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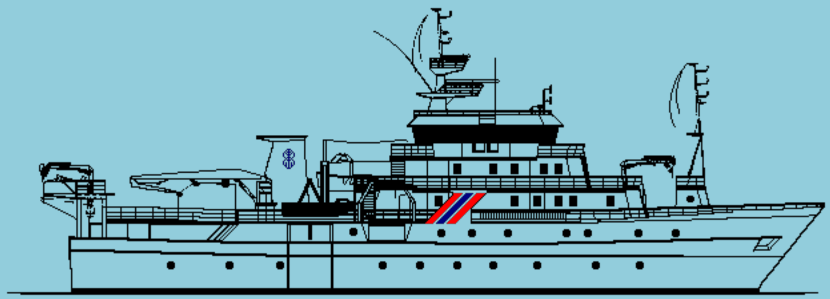
EAF – N/2015/8



SURVEYS OF THE FISH RESOURCES OF ANGOLA

15 August – 13 September 2015

Bergen, 10 November 2015

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Survey Report No 8/2015

by

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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.

O PROJETO EAF-NANSEN

A FAO iniciou a implementação do projeto "Fortalecimento da base de conhecimento para implementação do enfoque ecossistêmico para a pesca em países em desenvolvimento (EAF-Nansen GCP/INT/003/NOR)" em dezembro de 2006, com financiamento da Agência Norueguesa para Desenvolvimento e Cooperação (Norad). O Projeto EAF-Nansen dá continuidade a projetos e programas anteriores, numa parceria que envolve a FAO, a Norad e o Instituto de Investigação Marinha (IMR), Bergen, Noruega, voltados a avaliação e gestão dos recursos pesqueiros marinhos nos países em desenvolvimento. O projeto trabalha em parceria com governos e também projetos financiados pelo programa GEF-Grandes Ecossistemas Marinhos (LME) e outros projetos que têm o potencial de contribuir para alguns componentes do projecto EAF-Nansen.

O Projecto EAF-Nansen oferece uma oportunidade para os países costeiros da África sub-saariana, trabalhando em parceria com o projeto, para receber apoio técnico da FAO para o desenvolvimento de capacidade nacional e regional para a implementação do Enfoque Ecossistêmico para a gestão das pescas e para adquirir conhecimento adicional sobre os seus ecossistemas marinhos para a sua utilização no planejamento e monitoramento. O projeto contribui para o desenvolvimento da capacidade das agências nacionais de gestão das pescas em métodos de avaliação dos riscos ecológicos para identificar as questões críticas de manejo e na preparação, operacionalização e monitoramento o progresso da implementação dos planos de gestão das pescas coerente com o enfoque ecossistêmico.

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CHAPTER 1 INTRODUCTION

1.1 Objectives

This survey is one of a series aimed at monitoring the pelagic fish resources of Angola, as agreed with the Instituto Nacional de Investigação Pesqueira (INIP), Luanda. The surveys intend to improve the understanding and knowledge in terms of the biology, ecology and population dynamics of the main pelagic species in relation to the environment and the whole ecosystem. Acoustic surveying using echo integration is the principal tool for estimating relative stock abundance of pelagic species, and the time series of survey estimates can therefore form a basis for recommendation on the Total Allowable Catch (TAC).

The specific objectives of the survey were the following:

- To estimate the relative 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 *S. maderensis*, the Cunene horse mackerel *Trachurus trecae*, the Cape horse mackerel *Trachurus capensis* as well as other clupeid and carangid species.

- To collect biological information of target species: T. trecae, T. capensis, S. aurita, S. maderensis, Sardinops ocellata, Decapterus rhonchus, Selene dorsalis, Chloroscombrus chrysurus as well as Brachideuterus auritus.

- To collect otoliths from both horse mackerel species for analyses of length-age relationships.

- To collect depth stratified samples of zoo and phytoplankton in order to continue the studies on feeding biology, relating stomach contents to estimated zooplankton compositions and densities.

- To observe and make records of sea birds and sea mammals in the survey area.

- To map the general meteorological, hydrographical and biological conditions in the survey area by means of continuous recordings of weather data, CTD-casts (Temperature, Salinity and Oxygen), ADCP measurements (Acoustic Doppler Current Profiler) and plankton sampling along acoustical and hydrographical transect lines.

- On-the-job training of cruise participants on the main survey routines, including use of the Nansis database and scrutinizing acoustical observation (echograms) with the post-processing system, the Large Scale Survey System (LSSS).

1.2 Participation

The scientific staff consisted of:

From INIP, Angola:
15.08-13.09.2015: Aristóteles Amaro (Angola Team leader), Pedro Panzo, José Mateus da Silva, Paulo A. de Sousa Coelho, Geraldina de A. S. José, Joana Pinheiro, Victor Agostinho, Domingos Pedro, Edson Mangueira.

From IMR, Norway:
15.08-13.09.2015: Kathrine Michalsen (Cruise Leader), Oddgeir Alvheim (to 31.08), Diana Zaera-Pérez (from 31.08), Jan Frode Wilhelmsen, Inge Nymark.

1.3 Narrative

The vessel departed Walvis Bay on the 15th of August at 14:00 UTC and steamed northwards to the Cunene River where the survey started with the monitoring line off Cune River on the 17th of June at 08:30 UTC. The survey area has been divided into three regions:

Congo River - North of Pta. das Palmerinhas (6°-9°S):	ANGOLA NORTH
The region between 9°S and 13°S:	ANGOLA CENTRAL
The region between 13°S and Cunene River (17°15'S):	ANGOLA SOUTH

After a change in sampling design for the monitoring lines (increased number of WP2 and decreased number of multinet) the time used to complete the monitoring line increased with up to 5 hours compared to previous years. The total survey duration was sufficient for a complete coverage of the survey area in 2015.

The Southern region was completed by midnight on the 24th of August. The coverage of the central region was stopped on the 30th August and the vessel steamed to Luanda for a change of scientific crew. The coverage was continued on the 01st of September and was compleded by the 3 rd of September. The coverage of the northern region was completed on the 10th of September. The remaining survey time was spent on an acoustic mini-survey outside Ambriz, with dense coverage of a limited survey area. This surdy is conducted in order to study day/night effects on the biomass estimates. The results of this study are given in Annex VIII.

Just south of the Santa Maria CTD line (in the southern area), the wire broke and we lost the CTD at 750 depth. We manage to set up a replacement instument, but only with the standard sensors (conductivity, temperature, salinity and oxygen), but without a fluorometer (measured chlorophyll A in microgram per litre). It took some time to set up the new CTD, but luckily this happend in an area with very little acoustic fish recordings and just after the CTD transect of Santa Marta. For the monitoring line of Pta. das Palmerinhas, a spare flurometer was set up and working as previously.

A systematic survey track implemented in 2002 consisting of pseudo-parallel acoustic transect lines perpendicular to the coast line with equally spaced transect lines (6 nautical miles, NM, apart) was followed during the survey. The Cabinda region was not included in this survey due to stricter enforcement of regulations implied by the oil companies in the area since 2009. The oil exploitation in the northern region has been rapidly expanding in the last years affecting both the length and track of some of the original acoustic lines.

1.4 Survey effort

Figure 1, 2 and 3 shows the cruise tracks with fishing, plankton and hydrographical stations for the northern, central and southern regions of Angola. The sampling trawls, including the small (10 m vertical opening), the mid-sized (15 m vertical opening) pelagic trawls and the demersal trawl (5 m), 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 depth levels of zooplankton samples per station), WP2 and distance surveyed (log).

Survey region	Trawl stations			CTD	Multinet	WP2	Log (NM)
	BT	PT	Total				
Congo River - Pta. Palmerinhas	13	12	25	70	6	16	1178
Pta. Palmerinhas - Benguela	13	9	22	87	6	15	1517
Benguela - Cunene River	7	6	13	87	7	20	1216
Total	33	27	60	244	19	51	3911

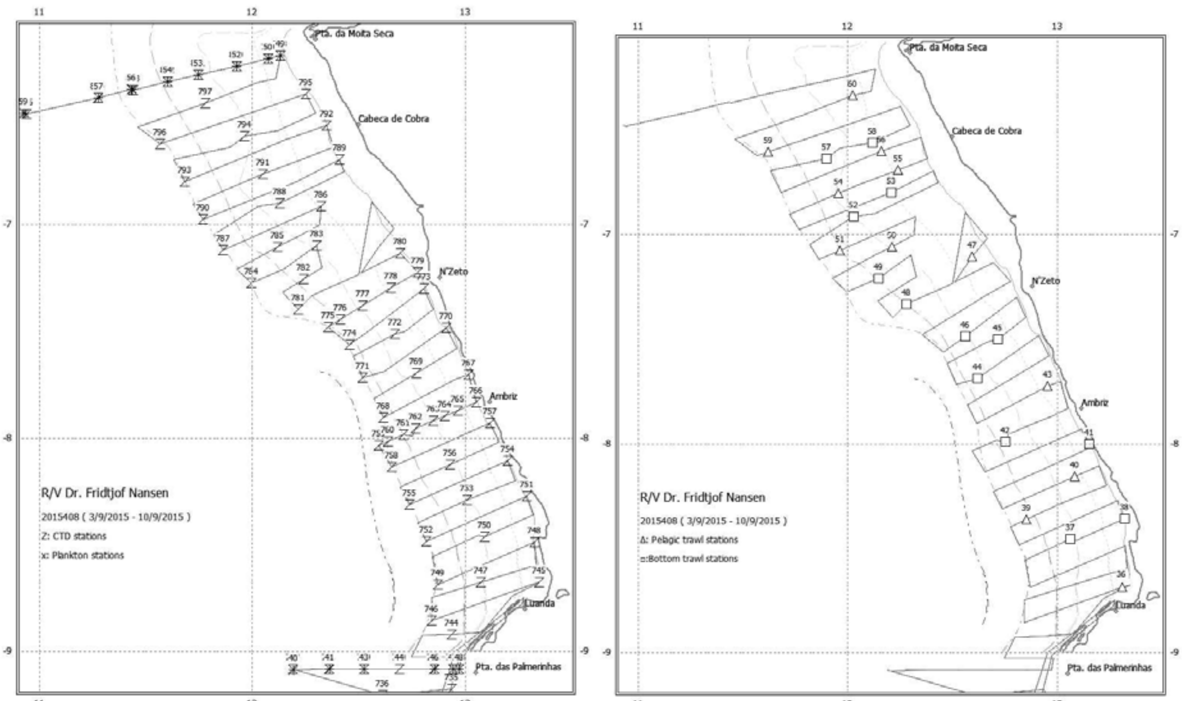


Figure 1. Course track with hydrographical and multinet stations (left panel) and trawl stations (right panel), Congo River - Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200, and 500m.

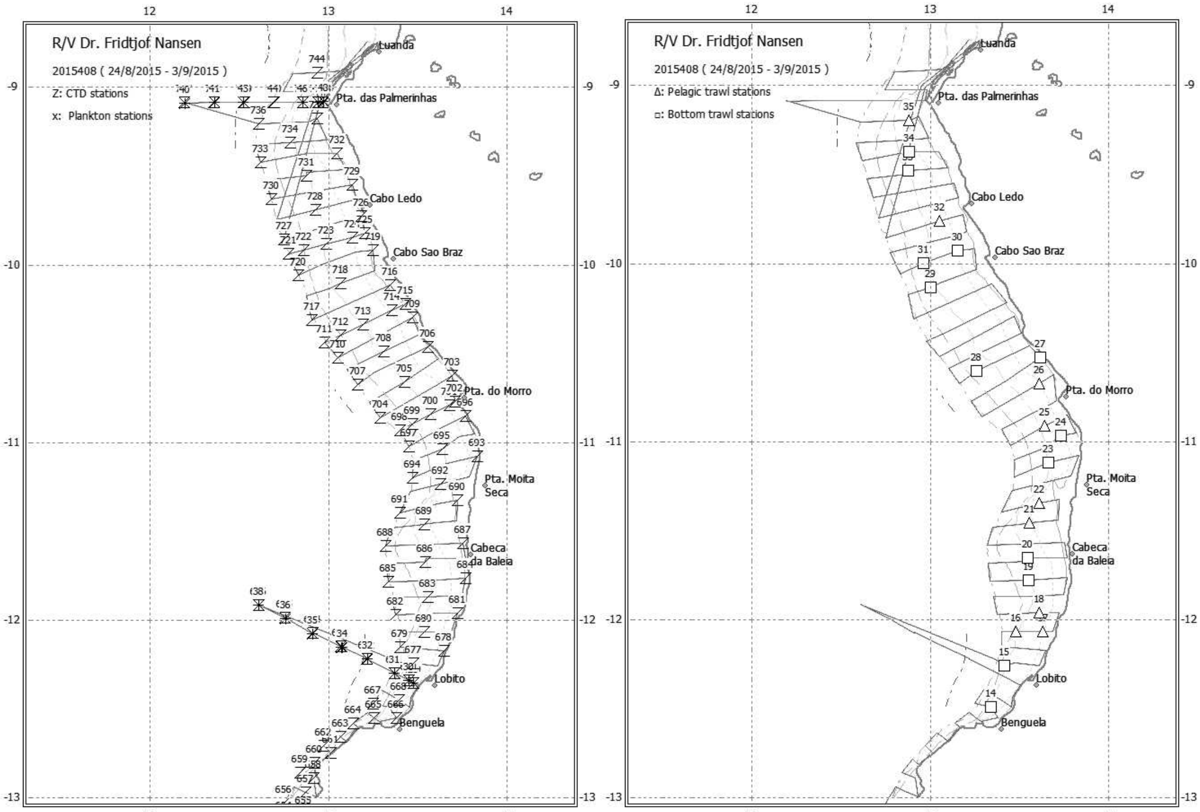


Figure 2. Course track with hydrographical and multinet stations (left panel) and trawl stations (right panel), Pta. das Palmerinhas - Benguela. Depth contours at 20, 50, 100, 200, and 500m.

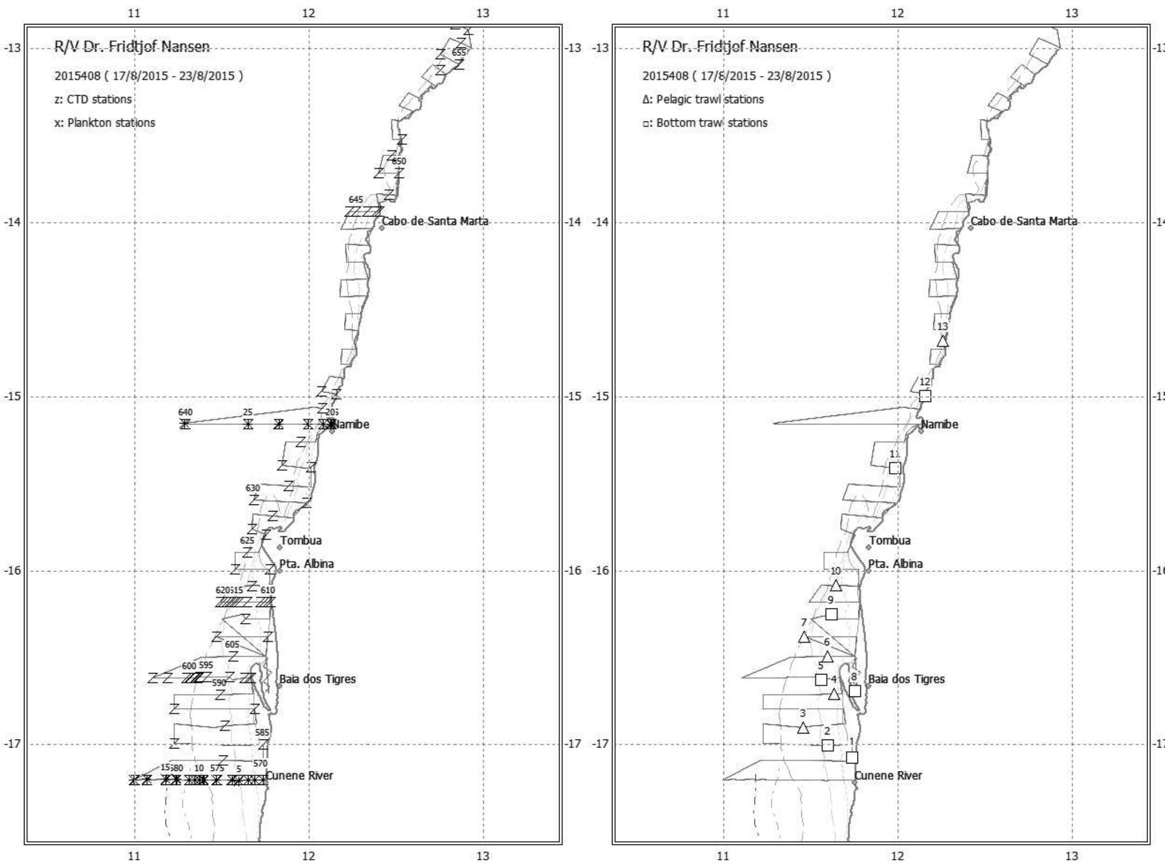


Figure 3. Course track with hydrographical and multinet stations (left panel) and trawl stations (right panel), Benguela-Cunene River. Depth contours at 20, 50, 100, 200, and 500m.

CHAPTER 2 METHODS

2.1 Hydrographical sampling

Location of stations belonging to monitoring lines or to standard hydrographical sections can be found in ANNEX VII. Additional CTD stations were cast along acoustic transects with typically either one CTD station in the middle of the transect or two casts in each end of the transect.

The general monitoring of the oceanographic condition along the Angola coast includes Main monitoring lines of highest priority (Red) (CRML, PML, LBML, NML, CML): Multinet, WP2, bottles and CTD (
Figure 4).

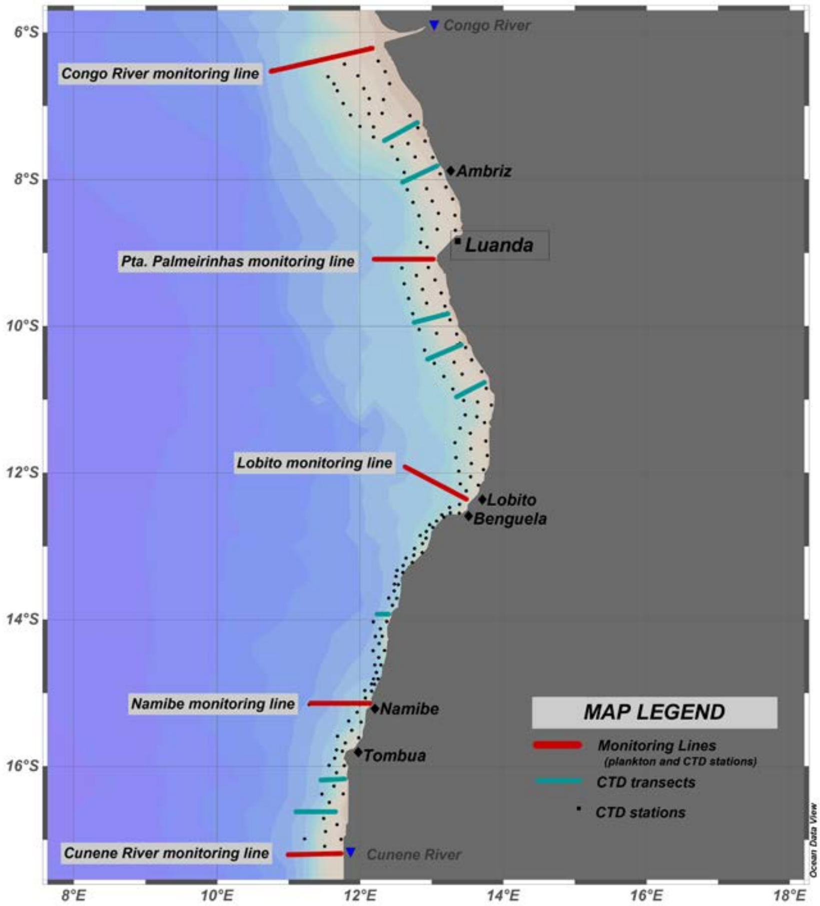


Figure 4. Monitoring lines and CTD transects in Angola. Additional CTD stations were carried out on the acoustic transects. See also Figure 1, Figure 2 and Figure 3.

2.1.1 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 monitoring lines. The casts were stopped a few meters above the bottom, and the maximum observing depth on this survey was close 2600m. The oxygen sensor has shown to be stable, and no calibration was conducted during the survey. The CTD samples were conducted along the 5 main monitoring lines off Congo River, Pta. das Palmerinhas, Lobito, Namibe and Cunene River and 21 standards transects (for more detail see

Figure 4 and ANNEX VII). CTD stations were conducted at bottom depths 20, 50, 100, 200 and 500 m along the standard transects and at different depths at main monitoring lines. Attached to the CTD was also a Chelsea fluorometer of the type Mk III Aquatrack. It measures chlorophyll A in microgram per litre with an uncertainty of 3%. Factory slope and offset was 1.000 and -0.00. This instrument was lost together with the CTD Just north of santa Marta on 22nd August.

2.1.2 Thermosalinograph

The SBE 21 Seacat thermosalinograph was running routinely during the survey, obtaining samples of sea surface salinity 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 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

2.1.3 Current speed and direction measurements (ADCP)

The vessel-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments was not functioning and we did not recorded information about current during this survey.

2.1.4 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 NM).

2.1.5 Mapping

To compare hydrological and biological condition between seasons, years and regions it's necessarily to produce map of comparable scales. From this survey we produce maps with scales shown in Table 2**.** The map scales were selected based on long term monitoring of hydrological and biological condition in the Angola waters, and the minimum and maximum observed values were selected as scale boundaries.

Table 2. Scales for temperature, salinity, oxygen and FLU (chlorophyll a) mapping.

Type of maps	Minimum value	Maximum value	Intervals
Temperature	10	32	1
Salinity	32	37	0.25
Oxygen	0	7	0.5
FLU (chlorophyll *a*)	0	3	0.1

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 sardinella, horse mackerel, sardine, round herring, anchovy, *Brachydeuterus auritus* and demersal species, mainly *Dentex spp*.

Biological samples were obtained for the sardinella, *Sardinops sagax* and horse mackerel species Total length (TL) and body weight were determined to the nearest 1cm and 1g below, respectively. 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). Length and weight was recorded for the species: *Selene dorsalis*, *Caranx rhonchus*, *Chloroscombrus chrysurus*, *Engraulis encrasicolus, Ilisha africana, Etrumeus Whiteheadi, Scomber japonicas* and other tunas.

2.3 Plankton sampling

2.3.1 Phytoplankton

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

2.3.2 Zooplankton

Zooplankton samples were collected with both a HYDROBIOS Multinet (180 µm) and a WP2 net (180 µm). Multinet sampling was conducted at five depth intervals, 0-25, 25-50, 50-75, 75-100 and 100-200 m, at 4 selected stations on the Cunenes, Namibe, Lobito, Luanda and Congo River monitoring lines. Once at the desired depth the unit was hauled at app. 1-1.5 m/s while the vessel was moving with approximately 2 knots. Data was recorded electronically from the outer flow meter of the Multinet. 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. For comparison, the WP2 samples were collected at the same stations as the mulitnet. At shallower stations (< 200m) the net was lowered to approximately 10 m off the bottom, while at deeper stations (> 200m) the net was lowered to a maximum depth corresponding to 200 m wire out. The net was vertically heaved at 0.5 m/s. Samples were preserved in 4% formalin. A flowmeter mounted in the centre of the WP2 recorded the distance sampled on all stations.

2.4 Acoustic sampling

2.4.1 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, 120 and 200 kHz. The survey was started without *a priori* calibration. All transceivers were calibrated in Baía dos Elephantes on the 21st of February and all results were within specifications. Technical specifications and operational settings of the echo sounder used during the survey are given in ANNEX VI.

2.4.2 Allocation of acoustic energy to species group

The acoustic data were scrutinized using the LSSS version 1.6.1 (built on August 22 2012, Korneliussen *et al.* 2006). Scatters were displayed at 38 kHz. The mean 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 VI. Ground truthing and estimation of mean length and weight were accomplished by means of targeted pelagic and demersal trawling.

2.4.3 Estimation of biomass

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

TS = 20 log L – 72 (dB) (1)

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

and on the simplest form $$CF = \frac{1.2612 \cdot 10^{6}}{\overline{L^2}} \quad (3)$$

where *CF* is the conversion factor from acoustic density to fish biomass and $\overline{L^2}$ is the mean of squared fish lengths. This target strength function was originally established for North Sea herring, but has later been attributed to clupeids in general (Foote *et al*., 1986; Foote, 1987).

No specific target strength relations presently are available for the species at hand, and equation (3) has therefore been applied consequently for all targeted species in this time series. The biomass was calculated by multiplying the number of fish by the expected length at weight, estimated by regression of the log-length (total) against total weight. Separate length-weight relationships were worked for each region (north, central, south), pooling all data within each region.

The boundaries of encountered fish aggregations (post strata) were determined by means of contouring within the inner and outer zero-value limits of the transect lines. The strata contours were digitised using Nansis Maptool Version 1.8. Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories:

1: $0 < s_A < 300$; 2: $300 \le s_A < 1000$; 3: $1000 \le s_A < 3000$; 4: $3000 \le s_A \le 10000$;5: $10000 \le s_A \le \propto$ (*m²/NM²*)

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

The overall length frequency distributions within strata were estimated by weighting the sample-distributions with the nearest valid 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. trachurus 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:

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

where: ρ_i = estimated number of fish in length group i

$<s_A>$ = 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

The Angolan shelf is characterized by the semi-annual seasonal cycle, with the two stratified periods, during February-March and in October-November. The principal upwelling season occurs in June-August while it is weak and less regular counterpart in December-January.

Wind, sea surface temperature (SST, 5m depth), salinity (SSS, 5m depth), oxygen (SSO, 5m depth) and fluorescence (SSF, 5m depth) were continuously recorded, during the survey. The Figures in subsections 3.1.1, 3.1.2 and 3.1.3 shows the horizontal distribution of these variables.

Standardization for map presentation is needed to avoid misunderstanding and to facilitate comparisons between annual and seasonal distribution of observations, and therefore we use the same scale for all surveys in this area (for more information see Table 2 in section 2.1 Hydrographical sampling).

3.1.1 Northern region

Figure 5 shows the spatial distribution of wind in the North Angolan region. It was observed variable wind directions along the region. Along most of the region, weak to moderate winds (14 knots) have been registered. The majority wind direction is from West and no difference between offshore areas and areas closer to shore.

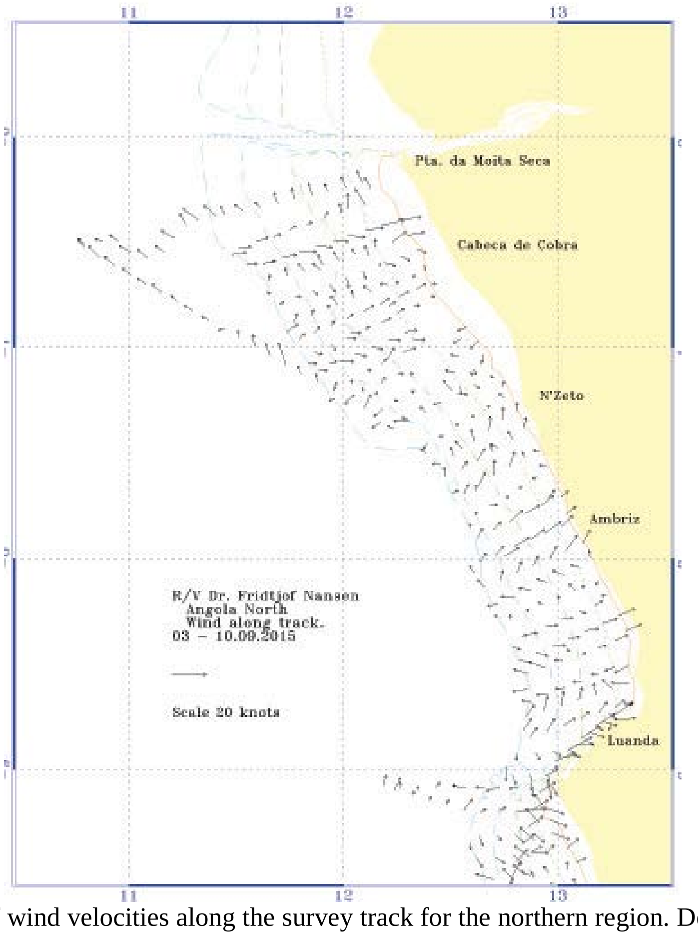


Figure 5. Distribution of wind velocities along the survey track for the northern region. Depth contours at 20, 50, 100, 200, and 500 m.

Figure 6 shows the surface distribution of temperature and salinity of the northern region of Angola. Most of the observed area is constituted by water bodies with temperatures ranging between 18 and 22 °C. The lowest temperature (18°C) was observed the coast in areas in areas near the mouth of rivers (Congo, Nzeto, Ambriz e Dande north of Luanda), while the highest temperatures were recorded in offshore waters. The salinity ranged between 32 and 35.75, with the lowest values at the mouth of the Congo River and in the area of Ponta das Palmeirinhas, which might be associated to the water flow from Kwanza River.

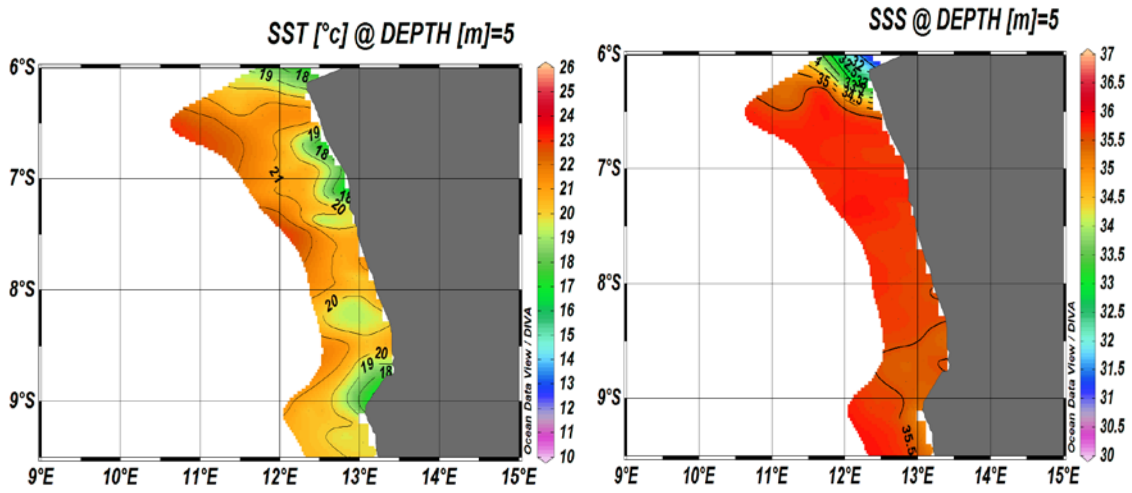


Figure 6. Surface distribution of water temperatures and salinity at 5m depth in the northern region

3.1.2 Central Region

The wind recorded along the Central Angolan region varied both in strength and direction (Figure 7). Moderate winds (15 knots) were observed between Pta do Morro and Cabo Sao Braz. Along the Lobito section a southernly and moderate wind was recorded. Along the section of Pta. das Palerinhas the wind was still moderate but the direction was more variable. Along Cabo Ledo section, the formation of anti-cyclonic winds can sometimes be observed. This transports the atmospheric warm air down, warming the sea surface; while the warm air flows from the high pressure areas (A), is deflected by coriolis effect in such a way that the winds circulate, around the high pressure area, in an anti-clockwise direction. To sumarize, in the central region there was a predominance of the Southern winds, together with influence of the fisical forces which have determined the dynamic changes in the region.

The hydrographical condition in the central region is shown in Figure 8. The sea surface temperature ranged between 16°C to 20°C. The lowest temperatures (16°C to 18°C) were observed near coast and the highest values (20°C) were observed of Lobito and Ponta of Morro in offshore waters. Less geographical variation was recorded for salinity (35.5 to 36). The minimum value (35.5) was observed near the coast in Ponta of Morro to Porto Amboim.

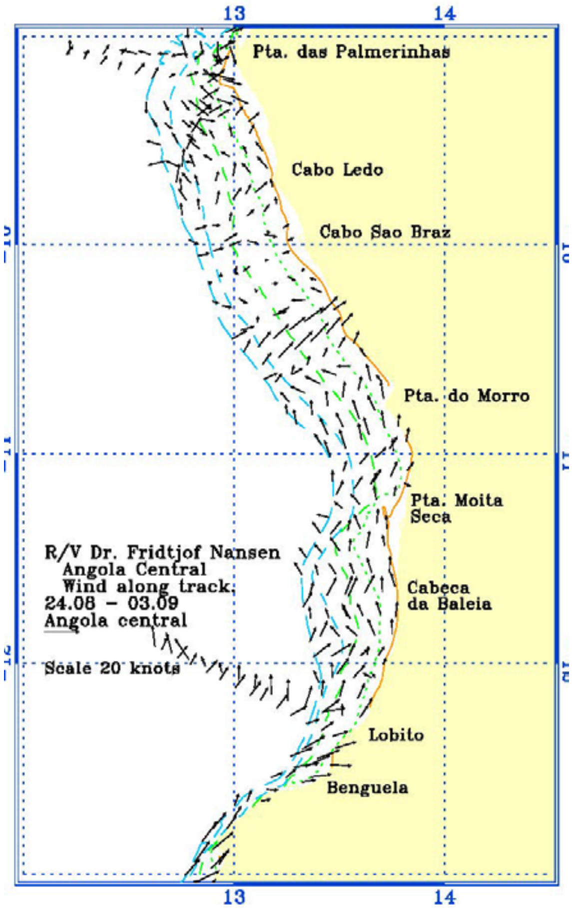


Figure 7. Distribution of wind velocities along the survey track for the central region. Depth contours at 20, 50, 100, 200, and 500 m.

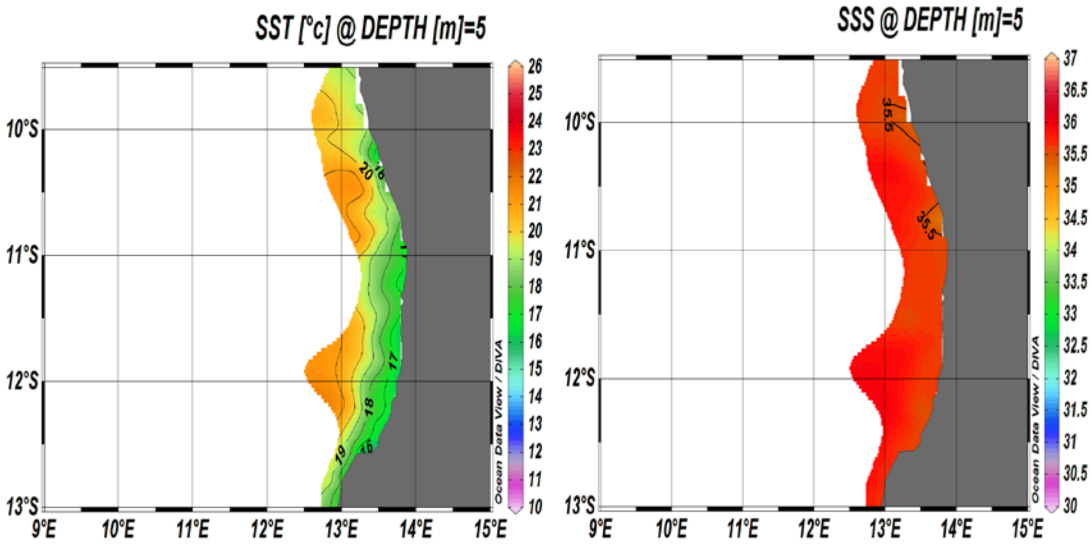


Figure 8. Surface distribution of water temperatures and salinity at 5m depth in the central

3.1.3 Southern Region

In this region, southernly winds have predominated. Coriolis and anticyclonic winds have previously shown to be important for the dynamic of the area. The survey started off at the Cunene section with strong wind (from 20 up to 35 knots). South of the sections of Baia dos Tigres and north of Cunene River, the stongest winds in the region were registered, reaching 35 knots (Figure 9). The strong wind continued up to the section of Namibe. A mix of weak (5 knots) and moderated winds (15 knots) were observed from Namibe to the sections of Santa Marta. Then the wind increased again (up to 20 knots).

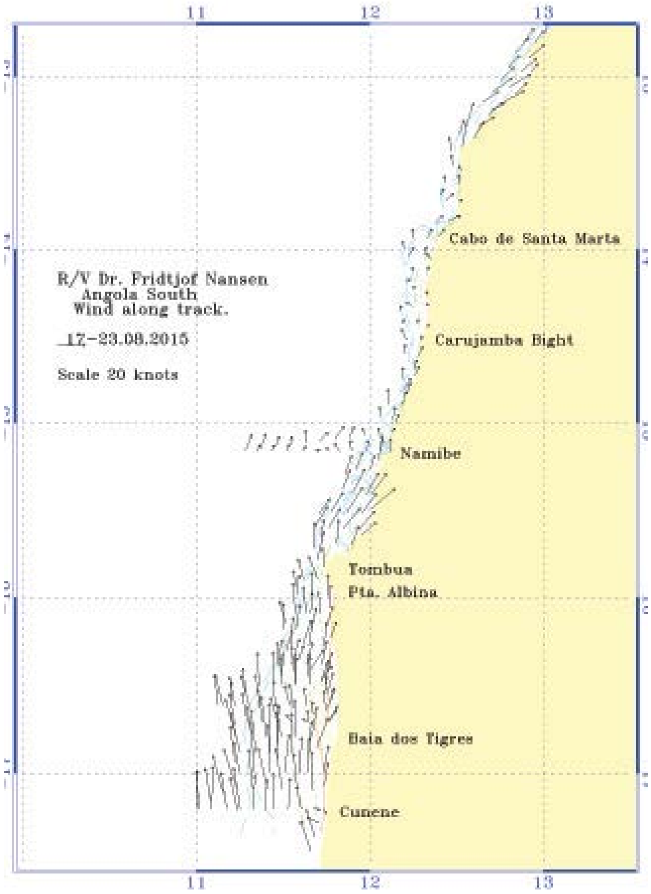


Figure 9. Distribution of wind velocities along the survey track for the southern region. Depth contours at 10, 20, 50, 100, 200 and 500 m.

The influence of the cold Benguela front can be observed in the isotherms from Figure 10. In this region, the surface temperature ranged from 14°C to 19°C. The lowest value (14°C) was observed off the mouth of the Cunene River and gradual increased (19°C) towards the Namibe section and the open sea. Lowest values of salinity (> 35.5) were observed in the sections of Cunene River, Tigers Bay and Ponta Albina south. The salinity increased slightly towards nort and west.

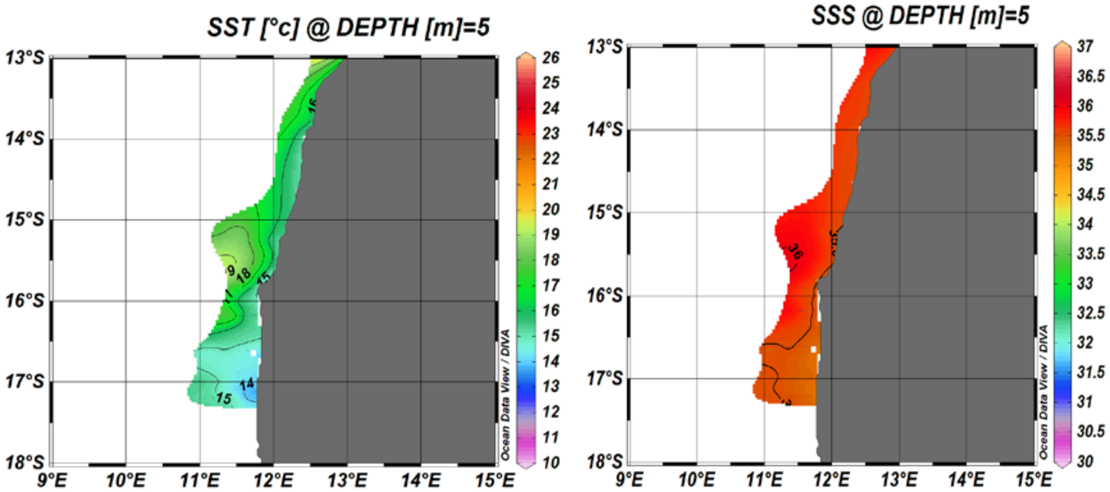


Figure 10. Surface distribution of water temperatures and salinity at 5m depth in the southern region

3.2 Main monitoring lines

3.2.1 Northern Region

Figure 11 shows the vertical distribution of temperature, salinity, oxygen and fluorescence along monitoring line of the Congo River. The surface temperature increases from the coast to the offshore parts (19-23 ° C) and decreases with depth reaching 8 °C at 500 meters, which indicates a well-defined thermal stratification without evidence of upwelling. Low values (33) of salinity were observed at the mouth of the Congo River in the surface, below this layer normal levels 35 to 35.5 were registered. Oxygen in the surface layers (0-20 m) shows values of 4.5 to 4 ml / l, with the highest values in the intermediate area between the coast and offshore waters. A layer of low levels of dissolved oxygen (<1 ml / l) was observed below 60 m depth along the whole section. The fluorescence was registered in the same intermediate area as the oxygen and the peaks ranged from 0.1 µg/l a 0.6 µg/l.

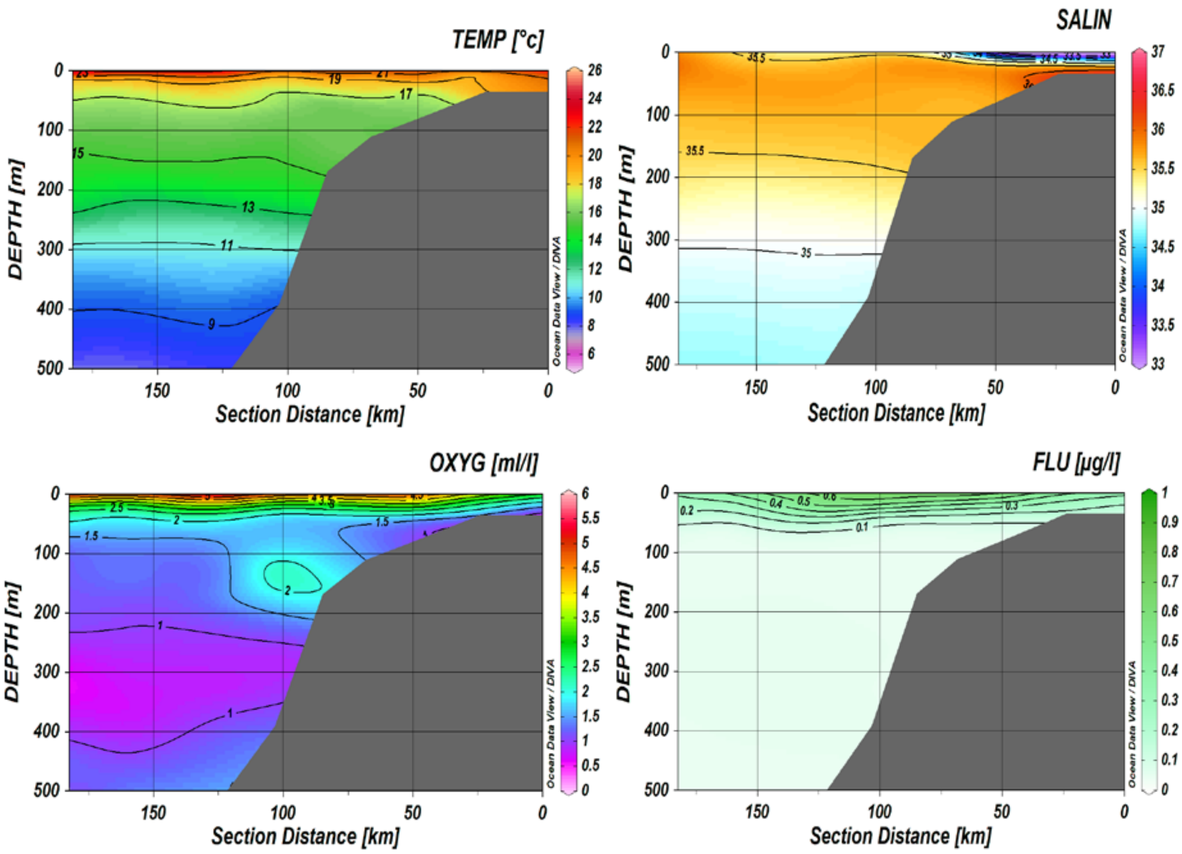


Figure 11. Vertical sections of temperature, salinity, oxygen and fluorescence off Congo River.

In the Ponta das Palmeirinhas monitoring line (Figure 12), the temperature of the surface layer (0 - 20 m) ranged between 19°C to 21°C and under this layer the temperature decreased gradually with depth. The salinity was stable (35.5) between depths 0 – 290 m and below this layer, dropped to 35. The oxygen showed large variation (1.5 ml/l – 4.5 ml/l) along the profile in the surface layer 0 – 40m, the minimum oxygen zone (OMZ) was recorded below 40 m deep and near the coast. The biological activity (fluorescence) recorded near the coast along the peaks ranging from 0.1 µg/l a 1 µg/l.

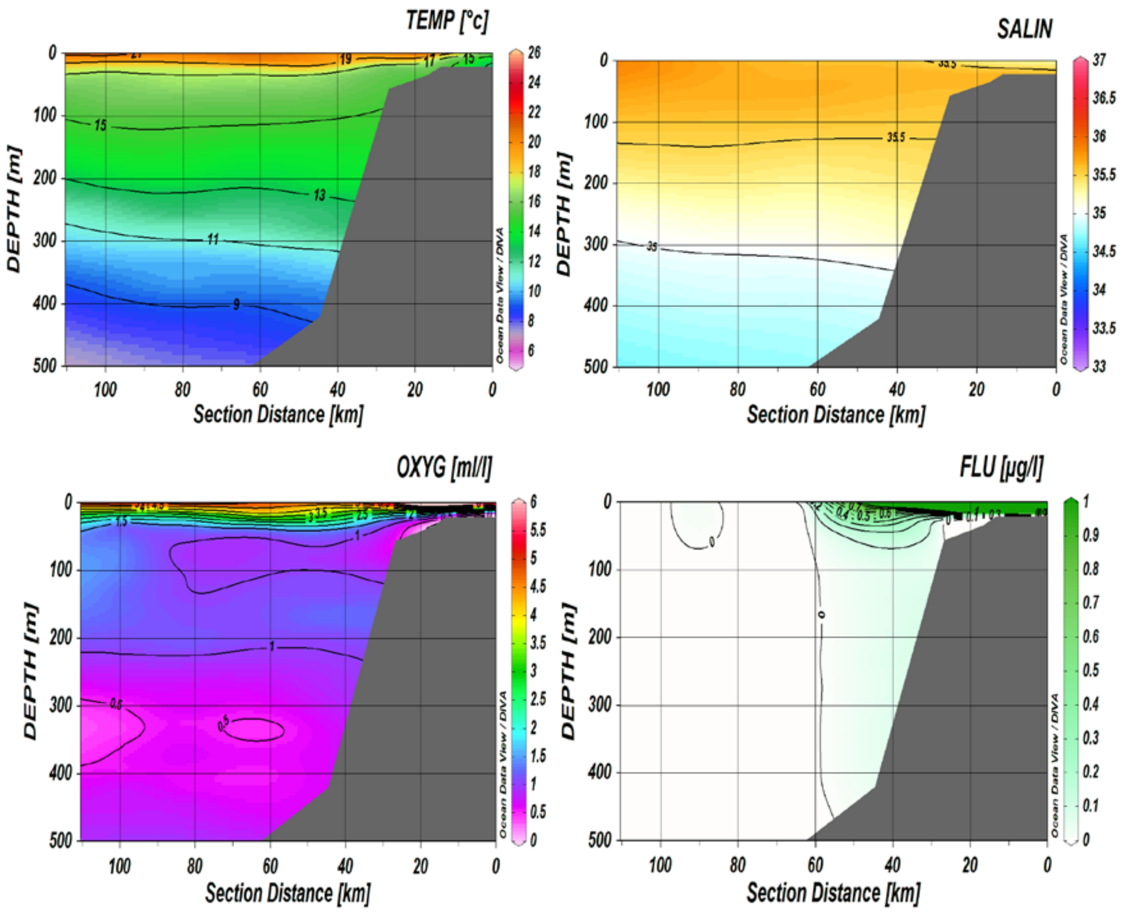


Figure 12. Vertical sections of temperature, salinity, oxygen and fluorescence off Pta. Palmeirinhas.

3.2.2 Central Region

In the Lobito section (Figure 13), the temperature of sea surface ranged between 19°C a 21°C, from 0 – to 20 m, below this depth the values decreased with increasing depth. Salinity values were homogeneous with depth (at35.5), from 0 to 150 m, while between 150 – 310 m the salinity was 35 and below this layer it was observed values lower than 35. In this section oxygen concentration varied significantly to 1.5ml/l to 5 ml/l, the lowest value (<1.5ml/l) was registered between 40 – 95 m depth along the coast and highest (5ml/l) in offshore areas. Because of the technical problems the fluorescence was not observed in this section.

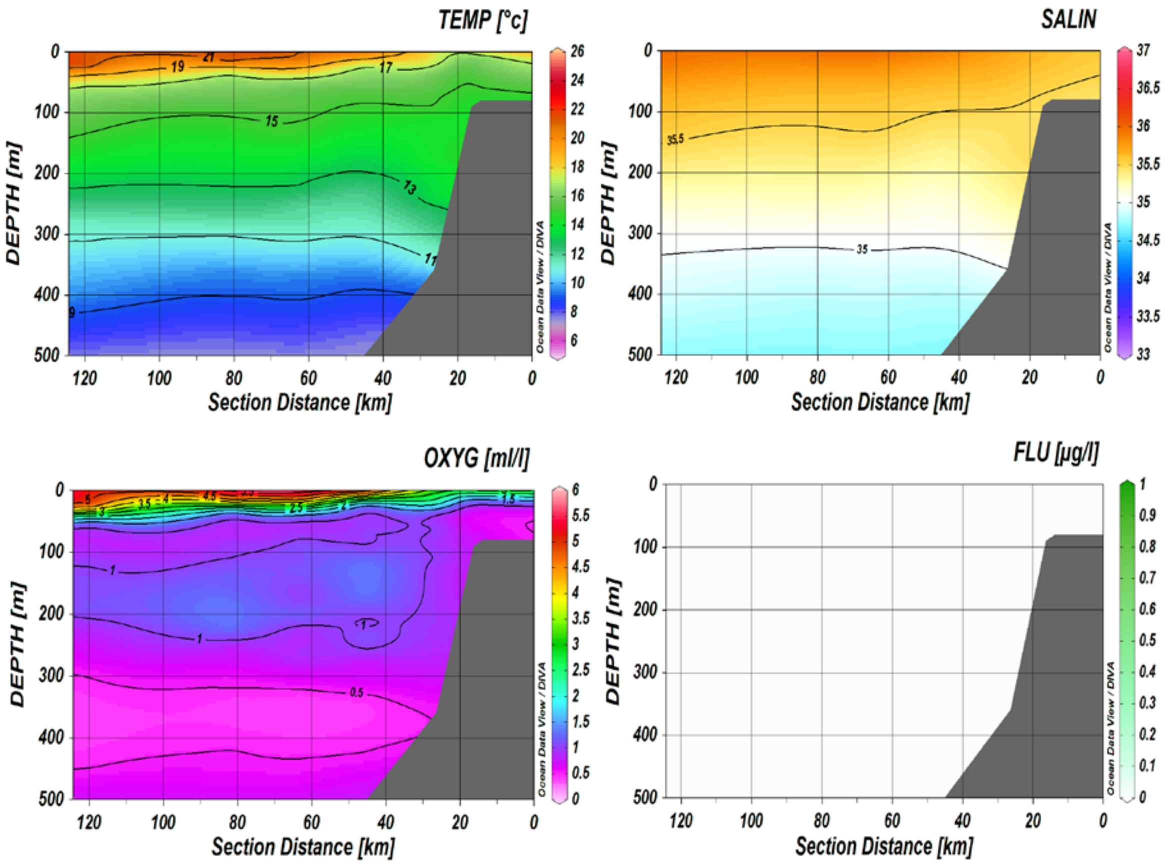


Figure 13. Vertical sections of temperature, salinity, oxygen and fluorescence off Lobito.

3.2.3 Southern Region

In Namibe section (Figure 14), the temperature varied between 9°C and 18°C. The highest fluctuation (18°C) was observed in offshore areas, where the temperature decreased gradually down to 9°C at 400 m depth. Salinity showed the same profile as the temperature, with high values (36) in the offshore area, while along the coast the salinity remained at 35.5. Below 90m depth the salinity decreased with depth. High levels (40-4.5 ml/l) of oxygen were observed in the offshore areas and along the coast, while the minimum oxygen zone (<1 ml/l) occurred as shallow as 60 meters in some areas. The fluorescence showed to be quite a homogeneous, varying with 1 µg/l in the surface layer between 0 - 25 m, in the offshore area towards the coast.

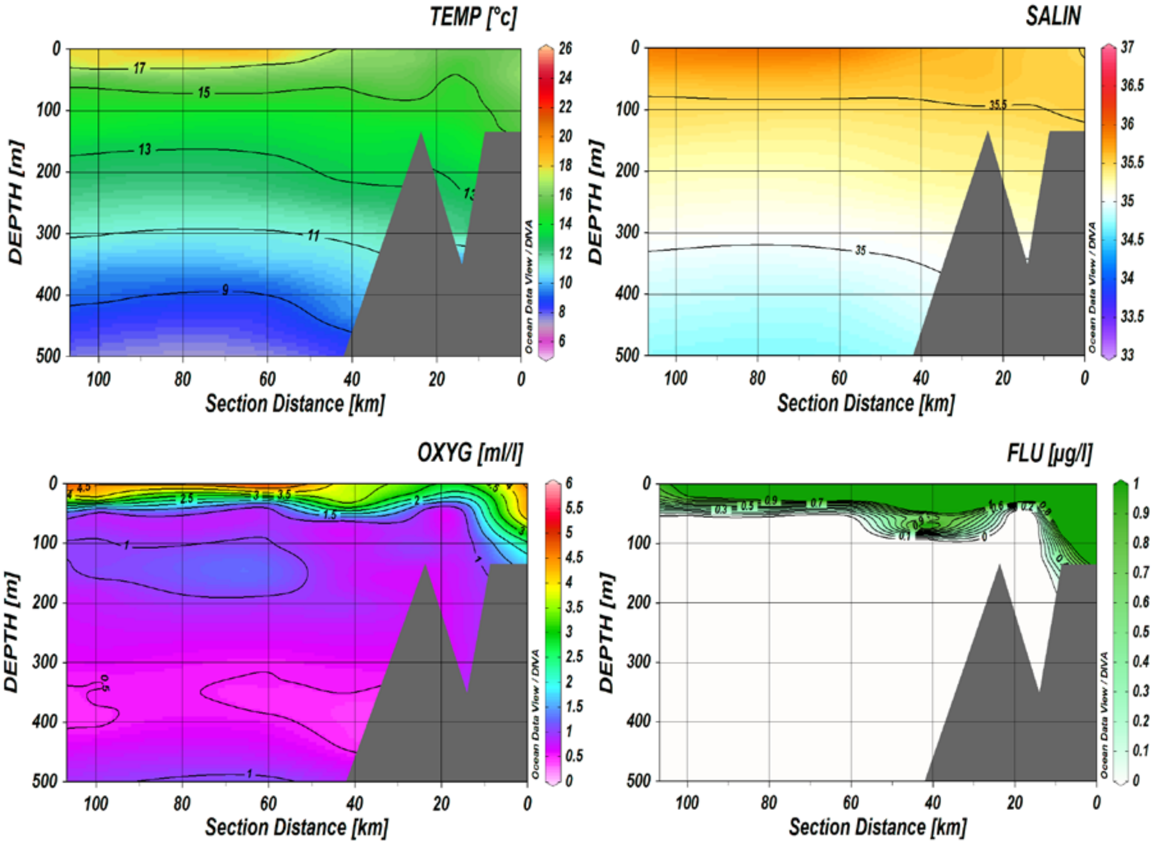


Figure 14. Vertical sections of temperature salinity, oxygen and fluorescence off Namibe.

Temperature in the section of Cunene River (Figure 15) was stable (15ºC) between depth layer 0 – 130 m. At deeper depths the temperature decreased gradually down (-1°C), reaching the 7°C at 480 m depth. It was recorded little variation in salinity (35.5) in depths between 0- 290 m and the salinity remained more or less unchanged (-0.5) below this depth. The oxygen varied significantly in the surface layer (0 – 50 m), the levels were between 3ml/l – 6 ml/l, with the highest levels (6ml/l) along the coast. The biological activity determined by fluorescence shoed a high peak (1µg/l) close to surface, in the intermediate area between the offshore and coastal area.

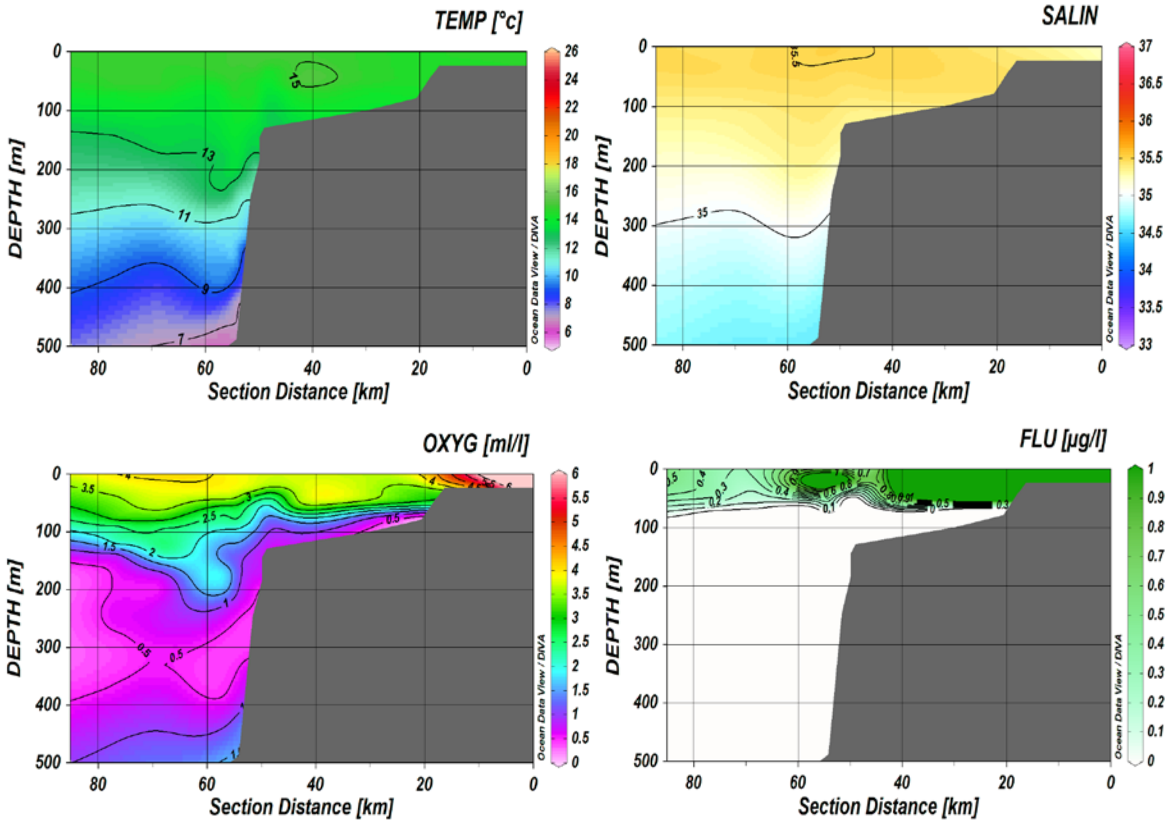


Figure 15. Vertical sections of temperature salinity, oxygen and fluorescence off Cunene River

CHAPTER 4 DISTRIBUTION, SIZE COMPOSITION AND BIOMASS ESTIMATES

4.1 Congo River - Pta. Palmerinhas

4.1.1 Sardinella

The sardinella were distributed over one main and three smaller areas (Figure 16). The northernmost area was located near the Cabeça da Cobra, while two were situated just north and south of N'Zeto. The larges area of distribution extended from Luando and north of Ambriz. The highest densities was observed in a small area south of N'Zeto with densities of ($1001<s_A<10\ 000$ m^2/NM^2). Most of the recordings were made in depths shallower than 100 m.

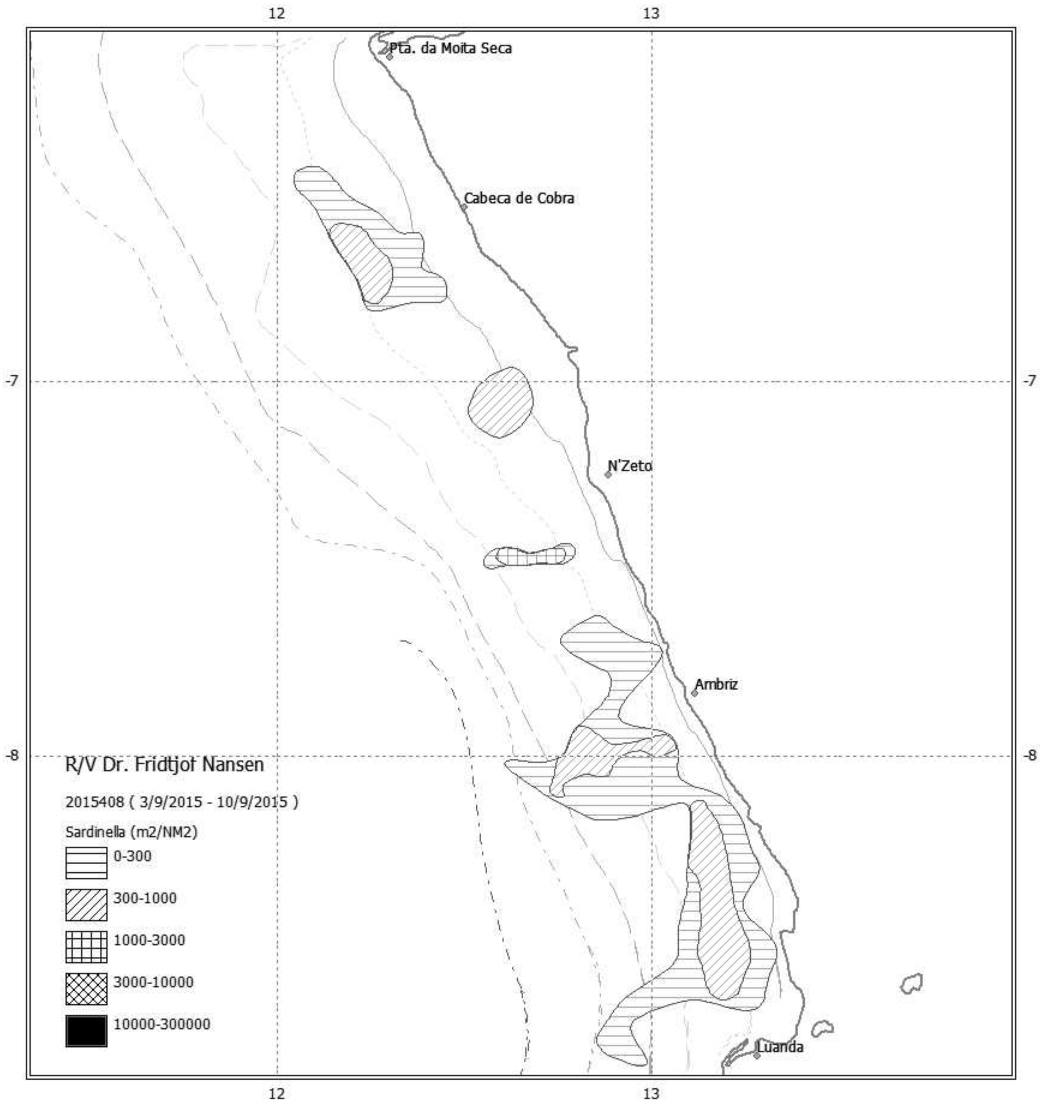
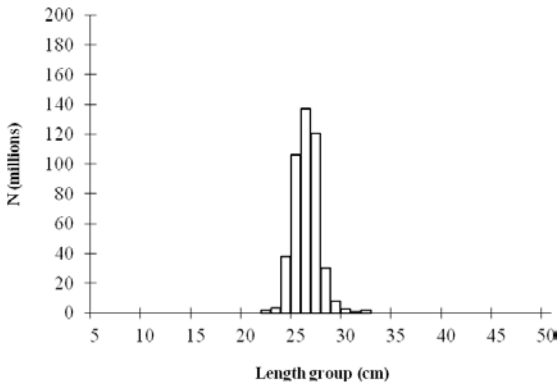


Figure 16. Distribution of *Sardinella maderensis* and *Sardinella aurita*. Congo River-Pta. das Palmerinhas Depth contours at 20, 50, 100, 200, and 500m.

Figure 17 shows the length distribution of the sardinellas in the northern region. *S. maderensis* showed one modal peak around 26 cm TL. Half (58%) of the total abundance contained fish from 22-26 cm length. On the other hand, *S. aurita* showed two modal peaks, around 9 and 25 cm TL. Half (59%) of the total biomass contained fish from 8-26 cm TL.

The estimated biomass for this region was 131 419 tonnes, (*Sardinella maderensis* was 76 314 tonnes and *Sarinella aurita* was 55 105 tonnes). The total biomass is slightly higher than for the same period in 2014 (117 000 tonnes), but the abundance of S. madrensis has decreased, while the biomass of S. aurita has increased, compared to the 2014 values. This year, *Sardinella maderensis* represent about 58% and *S. aurita* 42% in the northern area.



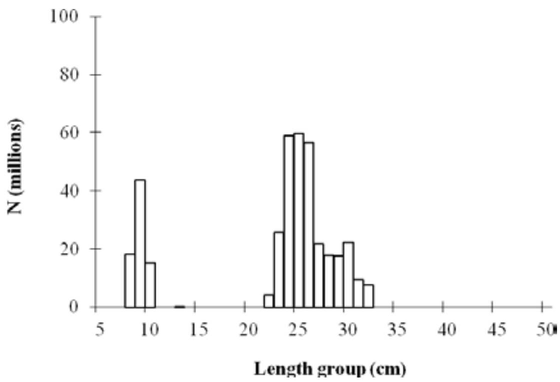


Figure 17. Total length distribution of *Sardinella maderensis* and *Sardinella aurita*, Congo River-Pta. das Palmerinhas.

4.1.2 Horse mackerel

Cunene horse mackerel, *T. trecae,* was found in a continus area along the coast from Pta. da Moita Seca to Luanda (Figure 18). Low densities were recorded in most of this area ($0<s_A<300$ m^2/NM^2), with some higher densities in small areas off-shore. Compared with last year, there is a large increase in the area of distribution of *Trachurus trecae.* During this survey, most fish were captured between 25-100 m depth. The horse mackerel was generally caught with bottom trawl during the day and pelagic trawl during the night, and mixed with unusual large individuals of Trichiurus lepturus.

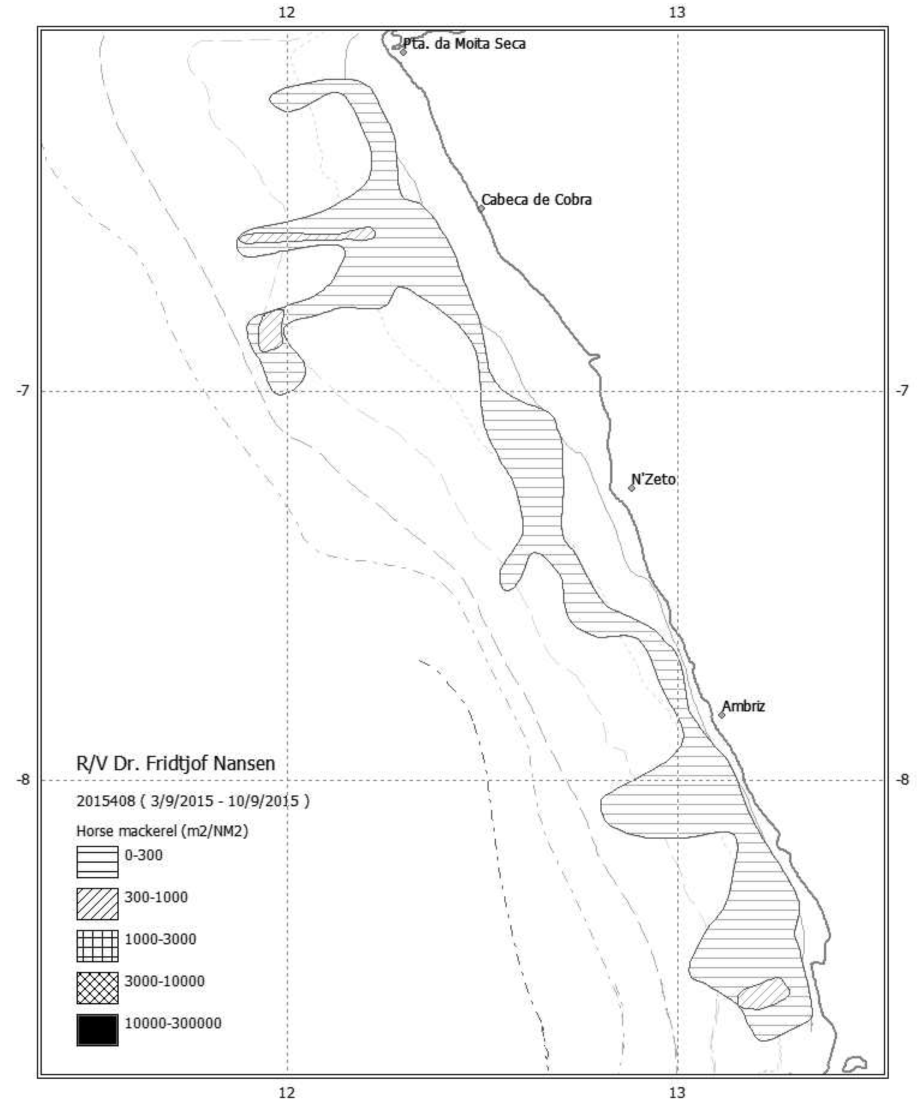


Figure 18. Distribution of Cunene horse mackerel (*Trachurus trecae*), Congo River-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200, and 500 m.

The length frequency of Cunene horse mackerel, *T. trecae*, showed a large variation in length. Half of the abundance contained individuals from 5-25 cm TL. It was a tendency towards 4 separate peaks (at 7, 18, 25 and 50 cm TL) (Figure 19).

The biomass of Cunene horse mackerel was estimated to 75 015 tonnes, corresponding to approximately 562 million fish. 26% of biomass belongs to juvenile fish of 10-20 cm length, while the adult fish of 21-50 cm contributed with 74% of the biomass. The observed biomass was much higher in comparison to the last years and has not reached such values since 2004 in the northern area.

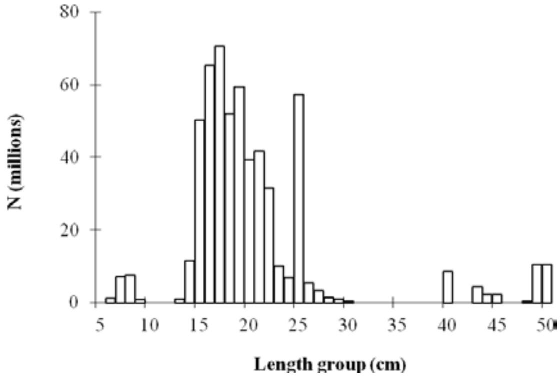


Figure 19. Total length frequency distribution of Cunene horse mackerel, Congo River - Pta. das Palmerinhas.

Of the 510 biological samples from the north area, 23% of the fish were found to be mature, 76 were immature. The majority of the fish were found in stage II for both female and males, but for stage V most (8 ind.) fish were females. The length at 50% maturity of *Trachurus trecae*, of this region, was 32 cm (Figure 20). Please note that the number of sampled fish above 20 cm is low and that results are given with some uncertainty.

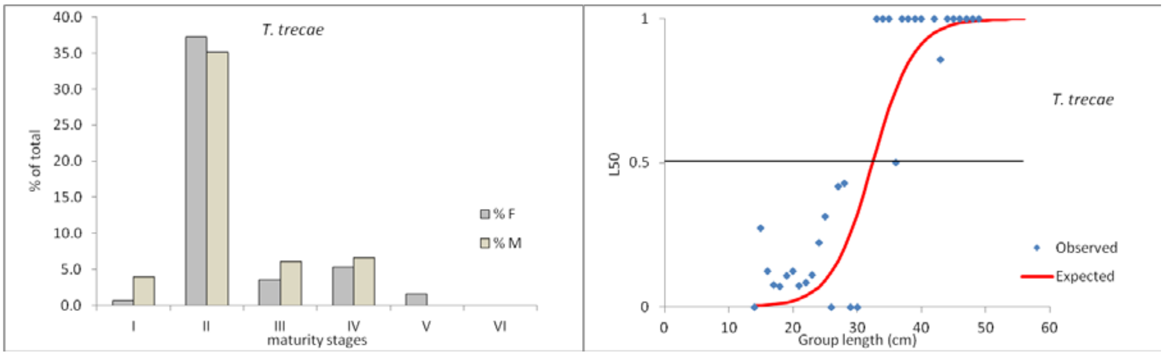


Figure 20. Maturity stages by sex and first length at maturity of *Trachurus trecae* in the Northern region.

4.1.3 Pelagic species Group 1

During the survey in 2015, *Ilisha africana* was the only species found belonging to this group, but only 39 individuals was caught at one station. Due to the low number the length distribution (Figure 21) is not shown. The biomass of *Ilisha africana* in the northern area, based on a standard mean length of 30 cm TL was estimated to be 12 197 tonnes.

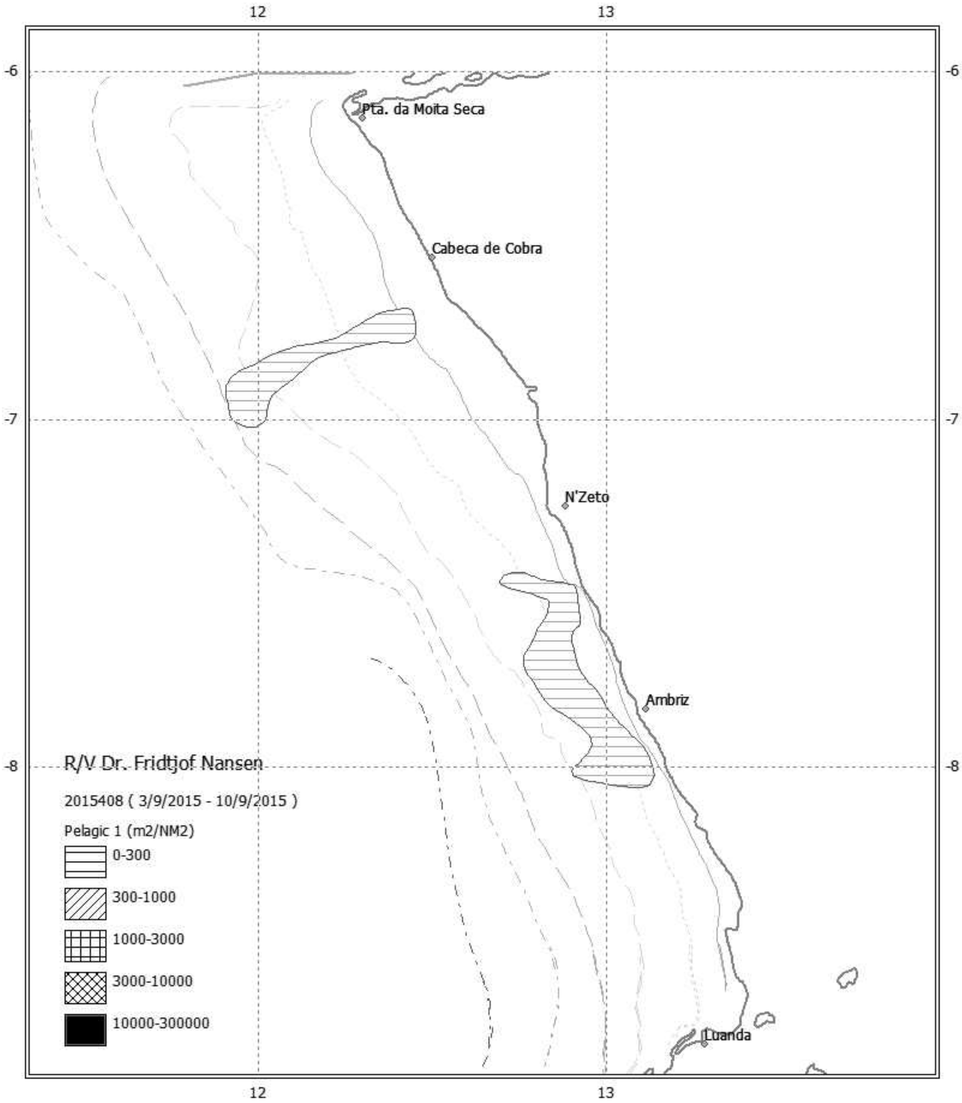


Figure 21. Distribution of Pelagic 1, Congo River-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200 and 500m.

4.1.4 Pelagic species Group 2

This year the dominant species was *Trichiurus lepturus*. The Carangidae, *Chloroscombrus chrysuru* and *Selene dorsalis* was also found in many of the trawl stations. Only areas of low densities ($0<S_A<300$ m^2/NM^2), were found, but the size of the area was quite large compared to previous years (Figure 22).

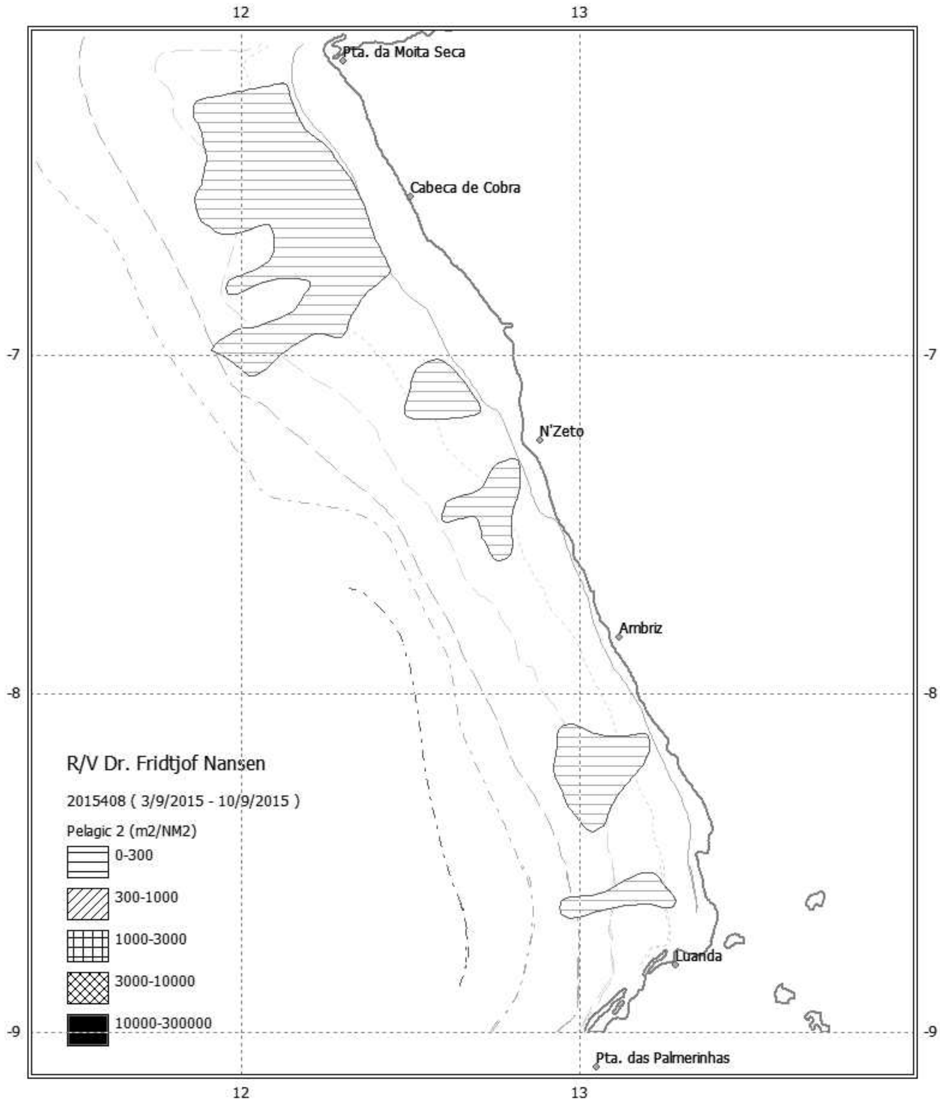


Figure 22. Distribution of Pelagic 2, Congo River-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200 and 500m.

The biomass calculation was based on an assumed average fish size of 30 cm and average condition factor of 1.0 and was estimated to be 54 268 tonnes. Further comments regarding the use of assumptions relating to average size and implications for potential bias (varying over time) will be given in chapter 5.3.

Table 3 shows the summary of the estimated abundance of main commercial species or species groups in northern region.

Table 3. Estimated abundance of pelagic fish (1000 tonnes), Congo River – Pta. das Palmerinhas.

Sardinella maderensis	Sardinella aurita	Trachurus trecae	Pelagic 1	Pelagic 2
76. 3	55. 1	75. 0	12.2	54.3

4.2 Pta. das Palmerinhas - Benguela

4.2.1 Sardinella

In the central area *Sardinella* was distributed continuously along the coast. Over most of the area, low ($1<s_A<300$ m^2/NM^2) and medium ($301<s_A<1000$ m^2/NM^2) densities of *Sardinella* was observed. Additionally, several small areas with high ($1001<s_A<3000$ m^2/NM^2) densities of sardinella were observed along the coast (Figure 23). Mostly large individuals (>25 cm length), from both *Sardinella* species, were caught in the trawl catches. *S. maderensis* was only occationally caught and in small numbers.

Sardinella was observed in the upper layer of the water column, schooling near the surface during daytime. During the day it was not possible to trawl on *Sardinella* schools due to trawl avoidance. This is to some extent limiting the ability to observe size composition, especially in the areas with the shortest transects.

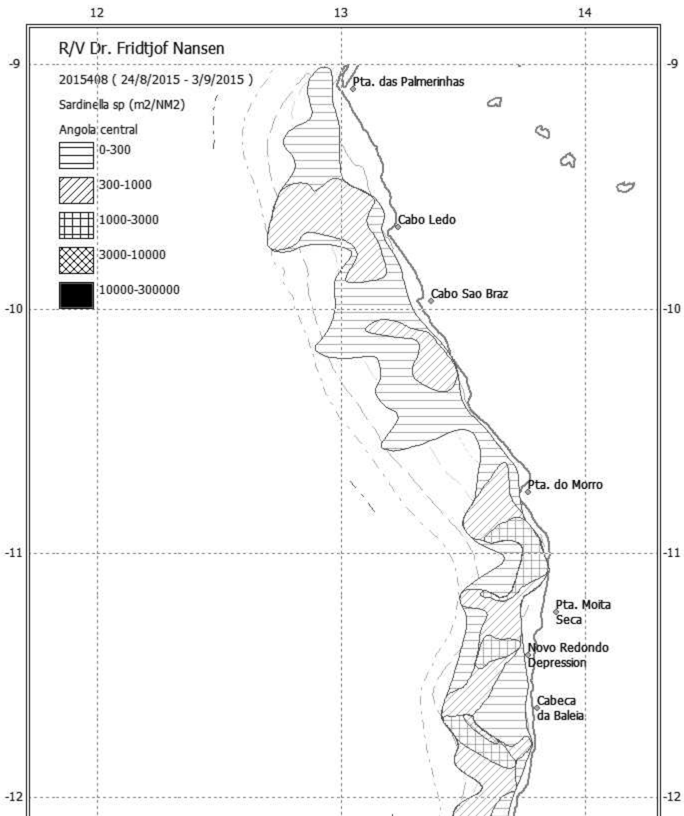


Figure 23. Distribution of *Sardinella* spp. Pta. das Palmerinhas- Benguela. Depth contours at 20, 50, 100 and 200 m.

The length distribution of *S. maderensis* is based on very few individual, but at tendency of two cohorts could be seen, peaking at 24 and 30 cm, while *S. aurita* is showing one peaks at 26 cm (Figure 24). Both species was distributed along the central area of the Angolan coast, but *S. maderensis* was only caught occationally.

The total biomass for both species of sardinella was estimated at 428 873 tonnes. Of this 333 799 was allocated for *S. aurita* and 95 074 tonnes was *S. maderensis*.

This year's estimated biomass, was 1.5 times as hig as the estimated biomass for 2014 (272 thousand tonnes) but less (26%) than the estimated biomass in the 2012 winter season, where the survey was conducted at approximately the same time of year as the current survey (584 thousand tonnes).

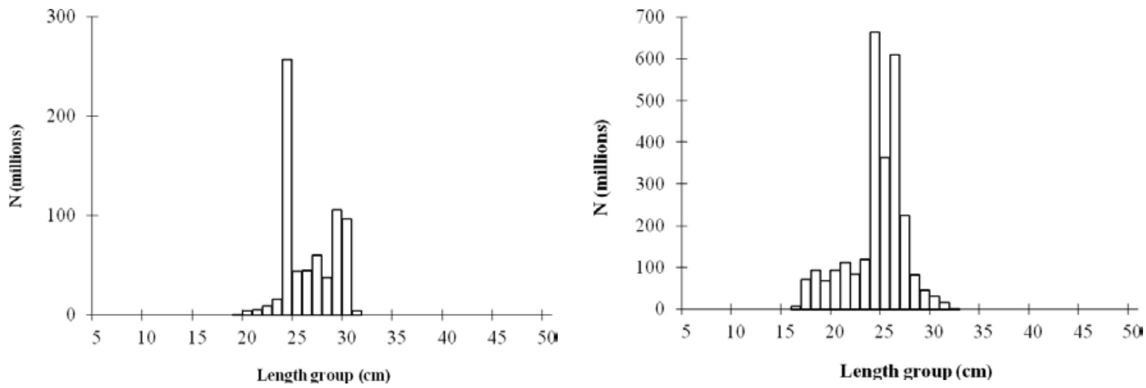


Figure 24. Total length distribution of S. *maderensis* and *S. aurita*. Pta. das Palmerinhas - Benguela.

4.2.2 Horse mackerel

Cunene horse mackerel, *Trachurus trecae*, was found in the Angolan central region. *T. trecae* was distributed in in a continues but low density ($0<s_A< 300\ m^2/NM^2$), from Benguela to Pta. das Palmerinhas. Patches with higher densities was observeds, especially outside Cabo Sao Braz. Its distribution ranged from approximately, 20 to 150 m bottom depth (Figure 25).

The biomass of Cunene horse mackerel was estimated at 149 131 tonnes. This biomass in this region was 6 times higher compared to 2014 (24 thousand tonnes), in the same season, and the third highest value observed in this area since 1985.

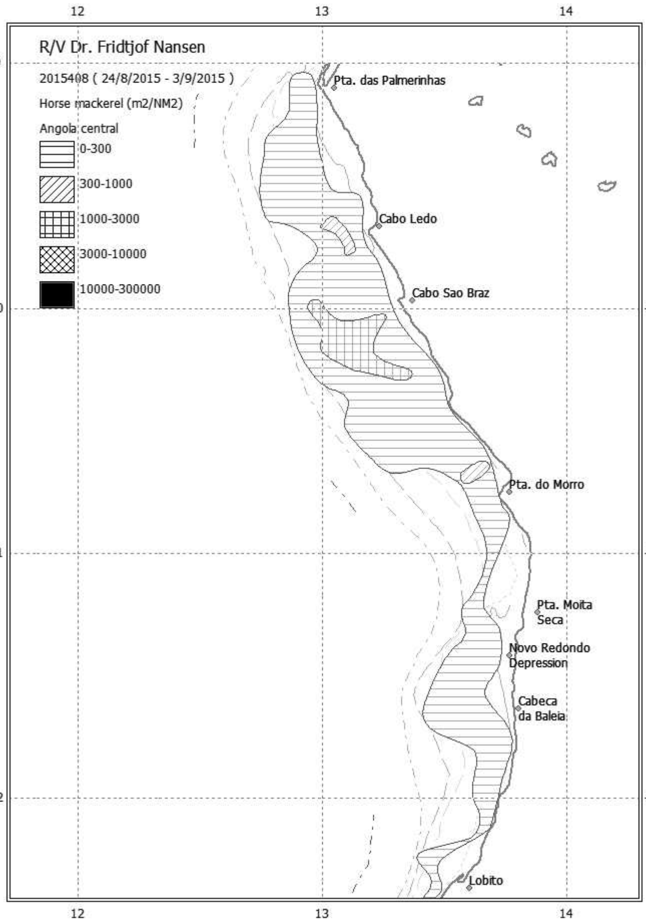


Figure 25. Distribution of horse mackerel (*Trachurus trecae*). Pta. das Palmerinhas- Benguela. Depth contours at 20, 50, 100, 200 and 500 m.

The length frequency distribution is shown in Figure 26. The length frequency ranged between 15 and 50 cm with two well-defined peaks at 19 cm and 30 cm. 45% of the biomass estimated comprised of fish <30 cm length.

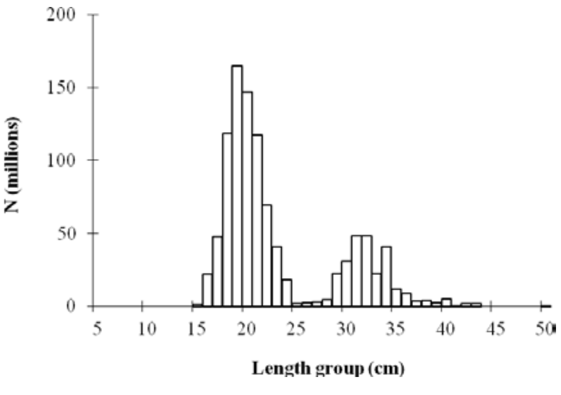


Figure 26. Total length distribution of horse mackerel (*Trachurus trecae*), Pta. das Palmerinhas- Benguela.

In the central region, biological sampling was conducted on a total of 537 fishes. From these, 56% were immature. The majority of the fish were found in stage II for both female and males. Spawning individuals (stage V) consisted mainly of females, however they were found in low numbers (Figure 27). The length at 50% maturity was 24 cm.

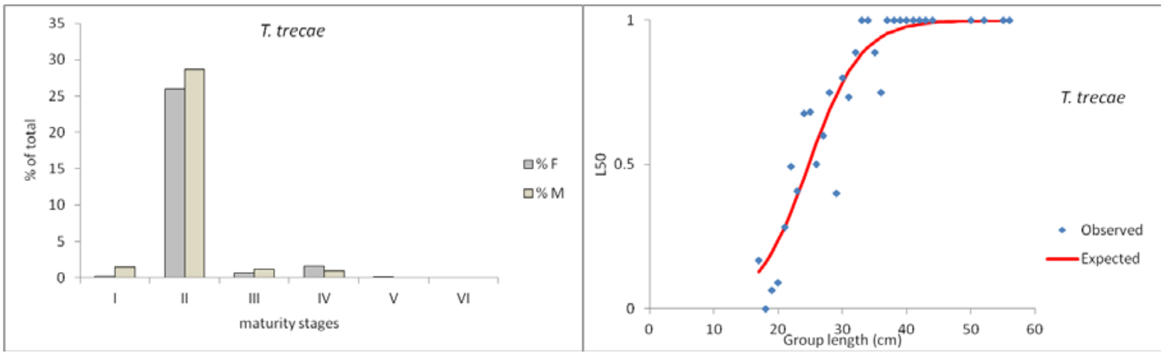


Figure 27. Maturity stages by sex and first length at maturity for *Trachurus trecae* in the Central region.

4.2.3 Pelagic species Group 1

No recording or catch of Pel 1 in the central area. The first obersvation of *Ilisha Africana* was done in the northern area (at 8 degrees South). Figure 29 and 30 are therefore not shown.

4.2.4 Pelagic species Group 2

This group was found in several small spots along the coast, with low densities ($0<s_A<300$ m^2/NM^2) (Figure 31). The most common species, from this group, caught in the trawl were Carangids: *Chloroscombrus chrysurus*, *Selene dorsalis*, and other species as *Trachiurus lepturus*, *Scomber japonicas*, *Sphyraena sp and Caranx rhoncus*.

The biomass estimate was 18 065 tonnes, based on an average length of 30 cm. Additional comments regarding potential sources of bias related to this method is given in chapter 5.3.

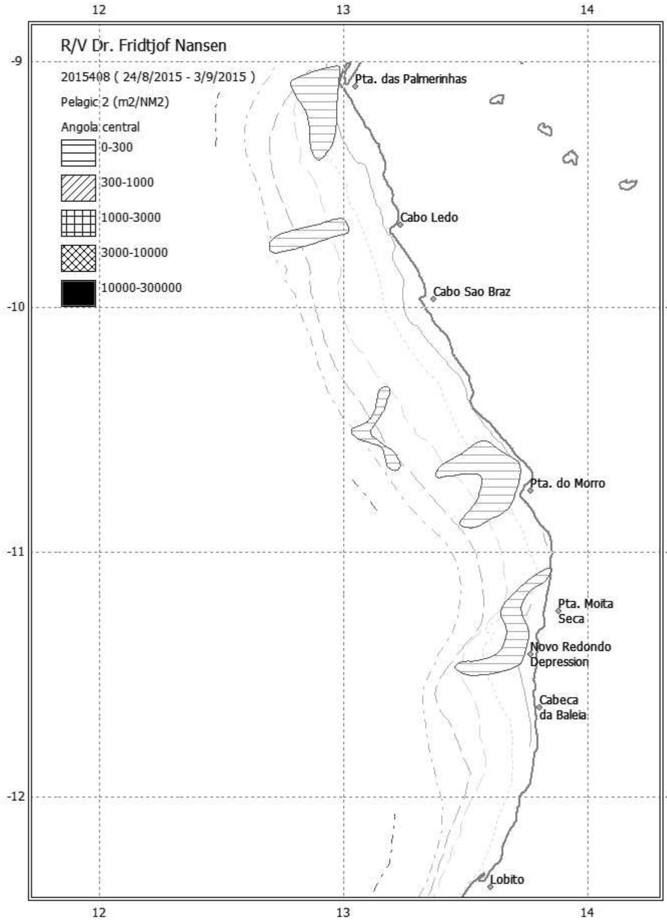


Figure 28. Distribution of pelagic species, group 2. Pta. das Palmerinhas- Benguela. Depth contours at 20, 50, 100, 200 and 500 m.

Table 4 shows the summary of the abundance estimated of main commercial species in central region.

Table 4. Estimated abundance of pelagic fish (1000 tonnes), Pta. das Palmeirinhas-Benguela.

Sardinella maderensis	Sardinella aurita	Trachurus trecae	Pelagic 1	Pelagic 2
95.1	333.8	149.1	0	18.1

4.3 Benguela - Cunene

4.3.1 Sardinella

No Sardinella (*S. aurita* and *S. maderensis*) were found in the coastal waters from Benguela to Cunene. The first recordings were north of Lobito in the central region.

4.3.2 Horse mackerel

Both species of horse mackerel, the Cunene horse mackerel (*Trachurus trecae*) and the Cape horse mackerel (*Trachurus capensis*) were found in southern region but did not have a completly continuous distribution along the coast (Figure 29). Three main areas were found. North of Namibe we found only *Trachurus trecae* at low density values (0< s_A <300 m^2/NM^2) while both species were found in a mix between Namibe and Cunene River at considerable higher densities and amounts. We observed large areas of both medium (301< s_A<1000 m^2/NM^2) and high densities (1001< s_A<3000 m^2/NM^2). Extra high densities (3001< s_A<10000 m^2/NM^2) was found in a small area north of Cunene River.

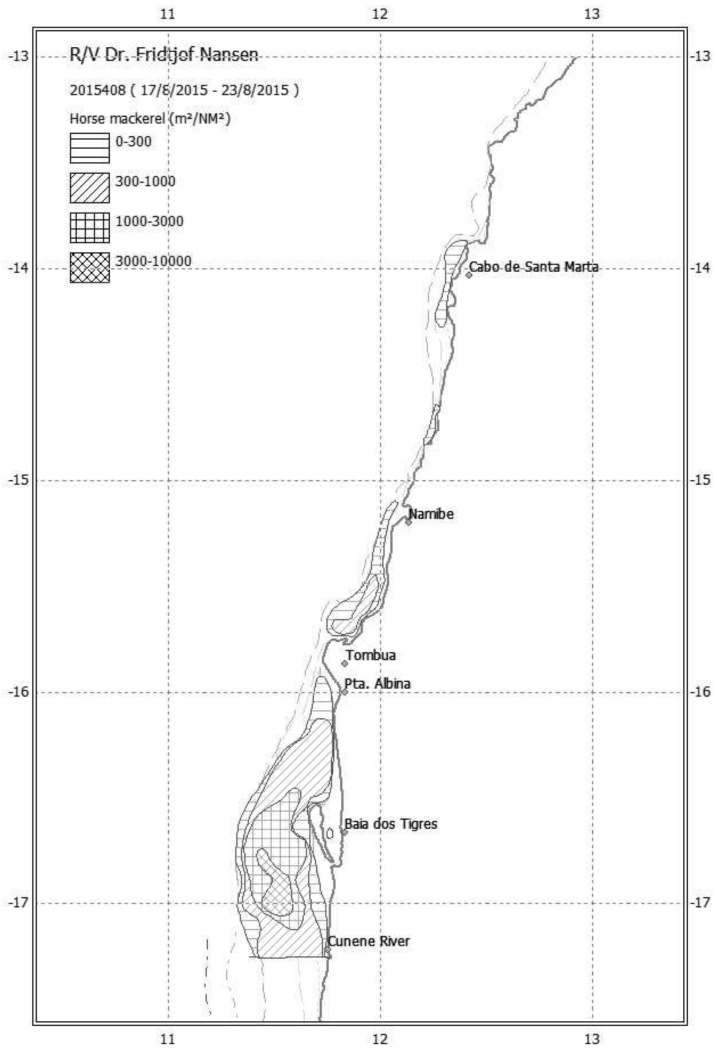


Figure 29. Distribution of horse mackerel (both species). Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 m.

Figure 30 shows the length frequency distributions of the Cunene and Cape horse mackerels, respectively. Cunene horse mackerel has a mode, peaking at about 16 cm TL. Cape horse mackerel shows two modes at around 10, 15 cm TL. The third mode at 36 cm TL, which was found last year, did not appear this year.

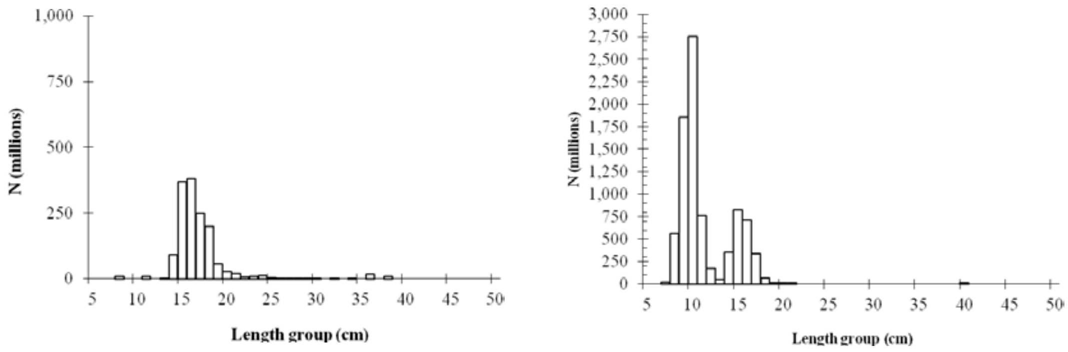


Figure 30. Total length distributions of *Trachurus trecae* (left) and *T. capensis* (right) Benguela-Cunene.

The biomass estimated for both horse mackerel species in the region, was 208 956 tonnes which is 90 000 tonnes less than last year. Of this, 36.2 % was Cunene horse mackerel while 63.8% was Cape horse mackerel. The reduction in biomass is mainly caused by Cunene horse mackerel, while the biomass of Cape Horse mackerel is similar to last year. Juveniles dominate the estimate in numbers for both species (80% of biomass from fish <20cm TL for Cunene horse mackerel and 90 % of biomass from fish <20% TL for cape horse mackerel).

Of the 123 biological samples from the south area, 54% were female, 46% male. 70% of the fish were found to be mature, 29% were immature. The majority of the fish were found in stage III and IV for female and in stage II. II and IV for males. The length at 50% maturity of *Trachurus trecae,* of this region, was 17 cm TL (Figure 31).

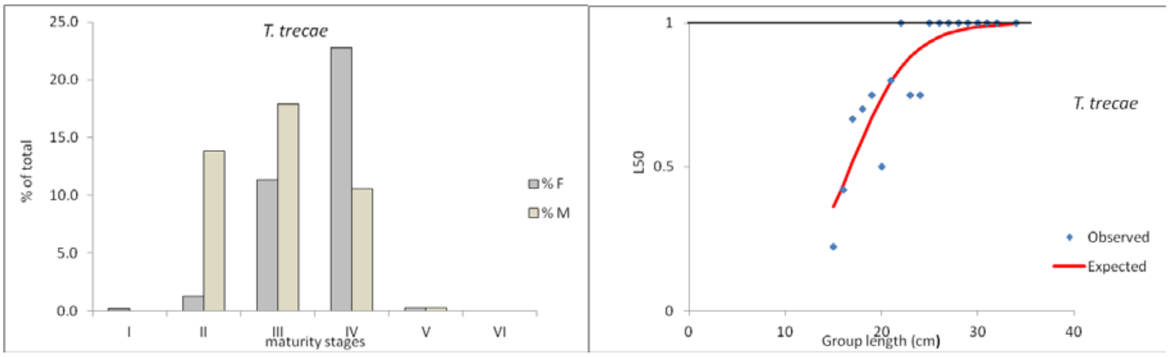


Figure 31. Maturity stages by sex and first length at maturity for *Trachurus trecae* in the South region.

4.3.3 Pelagic species Group 1

The dominant species belonging to this group were round herring (*Etrumeus whiteheadi*), and *Trichiurus lepturus* but almost no anchovy (*Engraulis encrasicolus*) was found. Pelagis species, group 1 was found in the area between Pta Albina and Cunene River of low densities areas ($0< s_A<300$ m^2/NM^2), (Figure 32).

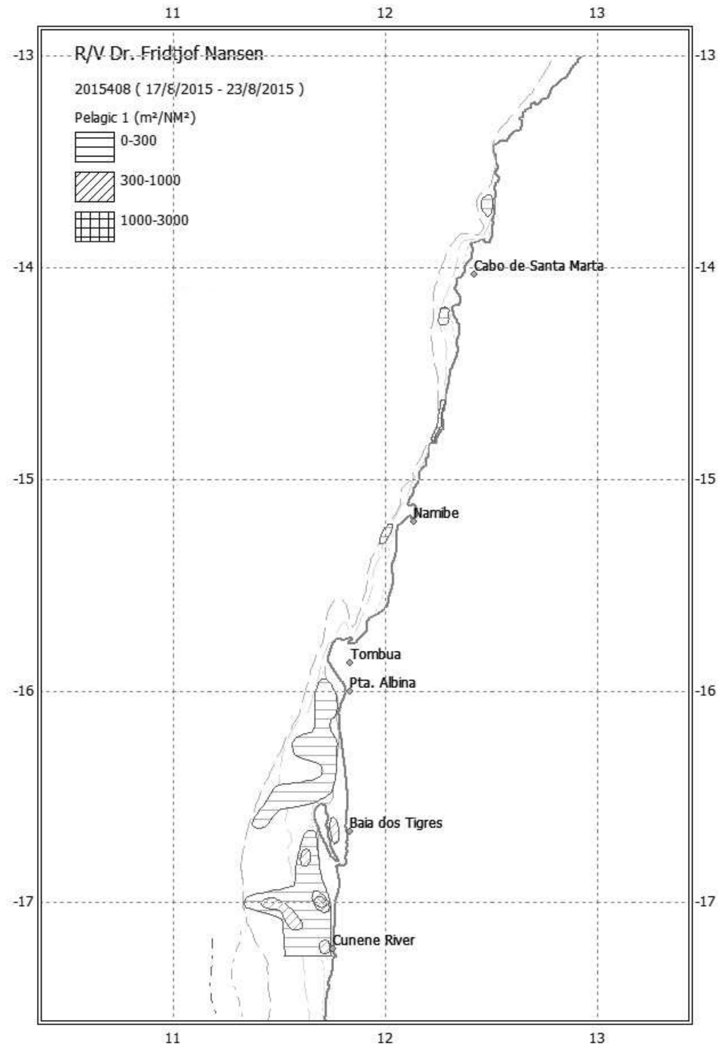


Figure 32. Distribution of Pelagic 1. Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 meters.

The biomass for this group was estimated to be 72 261 tonnes and consisted of mostly *Etrumeus whiteheadi*. The length distribution of *Etrumeus whiteheadi* has one mode at around 21 cm TL (Figure 33). The mean length of 30 cm TL was used as basis for the biomass estimate together with an observed length-weight relationship.

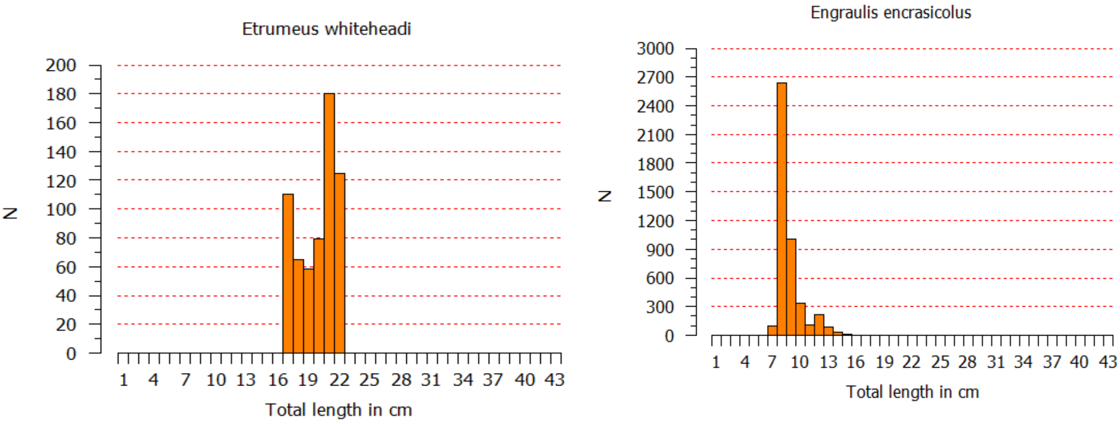


Figure 33. Total length distribution of *Etrumeus whiteheadi* and *Engraulis encrasicolus*. Benguela-Cunene.

4.3.4 Pelagic species Group 2

This group was found distributed along the coast between Tombua and Cunene in patched areas with low densities areas ($0<s_A<300$ m^2/NM^2) (Figure 39). The group was dominated by Carangids and other species as *Scomber japonicas*, *Trichiurus lepturus* and *Sphyraena sp*.

The biomass estimated was 42 455 tonnes, based on a standard average length of 30 cm TL. See also subsection 5.3 regarding assumptions and possible sources of bias.

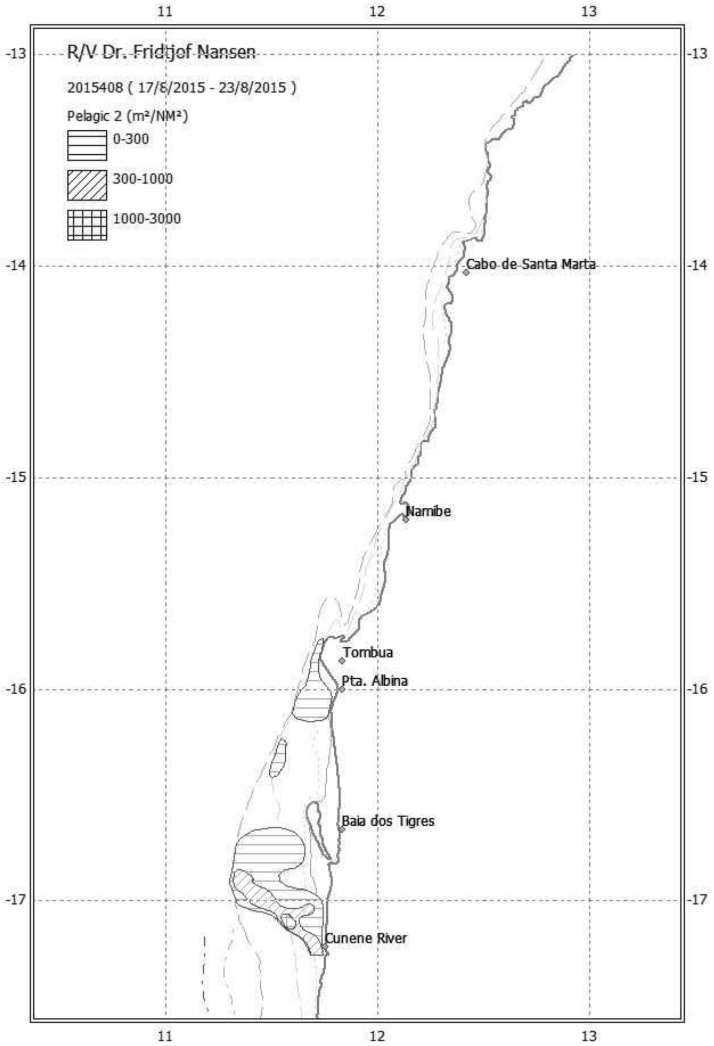


Figure 34. Distribution of Pelagic 2. Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 meters.

Table 5 shows the summary of the abundance estimated of main commercial species in the southern region.

Table 5. Estimated abundance of pelagic fish (tonnes), Benguela-Cunene (1000 tonnes).

Sardinella maderensis	Sardinella aurita	Trachurus trecae	Trachurus capensis	Pelagic 1	Pelagic 2
0	0	75.5	133.4	72.3	42.5

CHAPTER 5 SUMMARY OF SURVEY RESULTS

5.1 Sardinella

The estimated biomass of sardinella shows a cyclic fluctuating pattern throughout the time series (Figure 35). 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. On the overall, the Sardinella stocks presently seem to be in relatively good condition. The total biomass estimate for sardinellas was 560 000 tonnes. This is at the same level as the summer 2013 survey (565 000 tonnes) and 5'h highest value recorded since the start of the surveys in 1985. However, no Sardinella (*S. aurita* nor *S. maderensis*) were found in the coastal waters from Benguela to Cunene. The first recordings were north of Lobito in the central region.

The length/size compostion for both species shows highest abundance (in numbers) of size groups (15-20 cm) soon entering the fishery. The estimated numbers for the lowest size range below 10 cm is somewhat higher than what is usually observed during this survey, but estimates are more uncertain and the survey coverage must be assumed to be poor for these size groups often found in more shallow waters than the survey covers.

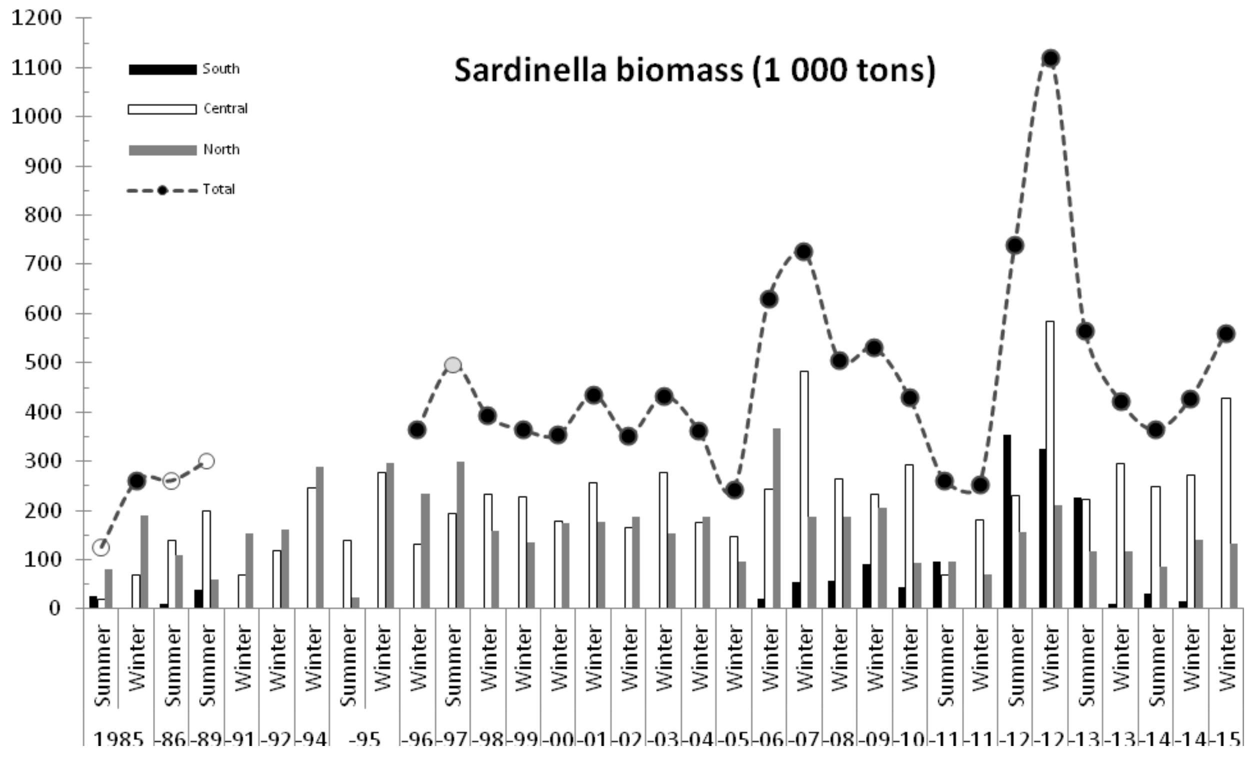


Figure 35. Biomass estimates of Sardinella by regions and surveys (1000 tonnes).

The overall length frequency distributions of the two Sardinella species show both juvenile and adult cohorts (Figure 36). The distribution of *S. aurita* shows well-defined cohorts with modal peaks around 9, and 26 cm total length. For *S. madrensis,* the distribution shows modal peak at 26 cm TL.

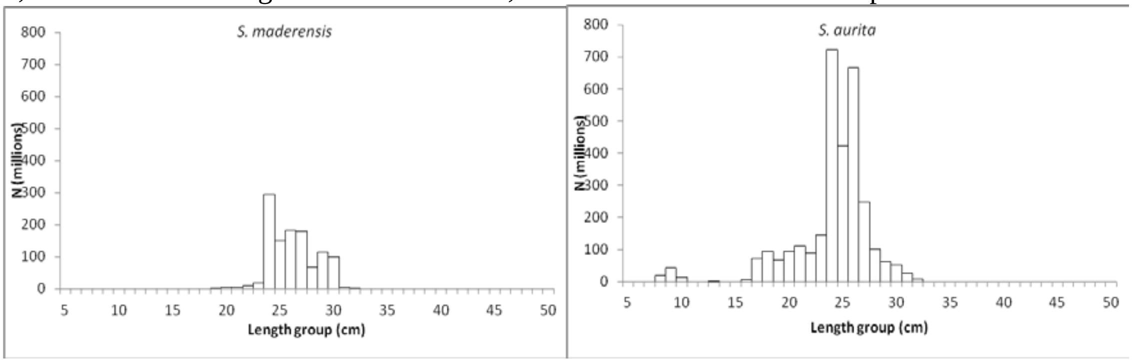


Figure 36. Overall total length distribution of S. *maderensis* and *S. aurita.*

5.2 Horse mackerel

The total biomass of Cunene horse mackerel was estimated to 300 000 tonnes (Figure 37). This is at the same level as last year summer survey (2014) and slightly less than in the survey of summer 2012. It is higher than the long term mean (2000-2015) of 207 000 tonnes. The bulk of the biomass is found in the central region which is in contrast to other years, where the main abundance has been in the southern area. The most abundant size group ranges from 15-19cm and will soon recruit to the fishery. There is a marked lack of Cunene horse mackerel > 30cm in the survey results. We would like to point to three possible causes for this:

- The survey coverage has certain limitations and both an offshore as well as an inshore component may be outside the survey area.
- Larger horse mackerel have a higher swimming capacity and may have higher avoidance to the sampling trawls used. Such gear avoidance may differ between years due to differences in environmental conditions like feeding conditions. This can also be linked due to changes in diurnal behavioural patterns like depth preferences.
- The fishing activity is primarily targeting large sized horse mackerel.

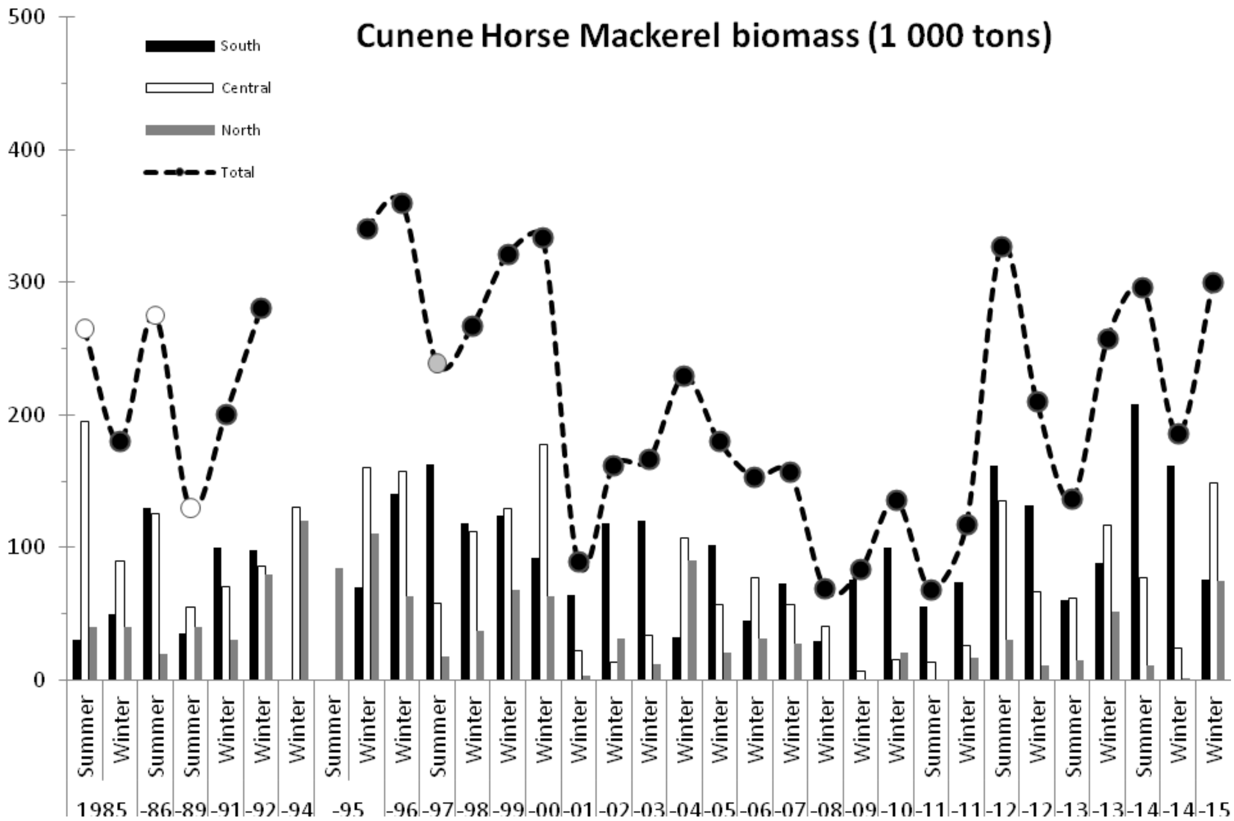


Figure 37. Biomass estimates of Cunene horse mackerel by regions and surveys (1 000 tonnes).

The overall length frequency distributions of the horse mackerel species include juvenile cohorts for both *T. Trecae* and *T. capensis* (Figure 38). The distribution of *T. capensis* shows well-defined cohorts with modal peaks around 10, and 17 cm TL. For *T. trecae,* the distribution shows a modal peak at 16 and a tendency to a peak at 32 cm TL.

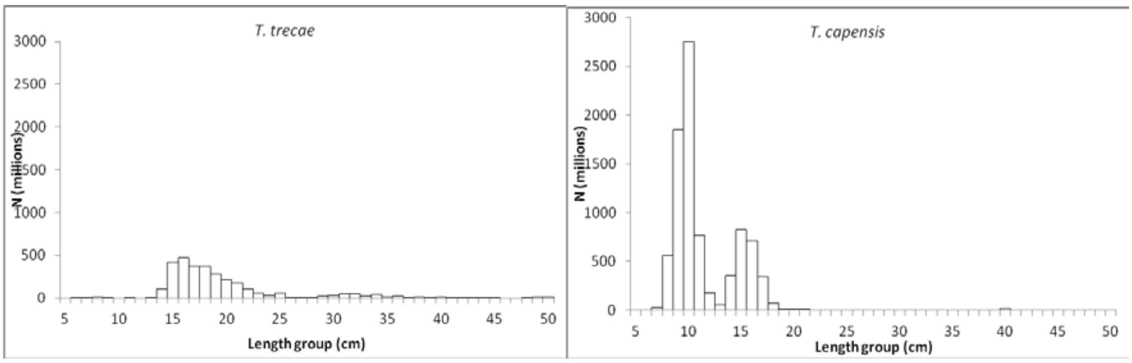


Figure 38. Overall total length distribution of *T. trecae* and *T. capensis.*

The total biomass of Cape horse mackerel was estimated at 133 400 tonnes. This is slightly less than in the winter 2014 survey (136 000 tonnes). The result for Cape horse mackerel should not be interpreted as an increase in stock size since such an increase can be caused by distributional shifts. More thorough analysis would be needed including survey information from Namibian waters. The possible shift in distribution (also observed for Cunene horse mackerel the last two years) may be linked to the position of the Angolan-Benguela front (ABF) and corresponding upwelling influencing the availability of horse mackerel to the survey.

5.3 Regarding simplified biomass estimation

Estimates of species groups (pelagic 1 and pelagic 2) are based on less detailed sampling than sardinellas and horse mackerels. This year the pelagic 1 group was dominated by single species (in their respective regions, *Ilisha africana* in the northern and central regions and *Etrumeus whiteheadi* in the southern region of the survey area) and the biomass estimate corresponds to this single species with a small proportion added. Pelagic 1 species are usually found very close to the surface and the the proportion of biomass found above the acoustic range may be considerable. This is a known source of bias and it is not known if this bias varies between years/seasons.

Pelagic 2 species are estimated assuming a fixed length of 30 cm and a mean condition factor. This practice introduces two potential sources of bias:

Conversion of echo abundance to number of fish depends on the average of squared lengths and this will change between years. This is a source of bias in the estimation of numbers of fish. Different length distributions may produce the same average squared length, but the corresponding biomass will be different.

Due to these bias issues overinterpretation of time series of pelagic 2 biomass estimates should be avoided.

Observed length frequencies of pelagic 2 species are presented in Annex II.

5.4 Summary

A summary of main findings are presented in Table 6. The reported biomass levels should be viewed with considerable caution. The estimates are relative indices rather than absolute estimates of abundance, and the cyclic variation pattern for sardinellas and horse mackerels may be accentuated by changes in distributional 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.

Observed variation in biomass may also be caused by favourable conditions increasing the availability to fishing gear. Increased availability does not necessarily mean increased abundance, sometimes availability may even increase with decreasing abundance. Continuing to fish on the basis of high availability therefore involves risk. It is particularly evident for Cunene horse mackerel confined to the Southern region and with biomass comprised by juveniles (TL < 18 cm).

Other biological references also clearly indicate that the Cunene horse mackerel stock is still under considerable pressure. From the reference year 1996, the length distributions have been shifting towards smaller fish, indicating high fishing pressure on the adult stock (Figure 38).

In this situation, increasing fishing pressure could involve a high risk for failure of the long-term recovery the of the Cunene horse mackerel stock.

Table 6. Estimated abundance of pelagic fish (1000 tonnes), Angolan coast Congo River-Cunene.

Species	North	Central	South	Total
Cunene horse mackerel	75. 0	149.1	75.5	299.6
Cape horse mackerel			133.4	133.4
Sardinella aurita	55. 1	333.8	0	388.9
Sardinella maderensis	76. 3	95.1	0	171.4
Pelagic 1	12.2	0	72.3	84.5
Pelagic 2	54.3	18.1	42.5	114.9

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ANNEX I. Records of fishing stations

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:    1
DATE  :18/08/15               GEAR TYPE: BT NO: 27   POSITION:Lat    S
17°4.51
         start      stop     duration                              Lon    E
11°44.25
TIME  :07:40:51 08:11:48  30.9 (min)          Purpose    : 1
LOG   : 1728.99  1730.93   1.9                Region     : 4050
FDEPTH:      19       21                      Gear cond.: 0
BDEPTH:      19       21                      Validity  : 0
Towing dir:   0°      Wire out    : 100  m    Speed      : 3.8 kn
Sorted    :  89      Total catch: 571.89      Catch/hour: 1108.67

   SPECIES                                       CATCH/HOUR      % OF TOT. C
SAMP
                                              weight   numbers
   Chelonia mydas                              232.63        8       20.98
   Mustelus mustelus                           214.80      107       19.37
   Pomatomus saltatrix                         107.40     1241        9.69
   JELLYFISH                                    91.41      582        8.24
   Arius parkii                                 89.76      397        8.10
   Myliobatis aquila                            80.26       58        7.24
   Trachurus trecae                               69.21      1425         6.24
1
   Dasyatis marmorata                           32.57       10        2.94
   Rhinobatos albomaculatus                     29.66       10        2.68
   Stromateus fiatola                           29.18       78        2.63
   Merluccius polli                             25.59     1047        2.31
   Callorhinchus capensis                       22.00       10        1.98
   Trichiurus lepturus                            19.58      979         1.77
2
   Raja miraletus                               17.84       29        1.61
   Argyrosomus inodorus                         13.84        2        1.25
   Merluccius capensis                           9.60      368        0.87
   Sepia orbignyana                              9.31       19        0.84
   Narke capensis                                3.00       78        0.27
   Starfish                                      2.81      359        0.25
   Selene dorsalis                               2.42       19        0.22
   C R A B S                                     1.55      107        0.14
   Umbrina canariensis                           1.26       48        0.11
   Pterothrissus belloci                         1.16       68        0.10
   G A S T R O P O D S                           0.78      126        0.07
   Cynoglossus senegalensis                      0.58       39        0.05
   Etrumeus whiteheadi                           0.48       19        0.04
                                              _______             _______
   Total                                      1108.67              100.00
```

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:    2
DATE  :18/08/15               GEAR TYPE: BT NO: 27   POSITION:Lat    S
17°0.33
         start      stop     duration                              Lon    E
11°35.80
TIME  :09:53:03 09:56:27  3.4  (min)          Purpose    : 1
LOG   : 1742.47  1742.57   0.1                Region     : 4050
FDEPTH:      86       86                      Gear cond.: 0
BDEPTH:      86       86                      Validity  : 0
Towing dir:   0°      Wire out    : 260  m    Speed      : 1.8 kn
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:2015408        STATION:    3
DATE  :18/08/15               GEAR TYPE: PT NO:  1   POSITION:Lat    S
16°54.12
         start      stop     duration                              Lon    E
11°27.39
TIME  :17:33:59 17:53:58  20.0 (min)          Purpose    : 1
LOG   : 1790.31  1791.42   1.1                Region     : 4050
FDEPTH:      90      100                      Gear cond.: 0
BDEPTH:     117      120                      Validity  : 0
Towing dir:   0°      Wire out    : 260  m    Speed      : 3.4 kn
Sorted    :  59      Total catch: 352.74      Catch/hour: 1059.28

   SPECIES                                       CATCH/HOUR      % OF TOT. C
SAMP
                                              weight   numbers
   Trachurus capensis                           1029.55    37495        97.19
3
   Dentex macrophthalmus                        10.09       72        0.95
   Chelidonichthys capensis                      8.11       36        0.77
   Trigla lyra                                   5.05       54        0.48
   Merluccius capensis                           3.24       72        0.31
   Sepia orbignyana                              3.24       18        0.31
                                              _______             _______
   Total                                      1059.28              100.00
```

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:    4
DATE  :19/08/15               GEAR TYPE: PT NO:  1   POSITION:Lat    S
16°42.57
         start      stop     duration                              Lon    E
11°37.93
TIME  :04:14:16 04:26:30  12.2 (min)          Purpose    : 1
LOG   : 1870.81  1871.48   0.7                Region     : 4050
FDEPTH:      30       40                      Gear cond.: 0
BDEPTH:      75       85                      Validity  : 0
Towing dir:   0°      Wire out    : 80   m    Speed      : 3.3 kn
Sorted    :  68      Total catch: 169.91      Catch/hour: 833.55

   SPECIES                                       CATCH/HOUR      % OF TOT. C
SAMP
                                              weight   numbers
   Trachurus capensis                           749.88    76695        89.96
4
   Scomber colias                                 70.52     1192         8.46
6
   Merluccius capensis                           9.47      260        1.14
   Engraulis encrasicolus                         3.43      505         0.41
5
   Etrumeus whiteheadi                           0.25       15        0.03
                                              _______             _______
   Total                                       833.55              100.00
```

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:    5
DATE  :19/08/15               GEAR TYPE: BT NO: 21   POSITION:Lat    S
16°37.60
         start      stop     duration                              Lon    E
11°33.48
TIME  :07:37:35 07:52:58  15.4 (min)          Purpose    : 1
LOG   : 1891.13  1891.98   0.8                Region     : 4050
FDEPTH:      99       98                      Gear cond.: 0
BDEPTH:      99       98                      Validity  : 0
Towing dir:   0°      Wire out    : 250  m    Speed      : 3.3 kn
Sorted    :  63      Total catch: 6525.00     Catch/hour: 25455.14

   SPECIES                                       CATCH/HOUR      % OF TOT. C
SAMP
                                              weight   numbers
   Trachurus capensis                        17318.27  1482835        68.03
8
   Chelidonichthys capensis                   2984.40    14629       11.72
   Merluccius capensis                        1375.16    26333        5.40
   Dentex macrophthalmus                       1345.90    64369         5.29
9
   Citharus linguatula                         848.50    29259        3.33
   Merluccius polli                            672.95     5852        2.64
   Trachurus trecae                             614.43    14629         2.41
7
   Illex coindetii                             207.74    20481        0.82
   Cynoglossus senegalensis                     58.52     5852        0.23
   GOBIIDAE                                     29.26     5852        0.11
                                              ________            _______
   Total                                     25455.14              100.00
```

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:    6
DATE  :19/08/15               GEAR TYPE: PT NO:  1   POSITION:Lat    S
16°29.45
         start      stop     duration                              Lon    E
11°35.57
TIME  :23:27:12 23:40:51  13.7 (min)          Purpose    : 1
LOG   : 1962.10  1962.85   0.8                Region     : 4050
FDEPTH:      30       35                      Gear cond.: 0
BDEPTH:      89       90                      Validity  : 0
Towing dir:   0°      Wire out    : 85   m    Speed      : 3.3 kn
Sorted    :   6      Total catch: 6.30        Catch/hour: 27.69

   SPECIES                                       CATCH/HOUR      % OF TOT. C
SAMP
                                              weight   numbers
   Sepia orbignyana                             21.23       18        76.67
   Trachurus capensis                             5.63      484         20.32
10
   Merluccius capensis                           0.57        9        2.06
   Etrumeus whiteheadi                           0.26        4        0.95
                                              _______             _______
   Total                                        27.69              100.00
```

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:    7
DATE  :20/08/15               GEAR TYPE: PT NO:  1   POSITION:Lat    S
16°22.74
         start      stop     duration                              Lon    E
11°27.73
TIME  :04:06:41 04:24:30  17.8 (min)          Purpose    : 1
LOG   : 2000.19  2001.05   0.9                Region     : 4050
FDEPTH:      35       45                      Gear cond.: 0
BDEPTH:     378      190                      Validity  : 0
Towing dir:   0°      Wire out    : 100  m    Speed      : 2.9 kn
Sorted    :   0      Total catch: 22.33       Catch/hour: 75.19

   SPECIES                                       CATCH/HOUR      % OF TOT. C
SAMP
                                              weight   numbers
   Trachurus capensis                             71.85     1889         95.57
11
   MYCTOPHIDAE                                   2.15      798        2.87
   Scomber colias                                0.57        3        0.76
   Trachurus trecae                              0.24        3        0.31
   Stomias boa boa                               0.20        3        0.27
   Lestrolepis intermedia                        0.10        3        0.13
   Synagrops microlepis                          0.07        3        0.09
                                              _______             _______
   Total                                        75.19              100.00
```

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:    8
DATE  :20/08/15               GEAR TYPE: BT NO: 21   POSITION:Lat    S
16°41.52
         start      stop     duration                              Lon    E
11°44.94
TIME  :08:58:32 09:26:50  28.3 (min)          Purpose    : 1
LOG   : 2037.04  2038.62   1.6                Region     : 4050
FDEPTH:      20       17                      Gear cond.: 0
BDEPTH:      20       17                      Validity  : 0
Towing dir:   0°      Wire out    : 100  m    Speed      : 3.4 kn
Sorted    : 106      Total catch: 342.99      Catch/hour: 727.19

   SPECIES                                       CATCH/HOUR      % OF TOT. C
SAMP
                                              weight   numbers
   Lithognathus mormyrus                       307.84    11296       42.33
   Diplodus capensis                           190.18     4796       26.15
   Pomatomus saltatrix                         162.95     2576       22.41
   Stromateus fiatola                           56.01      144        7.70
   Saurida brasiliensis                          2.54      763        0.35
   Etrumeus whiteheadi                            2.04       32         0.28
13
   Trichiurus lepturus                            1.78       76         0.24
12
   Atractoscion aequidens                        1.27       13        0.17
   Cynoglossus senegalensis                      1.21       51        0.17
   G A S T R O P O D S                           0.64      102        0.09
   Starfish                                      0.45       57        0.06
   C R A B S                                     0.19       25        0.03
   Engraulis encrasicolus                        0.08       21        0.01
                                              _______             _______
   Total                                       727.19              100.00
```

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 9
DATE :20/08/15 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°15.00
start stop duration Lon E 11°37.06
TIME :14:36:36 14:47:28 10.9 (min) Purpose : 1
LOG : 2085.76 2086.30 0.5 Region : 4050
FDEPTH: 74 75 Gear cond.: 0
BDEPTH: 74 75 Validity : 0
Towing dir: 0° Wire out : 200 m Speed : 3.0 kn
Sorted : 62 Total catch: 247.08 Catch/hour: 1363.83

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	982.96	36408	72.07	14
Chelidonichthys capensis	152.35	596	11.17	
Loligo vulgaris	74.63	574	5.47	
Spondyliosoma cantharus	35.33	199	2.59	
Trachurus capensis	24.95	1965	1.83	15
Sepia orbignyana	24.95	22	1.83	
Sepia officinalis	21.86	110	1.60	
Raja miraletus	15.23	22	1.12	
Mustelus mustelus	11.70	22	0.86	
Etrumeus whiteheadi	8.39	177	0.62	16
Merluccius capensis	8.39	132	0.62	
Citharus linguatula	1.77	88	0.13	
G A S T R O P O D S	1.32	88	0.10	
Total	1363.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 10
DATE :21/08/15 GEAR TYPE: PT NO: 1 POSITION:Lat S 16°5.10
start stop duration Lon E 11°38.48
TIME :00:13:44 00:29:18 15.6 (min) Purpose : 1
LOG : 2136.53 2137.33 0.8 Region : 4050
FDEPTH: 18 28 Gear cond.: 0
BDEPTH: 57 64 Validity : 0
Towing dir: 0° Wire out : 80 m Speed : 3.1 kn
Sorted : 64 Total catch: 349.68 Catch/hour: 1347.51

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	1284.59	147303	95.33	17
Engraulis encrasicolus	28.82	4027	2.14	18
Sepia orbignyana	22.04	23	1.64	
Trigla lyra	7.42	23	0.55	
Scomber colias	2.97	23	0.22	
Loligo vulgaris	1.27	23	0.09	
Synagrops microlepis	0.42	85	0.03	
Total	1347.53		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 11
DATE :21/08/15 GEAR TYPE: BT NO: 21 POSITION:Lat S 15°24.47
start stop duration Lon E 11°59.03
TIME :15:51:40 16:11:49 20.1 (min) Purpose : 1
LOG : 2266.43 2267.45 1.0 Region : 4050
FDEPTH: 73 76 Gear cond.: 0
BDEPTH: 73 76 Validity : 0
Towing dir: 0° Wire out : 200 m Speed : 3.0 kn
Sorted : 249 Total catch: 3630.62 Catch/hour: 10810.78

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	7336.50	134293	67.86	19
Dentex macrophthalmus	1431.72	35577	13.24	20
Pagellus bellottii	1354.00	10967	12.52	
Centrophorus squamosus	390.31	691	3.61	
Dentex barnardi	91.53	604	0.85	21
Mustelus mustelus	54.19	86	0.50	
Spondyliosoma cantharus	46.45	173	0.43	
Zeus faber	34.06	86	0.32	
Umbrina canariensis	29.42	259	0.27	
Lagocephalus laevigatus	17.03	86	0.16	
Chelidonichthys gabonensis	10.06	86	0.09	
Loligo vulgaris	7.74	86	0.07	
Chelidonichthys capensis	6.19	86	0.06	
Citharus linguatula	1.55	86	0.01	
Total	10810.78		100.0	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 12
DATE :22/08/15 GEAR TYPE: BT NO: 21 POSITION:Lat S 14°59.74
start stop duration Lon E 12°9.17
TIME :14:50:34 15:13:29 22.9 (min) Purpose : 1
LOG : 2413.70 2414.88 1.2 Region : 4050
FDEPTH: 66 64 Gear cond.: 0
BDEPTH: 66 64 Validity : 1
Towing dir: 0° Wire out : 180 m Speed : 3.1 kn
Sorted : 94 Total catch: 559.03 Catch/hour: 1463.43

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Pagellus bellottii	479.74	6058	32.78	
Umbrina canariensis	466.15	26113	31.85	
Dentex barnardi	192.77	1613	13.17	24
Dasyatis marmorata	41.62	29	2.84	
Rajella leopardus	40.73	16	2.78	
Dentex macrophthalmus	40.58	298	2.77	23
Sepia orbignyana	38.43	24	2.63	
Mustelus mustelus	34.48	29	2.36	
Lithognathus mormyrus	29.40	105	2.01	
Spondyliosoma cantharus	27.75	134	1.90	
Trachurus trecae	16.28	259	1.11	22
Atractoscion aequidens	14.63	29	1.00	
Diplodus cervinus cervinus	11.49	16	0.79	
Zeus faber	8.22	16	0.56	
Loligo vulgaris	4.71	29	0.32	
Chaetodon hoefleri	3.43	16	0.23	
Fistularia petimba	3.30	3	0.23	
Boops boops	2.70	16	0.18	
Chelidonichthys capensis	2.54	29	0.17	
Pomadasys jubelini	1.94	16	0.13	
Dentex gibbosus	1.34	3	0.09	
G A S T R O P O D S	1.20	29	0.08	
Total	1463.43		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 13
DATE :22/08/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 14°40.71
start stop duration Lon E 12°15.56
TIME :21:01:05 21:16:16 15.2 (min) Purpose : 1
LOG : 2459.55 2460.44 0.9 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 96 78 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.5 kn
Sorted : 199 Total catch: 198.73 Catch/hour: 785.49

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	623.32	4648	79.35	25
MYCTOPHIDAE	76.36	24285	9.72	
Onychoteuthis banksi	54.23	103	6.90	
Etrumeus whiteheadi	31.58	411	4.02	26
Total	785.49		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 14
DATE :24/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 12°29.44
start stop duration Lon E 13°20.46
TIME :12:28:58 12:58:34 29.6 (min) Purpose : 1
LOG : 2776.03 2777.47 1.4 Region : 4040
FDEPTH: 92 89 Gear cond.: 0
BDEPTH: 92 89 Validity : 0
Towing dir: 0° Wire out : 225 m Speed : 2.9 kn
Sorted : 0 Total catch: 369.33 Catch/hour: 748.39

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	561.32	5518	75.00	27
Dentex macrophthalmus	77.77	883	10.39	28
Chelidonichthys gabonensis	23.83	193	3.18	
Boops boops	21.36	184	2.85	
Etrumeus whiteheadi	19.70	255	2.63	29
Torpedo torpedo	12.95	22	1.73	
Citharus linguatula	5.49	128	0.73	
Trachurus trecae	4.68	4	0.63	49
Zeus faber	3.42	6	0.46	
Pterothrissus belloci	2.82	26	0.38	
Perulibatrachus rossignoli	2.25	12	0.30	
Chaetodon hoefleri	2.01	10	0.27	
Sepia officinalis	1.62	4	0.22	
Brotula barbata	1.60	10	0.21	
Octopus vulgaris	1.40	2	0.19	
Serranus accraensis	1.30	20	0.17	
Scorpaena normani	1.22	10	0.16	
Pontinus accraensis	1.16	2	0.15	
Pagellus bellottii	1.16	6	0.15	
E C H I N O D E R M A T A	0.81	63	0.11	
Pseudupeneus prayensis	0.34	2	0.05	
Blennius normani	0.12	2	0.02	
G A S T R O P O D S	0.08	4	0.01	
Total	748.39		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 15
DATE :25/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 12°15.33
start stop duration Lon E 13°24.94
TIME :13:09:32 13:36:57 27.4 (min) Purpose : 1
LOG : 2928.82 2930.22 1.4 Region : 4040
FDEPTH: 108 107 Gear cond.: 0
BDEPTH: 108 107 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.1 kn
Sorted : 0 Total catch: 151.37 Catch/hour: 331.23

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	163.33	1241	49.31	31
Chelidonichthys gabonensis	44.86	372	13.54	
Sphoeroides lobatus	34.49	59	10.41	
Dentex barnardi	20.92	61	6.32	32
Zeus faber	14.35	20	4.33	
Trachurus trecae	10.90	44	3.29	30
Dentex angolensis	9.12	46	2.75	33
Torpedo torpedo	5.38	4	1.63	
Raja miraletus	4.60	7	1.39	
Chaetodon hoefleri	4.14	22	1.25	
Atractoscion aequidens	4.09	2	1.24	
Umbrina canariensis	3.96	15	1.20	
Zenopsis conchifer	3.57	2	1.08	
Torpedo marmorata	2.49	2	0.75	
Pagellus bellottii	2.32	13	0.70	
Scorpaena normani	0.77	4	0.23	
Citharus linguatula	0.70	11	0.21	
Illex coindetii	0.44	18	0.13	
Sepia officinalis	0.31	4	0.09	
Peristedion cataphractum	0.31	2	0.09	
Etrumeus whiteheadi	0.20	2	0.06	
Total	331.23		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 16
DATE :25/08/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 12°3.90
start stop duration Lon E 13°28.86
TIME :19:13:08 19:23:49 10.7 (min) Purpose : 1
LOG : 2974.75 2975.36 0.6 Region : 4040
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 104 108 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.5 kn
Sorted : 0 Total catch: 68.51 Catch/hour: 384.89

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	372.19	14798	96.70	
Lestrolepis intermedia	12.70	56	3.30	
Total	384.89		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 17
DATE :25/08/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 12°4.02
start stop duration Lon E 13°37.92
TIME :21:17:36 21:34:22 16.8 (min) Purpose : 1
LOG : 2987.52 2988.44 0.9 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 53 56 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.3 kn
Sorted : 70 Total catch: 2557.15 Catch/hour: 9149.02

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	9087.66	131896	99.33	34
Sphyraena guachancho	31.34	132	0.34	
Trichiurus lepturus	30.02	1306	0.33	35
Total	9149.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 18
DATE :26/08/15 GEAR TYPE: PT NO: 1 POSITION:Lat S 11°57.71
start stop duration Lon E 13°36.65
TIME :00:09:24 00:33:55 24.5 (min) Purpose : 1
LOG : 3007.69 3008.95 1.3 Region : 4040
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 77 70 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.1 kn
Sorted : 0 Total catch: 4.70 Catch/hour: 11.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trichiurus lepturus	5.87	64	51.06	
Trachurus trecae	3.52	56	30.64	71
Sepia officinalis	1.15	5	10.00	
Sardinella maderensis	1.05	5	9.15	72
Total	11.60		100.85	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 19
DATE :26/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 11°46.84
start stop duration Lon E 13°33.03
TIME :08:25:25 08:55:36 30.2 (min) Purpose : 1
LOG : 3076.33 3077.94 1.6 Region : 4040
FDEPTH: 110 109 Gear cond.: 0
BDEPTH: 110 109 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.2 kn
Sorted : 0 Total catch: 109.82 Catch/hour: 218.33

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	160.30	1308	73.42	38
Dentex angolensis	7.75	54	3.55	40
Dentex macrophthalmus	6.18	56	2.83	39
Dentex barnardi	6.16	30	2.82	41
Chelidonichthys gabonensis	5.65	58	2.59	
Sphoeroides lobatus	5.15	14	2.36	
Atractoscion aequidens	4.69	2	2.15	
Trichiurus lepturus	4.00	4	1.83	42
Branchiostegus semifasciatus	2.72	4	1.25	
Perulibatrachus rossignoli	2.23	12	1.02	
Loligo vulgaris	1.91	54	0.87	
Umbrina canariensis	1.83	6	0.84	
Raja miraletus	1.81	2	0.83	
Pagellus bellottii	1.79	2	0.82	
Boops boops	1.67	18	0.76	
Citharus linguatula	1.57	40	0.72	
Pterothrissus belloci	1.43	12	0.66	
Zeus faber	0.99	2	0.46	
Brotula barbata	0.30	2	0.14	
Saurida brasiliensis	0.20	42	0.09	
Total	218.33		100.0	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 20
DATE :26/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 11°39.18
start stop duration Lon E 13°32.76
TIME :13:25:26 13:56:20 30.9 (min) Purpose : 1
LOG : 3114.16 3115.68 1.5 Region : 4040
FDEPTH: 102 104 Gear cond.: 0
BDEPTH: 102 104 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.0 kn
Sorted : 0 Total catch: 260.88 Catch/hour: 506.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	330.08	2672	65.16	44
Chelidonichthys gabonensis	57.55	540	11.36	
Brotula barbata	21.90	23	4.32	
Dentex barnardi	15.30	58	3.02	46
Citharus linguatula	10.17	192	2.01	
Dentex angolensis	9.75	89	1.92	47
Dentex macrophthalmus	8.43	74	1.66	45
Atractoscion aequidens	7.84	4	1.55	
Octopus vulgaris	7.73	16	1.53	
Branchiostegus semifasciatus	6.76	12	1.33	
Scorpaena normani	4.80	45	0.95	
Raja miraletus	4.17	6	0.82	
Uranoscopus albesca	3.92	17	0.77	
Zeus faber	3.77	6	0.74	
Pagellus bellottii	3.32	14	0.66	
Sphoeroides lobatus	3.13	8	0.62	
Pterothrissus belloci	2.68	17	0.53	
Saurida brasiliensis	1.34	217	0.26	
Perulibatrachus rossignoli	0.89	6	0.18	
Umbrina canariensis	0.68	2	0.13	
Dicologoglossa hexophthalma	0.64	10	0.13	
Sardinella aurita	0.58	4	0.11	48
Illex coindetii	0.52	12	0.10	
Chaetodon hoefleri	0.33	2	0.07	
Boops boops	0.27	2	0.05	
Total	506.56		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 21
DATE :26/08/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°27.47
start stop duration Lon E 13°33.50
TIME :21:43:13 22:00:13 17.0 (min) Purpose : 1
LOG : 3179.54 3180.42 0.9 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 60 62 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.1 kn
Sorted : 133 Total catch: 1126.64 Catch/hour: 3976.38

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	3397.50	21000	85.44	50
Trachurus trecae	368.40	4232	9.26	53
Lagocephalus laevigatus	144.30	272	3.63	
Sphyraena guachancho	32.40	120	0.81	54
Scomber colias	22.20	60	0.56	52
Alloteuthis africana	8.70	4800	0.22	
Trachinotus ovatus	2.40	32	0.06	
Sardinella maderensis	0.49	4	0.01	51
Total	3976.39		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 22
DATE :27/08/15 GEAR TYPE: PT NO: 1 POSITION:Lat S 11°20.75
start stop duration Lon E 13°36.89
TIME :01:04:22 01:34:23 30.0 (min) Purpose : 1
LOG : 3204.90 3206.43 1.5 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 54 58 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.1 kn
Sorted : 0 Total catch: 107.99 Catch/hour: 215.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	205.04	1547	95.00	56
Trachurus trecae	3.46	36	1.60	55
Sepia officinalis	2.30	14	1.06	
Selar crumenophthalmus	1.78	8	0.82	
Trachinotus ovatus	1.72	24	0.80	
Sardinella maderensis	0.90	8	0.42	57
Lagocephalus laevigatus	0.50	2	0.23	
Sphyraena guachancho	0.10	2	0.05	58
Pseudupeneus prayensis	0.04	2	0.02	
Total	215.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 23
DATE :27/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 11°6.94
start stop duration Lon E 13°39.83
TIME :08:53:59 09:24:00 30.0 (min) Purpose : 1
LOG : 3268.64 3270.16 1.5 Region : 4040
FDEPTH: 100 102 Gear cond.: 0
BDEPTH: 100 102 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.1 kn
Sorted : 137 Total catch: 641.03 Catch/hour: 1281.21

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Synagrops microlepis	597.35	42879	46.62	
Trachurus trecae	290.45	3408	22.67	59
Branchiostegus semifasciatus	105.77	108	8.26	
Dentex angolensis	85.54	136	6.68	60
Zeus faber	48.86	68	3.81	
Scorpaena normani	44.49	202	3.47	
Loligo vulgaris	29.72	504	2.32	
Pterothrissus belloci	20.31	108	1.59	
Brotula barbata	18.91	30	1.48	
Dentex barnardi	17.55	22	1.37	61
Atractoscion aequidens	6.30	4	0.49	
Dentex macrophthalmus	4.96	4	0.39	62
Octopus vulgaris	4.14	2	0.32	
G A S T R O P O D S	3.86	1107	0.30	
Perulibatrachus rossignoli	1.34	16	0.10	
Sorsogona prionota	1.34	34	0.10	
Merluccius polli	0.34	16	0.03	
Total	1281.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 24
DATE :27/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 10°57.82
start stop duration Lon E 13°44.01
TIME :14:36:01 15:05:29 29.5 (min) Purpose : 1
LOG : 3308.18 3309.91 1.7 Region : 4040
FDEPTH: 58 59 Gear cond.: 0
BDEPTH: 58 59 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3.5 kn
Sorted : 0 Total catch: 6.48 Catch/hour: 13.19

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Leptocephalus	7.33	32067	55.56	
Illex coindetii	1.93	37	14.66	
Octopus vulgaris	0.94	2	7.10	
G A S T R O P O D S	0.88	387	6.64	
Thorogobius sp.	0.73	1079	5.56	
Parapenaeopsis atlantica	0.39	236	2.93	
Dicologoglossa cuneata	0.29	8	2.16	
Coryphaena equiselis	0.26	179	2.01	
Sepia officinalis	0.24	2	1.85	
Penaeus notialis	0.14	4	1.08	
Pontinus accraensis	0.02	2	0.15	
Pomadasys incisus	0.02	2	0.15	
Squilla mantis	0.02	16	0.15	
Total	13.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 25
DATE :27/08/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 10°54.66
start stop duration Lon E 13°38.66
TIME :17:48:51 18:03:55 15.1 (min) Purpose : 1
LOG : 3330.80 3331.61 0.8 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 86 84 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.2 kn
Sorted : 132 Total catch: 500.00 Catch/hour: 1990.71

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sardinella aurita	811.65	4005	40.77	63
Trachurus trecae	520.49	6864	26.15	65
Sardinella maderensis	348.41	1688	17.50	64
Trichiurus lepturus	289.09	13338	14.52	66
Pomatomus saltatrix	13.54	16	0.68	
Sepia orbignyana	4.38	16	0.22	
Trachinotus ovatus	3.15	16	0.16	
Total	1990.71		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 26
DATE :28/08/15 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°40.26
start stop duration Lon E 13°36.73
TIME :01:41:51 02:01:36 19.8 (min) Purpose : 1
LOG : 3388.55 3389.45 0.9 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 53 57 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 2.7 kn
Sorted : 0 Total catch: 71.67 Catch/hour: 217.73

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sardinella aurita	125.71	808	57.74	68
Trachurus trecae	31.47	398	14.46	67
Sardinella maderensis	30.87	194	14.18	69
Trichiurus lepturus	19.81	665	9.10	70
Sepia officinalis	6.05	49	2.78	
Sarda sarda	3.01	3	1.38	
Fistularia petimba	0.82	3	0.38	
Total	217.73		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 27
DATE :28/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 10°31.59
start stop duration Lon E 13°37.02
TIME :08:45:24 09:15:33 30.1 (min) Purpose : 1
LOG : 3446.78 3448.53 1.8 Region : 4040
FDEPTH: 21 21 Gear cond.: 0
BDEPTH: 21 21 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.5 kn
Sorted : 0 Total catch: 188.18 Catch/hour: 374.61

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	153.88	1505	41.08	73
Trachurus trecae	123.90	989	33.07	74
Sardinella aurita	79.15	792	21.13	75
Pomadasys jubelini	13.30	54	3.55	
Trachinotus goreensis	3.19	10	0.85	
Sphyraena guachancho	0.38	2	0.10	
Sepia orbignyana	0.22	2	0.06	
Trichiurus lepturus	0.20	8	0.05	76
G A S T R O P O D S	0.20	66	0.05	
Narke capensis	0.12	2	0.03	
Epinephelus aeneus	0.04	2	0.01	
Starfish	0.04	26	0.01	
Total	374.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 28
DATE :28/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 10°36.19
start stop duration Lon E 13°15.60
TIME :12:09:34 12:39:17 29.7 (min) Purpose : 1
LOG : 3473.60 3475.09 1.5 Region : 4040
FDEPTH: 132 132 Gear cond.: 0
BDEPTH: 132 132 Validity : 0
Towing dir: 0° Wire out : 315 m Speed : 3.0 kn
Sorted : 0 Total catch: 124.18 Catch/hour: 250.70

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	164.43	456	65.59	77
Illex coindetii	14.58	244	5.81	
Umbrina canariensis	10.42	32	4.16	
Dentex macrophthalmus	9.15	34	3.65	78
Pterothrissus belloci	8.50	73	3.39	
Brotula barbata	7.67	12	3.06	
Chelidonichthys gabonensis	7.39	103	2.95	
Torpedo torpedo	6.50	12	2.59	
Dentex angolensis	3.71	176	1.48	79
Sphoeroides pachgaster	3.53	4	1.41	
Sepia officinalis	3.15	22	1.26	
Zeus faber	2.66	2	1.06	
Raja miraletus	2.08	2	0.83	
Bothus podas	2.00	83	0.80	
Octopus vulgaris	1.39	4	0.56	
Citharus linguatula	1.37	24	0.55	
Uranoscopus polli	1.05	6	0.42	
Bembrops greyi	0.38	14	0.15	
G A S T R O P O D S	0.34	26	0.14	
Trigla lyra	0.26	2	0.10	
Spicara alta	0.12	2	0.05	
Total	250.70		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 29
DATE :29/08/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 10°8.15
start stop duration Lon E 13°0.05
TIME :08:14:33 08:44:23 29.8 (min) Purpose : 1
LOG : 3642.78 3644.34 1.6 Region : 4040
FDEPTH: 107 109 Gear cond.: 0
BDEPTH: 107 109 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.1 kn
Sorted : 68 Total catch: 2383.43 Catch/hour: 4794.03

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Synagrops microlepis	2216.96	655863	46.24	
Dentex macrophthalmus	661.11	1859	13.79	84
Dasyatis margarita	431.44	66	9.00	
Zenopsis conchifer	402.24	199	8.39	
Trachurus trecae	279.54	670	5.83	80
Umbrina canariensis	203.11	332	4.24	
Sphoeroides pachgaster	188.51	266	3.93	
Dentex barnardi	135.41	266	2.82	82
Trichiurus lepturus	63.72	133	1.33	85
Zeus faber	56.42	133	1.18	
Dentex congoensis	46.46	398	0.97	83
Dentex angolensis	38.50	199	0.80	81
Scomber colias	29.87	66	0.62	86
Uranoscopus albesca	15.93	66	0.33	
Chelidonichthys gabonensis	14.60	133	0.30	
Rhinobatos albomaculatus	7.95	2	0.17	
Atractoscion aequidens	2.25	2	0.05	
Total	4794.03		100.00	

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R/V Dr. Fridtjof Nansen      SURVEY:2015408        STATION:   30
DATE  :29/08/15               GEAR TYPE: BT NO: 26  POSITION:Lat    S
9°55.47
        start     stop     duration                              Lon    E
13°9.15
TIME  :12:56:06 13:27:59  31.9 (min)          Purpose   : 1
LOG   : 3678.67  3680.28   1.6                Region    : 4040
FDEPTH:     50       51                       Gear cond.: 0
BDEPTH:     50       51                       Validity  : 0
Towing dir:   0°      Wire out   : 150  m     Speed     : 3.0 kn
Sorted    : 135      Total catch: 325.00      Catch/hour: 611.47
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SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	207.19	2484	33.88	87
Pomadasys incisus	103.22	896	16.88	89
Pseudupeneus prayensis	96.95	1052	15.86	
Pagellus bellottii	96.01	1558	15.70	
Rhinobatos albomaculatus	35.41	17	5.79	
Raja miraletus	17.37	23	2.84	
Sepia orbignyana	16.93	9	2.77	
Sepia officinalis	10.63	34	1.74	
Dentex barnardi	10.46	98	1.71	88
Fistularia petimba	6.02	11	0.98	
Syacium micrurum	3.09	30	0.50	
Boops boops	2.20	53	0.36	
Umbrina canariensis	1.62	17	0.26	
Zeus faber	1.52	4	0.25	
Scorpaena stephanica	0.77	4	0.13	
Alloteuthis africana	0.71	156	0.12	
Chaetodon hoefleri	0.51	9	0.08	
Citharus linguatula	0.43	26	0.07	
Illex coindetii	0.34	4	0.06	
Grammoplites gruveli	0.08	9	0.01	
Total	611.47		100.00	

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R/V Dr. Fridtjof Nansen      SURVEY:2015408        STATION:   31
DATE  :29/08/15               GEAR TYPE: BT NO: 26  POSITION:Lat    S
9°59.87
        start     stop     duration                              Lon    E
12°57.62
TIME  :15:09:10 15:40:44  31.6 (min)          Purpose   : 1
LOG   : 3693.82  3695.55   1.7                Region    : 4040
FDEPTH:    112      110                       Gear cond.: 0
BDEPTH:    112      110                       Validity  : 0
Towing dir:   0°      Wire out   : 260  m     Speed     : 3.3 kn
Sorted    : 123      Total catch: 318.56      Catch/hour: 605.44
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SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	350.46	1032	57.89	90
Dentex angolensis	52.07	390	8.60	91
Chelidonichthys gabonensis	46.66	357	7.71	
Dentex macrophthalmus	35.92	120	5.93	92
Cynoponticus ferox	16.91	2	2.79	
Zeus faber	16.21	48	2.68	
Umbrina canariensis	13.87	86	2.29	
Dentex congoensis	13.84	114	2.29	93
Squatina oculata	11.18	6	1.85	
Raja miraletus	6.71	10	1.11	
Octopus vulgaris	6.14	6	1.01	
Uranoscopus albesca	4.56	19	0.75	
Atractoscion aequidens	4.54	4	0.75	
Illex coindetii	4.47	120	0.74	
Sphoeroides pachgaster	3.67	6	0.61	
Torpedo torpedo	3.29	10	0.54	
Sepia officinalis	2.76	25	0.46	
Citharus linguatula	2.72	53	0.45	
Zenopsis conchifer	2.57	34	0.42	
Scorpaena normani	2.47	19	0.41	
Pterothrissus belloci	2.09	10	0.35	
Pagellus bellottii	1.05	6	0.17	
Chelidonichthys capensis	0.82	6	0.13	
Spicara alta	0.48	6	0.08	
Total	605.44		100.00	

```
R/V Dr. Fridtjof Nansen      SURVEY:2015408        STATION:   32
DATE  :29/08/15               GEAR TYPE: PT NO:  1  POSITION:Lat    S
9°45.50
        start     stop     duration                              Lon    E
13°3.21
TIME  :23:50:04 00:20:45  30.7 (min)          Purpose   : 1
LOG   : 3756.90  3758.35   1.4                Region    : 4040
FDEPTH:      0        0                       Gear cond.: 0
BDEPTH:     79       79                       Validity  : 0
Towing dir:   0°      Wire out   : 125  m     Speed     : 2.8 kn
Sorted    : 101      Total catch: 1106.27     Catch/hour: 2163.50
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	1397.23	8239	64.58	95
Trachurus trecae	388.51	4256	17.96	94
Sardinella maderensis	276.65	2022	12.79	96
Caranx crysos	83.68	108	3.87	
Chloroscombrus chrysurus	17.43	108	0.81	97
Total	2163.50		100.00	

```
R/V Dr. Fridtjof Nansen      SURVEY:2015408        STATION:   33
DATE  :02/09/15               GEAR TYPE: BT NO: 26  POSITION:Lat    S
9°28.76
        start     stop     duration                              Lon    E
12°52.49
TIME  :07:36:08 08:07:01  30.9 (min)          Purpose   : 1
LOG   : 4018.82  4020.47   1.6                Region    : 4040
FDEPTH:    100      104                       Gear cond.: 0
BDEPTH:    100      104                       Validity  : 0
Towing dir:   0°      Wire out   : 250  m     Speed     : 3.2 kn
Sorted    :   0      Total catch: 133.23      Catch/hour: 258.87
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex angolensis	84.91	365	32.80	99
Pterothrissus belloci	33.38	175	12.89	
Stromateus fiatola	17.35	25	6.70	
Uranoscopus albesca	12.82	39	4.95	
Zeus faber	11.66	33	4.50	
Brotula barbata	11.62	14	4.49	
Citharus linguatula	11.46	144	4.43	
Trichiurus lepturus	10.61	27	4.10	100
Sphoeroides pachgaster	9.83	12	3.80	
Chelidonichthys gabonensis	9.54	60	3.69	
Branchiostegus semifasciatus	8.28	8	3.20	
Pagellus bellottii	6.30	16	2.43	
Alloteuthis africana	5.15	1838	1.99	
Rajella leopardus	4.97	2	1.92	
Scorpaena normani	4.27	29	1.65	
Merluccius polli	3.61	698	1.40	
Torpedo torpedo	2.80	8	1.08	
Illex coindetii	2.27	56	0.88	
Atractoscion aequidens	2.00	2	0.77	
Octopus vulgaris	1.50	2	0.58	
Perulibatrachus rossignoli	1.13	8	0.44	
Chaetodon hoefleri	1.11	4	0.43	
Trachurus trecae	1.09	4	0.42	98
Umbrina canariensis	0.64	2	0.25	
GOBIIDAE	0.29	25	0.11	
Saurida brasiliensis	0.19	39	0.08	
Synagrops microlepis	0.08	52	0.03	
Total	258.87		100.00	

```
R/V Dr. Fridtjof Nansen      SURVEY:2015408        STATION:   34
DATE  :02/09/15               GEAR TYPE: BT NO:  1  POSITION:Lat    S
9°22.22
        start     stop     duration                              Lon    E
12°52.98
TIME  :11:50:40 12:20:48  30.1 (min)          Purpose   : 1
LOG   : 4053.16  4054.68   1.5                Region    : 4040
FDEPTH:     78       82                       Gear cond.: 0
BDEPTH:     78       83                       Validity  : 0
Towing dir:   0°      Wire out   : 240  m     Speed     : 3.0 kn
Sorted    :   0      Total catch: 118.26      Catch/hour: 235.50
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex angolensis	109.17	520	46.36	103
Trachurus trecae	34.53	265	14.66	101
Stromateus fiatola	24.61	24	10.45	
Selene dorsalis	16.17	66	6.87	105
Pterothrissus belloci	12.31	64	5.23	
Zeus faber	6.25	6	2.66	
Trichiurus lepturus	4.70	6	2.00	104
Alloteuthis africana	4.42	2447	1.88	
Sepia officinalis	3.29	16	1.40	
Citharus linguatula	3.05	50	1.29	
Umbrina canariensis	2.97	22	1.26	
Dentex barnardi	2.07	10	0.88	102
Pagellus bellottii	1.93	14	0.82	
Illex coindetii	1.69	58	0.72	
Brotula barbata	1.57	4	0.67	
Fistularia petimba	1.53	4	0.65	
Trachurus trecae	1.35	2	0.58	106
Chelidonichthys gabonensis	1.19	10	0.51	
Branchiostegus semifasciatus	1.08	2	0.46	
Octopus vulgaris	0.56	2	0.24	
Chelidonichthys capensis	0.46	2	0.19	
Brachydeuterus auritus	0.44	2	0.19	
Merluccius polli	0.06	10	0.03	
PORCELLANIDAE *	0.04	18	0.02	
Scorpaena normani	0.04	2	0.02	
GOBIIDAE	0.02	2	0.01	
Fishing gears	0.00	4	0.00	
Total	235.50		100.00	

```
R/V Dr. Fridtjof Nansen      SURVEY:2015408        STATION:   35
DATE  :02/09/15               GEAR TYPE: PT NO:  4  POSITION:Lat    S
9°11.56
        start     stop     duration                              Lon    E
12°53.01
TIME  :19:22:40 19:44:24  21.7 (min)          Purpose   : 1
LOG   : 4114.81  4116.01   1.2                Region    : 4040
FDEPTH:      0        0                       Gear cond.: 0
BDEPTH:     52       61                       Validity  : 0
Towing dir:   0°      Wire out   : 110  m     Speed     : 3.3 kn
Sorted    : 106      Total catch: 579.49      Catch/hour: 1600.06
```

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Jellyfish	601.05	442	37.56	
Brachydeuterus auritus	370.05	3485	23.13	111
Selene dorsalis	311.24	4125	19.45	112
Trachurus trecae	96.50	815	6.03	110
Sphyraena guachancho	81.45	3	5.09	107
Sardinella maderensis	70.69	685	4.42	109
Sardinella aurita	42.69	243	2.67	108
Chloroscombrus chrysurus	16.71	130	1.04	113
Sepia officinalis	6.41	28	0.40	
Trichiurus lepturus	3.29	157	0.21	114
Total	1600.06		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:   36
DATE  :03/09/15               GEAR TYPE: PT NO:  4  POSITION:Lat    S
8°41.22
         start      stop     duration                          Lon    E
13°18.68
TIME  :19:27:10 19:44:41  17.5 (min)         Purpose    : 1
LOG   : 4275.59  4276.56   1.0               Region     : 4054
FDEPTH:       0        0                     Gear cond.: 0
BDEPTH:      38       38                     Validity  : 0
Towing dir:   0°      Wire out   : 110  m    Speed      : 3.3 kn
Sorted    : 167       Total catch: 1466.79   Catch/hour: 5023.25
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	4485.31	57887	89.29	115
Sardinella aurita	396.95	2288	7.90	116
Sarda sarda	54.83	212	1.09	119
Scomber japonicus	37.36	661	0.74	117
Trichiurus lepturus	20.17	514	0.40	118
Sepia officinalis	15.38	31	0.31	
Fistularia petimba	10.55	31	0.21	
Mugil bananensis	2.71	31	0.05	
Total	5023.25		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:   37
DATE  :04/09/15               GEAR TYPE: BT NO: 26  POSITION:Lat    S
8°27.25
         start      stop     duration                          Lon    E
13°3.68
TIME  :10:35:06 10:54:52  19.8 (min)         Purpose    : 1
LOG   : 4407.39  4408.44   1.1               Region     : 4054
FDEPTH:     107      106                     Gear cond.: 0
BDEPTH:     107      106                     Validity  : 0
Towing dir:   0°      Wire out   : 250  m    Speed      : 3.2 kn
Sorted    :   0       Total catch: 62.98     Catch/hour: 191.14
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Dentex angolensis	97.57	595	51.05	122
Umbrina canariensis	11.32	52	5.92	
Illex coindetii	9.95	164	5.21	
Trichiurus lepturus	9.07	12	4.75	121
Jellyfish	9.04	352	4.73	
Pterothrissus belloci	8.44	46	4.41	
Branchiostegus semifasciatus	7.59	12	3.97	
Zeus faber	6.62	27	3.46	
Trachurus trecae	5.92	12	3.10	120
Octopus vulgaris	5.77	6	3.02	
Zenopsis conchifer	3.92	3	2.05	
Chelidonichthys gabonensis	3.40	24	1.78	
Uranoscopus polli	2.88	15	1.51	
Scorpaena normani	2.67	18	1.40	
Brotula barbata	2.19	6	1.14	
Citharus linguatula	1.76	42	0.92	
Dentex barnardi	1.49	3	0.78	123
Uranoscopus albesca	1.40	6	0.73	
Saurida brasiliensis	0.15	46	0.08	
Total	191.14		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:   38
DATE  :04/09/15               GEAR TYPE: BT NO: 26  POSITION:Lat    S
8°21.48
         start      stop     duration                          Lon    E
13°19.32
TIME  :13:03:52 13:44:38  40.8 (min)         Purpose    : 1
LOG   : 4425.09  4426.88   1.8               Region     : 4054
FDEPTH:      22       22                     Gear cond.: 0
BDEPTH:      22       22                     Validity  : 0
Towing dir:   0°      Wire out   : 105  m    Speed      : 2.6 kn
Sorted    :   0       Total catch: 13.64     Catch/hour: 20.07
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	8.30	110	41.35	124
Jellyfish	5.18	49	25.81	
Ephippion guttifer	1.81	1	9.02	
Pomadasys jubelini	1.28	3	6.38	
Brachydeuterus auritus	0.85	9	4.25	125
Illex coindetii	0.59	12	2.93	
G A S T R O P O D S	0.59	3	2.93	
Gymnothorax afer	0.54	1	2.71	
Octopus vulgaris	0.29	1	1.47	
Pomadasys incisus	0.28	1	1.39	
Cephalopholis nigri	0.19	10	0.95	
Citharus linguatula	0.12	3	0.59	
Trichiurus lepturus	0.04	1	0.22	
Plastic	0.00	0	0.00	
Total	20.07		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:   39
DATE  :04/09/15               GEAR TYPE: PT NO:  4  POSITION:Lat    S
8°21.80
         start      stop     duration                          Lon    E
12°51.27
TIME  :19:19:14 19:36:09  16.9 (min)         Purpose    : 1
LOG   : 4472.63  4473.56   0.9               Region     : 4054
FDEPTH:       0        0                     Gear cond.: 0
BDEPTH:     283      295                     Validity  : 0
Towing dir:   0°      Wire out   : 110  m    Speed      : 3.3 kn
Sorted    :   0       Total catch: 218.76    Catch/hour: 775.74
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	480.50	22766	61.94	
Sardinella aurita	144.36	514	18.61	126
Sardinella maderensis	91.06	387	11.74	127
Lestrolepis intermedia	29.11	3642	3.75	
Trichiurus lepturus	12.34	14	1.59	128
Synagrops microlepis	11.81	727	1.52	
Lagocephalus laevigatus	2.87	7	0.37	
Scomber colias	1.45	4	0.19	130
Sarda sarda	1.35	4	0.17	129
Trachinotus ovatus	0.89	4	0.11	
Total	775.74		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:   40
DATE  :05/09/15             GEAR TYPE: PT NO:  1  POSITION:Lat   S 8°9.45
         start      stop     duration                          Lon    E
13°4.97
TIME  :00:23:05 00:53:06  30.0 (min)         Purpose    : 1
LOG   : 4513.10  4514.47   1.4               Region     : 4054
FDEPTH:       0        0                     Gear cond.: 0
BDEPTH:      68       68                     Validity  : 0
Towing dir:   0°      Wire out   : 120  m    Speed      : 2.7 kn
Sorted    :   0       Total catch: 172.82    Catch/hour: 345.41
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	213.08	1677	61.69	136
Sardinella maderensis	54.66	306	15.83	133
Sardinella aurita	18.15	68	5.25	132
Trichiurus lepturus	15.11	42	4.37	135
Trachurus trecae	15.07	190	4.36	131
Lagocephalus laevigatus	7.63	14	2.21	
Caranx crysos	5.74	6	1.66	
Sphoeroides pachgaster	3.90	2	1.13	
Chloroscombrus chrysurus	3.68	24	1.06	134
Stromateus fiatola	2.24	6	0.65	
Sepia orbignyana	2.16	4	0.62	
Trachinotus ovatus	1.42	8	0.41	
Alloteuthis africana	1.26	656	0.36	
Sphyraena guachancho	0.94	2	0.27	
Scomber japonicus	0.14	4	0.04	137
Sepia officinalis	0.14	4	0.04	
Saurida brasiliensis	0.10	24	0.03	
Total	345.41		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:   41
DATE  :05/09/15             GEAR TYPE: BT NO: 26  POSITION:Lat   S 8°0.05
         start      stop     duration                          Lon    E
13°9.13
TIME  :07:48:39 08:02:29  13.8 (min)         Purpose    : 1
LOG   : 4575.70  4576.48   0.8               Region     : 4054
FDEPTH:      25       25                     Gear cond.: 0
BDEPTH:      25       25                     Validity  : 0
Towing dir:   0°      Wire out   : 110  m    Speed      : 3.4 kn
Sorted    : 108       Total catch: 3396.05   Catch/hour: 14733.41
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	10017.66	203887	67.99	140
Trachurus trecae	1414.49	25839	9.60	138
Ilisha africana	1293.32	20503	8.78	143
Pseudotolithus typus	717.14	1857	4.87	
Pomadasys jubelini	509.41	2473	3.46	
Galeoides decadactylus	314.06	742	2.13	
Selene dorsalis	181.74	1484	1.23	141
Chloroscombrus chrysurus	148.37	3341	1.01	139
Pomadasys incisus	53.19	247	0.36	
Pentheroscion mbizi	28.42	373	0.19	
Trichiurus lepturus	28.42	495	0.19	142
Stromateus fiatola	27.20	247	0.18	
Total	14733.41		100.00	

```
R/V Dr. Fridtjof Nansen       SURVEY:2015408        STATION:   42
DATE  :05/09/15               GEAR TYPE: BT NO: 26  POSITION:Lat    S
7°59.39
         start      stop     duration                          Lon    E
12°45.13
TIME  :16:15:03 16:34:38  19.6 (min)         Purpose    : 1
LOG   : 4631.10  4632.15   1.1               Region     : 4054
FDEPTH:     124      124                     Gear cond.: 0
BDEPTH:     124      124                     Validity  : 0
Towing dir:   0°      Wire out   : 330  m    Speed      : 3.2 kn
Sorted    :  10       Total catch: 259.67    Catch/hour: 795.72
```

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Synagrops microlepis	262.71	56740	33.01	
Dentex angolensis	179.42	729	22.55	145
Boops boops	109.06	1060	13.71	
Uranoscopus albesca	43.73	221	5.50	
Trachurus trecae	41.61	61	5.23	148
Loligo vulgaris	38.86	662	4.88	
Zeus faber	14.65	61	1.84	
Brotula barbata	13.02	12	1.64	
Spicara alta	11.74	110	1.47	
Zenopsis conchifer	11.64	12	1.46	
Umbrina canariensis	10.08	74	1.27	
Trichiurus lepturus	9.19	9	1.16	149
Dentex congoensis	7.97	89	1.00	144
Octopus vulgaris	7.60	12	0.96	
Chelidonichthys gabonensis	5.98	46	0.75	
Lagocephalus laevigatus	3.46	6	0.44	
Raja miraletus	3.25	6	0.41	
Dentex barnardi	3.16	6	0.40	146
Citharus linguatula	3.09	43	0.39	
Lophiodes kempi	2.76	12	0.35	
Pterothrissus belloci	2.57	12	0.32	
Branchiostegus semifasciatus	2.36	3	0.30	
Microchirus frechkopi	2.21	43	0.28	
Perulibatrachus rossignoli	2.05	3	0.26	
Dentex macrophthalmus	2.02	9	0.25	147
Scorpaena normani	1.53	3	0.19	
Total	795.72		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 43
DATE :05/09/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 7°43.55
start stop duration Lon E 12°57.29
TIME :21:27:47 21:48:00 20.2 (min) Purpose : 1
LOG : 4665.37 4666.47 1.1 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 44 41 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.3 kn
Sorted : 128 Total catch: 1589.67 Catch/hour: 4714.79

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	1800.30	9746	38.18	150
Sardinella maderensis	1740.39	7676	36.91	151
Trachurus trecae	520.81	7471	11.05	152
Scomber japonicus	357.33	1996	7.58	153
Chloroscombrus chrysurus	129.11	961	2.74	156
Brachydeuterus auritus	82.13	703	1.74	155
Sarda sarda	25.89	110	0.55	154
Trachinotus goreensis	21.06	74	0.45	
Dasyatis marmorata	20.70	36	0.44	
Selene dorsalis	14.41	110	0.31	157
Alectis alexandrinus	2.67	3	0.06	
Total	4714.79		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 44
DATE :06/09/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°41.22
start stop duration Lon E 12°37.10
TIME :07:40:15 08:10:11 29.9 (min) Purpose : 1
LOG : 4755.48 4757.15 1.7 Region : 4054
FDEPTH: 116 116 Gear cond.: 0
BDEPTH: 116 116 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.3 kn
Sorted : 0 Total catch: 31.50 Catch/hour: 63.13

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex angolensis	14.83	80	23.49	159
Lagocephalus laevigatus	13.17	226	20.86	
Dentex congoensis	10.48	168	16.60	160
Spicara alta	9.08	301	14.38	
Zeus faber	4.49	12	7.11	
Trachurus trecae	3.83	66	6.06	158
Ariomma bondi	1.84	30	2.92	
Chelidonichthys gabonensis	1.56	14	2.48	
Trachurus trecae	1.54	2	2.44	161
Boops boops	0.82	12	1.30	
Loligo vulgaris	0.80	26	1.27	
Chaetodon hoefleri	0.60	4	0.95	
Citharus linguatula	0.08	2	0.13	
Total	63.13		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 45
DATE :06/09/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°29.95
start stop duration Lon E 12°42.93
TIME :12:04:24 12:24:21 19.9 (min) Purpose : 1
LOG : 4788.78 4789.82 1.0 Region : 4054
FDEPTH: 75 74 Gear cond.: 0
BDEPTH: 75 74 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 3.1 kn
Sorted : 0 Total catch: 153.55 Catch/hour: 461.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex congoensis	287.64	5573	62.29	164
Chelidonichthys gabonensis	34.41	340	7.45	
Pagellus bellottii	29.17	253	6.32	
Rhinobatos albomaculatus	28.27	12	6.12	
Alloteuthis africana	23.40	7847	5.07	
Trachurus trecae	14.11	298	3.05	162
Fistularia petimba	13.77	36	2.98	
Dentex angolensis	11.46	334	2.48	163
Zeus faber	8.60	21	1.86	
Sphoeroides pachgaster	2.59	3	0.56	
Dentex barnardi	1.83	9	0.40	165
Boops boops	1.80	27	0.39	
Chaetodon hoefleri	1.53	9	0.33	
Torpedo torpedo	0.87	3	0.19	
Sepia officinalis	0.48	12	0.10	
Illex coindetii	0.45	3	0.10	
Spicara alta	0.39	66	0.08	
Octopoteuthis sp.	0.39	15	0.08	
Pseudupeneus prayensis	0.27	6	0.06	
Ariomma bondi	0.21	3	0.05	
Citharus linguatula	0.03	12	0.01	
Saurida brasiliensis	0.03	3	0.01	
Serranus cabrilla	0.03	3	0.01	
Selene dorsalis	0.03	3	0.01	
Monolene microstoma	0.03	3	0.01	
Total	461.81		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 46
DATE :06/09/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°29.28
start stop duration Lon E 12°33.58
TIME :16:14:57 16:38:24 23.5 (min) Purpose : 1
LOG : 4825.38 4826.60 1.2 Region : 4054
FDEPTH: 106 106 Gear cond.: 0
BDEPTH: 106 106 Validity : 0
Towing dir: 0° Wire out : 260 m Speed : 3.1 kn
Sorted : 0 Total catch: 171.16 Catch/hour: 437.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex congoensis	247.01	3813	56.43	169
Lagocephalus laevigatus	46.39	46	10.60	
Umbrina canariensis	39.03	97	8.92	
Chelidonichthys gabonensis	33.81	284	7.72	
Dentex angolensis	30.64	248	7.00	168
Trachurus trecae	13.71	274	3.13	166
Raja miraletus	6.37	8	1.45	
Octopus vulgaris	3.09	5	0.71	
Spicara alta	2.74	248	0.63	
Illex coindetii	2.40	192	0.55	
Squatina oculata	1.76	3	0.40	
Boops boops	1.71	28	0.39	
Uranoscopus polli	1.71	8	0.39	
Zeus faber	1.69	5	0.39	
Torpedo mackayana	1.48	3	0.34	
Trichiurus lepturus	1.20	3	0.27	167
Pterothrissus belloci	0.92	5	0.21	
Pagellus bellottii	0.79	3	0.18	
Citharus linguatula	0.59	23	0.13	
Saurida brasiliensis	0.46	90	0.11	
Scorpaena normani	0.18	3	0.04	
Arnoglossus imperialis	0.05	3	0.01	
Total	437.75		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 47
DATE :07/09/15 GEAR TYPE: PT NO: 1 POSITION:Lat S 7°6.20
start stop duration Lon E 12°35.58
TIME :02:25:03 02:50:47 25.7 (min) Purpose : 1
LOG : 4902.85 4904.05 1.2 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 40 41 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 2.8 kn
Sorted : 0 Total catch: 204.99 Catch/hour: 478.02

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	346.92	2187	72.57	171
Trachurus trecae	58.76	494	12.29	170
Scomber colias	51.40	816	10.75	172
Sarda sarda	8.93	37	1.87	173
Chloroscombrus chrysurus	6.67	49	1.40	176
Decapterus punctatus	4.85	47	1.01	174
Sardinella aurita	0.49	5	0.10	175
Total	478.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 48
DATE :07/09/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°19.85
start stop duration Lon E 12°16.72
TIME :08:40:28 09:12:32 32.1 (min) Purpose : 1
LOG : 4959.61 4961.18 1.6 Region : 4054
FDEPTH: 194 196 Gear cond.: 0
BDEPTH: 194 196 Validity : 0
Towing dir: 0° Wire out : 500 m Speed : 2.9 kn
Sorted : 0 Total catch: 149.28 Catch/hour: 279.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex angolensis	58.19	181	20.83	177
Umbrina canariensis	52.98	64	18.97	
Brotula barbata	27.99	43	10.02	
Trichiurus lepturus	24.85	24	8.90	178
Zenopsis conchifer	24.02	133	8.60	
Chlorophthalmus atlanticus	18.75	1416	6.71	
Loligo vulgaris	13.32	142	4.77	
Pterothrissus belloci	10.87	64	3.89	
Rajella leopardus	9.32	6	3.34	
Miracorvina angolensis	5.13	24	1.84	179
Bembrops heterurus	4.19	54	1.50	
Lophiodes kempi	3.67	7	1.31	
Squatina oculata	3.44	6	1.23	
Spicara alta	3.41	17	1.22	
Chelidonichthys gabonensis	3.29	24	1.18	
Penaeus notialis	3.20	561	1.15	
Uranoscopus polli	1.91	7	0.68	
Sphoeroides pachgaster	1.81	2	0.65	
Trigla lyra	1.74	9	0.62	
Synagrops microlepis	1.52	110	0.54	
Raja miraletus	1.46	2	0.52	
Erythrocles monodi	1.38	2	0.50	
Citharus linguatula	0.99	62	0.36	
Pontinus accraensis	0.64	4	0.23	
Illex coindetii	0.39	36	0.14	
GOBIIDAE	0.24	13	0.09	
Dicologoglossa cuneata	0.19	4	0.07	
Nezumia aequalis	0.15	4	0.05	
Bathyuroconger vicinus	0.13	4	0.05	
Peristedion cataphractum	0.09	2	0.03	
Merluccius polli	0.02	2	0.01	
Antigonia capros	0.02	4	0.01	
Total	279.29		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 49
DATE :07/09/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 7°12.58
start stop duration Lon E 12°8.80
TIME :14:50:47 15:18:47 28.0 (min) Purpose : 1
LOG : 5007.06 5008.48 1.4 Region : 4054
FDEPTH: 189 192 Gear cond.: 0
BDEPTH: 189 192 Validity : 0
Towing dir: 0° Wire out : 480 m Speed : 3.1 kn
Sorted : 11 Total catch: 243.22 Catch/hour: 521.19

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Synagrops microlepis	108.34	5758	20.79	
Dentex angolensis	69.64	174	13.36	180
Pterothrissus belloci	64.65	465	12.40	
Brotula barbata	61.71	69	11.84	
Umbrina canariensis	45.99	69	8.82	
Bembrops heterurus	23.70	270	4.55	
Squatina oculata	22.31	9	4.28	
Trichiurus lepturus	16.37	17	3.14	181
Chlorophthalmus atlanticus	15.75	630	3.02	
Spicara alta	14.55	180	2.79	
Rajella leopardus	10.07	4	1.93	
Illex coindetii	10.05	150	1.93	
Zenopsis conchifer	9.56	15	1.83	
Lophiodes kempi	8.55	15	1.64	
Pontinus accraensis	8.44	36	1.62	
Torpedo marmorata	7.20	30	1.38	
Miracorvina angolensis	5.10	15	0.98	182
Myctophid sp. A	3.39	934	0.65	
Uranoscopus polli	2.87	9	0.55	
Trachinocephalus myops	2.55	15	0.49	
Merluccius polli	2.19	13	0.42	
Parapenaeus longirostris	1.95	420	0.37	
Chelidonichthys gabonensis	1.91	13	0.37	
Bothus podas	1.65	90	0.32	
Nezumia aequalis	0.75	30	0.14	
Dicologoglossa sp.	0.75	15	0.14	
Peristedion cataphractum	0.60	15	0.12	
Gadella imberbis	0.45	15	0.09	
Malacocephalus laevis	0.15	15	0.03	
Total	521.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 50
DATE :07/09/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 7°3.53
start stop duration Lon E 12°12.78
TIME :19:46:33 20:17:31 31.0 (min) Purpose : 1
LOG : 5043.07 5044.77 1.7 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 101 104 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.3 kn
Sorted : 0 Total catch: 119.74 Catch/hour: 231.98

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Isurus oxyrinchus	116.24	6	50.11	
Trichiurus lepturus	98.88	116	42.63	183
Trachurus trecae	8.45	17	3.64	184
Jellyfish	6.86	50	2.96	
Synagrops microlepis	1.51	484	0.65	
Sepiella ornata	0.02	2	0.01	
Saurida brasiliensis	0.02	12	0.01	
Total	231.98		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 51
DATE :08/09/15 GEAR TYPE: PT NO: 1 POSITION:Lat S 7°4.51
start stop duration Lon E 11°57.70
TIME :00:43:22 00:53:41 10.3 (min) Purpose : 1
LOG : 5082.42 5082.98 0.6 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 211 235 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.3 kn
Sorted : 0 Total catch: 52.39 Catch/hour: 304.59

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Myctophid sp. A	151.28	120134	49.67	
Trichiurus lepturus	145.06	203	47.62	185
Trachurus trecae	8.26	12	2.71	186
Total	304.59		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 52
DATE :08/09/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 6°54.93
start stop duration Lon E 12°1.63
TIME :07:53:34 08:23:54 30.3 (min) Purpose : 1
LOG : 5115.13 5116.70 1.6 Region : 4054
FDEPTH: 102 105 Gear cond.: 0
BDEPTH: 102 105 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.1 kn
Sorted : 0 Total catch: 100.27 Catch/hour: 198.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	60.89	1292	30.70	187
Sphoeroides pachgaster	26.82	30	13.52	
Dentex congoensis	19.43	358	9.79	190
Umbrina canariensis	18.44	40	9.29	
Dentex angolensis	17.53	182	8.84	189
Brotula barbata	9.06	4	4.57	
Rhinobatos albomaculatus	5.97	2	3.01	
Chelidonichthys gabonensis	5.72	45	2.88	
Saurida brasiliensis	5.30	1614	2.67	
Sarda sarda	5.14	2	2.59	
Trichiurus lepturus	3.98	4	2.00	188
Mustelus mustelus	3.48	2	1.76	
Pagellus bellottii	3.30	12	1.67	
Illex coindetii	3.09	218	1.56	
Zeus faber	2.83	8	1.43	
Raja miraletus	1.82	2	0.92	
Uranoscopus polli	1.11	2	0.56	
Branchiostegus semifasciatus	0.93	2	0.47	
Loligo vulgaris	0.69	45	0.35	
Pterothrissus belloci	0.67	4	0.34	
Dentex barnardi	0.51	2	0.26	
Chaetodon hoefleri	0.42	2	0.21	
Spicara alta	0.36	16	0.18	
Jellyfish	0.34	2	0.17	
Citharus linguatula	0.26	16	0.13	
Alloteuthis africana	0.22	83	0.11	
Serranus africanus	0.02	2	0.01	
Arnoglossus imperialis	0.02	2	0.01	
Ariomma bondi	0.02	2	0.01	
Total	198.36		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 53
DATE :08/09/15 GEAR TYPE: BT NO: 26 POSITION:Lat S 6°47.89
start stop duration Lon E 12°12.55
TIME :13:27:42 13:58:01 30.3 (min) Purpose : 1
LOG : 5161.38 5162.97 1.6 Region : 4054
FDEPTH: 69 67 Gear cond.: 0
BDEPTH: 69 67 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 3.2 kn
Sorted : 13 Total catch: 149.62 Catch/hour: 296.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	114.68	4053	38.73	192
Jellyfish	42.88	12	14.48	
Pagellus bellottii	29.82	283	10.07	
Rhinobatos annulatus	27.63	10	9.33	
Dentex congoensis	24.49	469	8.27	195
Scomber japonicus	12.08	251	4.08	194
Umbrina canariensis	9.69	12	3.27	
Dentex barnardi	9.24	12	3.12	193
Sphoeroides pachgaster	6.31	12	2.13	
Fistularia petimba	4.04	6	1.36	
Alloteuthis africana	3.30	784	1.12	
Boops boops	2.83	65	0.96	
Trichiurus lepturus	2.83	4	0.96	191
Zeus faber	2.61	12	0.88	
Balistes capriscus	1.15	2	0.39	
Chelidonichthys capensis	1.09	12	0.37	
Chelidonichthys gabonensis	0.65	12	0.22	
Engraulis encrasicolus	0.44	55	0.15	
Sardinella aurita	0.32	34	0.11	196
Total	296.07		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2015408 STATION: 54
DATE :08/09/15 GEAR TYPE: PT NO: 4 POSITION:Lat S 6°48.18
start stop duration Lon E 11°57.33
TIME :19:34:39 19:58:02 23.4 (min) Purpose : 1
LOG : 5212.93 5214.10 1.2 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 103 100 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.0 kn
Sorted : 0 Total catch: 94.40 Catch/hour: 242.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	96.75	375	39.94	199
Manta birostris	82.12	3	33.90	
Trichiurus lepturus	45.42	38	18.75	197
Trachinotus ovatus	10.55	36	4.35	
Trachurus trecae	5.41	64	2.24	198
Trachurus trecae	1.75	3	0.72	200
Saurida brasiliensis	0.23	62	0.10	
Remora remora	0.03	3	0.01	
Total	242.26		100.00	

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R/V Dr. Fridtjof Nansen        SURVEY:2015408          STATION:   55
DATE  :08/09/15                 GEAR TYPE: PT NO:   4   POSITION:Lat    S
6°41.31
          start     stop     duration                                Lon    E
12°14.45
TIME  :22:27:43 22:41:54  14.2 (min)          Purpose    : 1
LOG   : 5233.37  5234.12   0.8                Region     : 4054
FDEPTH:       0        0                      Gear cond.: 0
BDEPTH:      52       53                      Validity  : 0
Towing dir:    0°     Wire out   : 110  m     Speed      : 3.2 kn
Sorted    :  30       Total catch: 229.52     Catch/hour: 970.49

   SPECIES                                     CATCH/HOUR      % OF TOT. C
SAMP
                                            weight   numbers
   Trachurus trecae                            213.11      3011        21.96
201
   Brachydeuterus auritus                      174.63      1937        17.99
204
   Selar crumenophthalmus                    159.66      406       16.45
   Sardinella maderensis                       141.73       846        14.60
203
   Scomber colias                              117.38      1488        12.09
205
   Sardinella aurita                            49.05       203         5.05
202
   Caranx crysos                              47.36       68        4.88
   Sarda sarda                                  39.92       169         4.11
207
   Sepia orbignyana                           13.78       21        1.42
   Sphyraena guachancho                         10.49        34         1.08
208
   Trachinotus ovatus                            3.38        34         0.35
206
                                              ________              ________
   Total                                        970.49               100.00
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R/V Dr. Fridtjof Nansen        SURVEY:2015408          STATION:   56
DATE  :09/09/15                 GEAR TYPE: PT NO:   1   POSITION:Lat    S
6°36.02
          start     stop     duration                                Lon    E
12°9.78
TIME  :02:03:28 02:35:21  31.9 (min)          Purpose    : 1
LOG   : 5262.97  5264.45   1.5                Region     : 4054
FDEPTH:       0        0                      Gear cond.: 0
BDEPTH:      58       54                      Validity  : 0
Towing dir:    0°     Wire out   : 110  m     Speed      : 2.8 kn
Sorted    :   0       Total catch: 247.20     Catch/hour: 465.24

   SPECIES                                     CATCH/HOUR      % OF TOT. C
SAMP
                                            weight   numbers
   Trachurus trecae                            191.95      1285        41.26
209
   Sardinella maderensis                       155.51       881        33.43
211
   Sardinella aurita                            41.59       213         8.94
210
   Brachydeuterus auritus                       24.92       188         5.36
214
   Caranx crysos                              13.66       15        2.94
   Scomber japonicus                            10.48       205         2.25
215
   Lagocephalus laevigatus                    7.51        24        1.61
   Sarda sarda                                   6.00        24         1.29
216
   Sphyraena guachancho                          4.18        15         0.90
213
   Sepia orbignyana                           3.44        6         0.74
   Alectis alexandrinus                       1.62        2         0.35
   Trichiurus lepturus                           1.36         2         0.29
212
   Sepia officinalis                          1.11        6         0.24
   Caranx rhonchus                               0.96         2         0.21
217
   Trachinotus goreensis                         0.94         2         0.20
                                              ________              ________
   Total                                        465.24               100.00
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R/V Dr. Fridtjof Nansen        SURVEY:2015408          STATION:   57
DATE  :09/09/15                 GEAR TYPE: BT NO: 26   POSITION:Lat    S
6°38.27
          start     stop     duration                                Lon    E
11°53.84
TIME  :09:08:54 09:38:55  30.0 (min)          Purpose    : 1
LOG   : 5323.10  5324.72   1.6                Region     : 4054
FDEPTH:     119      120                      Gear cond.: 0
BDEPTH:     119      120                      Validity  : 0
Towing dir:    0°     Wire out   : 300  m     Speed      : 3.2 kn
Sorted    :   0       Total catch: 81.02      Catch/hour: 161.93

   SPECIES                                     CATCH/HOUR      % OF TOT. C
SAMP
                                            weight   numbers
   Trichiurus lepturus                          98.37       112        60.75
218
   Dentex angolensis                            22.29       116        13.76
219
   Umbrina canariensis                        10.07       22        6.22
   Trachurus trecae                              8.71        50         5.38
220
   Dentex congoensis                             4.82        70         2.97
222
   Brotula barbata                            4.68        4         2.89
   Illex coindetii                            4.08      170         2.52
   Loligo vulgaris                            3.00       84         1.85
   Sphoeroides pachgaster                     1.54        2         0.95
   Jellyfish                                  1.34        4         0.83
   Saurida brasiliensis                       0.78      220         0.48
   Scorpaena stephanica                       0.62        2         0.38
   Citharus linguatula                        0.52       12         0.32
   Merluccius polli                           0.46       96         0.28
   Scomber colias                                0.44         2         0.27
221
   Physiculus huloti                             0.12         2         0.07
   Microchirus frechkopi                         0.10         2         0.06
                                              ________              ________
   Total                                        161.93               100.00
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R/V Dr. Fridtjof Nansen        SURVEY:2015408          STATION:   58
DATE  :09/09/15                 GEAR TYPE: BT NO: 26   POSITION:Lat    S
6°33.70
          start     stop     duration                                Lon    E
12°7.08
TIME  :12:01:44 12:32:01  30.3 (min)          Purpose    : 1
LOG   : 5341.87  5343.48   1.6                Region     : 4054
FDEPTH:      64       61                      Gear cond.: 0
BDEPTH:      64       61                      Validity  : 0
Towing dir:    0°     Wire out   : 185  m     Speed      : 3.2 kn
Sorted    :   0       Total catch: 51.21      Catch/hour: 101.47

   SPECIES                                     CATCH/HOUR      % OF TOT. C
SAMP
                                            weight   numbers
   Dentex barnardi                              30.24        89        29.80
225
   Trichiurus lepturus                          14.70        18        14.49
224
   Pagrus caeruleostictus                     13.99       30       13.79
   Pagrus pagrus                              8.78       16        8.65
   Alloteuthis africana                       7.37     2822        7.26
   Epinephelus aeneus                         6.06        4        5.98
   Caranx rhonchus                               5.31         6         5.23
226
   Pagellus bellottii                            5.23        36         5.16
227
   Pseudupeneus prayensis                     2.71       18        2.68
   Raja miraletus                             1.78        2        1.76
   Trachurus trecae                              1.35        10         1.33
223
   Fistularia petimba                         0.81        2        0.80
   Illex coindetii                            0.79       18        0.78
   Trachinus araneus                          0.71        2        0.70
   Uranoscopus polli                          0.65        6        0.64
   Zeus faber                                 0.61        2        0.61
   Chelidonichthys capensis                   0.36        2        0.35
                                              ________              ________
   Total                                        101.47               100.00
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R/V Dr. Fridtjof Nansen        SURVEY:2015408          STATION:   59
DATE  :09/09/15                 GEAR TYPE: PT NO:   4   POSITION:Lat    S
6°36.15
          start     stop     duration                                Lon    E
11°37.27
TIME  :19:22:13 20:03:36  41.4 (min)          Purpose    : 1
LOG   : 5402.02  5404.26   2.2                Region     : 4054
FDEPTH:       0        0                      Gear cond.: 0
BDEPTH:     409      343                      Validity  : 0
Towing dir:    0°     Wire out   : 110  m     Speed      : 3.2 kn
Sorted    :   0       Total catch: 119.14     Catch/hour: 172.75

   SPECIES                                     CATCH/HOUR      % OF TOT. C
SAMP
                                            weight   numbers
   Trichiurus lepturus                         141.43       186        81.87
229
   Trachurus trecae                             25.06        32        14.50
228
   Auxis thazard thazard                         5.26         6         3.05
231
   Scomber colias                                1.00         4         0.58
230
                                              ________              ________
   Total                                        172.75               100.00
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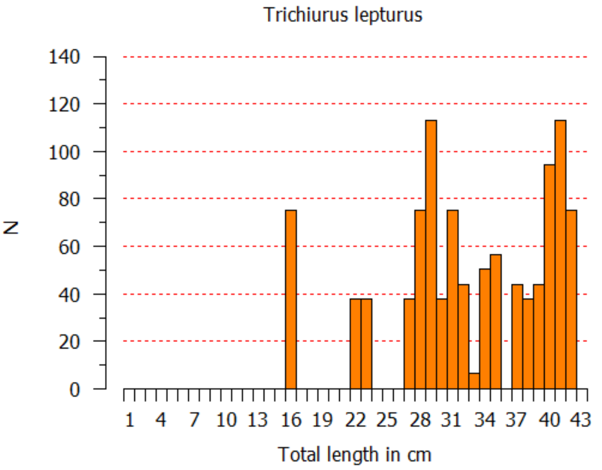
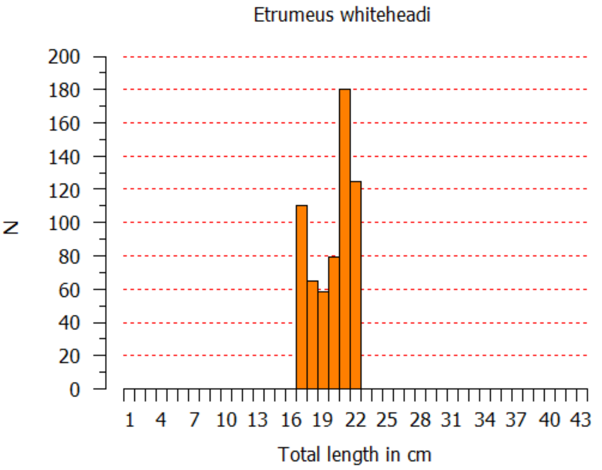
R/V Dr. Fridtjof Nansen        SURVEY:2015408          STATION:   60
DATE  :10/09/15                 GEAR TYPE: PT NO:   1   POSITION:Lat    S
6°19.95
          start     stop     duration                                Lon    E
12°1.53
TIME  :02:01:21 02:31:09  29.8 (min)          Purpose    : 1
LOG   : 5454.35  5455.85   1.5                Region     : 4054
FDEPTH:       0        0                      Gear cond.: 0
BDEPTH:      70       72                      Validity  : 0
Towing dir:    0°     Wire out   : 0    m     Speed      : 3.0 kn
Sorted    :  73       Total catch: 219.04     Catch/hour: 441.17

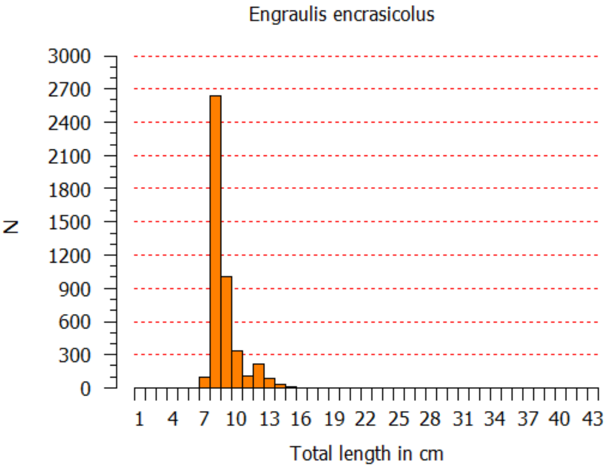
   SPECIES                                     CATCH/HOUR      % OF TOT. C
SAMP
                                            weight   numbers
   Alectis alexandrinus                      190.33      296       43.14
   Caranx crysos                             137.76      157       31.23
   Trichiurus lepturus                          63.85        97        14.47
232
   Selene dorsalis                              22.96        30         5.20
233
   Caranx senegallus                          9.85       18        2.23
   Sardinella maderensis                         7.35        30         1.67
234
   Lagocephalus laevigatus                    3.54        2        0.80
   Auxis thazard thazard                         1.69         2         0.38
236
   Trachurus trecae                              1.39         6         0.32
237
   Jellyfish                                  1.37       12        0.31
   Sardinella aurita                             1.07         4         0.24
235
                                              ________              ________
   Total                                        441.17               100.00
```

ANNEX II. Length frequencies of pelagic species

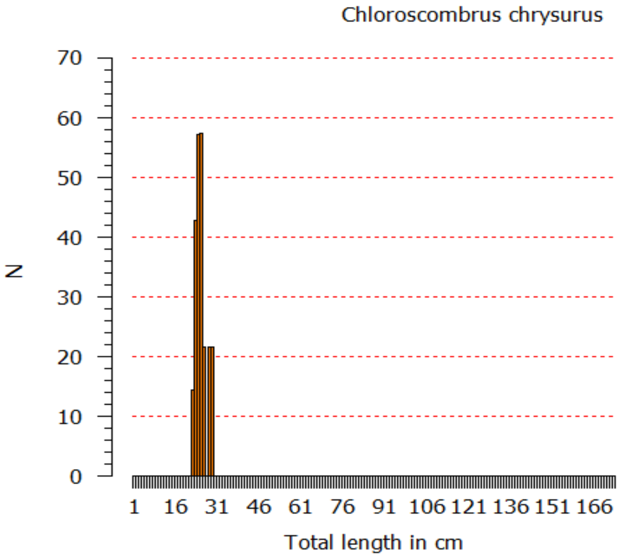
Angola South: Cunene River – Benguela

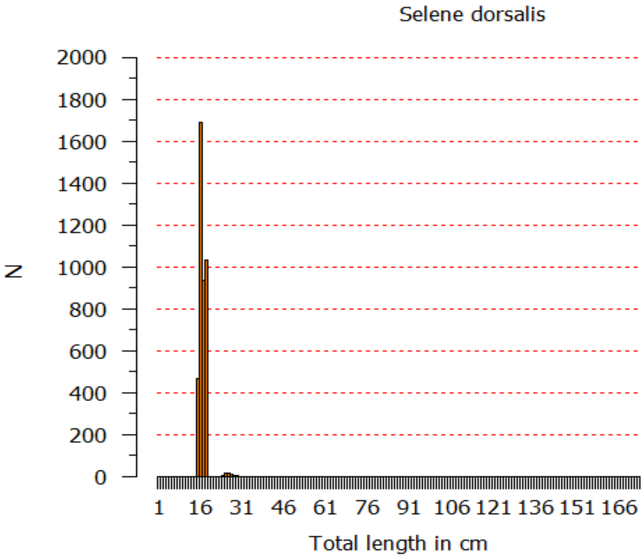


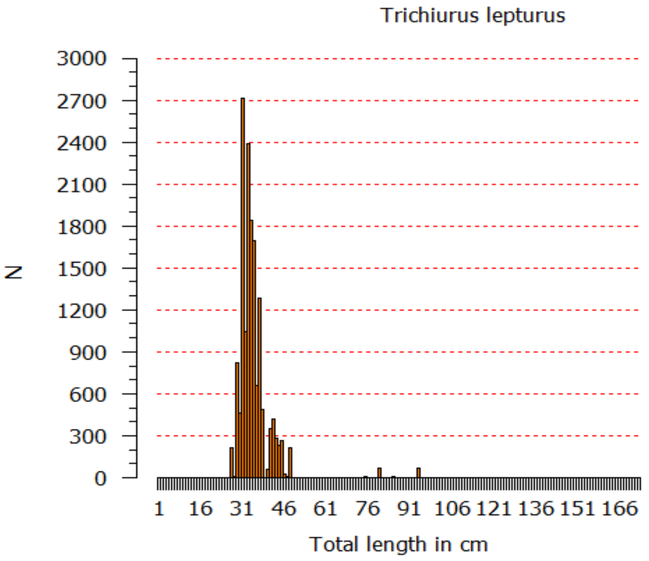




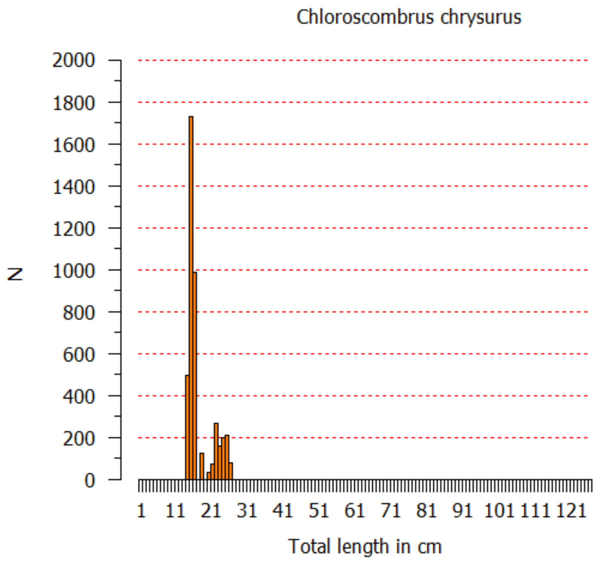
Angola Central: Benguela – Pta. Palmerinhas

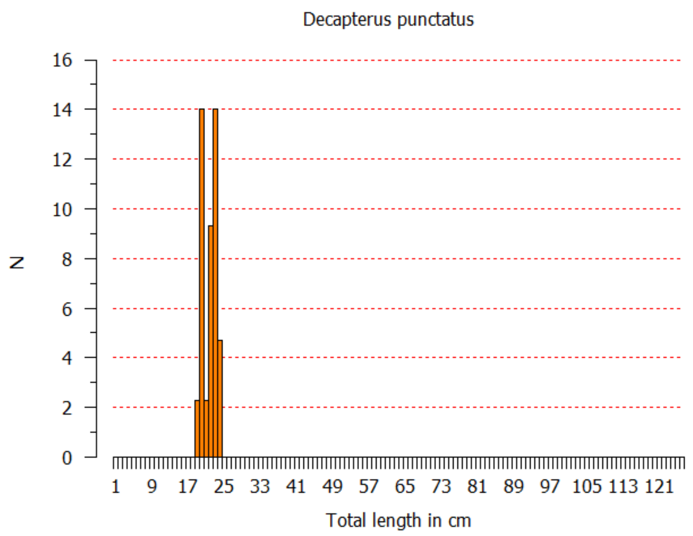


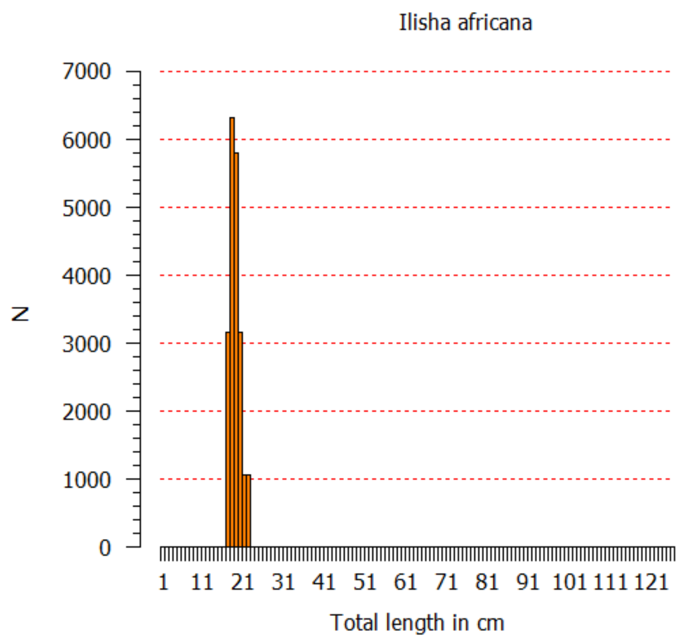


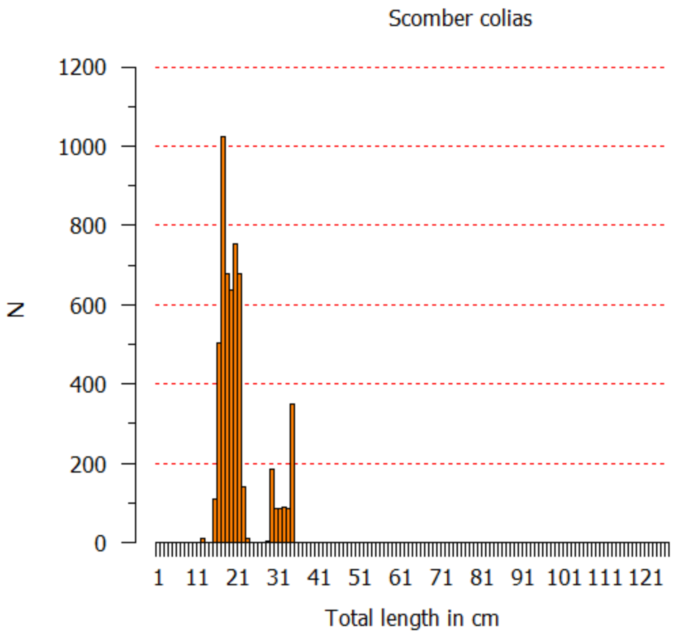


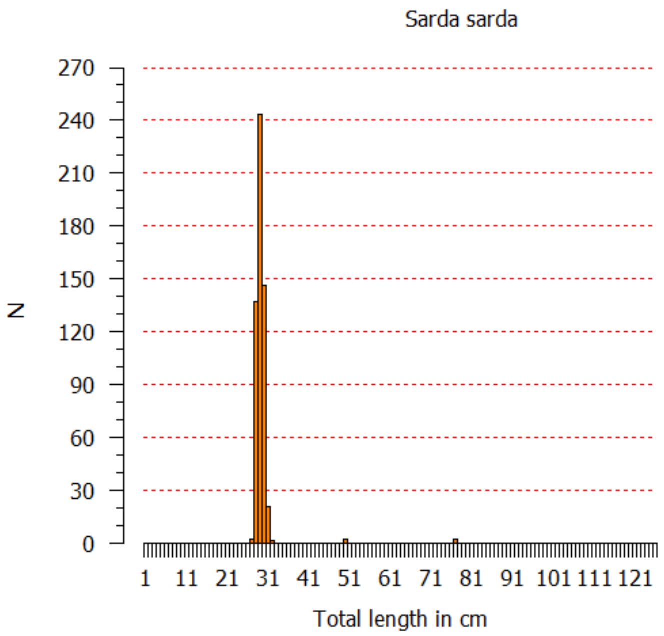
Angola North: Pta. Palmerinhas - Congo River

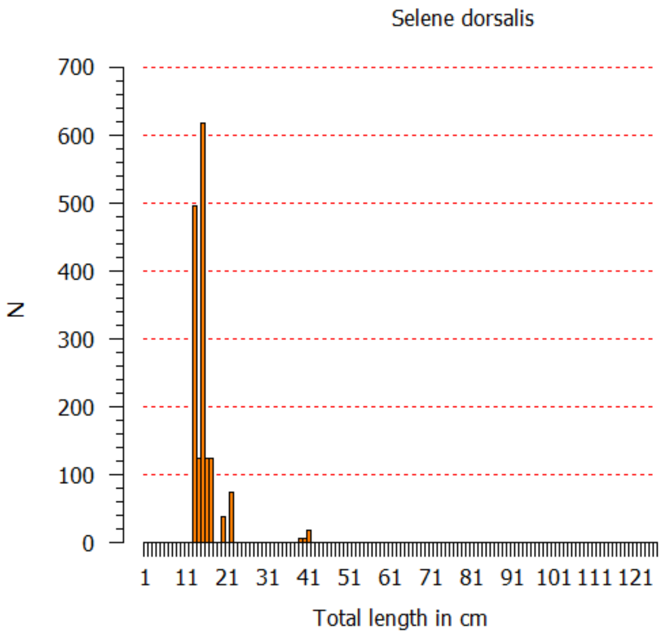


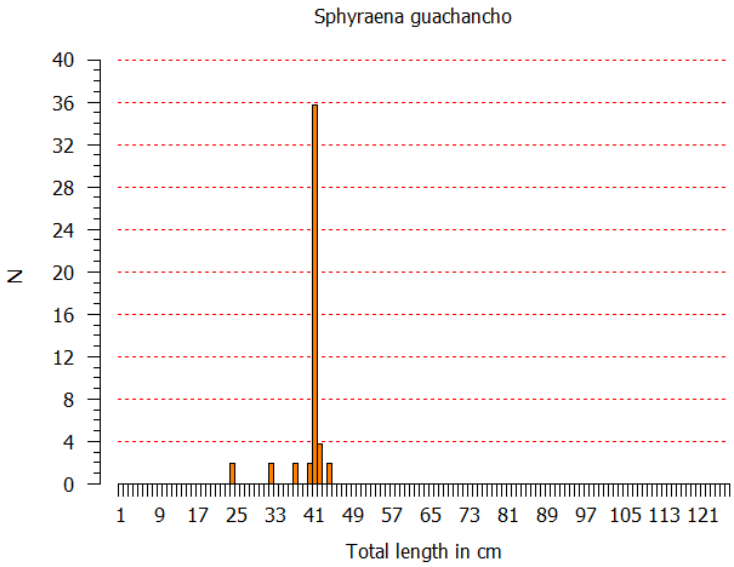

Decapterus punctatus
N
Total length in cm
16
14
12
10
8
6
4
2
0
1
9
17
25
33
41
49
57
65
73
81
89
97
105
113
121

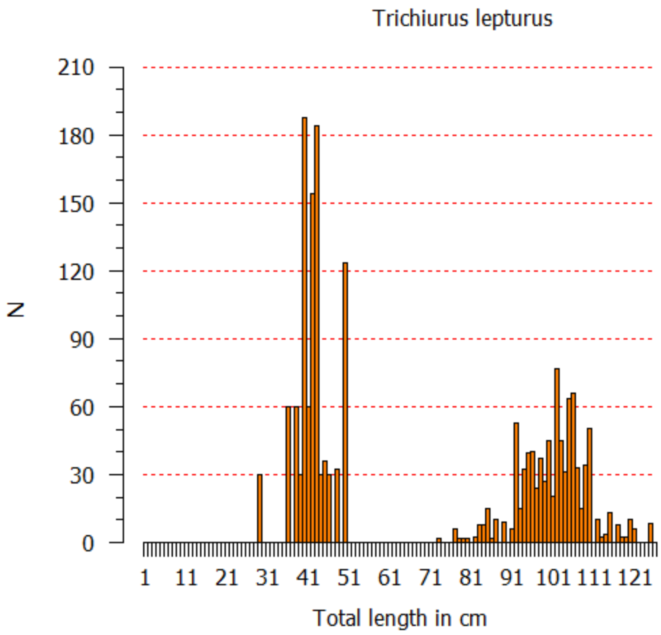

Ilisha africana
N
Total length in cm
7000
6000
5000
4000
3000
2000
1000
0
1
11
21
31
41
51
61
71
81
91
101
111
121


Scomber colias
1200
1000
800
600
400
200
0
N
1 11 21 31 41 51 61 71 81 91 101 111 121
Total length in cm


Sarda sarda
270
240
210
180
150
120
90
60
30
0
N
1 11 21 31 41 51 61 71 81 91 101 111 121
Total length in cm


Selene dorsalis
700
600
500
400
300
200
100
0
N
1 11 21 31 41 51 61 71 81 91 101 111 121
Total length in cm


Sphyraena guachancho
40
36
32
28
24
20
16
12
8
4
0
N
1 9 17 25 33 41 49 57 65 73 81 89 97 105 113 121
Total length in cm



Trichiurus lepturus
210
180
150
120
90
60
30
0
N
1
11
21
31
41
51
61
71
81
91
101
111
121
Total length in cm

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

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

ANNEX V. Biomass of Sardinella and Cunene horse mackerel 1985-2015

Sardinella biomass (1000 tonnes) estimated from acoustic indexes from surveys with research vessel Dr. Fridtjof Nansen from 1985-2015

Year	Season	Dates	Survey number	South Cunene-Benguela	Central Palmerinhas-Benguela	North Cabinda-Palmerinhas	Total Cunene-Cabinda
1985	Summer	28.01-26.02	1	25	20	80	125
	Winter	08.08-10.09	3	0	70	190	260
-86	Summer	22.01-10.03	1	10	140	110	260
-89	Summer	13.02-16.03	1	40	200	60	300
-91	Winter	06.08-18.09	2	?	68	154	
-92	Winter	05.08-22.09	1	?	119	161	
-94	Winter	02.08-17.08	ANG2	**	245	290	
-95	Summer	28.02-02.04	ANG1	**	140	24	
	Winter	10.08-20.09	ANG4	?	277	297	
-96	Winter	16.07-06.09	ANG2	0	130	233	363
-97	Summer	22.02-20.03	ANG1	0	195	300	495
-98	Winter	07.05-22.05	ANG3	0	233	159	392
-99	Winter	02.08-26.08	ANG2	0	228	135	363
-00	Winter	28.07-20.07	ANG2	0	179	174	353
-01	Winter	20.07-17.08	ANG2	0	257	177	434
-02	Winter	17.08-16.09	ANG2	0	165	187	352
-03	Winter	20.07-19.08	ANG2	2	277	153	432
-04	Winter	28.07-27.08	ANG2	0	175	187	362
-05	Winter	16.07-24.08	2005408	0	148	95	243
-06	Winter	21.07-21.08	2006408	20	244	366	630
-07	Winter	07.07-10.08	2007406	55	483	187	725
-08	Winter	15.05-02.07	2008404	56	264	186	506
-09	Winter	23.05-04.07	2009406	92	232	206	530
-10	Winter	18.06-11.08	2010406	43	293	93	429
-11	Summer	20.02-20.03	2011402	96	68	96	260
-11	Winter	18.07-16.08	2011408	0	181	71	252
-12	Summer	01.03-30.03	2012402	353	230	156	739
-12	Winter	26.08-06.10	2012405	325	584	210	1119
-13	Summer	16.02-17.03	2013402	226	222	117	565
-13	Winter	20.06-17.07	2013406	10	295	117	422
-14	Summer	04.02-03.03	2014401	31	247	85	363
-14	Winter	16.06-17.07	2014405	14	272	140	427
-15	Winter	15.08-13.09	2015408	0	429	131	560
	Average 06-15			102	278	156	536
	Average summer 2011-15			177	192	113	482
	Average winter 2010-15			98	406	158	662

Cunene Horse Mackerel biomass (1 000 tonnes) estimated from acoustic indexes from surveys from 1985-2015.

Year	Season	Dates	Survey number	South Cunene-Benguela	Central Palmerinhas-Benguela	North Cabinda-Palmerinhas	Total Cunene-Cabinda
1985	Summer	28.01-26.02	1	30	195	40	265
	Winter	08.08-10.09	3	50	90	40	180
-86	Summer	22.01-10.03	1	130	125	20	275
-89	Summer	13.02-16.03	1	35	55	40	130
-91	Winter	06.08-18.09	2	100	70	30	200
-92	Winter	05.08-22.09	1	98	86	80	280
-94	Winter	02.08-17.08	ANG2	**	130	120	
-95	Summer	28.02-02.04	ANG1	**	?	84	
	Winter	10.08-20.09	ANG4	70	160	110	340
-96	Winter	16.07-06.09	ANG2	140	157	63	360
-97	Summer	02.03-28.03	ANG1	163	58	18	239
-98	Winter	07.05-22.05	ANG3	118	112	37	267
-99	Winter	02.08-26.08	ANG2	124	129	68	321
-00	Winter	28.07-20.07	ANG2	92	178	63	333
-01	Winter	20.07-17.08	ANG2	64	22	3	89
-02	Winter	17.08-16.09	ANG2	118	13	31	162
-03	Winter	20.07-19.08	ANG2	120	34	12	166
-04	Winter	28.07-27.08	ANG2	32	107	90	229
-05	Winter	16.07-24.08	2005408	102	57	21	180
-06	Winter	21.07-21.08	2006408	45	77	31	153
-07	Winter	07.07-10.08	2007406	73	57	27	157
-08	Winter	15.05-02.07	2008404	29	40	0	69
-09	Winter	23.05-04.07	2009406	76	7	0	83
-10	Winter	18/06/2011	2010406	100	15	21	136
-11	Summer	20.02-20.03	2011402	55	13	0	68
-11	Winter	18.07-16.07	2011408	74	26	17	117
-12	Summer	01.03-30.03	2012402	162	135	30	327
-12	Winter	26.08-06.10	2012405	132	67	11	210
-13	Summer	16.02-17.03	2013402	60	62	15	137
-13	Winter	20.06-17.07	2013406	88	117	52	257
-14	Summer	04.02-03.03	2014401	208	77	11	295
-14	Winter	16.06-17.07	2014405	161	24	1	186
-15	Winter	15.08-13.09	201508	76	149	75	300
	Average 06-15			96	62	21	178
	Average summer 2011-15			121	72	14	207
	Average winter 2010-15			105	66	29	201

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 21.02.2015 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	25.13 dB
SA correction	-0.55 dB
Angle sensitivity	21.9
3 dB beam width	7.01º along ship
6.98º athwart ship	
Along ship offset	0.12º
Athwart ship offset	0.02º
Bottom detection menu	
Minimum level	-45 dB

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 m^2, 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.

ANNEX VII. Monitoring lines

ANGOLA MONITORING LINES, ANGOLA, updated winter 2013

Main Monitoring lines of highest priority (red): Multinet, bottles and CDT
Local monitoring lines (green) of next highest priority: Multinet, bottles and CDT
Standard Transect (yellow): CDT only

Line #	Sample	Location	Abbreviation	Latitude (S)	Longitude (E)	Depth (multinet)	Depth (bottles)	CTD	Depth CTD	Comments
THE NORTHERN ANGOLA										
1	1	Congo River	CRML	06º30.59’	10º46.12’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	2006	
1	2	Congo River	CRML	06º28.65’	10º56.55’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1527	
1	3	Congo River	CRML	06º26.25’	11º06.79’					Platform
1	3	Congo River	CRML	06º24.19’	11º16.47’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	745	
1	4	Congo River	CRML	06º21.92’	11º26.55’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	383	
1	5	Congo River	CRML	06º19.67’	11º36.26’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	166	
1	6	Congo River	CRML	06º17.71’	11º45.80’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	111	
1	7	Congo River	CRML	06º15.43’	11º55.58’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	65	
1	8	Congo River	CRML	06º13.35’	12º04.53’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	46	
1	9	Congo River	CRML	06º12.45’	12º07.97’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	35	
5		N’Zeto	St	7º37.44’	12º00.25’					Platform
5	1	N’Zeto	St	7º28.00’	12º21.21’	No multinet	No bottles	Yes	500	
5	2	N’Zeto	St	7º26.50’	12º24.01’	No multinet	No bottles	Yes	200	
5	3	N’Zeto	St	7º22.60’	12º31.00’	No multinet	No bottles	Yes	100	
5	4	N’Zeto	St	7º17.90’	12º39.00’	No multinet	No bottles	Yes	50	
5	5	N’Zeto	St	7º19.90’	12º47.10’	No multinet	No bottles	Yes	25	
7	1	Ambriz	St	8º00.41’	12º39.380’	No multinet	No bottles	Yes	500	
7	2	Ambriz	St	7º58.99’	12º42.650’	No multinet	No bottles	Yes	200	
7	3	Ambriz	St	7º57.30’	12º46.180’	No multinet	No bottles	Yes	120	
7	4	Ambriz	St	7º55.48’	12º50.260’	No multinet	No bottles	Yes	100	
7	5	Ambriz	St	7º53.69’	12º54.680’	No multinet	No bottles	Yes	80	
7	6	Ambriz	St	7º51.92’	12º58.820’	No multinet	No bottles	Yes	60	
7	7	Ambriz	St	7º50.03’	13º02.940’	No multinet	No bottles	Yes	25	

THE CENTRAL ANGOLA										
11	1	Palmerinhas	LDML	9º05.00’	12º58.314’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	21	
11	2	Palmerinhas	LDML	9º05.00	12º56.52’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	36	
11	3	Palmerinhas	LDML	9º05.00’	12º51.26’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	59	
11	4	Palmerinhas	LDML	9º05.00’	12º41.52’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	425	
11	5	Palmerinhas	LDML	9º05.00’	12º31.52’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	953	
11	6	Palmerinhas	LDML	9º05.00’	12º21.52’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1353	
11	7	Palmerinhas	LDML	9º05.00’	12º11.52’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1734	
13	1	Cabo Ledo	St	9º36.10’	13º09.15’	No multinet	No bottles	Yes	20	
13	2	Cabo Ledo	St			No multinet	No bottles	Yes	50	
13	3	Cabo Ledo	St			No multinet	No bottles	Yes	100	
13	4	Cabo Ledo	St			No multinet	No bottles	Yes	200	
13	5	Cabo Ledo	St	9º43.77’	12º42.76’	No multinet	No bottles	Yes	500	
15	1	Cabo S. Braz	St	9º36.10’	13º09.15’	No multinet	No bottles	Yes	20	
15	2	Cabo S. Braz	St			No multinet	No bottles	Yes	50	
15	3	Cabo S. Braz	St			No multinet	No bottles	Yes	100	
15	4	Cabo S. Braz	St			No multinet	No bottles	Yes	200	
15	5	Cabo S. Braz	St	10º13.21’	12º53.88’	No multinet	No bottles	Yes	500	
18	1	Benguela Velha	St	10º46.75’	13º42.72’	No multinet	No bottles	Yes	50	
18	2	Benguela Velha	St			No multinet	No bottles	Yes	100	
18	3	Benguela Velha	St			No multinet	No bottles	Yes	200	
18	4	Benguela Velha	St	10º53.83’	13º19.45’	No multinet	No bottles	Yes	500	
23	1	Lobito	LBML	12º20.91’	13º28.60’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	81	
23	2	Lobito	LBML	12º20.15’	13º27.16’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	90	
23	3	Lobito	LBML	12º17.90’	13º22.20’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	370	
23	4	Lobito	LBML	12º13.00’	13º13.02’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	997	
23	5	Lobito	LBML	12º08.80’	13º04.00’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1259	
23	6	Lobito	LBML	12º04.80’	12º54.80’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1483	
23	7	Lobito	LBML	11º58.75’	12º45.45’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1837	
23	8	Lobito	LBML	11º54.80’	12º36.66’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1846	
THE SOUTHERN ANGOLA										

30	1	Santa Marta	St	13º55.92’	12º24.40’	No multinet	No bottles	Yes	20	
30	2	Santa Marta	St			No multinet	No bottles	Yes	50	
30	3	Santa Marta	St			No multinet	No bottles	Yes	100	
30	4	Santa Marta	St			No multinet	No bottles	Yes	200	
30	5	Santa Marta	St	13º55.93’	12º13.22’	No multinet	No bottles	Yes	500	
35	1	Namibe	NML	15°09.381	12°07.827’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	130	
35	2	Namibe	NML	15°09.381	12°04.725’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	322	
35	3	Namibe	NML	15°09.381	11°59.554’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	133	
35	4	Namibe	NML	15°09.381	11°49.216’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1133	
35	5	Namibe	NML	15°09.381	11°39.000’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1780	
35	6	Namibe	NML	15°09.381	11°17.360’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	2599	
41	1	Ponta Albina	St	16º12.800	11º45.75’	No multinet	No bottles	Yes	20	
41	2	Ponta Albina	St	16º12.800	11º45.850’	No multinet	No bottles	Yes	36	
41	3	Ponta Albina	St	16º12.800	11º44.920’	No multinet	No bottles	Yes	42	
41	4	Ponta Albina	St	16º12.800	11º43.110’	No multinet	No bottles	Yes	50	
41	5	Ponta Albina	St	16º12.800	11º39.810’	No multinet	No bottles	Yes	61	
41	6	Ponta Albina	St	16º12.800	11º37.030’	No multinet	No bottles	Yes	72	
41	7	Ponta Albina	St	16º12.800	11º34.230’	No multinet	No bottles	Yes	82	
41	8	Ponta Albina	St	16º12.800	11º32.920’	No multinet	No bottles	Yes	100	
41	9	Ponta Albina	St	16º12.800	11º31.820’	No multinet	No bottles	Yes	200	
41	10	Ponta Albina	St	16º12.800	11º31.340’	No multinet	No bottles	Yes	347	
41	11	Ponta Albina	St	16º12.800	11º45.75’	No multinet	No bottles	Yes	500	
41	12	Ponta Albina	St	16º12.800	11º30.610’	No multinet	No bottles	Yes	570	
41	13	Ponta Albina	St	16º12.800	11º30.610’	No multinet	No bottles	Yes	708	
41	14	Ponta Albina	St	16º12.800	11º29.390’	No multinet	No bottles	Yes	850	
41	15	Ponta Albina	St	16º12.800	11º28.240’	No multinet	No bottles	Yes	964	
40	1	Baia Tigres	St	16º36.870	11º39.870’	No multinet	No bottles	Yes	22	
40	2	Baia Tigres	St	16º36.870	11º39.180’	No multinet	No bottles	Yes	44	
40	3	Baia Tigres	St	16º36.870	11º37.780’	No multinet	No bottles	Yes	80	
40	4	Baia Tigres	St	16º36.870	11º32.370’	No multinet	No bottles	Yes	101	
40	5	Baia Tigres	St	16º36.870	11º24.820’	No multinet	No bottles	Yes	122	
40	6	Baia Tigres	St	16º36.870	11º21.920’	No multinet	No bottles	Yes	130	
40	7	Baia Tigres	St	16º36.870	11º21.320’	No multinet	No bottles	Yes	163	
40	8	Baia Tigres	St	16º36.870	11º20.920’	No multinet	No bottles	Yes	196	

40	9	Baia Tigres	St	16º36.870	11º20.320	No multinet	No bottles	Yes	260	
40	10	Baia Tigres	St	16º36.870	11º18.940’	No multinet	No bottles	Yes	423	
40	11	Baia Tigres	St	16º36.870	11º18.560’	No multinet	No bottles	Yes	489	
40	12	Baia Tigres	St	16º36.870	11º17.670’	No multinet	No bottles	Yes	667	
40	13	Baia Tigres	St	16º36.870	11º11.150’	No multinet	No bottles	Yes	1330	
40	14	Baia Tigres	St	16º36.870	11º06.170’	No multinet	No bottles	Yes	1622	
43	1	Cunene River	GML	17º12.160	11º44.110’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	22	
43	2	Cunene River	GML	17º12.160	11º41.210’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
43	3	Cunene River	GML	17º12.160	11º38.880’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	77	
43	4	Cunene River	GML	17º12.160	11º35.870’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
43	5	Cunene River	GML	17º12.160	11º33.320’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	115	
43	6	Cunene River	GML	17º12.160	11.28.180’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	150	
43	7	Cunene River	GML	17º12.160	11º23.530’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	202	
43	8	Cunene River	GML	17º12.160	11º22.210’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	263	
43	9	Cunene River	GML	17º12.160	11º20.510’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	365	
43	10	Cunene River	GML	17º12.160	11º18.530’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
43	11	Cunene River	GML	17º12.160	11º14.110’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	721	
43	12	Cunene River	GML	17º12.160	11º10.630’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	989	
43	13	Cunene River	GML	17º12.160	11º04.050’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	1499	
43	14	Cunene River	GML	17º12.160	10º59.860’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	2104	

ANNEX VIII. RESULTS FROM ACOUSTIC MINI-SURVEY

During the ordinary survey it was observed that sardinella was very close to the surface during day, but on the acustic recordings, not “typical “ sardinella pattern could be seen. Sardinella was mainly caught by the pelagic trawl during nighttime, because during day it managed to avoid the trawl. During day we caught the horse mackerel with the demersal trawl, close to the bottom and with the pelagic trawl higher up in the water column. In order to study day/night effects on the biomass estimates, an acouctic mini-survey was conducted outside Ambriz. Dense coverage of a limited survey area (10 x 9 nmi) with 10 transects of 10 nmi and 1 nmi distance between the transects was conducted (Figure 40). The transect was surveyed once during night time and once during daytime (duration for the night coverage was 17:30 – 04:15 UTC, duration for the day coverage was 05:30-16:50 UTC). The area is close to Ambriz and the position of the northwest corner was 07.54S 12.54 E.

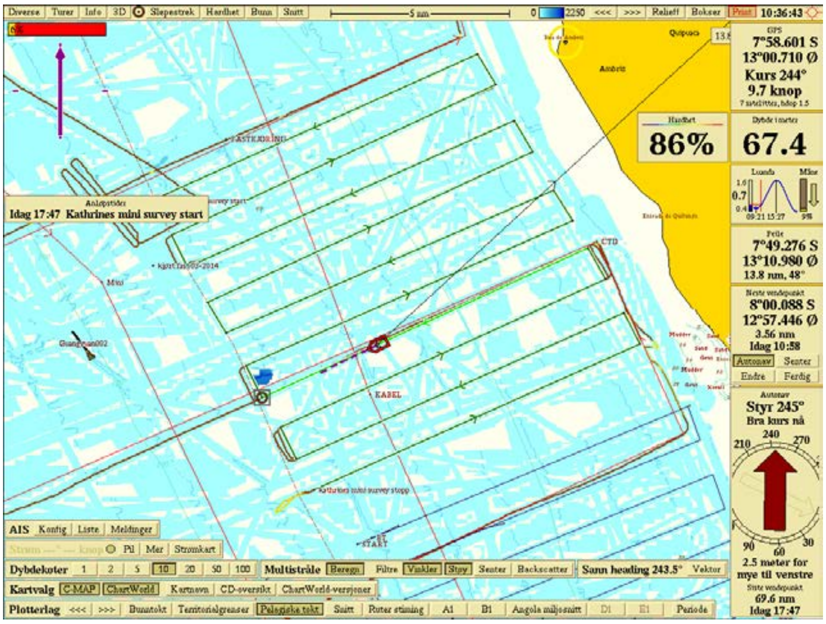


Figure 40. Course track for the acoustic mini-survey. 10 transects á 10 nmi and 1 nmi distance between the transects were covered two times, one time during darknes (night) and one time during daylight.

No trawling was conducted during the mini-survey, but length frequencies from trawl catches taken in the same area in the original survey, was used during biomass calculation. Already during the scrutinizing of the acoustic values it was evident the vertical distribution of the fish was quite different between night and day. The biomass was first calculated by taking all the mean s_A values recorded per species (and length frequency), and multiplied these with the total area of the mini-survey (10 x 9 nmi). Then 4 of the transects were removed so that the s_A values for only two transects was left, representing a typical survey situation with 6 nmi between the transects.

In Table 6 the biomass for horse mackerel and sardinella is shown, based on the two different survey designs. What are most apparent are the day/night differences in the biomass of horse mackerel, with four time’s higher values during day than during night. It seems like the horse mackerel is patchy distributed, so when comparing the values from the dense coverage, with the values from transects 6 nmi apart, the dense coverage gives 3 times as high biomass (3.1 compared to 1.2) during night and 2 times as high biomass during day (12.1 compared to 7.7). Daytime values in the dense coverage are almost 12 times higer than the night time values for the 6 nmi transects, for horse mackerel. For sardinella, no clear pattern can be found and there is less variation between day and night, as well as between dense and “normal” survey design (1 nmi compared to 6 nmi). For the dense coverage the night time values are higher than the day values, while for the transects 6 nmi apart, the day time values are twise as high as the night time values. However, we are probably underestimating the biomass of sardinella both day and night since sardinella stay so close to the surface that most of them are in the acoustic deadzone (from surface to 7-10 meter below surface).

The same area as the mini-survey, was covered by the ordinary survey one week earlier. That was done during night time and the values from the mini-survey are compared to the biomass values from the ordinary survey in Table 7. For horse mackerel the biomass is quite similar, but for sardinella det ordinary survey show twise as high biomass. This comparison only show that there is a large variation in the distribution of pelagic fish and the situation can be due to the time difference between the two recordings.

Table 6. Estimated abundance of pelagic fish (tonnes), acoustic mini-survey.

	1 nmi between transects		6 nmi between transects	
Species	Night	Day	Night	Day
Horse mackerel (*T. trecae*)	3.1	12.1	1.2	7.7
Sardinella *(S.aurita+madrensis)*	4.7	3.6	3.8	6.1

Table 7. Estimated abundance of pelagic fish (tonnes), acoustic mini-survey compared to ordinary survey.

	1 nmi between transects		Ordinary survey	
Species	Night	Day	Night	Day
Horse mackerel (*T. trecae*)	3.1	-	4.0	
Sardinella *(S.aurita+madrensis)*	4.7	-	8.0	

ANNEX IX. RESULTS FROM OBSERVATIONS OF SEABIRDS AND MARINE MAMMALS

DISTRIBUTION AND PATTERNS OF ABUNDANCE OF OBSERVATIONS OF SEABIRDS AND MARINE MAMMALS

Participant: José Mateus da Silva, INIP Luanda, from 15 August 2015.

AIMS

1. Make an inventory of seabird and marine mammal species present in the survey area
2. Analyse patterns of distribution and abundance in relation to oceanographic features and fish distribution.

METHODS

Counts of seabirds were made during daylight hours from the mid deck of the vessel, which offers excellent viewing conditions.When possible, standard "10-minute-counts" of the birds present around the vessel were conducted while the vessel was steaming at constant speed and direction. During each count period, all birds detected were counted, discriminating between birds seen actively following the vessel, birds flying and birds sitting or feeding. During the counts, scans with binoculars were conducted at least once every 2 minute to detect species that couldn't not be identified by eye only. Care was taken to count individual birds only once, particularly for species prone to follow or circle the vessel and not to conduct 10 minute counts soon after a station or trawl which have attracted birds to the vessel. Additional "incidental observations" were made, between counts when scarce or anusual species were observed and while the vessel was on station or during trawling. The time and duration of each observation and count was recorded with wristwatch. Sightings of marine mammals (Cape fur seals, whales and dolphins) and turtles were recorded following the same format.

RESULTS

A total of 560 counts were conducted between 17 August to 12 September 2015. In addition 43 counts were conducted during CTD stations, 21 during trawling and 38 incidental observations were logged. Additional information on the age classes of some species was noted (gannets, gulls and turtles). The summary of the species and numbers identified during the above is given in Table 1 for birds and seals, and in Table 2 for cetaceans.

Diomedeidae, Albatrosses:

Three species of albatrosses were encountered, all migrants from the southern ocean (*Thalassarche chrysostoma*, *Thalassarche melanophrys*, *Thalassarche chlororhynchos*) All birds of this species were from the Atlantic race D.c.chlororrhynchos which breeds at Gough Island and Tristan da Cunha group. All sightings of albatrosses were made in the southern part of the region, north of 15ºS, was the limite area for *Thalassarche chlororhynchos.*

Table 1: Seabird species and numbers of individuals identified during the observation periods and in total (including CTD, Trawl and incidental sightings). Cape fur seal numbers are also given.

Nr	Species	Total
01	*Thalassarche chororhynchos*	243
02	*Thalassarche chrysostoma*	55
03	*Thalassarche melanophrys*	12
04	*Daption capense*	4
05	*Procellaria aequinoctialis*	1.461
06	*Puffinus gravis*	5
07	*Puffinus griseus*	15
08	*Puffinus puffinus*	3
09	*Oceanites oceanicus*	633
10	*Phalacrocorax capensis*	1.085
11	*Phalacrocorax lucidus*	52
12	*Morus capensis*	4.446
13	*Pelicanus onocrotalus*	6
14	*Stercorarius parasiticus*	5
15	*Stercorarius pomarinus*	2
16	*Stercorarius longicaudus*	5
17	*Stercorarius sp*	4
18	*Catharacta antárctica*	89
19	*Larus cirrocephalus*	8
20	*Larus dominicanus*	2.835
21	*Xema sabine*	6
22	*Sterna hirundo*	538
23	*Sterna hirundo/paradisaea*	396
24	*Sterna máxima*	120
25	*Sterna sandvicensis*	2
26	*Arctocephalus pusilus*	228
	Subtotal-birds---	12.030
	Total (birds + seal)---	12.258

Procellariidae, Petrls and Shearwaters:

Out of four species of this group sighted during the survey, only the Manx shearwater (Puffinus puffinus) is a northern hemisphere visitor, all the others coming from the subantarctic region of the southern ocean. Only 5 sightngs (of single birds) were made of the Manx shearwater, two at 10º10`S and all the others 10º06`S. The White-chinned petrel (*Procellaria aequinoctialis*) was found abundante south of 15ºS. *Procellaria aequinoctialis*, breeding at Inaccessible Island (Tristan da Cunha Group). The Cape petrel, *Daption capense*, was very scarce, only four sightings all south of 16º37´S. The Sooty shearwater, *Puffinus griseus*, was scarce during the survey, 15 sightings of single birds south of 10º06´S.

Oceaniitidae, Storm-petrel:

Only one species of this group was recorded: the Wilson´s storm petrel, *Oceanites oceanicus*,a migrant from the southern ocean. This species was widespread and abundant but with marked variations in densities. It was most regular at the shelf break and offshore between 11º46´S, 10º10´S e 9º23´S. This species is a zooplankton surface feeder and its association with frontal zones and surface slicks is an indication of areas of zooplankton concentration at the surface.

Sulidae, Gannets:

The Cape gannet, *Morus capensis*, proved to be the most abundant and widespread seabird during the survey. Interestingly, of the 1.334 individuals that were aged, 60% were in adults, 30,35% were immature or sub adults and 9,65% were juveniles. This proves that Angolan waters are an important feeding and wintering area for all age classes of this vulnerable southern African endemic species. The highest densities of this species were observed primarily offshore between 16º36´S and 11º46´S, 11º34´S and 11º04´S.

Phalacrocoracidae, Cormorants:

Only two cormorant species were recorded during the survey, and only in coastal waters. *Phalacrocorax lucidus* is suspected to breed at several locations in the southern region from 13º15´S to Baia dos Tigres.The Cape cormorant *Phalacrocorax capensis*, an endemic species from the Benguela Current region, was observed only in the south of 16º40´S. A third species, the Reed cormorant, *Phalacrocorax africanus*, more associated with fresh inland waters, was observed in Luanda bay but not included in the survey,

Stercoraridae, Skuas:

Only three *Stercorarius* species (*Stercorarius pomarinus*, *Stercorarius parasiticus* and *Stercorarius longicaudus*) were recorded in extremely low numbers (only 14 individuals). This difference being certainly due to the earlier dates of the survey before the arrival of the bulk of these palaearctic migrants in the region. The subantarctic Skua, *Catharacta Antarctica* on the other hand, a visitor from the southern ocean, was slightly more frequent and geographically distributed in the same area as last year: with a concentration between 16º59´S and 16º53´S (71 sightings).

Laridae, Gulls:

Of the three species of gulls recorded, one species is palearctic migrant *Xema sabine*. The Grey-headed gull (*Larus cirrocephalus*), is a resident associated with coastal and inland waters which was sighted in vicinity of Kwanza river estuary. The Kelp gull (*Larus dominicanus vetula*), is endemic from Southern Africa and was widespread throughout the survey area with a marked increase in abundance from south 16º37´S and south of 16º14´S.

Sternidae, Terns:

Three of the four species recorded, are palearctic migrants (*Sterna hirundo*, *Sterna paradisaea* and *Sterna sandvicensis).* *Sterna hirundo* was widespread and throughout the area but in much llower numbers than during the some other years; again probably the effect of an earlier date on abundance of palearctic migrants. The tropical *Sterna maxima* was observed on nine occasions, totaling 111 individuals, between 17º12´S and 09º27´S.

Marine mammals:

Cape fur seal: *Arctocephalus pisillus*:
Fur seals were present in small numbers north of 15ºS to 09º27´S, absent all north. It was regular and abundant south of 16ºS. *Arctocephalus pisillus*, is generally restricted to the shelf in waters of less than 200 mdepth.

Cetaceans:
The summary of the cetacean sightings made during this part of the survey is given in the Table 2.
Twenty five sightings of Humpback whales (*Megaptera novaeangliae*) were made during this survey, all between 100 and 200 m depth, between 17º05´S to 07º27´S. Other species with sixteen sightings was *Balaenoptera musculus*, finded from 13º32´S to 08º27´S. During present survey were sightings eighteen Dolphin, (*Tursiops truncates* , between 0 8º16´S and 07º 59´S.

Turtles:

Marine turtles were encountered during four sightings for a total of 9 individuals. From the shape of the carapace they were identified as either loggerhead (*Lepidochelis olivacea*) or *Chelonia mydas*. The sightings were made south of 16º59´S, *L. olivacea* a family of 4 individuals. In the south of 10º10´S, a couple of *C. mydas* and south of 08º05´S other couple of *C. mydas.*

Table 2: Summary of cetacean sightings

Nr	Species	Date	Time	Latitude	Longitude	Total	Remark
01	*Megaptera novaeangliae*	19.8.2015	10h20	16º36´S	11º24´S	2	Couple
02	*Megaptera novaeangliae*	21.8.2015	9h10	15º40´S	11º40´S	2	“
03	*Megaptera novaeangliae*	21.8.2015	10h50	15º38´S	11º57´S	1	Single
04	*Balaenoptera musculus*	22.8.2015	14h20	15º03´S	12º00´S	1	Very big
05	*Megaptera novaeangliae*	22.8.2015	15h20	15º02´S	12º08´S	1	Single
06	*Megaptera novaeangliae*	23.8.2015	9h00	13º56´S	12º16´S	2	Couple
07	*Megaptera novaeangliae*	23.8.2015	10h40	13º52´S	12º23´S	1	Single
08	*Balaenoptera musculus*	23.8.2015	15h50	13º32´S	12º31´S	1	Medium
09	*Balaenoptera musculus*	23.8.2015	16h30	13º31´S	12º31´S	1	Big
10	*Megaptera novaeangliae*	24.8.2015	8h20	12º41´S	13º06´S	1	Spectacu lar
11	*Megaptera novaeangliae*	25.8.2015	16h30	12º11´S	13º38´S	1	single
12	*Balaenoptera edeni*	25.8.2015	17h15	12º10´S	13º34´S	1	Single
13	*Balaenoptera musculus*	26.8.2015	8h10	11º46´S	13º36´S	1	Big
14	*Balaenoptera musculus*	27.8.2015	12h00	11º11´S	13º28´S	1	Very big
15	*Balaenoptera musculus*	28.8.2015	9h50	10º31´S	13º30´S	1	Very big
16	*Balaenoptera musculus*	29.8.2015	12h00	10º02´S	13º13´S	1	Big
17	*Megaptera novaeangliae*	29.8.2015	15h00	09º57´S	13º06´S	3	Prob.fa-mily
18	*Balaenoptera musculus*	29.8.2015	15h20	09º58´S	13º04´S	1	Very big
19	*Balaenoptera musculus*	30.8.2015	9h40	08º59´S	12º58´S	1	Big
20	*Balaenoptera musculus*	30.8.2015	10h30	08º55´S	13º02´S	1	Big
21	*Balaenoptera musculus*	02.9.2015	10h30	09º27´S	13º04´S	1	Big
22	*Megaptera novaeangliae*	02.9.2015	10h30	09º27´S	13º04´S	1	Single
23	*Megaptera novaeangliae*	02.9.2015	11h00	09º24´S	13º24´S	1	Single
24	*Megaptera novaeangliae*	03.9.2015	15h40	08º56´S	12º47´S	2	Probab. couple
25	*Megaptera novaeangliae*	04.9.2015	11h10	08º26´S	13º02´S	1	Single
26	*Tursiops truncatus*	04.9.2015	15h10	08º16´S	13º16´S	7	Group
27	*Megaptera novaeangliae*	04.9.2015	16h20	08º19´S	13º09´S	1	Single
28	*Tursiops truncatus*	05.9.2015	9h40	07º58´S	13º08´S	5	Group

29	*Tursiops truncatus*	05.9.2015	16h20	07º59´S	12º42´S	6	Group
30	*Megaptera novaeangliae*	06.9.2015	13h50	07º27´S	12º45´S	4	Two couple
31	*Balaenoptera musculus*	06.9.2015	13h50	07º27´S	12º45´S	1	Mediu
32	*Balaenoptera musculus*	06.9.2015	14h20	07º24´S	12º50´S	1	Big
33	*Megaptera novaeangliae*	06.9.2015	15h40	07º19´S	12º45´S	2	Probab. couple
34	*Megaptera novaeangliae*	06.9.2015	16h20	07º23´S	12º41´S	2	Probab. Couple
35	*Megaptera novaeangliae*	07.9.2015	10h00	07º20´S	12º17´S	1	Single
36	*Megaptera novaeangliae*	07.9.2015	11h50	07º21´S	12º10´S	2	Probab. couple
37	*Megaptera novaeangliae*	08.9.2015	8h20	06º56´S	12º02´S	2	Probab. couple
38	*Megaptera novaeangliae*	08.9.2015	11h30	06º48´S	12º18´S	4	Pro... two cou
39	*Balaenoptera edeni*	08.9.2015	13h00	06º44´S	12º17´S	1	Medium
40	*Megaptera novaeangliae*	09.9.2015	9h20	06º37'S	11º50'S	3	Family
41	*Megaptera novaeangliae*	09.9.2015	10h40	06º36'S	11º53'S	3	Family
42	*Megaptera novaeangliae*	09.9.2015	13h10	06º33'S	12º07'S	4	Two couple
43	*Megaptera novaeangliae*	09.9.2015	14h30	06º29'S	12º14'S	2	Couple
44	*Megaptera novaeangliae*	09.9.2015	15h00	06º25'S	12º17'S	1	Single
45	*Megaptera novaeangliae*	09.9.2015	13h00	06º23'S	11º19'S	4	Two couple
	TOTAL-------------------------	---------------	---------	----------	-----------	86	=

Patterns of abundance:

On a broad scale and according to seabird and marine mammal distribution observed during last surveys, southern Angolan waters can be divided in 4 distinct zones (the latitudinal limits given below are approximate and the description of the patterns only for winter and spring).

a) 9º30´S to 12º30´S

This area is characterized by:

- Presence of the tropical Royal tern *Sterna maxima* in shore,
- Presence of the Sooty shearwater *Puffinus griseus* at low densities in deep waters only,
- Presence of White-chinned petrel *Procellaria aequinoctialis* at low density at the shelf break and beyond,
- Absence of Albatrosses, Cape petrel, Cape cormorant,
- Concentration of turtles (probably *Lepidochelis olivacea*) around the shelf break,
- Low densities of the Cape fur seal *Arctocephalus pusilus*, on the shelf,
- Presence of *Balaenoptera sp* (probably *Balaenoptera edeni*).

In the southern half of this zone, a small area stands out at around 11º10´S-11º15´S (the "Quicombo area"). In this area, exceptionally dense aggregations of Wilson´s storm petrels can be found marking the steep shelf break (indicating concentrations of zooplankton along a frontal zone). Also associated with this feature is the unexpected presence of the Subantarctic skua (*Catharacta Antarctica*). This species is otherwise found only south of the Angola-Benguela Front.

b) 12º30´S to 14º30´S

This area is noticeable because of the general low densities of all seabird species and is characterized by:

- Absence of the tropical Royal tern,
- Lowest density of the four most abundant and widespread species, Wilson´s Storm petrel, White-chinned petrel, Kelp gull and Cape Gannet,
- Absence of *Balaenoptera* sp and Turtles,
- Absence of Cape fur seal to 14ºS, and very iow abundance to 14º30´S.

c) 14º30´S to 16º00´S

This area seems to constitute a transition zone with the appearance at low density of some species more common further south such as Yellow-nosed albatrosa *Thalassarche chlororhynchos,* Cape cormorant *Phalacrocorax capensis* and Cape petrel *Daption capense* and a slight increase in fur seal abundance.

d) 16º00´S to 17º15´S

South of 16ºS, the avifauna changes dramatically and is marked by a large increase in density of many subantarctic species (Yelow-nosed albatross, Cape petrel, Sooty shearwater , Subantarctic skua, White-chinned petrel) as well as Benguela current region endemic (Cape gannet, Çape cormorant, Kelp gull). The density of Cape fur seal increases dramatically as well at around 16ºS. New sub-antarctic species more common in Namibia waters at this time of the year appear in this area (Black-browed albatross, Shy albatross) and marine mammals characteristic to the Benguela upwelling region are also present Heavisid´s dolphin, Dusky dolphin).

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