NORAD-FAO PROGRAMME
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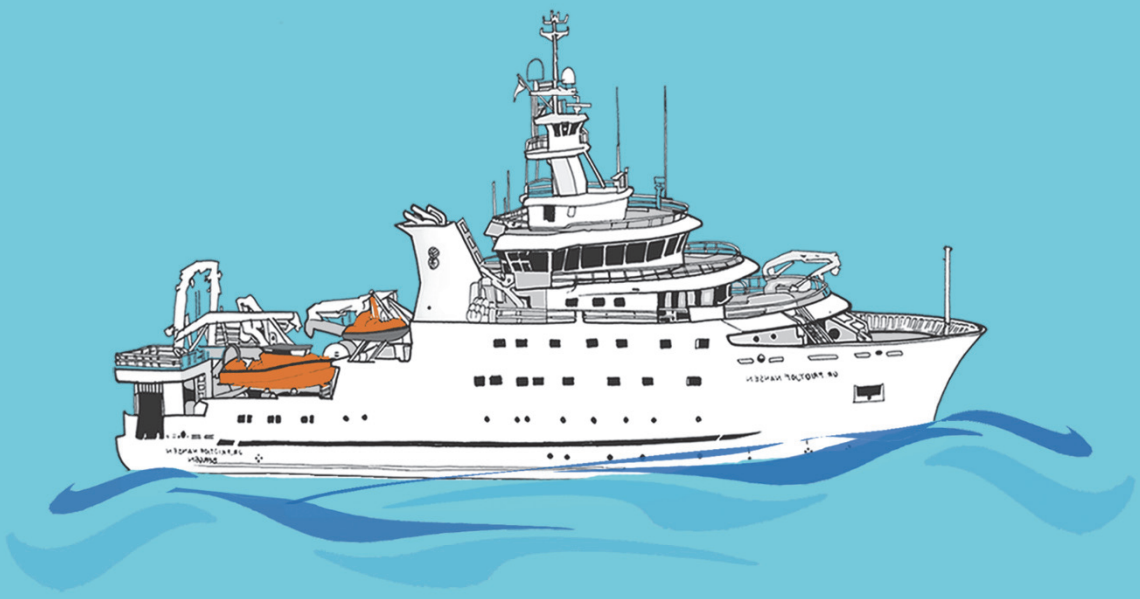
CRUISE REPORTS *DR FRIDTJOF NANSEN*
EAF-Nansen/CR/2019/15



MESOPELAGIC TRANSECT

Northwest Africa – Canary Basin

3–16 December 2019

Institut National de Recherche Halieutique, Morocco

Centre de Recherches Océanographiques de Dakar-Thiaroye, Senegal

Institute of Marine Research Bergen, Norway

THE EAF-NANSEN PROGRAMME (2017–2021)

The EAF-Nansen Programme "Supporting the Application of the Ecosystem Approach to Fisheries Management considering Climate and Pollution Impacts" supports partner countries and regional organizations in Africa and the Bay of Bengal improving their capacity for the sustainable management of their fisheries and other uses of marine and coastal resources through the implementation of the Ecosystem Approach to Fisheries (EAF), taking into consideration the impacts of the climate and pollution.

The Programme is executed by the Food and Agriculture Organization of the United Nations (FAO) in close collaboration with the Institute of Marine Research (IMR) of Bergen, Norway, and funded by the Norwegian Agency for Development Cooperation (Norad). This Programme is the current phase (2017–2021) of the Nansen Programme which started in 1975.

The aim of the Programme is that sustainable fisheries improve food and nutrition security for people in partner countries. It builds on three pillars, Science, Fisheries Management, and Capacity Development, and supports partner countries to produce relevant and timely evidence-based advice for management, to manage fisheries according to the EAF principles and to further develop their human and organizational capacity to manage fisheries sustainably. In line with the EAF principles, the Programme adopts a broad scope, taking into consideration a wide range of impacts of human activities and natural processes on marine resources and ecosystems including fisheries, pollution, climate variability and change.

A new state of the art research vessel, the *Dr Fridtjof Nansen*, is an integral part of the Programme. A comprehensive science plan, covering a broad selection of research areas, and directed at producing knowledge for informing policy and management decisions, guides the Programme's 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 (2017-2021)

Le programme EAF-Nansen « Soutenir l'application de l'approche écosystémique pour la gestion des pêches compte tenu des impacts du climat et de la pollution » appui les pays partenaires et les organisations régionales en Afrique et dans le golfe du Bengale pour améliorer leur capacité de gestion durable de leurs pêcheries et d'autres usages de la mer ainsi que les ressources côtières, grâce à la mise en œuvre de l'Approche écosystémique des pêches (AEP), en tenant compte des impacts du climat et de la pollution.

Le programme est exécuté par l'Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO) en étroite collaboration avec l'Institut de recherche marine (IMR) de Bergen, en Norvège, et financé par l'Agence norvégienne de coopération au développement (Norad). Ce programme est la phase actuelle (2017-2021) du programme Nansen qui a débuté en 1975.

L'objectif du programme est que la pêche durable améliore la sécurité alimentaire et nutritionnelle des populations des pays partenaires. Il s'appuie sur trois piliers, la science, la gestion des pêches et le développement des capacités, et aide les pays partenaires à produire des avis pertinents et opportuns fondés sur des données factuelles pour la gestion, à gérer les pêcheries conformément aux principes de l'AEP et à développer davantage leur capacité humaine et organisationnelle à gérer durablement les pêches. Conformément aux principes de l'AEP, le programme adopte une large vision, prenant en considération un large éventail d'impacts des activités humaines et des processus naturels sur les ressources et les écosystèmes marins, y compris la pêche, la pollution, la variabilité et le changement climatique.

Un nouveau navire de recherche de pointe, le *Dr Fridtjof Nansen*, fait partie intégrante du programme. Un plan scientifique complet, couvrant un large éventail de domaines de recherche et visant à produire des connaissances pour éclairer les décisions de politique et de gestion, guide les travaux scientifiques du programme.

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

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CRUISE REPORTS *DR FRIDTJOF NANSEN*

MESOPELAGIC TRANSECT

Northwest Africa – Canary Basin

3–16 December 2019

by

Nikolaos Nikolioudakis[1], Kamal Mamza[2], Stamatina Isari[1], Marek Ostrowski[1], David Cervantes[1], Ines Bernardes[1], Sara Zamora-Terol[1], Mohammed Idrissi[2], Abdoulaye Sarre[3]

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Institute of Marine Research
Bergen, 2021

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EXECUTIVE SUMMARY

A survey on mesopelagic resources was carried out along the transect off Northwest Africa from 3 to 16 December 2019. The survey's main objective was to monitor the acoustic properties and biological composition of the mesopelagic community along a transect spanning from inshore eutrophic coastal waters towards eutrophic oceanic waters off Northwest Africa and into the Canary Basin. In parallel, biological information and oceanographic data were collected, to facilitate studies in the framework of Theme 3 of the Science Plan of the EAF-Nansen Programme.

To achieve the collection of the different data, an inshore-offshore productivity gradient approach was followed, on which 24h stations were carried out to monitor diel vertical migration patterns. Within a 24h station, two different trawls were tested to study catchability characteristics and also multiple plankton sampling gear was used to obtain zooplankton and ichthyoplankton samples in different depth strata. CTD deployments provided oceanographic data and water chemistry samples to facilitate the association of patterns with the environment.

During the survey, moderate north-easterly winds were experienced without inhibiting the sampling effort. Mesoscale eddy structures that induced local upwelling and downwelling along the survey track were observed, also confirmed by satellite derived information. The survey was able to cover five 24h stations, with full sampling coverage, which constitutes the highest number of 24h stations fully sampled in this type of surveys with the R/V *Dr Fridtjof Nansen*. Moreover, the transect was extended further offshore than ever before, reaching depths of over 4 200 m. The previously observed pattern of increasing biodiversity when moving from inshore to offshore, with concurrent reduction in acoustic backscatter was also verified during the current survey. Increasing numbers of teleost fish families were captured as the survey moved offshore. Good quality comparative trawling data have allowed for a better insight on the efficiency of the two trawls used. Such knowledge can improve our understanding with regards to catchability/avoidance of the different mesopelagic functional groups targeted with different gear. The wealth of data collected will allow for important scientific work to be published, elucidating the structure and function of the mesopelagic community with respect to its ecological role, as well as to provide better biomass estimates for this potentially important resource. Information on all the types of biological samples collected is provided in Annex V.

RÉSUMÉ

Une campagne sur les ressources mésopélagiques a été réalisée le long du transect effectué au large de l'Afrique du Nord-Ouest du 3 au 16 décembre 2019. L'objectif principal de la campagne était de réaliser un suivi des propriétés acoustiques et de la composition biologique de la communauté mésopélagique le long d'un transect allant des eaux côtières eutrophiques côtières vers les eaux océaniques eutrophiques au large de l'Afrique du Nord-Ouest et dans le bassin des Canaries. En parallèle, des données océanographiques et sur la biologie des espèces ont été collectées, afin de faciliter les études dans le cadre du thème 3 du plan scientifique du Programme EAF-Nansen.

Pour collecter les différentes données, une approche de gradient de productivité côtière-offshore a été suivie, sur laquelle des stations de 24 heures ont été effectuées pour suivre les modèles de migration verticale durant le jour. Au sein d'une même station de 24 heures, deux chaluts différents ont été testés pour étudier les caractéristiques de capture et plusieurs engins d'échantillonnage du plancton ont été utilisés pour obtenir des échantillons de zooplancton et d'ichtyoplancton dans différentes strates de profondeur. Les déploiements de CTD ont fourni des données océanographiques et des échantillons de la chimie de l'eau pour faciliter l'association des modèles avec l'environnement.

Durant la campagne, des vents modérés de nord-est ont soufflé sans entraver les activités d'échantillonnage. Des structures tourbillonnaires de méso-échelle qui ont induit des upwellings et des plongées d'eau locales le long de la trajectoire du navire ont été observées, ce qui a également été confirmé par les informations satellitaires. La campagne a pu réaliser cinq stations de 24 heures, avec une couverture d'échantillonnage complète, ce qui constitue le plus grand nombre de stations de 24 heures entièrement échantillonnées dans ce type de campagne avec le N/R *Dr Fridtjof Nansen*. De plus, le transect a été étendu plus au large, ce qui ne s'était jamais fait, atteignant des profondeurs de plus de 4 200 m. Le modèle précédemment observé d'augmentation de la biodiversité en passant de la côte au large, avec une réduction simultanée de la rétrodiffusion acoustique, a également été vérifié au cours de la présente campagne. Un nombre croissant de familles de poissons téléostéens a été capturé lorsque le navire s'est déplacé vers le large. Les données comparatives de chalutage de bonne qualité ont permis de mieux comprendre l'efficacité des deux chaluts utilisés. Ces connaissances peuvent améliorer notre compréhension de la capturabilité/l'évitement des différents groupes fonctionnels mésopélagiques ciblés par les différents engins. La richesse des données collectées permettra de publier des travaux scientifiques d'importance et de déterminer la structure et la fonction de la communauté mésopélagique par rapport à son rôle écologique, ainsi que de fournir de meilleures estimations de la biomasse de cette ressource potentiellement importante. Des informations sur les différents types d'échantillons biologiques collectés sont fournies à l'annexe V.

CHAPTER 1. INTRODUCTION

The research activities under the EAF-Nansen Programme are guided by the EAF-Nansen Science Plan. The science plan is intended to ensure good scientific use of the wealth of data generated by the research vessel (R/V) *Dr Fridtjof Nansen* and other related data, addressing key research questions in support of tactical and strategic fisheries management. The science plan covers eleven research themes, presented in Figure 1. The present survey is part of the research programme under Theme 3 (Abundance and productivity of non-exploited species). The report provides an overview of the sampling, methods used and preliminary results while the data collected will be used as part of the ongoing research projects as part of Theme 3.

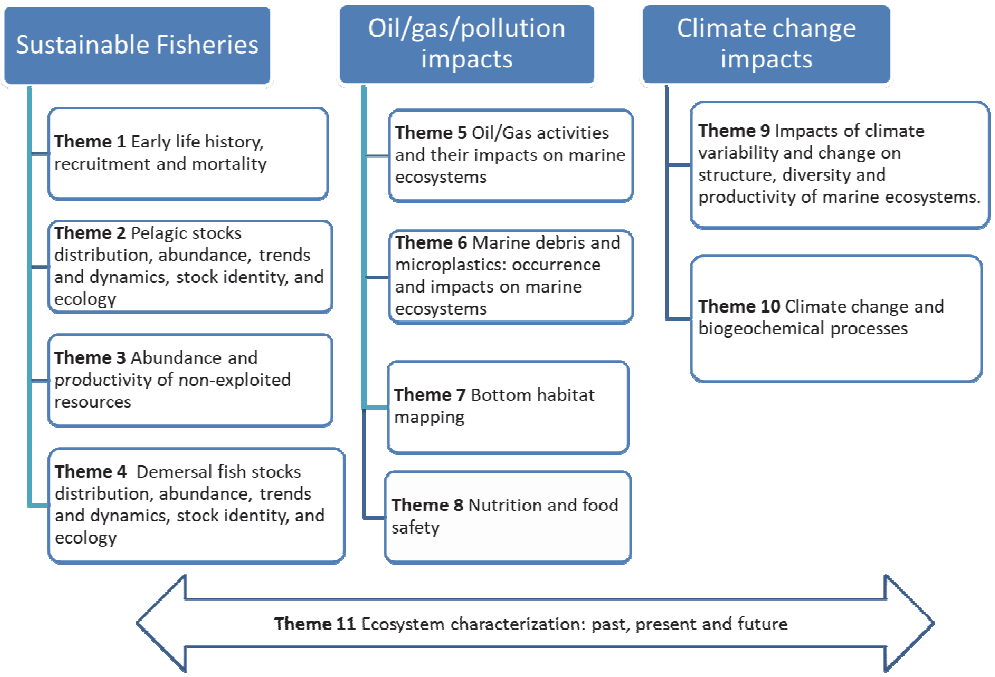


Figure 1. Research themes of the EAF-Nansen science plan

1.1 The survey area

The area surveyed in 2019 by the R/V *Dr Fridtjof Nansen* includes the continental shelf and upper slope of West Africa from South Africa to Morocco. Furthermore, a dedicated survey to the Discovery Sea Mounts was planned in collaboration with the South East Atlantic Fisheries Organisation (SEAFO). Two mesopelagic transects were also planned off Southwest and Northwest Africa, respectively following the sampling strategy used in 2017.

As part of the above programme, this survey aimed at repeating the mesopelagic transect carried out in 2017 off Northwest Africa but extended it further offshore, to more oligotrophic waters, as determined by in situ measurements of primary productivity.

1.2 Survey objectives

Main objective

The overall objective of the survey was to study the acoustic properties and biological composition of the mesopelagic community along a transect spanning from inshore eutrophic coastal waters towards eutrophic oceanic waters off Northwest Africa and into the Canary Basin.

Specific objectives

Mesopelagic community

- Obtain concurrent information on the acoustical properties and biological composition of the mesopelagic community.
- Study the acoustic properties of mesopelagic fishes and other mesopelagic organisms such as e.g. molluscs, crustaceans, cnidarians/ medusae, salps and other zooplankton including acoustic frequency response and target strength.
- Obtain biological samples and observations using different sampling gears (trawls, plankton nets and camera systems).
- Investigate the effectiveness of different sampling trawls used to sample the mesopelagic community.
- Collect samples for analysis of C and N stable isotope ratios and fatty acid composition to understand the trophic roles of mesopelagic species.
- Collect samples for levels of nutrients and contaminants including microplastics, parasites and microorganisms with regards to food safety and pollution.

Hydrography

- To map the hydrographic/environmental conditions in the survey area (temperature, salinity, oxygen, fluorescence, irradiant light, nutrients and pH).
- Estimate the productivity along the inshore-offshore eutrophication gradient.

Plankton and jellyfish

- To describe the abundance and biomass patterns of meso-zooplankton community, as well as its species composition along the productivity gradient and to determine changes in the meso-zooplankton vertical distribution patterns at stations where sampling throughout the diurnal cycle (24h) will be carried out.
- To provide information on the abundance patterns of ichthyoplankton community (fish eggs and larvae), at the lowest possible taxonomic level along the productivity gradient with special focus on the early life history stages of mesopelagic taxa.

- To elucidate the trophic pathways of dominant mesopelagic larval fish taxa throughout their developmental stages.
- To collect samples of jellyfish for a) morphological identification and taxonomic studies, b) genetic studies for the purposes of confirming identity, determining population structure and establishing regional and global connectivity, c) histological examination of reproductive maturity to determine reproductive synchronicity and semelparity within populations and individuals, and d) stable isotope analysis to determine trophic position.

1.3 Participation

In total, 19 participants took part in the survey. Mauritanian colleagues initially scheduled to participate were not able to join the survey due to lack of appropriate documentation. The following participants joined the survey:

Institut National de Recherche Halieutique (INRH), Morocco:
Kamal Mamza (co-cruise leader), Mohammed Idrissi
Said Charib, Mohamed Reda Benallal,
Mohammed Araabab, Abdelkrim Kalmouni, Ismail El Alaoui
Abdelaziz Agouzouk.

Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT), Senegal:
Abdoulaye Sarre, Ndague Diogoul.

Institute of Marine Research (IMR) Norway:
Nikolaos Nikolioudakis (cruise leader), Inês Bernardes, Rupert Wienerroither
Stamatina Isari, Marek Ostrowski, Olaf Sørås, Sarah Bruck, Benjamin Marum.

Instituto Español de Oceanografía:
Javier Rey Sanz.

1.4 Narrative

The vessel departed from Casablanca on 3 December 2019 steaming southwards to the Sahara Bight approximately 200 nautical miles (NM) south of Cap Bojador. The work started at 24° 59' N 15° 05' W on 6 December 2019 at 08:20 local time (UTC+01) with plankton and hydrography data and immediately after that the transect was initiated. The vessel proceeded offshore with heading 295°, to 26°41'N 19°08' W where it was terminated on 14 December 2019 approximately at 09:00, before commencing steaming to Las Palmas. The transect was carried out as planned, covering 241 NM and five 24h stations where comparative trawling, hydrographic data and plankton samples were collected at different positions along the transect. The vessel docked in Las Palmas on 15 December 2019 at 16:00. The weather was favourable, and no days were lost due to adverse conditions.

1.5 Survey design and effort

The survey design and the sampling followed the sailing order for Leg 4.5 and was based mainly on a similar survey conducted in 2017. The design involved the monitoring of mesopelagics by means of hydroacoustics and trawling, following a transect of productivity gradient. Additionally, designated 24h stations were carried out, using multiple samplers, to study the diel vertical migration patterns of the mesopelagic organisms. A total of five 24h stations were carried out along a transect of approximately 240 NM, which initiated at 40 m depth and terminated at approximately 4 270 m depth. At the stations, CTD casts were carried out, accompanied by LADCP. WBAT profiles and target strength measurements-at-depth were obtained, while different plankton samplers were used. Finally, 36 hauls were carried out using two types of pelagic trawls. Table 1.1 summarises the survey effort. The cruise track with different types of stations superimposed is displayed in Figure 1.2, Figure 1.3 and Figure 1.4. Finally, the sampling schedule followed during the survey and the sampling protocol while at the 24h stations are displayed in Table 1.2 and Table 1.3, respectively.

Table 1.1. Survey effort in number of sampling stations. Number of Pelagic trawl hauls, CTD casts, plankton samplers and WBAT deployments. The total distance sailed (in NM) is also provided

Distance sailed (in NM, including steaming)	CTD	WBAT	Plankton nets				Pelagic trawl	
Total	(+ LADCP)	(profiles + Target Strength measurements-at-depth)	WP-2 (180 µm)	WP-2 (64 µm)	Multinet (Mammoth + Midi)	Bongo	Krill trawl	Multpelt 624
1 633	38(22)	12	15	15	7 + 5	15	22	14

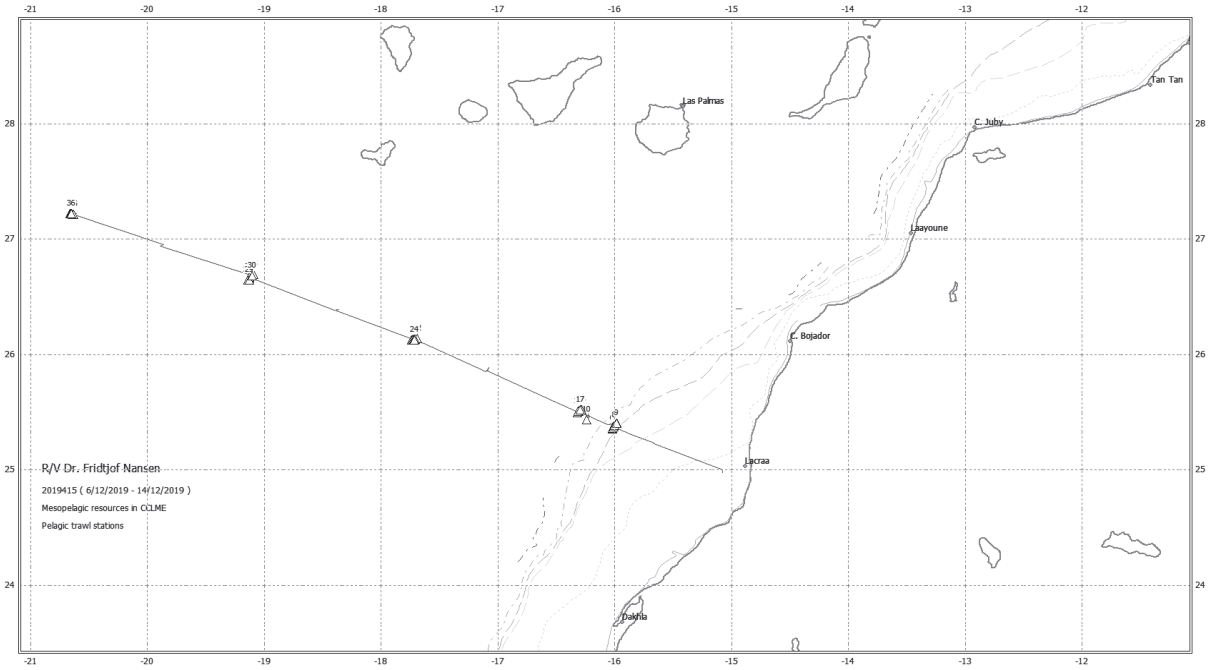


Figure 1.1. Course track with fishing stations showing the locations of the four 24-hour diel cycle stations. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and 1 000 m are indicated

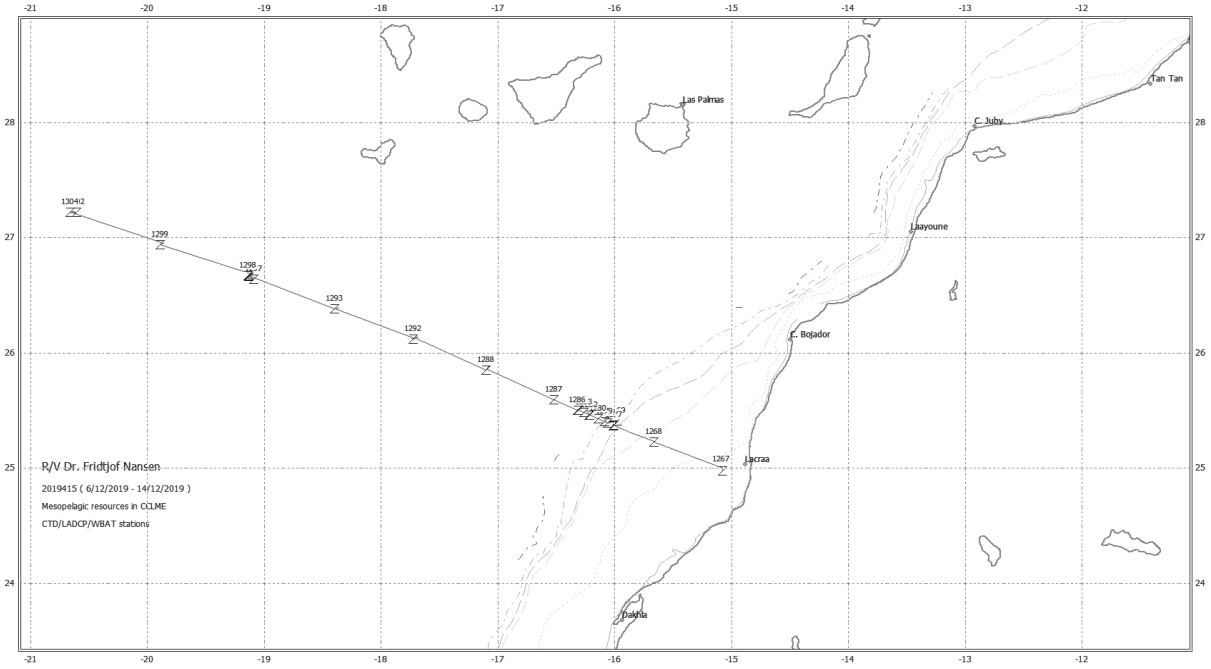


Figure 1.2. Course track with CTD/LADCP/WBAT stations along the transect line. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and 1 000 m are indicated

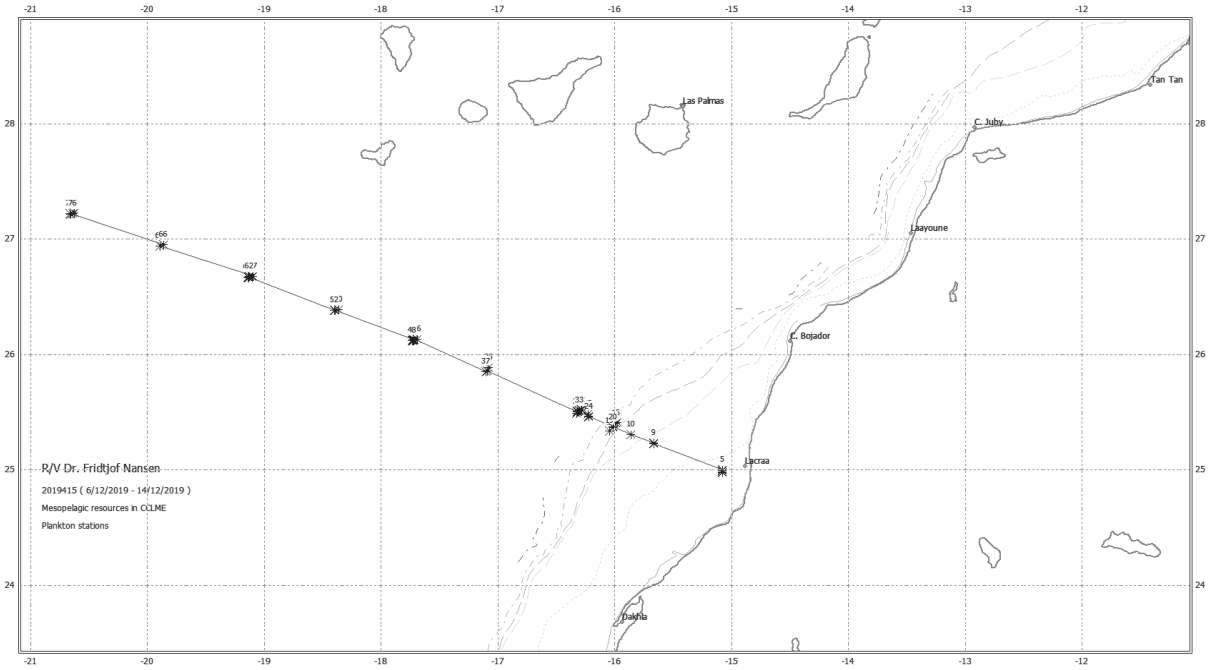


Figure 1.3. Course track with plankton stations from along the transect line. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and 1 000 m are indicated

Table 1.2. Sampling schedule followed during the survey

Day	3-5/12	6/12	7/12	8/12	9/12	10/12	11/12	12/12	13/12	14/12	15/12
Location		Onshore / Slope	Slope	Basin	Basin	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore
Depth		40/80: Plankton / CTD 250: 24h station	250	1450	1450	3000 - 3500	3000-3500	3500-3750	4250-4500	4250-4500	
UTC											
00:00	Steaming	Steaming	24 h #1	Transect	24 h #2	CTD / Plankton	24 h #3	24 h #4	Transect	24 h #5	Steaming
01:00											
02:00											
03:00						Transect			CTD / Plankton		
04:00											
05:00									Transect		
06:00											
07:00				CTD / Plankton							
08:00 dawn		CTD / Plankton				24 h #3	Transect				
09:00				Trawling							
10:00		Transect		Transect					24 h #5	Steaming	
11:00							CTD / Plankton				
12:00				CTD / Plankton							
13:00							Transect				
14:00		CTD / Plankton									
15:00							24 h #4	Transect			Las Palmas
16:00				24 h #2	Transect	24 h #3					
17:00											
18:00											
19:00											
20:00 dusk		24 h #1									
21:00											
22:00											
23:00											

Table 1.3. Sampling protocol for the 24-hour diel cycle stations (sunrise: ~07:45; sunset: ~19:30)

Local time	Diel cycle	Shift	EK 80 mode	WBAT	CTD / LADCP	Krill Trawl targeted	Multpelt targeted	Multinet tergeted	Bongo V-tow	WP2 180	WP2 64	Krill trawl V-tow	Speed knots
07:30-08:30	Dawn	D	CW									X	2.0-2.5
08:30-09:00	Day	D	CW										
09:00-10:30	Day	D	CW				X						3.0-3.5
10:30-11:00	Day	D	FM										3
11:00-12:00	Day	D	CW			X							2.0-2.5
12:00-13:00	Day	N	CW					5 nets					2.5 - 3
13:00-14:00	Day	N	CW*		+Niskin								0
14:00-15:00	Day	N	CW*							X	X		0
15:00-16:00	Day	N	CW*	X									0
16:00-17:00	Day	N	CW*						X				2.5 - 3
17:00-18:00	Day	N	CW										
18:00-19:00	Day	D	CW										
19:00-20:00	Dusk	D	CW									X	2.0-2.5
20:00-21:00	Night	D	CW					5 nets					2.5 - 3
21:00-22:00	Night	D	CW			X							2.0-2.5
22:00-22:30	Night	D	FM										3
22:30-00:00	Night	D	CW				X						3.0-3.5
00:00-01:00	Night	N	CW*		-Niskin								0
01:00-02:00	Night	N	CW*							X	X		0
02:00-03:00	Night	N	CW*	X									0
03:00-04:30	Night	N	CW*						X				2.5 - 3
04:00-06:00	Night	N	CW										
06:00-07:30	Night	D	CW										

* EK80 Bottom Detection: ON

The sampling schedule was designed to collect information about diel cycles, with daytime, twilight, and night-time defined after consulting a solar almanac (Table 1.4).

Table 1.4. Divisions of the day taken from a solar almanac for 25o N 17o W for December 10th, 2019. These times (in local time, i.e. UTC+01) were used to plan sampling activities in order to capture diel migration patterns

sunrise	08:41
sunset	19:19
morning nautical twilight	07:48
evening nautical twilight	20:12
dawn	07:48 – 08:41 (0h 53m)
day	08:41 – 19:19 (10h 38m)
dusk	19:19 – 20:12 (0h 53m)
night	20:12 – 07:48 (11:36)

CHAPTER 2. METHODS

2.1 Environmental observations

2.1.1 Meteorological observations

The vessel-mounted Automated Weather Station by (AWS) monitored wind direction and speed, air pressure, relative humidity, air temperature and solar radiation. The vessel's tracklog monitoring software uploaded the output from AWS to the Nansis database every 60 seconds. The content of this database was screened on daily bases. The screening revealed numerous interruptions in the wind data record with a duration ranging from several minutes to about six hours. On December 4 and 15, there were more gaps than valid data. Fortuitously, on the main section (6-13 December), the holes in the wind data were shorter and less frequent, so it was possible to obtain the map of wind along the survey track using these data. The postprocessing involved replacing data gaps with the linear fit between the end valid data points, low pass-filtering with a 10-minute time lag, and then spatial averaging on 10x10 km grid nodes. This last operation was to account for data clustering (duplicated points in space) at locations of 24-hour stations.

2.1.2 CTD

The vertical casts were carried out with a Sea-Bird 911plus CTD probe and post-processed using the Seasave software. CTD deployments were carried out along the transect line and at each 24h station. The CTD probe was deployed at 0.5 ms^{-1} vertical tow speed. Heave compensation (± 0.2 m) was engaged at depths greater than 50 m. The location of the CTD deployments were selected to ensure high sampling density over the shelf break and where hydrographical conditions were expected to be variable. This is to ensure that oceanographic structures such as e.g. thermo-, halo-, oxy- and nutriclines may be identified on a relatively fine scale. Niskin water-bottles attached to a CTD-mounted rosette were used to collect seawater at predefined depths once per 24h station, for the determination of nutrients, dissolved O_2, total alkalinity, pH and chl *a* concentrations. Above the shelf and slope, the profiles ranged from the surface to within a few metres above the bottom. The casts were stopped a few meters above the bottom. Offshore, the maximum sampling depth was 4 200 m.

The measured parameters included temperature, conductivity, oxygen, fluorescence and photosynthetically active radiation (PAR). Practical salinity was computed from temperature, conductivity and pressure (probe depth) using the UNESCO formula.

The oxygen sensor data were validated using the Winkler method. The result indicated a need to correct the sensor data by a factor of 1.019. Using this value, the CTD measured concentration of 4 ml l^{-1} would become 4.076 ml l^{-1}, 5.4 ml l^{-1} would become 5.095 ml l^{-1}. However, the correction was based on data from one station (Station1289), and it must be further refined against the titration results from other surveys before applying it to the data.

The salinity validation was not conducted because the salinometer (Guideline Portasal 8410A) was removed from the vessel for service. According to the validations from the preceding and

following surveys that used the same temperature and conductivity sensors, we assume the maximum uncertainty level of the CTD-derived salinity at +/- 0.01 PSU.

It is not possible to validate the temperature sensor drift using in situ samples. Instead, we checked the changes in the dual temperature sensor characteristics for this parameter over the usage period (Annex I). The comparison indicated that the relative offset between the two mounted temperature sensors had changed by about 0.002 °C from March to December 2019 – an indicator of their high stability.

No sensor drift adjustments were applied to the CTD temperature, salinity and oxygen data presented in this report. However, all data were screened and edited to eliminate dynamical errors, such as spikes, accidental spurious data near the sea surface or the upcast sections, not removed by the Seasave software.

The fluorescence sensor used during this survey malfunctioned. From station 1280, the recorded data displayed numerous spikes interspaced with multiple zeros. These data also subjected to screening and dynamical error correction, but the number of errors found in many profiles was too large to attempt their recovery. For this reason, the fluorescence data are not included in this report.

2.1.3 Thermosalinograph

Two SBE 21 SeaCAT Thermosalinograph (TSG) units operated underway, collecting data on temperature and conductivity from the water intake located at 4- and 6- meters depth, respectively. Salinity was calculated using temperature and conductivity data from the internal sensors mounted inside the instrument's housing. The ambient ocean temperature was measured with an external sensor fitted at the inlet where seawater is pumped into the system. The 4-meter unit was additionally equipped with a Sea-Bird WETStar Fluorometer.

The instruments' firmware sampled the sensor data at 10-second intervals. As the first step in the quality control, the raw data were screened for outliers, flow-pass filtered at 5-minute lag and subsampled to 2-minute averages. The screening revealed unrealistic offsets in the data produced with the 4-meter TSG unit. For this reason, these data were excluded from further analysis and presentation in this report.

During this survey, the TSG sensors were last calibrated in 2016, and therefore their accuracy was uncertain. The linear regression was used to determine the offsets of TSG sensors relative to the CTD standard. For this reason, the CTD temperature, conductivity, and salinity extracted from the profile at 6 meters were regressed against the respective TSG parameters sampled from the continuous underway record at times of CTD stations.

The results (Annex I) showed the linear response with the slopes and R2 (the measure of error explained) close to one, for both temperature and conductivity, indicating the same response of the two instruments to variability. However, concerning the absolute values, TSG appeared to report the values 0.75 °C higher compared with the CTD.

2.1.4 Current speed and direction measurements (ADCP)

The ship is equipped with two vessel-mounted Acoustic Doppler Current Profilers from Teledyne RDI, operating at frequency 75 and 150 kHz, respectively. During this survey, the 75 kHz unit was factory-serviced, not available onboard.

The 150 kHz ADCP was configured in narrowband mode with 8 m bins. The average vertical range of detected currents during this survey was 250 m, which is considerably below the maximum detection range for a 150 kHz ADCP (350-400 m). The range reduction was probably caused by low plankton densities in the water column. The heading data to rotate the currents from the instrument-referenced to the earth coordinates were obtained from the vessel's differential Seapath GPS. An additional rotation of -0.06 degrees was applied to correct for the misalignment between the true and the instrument pre-configured transducer orientation. This correction was obtained using statistical analysis (Annex I). An additional LADCP system (75 and 152 kHz transducers) was deployed on the CTD probe on selected CTD casts on the 24-hour diel cycle stations (Table 1.3).

2.1.5 Chlorophyll a

Seawater samples for analysis of chlorophyll *a* and phaeopigment concentrations were collected at predefined depths with rosette-mounted Niskin bottles attached to the CTD at the plankton stations. Seawater samples (250 ml) were collected from the standardized depths 5 m, 25 m, 50 m, 75 m, 100 m, 200 m, 300 m, 400 m, 500 m, 600 m, 800 m and 1 000 m, with bottom-depth restricting the number of samples collected from a given station. The seawater samples were filtered on Munktell glass-fibre filters (GF/C, 25 mm diameter) using a custom-made filtration system. The filter-samples were stored at -18°C in the dark for subsequent analysis on shore in the IMR laboratory in Norway. The pigments were extracted with 90% acetone in darkness over-night, and the extracts centrifuged and analyzed using a Turner Design fluorometer model 10 AU calibrated with pure chlorophyll a (Sigma Inc).

Interference from phaeopigments was corrected for by measuring the amount of pigments once again, after having added a weak acid (10% HCl). The method of determining the amount of chlorophyll *a* and phaeopigments extracted in 90% acetone was launched in the early nineteen-sixties (Yentsch & Menzel, 1963), but the method itself and the calibration-factors have later been changes several times (e.g. Holm-Hansen *et al.*, 1965; Jeffrey & Humphrey, 1975; Welschmeyer, 1994; Humphrey & Jeffrey 1997; Jeffrey & Welshmeyer, 1997). The measurement of chlorophyll *a* and phaeopigments by the fluorometer was performed according to the guidelines of the producer (Turner Designs, 1992), and the present version of the method was first described by Holm-Hansen & Riemann (1978). As part of the post-analysis quality control, the within-station depth profiles for chlorophyll as well as the chlorophyll/phaeopigment ratios were evaluated.

2.1.6 Nutrient samples

Seawater samples (20 ml) for nutrient analyses (nitrate, nitrite, silicate and phosphate) were taken from the Niskin water-bottles. Samples were collected from the standardized depths 5 m, 25 m, 50 m, 75 m, 100 m, 200 m, 300 m, 400 m, 500 m, 600 m, 800 m and 1 000 m,

with bottom-depth restricting the number of samples collected from a given station. The seawater samples were stored in 20 ml polyethylene vials, conserved with 0.2 ml chloroform, and kept cool and dark in a refrigerator (Hagebø and Rey, 1984). The analyses were made at the Institute of Marine Research (Bergen, Norway), using a modified Alpkem AutoAnalyzer C (O I Analytical, USA) and following standard procedures (Strickland and Parsons, 1972). Extra standards were added during the analysis to cover the whole measurement range. During the laboratory's quality control of the data, some outlying values that were obviously wrong were excluded. The quality control included evaluation of the ratios between the different nutrients.

2.1.7 Ocean acidification parameters (pH and total alkalinity)

Water samples for pH and total alkalinity analysis were collected in the same 250 ml borosilicate glass bottle using silicone tubing. Since no preservative was used, it was necessary to keep the samples in the dark while waiting to stabilise at 25°C (with a water bath) for analysis. pH was determined using an Agilent Cary 8454 UV-Vis Diode Array spectrophotometer and a 2-mM m-cresol purple indicator dye solution. The indicator dye was measured every 24 hours during analysis to determine the correction factor appropriate for sample measurements (Clayton and Byrne, 1993; Chierici *et al.*, 1999). All pH spectrophotometric measurements were performed in duplicates on board. Total alkalinity was measured via an open-cell potentiometric titration using a 0.05M HCl solution with a sodium chloride background as the titrant (Dickson *et al.*, 2007). A Metrohm 888 Titrando equipped with an Aquatrode plus pH electrode with Pt1000 temperature sensor was used in combination with the Metrohm tiamo™ software to measure the change in pH and perform the total alkalinity titrations. Certified Reference Material of known total alkalinity from Scripps Institution of Oceanography was measured every 24 hours during analysis to determine the correction factor appropriate for sample measurements. All total alkalinity titrations were performed in triplicates on board.

Calibration information for the various CTD and thermosalinograph as, well as the water chemistry quality assurance parameters is provided in Annex II.

2.2 Biological sampling

2.2.1 Plankton sampling

2.2.1.1 Multinet Midi (180 µm) & Multinet Mammoth (300 µm)

Depth stratified mesozooplankton sampling was conducted at 11 stations located along an inshore-offshore transect (Figure 2.1). Each station was sampled twice (day vs. night) and depth strata were selected based on the echograms. Sampling was initially conducted with a Multinet Midi equipped with five 180 µm-mesh nets. However, due to bad weather conditions, the Multinet Midi was only deployed in the Stations 1267, 1269, 1271 and 1284 (Figure 2.1), and then switched for a Multinet Mammoth (300 µm mesh size) to sample the rest of stations (the methodology employed for this net is explained further below). In

Station 1284, which was the last one before this transition between one multinet to another, there were some problems with the sampler and not all samples were collected (Figure 2.2).

After the collection, samples from each net were split into two subsamples using a Motoda splitter. One half was used for biomass estimation (size fractionation through 2 000 µm, 1 000 µm and 180 µm mesh sizes) and dried in the oven (60°C) in pre-weighted aluminium trays. Samples were transferred to IMR (Bergen) for analysis. The second half was preserved in 4% borax buffered formaldehyde solution for species identification and enumeration. Samples were shipped INRH (Casablanca, Morocco) for further laboratory analysis.

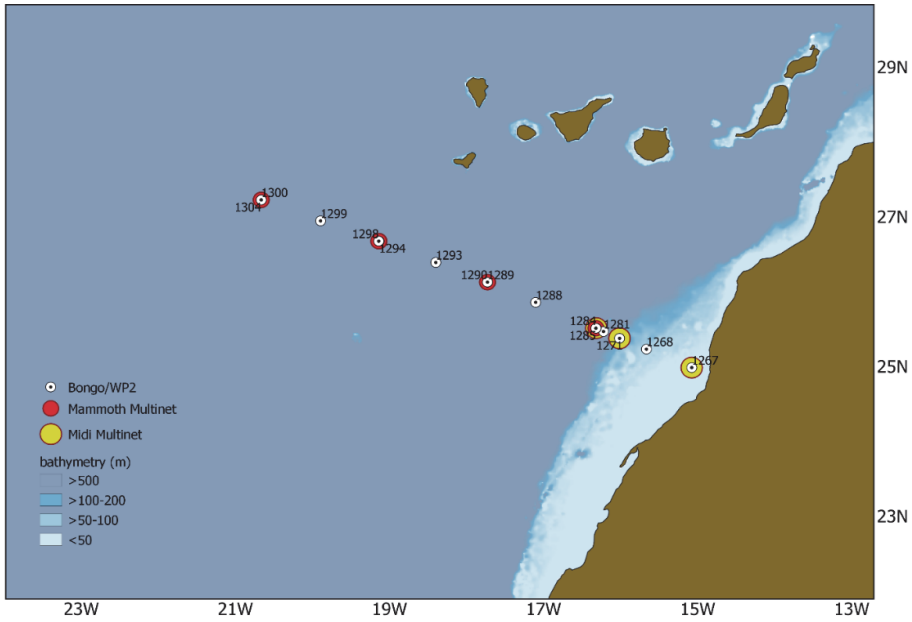


Figure 2.1. Map with plankton sampling stations with different samplers (in different colours), as well as the bathymetry in the survey area

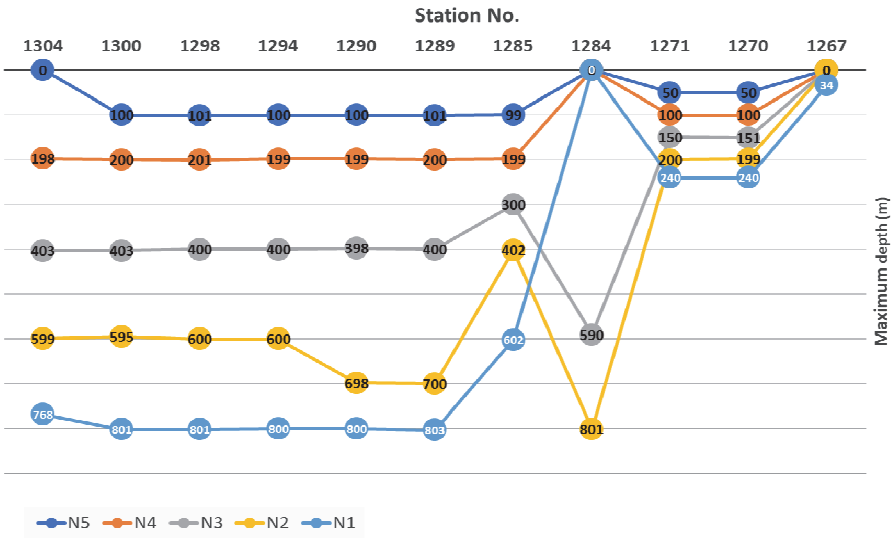


Figure 2.2. Schematic representation of the Multinet sampling stations (Station No.) with Midi and Mammoth samplers. The different nets (N1, N2, N3, N4, N5) and the maximum deployment depth (numbers inside the circles) are indicated. Multinet MIDI stations: 1267, 1269, 1271, 1284. The rest of stations were sampled with Multinet Mammoth

2.2.1.2 WP2 (64 µm) & WP2 (180 µm)

Zooplankton sampling was conducted with a 64 µm mesh size WP2 net at 15 stations and with a 180 µm mesh size WP2 net at 15 stations (Figure 2.1) to be used for stable isotope analysis (SIA) as a means to investigate the trophic ecology of larval fish. Vertical tows were conducted at daytime (8 tows) and night-time (7 tows) from 0-200 m for each mesh size net, except Stations 1267 and 1268 where the depth strata were 0-35 m and 0-83 m, respectively. Samples were frozen at -80°C onboard and shipped to INRH in Casablanca for further laboratory analysis.

2.2.1.3 Bongo (405 µm)

Ichthyoplankton was collected with double oblique tows of a Bongo net (405 µm) from 200 m depth to the surface, at 16 stations (Figure 2.1). As with the WP2, tows were conducted at daytime (8 tows) and night-time (7 tows) from 0-200 m, except Stations 1267 and 1268 that were sampled 0-35 m and 0-83 m, respectively. From one of the 2 Bongo nets, fish larvae were sorted on board, when possible, and the rest of samples were preserved in ethanol 96% for later analysis, and shipped to Bergen. The samples collected with the second net was frozen at -80°C for the purpose of the study of the trophic ecology of fish larvae by means of stable isotopes in parallel with their potential prey (see WP2 sampling above). These samples were shipped to INRH in Casablanca for further laboratory analysis.

2.2.2 Trawl sampling

Nekton organisms in the pelagic and mesopelagic zone were sampled using two different trawls: the Krill trawl, which is an 8 mm mesh pelagic sampling trawl with 11 520 x 8 mm mesh (92 m) circumference and the Multpelt 624, a large pelagic trawl with 52 x 12 m mesh (624 m) circumference and codend lined with 8 mm mesh to match cod end selectivity properties with the krill trawl. Details on trawl gear used during the survey are found in Annex III.

Upon retrieval, standard handling of the catch (registration of total catch weight, sorting into discrete taxa and taxonomic identification) was carried out, to obtain information on the mesopelagic community structure as characterized by trawl samples.

All jellyfish caught (or representative random samples thereof if too numerous), and in good condition, were individually identified and weighed. Specimens in good condition, of a variety of sizes from across the survey area, small pieces of oral arm tissue were removed and preserved in 96% ethanol prior to storage in the freezer; and the rest of the specimen was preserved in 5% formaldehyde.

For the following genera *Maurolicus*, *Diaphus*, *Argyropelecus* of mesopelagic species samples for Stable Isotope analysis and Fatty Acids were collected.

2.2.3 In-trawl video observations

The Deep Vision camera system was deployed in specific stations (mounted on the Multpelt trawl) and the recorded information was imported in LSSS and complemented the identification of organisms forming the various layers visible in the echograms.

2.3 Acoustic measurements

2.3.1 Hull borne

Multifrequency (18, 38, 70, 120, 200 and 333 kHz) acoustic data were collected continuously using the Simrad EK 80 echosounder operating in CW mode. Standard survey settings and maximum ping rate (~1 s^{-1}, dependent on depth/ sample range) were used. Raw acoustic data were logged to 1 000 m depth, with some additional measurements to long ranges (greater than bottom depth) to obtain *in situ* noise measurements. The EK80 was also operated in FM mode (broadband) for a 30 min periods while at the 24h stations (see Table 1.3). Details on used settings and calibration information can be found in Annex III.

2.3.2 Submersible

The Simrad WBAT (70 and 200 kHz) was deployed concurrently with the CTD probes on some of the deployments on diel cycle stations. The WBAT was operated in profiling mode, i.e. transmitting horizontally to 100 m at maximum ping rate in FM transmission mode. Downcast data were recorded with the 70 kHz transducer (55-90 kHz), while upcast data were recorded using the 200 kHz transducer (160-260 kHz). The WBAT mission plans were pre-programmed and uploaded to the WBAT prior to each deployment. The deployment of the CTD was timed to correspond to the transmission times set in the mission plans, ensuring that data were collected at the right times and that the WBAT would not transmit whilst out of water. The WBAT settings and deployment log are listed in Annex III.

2.3.3 Other acoustic equipment

While steaming towards the beginning and while steaming from the end of the mesopelagic transect to port, the SU90 sonar was operating to provide registrations in both shallow and deeper waters, in an effort to increase the availability of sonar data information in the NW Africa region, for which a dedicated project is being carried out within the Theme 2 of the Nansen Science Plan. Sonar settings can be found in the Nansen Survey Manual.

CHAPTER 3. RESULTS

3.1 Oceanographic conditions

3.1.1 Meteorological conditions

North-easterly trade winds prevailed over most of the survey. During the initial days, while steaming from Casablanca towards the mesopelagic section, a breeze-strength wind with a speed of 8 ms^{-1} dominated the observations. A brief period of wind relaxation followed on December 6 as the vessel turned west to start the mesopelagic section. Once occupying the section, between December 7 and 13, the survey experienced a steady north-easterly wind measuring 14-16 ms^{-1}. On December 14, upon completing the section and after the course change towards Las Palmas, the wind speed dropped to less than 8 ms^{-1}. The distribution of wind along the mesopelagic section is shown in Figure 3.1A.

3.1.2 Physical oceanography

In total, 38 total CTD deployments with temperature, salinity, dissolved oxygen and fluorescence sensors were performed along the mesopelagic transect. Water was collected in conjunction with 10 of those CTD deployments for vertical descriptions of pH, total alkalinity, chlorophyll a and nutrients (Table 3.1).

Table 3.1. Number of samples per measured water parameter from the CTD casts

CTD	CTD + Water	Dissolved Oxygen	pH	Total alkalinity	Nutrients	Chlorophyll *a*
38	10	7	88	88	88	45

Figure 3.1B presents current patterns from the 18-26 m layer, the shallowest the ADCP could detect. The orientation of the current vectors was very different from the wind patterns. Whereas the wind blew steadily from the northeast, the current speed and direction were variable. The two regions of opposite flow patterns, the first just west of 16°W and the second near 17°30'W, were the dominant features of the current distribution, indicating a presence of mesoscale eddies across the survey track. Figure 3.1C shows the satellite-derived geostrophic current observed on December 12 observed from space. The geostrophic current streamlines revealed the same mesoscale eddies as observed onboard with the ADCP: the cyclonic vortex (L) centred at 16°W and an anticyclonic one (H) located further offshore, centred at 18°W. The slight difference in the position of the same eddy in Figure 3.1B and C is due to the different observational time because this eddy was not stationary but propagated westward (information derived from tracking this eddy for several days in satellite data – not shown).

A direction in which an eddy rotates affects ocean productivity. The cyclonic eddies induce upwelling, whereas the anticyclones downwelling. The TSG temperature record (Figure 3.1C) confirms this, revealing sections of local cooling and warming that were locked to the position of the respective cyclone and anticyclone observed along the survey track (Figure 3.1C), thus confirm the presence of eddy-induced upwelling and downwelling along the survey track. Figure 3.2 presents the same TSG temperature (and salinity) distribution

along the section but reveals more details. Both temperature and salinity increased from the coast towards the open ocean, except for the two local extrema associated with the eddy-induced vertical convection (upwelling and downwelling at Vortex L and H, respectively).

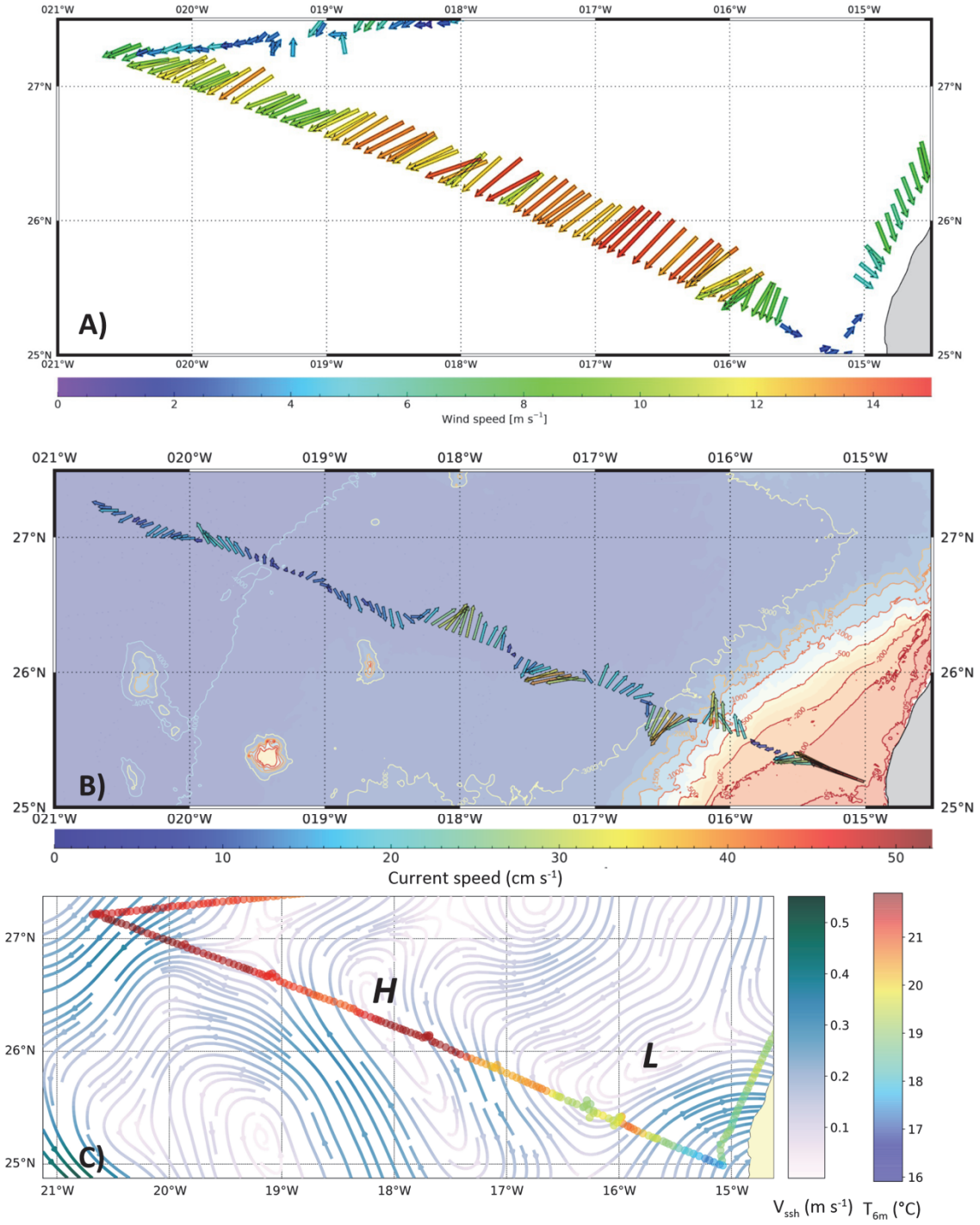


Figure 3.1. Wind speed and direction measured at the mainmast (A); ADCP-derived mean current at 18-26 m depth (B); TSG-measured temperature at 6 m depth overlaying streamlines of the surface geostrophic currents on December 12, derived from satellite altimetry (C). The magnitude of all the presented parameters is colour coded; the respective colour scales are presented under the figures (A, B) and on the right side of the plot (C)

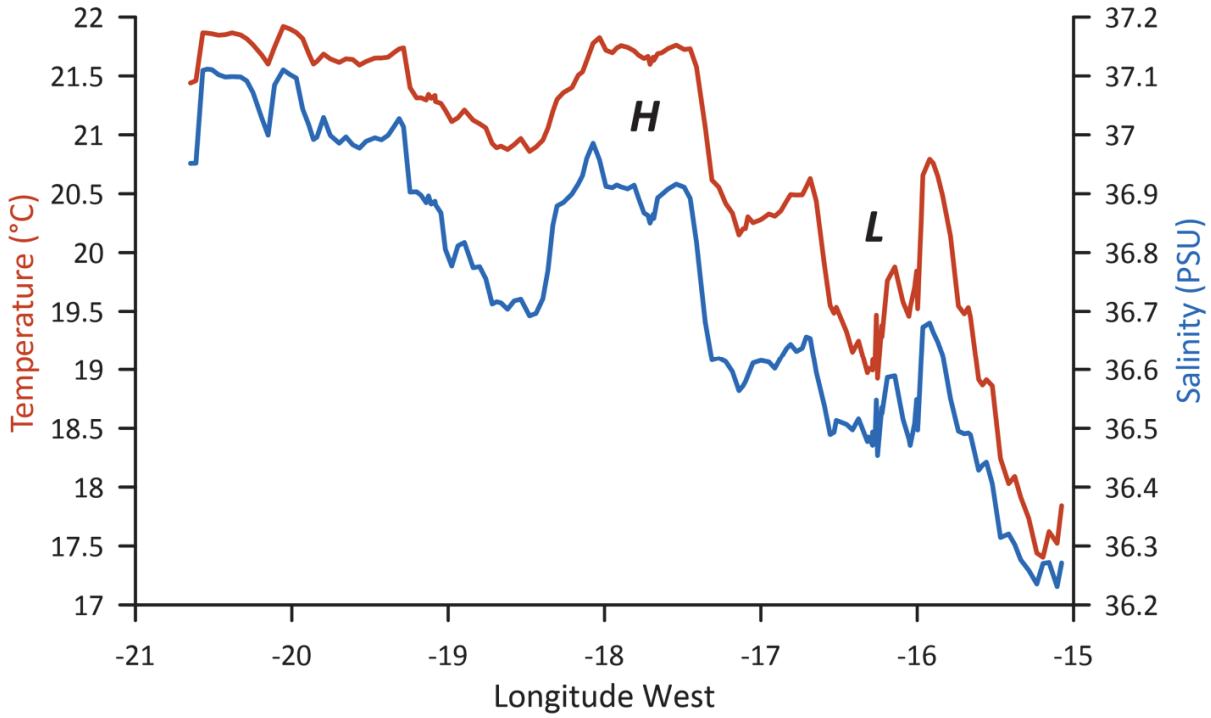


Figure 3.2. Distribution of temperature (red) and salinity (blue) at 6 m depth along the mesopelagic section, 6-13 December 2019. The data were recorded with the drop keel-mounted TSG unit. The H and L symbols over the top panel mark the anticyclonic and cyclonic eddy observed along the survey track

Figure 3.3 (A-C) present the vertical distributions of temperature (T), salinity (S) and dissolved oxygen (DO) along the mesopelagic section. The upward tilt of the T-S and DO contours near the coast (Stations 1267 to 1269) was associated with coastal upwelling. Further offshore, between Stations 1279 and 1287, the T-S contours arose towards the surface, in this case manifesting the upwelling at the centre of the cyclonic eddy (L, cf. Figure 3.1B and C). Near Station 1289, the depression of T-S contours marked the presence of eddy-induced downwelling centred at Station 1288.

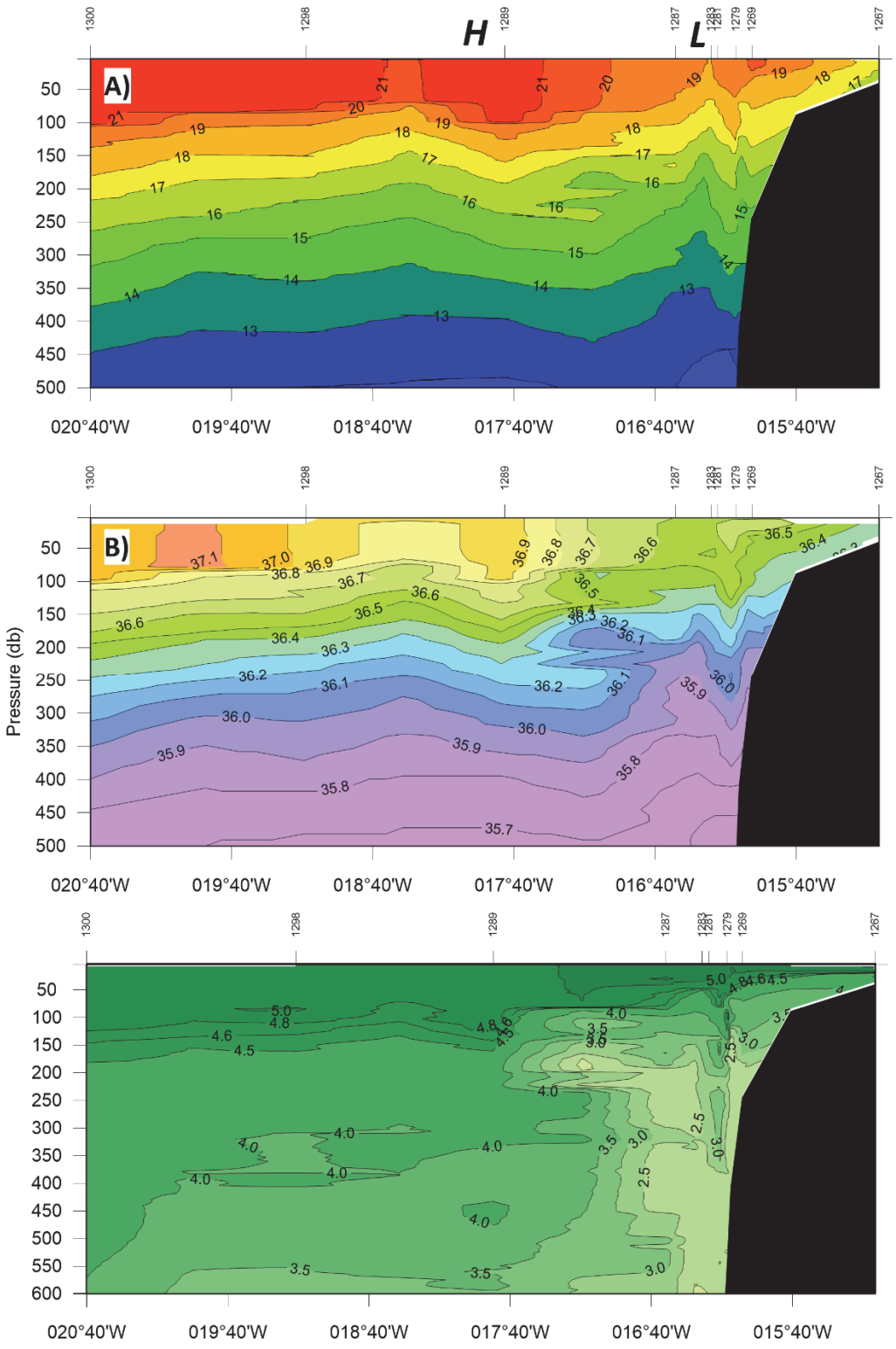


Figure 3.3. Distributions of potential temperature (A), salinity (B), and dissolved oxygen concentration (C) along the mesopelagic section, 6-13 December 2019. The H and L symbols over the top panel mark the anticyclonic and cyclonic eddy observed along the survey track

3.1.3 Water chemistry

3.1.3.1 pH and Dissolved Oxygen Relationship

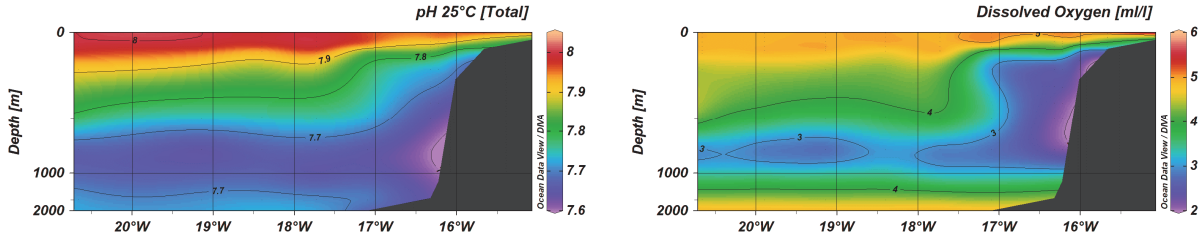


Figure 3.4. Vertical distribution of pH and dissolved oxygen from all water sampling CTD stations of the 2020 Leg 4.5 Mesopelagic survey. Depths between 0 to 1 000 m have been stretched to better visualize the horizontal layering throughout the survey

pH levels offshore ranged from 8.00 at the surface to 7.72 at 2 000 m (Figure 3.4). From 0 m to 750 m west of 17°W, a well-defined stratification of pH can be seen from 8.00 to 7.70. Between 750 m and 1 000 m (where possible) throughout the whole survey, pH minima are observed with values of 7.67 offshore and 7.60 approaching the shelf. This pH minima also coincides with the oxygen minimum zone (OMZ) observed in the same layer. Although not as low as in other areas of West Africa, at this OMZ offshore DO hovers at or below 3 ml l^{-1} but approaches 2.11 ml l^{-1} as the shelf is reached (Figure 3.4). Both observations of pH and DO decreasing as the shelf is approached and climbed indicates water being pushed up against the coast of Casablanca from offshore; a support for upwelling. Subsurface DO concentrations stay relatively consistent at 5 ml l^{-1} except for an increase to 5.6 ml l^{-1} at the innermost station. After going through the OMZ, the DO begins to increase again at 1 000 m and approaches concentrations just below 5 ml l^{-1}. For further analysis, the pH data collected combined with the total alkalinity and nutrient data can be used to calculate the other CO_2 parameters in addition to the aragonite saturation state of the survey.

3.1.3.2 Nutrients

Nutrient samples for nitrite, nitrate, phosphate and silicate determination have been sent to the Institute of Marine Research for analysis. Nutrient results are not presented at this time but the data is available for the partner countries.

3.1.3.3 Chlorophyll a

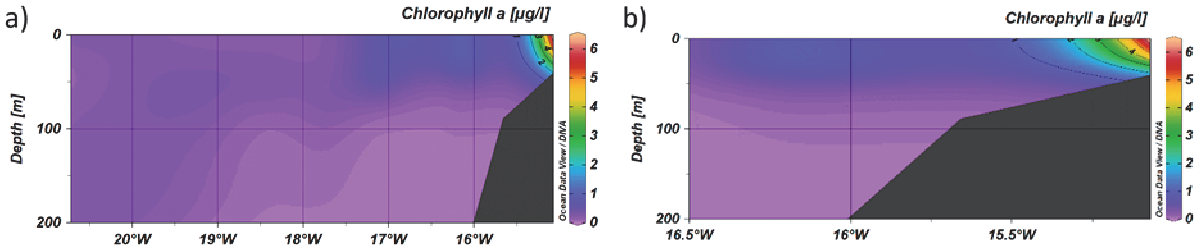


Figure 3.5. Chlorophyll a concentration as observed along a) all water sampling CTD stations and b) the shelf of the 2020 Leg 4.5 Mesopelagic survey

The majority of the survey covered waters with bottom depths near 2 000 m. The shelf outside of the Sahara Bight, however, from approximately 15°W to 16°W, exhibits the only waters with bottom depths shallower than 200 m, gradually increasing to greater depths as the vessel steamed away from the coast. Chlorophyll *a* measurements depict a maximum of 6.16 µg l^{-1} at the innermost station (bottom depth of 41 m) and drop below 1 µg l^{-1} already at 15.5°W. Chlorophyll *a* is concentrated no deeper than 50 m on the shelf before losing a detectable signal as the survey proceeds. With temperature levels also cooling at the coast to 17°C from ~21°C (Figure 3.3A), these two parameters in addition to the low levels of pH and DO (Figure 3.4) give additional support for upwelling in the area. No obvious diurnal effects are observed as all samples shown here are collected during the day except for two stations at 16.32°C and 17.1°W.

3.2 Plankton

Various plankton sampling gears were deployed to gain insight in the planktonic community throughout the water column. A summary of the number of plankton stations and type of samples collected is provided in Table 3.2.

Table 3.2. Overview of plankton stations and samples collected during the survey

Sampling gear	No of stations	Samples collected
WP2 (64 µm)	15	11
WP2 (180 µm)	15	11
BONGO (405 µm)	16	59
Multinet MIDI (180 µm)	4	13
Multinet MAMMOTH (300 µm)	7	34

3.2.1 MULTINET MIDI (180 µm) and MULTINET MAMMOTH (300 µm)

3.2.1.1 Total zooplankton biomass

A total of 127 aluminum trays for zooplankton dry weight estimation were produced during the survey and transferred to IMR for zooplankton biomass estimation. Mesozooplankton biomass of samples collected ranged between 3.54 10^{-4} to 2.6 10^{-2} g m^{-3} in the various depths of each station sampled. The zooplankton biomass was mostly concentrated in the upper 200 m distribution for most station, except at St. 1285 were most of the biomass was found below 200 m (Figure 3.6).

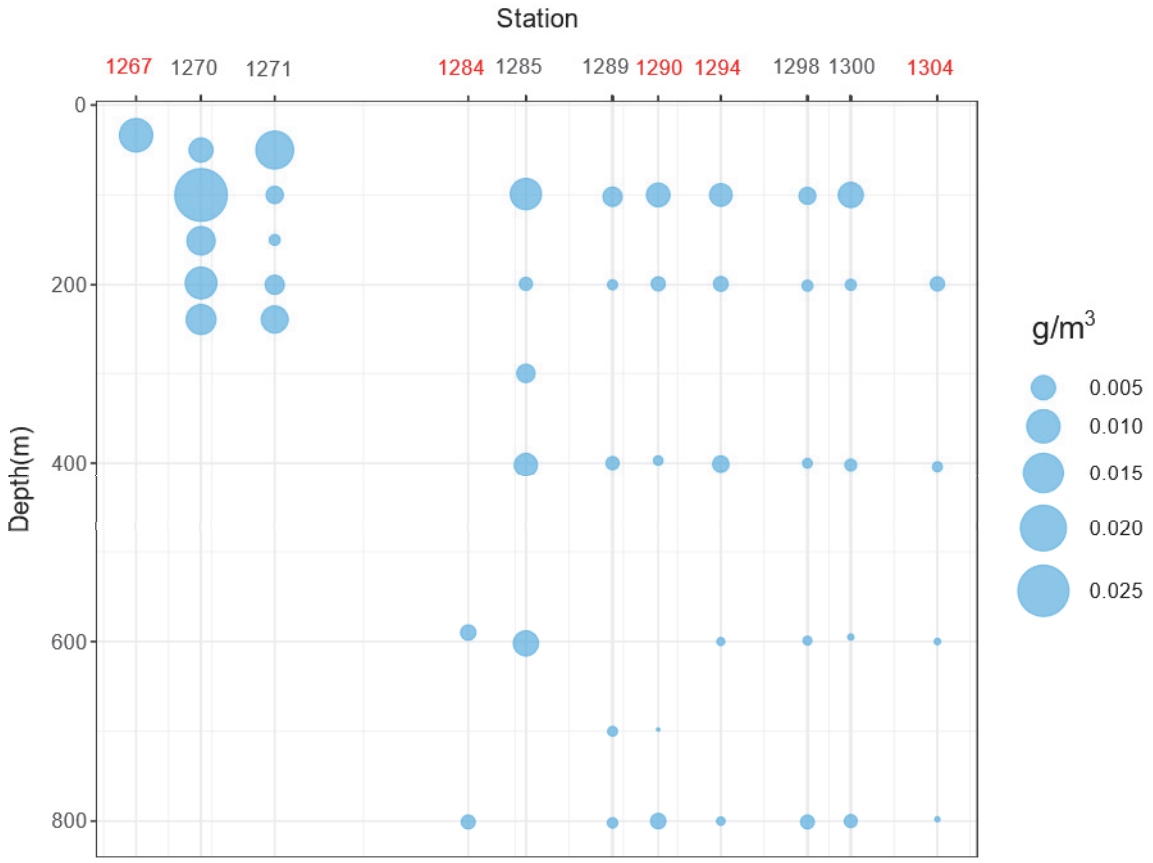


Figure 3.5. Vertical distribution of the mesozooplankton biomass (g m-3) based on Multinet MIDI and Mammoth samplings. *Stations 1267, 1270, 1271 and 1284 correspond to MIDI samplings, and the rest to Mammoth. **Black and red station numbers indicate day and night samplings respectively

3.2.1.2 Size fractionated zooplankton biomass

Size fractionation of samples revealed that most of the zooplankton biomass from organisms < 1 mm was concentrated in the upper 200 m, whereas for organisms > 1 mm the contribution of biomass found in deeper waters was also important (Figure 3.7).

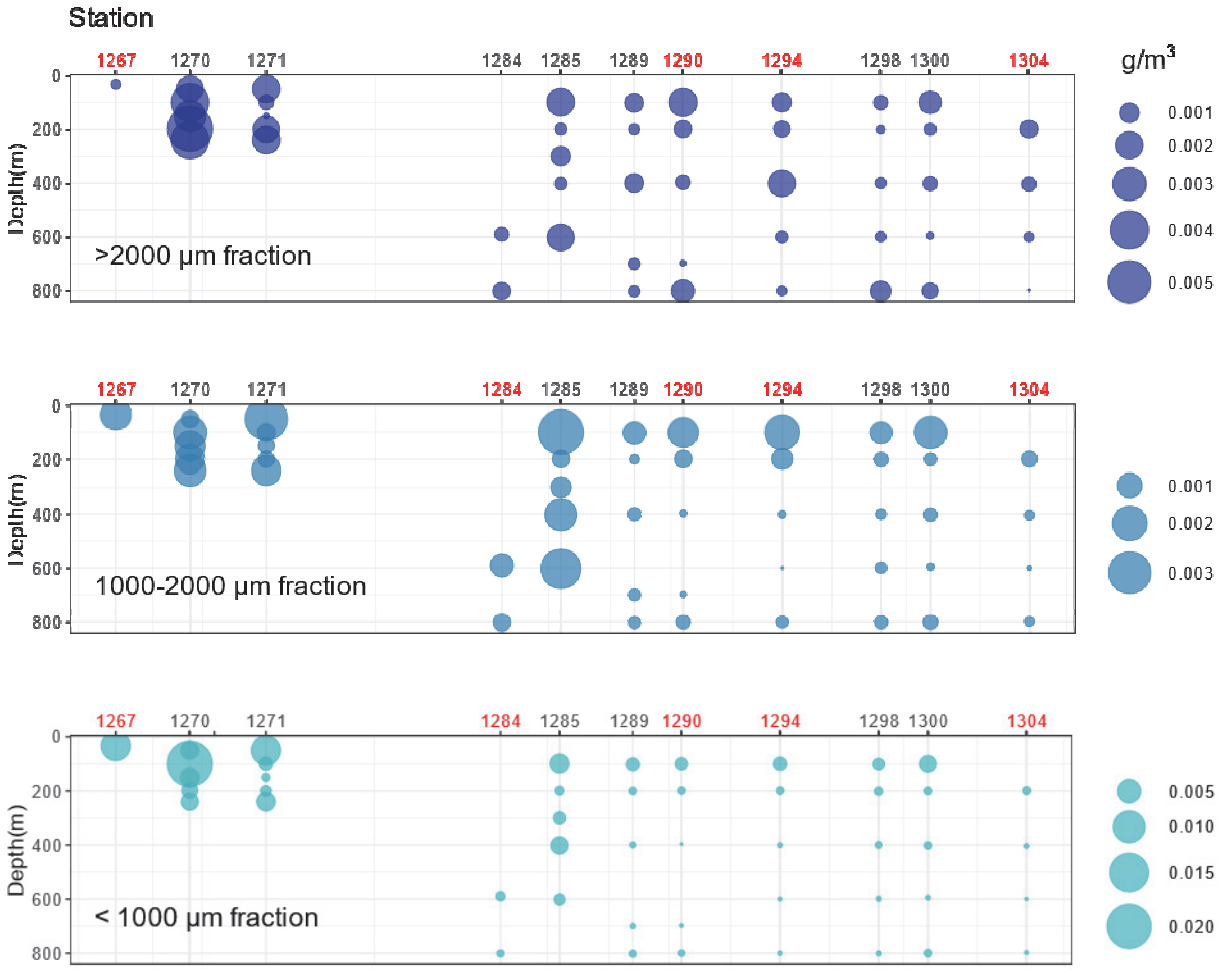


Figure 3.6. Vertical distribution of size fractionated zooplankton biomass (g m-3) from Multinet MIDI and Mammoth samples. Stations 1267, 1270, 1271 and 1284 correspond to MIDI samplings, and the rest to Mammoth. Note that the biomass scale differs among size fractions. Black and red colour in station numbers indicate sampling during day and night, respectively

3.2.2 Insights into the plankton community

3.2.2.1 Ichthyoplankton community based on Bongo tows

Approximately 1450 fish larvae were sorted from 16 Bongo samples collected. The onboard examination of collections revealed an overall inshore-offshore shift in the larval fish community structure (Figure 3.8). The upper 200 m of the water column at shallower stations closer to the coast were dominated by sardine larvae and eggs, while offshore and deeper stations presented higher abundances mesopelagic fish larvae taxa.

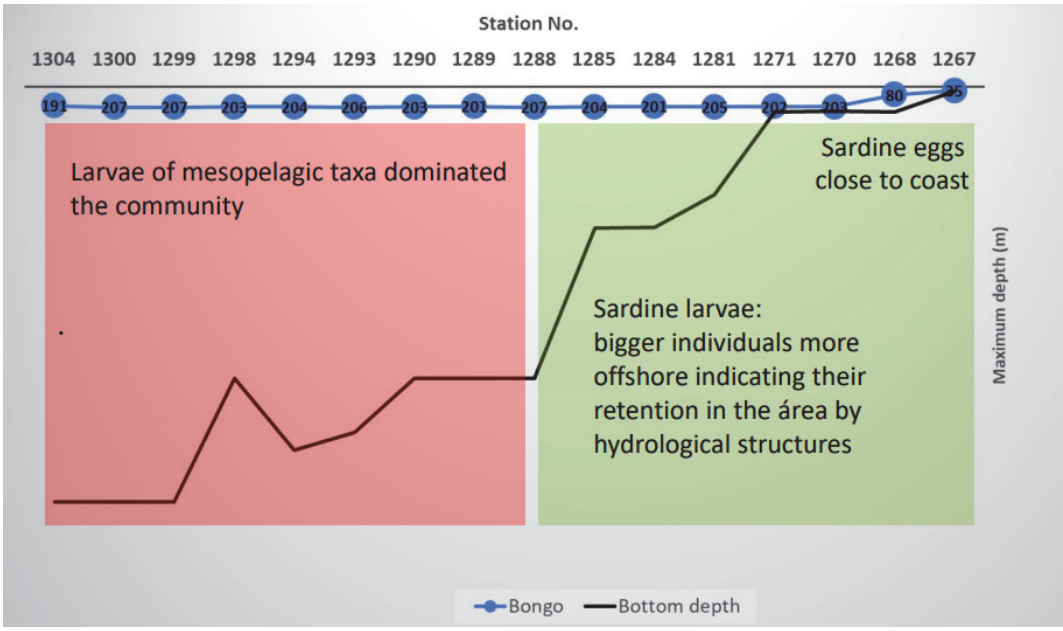


Figure 3.7. Schematic representation of the shift in the larval fish community at the upper 200 m of the water column based on fish larvae collected in samples from Bongo net. The station number and the maximum depth (inside each circle) that each Bongo-haul was carried out is also indicated

3.2.2.2 Zooplankton and fish larvae community based on Multinet tows

Samples collected with the Multinet sampler, both Midi and Mammoth, revealed the presence of several zooplankton taxa, mostly concentrated in the upper 100 m, indicating a higher productivity in the surface waters (Figure 3.9). Most fish larvae were also located in the 0-200 m depth zone. Deeper sampling layers were mainly dominated by juveniles of the mesopelagic genus *Cyclothone* and large crustaceans.

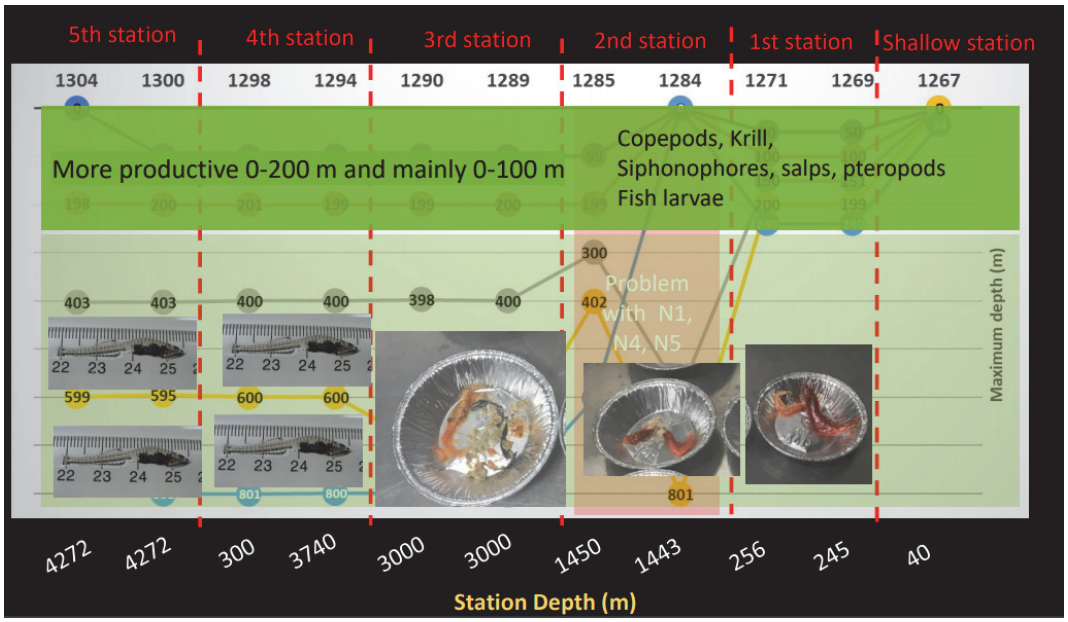


Figure 3.8. Schematic representation and pictures of organisms found in the samples that show the diversity of the ecosystem based on samples from Multinet deployments. The station numbers and depth are also indicated

3.3 Acoustic observations

3.3.1 Acoustic transect

The full acoustic transect was composed by several subsections recorded mainly during daytime (Table1.2). Figure 3.10 shows the LSSS screen dumps composing the full transect. There was no strong evidence of pelagic fish aggregations in the echograms (Figure 3.10). The onset of the mesopelagic layer was detected on the break of the shelf, at about 270 m bottom depth (Figure 3.10). Several features of the scattering layers are prominent as the transect progresses from the shelf and slope, and deeper into the Canary Abyssal plane (>4000 m bottom depth), notably:

1) The inshore aggregation on the shelf break (270-300 m bottom depth) was located relatively shallow (150-200 m depth).
2) The offshore aggregation had two main acoustic layers, one located at approximately 200 m depth and moving up to approximately 100 m during its Diel Vertical Migration (DVM), and another located deeper, between 400-600 m with, with weaker backscatter and relatively stable when it comes to DVM.
3) The acoustic densities were higher inshore than offshore.
4) There is a gradual decrease in acoustic density as the transect progressed offshore.

These are general features of mesopelagic aggregations and in line with the expected overall pattern, reflecting the proportionality between abundance of mesopelagic fish and the productivity of the system. Preliminary acoustic data scrutinization was carried out during the

survey, but mainly to exchange views with the local acoustic experts participating in the survey. Detailed scrutinization will be carried out once all the types of samples (trawl and plankton) have been analysed, as they are both necessary to get a thorough overview of the mesopelagic community.

3.3.2 24-hour stations

The five 24-hour diel cycle observation periods are illustrated in Figure 3.11.

The 24-hour revealed the common pattern of DVM typical for mesopelagic communities. This pattern was evident also in the progressively weaker total acoustic backscatter produced by the layers while moving offshore. Comparing inshore and offshore observations it is evident that the tendency is for vertical migrations to be longer the further offshore. In the 1st 24h station, DVM was observed for part of the acoustic backscatter, indicating that a portion of the biomass remained close to the bottom. Another interesting trait is that while the entire layer appeared to move in synchrony inshore, there were formations of separate layers that conducted different migrations further offshore, mixing near the surface at night and forming separate layers at different depths during daytime.

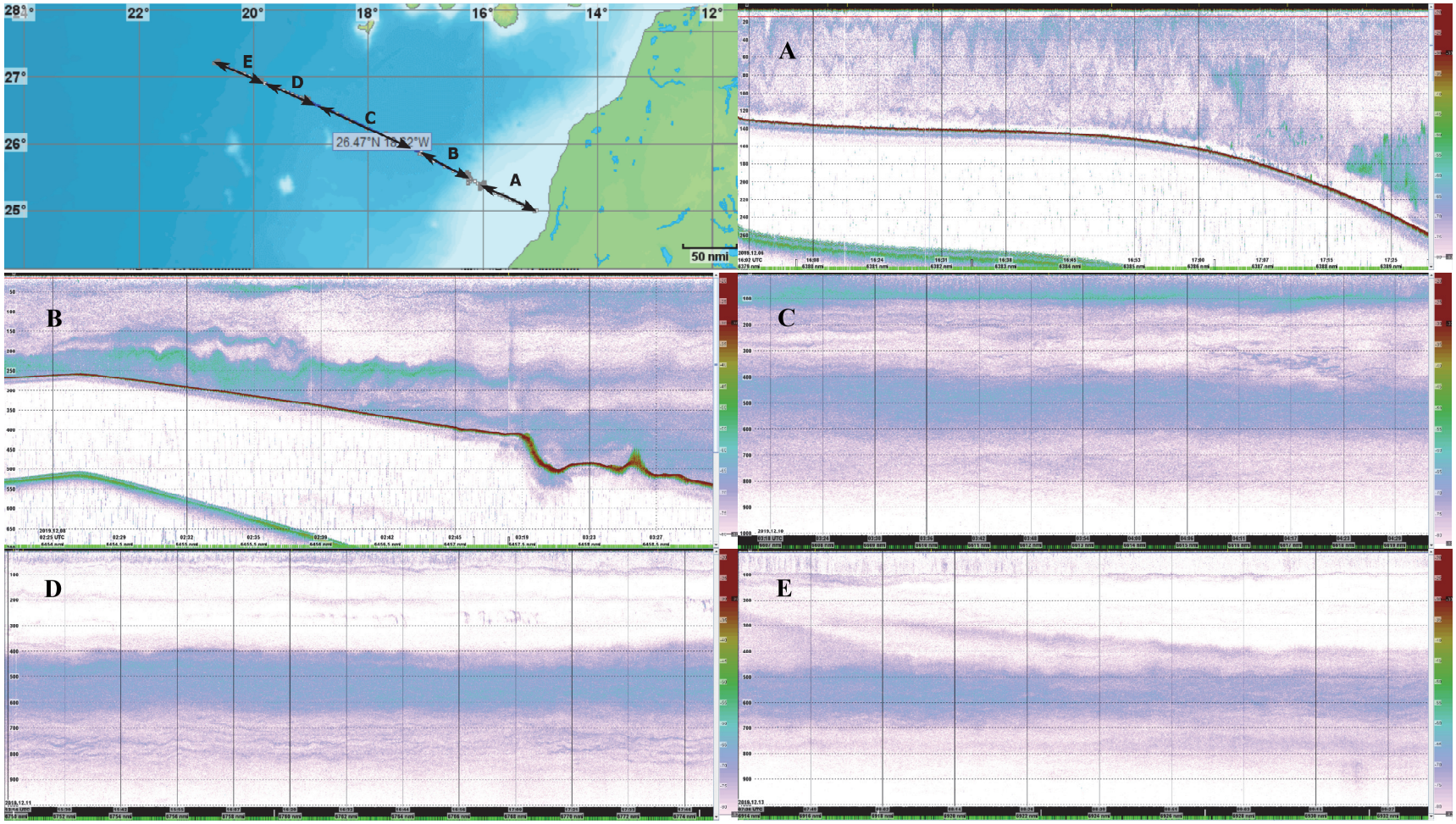


Figure 3.9. 2019415 mesopelagic survey transect map (upper left panel) and corresponding example echograms (A-E) displaying general patterns of pelagic and mesopelagic sound scattering layers observed during this survey. The survey transect was conducted from 24° 59' N 15° 05' W heading north-westwards and is here arbitrarily divided into five sections. All echograms are acoustic records at 38 kHz (narrow-band, continuous wave pulses). Water depth is displayed on the left-hand side in meters (scale varies). The horizontal axis is distance sailed. Colour scale on the right-hand side is in volume backscattering strength (SV, dB re 1m-1) with upper and lower cut-off thresholds at -30 and -82 dB, respectively

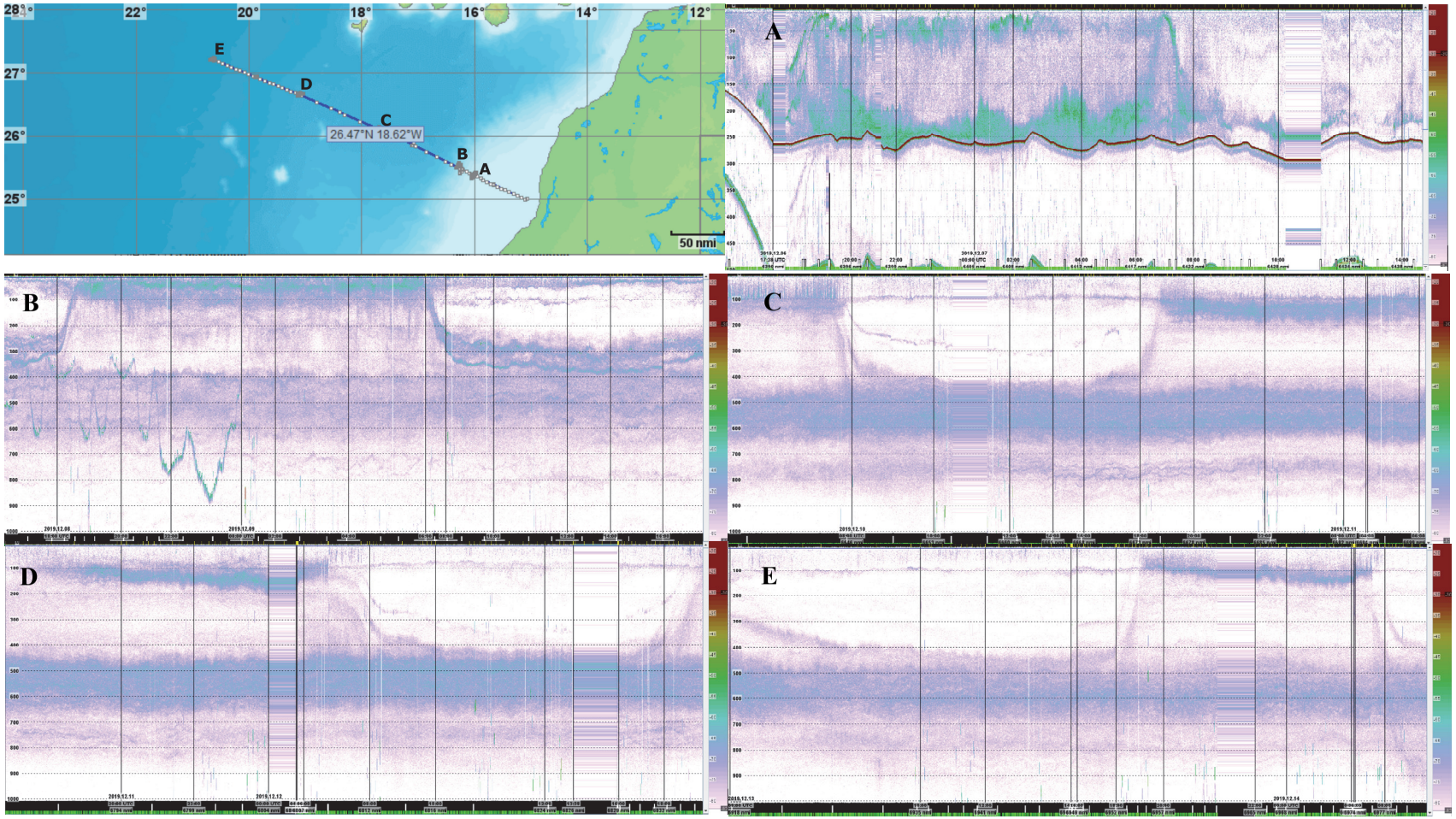


Figure 3.10. 2019415 mesopelagic survey transect map (upper left panel) and corresponding example echograms displaying general patterns of pelagic and mesopelagic sound scattering layers observed during the "24h" stations (A-E) in this survey. A variety of biological and oceanographic sampling activities were performed during these stations with ship echosounders generally kept on and recording. All echograms are acoustic records at 38 kHz (narrow-band, continuous wave pulses). Water depth is displayed on the left-hand side in meters (scale varies). The horizontal axis is distance sailed. Colour scale on the right-hand side is in volume backscattering strength (SV, dB re 1m-1) with upper and lower cut-off thresholds at -40 and -82 dB, respectively. Broadband registration periods are showing as distorted parts of the echogram (Table 1.3)

3.4 Summary of trawl samples

24-hour stations

In the first (#1) 24-hour station the V-hauls (PT1, PT4 and PT5) yielded small catches with respect to mesopelagic species captured. The dominant taxa were *Diaphus dumerilii*, krill and *Maurolicus muelleri* (Annex IV). The layer at 50 m depth (Figure 3.11) was targeted with PT3 and yielded large quantities of *Diaphus dumerilii*. In PT5 *Diaphus* individuals were not captured, which was unexpected given that it was a V-haul and thus should contain all species in the water column as it trawls the whole range from the bottom to the surface. Additionally, PT5 yielded a big catch of *Brama brama* (732 kg) that appeared to shoal closer to the bottom, near 220 m depth (Figure 3.11).

In 24-hour station #2 the diversity of taxa caught increased markedly compared to the 1st 24h station at the shelf break (Table 3.3, Table 3.4). However, the dominant taxon in the layers, as evidenced from the targeted hauls, was again *D. dumerilii* (Annex IV). During daytime, the acoustic layer was located between 200 m and 400 m (Figure 3.11) and PT11 that sampled the layer from 200 m to 350 m comprised >85% *Diaphus dumerilii*. During nighttime, the species was the main component of the acoustic layer located approximately at 50 m depth (Figure 3.11, Annex IV PT13).

In the 3rd 24h station, at 3 500 m depth, the diversity of caught taxa increased even more (Table 3.3, Table 3.4), with parallel marked decrease in the total catch weights. *Cyclothone braueri* was present in large densities in PT21, a V-tow haul. A preliminary onboard examination of the Multinet plankton samples revealed that the species was mainly located below 200 m depth, and detailed laboratory samples analysis is expected to complement the initial observations with more information on the vertical distribution of the species.

The 4th 24h station was carried out at approximately 3 750 m depth, further out along the transect line. However, the observed pattern was not markedly different than that of station #3, i.e. high diversity of species with small catches (Table 3.3, Table 3.4). *Cyclothone braueri* was also found to dominate a specific layer, as verified by targeted trawling and initial observations on plankton samples obtained with the Multinet sampler.

The last (#5) 24h station took place at almost 4 300 m depth. The pattern in biodiversity and total catch was the same as in stations #3 and #4, with the captured taxa remaining largely similar to previous trawl stations (Table 3.3, Table 3.4). Mesopelagic fish were captured in almost all the trawls carried out, though in low abundances in most of the cases where a non-targeted trawl was carried out; a result expected with increasing distance from the coast.

A generic pattern of the change in biodiversity of teleost fish families along the transect can be derived from the numbers of distinct families caught at each 24h station, by each of the two trawls used (Table 3.3). Increasing numbers of teleost fish families were captured as the survey moved offshore, with numbers already increasing markedly at the 2nd 24h station (approximately at 1 500 m depth) compared to those at the shelf break (1st 24h station).

Table 3.3. Number of families of teleost fishes caught in all the hauls per trawl type at each 24h station. Number in parenthesis indicates the number of distinct taxa not identified to the family level, while in brackets the number of stations per 24h station. Total: number of distinct families at the station [number of hauls]

Station type:		**24h Station**				
Trawl Type	**Haul Type**	**01**	**02**	**03**	**04**	**05**
Krill Trawl	Target	5 (1) [3]	9 (2) [2]	8 (4) [2]	10 (1) [2]	12 (2) [2]
Krill Trawl	V-haul	4 (2) [2]	12 (2) [2]	22 (5) [3]	17 (3) [2]	13 (2) [2]
Multpelt	Target	2 (0) [3]	10 (1) [3]	11 (3) [2]	2 (0) [1]	9 (1) [2]
Multpelt	V-haul	3 (0) [1]				
Total		**8 [9]**	**17 [7]**	**25 [7]**	**20 [5]**	**20 [6]**

Table 3.4. List of accepted trawl hauls (no-catch hauls are excluded) showing the type of trawl, bottom depth, tow duration, catch rates and their relative ratio, and the number of taxa caught. NM: nautical miles, [n]: number of individuals, MT: metric tonnes. Number in parenthesis in the Fish families column indicates the number of distinct taxa not identified to the family level. V: V-haul, T: Target-haul

					Catch rates					
no	**Station Type**	**Trawl type**	**Bottom depth (m)**	**Tow duration (min)**	**(k / NM)**	**(MT / NM^3)**	**(log_{10}([n] / NM))**	**(log_{10}([n] / NM^3))**	**Taxa present**	**Fish families**
1	24h #1	Krill Trawl	260	56.6	45.28	117.01	10.43	1.23	7	3 (1)
2	24h #1	Krill Trawl	269	45.0	19.29	2 029.36	4.36	21.30	3	2 (0)
3	24h #1	Multpelt (T)	261	45.0	11.15	115.24	4.73	70.56	2	1 (0)
4	24h #1	Krill Trawl	253	55.7	45.44	401.32	10.59	4.21	7	2 (1)
5	24h #1	Multpelt (V)	247	45.9	23.95	522.91	11.10	320.16	4	3 (0)
6	24h #1	Krill Trawl	256	44.5	46.96	482.81	12.11	5.07	7	3 (1)
7	24h #1	Multpelt (T)	256	55.5	27.19	43.03	14.34	26.35	4	2 (0)
8	24h #1	Multpelt (T)	260	15.0	11.49	231.01	5.07	141.44	2	1 (0)
9	24h #1	Krill Trawl	253	15.0	30.06	607.11	10.15	6.37	4	1 (0)
11	24h #2	Multpelt (T)	1443	50.6	131.71	99.67	44.95	61.02	27	9 (0)
12	24h #2	Krill Trawl	1443	63.4	208.78	312.63	29.54	3.28	36	10 (1)
13	24h #2	Krill Trawl	1443	20.0	98.96	867.13	34.23	9.10	13	2 (0)
14	24h #2	Multpelt (T)	1443	20.5	96.85	22.90	35.81	14.02	19	4 (1)
15	24h #2	Krill Trawl	1443	22.8	160.33	795.28	30.87	8.35	26	7 (1)
16	24h #2	Krill Trawl	1443	31.4	167.15	97.73	27.74	1.03	28	8 (1)
17	24h #2	Multpelt (T)	1443	31.1	90.44	23.44	26.18	14.35	20	5 (0)
18	24h #3	Krill Trawl	3000	62.3	322.66	37.53	18.94	0.39	61	12 (1)

					Catch rates					
no	Station Type	Trawl type	Bottom depth (m)	Tow duration (min)	(k / NM)	(MT / NM^3)	(log_{10}([n] / NM))	(log_{10}([n] / NM^3))	Taxa present	Fish families
19	24h #3	Krill Trawl	3000	30.4	87.32	1.08	7.66	<0.1	16	3 (1)
20	24h #3	Multpelt (T)	3558	30.4	65.11	<0.1	4.06	<0.1	19	5 (1)
21	24h #3	Krill Trawl	3000	67.1	349.12	12.92	10.55	0.14	68	15 (1)
22	24h #3	Krill Trawl	3000	52.2	198.56	20.02	24.30	0.21	35	7 (1)
23	24h #3	Multpelt (T)	3000	29.8	158.42	7.49	45.96	4.58	35	8 (1)
24	24h #3	Krill Trawl	3555	50.5	387.82	203.93	29.34	2.14	72	17 (1)
26	24h #4	Krill Trawl	3557	30.6	213.68	19.35	29.46	0.20	37	6 (1)
27	24h #4	Krill Trawl	3736	64.3	306.90	31.43	18.12	0.33	58	12 (1)
28	24h #4	Krill Trawl	3736	33.0	77.43	1.24	2.74	<0.1	15	6 (0)
29	24h #4	Multpelt (T)	3736	31.7	19.45	<0.1	0.17	<0.1	6	2 (0)
30	24h #4	Krill Trawl	3740	85.8	466.01	29.22	17.90	0.31	90	16 (1)
31	24h #5	Krill Trawl	4272	31.8	78.76	1.07	4.08	<0.1	15	6 (1)
32	24h #5	Multpelt (T)	4272	31.2	6.07	<0.1	-0.36	<0.1	2	2 (0)
33	24h #5	Krill Trawl	4272	79.1	394.56	45.46	41.05	0.48	71	12 (1)
34	24h #5	Krill Trawl	4272	45.0	200.81	42.01	31.52	0.44	34	9 (1)
35	24h #5	Multpelt (T)	4272	40.8	137.46	11.85	37.85	7.25	31	7 (1)
36	24h #5	Krill Trawl	4593	69.7	253.40	12.78	19.38	0.13	47	8 (0)

3.5 Comparative trawling trials

At each 24h station, comparative trawling was also carried out to assess the catch rates of the two different sampling gears. The resulting catch rates per functional group and gear for each comparative trawl pair, expressed in mass and numbers per volume or distance, can be found in Table 3.5. Similarly, Table 3.6 displays the same catch rates for mesopelagic fish families caught by the two trawl types.

In terms of biomass, when the filtered volume is not taken into account, the Multpelt appears to outperform the Krill trawl (M/K ratio for k / NM, Table 3.5). In terms of numbers caught per distance, the pattern was less clear, as the overall ratio for each pair comparison was varying, but the Multpelt also appeared to perform better than the Krill Trawl. There were, however, some few cases where the Krill Trawl was capturing higher numbers of individuals (irrespectively of the functional group) (M/K ratio for log_{10}([n] / NM), Table 3.5). When considering only fish families, in 80% of the pair comparisons, the Multpelt was outperforming the Krill trawl (M/K ratio for k / NM and log_{10}([n] / NM), Table 3.6).

On the contrary, in terms of catch rates per filtered volume, the Krill trawl was outperforming the Multpelt in total sampling efficiency, as the overall ratio for each pair comparison (irrespectively of the functional group) exemplified. This was identified for both mass and

numbers per filtered volume unit (M/K ratio for MT / NM^3 and $\log_{10}([n] / NM^3)$, Table 3.5). The same pattern was observed when only fish families catch rates were considered in 80% of the pair comparisons (M/K ratio for MT / NM^3 and $\log_{10}([n] / NM^3)$, Table 3.6). The reasons for the different patterns observed is a combination of geometry, filtering efficiency and performance of the two gears when deployed in the water column. In this sense the abovementioned observations require in depth analysis to provide statistically significant comparisons and should be considered just as initial observations.

Table 3.5. Catch rates in number and mass by distance towed and volume filtered by the trawls summarized by functional group from the comparative trawl haul pairs. Catch rates are shown for both trawl types used, along with the relative ratio between the two, and the relative contribution of each functional group to the total catch rate of the respective trawl haul (%). K: Krill trawl, M: Multpelt, NM: nautical miles, [n]: number of individuals, MT: metric tonnes, 24h: ID number of each 24h station. Note that for Totals, the Total is not equal to the sum of rows when it refers to log values. Ratios are calculated per row

Unit:			(k / NM)					(MT / NM^3)					(log_{10}([n] / NM))					(log_{10}([n] / NM^3))				
Group	**24h**	**Pair**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**
Cephalopods	01	02-03	0.30			0.4		0.49			0.4		0.10			<0.1		3.31			<0.1	
Cnidaria	01	02-03		<0.1			0.3		5.91			0.3		0.48			<0.1		5.46			<0.1
Fish	01	02-03	70.25	21.24	3.3	99.6	99.7	114.74	2 023.45	<0.1	99.6	99.7	4.63	3.88	1.2	100.0	100.0	7.85	13.84	0.6	100.0	100.0
Total	**01**	**02-03**	**70.56**	**21.30**	**3.3**	**100.0**	**100.0**	**115.24**	**2 029.36**	**<0.1**	**100.0**	**100.0**	**4.63**	**3.88**	**1.2**	**100.0**	**100.0**	**7.85**	**13.84**	**0.6**	**100.0**	**100.0**
Cnidaria	01	06-07		<0.1			1.2		5.88			1.2		0.57			<0.1		5.55			<0.1
Fish	01	06-07	25.91	3.91	6.6	98.4	77.2	42.32	372.84	0.1	98.4	77.2	7.64	3.92	1.9	100.0	25.1	14.07	23.84	0.6	100.0	100.0
Gelatinous	01	06-07	0.14	0.39	0.4	0.5	7.7	0.24	37.20	<0.1	0.5	7.7	3.08	3.24	0.9	<0.1	5.2	6.29	8.22	0.8	<0.1	<0.1
Krill	01	06-07	0.29	0.70	0.4	1.1	13.9	0.47	66.90	<0.1	1.1	13.9	3.62	4.37	0.8	<0.1	69.7	6.83	9.35	0.7	<0.1	<0.1
Total	**01**	**06-07**	**26.35**	**5.07**	**5.2**	**100.0**	**100.0**	**43.03**	**482.81**	**<0.1**	**100.0**	**100.0**	**7.64**	**4.53**	**1.7**	**100.0**	**100.0**	**14.07**	**23.84**	**0.6**	**100.0**	**100.0**
Cephalopods	01	08-09	0.41			0.3		0.67			0.3		0.11			<0.1		3.32			<0.1	
Cnidaria	01	08-09		<0.1			1.0		6.35			1.0		0.44			<0.1		5.42			<0.1
Fish	01	08-09	141.03	5.24	26.9	99.7	82.2	230.34	498.87	0.5	99.7	82.2	4.96	3.64	1.4	100.0	65.1	8.17	8.62	0.9	100.0	65.1
Gelatinous	01	08-09		1.00			15.7		95.28			15.7		2.85			10.7		7.83			10.7
Krill	01	08-09		<0.1			1.1		6.62			1.1		3.21			24.2		8.19			24.2
Total	**01**	**08-09**	**141.44**	**6.37**	**22.2**	**100.0**	**100.0**	**231.01**	**607.11**	**0.4**	**100.0**	**100.0**	**4.96**	**3.83**	**1.3**	**100.0**	**100.0**	**8.17**	**8.81**	**0.9**	**100.0**	**100.0**
Cephalopods	02	13-14	<0.1			0.3		0.08			0.3		1.37			<0.1		4.58			<0.1	
Cnidaria	02	13-14	<0.1	3.54	<0.1	0.5	38.9	0.11	337.33	<0.1	0.5	38.9	0.41	2.08	0.2	<0.1	<0.1	3.63	7.06	0.5	<0.1	<0.1
Crustaceans	02	13-14	0.16	0.12	1.3	1.1	1.3	0.26	11.59	<0.1	1.1	1.3	2.51	2.65	0.9	<0.1	<0.1	5.72	7.63	0.7	<0.1	<0.1
Fish	02	13-14	13.74	4.06	3.4	98.0	44.6	22.45	387.02	<0.1	98.0	44.6	31.52	24.97	1.3	100.0	100.0	82.93	74.76	1.1	100.0	100.0
Krill	02	13-14		1.38			15.1		131.20			15.1		4.54			<0.1		9.52			<0.1
Total	**02**	**13-14**	**14.02**	**9.10**	**1.5**	**100.0**	**100.0**	**22.90**	**867.13**	**<0.1**	**100.0**	**100.0**	**31.52**	**24.97**	**1.3**	**100.0**	**100.0**	**82.93**	**74.76**	**1.1**	**100.0**	**100.0**
Cephalopods	02	16-17	0.53	<0.1	290.5	3.7	0.2	0.87	0.17	5.0	3.7	0.2	3.75	0.31	12.1	<0.1	<0.1	10.18	5.29	1.9	<0.1	<0.1
Cnidaria	02	16-17	<0.1	<0.1	1.8	0.5	4.0	0.12	3.89	<0.1	0.5	4.0	0.43	1.58	0.3	<0.1	<0.1	3.64	6.56	0.6	<0.1	<0.1
Crustaceans	02	16-17	0.18	0.10	1.7	1.2	9.9	0.29	9.72	<0.1	1.2	9.9	2.03	2.28	0.9	<0.1	<0.1	5.24	7.26	0.7	<0.1	<0.1
Fish	02	16-17	13.56	0.61	22.3	94.5	59.3	22.14	57.99	0.4	94.5	59.3	18.97	16.37	1.2	100.0	100.0	67.16	130.88	0.5	100.0	100.0
Gelatinous	02	16-17	<0.1	<0.1	0.1	<0.1	7.2	0.02	7.00	<0.1	<0.1	7.2	1.00	2.46	0.4	<0.1	<0.1	4.22	7.44	0.6	<0.1	<0.1
Krill	02	16-17		0.20			19.4		18.96			19.4		4.74			<0.1		9.72			<0.1
Total	**02**	**16-17**	**14.35**	**1.03**	**14.0**	**100.0**	**100.0**	**23.44**	**97.73**	**0.2**	**100.0**	**100.0**	**18.97**	**16.37**	**1.2**	**100.0**	**100.0**	**67.16**	**130.88**	**0.5**	**100.0**	**100.0**
Cephalopods	03	19-20	<0.1	<0.1	1.3	11.7	15.6	<0.01	0.16	<0.1	11.7	15.6	-0.51	-0.27	1.9	0.1	<0.1	15.55	14.67	1.1	<0.1	<0.1
Cnidaria	03	19-20	<0.1			47.5		0.01			47.5		0.48			1.3		3.69			<0.1	
Crustaceans	03	19-20	<0.1	<0.1	1.0	15.5	27.4	<0.01	0.29	<0.1	15.5	27.4	2.22	3.59	0.6	71.6	73.9	15.07	28.48	0.5	<0.1	73.9
Fish	03	19-20	<0.1	<0.1	0.8	25.3	52.6	<0.01	0.55	<0.1	25.3	52.6	1.80	3.13	0.6	27.0	26.1	27.50	28.03	1.0	100.0	26.1
Other	03	19-20		<0.1			4.4		0.05			4.4		0.39			<0.1		5.37			<0.1
Total	**03**	**19-20**	**<0.1**	**<0.1**	**1.7**	**100.0**	**100.0**	**0.03**	**1.05**	**<0.1**	**100.0**	**100.0**	**2.36**	**3.72**	**0.6**	**100.0**	**100.0**	**27.50**	**28.61**	**1.0**	**100.0**	**100.0**

Unit:			(k / NM)					(MT / NM^3)					(log_{10}([n] / NM))					(log_{10}([n] / NM^3))				
Group	**24h**	**Pair**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**
Cephalopods	03	22-23	0.11	<0.1	10.8	2.5	5.1	0.19	1.01	0.2	2.5	5.1	4.38	0.63	7.0	<0.1	<0.1	23.66	5.61	4.2	<0.1	<0.1
Crustaceans	03	22-23	<0.1	<0.1	0.1	<0.1	2.9	<0.01	0.58	<0.1	<0.1	2.9	0.85	3.07	0.3	<0.1	<0.1	4.07	18.00	0.2	<0.1	<0.1
Fish	03	22-23	4.40	0.11	38.4	96.0	54.8	7.18	10.92	0.7	96.0	54.8	38.39	14.27	2.7	100.0	100.0	125.15	153.68	0.8	100.0	100.0
Gelatinous	03	22-23	<0.1	<0.1	1.1	1.5	31.8	0.11	6.34	<0.1	1.5	31.8	2.34	2.70	0.9	<0.1	<0.1	5.55	7.68	0.7	<0.1	<0.1
Krill	03	22-23		<0.1			5.4		1.09			5.4		2.41			<0.1		7.39			<0.1
Total	**03**	**22-23**	**4.58**	**0.21**	**21.9**	**100.0**	**100.0**	**7.49**	**19.94**	**0.4**	**100.0**	**100.0**	**38.39**	**14.27**	**2.7**	**100.0**	**100.0**	**125.15**	**153.68**	**0.8**	**100.0**	**100.0**
Cephalopods	04	28-29	<0.1			10.7		<0.01			10.7		-0.24			8.6		2.98			<0.1	
Cnidaria	04	28-29	<0.1	<0.1	1.3	62.8	75.5	0.02	0.88	<0.1	62.8	75.5	0.46	0.19	2.5	43.0	12.1	3.67	5.17	0.7	<0.1	<0.1
Crustaceans	04	28-29	<0.1	<0.1	<0.1	0.3	7.5	<0.01	0.09	<0.1	0.3	7.5	-0.24	0.75	<0.1	8.6	44.2	2.98	20.66	0.1	<0.1	<0.1
Fish	04	28-29	<0.1	<0.1	2.4	26.2	16.4	<0.01	0.19	<0.1	26.2	16.4	0.43	0.39	1.1	39.8	19.4	6.85	40.22	0.2	99.9	100.0
Krill	04	28-29		<0.1			0.6		<0.01			0.6		0.49			24.3		5.47			<0.1
Total	**04**	**28-29**	**<0.1**	**<0.1**	**1.5**	**100.0**	**100.0**	**0.03**	**1.17**	**<0.1**	**100.0**	**100.0**	**0.83**	**1.10**	**0.8**	**100.0**	**100.0**	**6.85**	**40.22**	**0.2**	**100.0**	**100.0**
Cephalopods	05	31-32		<0.1			0.9		<0.01			0.9		-0.08			1.1		4.90			<0.1
Crustaceans	05	31-32		<0.1			45.6		0.42			45.6		1.84			92.3		21.76			<0.1
Fish	05	31-32	<0.1	<0.1	0.1	100.0	53.5	<0.01	0.49	<0.1	100.0	53.5	-0.36	0.70	<0.1	100.0	6.6	6.07	40.53	0.1	100.0	100.0
Total	**05**	**31-32**	**<0.1**	**<0.1**	**<0.1**	**100.0**	**100.0**	**<0.01**	**0.91**	**<0.1**	**100.0**	**100.0**	**-0.36**	**1.88**	**<0.1**	**100.0**	**100.0**	**6.07**	**40.53**	**0.1**	**100.0**	**100.0**
Cephalopods	05	34-35	0.34	<0.1	616.0	4.6	0.1	0.55	0.05	10.6	4.6	0.1	4.40	-0.26	<0.1	<0.1	<0.1	23.68	4.72	5.0	<0.1	<0.1
Cnidaria	05	34-35		<0.1			1.5		0.62			1.5		0.44			<0.1		5.42			<0.1
Crustaceans	05	34-35	<0.1	<0.1	0.2	<0.1	2.5	<0.01	1.06	<0.1	<0.1	2.5	-0.05	1.59	<0.1	<0.1	<0.1	3.16	16.53	0.2	<0.1	<0.1
Fish	05	34-35	6.80	0.29	23.2	93.7	66.4	11.10	27.87	0.4	93.7	66.4	34.20	22.96	1.5	100.0	100.0	104.89	152.42	0.7	100.0	100.0
Gelatinous	05	34-35	0.12	<0.1	1.9	1.6	13.9	0.19	5.83	<0.1	1.6	13.9	-0.70	2.67	<0.1	<0.1	<0.1	5.73	7.65	0.7	<0.1	<0.1
Krill	05	34-35		<0.1			15.6		6.53			15.6		3.06			<0.1		8.04			<0.1
Total	**05**	**34-35**	**7.25**	**0.44**	**16.5**	**100.0**	**100.0**	**11.85**	**41.97**	**0.3**	**100.0**	**100.0**	**34.20**	**22.96**	**1.5**	**100.0**	**100.0**	**104.89**	**152.42**	**0.7**	**100.0**	**100.0**

Table 3.6. Catch rates, in number and mass by distance towed and volume filtered by the trawls, summarized by fish family from the comparative trawl haul pairs. Catch rates are shown for both trawl types used, along with the relative ratio between the two, and the relative contribution of each fish family to the total catch rate of the respective trawl haul (%). K: Krill trawl, M: Multpelt, NM: nautical miles, [n]: number of individuals, MT: metric tonnes. Note: only families of the functional group fish are considered, 24h: ID number of each 24h station. Note that for Totals, the Total is not equal to the sum of rows when it refers to log values. Ratios are calculated per row

Unit:			(k / NM)					(MT / NM^3)					(log_{10}([n] / NM))					(log_{10}([n] / NM^3))				
Families	**24h**	**Pair**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**
Exocoetidae	01	02-03		<0.1			0.1		2.86			0.1		-0.30			<0.1		4.68			<0.1
Myctophidae	01	02-03	70.25	21.21	3.3	100.0	99.9	114.74	2 020.59	<0.1	100.0	99.9	4.63	4.18	1.1	100.0	100.0	7.85	9.16	0.9	100.0	100.0
Total	**01**	**02-03**	**70.25**	**21.24**	**3.3**	**100.0**	**100.0**	**114.74**	**2 023.45**	**<0.1**	**100.0**	**100.0**	**4.63**	**4.18**	**1.1**	**100.0**	**100.0**	**7.85**	**9.16**	**0.9**	**100.0**	**100.0**
Bothidae	01	06-07		<0.1			<0.1		0.05			<0.1		-0.27			<0.1		4.70			<0.1
Myctophidae	01	06-07	23.36			90.2		38.16			90.2		4.16			82.3		7.37			82.3	
Unidentified	01	06-07		<0.1			<0.1		0.25			<0.1		0.20			<0.1		5.18			<0.1
Paralepididae	01	06-07		<0.1			<0.1		0.05			<0.1		-0.27			<0.1		4.70			<0.1
Sternoptychidae	01	06-07	2.55	3.91	0.7	9.8	99.9	4.16	372.49	<0.1	9.8	99.9	3.49	4.27	0.8	17.7	100.0	6.70	9.25	0.7	17.7	100.0
Total	**01**	**06-07**	**25.91**	**3.91**	**6.6**	**100.0**	**100.0**	**42.32**	**372.84**	**0.1**	**100.0**	**100.0**	**4.24**	**4.27**	**1.0**	**100.0**	**100.0**	**7.45**	**9.25**	**0.8**	**100.0**	**100.0**
Myctophidae	01	08-09	141.03	5.24	26.9	100.0	100.0	230.34	498.87	0.5	100.0	100.0	4.96	3.64	1.4	100.0	100.0	8.17	8.62	0.9	100.0	100.0
Total	**01**	**08-09**	**141.03**	**5.24**	**26.9**	**100.0**	**100.0**	**230.34**	**498.87**	**0.5**	**100.0**	**100.0**	**4.96**	**3.64**	**1.4**	**100.0**	**100.0**	**8.17**	**8.62**	**0.9**	**100.0**	**100.0**
Gempylidae	02	13-14	0.34	<0.1	4.2	2.5	2.0	0.56	7.73	<0.1	2.5	2.0	1.50	0.98	1.5	<0.1	<0.1	4.72	5.95	0.8	<0.1	<0.1
Myctophidae	02	13-14	13.25	3.98	3.3	96.4	98.0	21.64	379.30	<0.1	96.4	98.0	28.09	23.99	1.2	100.0	100.0	66.65	68.80	1.0	100.0	100.0
Nomeidae	02	13-14	<0.1			0.6		0.14			0.6		0.24			<0.1		3.45			<0.1	
Unidentified	02	13-14	<0.1			0.5		0.11			0.5		1.76			<0.1		4.97			<0.1	
Sternoptychidae	02	13-14	<0.1			<0.1		<0.01			<0.1		-0.06			<0.1		3.15			<0.1	
Total	**02**	**13-14**	**13.74**	**4.06**	**3.4**	**100.0**	**100.0**	**22.45**	**387.02**	**<0.1**	**100.0**	**100.0**	**28.09**	**23.99**	**1.2**	**100.0**	**100.0**	**66.65**	**68.80**	**1.0**	**100.0**	**100.0**
Caristiidae	02	16-17		<0.1			0.2		0.10			0.2		0.01			<0.1		4.99			<0.1
Gonostomatidae	02	16-17	<0.1	<0.1	0.4	<0.1	1.2	<0.01	0.68	<0.1	<0.1	1.2	-0.35	0.62	<0.1	<0.1	<0.1	6.08	10.58	0.6	<0.1	<0.1
Myctophidae	02	16-17	13.34	0.53	24.9	98.4	87.9	21.80	50.96	0.4	98.4	87.9	15.14	10.03	1.5	100.0	100.0	40.85	69.78	0.6	100.0	100.0
Nemichthyidae	02	16-17		<0.1			0.3		0.19			0.3		0.31			<0.1		5.29			<0.1
Unidentified	02	16-17		<0.1			1.7		0.98			1.7		1.43			<0.1		11.39			<0.1
Phosichthyidae	02	16-17	0.18	<0.1	6.0	1.3	4.9	0.29	2.82	0.1	1.3	4.9	2.79	2.11	1.3	<0.1	<0.1	6.01	7.09	0.8	<0.1	<0.1
Sciaenidae	02	16-17		<0.1			0.7		0.40			0.7		1.05			<0.1		6.03			<0.1
Sternoptychidae	02	16-17	<0.1	<0.1	177.6	0.1	<0.1	0.03	<0.01	3.0	0.1	<0.1	1.07	0.01	122.1	<0.1	<0.1	10.71	4.99	2.1	<0.1	<0.1
Stomiidae	02	16-17	<0.1	<0.1	0.7	<0.1	3.2	0.02	1.85	<0.1	<0.1	3.2	0.30	0.80	0.4	<0.1	<0.1	3.52	10.75	0.3	<0.1	<0.1
Total	**02**	**16-17**	**13.56**	**0.61**	**22.3**	**100.0**	**100.0**	**22.14**	**57.99**	**0.4**	**100.0**	**100.0**	**15.14**	**10.03**	**1.5**	**100.0**	**100.0**	**40.85**	**69.78**	**0.6**	**100.0**	**100.0**
Berycidae	03	19-20	<0.1			25.0		<0.01			25.0		-0.22			3.4		2.99			<0.1	
Bothidae	03	19-20	<0.1			13.8		<0.01			13.8		0.48			16.8		3.69			<0.1	
Carapidae	03	19-20	<0.1			8.8		<0.01			8.8		-0.22			3.4		2.99			<0.1	
Fistulariidae	03	19-20	<0.1			11.2		<0.01			11.2		0.25			10.1		3.47			<0.1	
Gempylidae	03	19-20		<0.1			12.7		0.07			12.7		1.29			51.9		6.27			<0.1
Unidentified	03	19-20	<0.1	<0.1	0.2	16.2	63.4	<0.01	0.35	<0.1	16.3	63.4	0.88	1.12	0.8	42.3	35.1	7.30	11.08	0.7	63.6	100.0

Unit:			(k / NM)					(MT / NM^3)					(log_{10}([n] / NM))					(log_{10}([n] / NM^3))				
Families	**24h**	**Pair**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**
Sternoptychidae	03	19-20		<0.1			21.1		0.12			21.1		0.21			4.3		5.19			<0.1
Tetraodontidae	03	19-20	<0.1	<0.1	7.4	25.0	2.8	<0.01	0.02	0.1	25.0	2.8	0.63	0.51	1.2	24.1	8.6	7.06	5.49	1.3	36.4	<0.1
Total	**03**	**19-20**	**<0.1**	**<0.1**	**0.8**	**100.0**	**100.0**	**<0.01**	**0.55**	**<0.1**	**100.0**	**100.0**	**1.25**	**1.58**	**0.8**	**100.0**	**100.0**	**7.50**	**11.08**	**0.7**	**100.0**	**100.0**
Echeneidae	03	22-23	<0.1			0.5		0.04			0.5		-0.19			<0.1		3.03			<0.1	
Fistulariidae	03	22-23	<0.1			<0.1		<0.01			<0.1		0.11			<0.1		3.33			<0.1	
Gonostomatidae	03	22-23	<0.1	<0.1	0.3	<0.1	2.6	<0.01	0.28	<0.1	<0.1	2.6	-0.19	-0.07	2.7	<0.1	<0.1	3.03	4.91	0.6	<0.1	<0.1
Myctophidae	03	22-23	4.23	<0.1	42.4	96.2	87.0	6.91	9.50	0.7	96.2	87.0	28.64	11.54	2.5	100.0	100.0	76.84	96.19	0.8	100.0	100.0
Unidentified	03	22-23	<0.1	<0.1	0.4	<0.1	3.2	<0.01	0.35	<0.1	<0.1	3.2	1.69	1.04	1.6	<0.1	<0.1	4.91	10.99	0.4	<0.1	<0.1
Paralepididae	03	22-23	0.14	<0.1	37.1	3.1	3.2	0.22	0.35	0.6	3.1	3.2	5.06	0.04	140.5	<0.1	<0.1	17.91	9.99	1.8	<0.1	<0.1
Phosichthyidae	03	22-23	<0.1	<0.1	2.4	<0.1	0.7	<0.01	0.08	<0.1	<0.1	0.7	1.82	0.53	3.4	<0.1	<0.1	8.24	5.51	1.5	<0.1	<0.1
Scopelarchidae	03	22-23	<0.1			<0.1		<0.01			<0.1		0.59			<0.1		3.80			<0.1	
Sternoptychidae	03	22-23		<0.1			0.4		0.05			0.4		0.23			<0.1		5.21			<0.1
Stomiidae	03	22-23		<0.1			2.8		0.30			2.8		1.03			<0.1		15.97			<0.1
Tetraodontidae	03	22-23	<0.1	<0.1	33.6	<0.1	<0.1	<0.01	<0.01	0.6	<0.1	<0.1	0.85	-0.07	<0.1	<0.1	<0.1	4.07	4.91	0.8	<0.1	<0.1
Total	**03**	**22-23**	**4.40**	**0.11**	**38.4**	**100.0**	**100.0**	**7.18**	**10.92**	**0.7**	**100.0**	**100.0**	**28.64**	**11.54**	**2.5**	**100.0**	**100.0**	**76.84**	**96.19**	**0.8**	**100.0**	**100.0**
Carangidae	04	28-29		<0.1			3.8		<0.01			3.8		-0.11			8.6		4.87			<0.1
Fistulariidae	04	28-29	<0.1	<0.1	0.3	4.2	38.5	<0.01	0.07	<0.1	4.2	38.5	0.06	0.19	0.3	33.3	17.3	3.28	5.17	0.6	33.3	<0.1
Myctophidae	04	28-29		<0.1			19.2		0.04			19.2		-0.34			5.1		14.60			100.0
Scorpaenidae	04	28-29		<0.1			3.8		<0.01			3.8		-0.11			8.6		4.87			<0.1
Sternoptychidae	04	28-29		<0.1			19.2		0.04			19.2		0.19			17.3		5.17			<0.1
Tetraodontidae	04	28-29	<0.1	<0.1	15.0	95.8	15.4	<0.01	0.03	0.3	95.8	15.4	0.36	0.59	0.6	66.7	43.1	3.58	5.56	0.6	66.7	<0.1
Total	**04**	**28-29**	**<0.1**	**<0.1**	**2.4**	**100.0**	**100.0**	**<0.01**	**0.19**	**<0.1**	**100.0**	**100.0**	**0.54**	**0.95**	**0.6**	**100.0**	**100.0**	**3.75**	**14.60**	**0.3**	**100.0**	**100.0**
Drepaneidae	05	31-32		<0.1			16.4		0.08			16.4		-0.08			7.8		4.90			<0.1
Fistulariidae	05	31-32	<0.1			36.4		<0.01			36.4		-0.18			50.0		3.03			50.0	
Gempylidae	05	31-32		<0.1			1.6		<0.01			1.6		0.23			15.6		5.20			<0.1
Myctophidae	05	31-32		<0.1			16.4		0.08			16.4		-0.08			7.8		4.90			<0.1
Unidentified	05	31-32		<0.1			44.3		0.22			44.3		0.62			38.9		5.60			<0.1
Notosudidae	05	31-32		<0.1			16.4		0.08			16.4		-0.08			7.8		4.90			<0.1
Paralepididae	05	31-32		<0.1			3.3		0.02			3.3		-0.15			6.5		9.81			100.0
Scopelarchidae	05	31-32		<0.1			1.6		<0.01			1.6		0.23			15.6		5.20			<0.1
Tetraodontidae	05	31-32	<0.1			63.6		<0.01			63.6		-0.18			50.0		3.03			50.0	
Total	**05**	**31-32**	**<0.1**	**<0.1**	**0.1**	**100.0**	**100.0**	**<0.01**	**0.49**	**<0.1**	**100.0**	**100.0**	**0.12**	**1.03**	**0.1**	**100.0**	**100.0**	**3.34**	**9.81**	**0.3**	**100.0**	**100.0**
Bothidae	05	34-35		<0.1			0.2		0.05			0.2		0.44			<0.1		5.42			<0.1
Gempylidae	05	34-35	<0.1			0.1		0.01			0.1		-0.05			<0.1		3.16			<0.1	
Gonostomatidae	05	34-35	<0.1	<0.1	<0.1	<0.1	17.3	<0.01	4.83	<0.1	<0.1	17.3	-0.05	2.63	<0.1	<0.1	<0.1	3.16	12.59	0.3	<0.1	<0.1
Melamphaidae	05	34-35		<0.1			0.4		0.12			0.4		0.74			<0.1		5.72			<0.1
Myctophidae	05	34-35	5.76	0.23	25.6	84.7	77.0	9.41	21.46	0.4	84.7	77.0	28.60	15.72	1.8	100.0	100.0	73.59	85.42	0.9	100.0	100.0
Nemichthyidae	05	34-35		<0.1			0.2		0.06			0.2		-0.26			<0.1		4.72			<0.1
Unidentified	05	34-35	<0.1	<0.1	6.9	0.2	0.6	0.02	0.16	0.1	0.2	0.6	1.53	0.94	1.6	<0.1	<0.1	4.74	5.92	0.8	<0.1	<0.1
Notosudidae	05	34-35		<0.1			1.1		0.31			1.1		0.52			<0.1		5.49			<0.1

Unit:			(k / NM)					(MT / NM^3)					(log_{10}([n] / NM))					(log_{10}([n] / NM^3))				
Families	**24h**	**Pair**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**	**M**	**K**	**M/K**	**M (%)**	**K (%)**
Paralepididae	05	34-35	<0.1	<0.1	2.8	0.2	1.3	0.02	0.36	<0.1	0.2	1.3	1.78	0.53	3.3	<0.1	<0.1	8.21	15.47	0.5	<0.1	<0.1
Phosichthyidae	05	34-35	<0.1	<0.1	8.1	0.6	1.8	0.07	0.49	0.1	0.6	1.8	2.24	1.67	1.3	<0.1	<0.1	5.45	6.65	0.8	<0.1	<0.1
Scombridae	05	34-35	0.96			14.1		1.57			14.1		0.49			<0.1		3.71			<0.1	
Stomiidae	05	34-35	<0.1			<0.1		<0.01			<0.1		-0.35			<0.1		2.86			<0.1	
Tetraodontidae	05	34-35		<0.1			<0.1		0.03			<0.1		0.04			<0.1		5.02			<0.1
Total	**05**	**34-35**	**6.80**	**0.29**	**23.2**	**100.0**	**100.0**	**11.10**	**27.87**	**0.4**	**100.0**	**100.0**	**28.60**	**15.72**	**1.8**	**100.0**	**100.0**	**73.59**	**85.42**	**0.9**	**100.0**	**100.0**

CHAPTER 4. CONCLUDING REMARKS

The mesopelagic survey carried out along the transect off Northwest Africa was executed according to plan, with no serious problems experienced. Moderate north-easterly winds were experienced during surveying, that did not inhibit the sampling effort. Mesoscale eddy structures that induced local upwelling and downwelling along the survey track were observed, also confirmed by satellite derived information. The survey was able to cover five 24h station, with full sampling coverage, which constitutes the highest number of 24h station fully sampled in this type of surveys with the R/V *Dr Fridtjof Nansen*. Moreover, the transect was extended further offshore than ever before, reaching depths of over 4 200 m. The previously observed pattern of increasing biodiversity when moving from inshore to offshore, with concurrent reduction in acoustic backscatter was also verified during the current survey. Increasing numbers of teleost fish families were captured as the survey moved offshore. Good quality comparative trawling data have allowed for a better insight on the efficiency of the two trawls used. Such knowledge can improve our understanding with regards to catchability/avoidance of the different mesopelagic functional groups targeted with different gear. The wealth of data collected will allow for important scientific work to be published, elucidating the structure and function of the mesopelagic community with respect to its ecological role, as well as to provide better biomass estimates for this potentially important resource. Information on all the types of biological samples collected is provided in Annex V.

ANNEX I. OCEANOGRAPHIC CORRECTIONS

The CTD vs TSG temperature, salinity and conductivity at 6m depth.

Figure I.1 presents the result of the linear fit between temperature (top left), salinity (top right) and conductivity (bottom). The CTD dataset includes the result at pressure from all stations occupied during survey 2019415. The corresponding TSG data were sub-sampled from the continuous underway record when the CTD probe during a cast sampled the water column at the TSG mounting depth (6 m). The TSG dataset supplied to this analysis was low-pass filtered from the original raw data using a 10-minute lag.

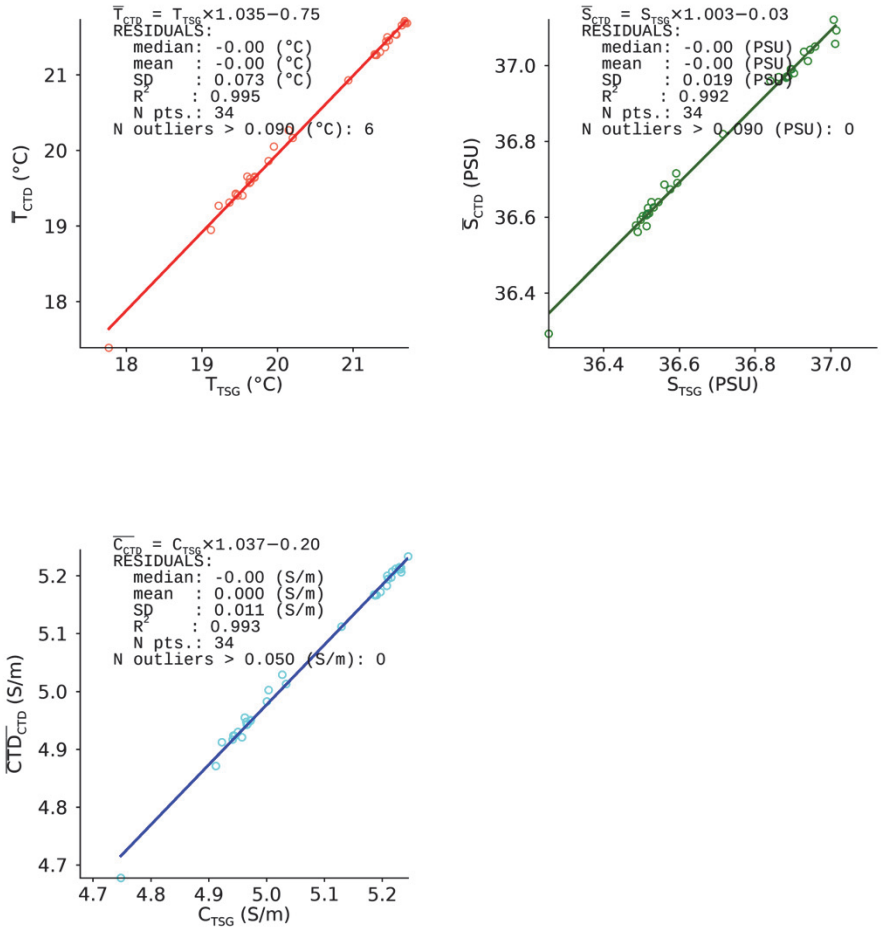
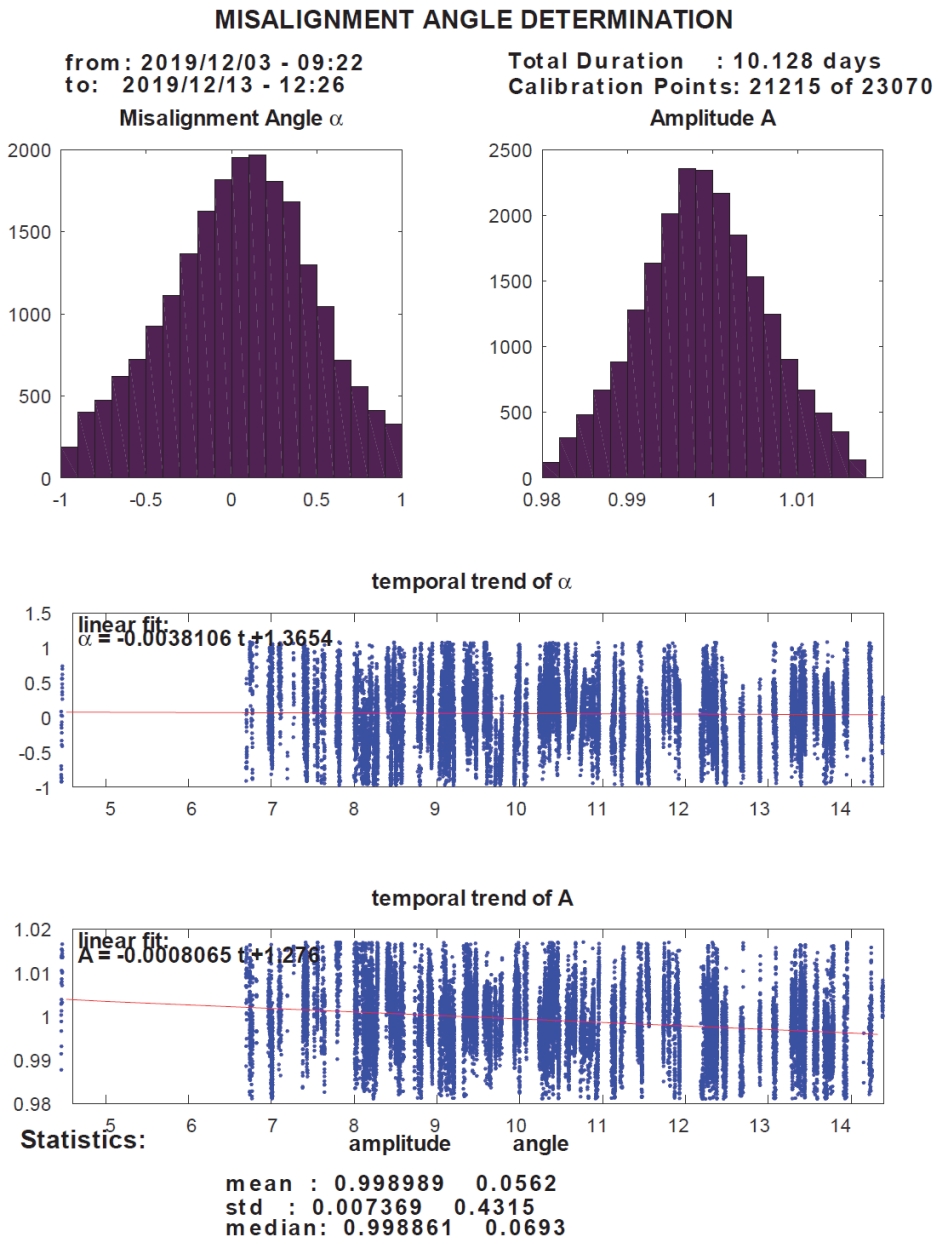


Figure I.1. Relationships between parameters measured by the CTD and the thermosalinograph

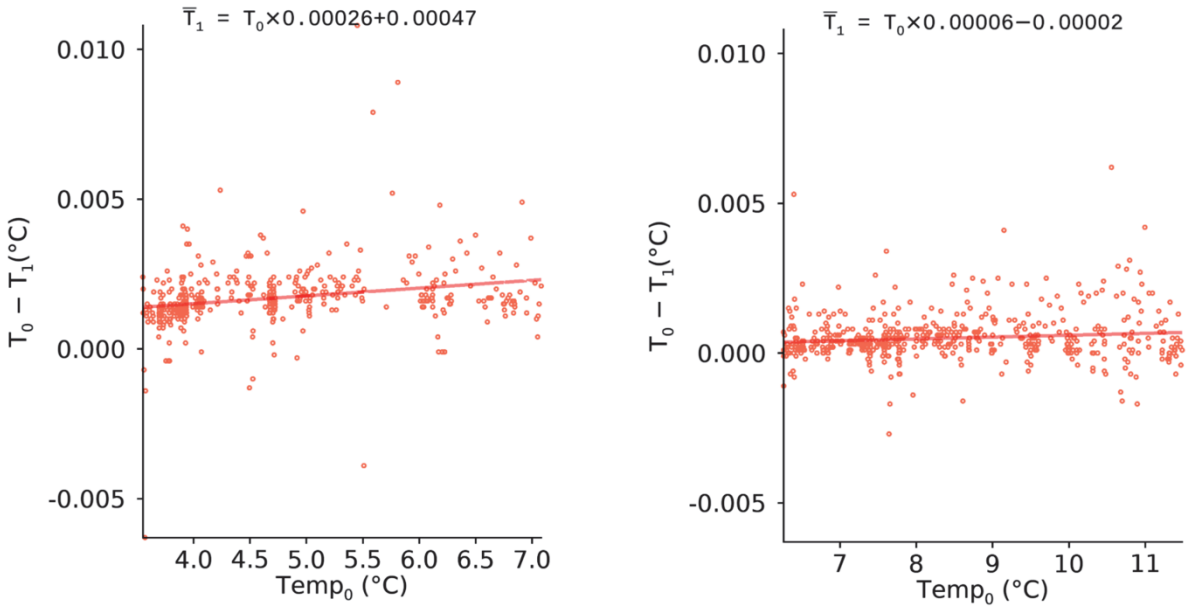
Misalignment correction of the 150 kHz ADCP.

Shown below is the protocol from the ADCP misalignment evaluation, preformed, according to Joyce (1989).



Relative drift of the temperature sensors mounted on the CTD probe used during the current survey.

The figure presents the changes between March (left) and December 2019 (right) of the temperature difference between the two sensors SBE 3 used on the SBE 911 CTD probe through 2019, SN1602 and SN4537. Both figures include the data from the depth range 500-100 m - at Sta 54 (left) and 1281 (right, this survey).



ANNEX II. OCEANOGRAPHIC SENSORS AND WATER CHEMISTRY QUALITY ASSURANCE

CTD Sensors

Type	Serial Number	Model	Calibration Date
Deck unit	11-1082	SBE 11plus	
Pressure sensor	127957	DigiQuartz	22.07.2013
Underwater unit	09P75372-1160	SBE 9plus 6800m	20.10.2018
Water sampler	32-0972	SBE 32 6800m	
Conductivity sensor	42037	SBE 4C 6800m	04.12.2018
Conductivity sensor	43080	SBE 4C 6800m	04.12.2018
Oxygen sensor	43-3525	SBE 43 7000m	02.02.2019
Submersible pump	52147	SBE 5T	2014
Submersible pump	054196	SBE 5T	
Temperature sensor	31602	SBE 3plus 6800m	18.12.2018
Temperature sensor	03P4537	SBE 3plus 6800m	18.12.2018
Fluorometer	FLRTD-4892	WET Labs ECO fluorometer	08.11.2017
Sonar Altimeter	1186	Benthos PSA-916	2005
Par sensor	1123	PAR-LOG ICSW	12.10.2017

Thermosalinograph Sensors – 4 m water intake

Type	Serial Number	Model	Calibration Date	Usage Start Date
Thermosalinograph	21-3418	SBE21	06.04.2016	15.04.2017
Conductivity sensor	3418	SBE21	06.04.2016	15.04.2017
Temperature sensor (Int)	3418	SBE21	06.04.2016	15.04.2017
Temperature sensor (Ext)	0880	SBE38	23.03.2016	15.04.2017
Fluorometer	2300402	Turner Designs C3	06.2019	21.11.2019

Water Chemistry Quality Assurance

pH and total alkalinity samples were measured in triplicates.

Parameter	Sample count	Average Triplicate* Standard Deviation
pH (25°C)	88	0.002
Total alkalinity	88	1.82

*Erroneous values removed

Fluorometric standard measurements were performed to quality assure chlorophyll a and phaeopigment measurements:

Parameter	Low Standard	High Standard
Standard Average	496	4304
Average Drift	-35	-300
Standard Deviation	20	173

CTD dissolved oxygen and salinity value validity statistics

Parameter	Sample Count	Offset from factory calibration
Dissolved Oxygen	7	1.9%
Salinity	N/A	N/A

The Portasal salinometer was not available onboard during Leg 4.5 (under repair) and therefore it was not possible to validate conductivity-derived salinity values from the CTD.

Annex III. DESCRIPTION OF ACOUSTIC INSTRUMENTS AND SAMPLING NETS

Acoustic instruments

The Simrad EK80/18, 38, 70, 120, 200 and 333 kHz scientific sounder was run during the survey. Acoustic data were recorded mainly in CW mode, but during the 24h stations 30-minute registrations were also taken during daytime and night-time in FM mode. Detailed postprocessing and scrutinizing of the acoustic data will require a priori analyses of samples obtained with the plankton nets and the sampling trawls and development of acoustic filters for separation of target groups. The last standard sphere calibration carried out on 05.10.2019 outside Dakar, Senegal, 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 transceiver. The settings for the 38 kHz transceiver, in CW mode, were as follows:

Transceiver 2 menu (38 kHz, CW)		
Transducer depth	5 m / 8 m	
Absorbtion coeff.	8.390 dB/km	
Pulse duration	medium (1024 ms)	
Max power	2000 Watt	
Equivalent beam angle	-20.7 dB	
gain	26.18 dB	
sA correction	-0.3386 dB	
Angle sensitivity	18	
3 dB beamwidth	6.83º alongship	6.85º athwartship
Alongship offset	-0.08º	
Athwardship offset	-0.07º	

The WBAT transducers were calibrated after the survey, on 23.01.2020 outside Las Palmas, Spain, using a WC38.1 calibration sphere. New gains were calculated with measurements made on the beam axis and introduced during post-processing in LSSS. Transducer details and settings applied are shown in the table below.

Name	ES70-18CD	ES200-7CD
Frequency [Hz]	70000	200000
Angle sensitivity	10.0	23.0
Beam width alongship [deg]	18.0	7.0
Beam width athw.ship [deg]	18.0	7.0
Equivalent beam angle [dB]	-13.0	-20.7
Gain [dB]	20.2	26.5
sA correction [dB]	0.0	0.0
Pulse duration [ms]	0.512	0.512
Transmit power [W]	125.0	75.0

WBAT deployment log

DATE	TIME (UTC)	Vessel log	Longitude	Latitude	Bottom depth (m)	CTD station #	Deployment type	Transducer orientation	Deployment depth (m)	Pulse type
07/12/2019	00:01:24	6405.01	-16.0132	25.3716	257	HD1270	Failed WBAT deployment	-	-	-
07/12/2019	14:19:32	6437.71	-16.0136	25.3707	256	HD1272	Failed WBAT deployment	-	-	-
07/12/2019	16:00:23	6439.27	-16.0149	25.3708	258	HD1274	Failed WBAT deployment	-	-	-
07/12/2019	20:06:38	6445.37	-16.0072	25.3733	250	HD1275	Failed WBAT deployment	-	-	-
07/12/2019	21:22:32	6445.39	-16.0063	25.3722	247	HD1276	Profile	Sideways looking	240	CW
07/12/2019	22:14:45	6445.39	-16.0082	25.3734	252	HD1277	TS measurements at layer	Downward looking	43	CW
09/12/2019	12:35:57	6547.9	-16.3199	25.506	1450	HD1285	Profile	Sideways looking	1450	CW
09/12/2019	15:42:36	6553.29	-16.3194	25.504	1457	HD1286	TS measurements at layer	Downward looking	250	FM
10/12/2019	17:37:41	6672.85	-17.7278	26.1212	3000	HD1290	Profile	Sideways looking	1000	CW
11/12/2019	00:33:51	6694.21	-17.7294	26.1185	3557	HD1291	Profile	Sideways looking	1000	CW
12/12/2019	03:22:23	6806.4	-19.1348	26.6691	3740	HD1295	TS measurements at layer	Downward looking	450	CW
12/12/2019	05:08:37	6806.44	-19.1351	26.6691	3740	HD1296	Profile	Sideways looking	800	CW
12/12/2019	12:45:34	6825.91	-19.0926	26.6426	3740	HD1297	Profile	Sideways looking	800	CW
13/12/2019	17:14:56	6952.4	-20.6653	27.2212	4272	HD1301	Profile	Sideways looking	1000	CW
13/12/2019	23:28:10	6967.73	-20.6085	27.2196	4272	HD1302	Profile	Sideways looking	1000	CW
14/12/2019	02:03:43	6973.71	-20.6646	27.2205	4272	HD1303	TS measurements at layer	Downward looking	100	CW

Fishing gear

Two four-panel pelagic sampling trawls were used during the survey: a MultPelt 624 trawl (Figure III.1) and a 'Krill trawl' (Figure III.2).

The MultPelt 624 (624 m circumference of the mouth opening) is a downscaled version of the the MultPelt 832 (832 m circumference), which is used for swept area estimates of near surface distributed mackerel in the Norwegian Sea during summer. The MultPelt trawls are designed for effectively catching fast swimming pelagic fish, with main features being a big mouth opening and relatively low towing speed, providing relatively high maximum tow speeds (appr. 5.5 knots). The horizontal opening of the MultPelt 624 is about 60 m and the vertical opening is about 35 m, giving a mouth opening of about 2 100 m^2. Meshes are progressively smaller from the from the fore section (12 m in the wings) towards the aft (22 mm in the codend). In tows targeted towards mesopelagic fish the he codend (33 m length) the trawl was fitted with the DeepVision system, and the aft 2/3 part of the codend (22 m) was fitted with a fine-meshed inner liner (8 mm).

The Krill trawl is s designed especially for catching small fish and large zooplankton without loss of fish through escapement through the meshes. The horizontal and vertical opening of the Krill trawl are about 6 m, giving a mouth opening cross section of about 36 m^2. The mesh sizes (8 mm, stretched mesh) are the same throughout the trawl. The krill trawl was used in dedicated comparative trials with the MultPelt 624 trawl targeting mesopelagic organisms.

The SCANMAR trawl monitoring system was used during all trawl hauls. The system consists of various 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 depth, door spread and angle, and a trawl eye sensor on the headline that provides information about the trawl opening and the distance of the footrope to the bottom.

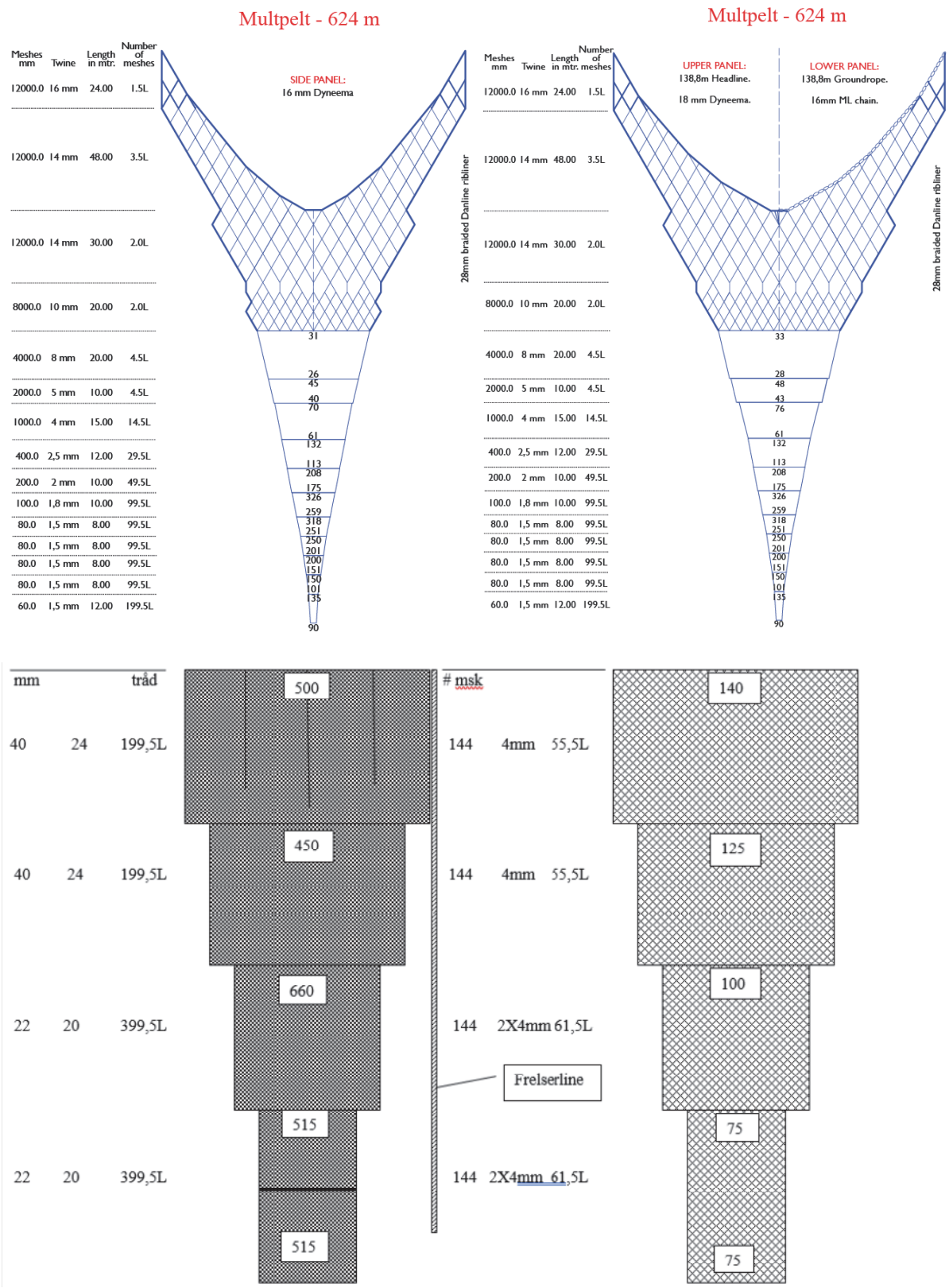


Figure III.1. Multpelt 624 (top) and codend (bottom). The aft 22 m of the codend are lined with 8 mm knotless mesh (not shown)

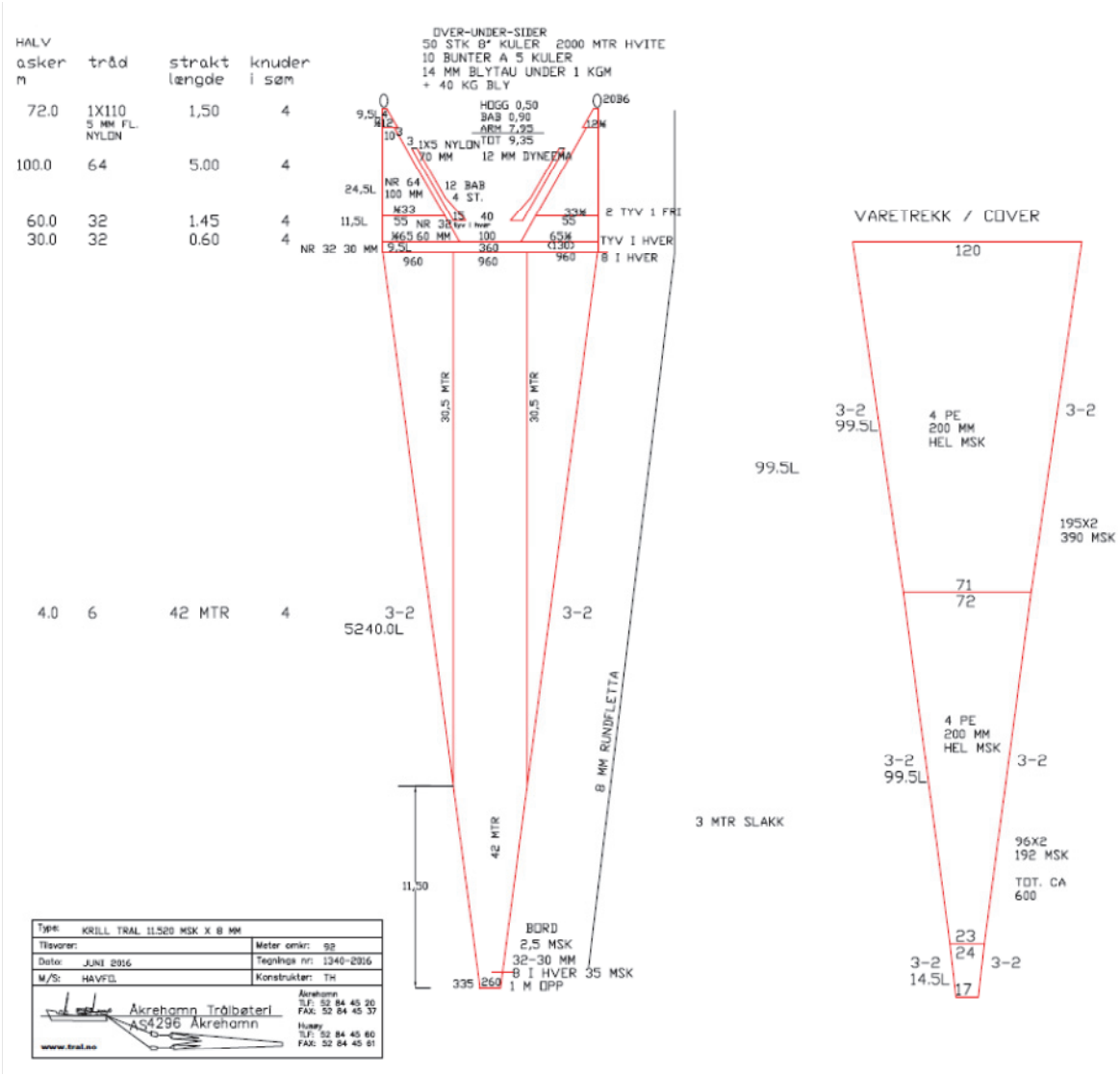


Figure III.2. Schematic drawing of the Krill trawl

ANNEX IV. Records of fishing stations

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 1
DATE :06/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°22.34
start stop duration Lon W 16°0.85
TIME :18:15:28 19:12:05 56.6 (min) Purpose : 1
LOG : 6391.11 6393.63 2.5 Region : 1100
FDEPTH: 190 0 Gear cond.: 0
BDEPTH: 260 243 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 2.7 kn
Sorted : 1 Total catch: 3.10 Catch/hour: 3.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	2.31	3460	70.24	1
Diaphus taaningi	0.33	205	10.07	
Krill	0.29	4132	8.78	
Diaphus dumerilii	0.28	156	8.39	
J E L L Y F I S H	0.07	3	2.13	
Leptocephalus	0.00	4	0.14	
SALPS	0.00	0	0.14	
BOTHIDAE, juvenile	0.00	4	0.14	
Total	3.29		100.04	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 2
DATE :06/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°23.07
start stop duration Lon W 16°0.52
TIME :22:03:09 22:48:08 45.0 (min) Purpose : 1
LOG : 6399.19 6401.19 2.0 Region : 1100
FDEPTH: 45 55 Gear cond.: 0
BDEPTH: 269 248 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 2.7 kn
Sorted : 0 Total catch: 42.60 Catch/hour: 56.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	56.57	40409	99.57	2
J E L L Y F I S H	0.17	8	0.29	
Cheilopogon sp.	0.08	1	0.14	
Waste General	0.00	0	0.00	
Total	56.81		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 3
DATE :07/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°23.37
start stop duration Lon W 16°0.08
TIME :01:27:32 02:12:32 45.0 (min) Purpose : 1
LOG : 6406.30 6408.70 2.4 Region : 1100
FDEPTH: 45 55 Gear cond.: 0
BDEPTH: 261 256 Validity : 0
Towing dir: 0° Wire out : 80 m Speed : 3.2 kn
Sorted : 0 Total catch: 170.04 Catch/hour: 226.72

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	225.75	137867	99.57	3
Todarodes sagittatus	0.97	4	0.43	
Total	226.72		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 4
DATE :07/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°24.68
start stop duration Lon W 15°59.00
TIME :06:49:34 07:45:13 55.7 (min) Purpose : 1
LOG : 6419.25 6421.05 1.8 Region : 1100
FDEPTH: 230 0 Gear cond.: 0
BDEPTH: 253 259 Validity : 0
Towing dir: 0° Wire out : 450 m Speed : 1.9 kn
Sorted : 1 Total catch: 7.60 Catch/hour: 8.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	5.60	86173	68.35	
Maurolicus muelleri	2.45	3852	29.94	4
Penaeopsis serrata	0.08	25	1.01	
J E L L Y F I S H	0.02	0	0.27	
Trachurus sp., juvenile	0.02	12	0.20	
SALPS	0.01	3	0.12	
Leptocephalus	0.01	12	0.08	
Plesionika heterocarpus	0.00	1	0.03	
Total	8.20		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 5
DATE :07/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°21.55
start stop duration Lon W 16°1.20
TIME :08:26:26 09:12:22 45.9 (min) Purpose : 1
LOG : 6423.00 6425.34 2.4 Region : 1100
FDEPTH: 220 220 Gear cond.: 0
BDEPTH: 247 261 Validity : 0
Towing dir: 0° Wire out : 700 m Speed : 3.1 kn
Sorted : 0 Total catch: 752.37 Catch/hour: 982.85

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brama brama	956.24	1400	97.29	
Maurolicus muelleri	14.51	36152	1.48	
Krill	11.87	169637	1.21	
Sphoeroides pachygaster	0.22	1	0.02	
Total	982.85		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 6
DATE :07/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°21.71
start stop duration Lon W 16°1.40
TIME :11:15:56 12:00:27 44.5 (min) Purpose : 1
LOG : 6431.85 6433.73 1.9 Region : 1100
FDEPTH: 220 220 Gear cond.: 0
BDEPTH: 256 241 Validity : 0
Towing dir: 0° Wire out : 550 m Speed : 2.5 kn
Sorted : 0 Total catch: 9.52 Catch/hour: 12.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	9.91	47190	77.18	
Krill	1.78	59171	13.86	
SALPS	0.99	4439	7.71	
J E L L Y F I S H	0.16	9	1.22	
Leptocephalus	0.01	4	0.05	
PARALEPIDIDAE	0.00	1	0.01	
Bothidae sp. juvenile	0.00	1	0.01	
Total	12.84		100.04	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 7
DATE :07/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°22.51
start stop duration Lon W 16°0.55
TIME :18:29:16 19:26:00 55.5 (min) Purpose : 1
LOG : 6439.69 6442.19 2.5 Region : 1100
FDEPTH: 220 0 Gear cond.: 0
BDEPTH: 256 249 Validity : 0
Towing dir: 0° Wire out : 550 m Speed : 3.0 kn
Sorted : 1 Total catch: 65.55 Catch/hour: 70.87

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	62.89	38472	88.75	6
Maurolicus muelleri	6.86	8252	9.68	5
Krill	0.78	11151	1.10	
SALPS	0.39	3227	0.55	
Total	70.92		100.08	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 8
DATE :07/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°23.43
start stop duration Lon W 15°59.99
TIME :23:50:35 00:05:33 15.0 (min) Purpose : 1
LOG : 6446.51 6447.30 0.8 Region : 1100
FDEPTH: 45 45 Gear cond.: 0
BDEPTH: 260 263 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.1 kn
Sorted : 0 Total catch: 110.32 Catch/hour: 442.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	441.18	285465	99.71	
Todarodes sagittatus	1.28	4	0.29	
Total	442.46		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 9
DATE :08/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°24.33
start stop duration Lon W 15°59.22
TIME :01:09:11 01:24:10 15.0 (min) Purpose : 1
LOG : 6451.37 6452.08 0.7 Region : 1100
FDEPTH: 45 45 Gear cond.: 0
BDEPTH: 253 261 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 2.9 kn
Sorted : 0 Total catch: 4.58 Catch/hour: 18.35

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	15.09	12584	82.24	
SALPS	2.88	2061	15.71	
Krill	0.20	4667	1.09	
J E L L Y F I S H	0.19	8	1.05	
Total	18.36		100.09	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 10
DATE :08/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°26.05
start stop duration Lon W 16°14.45
TIME :09:23:54 09:57:45 33.9 (min) Purpose : 1
LOG : 6473.39 6474.91 1.5 Region : 1100
FDEPTH: 200 350 Gear cond.: 0
BDEPTH: 925 925 Validity : 5
Towing dir: 0° Wire out : 800 m Speed : 2.7 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
N O C A T C H	0.00	0	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 11
DATE :08/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°31.16
start stop duration Lon W 16°17.78
TIME :15:44:26 16:35:05 50.6 (min) Purpose : 1
LOG : 6490.03 6492.33 2.3 Region : 1100
FDEPTH: 200 350 Gear cond.: 0
BDEPTH: 1443 1443 Validity : 0
Towing dir: 0° Wire out : 800 m Speed : 2.7 kn
Sorted : 1 Total catch: 140.98 Catch/hour: 167.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	139.88	173185	83.76	
Lobianchia dofleini	12.43	20982	7.44	
Diaphus rafinesquii	5.66	2997	3.39	
Notoscopelus resplendens	1.60	333	0.96	
Diaphus perspicillatus	1.43	666	0.86	
J E L L Y F I S H	0.81	30	0.48	
Chauliodus sloani	0.70	107	0.42	
Hygophum benoiti	0.66	333	0.40	
Diaphus metopoclampus	0.66	333	0.40	
Ceratoscopelus maderensis	0.66	666	0.40	
OPLOPHORIDAE	0.48	302	0.29	
Diaphus termophilus	0.46	333	0.28	
Krill	0.33	10946	0.20	
Heteroteuthis dispar	0.29	77	0.17	
Sudis hyalina	0.20	4	0.12	
Diaphus holti	0.13	333	0.08	
Abraliopsis (Abraliopsis) morisii	0.13	47	0.08	
Vinciguerria attenuata	0.09	333	0.06	
SALPS	0.09	11	0.05	
Diretmus argenteus	0.07	11	0.04	
Gonostoma denudatum	0.06	7	0.04	
TRICHIURIDAE	0.04	7	0.02	
Cubiceps gracilis	0.04	4	0.02	
Systellaspis sp.	0.03	44	0.02	
PYROTEUTHIDAE	0.02	14	0.01	
Argyropelecus aculeatus	0.01	7	0.01	
Sternoptyx diaphana	0.01	7	0.01	
Total	166.99		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 12
DATE :08/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°29.86
start stop duration Lon W 16°19.41
TIME :18:33:09 19:36:31 63.4 (min) Purpose : 1
LOG : 6498.96 6501.10 2.1 Region : 1100
FDEPTH: 400 0 Gear cond.: 0
BDEPTH: 1443 1443 Validity : 0
Towing dir: 0° Wire out : 700 m Speed : 2.0 kn
Sorted : 1 Total catch: 7.00 Catch/hour: 6.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	4.26	71153	64.30	
Diaphus dumerilii	0.38	541	5.80	
Systellaspis sp.	0.32	487	4.81	
Lobianchia dofleini	0.31	509	4.67	
J E L L Y F I S H	0.25	12	3.71	
Ceratoscopelus maderensis	0.13	108	1.99	
OPLOPHORIDAE	0.13	162	1.90	
Lampanyctus atrum	0.12	32	1.80	
Nannobrachium isaacsi	0.11	10	1.60	
Benthosema glaciale	0.09	227	1.30	
Stomias boa boa	0.07	2	1.00	
Eusergestes antarcticus	0.07	141	0.99	
Spirula spirula	0.06	10	0.94	
Sigmops elongatus	0.06	6	0.92	
Diaphus termophilus	0.05	10	0.76	
Notoscopelus resplendens	0.03	10	0.46	
Symbolophorus veranyi	0.03	10	0.39	
PYROTEUTHIDAE	0.02	22	0.36	
Vinciguerria attenuata	0.02	54	0.34	
Sergia robusta	0.02	4	0.30	
Chauliodus sloani	0.02	2	0.26	
Diaphus rafinesquii	0.02	10	0.26	
Nemichthys scolopaceus	0.02	3	0.23	
Melanocetus johnsonii	0.01	1	0.18	
Unidentified juvenile fish	0.01	10	0.16	
Diaphus holti	0.01	10	0.16	
ISOPODS	0.01	10	0.16	
Borostomias mononema	0.01	1	0.09	
Diretmus argenteus	0.01	1	0.09	
Gnathophausia sp.	0.00	1	0.03	
Howella sp.	0.00	7	0.03	
Argyropelecus aculeatus	0.00	3	0.03	
Melanocetus sp.	0.00	1	0.02	
Margrethia obtusirostra	0.00	1	0.01	
PLATYTROCTIDAE	0.00	1	0.00	
Total	6.63		100.02	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 13
DATE :09/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°30.68
start stop duration Lon W 16°18.51
TIME :00:44:11 01:04:13 20.0 (min) Purpose : 1
LOG : 6515.34 6516.08 0.7 Region : 1100
FDEPTH: 50 50 Gear cond.: 0
BDEPTH: 1443 1443 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 2.2 kn
Sorted : 0 Total catch: 6.74 Catch/hour: 20.17

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	7.85	267	38.90	
Diaphus dumerilii	3.26	131970	16.15	7
Krill	3.05	76311	15.13	
Ceratoscopelus maderensis	2.33	5206	11.57	8
Notoscopelus resplendens	1.70	539	8.45	
Lobianchia dofleini	0.99	1794	4.90	
OPLOPHORIDAE	0.27	989	1.34	
Benthosema glaciale	0.18	809	0.89	
Nealotus tripes	0.18	21	0.89	
Hygophum benoiti	0.09	180	0.45	
Diaphus perspicillatus	0.09	270	0.45	
Symbolophorus veranyi	0.09	180	0.45	
Ceratoscopelus warmingii	0.09	270	0.45	
Total	20.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 14
DATE :09/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°31.42
start stop duration Lon W 16°17.34
TIME :02:21:07 02:41:40 20.5 (min) Purpose : 1
LOG : 6519.33 6520.49 1.2 Region : 1100
FDEPTH: 50 50 Gear cond.: 0
BDEPTH: 1443 1443 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.4 kn
Sorted : 0 Total catch: 16.29 Catch/hour: 47.57

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	29.53	39056	62.08	
Ceratoscopelus maderensis	5.05	5369	10.62	
Notoscopelus resplendens	3.94	876	8.29	
Hygophum benoiti	2.22	987	4.67	
Notoscopelus bolini	2.22	549	4.67	
Nealotus tripes	1.16	108	2.44	
Lobianchia dofleini	0.73	1408	1.54	
OPLOPHORIDAE	0.54	1090	1.14	
Hygophum hygomii	0.32	111	0.68	
Diaphus taaningi	0.32	111	0.68	
Cubiceps gracilis	0.29	6	0.61	
Diaphus perspicillatus	0.28	438	0.60	
J E L L Y F I S H	0.24	9	0.50	
Leptocephalus	0.22	193	0.46	
Symbolophorus veranyi	0.16	1525	0.34	
OMMASTREPHIDAE	0.16	79	0.34	
Hygophum taaningi	0.06	219	0.14	
Ceratoscopelus warmingii	0.03	111	0.07	
Argyropelecus aculeatus	0.01	3	0.03	
Total	47.51		99.87	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 15
DATE :09/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°30.57
start stop duration Lon W 16°18.70
TIME :07:10:13 07:32:59 22.8 (min) Purpose : 1
LOG : 6532.17 6532.70 0.5 Region : 1100
FDEPTH: 210 0 Gear cond.: 0
BDEPTH: 1443 1443 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 1.4 kn
Sorted : 4 Total catch: 4.42 Catch/hour: 11.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	8.96	112039	76.85	
J E L L Y F I S H	1.14	37	9.79	
OPLOPHORIDAE	0.43	554	3.73	
Lobianchia dofleini	0.37	749	3.21	
Diaphus dumerilii	0.35	614	2.96	
Ceratoscopelus maderensis	0.09	100	0.79	
Systellapis debilis	0.05	66	0.45	
Vinciguerria attenuata	0.05	129	0.43	
Sigmops elongatus	0.04	5	0.36	
Diaphus rafinesquii	0.03	16	0.23	
Diaphus holti	0.02	32	0.16	
Diaphus effulgens	0.02	3	0.14	
Eusergestes antarcticus	0.01	29	0.11	
Stomias boa boa	0.01	34	0.11	
Diplospinus multistriatus	0.01	3	0.11	
Leptocephalus	0.01	11	0.09	
Lampanyctus photonotus	0.01	5	0.09	
PYROTEUTHIDAE	0.01	11	0.09	
Heteroteuthis dispar	0.01	3	0.09	
Hygophum hygomii	0.01	3	0.05	
Lampanyctus alatus	0.01	3	0.05	
Hygophum benoiti	0.00	3	0.02	
Trachurus sp., juvenile	0.00	5	0.02	
Nemichthys scolopaceus	0.00	3	0.02	
Benthosema glaciale	0.00	3	0.02	
Diaphus perspicillatus	0.00	3	0.02	
Total	11.66		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 16
DATE :09/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°31.46
start stop duration Lon W 16°17.16
TIME :08:10:40 08:42:03 31.4 (min) Purpose : 1
LOG : 6533.86 6534.84 1.0 Region : 1100
FDEPTH: 200 320 Gear cond.: 0
BDEPTH: 1443 1443 Validity : 0
Towing dir: 0° Wire out : 450 m Speed : 1.9 kn
Sorted : 1 Total catch: 1.01 Catch/hour: 1.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lobianchia dofleini	0.71	973	37.00	
Krill	0.37	103493	19.40	
OPLOPHORIDAE	0.19	357	9.95	
Lobianchia gemellarii	0.15	76	7.96	
SALPS	0.14	539	7.16	
Diaphus dumerilii	0.08	206	4.08	
J E L L Y F I S H	0.08	71	3.98	
Vinciguerria attenuata	0.06	241	2.88	
Chauliodus sloani	0.02	11	1.19	
Diaphus holti	0.02	15	0.99	
Unidentified juvenile fish	0.02	50	0.99	
Diaphus rafinesquii	0.02	10	0.90	
Stomias boa boa	0.01	2	0.70	
Ceratoscopelus maderensis	0.01	46	0.70	
Gonostoma denudatum	0.01	4	0.60	
Argyrosomus heinii	0.01	21	0.41	
Hygophum taaningi	0.00	2	0.20	
Nemichthys scolopaceus	0.00	4	0.20	
PSYCHROTEUTHIDAE	0.00	4	0.18	
Platyberyx sp, juvenile	0.00	2	0.10	
Diaphus mollis	0.00	4	0.10	
Diaphus perspicillatus	0.00	2	0.10	
Benthosema glaciale	0.00	4	0.10	
Margrethia cf obtusirostra	0.00	4	0.10	
Gonichthys cocco	0.00	2	0.01	
Valenciennellus tripunctulatus	0.00	2	0.01	
Hygophum benoiti	0.00	2	0.01	
Leptocephalus	0.00	2	0.01	
Total	1.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 17
DATE :09/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°31.41
start stop duration Lon W 16°17.88
TIME :10:56:13 11:27:18 31.1 (min) Purpose : 1
LOG : 6541.64 6543.12 1.5 Region : 1100
FDEPTH: 200 200 Gear cond.: 0
BDEPTH: 1443 1443 Validity : 0
Towing dir: 0° Wire out : 680 m Speed : 2.9 kn
Sorted : 1 Total catch: 21.38 Catch/hour: 41.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lobianchia dofleini	27.60	4498	66.87	
Diaphus dumerilii	6.64	13137	16.10	0
Diaphus rafinesquii	2.04	1380	4.95	
Ceratoscopelus maderensis	1.53	6031	3.71	
Heteroteuthis dispar	1.02	307	2.48	
Vinciguerria attenuata	0.51	1790	1.24	
Diaphus perspicillatus	0.51	614	1.24	
PYROTEUTHIDAE	0.51	153	1.24	
OPLOPHORIDAE	0.51	307	1.24	
J E L L Y F I S H	0.21	8	0.51	
Argyropelecus aculeatus	0.05	25	0.11	
Chauliodus sloani	0.04	6	0.09	
SALPS	0.03	29	0.07	
Diaphus dumerilii	0.02	6	0.06	
Symbolophorus veranyi	0.01	2	0.03	
Notoscopelus resplendens	0.01	2	0.03	
Gonostoma denudatum	0.00	2	0.01	
Margrethia obtusirostra	0.00	2	0.01	
Sternoptyx diaphana	0.00	2	0.01	
Argyropelecus hemigymnus	0.00	6	0.00	
Total	41.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 18
DATE :10/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°8.16
start stop duration Lon W 17°42.97
TIME :07:31:47 08:34:05 62.3 (min) Purpose : 1
LOG : 6644.82 6647.47 2.6 Region : 1100
FDEPTH: 700 0 Gear cond.: 0
BDEPTH: 3000 3558 Validity : 0
Towing dir: 0° Wire out : 900 m Speed : 2.6 kn
Sorted : 0 Total catch: 1.03 Catch/hour: 0.99

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	0.51	1913	51.41	
Cyclothone sp.	0.11	1477	11.30	
Cyclothone braueri	0.10	1260	9.64	
ISOPODS	0.05	364	4.87	
Cyclothone microdon	0.02	121	2.43	
OPLOPHORIDAE	0.02	38	2.04	
Chauliodus danae	0.02	13	2.04	
Acanthephyra sp.	0.02	18	2.04	
Systellapis debilis	0.02	17	1.66	
Sergia robusta	0.02	27	1.56	
Eusergestes antarcticus	0.01	49	1.17	
Ceratoscopelus warmingii	0.01	23	0.91	
Sigmops elongatus	0.01	2	0.88	
Hygophum taaningi	0.01	11	0.78	
Bathophilus vaillanti	0.01	1	0.68	
Diaphus rafinesquii	0.01	1	0.68	
Abraliopsis sp.	0.00	2	0.39	
Argyropelecus hemigymnus	0.00	17	0.39	
Bolanichthys indicus	0.00	18	0.34	
Nemichthys scolopaceus	0.00	3	0.29	
Gnathophausia sp.	0.00	9	0.29	
Lobianchia dofleini	0.00	7	0.26	
Cranchia scabra	0.00	1	0.19	
Gonostoma denudatum	0.00	1	0.19	
Serrivomer beanii	0.00	1	0.19	
Valenciennellus tripunctulatus	0.00	16	0.19	
C R A B S, juvenile	0.00	15	0.19	
Vinciguerria attenuata	0.00	27	0.19	
Opisthoproctus soleatus	0.00	1	0.19	
HETEROTEUTHIDINAE	0.00	1	0.17	
A M P H I P O D A	0.00	14	0.16	
Notoscopelus resplendens	0.00	1	0.13	
Unidentified juvenile fish	0.00	6	0.10	
Leptocephalus	0.00	3	0.10	
Evermannella melanoderma	0.00	1	0.10	
Bonapartia pedaliota	0.00	3	0.10	
Diplophos taenia	0.00	1	0.10	
Benthosema suborbitale	0.00	2	0.10	
Bolanichthys supralateralis	0.00	1	0.10	
Diaphus mollis	0.00	6	0.10	
Diaphus brachycephalus	0.00	2	0.10	
Hygophum proximum	0.00	2	0.10	
Lepidophanes gaussi	0.00	4	0.10	
Lampanyctus sp.	0.00	2	0.10	
Lampanyctus alatus	0.00	1	0.10	
Lampanyctus photonotus	0.00	2	0.10	
Lampanyctus crocodilus	0.00	3	0.10	0
Notolychnus valdiviae	0.00	1	0.10	
Sudis sp.	0.00	1	0.10	
S H R I M P S	0.00	7	0.10	
C E P H A L O P O D A	0.00	3	0.10	
Argyropelecus aculeatus	0.00	1	0.10	
Sternoptyx sp.	0.00	5	0.10	
Argyropelecus gigas	0.00	2	0.06	
Scopelarchus analis	0.00	1	0.05	
Astronesthes neopogon	0.00	1	0.02	
Symbolophorus rufinus	0.00	2	0.02	
PYROTEUTHIDAE	0.00	1	0.02	
Hygophum hygomii	0.00	1	0.01	
Scopelosaurus sp.	0.00	1	0.01	
Total	0.99		100.10	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 19
DATE :10/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°7.51
start stop duration Lon W 17°44.28
TIME :10:05:15 10:35:38 30.4 (min) Purpose : 1
LOG : 6653.48 6654.71 1.2 Region : 1100
FDEPTH: 90 110 Gear cond.: 0
BDEPTH: 3000 3558 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 2.4 kn
Sorted : 0 Total catch: 0.23 Catch/hour: 0.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	0.43	0	93.97	
Leptocephalus	0.01	8	1.72	
S H R I M P S, juvenile	0.00	79	0.86	
Argyropelecus hemigymnus	0.00	4	0.65	
Cranchia scabra	0.00	2	0.43	
CRANCHIIDAE	0.00	2	0.43	
Nealotus sp, juvenile	0.00	47	0.39	
STOMATOPODA, juvenile	0.00	2	0.30	
P O L Y C H A E T A	0.00	6	0.26	
Brachyura spp.	0.00	34	0.22	
Unidentified juvenile fish	0.00	10	0.22	
PALINURIDAE	0.00	16	0.17	
Unidentified crustacean larvae	0.00	10	0.13	0
TETRAODONTIDAE, juvenile	0.00	8	0.09	
C E P H A L O P O D A	0.00	2	0.04	
Unidentified crustacean larvae	0.00	4	0.04	
Lobster larvae	0.00	4	0.04	
Total	0.46		99.96	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 20
DATE :10/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 26°7.89
start stop duration Lon W 17°43.70
TIME :11:27:09 11:57:35 30.4 (min) Purpose : 1
LOG : 6658.69 6660.36 1.7 Region : 1100
FDEPTH: 90 100 Gear cond.: 0
BDEPTH: 3558 3000 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 3.3 kn
Sorted : 0 Total catch: 0.05 Catch/hour: 0.10

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	0.04	0	38.68	
J E L L Y F I S H	0.03	10	29.01	
Small crabs, juvenile	0.00	45	4.84	
Beryx decadactylus, juvenile	0.00	2	3.87	
OCTOPODIDAE	0.00	8	3.48	
BOTHIDAE, juvenile	0.00	10	2.13	
TETRAODONTIDAE, juvenile	0.00	12	1.93	
OPLOPHORIDAE	0.00	2	1.93	
Lagocephalus lagocephalus, juvenile	0.00	4	1.93	
Cranchia scabra	0.00	2	1.93	
Fistularia sp., juvenile	0.00	6	1.74	
C R A B S, juvenile	0.00	14	1.74	
Leptocephalus	0.00	6	1.55	
CARAPIDAE, juvenile	0.00	2	1.35	
Hyaloteuthis pelagica	0.00	2	1.35	
Unidentified juvenile fish	0.00	14	0.97	
A M P H I P O D A	0.00	16	0.97	
ENOPLOTEUTHIDAE	0.00	2	0.19	
Unidentified crustacean larvae	0.00	4	0.19	
OMMASTREPHIDAE	0.00	2	0.19	
Total	0.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 21
DATE :10/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°7.51
start stop duration Lon W 17°43.23
TIME :18:35:41 19:42:47 67.1 (min) Purpose : 1
LOG : 6673.32 6676.43 3.1 Region : 1100
FDEPTH: 610 0 Gear cond.: 0
BDEPTH: 3000 3000 Validity : 0
Towing dir: 0° Wire out : 1000 m Speed : 2.8 kn
Sorted : 0 Total catch: 0.62 Catch/hour: 0.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	0.18	0	33.23	
Cyclothone braueri	0.08	10527	14.03	
Sergestes sp.	0.03	614	5.69	
Systellapis debilis	0.03	28	4.76	
SALPS	0.02	3	4.19	
Leptocephalus	0.01	37	2.27	
Unidentified crustacean larvae	0.01	126	2.11	
Bolanichthys indicus	0.01	42	2.10	
Ceratoscopelus warmingii	0.01	21	1.94	
Chauliodus danae	0.01	12	1.77	
Acanthephyra sp.	0.01	13	1.64	
Hygophum taaningi	0.01	21	1.61	
Argyropelecus hemigymnus	0.01	27	1.45	
Derichthys serpentinus	0.01	1	1.45	
Sergia robusta	0.01	20	1.42	
Vinciguerria attenuata	0.01	18	1.29	
Vinciguerria nimbaria	0.01	18	1.29	
Sergestes sp.	0.01	18	1.27	0
Diaphus perspicillatus	0.01	2	1.13	
Lampanyctus photonotus	0.01	1	0.97	
Cyclothone sp.	0.00	46	0.82	
Vinciguerria poweriae	0.00	9	0.81	
Argyropelecus gigas	0.00	4	0.81	
Histioteuthis sp.	0.00	1	0.81	
OPLOPHORIDAE	0.00	4	0.73	
Lobianchia dofleini	0.00	7	0.65	
Lepidophanes gaussi	0.00	15	0.65	
Spirula spirula	0.00	1	0.65	
Lobianchia gemellarii	0.00	2	0.48	
Benthosema suborbitale	0.00	12	0.48	
Argyropelecus aculeatus	0.00	1	0.48	
Valenciennellus tripunctulatus	0.00	18	0.48	
Photonectes parvimanus	0.00	1	0.48	
UNIDENTIFIED FISH	0.00	7	0.40	
Eustomias filifer	0.00	1	0.32	
Hygophum reinhardtii	0.00	5	0.32	
Diaphus mollis	0.00	6	0.32	
Bolanichthys supralateralis	0.00	2	0.32	
Hygophum hygomii	0.00	1	0.32	
Taaningichthys minimus	0.00	1	0.21	

Notolychnus valdiviae	0.00	4	0.16
Aristostomias lunifer	0.00	1	0.16
Ichthyococcus ovatus**	0.00	1	0.16
Gonichthys cocco	0.00	1	0.16
Diaphus brachycephalus	0.00	4	0.16
Diaphus effulgens	0.00	1	0.16
Diaphus dumerilii	0.00	1	0.16
Chauliodus sloani	0.00	1	0.16
BOTHIDAE	0.00	1	0.16
Melanostomias sp.	0.00	1	0.16
Lampanyctus alatus	0.00	1	0.16
Lampanyctus pusillus	0.00	5	0.16
Lampadena atlantica	0.00	2	0.16
Myctophum selenops	0.00	1	0.16
Rhadinesthes decimus	0.00	1	0.16
Melamphaes sp.	0.00	3	0.16
Howella sp.	0.00	1	0.16
Sphoeroides sp.	0.00	2	0.16
Evermannella melanoderma	0.00	1	0.16
Sternoptyx sp.	0.00	2	0.16
TETRAODONTIDAE	0.00	1	0.16
Lestidiops sp.	0.00	2	0.08
Scopelarchus analis	0.00	4	0.06
Liocranchia reinhardtii	0.00	1	0.05
Abraliopsis (Abraliopsis) morisii	0.00	1	0.03
Magnisudis sp.	0.00	1	0.03
GEMPYLIDAE	0.00	2	0.02
Scopelosaurus sp.	0.00	1	0.02
Total	0.55		99.85

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 22
DATE :10/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°7.48
start stop duration Lon W 17°43.61
TIME :21:47:56 22:40:08 52.2 (min) Purpose : 1
LOG : 6684.09 6686.43 2.4 Region : 1100
FDEPTH: 110 110 Gear cond.: 0
BDEPTH: 3000 3000 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 2.7 kn
Sorted : 0 Total catch: 0.49 Catch/hour: 0.57

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
SALPS	0.18	1349	31.74	
Lepidophanes gaussi	0.07	237	11.70	9
Benthosema suborbitale	0.04	168	7.85	
Ceratoscopelus warmingii	0.04	38	7.67	
Krill	0.03	700	5.44	
Lobianchia dofleini	0.03	83	5.44	10
Abraliopsis (Abraliopsis) morisii	0.03	11	5.07	
Ceratoscopelus warmingii	0.02	94	4.18	0
Hygophum hygomii	0.02	7	3.04	
Diaphus perspicillatus	0.01	3	2.03	
Notoscopelus resplendens	0.01	5	1.83	
Lestidiops jayakari jayakari	0.01	1	1.58	
Hygophum taaningi	0.01	25	1.58	0
OPLOPHORIDAE	0.01	59	1.54	
Diplophos taenia	0.01	2	1.42	
Leptocephalus	0.01	11	1.18	
C R A B S	0.01	43	1.14	
Hygophum taaningi	0.00	3	0.75	
Bathophilus pawneei	0.00	2	0.59	
Leptocephalus	0.00	7	0.59	0
Diaphus mollis	0.00	9	0.55	
Chauliodus sloani	0.00	2	0.52	
Chauliodus sp.	0.00	40	0.41	
Vinciguerria nimbaria	0.00	9	0.41	
Unidentified crustacean larvae	0.00	45	0.39	
Argyropelecus hemigymnus	0.00	5	0.24	
Symbolophorus veranyi	0.00	2	0.24	
Notolychnus valdiviae	0.00	29	0.20	
S H R I M P S	0.00	9	0.20	
PARALEPIDIDAE	0.00	7	0.16	
Diaphus effulgens	0.00	5	0.16	
Lampanyctus sp.	0.00	2	0.12	
Diogenichthys atlanticus	0.00	5	0.08	
Hygophum reinhardtii	0.00	2	0.08	
TETRAODONTIDAE	0.00	2	0.04	
Total	0.57		100.15	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 23
DATE :10/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 26°7.88
start stop duration Lon W 17°42.51
TIME :23:21:21 23:51:09 29.8 (min) Purpose : 1
LOG : 6690.34 6691.88 1.5 Region : 1100
FDEPTH: 90 90 Gear cond.: 0
BDEPTH: 3000 3000 Validity : 0
Towing dir: 0° Wire out : 420 m Speed : 3.1 kn
Sorted : 1 Total catch: 7.06 Catch/hour: 14.21

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Ceratoscopelus warmingii	5.89	7117	41.43	0
Diaphus perspicillatus	3.02	849	21.26	
Hygophum hygomii	1.49	523	10.48	
Notoscopelus resplendens	1.10	556	7.75	
Hygophum taaningi	0.80	797	5.65	0
Lobianchia dofleini	0.37	785	2.59	
Lestidiops jayakari jayakari	0.37	105	2.59	0
SALPS	0.22	674	1.53	
Ceratoscopelus warmingii	0.14	76	0.99	
Abraliopsis (Abraliopsis) morisii	0.11	76	0.80	
Diaphus mollis	0.10	797	0.72	0
Myctophum nitidulum	0.07	12	0.52	
Lepidophanes gaussi	0.07	2617	0.52	
Remora brachyptera	0.07	2	0.48	
PYROTEUTHIDAE	0.06	30	0.44	
Selenoteuthis sp.	0.06	28	0.43	
Cranchia scabra	0.05	2	0.33	
Liocranchia reinhardtii	0.05	16	0.32	
Stemonosudis sp.	0.04	240	0.29	
Pyroteuthis margaritifera	0.02	10	0.17	
Benthosema suborbitale	0.02	837	0.15	
Myctophum selenops	0.01	2	0.08	
SCOPELARCHIDAE	0.01	12	0.08	
Stemonosudis sp.	0.01	105	0.07	0
Sphoeroides sp.	0.01	22	0.06	
Vinciguerria nimbaria	0.01	52	0.04	0
Notolychnus valdiviae	0.01	52	0.04	
Diogenichthys atlanticus	0.01	52	0.04	
Diaphus dumerilii	0.01	105	0.04	
Leptocephalus	0.00	153	0.03	
Diplophos taenia	0.00	2	0.02	
C R A B S	0.00	22	0.02	
Lestidiops jayakari jayakari	0.00	4	0.01	
Fistularia sp.	0.00	4	0.01	
Vinciguerria nimbaria	0.00	12	0.01	
Total	14.21		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 24
DATE :11/12/19 GEAR TYPE: PT NO: 2 POSITION:Lat N 26°7.51
start stop duration Lon W 17°43.00
TIME :06:27:41 07:18:08 50.5 (min) Purpose : 1
LOG : 6700.14 6702.12 2.0 Region : 1100
FDEPTH: 640 0 Gear cond.: 0
BDEPTH: 3555 3558 Validity : 0
Towing dir: 0° Wire out : 1120 m Speed : 2.4 kn
Sorted : 0 Total catch: 4.20 Catch/hour: 5.00

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Abraliopsis (Abraliopsis) morisii	1.02	486	20.39	
Histioteuthis reversa	0.53	1	10.52	
Sigmops elongatus	0.47	14	9.33	
SALPS	0.37	564	7.33	
Chauliodus sloani	0.25	10	4.95	
Notoscopelus resplendens	0.21	10	4.19	
Neonesthes capensis	0.18	1	3.57	
Bolanichthys indicus	0.18	61	3.52	
Diaphus mollis	0.16	18	3.29	
Lobianchia gemellarii	0.15	12	3.07	
Diaphus perspicillatus	0.11	10	2.17	
Pyroteuthis margaritifera	0.10	40	2.02	
Leptocephalus	0.10	29	1.95	
Enoploteuthis sp.	0.10	6	1.90	
Argyropelecus aculeatus	0.09	15	1.79	
Ceratoscopelus warmingii	0.07	71	1.48	
Diaphus rafinesquii	0.07	14	1.41	
Lampanyctus photonotus	0.07	4	1.31	
Melamphaes typhlops	0.06	1	1.12	
Melanonus zugmayeri	0.05	1	1.07	
Chtenopteryx sicula	0.05	14	1.02	
Gonostoma denudatum	0.05	5	0.93	
Sergia robusta	0.05	14	0.90	
Margrethia obtusirostra	0.04	23	0.88	
Searsia koefoedi	0.04	2	0.86	
Lampadena chavesi	0.04	6	0.80	
Hygophum taaningi	0.04	38	0.74	
Astronesthes gemmifer	0.03	1	0.69	
Astronesthes richardsoni	0.03	1	0.54	
Lobianchia dofleini	0.03	49	0.52	
Opisthoproctus soleatus	0.02	2	0.50	
Chauliodus danae	0.02	12	0.49	
Systellapis debilis	0.02	19	0.48	
Howella atlantica	0.02	4	0.43	
Derichthys serpentinus	0.02	1	0.38	
Lampanyctus atrum	0.02	4	0.38	
Myctophum selenops	0.02	4	0.34	
Diaphus brachycephalus	0.01	24	0.22	
Diaphus lucidus	0.01	1	0.21	
Lepidophanes gaussi	0.01	34	0.20	
Argyropelecus gigas	0.01	4	0.19	
Diaphus fragilis	0.01	4	0.19	
Lampadena atlantica	0.01	10	0.18	
Liocranchia reinhardtii	0.01	10	0.17	
Vinciguerria nimbaria	0.01	18	0.15	
Selenoteuthis sp.	0.01	4	0.15	
Nemichthys scolopaceus	0.01	1	0.14	
Taaningichthys minimus	0.01	4	0.13	
Spirula spirula	0.00	2	0.10	
Sternoptyx sp.	0.00	4	0.08	
Lestidiops affinis	0.00	10	0.07	
Pseudoscopelus sp.	0.00	1	0.07	
PARALEPIDIDAE	0.00	18	0.07	
OPLOPHORIDAE	0.00	2	0.07	
Lampanyctus cuprarius	0.00	1	0.05	
Shrimps unidentified	0.00	1	0.05	
Pterygioteuthis sp.	0.00	4	0.03	
Howella sp.	0.00	4	0.03	
Argyropelecus hemigymnus	0.00	4	0.02	
Eusergestes antarcticus	0.00	1	0.02	
Nessorhamphus sp	0.00	4	0.02	
Hygophum reinhardtii	0.00	6	0.02	
Serrivomer beanii	0.00	1	0.02	
Diaphus effulgens	0.00	4	0.01	
Vinciguerria attenuata	0.00	6	0.01	
Fistularia sp.	0.00	1	0.01	
Onychoteuthis banksii	0.00	1	0.01	
Benthosema suborbitale	0.00	4	0.01	
Bonapartia pedaliota	0.00	4	0.01	
Valenciennellus tripunctulatus	0.00	4	0.01	
GEMPYLIDAE	0.00	4	0.01	
Total	5.00		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 25
DATE :11/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°41.62
start stop duration Lon W 19°5.51
TIME :21:52:42 22:23:25 30.7 (min) Purpose : 1
LOG : 6798.80 6800.38 1.6 Region : 1100
FDEPTH: 125 125 Gear cond.: 0
BDEPTH: 3557 3557 Validity : 5
Towing dir: 0° Wire out : 380 m Speed : 3.1 kn
Sorted : 0 Total catch: 6.08 Catch/hour: 11.88

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Todarodes sagittatus	3.98	2	33.55	
Abraliopsis (Abraliopsis) morisii	1.33	797	11.18	
Lobianchia dofleini	1.11	1887	9.33	
Notoscopelus resplendens	1.01	297	8.50	0
Ceratoscopelus warmingii	0.99	1043	8.36	
Diaphus mollis	0.40	359	3.39	
Pyroteuthis margaritifera	0.40	250	3.34	
Diplophos taenia	0.33	94	2.75	
Diaphus perspicillatus	0.29	96	2.47	

Hygophum taaningi	0.29	414	2.43
Myctophum selenops	0.19	35	1.64
Enoploteuthis sp.	0.17	16	1.43
Hygophum hygomii	0.15	55	1.28
Diaphus splendidus	0.13	35	1.10
Notoscopelus resplendens	0.13	72	1.07
Lepidophanes gaussi	0.12	342	1.04
SALPS	0.12	313	1.02
Sigmops elongatus	0.08	6	0.66
PARALEPIDIDAE	0.07	234	0.56
Vinciguerria nimbaria	0.05	197	0.43
Lobianchia gemellarii	0.04	35	0.38
Bolanichthys indicus	0.04	107	0.36
Benthosema suborbitale	0.03	125	0.28
Astronesthes gemmifer	0.03	2	0.25
Lampadena chavesi	0.03	31	0.23
Ancistrocheirus lesueurii	0.02	2	0.21
Liocranchia reinhardtii	0.02	8	0.19
Histioteuthis sp.	0.02	2	0.13
Leptocephalus	0.02	47	0.13
Diaphus effulgens	0.02	35	0.13
Sandalops melancholicus	0.01	6	0.12
OPLOPHORIDAE	0.01	37	0.11
Chauliodus sloani	0.01	4	0.11
Hygophum reinhardtii	0.01	18	0.10
Lestidiops jayakari jayakari	0.01	2	0.09
Lagocephalus sp.	0.01	27	0.06
Astronesthes micropogon	0.01	2	0.05
Pseudoscopelus sp.	0.01	2	0.05
Astronesthes sp.	0.00	2	0.03
Bregmaceros sp.	0.00	4	0.02
Eusergestes antarcticus	0.00	18	0.02
Notolychnus valdiviae	0.00	18	0.02
Fistularia sp.	0.00	2	0.02
Chauliodus danae	0.00	2	0.01
Total	11.71		98.61

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 26
DATE :11/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°39.65
start stop duration Lon W 19°7.85
TIME :23:23:04 23:53:37 30.6 (min) Purpose : 1
LOG : 6803.05 6804.22 1.2 Region : 1100
FDEPTH: 80 90 Gear cond.: 0
BDEPTH: 3557 3557 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 2.3 kn
Sorted : 0 Total catch: 0.43 Catch/hour: 0.85

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
SALPS	0.39	0	45.62	
S H R I M P S	0.14	2286	16.59	
Ceratoscopelus warmingii	0.06	104	7.42	
Vinciguerria nimbaria	0.05	114	5.34	
Lobianchia dofleini	0.04	65	4.12	
PARALEPIDIDAE	0.02	137	2.67	
Chauliodus sp.	0.02	137	2.67	
Hygophum taaningi	0.02	35	2.21	0
Paralepidae	0.02	10	1.91	
Abraliopsis (Abraliopsis) morisii	0.01	4	1.71	
Lepidophanes gaussi	0.01	43	1.61	
Benthosema suborbitale	0.01	53	1.38	
Lobianchia gemellarii	0.01	8	1.07	
C R A B S	0.01	45	0.81	
Chauliodus sloani**	0.01	2	0.62	
Bathophilus longipinnis	0.00	2	0.58	
Notoscopelus resplendens	0.00	2	0.51	
Diaphus mollis	0.00	12	0.46	
Hygophum hygomii	0.00	2	0.46	
Bolanichthys indicus	0.00	20	0.37	
Cranchia scabra	0.00	2	0.35	
Unidentified juvenile fish	0.00	24	0.27	
Notolychnus valdiviae	0.00	45	0.27	
STERNOPTYCHIDAE	0.00	24	0.27	
Diaphus perspicillatus	0.00	4	0.15	
Notolychnus valdiviae	0.00	14	0.14	0
Diaphus sp.	0.00	10	0.14	0
Lampanyctus sp.	0.00	10	0.12	
Hygophum taaningi	0.00	69	0.11	
Stomias longibarbatus	0.00	24	0.08	
Pyroteuthis margaritifera	0.00	2	0.08	
Sigmops elongatus	0.00	4	0.07	
Diaphus brachycephalus	0.00	4	0.05	
Chauliodus danae	0.00	2	0.05	
MELANOSTOMIATIDAE	0.00	24	0.05	
Diaphus sp.	0.00	24	0.03	
Vinciguerria nimbaria	0.00	2	0.02	0
Melanostomiinae	0.00	2	0.01	
Total	0.86		100.37	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 27
DATE :12/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°40.38
start stop duration Lon W 19°7.65
TIME :07:43:20 08:47:36 64.3 (min) Purpose : 1
LOG : 6811.06 6813.52 2.5 Region : 1100
FDEPTH: 650 0 Gear cond.: 0
BDEPTH: 3736 3736 Validity : 0
Towing dir: 0° Wire out : 850 m Speed : 2.3 kn
Sorted : 0 Total catch: 0.80 Catch/hour: 0.75

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Opisthoproctus soleatus	0.18	1	24.38	
J E L L Y F I S H	0.17	550	22.78	
Krill	0.13	2199	17.52	
SALPS	0.13	1780	17.52	
Chauliodus danae	0.03	15	3.41	
Sergia robusta	0.01	2	1.37	
Abraliopsis (Abraliopsis) morisii	0.01	5	1.24	
CRANCHIIDAE	0.01	27	1.23	
Cyclothone braueri	0.01	114	0.94	
Systellapis debilis	0.01	10	0.75	
Hygophum reinhardtii	0.00	13	0.64	
Eusergestes antarcticus	0.00	12	0.56	
Ceratoscopelus warmingii	0.00	13	0.51	
Shrimps unidentified	0.00	2	0.50	
Bolanichthys indicus	0.00	13	0.47	
Notoscopelus resplendens	0.00	1	0.47	
Cyclothone pallida	0.00	37	0.45	
Vinciguerria attenuata	0.00	22	0.41	
Argyropelecus hemigymnus	0.00	22	0.36	
Leptocephalus	0.00	27	0.35	
Diaphus brachycephalus	0.00	1	0.26	
Sternoptyx sp.	0.00	2	0.25	
Cyclothone microdon	0.00	21	0.25	
Valenciennellus tripunctulatus	0.00	8	0.22	
Lobianchia gemellarii	0.00	1	0.21	
Sternoptyx diaphana	0.00	2	0.21	
Vinciguerria nimbaria	0.00	7	0.20	
OPLOPHORIDAE	0.00	5	0.19	
Photostomias guernei	0.00	1	0.18	
NOTOSUDIDAE	0.00	27	0.18	
Notolychnus valdiviae	0.00	27	0.17	
Lobianchia dofleini	0.00	3	0.17	
Valenciennellus tripunctulatus	0.00	7	0.17	0
Lampanyctus cuprarius	0.00	1	0.17	
Lepidophanes gaussi	0.00	4	0.13	
SCOPELARCHIDAE	0.00	2	0.13	
Chauliodus sloani	0.00	3	0.13	
Bonapartia pedaliota	0.00	2	0.12	
Lampanyctus pusillus	0.00	9	0.12	
Melanostomias bartonbeani	0.00	1	0.11	
PARALEPIDIDAE	0.00	2	0.09	
Ichthyococcus ovatus**	0.00	2	0.08	
Melanostomias melanops	0.00	1	0.07	
Hygophum reinhardtii	0.00	1	0.06	0
Melamphaes sp.	0.00	4	0.04	
Diaphus dumerilii	0.00	1	0.04	
Howella sp.	0.00	1	0.04	
Evermannella melanoderma	0.00	1	0.04	
Gnathophausia sp.	0.00	1	0.04	
Astronesthes leucopogon	0.00	1	0.03	
Diaphus mollis	0.00	2	0.02	
Vinciguerria poweriae	0.00	2	0.01	
Ahliesaurus berryi	0.00	1	0.01	
Symbolophorus veranyi	0.00	1	0.01	
Benthosema suborbitale	0.00	1	0.01	
Astronesthes micropogon	0.00	2	0.01	
Idiacanthus fasciola	0.00	1	0.01	
Total	0.75		100.07	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 28
DATE :12/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°38.98
start stop duration Lon W 19°8.42
TIME :10:28:23 11:01:26 33.0 (min) Purpose : 1
LOG : 6818.91 6820.21 1.3 Region : 1100
FDEPTH: 60 90 Gear cond.: 0
BDEPTH: 3736 3736 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 2.4 kn
Sorted : 0 Total catch: 0.04 Catch/hour: 0.08

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
SALPS	0.05	0	61.36	
J E L L Y F I S H	0.02	4	27.27	
Fistularia sp.	0.00	4	2.27	
Unidentified crustacean larvae	0.00	20	2.27	
OPLOPHORIDAE	0.00	4	1.14	
Valenciennellus tripunctulatus	0.00	4	1.14	
Shrimps unidentified	0.00	15	1.14	
TETRAODONTIDAE	0.00	9	0.91	
Ceratoscopelus warmingii	0.00	2	0.45	
Hygophum reinhardtii	0.00	2	0.45	
CARANGIDAE	0.00	2	0.23	
SCORPAENIDAE	0.00	2	0.23	
Bolanichthys indicus	0.00	2	0.23	
C R A B S	0.00	2	0.23	
Gnathophausia sp.	0.00	2	0.23	
Krill	0.00	7	0.23	
Total	0.08		99.77	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 29
DATE :12/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 26°39.03
start stop duration Lon W 19°7.79
TIME :11:45:42 12:17:25 31.7 (min) Purpose : 1
LOG : 6823.18 6824.90 1.7 Region : 1100
FDEPTH: 60 90 Gear cond.: 0
BDEPTH: 3736 3736 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 3.3 kn
Sorted : 0 Total catch: 0.03 Catch/hour: 0.06

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
J E L L Y F I S H	0.04	9	62.60	
Sphoeroides sp.	0.02	8	25.04	
Cranchia scabra	0.01	2	10.64	
Fistularia sp.	0.00	4	1.10	
C R U S T A C E A	0.00	2	0.31	
C R A B S	0.00	2	0.31	
Total	0.06		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 30
DATE :12/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 26°40.96
start stop duration Lon W 19°6.15
TIME :17:24:25 19:00:11 85.8 (min) Purpose : 1
LOG : 6831.33 6834.53 3.2 Region : 1100
FDEPTH: 650 0 Gear cond.: 0
BDEPTH: 3740 3740 Validity : 0
Towing dir: 0° Wire out : 950 m Speed : 3.0 kn
Sorted : 0 Total catch: 0.98 Catch/hour: 0.69

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Cyclothone sp.	0.16	1776	23.55	0
Chauliodus danae	0.10	45	15.09	
Systellapis debilis	0.07	76	9.58	
SALPS	0.05	518	7.24	
J E L L Y F I S H	0.04	9	5.76	
Eusergestes antarcticus	0.04	62	5.61	
Photostomias guernei	0.02	3	2.34	
OPLOPHORIDAE	0.02	16	2.24	
Hygophum taaningi	0.01	22	2.14	
Cyclothone microdon	0.01	66	2.03	

Ceratoscopelus warmingii	0.01	26	1.73	
Sigmops elongatus	0.01	1	1.72	
Myctophum nitidulum	0.01	2	1.33	
S H R I M P S	0.01	31	1.12	
Bolanichthys indicus	0.01	13	1.02	0
Argyropelecus aculeatus	0.01	3	0.94	
Lobianchia dofleini	0.01	13	0.94	
Krill	0.01	122	0.92	
Diaphus rafinesquii	0.01	1	0.81	
Lobianchia gemellarii	0.01	2	0.75	
Hygophum reinhardtii	0.00	12	0.70	
Hygophum hygomii	0.00	2	0.61	
Lepidophanes gaussi	0.00	15	0.61	0
Sternoptyx sp.	0.00	8	0.54	
Diaphus brachycephalus	0.00	2	0.45	
Hygophum taaningi	0.00	38	0.45	0
Lampanyctus crocodilus	0.00	3	0.43	
Notolychnus valdiviae	0.00	37	0.43	0
Lampanyctus photonotus	0.00	2	0.42	
Eustomias obscurus	0.00	1	0.41	
Serrivomer beanii	0.00	1	0.41	
Ceratoscopelus warmingii	0.00	31	0.39	0
Argyropelecus hemigymnus	0.00	11	0.39	
Scopelarchus michaelsarsi	0.00	1	0.37	
Myctophum selenops	0.00	1	0.37	
Melamphaes microps	0.00	1	0.35	
Abraliopsis (Abraliopsis) morisii	0.00	1	0.34	
Vinciguerria nimbaria	0.00	20	0.34	
Lepidophanes gaussi	0.00	11	0.28	
Lampanyctus cuprarius	0.00	1	0.25	
Nemichthys sp.	0.00	1	0.25	
ISOPODS	0.00	20	0.22	
Diaphus metopoclampus	0.00	1	0.22	
Lampanyctus sp.	0.00	18	0.21	
Taaningichthys minimus	0.00	1	0.20	
Bonapartia pedaliota	0.00	1	0.20	
Eustomias longibarba	0.00	1	0.19	
Valenciennellus tripunctulatus	0.00	1	0.18	
Bolanichthys indicus	0.00	8	0.17	
Spirula spirula	0.00	1	0.15	
Melamphaes sp.	0.00	8	0.15	
Benthosema suborbitale	0.00	3	0.13	0
Notoscopelus resplendens	0.00	1	0.13	
Lampanyctus alatus	0.00	1	0.12	
Leachia atlantica	0.00	1	0.12	
Leptocephalus	0.00	3	0.11	
Scopelarchoides sp.	0.00	1	0.11	
Benthosema suborbitale	0.00	8	0.11	
Unidentified crustacean larvae	0.00	41	0.11	
Astronesthes sp	0.00	1	0.10	
Scopelosaurus sp.	0.00	1	0.10	
Diaphus dumerilii	0.00	3	0.10	
Evermannella melanoderma	0.00	2	0.10	
Diaphus mollis	0.00	1	0.08	
Diaphus termophilus	0.00	1	0.08	
Scopelarchus analis	0.00	1	0.07	
Ichthyococcus ovatus**	0.00	2	0.06	
Margrethia obtusirostra	0.00	1	0.06	
FISH LARVAE	0.00	3	0.06	
Diaphus dumerilii	0.00	4	0.06	0
Diogenichthys atlanticus	0.00	3	0.06	
Vinciguerria attenuata	0.00	3	0.06	
Vinciguerria poweriae	0.00	3	0.06	
Nessorhamphus sp	0.00	1	0.05	
Photostomias atrox	0.00	1	0.05	
TETRAODONTIDAE	0.00	2	0.05	
Stomias brevibarbatus	0.00	1	0.05	
Diaphus perspicillatus	0.00	1	0.04	
Melanostomias biseriatus	0.00	2	0.03	
Stomias boa boa	0.00	1	0.03	
PARALEPIDIDAE	0.00	1	0.03	
Howella sp.	0.00	1	0.03	0
Gonichthys cocco	0.00	1	0.03	
Astronesthes sp	0.00	1	0.02	0
Idiacanthus fasciola	0.00	3	0.02	
Malacosteus niger	0.00	1	0.02	
Howella sp.	0.00	1	0.01	
GEMPYLIDAE	0.00	1	0.01	
Notolychnus valdiviae	0.00	1	0.01	
TETRAODONTIDAE	0.00	3	0.01	0
Total	0.69		100.05	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 31
DATE :13/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°13.18
start stop duration Lon W 20°39.55
TIME :09:49:10 10:20:58 31.8 (min) Purpose : 1
LOG : 6934.44 6935.64 1.2 Region : 1100
FDEPTH: 90 100 Gear cond.: 0
BDEPTH: 4272 4272 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 2.2 kn
Sorted : 0 Total catch: 0.31 Catch/hour: 0.58

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
SALPS	0.42	0 70.97	
J E L L Y F I S H	0.14	0 24.19	
Leptocephalus	0.01	9 0.87	
Systellapis debilis	0.01	4 0.87	
Unidentified crustacean larvae	0.00	55 0.48	
C R A B S	0.00	13 0.48	
NOTOSUDIDAE	0.00	2 0.32	
DREPANEIDAE	0.00	2 0.32	
MYCTOPHIDAE	0.00	2 0.32	
S H R I M P S	0.00	9 0.26	
C R U S T A C E A	0.00	4 0.16	
OPLOPHORIDAE	0.00	4 0.06	
SCOPELARCHIDAE	0.00	4 0.03	
Paralepis sp.	0.00	2 0.03	
C E P H A L O P O D A	0.00	2 0.03	
PARALEPIDIDAE	0.00	2 0.03	
GEMPYLIDAE	0.00	4 0.03	
Total	0.58	99.48	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 32
DATE :13/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 27°12.89
start stop duration Lon W 20°38.67
TIME :11:06:04 11:37:18 31.2 (min) Purpose : 1
LOG : 6938.34 6939.85 1.5 Region : 1100
FDEPTH: 70 100 Gear cond.: 0
BDEPTH: 4272 4272 Validity : 0
Towing dir: 0° Wire out : 260 m Speed : 2.9 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Sphoeroides sp.	0.00	2 63.64	
Fistularia sp.	0.00	2 36.36	
Total	0.00	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 33
DATE :13/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°13.34
start stop duration Lon W 20°39.63
TIME :18:20:24 19:39:30 79.1 (min) Purpose : 1
LOG : 6952.74 6955.31 2.6 Region : 1100
FDEPTH: 650 0 Gear cond.: 0
BDEPTH: 4272 4272 Validity : 0
Towing dir: 0° Wire out : 1000 m Speed : 1.9 kn
Sorted : 0 Total catch: 1.19 Catch/hour: 0.91

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Cyclothone sp.	0.19	3675 20.78	
SALPS	0.15	642 16.17	
Chauliodus danae	0.11	58 12.56	
Krill	0.08	1172 8.47	
Sigmops elongatus	0.07	5 7.66	
Sergia robusta	0.02	8 2.68	
Argyropelecus hemigymnus	0.02	147 2.46	
Melanostomias tentaculatus	0.02	1 2.43	
Diaphus perspicillatus	0.02	8 2.08	
Eusergestes antarcticus	0.02	84 1.92	
Lampanyctus photonotus	0.02	35 1.92	
Photostomias guernei	0.02	2 1.84	
Melamphaes sp.	0.02	56 1.77	
Hygophum hygomii	0.02	8 1.69	
Hygophum taaningi	0.01	23 1.51	
Histioteuthis sp.	0.01	8 1.31	
Systellapis debilis	0.01	19 1.24	
Ceratoscopelus warmingii	0.01	18 1.17	
S H R I M P S	0.01	9 1.00	
Pyroteuthis margaritifera	0.01	8 0.92	
Bolanichthys indicus	0.01	19 0.58	
Bonapartia pedaliota	0.00	3 0.50	
Scopelosaurus sp.	0.00	1 0.44	
C R A B S	0.00	28 0.39	
Chauliodus sloani	0.00	14 0.39	
Leptocephalus	0.00	3 0.37	
Astronesthes richardsoni	0.00	8 0.36	
Gnathophausia	0.00	11 0.33	
Hygophum reinhardtii	0.00	6 0.33	
Diplophos taenia	0.00	1 0.32	
Sternoptyx sp.	0.00	6 0.28	0
Argyropelecus gigas	0.00	2 0.28	
Abraliopsis (Abraliopsis) morisii	0.00	1 0.25	
Benthosema suborbitale	0.00	10 0.24	
Argyropelecus aculeatus	0.00	14 0.23	
Lepidophanes gaussi	0.00	11 0.23	
Vinciguerria nimbaria	0.00	10 0.21	
Vinciguerria attenuata	0.00	12 0.17	
Valenciennellus tripunctulatus	0.00	9 0.17	
Stomias brevibarbatus	0.00	8 0.15	
Unidentified crustacean larvae	0.00	425 0.15	
Scopelarchus analis	0.00	1 0.13	
Notoscopelus resplendens	0.00	1 0.13	
Lobianchia gemellarii	0.00	1 0.11	
Eustomias bigelowi	0.00	1 0.08	
OPLOPHORIDAE	0.00	1 0.08	
Photostomias atrox	0.00	2 0.08	
Argyropelecus sp.	0.00	14 0.08	
Scopelarchus michaelsarsi	0.00	8 0.08	
Scopelarchus analis	0.00	8 0.08	0
Liocranchia reinhardtii	0.00	8 0.08	
Myctophum nitidulum	0.00	14 0.08	
PALINURIDAE	0.00	8 0.08	
J E L L Y F I S H	0.00	8 0.08	
Howella sp.	0.00	8 0.08	
Ichthyococcus ovatus**	0.00	8 0.08	
Sternoptyx sp.	0.00	14 0.08	
Taaningichthys minimus	0.00	8 0.08	
Grammatostomias flagellibarba	0.00	8 0.08	
Evermannella melanoderma	0.00	8 0.08	
Pleuronectiformes juvenile	0.00	8 0.08	
SCOPELARCHIDAE	0.00	8 0.08	
Vinciguerria poweriae	0.00	2 0.05	
Lobianchia dofleini	0.00	1 0.05	
Serrivomer beanii	0.00	1 0.04	
Ceratias sp.	0.00	1 0.03	
Melanostomias biseriatus	0.00	1 0.03	
Lampanyctus sp.	0.00	2 0.02	
Borostomias mononema	0.00	1 0.02	
Notolychnus valdiviae	0.00	2 0.01	
Total	0.91	99.98	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 34
DATE :13/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°13.32
start stop duration Lon W 20°39.39
TIME :20:27:42 21:12:48 45.0 (min) Purpose : 1
LOG : 6959.32 6961.15 1.8 Region : 1100
FDEPTH: 90 90 Gear cond.: 0
BDEPTH: 4593 4593 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 2.2 kn
Sorted : 0 Total catch: 0.80 Catch/hour: 1.07

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Krill	0.17	2826 15.69	
Ceratoscopelus warmingii	0.16	209 14.70	
Bolanichthys indicus	0.15	1112 14.10	
SALPS	0.15	1132 13.99	
Diplophos taenia	0.12	20 11.25	
Lepidophanes gaussi	0.06	200 5.29	
Lampadena atlantica	0.05	20 4.25	
Lobianchia dofleini	0.04	108 4.11	
Notoscopelus resplendens	0.02	7 2.00	

Benthosema suborbitale	0.02	73	1.52
J E L L Y F I S H	0.02	7	1.50
Notoscopelus caudispinosus	0.01	1	1.25
Diogenichthys atlanticus	0.01	20	1.18
Hygophum hygomii	0.01	7	1.18
OPLOPHORIDAE	0.01	7	1.18
Vinciguerria nimbaria	0.01	115	1.18
Hygophum taaningi	0.01	7	0.89
Scopelosaurus sp.	0.01	8	0.75
Shrimps unidentified	0.01	4	0.75
Systellapis debilis	0.01	21	0.63
Hygophum reinhardtii	0.01	27	0.59
PARALEPIDIDAE	0.00	28	0.41
Lestidiops sp.	0.00	1	0.40
Leptocephalus	0.00	21	0.38
Lampanyctus sp.	0.00	27	0.35
Cyclothone sp.	0.00	128	0.35
Melamphaes sp.	0.00	13	0.30
Nemichthys curvirostris	0.00	1	0.15
Abraliopsis (Abraliopsis) morisii	0.00	1	0.13
Notolychnus valdiviae	0.00	33	0.11
Unidentified crustacean larvae	0.00	28	0.11
BOTHIDAE	0.00	7	0.11
Sudis sp.	0.00	1	0.06
TETRAODONTIDAE	0.00	3	0.06
Total	1.08		100.87

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 35
DATE :14/12/19 GEAR TYPE: PT NO: 8 POSITION:Lat N 27°13.10
start stop duration Lon W 20°37.88
TIME :00:37:18 01:18:07 40.8 (min) Purpose : 1
LOG : 6969.00 6971.24 2.2 Region : 1100
FDEPTH: 85 85 Gear cond.: 0
BDEPTH: 4272 4272 Validity : 0
Towing dir: 0° Wire out : 330 m Speed : 3.3 kn
Sorted : 0 Total catch: 16.25 Catch/hour: 23.89

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Ceratoscopelus warmingii	7.64	7585	31.98	
Hygophum hygomii	6.57	2793	27.48	
Auxis thazard thazard	3.17	10	13.25	
Diaphus perspicillatus	1.22	372	5.12	
Hygophum taaningi	1.14	1100	4.76	
Notoscopelus caudispinosus	0.72	113	3.02	
Notoscopelus resplendens	0.65	341	2.70	
Ancistrocheirus lesueurii	0.57	9	2.41	
SALPS	0.38	1	1.59	
Lepidophanes gaussi	0.37	1251	1.54	
Benthosema suborbitale	0.25	607	1.06	
Cranchia scabra	0.17	1	0.72	
Selenoteuthis scintillans	0.15	75	0.62	
Vinciguerria nimbaria	0.14	569	0.57	
Diaphus mollis	0.13	222	0.54	
Lobianchia dofleini	0.11	228	0.47	
Bolanichthys indicus	0.11	493	0.47	
Liocranchia reinhardtii	0.10	6	0.43	
PYROTEUTHIDAE	0.07	75	0.31	
Hygophum reinhardtii	0.04	76	0.17	
Leptocephalus	0.04	112	0.16	
Abraliopsis (Abraliopsis) morisii	0.04	75	0.15	
Diplospinus multistriatus	0.03	3	0.12	
Lestidiops jayakari jayakari	0.02	6	0.10	
Aequorea sp.	0.01	1	0.05	
PARALEPIDIDAE	0.01	112	0.05	
Diaphus dumerilii	0.01	38	0.05	
Diplophos taenia	0.01	3	0.05	
Lobianchia gemellarii	0.01	38	0.03	
Shrimps unidentified	0.01	3	0.02	
Stomias longibarbatus	0.00	1	0.00	
Total	23.89		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2019415 STATION: 36
DATE :14/12/19 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°13.17
start stop duration Lon W 20°39.12
TIME :07:52:40 09:02:23 69.7 (min) Purpose : 1
LOG : 6976.28 6978.71 2.4 Region : 1100
FDEPTH: 650 0 Gear cond.: 0
BDEPTH: 4593 4593 Validity : 0
Towing dir: 0° Wire out : 950 m Speed : 2.1 kn
Sorted : 0 Total catch: 0.33 Catch/hour: 0.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	0.08	417	27.88	
Systellapis debilis	0.03	47	11.13	
Krill	0.03	641	9.29	
Chauliodus danae	0.02	31	7.98	
S H R I M P S	0.02	10	7.98	
Eusergestes antarcticus	0.02	41	7.42	
Cyclothone braueri	0.02	324	5.58	
Gnathophausia	0.01	47	3.71	
OPLOPHORIDAE	0.01	10	3.71	
Amphitretus pelagicus	0.00	1	1.50	
Bolanichthys indicus	0.00	16	1.47	
Lobianchia gemellarii	0.00	1	1.17	
Bonapartia pedaliota	0.00	7	1.10	
Vinciguerria attenuata	0.00	21	0.95	
Ceratoscopelus warmingii	0.00	8	0.89	
Margrethis cf obtusirostra	0.00	1	0.67	
Valenciennellus tripunctulatus	0.00	10	0.54	
Histioteuthis sp.	0.00	2	0.52	
Diaphus mollis	0.00	1	0.52	
Vinciguerria nimbaria	0.00	6	0.52	
Lampanyctus photonotus	0.00	9	0.41	
Bolanichthys supralateralis	0.00	2	0.40	
Lepidophanes gaussi	0.00	8	0.40	
Hygophum taaningi	0.00	4	0.38	
Cyclothone pseudopallida	0.00	26	0.37	
C R U S T A C E A	0.00	41	0.37	
Abraliopsis (Abraliopsis) morisii	0.00	1	0.35	
Lobianchia dofleini	0.00	2	0.32	
Magnisudis atlantica	0.00	1	0.28	
Gonostoma denudatum	0.00	1	0.23	
Photostomias atrox	0.00	2	0.20	
A M P H I P O D A	0.00	5	0.18	
Vinciguerria poweriae	0.00	3	0.18	
Argyropelecus sp.	0.00	13	0.18	
Argyropelecus hemigymnus	0.00	9	0.17	
Hygophum reinhardtii	0.00	1	0.17	
Chauliodus sloani	0.00	3	0.12	
Notolychnus valdiviae	0.00	6	0.12	
Serrivomer lanceolatoides	0.00	1	0.11	
Symbolophorus veranyi	0.00	2	0.09	
Lampadena chavesi	0.00	2	0.09	
Stomias sp.	0.00	1	0.08	
Benthosema suborbitale	0.00	9	0.06	
Astronesthes micropogon	0.00	1	0.05	
Melamphaes sp.	0.00	2	0.03	
Lampanyctus sp.	0.00	2	0.03	
Ichthyococcus ovatus**	0.00	1	0.02	
Total	0.28		99.95	

ANNEX V. REVIEW OF COLLECTED SAMPLES

Table V.1. Overview of collected samples during Leg 4.5. Types of samples, recipient institutions and contact person information is also listed

Gear/equipment	Analyses	Samples	Preservation	Port of offloading	Type of transportation	Institution	Contact person Leg 4.5
Niskin bottles on CTD	Dissolved Nutrients	Water samples	0.2 ml chloroform (cool)	Las Palmas	Air fright	IMR	David Cervantes
Niskin bottles on CTD	Chlorophyll a	Filters			Onboard	IMR	David Cervantes
Niskin bottles on CTD	pH, AT, O_2				Onboard	IMR	David Cervantes
Niskin bottles on CTD	Stable isotope analysis	Filters	Frozen (-18 to -20 C, best -80)	Las Palmas	Air fright	IMR	Stamatina Isari
WP2 (180 µm) from max 200 m Split	Stable isotope analysis	Square plastic bottles	Frozen (-18 to -20 C, best -80)	Las Palmas	Air fright	INRH	Hinde Abdelouahab
WP2 (64 µm) from max 200 m	Stable isotope analysis	Square plastic bottles	Frozen (-18 to -20 C, best -80)	Las Palmas	Air fright	INRH	Hinde Abdelouahab
MultiNet (Midi, 5 nets x 180 µm), stratified sampling from max 1000 m ½ Split	Zooplankton Biomass	Aluminium trays	dried	Las Palmas	Air fright	INRH	Hinde Abdelouahab
MultiNet (Midi, 5 nets x 180 µm), stratified sampling from max 1000 m ½ Split	Zooplankton Taxonomy (depth stratified)	Square plastic bottles	4% formaldehyde	Las Palmas	Air fright	INRH	Hinde Abdelouahab
Bongo 1 (405 µm) oblique tow from max 200 m	Stable isotope analysis	Square plastic bottles	Frozen (-18 to -20 C, best -80)	Las Palmas	Air fright	INRH	Hinde Abdelouahab
Bongo 2 (405 µm) oblique tow from max 200 m	Stable isotope analysis	Square plastic bottles	Frozen (-18 to -20 C, best -80)	Las Palmas	Air fright	INRH	Hinde Abdelouahab
Trawl samples	Species identification	Jellyfish whole individual	Dried + frozen	Las Palmas	Air fright	UWC	Mark Gibbons
Trawl samples	Genetic analysis	Jellyfish arm	96% Ethanol + frozen	Las Palmas	Air fright	UWC	Mark Gibbons
Trawl samples	Species identification	Jellyfish the rest	4% formaldehyde	Las Palmas	Air fright	UWC	Mark Gibbons
Trawl samples	Stable Isotope analysis	Mesopelagic fish Whole specimens	Frozen	Las Palmas	Air fright	IMR	Stamatina Isari
Trawl samples	Morphometric analysis	Mesopelagic fish Whole specimens	4% formaldehyde	Las Palmas	Air fright	IMR	Stamatina Isari
Trawl samples	Taxonomy (Mesopelagic Guide)	Mesopelagic fish Whole specimens	Frozen	Las Palmas	Air fright	IEO	Jose González (Pepe)
Trawl samples	Contaminants / nutrients	Mesopelagic fish Whole specimens	Frozen	Las Palmas	Air fright	IMR	Marian Kjellevold