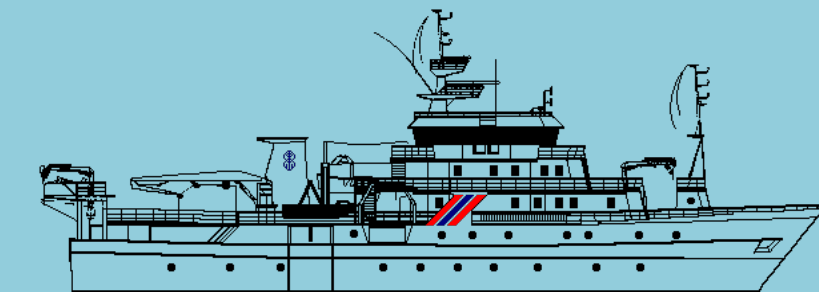


Cruise Report "Dr. Fridtjof Nansen"



SURVEY OF THE PELAGIC RESOURCES OF ANGOLA

16 February – 17 March 2013

Institute of Marine Research
IMR
Bergen

Instituto Nacional de Investigação Pesqueira
INIP
Luanda

Bergen 2013



THE EAF-NANSEN PROJECT

FAO started the implementation of the project “Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries (EAF-Nansen GCP/INT/003/NOR)” in December 2006 with funding from the Norwegian Agency for Development Cooperation (Norad). The EAF-Nansen project is a follow-up to earlier projects/programmes in a partnership involving FAO, Norad and the Institute of Marine Research (IMR), Bergen, Norway on assessment and management of marine fishery resources in developing countries. The project works in partnership with governments and also GEF-supported Large Marine Ecosystem (LME) projects and other projects that have the potential to contribute to some components of the EAF-Nansen project.

The EAF-Nansen project offers an opportunity to coastal countries in sub-Saharan Africa, working in partnership with the project, to receive technical support from FAO for the development of national and regional frameworks for the implementation of Ecosystem Approach to Fisheries management and to acquire additional knowledge on their marine ecosystems for their use in planning and monitoring. The project contributes to building the capacity of national fisheries management administrations in ecological risk assessment methods to identify critical management issues and in the preparation, operationalization and tracking the progress of implementation of fisheries management plans consistent with the ecosystem approach to fisheries.

LE PROJET EAF-NANSEN

La FAO a initié la mise en oeuvre du projet "Renforcement de la base des connaissances pour mettre en œuvre une approche écosystémique des pêcheries marines dans les pays en développement (EAF-Nansen GCP/INT/003/NOR)" en décembre 2006. Le projet est financé par de l'Agence norvégienne de coopération pour le développement (Norad). Le projet EAF-Nansen fait suite aux précédents projets/ programmes dans le cadre du partenariat entre la FAO, Norad et l'Institut de recherche marine (IMR) de Bergen en Norvège, sur l'évaluation et l'aménagement des ressources halieutiques dans les pays en développement. Le projet est mis en oeuvre en partenariat avec les gouvernements et en collaboration avec les projets grands écosystèmes marins (GEM) soutenus par le Fonds pour l'Environnement Mondial (FEM) et d'autres projets régionaux qui ont le potentiel de contribuer à certains éléments du projet EAF-Nansen.

Le projet EAF-Nansen offre l'opportunité aux pays côtiers de l'Afrique subsaharienne partenaires de recevoir un appui technique de la FAO pour le développement de cadres nationaux et régionaux visant une approche écosystémique de l'aménagement des pêches et la possibilité d'acquérir des connaissances complémentaires sur leurs écosystèmes marins. Ces éléments seront utilisés pour la planification et le suivi des pêcheries et de leurs écosystèmes. Le projet contribue à renforcer les capacités des administrations nationales responsables de l'aménagement des pêches en introduisant des méthodes d'évaluation des risques écologiques pour identifier les questions d'aménagement d'importance majeure ainsi que la préparation, la mise en œuvre et le suivi de progrès de la mise en œuvre de plans d'aménagement des ressources marines conformes à l'approche écosystémique des pêches.



SURVEYS OF THE FISH RESOURCES OF ANGOLA

Cruise Report No 1/2013

**Survey of the pelagic resources
16 February – 17 March 2013**

by

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Bergen, 2013

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CHAPTER 1 INTRODUCTION

1.1 Objectives

This survey is part of the time series of the pelagic living resources, aiming at monitoring the pelagic fish resources of Angola. The first surveys of the pelagic resources were carried out in 1985, with surveys both during winter and summer. The next surveys were carried out in 1986 and 1989 (summer surveys), before the time series of the winter surveys commenced in 1991. With the exception of 1993 (no survey) and 1997 (summer survey only) the winter time series has been carried out without interruption from 1991-2011. For 2013, surveys are planned for both the winter and summer seasons in order to investigate the intra-annual (seasonal variation) in the distribution and estimated abundance of the pelagic species. The same was done in 1985, 1995, 2011 and 2012.

The surveys are carried out on behalf of Instituto Nacional de Investigação Pesqueira (INIP), Luanda, who also staffs the vessel with a local co-cruise leader, as well as fisheries and oceanographic researchers. The IMR provides the IMR cruise leader, a survey technician and two instrument operators, according to the standard operating procedures, in accordance with the tri-partite agreement between NORAD, FAO and IMR, and with the MoU on the execution of the survey between INIP and FAO.

The surveys aim at improving the general knowledge of the biology, ecology and population dynamics of the main pelagic species in relation to the environment and the ecosystem as such. Acoustic echo integration is used to estimate stock abundance indices of the pelagic species, and in the absence of reliable fisheries statistics the survey estimates therefore form the main basis for the recommendations of the Total Allowable Catch (TAC).

The specific objectives of the present survey were:

- To estimate the abundance and map the distribution of the main commercially important pelagic and semi-pelagic fish species in Angolan waters, including the two sardinella species *Sardinella aurita* and *Sardinella maderensis*, the Cunene horse mackerel *Trachurus trecae* and the Cape horse mackerel *Trachurus capensis*.
- To collect stomach samples from both horse mackerel species for analyses of diet composition.
- To collect depth-stratified samples of zoo- and phytoplankton in order to continue the studies on feeding biology included relating stomach content to estimated zooplankton composition and observed density.
- To map the general meteorological and hydrographical conditions in the survey area by means of continuous recordings of weather data, CTD-casts (temperature, salinity and oxygen) and ADCP measurements (Acoustic Doppler Current Profiler) along acoustical and hydrographical transect lines.
- On-the-job training of cruise participants on the main survey routines, including using the Nansis database and scrutinizing acoustical data using IMR the post-processing system, the Large Scale Survey System (LSSS).

1.2 Participation

The scientific staff consisted of:

From INIP, Luanda: Francisco de Almeida (Co-cruise leader), Tito Milagre, Quilanda Fidel, Geraldina de A. Salvador José, Pedro Panzo, Antonio Bucu (10.03-17.03) and João Morais Domingos (10.03-17.03).

From IMR, Bergen: Sigbjørn Mehl, (Cruise leader), Tore Mørk (16.02-09.03), Magne Olsen, Jarle Kristiansen and Jan Frode Wilhelmsen (09.3-17.03)

1.3 Narrative

The vessel departed from Walvis Bay on the 16th of February at 15:00 UTC and steamed northwards to the Cunene River where the survey started on the 18th of March at 07:40 UTC. The survey area is divided into three standard regions:

- (a) The region between Cunene River (17°15' S) and Benguela (13° S): ANGOLA SOUTH
- (b) The region between 13°S and Pta. das Palmerinhas (9° S): ANGOLA CENTRAL
- (c) The region between (9° S) and the Congo River (6° S): ANGOLA NORTH.

An echo sounder calibration was carried out in Baía dos Elefantes the 24th of February and the Southern region was completed the next day at 10:00 UTC. The coverage of the Central region continued immediately and was completed on the 4th of March at 06:30 UTC. The vessel continued with the Northern region until the 7th of March (19:00 UTC) before a call upon Luanda for change of personnel. The remaining part of the Northern region was completed the 14th of March (05:00 UTC). A dense coverage of a small area was done 15th - 16th of March before the vessel steamed to Luanda.

1.4 Survey effort

Figures 1-3 shows the parallel acoustic transects with 6-7 nautical mile (NM) spacing with fishing, plankton and hydrographical stations for the Southern, Central and Northern regions of Angola. All sampling trawls, including the small (10 m vertical opening), the mid-sized (15 m vertical opening) pelagic trawls and the demersal trawl (5 m) (Annex VI), were used during the survey. Table 1 summarizes the survey effort by regions.

Table 1 Summary of survey effort by regions, including number of demersal (BT) and pelagic (PT) trawl hauls, CTD casts, Multinet stations (2-5 zooplankton samples per station) and distance surveyed.

Area	BT	PT	Total trawls	CTD	Multinet	Distance (NM)
Cunene River-Benguela	9	10	19	53	20	986
Benguela -Pta. Palmerinhas	10	7	17	57	15	1230
Pta. Palmerinhas-Congo River	12	9	21	24	9	1397
Minisurvey	2	4	6	5	5	247
Total	33	30	63	139	49	3860

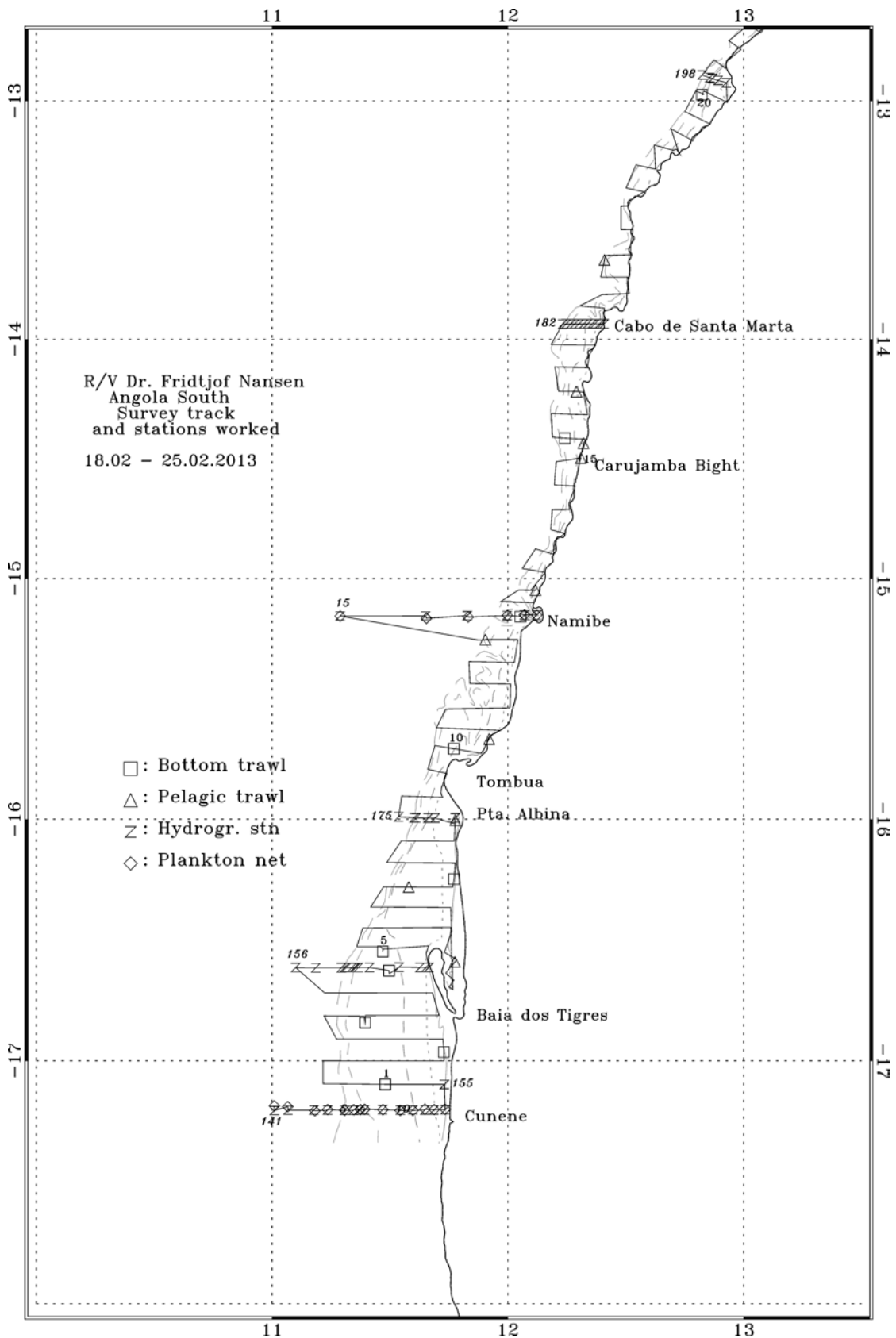


Figure 1 Course track with fishing, plankton and hydrographical stations, Cunene River – Benguela. Depth contours at 20, 50, 100, 200, and 500m

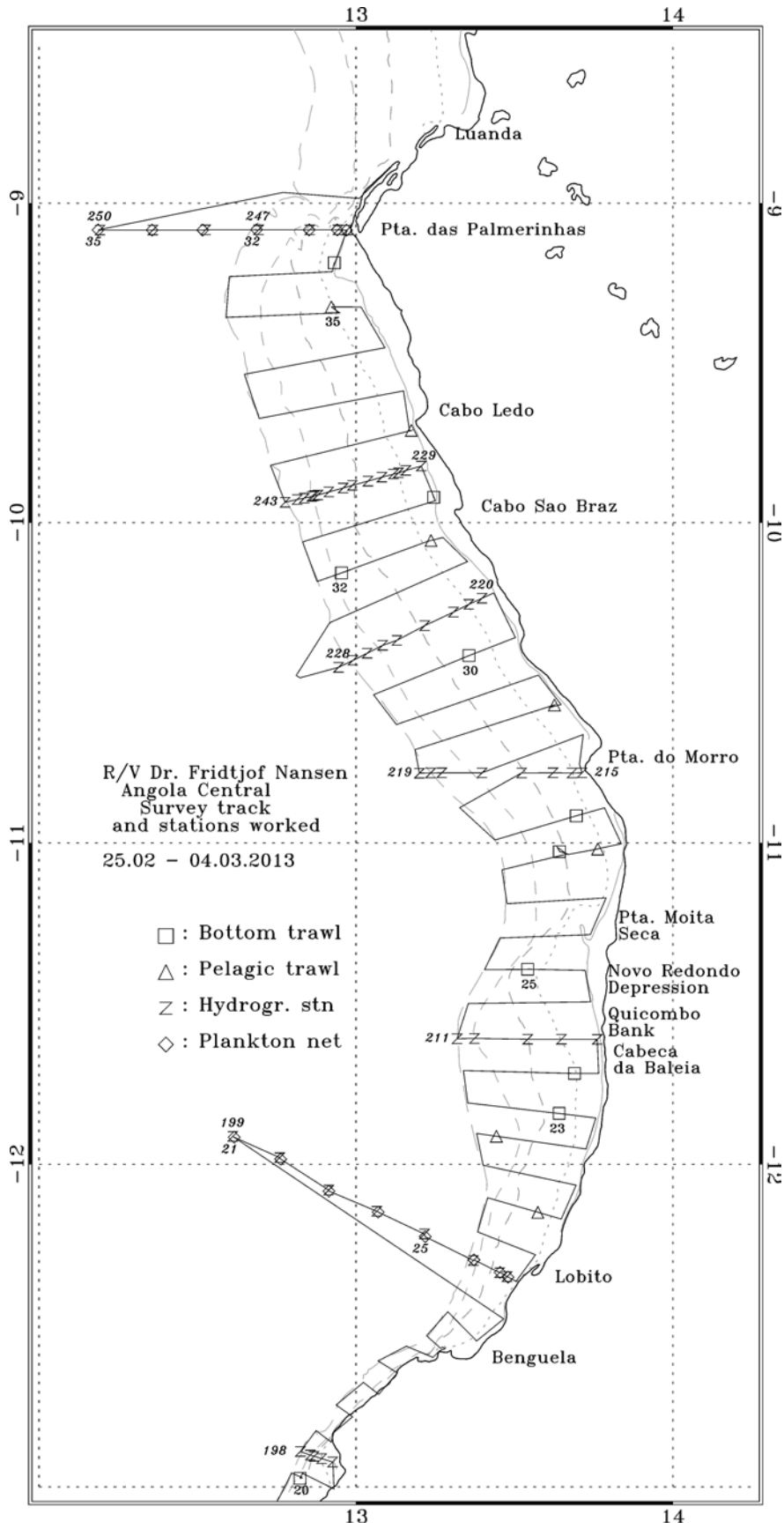


Figure 2 Course track with fishing, plankton and hydrographical stations, Benguela-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200, and 500m.

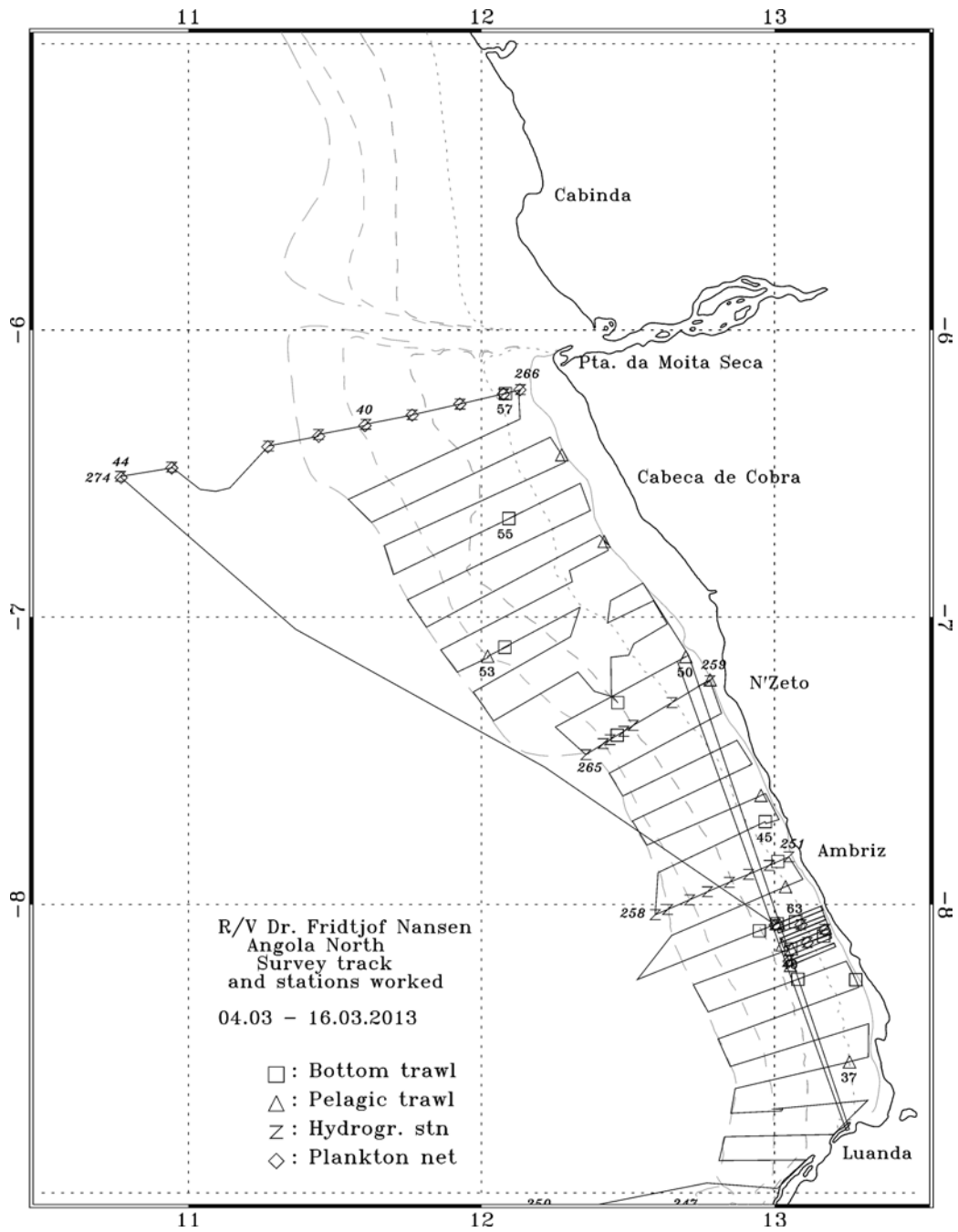


Figure 3 Course track with fishing, plankton and hydrographical stations, Pta. das Palmerinhas-Congo River. Depth contours at 20, 50, 100, 200, and 500m.

CHAPTER 2 SAMPLING AND ESTIMATION METHODS

2.1 Hydrographical sampling

CTD

A Seabird 911+ CTD probe was used to obtain vertical profiles of the temperature, salinity and oxygen. Real time logging was carried out using the PC based Seabird Seasave software. CTD casts were conducted at standard INIP transects and regional monitoring lines. The casts were stopped a few meters above the bottom. Additional CTD stations were added on approximately every sixth cruise track between the standard transects and monitoring lines at 20, 50, 100, 200 and 500 m bottom depth.

Attached to the CTD was also a Chelsea fluorometer of the type Mk III Aquatracka. It measures chlorophyll A in microgram per litre with an uncertainty of 3%. Factory slope and offset was 0.00921 and -0.02.

Thermosalinograph

The SBE 21 Seacat thermosalinograph was running routinely during the survey, obtaining samples of sea surface salinity (in PSU) and relative temperature and fluorescence (5 m depth) every 10 sec. An attached in-line Turner Design SCUFA Fluorometer was continuously measuring chlorophyll levels [RFU] at 5 m below the sea surface while underway during the entire cruise. The instrument was configured with a bright blue photodiode, a 420 nm Excitation filter and a 680 nm Emission filter. It was factory calibrated against the secondary orange standard dye. The maximum output was equivalent to 5Volt = 100%. It had a linear temperature compensation of 2.14%/°C

Current speed and direction measurements (ADCP)

The vessel-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments was out of order during the entire survey.

Meteorological observations

Meteorological data logged from the Norwegian Meteorological Institute's (DNMI) meteorological station on board, included air temperature, humidity, air pressure, wind direction and speed, and sea surface temperature (SST). All data were averaged by unit distance sailed (1 nautical mile, NM).

2.2 Fish sampling

A brief description of the fishing gear is provided in Annex VI. All trawl catches were sampled for species composition by weights and numbers. Records of catch rates are given in Annex I. Total length (TL) frequencies were taken for the commercial pelagic species such as the two species of sardinella and horse mackerel, anchovy (*Engraulis encrasicolus*), round herring (*Etrumeus whiteheadi*), scombrids, *Selene dorsalis*, *Chloroscombrus chrysurus*, big eye grunt (*Brachydeuterus auritus*) and a few demersal species, mainly *Dentex spp.* Total length frequency histograms of main pelagic species by region, pooled by catch/hour, are shown in Annex II.

Biological samples were obtained for the two species of sardinella and horse mackerel, *Scomber japonicus*, *Sarda sarda*, *S. dorsalis*, *C. chrysurus* and *B. auritus*. Total length (TL) and body weight were determined to the nearest 1 cm and 1 g below, respectively. For sardinella and horse mackerel these data were used to calculate length-weight relationships for the biomass estimates. Sex and reproductive stages were determined by means of macroscopic examination, scoring each fish according to the six-point classification scale used by INIP (Annex III).

Stomach samples of horse mackerel were collected for further analysis at INIP, Luanda. Feeding biology will be investigated in more details at a later stage by relating the stomach contents to recorded availability of zooplankton.

2.3 Plankton sampling

Phytoplankton

Samples of phytoplankton were collected on monitoring lines using the CTD bottles at 5, 15, 25, 50 and 75 meter depth. The samples were preserved in 2% formalin.

Zooplankton

The zooplankton sampling was conducted by means of HYDROBIOS Multinet (180 μm), at five depth intervals, 0-25, 25-50, 50-75, 75-100 and 100-200 m, on monitoring lines. Data from the flow meter was recorded electronically from the Multinet receiver unit. A SCANMAR depth sensor gave real-time information of the depth. The nets were opened and closed remotely from the bridge of the vessel. The samples were preserved in 4% formalin.

2.4 Acoustic sampling

Acoustic equipment

Acoustic data were recorded using a Simrad ER60 scientific echo sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38, and 120 kHz. The 200 kHz transducer was out of order during the survey. All three frequencies were calibrated in Baía dos Elefantes 24th of February, and the deviations from the previous calibration were relatively small (see instrument report). The technical specifications and operational settings of the echo sounder used during the survey are given in Annex VI.

Acoustic data were logged and post-processed using the latest acoustic data post-processing software, the Large Scale Survey System (LSSS) Version 1.61 (Korneliussen *et al.* 2006).

Allocation of acoustic energy to species group

The acoustic data were scrutinized using the LSSS version 1.61. Scatters were displayed at 38 kHz. The 5 nautical miles (nm) area backscattering coefficient s_A (m^2/nm^2) was allocated to a predefined set of species groups on the basis established echogram features. Acoustic groups and respective species are listed in Annex IV. The identification of and allocation of echo values to different species groups was based on visual scrutinization of echograms combined with information from targeted pelagic and demersal trawling.

Estimation of Echo Abundance

Mean area backscattering values (s_A values) was output from LSSS and used in the estimation of echo abundance for the three regions (south, central and north).

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

$$TS = 20\text{Log}(L) - 72 \text{ (dB)}$$

This corresponds to a conversion factor:

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

Or on a much simpler form:

$$CF = \frac{1.261218 \cdot 10^6}{\bar{L}^2}$$

The conversion factor is the multiplier transforming echo abundance into numbers of fish where \bar{L}^2 is the average of L^2 from the observed length distribution (and not the square of average L). The conversion factor is used as follows:

$$N = \text{Echo abundance} \cdot CF$$

The target strength parameters used was originally established for North Sea herring, but has later been attributed to clupeids in general (Foote *et al.*, 1986; Foote, 1987). No specific target strength relation is available for the horse mackerel species, but it seems that using the same relationship as for clupeids is common. The chosen target strength parameters for horse mackerel should be considered conservative and there are indications that target strength of horse mackerel may be strongly dependent on depth.

The boundaries of encountered fish aggregations (post strata) were determined by means of contouring within the inner and outer zero-value limits of the transect lines. The strata contours were digitised using NansisMapTool Version 1.7, and distribution plots and area calculations on the strata were carried out with the same software. Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories with unit m^2/NM^2 : 1: $s_A = 0-300$ (very scattered); 2: $s_A = 301-1\ 000$ (scattered); 3: $s_A = 1\ 001-3\ 000$ (dense); 4: $s_A = 3001-10\ 000$ (very dense) and 5: $s_A >10\ 000$ (extremely dense).

Mean 5-NM integrator values (s_A) computed along the transect lines were re-averaged for each stratum using NansisMapTool. The short spacing between the lines (6-7 NM) makes it impossible to exclude all between-transect values without removing some on-line contributions, particularly for sardinella on the inner shelf. The potential positive bias of including between-line values is likely smaller than the negative bias that would have been introduced by excluding high on-line contributions. This bias is also counteracted by the shallow distribution pattern (partly above the integration limit) and vessel avoidance behaviour of sardinella (Misund and Aglen, 1992). All estimates should consequently be considered as relative indices of abundance.

The overall length frequency distributions within strata were estimated by weighting the sample-distributions with the nearest valid 5-NM integrator value, or the average of two adjacent values. Target species of the same genus, i.e. *S. aurita* / *S. maderensis* and *T. trecae* / *T. capensis*, are not acoustically distinguishable, and the s_A values were therefore split according to the relative distributions of the two species in each length group. The total number of fish in each length group was estimated as:

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

where:

ρ_i	=	estimated number of fish in length group i
$\langle s_A \rangle$	=	mean recorded area backscattering coefficient (m^2/NM^2)
$t_{i,j}$	=	proportion of species j in length group i
u_i	=	proportion of sampled fish in length group i
A_s	=	horizontal area of stratum s
C_{Fi}	=	conversion factor for length group i
L_i	=	length group i (nearest full cm below total length)
$L_i+0.5$	=	mean length in L_i .

CHAPTER 3 OCEANOGRAPHIC CONDITIONS

3.1 Surface distribution

Wind, sea surface temperature (SST, 5m depth), sea surface salinity (SSS, 5 depth) and sea surface fluorescence, SSF) were continuously recorded during the survey. Figure 4 – 6 show the horizontal distribution of temperatures and salinity.

Southern region

Temperature values ranged from a minimum of 16° C to a maximum of 26° C and salinity content varied between a minimum of 34 to a maximum 36.2 (Figure 4). Temperature values of 21-22° C predominantly extended alongside the coast from 16° S to 14° S, while warm water (26° C) reached the coast at about 13° S and were visible seawards. An upwelling alike characteristic with cooler water (16-18° C) was found over a small area surrounding the Cunene River mouth and warmer water (24° C) were spotted surrounding Baía dos Tigres. The Angola Benguela Front Area (ABFA) seemed to be situated approximately at 15°30'-16° S (satellite imagery may elucidate the real ABFA at a given moment). A high salinity (>36) was found away from the shore whereas a salinity content of 35.5-36 broadly extended along the coast. Typically for the geographic location the lowest salinity (34-35.5) was found at the Cunene River mouth. Due to the mixing there was a presence of high salinity content of 36.2 at the same position.

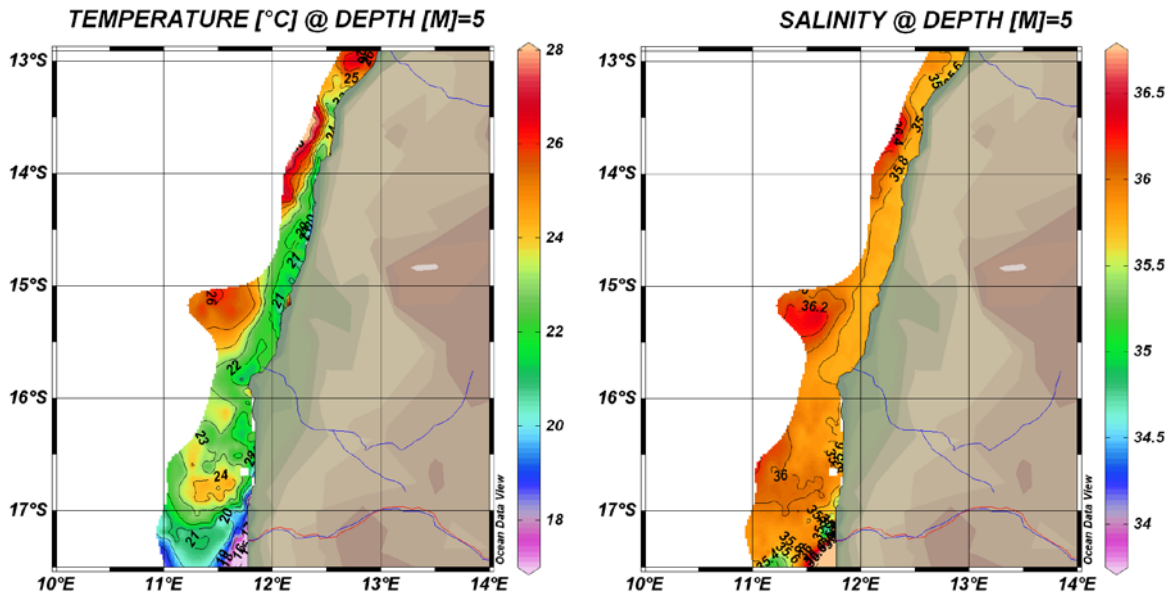


Figure 4 Distribution of water temperatures and salinity at 5m depth in the Southern region

Central region

The temperature values ranged from a minimum of 26° C to a maximum of 29° C while the salinity content varied between a minimum of 34.8 to a maximum of 36 (Figure 5). Superimposing both temperature and salinity distributions one may observe the presence of two water masses: warmer ($\geq 27^{\circ}\text{C}$) and more saline (>35.6) waters and subsequently “cool” (26-27° C) and less saline (<35.6) waters. Brackish water were found close by river mouths at 9° S and 11° S. “Cool” and less saline water laid parallel to the coast and the warmer and more saline water were broadly distributed offshore. A small ring of cooler water ($<25^{\circ}\text{C}$) was evident close the mouth of Cunene River and northwards. A second little bit bigger ring with cooler water was observed in NW direction of the first one. A pool of warmer and more saline water was evident at 12° S near the shore.

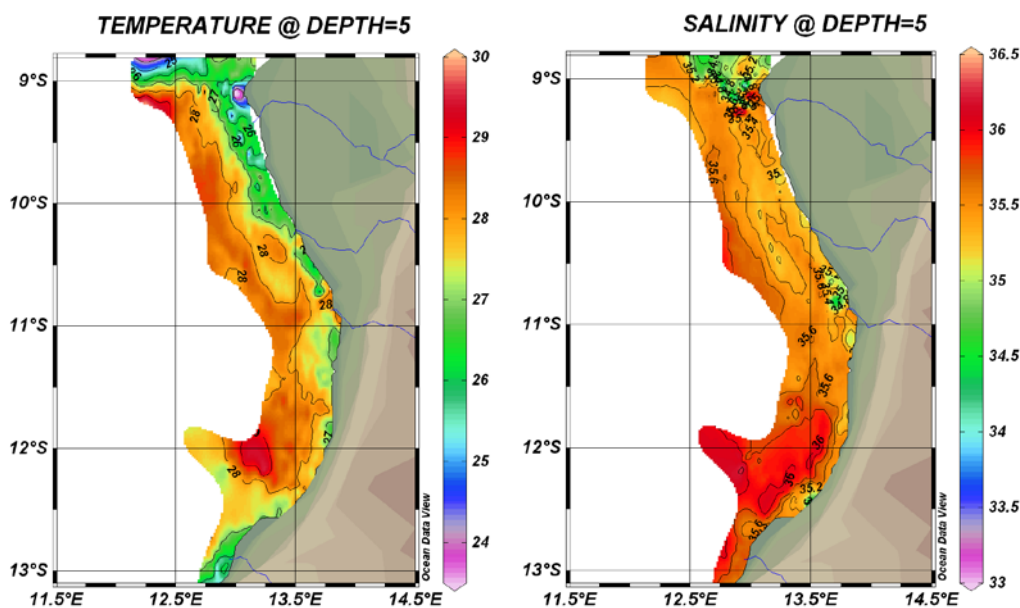


Figure 5 Distribution of water temperatures and salinity at 5m depth in the Central region.

Northern region

The temperature values ranged from a minimum of 25° C to the maximum of 30° C, and the salinity content from a minimum of 22 to the maximum 35 (Figure 6). The presence of brackish water is mainly caused by the discharge of the Congo River, and its mouth and surroundings had a spherical like salinity distribution with salinity content of 22 inside, gradually increasing to 30. Warm water (30° C) was observed in SW direction seawards. Near shore were recorded lower temperature values (26-27° C). South of Ambriz there was a small ring of cooler water (26° C), and near shore Pta. das Palmerinhas occurred an upwelling like characteristic with presence of cooler water (25° C) and at the surroundings were observed an isotherm of 26° C seaward. The isotherms of 29-30° C were visible between 6-8° S offshore. Isolines of 34-35 widely covered the whole area except the Congo River mouth and surroundings.

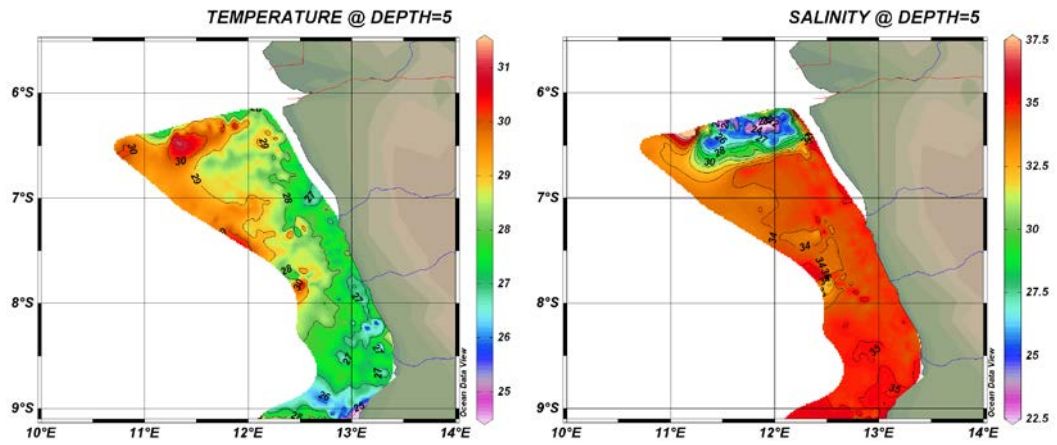


Figure 6 Distribution of water temperatures and salinity at 5m depth in the Northern region.

3.2 Standard sections

The vertical distributions of temperature, salinity, oxygen and fluorescence in the Cunene section (Figure 7) show a classic situation for the season. High temperatures (15-25° C) covered the water column between 0 and 100 m, while below 400 m the temperature was less than 10° C. A salinity content of 35 was found in the tiny surface layer close to the shore, while a content of about 36 was found widely over the seaward domain. Oxygen shows a similar pattern as the salinity with lower values (1-3 ml/l) close the shore; between 0 and 50 m was found a high oxygen content (4-5 ml/l) while between 200 and 400 m was found an Oxygen Minimum Zone (OMZ), with content of less than 1 ml/l. Concerning the fluorescence pattern, there was a mixing at the upper layer with lower values (0.2-0.4 $\mu\text{l/l}$) close to the shore and the highest values found below the upper surface layer between 0 and 50 m, offshore.

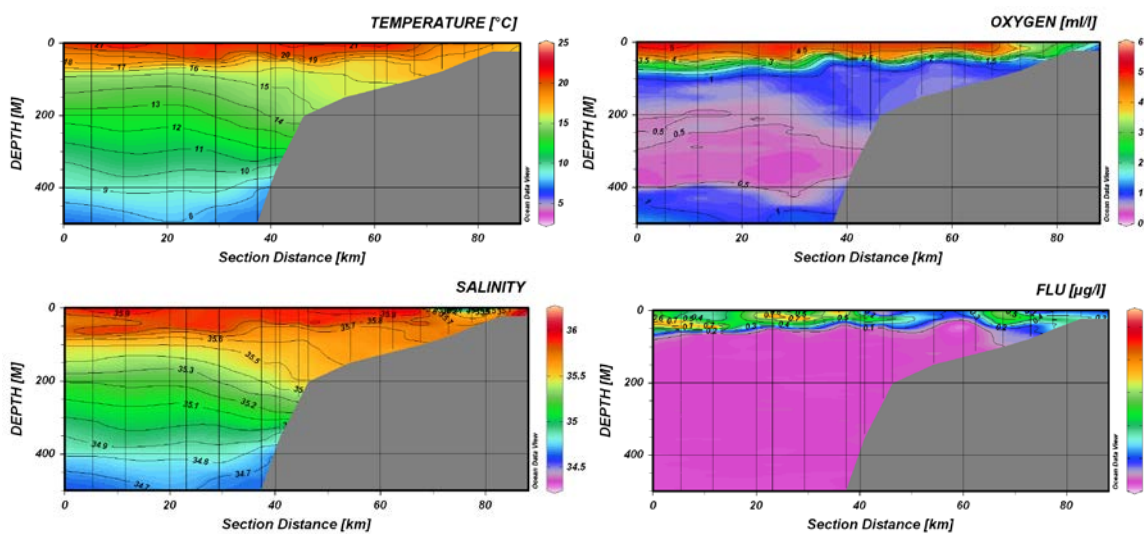


Figure 7 Vertical sections of temperature, salinity, oxygen and fluorescence off Cunene River.

In the Namibe section (Figure 8), an upwelling seemed to take place offshore, but not far from the shore, with warm water (22° C) blocked-up shoreward. The thermocline was located at +/- 50 m depth. A similar pattern was observed for both salinity and oxygen, high salinity content (>36) was present close the shore followed by less saline water (<36) in the layer that submerged and further offshore above it the upper layer had a higher salinity content (≥ 36). High oxygen values (5-6 ml/l) was isolated near the coast, while furthermore seaward the upper layer was covered by water with oxygen values of 4.5-5 ml/l. Noticeable less oxygen content was found from about 50 m depth downwards and the following intermediate layer being considered an OMZ with shoreward orientation. The highest fluorescence values (0.5-0.75 $\mu\text{l/l}$) were observed just near the coast (Namibe Town), while a value of 0.25 $\mu\text{l/l}$ was sporadically visible seawards.

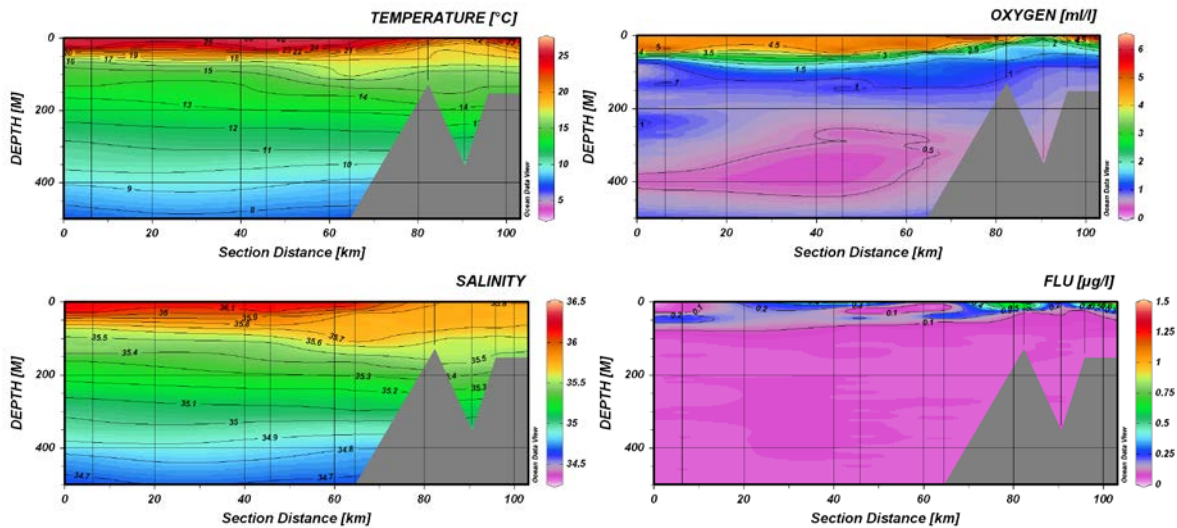


Figure 8 Vertical sections of temperature, salinity, oxygen and fluorescence off Namibe.

Moving northward to the section off Lobito (Figure 9) the southern situation has changed and the SST became warmer reaching $>25^{\circ}\text{C}$. Warm and well stratified water were found between 0 and 50 m. Perhaps due to the rainy season less salinity content (35.7) was observed close the coast along with more saline water (≥ 35.8) seaward. The highest oxygen content was also found in the surface layer reaching up to 5 ml/l while the OMZ was established below 200 to 500 m. The highest fluorescence value ($1.5\ \mu\text{l/l}$) was found offshore.

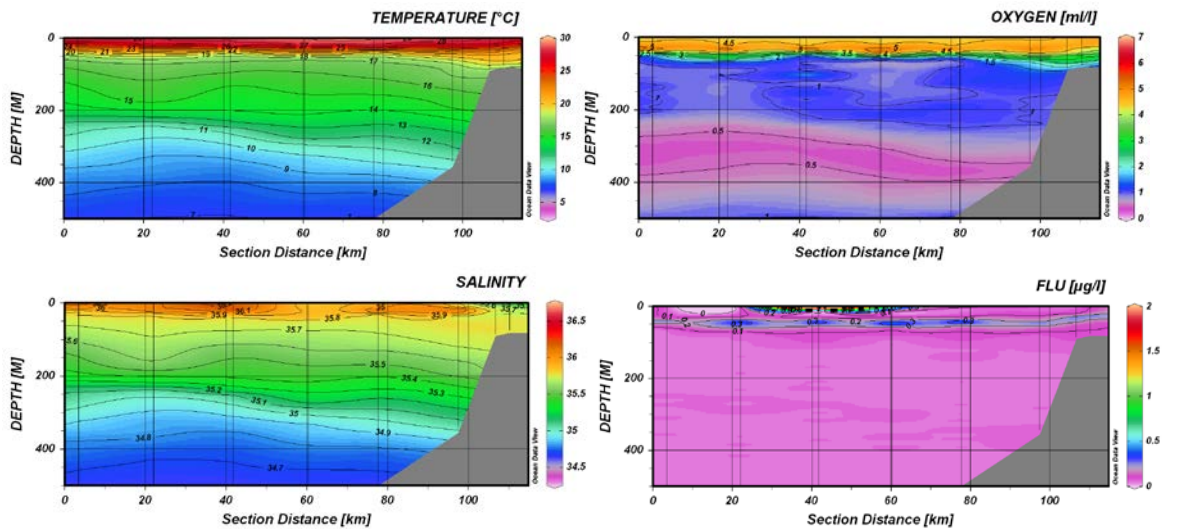


Figure 9 Vertical sections of temperature, salinity, oxygen and fluorescence off Lobito

In the section of Pta. do Morro (Figure 10), higher temperatures (25°C) were recorded next to the coast, and the layer of warmer water submerged below a tiny layer of $<25^{\circ}\text{C}$ water alongside seaward. Similar to the temperature, a tiny top layer with lower salinity content (35.5) depressed a layer with higher salinity content (>35.5) while in the intermediate layer the salinity content ranged between 35.8-35.6. Higher oxygen values of 4-5ml/l were observed in the top layer (0-50 m), while between 300-400 m depth an OMZ was evident. Regarding the fluorescence its values did not exceed $0.25\ \mu\text{l/l}$ and was offshore practically deficient.

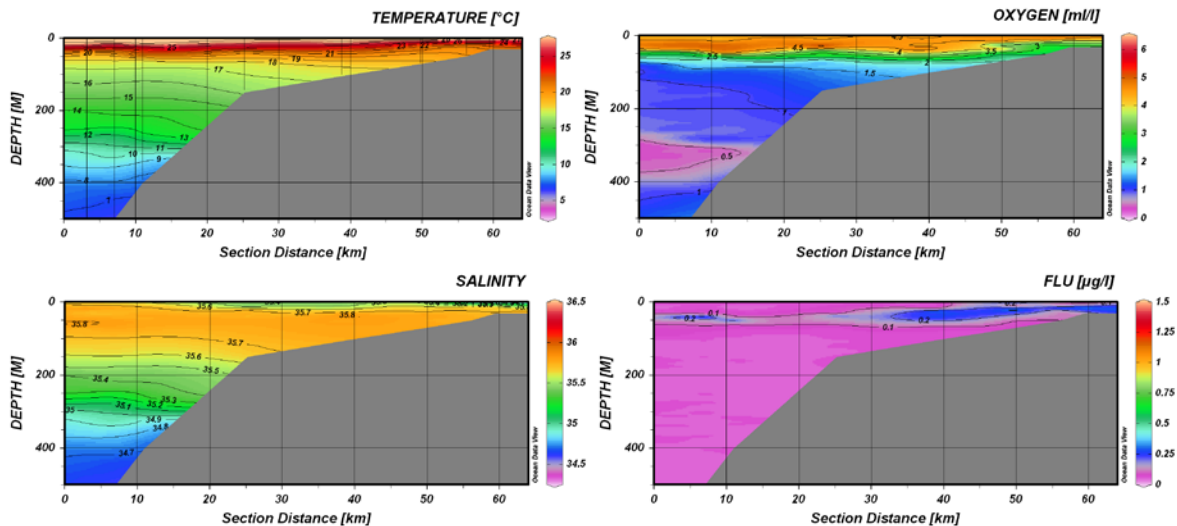


Figure 10 Vertical sections of temperature, salinity, oxygen and fluorescence off Pta. do Morro

In the section off Pta. das Palmerinhas (Figure 11), the surface layer (0-50m) was entirely covered by well stratified warm water (19-25° C). A top layer (0-50m) with minimum salinity content (≤ 35.7) lay over a layer with higher salinity content (>35.9). It is interesting to observe that a middle layer of 35.6 was enclosed between two layers containing more saline water. High oxygen values of >5 ml/l were observed near the shore and widely in a top layer (0 to 50m), oscillating between 4-5 ml/l. Between 300 and 400m depth the OMZ was evident. The fluorescence values (0.5-1 μ l/l) were higher near the coast and seaward, probably due to the Cuanza River discharge nearby.

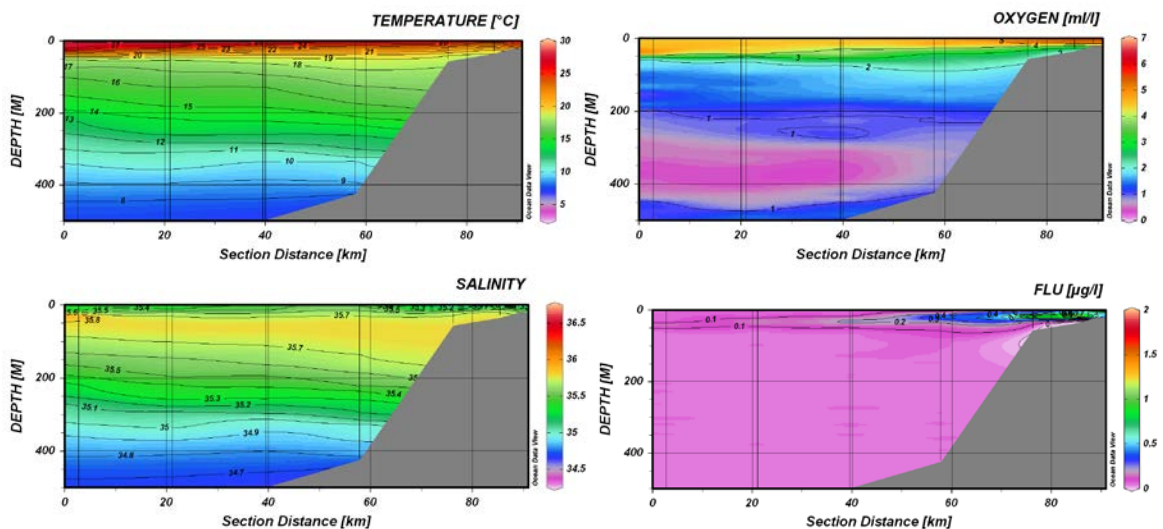


Figure 11 Vertical sections of temperature, salinity, oxygen and fluorescence off Pta. das Palmerinhas

The section off Ambriz (Figure 12) was similar to that the N'Zeto one (not shown). The difference was the presence of less saline water (<34.5) offshore being believed outflow water from Congo River. Isotherms of 22 and 23° C were uplifted at the surface (a small upwelling like event), with warm water (25° C) isolated close the shore. Towards the sea stratified isotherms of 25-22° C occupied the first 50 m of the water column. A tiny surface layer was covered with water of less salinity content (34.5-35) and water with high salinity content (35.8) occupied the intermediate layer (50 to 200 m) and salinity then gradually decreased.

High oxygen values (4-5 ml/l) were observed at the surface layer, gradually decreased and reaching OMZ at 300 to 400 m depth. The highest fluorescence value (0.25 $\mu\text{l/l}$) was observed near the coast below the surface, and might possibly be due to the discharge of a local river.

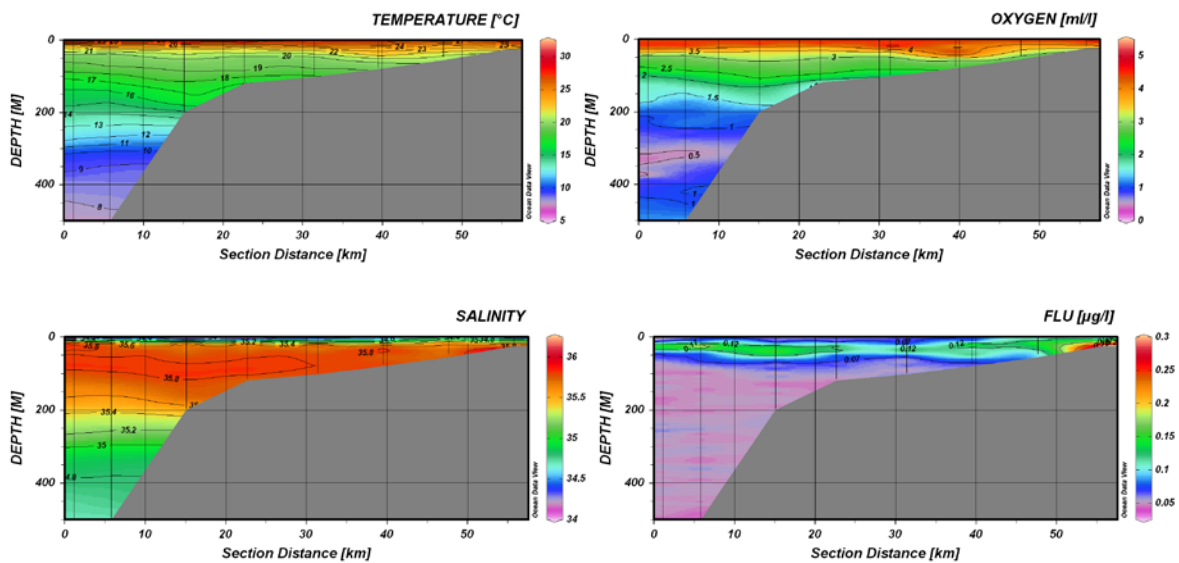


Figure 12 Vertical sections of temperature, salinity, oxygen and fluorescence off Ambriz

In the section off Pta. da Moita Seca isotherms of $>25^{\circ}\text{C}$ were confined in a 25 m tiny surface layer and warmer water (28°C) were found close the river's mouth. Brackish water (≤ 34.8) was widely observed in this layer. The Congo River discharge seasonally with higher outflow rate during March-April, the rainy and warm season. Temperature values of $<14^{\circ}\text{C}$ were found at 200 m depth and decreased downward. At an intermediate layer there was a presence of higher salinity content ranging between 35.8-35.2, decreasing from 350 m depth. A 10 m tiny surface layer was well oxygenated ($>5\text{ml/l}$), and below this layer oxygen values of 2-3 ml/l extended to the slopes of the continental shelf. Between 250 and 350 m depth a OMZ was found. Possibly due to the mixing caused by the Congo River outflow, at the upper layer the fluorescence varied (0.01-0.227 $\mu\text{l/l}$), while intermittently seaward and deeper the fluorescence dropped reaching value of $<0.1 \mu\text{l/l}$.

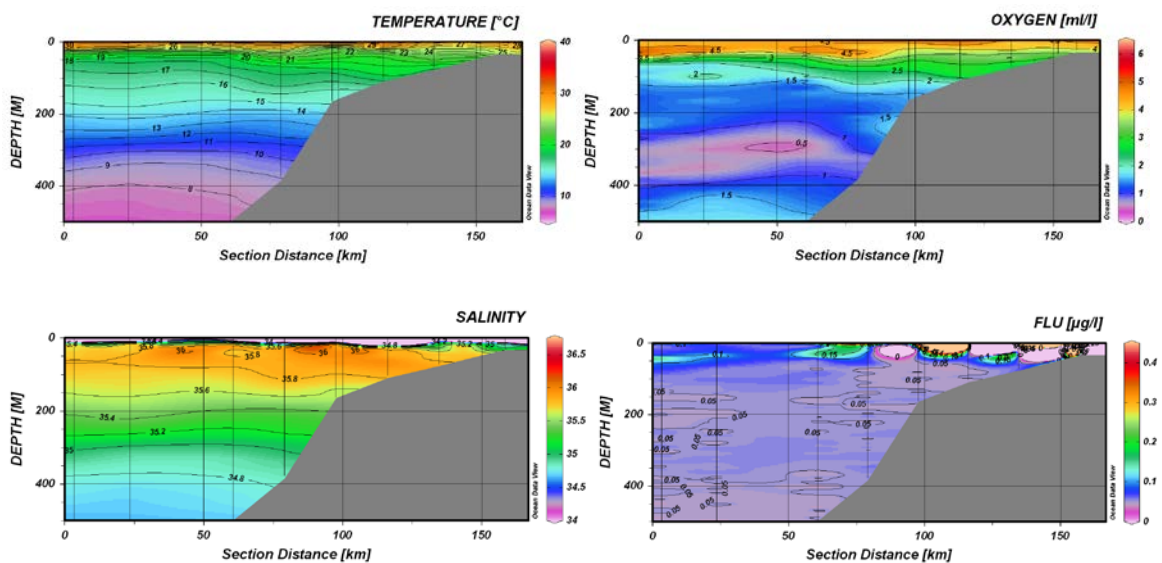


Figure 13 Vertical sections of temperature, salinity, oxygen and fluorescence off Pta. da Moita Seca

CHAPTER 4 DISTRIBUTION, SIZE COMPOSITION AND BIOMASS ESTIMATES

4.1 Cunene River-Benguela

Sardinella

S. aurita was caught only on one station just north of Cunene. *S. maderensis* was caught in some quantities on one station in Baía dos Tigres and in small numbers on another station a little further north. The estimated proportion of each species in the region is therefore very inexact.

The acoustic registrations allocated to *S. aurita* was a narrow area close to the shore north of Cunene (Figure 15) with extremely dense registrations ($S_A > 10\,000\text{ m}^2/\text{NM}^2$). The rest of the registrations further north were allocated to *S. maderensis*, and consisted mainly of relatively small patches with densities varying from very scattered to extremely dense. The highest densities were found from Baía dos Tigres to Carujamba Bight.

S. aurita had a distribution with a peak at 20-21 cm (Figure 14). The length frequency of *S. maderensis* consisted of only adult specimen, and was dominated of fish between 29 and 32 cm.

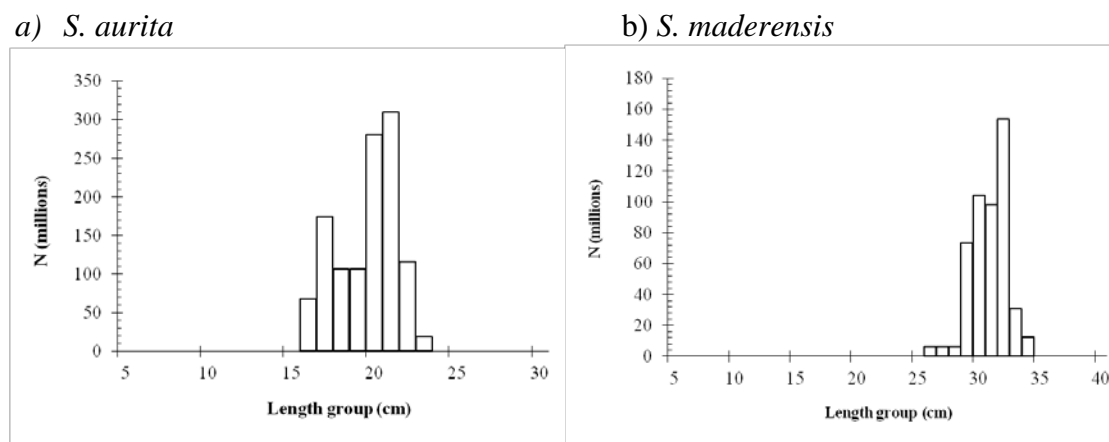


Figure 14 Total length distribution of *Sardinella aurita* and *S. maderensis* Cunene River-Benguela.

The estimated total biomass for the two sardinella species was 229 000 tonnes, which is considerable less than the biomass estimate last year in this season, but more than twice the summer estimate of 2011 and well above the average winter estimates over the three last years (Annex V). *S. maderensis* contributed about 60% of the total.

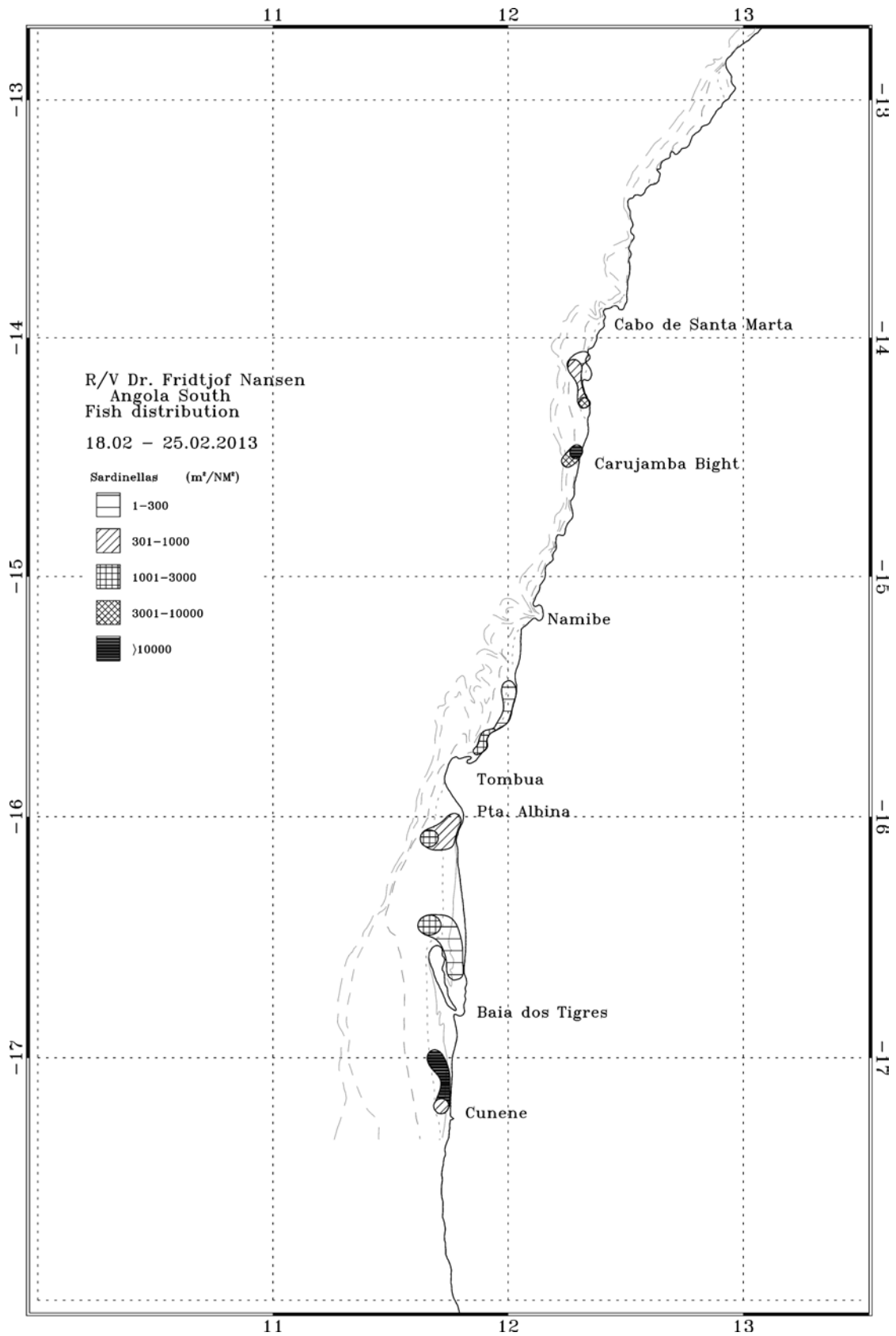


Figure 15 Distribution of *Sardinella* spp., Cunene River-Benguela. Depth contours at 10, 20, 50, 100, 200 and 500 m

Horse mackerel

Cunene horse mackerel, *Trachurus trecae*, normally distributes over most of the Angolan continental shelf while the Cape horse mackerel, *T. capensis*, is associated with cold waters of the Benguela current. Like in previous surveys both species of horse mackerel were found in the area.

Cape horse mackerel was caught on only three stations in the southern part of the region and was mainly observed in very scattered densities. Cunene horse mackerel was caught more frequently and in higher abundances in the trawl. It was also mainly observed acoustically in very scattered distributions in patches over most of the region, with some denser registrations from Cunene River to Tombua (Figure 17).

The size distribution of Cunene horse mackerel covered a wide size range (7-37 cm) (Figure 16). Fish larger than 20 cm contributed about 50% of the total biomass in the Southern region. Only a few fish below 10 cm were caught in the southern area. The Cape horse mackerel showed a narrower distribution with peak around 22 cm.

a) *Trachurus trecae*

b) *T. capensis*

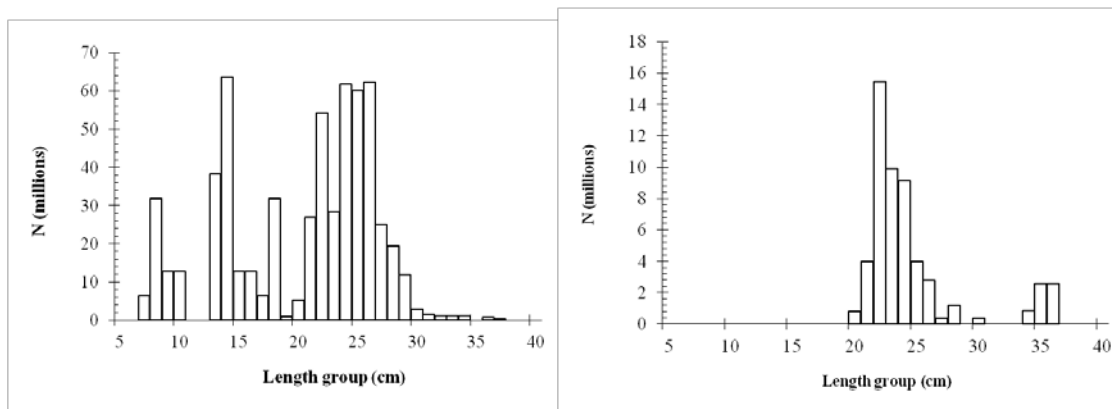


Figure 16 Total length distributions of *Trachurus trecae* and *T. capensis* Cunene River- Benguela.

In the southern area a sub sample of 284 *T. trecae* was taken for biological analysis. Maturity analysis showed that 94.4% of the fish were found maturing, 2.8% were immature and 2.8% were juvenile. Only 10.4% of *T. capensis* were mature. The majority of the fish were found to be in stages III to V in the ripening, ripe and spent status, respectively, for both males and females, the latter most abundant (Figure 18). A minority of fish were found in stage II, maturing virgin and recovering. Annex III gives a description of the maturity stages.

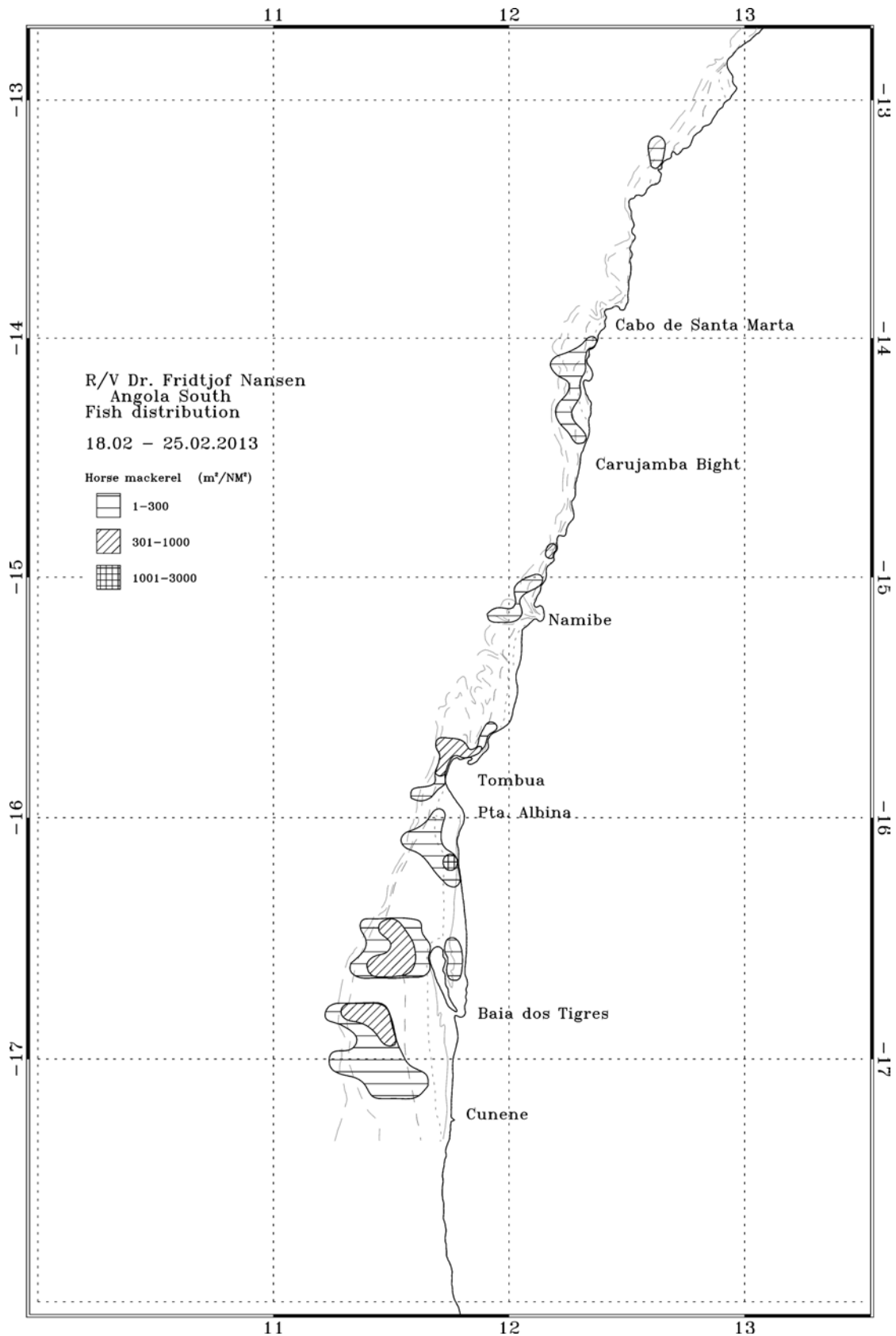


Figure 17 Distribution of Cunene horse mackerel, Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 m.

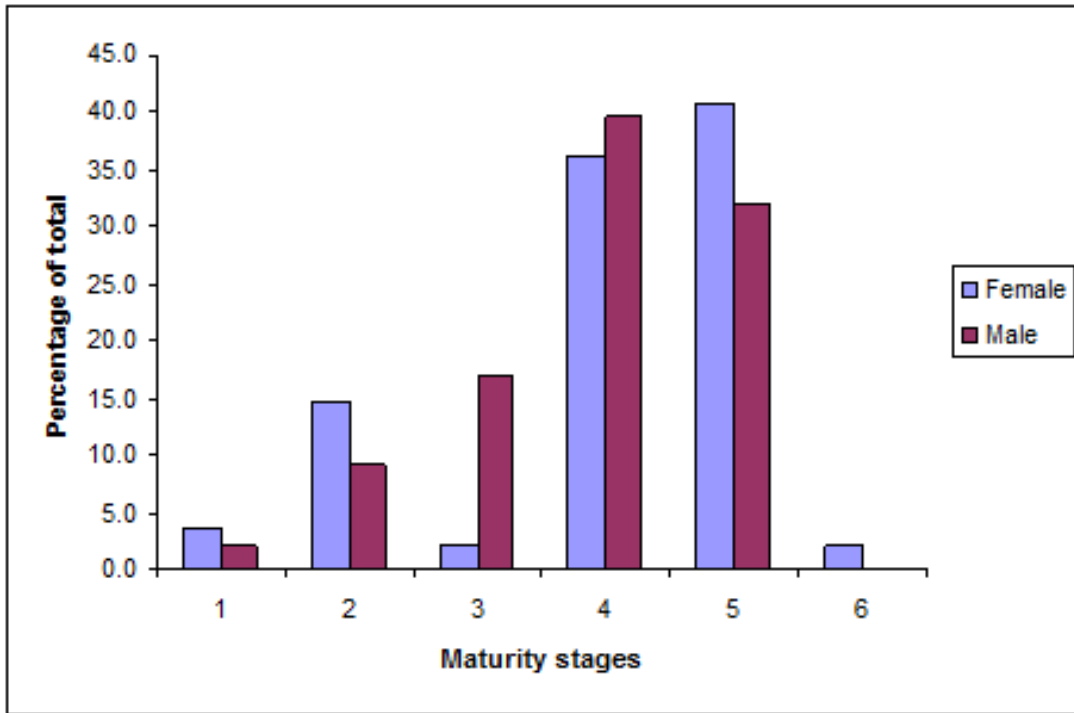


Figure 18 Distribution of maturity stages by sex for *Trachurus trecae* in the Southern region

The biomass for both horse mackerel species was estimated at 70 000 tonnes which is only about one third of the biomass estimate last year in this season, but quite similar to the 2011 estimate. The biomass of Cunene horse mackerel was estimated at 62 000 tonnes, which is well below the average of both the summer and winter estimates over the three last years (Annex V). The biomass of Cape horse mackerel was estimated at 8 000 tonnes.

Other species

Round herring (*Etrumeus whiteheadi*) and anchovy (*Engraulis encrasicolus*) were caught in low numbers on a couple of stations each in the southern part of the region (Table 2). Species belonging to the pelagic 1 group were observed in very scattered distributions ($0 > s_A > 300$) along the southern part of the region and no biomass was estimated for this group. Scombrids and carangids other than horse mackerel had also a low occurrence in the trawl catches in the region, and no barracudas and hairtails was caught (Table 2). Species belonging to the pelagic 2 group were also observed in very scattered densities over mainly the southern half of the region, and no biomass was estimated for this group either.

Table 2 Catch rates (kg/h) of the main groups of pelagic fish, Cunene River - Benguela

Station	Gear depth	Barracuda	Carangids	Clupeiods	Hairtails	Horse mackerel	Sardinella spp.	Scomberids	Other	Total
1	124	0	0	0	0	820.5	0	0	402.4	1222.9
2	22	0	0	32.6	0	1.6	1829.3	0	7408.8	9272.3
3	130	0	0	17.3	0	1421.1	0	0	24.3	1462.7
4	111	0	0	0	5	188.1	0	0	659.3	852.3
5	112	0	0	0.8	0	114.1	0	0	15.5	130.4
6	5	0	0	0	0	53	70.4	3.5	552.7	679.6
7	23	0	0	0	0	0	0	0	1.5	1.5
8	25	0	0	1.3	0.6	110.7	0	0	4250.2	4362.9
9	10	0	0	0	0	0	1.0	1.6	0	2.7
10	108	0	0	0	0	18.9	0	0	91.9	110.8
11	10	0	0	0	0	0	0	0	7.9	7.9
12	5	0	0	0	0	0	0	0	119.8	119.8
13	125	0	0	0	0	39.6	0	0	553.5	593
14	20	0	0	0	11.4	524.6	0	6.7	42.6	585.3
15	34	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	119	0	0	0	0	0.4	0	0	532.7	533.1
18	5	0	0	0	0	0	0	4.7	0	4.7
19	53	0	0	0	0	0	0	0	26.9	26.9
Mean	54.6	0	0	2.7	0.9	173.3	100.0	0.9	773.2	1051.0
Std dev	51.5	0	0	8.2	2.8	369.9	419.1	1.9	1872.5	2234.4
% catch		0	0	0.3	0.1	16.5	9.5	0.1	73.6	

4.2 Benguela-Pta. das Palmerinhas

Sardinella

Like in previous summer surveys sardinella was found in most of the area with continuous distribution from north of Lobito to north of Pta. do Morro and from Cabo São Braz to Cabo Ledo (Figure 20). The registrations showed a patchy pattern of very scattered, scattered, dense and very dense distributions.

The length distribution of *S. aurita* shows a peak at 25 cm, and no fish smaller than 20 cm was caught (Figure 19). The length distribution of *S. maderensis* was also dominated by adults (>25 cm TL) with a peak at around 29 cm TL. Also some smaller fish was found, with a peak at 17 cm.

a) *S. aurita*

b) *S. maderensis*

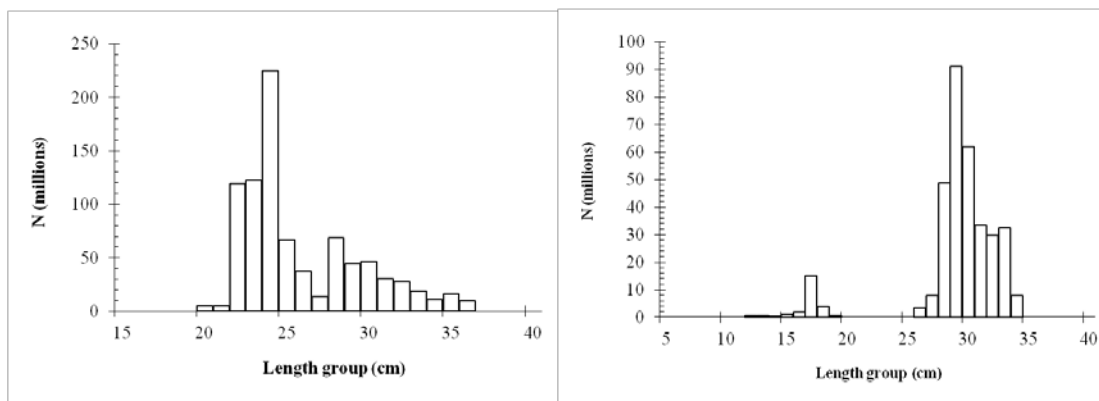


Figure 19 Total length distribution of *Sardinella aurita* and *S. maderensis* Benguela-Pta. das Palmerinhas.

The biomass for both sardinellas was estimated at 219 tonnes, which is almost the same as what was estimated summer 2012, but well below the average winter estimates over the three last years (Annex V). *S. aurita* was dominating, contributing 67% (145 000 tonnes) of the biomass, while *S. maderensis* contributed 33% (74 000 tonnes). However, the proportions of *S. aurita* and *S. maderensis* are opposite to what was found last summer.

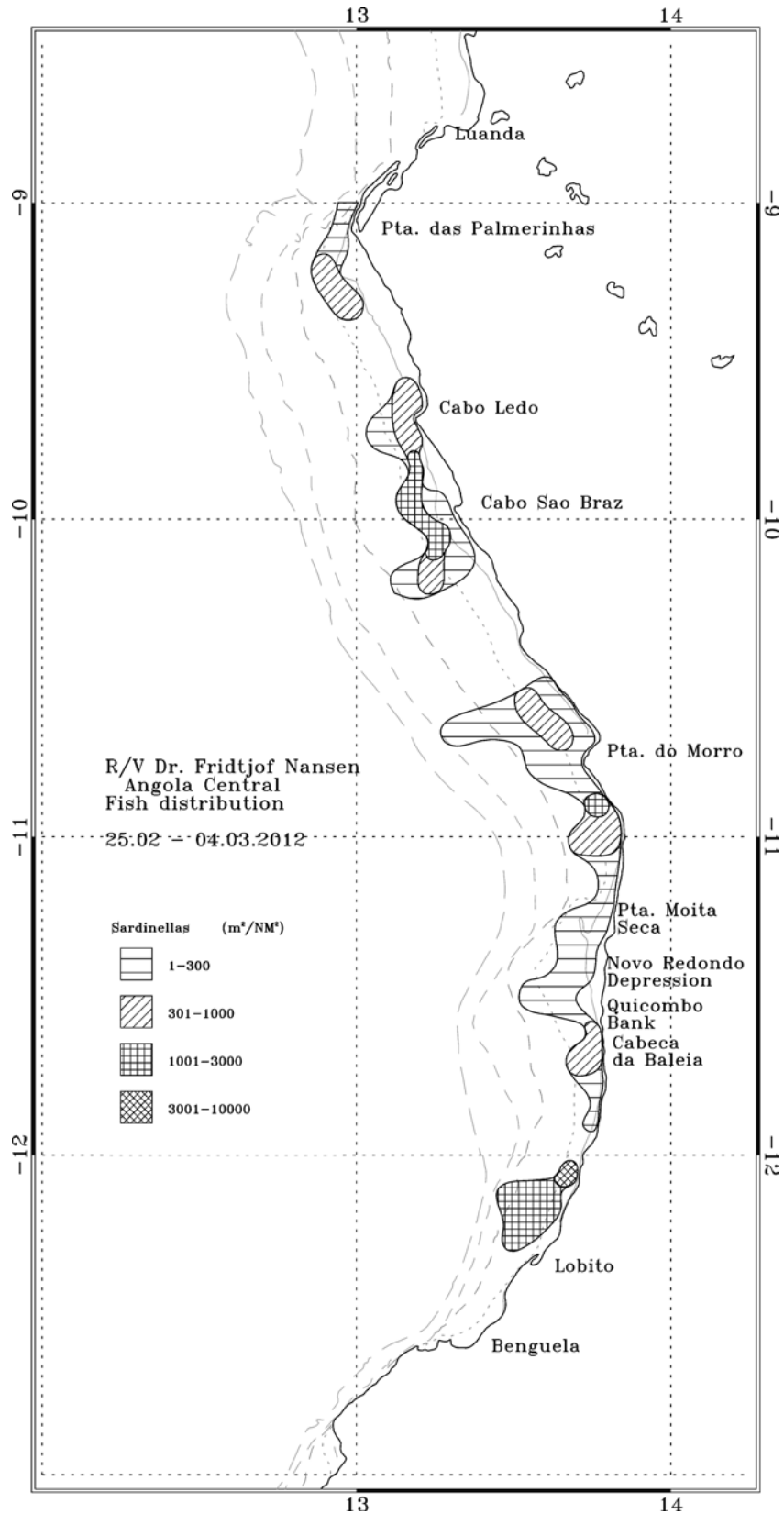


Figure 20 Distribution of *Sardinella* spp., Benguela-Pta. das Palmerinhas. Depth contours at 20, 50, 100 and 200 m.

Horse mackerel

The only species of horse mackerel found in this region was the Cunene horse mackerel (*T. trecae*). It was found throughout the area in large, very scattered patches (Figure 21). Offshore south off Cabeça da Baleia an area with scattered and dense registrations was recorded.

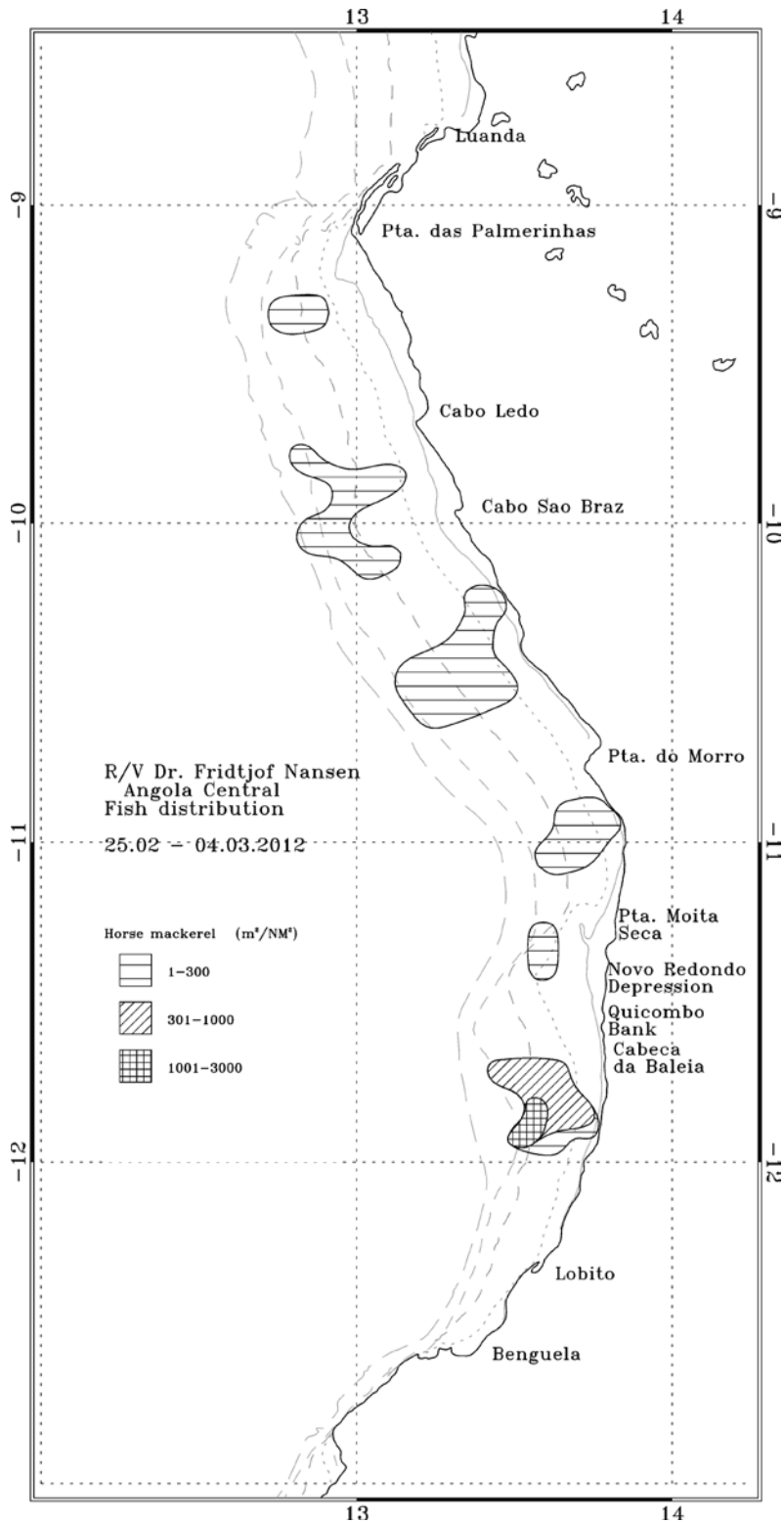


Figure 21 Distribution of Cunene horse mackerel (*Trachurus trecae*) Benguela-Pta. das Palmerinhas. Depth contours at 20, 50, 100 and 200 m

Figure 22 shows the total length frequency distribution. Three peaks were found around 15, 24 and 45 cm TL, which may be represent different cohorts.

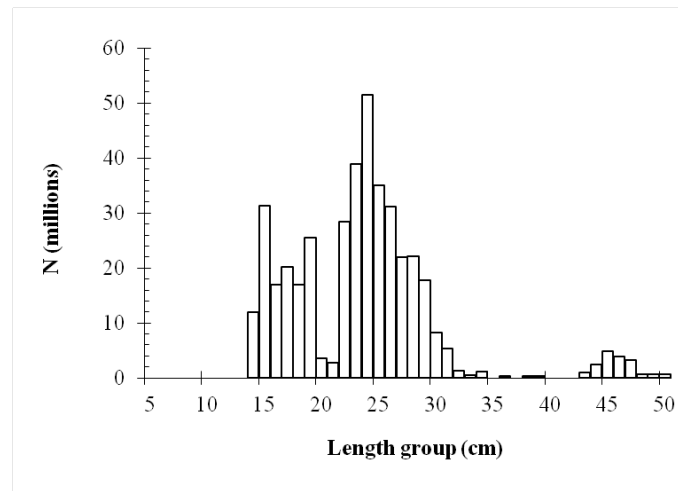


Figure 22 length distribution of *Sardinella aurita* and *S. maderensis* Benguela-Pta. das Palmerinhas

In 347 biological samples from the central area, 81.3% of the fish were found to be mature, 10.2% were immature and 8.5% were juveniles. The majority of the fish were found in stage II for both female and males, with females being most abundant (Figure 23). Fewer fish were found in stages III to V in the ripening, ripe and spent status, respectively.

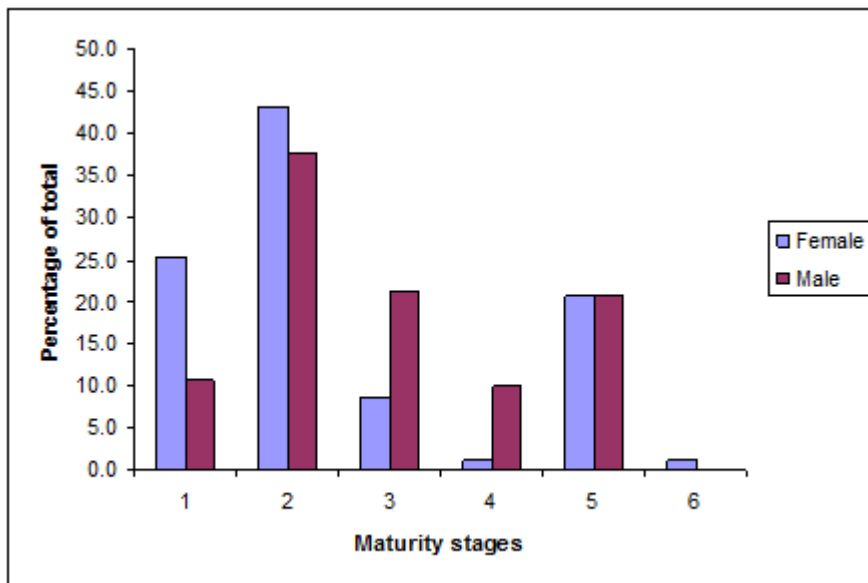


Figure 23 Distribution of maturity stages by sex for *Trachurus trecae* in the Central region

The biomass of Cunene horse mackerel was estimated at 62 000 tonnes. This biomass is only about half of what was estimated last year for this season, but quite similar to the biomass estimated in the winter season in 2012 and well above the average winter estimates for the three last years (Annex V).

Other pelagic species

Ilisha Africana was caught on three of stations in the Central region, of which one had a high catch rate (Table 3). Species belonging to the pelagic 1 group were only observed scattered in low densities ($0 >_{SA} > 300$) between Pta. do Morro and Cabo Sao Braz and no biomass was estimated for this group. Barracuda, carangids (mainly *Selene dorsalis* and *Chloroscombrus chrysurus*), hairtails and scombrids were caught frequently in the region (Table 3). Carangids had the highest catch rates. Species belonging to the pelagic 2 group were observed in very scattered distributions over most of the Central region (Figure 24). The biomass estimate, based on an average length of 30 cm and a condition factor equal to 0.01, was 29 000 tonnes. This is less than what was estimated winter 2011 and 2012 (about 50 000 tonnes), but well above the small estimate of summer 2011 (3 000 tonnes).

Table 3 Catch rates (kg/h) of the main groups of pelagic fish, Benguela – Pta. das Palmerinhas

Station	Gear depth	Barracuda	Carangids	Clupeiods	Hairtails	Horse mackerel	Sardinella spp.	Scombrids	Other	Total
20	116	0	0	0	0	0	0	0	493.3	493.3
21	18	10.8	0	0	0	125.3	5204.4	18.2	2	5360.8
22	5	0	0	0	1.3	0	0	0	43.9	45.3
23	72	1.1	4.4	0	0.5	54.4	3	0	62.9	126.4
24	60	1.4	7.9	0	110.3	42.6	0	0	100.1	262.3
25	54	0	0	0	0	1.6	0.2	0	5.1	6.9
26	109	0	36.9	0	472.9	454.4	25.6	0	139.4	1129.2
27	60	0	0	0	0	0	0	0	0.5	0.5
28	61	0	24.9	0	7.5	229.8	3.3	0	700.7	966.2
29	10	73.5	32.1	0.4	18.8	0	1.8	5.6	100.6	232.8
30	81	10.2	0	0	4.4	55.9	0.8	0	31.2	102.4
31	5	11.1	164.2	0	0	19.9	2636.5	4.8	20.3	2856.8
32	123	0	5.1	0	0	214.2	0	2.2	323.9	545.5
33	22	84.5	247	368.5	60.5	6	0	0	2449.2	3215.7
34	10	52.8	53.8	26.9	0	0	869.3	0	1132.8	2135.6
35	19	0	1.1	0	0	0	0	0	0	1.1
36	22	56.7	522.7	0	0	0	134.6	4.2	1408.4	2126.6
Mean	50	17.8	64.7	23.3	39.8	70.8	522.3	2.1	412.6	1153.4
Std dev		29.1	136	89.2	115.4	123.5	1373.3	4.6	673.5	1512.6
% catch		1.5	5.6	2.0	3.5	6.1	45.3	0.2	35.8	

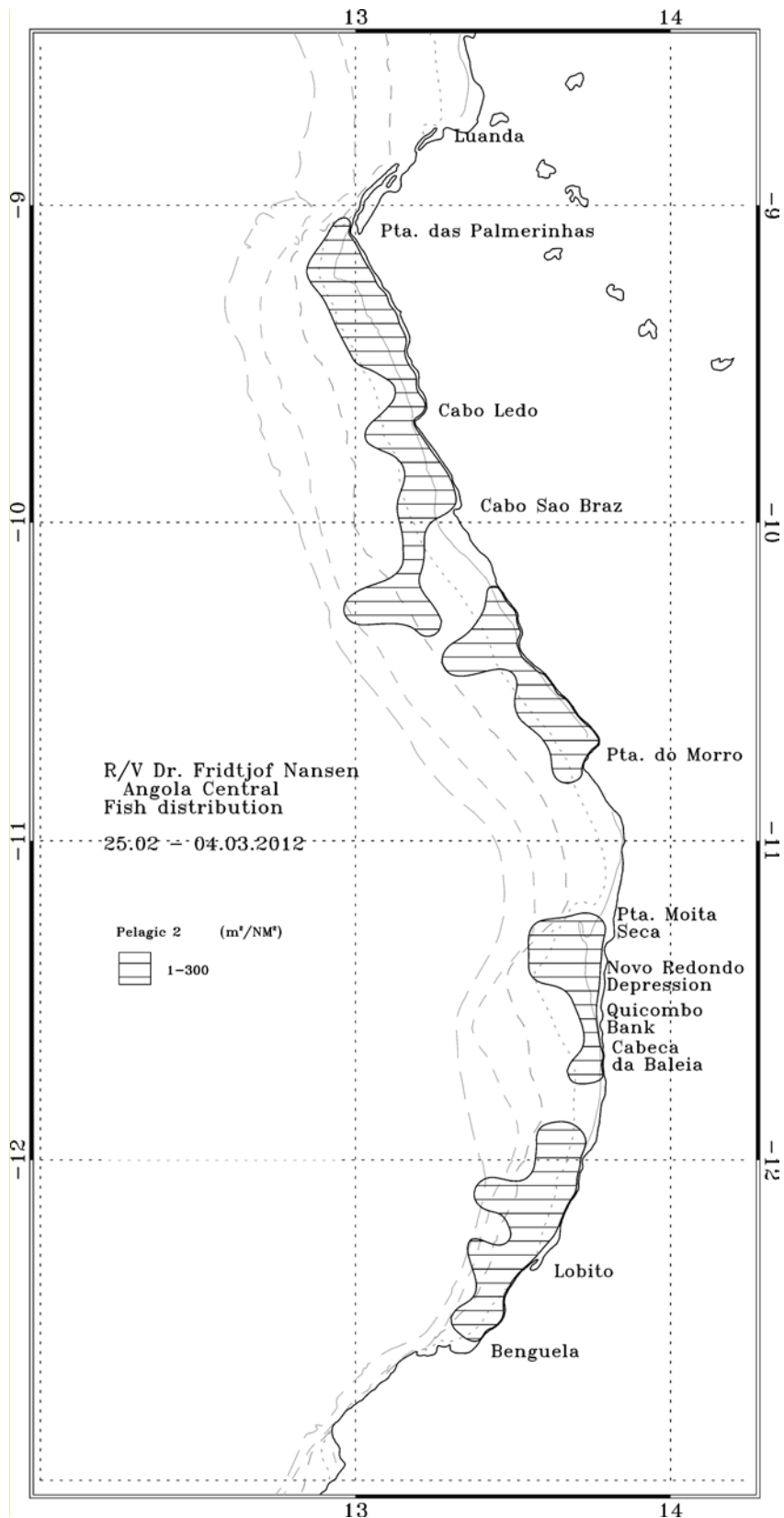


Figure 24 Distribution of Pel 2 Benguela-Pta. das Palmerinhas. Depth contours at 20, 50, 100 and 200 m

4.3 Pta. Palmerinhas - Congo River

Sardinella

Sardinella was found in continuous from Luanda to Ambriz and off N'Zeto in very scattered, scattered, dense and very dense distributions (Figure 26). The densest registrations were found north off Luanda.

For both species of sardinella the length distribution show peaks, for *S. aurita* at around 14 and 23 cm and for *S. maderensis* at around 22cm (Figure 25).

a) *S. aurita*

b) *S. maderensis*

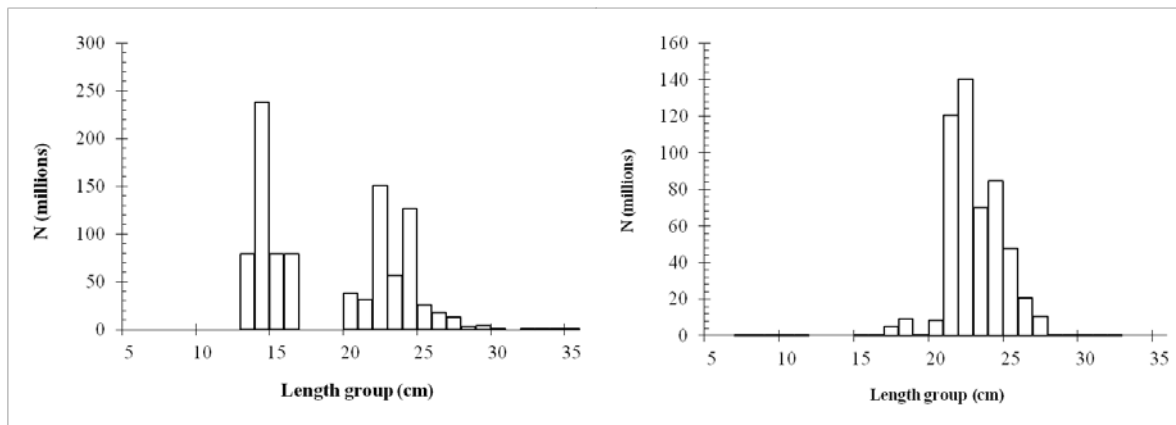


Figure 25 length distribution of *Sardinella aurita* and *S. maderensis* Pta. das Palmerinhas-Congo River.

The estimated biomass for this region was 117 000 tonnes, with *S. aurita* representing around 54 % of the total biomass, while *S. maderensis* contributed with 46 %. The estimate is lower than the biomasses estimated in both 2012 surveys, but similar to the average over the two-three last years (Annex V).

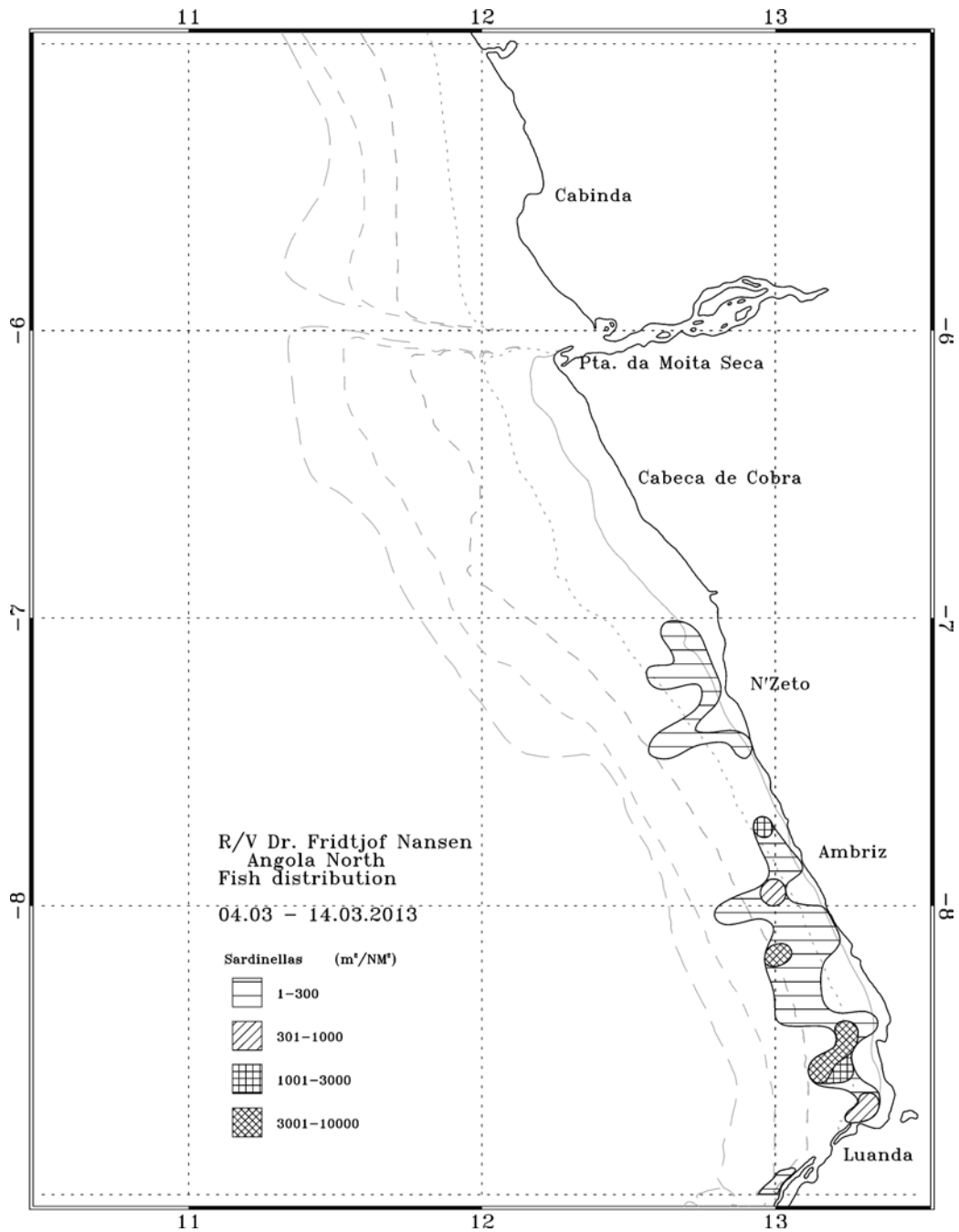


Figure 26 Distribution of *Sardinella* spp. Pta. das Palmerinhas-Congo River. Depth contours at 20, 50, 100, 200, and 500m.

Horse mackerel

In Northern region Cunene horse mackerel, *T. trecae*, was found offshore in low acoustic density areas ($0 < S_A < 300 \text{ m}^2/\text{NM}^2$) between Luanda and Cabeça da Cobra (Figure 29). The Cunene horse mackerel was primarily caught in bottom trawls mixed with demersal species.

The size distribution of Cunene horse mackerel showed peaks at about 14, 18, 25 and 30 cm TL (Figure 27).

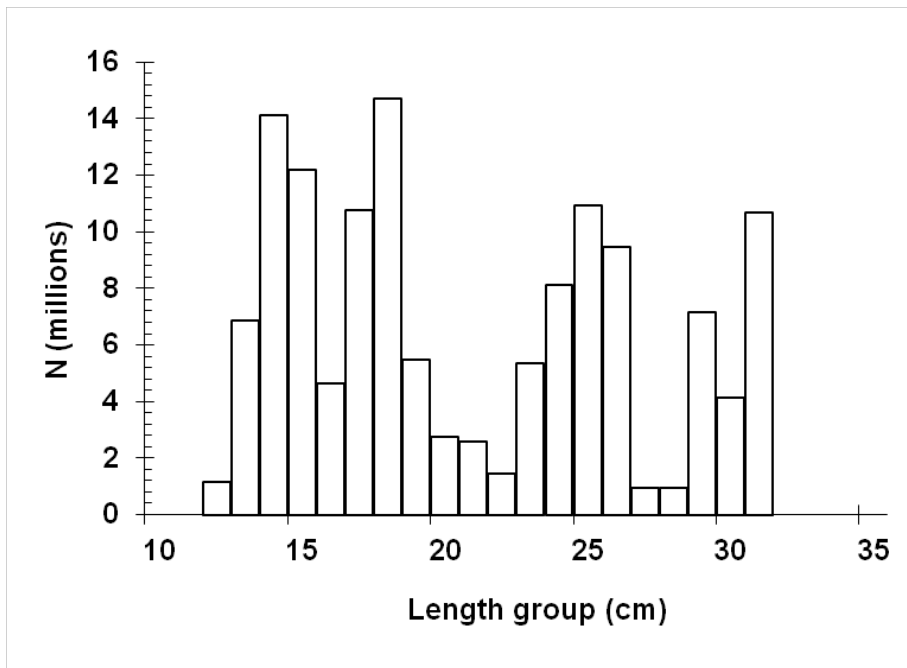


Figure 27 Total length frequency distribution of *Trachurus trecae* Pta. das Palmerinhas-Congo River

Of 197 *T. trecae* analysed in the Northern region, 56.8% were found mature, maturing or recovering, 15.7% were immature and 27.4% were juvenile. A large part of the fish was found in stages II and III, with maturing virgin females in the highest proportion. A minority of the fish were found in stages IV to V in ripening, ripe and spent status.

The biomass of horse mackerel was estimated at 15 000 tonnes, which half of the biomass estimated in summer 2012, but the same as the average over the most recent years (Annex V).

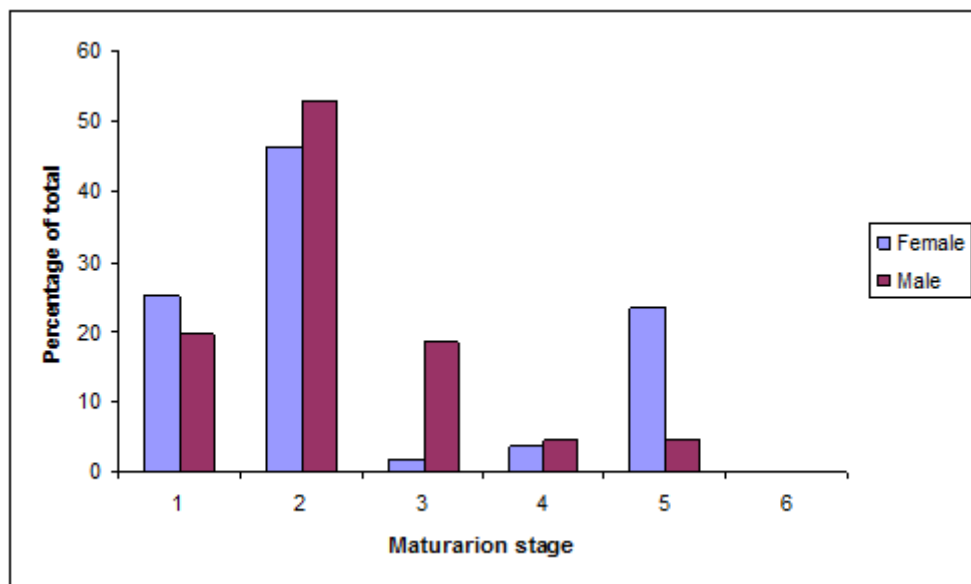


Figure 28 Distribution of maturity stages by sex for *Trachurus trecae* in the Northern region

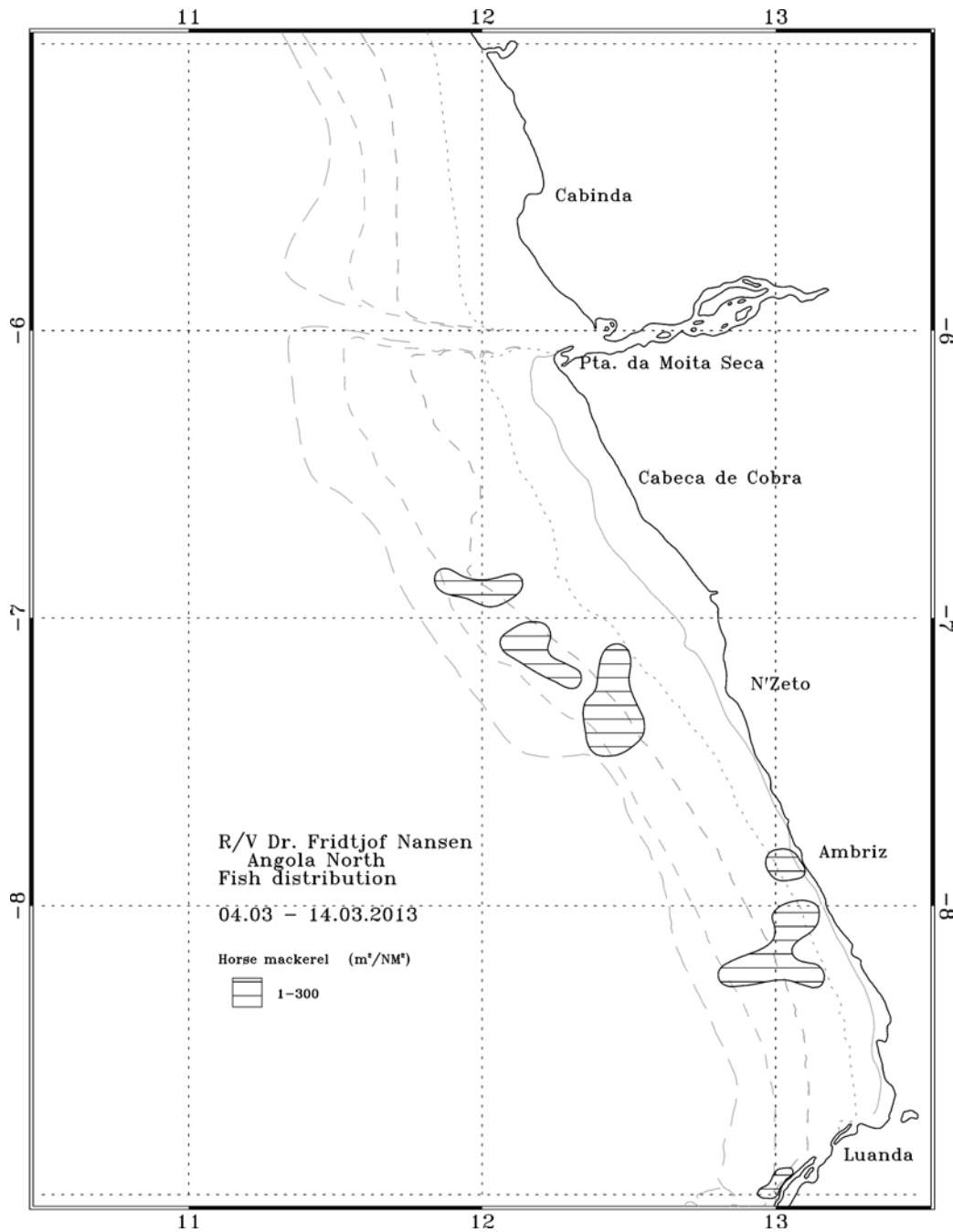


Figure 29 Distribution of *Trachurus trecae*, Pta. das Palmerinhas - Congo River. Depth contours at 20, 50, 100, 200, and 500m.

Other pelagic species

Ilisha Africana was caught on four of stations in the Northern region, of which one had a high catch rate (Table 4). Species belonging to the pelagic 1 group were only observed scattered in low densities ($0 > s_A > 300$), mainly south of Ambriz, and no biomass was estimated for this group. Barracuda, carangids (mainly *Selene dorsalis* and *Chloroscombrus chrysurus*), hairtails and scombrids were caught frequently in the region (Table 4). Carangids had the highest catch rates, mainly due to a couple of large catches of *C. chrysurus*. Species belonging to the pelagic 2 group were observed in very scattered distributions over most of the central region, with dense registrations north of Ambriz (Figure 30). The biomass estimate, based on

an average length of 30 cm and a condition factor equal to 0.01, was 76 000 tonnes. This is similar to what was estimated winter 2012 (71 000 tonnes), but above the estimate of summer 2011 (32 000 tonnes). However, in other years/seasons very low estimates are obtained or no estimates have been made. In some years sardinella and horse mackerel may be allocated to the pelagic 1 and 2 group, respectively, in other years it may be the other way around. The biomass estimates of both pelagic 1 and 2 should therefore be regarded as not very precise.

Table 4 Catch rates (kg/h) of the main groups of pelagic fish, Pta. das Palmerinhas – Congo River

Station	Gear depth	Barracuda	Carangids	Clupeiods	Hairtails	Horse mackerel	Sardinella spp.	Scombrids	Other	Total
37	10	12.6	898.5	6.9	0	0	456.0	0	500.7	1874.7
38	25	142.1	209.0	642.6	12.5	0	3.5	22.2	1248.1	2280
39	81	18.8	102.6	0	189.9	242.1	276.3	0	1485	2314.6
40	79	0	2.3	0	43.8	54.4	1.5	0	538.4	640.4
41	80	0	0	0	47.2	21.9	0	0	484.3	553.4
42	99	0	0	0	6.8	1.7	0	0	392.8	401.3
43	10	17.0	16.4	3.1	0	3.4	112.1	3.1	168.8	323.9
44	48	2.3	11.6	0	0	43.6	0	0	449	506.6
45	40	8.8	6804.1	0	0	0	8	0	27.5	6848.3
46	0	0	0	0	0	0	0	0	0	0
47	10	0	0	0	0	0	0	0	0	0
48	115	0	0	0	0	7.5	0	0	435.5	443
49	10	0	4.1	0	0	0	75.6	0	0	79.7
50	13	0	3.7	0	0	0	58.5	0	0	62.2
51	94	0	201.0	0	0	7	0	0	518.4	726.4
52	126	0	0	0	3.2	11.4	0	0	266.4	280.9
53	95	0	0	0	2.4	0	0	0	9.6	11.9
54	10	12.9	278.6	0	0	0	0	16.9	10.7	319.2
55	74	0	32.2	0	4.8	0	0	0	34.3	71.3
56	10	0	0.1	0.3	0	0	0	0	0.1	0.4
57	42	0	32.8	0	7.9	0	0	5.7	43	89.4
Mean	51	10.2	409.4	31.1	15.2	18.7	47.2	2.3	314.9	848.9
Std dev		30.9	1479.2	140.1	42.2	53.3	113.8	6.0	410.7	1549.2
% catch		1.2	48.2	3.7	1.8	2.2	5.6	0.3	37.1	

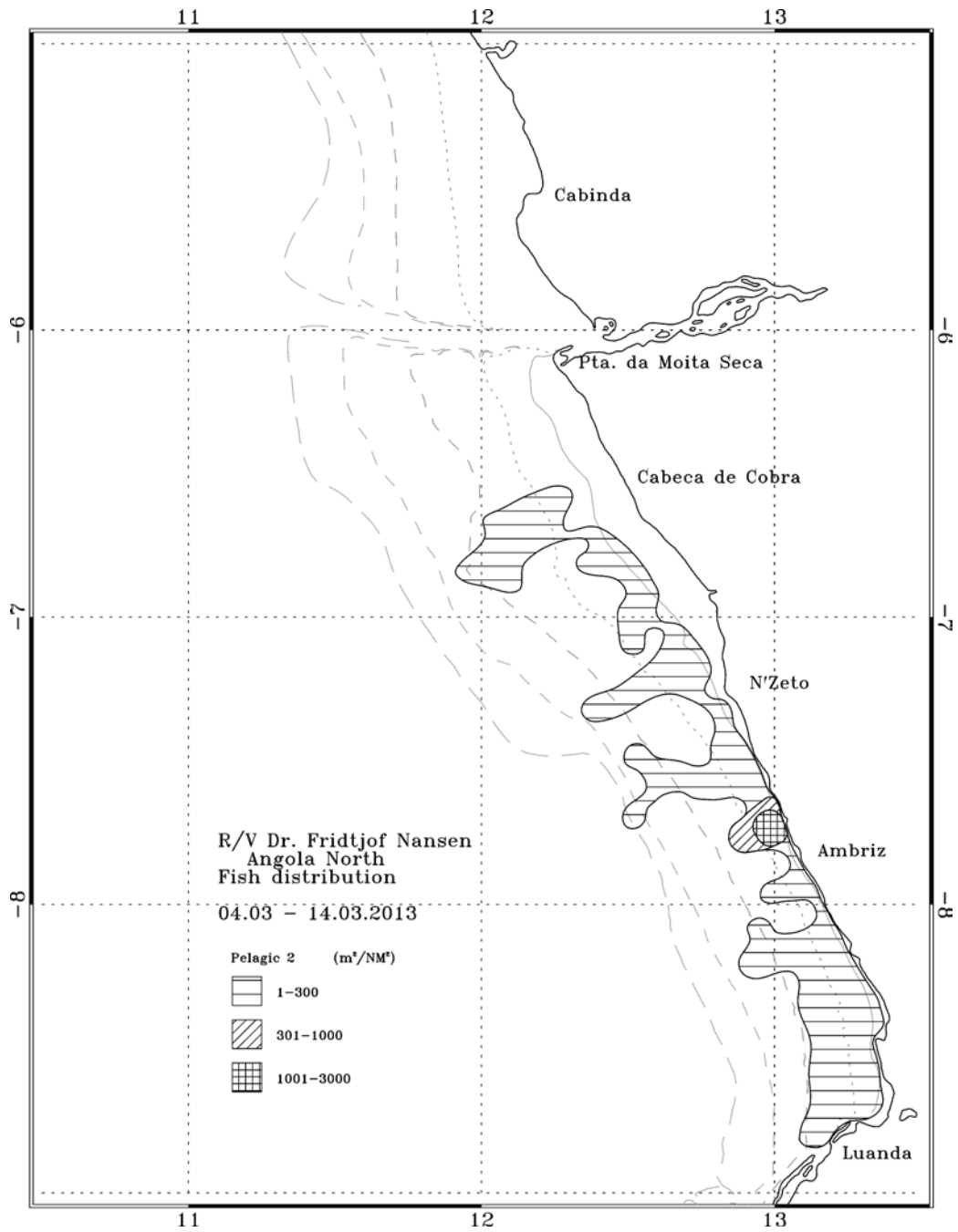


Figure 30 Distribution of Pelagic 2 species, Pta. das Palmerinhas-Congo River. Depth contours at 20, 50, 100 and 200 m

CHAPTER 5 SUMMARY OF SURVEY RESULTS

5.1 Sardinella

The estimated biomass of sardinella shows a cyclic fluctuating pattern throughout the time series (Figure 31). This is commonly found in pelagic species, usually reflecting actual changes in abundance but also variation in the availability of the surveyed populations, often caused by changes in the environmental conditions. The total biomass estimate for sardinellas was 565 000 tonnes. This is considerably lower than the biomass estimated in winter 2012 (1 119 000 tonnes) and last summer (739 000 tonnes). However, the present result is at about the average level of the most recent years (Annex V).

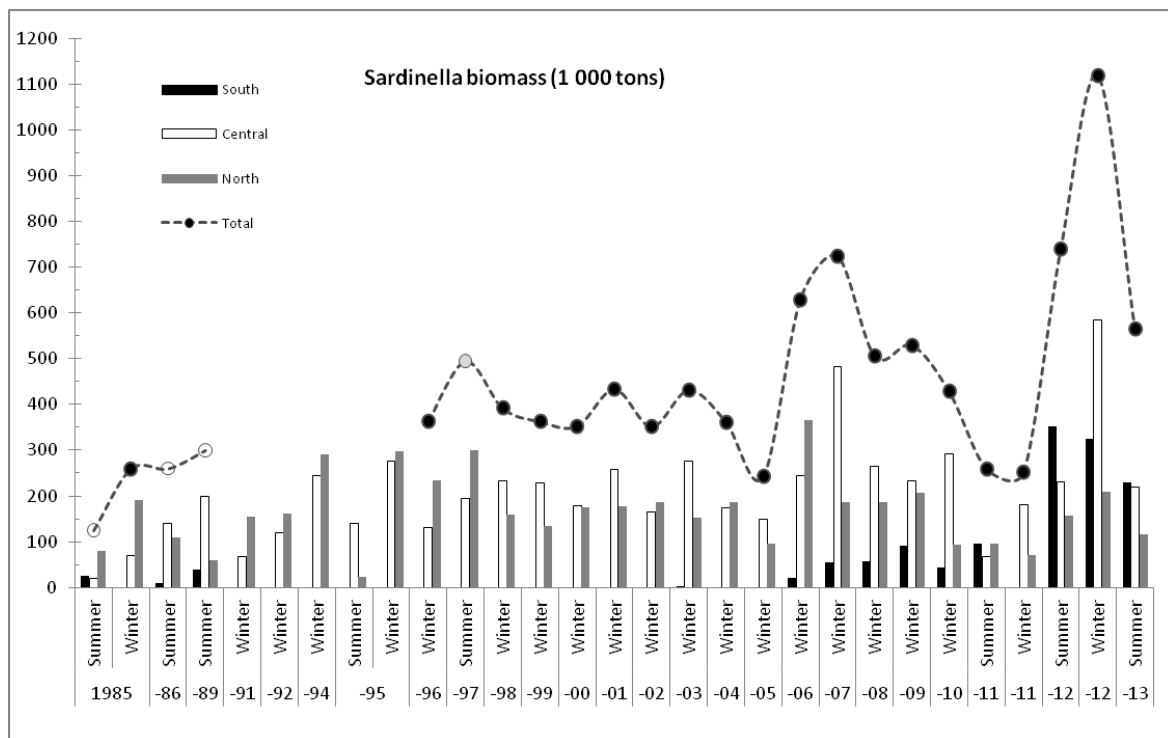
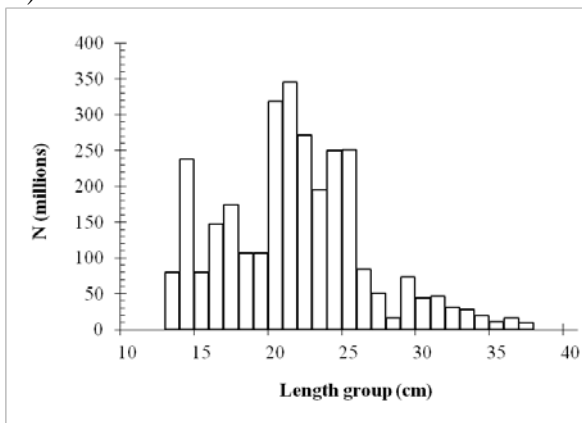


Figure 31 Biomass estimates of Sardinella by regions and surveys (1 000 tonnes).

The overall length frequency distributions of the two Sardinella species show both juvenile and adult cohorts (Figure 32). For *S. aurita*, the distribution shows peaks at about 14, 17, 21 and 25 cm TL. The distribution of *S. maderensis* shows peaks around 22 and 30 cm total length.

b) *S. aurita*



b) *S. maderensis*

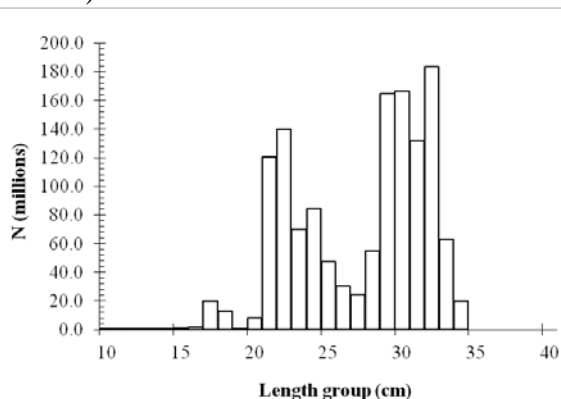


Figure 32 Overall total length distribution of *S. aurita* (a) and *S. maderensis* (b).

5.2 Cunene horse mackerel

The total biomass of Cunene horse mackerel was estimated at 138 000 tonnes. This is considerable lower than both 2012 estimates (Figure 33), but at about the same level as found in many surveys during the 2000s (Annex V).

In previous surveys the bulk of the biomass has been found in the Southern region, while in the present survey about equal biomass estimates were obtained in the Southern and Central regions. The biomass levels in the Northern region is still at a low level, contributing with only 15 000 tonnes (11%) to the total biomass.

The current Cunene horse mackerel biomass is very low compared with the reference year of 1996, when the biomass was estimated at around 360 000 tonnes for the winter survey.

The overall length frequency distributions of the horse mackerel species show juvenile cohorts in *T. trecae* (Figure 34). The distribution of *T. trecae* has peaks around 8, 14, 18 and 24 cm total length. For *T. capensis*, the distribution shows peaks at 22 and 35 cm TL.

The total biomass of Cape horse mackerel was estimated at only 7 000 tonnes. This is considerable lower than found in previous surveys.

The reported biomass levels should be considered with considerable caution. The estimates are relative indices rather than absolute estimates of abundance, and the cyclic variation pattern may be accentuated by changes in behaviour related to the environmental conditions. This variation is particularly evident in the Benguela Current frontal zone in the Southern region, where the cold Benguela meets the warm, subtropical Angola current.

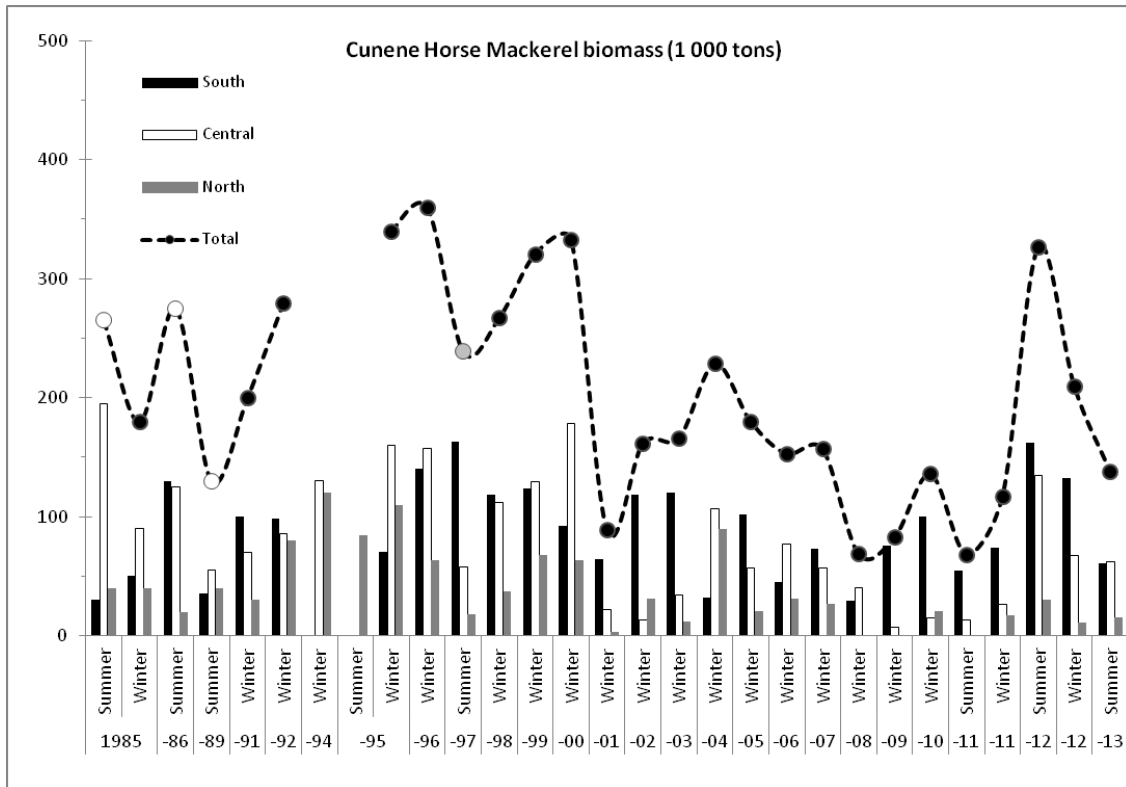


Figure 33 Biomass estimates of Cunene horse mackerel by regions and surveys (1 000 tonnes)

a) *T. trecae*

b) *T. capensis*

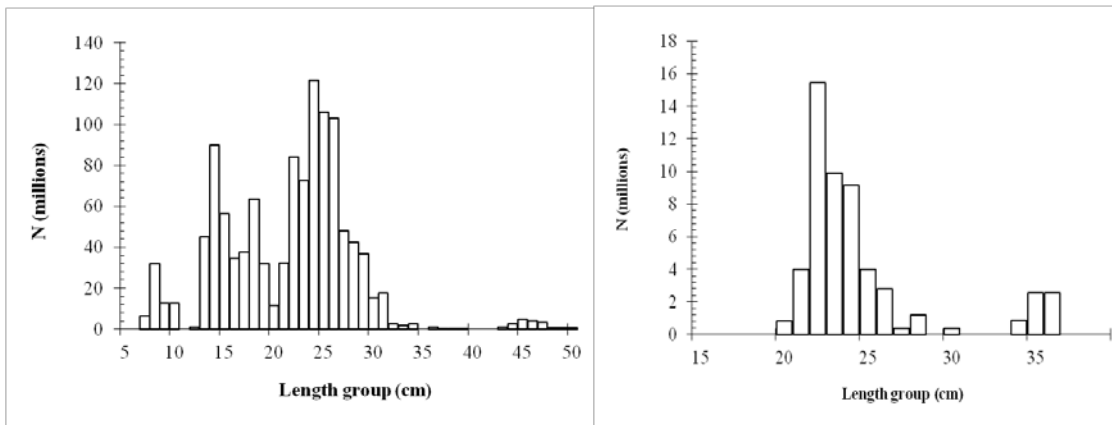


Figure 34 Overall total length distributions of *T. trecae* (a) and *T. capensis* (b)

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ANNEX I Records of fishing stations

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 1
 DATE :19/02/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 17°5.85
 start stop duration Lon E 11°28.81
 TIME :04:44:53 05:06:30 22.0 (min) Purpose : 1
 LOG : 6898.98 6900.10 1.1 Region : 4050
 FDEPTH: 126 121 Gear cond.: 0
 BDEPTH: 126 121 Validity : 0
 Towing dir: 0° Wire out : 300 m Speed : 3.1 kn
 Sorted : 0 Total catch: 448.38 Catch/hour: 1222.85

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	818.73	14032	66.95	1
Dentex macrophthalmus	308.29	4334	25.21	2
Synagrops microlepis	24.35	7797	1.99	
Loligo vulgaris	20.89	175	1.71	
Mustelus mustelus	12.55	5	1.03	
Chelidonichthys capensis	11.07	63	0.91	
Pterothrissus belloci	9.95	158	0.81	
Atractoscion aequidens	4.55	14	0.37	
Merluccius capensis	3.79	27	0.31	
Dicologlossa cuneata	2.54	221	0.21	
Trachurus capensis	1.75	16	0.14	
Todarodes angolensis	1.58	33	0.13	
Squalus megalops	1.55	5	0.13	
Sepia orbignyana	1.25	16	0.10	
Total	1222.85		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 2
 DATE :19/02/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°57.81
 start stop duration Lon E 11°43.69
 TIME :11:12:09 11:21:43 10.0 (min) Purpose : 1
 LOG : 6955.90 6956.39 0.5 Region : 4050
 FDEPTH: 22 22 Gear cond.: 0
 BDEPTH: 22 22 Validity : 0
 Towing dir: 0° Wire out : 70 m Speed : 3.0 kn
 Sorted : 0 Total catch: 1545.38 Catch/hour: 9272.28

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	7408.80	23940	79.90	
Sardinella aurita	1829.28	20934	19.73	3
Engraulis encrasicolus	32.58	3000	0.35	4
Trachurus trecae, juvenile	1.62	1032	0.02	
Total	9272.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 3
 DATE :19/02/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°50.57
 start stop duration Lon E 11°23.65
 TIME :04:54:07 05:21:01 27.0 (min) Purpose : 1
 LOG : 7006.21 7007.68 1.5 Region : 4050
 FDEPTH: 130 129 Gear cond.: 0
 BDEPTH: 130 129 Validity : 0
 Towing dir: 0° Wire out : 330 m Speed : 3.3 kn
 Sorted : 0 Total catch: 658.22 Catch/hour: 1462.71

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	871.29	6944	59.57	6
Trachurus trecae	549.82	4727	37.59	5
Etrumeus whiteheadi	17.33	267	1.19	7
Dentex macrophthalmus	12.82	173	0.88	8
Atractoscion aequidens	7.62	11	0.52	
Umbrina canariensis	2.67	11	0.18	
Pterothrissus belloci	1.16	11	0.08	
Total	1462.71		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 4
 DATE :20/02/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°37.62
 start stop duration Lon E 11°29.78
 TIME :06:41:14 06:55:22 14.0 (min) Purpose : 1
 LOG : 7095.54 7096.30 0.8 Region : 4050
 FDEPTH: 111 111 Gear cond.: 0
 BDEPTH: 111 111 Validity : 0
 Towing dir: 0° Wire out : 290 m Speed : 3.2 kn
 Sorted : 0 Total catch: 198.88 Catch/hour: 852.34

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex macrophthalmus	549.43	10371	63.41	10
Trachurus trecae	188.06	1371	22.06	9
Pterothrissus belloci	44.66	214	5.24	
Loligo vulgaris	24.09	154	2.83	
Merluccius capensis	12.39	39	1.45	
Zeus faber	8.91	17	1.05	
Atractoscion aequidens	8.91	9	1.05	
Spondyliosoma cantharus	7.71	17	0.91	
Chelidonichthys capensis	6.51	13	0.76	
Trichiurus lepturus	4.97	69	0.58	
Trigla lyra	1.93	13	0.23	
Ephippion guttifer	1.71	9	0.20	
Dentex barnardi	1.37	9	0.16	
Umbrina canariensis	0.69	9	0.08	
Total	852.34		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 5
 DATE :20/02/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°32.88
 start stop duration Lon E 11°28.16
 TIME :10:59:34 11:10:07 11.0 (min) Purpose : 1
 LOG : 7126.90 7127.41 0.5 Region : 4050
 FDEPTH: 112 111 Gear cond.: 0
 BDEPTH: 112 111 Validity : 0
 Towing dir: 0° Wire out : 290 m Speed : 2.9 kn
 Sorted : 0 Total catch: 23.91 Catch/hour: 130.42

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	114.11	616	87.49	11
Loligo vulgaris	5.78	33	4.43	
Dentex barnardi	3.65	16	2.80	
Trigla lyra	3.27	16	2.51	
Perulibatrachus rosignoli	1.04	5	0.79	
Etrumeus whiteheadi	0.82	11	0.63	
Lepidotrigla cadmani	0.60	5	0.46	
Illex coindetii	0.33	5	0.25	
PATELLIDAE	0.33	27	0.25	
Sea urchin	0.33	33	0.25	
Todaropsis eblanae	0.16	5	0.13	
DIOGENIDAE	0.01	5	0.00	
Total	130.42		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 6
 DATE :20/02/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°35.48
 start stop duration Lon E 11°46.55
 TIME :05:43:21 06:04:26 21.0 (min) Purpose : 1
 LOG : 7186.80 7187.90 1.1 Region : 4050
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 19 22 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.2 kn
 Sorted : 0 Total catch: 237.86 Catch/hour: 679.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	500.34	974	73.62	
Sardinella maderensis	70.40	229	10.36	12
Trachurus trecae	53.03	340	7.80	13
Pomatomus saltatrix	31.94	63	4.70	
Myliobatis aquila	20.34	9	2.99	
Sarda sarda	3.49	6	0.51	14
Stromateus fiatola, juvenile	0.07	3	0.01	
Total	679.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 7
 DATE :20/02/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 16°16.89
 start stop duration Lon E 11°34.77
 TIME :11:31:29 11:53:33 22.0 (min) Purpose : 1
 LOG : 7238.03 7239.32 1.3 Region : 4050
 FDEPTH: 20 25 Gear cond.: 0
 BDEPTH: 82 80 Validity : 0
 Towing dir: 0° Wire out : 80 m Speed : 3.5 kn
 Sorted : 0 Total catch: 0.55 Catch/hour: 1.50

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Illex coindetii	1.15	218	76.36	
Todaropsis eblanae	0.27	5	18.18	
MYCTOPHIDAE	0.08	35	5.45	
Total	1.50		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 8
 DATE :21/02/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°14.89
 start stop duration Lon E 11°46.31
 TIME :01:25:30 01:40:49 15.0 (min) Purpose : 1
 LOG : 7250.98 7251.72 0.7 Region : 4050
 FDEPTH: 24 25 Gear cond.: 0
 BDEPTH: 24 25 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 2.9 kn
 Sorted : 0 Total catch: 1090.72 Catch/hour: 4362.88

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Spondyliosoma cantharus	3926.40	77312	90.00	
Dasyatis marmorata	143.36	64	3.29	
Trachurus trecae	110.72	2624	2.54	15
Pagellus bellottii	104.96	4928	2.41	16
Pomadourus incisus	19.84	128	0.45	
Atractoscion aequidens	19.84	128	0.45	
Sepia orbignyana	13.44	128	0.31	
Boops boops	8.32	320	0.19	
Dentex barnardi	8.32	576	0.19	
Trigla lyra	2.56	192	0.06	
Trachinotus ovatus	1.92	64	0.04	
Penaeus notialis	1.28	64	0.03	
Engraulis encrasicolus	1.28	320	0.03	
Trichiurus lepturus	0.64	64	0.01	
Total	4362.88		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 9
 DATE :21/02/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°20.20
 start stop duration Lon E 11°46.63
 TIME :06:57:53 07:17:09 19.0 (min) Purpose : 1
 LOG : 7297.78 7298.74 1.0 Region : 4050
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 23 24 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.0 kn
 Sorted : 0 Total catch: 0.85 Catch/hour: 2.68

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sarda sarda	1.64	3	61.18	17
Sardinella maderensis	1.04	3	38.82	
Total	2.68		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 10
 DATE :21/02/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 15°42.45
 start stop duration Lon E 119°46.25
 TIME :02:49:30 03:00:29 11.0 (min) Purpose : 1
 LOG : 7355.90 7356.47 0.6 Region : 4050
 FDEPTH: 107 109 Gear cond.: 0
 BDEPTH: 107 109 Validity : 0
 Towing dir: 0° Wire out : 270 m Speed : 3.1 km
 Sorted : 0 Total catch: 20.32 Catch/hour: 110.84

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Squalus megalops	63.93 120	57.68	18
Trachurus trecae	18.93 115	17.08	
Zeus faber	11.67 22	10.53	
Dentex barnardi	10.42 55	9.40	19
Pagellus bellottii	2.18 16	1.97	
Sphoeroides pachgaster	2.13 5	1.92	
Dentex gibbosus	1.58 5	1.43	
Total	110.84	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 11
 DATE :21/02/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 15°39.99
 start stop duration Lon E 11°55.24
 TIME :04:38:52 05:00:17 21.0 (min) Purpose : 1
 LOG : 7369.04 7370.42 1.4 Region : 4050
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 56 75 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.1 km
 Sorted : 0 Total catch: 2.75 Catch/hour: 7.86

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chrysaora sp.	3.29 3	41.82	
Sphyrna zygaena	2.86 3	36.36	
Trachinotus ovatus	1.71 6	21.82	
Total	7.86	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 12
 DATE :22/02/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°15.25
 start stop duration Lon E 11°54.26
 TIME :02:04:57 02:24:39 20.0 (min) Purpose : 1
 LOG : 7458.70 7459.74 1.0 Region : 4050
 FDEPTH: 0 10 Gear cond.: 0
 BDEPTH: 401 279 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.2 km
 Sorted : 0 Total catch: 39.95 Catch/hour: 119.85

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
MYCTOPHIDAE	118.80 143370	99.12	
Trachipterus trachypterus	1.05 3	0.88	
Total	119.85	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 13
 DATE :22/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 15°9.51
 start stop duration Lon E 12°3.21
 TIME :04:23:53 04:35:36 12.0 (min) Purpose : 1
 LOG : 7549.11 7549.84 0.7 Region : 4050
 FDEPTH: 119 131 Gear cond.: 0
 BDEPTH: 119 131 Validity : 0
 Towing dir: 0° Wire out : 320 m Speed : 3.7 km
 Sorted : 0 Total catch: 118.61 Catch/hour: 593.05

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Dentex macrophthalms	529.15 4720	89.23	22
Trachurus trecae	27.40 85	4.62	21
Umbrina canariensis	14.65 100	2.47	
Trachurus capensis	12.15 35	2.05	20
Zeus faber	4.80 5	0.81	
Spicara alta	1.90 15	0.32	
Dentex barnardi	1.45 5	0.24	
Pterothrissus belloci	1.20 10	0.20	
Lepidotrigla cadmani	0.35 5	0.06	
Total	593.05	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 14
 DATE :22/02/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 15°2.92
 start stop duration Lon E 12°7.02
 TIME :09:25:27 09:46:03 21.0 (min) Purpose : 1
 LOG : 7581.36 7582.50 1.1 Region : 4050
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 97 118 Validity : 0
 Towing dir: 0° Wire out : 95 m Speed : 3.3 km
 Sorted : 0 Total catch: 204.86 Catch/hour: 585.31

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Trachurus trecae	524.57 2366	89.62	24
MYCTOPHIDAE	42.63 23446	7.28	
Trichiliurus lepturus	11.37 220	1.94	
Scomber japonicus	6.74 20	1.15	25
Total	585.31	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 15
 DATE :23/02/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 14°29.80
 start stop duration Lon E 12°18.60
 TIME :04:49:08 05:15:06 26.0 (min) Purpose : 1
 LOG : 7649.99 7651.31 1.3 Region : 4050
 FDEPTH: 32 35 Gear cond.: 0
 BDEPTH: 80 81 Validity : 0
 Towing dir: 0° Wire out : 110 m Speed : 3.0 km
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 16
 DATE :23/02/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 14°26.06
 start stop duration Lon E 12°19.27
 TIME :06:46:32 06:50:42 4.0 (min) Purpose : 1
 LOG : 7660.76 7661.00 0.2 Region : 4050
 FDEPTH: 0 0 Gear cond.: 0
 BDEPTH: 81 85 Validity : 0
 Towing dir: 0° Wire out : 110 m Speed : 3.5 km
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 17
 DATE :23/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 14°24.85
 start stop duration Lon E 12°14.53
 TIME :08:07:43 08:30:40 23.0 (min) Purpose : 1
 LOG : 7670.29 7671.52 1.2 Region : 4050
 FDEPTH: 123 114 Gear cond.: 0
 BDEPTH: 123 114 Validity : 0
 Towing dir: 0° Wire out : 310 m Speed : 3.2 km
 Sorted : 0 Total catch: 204.35 Catch/hour: 533.08

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Umbrina canariensis	186.83 944	35.05	
Dentex angoleensis	108.18 410	20.29	26
Dentex macrophthalms	60.60 960	11.37	28
Dentex barnardi	47.74 209	8.96	27
Spondyliosoma cantharus	29.22 50	5.48	
Myliobatis aquila	20.09 3	3.77	
Lepidotrigla cadmani	20.03 243	3.76	
Branchiostegus semifasciatus *	11.22 10	2.10	
Sphoeroides pachgaster	10.43 34	1.96	
Anthias anthias	8.50 83	1.60	
Sparus caeruleostictus *	8.50 8	1.60	
Atractoscion aequidens	7.46 3	1.40	
Pagellus bellottii	5.68 57	1.06	29
Scorpaena elongata	4.17 8	0.78	
Perulibrachius rossignoli	3.08 8	0.58	
Sepia officinalis	0.68 8	0.13	
Trachurus trecae	0.42 8	0.08	
Pontinus accraensis	0.16 8	0.03	
Illex coindetii	0.08 8	0.01	
Total	533.08	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 18
 DATE :23/02/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 14°13.14
 start stop duration Lon E 12°17.45
 TIME :11:59:57 12:19:05 19.0 (min) Purpose : 1
 LOG : 7701.98 7702.93 1.0 Region : 4050
 FDEPTH: 5 4 Gear cond.: 0
 BDEPTH: 56 31 Validity : 0
 Towing dir: 0° Wire out : 95 m Speed : 3.0 km
 Sorted : 0 Total catch: 1.50 Catch/hour: 4.74

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Euthymnus alletteratus	4.74 3	100.00	30
Total	4.74	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 19
 DATE :24/02/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 13°40.02
 start stop duration Lon E 12°24.58
 TIME :12:16:46 12:32:42 16.0 (min) Purpose : 1
 LOG : 7798.81 7799.69 0.9 Region : 4050
 FDEPTH: 50 55 Gear cond.: 0
 BDEPTH: 349 450 Validity : 0
 Towing dir: 0° Wire out : 116 m Speed : 3.3 km
 Sorted : 0 Total catch: 7.18 Catch/hour: 26.92

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
MYCTOPHIDAE	26.92 51788	100.00	
Total	26.92	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 20
 DATE :25/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 12°58.42
 start stop duration Lon E 12°49.38
 TIME :11:19:23 11:40:44 21.0 (min) Purpose : 1
 LOG : 7900.81 7901.85 1.0 Region : 4040
 FDEPTH: 117 114 Gear cond.: 0
 BDEPTH: 117 114 Validity : 0
 Towing dir: 0° Wire out : 290 m Speed : 3.0 km
 Sorted : 0 Total catch: 172.65 Catch/hour: 493.29

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Dentex macrophthalms	190.43 2526	38.60	31
Sphoeroides pachgaster	73.29 129	14.86	
Boops boops	56.91 257	11.54	
Chelidonichthys capensis	33.49 314	6.79	
Pontinus accraensis	26.23 57	5.32	
Umbrina canariensis	25.71 66	5.21	
Trigla lyra	15.94 73	3.23	
Scorpaena normani	14.51 223	2.94	
Brotula barbata	11.54 9	2.34	
Octopus vulgaris	7.66 9	1.55	
Raja miraletus	7.43 9	1.51	
Raja clavata	5.60 3	1.14	
Todaropsis eblanae	5.00 114	1.01	
Dentex barnardi	4.71 14	0.96	
Pagellus bellottii	3.37 14	0.68	
PATELIDAE	2.91 223	0.59	
Uranoscopus polli	2.57 6	0.52	
Anthias anthias	1.94 14	0.39	
Citharus linguatula	1.29 29	0.26	
Monoleone microstoma	1.14 34	0.23	
Bembrops greyi	0.71 6	0.14	
Peristedion cataphractum	0.51 6	0.10	
Illex coindetii	0.37 6	0.08	
Saurida brasiliensis	0.01 6	0.00	
Total	493.29	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 21
 DATE :26/02/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 12°8.92
 start stop duration Lon E 13°34.41
 TIME :11:02:34 11:07:55 5.0 (min) Purpose : 1
 LOG : 8160.68 8160.99 0.3 Region : 4040
 FDEPTH: 15 20 Gear cond.: 0
 BDEPTH: 75 77 Validity : 0
 Towing dir: 0° Wire out : 80 m Speed : 3.5 km
 Sorted : 0 Total catch: 446.73 Catch/hour: 5360.76

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardinella aurita	5179.92 36576	96.63	32
Trachurus trecae	125.28 1248	2.34	34
Sardinella maderensis	24.48 156	0.46	33
Scomber japonicus	18.24 48	0.34	35
Sphyrna guachancho	10.80 48	0.20	
Illex coindetii	2.04 516	0.04	
Total	5360.76	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 22
 DATE :27/02/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°54.75
 start stop duration Purpose : 1
 TIME :03:42:45 04:03:37 21.0 (min) Region : 4040
 LOG : 8202.14 8203.22 1.1 Gear cond.: 0
 FDEPTH: 5 5 Validity : 0
 BDEPTH: 344 371
 Towing dir: 0° Wire out : 90 m Speed : 3.1 km
 Sorted : 0 Total catch: 15.85 Catch/hour: 45.29

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
MYCTOPHIDAE	43.94	57317	97.03	
Trichiurus lepturus	1.34	66	2.97	
Total	45.29		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 23
 DATE :27/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 11°50.51
 start stop duration Purpose : 1
 TIME :07:44:35 08:14:40 30.0 (min) Region : 4040
 LOG : 8235.90 8237.64 1.7 Gear cond.: 0
 FDEPTH: 78 66 Validity : 0
 BDEPTH: 78 66
 Towing dir: 0° Wire out : 210 m Speed : 3.5 km
 Sorted : 0 Total catch: 63.19 Catch/hour: 126.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	54.40	508	43.04	37
Atractoscion aequidens	6.84	4	5.41	
Pomadasy incisus	6.54	50	5.17	
Zeus faber	6.48	12	5.13	
Pseudupeneus prayensis	4.84	42	3.83	
Dentex angolensis	4.54	94	3.59	40
Sea urchin	4.46	496	3.53	
Selene dorsalis	4.44	28	3.51	41
Alloteuthis africana	4.08	1142	3.23	
Torpedo torpedo	4.06	8	3.21	
Octopus vulgaris	3.50	4	2.77	
Citharus linguatula	3.24	136	2.56	
Pagellus bellottii	2.14	18	1.69	39
Sardinella aurita	1.92	18	1.52	36
Lagocephalus laevigatus	1.40	4	1.11	
Lepidotrigla cadmani	1.32	8	1.04	
Fistularia petimba	1.32	2	1.04	
Sepia officinalis	1.28	2	1.01	
Brachydeuterus auritus	1.24	20	0.98	38
Lepidotrigla carolae	1.12	12	0.89	
Sardinella maderensis	1.08	2	0.85	
Sphyræna sphyraena	1.08	2	0.85	
PATELLIDAE	0.96	20	0.76	
Chelidonichthys capensis	0.90	2	0.71	
Amoglossus imperialis	0.84	16	0.66	
Dentex barnardi	0.76	4	0.60	
Chaetodon hoefleri	0.70	4	0.55	
Trichiurus lepturus	0.54	2	0.43	
Grammolites gruvelli	0.30	2	0.24	
Thorogobius angolensis	0.06	2	0.05	
Total	126.38		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 24
 DATE :27/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 11°43.04
 start stop duration Purpose : 1
 TIME :01:25:13 01:45:43 20.0 (min) Region : 4040
 LOG : 8285.97 8287.06 1.1 Gear cond.: 0
 FDEPTH: 56 64 Validity : 0
 BDEPTH: 56 64
 Towing dir: 0° Wire out : 150 m Speed : 3.2 km
 Sorted : 0 Total catch: 87.44 Catch/hour: 262.32

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	110.34	423	42.06	
Brachydeuterus auritus	50.04	459	19.08	43
Trachurus trecae	42.60	264	16.24	42
Octopus vulgaris	13.02	9	4.96	
Raja miraletus	9.39	21	3.58	
Selene dorsalis	7.89	60	3.01	44
Pomadasy incisus	7.20	51	2.74	
Pagellus bellottii	6.66	48	2.54	45
Stromateus fiatola	6.63	9	2.53	
Pseudolithus senegalensis	3.30	3	1.26	
Torpedo torpedo	1.59	3	0.61	
Sphyræna sphyraena	1.35	6	0.51	
Galeoides decadactylus	1.26	3	0.48	
Dentex barnardi	0.75	6	0.29	
Grammolites gruvelli	0.27	6	0.10	
Citharus linguatula	0.03	3	0.01	
Total	262.32		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 25
 DATE :27/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 11°23.60
 start stop duration Purpose : 1
 TIME :11:46:51 12:13:16 1414.0(min) Region : 4040
 LOG : 8374.10 8375.47 1.4 Gear cond.: 0
 FDEPTH: 54 53 Validity : 0
 BDEPTH: 54 53
 Towing dir: 0° Wire out : 150 m Speed : 3.1 km
 Sorted : 0 Total catch: 161.86 Catch/hour: 6.87

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	2.15	13	31.30	47
Trachurus trecae	1.58	9	22.98	46
Chelidonichthys gabonensis	1.12	9	16.30	
Pseudupeneus prayensis	0.45	1	6.53	
Pomadasy incisus	0.45	2	6.53	
Trachinus armatus	0.24	3	3.45	
Sardinella maderensis	0.23	1	3.33	48
Lagocephalus laevigatus	0.22	0	3.24	
Bothus podas	0.14	2	2.06	
Trachinocephalus myops	0.12	1	1.74	
Balistes capricus	0.10	0	1.42	
Sepia officinalis	0.03	0	0.45	
Uranoscopus polli	0.02	0	0.25	
Boops boops	0.02	0	0.23	
Plectorhinchus mediterraneus	0.01	0	0.12	
Sardinella aurita	0.00	0	0.04	
Brotula barbata	0.00	0	0.02	
Total	6.87		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 26
 DATE :28/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 11°01.62
 start stop duration Purpose : 1
 TIME :08:51:07 09:06:43 16.0 (min) Region : 4040
 LOG : 8456.11 8457.03 0.9 Gear cond.: 0
 FDEPTH: 108 110 Validity : 0
 BDEPTH: 108 110
 Towing dir: 0° Wire out : 270 m Speed : 3.5 km
 Sorted : 0 Total catch: 301.12 Catch/hour: 1129.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	472.88	3442	41.88	
Trachurus trecae	454.43	2970	40.24	49
Selene dorsalis	36.90	112	3.27	53
Brachydeuterus auritus	29.40	165	2.60	52
Sardinella aurita	19.72	75	1.75	51
Brotula barbata	16.50	26	1.46	
Argyrosomus hololepidotus	14.70	15	1.30	
Octopus vulgaris	12.34	15	1.09	
Pontinus kuhllii	11.66	26	1.03	
Dentex barnardi	8.74	41	0.77	
Pterothrissus belloci	7.91	26	0.70	
Pomadasy incisus	7.91	15	0.70	
Pagellus bellottii	6.11	26	0.54	
Citharus linguatula	5.96	15	0.53	
Sardinella maderensis	5.85	26	0.52	50
Synagrops microlepis	5.70	1402	0.50	
Faranganeus longirostris	4.99	41	0.44	
Dentex angolensis	4.16	82	0.37	54
Chelidonichthys capensis	1.95	15	0.17	
Dentex macrophthalmus	1.39	15	0.12	
Total	1129.20		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 27
 DATE :28/02/13 GEAR TYPE: PT NO: 0 POSITION:Lat S 11°1.12
 start stop duration Purpose : 1
 TIME :11:07:10 11:35:12 28.0 (min) Region : 4040
 LOG : 8468.01 8469.49 1.5 Gear cond.: 0
 FDEPTH: 56 63 Validity : 0
 BDEPTH: 56 63
 Towing dir: 0° Wire out : 90 m Speed : 3.2 km
 Sorted : 0 Total catch: 0.23 Catch/hour: 0.49

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachinotus ovatus	0.49	2	0.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 28
 DATE :28/02/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 10°54.90
 start stop duration Purpose : 1
 TIME :02:02:21 02:22:40 20.0 (min) Region : 4040
 LOG : 8490.34 8491.46 1.1 Gear cond.: 0
 FDEPTH: 65 57 Validity : 0
 BDEPTH: 65 57
 Towing dir: 0° Wire out : 160 m Speed : 3.3 km
 Sorted : 0 Total catch: 322.05 Catch/hour: 966.15

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	531.30	17265	54.99	55
Trachurus trecae	229.80	2130	23.79	56
Pomadasy incisus	94.80	645	9.81	
Lagocephalus laevigatus	31.95	45	3.31	
Selene dorsalis	24.90	210	2.58	57
Dentex barnardi	10.35	165	1.07	
Pagellus bellottii	8.85	75	0.92	
Umbrina canariensis	8.85	105	0.92	
Trichiurus lepturus	7.50	75	0.78	
Raja miraletus	4.80	6	0.50	
Dicologlossa cuneata	3.60	15	0.37	
Sardinella maderensis	3.30	15	0.34	
Pseudupeneus prayensis	2.85	45	0.29	
Dentex angolensis	1.35	15	0.14	
Citharus linguatula	1.05	45	0.11	
Scorpaena normani	0.60	30	0.06	
Grammolites gruvelli	0.30	15	0.03	
Total	966.15		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 29
 DATE :01/03/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°34.16
 start stop duration Purpose : 1
 TIME :05:38:25 05:57:28 19.0 (min) Region : 4040
 LOG : 8616.92 8617.89 1.0 Gear cond.: 0
 FDEPTH: 10 10 Validity : 0
 BDEPTH: 31 36
 Towing dir: 0° Wire out : 125 m Speed : 3.0 km
 Sorted : 0 Total catch: 73.71 Catch/hour: 232.77

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sphyræna guachancho	73.52	145	31.58	
Stromateus fiatola	46.80	133	20.11	
Brachydeuterus auritus	31.20	423	13.40	58
Chloroscombrus chrysurus	20.40	145	8.76	59
Trichiurus lepturus	18.76	88	8.06	
Trachinotus ovatus	7.58	35	3.26	
Selene dorsalis	6.63	92	2.85	60
Scomberomus tritor	5.62	3	2.41	61
Caranx crysos	5.05	9	2.17	
Rhizoprionodon acutus	4.64	3	1.99	
Galeoides decadactylus	4.58	19	1.97	
Pseudolithus typus	3.47	9	1.49	
Sardinella maderensis	1.83	13	0.79	
Sepia officinalis	1.77	3	0.76	
Lagocephalus laevigatus	0.54	3	0.23	
Ilisha africana	0.38	3	0.16	
Total	232.77		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 30
 DATE :01/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 10°24.93
 start stop duration Lon E 13°21.38
 TIME :01:11:31 01:39:18 28.0 (min) Purpose : 1
 LOG : 8683.95 8685.43 1.5 Region : 4040
 FDEPTH: 77 84 Gear cond.: 0
 BDEPTH: 77 84 Validity : 0
 Towing dir: 0° Wire out : 200 m Speed : 3.2 kn
 Sorted : 0 Total catch: 47.81 Catch/hour: 102.45

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Trachurus trecae	55.93	902	54.59
Boops boops	10.63	381	10.37
Sphyræna sphyraena	10.16	34	9.91
Pomadasys incisus	6.30	41	6.15
Lagocephalus laevigatus	4.39	9	4.29
Trichiurus lepturus	4.37	9	4.27
Illex coindetii	4.22	1671	4.12
Dentex angolensis	2.64	39	2.57
Zeus faber	1.22	2	1.19
Dentex barnardi	0.71	4	0.69
Citharus linguatula	0.47	17	0.46
Sardinella maderensis	0.41	2	0.40
Sardinella aurita	0.36	2	0.36
Torpedo torpedo	0.19	2	0.19
Pagellus bellottii	0.19	2	0.19
Serranus cabrilla	0.17	2	0.17
Decapterus rhonchus	0.04	2	0.04
Saurida brasiliensis	0.04	6	0.04
Fishing gears	0.00	2	0.00
Total	102.45		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 31
 DATE :02/03/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 10°33.34
 start stop duration Lon E 13°14.20
 TIME :03:02:33 03:13:06 11.0 (min) Purpose : 1
 LOG : 8796.41 8796.99 0.6 Region : 4040
 FDEPTH: 0 10 Gear cond.: 0
 BDEPTH: 37 42 Validity : 0
 Towing dir: 0° Wire out : 80 m Speed : 3.3 kn
 Sorted : 0 Total catch: 523.74 Catch/hour: 2856.76

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Sardinella aurita	2269.36	13789	79.44
Sardinella maderensis	367.15	2285	12.85
Selene dorsalis	164.18	1849	5.75
Trachurus trecae	19.85	142	0.70
Lagocephalus laevigatus	13.42	55	0.47
Sphyræna sphyraena	11.13	27	0.39
Sarda sarda	4.80	5	0.17
Trachinotus ovatus	4.75	16	0.17
Illex coindetii	1.31	229	0.05
Saurida brasiliensis	0.55	404	0.02
Erythrocles monodi	0.27	27	0.01
Bregmaceros sp.	0.03	115	0.00
Total	2856.79		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 32
 DATE :02/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 10°9.43
 start stop duration Lon E 12°57.25
 TIME :05:46:58 06:15:11 28.0 (min) Purpose : 1
 LOG : 8816.99 8818.66 1.7 Region : 4040
 FDEPTH: 131 115 Gear cond.: 0
 BDEPTH: 131 115 Validity : 0
 Towing dir: 0° Wire out : 340 m Speed : 3.6 kn
 Sorted : 0 Total catch: 254.55 Catch/hour: 545.46

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Trachurus trecae	214.22	244	39.27
Dentex congoensis	74.01	778	13.57
Dentex angolensis	67.89	330	12.45
Spherooides pachgaster	38.57	39	7.07
Zenopsis conchifer	33.19	28	6.09
Boops boops	17.14	669	3.14
Erythrocles monodi	14.79	19	2.71
Zeus faber	13.48	32	2.47
Dentex barnardi	8.10	28	1.48
Raja miraletus	7.71	9	1.41
Illex coindetii	6.92	354	1.27
Lepidotrigla cadmani	6.28	47	1.15
Epinephelus aeneus	5.36	4	0.69
Selene dorsalis	5.14	4	0.94
Priacanthus arenatus	4.80	9	0.88
Torpedo torpedo	3.94	4	0.72
Gephyroberyx darwini	3.58	4	0.66
Ariomma bondi	3.54	90	0.65
Anthias anthias	3.43	32	0.63
Todaropsis eblanæ	2.64	15	0.48
Scomber japonicus	2.16	4	0.40
Dentex macropthalmus	2.01	4	0.37
Uranoscopus polli	1.93	4	0.35
Saurida brasiliensis	1.80	51	0.33
Coral	1.18	4	0.22
Spicara alta	1.18	24	0.22
Scorpaena normani	0.47	4	0.09
Total	545.46		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 33
 DATE :02/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 9°55.26
 start stop duration Lon E 13°14.70
 TIME :10:54:06 10:59:52 6.0 (min) Purpose : 1
 LOG : 8861.50 8861.85 0.4 Region : 4040
 FDEPTH: 22 21 Gear cond.: 0
 BDEPTH: 22 21 Validity : 0
 Towing dir: 0° Wire out : 75 m Speed : 3.7 kn
 Sorted : 0 Total catch: 321.57 Catch/hour: 3215.70

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Brachydeuterus auritus	1992.00	30350	61.95
Ilisha africana	368.50	5100	11.46
Galeoides decadactylus	265.00	1600	8.24
Chloroscombrus chrysurus	199.50	2200	6.20
Sphyræna sphyraena	84.50	300	2.63
Drepane africana	77.20	90	2.40
Trichiurus lepturus	60.50	250	1.88
Selene dorsalis	47.50	400	1.48
Pomadasys incisus	45.00	400	1.40
Pteroscion pelli	29.00	550	0.90
Pseudotolithus senegalensis	23.50	50	0.73
Lagocephalus laevigatus	10.50	50	0.33
Chelidonichthys capensis	7.00	50	0.22
Trachurus trecae	6.00	50	0.19
Total	3215.70		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 34
 DATE :02/03/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 9°42.69
 start stop duration Lon E 13°10.48
 TIME :09:16:07 09:22:10 6.0 (min) Purpose : 1
 LOG : 8932.39 8932.75 0.4 Region : 4040
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 26 28 Validity : 0
 Towing dir: 0° Wire out : 90 m Speed : 3.6 kn
 Sorted : 0 Total catch: 213.56 Catch/hour: 2135.60

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Brachydeuterus auritus	999.60	21850	46.81
Sardinella maderensis	831.90	7140	38.95
Pomadasys peroteti	81.90	180	3.83
Sphyræna sphyraena	52.80	110	2.47
Sardinella maderensis	37.40	210	1.75
Caranx crysos	34.60	70	1.62
Galeoides decadactylus	29.00	350	1.36
Ilisha africana	26.90	520	1.26
Chloroscombrus chrysurus	17.50	110	0.82
Trachinotus ovatus	16.40	40	0.77
Eucinostomus melanopterus	5.90	110	0.28
Selene dorsalis	1.70	70	0.08
Total	2135.60		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 35
 DATE :03/03/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 9°19.48
 start stop duration Lon E 12°55.33
 TIME :07:04:40 07:42:14 38.0 (min) Purpose : 1
 LOG : 9021.32 9023.40 2.1 Region : 4040
 FDEPTH: 18 20 Gear cond.: 0
 BDEPTH: 54 45 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.3 kn
 Sorted : 0 Total catch: 0.71 Catch/hour: 1.12

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Alectis alexandrina	1.12	2	100.00
Total	1.12		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 36
 DATE :03/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 9°11.21
 start stop duration Lon E 12°55.89
 TIME :01:36:13 01:52:06 16.0 (min) Purpose : 1
 LOG : 9074.97 9075.79 0.8 Region : 4040
 FDEPTH: 22 22 Gear cond.: 0
 BDEPTH: 22 22 Validity : 0
 Towing dir: 0° Wire out : 90 m Speed : 3.1 kn
 Sorted : 0 Total catch: 567.09 Catch/hour: 2126.59

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Brachydeuterus auritus	991.35	13388	46.62
Selene dorsalis	337.50	14962	15.87
Galeoides decadactylus	213.75	3308	10.05
Chloroscombrus chrysurus	181.35	2498	8.53
Sardinella aurita	73.13	292	3.44
Sardinella maderensis	61.43	1890	2.89
Pomadasys peroteti	61.20	180	2.88
Sphyræna guachancho, juvenile	56.70	2385	2.67
Pseudotolithus senegalensis	55.35	225	2.60
Arius parkii	38.48	180	1.81
Ephippion putifer	23.85	22	1.12
Pomadasys incisus	6.08	22	0.29
Pagellus bellottii	5.85	60	0.28
Scomberomorus tritor	4.24	4	0.20
Eucinostomus melanopterus	3.38	68	0.16
Lagocephalus laevigatus	3.15	22	0.15
Syacium microrum	3.15	22	0.15
Caranx crysos	2.93	22	0.14
Pseudupeneus prayensis	2.85	22	0.13
Decapterus rhonchus, juvenile	0.90	90	0.04
Total	2126.59		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 37
 DATE :04/03/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 8°32.75
 start stop duration Lon E 13°15.36
 TIME :08:07:19 08:13:48 6.0 (min) Purpose : 1
 LOG : 9307.28 9307.65 0.4 Region : 4054
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 50 53 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.3 kn
 Sorted : 0 Total catch: 187.47 Catch/hour: 1874.70

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Chloroscombrus chrysurus	877.50	13230	46.81
Brachydeuterus auritus	498.00	9280	26.56
Sardinella maderensis	292.80	2640	15.62
Sardinella aurita	163.20	1560	8.71
Selene dorsalis	21.00	90	1.12
Sphyræna guachancho	12.60	260	0.67
Ilisha africana	6.90	90	0.37
Bregmaceros sp.	2.10	630	0.11
Illex coindetii	0.60	180	0.03
Total	1874.70		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 38
 DATE :05/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 8°15.66
 start stop duration Lon E 13°16.63
 TIME :05:06:48 05:27:14 20.0 (min) Purpose : 1
 LOG : 9387.49 9388.76 1.3 Region : 4054
 FDEPTH: 25 24 Gear cond.: 0
 BDEPTH: 25 24 Validity : 0
 Towing dir: 0° Wire out : 72 m Speed : 3.7 kn
 Sorted : 0 Total catch: 759.99 Catch/hour: 2279.97

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Brachydeuterus auritus	889.80	17649	39.03
Ilisha africana	642.63	14253	28.19
Galeoides decadactylus	176.01	879	7.72
Sphyræna sphyraena	142.08	348	6.23
Selene dorsalis	119.40	2148	5.24
Chloroscombrus chrysurus	89.64	1179	3.93
Trachinotus teraia	75.30	24	3.30
Drepane africana	49.68	117	2.18
Stromateus fiatola	23.34	117	1.02
Scomberomorus tritor	22.17	24	0.97
Pseudotolithus typus	13.86	24	0.61
Trichiurus lepturus	12.48	93	0.55
Pomadasys peroteti	6.93	45	0.30
Penaeus notialis	6.69	138	0.29
Lagocephalus laevigatus	3.93	24	0.17
Sardinella maderensis	3.48	369	0.5
Pteroscion pelli	2.55	69	0.11
Total	2279.97		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 39
 DATE :05/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 8°15.54
 start stop duration Purpose : 1
 TIME :07:33:56 07:52:38 19.0 (min) Region : 4054
 LOG : 9403.55 9404.63 1.1 Gear cond.: 0
 FDEPTH: 84 78 Validity : 0
 BDEPTH: 84 78 Speed : 3.5 kn
 Towing dir: 0° Wire out : 200 m
 Sorted : 0 Total catch: 732.96 Catch/hour: 2314.61

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	1251.09	15205	54.05	90
Sardinella aurita	256.36	1478	11.08	91
Trachurus trecae	242.15	2700	10.46	92
Trichurus lepturus	189.85	625	8.20	
Selene dorsalis	102.60	824	4.43	93
Dentex angolensis	63.66	398	2.75	94
Chrysaora sp.	60.54	28	2.62	
Galeoides decadactylus	31.55	57	1.36	
Pomadasy peroteti	30.98	28	1.34	
Pomadasy incisus	24.73	85	1.07	
Sardinella maderensis	19.89	57	0.86	
Sphyræna sphyraena	18.76	28	0.81	
Pagellus bellottii	11.94	28	0.52	
Boops boops	10.52	28	0.45	
Total	2314.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 40
 DATE :05/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 8°9.23
 start stop duration Purpose : 1
 TIME :01:29:00 01:40:19 11.0 (min) Region : 4054
 LOG : 9455.08 9455.69 0.6 Gear cond.: 0
 FDEPTH: 78 80 Validity : 0
 BDEPTH: 78 80 Speed : 3.2 kn
 Towing dir: 0° Wire out : 200 m
 Sorted : 0 Total catch: 117.39 Catch/hour: 640.31

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	447.00	6322	69.81	95
Trachurus trecae	54.38	1255	8.49	96
Trichurus lepturus	43.80	76	6.84	
Dentex barnardi	32.78	147	5.12	98
Octopus vulgaris	15.87	5	2.48	
Dentex angolensis	14.89	125	2.33	97
Galeoides decadactylus	10.53	27	1.64	
Pseudotolithus senegalensis	6.33	5	0.99	
Pomadasy peroteti	4.64	11	0.72	
Pseudupeneus prayensis	4.64	49	0.72	
Selene dorsalis	2.35	22	0.37	
Pagellus bellottii	1.69	11	0.26	
Sardinella aurita	1.47	60	0.23	99
Total	640.36		100.01	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 41
 DATE :05/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 8°4.01
 start stop duration Purpose : 1
 TIME :04:51:44 05:07:19 16.0 (min) Region : 4054
 LOG : 9483.07 9483.85 0.8 Gear cond.: 0
 FDEPTH: 82 78 Validity : 0
 BDEPTH: 82 78 Speed : 3.0 kn
 Towing dir: 0° Wire out : 200 m
 Sorted : 0 Total catch: 147.58 Catch/hour: 553.43

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	400.88	4324	72.44	102
Dentex angolensis	62.06	319	11.21	101
Trichurus lepturus	47.25	92	8.54	
Trachurus trecae	21.86	611	3.95	100
Illex coindetii	7.05	2419	1.27	
Pomadasy peroteti	4.31	11	0.78	
Zeus faber	3.56	11	0.64	
Sepia orbignyana	3.53	4	0.64	
Chaetodon hoefleri	1.61	11	0.29	
Pagellus bellottii	0.94	19	0.17	
Citharus linguatula	0.38	11	0.07	
Total	553.42		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 42
 DATE :05/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 8°5.46
 start stop duration Purpose : 1
 TIME :06:20:48 06:43:08 22.0 (min) Region : 4054
 LOG : 9491.38 9492.63 1.3 Gear cond.: 0
 FDEPTH: 102 95 Validity : 0
 BDEPTH: 102 95 Speed : 3.3 kn
 Towing dir: 0° Wire out : 250 m
 Sorted : 0 Total catch: 146.25 Catch/hour: 398.86

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scorpaena normani	60.95	614	15.28	
Pagellus bellottii	49.00	581	12.03	106
Dentex angolensis	46.36	491	11.62	105
Chelidonichthys capensis	40.91	199	10.26	
Citharus linguatula	39.14	1129	9.81	
Brotula barbata	34.69	76	8.70	
Brachydeuterus auritus	30.35	281	7.61	104
Umbra canariensis	17.95	136	4.50	
Uranoscopus polli	12.63	104	3.17	
Pterothrissus belloci	11.40	49	2.86	
Trichurus lepturus	6.76	14	1.70	
Atractoscion aeguidens	5.86	8	1.47	
Pegusa lascaris	5.45	14	1.37	
Nettastoma sp.	4.04	90	1.01	
Spheroidea pachgaster	3.76	8	0.94	
Nematocarcinus africanus	3.41	281	0.85	
Zeus faber	2.86	8	0.72	
Torpedo torpedo	2.86	22	0.72	
Boops boops	2.86	22	0.72	
Thorogobius angolensis	2.59	158	0.65	
Squilla mantis	2.54	14	0.64	
Microchirus frachkopi	2.54	8	0.64	
Saurida brasiliensis	2.45	22	0.62	
Rhinobatos albomaculatus	2.05	3	0.51	
Pentheroscion mbizi	1.85	8	0.46	
Octopus vulgaris	1.77	3	0.44	
Trachurus trecae	1.72	46	0.43	103
Raja miraletus	0.82	8	0.21	
Antennarius occidentalis	0.27	14	0.07	
Total	398.86		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 43
 DATE :06/03/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 7°56.28
 start stop duration Purpose : 1
 TIME :02:14:19 02:29:38 15.0 (min) Region : 4054
 LOG : 9558.07 9558.97 0.9 Gear cond.: 0
 FDEPTH: 10 10 Validity : 0
 BDEPTH: 52 46 Speed : 3.5 kn
 Towing dir: 0° Wire out : 0 m
 Sorted : 0 Total catch: 80.98 Catch/hour: 323.92

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	166.08	1888	51.27	107
Sardinella maderensis	111.60	820	34.45	108
Sphyræna guachancho	17.00	84	5.25	
Selene dorsalis	11.84	156	3.66	109
Chloroscombrus chrysurus	4.60	60	1.42	110
Trachurus trecae	3.44	24	1.06	112
Euthynnus alletteratus	3.08	8	0.95	111
Ilisha africana	3.08	36	0.95	
Illex coindetii	1.56	416	0.48	
Lagocephalus laevigatus	1.08	4	0.33	
Sardinella aurita	0.48	4	0.15	
Bregmaceros sp.	0.08	60	0.02	
Total	323.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 44
 DATE :06/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°51.03
 start stop duration Purpose : 1
 TIME :04:08:56 04:23:37 15.0 (min) Region : 4054
 LOG : 9570.03 9570.81 0.8 Gear cond.: 0
 FDEPTH: 46 50 Validity : 0
 BDEPTH: 46 50 Speed : 3.2 kn
 Towing dir: 0° Wire out : 120 m
 Sorted : 0 Total catch: 126.65 Catch/hour: 506.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	142.12	3252	28.05	114
Galeoides decadactylus	136.40	632	26.92	
Pseudotolithus senegalensis	59.60	104	11.76	
Pomadasy incisus	51.40	360	10.15	
Trachurus trecae	43.60	272	8.61	113
Cynoglossus canariensis	10.60	72	2.09	
Raja miraletus	10.20	32	2.01	
Citharus linguatula	7.52	260	1.48	
Chelidonichthys capensis	7.12	32	1.41	
Chloroscombrus chrysurus	6.72	80	1.33	116
Pomadasy peroteti	6.12	20	1.21	
Sepia orbignyana	6.00	80	1.18	
Brachydeuterus auritus	5.04	20	0.99	
Selene dorsalis	4.92	60	0.97	115
Sphyræna guachancho	2.32	20	0.46	
Syacium micrum	1.72	12	0.34	
Uranoscopus cadenati	1.52	12	0.30	
Pseudupeneus prayensis	1.40	52	0.28	
Dicolloglossa cuneata	1.32	20	0.26	
Grammolites gruvelli	0.32	20	0.06	
Thorogobius angolensis	0.32	332	0.06	
Nettastoma sp.	0.20	12	0.04	
Illex coindetii	0.12	40	0.02	
Total	506.60		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 45
 DATE :06/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°42.71
 start stop duration Purpose : 1
 TIME :12:40:47 12:48:33 8.0 (min) Region : 4054
 LOG : 9632.56 9632.97 0.4 Gear cond.: 0
 FDEPTH: 40 40 Validity : 0
 BDEPTH: 40 40 Speed : 3.2 kn
 Towing dir: 0° Wire out : 100 m
 Sorted : 0 Total catch: 913.11 Catch/hour: 6848.33

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	6649.95	87788	97.10	117
Selene dorsalis	154.13	1815	2.25	119
Pagellus bellottii	16.88	165	0.25	120
Sardinella maderensis	8.03	60	0.12	118
Sphyræna guachancho	5.55	15	0.08	
Pseudotolithus senegalensis	5.55	8	0.08	
Chilomycterus spinosus mauret.	4.88	8	0.07	
Sphyræna sphyraena	3.23	15	0.05	
Raja miraletus	0.15	8	0.00	
Total	6848.33		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 46
 DATE :06/03/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 7°37.22
 start stop duration Purpose : 1
 TIME :02:09:06 02:18:40 10.0 (min) Region : 4054
 LOG : 9643.31 9643.82 0.5 Gear cond.: 0
 FDEPTH: 0 0 Validity : 0
 BDEPTH: 32 35 Speed : 3.2 kn
 Towing dir: 0° Wire out : 90 m
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 47
 DATE :07/03/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 7°13.07
 start stop duration Purpose : 1
 TIME :06:09:58 06:40:32 31.0 (min) Region : 4054
 LOG : 9786.02 9787.51 1.5 Gear cond.: 0
 FDEPTH: 8 10 Validity : 0
 BDEPTH: 22 27 Speed : 2.9 kn
 Towing dir: 0° Wire out : 100 m
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 48
 DATE :07/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°24.69
 start stop duration Lon E 12°27.80
 TIME :10:06:44 10:24:43 18.0 (min) Purpose : 1
 LOG : 9810.00 9810.94 0.9 Region : 4054
 FDEPTH: 116 114 Gear cond.: 0
 BDEPTH: 116 114 Validity : 0
 Towing dir: 0° Wire out : 300 m Speed : 3.2 km
 Sorted : 0 Total catch: 132.89 Catch/hour: 442.97

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Dentex angolensis	126.43	1060	28.54
Argyrosomus hololepidotus	124.00	30	27.99
Umbrina canariensis	72.40	290	16.34
Dentex congoensis	46.73	537	10.55
Hyperoglyphe moselii *	25.23	3	5.70
Dentex barnardi	17.70	57	4.00
Zeus faber	7.70	23	1.74
Trachurus trecae	7.50	217	1.69
Lepidotrigla cadmani	6.90	53	1.56
Branchiostegus semifasciatus *	3.37	3	0.76
Boops boops	2.27	117	0.51
Pagellus bellottii	1.40	7	0.32
Chelidonichthys capensis	0.50	3	0.11
Illex coindetii	0.30	33	0.07
Citharus linguatula	0.27	7	0.06
Brachydeuterus auritus	0.27	3	0.06
Total	442.97		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 49
 DATE :07/03/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 7°8.28
 start stop duration Lon E 12°41.82
 TIME :06:04:42 06:08:22 4.0 (min) Purpose : 1
 LOG : 9862.75 9862.96 0.2 Region : 4054
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 25 26 Validity : 0
 Towing dir: 0° Wire out : 90 m Speed : 3.4 km
 Sorted : 0 Total catch: 5.31 Catch/hour: 79.65

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella maderensis	59.85	660	75.14
Sardinella aurita	15.75	105	19.77
Selene dorsalis	4.05	45	5.08
Total	79.65		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 50
 DATE :07/03/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 7°8.26
 start stop duration Lon E 12°41.83
 TIME :06:41:55 07:11:52 30.0 (min) Purpose : 1
 LOG : 9864.92 9866.89 2.0 Region : 4054
 FDEPTH: 10 15 Gear cond.: 0
 BDEPTH: 25 33 Validity : 0
 Towing dir: 0° Wire out : 70 m Speed : 3.9 km
 Sorted : 0 Total catch: 31.11 Catch/hour: 62.22

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella aurita	29.36	166	47.19
Sardinella maderensis	29.16	284	46.87
Decapterus rhonchus	2.42	18	3.89
Selene dorsalis	1.28	6	2.06
Total	62.22		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 51
 DATE :11/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°17.87
 start stop duration Lon E 12°27.92
 TIME :07:40:08 08:02:42 23.0 (min) Purpose : 1
 LOG : 152.38 153.63 1.3 Region : 4054
 FDEPTH: 94 94 Gear cond.: 0
 BDEPTH: 94 94 Validity : 0
 Towing dir: 0° Wire out : 250 m Speed : 3.3 km
 Sorted : 0 Total catch: 278.47 Catch/hour: 726.44

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Atractoscion aequidens	382.33	219	52.63
Decapterus rhonchus	200.97	451	27.67
Dentex barnardi	91.10	224	12.54
Rhinobatos albomaculatus	14.14	10	1.95
Pagellus bellottii	10.67	29	1.47
Pomadourus incanus	10.20	47	1.40
Trachurus trecae	7.04	21	0.97
Dentex congoensis	3.10	18	0.43
Fistularia petimba	2.11	10	0.29
Dentex angolensis	1.59	5	0.22
Sperus pagrus africanus *	1.46	5	0.20
Raja miraletus	1.12	5	0.15
Illex coindetii	0.60	723	0.08
Total	726.44		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 52
 DATE :11/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°6.29
 start stop duration Lon E 12°4.76
 TIME :05:22:35 05:41:54 19.0 (min) Purpose : 1
 LOG : 238.74 239.81 1.1 Region : 4054
 FDEPTH: 127 124 Gear cond.: 0
 BDEPTH: 127 124 Validity : 0
 Towing dir: 0° Wire out : 310 m Speed : 3.3 km
 Sorted : 0 Total catch: 88.96 Catch/hour: 280.93

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Dentex congoensis	73.96	480	26.33
Umbrina canariensis	48.13	152	17.13
Dentex angolensis	47.37	208	16.86
Spicara alta	32.78	158	11.67
Zenopsis conchifer	15.60	19	5.55
Trachurus trecae	11.37	177	4.05
Spherooides pachgaster	9.79	13	3.48
Branchiostegus semifasciatus *	8.31	6	2.96
Atractoscion aequidens	5.97	3	2.12
Zeus faber	5.87	6	2.09
Trichiurus lepturus	3.16	3	1.12
Brotula barbata	2.72	3	0.97
Priacanthus arenatus	2.68	3	0.96
Boops boops	2.56	60	0.91
Illex coindetii	2.43	76	0.87
Saurida brasiliensis	2.24	316	0.80
Pagellus bellottii	1.33	3	0.47
Citharus linguatula	1.29	25	0.46
Syacium micrurum	1.14	9	0.40
Nettastoma sp.	1.14	3	0.40
Lepidotrigla carolae	1.11	3	0.39
Total	280.93		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 53
 DATE :11/03/13 GEAR TYPE: PT NO: 2 POSITION:Lat S 7°8.17
 start stop duration Lon E 12°1.28
 TIME :06:51:39 07:43:25 52.0 (min) Purpose : 1
 LOG : 246.93 250.24 3.3 Region : 4054
 FDEPTH: 75 115 Gear cond.: 0
 BDEPTH: 207 218 Validity : 0
 Towing dir: 0° Wire out : 250 m Speed : 3.8 km
 Sorted : 0 Total catch: 10.34 Catch/hour: 11.93

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Atractoscion aequidens	4.89	1	41.01
TRICHIURUS lepturus	2.35	3	19.73
Synagrops microlepis	1.72	120	14.41
J E L V F S H	0.55	5	4.64
Parapenaeus longirostris	0.51	150	4.26
Parapandalus narval	0.44	292	3.68
Myctophidae sp. small/mix	0.42	332	3.48
Nettastoma sp.	0.28	20	2.32
Gephyroberyx darwini	0.28	1	2.32
Echeneis naucrates	0.22	1	1.84
Saurida brasiliensis	0.08	27	0.68
Lepidotrigla carolae	0.05	1	0.39
Ommastrephes sp.	0.03	10	0.29
Illex coindetii	0.02	1	0.19
Lestidiops sp.	0.02	2	0.19
Zenopsis conchifer	0.01	0	0.10
NOMIDAE	0.01	1	0.10
Ophidion sp.	0.01	8	0.10
Sepia officinalis	0.01	1	0.10
Monolepis sp.	0.01	1	0.10
EXOCESTIDAE	0.01	1	0.10
Total	11.93		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 54
 DATE :12/03/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 6°44.17
 start stop duration Lon E 12°25.14
 TIME :02:12:09 02:29:05 17.0 (min) Purpose : 1
 LOG : 308.90 309.93 1.0 Region : 4054
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 23 22 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.6 km
 Sorted : 0 Total catch: 90.44 Catch/hour: 319.20

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Alectis alexandrina	240.71	342	75.41
Selene dorsalis	33.18	201	10.39
Sphyræna sphyraena	12.92	18	4.05
Scomberomorus tritor	10.24	18	3.21
Euthymus alletteratus	6.67	7	2.09
Elops lacerta	3.49	7	1.09
Decapterus rhonchus	3.04	4	0.95
Caranx crysos	1.73	4	0.54
Ballistes capriscus	1.62	4	0.51
Pagrus caeruleostictus	1.59	4	0.50
Pagellus bellottii	1.55	56	0.49
Brachydeuterus auritus	1.45	11	0.45
Eucinostomus melanopterus	0.56	11	0.18
Galeoides decadactylus	0.32	4	0.10
Sardinella aurita	0.04	4	0.01
Pseudupeneus prayensis	0.04	4	0.01
Penaeus notialis	0.04	4	0.01
Penaeus kerathurus	0.04	4	0.01
Total	319.20		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 55
 DATE :12/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 6°39.38
 start stop duration Lon E 12°5.62
 TIME :03:28:34 03:57:36 29.0 (min) Purpose : 1
 LOG : 427.61 429.18 1.6 Region : 4054
 FDEPTH: 76 72 Gear cond.: 0
 BDEPTH: 76 72 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 3.2 km
 Sorted : 0 Total catch: 34.46 Catch/hour: 71.30

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Selene dorsalis	27.48	43	38.54
Squatina oculata	12.87	2	18.05
Lagocephalus laevigatus	5.96	6	8.36
Trichiurus lepturus	4.82	10	6.76
Pagellus bellottii	4.53	50	6.36
Mustelus mustelus	3.89	2	5.46
Decapterus rhonchus	2.57	2	3.60
Torpedo torpedo	2.44	2	3.42
Caranx crysos	2.13	2	2.99
Fistularia petimba	1.59	6	2.23
Lepidotrigla cadmani	1.01	10	1.42
Zeus faber	0.64	2	0.90
Dentex angolensis	0.50	2	0.70
Dentex congoensis	0.41	6	0.58
Illex coindetii	0.23	17	0.32
Alloteuthis africana	0.23	68	0.32
Total	71.30		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 56
 DATE :12/03/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 6°26.08
 start stop duration Lon E 12°16.45
 TIME :11:59:46 12:29:22 1410.0 (min) Purpose : 1
 LOG : 506.37 507.72 1.4 Region : 4054
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 28 28 Validity : 0
 Towing dir: 0° Wire out : 110 m Speed : 2.7 km
 Sorted : 0 Total catch: 10.40 Catch/hour: 0.44

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Ilisha africana	0.27	13	60.46
Brachydeuterus auritus	0.05	6	12.02
Chloroscombrus chrysurus	0.04	0	9.71
Hemicaranx bicolor	0.04	0	9.04
Dactylopterus volitans	0.03	0	6.82
Selene dorsalis	0.01	0	1.73
Sardinella maderensis	0.00	0	0.10
Penaeus kerathurus	0.00	0	0.10
Sardinella aurita	0.00	0	0.01
Sepia officinalis	0.00	0	0.01
Callinectes amnicola	0.00	0	0.01
Total	0.44		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 57
 DATE :15/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 6°13.28
 start stop duration Lon E 12°4.92
 TIME :12:30:29 12:58:59 28.0 (min) Purpose : 1
 LOG : 608.29 609.68 1.4 Region : 4054
 FDEPTH: 44 40 Gear cond.: 0
 BDEPTH: 44 40 Validity : 0
 Towing dir: 0° Wire out : 115 m Speed : 2.9 km
 Sorted : 0 Total catch: 41.71 Catch/hour: 89.38

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Alectis alexandrina	22.37	19	25.03
Selene dorsalis	10.37	34	11.60
Trichiurus lepturus	7.95	17	8.89
Lagocephalus laevisgatus	7.95	17	8.89
Epinephelus aeneus	5.91	2	6.62
Scomberomorus tritor	5.68	4	6.35
Ballistes capricus	5.66	11	6.33
J E L Y F I S H	5.12	2	5.73
Pagrus caeruleostictus	4.67	11	5.23
Sparus pagrus africanus *	3.96	6	4.44
Elops lacerta	3.90	6	4.36
Alloteuthis africana	2.25	641	2.52
Raja miraletus	1.78	2	1.99
Pagellus bellottii	1.05	4	1.17
Brachydeuterus auritus	0.71	11	0.79
Decapterus rhonchus	0.04	2	0.05
Total	89.38		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 58
 DATE :15/03/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 8°3.83
 start stop duration Lon E 13°0.83
 TIME :12:51:27 12:58:49 7.0 (min) Purpose : 1
 LOG : 870.67 871.11 0.4 Region : 4054
 FDEPTH: 0 25 Gear cond.: 0
 BDEPTH: 79 81 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.6 km
 Sorted : 0 Total catch: 23.35 Catch/hour: 200.14

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella maderensis	182.23	969	91.05
Sardinella aurita	11.74	60	5.87
Brachydeuterus auritus	3.86	51	1.93
Trachurus trecae	0.77	26	0.39
Alloteuthis africana	0.69	206	0.34
Bregmaceros sp.	0.60	591	0.30
Saurida brasiliensis	0.17	60	0.09
Sepiella ornata	0.09	17	0.04
Total	200.14		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 59
 DATE :15/03/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 8°8.38
 start stop duration Lon E 13°1.61
 TIME :07:05:20 07:32:13 27.0 (min) Purpose : 1
 LOG : 918.35 919.76 1.4 Region : 4054
 FDEPTH: 20 23 Gear cond.: 0
 BDEPTH: 86 86 Validity : 0
 Towing dir: 0° Wire out : 90 m Speed : 3.1 km
 Sorted : 0 Total catch: 4.39 Catch/hour: 9.76

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella aurita	4.69	20	48.05
Sardinella maderensis	4.51	22	46.23
J E L Y F I S H	0.49	2	5.01
Sepiella ornata	0.04	7	0.46
Alloteuthis africana	0.02	16	0.23
Octopus vulgaris	0.00	2	0.03
Total	9.76		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 60
 DATE :15/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 8°6.58
 start stop duration Lon E 13°10.08
 TIME :12:24:37 12:42:34 18.0 (min) Purpose : 1
 LOG : 958.02 959.09 1.1 Region : 4054
 FDEPTH: 36 29 Gear cond.: 0
 BDEPTH: 36 29 Validity : 0
 Towing dir: 0° Wire out : 90 m Speed : 3.6 km
 Sorted : 0 Total catch: 339.13 Catch/hour: 1130.43

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Ilisha africana	373.70	11077	33.06
Galeoides decadaactylus	291.30	1220	25.77
Brachydeuterus auritus	171.93	5033	15.21
Pseudotolithus senegalensis	66.20	110	5.86
Sphyrna guachancho	50.80	407	4.49
Stromateus fiatola	45.87	110	4.06
Drepane africana	39.70	50	3.51
Pomadasy incisus	23.43	187	2.07
Pteroscion pelli	18.50	320	1.64
Trichiurus lepturus	13.43	110	1.19
Selene dorsalis	11.73	173	1.04
Chloroscombrus chrysurus	5.67	63	0.50
Dasyatis margarita	4.43	3	0.39
Pomadasy peroteti	3.10	13	0.27
SALPS	2.83	13	0.25
Pagellus bellottii	2.70	13	0.24
Sepia officinalis	2.00	3	0.18
Penaeus notialis	1.33	13	0.12
Eucinostomus melanopterus	1.00	13	0.09
Sardinella maderensis	0.63	63	0.06
Decapterus rhonchus	0.13	13	0.01
Sepiella ornata	0.01	13	0.00
Total	1130.45		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 61
 DATE :15/03/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 8°12.68
 start stop duration Lon E 13°3.29
 TIME :05:49:41 06:21:52 32.0 (min) Purpose : 1
 LOG : 995.93 997.81 1.9 Region : 4054
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 86 76 Validity : 0
 Towing dir: 0° Wire out : 80 m Speed : 3.5 km
 Sorted : 0 Total catch: 21.92 Catch/hour: 41.10

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella maderensis	27.64	142	67.24
Trichiurus lepturus	3.51	8	8.53
Sphyrna guachancho	2.55	26	6.20
Sardinella aurita	2.17	17	5.29
Brachydeuterus auritus	1.97	22	4.79
Trachurus trecae	1.37	41	3.33
Alloteuthis africana	0.62	188	1.51
Illex coindetii	0.62	446	1.51
Saurida brasiliensis	0.60	131	1.46
Sepiella ornata	0.04	4	0.09
Bregmaceros sp.	0.02	28	0.05
Total	41.10		100.00

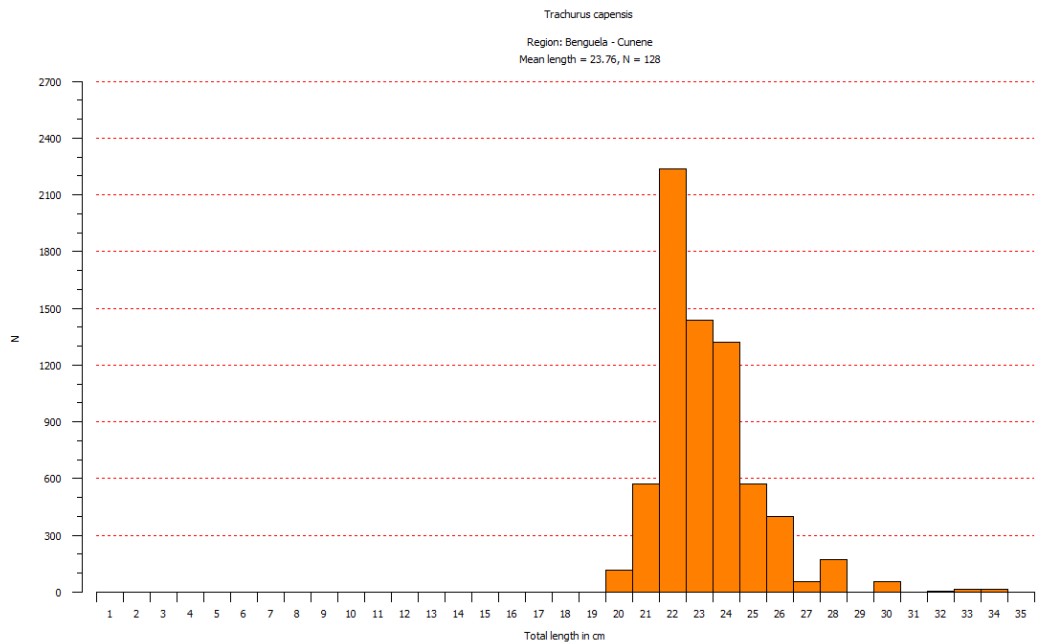
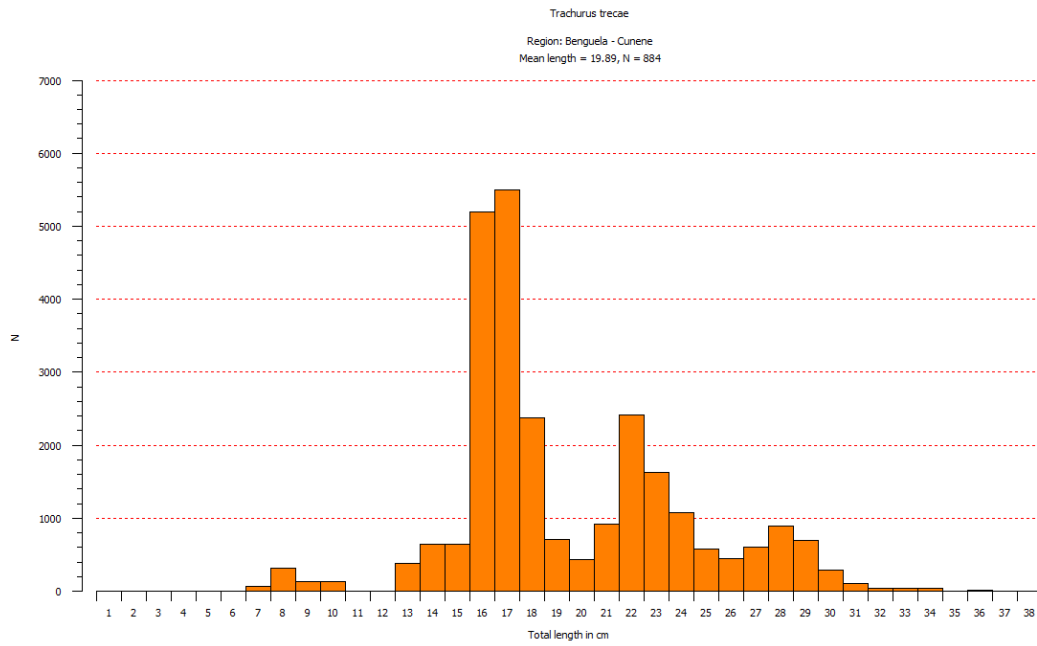
R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 62
 DATE :15/03/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 8°9.21
 start stop duration Lon E 13°3.51
 TIME :11:08:47 11:31:22 23.0 (min) Purpose : 1
 LOG : 1037.94 1039.12 1.2 Region : 4054
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 76 69 Validity : 0
 Towing dir: 0° Wire out : 110 m Speed : 3.1 km
 Sorted : 0 Total catch: 24.31 Catch/hour: 63.42

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella maderensis	49.41	300	77.91
Sardinella aurita	9.29	65	14.64
Brachydeuterus auritus	2.66	39	4.20
Sphyrna guachancho	1.12	8	1.77
Echeneis naucrates	0.50	5	0.78
Selene dorsalis	0.23	3	0.37
Decapterus rhonchus	0.13	5	0.21
Saurida brasiliensis	0.05	13	0.08
Engraulis encrasicolus	0.03	18	0.04
Total	63.42		100.00

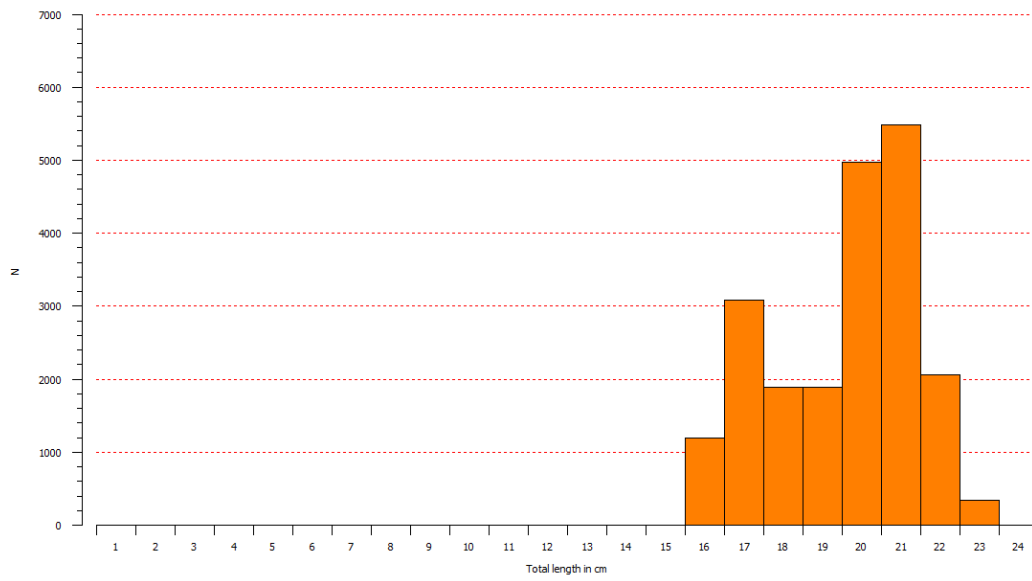
R/V Dr. Fridtjof Nansen SURVEY:2013402 STATION: 63
 DATE :16/03/13 GEAR TYPE: BT NO: 26 POSITION:Lat S 8°3.59
 start stop duration Lon E 13°4.28
 TIME :05:48:47 06:16:16 27.0 (min) Purpose : 1
 LOG : 1093.01 1094.46 1.5 Region : 4054
 FDEPTH: 63 72 Gear cond.: 0
 BDEPTH: 63 72 Validity : 0
 Towing dir: 0° Wire out : 165 m Speed : 3.2 km
 Sorted : 0 Total catch: 166.57 Catch/hour: 370.16

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Brachydeuterus auritus	134.78	2467	36.41
Galeoides decadaactylus	61.11	222	16.51
Stromateus fiatola	42.56	56	11.50
Trachurus trecae	31.33	322	8.46
Pomadasy incisus	21.96	53	5.93
Selene dorsalis	20.84	233	5.63
Sphyrna guachancho	10.67	93	2.88
Engraulis encrasicolus	9.78	3262	2.64
Dentex angolensis	9.73	67	2.63
Pagellus bellottii	6.40	71	1.73
Zeus faber	6.07	11	1.64
Raja miraletus	5.78	4	1.56
Fistularia petimba	2.51	11	0.68
Sardinella maderensis	1.36	7	0.37
Sarda sarda	1.29	2	0.35
Torpedo torpedo	1.11	4	0.30
Lagocephalus laevisgatus	1.11	2	0.30
Chloroscombrus chrysurus	0.78	4	0.21
Pseudupeneus prayensis	0.33	11	0.09
Citharus linguatula	0.33	11	0.09
Sardinella aurita	0.22	4	0.06
Decapterus rhonchus	0.06	4	0.02
Alloteuthis africana	0.06	122	0.02
Total	370.16		100.00

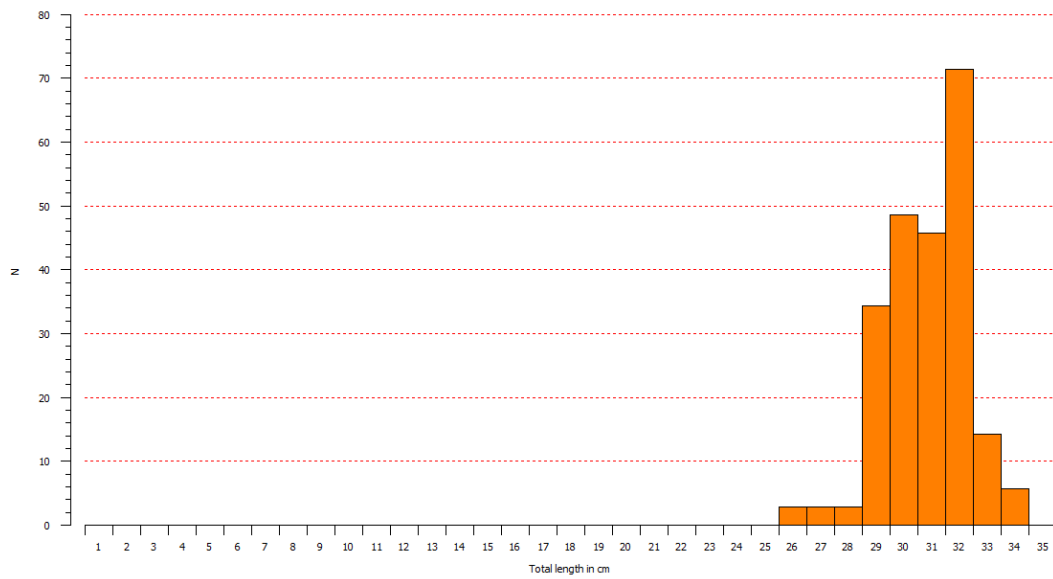
ANNEX II Length frequencies of main species



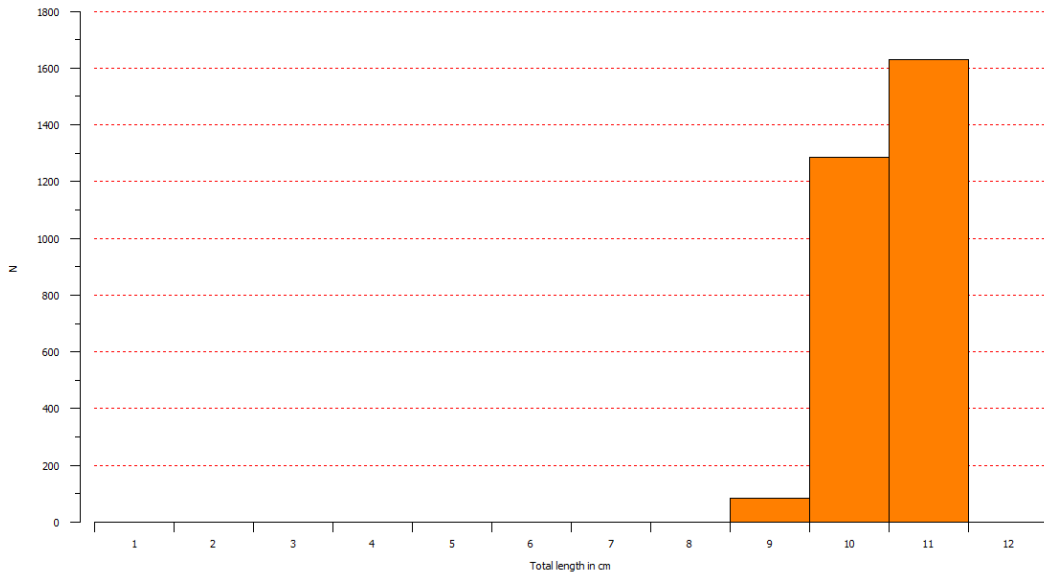
Sardinella aurita
Region: Benguela - Cunene
Mean length = 20.07, N = 122



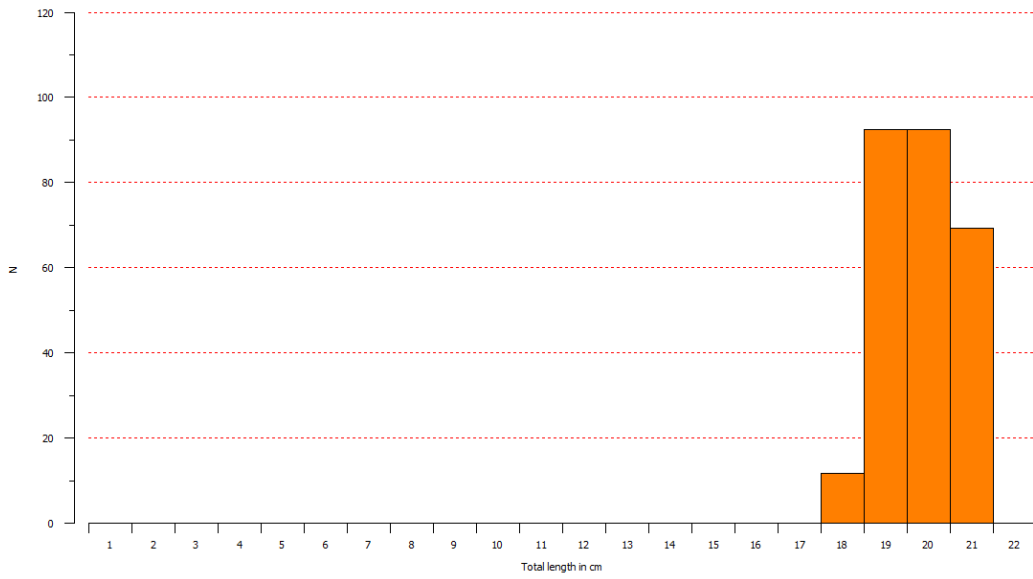
Sardinella maderensis
Region: Benguela - Cunene
Mean length = 31.35, N = 80

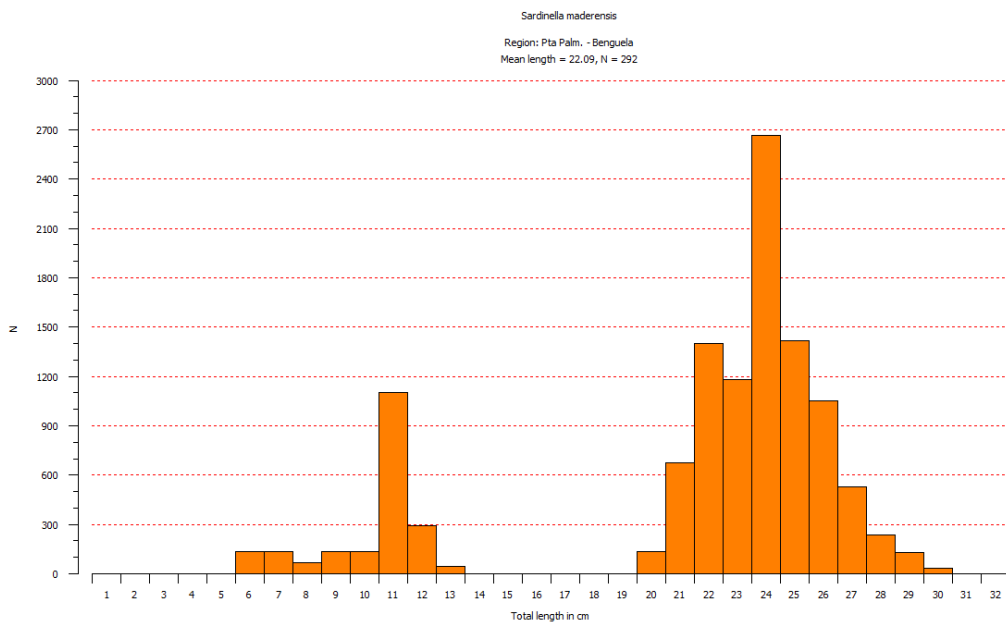
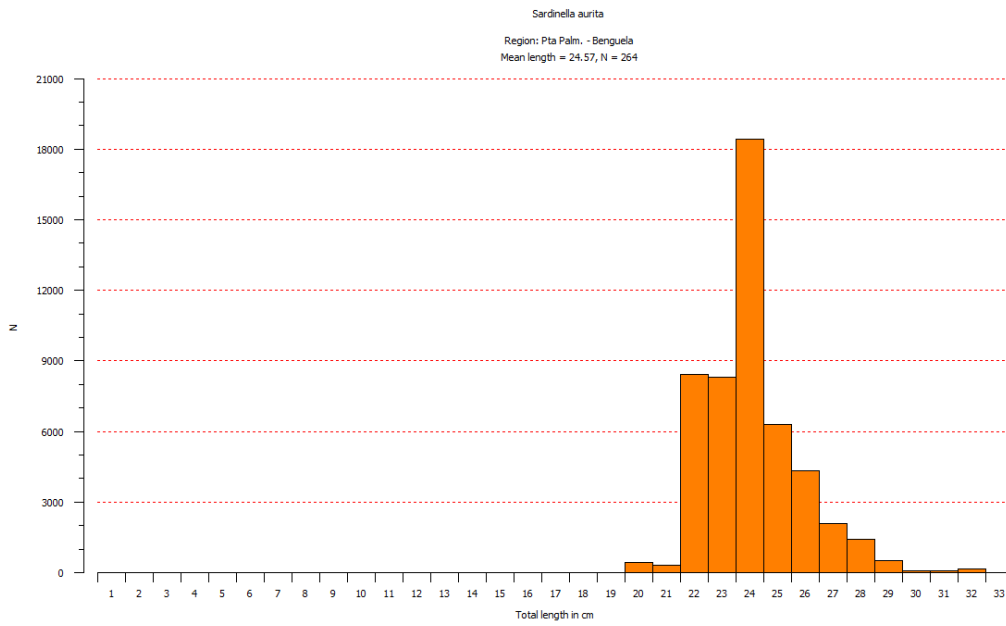


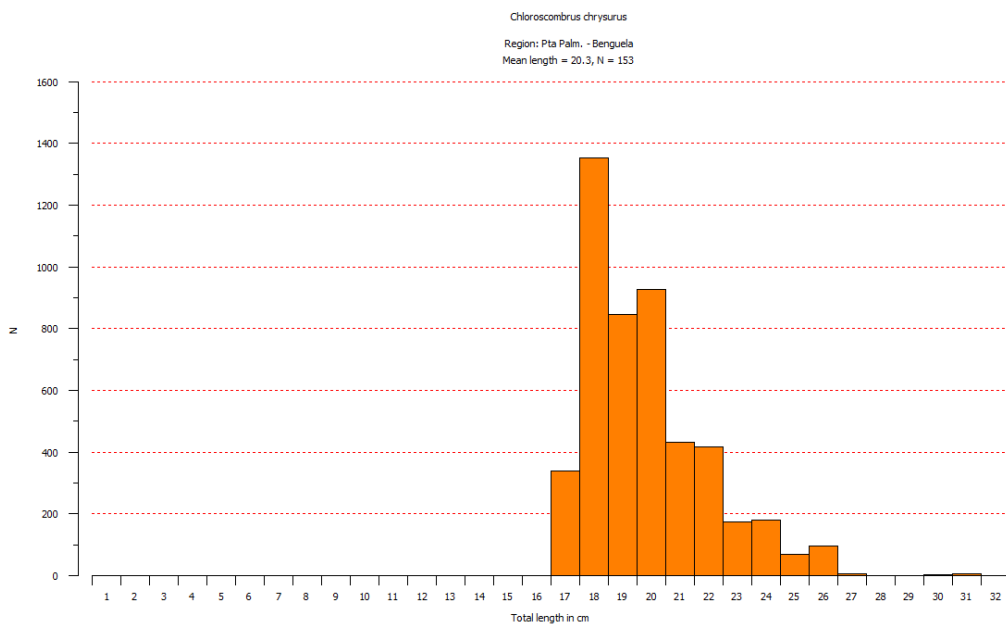
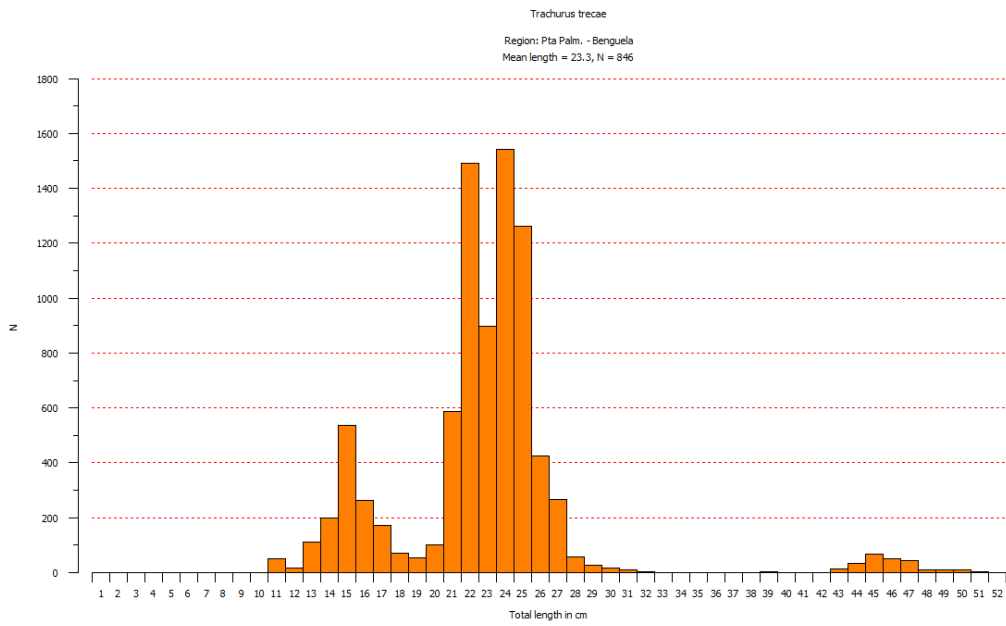
Engraulis encrasicolus
Region: Benguela - Cunene
Mean length = 11.01, N = 35



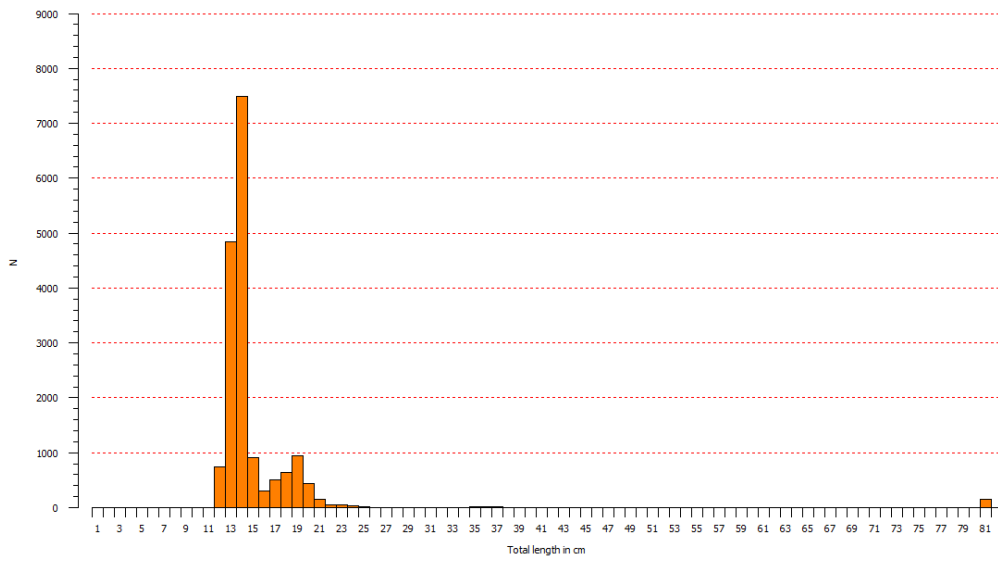
Etrumeus whiteheadi
Region: Benguela - Cunene
Mean length = 20.33, N = 23



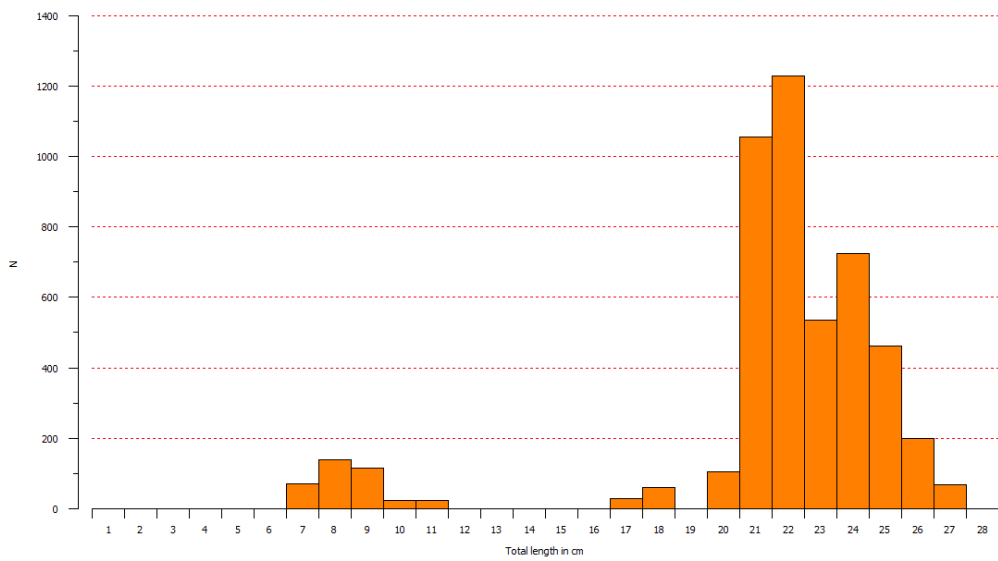




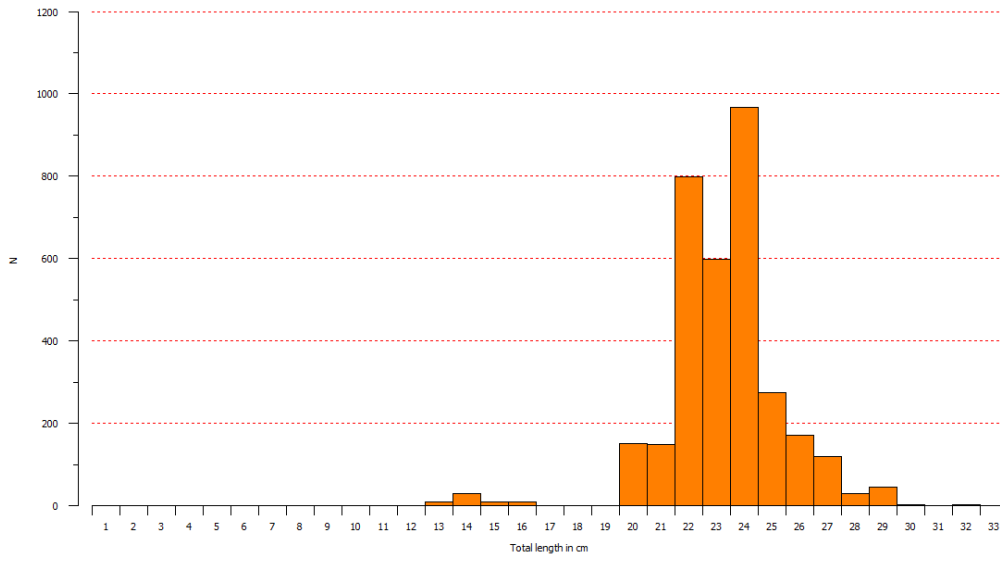
Selene dorsalis
Region: Pta Palm. - Benguela
Mean length = 15.65, N = 251



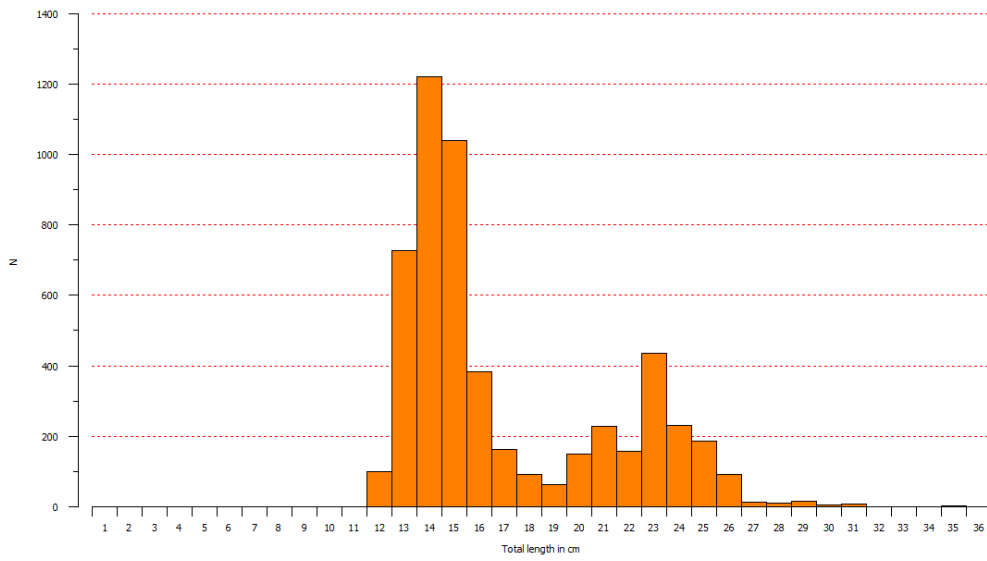
Sardinella maderensis
Region: Pta.das Palmeirinhas - Congo River
Mean length = 22.05, N = 377



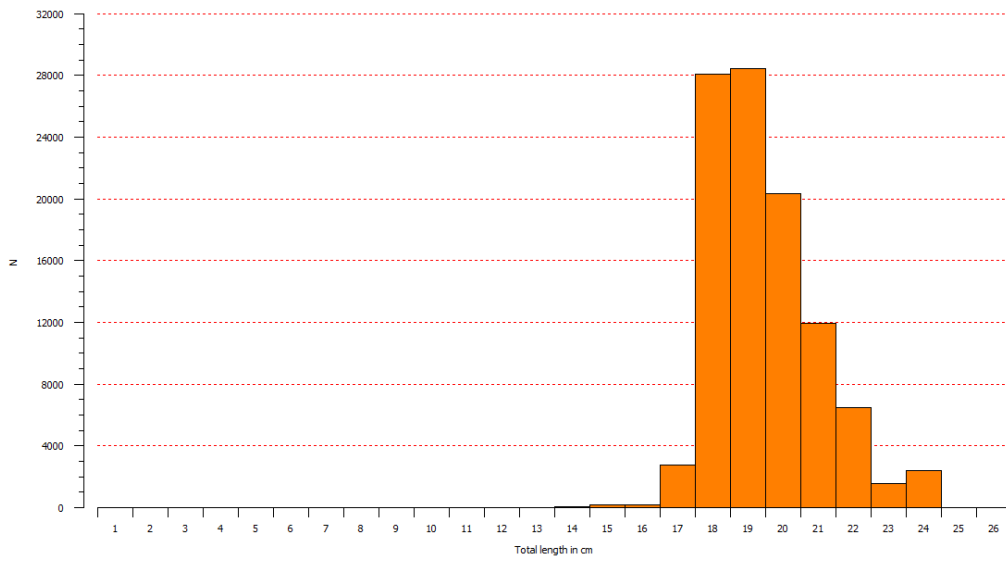
Sardinella aurita
Region: Pta.das Palmeirinhas - Congo River
Mean length = 23.77, N = 200



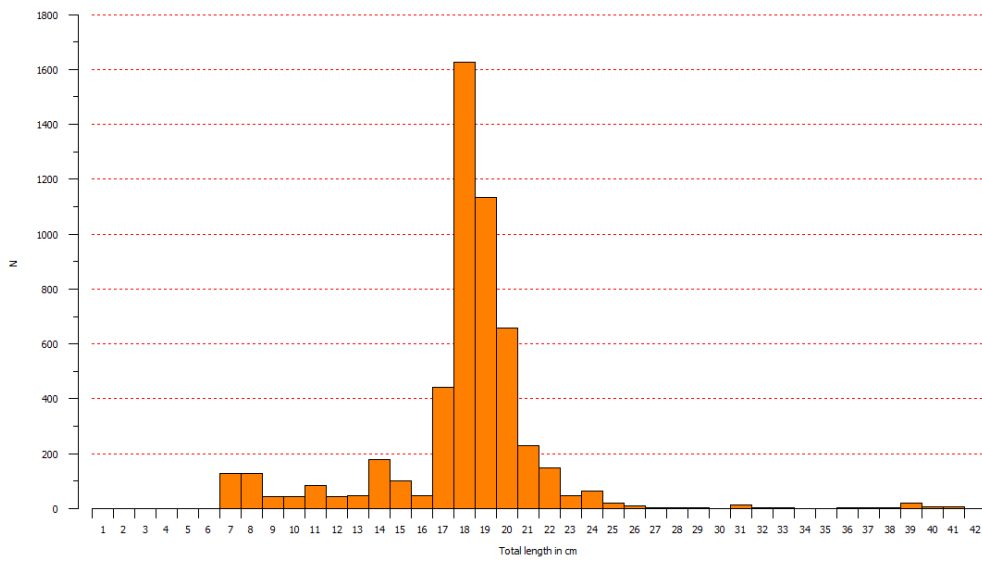
Trachurus trecae
Region: Pta.das Palmeirinhas - Congo River
Mean length = 17.5, N = 467



Chloroscombrus chrysurus
Region: Pta.das Palmeirinhas - Congo River
Mean length = 19.96, N = 291



Selene dorsalis
Region: Pta.das Palmeirinhas - Congo River
Mean length = 18.47, N = 245



ANNEX III Maturity stages for horse mackerel and sardinella

Stage	Maturity stage	Description
I	Immature	Small gonads, do not occupy more than 1/3 of abdominal cavity length. Ovary pinkish; testis whitish. Ovary not visible to naked eye
II	Maturing virgin and recovering spent	The gonads begin to develop, increasing substantially in size; about ½ length of the abdominal cavity. Gonads more opaque, small points visible to the naked eye (oocytes at the beginning of vitelogenese).The gonads in rest/recovery more flaccid with some more conspicuous blood than the gonads in development.
III	Mature. Before pre-spawning	At the beginning, oocytes more conspicuous giving the gonad a granular aspect. Ovary yellow-orange, testis creamy. Visible sperm in testis if open. Gonads quite swollen in the beginning of the reproduction period. Gonads that have spawned once lose consistency, but opaque oocytes present, and sperm in testis if cut. At the end of the stage is possible to find some translucent oocytes. Gonads occupy about 2/3 of abdominal cavity.
IV	Mature Pre-spawning	The gonads occupy about 2/3 of abdominal cavity. Ovaries orange in colour with visible blood vessels. Most oocytes translucent, testis creamy, flat and brilliant texture. The gonads stop flowing oocytes and sperm flows at low pressure.
V	Mature. In spawning	The gonads occupy about 2/3 or less of abdominal cavity. Ovaries orange in colour with the conspicuous blood vessels, blood stained mainly in one end. Most oocytes translucent; testis creamy, flat and brilliant texture. The gonads stop flowing oocytes and sperm flows at low pressure. Pink stains at the end of gonad.
VI	Post-spawning	The gonads decrease in size and occupy about ½ or less, of abdominal cavity. Gonads flaccid and bloody. Ovary can contain remaining oocytes that were not emitted. Testis may have sperm remaining in the seminal duct. Pinkish areas in the whole extension of the gonad.

ANNEX IV Allocation of acoustic densities to species groups.

Note that for the groups sardinella, horse mackerel, big-eye grunt and pilchard all encountered species are listed, while only examples are listed for the remaining groups.

Group	Taxon	Species
Sardinella	<i>Sardinella</i> sp.	<i>S. aurita</i> <i>S. maderensis</i>
Horse mackerel	<i>Trachurus</i> sp.	<i>T. trecae</i> <i>T. trachurus capensis</i>
Pilchard	Sardinops	<i>S. ocellatus</i>
Big-eye grunt		<i>Brachydeuterus auritus</i>
Pelagic species 1	Clupeiformes ¹	<i>Ilisha africana</i> <i>Etrumeus whiteheadi</i> <i>Engraulis encrasicolus</i>
Pelagic species 2	Carangidae ²	<i>Selene dorsalis</i> <i>Chloroscombrus chrysurus</i> <i>Decapterus rhonchus</i> <i>Seriola carpenteri</i>
	Scombridae	<i>Auxis thazard</i> <i>Sarda sarda</i> <i>Scomber japonicus</i>
	Sphyraenidae	<i>Sphyraena guachancho</i>
	Others	<i>Trichiurus lepturus</i> <i>Lepidopus caudatus</i>
Other demersal species	Sparidae ³	<i>Dentex angolensis</i> <i>D. macrophthalmus</i> <i>D. congoensis</i> <i>D. canariensis</i> <i>D. barnardi</i> <i>Pagellus bellottii</i> <i>Sparus caeruleostictus</i> <i>S. pagrus africanus</i>
	Other taxii	<i>Saurida brasiliensis</i> <i>Arioma bondi</i> <i>Pomadasys incisus</i> <i>Galeoides decadactylus</i>
Mesopelagic species	Myctophidae ₃	<i>Diaphus dumerili</i>
	Other mesopelagic fish	<i>Trachinocephalus myops</i>
Plankton	Calanoidae	<i>Calanus</i> sp.
	Euphausiidae	<i>Meganyctiphanes</i> sp.
	Other plankton	

¹ other than *Sardinops* sp.; ² other than *Trachurus* sp.; ³ main taxon in group.

Annex V Biomass of Sardinella and Cunene horse mackerel 1985-2013

Sardinella biomass (1 000 tons) estimated from acoustic indexes from surveys with research vessel Dr. Fridtjof Nansen from 1985-2013

Year	Season	Dates	Survey number	South Cunene-Benguela	Central Palmerinhas-Benguela	North Cabinda-Palmerinhas	Total Cunene-Cabinda	Notes
1985	Summer	28.01-26.02	1	25	20	80	125	
1985	Autumn	23.04-28.05	2	110	190	180	480	
1985	Winter	08.08-10.09	3	0	70	190	260	
1985	Spring	05.11-05.12	4	0	200	110	310	
1986	Summer	22.01-10.03	1	10	140	110	260	
1986	Autumn	22.04-05.06	2	10	130	130	270	
1989	Summer	13.02-16.03	1	40	200	60	300	
1989	Autumn	23.04-29.05	2	20	40	130	190	
1989	Spring	17.11-12.12	3	40	100	60	200	
1991	Autumn	04.05-19.06	1		180	120	300	1
1991	Winter	06.08-18.09	2		68	154	222	1
1992	Winter	05.08-22.09	1		119	161	280	1
1994	Summer	21.02-16.03	ANG1		410	100	510	2
1994	Winter	02.08-17.08	ANG2		245	290	535	2
1995	Summer	28.02-02.04	ANG1		140	24	164	2
1995	Winter	10.08-20.09	ANG4		277	297	574	1
1996	Summer	23.02-31.03	ANG1	49	175	70	294	
1996	Winter	16.07-06.09	ANG2	0	130	233	363	
1997	Summer	22.02-20.03	ANG1	0	195	300	495	3
1998	Summer	02.03-28.03	ANG1	75	389	79	543	3
1998	Winter	07.05-22.05	ANG3	0	233	159	392	3
1999	Winter	02.08-26.08	ANG2	0	228	135	363	3
2000	Winter	28.07-20.07	ANG2	0	179	174	353	3
2001	Winter	20.07-17.08	ANG2	0	257	177	434	3
2002	Winter	17.08-16.09	ANG2	0	165	187	352	3
2003	Winter	20.07-19.08	ANG2	2	277	153	432	3
2004	Winter	28.07-27.08	ANG2	0	175	187	362	3
2005	Winter	16.07-24.08	2005408	0	148	95	243	
2006	Winter	21.07-21.08	2006408	20	244	366	630	
2007	Winter	07.07-10.08	2007406	55	483	187	725	
2008	Winter	15.05-02.07	2008404	56	264	186	506	
2009	Winter	23.05-04.07	2009406	92	232	206	530	
2010	Winter	18.06-11.08	2010406	43	293	93	429	3
2011	Summer	20.02-20.03	2011402	96	68	96	260	3
2011	Winter	18.07-28.08	2011408	0	181	71	252	3
2012	Summer	01.03-30.03	2012402	353	230	156	739	3
2012	Winter	26.08-06.10	2012405	325	584	210	1119	3
2013	Summer	16.02-17.03	2013402	229	219	117	565	3

1 Data error (Southern Region)

2 Southern Region not surveyed

3 Cabinda not surveyed

Cunene Horse Mackerel biomass (1 000 tons) estimated from acoustic indexes from surveys from 1985-2011.

Year	Season	Dates	Survey number	South Cunene-Benguela	Central Palmerinhas-Benguela	North Cabinda-Palmerinhas	Total Cunene-Cabinda	Notes
1985	Summer	28.01-26.02	1	30	195	40	265	
1985	Autumn	23.04-28.05	2	55				1
1985	Winter	08.08-10.09	3	50	90	40	180	
1985	Spring	05.11-05.12	4	70	125	20	215	
1986	Summer	22.01-10.03	1	130				5
1986	Autumn	22.04-05.06	2	30				1
1989	Summer	13.02-16.03	1	35	55	40	130	
1989	Autumn	23.04-29.05	2	25				1
1989	Spring	17.11-12.12	3	170	40	35	245	
1991	Autumn	04.05-19.06	1	100	80	20	200	
1991	Winter	06.08-18.09	2	100	70	30	200	
1992	Winter	05.08-22.09	1	98	86	80	280	
1994	Autumn	21.02-16.03	ANG1		238	1	239	
1994	Winter	02.08-17.08	ANG2		130	120	250	
1995	Summer	28.02-02.04	ANG1		?	84	84	
1995	Winter	10.08-20.09	ANG4	70	160	110	340	
1996	Summer	23.02-31.03	ANG1	286	214	6	506	
1996	Winter	16.07-06.09	ANG2	140	157	63	360	
1997	Summer	22.02-20.03	ANG1	234	55	138	193	3
1998	Summer	02.03-28.03	ANG1	163	58	18	239	3
1998	Winter	07.05-22.05	ANG3	118	112	37	267	3
1999	Winter	02.08-26.08	ANG2	124	129	68	321	3
2000	Winter	28.07-20.07	ANG2	92	178	63	333	3
2001	Winter	20.07-17.08	ANG2	64	22	3	89	3
2002	Winter	17.08-16.09	ANG2	118	13	31	162	3
2003	Winter	20.07-19.08	ANG2	120	34	12	166	3
2004	Winter	28.07-27.08	ANG2	32	107	90	229	3
2005	Winter	16.07-24.08	2005408	102	57	21	180	
2006	Winter	21.07-21.08	2006408	45	77	31	153	
2007	Winter	07.07-10.08	2007406	73	57	27	157	
2008	Winter	15.05-02.07	2008404	29	40		69	4
2009	Winter	23.05-04.07	2009406	76	7		83	4
2010	Winter	18.06-11.08	2010406	100	15	21	136	3
2011	Summer	20.02-20.03	2011402	55	13		69	3,4
2011	Winter	18.07-16.07	2011408	74	26	17	117	3
2012	Summer	01.03-30.03	2012402	162	135	30	327	3
2012	Winter	26.08-06.10	2012405	132	67	11	210	3
2013	Summer	16.02-17.03	2013402	62	62	15	139	3

1 Data error (Central and Northern Regions)

2 Southern region not surveyed

3 Cabinda not surveyed

4 Fish density too low to estimate abundance (Northern Region)

5 Estimates reported together with previous report

ANNEX VI Instruments and fishing gear used

The Simrad ER-60/18, 38, and 120 kHz scientific sounder was run during the survey for fish observation and bottom conditions. The 200 kHz was out of order at the start of the survey.

Standard sphere calibrations were carried out in Baía dos Elefantes 24.02.2013 using 64 and 60 mm diameter copper spheres and 38.1 mm tungsten carbide sphere for 18, 38 and 120 kHz, respectively. The details of the settings of the 38 kHz echo sounder where as follows:

Transceiver-2 menu (38 kHz)

Transducer depth	5.50 m
Absorption coefficient (variable with conditions)	8.7 dB/km
Pulse length	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2-way beam angle	-20,6dB
Gain	25.69 dB
SA correction	-0.52 dB
Angle sensitivity	21.9
3 dB beam width	7.09° along ship 7.12° athwart ship
Along ship offset	0.11°
Athwart ship offset	0.02°

Bottom detection menu

Minimum level	-45 dB
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Fishing gear

The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super bottom trawl". Trawls were used for identification of acoustic targets only.

The bottom trawl has a headline of 31 m, footrope 47 m and 20 mm mesh size in the cod end with an inner net of 10 mm mesh size. The trawl height was about 4.5 m and distance between wings during towing about 21 m. The sweeps are 40 m long. The trawl is equipped with a 12" rubber bobbins gear. New doors are 'Thyborøn' combi type, 7.41 m², 1720 kg. These have been in use onboard since 19.02.08.

The SCANMAR system was used on 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 distance, and the trawl was equipped with a trawl eye that provides information about the trawl opening. A catch sensor on the cod-end indicated the size of the catch.