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CRUISE REPORTS *DR FRIDTJOF NANSEN*
EAF-Nansen/CR/2018/10



SURVEY OF REGIONAL RESOURCES AND ECOSYSTEM OF THE BAY OF BENGAL

Bangladesh

2 – 17 August 2018



**Department of Fisheries
Ministry of Fisheries & Livestock, Bangladesh**

**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.

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2 – 17 August 2018

By

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EXECUTIVE SUMMARY

This survey was part of a synoptic coverage of the Bay of Bengal marine resources and ecosystems to be conducted by the RV *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, the sampling methods used and provides preliminary results while the broader set of results is expected to come as part of the activities under the EAF-Nansen Science Plan and will be published separately.

The environmental conditions reflected what to be expected during this season, with surface temperatures approaching 30 degrees C, with an east-west gradient and warmer sea surface temperatures towards the west. A surface front between the fresh water plume and shelf waters of oceanic origin was observed where fish (probably hilsa shad) was concentrating and where numerous fishing boats were observed. Very low oxygen levels (< 0.1 ml/l) were observed below the thermocline at depths of about 70 to 100 m. These conditions are similar to what found in the Arabian Sea. Downwelling conditions suggesting that during that period oceanic nutrients were in poor supply and therefore the open ocean played a limited role in driving the biological productivity over the shelf. Productivity, at least during this season, seems to be driven by the river outflow.

According to survey objectives, biomass estimates were only possible for pelagic fish and resulted in a total of about 158 000 tonnes. These results are comparable to what found in previous surveys with the RV *Dr Fridtjof Nansen* in 1979 and 1980. It should be noted that shallow parts of the shelf (shallower than 20 m) were not covered by these surveys and that herefore the estimates represent an underestimate of the total pelagic fish biomass available.

Scientific results based on the samples collected on various aspects of marine ecology and pollution will be reported separately through collaborative work at the national, regional and interregional levels.

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 RV *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 EAF-Nansen 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. A post-survey meeting was held in Yangon on 19-21 February and this version includes comments and suggestions provided in that connection.

This report is intended to document the scientific scope of the survey, the sampling methods used and to provide preliminary results. A broader set of results are expected as part of the activities under the EAF-Nansen SciencePlan and will be published separately.

1.1 The survey area

The area surveyed in 2018 by the RV *Dr Fridtjof Nansen* included 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 mesopelagic communities. Figure 1 provides an overview of the surveys undertaken as part of Leg 3.

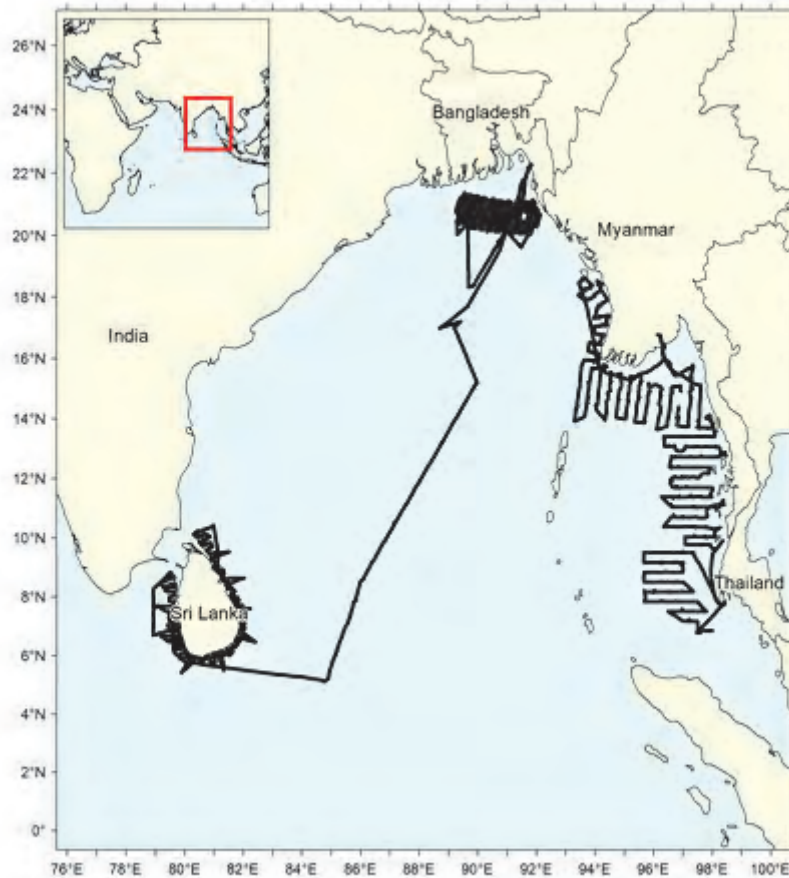


Figure 1. The survey plan for *Dr Fridtjof Nansen*, leg 3.

Leg 3 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 has been on pelagic resources, while in Myanmar on distribution of eggs and larvae. Off Thailand the priority has been to sample the deep waters of the Andaman Sea.

This report describes the ecosystem survey on the continental shelf of BangladeshEEZ, and extending offshore into deeper waters for a mesopelagic transects, to cover hydrographic conditions, phyto-, zoo- and ichthyoplankton, abundance of pelagic resources, biodiversity from trawl catches, pollution (micro plastics and food safety), and nutritional value of fish. The survey design prepared by the Bangladesh Marine Fisheries Survey Design Working Group was provided prior to the survey by the Department of Fisheries of Bangladesh (Figure 2).

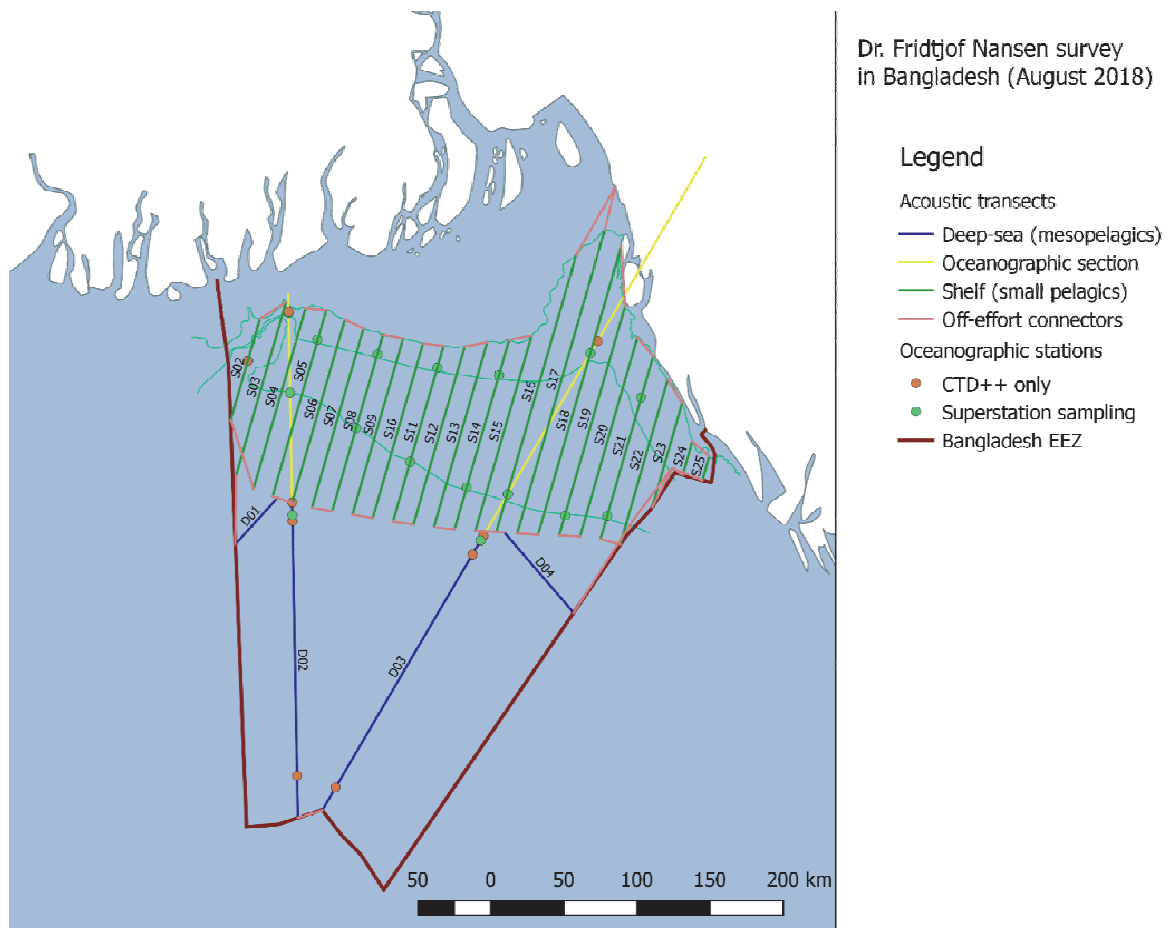


Figure 2. Proposed survey plan for the RV *Dr Fridtjof Nansen*, Leg 3.3, Bangladesh, 2018.

1.2 Survey objectives

Hydrography:

- To observe the hydrographic conditions off the coast of Bangladesh and on the continental shelf. Hydrographic stations were conducted in connection with the pelagic trawls to provide information on the environmental conditions within which fish was found. Two oceanographic transects from the continental shelf to the coast were also performed to assess the change in water parameters from the river outlets to the Bay of Bengal. The following hydrographic parameters were collected for analysis: temperature, salinity, dissolved oxygen, fluorescence, chlorophyll a, nutrients, pH and total alkalinity.

Phytoplankton, zooplankton, ichthyoplankton and jellyfish:

- To observe the distribution, abundance and composition of phytoplankton, zooplankton, ichthyoplankton and jellyfish off the coast of Bangladesh and on the continental shelf. Sampling for these biological parameters was also performed in connection with pelagic trawl stations. This was intended to provide data to better understand acoustic backscatter from zooplankton as compared to acoustic backscatter due to fish and jellyfish.

Pelagic and demersal fish stocks:

- To obtain information on abundance, distribution (also by size) of the main pelagic fish species, using the acoustic method, including targeted trawling, in a systematic grid survey strategy.
- To collect information on biodiversity of fish from trawl catches.
- To collect samples for genetic analysis for selected species.
- To collect stomach samples for analysis of contents (diet) including micro plastics.
- To collect species for taxonomic analysis and classification

Mesopelagic fish:

- To identify the main species of mesopelagic fish off the continental shelf and on the shelf break
- To determine the acoustic densities of mesopelagic fish off the continental shelf and on the shelf break

Contaminants:

- To collect samples of fish species consumed locally for analysis of contaminant levels and nutrient values.

Parasites:

- To determine the burden of macroparasites in fish species

Marine debris and pollution:

- To record occurrences and locations of surface marine debris and microplastics and to describe the neuston communities in the associated collected samples.

1.3 Participation

A total of 30 scientists and technicians from Bangladesh, India and Norway participated in the survey. The full list of the participants and their affiliations is given in Table 1 below.

Table 1. List of participants, their role and affiliation during the period of 02.08.2018 to 17.08.2018.

Name	Institute	Role
Erik OLSEN	IMR	Cruise leader
Md Abdullah AL-MAMUN	DoF, Bangladesh	Co - Cruise leader
Ines DIAS BERNARDES	IMR	Scientist
Sarah Ann BRUCK	IMR	Scientist
David CERVANTES	IMR	Scientist
Miguel Bao DOMINGUEZ	IMR	Scientist
Geir LANDA	IMR	Instrument chief
Hege ROGNALDSEN	IMR	Instrument operator
Anna NORDHAGEN	IMR	Scientist
Marek OSTROWSKI	IMR	Scientist

Name	Institute	Role
Bineesh KINATTUM KARA	ZSI, India	Scientist
Anil MOHAPATRA	ZSI, India	Scientist
Subhrendu Sekhar MISHRA	ZSI, India	Scientist
Abu Sayeed Muhammad SHARIF	BORI, Bangladesh	Scientist
Abu Ansar Mohammad RIZWAN	WF, Bangladesh	Scientist
K M Shahriar NAZRUL	DoF, Bangladesh	Scientist
Suman BARUA	DoF, Bangladesh	Scientist
Al MAMUN	DoF, Bangladesh	Scientist
Nripendra Kumar SINGHA	DoF, Bangladesh	Scientist
Md Sharif UDDIN	DoF, Bangladesh	Scientist
Moin Uddin AHMAD	DoF, Bangladesh	Scientist
Md Mahmudul Islam CHOWDHURY	DoF, Bangladesh	Scientist
Mohammad Mohidul ISLAM	BFRI, Bangladesh	Scientist
Sk Humaun KABIR	DoF, Bangladesh	Scientist
Mohammad Ashraful ALAM	BFRI, Bangladesh	Scientist
Sayedur Rahman CHOWDHURY	IMS, CU, Bangladesh	Scientist
Syed Shoeb MAHMUD	Navy, Bangladesh	Scientist
Md Jahangir SARKER	NSTU, Bangladesh	Scientist
Farhana LOVELY	DoF, Bangladesh	Scientist
Mosammat Rashida AKTER	DoF, Bangladesh	Scientist

List of institution abbreviations:

- IMR: Institute of Marine Research, Bergen, Norway
- ZSI: Zoological Survey of India, Kolkata, India
- NSTU: Noakhali Science and Technology University, Noakhali, Bangladesh
- DoF: Department of Fisheries, Bangladesh
- BORI: Bangladesh Oceanographic Research Institute
- BFRI: Bangladesh Fisheries Research Institute
- WF: WorldFish
- IMSF, CU: Institute of Marine Science, University of Chittagong

1.4 Narrative

The scientific team arrived on the vessel on the evening of 1st August. The next day a ‘Nansen event’ was organized with about 50 participants including the minister of fisheries, the Mayor of Chattagram, the member of parliament of a local constituency, officials from the Ministry of Fisheries and Livestock, officials from the Department of Fisheries, FAO Country Representative, the Charge d’Affairs of the Royal Norwegian Embassy, national press and more. As the event lasted into the afternoon the Nansen missed the tide and had to wait for departing Chattagram harbour until the 3rd August.

The Nansen left Chattagram harbour at 13:00 on 3rd August, and arrived at the start of the first pelagic transect in the afternoon. From the 3rd to 7th August the easternmost part of the pelagic survey area was covered. From 7th to 10th August the vessel carried out four mesopelagic transects off the continental shelf break in the southern part of the Bangladesh

EEZ. After finishing the mesopelagic transects the vessel continued with the pelagic transects on the shelf, starting in the westernmost part of the EEZ, over the submarine canyon area ‘Swatch of no ground’. The Nansen continued with the pelagic transects towards the east according to the survey plan (Figure 2) with sampling locations selected according to depth strata and observations of fish aggregations on the echosounder. In selected locations some demersal trawl hauls were made for biodiversity studies and collection of samples as reference specimens.

During the survey six open science seminars were held by the Norwegian, Indian and Bangladeshi scientists.

Sampling on stations ended in the afternoon of 16th August, after which the vessel headed north along the last pelagic transect (S16) towards port. On 17th August the vessel was at the anchorage site outside of Chattagram harbour waiting for the pilot who took the vessel to quay in Chattagram Harbour (Grain Silo Jetty) at 14:30.

Upon arrival in Chattagram the local scientific crew departed and samples destined for Bangladesh institutions were offloaded.

In the evening of 17th August the Ministry of Fisheries and Livestock hosted a welcome reception for all crew and scientists at the Chattagram Boat Club.

1.5 Survey effort

Hydrographic and biological parameters were sampled and measured to coincide with the pelagic trawls on the survey. At these “Super Stations” several different deployments were performed for extensive sampling. Table 2 displays the quantifiable survey effort for the hydrographic, plankton, microplastic, bottom and pelagic trawl sampling events during the survey.

Table 2. Survey effort for hydrographic, plankton and microplastic events during the survey.

Region	CTD with Water Sampling	CTD Only Station	Phytoplankton Net	WP-2 Net (Zooplankton) (≤ 30 m)	WP-2 Net (Zooplankton) (> 30 m)	Mammoth Multinet (Ichthyoplankton)	Manta Trawl (Microplastics)	Pelagic trawl	Bottom Trawl
Bay of Bengal	36	2	31	32	30	22	29	37	5

The positions of the sampling events (stations) listed in **Errore. L'origine riferimento non è stata trovata.** above are plotted on maps of the Bay of Bengal below, with the course track and trawl stations plotted in Figure 3, and CTD and plankton stations plotted in Figure 4.

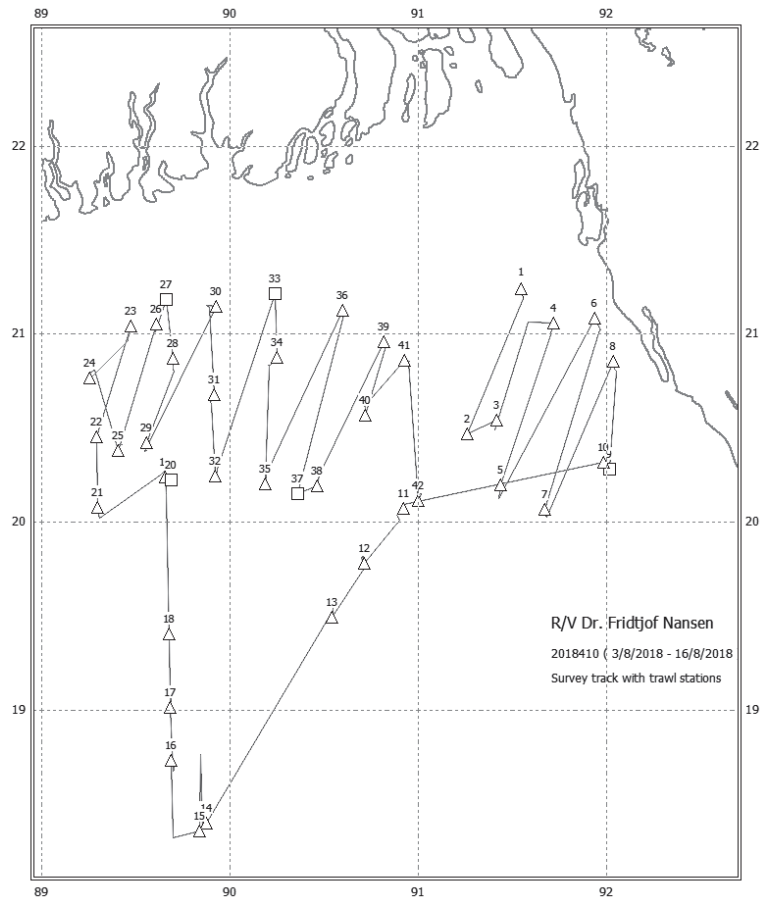


Figure 3. Course track and trawl stations.

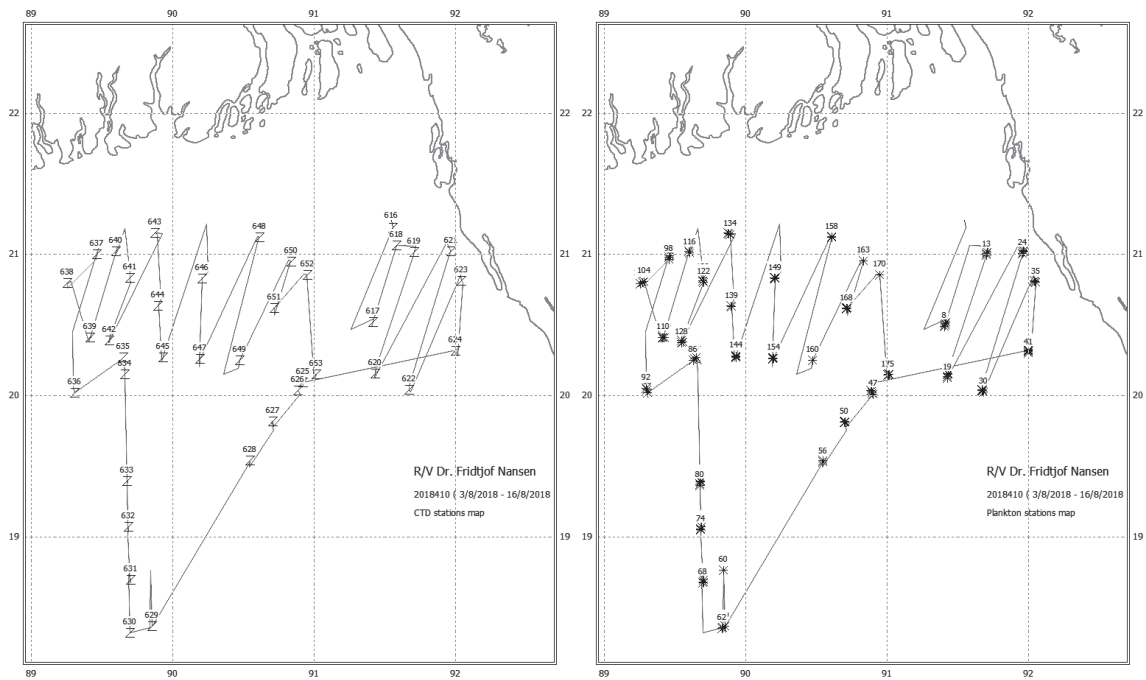


Figure 4. CTD (left) and plankton (right) stations map.

2.1 Oceanography

2.1.1 Underway sampling

The core of the underway water sampling system is an SBE-21 thermosalinograph (TSG), manufactured by Seabird Inc. (Bellevue, Wa, USA). It measures the temperature and conductivity of seawater of the engine cooling water; salinity is derived computationally in the data logging software; the sampling rate is 10 seconds. Each sample is referenced by UCT time and geographical position obtained from the onboard differential GPS. Seawater is supplied through the vessel’s piping system from the intake located midships on the starboard side at 4m depth. Another temperature sensor is installed as close as possible to the water intake to measure the true temperature of the ambient ocean. In addition to the standard sensors, the TSG onboard the vessel is fitted a Turner Design C3 Submersible Fluorometer to measure turbidity and fluorescence levels. During the survey the TSG operated continuously, providing the data covering the entire survey track from the 3rd to 17th of August.

The data restrictions affected the ADCP-derived current observation, limited to one section only, collected during the final survey stage.

2.1.2 Station sampling

To get a depiction of the chemical and biological makeup in the pelagic zone, hydrographic and biological station sampling was carried out to coincide with each pelagic trawl. Although most stations were shallower than 200 m, eight stations did have a maximum sampling depth of 500 m. Figure 5 below depicts the sampling events that occur at each of these “Super-stations” based on maximum depth. Only two stations during the survey were CTD-only stations. Table 3 gives an overview of the hydrographic samples collected.

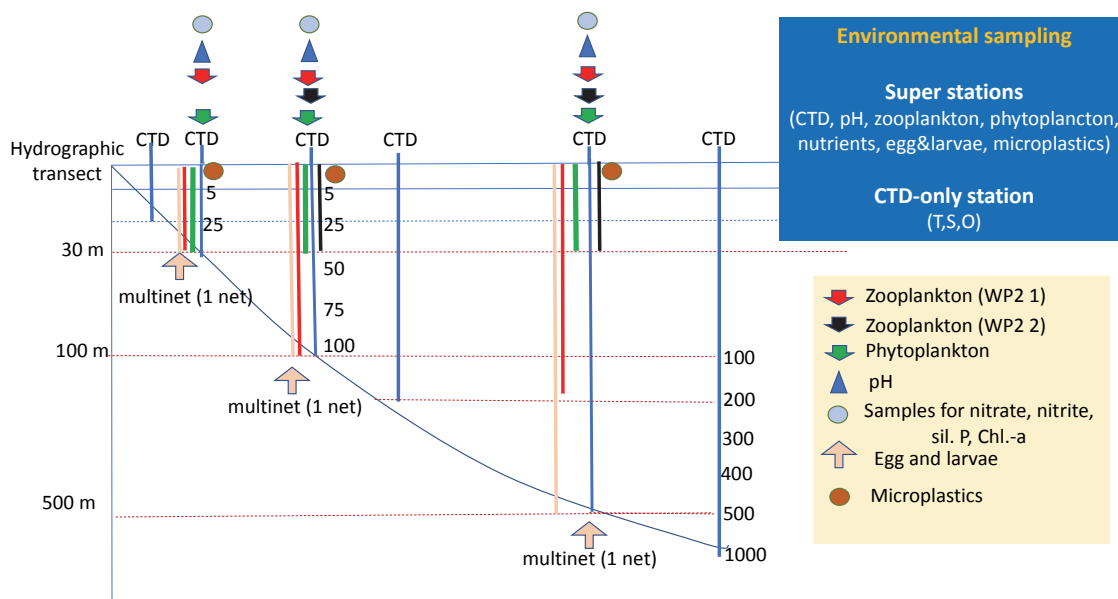


Figure 5. Super-station sampling diagram based on depth.

Table 3. Number of samples collected for hydrographic parameters.

Survey area	CTD Only Station	CTD with Water Sampling	pH & Total Alkalinity	Nutrients IMR	Chlorophyll a	Dissolved Oxygen	Salinity
Bay of Bengal	2	36	201	201	173	9	15

2.1.3 CTD sensors – temperature, salinity, oxygen and fluorescence

Hydrographic parameters were monitored at 36 Super Stations and 2 CTD only stations throughout the survey (Figure 6). The CTD and additional sensors mounted on the 12-bottle rosette collected vertical profiles for conductivity (salinity), temperature, pressure (depth), dissolved oxygen, fluorescence, and photosynthetically active radiation (PAR).

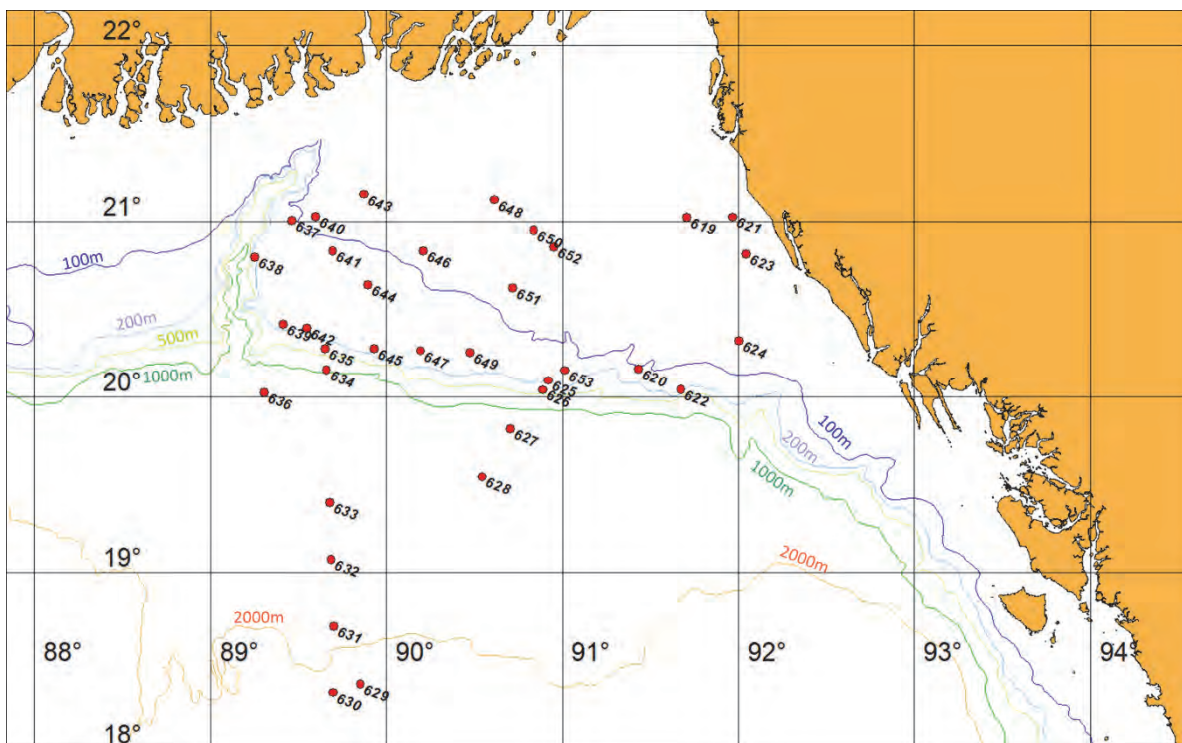


Figure 6. Distribution of the 38 CTD stations occupied during the survey. The station numbers shown in italics; the bottom contours of 100, 200, 500, 1000 and 2000 m are color coded. All CTD stations collected vertical profiles for salinity, temperature, oxygen, fluorescence and Photosynthetically Active Radiation (PAR).

Vertical temperature and salinity profiles were obtained by a Seabird 911plus CTD containing a SBE 3plus temperature sensor, SBE 4C conductivity sensor and a Digiquartz® pressure sensor. In addition, *in situ* concentrations of dissolved oxygen were measured using a CTD-mounted SBE 43 dissolved oxygen sensor. Attached to the CTD was also an uncalibrated Chelsea III Aquatracka fluorometer, which measures *in situ* fluorescence on a relative scale. Lastly, a LI-COR Biospherical Photosynthetic Active Radiation (PAR) Sensor is also attached to measure the downwelling irradiance in the water column. Real time logging and plotting was performed using the Seabird Seasave software.

Water bottle samples for salinity and dissolved oxygen for sensor validation were obtained at the end of the survey due to data restrictions in force during most of the survey. Water samples were collected and measured on board with a Guildline Portasal Salinometer 8410A to validate the salinity calculated from the CTD conductivity sensor (Figure 7). The dissolved oxygen sensor measurements were validated via Winkler titration (Grasshoff *et al.* 1983) (Figure 8) which was also performed on the vessel. Ideally, validations would take place throughout the survey. However, a limited number of validations were performed near the end of the survey due to initial data restrictions. Both the dissolved oxygen and salinity sensor measurements were validated successfully on the survey.

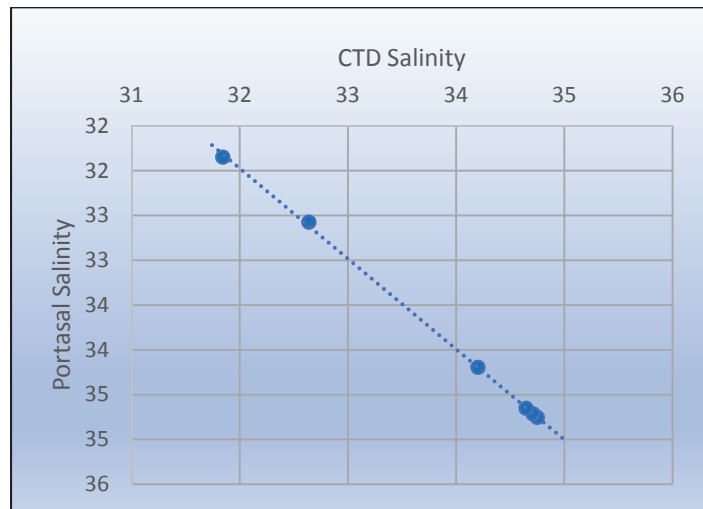


Figure 7. CTD calculated salinity values compared to Portasal calculated salinity values from water collected at the same depths.

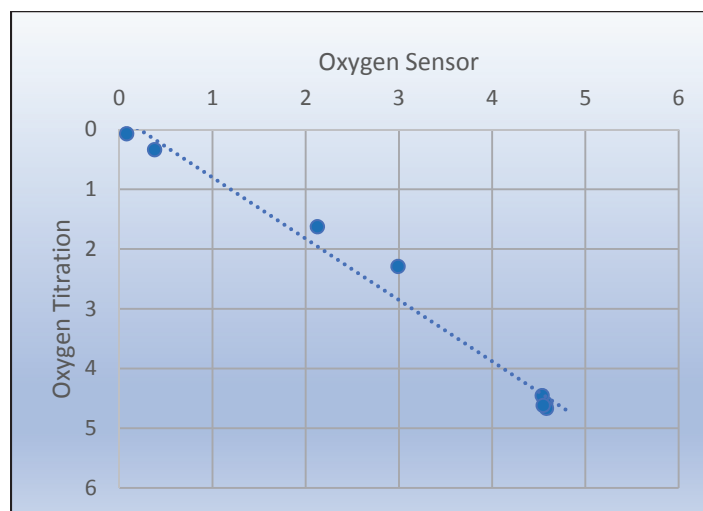


Figure 8. CTD mounted SBE 43 dissolved oxygen sensor measurements compared to Winkler titration measurements from water collected at the same depths.

2.1.4 Rosette Water Sampling

Dr Fridtjof Nansen is equipped with a 12 Niskin bottle (10 L) rosette that is used to collect water samples from pre-defined depths. The standard water sampling depths were set to: 5, 25, 50, 75, 100, 200, 300, 400 and 500 m.

Ocean acidification parameters (pH and total alkalinity)

In addition to the CTD profiles, the vertical profiles of pH and total alkalinity were obtained from the onboard analysis of water bottle samples. Seawater samples for pH and total alkalinity analyses were collected at each Super Station in borosilicate glass bottles (250 ml) using silicone tubing to reduce air exchange. Both pH and total 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. Total alkalinity was measured by potentiometric titration with acid (0.05M HCl) and changes in pH were measured with an electrode (potential in mV) using the Metrohm tiamo software. Further processing of the data will be at the Institute of Marine Research and will provide more information on the marine carbonate system and parameters for ocean acidification and will be used for collaborative studies with partners from the countries where the data have been collected. Nutrients

Nutrients

Seawater samples for nutrient analyses (nitrate, nitrite, silicate and phosphate) were collected at each Super Station in 20 ml polyethylene vials, preserved with 0.2 ml chloroform, and kept cool and dark in a refrigerator. The analyses will be made on shore at the Institute of Marine Research, using a modified Alpkem AutoAnalyzer C (O.I. Analytical, USA) and following standard procedures (Grasshoff, 1965). Another batch of the nutrient samples went to the Bangladesh Ocean Research Institute (BORI) for a comparative analysis.

Storage may introduce loss of accuracy of the results, especially when the concentrations of nitrate, nitrite, silicate and phosphate are low.

2.2 Plankton sampling

2.2.1 Chlorophyll a

Seawater samples for chlorophyll a analyses (an indicator of phytoplankton biomass) were collected from Niskin bottles corresponding to depths from 200 m to the surface at each Super Station. Samples were collected in 500 ml polyethylene bottles and immediately filtered with a 0.7 μ m filter (25 mm Munktell glass-fibre filters Grade: MGF) and vacuum pump at 200 mm Hg. Due to a lack of time and personnel, filters were stored at -20°C for subsequent chlorophyll a analysis post-survey.

2.2.2 Phytoplankton Net

Qualitative phytoplankton samples were collected at each Super Station with a 10 μ m net with a 35 cm diameter. The net was hauled vertically at a speed of 0.1 ms⁻¹ from a depth of

30 m to the surface (or 5 m above bottom at the ≤ 30 m stations). These samples are not quantitative, but used to establish the taxonomic composition of the phytoplankton community. After sampling, the cod-end was rinsed and the sample was preserved with Lugol's Iodine.

A total of 31 phytoplankton net deployments were performed during the survey. On board analysis of the samples did not take place but the samples were sent to the Bangladesh Ocean Research Institute for taxonomic analysis. Additionally, 5 litres of water from each Niskin bottle were filtered over a 10 μm sieve to collect a concentrated sample for plankton analyses at the Bangladesh Ocean Research Institute. The specific analysis has not yet been determined for these 32 concentrated plankton samples.

2.2.3 Zooplankton sampling

Zooplankton were collected at each Super Station with a WP2 net (mesh size 180 μm , 56 cm diameter) (Fraser 1966) and hauled vertically at a speed of $\sim 0.5 \text{ ms}^{-1}$. At stations with bottom depths ≤ 30 m, the WP2 net was lowered to 5 m above the bottom. At stations of depths of at least 100 m, a second WP2 net was deployed to 5 m above the bottom. For the much deeper stations, the maximum bottom depth for the second WP2 net was 200 m. The purpose of the second WP2 deployment at 30 m was to enable a direct comparison of the zooplankton composition and concentrations in the uppermost layer of the water-column to the bottom-depth gradient.

Each of the 62 zooplankton net deployment samples was divided into two equal parts using a Motoda plankton splitter (Motoda 1959). The first part of the sample was size-fractionated by using a series of sieves with decreasing mesh-sizes of 2000 μm , 1000 μm and 180 μm . The zooplankton retained on each sieve were dried on aluminium trays at $\sim 60^\circ\text{C}$ for 24 h. These samples are undergoing a second pass drying and weighing at the Institute of Marine Research for biomass estimation for the different size-groups. The second part of the sample was preserved in seawater with concentrated formalin buffered with borax for subsequent species identification at the Bangladesh Oceanographic Research Institute.

2.2.4 Ichthyoplankton

Ichthyoplankton (fish eggs and larvae) were collected at each Super Station using a Multinet Mammoth net (1 m^2) with a mesh size of 300 μm . Oblique MultiNet Mammoth (300 μm -mesh) tows to collect fish eggs and larvae were conducted at 22 super stations. The samples were taken obliquely from $\sim 25 - 0$ m at 30 m bottom depth, and 100 - 0 m at greater depths using a single net. The samples were rinsed from the net, collected in the cod-end, and preserved with formalin. Fish larvae visible with "the naked eye" are usually removed from the total sample, photographed and transferred to Eppendorf tubes in 96% ethanol, but limited time and personnel did not allow for this processing on this survey. Instead, the whole cod-end sample was collected in 100 ml polyethylene bottles with concentrated formalin to be analysed at the Bangladesh Oceanographic Research Institute.

2.2.5 Microplastics

Microplastics were collected at each Super Station by towing a Manta trawl at the surface. The Manta trawl has a rectangular opening of 19 cm × 61 cm, mesh-size 335 µm and two wings to keep it balanced at the surface during towing. Trawls were hauled horizontally 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 of the starboard side, about mid-ship, attempting to avoid the wake of the vessel. Each of the cod-ends from the 29 Manta trawl was washed in filtered seawater over a sieve with a mesh-size of 180 µm. Because the Institute of Marine Sciences, University of Chittagong had interest in analysing the samples for microplastics and neuston, the whole sample was split in halves and preserved with ethanol so that a set of samples would be available for this institution in addition to the samples shipped to IMR as part of what planned within Theme 6 of the EAF-Nansen Science Plan.

2.3 Bottom mapping echo sounder

The EM 710 and EM 302 multibeam echo sounders are both belonging to a high to 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 was logged to the on-board Olex plotting system and to rawdata files.

The EM 710 and EM 302 were not allowed to be used until 12th August. During the survey, swath coverage and depth range settings were adjusted accordingly to optimize the mapping. The measured sound speed profile was also input in the system when CTD measurements were carried out. Tide correction was not done.

The recorded data was viewed on Seafloor Information System (SIS), Kongsberg real time software designed to be the user interface and the realtime data processing system for its hydrographic instruments, and on Olex, the onboard navigation planning system. An offloaded copy of the Olex bathymetric data is later loaded onto the Olex chartplotter of the national research vessel R.V. Meen Sandhani.

2.4 Biological trawl sampling

2.4.1 Fish sampling

Biological sampling of the fish was carried out using pelagic and bottom trawls. Pelagic trawls were conducted using the MultPelt trawl and a few bottom trawls were also done. All catches were sampled for composition by weight and numbers of each species caught. For the selected target species, length (total length to the nearest cm) and weight (to the nearest 0,5 g) were also recorded. The list of species chosen for collection of length, weight, stomach or genetics is found in Annex VI. In addition, all families used for the acoustic abundance like Scombridae, Carangidae, Trichiuridae and Clupeidae would be also selected for the length-weight measurements. Other specimens were collected and frozen for later stomach content analysis and genetics.

All catches were sampled for composition by weight and numbers of each species caught. Species identification was based on the FAO Species Catalogues. For the selected target species length (total length to the nearest cm), weight (to the nearest 0,5 g) were recorded. When the size distribution of the target species in the catch was seemingly narrow (similarly sized individuals), a total of 50 to 100 individuals were selected for the measurement of length and weight. Length and weight measurements were used to estimate the length-weight relationship and together with length frequency distributions applied in biomass calculations.

2.4.2 Taxonomy

Fish and invertebrate species identification was made to the lowest taxonomic level possible by experienced taxonomists and followed FAO species identification sheets for Fishery purposes, Fishing Area 51 (Fischer and Bianchi, 1984) and several online databases especially the catalog of fishes (Eschmeyer et al. 2018), WoRMS database (WoRMS Ed. Board 2018) and FishBase (Froese and Pauly 2018).

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.

2.4.3 Jellyfish

Jellyfish caught as part of the trawl haul were identified to the lowest possible taxonomic level, and counted and weighed. Jellyfish specimens that were in a 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 ethanol 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.

2.5 Acoustic sampling and biomass estimation

2.5.1 Sonar data

The SU 93 sonar was used for searching for schools, but no data was logged.

2.5.2 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 23rd January, 2017. Annex I gives the details of the acoustic settings used during the survey.

2.5.3 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 sA (m^2/NM^2) was allocated to a predefined set of species groups on the basis 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 4. Ground truthing and estimation of mean length and weight were accomplished by means of targeted pelagic trawling. In cases where the integrated echo contained more than one category of fish (see Table 4), the mean sA -value allocated to each category was in the same ratio as their contribution to the abundance in trawls in that area.

The acoustic backscatter was scrutinized daily and allocated to the various target groups. The sV threshold used when sardinellas occurred to filter out other species and plankton was -45 dB, or in regions where the plankton layer was extremely dense and even lower threshold had to be used. For Pelagic I, Pelagic II and “other pelagic species” -50 dB was used, or even lower if the plankton layer was extremely dense. 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 4 below).

Table 4. Allocation of acoustic densities to species groups. Most common taxa are listed for the groups of Pel1 and Pel2 while for other groups only families are listed.

Group	Taxon	Species
SARDINELLA	Clupeidae	<i>Sardinella</i> sp.
Pelagic species group 1 (Pel1)	Clupeidae	<i>Anodontostoma chacunda</i>
	Engraulididae	<i>Coilia dussumieri</i>
		<i>Setipinna phasa</i>
		<i>Setipinna tenuifilis</i>
		<i>Stolephorus andhraensis</i>
		<i>Stolephorus commersonii</i>
	<i>Thryssa dussumieri</i>	
Chirocentridae	<i>Chirocentrus</i> spp	
Dussumeridae	<i>Dussumieria elopsoides</i>	
Pelagic species group 2 (Pel2)	Carangidae	<i>Megalaspis cordyla</i>
		<i>Atule mate</i>
		<i>Alepes kleinii</i>
		<i>Atropus atropos</i>

Group	Taxon	Species
		<i>Selar crumenophthalmus</i>
		<i>Scomberoides commersonnianus</i>
		<i>Scomberoides tol</i>
		<i>Parastromateus niger</i>
		<i>Decapterus macrosoma</i>
		<i>Decapterus russelli</i>
	Scombridae	<i>Rastrelliger brachysoma</i>
		<i>Rastrelliger kanagurta</i>
		<i>Auxis thazard</i>
		<i>Auxis rochei</i>
		<i>Thunnus tonggol</i>
		<i>Euthynnus affinis</i>
		<i>Scomberomorus guttatus</i>
	<i>Scomberomorus guttatus</i>	
	Sphyraenidae	<i>Sphyraena spp.</i>
Trichiuridae	<i>Trichiurus lepturus</i>	
	<i>Trichiurus gangeticus</i>	
	<i>Lepturacanthus savala</i>	
	<i>Eupleurogrammus muticus</i>	
Mesopelagic species	Myctophidae	
	Other mesopelagic fish	
Main demersal species	all demersal fishes	
Plankton	all plankton	

2.5.4 Estimation of biomass from acoustic measurements

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

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

or

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

and in the simplest form

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

where CF is the conversion factor from acoustic density to fish biomass and \bar{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 (north, central, south), 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: $1000 \leq s_A < 3000$;
- 4: $3000 \leq s_A \leq 10000$; 5: $10000 \leq s_A \leq \infty$ (m²/NM²)

The basis for contouring is averages of five 1NM values along transects. At the end of transects and in connection with trawl stations the averaging may include fewer (from 1 to 4 single NM observations). This is a source of bias, but this bias is limited due to observations within strata having similar values. Other sources of bias of concern are the shallow distribution pattern (above integration limit), vessel avoidance behaviour of sardinella (Misund and Aglen, 1992) and inshore distribution (at depths smaller than 20meters). All estimates should consequently be considered as relative indices of abundance.

The overall length frequency distributions within strata were estimated by weighting the sample-distributions with the nearest valid 1 NM integrator value, or the average of two adjacent values. Target species of the same genus, i.e. *S. aurita* / *S. maderensis* and *T. trecae* / *T. trachurus capensis*, are not acoustically distinguishable, and the sA values were therefore split according to the relative distributions of the two species in each length group. The total number of fish in each length group was estimated as:

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

- where: ρ_i = estimated number of fish in length group i
 $\langle s_A \rangle$ = mean recorded area backscattering coefficient (m²/NM²)
 $t_{i,j}$ = proportion of species j in length group i
 u_i = proportion of sampled fish in length group i
 A_s = horizontal area of stratum s
 C_{Fi} = conversion factor for length group i
 L_i = length group i (nearest full cm below total length)
 $L_i+0.5$ = mean length in L_i .

The basis for contouring is averages of 1NM values along transects. One sources of bias of concern are the shallow distribution pattern (above integration limit), vessel avoidance behaviour of sardinella (Misund and Aglen, 1992) and inshore distribution (at depths smaller

than 20meters). All estimates should consequently be considered as relative indices of abundance.

The above equations show that the conversion from sA-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.

When the size classes (of e.g. young fish and older fish) were well mixed, the various length distributions were pooled together with equal importance. Otherwise, when the size classes were segregated, the total distribution area was post-stratified, according to length distributions, and separate estimates were made for the strata containing fish with equal size.

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, NM²), and
- 3) A representative length distribution of the fish in the region.

If the targeted fish was a mixture of more than one species, for example sardinellas, representative distributions of all the species within the stratum, as shown in the trawl catches, was used. Length distributions representing the various species for each catch was calculated and normalized to a unit number (usually 100). These were then averaged without weighting. Very small catches (normally less than about 20 fish) were not included. The total catch of each species from all the trawls in a stratum was used as a proxy for estimating the proportion of the total biomass of each species present. While it is recognised that catch is a poor indicator of relative abundance, especially for pelagic fish, no other method is accessible from the data available.

The process followed was therefore to

- a) divide the sA-value between groups of fish and/or species,
- b) produce pooled length distributions of a target species/category for use in the above equation and
- c) calculate the biomass estimates for a region,

using the following procedure:

- The length-frequency samples of the species in the category were respectively pooled together with equal importance (normalized).
- The mean back scattering strength (ρ/sA) of each length frequency distribution of the target group/ species was calculated and summed. This was automatically done in the Excel spread-sheet made available for acoustic abundance estimation on board RV *Dr Fridtjof Nansen*.

- The pooled length distribution was used, together with the mean sA-value, to calculate the density (numbers per square NM) by length groups and species, using the above formula. The total number by length group in the area was obtained by multiplying each number by the area.
- The numbers were then converted to biomass using the estimated weight at length.

2.6 Food safety and nutrition

The aim was to sample and analyse fish for nutritional value and contaminants that are caught in pelagic-, mesopelagic- and demersal trawl. The main target was commercial pelagic fish. Samples of one or a few dominant species in each catch were taken. In case only a few individuals of each species were available, samples were pooled from catches of multiple stations.

Pelagic species (>25 cm) will be analysed as individual samples. To get enough sample material, 25 specimens of each species, (or at least 15) are required for a given area. The sample consists of muscle tissue. In addition, liver samples from the first 15 fishes were retained, and 5 pooled samples of the 25 fillets (1-5, 6-10 and so on). If the species were shorter than 25 cm, composite samples contained at least 25 individuals or 120 g wet sample material. When many specimens of the same species occurred in one haul, up to 3 parallel composite samples were taken.

The samples were homogenised by using a food processor. Approximately 20 g of the homogenised paste were transferred to a labelled 50 ml tubes. The rest of the homogenised samples were added to labelled salad tray for further freeze-drying.

Samples of whole fish and fillet were sampled and stored pending analysis. The priority will be on selected nutrients and metals. Samples for other nutrients and contaminants will be stored pending budget for analysis.

The analyses will be carried out at 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: Analyses of heavy metals will be carried out. Samples will be stored pending budget for analysis of inorganic arsenic, methyl mercury, PCB, dioxins, furans, PBDE, pesticides, and PAH.

All samples were stored at -20 °C pending shipment to Institute of Marine Research for chemical analysis of selected nutrients and undesirables

2.7 Parasitological sampling

With the purpose of providing new knowledge about the parasites present in fish species of the region, an opportunistic parasitological sampling was carried out. The sampling was mainly focussed on the detection of zoonotic nematodes of the genus *Anisakis*, due to their medical and economic importance worldwide, since they are responsible of human disease (i.e. anisakiasis and allergy). The UV-press methodology was applied for parasite detection (Karl & Leinemann, 1993). Briefly, the method uses the fluorescence of frozen nematodes (Pippy, 1970) and is based on visual inspection of pressed viscera and/or fish fillets under UV light, i.e. tissues are 1) introduced in plastic bags, 2) flattened by hydraulic press, 3) deep-frozen, and finally thawed before inspection (Karl and Leinemann, 1993; Levsen and Lunestad, 2010). All parasite samples will be identified by morphological and/or molecular means at the facilities of the IMR in Bergen, and results will be further analysed and discussed.

CHAPTER 3 SURVEY RESULTS

3.1 Oceanography

3.1.1 Underway sampling

The continuous, underway sampling at 4 m depth by means of the on board thermosalinograph covered the length of entire survey track. The collected parameters included temperature, salinity, fluorescence (chlorophyll a) and turbidity. Figure 9 depicts the color-coded levels of these parameters along the the survey track from 3 August 2018 to 17 August 2018.

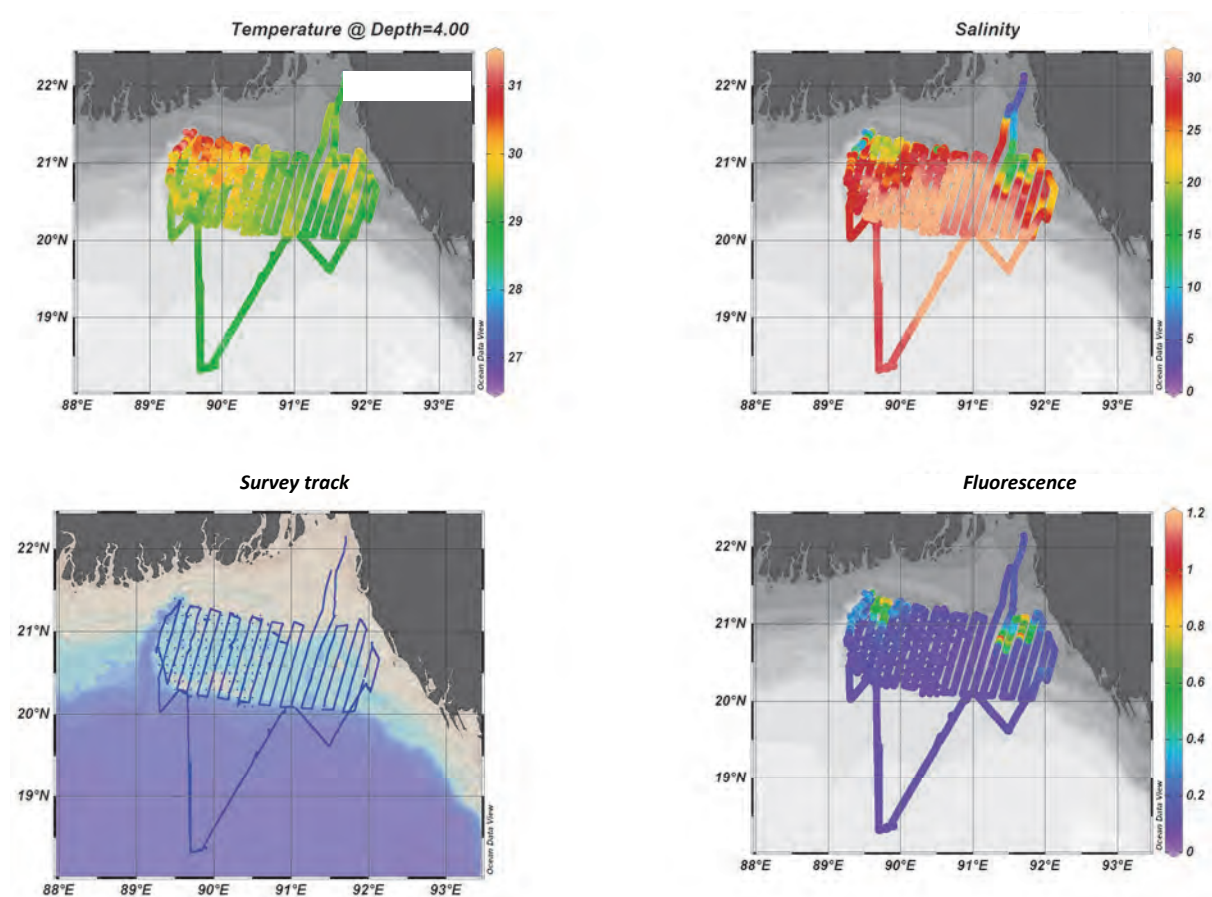


Figure 9. The survey track (bottom-left) and along-track distributions of temperature (top-left), salinity (top-right), survey and fluorescence (bottom-right) at 4m depth from the thermosalinograph observations.

Figure 910 shows the sea surface very warm, approaching almost 30°C across the surveyed area. The western part of the survey area is generally warmer. The cooler surface waters towards the east coast observed in this figure is consistent with the August climatology of the northern Bay of Bengal derived from satellite observations (Figure 101).

In addition to the overall east-west temperature increase, Figure 910 A exhibits two regions of locally warmer water pools towards the northern boundary of the surveyed region. Noteworthy, the salinity and chlorophyll distributions (Figure 910 B and C, respectively) and

exhibit strong contrasts with surrounding ocean at the same locations. The sharp increase in the surface temperature, decrease in salinity in connection with the primary productivity increase suggests that at these two locations, the survey encountered the fronts of river the plume expanding into the oceanic waters.

The survey took place in the Meghna estuary region during August. During this period the river discharge is the annual maximum, and therefore the connection of the two low salinity surface water pools observed in Figure 910 is obvious. What is intriguing, however, is how the presence of such large pools of brackish water impacts the coastal circulation and how it contributes to overall shelf productivity, including fish production.

By analogy to other coastal regions where the dynamics of buoyant coastal plumes have been better studied, we interpret the observations in Figure 9 in the frame of the coastal buoyancy plume dynamics. In brief, when water plume is of fluvial origin, it is much lighter from ambient oceanic waters. It would therefore expand from the river mouth on top of the oceanic layer. Under the Earth rotation, the flow becomes deflected to the right of the discharge source, leading to the formation of the coastal buoyancy current (CBC) associated with density and salinity fronts at the sea surface. The coastal buoyancy fronts tend to develop a meandering pattern along the affected coasts. The observation of the fluvial origin water pools forming a meandering pattern within the area covered by the survey as shown Figure 10 suggest for a role of the CBC and the associated frontal mechanisms in the bottom-up control over the ocean productivity in this sector of the Bangladeshi shelf.

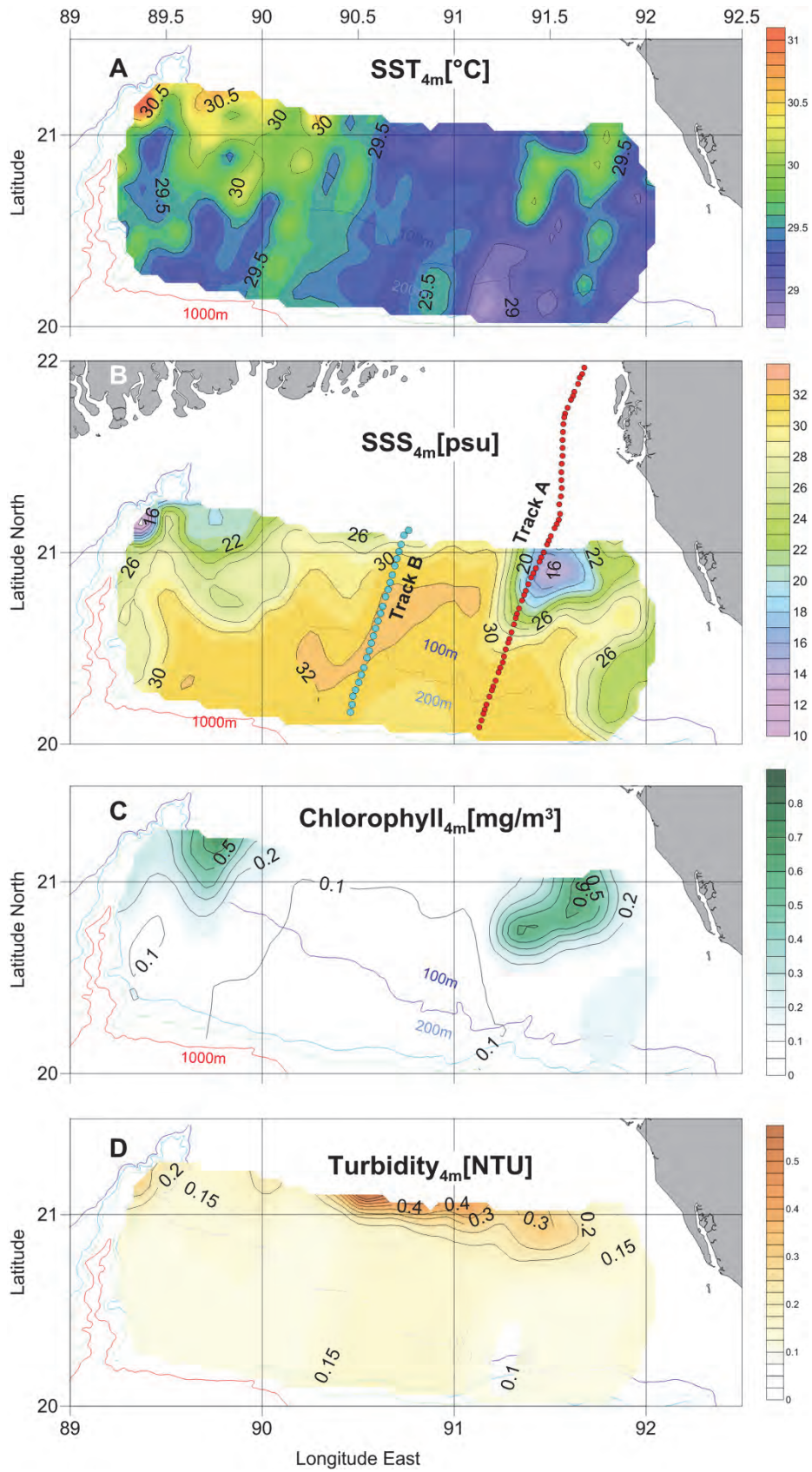


Figure 10. The statistically interpolated distributions of salinity (A), temperature (B) fluorescence (C) and turbidity (D) based on the underway data presented in Figure 9. Track A shows the vessel track between the mouth of the Karnaphuli River and outer shelf. Track B shows the ADCP line collected on August 14.

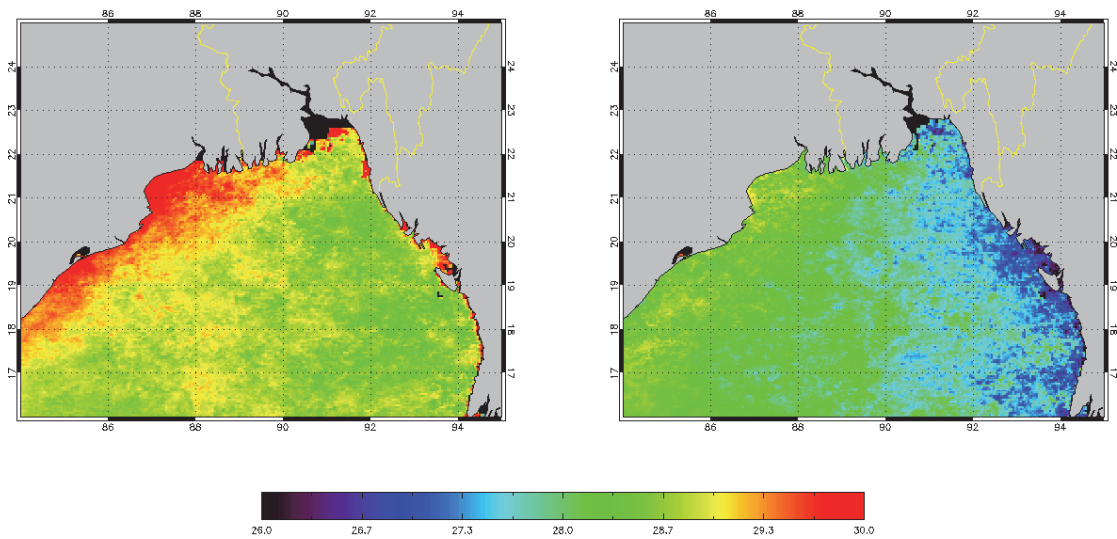


Figure 11. Satellite-derived sea surface temperature climatology 2002-2018 during August for the northern Bay of Bengal. The daytime and night-time climatologies shown in the left and right panels, respectively. Both figures use the same colour scale in degrees Celsius depicted below the figures. The result is derived from the monthly AQUA Modis SST data product obtained from NASA OceanColor Web (<https://oceancolor.gsfc.nasa.gov>).

Figure 11 shows hydrographic sections from the CTD stations occupied nearest to the 21°N latitude line. The section covers the eastward ascending sector of the continental shelf bottom. The pools of the fluvial origin water pool identified in the TSG data, can be observed in the salinity and fluorescence distributions, centered at stations 643 and 619, respectively. Noteworthy, there is also a region of supersaturated oxygen concentrations ($O_2 > 5$ ml/l), which is located between stations 618 and 621. However, the river plume is indistinguishable in the potential temperature data, elucidating the fact that the dynamics of these plumes is driven by fresh water input, rather than by temperature gradients.

The surface front between the fresh water plume and oceanic origin shelf waters was clearly observed from the deck as a sharp change in the sea surface colour (Figure 11). The front apparently attracted the Hilsa shad (*Tenualosa ilisha*) fishers, as fishing boats were numerous and all were deploying gillnets precisely along the line of separation between the brackish and oceanic waters presented in Figure 1313.

The salinity and fluorescence signatures of the plumes revealed by Figure 12 are very shallow. From the salinity and chlorophyll distributions it is clear that that the plume does not extend vertically beyond the top ten meters of the water column. The deep chlorophyll peak observed in the same figure, at 50 m depth, Sta. 646, is a case of the oceanic deep chlorophyll maximum that is not connected to the fluvial water inputs (see Figure 12).

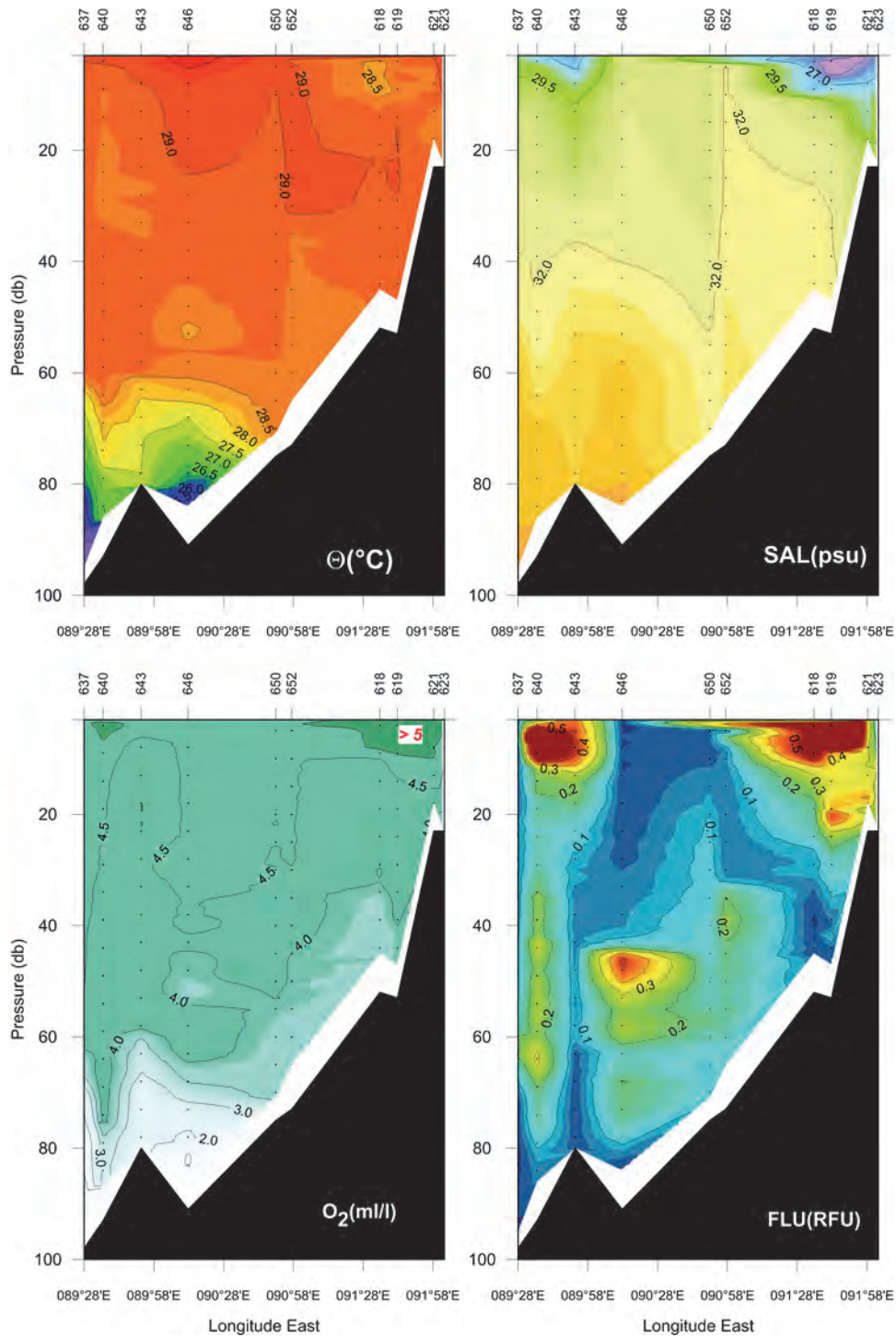


Figure 12. Zonal hydrographic section of potential temperature, salinity, oxygen concentration and chlorophyll along the northern perimeter of the survey area presented in Figure 10. The stations numbers are described along the top edges of each transect. The horizontal axis represents the stations' longitude.



Figure 13. A snapshot of the coastal buoyancy front captured on August 13th from the RV *Dr Fridtjof Nansen*. The waters of fluvial origin are on the greener side of the front. The local fishermen examine the frontal area in search of Hilsa shad (*Tenualosa ilisha*) concentrations.

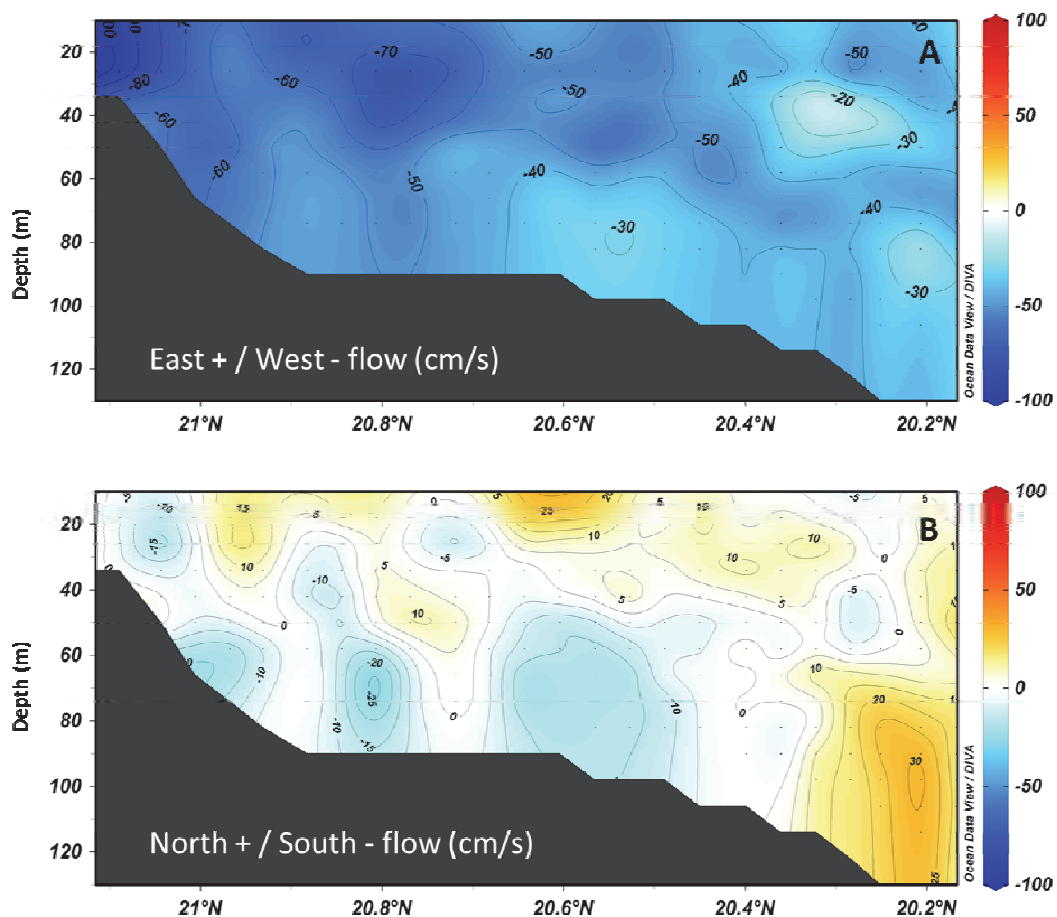


Figure 14. The east-west (A) and north-south (B) components of the ADCP-detected coastal current along Track B on August 14th, 2018. See Figure 10 B for the location of this section on the map. The blue colour denotes the negative (westward or southward) flow; the red colour denotes the positive (eastward or northward) flow, respectively.

Consistent with the buoyancy flow dynamics, the westward current dominated the survey area. Figure 14 presents an example of the flow across the survey region recorded with the vessel-mounted ADCP unit on August 14th. The location of this ADCP survey line is marked as “Track B” in Figure 10, panel B. The westward flow is in the order of 30 cm/s at the shelf break and accelerates to 90 cm/s as the vessel enters the coastal buoyancy current to the north of 21°N (Figure 14, panel A). The current direction changes at the depth of the main thermocline (depth 40-50 m). Although the westward flow dominates, its direction differs slightly above and below the thermocline. The meridional current section presented in Figure 14 B, as the mean north-south flow is weak, exposes better the directional contrast: the meridional current above 40 m depth is oriented northwards while that below 40 m is southward. There is also a strengthening of the northward flow at the shelf break between 60 and 120 m, associated with the topographic steering of the flow in this depth range.

3.1.2 Observations at the transition between the coastal and open Bay of Bengal

The hydrographic section occupied between 8th and 9th of August extended to 18°20' N, covering the oceanic portion of the Bangladeshi EEZ. The observations along that section are hereby combined with the results from CTD casts performed at the later time over the shelf area in order to study the transition from the open to coastal ocean. Figure 15 shows the resulting distributions of potential temperature, salinity oxygen concentration and chlorophyll (fluorescence). All distributions exhibit a clear separation between the open ocean conditions (Stas. 630-633) and continental shelf characteristics (Stas. 641, 643 and 644).

The temperature distribution on the open ocean side (seaward of Sta. 627) exhibits the top thermostad region of the water column, extending to a depth of 35-40 meters, is characterized by the narrow temperature range of 28-28.5°C. In contrast, the salinity distribution in the same depth region displays a strong gradient already at the depth of 20 meters. The mismatch between the depth of the maximum temperature and salinity gradient leads to the formation of a dual density stratification. The top region, controlled by the salinity gradient, is termed the barrier layer. The barrier layers are the ubiquitous feature of the surface waters in the Bay of Bengal (BoB). Under intense solar radiation, these layers heat up, increasing the stratification, which in turn draws the upward flux of the underlying nutrient-rich waters to the euphotic zone. Copious rainfalls during the summer monsoon season decrease the surface salinity, increasing further the vertical stratification. As the result, the top 20 meters of the water column during the summer monsoon are devoid of biological production and are characterized by excessive sea surface temperatures, uniform across the Bay.

The oxygen distribution presented in Figure 15 (bottom, left) shows the separation between the supersaturated layers above the main thermocline and the poorly aerated waters below. This pattern is a typical to the tropical ocean. In the Atlantic and Pacific Ocean case, however, the oxygen distributions display a distinct oxygen minimum zone (OMZ), typically between located 200 and 400 m. In contrast, along the observed section, the classical OMZ was not observed. Rather, the uniform anoxic conditions at less than 0.1 ml/l dominated the entire sub-thermocline water layer below the thermocline depth (50-70 m). The observed oxygen distribution resembled more the conditions found in poorly ventilated seas such as the Arabian Sea.

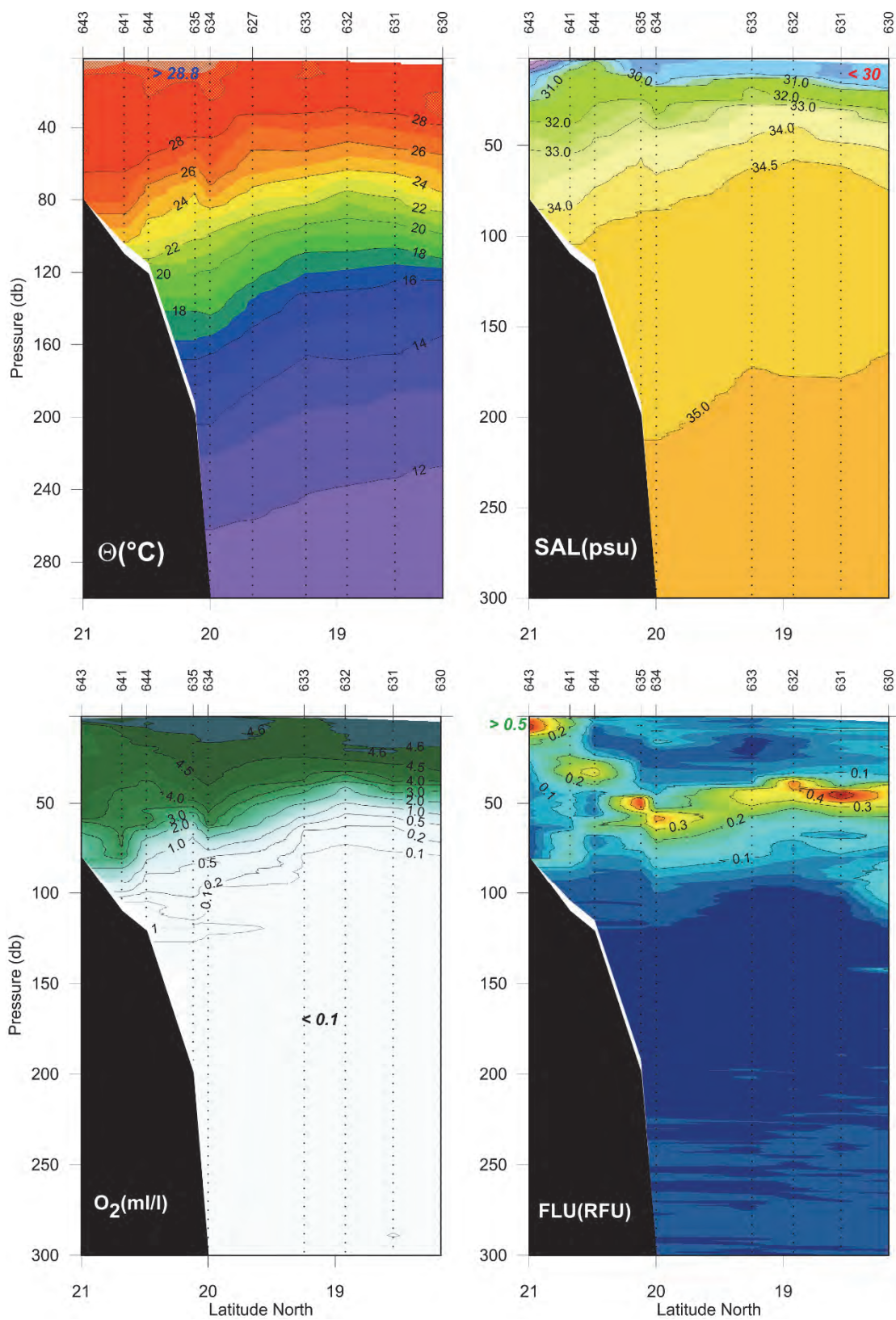


Figure 15. Distributions of potential temperature, salinity, oxygen concentrations and chlorophyll (fluorescence) along the open to coastal ocean section. The stations along this section were occupied between 8 and 12 August 2018. The station numbers are shown at the top of each figure. The bottom axis describes the stations' longitude.

The primary productivity in the open BoB region, as indicated by Figure 15, was concentrated within the Deep Chlorophyll Maximum (DCM), located at a depth of 60 m, thus just below the main thermocline. It is a typical situation for an oligotrophic ocean where ocean productivity is nutrient-limited and develops just below the main thermocline where the deep nutrient pool becomes available, and a fraction of the sunlight energy still reaches these depths.

Moving closer towards the Bangladesh coast along the sections in Figure 15, the survey entered the coastal transition zone (Stas. 633-635). That zone is characterised by the large-scale downward tilt of the thermocline towards the coast, manifesting the downwelling conditions. The likely causes of downwelling at this section of the coast include large scale wind-patterns over the BoB or propagation of Kelvin waves along the eastern boundary of the Bay. More detailed studies are necessary to understand the mechanisms causing the observed downwelling. Our data only indicate its presence during the survey period, suggesting that during that period oceanic nutrients were in poor supply and therefore the open ocean played a limited role in driving the biological productivity over the shelf.


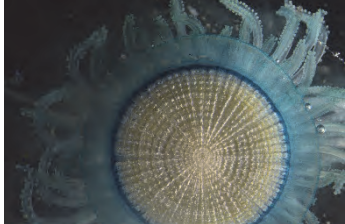

The inner shelf region, represented in Figure 1515 by Sta. 643, is characterized by the buoyancy plume dynamics and surface productivity boosted by terrestrial nutrients brought to the coast by the river transported waters, as discussed in section 4.3.1. Given the observed large-scale downwelling conditions at the Bangladeshi coast, the supply of the terrestrial nutrients by the river discharge appears to be the main factor driving productivity at this coast during the monsoon season.

3.2 Phytoplankton, zooplankton, jellyfish and microplastics

3.2.1 Phytoplankton, zooplankton, ichthyoplankton

The samples collected are still under processing.

Although very little on board analysis was done on the survey, the Bangladesh representatives did manage to photograph and identify various types of plankton and jellyfish (Figure 16).

		
Copepod	Blue button jellyfish	Acetes shrimp




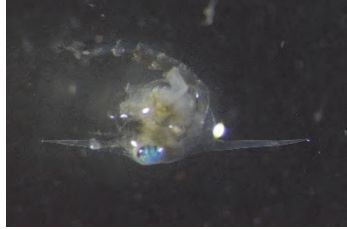

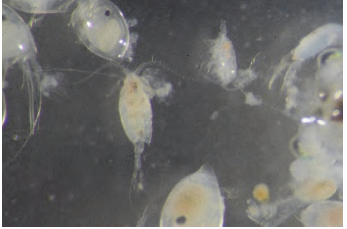

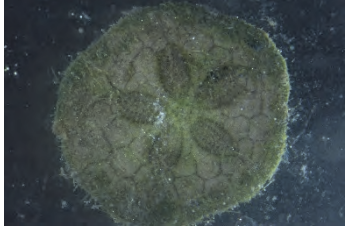




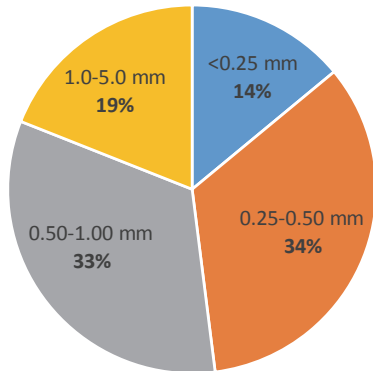
		
Crab larvae	Ostracods	Acetes shrimp
		
Crab larvae	Fish larvae	Copepod and ostracods
		
Amphipoda	Sand dollar	Jellyfish larvae
		
Cephalopods larvae	Squid larvae	Fish larvae

Figure 16. Pictures of some of the plankton identified in the samples collected.

3.2.2 Microplastics

Halves of the split-samples are still under processing at the Institute of Marine Research, Norway. As of writing this report, the other halves of 14 stations have been analysed at the Institute of Marine Sciences, University of Chittagong, Bangladesh (IMSCU). Upon full completion of laboratory analyses data will be scrutinized and organized by plastic type, color, shape and size group. The final results will be reported afterwards. IMSCU has completed analysis of 14 samples drawn on the continental shelf. Composition of plastic particles by type and size is shown in Figure 17 while the relative abundance of microplastics in the different locations where the samples were taken is shown in Figure 18.

Microplastic in samples by size



Microplastic in samples by type

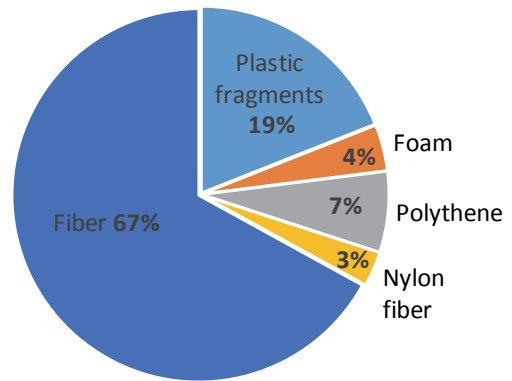


Figure 17. Overall composition of microplastics from 14 sampling stations by size (left) and type (right).

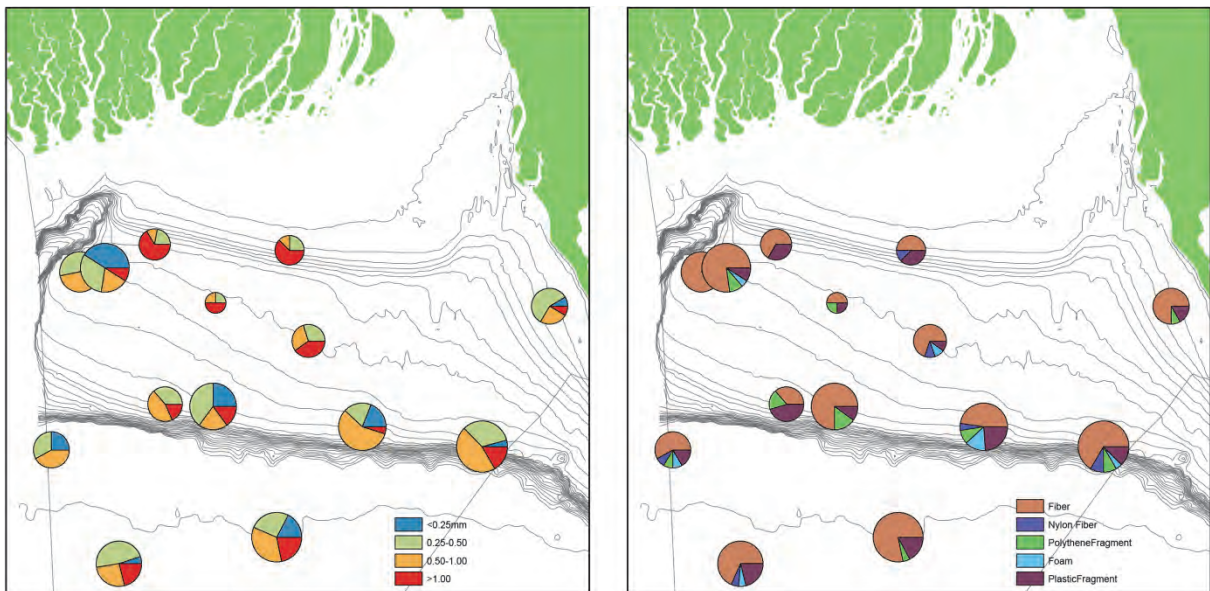


Figure 18. Relative abundance of microplastics in 14 locations shown by size (left) and type (right).

3.3 TRAWL SAMPLING

3.3.1 Biological sampling of trawl catches

Myctophidae comprised the largest group caught with a total of 2554 kg for all trawls, being found in 20 stations in total. Bragmacerotidae catches comprised a total of 430 kg, for all the 18 stations in which they were caught. Carangidae were caught in 45 stations with a total of 419 kg, with *Selar crumenophthalmus* and *Megalaspis cordyla* being the species most frequently caught. Clupeidae catch, for all stations, was 135 kg and were found 24 stations. Of these, *Dussumeieria elopsoides* was the most abundant, followed by *Sardinella fimbriata*. Scombridae were caught in 23 stations with a total of 85 Kg. Of the scombrids,

Scomberomorus was the genus with highest abundance. Carangids, cephalopods, clupeids and scombrids were the groups caught more often in the trawl, being caught in 45, 36, 24 and 23 stations, respectively.

The L-W figures (Annex IX) show the length-weight relationship for the commercially most important species, as well as Myctophidae which was the most abundant species caught. Length and weight from myctophids were taken even if the fish were only identified to genus or family level. *Benthoosema* and *Diaphus* were the most frequently caught genus. The plots where it is observed two distribution patterns are likely to show two different species.

3.3.2 Taxonomy

A total of about 172 different species were recorded during the survey of which 136 species were fishes followed by crustaceans (23 species). Among the fish species the bony fish with 131 different species was the dominant in the catch, along with only 5 cartilaginous species (Table 5). A total of 16 species were preserved in formaldehyde for the identification conformation by experts.

It is too early to conclude regarding the number of new records observed for Bangladesh. However, it is likely that several species found during the survey may result as new records for Bangladesh. These were handed over to expert taxonomist at Sher-e-Bangla Agriculture University, Dhaka for identification and description.

Samples were taken of whole specimens to confirm the species identification (ANNEX VIII, Table 53). All samples were sent for identification, description and genetic analyses to Sher-e-Bangla Agricultural University, Dhaka. Twentynine (29) specimens have been identified by combined morpho-meristic and molecular analysis (i.e., analysis of mtDNA COI or 16S rRNA sequence). Five species, namely *Champsodon snyderi* (Franz 1910), *Upeneus supravittatus* (Uiblein & Heemstra, 2010) *Tentoriceps cristatus* (Klunzinger, 1884) *Lestrolepis japonica* (Tanaka, 1908) and *Vinciguerrria lucetia* (Garman, 1899) are testified by the laboratory to be first reported occurrence from Bangladesh. Detailed accounts of the studied fishes and the result of the genetic analyses and genetic barcoding will be presented in a separate data report.

Table 5. List of species collected during the survey in Bangladesh waters.

Sl. No	Order	Family	Species
1	Carchaniformes	Sphyrnidae	<i>Sphyrna lewini</i> (Griffith & Smith 1834)
2			<i>Sphyrna mokarran</i> (Rüppell 1837)
3			<i>Scoliodon laticaudus</i> Müller & Henle 1838
4	Torpediniformes	Narkidae	<i>Narke dipterygia</i> (Bloch & Schneider 1801)
5	Myliobatiformes	Mobulidae	<i>Mobula tarapacana</i> (Philippi 1892)
6	Anguilliformes	Ophichthidae	<i>Pisodonophis cancrivorus</i> (Richardson 1848)
7		Muraenidae	<i>Strophidon dorsalis</i> (Seale 1917)
8			<i>Ariosoma</i> sp
9			Anguilliformes sp unidentified
10			Leptocephalus larvae
11	Myctophiformes	Myctophidae	<i>Benthoosema pterotum</i> (Alcock 1890)
12			<i>Benthoosema fibulatum</i> (Gilbert & Cramer 1897)
13			<i>Diaphus</i> sp.1
14			<i>Diaphus</i> sp.2
15		Phosichthyidae	<i>Vinciguerrria attenuata</i> (Cocco 1838).
16	Aulopiformes	Synodontidae	<i>Harpadon nehereus</i> (Hamilton 1822)
17			<i>Saurida longimanus</i> Norman 1939

Sl. No	Order	Family	Species
18			<i>Saurida tumbil</i> (Bloch 1795)
19			<i>Saurida undosquamis</i> (Richardson 1848)
20			<i>Saurida</i> sp
21	Gadiformes	Bregmacerotidae	<i>Bregmaceros mccllellandi</i> Thompson 1840
22	Clupeiformes	Engraulidae	<i>Coilia dussumieri</i> Valenciennes 1848
23			<i>Setipinna phasa</i> (Hamilton 1822)
24			<i>Setipinna tenuifilis</i> (Valenciennes 1848)
25			<i>Stolephorus andhraensis</i> Babu Rao 1966
26			<i>Stolephorus commersonii</i> Lacepède 1803
27			<i>Thryssa dussumieri</i> (Valenciennes 1848)
28		Clupeidae	<i>Sardinella fimbriata</i> (Valenciennes 1847)
29			<i>Sardinella albella</i> (Valenciennes 1847)
30			<i>Anodontostoma chacunda</i> (Hamilton 1822)
31		Pristigasteridae	<i>Raonda russeliana</i> Gray 1831
32			<i>Pellona ditchela</i> Valenciennes 1847
33			<i>Ilisha melastoma</i> (Bloch & Schneider 1801)
34			<i>Ilisha striatula</i> Wongratana 1983
35			<i>Ilisha filigera</i> (Valenciennes, 1847)
36		Dussumieriidae	<i>Dussumieria elopsoides</i> Bleeker 1849
37		Chirocentridae	<i>Chirocentrus dorab</i> (Forsskål 1775)
38	Mugiliformes	Mugilidae	<i>Osteomugil cunnesius</i> (Valenciennes, 1836)
39	Perciformes	Terapontidae	<i>Terapon jarbua</i> (Forsskål 1775)
40			<i>Terapon puta</i> Cuvier 1829
41			<i>Terapon theraps</i> Cuvier 1829
42		Polynemidae	<i>Eleutheronema tetradactylum</i> (Shaw 1804)
43			<i>Polynemus paradiseus</i> Linnaeus 1758
44			<i>Polydactylus sextarius</i> (Bloch & Schneider 1801)
45		Champsodontidae	<i>Champsodon vorax</i> Günther, 1867
46		Stromateidae	<i>Pampus argenteus</i> (Euphrasen 1788)
47			<i>Pampus chinensis</i> (Euphrasen 1788)
48		Trichiuridae	<i>Trichiurus lepturus</i> Linnaeus 1758
49			<i>Trichiurus gangeticus</i> Gupta 1966
50			<i>Lepturacanthus savala</i> (Cuvier 1829)
51			<i>Eupleurogrammus muticus</i> (Gray 1831)
52		Lobotidae	<i>Lobotes surinamensis</i> (Bloch 1790)
53		Mullidae	<i>Upeneus moluccensis</i> (Bleeker 1855). Mullidae
54			<i>Upeneus taeniopterus</i> Cuvier 1829
55			<i>Upeneus</i> sp1
56		Callionymidae	<i>Callionymus</i> sp1
57		Drepaneidae	<i>Drepane longimana</i> (Bloch & Schneider, 1801)
58		Gerreidae	<i>Pentaprion longimanus</i> (Cantor, 1849)
59		Scombridae	<i>Rastrelliger brachysoma</i> (Bleeker, 1851)
60			<i>Rastrelliger faughni</i> Matsui, 1967
61			<i>Rastrelliger kanagurta</i> (Cuvier, 1816)
62			<i>Auxis thazard</i> (Lacepède, 1800)
63			<i>Auxis rochei</i> (Risso, 1810)
64			<i>Thunnus tonggol</i> (Bleeker 1851)
65			<i>Euthynnus affinis</i> (Cantor, 1849)
66			<i>Scomberomorus guttatus</i> (Bloch & Schneider 1801)
67			<i>Scomberomorus commerson</i> (Lacepède 1800)
68		Sciaenidae	<i>Pennahia anea</i> (Bloch, 1793)
69			<i>Johnius coitor</i> (Hamilton, 1822)
70			<i>Otolithes ruber</i> (Bloch & Schneider, 1801)
71			<i>Otolithoides pama</i> (Hamilton, 1822)
72			<i>Johnius dussumieri</i> (Cuvier, 1830)
73			<i>Chrysochir aureus</i> (Richardson, 1846)
74			<i>Pterotolithus maculatus</i> (Cuvier, 1830)
75		Gempylidae	<i>Gempylus serpens</i> Cuvier, 1829
76			<i>Neopinnula orientalis</i> (Gilchrist & von Bonde 1924)
77		Rachycentridae	<i>Rachycentron canadum</i> (Linnaeus, 1766)
78		Priacanthidae	<i>Priacanthus</i> sp1
79		Coryphaenidae	<i>Coryphaena equiselis</i> Linnaeus 1758.
80		Caesionidae	<i>Dipterygonotus balteatus</i> (Valenciennes 1830)
81		Carangidae	<i>Megalaspis cordyla</i> (Linnaeus, 1758)
82			<i>Decapterus russelli</i> (Rüppell, 1830)
83			<i>Decapterus macrosoma</i> Bleeker 1851

Sl. No	Order	Family	Species
84			<i>Atule mate</i> (Cuvier, 1833)
85			<i>Alepes kleinii</i> (Bloch 1793)
86			<i>Atropus atropos</i> (Bloch & Schneider, 1801)
87			<i>Selar crumenophthalmus</i> (Bloch, 1793)
88			<i>Scomberoides commersonianus</i> Lacepède, 1801
89			<i>Scomberoides tol</i> (Cuvier, 1832)
90			<i>Parastromateus niger</i> (Bloch, 1795)
91		Acropomatidae	<i>Acropoma</i> sp 1
92			<i>Acropoma</i> sp 2
93			<i>Synagrops</i> sp1
94		Siganidae	<i>Siganus canaliculatus</i> (Park, 1797)
95			<i>Siganus javus</i> (Linnaeus, 1766)
96		Nemipteridae	<i>Nemipterus nematophorus</i> (Bleeker 1854)
97			<i>Nemipterus japonicus</i> (Bloch 1791)
98		Echeneidae	<i>Echeneis naucrates</i> Linnaeus, 1758
99			<i>Remora remora</i> (Linnaeus, 1758)
100		Menidae	<i>Mene maculata</i> (Bloch & Schneider, 1801)
101		Leiognathidae	<i>Equulites lineolatus</i> (Valenciennes 1835)
102			<i>Photopectoralis bindus</i> (Valenciennes 1835)
103			<i>Secutor ruconius</i> (Hamilton 1822)
104			<i>Leiognathus</i> sp.
105		Apogonidae	<i>Jaydia striata</i> (Smith & Radcliffe 1912)
106			<i>Ostorhinchus fasciatus</i> (White, 1790)
107		Sphyraenidae	<i>Sphyraena obtusata</i> Cuvier 1829
108			<i>Sphyraena putnamae</i> Jordan & Seale 1905
109			<i>Sphyraena forsteri</i> Cuvier 1829
110		Nomeidae	<i>Cubiceps pauciradiatus</i> Günther 1872
111			<i>Cubiceps whiteleggii</i> (Waite 1894)
112			<i>Psenes cyanophrys</i> Valenciennes, 1833
113			<i>Psenes</i> sp1
114		Acanthuridae	<i>Acanthurus</i> sp1
115		Paralepididae	<i>Lestrolepis japonica</i> (Tanaka, 1908)
116		Uranoscopidae	<i>Uranoscopus cognatus</i> Cantor, 1849
117	Tetraodontiformes	Tetraodontidae	<i>Lagocephalus guentheri</i> Miranda Ribeiro 1915
118			<i>Arothron immaculatus</i> (Bloch & Schneider 1801)
119			<i>Takifugu oblongus</i> (Bloch 1786)
120			<i>Lagocephalus spadiceus</i> (Richardson 1845)
121		Triacanthidae	<i>Triacanthus nieuhofii</i> Bleeker 1852
122		Balistidae	<i>Canthidermis maculata</i> (Bloch, 1786)
123			<i>Melichthys niger</i> (Bloch, 1786)
124	Siluriformes	Ariidae	<i>Osteogeneiosus militaris</i> (Linnaeus 1758)
125			<i>Plicofollis argyropleuron</i> (Valenciennes, 1840)
126			<i>Plicofollis dussumieri</i> (Valenciennes, 1840)
127	Pleuronectiformes	Cyanoglossidae	<i>Cyanoglossus</i> sp
128			<i>Cynoglossus arel</i> (Bloch & Schneider, 1801)
129		Bothidae	<i>Laeops</i> sp.
130		Citharidae	<i>Brachypleura novaezeelandiae</i> Günther 1862
131		Soleidae	<i>Zebrias altipinnis</i> (Alcock 1890)
132			<i>Solea ovata</i> Richardson, 1846
133	Scorpaeniformes	Platycephalidae	<i>Suggrundus macracanthus</i> (Bleeker 1869)
134			<i>Kumococius rodericensis</i> (Cuvier 1829)
135		Scorpaenidae	<i>Brachypterois serrulifer</i> Fowler 1938
136			<i>Neomerinthe</i> sp.

Crustacea

1			<i>Harpiosquilla</i> sp 1
2			<i>Harpiosquilla</i> sp 2
3	Decapoda	Shrimp	<i>Metapenaeus brevicornis</i> (H. Milne Edwards, 1837)
4			<i>Metapenaeus monoceros</i> (Fabricius, 1798)
5			<i>Metapenaeus affinis</i> (H. Milne Edwards, 1837)
6			<i>Metapenaeus lysianassa</i> (de Man, 1888)
7			<i>Penaeus monodon</i> Fabricius, 1798
8			<i>Penaeus indicus</i> H. Milne Edwards, 1837
9			<i>Penaeus merguensis</i> de Man, 1888
10			<i>Palaemon styliferus</i> H. Milne Edwards, 1840

Sl. No	Order	Family	Species
11			<i>Penaeus</i> sp1
12			<i>Solenocera crassicornis</i> (H. Milne Edwards, 1837)
13			Solenocera sp
14			Red shrimp
15			banded shrimp
16		Portunidae	<i>Portunus pelagicus</i> (Linnaeus, 1758)
17			<i>Portunus sanguinolentus</i> (Herbst, 1783)
18			<i>Charybdis feriata</i> (Linnaeus, 1758)
19			<i>Calappa guerini</i> Brito Capello, 1870
20			<i>Calappa</i> sp
21			Crab
22			<i>Scylla olivacea</i> (Herbst, 1796)
23		Sand lobster	<i>Thenus orientalis</i> (Lund, 1793)
	Mollusca		
1			<i>Octopus vulgaris</i> Cuvier, 1797
2			Sepia
3			<i>Sepia esculenta</i> Hoyle 1885
4			Jelly fish sp1
5			<i>Uroteuthis duvaucelii</i> (d'Orbigny, 1835)
6			Onychoteuthidae
7			<i>Sthenoteuthis oualaniensis</i> (Lesson, 1830)
8			Cephalopod unidentified
9			Oceanic squid
10			<i>Ommastrephes bartramii</i> (Lesueur, 1821)
	Reptiles		
1	Snake		<i>Hydrophis platurus</i> (Linnaeus 1766)
2			Hydrophis sp.
1			Pyrosoma

3.3.3 Stomach content

Quantitative analysis of the stomach content of pelagic fishes showed similarity in the food and feeding habits among species and families. Index of stomach fullness for pelagic species was found as: 40% bursting, 25% filled, 15% medium filled, 10% poorly filled and 10% nearly empty. The index of preponderance revealed that most fish species preyed mainly on zooplankton and fish. 35% of total studied fishes including *Sardinella fimbriata*, *Dussumieria elopoides*, *Parastromateus niger*, *Setipinna tenuifilis*, *Diaphus* sp., *Benthosoma* sp., *Vinciguerria* sp. were zooplankton feeders, preying mainly on crustaceans, especially copepods and shrimps. 40% of the fish species were carnivores and zooplankton feeders, e.g. *Decapterus macrosoma*, *Euthynnus affinis*, *Auxis thazard*, *Cubiceps pauciradiatus*, *Psenes whiteleggi*, *Lestrolepis japonica*, *Lestidium* sp., and *Dipterygonotus balteatus*. Only 5% fish including *Sphyraena obtusata* were found to be carnivore preying mainly on other fish species. Food content of the rest (20%) of the fish species which include *Raconda russeliana*, *Magalaspis cordyla*, *Echeneis naucrates*, and *Acanthurus* sp. could not be determined due to near complete digestion of the content.

Majority of the demersal fish species preyed on zooplankton, crustaceans, benthic animals and fishes. 35% fish species preyed on zooplankton, 15% preyed on different types of fishes, 40% fish species preferred both zooplankton and fishes, 5% species preferred benthic macro-organisms and 5% species preferred both animals and plant matters. Stomach fullness states were: 35% bursting, 10% filled, 20% medium filled, 20% poorly filled and 15% almost empty.

3.4 Acoustic biomass estimates and distribution of fish species

The hydro acoustic survey covered the shelf and slope from roughly 20 m depth to 250 m depth. Continuous acoustic recording and analysis were carried out throughout the survey. Acoustic distribution and abundance was estimated for three species groups during the survey. These were sardinella, 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 Hairtail (Table 4). 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 than the Carangidae and other Pel2 species (although few schools were detected and most differentiation between the three groups was done on the basis of catch composition). Length distributions of all species groups and length-weight relationships were calculated for all acoustic groups for which biomass was estimated.

In addition, the acoustic backscatter strength of mesopelagic fish was estimated and mapped.

Summary of backscattered $\langle sA \rangle$ values and biomass estimates for the three pelagic fish categories can be found in tables 6, 7 and 8, respectively.

3.4.1 Sardinella

Sardinella (*S. fimbriata*) were found in the shallower parts of the shelf and it is likely that the survey only covered the southernmost part of the species distribution area (see Figure 19).

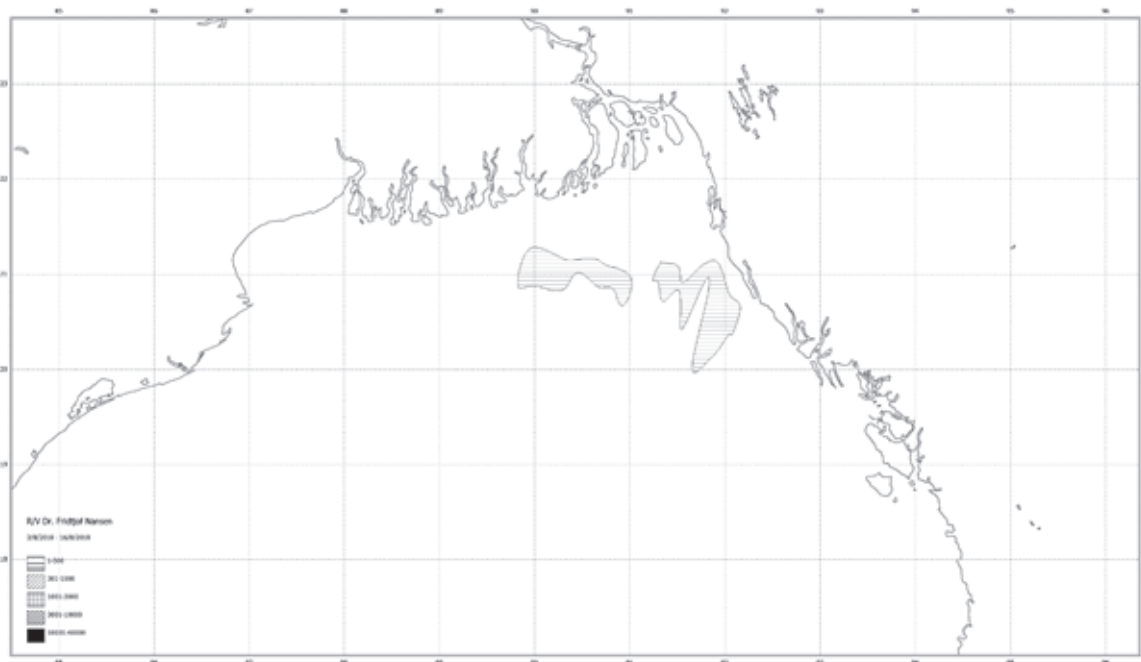


Figure 19. Acoustic backscatter strength of the sardinella acoustic group determined from scrutinizing multi-frequency echograms using LSSS software and plotted in Nansis Maptool.

3.4.2 Pelagic 1

The pelagic 1 group (Clupeids excluding *Sardinella*, Engraulidae, Chirocentridae and Dussumeridae) were distributed on the shelf, overlapping with both sardinella, pel 1 and mesopelagic fish (Figure 20).



Figure 20. Acoustic backscatter strength of the PELAGIC 1 acoustic group determined from scrutinizing multi-frequency echograms using LSSS software and plotted in Nansis Maptool.

3.4.3 Pelagic 2

The Pel 2 group had the widest distribution of the shelf-pelagic species, which is as expected the variety of species that were included in this group (see Figure 21).

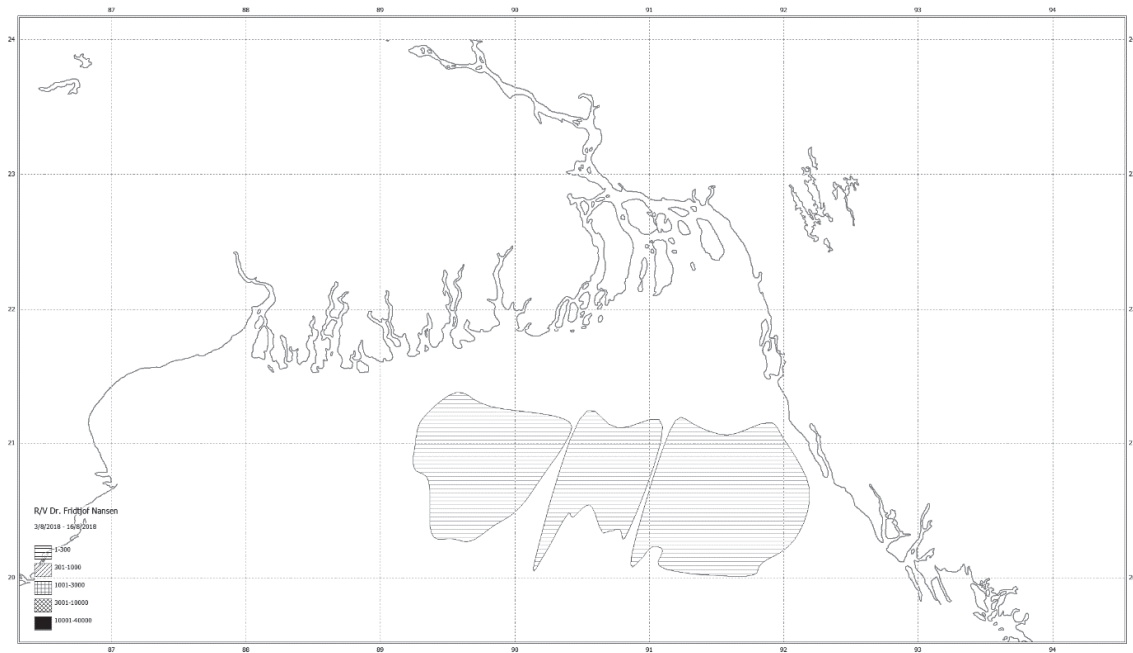


Figure 21. Acoustic backscatter strength of the PELAGIC 2 acoustic group determined from scrutinizing multi-frequency echograms using LSSS software and plotted in Nansis Maptool.

3.4.4 Mesopelagic fish

Mesopelagic fishes were distributed mostly on the deeper parts of the shelf, the shelf break and over deeper waters, although the mesopelagic transects were not included in the analysis for Figure 22 below.

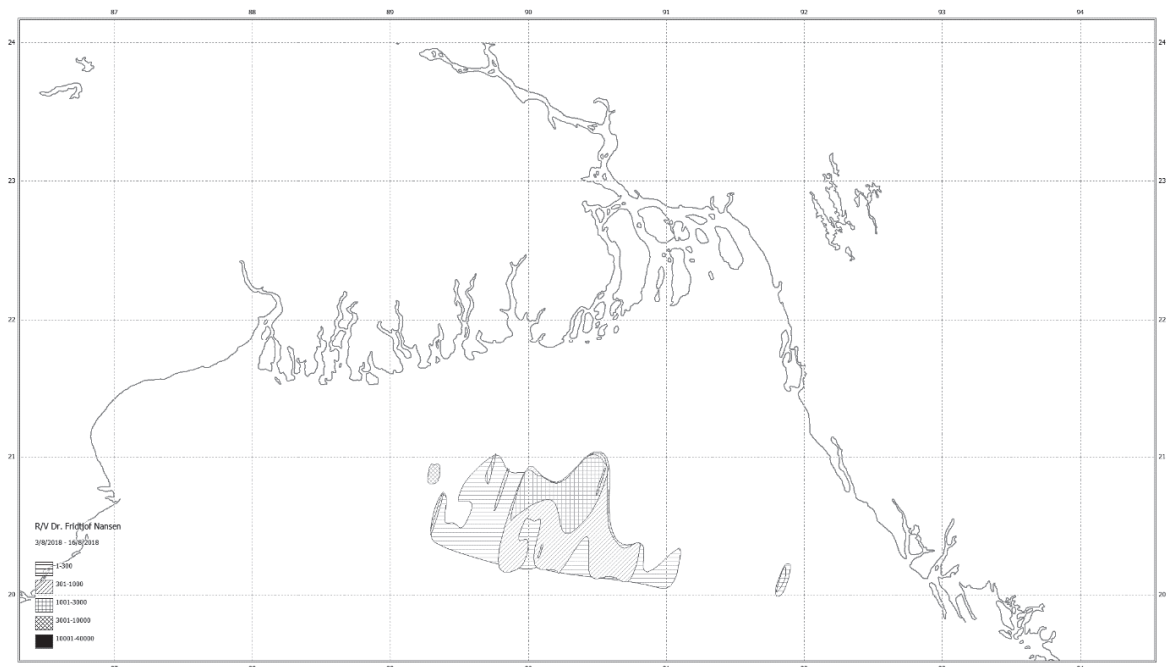


Figure 22. Acoustic backscatter strength of the Mesopelagic Fish acoustic group determined from scrutinizing multi-frequency echograms using LSSS software and plotted in Nansis Maptool.

3.4.5 Biomass estimates

The total acoustic biomass estimate for all three groups (Sardinella, Pel 1 and Pel 2) was 158 100 tonnes (see Table 6, 7 and 8) which is comparable to the RV *Dr Fridtjof Nansen* estimates in 1979 and 1980.

Table 6. The acoustic estimate of sardinella.

Stratum	1	2	Total:
Area (nm ²)	1171.1	1565.5	2736.6
<S _A >:	10.9	7.2	18.1
Biomass (1000t):	2.41	2.10	4.51

Table 7. The acoustic estimate of Clupeoid fish (Pel1).

Stratum	1	2	3	4	5	6	Total:
Area (nm ²)	1386.8	40.4	55.1	862.2	171.3	131.0	2646.7
<S _A >:	217.1	713.3	0.9	1.8	1.0	2.8	936.9
Biomass (1000t):	64.7	6.2	0.0	0.3	0.0	0.1	71.3

Table 8. The acoustic estimate of Pel2 species.

Stratum	1	2	3	Total:
Area (nm ²)	2844.9946	1786.3043	3877.381	8508.68
<S _A >:	12.493	19.729	19.56	51.782
Biomass:	19.39	21.92	41.38	82.70

3.5 Food safety and nutrition

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 9 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 Institute of Marine Research in Bergen, Norway.

Table 9. 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.

Nr	Station	Species	Length (cm)	N (total)	N (pooled samples)	Total weight of sample (g)	LIMS-nr
1	4	Sardinella fimbriata	16.3 cm	68	3	820g	2018-928
2	6	Sardinella fimbriata	16.3 cm	75	3	765g	2018-929
3	9	Pentaptyrion longimanus	11.44 cm	75	3	720	2018-930
4	10	Dussumieria Elopsoides	17 cm	75	3	690g	2018-931

Nr	Station	Species	Length (cm)	N (total)	N (pooled samples)	Total weight of sample (g)	LIMS-nr
5	23	Dussumieria Elopsoides	20,26 cm	75	3	1260g	2018-932
6	23	Megalaspis Cordyla	25,5 cm	25	13	1470g	2018-357
7	24	Bentho-serma Fibulatum	<5cm	750	3	487g	2018-945
8	27	Harpadon Neherius	25,5 cm	60	3	1030g	2018-946
9	30	Sardinella Fimbriata	16,34 cm	75	3	822g	2018-947
10	31	Bregmaceros McClellandi	<6 cm	840	3	460g	2018-948
11	33	Harpadon Neherius	24,16 cm	60	3	1070g	2018-949
12	39	Dussumieria Elopsoides	19,31 cm	68	3	855g	2018-950

3.6 Parasites

Results showed absence or low infection values of parasitic nematodes in many of the fish species sampled, e.g. *Cubiceps pauciradiatus*, *Dussumieria elopsoides*, *Megalapsis cordyla*, *Mene maculata*, *Sardinella fimbriata* and *Sellar crumenophthalmus*. The species *Trichiurus lepturus* (prevalence= 76% (29 fish infected out of 34)) and *Harpadon nehereus* (prevalence= 32%, i.e.16 out of 50) showed higher infection values. The majority of the nematodes were present in the viscera, while very few were found in the muscle. Further work is recommended (i.e. sampling higher numbers of specimens from different sea areas and period of the year) to confirm the infection values found in this study. In addition, the spiral valve of *Mobula tarapacana* was found parasitized by helminths (likely cestodes), and myctophids of the genus *Bentho-sema* were found to be infected by helminths (probably trematodes). All parasite samples will be identified by morphological and/or molecular means at the facilities of the IMR in Bergen, and results will be further analysed and discussed as part of Theme 8 of the EAF-Nansen Science Plan.

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ANNEX I DESCRIPTION OF SAMPLING AT SUPER STATIONS

Super Station

1. CTD-mounted rosette equipped with 12 Niskin bottle (10 L). The standard water sampling depths are: 5, 25, 50, 75, 100, 200, 300, 400 and 500 m.
2. Phytoplankton net to 30 m (or 5 m above bottom at ≤ 30 m stations) - maximum haul speed $0.1 \text{ m}^{-\text{s}}$
3. WP2 beyond 30 m with a maximum depth of 200 m – maximum haul speed $0.5 \text{ m}^{-\text{s}}$
4. WP2 to 30m when deeper WP2 deployment is performed – maximum haul speed $0.5 \text{ m}^{-\text{s}}$
5. MultiNet Mammoth to bottom or maximum depth of 200 m – maximum speed $1.5 \text{ m}^{-\text{s}}$
6. Manta trawl at surface for 15 minutes - maximum speed $1-1.5 \text{ m}^{-\text{s}}$

ANNEX II DESCRIPTION OF ACOUSTIC INSTRUMENTS AND FISHING GEAR

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	6.22° along ship 6.28° athwart ship
Alongship offset	0.10°
Athwardship offset	0.06°

Bottom detection menu Minimum level 50 Db

Fishing gear

The vessel has one small four-panel Åkrahamn pelagic trawl, one MultPelt 624 trawl (Figure 21, new in 2017) and one 'Gisund super bottom trawl'. 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. During the 2018410 survey only the MultPelt 624 trawl was used for pelagic trawling, except in shallow waters where the bottom trawl rigged with floats was used.

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 interdistance 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.

The all 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.

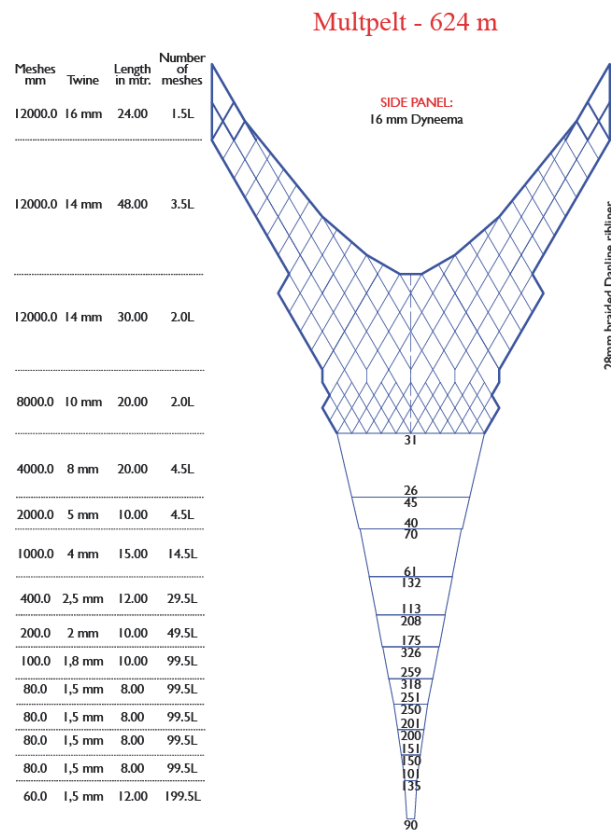
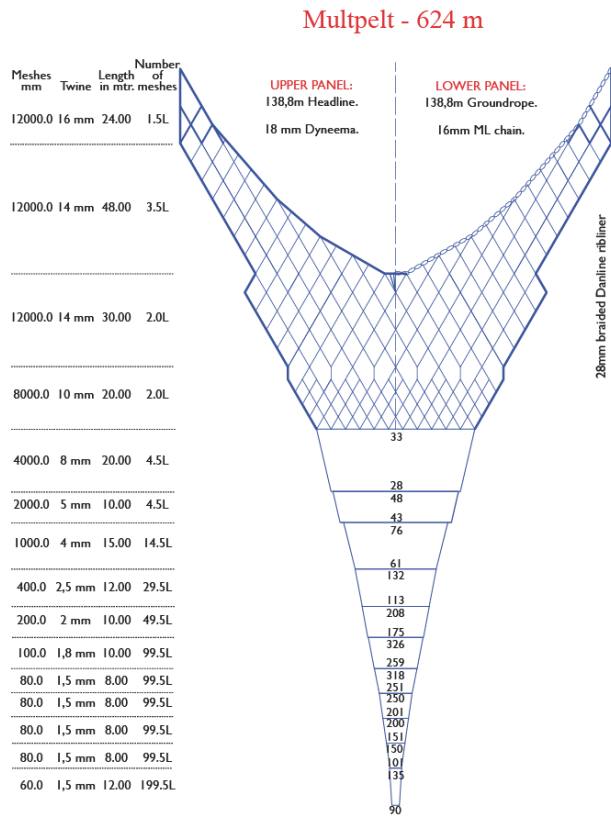


Figure 1. Schematic drawing of the MultiPelt 624.

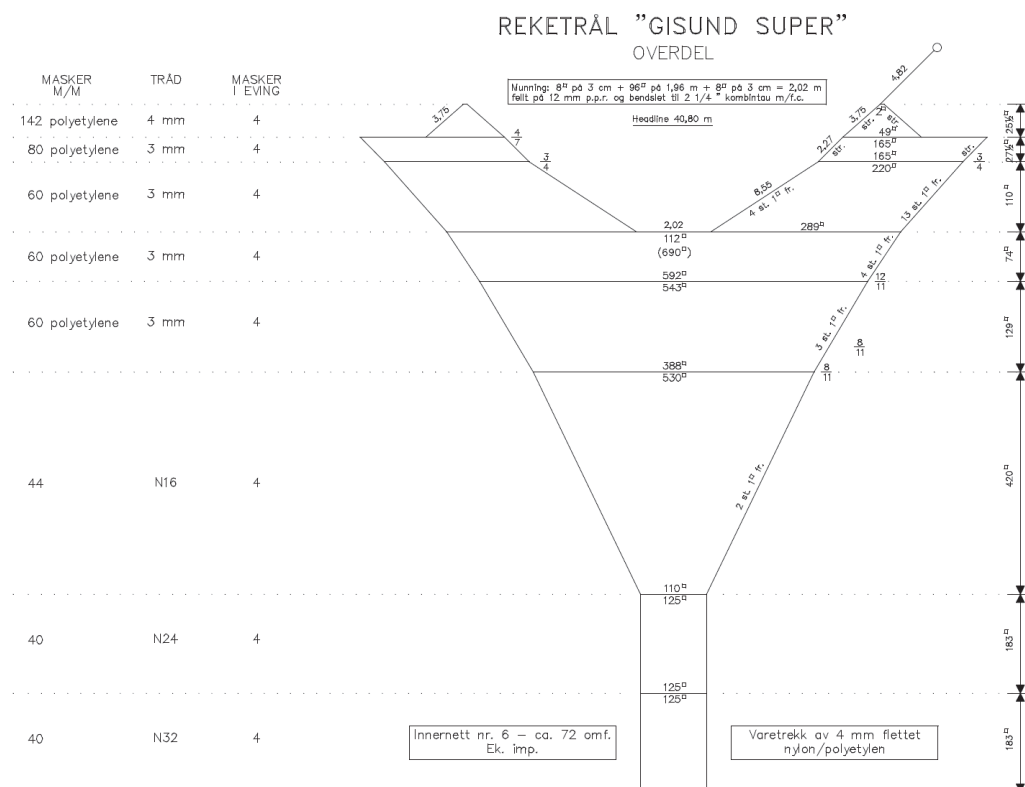
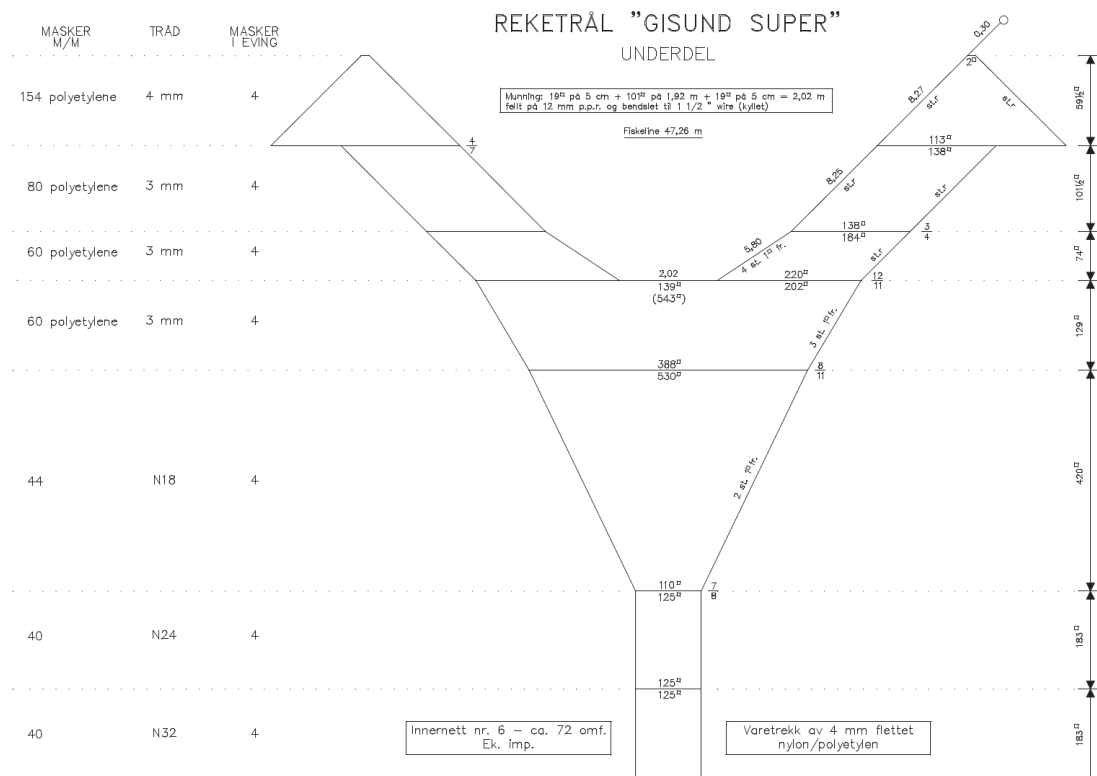


Figure 2. Schematic drawing of the Super Gisund bottom trawl.

ANNEX III RECORDS OF FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 1
 DATE : 03/08/18 GEAR TYPE: PT NO: 7 POSITION: Lat N 21°14.59 Lon E 91°32.83
 TIME : 14:35:31 15:03:19 27.8 (mi n) Purpose : 3
 LOG : 6306.44 6308.34 1.9 Region : 10200
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 22 22 Validity: 0
 Towing dir.: 0° Wire out : 150 m Speed : 4.1 kn
 Sorted : 140 Total catch: 140.36 Catch/hour: 302.83

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Harpadon nehereus	269.47	88.98	4
PORTUNIDAE	9.10	3.01	
Sardinella fimbriata	5.46	1.80	6
Lobotes surinamensis	2.93	0.97	
Shrimps undentifid	2.11	0.70	
Trichurus sp.	2.03	0.67	
Taki Fugu oblongus	1.64	0.54	
Scollodon latidcaudus	1.51	0.50	5
Terapon theraps	1.42	0.47	
Osteogenesius militaris	1.38	0.46	3
Setipinna tenuifilis	1.21	0.40	2
Shrimps undentifid	0.65	0.21	0
Squilla sp.	0.56	0.19	1
Racunda russelliana	0.52	0.17	
Anodontostoma chacunda	0.47	0.16	
Pisodonophis cancrivorus	0.43	0.14	
Lagocephalus spadicus	0.35	0.12	
Dussumieri a el opsoi des	0.26	0.09	
Sepia sp.	0.22	0.07	
Otololithoides pama	0.17	0.06	
Portunus sanguinolentus	0.17	0.06	
Pentapron longimanus	0.13	0.04	
Drepane longimanus	0.13	0.04	
Callia dussumieri	0.13	0.04	
MUGILIDAE	0.13	0.04	0
Portunus sp.	0.04	0.01	
Bregmaceros mclcllandi	0.04	0.01	
Callappa sp.	0.04	0.01	
Pampus argenteus	0.04	0.01	
C R A B S	0.04	0.01	
Plastic	0.02	0.01	
Cynoglossus sp.	0.00	0.00	
Callionymus sp.	0.00	0.00	
Stelophorus commersonii	0.00	0.00	
Ililisha sp.	0.00	0.00	
Total	302.83	100.00	

Pampus chinensis 2.48 5 4.22 15
 Trichurus lepturus 1.55 8 2.64
 Terapon jarbua 1.50 2 1.95
 Pampus argenteus 0.69 2 1.18 14
 Lagocephalus guentheri 0.57 2 0.98
 Chirocentrus dorab 0.40 2 0.69
 Megalaspis cordyla 0.24 2 0.40
 Alpeges kleimii 0.17 3 0.29
 Atropus atropus 0.10 2 0.17
 Setipinna tenuifilis 0.07 3 0.11
 Dussumieri a el opsoi des 0.06 2 0.11
 Parastronateus niger 0.00 10 0.00
 Total 58.36 99.43

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 7
 DATE : 05/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°4.09 Lon E 91°40.34
 TIME : 18:48:05 19:18:09 30.1 (mi n) Purpose : 3
 LOG : 6682.01 6684.25 2.2 Region : 10200
 FDEPTH: 0 5 Gear cond.: 0
 BDEPTH: 133 275 Validity: 0
 Towing dir.: 0° Wire out : 210 m Speed : 4.5 kn
 Sorted : 4 Total catch: 52.98 Catch/hour: 105.75

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Benthosema fibulatum	80.98	80.98	76.58
Bregmaceros sp	17.76	106004	16.80
Echeneis naucrates	2.44	2.44	2.30
Stenoteuthis oualaniensis	2.09	2.09	2.00
SALPS	0.09	0.09	0.94
Leptocephalus	0.65	523	0.62
Champsodon sp.	0.52	20152	0.49
ACROPMATIDAE, juvenile	0.16	78	0.15
MULLIDAE, juvenile	0.16	26	0.15
Plastic	0.00	26	0.00
Total	105.75	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 8
 DATE : 06/08/18 GEAR TYPE: PT NO: 7 POSITION: Lat N 20°51.28 Lon E 92°2.45
 TIME : 03:38:47 04:08:13 29.4 (mi n) Purpose : 3
 LOG : 6746.93 6748.46 1.5 Region : 10200
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 22 23 Validity: 0
 Towing dir.: 0° Wire out : 180 m Speed : 3.1 kn
 Sorted : 11 Total catch: 11.28 Catch/hour: 22.99

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Eupleurogrammus guttatus	4.24	67	18.45
Scomberomorus guttatus	3.33	4	20
Sardinella fimbriata	2.65	59	11.53
J E L L Y F I S H	2.20	2	9.58
Trichurus lepturus	1.75	4	7.63
Terapon jarbua	1.71	8	7.45
Parastronateus niger	1.67	6	7.27
Triacanthus niuhofii	1.47	6	6.39
Pampus argenteus	1.30	8	5.68
Lagocephalus guentheri	0.86	2	3.73
Sardinella albellia	0.73	12	7.19
Elutheronema tetradactylum	0.57	2	2.48
Chirocentrus dorab	0.37	2	1.60
Uroteuthis duvaucelii	0.12	2	0.53
Atropus atropus	0.10	2	0.00
MULLIDAE, juvenile	0.00	2	0.00
C R A B S	0.00	2	0.00
Total	22.99	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 9
 DATE : 06/08/18 GEAR TYPE: PT NO: 0 POSITION: Lat N 20°16.91 Lon E 92°0.93
 TIME : 10:48:02 11:16:31 28.5 (mi n) Purpose : 3
 LOG : 6788.36 6789.84 1.5 Region : 10200
 FDEPTH: 80 80 Gear cond.: 0
 BDEPTH: 80 77 Validity: 0
 Towing dir.: 0° Wire out : 220 m Speed : 3.1 kn
 Sorted : 36 Total catch: 36.33 Catch/hour: 76.51

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Sphyrna lewini	21.14	8	27.64
Pentapron longimanus	7.41	3557	9.69
Trichurus lepturus	7.20	40	9.41
Eupleurogrammus guttatus	6.32	139	8.26
Saurida tumbi	5.73	21	7.49
Dussumieri a el opsoi des	3.45	25	5.1
SYNDONANTIDAE	2.91	69	3.80
Hydrophis hardwickii	2.49	61	3.63
Upenus taeniopoter	2.49	61	3.63
Sphyrna obtusata	2.36	21	3.08
Sepia esculenta	2.27	13	2.97
Photopectoralis binnus	1.74	7057	2.53
Acropoma sp.	1.47	150	1.93
Nemipterus japonicus	1.22	29	1.60
Lagocephalus spadicus	1.18	13	1.54
Metapneustes monoceros	1.14	53	1.49
Nemipterus nematophorus	0.72	8	0.94
Terapon jarbua	0.67	4	0.88
Selar crumenophthalmus	0.63	4	0.83
Lagocephalus guentheri	0.55	4	0.72
Saurida longimanus	0.46	76	0.61
LEIOGANTHIDAE	0.42	124	0.55
Upeneus moluccensis	0.44	19	0.44
Callappa guerinii	0.25	2	0.33
Zebrias altipinnis	0.21	4	0.28
Atropus atropus	0.17	2	0.22
Kumococua rodericensis	0.13	4	0.17
L O B S T E R S	0.13	2	0.17
CHAETODONTIDAE	0.09	97	0.12
Brachyura novaezeelandiae	0.08	15	0.11
Suggrundus macracanthus	0.08	2	0.11
Jaydia striata	0.04	8	0.06
Nesoclinthe sp.	0.04	2	0.06
Arothron immaculatus	0.04	2	0.06
PORTUNIDAE	0.04	4	0.06
Octopus vulgaris	0.03	2	0.04
Laeops sp.	0.02	4	0.03
Atalapha	0.02	2	0.03
Metapneustes affinis	0.02	4	0.03
Brachypterois serrulifer	0.02	2	0.03
G A S T R O P O D S	0.02	2	0.03
Total	76.25	99.67	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 2
 DATE : 03/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°28.30 Lon E 91°15.76
 TIME : 21:21:48 21:51:17 29.5 (mi n) Purpose : 3
 LOG : 6356.26 6358.25 2.0 Region : 10200
 FDEPTH: 25 5 Gear cond.: 0
 BDEPTH: 93 93 Validity: 0
 Towing dir.: 0° Wire out : 170 m Speed : 4.0 kn
 Sorted : 104 Total catch: 104.32 Catch/hour: 212.25

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Mene maculata	146.78	732	69.15
Auxis thazard	33.00	116	15.55
Auxis rochei	20.14	79	9.49
Euthynnus affinis	5.70	18	2.68
Megalaspis cordyla	2.36	14	2.48
Selar crumenophthalmus	2.03	28	0.96
Dussumieri a el opsoi des	0.94	16	0.44
Echeneis naucrates	0.53	2	0.25
Leiognathus lineolatus	0.49	67	0.23
Rastrelliger kanagartha	0.20	10	0.20
MULLIDAE, juvenile	0.08	10	0.04
Lagocephalus spadicus	0.00	2	0.00
Total	212.25	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 3
 DATE : 04/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°32.45 Lon E 91°25.19
 TIME : 04:38:12 05:08:55 29.5 (mi n) Purpose : 3
 LOG : 6420.52 6422.46 1.9 Region : 10200
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 87 89 Validity: 0
 Towing dir.: 0° Wire out : 350 m Speed : 3.8 kn
 Sorted : 0 Total catch: 0.33 Catch/hour: 0.64

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
J E L L Y F I S H	0.64	100.00	
Total	0.64	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 4
 DATE : 04/08/18 GEAR TYPE: PT NO: 4 POSITION: Lat N 21°3.44 Lon E 91°43.20
 TIME : 13:50:07 14:20:02 29.9 (mi n) Purpose : 3
 LOG : 6473.63 6475.26 1.6 Region : 10200
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 50 53 Validity: 0
 Towing dir.: 0° Wire out : 150 m Speed : 3.3 kn
 Sorted : 0 Total catch: 15.12 Catch/hour: 30.31

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Trichurus lepturus	15.23	104	43.65
Sardinella fimbriata	13.21	148	17.20
Parastronateus niger	3.41	18	11.24
Saurida tumbi	1.84	535	6.08
Metapneustes brevicornis	1.08	251	3.57
Dussumieri a el opsoi des	0.80	14	2.65
Jaydia striata	0.72	378	2.98
Megalaspis cordyla	0.68	4	2.25
Setipinna tenuifilis	0.64	50	2.12
Eupleurogrammus muticus	0.56	6	1.85
Thryssa dussumieri	0.48	92	1.59
Bregmaceros mclcllandi	0.44	128	1.46
J E L L Y F I S H	0.44	14	1.46
Atropus atropus	0.28	2	0.93
SEPIIDAE	0.24	14	0.79
Ililisha melastoma	0.12	2	0.40
Pelionotichela	0.08	2	0.26
Secutor ruconius	0.04	54	0.13
Total	30.31	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 10
 DATE : 06/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°11.94 Lon E 91°26.37
 TIME : 13:31:19 14:01:45 30.4 (mi n) Purpose : 3
 LOG : 6793.89 6796.16 2.3 Region : 10200
 FDEPTH: 8 8 Gear cond.: 0
 BDEPTH: 78 74 Validity: 0
 Towing dir.: 0° Wire out : 190 m Speed : 4.5 kn
 Sorted : 5 Total catch: 129.09 Catch/hour: 254.62

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Bregmaceros mclcllandi	118.93	713134	46.71
Photopectoralis binnus	51.93	51856	24.32
Dussumieri a el opsoi des	20.83	418	8.18
Scomberomorus guttatus	19.64	18	7.72
Selar crumenophthalmus	9.70	61	3.81
Megalaspis cordyla	6.86	26	2.70
Scomberomorus guttatus	5.09	10	2.00
Laturacanthus savala	4.89	83	1.92
Rastrelliger faughni	2.21	16	0.87
Sphyrna obtusata	1.78	20	0.70
Lagocephalus guentheri	1.14	10	0.45
Sphyrna forsteri	0.67	6	0.26
Saurida longimanus	0.59	91	0.23
Atalapha	0.30	2	0.12
Uroteuthis duvaucelii	0.04	18	0.02
Hydrophis platurus	0.00	6	0.00
Total	254.62	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 6
 DATE : 05/08/18 GEAR TYPE: PT NO: 7 POSITION: Lat N 21°5.13 Lon E 91°55.23
 TIME : 09:42:19 10:17:55 35.6 (mi n) Purpose : 3
 LOG : 6617.77 6619.21 1.4 Region : 10200
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 25 24 Validity: 0
 Towing dir.: 0° Wire out : 165 m Speed : 2.4 kn
 Sorted : 0 Total catch: 34.83 Catch/hour: 58.70

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Triacanthus niuhofii	23.66	393	40.31
Sardinella fimbriata	13.33	330	22.71
Scomberomorus commersoni	7.99	10	13.61
Scomberoides commersoni	5.90	2	10.05

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 11

DATE : 07/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°4.33
 start stop duration
 TIME : 02:14:07 02:44:14 30.1 (min)
 LOG : 6896.81 6898.90 2.1
 FDEPTH: 35
 BDEPTH: 184 339
 Towing dir: 0° Wire out : 330 m
 Sorted : 66 Total catch: 65.64

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Sphyrna lewini	129.48	2	99.02
Echeneis naucrates	1.27	2	0.98
Total	130.76		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 12
 DATE : 07/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 19°46.81
 start stop duration
 TIME : 08:07:31 08:27:18 19.8 (min)
 LOG : 6924.85 6926.07 1.2
 FDEPTH: 200 170
 BDEPTH: 1362 1333
 Towing dir: 0° Wire out : 600 m
 Sorted : 0 Total catch: 17.61

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Vinciguerria attenuata	27.79	80924	52.02
Pyrosoma	24.57	0	46.00
C E P H A L O P O D A	0.97	6	1.82
J E L L Y F I S H	0.05	130	0.10
Leptocephalus	0.03	3	0.06
Plastic	0.00	3	0.00
Total	53.41		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 13
 DATE : 07/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 19°29.65
 start stop duration
 TIME : 13:17:42 13:47:54 30.2 (min)
 LOG : 6951.67 6953.95 2.3
 FDEPTH: 10 1
 BDEPTH: 1569 1549
 Towing dir: 0° Wire out : 190 m
 Sorted : 36 Total catch: 173.51

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Cubiiceps pauciradiatus	332.79	27289	96.51
C E P H A L O P O D A	9.04	880	4.62
Coryphaena equiselis	2.11	38	0.61
Hydrophis platurus	0.44	2	0.13
Diaphus sp.	0.22	21	0.06
Lestrolepis sp.	0.08	10	0.02
Total	344.68		99.95

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 14
 DATE : 08/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 18°24.11
 start stop duration
 TIME : 00:35:13 01:05:00 29.8 (min)
 LOG : 7033.41 7034.90 1.5
 FDEPTH: 200 300
 BDEPTH: 2025 2017
 Towing dir: 0° Wire out : 750 m
 Sorted : 0 Total catch: 0.35

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Vinciguerria sp.	0.04	12	5.43
PRICANTHIDAE	0.02	54	3.43
MYCTOPHIDAE	0.01	6	1.43
Total	0.71		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 15
 DATE : 08/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 18°21.40
 start stop duration
 TIME : 04:29:19 04:49:43 20.4 (min)
 LOG : 7043.43 7044.65 1.2
 FDEPTH: 200 220
 BDEPTH: 2020 2005
 Towing dir: 0° Wire out : 750 m
 Sorted : 0 Total catch: 8.93

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Vinciguerria sp.	26.26	78794	100.00
Total	26.26		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 16
 DATE : 08/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 18°43.90
 start stop duration
 TIME : 10:15:36 10:42:26 26.8 (min)
 LOG : 7083.20 7085.30 1.5
 FDEPTH: 200 150
 BDEPTH: 1947 1958
 Towing dir: 0° Wire out : 720 m
 Sorted : 0 Total catch: 1.83

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Vinciguerria sp.	3.04	8917	74.22
J E L L Y F I S H	0.72	0	17.46
Leptocephalus	0.13	92	3.46
Cubiiceps sp.	0.04	98	1.09
J E L L Y F I S H	0.04	7	1.09
C E P H A L O P O D A	0.04	20	1.09
Priacanthus sp., juvenile	0.04	9	1.09
Benthosoma fibulatum	0.02	0.44	0.25
Acanthus sp., juvenile	0.01	2	0.13
Diptyerogonotus balteatus	0.00	2	0.09
UNIDENTIFIED FISH	0.00	2	0.02
Total	4.10		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 17
 DATE : 08/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 19°0.91
 start stop duration
 TIME : 15:32:26 16:03:17 30.9 (min)
 LOG : 7108.20 7110.68 2.5
 FDEPTH: 15 14
 BDEPTH: 1875 1862
 Towing dir: 0° Wire out : 190 m
 Sorted : 2 Total catch: 24.13

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Ommastrephes bartramii	22.83	2534	48.65
Cubiiceps pauciradiatus	11.70	753	24.92
Diaphus sp.	2.23	1503	4.75
Benthosoma sp.	1.40	4	2.98
Lestrolepis sp.	0.58	68	1.24
Psenes cyanophrys	0.23	2	0.50
Diaphus sp.	0.19	124	0.41
Euthynnus sp.	0.19	8	0.41
Bregmaceros maclellandi	0.14	780	0.30
Hydrophis platurus	0.12	2	0.25
Psenes	0.08	2	0.17
Priacanthus sp.	0.00	2	0.00
UNIDENTIFIED FISH	0.00	2	0.00
Total	46.94		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 18
 DATE : 08/08/18 GEAR TYPE: PT NO: 5 POSITION: Lat N 19°24.39
 start stop duration
 TIME : 21:22:29 21:54:11 31.7 (min)
 LOG : 7136.66 7138.51 1.9
 FDEPTH: 5 30
 BDEPTH: 1729 1734
 Towing dir: 0° Wire out : 300 m
 Sorted : 0 Total catch: 79.90

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
MYCTOPHIDAE	71.62	83540	47.36
Ommastrephes bartramii	40.70	3142	26.91
Cubiiceps pauciradiatus	20.61	1365	13.63
Diaphus sp.	5.67	1845	3.75
Small squids	5.15	1287	3.41
Lestrolepis japonica	1.55	206	1.02
Psenes cyanophrys	1.29	13	0.85
Total	148.57		100.00

Atule mate 1.13 51 0.75
 Bregmaceros sp. 1.03 4139 0.68
 Leptocephalus 0.77 0 0.51
 MULLIDAE, juvenile 0.62 182 0.41
 Cubiiceps whittogei 0.53 2 0.35
 Gempylus serpens 0.32 9 0.21
 Diptyerogonotus balteatus 0.13 79 0.09
 Priacanthus sp. 0.08 25 0.05
 Selar crumenophthalmus 0.04 2 0.03
 Total 151.23 100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 19
 DATE : 09/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°14.41
 start stop duration
 TIME : 08:27:42 09:15:22 47.7 (min)
 LOG : 7199.84 7202.38 2.5
 FDEPTH: 242 390
 BDEPTH: 827 915
 Towing dir: 0° Wire out : 800 m
 Sorted : 2 Total catch: 49.93

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Benthosoma sp.	58.75	193887	93.50
J E L L Y F I S H	2.74	55	4.37
Leptocephalus	1.10	247	1.74
Nesiarcturus nasutus	0.25	28	0.39
Total	62.84		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 20
 DATE : 09/08/18 GEAR TYPE: PT NO: 0 POSITION: Lat N 20°13.46
 start stop duration
 TIME : 10:35:18 11:04:34 29.3 (min)
 LOG : 7209.57 7210.90 1.3
 FDEPTH: 260 261
 BDEPTH: 260 261
 Towing dir: 0° Wire out : 0 m
 Sorted : 0 Total catch: 16.82

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
SOLENOCERIDAE	16.36	4440	47.44
J E L L Y F I S H	15.21	151	44.11
Neopinnularia orientalis	1.27	131	3.69
Benthosoma fibulatum	1.23	2860	3.57
Priacanthus sp.	0.25	4	0.71
Synagrops sp.	0.12	55	0.36
Bregmaceros maclellandi	0.02	14	0.06
B I V A L V E S	0.02	47	0.06
Total	34.48		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 21
 DATE : 09/08/18 GEAR TYPE: PT NO: 0 POSITION: Lat N 20°4.90
 start stop duration
 TIME : 19:04:28 19:34:30 30.0 (min)
 LOG : 7246.31 7248.10 0.0
 FDEPTH: 1142 1104
 BDEPTH: 1142 1104
 Towing dir: 0° Wire out : 0 m
 Sorted : 11 Total catch: 77.28

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Diaphus sp.	35.90	34812	23.22
Squid unidentifed	32.15	27318	20.80
Cubiiceps pauciradiatus	31.92	2024	20.65
BATHYTEUTHIDAE	15.68	28	10.14
Benthosoma suborbitale	8.98	11842	5.81
Small squids	8.04	4818	5.20
Bregmaceros maclellandi	7.98	28328	5.16
Psenes cyanophrys	4.85	42	3.14
Diaphus sp.	3.59	3406	2.32
Leptocephalus	2.57	3	1.66
Decapod sp.	0.86	14	0.55
Scyllarholiacea	0.64	4	0.41
Euthynnus affinis	0.57	28	0.37
MULLIDAE, juvenile	0.57	100	0.37
Priacanthus sp.	0.29	444	0.19
ACROPMATIDAE, juvenile	0.01	28	0.01
Total	154.58		100.01

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 22
 DATE : 09/08/18 GEAR TYPE: PT NO: 5 POSITION: Lat N 20°27.39
 start stop duration
 TIME : 22:15:01 22:45:05 30.1 (min)
 LOG : 7268.79 7270.61 1.8
 FDEPTH: 0 0
 BDEPTH: 186 168
 Towing dir: 0° Wire out : 280 m
 Sorted : 0 Total catch: 59.70

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Bregmaceros maclellandi	87.56	183316	73.50
ACROPMATIDAE	24.12	13578	20.25
Cubiiceps pauciradiatus	6.89	449	5.79
Leptocephalus	0.34	239	0.29
FISH larvae	0.17	1235	0.14
JUVENILE FISHES	0.03	102	0.03
Hydrophis platurus	0.00	2	0.00
Total	119.12		99.99

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 23
 DATE : 10/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 21°2.55
 start stop duration
 TIME : 03:12:57 03:42:07 29.2 (min)
 LOG : 7307.72 7309.51 1.8
 FDEPTH: 35 25
 BDEPTH: 96 98
 Towing dir: 0° Wire out : 260 m
 Sorted : 0 Total catch: 127.19

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Dussumieriella opsoidea	124.65	1430	47.65
Mene maculata	107.54	490	41.10
Megalaspis cordyla	13.16	95	5.03
Leptocephalus spadicus	10.53	66	4.03
Scomberomorus guttatus	3.41	4	1.31
Remora remora	1.69	2	0.64
Siphanocaris callosus	0.49	6	0.19
Trichiurus lepturus	0.14	2	0.06
Total	261.62		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 24
 DATE : 10/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°45.91
 start stop duration
 TIME : 13:39:41 13:57:56 18.2 (min)
 LOG : 7383.28 7384.55 1.3
 FDEPTH: 35 25
 BDEPTH: 131 129
 Towing dir: 0° Wire out : 240 m
 Sorted : 0 Total catch: 2500.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Benthosoma sp.	7331.44	1196701	89.20
Mobula tarapacana	394.52	3	4.80
Selar crumenophthalmus	184.11	921	2.24
Synagrops sp., juvenile	149.62	89773	1.82
Bregmaceros maclellandi	149.62	149819	1.82
Remora remora	3.29	10	0.04
Trichiurus lepturus	3.09	30	0.04
Acropoma japonicum	0.46	36	0.01
Neopinnularia orientalis	0.07	7	0.00
Total	8216.22		99.96

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 25
 DATE : 10/08/18 GEAR TYPE: PT NO: 5 POSITION: Lat N 20°23.02
 start stop duration
 TIME : 20:29:58 21:00:02 30.1 (min)
 LOG : 7415.75 7417.49 1.7
 FDEPTH: 0 0
 BDEPTH: 196 171
 Towing dir: 0° Wire out : 290 m
 Sorted : 4 Total catch: 152.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
ACROPMATIDAE	176.67	106002	58.23
Total	176.67		100.00

Bregmaceros mcl el landi	100.82	322619	33.23
Small squids	5.76	8641	1.92
MULLIDAE, juvenile	4.80	1824	1.58
Echeneis naucrates	4.67	2	1.54
Leptocephalus	3.84	4128	1.27
Neopinnula orientalis	2.88	383	0.95
Selair crumenophthalmas, juvenile	1.92	96	0.63
Selair crumenophthalmas	1.16	6	0.38
FISH LARVAE	0.67	1441	0.22
Hydrophis platurus	0.20	2	0.07
Total	303.39		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 26
 DATE : 11/08/18 GEAR TYPE: PT NO: 0 POSITION: Lat N 21°3.24 Lon E 89°36.64
 TIME : 04:28:38 04:55:14 26.8 (min) Purpose : 3
 LOG : 7464.14 7465.90 1.8 Region : 10200
 FDEPTH: 0 Gear cond.: 0
 BDEPTH: 91 94 Validity: 0
 Towing dir.: 0° Wire out : 0 m Speed : 0.0 kn
 Sorted : 0 Total catch: 0.11 m Catch/hour: 0.25

SPECIES			
Dussumieri a el opsoi des	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
	0.25	4	100.00
Total	0.25		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 27
 DATE : 11/08/18 GEAR TYPE: BT NO: 0 POSITION: Lat N 21°11.13 Lon E 89°39.65
 TIME : 08:22:49 08:36:54 14.1 (min) Purpose : 3
 LOG : 7481.68 7482.26 0.6 Region : 10200
 FDEPTH: 78 78 Gear cond.: 0
 BDEPTH: 78 78 Validity: 0
 Towing dir.: 0° Wire out : 225 m Speed : 2.5 kn
 Sorted : 0 Total catch: 40.59 m Catch/hour: 172.95

SPECIES			
Harpadon nehereus	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
Benthoema sp.	31.02	77557	17.94
Pennahi a anea	15.68	366	9.07
Portunus sanguinolento	13.04	85	7.54
Penaeus sp.	12.19	759	7.05
C E P H A L O P O D A	10.14	2536	5.86
Trichurus lepturus	9.63	286	5.57
PORTUNIDAE	6.43	7423	3.72
SEPIIDAE	3.07	141	1.77
Cynoglossus arel	2.60	38	1.59
Johni us dussumieri	2.47	34	1.43
Waste General	2.22	4	1.28
G A S T R O P O D S	1.96	217	4.42
Charybdi s ferata	1.58	13	0.91
MURAENIDAE	1.53	4	0.89
SQUILLIDAE	1.41	77	1.81
PENAEIDAE	1.28	298	0.74
Bregmaceros mcl el landi	1.19	179	0.69
Grammolites scaber	1.11	47	0.64
Polydactylus sextarius	0.94	13	0.54
Penaeus monodon	0.94	17	0.54
Selair crumenophthalmas	0.89	4	0.52
Nemipterus japonicus	0.89	9	0.52
Chrysochir aureus	0.85	9	0.49
Kunococcus rodriguezii	0.72	26	0.42
ACROPMATIDAE	0.68	55	0.39
Sugrindurus macracanthus	0.60	26	0.34
Portunus pelagicus	0.60	4	0.10
Metapenaeus brevicornis	0.17	34	0.10
Sepia sp.	0.17	4	0.10
Upeneus sulphureus	0.13	30	0.07
S H R I M P S	0.13	47	0.07
Uranoscopus cognatus	0.09	4	0.05
Saurida undooquami	0.09	4	0.05
Solea ovata	0.09	13	0.05
Squid sp.	0.09	13	0.05
Brachypteryx serrulifer	0.09	4	0.05
PENAEIDAE	0.09	77	0.05
Dussumieri a el opsoi des	0.08	13	0.05
Johni us coltor	0.01	4	0.00
Photoplectroli s binidus	0.00	4	0.00
Jaydi a sp.	0.00	4	0.00
Total	172.22		99.58

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 28
 DATE : 11/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°52.31 Lon E 89°41.95
 TIME : 13:46:01 14:16:36 30.6 (min) Purpose : 3
 LOG : 7525.43 7527.38 1.9 Region : 10200
 FDEPTH: 38 Gear cond.: 0
 BDEPTH: 108 110 Validity: 0
 Towing dir.: 0° Wire out : 265 m Speed : 3.8 kn
 Sorted : 0 Total catch: 50.13 m Catch/hour: 98.36

SPECIES			
Mene maculata	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
Bregmaceros mcl el landi	72.87	361	74.09
Trichurus lepturus	15.01	16164	15.26
J E L L Y F I S H	2.32	6	2.35
Hydrophis platurus	1.33	2	1.36
Decapoda macrozoa	0.98	6	0.24
Lagocephalus spadi ceus	0.24	2	0.20
Megal aspi s cordyla	0.20	4	0.04
Acrozoa sp.	0.04	4	0.04
Total	98.36		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 29
 DATE : 11/08/18 GEAR TYPE: PT NO: 5 POSITION: Lat N 20°25.43 Lon E 89°33.46
 TIME : 19:17:47 19:57:59 40.2 (min) Purpose : 3
 LOG : 7554.10 7555.97 1.9 Region : 10200
 FDEPTH: 0 Gear cond.: 0
 BDEPTH: 151 158 Validity: 0
 Towing dir.: 0° Wire out : 290 m Speed : 3.7 kn
 Sorted : 3 Total catch: 20.29 m Catch/hour: 40.32

SPECIES			
Bregmaceros mcl el landi	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
ACROPMATIDAE, juvenile	18.82	31367	46.68
Leptocephalus	4.67	5384	11.58
Auxis thazard	0.74	2	1.82
Upeneus sp., juvenile	0.64	205	1.59
FISH LARVAE	0.45	2583	1.12
SALPS	0.41	117	1.02
Neopinnula orientalis	0.29	87	0.72
JUVENILE FISHERS	0.20	759	0.51
Champsodon sp.	0.15	87	0.36
Selair crumenophthalmas	0.10	2	0.25
Squid undentifled, juvenile	0.07	205	0.18
Priacanthus sp., juvenile	0.06	6	0.15
Total	40.32		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 30
 DATE : 12/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 21°8.98 Lon E 89°55.69
 TIME : 05:23:38 05:54:41 31.0 (min) Purpose : 3
 LOG : 7627.33 7629.60 2.3 Region : 10200
 FDEPTH: 0 Gear cond.: 0
 BDEPTH: 80 81 Validity: 0
 Towing dir.: 0° Wire out : 180 m Speed : 4.4 kn
 Sorted : 0 Total catch: 15.96 m Catch/hour: 30.85

SPECIES			
Dussumieri a el opsoi des	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
Sardinella fimbriata	8.04	122	26.07
Megal aspi s cordyla	7.19	170	23.31
Parastromateus niger	6.88	44	22.31
Mene maculata	2.24	6	7.27
Scomberomorus guttatus	1.93	10	6.27
Scomberomorus commerson	1.89	2	6.14
Scomberomorus	1.72	2	5.58
Si ganus canal iculatus	0.56	4	1.00
Lepturacanthus savala	0.31	6	1.00
Lagocephalus spadi ceus	0.19	2	0.63
Total	30.97		100.38

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 31
 DATE : 12/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°40.69 Lon E 89°55.02
 TIME : 13:58:47 14:29:47 31.0 (min) Purpose : 3
 LOG : 7683.40 7685.31 1.9 Region : 10200

FDEPTH: 45 48 Gear cond.: 0
 BDEPTH: 116 120 Validity: 0
 Towing dir.: 0° Wire out : 260 m Speed : 3.7 kn
 Sorted : 0 Total catch: 172.57 m Catch/hour: 334.01

SPECIES			
Bregmaceros mcl el landi	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
ACROPMATIDAE	25.95	12459	7.77
Selair crumenophthalmas	4.30	21	1.29
Megal aspi s cordyla	4.03	29	1.21
Mene maculata	3.52	15	1.05
Lagocephalus guentheri	1.47	12	0.44
Trichurus lepturus	1.39	12	0.42
J E L L Y F I S H	1.12	2	0.34
Eupleurgrammus multicus	0.93	10	0.28
Scomberol des tol	0.50	2	0.15
Si ganus canal iculatus	0.15	2	0.05
Total	334.01		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 32
 DATE : 12/08/18 GEAR TYPE: PT NO: 5 POSITION: Lat N 20°14.72 Lon E 89°55.43
 TIME : 20:09:25 20:39:29 30.1 (min) Purpose : 3
 LOG : 7720.69 7722.26 1.6 Region : 10200
 FDEPTH: 0 Gear cond.: 0
 BDEPTH: 155 155 Validity: 0
 Towing dir.: 0° Wire out : 290 m Speed : 3.1 kn
 Sorted : 3 Total catch: 31.20 m Catch/hour: 62.28

SPECIES			
Bregmaceros mcl el landi	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
ACROPMATIDAE	40.72	14046	64.42
C E P H A L O P O D A	9.69	4836	15.56
Neopinnula orientalis	8.77	144	14.09
Leptocephalus	1.25	234	2.01
Hydrophis platurus	1.04	1218	1.67
Canthidom s maculata	0.52	2	0.83
Selair crumenophthalmas	0.42	2	0.67
Priacanthus sp.	0.18	18	0.29
Squid undentifled	0.18	72	0.29
FISH LARVAE	0.07	287	0.12
Total	62.29		100.03

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 33
 DATE : 13/08/18 GEAR TYPE: BT NO: 0 POSITION: Lat N 21°12.96 Lon E 90°14.26
 TIME : 05:18:28 05:40:48 22.2 (min) Purpose : 3
 LOG : 7785.50 7786.89 1.4 Region : 10200
 FDEPTH: 25 25 Gear cond.: 0
 BDEPTH: 165 165 Validity: 0
 Towing dir.: 0° Wire out : 120 m Speed : 3.7 kn
 Sorted : 1 Total catch: 93.14 m Catch/hour: 250.38

SPECIES			
Trichurus lepturus	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
Harpadon nehereus	38.87	317	18.66
Trichurus sp., juvenile	22.96	8317	9.17
Shrimps undentifled	12.26	16062	9.17
Eutheronema tetradactylum	15.86	65	6.33
Sardinella fimbriata	12.90	352	5.15
Lagocephalus spadi ceus	11.40	38	4.55
Pilocoli s dussumieri	11.29	108	4.51
Trichurus gangeticus	8.28	570	3.31
Otolithes ruber	7.72	78	3.08
Chrysochir aureus	7.10	54	2.83
Portunus sanguinolento	6.45	56	2.58
Megal aspi s cordyla	4.84	40	1.93
Scomberomorus guttatus	3.92	3	1.57
Pterotolithus lateoides	3.17	8	1.27
Drapane longimana	3.01	70	2.70
Terapon jarbua	2.74	16	1.10
Raconda russelliana	1.89	108	0.75
Exopalaemon stvii Ferus	1.02	71	0.71
Secutor ruconius	1.72	688	0.69
Penaeus indicus	1.56	35	0.62
Atropus atropus	1.56	16	0.56
Terapon theraps	1.45	30	0.58
Thryssa sp.	1.08	54	0.43
Thryssa dussumieri	1.02	97	0.41
Trichurus sp.	0.75	0	0.30
Ostorhynchus fasciatus	0.57	56	0.23
Pilocoli s argyroleuron	0.56	2	0.23
Harpadon nehereus	0.56	172	0.23
C R A B S	0.56	288	0.23
Pennahi a anea	0.56	5	0.23
Portunus pelagicus	0.54	5	0.21
Polynemus paradi seus	0.48	13	0.19
Eupleurgrammus multicus	0.48	8	0.19
Muraenesox ci neurus	0.38	5	0.15
Cynoglossus arel	0.32	8	0.13
Osteocheilus cuneus	0.32	8	0.13
SEPIIDAE	0.27	16	0.11
Metapenaeus lysianassa	0.24	43	0.10
Osteocheilus miltari s	0.22	6	0.09
Narke di pterygia	0.22	3	0.09
Thryssa dussumieri	0.22	27	0.09
Metapenaeus brovi cornis	0.22	22	0.09
PALAEMONIDAE	0.22	180	0.09
Il l i s s a F i l i g e r a	0.22	3	0.09
Dussumieri a el opsoi des	0.11	3	0.04
Mi erspenaeopsi s hardwicki i	0.08	11	0.03
Penaeus merguie nsi s	0.05	8	0.02
Solenocera crassi cornis	0.05	3	0.01
Stolephorus andhraensis	0.01	3	0.01
Total	250.42		100.02

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 34
 DATE : 13/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°52.74 Lon E 90°14.94
 TIME : 09:23:13 09:58:26 35.2 (min) Purpose : 3
 LOG : 7814.54 7817.12 2.6 Region : 10200
 FDEPTH: 22 Gear cond.: 0
 BDEPTH: 88 90 Validity: 0
 Towing dir.: 0° Wire out : 275 m Speed : 4.4 kn
 Sorted : 0 Total catch: 0.28 m Catch/hour: 0.48

SPECIES			
Melichthys platurus	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
Hydrophis platurus	0.27	2	57.14
Total	0.20	2	42.86
Total	0.48		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 35
 DATE : 13/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°12.36 Lon E 90°11.24
 TIME : 17:14:21 17:50:22 36.0 (min) Purpose : 3
 LOG : 7868.04 7870.64 2.6 Region : 10200
 FDEPTH: 1 Gear cond.: 0
 BDEPTH: 156 142 Validity: 0
 Towing dir.: 0° Wire out : 220 m Speed : 4.3 kn
 Sorted : 5 Total catch: 85.82 m Catch/hour: 142.91

SPECIES			
Benthoema pteropus	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
Bregmaceros mcl el landi	88.92	81091	62.22
Leptocephalus	35.04	131412	24.52
Echeneis naucrates	6.77	7537	4.74
C E P H A L O P O D A	5.63	55	3.94
Shrimps, larvae	4.12	88	2.88
Squid undentifled, juvenile	0.88	12603	0.62
Upeneus sp., juvenile	0.59	1590	0.41
Selair crumenophthalmas	0.56	206	0.39
JUVENILE FISHERS	0.25	10	0.17
Total	142.91		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 36
 DATE : 14/08/18 GEAR TYPE: PT NO: 7 POSITION: Lat N 21°7.79 Lon E 90°35.91
 TIME : 03:29:36 03:59:47 30.2 (min) Purpose : 3
 LOG : 7940.47 7942.81 2.3 (min) Region : 10200
 FDEPTH: 0 Gear cond.: 0
 BDEPTH: 26 24 Validity: 0
 Towing dir.: 0° Wire out : 200 m Speed : 4.6 kn
 Sorted : 0 Total catch: 12.38 m Catch/hour: 24.60

SPECIES			
Sardinella fimbriata	weight	CATCH/HOUR numbers	% OF TOT. C SAMP
Scomberomorus guttatus	1.51	6	6.14
Chirocentrus dorab	0.60	4	2.42
Total	2.11	10	8.56

Scomberoides tol	0.44	2	1.78	66
Atropus atropus	0.16	2	0.65	
Plastic	0.00	4	0.00	
Total	24.60		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 37
 DATE : 14/08/18 GEAR TYPE: PT NO: 0 POSITION: Lat N 20°9.26
 Lon E 90°21.61
 TIME : 15:01:55 15:29:19 27.4 (min) Purpose : 3
 LOG : 8023.77 8025.25 1.5 Region : 10200
 FDEPTH: 160 159 Gear cond.: 0
 BDEPTH: 160 159 Validity: 0
 Towing dir.: 0° Wire out : 390 m Speed : 3.2 kn
 Sorted : 0 Total catch: 8.32 Catch/hour: 18.22

SPECIES		CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers		
Benthosema pterotum	13.36	21469	73.32	
C E P H A L O P O D A	2.54	4	13.94	
S H R I M P S	1.62	637	8.89	
J E L L Y F I S H	0.26	0	1.44	
Benthosema fibulatum	0.15	48	0.84	
Champsodon sp., juvenile	0.11	22	0.60	
Synagrops sp.	0.04	18	0.24	
Neocyttus sp.	0.04	18	0.24	
OMMASTREPHI DAE	0.04	7	0.24	
CONGRIDAE	0.04	18	0.24	
Total	18.22		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 38
 DATE : 14/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°11.64
 Lon E 90°27.94
 TIME : 17:22:59 17:51:44 28.7 (min) Purpose : 3
 LOG : 8037.02 8039.28 2.3 Region : 10200
 FDEPTH: 10 12 Gear cond.: 0
 BDEPTH: 135 128 Validity: 0
 Towing dir.: 0° Wire out : 220 m Speed : 4.7 kn
 Sorted : 101 Total catch: 111.41 Catch/hour: 232.59

SPECIES		CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers		
Sphyrna mokarran	208.77	2	89.76	
Bregmaceros micellandi	18.80	82699	8.08	
Leptocephalus	1.79	0	0.77	
Squid unidentified, juvenile	1.79	2476	0.77	
ACROPMIATIDAE	0.72	324	0.31	
Selar crumenophthalmus	0.21	2	0.09	
Squid unidentified	0.17	2	0.07	
Priacanthus sp., juvenile	0.17	31	0.07	
Upeneus sp., juvenile	0.13	35	0.05	
Echeneis naucrates, juvenile	0.04	2	0.02	
Total	232.59		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 39
 DATE : 15/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°57.68
 Lon E 90°48.96
 TIME : 03:19:11 03:49:37 30.4 (min) Purpose : 3
 LOG : 8114.05 8116.58 2.5 Region : 10200
 FDEPTH: 28 42 Gear cond.: 0
 BDEPTH: 74 73 Validity: 0
 Towing dir.: 0° Wire out : 240 m Speed : 5.0 kn
 Sorted : 100 Total catch: 99.80 Catch/hour: 196.71

SPECIES		CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers		
Megalaspis cordyla	136.83	613	69.56	69
Scomberomorus commerson	25.82	2	13.13	
Dussumeria elopoides	13.05	138	6.63	71
Sardinella fimbriata	11.91	209	6.05	70
Scomberomorus commerson	7.06	4	3.59	72
Scomberomorus guttatus	1.18	4	0.60	73
Trichiurus lepturus	0.87	10	0.44	
Total	196.71		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 40
 DATE : 15/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°34.27
 Lon E 90°43.17
 TIME : 09:13:08 09:42:44 29.6 (min) Purpose : 3
 LOG : 8151.27 8153.13 1.9 Region : 10200
 FDEPTH: 30 55 Gear cond.: 0
 BDEPTH: 88 87 Validity: 0
 Towing dir.: 0° Wire out : 300 m Speed : 3.8 kn
 Sorted : 0 Total catch: 137.07 Catch/hour: 277.75

SPECIES		CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers		
Mene maculata	270.13	1386	97.26	
Megalaspis cordyla	7.01	32	2.52	
Rachycentron canadum	0.61	2	0.22	
Total	277.75		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 41
 DATE : 15/08/18 GEAR TYPE: PT NO: 5 POSITION: Lat N 20°51.76
 Lon E 90°55.61
 TIME : 21:00:59 21:31:01 30.0 (min) Purpose : 3
 LOG : 8241.38 8243.80 2.4 Region : 10200
 FDEPTH: 0 0 Gear cond.: 0
 BDEPTH: 74 76 Validity: 0
 Towing dir.: 0° Wire out : 300 m Speed : 4.8 kn
 Sorted : 0 Total catch: 278.17 Catch/hour: 555.60

SPECIES		CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers		
Megalaspis cordyla	487.87	2255	87.81	76
Dussumeria elopoides	16.50	256	2.97	75
Rastrelliger brachysoma	14.26	76	2.57	78
Selar crumenophthalmus	11.70	74	2.11	77
Sphyrna obtusata	5.07	56	0.91	
Thunnus tonggol	4.79	6	0.86	80
Sardinella fimbriata	2.96	52	0.53	74
Sphyrna putnamae	2.88	4	0.52	
Small squids	2.72	310	0.49	
Auxis thazard	2.24	6	0.40	79
Echeneis naucrates	1.64	2	0.29	
Trichiurus lepturus	1.56	50	0.28	
Siganus canaliculatus	0.68	6	0.12	
Squid unidentified	0.42	2	0.08	
Ilishastriata	0.22	4	0.04	
Stolephorus andhraensis	0.06	8	0.01	
Photopectoralis bidus	0.03	32	0.01	
Upeneus sp., juvenile	0.01	2	0.00	
Total	555.60		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2018410 STATION: 42
 DATE : 16/08/18 GEAR TYPE: PT NO: 8 POSITION: Lat N 20°6.85
 Lon E 91°0.02
 TIME : 09:50:55 10:23:53 33.0 (min) Purpose : 3
 LOG : 8345.51 8347.43 1.9 Region : 10200
 FDEPTH: 50 67 Gear cond.: 0
 BDEPTH: 144 134 Validity: 0
 Towing dir.: 0° Wire out : 350 m Speed : 3.5 kn
 Sorted : 0 Total catch: 4.54 Catch/hour: 8.25

SPECIES		CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers		
J E L L Y F I S H	7.46	0	90.41	
S E L L Y F I S H	0.36	4	4.41	0
Leptocephalus	0.22	0	2.65	
Benthosema sp.	0.14	5230	1.65	
ACANTHURI DAE, juvenile	0.02	18	0.22	
OMMASTREPHI DAE	0.02	7	0.22	
UNI DENTI FIED FISH	0.01	22	0.17	
UNI DENTI FIED FISH	0.01	9	0.11	
C E P H A L O P O D A	0.01	13	0.09	0
Priacanthus sp.	0.00	2	0.06	
Lagocephalus sp., juvenile	0.00	4	0.02	
Total	8.25		100.00	

ANNEX IV **BIOLOGY SCALES**

Sexual maturity

Stage	State	Description
I	Immature	Ovary and testis about 1/3rd length of body cavity. Ovaries pinkish, translucent, testis whitish. Ova not visible to naked eye.
II	Maturing virgin and recovering spent	Ovary and testis about ½ length of body cavity. Ovary pinkish, translucent, testis whitish, symmetrical. Ova not visible to naked eye.
III	Ripening	Ovary and testis is about 2/3rds length of body cavity. Ovary pinkish yellow colour with granular appearance, testis whitish to creamy. No transparent or translucent ova visible.
IV	Ripe	Ovary and testis from 2/3rds to full length of body cavity. Ovary orange-pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova visible. Testis whitish-creamy, soft.
V	Spent	Ovary and testis shrunken to about ½ length of 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	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 throughout the water column at all Super Stations that coincided with a pelagic trawl. Samples were analysed on board for pH and total alkalinity, whereas nutrient analysis will take place on shore at Institute of Marine Research. 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.

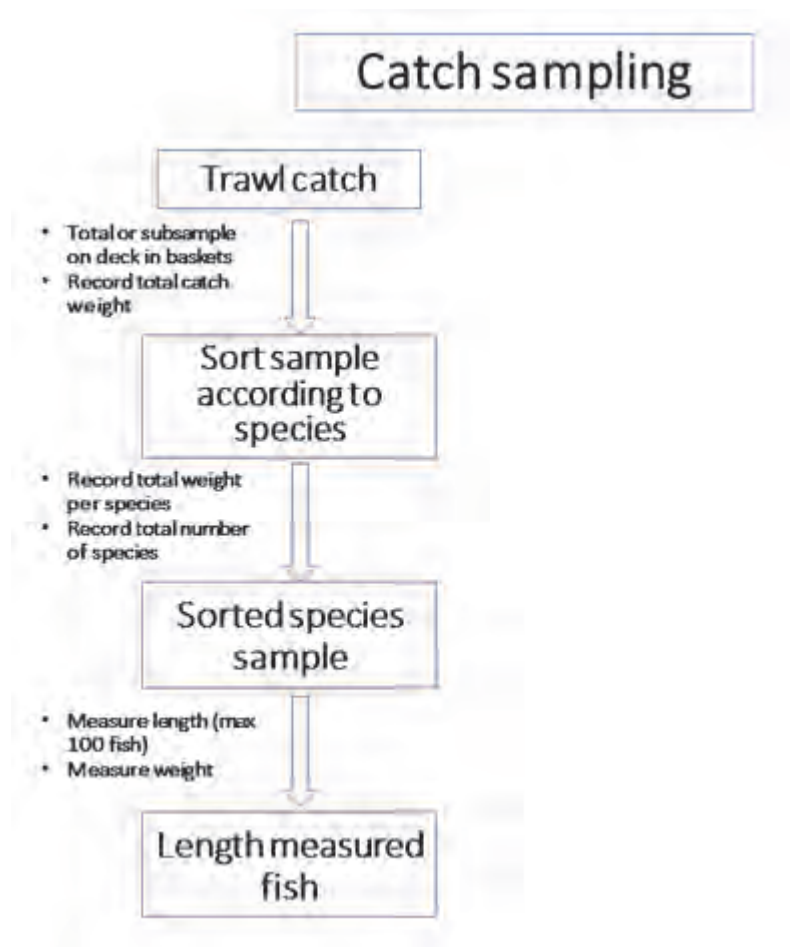
Saturation state of calcium carbonates is an indicator used for monitoring development of ocean acidification in seawater. A saturation state value below one for a calcium carbonate mineral, means the water is under-saturated for the mineral. Under-saturation predicts that over time the mineral will dissolve. 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 LIST OF PRIORITY SPECIES AND BIOLOGICAL SAMPLES COLLECTED FOR FUTURE ANALYSIS

Table 1. List of priority species selected for length and weight and biological samples.

Main Groups	Families	Typical Species	Species Code	Fishmeter code	Length and Weight	Microplastics	Stomach	Genetics	Fish Nutrient
Pelagic	Carangidae (Jacks, Queen fish, Pompanos)	<i>Megalaspis cordyla</i>	CARME01	1	√				
		<i>Parastromateus niger</i>	CARPA01	2	√		√	√	√
		<i>Scomberoides commersonianus</i>	CARSC02	3	√		√	√	√
	Chirocentridae	<i>Chirocentrus dorab</i>	CHRCH01	4	√				
	Clupeidae	<i>Ilisha filigera</i>	CLUIL05	5	√				
		<i>Thryssa mystax</i>	ENGTH02	6	√				
		<i>Sardinella fimbriata</i>	CLUSL06	7	√		√	√	√
		<i>Tenualosa ilisha</i>	CLUTE03	8	√		√	√	√
		<i>Dussumieria acuta</i>	CLUDU01	9	√				
		<i>Anodontostoma chacunda</i>	CLUAM01	10	√				
		<i>Scomberomorus commerson</i>	SCMSM03	11	√				
	Scombridae	<i>Scomberomorus guttatus</i>	SCMSM04	12	√		√	√	√
		<i>Thunnus obesus</i>	SCMTH01	13	√				
		<i>Auxis thazard</i>	SCMAU01	14	√				
		<i>Thunnus tonggol</i>	SCMTH05	15	√				
		<i>Katsuwonus pelamis</i>	SCMKA01	16	√				
		<i>Rastrelliger kanagurta</i>	SCMSM04	17	√		√	√	√
		Sphyraenidae	<i>Sphyraena forsteri</i>	SPHSP04	18	√			
	<i>Sphyraena barracuda</i>		SPHSP05	19	√				
	Istiophoridae	<i>Istiophorus platyterus</i>	ISTIS02	20	√				
		<i>Makaira indica</i>	ISTMA02	21	√				
Mesopelagic						√			
Uncommon							√		
Demersal	Drepanidae	<i>Drepane longimana</i>	DREDR03	22	√				
	Ephippidae	<i>Ephippus orbis</i>	EPHEP01	23	√				
	Harpadontidae	<i>Harpadon nehereus</i>	SYNHA01	24	√		√	√	√
	Lactariidae	<i>Lactarius lactarius</i>	LACLA01	25	√				
	Lutjanidae	<i>Lutjanus sanguineus</i>	LUTLU22	26	√				
		<i>Lutjanus johnii</i>	LUTLU10	27	√		√	√	√
<i>Lutjanus malabaricus</i>		LUTLU15	28	√					

Main Groups	Families	Typical Species	Species Code	Fishmeter code	Length and Weight	Microplastics	Stomach	Genetics	Fish Nutrient
	Mullidae	<i>Upeneus sulphureus</i>	MULUP05	29	√				
	Nemipteridae	<i>Nemipterus japonicus</i>	NEMNE03	30	√		√	√	√
	Pomadasyidae	<i>Pomadasyus hasta</i>	PODPO29	31	√				
		<i>Pomadasyus maculatus</i>	PODPO06	32	√				
	Polynemidae	<i>Polynemus indicus</i>	PLNPO04	33	√				
		<i>Eleutheronema tetradactylum</i>	PLNEL01	34	√				
	Psettodidae	<i>Psettodes erumei</i>	PSEPS02	35	√				
	Synodontidae	<i>Saurida tumbil</i>	SYNSA02	36	√				
	Sillagonidae	<i>Sillago domina</i>	SILSI99	37	√				
	Sciaenidae	<i>Pterolithus maculatus</i>	SCIPU02	38	√		√	√	√
		<i>Pennahia argentata</i>	SCICE01	39	√		√	√	√
		<i>Otolithes cuvieri</i>	SCIOT02	40	√				
	Sparidae	<i>Argyrops spinifer</i>	SPAAR01	41	√				
	Arridae	<i>Arius – spp.</i>	ARDAR00	42	√		√	√	√
	Stromateidae	<i>Pampus chinensis</i>	STRPA02	43	√		√	√	√
		<i>Pampus argenteus</i>	STRPA01	44	√		√	√	√
	Trichiuridae	<i>Lepturacanthus savala</i>	TRILT01	45	√		√	√	√
	Theraponidae	<i>Therapon jarbua</i>	THETH01	46	√				
	Shark and rays	<i>Scoliodon laticaudus</i>	SHACA71	47	√				
		<i>Himantura uarnak</i>	RAYDA23	48	√				
		<i>Rhinobatus granulatus</i>	RAYRB23	49	√				
		<i>Eusthyra blochii</i>	SHASP21	50	√				
	Muraenesocidae	<i>Muraenesox talabonides</i>	MUXCU01	51	√		√	√	√
	Cephalopods	<i>Sepia esculenta</i>	SQUSE18	52	√				
		<i>Uroteuthis duvaucelli</i>	SQULO71	53	√				
		<i>Octopus vulgaris</i>	SQUOC11	54	√				
	Shrimps	<i>Metapenaeus monoceros</i>	SHRPE71	55	√		√	√	√
		<i>Penaeus indicus</i>	SHRPE64	56	√				
		<i>Penaeus monodon</i>	SHRPE63	57	√		√	√	√



ANNEX VIII

OVERVIEW OF THE SAMPLES

Table 2. List of species collected for stomach content analysis.

Sl. No.	St. no.	Species name	Species code	Collection date	Remarks
1	1	<i>Harpadon nehereus</i>	SYNHA01	04.08.18	
2	1	<i>Setipinna tenuifilis</i>	ENGSE03	04.08.18	
3	1	<i>Osteogeneiosus militaris</i>	ARDOS01	04.08.18	
4	1	<i>Raconda russeliana</i>	PRSR01	04.08.18	
5	2	<i>Euthynnus affinis</i>	SCMEU02	04.08.18	
6	2	<i>Megalaspis cordyla</i>	CARME01	04.08.18	
7	4	<i>Lepturacanthus savala</i>	TRILT01	04.08.18	
8	5	<i>Decapterus macrosoma</i>	CARDE05	05.08.18	
9	5	<i>Echeneis naucrates</i>	ECNEC01	05.08.18	
10	6	<i>Pampus chinensis</i>	STRPA02	05.08.18	
11	6	<i>Terapon jarbua</i>	THETH01	05.08.18	
12	7	<i>Myctophidae</i>	MYCAA00	06.08.18	
13	7	<i>Bregmaceros mclellandi</i>	BREBR01	06.08.18	
14	7	<i>Sthenoteuthis oualaniensis</i>	SQUMOC1	06.08.18	
15	7	<i>Champsodon vorax</i>	CHMCH03	06.08.18	
16	8	<i>Sardinella fimbriata</i>	CLUSL06	06.08.18	
17	8	<i>Lepturacanthus savala</i>	TRILT01	06.08.18	
18	8	<i>Parastromateus niger</i>	CARPA01	06.08.18	
19	9	<i>Nemipterus nematophorus</i>	NEMNE07	06.08.18	
20	9	<i>Nemipterus japonicus</i>	NEMNE03	06.08.18	
21	9	<i>Selar crumenophthalmus</i>	CARSA01	06.08.18	
22	9	<i>Upeneus moluccensis</i>	MULUP03	06.06.18	
23	9	<i>Saurida tumbil</i>	SYNSA02	06.06.18	
24	12	<i>Vinciguerria spp.</i>	GONVI00	07.08.18	
25	13	<i>Cubiceps pauciradiatus</i>	NOMCU05	07.08.18	
26	16	<i>Acanthurus sp.</i>	ACAAC00	08.08.18	
27	16	<i>Dipterygnotus balteatus</i>	CAEDI01	08.08.18	
28	16	<i>Benthoosema</i>	MYCBE00	08.08.18	
29	16	<i>Priacanthus sp.</i>	PRIPR00	08.08.18	
30	17	<i>Lestidium sp.</i>	PARLE00	08.08.18	
31	18	<i>Psenes sp.</i>	NOMPS00	09.08.18	

Sl. No.	St. no.	Species name	Species code	Collection date	Remarks
32	18	<i>Neoepinnula orientalis</i>	GEMNP01	09.08.18	
33	18	<i>Lestrolepis japonica</i>	PARLP03	09.08.18	
34	18	<i>Diaphus sp.</i>	MYCDI00	09.08.18	
35	22	<i>Synagrops japonicus</i>	ACRSY02	10.08.18	
36	23	<i>Mene maculate</i>	MENME01	10.08.18	
37	23	<i>Dussumieria elopsoides</i>	CLUDU02	10.08.18	
38	27	<i>Sphoeroides dorsalis</i>	TETSP11	11.08.18	
39	27	<i>Grammoplites scaber</i>	PLAGR04	11.08.18	
40	27	<i>Johnius sp.</i>	SCIJO00	11.08.18	
41	29	<i>Auxis thazard</i>	SCMAU01	12.08.18	
42	29	<i>Acropomatidae</i>	ACRAA00	12.08.18	
43	41	<i>Sphyraena obtusata</i>	SPHSP06	16.08.18	
44	41	<i>Siganus canaliculatus</i>	SIGSI01	16.08.18	

Table 3. List of samples collected for genetic identification.

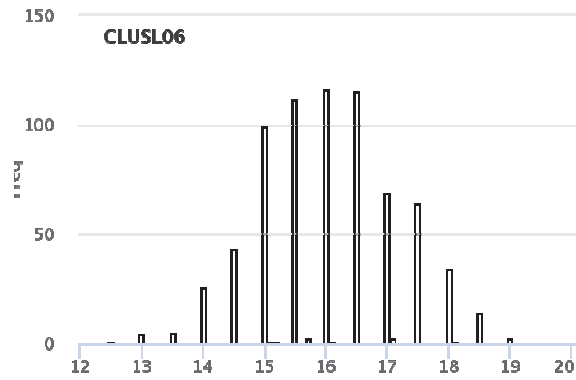
Sl. No.	St. no.	Number of specimens	Collection date	Remarks
1	4	7	04.08.18	
2	5	1	05.08.18	
3	6	11	05.08.18	
4	7	3	06.08.18	
5	8	7	06.08.18	
6	9	10	06.08.18	
7	12	1	07.08.18	
8	13	3	07.08.18	
9	17	2	08.08.18	
10	18	3	09.08.18	
11	20	1	09.08.18	
12	21	1	09.08.18	
13	23	2	10.08.18	
14	27	1	11.08.18	
15	28	2	11.08.18	
16	31	4	12.08.18	
Total		59	-	

Table 4. List of specimens collected for analysis of microplastics gut content.

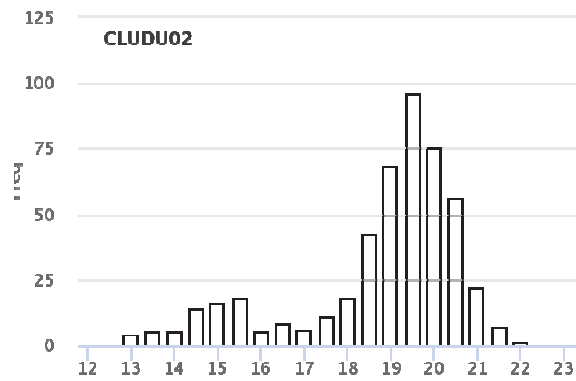
Sl. No.	St. no.	Species name	Species code	Collection date	Remarks
1	13	<i>Cubiceps pauciradiatus</i>	NOMCU05	07.08.18	
2	15	<i>Vinciguerria spp.</i>	GONVI00	08.08.18	
3	18	<i>Lestrolepis japonica</i>	PARLP03	09.08.18	
4	18	<i>Diaphus sp.</i>	MYCDI00	09.08.18	
5	18	<i>Psenes sp</i>	NOMPS00	09.08.18	
6	19	<i>Benthoosema</i>	MYCBE00	09.08.18	
7	21	<i>Myctophidae</i>	MYCAA00	10.08.18	
8	21	<i>Priacanthus sp.</i>	PRIPR00	10.08.18	
9	21	<i>Neopinnula orientalis</i>	GEMNP01	10.08.18	

ANNEX IX

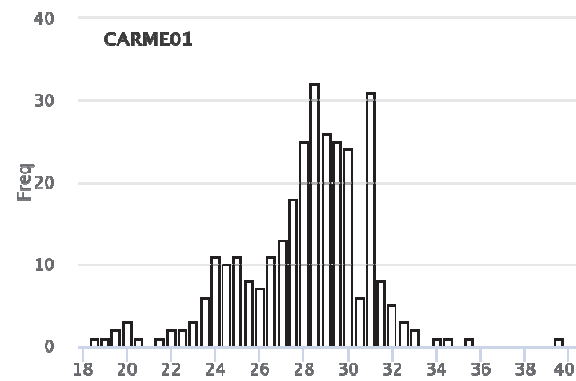
LENGTH-WEIGHT RELATIONSHIP AND LENGTH FREQUENCY FOR SELECTED FISH SPECIES



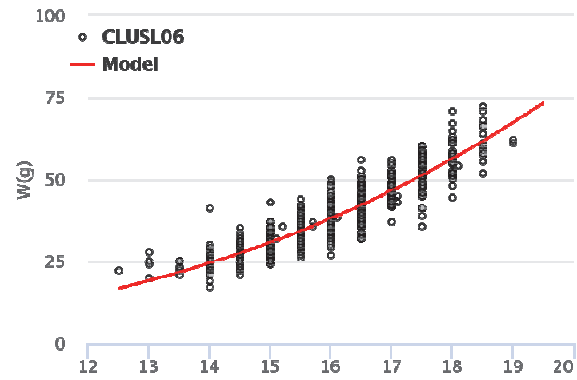
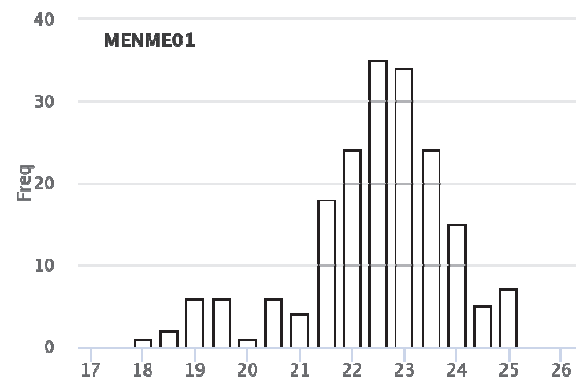
Sardinella fimbriata



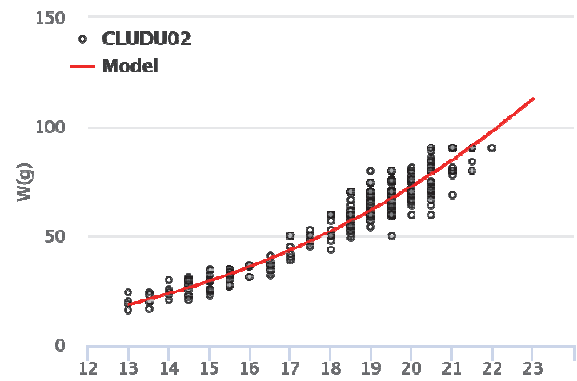
Dussumieria elopsoides



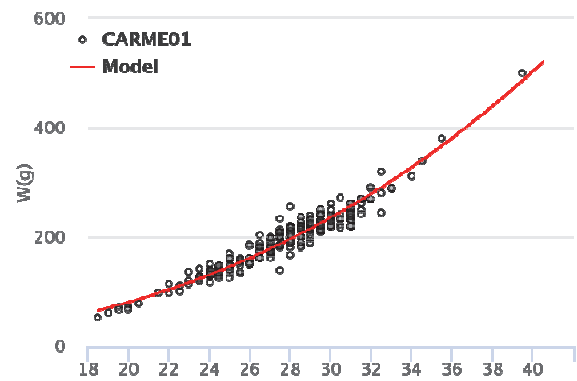
Megalapsys cordyla



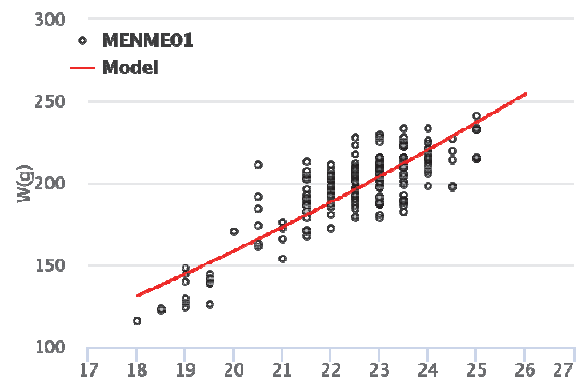
$W = 0.004 * L^{3.314}, R^2 = 0.8147 (0.9026^2), N = 709$



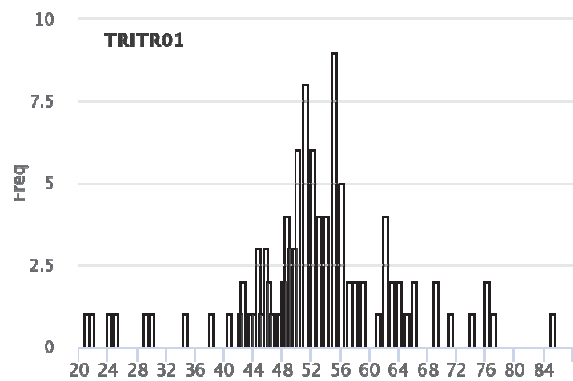
$W = 0.006 * L^{3.148}, R^2 = 0.938 (0.9685^2), N = 477$



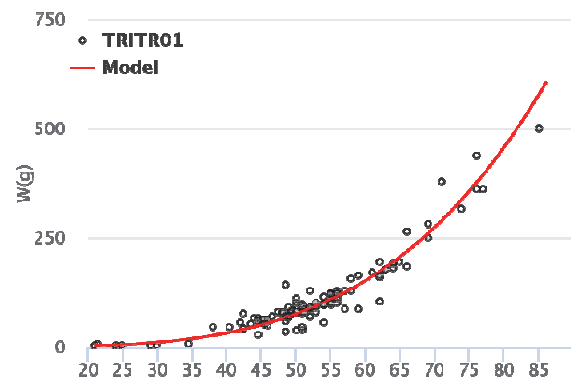
$W = 0.029 * L^{2.645}, R^2 = 0.9369 (0.968^2), N = 302$



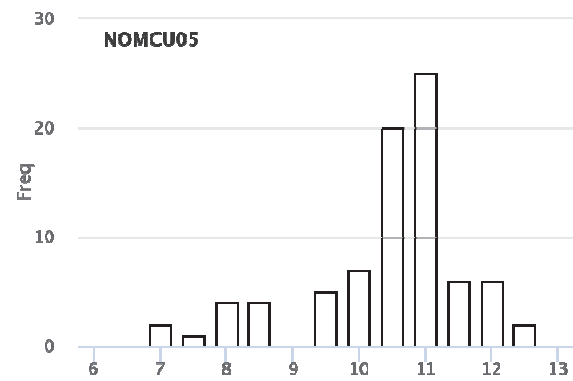
Mene maculata



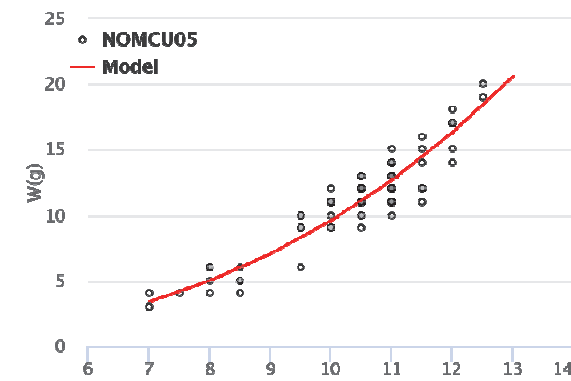
$W = 0.719 * L^{1.801}$, $R^2=0.727$ (0.8526^2), $N=188$



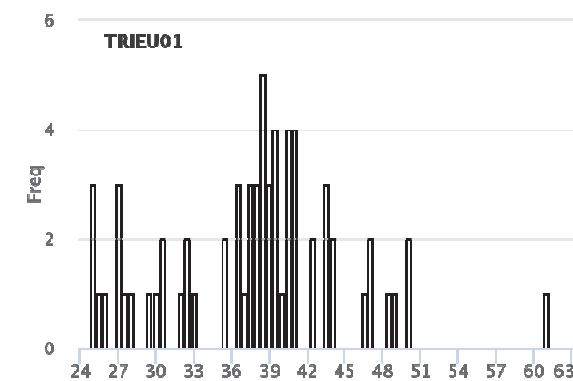
Trichiurus lepturus



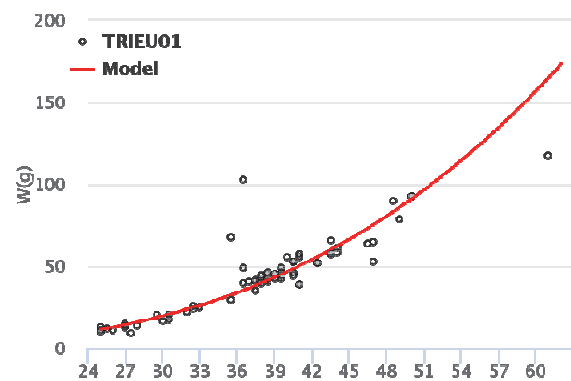
$W = 0 * L^{3.839}$, $R^2=0.8948$ (0.946^2), $N=105$



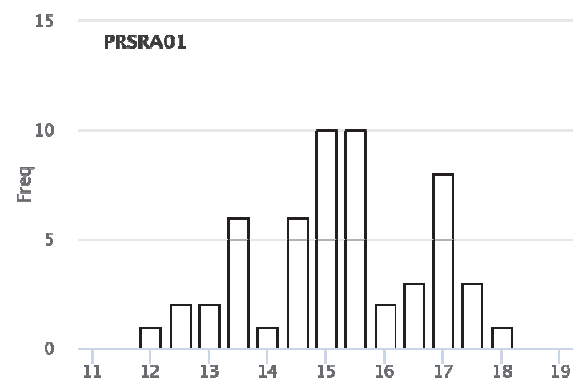
Cubiceps pauciradiatus



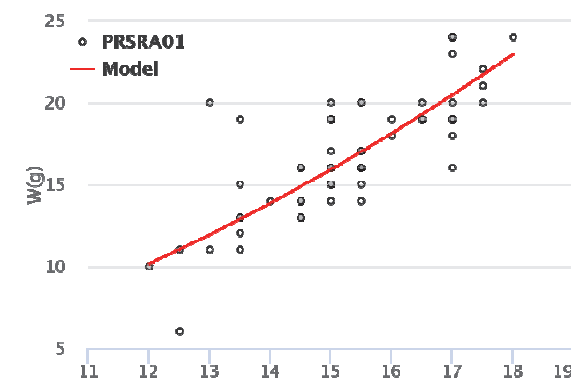
$W = 0.012 * L^{2.919}$, $R^2=0.8882$ (0.9424^2), $N=82$



Eupleurogrammus muticus

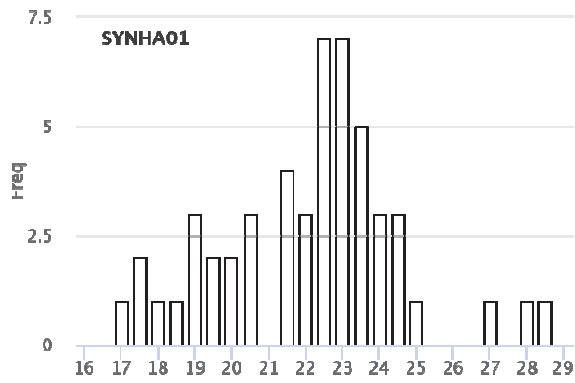


$W = 0.001 * L^{2.988}$, $R^2=0.8859$ (0.9412^2), $N=66$

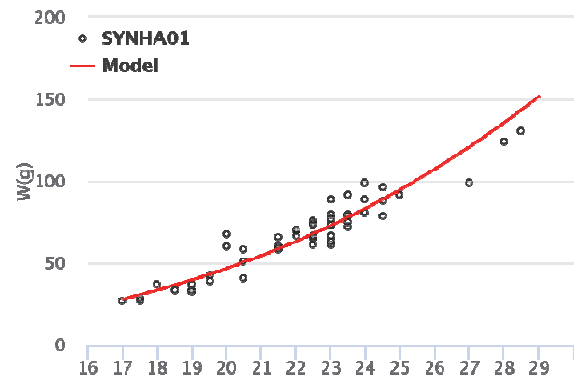


Raonda russeliana

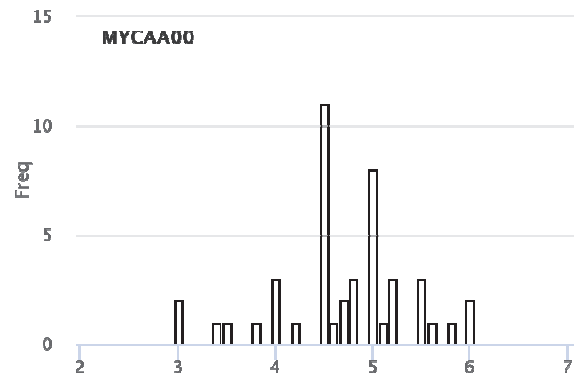
$W = 0.069 * L^{2.01}$, $R^2=0.6048$ (0.7777^2), $N=55$



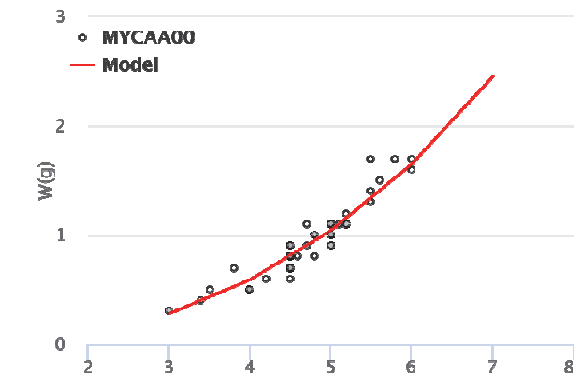
Harpadon nehereus



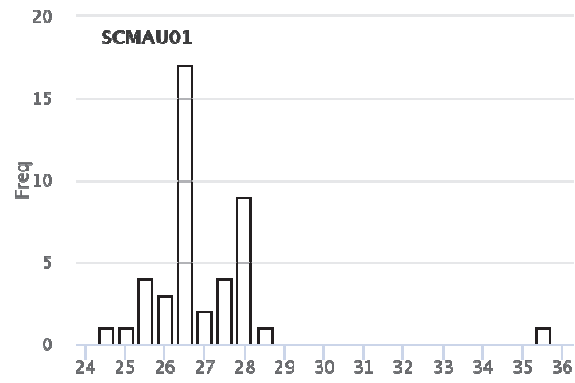
$W = 0.004 * L^{3.167}, R^2 = 0.8984 (0.9478^2), N = 51$



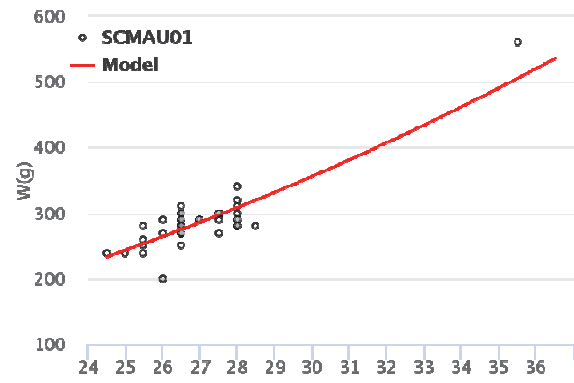
MYCTOPHIDAE



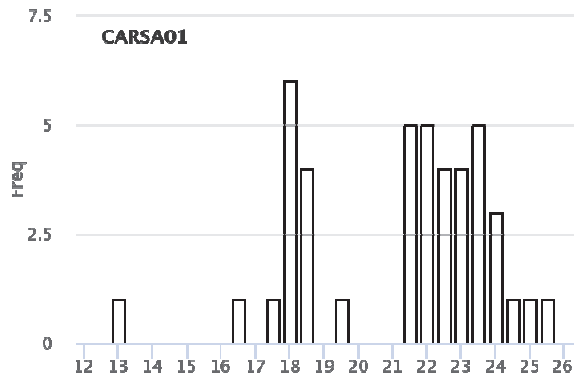
$W = 0.018 * L^{2.537}, R^2 = 0.9177 (0.958^2), N = 45$



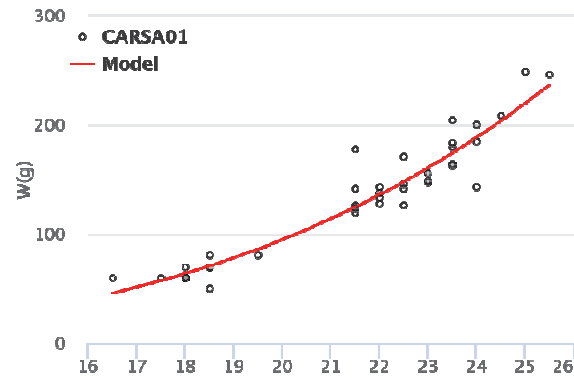
Auxis thazard



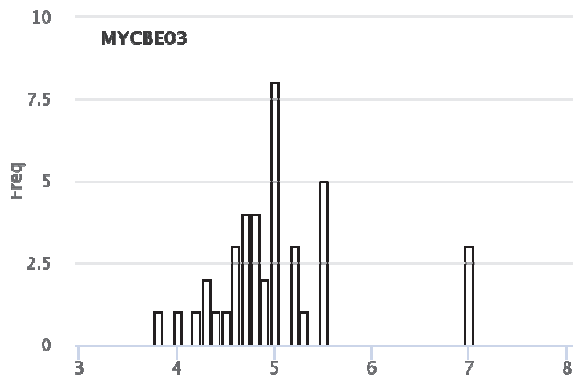
$W = 0.3 * L^{2.082}, R^2 = 0.6941 (0.8332^2), N = 43$



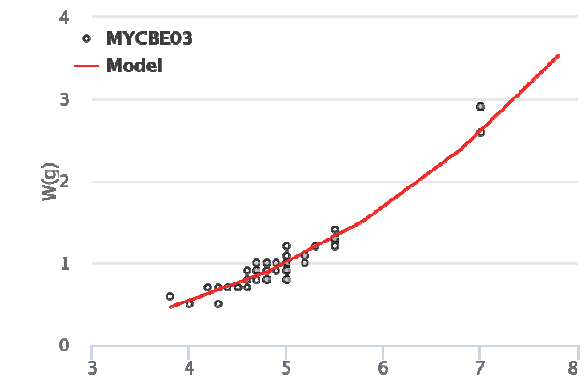
Selar crumenophthalmus



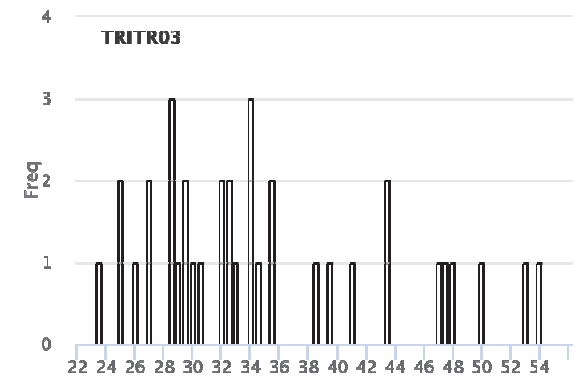
$W = 0.001 * L^{3.759}, R^2 = 0.9317 (0.9652^2), N = 42$



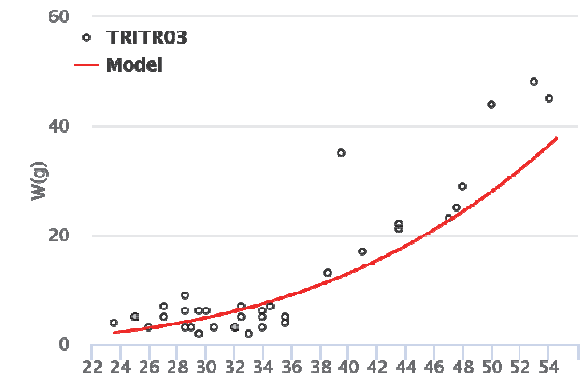
Benthosema suborbital



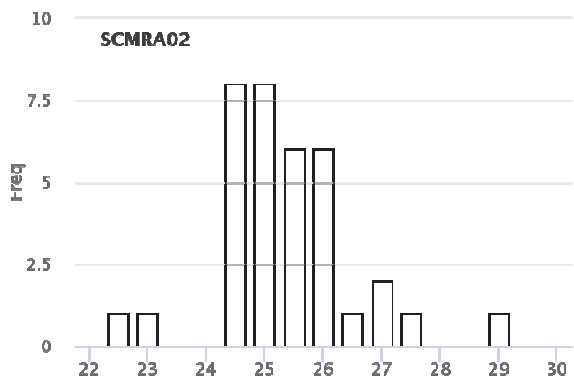
$W = 0.01 * L^{2.838}$, $R^2=0.9138$ (0.9559^2), $N=40$



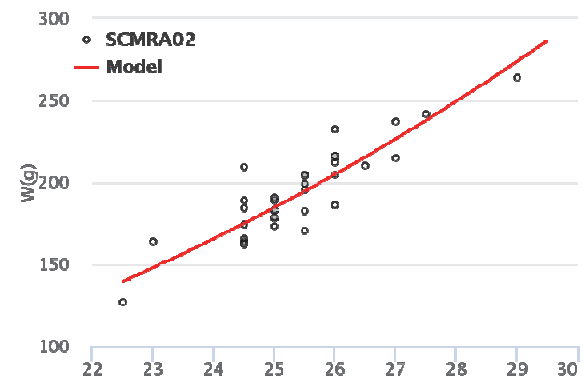
Trichiurus gangeticus



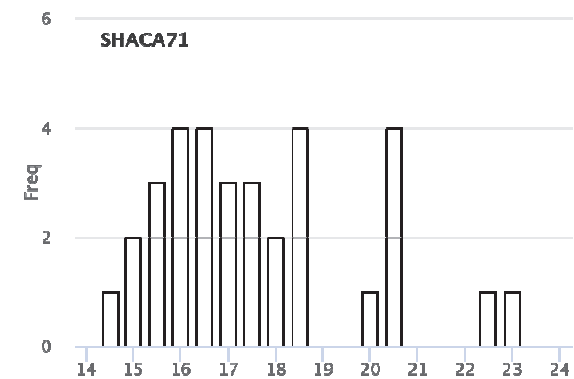
$W = 0 * L^{3.432}$, $R^2=0.676$ (0.8222^2), $N=36$



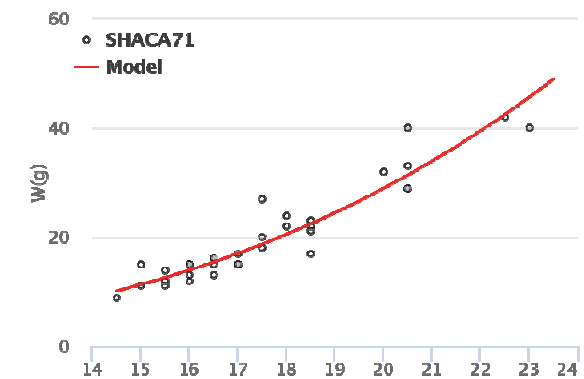
Rastrelliger brachysoma



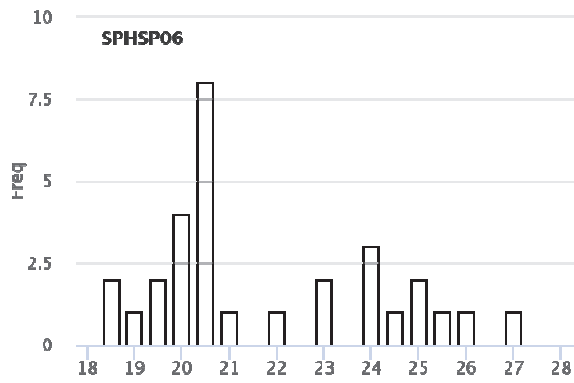
$W = 0.036 * L^{2.658}$, $R^2=0.7715$ (0.8784^2), $N=34$



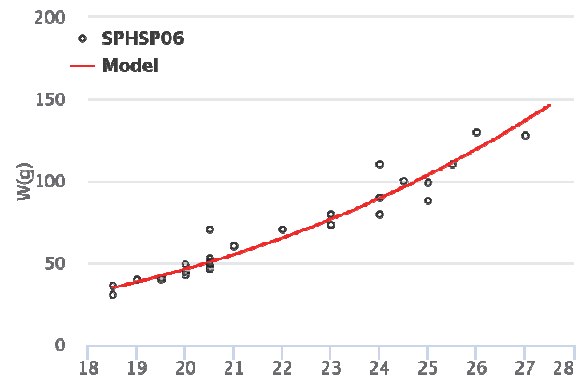
Scoliodon laticaudus



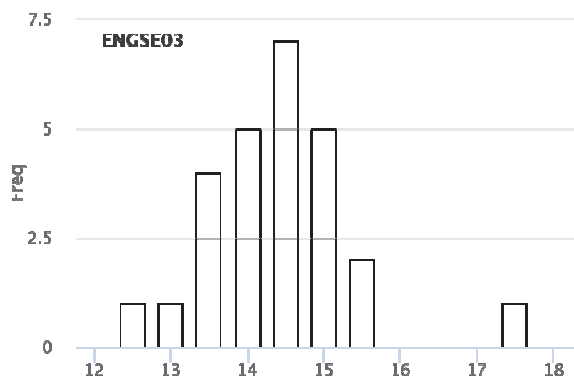
$W = 0.002 * L^{3.261}$, $R^2=0.8903$ (0.9435^2), $N=33$



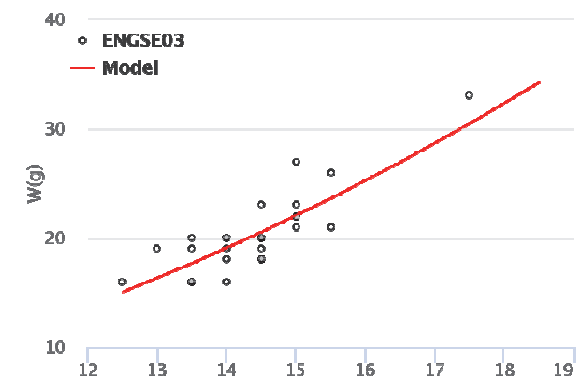
Sphyrnaea obtusata



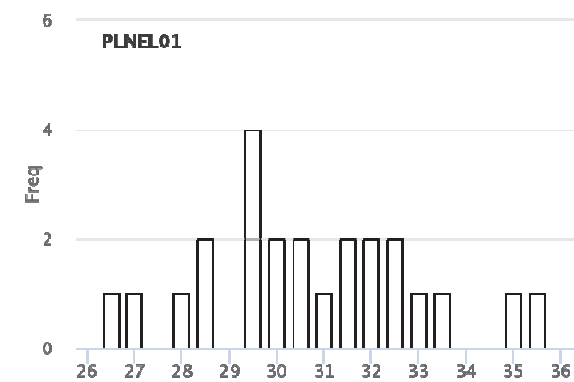
$W = 0.001 * L^{3.617}, R^2=0.943 (0.9711^2), N=30$



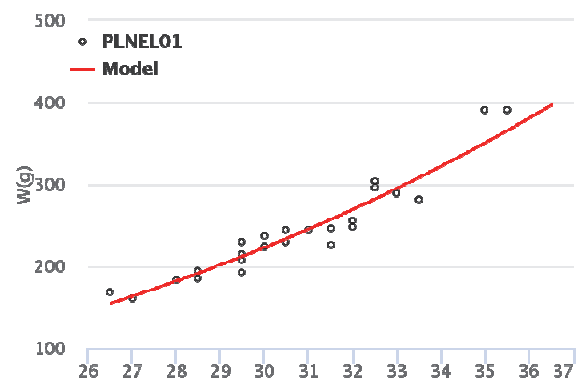
Setipinna tenuifilis



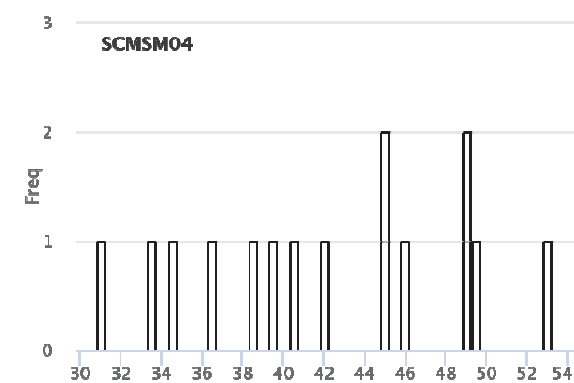
$W = 0.076 * L^{2.096}, R^2=0.6687 (0.8177^2), N=26$



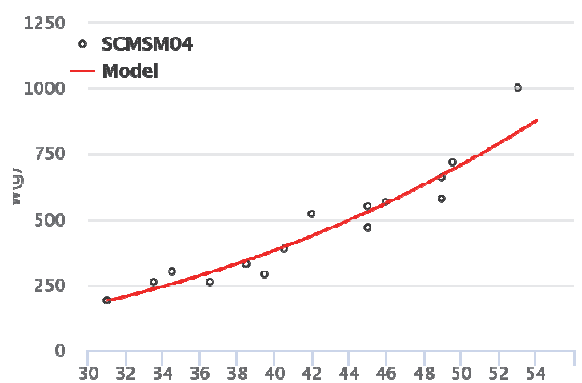
Eleutheronema tetradactylum



$W = 0.01 * L^{2.941}, R^2=0.9251 (0.9618^2), N=24$



Scomberomorus guttatus



$W = 0.014 * L^{2.764}, R^2=0.9263 (0.9625^2), N=15$

ANNEX X

OVERVIEW OF SAMPLES AND INSTITUTIONS

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person Leg 3.3 (e-mail, phone no)	Deadline for analysis
Niskin bottles on CTD		Nutrients	0.2 ml chloroform (keep cool)	Chittagong	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Kjell.gundersen@hi.no	
Niskin bottles on CTD		Chlorophyll a	Frozen (-18 to -20 C, best -80)					Processed onboard
WP2 (180 µm) 30 m 1/2 split		Zooplankton Biomass	dried	Phuket	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Kjell.gundersen@hi.no	
WP2 (180 µm) 30 m 1/2 split	Species identification	Zooplankton Taxonomy	4% formaldehyde	Chittagong	By road	BORI, SBAU	Abu Sayeed Muhammad Sharif, Dr. Kaji Ahsan Habib	
WP2 (180 µm) from max 200 m 1/2 Split		Zooplankton Biomass	dried	Phuket	Airfreight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Kjell.gundersen@hi.no	
WP2 (180 µm) from max 200 m 1/2 Split	Species identification	Zooplankton Taxonomy	4% formaldehyde	Chittagong	By road	BORI, SBAU	Abu Sayeed Muhammad Sharif, Dr. Kaji Ahsan Habib	
MultiNet (Midi, 1 or 5 x 405 µm), oblique tow from max 200 m	Species identification	zooplankton taxonomy (depth related)	4% formaldehyde	Chittagong	By road	BORI, SBAU	Abu Sayeed Muhammad Sharif, Dr. Kaji Ahsan Habib	
MultiNet (Midi, 1 or 5 x 405 µm), oblique tow from max 200 m	Species identification	Ichthyoplankton egg	4% formaldehyde	Chittagong		BORI, SBAU, BFRI		

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person Leg 3.3 (e-mail, phone no)	Deadline for analysis
MultiNet (Midi, 1 or 5 x 405 µm), oblique tow from max 200 m	Species identification	Ichthyoplankton larvae	4% formaldehyde	Chittagong		BORI, SBAU, BFRI		
MultiNet (Midi, 1 or 5 x 405 µm), oblique tow from max 200 m	Abundance and chemical composition	plastic particles	Frozen	Phuket		Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Bjorn.einar.grosvik@hi.no	
MultiNet (Midi, 1 or 5 x 405 µm), oblique tow from max 200 m	Species identification	or bulk sample	4% formaldehyde			BORI, SBAU, BFRI		
Manta trawl (375 µm): surface tow for 15 mins	Species identification	Neuston community identification	4% formaldehyde					
Manta trawl (375 µm): surface tow for 15 mins	Abundance and chemical composition	Microplastics	Photographed and freezeed			Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Bjorn.einar.grosvik@hi.no	NEEDS TO BE CLARIFIED
Surface water pump inlett (2 m) 405 µm	Abundance and chemical composition	Microplastic samples	Frozen			Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	Bjorn.einar.grosvik@hi.no	Not taken
Trawl samples	Species identification	Jellyfish whole individual	Dried + frozen	Chittagong	By road	IMSFCU		
Trawl samples	Genetic analyses?	Jellyfish arm	96% Ethanol + frozen	Chittagong	By road	SBAU		
Trawl samples	??	Jellyfish the rest	4% formaldehyde					
Trawl samples	Genetic analyses (stock identity)	Finclips of priority species	96% Ethanol	Chittagong	By road	SBAU		

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person Leg 3.3 (e-mail, phone no)	Deadline for analysis
Trawl samples	Diet analyses	Stomachs	frozen	Chittagong	By road	Noakhali Science and technology university (NSTU) /World fish center (WFC)		
Trawl samples	Morphometric analyses	whole specimens	Frozen/4% formaldehyde	Chittagong	By road	DOF/IMSFCN		
Trawl samples	chemical analyses	Otoliths	dry					
Trawl samples	Taxonomy (course)	whole specimens for morphometric analysis (Taxonomic course, Bergen)	Frozen	Phuket	Rupert Wienerroither	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen Norway	rupert.wienerroither@hi.no	
Trawl samples	Museum collection	Whole specimen Museum collection	4% formaldehyde					Not taken
Trawl samples	Museum collection	Fin clips or other flesh sample museum collection from each specimen	96% Ethanol	Chittagong	By road	DOF		
Trawl samples	chemical composition	Food safety samples	freezed dried / vacuum packed	Phuket	Air freight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen		
Trawl samples	chemical composition	fish liver - food safety	Frozen -80	Phuket	Air freight	Institute of Marine Research, P.O. Box 1870 Nordnes, Bergen		
Trawl sediment pipe	chemical analyses /granulometric analyses	Trawl cylinder sediment	Frozen / 4% formaldehyde	Chittagong	By road	IMSCU, BORI		

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution address	Contact person Leg 3.3 (e-mail, phone no)	Deadline for analysis
Supplementary sampling/requested by participants								
Phytoplankton (from niskin bottle)	Species identification	phytoplankton taxonomy	4% formaldehyde /lugol	Chittagong	By road	Bangladesh Ocean Research Institute, COX BAZAR	Abu Sayeed Muhammad Sharif	
Trawl samples	Mesopelagic taxonomy identification	Whole mesopelagic specimens for morphometric analysis (Taxonomic identification, Bangladesh)	Frozen	Chittagong	By road	SBAU, Dhaka	Dr. Kaji Ahsan Habib	
Niskin bottles on CTD (2 nd set o samples)		Nutrients	0.2 ml chloroform (keep cool)	Chittagong	By road	Bangladesh Ocean Research Institute, COX BAZAR	Abu Sayeed Muhammad Sharif	
WPII	Species identification	Jellyfish samples	Formalin	Chittagong	By road	Institute of marine Sciences and Fisheries IMSFC, Chittagong	Sayedur	
Trawl samples	Stomach samples	Stomach for microplastics analysis	Frozen			BAU	Dr.Harun	

