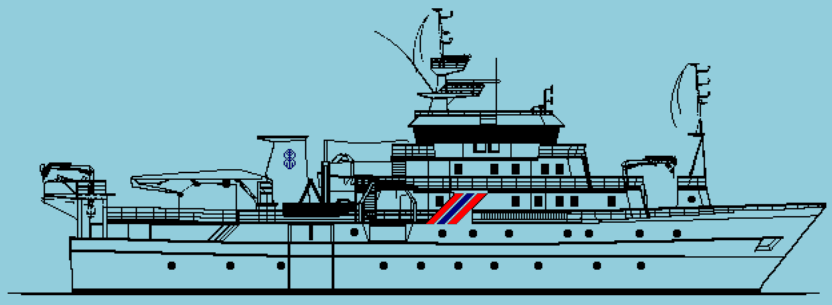


SURVEYS OF THE FISH RESOURCES OF ANGOLA

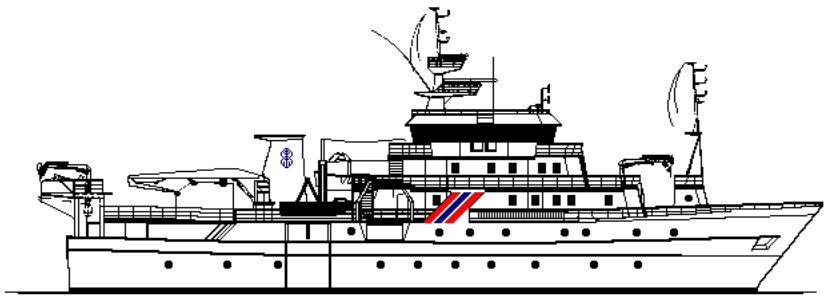
Cruise Report No 6/2013

Survey of the pelagic fish resources
20 June – 17 July 2013

Institute of Marine Research
IMR, Bergen
Norway

Instituto Nacional de Investigação Pesqueira
INIP
Luanda, Angola

Bergen 2013



SURVEYS OF THE FISH RESOURCES OF ANGOLA

Cruise Report No 6/2013

Survey of the pelagic fish resources
20 June – 17 July 2013

Institute of Marine Research
IMR
Bergen

Instituto Nacional de Investigação Pesqueira
INIP
Luanda

SURVEYS OF THE FISH RESOURCES OF ANGOLA

Cruise Report No 6/2013

Survey of the pelagic fish resources
20 June – 17 July 2013

by

Elena Eriksen
Odgeir Alvheim

Institute of Marine Research
P.O. Box 1870 Nordnes N-5817 Bergen
Norway

Aristóteles P. da S. Amaro
Bomba Bazica

Instituto Nacional de
Investigação Pesqueira
P.O. Box 2601 Luanda
Angola

Bergen, 2013

TABLE OF CONTENTS

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. As agreed, the goals are to improve the understanding and knowledge in terms of the biology, ecology and population dynamics of the main pelagic species, in relation to the ecosystem. Acoustic surveying, using echo integration, is the principal tool for estimating stock abundance of pelagic species. The survey estimates form, therefore, the basis for recommendation on the Total Allowable Catch (TAC).

The specific objectives of the survey were the following:

- To estimate the abundance and map the distribution of the main commercially important pelagic and semi-pelagic fish species in Angolan waters. This includes 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 stomachs and otoliths from both sardinellas species for analyses of diet composition and 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 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 using the Nansis database and scrutinizing acoustical data with the post-processing system, the Large Scale Survey System (LSSS).

1.2 Participation

The scientific staff consisted of:

From INIP, Angola:
20.06-17.07.2013: Aristóteles P. da S. Amaro (Angola Team leader), Bomba Basíca Sangolay, Fátima Delicado, Geraldina de A. S. José, Djamila Pedro, João Morais Domingos, Eusébio Dias dos Santos, Domingos Pedro, Tito Milagre.

From Imr, Norway:
20.06-17.07.2013: Elena Eriksen (Cruise Leader), Oddgeir Avlheim, Ole Sverre Fossheim, Jan Frode Wilhelmsen

1.3 Narrative

The vessel departed Luanda on the 20th of June at 16:55 UTC and steamed northwards to the Congo River. The survey started with the monitoring line off Moita Seca (Congo River) on the 21th of June at 14:20 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.

The effective duration of 2013 survey was 2 and 3 days shorter than in 2011 and 2012, respectively. Therefore, survey effort was reduced in the northern area, being this an area of low amounts of target species, and by increasing distance from 6-7 nm to 10 nm between cruise lines. The two other regions were surveyed with the ordinary effort.

The survey of the northern region was completed on the 28th of July with the monitoring line off Pta. das Palmerinhas. The vessel continued the coverage of the central region, which was completed on the 6th of July. The coverage of the Southern region was completed on the 15th of August.

Calibration of the Simrad ER 60 Scientific echo sounder (18, 38, 120 kHz transducers) was done in Baía dos Elephantes on the 6th of July.

During survey the location of stations belongs to the monitoring lines were controlled and found several mistakes. Therefore the file "ANGOLA MONITORING LINES AND STANDARD TRANSECTS.doc" was updated and presented in Figure 2 and Annex VII.

A systematic survey track, implemented in 2002 and consisting of pseudo-parallel acoustic transect lines perpendicular to the coastline 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(a-c) shows the cruise tracks with fishing, plankton and hydrographical stations for the northern, central and southern regions of Angola. Sampling trawls, including the small (10 m vertical opening) and 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 zooplankton samples per station) and distance surveyed (log).

Area	BT	PT	Total trawls	CTD casts	Multinet stations	Log (NM)
Congo River - Pta. Palmerinhas	6	9	15	54	28	1043
Pta. Palmerinhas - Benguela	14	20	34	82	39	1478
Benguela - Cunene River	13	16	29	96	45	1210
Total	33	45	78	232	112	3731

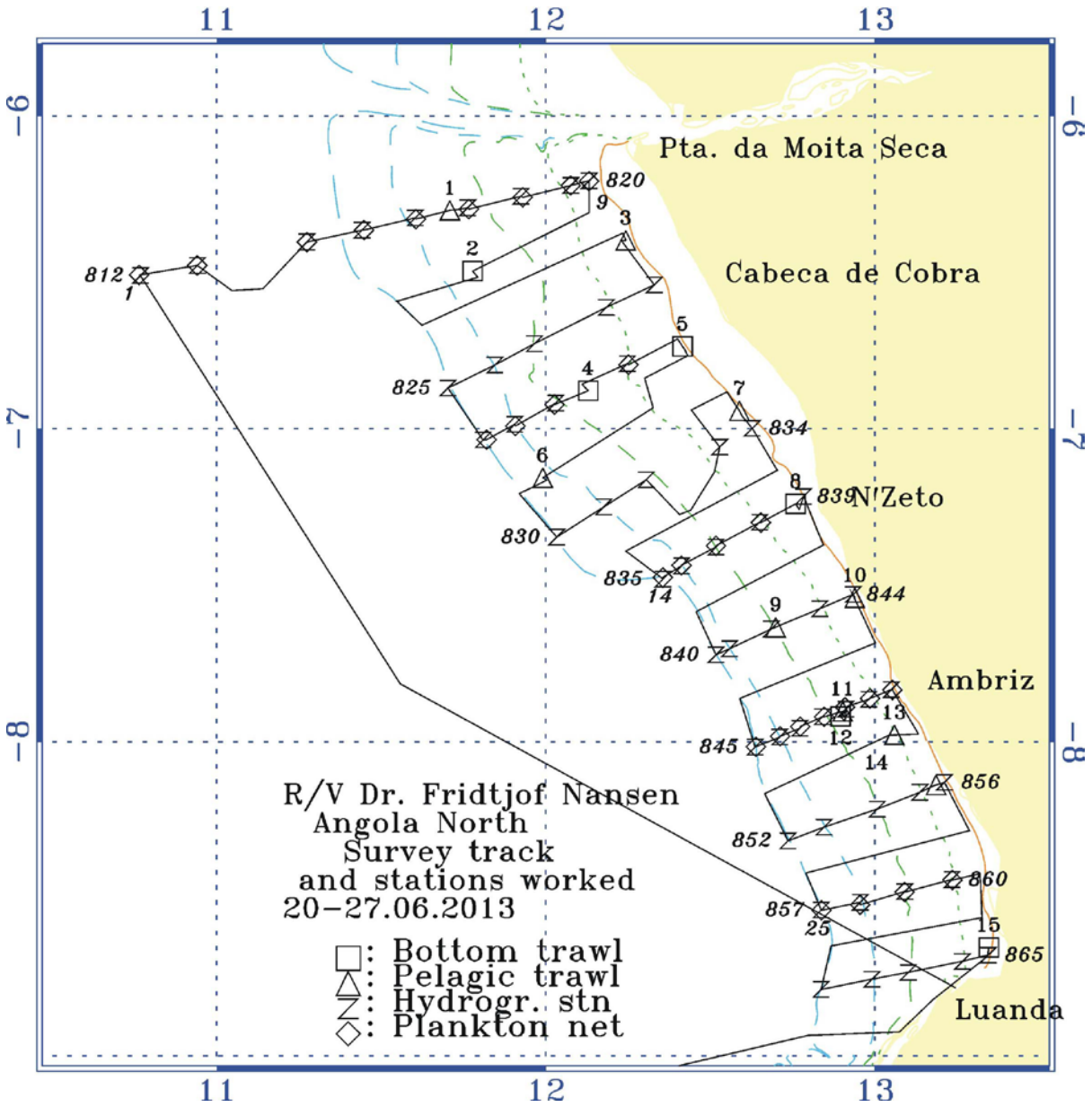


Figure 1a. Course track with fishing, plankton and hydrographical stations. Congo River - Pta. das Palmerinhas region. Depth contours at 20, 50, 100, 200, and 500m.

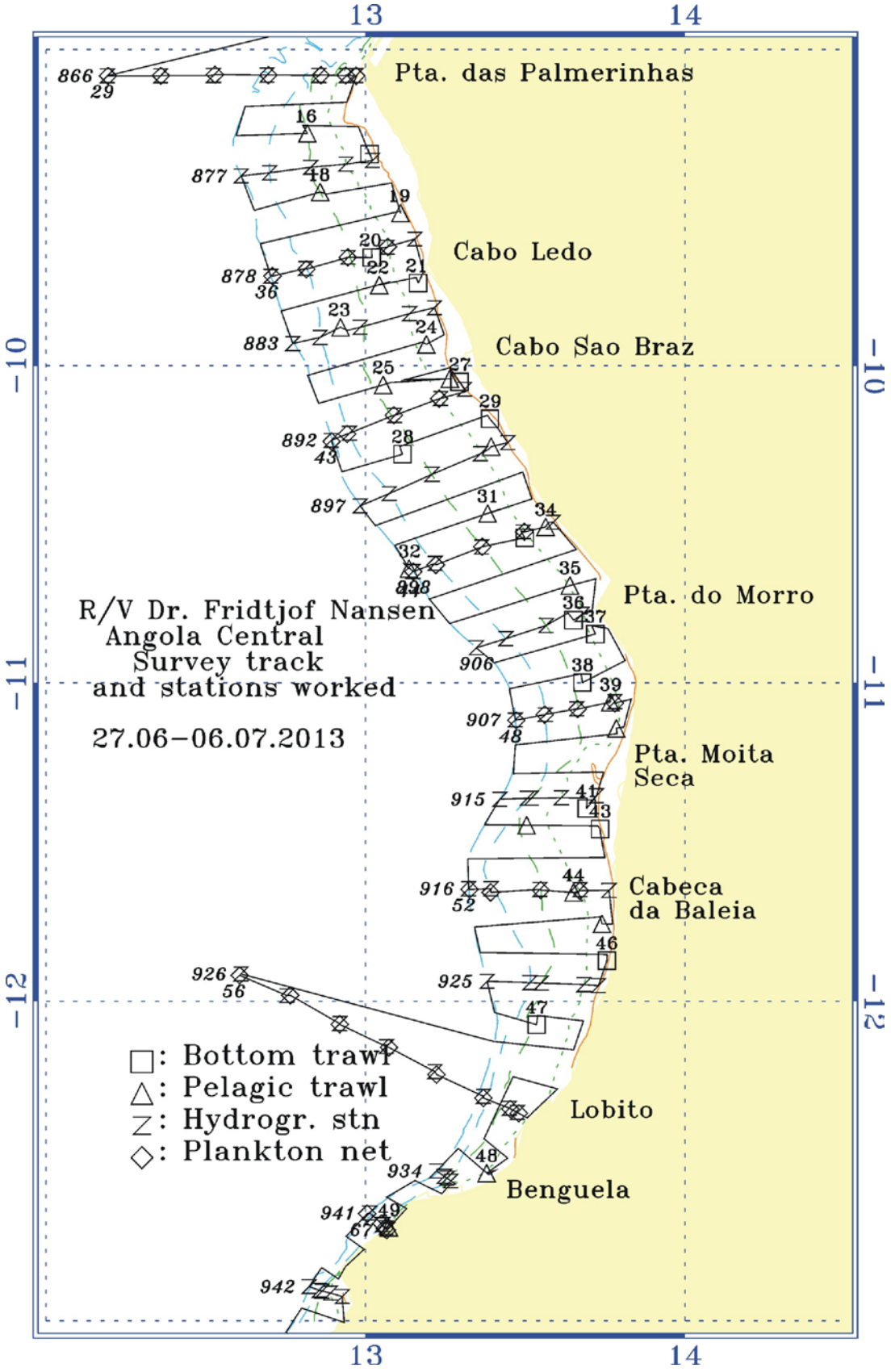


Figure 1b. Course track with fishing, plankton and hydrographical stations. Pta. das Palmerinhas – Benguela region. Depth contours at 20, 50, 100, 200, and 500m.

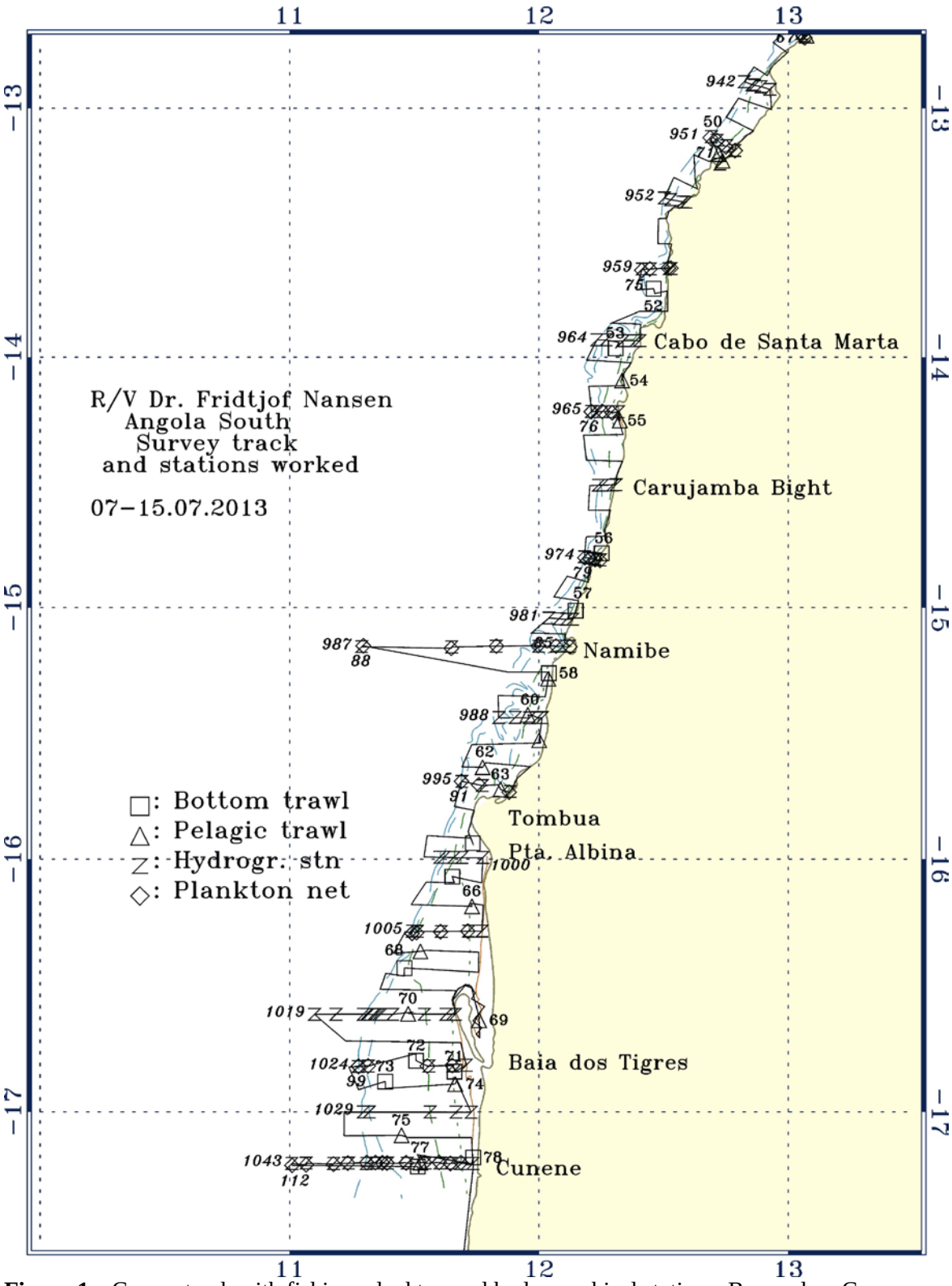


Figure 1c. Course track with fishing, plankton and hydrographical stations. Benguela – Cunene region. Depth contours at 10, 20, 50, 100, 200 and 500 m.

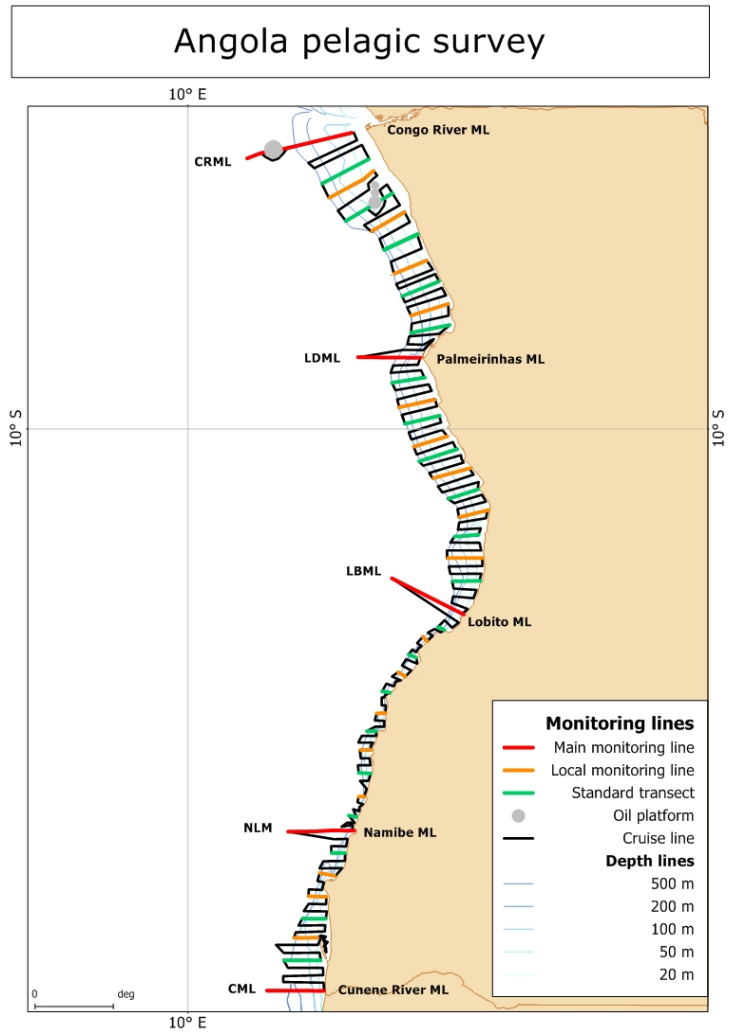
CHAPTER 2 METHODS

2.1 Hydrographical sampling

Details on the stations' location and of sampling along the monitoring lines can be consulted in the table in Annex VII.

The monitoring the oceanographic condition along the Angola coast includes

- Main monitoring lines of highest priority (CRML, PML, LBML, NML, CML, Annex VII, red): multinet, bottles and CTD
- Local monitoring lines of next highest priority (Annex VII, green): Multinet, bottles and CDT
- Standard Transect (Annex VII, yellow): CDT only



The five main monitoring lines of highest priority are long-term series of both hydrological and biological (plankton) conditions and should be continued without changes.

The local monitoring lines were taken sporadically, since these have been dependent of effort and time allocation during recent years. Monitoring of hydrological and biological (plankton) conditions should be continued, but some changes are allowed.

Standard transects monitor only the hydrological condition and these transects should be also continued, but some changes are allowed.

Figure 2. Main (red) and local (yellow) monitoring lines and standard transects along Angola coast.

The monitoring lines and standard transects were carried out in accordance with the monitoring lines run by INIP.

2.1.1 CTD

A Seabird 911*plus* 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. The casts were stopped a few meters above the bottom, and at a maximum of 1500 m depth. 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), 17 local monitoring lines and 21 standards transects (for more detail see Figure 2 and ANNEX VII). CTD profiles were taken at bottom depths 20, 50, 100, 200 and 500 m. These depths were used both along the standard transects and local monitoring lines. At main monitoring lines, the profiles were taken at different depths.

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 0.921 and -0.02.

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 during the 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 similar scale. Therefore, from this survey we propose to produce the maps with scales showed 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 bounders.

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 IV. 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 sardinella, horse mackerel, *Sardinops ocellatus, Decapterus rhonchus, Selene dorsalis, Brachideuterus auritus* and *Chloroscombrus chrysurus*. Total length (TL) and body weight were determined to the nearest 1 cm and 1 g bellow, respectively. Sex and reproductive stages were determined by means of macroscopic examination, scoring each fish according to the six-point classification scale first proposed by INIP (Annex III).

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

2.3 Plankton sampling

2.3.1 Phytoplankton

Samples of phytoplankton were collected on monitoring lines using CTD bottles at 5, 15, 25, 50 and 75 meter depths. Some extra samples were collected every third acoustic line.

2.3.2 Zooplankton

The zooplankton sampling was conducted by means of HYDROBIOS Multinet (180 µm), at five depths intervals, 0-25, 25-50,50-75,75-100 and 100-200 m. This sampling was performed at the main and local monitoring lines (for details see Figure 2 and ANNEX VII). Data from the flow meter was recorded electronically from the Multinet receiver unit. A SCANMAR depth sensor gave real-time information of the depth. The nets were opened and closed remotely from the bridge of the vessel. The samples were preserved in formalin 4%.

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 and 120 kHz. A 200 kHz transducer on the vessel was out of order during the survey. The survey was started without *a priori* calibration. All transceivers were calibrated in Baía dos Elephantes on the 6th of July. The 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. 61. 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 IV. Targeted pelagic and demersal trawling were used for ground truthing and estimation of mean length and weight.

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:

$$TS = 20 \log L - 72 \text{ (dB)} \quad (1)$$

or

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

where C_F is the conversion factor from acoustic density to fish biomass and L is the mean total fish length. 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 (2) 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 1.51. Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories: 1: s_A = 0-300; 2: s_A = 301-1 000; 3: s_A = 1 001-3 000; 4: s_A > 3 001 (m^2/NM^2).

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

The overall length frequency distributions within strata were estimated by weighting the sample-distributions with the nearest valid 5 NM integrator value, or the average of two adjacent values. Target species of the same genus, i.e. *S. aurita* / *S. maderensis* and *T. trecae* / *T. 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:

$$\rho_i = \frac{< s_A > t_{i,j} \cdot u_i}{\sum_i \frac{u_i}{C_{Fi}}} \cdot A_s = \frac{10^{7.2} \cdot t_{i,j} \cdot u_i \cdot < s_A > \cdot A_s}{4\pi \sum_i u_i \cdot (L_i + 0.5)^2} \quad (3)$$

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

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. Figures 2-3 show the horizontal distribution of these parameters, respectively.

Standardization for map presentation is needed to avoid misunderstanding and get better comparison between annual and seasonal distribution of parameters, and therefore from this survey we proposed use the same scale between all surveys in this area (for more information see "2.1 Hydrographical sampling" under Chapter 2 Methods" in this reports).

3.1.1 Northern region

The surface wind distribution from the northern region during this survey shows some variability in both intensity and direction (**Figure 3a**). Very weak winds, of 1-2 knots, were observed along the coast and adjacent waters of Cabeça de Cobra, North of N'Zeto as between the southern off N'Zeto and Ambriz. However, the moderate winds of about 14 knots (about 7 m/s) were observed over the larger area, especially offshore. Also noteworthy is that around Luanda winds were blowing in all directions, with the possibility to cause gyres.

Figure 4 show the surface distribution of temperature, salinity, oxygen and fluorescence in the northern region of Angola. The most of observed area was occupied by water masses of 21-22°C, which were distributed along the coast. The highest temperature (23°C) was found offshore in area, between 6ºS and 7ºS, and the lowest temperature (20ºC) were found in coastal areas from Ponta das Palmeirinhas to N'Zeto. The configuration of the isotherms indicates upwelling along the entire northern region and in the coastal area of Luanda, where warmer water masses of 22 ºC, similar to the offshore ones, were recorded.

Most of the surveyed area was dominated by saline (36) water masses. Some pockets of less saline waters were observed in the south areas, indicating the upwelling there. The occurrence of these pockets of low water salinity of 35 in Luanda and 35.5 in Ponta das Palmeirinhas may be associated with outflow from rivers Bengo and Kwanza.

Oxygen values (Figure 4) along the surveyed ranged between 3.5 and 6 ml/l. The water masses of higher concentration of dissolved oxygen (6 ml/l) were observed in the area between Cabeça de Cobra and N'Zeto as well close the coast of Luanda. Water masses of low oxygen (3-5.5 ml/l) extended from the Congo River to N'Zeto and from Barra do Dande to Palmeirinhas.

The highest concentrations of fluorescence are associated with areas of cooler water along the coast and in areas with oxygen rich water masses, indicating a high primary production (Figures 4).

3.1.2 Central Region

During this survey the surface wind distribution shows some variability in both intensity and direction in the central region (Figure 3b). The stronger wind condition was recorded in the central area compared to the northern area. The moderate-fresh breeze (14.5 knots ≈ 8 m/s) were recorded in some localtions, namely near the Baía Farta, north of Lobito, along of Cabeça da Baleia, Ponta Ponta do Morro and Ponta das Palmeirinhas coasts. The light breeze of 2-3 m/s (5knots) was recorded in the Ponta Moita Seca and Cabo Ledo areas.

Figure 5 describes the spatial oceanographic conditions in the central area. The SST indicated weak upwelling, illustrated by isolines of decreasing temperature close to the coast. The low temperatures of 19-20°C were observed close to the coast of Ponta do Morro and north of Lobito. Warmer waters, of about 22°C, were found offshore being 23ºC the highest temperature recorded (Figure 5).

The spatial distribution of salinity in the central area was similar to the pattern observed in the northern region, as most of covered area dominated by saline (36) water masse. Waters near to Ponta das Palmeirinhas and Ponta do Morro were less saline (35.5), probably related to the local rivers' outflow (Kwanza and Longa) .

Oxygen rich water masses (4.5-5 ml/l) were observed in most of the central area, except for few small coastal areas in the north and south of Benguela city. High levels of chlorophyll, indicating nutrient rich water, were observed close to the coast. The highest concentration of fluorescence (1.1µg/l) was registered close to the Kwanza River. However in the southern part (south of Benguela city) no fluorescence (flu=0µg/l) was observed at the surface, likely due to low oxygen and cold water masses in this area.

3.1.3 Southern Region

The wind field in the southern region was dominated by unusually calm winds for winter time, when comparing with earlier records (2002-2012) for the area (**Figure 3c**). The weak wind of 5 knots (2m/s) was observed over most of the region, from Cabo de Santa Marta to Baia dos Tigres. However, strong winds of 20 knots (10m/s), characterized as fresh breeze, were observed between12°S and 13°S and from north of Baia dos Elefantes to Cunene River. From Cunene to Pta Albine wind blew parallel to the coast line, leading to intense upwelling resulting in colder and saline waters in the area while coastward wind in Namibe area, especially offshore, caused downwelling of surface waters.

In the southern region, water temperature ranged between 16°C and 20°C with maximum values offshore (**Figure 6**). The highest temperature was observed in two areas offshore of Namibe and Cabo de Santa Marta, associated with moderate winds towards the coast and sinking of thermocline. In these areas the highest concentrations of oxygen (5ml/l) and fluorescence (0.5µg/l) were observed. In the area of Cunene mouth the lowest salinity (35) was recorded, likely due to outflow from the river and coastal upwelling due to strong wind (Figure 3c, 6). No sign on Angola-Benguela front was found in this region when comparing with previous years. The uplifting of isotherms in the area may probably indicate that the front was situated further south.

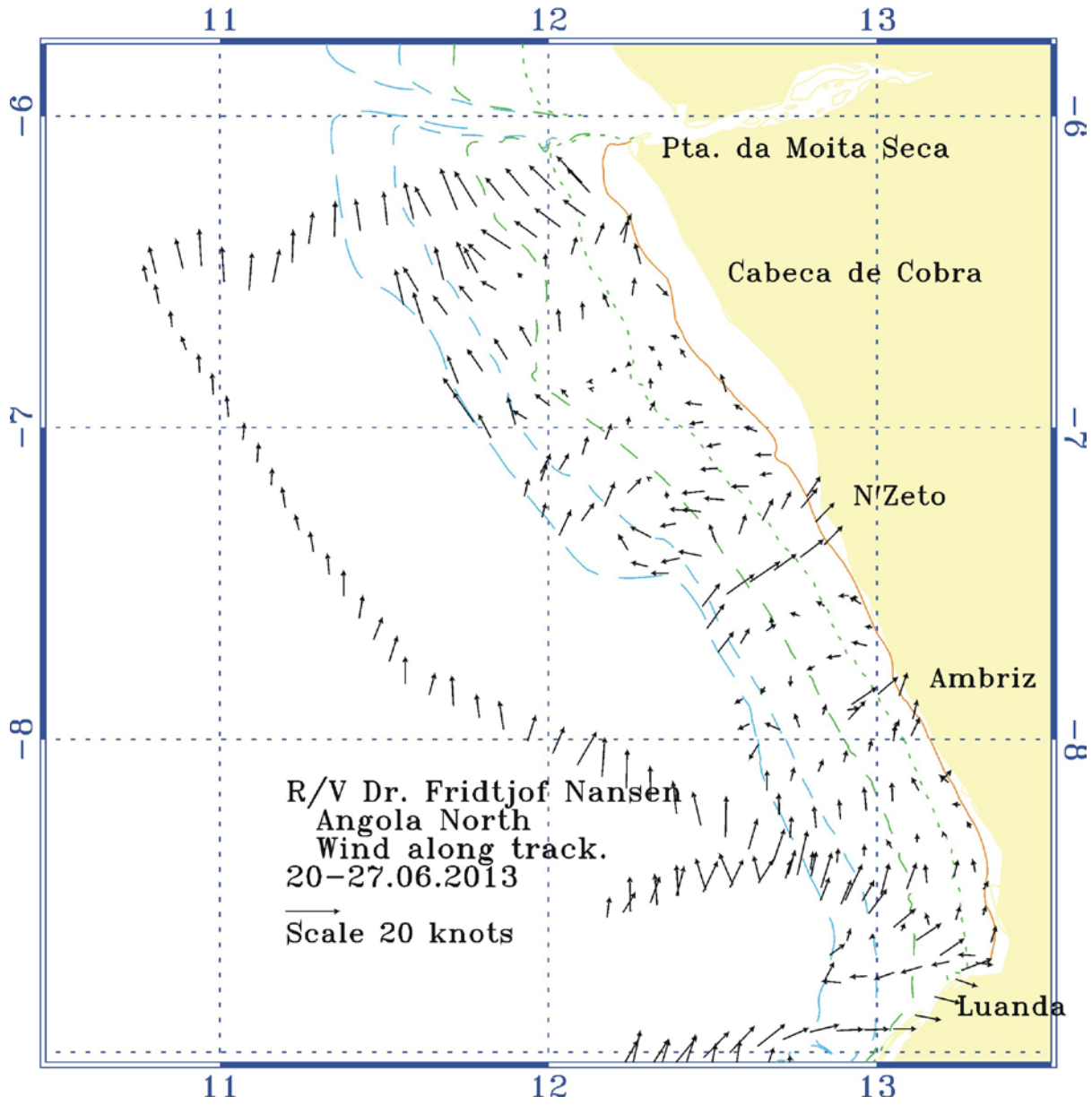


Figure 3a - Distribution of wind velocities along the survey track for the northern region. Depth contours at 20, 50, 100, 200, and 500 m.

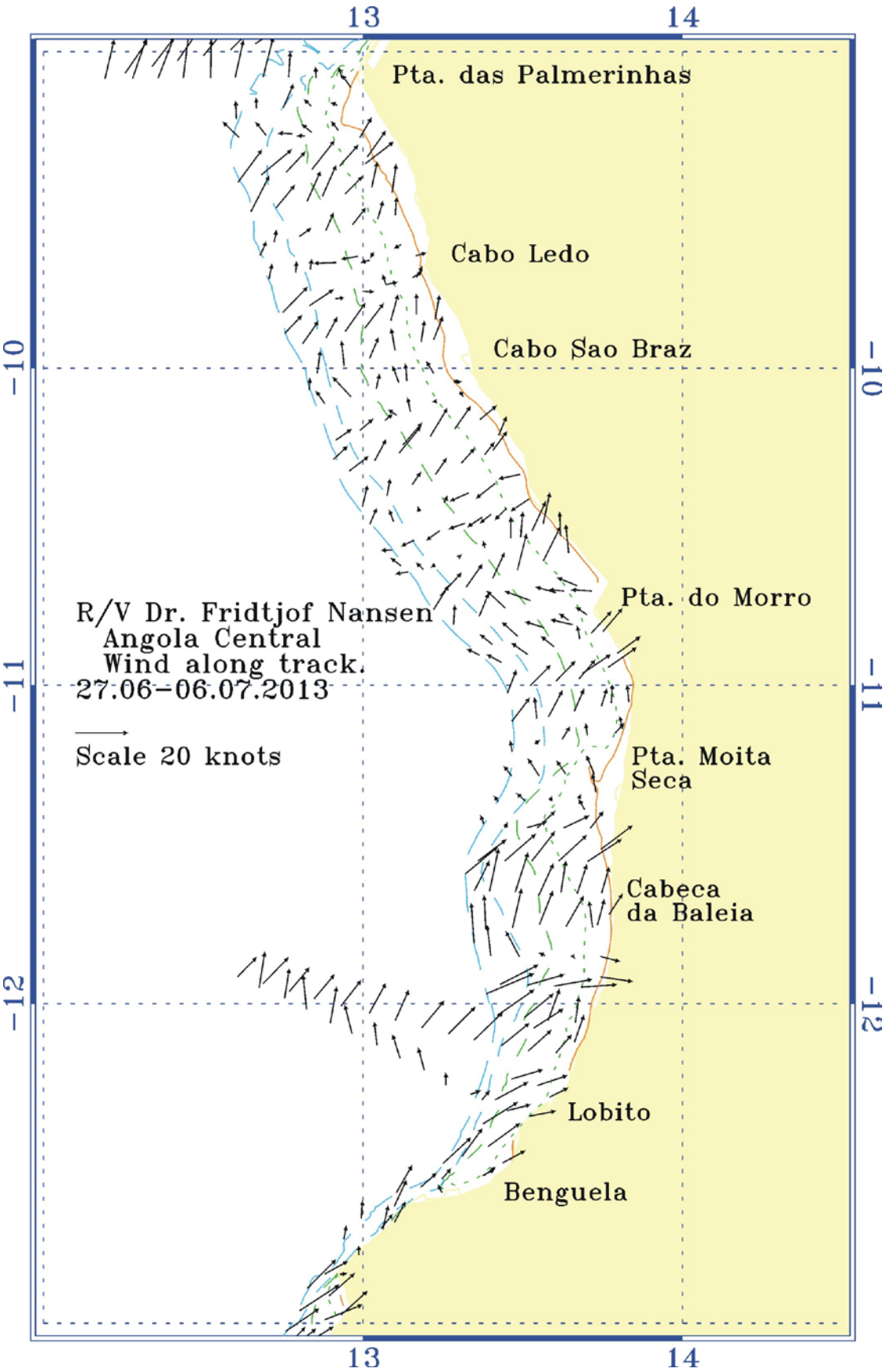


Figure 3b - Distribution of wind velocities along the survey track for the central region. Depth contours at 20, 50, 100, 200, and 500 m.

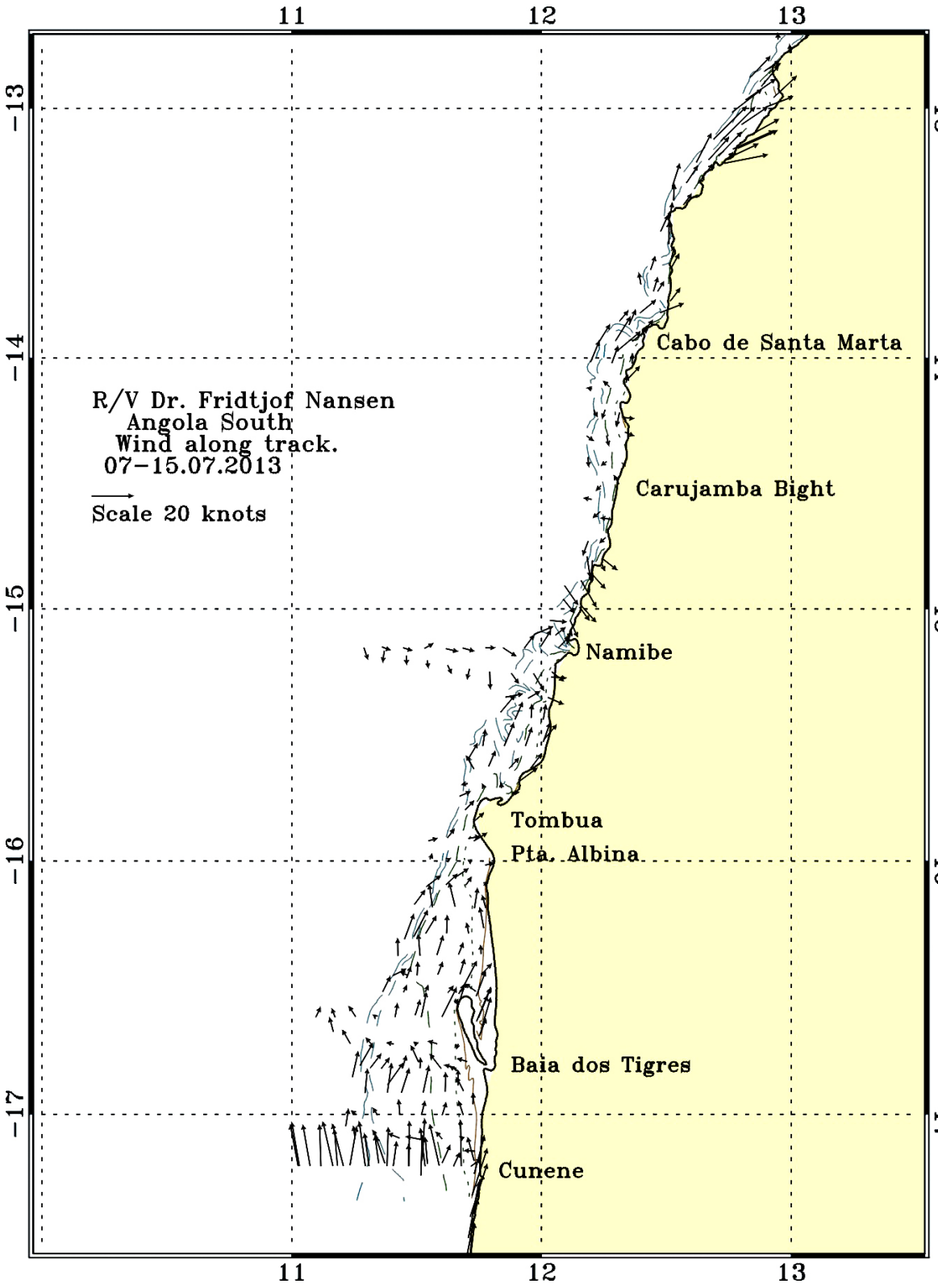


Figure 3c - Distribution of wind velocities along the survey track for the southern region. Depth contours at 10, 20, 50, 100, 200 and 500 m.

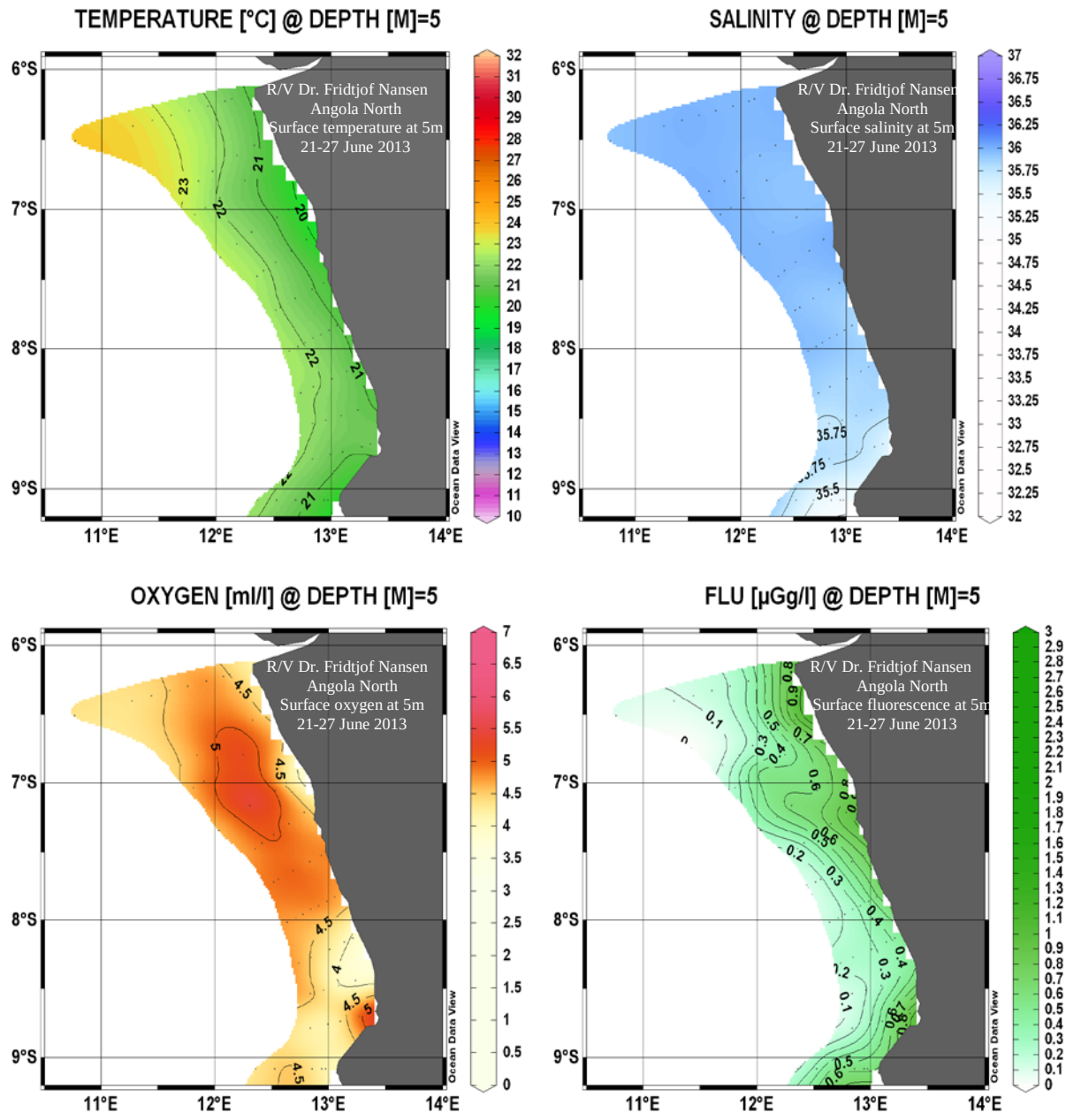


Figure 4 - Surface distribution of water temperatures, salinity, oxygen and fluorescence at 5m depth in the northern region (21 June- 27 June 2013).

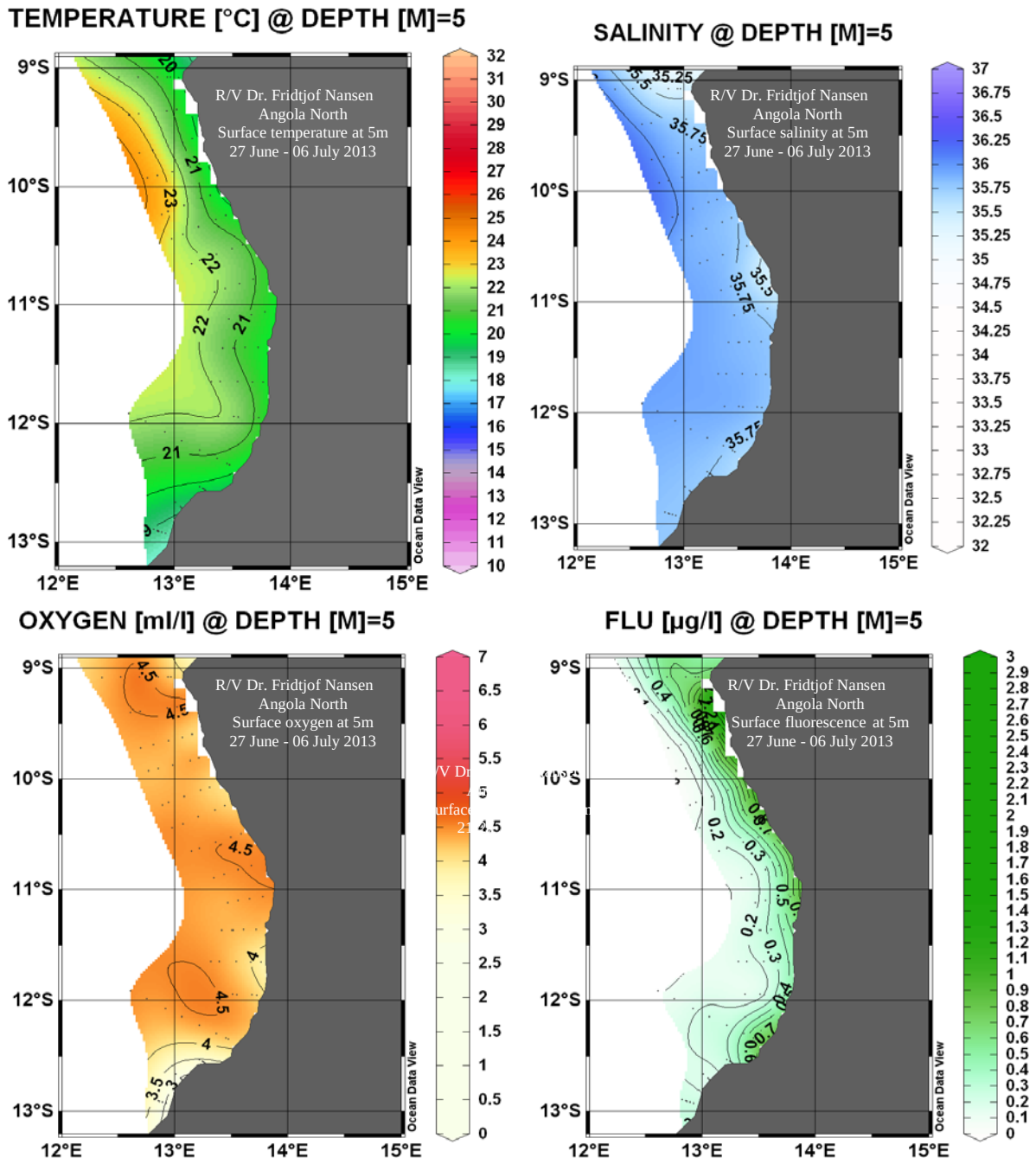


Figure 5 - Surface distribution of water temperatures, salinity, oxygen and fluorescence at 5m depth in the central region (27 June- 06 July 2013).

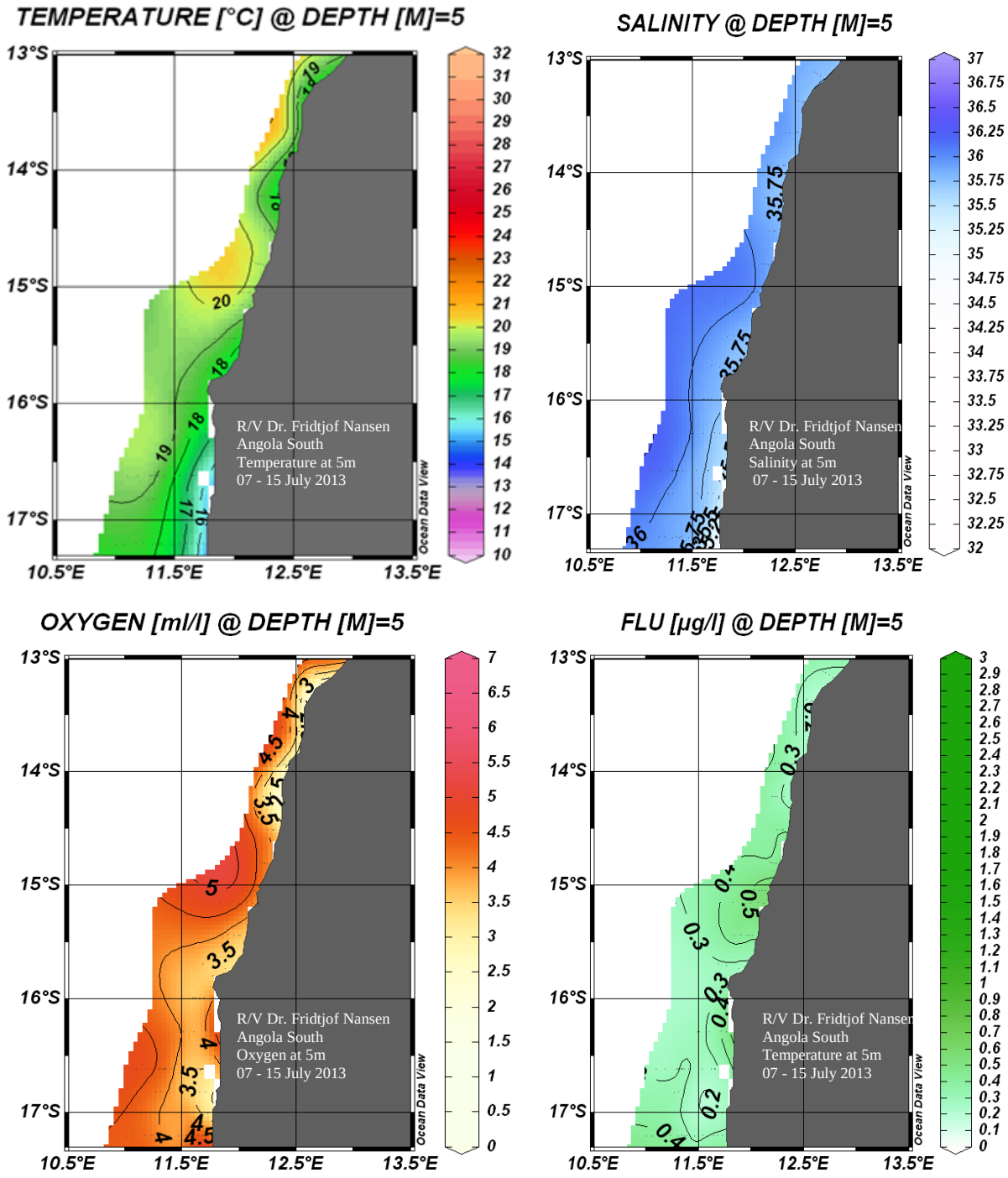


Figure 6 - Surface distribution of water temperatures, salinity, oxygen and fluorescence at 5m depth in the southern region (07 June- 15 July 2013).

3.2 Main monitoring lines

3.1.4 Northern Region

Figure 4a shows the vertical distribution of temperature, salinity, oxygen and fluorescence along the main monitoring line - **Congo River (Figure 7a)**. The result showed a lack of outflow of fresh water, which is unusual for this region. The surface water along the monitoring line was dominated by saline (36) water masses, down to 20-25 meter depth. Deeper than 25 meters, salinity gradually decreased to 35.

Temperature and salinity distribution in the water column were typical for this season. The temperature decreased with depth from 23ºC at surface to 8°C near the bottom and salinity from 36 at surface to 35 near the bottom, indicating a well-defined thermal and saline stratification. Additionally, the occurrence of slight upwelling was observed, related by the uplift of moderately cold deep sea waters.

The vertical distribution of oxygen and fluorescence is presented in Figure 4a. Sea surface oxygen ranged from 4.0 ml/l to 4.5 ml/l and the sea surface fluorescence between 0.4µg/l and 0.6µg/l respectively. The highest concentration of dissolved oxygen (4.5 ml/l) and fluorescence (0.6µg/l) were recorded near the Congo River mouth and along the monitoring lines at depths of 0-10m.

Hydrographical condition along the **N'Zeto** was similar to the observed along the Congo River monitoring line (Figure 7b). However, moderate upwelling and stronger influence by tropical waters were observed in N'Zeto, indicated by higher values of temperature (23°C), salinity (36 ml/l), oxygen (5.5 ml/l) and fluorescence (0.8 µg/l) in the upper water layer on the continental shelf. Additionally, the minimum oxygen content (0.5 ml/l) and no fluorescence (flu=0µg/l) were observed near the bottom of 70-200m depth along the slope of the continental shelf, that may most likely influence negatively both fish and benthos communities there.

Hydrographical condition along the main monitoring line-**Ambriz** was almost similar to the two previous, although showed some lower values of all parameters (Figure 7c). The highest values of temperature (21°C), salinity (35.5 ml/l), oxygen (4.5 ml/l) and fluorescence (0.8µg/l) were observed in the upper water layer. The major fluorescence contents (0.4 - 0.8 µg/l) were observed only in surface inshore waters, and it's decreased rapidly towards offshore and depth.

During this winter survey unusually low concentrations of oxygen and fluorescence were observed along the monitoring lines of N'Zeto, Ambriz and Ponta das Palmeirinhas near the bottom of continental shelf. Value of oxygen and fluorescence were 1ml/l and 0µg/l, correcpondently, which are much lower those in previous years during winter.

3.1.5 Central Region

The vertical distribution of temperature at the **Ponta das Palmeirinhas** (Figure 8a) ranged between 22ºC in offshore and 19-20°C in the coastal zone. The temperature was gradually decreased with depth, reaching 8°C at 450m depth. The water column was well stratified, showing upwelling signs above 80m depth. A thin surface layer of less saline waters with value around 35.5 was observed at the three coastal stations assuming, indicating outflow from the Kwanza River. However, the remaining surface water of the continental shelf was homogeneous with salinity of 35.5-36, observed throughout the surface layer from the coast and offshore.

The distribution pattern of dissolved oxygen and temperature showed upwelling. This was indicated by gradually increasing of oxygen from 450m depth, where oxygen was lowest (0.5) to the surface, where oxygen was at highst level of 4.5. Along the coast the fluorescence values (0.4-0.5µg/l) were highest, decreasing with depth and towards offshore.

The vertical distribution of temperature, salinity and dissolved oxygen along the North of **the Cabo Ledo** monitoring line**,** showed stronger upwelling than along the Ponta das Palmeirinhas (Figure 8b). The surface temperature increased from 20ºC inshore to 23ºC offshore. The maximum salinity in the previous monitoring line was observed in the bed of the continental shelf, but along **Cabo Ledo's** monitoring line the highest salinity was observed at surface offshore. The distribution of dissolved oxygen was similar to the previous monitoring line, being the minimum value (0.5 ml/l) recorded at the same depth of 450m. The highest fluorescence level was observed along the coast, which likely indicates this area as the most important area of biological activity along the Angolan coast.

The Cabo São Braz is an area of greatest oceanic influence (Figure 8c). The surface water along the monitoring line was warmest offshore (24°) and dominated by saline (36) water masses down to 25m depth, such as along the Congo River monitoring line. The highest values of oxygen (5 ml/l) occurred in the upper water layer. Lesser fluorescence (0.4 µg/l) was observed near the Cabo São Braz than further north.

Colder temperature conditions along the monitoring line of **Ponta do Morro** were observed during winter 2013 than in previous years (Figure 8d). The highest temperature at the surface was around 22°C. No variation in the water stratification was observed. Salinity varied along the monitoring lines, was 35.5 over a limited area at surface inshore, reaching 35.75 at 75m offshore. The minimum value of dissolved oxygen was observed near the bottom of continental slope at 75-130m depth. A similar situation was observed, during this survey, in the Northern area and along Cabo Ledo in central area of Angola coast. Fluorescence varied and was at moderate level (0.4 µg/l) inshore, at surface, decreasing gradually to offshore and with depth.

The thermocline and halocline along the **Cabeça da Baleia** were observed at the same depths as the previous monitoring lines. The surface temperature ranged between 20°C in the coastal zone and 22ºC offshore. Isotherms showed moderate uplift from bottom to the upper layers. Saline water of 35.75, indicating tropical waters in the austral summer (Reports Dr Fridtjof Nansen, March 2011-2013) were registered in the upper 75-100m, and then salinity gradually decreased with the depth. The surface water layer (0- 50m) was rich in dissolved oxygen, and values varied between 4.5 ml/l at surface to 2 ml/l at 50m depth. The areas with limited oxygen content (0.5 ml/l) were observed in the deeper water of 300-450 m. Coastal waters were also fluorescence rich (0.4µg/l), although values for the upper layer varied between 0.2 and 0.1µg/l.

The vertical distributions of temperature in **Lobito** (Fig. 4h) represent two different scenarios: the tropical upwelling type (uplifting of water from 25m depth to the surface) and the sinking of subsurface waters (from 25m to 200m). The water mass depper than 200m was well stratified with some impacts of internal waves. Salinity above 35.75 dominated the whole surface layer from the shelf break and off the continental shelf while slightly lower salinity was found close inshore. The stratification showed no mixing process. The surface waters along Lobito monitoring line were oxygen rich (5 ml/l). Dissolved oxygen decreased to 2 ml/l at 50 m depth, reaching a minimum of <0.5ml/l at 300-450m depth. The coastal zone was also fluorescence rich (0.9 g / l), with values decreasing as usually.

3.1.6 Southern Region

The vertical distribution of temperature in the surface water along the monitoring line of **Cabo de Santa Marta** (**Figure 9a**) showed depression, from slope of continental shelf to offshore, in water column between 0-200m depth. The highest temperature of 20^0C was observed offshore. The salinity of 35.75 was found in upper 25 meters, which is representative for the entire Angola coast. Salinity had a similar pattern with the temperature, decreasing with depth. The lowest concentrations of dissolved oxygen (0.5 ml/l) were found in the slope of continental shelf and in depths of 320-400m. The highest concentration of fluorescence (0.4µg/l) was observed over shelf break while lack of fluorescence was observed along the slope at 90-140m depths. This absence can be likely associated with the lack of oxygen in this area.

The environmental parameters of the **Namibe section (Figure 9b)** showed the same distribution pattern as the section of Cabo Santa Marta in upper 50 m, with no signs of water mixing. Water masses deeper than 50 meters sank indicating the local internal waves inshore. The temperature decreased gradually in the water column from the surface (20^0C) to the bottom (8^0C). Salinity distribution showed similar pattern as temperature, both inshore and offshore. Salinity decreased gradually with depth, with the highest salinity (36.25) offshore in the surface waters and lowest (34.75) at 500 m depth. The surface waters were rich in oxygen (4 ml/l) and fluorescence (0. 5 µg/l). The minimum oxygen content (0.5 ml/l) was found in a layer around 200-420 m.

The vertical distribution of temperature in the surface water along the monitoring line of **Tômbwa** showed signs of tropical upwelling characterized by the marked lifting of subsurface waters. In the southern region, decreasing of temperature towards offshore and with depth is more marked than other regions (**Figure 9c)**. The highest value of temperature (19°C), salinity (37.75), oxygen (3.5-4.0 ml/l) and fluorescence (0.3.5µg/l) was found offshore, while the lowest temperature of 7°C and less saline waters were recorded in the deeper water of 400-500m. The lowest oxygen was recorded along the shelf break of 150-300 meter, which led to no fluorescence there.

The **Baia dos Tigres (Figure 9d)** monitoring line showed intense tropical uplifting of isotherms, characterising by rising of water bodies in subsurface (0-100m), where temperature ranged between 13°C and 20°C. This most likely caused by the strong wind in the area. The opposite pattern was found in waters masses below 100m, with sinking of waters along the slope of continental shelf. The tropical water masses, characterized by salinity of 36-36.5 were observed offshore, at surface. The highest oxygen and fluorescence level was recorded in these tropical waters.

Unusually no sign on Angola-Benguela front was found in region of the **Cunene (Figure 9e)** monitoring line, comparing with previous years. The surface temperature ranged from 16°C inshore to 19 °C offshore. Salinity was much lower than along Baia dos Tigres monitoring line. The lowest salinity of 35.25 was recorded near the Cunene River, and probably caused by Cunene River bloom leading to local water mixing. The highest values of dissolved oxygen were found at surface from inshore to offshore and lowest in depth of 250-400m. Intense biological activity was recorded at surface offshore with fluorescence values around 0.4 µg/l. and 0.5µg/l.

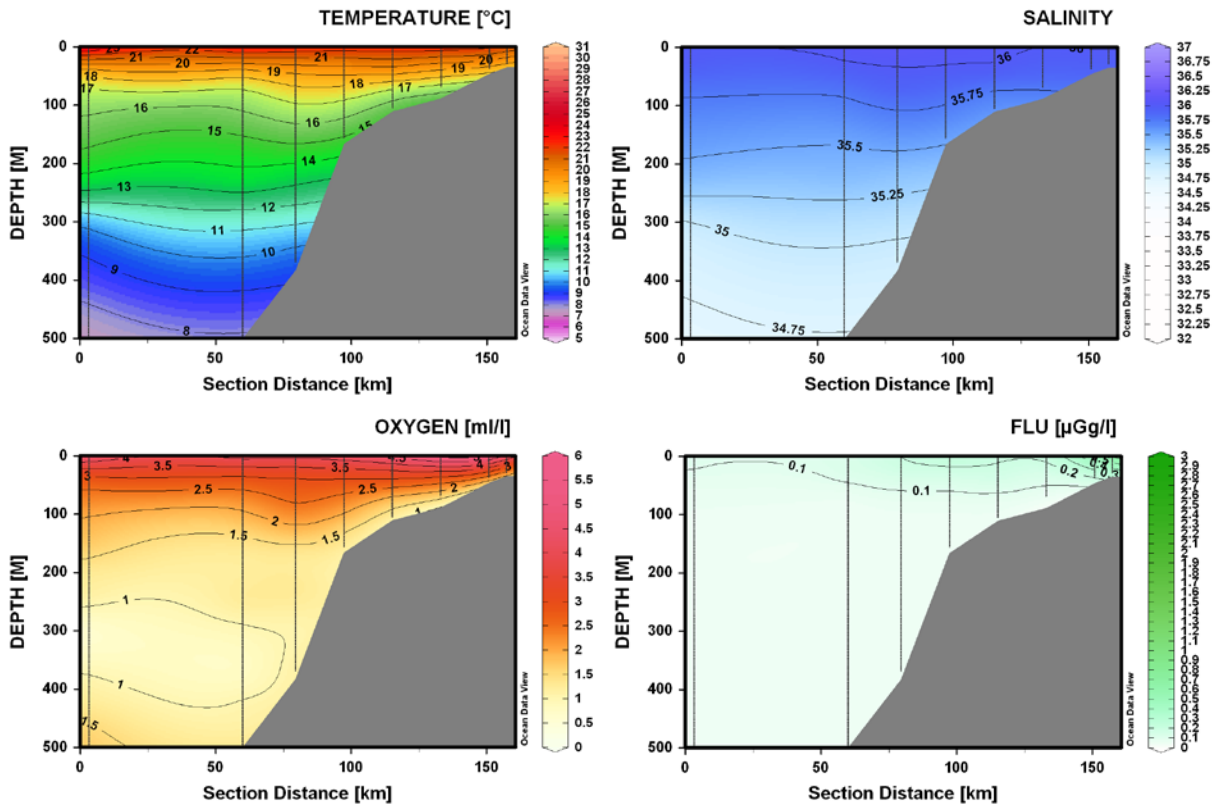


Figure 7a - Vertical sections of temperature, salinity, oxygen and fluorescence off Congo River (June 2013)

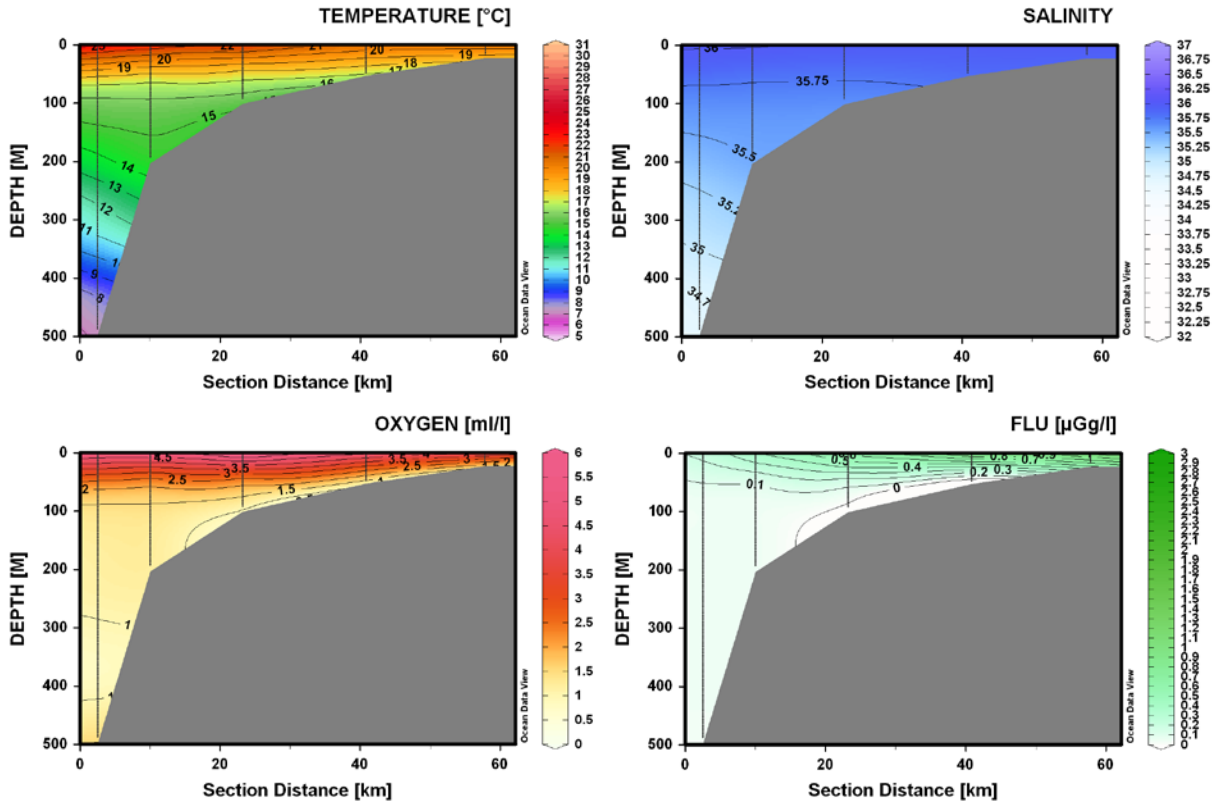


Figure 7b - Vertical sections of temperature, salinity, oxygen and fluorescence off N'Zeto (June 2013)

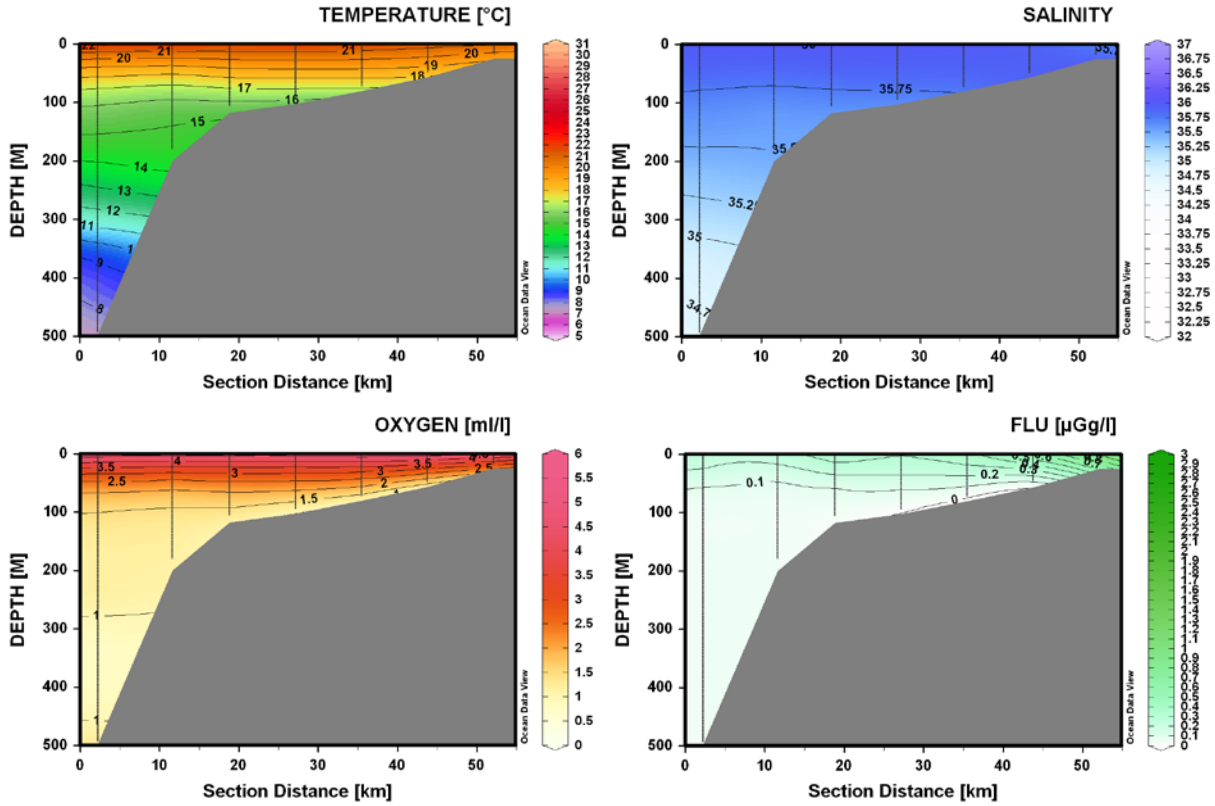


Figure 7c - Vertical sections of temperature, salinity, oxygen and fluorescence off Ambriz (June 2013)

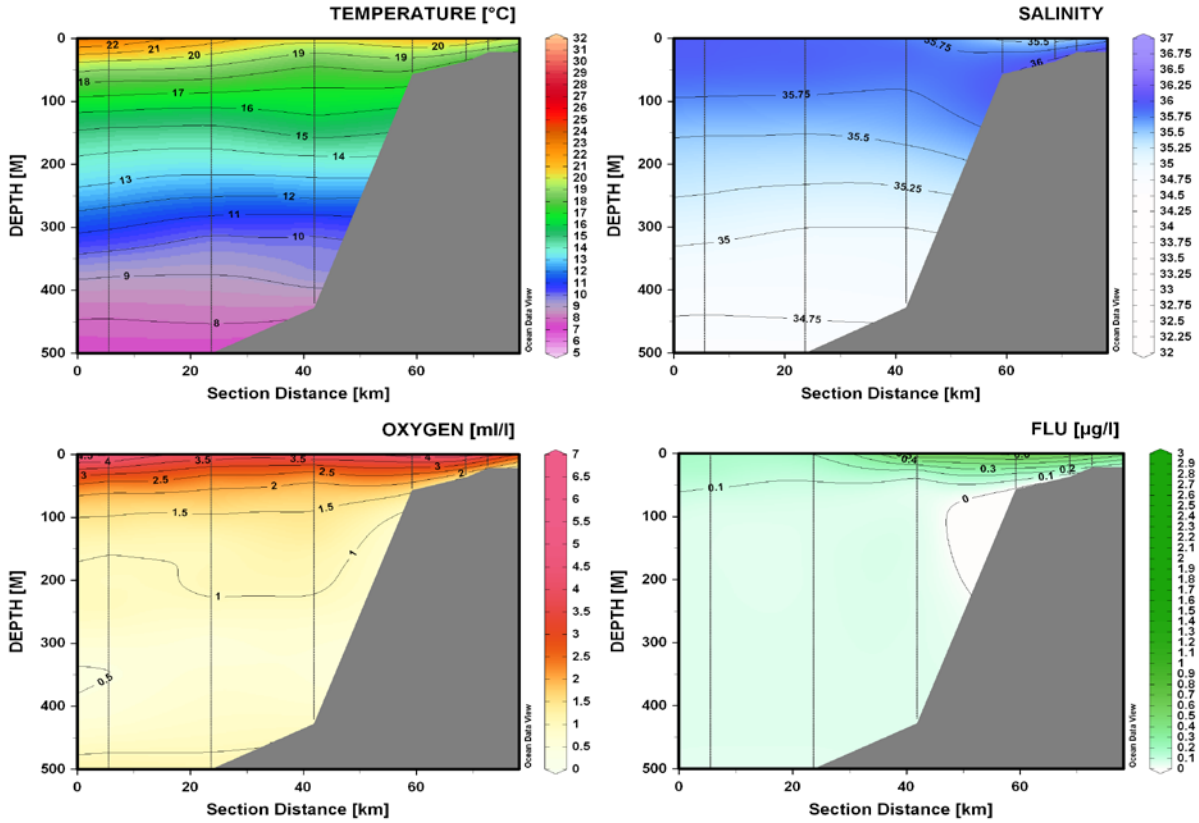


Figure 8a - Vertical sections of temperature, salinity, oxygen and fluorescence off Pta. Palmerinhas - (June 2013)

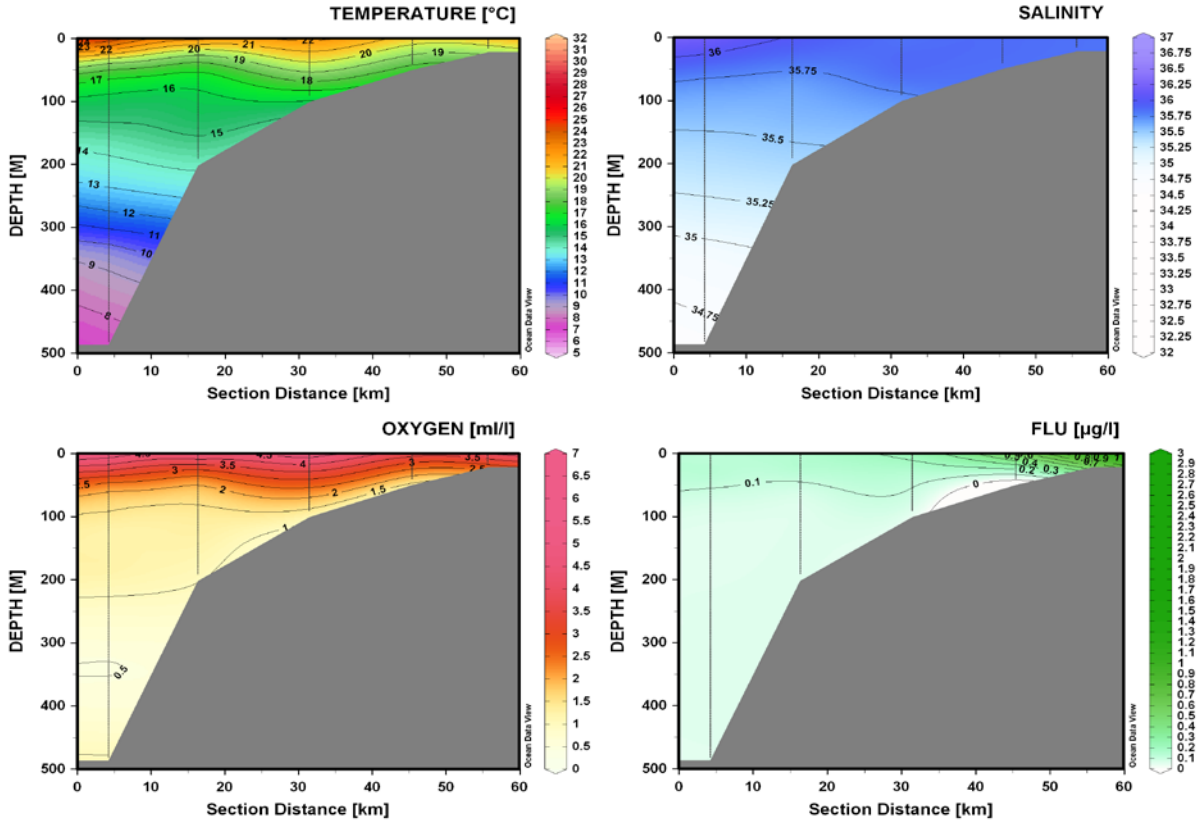


Figure 8b - Vertical sections of temperature, salinity, oxygen and fluorescence off North of Cabo Ledo – (June 2013)

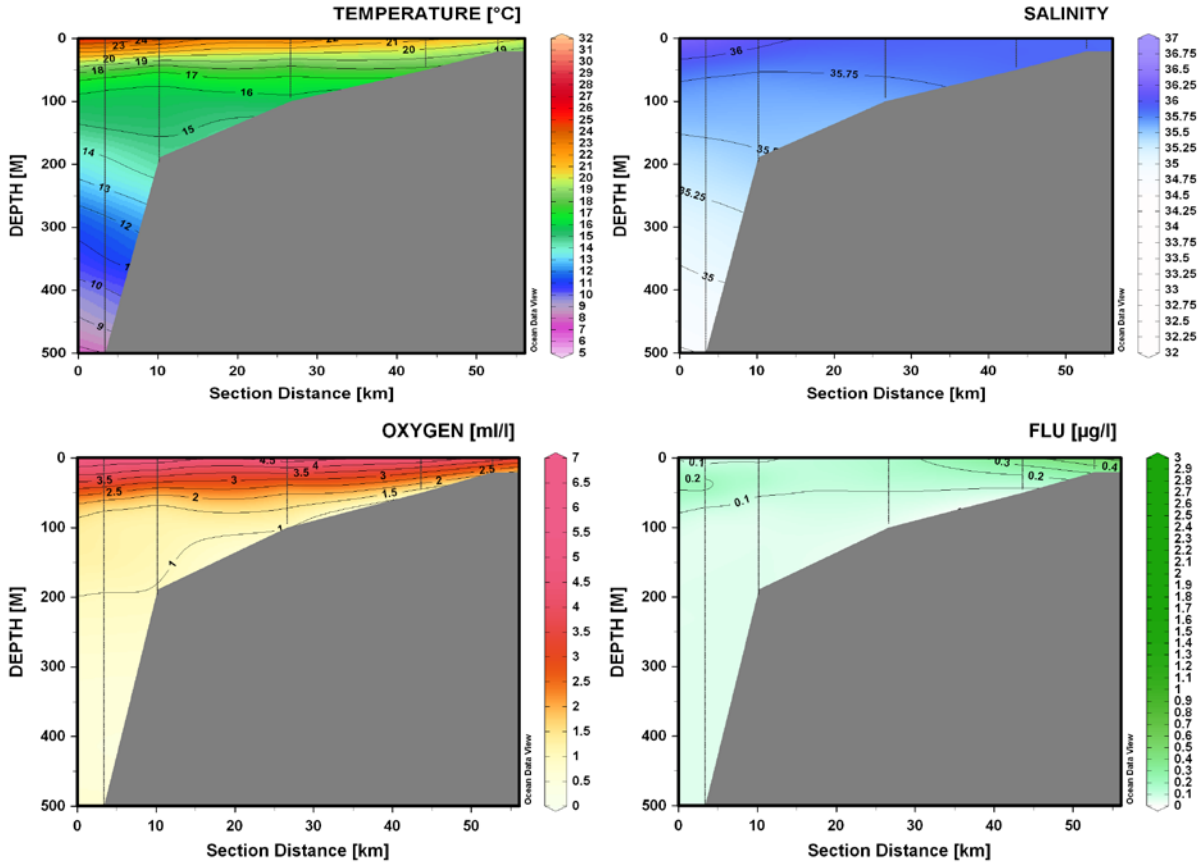


Figure 8c - Vertical sections of temperature, salinity, oxygen and fluorescence off south Cabo São Braz - (June 2013).

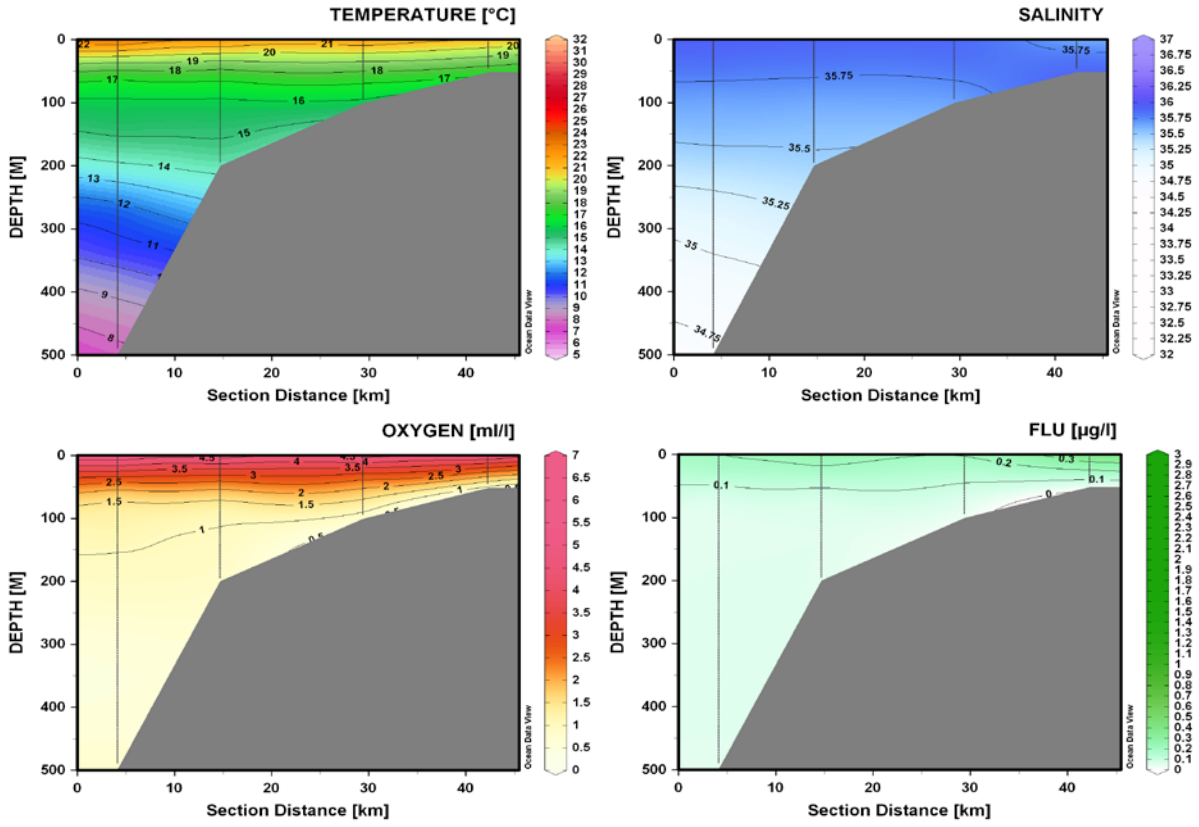


Figure 8d - Vertical sections of temperature salinity, oxygen and fluorescence off Pta. do Morro (July 2013)

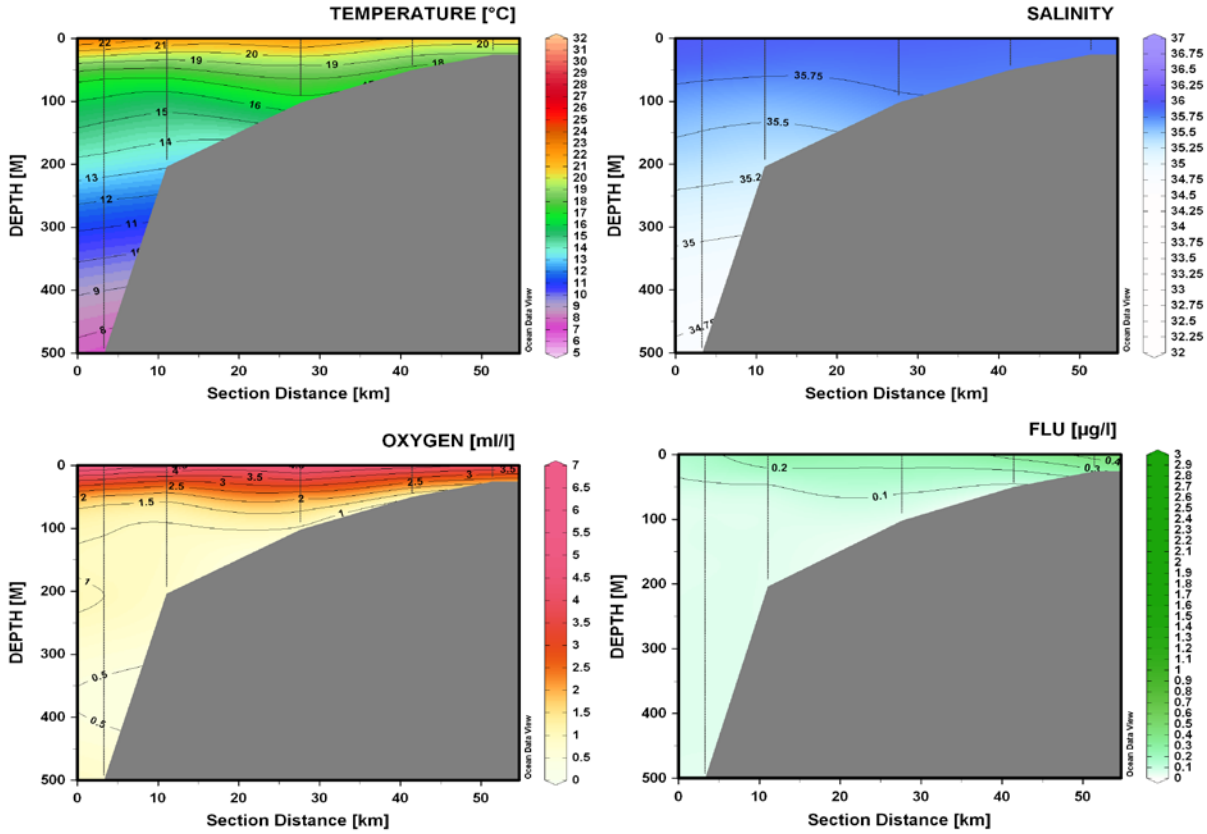


Figure 8e - Vertical sections of temperature salinity, oxygen and fluorescence off Cabeça da Baleia – (July 2013)

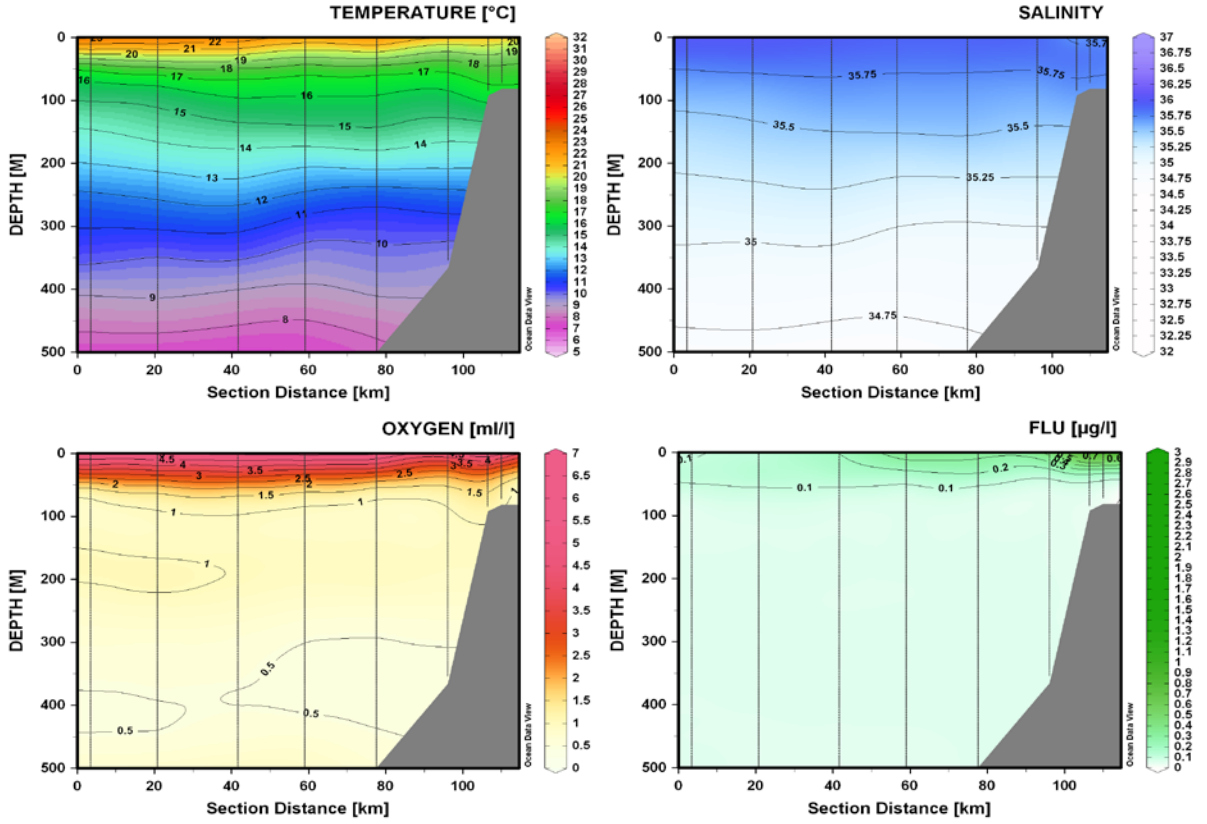


Figure 8f - Vertical sections of temperature salinity, oxygen and fluorescence off Lobito – (July 2013)

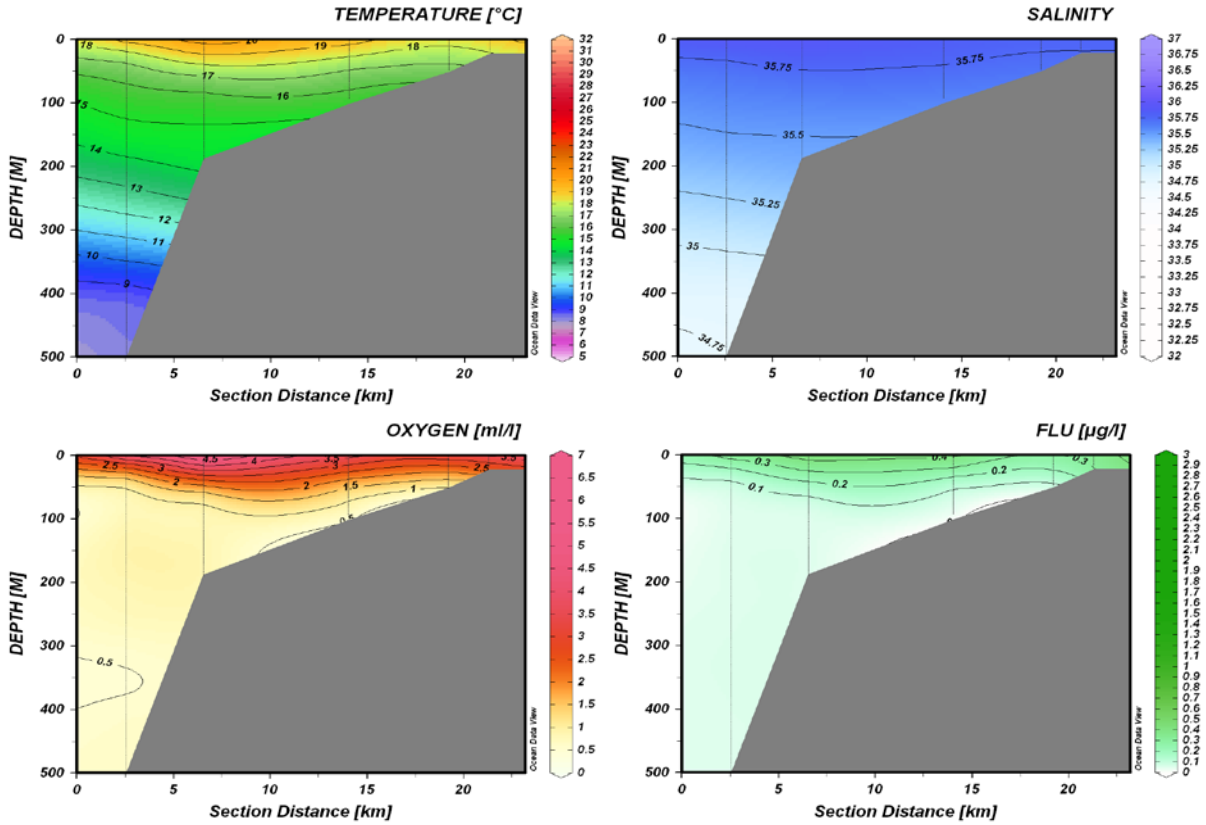


Figure 9a - Vertical sections of temperature salinity, oxygen and fluorescence off Cabo Santa Marta (July 2013).

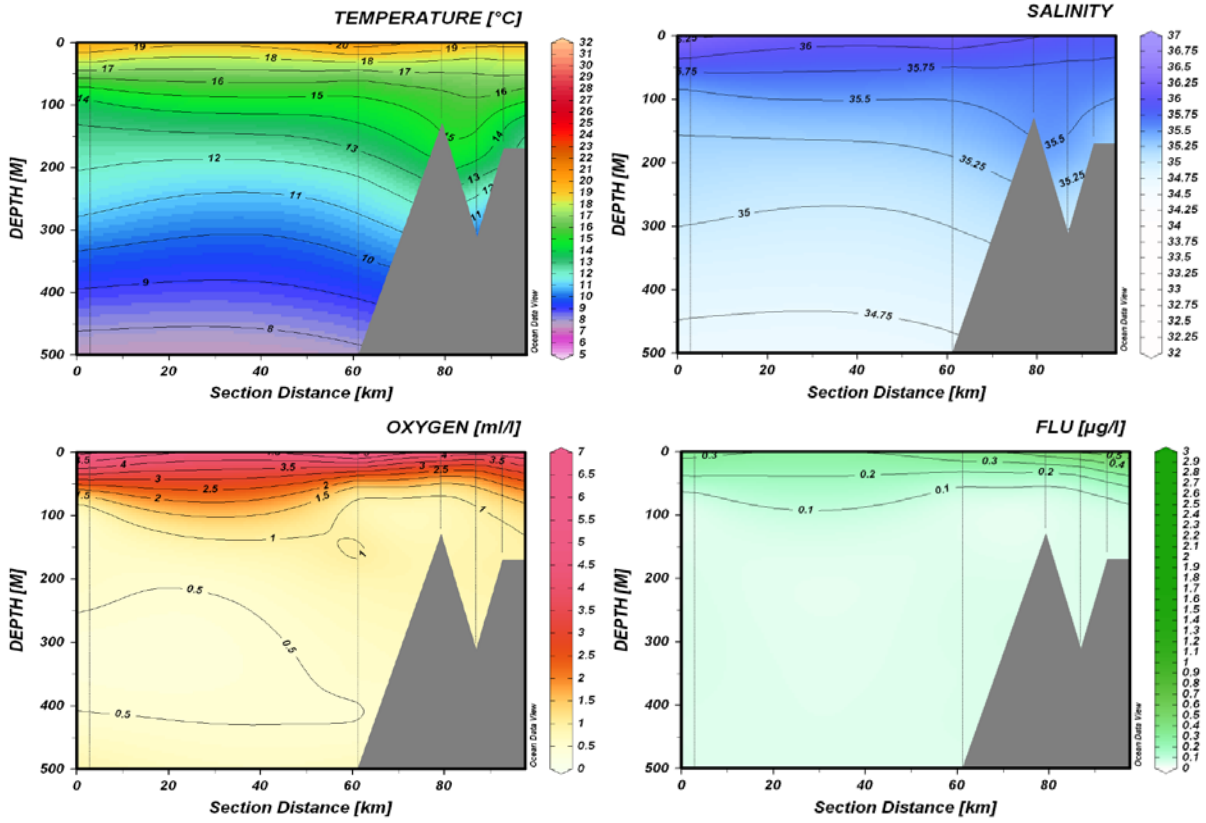


Figure 9b - Vertical sections of temperature salinity, oxygen and fluorescence off Namibe (July 2013).

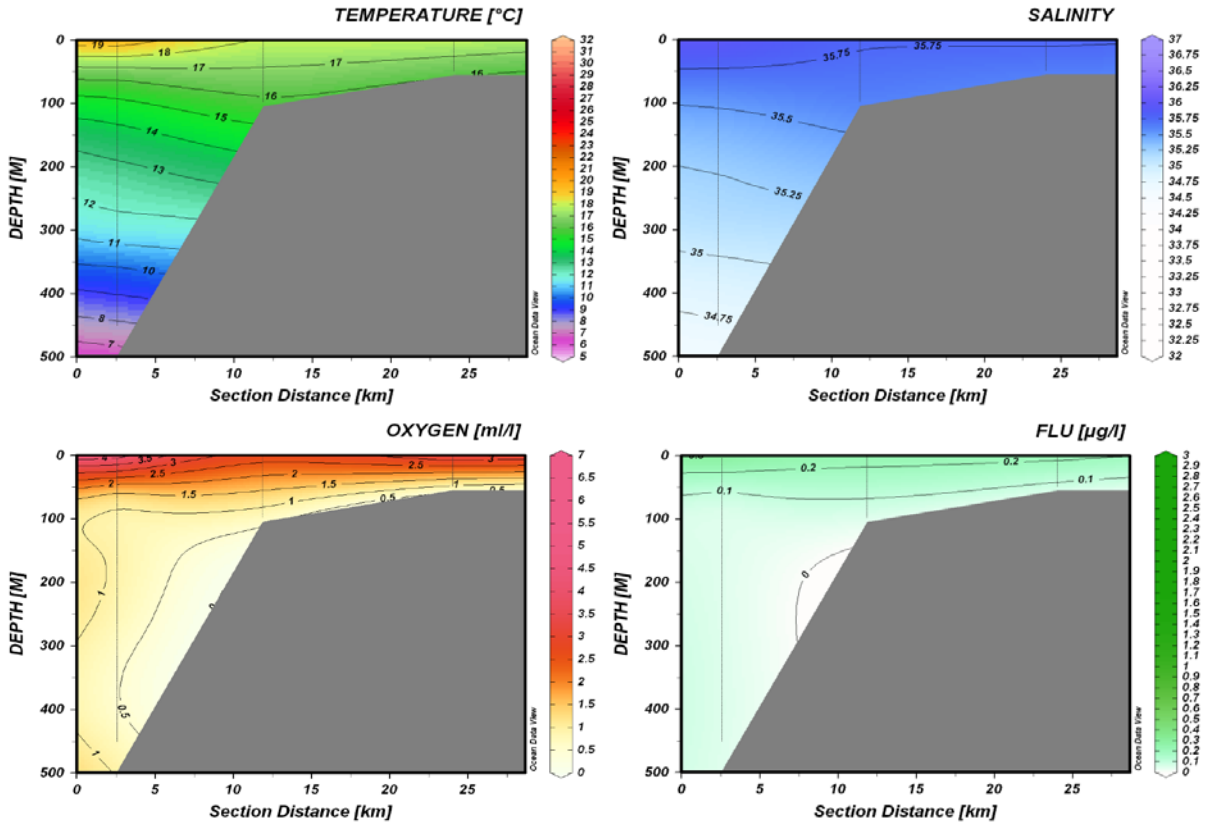


Figure 9c - Vertical sections of temperature salinity, oxygen and fluorescence off Tômbwa (July 2013).

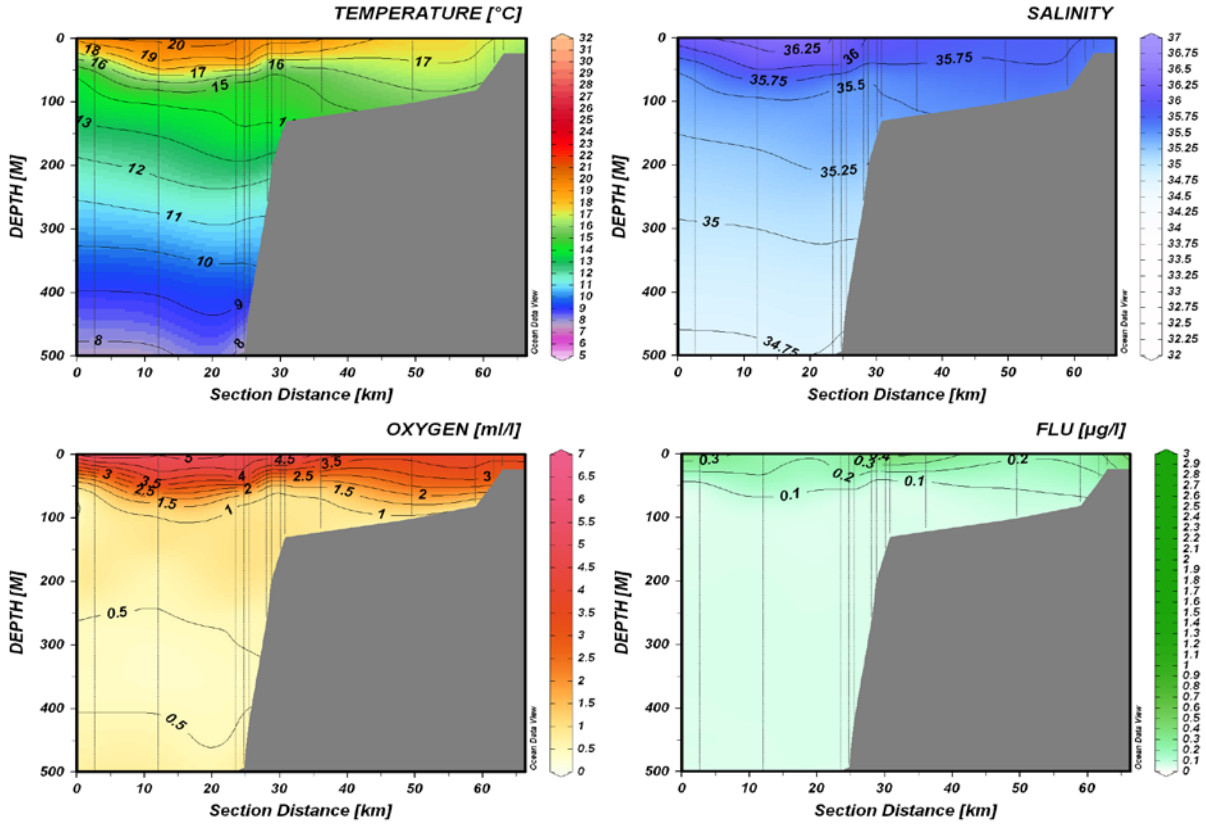


Figure 9d - Vertical sections of temperature salinity, oxygen and fluorescence off Baía dos Tigres (July 2013).

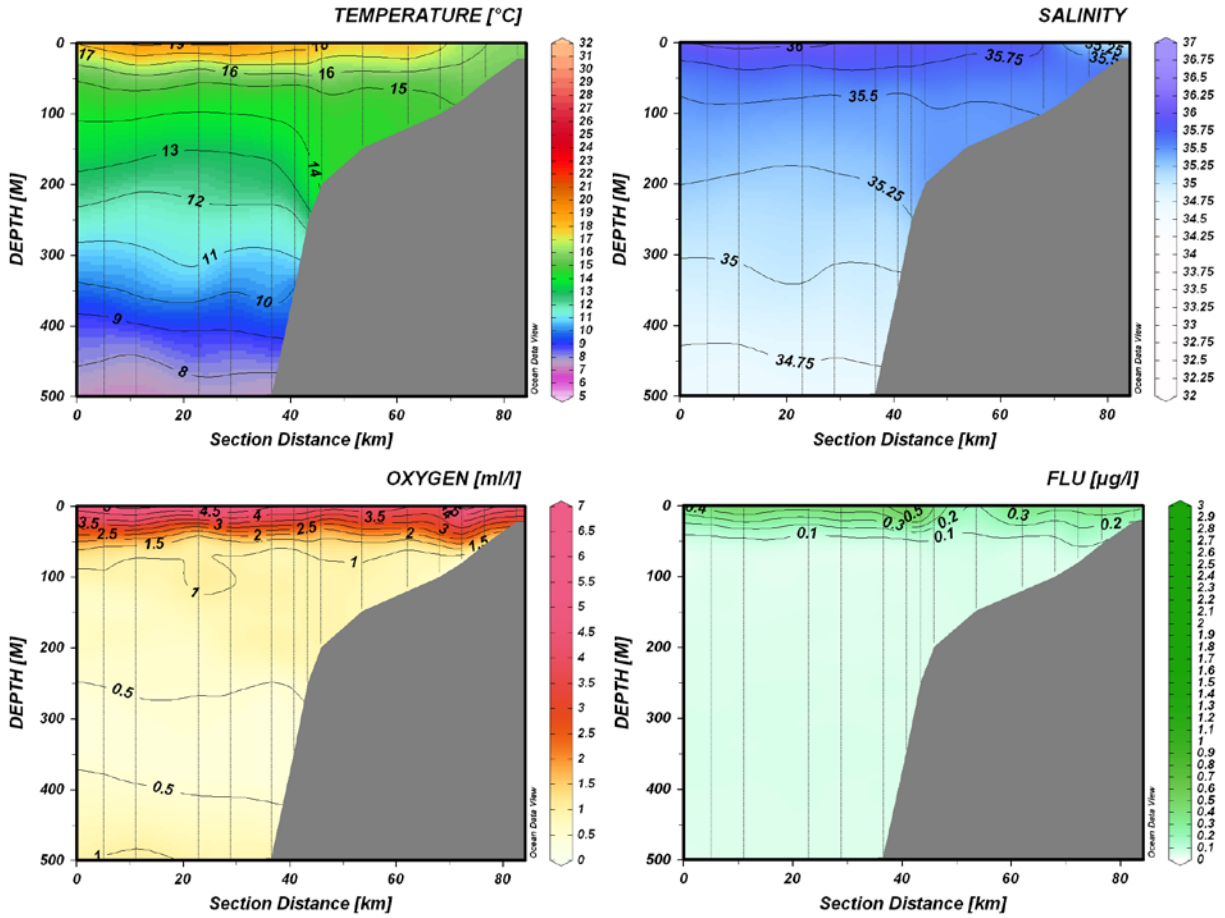


Figure 9f - Vertical sections of temperature salinity, oxygen and fluorescence off Cunene River (July 2013).

CHAPTER 4 DISTRIBUTION, SIZE COMPOSITION AND BIOMASS ESTIMATES

4.1 Congo River - Pta. Palmerinhas

4.1.1 Sardinella

The sardinella (*Sardinella maderensis*) were distributed over two separated areas (Figure 10). The northern distribution area was located near the Cabeça da Cobra, and dense fish concentrations ($301<s_A<1\ 000$ m^2/NM^2) of sardinella occupied a large part of this area. The southern area, with densest concentrations of sardinella, was located along the coast, extending from N'Zeto to Luanda. Fish density varied from scattered ($0<s_A<300$ m^2/NM^2) to very dense ($1\ 001<s_A<3\ 000$ m^2/NM^2) there. The most of fish were found in the shallow waters of 20-50 meters, while some sardinellas were found in deeper area of 50-100 meters. Sardinella occupied smaller area in 2013 than in 2012, and was observed close to the coast such as in 2011.

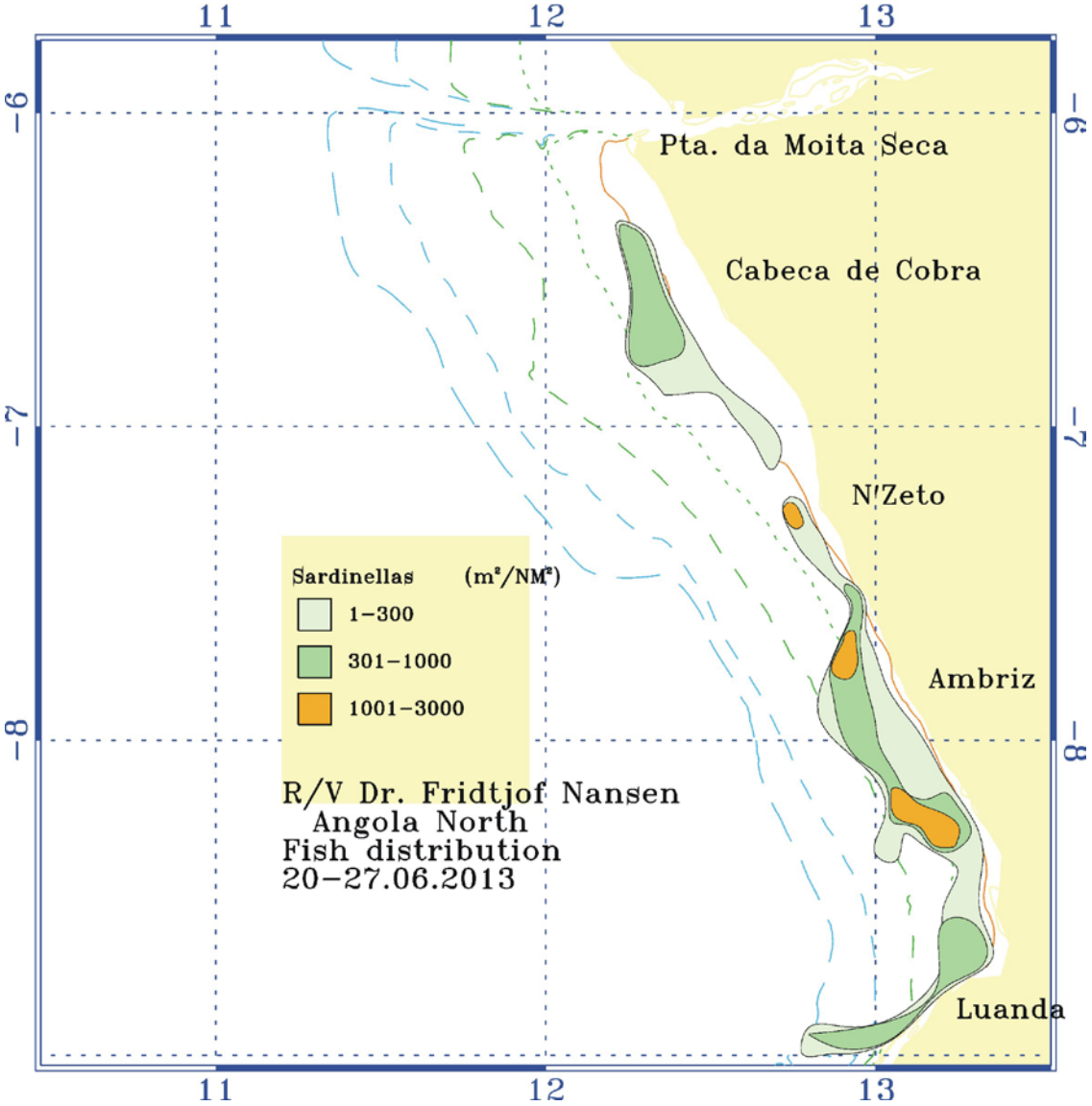


Figure 10. Distribution of *Sardinella maderensis*. Congo River-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200, and 500m.

Figure 11 shows the length distribution of the sardinellas in the northern region. *S. maderensis* showed two modal peaks around 9 and 24 cm TL, and the total abundance dominated by fish of 21-30 cm length (65%).

The estimated biomass for this region was 179 000 tonnes, which is lower than for the same period in 2012, but higher than the biomass estimated in 2010-2011. *Sardinella maderensis* was found only in the northern area, while *S. aurita* distributed further south in the region, for 2013.

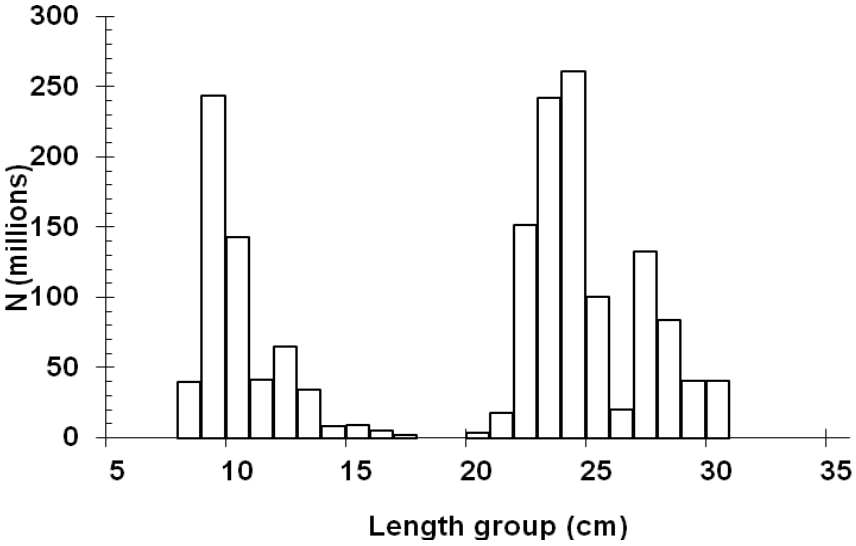


Figure 11. Total length distribution of *Sardinella maderensis*, Congo River-Pta. das Palmerinhas.

4.1.2 Horse mackerel

Cunene horse mackerel, *T. trecae*, was found in small low-density areas ($0<s_A<300$ m^2/NM^2) from Pta. da Moita Seca to N'Zeto (Figure 12). Compared with last year, the species occupied larger area, which is located between north of Ambriz and Luanda, and the fish density varied from scattered ($0<s_A<300$ m^2/NM^2) to medium dense ($301<s_A<1$ 000 m^2/NM^2). The most of fish stay in the waters of 20-50 m depth. The horse mackerel was generally caught with bottom trawl during the day and pelagic trawl during the night, and mixed with Clupeiods, Hairtails and Sardinellas, depending on depth.

The length frequency of Cunene horse mackerel, *T. trecae*, consisted of both juvenile and adult specimen, and was dominated (52%) of fish between 15 and 21 cm (Figure 13).

This year the biomass estimate was 52 000 tonnes, corresponding to approximately 367 million Cunene horse mackerel. The bulk of biomass belongs to adult fish of 26-29 cm length, while the small fish of 15-21 cm contributed 30% only. The biomass was much higher in 2013, comparing with 2011 and 2012.

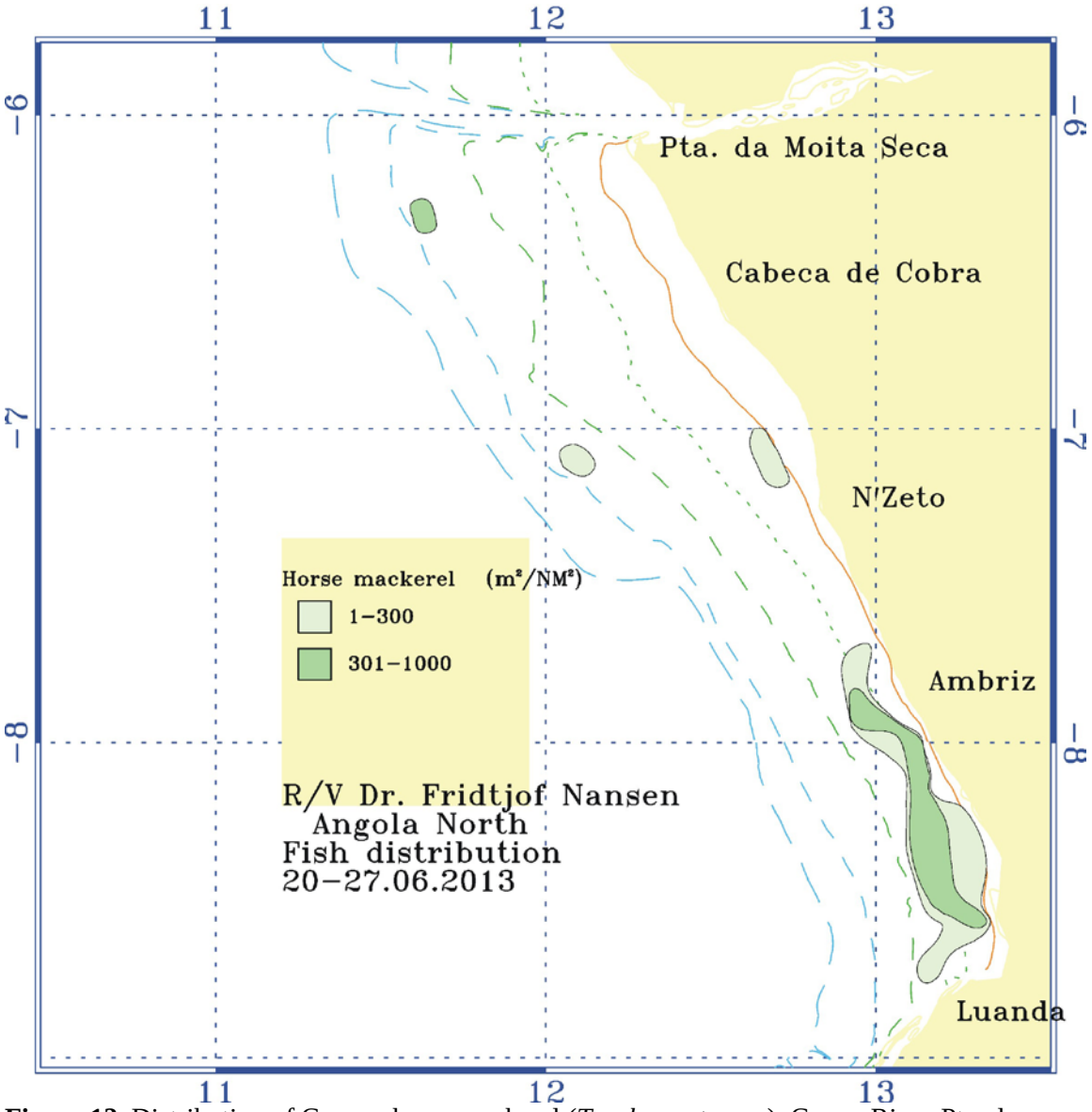


Figure 12. Distribution of Cunene horse mackerel (*Trachurus trecae*), Congo River-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200, and 500 m.

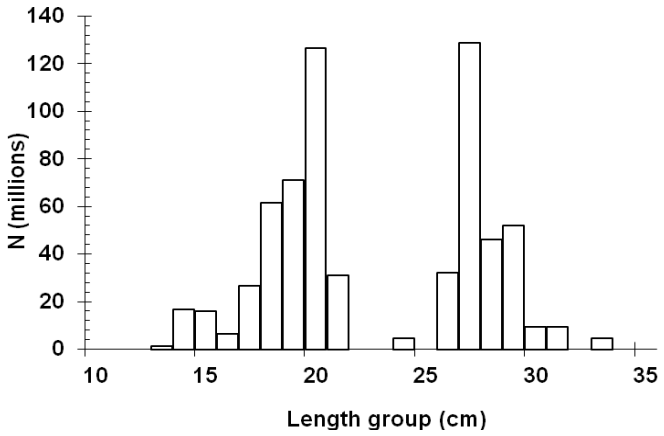


Figure 13. Total length frequency distribution of Cunene horse mackerel, Congo River - Pta. das Palmerinhas

4.1.3 Pelagic species Group 1

During the survey 2013 *Ilisha africana* was the only species, belonging to this group, found. *Ilisha africana* was patchily distributed between south of Ambriz to Cabeca de Cobra. The small areas of low densities ($0<S_A<300$ m^2/NM^2) were observed near the coast. Only one area of medium-dense concentration ($301<S_A<1000$ m^2/NM^2) was observed south of Ambriz (Figure 14).

The biomass of *Ilisha africana* in the northern area, based on an average fish size of 16 cm TL and an average condition factor of 0.01, was estimated to be 23 000 tonnes.

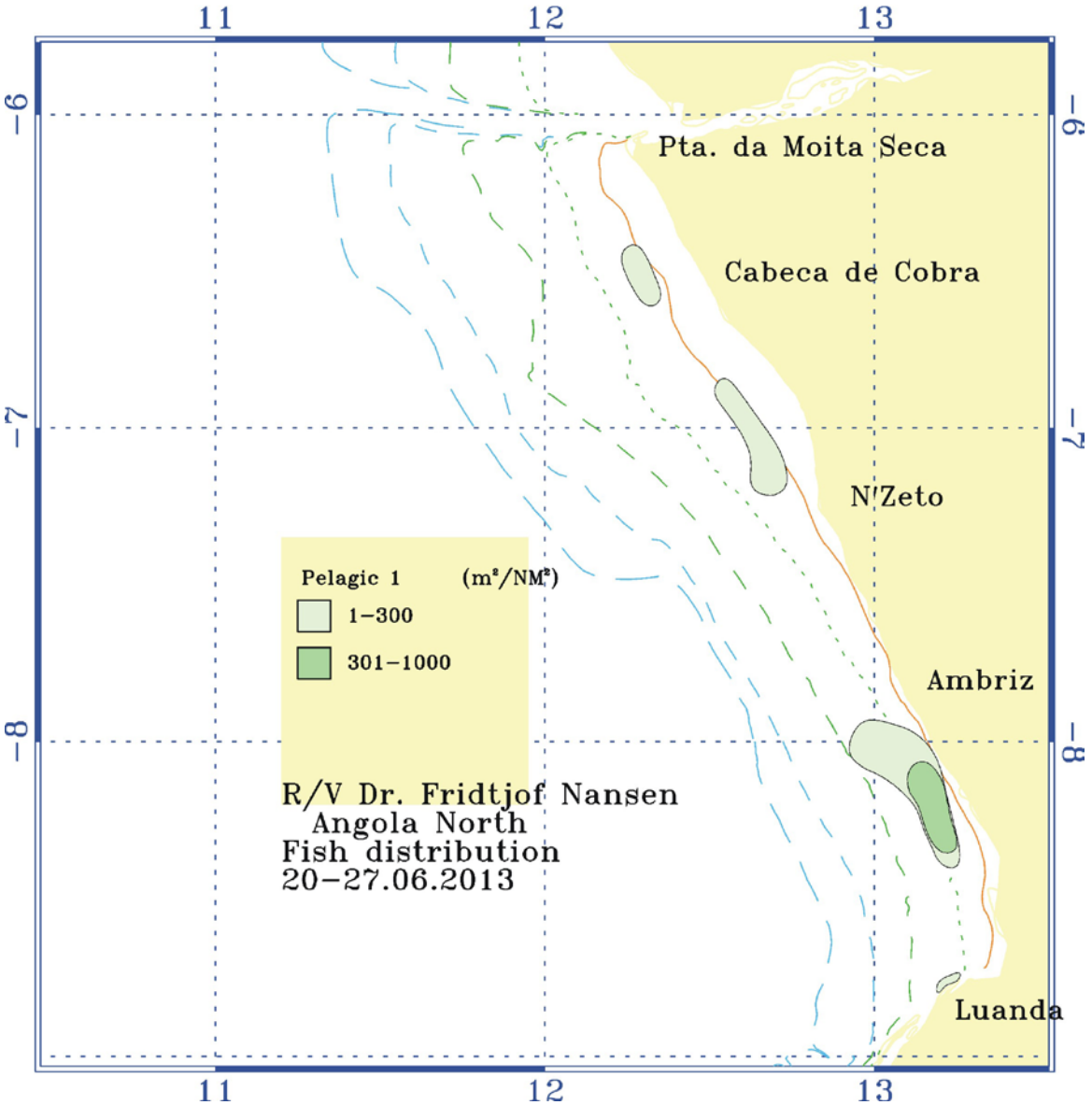


Figure 14. Distribution of Pelagic 1, Congo River-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200 and 500m.

4.1.4 Pelagic species Group 2

This year the dominant species belonged to the Carangidae, *Chloroscombrus chrysuru, Selene dorsalis and Trichiurus lepturus*. These fishes were patchy distributed between Cabeça de Cobra and N'Zeto, and almost continuously distributed from north of Ambriz to southwest of Luanda (Figure 15). The fish concentrations of medium ($301<S_A<1000$ m^2/NM^2), high ($1001<S_A<3000$ m^2/NM^2) and very high density

were situated in the southern part of their distribution. This year the Carangidae was dominant, followed by sardinella and other demersal species (Table 3).

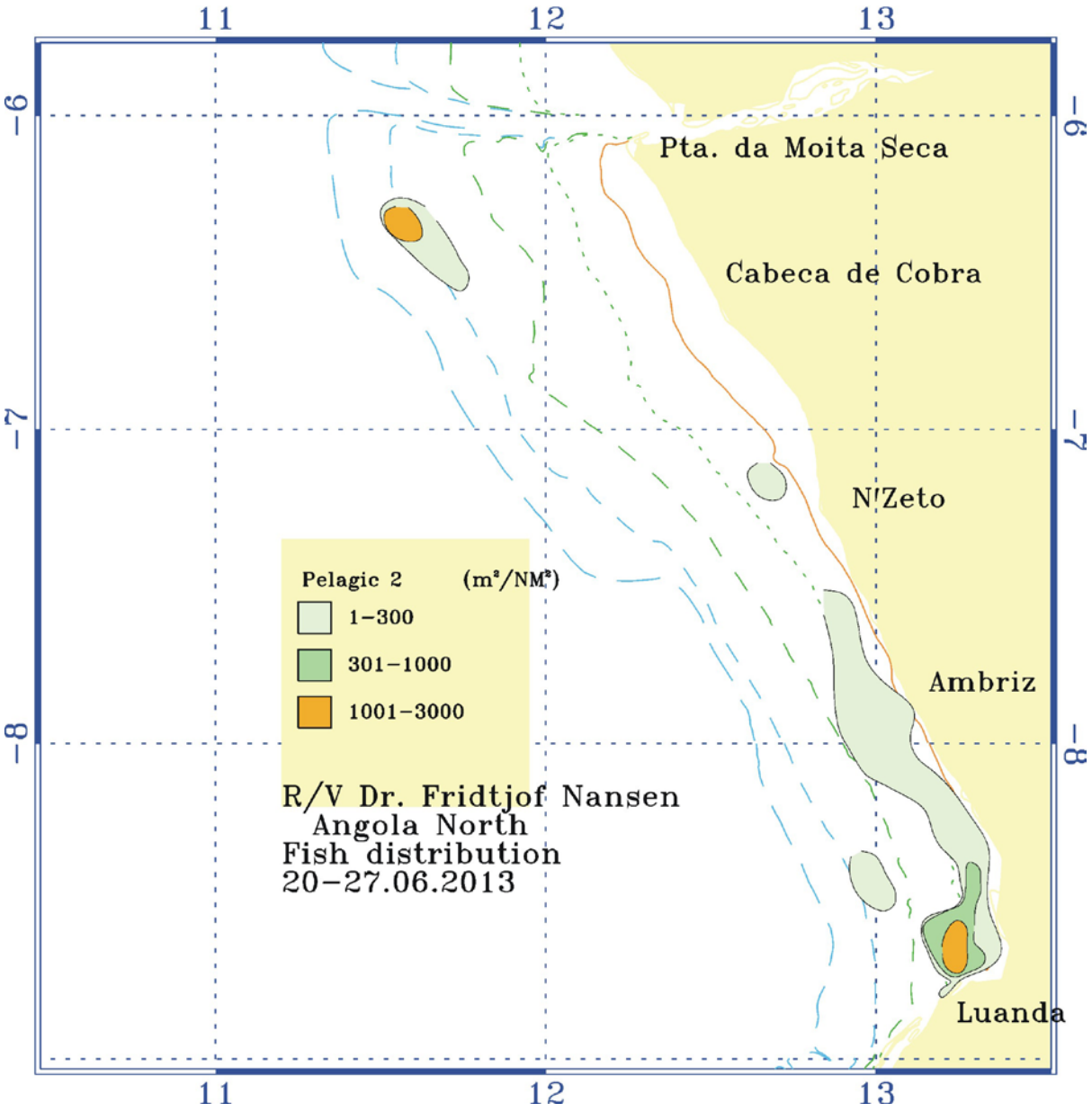


Figure 15. Distribution of Pelagic 2, Congo River-Pta. das Palmerinhas. Depth contours at 20, 50, 100, 200 and 500m.

The biomass calculation was based on an average fish size of 30 cm and average condition factor of 0.01 and was estimated to be 134 000 tonnes.

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

Station	Gear depth	Barracuda	Carangids	Clupeoids	Hairtails	Horse mackerel	SARD	Scombrids	Other	Total
1	10	0	7.1	0	2	7.1	0	0	0	10.4
2	128.5	0	12.6	0	3.6	12.6	0	0	207.5	236.3
3	0	37.1	41.3	1640.7	11.4	0	1601.7	2.4	0	2120.1
4	85	0	0	0	0	0	0	0	279.2	279.2
5	23	20.8	899.5	36.9	0	0	36.9	0	1200	2231
6	290	0	0	0	15.3	0	0	0	831.7	847.1
7	0	0.5	20.9	0.5	0	0	0.5	0	71.5	94.3
8	29	18	4	0	0	0	0	0	920.2	942.2
9	45	0	0	0	24.4	0	0	0	10.1	34.5
10	10	49.3	0	170.5	9.5	0	159.2	1.8	0	268.5
11	0	0	0	0	0	0	0	0	0	0
12	86.5	0	554	12.2	10.2	35	12.2	0	407.9	1043.6
13	10	0	7.4	77.3	0.1	6.5	57	0	490.3	715.8
14	10	7.2	5.2	20.4	0.5	0	10.2	0	742.7	806.6
15	23.5	47.9	91.1	309.3	20.2	0	305.6	0	2526.6	3610
Mean	50	12.1	109.5	151.2	6.5	4.1	145.6	0.3	302.3	882.6
Std dev	76.6	18.4	260	421	8.2	9.4	411.6	0.7	1112.1	1031.4

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 sardinella, of low ($1<s_A<300$ m^2/NM^2) and medium ($301<s_A<1000$ m^2/NM^2) densities, 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 16). The most of fish occupied the coastal water of 20-50 meters, the oxygen and fluorescence rich area.

The sardinella was observed in the upper water layers, schooling near the surface during daytime. However was not possible to catch sardinella during daytime due to trawl avoidance. Along the coast of central area survey transects are very short, and in addition to reduced time for sardinella catching, 16 monitoring lines and standard transects located along the 195 nm coast, reduce even more effective trawling. Therefore, limited pelagic trawling in the area with sardinella might, most likely, influence negatively the biomass estimates in this area.

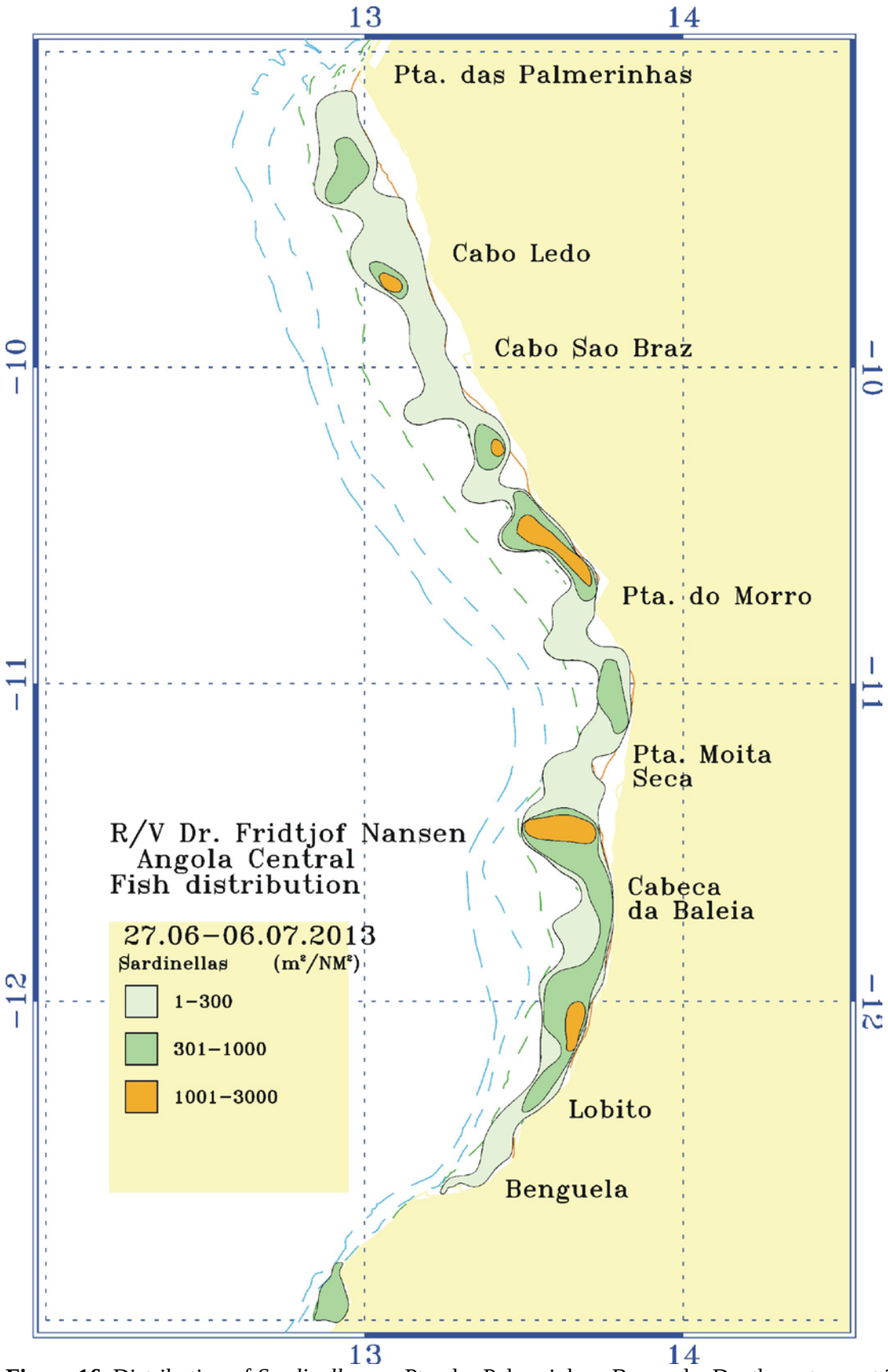


Figure 16. Distribution of *Sardinella* spp. Pta. das Palmerinhas- Benguela. Depth contours at 20, 50, 100 and 200 m.

The length distribution of *S. maderensis* showed two cohorts, peaking at 13 and 24 cm. *S. aurita* was dominated by adult individuals, showing one peak at 24 cm (Figure 17a,b). *S. maderensis* was distributed along the northern and central areas of Angola coast, while *S. aurita* were found only south of Cabo Ledo (10°S). Usually, both species were found mixed along almost the whole Angola coast; however the colder temperature condition during winter 2013 probably led to a more southern distribution of *S. aurita*.

The total biomass for both species of sardinella was estimated at 295 100 tonnes. Of this 167 500 was allocated for *S. aurita* and 127 600 was *S. maderensis*. Less *S. maderensis* were found in the central area, compared to the northern area. This biomass is higher than long term mean (1985-2012, winter) and the highest since 2008 for this region.

In previous years, the biomass of sardinella in this region has been dominated by *S. aurita*, representing around 77% of the total biomass. This year *S. aurita* was also dominant, consisting 57% of the total biomass estimate.

a) Sardinella aurita *b) Sardinella maderensis*

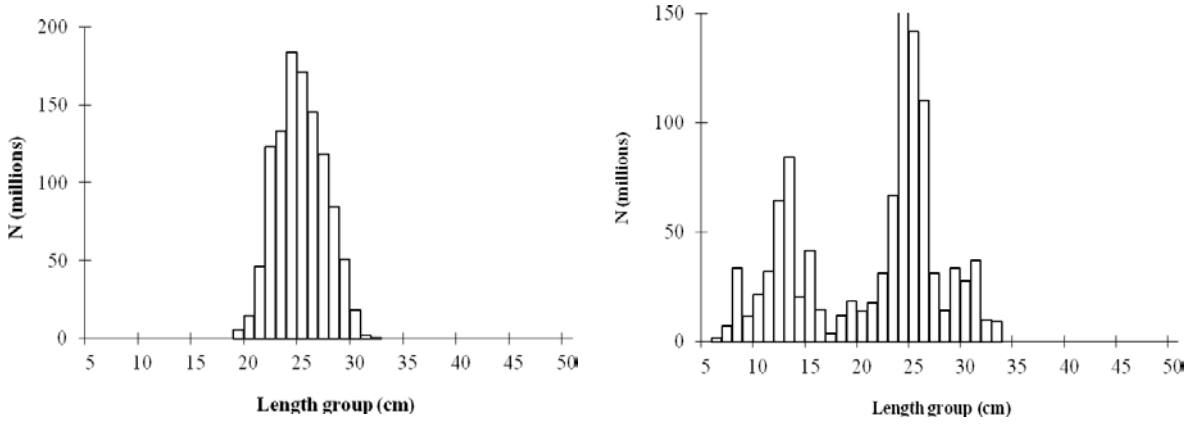


Figure 17 a,b. Total length distribution of S. *aurita* and *S. maderensis*. Pta. das Palmerinhas - Benguela.

4.2.2 Horse mackerel

Only Cunene horse mackerel, *Trachurus trecae*, was found in this region. *T. trecae* distributed in patches of medium densities ($301<s_A<1000$ m^2/NM^2) between Pta. das Palmerinhas and Pta. do Morro, while low densities ($0<s_A<300$ m^2/NM^2) were found over relatively large areas along the coast. Its distribution is wide, ranging from around 20 m bottom depth to approximately 200 m depth (Figure 18).

The biomass of Cunene horse mackerel was estimated at 117 000 tonnes. This biomass is higher than long term mean (2000-2012, winter) and highest recorded since 2001 for this region.

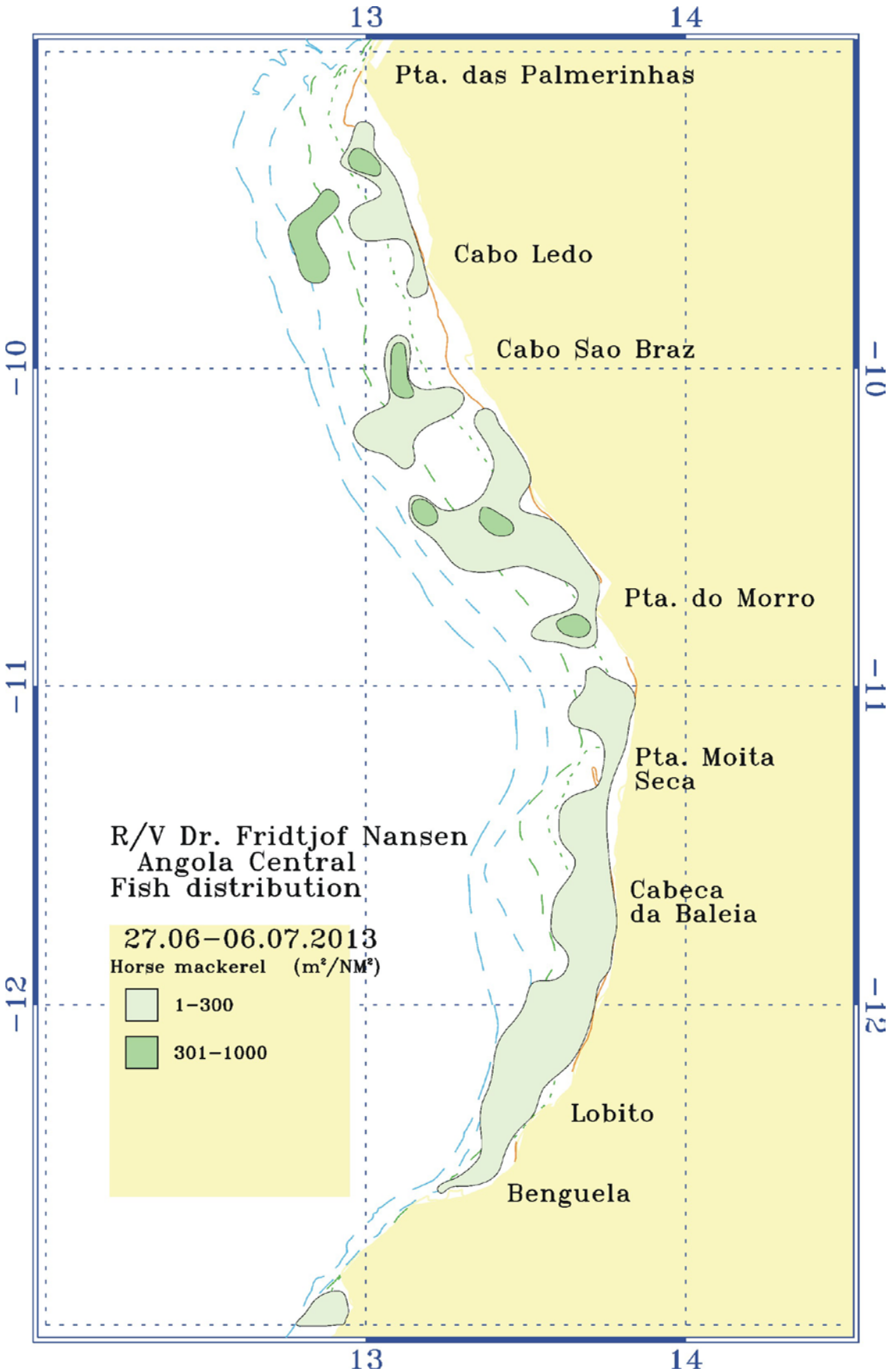


Figure 18. Distribution of horse mackerel (*Trachurus trecae*). Pta. das Palmerinhas- Benguela. Depth contours at 20, 50, 100, 200 and 500 m.

The length frequency distribution is shown in Figure 19. The population shows 4 cohorts with peaks at around 20, 29, 34, and 43 cm. Young fish <5 cm is difficult to catch with the trawl and therefore this group is underestimated.

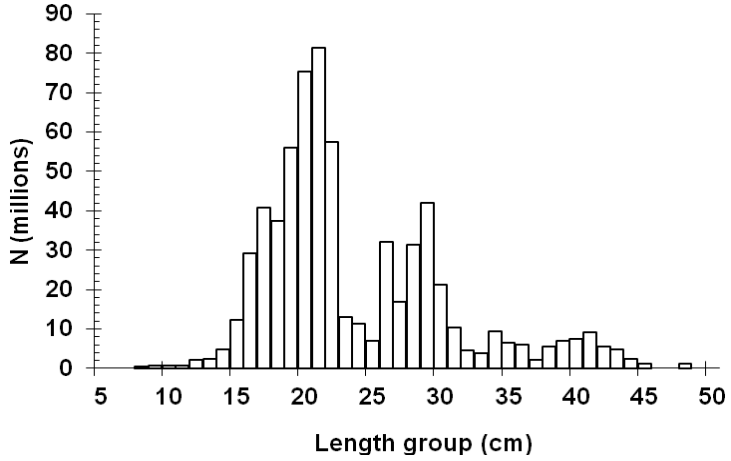


Figure 19. Total length distribution of horse mackerel (*Trachurus trecae*), Pta. das Palmerinhas-Benguela.

4.2.3 Pelagic species Group 1

In the central area, belonging to this group, both *Ilisha africana* and *Engraulis encrasicolus* were found (Figure 20). However, *I.africana* dominated the catches and only a few catches of 100 gram of *E. encrasicolus* were recorded. Therefore, results presented mostly *I.africana.*

Pelagic fish of low densities ($0<S_A<300$ m^2/NM^2) was patchily distributed between Pta. das Palmerinhas and Lobito (Figure 21). Length distribution varied between 5 cm and 26 cm with one peak at 20 cm.

The biomass in the central area, based on an average fish size of 16 cm TL and an average condition factor of 0.01, was estimated to be 31 000 tonnes.

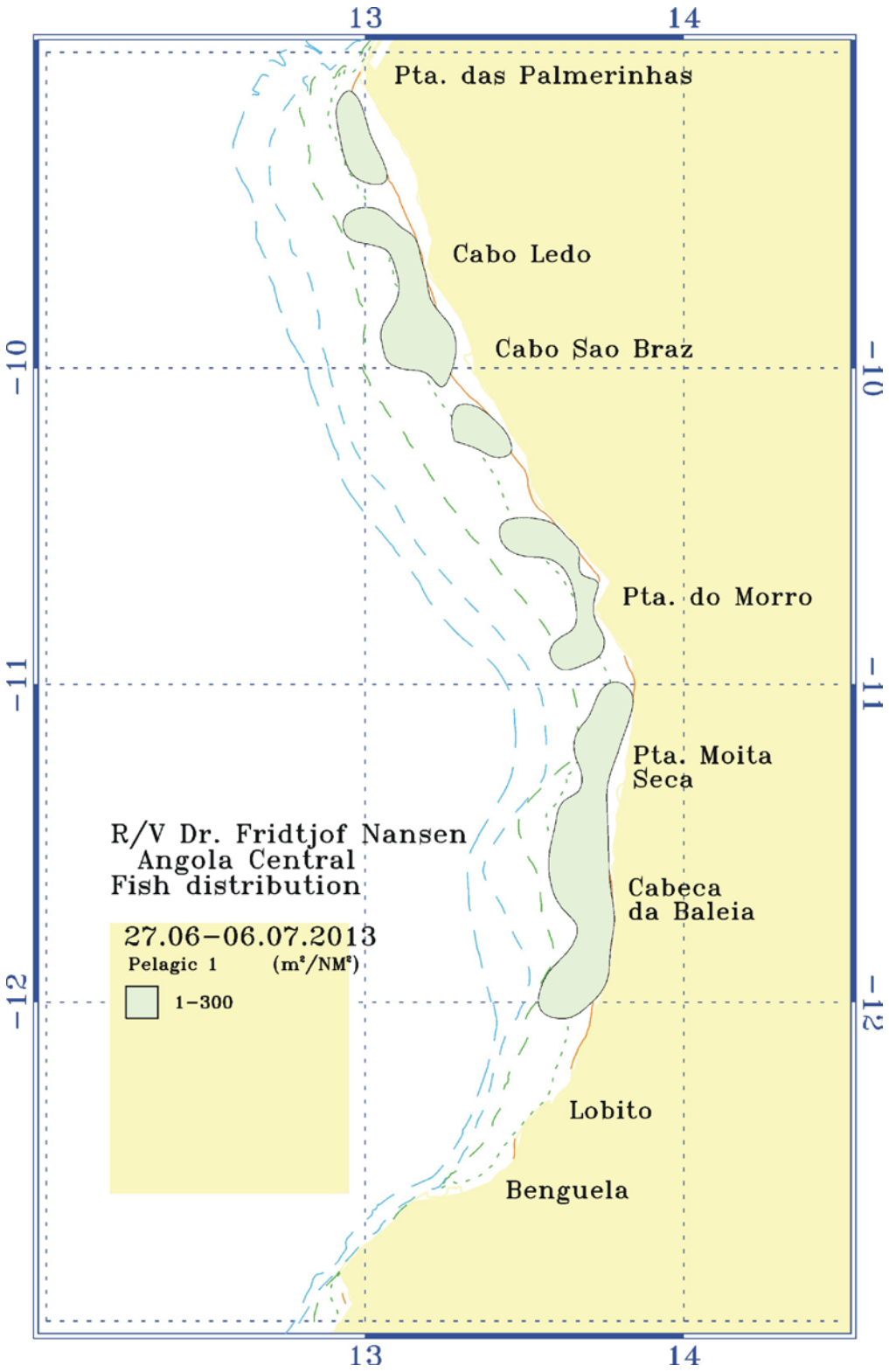


Figure 20. Distribution of other pelagic species, group 1. Pta. das Palmerinhas- Benguela. Depth contours at 20, 50, 100, 200 and 500 m.

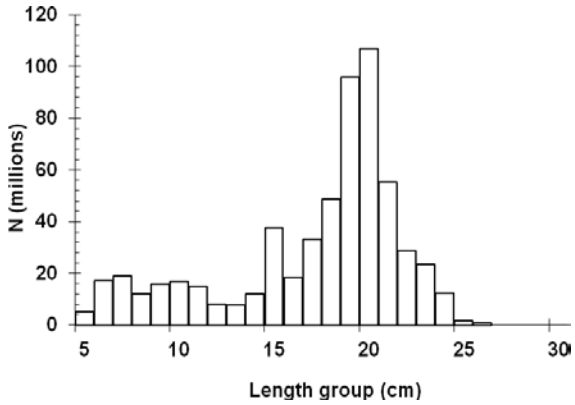


Figure 21. Total length distribution of mostly *Ilisha Africana,*, Pta. das Palmerinhas- Benguela.

4.2.4 Pelagic species Group 2

This group was found almost continuously distributed along the coast at low densities ($0<s_A<300$ m^2/NM^2) (Figure 22). Excluding the sardinella species and *T. trecae*, the most common species caught in the trawls were the Carangid *Chloroscombrus chrysurus* (Table 4).

The biomass estimate, based on an average length of 30 cm and a condition factor equal to 0.01, was 70 000 tonnes, which is higher than recent 5 years.

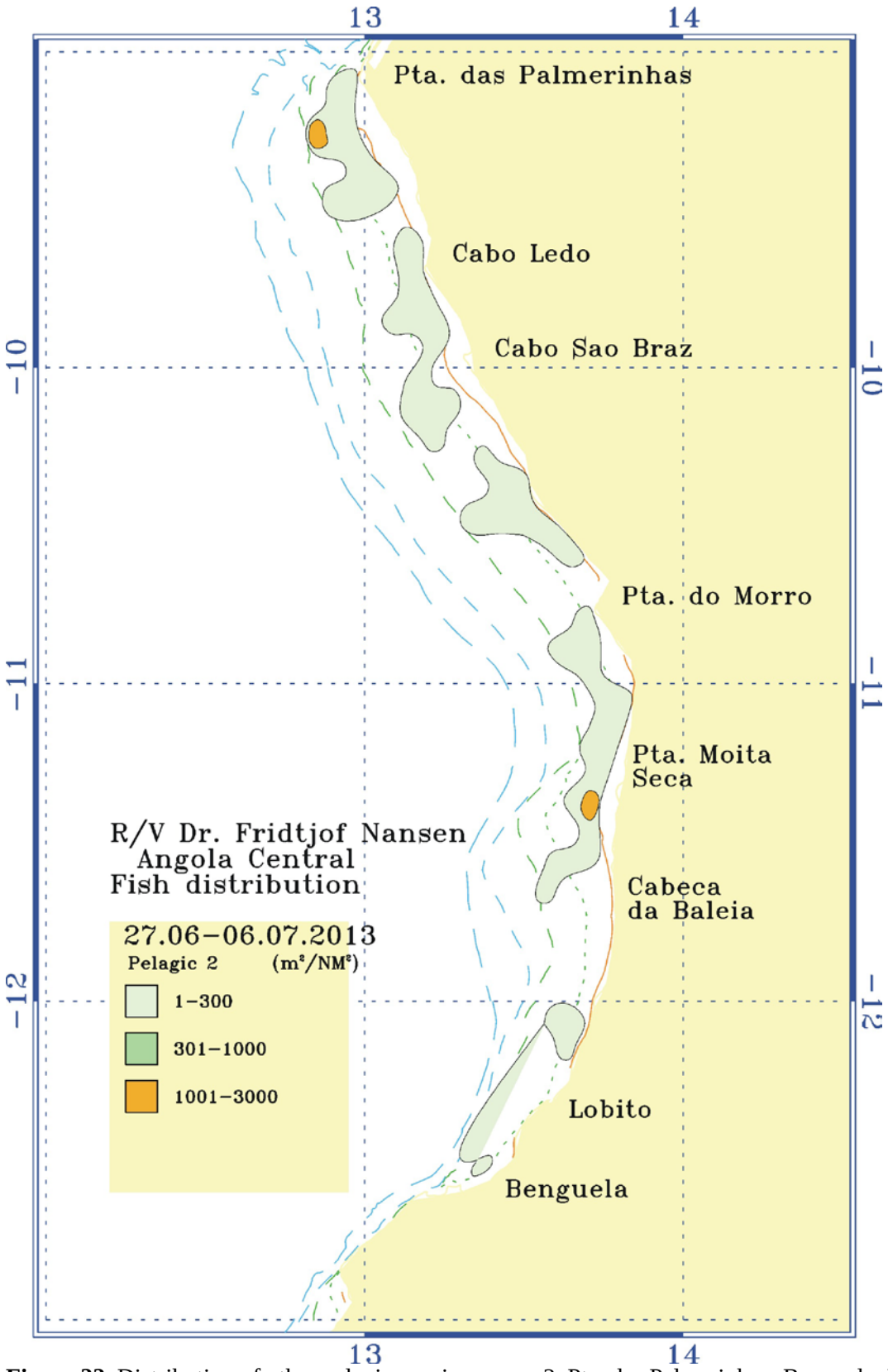


Figure 22. Distribution of other pelagic species, group 2. Pta. das Palmerinhas- Benguela. Depth contours at 20, 50, 100, 200 and 500 m.

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

Station	Gear depth	Barracuda	Carangids	Clupeiods	Hairtails	Horse mackerel	SARD	Scombrids	Other	Total
16	45	0	0	0	0	0	0	0	4.5	4.5
17	23.5	79.8	234.5	96.6	0	231.5	24.4	0	2001	2667.8
18	0	0	33.8	0	181.9	33.8	3.3	0	21.4	274.1
19	0	1.3	0.4	1.8	0.2	0	14	0	84.7	102.3
20	79.5	0	493.2	0	10.2	462.4	2.6	0	0	706.5
21	32	0.9	80.9	155	1.4	73.3	0	0	90.2	401.7
22	25	0	0	0	0	0	0	0	2.2	2.2
23	0	0	0.2	0	11	0.2	0	91.2	11.6	114.3
24	0	17.3	124.7	39.2	0.6	50.6	834.1	0	0	1060.2
25	0	0	2.1	0	3.8	0	0	0	39.7	45.6
26	40	0	0	0	14.4	0	0	0	2.5	16.9
27	20.5	6.3	51.6	94.2	9.9	15.8	3.2	0	884	1064.9
28	106.5	0	50.3	0	0	50.3	0	0	434.1	534.7
29	23.5	0	10.3	14.9	1.8	10.3	43.8	0	506.6	587.8
30	5	1.2	28.6	71.9	15.3	28.6	827.7	10.1	840.5	1823.9
31	72	0	6.6	0	3.8	6.6	0	0	0	10.5
32	151	0	0	0	0	0	0	0	2.9	2.9
33	53	0.7	98.2	19.8	17.8	98.2	14.1	0	5198.1	5446.9
34	5.5	18.2	35.9	42	11.6	35.4	3960.2	0	1445.5	5548.9
35	0	2.8	2.2	4.7	21.1	0.9	104.3	0	45.3	181.3
36	65.5	0.1	0.2	0	221.8	0.1	0	0	220.1	442.3
37	41.5	0	0	8.8	35.6	0	0	0	350	394.4
38	83	0	18.5	0	106.2	18.5	0	0	543.8	687
39	0	0.1	55.8	0.8	7.2	55.8	162	0	45.1	326.8
40	0	1.8	163.2	0	29.6	163.2	2347.3	0	292.1	2997.3
41	29	14.5	818.1	174.2	8.7	815.7	525.2	0	633	2989.4
42	55	0	0	0	0	0	0	0	0	0
43	21	0.7	0	63.4	25.2	0	376.2	0	1182.1	1647.7
44	0	5.5	14.9	0	0	11.8	0	0	0	28.6
45	10	4.8	216.9	0.4	0	216.9	1284.6	0	0	1603.8
46	23	0	0.5	13.8	52.9	0	362.4	0	489.6	919.2
47	94.5	0	1052.3	0	0	1052.3	0	37.4	0	1798.4
48	0	2.3	38.3	1.6	27.1	38.3	73.9	0	347.2	528.5
49	0	0	2.7	0	0	2.7	270.5	0	7.3	283.1
Mean	32.5	4.7	106.9	23.6	24.1	102.2	330.4	4.1	440.7	1036.6
Std dev	37.4	14.1	233.9	45.1	49.8	232.8	801.1	16.7	975.1	1420.9

4.3 Benguela - Cunene

4.3.1 Sardinella

Both species of Sardinella (*S. aurita* and *S. maderensis*) were found in the coastal waters from Cabo de Santa Marta to Namibe and small areas north of Cabo de Santa Marta, in low fish densities ($0<s_A<300$ m^2/NM^2). The small area of medium fish density was found south of Cabo de Santa Marta (Figure 23). Sardinella occupied unusual small area in the southern region comparing with earlier years.

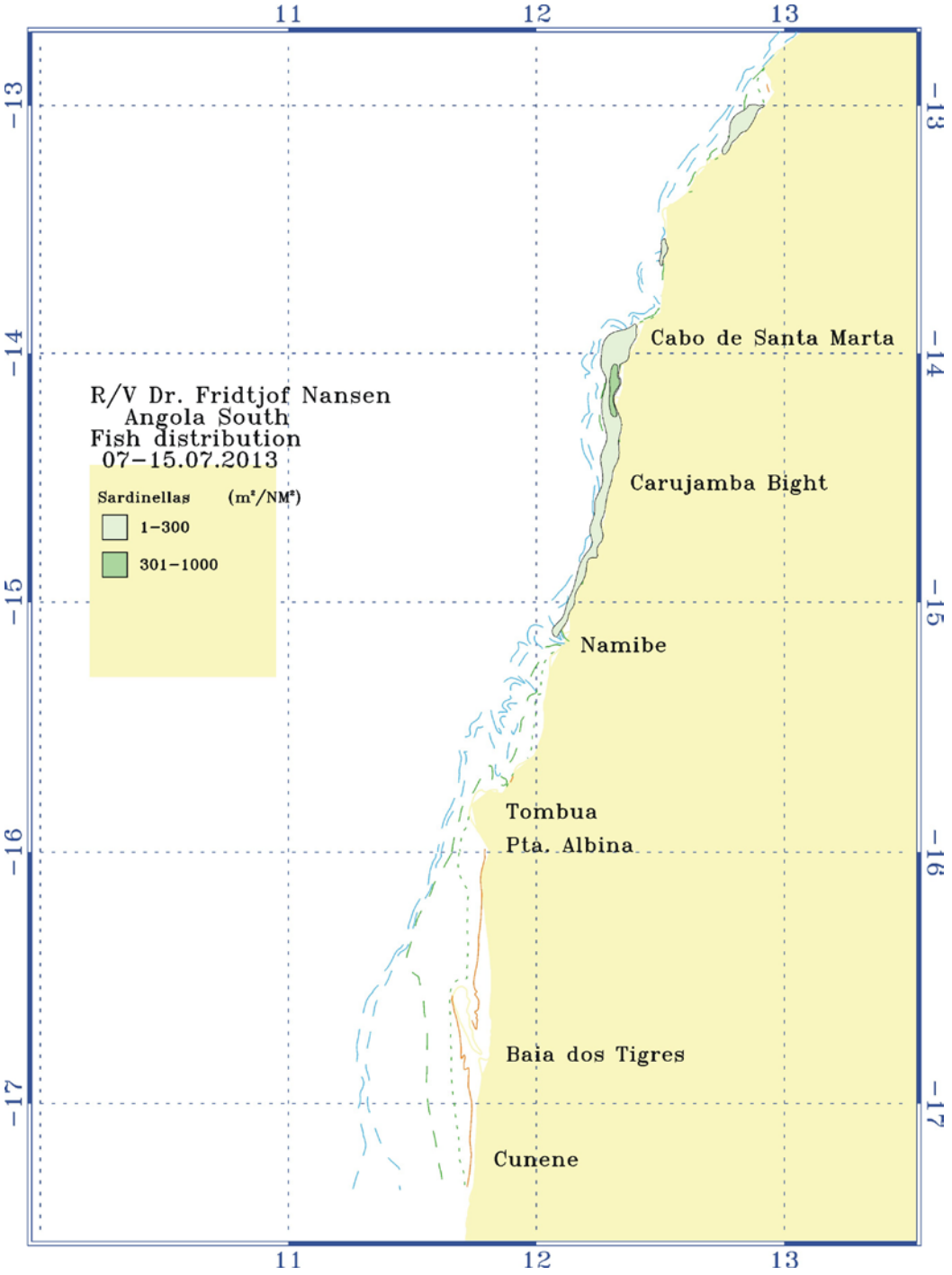


Figure 23. Distribution of *Sardinella aurita* and *S. maderensis*. Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 m.

Figure 24 shows the distribution of the length frequencies of both sardinellas. Juvenile *S. maderensis* were found in the northern parts of the region. Length distribution *S. maderensis* shows cohorts with two peaks of 8 cm and 30 cm (Figure 24b). The length distribution of *S. aurita* was dominated by adult individuals, showing three modal peaks at 22, 26, and 29 cm (Figure 24a).

The total biomass for both species of sardinella was estimated at 9 800 tonnes, which is extremely low, which was 12 times lower than in recent years (mean of 123 000 tonnes for 2010-2012) for this area. *S. aurita* dominated (71%) in the southern region, and its biomass was 6 900, while *S. maderensis* biomass was only 2 900 tonnes. The low biomass *S. maderensis* may, most likely, be influenced by dominance of juveniles in the southern region.

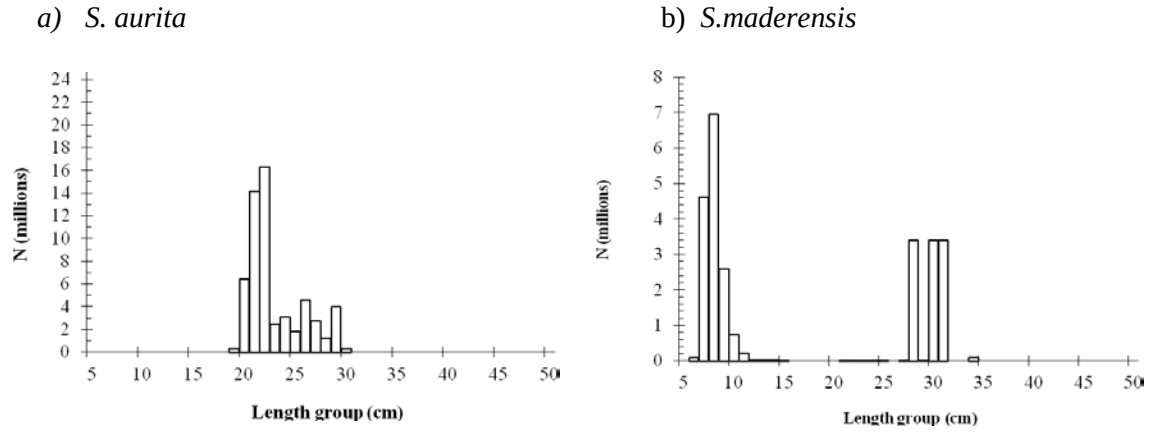


Figure 24 a,b. Total length distributions of (a) *S. aurita* and *S. maderensis* Benguela-Cunene.

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 (Figure 25). Overlap of these two species was unusually small this winter. This year *T. capensis* was distributed further south than in the previously years, and was found southwest of Baia dos Tigres (first encounter of *T. capensis* was at 16°45'S). *T. trecae* was almost continuously distributed from Benguela to Cunene River. Both species were generally caught with bottom trawl mixed with demersal species, mainly *Dentex* species. Most of the distribution area showed low density values ($0< s_A <300$ m^2/NM^2). Nevertheless, medium fish densities ($300< s_A<1000$ m^2/NM^2) were recorded in area between Tômbua and Cunene, and high fish densities ($1000< s_A<3000$ m^2/NM^2) observed near Baía dos Tigres. Higher echo registrations were recorded in the end of surveys from Baia dos Tigres to Cunene River, and some of them showed in Photo 1.

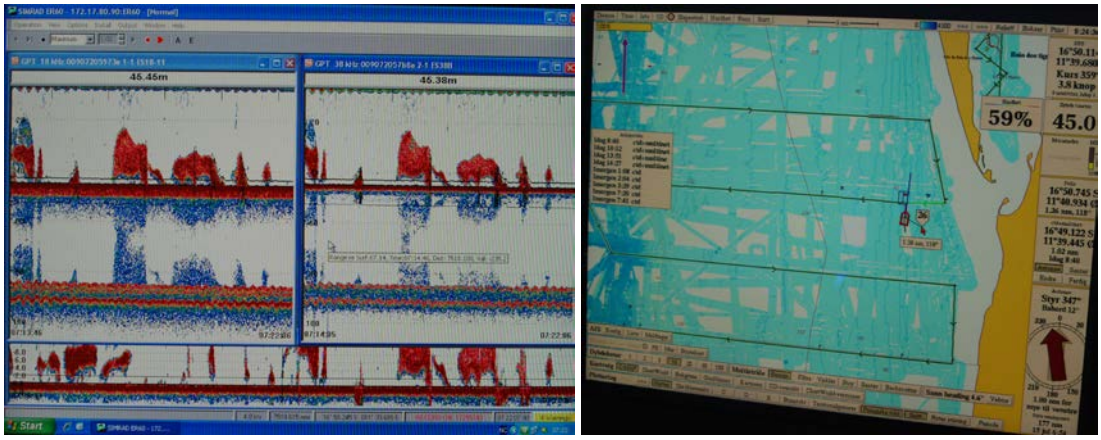


Photo 1. Acoustic registration of horse mackerel south of Baia dos Tigres (16°50'S, 11°39'E).

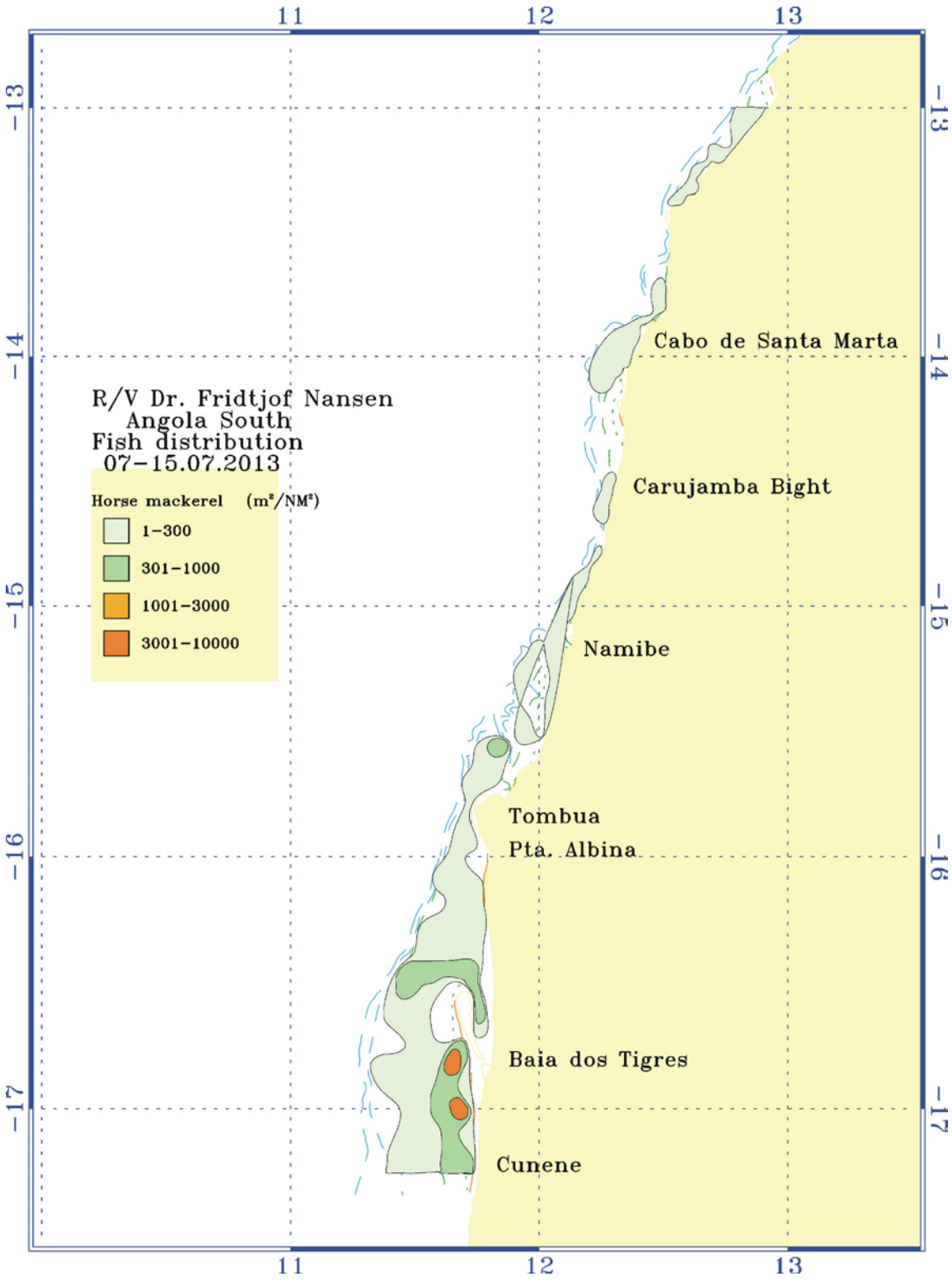
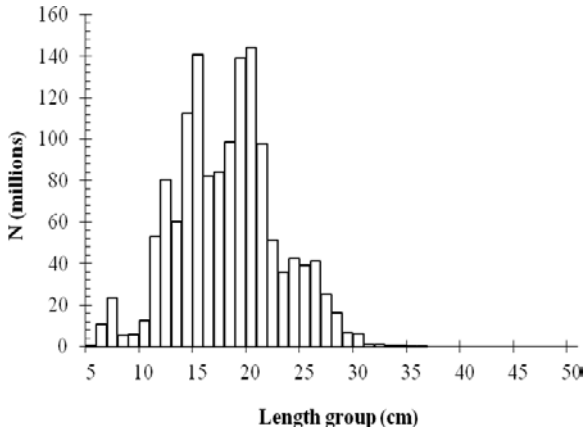


Figure 25. Distribution of horse mackerel (both species). Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 m.

Figure 26 (a,b) shows the length frequency distribution of the Cunene and Cape horse mackerels, respectively. Cunene horse mackerel has four modes, peaking at about 7, 15, 22 and 24/26 cm TL (Figure 26 a). Cape horse mackerel shows two modes at around 12 and 17 cm TL (Figure 26 b). Fish >25 cm TL were practically absent in the catches.

a) Trachurus trecae



b) *Trachurus capensis*

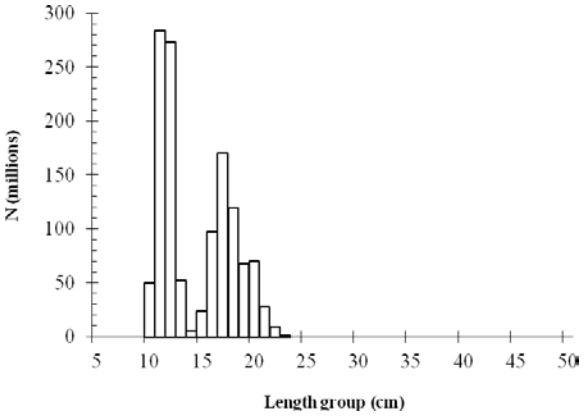


Figure 26 a,b. Total length distributions of *Trachurus trecae* and *T. capensis* Benguela-Cunene.

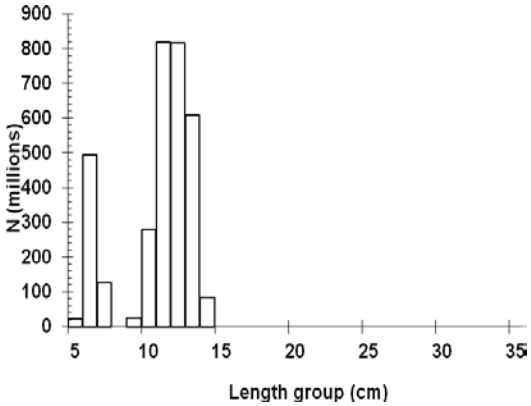
The biomass estimate for both horse mackerel species in the region, was 125 800 tonnes, which is lower than the biomass estimated in 2010 (241 000 tons) and 2012 (324 800 tons), but at the same level as in 2011 (124 500 tonnes). The total biomass was dominated (70%), as usual, by Cunene horse mackerel. The biomass of Cunene horse mackerel was estimated 88 300 tonnes, while Cape horse mackerel biomass was only 37 500 tons.

4.3.3 Pelagic species Group 1

The dominant species belonging to this group were round herring (*Etrumeus whiteheadi*) and anchovy (*Engraulis encrasicolus*). They were found in the area between Namibe and Cunene River of low densities areas ($0< s_A<300$ m^2/NM^2). Area with high fish densities ($301< s_A<1000$ m^2/NM^2), and several schools of very high density ($1001< s_A<10\ 000$ m^2/NM^2) was recorded between Baia dos Tigres and Cunene River (Figure 23).

The biomass for this group was estimated to be 134 000 tonnes. Biomass round herring was 103 000 tons, considering an average TL of 20 cm (based on caught fish) were estimated for and a condition factor of 0.01. Biomass of anchovy was much lower and was 31 000 tons. The length distribution of anchovy two modes at around 6 and 11/12 cm TL, and anchovy length varied from 5 cm to 14 cm.

a) Engraulis encrasicolus



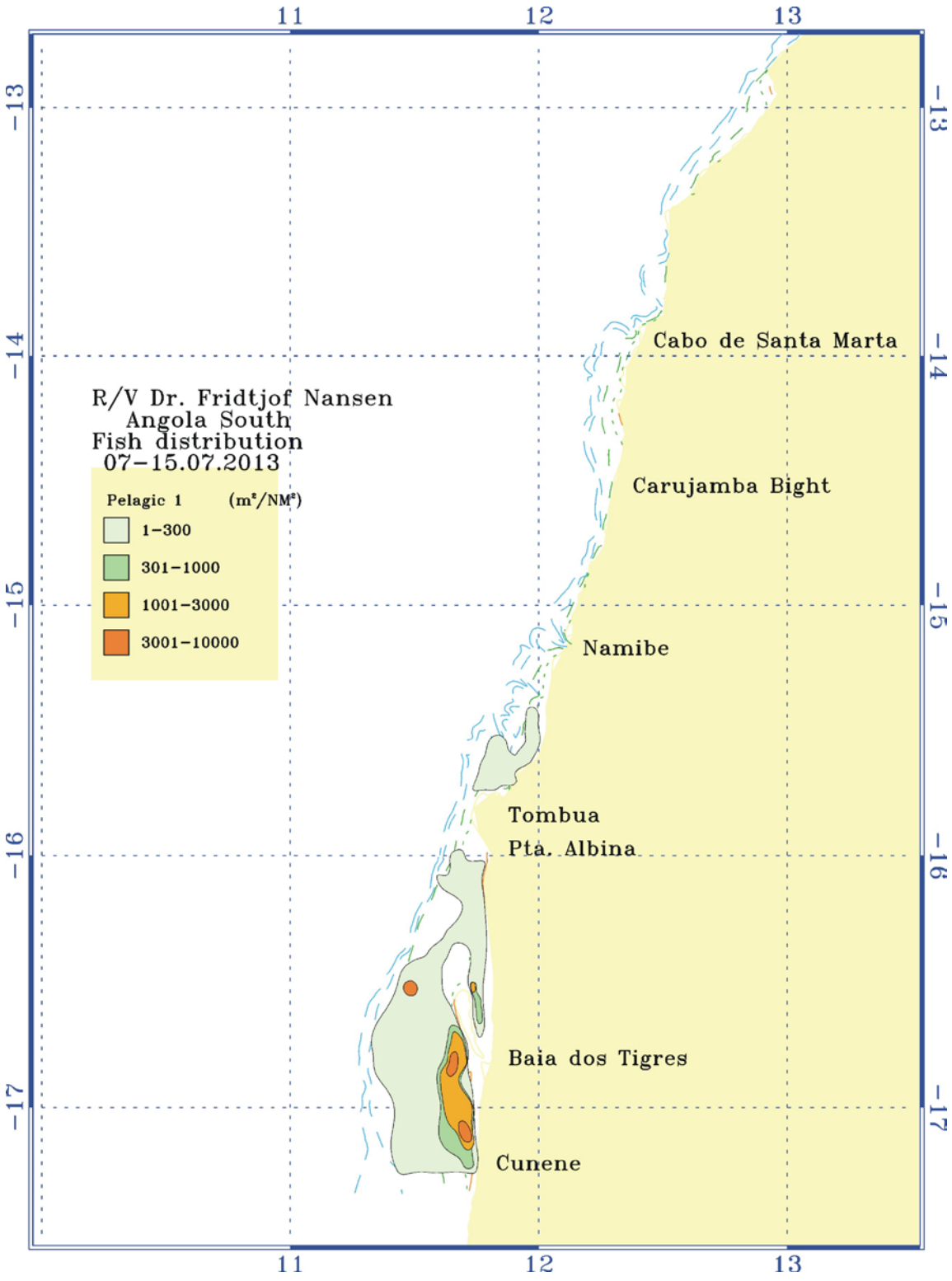


Figure 23. Distribution of Pelagic 1. Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500

4.3.4 Pelagic species Group 2

This group was found distributed within low densities areas ($0<s_A<300$ m^2/NM^2) along the coast between Cabo de Santa Marta and Cunene (Figure 24). The group was dominated by Carangids and Clupeiods (Table 5).

The biomass estimate, based on an average length of 30 cm TL and a condition factor equal to 0.01, was of 33 000 tonnes, compared with 5 000 tons in 2012 and 17 500 tons in 2011.

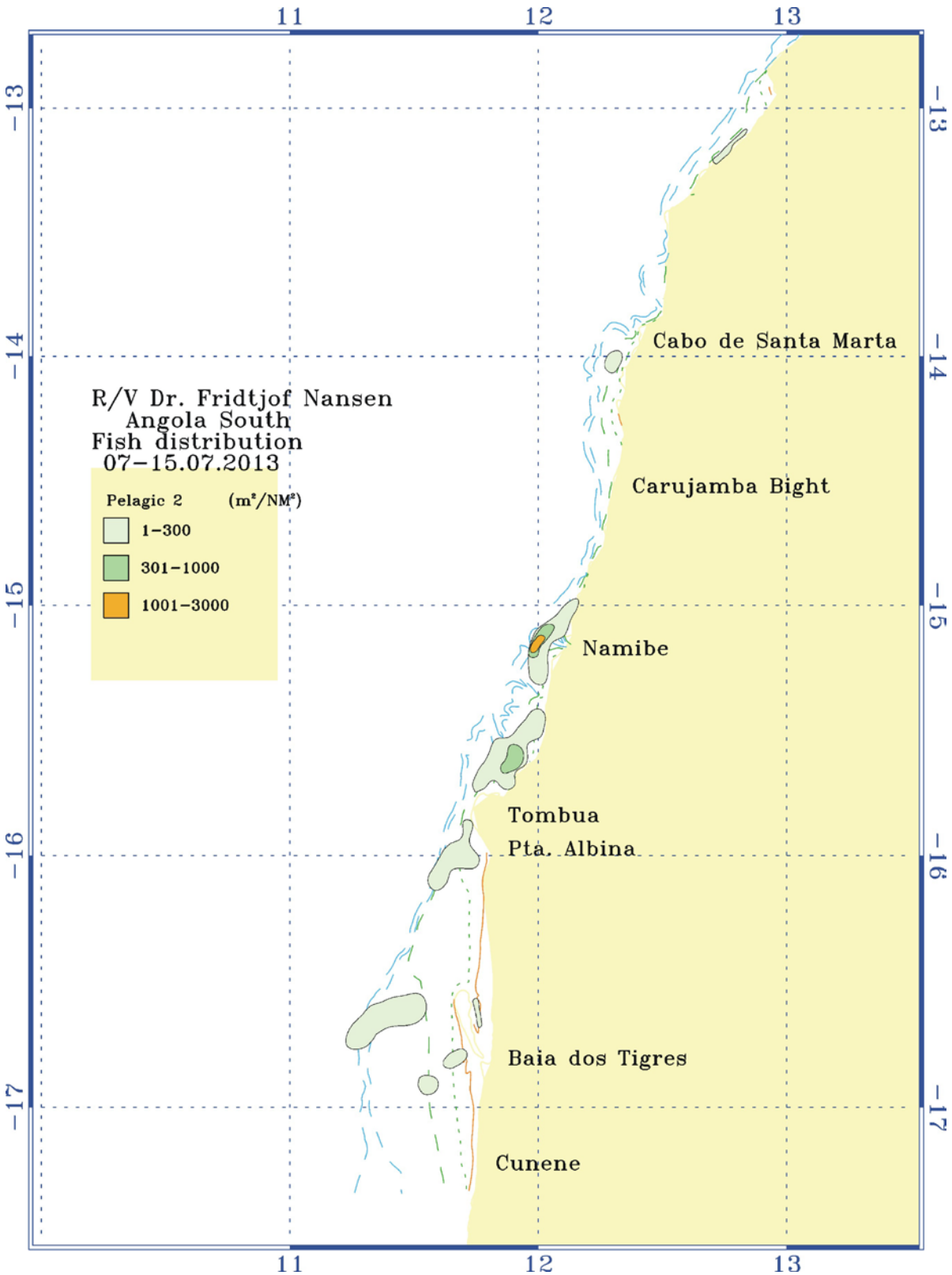


Figure 24. Distribution of Pelagic 2. Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500

Table 5. Catch rates (kg/h) of the main groups of pelagic fish, Benguela - Cunene River.

Station	Gear depth	Barracuda	Carangids	Clupeiods	Hairtails	Horse mackerel	SARD	Scombrids	Other	Total
50	0	0	30.4	0	0.8	30.4	0.9	0	0	45.5
51	0	0	10	0	1.7	10	7.5	0	1.3	30.6
52	125	0	596.4	0	0	596.4	0	0	0	948
53	120	0	53.6	0	0	53.6	0	0	264.1	371.3
54	25	0	728.9	0	0	728.9	6.9	16.8	0	830.7
55	0	0.8	40.3	0.4	0	38.7	359.7	0	0	409.2
56	65.5	0	980.9	0	0	574.7	0	3.3	329	1887.9
57	66.5	0	2159.8	0	0	2159.8	0	0	0	2829.1
58	31	0	874	0	0	845.6	0	0	1167.8	2887.5
59	10	0	1.5	0	0	1.5	0	0	0	1.5
60	0	0	0	14.8	5.7	0	0	0	45.1	65.6
61	0	0	1538.1	0	0	1538.1	0	2.9	0	1564.5
62	0	0	1031.3	29.3	0	1031.3	0	12.7	0	1491.9
63	0	0	197.9	0.2	3.1	197.9	0	16	0	258.7
64	21	0	235.9	0	1.2	235.7	0	0	763.4	1236.1
65	54.5	0	6.9	0	0	6.9	0	0	325.1	339
66	0	0	25.5	0.1	0	25.5	0	0	0	32.1
67	0	0	0	20.9	0	0	0	0	50.2	71.1
68	106	0	39.4	38.3	0	39.4	0	0.4	99.5	217.1
69	10	0	32.4	0.6	0	32.4	0	0	0	36.7
70	0	0	9.6	33	2.4	9.6	0	31.2	37	122.8
71	45	0	17644.9	13088.8	0	17644.9	0	0	0	31311.2
72	110.5	0	732.1	94	0	732.1	0	10.1	742.1	2310.4
73	136.5	0	156.7	0	0	156.7	0	0	652.6	966
74	22.5	0	118.4	463.4	2.4	118.4	0	0.8	0	608.6
75	10	0	0.8	107	0	0.8	0	0	3.9	112.4
76	133.5	0	442.8	0	0	442.8	0	0	900	1785.7
77	60	0	0	0	0	0	0	0	0	0
78	20.5	0	1905.4	485.6	45.2	1905.4	0	0	0	3233.5
Mean	40.4	0	1020.5	495.7	2.1	1005.4	12.9	3.3	-608.8	1931.2
Std dev	47.4	0.1	3253.3	2425	8.4	3254.4	66.7	7.3	3225	5734.6

4.4 Distribution of juveniles and mature fish

Table 6 show the number of biological samples of the target species taken throughout the survey. Measurements of total length, total weight, sex and gonad stage and weight were recorded. To better illustrate the variation in gonad stage throughout the survey area the results per station has been plotted in "Manifold". Before the survey it was decided that stage 6 (post spawners) will not be used due difficulties with separation between stage 6 and stage 1. Therefore results from this survey will not be comparable to the previous surveys.

Fish species	Number of stations	Number of fish
Sardinella maderensis	25	440
Sardinella aurita	14	562
Trachurus trecae	50	1491
Trachurus capensis	5	108
Scomber japonicus	7	18
Total	**101**	**2619**

4.4.1 Sardinella

Sardinella maderensis and *S. aurita* are indeterminate spawners. The spawning periodicity of both species in Angolan waters is not known, but it is likely that they have a prolonged spawning season linked with the seasonal environmental variability and migration pattern.

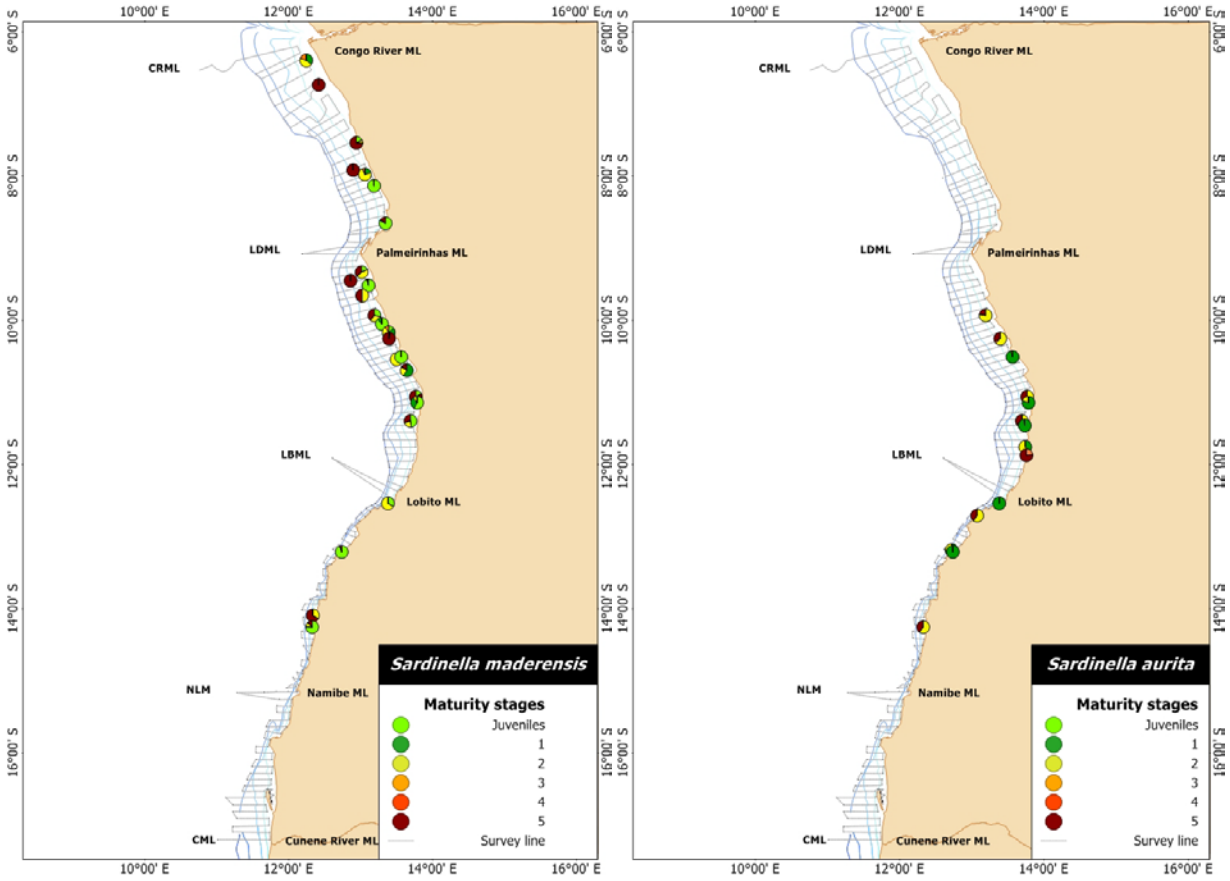


Figure 25. Maturation stages of *S. maderensis* and *Sardinella aurita* during the survey winter 2013. Proportion of maturation stages per station are showed in different colours.

The map of *S. maderensis* maturity stages showed that the most of spawners were distributed in the northern and central areas, and some the mature fish occupied deeper areas than immature. Juveniles and younger fish were distributed along the coast between 6°S and 14°S. In the northern region, the proportion of juveniles, females and males was approximately similar. In the central region 76% of the fish sampled was juveniles while 13% was male while females accounted for 10%. In the southern region, the proportion of female, male and juveniles was similar to the northern area.

The map of gonad stages of *Sardinella aurita* along the Angolan cost shows that younger and smallest observed fish with maturation stage of 1 were distributed separately from other. Samples dominated by fish in maturaty stage 2, and fisg of maturity stage 5 in lesser numbers. In the central region 74% of the fish sampled was female while 26% was male and juveniles accounted for 19%. In the southern region the proportion of female and male fish was 58% and 48% respectively.

4.4.2 Horse mackerel

Horse mackerels *T. trecae* and *T. capensis* are indeterminate spawners. A latitudinal trend in oocyte development in both species indicates that spawning is segregated and widely distributed, and both species probably have a prolonged spawning season (Ndjaula et al in press). *T. capensis* spawn in Namibian waters throughout the year with peak between December and March (Wysokinski 1985). There is no information on the spawning seasons of *T. trecae* in Angolan waters.

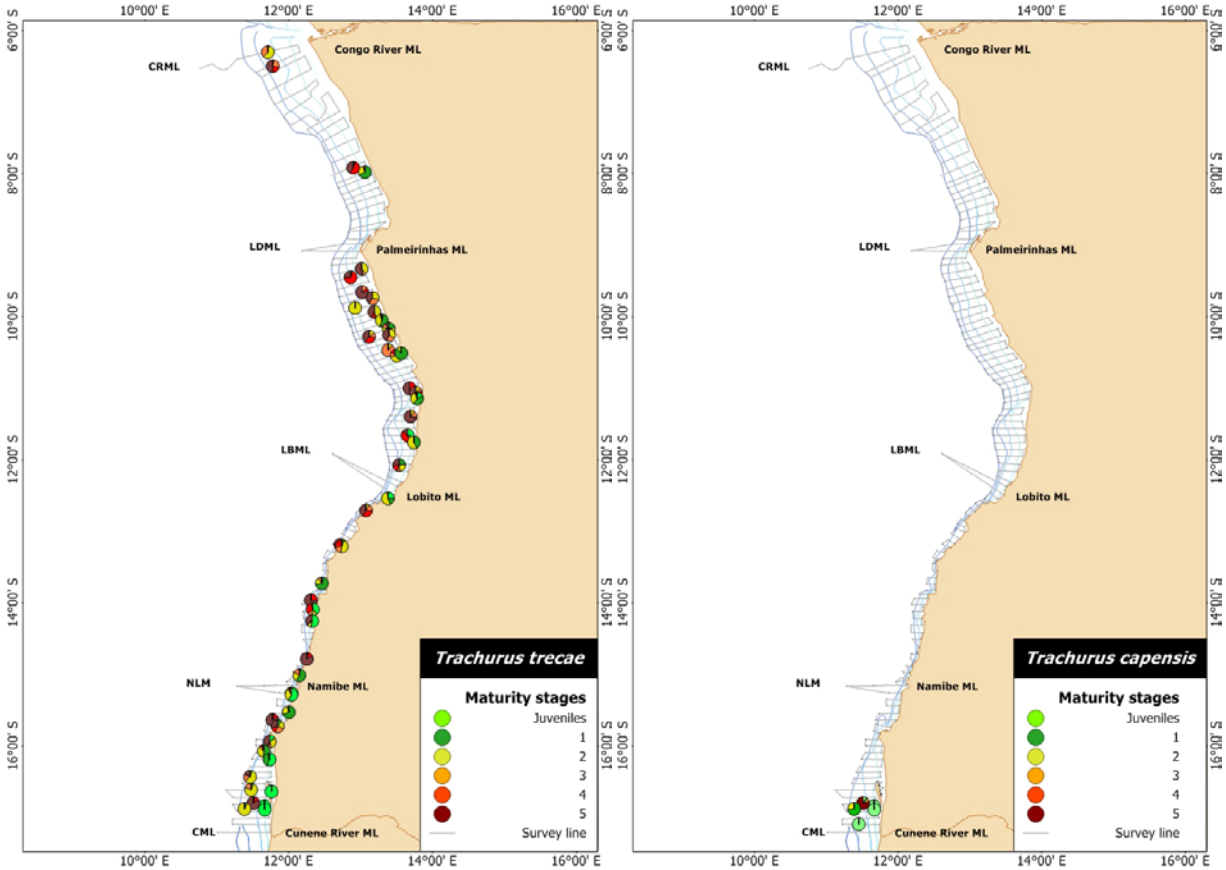


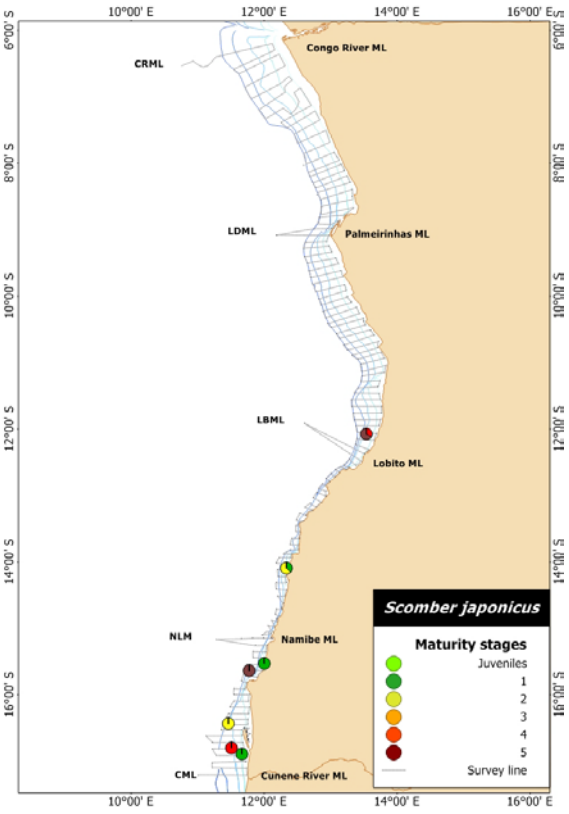
Figure 26. Maturation stages of horse mackerels *T. trecae* and *T. capensis* during the survey winter 2013. Proportion of maturation stages per station are showed in different colours.

The map of *T. trecae* maturity stages showed that juveniles found mainly inshore, while spawners (stage 5) in the deeper areas. In the northern area no juveniles were found, and 47% of the fish sampled was

female while 53% was male. In the central region 52% of the fish sampled was female while 44% was male and juveniles accounted for 3%. In the southern region the proportion of males and juveniles increased comparing to northern and central area, since 33% of the fish sampled was female while 46% was male and 21% was juveniles.

We only found *T. trecae* in the southern region of Angola and the samples were dominated by juveniles (50%), while the female and male accounted for 31% and 27%, respectively of the samples. The *Trachurus capensis* was distributed further south than previously years, being found only south of Tiger Bay. Only 21% of fish were spawners at stage 5, and they were found separately from the other stage fish.
Juvenile fish dominated with 56% of the samples in this region.

4.4.3 Scomber japonicus



Only few *Scomber japonicus* were found in the central (21 fish) and southern (76 fish) regions. The biological samples were taken from 18 fish.

In the central region were taken 3 fish and all of them were males, while in the southern region the biological samples number of females and males were approximately similar.

CHAPTER 5 SUMMARY OF SURVEY RESULTS

5.1 Sardinella

The estimated biomass of sardinella shows a cyclic fluctuating pattern throughout the time series (Figure 30). 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 sardinella was 484 000 tons. This is, however, about 20% lower than the biomass estimated in previous years 2010-2012 (600 000 tons), and continues the downward trend since winter 2012. The current downward trend still warrants for some caution in the management of these stocks. It is therefore important to follow the landings of these stocks carefully, and the development of the biomass levels over the next years should be followed closely. At this point in time, it is not advisable to increase the fishing pressure on these stocks.

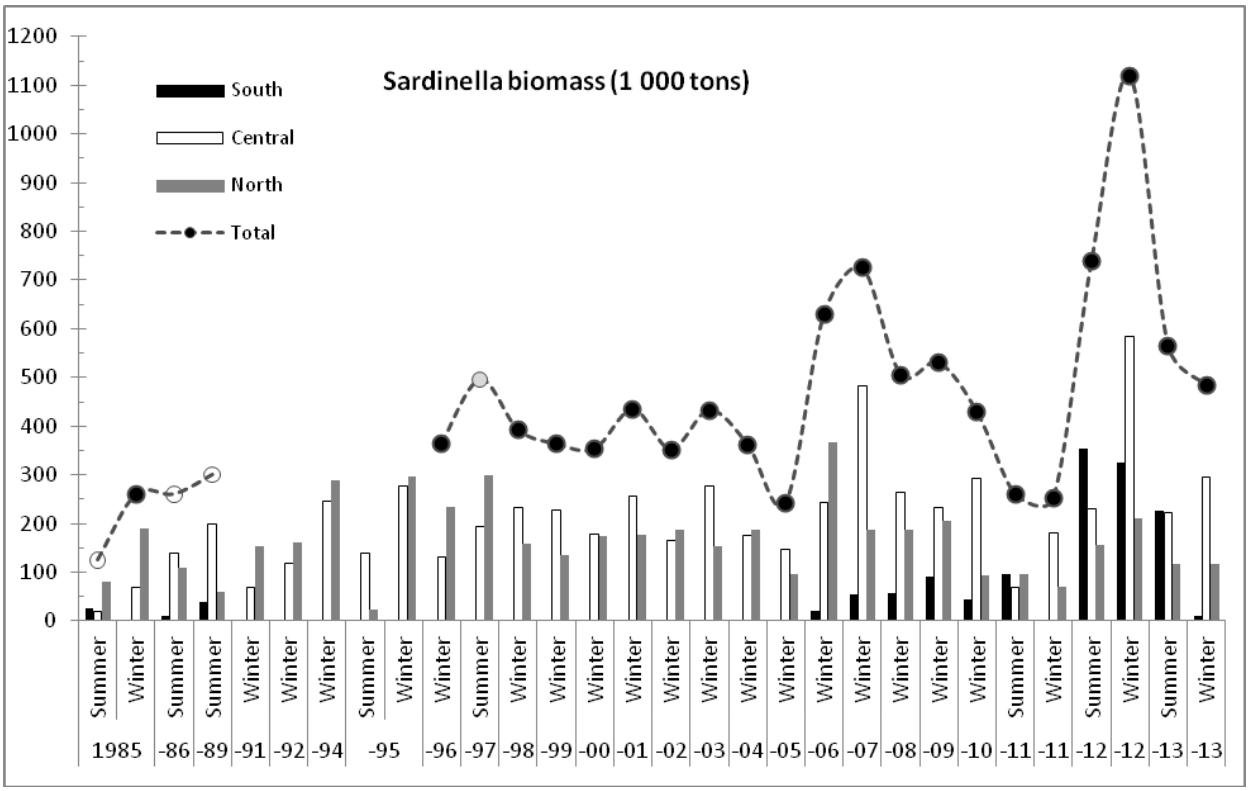


Figure 30. Biomass estimates of Sardinella by regions and surveys (1 000 tonnes).

5.2 Cunene horse mackerel

The total biomass of Cunene horse mackerel was estimated at 257 000 tons (Figure 31). This is higher than winter 2012 and summer 2013 estimates, and higher than long term mean (2000-12) of 160 000 tons.

The bulk of the biomass was unusually found in the central region (117 000 tons), comparing to previous years when the bulk of biomass was found in the Southern region. The biomass levels in the northern and southern regions was at a low level, contributing with 140 000 tonnes to the total biomass. There is a positive tendency of increasing biomass of adult fish >20 cm total length in all regions, and a bulk of biomass was made of fish with 20-30 cm, while larger fish (>30 cm) contributed only 20 %. Distribution shift from the southern area to the central area may probably cause the dominance of younger fish, which contributed 51 % of total abundance.

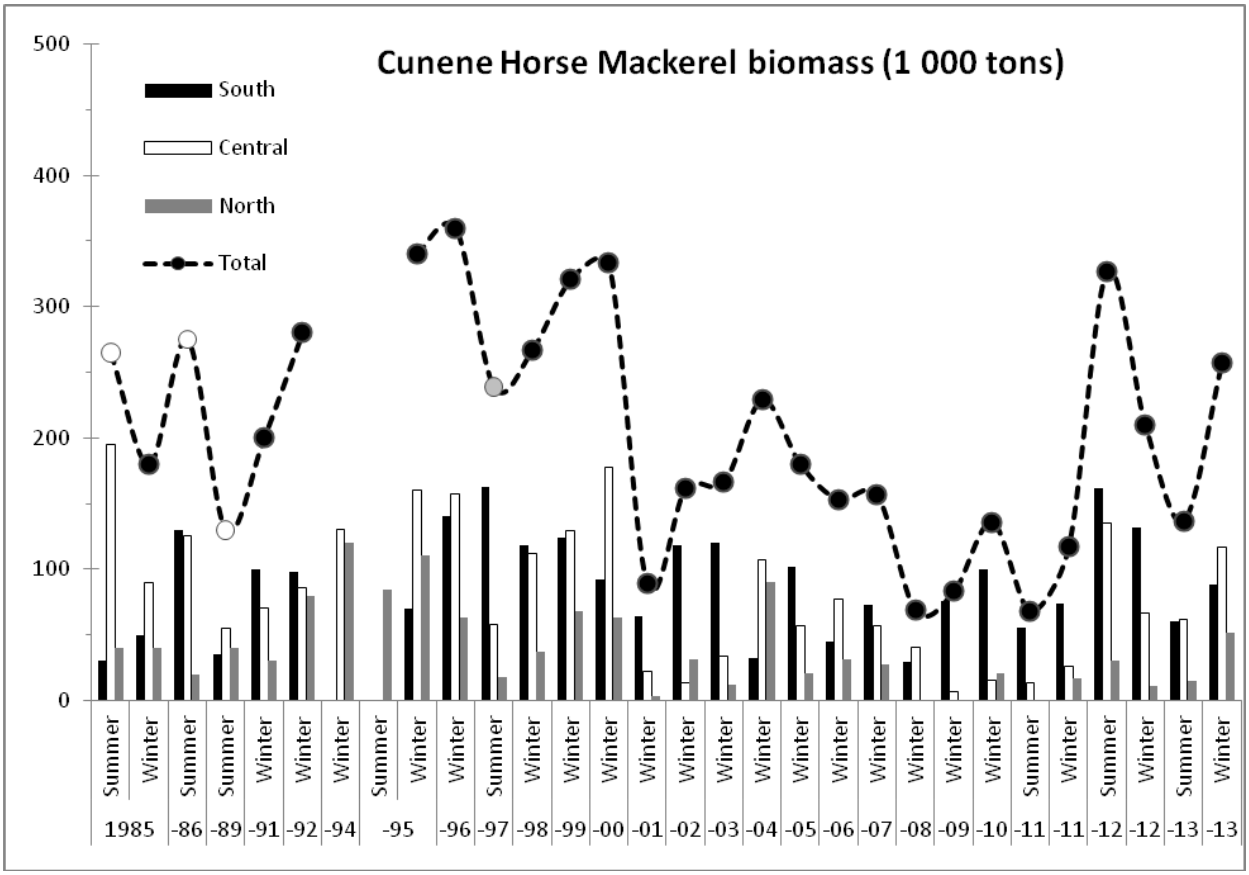


Figure 31. Biomass estimates of Cunene horse mackerel by regions and surveys (1 000 tonnes).

The total biomass of Cape horse mackerel was estimated at 123 000 tonnes. This is, about 41% higher the biomass estimated in 2011 (50 300 tonnes) for the winter survey.

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

REFERENCES

FOOTE, K. G. 1987 — Fish target strengths for use in echo integrator surveys. *J. Acoust. Soc. Am.* **82**(3): 981-987.

FOOTE, K. G., AGLEN, A. and O. NAKKEN 1986 — Measurements of fish target strength with a split-beam echo sounder. *J. Acoust. Soc. Am.* **80**(2): 612-621.

KORNELIUSSEN, R.J., ONA, E., ELIASSEN, I.K., HEGGELUND, Y., PATEL, R., GODØ, O.R., GIERTSEN, C., PATEL, D., NORNES, E.H., BEKKVIK, T., KNUDSEN, H.P. and LIEN, G. 2006. The Large Scale Survey System-LSSS, a new post-processing system for multi-frequency echo sounder data. ICES WGFAST Report 2006

MISUND, O. A. and A. AGLEN 1992 — Swimming behaviour of fish schools in the North Sea during acoustic surveying and pelagic trawl sampling. *ICES J. Mar. Sci.* **49**: 3

H.O.N. NDJAULA, J-O KRAKSTAD and O.S. KJESBU. Accepted. — Reproductive biology of horse mackerel Trachurus capensis and Trachurus trecae in Namibia and Angola. African Journal of Marine Science

ANNEX I. RECORDS OF FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 1
DATE :22/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 6°18.13
start stop duration Lon E 11°42.52
TIME :02:20:44 02:40:09 19.4 (min) Purpose : 1
LOG : 4064.25 4065.28 1.0 Region : 4054
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 117 116 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.2 kn
Sorted : 3 Total catch: 3.37 Catch/hour: 10.41

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	7.11	142	68.25	1
Trichiurus lepturus	1.98	3	18.99	
J E L L Y F I S H	0.87	3	8.31	
Ariomma bondi	0.28	12	2.67	
Illex coindetii	0.06	6	0.59	
Lagocephalus laevigatus	0.06	19	0.59	
Saurida brasiliensis	0.03	9	0.30	
Selene dorsalis	0.03	3	0.30	
Total	10.41		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 2
DATE :22/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 6°29.76
start stop duration Lon E 11°46.65
TIME :10:32:53 11:02:47 29.9 (min) Purpose : 1
LOG : 4124.43 4125.97 1.5 Region : 4054
FDEPTH: 129 128 Gear cond.: 0
BDEPTH: 129 128 Validity : 0
Towing dir: 0° Wire out : 330 m Speed : 3.1 kn
Sorted : 21 Total catch: 117.75 Catch/hour: 236.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex angolensis	110.89	644	46.93	2
Dentex congoensis	33.15	670	14.03	3
Pterothrissus belloci	18.06	163	7.64	
G A S T R O P O D S	15.93	1732	6.74	
Spicara alta	12.64	229	5.35	
Lepidotrigla carolae	12.60	237	5.33	
Trachurus trecae	12.58	201	5.32	4
Illex coindetii	4.49	163	1.90	
Zeus faber	4.41	10	1.87	
Trichiurus lepturus	3.61	8	1.53	
Ariomma bondi	2.75	54	1.16	
Octopus vulgaris	1.10	2	0.47	
Sepia orbignyana	1.04	12	0.44	
Citharus linguatula	1.04	76	0.44	
Raja miraletus	0.62	4	0.26	
Peristedion cataphractum	0.58	16	0.25	
Uranoscopus polli	0.32	2	0.14	
Saurida brasiliensis	0.24	56	0.10	
Microchirus wittei	0.10	2	0.04	
Starfish	0.08	2	0.03	
Arnoglossus imperialis	0.02	4	0.01	
Total	236.29		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 3
DATE :22/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 6°23.88
start stop duration Lon E 12°14.57
TIME :06:17:33 06:29:08 11.6 (min) Purpose : 1
LOG : 4192.60 4193.44 0.8 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 28 30 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 4.4 kn
Sorted : 124 Total catch: 409.54 Catch/hour: 2120.14

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	1601.73	14915	75.55	5
Brachydeuterus auritus	382.67	4561	18.05	6
Ilisha africana	38.93	1077	1.84	7
Caranx senegallus	37.74	186	1.78	
Sphyraena guachancho	25.78	88	1.22	
Trichiurus lepturus	11.44	104	0.54	
Sphyraena sphyraena	11.29	36	0.53	
Galeoides decadactylus	3.93	36	0.19	
Selene dorsalis	3.57	36	0.17	
Scomberomorus tritor	2.38	5	0.11	8
Penaeus notialis	0.68	16	0.03	
Total	2120.15		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 4
DATE :23/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 6°52.74
start stop duration Lon E 12°7.73
TIME :07:22:33 07:54:26 31.9 (min) Purpose : 1
LOG : 4287.52 4289.18 1.7 Region : 4054
FDEPTH: 85 85 Gear cond.: 0
BDEPTH: 85 85 Validity : 0
Towing dir: 0° Wire out : 230 m Speed : 3.1 kn
Sorted : 17 Total catch: 148.33 Catch/hour: 279.17

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pagellus bellottii	58.34	651	20.90	12
Dentex congoensis	55.80	1216	19.99	11
Dentex angolensis	35.31	352	12.65	10
Trigla lyra	24.77	181	8.87	
Rhinobatos albomaculatus	17.50	6	6.27	
Fistularia petimba	16.64	41	5.96	
G A S T R O P O D S	13.25	155	4.75	
Mustelus mustelus	11.33	6	4.06	
Octopus vulgaris	7.89	6	2.82	
Illex coindetii	6.87	260	2.46	
Sepia orbignyana	6.46	107	2.31	
Alloteuthis africana	5.51	636	1.98	
Raja miraletus	3.59	6	1.29	
Lagocephalus laevigatus	3.14	2	1.13	
Raja clavata	2.92	2	1.04	
Saurida brasiliensis	2.71	557	0.97	
Starfish	2.50	964	0.90	
Branchiostegus semifasciatus *	1.34	2	0.48	
Zeus faber	1.28	8	0.46	
Citharus linguatula	1.05	207	0.38	
Dentex barnardi	0.81	4	0.29	9
Bembrops heterurus	0.13	4	0.05	
Arnoglossus imperialis	0.02	4	0.01	
Total	279.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 5
DATE :23/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 6°44.25
start stop duration Lon E 12°24.94
TIME :11:13:57 11:27:40 13.7 (min) Purpose : 1
LOG : 4313.09 4313.88 0.8 Region : 4054
FDEPTH: 23 23 Gear cond.: 0
BDEPTH: 23 23 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.5 kn
Sorted : 128 Total catch: 510.16 Catch/hour: 2231.02

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	890.73	10181	39.92	14
Selene dorsalis	500.29	3499	22.42	15
Chloroscombrus chrysurus	397.78	3026	17.83	16
Galeoides decadactylus	194.17	962	8.70	
Pagrus caeruleostictus	48.98	87	2.20	
Pseudotolithus senegalensis	47.93	52	2.15	
Sardinella maderensis	36.91	245	1.65	13
Pagellus bellottii	26.76	122	1.20	17
Arius parkii	23.79	52	1.07	
Sphyraena guachancho	20.82	52	0.93	
Rhinobatos albomaculatus	20.82	17	0.93	
Ephippion guttifer	12.59	17	0.56	
Pseudupeneus prayensis	3.15	35	0.14	
Dicologoglossa hexophthalma	2.80	17	0.13	
Stephanolepis hispidus	2.10	17	0.09	
Decapterus rhonchus	1.40	17	0.06	
Total	2231.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 6
DATE :23/06/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 7°9.44
start stop duration Lon E 11°59.44
TIME :04:05:20 04:20:04 14.7 (min) Purpose : 1
LOG : 4357.13 4357.96 0.8 Region : 4054
FDEPTH: 280 300 Gear cond.: 0
BDEPTH: 321 316 Validity : 0
Towing dir: 0° Wire out : 750 m Speed : 3.4 kn
Sorted : 19 Total catch: 207.81 Catch/hour: 847.05

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	831.73	556	98.19	
Trichiurus lepturus	15.33	29	1.81	
Total	847.05		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 7
DATE :24/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 6°56.57
start stop duration Lon E 12°35.32
TIME :02:08:58 02:28:54 19.9 (min) Purpose : 1
LOG : 4441.04 4442.22 1.2 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 24 26 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.6 kn
Sorted : 0 Total catch: 31.35 Catch/hour: 94.33

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Decapterus rhonchus	20.88	69	22.14	19
Brachydeuterus auritus	14.44	153	15.31	18
Galeoides decadactylus	10.83	54	11.48	
Pagellus bellottii	9.87	63	10.46	20
Pagrus caeruleostictus	7.88	21	8.36	
Atractoscion aequidens	7.58	3	8.04	
MYCTOPHIDAE	7.40	4381	7.85	
Aluterus heudelotii	2.65	3	2.81	
Plectorhinchus mediterraneus	2.59	3	2.74	
Sepia officinalis	2.38	3	2.52	
Stromateus fiatola	2.20	3	2.33	
Dentex gibbosus	1.59	9	1.69	
Lutjanus agennes	1.11	39	1.18	
Pseudupeneus prayensis	0.96	48	1.02	
Sphyraena sphyraena	0.51	6	0.54	
Sardinella maderensis	0.48	3	0.51	
Calappa rubroguttata	0.39	3	0.41	
Pomadasys incisus	0.39	3	0.41	
Boops boops	0.18	15	0.19	
Total	94.33		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 8
DATE :24/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 7°14.43
start stop duration Lon E 12°45.56
TIME :02:11:01 02:30:27 19.4 (min) Purpose : 1
LOG : 4529.82 4531.06 1.2 Region : 4054
FDEPTH: 29 29 Gear cond.: 0
BDEPTH: 29 29 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
Sorted : 124 Total catch: 305.13 Catch/hour: 942.24

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	299.78	5484	31.82	21
Pagrus caeruleostictus	188.92	596	20.05	
Pomadasys incisus	140.91	1272	14.95	
Stromateus fiatola	100.42	164	10.66	
Galeoides decadactylus	55.83	219	5.93	
Epinephelus aeneus	53.79	9	5.71	
Dentex gibbosus	20.04	49	2.13	24
Pseudupeneus prayensis	13.65	170	1.45	
Pagellus bellottii	12.91	71	1.37	22
Pagrus africanus	11.64	6	1.24	
Sphyraena guachancho	10.31	37	1.09	
Dentex barnardi	10.10	43	1.07	23
Sphyraena sphyraena	7.66	28	0.81	
Sepia officinalis	6.39	3	0.68	
Selene dorsalis	4.05	28	0.43	
Zanobatus shoenleinii	2.50	6	0.27	
Pomadasys rogeri	2.41	6	0.26	
Chaetodon robustus	0.93	15	0.10	
Total	942.24		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 9
DATE :24/06/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 7°38.07
start stop duration Lon E 12°41.91
TIME :10:03:22 10:10:02 6.7 (min) Purpose : 1
LOG : 4594.77 4595.15 0.4 Region : 4054
FDEPTH: 40 50 Gear cond.: 0
BDEPTH: 98 100 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.4 kn
Sorted : 0 Total catch: 3.83 Catch/hour: 34.45

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trichiurus lepturus	24.38	63	70.76	
Sepia officinalis	5.49	9	15.93	
Saurida brasiliensis	2.43	2042	7.05	
Illex coindetii	2.16	9	6.27	

Total	34.45	100.00

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 10
DATE :25/06/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 7°32.40
start stop duration Lon E 12°56.33
TIME :12:58:54 01:14:28 15.6 (min) Purpose : 1
LOG : 4616.41 4617.39 1.0 Region : 4054
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 25 25 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.8 kn
Sorted : 0 Total catch: 69.68 Catch/hour: 268.52

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Sardinella maderensis	159.19	1299 59.29	25
Sphyraena guachancho	49.33	189 18.37	
Brachydeuterus auritus	11.56	728 4.31	26
Ilisha africana	11.29	551 4.20	27
Trichiurus lepturus	9.52	285 3.54	
Galeoides decadactylus	7.82	139 2.91	
Arius parkii	6.28	4 2.34	
Dentex barnardi	3.78	12 1.41	
Pomadasys incisus	3.43	31 1.28	
Eucinostomus melanopterus	3.31	39 1.23	
Scomberomorus tritor	1.77	4 0.66	
Pomadasys sp.	0.85	19 0.32	
Sepia officinalis	0.27	4 0.10	
Penaeus notialis	0.12	4 0.04	
Total	268.52	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 11
DATE :25/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 7°54.14
start stop duration Lon E 12°54.13
TIME :11:26:10 11:33:52 7.7 (min) Purpose : 1
LOG : 4686.52 4686.96 0.4 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 83 82 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.4 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 12
DATE :25/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 7°55.13
start stop duration Lon E 12°53.76
TIME :12:18:25 12:43:10 24.8 (min) Purpose : 1
LOG : 4690.50 4691.73 1.2 Region : 4054
FDEPTH: 87 86 Gear cond.: 0
BDEPTH: 87 86 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 3.0 kn
Sorted : 101 Total catch: 430.48 Catch/hour: 1043.59

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Selene dorsalis	518.96	2456 49.73	30
Pomadasys incisus	200.00	7 19.16	
Dentex congoensis	58.88	960 5.64	32
Trachurus trecae	35.01	145 3.35	28
Sepia orbignyana	32.48	97 3.11	
Rhinobatos albomaculatus	29.04	7 2.78	
Alloteuthis africana	28.41	5096 2.72	
Dentex angolensis	23.61	383 2.26	31
Lepidotrigla cadmani	19.27	208 1.85	
Pseudupeneus prayensis	15.61	303 1.50	
Pagellus bellottii	13.12	143 1.26	33
Raja miraletus	13.04	32 1.25	
Sardinella maderensis	12.17	56 1.17	29
Trichiurus lepturus	10.18	7 0.98	
Octopus vulgaris	6.16	7 0.59	
Citharus linguatula	6.08	480 0.58	
Torpedo torpedo	6.08	7 0.58	
Uranoscopus cadenati	2.88	17 0.28	
Umbrina canariensis	2.88	17 0.28	
Zeus faber	2.81	7 0.27	
Saurida brasiliensis	2.08	352 0.20	
Brotula barbata	1.67	7 0.16	
Chaetodon hoefleri	1.53	7 0.15	
Grammoplites gruveli	1.04	17 0.10	
Boops boops	0.32	7 0.03	
Illex coindetii	0.24	7 0.02	
Total	1043.59	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 13
DATE :25/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 7°58.68
start stop duration Lon E 13°3.52
TIME :05:23:56 05:39:23 15.4 (min) Purpose : 1
LOG : 4722.91 4724.02 1.1 Region : 4054
FDEPTH: 0 20 Gear cond.: 0
BDEPTH: 53 59 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 4.3 kn
Sorted : 5 Total catch: 184.19 Catch/hour: 715.76

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Brachydeuterus auritus	630.58	9785 88.10	34
Sardinella maderensis	57.05	451 7.97	36
Ilisha africana	20.21	163 2.82	37
Trachurus trecae	6.45	74 0.90	35
Chloroscombrus chrysurus	0.97	8 0.14	
Alloteuthis africana	0.39	97 0.05	
Trichiurus lepturus	0.08	4 0.01	
Saurida brasiliensis	0.04	354 0.01	
Total	715.76	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 14
DATE :26/06/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 8°8.21
start stop duration Lon E 13°11.15
TIME :01:48:10 02:02:39 14.5 (min) Purpose : 1
LOG : 4792.60 4793.43 0.8 Region : 4054
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 34 39 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.4 kn
Sorted : 65 Total catch: 194.67 Catch/hour: 806.64

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Brachydeuterus auritus	773.08	26465 95.84	38
Ilisha africana	10.19	162 1.26	39
Sardinella maderensis	10.19	323 1.26	40
Sphyraena guachancho	7.21	25 0.89	
Selene dorsalis	3.73	37 0.46	
Chloroscombrus chrysurus	1.49	12 0.18	
Trichiurus lepturus	0.50	25 0.06	
Sepia officinalis	0.12	12 0.02	
Saurida brasiliensis	0.12	12 0.02	
Total	806.64	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 15
DATE :27/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 8°39.31
start stop duration Lon E 13°20.77
TIME :09:58:32 10:26:39 28.1 (min) Purpose : 1
LOG : 5037.44 5039.13 1.7 Region : 4054
FDEPTH: 24 23 Gear cond.: 0
BDEPTH: 24 23 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.6 kn
Sorted : 154 Total catch: 1691.91 Catch/hour: 3610.05

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Brachydeuterus auritus	2022.72	55110 56.03	42
Sepia orbignyana	532.79	446 14.76	
Sardinella maderensis	305.59	22415 8.46	41
Galeoides decadactylus	136.83	1009 3.79	
Pseudupeneus prayensis	113.83	1174 3.15	
Pagellus bellottii	88.49	751 2.45	44
Pomadasys incisus	81.44	868 2.26	
Pseudotolithus senegalensis	66.66	164 1.85	
Trachinotus teraia	51.40	23 1.42	
Sphyraena guachancho	47.88	681 1.33	
Balistes capriscus	36.38	70 1.01	
Selene dorsalis	35.68	563 0.99	43
Cynoglossus senegalensis	21.36	23 0.59	
Trichiurus lepturus	20.18	563 0.56	
Pteroscion peli	11.03	141 0.31	
Aluterus heudelotii	8.45	23 0.23	
Eucinostomus melanopterus	6.10	70 0.17	
Epinephelus aeneus	5.87	23 0.16	
Penaeus notialis	4.22	70 0.12	
Chloroscombrus chrysurus	3.99	70 0.11	
Ilisha africana	3.76	47 0.10	
Penaeus kerathurus	3.76	70 0.10	
Grammoplites gruveli	1.64	211 0.05	
Total	3610.05	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 16
DATE :28/06/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 9°15.95
start stop duration Lon E 12°49.08
TIME :10:05:30 10:35:37 30.1 (min) Purpose : 1
LOG : 5210.09 5211.77 1.7 Region : 4040
FDEPTH: 30 60 Gear cond.: 0
BDEPTH: 100 103 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.3 kn
Sorted : 2 Total catch: 2.24 Catch/hour: 4.46

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
THYSANOTEUTHIDAE	4.46	4 100.00	
Total	4.46	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 17
DATE :28/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 9°19.90
start stop duration Lon E 13°0.79
TIME :12:45:06 01:04:06 19.0 (min) Purpose : 1
LOG : 5230.20 5231.30 1.1 Region : 4040
FDEPTH: 23 24 Gear cond.: 0
BDEPTH: 23 24 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.5 kn
Sorted : 108 Total catch: 844.81 Catch/hour: 2667.82

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Brachydeuterus auritus	1265.34	23769 47.43	47
J E L L Y F I S H	607.42	764 22.77	
Trachurus trecae	231.54	2637 8.68	45
Ilisha africana	96.57	1699 3.62	49
Sphyraena guachancho	79.83	272 2.99	
Pagellus bellottii	73.17	493 2.74	48
Galeoides decadactylus	70.20	543 2.63	
Pteroscion peli	61.07	739 2.29	
Pomadasys incisus	59.12	493 2.22	
Pseudupeneus prayensis	26.84	272 1.01	
Sardinella maderensis	24.38	271 0.91	46
Stromateus fiatola	19.71	51 0.74	
Sepia orbignyana	15.47	9 0.58	
Arius parkii	10.11	25 0.38	
Eucinostomus melanopterus	9.35	73 0.35	
Pseudotolithus senegalensis	6.88	25 0.26	
Trachinus armatus	4.42	51 0.17	
Selene dorsalis	2.97	51 0.11	
Calappa rubroguttata	1.58	25 0.06	
Trachinocephalus myops	1.23	25 0.05	
Penaeus kerathurus	0.63	25 0.02	
Total	2667.82	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 18
DATE :28/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 9°27.09
start stop duration Lon E 12°51.52
TIME :07:15:00 07:44:58 30.0 (min) Purpose : 1
LOG : 5279.92 5281.75 1.8 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 99 95 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.7 kn
Sorted : 13 Total catch: 136.93 Catch/hour: 274.13

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Trichiurus lepturus	181.90	494 66.36	
Lagocephalus laevigatus	51.49	54 18.78	
Trachurus trecae	33.75	58 12.31	50
Sardinella maderensis	3.32	12 1.21	51
Saurida brasiliensis	3.22	2 1.18	
Alloteuthis africana	0.44	144 0.16	
Total	274.13	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 19
DATE :28/06/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 9°31.06
start stop duration Lon E 13°6.57
TIME :10:15:24 10:44:16 28.9 (min) Purpose : 1
LOG : 5301.42 5302.98 1.6 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 24 24 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.2 kn
Sorted : 0 Total catch: 49.23 Catch/hour: 102.31

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers	SAMP
Pagellus bellottii	42.06	71 41.11	54
Brachydeuterus auritus	33.46	316 32.70	52
Sardinella maderensis	13.97	1958 13.65	53
Balistes capriscus	3.24	4 3.17	
Dentex barnardi	2.04	6 1.99	
Ilisha africana	1.79	27 1.75	55
Galeoides decadactylus	1.66	6 1.63	
Sphyraena guachancho	1.29	17 1.26	
Stromateus fiatola	1.10	2 1.08	
Chelidonichthys capensis	0.56	2 0.55	
Decapterus rhonchus	0.37	2 0.37	
Boops boops	0.33	12 0.33	56
Pteroscion peli	0.25	2 0.24	
Trichiurus lepturus	0.19	6 0.18	
Total	102.31	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 20
DATE :29/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 9°39.50
start stop duration Lon E 13°1.20
TIME :07:36:16 08:07:11 30.9 (min) Purpose : 1
LOG : 5362.20 5363.81 1.6 Region : 4040
FDEPTH: 80 79 Gear cond.: 0
BDEPTH: 80 79 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 3.1 kn
Sorted : 130 Total catch: 364.07 Catch/hour: 706.47

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	462.44	2071	65.46	68
Stromateus fiatola	54.99	76	7.78	
Selene dorsalis	30.75	93	4.35	61
Sepia orbignyana	17.17	39	2.43	
Dentex barnardi	17.01	76	2.41	58
Alloteuthis africana	16.90	8111	2.39	
Lagocephalus laevigatus	14.29	16	2.02	
Raja miraletus	12.82	21	1.82	
Dentex angolensis	12.50	142	1.77	59
Octopus vulgaris	10.54	12	1.49	
Zeus faber	10.32	12	1.46	
Trichiurus lepturus	10.16	12	1.44	
Pagellus bellottii	9.83	60	1.39	60
G A S T R O P O D S	2.99	483	0.42	
Epinephelus aeneus	2.93	6	0.42	
Citharus linguatula	2.77	169	0.39	
Sardinella maderensis	2.61	11	0.37	57
Boops boops	2.61	109	0.37	62
Starfish	2.17	522	0.31	
Brotula barbata	1.85	12	0.26	
Chelidonichthys gabonensis	1.68	12	0.24	
Branchiostegus semifasciatus *	1.68	6	0.24	
Pseudupeneus prayensis	1.30	6	0.18	
Bembrops heterurus	1.03	16	0.15	
Saurida brasiliensis	1.03	239	0.15	
Dentex congoensis	0.65	6	0.09	
Microchirus frechkopi	0.33	6	0.05	
Syacium micrurum	0.33	49	0.05	
J E L L Y F I S H	0.22	6	0.03	
Uranoscopus cadenati	0.17	6	0.02	
Illex coindetii	0.16	6	0.02	
C R A B S	0.11	16	0.02	
Anthias anthias	0.05	6	0.01	
GOBIIDAE	0.05	6	0.01	
Total	706.46		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 21
DATE :29/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 9°44.35
start stop duration Lon E 13°9.91
TIME :11:24:39 11:47:11 22.5 (min) Purpose : 1
LOG : 5385.48 5386.63 1.1 Region : 4040
FDEPTH: 32 32 Gear cond.: 0
BDEPTH: 32 32 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.0 kn
Sorted : 33 Total catch: 150.89 Catch/hour: 401.66

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Ilisha africana	154.95	2667	38.58	67
Trachurus trecae	73.31	833	18.25	66
Pteroscion peli	59.23	1315	14.75	
Brachydeuterus auritus	28.46	689	7.08	64
Eucinostomus melanopterus	17.76	202	4.42	
Galeoides decadactylus	15.39	287	3.83	
Selene dorsalis	7.56	181	1.88	63
Pagellus bellottii	6.39	59	1.59	65
Pseudotolithus senegalensis	6.04	21	1.50	
Raja miraletus	5.83	8	1.45	
Ephippion guttifer	4.23	3	1.05	
Dasyatis marmorata	4.18	3	1.04	
Rhinobatos albomaculatus	3.62	3	0.90	
Chilomycterus spinosus mauret.	3.51	8	0.87	
Stromateus fiatola	2.50	8	0.62	
Cynoglossus senegalensis	1.73	8	0.43	
Trichiurus lepturus	1.44	59	0.36	
Pomadasys incisus	1.30	13	0.32	
Sphyraena guachancho	0.85	13	0.21	
Citharus linguatula	0.77	29	0.19	
Pseudupeneus prayensis	0.59	8	0.15	
Boops boops	0.56	8	0.14	
C R A B S	0.43	21	0.11	
Dicologoglossa cuneata	0.37	8	0.09	
Rypticus saponaceus	0.37	8	0.09	
Grammoplites gruveli	0.29	13	0.07	
Total	401.66		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 22
DATE :29/06/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 9°44.71
start stop duration Lon E 13°2.61
TIME :01:04:21 01:31:28 27.1 (min) Purpose : 1
LOG : 5395.27 5396.97 1.7 Region : 4040
FDEPTH: 25 25 Gear cond.: 0
BDEPTH: 82 71 Validity : 0
Towing dir: 0° Wire out : 80 m Speed : 3.7 kn
Sorted : 0 Total catch: 0.98 Catch/hour: 2.17

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Lagocephalus laevigatus	2.17	2	100.00	
Total	2.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 23
DATE :29/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 9°52.71
start stop duration Lon E 12°55.32
TIME :06:14:20 06:48:23 34.1 (min) Purpose : 1
LOG : 5435.23 5437.29 2.0 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 119 114 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 3.6 kn
Sorted : 20 Total catch: 64.85 Catch/hour: 114.27

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Auxis thazard thazard	91.15	238	79.77	69
Trichiurus lepturus	11.00	21	9.62	
Ariomma bondi	10.34	321	9.05	
Saurida brasiliensis	1.06	433	0.93	
Illex coindetii	0.42	39	0.37	
Trachurus trecae	0.25	4	0.22	70
SALPS	0.05	9	0.05	
Total	114.27		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 24
DATE :29/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 9°55.95
start stop duration Lon E 13°11.43
TIME :10:25:20 10:47:58 22.6 (min) Purpose : 1
LOG : 5465.14 5466.52 1.4 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 36 39 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.7 kn
Sorted : 132 Total catch: 399.86 Catch/hour: 1060.17

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sardinella maderensis	606.73	6228	57.23	73
Sardinella aurita	227.33	1384	21.44	72
Trachurus trecae	50.59	620	4.77	71
Ilisha africana	38.74	557	3.65	76
Selene dorsalis	36.11	795	3.41	75
Brachydeuterus auritus	35.48	382	3.35	74
Chloroscombrus chrysurus	32.13	708	3.03	77
Sphyraena guachancho	17.26	64	1.63	
Dasyatis sp.	7.61	3	0.72	
Selar crumenophthalmus	3.58	24	0.34	
Caranx crysos	1.43	8	0.14	
Sepia orbignyana	1.19	3	0.11	
Trachinotus ovatus	0.87	8	0.08	
Trichiurus lepturus	0.64	8	0.06	
Engraulis encrasicolus	0.48	32	0.05	
Total	1060.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 25
DATE :30/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 10°3.63
start stop duration Lon E 13°3.35
TIME :03:21:28 03:51:28 30.0 (min) Purpose : 1
LOG : 5508.02 5509.56 1.5 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 93 87 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.1 kn
Sorted : 0 Total catch: 22.80 Catch/hour: 45.60

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Saurida brasiliensis	36.76	9832	80.61	
Trichiurus lepturus	3.84	8	8.42	
Trachinotus ovatus	2.06	6	4.52	
Alloteuthis africana	1.72	4352	3.77	
Illex coindetii	1.22	666	2.68	
Total	45.60		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 26
DATE :30/06/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°2.43
start stop duration Lon E 13°15.84
TIME :04:45:50 04:50:50 5.0 (min) Purpose : 1
LOG : 5521.44 5521.62 0.2 Region : 4040
FDEPTH: 40 40 Gear cond.: 0
BDEPTH: 85 83 Validity : 0
Towing dir: 0° Wire out : 270 m Speed : 4.0 kn
Sorted : 0 Total catch: 1.41 Catch/hour: 16.92

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trichiurus lepturus	14.40	36	85.11	
Alloteuthis africana	2.52	936	14.89	
Total	16.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 27
DATE :30/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 10°3.05
start stop duration Lon E 13°17.66
TIME :07:24:50 07:56:53 32.1 (min) Purpose : 1
LOG : 5533.07 5535.19 2.1 Region : 4040
FDEPTH: 20 21 Gear cond.: 0
BDEPTH: 20 21 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 4.0 kn
Sorted : 126 Total catch: 568.85 Catch/hour: 1064.92

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	412.79	8147	38.76	78
Ephippion guttifer	136.98	9	12.86	
Galeoides decadactylus	111.71	970	10.49	
Ilisha africana	94.18	1668	8.84	80
Pteroscion peli	63.86	1559	6.00	
Cynoglossus canariensis	61.33	51	5.76	
Selene dorsalis	34.54	1054	3.24	81
Dasyatis margarita	19.88	9	1.87	
Eucinostomus melanopterus	17.78	228	1.67	
Trachurus trecae	15.75	212	1.48	79
Pseudotolithus senegalensis	15.08	118	1.42	
Sepia orbignyana	13.06	34	1.23	
J E L L Y F I S H	11.12	84	1.04	
Pomadasys incisus	10.53	110	0.99	
Trichiurus lepturus	9.86	161	0.93	
Arius parkii	9.52	17	0.89	
Gymnura micrura	6.91	9	0.65	
Sphyraena guachancho	6.32	101	0.59	
C R A B S	3.29	708	0.31	
Sardinella maderensis	3.20	67	0.30	82
Starfish	2.44	657	0.23	
Penaeus notialis	1.94	522	0.18	
Trachinotus ovatus	1.26	17	0.12	
G A S T R O P O D S	0.84	303	0.08	
Dicologoglossa cuneata	0.76	17	0.07	
Total	1064.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 28
DATE :30/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 10°16.77
start stop duration Lon E 13°6.96
TIME :04:22:38 04:53:27 30.8 (min) Purpose : 1
LOG : 5588.96 5590.50 1.5 Region : 4040
FDEPTH: 107 106 Gear cond.: 0
BDEPTH: 107 106 Validity : 0
Towing dir: 0° Wire out : 290 m Speed : 3.0 kn
Sorted : 83 Total catch: 274.67 Catch/hour: 534.72

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trigla lyra	116.11	146	21.71	
Boops boops	81.18	2178	15.18	87
Dentex congoensis	59.22	631	11.08	85
Umbrina canariensis	54.32	146	10.16	
Trachurus trecae	50.32	134	9.41	83
Lagocephalus laevigatus	23.30	47	4.36	
Scorpaena normani	21.49	292	4.02	
Brotula barbata	19.27	18	3.60	
Zeus faber	17.11	35	3.20	
Octopus vulgaris	16.82	18	3.15	
Atractoscion aequidens	16.12	6	3.01	
Dentex angolensis	15.83	169	2.96	89
Dentex macrophthalmus	14.25	41	2.67	86
Raja miraletus	8.88	12	1.66	
Alloteuthis africana	5.67	1285	1.06	
Citharus linguatula	5.26	479	0.98	
Sea urchin	2.98	193	0.56	
Saurida brasiliensis	2.16	450	0.40	
Pagellus bellottii	1.99	35	0.37	88
Dentex barnardi	1.52	12	0.28	90
C R A B S	0.29	29	0.05	
Illex coindetii	0.23	23	0.04	
Microchirus frechkopi	0.23	6	0.04	

Blennius normani	0.18	6	0.03
Total	534.72		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 29
DATE :30/06/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 10°10.05
start stop duration Lon E 13°23.39
TIME :07:09:32 07:40:53 31.4 (min) Purpose : 1
LOG : 5608.89 5610.81 1.9 Region : 4040
FDEPTH: 23 24 Gear cond.: 0
BDEPTH: 23 24 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.7 kn
Sorted : 65 Total catch: 307.14 Catch/hour: 587.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pteroscion peli	185.34	4117	31.53	
Brachydeuterus auritus	74.58	2867	12.69	91
Galeoides decadactylus	69.42	655	11.81	
Sardinella maderensis	43.85	620	7.46	94
Pseudotolithus senegalensis	42.20	517	7.18	
Penaeus notialis	40.40	51761	6.87	
Dasyatis margarita	26.35	17	4.48	
Eucinostomus melanopterus	17.49	199	2.98	
Ilisha africana	14.89	1939	2.53	93
Pomadasys incisus	13.09	130	2.23	
Trachurus trecae	10.33	78	1.76	92
J E L L Y F I S H	9.30	34	1.58	
Dicologoglossa cuneata	9.22	268	1.57	
Pomadasys rogeri	9.05	0	1.54	
Parakuhlia macrophthalmus	8.36	138	1.42	
Torpedo marmorata	5.17	10	0.88	
Spondyliosoma cantharus	2.66	10	0.45	
Trichiurus lepturus	1.80	59	0.31	
Boops boops	1.11	27	0.19	
C R A B S	1.11	276	0.19	
Saurida brasiliensis	0.61	96	0.10	
Starfish	0.52	86	0.09	
Cynoglossus canariensis	0.44	34	0.07	
Octopus vulgaris	0.34	10	0.06	
Sepiella ornata	0.17	34	0.03	
Total	587.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 30
DATE :30/06/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 10°15.33
start stop duration Lon E 13°23.61
TIME :09:09:22 09:32:13 22.9 (min) Purpose : 1
LOG : 5619.45 5620.68 1.2 Region : 4040
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 38 42 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.2 kn
Sorted : 63 Total catch: 694.59 Catch/hour: 1823.87

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	774.62	9445	42.47	97
Sardinella maderensis	590.28	1820	32.36	96
Sardinella aurita	237.43	1415	13.02	95
Ilisha africana	71.92	1040	3.94	99
Stromateus fiatola	59.79	144	3.28	
Pomadasys jubelini	34.66	58	1.90	
Trachurus trecae	28.60	260	1.57	98
Trichiurus lepturus	15.31	231	0.84	
Auxis thazard thazard	10.11	29	0.55	100
Sphyraena guachancho	1.16	29	0.06	
Total	1823.87		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 31
DATE :01/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°28.01
start stop duration Lon E 13°22.96
TIME :06:36:30 07:12:50 36.3 (min) Purpose : 1
LOG : 5697.72 5699.83 2.1 Region : 4040
FDEPTH: 78 66 Gear cond.: 0
BDEPTH: 79 67 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.5 kn
Sorted : 0 Total catch: 6.36 Catch/hour: 10.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	6.60	31	62.89	101
Trichiurus lepturus	3.80	8	36.16	
Sepiella ornata	0.10	3	0.94	
Total	10.50		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 32
DATE :01/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°38.42
start stop duration Lon E 13°8.21
TIME :10:30:18 10:59:41 29.4 (min) Purpose : 1
LOG : 5728.95 5730.52 1.6 Region : 4040
FDEPTH: 150 152 Gear cond.: 0
BDEPTH: 519 542 Validity : 0
Towing dir: 0° Wire out : 352 m Speed : 3.2 kn
Sorted : 0 Total catch: 1.42 Catch/hour: 2.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	2.21	406	76.06	
SALPS	0.41	14	14.08	
Lagocephalus laevigatus	0.16	8	5.63	
Euphausiacea	0.12	472	4.23	
Total	2.90		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 33
DATE :01/07/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 10°32.56
start stop duration Lon E 13°29.93
TIME :04:36:21 05:06:38 30.3 (min) Purpose : 1
LOG : 5761.40 5763.02 1.6 Region : 4040
FDEPTH: 53 53 Gear cond.: 0
BDEPTH: 53 53 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.2 kn
Sorted : 124 Total catch: 2749.77 Catch/hour: 5446.89

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pomadasys incisus	3075.27	3082	56.46	
Brachydeuterus auritus	1451.96	22570	26.66	102
Pagellus bellottii	321.20	1892	5.90	103
Pomadasys peroteti	157.18	182	2.89	
Trachurus trecae	98.18	683	1.80	104
Pseudotolithus senegalensis	61.96	91	1.14	
Raja miraletus	57.86	91	1.06	
Pteroscion peli	40.41	364	0.74	
Pomatomus saltatrix	21.87	24	0.40	
Ilisha africana	19.82	160	0.36	106
Trichiurus lepturus	17.77	547	0.33	
Citharus linguatula	16.40	547	0.30	
Sardinella maderensis	14.12	91	0.26	105
Umbrina canariensis	12.76	69	0.23	
Torpedo torpedo	11.85	91	0.22	
Dentex barnardi	11.16	69	0.20	107
Syacium micrurum	11.16	160	0.20	
Pseudupeneus prayensis	10.71	91	0.20	
Galeoides decadactylus	9.57	69	0.18	
Lagocephalus laevigatus	8.20	24	0.15	
Chelidonichthys gabonensis	5.92	46	0.11	
Bembrops heterurus	4.78	297	0.09	
Dicologoglossa cuneata	2.05	69	0.04	
Arnoglossus imperialis	1.59	91	0.03	
Alloteuthis africana	1.31	525	0.02	
Sphyraena guachancho	0.68	46	0.01	
C R A B S	0.46	68	0.01	
GOBIIDAE	0.46	46	0.01	
Squilla mantis	0.23	228	0.00	
Total	5446.89		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 34
DATE :01/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 10°30.52
start stop duration Lon E 13°33.83
TIME :07:00:17 07:30:15 30.0 (min) Purpose : 1
LOG : 5770.74 5772.63 1.9 Region : 4040
FDEPTH: 5 6 Gear cond.: 0
BDEPTH: 31 26 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
Sorted : 100 Total catch: 2771.66 Catch/hour: 5548.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	3951.35	27405	71.21	108
Brachydeuterus auritus	1361.56	22488	24.54	109
Pteroscion peli	85.65	2376	1.54	
Ilisha africana	41.99	1547	0.76	110
Trachurus trecae	35.36	496	0.64	111
Sphyraena sphyraena	18.23	56	0.33	
Stromateus fiatola	12.16	56	0.22	
Trichiurus lepturus	11.60	332	0.21	
J E L L Y F I S H	11.05	56	0.20	
Sardinella maderensis	8.84	496	0.16	112
Pomadasys incisus	4.42	56	0.08	
Galeoides decadactylus	2.76	56	0.05	
Penaeus notialis	2.21	717	0.04	
Sepiella ornata	1.11	56	0.02	
Selene dorsalis	0.55	166	0.01	
Total	5548.85		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 35
DATE :02/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 10°41.60
start stop duration Lon E 13°38.40
TIME :03:22:48 03:53:16 30.5 (min) Purpose : 1
LOG : 5841.17 5842.80 1.6 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 50 58 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.2 kn
Sorted : 0 Total catch: 92.06 Catch/hour: 181.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	104.27	734	57.52	113
Brachydeuterus auritus	30.21	323	16.66	115
Trichiurus lepturus	21.07	112	11.62	
Sepia orbignyana	10.16	4	5.61	
Pomatomus saltatrix	5.83	12	3.22	
Ilisha africana	4.73	47	2.61	116
Sphyraena guachancho	2.84	4	1.56	
Trachinotus ovatus	1.30	10	0.72	
Trachurus trecae	0.89	10	0.49	114
Total	181.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 36
DATE :02/07/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 10°48.13
start stop duration Lon E 13°39.07
TIME :06:37:41 07:08:19 30.7 (min) Purpose : 1
LOG : 5863.40 5865.07 1.7 Region : 4040
FDEPTH: 64 67 Gear cond.: 0
BDEPTH: 64 67 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 3.3 kn
Sorted : 25 Total catch: 225.93 Catch/hour: 442.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trichiurus lepturus	221.79	17	50.15	
Dentex angolensis	61.55	476	13.92	118
Brachydeuterus auritus	41.15	846	9.30	117
Pagellus bellottii	35.63	292	8.06	119
Pomadasys incisus	21.46	100	4.85	
Sepia orbignyana	11.65	4	2.63	
Citharus linguatula	10.08	96	2.28	
Pomatomus saltatrix	8.57	8	1.94	
Lagocephalus laevigatus	5.95	6	1.35	
Brotula barbata	3.62	20	0.82	
Stromateus fiatola	3.09	8	0.70	
Bembrops heterurus	2.70	37	0.61	
Octopus vulgaris	2.60	6	0.59	
Torpedo torpedo	2.29	8	0.52	
Pterothrissus belloci	1.80	18	0.41	
Raja miraletus	1.29	2	0.29	
Alloteuthis africana	1.29	450	0.29	
Chilomycterus spinosus mauret.	0.94	4	0.21	
Pseudupeneus prayensis	0.70	4	0.16	
Umbrina canariensis	0.69	4	0.15	
Dentex barnardi	0.49	4	0.11	121
Scorpaena stephanica	0.41	6	0.09	
Serranus accraensis	0.35	6	0.08	
Zeus faber	0.31	6	0.07	
Boops boops	0.31	6	0.07	120
Microchirus frechkopi	0.29	8	0.07	
G A S T R O P O D S	0.27	45	0.06	
Parapenaeus longirostris	0.23	106	0.05	
Trachurus trecae	0.14	2	0.03	122
Sphoeroides marmoratus	0.12	20	0.03	
C R A B S	0.12	96	0.03	
Sepiella ornata	0.12	4	0.03	
Sphyraena guachancho	0.08	2	0.02	
Selene dorsalis	0.06	27	0.01	123
GOBIIDAE	0.04	20	0.01	
Sea cucumber	0.04	6	0.01	
Chaetodon hoefleri	0.03	2	0.01	
Total	442.27		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 37
DATE :02/07/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 10°50.78
start stop duration Lon E 13°43.16
TIME :01:01:07 01:31:58 30.9 (min) Purpose : 1
LOG : 5911.34 5912.97 1.6 Region : 4040
FDEPTH: 42 41 Gear cond.: 0
BDEPTH: 42 41 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.2 kn
Sorted : 100 Total catch: 202.78 Catch/hour: 394.39

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	86.35	937	21.90	84
Dicologoglossa cuneata	57.80	1155	14.66	

Pteroscion peli	44.65	1097	11.32	
Raja miraletus	37.34	43	9.47	
Trichiurus lepturus	35.63	1035	9.03	
Sepia orbignyana	32.52	31	8.25	
Dasyatis margarita	22.02	16	5.58	
Dasyatis marmorata	16.18	4	4.10	
Pomadasys incisus	12.37	89	3.14	
Grammoplites gruveli	9.88	451	2.51	
Ilisha africana	8.75	89	2.22	124
Epinephelus aeneus	6.53	4	1.66	
Citharus linguatula	3.70	148	0.94	
Pseudotolithus senegalensis	3.31	12	0.84	
Rhinobatos albomaculatus	3.23	4	0.82	
Penaeus notialis	2.61	39	0.66	
Brotula barbata	2.33	27	0.59	
VOLUTIDAE	2.02	12	0.51	
Cynoponticus ferox	1.52	16	0.38	
Plectorhinchus mediterraneus	0.86	4	0.22	
Pagellus bellottii	0.74	4	0.19	
Torpedo torpedo	0.74	4	0.19	
Octopus vulgaris	0.66	4	0.17	
Atractoscion aequidens	0.54	4	0.14	
Penaeus kerathurus	0.47	4	0.12	
Leptocephalus	0.35	163	0.09	
Calappa pelii	0.31	4	0.08	
Squilla mantis	0.27	16	0.07	
Galeoides decadactylus	0.27	4	0.07	
Bothus podas	0.19	4	0.05	
Antennarius occidentalis	0.12	4	0.03	
Umbrina canariensis	0.12	4	0.03	
Total	394.39		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 38
DATE :02/07/13 GEAR TYPE: BT NO: 21 POSITION:Lat S 10°59.92
start stop duration Lon E 13°40.74
TIME :04:06:10 04:36:24 30.2 (min) Purpose : 1
LOG : 5935.87 5937.53 1.7 Region : 4040
FDEPTH: 84 82 Gear cond.: 0
BDEPTH: 84 82 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 3.3 kn
Sorted : 105 Total catch: 346.12 Catch/hour: 686.97

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	406.09	2769	59.11	125
Trichiurus lepturus	106.19	750	15.46	
Octopus vulgaris	22.27	6	3.24	
Raja miraletus	21.24	46	3.09	
Trachurus trecae	18.47	40	2.69	126
Pterothrissus belloci	17.88	125	2.60	
Alloteuthis africana	14.67	753	2.14	
Torpedo torpedo	12.90	60	1.88	
Brotula barbata	10.74	40	1.56	
GOBIIDAE	9.37	1002	1.36	
Stromateus fiatola	9.04	20	1.32	
Synagrops microlepis	8.58	1820	1.25	
Dentex angolensis	8.25	60	1.20	127
Pagellus bellottii	6.29	40	0.92	128
Citharus linguatula	4.85	65	0.71	
Parapenaeus longirostris	3.54	1310	0.51	
Chelidonichthys gabonensis	2.42	6	0.35	
ANTENNARIIDAE	1.18	20	0.17	
Bembrops heterurus	0.92	20	0.13	
Microchirus frechkopi	0.52	52	0.08	
Dicologoglossa cuneata	0.46	6	0.07	
G A S T R O P O D S	0.46	248	0.07	
Scorpaena normani	0.26	6	0.04	
Sepiella ornata	0.13	6	0.02	
Saurida brasiliensis	0.07	6	0.01	
Squilla mantis	0.07	6	0.01	
Blennius normani	0.07	6	0.01	
Uranoscopus polli	0.07	6	0.01	
Total	686.97		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 39
DATE :02/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°3.64
start stop duration Lon E 13°45.99
TIME :11:26:09 11:56:50 30.7 (min) Purpose : 1
LOG : 5978.43 5980.24 1.8 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 57 57 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.5 kn
Sorted : 0 Total catch: 167.05 Catch/hour: 326.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	139.95	1006	42.83	131
Brachydeuterus auritus	87.94	1137	26.91	132
Trachurus trecae	55.83	452	17.08	129
Sardinella aurita	22.01	110	6.73	130
Trichiurus lepturus	7.16	78	2.19	
Lagocephalus laevigatus	6.94	6	2.13	
Sepia orbignyana	6.03	8	1.84	
Ilisha africana	0.80	8	0.25	133
Sphyraena guachancho	0.14	2	0.04	
Total	326.80		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 40
DATE :03/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°8.58
start stop duration Lon E 13°47.10
TIME :02:08:15 02:37:35 29.4 (min) Purpose : 1
LOG : 5993.94 5995.56 1.6 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 52 48 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.3 kn
Sorted : 183 Total catch: 1466.16 Catch/hour: 2997.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	2202.11	14245	73.47	135
Brachydeuterus auritus	282.60	4007	9.43	137
Sepia orbignyana	172.70	131	5.76	
Trachurus trecae	163.22	1635	5.45	134
Sardinella maderensis	145.23	5070	4.85	136
Trichiurus lepturus	29.60	654	0.99	
Sphyraena guachancho	1.80	16	0.06	
Total	2997.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 41
DATE :03/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 11°23.68
start stop duration Lon E 13°41.57
TIME :08:30:18 08:59:59 29.7 (min) Purpose : 1
LOG : 6048.64 6050.56 1.9 Region : 4040
FDEPTH: 29 29 Gear cond.: 0
BDEPTH: 29 29 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.9 kn
Sorted : 186 Total catch: 1479.25 Catch/hour: 2989.39

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	853.24	27460	28.54	141
Trachurus trecae	815.73	8259	27.29	138
Sardinella aurita	319.04	1829	10.67	139
Sardinella maderensis	206.17	5202	6.90	140
Pteroscion peli	186.63	4319	6.24	
Ilisha africana	174.02	2223	5.82	142
Sepia orbignyana	74.87	63	2.50	
Rhinobatos albomaculatus	68.41	32	2.29	
Gymnura micrura	56.38	6	1.89	
Ephippion guttifer	47.92	32	1.60	
Cynoglossus senegalensis	28.21	16	0.94	
Dicologoglossa cuneata	24.90	489	0.83	
Galeoides decadactylus	22.69	519	0.76	
Pagellus bellottii	19.87	111	0.66	143
Pseudotolithus senegalensis	16.71	79	0.56	
Pomadasys incisus	16.55	253	0.55	
Sphyraena guachancho	11.82	190	0.40	
Chilomycterus spinosus mauret.	9.46	32	0.32	
Trichiurus lepturus	8.67	174	0.29	
Dasyatis margarita	8.20	16	0.27	
Penaeus notialis	4.26	158	0.14	
Alloteuthis africana	3.15	1293	0.11	
Sphyraena sphyraena	2.69	16	0.09	
Trachinus arenatus	2.69	16	0.09	
Selene dorsalis	2.36	47	0.08	144
Pseudupeneus prayensis	1.58	16	0.05	
Eucinostomus melanopterus	1.11	16	0.04	
Squilla mantis	0.95	46	0.03	
C R A B S	0.63	283	0.02	
Calappa pelii	0.16	16	0.01	
Engraulis encrasicolus	0.16	16	0.01	
G A S T R O P O D S	0.16	32	0.01	
Total	2989.39		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 42
DATE :03/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 11°26.86
start stop duration Lon E 13°30.26
TIME :01:29:49 01:43:26 13.6 (min) Purpose : 1
LOG : 6082.64 6083.35 0.7 Region : 4040
FDEPTH: 55 55 Gear cond.: 0
BDEPTH: 86 92 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.1 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 43
DATE :03/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 11°27.53
start stop duration Lon E 13°44.05
TIME :03:32:01 04:01:53 29.9 (min) Purpose : 1
LOG : 6098.72 6100.61 1.9 Region : 4040
FDEPTH: 21 21 Gear cond.: 0
BDEPTH: 21 21 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.8 kn
Sorted : 137 Total catch: 820.27 Catch/hour: 1647.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pomadasys jubelini	640.58	29890	38.88	
Sardinella aurita	375.63	3001	22.80	145
Brachydeuterus auritus	186.81	7207	11.34	147
Pteroscion peli	136.67	22473	8.29	
Sepia orbignyana	94.49	108	5.73	
Ilisha africana	62.55	1089	3.80	146
Pomadasys peroteti	51.82	229	3.15	
Trichiurus lepturus	25.19	627	1.53	
Galeoides decadactylus	19.77	193	1.20	
Pseudotolithus senegalensis	16.63	241	1.01	
Penaeus notialis	13.86	30	0.84	
Dicologoglossa cuneata	7.95	193	0.48	
Pomadasys incisus	6.39	48	0.39	
Torpedo torpedo	3.25	24	0.20	
Sepiella ornata	2.41	72	0.15	
Sardinops ocellatus	0.84	12	0.05	149
Sphyraena guachancho	0.72	12	0.04	
Sardinella maderensis	0.60	12	0.04	148
Squilla mantis	0.60	12	0.04	
Starfish	0.48	12	0.03	
Stromateus fiatola	0.42	12	0.03	
Total	1647.68		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 44
DATE :04/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°39.52
start stop duration Lon E 13°39.10
TIME :12:41:13 01:11:51 30.6 (min) Purpose : 1
LOG : 6159.37 6160.99 1.6 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 61 53 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.2 kn
Sorted : 0 Total catch: 14.61 Catch/hour: 28.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	11.75	249	41.07	150
Sphyraena sphyraena	5.52	61	19.30	
Alloteuthis africana	4.39	1222	15.33	
Trachinotus ovatus	3.15	16	11.02	
Lagocephalus laevigatus	2.08	4	7.26	
Saurida brasiliensis	1.43	262	5.00	
Sepia orbignyana	0.25	2	0.89	
Engraulis encrasicolus	0.04	25	0.14	
Total	28.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 45
DATE :04/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°45.45
start stop duration Lon E 13°44.41
TIME :03:44:27 04:11:33 27.1 (min) Purpose : 1
LOG : 6176.65 6178.22 1.6 Region : 4040
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 32 32 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.5 kn
Sorted : 152 Total catch: 724.39 Catch/hour: 1603.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	1284.58	7094	80.10	152
Trachurus trecae	216.85	3430	13.52	151
Brachydeuterus auritus	88.97	3082	5.55	153
Sepia orbignyana	6.11	2	0.38	
Sphyraena guachancho	4.84	105	0.30	
Arius parkii	2.04	2	0.13	
Engraulis encrasicolus	0.42	21	0.03	
Total	1603.80		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 46
DATE :04/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 11°52.37
start stop duration Lon E 13°45.33
TIME :10:14:29 10:39:10 24.7 (min) Purpose : 1
LOG : 6234.34 6235.98 1.6 Region : 4040
FDEPTH: 22 24 Gear cond.: 0

BDEPTH: 22 24 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 4.0 kn
Sorted : 97 Total catch: 378.10 Catch/hour: 919.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	362.41	2633	39.43	154
Gymnura altavela	88.37	7	9.61	
Sepia orbignyana	75.41	131	8.20	
Dasyatis centroura	58.69	2	6.38	
Brachydeuterus auritus	55.14	1692	6.00	156
Trichiurus lepturus	52.88	1072	5.75	
Pomadasys jubelini	41.72	292	4.54	
Rhinobatos albomaculatus	32.58	12	3.54	
Dasyatis margarita	30.51	15	3.32	
Ilisha africana	13.78	365	1.50	155
Dicologoglossa cuneata	13.49	306	1.47	
Ephippion guttifer	12.25	7	1.33	
Stromateus fiatola	11.74	36	1.28	
Arius parkii	11.60	7	1.26	
Pteroscion peli	11.16	372	1.21	
Pseudotolithus senegalensis	10.72	36	1.17	
Raja miraletus	9.34	22	1.02	
Pomadasys incisus	6.49	117	0.71	
Torpedo marmorata	5.98	7	0.65	
Galeoides decadactylus	4.01	73	0.44	
Penaeus notialis	3.94	88	0.43	
Cynoponticus ferox	2.04	7	0.22	
Pagellus bellottii	1.90	7	0.21	
Torpedo torpedo	1.39	7	0.15	
Eucinostomus melanopterus	1.17	7	0.13	
Chloroscombrus chrysurus	0.51	7	0.06	
Total	919.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 47
DATE :04/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 12°4.41
start stop duration Lon E 13°32.15
TIME :04:03:20 04:34:42 31.4 (min) Purpose : 1
LOG : 6277.19 6278.88 1.7 Region : 4040
FDEPTH: 95 94 Gear cond.: 0
BDEPTH: 95 94 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.2 kn
Sorted : 133 Total catch: 940.24 Catch/hour: 1798.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	1052.34	10604	58.52	157
Boops boops	242.33	3087	13.48	161
Dentex macrophthalmus	89.97	763	5.00	160
Trigla lyra	82.21	924	4.57	
Sphoeroides pachgaster	79.53	27	4.42	
Pagellus bellottii	57.30	442	3.19	158
Sarda sarda	25.17	13	1.40	163
Dentex barnardi	18.88	54	1.05	162
Raja miraletus	18.88	27	1.05	
Atractoscion aequidens	17.54	13	0.98	
Citharus linguatula	14.19	509	0.79	
Umbrina canariensis	12.99	67	0.72	
Uranoscopus polli	12.32	54	0.68	
Scomber japonicus	12.18	40	0.68	
G A S T R O P O D S	11.92	1566	0.66	
Alloteuthis africana	11.11	6962	0.62	
Scorpaena stephanica	10.58	13	0.59	
Dentex angolensis	10.18	107	0.57	159
Illex coindetii	4.95	235	0.28	
Sepia orbignyana	4.82	40	0.27	
Scorpaena normani	3.35	27	0.19	
Chaetodon hoefleri	2.81	13	0.16	
Sea urchin	1.07	174	0.06	
SALPS	0.94	120	0.05	
Zeus faber	0.40	13	0.02	
Syacium micrurum	0.40	27	0.02	
Total	1798.36		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 48
DATE :05/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 12°32.34
start stop duration Lon E 13°22.75
TIME :07:53:06 08:24:24 31.3 (min) Purpose : 1
LOG : 6461.99 6463.89 1.9 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 42 30 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.6 kn
Sorted : 23 Total catch: 275.72 Catch/hour: 528.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Alloteuthis africana	366.13	1	69.27	
Sardinella aurita	72.50	667	13.72	166
Trachurus trecae	38.26	707	7.24	164
Trichiurus lepturus	27.11	217	5.13	
Sepia orbignyana	17.39	13	3.29	
Pomadasys rogeri	1.76	6	0.33	
Engraulis encrasicolus	1.57	291	0.30	
Sardinella maderensis	1.38	6	0.26	165
Sphyraena guachancho	1.15	8	0.22	
Sphyraena sphyraena	1.11	4	0.21	
Saurida brasiliensis	0.13	86	0.03	
Lagocephalus laevigatus	0.00	10	0.00	
Total	528.50		99.99	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 49
DATE :06/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 12°42.51
start stop duration Lon E 13°4.40
TIME :02:13:11 02:42:50 29.7 (min) Purpose : 1
LOG : 6509.24 6510.82 1.6 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 80 182 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.2 kn
Sorted : 0 Total catch: 139.91 Catch/hour: 283.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	270.50	1888	95.54	167
MYCTOPHIDAE	6.19	2234	2.19	
J E L L Y F I S H	3.40	4	1.20	
Trachurus trecae	2.67	49	0.94	168
Alloteuthis africana	0.14	6	0.05	
Todarodes sagittatus	0.14	4	0.05	
Saurida brasiliensis	0.08	18	0.03	
Total	283.12		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 50
DATE :07/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 13°11.09
start stop duration Lon E 12°43.16
TIME :07:48:23 08:19:37 31.2 (min) Purpose : 1
LOG : 6615.25 6617.12 1.9 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 97 102 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.6 kn
Sorted : 1 Total catch: 23.70 Catch/hour: 45.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	30.42	159	66.84	169
MYCTOPHIDAE	5.72	2793	12.57	
SALPS	4.82	27	10.59	
Illex coindetii	1.59	2	3.50	
Starfish	1.04	23	2.28	
Sardinella aurita	0.88	8	1.94	170
Trichiurus lepturus	0.77	2	1.69	
Alloteuthis africana	0.17	60	0.38	
Saurida brasiliensis	0.10	27	0.21	
Total	45.52		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 51
DATE :07/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 13°12.67
start stop duration Lon E 12°44.19
TIME :08:56:25 09:23:37 27.2 (min) Purpose : 1
LOG : 6620.37 6622.03 1.7 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 62 93 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.7 kn
Sorted : 2 Total catch: 13.86 Catch/hour: 30.57

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	10.57	902	34.56	
Trachurus trecae	10.01	57	32.76	171
Sardinella maderensis	6.44	807	21.07	173
Trichiurus lepturus	1.72	40	5.63	
Sardinella aurita	1.06	9	3.46	172
MYCTOPHIDAE	0.24	207	0.79	
Alloteuthis africana	0.20	82	0.65	
Starfish	0.15	18	0.51	
Saurida brasiliensis	0.13	68	0.43	
Engraulis encrasicolus	0.04	4	0.14	
Total	30.57		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 52
DATE :08/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 13°43.49
start stop duration Lon E 12°27.62
TIME :08:48:43 09:10:37 21.9 (min) Purpose : 1
LOG : 6698.44 6699.63 1.2 Region : 4050
FDEPTH: 121 129 Gear cond.: 0
BDEPTH: 121 129 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.3 kn
Sorted : 124 Total catch: 346.00 Catch/hour: 947.94

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	596.41	8214	62.92	174
Dentex macrophthalmus	172.84	1282	18.23	175
Pagellus bellottii	54.40	444	5.74	176
Dentex angolensis	27.12	90	2.86	177
Boops boops	24.63	323	2.60	179
Trigla lyra	22.83	233	2.41	
Squatina oculata	16.77	8	1.77	
Dentex barnardi	8.77	22	0.92	178
G A S T R O P O D S	8.59	1085	0.91	
Branchiostegus semifasciatus *	5.95	8	0.63	
Pontinus kuhlii	4.60	8	0.48	
Zeus faber	2.49	8	0.26	
Sphoeroides pachgaster	2.19	8	0.23	
Illex coindetii	0.30	16	0.03	
Syacium micrurum	0.08	8	0.01	
Total	947.95		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 53
DATE :08/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 13°57.81
start stop duration Lon E 12°18.46
TIME :02:13:28 02:44:00 30.5 (min) Purpose : 1
LOG : 6742.59 6744.20 1.6 Region : 4050
FDEPTH: 122 118 Gear cond.: 0
BDEPTH: 122 118 Validity : 0
Towing dir: 0° Wire out : 330 m Speed : 3.2 kn
Sorted : 78 Total catch: 188.93 Catch/hour: 371.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	206.90	1199	55.72	182
Trachurus trecae	53.61	218	14.44	180
Pagellus bellottii	27.36	248	7.37	184
Dentex barnardi	19.30	83	5.20	183
Dentex angolensis	17.81	83	4.80	181
G A S T R O P O D S	7.15	1281	1.93	
Myliobatis aquila	6.54	2	1.76	
Brotula barbata	5.50	8	1.48	
Chelidonichthys capensis	4.83	71	1.30	
Sphoeroides pachgaster	4.48	8	1.21	
Branchiostegus semifasciatus *	3.50	4	0.94	
Trigla lyra	3.34	20	0.90	
Octopus vulgaris	2.83	2	0.76	
Raja miraletus	2.75	4	0.74	
Dentex gibbosus	2.52	4	0.68	
Sepia orbignyana	2.00	16	0.54	
Perulibatrachus rossignoli	0.63	4	0.17	
Citharus linguatula	0.24	4	0.06	
Total	371.30		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 54
DATE :08/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 14°5.53
start stop duration Lon E 12°20.03
TIME :06:15:24 06:33:19 17.9 (min) Purpose : 1
LOG : 6772.61 6773.80 1.2 Region : 4050
FDEPTH: 20 30 Gear cond.: 0
BDEPTH: 53 53 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 4.0 kn
Sorted : 95 Total catch: 248.09 Catch/hour: 830.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	728.91	6998	87.75	185
Boops boops	60.07	723	7.23	186
Atractoscion aequidens	17.68	33	2.13	
Scomber japonicus	16.81	70	2.02	187
Sardinella maderensis	6.86	26	0.83	188
G A S T R O P O D S	0.33	33	0.04	
Total	830.66		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 55
DATE :09/07/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 14°15.20
start stop duration Lon E 12°19.50
TIME :12:15:37 12:44:40 29.1 (min) Purpose : 1
LOG : 6804.99 6806.68 1.7 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 20 24 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.5 kn
Sorted : 0 Total catch: 198.10 Catch/hour: 409.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	348.68	3055	85.22	189

Trachurus trecae	38.71	6083	9.46	191
Sardinella maderensis	11.03	841	2.70	190
Sphyrna lewini	3.10	2	0.76	
Brachydeuterus auritus	2.56	469	0.63	192
Pomatomus saltatrix	2.11	6	0.51	
Decapterus rhonchus	1.55	6	0.38	
Sphyraena guachancho	0.76	50	0.19	
Sardinops ocellatus	0.27	4	0.07	193
Chaetodon hoefleri	0.25	2	0.06	
Engraulis encrasicolus	0.14	4	0.04	
Total	409.16		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 56
DATE :09/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 14°47.01
start stop duration Lon E 12°15.09
TIME :12:38:00 01:02:54 24.9 (min) Purpose : 1
LOG : 6889.96 6891.22 1.3 Region : 4050
FDEPTH: 67 64 Gear cond.: 0
BDEPTH: 67 64 Validity : 0
Towing dir: 0° Wire out : 170 m Speed : 3.0 kn
Sorted : 140 Total catch: 783.46 Catch/hour: 1887.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	574.65	3036	30.44	194
Decapterus rhonchus	406.22	1658	21.52	195
Lithognathus mormyrus	196.14	928	10.39	
Pagellus bellottii	165.13	1696	8.75	196
Sepia orbignyana	135.18	67	7.16	
Spondyliosoma cantharus	65.54	306	3.47	
Dentex barnardi	59.37	306	3.15	197
Dentex gibbosus	55.93	359	2.96	198
Rhinobatos albomaculatus	50.63	14	2.68	
Pagrus auriga	46.12	41	2.44	
Dasyatis marmorata	46.12	27	2.44	
Squatina oculata	26.36	5	1.40	
Pomadasys incisus	25.06	253	1.33	
Chelidonichthys gabonensis	10.87	133	0.58	
Pseudupeneus prayensis	9.28	67	0.49	
Epinephelus aeneus	4.60	2	0.24	
Loligo vulgaris	3.59	27	0.19	
Scomber japonicus	3.33	14	0.18	
Chilomycterus spinosus mauret.	1.73	14	0.09	
Sphoeroides marmoratus	1.06	14	0.06	
SALPS	0.80	41	0.04	
Zeus faber	0.14	14	0.01	
Total	1887.86		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 57
DATE :09/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 15°0.74
start stop duration Lon E 12°8.82
TIME :04:37:17 04:59:42 22.4 (min) Purpose : 1
LOG : 6919.82 6920.96 1.1 Region : 4050
FDEPTH: 69 64 Gear cond.: 0
BDEPTH: 69 64 Validity : 0
Towing dir: 0° Wire out : 170 m Speed : 3.1 kn
Sorted : 114 Total catch: 1057.14 Catch/hour: 2829.10

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	2159.81	22012	76.34	199
Rhinoptera marginata	328.10	174	11.60	
Dentex macrophthalmus	166.24	1742	5.88	201
Pagellus bellottii	56.74	798	2.01	202
Umbrina canariensis	39.82	273	1.41	
Dentex barnardi	18.92	100	0.67	200
Argyrosomus hololepidotus	18.68	24	0.66	
Squalus megalops	18.17	24	0.64	
Atractoscion aequidens	14.72	24	0.52	
Chelidonichthys gabonensis	3.77	24	0.13	
Boops boops	3.13	24	0.11	203
Sphoeroides marmoratus	0.99	24	0.04	
Total	2829.09		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 58
DATE :10/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 15°15.67
start stop duration Lon E 12°2.43
TIME :12:56:50 01:14:29 17.7 (min) Purpose : 1
LOG : 7046.67 7047.56 0.9 Region : 4050
FDEPTH: 29 33 Gear cond.: 0
BDEPTH: 29 33 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.0 kn
Sorted : 139 Total catch: 849.40 Catch/hour: 2887.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Pagellus bellottii	1528.52	60129	52.94	205
Trachurus trecae	845.64	37346	29.29	204
Dasyatis marmorata	381.82	326	13.22	
Loligo vulgaris	57.72	469	2.00	
Lichia amia	28.35	3	0.98	
Gymnura altavela	20.26	7	0.70	
Sepia orbignyana	12.44	20	0.43	
Sphyrna lewini	10.88	3	0.38	
Citharus linguatula	1.84	20	0.06	
Total	2887.48		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 59
DATE :10/07/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 15°17.01
start stop duration Lon E 12°2.27
TIME :01:46:32 02:06:14 19.7 (min) Purpose : 1
LOG : 7049.21 7050.20 1.0 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 33 31 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.0 kn
Sorted : 0 Total catch: 0.48 Catch/hour: 1.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	1.46	37	0.00	206

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 60
DATE :10/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°25.59
start stop duration Lon E 11°57.31
TIME :06:06:13 06:37:20 31.1 (min) Purpose : 1
LOG : 7081.46 7083.41 1.9 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 236 81 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
Sorted : 2 Total catch: 34.04 Catch/hour: 65.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
SALPS	42.42	4344	64.63	
Etrumeus whiteheadi	14.83	229	22.59	
Trichiurus lepturus	5.67	58	8.64	
Unidentified larvae	2.31	125	3.53	
J E L L Y F I S H	0.37	2	0.56	
Illex coindetii	0.02	8	0.03	
Saurida brasiliensis	0.02	2	0.03	
Total	65.63		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 61
DATE :10/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°31.67
start stop duration Lon E 12°0.07
TIME :08:15:00 08:45:18 30.3 (min) Purpose : 1
LOG : 7092.33 7094.25 1.9 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 35 35 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
Sorted : 66 Total catch: 790.08 Catch/hour: 1564.51

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	1538.14	19703	98.31	207
Dasyatis marmorata	23.52	24	1.50	
Scomber japonicus	2.85	24	0.18	208
Total	1564.51		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 62
DATE :11/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°38.11
start stop duration Lon E 11°46.45
TIME :12:02:05 12:31:44 29.6 (min) Purpose : 1
LOG : 7123.61 7125.01 1.4 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 115 113 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 2.8 kn
Sorted : 111 Total catch: 737.02 Catch/hour: 1491.94

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	1031.28	6854	69.12	209
SALPS	389.31	43769	26.09	
Etrumeus whiteheadi	29.25	520	1.96	
J E L L Y F I S H	19.37	415	1.30	
Scomber japonicus	12.69	40	0.85	210
Sphyrna lewini	10.04	2	0.67	
Total	1491.94		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 63
DATE :11/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°43.42
start stop duration Lon E 11°50.79
TIME :03:40:47 04:10:25 29.6 (min) Purpose : 1
LOG : 7148.51 7149.96 1.5 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 195 333 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 2.9 kn
Sorted : 1 Total catch: 127.78 Catch/hour: 258.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	197.91	1344	76.51	211
SALPS	40.69	3838	15.73	
Sarda sarda	15.99	22	6.18	
Trichiurus lepturus	3.08	43	1.19	
Lagocephalus laevigatus	0.45	4	0.17	
Loligo vulgaris	0.24	2	0.09	
Etrumeus whiteheadi	0.18	4	0.07	
MYCTOPHIDAE	0.12	46	0.05	
Total	258.66		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 64
DATE :11/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 15°56.22
start stop duration Lon E 11°44.12
TIME :09:24:09 09:44:21 20.2 (min) Purpose : 1
LOG : 7183.58 7184.85 1.3 Region : 4050
FDEPTH: 21 21 Gear cond.: 0
BDEPTH: 21 21 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.8 kn
Sorted : 0 Total catch: 416.17 Catch/hour: 1236.15

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dasyatis marmorata	364.72	181	29.50	
Trachurus trecae	235.66	3359	19.06	212
Myliobatis aquila	180.45	68	14.60	
Mustelus mustelus	142.87	98	11.56	
Atractoscion aequidens	48.42	273	3.92	
Pomatomus saltatrix	39.50	151	3.20	
Sphyrna lewini	37.49	0	3.03	
Arius heudelotii	30.12	42	2.44	
Rhinobatos albomaculatus	28.75	12	2.33	
Pomadasys incisus	22.46	832	1.82	
Dicologoglossa cuneata	20.23	612	1.64	
Umbrina canariensis	11.70	149	0.95	
Raja miraletus	11.67	27	0.94	
Trachinus armatus	11.23	315	0.91	
Torpedo torpedo	10.63	15	0.86	
Loligo vulgaris	9.33	74	0.75	
Sepia orbignyana	7.69	15	0.62	
Gymnura altavela	6.00	3	0.49	
Alloteuthis africana	5.35	2207	0.43	
Trachinus draco	4.10	33	0.33	
Trachinocephalus myops	1.43	9	0.12	
Spondyliosoma cantharus	1.31	27	0.11	
Trichiurus lepturus	1.19	15	0.10	
J E L L Y F I S H	1.07	12	0.09	
Dentex barnardi	0.77	30	0.06	
Lithognathus mormyrus	0.74	6	0.06	
Starfish	0.68	50	0.06	
Selene dorsalis	0.27	6	0.02	
Pagellus bellottii	0.21	3	0.02	
Zeus faber	0.09	3	0.01	
Penaeus notialis	0.03	3	0.00	
Total	1236.15		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 65
DATE :11/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°4.17
start stop duration Lon E 11°39.19
TIME :03:51:24 04:17:54 26.5 (min) Purpose : 1
LOG : 7231.34 7232.84 1.5 Region : 4050
FDEPTH: 55 54 Gear cond.: 0
BDEPTH: 55 54 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3.4 kn
Sorted : 31 Total catch: 149.65 Catch/hour: 338.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Mustelus mustelus	116.33	118	34.32	
Loligo vulgaris	46.57	960	13.74	
Chelidonichthys capensis	33.16	199	9.78	
Sepia orbignyana	31.85	23	9.40	
Sponges - yellow	27.09	3035	7.99	
Raja miraletus	20.29	27	5.99	
Pagellus bellottii	19.66	236	5.80	214
Sphyrna lewini	13.09	7	3.86	
Scorpaena stephanica	9.06	63	2.67	
Trachurus trecae	6.91	91	2.04	213
G A S T R O P O D S	5.07	317	1.50	
Spondyliosoma cantharus	4.35	54	1.28	
SALPS	2.72	127	0.80	
Merluccius polli	1.09	9	0.32	
Sphoeroides sp.	1.09	27	0.32	

Citharus linguatula	0.36	9	0.11
Starfish	0.27	36	0.08
Total	338.96		100.00

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 66
DATE :11/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 16°11.23
start stop duration Lon E 11°43.91
TIME :07:18:54 07:50:21 31.5 (min) Purpose : 1
LOG : 7261.15 7263.09 1.9 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 47 49 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.7 kn
Sorted : 4 Total catch: 16.80 Catch/hour: 32.05

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Trachurus trecae	25.49	946	79.52	215
Loligo vulgaris	5.28	259	16.49	
Alloteuthis africana	0.88	324	2.74	
Unidentified larvae	0.23	4	0.71	
Etrumeus whiteheadi	0.11	2	0.36	
Engraulis encrasicolus	0.02	4	0.06	
Lagocephalus sp.	0.02	2	0.06	
Lagocephalus guntheri	0.02	4	0.06	
Total	32.05		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 67
DATE :12/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 16°21.93
start stop duration Lon E 11°31.51
TIME :02:43:45 03:13:16 29.5 (min) Purpose : 1
LOG : 7307.32 7308.85 1.5 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 86 85 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.1 kn
Sorted : 0 Total catch: 34.98 Catch/hour: 71.10

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
SALPS	43.31	2549	60.92	
Etrumeus whiteheadi	20.85	396	29.33	
J E L L Y F I S H	6.50	61	9.15	
Loligo vulgaris	0.43	6	0.60	
Total	71.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 68
DATE :12/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°25.89
start stop duration Lon E 11°27.66
TIME :07:35:24 08:06:57 31.6 (min) Purpose : 1
LOG : 7349.29 7351.17 1.9 Region : 4050
FDEPTH: 106 106 Gear cond.: 0
BDEPTH: 106 106 Validity : 0
Towing dir: 0° Wire out : 290 m Speed : 3.6 kn
Sorted : 0 Total catch: 114.15 Catch/hour: 217.08

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
G A S T R O P O D S	44.96	4115	20.71	
Trachurus trecae	39.44	281	18.17	216
Etrumeus whiteheadi	38.30	717	17.64	
Lagocephalus sp.	17.29	53	7.96	
Chelidonichthys capensis	14.30	135	6.59	
Sepia orbignyana	11.68	76	5.38	
Trigla lyra	9.62	143	4.43	
Urchin	8.63	468	3.98	
Dentex macrophthalmus	5.84	53	2.69	218
Octopus vulgaris	5.78	4	2.66	
Pagellus bellottii	4.75	34	2.19	217
Hexanchus griseus	4.09	2	1.88	
Raja miraletus	3.18	4	1.46	
Zeus faber	2.87	6	1.32	
Loligo vulgaris	2.15	17	0.99	
Mustelus mustelus	1.45	2	0.67	
Illex coindetii	0.86	11	0.39	
Arnoglossus imperialis	0.63	23	0.29	
Citharus linguatula	0.46	13	0.21	
Scomber japonicus	0.42	2	0.19	219
SALPS	0.15	10	0.07	
Lophiodes kempi	0.13	2	0.06	
Dicologoglossa cuneata	0.11	11	0.05	
Total	217.08		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 69
DATE :12/07/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°38.30
start stop duration Lon E 11°45.61
TIME :02:21:26 02:58:42 37.3 (min) Purpose : 1
LOG : 7411.83 7414.06 2.2 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 22 22 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.6 kn
Sorted : 0 Total catch: 22.79 Catch/hour: 36.69

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Trachurus trecae	32.36	6116	88.20	220
G A S T R O P O D S	2.72	610	7.42	
Raja miraletus	0.89	2	2.41	
Engraulis encrasicolus	0.50	111	1.36	221
Etrumeus whiteheadi	0.11	5	0.31	
Boops boops	0.08	2	0.22	
Scomber japonicus	0.03	3	0.09	
Total	36.69		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 70
DATE :12/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 16°36.73
start stop duration Lon E 11°28.55
TIME :06:57:48 07:38:23 40.6 (min) Purpose : 1
LOG : 7443.65 7445.87 2.2 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 116 111 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3.3 kn
Sorted : 3 Total catch: 83.09 Catch/hour: 122.82

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Sphyrna lewini	41.09	1	33.46	
Etrumeus whiteheadi	32.96	639	26.84	
Sarda sarda	31.22	35	25.42	223
Trachurus trecae	9.64	120	7.85	222
Unidentified larvae	5.51	157	4.49	
Trichiurus lepturus	2.39	34	1.95	
Total	122.82		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 71
DATE :13/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°50.49
start stop duration Lon E 11°39.70
TIME :07:18:20 07:29:26 11.1 (min) Purpose : 1
LOG : 7518.37 7519.07 0.7 Region : 4050
FDEPTH: 45 45 Gear cond.: 0
BDEPTH: 45 45 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.8 kn
Sorted : 74 Total catch: 5792.58 Catch/hour: 31311.24

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Trachurus capensis	17130.49	1253903	54.71	225
Engraulis encrasicolus	12924.32	916605	41.28	226
Trachurus trecae	514.38	20659	1.64	224
Starfish	274.05	59449	0.88	
Todarodes angolensis	168.65	843	0.54	
Etrumeus whiteheadi	164.43	8432	0.53	
Calappa pelii	50.59	843	0.16	
Maja squinado	37.95	843	0.12	
Dicologoglossa cuneata	37.95	843	0.12	
Calappa sp.	4.22	422	0.01	
Dentex macrophthalmus	4.22	422	0.01	
Total	31311.24		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 72
DATE :13/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°47.89
start stop duration Lon E 11°30.48
TIME :10:14:06 10:44:06 30.0 (min) Purpose : 1
LOG : 7532.41 7534.07 1.7 Region : 4050
FDEPTH: 110 111 Gear cond.: 0
BDEPTH: 110 111 Validity : 0
Towing dir: 0° Wire out : 290 m Speed : 3.3 kn
Sorted : 112 Total catch: 1154.83 Catch/hour: 2310.43

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Dentex macrophthalmus	812.33	21039	35.16	229
Trachurus trecae	396.47	2823	17.16	227
Trachurus capensis	335.67	6492	14.53	228
Sepia orbignyana	328.47	412	14.22	
Mustelus mustelus	145.07	144	6.28	
Etrumeus whiteheadi	93.97	1897	4.07	
Loligo vulgaris	82.23	494	3.56	
Chelidonichthys capensis	45.74	206	1.98	
Arius heudelotii	13.60	20	0.59	
Scomber japonicus	10.10	21	0.44	230
G A S T R O P O D S	8.44	1442	0.37	
Spondyliosoma cantharus	7.62	20	0.33	
Umbrina canariensis	6.60	62	0.29	
Pagellus bellottii	6.60	41	0.29	
Starfish	6.38	1711	0.28	
Trigla lyra	3.50	41	0.15	
Lagocephalus sp.	3.50	20	0.15	
Zeus faber	1.44	20	0.06	
Citharus linguatula	1.24	42	0.05	
Dicologoglossa cuneata	0.82	20	0.04	
Scorpaena normani	0.62	20	0.03	
Total	2310.43		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 73
DATE :13/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°52.80
start stop duration Lon E 11°23.02
TIME :04:48:07 05:18:41 30.6 (min) Purpose : 1
LOG : 7575.85 7577.52 1.7 Region : 4050
FDEPTH: 134 139 Gear cond.: 0
BDEPTH: 134 139 Validity : 0
Towing dir: 0° Wire out : 320 m Speed : 3.3 kn
Sorted : 123 Total catch: 492.16 Catch/hour: 965.97

SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Dentex macrophthalmus	441.22	5841	45.68	234
Trachurus trecae	132.52	1625	13.72	231
Pterothrissus belloci	90.91	879	9.41	
Merluccius capensis	73.48	361	7.61	
Mustelus mustelus	48.36	141	5.01	
Chelidonichthys capensis	41.30	385	4.28	
Pagellus bellottii	29.83	220	3.09	233
Trachurus capensis	24.18	526	2.50	232
G A S T R O P O D S	19.00	2041	1.97	
Illex coindetii	17.59	16	1.82	
Scorpaena normani	16.64	228	1.72	
Todarodes angolensis	8.48	47	0.88	
Sepia orbignyana	5.97	63	0.62	
Umbrina canariensis	3.93	31	0.41	
Raja miraletus	3.14	24	0.33	
Dicologoglossa cuneata	3.06	149	0.32	
Zeus faber	2.83	16	0.29	
Arnoglossus imperialis	1.10	47	0.11	
Acanthocepola indica	0.86	39	0.09	
Trigla lyra	0.79	8	0.08	
Synagrops microlepis	0.71	408	0.07	
Gobidae sp. 'bars'	0.08	86	0.01	
Total	965.97		100.00	

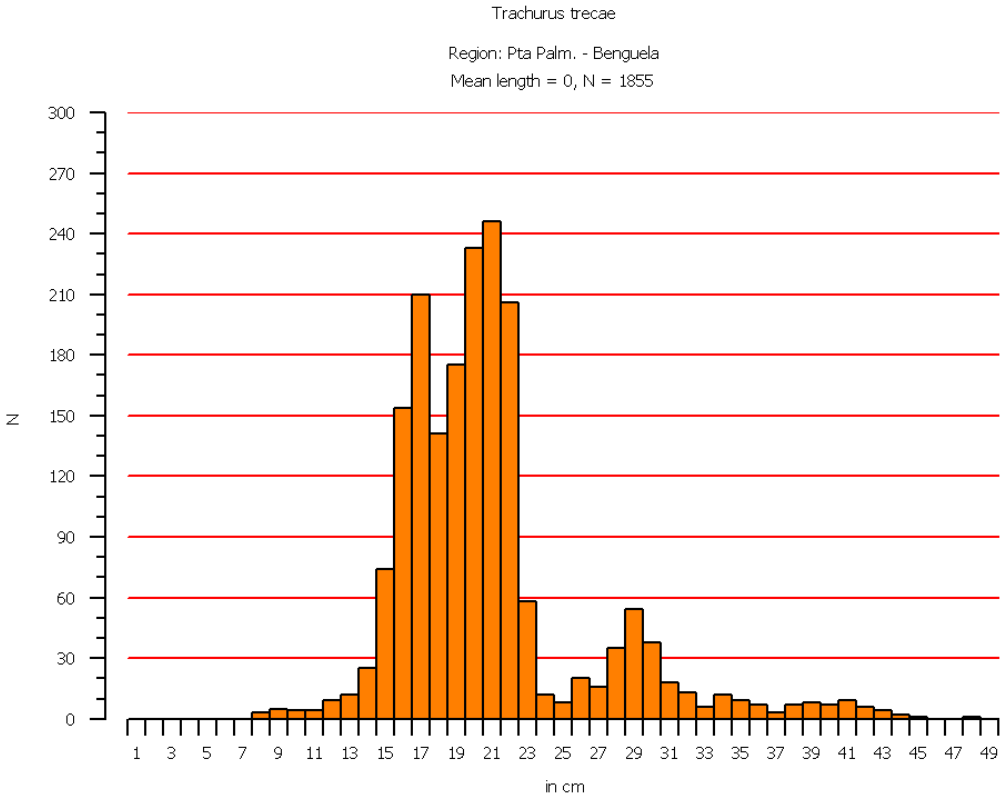
R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 74
DATE :13/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 16°53.41
start stop duration Lon E 11°39.89
TIME :07:37:37 07:51:46 14.2 (min) Purpose : 1
LOG : 7595.81 7596.70 0.9 Region : 4050
FDEPTH: 20 25 Gear cond.: 0
BDEPTH: 44 38 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.8 kn
Sorted : 36 Total catch: 143.52 Catch/hour: 608.57

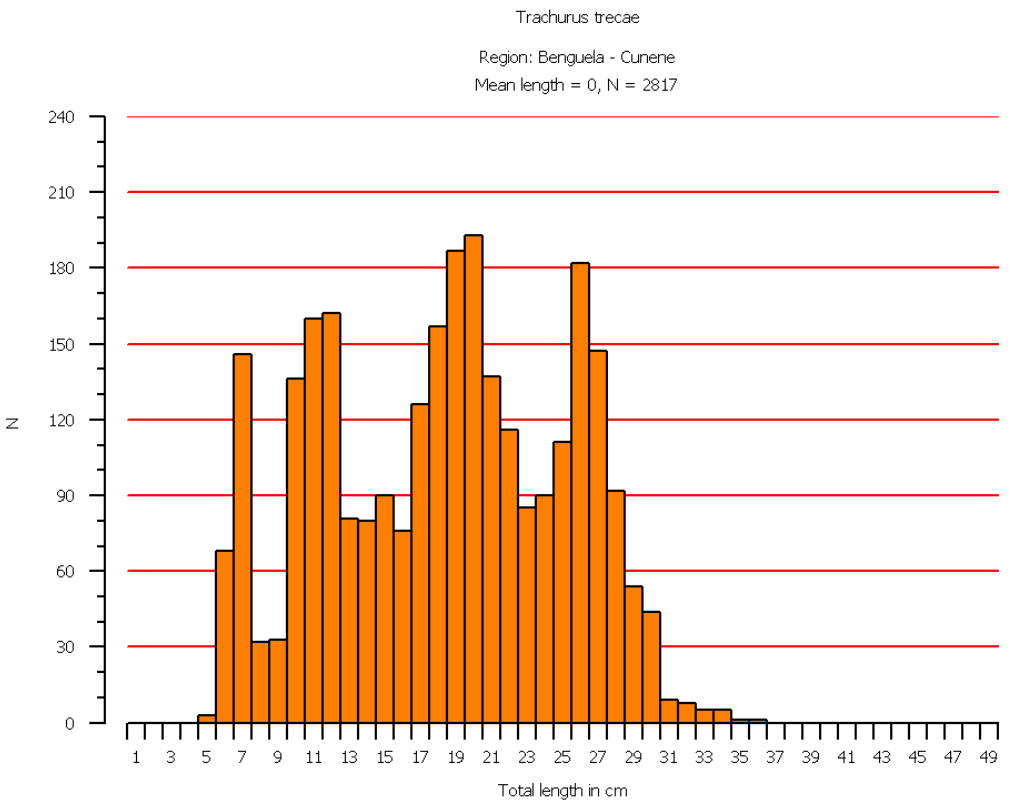
SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Engraulis encrasicolus	397.57	30530	65.33	238
Trachurus capensis	80.57	5601	13.24	236
Etrumeus whiteheadi	65.81	8040	10.81	
Trachurus trecae	37.82	2222	6.22	235
Chrysaora hysoscella	19.34	899	3.18	
Todarodes sp.	4.24	322	0.70	
Trichiurus lepturus	2.37	51	0.39	
Scomber japonicus	0.85	17	0.14	237
Total	608.57		100.00	

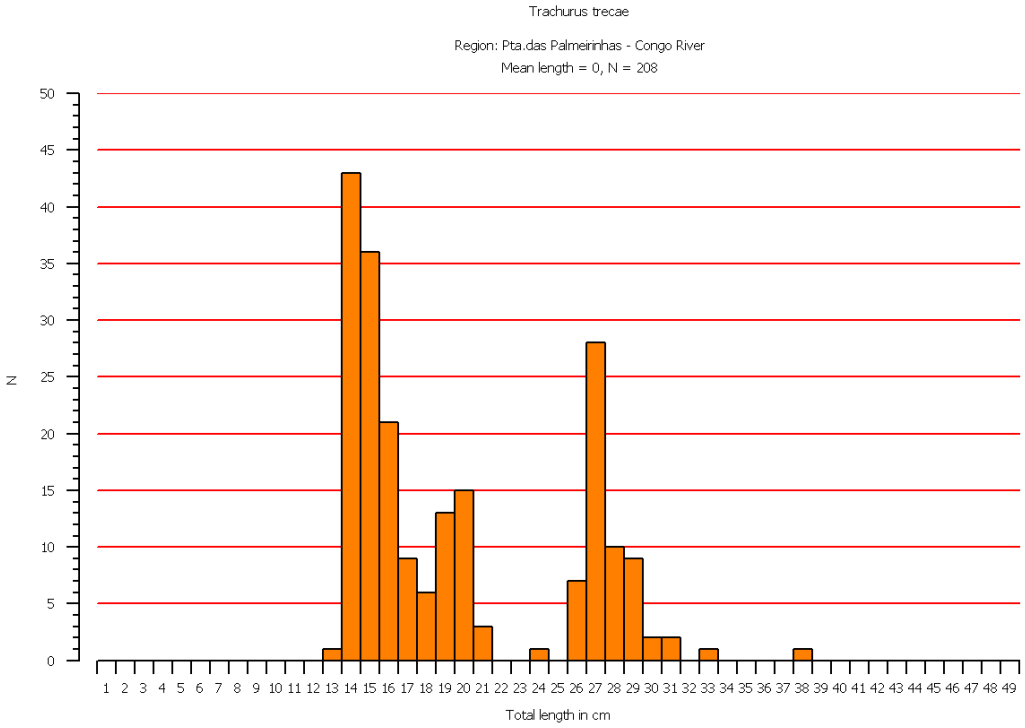
R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 75
DATE :14/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 17°5.55
start stop duration Lon E 11°26.97
TIME :03:08:47 03:38:15 29.5 (min) Purpose : 1
LOG : 7657.40 7659.09 1.7 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 132 127 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.4 kn
Sorted : 0 Total catch: 55.16 Catch/hour: 112.38

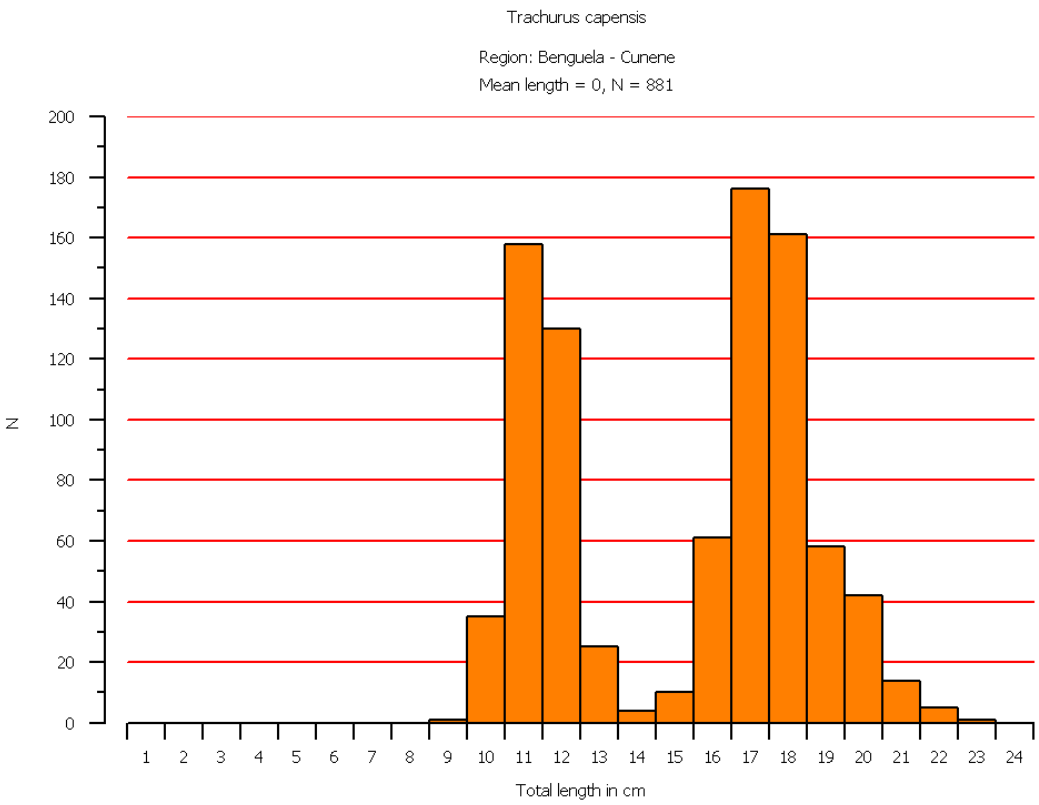
SPECIES	CATCH/HOUR weight	% OF TOT. C numbers		SAMP
Etrumeus whiteheadi	106.96	2292	95.18	
Loligo vulgaris	2.77	20	2.47	
Synagrops microlepis	1.81	972	1.61	
Trachurus capensis	0.77	20	0.69	239
J E L L Y F I S H	0.04	2	0.04	
Merluccius polli	0.02	4	0.02	
Total	112.38		100.00	

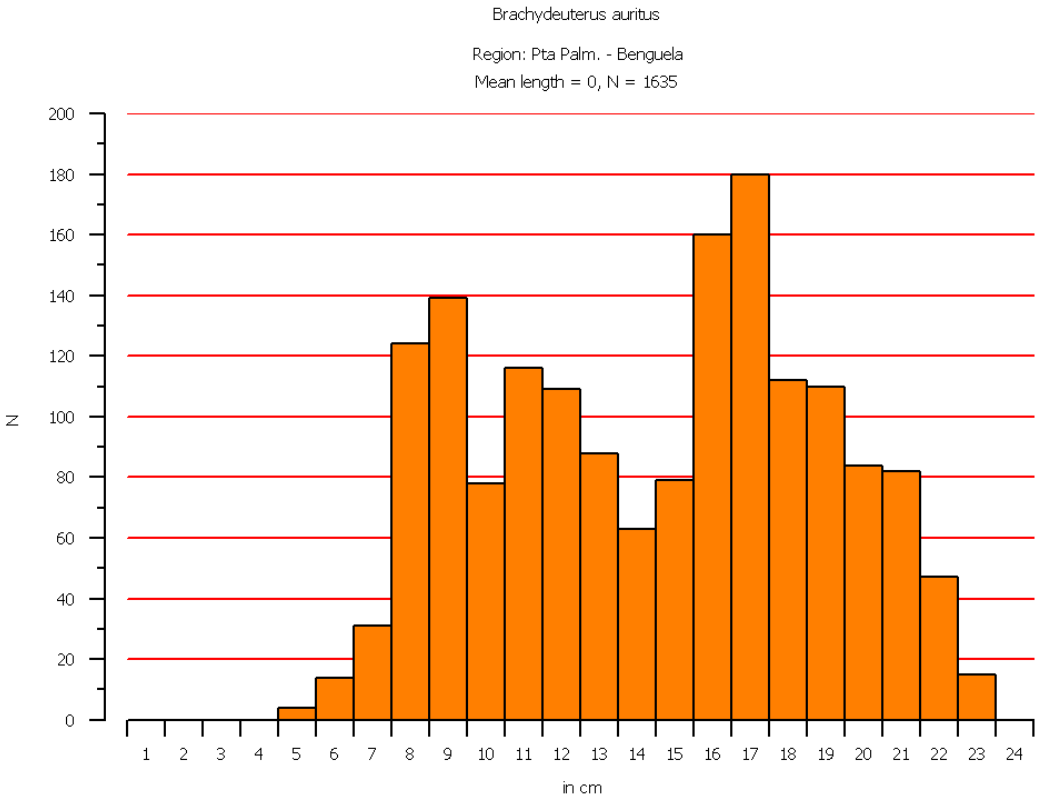
ANNEX II. LENGTH FREQUENCIES OF MAIN SPECIES

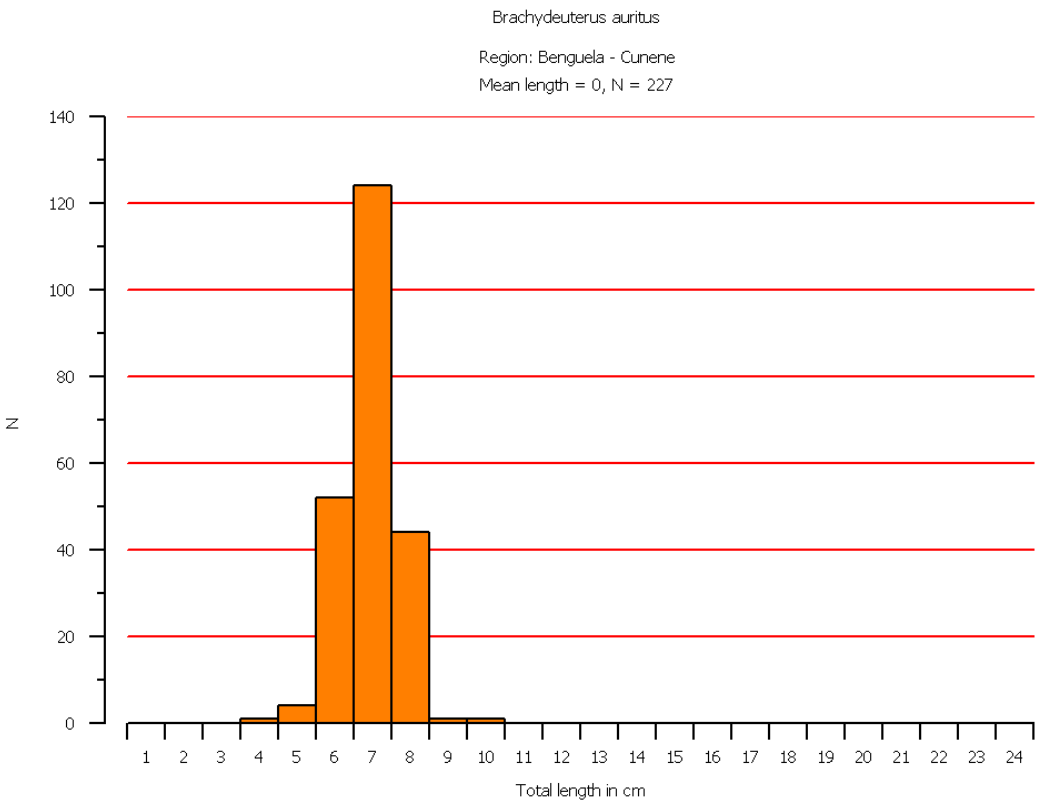


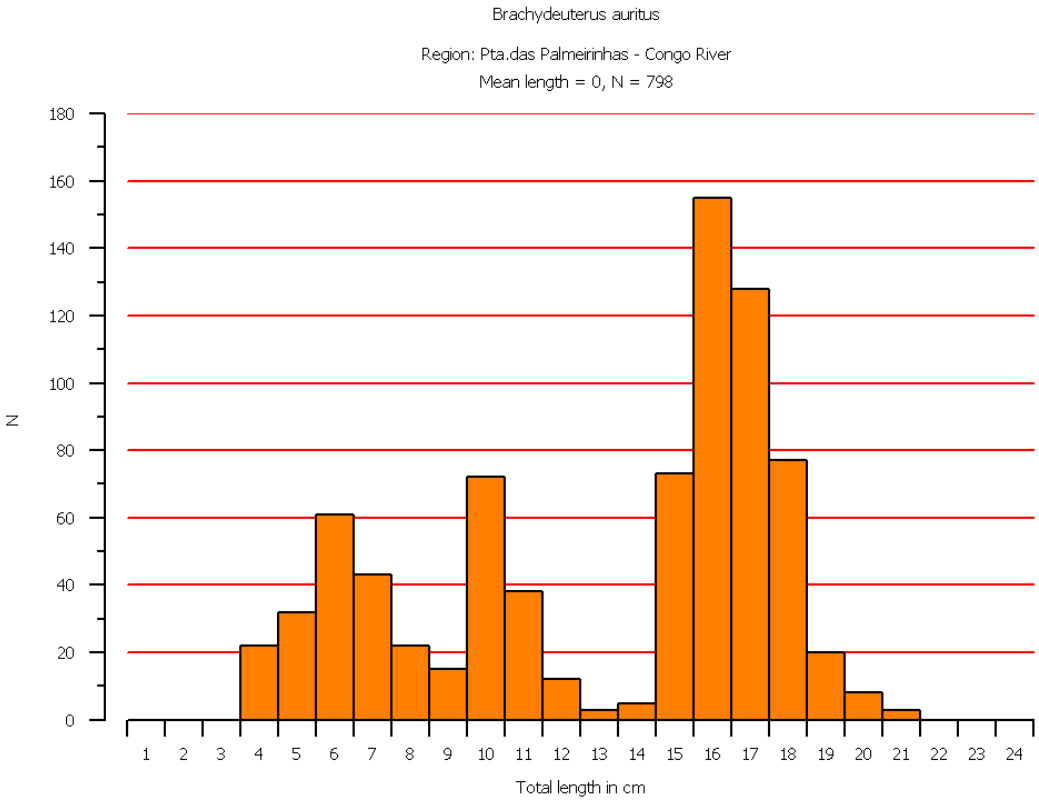

Trachurus trecae
Region: Benguela - Cunene
Mean length = 0, N = 2817
N
Total length in cm

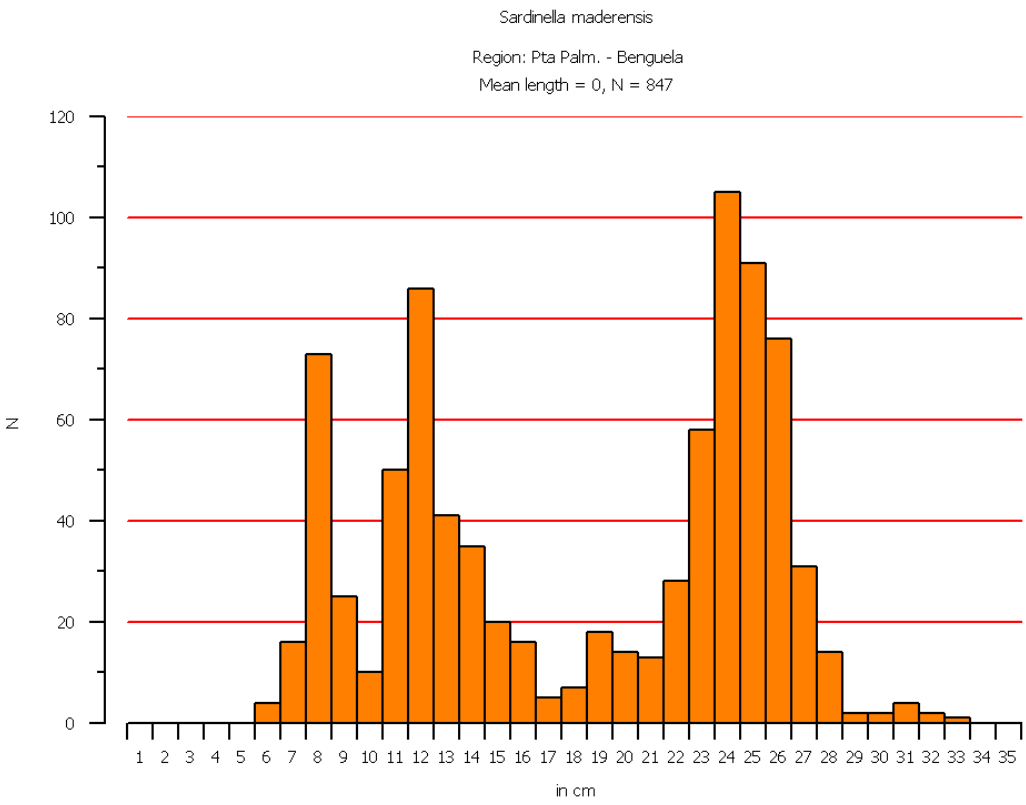

Trachurus trecae
Region: Pta.das Palmeirinhas - Congo River
Mean length = 0, N = 208
N
Total length in cm

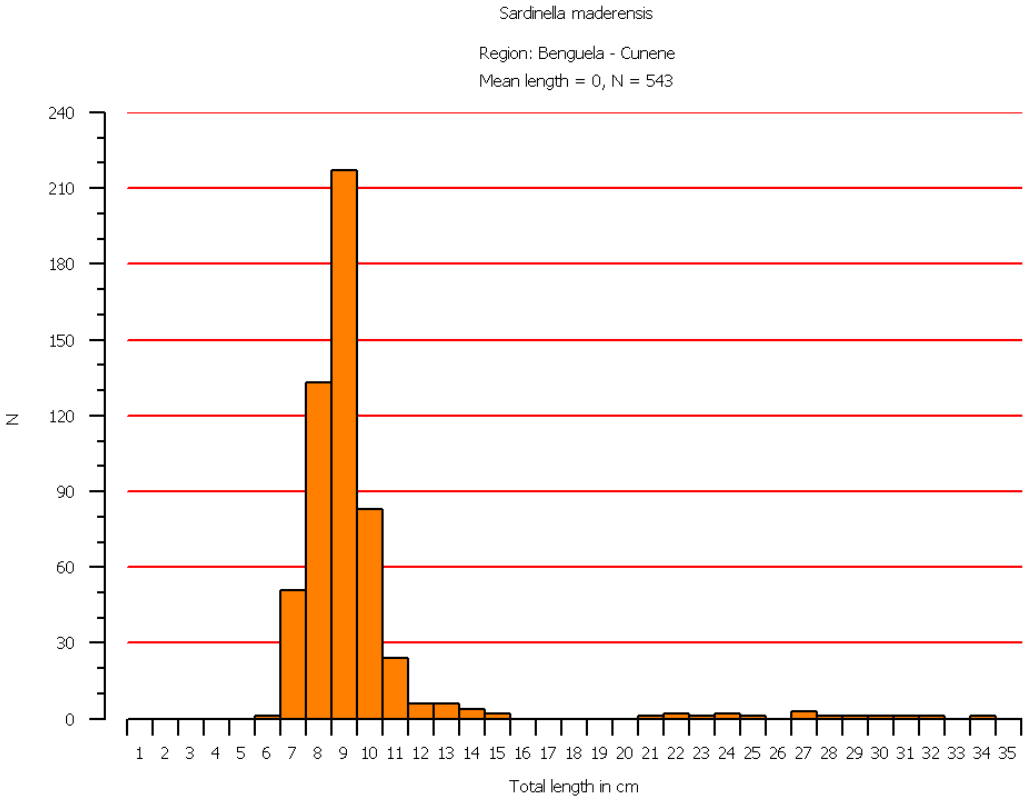

Trachurus capensis
Region: Benguela - Cunene
Mean length = 0, N = 881
N
0
20
40
60
80
100
120
140
160
180
200
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Total length in cm

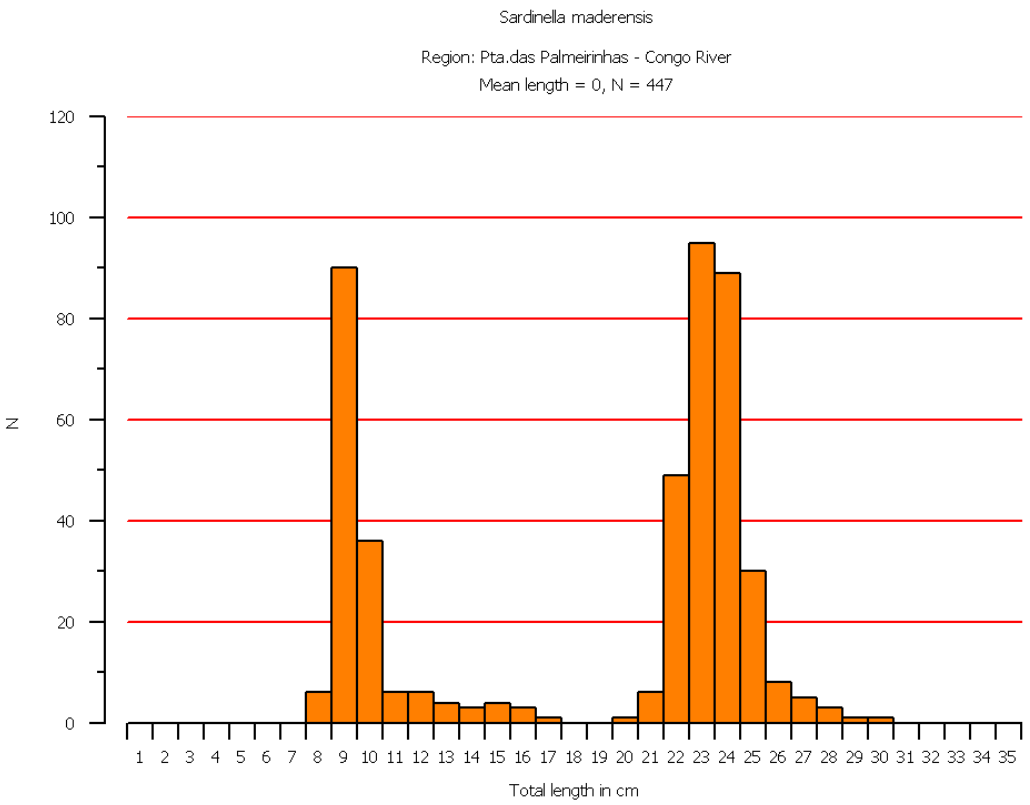

Brachydeuterus auritus
Region: Pta Palm. - Benguela
Mean length = 0, N = 1635
N
0
20
40
60
80
100
120
140
160
180
200
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
in cm

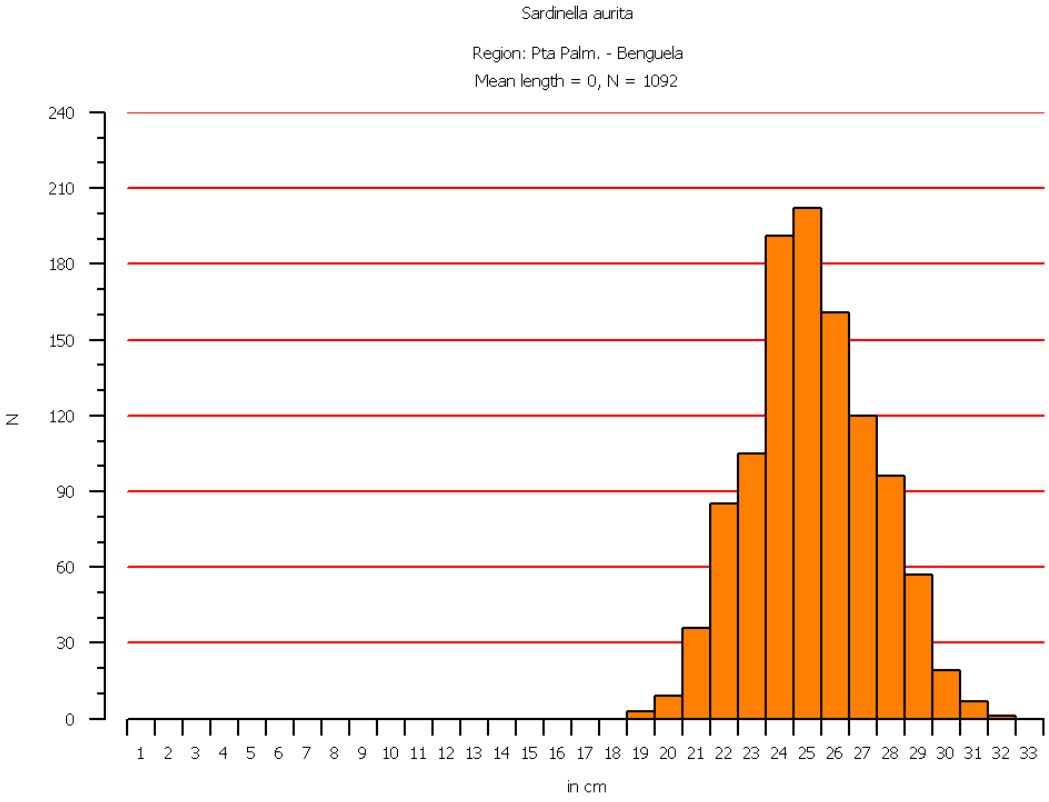

Brachydeuterus auritus
Region: Benguela - Cunene
Mean length = 0, N = 227
N
0
20
40
60
80
100
120
140
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Total length in cm


Brachydeuterus auritus
Region: Pta.das Palmeirinhas - Congo River
Mean length = 0, N = 798
N
0
20
40
60
80
100
120
140
160
180
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Total length in cm


Sardinella maderensis
Region: Pta Palm. - Benguela
Mean length = 0, N = 847
N
0
20
40
60
80
100
120
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
in cm


Sardinella maderensis
Region: Benguela - Cunene
Mean length = 0, N = 543
N
0
30
60
90
120
150
180
210
240
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
Total length in cm

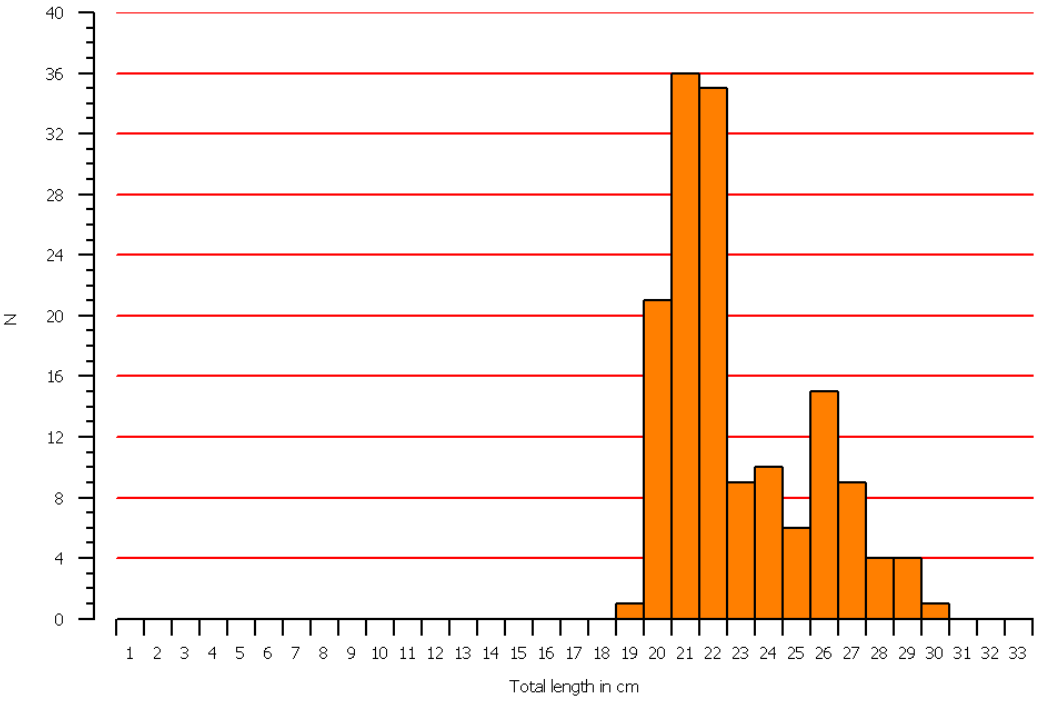

Sardinella maderensis
Region: Pta.das Palmeirinhas - Congo River
Mean length = 0, N = 447
N
0
20
40
60
80
100
120
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
Total length in cm


Sardinella aurita
Region: Pta Palm. - Benguela
Mean length = 0, N = 1092
N
0
30
60
90
120
150
180
210
240
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
in cm

Sardinella aurita

Region: Benguela - Cunene

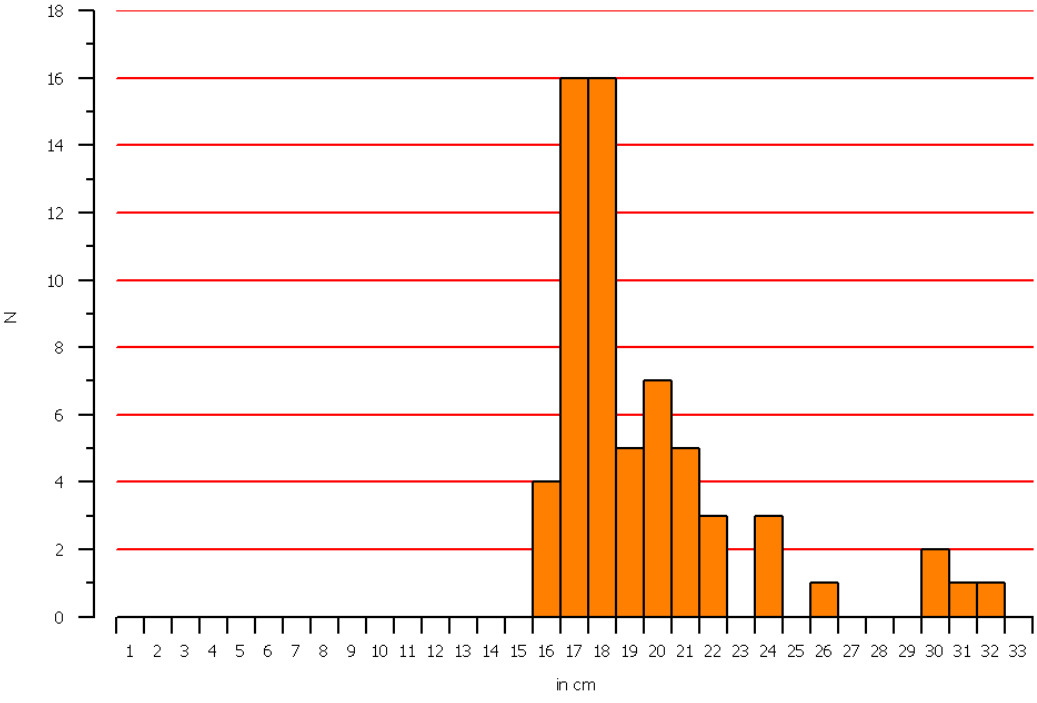
Mean length = 0, N = 151

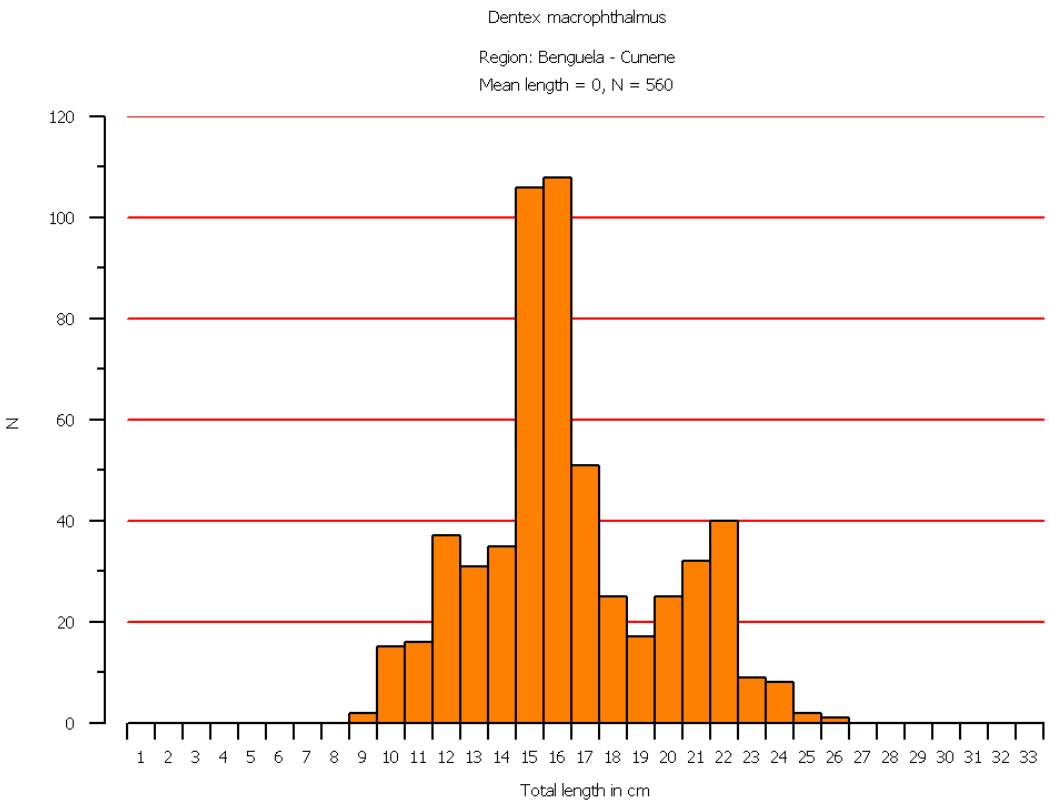


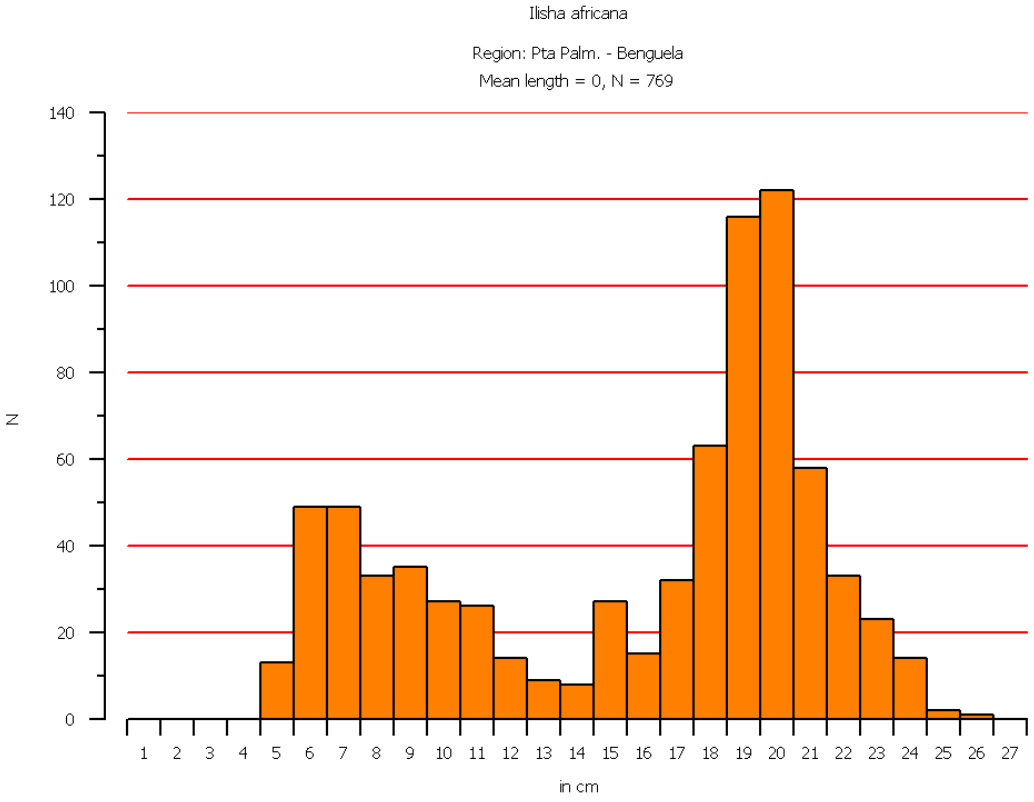
Dentex macrophthalmus

Region: Pta Palm. - Benguela

Mean length = 0, N = 64



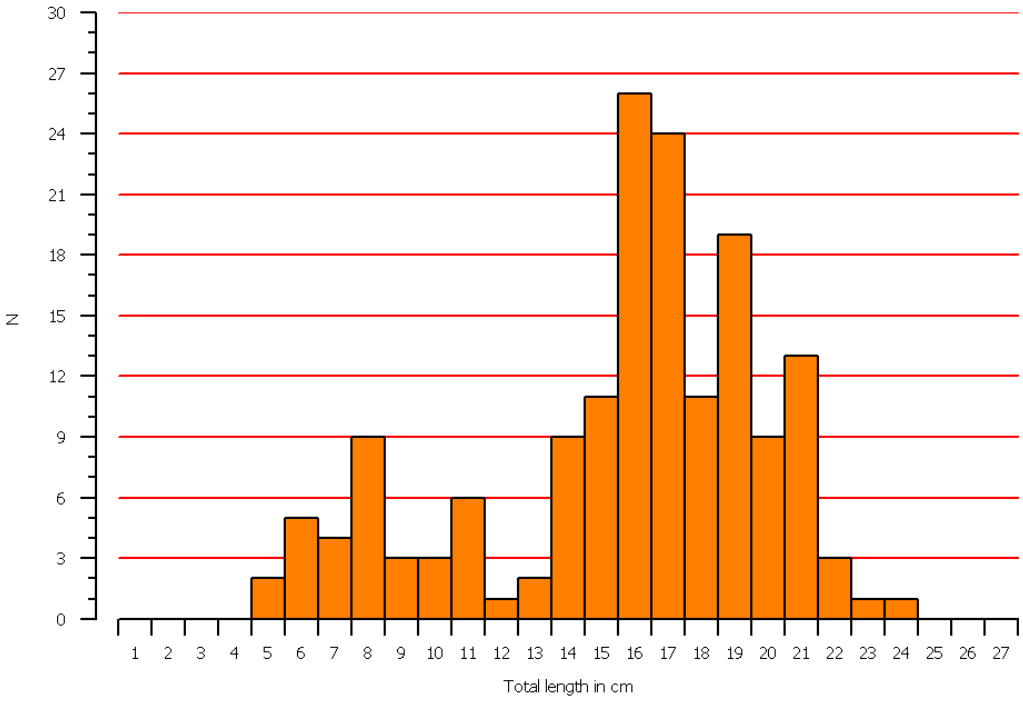

Dentex macrophthalmus
Region: Benguela - Cunene
Mean length = 0, N = 560
N
0
20
40
60
80
100
120
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
Total length in cm


Ilisha africana
Region: Pta Palm. - Benguela
Mean length = 0, N = 769
N
0
20
40
60
80
100
120
140
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
in cm

Ilisha africana

Region: Pta.das Palmeirinhas - Congo River

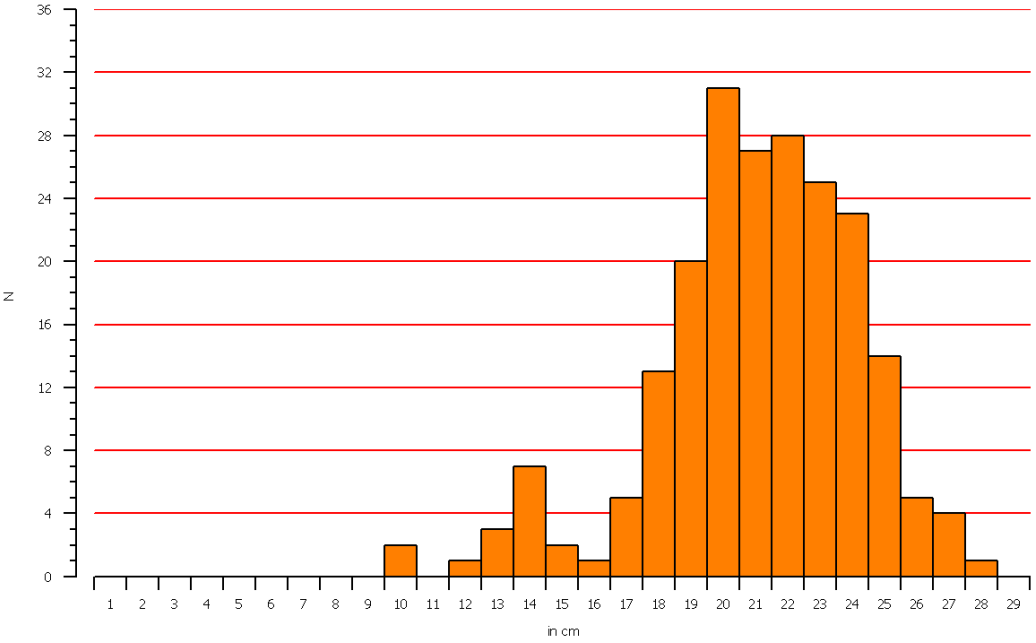
Mean length = 0, N = 162

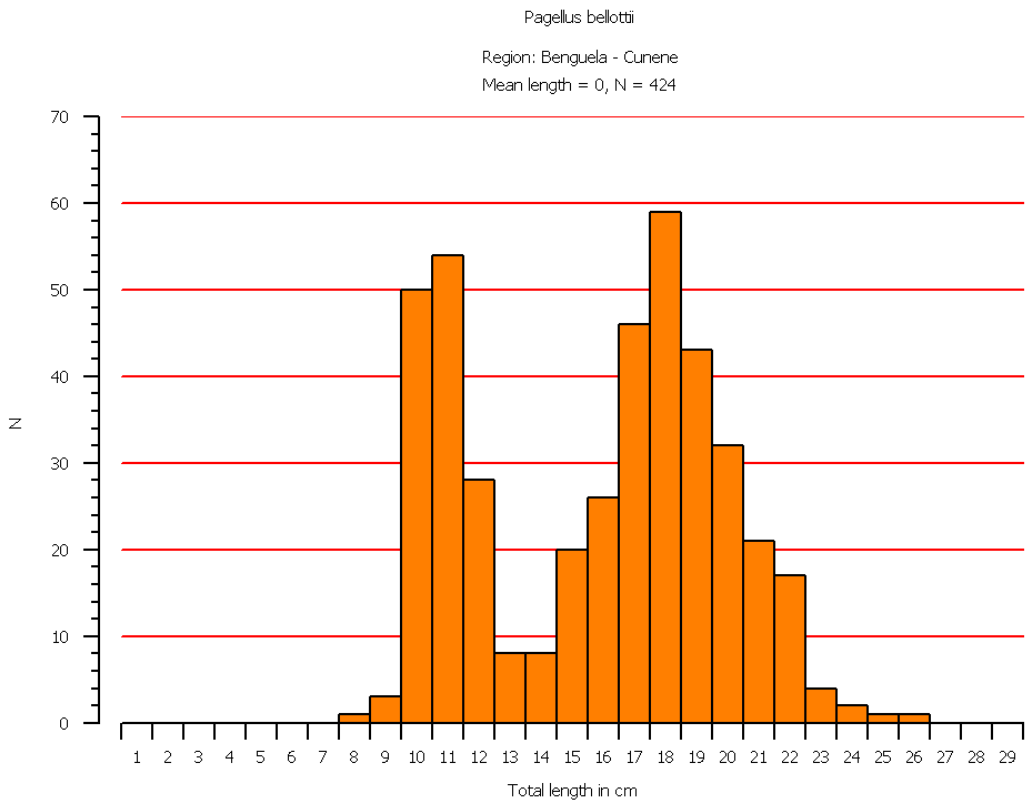


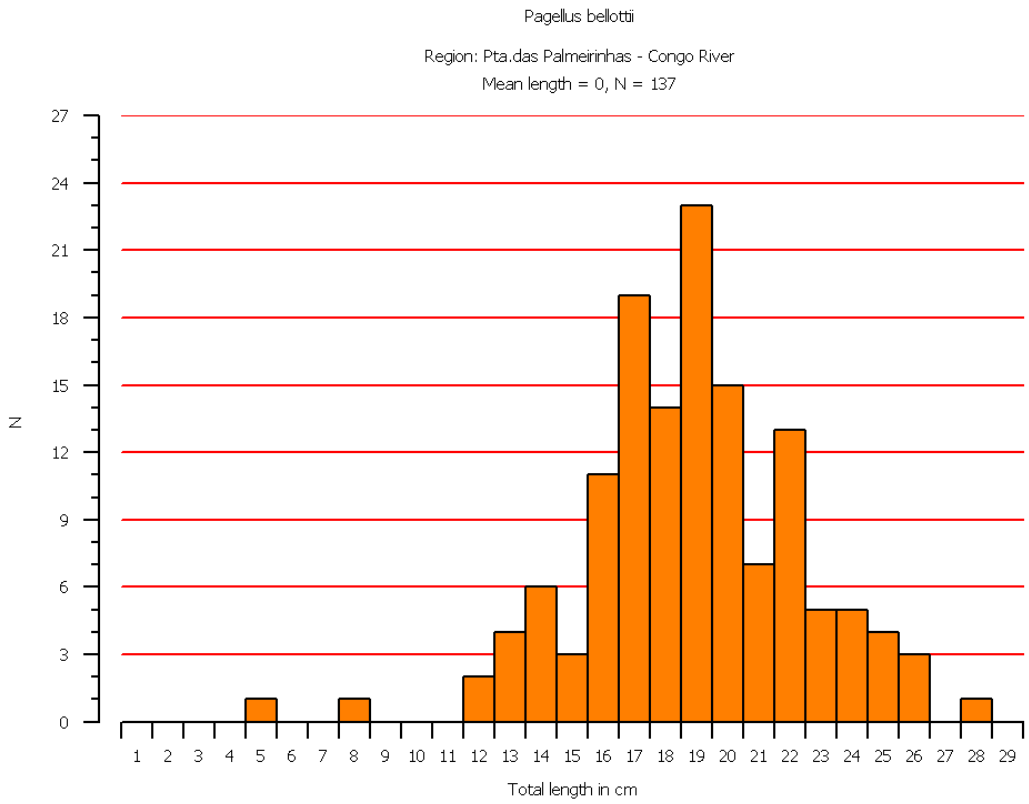
Pagellus bellottii

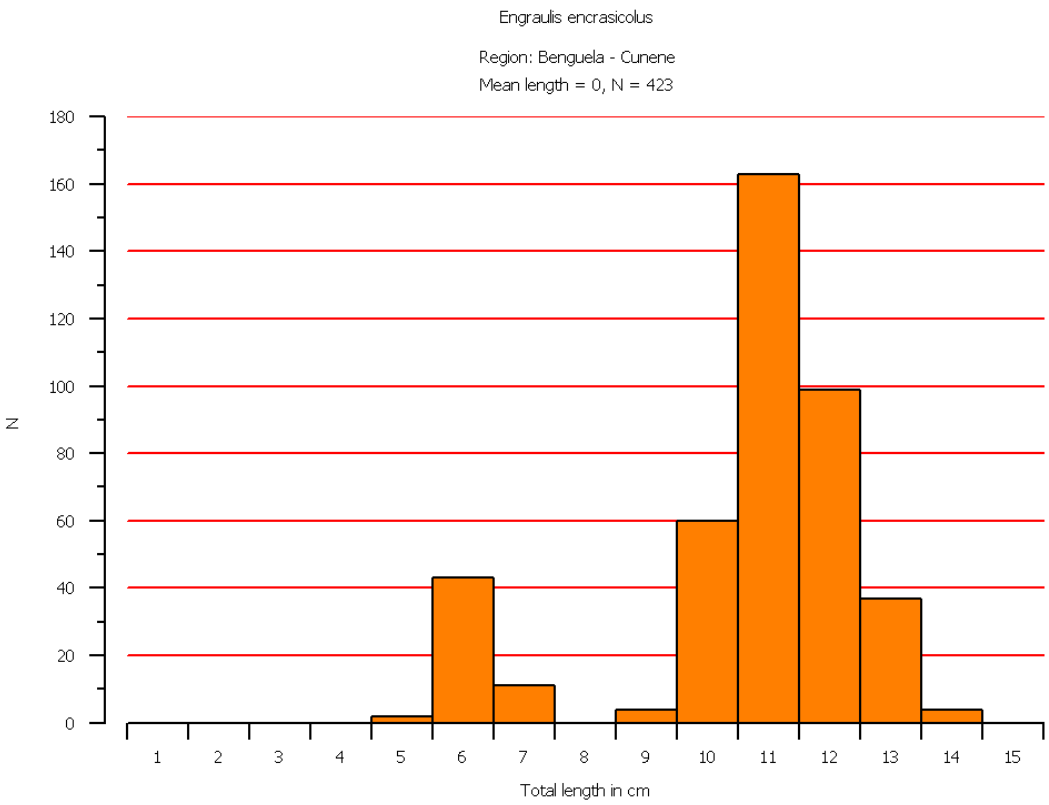
Region: Pta Palm. - Benguela

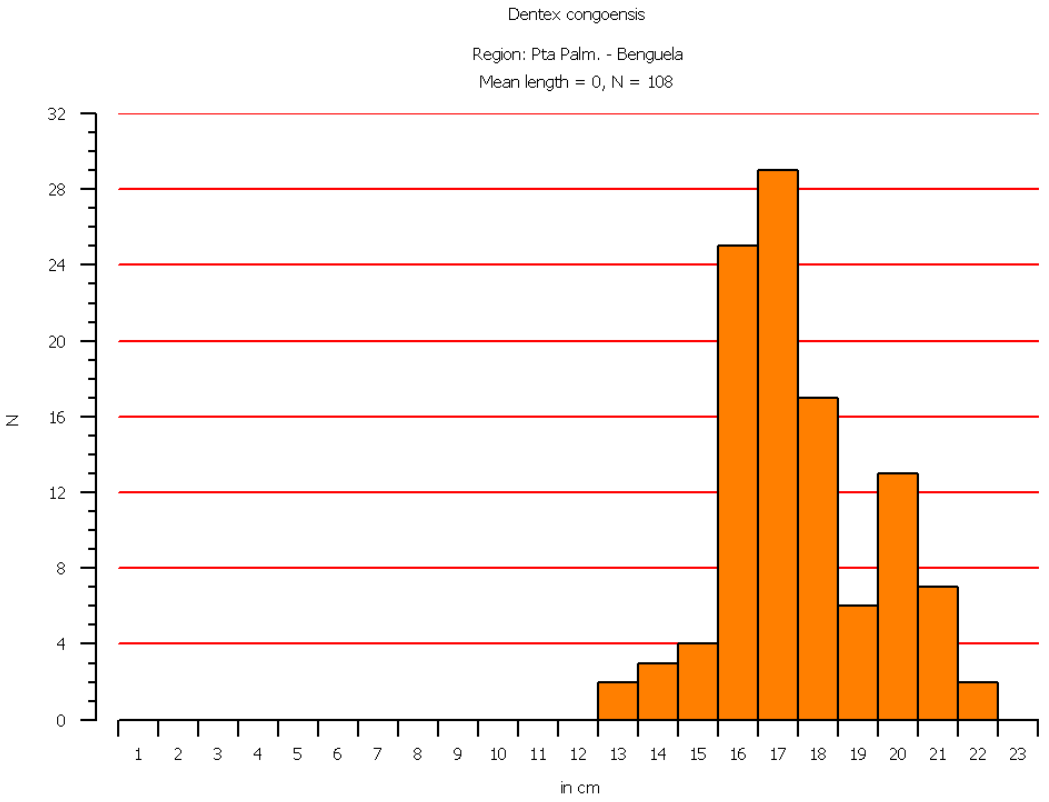
Mean length = 0, N = 212




Pagellus bellottii
Region: Benguela - Cunene
Mean length = 0, N = 424
N
Total length in cm


Pagellus bellottii
Region: Pta.das Palmeirinhas - Congo River
Mean length = 0, N = 137
N
Total length in cm

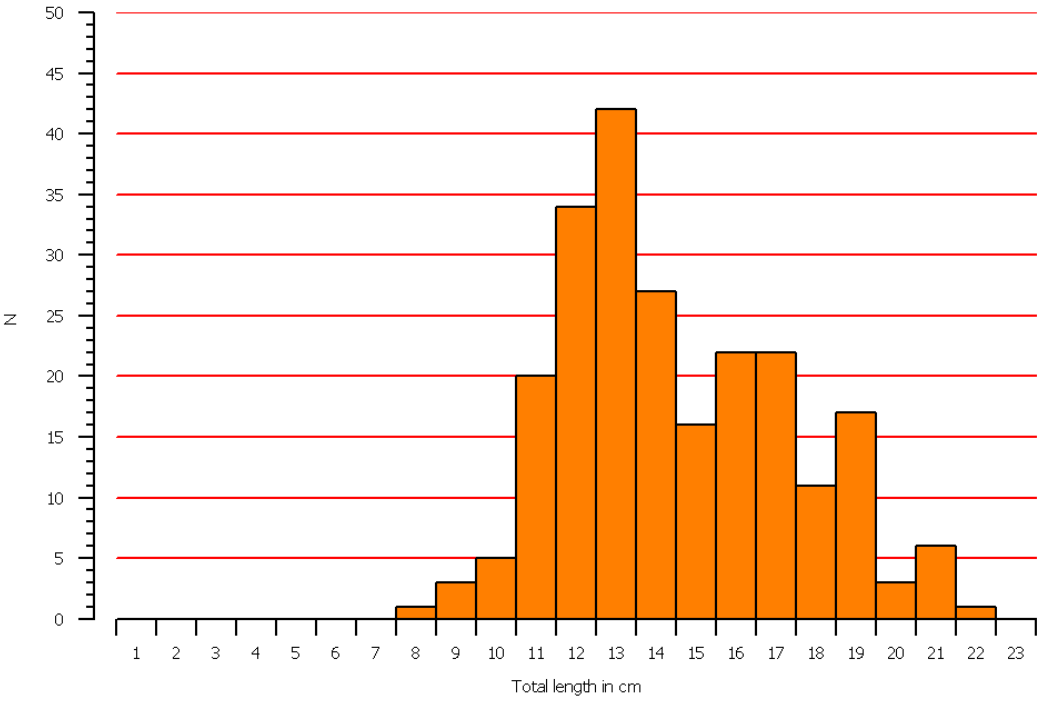

Engraulis encrasicolus
Region: Benguela - Cunene
Mean length = 0, N = 423
N
0
20
40
60
80
100
120
140
160
180
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Total length in cm


Dentex congoensis
Region: Pta Palm. - Benguela
Mean length = 0, N = 108
N
0
4
8
12
16
20
24
28
32
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
in cm

Dentex congoensis

Region: Pta.das Palmeirinhas - Congo River

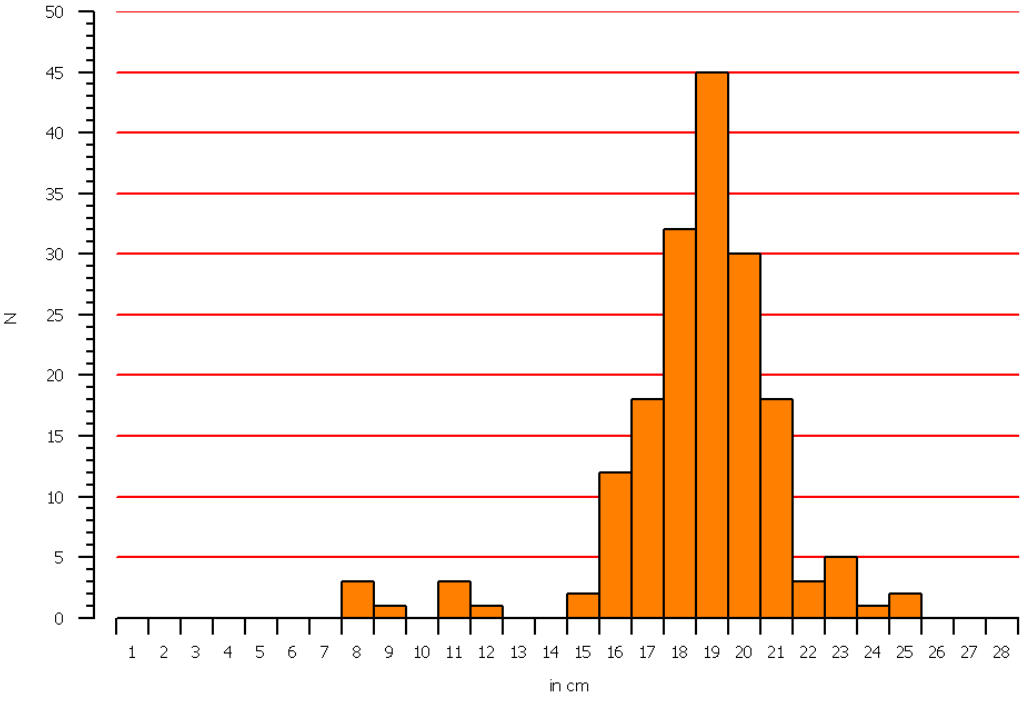
Mean length = 0, N = 230

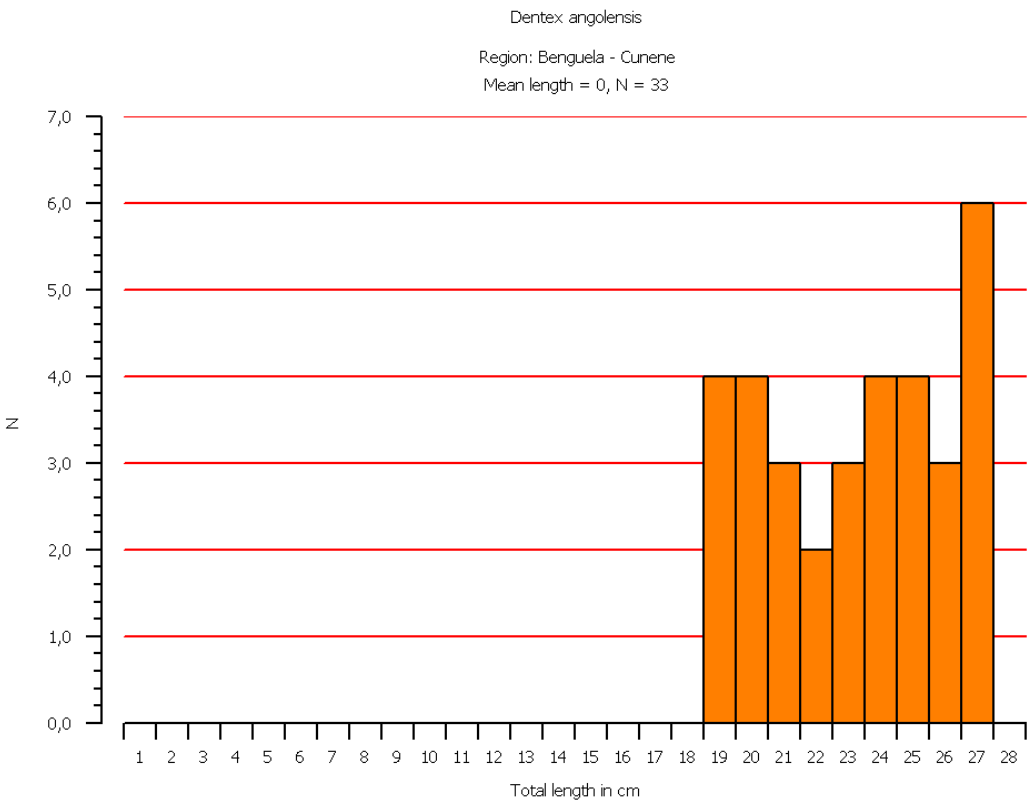


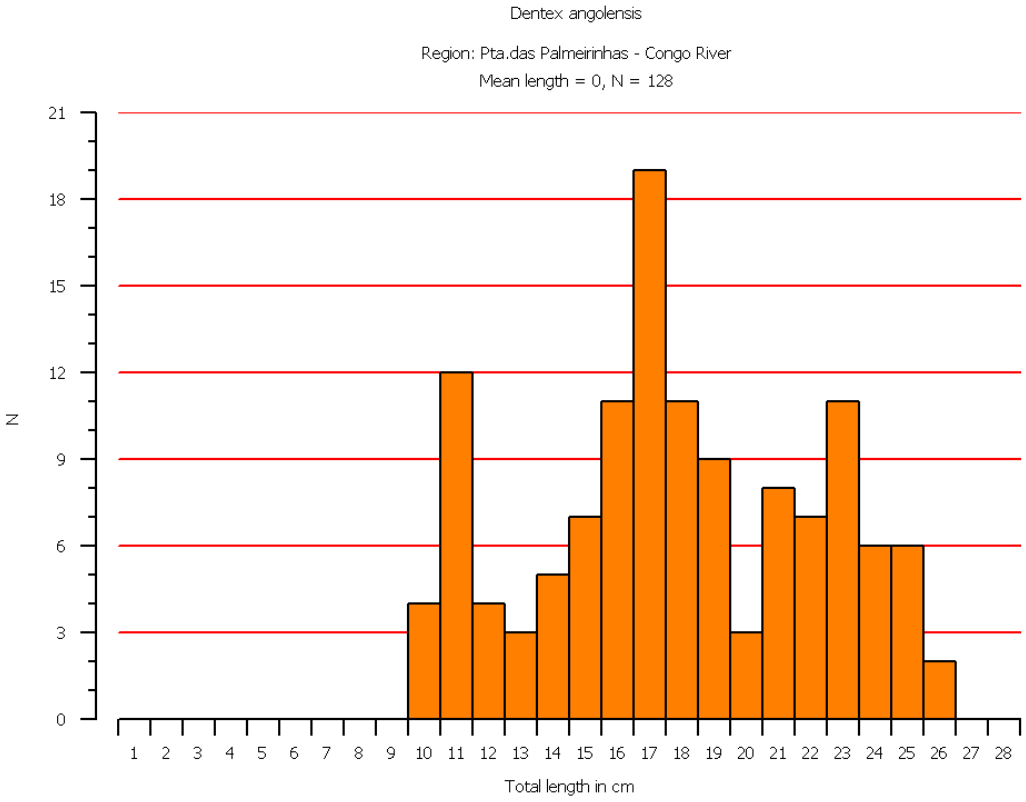
Dentex angolensis

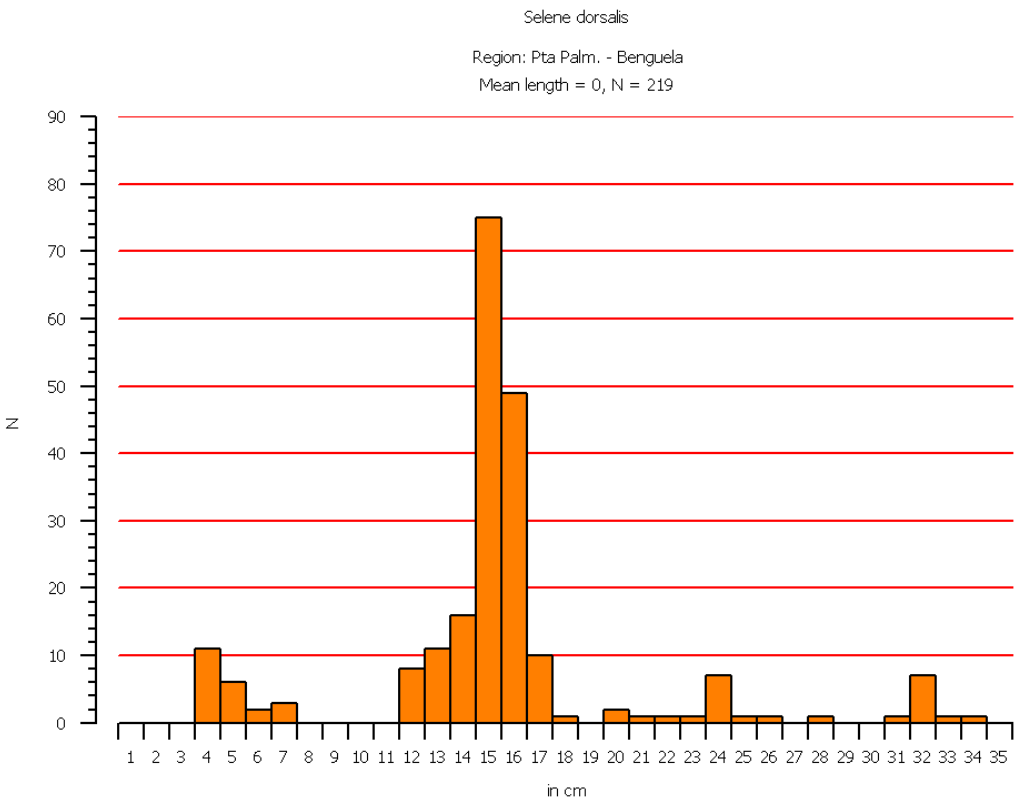
Region: Pta Palm. - Benguela

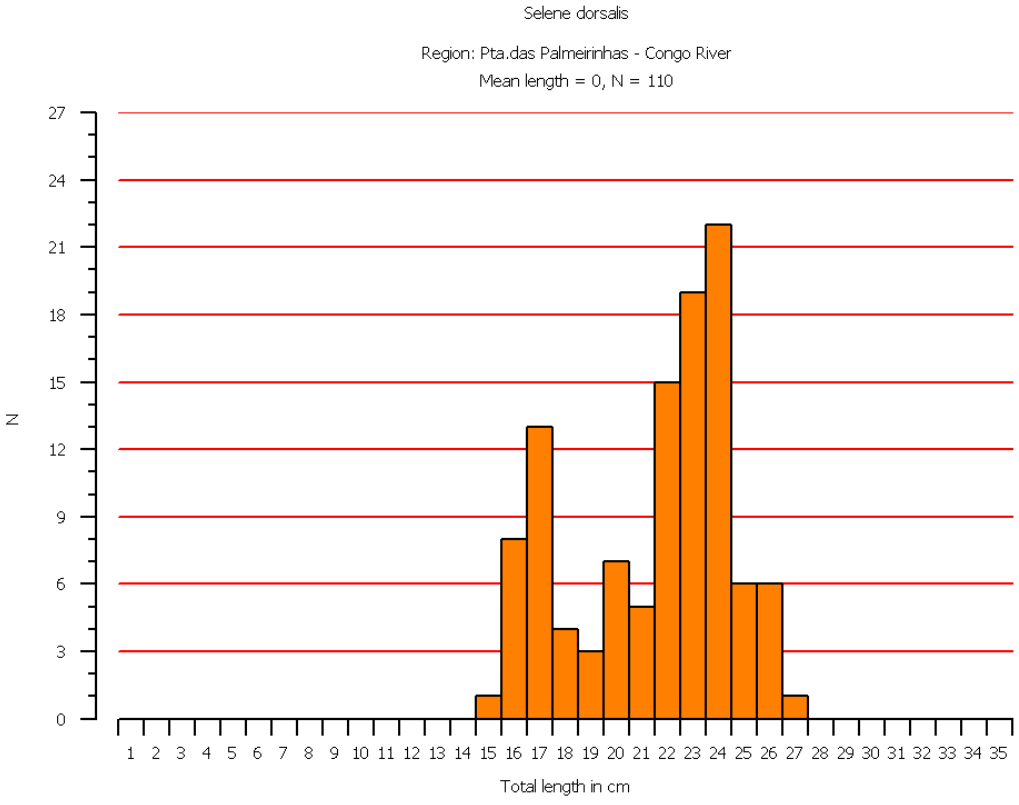
Mean length = 0, N = 176

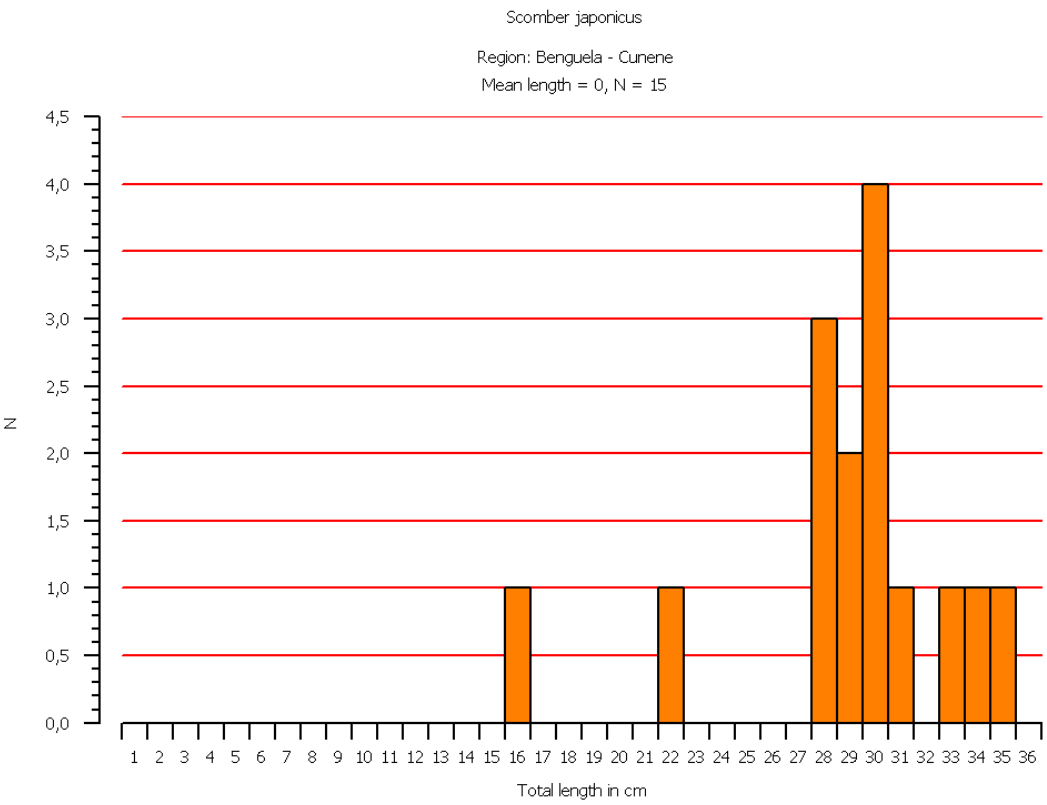



Dentex angolensis
Region: Benguela - Cunene
Mean length = 0, N = 33
N
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0,0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Total length in cm


Dentex angolensis
Region: Pta.das Palmeirinhas - Congo River
Mean length = 0, N = 128
N
21
18
15
12
9
6
3
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Total length in cm


Selene dorsalis
Region: Pta Palm. - Benguela
Mean length = 0, N = 219
N
0 10 20 30 40 50 60 70 80 90
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
in cm


Selene dorsalis
Region: Pta.das Palmeirinhas - Congo River
Mean length = 0, N = 110
N
0 3 6 9 12 15 18 21 24 27
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
Total length in cm


Scomber japonicus
Region: Benguela - Cunene
Mean length = 0, N = 15
N
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
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. trachurus 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 japonicus
	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	$Myctophidae_3$	*Diaphus dumerili*
	Other mesopelagic fish	*Trachinocephalus myops*
Plankton	Calanoidae	*Calanus* sp.
	Euphausiidae	*Meganyctiphanes sp.*
	Other plankton	

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

ANNEX V. BIOMASS OF SARDINELLA AND CUNENE HORSE MACKEREL 1985-2013

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

Year	Season	Dates	Survey number	South Cunene-Benguela	Central Palmerinhas-Benguela	North Cabinda-Palmerinhas	Total Cunene-Cabinda	Notes
1985	Summer	28.01-26.02	1	25	20	80	125	
1985	Autumn	23.04-28.05	2	110	190	180	480	
1985	Winter	08.08-10.09	3	0	70	190	260	
1985	Spring	05.11-05.12	4	0	200	110	310	
1986	Summer	22.01-10.03	1	10	140	110	260	
1986	Autumn	22.04-05.06	2	10	130	130	270	
1989	Summer	13.02-16.03	1	40	200	60	300	
1989	Autumn	23.04-29.05	2	20	40	130	190	
1989	Spring	17.11-12.12	3	40	100	60	200	
1991	Autumn	04.05-19.06	1		180	120	300	1
1991	Winter	06.08-18.09	2		68	154	222	1
1992	Winter	05.08-22.09	1		119	161	280	1
1994	Summer	21.02-16.03	ANG1		410	100	510	2
1994	Winter	02.08-17.08	ANG2		245	290	535	2
1995	Summer	28.02-02.04	ANG1		140	24	164	2
1995	Winter	10.08-20.09	ANG4		277	297	574	1
1996	Summer	23.02-31.03	ANG1	49	175	70	294	
1996	Winter	16.07-06.09	ANG2	0	130	233	363	
1997	Summer	22.02-20.03	ANG1	0	195	300	495	3
1998	Summer	02.03-28.03	ANG1	75	389	79	543	3
1998	Winter	07.05-22.05	ANG3	0	233	159	392	3
1999	Winter	02.08-26.08	ANG2	0	228	135	363	3
2000	Winter	28.07-20.07	ANG2	0	179	174	353	3
2001	Winter	20.07-17.08	ANG2	0	257	177	434	3
2002	Winter	17.08-16.09	ANG2	0	165	187	352	3
2003	Winter	20.07-19.08	ANG2	2	277	153	432	3
2004	Winter	28.07-27.08	ANG2	0	175	187	362	3
2005	Winter	16.07-24.08	2005408	0	148	95	243	
2006	Winter	21.07-21.08	2006408	20	244	366	630	
2007	Winter	07.07-10.08	2007406	55	483	187	725	
2008	Winter	15.05-02.07	2008404	56	264	186	506	
2009	Winter	23.05-04.07	2009406	92	232	206	530	
2010	Winter	18.06-11.08	2010406	43	293	93	429	3
2011	Summer	20.02-20.03	2011402	96	68	96	260	3
2011	Winter	18.07-28.08	2011408	0	181	71	252	
2012	Summer	01.03-30.03	2012402	353	230	156	739	
2012	Winter	26.08-06.10	2012405	325	584	210	1119	
2013	Summer	16.02-17.03	2013402	229	219	117	565	
2013	Winter	20.06-17.07	2012406	10	295	179	484	

1 Data error (Southern Region)
2 Southern Region not surveyed
3 Cabinda not surveyed

Cunene Horse Mackerel biomass (1 000 tons) estimated from acoustic indexes from surveys from 1985-2013.

Year	Season	Dates	Survey number	South Cunene-Benguela	Central Palmerinhas-Benguela	North Cabinda-Palmerinhas	Total Cunene-Cabinda	Notes
1985	Summer	28.01-26.02	1	30	195	40	265	
1985	Autumn	23.04-28.05	2	55				1
1985	Winter	08.08-10.09	3	50	90	40	180	
1985	Spring	05.11-05.12	4	70	125	20	215	
1986	Summer	22.01-10.03	1	130				5
1986	Autumn	22.04-05.06	2	30				1
1989	Summer	13.02-16.03	1	35	55	40	130	
1989	Autumn	23.04-29.05	2	25				1
1989	Spring	17.11-12.12	3	170	40	35	245	
1991	Autumn	04.05-19.06	1	100	80	20	200	
1991	Winter	06.08-18.09	2	100	70	30	200	
1992	Winter	05.08-22.09	1	98	86	80	280	
1994	Autumn	21.02-16.03	ANG1		238	1	239	
1994	Winter	02.08-17.08	ANG2		130	120	250	
1995	Summer	28.02-02.04	ANG1		?	84	84	
1995	Winter	10.08-20.09	ANG4	70	160	110	340	
1996	Summer	23.02-31.03	ANG1	286	214	6	506	
1996	Winter	16.07-06.09	ANG2	140	157	63	360	
1997	Summer	22.02-20.03	ANG1	234	55	138	193	3
1998	Summer	02.03-28.03	ANG1	163	58	18	239	3
1998	Winter	07.05-22.05	ANG3	118	112	37	267	3
1999	Winter	02.08-26.08	ANG2	124	129	68	321	3
2000	Winter	28.07-20.07	ANG2	92	178	63	333	3
2001	Winter	20.07-17.08	ANG2	64	22	3	89	3
2002	Winter	17.08-16.09	ANG2	118	13	31	162	3
2003	Winter	20.07-19.08	ANG2	120	34	12	166	3
2004	Winter	28.07-27.08	ANG2	32	107	90	229	3
2005	Winter	16.07-24.08	2005408	102	57	21	180	
2006	Winter	21.07-21.08	2006408	45	77	31	153	
2007	Winter	07.07-10.08	2007406	73	57	27	157	
2008	Winter	15.05-02.07	2008404	29	40		69	4
2009	Winter	23.05-04.07	2009406	76	7		83	4
2010	Winter	18.06-11.08	2010406	100	15	21	136	3
2011	Summer	20.02-20.03	2011402	55	13		69	3, 4
2011	Winter	18.07-16.07	2011408	74	26	17	117	3
2012	Summer	01.03-30.03	2012402	162	135	30	327	3
2012	Winter	26.08-06.10	2012405	132	67	11	210	3
2013	Summer	16.02-17.03	2013402	62	62	15	139	3
2013	Winter	20.06-17.07	2012406	88	117	52	257	

1 Data error (Central and Northern Regions)

2 Southern region not surveyed

3 Cabinda not surveyed

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

5 Estimates reported together with previous report

ANNEX VI. INSTRUMENTS AND FISHING GEAR USED

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

Standard sphere calibrations were carried out in Baía dos Elefantes 06.07.2013 using 64 and 60 mm diameter copper spheres and 38.1 mm tungsten carbide sphere for 18, 38 and 120 kHz, respectively. The details of the settings of the 38 kHz echo sounder where as follows:

Transceiver-2 menu (38 kHz)

Transducer depth	5.50 m
Absorption coefficient (variable with conditions)	8.7 dB/km
Pulse length	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2-way beam angle	-20.6dB
Gain	25.13 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	
2	1	2	St	06°32.44’	12°19.78’	No multinet	No bottles	Yes	25	
2	2	2	St	06°36.77’	12°11.02’	No multinet	No bottles	Yes	50	
2	3	2	St	06°43.69	11°57.96’	No multinet	No bottles	Yes	100	
2	4	2	St	06°44.81’	11°50.71’	No multinet	No bottles	Yes	200	
2	5	2	St	06°52.24’	11°42.16’	No multinet	No bottles	Yes	500	
3	1	ML3	St	07°02.15’	11°48.59’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
3	2	ML3	St	06°59.18’	11°54.34’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
3	3	ML3	St	06°55.10’	12°01.78’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
3	4	ML3	St	06°47.51’	12°14.88’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
4	1	4	St	06°59.97’	12°37.64’	No multinet	No bottles	Yes	500	

4	2	4	St	07°03.52’	12°31.72’	No multinet	No bottles	Yes	200	
4	3	4	St	07°09.79’	12°18.32’	No multinet	No bottles	Yes	100	
4	4	4	St	07°14.98’	12°10.35’	No multinet	No bottles	Yes	50	
4	5	4	St	07°20.80’	12°02.02’	No multinet	No bottles	Yes	25	
5		N’Zeto	St	7°37.44’	12°00.25’					Platform
5	1	N’Zeto	St	7°28.00’	12°21.21’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
5	2	N’Zeto	St	7°26.50’	12°24.01’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
5	3	N’Zeto	St	7°22.60’	12°31.00’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
5	4	N’Zeto	St	7°17.90’	12°39.00’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
5	5	N’Zeto	St	7°19.90’	12°47.10’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	25	
6	1	6	St	7°43.34’	12°31.01’	No multinet	No bottles	Yes	500	
6	2	6	St	7°42.18’	12°33.82’	No multinet	No bottles		200	
6	3	6	St	7°41.13’	12°38.41’	No multinet	No bottles	Yes	100	
6	4	6	St	7°49.97’	12°34.51’	No multinet	No bottles	Yes	50	
6	5	6	St	7°56.00’	12°31.78’	No multinet	No bottles	Yes	25	
7	1	Ambriz	St	8°00.41’	12°39.380’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
7	2	Ambriz	St	7°58.99’	12°42.650’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
7	3	Ambriz	St	7°57.30’	12°46.180’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	120	
7	4	Ambriz	St	7°55.48’	12°50.260’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
7	5	Ambriz	St	7°53.69’	12°54.680’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	80	
7	6	Ambriz	St	7°51.92’	12°58.820’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	60	
7	7	Ambriz	St	7°50.03’	13°02.940’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	25	
8	1	8	St	8°46.71’	13°12.26’	No multinet	No bottles	Yes	25	
8	1	8	St			No multinet	No bottles	Yes	50	
8	2	8	St			No multinet	No bottles	Yes	100	
8	3	8	St			No multinet	No bottles	Yes	200	
8	4	8	St	8°53.88’	12°49.98’	No multinet	No bottles	Yes	500	
9	1	Dande	St	8°25.20’	13°14.000’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
9	2	Dande	St	8°28.35’	13°05.400’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
9	3	Dande	St	8°31.32’	12°57.690’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
9	4	Dande	St	8°33.57’	12°50.980’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	

10	1	Luanda	St	8º17.28’	13º17.28’	No multinet	No bottles	Yes	25	
10	1	Luanda	St	8º46.68’	13º12.89’	No multinet	No bottles	Yes	50	
10	2	Luanda	St	8º47.28’	13º06.09’	No multinet	No bottles	Yes	100	
10	3	Luanda	St	8º47.75’	12º59.72’	No multinet	No bottles	Yes	200	
10	4	Luanda	St	8º28.71’	12º49.46’	No multinet	No bottles	Yes	500	
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	
12	1	12	St	9º20.33’	13º01.02’	No multinet	No bottles	Yes	20	
12	2	12	St			No multinet	No bottles	Yes	50	
12	3	12	St			No multinet	No bottles	Yes	100	
12	4	12	St			No multinet	No bottles	Yes	200	
12	5	12	St	9º24.43’	12º36.62’	No multinet	No bottles	Yes	500	
13	1	Cabo Ledo	St	9º36.10’	13º09.15’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
13	2	Cabo Ledo	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
13	3	Cabo Ledo	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
13	4	Cabo Ledo	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
13	5	Cabo Ledo	St	9º43.77’	12º42.76’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
14	1	14	St	9º56.77’	12º46.72’	No multinet	No bottles	Yes	20	
14	2	14	St			No multinet	No bottles	Yes	50	
14	3	14	St			No multinet	No bottles	Yes	100	
14	4	14	St			No multinet	No bottles	Yes	200	
14	5	14	St	9º49.83’	12º12.22’	No multinet	No bottles	Yes	500	
15	1	Cabo S. Braz	St	9º36.10’	13º09.15’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
15	2	Cabo S. Braz	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
15	3	Cabo S. Braz	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
15	4	Cabo S. Braz	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	

15	5	Cabo S. Braz	St	10º13.21’	12º53.88’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
16	1	16	St	10º15.25’	13º26.42’	No multinet	No bottles	Yes	20	
16	2	16	St			No multinet	No bottles	Yes	50	
16	3	16	St			No multinet	No bottles	Yes	100	
16	4	16	St			No multinet	No bottles	Yes	200	
16	5	16	St	10º24.43’	12º57.95’	No multinet	No bottles	Yes	500	
17	1	17	St	10º37.10’	13º09.15’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
17	2	17	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
17	3	17	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
17	4	17	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
17	5	17	St	10º30.21’	13º36.88’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
18	1	18	St	10º46.75’	13º42.72’	No multinet	No bottles	Yes	50	
18	2	18	St			No multinet	No bottles	Yes	100	
18	3	18	St			No multinet	No bottles	Yes	200	
18	4	18	St	10º53.83’	13º19.45’	No multinet	No bottles	Yes	500	
19	1	19	St	11º02.05’	13º50.85’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
19	2	19	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
19	3	19	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
19	4	19	St	11º08.21’	12º28.48’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
20	1	20	St	11º21.75’	13º42.72’	No multinet	No bottles	Yes	20	
	2	20	St			No multinet	No bottles	Yes	50	
20	3	20	St			No multinet	No bottles	Yes	100	
20	4	20	St			No multinet	No bottles	Yes	200	
20	5	20	St	11º22.33’	13º24.45’	No multinet	No bottles	Yes	500	
21	1	21	St	11º39.85’	13º46.75’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
21	2	21	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
21	3	21	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
21	4	21	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
21	5	21	St	11º39.21’	13º19.48’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	

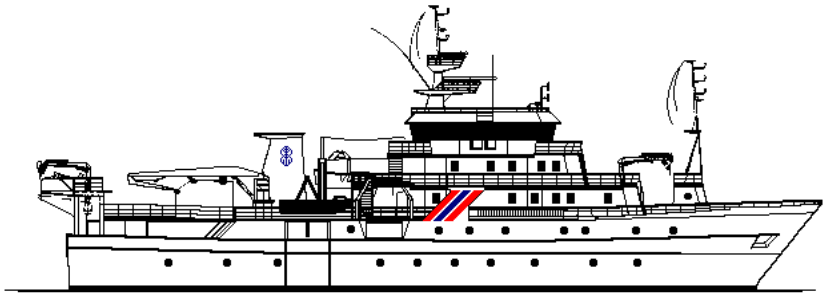
22	1	22	St	11º57.95’	13º43.72’	No multinet	No bottles	Yes	20	
22	2	22	St			No multinet	No bottles	Yes	50	
22	3	22	St			No multinet	No bottles	Yes	100	
22	4	22	St			No multinet	No bottles	Yes	200	
22	5	22	St	11º56.36’	13º22.35’	No multinet	No bottles	Yes	500	
23	1	Lobito	LBML	12º20.91’	13º28.60’	0-25; 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	
24	1	24	St	12º32.53’	13º11.18’	No multinet	No bottles	Yes	50	
24	2	24	St			No multinet	No bottles	Yes	100	
24	3	24	St			No multinet	No bottles	Yes	200	
24	4	24	St	12º34.56’	13º16.27’	No multinet	No bottles	Yes	500	
25	1	25	St	12º43.72’	13º03.05’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
25	2	25	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
25	3	25	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
25	4	25	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
25	5	25	St	12º36.60’	13º04.07’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
26	1	26	St	12º55.92’	12º55.92’	No multinet	No bottles	Yes	20	
26	2	26	St			No multinet	No bottles	Yes	50	
26	3	26	St			No multinet	No bottles	Yes	100	
26	4	26	St			No multinet	No bottles	Yes	200	
26	5	26	St	12º53.89’	12º49.82’	No multinet	No bottles	Yes	500	
THE SOUTHERN ANGOLA										
27	1	27	St	13º10.17’	12º47.38’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
27	2	27	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
27	3	27	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
27	4	27	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	

27	5	27	St	13º06.10’	12º41.68’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
28	1	28	St	13º21.35’	12º29.48’	No multinet	No bottles	Yes	20	
28	2	28	St			No multinet	No bottles	Yes	50	
28	3	28	St			No multinet	No bottles	Yes	100	
28	4	28	St			No multinet	No bottles	Yes	200	
28	5	28	St	13º22.37’	12º35.58’	No multinet	No bottles	Yes	500	
29	1	29	St	13º38.63’	12º31.52’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
29	2	29	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
29	3	29	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
29	4	29	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
29	5	29	St	13º138.63’	12º25.42’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
30	1	30	St	13º55.92’	12º24.40’	No multinet	No bottles	Yes	20	
30	2	30	St			No multinet	No bottles	Yes	50	
30	3	30	St			No multinet	No bottles	Yes	100	
30	4	30	St			No multinet	No bottles	Yes	200	
30	5	30	St	13º55.93’	12º13.22’	No multinet	No bottles	Yes	500	
31	1	31	St	14º13.22’	12º19.32’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
31	2	31	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
31	3	31	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
31	4	31	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
31	5	31	St	14º13.28’	12º12.20’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
32	1	32	St	14º30.50’	12º18.30’	No multinet	No bottles	Yes	20	
32	2	32	St			No multinet	No bottles	Yes	50	
32	3	32	St			No multinet	No bottles	Yes	100	
32	4	32	St			No multinet	No bottles	Yes	200	
32	5	32	St	14º30.50’	12º12.20’	No multinet	No bottles	Yes	500	
33	1	33	St	14º48.80’	12º14.23’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
33	2	33	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
33	3	33	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
33	4	33	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	

33	5	33	St	14º47.78’	12º10.17’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
34	1	34	St	15º02.03’	12º08.13’	No multinet	No bottles	Yes	20	
34	2	34	St			No multinet	No bottles	Yes	50	
34	3	34	St			No multinet	No bottles	Yes	100	
34	4	34	St			No multinet	No bottles	Yes	200	
34	5	34	St	15º02.03	12º02.03’	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	
36	1	36	St	15º26.43’	12º00.00’	No multinet	No bottles	Yes	20	
36	2	36	St			No multinet	No bottles	Yes	50	
36	3	36	St			No multinet	No bottles	Yes	100	
36	4	36	St			No multinet	No bottles	Yes	200	
36	5	36	St	15º26.43’	11º50.83’	No multinet	No bottles	Yes	500	
37	1	37	St	15º43.72’	11º53.88’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
37	2	37	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
37	3	37	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
37	4	37	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
37	5	37	St	15º41.68’	11º41.68’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
38	1	38	St	15º59.98’	11º46.77’	No multinet	No bottles	Yes	20	
38	2	38	St			No multinet	No bottles	Yes	50	
38	3	38	St			No multinet	No bottles	Yes	100	
38	4	38	St			No multinet	No bottles	Yes	200	
38	5	38	St	15º59.98’	11º32.53’	No multinet	No bottles	Yes	500	
39	1	39	St	16º12.47’	11º28.75’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	20	
39	2	39	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	50	
39	3	39	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	

39	4	39	St			0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
39	5	39	St	16º16.67’	11º45.75’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	500	
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	
41	1	Ponta Albina	St	16º40.47’	11º45.75’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	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’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	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’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	100	
41	9	Ponta Albina	St	16º12.800’	11º31.820’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	Yes	200	
41	10	Ponta Albina	St	16º12.800’	11º31.340’	No multinet	No bottles	Yes	347	
41	11	Ponta Albina	St	16º40.67’	11º45.75’	0-25; 25-50; 50-75; 75-100; 100-200	5; 15; 25; 50; 75	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	
42	1	42	St	16º40.67’	11º45.75’	No multinet	No bottles	Yes	20	
42	2	42	St			No multinet	No bottles	Yes	50	
42	3	42	St			No multinet	No bottles	Yes	100	

42	4	42	St			No multinet	No bottles	Yes	200	
42	5	42	St	16º32.53’	11º44.73’	No multinet	No bottles	Yes	500	
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	



A TRANSBOUNDARY STUDY OF THE PELAGIC FISH STOCKS OF SOUTHERN ANGOLA AND NORTHERN NAMBIA

BCC Cruise Report No 1/2013

Institute of Marine Research
IMR
Bergen

Instituto Nacional de Investigação Pesqueira
INIP
Luanda

National Marine Information and Research Centre
NatMIRC
Swakopmund

A TRANSBOUNDARY STUDY OF THE PELAGIC FISH STOCKS OF SOUTHERN ANGOLA AND NORTHERN NAMBIA

BCC Cruise Report No 1/2013

18 July – 02 August 2013

by

Knut Korsbrekke[1], Inês Bernardes[1], Aristóteles P. da S. Amaro[2], Bomba Sangolay[2] and Moses Kalola[3]

[1)] Institute of Marine Research, Bergen, Norway
[2)] Instituto Nacional de Investigação Pesqueira, Luanda, Angola
[3)] National Marine Information and Research Centre, Swakopmund, Namibia

Bergen 2013

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1. INTRODUCTION

1.1. Introduction

The transboundary pelagic survey is a dedicated research survey covering the pelagic fish resources and hydrographical conditions in the region ranging from southern Angola to northern Namibia. The main focus of the work was to assess the biomass of all commercially important pelagic fish stocks in the transboundary region, with emphasis on the horse mackerel stocks. The overall ship time available, of eleven days, was integrated into the yearly pelagic survey of Angola conducted by the 'R/V Dr Fridtjof Nansen'. In order to be able to continue the coverage carried out as part of the Angolan effort and to utilize the ship time optimally, the survey was extended southwards in central Namibia to Dune Point at 20°15' S.

The overall transboundary area is defined from Ponta Albina, near Tombua (Angola), in the north (15°50' S) to the Cape Frio upwelling cell (Namibia) in the south (at around 19°00' S). The northern boundary is located at the northernmost part of the Tiger Bank, from where the continental shelf starts widening while the southern boundary represents a natural biological boundary in Namibian waters due to the presence of the massive upwelling cell near Cape Frio. The survey design is based on the assumption that the northern boundary of the transboundary area could be described as the northern limits of the distribution of Cape horse mackerel, while the southern limits of the distribution of the Sardinellas and/or Cunene horse mackerel indicates its southern extend. The definition of the transboundary area here applied is expected to be wide enough as to cover the likely distribution area of fish migrating between Namibian and Angolan waters, at both warm and cold seasons.

The zone across the Angolan-Namibian border is particularly important as this area hosts co-occurring population of carangids, *i.e*. Cape horse mackerel, *Trachurus capensis,* and Cunene horse mackerel, *Trachurus trecae*, as well as clupeids, including sardine (Pilchard) *Sardinops sagax*, round herring (Redeye) *Etrumeus whiteheadi* and anchovy *Engraulis* spp. There is special concern about the situation in the transboundary area since these stocks are known to be in low abundance, while they are intensively fished in the border area.

The main purpose of this survey was to map the distribution and estimate the abundance of the most commercially important pelagic species in the Namibia-Angola transboundary area during the cold season. The study complemented the pelagic survey carried out in Angola by extending the survey grid into Namibian waters. The survey and fish sampling strategy (pelagic and demersal trawling on acoustic targets) as well as the hydrographical mapping in the transboundary area follow the established standard for the yearly pelagic surveys in Angolan waters (Dr. Fridtjof Nansen Survey Report of the Angolan Pelagic Resources No.

2/2007), thus the transboundary survey provide a the additional information needed for a complete coverage of the Cunene horse mackerel, including the proportion of the stock present in Namibian waters at the time of the pelagic survey in Angola. For sardine and the other clupeids as well as Cape horse mackerel, however, the survey would not cover the entire distribution area of the species.

Please note: All results given as numbers of fish or biomass of fish must be considered relative indices of abundance, and are more useful to describe trends over time. The indices should not be interpreted as absolute estimates of abundance (absolute estimates of abundance will typically be results from stock assessment modelling usually including overall catches of the stock as additional input together with assumptions regarding natural mortality etc.). The results being (biased) indices will not affect the proportions observed in the different areas.
For sardine, Cape horse mackerel and other pelagic (clupeids) the estimates do not cover the entire distribution of the sardine stock, of which *e.g*. sardine is known to migrate between Angolan and Namibian waters, and differences from one year to another may well be caused by migration patterns rather than population changes. As for all acoustic estimates, the indices presented here are prone to survey errors such as statistical sampling errors, vessel avoidance and the availability to acoustic sampling (Anon. 2003, 2004).

1.2. Objectives

The main objectives of the survey were the following:

To map the distribution and estimate indices of abundance of the most commercially important pelagic species in the Namibia-Angola transboundary area (15°50-19°00'), following the survey design utilized in Angolan waters (6 n.mi spacing between transect lines), with special emphasis on the two horse mackerel Cunene horse mackerel (*Trachurus trecae)* and Cape horse mackerel (*Trachurus capensis)*, sardine "Pilchard" (*Sardinops sagax)* and other small pelagic species, including anchovy (*Engraulis capensis)* and round herring (*Etrumeus whiteheadi)*.
To map the distributions and estimate the abundance of the same species in central Namibia south to Dune Point (20°15' S), following the established survey design with 6 n.mi spacing between the transect lines.
To study and analyse the biological state of the main species, including length frequencies, length-weight relationships, reproductive stages and length-at-maturity.
To map the meteorological and hydrographical conditions in the survey area by means of continuous recordings of weather data such as Sea-surface temperature (SST), Sea-surface salinity (SSS), wind speed and direction, using CTD-casts (Temperature, Salinity and Oxygen).

1.3. Participation

The following scientific staff participated in the survey:

From INIP, Angola:
Aristóteles P. Da S. Amaro (Angolan team leader), Bomba Bazíka Sangolay, João Morais Domingos, Fátima Delicado, Geraldina Salvador, Eusébio Dos Santos, Tito Milagre, Djamila Maurício and Domingos Pedro.

From NatMIRC, Namibia:
Moses Kalola (Namibian team leader), Vincia Katjindee

From IMR, Norway:
Knut Korsbrekke (cruise leader), Inês Bernardes, Ole Sverre Fossheim and Håkon Langøen.

1.4. Survey schedule and effort

A full transceiver calibration of the 18, 38 and 120 and 200 kHz transducers was carried out prior to the survey. The calibration was done in Baía dos Elephantes, Angola, on 06th of July. The 200 kHz transducer was malfunctioning and no calibration was attempted. The vessel completed the pelagic survey in Angola, including the Angolan part of the transboundary area, and reached the Angolan-Namibian border at the Cunene River (17°15' S) on the 15th of July. The coverage of the transboundary area south continued on the 22nd July (after a call in Walvis Bay) to Rocky Point at 19°00'S on 26th July. The survey was extended southwards and it ended at 20°15'S the 29th July, where the course track was then completed. The vessel docked in Walvis Bay 31th August in the morning. Course track including sampling activities is shown in Figure 1.

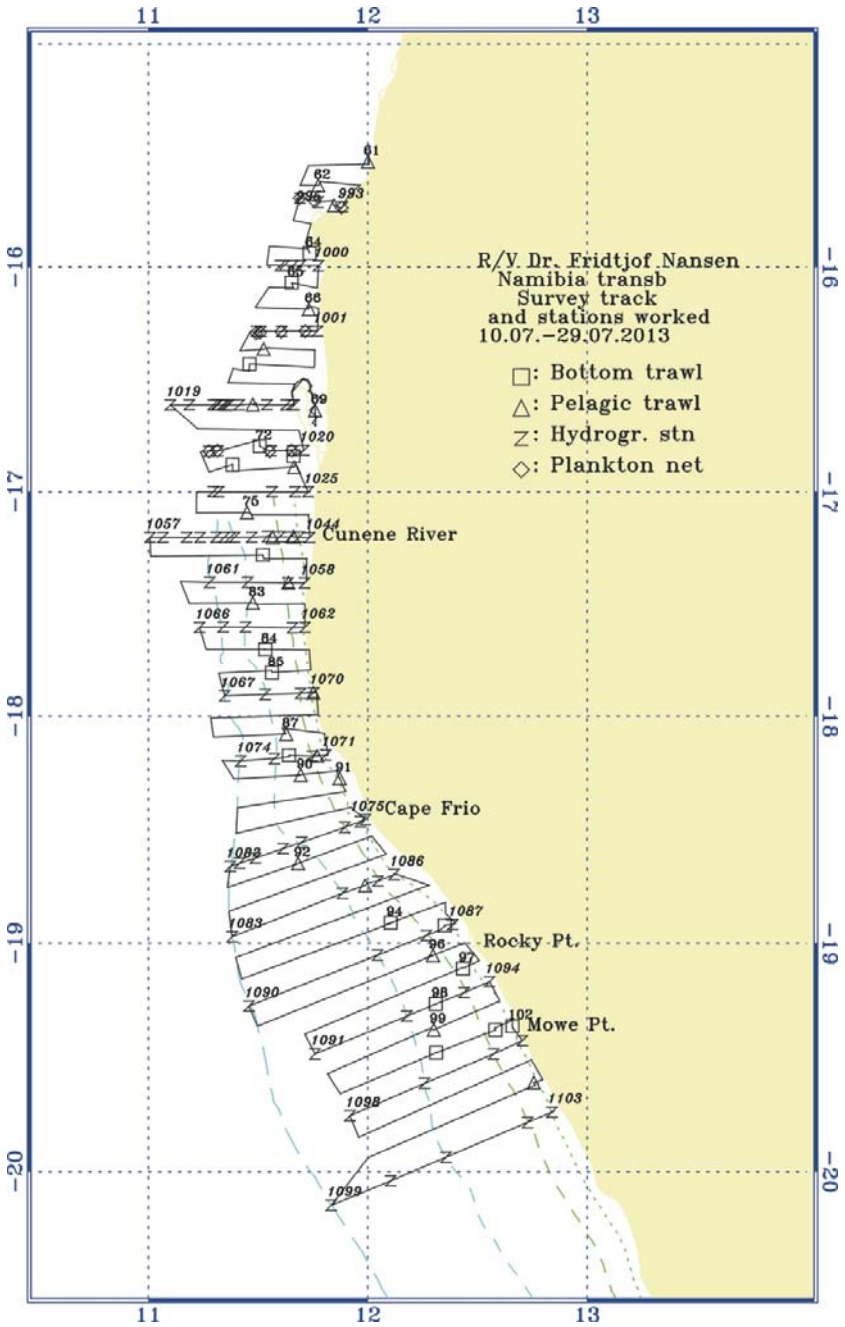


Figure 1 Course track with pelagic and demersal trawl stations and CTD stations in the trans-boundary area (15°50'-19°00' S) and Northern Namibia (19°00'S -20°15' S)

The survey effort in terms of distance sailed, stations trawled and CTD stations are summarised in Table 1 below.

Table 1 Summary of survey effort, including number of demersal (BT) and pelagic (PT) trawl haul deployments, CTD casts and distance surveyed (Log, in n.mi).

Area	BT trawls	PT trawls	Total trawls	CTD casts	Log distance (n.mi)
Transboundary Angola (15°50'S - 17°15' S)	8	12	20	65	766
Transboundary Namibia (17°15'S -19°00' S)	6	9	15	33	889
Northern Namibia (19°00'S -20°15' S)	5	3	8	13	552
Total	19	24	43	111	2207

CHAPTER 2. MATERIALS AND METHODS

2.1. Survey grid

The survey design of equidistant pseudo-parallel transects (6 nautical miles apart) perpendicular to the coastline, as applied in Angola, was also followed in the extension into Namibian waters (Fig. 1), following the established practice for the transboundary surveys. Transects generally covered a depth range of 20-500 meters. As in previous surveys, some of the lines had to be stopped at 30-35 m depth due to the steeply inclining bottom near the shoreline. A few transect lines in the border area from the Cunene River to Cape Frio were extended to the 2000 m isobaths in order to check for possible offshore aggregations of horse mackerel. This strategy ensured that the Namibian component of the transboundary area was covered in a way that was comparable to the data already collected in Angola. In this way, distribution maps and biomass estimates could be drawn across the border area.

2.2. Acoustical sampling

A standard sphere calibration was carried out at Baía dos Elephantes in Angola during the survey. Standard calibration procedures were followed using the appropriate calibration spheres (18, 38 and 120 and kHz). The 200 kHz transducer was malfunctioning during the survey and no calibration was attempted. There were no significant deviations from the previous calibrations for 18 and 38kHz with a possible drift for 120KHz. Subsequently no changes in the calibration parameters were made. The acoustic recordings were conducted using two Simrad ER 60 echosounders with keel mounted transducers at nominal operating frequencies of 18, 38 and 120 kHz. The technical specifications and operational settings of the echosounder used during the survey are given in Annex III.

Acoustic data were post-processed using acoustic data post-processing software, the Large Scale Survey System (LSSS) Version 1.61. The mean 5 n.mi area backscattering coefficients s_A ($m^2/n.mi^2$) were allocated to a predefined set of acoustic target groups on the basis of characteristic echogram features in conjunction with information about the species - and size compositions - as derived from the trawl catches. Definitions of the acoustic target groups are given in Table 2 below.

Table 2 Allocation of acoustic backscattering coefficients to acoustic target groups and their definitions. Note that for horse mackerel 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. trachurus 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 japonicus
	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	$Myctophidae_3$	*Diaphus dumerili*
	Other mesopelagic fish	*Trachinocephalus myops*
Plankton	Calanoidae	*Calanus* sp**.**
	Euphausiidae	*Meganyctiphanes sp.*
	Other plankton	

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

2.3. Estimation of fish abundance

The following target strength (TS) to length relationship was used to convert mean area backscattering coefficient s_A (m^2/n.mi^2) at 38 kHz to number of fish:

TS = 20 log L – 72 (dB) (1)

Or

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

where C_F is the conversion factor from acoustic density to fish biomass and $\overline{L^2}$ is the mean of total fish lengths squared. 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 (2) has therefore been applied consequently for all targeted species in this time series, following the established practice in the Namibian and Angolan national surveys. All estimates should consequently be considered as relative indices of abundance. The biomass was calculated by multiplying the number of fish by the expected length at weight, as estimated by regression of the log-length (total) against total weight.

The boundaries of encountered fish aggregations (*ad hoc* stratification) were determined by means of contouring within the inner and outer zero-value limits of the transect lines using the Nansis Maptool software.
Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories: 1: s_A = 0-300; 2: s_A = 300-1,000; 3: s_A = 1,000-3,000; 4: s_A > 3,000. Mean 5-n.mi integrator values (s_A) computed along the transect lines were averaged for each stratum. The overall length frequency distributions within strata were estimated by weighting the sample-distributions with the nearest valid 5 n.mi integrator value, or the average of two adjacent values. The total number of fish in each length group was estimated as:

$$\rho_i = \frac{< s_A > t_{i,j} \cdot u_i}{\sum_i \frac{u_i}{C_{Fi}}} \cdot A_s = \frac{10^{7.2} \cdot t_{i,j} \cdot u_i \cdot < s_A > \cdot A_s}{4\pi \sum_i u_i \cdot (L_i + 0.5)^2} \quad (3)$$

where:

ρ_i = estimated number of fish in length group i
$<s_A>$ = mean recorded area backscattering coefficient (m^2/n.mi^2)

$t_{i,j}$ = proportion of species j sampled in length group i
u_i = proportion of fish sampled in length group i
A_s = 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.

2.4. Trawl sampling procedures

Targeted trawling was carried out on identified acoustic targets using the smallest pelagic sample trawl (10 m vertical opening), the mid-sized pelagic sample trawl (12 m) and the demersal sample trawl (5 m). Samples were taken in baskets on deck and weighed, and the number of fish of each species was determined from a subsample of the collected sample.

Scanmar sensors provided real-time information of the depth of the head rope, the vertical opening of the mouth of the trawl and the clearance between the ground gear and the bottom. The trawl eye and catch sensor gave information of fish entering into the trawl and the catch retained in the codend, respectively.

All trawl catches were sampled for species composition by weight and numbers. Records of catch rates are given in Annex II. Other species (mostly of commercial value) were collected and identified to species level and length measurements were taken (Table 2).

2.5. Biological sampling

Samples of the main target species *Trachurus capensis*, *Trachurus trecae* and *Sardinops sagax*, as well as *Etrumeus whiteheadi* and *Engraulis capensis* were collected and measured for length and weight. Total length and body weight were determined to the nearest cm and g below, respectively. Sex and reproductive stages were determined by means of macroscopic examination, scoring each fish according to the six-point classification scale used during Angolan national surveys (Annex IV). Length-weight relationships of target species were determined from the regression analysis (power fit, a, b) of the total weight to the total length recorded for all sampled specimens.

$$\mathbf{W} = a\,\mathbf{L}^{b}$$

2.6. Meteorological and hydrographical sampling

Wind direction and speed, air temperature, global radiation and sea surface temperature (at 5 m depth) were recorded using the Norwegian Meteorological Institute's (DNMI) meteorological station on board. Values averaged over 10 min intervals were logged continuously. The weather station data were logged continuously throughout the survey. The results presented in this report are based on a standard output from the logging system, *i.e*. one nautical mile averages along the ship's track.

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 along the cruise track in transects at CTD lines with 60 n.mi distance and on every 2nd transect at 200, 100 and 50 m depths. The casts were stopped a few meters above the bottom.

Hydrographical sections were carried out at Pta. Albina, Baía dos Tigres, Cunene River (17°15' S), Cape Frio and at standard sections.

CHAPTER 3. OCEANOGRAPHIC CONDITIONS

3.1. Wind

Wind in the transboundary region (Figure 2) was variable in direction and speed. The northern area located from 15ºS to 17ºS was dominated by variable weak winds showing relaxed weather conditions in northern area. The area from 17ºS to 20ºS recorded the strongest winds with except in the vicinity of Cunene River and Cape Frio areas where moderate winds occurred with average speed around 4-5m/s. The strongest winds about 30 knots (15m/s) were observed close Möve Point and just north of Cape Frio. Most of them were parallel to the coast northwards. Most of winds between Cape Frio and Rocky Point were driven southwards but also parallel to coast.

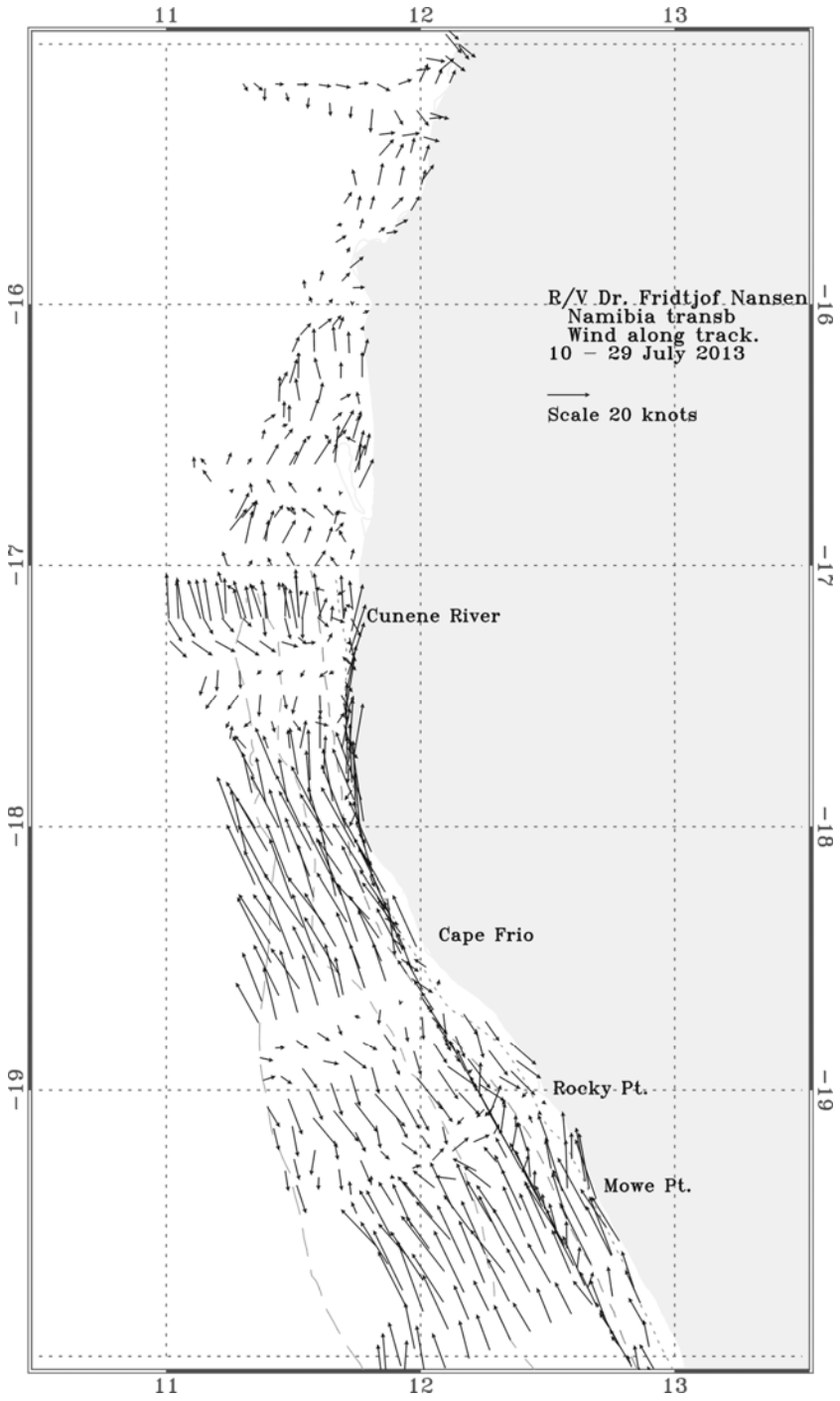


Figure 2 Wind observations recorded in the transboundary area and North Namibia (15°50' - 20°00' S) during the survey.

3.2. Surface distributions of temperature, salinity, oxygen and fluorescence

Figure 3 describes the horizontal distribution of temperature (°C), salinity, the dissolved oxygen (ml/l) and fluorescence (µg/l) recorded at 5 m depth. Configurations of isopleths

characterized both Angola and Benguela ecosystems. The convergence of both currents designed the frontal zone which was located at vicinity of Cunene River mouth between 17° - 17° 50'S. The lowest value of temperature (14ºC), salinity (≤35) and oxygen (2.5 ml/l) were observed inshore revealing the presence of intensive upwelling in this region and in particular from Baía dos Tigres to Dune Point. The tropical water mass characterized by high temperatures (t≥19ºC) and salinity (S≥36) were located offshore near Ponta Albina – Baia dos Tigres area. Variation of dissolved oxygen and fluorescence was consistent such that low dissolved oxygen values were associated to low fluorescence values and vice-versa. The highest value of oxygen (6 ml/l) and fluorescence (0.8 µg/l) were recorded in the centre of the gyres identified near the Rocky Point area.

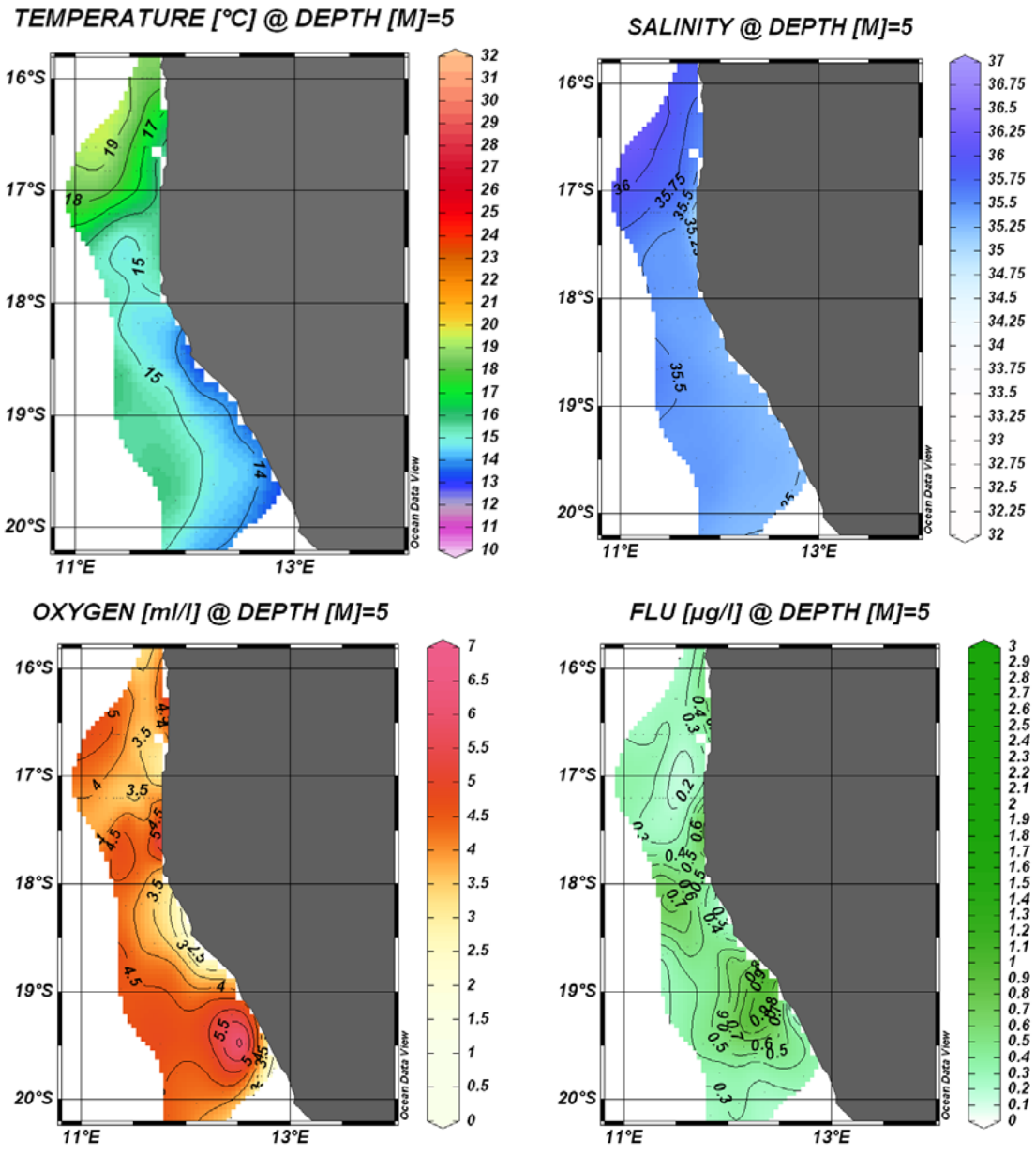


Figure 3 Sea surface temperature (°C), salinity, oxygen content and fluorescence, at 5 m depth, in the Angola-Namibia transboundary area (15°50'-19°00' S) and south of transboundary area (19°00' S-20°15' S) derived from the CTD stations.

3.3. Vertical hydrographical sections

The vertical distribution of temperature in the surface water along the monitoring line of **the Tômbwa** showed signs of tropical upwelling characterized by the marked lifting of subsurface waters. In the southern region decreasing of temperature towards offshore and with depth is more marked than other regions (Figure 4**)**. The highest value of temperature (19°C), salinity (37.75), oxygen (3.5-4.0) and fluorescence (0.3.5µg/l) was found offshore, while the lowest temperature of 7°C and less saline waters were recorded in the deeper water of 400-500m. The lowest oxygen was recorded along the shelf break of 150-300 meter, which led to no fluorescence there.

The **Baia dos Tigres section (**Figure 5**)** monitoring line showed intense tropical uplifting of isotherms, charactered by rising of water into subsurface (0-100m), where temperature ranged between 13°C and 20°C. This most likely caused by the strong wind in the area. The opposite pattern was found in waters masses below 100m, where sinking of waters along the slope of continental shelf. The tropical water masses, characterising by salinity of 36-36.5 were observed at surface offshore. The highest oxygen and fluorescence level was recorded in area of tropical waters.

Unusually no sign on Angola-Benguela front was found in region, covered by monitoring line of **Cunene (**Figure 6**)**, comparing with previous years. The surface temperature ranged from 16°C inshore to 19 °C offshore. The salinity was much lower than along **Baía dos Tigres** monitoring line. The lowest salinity of 35.25 was recorded near the Cunene River, and probably caused by Cunene River plume leading to local water mixing. The highest values of dissolved oxygen were found at surface from inshore to offshore and lowest in depth of 250 -400m. Intense biological activity was recorded at surface offshore with fluorescence values around 0.4 µg/l. and 0.5µg/l.

The section in the vicinity of southern part of Cunene River (**17.6ºS,** Figure 7) experiences both downwelling offshore and upwelling inshore with highest temperature about 15°C occurred inshore. These characteristics are clearly evident above 200m depth where thermocline was limited by isotherm of 14°C. In contrast, below 200m the stability of cold water column is shown by parallel isotherms. Surface temperature ranged from 14.8°C offshore to 15°C inshore, while salinity contents was very homogeneous above 200m. (35.25 ≥ Sal ≥ 35.5). Dissolved oxygen values ranged from 3 to 4.5ml/l occurred above 100m and covered most of continental shelf. The lowest value (0.5ml/l) was recorded between 250 and 400m depth. Fluorescence was abundant inshore with highest value about 0.7µg/l.

The structure of vertical distribution of temperature in **Cape Frio Section** (Figure 8) presented two types of upwelling phenomena: one tropical upwelling occurred up than

150m and another known as coastal upwelling recorded from bottom to 200m where inhibited by stable water masses. Sea surface temperature ranged from 14ºC inshore to 16ºC offshore and then temperature varied gradually along the water column. Behavior of vertical distribution of salinity was similar to temperature showing signs of intensive upwelling exhibited by well marked uplift isopleths. The maximum salinity content with value about 35.5 was located in the most oceanic stations. Also evident signs of intensive upwelling were exhibited by dissolved oxygen along the entire water column and the slope was considered as an anoxic zone due to presence of deficient oxygen content. The chlorophyll A was the predominant and extensive in the Cape Frio zone with value in order to 0.2µg/l reaching 100m depth.

In the Rocky Point section (Figure 9) were observed authenticable oceanographic conditions of coastal upwelling with clear stratification into layers. Sea surface temperatures recorded were 14ºC inshore and 15ºC offshore and the minimum (9ºC) occurred around 470m depth. In terms of salinity, also water column was well stratified with different homogeneous water layers varying with the depth. Layers above 150m depth contained dissolved oxygen between 1.5 and 4.5ml/l. The slope was characterized as a dead zone due to the presence of reduced dissolved oxygen and the absence of biological activity expressed by 0µg/l.

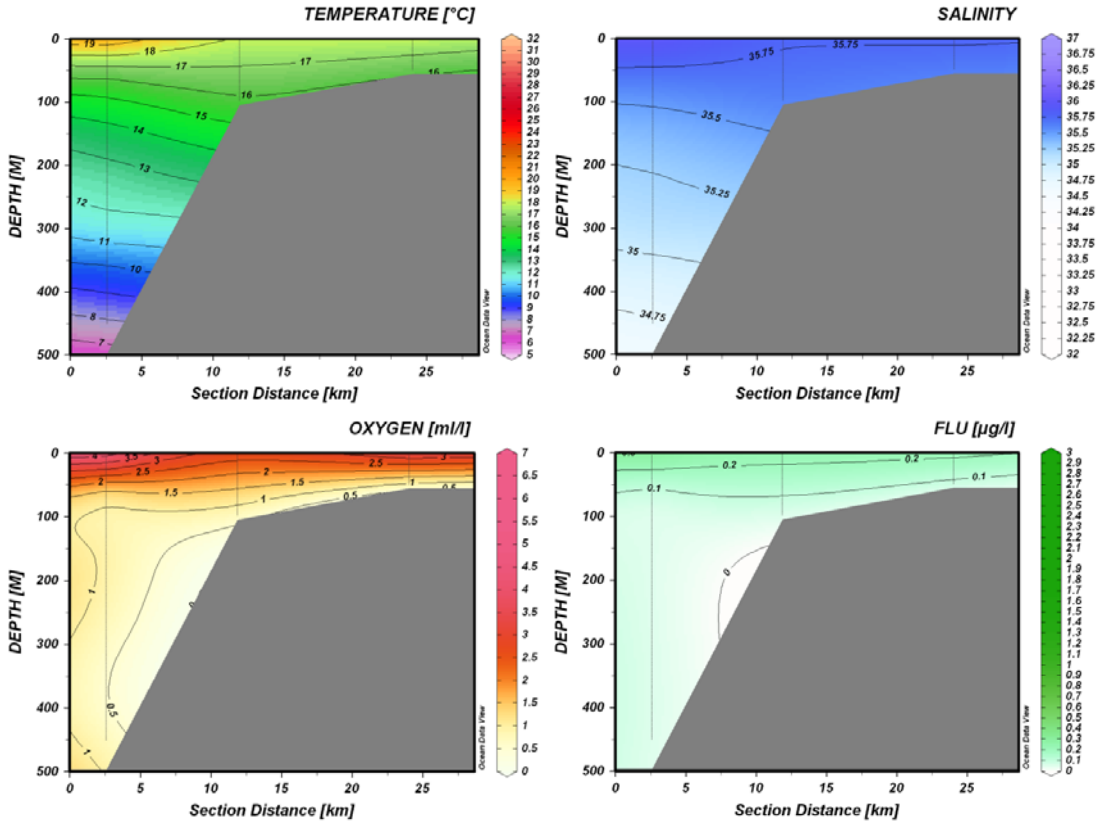


Figure 4 Vertical sections of temperature salinity, oxygen and fluorescence off Tômbwa (July 2013).

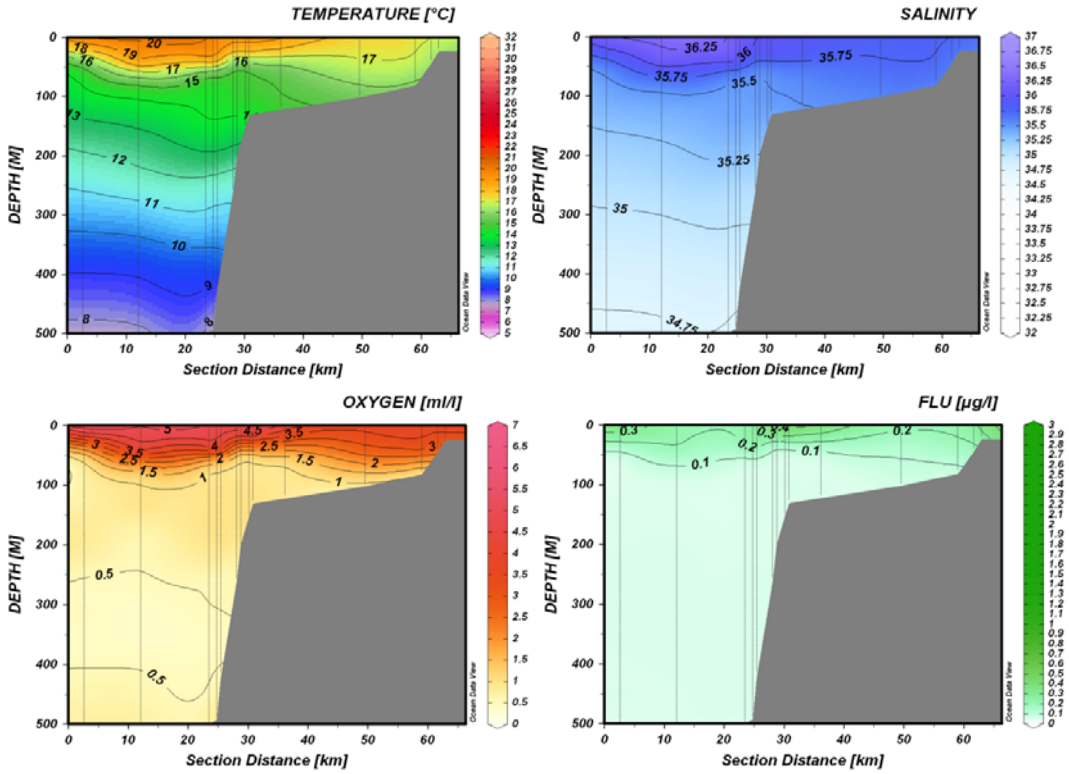


Figure 5 Vertical sections of temperature salinity, oxygen and fluorescence off Baía dos Tigres (July 2013).

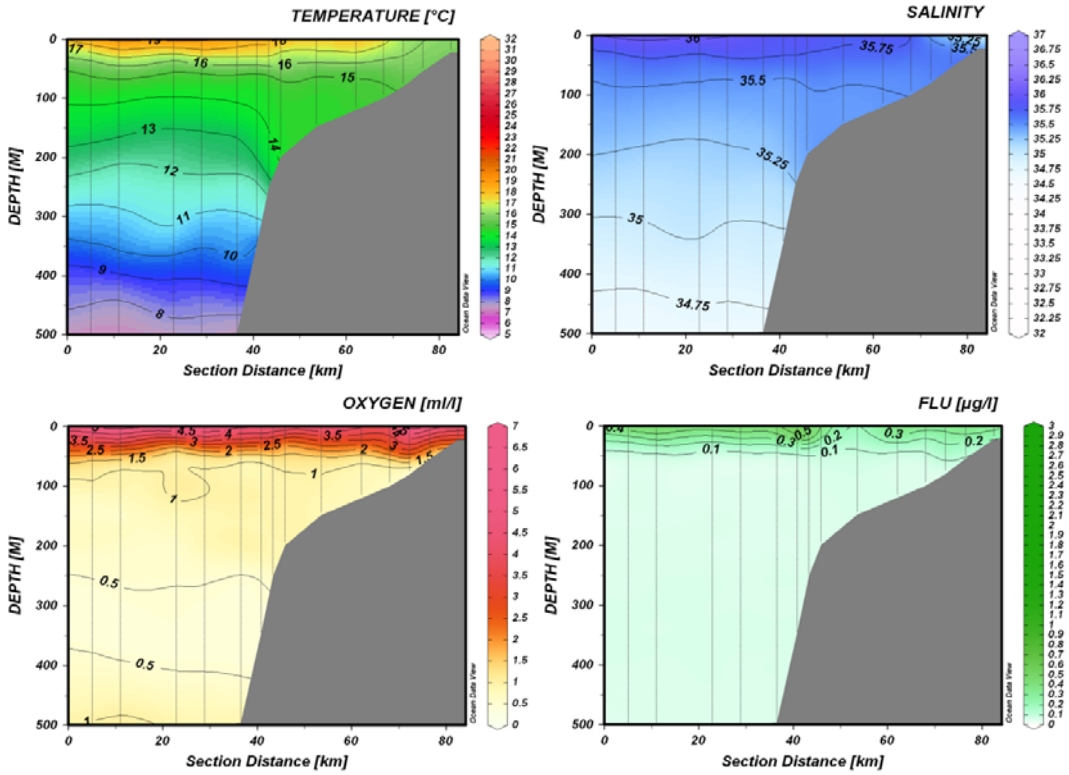


Figure 6 Vertical sections of temperature salinity, oxygen and fluorescence off Cunene River (July 2013).

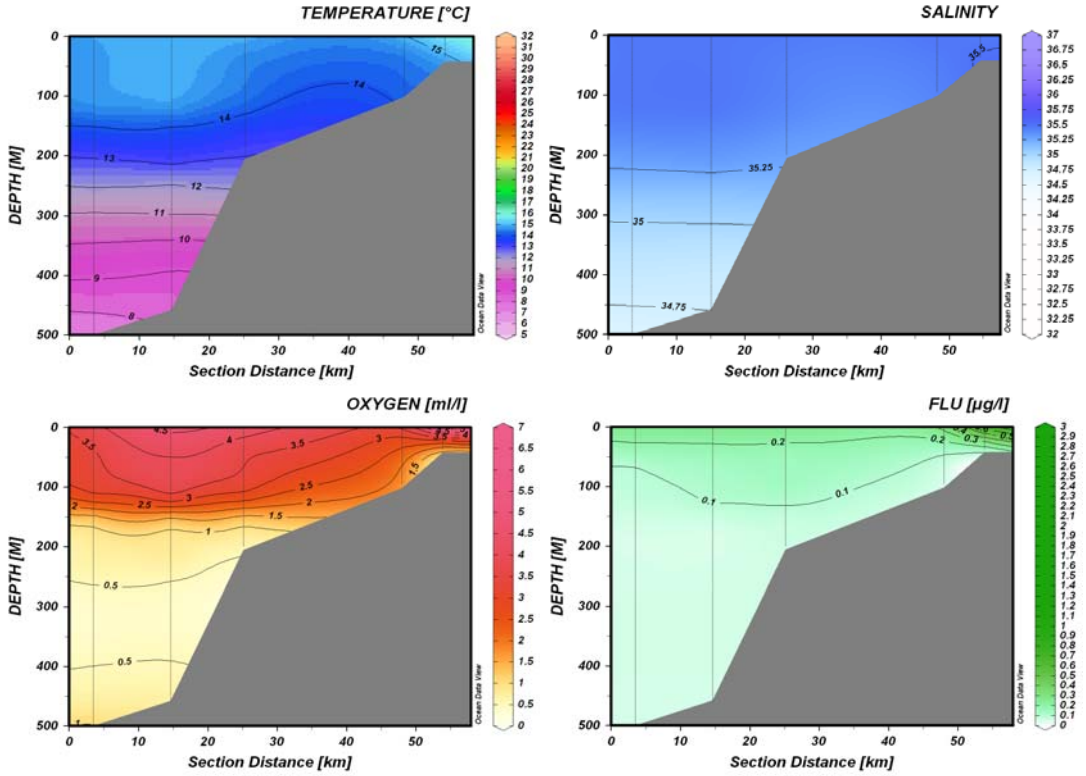


Figure 7 Vertical sections of temperature, salinity and dissolved oxygen off 17.6°S zone.

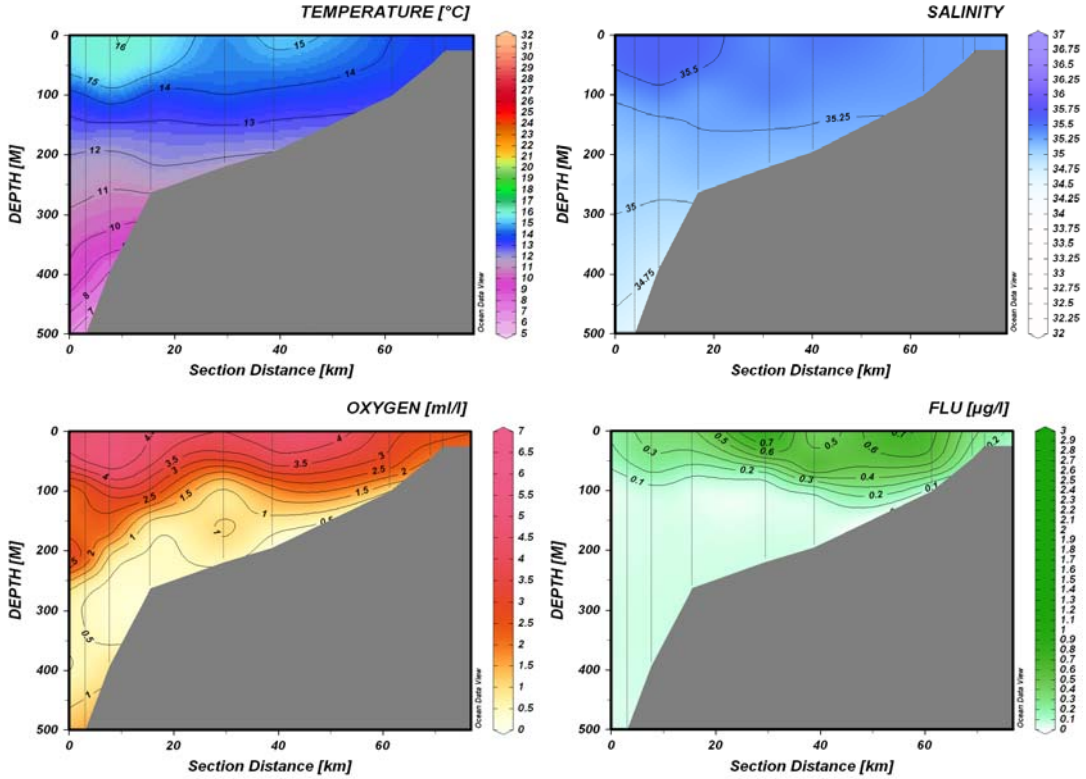


Figure 8 Vertical sections of temperature, salinity and dissolved oxygen off Cape Frio (July 2013).

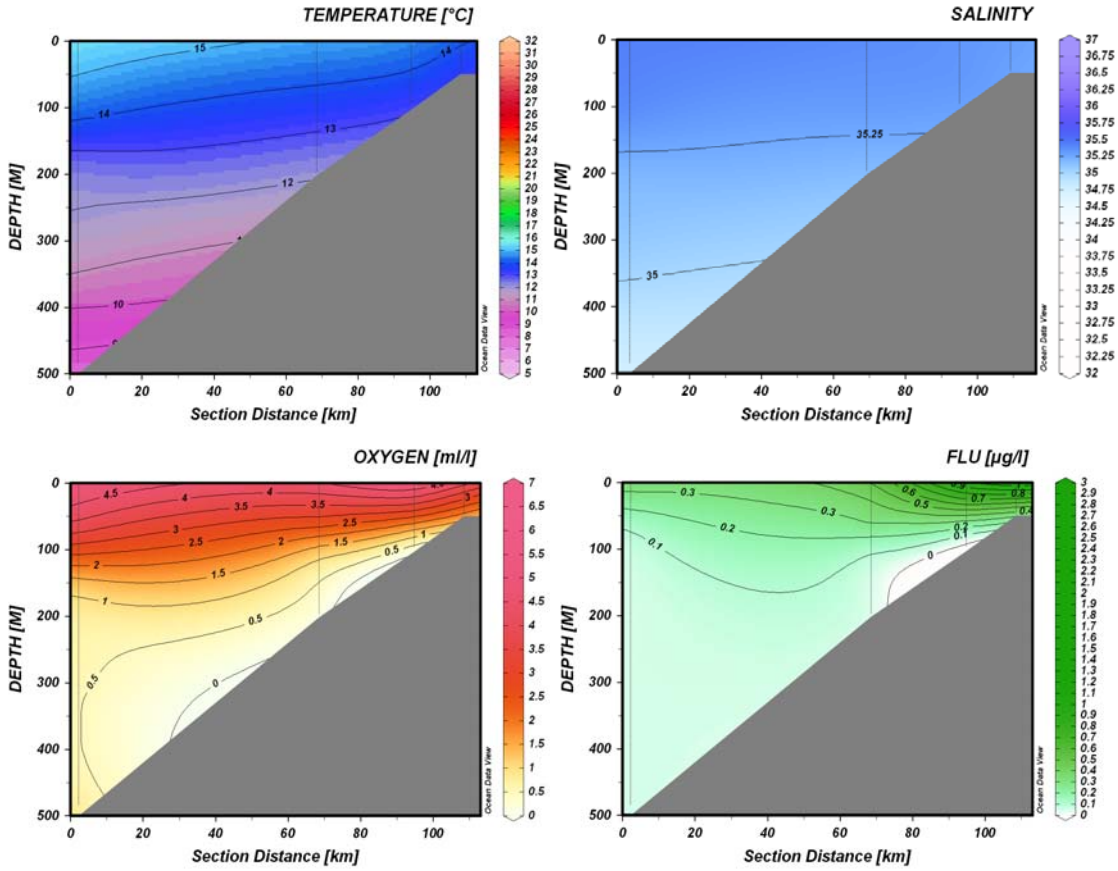


Figure 9 Vertical sections of temperature, salinity and dissolved oxygen off Rocky Point (July 2013).

CHAPTER 4. DISTRIBUTION, SIZE COMPOSITION AND BIOMASS ESTIMATES

4.1. Transboundary area

Trachurus capensis

The first encounter of *T. capensis* this year was further south of the transboundary area (Figure 10), at S 16°50'49 as compared with last year's position (S 15°33'67) and 2011 (S 16°12'23). *T. capensis* was was found in almost every trawl catch south of 16°50'49. The two largest aggregations was found between Cunene river and Cape Frio and just off Rocky Pt (see Figure 10). Most trawl catches was dominated by either juvenile horse mackerel (around 10cm long) or by large mackerel indicating a "schooling-by size" effect. Juveniles were on general found closer to shore within the transboundary area.

There have been overlaps between shoals found offshore and inshore, this can clearly be seen within areas around 16°49' S (south of Tiger Bay), North of Cape Frio (18°14' S) and immediately before Rocky Point. Overall, most of the fish were offshore compared to those found inshore. There was an unusual behaviour for the Namibian *T. capensis* whereby there was no vertical migration (diurnal) during the night to the upper water column. Therefore, many bottom trawls done during the night contained significant amounts of *T. capensis*. This is typical of *T. capensis* found in Angola and South Africa.

The estimated total biomass of *T. capensis* was at 169 200 tonnes this year, this a significant decrease, by 42%, compared to 2012 biomass (290 700 tonnes). Taken from the maturity proportions, 14 % of this year's biomass was made up of adult fish (>17cm total length) as compared to 41 % for previous year and 82 % for 2011. This year the Namibian side of the transboundary area contributed 78 % of the total biomass (131 700 tonnes), leaving the Angolan side with only 22 % (37 500 tonnes). As for previous years, 46% and 14% of the biomass was found in Angolan waters for 2012 and 2011, respectively.

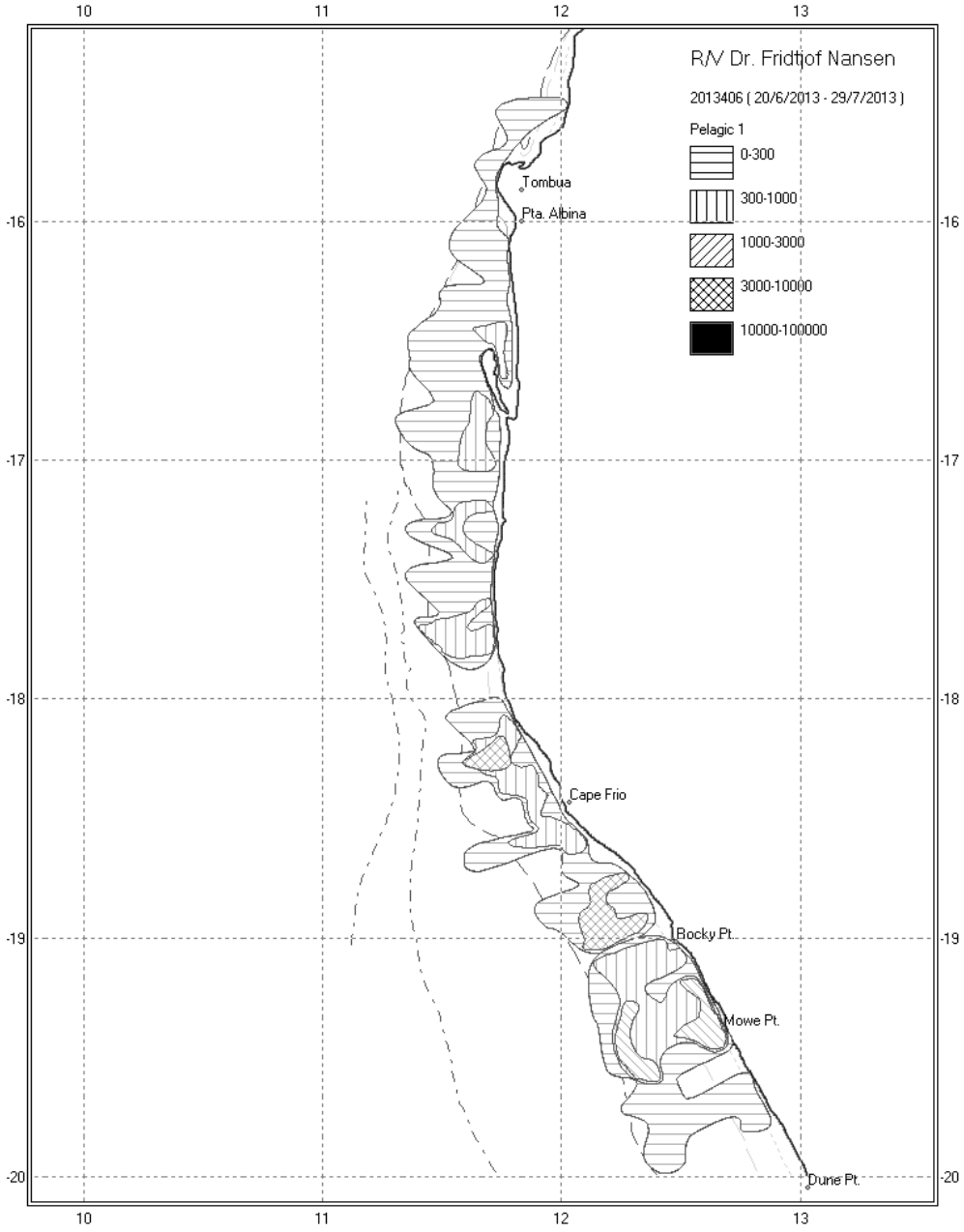


Figure 10 Distribution of the horse mackerel (*T. capensis and T. trecae*) in the Angola-Namibia transboundary area (15°50'-19°00' S) and south of transboundary area (19°00' S-20°00' S). Isobaths are indicated at 100, 200, 500, 1,000 and 2,000 m depths.

The size composition showed multimodal distribution with modal peaks at 8 cm, 12cm and 16-17 cm length classes (Figure 11) (*N*= 8 820 mill. individuals). This distribution is calculated based on the length frequency data as the acoustic estimates.

A total of 3346 fish were sampled for length frequency analysis. Mean length was thus calculated, based on the length frequency data and acoustic indexes, which yielded a mean total length of 11,98 cm which corresponds to mean individual total weight of 19,18 g.

Therefore there is an decrease in mean total length compared to that of last year (16,4 cm). The length weight relationship showed a good fit (r^2=0.99) just like last year and resulted into 0.0082 and 2,9736 for *a* and *b* respectively (Figure 12).

Further, a sub sample of 493 fish was taken from 3346 fish sampled for biological analysis. Maturity analysis showed that, 339 fish were found immature while 154 fish were mature. The majority of the fish was found to be juvenile with males dominating stages 1,2 and 5. See Annex IV for a description of the maturity stages

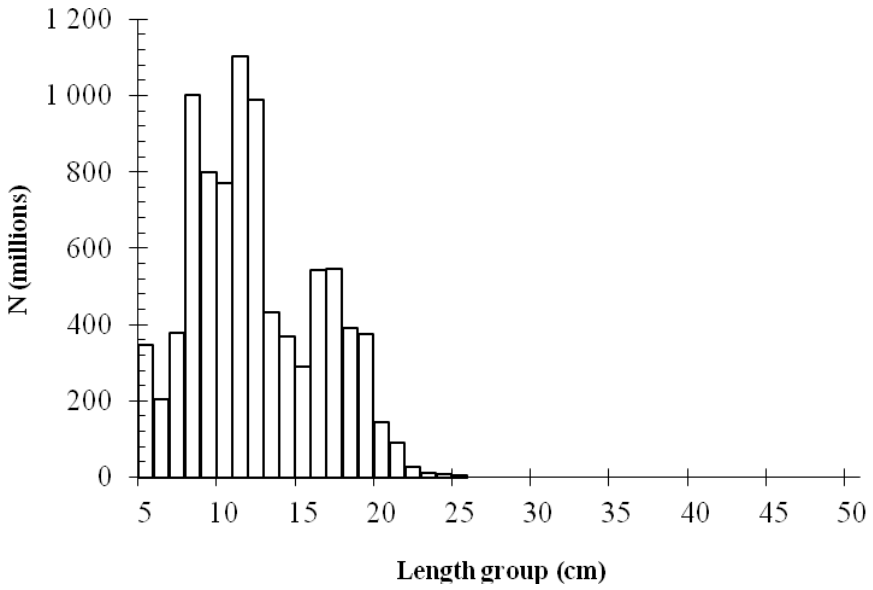


Figure 11 Estimated length distribution of *T. capensis* in the transboundary area (15°50'-19°00' S)

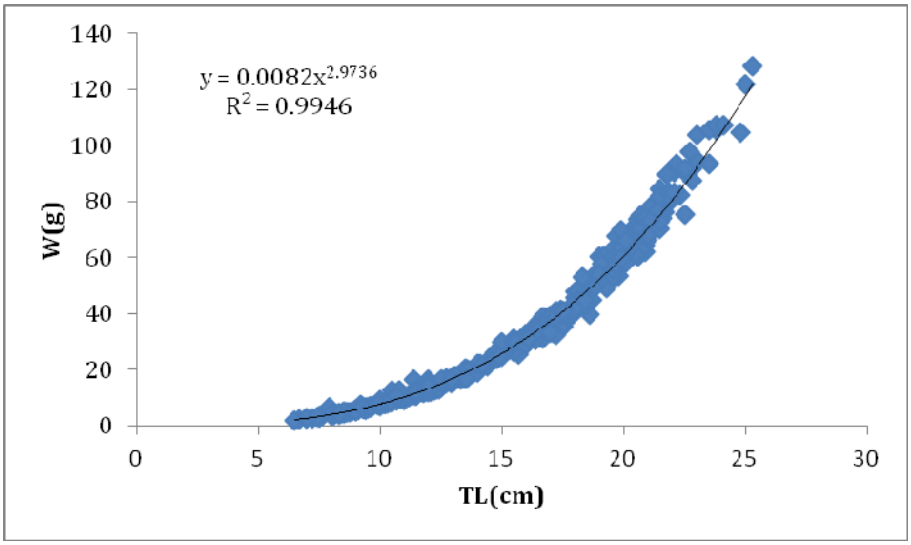


Figure 12 Length-weight relationship for *T. capensis* in the transboundary area (15°50'-19°00' S) (n=493)

The overall sex ratio was in favour of the males (M:F) 1:1,28. Mature-before-pre-spawning and mature-pre-spawning stages were the predominant stages for males, while mature-before-pre-spawning and mature-in-spawning were the dominant stages in females (Figure 13). The smallest sexually mature male was 14,8cm TL weighing 23,9 g, the female was 15,0 cm TL with a weight of 24,6 g.

In mature males, total length ranged from 15.0 to 25.3 cm TL and weight ranged from 14,8 to 128,5 g. In mature females, total length ranged between 15,0 to 25,0 cm and weight ranged from 24,6 to 121,9 g.

According to the estimates of mean length at sexual maturity, males attain sexual maturity at a slightly smaller size than females (mean male length = 19,9 cm TL, mean female length = 18,4 cm TL). Mean total length at 50% maturity (for both sexes, including the juvenile group) was estimated at around 19,5 cm TL (Figure 14)

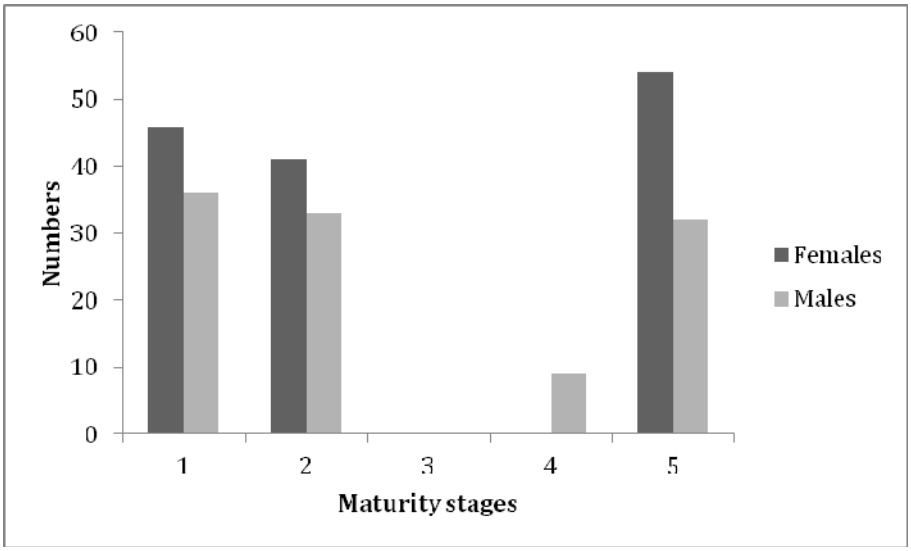


Figure 13 Number of specimens by maturity stages for *T. capensis* in the transboundary area (males *n* = 110 and females *n* = 141).

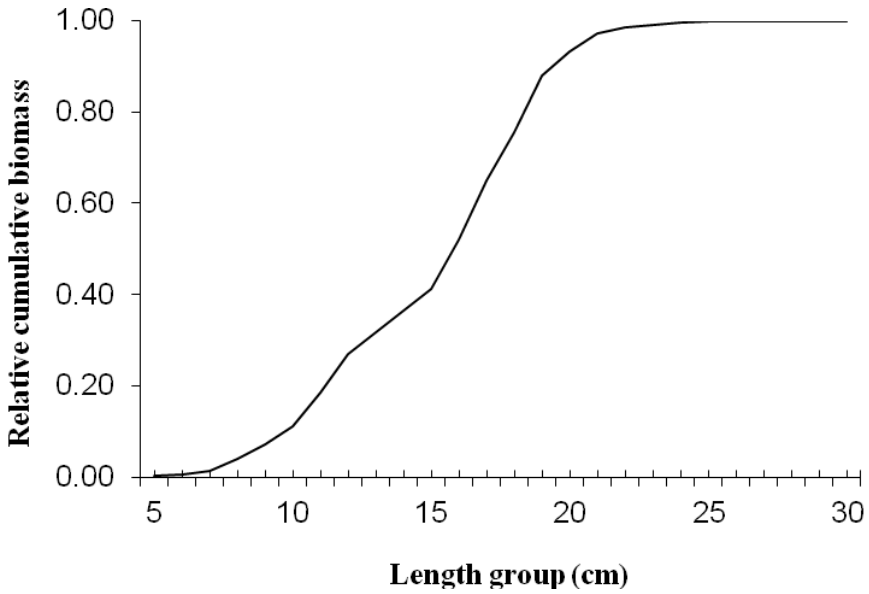


Figure 14 Cumulative numbers for *T. capensis* in the transboundary area.

Trachurus trecae

T. trecae's was found from the Angolan side of the transboundary area at 15°31,67 S. Its distribution went as far as 17°53'71 S. No *T. trecae* were observed further south of the transboundary area. *T. trecae* was mostly encountered in low densities (S_A< 1000).

The total biomass of *T. trecae* was estimated in 76 200 tonnes which is 27 % higher compared to last year (59 800 tonnes). About 55 % of the biomass was adult fish (>17 cm total length) while the rest, 45 %, were juveniles. A large part of the biomass was found at the Angolan side of the transboundary area (97%, corresponding to 74 100 tonnes). The abundance estimate is relatively uncertain since the species split is made based on trawl catch information. The size composition could possibly be more reliable, but is an additional uncertainty factor.

This year a total of 538 fish were biologically analysed with 212 fish immature and 326 mature. The majority of the fish were found in stages 3 and 4 with female dominations at both stages (Figure 17). Females dominated most of the maturity stages, except stages 1 and 2, which were dominated by males. See Annex IV for a description of the maturity stages. The overall sex ratio was in favour of the males (M:F) 1:0,78. Maturing-virgin-and-recovering-spent and mature-before-pre-spawning stages were the predominant for males, while mature-before-pre-spawning and mature-pre-spawning were the dominant stages in females (Figure 17).

A total of 2043 fish with an overall size distribution ranging from 5-35 cm total length were sampled for length-frequency. Mean length was thus calculated, based on the length frequency data and acoustic indexes, which yielded a mean total length of 13,63 cm which corresponds to mean individual total weight of 31,62 g. The length weight relationship for *T. trecae* showed a very good fit (r^2=0.9961), where *a* and *b* were estimated at 0.009 and 2.9803, respectively (Figure 16). The size composition, from the acoustic estimate, was dominated by fish around 11-12cm and potential additional modes around 7cm, 18cm and 24cm (Figure 15).

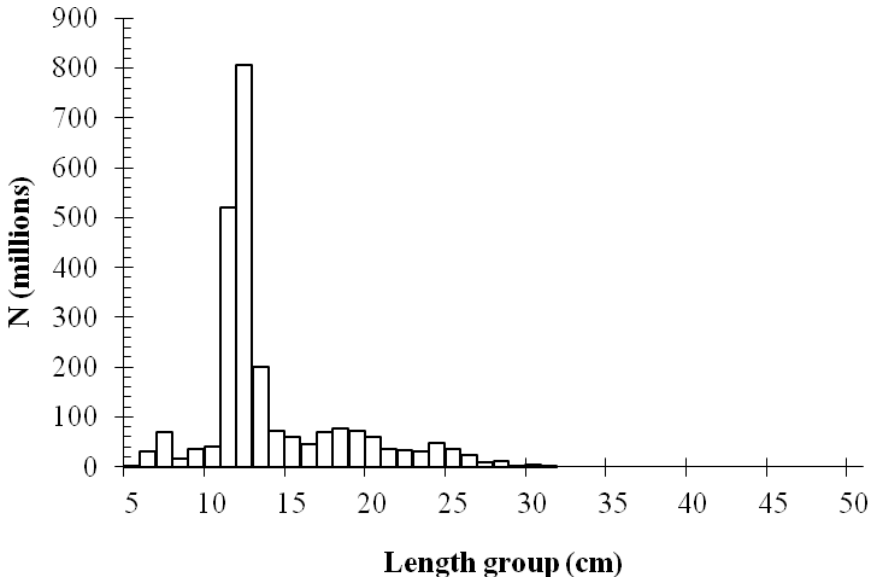


Figure 15 Estimated length distribution of *T. trecae* in the transboundary area (15°50'-19°00' S)

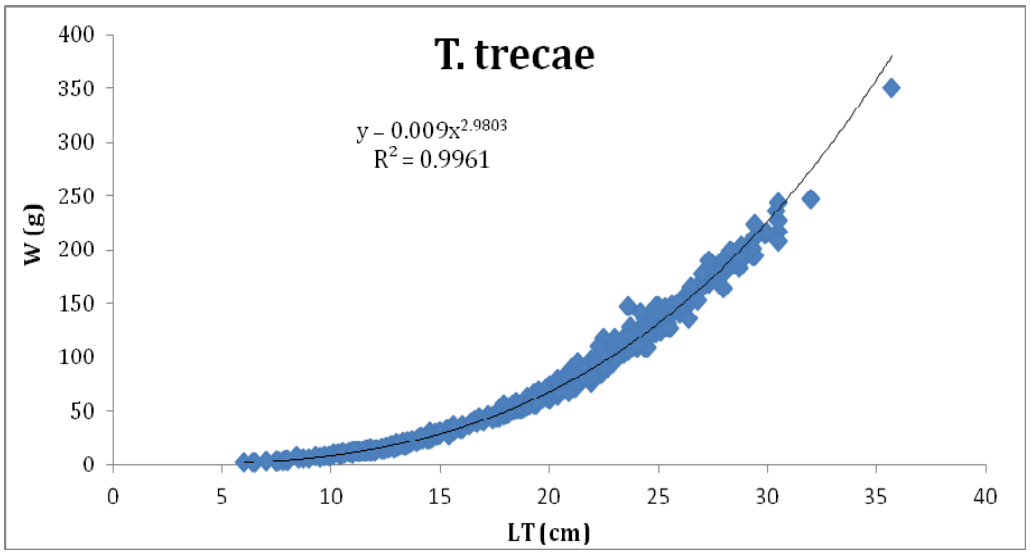


Figure 16 Length-weight relationship for *T. trecae* in the transboundary area (15°50'-19°00' S) (*n*=538).

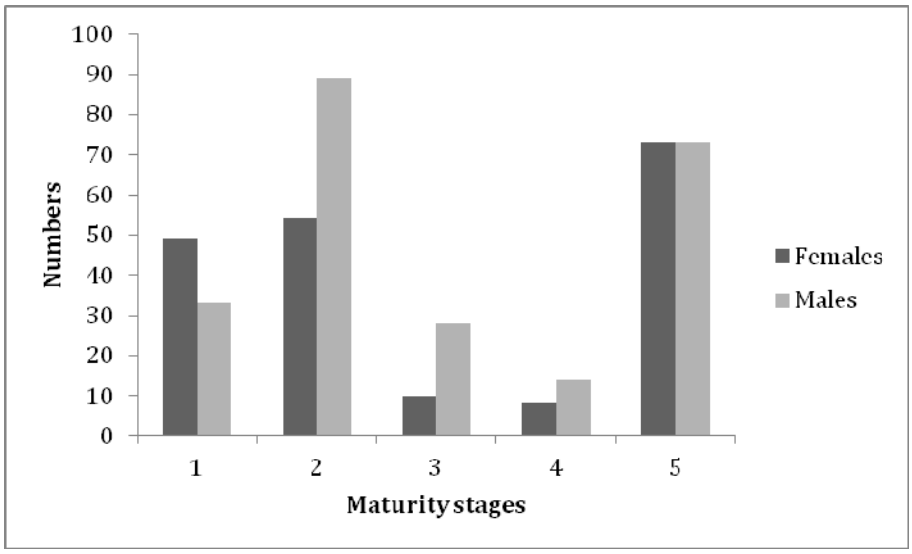


Figure 17 Number of specimens by maturity stages for *T. trecae* in the transboundary area (males *n* = 237 and females *n* = 194)

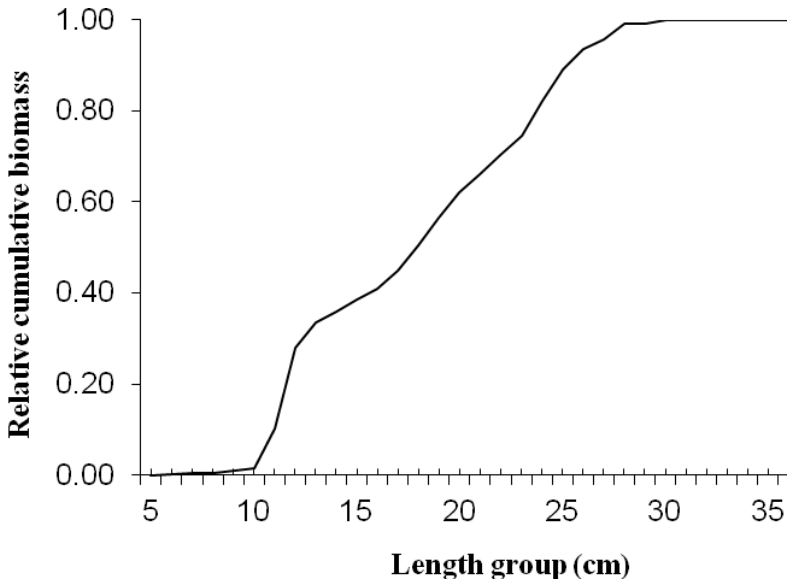


Figure 18 Cumulative numbers for T. trecae in the transboundary area.

Sardinops sagax

Low to medium densities of *Sardinps sagax* were found in 4 small areas along the transboundary coast. The distribution of *Sardinops sagax* is not mapped since very few numbers (2 200 tonnes) ware found during this survey. Sporadic observations are not suitable for abundance estimation, but the overall impression is afurther decline from last survey.

The survey area does not cover the entire distribution of the sardine stock, which is known to migrate between Angolan and Namibian waters. Sardinops species are challenging species to observe due to vessel avoidance and the availability to acoustic sampling (upper blind zone errors) at the time of the survey (Anon. 2003, 2004).

Length frequency data was collected from 241 specimens. The total length of *S. sagax* sampled ranged from 11 to 22 cm TL, with muiltimodes at 15 cm and 18cm (Figure 19). A sub sample of 64 was taken for length-weight and biological analyses. The length-weight relationship for *S. sagax* showed r^2=0.9818, where *a* and *b* were estimated at 0.0018 and 3,4945, respectively (Figure 20).

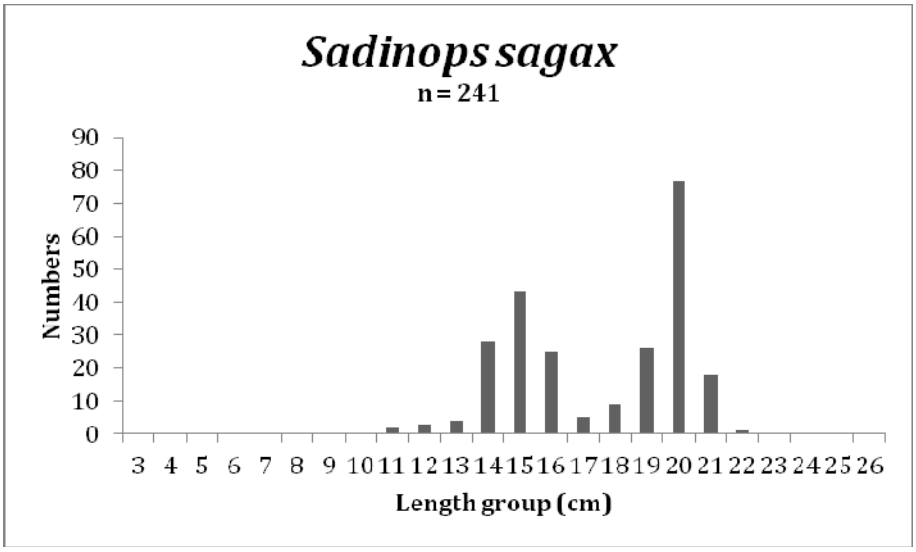


Figure 19 Length frequency of *S. sagax* from the trawl samples along the transboundary area (15°50'-19°00' S) (*n*= 241)

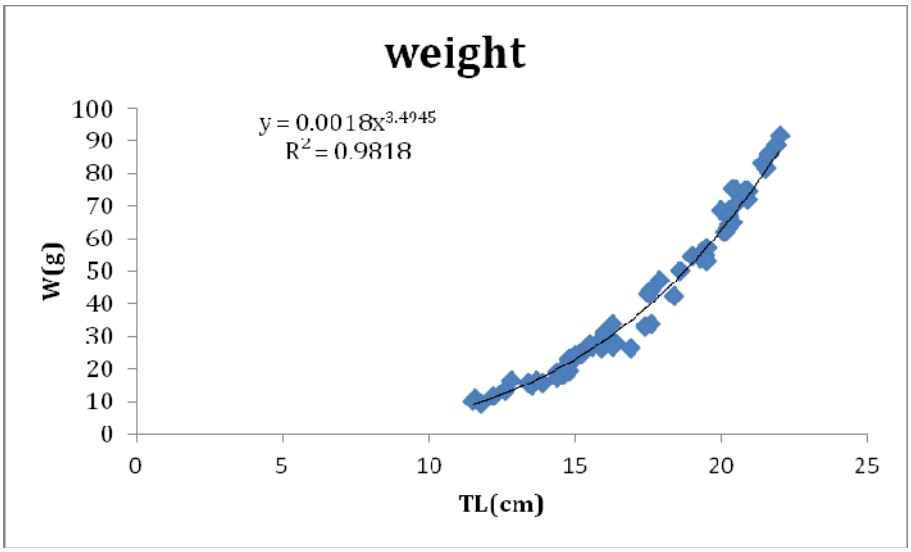


Figure 20 Length-weight relationship for *S. sagax* in the transboundary area (15°50'-19°00' S) (n=64)

Pelagic 1 (*Etrumeus whiteheadii* and *Engraulis capensis*)

E. whiteheadii and *E. capensis* were as usual mostly found in mixed shoals and were thus recorded jointly as Pelagic Species 1 (other clupeids, Table 2). The distribution of *E. whiteheadii* and *E. capensis* is given in Figure 21 below. These species were found throughout the transboundary area, ranging from Pta. Albina (16°00 S) in Angola, to north of Rock Point in Namibia. The biomass for the *E. whiteheadii* and *E. Capensis* combined was

calculated at 220 122 tonnes. This point estimate relies heavily on an assumption of average total fish length of 16cm and could be considerably smaller if average length is less.

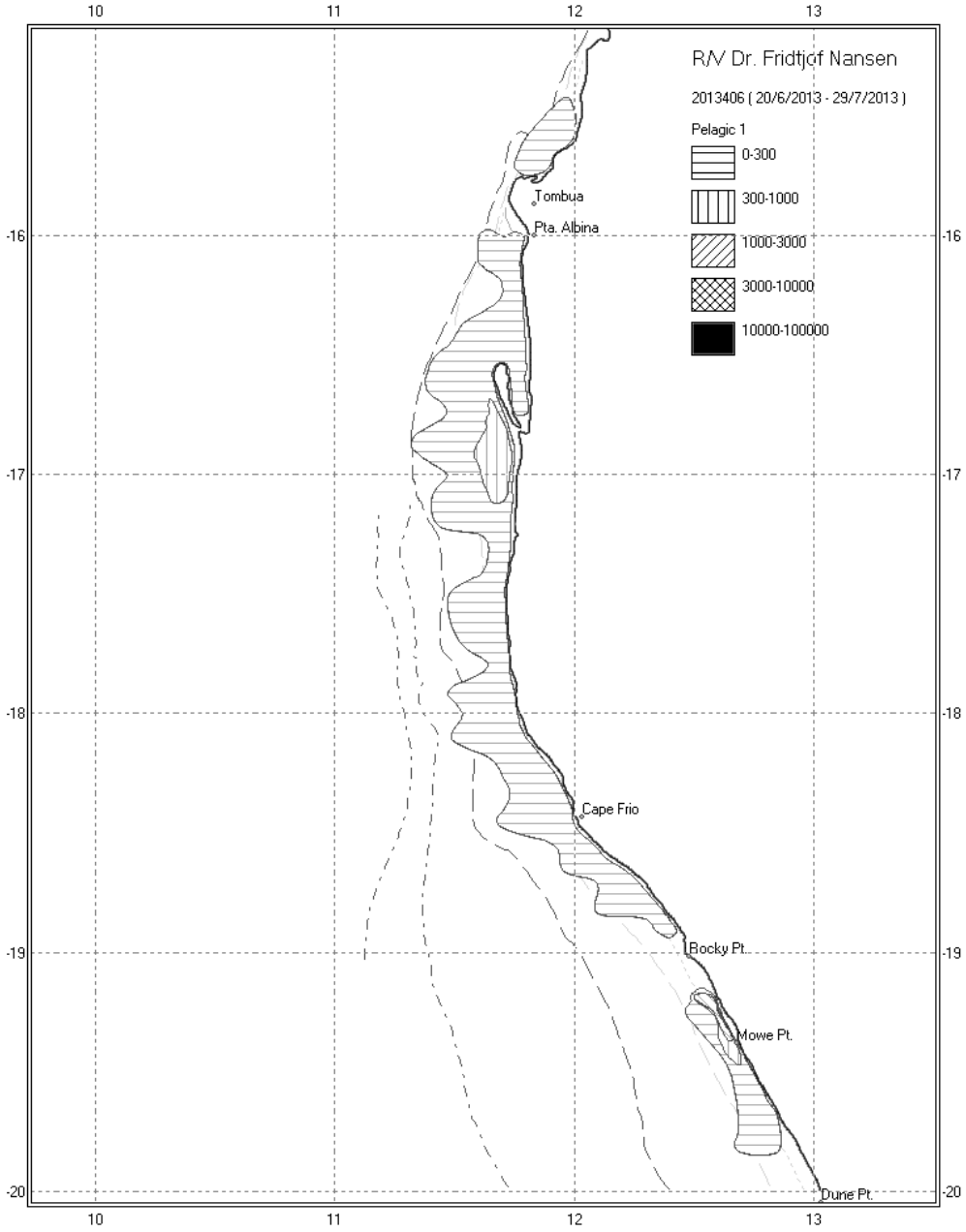


Figure 21 Distribution of the Pelagic 1 (*Etrumeus whiteheadi* and *Engraulis encrasiolocus*) in the Angola-Namibia transboundary area (15°50' - 19°00' S) and south of transboundary area (19°00' S - 20°15' S). Isobaths are indicated at 100, 200, 500, 1,000 and 2,000 m depths.

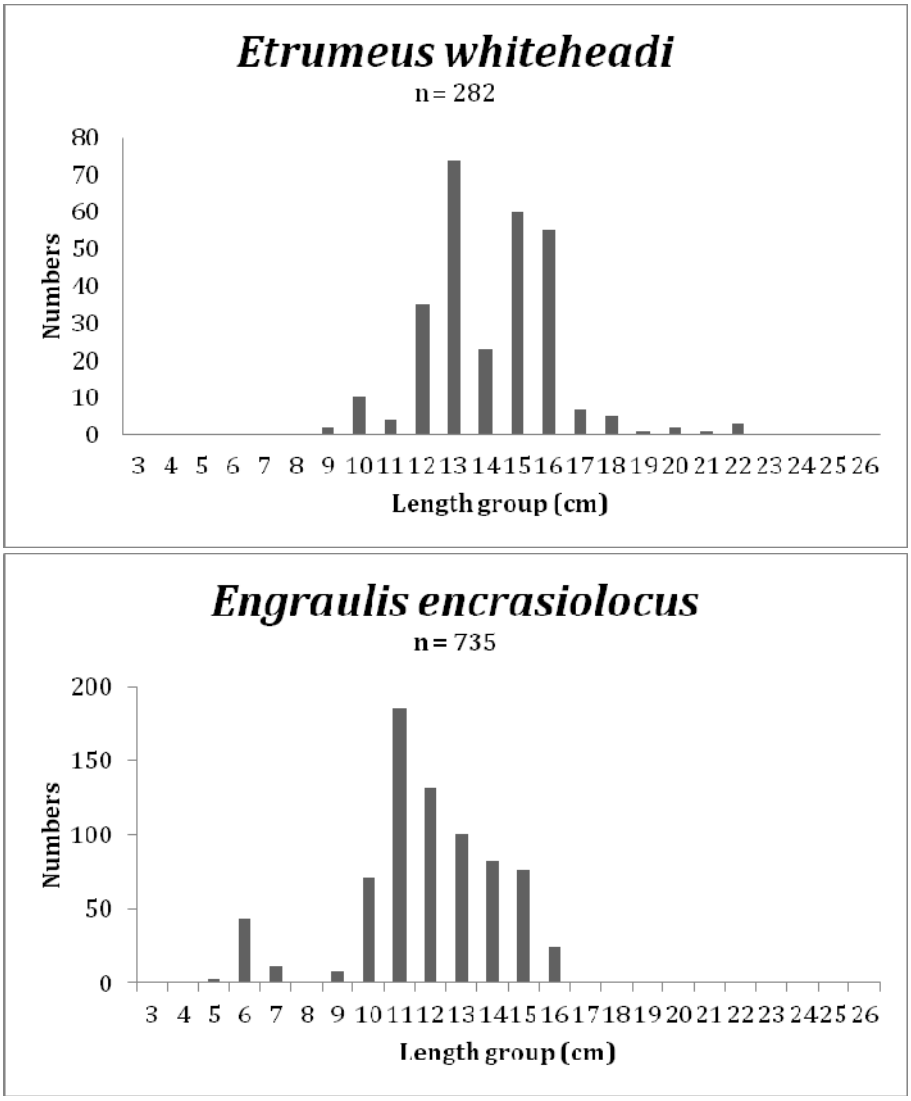


Figure 22 Overall length frequencies of *E. whiteheadii* (n = 282) and *E. encrasiolocus* (n = 735) in the transboundary area (15°50'-19°00' S).

4.2. Northern Namibia (19-20° S)

Horse mackerel (*Trachurus capensis*)

No *T. trecae* was encountered south of the transboundary area this year. The distribution of *Trachurus* was shown in Figure 10.

The distribution of *T. capensis* was continuous from Rocky Point (19°00'S) to the last transect at Dune Point (20°15'S) with a primarily inshore distribution throughout the area, although there was an offshore component immediately south of Rocky Point (19°20'S). The total biomass of *T. capensis* in northern Namibia (19-20°15' S) was estimated at 13 200 tonnes, lower than the 31 800 tonnes from the previous year.

South from the transboundary area, the estimated size distribution of *T. capensis* (from 6-23 cm total length) was tri-modal with modal peaks at 13 cm cm and 19 cm total length (Figure 23).

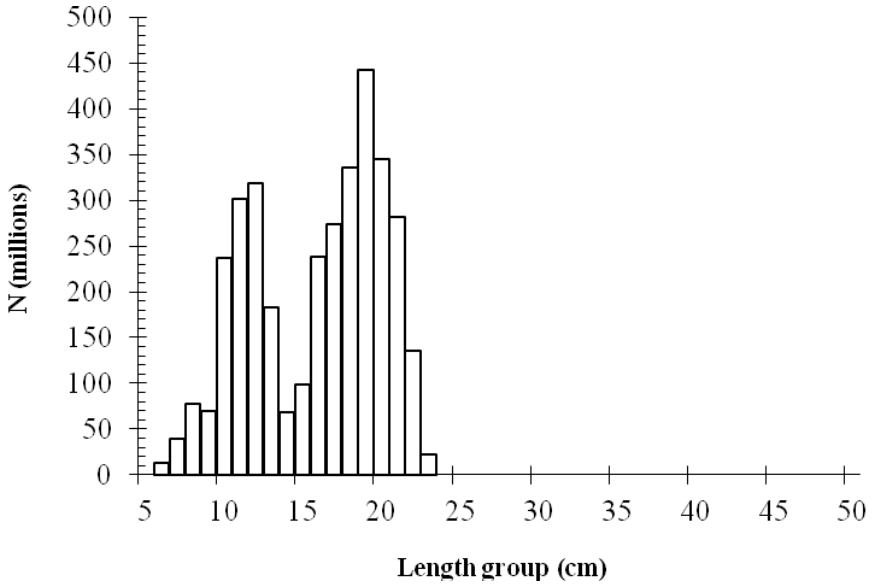


Figure 23 Overall length frequency of *T. capensis* in Northern Namibia (19-20°15 S)

Pelagic 1 (*Etrumeus whiteheadii* and *Engraulis capensis*)

The distribution of Pelagic 1 (*Etrumeus whiteheadii* and *Engraulis capensis*) is shown in Figure 21 above. The total biomass for the two species combined was calculated 34 453 tonnes, being a significant increase from the 10 500 tonnes estimated the previous year.

CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

The results from this year's survey show the transboundary nature of the fish resources under study. The results show a clear downward trend for biomass of *T. capensis* and an increasing trend for *T. Trecae.* Only scattered desnities was found of *S. Sagax* with a very low biomass estimate. Caution should be taken when interpreting the data, as changes from year to year may reflect changes in migration in and out of the transboundary area rather than increases/decreases in the biomass levels. It should also be noted that the estimates are relative indices, not absolute estimates of abundance, and that all estimates, in particular for the densely and patchily aggregated sardine, are prone to acoustical survey errors (Anon. 2003, 2004).

As for previous years, the results also show that the *T. capensis* population is dominating relative to *T. trecae* in terms of estimated biomass within the transboundary areas. It should, however, be emphasized that the time series of the transboundary region cannot be interpreted as timeseries of the stock units, as some of the populations have distribution areas that go beyond the transboundary area and are characterized by migrations in and out of the transboundary area due to external factors and, in particular, the positioning of the Angola-Benguela Front (ABF). Fluctuations in the abundance estimates within the transboundary area do thus not necessarily reflect fluctuations in the stock units.

Sardinella aurita has so far not been considered a transboundary species, but was in 2010 for the first time in the transboundary time series encountered in sizeable aggregations within the transboundary area (in Angola).

The main findings from the 2013 survey can be summarized as:

The biomass estimate of *T. capensis* was lower (192 700) than last year's (290 700 tonnes) but higher than in previous years (see table below).

Table 3 Biomass of *Trachurus* species in the Transboundary area

Biomass of *Trachurus* species in the Transboundary area

Year	*T. capensis*	*T. Trecae*	*Sardinops sagax*
2013	169 200	76 200	2 200
2012	290 700	59 800	87 100
2011	558 500	39 500	51 500
2010	516 600	45 500	399 000
2009	202 300	50 700	35 700
2008	205 000	20 000	0

Approximately 22 % (by weight) of *T. capensis* in the transboundary area was found in Angolan waters. The relative percentages for each country are presented in the following table.

Table 4 Proportion of biomass found in Angola and Namibia for the two *Trachurus* species. *n.a.* refers to non-available data.

Distribution of the species in the transboundary area (in percentage)

Year	*T. capensis*		*T. Trecae*	
	Angola	Namibia	Angola	Namibia
2013	22%	78%	97%	3%
2012	46%	54%	*n.a.*	*n.a.*
2011	14%	86%	75%	25%
2010	13%	87%	75%	25%
2009	11%	89%	78%	22%
2008	10%	90%	80%	20%
2007	*n.a.*	*n.a.*	*n.a.*	*n.a.*
2006	*n.a.*	*n.a.*	*n.a.*	*n.a.*
2005	64%	36%	100%	0%

The variation in abundance of *T. capensis* in the transboundary area and the relative distribution of the biomass in Angolan and Namibian waters between years, show that the aggregation dynamics is highly dynamic within the transboundary area, and that both the total biomass and the relative distribution in the countries may fluctuate considerably over time, largely reflecting the impacts of a changing positioning of the Angola-Benguela Front (ABF).

An unusual behaviour for the Namibian *T. capensis* was observed during this survey whereby there was no vertical migration (diurnal) during the night to the upper part of the water column. Therefore, many bottom trawls done during the night contained significant amounts of *T. capensis*. This is more typical of *T. trecae* in Angolan waters and *T. capensis* in South African waters and probably caused by more oxygenated water masses during the period of this survey, or possibly a lack of diurnal migration by the horse mackerel prey.

The estimate of *T. trecae* was 76 200 tonnes which is higher than in previous years (see table 3). The majority of the biomass (97%) was found in Angolan waters.

Given yearly fluctuations due to oceanographic conditions (the position of the ABF), it seems that the main bulk of the Cunene horse mackerel biomass within the transboundary

region is presently found predominantly in Angolan waters (97 %), while the bulk of the Cape horse mackerel biomass (78 %) is found in Namibian waters.

In 2013, the sardine was nearly not found. It was found scattered in low densities aggregations along the transboundary coast. The biomass of Sardine (*Sardinops sagax*, "pilchard") decreased (2 200 tonnes) compared to previous years. It should however be noted that these estimates are relative indices, not absolute estimates of abundance and so the population estimate should not be interpreted in absolute terms. In addition will any changes in the proportion of fish found close to the surface and in the acoustic dead-zone have a drastic impact on our ability to detect and observe aggregations of fish.

As for Cape horse mackerel, both the aggregation pattern and the relative distribution between Angolan and Namibian zones within the transboundary area appear to fluctuate dramatically with environmental conditions between years. However, the more inshore-bound and short-lived life-history of the sardine compared to the carangid horse mackerels, combined with the fact that the sardine is still in a recovery phase from heavy fishing over the past decades, may add further to the dynamic picture for sardine compared to horse mackerel, rendering a yet more volatile and less predictable scenario in terms of abundance and distribution pattern for sardine compared to horse mackerel within the transboundary area.

Similarly to 2012, no *Sardinella aurita* was found in the transboundary area this year.

The other clupeid species (*Engraulis* and *Etrumeus*) were found along the entire transboudary coast in extended, homogenous aggregation just like previous years (2011 and 2012).

5.1. Recommendations

The main recommendations are:

1. The time series should continue, at the same time of the year, in order to monitor changes within the transboundary area over time and to establish whether the observed patterns are persistent over time.

2. Additional surveys should be conducted in the warm season, as the distribution patterns of all the targeted species are likely to be seasonal. Horse mackerel distributions over the transboundary area generally follow the position of the Angola-Benguela front (ABF), *i.e*. both species have a more southern distribution in the warm season, leading expectations of more Cunene horse mackerel in Namibian waters and less Cape horse mackerel in Angolan waters during summer.

3. Angola and Namibia should, through the BCC, put in place mechanisms for continuing the monitoring of the transboundary area and expand on the established collaboration in the management of the transboundary pelagic fish resources there; all populations studied are to some extent transboundary, and most are in low abundance.

4. Collaborative monitoring should focus on joint training and harmonization of survey techniques, irrespective of the future of the transboundary surveys.

5. There is a need to further develop the acoustic survey methodology to include estimates of precision for the results. Such development should be a trilateral cooperation between Angola, Namibia and Norway including training of scientists as a part of implementing new methodology.

6. Some species like *Sardinella*, *Sardinops* and round-eye herring will at times of day partly be distributed in the acoustic dead-zone close to the surface. Acoustic observation technology to observe close to surface aggregation of fish should be developed including estimates of target strength varying as a response to the vessel or other factors.

CHAPTER 6. REFERENCES

ANONYMOUS 2003 — BENEFIT Report on Survey Errors workshop, Cape Town, South-Africa 4–7 December 2000. BENEFIT Secretariat, Swakopmund, Namibia. 45 pp.

ANONYMOUS 2004 — BENEFIT Report on Survey Errors workshop, Cape Town, South-Africa 14-15 November 2003. BENEFIT Secretariat, Swakopmund, Namibia. 31 pp.

CRUISE REPORT NO 2/2009. 2009. SURVEYS OF THE FISH RESOURCES OF ANGOLA, Survey of the pelagic resources, 23 May – 4 July 2009. Draft report. *Unpublished*

FOOTE, K. G. 1987 — Fish target strengths for use in echo integrator surveys. *J. Acoust. Soc. Am.* **82**(3): 981-987.

FOOTE, K. G., AGLEN, A. and O. NAKKEN 1986 — Measurements of fish target strength with a split-beam echosounder. *J. Acoust. Soc. Am.* **80**(2): 612-621.

ZAERA, D., BARRADAS, A., NDJAULA, H., MUNDJULU, I. 2011. BCC SURVEY: A transboundary study of the pelagic fish stocks of Southern Angola and Northern Namibia. 29 July – 28 August. BCC Project: LMR/NANSEN/1/11. *Cruise Reports 'Dr. Fridtjof Nansen'*. Cruise report No. 01/2011. Institute of Marine Research, Bergen, Norway. 51p.

ANNEX I. RECORDS OF FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 61
DATE :10/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°31,67
start stop duration Lon E 12°0,07
TIME :08:15:00 08:45:18 30,3 (min) Purpose : 1
LOG : 7092,33 7094,25 1,9 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 35 35 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3,8 kn
Sorted : 66 Total catch: 790,08 Catch/hour: 1564,51

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	1538,14	19703	98,31	207
Dasyatis marmorata	23,52	24	1,50	
Scomber japonicus	2,85	24	0,18	208
Total	1564,51		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 62
DATE :11/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°38,11
start stop duration Lon E 11°46,45
TIME :12:02:05 12:31:44 29,6 (min) Purpose : 1
LOG : 7123,61 7125,01 1,4 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 115 113 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 2,8 kn
Sorted : 111 Total catch: 737,02 Catch/hour: 1491,94

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	1031,28	6854	69,12	209
SALPS	389,31	43769	26,09	
Etrumeus whiteheadi	29,25	520	1,96	
J E L L Y F I S H	19,37	415	1,30	
Scomber japonicus	12,69	40	0,85	210
Sphyrna lewini	10,04	2	0,67	
Total	1491,94		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 63
DATE :11/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°43,42
start stop duration Lon E 11°50,79
TIME :03:40:47 04:10:25 29,6 (min) Purpose : 1
LOG : 7148,51 7149,96 1,4 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 195 333 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 2,9 kn
Sorted : 1 Total catch: 127,78 Catch/hour: 258,66

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	197,91	1344	76,51	211
SALPS	40,69	3838	15,73	
Sarda sarda	15,99	22	6,18	
Trichiurus lepturus	3,08	43	1,19	
Lagocephalus laevigatus	0,45	4	0,17	
Loligo vulgaris	0,24	2	0,09	
Etrumeus whiteheadi	0,18	4	0,07	
MYCTOPHIDAE	0,12	46	0,05	
Total	258,66		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 64
DATE :11/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 15°56,22
start stop duration Lon E 11°44,12
TIME :09:24:09 09:44:21 20,2 (min) Purpose : 1
LOG : 7183,58 7184,85 1,3 Region : 4050
FDEPTH: 21 21 Gear cond.: 0
BDEPTH: 21 21 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3,8 kn
Sorted : 0 Total catch: 416,17 Catch/hour: 1236,15

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Dasyatis marmorata	364,72	181	29,50	
Trachurus trecae	235,66	3359	19,06	212
Myliobatis aquila	180,45	68	14,60	
Mustelus mustelus	142,87	98	11,56	
Atractoscion aequidens	48,42	273	3,92	
Pomatomus saltatrix	39,50	151	3,20	
Sphyrna lewini	37,49	0	3,03	
Arius heudelotii	30,12	42	2,44	
Rhinobatos albomaculatus	28,75	12	2,33	
Pomadasys incisus	22,46	832	1,82	
Dicologoglossa cuneata	20,23	612	1,64	
Umbrina canariensis	11,70	149	0,95	
Raja miraletus	11,67	27	0,94	
Trachinus armatus	11,23	315	0,91	
Torpedo torpedo	10,63	15	0,86	
Loligo vulgaris	9,33	74	0,75	
Sepia orbignyana	7,69	15	0,62	
Gymnura altavela	6,00	3	0,49	
Alloteuthis africana	5,35	2207	0,43	
Trachinus draco	4,10	33	0,33	
Trachinocephalus myops	1,43	9	0,12	
Spondyliosoma cantharus	1,31	27	0,11	
Trichiurus lepturus	1,19	15	0,10	
J E L L Y F I S H	1,07	12	0,09	
Dentex barnardi	0,77	30	0,06	
Lithognathus mormyrus	0,74	6	0,06	
Starfish	0,68	50	0,06	
Selene dorsalis	0,27	6	0,02	
Pagellus bellottii	0,21	3	0,02	
Zeus faber	0,09	3	0,01	
Penaeus notialis	0,03	3	0,00	
Total	1236,15		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 65
DATE :11/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°4,17
start stop duration Lon E 11°39,19
TIME :03:51:24 04:17:54 26,5 (min) Purpose : 1
LOG : 7231,34 7232,84 1,5 Region : 4050
FDEPTH: 55 54 Gear cond.: 0
BDEPTH: 55 54 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3,4 kn
Sorted : 31 Total catch: 149,65 Catch/hour: 338,96

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Mustelus mustelus	116,33	118	34,32	
Loligo vulgaris	46,57	960	13,74	
Chelidonichthys capensis	33,16	199	9,78	
Sepia orbignyana	31,85	23	9,40	
Not found	27,09	3035	7,99	
Raja miraletus	20,29	27	5,99	
Pagellus bellottii	19,66	236	5,80	214
Sphyrna lewini	13,09	7	3,86	
Scorpaena stephanica	9,06	63	2,67	
Trachurus trecae	6,91	91	2,04	213
G A S T R O P O D S	5,07	317	1,50	
Spondyliosoma cantharus	4,35	54	1,28	
SALPS	2,72	127	0,80	
Merluccius polli	1,09	9	0,32	
Sphoeroides sp.	1,09	27	0,32	
Citharus linguatula	0,36	9	0,11	
Not found	0,27	36	0,08	
Total	338,96		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 66
DATE :11/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 16°11,23
start stop duration Lon E 11°43,91

TIME :07:18:54 07:50:21 31,4 (min) Purpose : 1
LOG : 7261,15 7263,09 1,9 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 47 49 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3,7 kn
Sorted : 4 Total catch: 16,80 Catch/hour: 32,05

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	25,49	946	79,52	215
Loligo vulgaris	5,28	259	16,49	
Alloteuthis africana	0,88	324	2,74	
Unidentified larvae	0,23	4	0,71	
Etrumeus whiteheadi	0,11	2	0,36	
Engraulis encrasicolus	0,02	4	0,06	
Lagocephalus sp.	0,02	2	0,06	
Lagocephalus guntheri	0,02	4	0,06	
Total	32,05		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 67
DATE :12/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 16°21,93
start stop duration Lon E 11°31,51
TIME :02:43:45 03:13:16 29,5 (min) Purpose : 1
LOG : 7307,32 7308,85 1,5 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 86 85 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3,1 kn
Sorted : 0 Total catch: 34,98 Catch/hour: 71,10

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
SALPS	43,31	2549	60,92	
Etrumeus whiteheadi	20,85	396	29,33	
J E L L Y F I S H	6,50	61	9,15	
Loligo vulgaris	0,43	6	0,60	
Total	71,10		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 68
DATE :12/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°25,89
start stop duration Lon E 11°27,66
TIME :07:35:24 08:06:57 31,6 (min) Purpose : 1
LOG : 7349,29 7351,17 1,9 Region : 4050
FDEPTH: 106 106 Gear cond.: 0
BDEPTH: 106 106 Validity : 0
Towing dir: 0° Wire out : 290 m Speed : 3,6 kn
Sorted : 0 Total catch: 114,15 Catch/hour: 217,08

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
G A S T R O P O D S	44,96	4115	20,71	
Trachurus trecae	39,44	281	18,17	216
Etrumeus whiteheadi	38,30	717	17,64	
Lagocephalus sp.	17,29	53	7,96	
Chelidonichthys capensis	14,30	135	6,59	
Sepia orbignyana	11,68	76	5,38	
Trigla lyra	9,62	143	4,43	
Urchin	8,63	468	3,98	
Dentex macrophthalmus	5,84	53	2,69	218
Octopus vulgaris	5,78	4	2,66	
Pagellus bellottii	4,75	34	2,19	217
Hexanchus griseus	4,09	2	1,88	
Raja miraletus	3,18	4	1,46	
Zeus faber	2,87	6	1,32	
Loligo vulgaris	2,15	17	0,99	
Mustelus mustelus	1,45	2	0,67	
Illex coindetii	0,86	11	0,39	
Arnoglossus imperialis	0,63	23	0,29	
Citharus linguatula	0,46	13	0,21	
Scomber japonicus	0,42	2	0,19	219
SALPS	0,15	10	0,07	
Lophiodes kempi	0,13	2	0,06	
Dicologoglossa cuneata	0,11	11	0,05	

Total	217,08	100,00

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 69
DATE :12/07/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°38,30
start stop duration Lon E 11°45,61
TIME :02:21:26 02:58:42 37,3 (min) Purpose : 1
LOG : 7411,83 7414,06 2,2 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 22 22 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3,6 kn
Sorted : 0 Total catch: 22,79 Catch/hour: 36,69

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	32,36	6116	88,20	220
G A S T R O P O D S	2,72	610	7,42	
Raja miraletus	0,89	2	2,41	
Engraulis encrasicolus	0,50	111	1,36	221
Etrumeus whiteheadi	0,11	5	0,31	
Boops boops	0,08	2	0,22	
Scomber japonicus	0,03	3	0,09	
Total	36,69		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 70
DATE :12/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 16°36,73
start stop duration Lon E 11°28,55
TIME :06:57:48 07:38:23 40,6 (min) Purpose : 1
LOG : 7443,65 7445,87 2,2 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 116 111 Validity : 0
Towing dir: 0° Wire out : 125 m Speed : 3,3 kn
Sorted : 3 Total catch: 83,09 Catch/hour: 122,82

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sphyrna lewini	41,09	1	33,46	
Etrumeus whiteheadi	32,96	639	26,84	
Sarda sarda	31,22	35	25,42	223
Trachurus trecae	9,64	120	7,85	222
Unidentified larvae	5,51	157	4,49	
Trichiurus lepturus	2,39	34	1,95	
Total	122,82		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 71
DATE :13/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°50,49
start stop duration Lon E 11°39,70
TIME :07:18:20 07:29:26 11,1 (min) Purpose : 1
LOG : 7518,37 7519,07 0,7 Region : 4050
FDEPTH: 45 45 Gear cond.: 0
BDEPTH: 45 45 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3,8 kn
Sorted : 74 Total catch: 5792,58 Catch/hour: 31311,24

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	17130,49	1352984	54,71	225
Engraulis encrasicolus	12924,32	916605	41,28	226
Trachurus trecae	514,38	20659	1,64	224
Not found	274,05	59449	0,88	
Todarodes angolensis	168,65	843	0,54	
Etrumeus whiteheadi	164,43	8432	0,53	
Calappa pelii	50,59	843	0,16	
Maja squinado	37,95	843	0,12	
Dicologoglossa cuneata	37,95	843	0,12	
Calappa sp.	4,22	422	0,01	
Dentex macrophthalmus	4,22	422	0,01	
Total	31311,24		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 72
DATE :13/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°47,89
start stop duration Lon E 11°30,48
TIME :10:14:06 10:44:06 30,0 (min) Purpose : 1
LOG : 7532,41 7534,07 1,7 Region : 4050
FDEPTH: 110 111 Gear cond.: 0
BDEPTH: 110 111 Validity : 0
Towing dir: 0° Wire out : 290 m Speed : 3,3 kn
Sorted : 112 Total catch: 1154,83 Catch/hour: 2310,43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	812,33	21039	35,16	229
Trachurus trecae	396,47	5536	17,16	227
Trachurus capensis	335,67	6492	14,53	228
Sepia orbignyana	328,47	412	14,22	
Mustelus mustelus	145,07	144	6,28	
Etrumeus whiteheadi	93,97	1897	4,07	
Loligo vulgaris	82,23	494	3,56	
Chelidonichthys capensis	45,74	206	1,98	
Arius heudelotii	13,60	20	0,59	
Scomber japonicus	10,10	21	0,44	230
G A S T R O P O D S	8,44	1442	0,37	
Spondyliosoma cantharus	7,62	20	0,33	
Umbrina canariensis	6,60	62	0,29	
Pagellus bellottii	6,60	41	0,29	
Starfish	6,38	1711	0,28	
Trigla lyra	3,50	41	0,15	
Lagocephalus sp.	3,50	20	0,15	
Zeus faber	1,44	20	0,06	
Citharus linguatula	1,24	42	0,05	
Dicologoglossa cuneata	0,82	20	0,04	
Scorpaena normani	0,62	20	0,03	
Total	2310,43		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 73
DATE :13/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°52,80
start stop duration Lon E 11°23,02
TIME :04:48:07 05:18:41 30,6 (min) Purpose : 1
LOG : 7575,85 7577,52 1,7 Region : 4050
FDEPTH: 134 139 Gear cond.: 0
BDEPTH: 134 139 Validity : 0
Towing dir: 0° Wire out : 320 m Speed : 3,3 kn
Sorted : 123 Total catch: 492,16 Catch/hour: 965,97

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	441,22	5841	45,68	234
Trachurus trecae	132,52	1625	13,72	231
Pterothrissus belloci	90,91	879	9,41	
Merluccius capensis	73,48	361	7,61	
Mustelus mustelus	48,36	141	5,01	
Chelidonichthys capensis	41,30	385	4,28	
Pagellus bellottii	29,83	220	3,09	233
Trachurus capensis	24,18	526	2,50	232
G A S T R O P O D S	19,00	2041	1,97	
Illex coindetii	17,59	16	1,82	
Scorpaena normani	16,64	228	1,72	
Todarodes angolensis	8,48	47	0,88	
Sepia orbignyana	5,97	63	0,62	
Umbrina canariensis	3,93	31	0,41	
Raja miraletus	3,14	24	0,33	
Dicologoglossa cuneata	3,06	149	0,32	
Zeus faber	2,83	16	0,29	
Arnoglossus imperialis	1,10	47	0,11	
Acanthocepola indica	0,86	39	0,09	
Trigla lyra	0,79	8	0,08	
Synagrops microlepis	0,71	408	0,07	
GOBIIDAE	0,08	86	0,01	
Total	965,97		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 74
DATE :13/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 16°53,41
start stop duration Lon E 11°39,89
TIME :07:37:37 07:51:46 14,2 (min) Purpose : 1
LOG : 7595,81 7596,70 0,9 Region : 4050
FDEPTH: 20 25 Gear cond.: 0
BDEPTH: 44 38 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3,8 kn
Sorted : 36 Total catch: 143,52 Catch/hour: 608,57

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	397,57	30530	65,33	238
Trachurus capensis	80,57	5601	13,24	246
Etrumeus whiteheadi	65,81	8040	10,81	
Trachurus trecae	37,82	2222	6,22	235
Chrysaora hysoscella	19,34	899	3,18	
Todarodes sp.	4,24	322	0,70	
Trichiurus lepturus	2,37	51	0,39	
Scomber japonicus	0,85	17	0,14	237
Total	608,57		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 75
DATE :14/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 17°5,55
start stop duration Lon E 11°26,97
TIME :03:08:47 03:38:15 29,4 (min) Purpose : 1
LOG : 7657,40 7659,09 1,7 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 132 127 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3,4 kn
Sorted : 0 Total catch: 55,16 Catch/hour: 112,38

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	106,96	2292	95,18	
Loligo vulgaris	2,77	20	2,47	
Synagrops microlepis	1,81	972	1,61	
Trachurus capensis	0,77	20	0,69	239
J E L L Y F I S H	0,04	2	0,04	
Merluccius polli	0,02	4	0,02	
Total	112,38		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 76
DATE :15/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°12,96
start stop duration Lon E 11°30,85
TIME :04:07:26 04:37:45 30,3 (min) Purpose : 1
LOG : 7779,57 7781,11 1,5 Region : 4050
FDEPTH: 132 135 Gear cond.: 0
BDEPTH: 132 135 Validity : 0
Towing dir: 0° Wire out : 325 m Speed : 3,0 kn
Sorted : 200 Total catch: 902,06 Catch/hour: 1785,67

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Dicologoglossa cuneata	748,27	331	41,90	
Trachurus capensis	442,82	6287	24,80	240
Dentex macrophthalmus	427,05	6299	23,92	241
Pterothrissus belloci	54,34	837	3,04	
Mustelus mustelus	20,23	62	1,13	
Merluccius capensis	18,08	348	1,01	
Sepia orbignyana	14,00	81	0,78	
Chelidonichthyes capensis	11,94	99	0,67	
Gobidae sp. 'bars'	8,55	1453	0,48	
G A S T R O P O D S	7,94	4286	0,44	
Octopus vulgaris	7,66	36	0,43	
Scorpaena normani	6,24	143	0,35	
Brotula barbata	4,37	27	0,24	
Atractoscion aequidens	3,83	0	0,21	
Todarodes sp.	3,31	18	0,19	
TRIGLIDAE	2,76	10	0,15	
Zeus faber	1,70	18	0,10	
Squilla mantis	0,98	36	0,05	
Synagrops microlepis	0,98	321	0,05	
Halobatrachus didactylus	0,18	10	0,01	
Ophidion barbatum	0,18	10	0,01	

Goneplax angulata	0,09	10	0,00
Callinectes sp.	0,09	18	0,00
Trigla lyra	0,09	10	0,00
Total	1785,67		100,00

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 77
DATE :15/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°12,03
start stop duration Lon E 11°31,48
TIME :05:40:35 06:19:31 38,9 (min) Purpose : 1
LOG : 7786,64 7788,57 1,9 Region : 4050
FDEPTH: 50 70 Gear cond.: 0
BDEPTH: 125 124 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3,0 kn
Sorted : 0 Total catch: 0,00 Catch/hour: 0,00

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
N O C A T C H	0,00	0	0,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 78
DATE :15/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°10,80
start stop duration Lon E 11°44,17
TIME :08:32:09 09:02:22 30,2 (min) Purpose : 1
LOG : 7807,85 7809,75 1,9 Region : 4050
FDEPTH: 22 19 Gear cond.: 0
BDEPTH: 22 19 Validity : 0
Towing dir: 0° Wire out : 115 m Speed : 3,8 kn
Sorted : 102 Total catch: 1629,16 Catch/hour: 3233,53

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	1905,39	45507	58,93	243
Sardinops ocellatus	437,61	6065	13,53	242
Myliobatis aquila	288,98	159	8,94	
J E L L Y F I S H	171,80	1239	5,31	
Chimaera monstrosa	89,75	64	2,78	
Arius heudelotii	55,89	476	1,73	
Trichiurus lepturus	45,15	1683	1,40	
Etrumeus whiteheadi	36,20	1969	1,12	
Chrysaora hysoscella	31,76	1874	0,98	
Loligo vulgaris	26,99	159	0,83	
Chelidonichthys capensis	24,77	32	0,77	
Not found	17,78	3557	0,55	
Argyrosomus hololepidotus	17,23	2	0,53	
Mustelus mustelus	16,20	32	0,50	
Narkidae sp.	15,88	64	0,49	
Atractoscion aequidens	14,29	159	0,44	
Engraulis encrasicolus	11,75	730	0,36	244
Sepia orbignyana	6,67	3	0,21	
Pomatomus saltatrix	6,35	32	0,20	
Maja squinado	4,76	1111	0,15	
Cynoglossus canariensis	3,18	381	0,10	
G A S T R O P O D S	2,22	445	0,07	
Penaeus notialis	1,91	1302	0,06	
Umbrina canariensis	0,64	32	0,02	
Not found	0,32	32	0,01	
Not found	0,06	603	0,00	
Chelonia mydas	0,00	12	0,00	
Total	3233,53		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 79
DATE :22/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°12,05
start stop duration Lon E 11°39,67
TIME :12:42:52 12:53:47 10,9 (min) Purpose : 1
LOG : 8588,31 8589,20 0,9 Region : 5010
FDEPTH: 40 0 Gear cond.: 0
BDEPTH: 74 80 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 4,9 kn
Sorted : 0 Total catch: 10,95 Catch/hour: 60,16

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	59,45	3533	98,81	
Loligo vulgaris	0,33	16	0,55	
Synagrops microlepis	0,16	27	0,27	
Trachurus capensis	0,11	5	0,18	
Aequorea forskalea	0,11	11	0,18	
Total	60,16		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 80
DATE :22/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°12,13
start stop duration Lon E 11°34,00
TIME :02:22:23 02:41:46 19,4 (min) Purpose : 1
LOG : 8597,21 8597,75 0,6 Region : 5010
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 112 116 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 1,7 kn
Sorted : 0 Total catch: 16,06 Catch/hour: 49,70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	41,96	5786	84,43	245
Aequorea forskalea	3,28	19	6,60	
Sepia orbignyana	2,04	3	4,11	
Chrysaora hysoscella	1,08	19	2,18	
Merluccius capensis	0,71	3	1,43	
Loligo vulgaris	0,31	3	0,62	
Trichiurus lepturus	0,31	6	0,62	
Total	49,70		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 81
DATE :22/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°16,86
start stop duration Lon E 11°31,33
TIME :02:45:38 03:02:34 16,9 (min) Purpose : 1
LOG : 8671,24 8672,19 0,9 Region : 5010
FDEPTH: 143 143 Gear cond.: 0
BDEPTH: 143 143 Validity : 0
Towing dir: 0° Wire out : 380 m Speed : 3,4 kn
Sorted : 123 Total catch: 493,72 Catch/hour: 1749,75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	1162,43	17366	66,43	249
Trachurus trecae	211,79	3998	12,10	247
Pterothrissus belloci	104,05	1857	5,95	
Merluccius capensis	64,78	284	3,70	
Trachurus capensis	54,58	3643	3,12	248
Loligo vulgaris	45,36	227	2,59	
Callorhinchus capensis	24,52	14	1,40	
Chelidonichthys capensis	17,58	57	1,00	
Raja miraletus	13,18	28	0,75	
GOBIIDAE	7,94	1602	0,45	
Mustelus mustelus	7,66	71	0,44	
Trichiurus lepturus	7,51	99	0,43	
Sepia orbignyana	5,39	28	0,31	
G A S T R O P O D S	5,10	2155	0,29	
Synagrops microlepis	4,68	1786	0,27	
Trigla lyra	3,97	57	0,23	
Aequorea forskalea	3,54	170	0,20	
Zeus faber	3,40	57	0,19	
Brotula barbata	0,85	14	0,05	
Dicologoglossa cuneata	0,57	57	0,03	
Todaropsis eblanae	0,43	14	0,02	
Octopus vulgaris	0,28	14	0,02	
Callinectes pallidus	0,14	14	0,01	
Total	1749,75		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 82
DATE :22/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°24,25
start stop duration Lon E 11°38,34
TIME :06:03:37 06:16:33 12,9 (min) Purpose : 1
LOG : 8696,51 8697,24 0,7 Region : 5010
FDEPTH: 60 60 Gear cond.: 0
BDEPTH: 99 92 Validity : 0
Towing dir: 0° Wire out : 105 m Speed : 3,4 kn
Sorted : 0 Total catch: 84,78 Catch/hour: 393,41

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	390,02	35341	99,14	250
Etrumeus whiteheadi	1,21	65	0,31	252
Todaropsis eblanae	0,93	9	0,24	

Trichiurus lepturus	0,46	14	0,12	
Octopus vulgaris	0,32	5	0,08	
Aequorea forskalea	0,28	14	0,07	
Scomber japonicus	0,19	9	0,05	251
Total	393,41		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 83
DATE :23/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°29,64
start stop duration Lon E 11°28,58
TIME :01:04:51 01:21:03 16,2 (min) Purpose : 1
LOG : 8751,94 8752,92 1,0 Region : 5010
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 181 167 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 3,6 kn
Sorted : 42 Total catch: 105,99 Catch/hour: 392,56

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Aequorea forskalea	220,00	8148	56,04	
Trachurus capensis	143,89	25881	36,65	253
Chrysaora hysoscella	26,59	511	6,77	
Synagrops microlepis	1,41	500	0,36	
Engraulis encrasicolus	0,37	56	0,09	254
MYCTOPHIDAE	0,30	85	0,08	
Total	392,56		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 84
DATE :23/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°41,99
start stop duration Lon E 11°32,00
TIME :10:15:25 10:22:19 6,9 (min) Purpose : 1
LOG : 8823,69 8824,07 0,4 Region : 5010
FDEPTH: 171 173 Gear cond.: 0
BDEPTH: 171 173 Validity : 0
Towing dir: 0° Wire out : 420 m Speed : 3,3 kn
Sorted : 93 Total catch: 278,55 Catch/hour: 2422,17

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	1138,43	26687	47,00	255
Dentex macrophthalmus	410,09	5452	16,93	256
Synagrops microlepis	270,26	77609	11,16	
Merluccius capensis	161,74	1826	6,68	
Callorhinchus capensis	106,96	52	4,42	
Myliobatis aquila	76,70	26	3,17	
Chelidonichthys capensis	73,57	104	3,04	
Pterothrissus belloci	53,22	1043	2,20	
Trigla lyra	35,48	417	1,46	
Chlorophthalmus atlanticus	23,48	4774	0,97	
Dicologoglossa cuneata	18,52	443	0,76	
Raja miraletus	17,74	52	0,73	
Pontinus accraensis	15,91	313	0,66	
Todaropsis eblanae	7,30	78	0,30	
Squilla mantis	4,17	261	0,17	
GOBIIDAE	3,39	991	0,14	
Aequorea forskalea	3,13	261	0,13	
S H R I M P S	1,04	183	0,04	
Callinectes pallidus	0,78	52	0,03	
Goneplax angulata	0,26	26	0,01	
Total	2422,17		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 85
DATE :23/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°48,36
start stop duration Lon E 11°33,81
TIME :01:57:50 02:06:30 8,7 (min) Purpose : 1
LOG : 8855,13 8855,67 0,5 Region : 5010
FDEPTH: 164 165 Gear cond.: 0
BDEPTH: 164 165 Validity : 0
Towing dir: 0° Wire out : 415 m Speed : 3,7 kn
Sorted : 92 Total catch: 1935,16 Catch/hour: 13392,11

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	11980,90	203751	89,46	257
Dentex macrophthalmus	848,72	7993	6,34	258
Merluccius capensis	183,39	1017	1,37	
Chelidonichthys capensis	130,80	145	0,98	
Synagrops microlepis	91,35	11626	0,68	
G A S T R O P O D S	45,05	7266	0,34	
Pontinus accraensis	37,79	581	0,28	
Pterothrissus belloci	24,71	436	0,18	
Brotula barbata	20,35	145	0,15	

Etrumeus whiteheadi	10,17	145	0,08
Dicologoglossa cuneata	8,72	145	0,07
Trigla lyra	5,81	145	0,04
Squilla mantis	4,36	145	0,03
Total	13392,11		100,00

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 86
DATE :23/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°53,71
start stop duration Lon E 11°45,14
TIME :07:57:06 08:07:44 10,6 (min) Purpose : 1
LOG : 8901,00 8901,63 0,6 Region : 5010
FDEPTH: 20 22 Gear cond.: 0
BDEPTH: 50 66 Validity : 0
Towing dir: 0° Wire out : 80 m Speed : 3,6 kn
Sorted : 0 Total catch: 14,06 Catch/hour: 79,44

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Aequorea forskalea	34,35	1763	43,24	
Chrysaora hysoscella	17,85	96	22,48	
Sardinops ocellatus	13,84	520	17,43	260
Etrumeus whiteheadi	9,10	638	11,45	261
Trachurus trecae	2,54	119	3,20	259
Trichiurus lepturus	1,02	34	1,28	
Engraulis encrasicolus	0,28	40	0,36	262
Trachurus capensis	0,23	17	0,28	263
Merluccius capensis	0,11	6	0,14	
Illex coindetii	0,11	6	0,14	
Total	79,44		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 87
DATE :24/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°4,69
start stop duration Lon E 11°37,73
TIME :03:21:41 03:50:53 29,2 (min) Purpose : 1
LOG : 8963,21 8965,14 1,9 Region : 5010
FDEPTH: 140 0 Gear cond.: 0
BDEPTH: 146 162 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 4,0 kn
Sorted : 12 Total catch: 68,73 Catch/hour: 141,23

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Aequorea forskalea	100,89	2969	71,44	
Chrysaora hysoscella	18,80	103	13,31	
Trachurus capensis	18,62	935	13,18	264
Merluccius capensis	1,99	31	1,41	
Etrumeus whiteheadi	0,41	21	0,29	
Sardinops ocellatus	0,31	10	0,22	
MYCTOPHIDAE	0,21	62	0,15	
Total	141,23		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 88
DATE :24/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°10,51
start stop duration Lon E 11°46,19
TIME :07:08:10 07:17:57 9,8 (min) Purpose : 1
LOG : 8987,55 8988,11 0,6 Region : 5010
FDEPTH: 50 55 Gear cond.: 0
BDEPTH: 87 72 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3,4 kn
Sorted : 0 Total catch: 165,48 Catch/hour: 1015,21

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	507,85	26160	50,02	265
Chrysaora hysoscella	475,64	5399	46,85	
Etrumeus whiteheadi	28,28	1675	2,79	266
Aequorea forskalea	2,88	110	0,28	
Illex coindetii	0,55	31	0,05	
Total	1015,21		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 89
DATE :24/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°10,33
start stop duration Lon E 11°38,45
TIME :09:03:02 09:11:29 8,4 (min) Purpose : 1
LOG : 8998,60 8999,04 0,4 Region : 5010
FDEPTH: 143 140 Gear cond.: 0
BDEPTH: 143 140 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 3,1 kn
Sorted : 26 Total catch: 337,77 Catch/hour: 2398,37

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
PORIFERA (Sponges)	758,91	72824	31,64	
Trachurus capensis	511,74	8095	21,34	267
Dentex macrophthalmus	482,20	5744	20,11	268
Merluccius paradoxus	424,26	6234	17,69	269
Aequorea forskalea	85,28	3607	3,56	
Synagrops microlepis	37,21	5851	1,55	
Chelidonichthys capensis	16,97	50	0,71	
Callorhinchus capensis	16,12	7	0,67	
Dicologoglossa cuneata	13,70	50	0,57	
MYCTOPHIDAE	13,70	3174	0,57	
G A S T R O P O D S	10,93	547	0,46	
Chlorophthalmus atlanticus	7,67	1093	0,32	
Pterothrissus belloci	7,10	163	0,30	
Chrysaora hysoscella	6,04	107	0,25	
Scorpaena normani	4,90	163	0,20	
PORTUNIDAE	1,63	107	0,07	
Total	2398,37		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 90
DATE :24/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°15,55
start stop duration Lon E 11°41,66
TIME :03:13:38 03:26:27 12,8 (min) Purpose : 1
LOG : 9041,63 9042,37 0,7 Region : 5010
FDEPTH: 50 55 Gear cond.: 0
BDEPTH: 139 147 Validity : 0
Towing dir: 0° Wire out : 160 m Speed : 3,4 kn
Sorted : 69 Total catch: 2451,15 Catch/hour: 11471,84

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Aequorea forskalea	9203,68	19910	80,23	
Trachurus capensis	2230,25	265849	19,44	270
Chrysaora hysoscella	37,91	473	0,33	
Total	11471,84		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 91
DATE :24/07/13 GEAR TYPE: PT NO: 7 POSITION:Lat S 18°16,45
start stop duration Lon E 11°52,33
TIME :05:46:09 05:52:25 6,3 (min) Purpose : 1
LOG : 9057,67 9058,08 0,4 Region : 5010
FDEPTH: 15 20 Gear cond.: 0
BDEPTH: 36 40 Validity : 0
Towing dir: 0° Wire out : 80 m Speed : 3,9 kn
Sorted : 0 Total catch: 125,14 Catch/hour: 1197,51

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Aequorea forskalea	953,21	16019	79,60	
Engraulis encrasicolus	210,91	14641	17,61	273
PORIFERA (Sponges)	18,37	1914	1,53	
Chrysaora hysoscella	8,90	10	0,74	
Sardinops ocellatus	3,06	163	0,26	272
Todaropsis eblanae	1,72	19	0,14	
Etrumeus whiteheadi	1,24	153	0,10	271
PORTUNIDAE	0,10	10	0,01	
Total	1197,51		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 92
DATE :25/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°38,94
start stop duration Lon E 11°40,96
TIME :12:53:54 01:05:41 11,8 (min) Purpose : 1
LOG : 9200,64 9201,40 0,8 Region : 5010
FDEPTH: 80 90 Gear cond.: 0
BDEPTH: 238 239 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 3,8 kn
Sorted : 23 Total catch: 161,09 Catch/hour: 820,49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	720,92	1355	87,86	
Aequorea forskalea	82,72	1890	10,08	
J E L L Y F I S H	9,37	5	1,14	
Trachurus capensis	6,77	107	0,83	
MYCTOPHIDAE	0,71	36	0,09	
Total	820,49		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 93
DATE :26/07/13 GEAR TYPE: PT NO: 4 POSITION:Lat S 18°44,76
start stop duration Lon E 11°59,27
TIME :02:35:50 02:50:51 15,0 (min) Purpose : 1
LOG : 9317,15 9318,05 0,9 Region : 5010
FDEPTH: 5 10 Gear cond.: 0
BDEPTH: 127 122 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 3,6 kn
Sorted : 0 Total catch: 110,71 Catch/hour: 442,25

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	209,56	7818	47,39	276
Chrysaora hysoscella	113,65	312	25,70	
Aequorea forskalea	97,47	2157	22,04	
Sardinops ocellatus	19,57	555	4,43	275
Trachurus capensis	2,00	683	0,45	274
Total	442,25		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 94
DATE :26/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°54,57
start stop duration Lon E 12°6,29
TIME :03:40:58 03:45:37 4,6 (min) Purpose : 1
LOG : 9438,04 9438,31 0,3 Region : 5010
FDEPTH: 125 127 Gear cond.: 0
BDEPTH: 125 127 Validity : 0
Towing dir: 0° Wire out : 310 m Speed : 3,4 kn
Sorted : 98 Total catch: 2021,47 Catch/hour: 26139,70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	25308,62	553151	96,82	277
Chrysaora hysoscella	499,66	2987	1,91	
Dentex macrophthalmus	146,64	1629	0,56	278
Chelidonichthys capensis	105,91	543	0,41	
Scomber japonicus	27,16	272	0,10	
Synagrops microlepis	10,86	1358	0,04	
Etrumeus whiteheadi	10,86	272	0,04	
Merluccius paradoxus	8,28	8961	0,03	
GOBIIDAE	8,15	543	0,03	
Pterothrissus belloci	8,15	272	0,03	
Illex coindetii	2,72	272	0,01	
Starfish	2,72	815	0,01	
Total	26139,70		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 95
DATE :26/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°55,28
start stop duration Lon E 12°21,06
TIME :06:58:28 07:02:17 3,8 (min) Purpose : 1
LOG : 9465,58 9465,78 0,2 Region : 5010
FDEPTH: 72 72 Gear cond.: 0
BDEPTH: 72 72 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 3,1 kn
Sorted : 69 Total catch: 573,94 Catch/hour: 9014,76

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus trecae	6232,46	290890	69,14	279
Chrysaora hysoscella	998,95	3770	11,08	
Aequorea forskalea	821,78	24628	9,12	
Argyrosomus hololepidotus	382,30	126	4,24	
Chelidonichthys capensis	221,15	377	2,45	
Merluccius capensis	198,53	3141	2,20	
J E L L Y F I S H	108,06	126	1,20	
Dicologoglossa cuneata	25,13	880	0,28	
Not found	20,10	8670	0,22	
Pterothrissus belloci	3,77	126	0,04	
Gobidae sp. 'bars'	2,51	1005	0,03	
Total	9014,76		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 96
DATE :27/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°3,21
start stop duration Lon E 12°17,89
TIME :08:01:51 08:26:04 24,2 (min) Purpose : 1
LOG : 9578,36 9579,82 1,5 Region : 5010
FDEPTH: 20 41 Gear cond.: 0
BDEPTH: 111 116 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3,6 kn
Sorted : 38 Total catch: 457,24 Catch/hour: 1132,72

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	487,53	164928	43,04	280
Aequorea forskalea	344,34	7194	30,40	
Chrysaora hysoscella	300,84	1873	26,56	
Total	1132,72		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 97
DATE :27/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°6,65
start stop duration Lon E 12°26,05
TIME :11:20:14 11:25:03 4,8 (min) Purpose : 1
LOG : 9604,98 9605,25 0,3 Region : 5010
FDEPTH: 88 88 Gear cond.: 0
BDEPTH: 88 88 Validity : 0
Towing dir: 0° Wire out : 240 m Speed : 3,4 kn
Sorted : 64 Total catch: 723,61 Catch/hour: 9007,59

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	3619,05	159934	40,18	281
Aequorea forskalea	3334,23	80515	37,02	
Chrysaora hysoscella	701,08	3149	7,78	
Merluccius paradoxus	594,27	9859	6,60	
Chelidonichthys capensis	323,15	959	3,59	
Atractoscion aequidens	261,91	149	2,91	
GOBIIDAE	50,66	5340	0,56	
PORIFERA (Sponges)	46,56	822	0,52	
Dicologoglossa sp.	34,23	137	0,38	
Merluccius capensis	27,39	411	0,30	
Loligo vulgaris	10,95	137	0,12	
Dicologoglossa cuneata	4,11	137	0,05	
Total	9007,59		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 98
DATE :27/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°15,99
start stop duration Lon E 12°18,63
TIME :09:08:20 09:10:17 1,9 (min) Purpose : 1
LOG : 9691,61 9691,72 0,1 Region : 5010
FDEPTH: 133 133 Gear cond.: 0
BDEPTH: 133 133 Validity : 0
Towing dir: 0° Wire out : 340 m Speed : 3,5 kn
Sorted : 61 Total catch: 672,76 Catch/hour: 20700,31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	18639,08	325938	90,04	282
Chrysaora hysoscella	1279,38	18615	6,18	
Merluccius paradoxus	473,85	9477	2,29	
Aequorea forskalea	142,15	3723	0,69	
Chelidonichthys capensis	104,92	677	0,51	
Sardinops ocellatus	30,46	338	0,15	283
Not found	20,31	12523	0,10	
Illex coindetii	10,15	338	0,05	
Total	20700,31		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 99
DATE :28/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°22,77
start stop duration Lon E 12°18,08
TIME :01:52:00 02:11:45 19,8 (min) Purpose : 1
LOG : 9732,25 9733,37 1,1 Region : 5010
FDEPTH: 5 10 Gear cond.: 0
BDEPTH: 136 138 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3,4 kn
Sorted : 31 Total catch: 93,09 Catch/hour: 282,81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	235,14	702	83,15	
Aequorea forskalea	47,67	1103	16,85	
Total	282,81		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 100
DATE :28/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°28,77
start stop duration Lon E 12°18,70
TIME :09:32:58 09:34:12 1,2 (min) Purpose : 1
LOG : 9798,42 9798,49 0,1 Region : 5010
FDEPTH: 144 144 Gear cond.: 0
BDEPTH: 144 144 Validity : 0
Towing dir: 0° Wire out : 360 m Speed : 3,2 kn
Sorted : 63 Total catch: 944,25 Catch/hour: 46060,98

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	41100,00	34585	89,23	284
Merluccius paradoxus	3497,56	59268	7,59	
Chrysaora hysoscella	1331,71	12439	2,89	
Dentex macrophthalmus	95,12	732	0,21	
Not found	21,95	14634	0,05	
Gobidae sp. 'bars'	7,32	14634	0,02	
Synagrops microlepis	7,32	732	0,02	
Total	46060,98		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 101
DATE :28/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°22,80
start stop duration Lon E 12°34,91
TIME :12:05:55 12:16:20 10,4 (min) Purpose : 1
LOG : 9818,42 9818,98 0,6 Region : 5010
FDEPTH: 80 80 Gear cond.: 0
BDEPTH: 80 80 Validity : 0
Towing dir: 0° Wire out : 220 m Speed : 3,2 kn
Sorted : 97 Total catch: 2123,44 Catch/hour: 12227,10

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	8626,87	502537	70,56	285
Aequorea forskalea	1051,44	29390	8,60	
Chrysaora hysoscella	993,17	3167	8,12	
Etrumeus whiteheadi	706,87	32303	5,78	286
Chelidonichthys capensis	495,32	887	4,05	
Merluccius paradoxus	326,83	4940	2,67	
Sardinops ocellatus	20,27	253	0,17	
Starfish	3,80	1013	0,03	
GOBIIDAE	2,53	127	0,02	
Total	12227,10		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 102
DATE :28/07/13 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°21,78
start stop duration Lon E 12°39,57
TIME :01:59:09 02:04:17 5,1 (min) Purpose : 1
LOG : 9830,92 9831,24 0,3 Region : 5010
FDEPTH: 47 48 Gear cond.: 0
BDEPTH: 47 48 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3,7 kn
Sorted : 36 Total catch: 296,88 Catch/hour: 3472,28

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	1439,06	75789	41,44	287
Chrysaora hysoscella	1285,61	5801	37,03	
J E L L Y F I S H	311,58	187	8,97	
Not found	185,26	6082	5,34	
Atractoscion aequidens	144,09	35	4,15	
Etrumeus whiteheadi	54,27	2152	1,56	289
Merluccius paradoxus	31,81	936	0,92	
Engraulis encrasicolus	12,16	749	0,35	288
Microchirus wittei	4,68	94	0,13	
Starfish	2,81	561	0,08	
Leptocephalus	0,94	187	0,03	
Total	3472,28		100,00	

R/V Dr. Fridtjof Nansen SURVEY:2013406 STATION: 103
DATE :29/07/13 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°36,69
start stop duration Lon E 12°45,43
TIME :05:25:58 05:41:36 15,6 (min) Purpose : 1
LOG : 9951,84 9952,58 0,7 Region : 5010
FDEPTH: 40 36 Gear cond.: 0
BDEPTH: 61 60 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 2,9 kn
Sorted : 38 Total catch: 1575,42 Catch/hour: 6047,68

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Engraulis encrasicolus	4530,52	292146	74,91	292
Sardinops ocellatus	715,85	28215	11,84	290
Chrysaora hysoscella	477,24	1774	7,89	
Aequorea forskalea	257,97	7417	4,27	
Etrumeus whiteheadi	56,43	3708	0,93	291
Chelidonichthys capensis	6,45	161	0,11	
Trachurus capensis	3,22	645	0,05	293
Total	6047,68		100,00	

ANNEX II. CATCH RATES

Table 5 Catch rates (kg/h) of the main groups of pelagic on the Transboundary area between Angola-Namibia (15°50'-19°00' S).

Station	Gear depth	E encrasicolus	E whiteheadi	S. maderensis	S.aurita	Sardinops	T. capensis	T. trecae	Other	Total
61	0	0	0	0	0	0	0	98.3	1.7	1564.5
62	0	0	2	0	0	0	0	69.1	28.9	1491.9
63	0	0	0.1	0	0	0	0	76.5	23.4	258.7
64	21	0	0	0	0	0	0	19.1	80.9	1236.1
65	54.5	0	0	0	0	0	0	2	98	339
66	0	0.1	0.4	0	0	0	0	79.5	20.1	32.1
67	0	0	29.3	0	0	0	0	0	70.7	71.1
68	106	0	17.6	0	0	0	0	18.2	64.2	217.1
69	10	1.4	0.3	0	0	0	0	88.2	10.1	36.7
70	0	0	26.8	0	0	0	0	7.8	65.3	122.8
71	45	41.3	0.5	0	0	0	54.7	1.6	1.8	31311.2
72	110.5	0	4.1	0	0	0	14.5	17.2	64.2	2310.4
73	136.5	0	0	0	0	0	2.5	13.7	83.8	966
74	22.5	65.3	10.8	0	0	0	13.2	6.2	4.4	608.6
75	10	0	95.2	0	0	0	0.7	0	4.1	112.4
76	133.5	0	0	0	0	0	24.8	0	75.2	1785.7
77	60	0	0	0	0	0	0	0	0	0
78	20.5	0.4	1.1	0	0	13.5	0	58.9	26.1	3233.5
79	20	0	98.8	0	0	0	0.2	0	1	60.2
80	0	0	0	0	0	0	84.4	0	15.6	49.7
81	143	0	0	0	0	0	3.1	12.1	84.8	1749.7
82	60	0	0.3	0	0	0	99.1	0	0.6	393.4
83	0	0.1	0	0	0	0	36.7	0	63.3	392.6
84	172	0	0	0	0	0	47	0	53	2422.2
85	164.5	0	0.1	0	0	0	89.5	0	10.5	13392.1
86	21	0.4	11.5	0	0	17.4	0.3	3.2	67.3	79.4
87	70	0	0.3	0	0	0.2	13.2	0	86.3	141.2
88	52.5	0	2.8	0	0	0	50	0	47.2	1015.2
89	141.5	0	0	0	0	0	21.3	0	78.7	2398.4
90	52.5	0	0	0	0	0	19.4	0	80.6	11471.8
91	17.5	17.6	0.1	0	0	0.3	0	0	82	1197.5
92	85	0	0	0	0	0	0.8	0	99.2	820.5
93	7.5	0	47.4	0	0	4.4	0.5	0	47.7	442.3
94	126	0	0	0	0	0	96.8	0	3.1	26139.7
95	72	0	0	0	0	0	0	69.1	30.9	9014.8

ANNEX III. 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 06.07.2013 using 64 and 60 mm diameter copper spheres and 38.1 mm tungsten carbide sphere for 18, 38 and 120 kHz, respectively. The details of the settings of the 38 kHz echo sounder where as follows:

Transceiver-2 menu (38 kHz)	
Transducer depth	5.50 m
Absorption coefficient (variable with conditions)	8.7 dB/km
Pulse length	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2-way beam angle	-20.6dB
Gain	25.13 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 IV. 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.

*According to INIP directions, this stage is not used in the classification.