor	x	x			
		Puerulus sewelli	x	x			
	Scyllaridae	*Scyllarus batei*	x	x			
Shrimps	Penaeidae	*Penaeus indicus*	x	x			
		Penaeus merguiensis	x	x			
		Penaeus monodon	x	x			
		Penaeus semisulcatus	x	x			
Seacucumber	Holothuroidae	*Bohadschia marmorata*	x	x			
		Holothuria scabra	x	x			
		Holothuria spinifera	x	x			
Octopus	Octopodidae	*Octopus sp.*	x	x			
Cuttlefish	Sepidae	*Sepia sp.*	x	x			
Squids	Loliginidae	*Loligo sp.*	x	x			

ANNEX VII. OVERVIEW OF SAMPLING PROCEDURES IN THE FISH LAB



ANNEX VIII. SIGHTING RECORD OF THE MARINE MAMMALS

Date	Time	GPS point	Location		Ship heading	Bearing	Distance	Species	Scientific name	Group size			Behavior	What did you see
			Latitude	Longitude						Min	Max	Best		
24.06.2018		163	05 54.556	080 22.873	110	100	50	Brydes whale	*Balaenoptera edeni*	1	1	1		Blow
		165	05 53.541	080 31.015	110	170	2000	Blue whale	*Balaenoptera musculus*	1	1	1		Blow
		166	05 53.455	080 32.103	110	160	3000	Brydes whale	*Balaenoptera edeni*	1	1	1		Blow
25.06.2018	10.16	168	07 34.001	081 55.155	330	330	20	UID		4	6	5		Body
27.06.2018	8.23	172	10 04.732	080 48.852	140	140	30	UID		2	2	2		All
	11.50		10 01.223	080 47. 435	240	340	250	Short finned pilot whale	*Globicephala macrorhynchus*	8	12	10	Swim	All
	12.01	173	09 57.861	080 46.157	240	300	340	Short finned pilot whale	*Globicephala macrorhynchus*	9	15	10	Swim	All
28.06.2018	9.08	174	09 28.978	080 56.509	90	105	1500	UID		20	30	25	Swim	Dorsal fin
	12.10	176	09 31.241	081 28.001	260	240	150	Short finned pilot whale	*Globicephala macrorhynchus*	25	35	30	Swim/rest	All
01.07.2018	9.31	182	07 50.981	081 50.738	250	295	2500	Spinner dolphin	*Stenella longirostris*	18	25	20	Swimming	flank
02.07.2018	10.37	189	07 28.125	081 57.343	240	170	600	Spinner dolphin	*Stenella longirostris*	3	5	3	Swim fast	All
	17.47	191	07 15.701	082.01.266	180	230	800	UID				5		
03.07.2018	8.32	192	06 45.372	081 54.385	150	140	200	Spinner dolphin	*Stenella longirostris*	18	25	20	Feeding	All
	5.50	193	06 41.426	082 05 550	270	100	1800	Blue whale	*Balaenoptera musculus*	6	6	6	feeding/resting	Blow
04.07.2018	6.37	194	06 18.677	081 42.670	300	50	2500	Blue whale	*Balaenoptera musculus*	2	2	2	Feeding	Blow
	6.52	195	06 20.289	081 41.965	300	90	1800	UIBW		1	1	1	Feeding	Blow
	7.09	196	06 20.073	081 40.298	240	60	2500	Blue whale	*Balaenoptera musculus*	2	2	2	Feeding	Blow, dorsal fin
	7.17	197	06 19.048	081 39.543	240	80	1000	Blue whale	*Balaenoptera musculus*	1	1	1	Feeding	Blow, fluke
05.07.2018	6.15	198	05 32.504	081 19.216	330	230	2800	Blue whale	*Balaenoptera musculus*	1	2	1	Feeding	Blow, fluke
	6.15	198	05 32.504	081 19.216	330	240	2500	Blue whale	*Balaenoptera musculus*	1	2	1	Feeding	Blow, fluke
	6.45	199	05 36.943	081 17.455	340	50	5800	Blue whale	*Balaenoptera musculus*	1	3	1	Undefined	Blow
	6.58	199	05 36.943	081 17.455	340	360	3000	Blue whale	*Balaenoptera musculus*	2	1	3	Feeding	Blow
	6.58	200	05 38.496	081 16.919	340	180	1400	Blue whale	*Balaenoptera musculus*	1	1	1	Feeding	Blow
	7.08	200	05 38.496	081 16.919	340	180	4000	Blue whale	*Balaenoptera musculus*	1	1	1	Undefined	Blow, Fluke
	7.08	201	05 40.443	081 16.249	260	140	2000	Blue whale	*Balaenoptera musculus*	1	1	1	Feeding	Blow
	8.04	202	05 41.040	081 16.072	260	130	5100	Blue whale	*Balaenoptera musculus*	1	1	1	Undefined	Blow
	15.15	203	05 55.477	081 12.087	250	340	4000	Blue whale	*Balaenoptera musculus*	1	1	1	Undefined	Blow
06.07.2018	8.11	204	05 51.468	080 41.820	200	260	1500	Blue whale	*Balaenoptera musculus*	5	6	8	Feeding	Blow, Dorsal fin, fluke
	8.40	205	05 49.674	080 38.726	290	290	1700	Blue whale	*Balaenoptera musculus*	4	5	6	Feeding	Blow, Dorsal fin
	8.42	206	05 49.643	080 37.457	280	10	1300	Blue whale	*Balaenoptera musculus*	1	1	1	Undefined	Blow
	8.56	207	05 49.623	080 36.164	270	300	2500	Blue whale	*Balaenoptera musculus*	1	1	1	Feeding	Blow, dorsal fin
		207	05 49.623	080 36.164	270	290	6500	Blue whale	*Balaenoptera musculus*	1	1	1	Undefined	Blow
	9.13	208	05 49.639	080 33.389	270	350	4500	Blue whale	*Balaenoptera musculus*	1	2	1	Undefined	Blow
	9.19	209	05 49.656	080 32.345	270	360	300	Blue whale	*Balaenoptera musculus*	2	2	2	resting	Blow
	14.32	210	05 53.236	080 22.149	210	170	4800	Blue whale	*Balaenoptera musculus*	4	5	6	feeding/resting	Blow
		210	05 53.236	080 22.149	210	190	5200	Blue whale	*Balaenoptera musculus*	3	4	4	feeding/resting	Blow
	14.44	211	05 51.433	080 21.404	210	270	6000	Blue whale	*Balaenoptera musculus*	4	5	6	feeding/resting	Blow
		211	05 51.433	080 21.404	190	270	3500	Blue whale	*Balaenoptera musculus*	3	4	4	feeding/resting	Blow
		211	05 51.433	080 21.404	130	230	3500	Blue whale	*Balaenoptera musculus*	2	2	2	feeding/resting	Blow, dorsal fin
		211	05 51.433	080 21.404	105	290	2500	Blue whale	*Balaenoptera musculus*	2	2	2	feeding/resting	

Date	Time	GPS point	Location		Ship heading	Bearing	Distance	Species	Scientific name	Group size			Behavior	What did you see
			Latitude	Longitude						Min	Max	Best		
		211	05 51.433	080 21.404	255	290	5000	Blue whale	*Balaenoptera musculus*	1	1	1	feeding/resting	
	14.52	212	05 50.310	080 20.868	280	310	6250	Blue whale	*Balaenoptera musculus*	3	4	3	feeding/resting	Blow
	16.36	215	05 38.182	080 10.209	260	280	100	Blue whale	*Balaenoptera musculus*	1	1	1	resting	Blow, dorsal fin
	17.15	216	05 34.049	080 05.730	240	330	100	Blue whale	*Balaenoptera musculus*	2	2	2	Undefined	Blow
	18.30	217	05 28.243	079 58.154	240	220	800	Blue whale	*Balaenoptera musculus*	6	8	8	Undefined	Blow,fluke
07.07.2018	8.26	218	05 57.725	080 13.992	10	260	1500	Blue whale	*Balaenoptera musculus*	1	1	1	feeding	Blow
	13.03	220	05 52 787	080 22.627	160	100	5800	Blue whale	*Balaenoptera musculus*	1	1	1	Resting	Blow
	13.12	221	05 52.826	080 23.254	260	160	3000	Blue whale	*Balaenoptera musculus*	5	6	6	resting	Blow
		222	05 52.961	080 22.104	290	200	5750	Blue whale	*Balaenoptera musculus*	12	16	14	resting/Feeding	Blow, Fluke,
08.07.2018	07.03	224	06 12.378	079 46.189	270	350	900	Blue whale	*Balaenoptera musculus*	3	3	3	Feeding	Blow
		224	06 12.378	079 46.189	270	350	800	Blue whale	*Balaenoptera musculus*	2	2	2	Feeding	Blow
		227	06 21.238	079 46.830	320	280	750	Blue whale	*Balaenoptera musculus*	1	1	1	Feeding	Blow
	12.36	229	06 20.047	079 57.361	200	200	500	UID		90	120	100	Swim	Dorsal fin
09.07.2018	09.40	231	06 39.442	079 39.893	90	95	700	Blue whale	*Balaenoptera musculus*	1	1	1	Feeding/resting	Blow, Dorsal fin
		231	06 39.442	079 39.893	90	360	2500	Blue whale	*Balaenoptera musculus*	4	4	6	Feeding/resting	Blow
		231	06 39.442	079 39.893	90	70	1500	Blue whale	*Balaenoptera musculus*	1	2	1	Feeding/resting	Blow
		231	06 39.442	079 39.893	90	170	3500	Blue whale	*Balaenoptera musculus*	5	6	5	Feeding/resting	Blow
		231	06 39.442	079 39.893	90	200	1000	Blue whale	*Balaenoptera musculus*	2	2	2	undefined	Blow
		231	06 39.442	079 39.893	90	200	800	Blue whale	*Balaenoptera musculus*	1	1	1	undefined	Blow
	12.14	232	06 39.111	079 42.592	90	290	3000	Blue whale	*Balaenoptera musculus*	4	6	4		Blow
		232	06 39.111	079 42.592	90	30	1500	Blue whale	*Balaenoptera musculus*	1	1	1		Blow
	13.29	233	06 38.858	079 43.857	300	310	3800	Blue whale	*Balaenoptera musculus*	3	3	3	Rest	Blow, Fluke
		233	06 38.858	079 43.857	300	310	7200	Blue whale	*Balaenoptera musculus*	1	1	1		Blow
	15.02	234	06 38.705	079 43.467	300	310	4000	Blue whale	*Balaenoptera musculus*	3	3	3		Blow, Fluke
	16.20	236	06 38.618	079 45.075	340	290	3500	Blue whale	*Balaenoptera musculus*	3	4	3	resting	Blow
10.07.2018	15.15	238	07 20.434	079 35.927	80	40	400	Blue whale	*Balaenoptera musculus*	2	2	2		Blow, Fluke
		238	07 20.434	079 35.927	80	130	800	Blue whale	*Balaenoptera musculus*	1	1	1		Blow
	17.07	239	07 19.499	079 38.420	350	310	2000	UIBW		1	1	1		Blow
		240	07 20.608	079 38.350	360	270	800	Melon headed whale	*Preponocephala electra*	20	28	25		Blow
11.07.2018	10.57	242	07 40.296	079 34.841	80	120	2000	Blue whale	*Balaenoptera musculus*	1	1	1	resting	Blow
	12.03	243	07 40.197	079 37.046		360	1800	Blue whale	*Balaenoptera musculus*	2	2	2		Blow
		243	07 40.197	079 37.046		350	500	UIBW		2	2	2		Blow
	13.04	244	07 48.080	079 37.032	360	360	1200	Blue whale	*Balaenoptera musculus*	2	2	2		Blow
	13.37	246	07 47.956	079 37.873	20	250	1500	UIBW		2	2	2		Blow
	14.30	249	07 56.070	079 38.017	280	230	800	UIBW		1	1	1		Blow
	14.50	250	07 50.381	079 34.627	280	230	250	UIBW		1	1	1		Blow
	17.10	251	08 00.655	079 36.923	90	90	1000	Blue whale	*Balaenoptera musculus*	2	2	2		Blow
12.07.2018	9.07	253	08 39.324	079 38.529	60	30	400	UIW		18	25	20		Blow
	12.36	267	08 39.254	079 39.261	170	250	1200	UIW		3	5	3		Blow

UIBW - Un identified baleen whale, UIB - Un identified whale, UID – Un identified dolphin

ANNEX IX. OVERVIEW OF SAMPLES AND INSTITUTIONS

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person (e-mail, phone no)	Status	Expected Date of finalize	Storage
Niskin bottles on CTD	Chemical	Nutrients	0.2 ml chloroform (keep cool)	Simonstown	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Padmini Dalpadado, padmini.dalpadado@hi.no	Processed. Results include at the survey report.		IMR dB
Phytoplankton net	Species identification	phytoplankton taxonomy	4% formaldehyde /lugol	Colombo	By car	NARA University of Kelaniya	Prabath Jayasinghe Rasika Wanigatunga	Processed. Results include at the survey report.		NARA dB
WP2 (180 µm) 30 m 1/2 split	Dry weight	Zooplankton Biomass	dried	Colombo	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen	Padmini Dalpadado, padmini.dalpadado@hi.no	Processed. Results include at the survey report.		IMR dB
WP2 (180 µm) 30 m 1/2 split	Species identification	Zooplankton Taxonomy	4% formaldehyde	Colombo	By car	NARA	Udesika Wimalasiri	Processed. Results include at the survey report.		NARA dB
WP2 (180 µm) from max 200 m 1/2 Split	Dry weight	Zooplankton Biomass	dried	Colombo	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Padmini Dalpadado, padmini.dalpadado@hi.no	Processed.Results include at the survey report.		IMR dB
WP2 (180 µm) from max 200 m 1/2 Split	Species identification	Zooplankton Taxonomy	4% formaldehyde	Colombo	By car	NARA	Udesika Wimalasiri	Processed. Results include at the survey report.		NARA dB
MultiNet (Mamouth), 1 x 405 µm), oblique tow from max 100 m	Species identification	zooplankton taxonomy (depth related)	4% formaldehyde	Colombo	By car	NARA	Udesika Wimalasiri	Processed. some Results include at the survey report.		NARA dB

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person (e-mail, phone no)	Status	Expected Date of finalize	Storage
MultiNet (Mamouth, 1 x 405 µm), oblique tow from max 100 m	Species identification	Ichthyoplankton egg	4% formaldehyde	Colombo	By car	NARA	Ishara Rathnasuriya	Processed. Some Results include at the survey report.		NARA dB
MultiNet (Mamouth, 1 x 405 µm), oblique tow from max 100 m	Species identification	Ichthyoplankton larvae	4% formaldehyde	Colombo	By car	NARA	Ishara Rathnasuriya	Processed. Some Results include at the survey report.		NARA dB
MultiNet (Mamouth, 1 x 405 µm), oblique tow from max 100 m	Abundance and chemical composition	plastic particles	Frozen	Colombo	By car	NARA	Ashoka Weerakoon	Processed. Results include at the survey report.		NARA dB
Manta trawl (375 µm): surface tow for 15 mins	Species identification	Neuston community identification	4% formaldehyde	Colombo	By car	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Padmini Dalpadado	Processed. Results include at the survey report.		NARA dB
Manta trawl (375 µm): surface tow for 15 mins	Abundance and chemical composition	Microplastics	Photographed and packed dry	Colombo	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Bjørn Einar Grøsvik Ashoka Weerakoon	Samples to be analyzed in connection to the science plan		
Surface water pump inlett (2 m) 405 µm	Abundance and chemical composition	Microplastic samples	Frozen -20	Colombo	By car	NARA	Ashoka Weerakoon	Processed. Results include at the survey report.		NARA dB
Surface water pump inlett (2 m) 405 µm	Species identification	Neuston community identification	4% formaldehyde	Colombo	By car	NARA	Ashoka Weerakoon			NARA dB
Trawl samples	Species identification	Jellyfish whole individual	Dried + frozen	Simonstown	Airfreight	University of Western Cape, Cape Town, South Africa	Mark Gibbons	Samples to be analyzed in connection to the science plan		

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person (e-mail, phone no)	Status	Expected Date of finalize	Storage
Trawl samples	Genetic analyses?	Jellyfish arm	96% Ethanol + frozen	Simonstown	Airfreight	University of Western Cape, Cape Town, South Africa	Mark Gibbons	Samples to be analyzed in connection to the science plan		
Trawl samples	Morphomethric analyses	Jellyfish the rest	4% formaldehyde	Simonstown	Airfreight	University of Western Cape, Cape Town, South Africa	Mark Gibbons	Samples to be analyzed in connection to the science plan		
Trawl samples	Genetic analyses (stock identity)	Finclips of priority species (see Annex IV)	96% Ethanol	Colombo	By car	NARA	Sisira Haputanthantri	Processed. Not completed. Expected to complete 30.04.2019	30.04.2019	NARA dB
Trawl samples	Diet analyses	Stomachs (see Annex IV)	Frozen -20	Colombo	By car	NARA	Sisira Haputanthantri	Processed. Not completed. Expected to complete 30.04.2019	30.04.2019	NARA dB
Trawl samples	Morphomethric analyses	whole specimens,	Frozen – 20	Simonstown	Airfreight	SAIAB/FAO	Peter Psomadakis to decide			
		Difficult sp. and Peter's priority taxa	/4% formaldehyde							
Trawl samples	Taxonomy (course)	whole specimens for morphometric analysis (Taxonomic course, Bergen)	Frozen -20	Simonstown	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen	Rupert Wienerroither,	Samples to be analyzed during a taxonomic course, Bergen		
						Norway	Fiskeridynamikk			

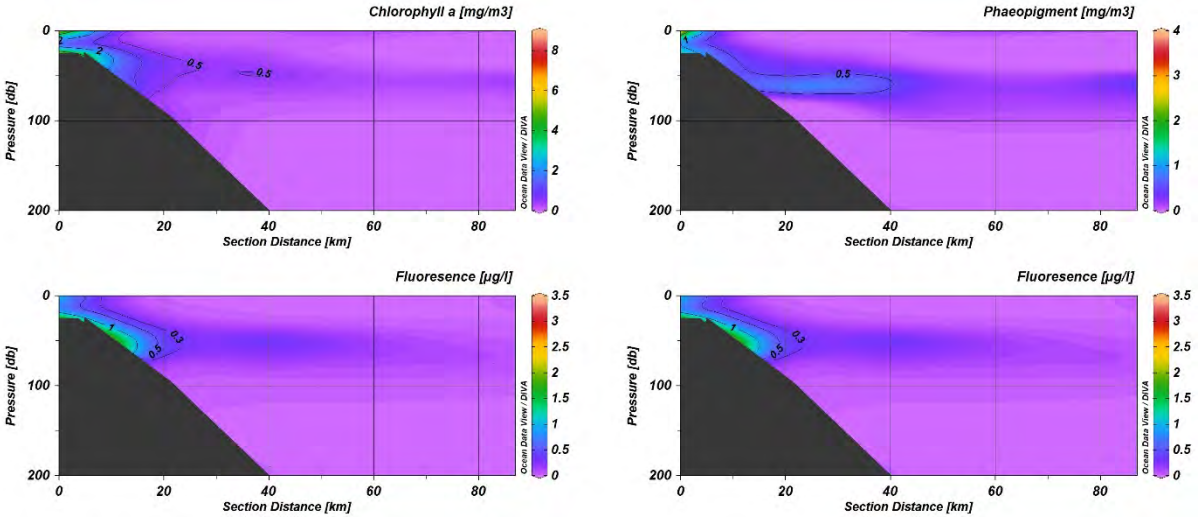
Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person (e-mail, phone no)	Status	Expected Date of finalize	Storage
Trawl samples	Museum collection	Whole specimen Museum coollection	4% formaldehyde	Simonstown	Car	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Peter Psomadakis FAO			
Trawl samples	Museum collection	Fin clips or other flesh sample museum collection from each specimen	96% Ethanol	Simonstown	Car	SAIAB/FAO Norway	Peter Psomadakis FAO	Under Processing. 31.12.2019		
Trawl samples	Museum collection	Whole specimen Museum coollection	4% formaldehyde	Colombo	By car	NARA	K.G.S. Nirbada	Processed. Not completed. Expected to complete 30.04.2019	30.04.2019	NARA dB
Trawl samples	Museum collection	Fin clips or other flesh sample museum collection from each specimen	96% Ethanol	Colombo	By car	NARA	Kasun Dalpathadu	Processed. Not completed. Expected to complete 30.04.2019	30.04.2019	NARA dB
Trawl samples	chemical composition / nutritional value	Food safety samples	freezed dried / vacum packed	Simonstown	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	NIFES			
	Radioactivity	Priority species (see Annex IV)		Colombo	By car	NARA	Thiruchenduran Somasundaran	Processed. Not completed. Expected to complete 30.04.2019	30.04.2019	

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person (e-mail, phone no)	Status	Expected Date of finalize	Storage
Trawl samples	chemical composition / nutritional value	Food safety samples (see Annex IV)	Frozen -20	Colombo	By car	NARA	Thiruchenduran Somasundaran	Processed. Not completed. Expected to complete 30.04.2019	30.04.2019	
Trawl samples	Species identification	Sharks		Simonstown	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Diana Zaera			
Trawl samples	Species identification	whole specimens of sponges	Frozen + photo	Colombo	By car	NARA	Prabath Jayasinghe	Processed. Not completed. Expected to complete 30.10.2019	30.10.2019	
Trawl sediment pipe	granulomethric analyses	Trawl cylinder sediment	Frozen	Colombo	By car	NARA	Prabath Jayasinghe	Processed. Granualr analysis completed.	30.04.2019	
	chemical analyses							Processed. Chemical analysis not completed.		
	biological analysis							Processed. Granualr analysis completed.		

Annex X. Chlorophyll a measurements vs Fluorescence measurements

Plot comparisons of the chlorophyll a measurements from the Turner Designs 10 AU Fluorometer vs the Fluorescence measurements from the AquaTracka III Fluorometer. mg/m^3 = µg/l

Transect 1



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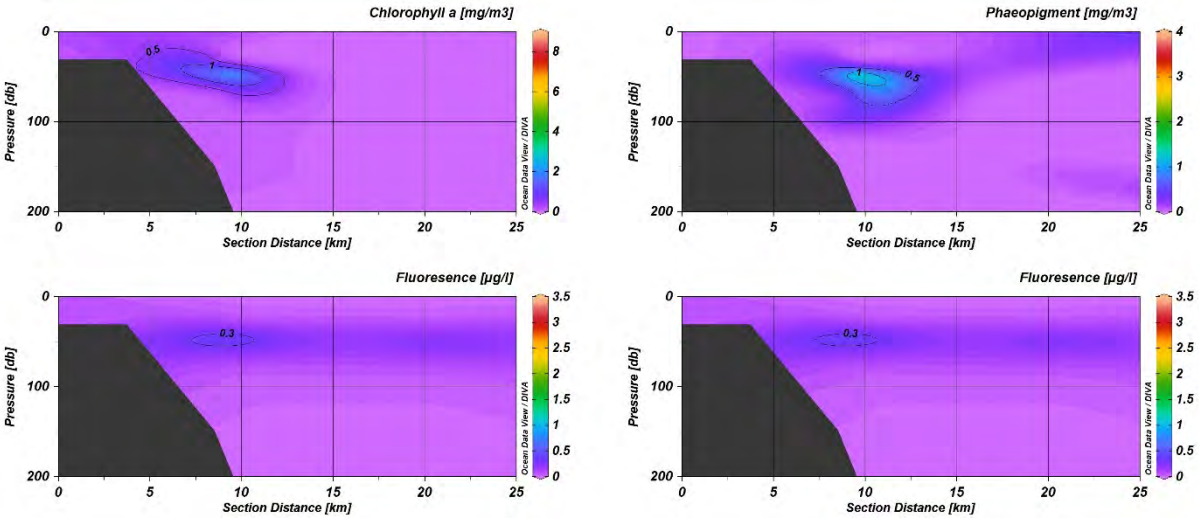
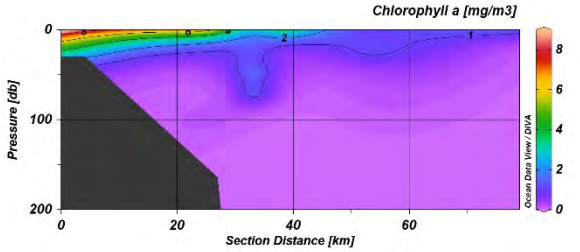
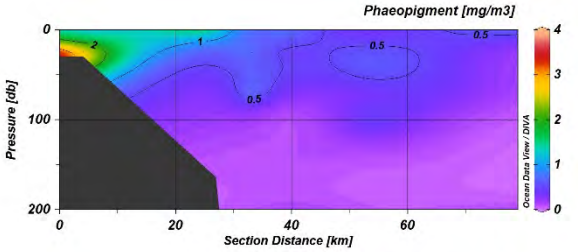
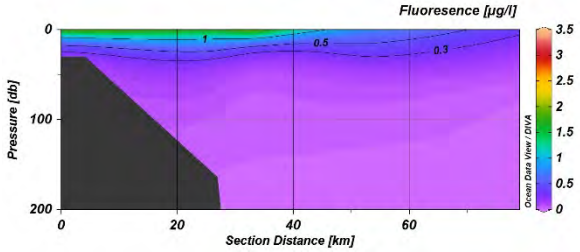
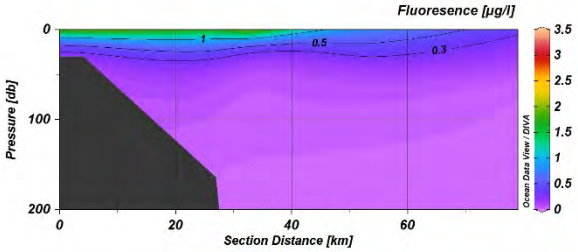


Transect 6









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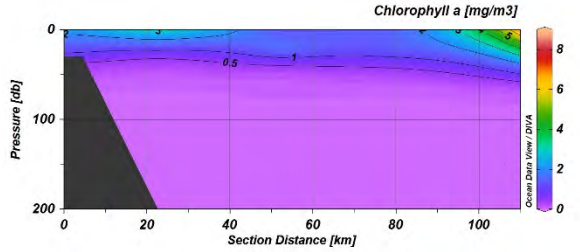

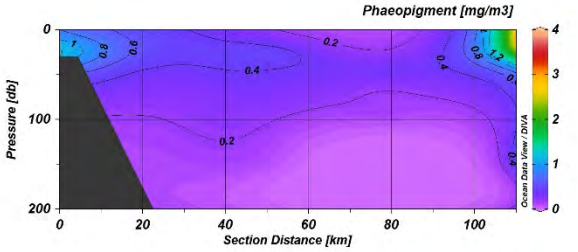

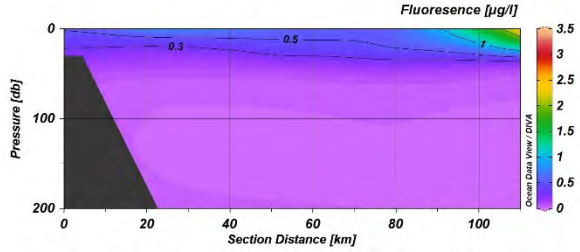

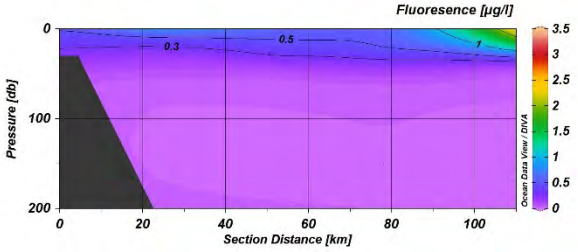

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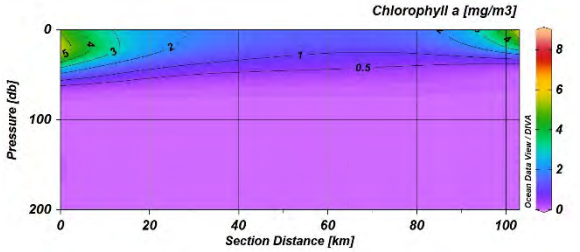
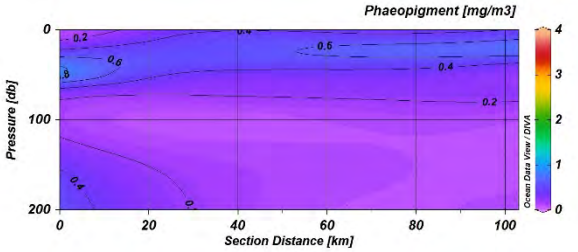
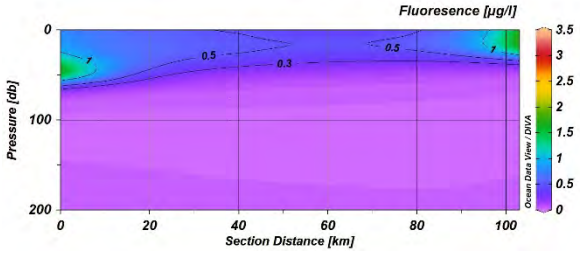
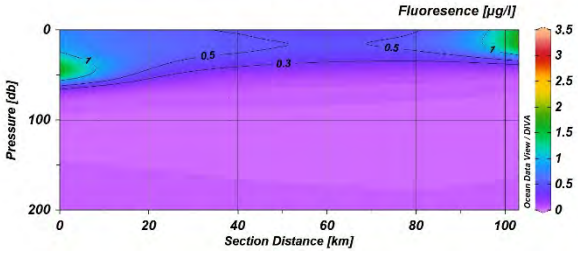








Annex XI. Nansis results vs results from the StoX software

Throughout the report the data reported has been worked up in the standard way used during all *Dr Fridtjof Nansen* surveys. However, a new biomass estimation software (StoX) was tested during the survey and Sri Lankan participants was trained in the use of this.

An alternative method of estimating biomass from acoustic trawl survey

A new software, StoX (Johnsen E. *et al*, 2018, in progress), was tested for the first time within the Nansen program during this survey. This estimation software for acoustic-trawl and swept area calculations has been implemented on several stocks throughout the North Atlantic region. The approach for acoustic abundance estimations is slightly different than the method used in Nansis. Instead of using post-stratifications, a predefined strata-system is used. This allows for the calculation of variance through boot-strapping of the acoustic and trawl data. The primary sampling unit is the acoustic transect rather than the individual integrator values.

Alternative software for estimation of swept area biomass from bottom trawl survey

Swept area abundances were calculated also using the StoX software in addition to the standard estimates from Nansis. The two programs use almost identical methodology and the estimates are therefore very similar as shown in the Result section of the report.

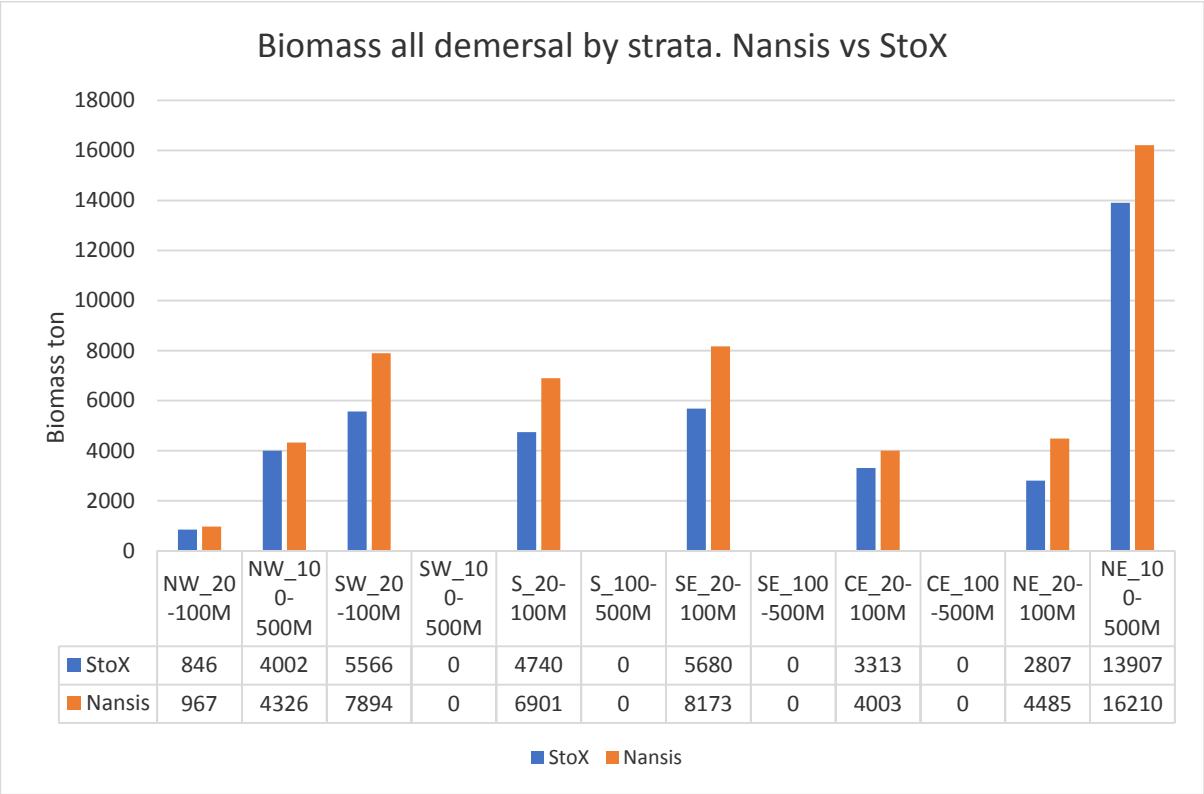
Comparison of acoustic estimates using the Nansis and StoX methodology

As expected, a comparison between the official estimates from Nansis and the results from StoX, showed very similar abundance indices for the Pel1 and Pel2 acoustic species groups. The relative abundance between the two methods in the 6 regions, showed the same distribution pattern between the two methods. The difference observed can mainly be attributed to a more conservative area calculation in Stox (Table XI.1). Also the biomass for different regions were given in Figure XI.2.

Table XI.1. Calculated total biomass (ton) using Nansis and Stox.

Species group	Nansis	StoX
PEL1	21000	17300
PEL2	101000	73000

Comparison of swept area estimates using Nansis and StoX



	NW_20-100M	NW_100-500M	SW_20-100M	SW_100-500M	S_20-100M	S_100-500M	SE_20-100M	SE_100-500M	CE_20-100M	CE_100-500M	NE_20-100M	NE_100-500M
StoX	846	4002	5566	0	4740	0	5680	0	3313	0	2807	13907
Nansis	967	4326	7894	0	6901	0	8173	0	4003	0	4485	16210

Figure XI.1. Swept area biomass estimates from Nansis and StoX for all demersal species by regional depth strata.

The two bottom trawl swept area estimates from Nansis and StoX software show very similar results, with total demersal abundance of 53000 and 41000 tons for Nansis and StoX, respectively. Differences are mainly due to the differently applied depth strata definitions and thereby the area and abundance. We did not have access to high accuracy bottom contour data for the Sri Lankan shelf. Due to this, the strata boundaries had to be adjusted manually where echo sounder recordings showed different depth than the map data.

As for the acoustic-trawl estimates, the variance estimates from StoX, revealed that the estimate is subject to considerable uncertainty and therefore needs to be understood as indices and not absolute estimates of abundance. As described before, this was to be expected.

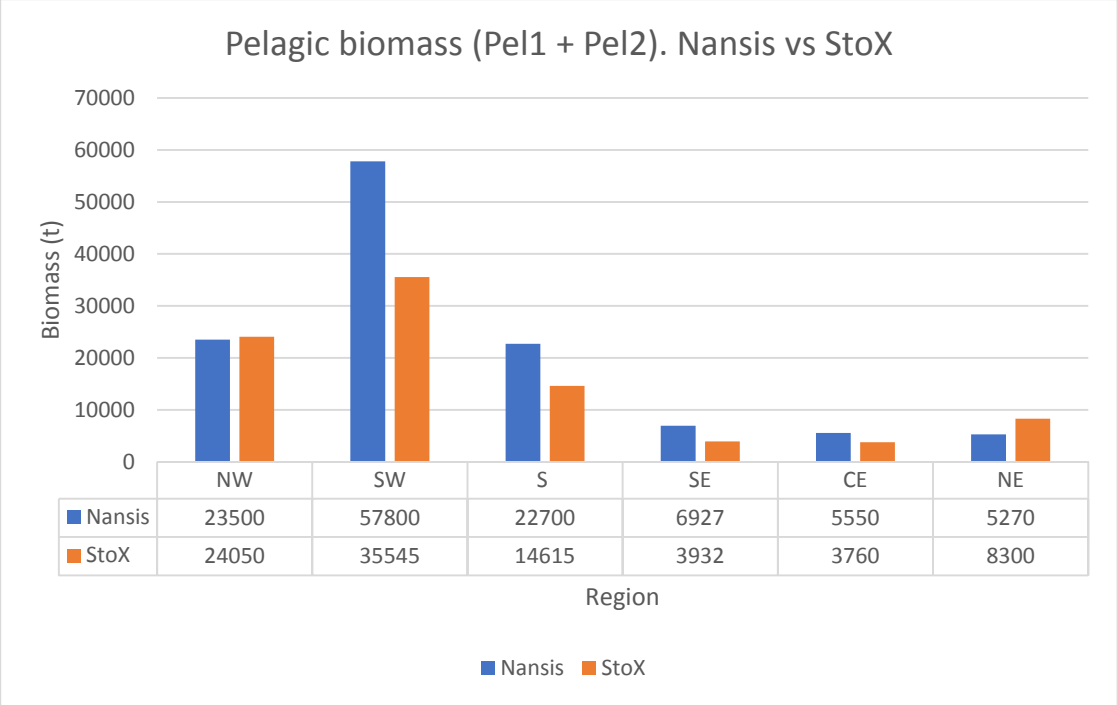


Figure XI.2. Comparison of acoustic biomass estimates by region for pelagic fish (Pell+Pel2) between Nansis and StoX.

The variance estimates from StoX confirmed the explanations and conclusions given elsewhere in this report, that the estimates are subject to considerable uncertainty and therefore needs to be understood as indices and not absolute estimates of abundance.