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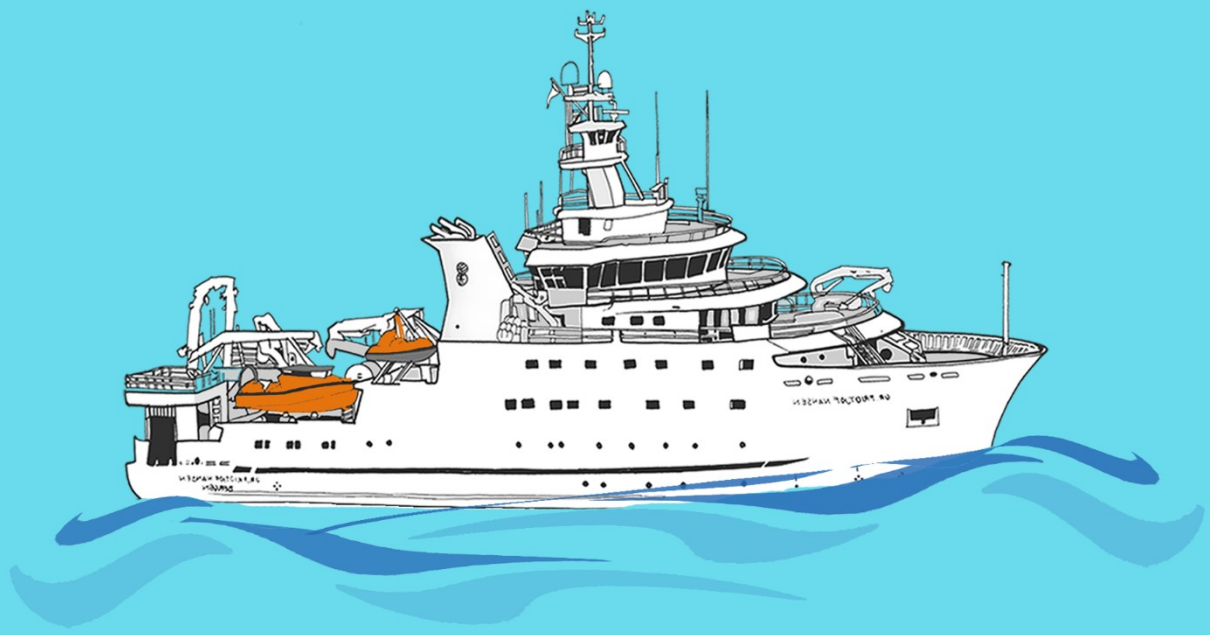
CRUISE REPORTS *DR FRIDTJOF NANSEN* EAF-Nansen/CR/2017/3



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.

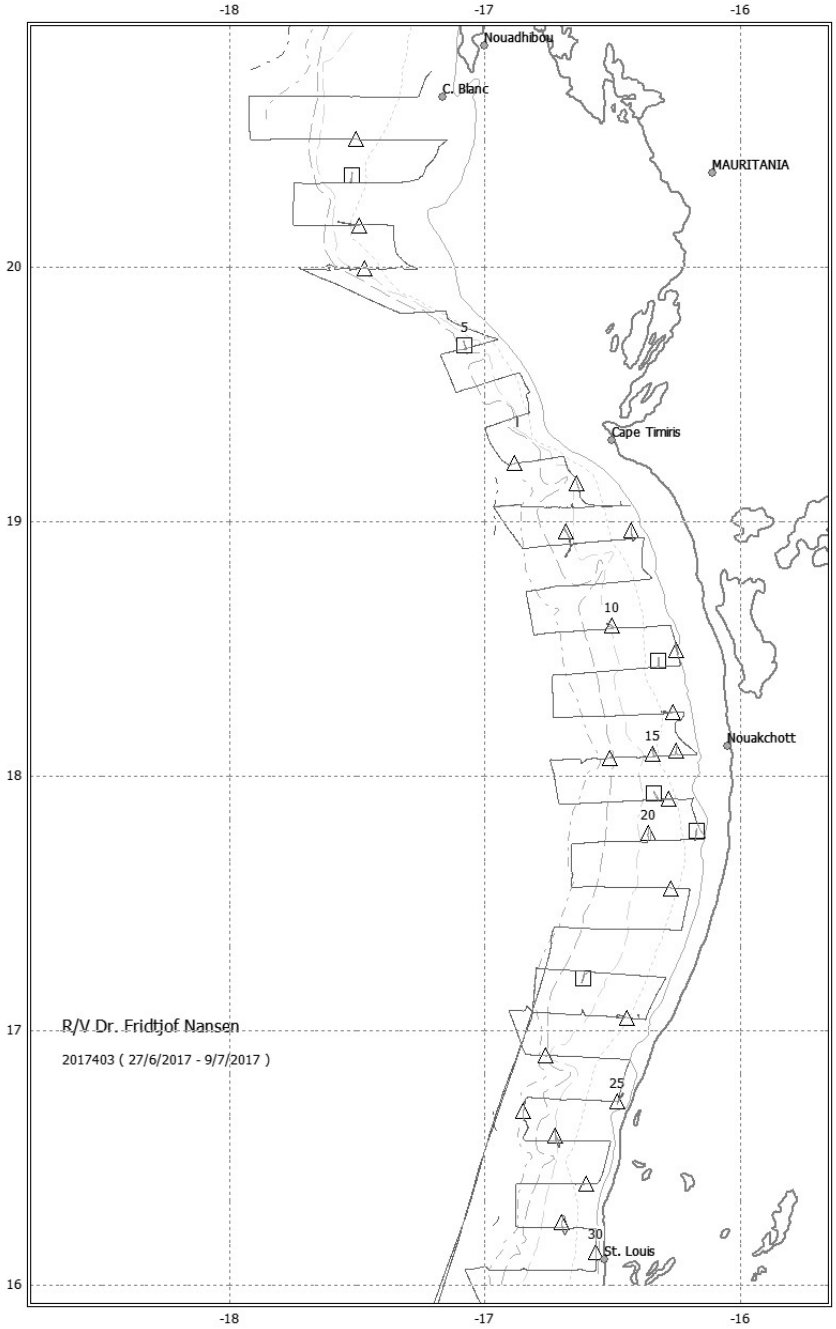


Figure 1.1 Course tracks with trawl stations along Mauritania.
Symbols: Δ: pelagic trawl; □: bottom trawl

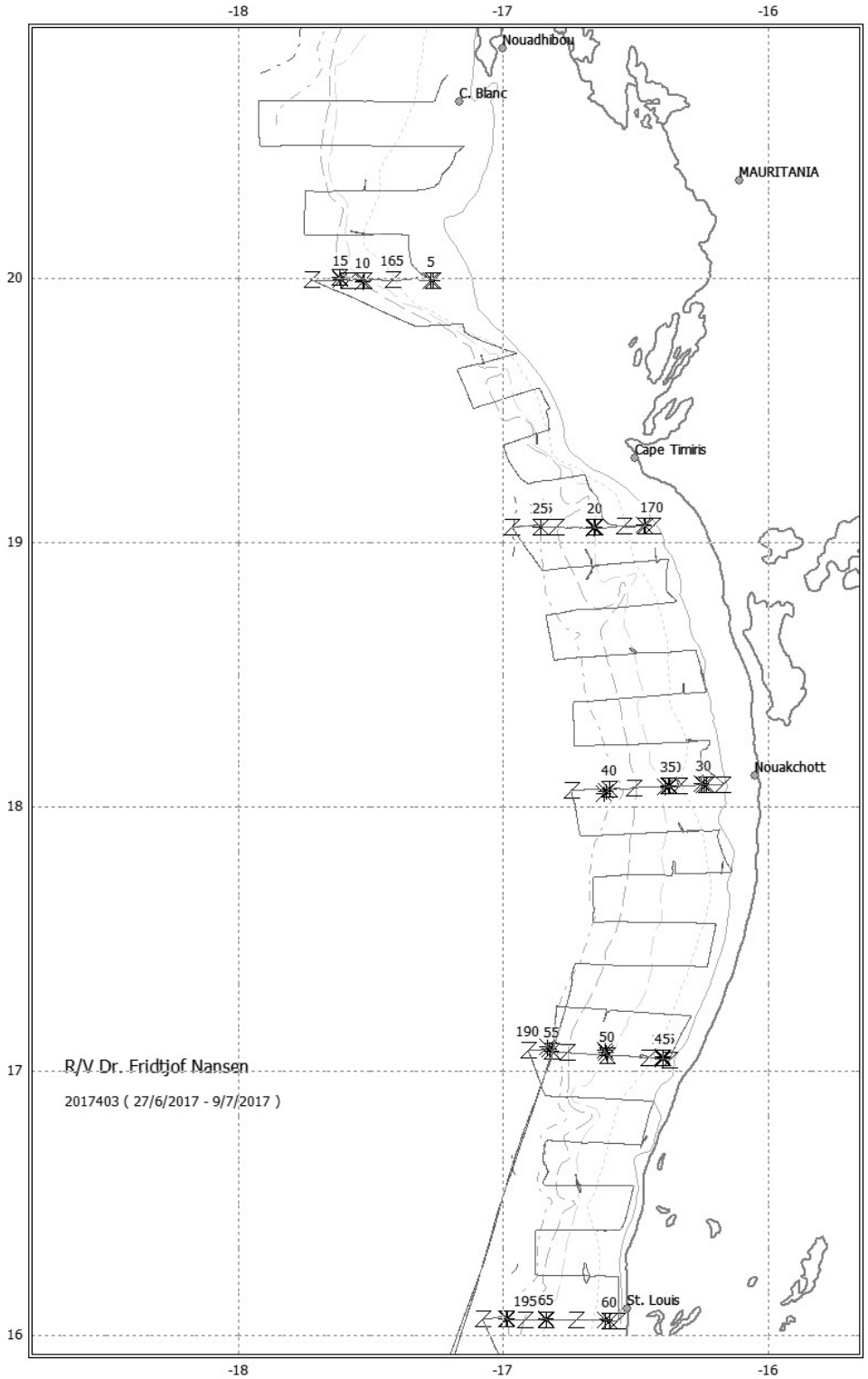


Figure 1.2. Course track with hydrographic and plankton stations.

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".

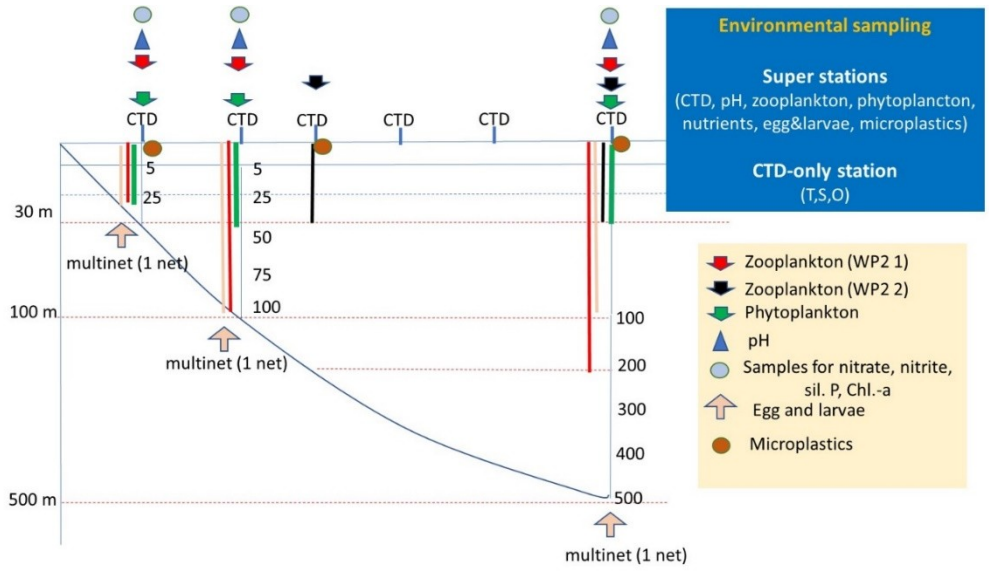


Figure 2.1. Overall sampling scheme in connection with the hydrographic transects, including "superstations".

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

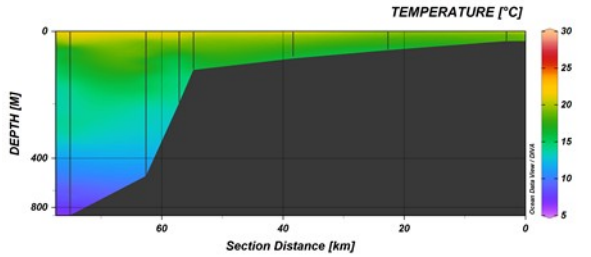
Figure 3.1 shows the distribution of temperature, salinity, fluorescence and oxygen from the five hydrographic transects collected during the survey. Data are plotted with the software Ocean Data View (ODV) using a nonlinear y-axis. Maximum depth is 1000 m.

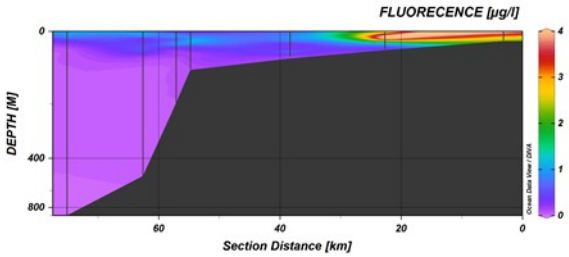
The northernmost part of Mauritania at Cap Blanc shows a typical upwelling situation with limited stratification and high primary production (fluorescence) on the inner shelf.

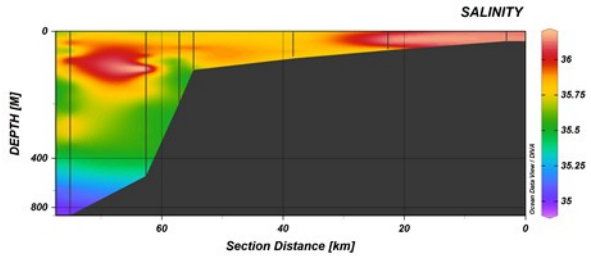
Moving southwards surface temperature starts increasing and highest fluorescence is visible on the shelf break and offshore. At 19°N water masses become increasingly more stratified especially offshore with warm saline tropical water masses observed in the surface layers and close inshore where water 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.

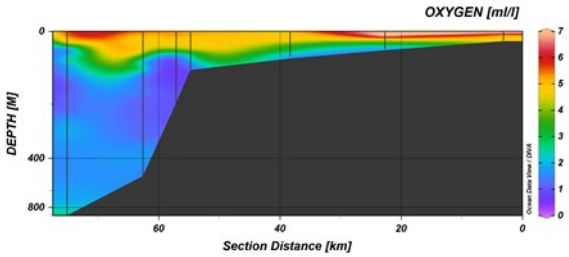
Overall, the observed conditions suggest very limited upwelling activity during the survey, which is in line with what could be expected at this time of the year in this region.

20°50’N Cap Blanc

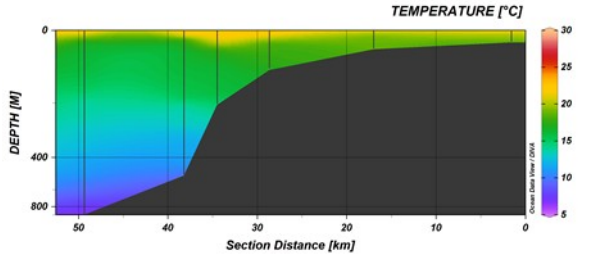


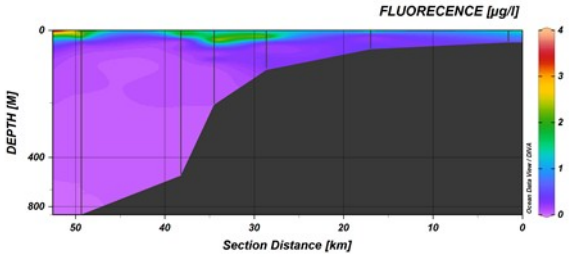


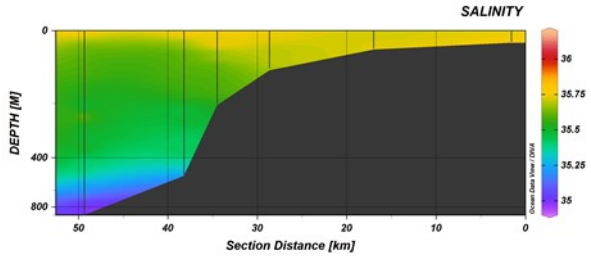


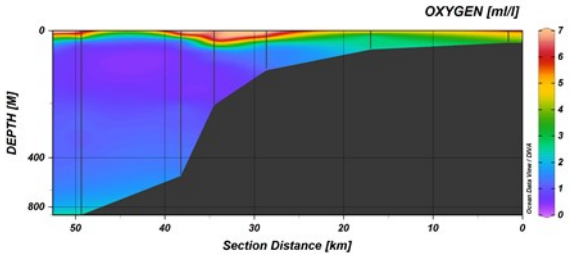


20°00’N

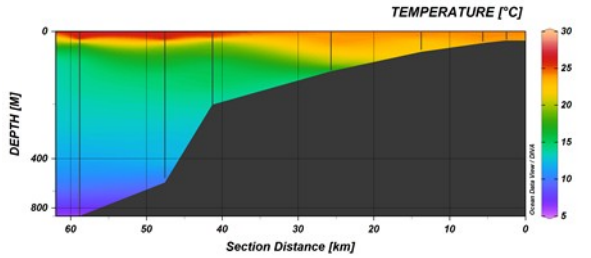


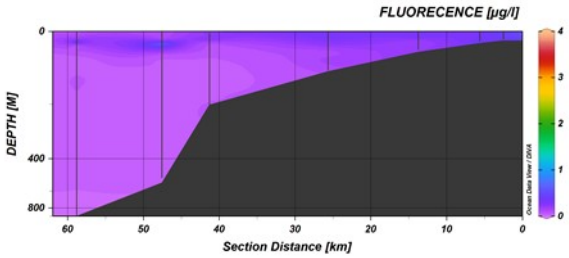


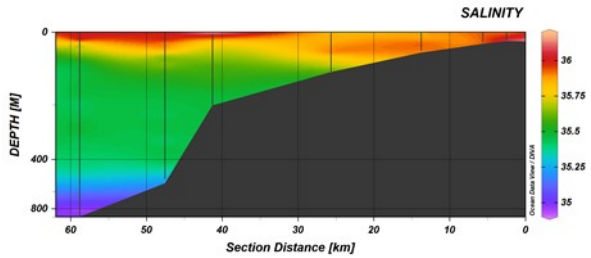


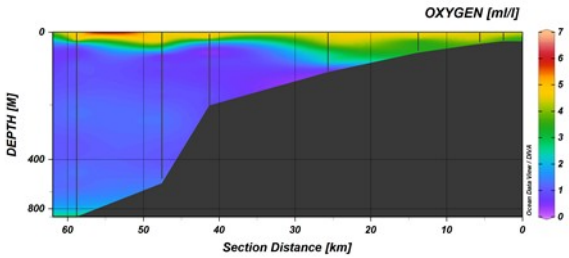


19°00’N









18°00’N Nouakchott

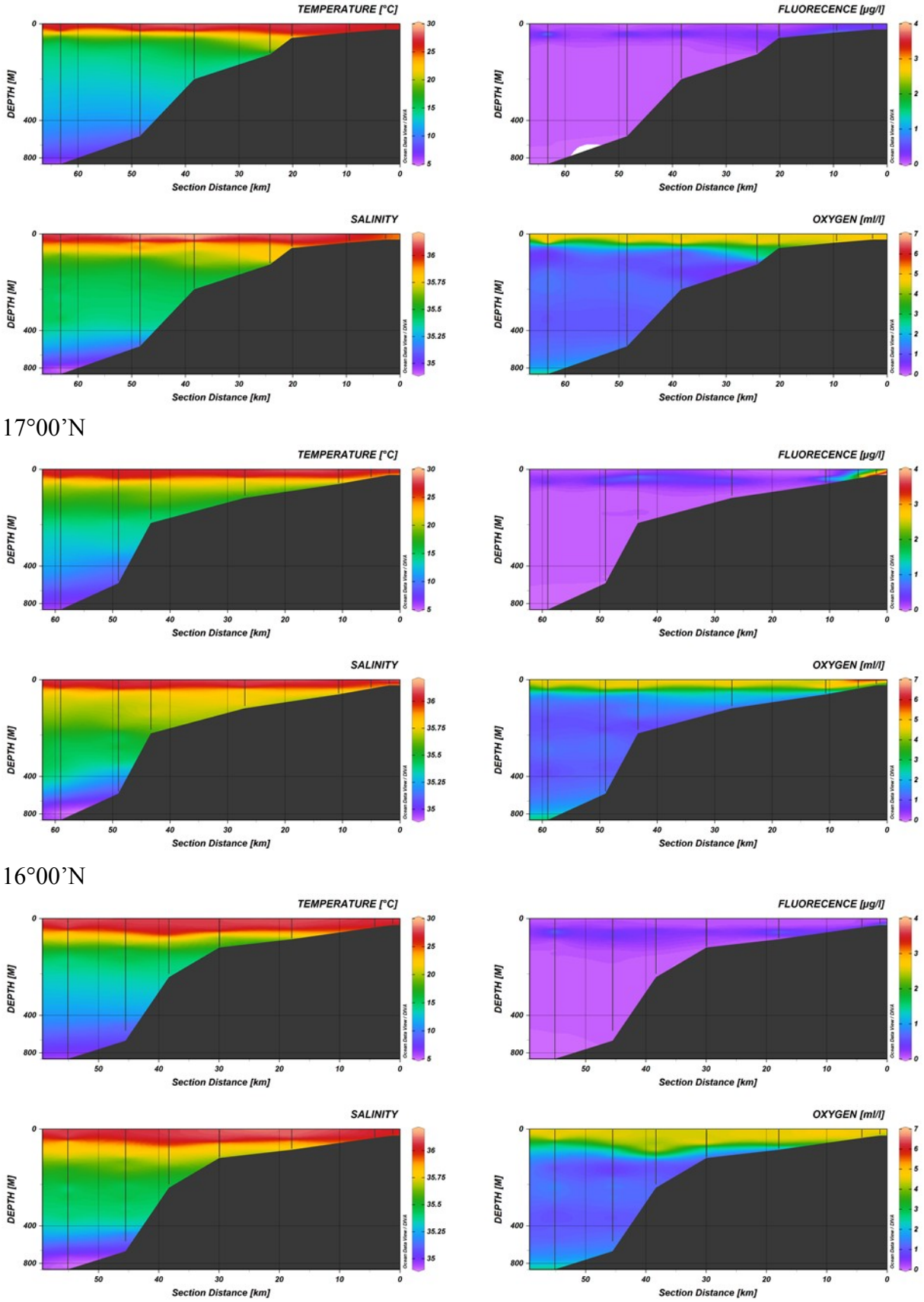


Figure 3.1. Hydrographic profiles with distribution of temperature, salinity and oxygen

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.

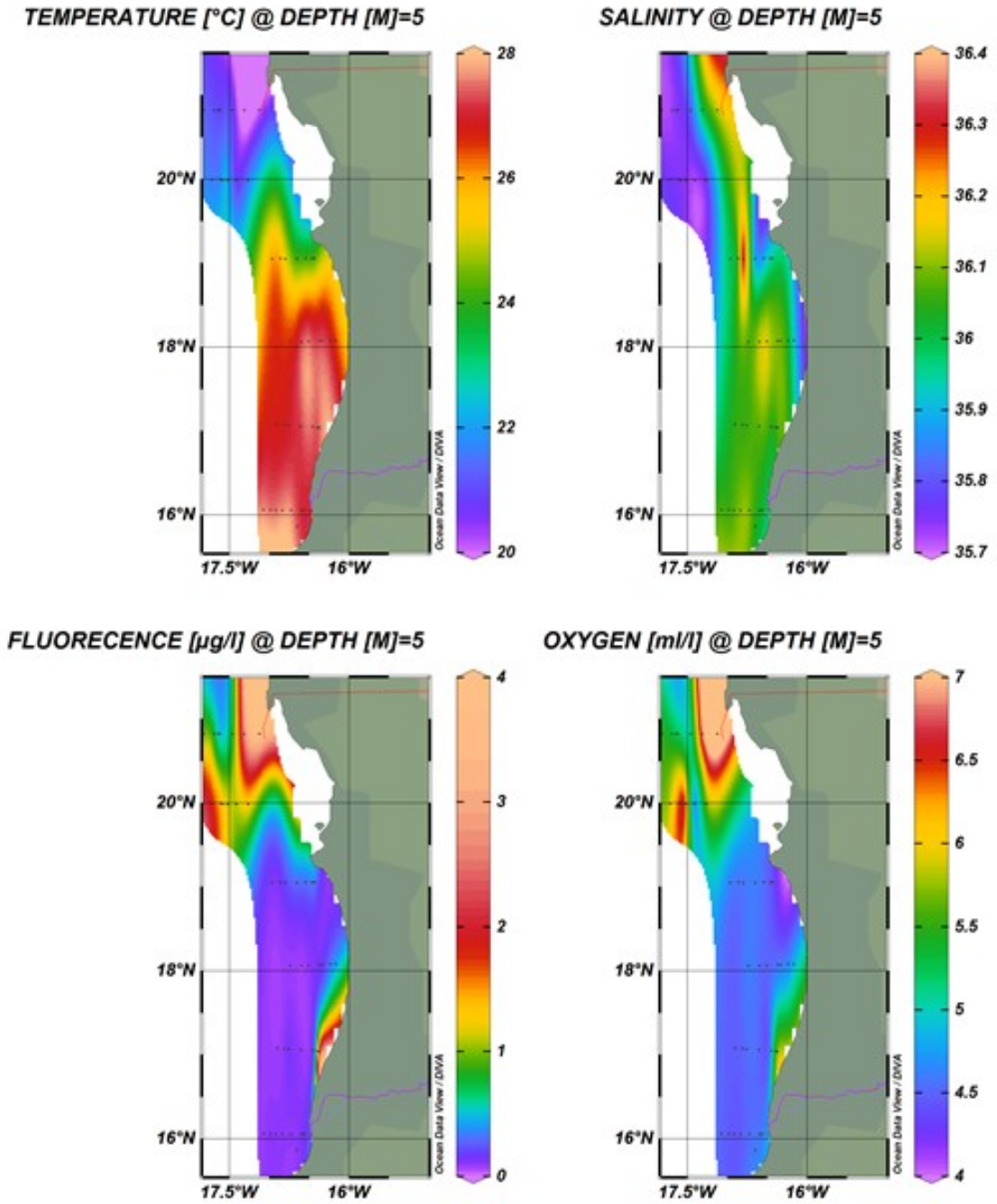


Figure 3.2 shows the sea surface temperature, salinity, fluorescence and oxygen at 5 m of depth

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.

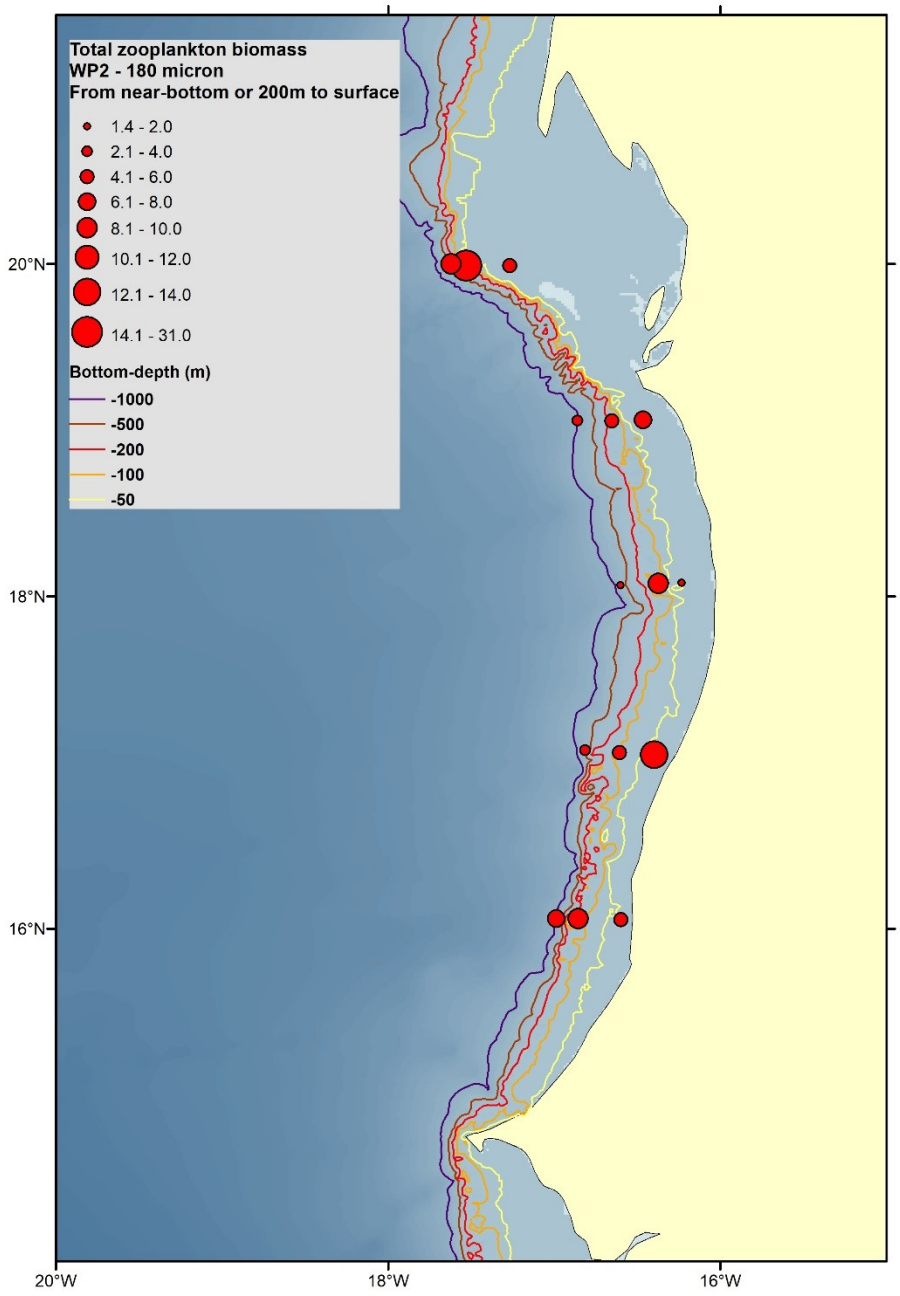


Figure 3.3. Total zooplankton biomasses (dry-weight, g/m2) for sampling-strata of ~ 25-0 m at bottom-depth of 30m, ~ 90-0 m at bottom-depth of 100 m, and ~ 200-0 m at bottom-depth of 500 (c.f. bottom-depth contours in the figure). Hence, the samples here shown for different bottom-depths are not directly 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.

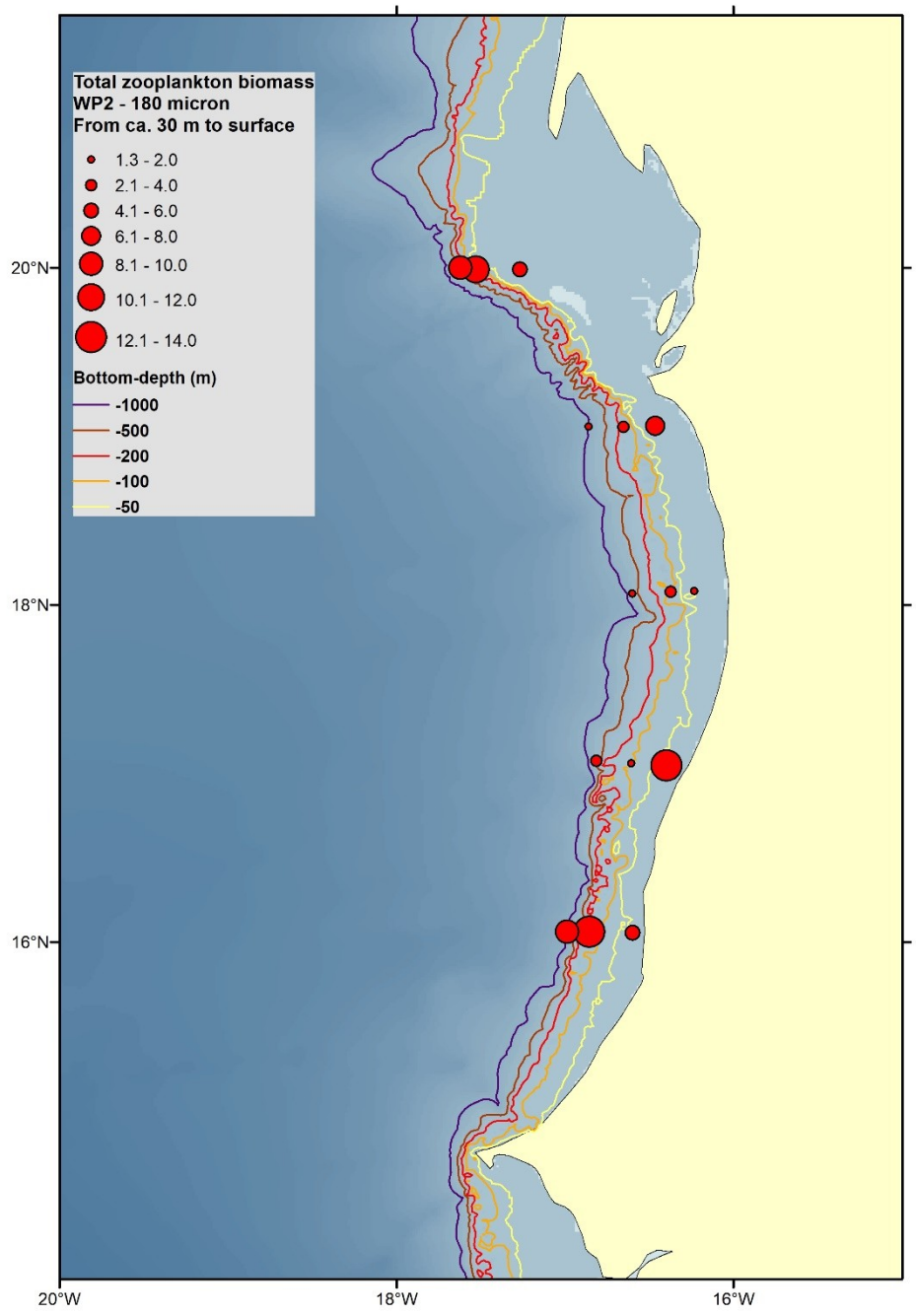


Figure 3.4. Total zooplankton biomasses (dry-weight, g/m^2) for the uppermost ~ 30 m. Both day and night samples are included. See comments in the text regarding a possible bias in some samples due to inclusion of phytoplankton.

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.

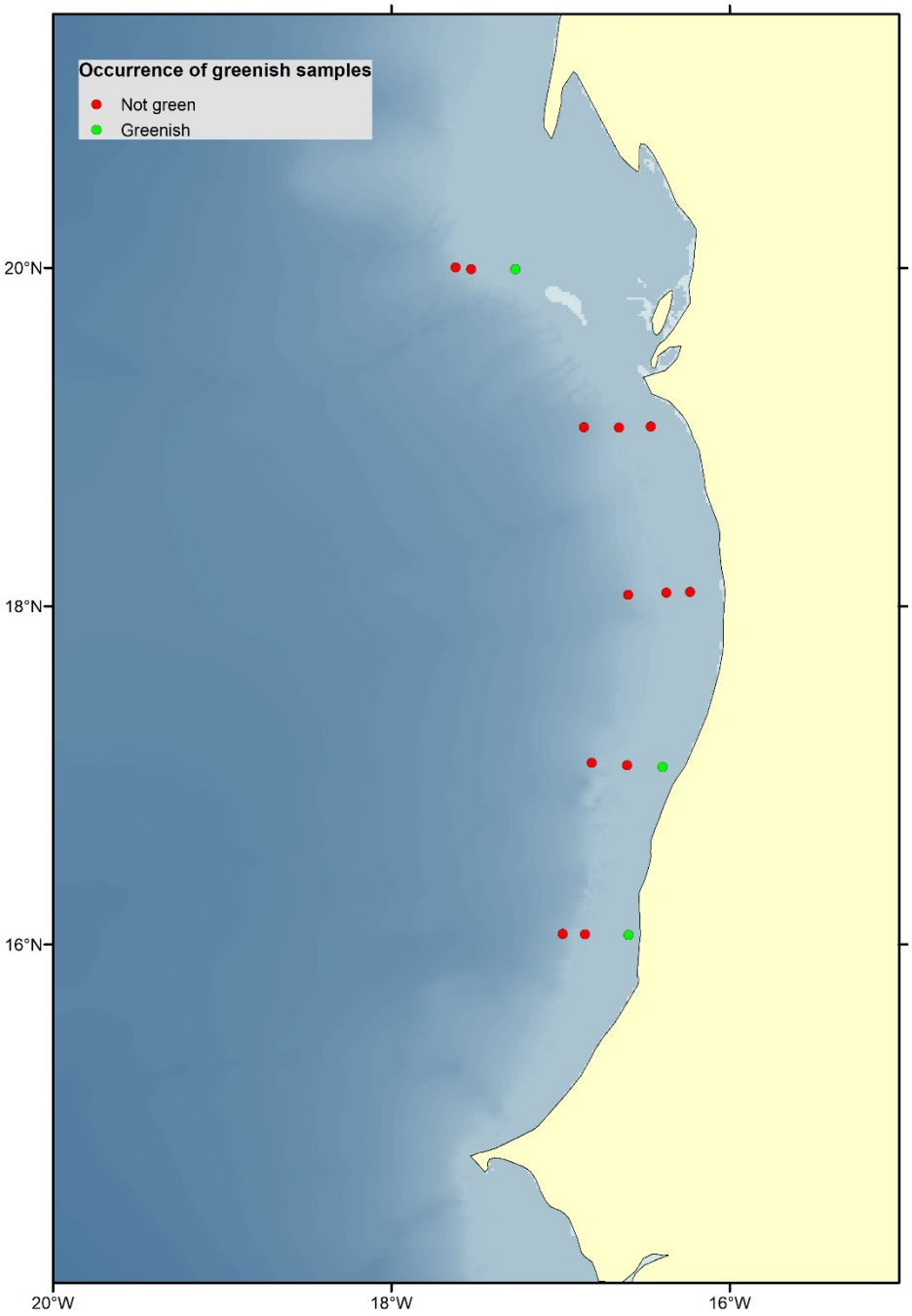


Figure 3.5. Indication of zooplankton biomass samples with notable green colour revealing contents of phytoplankton – which to some degree implies overestimation of zooplankton biomass. Figure based on the samples covering the bottom (or 200 m) - surface stratum.

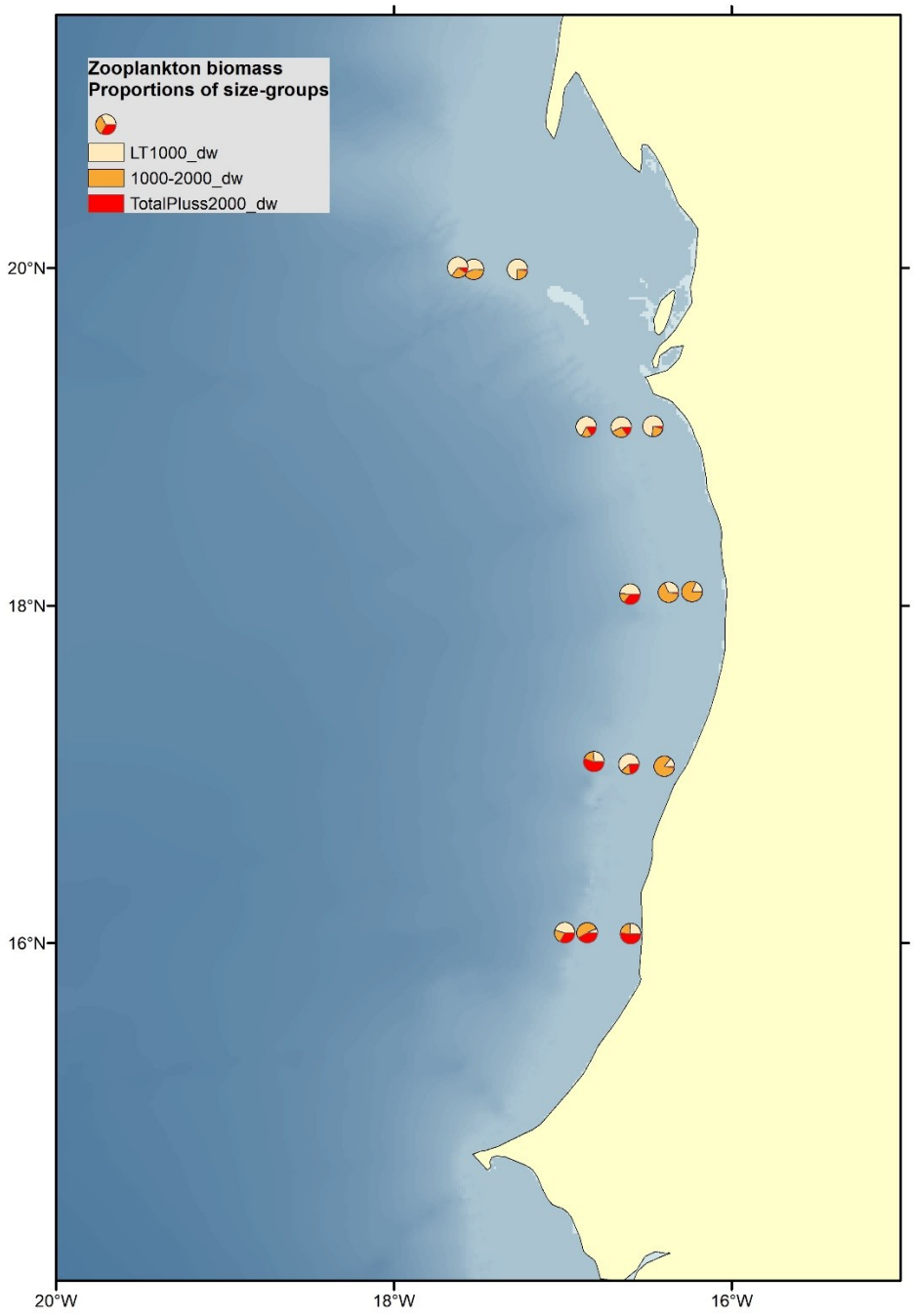


Figure 3.6. Weight-proportions of three zooplankton size-groups (180-1000 µm in yellow, 1000-2000 µm in orange, and > 2000 µm in red). The results presented here represent the sampling strata of ~ 25-0 m at bottom-depth of 30 m, ~ 90-0~m at bottom-depth of 100 m, and ~ 200-0 m at bottom-depth of 500 (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

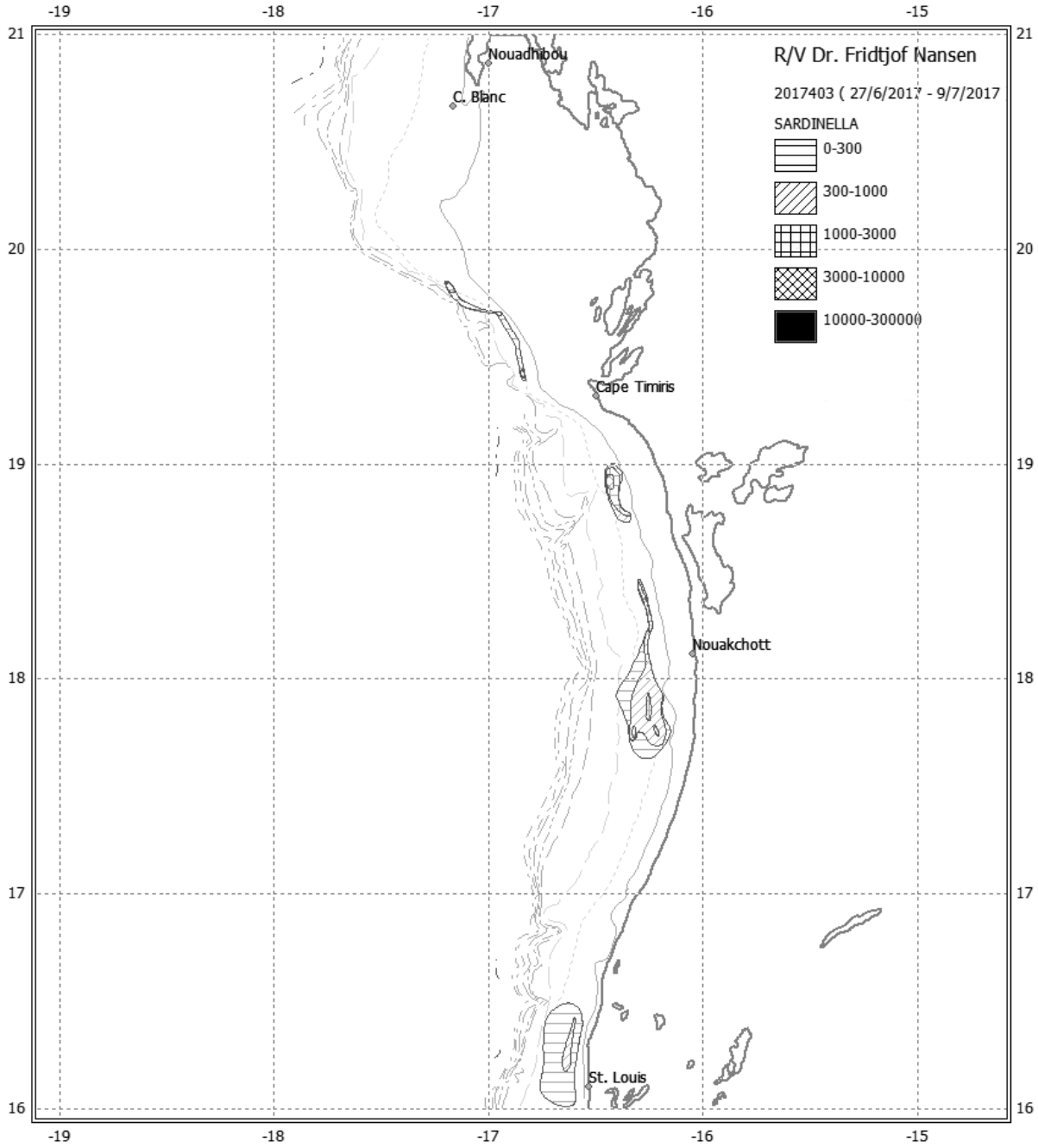


Figure 3.7. Distribution of sardinellas, Cap Blanc - St. Louis

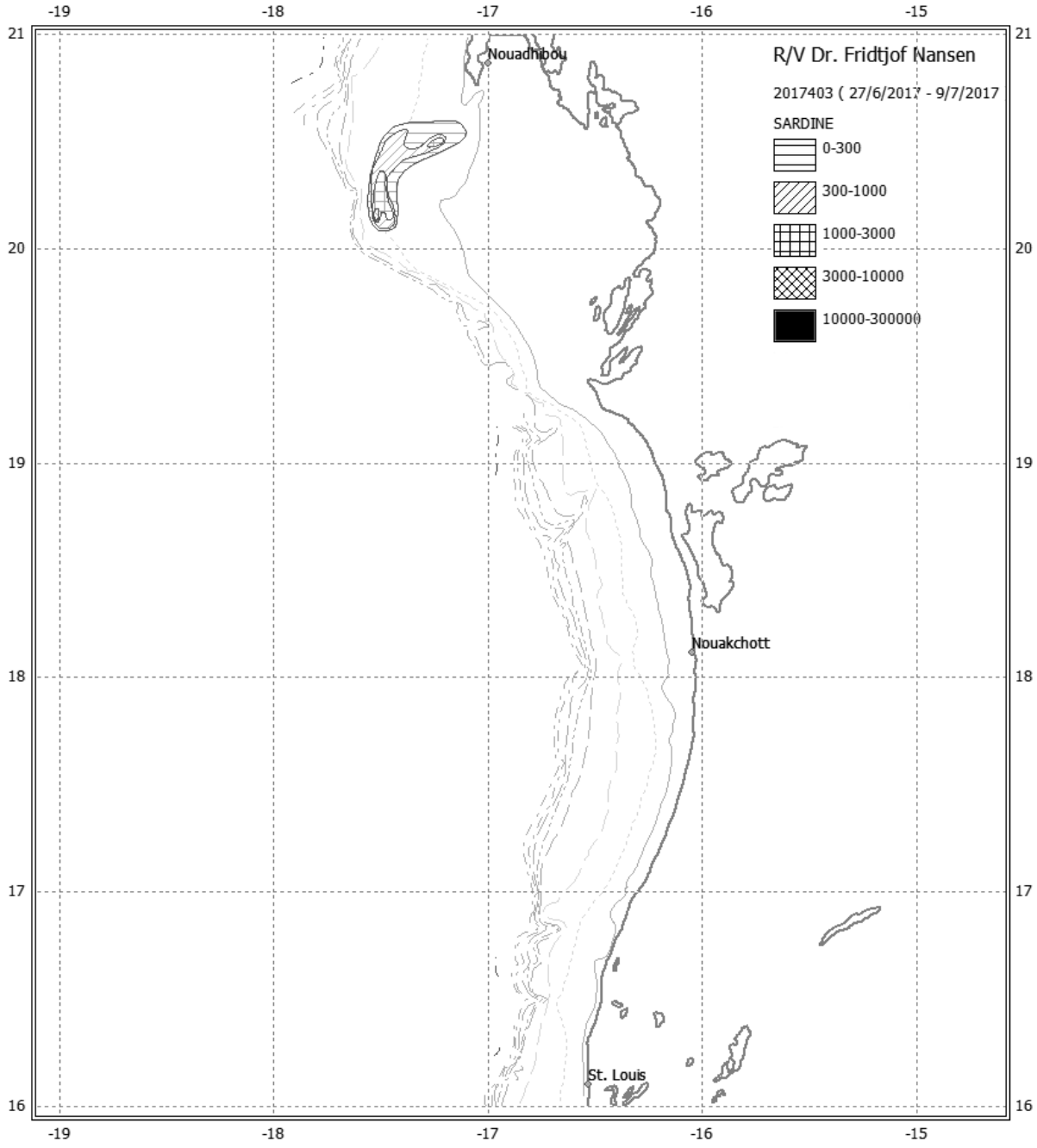


Figure 3.8. Distribution of sardine, Cap Blanc - St. Louis

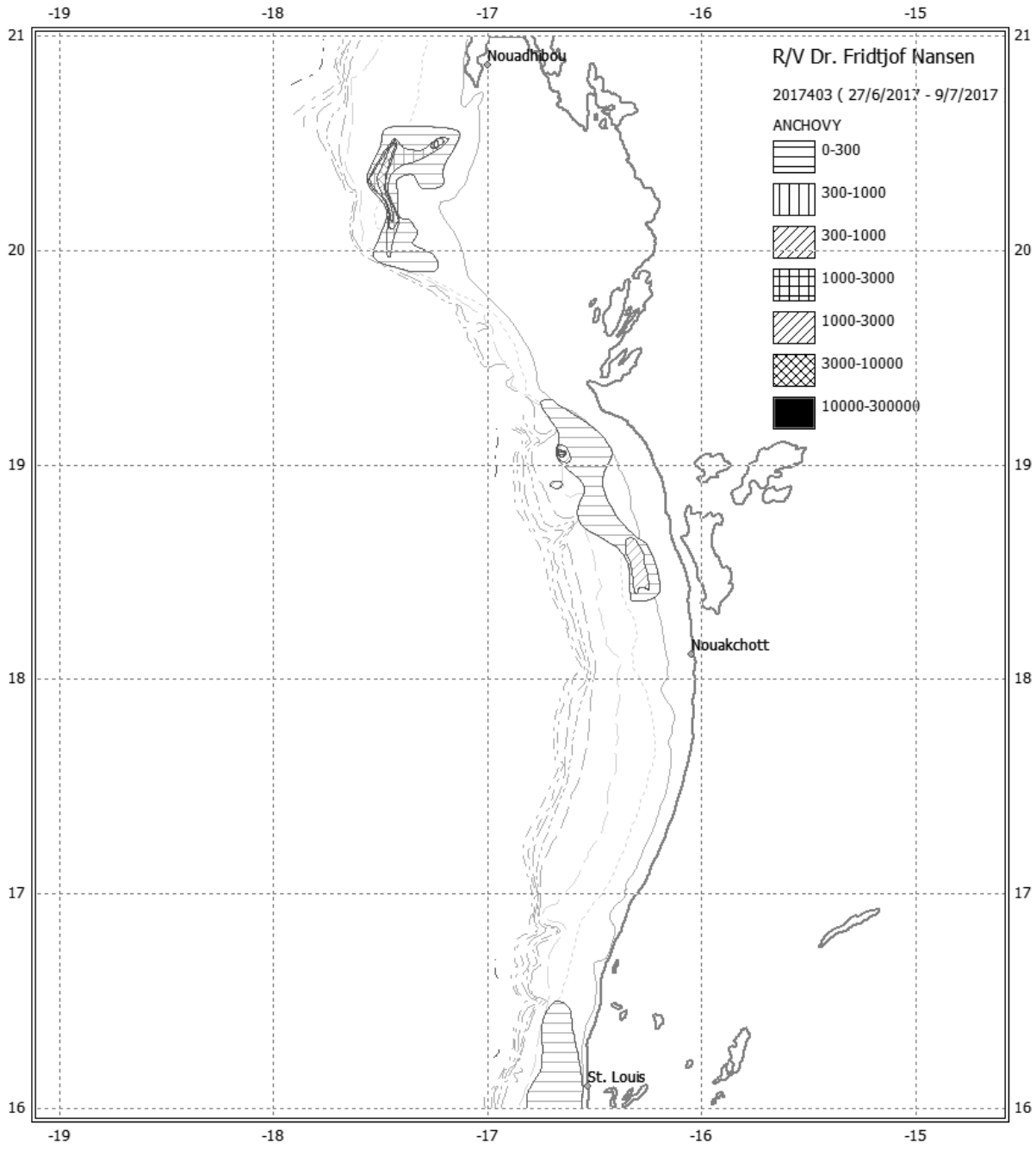


Figure 3.9. Distribution of anchovy, Cap Blanc - St. Louis

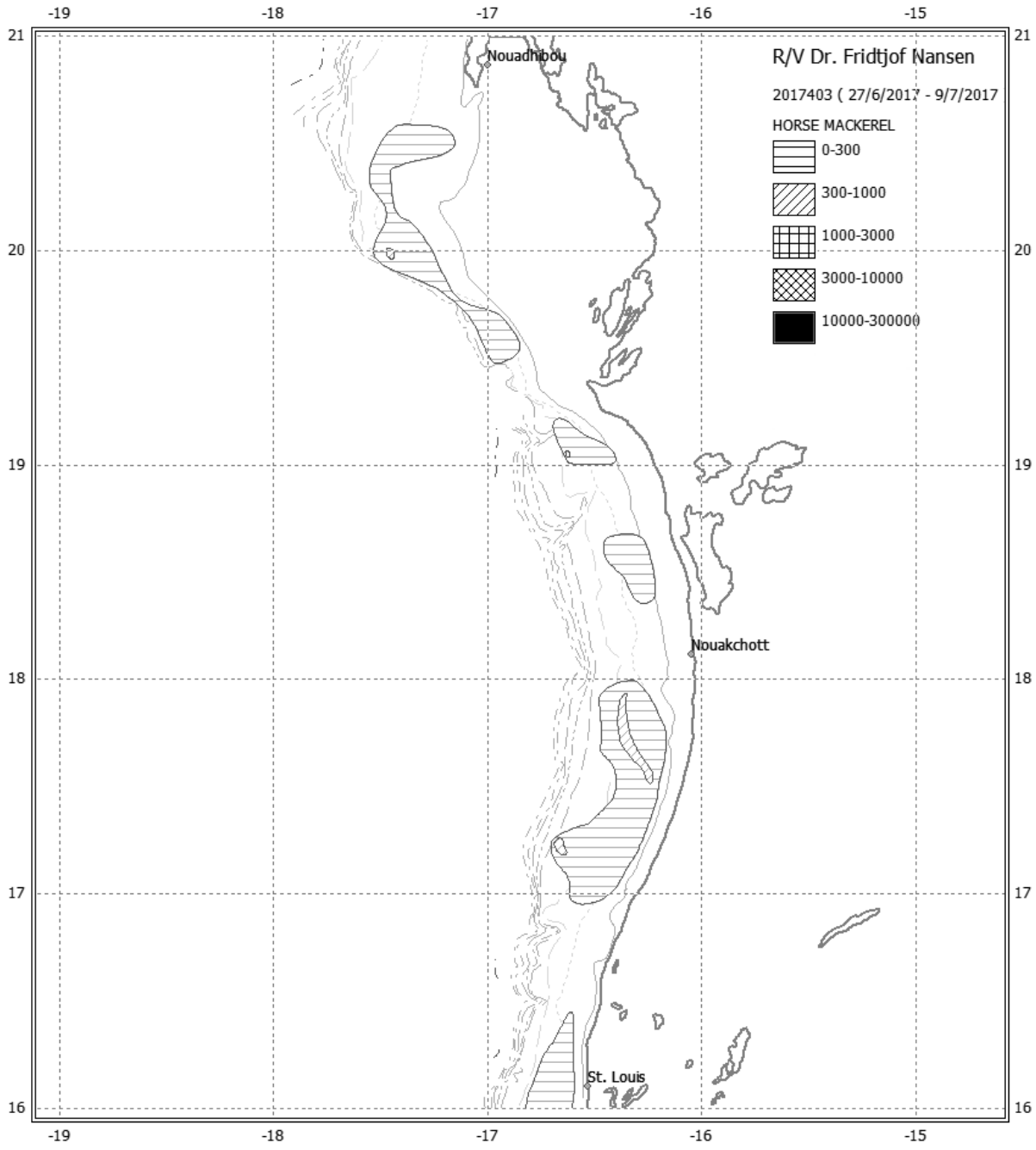


Figure 3.10. Distribution of horse mackerels, Cap Blanc - St. Louis

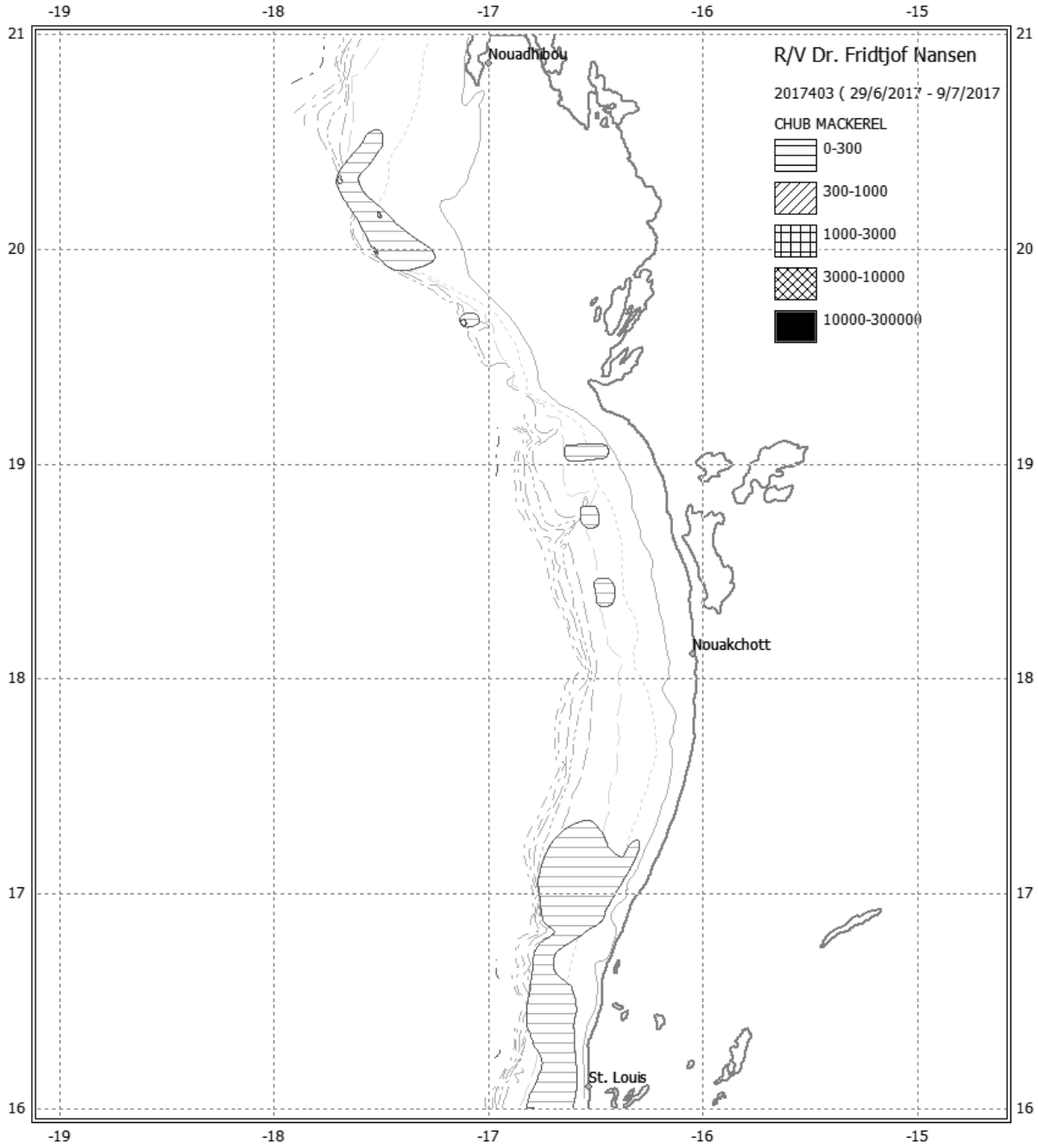


Figure 3.11. Distribution of chub mackerel, Cap Blanc - St. Louis

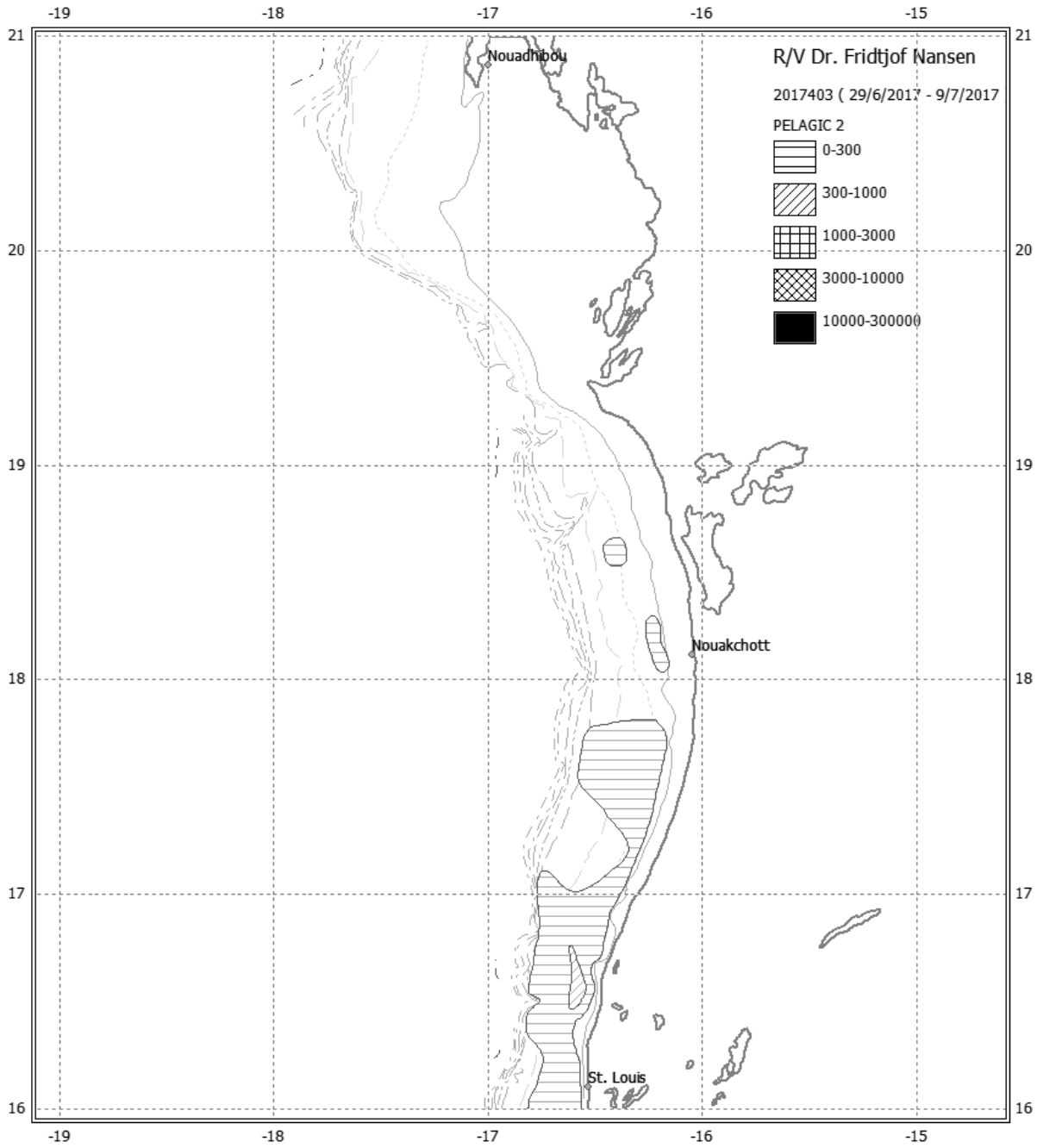


Figure 3.12. Distribution of carangids and associated species, Cap Blanc - St. Louis

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.

[1] Now IMR

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

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

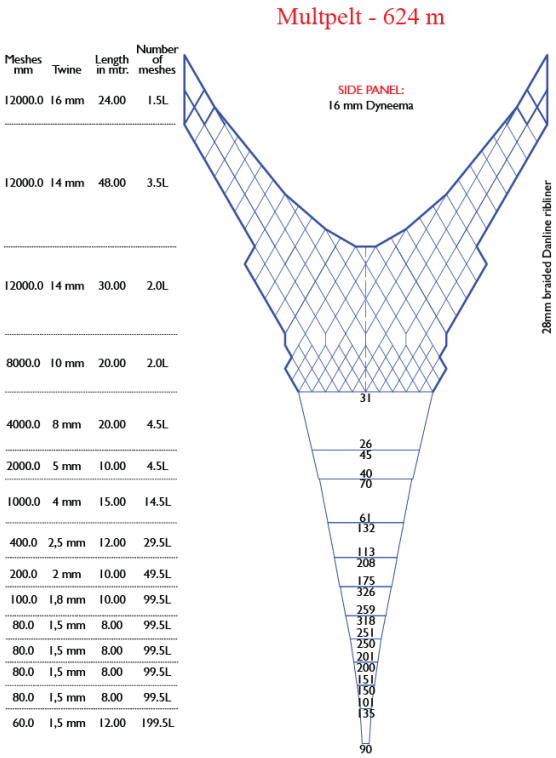
Fishing gear

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.



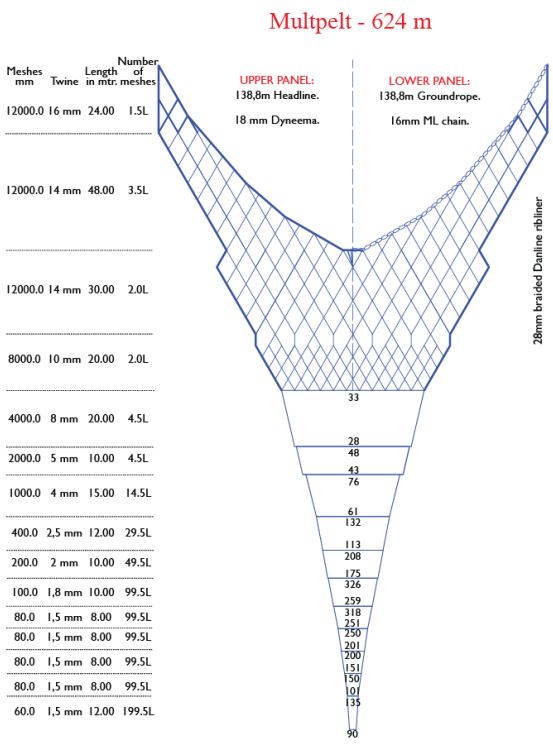
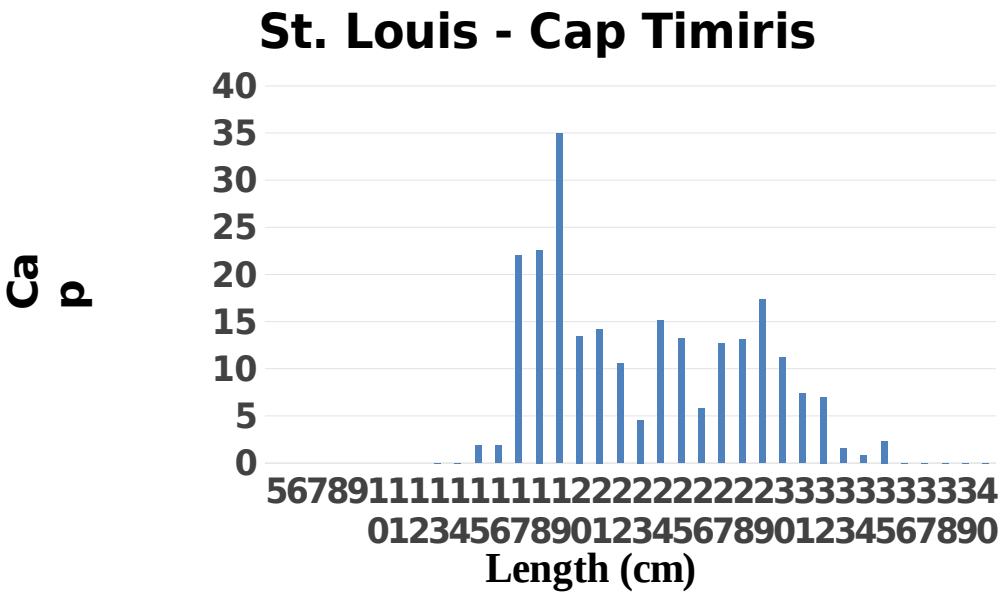


Figure 1. Schematic drawing of the MultPelt 624.

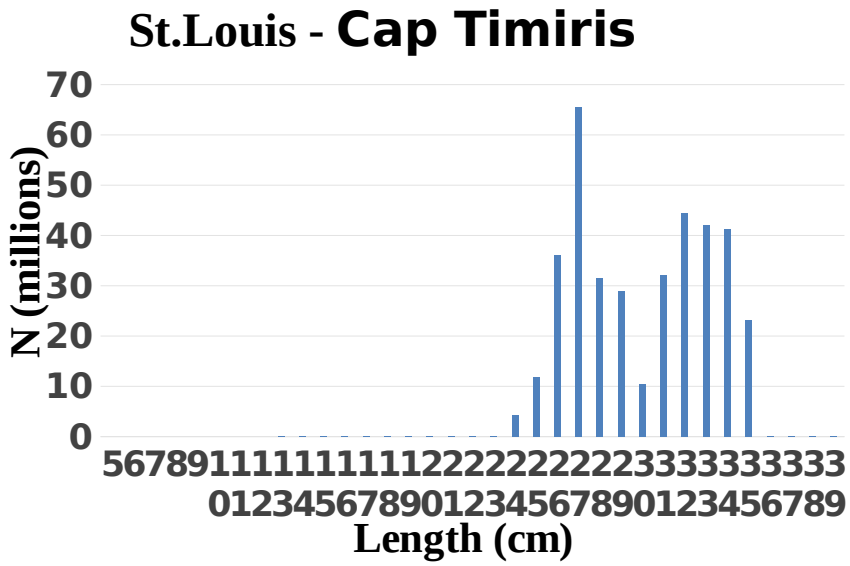
ANNEX IV LENGTH DISTRIBUTIONS BY SPECIES AND REGION

St. Louis – Cap Timiris

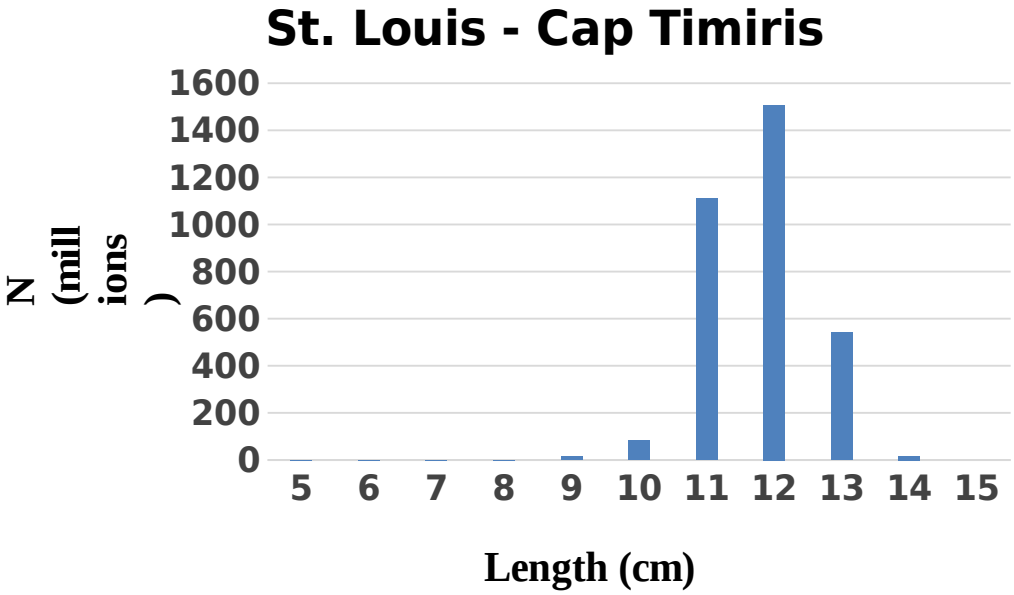
Sardinella aurita



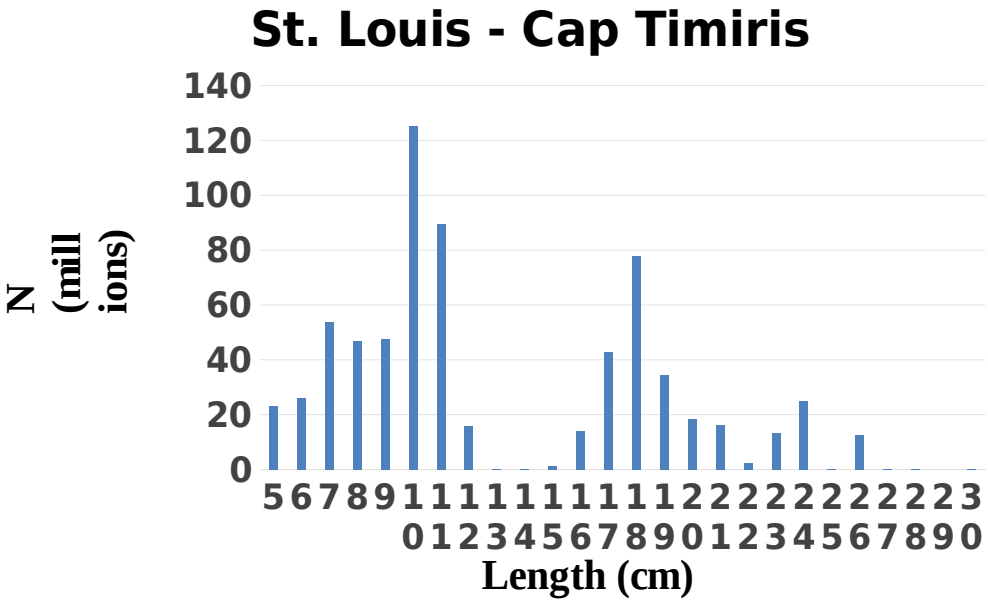
Sardinella maderensis



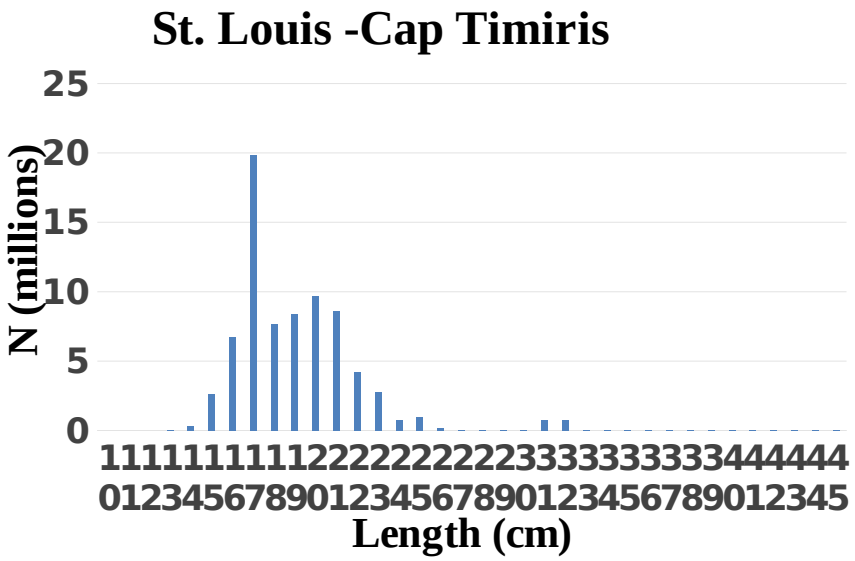
Anchovy



Trachurus trecae

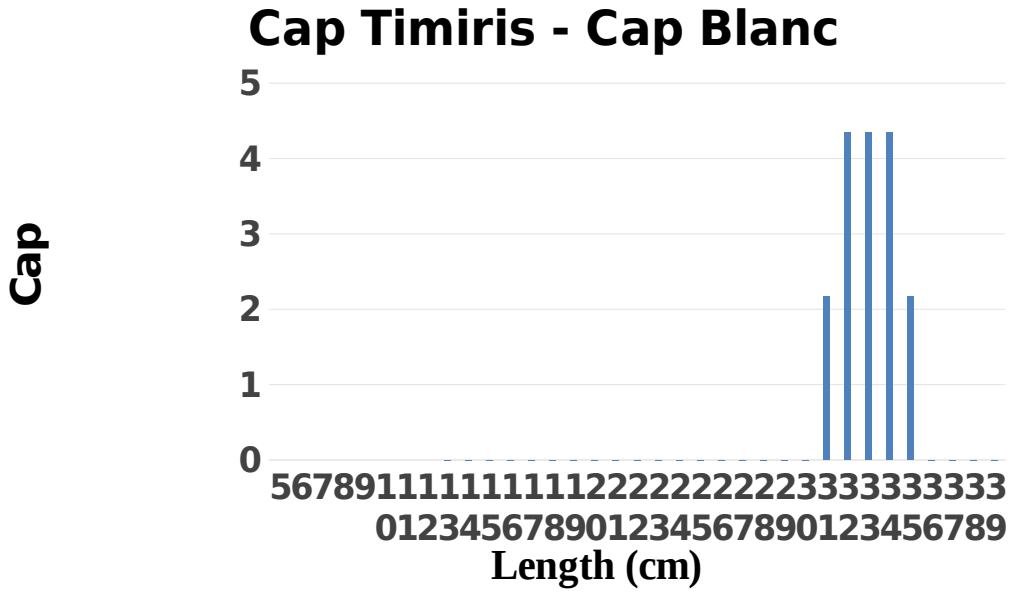


Scomber colias

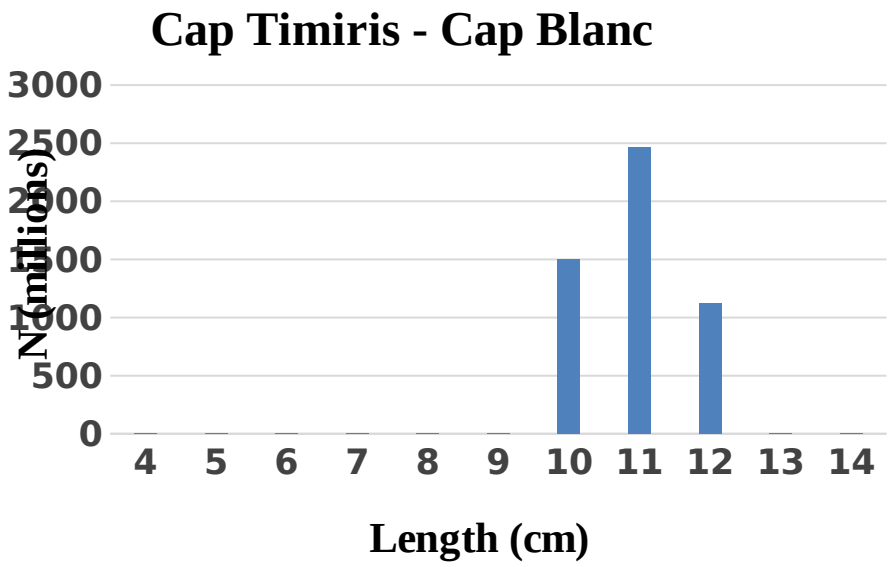


Cap Timiris - Cap Blanc

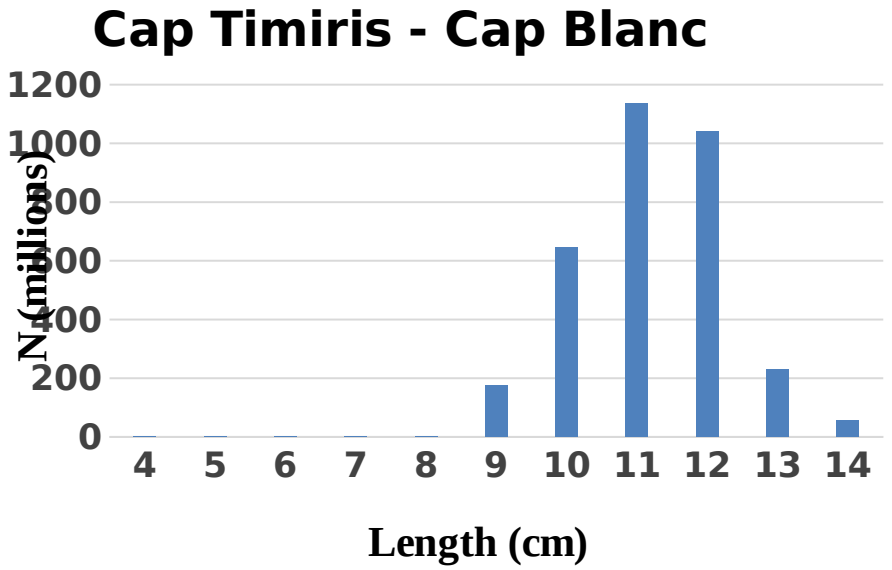
Sardinella maderensis



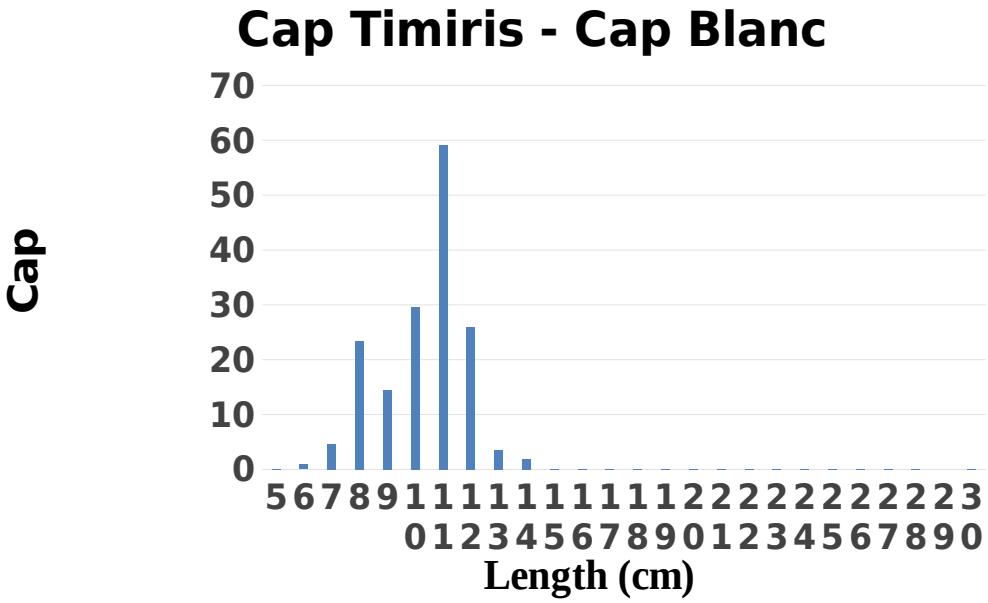
Sardina pilchardus



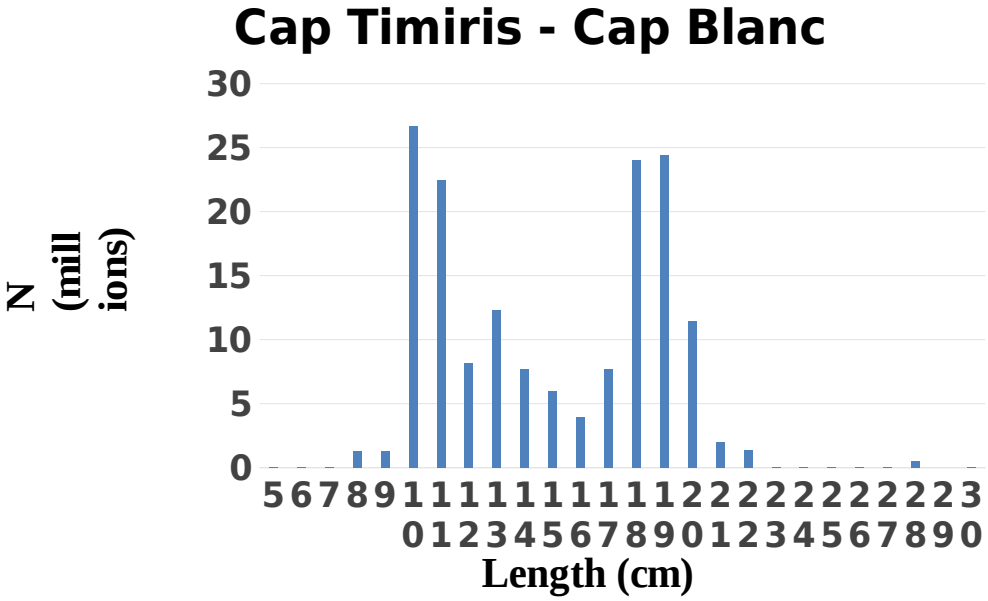
Engraulis encrasicolus



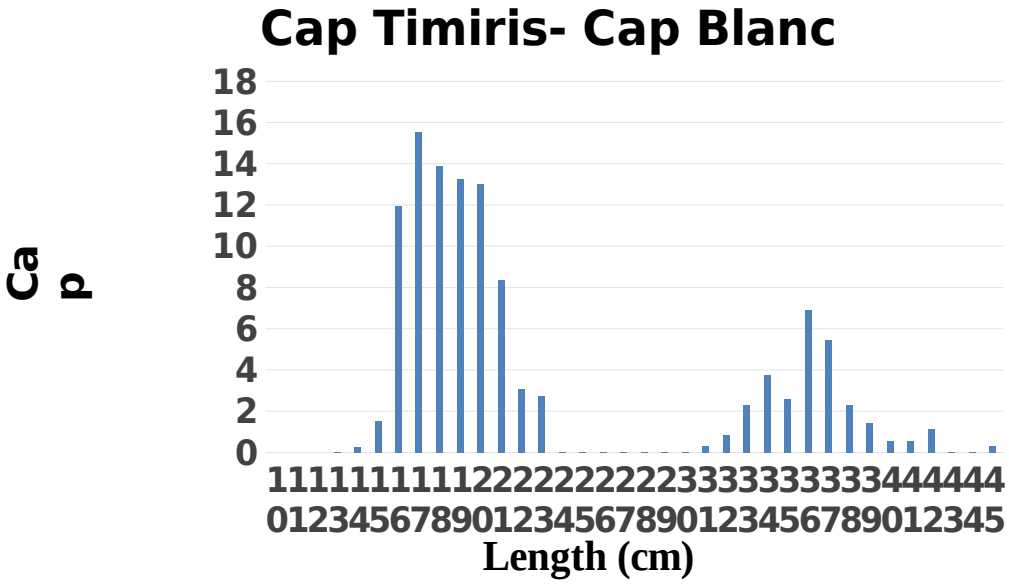
Trachurus trachurus



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