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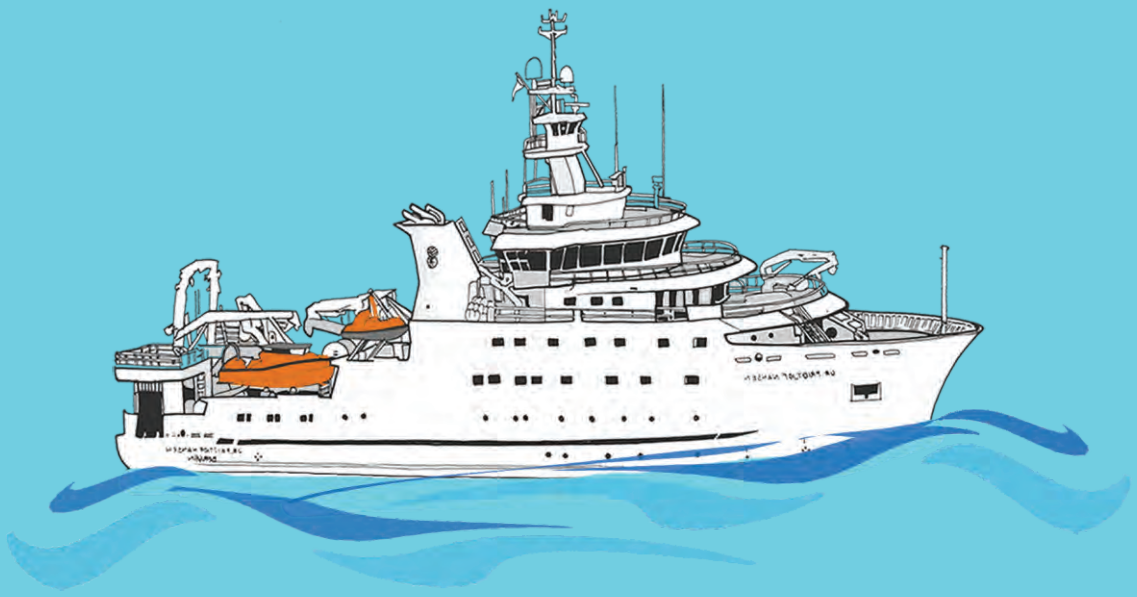
CRUISE REPORTS *DR FRIDTJOF NANSEN*
EAF-Nansen/CR/2017/3



SURVEY OF THE PELAGIC FISH RESOURCES AND ECOSYSTEM OFF WEST AFRICA

Mauritania

27 June – 9 July 2017

Institut Mauritanien de Recherches Océanographiques et des Pêches
Nouadhibou, Mauritania

Institute of Marine Research
Bergen, Norway

The EAF-Nansen Programme

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

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

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

Le Programme EAF-Nansen

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

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

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

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CRUISE REPORTS *DR FRIDTJOF NANSEN*

SURVEY OF THE PELAGIC FISH RESOURCES AND ECOSYSTEM OFF WEST AFRICA

Mauritania

27 June - 9 July 2017

by

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EXECUTIVE SUMMARY

The R/V Dr Fridtjof Nansen surveyed the Mauritania shelf and upper slope area between Cap Blanc and St. Louis from 27 June to 9 July 2017 as part of Leg 1 (Morocco to Senegal) of the regional coverage of the pelagic resources and ecosystems of West Africa.

A common survey design was adopted in the entire region with parallel transects perpendicular to the coastline, 10 NM apart, and acoustic measurements of pelagic fish obtained on the shelf from the 20 m to the 500 m bottom depth. At each degree latitude, a hydrographic transect was carried out to a depth of 1000 m. Meteorological and hydrographic measurements were recorded routinely on these transects in addition to samples on ocean acidification parameters (pH and alkalinity), nutrients, phytoplankton, zooplankton, fish eggs and larvae and microplastics. Weather conditions were good for surveying during the entire period.

At Cap Blanc a clear separation of water masses from the northern and southern Canary Current system can be observed, with strong increase in temperature from around 20°C (off Cap Blanc) to 28°C south of Cap Timiris. There is an indication of southward protruding water masses inshore in this region while offshore northwards moving water masses affect the outer shelf in the surface. Upwelling affects especially the northern region and primary production (fluorescence) is high inshore. Higher productivity can also be observed in the southern part of Mauritania close to the coast. These two regions are separated by a central region with low primary production and strongly stratified water masses. At 19°N and 18°N water masses are getting increasingly more stratified especially offshore with warm saline tropical water masses observed in the surface layers. Primary production is low across the shelf. Low oxygen waters < 1 ml/l can be observed close to the bottom on the central outer shelf.

The biomass estimates for the main small pelagic species were in general lower than in recent years. A few sardines were present although the bulk of the biomass was found considerably further north and the Mauritania estimate was 61 thousand tonnes. The anchovy distribution in Mauritania varies greatly with season and the species is not always recorded in the surveys, the bulk of the biomass is usually found further north although they migrate south to Senegal to spawn during the summer period. The biomass estimate this year was 78 thousand tonnes.

The sardinella is usually relatively abundant in Mauritania, and in autumn 2015 a total of 568 thousand tonnes was observed, of this the bulk of the biomass, 462 thousand tonnes, was *S. maderensis*. In 2017 the biomass was considerably lower and the lowest in the time series after the 1980's. *S. maderensis* was the dominating species and was estimated to be 116 thousand tonnes, while the biomass of *S. aurita* 34 thousand tonnes.

In total the horse mackerel was estimated to be 92 thousand tonnes, of this *Trachurus trecae* was dominating entirely with an estimate of 90 thousand tonnes. This is, as with the sardinellas, among the lowest estimates recorded in Mauritania. The 2015 estimate was 230 thousand tonnes. Chub mackerel is often not observed in quantities sufficient to warrant a separate biomass estimate in Mauritania, this year high concentrations were found further north and in Mauritania 25 thousand tonnes were recorded, in addition the Pel2 group was

estimated to be 40 thousand tonnes, bringing the total of carangids and associated species up to 157 thousand tonnes.

RÉSUMÉ

Le N/R Dr Fridtjof Nansen a conduit une campagne sur le plateau et le talus de la Mauritanie entre Cap Blanc et St. Louis du 27 juin au 9 juillet 2017, dans le cadre de la campagne synoptique des ressources pélagiques et des écosystèmes de l'Afrique de l'Ouest.

Un plan d'échantillonnage commun a été adopté dans toute la région avec des transects parallèles perpendiculaires à la côte, distants de 10 MN, et échantillonnage acoustique de poissons pélagiques obtenues sur le plateau de 20 à 500 m de profondeur. À chaque degré de latitude, un transect hydrographique a été effectué jusqu'à une profondeur de 1000 m. Les conditions météorologiques et hydrographiques ont été enregistrées régulièrement sur ces transects en plus des échantillons sur les paramètres d'acidification des océans (pH et alcalinité), les nutriments, le phytoplancton, le zooplancton, les œufs de poissons, les larves et les microplastiques ont aussi été prises. Les conditions météorologiques étaient bonnes pour l'exécution de la campagne pendant toute la période.

Au cap Blanc, on observe une nette séparation des masses d'eau du système nord et sud canarien, avec une forte augmentation de la température, d'environ 20 ° C (au large du Cap Blanc) à 28 ° C au sud du Cap Timiris. Il y a une indication de masses d'eau en déplacement vers le sud et situés près de la côte tandis que des masses d'eau en déplacement vers le nord affectent le plateau externe de la surface. L'upwelling affecte particulièrement la région du nord et la production primaire (fluorescence) est élevée dans la zone côtière. Une productivité plus élevée peut également être observée dans la partie sud de la Mauritanie, près de la côte. Ces deux régions sont séparées par une région centrale à faible production primaire et à masses d'eau fortement stratifiées. À 19 ° N et 18 ° N, les masses d'eau deviennent de plus en plus stratifiées, en particulier au large, avec des masses d'eaux tropicales salées chaudes observées dans les couches superficielles. La production primaire est faible d'un bout à l'autre du plateau. Des eaux à faible teneur en oxygène <1 ml / l peuvent être observées près du fond sur a partie centrale et externe du plateau continental.

Les estimations de la biomasse pour les principales espèces des petites pélagiques étaient en général inférieures à celles des dernières années. Quelques sardines étaient présentes bien que la majeure partie de la biomasse se trouvait beaucoup plus au nord et l'estimation de la Mauritanie était de 61 000 tonnes. La répartition des anchois en Mauritanie varie considérablement selon la saison et l'espèce n'est pas toujours enregistrée, la majeure partie de la biomasse se trouve généralement plus au nord, bien qu'elle émigre vers le sud pour frayer pendant la période estivale. L'estimation de la biomasse cette année était de 78 000 tonnes.

La sardinelle est généralement relativement abondante en Mauritanie, et en 2015, un total de 568 000 tonnes a été observé, dont la majeure partie de la biomasse, soit 462 000 tonnes, était *S. maderensis*. En 2017, la biomasse était considérablement plus faible et la plus faible de la série chronologique après les années 1980. *S. maderensis* était l'espèce dominante et était estimée à 116 000 tonnes, tandis que la biomasse de *S. aurita* était de 34 000 tonnes.

Au total, le chinchard était estimé à 92 000 tonnes, dont *Trachurus trecae* dominait entièrement avec une estimation de 90 000 tonnes. C'est, comme pour les sardinelles, parmi les estimations les plus basses enregistrées en Mauritanie. L'estimation de 2015 était de 230 000 tonnes. Le maquereau n'est souvent pas observé en quantités suffisantes pour justifier une

estimation séparée de la biomasse en Mauritanie, cette année des concentrations élevées ont été trouvées plus au nord et en Mauritanie, 25 000 tonnes ont été enregistrées, en plus le groupe Pel2 a été estimé à 40 000 tonnes. Le total des carangidés et des espèces associées était de 157 000 tonnes.

CHAPTER 1. INTRODUCTION

1.1 Survey objectives

This survey was planned as part of a synoptic coverage of West Africa's pelagic resources and ecosystems conducted from Morocco to South Africa, from May to December 2017 as part of the EAF-Nansen Programme (2017-2021).

In connection with this phase of the Programme, a Science Plan has been developed that addresses 11 different themes within three main lines of research related to resources, impacts of oil/mining activities and pollution on resources and ecosystems and climate change. Therefore, in addition to providing key information on abundance and distribution of main pelagic stocks, the survey programme was designed to also support data collection for priority research questions that will be addresses as part of specific research projects under the science plan.

Overall survey objectives and the sampling plan was agreed with the respective partner institutions and a detailed sailing order was prepared that describes these in detail.

The specific objectives include:

Hydrography:

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

Phytoplankton, zooplankton, ichthyoplankton and jellyfish:

- To establish as far as possible, the distribution, abundance and composition of phyto- and zooplankton, and fish eggs and larvae;
- To contribute to increase the understanding of taxonomy, biology and ecological role of jellyfish.

Pelagic stocks abundance, distribution and biology:

- To obtain information on abundance, distribution (also by size) of *Sardina pilchardus*, *Sardinella aurita, Sardinella maderensis, Trachurus trachurus, Trachurus trecae*, *Scomber colias, and Engraulis encrasicolus* using acoustic methods and a systematic grid survey strategy.
- To collect samples for genetic and morphometric analysis (for stock identification of *S. aurita*, *S. pilchardus, S. colias*).
- To obtain information on maturity stages of *S. aurita*, *S. pilchardus, S. colias*.
- To collect stomach samples for analysis of contents for selected species (*S. aurita*, *S. pilchardus, S. colias)*.
- To collect otoliths, *S. aurita*, *S. pilchardus,* and *S. colias* for stock identification.

Food safety:

- To collect samples for levels of environmental contaminants, nutrients, parasites and microorganisms with regards to food safety and pollution.

Microplastics:

- To collect samples of microplastic particles in surface waters.

1.2 Participation

Leg 1.3. Las Palmas to Dakar (11th June – 5th July)

Institut National de Recherche Halieutique (INRH), Morocco:
Majjih Zakaria (team leader, Morocco), Amouri Oussama, Yassir Anas, El Mghouchi Karim, Fadili Mohamed, El Ouehabi Zineb, Bessa Ismail, El Qendouchi Mouna and Hind Abdelouhab.

Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), Mauritania:
Mohamed Ahmed Jeyid (team leader Mauritania), Abdelkerim Souleimane, Wagne Moulaye Mohamed, Niang Alioune Hamady, Abdellahi Samba, Diagne Ahmed and Sid'ahmed Reyough.

Department of Fisheries (FD), The Gambia:
Momodou S Jallow (Gambian team leader) and Salifu Ceesay

Institute of Marine Research (IMR), Norway:
Jens Otto Krakstad (cruise leader), Espen Bagøien and Helene Hodal Lødemel.

Centro Oceanográfico de Canarias, Instituto Español de Oceanografía:
Alba Jurado Ruzafa

University of Western Cape, South Africa:
Drikus Kuyper

FAO, Rome, Italy:
Peter Psomadakis.

Leg 1.4 Dakar -Dakar (5th – 18th July)

Institute of Marine Research, Norway (IMR), Norway:
Oddgeir Berg Alvheim, Geir Landa, Jostein Andre Solhaug, Elisabeth Lundsør, Tore Johannessen (Cruise leader), Tor Magne Ensrud and Thomas James Williams,

National Institute of Nutrition and Seafood Research (NIFES), Norway:

Edel Erdal

Centro de Investigação Pesqueira Aplicada, Guinea Bissau:
Duarte Bucal (team leader Guinea Bissau), Martinho Joaquim Gomes, Abrigo Menda and Amadeu Mendes De Almeida.

Centre de Recherches Océanographiques de Dakar-Thiaroye, Senegal:
Oumar Sadio (team leader Senegal), Tamsir Ousmane Sow, Saliou Faye, Limale Deme, Aboubacar Gueye, Naby Souleymane Faye and Ndague Diougoul.

Marine Nationale Sénégalaise, Senegal:
Mamadou Diene (Navy observer)

Instituto Español de Oceanografía, Spain:
Begoña Maria Sotillo De Olano.

The University of the Western Cape, South Africa:
Yasmeen Parker.

Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), Mauritania:
Alioune Niang, Cheikhna Gandega and Ahmed Diagne.

Department of Fisheries (FD), The Gambia:
Momodou S Jallow (Gambian team leader), Salifu Ceesay, Momodou Sidibeh.

Instituto Nacional De Desenvolvimento Das Pescas, Cape Verde:
Ivanice Oliveira Monteiro and Nuno Roberto Dias Brito Vieira.

1.3 Narrative

Figures 1.1 and 1.2 show the cruise track and the stations worked during the survey. The survey continued from the previous leg (Leg 1.3) and crossed over the border to Mauritania on the 27 June at 20:00 hrs GMT. The survey proceeded with an acoustic sampling grid with transects perpendicular to the coast and a distance between them of approximately 10 NM, covering the shelf and upper slope to 500 m bottom depth. The shelf of Mauritania was divided in two strata. Cap Blanc to Cap Timiris and Cap Timiris to St. Louis. The first stratum was completed on 29 June at 19:00 hrs GMT, at the end of transect 9 of this leg.

On the 3 July at 07:40 hrs GMT the vessel steamed to Dakar for a crew change. The vessel departed from Dakar with new scientific crew on the 6 July at 12:30 hrs GMT and arrived at the beginning of transect 22 on the 7 July at 08:00 hrs GMT. The rest of the shelf in Mauritania was surveyed and the vessel crossed over to Senegal on 9. July at 10:40 hrs GMT, at the end of transect 29.

1.4 Survey effort

Altogether 30 trawl hauls were carried out to identify acoustic targets during the survey. 34 CTD casts were made along hydrographic transects to describe the water properties in the survey area. Table 1 shows the survey effort during the survey. Annex I provides the full details of the trawl stations.

Standard hydrographic sections were sampled approximately each degree of latitude, mostly from close to the coast (between 20 and 30 m bottom depth) to 1000 m bottom depth. Some hydrographic sections ended at 500 m.

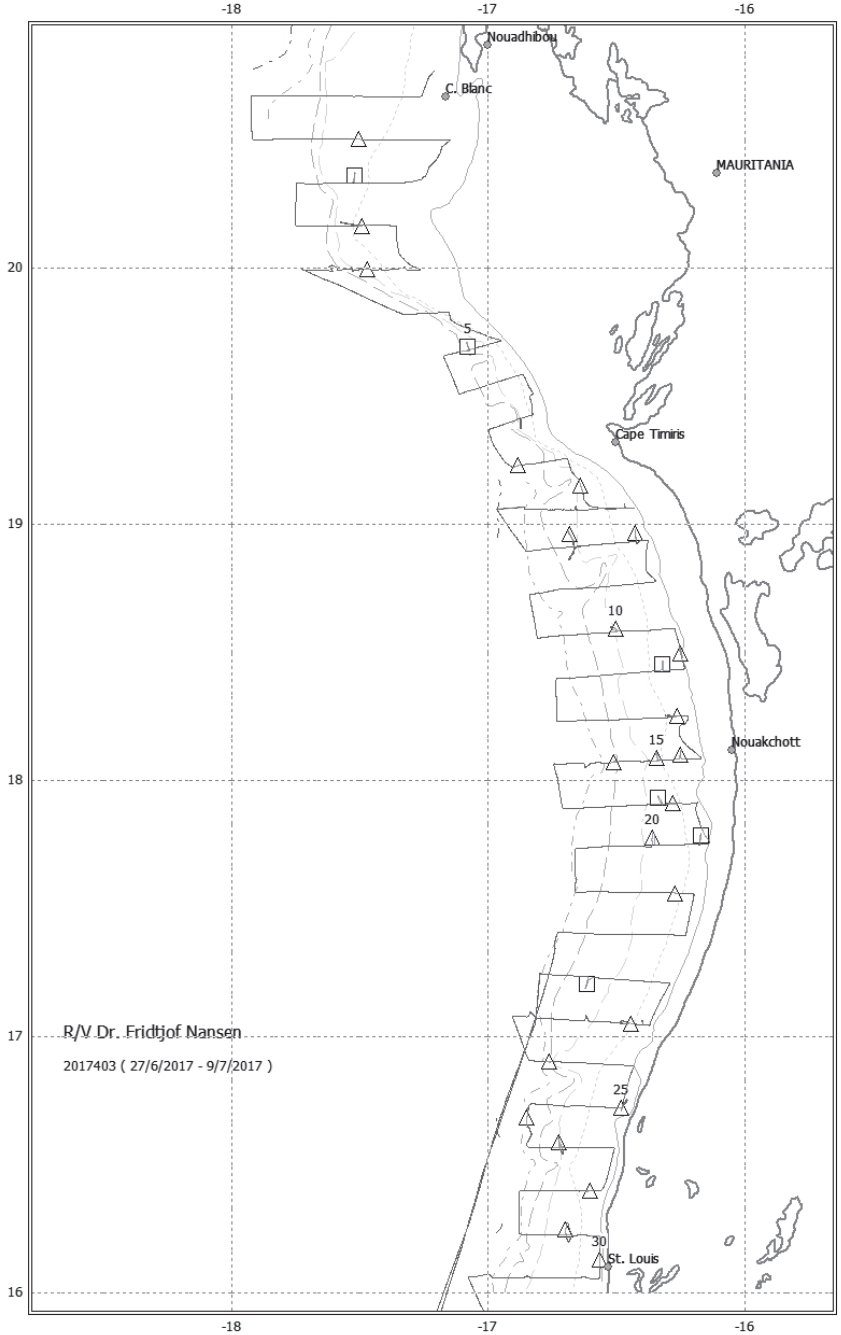


Figure 1.1 Course tracks with trawl stations along Mauritania.
Symbols: △: pelagic trawl; □: bottom trawl

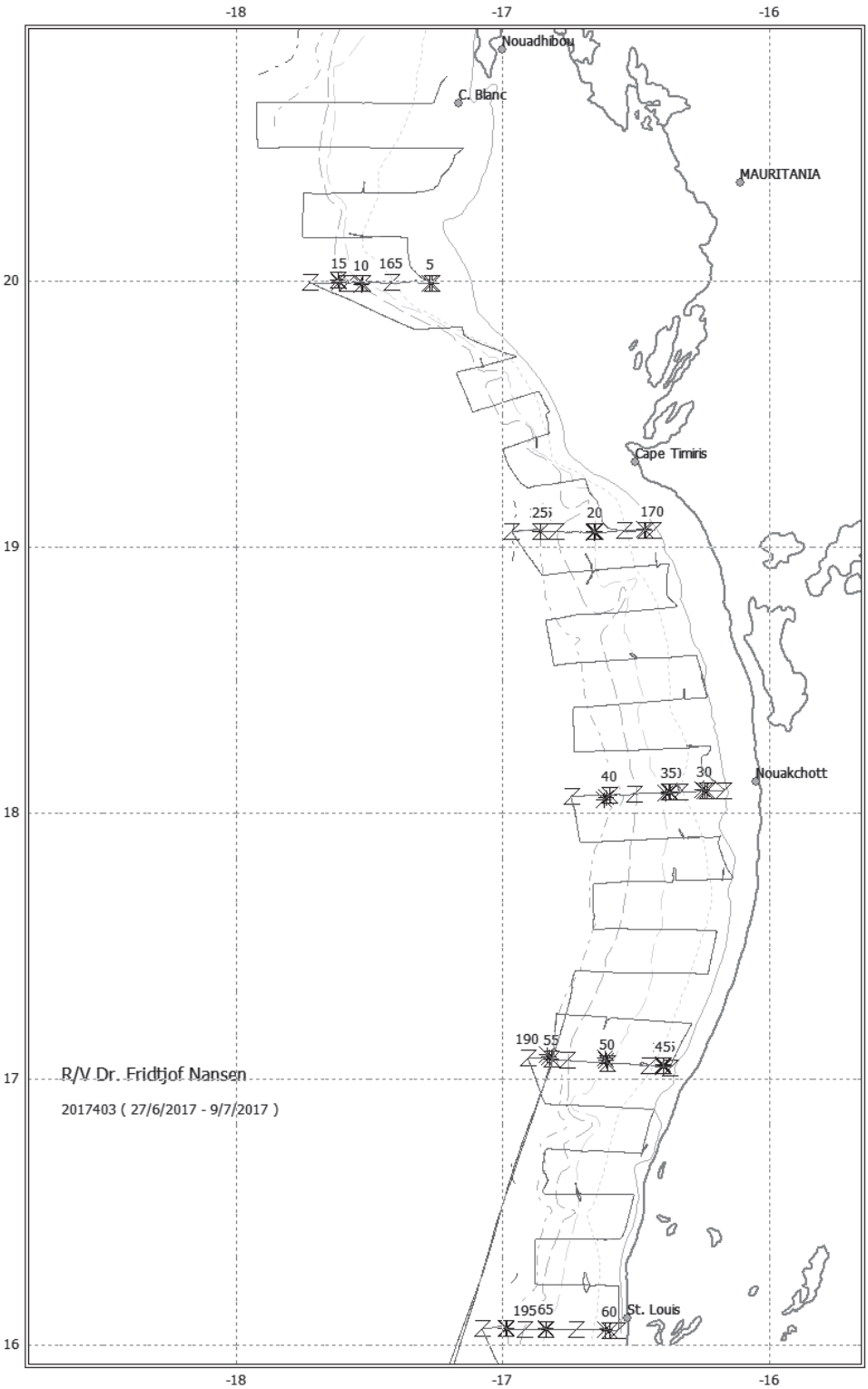


Figure 1.2. Course track with hydrographic and plankton stations.

Symbols: Z: CTD ; *: CTD, chemical seawater analyses, plankton, multi net for eggs and larvae, manta trawl for plastic.

Table 1. Survey effort

Region	Distance	CTD	Phyto	WP-2	Multi	Manta	BT	PT
Cap Blanc – Cap Timiris	347	6	3	5	3	3	2	3
Cap Timiris – St Louis	1222	28	9	20	11	8	4	21
Total	1569	34	12	25	14	11	6	24

Phyto: Phytoplankton net, WP-2: Zooplankton net, Multi: Multinet for eggs and larvae, Manta: Manta trawl for plastic particles in the surface, BT: Bottom Trawl, PT: Pelagic Trawl).

CHAPTER 2. METHODS

2.1 Meteorological data recording

Meteorological data were logged continuously from the AANDERAA Smartguard meteorological station, including wind direction and speed, air pressure, humidity, air temperature and solar radiation. All data were logged to the Nansis tracklog system averaged by unit distance sailed (1 NM).

2.2 Oceanography

Thermosalinograph

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

CTD

Oceanographic conditions were sampled along transects spaced at about 1 degree of latitude. Vertical temperature and salinity profiles were obtained by a Seabird 911 CTD, while *in situ* concentrations of dissolved oxygen were measured using a CTD-mounted SBE 43 oxygen sensor. Real time logging and plotting was performed using the Seabird Seasave software installed on a PC. Attached to the CTD was also an uncalibrated Chelsea Mk III Aquatracka fluorometer, which measures *in situ* fluorescence on relative scale. The CTD was stopped at the designated depths for 15 seconds before closing the Niskin-bottles. CTD casts were conducted at, or close to every latitude, from the coast and offshore to approximately 500 m bottom-depth. In the southern part of the area, most sampling continued offshore to 1000 m bottom-depth. At bottom-depths of 30 m, 100 m and 500 m, the following type of samples/data were collected at stations named “Superstations”: salinity, temperature, dissolved oxygen and fluorescence measured by the CTD with additional sensors, sea-water samples, phytoplankton, zooplankton, fish larvae and eggs, as well as microplastics.

12 Niskin water-bottles (10 l) attached to a CTD-mounted rosette were used to collect water at pre-defined depths. The standard sampling depths were: 1000, 750, 500, 400, 300, 250, 200, 150, 100, 75, 50, 25, and 5 m. On stations with bottom-depth of 1000 m, the sample from 250 m was not collected due to the limitation to 12 Niskin bottles. In some parts of the survey, extra samples from the surface mixed layer were collected (10 and 2 m), and standard depths were then rearranged.

To validate the oxygen-data from the CTD-mounted sensor, concentrations of dissolved oxygen in the seawater-samples collected with the Niskin-bottles were analysed in the ship laboratory by Winkler red-ox titration. The validation was carried out during the survey

2017401 (See Cruise report for 2017401). The method is based on Winkler (1888), but modified for enhanced precision (e.g. Carpenter 1965, Murray et al. 1968, Strickland and Parsons 1968, Culberson et al. 1991). The present version of the method is described by Grasshoff et al. (1983). For stations 133, 134, 148 and 149 a total of 45 samples were analysed. The average difference between the results of the oxygen sensor and the Winkler titration was 0.235 mL/L (±0,035 mL/L), with the Winkler results always being higher that the CTD sensor. The offset between the sensor-results and the measured results was concluded to be larger than accepted. Therefore, a new oxygen-sensor was mounted on the CTD. New samples were collected from stations 157 and 158 (a total of 22 samples). The average difference between the results of the sensor versus the chemical analysis was then reduced to 0,063 mL/L (±0,059 mL/L).

Superstations

In connection with the CTD transects, and in correspondence with depths of 30, 100 and 500 m, sampling was carried out also for pH (acidity/alkalinity), nutrients, phyto- and zooplankton, eggs and larvae and microplastics according to the scheme shown in figure 2. These stations were named "superstations".

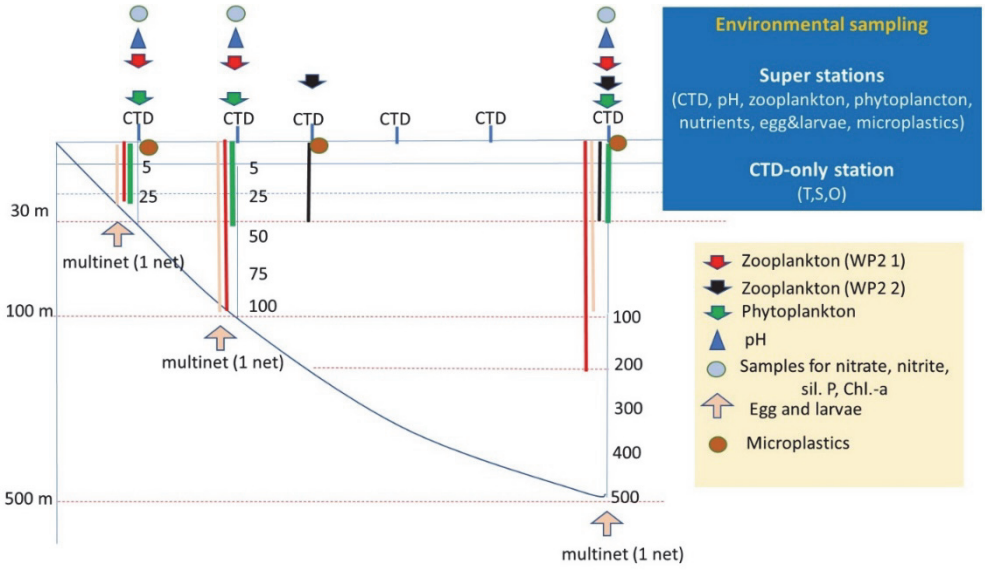


Figure 2.1. Overall sampling scheme in connection with the hydrographic transects, including "superstations".

Ocean acidification parameters (pH and alkalinity)

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

in mV) using tiamo software. Further processing of the data will be done as part of the science plan Theme 10: Climate change and biogeochemical processes, expected to provide more information on the marine carbonate system and parameters for ocean acidification.

Nutrients

Seawater samples (20 ml) for nutrient analyses (nitrate, nitrite, silicate and phosphate) were collected from the Niskin water-bottles. The seawater samples were stored in 20 ml polyethylene vials, conserved with 0.2 ml chloroform, and kept cool and dark in a refrigerator (Hagebø and Rey, 1984). The analyses for nutrient content will be made on shore by the Institute of Marine Research (Bergen, Norway), using a modified Alpkem AutoAnalyzer C (O I Analytical, USA) and following standard procedures (Strickland and Parsons, 1968).

During transport from the ship to the IMR laboratory in Norway, the nutrient-samples were most likely subjected to temperatures above the recommended 4°C. The temperatures to which the samples were exposed to, and the duration of this exposure, is not clear. It is not evident whether this may have caused degradation of the nutrient samples. The samples have been analysed at IMR but some were excluded from the database because of uncertainty in their quality.

2.3 Plankton

Phytoplankton biomass

Chlorophyll-*a* was sampled as an indicator of phytoplankton biomass. For chlorophyll-*a* and phaeopigment measurements, seawater was collected from the CTD at the standard depths (but not below 200 meters). The water was filtered using a 0.7 µm filtration system (Munktell glassfiber filters Grade: MGF, vacuum 200 mm Hg). Water samples were filtered from each depth and stored at -20 °C. All samples were transferred to IMR (Bergen) for subsequent analyses. The assay is performed by extraction with 90% acetone followed by centrifugation, and analysed with a fluorometer (model 10 AU, Turner Designs Inc., Sunnyvale, Ca., USA), according to Welshmeyer (1994) and Jeffrey and Humphrey (1975).

Phytoplankton identification

Phytoplankton was collected along the hydrographic transects at stations positioned at bottom-depths of approximately 30 m, 100 m and 500 m. At each plankton-station, qualitative phytoplankton samples were collected with a net (35 cm in diameter and mesh-size of 10 µm), hauled vertically at a speed of 0.1 ms^{-1} from the depth of 30 m to the surface (from ca. 5 m above bottom at the 30 m stations). During the first part of the survey, north of Cap Juby, the samples were preserved with Lugol's solution, while during the second part of the survey southwards from Cap Juby, the samples were preserved with 2 ml of 20 % formalin buffered with hexamine in 100 ml bottles (i.e. a final solution of ca. 0.4% formaldehyde). These samples are not quantitative, but used to establish the taxonomic composition of the phytoplankton community.

Zooplankton

Mesozooplankton was collected with a WP2-net along the hydrographic transects at stations positioned at bottom-depths of ~ 30 m, 100 m and 500 m. The WP2-net (56 cm diameter, mesh-size 180 µm) (Fraser 1966, Anonymous 1968) was hauled vertically at a speed of ~ 0.5 ms-1 at each station. At the shallowest and intermediately deep stations (bottom-depths of 30 m and 100 m, respectively), the sampling-strata were from near-bottom to the surface (lower sampling-depths of ~25 and 90 m, respectively). At the deepest stations with bottom-depth of ~500 m, the sampling-stratum was from the depth of 200 m to the surface.

Furthermore, a second collection with the WP2 net was performed for the depth-stratum of 30-0 m at the stations with bottom-depths of 100 m and 500 m. The purpose of these additional samplings was to enable a direct comparison of the zooplankton composition and concentrations in the uppermost layer of the water-column along the bottom-depth gradient.

Each zooplankton-sample was divided into two equally large parts using a Motoda plankton splitter (Motoda 1959). Prior to this, all visible jellyfish (or remains of such) were removed from the samples and their volume measured. The first part of the sample was preserved in seawater with a final solution of 4% formaldehyde buffered with borax for subsequent species identification and quantification on land. The second part of the unpreserved sample was size-fractioned by using a series of sieves with the decreasing mesh-sizes of 2000 µm, 1000 µm and 180 µm, and the zooplankton retained on each sieve were thereafter dried on aluminium-trays at ~60 ºC for 6-24 h. Limited storage capacity in the drying cabinet restricted the drying period. The size-fractioned biomass samples were thereafter kept frozen at -18°C for subsequent weighing of dry-weight - following a second drying period - in the laboratory of IMR (Norway). During the weighing process, samples with some degree of greenish colour that indicates inclusion of phytoplankton were identified and noted.

Ichthyoplankton

Sampling was performed with a Hydro-Bios Multinet with mesh-size 405 µm at stations with bottom depths of ca. 30 m, 100 m and 500 m. The net was towed obliquely from ~10 m above the bottom, or from a maximum depth of 100 m, to the surface with a speed of ~1.5 ms-1. Once the Multinet was on board after a haul, the sample was collected.

Samples with both fish-eggs and larvae were preserved in a final solution of 4% formaldehyde buffered with borax. Thereafter, the whole samples were checked under stereo-microscope, and all fish larvae sorted and put on a separate bottle in 4% formaldehyde buffered with borax. Selected fish-larvae in a good state were photographed. The fish-eggs are to be sorted, and the larvae identified, on shore after the cruise in connection with a regional workshop.

Microplastics

Microplastics were collected along the hydrographic transects at stations positioned at bottom-depths of ~ 30 m, 100 m and 500 m. At each station, the surface layer was sampled with a Manta-trawl, with a rectangular opening of 19 cm × 61 cm (HxW), mesh-size 335 µm and two wings to keep it in balance and at the surface during the tow. On each sampling occasion, the trawl was hauled horizontally at a speed of ~1.5 ms-1 for 15 minutes. The counts of a manual flowmeter attached below the trawl opening were recorded at start and stop of each trawl-event. Trawling was performed some meters away from of the right-hand side of the vessel, about mid-ship, attempting to avoid the wake of the vessel. Geographical start and stop positions were recorded in the bridge-log.

Once the Manta-trawl was back on the ship after trawling, the samples were washed in filtered sea-water over a sieve with mesh-size 180 µm. Microplastic particles were sorted from the sample under a stereo-microscope, and the sorted sample was then checked once more to reduce the risk of overlooking the smallest plastic particles. All assumed plastic items were then placed on a gridded petri-dishes for examination under the stereo-microscope, photographed and, to the extent possible, also measured and described (e.g. length, shape, type and colour). The sorted microplastics were washed with distilled water and dried in pre-weighed aluminium-trays in a drying cabinet at 30 ºC. The trays were packed in aluminium foil and stored in room-temperature until transport to the laboratory of IMR, where they will be studied in more detail. After removing the plastics, the remaining part of the samples - mainly biological material - was preserved for studies of neuston on shore after the cruise.

2.4 Trawl sampling

Biological sampling of the fish was carried out using pelagic or bottom trawls. In shallow water (<30 m) or at night when pelagic fish was close to the surface the pelagic trawl with floats or bottom trawl with floats was used for sampling. Annex III gives a description of the instruments and the fishing gear used. All catches were sampled for composition by weight and numbers of each species caught. Species identification was based on the FAO Species Identification Sheets. Length frequency distributions, by total fish length to the nearest cm below, of the selected target species were taken in all the stations where they were present. Individual weight measurements and biological information on sex, maturity, and stomach fullness was recorded for 30 fish of all target species. The length measurements were used to estimate the length-weight relationship used in the biomass calculations.

In addition, biological samples of fish were taken: otoliths, fin clipping for genetic analysis, stomach and liver samples, and samples for future biological investigations.

The target groups used for this survey can be found below, while the complete records of fishing stations and catches are shown in Annex I. A full list of biological samples per species and trawl station is given in Annex II.

2.5 Sampling for food safety

Whole fish, fillet and different organs from various fish and octopus were sampled during this survey. All the samples will be analysed at IMR for a wide variety of nutrients and contaminants in close cooperation with partner institutions as part of Theme 8 of the science plan: Nutrition and food safety. Tissue samples from mackerel samples will be analysed for the parasite Kudoa.

Some of the samples will also be analysed for correspondence between the microbiota and the metal content of the gut. One pelagic fish sample and two mesopelagic fish samples will be analysed for the content of microplastic particles.

2.6 Acoustic sampling

Current speed and direction measurements

Two hull-mounted Acoustic Doppler Current Profiler (ADCP) from RD Instruments ran during the survey. The frequency of the ADCP are 75 and 150 kHz. The system is run in narrow band mode and data were averaged in 16 and 4 m vertical bins at 75 and 150 kHz respectively and stored on files for post survey processing

Sonar data

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

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

No other sonars were used during the survey.

Bottom mapping echo sounder

The EM 710 multibeam echo sounder is a high to very high-resolution seabed mapping system. Acquisition depth is approximately 3 m below the transducers and the maximum acquisition depth is limited in practice to 1000 - 1500 m on *Dr Fridtjof Nansen*. Across track

coverage (swath width) is up to 5.5 times water depth and may be limited by the operator either in angle or in swath width without reducing the number of beams. The operating frequencies are between 70 to 100 kHz. There are 128 beams with dynamic focusing employed in the near field. The transmitting fan is divided into three sectors to maximize range capability and to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping and use distinct frequencies or waveforms. The along track beam width is 1 degree. Ping rate is set according to depth. The receiving beam width is 2 degrees. Sound profiles were set manually in the system according to the area of operation. The data was logged to the on-board Olex plotting system.

Acoustic estimates of fish biomass

Acoustic data were recorded using a Simrad EK80 Scientific Split Beam Echo Sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38, 70, 120, 200 and 333 kHz. The survey was started without *a priori* calibration, but the sounders were calibrated in Bergen on the 23rd January 2017.

Acoustic data were logged and post-processed using the latest acoustic data post-processing software, the Large-Scale Survey System (LSSS) Version 2.0. The technical specifications and operational settings of the echo sounder used during the survey are given in Annex III.

In cases where the target category of fish contains more than one species (e.g. sardinella and horse mackerel), the mean s_A-value allocated to the category is divided between the species in the same ratio as their contribution to the mean back scattering strength in the catches (relative amount by number at length in the catches).

The following target strength (TS) function was applied to convert s_A-values (mean integrator value for a given species or group of species in a specified area) to number of fish:

$$TS = 20 \log L - 72 \text{ dB}$$

Which can be converted (see Toresen *et al*. 1998 for details) to the area form (scattering cross sections of acoustic targets):

$$C_{Fi} = 1.26\ 10^{6}\ L^{-2}$$

where L is total length in 1 cm length group *i* and C_{Fi} (m^{-2}) is the reciprocal back scattering strength, or so-called fish conversion function. To split and convert the allocated s_A-values (m^2/NM^2) to fish densities (numbers per length group per NM^2), the following formula was used:

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

where

ρ_i = density of fish in length group *i*

s_A = mean integrator value

p_i = proportion of fish in length group *i*

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

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

The integrator outputs were split in fish groups using a combination of behaviour pattern as deduced from echo diagrams, the LSSS analysis and catch composition as described below.

The following target groups were used for Mauritania:

1) Sardine (European pilchard *Sardina pilchardus*).
2) Sardinellas (round sardinella *Sardinella aurita* and flat sardinella *S. maderensis*).
3) Anchovy (European anchovy *Engraulis encrasicolus*).
4) Horse mackerels (Atlantic horse mackerel *Trachurus trachurus,* and Cunene horse mackerel *T. trecae)*.
5) Mackerel (Atlantic chub mackerel, Former scientific name *Scomber japonicus,* new name *S. colias).*
6) Other pelagic scombrids, carangids and associated species (such as *Auxis* sp., *Caranx* sp. and hairtail *Trichiurus lepturus*) (*Macrophosus scolopax* and *M. gracilis* were included in this group due to their very high abundance), LSSS group PEL2.
7) Other demersal species (such as Sparidae, Haemulidae and Merluccidae).

The above equations show that the conversion from s_A-values to number of fish is dependent on the length composition of the fish. It is therefore important to get representative length distributions from the stock in the whole distribution area.

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

For a region representing a distribution of a target-species, the following basic data are needed for the estimation of abundance:

1) The average s_A-value for the region,
2) The surface (usually square nautical miles, NM^2), and
3) A representative length distribution of the target species in the region.

If the targeted fish is a mixture of more than one species, for example sardinellas, a representative distribution of the two, within the region, as shown in the trawl catches, are used. A length distribution representing the number of the two species for each catch must be calculated. Thereafter, these distributions must be normalized to a unit number (usually 100) so they are equally weighted (independent of sample size).

A systematic approach to a) divide the s_A-value between species in a category of fish (e.g. *Sardinella aurita* and *S. maderensis*) and b) produce pooled length distributions of a target species for use in the above equation and c) calculate the biomass estimates for a region, is obtained through the following procedure:

- The samples of the species in the category (e.g. sardinellas) are respectively pooled together with equal importance (normalized).
- The mean back scattering strength (ρ/s_A) of each length frequency distribution of the target species is calculated and summed. This is automatically done in the Excel spread-sheet made available for acoustic abundance estimation on board RV "Dr. Fridtjof Nansen", provided the data are punched in this sheet.
- The mean s_A-value allocated to the category of fish in the region is divided between the species in the same ratio as their relative contribution to the mean back scattering strength of the length groups in the sample representing the region
- The pooled length distribution is used, together with the mean s_A-value, to calculate the density (numbers per square NM) by length groups and species, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area.
- The numbers are then converted to biomass using the estimated weight at length.

CHAPTER 3. SURVEY RESULTS

3.1 Hydrographic conditions

Hydrographic data were collected on fixed CTD stations to 1000 m depth and from the Aanderaa weather station that continuously collect sea surface temperature, wind speed and direction, solar radiation etc. during the survey.

Cross shelf hydrographic profiles

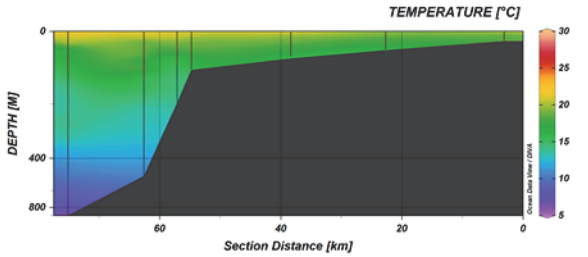
Figure 3.1 shows the distribution of temperature, salinity, fluorescence and oxygen from the five hydrographic transects collected during the survey. Data are plotted with the software Ocean Data View (ODV) using a nonlinear y-axis. Maximum depth is 1000 m.

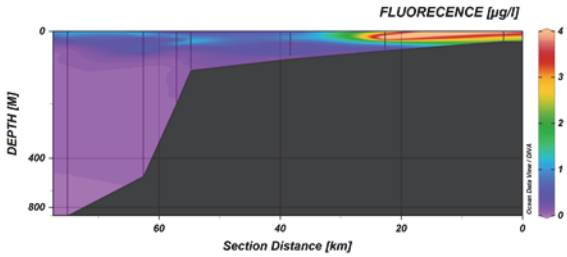
The northernmost part of Mauritania at Cap Blanc shows a typical upwelling situation with limited stratification and high primary production (fluorescence) on the inner shelf.

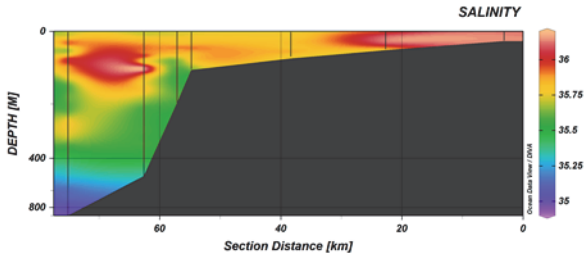
Moving southwards surface temperature starts increasing and highest fluorescence is visible on the shelf break and offshore. At 19°N water masses become increasingly more stratified especially offshore with warm saline tropical water masses observed in the surface layers and close inshore where water masses are mixed. This appears to be the frontal area between cooler water masses in the north and warmer tropical water masses from the south. Primary production is low across the shelf. Low oxygen waters < 1 ml/l can be observed close to the bottom on the outer shelf. The section at 18°N is similar to the section at 19°N but with stronger stratification of the water masses in the upper 30 m. At 17°N the most striking feature is the presence of high florescence close to the coast. The thermocline is found at around 30 m depth. Southwards, towards the border with Senegal, temperature and salinity above the thermocline increase and the thermocline becomes deeper, and at 16°N is found at around 45-50 m depth. Primary production is low except for close inshore. Here oxygen concentrations are around 5 ml/l in the surface layer, decreasing to 1-2 ml/l below the thermocline.

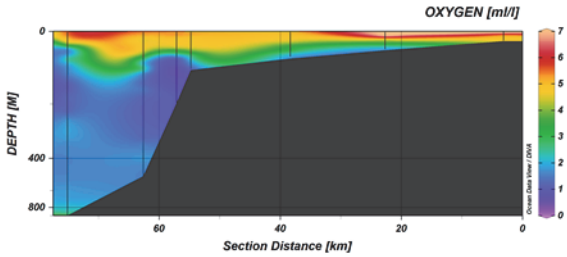
Overall, the observed conditions suggest very limited upwelling activity during the survey, which is in line with what could be expected at this time of the year in this region.

20°50’N Cap Blanc

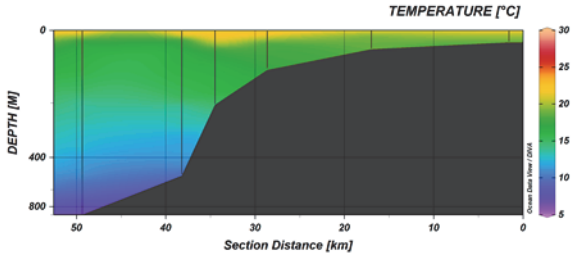


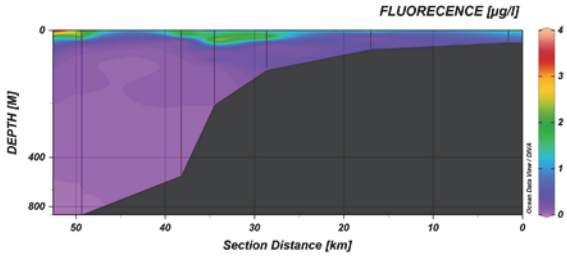


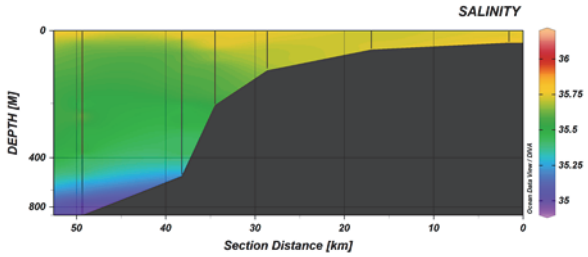


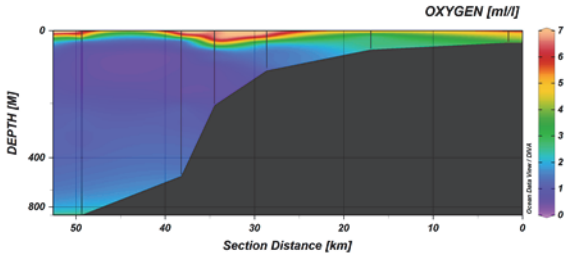


20°00’N

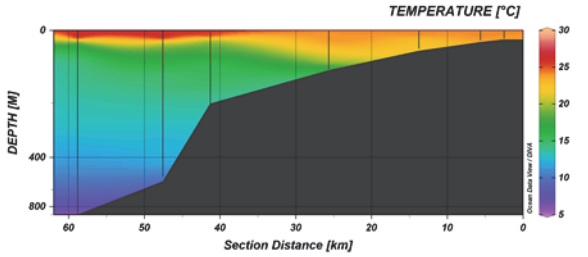


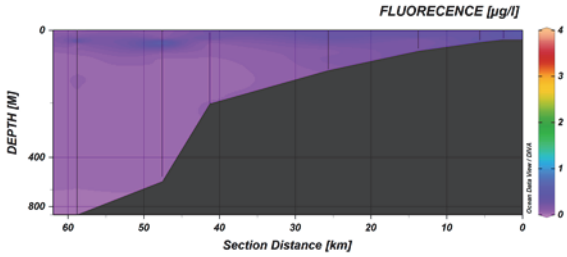


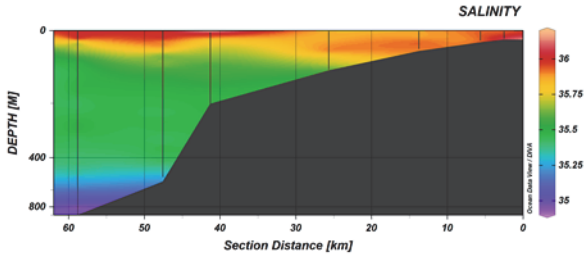


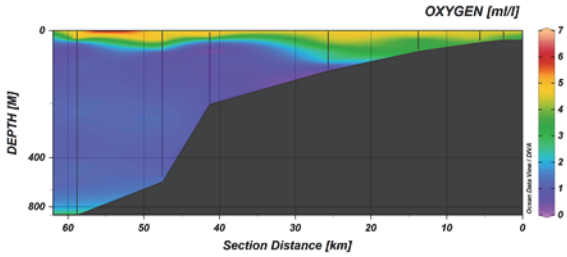


19°00’N









18°00’N Nouakchott

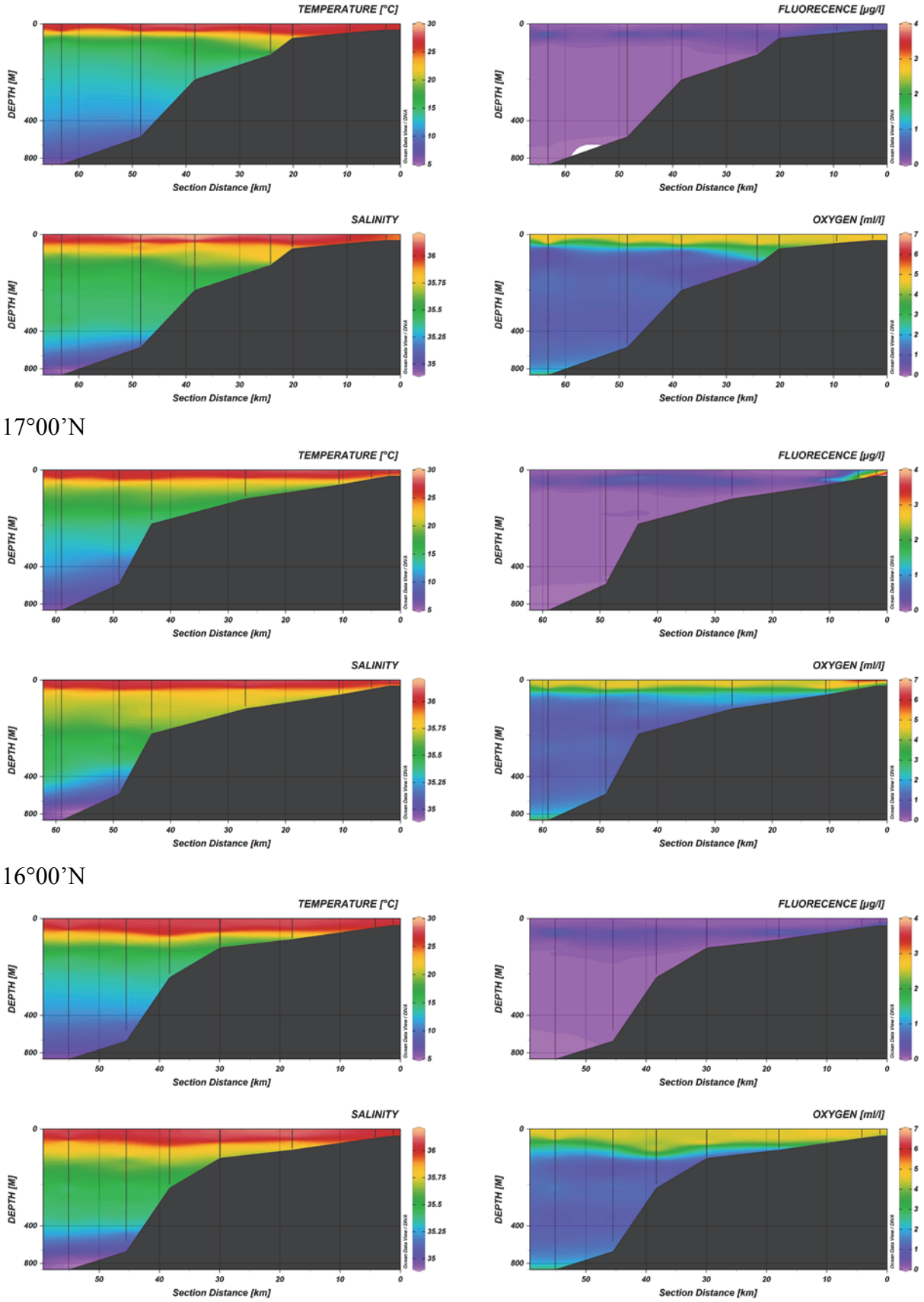


Figure 3.1. Hydrographic profiles with distribution of temperature, salinity and oxygen

Sea surface distribution of temperature, fluorescence and oxygen

The surface map produced from CTD data at 5 m depth show a clear separation of water masses from the northern and southern Canary Current system respectively (Figure 3.2). A strong increase in temperature from around 20°C at Cap Blanc to 28° south of Cap Timiris can be observed. It is an indication of southward protruding water masses inshore in this region while offshore northwards moving water masses affect the outer shelf in the surface. Primary production (fluorescence) and oxygen is also high inshore in this northern part of Mauritania. High fluorescence and oxygen concentration can also be found in the southern part of Mauritania close to the coast where water masses are hot and saline.

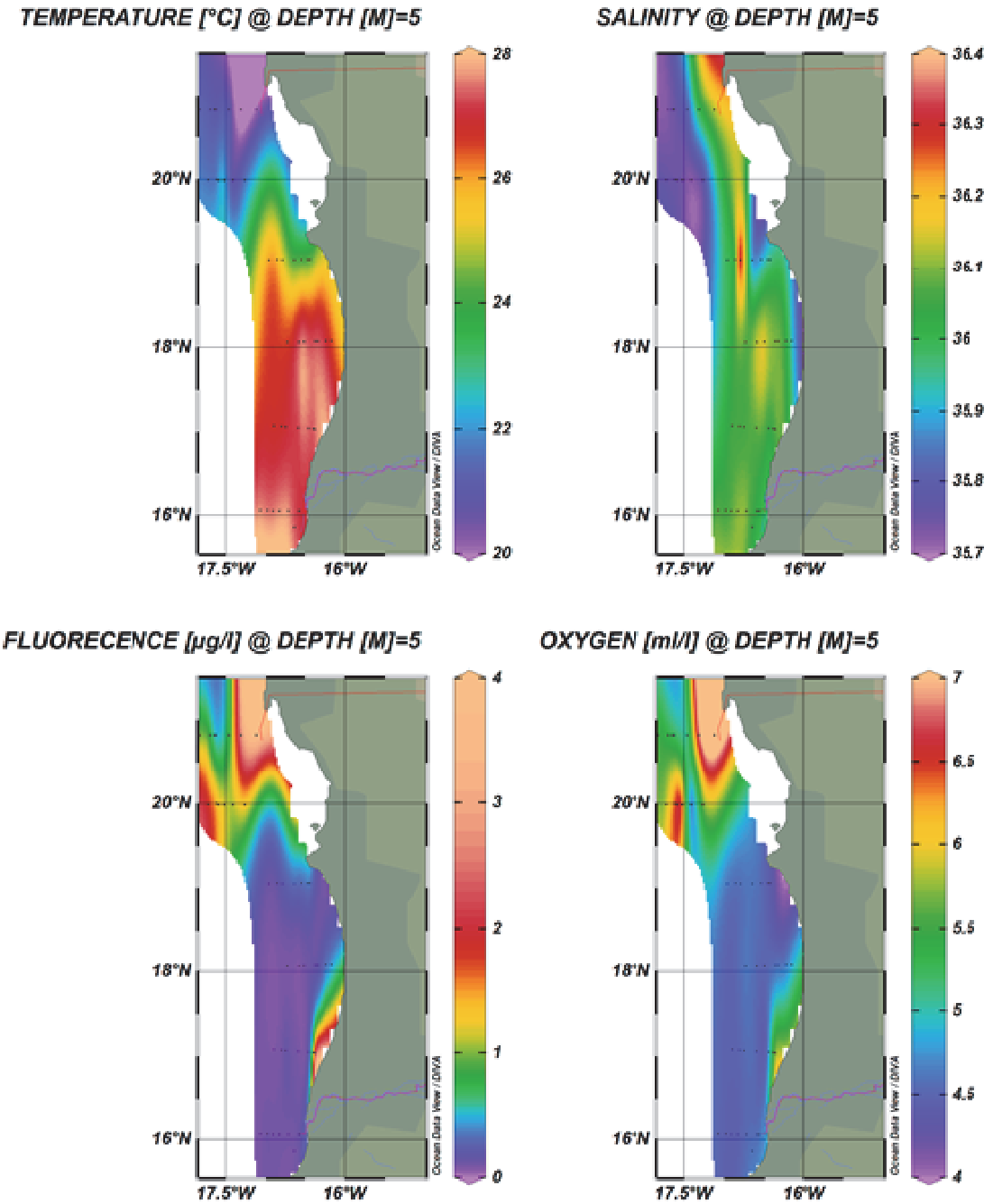


Figure 3.2 shows the sea surface temperature, salinity, fluorescence and oxygen at 5 m of depth

Nutrients

No onboard analysis were conducted. These samples are to be analysed in the IMR laboratory in Norway.

3.2 Plankton

Phytoplankton

No analyses are yet carried out (material to be analysed through regional collaborative work).

Chlorophyll-*a*

This material was sent to Norway and has not yet been analysed. Data will be distributed once these analyses are completed.

Zooplankton

Zooplankton biomass distributions for the survey area from Cap Blanc and southwards to ~ 16° N are given in Figures 3.3 and 3.4. When considering a subset of data representing the whole water-column for stations with bottom-depths of ~100 m or less, and restricted to the uppermost 200m for stations with bottom-depths of ~ 500 m, the average zooplankton biomass was 7.6 g dry-weight m^{-2}. "Repeated samples" for the uppermost 30 m were here excluded. The standard deviation was 7.1 g dry-weight m^{-2}, and the number of observations was 15, with the biomasses ranging between 1.5 and 30.3 g m^{-2}. The maximum observation (30.3 g m^{-2}) was made along the northernmost transect at bottom-depth of ~100m. The second highest observed biomass was 13.1 g m^{-2}, and if excluding the extreme observation of 30.3 g m^{-2}, the average of the remaining 14 observations would be 5.9 g m^{-2} with a standard deviation of 3.4 g m^{-2}. For comparison, when only considering the uppermost ~ 30 m of the water column (Figure 3.4), regardless of bottom-depth, the average biomass for the whole study area was 5.5 dry-weight m^{-2} (standard deviation of 4.3 g dry-weight m^{-2}, and 15 observations). These biomasses ranged between 1.3 and 13.1 g m^{-2}, and included both day and night samples.

Considering the total zooplankton biomass for the whole study area (Figures. 3.3 and 3.4), no clear geographical patterns emerged.

Note that a direct comparison of the biomasses along transects in Figure 3.3, running perpendicular to the coast-line, would not make much sense as sampling volumes increased with increasing bottom-depth.

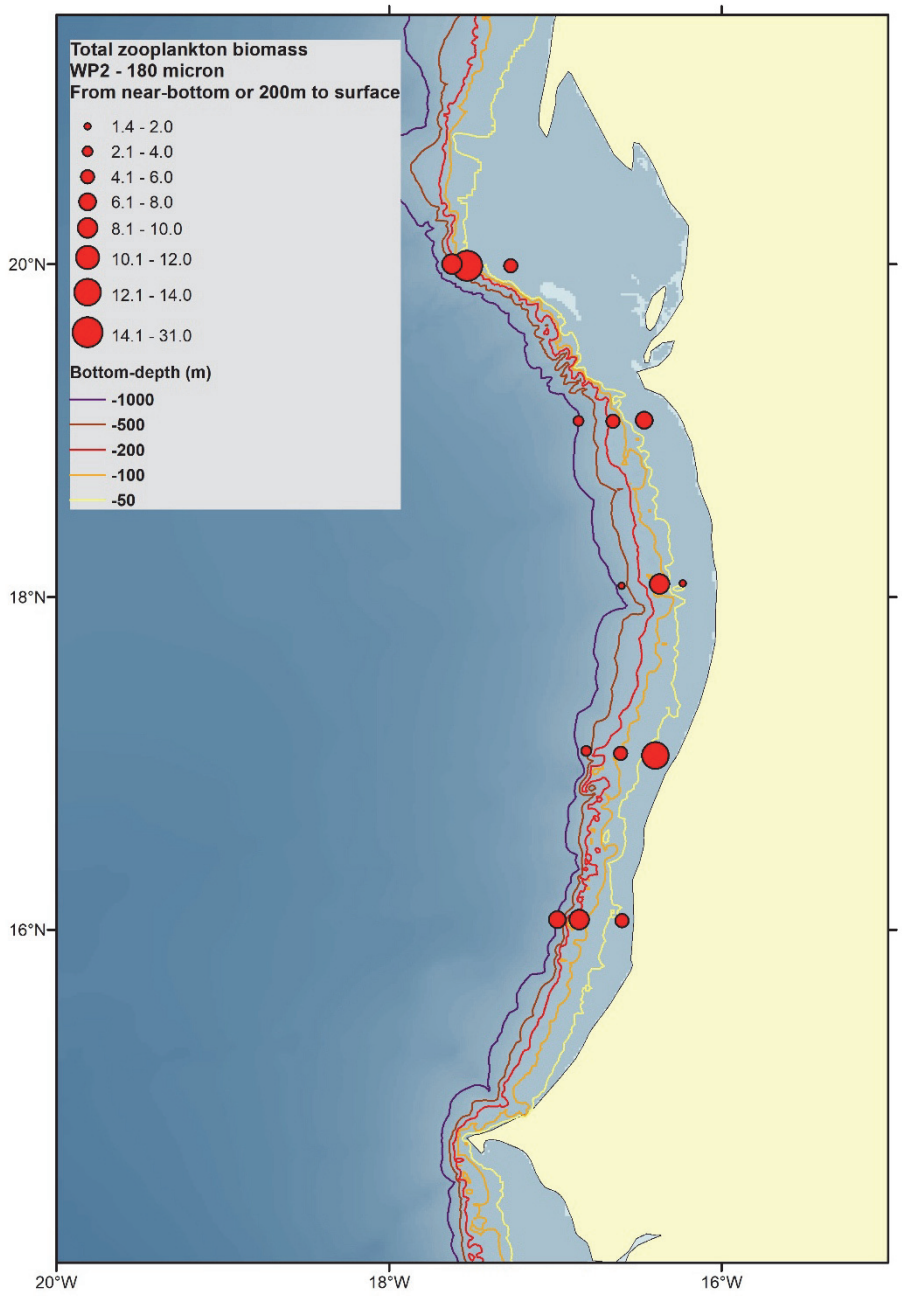


Figure 3.3. Total zooplankton biomasses (dry-weight, g/m2) for sampling-strata of ~ 25-0 m at bottom-depth of 30m, ~ 90-0 m at bottom-depth of 100 m, and ~ 200-0 m at bottom-depth of 500 (c.f. bottom-depth contours in the figure). Hence, the samples here shown for different bottom-depths are not directly inter-comparable but rather indicate the zooplankton biomasses from the bottom (or 200 m) to the surface. Also see comments in the text regarding a possible bias in some samples due to inclusion of phytoplankton.

However, we also present results for samples collected only from the uppermost ~ 30m, regardless of bottom-depth (Figure 3.4). Figure 3.4 includes both day and night samples, and we have here not accounted for diel vertical migrations of the plankton which might represent some bias when comparing the biomasses. Neither in this case was any clear geographical pattern observed when considering the whole study area.

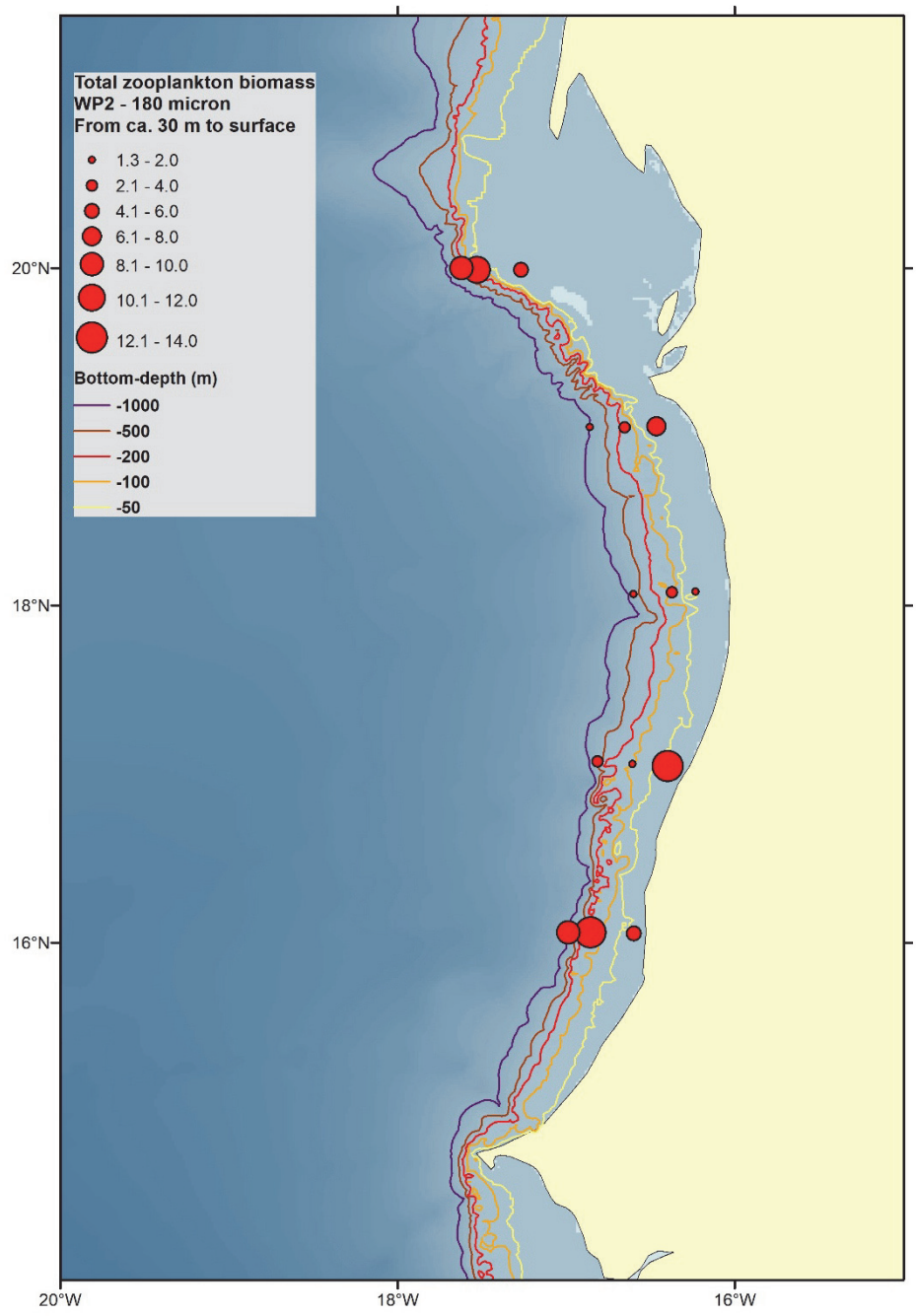


Figure 3.4. Total zooplankton biomasses (dry-weight, g/m^2) for the uppermost ~ 30 m. Both day and night samples are included. See comments in the text regarding a possible bias in some samples due to inclusion of phytoplankton.

Presence of phytoplankton was noted in three of the zooplankton biomass samples. All three of these cases represented stations with bottom-depths of ca. 30 m – i.e. the stations closest to shore along these given transects (Figure 3.5). One of these stations was located on the northernmost transect, while the last two stations belonged to the southernmost transects. During the cruise it was not possible to eliminate the phytoplankton from the samples, due to the risk of losing zooplankton. The samples with phytoplankton contents did not show particularly high biomasses in two of the cases, while the third case had a biomass of 13.1 g

m^2. To which degree phytoplankton may have contributed to the measured biomasses – hence representing overestimation – is not clear.

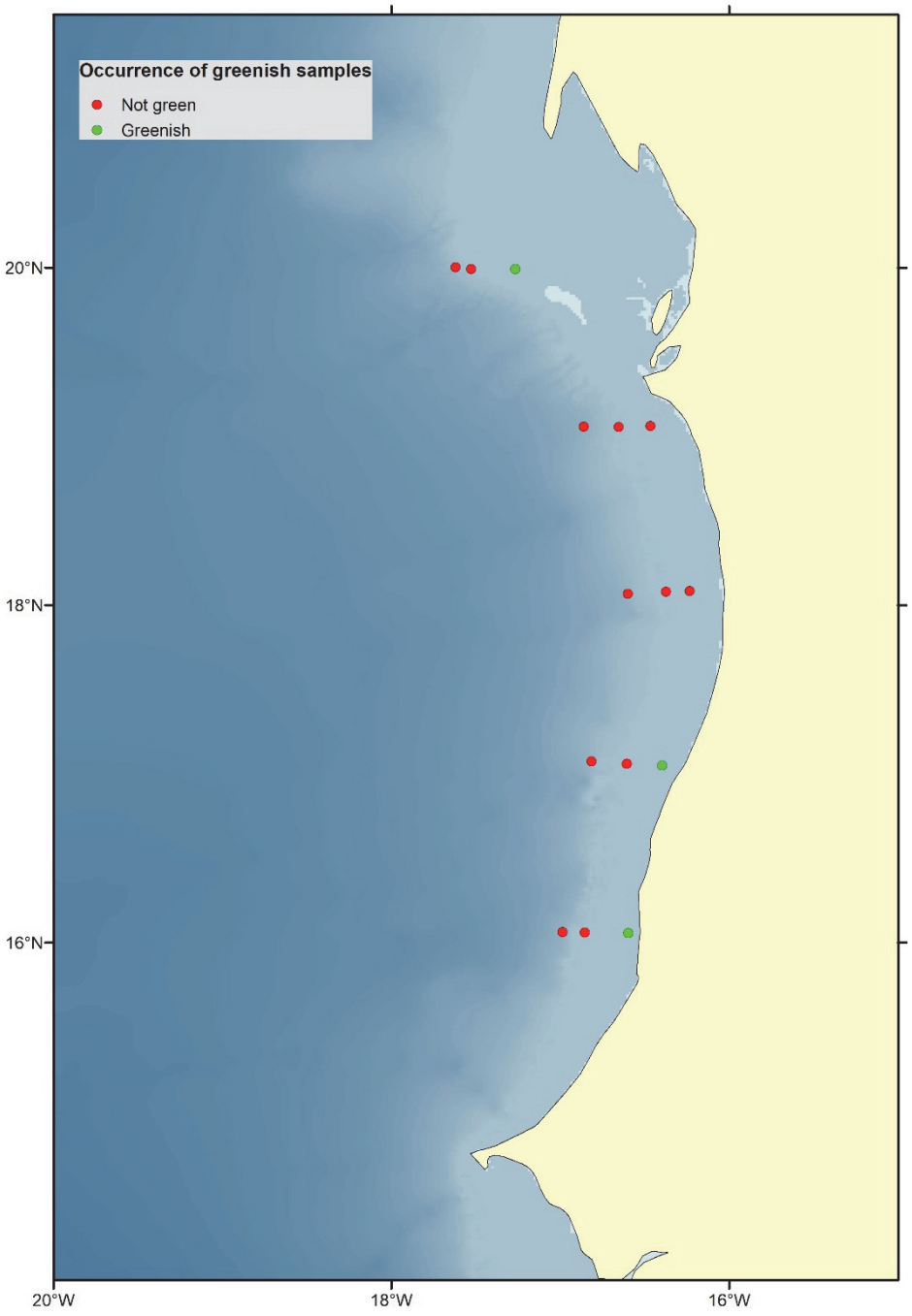


Figure 3.5. Indication of zooplankton biomass samples with notable green colour revealing contents of phytoplankton – which to some degree implies overestimation of zooplankton biomass. Figure based on the samples covering the bottom (or 200 m) - surface stratum.

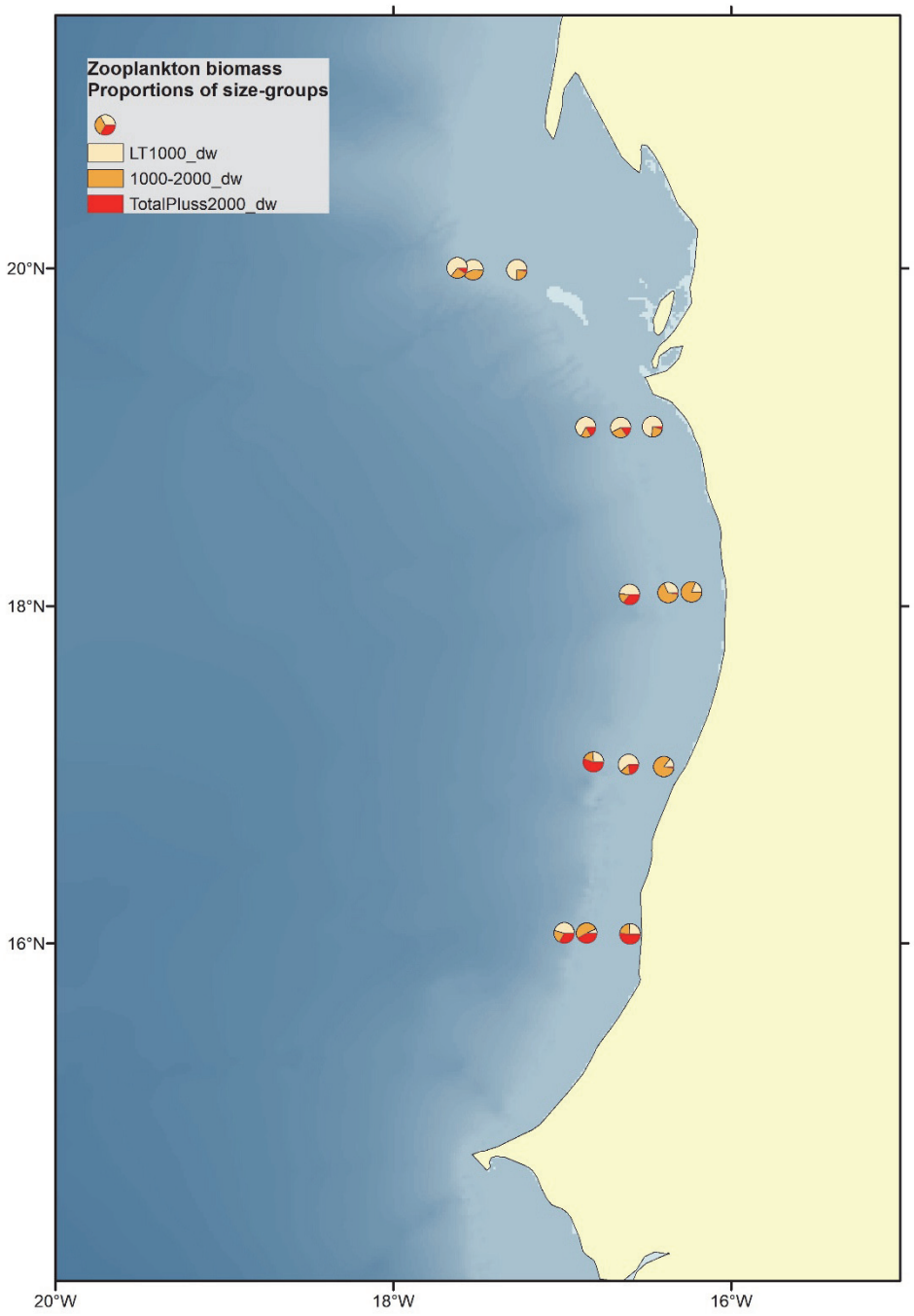


Figure 3.6. Weight-proportions of three zooplankton size-groups (180-1000 µm in yellow, 1000-2000 µm in orange, and > 2000 µm in red). The results presented here represent the sampling strata of ~ 25-0 m at bottom-depth of 30 m, ~ 90-0~m at bottom-depth of 100 m, and ~ 200-0 m at bottom-depth of 500 (see bottom-contours in Figure 3.3). Hence, the samples here shown for different bottom-depths within the same transect are not directly inter-comparable but rather indicate the zooplankton size-composition in the water-column above the bottom or depth of 200 m.

Considering the whole region, the weight-proportions of the sampled zooplankton tended to be dominated by the by the smallest size-fraction (180-1000 µm) in the northern part of the area, while intermediate and large size-fractions seemed to be relatively more important in the southern part (Figure 3.6). This tendency was indicated also when only considering the uppermost 30 m of the water-column (not shown).

Ichthyoplankton

Multinet samples were taken from station 164,166,168,171,173,175,178,180 and 182 (CTD station as reference). The material will be analysed in Morocco during a planned workshop in 2018 and presented separately from this report.

Microplastics

Manta trawl samples were taken from seven stations 164, 166, 168, 171, 178, 180,182. The sampling was cancelled at two stations, 173 and 175 due to weather constrains. (CTD station as reference).

Due to high biomass in the samples only ¼ sample was sorted at station 164, 166, 168 and 171 and sent to Norway for analyses. The rest of the material was sent to Mark Gibbons at UCT, South Africa.

The material will be presented separately once processed.

3.3 Distribution and abundance of pelagic fish

Generally, the fish biomass in Mauritania was lower than what is often observed during the surveys. However, the season was slightly different from the period most of the surveys with *Dr Fridtjof Nansen* have been carried out in the past. Below is a description of the findings within the two regions of the survey. The contoured acoustic densities for the main groups of pelagic fish for the shelf of Mauritania are presented in Figures 3.7-3.12 while the estimated biomass of the main groups of pelagic fish is presented in Tables 2 to 4. Size distributions of target species are presented in Annex IV.

Cap Blanc - Cap Timiris

Sardinella

Very little sardinella was found in the northern region. Some *S. maderensis*, 6.5 thousand tonnes were estimated while no *S. aurita* was observed. These were found in a thin band inshore of the shelf break just north of Cap Timiris (Figure 3.7).

Sardine

The biomass of sardine in Mauritania was estimated to 61 thousand tonnes. It was found in one area on the outer shelf south of Cap Blanc. This was the furthest south the sardine was found during this survey (Figure 3.8). The size distribution found in the region was narrow with a modal peak at 11 cm representing juvenile fish only.

Anchovy
34 thousand tonnes of Anchovy were found in the northern region, on the shelf south of Cap Blanc. The modal peak was at 11 cm (Figure 3.9), and the fish were mixed with sardine of the same size within the distribution area.

Horse mackerels
A total of 67 thousand tonnes of horse mackerel was found between Cap Blanc and Cap Timiris. Of this, 2 thousand tonnes were *Trachurus trachurus* while 65 thousand tonnes was *T. trecae*. The size distribution of the two species in the region is found in Figure 3.10. The *T. trachurus* were generally juvenile fish with a modal peak at 11 cm. The *T. capensis* showed a modal peak at 10 cm and another at 18-19 cm.

Chub mackerel
A total of 20 thousand tonnes of Chub mackerel was observed between Cap Blanc and Cap Timiris. Chub mackerel was generally found in deeper waters than most of the other species, but with a dominance on the shelf and over the shelf break. The densities were generally low. One distribution area was found on the outer shelf south of Cap Blanc (Figure 3.11).

Carangids etc.
Chub mackerel are often calculated as part of the Pel2 group but this year, due to its relatively large presence, a separate estimate was made. No other Pel2 type of fish was estimated in the northern region (Figure 3.12).

Table 2. Cap Blanc - Cap Timiris. Biomass estimates of pelagic fish, thousand tonnes.

S. maderensis	*S. aurita*	Horse mackerels	Chub mackerel	Sardine	Anchovy	Carangids etc.
6,5	0	67,0	20,4	61,3	34,0	0

Cap Timiris - St. Louis

The estimated biomass between St. Louis and Timiris is presented in Table 3.

Sardinella
A total of 109 thousand tonnes of *S. maderensis* and 34 thousand tonnes of *S. aurita* was found in the region. In the southern region sardinella was more widely distributed on the shelf than further north. The different patches were found, one south of Cap Timiris, one off Nouakchott and one close to St. Louis. The size distribution of the two species is found in Figure 3.7.

Sardine
The sardine is known to occur in the cold northern part of the Canary Current ecosystem and no sardine was not found in the warm tropical water mases south of Cap Timiris.

Anchovy
44,3 thousand tonnes of Anchovy were found in two separate areas along the shelf, the first was found between Cap Timiris and Nouakchott, while the second region was found in the south of Mauritania at the border with Senegal. The size distribution is presented in Figure 3.9.

Trachurus trecae
A total of 25 thousand tonnes of *T. trecae* was found south of Cap Timiris. The fish showed modal peaks at 12 cm, 18 cm and 24 cm Figure 3.10. The fish was generally distributed in four low density patches on the shelf between 20-100 m depth.

T.capensis
No *T. trachurus* was found in the region.

Chub mackerel
4,9 thousand tonnes of Chub mackerel were found in the southern region. Small patches of fish were found between Cap Timiris and Nouakchott while further south the distribution was more continues from 17°N to St. Louis (Figure 3.11).

Carangids etc.
A total of 40 thousand tonnes of the carangids and associated species (Pel2) species group was found. The Pel2 was found in the warm tropical waters of the southern part of Mauritania with relatively continues distribution in a low-density area from 18°N and southwards.

Table 3. Cap Timiris - St. Louis –. Biomass estimates of pelagic fish, thousand tonnes.

S. maderensis	*S. aurita*	Horse mackerels	Chub mackerel	Sardine	Anchovy	Carangids etc.
109,4	34,0	24,8	4,9	0	44,3	40,2

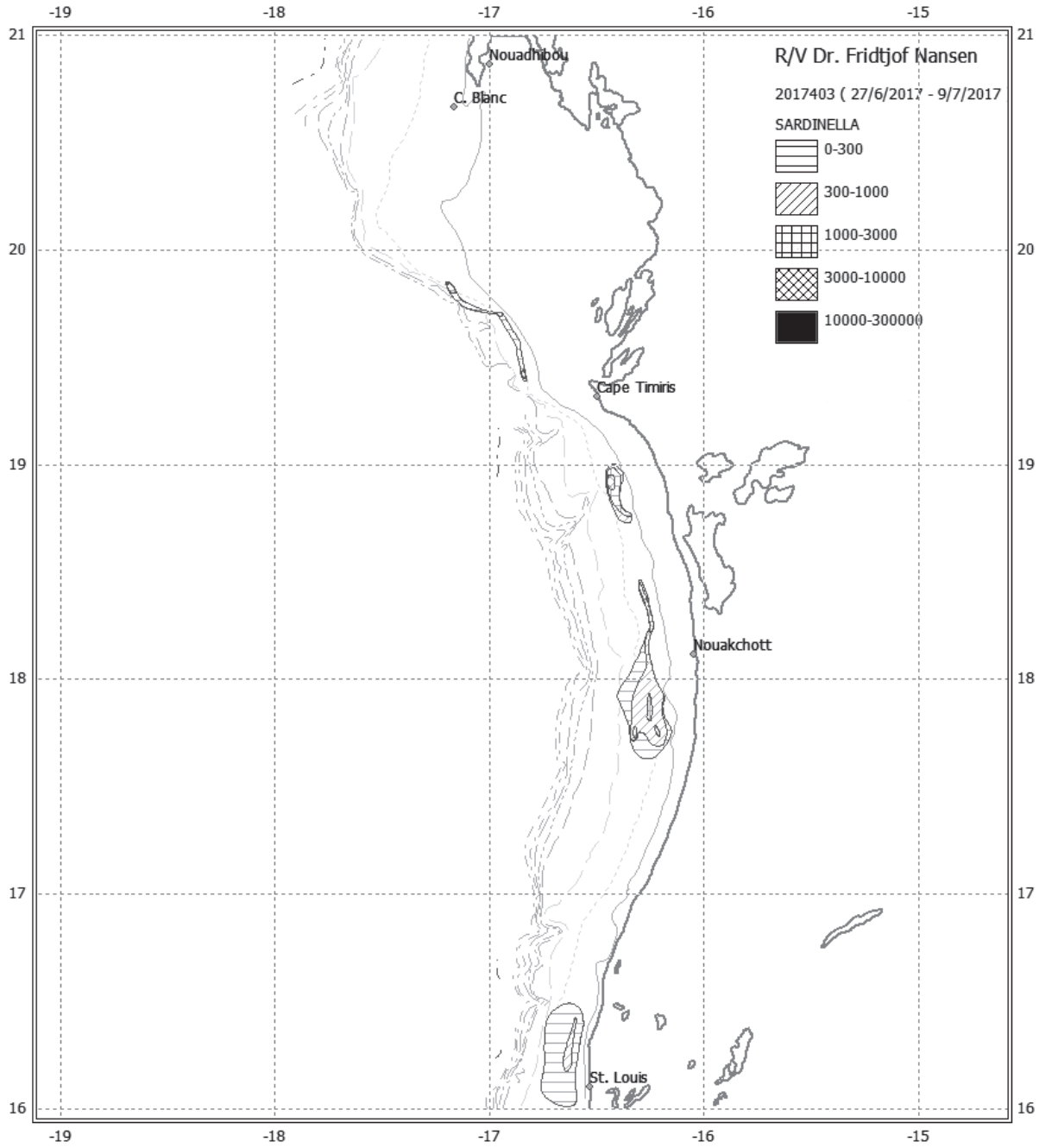


Figure 3.7. Distribution of sardinellas, Cap Blanc - St. Louis

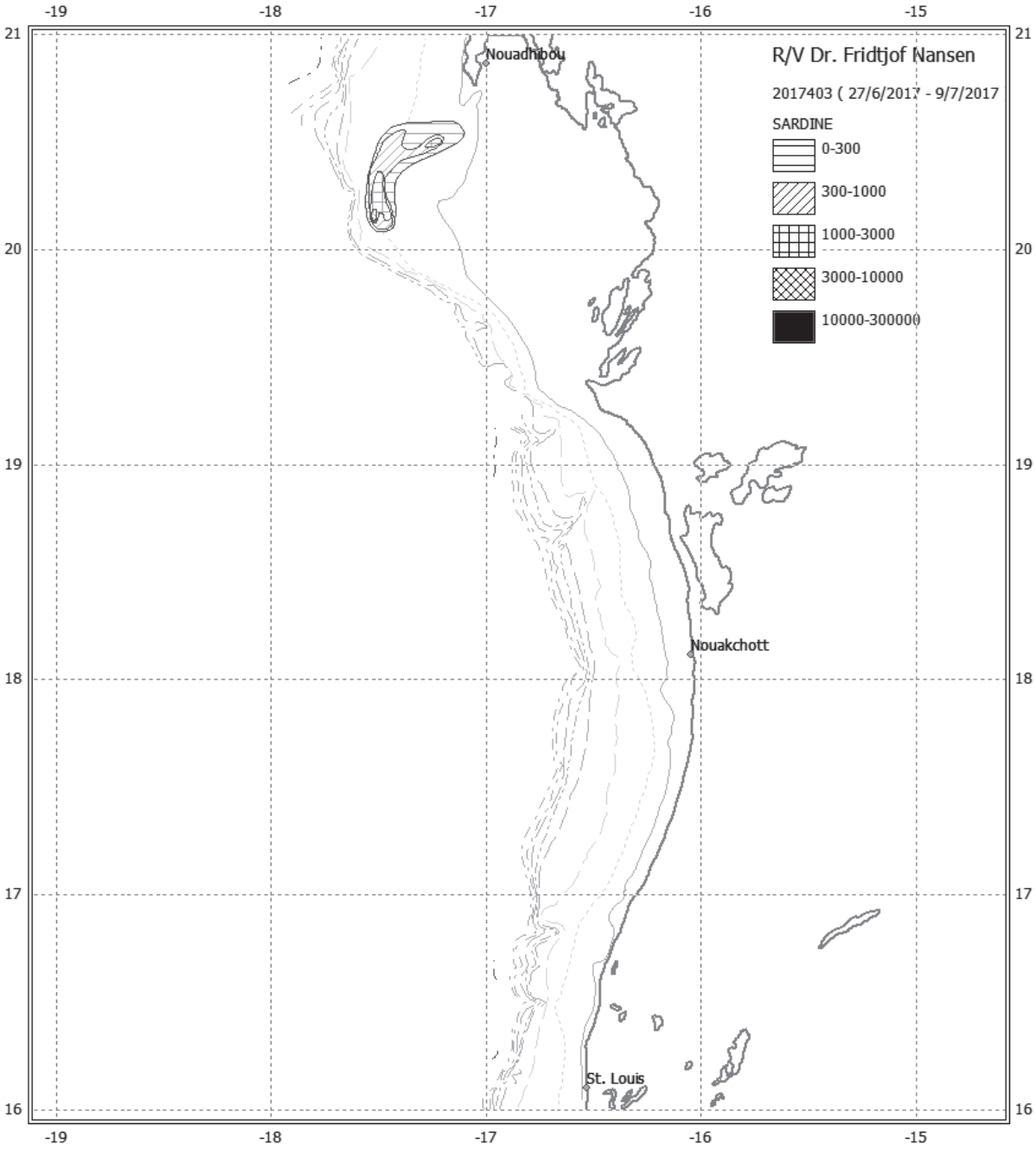


Figure 3.8. Distribution of sardine, Cap Blanc - St. Louis

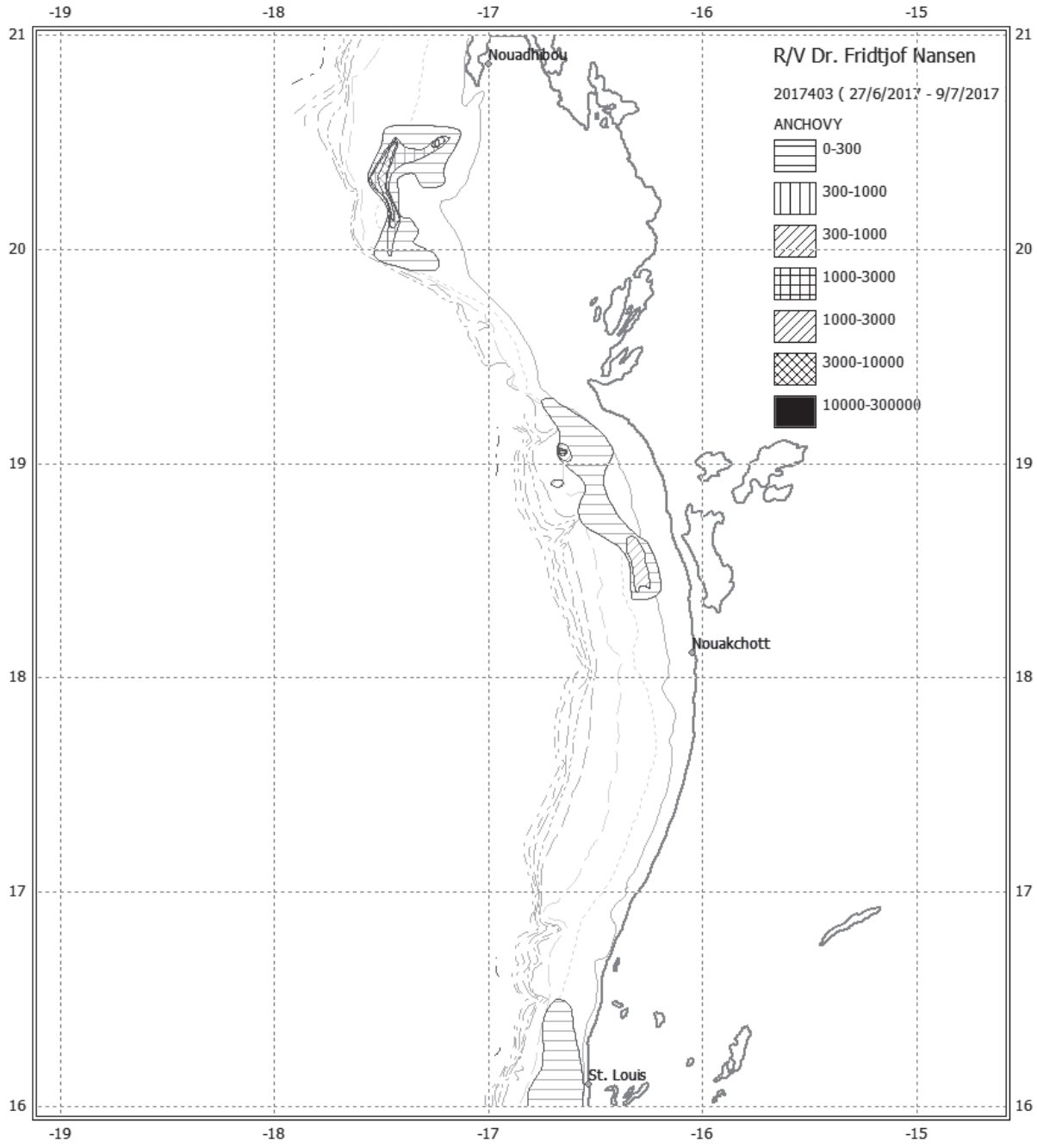


Figure 3.9. Distribution of anchovy, Cap Blanc - St. Louis

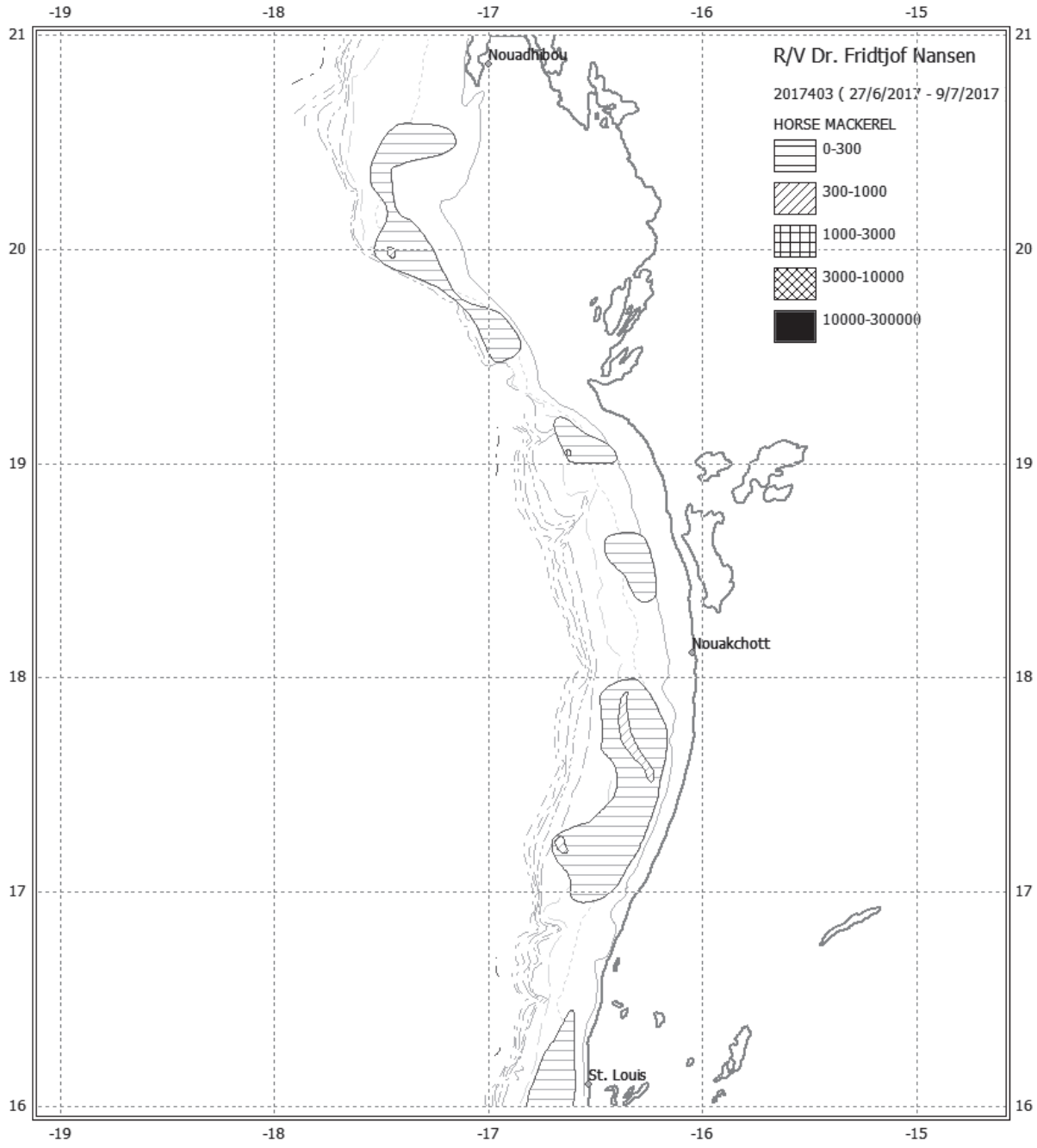


Figure 3.10. Distribution of horse mackerels, Cap Blanc - St. Louis

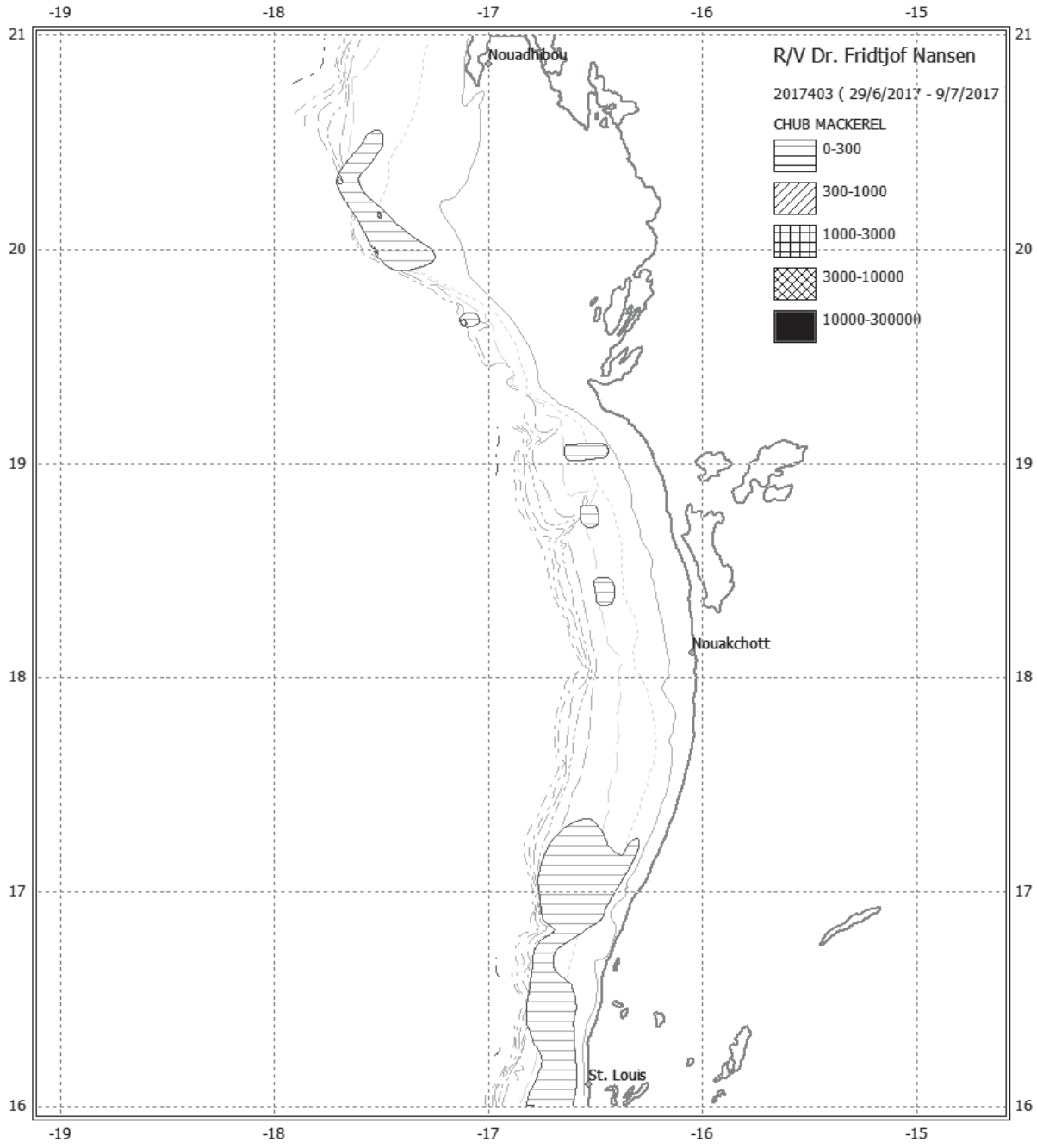


Figure 3.11. Distribution of chub mackerel, Cap Blanc - St. Louis

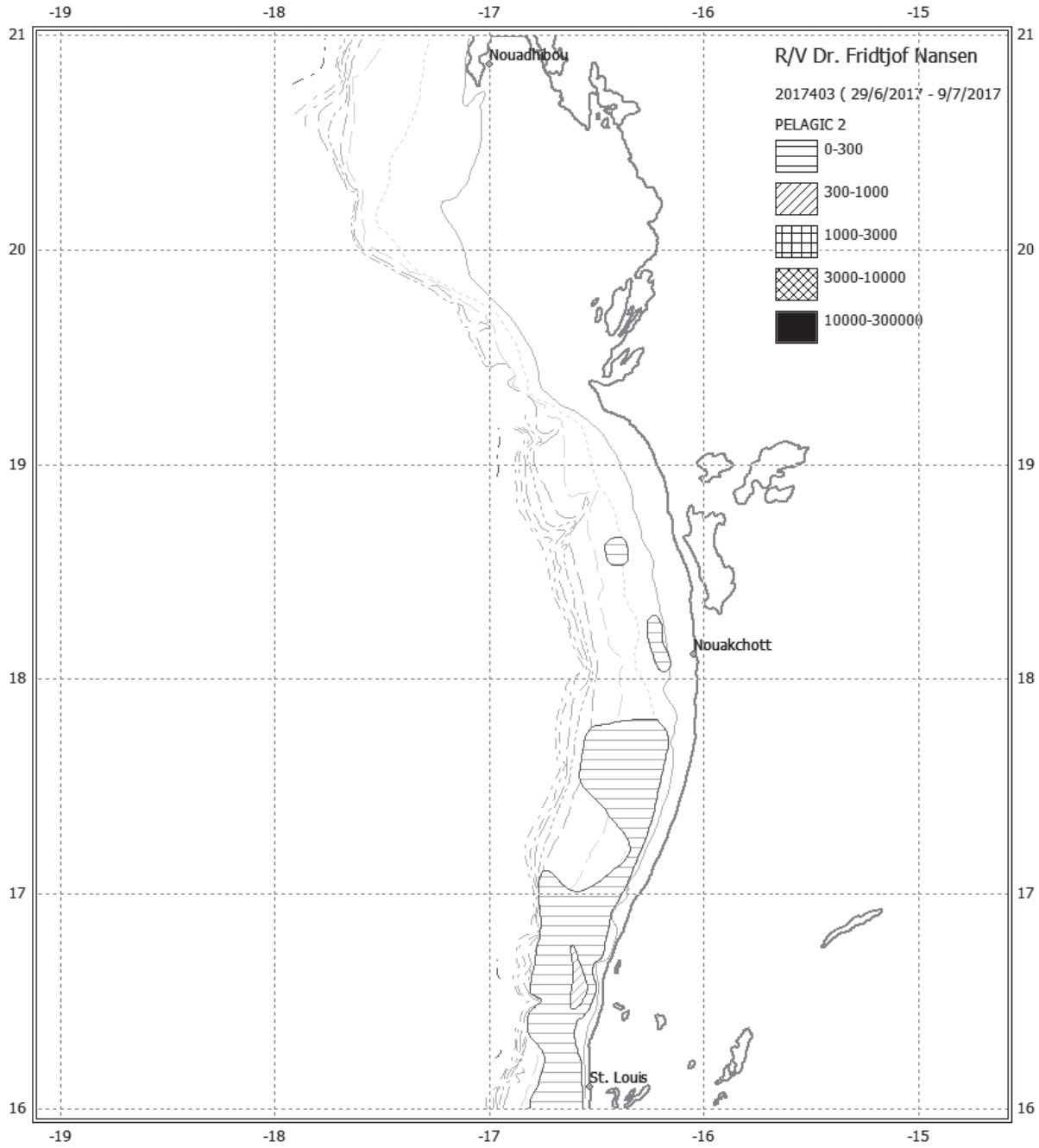


Figure 3.12. Distribution of carangids and associated species, Cap Blanc - St. Louis

3.4 Summary of biomass estimates

A summary of the biomass estimates provided above is given in Table 4. The size distribution of the various target species per sub-region (Cap Blanc-Cap Timiris and Cap Timiris-St Louis) can be found in Annex IV while detailed regional biomass estimates in number and weight by length groups from Senegal to Morocco are shown in Annex V.

Table 4. Summary of biomass estimates of pelagic fish, Mauritania (1000 t).

	S. maderensis	*S. aurita*	Horse mackerels	Chub mackerel	Sardine	Anchovy	Carangids etc.
St. Louis-Cap Timiris	109,4	34,0	24,8	4,9	0	44,3	40,2
Cap Timiris - Cap Blanc	6,5	0	67,0	20,4	61,3	34,0	0
Total	115,9	34,0	91,8	25,3	61,3	78,2	40,2

3.5 Overview of samples collected for future analysis

With the expanding scope of the research to be carried out in the context of the EAF-Nansen Programme, the survey objectives and related sampling strategy have been expanded to support research on life cycles, stock identities, trophic relationships, and food safety amongst others.

An overview of the biological samples is provided in Annex II.

CHAPTER 4. REGIONAL SUMMARY

The R/V *Dr Fridtjof Nansen* survey of the pelagic resources in Northwest Africa (Leg 1.1 of the western Africa coverage for 2017) encompassed Morocco to Cape Blanc. The second leg (Leg 1.2), conducted an experimental survey of the mesopelagic resources of the region, and the third and fourth legs (1.3 and 1.4) conducted pelagic surveys for Mauritania and Senegal, respectively.

The first leg of the survey covered the region between Tangier and Cape Blanc from 7-27 May 2017 (Leg1.1). This was temporarily postponed so the vessel could conduct a survey on mesopelagic resources for West Africa from 26 May to 11 June (Leg 1.2), and for an unscheduled maintenance period of the vessel. The third leg for pelagic resources took place for Mauritania from 27 June – 9 July, and for Senegal and the Gambia from 9-18 July (there was a break in service from 3-6 July to allow for a crew change on the vessel). After completing the survey in Mauritania, the vessels continued surveying Senegal and Gambia from 9-18 July 2017 (Leg1.4). A common survey design was adopted in the entire region with parallel transects perpendicular to the coastline, 10 nm apart, and acoustic measurements of pelagic fish obtained on the shelf from 20-500 m bottom depth. At each degree latitude, a hydrographical transect was carried out to a depth of 1 000 m. Meteorological and hydrographic measurements were recorded routinely on these transects in addition to samples on ocean acidification parameters (pH and alkalinity), nutrients, phytoplankton, zooplankton, fish eggs and larvae and microplastics. Weather conditions were good for surveying during the entire period.

Oceanographic Conditions

Between Tangier and Cape Blanc, the oceanographic conditions showed a gradual increase in surface temperatures and lowering of the thermocline from the north to the south, and a corresponding decrease in oxygen in the upper 50 m (as observed at the 100 m CTD stations). The region north of 32° show the most stable water masses and the least upwelling. Close inshore, at the 30 m CTD stations, a clear separation in conditions is observed around 25°N, where water masses close to the coast are more fully mixed south of this latitude. Salinity in the upper 200 m are generally high across the entire region (> 36), and highest salinity is found at 24°N where salinity close to the coast is above 36.3 across the water column corresponding with lower fluorescence values. The areas of highest Chlorophyll *a* concentrations typically a4 3correspond with areas of lower salinity and indicates upwelling. These areas are roughly between 32°N- 30°N, around 27°N extending to both sides, and especially from 23°N and southwards where Chlorophyll *a* values increase > 4 µg/l. A clear frontal Zone was visible in the region around Cape Blanc.

At Cape Blanc, a clear separation of water masses from the northern and southern Canary Current system with strong increase in temperature from around 20°C (of Cape Blanc) to 28°C south of Cape Timiris can be observed. There is an indication of southward protruding water masses inshore in this region while offshore northwards moving water masses affect the outer shelf in the surface. Upwelling affects especially the northern border region of Mauritania and primary production (fluorescence) and oxygen is high inshore. A similar situation can also be observed in the far southern part of Mauritania close to the coast. These two regions are separated by a central region with low primary production and strongly stratified water masses. At 19°N and 18°N, water masses are becoming increasingly more stratified, especially offshore with warm saline tropical water masses observed in the surface layers.

Primary production is low across the shelf. Low oxygen waters < 1 ml/l can be observed close to the bottom on the central outer shelf.

The hydrographical conditions in Senegal and the Gambia were relatively uniform considering the geographical spread of stations. The surface layer had typical characteristics of tropical water masses with high temperatures and high salinities. Thermoclines were present around 50 m depths. Above the thermoclines, the water masses were well oxygenated, while in deeper waters, oxygen concentrations were low, varying between 1 and 2 ml l-1. This agrees with recent measurements in these waters. Some transects had indications of subsurface maximum Chlorophyll *a*.

Fish distribution and abundance

Surveys with the previous R/V *Dr Fridtjof Nansen* (1994-2016) were carried out in the same way as the present survey (2017-present) with regard to both survey design, acoustic scrutinizing and biomass estimation methodology. The methodology followed the recommendations of the Northwest Africa acoustic survey planning group. This allows for direct comparison of biomass estimates from the present survey with historic surveys. Still, the 2017 survey was carried out in May-July while most of the historic surveys that are part of the time series were carried out between October-December. This will affect the distribution of the fish, and potentially also their availability in the survey area. Table 5 presents the biomass estimates by main species and sub-region while Table 6 shows the trends over time based on the surveys with the R/V Dr. Fridtjof Nansen.

A strong separation between the stocks in northern and southern part of the CCLME region is observed. The total biomass north of Cape Blanc is high while the southern part of the region is struggling with declining stock sizes for several species.

As during all the historic surveys, the same target strength was used for all species. For species with low target strength, such as Atlantic chub mackerel (*Scomber colias*), the biomass will be underestimated due to this. In addition, large shallow water areas with bottom depth < 20 m were not covered by the surveys and there are known seasonal variations in the abundance of pelagic fish in shallow waters, especially *Sardinella maderensis.* For the present survey, the length-weight ratio applied in the estimate is based on data collected in the respective areas of the survey. Historically this has to some extent varied between surveys. A study to identify the effect of this in the assessment may be undertaken in the future.

Sardine (*Sardina pilchardus*). Sardine were found with variable densities in the northern CCLME region between Cap Spartel in the north and Cap Blanc, with generally very high density almost without interruption between Cape Blanc and Cape Juby. The highest densities were found between Cape Barbas and Cape Bojador. The main distribution was found inshore of 40 m bottom depth and the fish was strongly aggregated in most of the area, only occasionally extending much beyond 50 m isobath. The total biomass registered in Morocco is around 5 million tonnes, representing 98% of the total biomass in the region. South of Cape Blanc, the biomass was estimated to 61 thousand tonnes, and it was found in one area on the outer shelf north of Cape Timiris. This was the furthest south the sardine was found during this survey and no sardine was found in the warm tropical water masses further south.

Sardinella (*Sardinella aurita* and *S. maderensis*). The sardinella, *S. aurita,* was found north to Dakhla, and only a few fish were found further north close to Cape Bojador. *S. aurita* were found

in relatively patchy low to medium density aggregation. The total biomass registered north of Cape Blanc was around 140 thousand tonnes, representing 54% of the total biomass in the region. In Mauritanian waters, both species were found. A very low biomass was found from Cape Blanc - Cape Timiris with only 7 thousand tonnes of *S. maderensis* while a total of 109 thousand tonnes of *S. maderensis* and 34 thousand tonnes of *S. aurita* was found from Cape Timiris to St Louis. In Senegal, no sardinella was found north of Dakar. Sardinella were distributed only in Petite Cote, from Cap Vert to Banjul and the total biomass is estimated to 86 thousand tonnes for *S. aurita* (33% of the total biomass in the region) and 96 thousand tonnes for *S. maderensis* (45% of the total biomass in the region). Generally, the biomass of both species of sardinella was low.

Anchovies (*Engraulis encrasicolus*). Anchovies were found only in the northern most part of the region between Cape Bojador and Cape Spartel, and in the southern part of this region between Cape Barbas and Cape Blanc. Between these areas no anchovy were found. The fish were confined inshore in water depths < 50 m, and the density was medium. The total biomass north of Cap Blanc is around 65 thousand tonnes, representing 45% of the total biomass in the region. In Mauritania, 34 thousand tonnes were found in the northern region, on the shelf south of Cape Blanc. The fish were mixed with sardine of the same size within the distribution area. South of Cape Timiris, around 44 thousand tonnes of anchovy were found in two separate areas along the shelf. No anchovy were found in Senegal.

In the northern part of the survey area, north of Cap Blanc, **Horse mackerels** (*Trachurus trachurus* and *T. trecae*) were found patchily and in generally low density over the outer shelf in most of the area between Cape Blanc and Cape Spartel. *Trachurus trachurus* was the main species while *T. trecae* was found only between Cap Blanc and Cape Barbas. The total biomass registered in Morocco for *Trachurus trachurus* is 95 thousand tonnes (98% of the total biomass in the region) and 31 thousand tonnes for *Trachurus trecae* (24% of the total biomass in the region). Only 9 thousand tonnes of horse mackerel were found in Mauritania from Cape Blanc to Cape Timiris. This was the southernmost distribution of *Trachurus trachurus,* with a biomass of 2 thousand tonnes while 7 thousand tonnes was *T. trecae*. Between Cap Timiris and St. Louis a total of 25 thousand tonnes of *T. trecae* was found, the distribution continued southwards into Senegal all along the shelf from St. Louis to Casamance with total biomass estimated to 66 thousand tonnes (51% of the total biomass in the region)

Atlantic chub mackerel (*S. colias*) were recorded almost continuously covering most of the shelf in the northern CCLME region between 150-20 m depth from Cape Blanc to Cape Spartel, with the highest densities on the mid and outer shelf. Concentrations were highest off Dakhla and between Laayoune and Cape Bojador. The total biomass registered north of Cap Blanc is 388 thousand tonnes, representing 88% of the total biomass in the region (total 441 thousand tonnes). In Mauritania, a total of 20 thousand tonnes of chub mackerel was observed between Cape Blanc and Cape Timiris. In this region also, Chub mackerel was found in deeper waters than most of the other species, but with a dominance on the shelf and over the shelf break. The densities were generally low. In the southern region, from Cape Timiris to St Louis, around 5 thousand tonnes of Chub mackerel were found. Small patches of fish were found between Cape Timiris and Nouakchott while further south, the distribution was more continues from 17°N to St. Louis. In Senegal, the chub mackerel was distributed from Kayar to Casamance with main concentrations off Sine Saloum. The total biomass was estimated to 28 thousand tonnes (6% of the total biomass in the region).

Table 5: Regional biomass estimates from the 2017 R/V *Dr Fridtjof Nansen* survey.

	Biomass ('000 tonnes)									
	Tanger **Cap Cantin**	**Cap Cantin** **Cap Juby**	**Cap Juby** **Cap Blanc**	**Cap Blanc** **Cap Timiris**	**Cap Timiris** **St Louis**	**St Louis** **Cap Vert**	**Cap Vert** **The Gambia**	**The Gambia**	**The Gambia** **Casamance**	**TOTAL**
Sardina pilchardus	19	502	4 471	61	0	0	0	0	0	**5 053**
Sardinella aurita	0	0	140	0	34	0	86	0	0	**260**
Sardinella maderensis	0	0	0	7	109	0	86	10	0	**212**
Engraulis encrasicolus	10	15	40	34	44	0	0	0	0	**143**
Trachurus trachurus	28	52	15	2	0	0	0	0	0	**97**
Trachurus tracae	0	0	31	7	25	48	14	1	3	**129**
Scomber colias	98	171	119	20	5	8	2	18	0	**441**

Table 6: Regional acoustic biomass data (million tonnes) from R/V *Dr Fridtjof Nansen* surveys 1995-2017 for the main species.

YEAR	*S. pilchardus*	*S. aurita*	*S. maderensis*	*T. trachurus*	*T. trecae*	*S. colias*	*E. encrasicolus*	*Total (without sardine)*	**Total**
1995	3.75	1.62	1.88	0.26	0.18			3.94	7.69
1996	5.56	1.63	1.53	0.45	0.66			4.27	9.83
1997	1.13	0.82	1.00	0.54	0.66			3.02	4.15
1998	1.63	0.82	1.00	0.18	0.80			2.80	4.43
1999	2.67	2.13	1.48	0.10	0.65	0.27		4.64	7.30
2000	3.65	1.91	0.79	0.28	1.76	0.10	0.24	5.08	8.73
2001	4.75	1.80	1.43	0.12	0.36	0.31	0.02	4.04	8.79
2002	6.30	1.43	0.99	0.28	0.58	0.29	0.04	3.61	9.91
2003	5.70	1.26	1.77	0.32	0.39	0.55	0.03	4.31	10.01
2004	7.41	1.59	2.45	0.18	0.73	0.51	0.08	5.54	12.95
2005	8.01	0.81	1.33	0.14	1.21	0.24	0.11	3.85	11.86
2006	3.62	1.13	2.05	0.04	0.40	0.44	0.08	4.14	7.76
2007	**5.88**	0.99	1.19	0.45	0.99	0.61	0.19	4.41	10.29
2008	**4.42**	2.00	0.55	0.33	0.70	0.63	0.12	4.32	8.74
2009	**5.04**	**2.86**	**1.67**	**0.13**	**0.87**	**0.76**	**0.05**	**6.35**	**11.39**
2010	**2.60**					0.28			
2011	**1.95**					0.38			
2012	**2.07**					0.45			
2013	**3.77**					0.65			
2014	**4.10**					1.08			
2015	4.50	0.621	0.867	0.405	0.542	0.72	0.158	3.31	7.81
2016	**2.964**	**0.036**	**0.052**	**0.225**	**0.048**	**1.056**	**0.079**		
2017	5.05	0.26	0.212	0.097	0.129	0.44	0.14	2.12	

Years 1995-2006, 2015 and 2017: data from the R/V *Dr Fridtjof Nansen.*
Years 2007-2008: data are *Nansen* equivalents of local vessels using agreed conversion factors.
Year 2009: all data from the Mauritanian R/V *Al Awan* and the Moroccan R/V *Al Amir*, and data for Senegal and the Gambia were estimated by the Working Group.
Year 2010: No estimates for the Mauritanian R/V *Al Awan*, the Moroccan R/V *Al Amir*, Senegal, and the Gambia.
Year 2011: Some estimates for the CCLME (from the R/V *Dr Fridtjof Nansen*) were presented by the CCLME project coordinator.
Year 2012: Data from Mauritanian R/V *Al Amir* were presented to the Working Group for North of Cape Blanc, and results from a survey by the Russian R/V *Atlantida* in Mauritania and Senegal.
Years 2013 and 2014: Survey data from Morocco, Mauritania, and the Russian R/V *Atlantida*.

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ANNEX I RECORDS OF FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 1
DATE :28/06/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 20°30.82
start stop duration Lon W 17°45.72
TIME :05:00:00 05:30:16 30.3 (min) Purpose : 1
LOG : 16.98 17.11 0.1 Region : 1200
FDEPTH: 10 300 Gear cond.: 0
BDEPTH: 329 329 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.0 kn
Sorted : 145 Total catch: 645.10 Catch/hour: 1278.69

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	1197.07	90688	93.62	1
Brama brama	36.76	28	2.87	
Trachurus trecae	17.92	325	1.40	5
Sarda sarda	11.22	24	0.88	
Trachurus trachurus	5.24	515	0.41	4
Sardina pilchardus	1.78	141	0.14	2
Scomber colias	1.29	24	0.10	3
Sphoeroides pachygaster	1.08	4	0.08	
Saurida brasiliensis	0.52	24	0.04	
Loligo vulgaris	0.11	2	0.01	
Sepia bertheloti	0.09	2	0.01	
Alloteuthis subulata	0.01	2	0.00	
Total	1273.08		99.56	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 2
DATE :28/06/17 GEAR TYPE: BT NO: 1 POSITION:Lat N 20°21.56
start stop duration Lon W 17°31.32
TIME :09:54:51 10:10:40 15.8 (min) Purpose : 1
LOG : 8913.53 8914.30 0.8 Region : 1200
FDEPTH: 60 60 Gear cond.: 6
BDEPTH: 60 60 Validity : 3
Towing dir: 0° Wire out : 180 m Speed : 2.9 kn
Sorted : 76 Total catch: 266.77 Catch/hour: 1011.77

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	718.58	62625	71.02	6
Sardina pilchardus	257.27	22422	25.43	7
Trachurus trecae	21.41	516	2.12	8
INACHIDAE	6.64	159	0.66	
JELLYFISH	1.59	118	0.16	
Trachurus trachurus	0.80	118	0.08	9
Loligo vulgaris	0.70	8	0.07	
G A S T R O P O D S	0.56	38	0.06	
Macropipus rugosus	0.55	64	0.05	
Capros aper	0.55	144	0.05	
Lesueurigobius sanzi	0.53	80	0.05	
Alloteuthis subulata	0.29	27	0.03	
Total	1009.48		99.77	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 3
DATE :28/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 20°9.84
start stop duration Lon W 17°29.66
TIME :14:59:04 15:42:55 43.9 (min) Purpose : 1
LOG : 8955.49 8958.88 3.4 Region : 1200
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 47 56 Validity : 0
Towing dir: 0° Wire out : 360 m Speed : 4.6 kn
Sorted : 365 Total catch: 1016.08 Catch/hour: 1390.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	918.28	1661	66.05	11
Sarda sarda	449.34	302	32.32	10
Trachinotus ovatus	14.59	37	1.05	12
Pomatomus saltatrix	4.13	1	0.30	
Dasyatis sp.	3.28	1	0.24	
Auxis rochei	1.86	3	0.13	
Total	1391.48		100.08	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 4
DATE :28/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 19°59.56
start stop duration Lon W 17°28.42
TIME :21:57:54 22:10:47 12.9 (min) Purpose : 1
LOG : 8997.63 8998.40 0.8 Region : 1200
FDEPTH: 8 17 Gear cond.: 0
BDEPTH: 68 70 Validity : 0
Towing dir: 0° Wire out : 85 m Speed : 3.6 kn
Sorted : 0 Total catch: 21.12 Catch/hour: 98.39

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trachurus	39.69	3363	40.34	14
Engraulis encrasicolus	28.88	3438	29.36	13
Scomber colias	21.89	382	22.25	16
Trachurus trecae	4.19	126	4.26	15
Jellyfish	2.61	345	2.65	
Sphoeroides pachygaster	0.65	5	0.66	
Belone belone gracilis	0.37	5	0.38	
Sardinella aurita	0.09	5	0.09	
Total	98.39		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 5
DATE :29/06/17 GEAR TYPE: BT NO: 1 POSITION:Lat N 19°41.61
start stop duration Lon W 17°4.80
TIME :12:29:52 12:45:26 15.6 (min) Purpose : 1
LOG : 9076.72 9077.52 0.8 Region : 1200
FDEPTH: 118 126 Gear cond.: 0
BDEPTH: 118 126 Validity : 0
Towing dir: 0° Wire out : 370 m Speed : 3.1 kn
Sorted : 0 Total catch: 791.04 Catch/hour: 3048.32

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	1021.97	22119	33.53	18
Trachurus trecae	830.83	12513	27.26	17
Synagrops microlepis	816.96	116705	26.80	19
Zeus faber	272.18	732	8.93	
Zenopsis conchifer	28.21	343	0.93	
Dentex angolensis	15.18	42	0.50	
Merluccius senegalensis	14.26	96	0.47	
Sphoeroides pachygaster	10.94	23	0.36	
Octopus vulgaris	10.33	8	0.34	
Illex coindetii	9.75	486	0.32	
Scorpaena stephanica	8.86	42	0.29	
Loligo vulgaris	2.04	23	0.07	
Trichiurus lepturus	1.93	4	0.06	
JELLYFISH	1.27	23	0.04	
Paracentrotus sp.	1.27	23	0.04	
Chlorophthalmus atlanticus	1.27	46	0.04	
Pterothrissus belloci	1.08	8	0.04	
Scorpaena loppei	0.01	8	0.00	
Total	3048.32		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 6
DATE :29/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 19°13.67
start stop duration Lon W 16°53.05
TIME :20:34:07 20:40:47 6.7 (min) Purpose : 1
LOG : 9145.73 9146.06 0.3 Region : 1200
FDEPTH: 10 18 Gear cond.: 0
BDEPTH: 454 432 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 2.9 kn
Sorted : 0 Total catch: 31.88 Catch/hour: 286.78

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus dumerilii	156.16	195202	54.45	
Scomber colias	85.64	1079	29.86	20
Brama brama	22.85	36	7.97	
Jellyfish	19.61	9	6.84	
Hirundichthys affinis	1.80	9	0.63	
Thysanoteuthis rhombus	0.54	18	0.19	
PARALEPIDIDAE	0.18	27	0.06	
Total	286.78		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 7
DATE :29/06/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 19°8.96
start stop duration Lon W 16°38.36
TIME :23:01:29 23:37:02 35.5 (min) Purpose : 1
LOG : 9164.04 9166.14 2.1 Region : 1200
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 80 77 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.5 kn
Sorted : 37 Total catch: 191.26 Catch/hour: 322.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	94.51	6663	29.28	21
Trichiurus lepturus	87.43	565	27.08	
Trachurus trecae	80.34	9924	24.89	24
Scomber colias	45.57	1224	14.12	22
Sarda sarda	8.03	5	2.49	
Alectis alexandrinus	4.39	5	1.36	
Synagrops microlepis	2.53	363	0.78	
Total	322.80		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 8
DATE :30/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 18°57.57
start stop duration Lon W 16°40.99
TIME :14:36:16 15:45:56 69.7 (min) Purpose : 1
LOG : 9243.97 9249.07 5.1 Region : 1200
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 115 139 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 4.4 kn
Sorted : 0 Total catch: 166.60 Catch/hour: 143.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	123.19	9499	85.86	25
JELLYFISH	12.92	5	9.00	
Auxis rochei	5.24	9	3.65	
Scomber colias	2.07	25	1.44	26
Sardinella aurita	0.07	2	0.05	
Total	143.48		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 9
DATE :30/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 18°57.93
start stop duration Lon W 16°25.67
TIME :18:46:25 19:14:28 28.1 (min) Purpose : 1
LOG : 9270.50 9272.07 1.6 Region : 1200
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 27 30 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.4 kn
Sorted : 8 Total catch: 7.88 Catch/hour: 16.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aglaura or ctenophora	9.37	1070	55.62	
Sardinella maderensis	6.84	17	40.63	27
Caranx rhonchus	0.60	2	3.56	
Sepia sp	0.03	2	0.19	
Total	16.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 10
DATE :01/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 18°35.53
start stop duration Lon W 16°30.21
TIME :03:47:51 04:02:55 15.1 (min) Purpose : 1
LOG : 9343.63 9344.46 0.8 Region : 1200
FDEPTH: 40 50 Gear cond.: 0
BDEPTH: 93 104 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.3 kn
Sorted : 0 Total catch: 4116.00 Catch/hour: 16387.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	14787.95	1315891	90.24	28
Trachurus trecae	835.62	74277	5.10	29
Jellyfish	745.32	207	4.55	
Saurida brasiliensis	14.77	844	0.09	
Caranx senegallus	4.22	8	0.03	
Total	16387.88		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 11
DATE :01/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 18°29.67
start stop duration Lon W 16°14.92
TIME :07:16:14 07:34:10 17.9 (min) Purpose : 1
LOG : 9367.95 9368.87 0.9 Region : 1200
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 21 21 Validity : 0
Towing dir: 0° Wire out : 200 m Speed : 3.1 kn
Sorted : 2 Total catch: 2.34 Catch/hour: 7.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachinotus ovatus	4.89	13	62.39	
Caranx rhonchus	2.94	13	37.61	
Total	7.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 12
DATE :01/07/17 GEAR TYPE: BT NO: 1 POSITION:Lat N 18°27.14
start stop duration Lon W 16°19.21
TIME :09:28:45 09:33:57 5.2 (min) Purpose : 1
LOG : 9382.81 9383.07 0.3 Region : 1200
FDEPTH: 39 39 Gear cond.: 0
BDEPTH: 39 39 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.1 kn
Sorted : 34 Total catch: 169.20 Catch/hour: 1952.31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Jellyfish	1947.69	119827	99.76	
Chelidonichthys obscurus	4.62	35	0.24	
Total	1952.31		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 13
DATE :01/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 18°15.05
start stop duration Lon W 16°15.83
TIME :16:35:43 17:05:18 29.6 (min) Purpose : 1
LOG : 9445.45 9447.32 1.9 Region : 1200
FDEPTH: 20 35 Gear cond.: 0
BDEPTH: 38 47 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.8 kn
Sorted : 10 Total catch: 10.00 Catch/hour: 20.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	8.68	609	42.80	
JELLYFISH	4.95	6	24.40	
Selene dorsalis	2.03	6	10.00	
Caranx rhonchus	1.26	6	6.20	
Trachurus trecae	1.14	4	5.60	
Chrysaora hysoscella	1.05	4	5.20	
Scomber colias	0.77	8	3.80	
Sphyraena sphyraena	0.41	2	2.00	
Total	20.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 14
DATE :01/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 18°6.11
start stop duration Lon W 16°15.12
TIME :21:14:32 21:25:52 11.3 (min) Purpose : 1
LOG : 9471.60 9472.18 0.6 Region : 1200
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 37 36 Validity : 0
Towing dir: 0° Wire out : 215 m Speed : 3.1 kn
Sorted : 29 Total catch: 997.75 Catch/hour: 5283.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
JELLYFISH	5258.29	1006	99.52	
Sardinella aurita	14.93	154	0.28	30
Trichiurus lepturus	7.41	16	0.14	
Alectis alexandrinus	3.12	5	0.06	
Total	5283.76		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 15
DATE :01/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 18°5.33
start stop duration Lon W 16°20.44
TIME :23:15:16 23:30:06 14.8 (min) Purpose : 1
LOG : 9481.09 9481.90 0.8 Region : 1200
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 52 55 Validity : 0
Towing dir: 0° Wire out : 170 m Speed : 3.3 kn
Sorted : 78 Total catch: 512.76 Catch/hour: 2074.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
JELLYFISH	1881.32	607	90.69	
Scomber colias	88.20	874	4.25	32
Dasyatis sp.	79.22	4	3.82	
Sardinella aurita	13.19	170	0.64	31
Sepia sp	2.67	28	0.13	
Trichiurus lepturus	2.63	4	0.13	
Sepia bertheloti	2.51	16	0.12	
Pomadasys incisus	2.18	12	0.11	
Caranx rhonchus	1.54	8	0.07	
Pagellus bellottii	0.73	49	0.04	
Caranx senegallus	0.24	93	0.01	
Trachurus trecae	0.10	4	0.00	
Saurida brasiliensis	0.04	4	0.00	
Total	2074.57		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 16
DATE :02/07/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 18°4.31
start stop duration Lon W 16°30.75
TIME :03:26:19 03:36:23 10.1 (min) Purpose : 1
LOG : 9496.22 9496.74 0.5 Region : 1200
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 216 237 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3.1 kn
Sorted : 29 Total catch: 28.73 Catch/hour: 171.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	161.23	1668	94.17	33
Diaphus dumerilii	8.70	3414	5.08	
Engraulis encrasicolus	0.36	42	0.21	
Sardinella aurita	0.12	12	0.07	
PARALEPIDIDAE	0.12	12	0.07	
Selene dorsalis	0.08	6	0.05	
Caranx senegallus	0.02	12	0.01	
Total	170.62		99.66	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 17
DATE :02/07/17 GEAR TYPE: BT NO: 1 POSITION:Lat N 17°56.02
start stop duration Lon W 16°20.25
TIME :12:48:10 13:18:16 30.1 (min) Purpose : 1
LOG : 9546.48 9548.06 1.6 Region : 1200
FDEPTH: 79 77 Gear cond.: 0
BDEPTH: 79 77 Validity : 0
Towing dir: 0° Wire out : 240 m Speed : 3.1 kn
Sorted : 0 Total catch: 332.13 Catch/hour: 662.05

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Miracorvina angolensis	276.06	203	41.70	
JELLYFISH	133.63	80	20.18	
Umbrina canariensis	67.30	114	10.16	
Trachurus trecae	48.72	730	7.36	34
Pagellus bellottii	41.54	4	6.27	
Loligo vulgaris	34.52	805	5.21	
Dentex canariensis	23.36	68	3.53	
Dentex angolensis	14.51	72	2.19	
Caranx rhonchus	7.42	28	1.12	35
Plectorhinchus mediterraneus	5.10	8	0.77	
Scorpaena stephanica	3.31	8	0.50	
Sphyrna sp.	1.79	4	0.27	
Zeus faber	1.08	2	0.16	
Echelus myrus	0.97	2	0.15	
Trichiurus lepturus	0.56	6	0.08	
Sepia bertheloti	0.48	4	0.07	
Sardinella aurita	0.47	2	0.07	
Brachydeuterus auritus	0.38	2	0.06	
Boops boops	0.26	2	0.04	
Citharus linguatula	0.24	4	0.04	
Prognathodes marcellae	0.16	4	0.02	
Sphoeroides marmoratus	0.08	2	0.01	
Engraulis encrasicolus	0.05	8	0.01	
Paraconger notialis	0.05	2	0.01	
Lepidotrigla cadmani	0.02	2	0.00	
Total	662.05		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 18
DATE :02/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 17°54.60
start stop duration Lon W 16°16.67
TIME :14:35:09 14:45:09 10.0 (min) Purpose : 1
LOG : 9554.44 9555.24 0.8 Region : 1200
FDEPTH: 0 0 Gear cond.: 5
BDEPTH: 66 69 Validity : 3
Towing dir: 0° Wire out : 240 m Speed : 4.8 kn
Sorted : 52 Total catch: 52.44 Catch/hour: 314.61

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
JELLYFISH	268.08	84	85.21	
Sardinella maderensis	42.24	180	13.43	36
Alectis alexandrinus	4.29	6	1.36	
Total	314.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 19
DATE :02/07/17 GEAR TYPE: BT NO: 1 POSITION:Lat N 17°47.07
start stop duration Lon W 16°10.23
TIME :17:50:37 18:20:45 30.1 (min) Purpose : 1
LOG : 9579.77 9581.36 1.6 Region : 1200
FDEPTH: 30 31 Gear cond.: 0
BDEPTH: 30 31 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.2 kn
Sorted : 81 Total catch: 618.24 Catch/hour: 1231.15

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
JELLYFISH	830.84	233	67.49	
Caranx rhonchus	99.97	661	8.12	37
Pagrus caeruleostictus	82.92	207	6.74	38
Pagellus bellottii	41.02	570	3.33	40
Chloroscombrus chrysurus	32.26	199	2.62	41
Sphyraena sphyraena	25.01	88	2.03	
Pseudupeneus prayensis	20.79	159	1.69	
Pomadasys incisus	19.44	104	1.58	39
Pomadasys rogeri	18.88	26	1.53	
Eucinostomus melanopterus	13.54	96	1.10	
Trachinotus ovatus	12.67	14	1.03	
Lagocephalus laevigatus	9.88	8	0.80	
Dasyatis marmorata	9.48	16	0.77	
Alectis alexandrinus	8.32	6	0.68	
Trichiurus lepturus	7.89	10	0.64	
Dentex canariensis	5.74	44	0.47	
Drepane africana	2.07	4	0.17	
Carlarius parkii	1.79	2	0.15	
Plectorhinchus mediterraneus	1.75	12	0.14	
Balistes sp.	1.61	2	0.13	
Fistularia petimba	1.12	12	0.09	
Trachurus trecae	0.56	40	0.05	42
Serranus scriba	0.48	4	0.04	
Scorpaena sp.	0.40	4	0.03	
Caranx senegallus	0.08	36	0.01	
Parapenaeus sp.	0.04	2	0.00	
Total	1248.53		101.41	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 20
DATE :02/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 17°46.62
start stop duration Lon W 16°21.64
TIME :20:24:58 20:47:41 22.7 (min) Purpose : 1
LOG : 9596.11 9597.52 1.4 Region : 1200
FDEPTH: 20 26 Gear cond.: 0
BDEPTH: 96 93 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 3.7 kn
Sorted : 180 Total catch: 3000.00 Catch/hour: 7922.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Caranx rhonchus	5030.91	4394	63.50	44
Sardinella maderensis	1339.47	4394	16.91	43
Sardinella aurita	1029.21	4307	12.99	45
Sarda sarda	109.86	0	1.39	
Alectis alexandrinus	100.19	132	1.26	
Trachurus trecae	73.83	396	0.93	47
Scomber colias	72.07	351	0.91	46
Brachydeuterus auritus	50.10	264	0.63	
Auxis rochei	36.91	45	0.47	
Sphyraena sphyraena	29.88	87	0.38	
Trachinotus ovatus	25.49	132	0.32	
Loligo vulgaris	24.61	306	0.31	
Total	7922.52		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 21
DATE :03/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 17°33.61
start stop duration Lon W 16°16.17
TIME :02:54:08 03:09:42 15.6 (min) Purpose : 1
LOG : 9647.98 9648.86 0.9 Region : 1200
FDEPTH: 20 30 Gear cond.: 0
BDEPTH: 56 52 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.4 kn
Sorted : 13 Total catch: 12.77 Catch/hour: 49.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
JELLYFISH	33.91	12	68.91	
Caranx rhonchus	9.02	46	18.32	48
Carlarius heudelotii	2.70	4	5.48	
Sardinella maderensis	1.54	8	3.13	50
Trachurus trecae	1.54	35	3.13	49
Scomber colias	0.46	4	0.94	
Alloteuthis africana	0.04	27	0.08	
Total	49.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 22
DATE :07/07/17 GEAR TYPE: BT NO: 1 POSITION:Lat N 17°12.46
start stop duration Lon W 16°36.84
TIME :09:58:11 10:12:01 13.8 (min) Purpose : 1
LOG : 77.07 77.80 0.7 Region : 1200
FDEPTH: 120 121 Gear cond.: 0
BDEPTH: 120 121 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.2 kn
Sorted : 5 Total catch: 235.25 Catch/hour: 1020.61

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	821.26	73323	80.47	51
Sphoeroides pachygaster	69.85	139	6.84	
Scomber colias	69.24	2017	6.78	52
Loligo vulgaris	27.85	781	2.73	
Todaropsis eblanae	16.66	534	1.63	
Alloteuthis africana	2.86	833	0.28	
Merluccius senegalensis	2.60	78	0.26	
Dentex angolensis	2.00	4	0.20	
Sphyraena guachancho	2.00	4	0.20	
Caranx rhonchus	1.82	4	0.18	
Pterothrissus belloci	1.56	13	0.15	
Scorpaena scrofa	1.48	4	0.14	
Parapagurus bouveri	0.39	78	0.04	
Thorogobius angolensis	0.26	78	0.03	
Munida sp.	0.26	78	0.03	
Saurida parri	0.26	26	0.03	
Monolene microstoma	0.26	13	0.03	
Total	1020.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 23
DATE :07/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 17°3.14
start stop duration Lon W 16°26.67
TIME :15:45:29 16:09:26 23.9 (min) Purpose : 1
LOG : 113.28 115.20 1.9 Region : 1200
FDEPTH: 0 15 Gear cond.: 5
BDEPTH: 50 64 Validity : 5
Towing dir: 0° Wire out : 180 m Speed : 4.8 kn
Sorted : 5 Total catch: 4.58 Catch/hour: 11.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachinotus ovatus	9.97	33	86.90	
Auxis thazard	0.80	3	6.99	
Sardinella maderensis	0.45	3	3.93	
Scomber colias	0.25	3	2.18	
Total	11.47		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 24
DATE :08/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 16°54.09
start stop duration Lon W 16°45.76
TIME :02:22:37 02:55:47 33.2 (min) Purpose : 1
LOG : 163.22 165.54 2.3 Region : 1200
FDEPTH: 5 0 Gear cond.: 0
BDEPTH: 148 98 Validity : 0
Towing dir: 0° Wire out : 230 m Speed : 4.2 kn
Sorted : 66 Total catch: 266.80 Catch/hour: 482.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	191.56	2825	39.69	53
J E L L Y F I S H	110.16	29	22.83	
MYCTOPHIDAE	77.96	43413	16.15	
Euthynnus alletteratus	53.18	36	11.02	
Caranx crysos	42.33	51	8.77	
Carlarius latiscutatus	4.31	2	0.89	
Todaropsis eblanae	0.90	36	0.19	
Sphyraena guachancho	0.76	2	0.16	
PARALEPIDIDAE	0.36	22	0.07	
Ariomma bondi	0.36	7	0.07	
Lagocephalus laevigatus	0.14	14	0.03	
Total	482.03		99.88	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 25
DATE :08/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 16°43.34
start stop duration Lon W 16°28.75
TIME :06:35:28 07:08:36 33.1 (min) Purpose : 1
LOG : 193.94 195.78 1.8 Region : 1200
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 21 21 Validity : 0
Towing dir: 0° Wire out : 260 m Speed : 3.3 kn
Sorted : 34 Total catch: 152.08 Catch/hour: 275.42

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chloroscombrus chrysurus	195.45	1898	70.96	
Caranx senegallus	39.26	87	14.26	
Alectis alexandrinus	11.77	9	4.27	
Stromateus fiatola	9.42	29	3.42	
Lagocephalus laevigatus	6.23	7	2.26	
Sphyraena guachancho	3.30	5	1.20	
Trachinotus ovatus	2.61	14	0.95	
Drepane africana	2.57	2	0.93	
Sardinella maderensis	2.17	7	0.79	54
Caranx rhonchus	0.94	2	0.34	
Engraulis encrasicolus	0.87	601	0.32	57
Sphyraena sphyraena	0.83	4	0.30	
J E L L Y F I S H	0.00	4	0.00	
Total	275.42		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 26
DATE :08/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 16°41.14
start stop duration Lon W 16°50.94
TIME :10:20:23 10:54:44 34.4 (min) Purpose : 1
LOG : 222.55 225.48 2.9 Region : 1200
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 454 383 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 5.1 kn
Sorted : 1 Total catch: 0.83 Catch/hour: 1.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	0.80	0	55.09	
Abraliopsis sp.	0.44	183	29.94	
Auxis thazard, juvenile	0.19	12	13.17	
Selene dorsalis, juvenile	0.01	2	0.48	
Alloteuthis africana	0.01	2	0.48	
Sepia officinalis, juvenile	0.01	5	0.36	
HOLUTHUROIDEA	0.00	2	0.24	
Lagocephalus laevigatus, juvenile	0.00	2	0.12	
Phyllosoma	0.00	2	0.06	
Total	1.46		99.94	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 27
DATE :08/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 16°35.38
start stop duration Lon W 16°43.57
TIME :13:15:42 13:43:31 27.8 (min) Purpose : 1
LOG : 242.44 244.57 2.1 Region : 1200
FDEPTH: 5 10 Gear cond.: 0
BDEPTH: 61 56 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 4.6 kn
Sorted : 28 Total catch: 28.44 Catch/hour: 61.34

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Euthynnus alletteratus	32.57	54	53.09	
Auxis thazard	14.41	37	23.49	
J E L L Y F I S H	11.04	2	18.00	
Sarda sarda	2.93	4	4.78	
Loligo vulgaris	0.39	2	0.63	
Total	61.34		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 28
DATE :08/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 16°23.90
start stop duration Lon W 16°36.24
TIME :17:16:20 17:46:37 30.3 (min) Purpose : 1
LOG : 274.11 275.96 1.9 Region : 1200
FDEPTH: 10 19 Gear cond.: 0
BDEPTH: 27 35 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.7 kn
Sorted : 0 Total catch: 0.25 Catch/hour: 0.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachinotus ovatus	0.50	2	100.00	
Total	0.50		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 29
DATE :08/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 16°14.99
start stop duration Lon W 16°41.88
TIME :22:26:44 22:50:35 23.9 (min) Purpose : 1
LOG : 316.32 318.21 1.9 Region : 1200
FDEPTH: 0 25 Gear cond.: 0
BDEPTH: 75 72 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 4.8 kn
Sorted : 75 Total catch: 202.40 Catch/hour: 509.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	241.13	1001	47.36	59
Trichiurus lepturus	83.77	800	16.45	
Trachinotus ovatus	61.01	221	11.98	
Sardinella aurita	28.05	126	5.51	58
Caranx rhonchus	21.76	83	4.27	
Trachurus trecae	15.09	259	2.96	61
Brachydeuterus auritus	14.54	81	2.86	
Scomber colias	14.21	176	2.79	60
Euthynnus alletteratus	8.20	15	1.61	
Sarda sarda	7.75	10	1.52	
J E L L Y F I S H	6.39	3	1.25	
Engraulis encrasicolus	3.14	473	0.62	62
Sphyraena guachancho	2.06	8	0.41	
Loligo vulgaris	0.75	20	0.15	
Liza ramada	0.65	3	0.13	
Sphyraena sphyraena	0.65	3	0.13	
Total	509.18		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017403 STATION: 30
DATE :09/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 16°7.82
start stop duration Lon W 16°33.96
TIME :00:58:31 01:28:01 29.5 (min) Purpose : 1
LOG : 333.09 334.72 1.6 Region : 1200
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 24 23 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.3 kn
Sorted : 77 Total catch: 238.78 Catch/hour: 485.65

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	159.62	4015	32.87	
Chloroscombrus chrysurus	66.14	500	13.62	67
Pomadasys jubelini	55.77	201	11.48	
Selene dorsalis	45.64	61	9.40	
Ilisha africana	29.65	476	6.11	
Carlarius parkii	26.60	31	5.48	
Caranx rhonchus	19.16	445	3.95	64
Stromateus fiatola	18.55	31	3.82	
Alopias vulpinus	15.99	37	3.29	
Sardinella maderensis	10.01	43	2.06	65
Trichiurus lepturus	7.81	98	1.61	
Gymnura altavela	7.53	2	1.55	
Drepane africana	5.74	2	1.18	
Engraulis encrasicolus	5.37	1249	1.11	66
Pagrus caeruleostictus	2.44	6	0.50	
Galeoides decadactylus	2.32	31	0.48	
Lagocephalus laevigatus	2.20	2	0.45	
Sphyraena guachancho	2.07	6	0.43	
Chaetodipterus lippei	1.83	2	0.38	
Trachinotus ovatus	1.22	6	0.25	
Sphyraena sp., juvenile	0.00	4	0.00	
Total	485.66		100.00	

ANNEX II OVERVIEW OF BIOLOGICAL SAMPLES

Biological samples

Table II.1- number of individuals sampled including length measurement per species for Leg 3 Mauritania

Survey	Species code	Species name	Lengths	Biology	liver	stomach	otoliths	fin clip
2017403	CARCA27	*Caranx rhonchus*	246	54	54	43		
2017403	CARTR01	*Trachurus trachurus*	172	30	30	30	30	30
2017403	CARTR02	*Trachurus trecae*	738	198	198	197	18	18
2017403	CLUSL01	*Sardinella aurita*	185	108	108	100	107	108
2017403	CLUSL02	*Sardinella mederensis*	251	109	109	102	108	109
2017403	ENGEN01	*Engraulis encrasicolus*	867	179	178	120	178	180
2017403	SCMSC04	*Scomber colias*	971	296	296	296	280	296
2017403	ACRSY01	*Synagrops microlepis*	100					
2017403	CARCH01	*Chloroscombrus chrysurus*	138					
2017403	CARTC03	*Trachinotus ovatus*	27					
2017403	CLUSD01	*Sardina pilchardus*	97					
2017403	HAEPO02	*Pomadasys incisus*	26					
2017403	SCMSA01	*Sarda sarda*	75					
2017403	SPAPA02	*Pagellus bellottii*	91					
2017403	SPAPR07	*Pagrus caeruleostictus*	51					
Total number of individuals			**4035**	**974**	**973**	**888**	**721**	**741**

Table II.2- number of individuals sampled excluding length measurement per species for Leg 3 Mauritania

	Survey	Station	Species code	Species name	Biology	liver	stomach	otoliths	fin clip
Part 1	2017403	4	CARTR01	*Trachurus trachurus*	30	30	30	30	30
	2017403	4	CARTR02	*Trachurus trecae*	18	18	18	18	18
	2017403	4	ENGEN01	*Engraulis encrasicolus*	30	30	30	30	30
	2017403	4	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	5	CARTR02	*Trachurus trecae*	30	30	30		
	2017403	5	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	6	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	7	CARTR02	*Trachurus trecae*	30	30	30		
	2017403	7	ENGEN01	*Engraulis encrasicolus*	30	30	30	30	30
	2017403	7	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	8	ENGEN01	*Engraulis encrasicolus*	30	30	30	30	30
	2017403	8	SCMSC04	*Scomber colias*	28	28	28	12	28
	2017403	9	CLUSL02	*Sardinella maderensis*	8	8	8	8	8
	2017403	10	CARTR02	*Trachurus trecae*	30	30	30		
	2017403	10	ENGEN01	*Engraulis encrasicolus*	30	30	30	30	30
	2017403	14	CLUSL01	*Sardinella aurita*	29	29	29	29	29
	2017403	15	CLUSL01	*Sardinella aurita*	30	30	30	30	30
	2017403	15	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	16	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	17	CARCA27	*Caranx rhonchus*	12	12	12		
	2017403	17	CARTR02	*Trachurus trecae*	30	30	30		
	2017403	18	CLUSL02	*Sardinella maderensis*	30	30	30	30	30
	2017403	20	CARCA27	*Caranx rhonchus*	30	30	30		
	2017403	20	CLUSL01	*Sardinella aurita*	30	30	30	30	30
	2017403	20	CLUSL02	*Sardinella maderensis*	30	30	30	30	30
	2017403	21	CARCA27	*Caranx rhonchus*	12	12	1		
Part 2	2017403	22	CARTR02	*Trachurus trecae*	30	30	30		
	2017403	22	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	24	SCMSC04	*Scomber colias*	30	30	30	30	30
	2017403	25	CLUSL02	*Sardinella maderensis*	4	4	4	4	4
	2017403	29	CARTR02	*Trachurus trecae*	30	30	29		
	2017403	29	CLUSL01	*Sardinella aurita*	19	19	11	18	19
	2017403	29	CLUSL02	*Sardinella maderensis*	30	30	30	29	30
	2017403	29	ENGEN01	*Engraulis encrasicolus*	29	28		28	30
	2017403	29	SCMSC04	*Scomber colias*	28	28	28	28	28
	2017403	30	CLUSL02	*Sardinella maderensis*	7	7		7	7
	2017403	30	ENGEN01	*Engraulis encrasicolus*	30	30		30	30
	Total number of individuals				**974**	**973**	**888**	**721**	**741**

Food safety

Table II.3 shows the number of samples for the different kind of analysis of fish for food safety. The fish was caught outside the coast of Mauritania. The analysis will be carried out at NIFES[1], Bergen, Norway.

Table II.3. The sampling done for analytical work for each species.

Species	**No. of samples**	**No of positions**	**Tissue**	**Nutr.[1]**		**Cont.[2]**	**Other**
Sardinella maderensis	25	25	Fillet Liver samples	X		X	
Sardinella aurita	25	25	Fillet Liver samples	X		X	

[1] Nutrition: Energy, water content, total fat, proteins, ash, fatty acids, cholesterol, amino acids, tryptophan, vitamins (D, A, E, K, C, thiamine, riboflavin, B6, B12, folate, niacin, pantotene, biotin), iodine, selenium and other minerals.

[2] Contaminants: Heavy metals, Inorganic arsenic, PAH, PBDE, PCB, dioxins, furans, PFAS, pesticides, HBCD, TBBP-A.

TBARS = Thiobarbituric acid reactive substances
PAH = Poly Aromatic Hydrocarbons
PBDE = Polybrominated diphenyl ethers
PCB= Polychlorinated biphenyls
PFAS = Polyfluoroalkyl substances
HBCD = Hexa Bromo CycloDodecane
TBBP-A = Tetrabromobisphenol A

[1] Now IMR

ANNEX III DESCRIPTION OF INSTRUMENTS AND FISHING GEAR

Acoustic instruments

The Simrad EK80/18, 38, 70, 120, 200 and 333 kHz scientific sounder was run during the survey. Scrutinizing was done in LSSS using the data from the 38 kHz transducer. Last standard sphere calibrations were on the 23.01.2017 at Sandviksflaket, Bergen, Norway using Cu-64 for the 18 kHz, Cu-60 sphere for the 38 kHz, WC-38.1 for the 70, 120 and 200 kHz, and the WC-22 for the 333 kHz. The details of the settings for the 38 kHz echo sounder were as follows:

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

Bottom detection menu Minimum level -50 dB

Fishing gear

The vessel has one small four-panel 'Åkrahamn' pelagic trawl, one MultPelt 624 trawl (Figure 1) and one 'Gisund super bottom trawl'. All trawls were used during the survey. The smallest pelagic trawl has 10-12 m vertical opening under normal operation, whereas the MultPelt 624 trawl has 30-40 m opening.

The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m^2 and weigh 2000 kg. The door spreading is about 45 m when using restraining rope. Trawling was conducted for species identification only and no restraining rope was therefore used during the survey.

The SCANMAR system was used during all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their inter-distance and angle, while a height sensor is fitted on the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

The pelagic trawls are equipped with a trawl eye that provides information about the trawl opening and the distance of the footrope to the bottom. A pressure sensor is used to show the depth on the headline.

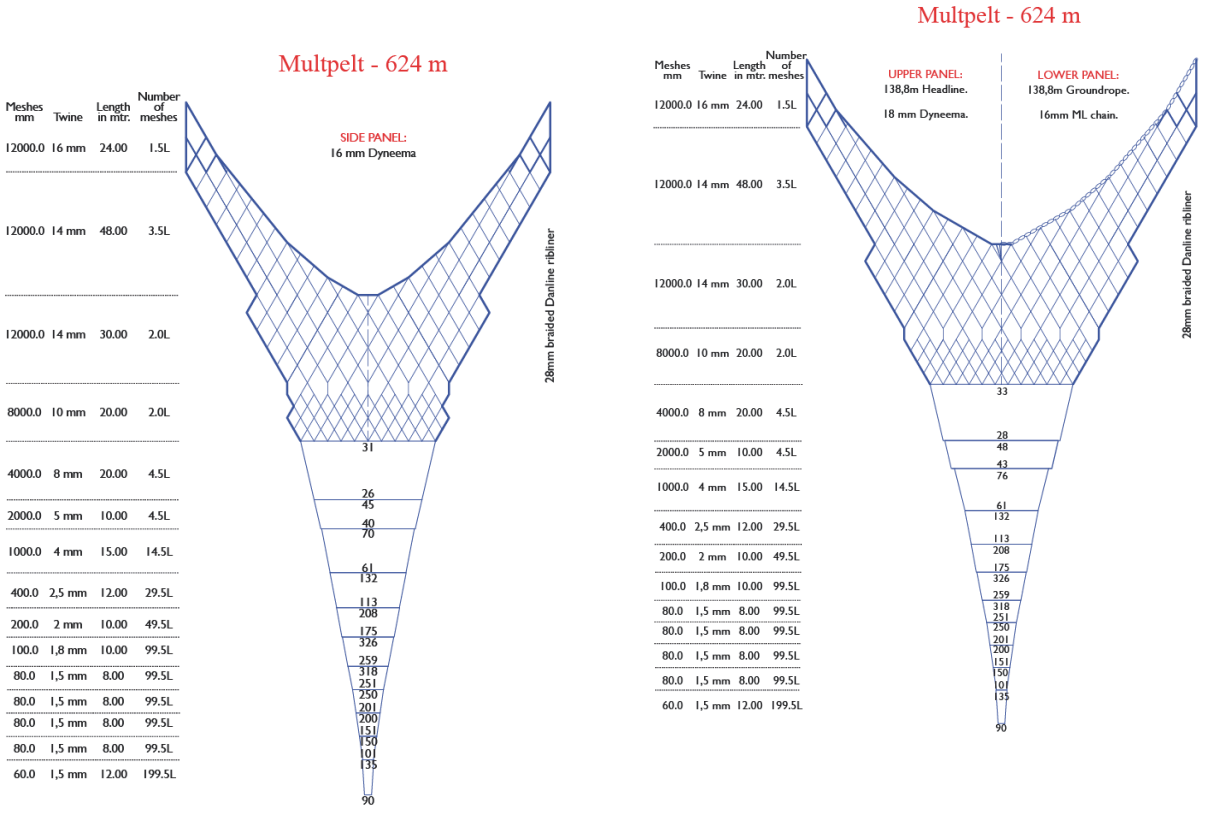
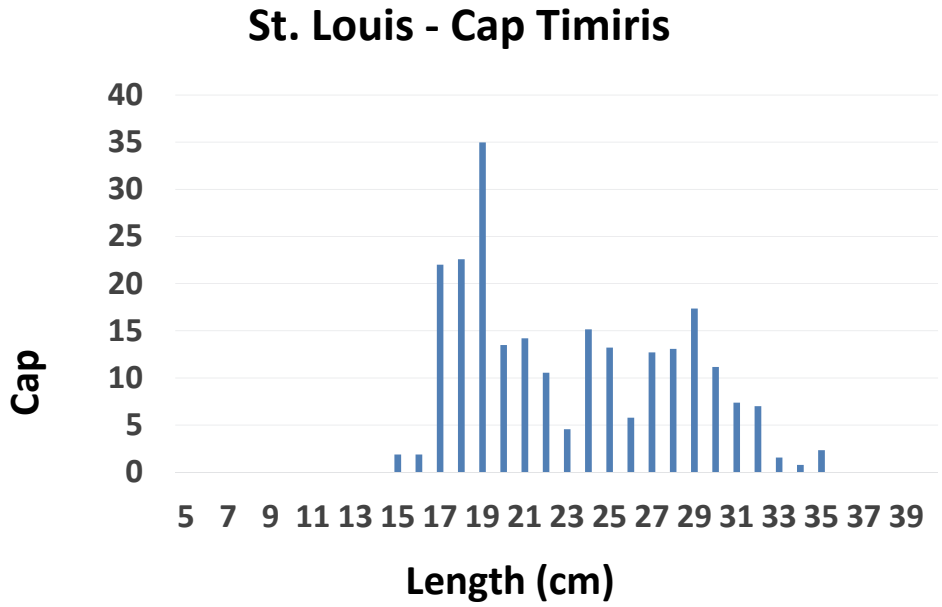


Figure 1. Schematic drawing of the MultPelt 624.

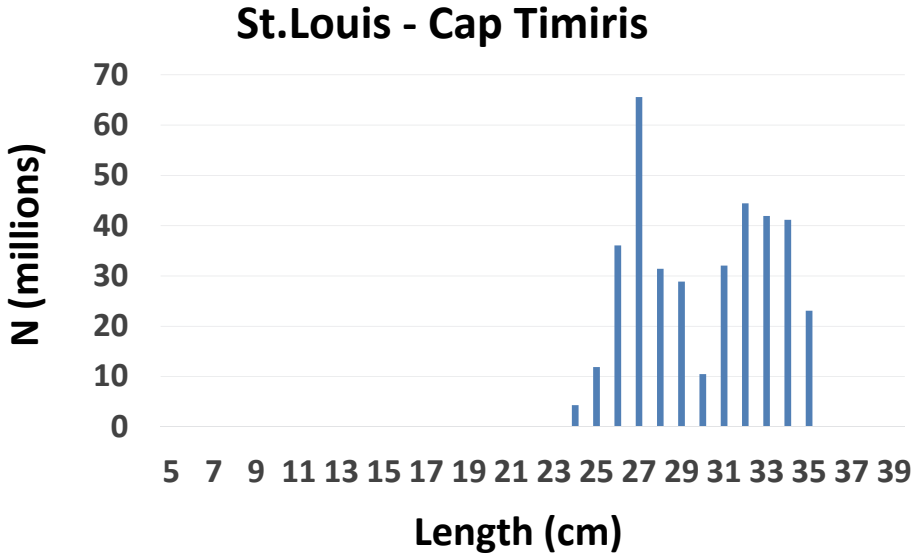
ANNEX IV LENGTH DISTRIBUTIONS BY SPECIES AND REGION

St. Louis – Cap Timiris

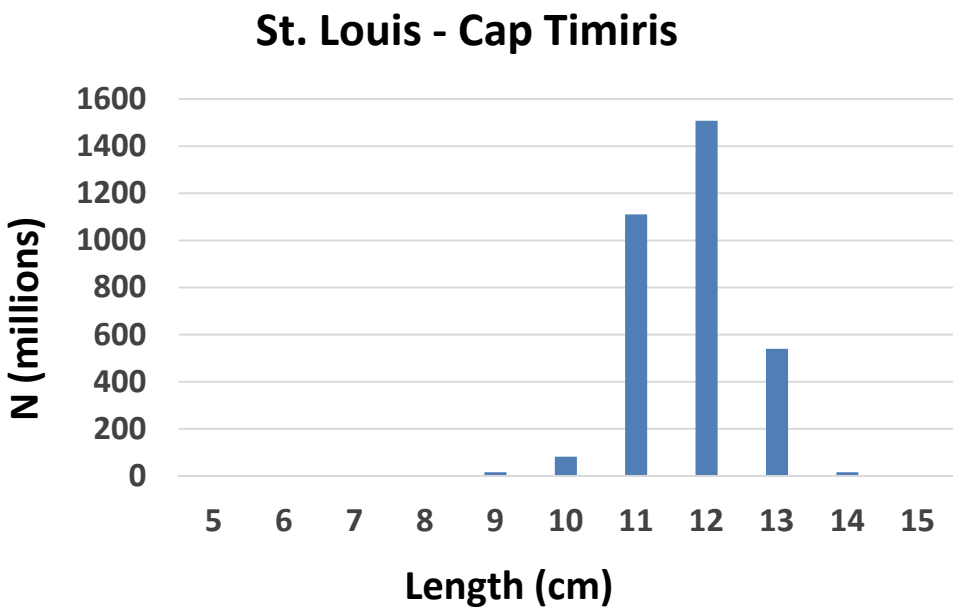
Sardinella aurita



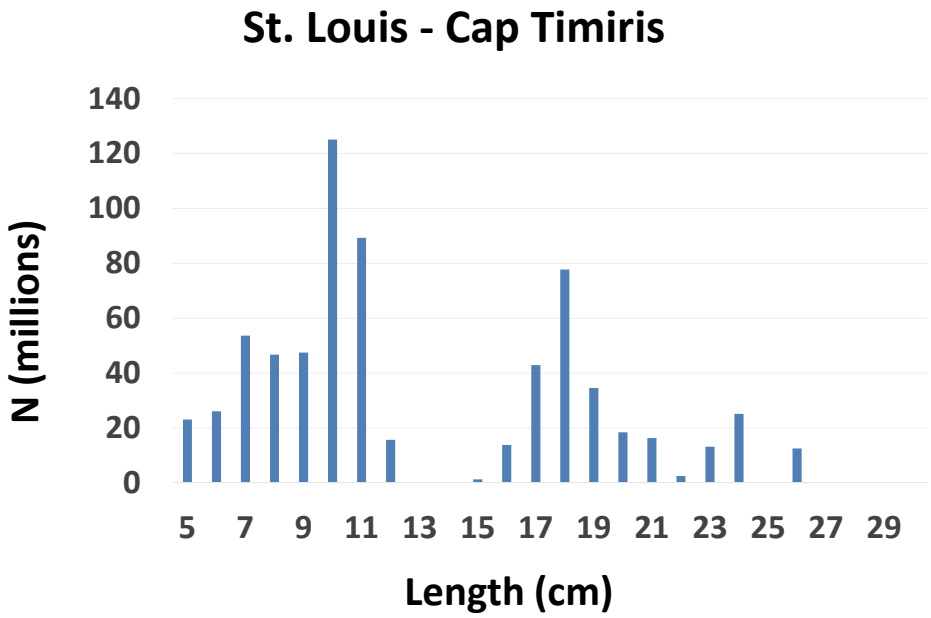
Sardinella maderensis



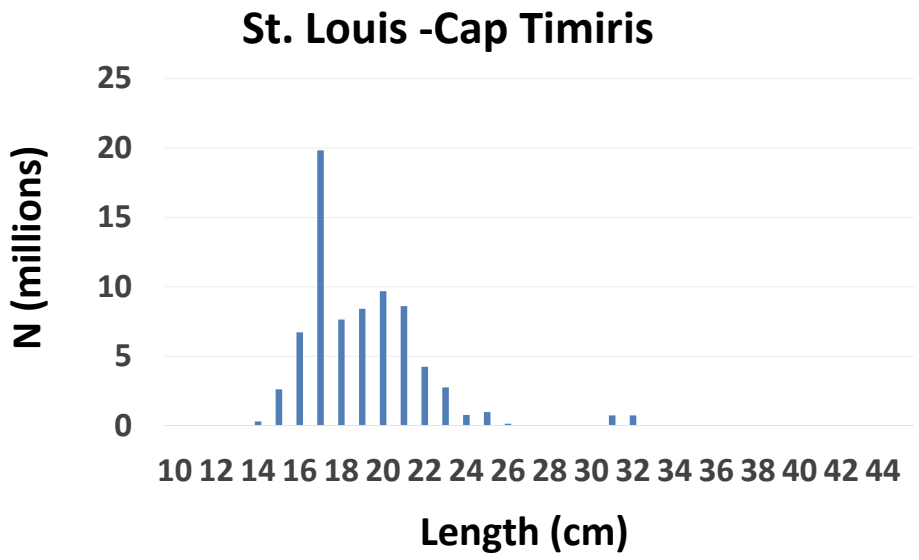
Anchovy



Trachurus trecae

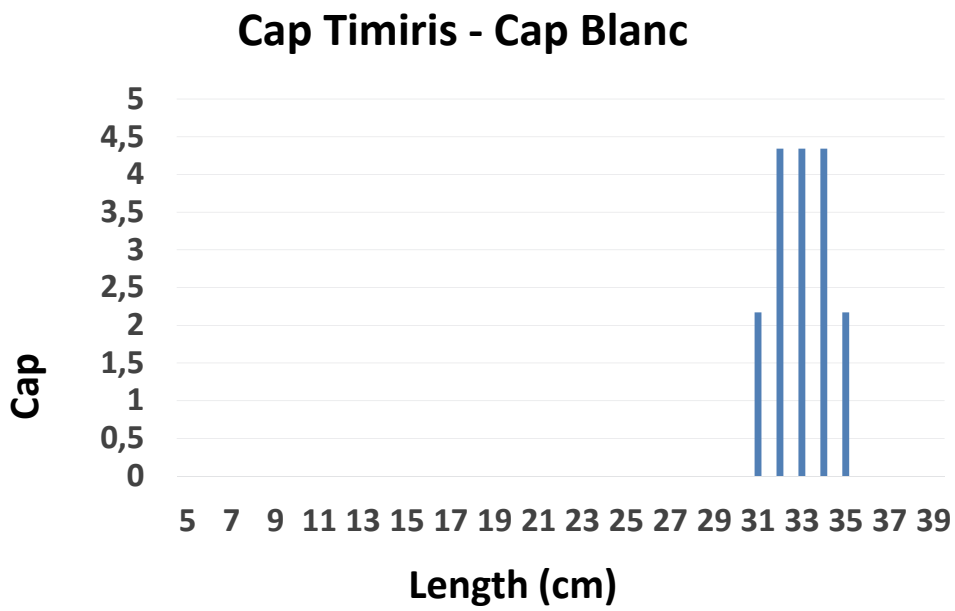


Scomber colias

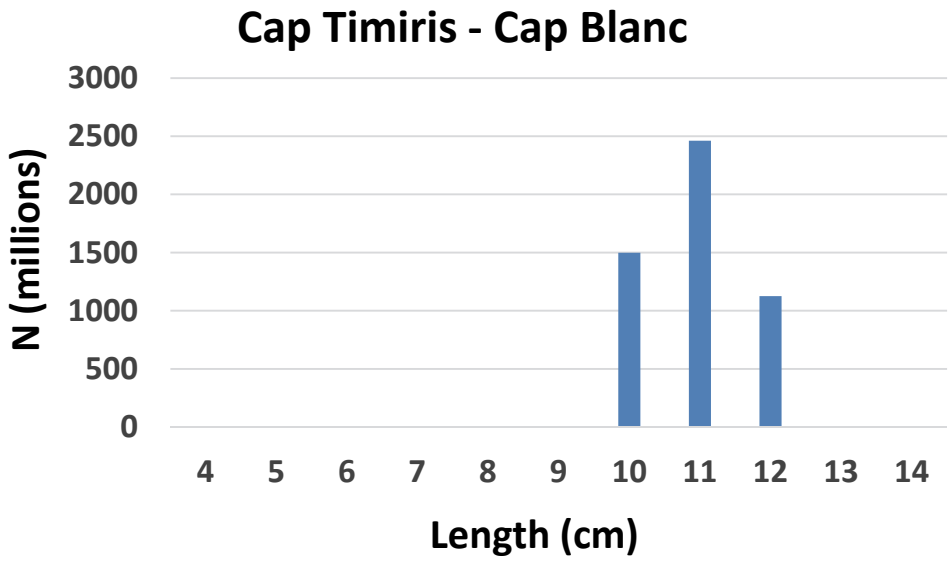


Cap Timiris - Cap Blanc

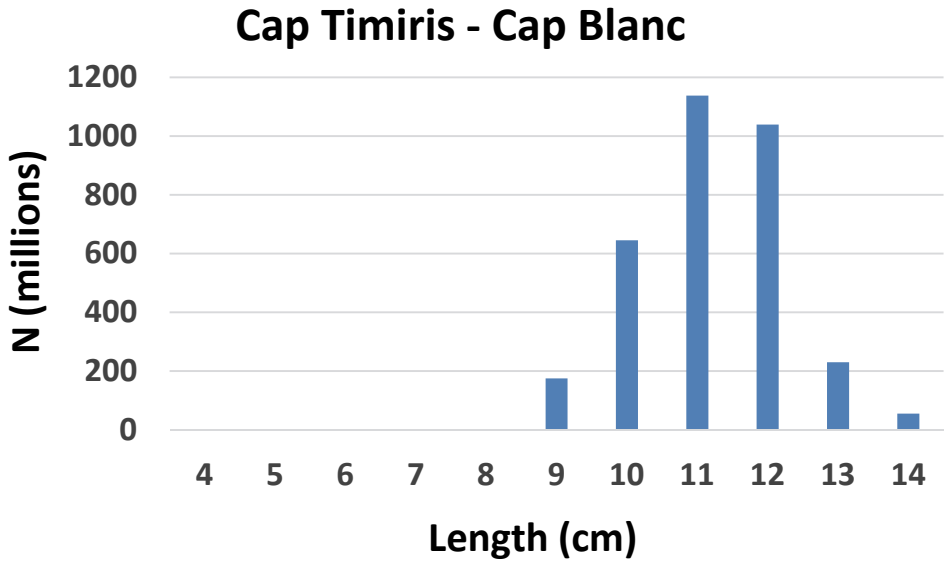
Sardinella maderensis



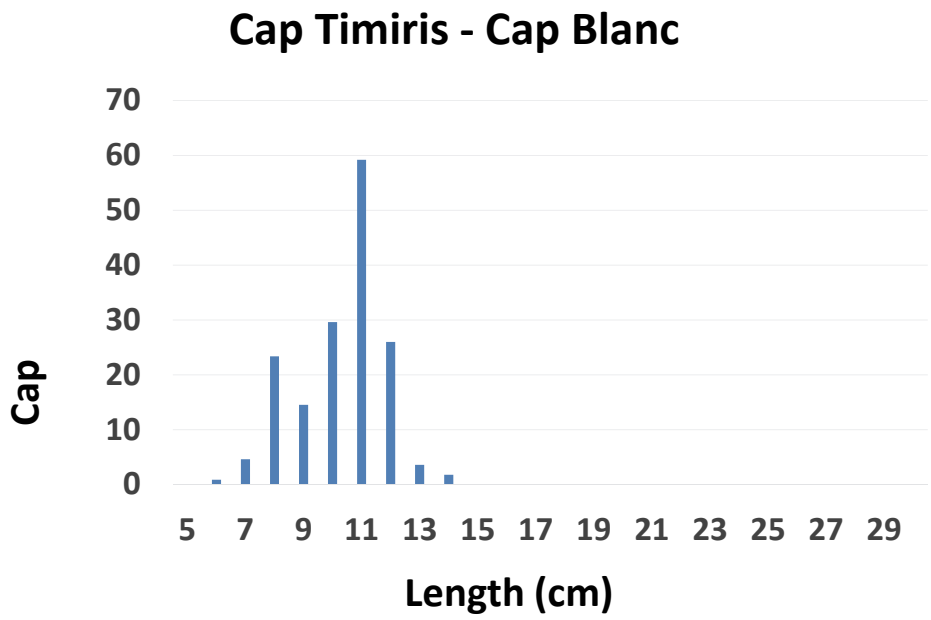
Sardina pilchardus



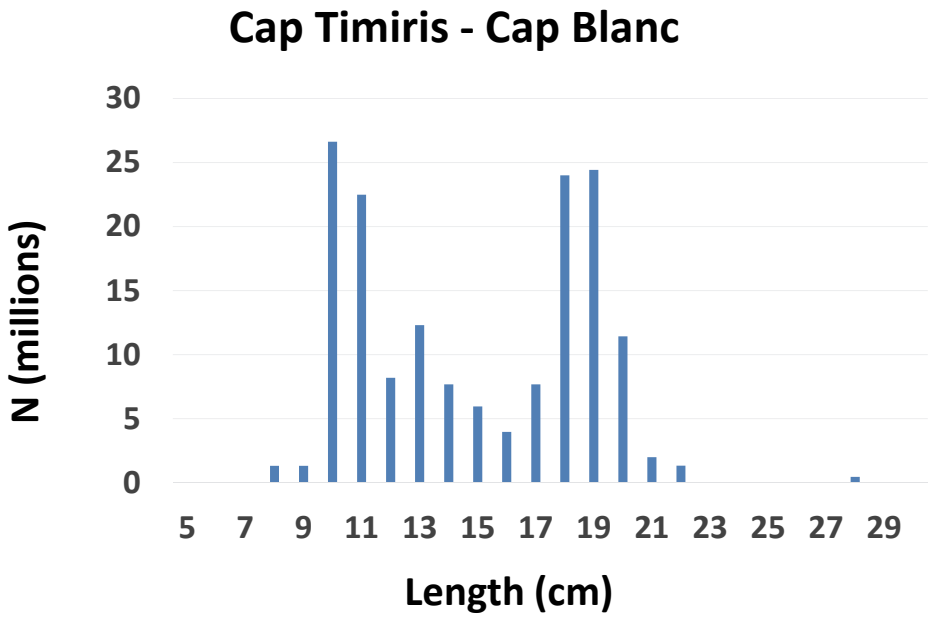
Engraulis encrasicolus



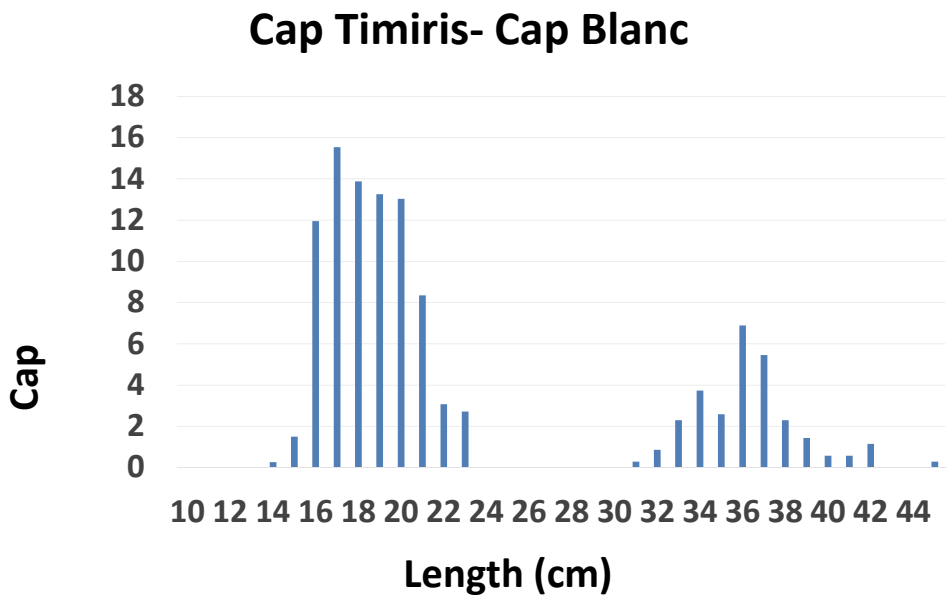
Trachurus trachurus



Trachurus trecae



Scomber colias



ANNEX V REGIONAL ESTIMATES, NUMBERS AND BIOMASS BY SPECIES AND LENGTH CLASS BY SUB-REGION

ABUNDANCE

Sardina pilchardus, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										
6										
7			129							129
8			604							604
9			1390							1390
10			2502	1499						4001
11		2	5257	2462						7720
12		11	7764	1126						8901
13	1	120	10818							10939
14	16	510	3599							4125
15	97	2062	666							2825
16	144	2447	906							3496
17	124	2078	1671							3873
18	53	1599	1759							3412
19	24	1180	3830							5034
20	4	337	7083							7424
21	1	58	4935							4995
22			4797							4797
23		18	7463							7481
24			5145							5145
25			2308							2308
26			306							306
27										
28										
29										
30										
TOTAL	463708	10421966	72932553	5087						83823314

Sardinella aurita, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11			4							4
12			4							4
13			9							9
14			61							61
15			52		2					54
16			26		2					28
17			17		22					39
18					23					23
19					35					35
20			8		13					22
21			41		14		10			66
22			212		11		42			265
23			331		5		92			428
24			125		15		87			227
25			156		13		108			277
26			111		6		97			214
27			34		13		60			107
28			9		13		23			45
29					17		8			25
30					11		4			15
31					7					7
32					7					7
33					2					2
34					1					1
35					2					2
TOTAL	0	0	1124	0	234	0	531	1	0	1889

Sardinella maderensis, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11								1		1
12								1		1
13										0
14										0
15										0
16								1		1
17										0
18							2			2
19							2	1		3
20										0
21							48	1		49
22							23	2		25
23							52	6		58
24					4		106	13		123
25					12		161	12		185
26					36		108	13		157
27					66		29	8		103
28					31			1		32
29					29					29
30					10					10
31				2	32					34
32				4	44					49
33				4	42					46
34				4	41					46
35				2	23					25
TOTAL	0	0	0	17	372	0	532	60	0	981

Engraulis encrasicolus, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7			0							0
8			0							0
9		0	1	0	0					1
10		0	1	1	0					1
11	0	0	1	1	1					3
12	0	0	1	1	2					3
13	0	0	1	0	1					2
14	0	0	0	0	0					1
15	0	0	0							0
16	0	0	0							0
17										0
18										0
19										0
20										0
TOTAL	0	1	4	3	3	0	0	0	0	11

Trachurus trachurus, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4										0
5										0
6				1						1
7				5						5
8			1	23						24
9				15						15
10		2	15	30						47
11			71	59						130
12		2	73	26						100
13			22	4						26
14	4	1	13	2						20
15	33	12	21							66
16	19	30	12							61
17	10	33	12							55
18	25	43	31							99
19	94	88	43							225
20	79	154	43							277
21	34	128	7							169
22	29	71	1							102
23	16	50								66
24	4	23	10							37
25	3	12								15
26	1	6	1							8
27	3	3								6
28	1	2								3
29		1								1
30		1								1
31		3								3
32		1								1
33		0								0
34		0								0
35										0

36										0
37										0
38		1								1
39										0
TOTAL	356	666	378	164	0	0	0	0	0	1564

Trachurus trecae, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4					22					22
5					23					23
6					26					26
7					54					54
8				1	47					48
9				1	47	8			1	58
10			1	27	125	93		1	3	250
11			1	22	89	56	2	2	4	177
12			3	8	16	29		1	1	58
13			7	12	0					19
14			30	8						38
15			35	6	1					42
16			14	4	14	4				35
17			60	8	43	18	29			158
18			121	24	78	46	116	1		385
19			208	24	35	94	68	1		430
20			78	11	18	41	9			158
21			9	2	16	9	2	1	2	41
22			1	1	3			1	2	8
23					13			2	4	19
24					25					25
25						11				11
26					13	13		1	3	30
27						55		1	1	57
28				0		17		1	3	21
29						23		1	1	25
30						11				11
31						4			1	5
32										0
33										0
34										0
35										0
TOTAL	0	0	567	161	707	533	226	14	24	2233

Scomber japonicus, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10			9							9
11			1							1
12		6	56			2				65
13	8	18	111		0	21		3		161
14	87	227	174	0	0	54	1	6		549
15	305	1 525	296	2	3	42	4	8		2184
16	324	1 148	268	12	7	59	5	14		1836
17	189	530	174	16	20	52	6	14		1001
18	72	284	156	14	8	14	6	31		584
19	75	192	139	13	8	1	3	33		463
20	62	219	109	13	10	1	2	69		484
21	38	117	201	8	9			56		429
22	42	65	174	3	4		2	25		315
23	40	17	95	3	3		1	11		169
24	6	10	79		1			8		103
25	4	6	38		1					49
26	1		27		0					27
27	1	1	8							9
28			10							10
29			5							5
30			2							2
31	1		4	0	1					6
32			4	1	1					6
33	1		2	2						6
34			1	4						5
35			1	3						4
36	1		1	7						9

37				5						5
38				2						2
39			1	1						3
40				1						1
41				1						1
42				1						1
43										0
44										0
45				0						0
TOTAL	1254	4364	2147	112	74	246	31	278	0	8506

BIOMASS

Sardina pilchardus, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										
6										
7			0							0
8			3							3
9			11							11
10			26	14						40
11		0	71	30						101
12		0	135	17						152
13	0	3	237							240
14	0	16	98							114
15	3	75	22							100
16	6	104	36							146
17	5	103	80							188
18	3	92	99							194
19	1	78	253							332
20	0	25	544							570
21	0	5	437							442
22			487							487
23		2	864							866
24			675							675
25			341							341
26			51							51
27										
28										
29										
30										
TOTAL	19	502	4471	61						5054

Sardinella aurita, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11			0							0
12			0							0
13			0							0
14			2							2
15			2		0					2
16			1		0					1
17			1		1					2
18					1					1
19					3					3
20			1		1					2
21			4		1		1			6
22			22		1		5			28
23			40		1		12			52
24			17		2		13			32
25			24		2		18			44
26			19		1		18			38
27			6		3		12			21
28			2		3		5			10
29					4		2			6
30					3		1			4
31					2					2
32					2					2
33					1					1
34					0					0
35					1					1
TOTAL	0	0	140	0	34	0	86	0	0	260

Sardinella maderensis, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11										0
12										0
13										0
14										0
15										0
16										0
17										0
18										0
19										0
20										0
21							5			5
22							3			3
23							7	1		8
24					1		16	2		19
25					2		28	2		32
26					7		21	2		30
27					14		6	2		22
28					7					7
29					8					8
30					3					3
31				1	10					11
32				1	15					17
33				2	16					17
34				2	17					18
35				1	10					11
TOTAL	0	0	0	7	109	0	86	10	0	212

Engraulis encrasicolus, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7			0							0
8			0							0
9		0	3	1	0					4
10		1	5	5	1					10
11	0	1	6	11	12					30
12	1	2	8	13	21					46
13	3	2	11	4	10					29
14	3	3	5	1	0					12
15	3	5	2							10
16	1	1	0							3
17										0
18										0
19										0
20										0
TOTAL	10	15	40	34	44	0	0	0	0	143

Trachurus trachurus, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4										0
5										0
6				0						0
7				0						0
8			0	0						0
9				0						0
10		0	0	0						1
11			1	1						2
12		0	1	1						2
13			0	0						1
14	0	0	0	0						1
15	1	0	1							2
16	1	1	0							3
17	1	2	1							3
18	2	2	2							6
19	7	6	3							15
20	7	11	3							21
21	3	10	1							14
22	3	7	0							10
23	2	5								7
24	0	3	1							4
25	0	2								2
26	0	1	0							1
27	0	0								1
28		0								0
29		0								0
30		0								0
31		1								1
32		0								0
33		0								0
34		0								0
35										0

36										0
37										0
38		0								0
39										0
TOTAL	28	52	15	2	0	0	0	0	0	97

Trachurus trecae, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4					0					0
5					0					0
6					0					0
7					0					0
8				0	0					0
9				0	0					0
10			0	3	1	1				5
11			0	3	1	1				5
12			0	1	0	1				3
13			0	3	0					3
14			1	2						3
15			1	2	0					3
16			1	2	1					3
17			3	4	2	1	1			11
18			6	14	5	3	7			35
19			13	17	2	7	5			44
20			5	9	2	4	1			21
21			1	2	2	1				5
22			0	1	0					2
23					2					2
24					4					4
25						2				2
26					2	2				4
27						12				12
28				1		4			1	6
29						6				6
30						3				3
31						1				1
32										0
33										0
34										0
35										0
TOTAL	0	0	31	65	25	48	14	1	3	187

Scomber japonicus, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10			1							1
11			0							0
12		0	7							7
13	0	0	19		0					19
14	5	6	37	0	0					47
15	19	46	78	0	0	1				144
16	23	41	87	0	0	1				152
17	15	22	69	1	1	2				109
18	6	14	74	1	0	2		1		98
19	7	11	78	1	1	1		1		99
20	6	14	72	1	1			2		96
21	4	8	156	1	1			5		174
22	5	5	156	0	0			4		172
23	6	2	98	0	0			2		108
24	1	1	94		0			1		97
25	1	1	52		0			1		54
26	0		41		0					41
27	0	0	14							14
28			19							19
29			12							12
30			5							5
31	0		11	0	0					12
32			13	0	0					14
33	0		7	1						9
34			5	2						6
35			5	1						6
36	0		6	4						9

37				3						3
38				1						1
39			7	1						8
40				0						0
41				0						0
42				1						1
43										0
44										0
45				0						0
TOTAL	98	171	1221	20	5	8	2	18	0	1543

ANNEX VI BIOLOGICAL SCALES- MATURITY, STOMACK FULLNESS AND FAT RESERVES

SEXUAL MATURITY:

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

STOMACH FULLNES:

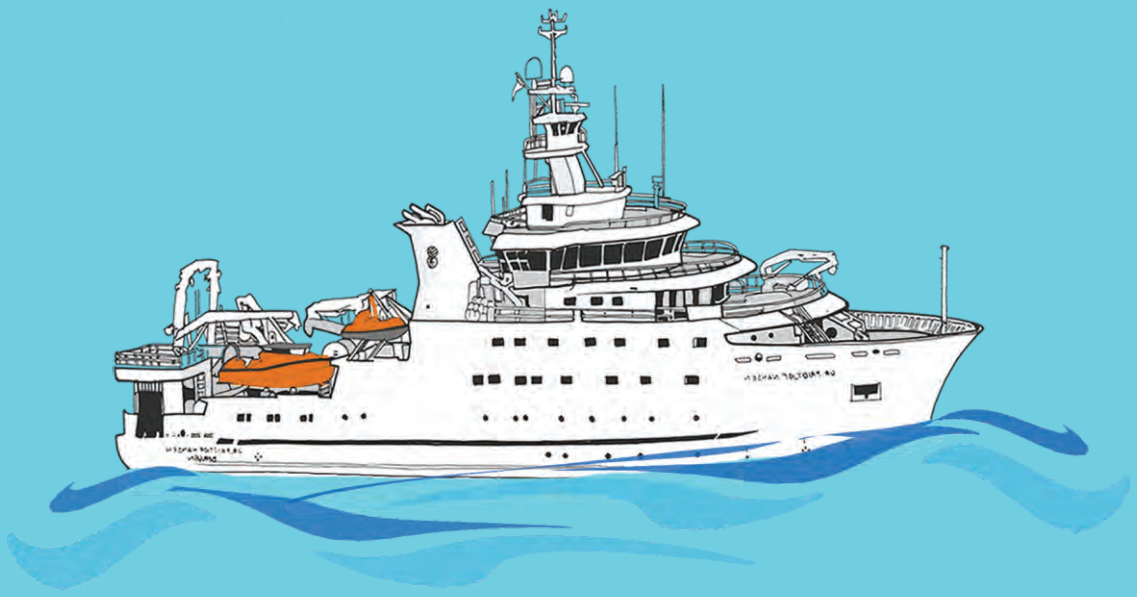
SCALE	DESIGNATION	DESCRIPTION
0	Empty	Stomach empty except for water.
1	Very little content	Stomach is almost empty. Only traces of small organisms can be found.
2	Some content	Stomach not completely full and not dilated.
3	Stomach full	Stomach full, but not bloated/dilated.
4	Bloated/dilated	The stomach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

FAT RESERVES:

SCALE	DESIGNATION	DESCRIPTION
0	No fat	Complete absence of fat in body cavity.
1	Very little fat	A small line of fat along the intestine.
2	Moderate fat	Moderate fat deposits around the intestine, stomach, the kidney, swimbladder and vertebrae.
3	Excessive fat	Excessive fat deposits around the intestine and stomach. The abdominal cavity is completely covered by fat.

NORAD-FAO PROGRAMME
GCP/GLO/690/NOR

CRUISE REPORTS *DR FRIDTJOF NANSEN*
EAF-Nansen/CR/2017/1



SURVEY OF THE PELAGIC FISH RESOURCES AND ECOSYSTEM OFF WEST AFRICA

Tanger – Cap Blanc

7 May – 27 June 2017

Institut National de Recherche Halieutique
Casablanca, Morocco

Institute of Marine Research
Bergen, Norway

The EAF-Nansen Programme

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

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

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

Le Programme EAF-Nansen

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

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

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

Toresen, R., Kamal, M., Søiland, H., Olsen, M., Zakaria, M., Ismail, B., Abdelouhab, H., Ruzafa, A. J., Psomadakis, P., Bagøyen, E., Lødemel, H. H., Krakstad, J. O.. 2018. Survey of the pelagic fish resources and ecosystem off West Africa. Tanger – Cap Blanc.7 May – 27 June 2017. NORAD-FAO PROGRAMME GCP/GLO/690/NOR, CRUISE REPORTS DR FRIDTJOF NANSEN, EAF-Nansen/CR/2017/1

CRUISE REPORTS *DR FRIDTJOF NANSEN*

SURVEY OF THE PELAGIC FISH RESOURCES AND ECOSYSTEM OFF WEST AFRICA

Tanger - Cap Blanc

7 May - 27 June 2017

by

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Institute of Marine Research
Bergen, 2018

CONTENTS

EXECUTIVE SUMMARY

The R/V Dr Fridtjof Nansen surveyed the region between Tanger and Cap Blanc from 7 May to 27 May 2017 as part of Leg 1 of the regional coverage of the pelagic resources and ecosystems of West Africa. Between 26 May and 11 June, a gap in the survey was allowed for a mesopelagic transect (Leg 1.2), and for an unscheduled maintenance period of the vessel.

A common survey design was adopted with parallel transects perpendicular to the coastline, 10 NM apart, and acoustic measurements of pelagic fish obtained on the shelf from the 20 m to the 500 m bottom depth. At each degree of latitude, a hydrographic transect was carried out to a depth of 1000 m. Meteorological and hydrographic measurements were recorded routinely on these transects in addition to samples on ocean acidification parameters (pH and alkalinity), nutrients, phytoplankton, zooplankton, fish eggs and larvae and microplastics on some stations.

Weather conditions were good for surveying during the entire period. The oceanographic conditions in the surveyed region showed a gradual increase in surface temperatures and lowering of the thermocline from the north to the south, and a corresponding decrease in oxygen in the upper 50 m (as observed at the 100 m CTD stations). The region north of 32° show the most stable watermasses and the least upweeling. Close inshore, at the 30 m CDT stations, a clear separation in conditions is observed around 25 °N, where watermasses close to the coast are more fully mixed. The areas of highest chlorofyll-a concentrations typically correspond with areas of lower salinity and indicate upwelling. These areas are roughly found between 32 °N and 30 °N, around 27 °N extending to both sides, and especially from 23 °N and southwards where chlorophyll *a* values increase to > 4 µg/l.

The biomass of the main small pelagic fish resources was estimated to be 4 993 thousand tonnes for sardine, 140 thousand tonnes for round sardinella and 65 thousand tonnes for anchovy. The biomass estimate for sardine is among the highest estimate of this species recorded in this area. No flat sardinella was found.
Of the horse mackerels the majority were Atlantic horse mackerel with a biomass of 95 thousand tonnes while the biomass of Cunene horse mackerel was estimated at 31 thousand tonnes.

Chub mackerel was relatively abundant in the survey area, with an estimated biomass of 389 thousand tonnes.
Snipefish are not normally recorded as part of the main pelagic species. However, the abundance of this species in the survey area was unusually high and an attempt the biomass was estimated to be 177 thousand tonnes.

RÉSUMÉ

Le N/R Dr Fridtjof Nansen a conduit une campagne dans région entre Tanger et Cap Blanc du 7 au 27 mai 2017, dans le cadre de la première étape de la campagne régionale des ressources pélagiques et des écosystèmes de l'Afrique de l'Ouest, du Maroc à l'Afrique du Sud. Entre le 26 mai et le 11 juin, la campagne a subi une interruption pour permettre l'execution d'un transect mésopélagique (étape 1.2) et pour une période de maintenance non planifiée du navire.

Un plan d'échantillonnage a été adopté avec des transects parallèles perpendiculaires à la côte, espacés de 10 MN, et des mesures acoustiques de poissons pélagiques obtenues sur le plateau de 20 m à 500 m de profondeur. À chaque degré de latitude, un transect hydrographique a été effectué jusqu'à une profondeur de 1000 m. Des mesures météorologiques et hydrographiques ont été enregistrées régulièrement au cours de la campagne. En plus, des échantillons sur les paramètres d'acidification des océans (pH et alcalinité), les nutriments, le phytoplancton, le zooplancton, les œufs de poissons, les larves et les microplastiques ont aussi été recueillies

Les conditions météorologiques étaient bonnes pendant toute la période. Les conditions océanographiques dans la région étudiée ont montré une augmentation graduelle des températures de surface et un abaissement de la thermocline du nord au sud et une diminution correspondante de l'oxygène dans les eaux de surface jusqu'à 50 m (comme observé aux stations CTD à 100 m). La région au nord de 32 °N est caracterisée par des masses d'eau les plus stables et les moins ascendantes. Près des côtes, aux stations hydrographic de 30 m, on observe une séparation nette des conditions, surtout autour de 25 °N, où les masses d'eau près de la côte commence à être plus mélangées. Les zones ayant les concentrations les plus élevées de chlorofylle *a* correspondent généralement à une salinité plus faible et indiquent une remontée d'eau (upwelling). Ces zones se trouvent approximativement entre 32 °N et 30 °N, autur des 27 °N s'étendant des deux côtés, et en particulier à partir de 23 °N et vers le sud où les valeurs de chlorophylle *a* augmentent à des valeures > 4 µg / l.

La biomasse des principales ressources halieutiques en petits pélagiques était estimée à 4 993 000 tonnes pour la sardine, 140 000 tonnes pour la sardinelle ronde et 65 000 tonnes pour l'anchois. L'estimation de la biomasse de la sardine figure parmi les estimations les plus élevées de cette espèce enregistrées dans cette zone. Aucune sardinelle plate n'a été trouvée. L'anchois était estimé à 65 mille tonnes.

Parmi les chinchards, la majorité des poissons trouvés étaient des chinchards de l'Atlantique, avec 95 000 tonnes, tandis que les chinchards du Cunene étaient estimee à 31 000 tonnes.

Le maquereau était relativement abondant dans la zone d'étude, avec une biomasse estimée à 389 000 tonnes.
Les bécasses de mer ne sont normalement pas enregistrées comme faisant partie des principales espèces pélagiques. Cependant, l'abondance de cette espèce dans la zone était exceptionnellement élevée et une tentative de calculer la biomasse a été effectuée et a été estimée à 177 000 tonnes.

CHAPTER 1. INTRODUCTION

1.1 Survey objectives

This survey was planned as part of a synoptic coverage of West Africa's pelagic resources and ecosystems to be conducted from Morocco to South Africa, from May to December 2017 and was the first to be carried out as part of the EAF-Nansen Programme (2017-2021).

In connection with this phase of the Programme, a Science Plan has been developed that addresses 11 different themes within three main lines of research related to resources, impacts of oil/mining activities and pollution on resources and ecosystems and climate change. Therefore, in addition to providing key information on abundance and distribution of main pelagic stocks, the survey programme was designed to also support data collection for priority research questions that will be addresses as part of specific research projects under the science plan. Overall survey objectives and the sampling plan was agreed with the respective partner institutions and and a sailing order was prepared that describes these in detail.

The specific objectives include:

Hydrography:

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

Phytoplankton, zooplankton, ichthyoplankton and jellyfish:

- To establish as far as possible, the distribution, abundance and composition of phyto- and zooplankton, and fish eggs and larvae.
- To contribute to increase the understanding of taxonomy, biology and ecological role of jellyfish.

Pelagic stocks abundance, distribution and biology:

- To obtain information on abundance, distribution (also by size) of *Sardina pilchardus, Sardinella aurita, Sardinella maderensis, Trachurus trachurus, Trachurus trecae, Scomber colias,* and *Engraulis encrasicolus* using acoustic methods and a systematic survey design.
- To collect samples for genetic and morphometric analysis (for stock identification of *S. aurita, S. pilchardus, Scomber colias*).
- To obtain information on maturity stages of *S. aurita, S. pilchardus, Scomber colias.*
- To collect stomach samples for analysis of contents for *S. aurita, Scomber colias, S. pilchardus*
- To collect otoliths, *S. aurita, S. pilchardus, and S. colias* for stock identification.

Food safety:

- To collect fillet samples of fish (homogenized and freeze-dried), samples of whole fish and liver, kidney and gut samples for later analyses of chemical contaminants, nutrients, stable C, N and S isotopes, presence of Kudoa, salmonella, enterobacteria and presence of biomarkers (see sailing orders for greater detail).

Others:

- Record occurrence of jellyfish.
- Record occurrence of top predators.
- Record occurrence of marine debris (surface).
- Map occurrence of microplastics and describe associated neustonic communities.

1.2 Participation

Leg 1.1 Tanger to Las Palmas (7th – 26th May)

Institut National de Recherche Halieutique (INRH), Morocco :
Mamza Kamal (team leader), Benziane Meryem, Haddi Imane, Falah Samira, Chioua Jamal, Belabchir Youness, Faid El Madani, Elgarni Abdelmouhssine, Hdoufane Abderrahman.

Institute of Marine Research (IMR), Norway:
Reidar Toresen (Cruise Leader 1st Leg), Magne Olsen, Merete Kvalsund, Henrik Søiland, Geir Landa, Olaf Sørås.

University of Oslo (UiO), Norway:
Rita Amundsen.

National Institute of Nutrition and Seafood Research (NIFES), Norway:
Anette Kausland, Annbjørg Bøkevoll.

Leg 1.2 (mesopelagic fish investigations) is reported separately.

Leg 1.3 Las Palmas to Cap Blanc (11th – 27 June)

Institut National de Recherche Halieutique (INRH), Morocco :
Majjih Zakaria (team leader, Morocco), Amouri Oussama, Yassir Anas, El Mghouchi Karim, Fadili Mohamed, El Ouehabi Zineb, Bessa Ismail, El Qendouchi Mouna, Hind abdelouhab.

Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), Mauritania :
Mohamed Ahmed Jeyid (team leader Mauritania), Abdelkerim Souleimane, Wagne Moulaye Mohamed, Niang Alioune Hamady, Abdellahi Samba, Diagne Ahmed, Sid'ahmed Reyough.

Department of Fisheries (FD), The Gambia:
Momodou S Jallow (Gambian team leader), Salifu Ceesay.

Institute of Marine Research (IMR), Norway:
Jens Otto Krakstad (Cruise leader), Espen Bagøien, Helene Hodal Lødemel.

Centro Oceanográfico de Canarias, Instituto Español de Oceanografía:
Alba Jurado Ruzafa.

University of Western Cape:
Drikus Kuyper.

FAO, Rome, Italy:
Peter Psomadakis.

1.3 Narrative

Figures 1.1 a-f show the cruise track and the stations worked during the survey. The vessel departed from Casablanca on 7 May, starting the sampling work off Tanger. The survey was interrupted for a call at Las Palmas on 26 and 27 May for change of scientific crew. The vessel departed from Las Palmas at 16:45 on 27 May for a transect that aimed at developing abundance estimation methodology for mesopelagic fish (Leg 1.2- covered in a separate survey report). This part of the survey lasted until the evening of 5 June, and the vessel did a call in Las Palmas for change of scientific crew. Leg 1.3 started on 11 June after a delay due to engine repairs and the survey resumed on the following morning at Cap Juby. The sampling continued southwards following the same sampling strategy as in the north. Cap Bojador was reached on 15 June and Cap Blanc on 27 June. The survey then continued into Mauritanian waters (covered in a separate report).

The weather was generally favourable, but the survey was disrupted for about 12 hours because of a gale on 18 May.

1.4 Survey effort

The survey adopted an acoustic sampling grid with transects perpendicular to the coast and a distance between them of approximately 10 NM, covering the shelf and upper slope to 500 m bottom depth (Leg 1.1 and 1.3). Altogether 104 trawl hauls were carried out to identify acoustic targets during the survey.

Hydrographic transects were sampled approximately each degree of latitude, mostly from close to the coast (between 20 and 30 m bottom depth) to 1000 m bottom depth. Some hydrographic sections ended at 500 m. A total of 122 CTD casts were made along hydrographic transects to describe the water properties in the survey area.

Table 1 shows the survey effort and Annex I provides details of the trawl stations.

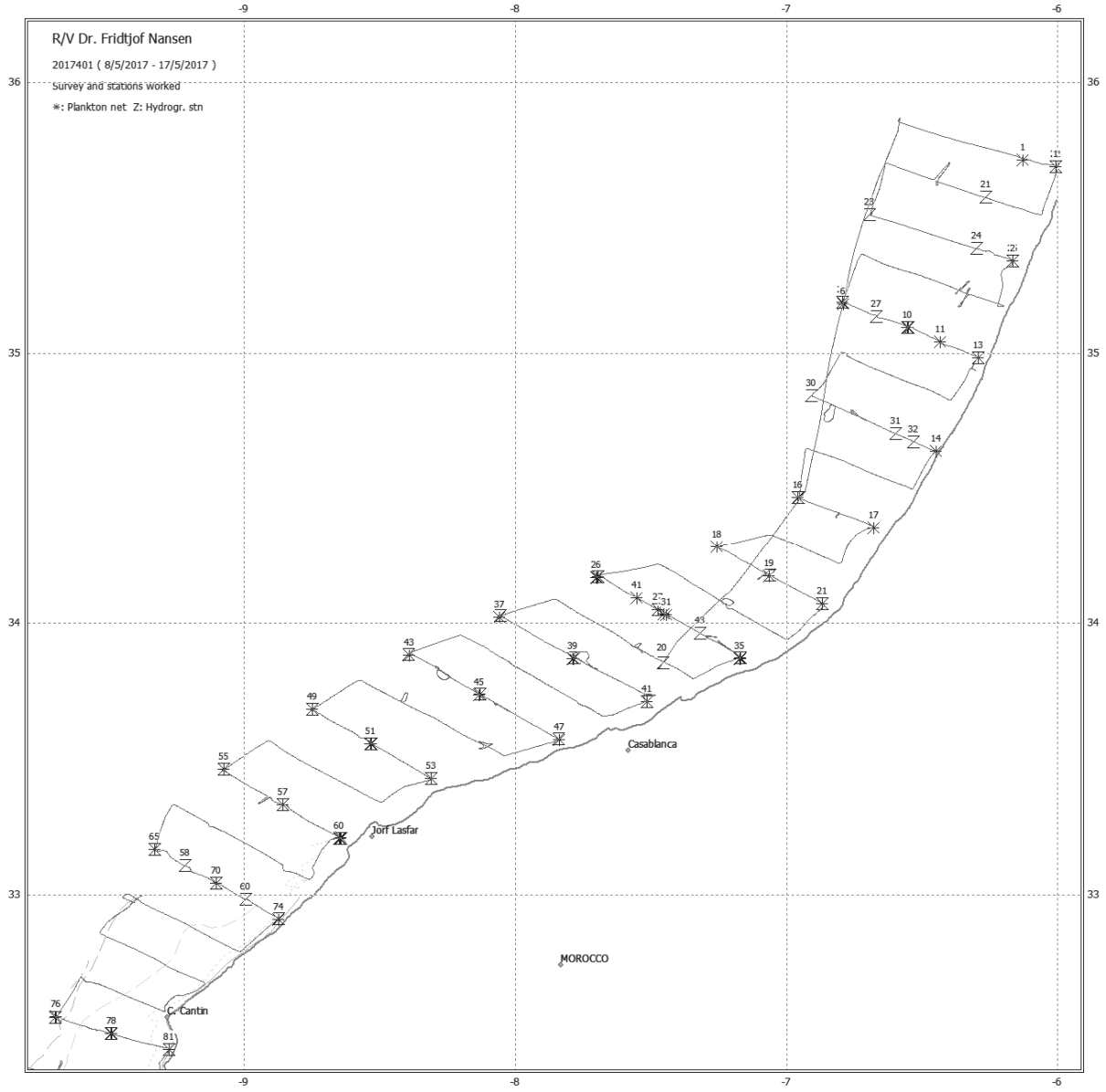


Figure 1.1. Course track with hydrographic stations and "superstations", Tanger to Cap Cantin.

Symbols: z: hydrographic station; ✳: "superstations" (nutrients, plankton, eggs and larvae, microplastics). Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and at 1000 m.

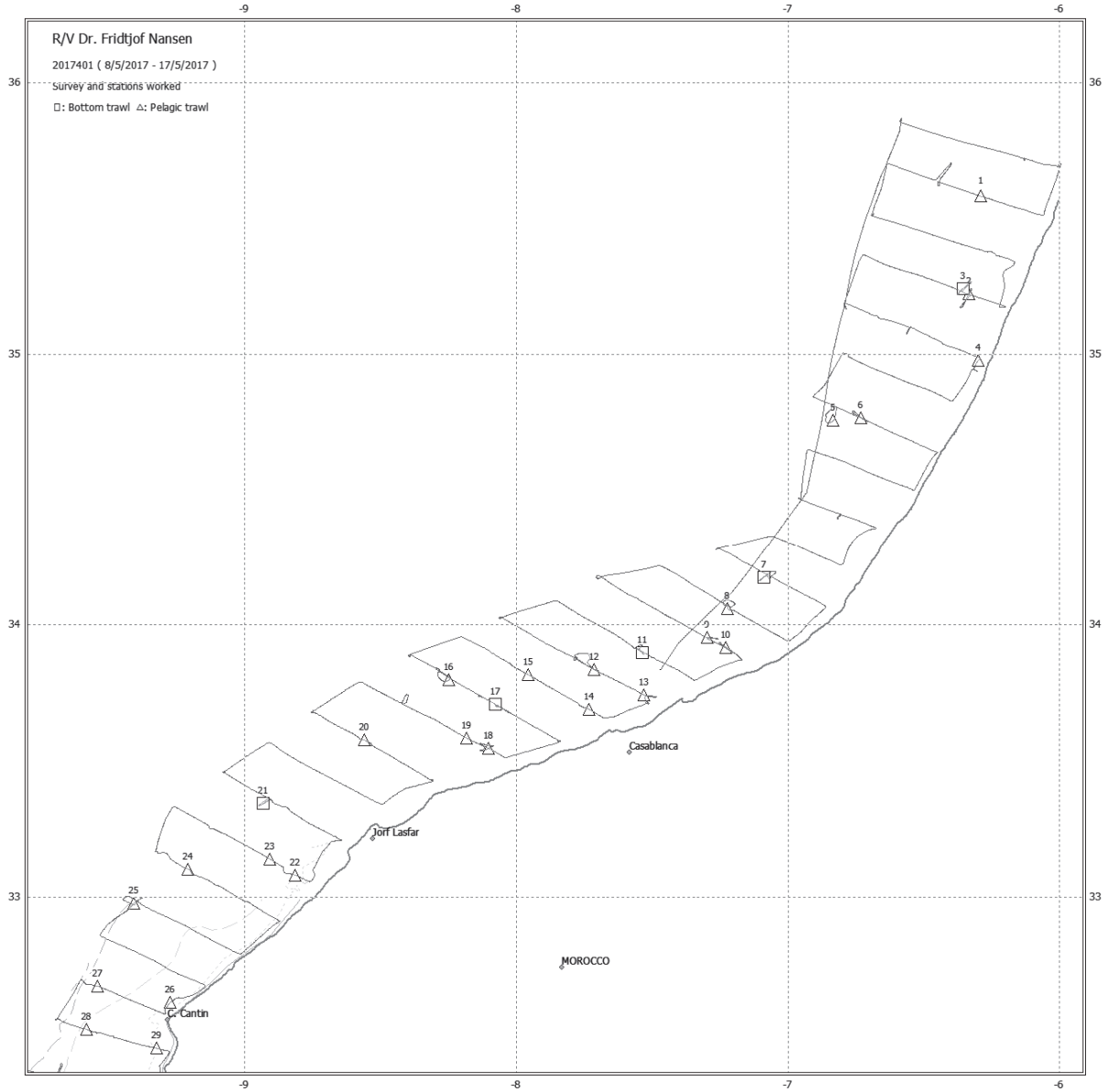


Figure 1.2. Course track with trawl stations, Tanger to Cap Cantin. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and at 1000 m.

Symbols: △ : pelagic trawl; □: bottom trawl

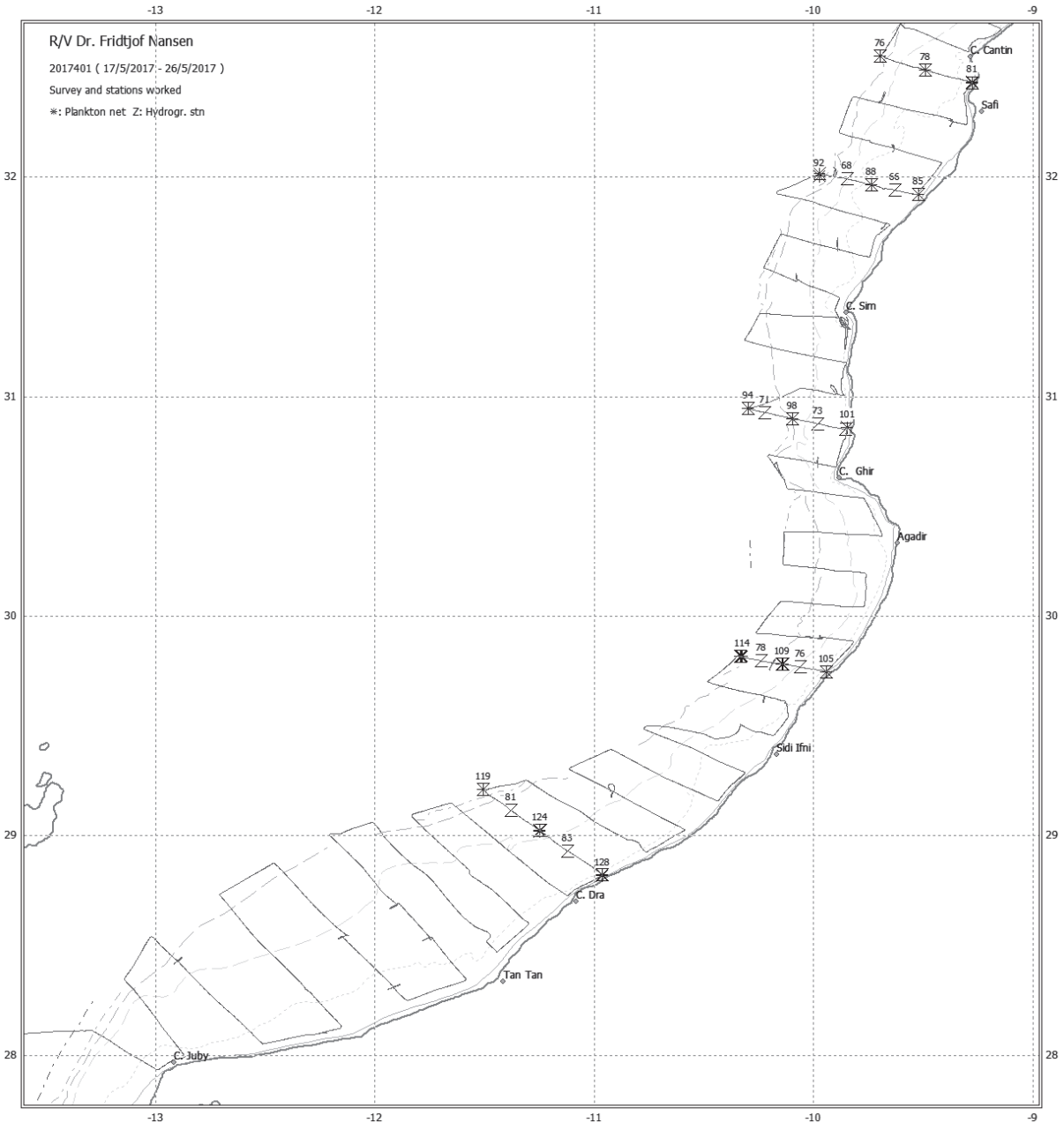


Figure 1.3. Course track with hydrographic stations and "superstations", Cap Cantin to Cap Juby. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and at 1000 m.

Symbols: z: hydrographic station; ✳: "superstations" (nutrients, plankton, eggs and larvae, microplastics).

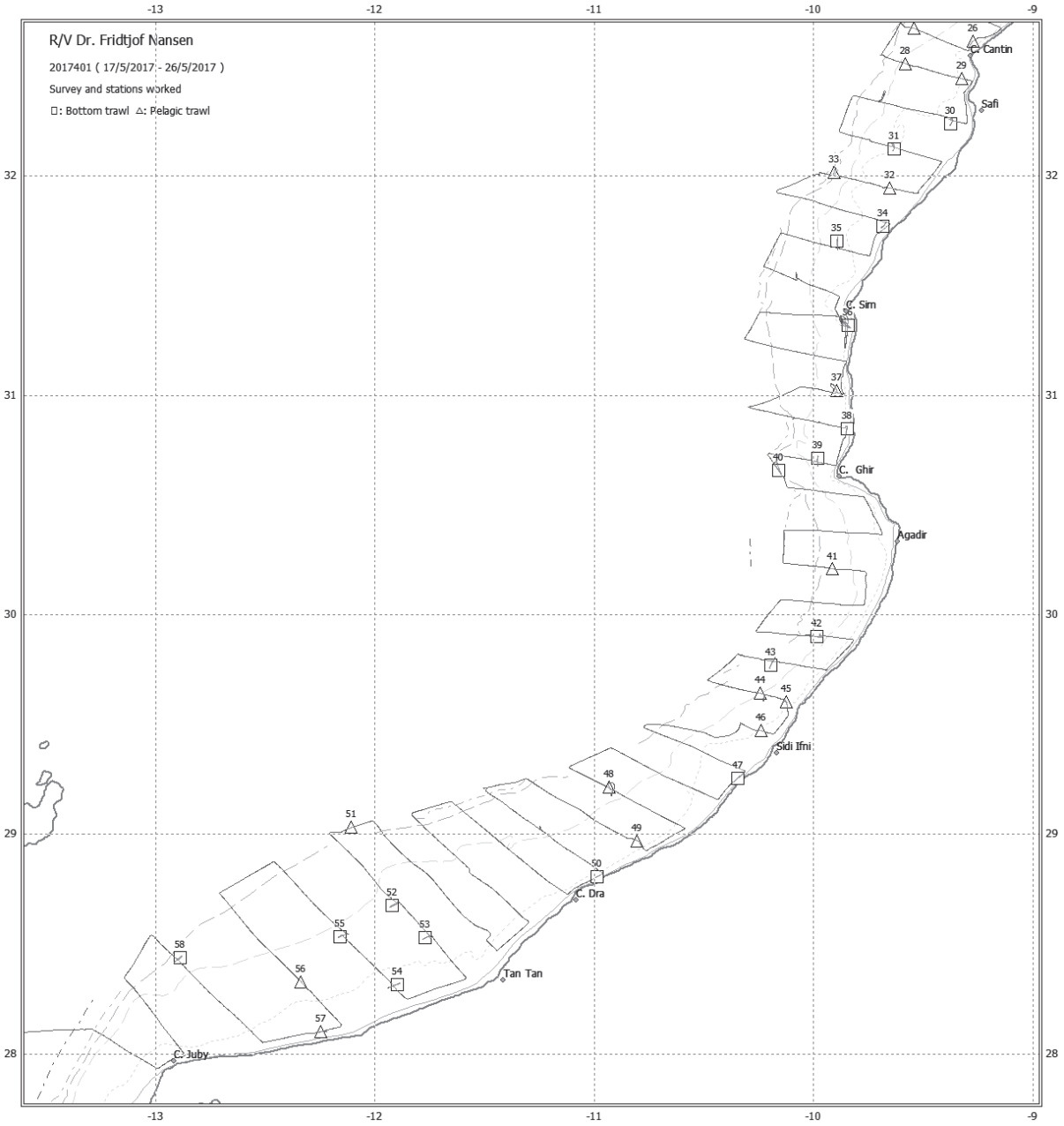


Figure 1.4. Course track with trawl stations, Cap Cantin to Cap Juby. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and at 1000 m.

Symbols: △: pelagic trawl; □: bottom trawl

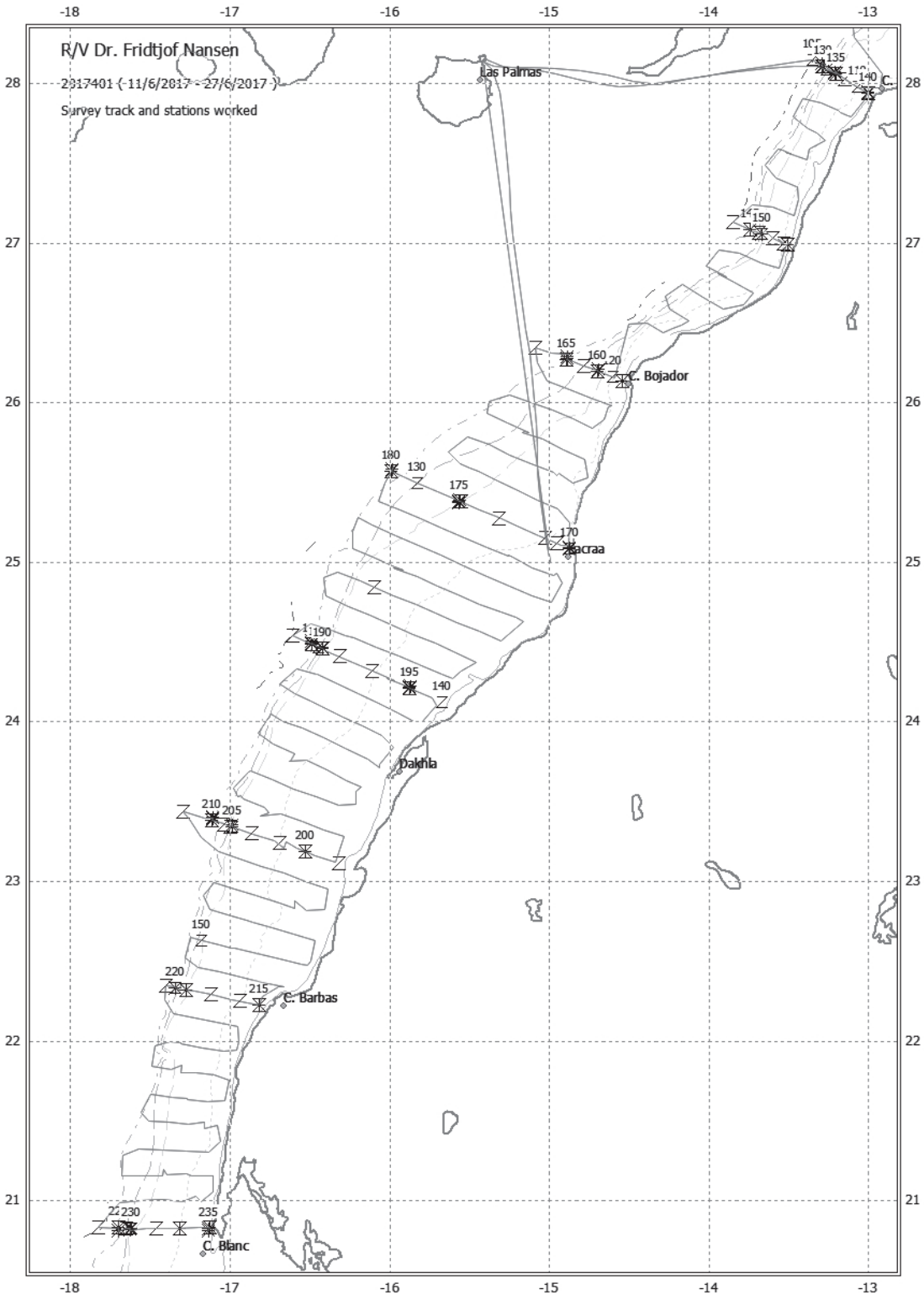


Figure 1.5. Course track with hydrographic stations and "superstations", Cap Juby to Cap Blanc. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and at 1000 m.

Symbols: z: hydrographic station; ✳: "superstations" (nutrients, plankton, eggs and larvae, microplastics).

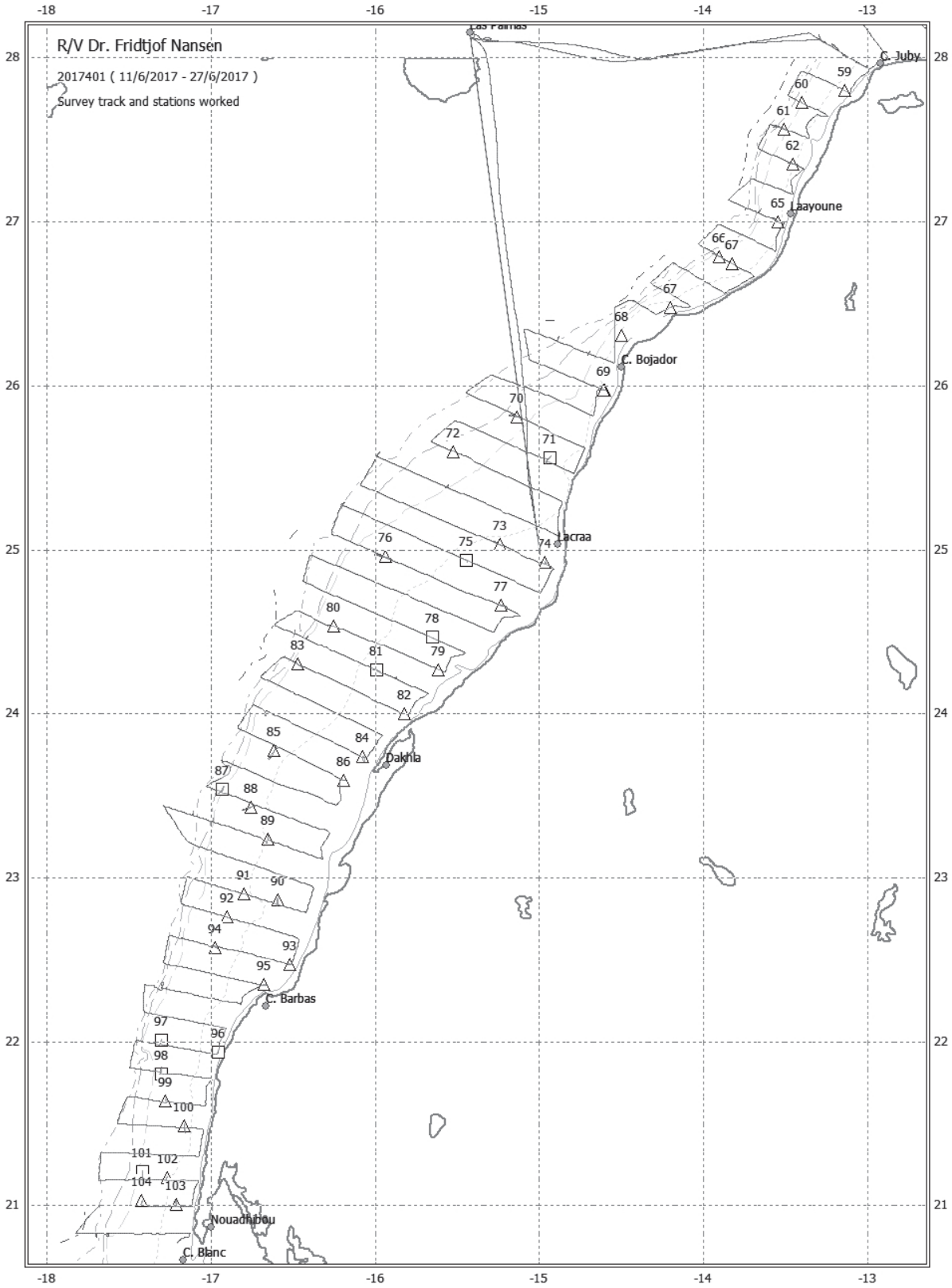


Figure 1.6. Course track with trawl stations, Cap Juby to Cap Blanc. Depth contours at 20 m, 50 m, 100 m, 200 m, 500 m and at 1000 m.

Symbols: △: pelagic trawl; ☐: bottom trawl

Table 1. Survey effort.

Region	NM sailed	CTD	Phyto	WP-2	Multi	Manta	BT	PT
Tanger – Cap Cantin	1280	43	9	22	24	21	5	23
Cap Cantin – Cap Juby	1483	22	9	20	12	11	17	13
Cap Juby–Cap Blanc	2747	59	19	40	24	20	8	34
Total	5510	124	37	82	60	52	30	70

Phyto: phytoplankton net, WP-2: zooplankton net, Multi: multinet for eggs and larvae, Manta: manta trawl for plastic particles in the surface, BT: Bottom Trawl, PT: Pelagic Trawl.

CHAPTER 2. METHODS

2.1 Meteorological data recording

Meteorological data was logged continuously from the AANDERAA Smartguard meteorological station and included wind direction and speed, air pressure, humidity, air temperature and solar radiation. All data were logged to the Nansis tracklog system averaged by unit distance sailed (1 NM).

2.2 Oceanography

Thermosalinograph

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

CTD

Vertical temperature and salinity profiles were obtained by a Seabird 911 CTD, while *in situ* concentrations of dissolved oxygen were measured using a CTD-mounted SBE 43 oxygen sensor. Real time logging and plotting was performed using the Seabird Seasave software installed on a PC. Attached to the CTD was also an uncalibrated Chelsea Mk III Aquatracka fluorometer, which measures *in situ* fluorescence on relative scale. The CTD was stopped at the designated depths for 15 seconds before closing the Niskinbottles. The CTD was deployed at, or close to every degree of latitude, from the coast out to approximately 500 m bottom depth. In the southern part of the area, most sampling continued offshore to 1000 m bottom depth. At bottom depths of 30 m, 100 m and 500 m, the following type of samples/data were collected at stations named “Superstations”: salinity, temperature, dissolved oxygen and fluorescence (measured by the CTD with additional sensors), seawater samples, phytoplankton, zooplankton, fish larvae and eggs, as well as microplastics.

Twelve Niskin bottles (10 l) attached to a CTD-mounted rosette were used to collect water at pre-defined depths. The standard sampling depths were: 1000, 750, 500, 400, 300, 250, 200, 150, 100, 75, 50, 25, and 5 m. On stations with bottom depth of 1000 m, the sample from 250 m was not collected due to the limitation to 12 Niskin bottles. In some parts of the survey, extra samples from the surface mixed layer were collected (10 and 2 m), and standard depths were then rearranged.

For validation of the salinity (conductivity) measurements of the CTD, the salinity of seawater at various stations and depths (in total 85 samples) was analysed using a Portasal salinometer (mod. 8410A) on board the vessel. The salinity readings of the sensor from station 34 to station 82 were on average confirmed to the 2 decimal (Figure 2.1).

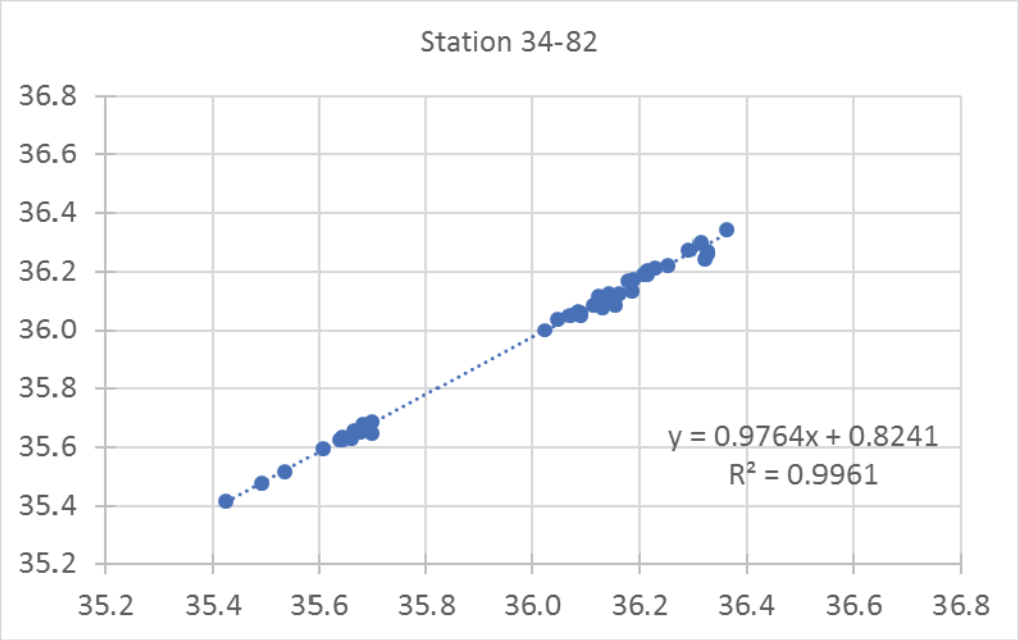


Figure 2.1. Salinity measured using a Portasal salinometer plotted against results from the CTD sensor. In total 42 samples taken from Niskin bottles between stations 34 to 82 (Some samples were excluded from the analyses).

During the analyses of water samples from stations 34 to 82, problems with the pressure inside the salinometer-cells made it difficult to flush and fill the cells. The problem with the pressure was identified to be related to the tube coming out of the instrument, which purpose is to drain the cells. If water was trapped in this tube after flushing, re-filling of the cells became difficult. After solving this issue and cleaning the tubes from the cells, new measurements from stations 105 to 149 (44 samples) were made. The precision became improved after this (Figure 2.2).

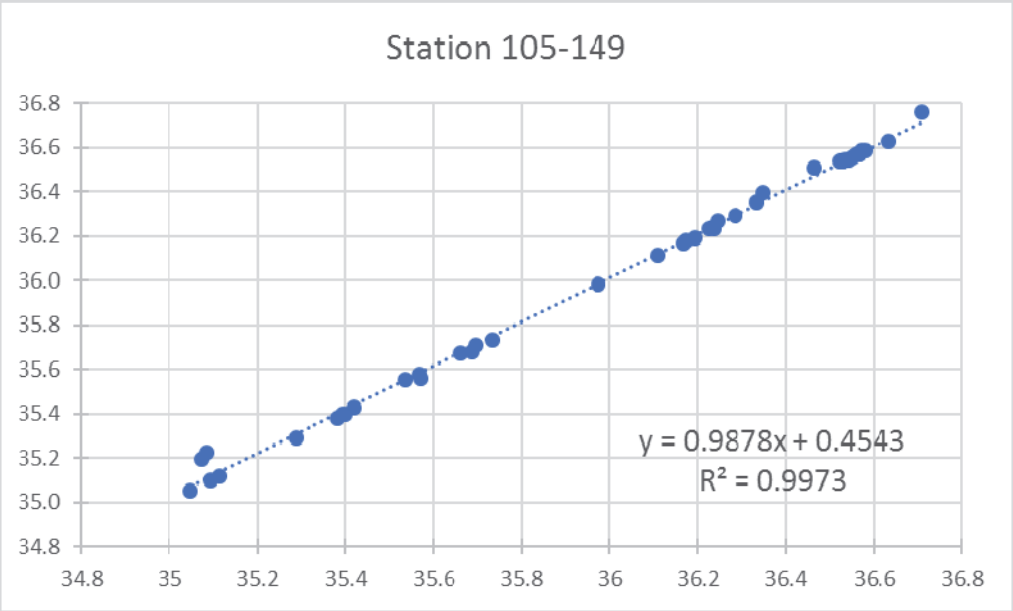


Figure 2.2. Repeated readings of salinity using the Portasal salinometer plotted against results from the CTD sensor. Stations included: 105 to 149 (44 samples).

To validate the oxygen-data from the CTD-mounted sensor, concentrations of dissolved oxygen in the seawater samples collected with the Niskin bottles were analysed in the ship laboratory by Winkler red-ox titration. The method is based on Winkler (1888), but modified for enhanced precision (e.g. Carpenter 1965, Murray et al. 1968, Strickland and Parsons 1968, Culberson et al. 1991). The present version of the method is described by Grasshoff *et al*. (1983). For stations 133, 134, 148 and 149 a total of 45 samples were analysed. The average difference between the results of the oxygen sensor and the Winkler titration was 0.235 mL/L (±0,035 mL/L), with the Winkler results always being higher than the CTD sensor (Figure 2.3).

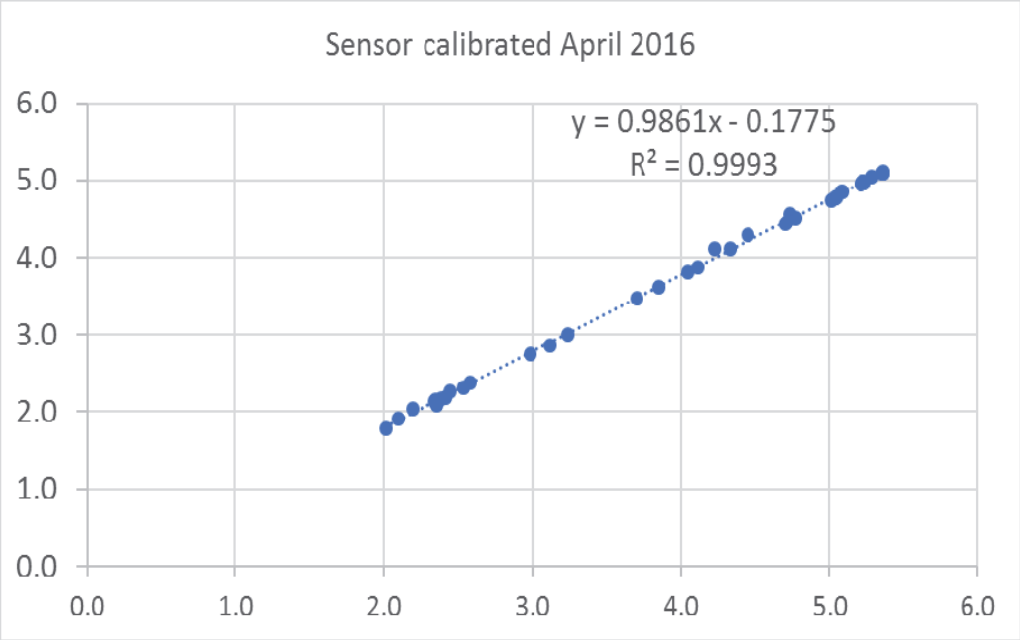


Figure 2.3. Measured oxygen concentrations from water samples collected from Niskin bottles at stations 133, 134, 148 and 149 (45 samples) plotted against oxygen sensor data from April 2016.

The difference between the sensor results and the measured results was concluded to be larger than accepted. Therefore, a new oxygen-sensor (calibrated in April 2017) was mounted on the CTD. New samples were collected from stations 157 and 158 (a total of 22 samples). The average difference between the results of the sensor versus the chemical analysis (Winkler titration) was then reduced to 0,063 mL/L (±0,059 mL/L). Figure 2.4.

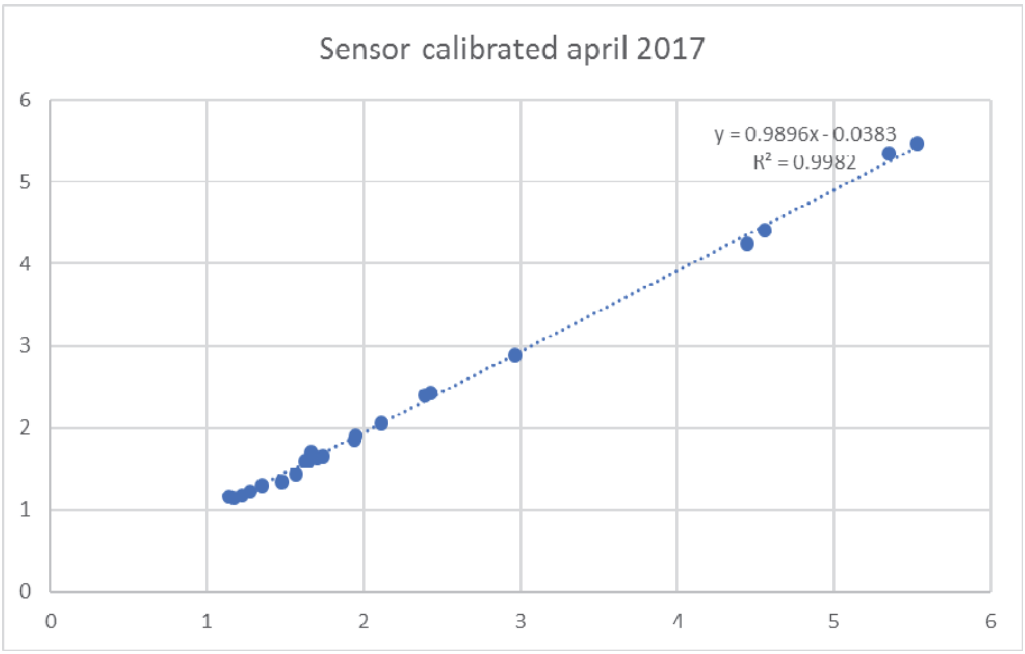


Figure 2.4. Measured oxygen concentrations from water samples collected from Niskin bottles at station 157 and 158 (22 samples) plotted against oxygen sensor data from sensor calibrated in April 2017.

Superstations

In connection with the CTD transects, at depths of 30, 100 and 500 m, sampling was also carried out for pH (acidity/alkalinity), nutrients, phyto- and zooplankton, egg and larvae and microplastics according to the scheme shown in figure 2.5. These stations were named "superstations".

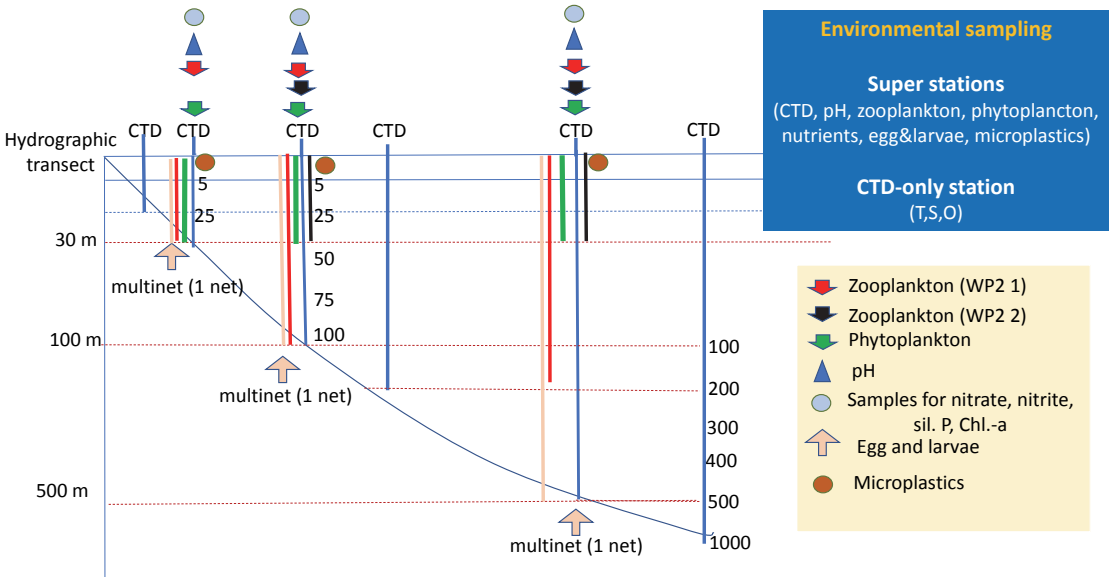


Figure 2.5. A diagrammatic scheme of the sampling along a transect, showing the three superstations sampled (at the 25/30 m, 100 m and 500 m isobaths) and the extra CTD stations carried out when the

distance between superstations was greater than 15 NM (most extra stations were actually carried out between the inshore and 100 m superstations)

Ocean acidification parameters (pH and alkalinity)

Seawater samples (250 ml) from the CTD-mounted Niskin bottles were collected in borosilicate glass bottles using silicone tubing to reduce air exchange. Both pH and alkalinity were analysed on board the vessel. pH was determined spectrophotometrically using a diode array spectrophotometer and a pH sensitive indicator, m-cresol purple in 2 mM solution, as described by Clayton and Byrne, 1993; Chierici *et al*., 1999. Alkalinity was measured by titration with acid (0.05M HCl) and changes in pH were measured with an electrode (potential in mV) using tiamo software. Further processing of the data will be done at IMR, Norway, and will provide more information on the marine carbonate system and parameters for ocean acidification. Data will be used in the context of the EAF-Nansen Science plan, Theme 10.

Nutrients

Seawater samples (20 ml) for nutrient analyses (nitrate, nitrite, silicate and phosphate) were collected from the Niskin water bottles. The seawater samples were stored in 20 ml polyethylene vials, conserved with 0.2 ml chloroform, and kept cool and dark in a refrigerator (Hagebø and Rey, 1984). The analyses for nutrient content will be made by 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).

During transport from the ship to the IMR laboratory in Norway, the nutrient-samples were most likely subjected to temperatures above the recommended 4 °C. The temperatures to which the samples were exposed to, and the duration of this exposure, is not clear. It is not evident whether this may have caused degradation of the nutrient samples, which are currently being analysed.

2.3 Plankton

Phytoplankton biomass

Chlorophyll *a* was sampled as an indicator of phytoplankton biomass. For chlorophyll *a* and phaeopigment measurements, seawater was collected from the CTD at the standard depths (but not below 200 meters). The water was filtered using a 0.7 µm filtration system (Munktell glassfiber filters Grade: MGF, vacuum 200 mm Hg). Water samples were filtered from each depth and stored at -20 °C. All samples were transferred to IMR (Bergen) for subsequent analyses. The assay is performed by extraction with 90% acetone followed by centrifugation, and analysed with a fluorometer (model 10 AU, Turner Designs Inc., Sunnyvale, Ca., USA), according to Welshmeyer (1994) and Jeffrey and Humphrey (1975).

Phytoplankton identification

Phytoplankton was collected along the hydrographic transects at stations positioned at bottom depths of approximately 30 m, 100 m and 500 m. At each plankton station, qualitative phytoplankton samples were collected with a net (35 cm in diameter and mesh size of 10 µm), hauled vertically at a speed of 0.1 ms^{-1} from the depth of 30 m to the surface (from ca. 5 m above bottom at the 30 m stations). During the first part of the survey, north of Cap Juby, the samples were preserved with Lugol's solution, while during the second part of the survey southwards from Cap Juby, the samples were preserved with 2 ml of 20% formalin buffered with hexamine in 100 ml bottles (i.e. a final solution of ca. 0.4% formaldehyde). These samples are not for quantitative analysis but used to establish the taxonomic composition of the phytoplankton community. This work is to be followed up with partners from the region.

Zooplankton

Mesozooplankton was collected with a WP2 net along the hydrographic transects at stations positioned at bottom-depths of ~ 30 m, 100 m and 500 m. The WP2 net (56 cm diameter, mesh size 180 µm) (Fraser 1966, Anonymous 1968) was hauled vertically at a speed of ~ 0.5 ms^{-1} at each station. At the 30 and 100 m bottom depth stations, the sampling strata were from near bottom to the surface (lower sampling depths of ~25 and 90 m, respectively). At the deepest stations with bottom depth of ~500 m, the sampling stratum was from the depth of 200 m to the surface.

Furthermore, a second collection with the WP2 net was performed for the depth stratum of 30 to the surface at the stations with bottom depths of 100 m and 500 m. The purpose of this additional sampling was to enable a direct comparison of the zooplankton composition and concentrations in the uppermost layer of the water column along the bottom depth gradient.

Each zooplankton sample was divided into two equally large parts using a Motoda plankton splitter (Motoda 1959). Prior to this, all visible jellyfish (or remains of such) were removed from the samples and their volume measured. The first part of the sample was preserved in seawater with a final solution of 4% formaldehyde buffered with borax for subsequent species identification and quantification on land. The second part of the sample was size-fractioned by using a series of sieves with decreasing mesh sizes of 2000 µm, 1000 µm and 180 µm, and the zooplankton retained on each sieve were thereafter dried on aluminium trays at ~60 ºC for 6-24 h. Limited storage capacity in the drying cabinet restricted the drying period. The size-fractioned biomass samples were thereafter kept frozen at -18 °C for subsequent weighing of dry-weight - following a second drying period - in the laboratory of IMR (Norway). During the weighing process, samples with some degree of greenish colour, indicating inclusion of phytoplankton, were identified and noted. In processing the zooplankton biomass data, a few samples were excluded from the dataset presented in this report due to possible confounding of tray numbers used for the biomass samples.

Ichthyoplankton

At the beginning of the survey (from approximately Tanger to Cap Juby), fish eggs and larvae were collected along every second transect, but later sampling was carried out only along the hydrographic transects, i.e. every degree of latitude. Sampling was performed with a Hydro-Bios Multinet with mesh size of 405 µm at stations with bottom depths of ca. 30 m, 100 m and 500 m. The net was towed obliquely from ~10 m above the bottom, or from a maximum depth of 100 m, to the surface with a speed of ~1.5 ms^{-1}. Once the Multinet was on board after a haul, the sample was collected.

During the first part of the cruise, north of Cap Juby, all fish larvae visible with "the naked eye" were removed from the total sample for a given station, and transferred to a bottle. These fish larvae were then preserved in 4% formaldehyde buffered with borax. When all visible fish larvae had been removed from the Multinet sample, the rest of the sample was preserved the same way in a separate bottle so that fish eggs and overlooked larvae can be analysed on shore after the cruise.

During the last part of the cruise, between Cap Juby and Cap Blanc, the entire samples including both fish eggs and larvae were preserved directly in a final solution of 4% formaldehyde buffered with borax. Thereafter, the whole samples were checked under stereomicroscope, and all fish larvae sorted and put on a separate bottle in 4% formaldehyde buffered with borax. Selected fish larvae in a good state were photographed. The fish eggs will be sorted, and the larvae identified on shore after the cruise, in close cooperation with partners from the region and as part of Theme 1 of the Science Plan.

Microplastics

Microplastics were collected along the hydrographic transects at stations positioned at bottom depths of ~ 30 m, 100 m and 500 m. At each station, the surface layer was sampled with a Manta trawl, with a rectangular opening of 19 cm × 61 cm (HxW), mesh size of 335 µm and two wings to keep it in balance and at the surface during the tow. On each sampling occasion, the trawl was hauled horizontally at a speed of ~1.5 ms^{-1} for 15 minutes. The counts of a manual flowmeter attached below the trawl opening were recorded at start and stop of each trawl event. Trawling was performed some meters away from of the starboard side of the vessel, about mid-ship, attempting to avoid the wake of the vessel. Geographical start and stop positions were recorded in the bridge-log.

Once the Mantatrawl was back on the ship after trawling, the samples were washed in filtered sea water over a sieve with mesh size of 180 µm. Microplastic particles were sorted from the sample under a stereomicroscope, and the sorted sample was then checked once more to reduce the risk of overlooking the smallest plastic particles. All assumed plastic items were then placed on a gridded petri-dishes for examination under the stereomicroscope,

photographed and, to the extent possible, also measured and described (e.g. length, shape, type and colour). The sorted microplastics were washed with distilled water and dried in pre-weighed aluminium trays in a drying cabinet at 30 ºC. The trays were packed in aluminium foil and stored in room temperature until transport to the laboratory of IMR, where they will be studied in more detail. After removing the plastics, the remaining part of the samples - mainly biological material - was preserved for studies of neuston on shore after the cruise, in collaboration with the the University of Western Cape that will receive all the neuston samples.

It should be mentioned that some paint fragments, assumedly from the vessel, were recorded in the samples. During the first part of the cruise, north of Cap Juby, the Manta trawl was attached to a plank mounted about mid-ship, perpendicularly to the ship side. To avoid or reduce this problem it was decided to increased the distance between the trawl and the ship, and the Manta trawl was instead attached to a large ship-crane. This change was made starting at Cap Juby and moving southwards. However, paint was still detected in the samples. The colours of these particles matched the yellow and red paint on the shackle used to attach the trawl to the crane, and in addition, white paint fragments were recurring in the samples. For this reason, early in the second part of the cruise the yellow and as much as possible of the red parts of the shackle were covered with tape. The number of yellow and red fragments in the samples was thereafter reduced. Paint samples from the crane and the jackal will be compared with the fragments found in the samples after the cruise. Samples collected will be processed in collaboration with partners from the region and analysed as part of Theme 6 of the Science Plan.

2.4 Trawl sampling

Biological sampling of the fish was carried out using pelagic and bottom trawls. In shallow water (< 30 m) or at night, when pelagic fish was close to the surface, the pelagic trawl with floats or bottom trawl with floats was used for sampling. Annex III gives a description of the instruments and the fishing gear used. All catches were sampled for composition by weight and numbers of each species caught. Species identification was based on the FAO Species Identification Guides. Length frequency distributions, by total fish length to the nearest cm below, of the selected target species (see age 6) were taken in all the stations where they were present. Individual weight measurements and biological information on sex, maturity, and stomach fullness was recorded for 30 fish/sample of all target species (see. Length measurements were taken to estimate the length-weight relationship for the biomass calculations. In addition, the following biological samples of fish were taken: otoliths, fin clips for genetic analysis, stomach and liver samples, and samples of whole fish for future biological investigations as part of Theme 2 of the Science Plan.

The complete records of fishing stations and catches are shown in Annex I. A full list of biological samples per species and trawl station is given in Annex II.

2.5 Sampling for food safety

Whole fish, fillet and different organs from various fish and octopus were sampled during this survey. All the samples will be analyzed for a wide variety of nutrients and contaminants at IMR in close cooperation with partners form the region and as part of Theme 8 of the Science Plan. Tissues from mackerel samples will be analysed for the parasite Kudoa.

Some of the samples will also be analysed for correspondence between the microbiota and the metal content of the gut. One pelagic fish sample and two mesopelagic fish samples will be analysed for the content of microplastic particles.

2.6 Acoustic sampling

Current speed and direction measurements

Two hull-mounted Acoustic Doppler Current Profiler (ADCP) from RD Instruments ran during the survey. The frequency of the ADCP are 75 and 150 kHz. The system is run in narrow band mode and data were averaged in 16 and 4 m vertical bins at 75 and 150 kHz respectively and stored on files for post survey processing. The 150 kHz was run continuously while the 75 kHz was turned off during the last part of the survey due to interference with the ping rate of the EK80 echosounder.

Sonar data

A Simrad SH90 Sonar was recording data continuously during the survey d stored for post processing after the survey, as part of the Science Plan Theme 2. The sonar was set to a frequency of 26 kHz, in FM Normal mode. The sonar was operated using bow up/180 degree operation mode with the bearing of the vertical beams at 90 degrees, perpendicular to the vessel direction with a range of 450 m and with the horizontal beams set to 450 m with a tilt angle of 3 deg. The filters built into the sonar software to improve the school representation (i.e. AGC, RCG and ping to ping) were set to default values except for the noise filter, that was turned off.

The settings including range and tilt was kept the same during all the survey except during trawling operations where the sonar at times were used actively to focus in on targets.
No other sonars were used during the survey.

Bottom mapping echo sounder

The EM 710 multibeam echo sounder is a high to very high-resolution seabed mapping system. Acquisition depth is approximately 3 m below the transducers and the maximum acquisition depth is limited in practice to 1000 - 1500 m on the R/V *Dr Fridtjof Nansen*. Across track coverage (swath width) is up to 5.5 times water depth and may be limited by the operator either in angle or in swath width without reducing the number of beams. The operating frequencies are between 70 to 100 kHz. There are 128 beams with dynamic

focusing employed in the near field. The transmitting fan is divided into three sectors to maximize range capability and to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping and use distinct frequencies or waveforms. The along track beam width is 1 degree. Ping rate is set according to depth. The receiving beam width is 2 degrees. Sound profiles were set manually in the system according to the area of operation. The data was logged to the onboard Olex plotting system.

Acoustic estimates of fish biomass

Acoustic data were recorded using a Simrad EK80 Scientific Split Beam Echo Sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38, 70, 120, 200 and 333 kHz. The survey was started without *a priori* calibration, but the sounders were calibrated in Bergen on the 23rd January 2017. Annex III gives the details of the acoustic settings used during the survey.

Acoustic data were logged and post-processed using the latest acoustic data post-processing software, the Large-Scale Survey System (LSSS) Version 2.0. The technical specifications and operational settings of the echo sounder used during the survey are given in Annex III.

In cases where the target category of fish contains more than one species (e.g. sardinellas or horse mackerel), the mean s_A-value allocated to the category is divided between the species in the same ratio as their contribution to the mean backscattering strength in the catches (relative amount by number at length in the catches).

The following target strength (TS) function was applied to convert s_A-values (mean integrator value for a given species or group of species in a specified area) to number of fish:

$$TS = 20 \log L - 72 \text{ dB}$$

(formula 1)

which can be converted (see Toresen *et al*. 1998 for details) to the area form (scattering cross sections of acoustic targets):

$$C_{Fi} = 1.26\ 10^{6}\ L^{-2}$$

(formula 2)

where L is total length in 1 cm length group *i* and C_{Fi} (m^{-2}) is the reciprocal backscattering strength, or so-called fish conversion function. To split and convert the allocated s_A-values (m^2/NM^2) to fish densities (numbers per length group per NM^2), the following formula was used:

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

(formula 3)

where

ρ_i = density of fish in length group *i*
s_A = mean integrator value
p_i = proportion of fish in length group *i*
$\sum_{i=1}^{n} \frac{p_i}{C_{Fi}}$ = the relative backscattering cross section (m^2) of the length frequency sample of the target species, and
C_{Fi} = reciprocal backscattering cross section (σ_{bs}^{-1}) of a fish in length group *i.*

The integrator outputs were allocated to fish groups using a combination of behaviour pattern as deduced from echo diagrams, LSSS analysis and catch composition as described below.

The following target groups were used for this survey:

1) Sardine (European pilchard *Sardina pilchardus*)
2) Sardinellas (round sardinella *Sardinella aurita* and flat sardinella *S. maderensis*),
3) Anchovy (European anchovy *Engraulis encrasicolus*),
4) Horse mackerels (Atlantic horse mackerel *Trachurus trachurus* and Cunene horse mackerel *T. trecae*)
5) Mackerel (Atlantic chub mackerel, former scientific name *Scomber japonicus,* new name *S. colias)*
6) Other pelagic scombrids, carangids and associated species (such as *Auxis* sp., *Caranx* sp. and hairtail *Trichiurus lepturus*) (*Macroramphosus scolopax* and *M. gracilis* was included in this group during the 2nd leg of the survey due to their very high abundance), were included in the PEL2 group
7) Other demersal species (such as Sparidae, Haemulidae and Merluccidae).

The above equations show that the conversion from s_A-values to number of fish is dependent on the length composition of the fish. It is therefore important to get representative length distributions from the stock in the whole distribution area.

When the size classes (e.g. young fish and older fish) are well mixed, the various length distributions can be pooled together with equal importance. Otherwise, when the size classes

are segregated, the total distribution area is post-stratified, according to the length distributions, and separate estimates are made for the regions containing fish with equal size.

For each region representing a distribution of a target-species, the following basic data are needed for the estimation of abundance:

1) The average s_A-value for the region;
2) The area (usually square nautical miles, NM^2) of the given region, and
3) A representative length distribution of the target species in the region.

If the target group is a mixture of more than one species, for example sardinellas, a representative distribution of the two, within the region, as shown in the trawl catches, is used. A length distribution representing the number of the two species for each catch must be calculated. Thereafter, these distributions must be normalized to a unit number (usually 100) so they are equally weighted (independent of sample size).

A systematic approach to a) divide the s_A-value between species in a target group (e.g. *Sardinella aurita* and *S. maderensis*) and b) produce pooled length distributions of a target species for use in the above equation and c) calculate the biomass estimates for a region, is obtained through the following procedure:

- All length frequency samples of the species within a stratum (e.g. sardinellas) are normalized (pooled together with equal importance).
- The mean backscattering strength (ρ/s_A) of each length frequency distribution of the target species is calculated and summed. This can automatically be done in the Excel spreadsheet made available for acoustic abundance estimation on board the R/V *Dr. Fridtjof Nansen*.
- The mean s_A-value allocated to the acoustic category (e.g. sardinellas) in the stratum is divided between the species within this category in the same ratio as their relative contribution to the mean backscattering strength in each length groups in the pooled sample.
- The pooled length distribution is used, together with the mean s_A-value, to calculate the density (numbers per square NM) by length groups and species, using the above formula (3). The total number by length group in the area is obtained by multiplying each number by the area.
- The numbers are then converted to biomass using the estimated weight at length.

CHAPTER 3. SURVEY RESULTS

3.1 Hydrographic conditions

The region is characterized by two main seasons: a dry or cold season (January to May) and a wet or hot season (July to October), with transitional seasons in between. The time of the survey corresponds to the transitional months (May and June) before the summer, when the Inter-Tropical Convergence Zone (ITCZ) moves north and the trade winds gradually weaken.

During the survey the region north of 32 ° had the most stable water masses and the least upwelling, with a gradual lowering of the thermocline towards the south. Higher surface temperatures offshore and lower surface temperatures towards the coast is a sign of ongoing, although perhaps weak, upwelling. Close inshore, at the 30 m CDT stations, a clear separation in oceanographic conditions is observed from around 25 °N and southwards, with watermasses close to the coast more fully mixed. The areas of highest chlorofyll *a* concentrations typically correspond to areas of lower salinity and show ongoing upwelling. These areas are roughly between 32 °N – 30 °N, around 27 °N extending to both sides, and especially from 23 °N and southwards where chlorophyll *a* values increase to >4 µg/l.

Cross shelf hydrographic profiles

Cross shelf distribution of temperature, salinity, oxygen, and fluorescence is shown in Figures 3.1 to 3.15 for all the hydrographic transects. Note the expanded surface region on the y axis and the different colour scales on the different figures.

The three sections at 35 °N, 34 °N and 33 °N (Figures 3.1, 3.2 and 3.3) have very similar structure even though the actual measured values are different. All three sections have a warm saline surface layer, with lower salinities and temperatures deeper down.The lowest temperatures and salinities are observed close to the bottom on the shelf slope. On these three section we observe a subsurface (75 - 100 m) maximum in fluorescence and low surface values. A local maximum in oxygen is located on the shallow side of the fluorescence maximum. Lower oxygen values are seen close to the bottom on the shelf, with the lowest values in deeper waters on the slope (3.5 - 4.0 ml/l).

The section at 31 °N (Figure 3.5) is clearly influenced by upwelling as shown by the lifting of the thermocline closer to the coast and low surface temperature (observed better from the thermosalinograph, Figure 3.17), low salinities close to the surface on the shelf, and maximum fluorescence values close to the surface on the inner shelf. The surface water has a weak temperature minimum on the outer shelf, and despite the upwelling, a thin warm surface layer is observed close to the shore. On the sections to the north at 33 °N (Figure 3.4) and to the south at 30 °N, there is a thin warm surface layer.

The properties on the two next sections at 29 °N and 28 °N (Figures 3.7 and 3.8) are similar as seen on the first sections, with a warm surface layer and subsurface maximum in fluorescence. However, at the coast lower surface temperature and maximum fluorescence close to the surface are observed. On the shelf the oxygen concentrations close to the bottom drop below 3.5 ml/l on the inner shelf on the 29 °N section.

The section at 27 °N (Figure 3.9) is clearly influenced by upwelling with a lifting of the thermocline towards the coast. Relatively low temperatures and salinities are observed on the inner shelf. In addition, very high values of fluorescence are observed across the whole shelf with the highest values over the shallow part of the shelf. The oxygen concentrations close to bottom at the shallow shelf are as low as 2.75 ml/l, whereas the values remain between 3.0 and 3.5 ml/l on the outer part of the shelf.

On the sections from 2°N to 21°N (Figures 3.10 to 3.14) colder water close to the coast and warm water at the outer shelf are observed. In addition, there are high values of fluorescence close to the surface along the shore and a subsurface maximum at the outer shelf. This is very distinct on the section at 25 °N (Figure 3.11), in the centre of the region, with large differences in surface temperature seen from the thermosalinograph measurements (Figure 3.18) as well as on the section at 26 °N. On the three sections at 24 °N to 22 °N it is not as prominent, but the results of upwelling of cool (nutrient rich water) close to the coast is seen there as well.

On the southernmost section at 21 °N (Figure 3.15) there are high values of fluorescence near the coast. Lower values are observed on the outer shelf, but the maximum values remain close to the surface. The difference in surface temperature between the inner and outer shelf is also small.

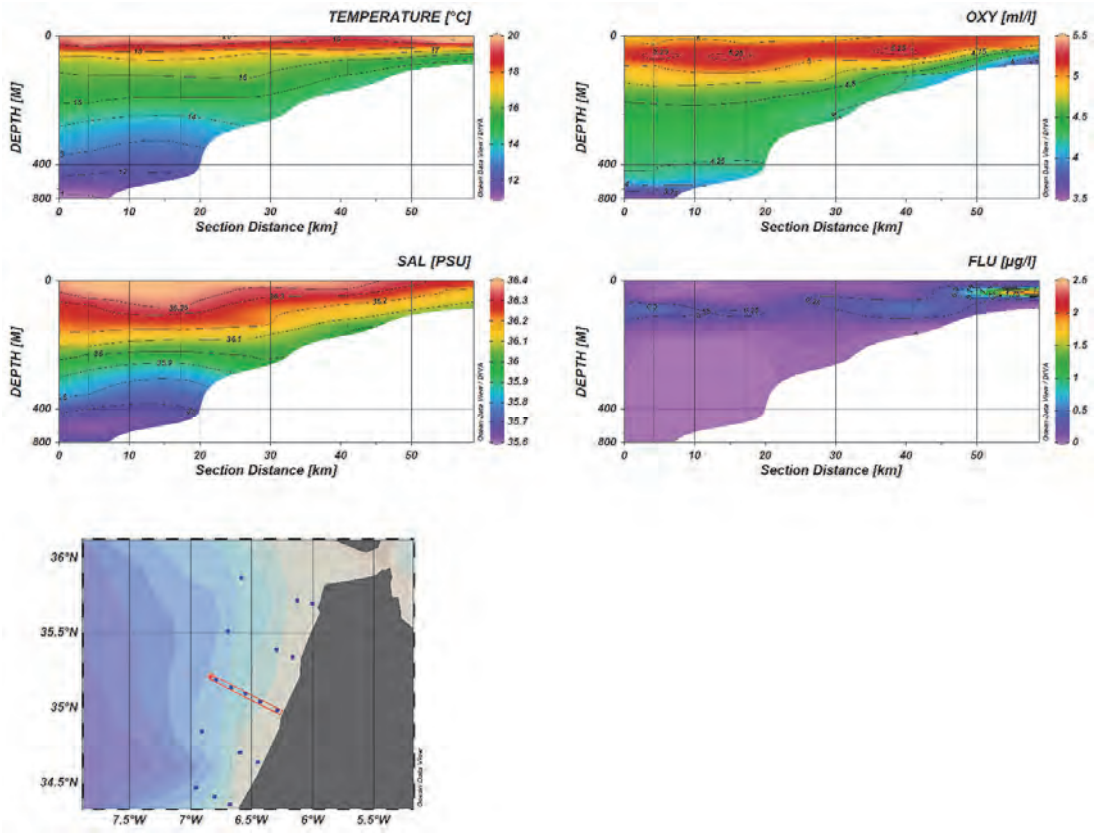


Figure 3.1 Hydrographic section at 35 °N

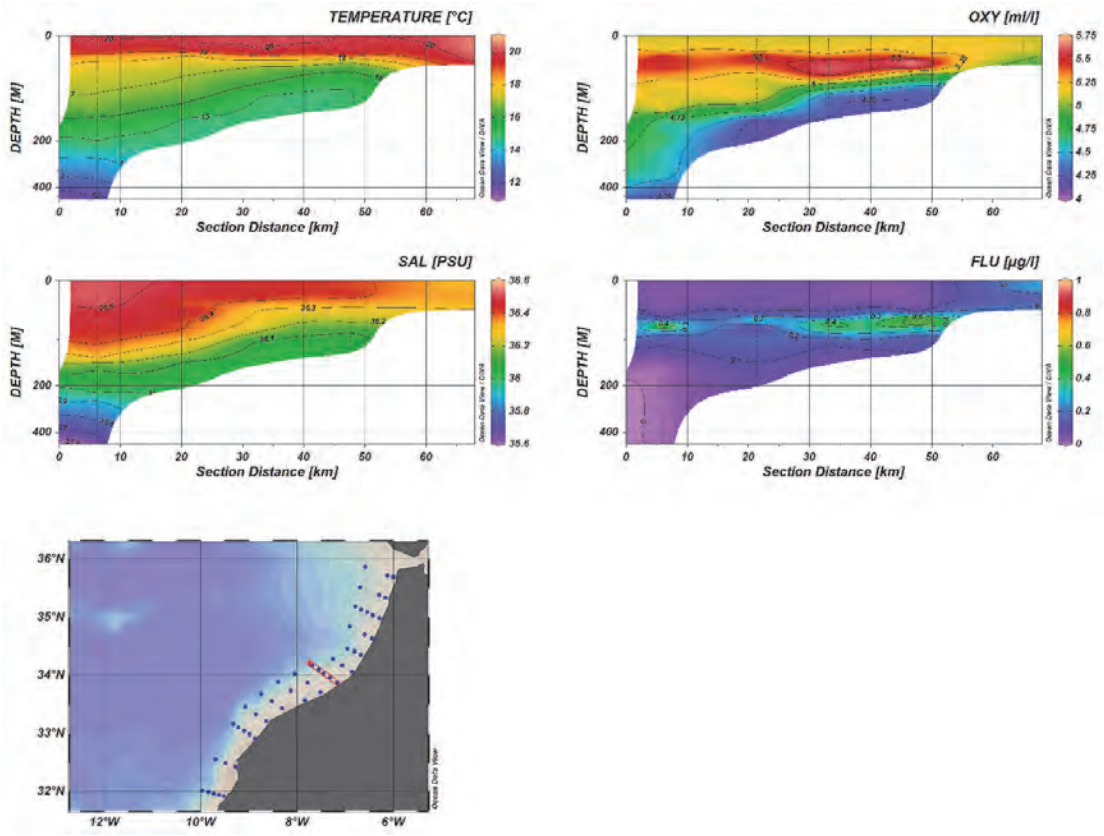


Figure 3.2 Hydrographic section at 34 °N

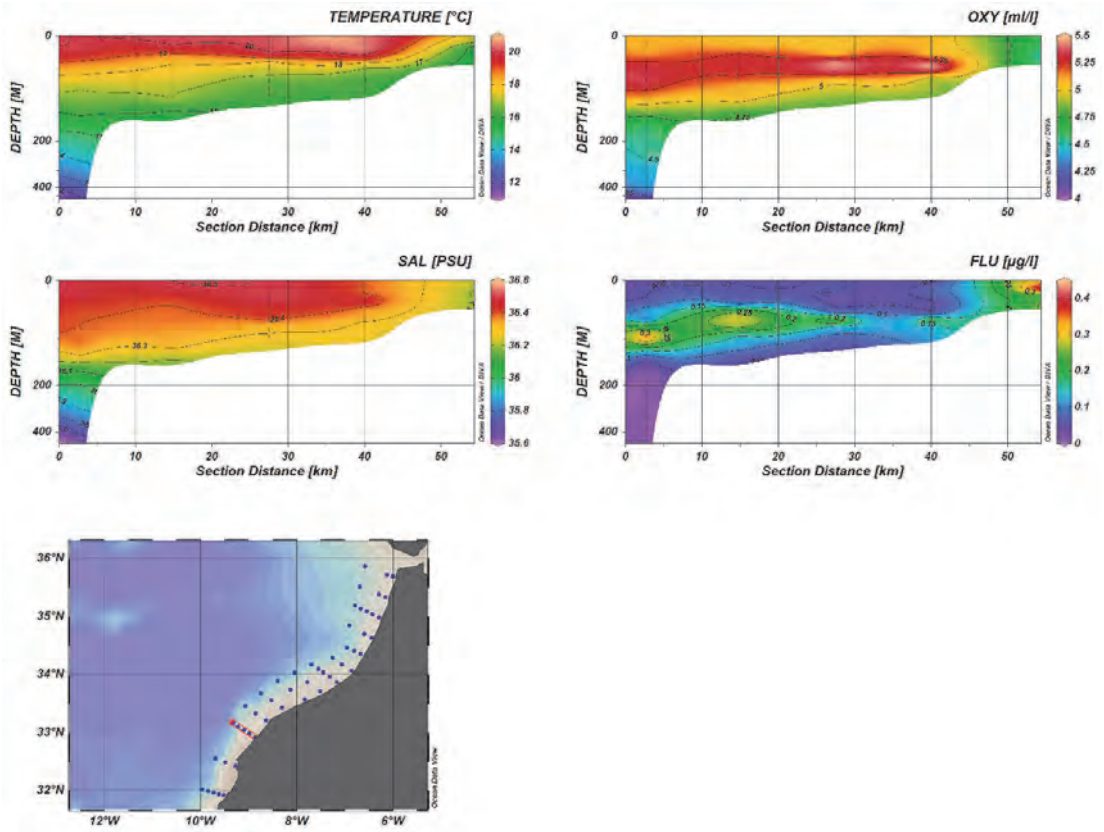


Figure 3.3 Hydrographic section at 33 °N

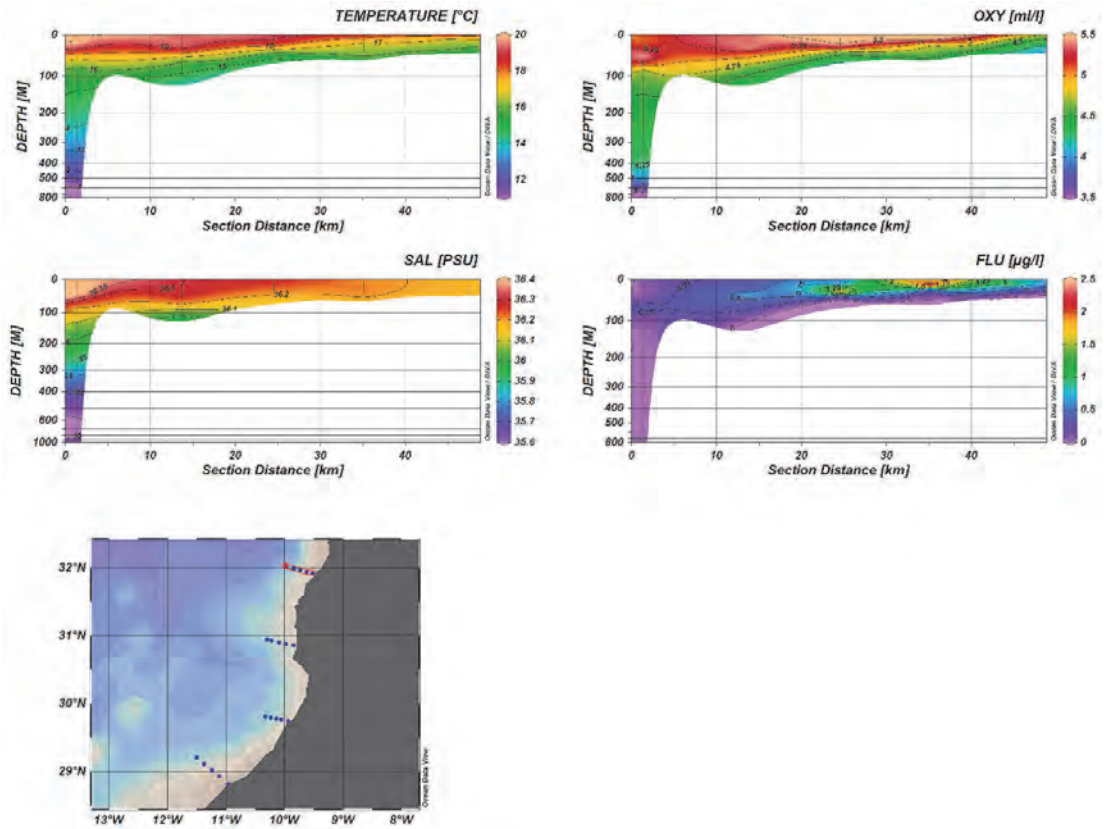


Figure 3.4 Hydrographic section at 32 °N

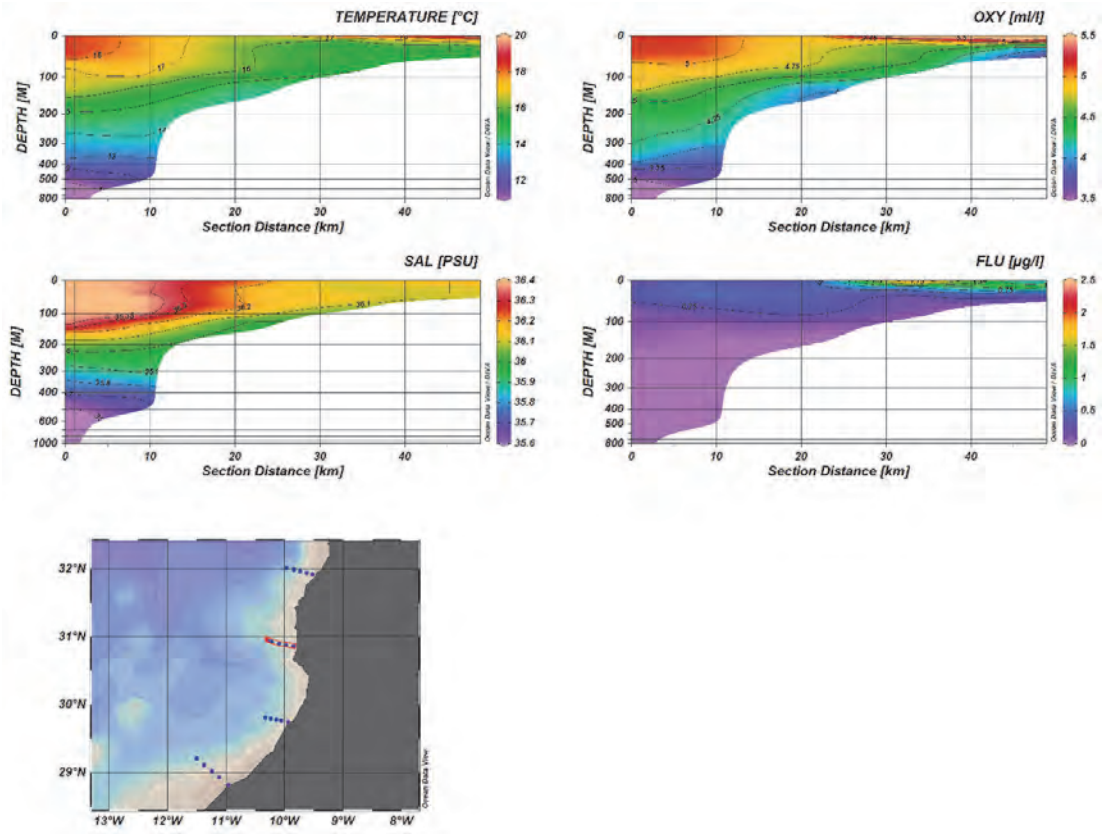


Figure 3.5 Hydrographic section at 31 °N

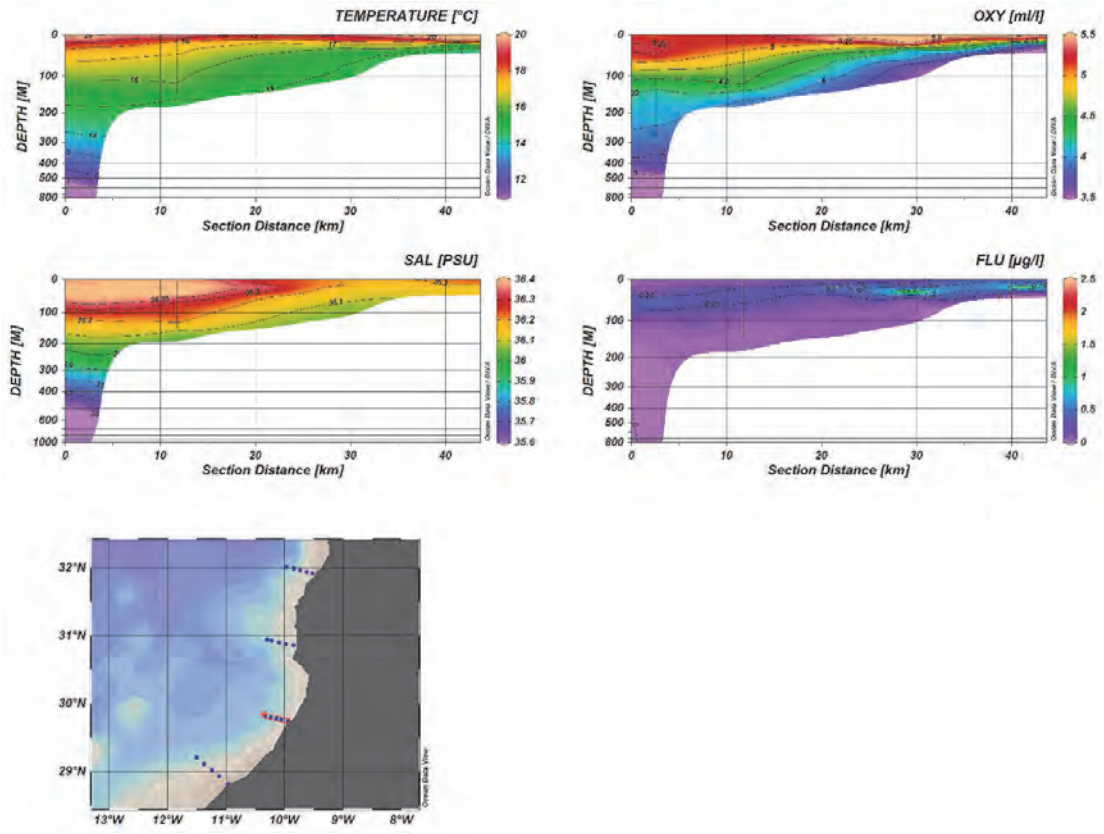


Figure 3.6 Hydrographic section at 30 °N

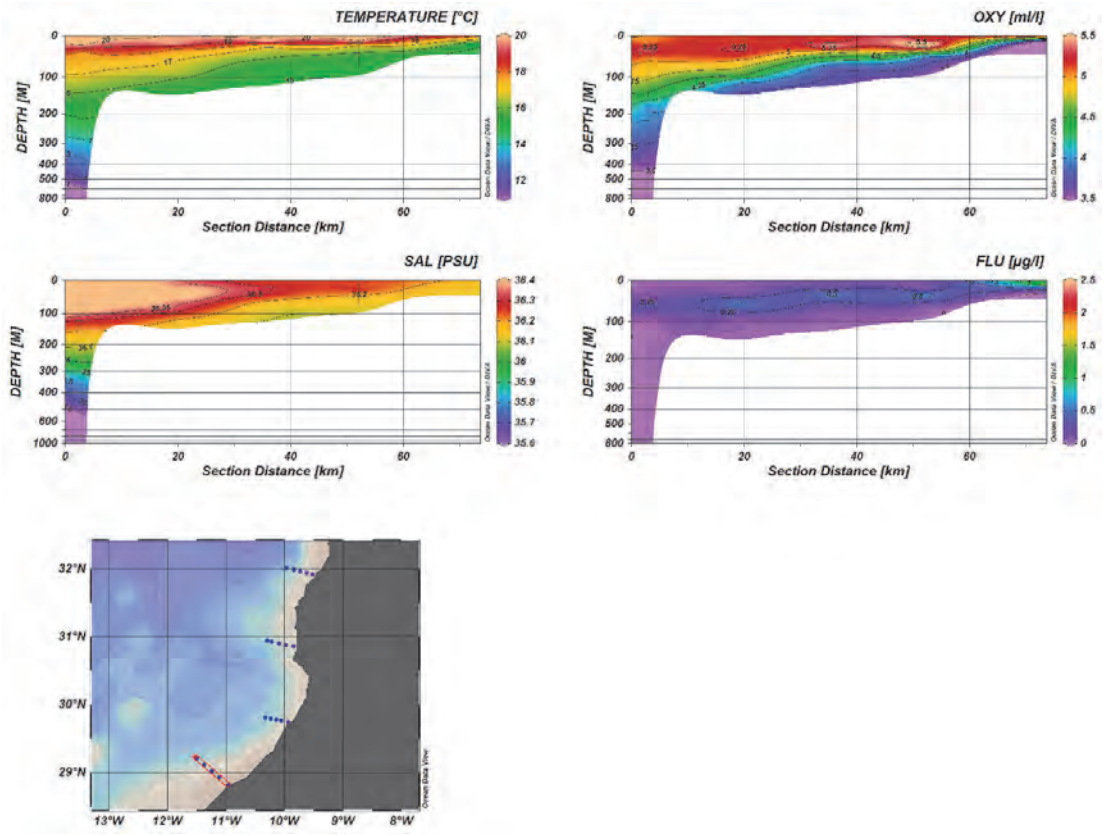


Figure 3.7 Hydrographic section at 29 °N

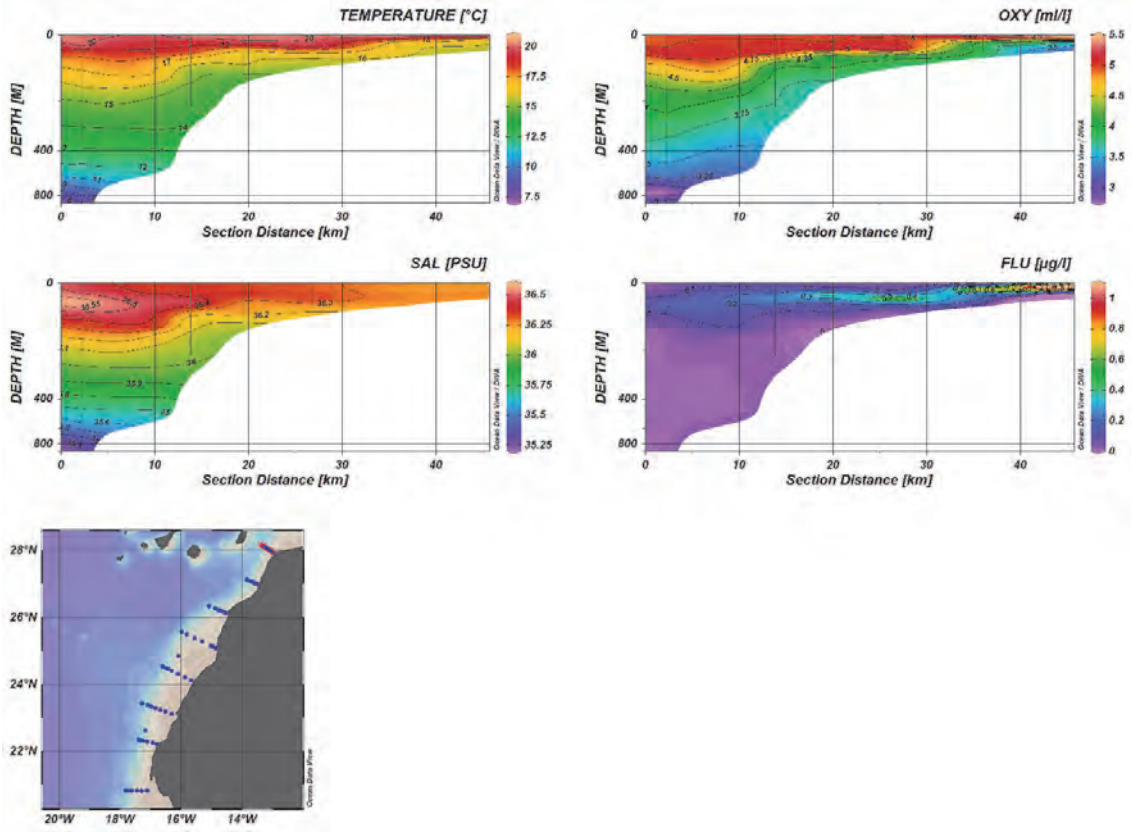


Figure 3.8 Hydrographic section at 28 °N

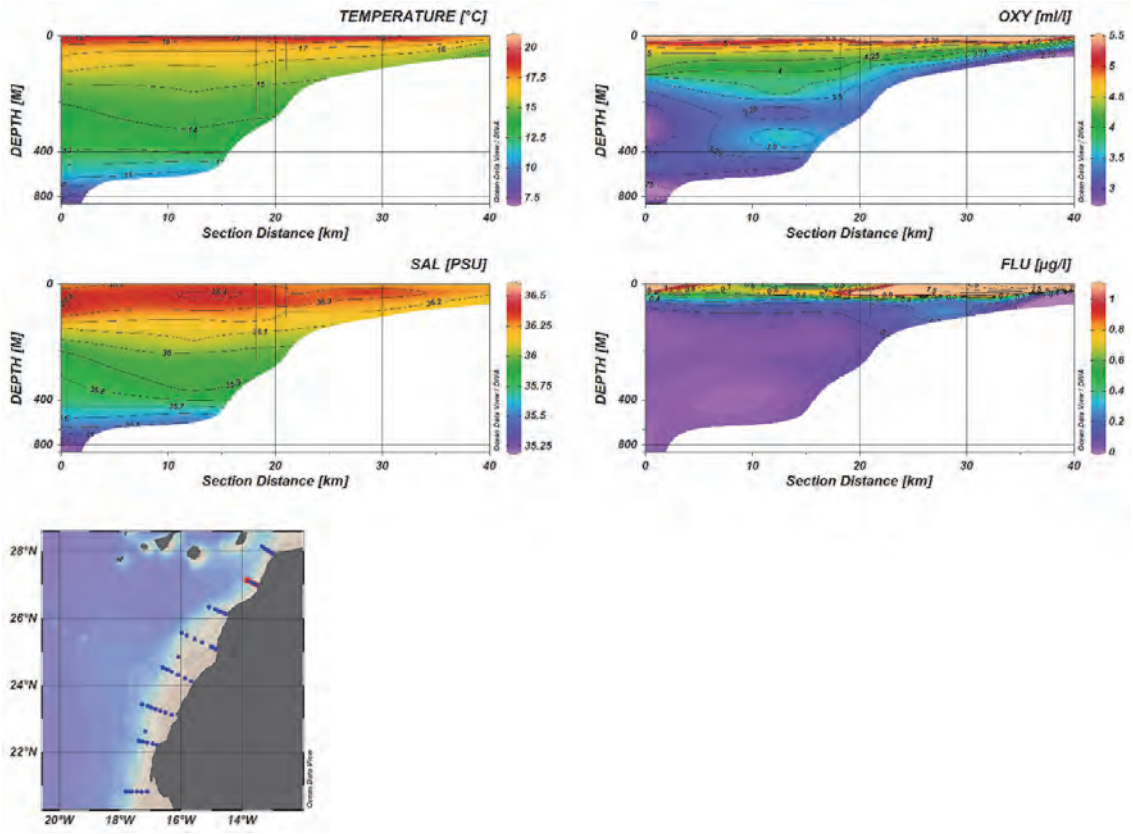


Figure 3.9 Hydrographic section at 27 °N

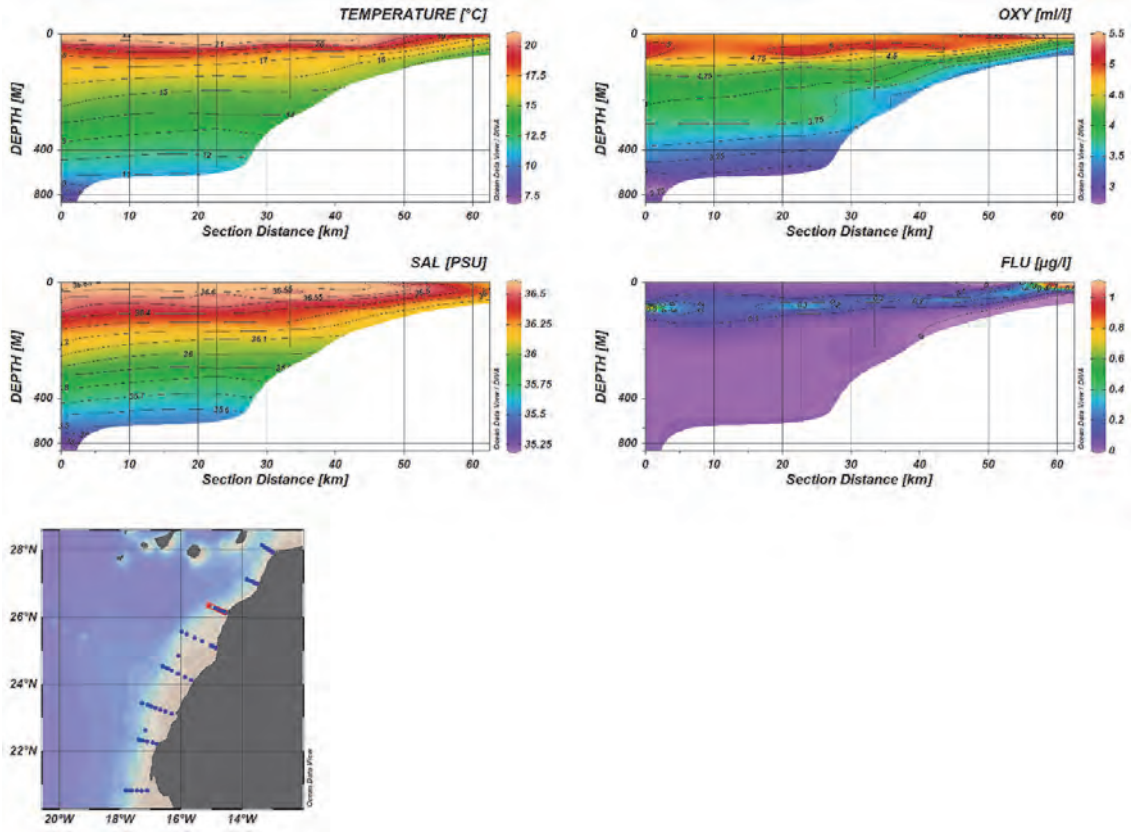


Figure 3.10 Hydrographic section at 26 °N

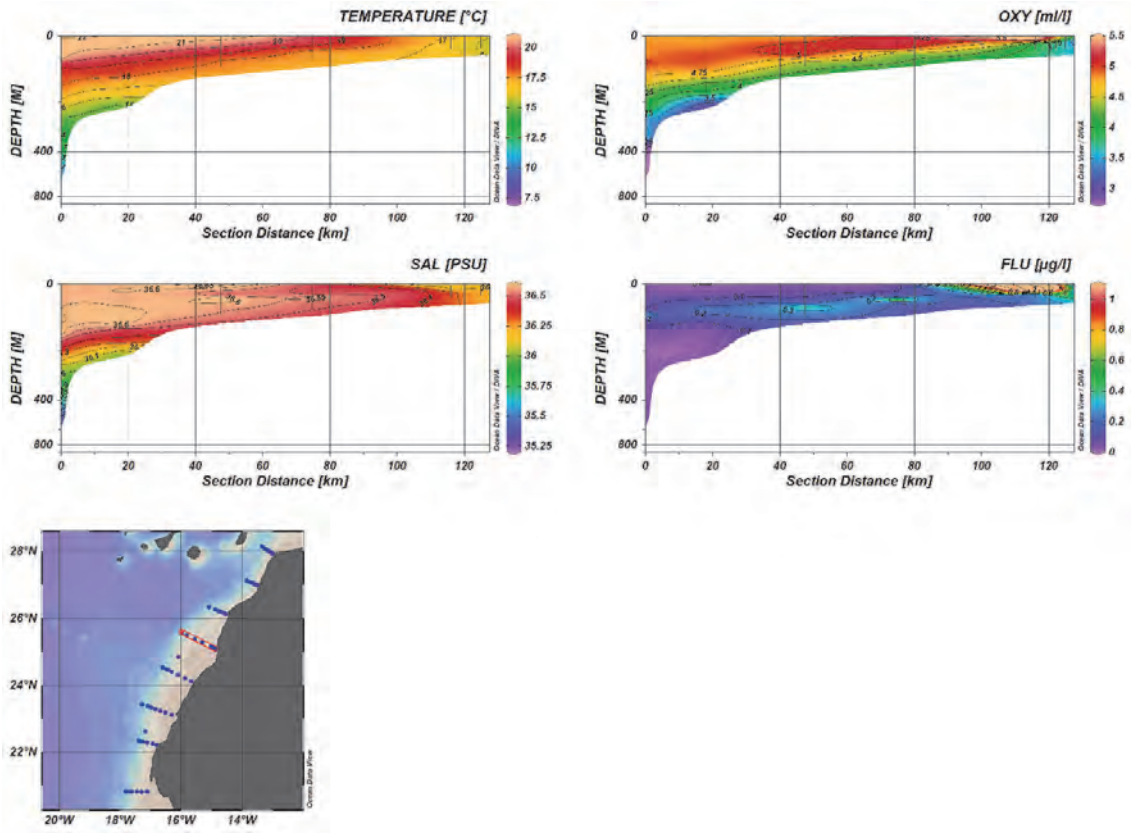


Figure 3.11 Hydrographic section at 25°N

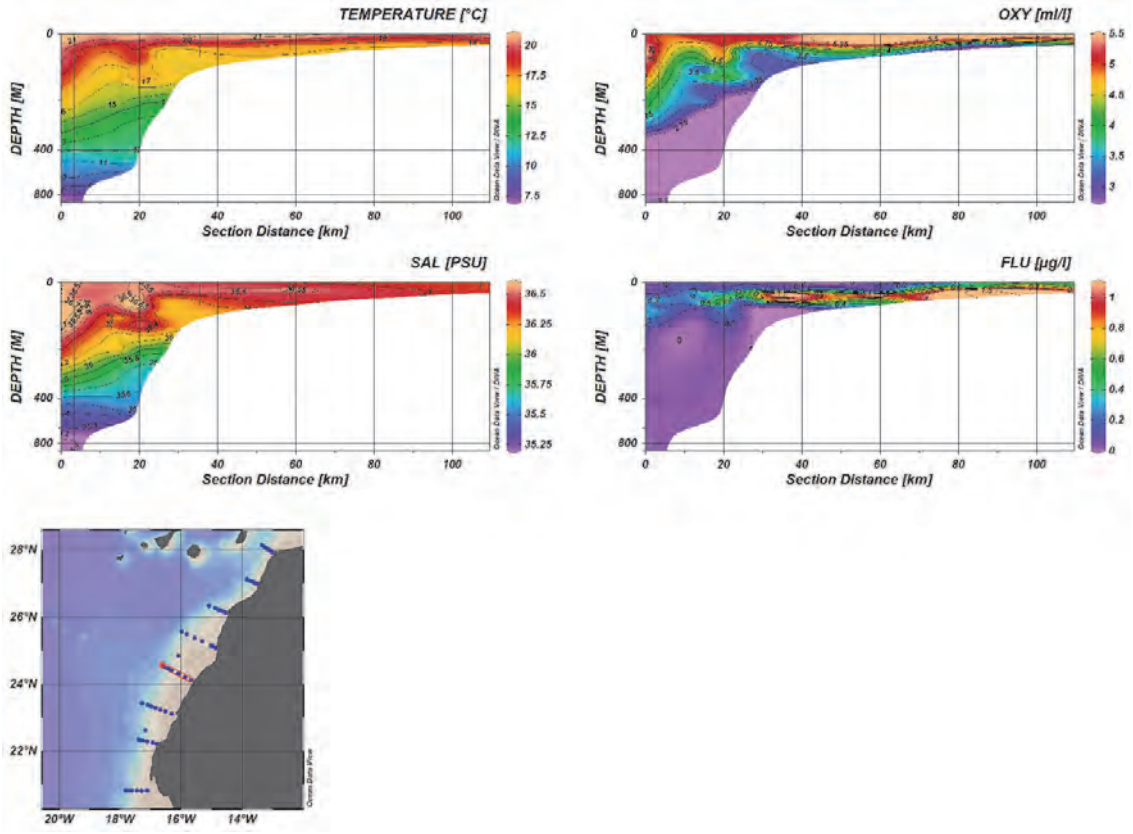


Figure 3.12 Hydrographic section at 24 °N

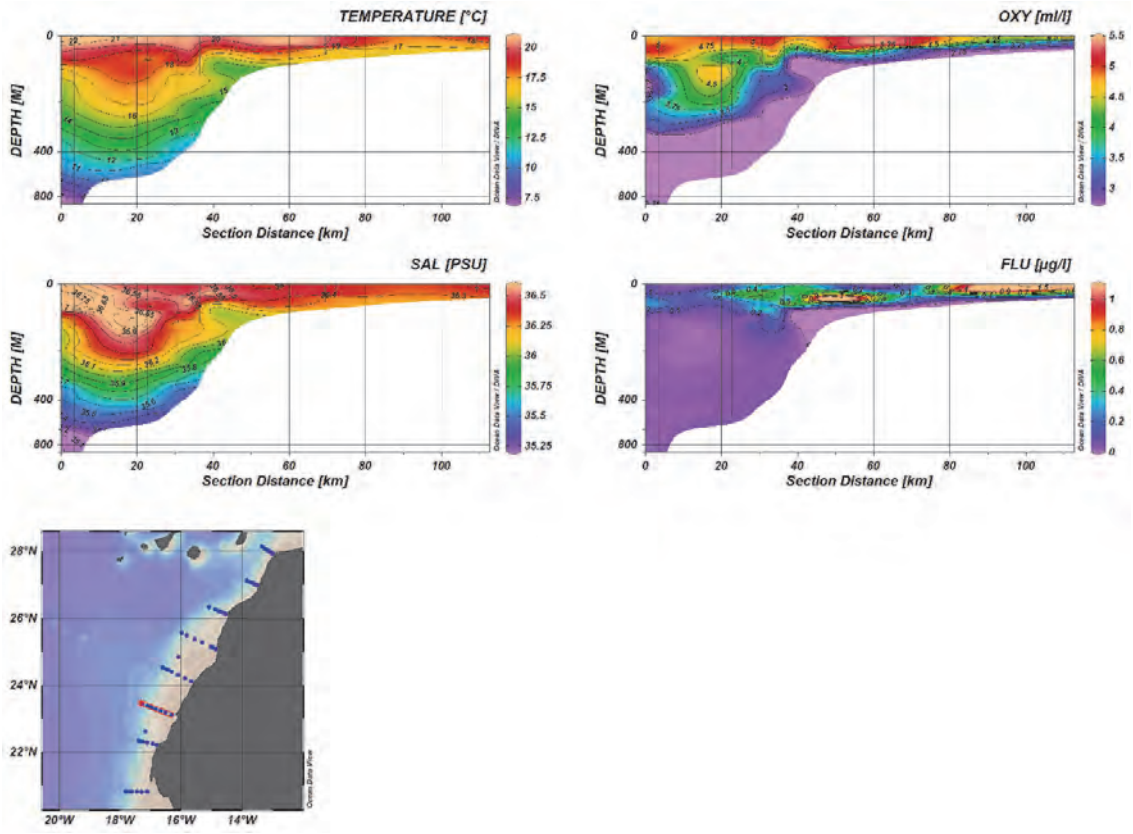


Figure 3.13 Hydrographic section at 23 °N

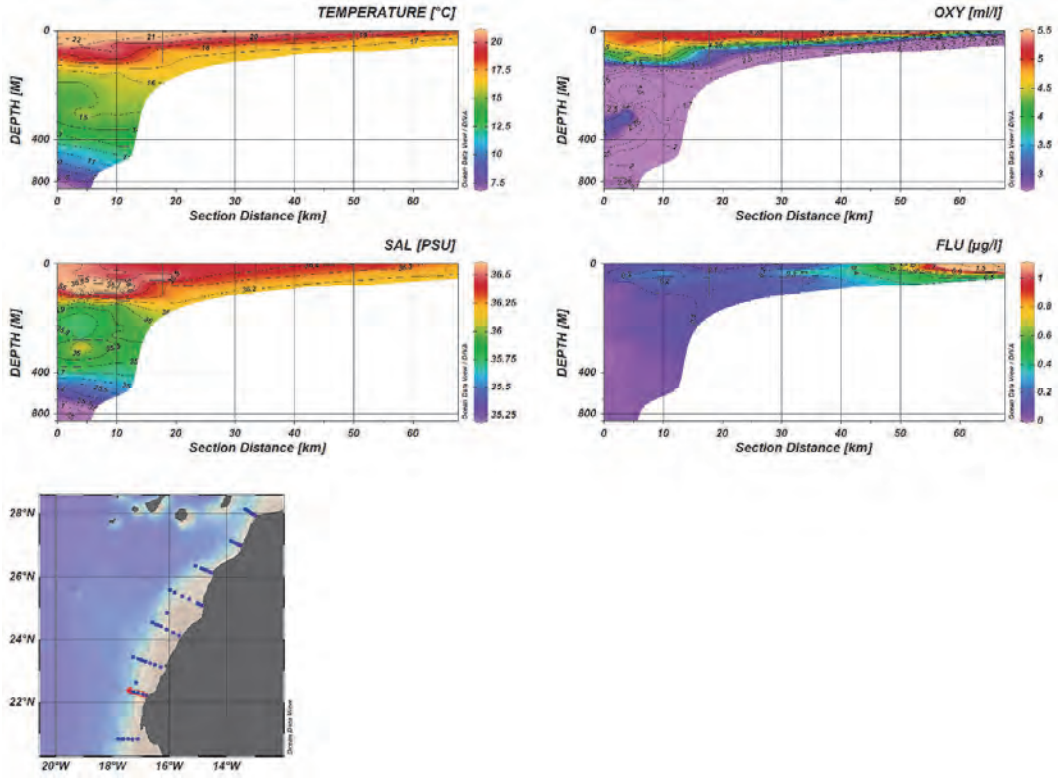


Figure 3.14 Hydrographic section at 22 °N

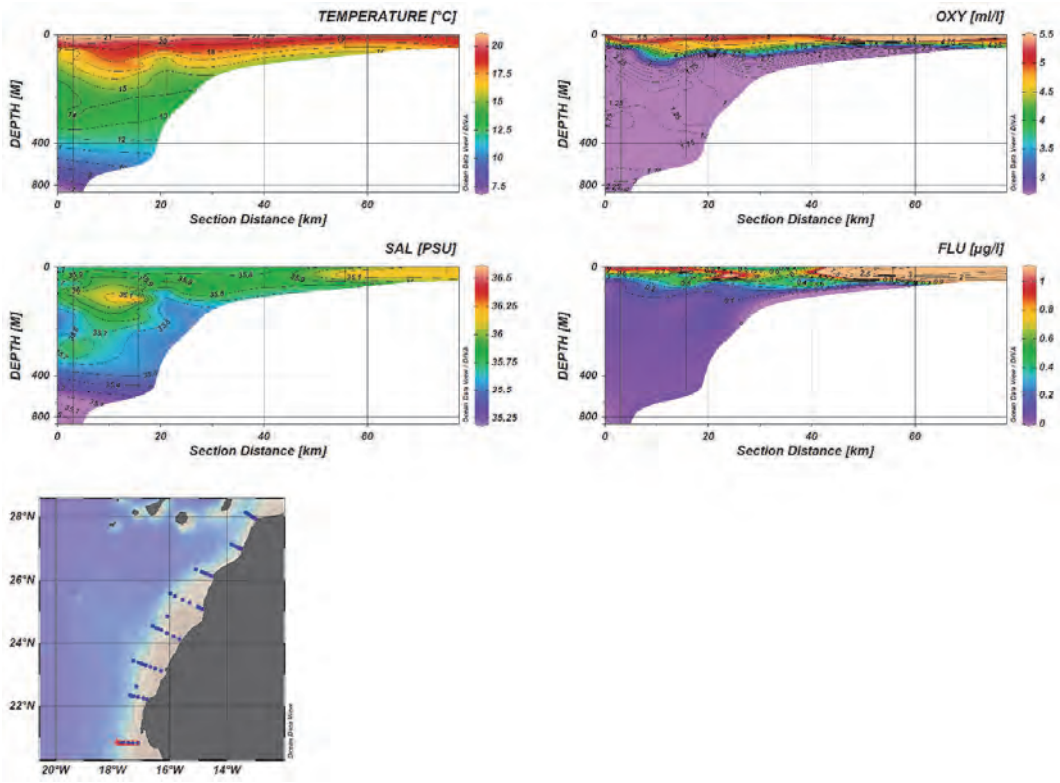


Figure 3.15 Hydrographic section at 21 °N

Figure 3.1 to 3.15. Hydrographic cross shelf sections from 36 °N to 21 °N, with distribution of temperature, salinity, oxygen and fluorescence. Note that transects between 36 °N and 29 °N are presented with higher resoltution in figures 3.1 to 3.7. Different colour scales have been used in the figures to ensure that structure of water masses could easily be detected.

Sea surface distribution of temperature

The horizontal distribution of sea surface temperature (SST) recorded from the thermosalinograph at 4 m depth throughout the survey is depicted in Figure 3.16 - 3.19.

Surface temperatures are quite homogenous across the shelf between 33 and 36 °N (Figure 3.16), slightly cooler in the north (18-20 °C) increasing to 19-21 °C further south. Around Cap Cantin lower temperatures are observed (16-18 °C) (Figure 3.17), indicating upwelling of cooler water on the shelf. South of this upwelling region , on the shelf between 26 and 30 °N, relativly small cross shelf gradients are observed, and the temperatures are in the range of 19-21 °C (Figures 3.17 and 3.18). Around 26 °N a sharp transition to a regime with high surface temperatures (21-23 °C) on the outer shelf and low temperatures (16-18 °C) on the inner shelf is observed. Further south (N 21°-24°, Figure 3.19) the lowest surface temperatures are in general observed on the inner shelf, but the difference in temperature between the inner and outer shelf is not as pronounced as for the above-mentioned area.

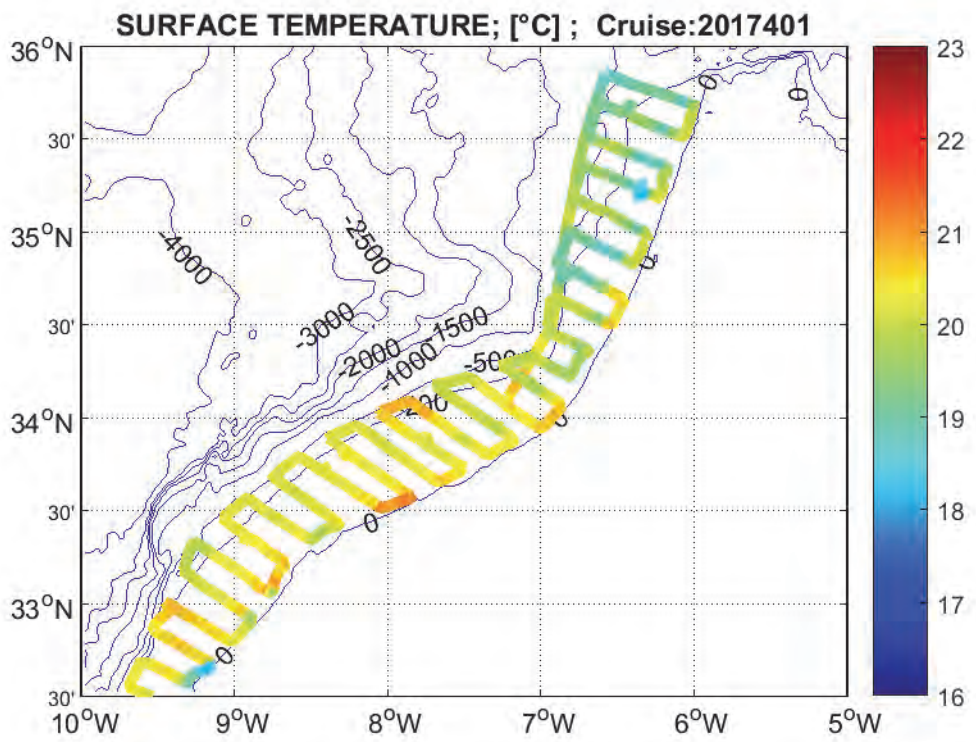


Figure 3.16 Sea surface temperature (at 4 m depth), Tanger to Cap Cantin.

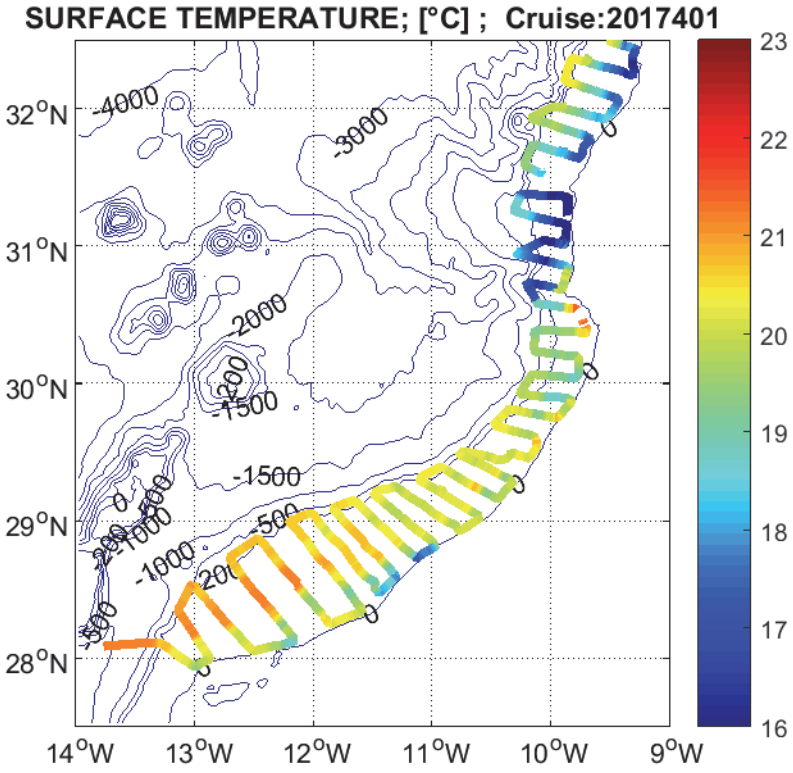


Figure 3.17 Sea surface temperature (at 4 m depth), Cap Juby to Cap Cantin.

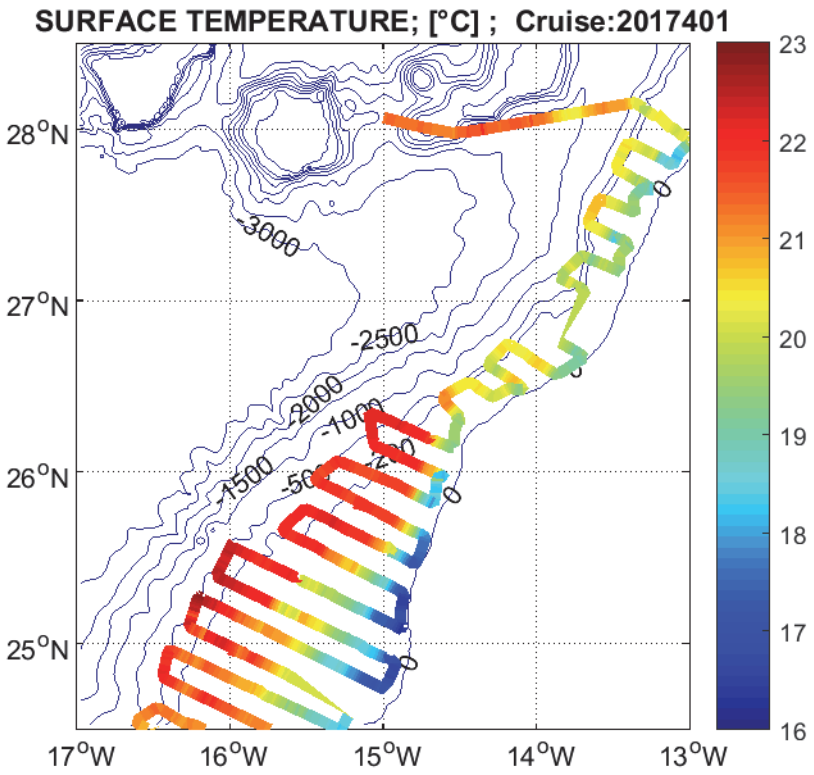


Figure 3.18 Sea surface temperature (at 4 m depth), (insert area references as above)

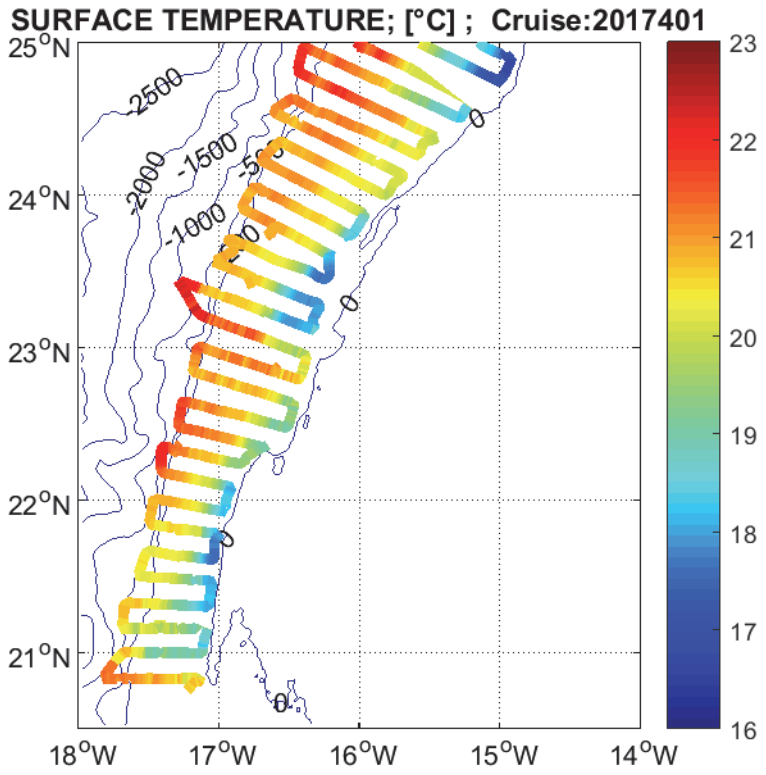


Figure 3.19 Sea surface temperature (at 4 m depth).

Currents (150kHz-ADCP)

The current measurements with the 150 kHz ADCP are shown for a layer (22-38 m) below the surface along the cruise track in Figures 3.20-3.23. Tides have not been removed. As expected the currents are varying in strength and direction along the shelf. However, in general the flow is toward the south west along the shelf. In some regions this flow is covering the whole width of the shelf and reaches 0.5 m/s, i.e. between 33 °30 'N and 32 ° 30 'N. As one moves south of this area, the flow is in general more variable however it is stronger on the outer shelf. Between 30 °N and 26 °N the currents are rather weak and variable, whereas between 26 °N and 25 °N the flow is toward the south west.

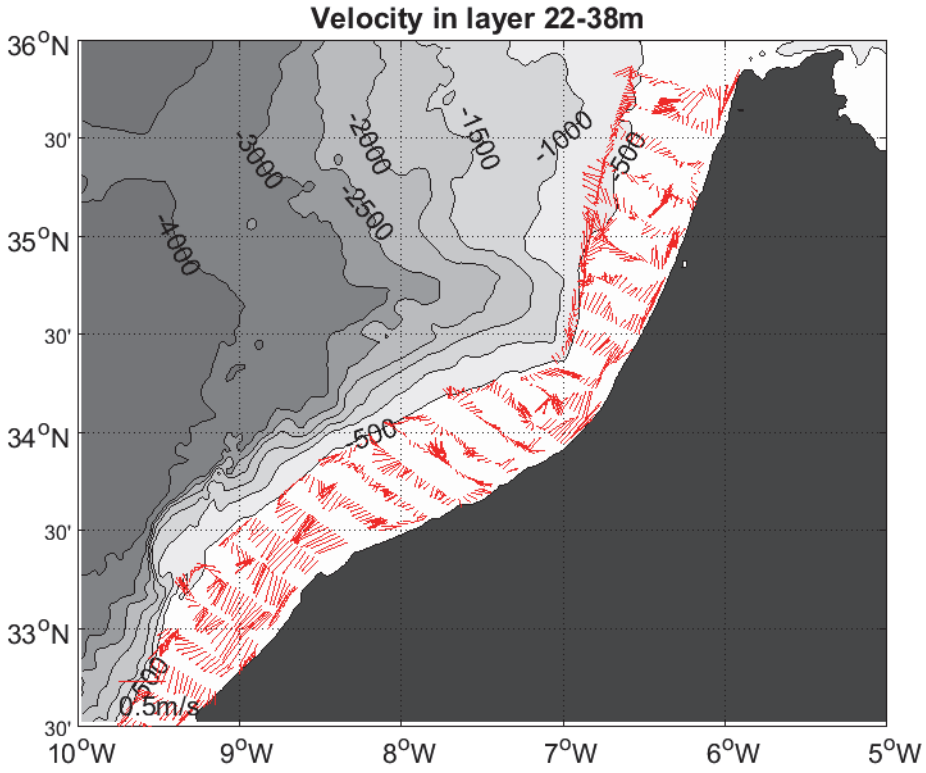


Figure 3.20 Velocity in layer 22-38 m depth, Tanger to Cap Cantin.

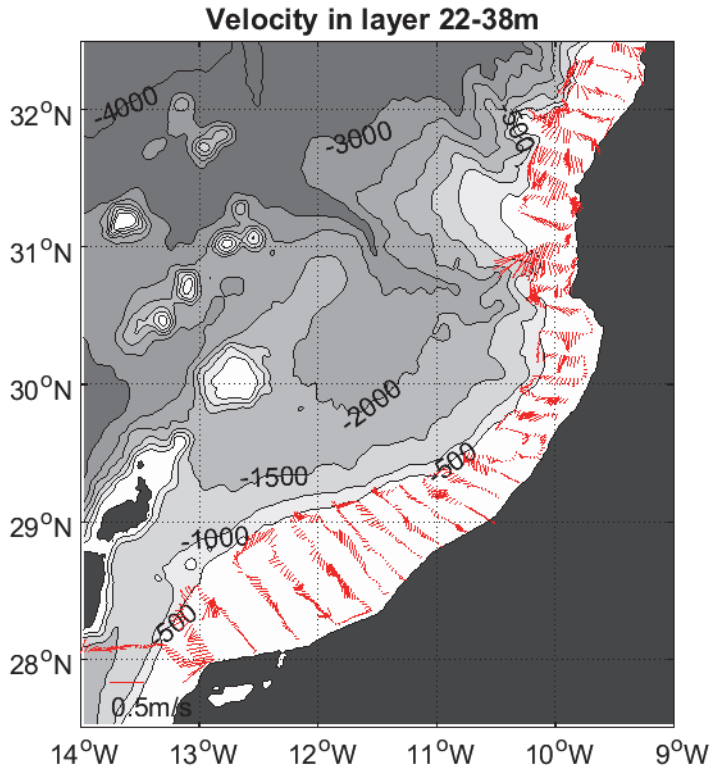


Figure 3.21 Velocity in layer 22-38 m depth, Cap Juby to Cap Cantin

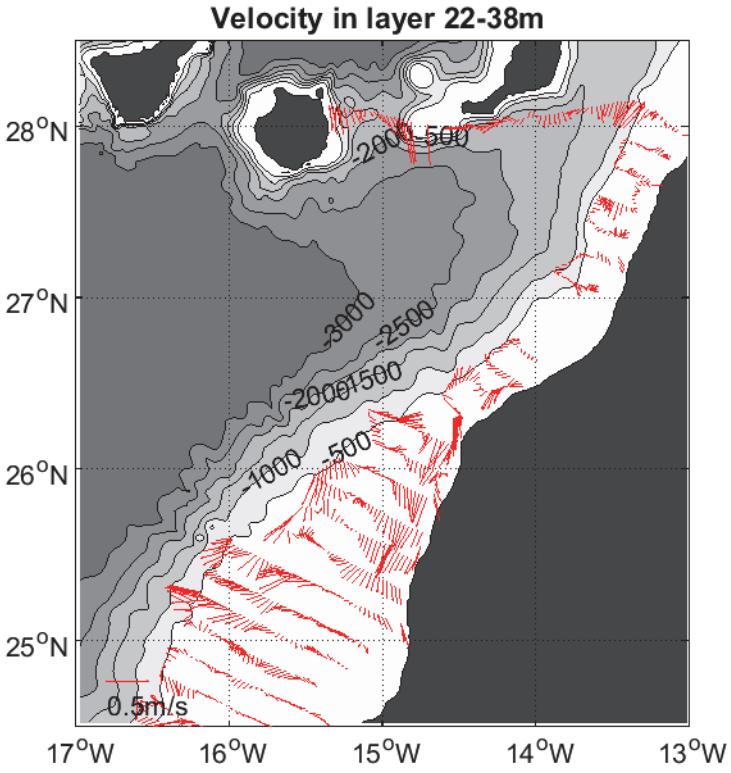


Figure 3.22 Velocity in layer 22-38 m depth

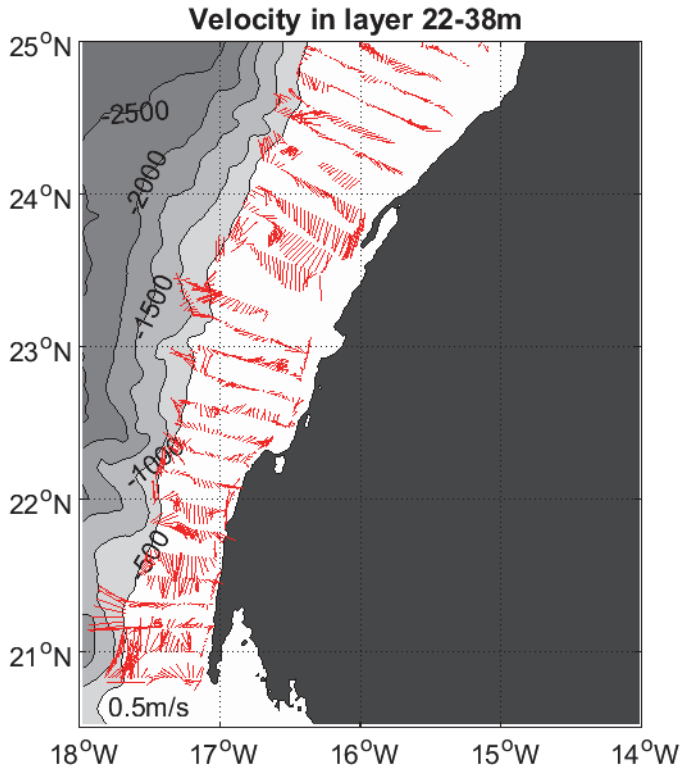


Figure 3.23 Velocity in layer 22-38 m depth

The mixed layer depth (MLD)

Estimates of the ocean mixed layer depth (MLD) is important to a wide variety of oceanic investigations, because it defines the ocean surface that directly interacts with the atmosphere (Thomson et Fine 2003). The seasonal variability of the MLD is directly related to many processes that cause ocean mixing (winds, surface forcing, the Ekman force, internal waves, etc.) and varies greatly across the region (Kara, Rochford et Hurlburt 2003). From the cross shelf sections depicted in figures 3.1 to 3.15, the MLD can be observed as corresponding roughly to the depth of the thermocline.

In this survey, we used CTD data to estimate the MLD in the absence of direct measurements of turbulence. The most widely used method for finding the MLD is the threshold method, this method define the MLD as the depth at which the temperature or density change by a predefined arbitrary value relative to the surface.

$$| d(p) - d(p0)| \geq \Delta d$$

Where d is the potential density, p is the depth, $p0$ is the reference depth, and Δd is the density threshold. In this study, we used the optimal threshold value in the North Atlantic using the potential density of 0.125 $kg.m^{-3}$ (Monterey et S. Levitus 1997).

Surface distribution of the MLD and surface distribution of the depth of the sub-surface chlorophyll *a* maximum is shown in Figure 3.24. For all the transects carried out from Cap Juby to Cap Blanc (28 °N-21 °N) the MLD did not exceed 50 m depth, coinciding with the known upwelling activity during the summer season in this region. The MLD was shallow (10 m) in the most inner stations where the upwelling is strongest and deeper (50 m) further off the shelf. The depth of the MLD corresponds well with the depths of the sub surface chlorophyll *a* maximum. The water masses in the mixed layer (above the MLD) will be depleted for nutrients and the phytoplankton therefore grow just below the mixed layer in connection to the thermocline.

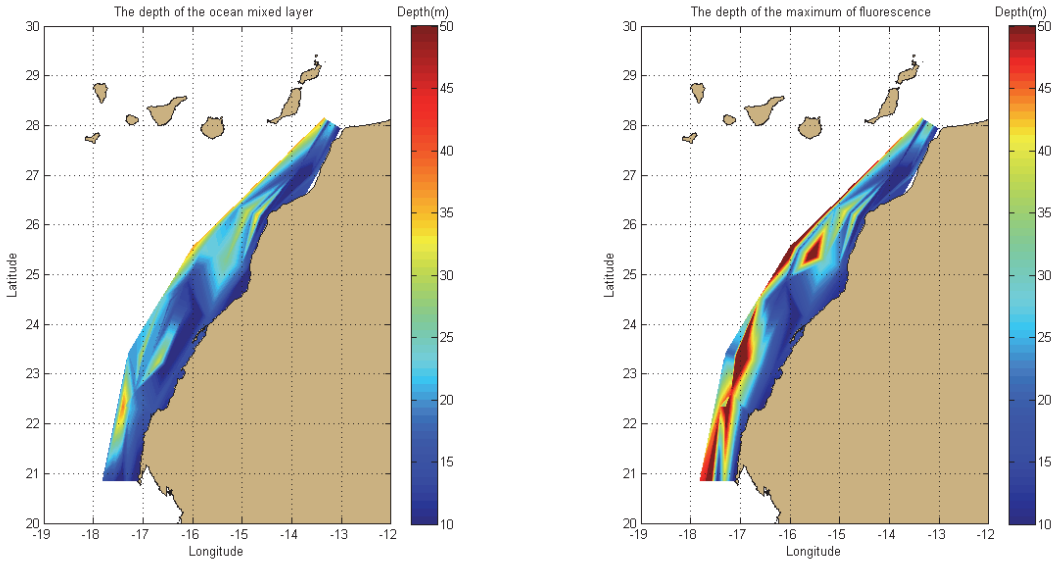
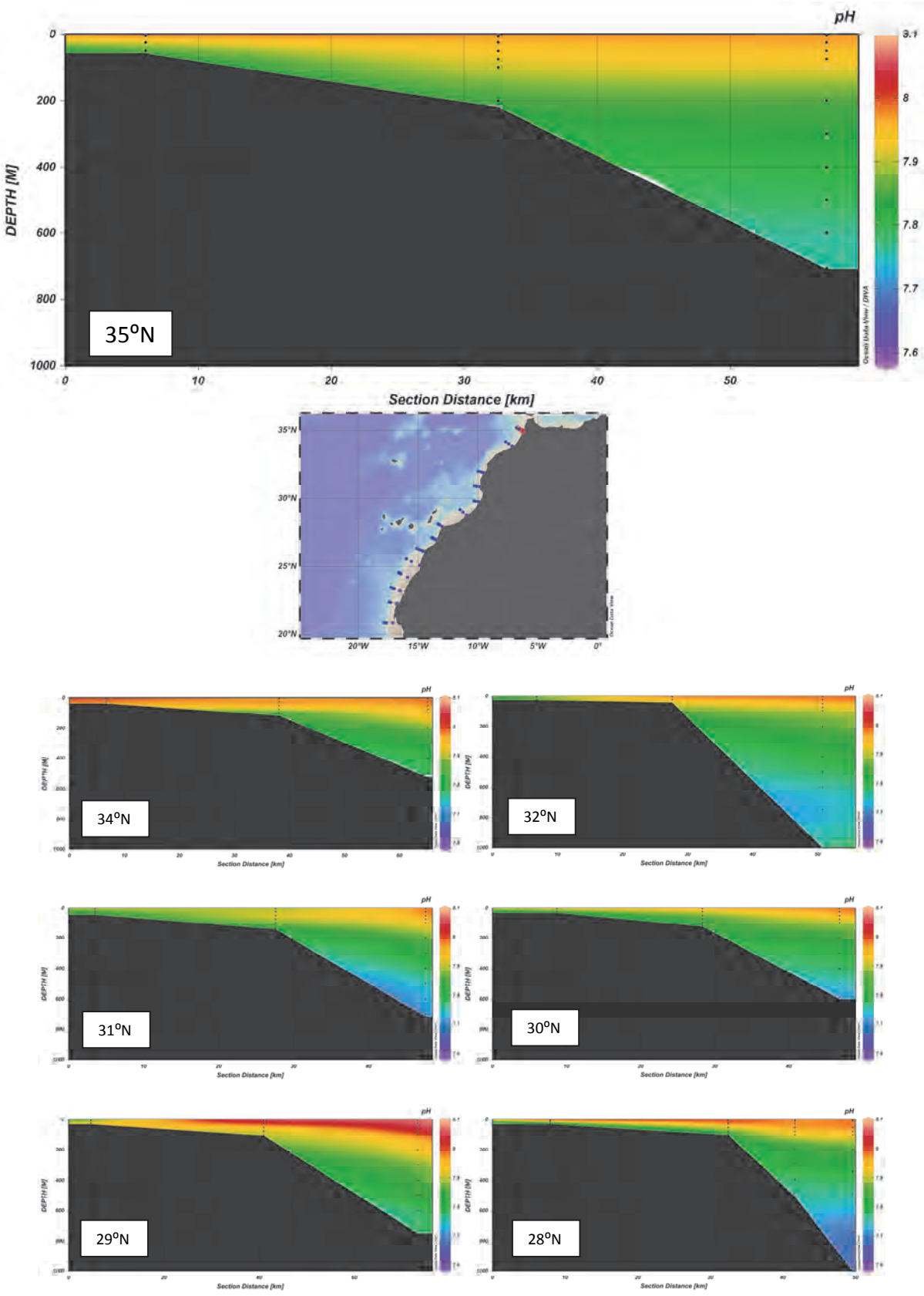


Figure 3.24 Surface distribution of the MLD (a) and surface distribution of the sub-surface chlorophyll *a* maximum depth (b).

pH cross shelf distribution

Cross shelf distribution of pH in the survey region is shown in figure 2.25. In general, the pH was highest in the surface and decreased gradually with depth. The shallow parts of the shelf were dominated by pH values between 7.81 and 8.02 from the north and down to 23 °N. Further south (21 °N and 22 °N) water masses with lower pH (7.7) moved into the bottom of the shelf areas. At Cap Blanc (21 °N) water masses with low pH (<7.7) were dominating the water column deeper than 50 m. At depths between 500 and 750 m water masses with very low pH (7.58) were present.


pH
DEPTH [M]
Section Distance [km]
35°N
34°N
32°N
31°N
30°N
29°N
28°N

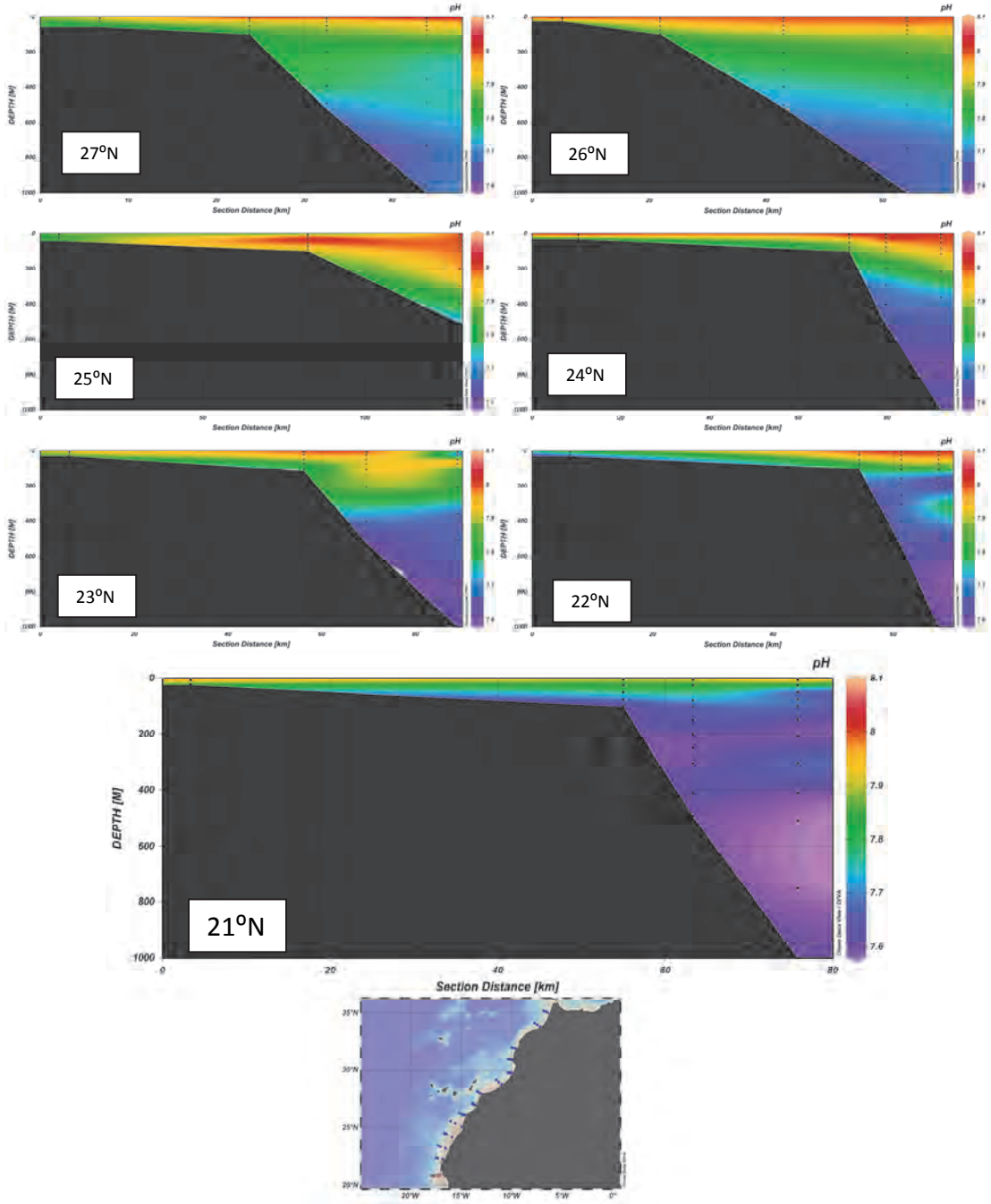


Figure 3.25. Cross shelf distribution of pH from Cap Juby (28 °N) to Cap Blanc (21 °N).

Nutrients

No onboard analysis were conducted. These samples are to be analysed in the IMR laboratory in Norway. It should be noted that the quality of samples may have been affected during the transport from the ship to Norway. The resulting data will be distributed and further analysis agreed upon in the context of the scince plan once the samples have been analysed.

3.2 Plankton

Phytoplankton

No analyses are yet carried out. Material has been sent to the laboratory in INRH, Morocco for taxonomic analyses, to be arranged as regional collaborative work.

Chlorophyll *a*

This material is to be Norway and has not yet been analysed. Data will be distributed once these analyses are completed.

Zooplankton

Zooplankton biomass distributions for the whole study area from Tanger to Cap Blanc are given in Figures 3.26 and 3.27. When considering a subset of data representing the whole water column for stations with bottom depths of ~100m or less, and restricted to the uppermost 200m for stations with bottom-depths of ~ 500 m, the average zooplankton biomass was 3.1 g dry-weight m^{-2}. "Repeated samples" for the uppermost 30 m were here excluded. The standard deviation was 2.6 g dry-weight m^{-2}, and the number of observations was 49, with the biomasses ranging between 0.064 and 11.1 g m^{-2}. For comparison, when only considering the uppermost ~ 30 m (a few samples went somewhat deeper but to a maximum of 44 m) of the water column (Figure 3.27), regardless of bottom-depth, the average biomass for the whole study area was 2.2 dry-weight m^{-2} (standard deviation of 1.8 dry-weight m^{-2}, and 52 observations). These biomasses ranged between 0.064 and 7.5 g m^{-2}, and included both day and night samples.

Considering the overall pattern for the zooplankton biomass in the study area (Figures 3.26 and 3.27), there seemed to be higher biomasses in the southern than the northern part of the study area. This main difference is observed between the areas north versus south of about 28 °N. Note that a direct comparison of the biomasses along each transect in Figure 3.26, that ran perpendicular to the coast line, would not make much sense as the lower sampling depths and hence sampling volumes increased with increasing bottom depth. Thus the samples taken at different depths are not directly comparable.

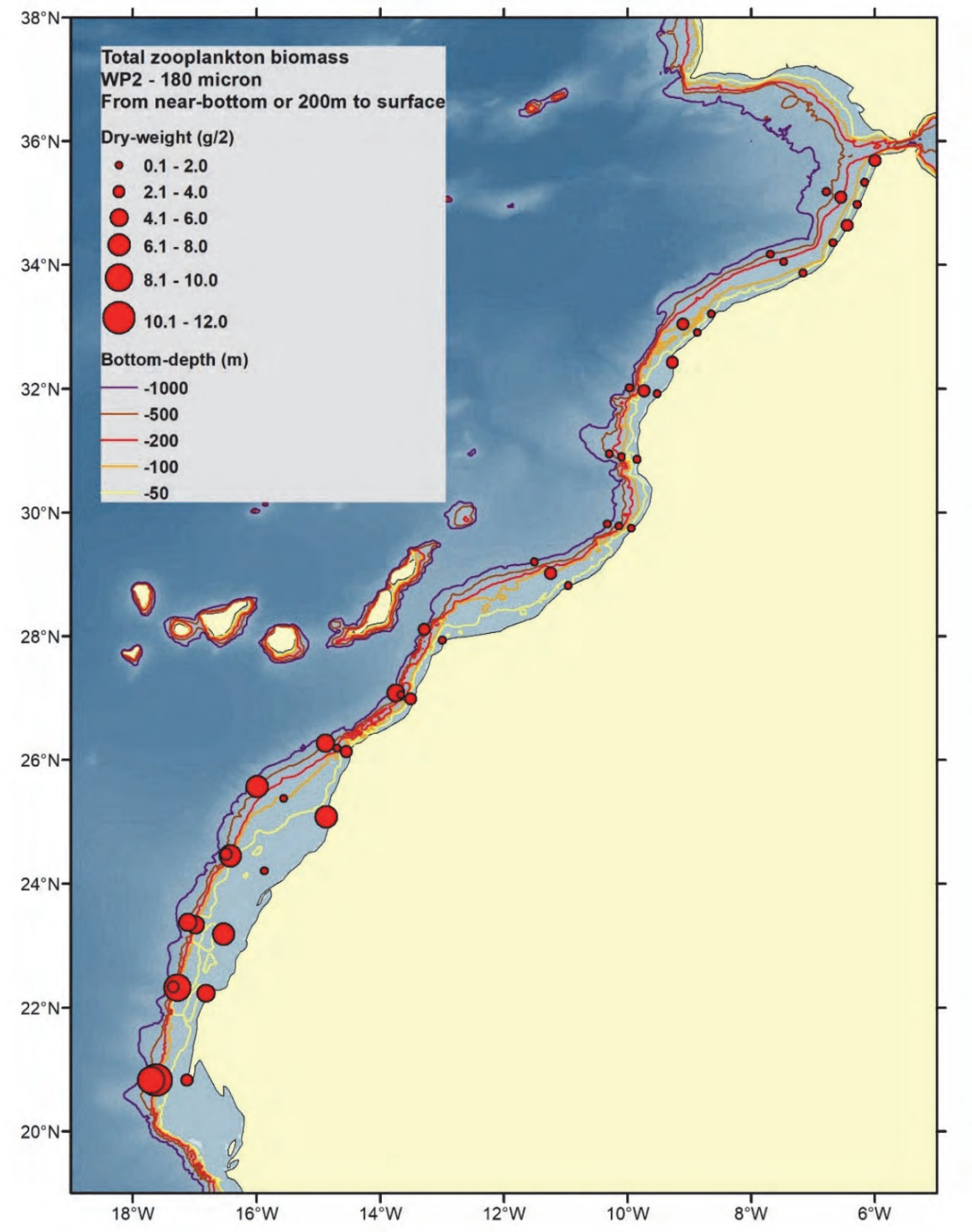


Figure 3.26. Total zooplankton biomasses for sampling strata of ~ 25-0 m at bottom depth of 30 m, ~ 90-0 m at bottom depth of 100 m, and ~ 200-0 m at bottom depth of 500 m (c.f. bottom depth contours in the figure). Hence, the samples here shown for different bottom depths are not directly inter-comparable but rather indicate the zooplankton biomasses from the bottom (or 200 m) to the surface. Also see comments in the text regarding a possible bias in some samples due to inclusion of phytoplankton.

Results for samples collected only from the uppermost ~ 30 m, regardless of bottom depth (Figure 3.27) are also presented. Figure 3.27 includes both day and night samples, and diel vertical migrations of the plankton are not accounted for, which might represent some bias when comparing the biomasses directly.

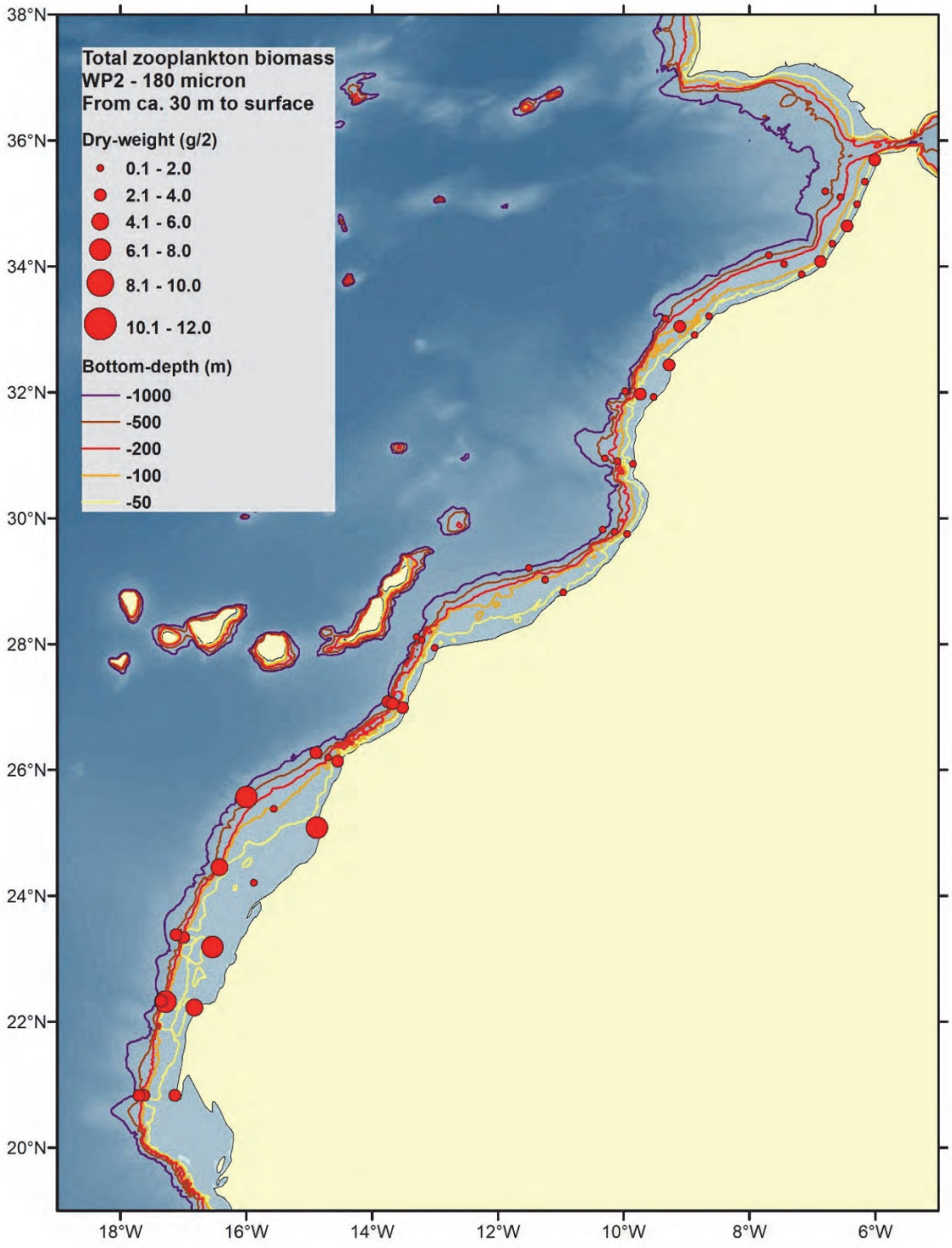


Figure 3.27. Total zooplankton biomasses for the uppermost ~ 30 m (a few depths were slightly greater – but maximally 44 m). Both day and night samples are included. Note that even if the maximum biomass measured in the upper layer was 7.5 g m^{-2}, the same scale as in Figure 3.26 was

used to ease comparability. Also see comments in the text regarding a possible bias in some samples due to inclusion of phytoplankton.

For the southern part of the study area, phytoplankton contents were noted in several samples collected at stations with bottom depths of 100 and 500 m, while for the stations closest to shore this was only observed just outside of Cap Blanc (Figure 3.28). Potential contents of phytoplankton in the zooplankton samples were not noted in the journal for the northern part of the study area - hence these stations are marked with “no information” in Figure 3.28. During the cruise it was not possible to eliminate the phytoplankton from the samples, due to the risk of losing zooplankton, which was typically tangled into the phytoplankton material. Still, several of the shallowest stations in the southern region, where no phytoplankton was noted in the samples, displayed markedly higher biomasses than what was observed for the northern region. This was also the case for a few samples collected at deeper stations.

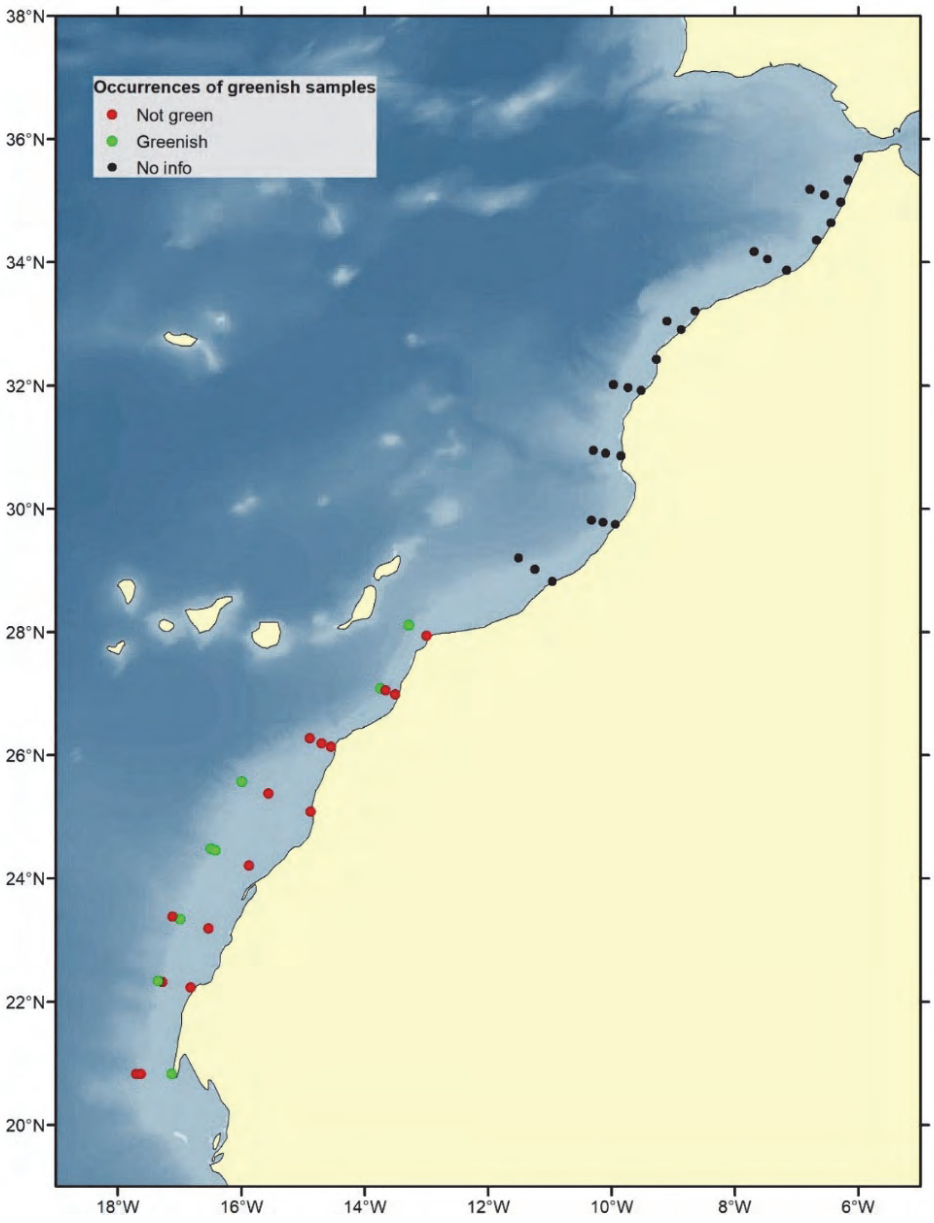


Figure 3.28. Indication of zooplankton biomass samples with notable green colour revealing contents of phytoplankton – which to some degree implies overestimation of zooplankton biomass. Figure based on the samples collected at depths from 200 m to the surface.

This suggests that, at least for the shallowest stations, the zooplankton biomasses were higher in the southern region. Regarding the samples from stations with bottom depths of 100 m and deeper, the relative contribution of phytoplankton to the estimated zooplankton biomasses is not clear. To evaluate the zooplankton abundances in the different areas in a proper way requires that the samples with formalin-preserved zooplankton are analysed.

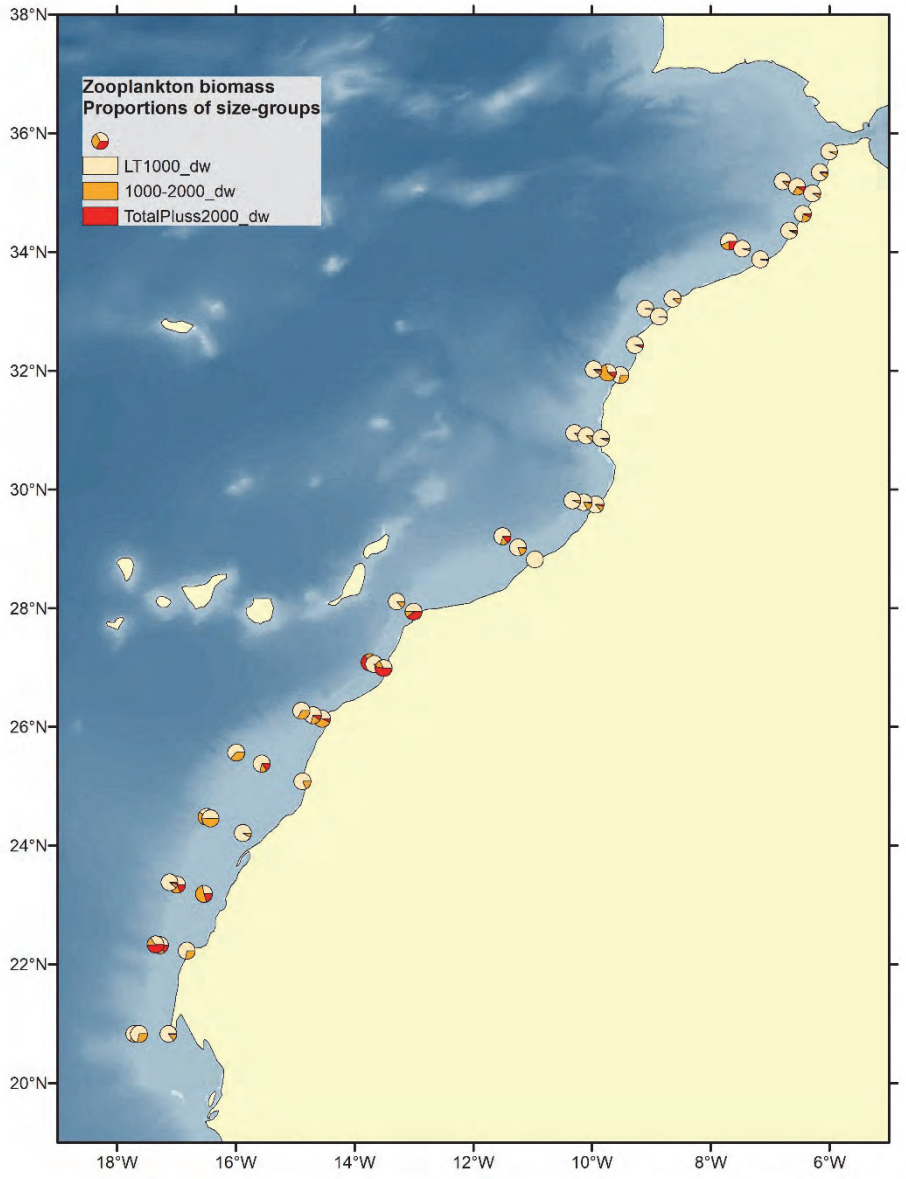


Figure 3.29. Weight proportions of three zooplankton size-groups (180-1000 µm in yellow, 1000-2000 µm in orange, and > 2000 µm in red). The results represent the sampling strata of ~ 25-0 m at bottom depth of 30 m, ~ 90-0 m at bottom depth of 100 m, and ~ 200-0 m at bottom depth of 500 m (see bottom contours in Figure 3.26). Tthe samples shown for different bottom depths for the same transect are not directly inter-comparable but rather indicate the zooplankton size composition in the water column above the bottom or depth of 200 m. Still, when considering only the uppermost 30 m – the patterns (not presented) did not change compared to those shown in the figure.

With few exceptions, the weight proportions of the sampled zooplankton were dominated by the smallest size fraction (180-1000 µm) (Figure 3.29). This seemed to be more pronounced in the northern part of the study area.

Ichthyoplankton

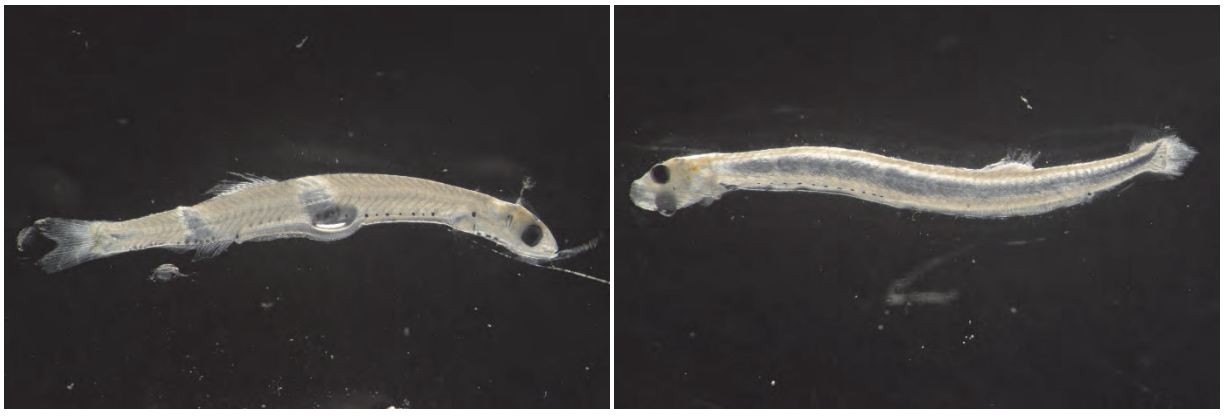
Fish larvae visible with the naked eye were sorted from the samples and preserved separately during the first part of the cruise north of Cap Juby. These samples need further processing before results can be presented. Below, we give preliminary results regarding fish larvae for the last part of the cruise, covering the area between Cap Juby and Cap Blanc, since these sample were checked directly under a stereomicroscope.

Fish eggs and larvae were collected along a total of 8 transects, comprising 24 stations, during the last part of the cruise. After sorting all the larvae from the samples, the numbers of larvae at the shallow versus the deeper stations were evaluated. Preliminary results suggest that more larvae occurred at the shallowest stations. At this stage, however, effects of sampling volumes and lower sampling depth have not yet been analysed.

In the northern part of the study area, we found anchovy larvae (*Engraulis encrasicolus*), in addition to sardine larvae (*Sardina pilchardus*). Moving southwards, larvae of flat fish species appeared. Bothidae and Soleidae larvae were identified (Figure 3.30). These larvae were found at stations located between Dakhla and Cap Blanc. At some stations, no fish larvae were found.

Large copepods and chaetognaths were common in most samples.

Fish eggs have been observed in many samples while sorting the fish larvae, but these will be sorted and identified in the laboratory on shore after the cruise. Furthermore, the fish larvae will be studied in more detail after the cruise.



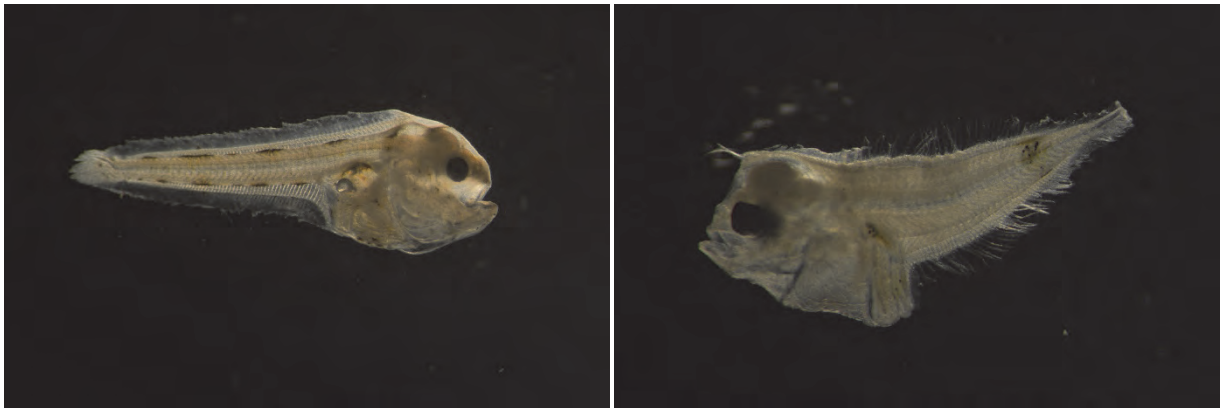


Figure 3.30. Selected photographs of fish larvae collected during the cruise. Upper-left: anchovy larvae (*Engraulis encrasicolus*); upper-right: sardine larvae (*Sardina pilchardus*); lower-left: Soleidae larvae; lower-right: Bothidae larvae.

Microplastics

The results from the first part of the cruise (Leg 1.1) are not yet fully processed and data will be analysed as part of the Science Plan Theme 6.

During the last part of the survey (Leg 1.3), a total of 20 stations were sampled: 4 of the 24 stations were not sampled for microplastics due to strong wind. Each sample represents the catch of the Manta trawl towed in the surface layer for 15 minutes at ~1.5 m/s (see Materials for specifications of the Manta trawl). The sorted microplastics were described according to the protocol: colour, shape, measurements, etc. (not presented in the cruise report). A large variability in the numbers and types of microplastics was observed. As an example, a photography of some microplastics collected is shown in Figure 3.31.

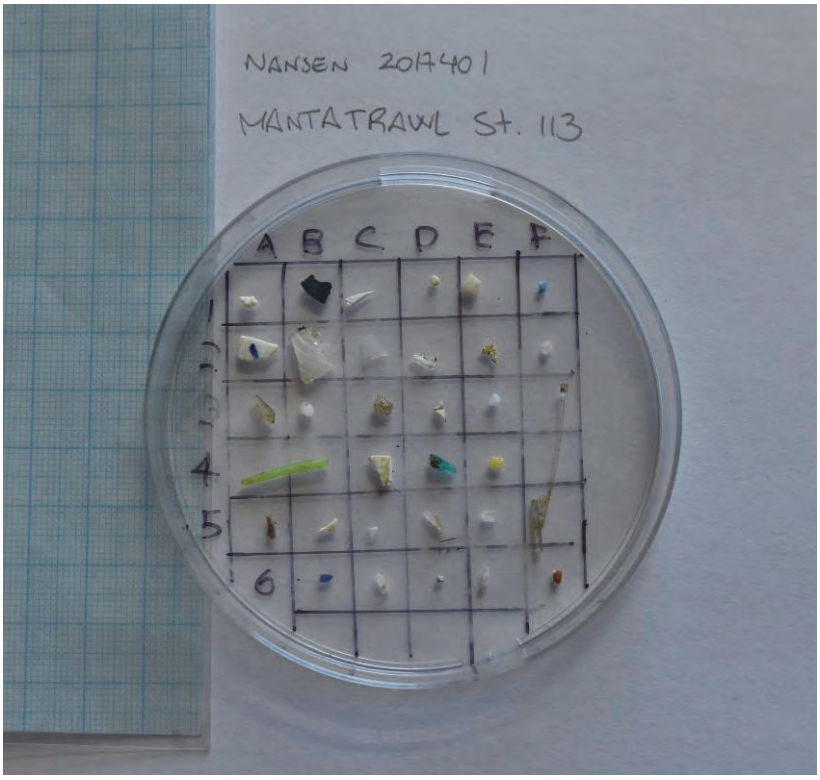


Figure 3.31. Example of some microplastics found in sample PL113.

Preliminary results from the coastal area between Cap Juby and Cap Blanc are presented in Table 2. Apart from one sample containing very high numbers of microplastics (station 113 – plastics not yet counted, nor described), a total of 217 objects were collected from the rest of the stations. These preliminary results can be summarized as:

- 2 samples showed no microplastics (10%)
- 10 samples contained 1 to 10 microplastics
- 5 samples held between 10 and 25 microplastics
- 1 sample had 25 to 50 microplastics
- 1 sample contained 50 to 100 microplastics
- 1 sample displayed >100 microplastics

The distribution of microplastics on shallow, intermediate and deep stations, as well as size and type distributions will be evaluated after the cruise.

Whether the abundances of microplastics found during this survey indicate low or high levels of pollution in this area, will require further analyses.

Table 2. Preliminary number of microplastics in the area between Cap Juby and Cap Blanc (Leg 1.3).

CTD-Station	Depth (m)	Preliminary count of objects assumed to be Microplastics *	Yellow, red or white objects classified as paint from ship or crane **	Additional objects that might be microplastics
106	500	17	P	3
108	100	13	P	0
111	30	4	P	1
113	500	> 300***	Not known yet	Not known yet
115	100	32	P	10
118	30	0	P	0
119	30	12	A	1
121	100	9	P	1
123	500	1	P	0
125	30	5	P	5
129	100	4	P	0
131	500	61	P	1
134	500	3	P	1
136	100	9	P	0
139	30	21	P	0
142	30	No sampling	No sampling	No sampling
145	100	0	P	0
148	500	13	P	1
151	30	No sampling	No sampling	No sampling
154	100	No sampling	No sampling	No sampling
155	500	No sampling	No sampling	No sampling
158	500	6	P	2
160	100	4	P	4
163	30	3	P	1
Totals		217 (+ >300 at station 113)		31

* Preliminary count objects in Manta trawl sample assumed to be microplastics. These objects must be evaluated in the laboratory on shore after the cruise for confirmation.

** P= Present, A= Absent. Fragments of what was assumed to be paint stemming from the crane of the ship, or the ship itself, were sorted but not included in the counts of microplastics. This needs to be checked in the IMR laboratory after the cruise.

*** More than 300 objects, but a proper count will be made on shore after the cruise

3.3 Distribution and abundance of pelagic fish

Tanger to Cap Cantin

Typically, pelagic fish in the northern region was distributed in mixed schools, particularly inshore where all four target pelagic species/groups tended to occur together.

Sardine was present at very low densities in this region except for some denser concentrations off Cap Cantin (Figure 3.32). The aggregations consisted of fish with size between 13 and 21 cm. A modal peak at 16 cm can be observed (Figure 3.36).

Anchovy was found in three low density areas, one off Cap Cantin, another off Casablanca, and the third at about 35 ^{o}N. It occurred on the shelf at about 50 m depth although occasionally the distribution extended also over the outer shelf. The schools of anchovy were typically mixed with sardine, and acoustic species separation was at times difficult (Figure 3.33). The fish ranged in size between 10 and 16 cm, with a modal peak at 12 cm.

Horse mackerels, mainly Atlantic horse mackerel, were found in a few low-density areas over the entire shelf. Horse mackerel typically formed schools close to the bottom which dispersed during night time. The distribution extended from the coast where the fish schooled with other pelagic species to offshore, typically to 150 m bottom depth (Figure 3.34). The fish ranged in size from 13 to 28 cm, and modal peaks of 15 and 19 cm were observed.

The **Atlantic chub mackerel** was distributed over a wide area of the shelf. Three distribution areas, one larger and two much smaller can be observed on the map (Figure 3.35). The fish caught were between 13 and 24 cm with a peak at 16 cm.

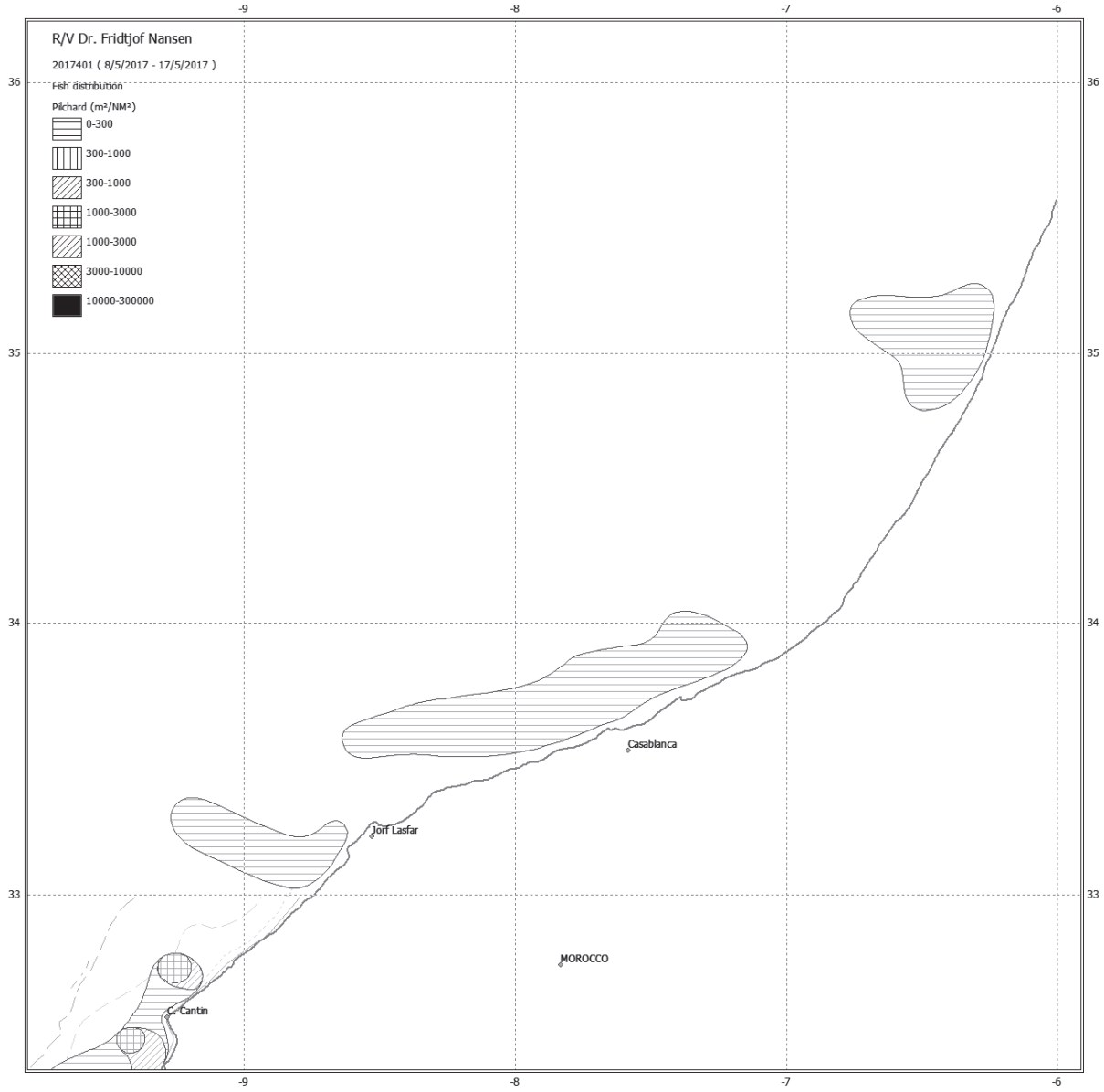


Figure 3.32. Distribution of sardine from Tanger to Cap Cantin. Depth contours as in Figure 1.1.

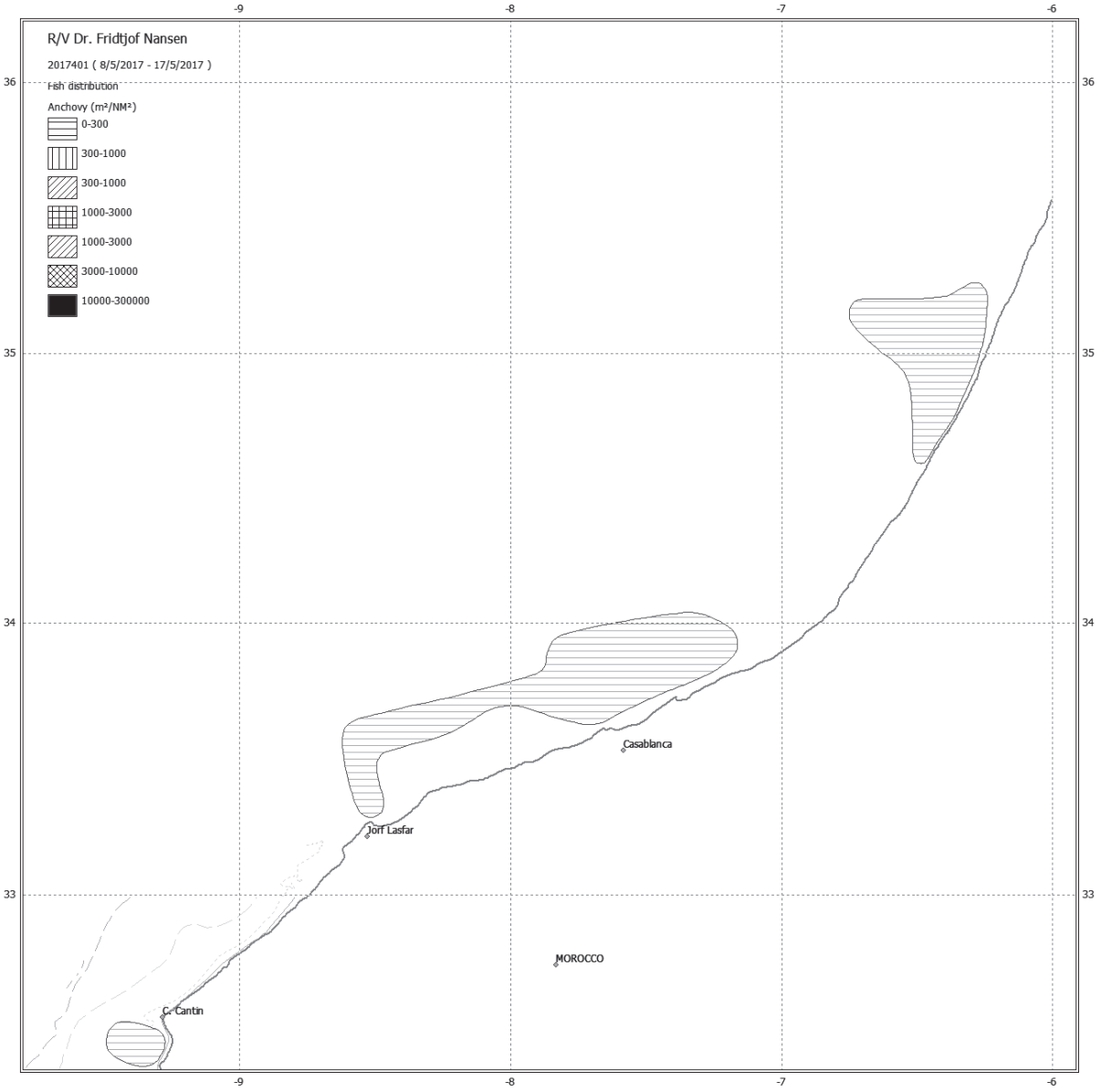


Figure 3.33. Distribution of anchovy from Tanger to Cap Cantin. Depth contours as in Figure 1.1.

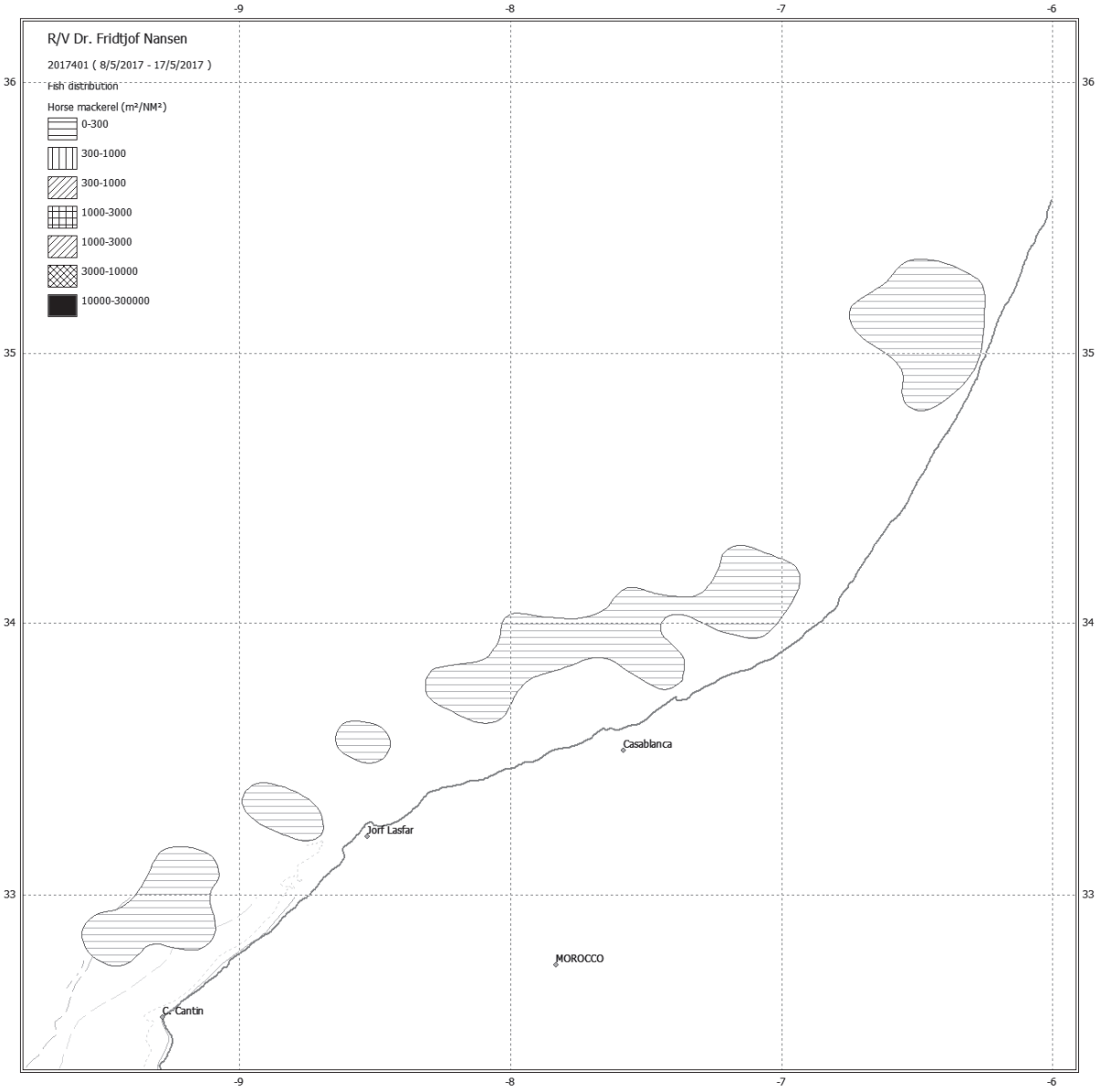


Figure 3.34. Distribution of horse mackerel from Tanger to Cap Cantin. Depth contours as in Figure 1.1.

Figure 3.35. Distribution of chub mackerel, from Tanger to Cap Cantin. Depth contours as in Figure 1.1.

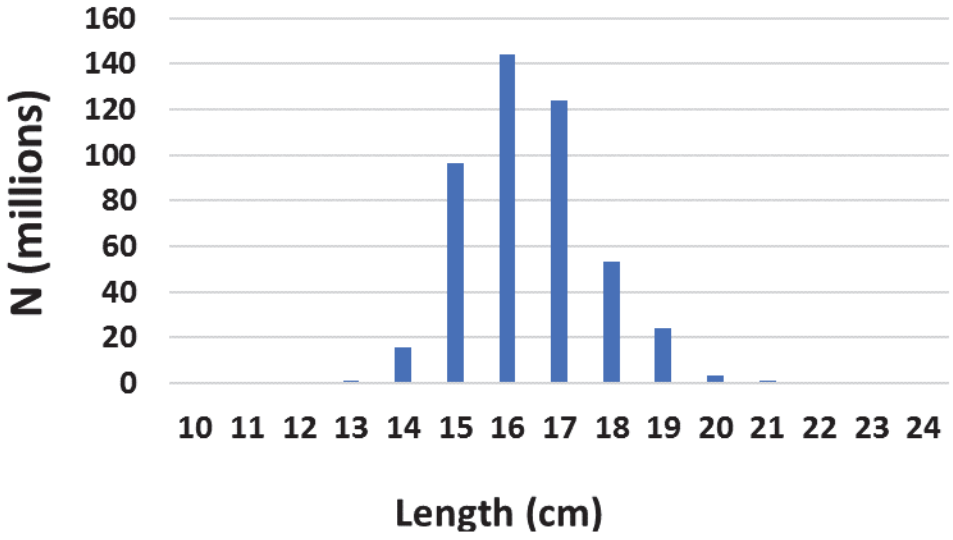


Figure 3.36. Length frequency distribution of sardine, from Tanger to Cap Cantin.

Cap Cantin to Cap Juby

Sardine was recorded in several low and medium density areas. High density areas of fish were found mainly inshore of 50 m depth between Agadir and Cap Cantin and south of Cap Dra (Figure 3.37). The aggregations consisted of fish with size from 13 to 23 cm. A modal peak at 16 cm can be observed (Figure 3.41).

Anchovy was distributed over a larger geographical area than typical, in general with highest concentrations close inshore and decreasing densities offshore to 50 m depth, sometimes also into deeper waters. The concentrations were low (Figure 3.38). The fish ranged in size between 9 and 16 cm, with modal peaks at 12 and 15 cm.

Horse mackerels, mainly Atlantic horse mackerel, were distributed widely but with low densities along the shelf, typically with highest concentrations close inshore and offshore inside the shelf break (Figure 3.39). The distribution area overlapped with that of chub mackerel. The fish ranged in size from 6 to 19 cm (a few individuals up to 23 cm), and a modal peak of 11 cm was observed.

Atlantic chub mackerel was found all along the coast from Cap Juby to Cap Cantin. It was generally in low densities, covering most of the shelf to > 100 m depth. Some few patches of slightly higher densities were found inshore south of Safi and off Tan Tan (Figure 3.40). The fish ranged in size between 13 and 24 cm with a main modal peak at 15 cm.

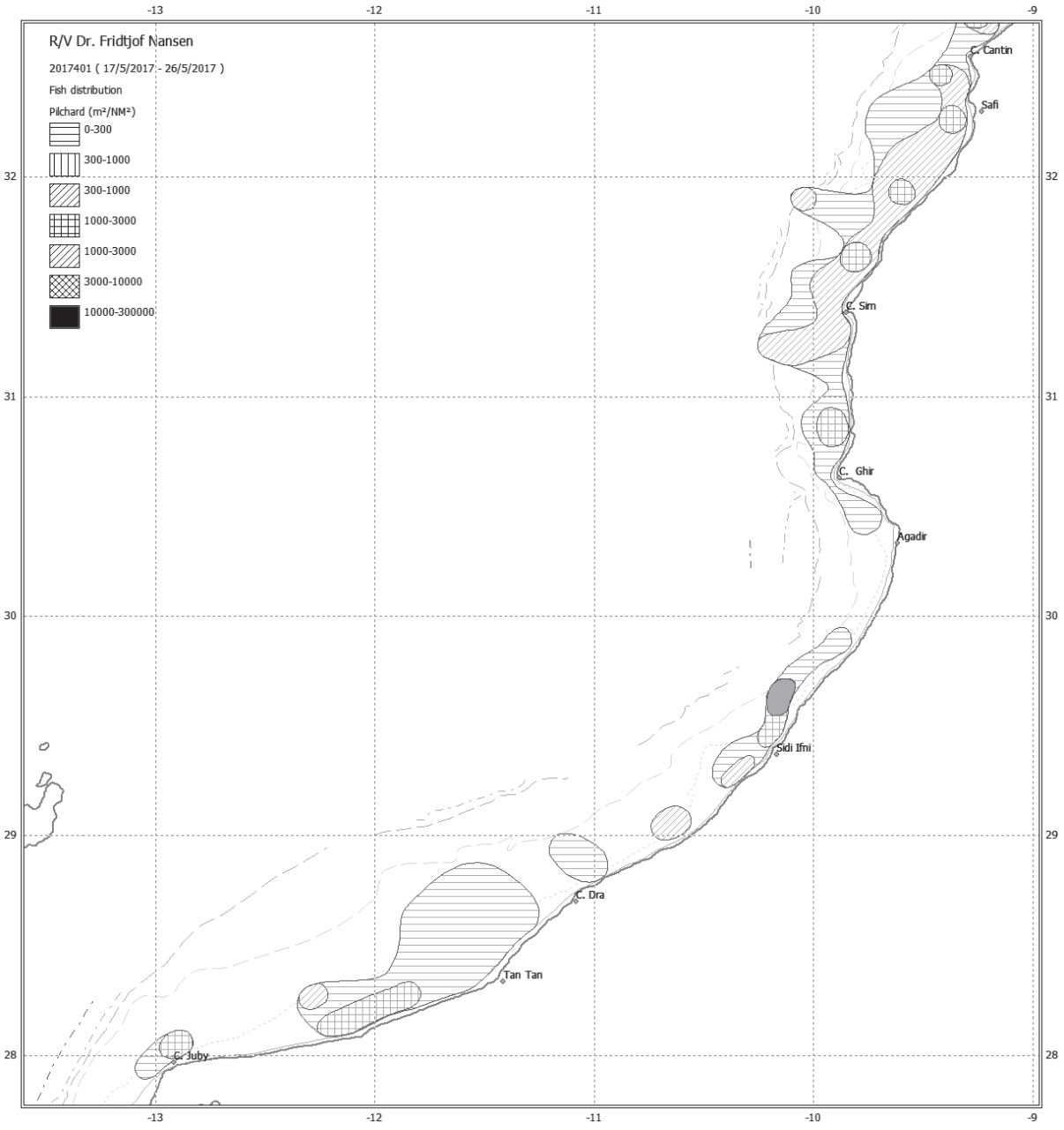


Figure 3.37. Distribution of sardine, from Cap Cantin to Cap Juby. Depth contours as in Figure 1.1.

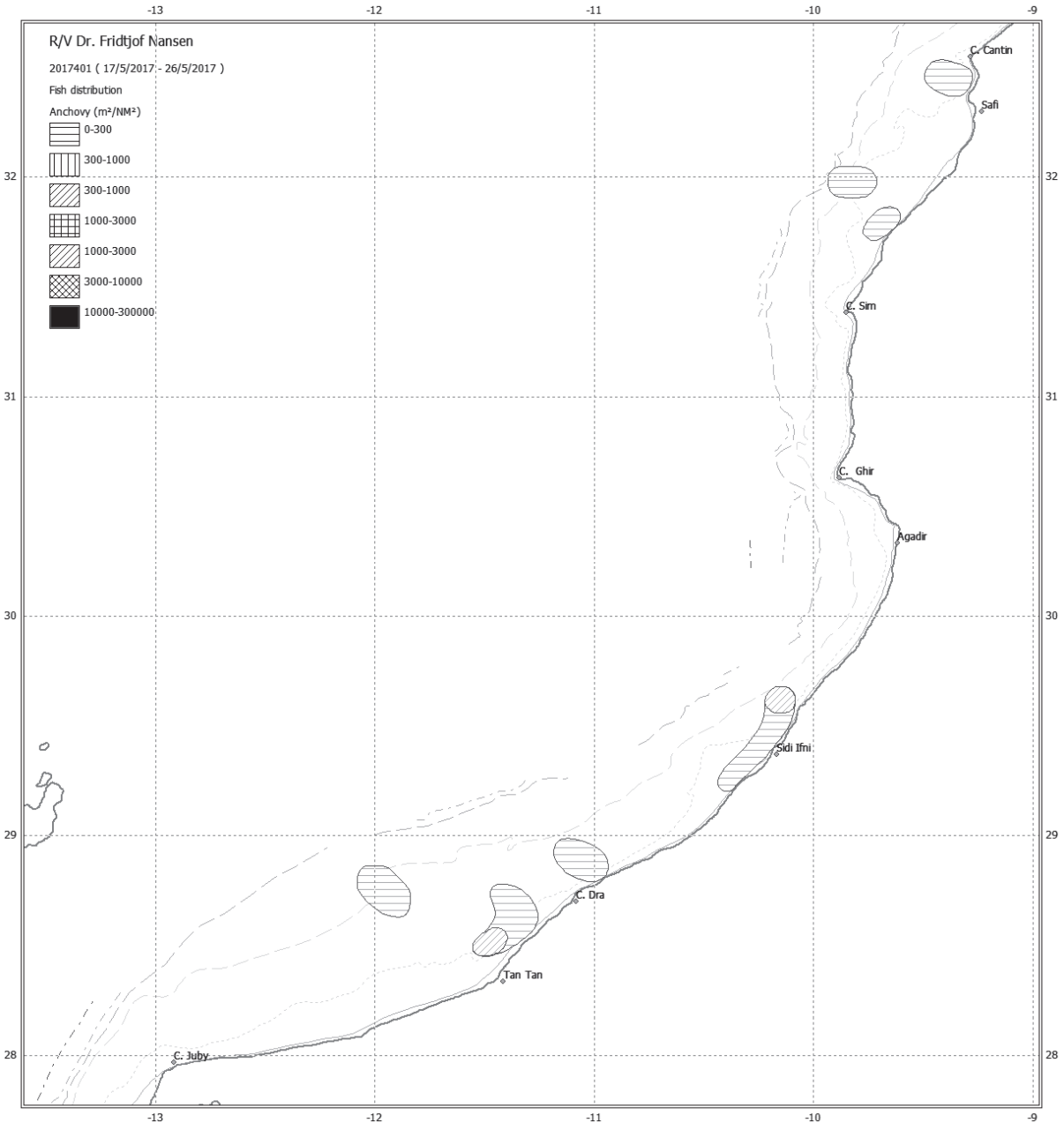


Figure 3.38. Distribution of anchovy from Cap Cantin to Cap Juby. Depth contours as in Figure 1.1.

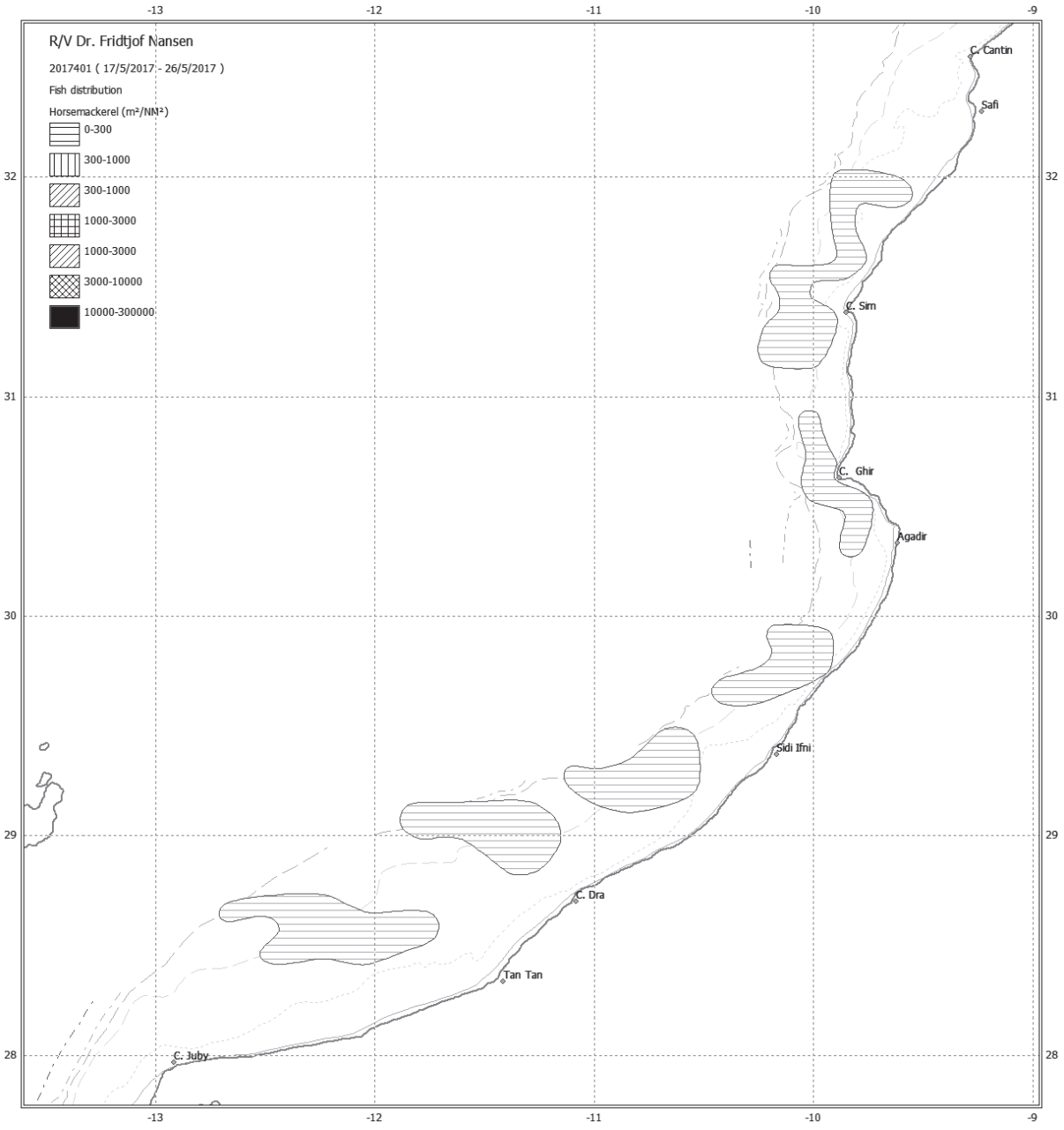


Figure 3.39. Distribution of Horse mackerel from Cap Cantin to Cap Juby. Depth contours as in Figure 1.1.

Figure 3.40. Distribution of chub mackerel from Cap Cantin to Cap Juby. Depth contours as in Figure 1.1.

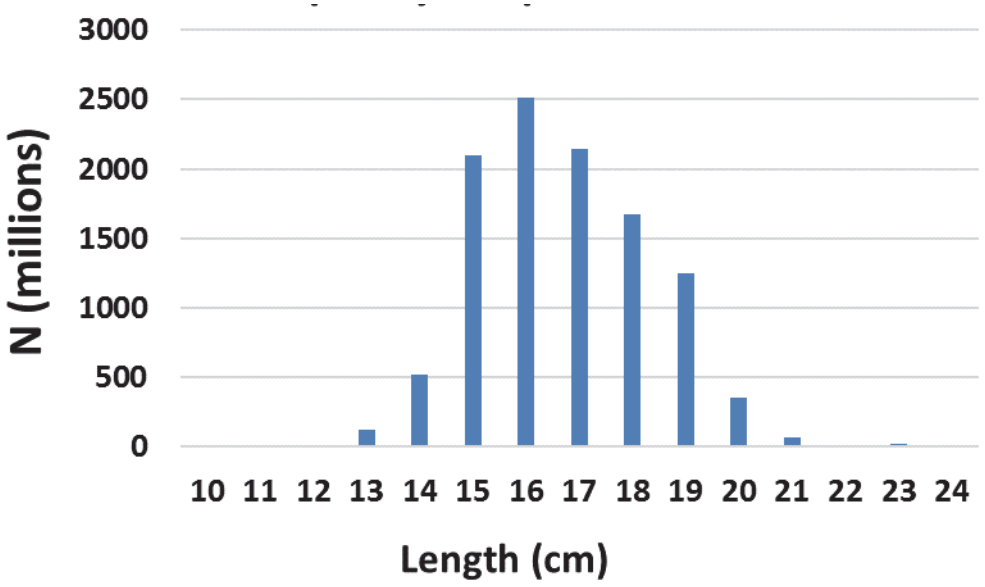


Figure 3.41. Length frequency distribution of sardine from Cap Cantin to Cap Juby.

Cap Juby to Cap Blanc

Sardine was found with variable but generally very high density almost without interruption between Cap Blanc and Cap Juby (Figure 3.42). The highest densities were found between Cap Barbas and Cap Bojador. The main distribution was found inshore of 30 m bottom depth and the fish was strongly aggregated in most of the area, only occasionally extending much beyond 50 m isobath. The length distribution in the stock between Cap Blanc and Cap Juby is shown in Figure 3.48. A cohort with peak around 13 cm can be seen together with cohorts with modal peaks of 20 and 23 cm.

Sardinellas (mainly round sardinella) was generally found south of Dakhla. A few fish were found further north close to Cap Bojador. The sardinella was found in relatively patchy low to medium density aggregation (Figure 3.43). Three modal peaks were visible in the size distribution of the fish in the area, one at 14 cm, then at 23 and 25 cm. The sardinellas were found inshore of 50 m depth. *S. maderensis* was not found in this area.

Anchovy was found only in the northernmost part of the region between Cap Bojador and Cap Juby, and in the southern part of this region between Cap Barbas and Cap Blanc. Between these areas no anchovy was found. The fish was confined inshore in water depths <50 m, and the density was medium (Figure 3.44). The length distribution ranges between 7 and 16 cm mainly dominated by the mode between 10 and 13 cm.

Horse mackerels (Atlantic and Cunene horse mackerel) were found patchily and generally in low density over the outer shelf in most of the area between Cap Blanc and Cap Juby. The

Atlantic horse mackerel was the main species while the Cunene horse mackerel was found only between Cap Blanc and Cap Barbas (Figure 3.45). The Atlantic horse mackerel showed the opposite trend, as should be expected, with low densities south of Cap Barbas, and increasing catches northwards.

Atlantic chub mackerel was recorded almost continuously covering most of the shelf between 20 and 150 m depth from Cap Juby to Cap Blanc, with the highest densities on the mid and outer shelf (Figure 3.46). Concentrations were highest off Dakhla and between Laayoune and Cap Bojador. The fish ranged from 10 to 39 cm but was dominated by a cohort around 15 cm. Another cohort with a modal peak at 21 cm can also be observed.

Snipefish was very abundant in the offshore part of the survey area, and a separate estimate was made due to the high biomass observed. The species was abundant between Cap Bojador and Cap Blanc around the shelf break but with distribution extending into considerably shallower waters (<50 m depth) along large parts of the shelf (Figure 3.47). The fish ranged in size between 7 and 16 cm with a modal peak around 12 cm.

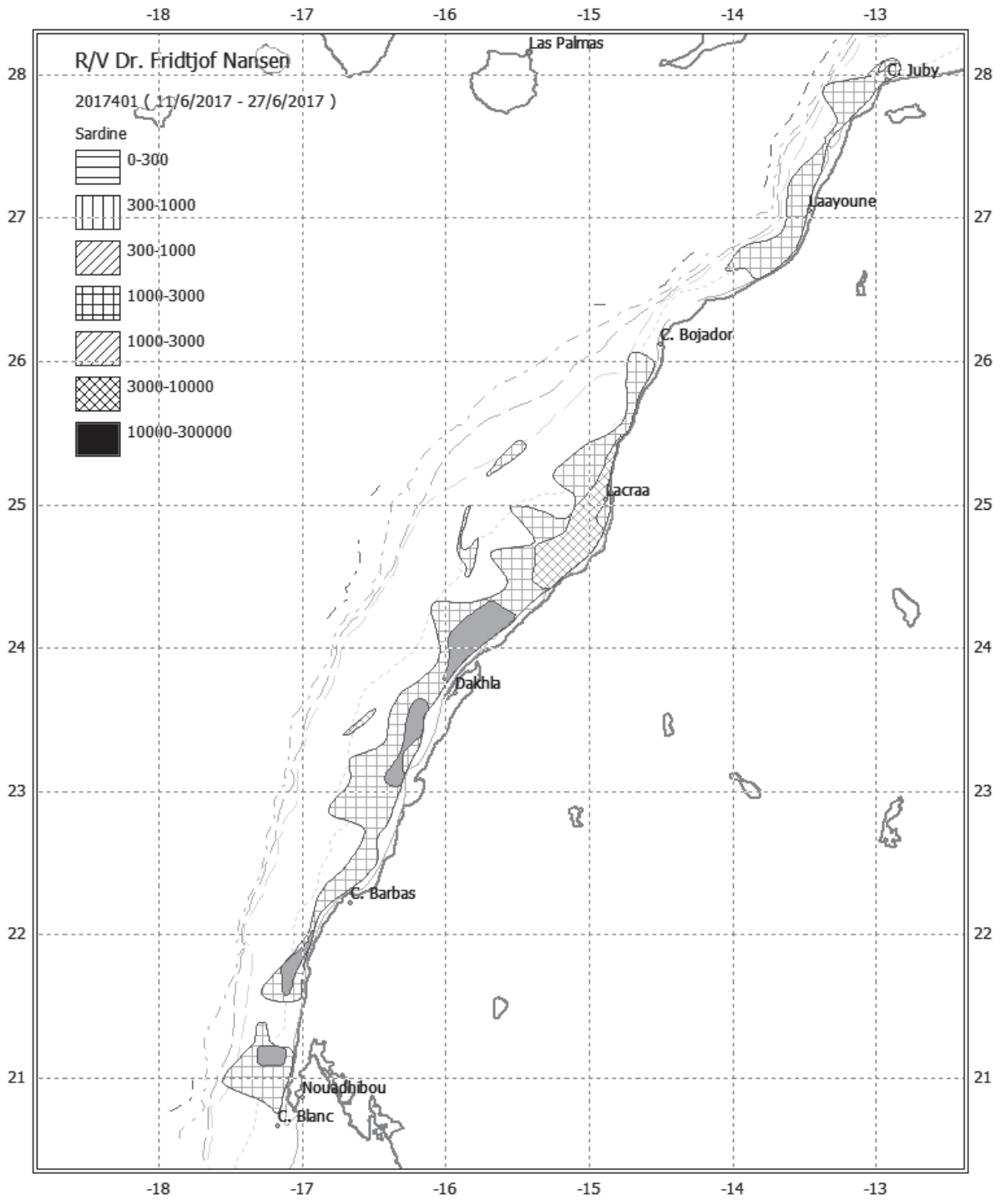


Figure 3.42. Distribution of sardine from Cap Juby to Cap Blanc. Depth contours as in Figure 1.1.

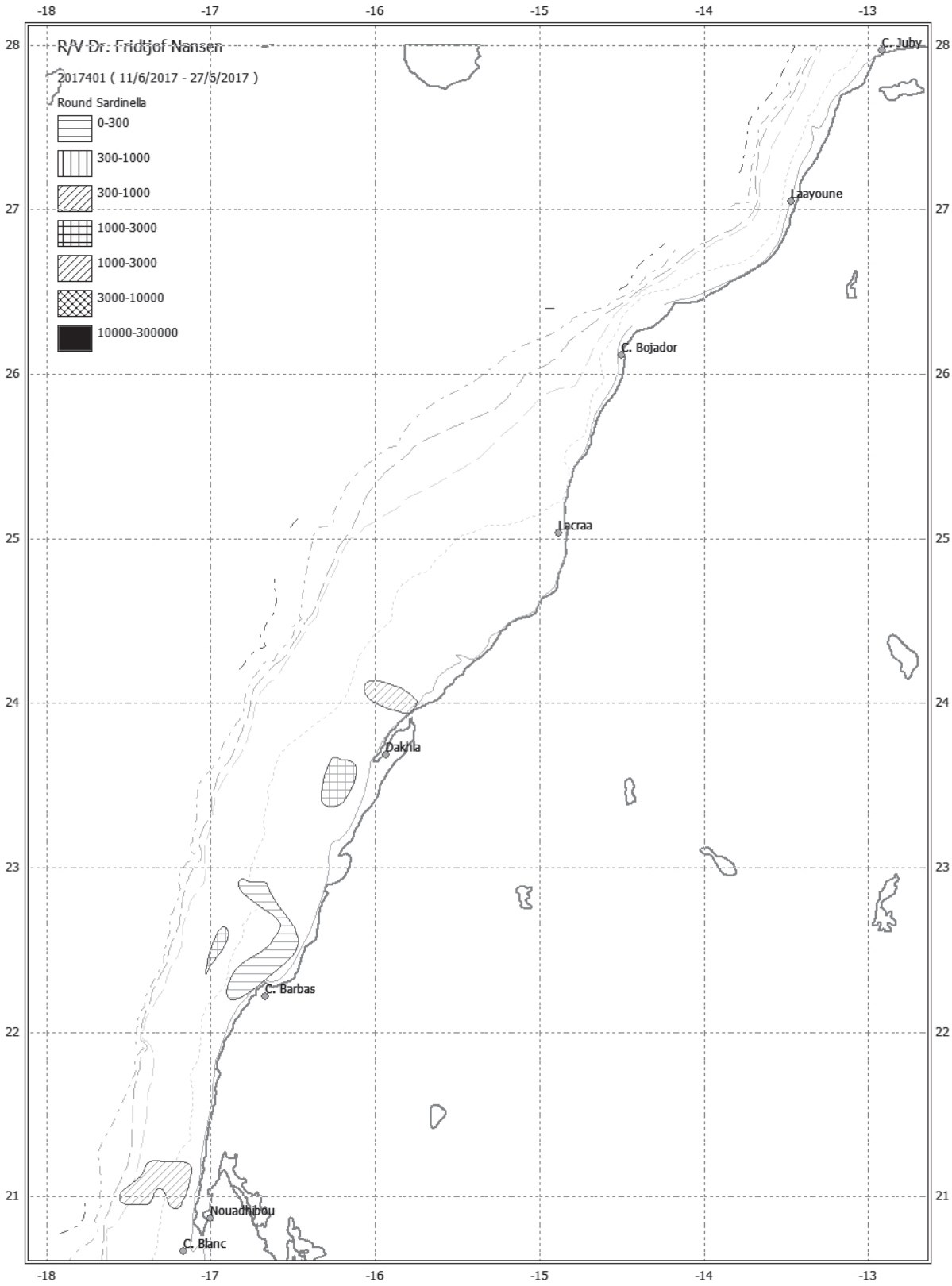


Figure 3.43. Distribution of sardinella from Cap Juby to Cap Blanc. Depth contours as in Figure 1.1.

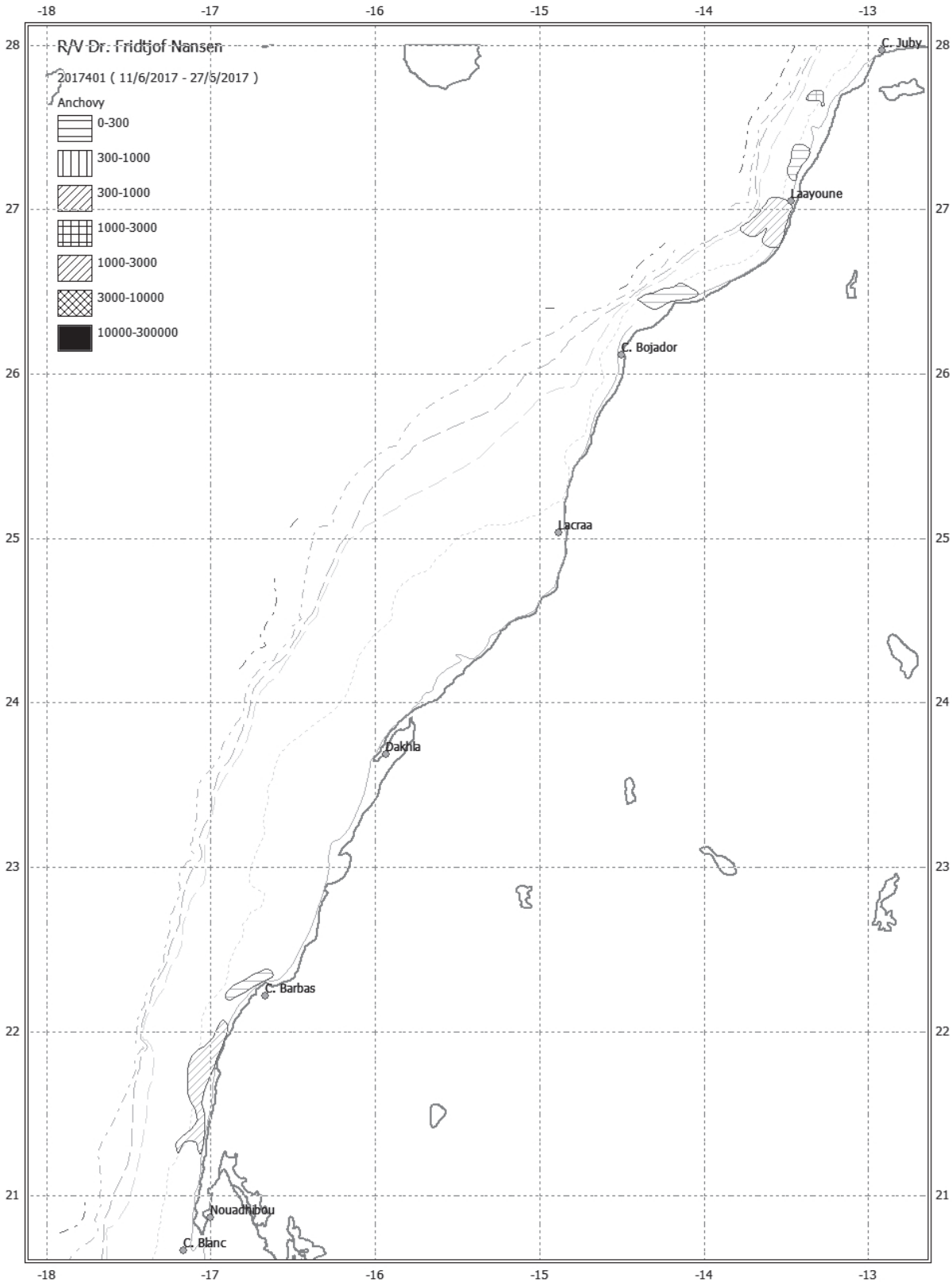


Figure 3.44. Distribution of anchovy from Cap Juby to Cap Blanc. Depth contours as in Figure 1.1.

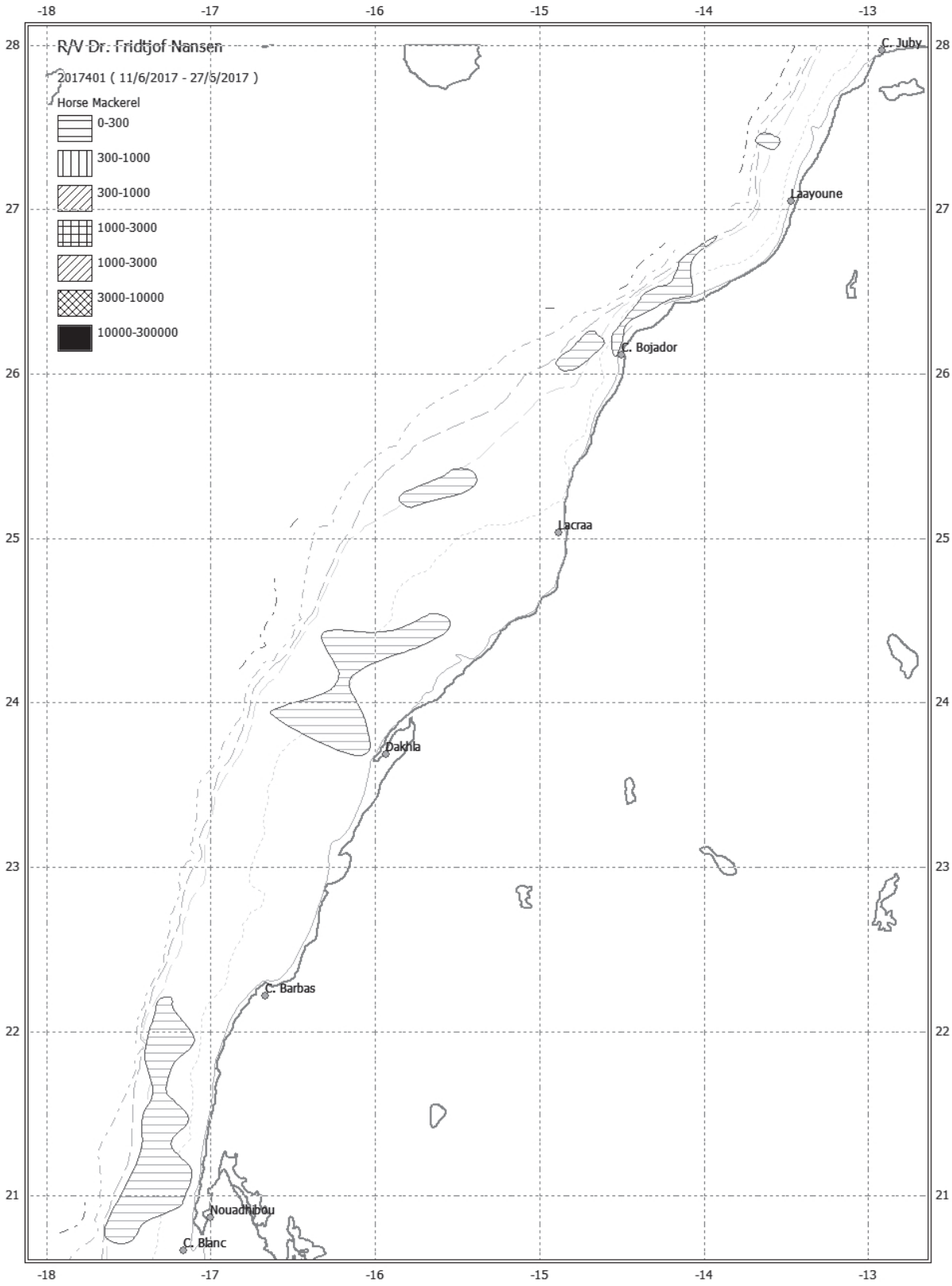


Figure 3.45. Distribution of horse mackerel from Cap Juby to Cap Blanc. Depth contours as in Figure 1.1.

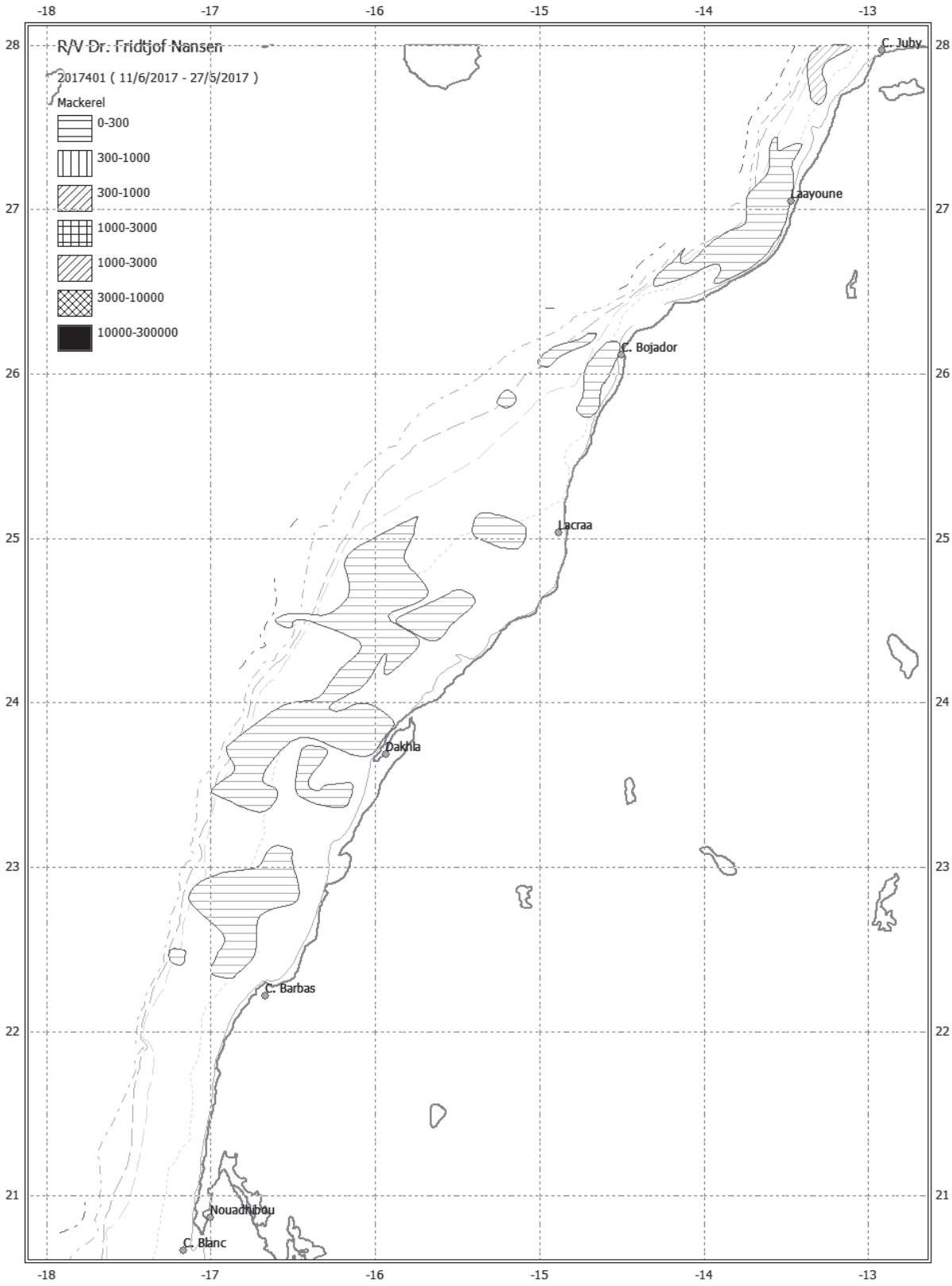


Figure 3.46. Distribution of chub mackerel from Cap Juby to Cap Blanc. Depth contours as in Figure 1.1.

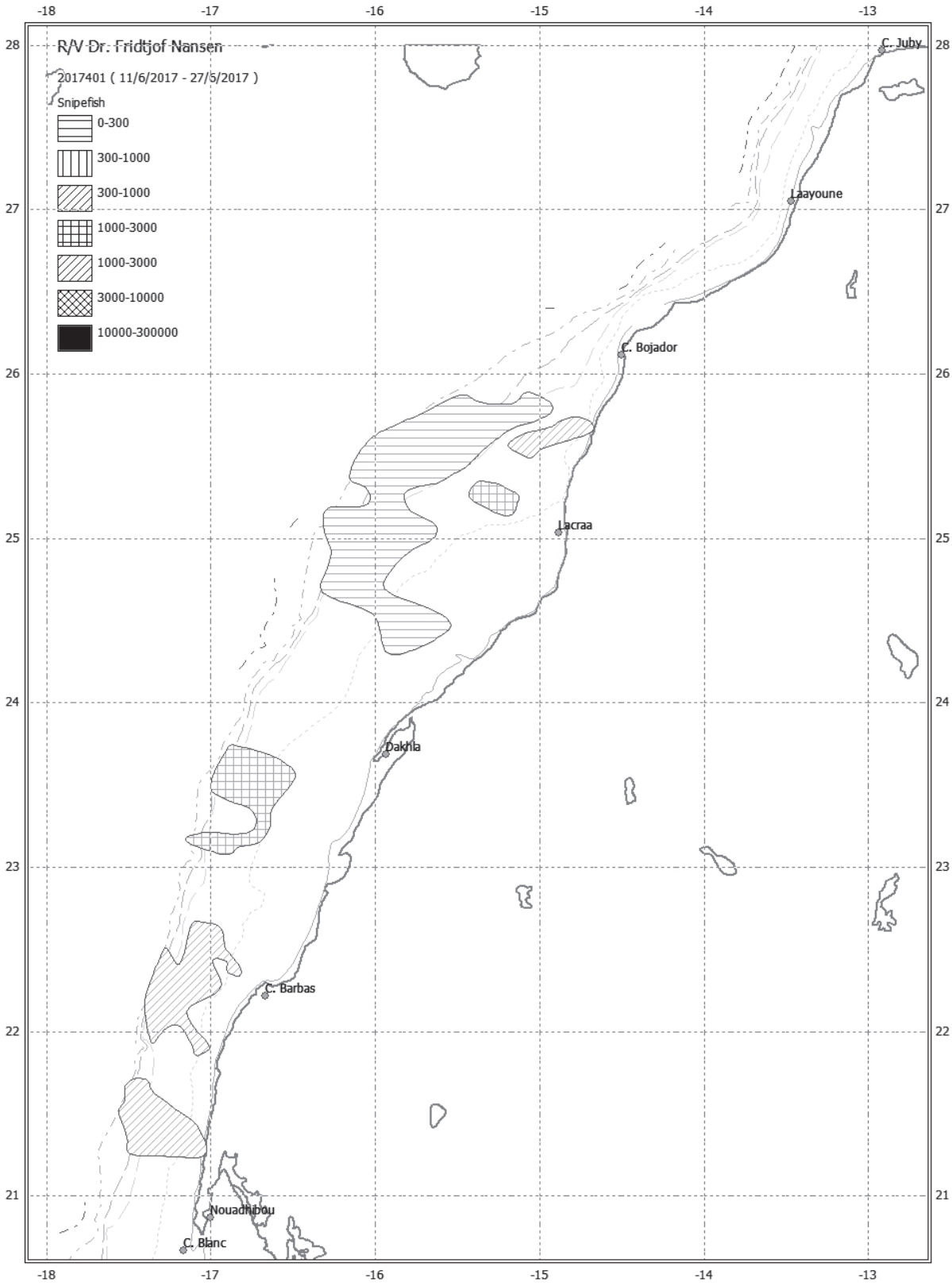


Figure 3.47. Distribution of snipefish from Cap Juby to Cap Blanc. Depth contours as in Figure 1.1.

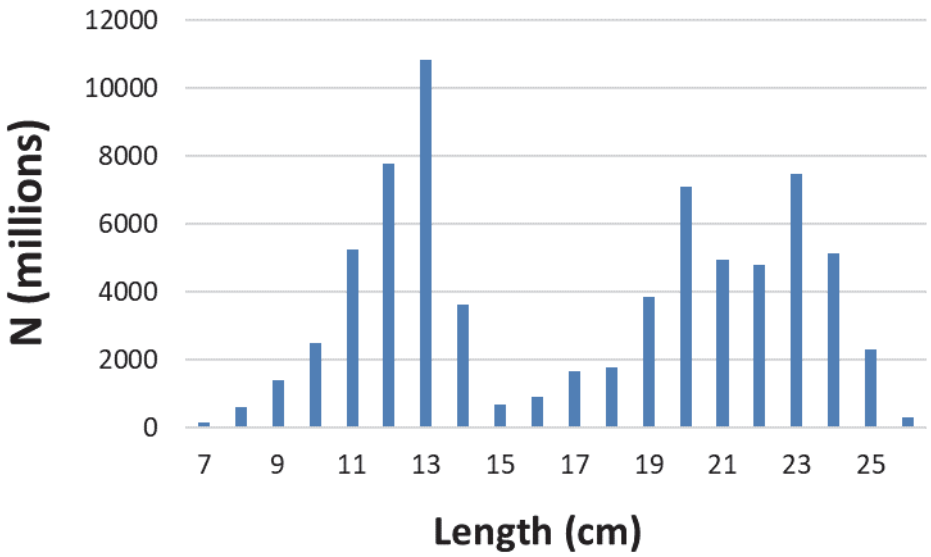


Figure 3.48. Length frequency distributions of sardine from Cap Juby to Cap Blanc.

3.4 Summary of biomass estimates

A summary of biomass estimates is given in Table 3. The size distribution of the various target species per region can be found in Annex IV while detailed regional biomass estimates in number and weight by length groups from Senegal to Morocco are shown in Annex V.

Table 3. Summary of biomass estimates of pelagic fish, thousand tonnes.

Region	Sardines	Round sardinella	Atlantic horse mackerel	Cunene horse mackerel	Chub mackerel	Anchovy	Snipefish
Tanger-Cap Cantin	19		28		98	10	
Cap Cantin-Cap Juby	502		52		171	15	
Cap Juby-Cap Blanc	4 471	140	15	31	119	40	177
Total	4 993	140	93	31	388	65	177

Tanger - Cap Cantin

This region has not been surveyed as part of the historic R/V *Dr Fridtjof Nansen* surveys. However, it is regularly surveyed as part of the Moroccan national pelagic surveys. The total

abundance of fish in this region was relatively good considering that this region usually has low abundance of pelagic fish.

Biomass of **sardine** was estimated to 19 thousand tonnes. The abundance in numbers is about 0.5 billion fish. The main part of the biomass is made up of young fish < 20 cm length.
Biomass of Anchovy was estimated to 10 thousand tonnes with an abundance in numbers of 0.5 billion fish.

Horse mackerel was not very abundant in this region. A biomass of28 thousand tonnes was estimated and a total of about 0.4 billion fish. More than 90% of the fish was below 24 cm.

Biomass of Chub mackerel was estimated to 98 thousand tonnes and 1.2 billion fish. The size ranged between 13 cm and 24 cm with a modal peak at 16 cm.

Cap Cantin - Cap Juby

Biomass of **sardine** was estimated to 502 thousand tonnes, a somewhat higher estimate since 2015 where 331 thousand tonnes were found (albeit in a different season). The abundance in numbers is about 10 billion, about the same number as in 2015. The main part of the biomass is made up of young fish < 20 cm length.

With respect to anchovy a biomass of 15 thousand tonnes was estimated and a total of 0.8 billion fish**Atlantic horse mackerel** provided a biomass of 52 thousand tonnes. Of this the largest proportion of the fish found in this area was young, and 0.7 billion, or more than 90% of the fish by abundance, was between 7 and 17 cm.

Atlantic chub mackerel biomass was estimated to 171 thousand tonnes and a total of 4.3 billion fish. The chub mackerel is probably grossly underestimated due to the low but uncertain target strength of the species.

Cap Juby - Cap Blanc

Biomass of **sardine** was estimated to 4.47 million tonnes, which is considerably higher than the 3.5 million tonnes found in 2015 (comparison to be treated with care because of the surveys were in different seasons) and the 3.3 million tonnes found in this area in 2006. Also during this survey very little sardine was found further south in Mauritania. The length distribution is shown in Figure 3.48. The major share of the fish in terms of biomass consists of older fish. Table 4 shows trends of adult sardine in this region.

Table 4. Trends in Biomass and abundance of adult **(>19 cm)** sardine from the the surveys with the R/V *Dr Fridtjof Nansen* in the region Cap Juby-Cap Blanc

Survey	Thousand tonnes	Million fish
November-December 1996	4 600	47 400
November-December 1997	240	2 900
November-December 1998	340	3 400
November-December 1999	1 000	11 500
November-December 2000	1 260	13 200
May-June 2001*	**1 975**	**22 500**
November-December 2001	3 200	32 000
May-June 2002*	**2 100**	**21 400**
November-December 2002	3 700	35 500
June 2003*	**5 580**	**59 300**
November-December 2003*	4 370	43 600
November-December 2004*	5 720	51 900
November -December 2005*	7 630	68 300
November -December 2006	3 130	27 600
November -December 2015	2 655	28 500
May- June 2017	**3 399**	**32 038**

* Including sardine in Mauritania

The young fish (<20 cm) consist of 41 billion fish and 56% of the total. The recruitment to the stock is high, this is a positive sign and indicates that the stock may increase next year if conditions are otherwise favourable.

Biomass of **Sardinella** (mainly round sardinella) was estimated to be 140 thousand tonnes. This was considerably lower than the 547 thousand tonnes found in 2015. In 2015, 392 thousand tonnes were round sardinella and 155 thousand tonnes were flat sardinella respectively. It should be noted however that the survey in 2015 took place in November/December, a time of the year when the round sardinella has its northermost distribution while the timing of the current survey coincided with a period when sarinella is mainly found in Mauritania and southwards.

Anchovy was estimated to 40 thousand tonnes, corresponding to 3.6 billion fish. This was about half of the 86 thousand tonnes found in 2015, corresponding to 9.6 billion fish. (Annex V).

The two species of **horse mackerel** combined were estimated to 46 thousand tonnes, of which, 15 thousand tonnes were Atlantic horse mackerel while 31 thousand tonnes were Cunene horse mackerel. In 2015, 394 thousand tonnes of horse mackerels were found, of which roughly 220 and 174 thousand tonnes were Atlantic and Cunene horse mackerel respectively. The two species are also distributed south of Cap Blanc into Mauritania and Senegal. Annex V gives the details of the total abundance.

Atlantic chub mackerel was estimated to about 119 thousand tonnes. In 2015, a biomass of 422 000 tonnes was recorded. Young fish of chub mackerel (11-19 cm) constitute about 64% of the total abundance in numbers. Chub mackerel has a smaller swim bladder than sardine, and thus a low target strength (TS) (see e.g. p309 in ICES 2017). In lack of reliable target strength for chub mackerel, the TS for sardine has been applied in the estimates. The estimates are therefore probably underestimates, especially for the adult part of the stock. Furthermor, the use of the Multpelt pelagic trawl may have changed the representation of this fast swimming species in the trawl catches as compared to earlier surveys (Multpelt is more efficient in catching fastswimming species). This may have implications for the allocation of S_a values to different species groups.

Snipefish was abundant in the survey area between Cap Blanc and Cap Juby. The biomass was estimated to 177 thousand tonnes and about 17 billion individuals. No previous estimate of this species has been carried out. The species seems to have increased considerably in recent years. No target strength equation is available for this species and it is assumed that the target strength for sardine that has been applied underestimate the true abundance considerably.

3.5 Overview of samples collected for future analysis

With the expanding scope of the research to be carried out in the context of the EAF-Nansen Programme, the survey objectives and related sampling strategy have been expanded to support research on life cycles, stock identities, trophic relationships, and food safety amongst others.

Pelagic fish samples were therefore collected for several biological parameters (otoliths, fin clips, stomachs, and fat content) and gonad maturity stage for post-survey age and growth, stock structure, population biology and trophic interaction studies. Otoliths and fin clips were collected for a total of 1426 and 1387 individuals of target species, respectively. An overview of the biological samples is provided in Annex II.

CHAPTER 4. REGIONAL SUMMARY

The R/V *Dr Fridtjof Nansen* survey of the pelagic resources in Northwest Africa (Leg 1.1 of the western Africa coverage for 2017) encompassed Morocco to Cape Blanc. The second leg (Leg 1.2), conducted an experimental survey of the mesopelagic resources of the region, and the third and fourth legs (1.3 and 1.4) conducted pelagic surveys for Mauritania and Senegal, respectively.

The first leg of the survey covered the region between Tangier and Cape Blanc from 7-27 May 2017 (Leg1.1). This was temporarily postponed so the vessel could conduct a survey on mesopelagic resources for West Africa from 26 May to 11 June (Leg 1.2), and for an unscheduled maintenance period of the vessel. The third leg for pelagic resources took place for Mauritania from 27 June – 9 July, and for Senegal and the Gambia from 9-18 July (there was a break in service from 3-6 July to allow for a crew change on the vessel). After completing the survey in Mauritania, the vessels continued surveying Senegal and Gambia from 9-18 July 2017 (Leg1.4). A common survey design was adopted in the entire region with parallel transects perpendicular to the coastline, 10 nm apart, and acoustic measurements of pelagic fish obtained on the shelf from 20-500 m bottom depth. At each degree latitude, a hydrographical transect was carried out to a depth of 1 000 m. Meteorological and hydrographic measurements were recorded routinely on these transects in addition to samples on ocean acidification parameters (pH and alkalinity), nutrients, phytoplankton, zooplankton, fish eggs and larvae and microplastics. Weather conditions were good for surveying during the entire period.

Oceanographic Conditions

Between Tangier and Cape Blanc, the oceanographic conditions showed a gradual increase in surface temperatures and lowering of the thermocline from the north to the south, and a corresponding decrease in oxygen in the upper 50 m (as observed at the 100 m CTD stations). The region north of 32° show the most stable water masses and the least upwelling. Close inshore, at the 30 m CTD stations, a clear separation in conditions is observed around 25°N, where water masses close to the coast are more fully mixed south of this latitude. Salinity in the upper 200 m are generally high across the entire region (> 36), and highest salinity is found at 24°N where salinity close to the coast is above 36.3 across the water column corresponding with lower fluorescence values. The areas of highest Chlorophyll *a* concentrations typically a4 3correspond with areas of lower salinity and indicates upwelling. These areas are roughly between 32°N- 30°N, around 27°N extending to both sides, and especially from 23°N and southwards where Chlorophyll *a* values increase > 4 µg/l. A clear frontal Zone was visible in the region around Cape Blanc.

At Cape Blanc, a clear separation of water masses from the northern and southern Canary Current system with strong increase in temperature from around 20°C (of Cape Blanc) to 28°C south of Cape Timiris can be observed. There is an indication of southward protruding water masses inshore in this region while offshore northwards moving water masses affect the outer shelf in the surface. Upwelling affects especially the northern border region of Mauritania and primary production (fluorescence) and oxygen is high inshore. A similar situation can also be observed in the far southern part of Mauritania close to the coast. These two regions are separated by a central region with low primary production and strongly stratified water masses. At 19°N and 18°N, water masses are becoming increasingly more stratified, especially offshore with warm saline tropical water masses observed in the surface layers. Primary production is low across the shelf. Low oxygen waters < 1 ml/l can be observed close to the bottom on the central outer shelf.

The hydrographical conditions in Senegal and the Gambia were relatively uniform considering the geographical spread of stations. The surface layer had typical characteristics of tropical water masses with high temperatures and high salinities. Thermoclines were present around 50 m depths. Above the thermoclines, the water masses were well oxygenated, while in deeper waters, oxygen concentrations were low, varying between 1 and 2 ml l-1. This agrees with recent measurements in these waters. Some transects had indications of subsurface maximum Chlorophyll *a*.

Fish distribution and abundance

Surveys with the previous R/V *Dr Fridtjof Nansen* (1994-2016) were carried out in the same way as the present survey (2017-present) with regard to both survey design, acoustic scrutinizing and biomass estimation methodology. The methodology followed the recommendations of the Northwest Africa acoustic survey planning group. This allows for direct comparison of biomass estimates from the present survey with historic surveys. Still, the 2017 survey was carried out in May-July while most of the historic surveys that are part of the time series were carried out between October-December. This will affect the distribution of the fish, and potentially also their availability in the survey area. Table 6 presents the biomass estimates by main species and suregion while Table 7 shows the trends over time based on the surveys with Dr.Fridtjof Nansen.

A strong separation between the stocks in northern and southern part of the CCLME region is observed. The total biomass north of Cape Blanc is high while the southern part of the region is struggling with declining stock sizes for several species.

As during all the historic surveys, the same target strength was used for all species. For species with low target strength, such as Atlantic chub mackerel (*Scomber colias*), the biomass will be underestimated due to this. In addition, large shallow water areas with bottom depth < 20 m were not covered by the surveys and there are known seasonal variations in the abundance of pelagic fish in shallow waters, especially *Sardinella*

maderensis. For the present survey, the length-weight ratio applied in the estimate is based on data collected in the respective areas of the survey. Historically this has to some extent varied between surveys. A study to identify the effect of this in the assessment may be undertaken in the future.

Sardine (*Sardina pilchardus*). Sardine were found with variable densities in the northern CCLME region between Cap Spartel in the north and Cap Blanc, with generally very high density almost without interruption between Cape Blanc and Cape Juby. The highest densities were found between Cape Barbas and Cape Bojador. The main distribution was found inshore of 40 m bottom depth and the fish was strongly aggregated in most of the area, only occasionally extending much beyond 50 m isobath. The total biomass registered in Morocco is around 5 million tonnes, representing 98% of the total biomass in the region. South of Cape Blanc, the biomass was estimated to 61 thousand tonnes, and it was found in one area on the outer shelf north of Cape Timiris. This was the furthest south the sardine was found during this survey and no sardine was found in the warm tropical water masses further south.

Sardinella (*Sardinella aurita* and *S. maderensis*). The sardinella, *S. aurita*, was found north to Dakhla, and only a few fish were found further north close to Cape Bojador. *S. aurita* were found in relatively patchy low to medium density aggregation. The total biomass registered north of Cape Blanc was around 140 thousand tonnes, representing 54% of the total biomass in the region. In Mauritanian waters, both species were found. A very low biomass was found from Cape Blanc - Cape Timiris with only 7 thousand tonnes of *S. maderensis* while a total of 109 thousand tonnes of *S. maderensis* and 34 thousand tonnes of *S. aurita* was found from Cape Timiris to St Louis. In Senegal, no sardinella was found north of Dakar. Sardinella were distributed only in Petite Cote, from Cap Vert to Banjul and the total biomass is estimated to 86 thousand tonnes for *S. aurita* (33% of the total biomass in the region) and 96 thousand tonnes for *S. maderensis* (45% of the total biomass in the region). Generally, the biomass of both species of sardinella was low.

Anchovies (*Engraulis encrasicolus*). Anchovies were found only in the northern most part of the region between Cape Bojador and Cape Spartel, and in the southern part of this region between Cape Barbas and Cape Blanc. Between these areas no anchovy were found. The fish were confined inshore in water depths < 50 m, and the density was medium. The total biomass north of Cap Blanc is around 65 thousand tonnes, representing 45% of the total biomass in the region. In Mauritania, 34 thousand tonnes were found in the northern region, on the shelf south of Cape Blanc. The fish were mixed with sardine of the same size within the distribution area. South of Cape Timiris, around 44 thousand tonnes of anchovy were found in two separate areas along the shelf. No anchovy were found in Senegal.

In the northern part of the survey area, north of Cap Blanc, **Horse mackerels** (*Trachurus trachurus* and *T. trecae*) were found patchily and in generally low density over the outer shelf in most of the area between Cape Blanc and Cape Spartel. *Trachurus trachurus*

was the main species while *T. trecae* was found only between Cap Blanc and Cape Barbas. The total biomass registered in Morocco for *Trachurus trachurus* is 95 thousand tonnes (98% of the total biomass in the region) and 31 thousand tonnes for *Trachurus trecae* (24% of the total biomass in the region). Only 9 thousand tonnes of horse mackerel were found in Mauritania from Cape Blanc to Cape Timiris. This was the southernmost distribution of *Trachurus trachurus,* with a biomass of 2 thousand tonnes while 7 thousand tonnes was *T. trecae*. Between Cap Timiris and St. Louis a total of 25 thousand tonnes of *T. trecae* was found, the distribution continued southwards into Senegal all along the shelf from St. Louis to Casamance with total biomass estimated to 66 thousand tonnes (51% of the total biomass in the region)

Atlantic chub mackerel (*S. colias*) were recorded almost continuously covering most of the shelf in the northern CCLME region between 150-20 m depth from Cape Blanc to Cape Spartel, with the highest densities on the mid and outer shelf. Concentrations were highest off Dakhla and between Laayoune and Cape Bojador. The total biomass registered north of Cap Blanc is 388 thousand tonnes, representing 88% of the total biomass in the region (total 441 thousand tonnes). In Mauritania, a total of 20 thousand tonnes of chub mackerel was observed between Cape Blanc and Cape Timiris. In this region also, Chub mackerel was found in deeper waters than most of the other species, but with a dominance on the shelf and over the shelf break. The densities were generally low. In the southern region, from Cape Timiris to St Louis, around 5 thousand tonnes of Chub mackerel were found. Small patches of fish were found between Cape Timiris and Nouakchott while further south, the distribution was more continues from 17°N to St. Louis. In Senegal, the chub mackerel was distributed from Kayar to Casamance with main concentrations off Sine Saloum. The total biomass was estimated to 28 thousand tonnes (6% of the total biomass in the region).

Table 6: Regional biomass estimates from 2017 R/V *Dr Fridtjof Nansen* survey.

	Biomass ('000 tonnes)									
	Tanger **Cap Cantin**	**Cap Cantin** **Cap Juby**	**Cap Juby** **Cap Blanc**	**Cap Blanc** **Cap Timiris**	**Cap Timiris** **St Louis**	**St Louis** **Cap Vert**	**Cap Vert** **The Gambia**	**The Gambia**	**The Gambia** **Casamance**	**TOTAL**
S. pilchardus	19	502	4 471	61	0	0	0	0	0	**5 053**
S. aurita	0	0	140	0	34	0	86	0	0	**260**
S. maderensis	0	0	0	7	109	0	86	10	0	**212**
E. encrasicolus	10	15	40	34	44	0	0	0	0	**143**
T. trachurus	28	52	15	2	0	0	0	0	0	**97**
T. tracae	0	0	31	7	25	48	14	1	3	**129**
S. colias	98	171	119	20	5	8	2	18	0	**441**

Table 7: Regional acoustic biomass data (million tonnes) from R/V *Dr Fridtjof Nansen* surveys 1995-2017 for the main species.

YEAR	*S. pilchardus*	*S. aurita*	*S. maderensis*	*T. trachurus*	*T. trecae*	*S. colias*	*E. encrasicolus*	*Total (without sardine)*	**Total**
1995	3.75	1.62	1.88	0.26	0.18			3.94	7.69
1996	5.56	1.63	1.53	0.45	0.66			4.27	9.83
1997	1.13	0.82	1.00	0.54	0.66			3.02	4.15
1998	1.63	0.82	1.00	0.18	0.80			2.80	4.43
1999	2.67	2.13	1.48	0.10	0.65	0.27		4.64	7.30
2000	3.65	1.91	0.79	0.28	1.76	0.10	0.24	5.08	8.73
2001	4.75	1.80	1.43	0.12	0.36	0.31	0.02	4.04	8.79
2002	6.30	1.43	0.99	0.28	0.58	0.29	0.04	3.61	9.91
2003	5.70	1.26	1.77	0.32	0.39	0.55	0.03	4.31	10.01
2004	7.41	1.59	2.45	0.18	0.73	0.51	0.08	5.54	12.95
2005	8.01	0.81	1.33	0.14	1.21	0.24	0.11	3.85	11.86
2006	3.62	1.13	2.05	0.04	0.40	0.44	0.08	4.14	7.76
2007	**5.88**	0.99	1.19	0.45	0.99	0.61	0.19	4.41	10.29
2008	**4.42**	2.00	0.55	0.33	0.70	0.63	0.12	4.32	8.74
2009	**5.04**	**2.86**	**1.67**	**0.13**	**0.87**	**0.76**	**0.05**	**6.35**	**11.39**
2010	**2.60**					0.28			
2011	**1.95**					0.38			
2012	**2.07**					0.45			
2013	**3.77**					0.65			
2014	**4.10**					1.08			
2015	4.50	0.621	0.867	0.405	0.542	0.72	0.158	3.31	7.81
2016	**2.964**	**0.036**	**0.052**	**0.225**	**0.048**	**1.056**	**0.079**		
2017	5.05	0.26	0.212	0.097	0.129	0.44	0.14	2.12	

Years 1995-2006, 2015 and 2017: data from the R/V *Dr Fridtjof Nansen.*
Years 2007-2008: data are *Nansen* equivalents of local vessels using agreed conversion factors.
Year 2009: all data from the Mauritanian R/V *Al Awan* and the Moroccan R/V *Al Amir*, and data for Senegal and the Gambia were estimated by the Working Group.
Year 2010: No estimates for the Mauritanian R/V *Al Awan*, the Moroccan R/V *Al Amir*, Senegal, and the Gambia.
Year 2011: Some estimates for the CCLME (from the R/V *Dr Fridtjof Nansen*) were presented by the CCLME project coordinator.
Year 2012: Data from Mauritanian R/V *Al Amir* were presented to the Working Group for North of Cape Blanc, and results from a survey by the Russian R/V *Atlantida* in Mauritania and Senegal.
Years 2013 and 2014: Survey data from Morocco, Mauritania, and the Russian R/V *Atlantida*.

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ANNEX I RECORDS OF FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 1
DATE :09/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 35°34.95
start stop duration Lon W 6°17.47
TIME :18:43:20 19:27:39 44.3 (min) Purpose : 1
LOG : 2141.02 2141.02 0.0 Region : 1100
FDEPTH: 30 110 Gear cond.: 0
BDEPTH: 127 125 Validity : 0
Towing dir: 0° Wire out : 400 m Speed : 5.0 kn
Sorted : 0 Total catch: 4.58 Catch/hour: 6.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Liocarcinus corrugatus	4.49	328	72.46	
Scomber colias	1.71	30	27.50	1
Trachurus trachurus	0.00	1	0.04	
Total	6.20		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 2
DATE :10/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 35°13.33
start stop duration Lon W 6°20.07
TIME :08:31:05 08:54:26 23.4 (min) Purpose : 1
LOG : 2233.39 2235.27 1.9 Region : 1100
FDEPTH: 30 70 Gear cond.: 0
BDEPTH: 110 115 Validity : 0
Towing dir: 0° Wire out : 420 m Speed : 4.8 kn
Sorted : 0 Total catch: 2.12 Catch/hour: 5.45

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Liocarcinus corrugatus	5.30	390	97.41	
Sphoeroides cf. pachygaster	0.12	3	2.12	
Trachurus picturatus	0.03	3	0.47	
Total	5.45		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 3
DATE :10/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 35°14.46
start stop duration Lon W 6°21.39
TIME :10:41:05 11:11:47 30.7 (min) Purpose : 1
LOG : 2245.03 2246.18 1.1 Region : 1100
FDEPTH: 119 116 Gear cond.: 0
BDEPTH: 119 116 Validity : 0
Towing dir: 0° Wire out : 370 m Speed : 2.3 kn
Sorted : 0 Total catch: 94.16 Catch/hour: 183.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	150.63	7846	81.88	5
Trachurus trachurus	14.85	293	8.07	3
Sardina pilchardus	13.17	326	7.16	2
Scomber colias	3.24	70	1.76	4
Alloteuthis subulata	0.55	70	0.30	
Merluccius merluccius	0.47	12	0.25	
Liocarcinus corrugatus	0.24	27	0.13	
Parapenaeus longirostris	0.16	59	0.08	
Eledone cirrhosa**	0.16	4	0.08	
Gobius sp.	0.11	23	0.06	
C R A B S	0.10	2	0.05	
Torpedo marmorata	0.10	2	0.05	
VENERIDAE	0.04	2	0.02	
Arnoglossus imperialis	0.04	6	0.02	
Starfish	0.02	10	0.01	
Citharus linguatula	0.02	2	0.01	
Macrorhamphosus scolopax	0.01	2	0.01	
Ophidion barbatum	0.00	4	0.00	
INACHIDAE	0.00	2	0.00	
Total	183.90		99.97	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 4
DATE :10/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 34°58.58
start stop duration Lon W 6°18.06
TIME :23:28:57 00:11:18 42.4 (min) Purpose : 1
LOG : 2314.74 2318.09 3.4 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 111 66 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.0 kn
Sorted : 56 Total catch: 56.20 Catch/hour: 79.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Liocarcinus corrugatus	50.30	4250	63.17	
Sardina pilchardus	12.30	354	15.45	6
Scomber colias	7.08	95	8.90	7
Alloteuthis subulata	4.68	1438	5.87	
Engraulis encrasicolus	3.53	564	4.43	
Trachurus trachurus	1.70	20	2.14	8
Boops boops	0.04	1	0.05	
Total	79.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 5
DATE :11/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 34°45.32
start stop duration Lon W 6°50.01
TIME :08:39:31 09:22:09 42.6 (min) Purpose : 1
LOG : 2369.37 2372.73 3.4 Region : 1100
FDEPTH: 25 70 Gear cond.: 0
BDEPTH: 198 266 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 4.7 kn
Sorted : 0 Total catch: 0.31 Catch/hour: 0.43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Liocarcinus corrugatus	0.42	44	97.66	
Trachurus picturatus	0.01	1	2.34	
Total	0.43		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 6
DATE :11/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 34°45.96
start stop duration Lon W 6°43.88
TIME :11:14:43 11:46:28 31.8 (min) Purpose : 1
LOG : 2383.81 2385.51 1.7 Region : 1100
FDEPTH: 50 60 Gear cond.: 0
BDEPTH: 140 155 Validity : 0
Towing dir: 0° Wire out : 165 m Speed : 3.2 kn
Sorted : 0 Total catch: 0.39 Catch/hour: 0.73

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Liocarcinus corrugatus	0.73	62	100.00	
Total	0.73		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 7
DATE :12/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 34°10.54
start stop duration Lon W 7°5.42
TIME :08:22:22 08:49:44 27.4 (min) Purpose : 1
LOG : 2518.53 2520.18 1.6 Region : 1100
FDEPTH: 140 139 Gear cond.: 0
BDEPTH: 140 139 Validity : 0
Towing dir: 0° Wire out : 400 m Speed : 3.6 kn
Sorted : 60 Total catch: 183.46 Catch/hour: 402.18

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Macrorhamphosus scolopax	141.13	8427	35.09	
	Scomber colias	120.09	3849	29.86	10
	Trachurus trachurus	67.74	919	16.84	9
	Merluccius merluccius	21.44	164	5.33	
	Pagellus acarne	15.65	59	3.89	
	Mullus surmuletus	15.45	164	3.84	
	Zeus faber	9.97	4	2.48	
	Dentex maroccanus	7.50	26	1.86	
	Lepidotrigla sp.	0.99	26	0.25	
	Eledone cirrhosa**	0.59	7	0.15	
	Scorpaena scrofa	0.56	13	0.14	
	Liocarcinus corrugatus	0.46	7	0.11	
	Zenopsis conchifer	0.23	7	0.06	
	Trachurus picturatus	0.21	13	0.05	11
	Sepia officinalis	0.13	13	0.03	
	Boops boops	0.03	7	0.01	
	Total	402.18		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 8
DATE :12/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 34°3.53
start stop duration Lon W 7°13.29
TIME :15:06:02 15:09:31 3.5 (min) Purpose : 1
LOG : 2558.38 2561.00 2.6 Region : 1100
FDEPTH: 30 80 Gear cond.: 0
BDEPTH: 127 138 Validity : 0
Towing dir: 0° Wire out : 550 m Speed : 5.0 kn
Sorted : 0 Total catch: 4.25 Catch/hour: 73.19

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Scomber colias	67.93	1000	92.82	12
	Brachydeuterus auritus	3.28	52	4.48	
	Liocarcinus corrugatus	1.98	207	2.71	
	Total	73.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 9
DATE :13/05/17 GEAR TYPE: PL NO: 1 POSITION:Lat N 33°57.19
start stop duration Lon W 7°17.82
TIME :02:32:13 03:00:18 28.1 (min) Purpose : 1
LOG : 2618.06 2619.47 1.4 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 111 108 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.0 kn
Sorted : 29 Total catch: 172.54 Catch/hour: 368.68

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardina pilchardus	194.87	4429	52.86	13
	Scomber colias	125.64	2802	34.08	14
	Engraulis encrasicolus	48.14	1938	13.06	15
	Liocarcinus corrugatus	0.03	2	0.01	
	Total	368.69		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 10
DATE :13/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 33°55.04
start stop duration Lon W 7°13.66
TIME :04:42:31 05:01:59 19.5 (min) Purpose : 1
LOG : 2629.79 2630.84 1.1 Region : 1100
FDEPTH: 40 50 Gear cond.: 0
BDEPTH: 81 97 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.2 kn
Sorted : 6 Total catch: 6.08 Catch/hour: 18.74

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Mola mola	12.51	3	66.78	
	Sardina pilchardus	4.56	114	24.34	16
	Trachurus trachurus	0.68	3	3.62	18
	Boops boops	0.63	6	3.37	
	Scomber colias	0.23	3	1.23	17
	Alloteuthis subulata	0.12	22	0.66	
	Total	18.74		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 11
DATE :13/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 33°54.00
start stop duration Lon W 7°32.29
TIME :10:05:27 10:08:59 3.5 (min) Purpose : 1
LOG : 2665.72 2667.00 1.3 Region : 1100
FDEPTH: 119 123 Gear cond.: 0
BDEPTH: 119 123 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 3.0 kn
Sorted : 68 Total catch: 283.20 Catch/hour: 4799.97

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Trachurus trachurus	2562.71	35780	53.39	19
	Engraulis encrasicolus	964.07	60254	20.08	22
	Scomber colias	782.37	17780	16.30	21
	Merluccius merluccius	151.86	2169	3.16	
	Zeus faber	150.85	68	3.14	
	Sardina pilchardus	115.59	2847	2.41	20
	Lepidopus caudatus	44.75	271	0.93	
	Parapenaeus longirostris	11.53	1153	0.24	
	Mullus surmuletus	7.46	68	0.16	
	Liocarcinus corrugatus	5.42	68	0.11	
	Boops boops	5.08	68	0.11	
	Alloteuthis subulata	1.36	136	0.03	
	Sepia officinalis	1.36	136	0.03	
	Gobius sp.	0.68	136	0.01	
	Scorpaena notata	0.51	17	0.01	
	Starfish	0.41	203	0.01	
	Venus sp.	0.14	136	0.00	
	Total	4806.14		100.13	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 12
DATE :13/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 33°50.22
start stop duration Lon W 7°42.92
TIME :18:32:40 19:33:58 61.3 (min) Purpose : 1
LOG : 2721.37 2726.42 5.1 Region : 1100
FDEPTH: 30 85 Gear cond.: 0
BDEPTH: 118 128 Validity : 0
Towing dir: 0° Wire out : 420 m Speed : 4.9 kn
Sorted : 70 Total catch: 350.35 Catch/hour: 342.92

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardina pilchardus	200.16	5381	58.37	23
	Scomber colias	121.37	3390	35.39	24
	Engraulis encrasicolus	20.75	778	6.05	25
	Liocarcinus corrugatus	0.64	59	0.19	
	Total	342.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 13
DATE :13/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 33°44.65
start stop duration Lon W 7°31.92
TIME :22:23:24 22:45:40 22.3 (min) Purpose : 1
LOG : 2743.83 2744.98 1.2 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 66 58 Validity : 0
Towing dir: 0° Wire out : 135 m Speed : 3.1 kn
Sorted : 72 Total catch: 72.39 Catch/hour: 195.02

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Scomber colias	132.77	2562	68.08	28
	Sardina pilchardus	52.86	1323	27.11	26
	Engraulis encrasicolus	4.53	310	2.32	27
	Trachurus trachurus	3.61	19	1.85	29
	Liocarcinus corrugatus	0.92	86	0.47	
	Alloteuthis subulata	0.19	57	0.10	
	Boops boops	0.15	3	0.08	
	Total	195.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 14
DATE :14/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 33°41.47
start stop duration Lon W 7°44.05
TIME :02:05:20 02:35:09 29.8 (min) Purpose : 1
LOG : 2763.44 2764.90 1.5 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 70 80 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 2.9 kn
Sorted : 48 Total catch: 47.74 Catch/hour: 96.07

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardina pilchardus	45.67	1157	47.54	31
	Scomber colias	40.52	1054	42.18	32
	Engraulis encrasicolus	9.46	644	9.84	30
	Liocarcinus corrugatus	0.19	18	0.20	
	Alloteuthis subulata	0.13	60	0.14	
	Belone belone gracilis	0.09	2	0.09	
	Total	96.07		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 15
DATE :14/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 33°49.08
start stop duration Lon W 7°57.45
TIME :04:26:41 05:00:32 33.9 (min) Purpose : 1
LOG : 2777.09 2779.66 2.6 Region : 1100
FDEPTH: 80 80 Gear cond.: 0
BDEPTH: 125 130 Validity : 0
Towing dir: 0° Wire out : 500 m Speed : 4.6 kn
Sorted : 70 Total catch: 703.20 Catch/hour: 1246.44

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Scomber colias	1076.28	32032	86.35	33
	Sardina pilchardus	124.08	3300	9.95	34
	Engraulis encrasicolus	46.09	1728	3.70	35
	Total	1246.44		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 16
DATE :14/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 33°47.90
start stop duration Lon W 8°14.91
TIME :09:45:55 09:46:58 1.1 (min) Purpose : 1
LOG : 2813.22 2816.00 2.8 Region : 1100
FDEPTH: 30 130 Gear cond.: 0
BDEPTH: 148 172 Validity : 0
Towing dir: 0° Wire out : 650 m Speed : 4.5 kn
Sorted : 0 Total catch: 1.22 Catch/hour: 69.71

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Scomber scombrus	33.43	457	47.95	37
	Scomber colias	32.29	800	46.31	36
	Boops boops	4.00	57	5.74	
	Total	69.71		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 17
DATE :14/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 33°42.51
start stop duration Lon W 8°4.63
TIME :13:32:03 14:15:00 43.0 (min) Purpose : 1
LOG : 2833.37 2838.00 4.6 Region : 1100
FDEPTH: 112 109 Gear cond.: 0
BDEPTH: 112 109 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.0 kn
Sorted : 78 Total catch: 194.70 Catch/hour: 271.93

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Engraulis encrasicolus	173.18	1082	63.69	39
	Scomber colias	40.50	1205	14.89	
	Trachurus trachurus	34.22	446	12.58	41
	Sardina pilchardus	18.30	418	6.73	38
	Merluccius merluccius	2.72	56	1.00	
	Scomber scombrus	1.05	14	0.39	40
	Eledone cirrhosa**	0.60	3	0.22	
	Mullus surmuletus	0.56	7	0.21	
	Boops boops	0.56	7	0.21	
	Sepia officinalis	0.15	7	0.06	
	Alloteuthis subulata	0.01	3	0.00	
	Total	271.85		99.97	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 18
DATE :14/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 33°32.83
start stop duration Lon W 8°6.10
TIME :19:44:40 19:57:05 12.4 (min) Purpose : 1
LOG : 2874.60 2875.36 0.8 Region : 1100
FDEPTH: 20 40 Gear cond.: 0
BDEPTH: 57 56 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.7 kn
Sorted : 31 Total catch: 31.05 Catch/hour: 150.02

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	98.55	1918	65.69	42
Sardina pilchardus	51.50	1285	34.33	43
Liocarcinus corrugatus	0.07	10	0.05	
Total	150.12		100.06	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 19
DATE :14/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 33°35.10
start stop duration Lon W 8°11.03
TIME :20:53:47 22:39:43 105.9(min) Purpose : 1
LOG : 2881.53 0.00 0.0 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 73 0 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 0.0 kn
Sorted : 0 Total catch: 100.36 Catch/hour: 56.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	49.03	1679	86.26	44
Sardina pilchardus	6.86	161	12.08	46
Engraulis encrasicolus	0.89	40	1.57	45
Total	56.79		99.91	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 20
DATE :15/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 33°34.68
start stop duration Lon W 8°33.61
TIME :04:35:30 05:07:41 32.2 (min) Purpose : 1
LOG : 2933.24 2934.69 1.4 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 128 119 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 2.7 kn
Sorted : 28 Total catch: 27.94 Catch/hour: 52.09

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	25.62	615	49.18	47
Scomber colias	25.58	893	49.11	48
Engraulis encrasicolus	0.89	17	1.70	49
Trachurus picturatus	0.01	2	0.02	
Total	52.09		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 21
DATE :15/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 33°20.66
start stop duration Lon W 8°55.89
TIME :15:25:55 15:49:45 23.8 (min) Purpose : 1
LOG : 3010.63 3011.90 1.3 Region : 1100
FDEPTH: 163 159 Gear cond.: 0
BDEPTH: 163 159 Validity : 0
Towing dir: 0° Wire out : 450 m Speed : 3.2 kn
Sorted : 68 Total catch: 1842.09 Catch/hour: 4638.07

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	2522.11	74178	54.38	50
Trachurus picturatus	1116.26	22323	24.07	51
Centracanthus cirrus	957.18	191436	20.64	
Sardina pilchardus	10.20	136	0.22	
Engraulis encrasicolus	9.84	340	0.21	52
Sphoeroides cf. pachygaster	6.32	8	0.14	
Zenopsis conchifer	4.76	136	0.10	
Zeus faber	3.84	3	0.08	
Boops boops	3.40	68	0.07	
Capros aper	1.70	136	0.04	
Pagellus acarne	1.63	68	0.04	
Mullus surmuletus	0.82	68	0.02	
Total	4638.06		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 22
DATE :15/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 33°4.89
start stop duration Lon W 8°48.90
TIME :20:58:21 21:15:47 17.4 (min) Purpose : 1
LOG : 3043.73 3044.67 0.9 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 68 88 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.2 kn
Sorted : 55 Total catch: 110.32 Catch/hour: 379.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	322.20	8262	84.84	54
Scomber colias	53.01	1236	13.96	53
Engraulis encrasicolus	3.58	269	0.94	55
Boops boops	0.96	21	0.25	
Total	379.76		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 23
DATE :15/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 33°8.41
start stop duration Lon W 8°54.42
TIME :23:27:19 23:55:09 27.8 (min) Purpose : 1
LOG : 3050.07 3050.07 0.0 Region : 1100
FDEPTH: 30 35 Gear cond.: 0
BDEPTH: 116 198 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 0.0 kn
Sorted : 0 Total catch: 9.44 Catch/hour: 20.34

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	14.79	476	72.71	58
Sardina pilchardus	5.19	132	25.49	57
Engraulis encrasicolus	0.37	13	1.80	56
Total	20.34		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 24
DATE :16/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 33°6.22
start stop duration Lon W 9°12.60
TIME :05:14:12 05:37:59 23.8 (min) Purpose : 1
LOG : 3090.24 3091.31 1.1 Region : 1100
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 130 128 Validity : 0
Towing dir: 0° Wire out : 125 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:2017401 STATION: 25
DATE :16/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 32°58.74
start stop duration Lon W 9°24.50
TIME :14:39:37 15:38:39 59.0 (min) Purpose : 1
LOG : 3154.08 3158.47 4.4 Region : 1100
FDEPTH: 30 130 Gear cond.: 0
BDEPTH: 171 173 Validity : 0
Towing dir: 0° Wire out : 850 m Speed : 4.5 kn
Sorted : 0 Total catch: 0.10 Catch/hour: 0.11

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber scombrus	0.11	1	100.00	59
Total	0.11		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 26
DATE :16/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 32°36.90
start stop duration Lon W 9°16.42
TIME :20:01:29 20:15:08 13.7 (min) Purpose : 1
LOG : 3194.14 3194.93 0.8 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 61 59 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.5 kn
Sorted : 72 Total catch: 358.40 Catch/hour: 1575.38

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	1534.07	37235	97.38	60
Scomber colias	41.32	1560	2.62	61
Total	1575.38		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 27
DATE :16/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 32°40.50
start stop duration Lon W 9°32.60
TIME :22:19:00 22:42:00 23.0 (min) Purpose : 1
LOG : 3211.00 3212.00 1.0 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 106 180 Validity : 0
Towing dir: 0° Wire out : 135 m Speed : 0.0 kn
Sorted : 51 Total catch: 152.21 Catch/hour: 397.07

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	371.11	12537	93.46	62
Sardina pilchardus	12.99	352	3.27	63
Engraulis encrasicolus	10.20	368	2.57	64
Trachurus picturatus	2.37	110	0.60	65
Illex coindetii	0.37	3	0.09	
Total	397.04		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 28
DATE :17/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 32°30.85
start stop duration Lon W 9°34.89
TIME :01:58:01 02:31:16 33.3 (min) Purpose : 1
LOG : 3231.43 3233.07 1.6 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 89 97 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.0 kn
Sorted : 38 Total catch: 37.60 Catch/hour: 67.85

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	65.14	1063	96.01	67
Sardina pilchardus	2.55	56	3.76	68
Engraulis encrasicolus	0.16	5	0.23	66
Total	67.85		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 29
DATE :17/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 32°26.73
start stop duration Lon W 9°19.49
TIME :04:47:40 05:09:38 22.0 (min) Purpose : 1
LOG : 3245.32 3246.51 1.2 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 49 45 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.2 kn
Sorted : 45 Total catch: 44.88 Catch/hour: 122.57

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	116.67	3135	95.19	69
Engraulis encrasicolus	5.13	385	4.19	71
Scomber colias	0.60	16	0.49	70
Alloteuthis subulata	0.16	44	0.13	
Total	122.57		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 30
DATE :17/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 32°14.43
start stop duration Lon W 9°22.39
TIME :08:18:55 08:39:19 20.4 (min) Purpose : 1
LOG : 3267.71 3268.84 1.1 Region : 1100
FDEPTH: 43 44 Gear cond.: 0
BDEPTH: 43 44 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.3 kn
Sorted : 68 Total catch: 103.17 Catch/hour: 303.43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	180.26	2844	59.41	72
Scomber colias	108.97	2368	35.91	73
Engraulis encrasicolus	4.85	294	1.60	74
Merluccius merluccius	2.43	15	0.80	
Diplodus vulgaris	2.03	47	0.67	
Boops boops	2.03	26	0.67	
Trachinus draco	0.94	12	0.31	
Sepia officinalis	0.76	3	0.25	
Mullus surmuletus	0.25	3	0.08	
Starfish	0.22	35	0.07	
Arnoglossus imperialis	0.19	9	0.06	
Trachurus trachurus	0.18	6	0.06	
Dicologoglossa cuneata	0.12	3	0.04	
Alloteuthis subulata	0.11	26	0.04	

Gobius sp.	0.09	26	0.03
Total	303.43		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 31
DATE :17/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 32°7.60
start stop duration Lon W 9°37.90
TIME :14:26:14 14:40:40 14.4 (min) Purpose : 1
LOG : 3325.25 3326.00 0.8 Region : 1100
FDEPTH: 56 55 Gear cond.: 0
BDEPTH: 56 55 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3.0 kn
Sorted : 61 Total catch: 151.65 Catch/hour: 630.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	450.10	9376	71.38	75
Scomber colias	158.00	2840	25.06	76
Pagellus acarne	12.16	62	1.93	
Trachurus trachurus	8.84	62	1.40	77
Diplodus vulgaris	1.46	4	0.23	
Total	630.56		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 32
DATE :17/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 31°56.80
start stop duration Lon W 9°39.19
TIME :20:15:54 20:35:21 19.4 (min) Purpose : 1
LOG : 3357.69 3358.71 1.0 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 43 42 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.1 kn
Sorted : 72 Total catch: 178.78 Catch/hour: 551.51

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	323.44	8557	58.65	78
Scomber colias	192.34	4982	34.88	79
Trachurus trachurus	31.93	540	5.79	81
Engraulis encrasicolus	2.16	133	0.39	80
Boops boops	0.77	15	0.14	
Trachinus draco	0.77	9	0.14	
Alloteuthis subulata	0.09	15	0.02	
Total	551.51		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 33
DATE :17/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 32°0.95
start stop duration Lon W 9°54.42
TIME :23:23:30 23:53:35 30.1 (min) Purpose : 1
LOG : 3372.32 3373.80 1.5 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 149 304 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.0 kn
Sorted : 0 Total catch: 86.00 Catch/hour: 171.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	156.42	4181	91.19	82
MYCTOPHIDAE	10.08	10083	5.88	
Scomber scombrus	2.69	36	1.57	83
Illex coindetii	1.29	12	0.75	
Trachurus trachurus	0.72	18	0.42	85
Engraulis encrasicolus	0.33	12	0.19	84
Alloteuthis subulata	0.01	6	0.00	
Total	171.54		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 34
DATE :18/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 31°46.27
start stop duration Lon W 9°41.09
TIME :08:25:22 08:40:14 14.9 (min) Purpose : 1
LOG : 3422.89 3423.74 0.8 Region : 1100
FDEPTH: 33 34 Gear cond.: 0
BDEPTH: 33 34 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.4 kn
Sorted : 74 Total catch: 1002.94 Catch/hour: 4046.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	2794.42	79840	69.05	86
Scomber colias	704.87	16317	17.42	87
Engraulis encrasicolus	446.67	31529	11.04	88
Diplodus vulgaris	43.58	218	1.08	
Campogramma glaycos	35.39	165	0.87	
Merluccius merluccius	10.61	165	0.26	
Boops boops	7.34	109	0.18	
VOLUTIDAE	2.30	4	0.06	
Alloteuthis subulata	1.09	218	0.03	
Trachurus trachurus	0.56	56	0.01	
Total	4046.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 35
DATE :18/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 31°42.33
start stop duration Lon W 9°53.56
TIME :11:57:14 12:25:17 28.1 (min) Purpose : 1
LOG : 3449.46 3451.14 1.7 Region : 1100
FDEPTH: 72 72 Gear cond.: 0
BDEPTH: 72 72 Validity : 0
Towing dir: 0° Wire out : 210 m Speed : 3.6 kn
Sorted : 71 Total catch: 249.10 Catch/hour: 532.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	473.01	24678	88.77	89
Trachurus trachurus	46.46	518	8.72	90
Merluccius merluccius	6.89	75	1.29	
Spondyliosoma cantharus	1.81	2	0.34	
Alloteuthis subulata	1.30	293	0.24	
Starfish	1.24	637	0.23	
Lepidopus caudatus	0.56	53	0.10	
Scomber colias	0.45	9	0.08	
Capros aper	0.39	9	0.07	
Squilla mantis	0.17	4	0.03	
Liocarcinus sp	0.11	2	0.02	
Gobius sp.	0.11	15	0.02	
Goneplax sp.	0.09	15	0.02	
Aphroditidae spCV1	0.09	2	0.02	
DORIPPIDAE	0.06	2	0.01	
Cepola macrophthalma	0.06	2	0.01	
VOLUTIDAE	0.05	2	0.01	
Total	532.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 36
DATE :19/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 31°19.14
start stop duration Lon W 9°50.61
TIME :07:55:07 08:29:38 34.5 (min) Purpose : 1
LOG : 3521.01 3522.87 1.9 Region : 1100
FDEPTH: 45 43 Gear cond.: 0
BDEPTH: 45 43 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.2 kn
Sorted : 67 Total catch: 268.94 Catch/hour: 467.45

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	253.77	3532	54.29	91
Trachurus trachurus	134.46	1415	28.76	93
Diplodus puntazzo	43.24	70	9.25	
Merluccius merluccius	15.54	278	3.32	
Sardina pilchardus	4.94	97	1.06	94
Engraulis encrasicolus	4.83	322	1.03	92
Boops boops	2.82	35	0.60	
Alloteuthis subulata	2.40	600	0.51	
Octopus vulgaris	2.29	2	0.49	
Cepola macrophthalma	0.87	21	0.19	
Squilla mantis	0.83	28	0.18	
Aspitrigla obscura	0.63	7	0.13	
Callionymus lyra	0.45	14	0.10	
PAGUROIDEA	0.14	7	0.03	
Gobius sp.	0.10	3	0.02	
Liocarcinus sp	0.10	7	0.02	
Starfish	0.03	2	0.01	
Total	467.45		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 37
DATE :19/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 31°1.48
start stop duration Lon W 9°53.68
TIME :21:20:04 21:49:00 28.9 (min) Purpose : 1
LOG : 3611.05 3612.63 1.6 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 66 68 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.3 kn
Sorted : 16 Total catch: 22.91 Catch/hour: 47.53

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	20.70	6	43.55	95
Alopias vulpinus	13.98	2	29.41	
JELLYFISH	8.86	2	18.63	
Alloteuthis subulata	2.36	630	4.97	
Engraulis encrasicolus	0.81	48	1.70	97
Sardina pilchardus	0.59	25	1.24	96
Merluccius merluccius	0.21	10	0.44	
Trachurus trachurus	0.02	2	0.04	
Total	47.53		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 38
DATE :20/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 30°50.98
start stop duration Lon W 9°50.89
TIME :08:01:57 08:22:43 20.8 (min) Purpose : 1
LOG : 3667.93 3669.16 1.2 Region : 1100
FDEPTH: 47 50 Gear cond.: 0
BDEPTH: 47 50 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3.5 kn
Sorted : 75 Total catch: 565.83 Catch/hour: 1634.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	1131.39	33276	69.22	98
Trachurus trachurus	226.19	0	13.84	100
Scomber colias	158.16	2372	9.68	99
Merluccius merluccius	35.65	390	2.18	
Pagellus acarne	22.65	260	1.39	
Trigla sp.	20.60	23	1.26	
Spondyliosoma cantharus	13.43	110	0.82	
Boops boops	10.63	87	0.65	
Trisopterus luscus	7.92	153	0.48	
Raja asterias	4.62	3	0.28	
Starfish	0.87	23	0.05	
Callionymus lyra	0.87	23	0.05	
PAGUROIDEA	0.66	43	0.04	
Alloteuthis subulata	0.66	260	0.04	
Engraulis encrasicolus	0.32	23	0.02	101
Total	1634.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 39
DATE :20/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 30°42.89
start stop duration Lon W 9°58.78
TIME :10:41:03 11:08:33 27.5 (min) Purpose : 1
LOG : 3685.51 3687.07 1.6 Region : 1100
FDEPTH: 83 83 Gear cond.: 0
BDEPTH: 83 83 Validity : 0
Towing dir: 0° Wire out : 230 m Speed : 3.4 kn
Sorted : 60 Total catch: 244.28 Catch/hour: 532.99

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trachurus	315.84	3388	59.26	103
Scomber colias	170.53	4951	32.00	104
Sardina pilchardus	13.88	419	2.60	102
Merluccius merluccius	6.68	61	1.25	
Octopus vulgaris	6.26	4	1.17	
Engraulis encrasicolus	5.85	175	1.10	105
Lepidopus caudatus	5.24	279	0.98	
Scorpaena scrofa	2.36	44	0.44	
Alloteuthis subulata	1.70	524	0.32	
Palinurus mauritanicus	1.36	2	0.26	
Trisopterus luscus	1.13	9	0.21	
Trigla sp.	0.79	2	0.15	
Squilla mantis	0.39	9	0.07	
Citharus linguatula	0.26	9	0.05	
Liocarcinus sp	0.26	9	0.05	
Conger sp.	0.26	9	0.05	
Capros aper	0.22	79	0.04	
Gobius sp.	0.09	9	0.02	
Macrorhamphosus scolopax	0.09	9	0.02	
Goneplax sp.	0.04	9	0.01	
Total	533.23		100.05	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 40
DATE :20/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 30°39.57
start stop duration Lon W 10°9.49
TIME :13:54:57 14:27:04 32.1 (min) Purpose : 1
LOG : 3707.97 3709.83 1.9 Region : 1100
FDEPTH: 155 163 Gear cond.: 0
BDEPTH: 155 163 Validity : 0
Towing dir: 0° Wire out : 470 m Speed : 3.5 kn
Sorted : 57 Total catch: 316.05 Catch/hour: 590.37

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trachurus	407.05	3271	68.95	106
Trachurus picturatus	58.41	463	9.89	107
Scomber colias	42.89	596	7.26	108
Capros aper	41.62	1423	7.05	
Lepidopus caudatus	35.47	801	6.01	
Parapenaeus longirostris, female	1.85	176	0.31	
Sea cucumber	1.70	6	0.29	
Dentex macrophthalmus	0.89	4	0.15	
Mullus surmuletus	0.35	2	0.06	
Loligo vulgaris	0.25	2	0.04	
PAGUROIDEA	0.13	2	0.02	
Total	590.61		100.04	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 41
DATE :20/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 30°12.44
start stop duration Lon W 9°54.88
TIME :23:42:58 00:12:09 29.2 (min) Purpose : 1
LOG : 3792.74 3794.09 1.4 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 133 131 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 2.8 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:2017401 STATION: 42
DATE :21/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 29°53.89
start stop duration Lon W 9°59.13
TIME :07:37:35 08:03:40 26.1 (min) Purpose : 1
LOG : 3859.07 3860.54 1.5 Region : 1100
FDEPTH: 118 128 Gear cond.: 0
BDEPTH: 118 128 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 3.4 kn
Sorted : 65 Total catch: 537.31 Catch/hour: 1236.14

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trachurus	760.67	10594	61.54	109
Scomber colias	353.37	12186	28.59	110
Pagellus acarne	32.85	110	2.66	
Conger conger	31.52	2	2.55	
Merluccius merluccius	13.25	202	1.07	
Trisopterus luscus	12.61	258	1.02	
Lepidopus caudatus	11.96	667	0.97	
Engraulis encrasicolus	5.80	239	0.47	111
Capros aper	5.61	248	0.45	
Sea cucumber	5.38	16	0.44	
Palinurus mauritanicus	1.61	2	0.13	
Starfish	0.51	5	0.04	
Macrorhamphosus scolopax ***	0.37	74	0.03	
Scorpaena notata	0.37	18	0.03	
Alloteuthis subulata	0.25	92	0.02	
Total	1236.14		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 43
DATE :21/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 29°46.05
start stop duration Lon W 10°11.75
TIME :14:30:09 15:00:28 30.3 (min) Purpose : 1
LOG : 3900.25 3901.97 1.7 Region : 1100
FDEPTH: 123 132 Gear cond.: 0
BDEPTH: 123 132 Validity : 0
Towing dir: 0° Wire out : 370 m Speed : 3.4 kn
Sorted : 61 Total catch: 188.47 Catch/hour: 372.95

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trachurus	280.80	4249	75.29	112
Scomber colias	73.73	0	19.77	113
Zeus faber	7.22	4	1.94	
Merluccius merluccius	5.70	12	1.53	
Dentex maroccanus	2.49	24	0.67	
Sea cucumber	0.98	6	0.26	
Pagellus acarne	0.46	6	0.12	
Boops boops	0.42	6	0.11	
Engraulis encrasicolus	0.40	18	0.11	114
Lepidopus caudatus	0.40	30	0.11	
Microchirus variegatus	0.24	6	0.06	
Raja miraletus	0.12	2	0.03	
Total	372.95		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 44
DATE :21/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 29°38.43
start stop duration Lon W 10°14.59
TIME :20:28:20 21:00:56 32.6 (min) Purpose : 1
LOG : 3936.47 3938.23 1.8 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 100 81 Validity : 0
Towing dir: 0° Wire out : 135 m Speed : 3.2 kn
Sorted : 44 Total catch: 44.35 Catch/hour: 81.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	80.43	1277	98.52	115
Engraulis encrasicolus	1.03	42	1.26	116
Sardina pilchardus	0.14	4	0.17	117
Alloteuthis subulata	0.02	13	0.02	
Sepia officinalis	0.02	4	0.02	
Total	81.63		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 45
DATE :21/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 29°36.04
start stop duration Lon W 10°7.52
TIME :22:34:08 22:44:45 10.6 (min) Purpose : 1
LOG : 3948.62 3949.22 0.6 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 60 53 Validity : 0
Towing dir: 0° Wire out : 135 m Speed : 3.4 kn
Sorted : 0 Total catch: 206.88 Catch/hour: 1168.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	1097.63	25977	93.91	119
Engraulis encrasicolus	71.19	5621	6.09	118
Total	1168.81		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 46
DATE :22/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 29°28.22
start stop duration Lon W 10°14.38
TIME :00:34:53 01:02:45 27.9 (min) Purpose : 1
LOG : 3961.67 3963.18 1.5 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 49 53 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.3 kn
Sorted : 0 Total catch: 214.11 Catch/hour: 460.95

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	443.83	1445	96.29	122
Engraulis encrasicolus	13.30	943	2.89	120
Scomber colias	3.81	116	0.83	121
Total	460.95		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 47
DATE :22/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 29°15.31
start stop duration Lon W 10°20.67
TIME :08:10:29 08:23:16 12.8 (min) Purpose : 1
LOG : 4024.15 4025.01 0.9 Region : 1100
FDEPTH: 30 29 Gear cond.: 0
BDEPTH: 30 29 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 4.0 kn
Sorted : 60 Total catch: 217.82 Catch/hour: 1022.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	763.43	0	74.65	125
Engraulis encrasicolus	81.41	7080	7.96	123
Diplodus vulgaris	78.87	1192	7.71	
Raja undulata	21.13	5	2.07	
Trachurus trachurus	19.81	296	1.94	
Scomber colias	11.60	347	1.13	124
Pomadasys incisus	9.39	99	0.92	
Pagellus acarne	6.67	9	0.65	
Merluccius merluccius	5.02	42	0.49	
Trachinus draco	4.77	42	0.47	
Penaeus kerathurus	4.18	70	0.41	
Raja microocellata	3.76	5	0.37	
Loligo vulgaris	2.49	5	0.24	
Alloteuthis subulata	0.85	33	0.08	
Total	1013.36		99.09	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 48
DATE :22/05/17 GEAR TYPE: PT NO: 2 POSITION:Lat N 29°12.86
start stop duration Lon W 10°55.90
TIME :15:15:44 16:03:09 47.4 (min) Purpose : 1
LOG : 4086.56 4090.56 4.0 Region : 1100
FDEPTH: 30 80 Gear cond.: 0
BDEPTH: 110 102 Validity : 0
Towing dir: 0° Wire out : 550 m Speed : 5.1 kn
Sorted : 16 Total catch: 16.20 Catch/hour: 20.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	16.63	605	81.11	
Mola mola	3.69	1	18.02	
Scomber colias	0.09	1	0.46	126
Sphoeroides cf. pachygaster	0.08	1	0.40	
Total	20.50		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 49
DATE :22/05/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 28°58.21
start stop duration Lon W 10°48.22
TIME :20:28:49 20:58:35 29.8 (min) Purpose : 1
LOG : 4128.68 4130.32 1.6 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 58 59 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.3 kn
Sorted : 70 Total catch: 69.75 Catch/hour: 140.59

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	112.06	2179	79.71	128
Sardina pilchardus	18.24	421	12.97	127
Trachurus trachurus	9.37	18	6.67	129
Alloteuthis subulata	0.69	343	0.49	
Engraulis encrasicolus	0.23	12	0.16	130
Total	140.59		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 50
DATE :23/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 28°48.32
start stop duration Lon W 10°59.27
TIME :09:28:24 09:53:18 24.9 (min) Purpose : 1
LOG : 4212.73 4214.15 1.4 Region : 1100
FDEPTH: 29 29 Gear cond.: 0
BDEPTH: 29 29 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.4 kn
Sorted : 72 Total catch: 794.80 Catch/hour: 1915.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	977.54	0	51.04	131
Sardina pilchardus	880.00	44222	45.95	132
Scomber colias	23.86	186	1.25	133
Raja microocellata	18.99	10	0.99	
Diplodus vulgaris	9.28	80	0.48	
Merluccius merluccius	3.59	106	0.19	
JELLYFISH	0.81	2	0.04	
Starfish	0.53	398	0.03	
Liocarcinus corrugatus	0.53	80	0.03	
Alloteuthis subulata	0.05	53	0.00	
Total	1915.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 51
DATE :24/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 29°1.80
start stop duration Lon W 12°6.48
TIME :03:13:14 03:44:35 31.4 (min) Purpose : 1
LOG : 4374.70 4376.68 2.0 Region : 1100
FDEPTH: 35 30 Gear cond.: 0
BDEPTH: 459 425 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.8 kn
Sorted : 0 Total catch: 18.88 Catch/hour: 36.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	34.91	19041	96.64	
SALPS	1.22	40	3.36	
Total	36.12		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 52
DATE :24/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 28°40.50
start stop duration Lon W 11°55.28
TIME :07:24:53 07:47:02 22.1 (min) Purpose : 1
LOG : 4408.32 4409.52 1.2 Region : 1100
FDEPTH: 84 85 Gear cond.: 0
BDEPTH: 84 85 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 3.3 kn
Sorted : 69 Total catch: 2967.86 Catch/hour: 8039.35

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	6366.72	225771	79.19	134
Engraulis encrasicolus	1382.60	69828	17.20	135
Trachurus trachurus	162.50	2446	2.02	136
Pagellus acarne	104.83	466	1.30	
Diplodus vulgaris	20.40	116	0.25	
Merluccius merluccius	2.33	116	0.03	
Total	8039.38		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 53
DATE :24/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 28°31.64
start stop duration Lon W 11°46.28
TIME :09:58:54 10:19:16 20.4 (min) Purpose : 1
LOG : 4425.99 4427.11 1.1 Region : 1100
FDEPTH: 59 60 Gear cond.: 0
BDEPTH: 59 60 Validity : 0
Towing dir: 0° Wire out : 170 m Speed : 3.3 kn
Sorted : 69 Total catch: 588.31 Catch/hour: 1732.87

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	1538.26	0	88.77	137
Trachurus trachurus	93.14	186	5.37	139
Sardina pilchardus	64.48	180	3.72	138
Diplodus vulgaris	11.63	77	0.67	
Pagellus acarne	10.01	77	0.58	
Spondyliosoma cantharus	8.39	100	0.48	
Mullus surmuletus	3.12	27	0.18	
Boops boops	2.12	27	0.12	
Trachinus draco	1.38	27	0.08	
Starfish	0.24	3	0.01	
PAGUROIDEA	0.09	6	0.01	
Total	1732.87		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 54
DATE :24/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 28°18.96
start stop duration Lon W 11°53.80
TIME :14:29:42 14:58:04 28.4 (min) Purpose : 1
LOG : 4464.64 4466.32 1.7 Region : 1100
FDEPTH: 47 46 Gear cond.: 0
BDEPTH: 47 46 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3.5 kn
Sorted : 71 Total catch: 172.40 Catch/hour: 364.61

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	220.69	5932	60.53	141
Sardina pilchardus	102.26	2185	28.05	140
Spondyliosoma cantharus	7.24	74	1.99	
Pagellus acarne	6.05	21	1.66	
Jellyfish	6.00	6	1.64	
Diplodus vulgaris	5.79	27	1.59	
Trachinus draco	3.89	95	1.07	
Loligo vulgaris	3.60	32	0.99	
Trachurus trachurus	3.23	42	0.88	142
Merluccius merluccius	1.77	21	0.49	
Dentex maroccanus	1.32	6	0.36	
Torpedo sp.	1.16	2	0.32	
Starfish	0.93	11	0.25	
Trigla sp.	0.69	2	0.19	
Total	364.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 55
DATE :24/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 28°31.98
start stop duration Lon W 12°9.58
TIME :17:43:19 18:13:54 30.6 (min) Purpose : 1
LOG : 4489.17 4490.84 1.7 Region : 1100
FDEPTH: 94 91 Gear cond.: 0
BDEPTH: 94 91 Validity : 0
Towing dir: 0° Wire out : 295 m Speed : 3.3 kn
Sorted : 68 Total catch: 353.78 Catch/hour: 694.14

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	493.46	17976	71.09	143
Trachurus trachurus	145.19	2272	20.92	144
Sphoeroides cf. pachygaster	16.72	14	2.41	
Pagellus acarne	15.16	69	2.18	
Octopus vulgaris	7.18	2	1.03	
Spondyliosoma cantharus	4.66	29	0.67	
Engraulis encrasicolus	3.14	167	0.45	145
Raja miraletus	2.67	0	0.38	
Diplodus vulgaris	2.35	10	0.34	
Dentex macrophthalmus	1.96	10	0.28	
Merluccius merluccius	0.59	10	0.08	
Macrorhamphosus scolopax	0.49	10	0.07	
Trigla sp.	0.20	10	0.03	
Capros aper	0.15	10	0.02	
PAGUROIDEA	0.13	2	0.02	
Citharus linguatula	0.10	10	0.01	
Total	694.14		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 56
DATE :25/05/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°19.69
start stop duration Lon W 12°20.16
TIME :02:06:21 02:38:35 32.2 (min) Purpose : 1
LOG : 4565.15 4566.80 1.6 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 56 54 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.1 kn
Sorted : 0 Total catch: 35.73 Catch/hour: 66.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	65.98	2104	99.17	148
Sardina pilchardus	0.20	4	0.31	147
Engraulis encrasicolus	0.20	17	0.29	146
MYCTOPHIDAE	0.13	93	0.20	
Loligo vulgaris	0.02	4	0.03	
Total	66.52		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 57
DATE :25/05/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 28°6.00
start stop duration Lon W 12°14.69
TIME :05:19:21 05:33:55 14.6 (min) Purpose : 1
LOG : 4587.95 4588.70 0.8 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 30 28 Validity : 0
Towing dir: 0° Wire out : 135 m Speed : 3.1 kn
Sorted : 0 Total catch: 36.49 Catch/hour: 150.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	134.08	2771	89.22	149
Scomber colias	15.61	432	10.38	150
Engraulis encrasicolus	0.58	95	0.38	151
Alloteuthis subulata	0.02	4	0.01	
Total	150.29		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 58
DATE :25/05/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 28°26.14
start stop duration Lon W 12°53.29
TIME :10:40:12 11:10:21 30.1 (min) Purpose : 1
LOG : 4638.15 4639.69 1.5 Region : 1100
FDEPTH: 109 109 Gear cond.: 0
BDEPTH: 109 109 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.1 kn
Sorted : 71 Total catch: 412.64 Catch/hour: 821.17

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	671.46	50486	81.77	152
Centracanthus cirrus	73.92	2310	9.00	
Trachurus trachurus	50.35	927	6.13	153
Boops boops	6.41	92	0.78	
Macrorhamphosus scolopax	4.12	275	0.50	
Octopus vulgaris	4.05	2	0.49	
Dentex maroccanus	3.15	24	0.38	
Pagellus acarne	1.89	12	0.23	
Trachurus picturatus	1.72	70	0.21	154
Paracentrotus sp.	1.37	92	0.17	
Dentex macrophthalmus	0.86	12	0.10	
Raja miraletus	0.81	2	0.10	
Macrorhamphosus gracilis	0.69	171	0.08	
Sphoeroides cf. pachygaster	0.39	2	0.05	
Total	821.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 59
DATE :12/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 27°48.09
start stop duration Lon W 13°8.40
TIME :21:07:32 21:34:40 27.1 (min) Purpose : 1
LOG : 6203.80 6205.34 1.5 Region : 1100
FDEPTH: 10 15 Gear cond.: 0
BDEPTH: 42 45 Validity : 0
Towing dir: 0° Wire out : 200 m Speed : 3.4 kn
Sorted : 104 Total catch: 629.78 Catch/hour: 1392.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	1369.67	32112	98.34	155
Scomber colias	12.38	166	0.89	156
Pomatomus saltatrix	5.13	11	0.37	
Loligo vulgaris	3.12	11	0.22	
Engraulis encrasicolus	2.85	40	0.20	
Belone belone gracilis	0.93	4	0.07	
Trachurus trachurus	0.22	4	0.02	
Merluccius merluccius	0.13	2	0.01	
Total	1394.44		100.12	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 60
DATE :13/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°43.60
start stop duration Lon W 13°23.88
TIME :02:22:06 03:00:35 38.5 (min) Purpose : 1
LOG : 6235.74 6237.64 1.9 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 100 88 Validity : 0
Towing dir: 0° Wire out : 170 m Speed : 3.0 kn
Sorted : 0 Total catch: 1.24 Catch/hour: 1.93

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Octopus vulgaris	1.38	2	71.37	
Engraulis encrasicolus	0.41	28	20.97	157
Diaphus dumerilii	0.08	23	4.03	
Scomber colias	0.05	3	2.82	
Macrorhamphosus gracilis	0.01	3	0.40	
Sepiola atlantica	0.01	5	0.40	
Total	1.93		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 61
DATE :13/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 27°34.07
start stop duration Lon W 13°30.45
TIME :08:13:37 08:57:06 43.5 (min) Purpose : 1
LOG : 6278.65 6281.60 3.0 Region : 1100
FDEPTH: 50 80 Gear cond.: 0
BDEPTH: 103 348 Validity : 0
Towing dir: 0° Wire out : 500 m Speed : 4.1 kn
Sorted : 0 Total catch: 0.06 Catch/hour: 0.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Macrorhamphosus gracilis	0.04	11	50.00	
Scomber colias	0.03	1	33.33	
PYROSOMIDAE	0.01	1	16.67	
Total	0.08		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 62
DATE :13/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°21.34
start stop duration Lon W 13°27.22
TIME :12:41:05 13:01:10 20.1 (min) Purpose : 1
LOG : 6311.24 6312.28 1.0 Region : 1100
FDEPTH: 35 55 Gear cond.: 0
BDEPTH: 57 72 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.1 kn
Sorted : 72 Total catch: 178.40 Catch/hour: 533.07

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	291.33	16291	54.65	158
Scomber colias	215.68	10192	40.46	159
Engraulis encrasicolus	26.05	5151	4.89	160
Total	533.06		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 63
DATE :13/06/17 GEAR TYPE: MT NO: 1 POSITION:Lat N 27°4.27
start stop duration Lon W 13°44.67
TIME :22:07:25 22:22:09 14.7 (min) Purpose : 1
LOG : 6362.92 6363.49 0.6 Region : 1100
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 657 552 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 2.3 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:2017401 STATION: 64
DATE :14/06/17 GEAR TYPE: MT NO: 1 POSITION:Lat N 27°4.03
start stop duration Lon W 13°39.45
TIME :01:05:00 01:20:31 15.5 (min) Purpose : 1
LOG : 6369.21 6369.86 0.7 Region : 1100
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 99 97 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 2.5 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:2017401 STATION: 65
DATE :14/06/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 27°0.02
start stop duration Lon W 13°32.78
TIME :03:12:08 03:42:13 30.1 (min) Purpose : 1
LOG : 6380.41 6381.95 1.5 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 62 70 Validity : 0
Towing dir: 0° Wire out : 185 m Speed : 3.1 kn
Sorted : 0 Total catch: 402.96 Catch/hour: 803.78

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	377.82	84620	47.01	161
Sardina pilchardus	370.70	18718	46.12	163
Scomber colias	53.27	1165	6.63	162
Campogramma glaycos	1.40	32	0.17	
Trachurus trachurus	0.43	8	0.05	
Lepidopus caudatus	0.16	10	0.02	
Total	803.78		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 66
DATE :14/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 26°47.39
start stop duration Lon W 13°54.17
TIME :12:11:04 12:32:43 21.6 (min) Purpose : 1
LOG : 6440.94 6442.40 1.5 Region : 1100
FDEPTH: 20 26 Gear cond.: 0
BDEPTH: 82 91 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 4.1 kn
Sorted : 0 Total catch: 1095.04 Catch/hour: 3034.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	2955.38	162374	97.38	164
Trachurus mediterraneus	47.72	191	1.57	165
Spondyliosoma cantharus	19.34	144	0.64	166
Boops boops	8.42	47	0.28	167
Scomber scombrus	3.38	6	0.11	
Sardina pilchardus	3.38	6	0.11	
Trachurus trachurus	0.03	3	0.00	
Macrorhamphosus gracilis	0.03	3	0.00	
Total	3037.69		100.10	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 67
DATE :14/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 26°28.62
start stop duration Lon W 14°12.17
TIME :21:46:50 22:07:58 21.1 (min) Purpose : 1
LOG : 6524.35 6525.67 1.3 Region : 1100
FDEPTH: 20 22 Gear cond.: 0
BDEPTH: 29 29 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.8 kn
Sorted : 10 Total catch: 10.18 Catch/hour: 28.91

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Campogramma glaycos	19.31	57	66.80	
Trichiurus lepturus	3.69	9	12.77	169
Trachurus trachurus	3.58	9	12.38	
Engraulis encrasicolus	1.45	187	5.01	170
Sardina pilchardus	0.81	9	2.80	168
Loligo vulgaris	0.07	17	0.25	
Total	28.91		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 68
DATE :15/06/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 26°30.80
start stop duration Lon W 14°50.00
TIME :02:59:00 03:29:00 30.0 (min) Purpose : 1
LOG : 6561.00 6564.00 3.0 Region : 1100
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 36 63 Validity : 0
Towing dir: 0° Wire out : 170 m Speed : 0.0 kn
Sorted : 29 Total catch: 28.96 Catch/hour: 57.92

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardinella aurita	39.40	108	68.02	171
	Sepia hieredda**	10.28	2	17.75	
	Scomber colias	3.68	80	6.35	173
	Spondyliosoma cantharus	2.08	18	3.59	
	Sphyrna zygaena	1.64	2	2.83	
	Engraulis encrasicolus	0.84	68	1.45	172
	Total	57.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 69
DATE :15/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°58.39
start stop duration Lon W 14°36.36
TIME :21:36:37 22:02:31 25.9 (min) Purpose : 1
LOG : 6657.85 6659.40 1.6 Region : 1100
FDEPTH: 15 33 Gear cond.: 0
BDEPTH: 49 53 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.6 kn
Sorted : 0 Total catch: 69.12 Catch/hour: 160.12

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardina pilchardus	132.83	1105	82.96	175
	Scomber colias	25.48	507	15.91	174
	BELONIDAE	0.44	7	0.27	
	Trachurus trachurus	0.25	5	0.16	
	Sardinella aurita	0.15	9	0.09	
	Diplodus bellottii	0.15	2	0.09	
	Loligo vulgaris	0.15	9	0.09	
	Total	159.46		99.59	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 70
DATE :16/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°48.72
start stop duration Lon W 15°7.94
TIME :06:51:35 07:24:54 33.3 (min) Purpose : 1
LOG : 6738.93 6741.21 2.3 Region : 1100
FDEPTH: 40 50 Gear cond.: 0
BDEPTH: 172 186 Validity : 0
Towing dir: 0° Wire out : 400 m Speed : 4.1 kn
Sorted : 0 Total catch: 225.58 Catch/hour: 406.21

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Macrorhamphosus gracilis	403.66	43621	99.37	
	Sphoeroides pachgaster	1.04	5	0.26	
	Total	404.71		99.63	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 71
DATE :16/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 25°33.86
start stop duration Lon W 14°56.23
TIME :13:25:22 13:58:34 33.2 (min) Purpose : 1
LOG : 6794.08 6795.97 1.9 Region : 1100
FDEPTH: 79 78 Gear cond.: 0
BDEPTH: 79 78 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 3.4 kn
Sorted : 0 Total catch: 6.79 Catch/hour: 12.26

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Dentex canariensis	7.41	20	60.43	176
	Chelidonichthys obscurus	2.28	27	18.57	177
	Diplodus cervinus cervinus	2.24	2	18.28	
	Dicologoglossa cuneata	0.13	2	1.03	
	Trachinus draco	0.11	2	0.88	
	Pecten sp.	0.10	2	0.81	
	Total	12.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 72
DATE :16/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 25°36.03
start stop duration Lon W 15°31.35
TIME :20:11:45 20:48:38 36.9 (min) Purpose : 1
LOG : 6851.67 6854.59 2.9 Region : 1100
FDEPTH: 0 10 Gear cond.: 0
BDEPTH: 161 161 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 4.7 kn
Sorted : 0 Total catch: 41.42 Catch/hour: 67.39

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Macrorhamphosus gracilis	60.52	11727	89.81	
	Scomber colias	6.51	133	9.66	178
	Loligo vulgaris	0.33	2	0.48	
	Total	67.35		99.95	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 73
DATE :17/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°1.92
start stop duration Lon W 15°14.26
TIME :23:42:55 00:14:58 32.0 (min) Purpose : 1
LOG : 7046.25 7048.30 2.0 Region : 1100
FDEPTH: 15 25 Gear cond.: 0
BDEPTH: 43 46 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.8 kn
Sorted : 0 Total catch: 21.36 Catch/hour: 40.00

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Scomber colias	16.66	530	41.66	179
	Boops boops	7.49	114	18.72	182
	Spondyliosoma cantharus	6.22	58	15.54	
	Diplodus bellottii	4.90	64	12.26	184
	Pagellus erythrinus	1.12	6	2.81	
	Trachurus trecae	0.94	4	2.34	
	Engraulis encrasicolus	0.70	39	1.76	180
	Pomadasys incisus	0.47	2	1.17	
	Sardinella aurita	0.47	4	1.17	183
	Pagellus acarne	0.47	2	1.17	
	BELONIDAE	0.37	6	0.94	
	Trachurus trachurus	0.19	4	0.47	
	Total	40.00		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 74
DATE :18/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 24°55.38
start stop duration Lon W 14°57.76
TIME :02:57:02 03:17:06 20.1 (min) Purpose : 1
LOG : 7068.55 7069.39 0.8 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 34 35 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 2.5 kn
Sorted : 0 Total catch: 103.02 Catch/hour: 307.98

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardina pilchardus	307.68	3190	99.90	185
	Scomber colias	0.30	6	0.10	186
	Total	307.98		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 75
DATE :18/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 24°56.31
start stop duration Lon W 15°26.80
TIME :08:53:55 09:26:01 32.1 (min) Purpose : 1
LOG : 7118.05 7119.85 1.8 Region : 1100
FDEPTH: 43 46 Gear cond.: 0
BDEPTH: 43 46 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3.4 kn
Sorted : 0 Total catch: 167.15 Catch/hour: 312.42

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Plectorhinchus mediterraneus	260.52	520	83.39	187
	Diplodus vulgaris	16.75	118	5.36	190
	Spondyliosoma cantharus	13.87	198	4.44	189
	Dentex canariensis	6.92	30	2.21	188
	Octopus vulgaris	3.93	2	1.26	
	Dentex gibbosus	3.33	6	1.06	
	Loligo vulgaris	3.21	6	1.03	
	Pagellus bellottii	1.16	9	0.37	
	HOLUTHUROIDEA	0.90	2	0.29	
	Chelidonichthys obscurus	0.56	7	0.18	
	Pomadasys incisus	0.34	2	0.11	
	Pagellus erythrinus	0.30	2	0.10	
	Sepia sp	0.26	2	0.08	
	Trachinus draco	0.22	4	0.07	
	SOLEIDAE	0.15	2	0.05	
	Total	312.41		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 76
DATE :18/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 24°57.48
start stop duration Lon W 15°56.37
TIME :18:43:53 19:19:10 35.3 (min) Purpose : 1
LOG : 7204.74 7207.27 2.5 Region : 1100
FDEPTH: 5 70 Gear cond.: 0
BDEPTH: 72 76 Validity : 0
Towing dir: 0° Wire out : 400 m Speed : 4.3 kn
Sorted : 0 Total catch: 890.56 Catch/hour: 1514.56

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Macrorhamphosus gracilis	807.62	100952	53.32	192
	Scomber colias	706.94	7170	46.68	191
	Macrorhamphosus scolopax	0.03	2	0.00	
	Total	1514.59		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 77
DATE :19/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 24°39.76
start stop duration Lon W 15°13.98
TIME :01:26:16 02:09:05 42.8 (min) Purpose : 1
LOG : 7260.43 7262.67 2.2 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 29 28 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.1 kn
Sorted : 36 Total catch: 293.00 Catch/hour: 410.55

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardina pilchardus	404.81	5234	98.60	193
	Scomber colias	2.62	56	0.64	
	Plectorhinchus mediterraneus	2.52	6	0.61	
	Diplodus bellottii	0.50	7	0.12	
	Caranx rhonchus	0.09	1	0.02	
	Total	410.55		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 78
DATE :19/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 24°27.99
start stop duration Lon W 15°39.25
TIME :17:30:19 17:57:04 0.0 (min) Purpose : 1
LOG : 7406.03 7407.53 0.0 Region : 1100
FDEPTH: 17 18 Gear cond.: 0
BDEPTH: 17 18 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 0.0 kn
Sorted : 32 Total catch: 53.22 Catch/hour: 0.00

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Diplodus bellottii	0.00	0	68.68	196
	Trachurus trachurus	0.00	0	14.20	194
	Scomber colias	0.00	0	11.11	195
	Caranx rhonchus	0.00	0	4.10	
	Spondyliosoma cantharus	0.00	0	1.41	
	Trachurus trecae	0.00	0	0.41	
	Trachinus draco	0.00	0	0.09	
	Total	0.00		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 79
DATE :19/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 24°16.24
start stop duration Lon W 15°36.81
TIME :21:19:42 21:26:37 6.9 (min) Purpose : 1
LOG : 7435.86 7436.28 0.4 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 24 19 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 3.7 kn
Sorted : 0 Total catch: 250.84 Catch/hour: 2174.91

	SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
	Sardina pilchardus	2072.08	17532	95.27	197
	Scomber colias	48.38	503	2.22	199
	Caranx rhonchus	22.20	338	1.02	198
	Diplodus bellottii	14.74	243	0.68	
	Diplodus sargus	10.58	9	0.49	
	Pomadasys incisus	5.72	35	0.26	
	Spondyliosoma cantharus	1.21	9	0.06	
	Total	2174.91		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 80
DATE :20/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°32.00
start stop duration Lon W 16°15.11
TIME :01:53:28 02:23:48 30.3 (min) Purpose : 1
LOG : 7474.43 7476.23 1.8 Region : 1100
FDEPTH: 40 50 Gear cond.: 0
BDEPTH: 74 76 Validity : 0
Towing dir: 0° Wire out : 170 m Speed : 3.6 kn
Sorted : 0 Total catch: 12.24 Catch/hour: 24.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	24.09	819	99.51	200
Belone belone gracilis	0.12	2	0.49	
Total	24.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 81
DATE :20/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 24°15.97
start stop duration Lon W 15°59.32
TIME :15:58:59 16:18:57 20.0 (min) Purpose : 1
LOG : 7543.05 7544.13 1.1 Region : 1100
FDEPTH: 40 40 Gear cond.: 0
BDEPTH: 40 40 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.2 kn
Sorted : 0 Total catch: 686.58 Catch/hour: 2062.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	1917.66	25637	92.96	201
Scomber colias	119.34	3083	5.79	202
Spondyliosoma cantharus	27.16	255	1.32	
Diplodus bellottii	15.20	156	0.74	
Trachurus trachurus	4.21	63	0.20	203
Pomadasys incisus	3.91	18	0.19	
Pagellus bellottii	2.58	18	0.13	
Pagellus erythrinus	2.16	6	0.10	
Caranx rhonchus	0.42	6	0.02	
Sea urchin	0.24	3	0.01	
Total	2092.88		101.46	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 82
DATE :20/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 24°0.09
start stop duration Lon W 15°49.39
TIME :21:53:52 22:04:55 11.1 (min) Purpose : 1
LOG : 7579.07 7579.72 0.6 Region : 1100
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 24 25 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.5 kn
Sorted : 33 Total catch: 160.48 Catch/hour: 871.38

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	758.99	6310	87.10	204
Sardinella aurita	67.00	608	7.69	206
Diplodus sargus	27.69	22	3.18	
Plectorhinchus mediterraneus	14.01	11	1.61	
Caranx rhonchus	2.50	43	0.29	205
Pomadasys incisus	1.19	5	0.14	
Total	871.38		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 83
DATE :21/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°18.19
start stop duration Lon W 16°28.43
TIME :03:06:18 03:36:47 30.5 (min) Purpose : 1
LOG : 7620.62 7622.30 1.7 Region : 1100
FDEPTH: 40 50 Gear cond.: 0
BDEPTH: 87 79 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.3 kn
Sorted : 2 Total catch: 2.02 Catch/hour: 3.97

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	3.94	53	99.11	207
Macrorhamphosus gracilis	0.03	8	0.74	
C E P H A L O P O D A	0.01	2	0.15	
Total	3.97		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 84
DATE :21/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 23°44.47
start stop duration Lon W 16°4.62
TIME :12:49:29 13:16:22 26.9 (min) Purpose : 1
LOG : 7699.18 7701.00 1.8 Region : 1100
FDEPTH: 10 20 Gear cond.: 0
BDEPTH: 30 29 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 4.1 kn
Sorted : 0 Total catch: 2019.42 Catch/hour: 4507.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	2061.49	19603	45.73	208
Diplodus bellottii	1142.14	13060	25.34	0
Pagellus acarne	596.18	5292	13.23	212
Trachurus trachurus	326.74	4763	7.25	209
Scomber colias	146.56	1855	3.25	210
Spondyliosoma cantharus	71.82	842	1.59	
Diplodus vulgaris	39.04	134	0.87	
Caranx rhonchus	30.99	382	0.69	211
Plectorhinchus mediterraneus	30.62	38	0.68	
Pagellus bellottii	23.09	116	0.51	
Pagellus erythrinus	14.93	58	0.33	
Loligo vulgaris	13.34	58	0.30	
Trachurus trecae	6.53	0	0.14	
Total	4503.46		99.91	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 85
DATE :21/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 23°46.56
start stop duration Lon W 16°36.84
TIME :21:20:20 21:49:00 28.7 (min) Purpose : 1
LOG : 7775.77 7778.02 2.3 Region : 1100
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 62 63 Validity : 0
Towing dir: 0° Wire out : 230 m Speed : 4.7 kn
Sorted : 0 Total catch: 308.38 Catch/hour: 645.37

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	609.75	9323	94.48	213
Prionace glauca	28.00	2	4.34	
Sarda sarda	6.70	17	1.04	214
Lagocephalus lagocephalus	0.54	2	0.08	
Loligo vulgaris	0.38	4	0.06	
Total	645.37		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 86
DATE :22/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 23°35.71
start stop duration Lon W 16°11.39
TIME :01:59:28 02:12:59 13.5 (min) Purpose : 1
LOG : 7812.71 7813.59 0.9 Region : 1100
FDEPTH: 20 20 Gear cond.: 0
BDEPTH: 30 20 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.9 kn
Sorted : 72 Total catch: 287.48 Catch/hour: 1275.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	1101.04	12080	86.30	215
Sardinella aurita	111.06	994	8.71	216
Scomber colias	43.65	568	3.42	217
Diplodus bellottii	12.06	89	0.95	
Spondyliosoma cantharus	1.95	18	0.15	
Loligo vulgaris	1.33	4	0.10	
Pomadasys incisus	1.24	4	0.10	
Trachurus trachurus	1.07	13	0.08	
Caranx rhonchus	0.80	4	0.06	
Pagellus bellottii	0.71	18	0.06	
Chelidonichthys obscurus	0.53	4	0.04	
Belone belone gracilis	0.36	4	0.03	
Total	1275.80		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 87
DATE :22/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 23°32.32
start stop duration Lon W 16°55.99
TIME :10:57:17 11:17:16 20.0 (min) Purpose : 1
LOG : 7891.65 7892.69 1.0 Region : 1100
FDEPTH: 108 107 Gear cond.: 0
BDEPTH: 108 107 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.1 kn
Sorted : 0 Total catch: 214.52 Catch/hour: 644.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Macrorhamphosus scolopax	364.56	3574	56.59	218
Macrorhamphosus gracilis	216.82	20453	33.66	219
Zeus faber	18.68	27	2.90	
Sphoeroides pachgaster	12.73	6	1.98	
Scorpaena scrofa	11.05	6	1.72	
Dentex maroccanus	5.05	63	0.78	
Leucoraja naevus	4.98	3	0.77	
Scomber colias	3.00	270	0.47	220
Pagellus bellottii	1.86	3	0.29	
Torpedo marmorata	1.68	3	0.26	
Serranus cabrilla	1.44	6	0.22	
Scyliorhinus canicula	1.32	3	0.21	
Anthias anthias**	1.02	42	0.16	
Total	644.20		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 88
DATE :22/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 23°25.97
start stop duration Lon W 16°45.41
TIME :13:29:40 13:57:48 28.1 (min) Purpose : 1
LOG : 7908.94 7911.24 2.3 Region : 1100
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 64 64 Validity : 0
Towing dir: 0° Wire out : 210 m Speed : 4.9 kn
Sorted : 0 Total catch: 2240.66 Catch/hour: 4779.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Macrorhamphosus gracilis	4752.22	6988	99.44	221
Sarda sarda	16.21	34	0.34	222
Isurus oxyrinchus	10.45	2	0.22	
Belone belone gracilis	0.33	2	0.01	
Total	4779.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 89
DATE :22/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 23°14.31
start stop duration Lon W 16°39.23
TIME :22:53:04 23:11:31 18.4 (min) Purpose : 1
LOG : 7978.41 7979.47 1.1 Region : 1100
FDEPTH: 0 20 Gear cond.: 0
BDEPTH: 44 42 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.5 kn
Sorted : 0 Total catch: 102.90 Catch/hour: 334.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	334.63	3785	100.00	223
Total	334.63		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 90
DATE :23/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°51.97
start stop duration Lon W 16°35.61
TIME :19:41:43 20:08:27 26.7 (min) Purpose : 1
LOG : 8109.85 8111.38 1.5 Region : 1100
FDEPTH: 10 20 Gear cond.: 0
BDEPTH: 40 41 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.4 kn
Sorted : 0 Total catch: 52.72 Catch/hour: 118.34

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	118.34	2725	100.00	224
Total	118.34		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 91
DATE :23/06/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 22°54.11
start stop duration Lon W 16°47.82
TIME :22:01:20 22:26:47 25.4 (min) Purpose : 1
LOG : 8124.10 8125.34 1.2 Region : 1100
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 59 59 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 2.9 kn
Sorted : 0 Total catch: 411.80 Catch/hour: 970.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	744.83	17425	76.72	225
Sardina pilchardus	157.96	1499	16.27	226
Sardinella aurita	61.58	538	6.34	227
Sarda sarda	5.56	14	0.57	
Engraulis encrasicolus	0.48	33	0.05	228
Loligo vulgaris	0.31	2	0.03	
Trachinus draco	0.12	2	0.01	
Total	970.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 92
DATE :24/06/17 GEAR TYPE: PT NO: 4 POSITION:Lat N 22°45.58
start stop duration Lon W 16°54.04
TIME :03:49:37 04:28:50 39.2 (min) Purpose : 1
LOG : 8171.02 8172.86 1.8 Region : 1100
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 58 57 Validity : 0
Towing dir: 0° Wire out : 145 m Speed : 2.8 kn
Sorted : 0 Total catch: 148.68 Catch/hour: 227.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	213.01	6574	93.65	230
Sardinella aurita	14.44	98	6.35	229
Total	227.46		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 93
DATE :24/06/17 GEAR TYPE: PT NO: 7 POSITION:Lat N 22°28.35
start stop duration Lon W 16°31.17
TIME :08:54:42 09:25:17 30.6 (min) Purpose : 1
LOG : 8210.41 8211.92 1.5 Region : 1100
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 32 33 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.0 kn
Sorted : 0 Total catch: 74.06 Catch/hour: 145.31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	105.13	5203	72.35	231
Sardinella aurita	29.67	186	20.42	232
Diplodus vulgaris	8.24	16	5.67	
Sarda sarda	1.53	2	1.05	
Loligo vulgaris	0.43	4	0.30	
Belone belone gracilis	0.31	4	0.22	
Total	145.31		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 94
DATE :24/06/17 GEAR TYPE: PT NO: 8 POSITION:Lat N 22°34.63
start stop duration Lon W 16°58.59
TIME :12:49:06 13:01:52 12.8 (min) Purpose : 1
LOG : 8240.19 8241.12 0.9 Region : 1100
FDEPTH: 15 10 Gear cond.: 0
BDEPTH: 59 59 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 4.4 kn
Sorted : 25 Total catch: 5006.98 Catch/hour: 23525.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Macrorhamphosus gracilis	23492.56	3011746	99.86	233
Sarda sarda	30.16	61	0.13	234
Scomber colias	2.63	9	0.01	
Total	23525.36		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 95
DATE :24/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°20.99
start stop duration Lon W 16°40.47
TIME :20:54:26 21:00:42 6.3 (min) Purpose : 1
LOG : 8304.78 8305.15 0.4 Region : 1100
FDEPTH: 10 17 Gear cond.: 0
BDEPTH: 35 36 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.5 kn
Sorted : 189 Total catch: 2500.00 Catch/hour: 23923.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	22709.57	987368	94.93	235
Engraulis encrasicolus	954.86	140421	3.99	236
Trichiurus lepturus	92.15	57	0.39	
Caranx rhonchus	68.20	1263	0.29	237
Sardinella aurita	60.67	507	0.25	
Trachurus trecae	22.73	383	0.10	
Sepia hieredda**	7.70	10	0.03	
Scomber colias	7.58	124	0.03	
Total	23923.46		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 96
DATE :25/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 21°56.11
start stop duration Lon W 16°57.47
TIME :13:50:42 13:58:00 7.3 (min) Purpose : 1
LOG : 8408.17 8408.57 0.4 Region : 1100
FDEPTH: 31 31 Gear cond.: 0
BDEPTH: 31 31 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.3 kn
Sorted : 0 Total catch: 193.70 Catch/hour: 1592.05

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	1482.41	37438	93.11	238
Engraulis encrasicolus	101.59	12099	6.38	239
Sardinella aurita	4.11	33	0.26	
Campogramma glaycos	2.14	25	0.13	
Loligo vulgaris	1.07	115	0.07	
Pomadasys incisus	0.49	8	0.03	
Alloteuthis africana	0.25	33	0.02	
Total	1592.05		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 97
DATE :25/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 22°0.48
start stop duration Lon W 17°18.30
TIME :17:04:44 17:26:36 21.9 (min) Purpose : 1
LOG : 8433.53 8434.72 1.2 Region : 1100
FDEPTH: 71 72 Gear cond.: 0
BDEPTH: 71 72 Validity : 0
Towing dir: 0° Wire out : 240 m Speed : 3.3 kn
Sorted : 0 Total catch: 28.59 Catch/hour: 78.45

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	27.00	826	34.41	242
Trachurus trecae	19.26	373	24.55	240
Trichiurus lepturus	15.25	16	19.44	
Zeus faber	6.91	14	8.81	
Trachurus trachurus	2.47	49	3.15	241
Uranoscopus scaber	1.37	3	1.75	
Octopus vulgaris	0.88	5	1.12	
Dentex maroccanus	0.77	27	0.98	243
Pagellus bellottii	0.44	3	0.56	
Lepidopus caudatus	0.22	11	0.28	
Serranus cabrilla	0.22	5	0.28	
Holothuria sp.	0.18	5	0.23	
Citharus linguatula	0.16	11	0.21	
Capros aper	0.16	44	0.21	
Sygnathus acus	0.14	3	0.17	
Microchirus boscanion	0.11	16	0.14	
Sepia bertheloti	0.11	3	0.14	
Arnoglossus imperialis	0.05	3	0.07	
Scyllarus sp.	0.03	8	0.03	
INACHIDAE	0.01	5	0.02	
Loligo vulgaris	0.00	3	0.00	
Total	75.75		96.56	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 98
DATE :26/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°22.52
start stop duration Lon W 17°18.36
TIME :03:43:00 04:12:00 29.0 (min) Purpose : 1
LOG : 8512.60 8514.00 1.4 Region : 1100
FDEPTH: 30 48 Gear cond.: 0
BDEPTH: 68 68 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.0 kn
Sorted : 32 Total catch: 32.13 Catch/hour: 66.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trachurus	8.40	176	12.63	244
Dentex maroccanus	6.70	286	10.08	
Macropipus sp.	6.21	674	9.34	
Serranus cabrilla	5.71	170	8.59	
Trachurus trecae	5.01	83	7.53	245
Umbrina canariensis	4.72	14	7.10	
Octopus vulgaris	4.34	8	6.53	
Zeus faber	4.10	6	6.16	
Pagellus bellottii	3.93	14	5.91	
Citharus linguatula	3.48	265	5.23	
Uranoscopus scaber	2.94	4	4.42	
Arnoglossus imperialis	2.40	840	3.61	
Trachurus sp.	2.15	37	3.24	
Scomber colias	1.37	31	2.05	246
Spondyliosoma cantharus	0.83	2	1.24	
Microchirus sp.	0.74	128	1.12	
Scyllarus sp.	0.74	149	1.12	
Scorpaena notata	0.70	14	1.06	
Todarodes sagittatus	0.54	2	0.81	
Lepidopus caudatus	0.52	17	0.78	
Ariosoma balearicum	0.37	10	0.56	
Belone belone gracilis	0.21	4	0.31	
Solenocera africana	0.12	41	0.19	
Gnathopis mystax	0.10	2	0.16	
Capros aper	0.08	25	0.12	
Microchirus ocellatus	0.04	2	0.06	
Ophidion barbatum	0.03	2	0.05	
Total	66.49		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 99
DATE :26/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°29.13
start stop duration Lon W 17°9.82
TIME :10:15:00 10:45:00 30.0 (min) Purpose : 1
LOG : 8565.00 8566.00 1.0 Region : 1100
FDEPTH: 25 43 Gear cond.: 0
BDEPTH: 60 60 Validity : 0
Towing dir: 0° Wire out : 145 m Speed : 3.0 kn
Sorted : 0 Total catch: 56.42 Catch/hour: 112.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomber colias	101.25	3224	89.73	247
Todarodes sagittatus	4.60	14	4.08	
Trachurus trecae	3.44	66	3.05	248
Sarda sarda	3.42	12	3.03	249
Belone belone gracilis	0.09	2	0.08	
Trachurus trachurus	0.04	2	0.04	
Total	112.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 100
DATE :26/06/17 GEAR TYPE: BT NO: 26 POSITION:Lat N 21°11.90
start stop duration Lon W 17°35.10
TIME :20:00:00 20:26:00 26.0 (min) Purpose : 1
LOG : 8649.00 8650.00 1.0 Region : 1100
FDEPTH: 92 92 Gear cond.: 0
BDEPTH: 92 92 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.2 kn
Sorted : 75 Total catch: 301.28 Catch/hour: 695.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	680.31	36185	97.85	250
Engraulis encrasicolus	14.95	1662	2.15	251
Total	695.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 101
DATE :26/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°6.39
start stop duration Lon W 17°24.10
TIME :22:01:00 22:02:00 1.0 (min) Purpose : 1
LOG : 8660.50 8661.00 0.5 Region : 1100
FDEPTH: 10 18 Gear cond.: 0
BDEPTH: 60 60 Validity : 0
Towing dir: 0° Wire out : 85 m Speed : 3.3 kn
Sorted : 0 Total catch: 126.24 Catch/hour: 7574.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Plesionika cf sp	1421.10	1101480	18.76	
Sardina pilchardus	1187.16	58140	15.67	253
Engraulis encrasicolus	579.12	45420	7.65	254
Trachurus trachurus	552.48	34740	7.29	255
Trachurus trecae	533.28	15540	7.04	266
GOBIIDAE	525.84	97740	6.94	
Todarodes sagittatus	516.30	1740	6.82	
Dentex macrophthalmus	449.88	16440	5.94	
Macropipus rugosus**	293.04	34500	3.87	
Arnoglossus imperialis	277.98	31980	3.67	
Citharus linguatula	273.36	14580	3.61	
Octopus vulgaris	257.28	360	3.40	
Microchirus sp.	138.96	23160	1.83	
Zeus faber	131.34	240	1.73	
Scomber colias	113.70	1980	1.50	252
Ophidion barbatum	88.02	4620	1.16	
Merluccius polli	64.50	600	0.85	
Belone belone gracilis	49.08	360	0.65	
Dentex angolensis	32.94	240	0.43	
Scorpaena normani	24.30	1380	0.32	
Sepia sp	11.58	1860	0.15	
Lepidopus caudatus	9.48	420	0.13	
Chelidoperca sp.	9.24	120	0.12	
Sphoeroides pachgaster	8.70	60	0.11	
Sardinella aurita	6.30	60	0.08	
Hoplunnis punctata	5.70	180	0.08	
Serranus cabrilla	5.10	60	0.07	
Lepidotrigla carolae	4.62	120	0.06	
Allothunnus fallai	1.14	60	0.02	
Squilla mantis	1.14	60	0.02	
Capros aper	0.90	240	0.01	
Scyllarides sp.	0.24	900	0.00	
Total	7573.80		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 102
DATE :27/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°0.50
start stop duration Lon W 17°12.70
TIME :01:26:00 01:35:00 9.0 (min) Purpose : 1
LOG : 8687.90 8688.40 0.5 Region : 1100
FDEPTH: 20 20 Gear cond.: 0
BDEPTH: 43 47 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.3 kn
Sorted : 114 Total catch: 457.20 Catch/hour: 3048.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	2955.20	184033	96.96	256
Sardinella aurita	13.27	320	0.44	259
Trachurus trecae	10.53	200	0.35	258
Scomber colias	7.20	260	0.24	257
Loligo vulgaris	1.20	7	0.04	
Belone belone gracilis	0.67	7	0.02	
Trachurus trachurus	0.13	13	0.00	
Total	2988.20		98.04	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 103
DATE :27/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°0.80
start stop duration Lon W 17°25.60
TIME :03:45:00 03:55:00 10.0 (min) Purpose : 1
LOG : 8704.10 8705.00 0.9 Region : 1100
FDEPTH: 45 50 Gear cond.: 0
BDEPTH: 78 78 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.4 kn
Sorted : 87 Total catch: 87.25 Catch/hour: 523.53

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardina pilchardus	504.24	21186	96.32	260
Gymnura altavela	10.56	6	2.02	
Scomber colias	5.64	162	1.08	261
Sardinella aurita	2.28	36	0.44	
Trachurus trecae	0.72	18	0.14	
Engraulis encrasicolus	0.06	6	0.01	
Trachurus trachurus	0.03	6	0.01	
Total	523.53		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2017401 STATION: 104
DATE :27/06/17 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°10.18
start stop duration Lon W 17°25.12
TIME :03:45:00 03:55:00 10.0 (min) Purpose : 1
LOG : 8704.10 8705.00 0.9 Region : 1100
FDEPTH: 45 50 Gear cond.: 0
BDEPTH: 78 78 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.3 kn
Sorted : 209 Total catch: 209.17 Catch/hour: 1255.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	1060.68	69780	84.52	264
Scomber colias	138.84	3792	11.06	262
Trachurus trecae	21.48	684	1.71	263
Brama brama	17.76	12	1.42	
Trachurus trachurus	12.48	840	0.99	265
Sarda sarda	2.64	6	0.21	
Sardina pilchardus	0.60	12	0.05	
Sardinella aurita	0.48	6	0.04	
Alloteuthis sp.	0.03	6	0.00	
Citharus linguatula	0.01	6	0.00	
Total	1255.00		100.00	

ANNEX II OVERVIEW OF BIOLOGICAL SAMPLES

Biological samples

Table II.1. Total number of fish samples collected for future biological analysis by station.

Fish samples collected for future biological analysis		
SPECIES	STATION	No/INDIVIDUALS
Scomber colias	44	30
Engraulis encrasicolus	45	30
Sardina pilchardus	45	30
Engraulis encrasicolus	47	30
Scomber colias	42	30
Scomber colias	39	30
Scomber colias	37	30
Scomber colias	38	30
Sardina pilchardus	38	30
Sardina pilchardus	47	30
Total	300	

Table II.2. Total number of sampled for different analysis

Sample	Number
Otoliths	96
Genetic (fin clips)	400
Stomachs (liver/intestine/fish)	960
Biology	300

Table II.3. Total number of fin clips sampled for genetic analysis

	Fin Clips (Genetic for genetic analysis)							
	Sardina pilchardus		*Scomber colias*		*Trachurus trachurus*		*Sardinella aurita*	
	No	Station	No	Station	No	Station	No	Station
	100	45	100	43	100	42		
	100	47						
Total/species	200		100		100		0	
TOTAL ALL SPECIES	400							

Table II.4. Total number of individuals for each target species sampled for gonads, stomachs and fat reserve.

Species	Gonads	Stomach	Fat
Trachurus trachurus	188	156	187
Trachurus trecae	173	173	173
Trachurus mediterraneus	30	29	30
Sardina pilchardus	599	595	599
Sardinella aurita	209	209	209
Engraulis encrasicolus	323	316	320
Scomber colias	789	787	788

Table II.5. Total number of individuals sampled for stomach content analysis

Stomachs (for future stomach content analysis)			
Species	Station	LIVER/INTESTIN	INDIVIDUALS
Scomber colias	44	+ +	30
Sardina pilchardus	45	+ +	30
Sardina pilchardus	47	+ +	30
Scomber colias	3	+ +	30
Scomber colias	7	+ +	30
Scomber colias	12	+ +	30
Sardina pilchardus	19	+ +	30
Sardina pilchardus	9	+ +	30
Scomber colias	18	+ +	30
Sardina pilchardus	20	+ +	30
Horse mackerels	7	+ +	30
Scomber colias	21	+ +	30
Scomber colias	26	+ +	30
Sardina pilchardus	15	+ +	30
Scomber colias	15	+ +	30
Sardina pilchardus	12	+ +	30
Sardina pilchardus	47	+ +	30
Sardina pilchardus	23	+ +	30
Engraulis encrasicolus	29	+ +	30
Sardina pilchardus	45	+ +	30
Scomber colias	36	+ +	30
Scomber colias	43	+ +	30
Scomber colias	38	+ +	30
Sardina pilchardus	38	+ +	30
Scomber colias	9	+ +	30
Sardina pilchardus	32	+ +	30
Sardina pilchardus	26	+ +	30
Sardina pilchardus	34	+ +	30
Scomber colias	44	+ +	30
Scomber colias	30	+ +	30
Scomber colias	28	+ +	30
Horse mackerels	42	+ +	30
Total		960	

Food safety

Table II.6 shows the number of samples taken for the different types of analysis of fish for food safety. The analysis will be carried out at IMR, Bergen, Norway, in close collaboration with partners form the region.

Table II.6. Samples for food safety and nutritional value, by species.

Species	No. of samples	No of positions	Type	Nutr.[1]	Cont.[2]	Other
Trachurus trachurus	25	1	Fillet Liver Gut content	X	X	Biomarkers TBARS Microbiota
Trachurus trachurus	30	1	Heart Spleen Head kidney			Kudoa (parasite)
Engraulis encrasicolus	3x25 3x25	2 2	Fillet w/skin and bone Whole fish	X X	X X	TBARS
Engraulis encrasicolus	3	1	Whole fish			Microplastics
Pagellus acarne	25	2	Fillet Liver Gut content	X	X	Biomarkers TBARS Microbiota
Sardina pilchardus	3x25 3x25	3 3	Fillet w/skin and bone Whole fish	X X	X X	TBARS
Octopus (various species)	7	1	Muscle and tentacles	X	X	TBARS

[1] Nutrition: Energy, water content, total fat, proteins, ash, fatty acids, cholesterol, amino acids, tryptophan, vitamins (D, A, E, K, C, thiamine, riboflavin, B6, B12, folate, niacin, pantotene, biotin), iodine, selenium and other minerals.

[2] Contaminants: Heavy metals, Inorganic arsenic, PAH, PBDE, PCB, dioxins, furans, PFAS, pesticides, HBCD, TBBPA.

TBARS = Thiobarbituric acid reactive substances
PAH = Polycyclic Aromatic Hydrocarbons
PBDE = Polybrominated diphenyl ethers
PCB= Polychlorinated biphenyls
PFAS = Polyfluoroalkyl substances
HBCD = Hexa Bromo CycloDodecane
TBBPA = Tetrabromobisphenol A

ANNEX III DESCRIPTION OF INSTRUMENTS AND FISHING GEAR

Acoustic instruments

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

Transceiver2 menu (38 kHz)	
Transducer depth	58 m
Absorbtion coeff.	8.3 dB/km
Pulse duration	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2way beam angle	20,6 dB
Gain	26,95 dB
S_A correction	0.03 dB
Angle sensitivity	21.9
3 dB beamwidth	6.22º along ship
	6.28 athwart ship
Alongship offset	0.10º
Athwardship offset	0.06º

Bottom detection menu Minimum level 50 dB

Fishing gear

The vessel has one small fourpanel 'Åkrahamn' pelagic trawl, one MultPelt 624 trawl (Figure 1, new in 2017) and one ‘Gisund super bottom trawl’. All trawls were used during the survey. The smallest pelagic trawl has 10 to 12 m vertical opening under normal operation, whereas the MultPelt 624 trawl has 30 to 40 m opening.

The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m^2 and weigh 2000 kg. The door spreading is about 45 m when using restraining rope. Trawling was conducted for species identification only and no restraining rope was therefore used during the survey.

The SCANMAR system was used during all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their interdistance and angle, while a height sensor is fitted on the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

The pelagic trawls are equipped with a trawl eye that provides information about the trawl opening and the distance of the footrope to the bottom. A pressure sensor is used to show the depth on the headline.

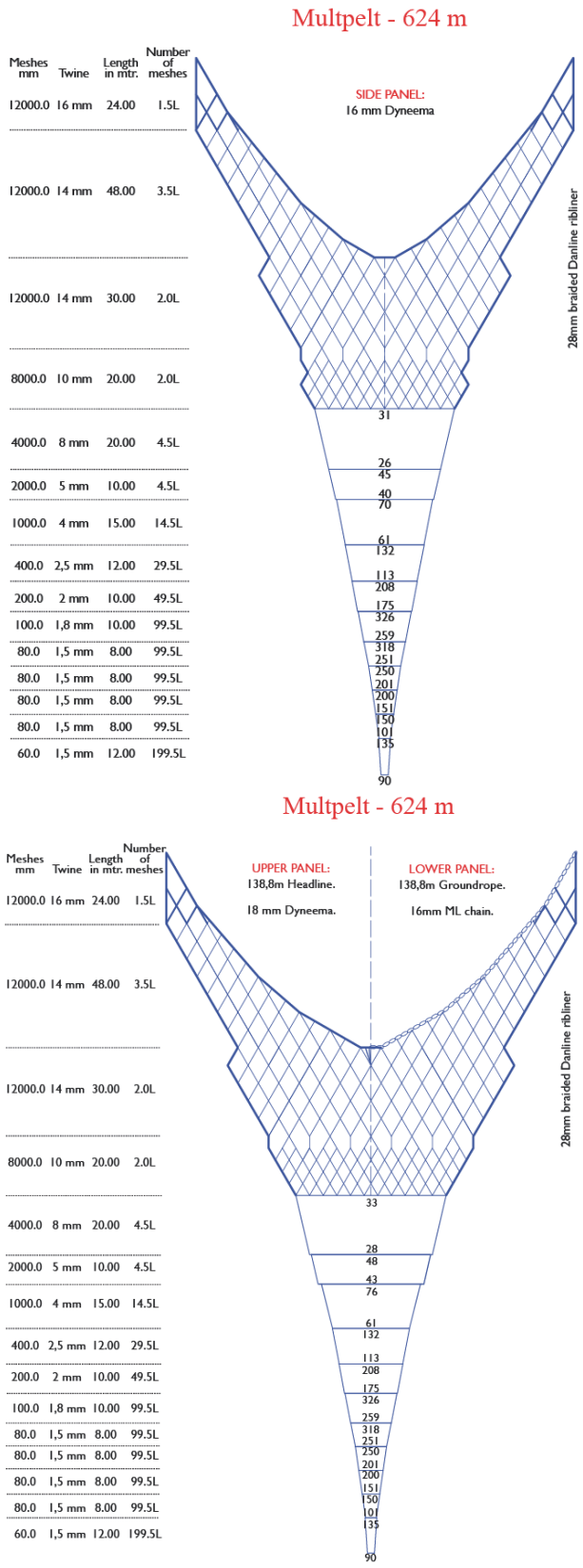
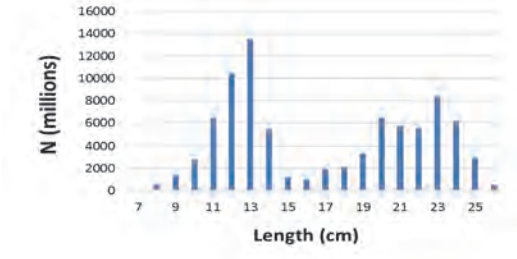


Figure 1. Schematic drawing of the MultPelt 624.

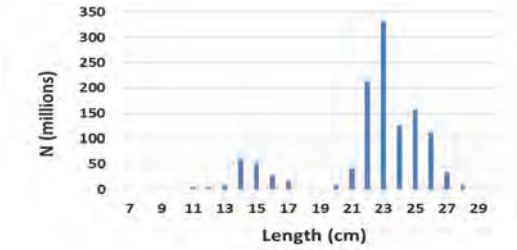
ANNEX IV LENGTH DISTRIBUTIONS BY SPECIES AND REGION

C. Blanc - C. Juby

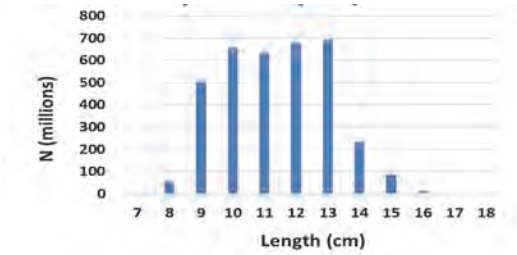
Sardine



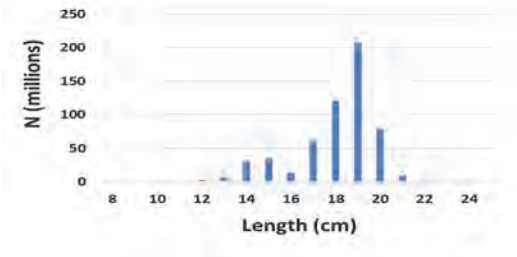
Round sardinella



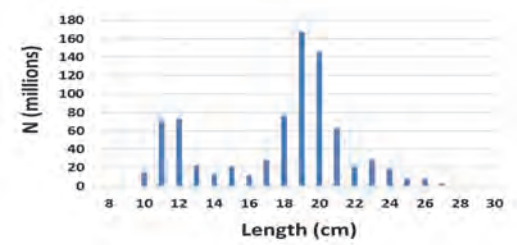
Anchovy



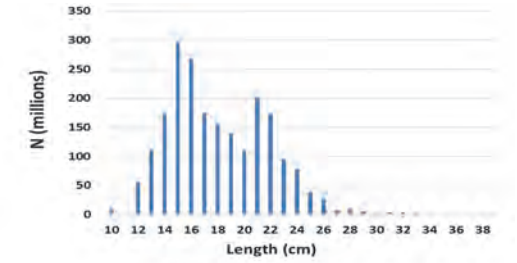
Cunene horse mackerel



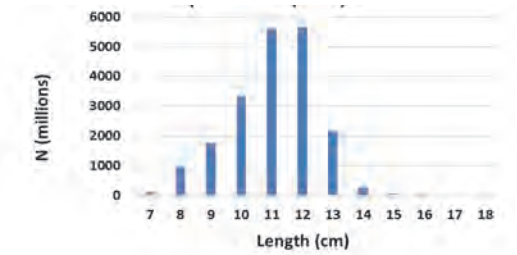
Atlantic horse mackerel



Atlantic chub mackerel

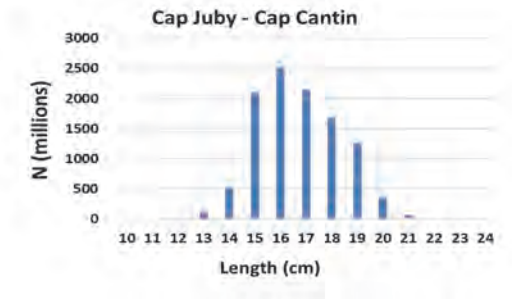


Snipefish

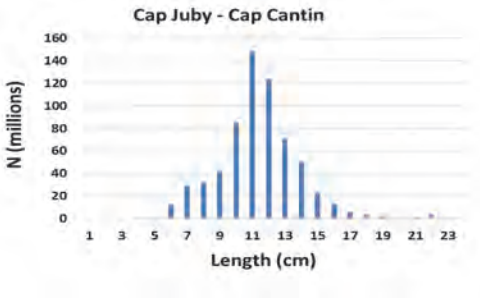


Cap Juby - Cap Cantin

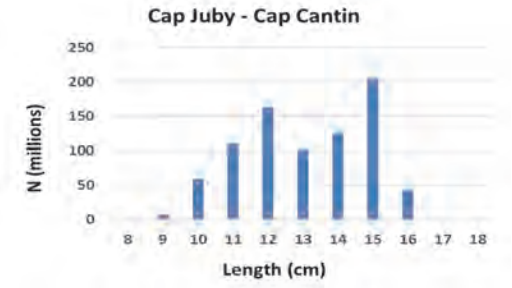
Sardine



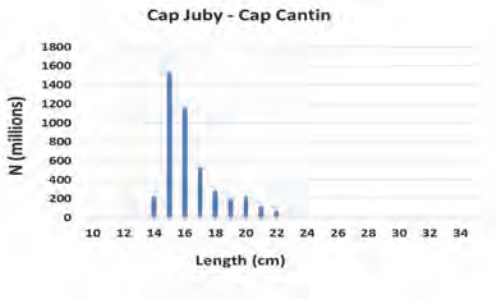
Atlantic horse mackerel



Anchovy

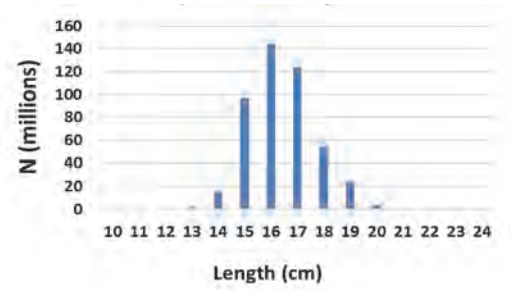


Atlantic Chub mackerel

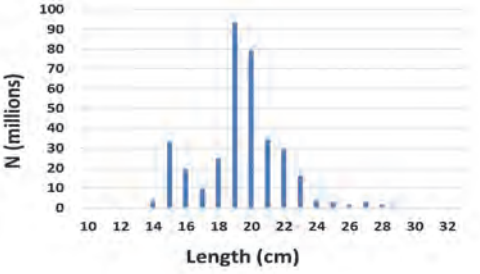


Tanger - Cap Cantin

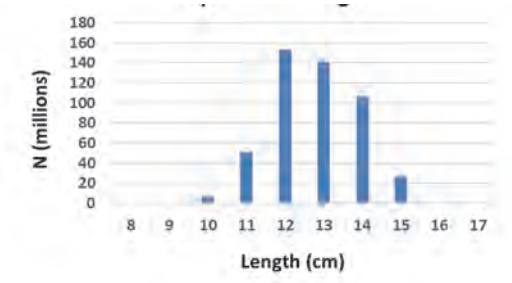
Sardine



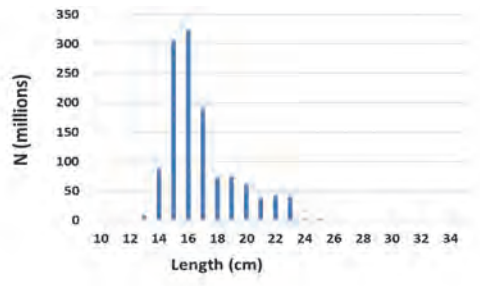
Atlantic horse mackerel



Anchovy



Atlantic Chub mackerel



ANNEX V REGIONAL ESTIMATES, NUMBERS AND BIOMASS BY SPECIES AND LENGTH CLASS BY SUB-REGION

ABUNDANCE

Sardina pilchardus, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										
6										
7			129							129
8			604							604
9			1390							1390
10			2502	1499						4001
11		2	5257	2462						7720
12		11	7764	1126						8901
13	1	120	10818							10939
14	16	510	3599							4125
15	97	2062	666							2825
16	144	2447	906							3496
17	124	2078	1671							3873
18	53	1599	1759							3412
19	24	1180	3830							5034
20	4	337	7083							7424
21	1	58	4935							4995
22			4797							4797
23		18	7463							7481
24			5145							5145
25			2308							2308
26			306							306
27										
28										
29										
30										

TOTAL	463708	10421966	72932553	5087						83823314

Sardinella aurita, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11			4							4
12			4							4
13			9							9
14			61							61
15			52		2					54
16			26		2					28
17			17		22					39
18					23					23
19					35					35
20			8		13					22
21			41		14		10			66
22			212		11		42			265
23			331		5		92			428
24			125		15		87			227
25			156		13		108			277
26			111		6		97			214
27			34		13		60			107
28			9		13		23			45
29					17		8			25
30					11		4			15
31					7					7
32					7					7
33					2					2
34					1					1
35					2					2

TOTAL	0	0	1124	0	234	0	531	1	0	1889

Sardinella maderensis, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11								1		1
12								1		1
13										0
14										0
15										0
16								1		1
17										0
18							2			2
19							2	1		3
20										0
21							48	1		49
22							23	2		25
23							52	6		58
24					4		106	13		123
25					12		161	12		185
26					36		108	13		157
27					66		29	8		103
28					31			1		32
29					29					29
30					10					10
31				2	32					34
32				4	44					49
33				4	42					46
34				4	41					46
35				2	23					25

TOTAL	0	0	0	17	372	0	532	60	0	981

Engraulis encrasicolus, Numbers in billions

	N (billions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7			0							0
8			0							0
9		0	1	0	0					1
10		0	1	1	0					1
11	0	0	1	1	1					3
12	0	0	1	1	2					3
13	0	0	1	0	1					2
14	0	0	0	0	0					1
15	0	0	0							0
16	0	0	0							0
17										0
18										0
19										0
20										0
TOTAL	0	1	4	3	3	0	0	0	0	11

Trachurus trachurus, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4										0
5										0
6				1						1
7				5						5
8			1	23						24
9				15						15
10		2	15	30						47
11			71	59						130
12		2	73	26						100
13			22	4						26
14	4	1	13	2						20
15	33	12	21							66
16	19	30	12							61
17	10	33	12							55
18	25	43	31							99
19	94	88	43							225
20	79	154	43							277
21	34	128	7							169
22	29	71	1							102
23	16	50								66
24	4	23	10							37
25	3	12								15
26	1	6	1							8
27	3	3								6
28	1	2								3
29		1								1
30		1								1
31		3								3
32		1								1
33		0								0

34		0								0
35										0
36										0
37										0
38		1								1
39										0
TOTAL	356	666	378	164	0	0	0	0	0	1564

Trachurus trecae, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4					22					22
5					23					23
6					26					26
7					54					54
8				1	47					48
9				1	47	8			1	58
10			1	27	125	93		1	3	250
11			1	22	89	56	2	2	4	177
12			3	8	16	29		1	1	58
13			7	12	0					19
14			30	8						38
15			35	6	1					42
16			14	4	14	4				35
17			60	8	43	18	29			158
18			121	24	78	46	116	1		385
19			208	24	35	94	68	1		430
20			78	11	18	41	9			158
21			9	2	16	9	2	1	2	41
22			1	1	3			1	2	8
23					13			2	4	19
24					25					25
25						11				11
26					13	13		1	3	30
27						55		1	1	57
28				0		17		1	3	21
29						23		1	1	25
30						11				11
31						4			1	5
32										0
33										0
34										0
35										0

TOTAL	0	0	567	161	707	533	226	14	24	2233

Scomber colias, Numbers in millions

	N (millions)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10			9							9
11			1							1
12		6	56			2				65
13	8	18	111		0	21		3		161
14	87	227	174	0	0	54	1	6		549
15	305	1 525	296	2	3	42	4	8		2184
16	324	1 148	268	12	7	59	5	14		1836
17	189	530	174	16	20	52	6	14		1001
18	72	284	156	14	8	14	6	31		584
19	75	192	139	13	8	1	3	33		463
20	62	219	109	13	10	1	2	69		484
21	38	117	201	8	9			56		429
22	42	65	174	3	4		2	25		315
23	40	17	95	3	3		1	11		169
24	6	10	79		1			8		103
25	4	6	38		1					49
26	1		27		0					27
27	1	1	8							9
28			10							10
29			5							5
30			2							2
31	1		4	0	1					6

32			4	1	1					6
33	1		2	2						6
34			1	4						5
35			1	3						4
36	1		1	7						9
37				5						5
38				2						2
39			1	1						3
40				1						1
41				1						1
42				1						1
43										0
44										0
45				0						0
TOTAL	1254	4364	2147	112	74	246	31	278	0	8506

BIOMASS

Sardina pilchardus, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										
6										
7			0							0
8			3							3
9			11							11
10			26	14						40
11		0	71	30						101
12		0	135	17						152
13	0	3	237							240
14	0	16	98							114
15	3	75	22							100
16	6	104	36							146
17	5	103	80							188
18	3	92	99							194
19	1	78	253							332
20	0	25	544							570
21	0	5	437							442
22			487							487
23		2	864							866
24			675							675
25			341							341
26			51							51
27										
28										
29										
30										
TOTAL	19	502	4471	61						5054

Sardinella aurita, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11			0							0
12			0							0
13			0							0
14			2							2
15			2		0					2
16			1		0					1
17			1		1					2
18					1					1
19					3					3
20			1		1					2
21			4		1		1			6
22			22		1		5			28
23			40		1		12			52
24			17		2		13			32
25			24		2		18			44
26			19		1		18			38
27			6		3		12			21
28			2		3		5			10
29					4		2			6
30					3		1			4
31					2					2
32					2					2
33					1					1
34					0					0
35					1					1
TOTAL	0	0	140	0	34	0	86	0	0	260

Sardinella maderensis, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10										0
11										0
12										0
13										0
14										0
15										0
16										0
17										0
18										0
19										0
20										0
21							5			5
22							3			3
23							7	1		8
24					1		16	2		19
25					2		28	2		32
26					7		21	2		30
27					14		6	2		22
28					7					7
29					8					8
30					3					3
31				1	10					11
32				1	15					17
33				2	16					17
34				2	17					18
35				1	10					11
TOTAL	0	0	0	7	109	0	86	10	0	212

Engraulis encrasicolus, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7			0							0
8			0							0
9		0	3	1	0					4
10		1	5	5	1					10
11	0	1	6	11	12					30
12	1	2	8	13	21					46
13	3	2	11	4	10					29
14	3	3	5	1	0					12
15	3	5	2							10
16	1	1	0							3
17										0
18										0
19										0
20										0
TOTAL	10	15	40	34	44	0	0	0	0	143

Trachurus trachurus, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4										0
5										0
6				0						0
7				0						0
8			0	0						0
9				0						0
10		0	0	0						1
11			1	1						2
12		0	1	1						2
13			0	0						1
14	0	0	0	0						1
15	1	0	1							2
16	1	1	0							3
17	1	2	1							3
18	2	2	2							6
19	7	6	3							15
20	7	11	3							21
21	3	10	1							14
22	3	7	0							10
23	2	5								7
24	0	3	1							4
25	0	2								2
26	0	1	0							1
27	0	0								1
28		0								0
29		0								0
30		0								0
31		1								1
32		0								0
33		0								0

34		0								0
35										0
36										0
37										0
38		0								0
39										0
TOTAL	28	52	15	2	0	0	0	0	0	97

Trachurus trecae, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
4					0					0
5					0					0
6					0					0
7					0					0
8				0	0					0
9				0	0					0
10			0	0	1	1				5
11			0	0	1	1				5
12			0	0	0	1				3
13			0	0	0					3
14			1	0						3
15			1	0	0					3
16			1	0	1					3
17			3	0	2	1	1			11
18			6	1	5	3	7			35
19			13	2	2	7	5			44
20			5	1	2	4	1			21
21			1	0	2	1				5
22			0	0	0					2
23					2					2
24					4					4
25						2				2
26					2	2				4
27						12				12
28				0		4			1	6
29						6				6
30						3				3
31						1				1
32										0
33										0
34										0
35										0

TOTAL	0	0	31	7	25	48	14	1	3	187

Scomber colias, Biomass in thousand tonnes

	Biomass ('000 tonnes)									
Length cm	Tanger Cap Cantin	Cap Cantin Cap Juby	Cap Juby Cap Blanc	Cap Blanc Cap Timiris	Cap Timiris St Louis	St Louis Cap Vert	Cap Vert The Gambia	The Gambia	The Gambia Casamance	TOTAL
5										0
6										0
7										0
8										0
9										0
10			0							0
11			0							0
12		0	1							1
13	0	0	2		0					2
14	5	6	4	0	0					15
15	19	46	8	0	0	1				74
16	23	41	9	0	0	1				74
17	15	22	7	1	1	2				48
18	6	14	7	1	0	2		1		31
19	7	11	8	1	1	1		1		30
20	6	14	7	1	1			2		31
21	4	8	15	1	1			5		34
22	5	5	15	0	0			4		29
23	6	2	10	0	0			2		20
24	1	1	9		0			1		12
25	1	1	5		0			1		8
26	0		4		0					4
27	0	0	1							1
28			2							2
29			1							1
30			0							0
31	0		1	0	0					1
32			1	0	0					1
33	0		1	1						2

34			0	2						2
35			0	1						1
36	0		1	4						5
37				3						3
38				1						1
39			1	1						2
40			0	0						0
41				0						0
42				1						1
43										0
44										0
45				0						0
TOTAL	98	171	119	20	5	8	2	18	0	441

ANNEX VI BIOLOGICAL SCALES- MATURITY, STOMACK FULLNESS AND FAT RESERVES

SEXUAL MATURITY:

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

STOMACH FULLNES:

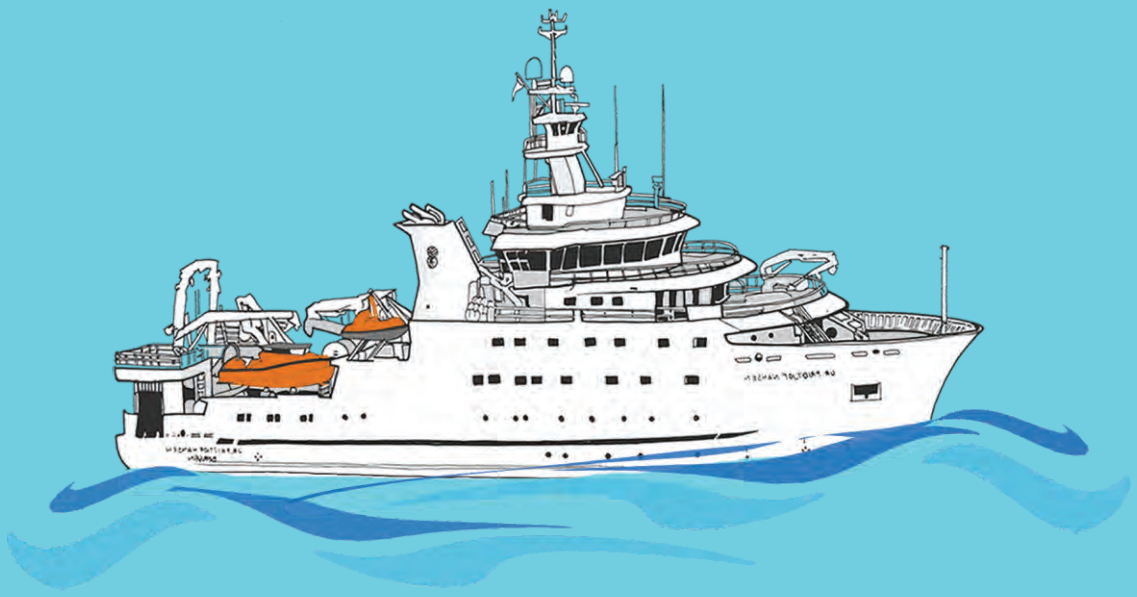
SCALE	DESIGNATION	DESCRIPTION
0	Empty	Stomach empty except for water.
1	Very little content	Stomach is almost empty. Only traces of small organisms can be found.
2	Some content	Stomach not completely full and not dilated.
3	Stomach full	Stomach full, but not bloated/dilated.
4	Bloated/dilated	The stomach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

FAT RESERVES:

SCALE	DESIGNATION	DESCRIPTION
0	No fat	Complete absence of fat in body cavity.
1	Very little fat	A small line of fat along the intestine.
2	Moderate fat	Moderate fat deposits around the intestine, stomach, the kidney, swimbladder and vertebrae.
3	Excessive fat	Excessive fat deposits around the intestine and stomach. The abdominal cavity is completely covered by fat.

NORAD-FAO PROGRAMME
GCP/GLO/690/NOR

CRUISE REPORTS *DR FRIDTJOF NANSEN*
EAF-Nansen/CR/2017/4



SURVEY OF THE PELAGIC FISH RESOURCES AND ECOSYSTEM OFF WEST AFRICA

Senegal and The Gambia

9 July – 18 July 2017

Centre de Recherches Océanographiques de Dakar-Thiaroye
Dakar, Senegal

Department of Fisheries
Banjul, The Gambia

Institute of Marine Research
Bergen, Norway

The EAF-Nansen Programme

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

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

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

Le Programme EAF-Nansen

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

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

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

CRUISE REPORTS "DR FRIDTJOF NANSEN"

Johannessen, T., Sadio, O., Jallow M. S., Bagøyen, E.. 2018. Survey of the pelagic fish resources and ecosystem off West Africa. Senegal and The Gambia. 9 – 18 July 2017. NORAD-FAO PROGRAMME GCP/GLO/690/NOR, CRUISE REPORTS DR FRIDTJOF NANSEN, EAF-Nansen/CR/2017/4

SURVEY OF THE PELAGIC FISH RESOURCES AND ECOSYSTEM OFF WEST AFRICA

Senegal and The Gambia
9 July - 18 July 2017

By

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Institute of Marine Research
Bergen, 2018

Contents

EXECUTIVE SUMMARY

The R/V Dr Fridtjof Nansen surveyed along the coast of Senegal and The Gambia, from St. Louis to the Casamance.

A common survey design was adopted with parallel transects perpendicular to the coastline, 10 NM apart, and acoustic measurements of pelagic fish obtained on the shelf from the 20 m to the 500 m bottom depth. At each degree of latitude, a hydrographic transect was carried out to a depth of 1000 m. Meteorological and hydrographic measurements were recorded routinely on these transects in addition to samples on ocean acidification parameters (pH and alkalinity), nutrients, phytoplankton, zooplankton, fish eggs and larvae and microplastics on some stations.

The survey was carried out with a scientific personnel of 30, coming from eight different countries.

Data collection along the coasts of Senegal and The Gambia was extensive, covering a wide range of scientific fields related to marine biology and ecology: hydrography, meteorology, microplastic, phytoplankton, zooplankton, jellyfish, eggs and larvae, fish biology, genetics, fish abundance, and food safety. A large part of the samples and of the data collected has not been analysed and this will be done in the context of the Science Plan. Hence, this survey report only gives an account of what was done during the survey and presents some preliminary results.

The hydrographic conditions were quite similar along the coasts of Senegal and The Gambia. The surface layer had typical characteristics of tropical water masses with high temperatures and high salinities.

Fluorescence measurements indicated low algal concentrations throughout the area. pH values were highest in the surface and decreased with depth. There were no clear geographical patterns in the biomass of zooplankton along the coast of Senegal and The Gambia.

Microplastics were found at 15 of the 18 sampling stations, and the highest concentrations were found at a station relatively close to Dakar.

With respect to main groups of pelagic fish encountered during the survey of Senegal and The Gambia, sardinellas were mainly distributed between Cabo Verde and The Gambia, with approximately the same biomass of *S. aurita* and *S. maderensis.* The highest abundance of *T. trecae* was found north of Cabo Verde. The biomass of *S. colias* was low throughout the sampling area. Carangids and associated species were found in all areas, with the highest abundance on the shelf of The Gambia. Among the non-target species, *Boops boops* constituted the highest biomass in the trawl catches, followed by *Brachydeuterus auritus.*

With regard to biomass estimates of sardinellas and carangids and associated species (including *T. trecae*) for Senegal and The Gambia, the results show that in 2017, the biomass had decreased to almost half of that in 2015 and was just below the long-term mean, noting that the 2015 estimate was one of the highest on records. The biomass of sardinella was well below the long-term mean already in 2015, and in 2017, it had dropped to the second lowest on records.

RÉSUMÉ

Le N/R Dr Fridtjof Nansen a conduit une campagne le long des côtes du Sénégal et de la Gambie, de Saint-Louis au Casamance.

Un plan d'échantillonnage a été adopté avec des transects parallèles perpendiculaires à la côte, espacés de 10 MN, et des mesures acoustiques de poissons pélagiques obtenues sur le plateau de 20 m à 500 m de profondeur. À chaque degré de latitude, un transect hydrographique a été effectué jusqu'à une profondeur de 1000 m. Des mesures météorologiques et hydrographiques ont été enregistrées régulièrement au cours de la campagne. En plus, des échantillons sur les paramètres d'acidification des océans (pH et alcalinité), les nutriments, le phytoplancton, le zooplancton, les œufs de poissons, les larves et les microplastiques ont aussi été recueillies

La campagne a été réalisée avec un personnel scientifique composé de 30 personnes provenant de huit pays différents.

La collecte des données au cours de cette campagne le long des côtes du Sénégal et de la Gambie a été intense, couvrant un large éventail de domaines scientifiques liés à la biologie marine et à l'écologie : l'hydrographie, la météorologie, les microplastiques, le phytoplancton, le zooplancton, les méduses, la biologie de la pêche, y compris les œufs et les larves, la génétique et l'abondance de poisson. Beaucoup de données n'ont pas encore été analysées. Par conséquent, ce rapport donne seulement un aperçu de ce qui a été fait pendant la campagne et présente quelques résultats.

Les conditions hydrographiques étaient assez similaires le long des côtes du Sénégal et de la Gambie. La couche superficielle avait des caractéristiques typiques des masses d'eau tropicales avec des températures et salinités élevées.

Les niveaux de fluorescence ont montré une présence faible de phytoplancton. On pas trouvé de schéma géographique de la biomasse du zooplancton le long des côtes du Sénégal et de la Gambie.

Des microplastiques ont été trouvés dans 15 des 18 stations d'échantillonnage, et les concentrations les plus élevées ont été trouvées dans une station relativement proche à Dakar.

En ce qui concerne les principaux groupes de poissons pélagiques rencontrés lors de l'enquête du Sénégal et de la Gambie, les sardinelles étaient principalement réparties entre le Cabo Verde et la Gambie, avec approximativement la même biomasse de *S. aurita* et *S. maderensis*. L'abondance la plus élevée de *T. trecae* a été observée au nord du Cabo Verde. La biomasse de *S. colias* était faible dans toute la zone d'échantillonnage. Des carangidés et des espèces associées ont été trouvés dans toutes les régions, l'abondance la plus élevée se trouvant sur le plateau de la Gambie. Parmi les espèces non ciblées, les *Boops boops* constituaient la biomasse la plus élevée dans les captures au chalut, suivies par le *Brachydeuterus auritus*.

En ce qui concerne les estimations de la biomasse de sardinelles et de carangidés et des espèces associées (y compris *T. trecae*) pour le Sénégal et la Gambie, les résultats montrent qu'en 2017, la biomasse avait été réduite de près de la moitié de celle de 2015 et qu'elle était juste en dessous du niveau à long terme, notant que l'estimation de 2015 était l'une des plus élevées jamais enregistrées. La biomasse de sardinelles était déjà bien inférieure à la moyenne à long terme en 2015 et, en 2017, elle était tombée au deuxième niveau le plus bas jamais enregistré.

CHAPTER 1. INTRODUCTION

1.1 Survey objectives

This survey was planned as part of a synoptic coverage of West Africa's pelagic resources and ecosystems conducted from Morocco to South Africa, from May to December 2017 as part of the EAF-Nansen Programme (2017-2021).

In connection with this phase of the Programme, a Science Plan has been developed that addresses 11 different themes within three main lines of research related to resources, impacts of oil/mining activities and pollution on resources and ecosystems and climate change. Therefore, in addition to providing key information on abundance and distribution of main pelagic stocks, the survey programme was designed to also support the research projects under the science plan.

The specific objectives include:

Hydrography:

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

Phytoplankton, zooplankton, ichthyoplankton and jellyfish:

- To establish as far as possible, the distribution, abundance and composition of phyto- and zooplankton, and fish eggs and larvae;
- To contribute to increase the understanding of taxonomy, biology and ecological role of jellyfish.

Pelagic stocks abundance, distribution and biology:

- To obtain information on abundance, distribution (also by size) of *Sardina pilchardus, Sardinella aurita, Sardinella maderensis, Trachurus trachurus, Trachurus trecae, Scomber colias, and Engraulis encrasicolus* using acoustic methods and a systematic grid survey strategy.
- To collect samples for genetic and morphometric analysis (for stock identification of *S. aurita, S. pilchardus* and *Scomber colias*).
- To obtain information on maturity stages of *S. aurita, S. pilchardus* and *Scomber colias.*
- To collect stomach samples for analysis of contents for selected species.
- To collect otoliths, *S. aurita, S. pilchardus* and *Scomber colias* for stock identification.

Food safety:

- To collect samples for levels of environmental contaminants, nutrients, parasites and microorganisms with regards to food safety and pollution.

Microplastics:

- To collect samples of microplastic particles in surface waters.

1.2 Participation

Institute of Marine Research, Norway (IMR), Norway:
Oddgeir Berg Alvheim, Geir Landa, Jostein Andre Solhaug, Elisabeth Lundsør, Tore Johannessen (Cruise leader), Tor Magne Ensrud and Thomas James Williams,

National Institute of Nutrition and Seafood Research (NIFES), Norway:
Edel Erdal

Centre de Recherches Océanographiques de Dakar-Thiaroye, Senegal,
Oumar Sadio (team leader Senegal), Tamsir Ousmane Sow, Saliou Faye, Limale Deme, Aboubacar Gueye, Naby Souleymane Faye and Ndague Diougoul.

Marine Nationale Sénégalaise, Senegal
Mamadou Diene (Navy observer)

Department of Fisheries (FD), The Gambia:
Momodou S Jallow (Gambian team leader), Salifu Ceesay, Momodou Sidibeh.

Centro de Investigação Pesqueira Aplicada, Guinea Bissau:
Duarte Bucal (team leader Guinea Bissau), Martinho Joaquim Gomes, Abrigo Menda and Amadeu Mendes De Almeida.

Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), Mauritania :
Alioune Niang, Cheikhna Gandega and Ahmed Diagne.

Instituto Nacional de Desenvolvimento das Pescas, Cabo Verde:
Ivanice Oliveira Monteiro and Nuno Roberto Dias Brito Vieira.

Instituto Español de Oceanografía, Spain:
Begoña Maria Sotillo De Olano.

The University of the Western Cape, South Africa:
Yasmeen Parker.

1.3 Narrative

The R/V *Dr. Fridtjof Nansen* departed from Dakar, Senegal, on 6 July 2017 to finish the last part of the survey off Mauritania. On 9 July, at 16 00 GMT, the vessel entered northern

Senegalese waters and thus the present survey along the coast of Senegal and The Gambia could start. Gambian waters were entered on 13 July at 03 00 GMT, and reached the southern border on 14 July at 12 00 GMT. The border between Senegal and Guinea-Bissau was reached on 17 July at 04 00 GMT, which concluded the survey. The R/V *Dr Fridtjof Nansen* then returned to Dakar on 18 July at 12 00 GMT. The weather conditions were good during the entire survey.

1.4 Survey effort

During all surveys along the west coast of Africa, a common survey design was adopted. The survey was run along parallel transects, 10 NM (nautical miles) apart. The transects were laid approximately perpendicular to the coastline, and acoustic measurements of pelagic fish were obtained on the shelf from the 20 m to the 500 m isobath. Trawling was done either to identify echo registrations or to check 'blindly' if fish were mixed with the plankton in the upper layers of the water column. Pelagic trawl with floats was occasionally used to catch fish close to the surface. A smaller pelagic trawl or the bottom trawl with floats were used for sampling pelagic fish in shallow waters (depth less than 30 m). Figure 1.1 shows the course track and trawl stations.

At each degree of latitude, a hydrographic transect was carried out to a depth of 1 000 m. These transects included CTD casts and sampling of phytoplankton, zooplankton, fish eggs and larvae, and plastics. To obtain hydrographic measurements from Gambian waters, an additional hydrographic transect was carried out between 13 and 14 °N. Figure 1.2 shows the position of hydrographic stations, and Table 1 shows effort during the survey in terms of number of trawl stations, CTD casts and samples of plastic (Manta trawl), phytoplankton, zooplankton (WP2) and fish eggs and larvae (Multi net).

Fish were also sampled for analyses of food safety. No. of samples for this purpose are given in Table 2.

Overview of samples for biological purposes is provided in Annex II.

Table 1. Survey effort. Phyto: phytoplankton net, WP-2: zooplankton net; Multi: multinet for eggs and larvae; Manta: manta trawl for plastic particles in the surface; BT: Bottom trawl; PT: Pelagic trawl. Samples from a hydrographic transect that was carried out on the border between The Gambia and Casamance, Senegal, was allocated to Casamance. An extra hydrographic transect was conducted in the middle of the Gambian EEZ (13.33°N, east- west). Three additional Manta hauls sampling plastic were carried out, near St. Louis, Dakar and Banjul.

	NM sailed	CTD	Phyto	WP-2	Multi	Manta	BT	PT
St Louis - Cabo Verde	257	6	3	5	3	4	2	5
Cabo Verde - The Gambia	321	9	3	5	3	5	2	7
The Gambia	209	11	3	5	3	4	1	4
Casamance	248	16	6	10	6	6	2	3
Total	1035	42	14	25	15	19	7	19

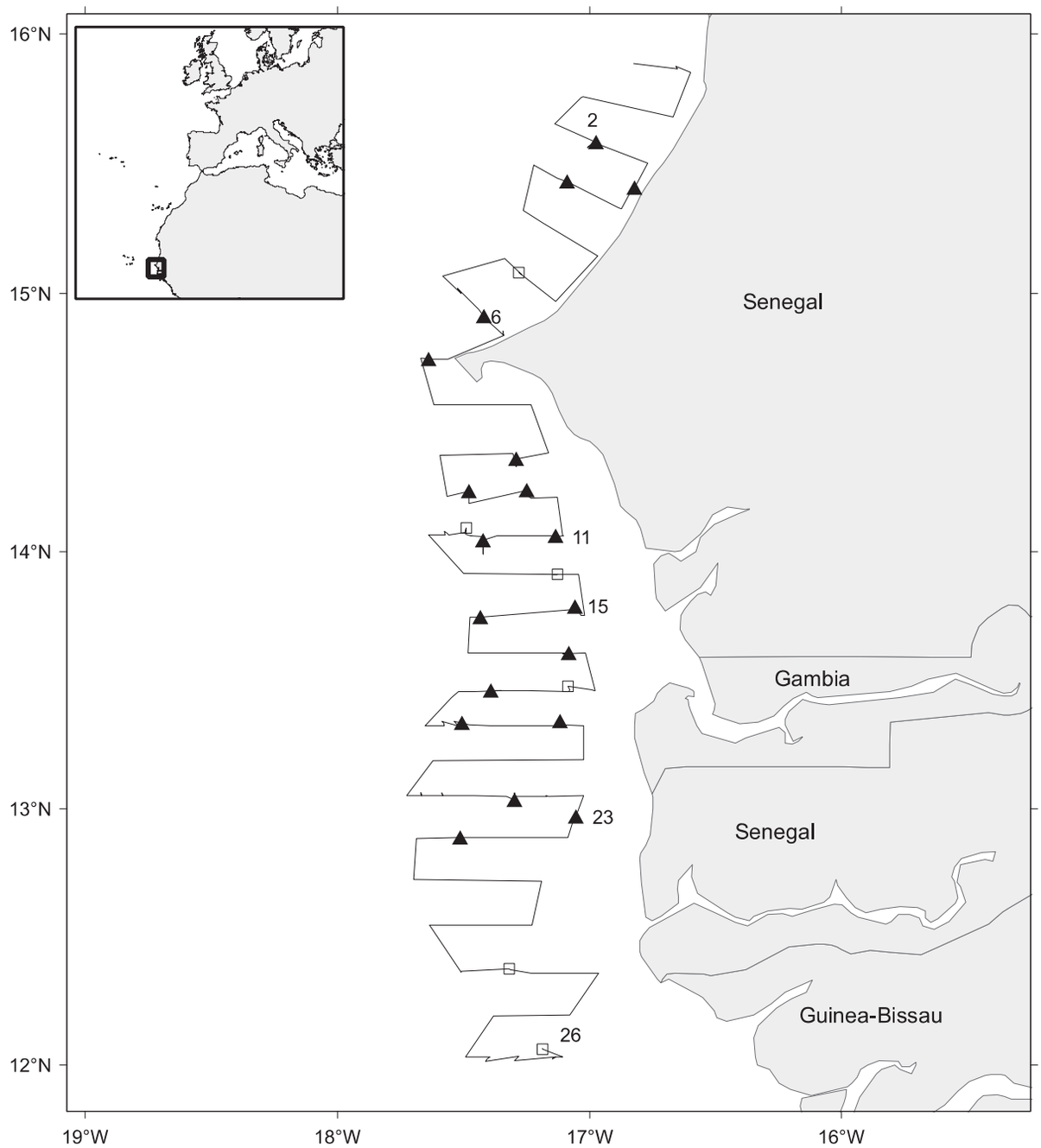


Figure 1.1. Course tracks with trawl stations along Senegal and The Gambia – squares indicate bottom trawl and triangles pelagic trawl. Symbols:▲: pelagic trawl; □ : bottom trawl

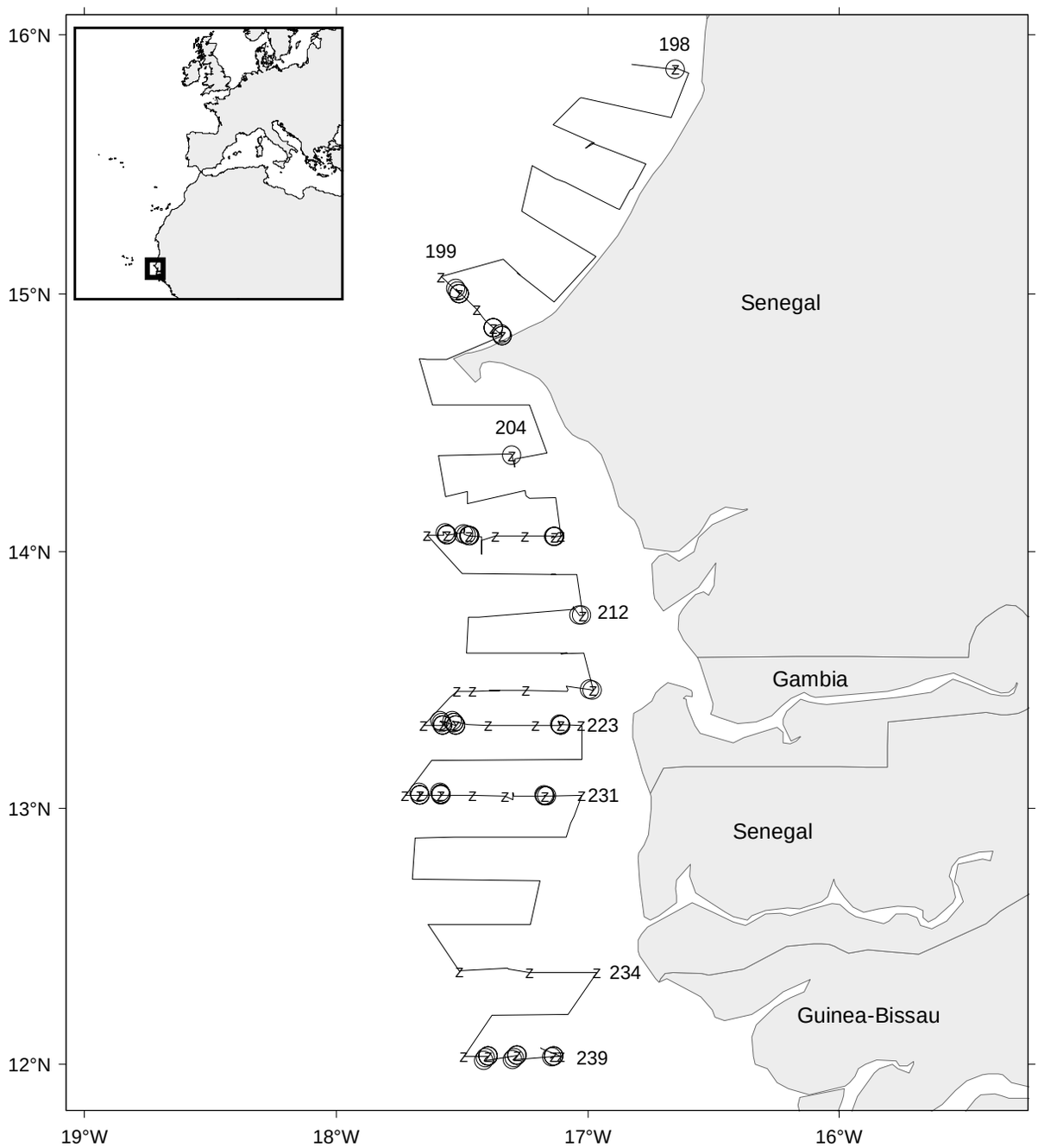


Figure 1.2. Course track with hydrographic and plankton stations – Z indicates CTD; O indicates CTD, plankton, Multi net for eggs and larvae, Manta net for plastic and chemical seawater analyses.

Table 2. No of fish samples collected for food safety analyses per species.

Species	**No. of samples**	**No of positions**	**Tissue**	**Nutr.**	**Cont.**	**Other**
Auxis thazard	18	18	Fillet Liver samples	X	X	
Sardinella maderensis	25	25	Fillet Liver samples	X	X	
Sardinella aurita	25	25	Fillet Liver samples	X	X	
Galeoides decadactylus	19	19	Fillet Liver samples	X	X	

Nutrition: Energy, water content, total fat, proteins, ash, fatty acids, cholesterol, amino acids, tryptophan, vitamins (D, A, E, K, C, thiamine, riboflavin, B6, B12, folate, niacin, pantothene, biotin), iodine, selenium and other minerals.
Contaminants: Heavy metals, Inorganic arsenic, PAH, PBDE, PCB, dioxins, furans, PFAS, pesticides, HBCD, TBBP-A.

TBARS = Thiobarbituric acid reactive substances
PAH = Polycyclic Aromatic Hydrocarbons
PBDE = Polybrominated diphenyl ethers
PCB= Polychlorinated biphenyls
PFAS = Polyfluoroalkyl substances
HBCD = Hexa Bromo CycloDodecane
TBBPA = Tetrabromobisphenol A

CHAPTER 2. METHODS

2.1 Meteorological data recording

Meteorological data were logged continuously from the AANDERAA Smartguard meteorological station, including wind direction and speed, air pressure, humidity, air temperature and solar radiation. All data were logged to the Nansis tracklog system averaged by unit distance sailed (1 NM).

2.2 Oceanography

Thermosalinograph

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

CTD

Sampling along transects

Vertical temperature and salinity profiles were obtained by a Seabird 911 CTD, while *in situ* concentrations of dissolved oxygen were measured using a CTD-mounted SBE 43 oxygen sensor. Real time logging and plotting was performed using the Seabird Seasave software installed on a PC. Attached to the CTD was also an uncalibrated Chelsea Mk III Aquatracka fluorometer, which measures *in situ* fluorescence on relative scale. The CTD was stopped at the designated depths for 15 seconds before closing the Niskin bottles. CTD casts were conducted at, or close to every degree of latitude, from the coast and offshore to approximately 1 000 m bottom depth. An additional hydrographic transect was carried out in the middle of the Gambian EEZ (13.33 °N, east- west). 12 Niskin bottles (10 l), attached to a CTD-mounted rosette, were used to collect water at standard sampling depths: 5, 25, 50, 75, 100, 150, 200, 250, 300, 400, 500, 750, and 1 000 m. At stations with bottom depth of 1000 m, the sample from 250 m was not collected due to the limitation to 12 Niskin bottles.

Superstations

At bottom depths of 30 m, 100 m and 500 m, the following type of samples/data were collected (so-called “Superstations”): salinity, temperature, dissolved oxygen and fluorescence measured by the CTD with additional sensors, seawater samples, phytoplankton, zooplankton, fish larvae and eggs, and microplastics.

Ocean acidification parameters (pH and alkalinity)

Seawater samples (250 ml) from the CTD-mounted Niskin bottles were collected in borosilicate glass bottles using silicone tubing to reduce air exchange. Both pH and alkalinity

were analysed on board the vessel. pH was determined spectrophotometrically using a diode array spectrophotometer and a pH sensitive indicator, m-cresol purple in 2 mM solution, as described by Clayton and Byrne (1993) and Chierici et al. (1999). Alkalinity was measured by titration with acid (0.05M HCl) and changes in pH were measured with an electrode (potential in mV) using tiamo software. Further processing of the data will be done as part of the science plan Theme 10: Climate change and biogeochemical processes, expected to provide more information on the marine carbonate system and parameters for ocean acidification.

Nutrients

Seawater samples (20 ml) for nutrient analyses (nitrate, nitrite, silicate and phosphate) were collected from the Niskin water-bottles. The seawater samples were stored in 20 ml polyethylene vials, conserved with 0.2 ml chloroform, and kept cool and dark in a refrigerator (Hagebø and Rey, 1984). The analyses will be made on shore by 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).

2.3 Plankton

Phytoplankton biomass

Chlorophyll-*a* was sampled as an indicator of phytoplankton biomass. For chlorophyll-*a* and phaeopigment measurements, seawater was collected from the CTD at the standard depths (not below 200 meters). The water was filtered using a 0.7µm filtration system (Munktell fiberglass filters Grade: MGF, vacuum 400 mm Hg) and stored at 20°C until analysis on shore by the Institute of Marine Research. The assay is performed by extraction with 90% acetone followed by centrifugation, and the measurements are taken with a fluorometer (model 10 AU, Turner Designs Inc., Sunnyvale, Ca., USA), according to Welshmeyer (1994) and Jeffrey and Humphrey (1975).

In the southern part of the survey-area (stations 105 to 163), 3 parallels were filtered from each depth and stored at -20°C. After 3 weeks, all batches were transferred to -80 C. One of the batches was then freeze-dried and thereafter stored at -80 °C. For chlorophyll-a and phaeopigment measurements, water is collected (263 ml) at the standardized depths. The water is filtered using a 0.7µm filtration system (Munktell fiberglass filters Grade: MGF, vacuum 400 mm Hg).

Two batches (one freeze-dried and one only frozen at -80 C) were transported to Norway (Bergen) for subsequent analyses. The last batch in the -80 C freezer was left on the ship for later analyses on board. The analyses in Norway will be done by the Institute of Marine Research which is an accredited laboratory. The assay is performed by extraction with 90% acetone followed by centrifugation, and analysed with a fluorometer (model 10 AU, Turner Designs Inc., Sunnyvale, Ca., USA), according to Welshmeyer (1994) and Jeffrey and Humphrey (1975). The same assay (but not accredited) will be implemented on board the R/V *Dr. Fridtjof Nansen* during fall 2017.

Phytoplankton identification

Phytoplankton was collected along the hydrographic transects at stations positioned at bottom depths of approximately 30 m, 100 m and 500 m. At each plankton-station, qualitative phytoplankton samples were collected with a net (35 cm in diameter and mesh size of 10 µm), hauled vertically at a speed of 0.1 ms^{-1} from the depth of 30 m to the surface (from ca. 5 m above bottom at the 30 m stations). The samples were preserved with 2 ml of 20 % formalin buffered with hexamine in 100 ml bottles (i.e. a final solution of ca. 0.4% formaldehyde). These samples are not quantitative but used to establish the taxonomic composition of the phytoplakton community.

Zooplankton

Mesozooplankton was collected with a WP2-net along the hydrographic transects at stations positioned at bottom depths of approximately 30 m, 100 m and 500 m. The WP2-net (56 cm diameter, mesh size 180 µm) (Fraser 1966, Anonymous 1968) was hauled vertically at a speed of ~0.5 ms^{-1} at each station. At the shallowest and intermediately deep stations (bottom depths of 30 m and 100 m, respectively), the sampling-strata were from near-bottom to the surface (lower sampling-depths of ~25 and 90 m, respectively). At the deepest stations with bottom depth of ~500 m, the sampling-stratum was from the depth of 200 m to the surface.

Furthermore, a second collection with the WP2-net was performed for the depth-stratum of 30-0 m at the stations with bottom depths of 100 m and 500 m. The purpose of these additional samplings was to enable a direct comparison of the zooplankton composition and concentrations in the uppermost layer of the water-column along the bottom depth gradient. Each zooplankton-sample was divided into two equally large parts using a Motoda plankton splitter (Motoda 1959). The first part of the sample was size-fractioned by using a series of sieves with the decreasing mesh-sizes of 2000 µm, 1000 µm and 180 µm, and the zooplankton retained on each sieve were thereafter dried on aluminium-trays at ~60 ºC for 24 h. These samples will be dried once more and weighed on shore after the cruise for estimation of biomasses for the different size-groups. The second part of the sample was preserved in seawater with a final solution of 4% formaldehyde buffered with borax for subsequent species identification and quantification on land.

Ichthyoplankton

Fish eggs and larvae were collected using a Hydro-Bios Multinet with 405 µm meshes. Samples were obtained along the hydrographic transects at approximately 30, 100 and 500 m depth. The net was towed obliquely from the bottom or a maximum depth of 100 m to the surface with a towing speed of 1.5 ms^{-1}. All fish larvae visible to "the naked eye" were removed from the total sample, transferred to vials and preserved in 4% borax buffered formaldehyde. After removing visible fish larvae, the Multinet sample was fractionated using a Motoda plankton splitter for enumeration of eggs under a stereomicroscope (Motoda 1959). The principle of this procedure is to split a homogenised sample into two "equal" parts, which

again can be split further depending on the sample size. Small fish larvae overlooked by the "naked eye" scan were collected under the stereomicroscope and preserved in a separate vial noting the splitting factor. The remaining fish eggs were preserved in 4% borax buffered formaldehyde in vials noting the splitting factor. The rest of the sample was fixed for reference purpose and for possible later checks of overlooked egg and larvae.

Microplastics

Microplastics were collected along the hydrographic transects at bottom depths of approximately 30 m, 100 m and 500 m. At each station, the surface layer was sampled with a Manta-trawl with a rectangular opening of 19 cm × 61 cm (HxW), mesh size of 335 µm and two wings to keep it in balance and at the surface during the tow. Trawls were hauled horizontally at a speed of ~1.5 ms^{-1} for 15 minutes. Trawling was performed some meters away from of the right-hand side, about mid-ship, attempting to avoid the wake of the vessel. Geographical start and stop positions were recorded in the bridge-log. In addition, the counts of a flowmeter attached below the trawl opening were recorded at start and stop of each trawl event.

The Manta-trawl samples were washed in filtered seawater over a sieve with mesh size of 180 µm. Plastic particles will be picked with the aid of a dissecting stereomicroscope. Plastic particles were picked from the sample under a stereomicroscope. This repeated twice to ensure detection of the smallest plastic particles. All assumed plastic items were then placed on a gridded petri dish for examination under the stereo-microscope, photographed and, to the extent possible, also measured and described (e.g. length, shape, type and colour). The sorted microplastics were washed with distilled water and dried in pre-weighed aluminium-trays in a drying cabinet at 30 ºC. The trays were packed in aluminium foil and stored at room temperature until transport to the laboratory at IMR, where they will be studied in more detail. After removing the plastics, the remaining part of the samples - mainly biological material - was preserved for studies of neuston that will be carried out after the cruise.

2.4 Trawl sampling

Species composition and size distribution of pelagic fish were estimated based on samples obtained from pelagic and bottom trawl hauls. This information is essential for estimating the biomass of the various species from the acoustic measurements. Annex III gives a description of the instruments and the fishing gear used. In shallow water (< 30 m) or at night when pelagic fish was close to the surface, a small pelagic trawl with floats or a bottom trawl with floats were used for sampling. All catches were sorted, and subsamples taken to measure number and weight by species. Species identification was based on the FAO Species Guides. Individual fish were measured by total length (nearest cm below) and weight. For target species, 30 individuals were investigated with respect to sex, maturity and stomach fullness. In addition, for target species, the following biological samples were collected for later use: otoliths for aging, fin clips for genetic analyses, stomachs for diet studies and liver for condition studies. Based on obtained measurements, length-weight relationships were established for acoustically estimates of the biomass of target species.

The target species during this survey can be found below, while the complete records of fishing stations and catches are shown in Annex I. A full list of biological samples per species and trawl station is given in Annex II.

2.5 Sampling for food safety

Whole fish, fillet and different organs from various fish and octopus were sampled during this survey. All the samples will be analysed for a wide variety of nutrients and contaminants at IMR. Tissue samples from mackerel will be analysed for the parasite *Kudoa*.

Some of the samples will also be analysed for correspondence between the microbiota and the metal content of the gut. One pelagic fish sample will be analysed for the content of microplastic particles. This work will be carried out in close cooperation with partners in the region.

2.6 Acoustic sampling

Current speed and direction measurements

Two hull-mounted Acoustic Doppler Current Profiler (ADCP) from RD Instruments ran during the survey. The frequency of the ADCP are 75 and 150 kHz. The system is run in narrow band mode and data were averaged in 16 and 4 m vertical bins at 75 and 150 kHz respectively and stored on files for post survey processing. The 150 kHz was run continuously while the 75 kHz was turned off during the last part of the survey due to interference with the ping rate of the EK80 echosounder.

Sonar data

A Simrad SH90 Sonar was recording data continuously during the survey and stored for post processing after the survey. The sonar was set to a frequency of 26 kHz, in FM Normal mode. The sonar was operated using bow up/180 degrees operation mode with the bearing of the vertical beams perpendicular to the vessel direction, and a horizontal range of 450 m and tilt angle of 3 degrees. The filters built in the sonar software to improve the school representation (i.e. AGC, RCG) and ping to ping was set to default values, except for the noise filter, which was turned off. The settings, including range and tilt, were kept the same throughout the survey, except during trawling operations when the sonar in some instances was used to target fish schools.

Bottom mapping echo sounder

The EM 710 multibeam echo sounder is a high to very high-resolution seabed mapping system. Acquisition depth is approximately 3 m below the transducers and the maximum acquisition depth is limited in practice to 1000 - 1500 m on R/V *Dr. Fridtjof Nansen*. Across track coverage (swath width) is up to 5.5 times water depth and may be limited by the operator either in angle or in swath width without reducing the number of beams. The

operating frequencies are between 70 to 100 kHz. There are 128 beams with dynamic focusing employed in the near field. The transmitting fan is divided into three sectors to maximize range capability and to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping and use distinct frequencies or waveforms. The along track beam width is 1 degree. Ping rate is set according to depth. The receiving beam width is 2 degrees. Sound profiles were set manually in the system according to the area of operation. The data was logged to the on-board Olex plotting system.

Acoustic estimates of fish biomass

Acoustic data were recorded using a Simrad EK80 Scientific Split Beam Echo Sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38, 70, 120, 200 and 333 kHz. The survey was started without *a priori* calibration, but the sounders were calibrated in Bergen on the 23rd January 2017. Annex III gives the details of the acoustic settings used during the survey.

Acoustic data were logged and post-processed using the latest acoustic data post-processing software, the Large-Scale Survey System (LSSS) Version 2.0. The technical specifications and operational settings of the echo sounder used during the survey are given in Annex III.
In cases where the target category of fish contains more than one species (e.g. sardinellas and *Trachurus trecae*), the mean s_A-value allocated to the category is divided between the species in the same ratio as their contribution to the mean backscattering strength in the catches (relative amount by number at length in the catches). The following target strength (TS) function was applied to convert s_A-values (mean integrator value for a given species or group of species in a specified area) to number of fish:

$$TS = 20 \log L - 72 \text{ dB},$$

which can be converted (see Toresen et al. 1998 for details) to the area form (scattering cross sections of acoustic targets):

$$C_{Fi} = 1.26\ 10^6\ L^{-2},$$

where L is total length in 1 cm length group *i* and C_{Fi} (m^{-2}) is the reciprocal backscattering strength, or so-called fish conversion function. In order to split and convert the allocated s_A-values (m^2/NM^2) to fish densities (numbers per length group per NM^2), the following formula was used:

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

where

ρ_i = density of fish in length group *i*
s_A = mean integrator value
p_i = proportion of fish in length group *i*

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

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

The integrator outputs were split in fish groups using a combination of behaviour pattern as deduced from echo diagrams. The LSSS analysis and catch composition as described below.

The following target species/groups were used:

1) Sardinellas, round sardinella, *Sardinella aurita*, and flat sardinella, *S. maderensis*.
2) Cunene horse mackerel, *Trachurus trecae*
3) Atlantic chub mackerel, *Scomber colias*
4) Other pelagic species, i.e. carangids and associated species
5) Other demersal species.

The equations above show that the conversion from s_A-values to number of fish is dependent on the length composition of the fish. It is therefore important to get representative length distributions from the stock in the whole distribution area.

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

For a region representing a distribution of a target species, the following basic data are needed for the estimation of abundance:

1) The average s_A-value for the region,
2) The surface (usually square nautical miles, NM^2), and
3) A representative length distribution of the target species in the region.

If the targeted fish is a mixture of more than one species, for example sardinellas, a representative distribution of the two, within the region, as shown in the trawl catches, are used. A length distribution representing the number of the two species for each catch must be calculated. Thereafter, these distributions must be normalized to a unit number (usually 100) so they are equally weighted (independent of sample size).

A systematic approach to a) divide the s_A-value between species in a category of fish (e.g. *S. aurita* and *S. maderensis*) and b) produce pooled length distributions of a target species for

use in the above equation and c) calculate the biomass estimates for a region, is obtained through the following procedure:

- The samples of the species in the category (e.g. sardinellas) are respectively pooled together with equal importance (normalized).
- The mean backscattering strength (ρ/s_A) of each length frequency distribution of the target species is calculated and summed. This is automatically done in the Excel Spreadsheet made available for acoustic abundance estimation on board the R/V *Dr. Fridtjof Nansen*, provided the data are punched in this sheet.
- The mean s_A-value allocated to the category of fish in the region is divided between the species in the same ratio as their relative contribution to the mean backscattering strength of the length groups in the sample representing the region.
- The pooled length distribution is used, together with the mean s_A-value, to calculate the density (numbers per square NM) by length groups and species, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area.
- The numbers are then converted to biomass using the estimated weight at length.

CHAPTER 3. SURVEY RESULTS

3.1 Hydrographic conditions

Cross shelf hydrographic profiles

Cross shelf hydrographic profiles of temperature, salinity, oxygen and fluorescence are presented in Figure 3.1 to 3.5. Notice the non-linear y axes, and different colour scales on the various panels. The hydrographic conditions were quite similar at all five transects. The surface layer had typical characteristics of tropical water masses with high temperatures and high salinities. The thermocline was present at around 50 m depth. Above the thermoclines, the water masses were well oxygenated with concentrations of 3-5 ml l^{-1}. At deeper waters, oxygen concentrations were low, varying between 1 and 2 ml l^{-1}, in line with previous measurements in these waters. At some of transects there was indication of subsurface maxima of Chl *a* (fluorescence). However, is should be noted that the maximum values of the scale ranges are low. Hence, the overall picture of Chl *a* along the coasts of Senegal and The Gambia is generally one of low concentrations.

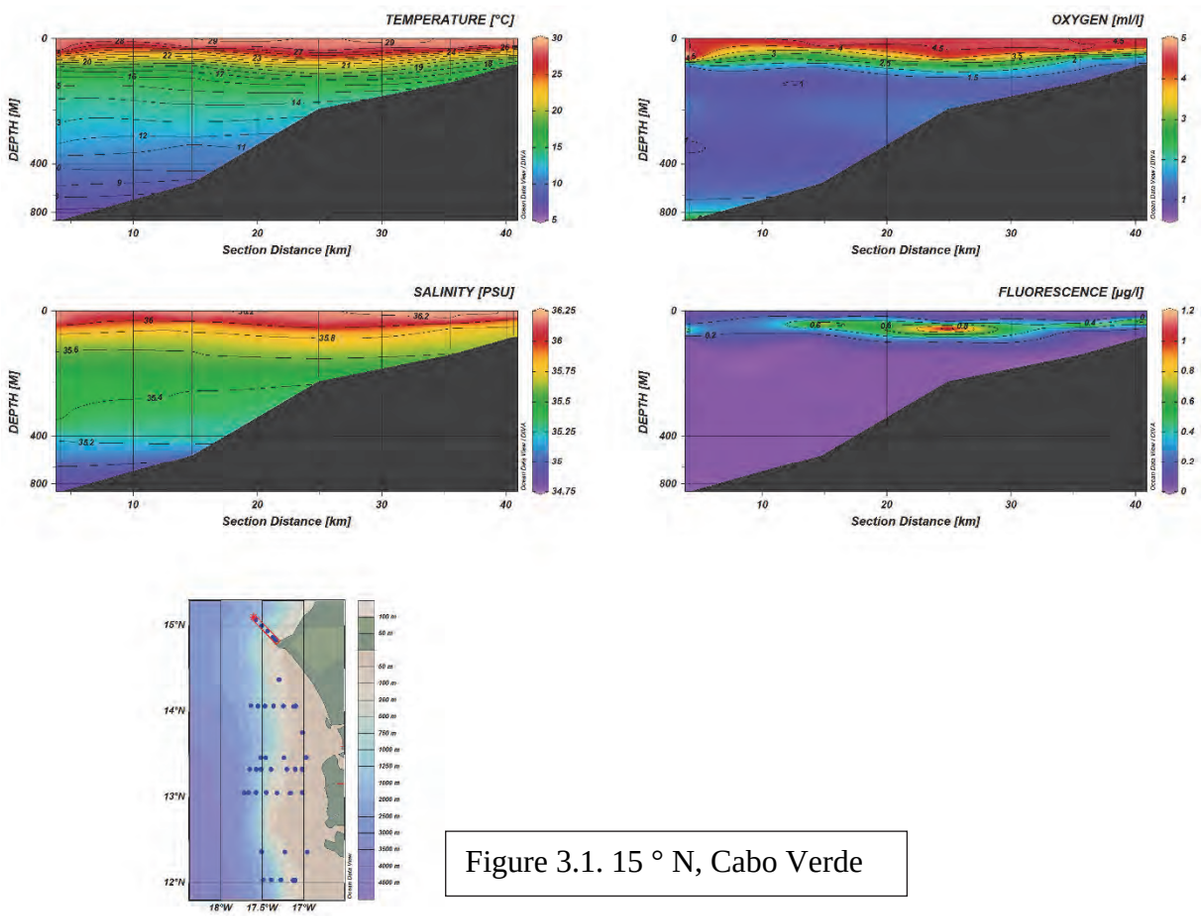
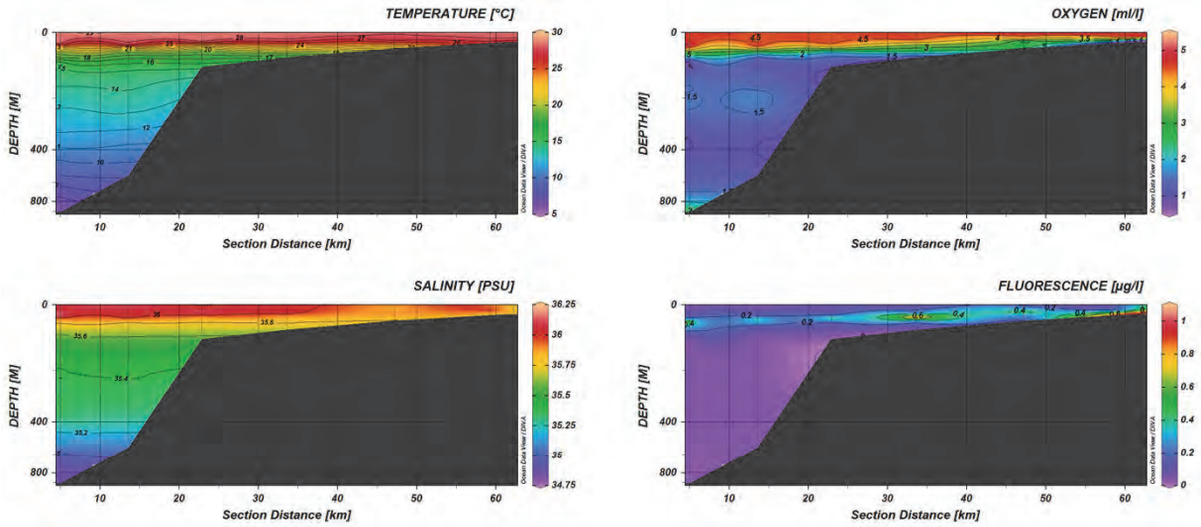


Figure 3.1. 15 ° N, Cabo Verde



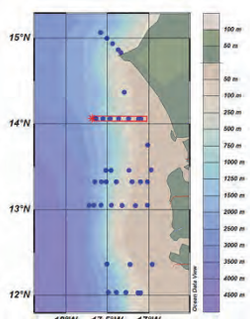
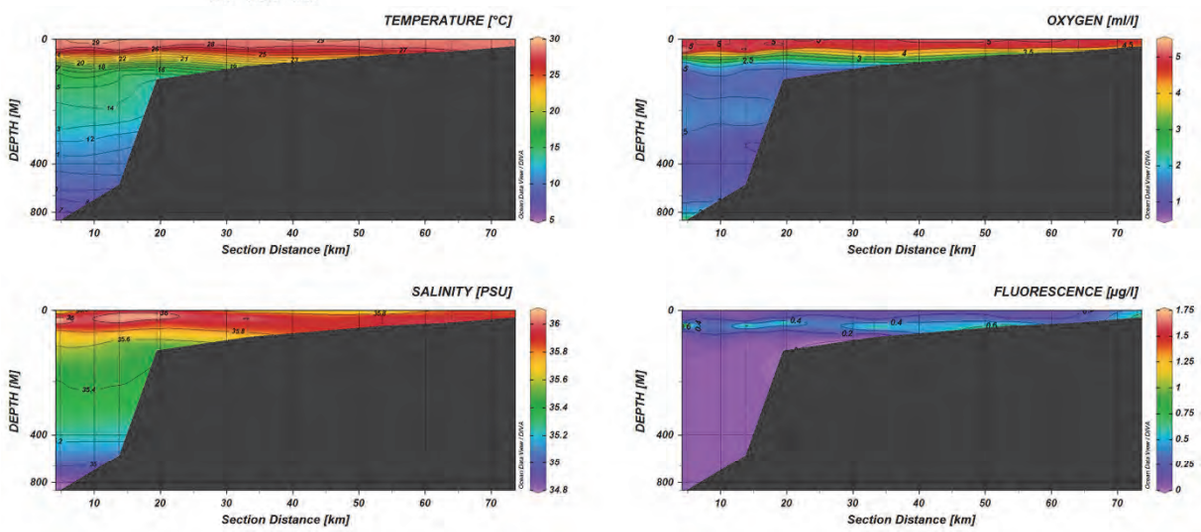


Figure 3.2. 14 ° N, between Cabo Verde and The Gambia.



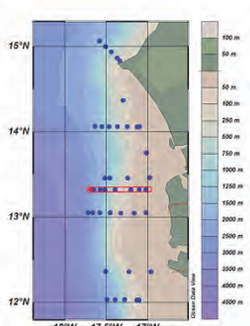
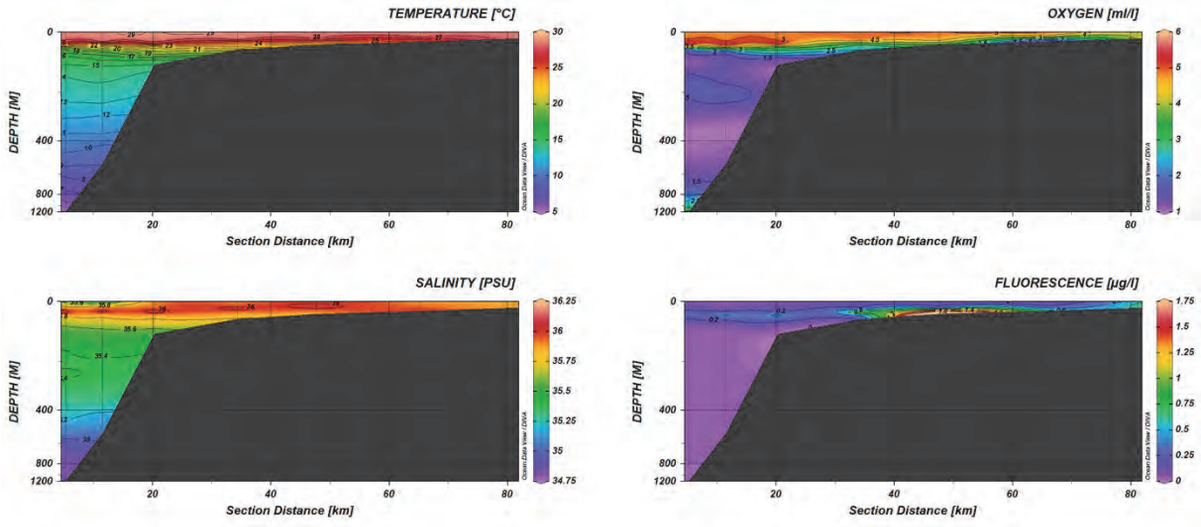


Figure 3.3. 13.3 °N, The Gambia.



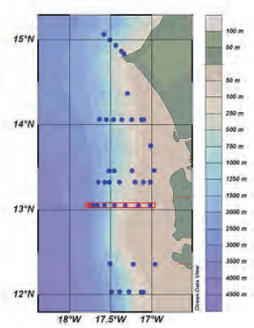
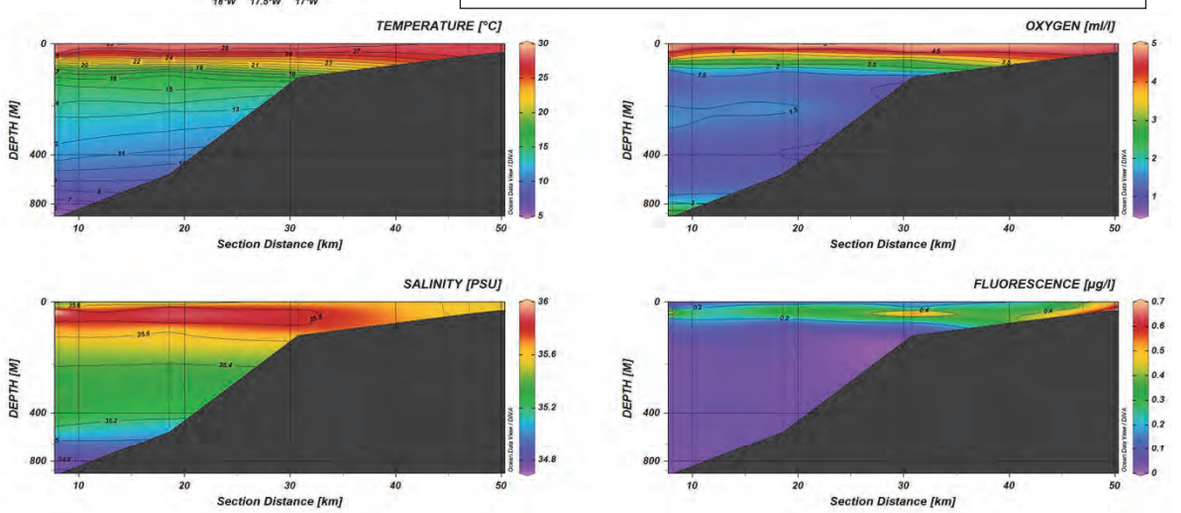


Figure 3.4. 13 °N, border between the Gambia and Casamance, Senegal.



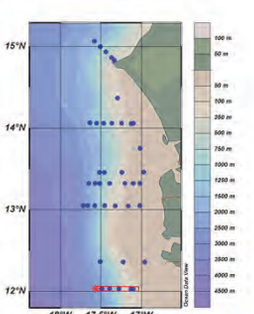


Figure 3.5. 12 °N, border between Senegal (Casamance) and Guinea Bissau.

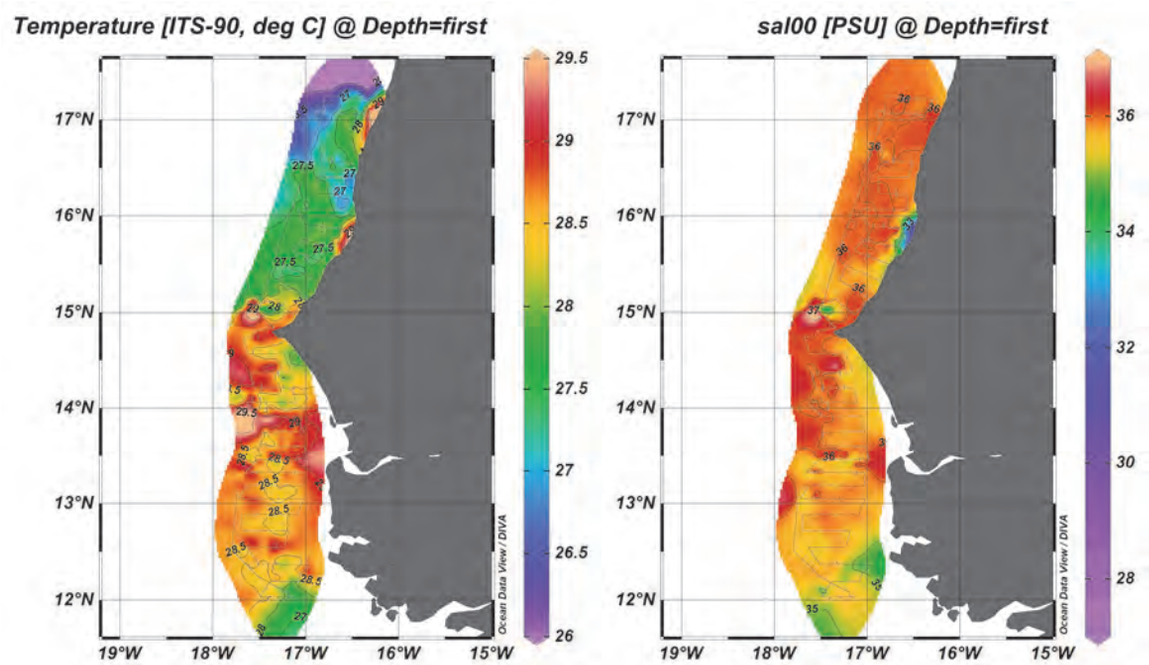
Figure 3.1 - 3.5. Cross-shelf distribution of temperature, salinity, oxygen and fluorescence (Chl *a*) from five hydrographic transects between 12 and 15 °N, presented from north to south.

Sea surface distribution of temperature, salinity and fluorescence

Figure 3.6 shows sea surface temperature, salinity and Chl *a* along the coasts of Senegal and The Gambia (~12 to 16 °N). Notice that the range of the colour scales are relatively narrow, which may leave a visual impression of higher variability than what was observed. North of Cabo Verde (15 °N) the surface temperature was relatively homogeneous around 27.5 °C, except near the mouth of Senegal River (St. Louis, 16 °N) where the temperature reached almost 30 °C. The same pattern was observed in salinity, with generally high, homogeneous salinities around 36 PSU, but with lower salinities near the mouth of River Senegal.

South of Cabo Verde the sea surface temperature varied between 28.5 and 29.5 °C, except for slightly lower temperatures south of Dakar and near the southern border of Casamance (12 °N). The salinity south of Cabo Verde varied between 35 and 36.5 PSU, except near the southern border of Casamance where salinity dropped below, probably as a result of influence from rivers.

The Chl *a* was low throughout the sampling area, with concentrations generally <0.2 µg l^{-1}.



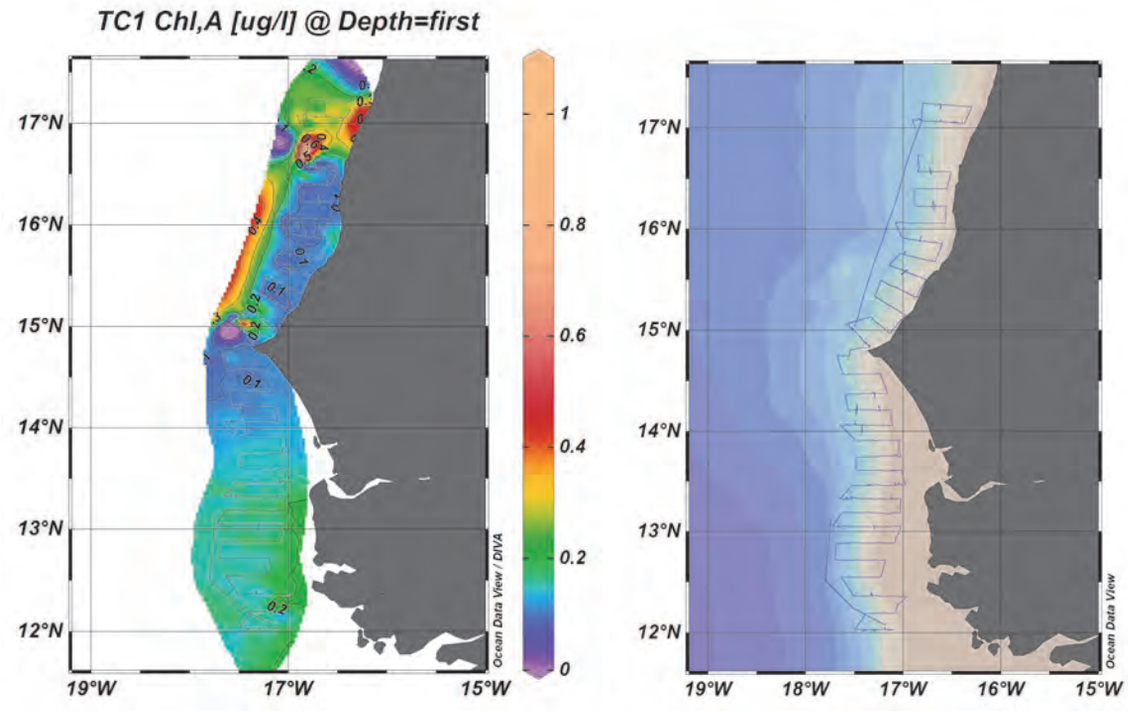
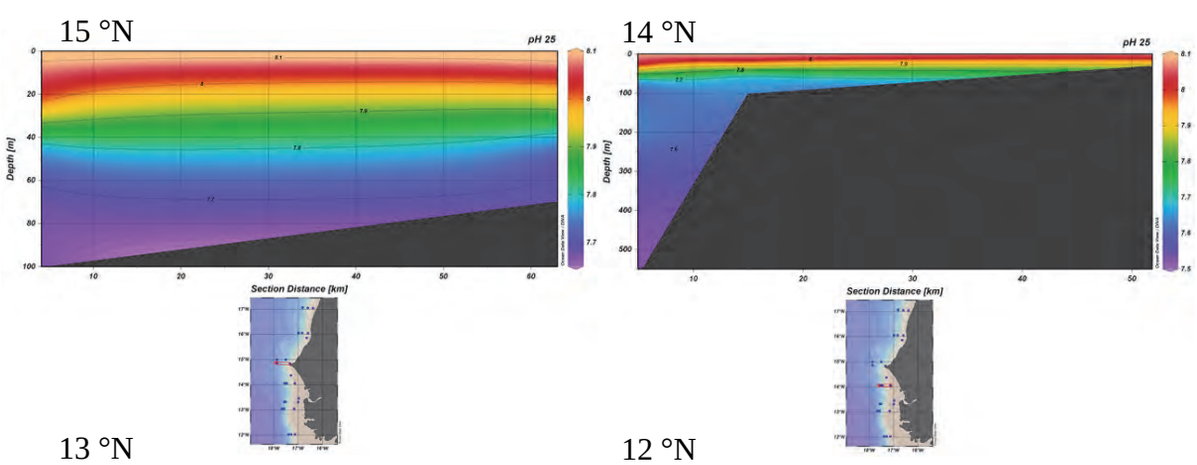


Figure 3.6 Sea surface temperature, salinity and Chl *a* (fluorescence); Senegal and The Gambia (~between 12 and 16 °N).

Cross shelf distribution of pH

Cross shelf distributions of pH are presented in Figure 3.7. Notice different and nonlinear scales on y axes. pH showed the same pattern at all transects, with highest values near the surface and gradually decreasing values with depth.



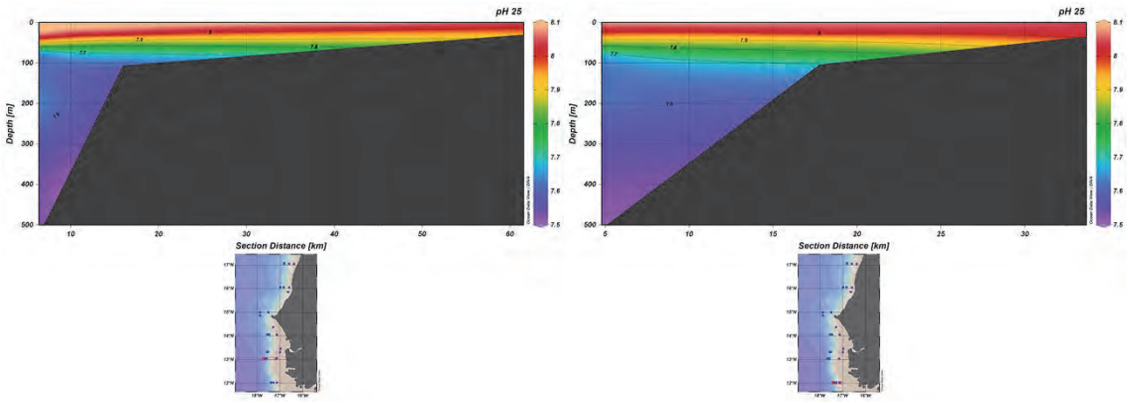


Figure 3.7. Cross shelf distribution of pH along the coasts of Senegal and The Gambia.

Nutrients

Nutrient samples will be analysed in the IMR laboratory in Norway, and data distributed once these analyses have been completed.

3.2 Plankton

Phytoplankton

Phytoplankton was not analysed prior to the completion of this report.

Chlorophyll *a*

This material will be analysed by IMR in Norway, and the data distributed once these analyses have been completed.

Zooplankton

Zooplankton biomass distributions for the coastal area of Senegal and The Gambia are given in Figures 3.8 and 3.9. When considering a subset of data representing the whole water-column for stations with bottom depths of ~100 m or less and restricted to the uppermost 200 m for stations with bottom depths of ~ 500 m, the average zooplankton biomass was 4.9 g dry-weight m^{-2}. "Repeated samples" for the uppermost 30 m were here excluded. The standard deviation was 2.8 g m^{-2} dry-weight, and the number of observations was 14, with the biomasses ranging between 1.5 and 10.6 gm^{-2}. For comparison, when only considering the uppermost ~ 30 m of the water column (Figure 3.9), regardless of bottom depth, the average biomass for the whole study area was 1.5 dry-weight m^{-2} (standard deviation of 0.9 g dry-weight m^{-2}, and 14 observations). These biomasses ranged between 1.5 and 4.8 g m^{-2}, and included both day and night samples.

Considering the total zooplankton biomass for the whole study area (Figures 3.8 and 3.9), no clear geographical patterns emerged.

Notice that a direct comparison of the biomasses along each transect in Figure 3.8, that ran perpendicular to the coast-line, would not make much sense as the lower sampling depths and hence sampling volumes increased with increasing bottom depth.

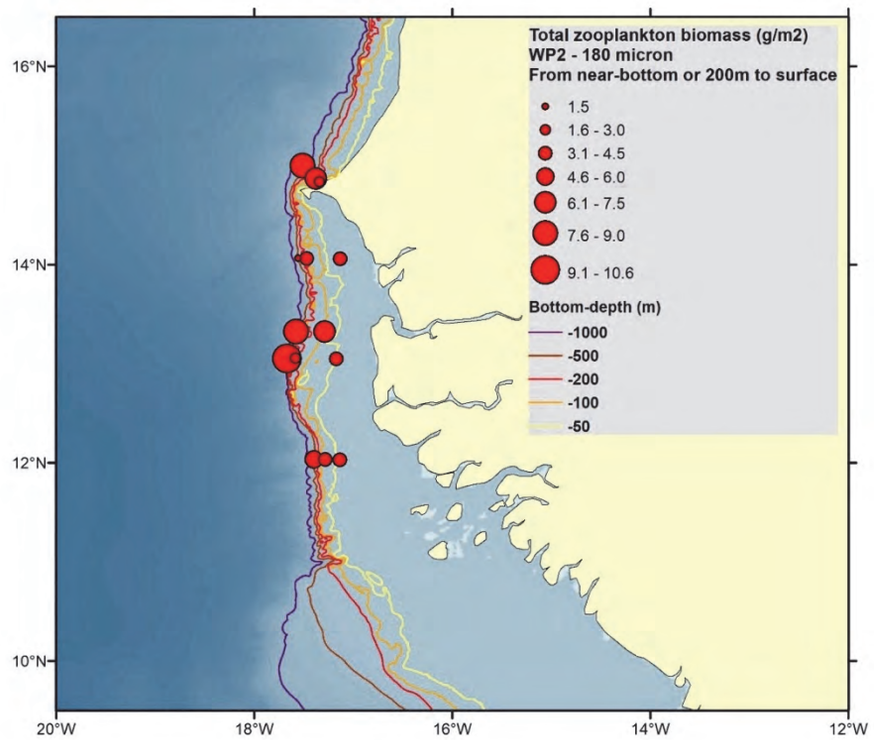


Figure 3.8. Total zooplankton biomasses (dry weight, g/m^2) for sampling-strata of ~ 25-0 m at bottom depth of 30 m, ~ 90-0 m at bottom depth of 100 m, and ~ 200-0 m at bottom depth of 500 m (c.f. bottom depth contours in the figure). Hence, the samples here shown for different bottom depths are not directly inter-comparable but rather indicate the zooplankton biomasses from the bottom (or 200 m) to the surface. Both day and night samples are included.

However, in Figure 3.9 we also present results for samples collected only from the uppermost ~ 30 m, regardless of bottom depth. Figure 3.9 includes both day and night samples, and we have here not accounted for diel vertical migrations of the plankton which might represent some bias when comparing the biomasses. Neither in this case was any clear geographical pattern observed when considering the whole study area.

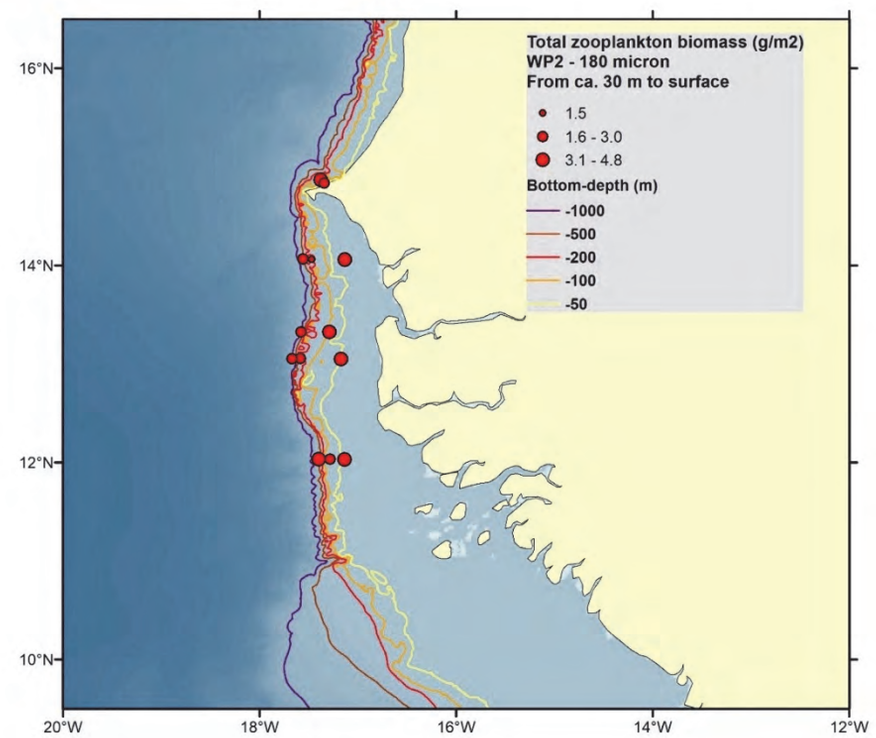


Figure 3.9. Total zooplankton biomasses (dry weight, g/m^2) for the uppermost ~ 30 m. Both day and night samples are included.

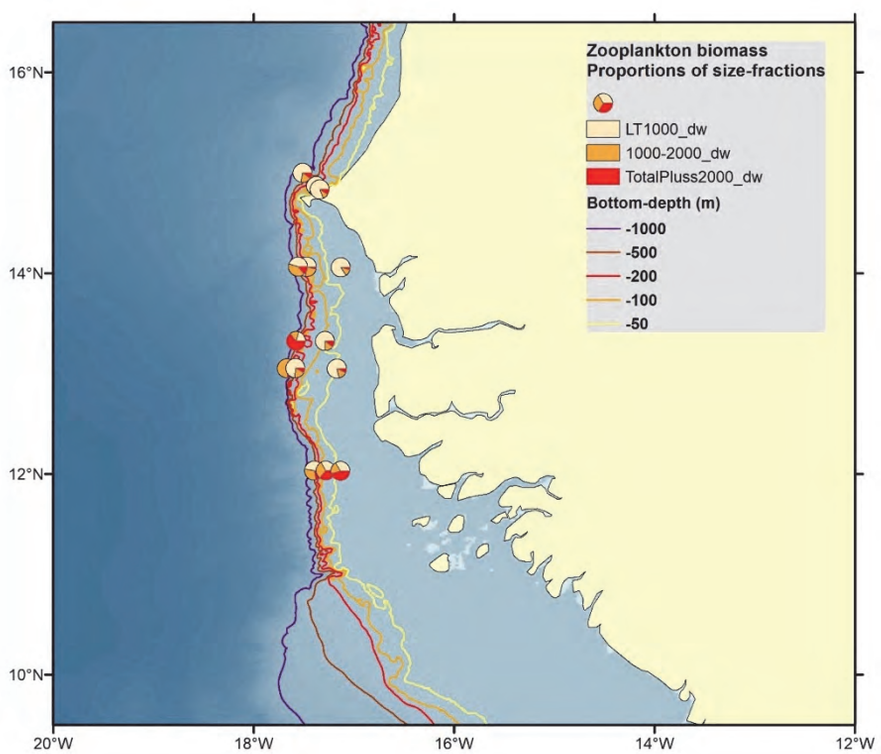


Figure 3.10. Weight proportions of three zooplankton size groups (180-1 000 µm in yellow, 1 000-2 000 µm in orange, and > 2 000 µm in red). The results presented here represent the sampling strata of ~ 25-0 m at bottom depth of 30 m, ~ 90-0 ~m at bottom depth of 100 m, and ~ 200-0 m at bottom depth of 500 m. Hence, the samples here shown for different bottom depths within the same transect

are not directly inter-comparable but rather indicate the zooplankton size composition in the water column above the bottom or depth of 200 m.

Considering the whole region, the weight-proportions of the sampled zooplankton tended to be dominated by the smallest (180-1000 µm) and intermediate (180-1000 µm) size-fractions of the biomass – though with a few exceptions (Figure 3.10). This tendency was indicated also when only considering the uppermost 30 m of the water column (not shown).

Ichtyoplankton

Samples of fish eggs and fish larvae have not yet been analysed, and will be presented separately from this report.

Microplastics

Preliminary results from sampling of microplastics along the coasts of Senegal and The Gambia are presented in Table 3 and Figure 3.11. Apart from a sample containing very high presence of microplastics (station 113 – plastics not yet counted, nor described), a total of 217 objects were collected from the rest of the stations. Plastic particles were found at 15 out of 18 stations. The highest numbers were found at station 204, which is situated south of Dakar.

Table 3. Number of plastic particles per stations and length group along the coasts of Senegal and The Gambia.

	Length groups				
Station	**<1mm**	**1-2.5mm**	**2.5-5mm**	**5-10mm**	**>10mm**
198	0	1	1	1	1
200	2	5	0	1	2
202	0	0	2	0	3
203	0	2	0	0	0
204	0	28	23	19	8
206	1	0	5	0	1
209	0	0	0	4	32
210	0	0	0	0	0
213	3	4	2	4	5
218	0	0	0	0	0
219	0	0	0	1	0
222	1	2	0	0	0
225	0	0	0	0	0
227	0	0	0	0	0
230	2	3	1	0	1
236	2	2	4	0	0
237	1	1	1	0	0
238	8	6	0	0	0

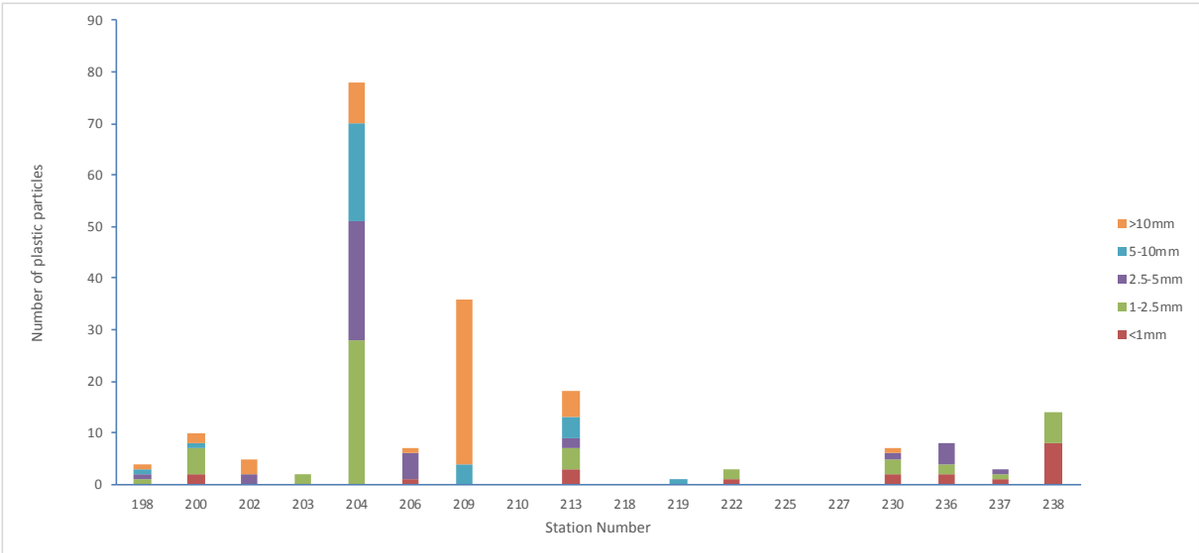


Figure 3.11. Number of plastic particles per station along the coasts of Senegal and The Gambia.

3.3 Distribution and abundance of pelagic fish

Catches per trawl haul are presented in Annex I, overview of biological sampling of fish in Annex II, length distribution of target species in Annex IV and estimated numbers and biomass by length group in Annex V. The main groups of pelagic fish encountered during the survey of Senegal and The Gambia are illustrated with contoured acoustic densities in Figures 3.12 to 3.15.

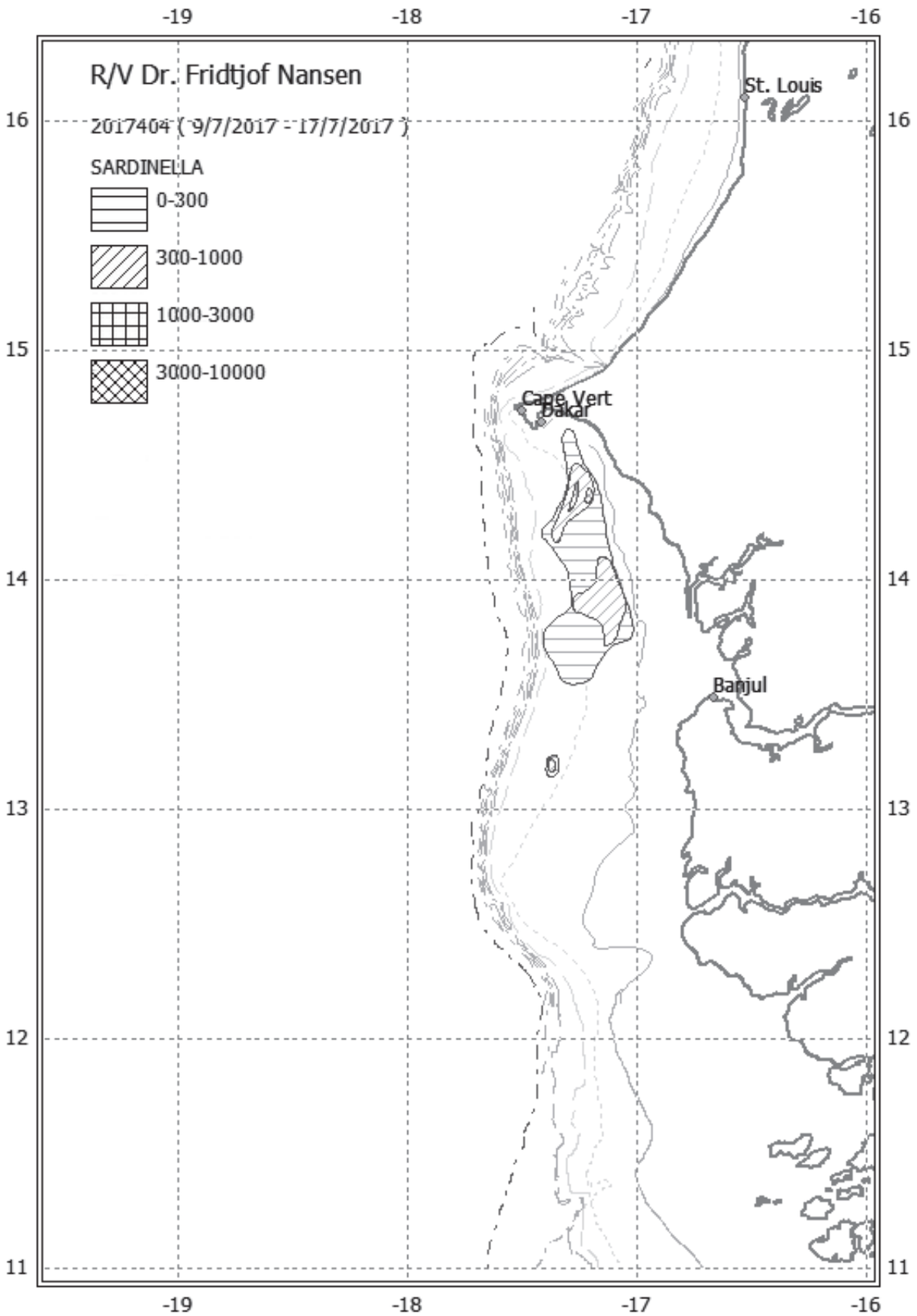


Figure 3.12. Distribution of sardinellas, St. Louis to Casamance.

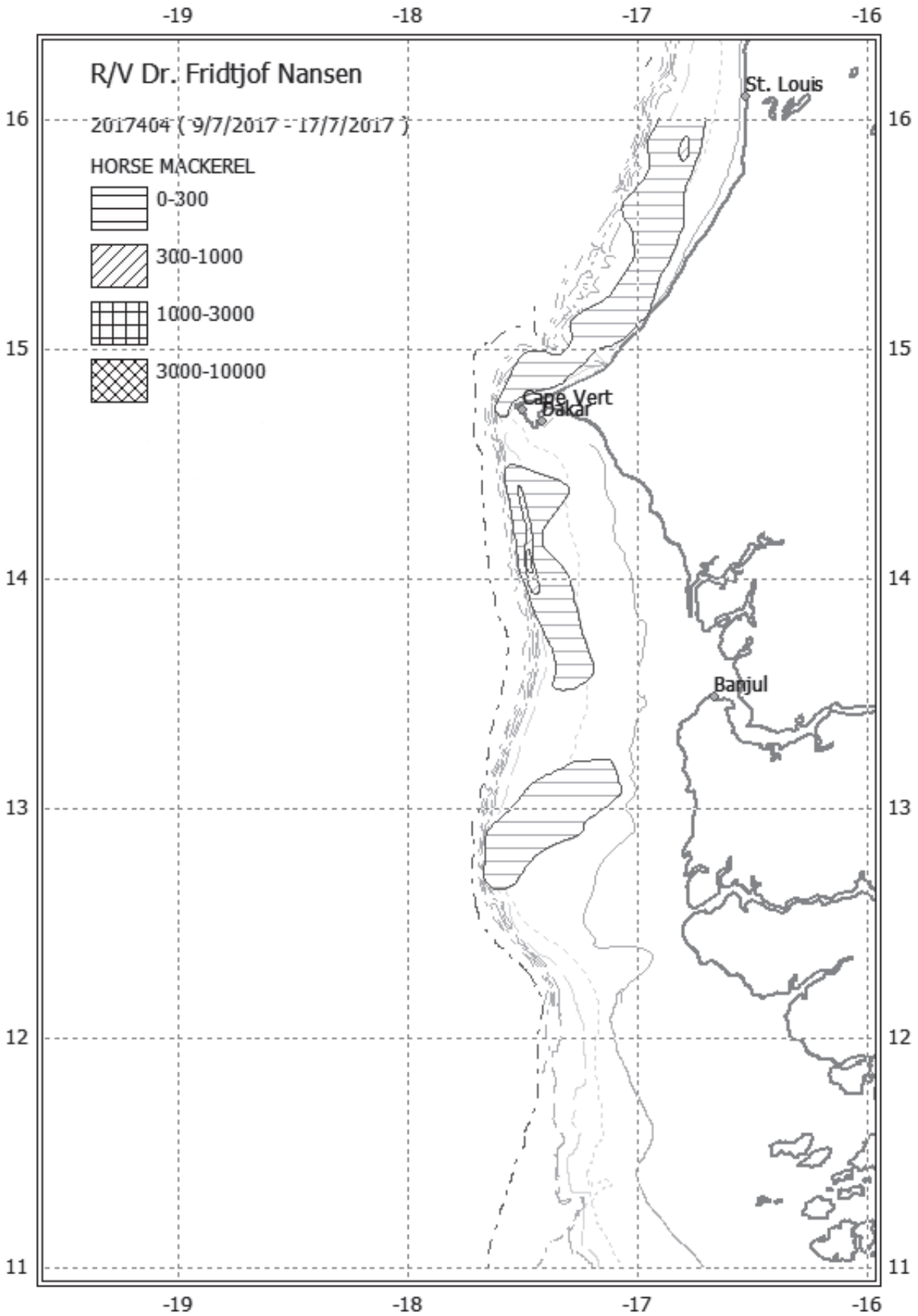


Figure 3.13. Distribution of *Trachurus trecae*, St. Louis to Casamance.

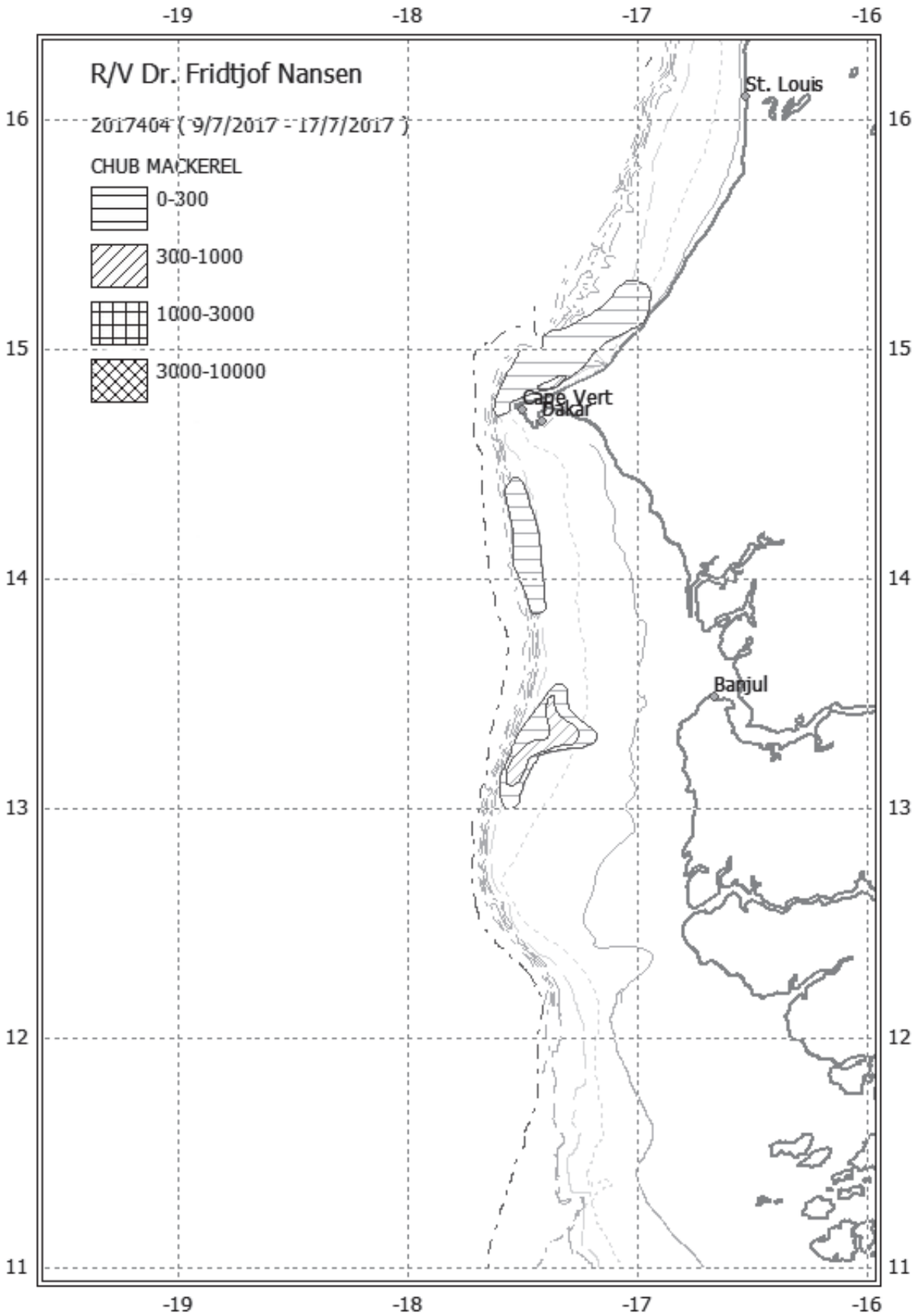


Figure 3.14. Distribution of Chub mackerel, St. Louis to Casamance.

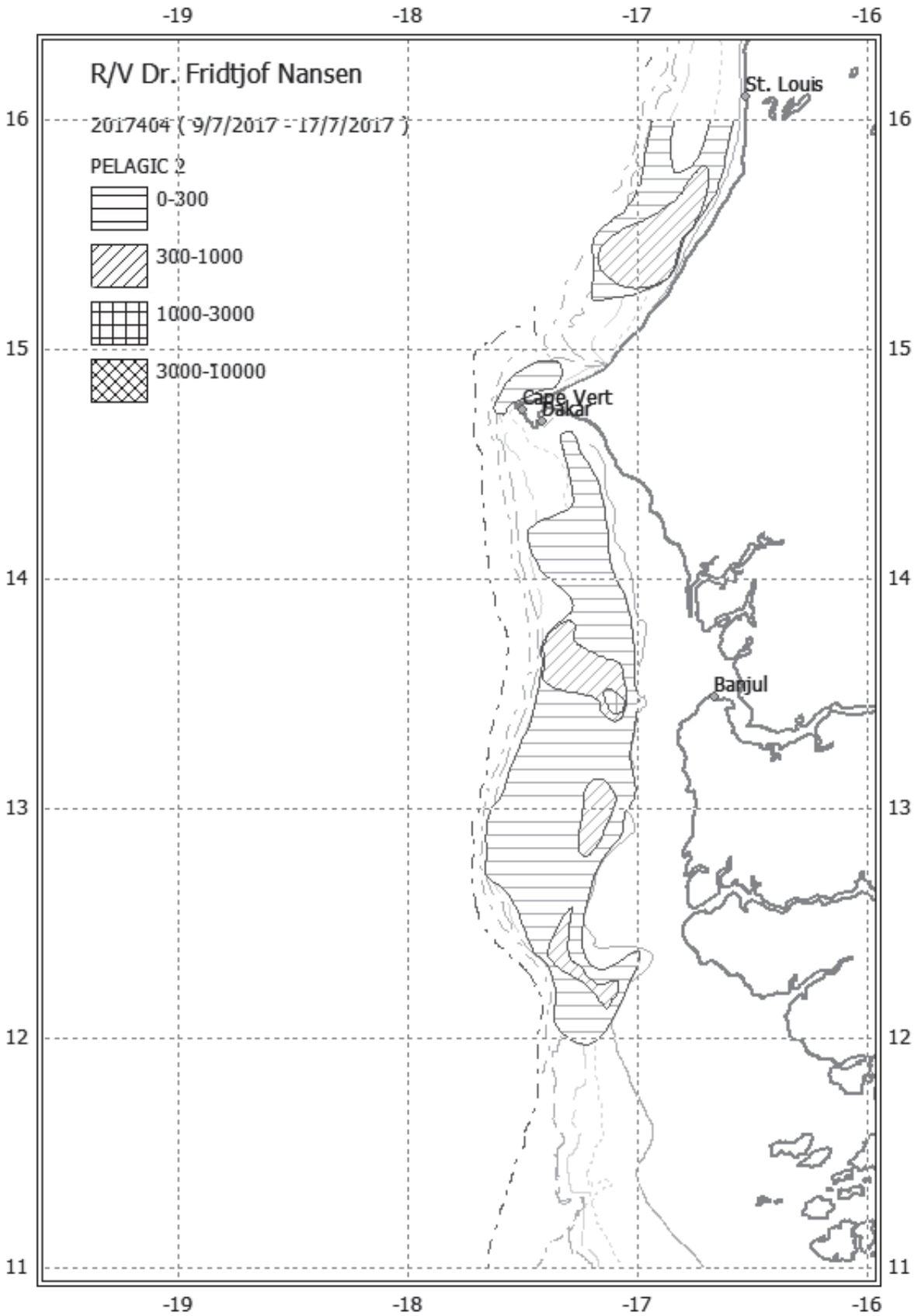


Figure 3.15. Carangids and associated species, St. Louis to Casamance.

St. Louis – Cabo Verde

No sardinellas were observed in the area. *T. trecae* were found in a continuous belt between St. Louis and Cabo Verde. The biomass was estimated to 48.2 thousand tonnes, and the length distribution showed three modal peaks, at 10, 19 and 27 cm (see Annex V). *S. colias* were found in low concentrations just north of Cabo Verde. Carangids and associated species were found in two separate distributions, with the highest concentrations south close to the Mauritanian border.

The estimated biomasses of the main groups of pelagic fish between Cabo Verde and St. Louis are presented in Table 4.

Table 4. St. Louis – Cabo Verde. Biomass estimates of pelagic fish, thousand tonnes.

Region	*S. maderensis*	*S. aurita*	*T. trecae*	*S. colias*	Carangids etc.
St. Louis - Cabo Verde	0,0	0,0	48,2	7,7	63,4

Cabo Verde – The Gambian border

Sardinellas were distributed from south of Dakar to the Gambian border. The estimated biomass of *S. aurita* and *S. maderensis* were the same, about 86 thousand tonnes each. Both species showed one modal peak, at 25 cm. *T. trecae* was observed in low concentration in the same area as the sardinellas, but slightly more offshore. The biomass was estimated to 13.6 thousand tonnes, and the length distribution showed one modal peak at 18 cm. *S. colias* was only found in very low abundances, and carangids and associated species were found in a continuous band from Dakar to the Gambian border.

Table 5 below shows biomass estimates.

Table 5. Cabo Verde – The Gambian border. Biomass estimates of pelagic fish, thousand tonnes.

Region	*S. maderensis*	*S. aurita*	*T. trecae*	*S. colias*	Carangids etc.
Cabo Verde - The Gambia	86,4	85,9	13,6	1,5	43,4

The Gambian shelf

In Gambian waters, an estimated biomass of 9.8 thousand tonnes of *S. maderensis* were found in one small area (Figure 3.12 and Table 6). The length distribution showed one modal peak of ~25 cm. Both *S. aurita* and *T. trecae* were practically absent. *S. colias* was found at some distance from the coast in one distribution. The biomass was estimated to 18.3 thousand tonnes, and the length distribution showed one modal peak at 20 cm. The biomass of carangids and associated species was estimated to 95.9 thousand tonnes. The distribution was wide and a continuation from that further north.

Table 6. The Gambia. Biomass estimates of pelagic fish, thousand tonnes.

Region	*S. maderensis*	*S. aurita*	*T. trecae*	*S. colias*	Carangids etc.
The Gambia	9,8	0,2	1,5	18,3	95,9

The Casamance shelf

Only carangids and associate species were found in noticeable concentration on the Casamance shelf. The biomass was estimated to 53.9 thousand tonnes, and distribution was connected with the distribution further north.

Table 7. The Casamance shelf. Biomass estimates of pelagic fish, thousand tonnes.

Region	*S. maderensis*	*S. aurita*	*T. trecae*	*S. colias*	Carangids etc.
Casamance	0,0	0,0	2,7	0,0	53,9

3.4 Summary of biomass estimates

Table 8 below provides an overview of the biomass estimates of the main pelagic species.

Table 8. Summary of biomass estimates of pelagic fish, Senegal and The Gambia.

Region	*S. maderensis*	*S. aurita*	*T. trecae*	*S. colias*
St. Louis - Cabo Verde	0,0	0,0	48,2	7,7
Cabo Verde - The Gambia	86,4	85,9	13,6	1,5
Casamance	0,0	0,0	2,7	0,0
Total	*86,4*	*85,9*	*64,5*	*9,2*
The Gambia	9,8	0,2	1,5	18,3

CHAPTER 4. REGIONAL SUMMARY

The R/V *Dr Fridtjof Nansen* survey of the pelagic resources in Northwest Africa (Leg 1.1 of the western Africa coverage for 2017) encompassed Morocco to Cape Blanc. The second leg (Leg 1.2), conducted an experimental survey of the mesopelagic resources of the region, and the third and fourth legs (1.3 and 1.4) conducted pelagic surveys for Mauritania and Senegal, respectively.

The first leg of the survey covered the region between Tangier and Cape Blanc from 7-27 May 2017 (Leg1.1). This was temporarily postponed so the vessel could conduct a survey on mesopelagic resources for West Africa from 26 May to 11 June (Leg 1.2), and for an unscheduled maintenance period of the vessel. The third leg for pelagic resources took place for Mauritania from 27 June – 9 July, and for Senegal and the Gambia from 9-18 July (there was a break in service from 3-6 July to allow for a crew change on the vessel). After completing the survey in Mauritania, the vessels continued surveying Senegal and Gambia from 9-18 July 2017 (Leg1.4). A common survey design was adopted in the entire region with parallel transects perpendicular to the coastline, 10 nm apart, and acoustic measurements of pelagic fish obtained on the shelf from 20-500 m bottom depth. At each degree latitude, a hydrographical transect was carried out to a depth of 1 000 m. Meteorological and hydrographic measurements were recorded routinely on these transects in addition to samples on ocean acidification parameters (pH and alkalinity), nutrients, phytoplankton, zooplankton, fish eggs and larvae and microplastics. Weather conditions were good for surveying during the entire period.

Oceanographic Conditions

Between Tangier and Cape Blanc, the oceanographic conditions showed a gradual increase in surface temperatures and lowering of the thermocline from the north to the south, and a corresponding decrease in oxygen in the upper 50 m (as observed at the 100 m CTD stations). The region north of 32° show the most stable water masses and the least upwelling. Close inshore, at the 30 m CTD stations, a clear separation in conditions is observed around 25°N, where water masses close to the coast are more fully mixed south of this latitude. Salinity in the upper 200 m are generally high across the entire region (> 36), and highest salinity is found at 24°N where salinity close to the coast is above 36.3 across the water column corresponding with lower fluorescence values. The areas of highest Chlorophyll *a* concentrations typically a4 3correspond with areas of lower salinity and indicates upwelling. These areas are roughly between 32°N- 30°N, around 27°N extending to both sides, and especially from 23°N and southwards where Chlorophyll *a* values increase > 4 µg/l. A clear frontal Zone was visible in the region around Cape Blanc.

At Cape Blanc, a clear separation of water masses from the northern and southern Canary Current system with strong increase in temperature from around 20°C (of Cape Blanc) to 28°C south of Cape Timiris can be observed. There is an indication of southward protruding

water masses inshore in this region while offshore northwards moving water masses affect the outer shelf in the surface. Upwelling affects especially the northern border region of Mauritania and primary production (fluorescence) and oxygen is high inshore. A similar situation can also be observed in the far southern part of Mauritania close to the coast. These two regions are separated by a central region with low primary production and strongly stratified water masses. At 19°N and 18°N, water masses are becoming increasingly more stratified, especially offshore with warm saline tropical water masses observed in the surface layers. Primary production is low across the shelf. Low oxygen waters < 1 ml/l can be observed close to the bottom on the central outer shelf.

The hydrographical conditions in Senegal and the Gambia were relatively uniform considering the geographical spread of stations. The surface layer had typical characteristics of tropical water masses with high temperatures and high salinities. Thermoclines were present around 50 m depths. Above the thermoclines, the water masses were well oxygenated, while in deeper waters, oxygen concentrations were low, varying between 1 and 2 ml l-1. This agrees with recent measurements in these waters. Some transects had indications of subsurface maximum Chlorophyll *a*.

Fish distribution and abundance

Surveys with the previous R/V *Dr Fridtjof Nansen* (1994-2016) were carried out in the same way as the present survey (2017-present) with regard to both survey design, acoustic scrutinizing and biomass estimation methodology. The methodology followed the recommendations of the Northwest Africa acoustic survey planning group. This allows for direct comparison of biomass estimates from the present survey with historic surveys. Still, the 2017 survey was carried out in May-July while most of the historic surveys that are part of the time series were carried out between October-December. This will affect the distribution of the fish, and potentially also their availability in the survey area. Table 9 presents the biomass estimates by main species and sub-region while Table 10 shows the trends over time based on the surveys with Dr. Fridtjof Nansen.

A strong separation between the stocks in northern and southern part of the CCLME region is observed. The total biomass north of Cape Blanc is high while the southern part of the region is struggling with declining stock sizes for several species.

As during all the historic surveys, the same target strength was used for all species. For species with low target strength, such as Atlantic chub mackerel (*Scomber colias*), the biomass will be underestimated due to this. In addition, large shallow water areas with bottom depth < 20 m were not covered by the surveys and there are known seasonal variations in the abundance of pelagic fish in shallow waters, especially *Sardinella maderensis.* For the present survey, the length-weight ratio applied in the estimate is based on data collected in the respective areas of the survey. Historically this has to some extent varied between surveys. A study to identify the effect of this in the assessment may be undertaken in the future.

Sardine (*Sardina pilchardus*). Sardine were found with variable densities in the northern CCLME region between Cap Spartel in the north and Cap Blanc, with generally very high density almost without interruption between Cape Blanc and Cape Juby. The highest densities were found between Cape Barbas and Cape Bojador. The main distribution was found inshore of 40 m bottom depth and the fish was strongly aggregated in most of the area, only occasionally extending much beyond 50 m isobath. The total biomass registered in Morocco is around 5 million tonnes, representing 98% of the total biomass in the region. South of Cape Blanc, the biomass was estimated to 61 thousand tonnes, and it was found in one area on the outer shelf north of Cape Timiris. This was the furthest south the sardine was found during this survey and no sardine was found in the warm tropical water masses further south.

Sardinella (*Sardinella aurita* and *S. maderensis*). The sardinella, *S. aurita*, was found north to Dakhla, and only a few fish were found further north close to Cape Bojador. *S. aurita* were found in relatively patchy low to medium density aggregation. The total biomass registered north of Cape Blanc was around 140 thousand tonnes, representing 54% of the total biomass in the region. In Mauritanian waters, both species were found. A very low biomass was found from Cape Blanc - Cape Timiris with only 7 thousand tonnes of *S. maderensis* while a total of 109 thousand tonnes of *S. maderensis* and 34 thousand tonnes of *S. aurita* was found from Cape Timiris to St Louis. In Senegal, no sardinella was found north of Dakar. Sardinella were distributed only in Petite Cote, from Cabo Verde to Banjul and the total biomass is estimated to 86 thousand tonnes for *S. aurita* (33% of the total biomass in the region) and 96 thousand tonnes for *S. maderensis* (45% of the total biomass in the region). Generally, the biomass of both species of sardinella was low.

Anchovies (*Engraulis encrasicolus*). Anchovies were found only in the northern most part of the region between Cape Bojador and Cape Spartel, and in the southern part of this region between Cape Barbas and Cape Blanc. Between these areas no anchovy were found. The fish were confined inshore in water depths < 50 m, and the density was medium. The total biomass north of Cap Blanc is around 65 thousand tonnes, representing 45% of the total biomass in the region. In Mauritania, 34 thousand tonnes were found in the northern region, on the shelf south of Cape Blanc. The fish were mixed with sardine of the same size within the distribution area. South of Cape Timiris, around 44 thousand tonnes of anchovy were found in two separate areas along the shelf. No anchovy were found in Senegal.

In the northern part of the survey area, north of Cap Blanc, **Horse mackerels** (*Trachurus trachurus* and *T. trecae*) were found patchily and in generally low density over the outer shelf in most of the area between Cape Blanc and Cape Spartel. *Trachurus trachurus* was the main species while *T. trecae* was found only between Cap Blanc and Cape Barbas. The total biomass registered in Morocco for *Trachurus trachurus* is 95 thousand tonnes (98% of the total biomass in the region) and 31 thousand tonnes for *Trachurus trecae* (24% of the total biomass in the region). Only 9 thousand tonnes of horse mackerel were found in Mauritania from Cape Blanc to Cape Timiris. This was the southernmost distribution of *Trachurus trachurus,* with a biomass of 2 thousand tonnes while 7 thousand tonnes was *T.*

trecae. Between Cap Timiris and St. Louis a total of 25 thousand tonnes of *T. trecae* was found, the distribution continued southwards into Senegal all along the shelf from St. Louis to Casamance with total biomass estimated to 66 thousand tonnes (51% of the total biomass in the region).

Atlantic chub mackerel (*S. colias*) were recorded almost continuously covering most of the shelf in the northern CCLME region between 150-20 m depth from Cape Blanc to Cape Spartel, with the highest densities on the mid and outer shelf. Concentrations were highest off Dakhla and between Laayoune and Cape Bojador. The total biomass registered north of Cap Blanc is 388 thousand tonnes, representing 88% of the total biomass in the region (total 441 thousand tonnes). In Mauritania, a total of 20 thousand tonnes of chub mackerel was observed between Cape Blanc and Cape Timiris. In this region also, Chub mackerel was found in deeper waters than most of the other species, but with a dominance on the shelf and over the shelf break. The densities were generally low. In the southern region, from Cape Timiris to St Louis, around 5 thousand tonnes of Chub mackerel were found. Small patches of fish were found between Cape Timiris and Nouakchott while further south, the distribution was more continues from 17°N to St. Louis. In Senegal, the chub mackerel was distributed from Kayar to Casamance with main concentrations off Sine Saloum. The total biomass was estimated to 28 thousand tonnes (6% of the total biomass in the region).

Table 9: Regional biomass estimates from 2017 R/V *Dr Fridtjof Nansen* survey.

	Biomass ('000 tonnes)									
	Tanger **Cap Cantin**	**Cap Cantin** **Cap Juby**	**Cap Juby** **Cap Blanc**	**Cap Blanc** **Cap Timiris**	**Cap Timiris** **St Louis**	**St Louis** **Cabo Verde**	**Cabo Verde** **The Gambia**	**The Gambia**	**The Gambia** **Casamance**	**TOTAL**
Sardina pilchardus	19	502	4 471	61	0	0	0	0	0	**5 053**
Sardinella aurita	0	0	140	0	34	0	86	0	0	**260**
Sardinella maderensis	0	0	0	7	109	0	86	10	0	**212**
Engraulis encrasicolus	10	15	40	34	44	0	0	0	0	**143**
Trachurus trachurus	28	52	15	2	0	0	0	0	0	**97**
Trachurus tracae	0	0	31	7	25	48	14	1	3	**129**
Scomber colias	98	171	119	20	5	8	2	18	0	**441**

Table 10: Regional acoustic biomass data (million tonnes) from R/V *Dr Fridtjof Nansen* surveys 1995-2017 for the main species.

YEAR	*S. pilchardus*	*S. aurita*	*S. maderensis*	*T. trachurus*	*T. trecae*	*S. colias*	*E. encrasicolus*	*Total (without sardine)*	**Total**
1995	3.75	1.62	1.88	0.26	0.18			3.94	7.69
1996	5.56	1.63	1.53	0.45	0.66			4.27	9.83
1997	1.13	0.82	1.00	0.54	0.66			3.02	4.15
1998	1.63	0.82	1.00	0.18	0.80			2.80	4.43
1999	2.67	2.13	1.48	0.10	0.65	0.27		4.64	7.30
2000	3.65	1.91	0.79	0.28	1.76	0.10	0.24	5.08	8.73
2001	4.75	1.80	1.43	0.12	0.36	0.31	0.02	4.04	8.79
2002	6.30	1.43	0.99	0.28	0.58	0.29	0.04	3.61	9.91
2003	5.70	1.26	1.77	0.32	0.39	0.55	0.03	4.31	10.01
2004	7.41	1.59	2.45	0.18	0.73	0.51	0.08	5.54	12.95
2005	8.01	0.81	1.33	0.14	1.21	0.24	0.11	3.85	11.86
2006	3.62	1.13	2.05	0.04	0.40	0.44	0.08	4.14	7.76
2007	**5.88**	0.99	1.19	0.45	0.99	0.61	0.19	4.41	10.29
2008	**4.42**	2.00	0.55	0.33	0.70	0.63	0.12	4.32	8.74
2009	**5.04**	**2.86**	**1.67**	**0.13**	**0.87**	**0.76**	**0.05**	**6.35**	**11.39**
2010	**2.60**					0.28			
2011	**1.95**					0.38			
2012	**2.07**					0.45			
2013	**3.77**					0.65			
2014	**4.10**					1.08			
2015	4.50	0.621	0.867	0.405	0.542	0.72	0.158	3.31	7.81
2016	**2.964**	**0.036**	**0.052**	**0.225**	**0.048**	**1.056**	**0.079**		
2017	5.05	0.26	0.212	0.097	0.129	0.44	0.14	2.12	

Years 1995-2006, 2015 and 2017: data from the R/V *Dr Fridtjof Nansen.*
Years 2007-2008: data are *Nansen* equivalents of local vessels using agreed conversion factors.
Year 2009: all data from the Mauritanian R/V *Al Awan* and the Moroccan R/V *Al Amir*, and data for Senegal and the Gambia were estimated by the Working Group.
Year 2010: No estimates for the Mauritanian R/V *Al Awan*, the Moroccan R/V *Al Amir*, Senegal, and the Gambia.
Year 2011: Some estimates for the CCLME (from the R/V *Dr Fridtjof Nansen*) were presented by the CCLME project coordinator.
Year 2012: Data from Mauritanian R/V *Al Amir* were presented to the Working Group for North of Cape Blanc, and results from a survey by the Russian R/V *Atlantida* in Mauritania and Senegal.
Years 2013 and 2014: Survey data from Morocco, Mauritania, and the Russian R/V *Atlantida*.

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ANNEX I RECORDS OF FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 1
DATE :09/07/17 GEAR TYPE: BT NO: 1 POSITION:Lat N
15°54.20
start stop duration Lon W
16°49.28
TIME :13:32:47 13:56:32 23.8 (min) Purpose : 1
LOG : 392.42 393.81 1.4 Region : 1300
FDEPTH: 84 83 Gear cond.: 0
BDEPTH: 84 83 Validity : 0
Towing dir: 0° Wire out : 240 m Speed : 3.5 kn
Sorted : 58 Total catch: 58.30 Catch/hour: 147.28

SPECIES C SAMP	CATCH/HOUR weight	% OF TOT. numbers
Trachurus trecae	65.28	452 44.32
1		
Boops boops	13.74	278 9.33
2		
Illex coindetii	12.18	192 8.27
Mustelus mustelus	9.55	3 6.48
Trichiurus lepturus	7.68	18 5.21
Brachydeuterus auritus	7.53	33 5.11
Zeus faber	6.37	18 4.32
SALPS	4.55	455 3.09
Priacanthus arenatus	3.94	8 2.68
Dentex angolensis	3.69	28 2.50
3		
Selene dorsalis	3.33	3 2.26
Alloteuthis africana	2.93	480 1.99
Sphyraena guachancho	2.83	8 1.92
Raja miraletus	2.07	3 1.41
Lepidotrigla carolae	0.35	8 0.24
Scorpaena stephanica	0.30	3 0.21
Pagellus bellottii	0.30	5 0.21
Octopus vulgaris	0.30	3 0.21
LEUCOSIIDAE	0.13	3 0.09
Unidentified crab	0.13	58 0.09
Syacium micrurum	0.10	3 0.07
Total	147.28	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 2
DATE :09/07/17 GEAR TYPE: BT NO: 1 POSITION:Lat N
15°35.05
start stop duration Lon W
16°58.52
TIME :13:32:47 13:56:32 23.8 (min) Purpose : 1
LOG : 392.42 393.81 1.4 Region : 1300
FDEPTH: 84 83 Gear cond.: 0
BDEPTH: 84 83 Validity : 0
Towing dir: 0° Wire out : 240 m Speed : 3.5 kn
Sorted : 160 Total catch: 935.08 Catch/hour: 2362.31

SPECIES C SAMP	CATCH/HOUR weight	% OF TOT. numbers
Trichiurus lepturus	848.84	1698 35.93
Brachydeuterus auritus	480.15	2089 20.33
6		
Priacanthus arenatus	443.87	1683 18.79
7		
Trachurus trecae	324.83	12788 13.75
4		
J E L L Y F I S H	80.24	20 3.40
Caranx rhonchus	76.40	268 3.23
Trachinotus ovatus	29.99	114 1.27
Alectis alexandrinus	25.47	99 1.08
Sardinella maderensis	19.76	109 0.84
5		
Euthynnus alletteratus	18.39	43 0.78
Sarda sarda	4.75	5 0.20
Sphyraena guachancho	4.52	15 0.19
Scomber colias	3.69	28 0.16
Illex coindetii	1.41	43 0.06
Total	2362.31	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 3
DATE :10/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N
15°24.51
start stop duration Lon W
16°49.30
TIME :02:40:09 02:54:50 14.7 (min) Purpose : 1
LOG : 494.78 495.53 0.8 Region : 1300
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 23 25 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.1 kn
Sorted : 55 Total catch: 55.38 Catch/hour: 226.35

SPECIES C SAMP	CATCH/HOUR weight	% OF TOT. numbers
Chloroscombrus chrysurus	77.33	752 34.16
11		
Brachydeuterus auritus	55.59	1847 24.56
9		
Ilisha africana	39.81	789 17.59
8		
Selene dorsalis	14.31	270 6.32
10		
Sardinella maderensis	13.08	74 5.78
Trichiurus lepturus	6.46	98 2.85
Eucinostomus melanopterus	5.64	41 2.49
Alectis alexandrinus	5.07	8 2.24
Caranx senegallus	4.99	20 2.20
Caranx rhonchus	2.86	16 1.26
Trachinotus ovatus	0.65	4 0.29
Engraulis encrasicolus	0.33	168 0.14
Trachurus trecae	0.16	8 0.07
Sepia officinalis	0.08	16 0.04
Total	226.35	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 4
DATE :10/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N
15°25.83
start stop duration Lon W
17°5.31
TIME :05:37:04 06:11:32 34.5 (min) Purpose : 1
LOG : 515.04 517.45 2.4 Region : 1300
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 151 211 Validity : 0
Towing dir: 0° Wire out : 210 m Speed : 4.2 kn
Sorted : 114 Total catch: 319.82 Catch/hour: 556.69

SPECIES C SAMP	CATCH/HOUR weight	% OF TOT. numbers
Trachinotus ovatus	244.18	938 43.86
MYCTOPHIDAE	176.69	65443 31.74
Abraliopsis sp.	92.69	28089 16.65
Synagrops microlepis	20.99	50 3.77
Euthynnus alletteratus	12.64	19 2.27
Lestidiops sp.	3.26	345 0.58
0		
Lestidiops sp.	2.35	289 0.42
Lagocephalus laevigatus	1.08	73 0.19
Brachydeuterus auritus	1.04	5 0.19
OMMASTREPHIDAE	0.91	17 0.16
0		
Not found	0.66	2 0.12
Saurida waniesco	0.17	17 0.03
Total	556.66	99.99

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 5
DATE :10/07/17 GEAR TYPE: BT NO: 2 POSITION:Lat N
15°4.90
start stop duration Lon W
17°16.82
TIME :14:08:06 14:20:29 12.4 (min) Purpose : 1
LOG : 584.54 585.21 0.7 Region : 1300
FDEPTH: 137 128 Gear cond.: 0
BDEPTH: 137 128 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 3.2 kn
Sorted : 72 Total catch: 292.28 Catch/hour: 1416.54

SPECIES C SAMP	CATCH/HOUR weight	% OF TOT. numbers
Scomber colias	904.56	23554 63.86
12		
Trachurus trecae	464.49	6344 32.79
13		
Capros aper	12.41	155 0.88
Zenopsis conchifer	12.31	5 0.87
Ariomma bondi	10.47	155 0.74
Pontinus kuhlii	5.04	78 0.36
Sphoeroides pachgaster	2.33	19 0.16
Aulopus filamentosus	1.74	10 0.12
Todarodes pacificus	1.45	34 0.10
Antigonia capros	1.36	58 0.10
Munida sp.	0.39	58 0.03
Total	1416.54	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 6
DATE :10/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N
14°54.65
start stop duration Lon W
17°25.12
TIME :21:49:40 22:03:10 13.5 (min) Purpose : 1
LOG : 623.33 624.33 1.0 Region : 1300
FDEPTH: 0 10 Gear cond.: 0
BDEPTH: 143 132 Validity : 0
Towing dir: 0° Wire out : 210 m Speed : 4.4 kn
Sorted : 35 Total catch: 365.89 Catch/hour: 1626.18

SPECIES C SAMP	CATCH/HOUR weight	% OF TOT. numbers
Trachurus trecae	1035.56	87760 63.68
15		
Scomber colias	512.00	20644 31.48
14		
Auxis thazard	28.89	80 1.78
Euthynnus alletteratus	27.73	22 1.71
Engraulis encrasicolus	12.44	933 0.77
18		
Caranx crysos	8.44	13 0.52
0		
Sphyraena sphyraena	0.98	4 0.06
Saurida waniesco	0.13	89 0.01
Total	1626.18	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 7
DATE :11/07/17 GEAR TYPE: PT NO: 4 POSITION:Lat N
14°44.66
start stop duration Lon W
17°38.28
TIME :04:11:35 04:38:23 26.8 (min) Purpose : 1
LOG : 654.59 656.12 1.5 Region : 1300
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 336 478 Validity : 0
Towing dir: 0° Wire out : 145 m Speed : 3.4 kn
Sorted : 2 Total catch: 2.27 Catch/hour: 5.07

SPECIES C SAMP	CATCH/HOUR weight	% OF TOT. numbers
Not found	4.16	2 82.12
Diaphus effulgens	0.49	488 9.71
Alloteuthis africana	0.18	40 3.53
SALPS	0.11	2 2.21
Ascidiacea	0.11	4 2.21
Phyllosoma	0.00	2 0.04

Balistes capriscus, juvenile	0.00	2	0.04
CARANGIDAE, juvenile	0.00	2	0.04
Acanthurus monroviae, juvenile	0.00	2	0.04
SOLEIDAE, juvenile	0.00	2	0.04
Total	5.07		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 8
DATE :11/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N
14°21.62
start stop duration Lon W
17°17.49
TIME :11:43:08 12:13:09 30.0 (min) Purpose : 1
LOG : 712.74 714.52 1.8 Region : 1300
FDEPTH: 10 23 Gear cond.: 0
BDEPTH: 45 45 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.6 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR	% OF TOT.
C SAMP		
	weight numbers	
Plastic	0.00 2	0.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 9
DATE :11/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N
14°13.98
start stop duration Lon W
17°28.62
TIME :17:54:05 18:29:27 35.4 (min) Purpose : 1
LOG : 756.04 758.82 2.8 Region : 1300
FDEPTH: 50 65 Gear cond.: 0
BDEPTH: 104 100 Validity : 0
Towing dir: 0° Wire out : 550 m Speed : 4.7 kn
Sorted : 4 Total catch: 3.88 Catch/hour: 6.59

SPECIES	CATCH/HOUR	% OF TOT.
C SAMP		
	weight numbers	
Ascidiacea	6.17 409	93.77
Trachurus trecae	0.15 2	2.32
Todaropsis eblanae	0.10 2	1.55
Todaropsis eblanae	0.10 2	1.55
0		
SALPS	0.05 2	0.77
Acanthurus monroviae, juvenile	0.00 3	0.03
Sphoeroides sp., juvenile	0.00 3	0.03
Total	6.59	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 10
DATE :11/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N
14°14.22
start stop duration Lon W
17°14.85
TIME :22:26:48 22:47:25 20.6 (min) Purpose : 1
LOG : 784.29 785.50 1.2 Region : 1300
FDEPTH: 17 19 Gear cond.: 0
BDEPTH: 40 41 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.5 kn
Sorted : 60 Total catch: 60.38 Catch/hour: 175.69

SPECIES	CATCH/HOUR	% OF TOT.
C SAMP		
	weight numbers	
Chloroscombrus chrysurus	119.30 1219	67.90
Sardinella aurita	35.79 274	20.37
19		
Sardinella maderensis	11.17 0	6.36
22		
Trachurus trecae	2.33 15	1.32
21		
Dactylopterus volitans	2.10 3	1.19
Alectis alexandrinus	1.75 3	0.99
Sphyraena guachancho	0.81 3	0.46
Brachydeuterus auritus	0.76 6	0.43
Selene dorsalis	0.47 3	0.26
Caranx rhonchus	0.41 3	0.23
Pomadasys incisus	0.41 3	0.23
Scomber colias	0.12 3	0.07
Total	175.40	99.83

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 11
DATE :12/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N
14°3.60
start stop duration Lon W
17°8.16
TIME :02:33:12 02:52:32 19.3 (min) Purpose : 1
LOG : 806.87 808.01 1.1 Region : 1300
FDEPTH: 20 25 Gear cond.: 0
BDEPTH: 31 33 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.5 kn
Sorted : 105 Total catch: 288.29 Catch/hour: 894.86

SPECIES	CATCH/HOUR	% OF TOT.
C SAMP		
	weight numbers	
Sardinella maderensis	759.86 4730	84.91
23		
Sardinella aurita	40.07 214	4.48
24		
Chloroscombrus chrysurus	30.45 174	3.40
25		
Brachydeuterus auritus	25.33 258	2.83
Pagellus bellottii	14.46 99	1.62
Pomadasys incisus	6.46 65	0.72
Pagrus caeruleostictus	6.33 31	0.71
Caranx rhonchus	4.97 50	0.55
Eucinostomus melanopterus	1.99 25	0.22
Selene dorsalis	1.12 9	0.12
Not found	0.74 3	0.08
Pomadasys rogeri	0.74 3	0.08
Trichiurus lepturus	0.56 3	0.06
Plectorhinchus mediterraneus	0.50 3	0.06
Dactylopterus volitans	0.37 3	0.04
Galeoides decadactylus	0.31 3	0.03
Echeneis naucrates	0.31 3	0.03
Diplodus bellottii	0.25 3	0.03
Parapenaeus longirostris	0.04 6	0.00
Total	894.86	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 12
DATE :12/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N
14°2.62
start stop duration Lon W
17°25.42
TIME :05:49:17 06:28:51 39.6 (min) Purpose : 1
LOG : 824.99 828.20 3.2 Region : 1300
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 89 88 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 4.9 kn
Sorted : 25 Total catch: 24.90 Catch/hour: 37.76

SPECIES	CATCH/HOUR	% OF TOT.
C SAMP		
	weight numbers	
Auxis thazard	15.38 71	40.72
Ascidiacea	10.49 2187	27.79
Euthynnus alletteratus	6.22 9	16.47
Scomber colias	3.43 56	9.08
26		
Sarda sarda	2.24 5	5.94
Total	37.76	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 13
DATE :12/07/17 GEAR TYPE: BT NO: 2 POSITION:Lat N
14°5.56
start stop duration Lon W
17°29.41
TIME :10:02:40 10:09:19 6.7 (min) Purpose : 1
LOG : 842.79 843.15 0.4 Region : 1300
FDEPTH: 109 110 Gear cond.: 0
BDEPTH: 109 110 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.2 kn
Sorted : 65 Total catch: 1502.48 Catch/hour: 13556.21

SPECIES	CATCH/HOUR	% OF TOT.
C SAMP		
	weight numbers	
Boops boops	9600.00 236373	70.82
Trachurus trecae	3148.87 52177	23.23
27		
Scomber colias	532.33 18090	3.93
28		
Dentex macrophthalmus	144.36 830	1.06
Ascidiacea	63.16 4159	0.47
Sphoeroides pachgaster	36.09 208	0.27
Scyliorhinus cervigoni	14.26 9	0.11
Scorpaena angolensis	10.47 9	0.08
Raja miraletus	6.68 9	0.05
Total	13556.21	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 14
DATE :12/07/17 GEAR TYPE: BT NO: 2 POSITION:Lat N
13°54.74
start stop duration Lon W
17°7.57
TIME :18:09:13 18:29:58 20.8 (min) Purpose : 1
LOG : 889.36 890.51 1.1 Region : 1300
FDEPTH: 33 35 Gear cond.: 0
BDEPTH: 33 35 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.3 kn
Sorted : 4 Total catch: 4.20 Catch/hour: 12.14

SPECIES	CATCH/HOUR	% OF TOT.
C SAMP		
	weight numbers	
Pagrus caeruleostictus	3.35 46	27.62
Pseudupeneus prayensis	2.20 26	18.10
Pagellus bellottii	1.79 17	14.76
Sarda sarda	1.73 3	14.29
Ascidiacea	1.39 353	11.43
Brachydeuterus auritus	0.69 6	5.71
Scarus hoefleri	0.29 3	2.38
Eucinostomus melanopterus	0.23 3	1.90
Diplodus bellottii	0.23 3	1.90
Fistularia tabacaria	0.12 3	0.95
PAGUROIDEA	0.06 14	0.48
Alloteuthis africana	0.06 52	0.48
Total	12.14	100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 15
DATE :12/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N
13°47.19
start stop duration Lon W
17°3.57
TIME :21:59:32 22:11:58 12.4 (min) Purpose : 1
LOG : 913.21 913.80 0.6 Region : 1300
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 29 29 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 2.9 kn
Sorted : 103 Total catch: 103.27 Catch/hour: 498.50

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Brachydeuterus auritus	229.57	2076	46.05
Chloroscombrus chrysurus	94.32	1023	18.92
31			
Sardinella aurita	74.34	415	14.91
29			
Sardinella maderensis	37.75	232	7.57
30			
Caranx rhonchus	17.96	87	3.60
Not found	10.72	53	2.15
Octopus vulgaris	9.36	10	1.88
Sphyraena guachancho	5.21	10	1.05
Alectis alexandrinus	5.12	10	1.03
Eucinostomus melanopterus	2.90	24	0.58
Pomadasys jubelini	2.70	10	0.54
Galeoides decadactylus	1.93	14	0.39
Trachinotus ovatus	1.74	10	0.35
Trichiurus lepturus	1.35	10	0.27
Sphoeroides pachgaster	1.06	5	0.21
Pomadasys incisus	1.04	5	0.21
Penaeus kerathurus	0.54	19	0.11
Scomber colias	0.39	5	0.08
J E L L Y F I S H	0.32	5	0.06
Fistularia tabacaria	0.17	5	0.03
Total	498.50		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 16
DATE :13/07/17 GEAR TYPE: PT NO: 4 POSITION:Lat N
13°44.83
start stop duration Lon W
17°25.93
TIME :01:08:56 01:40:04 31.1 (min) Purpose : 1
LOG : 936.27 937.83 1.6 Region : 1300
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 122 385 Validity : 0
Towing dir: 0° Wire out : 145 m Speed : 3.0 kn
Sorted : 1 Total catch: 9.38 Catch/hour: 18.08

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Todaropsis eblanae	6.05	18	33.47
Ariomma bondi	5.67	108	31.34
MYCTOPHIDAE	3.32	2066	18.33
Ascidiacea	1.93	100	10.66
SALPS	0.73	25	4.05
Scomber colias	0.35	12	1.92
32			
Lestidiops sp.	0.04	2	0.21
Acanthurus monroviae, juvenile	0.00	2	0.01
Plastic	0.00	2	0.00
Total	18.08		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 17
DATE :13/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N
13°36.34
start stop duration Lon W
17°5.04
TIME :05:52:03 06:13:30 21.4 (min) Purpose : 1
LOG : 971.20 972.44 1.2 Region : 1400
FDEPTH: 15 20 Gear cond.: 0
BDEPTH: 30 33 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.5 kn
Sorted : 108 Total catch: 107.82 Catch/hour: 301.59

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Chloroscombrus chrysurus	136.45	2643	45.24
33			
Caranx rhonchus	105.85	445	35.10
34			
Brachydeuterus auritus	15.50	134	5.14
Pagellus bellottii	7.27	42	2.41
Pagrus caeruleostictus	6.71	25	2.23
Alectis alexandrinus	5.15	11	1.71
Not found	4.81	22	1.60
Sphyraena guachancho	4.08	11	1.35
Eucinostomus melanopterus	3.08	22	1.02
Selene dorsalis	2.97	17	0.98
Not found	2.18	3	0.72
Sardinella maderensis	1.51	8	0.50
Trachinotus goreensis	1.34	3	0.45
0			
Galeoides decadactylus	1.23	3	0.41
Trachinotus ovatus	1.12	6	0.37
Sphyraena barracuda	0.67	3	0.22
Pomadasys incisus	0.62	3	0.20
Pseudupeneus prayensis	0.56	6	0.19
Fistularia tabacaria	0.22	3	0.07
Halobatrachus didactylus	0.17	3	0.06
Penaeus kerathurus	0.11	3	0.04
J E L L Y F I S H	0.00	3	0.00
Total	301.59		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 18
DATE :13/07/17 GEAR TYPE: BT NO: 2 POSITION:Lat N
13°28.56
start stop duration Lon W
17°5.18
TIME :10:03:17 10:19:05 15.8 (min) Purpose : 1
LOG : 998.80 999.67 0.9 Region : 1300
FDEPTH: 31 31 Gear cond.: 0
BDEPTH: 31 31 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.3 kn
Sorted : 67 Total catch: 353.12 Catch/hour: 1340.97

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Not found	562.03	2343	41.91
Brachydeuterus auritus	412.03	4075	30.73
Pomadasys jubelini	266.20	1082	19.85
Caranx rhonchus	28.66	110	2.14
36			
Trichiurus lepturus	18.53	65	1.38
Galeoides decadactylus	15.57	38	1.16
Sphyraena guachancho	15.19	38	1.13
Trachinotus goreensis	9.11	23	0.68
Chloroscombrus chrysurus	7.59	133	0.57
35			
Drepane africana	4.56	4	0.34
Chrysaora sp.	1.51	42	0.11
Total	1340.97		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 19
DATE :13/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N
13°27.55
start stop duration Lon W
17°23.43
TIME :13:32:28 14:12:54 40.4 (min) Purpose : 1
LOG : 1020.85 1023.39 2.5 Region : 1400
FDEPTH: 15 35 Gear cond.: 0
BDEPTH: 83 71 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.8 kn
Sorted : 9 Total catch: 8.74 Catch/hour: 12.97

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Euthynnus alletteratus	5.11	15	39.36
Caranx crysos	3.71	7	28.60
Trachinotus ovatus	2.34	10	18.08
Sardinella maderensis	1.81	9	13.96
37			
Total	12.97		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 20
DATE :13/07/17 GEAR TYPE: PT NO: 8 POSITION:Lat N
13°20.10
start stop duration Lon W
17°30.27
TIME :23:45:55 00:08:09 22.2 (min) Purpose : 1
LOG : 1061.64 1063.24 1.6 Region : 1400
FDEPTH: 0 30 Gear cond.: 0
BDEPTH: 107 99 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 4.3 kn
Sorted : 35 Total catch: 190.62 Catch/hour: 514.50

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Scomber colias	215.11	3166	41.81
39			
Abraliopsis sp.	125.91	34340	24.47
MYCTOPHIDAE	80.16	41225	15.58
Brachydeuterus auritus	39.68	283	7.71
Caranx crysos	34.22	0	6.65
38			
Ascidiacea	6.21	486	1.21
Echeneis naucrates	3.01	3	0.59
Sphyraena guachancho	2.94	11	0.57
Saurida waniesco	2.16	513	0.42
Sarda sarda	1.29	3	0.25
Trachurus trecae	1.08	216	0.21
Euthynnus alletteratus	0.99	3	0.19
Dactylopterus volitans	0.65	3	0.13
Trachinotus ovatus	0.59	3	0.12
Paralepidae	0.50	40	0.10
Total	514.50		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 21
DATE :14/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N
13°20.56
start stop duration Lon W
17°7.02
TIME :04:51:56 05:06:05 14.2 (min) Purpose : 1
LOG : 1087.45 1088.28 0.8 Region : 1400
FDEPTH: 20 20 Gear cond.: 0
BDEPTH: 34 33 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.5 kn
Sorted : 25 Total catch: 166.10 Catch/hour: 704.30

C	SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
	Brachydeuterus auritus	490.56	5813	69.65
	Chloroscombrus chrysurus	153.16	1573	21.75
41				
	Sardinella maderensis	19.55	127	2.78
40				
	Pagellus bellottii	16.54	81	2.35
	Sphyraena afra	5.51	8	0.78
	Caranx rhonchus	5.51	81	0.78
42				
	Pomadasys incisus	4.79	25	0.68
	Eucinostomus melanopterus	3.56	34	0.51
	Not found	2.79	13	0.40
	Selene dorsalis	1.38	17	0.20
	Trachinotus ovatus	0.75	4	0.11
	Alloteuthis africana	0.19	127	0.03
	Total	704.29		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 22
DATE :14/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N
13°2.12
start stop duration Lon W
17°17.93
TIME :20:52:46 21:25:06 32.3 (min) Purpose : 1
LOG : 1178.82 1180.47 1.7 Region : 1300
FDEPTH: 20 20 Gear cond.: 0
BDEPTH: 41 43 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.1 kn
Sorted : 77 Total catch: 76.86 Catch/hour: 142.64

C	SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
	Chloroscombrus chrysurus	119.85	1193	84.03
46				
	Trachurus trecae	6.60	32	4.63
44				
	Caranx rhonchus	4.59	28	3.22
43				
	Selene dorsalis	4.25	46	2.98
45				
	Brachydeuterus auritus	2.64	20	1.85
	Pagellus bellottii	1.78	9	1.25
	Pomadasys incisus	0.93	6	0.65
	Sardinella maderensis	0.82	6	0.57
	Trachinotus ovatus	0.37	2	0.26
	Pseudupeneus prayensis	0.37	7	0.26
	Hemicaranx bicolor	0.30	2	0.21
	Eucinostomus melanopterus	0.14	2	0.10
	Total	142.64		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 23
DATE :15/07/17 GEAR TYPE: PT NO: 7 POSITION:Lat N
12°58.14
start stop duration Lon W
17°3.34
TIME :01:25:35 01:58:38 33.0 (min) Purpose : 1
LOG : 1203.08 1204.81 1.7 Region : 1300
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 21 22 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.1 kn
Sorted : 64 Total catch: 64.38 Catch/hour: 116.87

C	SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
	Chloroscombrus chrysurus	90.81	762	77.70
48				
	Brachydeuterus auritus	12.24	109	10.47
	Sardinella maderensis	4.32	36	3.70
47				
	Caranx senegallus	2.63	16	2.25
51				
	Ilisha africana	2.43	33	2.08
49				
	Trachinotus ovatus	1.52	9	1.30
	Caranx rhonchus	1.28	7	1.10
50				
	Alectis alexandrinus	0.58	2	0.50
	Caranx crysos	0.36	2	0.31
	Trachurus trecae	0.33	2	0.28
	Caranx rhonchus, juvenile	0.22	24	0.19
	Selene dorsalis	0.15	2	0.12
	Alloteuthis africana	0.01	5	0.01
	Brachydeuterus auritus, juvenile	0.01	5	0.00
	Total	116.87		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 24
DATE :15/07/17 GEAR TYPE: PT NO: 1 POSITION:Lat N
12°53.36
start stop duration Lon W
17°30.82
TIME :05:30:38 05:50:19 19.7 (min) Purpose : 1
LOG : 1233.62 1234.69 1.1 Region : 1300
FDEPTH: 25 35 Gear cond.: 0
BDEPTH: 52 54 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.3 kn
Sorted : 61 Total catch: 253.93 Catch/hour: 774.18

C	SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
	Brachydeuterus auritus	643.17	6381	83.08
	Caranx rhonchus	53.90	268	6.96
53				
	Chloroscombrus chrysurus	27.56	232	3.56
52				
	Sphyraena guachancho	16.24	55	2.10
56				
	Selene dorsalis	15.37	134	1.98
58				
	Sardinella maderensis	5.84	34	0.75
55				
	Trachurus trecae	3.65	30	0.47
57				
	Trichiurus lepturus	2.20	3	0.28
	Galeoides decadactylus	1.77	9	0.23
	Dactylopterus volitans	1.52	9	0.20
	Scomber colias	1.40	12	0.18
	Trachinotus ovatus	0.67	3	0.09
	Pomadasys incisus	0.58	3	0.08
	Eucinostomus melanopterus	0.30	3	0.04
	Total	774.18		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 25
DATE :16/07/17 GEAR TYPE: BT NO: 2 POSITION:Lat N
12°22.60
start stop duration Lon W
17°19.14
TIME :10:22:25 10:33:18 10.9 (min) Purpose : 1
LOG : 1343.74 1344.29 0.6 Region : 1300
FDEPTH: 46 46 Gear cond.: 0
BDEPTH: 46 46 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.0 kn
Sorted : 59 Total catch: 58.68 Catch/hour: 323.90

C	SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
	Galeoides decadactylus	78.55	237	24.25
	Ilisha africana	75.84	1292	23.42
	Cymbium cymbium	28.92	6	8.93
	Selene dorsalis	25.17	121	7.77
60				
	Rhizoprionodon acutus	13.80	11	4.26
	Pseudotolithus senegalensis	11.50	17	3.55
	Trichiurus lepturus	10.44	39	3.22
	Sphyraena guachancho	8.40	33	2.59
61				
	Octopus vulgaris	7.56	11	2.33
	Elops senegalensis	7.13	17	2.20
	Trichiurus lepturus, juvenile	7.11	1352	2.19
	Chloroscombrus chrysurus	6.30	50	1.94
59				
	Brachydeuterus auritus, juvenile	5.01	2136	1.55
	Galeoides decadactylus, juvenile	4.16	1115	1.28
	Sepia bertheloti	3.89	11	1.20
	Ilisha africana, juvenile	3.44	1093	1.06
	Penaeus notialis	3.29	397	1.02
	Brachydeuterus auritus	3.15	50	0.97
	Alectis alexandrinus	3.06	6	0.94
	Thorogobius angolensis	2.94	1606	0.91
	Caranx rhonchus	2.19	6	0.67
	Pisodonophis semicinctus	2.11	6	0.65
	Not found	1.66	11	0.51
	Serranus accraensis	1.38	6	0.43
	Syacium micrurum	1.27	11	0.39
	Sardinella maderensis	1.02	6	0.32
	Not found	0.95	6	0.29
	Brotula barbata	0.94	6	0.29
	Lagocephalus laevigatus	0.92	22	0.28
	Grammoplites gruveli	0.47	22	0.14
	Not found	0.47	204	0.14
	Pseudupeneus prayensis	0.34	6	0.11
	Alloteuthis africana	0.20	132	0.06
	Scyllarides herklotsii	0.11	17	0.03
	Cynoponticus ferox, juvenile	0.06	6	0.02
	Saurida waniesco, juvenile	0.06	55	0.02
	Sea urchin	0.04	6	0.01
	Stenorhynchus lanceolatus	0.03	6	0.01
	Sepia bertheloti, juvenile	0.03	6	0.01
	Selene dorsalis, juvenile	0.00	6	0.00
	Engraulis encrasicolus	0.00	6	0.00
	Total	323.89		100.00

R/V Dr. Fridtjof Nansen SURVEY:2017404 STATION: 26
DATE :17/07/17 GEAR TYPE: BT NO: 2 POSITION:Lat N
12°3.67
start stop duration Lon W
17°11.23
TIME :03:29:56 03:35:36 5.7 (min) Purpose : 1
LOG : 1446.18 1446.44 0.3 Region : 1300
FDEPTH: 59 57 Gear cond.: 0
BDEPTH: 59 57 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 2.7 kn
Sorted : 0 Total catch: 103.66 Catch/hour: 1096.96

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Pseudotolithus senegalensis	229.21	317	20.89
Galeoides decadactylus	209.31	624	19.08
Pentheroscion mbizi	147.94	1630	13.49
Albula vulpes	120.00	159	10.94
Pegusa lascaris	60.53	455	5.52
Pomadasys perotaei	54.78	85	4.99
Pisodonophis semicinctus	49.31	159	4.50
Not found	49.21	74	4.49
Brachydeuterus auritus	24.22	381	2.21
Trichiurus lepturus	22.68	74	2.07
Not found	16.53	116	1.51
Pteroscion peli	15.10	116	1.38
PAGUROIDEA	13.97	529	1.27
Ophiotrix sp.	11.01	0	1.00
Epinephelus aeneus	10.05	21	0.92
G A S T R O P O D S	8.73	698	0.80
Pseudupeneus prayensis	8.05	53	0.73
Elops senegalensis	5.72	11	0.52
Mystriophis rostellatus	5.49	53	0.50
Thorogobius angolensis	4.87	2963	0.44
Sardinella maderensis	4.65	21	0.42
Bembrops greyi	4.53	53	0.41
Scyllarides herklotsii	4.34	2963	0.40
Scorpaena angolensis	3.77	53	0.34
Cynoponticus ferox	3.49	32	0.32
Sphyraena guachancho	2.06	11	0.19
B I V A L V E S	1.93	4709	0.18
Thorogobius angolensis	1.56	138	0.14
Brotula barbata	1.39	32	0.13
Not found	0.85	169	0.08
Not found	0.74	169	0.07
DROMIIDAE	0.53	169	0.05
Parapenaeus longirostris	0.22	32	0.02
LEUCOSIIDAE	0.21	201	0.02
Plastic	0.00	11	0.00
Total	1096.96		100.00

ANNEX II OVERVIEW OF BIOLOGICAL SAMPLES

Table II.1- Number of individuals sampled including length measurement per species for Senegal and The Gambia

Species name	Length	liver	stomach	otoliths	fin clip
Trachurus trecae	408	125	1	155	
Sardinella aurita	209	60	86	60	60
Sardinella maderensis	255	181	174	181	181
Engraulis encrasicolus	21	21	21	21	21
Scomber colias	368	150	149	150	150
Caranx crysos	18				
Caranx senegallus	9				
Caranx rhonchus	220				
Chloroscombrus chrysurus	632				
Selene dorsalis	122				
Brachydeuterus auritus	185				
Ilisha africana	117				
Boops boops	100				
Dentex angolensis	11				
Sphyraena guachancho	25				
Total number of individuals	2700	537	431	567	412

Table II. 2. Number of individuals sampled per species and station for Senegal and The Gambia, excluding length measurements.

Station	Species name	liver	stomach	otoliths	fin clip
1	*Trachurus trecae*	30	30		
2	*Trachurus trecae*	30	30	1	
2	*Sardinella maderensis*	30	30	23	30
5	*Trachurus trecae*	30	30		
5	*Scomber colias*	30	30	30	30
6	*Trachurus trecae*	30			
6	*Engraulis encrasicolus*	21	21	21	21
6	*Scomber colias*	30	30	30	30
10	*Trachurus trecae*	5	5		
10	*Sardinella aurita*	30	30	29	30
10	*Sardinella maderensis*	24	24	24	24
11	*Sardinella aurita*	27	27	27	27
11	*Sardinella maderensis*	30	30	30	30
12	*Scomber colias*	30	30	30	30
13	*Trachurus trecae*	30	30		
13	*Scomber colias*	30	30	29	30
15	*Sardinella aurita*	3	3	30	3
15	*Sardinella maderensis*	30	30	30	30
19	*Sardinella maderensis*	6	6	6	6
20	*Scomber colias*	30	30	30	30
21	*Sardinella maderensis*	30	30	30	30
23	*Sardinella maderensis*	20	20	20	20
24	*Sardinella maderensis*	11	11	11	11
Total number of individuals		567	537	431	412

ANNEX III DESCRIPTION OF INSTRUMENTS AND FISHING GEAR

Acoustic instruments

The Simrad EK80/18, 38, 70,120, 200 and 333 kHz scientific sounder was run during the survey. Scrutinizing was done in LSSS using the data from the 38 kHz transducer. Last standard sphere calibrations was checked on the 23.01.2017 in Sandviksflaket, Bergen, Norway using Cu-64 for the 18 kHz, Cu-60 for the 38 kHz, WC-38.1 for the 70, 120 and 200 kHz, and the WC-22 for the 333 kHz. The details of the settings for the 38 kHz echo sounder were as follows:

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

Bottom detection menu Minimum level -50 dB

Fishing gear

The vessel has one small four-panel 'Åkrahamn' pelagic trawl, one MultPelt 624 trawl (Figure 1) and one ‘Gisund super bottom trawl’. All trawls were used during the survey. The smallest pelagic trawl has 10-12 m vertical opening under normal operation, whereas the MultPelt 624 trawl has 30-40 m opening.

The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m^2 and weigh 2 000 kg. The door spreading is about 45 m when using restraining rope. Trawling was conducted for species identification only and no restraining rope was therefore used during the survey.

The SCANMAR system was used during all trawl hauls. This equipment consists of sensors,

a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their inter-distance and angle, while a height sensor is fitted on the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

The pelagic trawls are equipped with a trawl eye that provides information about the trawl opening and the distance of the footrope to the bottom. A pressure sensor is used to show the depth on the headline.

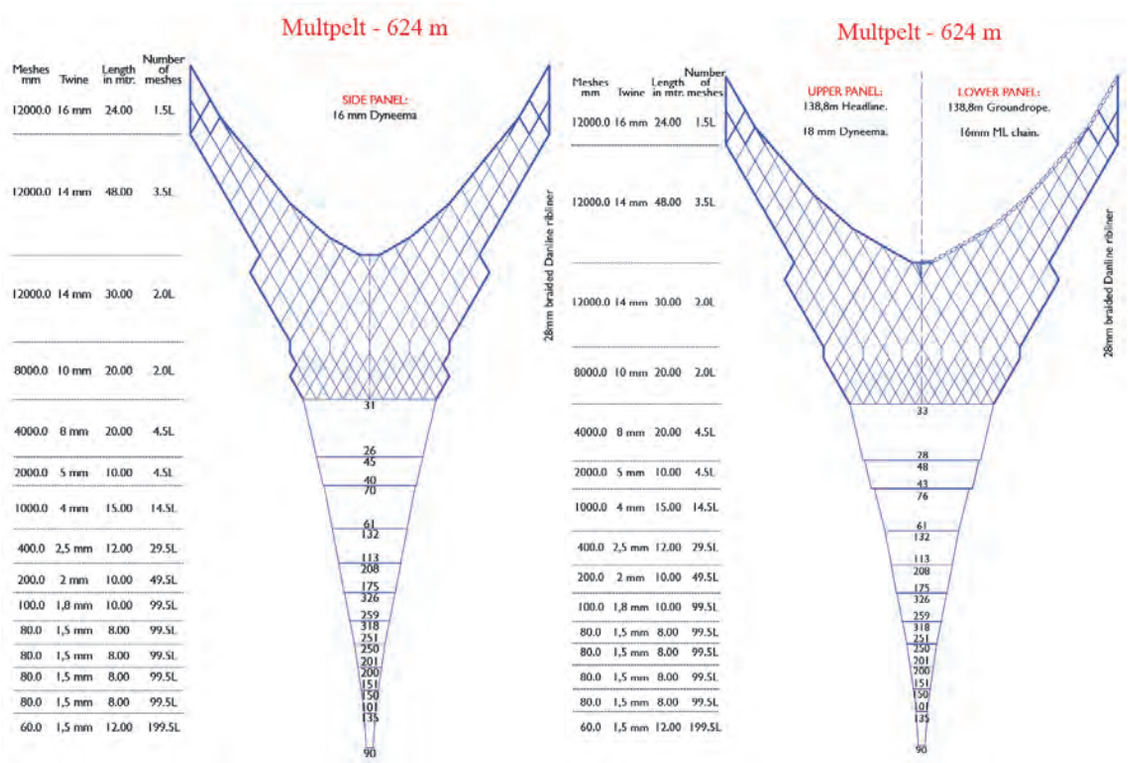
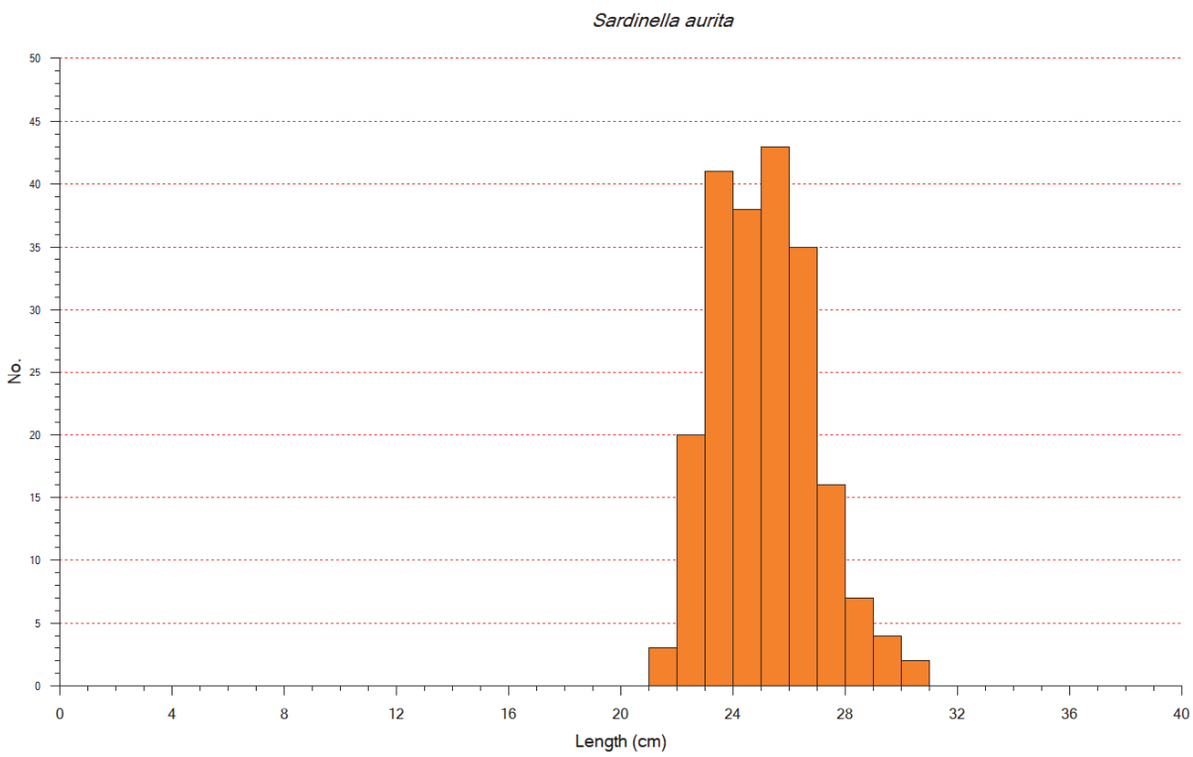


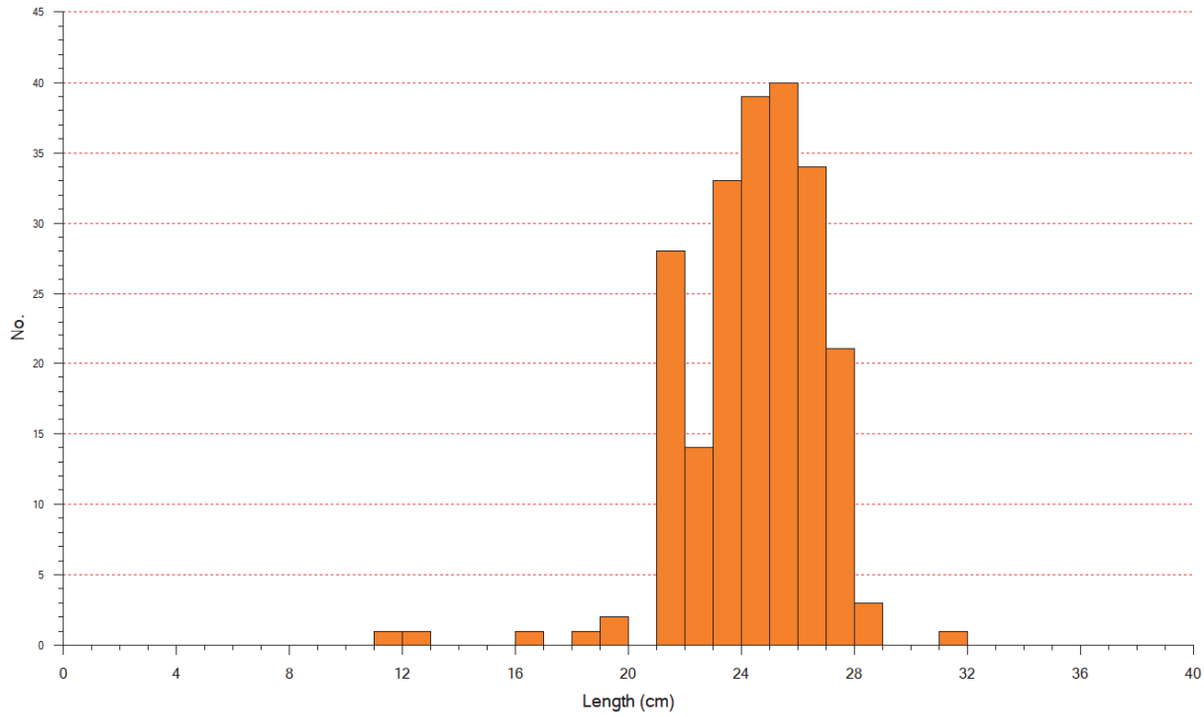
Figure 1. Schematic drawing of the MultPelt 624.

ANNEX IV LENGTH DISTRIBUTION BY SPECIES AND REGION

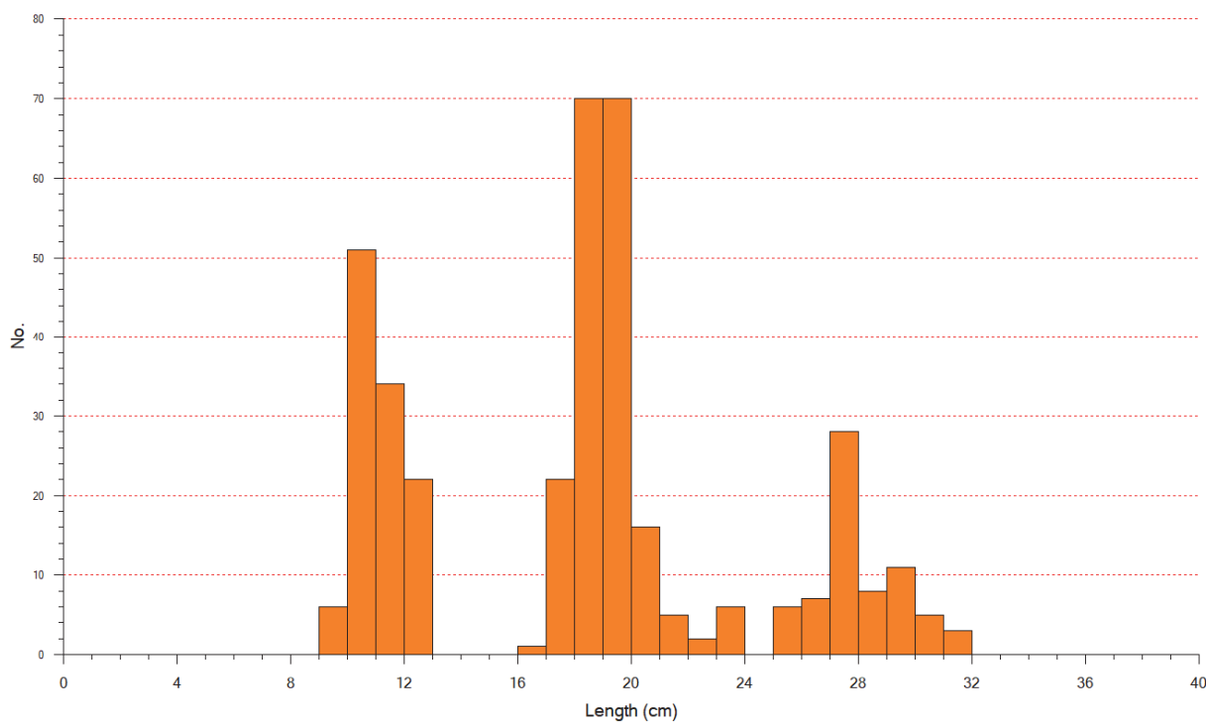
Senegal



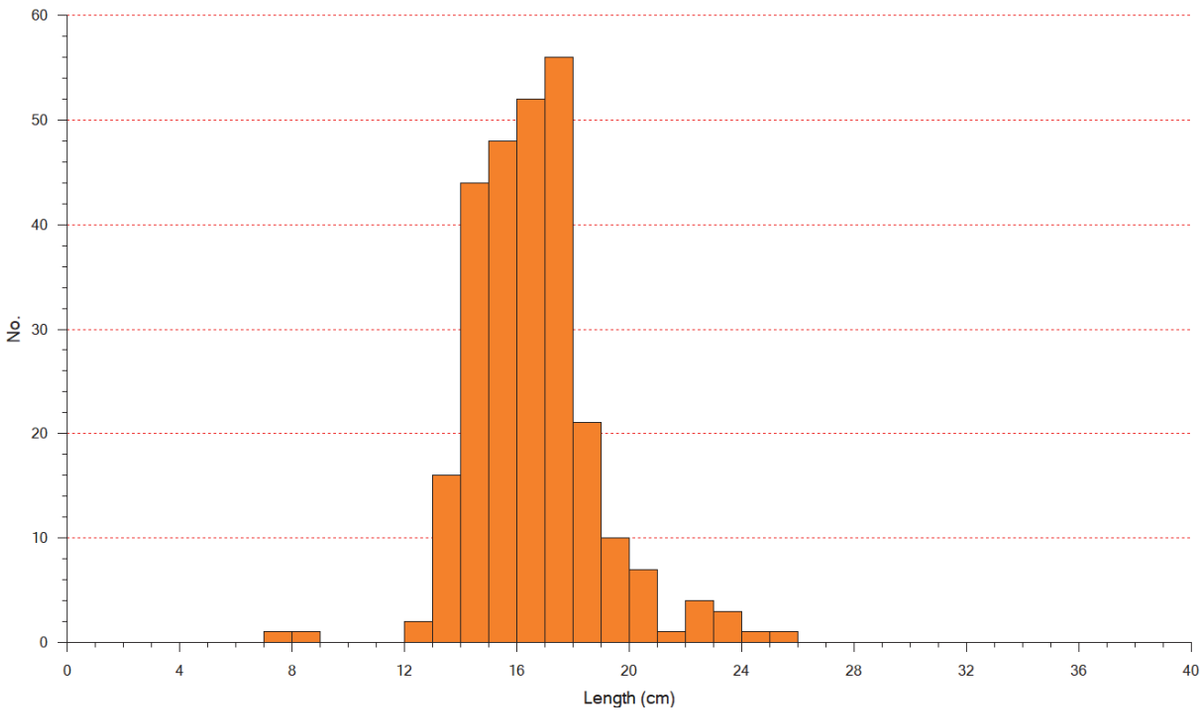
Sardinella maderensis



Trachurus trecae

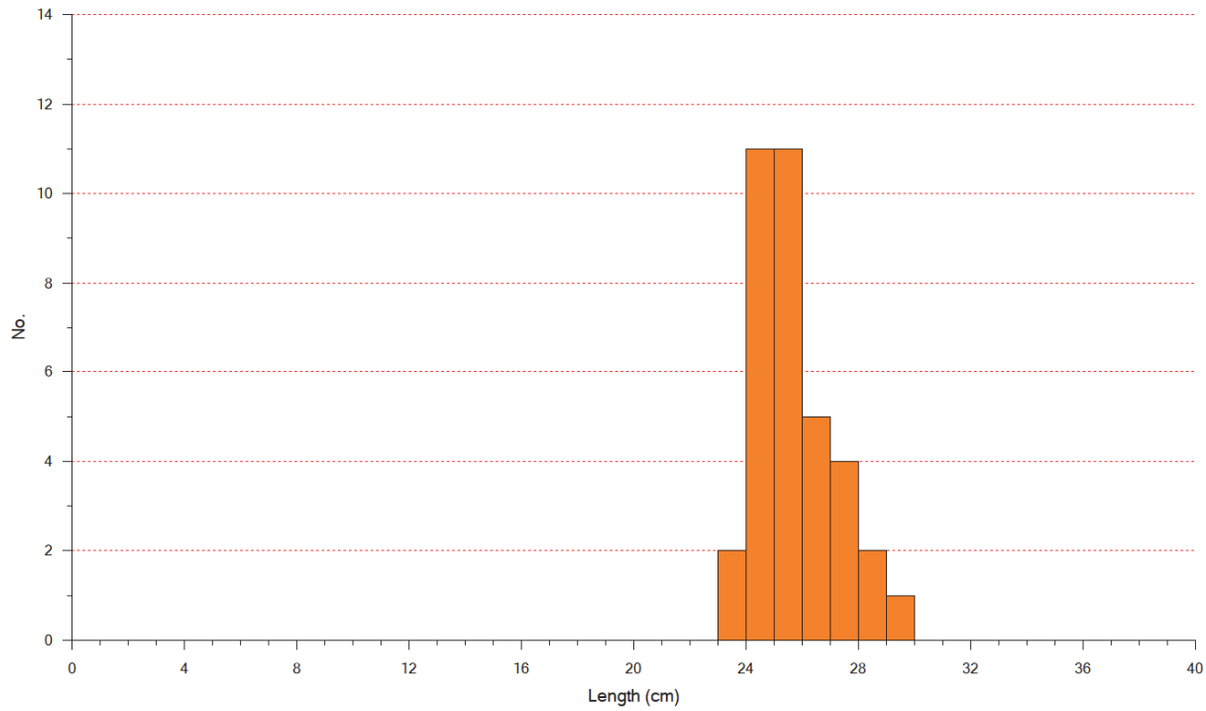


Scomber colias

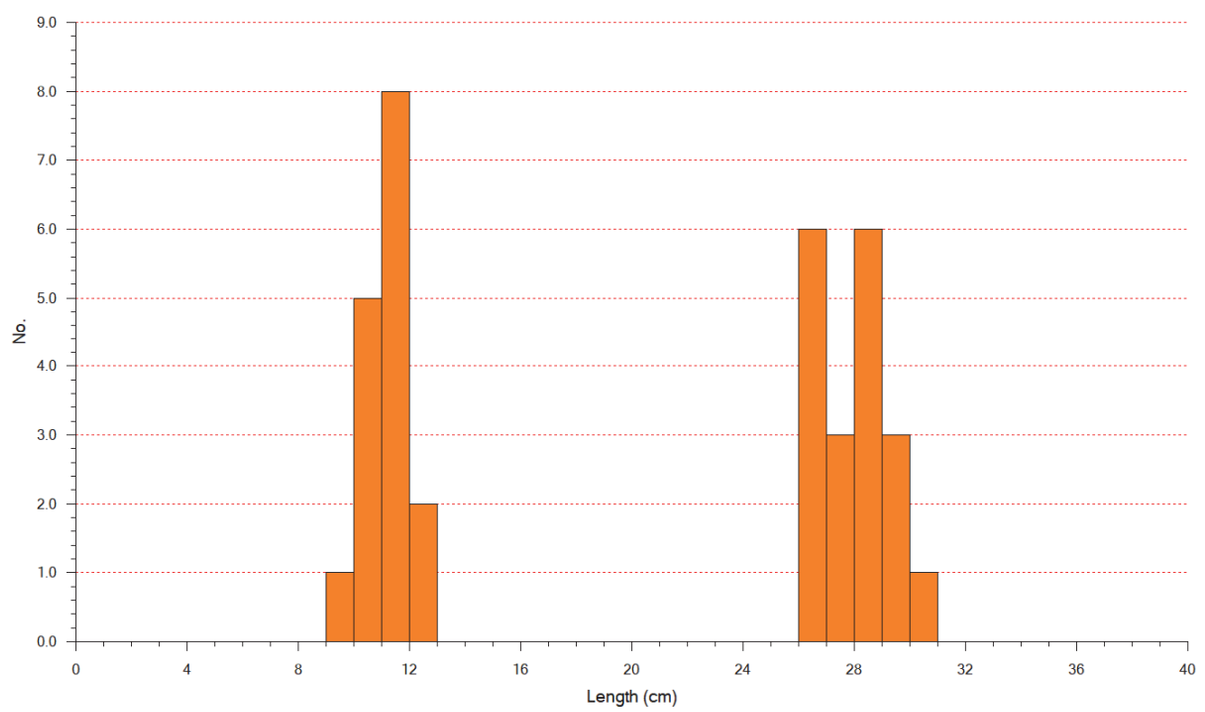


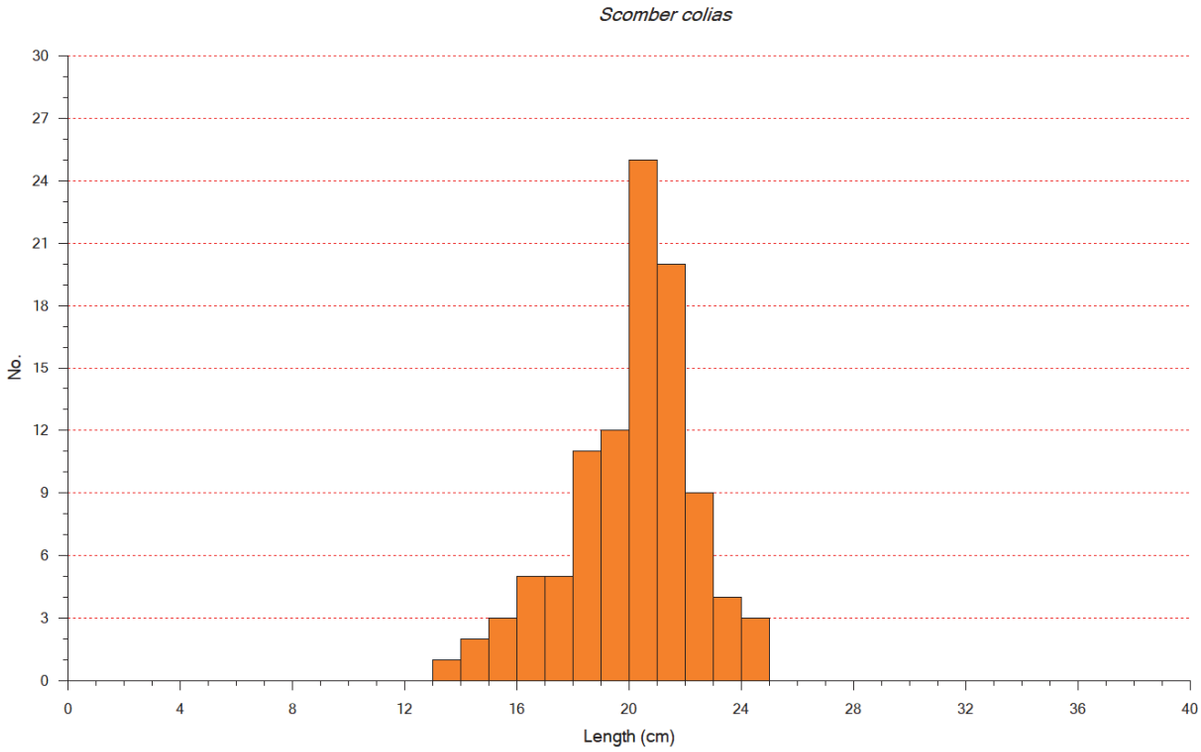
The Gambia

Sardinella maderensis



Trachurus trecae




Scomber colias
No.
Length (cm)
0
3
6
9
12
15
18
21
24
27
30
0
4
8
12
16
20
24
28
32
36
40

ANNEX V ESTIMATED NUMBERS AND BIOMASS BY LENGTH-GROUP AND SUB-REGION

Round sardinella *(Sardinella aurita)*

Numbers in millions					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21		10			**10**
22		42			**43**
23		92			**92**
24		87			**88**
25		108			**109**
26		97			**97**
27		60			**60**
28		23			**23**
29		8			**8**
30		4			**4**
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total		**532**	**1**		**533**

Biomass in 1 000 tonnes					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21		1			**1**
22		5			**5**
23		12			**12**
24		13			**13**
25		18			**18**
26		18			**18**
27		12			**12**
28		5			**5**
29		2			**2**
30		1			**1**
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total		**86**			**86**

Flat sardinella *(Sardinella maderensis)*

Numbers in millions					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9					
10					
11			1		**1**
12			1		**1**
13					
14					
15					
16			1		**1**
17					
18		2			**2**
19		2	1		**3**
20					
21		48	1		**49**
22		23	2		**25**
23		52	6		**58**
24		106	13		**119**
25		161	12		**174**
26		108	13		**121**
27		29	8		**37**
28			1		**1**
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total		**532**	**60**		**592**

Biomass in 1 000 tonnes					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21		5			**5**
22		3			**3**
23		7	1		**8**
24		16	2		**18**
25		28	2		**30**
26		21	2		**23**
27		6	2		**8**
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total		**86**	**10**		**96**

Cunene horse mackerel *(Trachurus trecae)*

Numbers in millions					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9	8			1	**9**
10	93		1	3	**97**
11	56	2	2	4	**65**
12	29		1	1	**31**
13					
14					
15					
16	4				**4**
17	18	29			**48**
18	46	116	1		**163**
19	94	68	1		**162**
20	41	9			**50**
21	9	2	1	2	**14**
22			1	2	**2**
23			2	4	**6**
24					
25	11				**11**
26	13		1	3	**17**
27	55		1	1	**57**
28	17		1	3	**21**
29	23		1	1	**25**
30	11				**11**
31	4			1	**5**
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total	**533**	**226**	**14**	**24**	**798**

Biomass in 1 000 tonnes					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9					
10	1				**1**
11	1				**1**
12	1				**1**
13					
14					
15					
16					
17	1	1			**2**
18	3	7			**10**
19	7	5			**12**
20	4	1			**4**
21	1				**1**
22					
23					**1**
24					
25	2				**2**
26	2				**3**
27	12				**12**
28	4			1	**5**
29	6				**7**
30	3				**3**
31	1				**2**
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total	**48**	**14**	**1**	**3**	**66**

Chub mackerel *(Scomber colias)*

Numbers in millions					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9					
10					
11					
12	2				**2**
13	21		3		**24**
14	54	1	6		**60**
15	42	4	8		**54**
16	59	5	14		**78**
17	52	6	14		**72**
18	14	6	31		**50**
19	1	3	33		**38**
20	1	2	69		**73**
21			56		**56**
22		2	25		**27**
23		1	11		**12**
24			8		**9**
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total	**246**	**31**	**278**		**554**

Biomass in 1 000 tonnes					
Length (cm)	St. Louis-C. Verde	C. Verde - Gambia	The Gambia	Casamance	**Total**
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15	1				**1**
16	1				**1**
17	2				**3**
18	2		1		**3**
19	1		1		**2**
20			2		**2**
21			5		**5**
22			4		**4**
23			2		**2**
24			1		**1**
25			1		**1**
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
Total	**8**	**2**	**18**		**28**

ANNEX VI BIOLOGICAL SCALES- MATURITY, STOMACK FULLNESS AND FAT RESERVES

SEXUAL MATURITY:

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

STOMACH FULLNES:

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

FAT RESERVES:

SCALE	DESIGNATION	DESCRIPTION
0	No fat	Complete absence of fat in body cavity.
1	Very little fat	A small line of fat along the intestine.
2	Moderate fat	Moderate fat deposits around the intestine, stomach, the kidney, swimbladder and vertebrae.
3	Excessive fat	Excessive fat deposits around the intestine and stomach. The abdominal cavity is completely covered by fat.