

## **SURVEYS OF THE FISH RESOURCES OF ANGOLA**

**Survey of the pelagic resources**  
28 July – 27 August 2004

**Institute of Marine Research**  
**IMR**  
**Bergen**

**Instituto Investigaç o Marinha**  
**IIM**  
**Luanda**

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by

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The Programme has previously conducted the following demersal surveys in the area:

<b>Area</b>		<b>Period</b>
January 1985	-	June 1986 (6 surveys)
January 1989	-	December 1989 (3 surveys)
May 1991	-	September 1992 (3 surveys)
January 1994	-	August 2004 (14 surveys)

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## CHAPTER 1 INTRODUCTION

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### 1.1 Objectives

This survey is one of a series aimed at monitoring the pelagic fish resources of Angola, as agreed with the Instituto de Investigação Marinha (IIM), Luanda.

The main objectives of the survey were the following:

- To estimate the abundance and to map the distribution of the main commercially important pelagic and semi-pelagic fish species in Angolan waters, including the two sardinella species *Sardinella aurita* and *S. maderensis*, the Cunene horse mackerel *Trachurus trecae*, the Cape horse mackerel *Trachurus trachurus capensis*, the pilchard *Sardinops ocellatus* and other pelagic species, mainly carangids.
- To study the biological condition of the main species, including length-weight relationships, reproductive stages and stomach fullness.
- To collect gonads, stomachs and otoliths from both horse mackerel species and to collect depth stratified samples of zooplankton in order to continue the studies of horse mackerel 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 for the Angolan participants on the main survey routines, including using the NAN-SIS and Hydrobase software, scrutinizing acoustical data (BEI) and producing acoustical biomass estimates. Dr. Marek Ostrowski (IMR) will instruct in database management and analysis of hydrographical data.

The aim of the time series that this survey is part of is to map fluctuations in stock levels in the main pelagic species and to improve the understanding of these fluctuations in terms of the biology of the main species in relation to the environment. Pelagic management decisions for 2005 will be based on the results obtained from this survey.

## 1.2 Participation

The scientific staff consisted of:

From IIM, Luanda:

Henriette LUTUBA\_NSILULU (Team Leader, 28/7 – 7/8), Filomena VAZ-VELHO (Team Leader, 7/8 – 27/8), Francisco De ALMEIDA (28/7 – 27/8), António BARRADAS (28/7 – 27/8), Bomba BASIKA (7/8 – 27/8), Margarida SOUSA (28/7 – 27/8), Domingos AZEVEDO (28/7 – 27/8).

From University Agostinho Neto Luanda:

José da SILVA (7/8 – 27/8).  
Miguel MORAIS (7/8 – 27/8).

From UNDP, Luanda:

Tamar RON (7/8 – 27/8).

From NatMIRC, Swakopmund:

Jean-Paul ROUX (7/8 – 27/8).

From IMR, Bergen:

Bjørn Erik AXELSEN (Cruise leader, 28/7 - 27/8), Diana ZAERA (28/7 – 27/8), Marek OSTROWSKI (7/8 - 27/8), Tor Egil JOHANSSON (28/7 - 27/8), Jan Frode WILHELMSSEN (28/7 - 27/8).

### 1.3 Narrative

The vessel departed Luanda 28 July at 16:00 UTC and steamed north towards the Congo River at the border between Angola and The Democratic Republic of the Congo (DRC), arriving 29 July at 09:30. Following established practice, the surveyed area was divided into three regions: the region limited by the Cunene River (17°15'S) and the parallel of 13°S-ANGOLA SOUTH; the region between 13°S and 09°S-ANGOLA CENTRAL; and from north of Pta. das Palmerinhas (6°-9°S) to Congo River-ANGOLA NORTH. The Northern region was completed on the 6 August at 14:00 UTC. The ship called on Luanda on 6 August at 16:00 UTC and departed next day 7 August at 17:30 UTC. The survey was reassumed same day at 20:00 UTC. The coverage of the Central region was completed on the 17 August 10:30 UTC and the vessel reached the end of the Southern region and the survey grid at the Cunene River outlet on 23 August at 15:30 UTC, The transducer keel was lowered on the 16 August 07:00 UTC.

The acoustic transducers (18, 38 and 120 kHz (split beam, EK500 1) and 200 kHz (single beam, EK500 2)) were calibrated on the 17 August in Baía Farta. During the calibration process some fish and plankton disturbed the measurement, the difference in Sv transducer sensitivity was greater than 0,3 dB, therefore it was decided to make another calibration on the 25 August in Langstrand Bay. The sampling trawls were conducted with the small pelagic trawl, the mid-sized (15 m vertical opening) pelagic trawl fitted with the codend multisampler and the demersal trawl (5.5 m vertical opening).

The standardized survey strategy applied in 2002 is now implemented, and a systematic survey track with equally spaced transect lines (6 nautical miles, NM) perpendicular to the coast was followed.

The acoustic transects generally covered a depth range from 20 to 500 m. In certain areas in the central region surveying was stopped at about 50 m depth due to extreme steepness of the shelf. The shallowest part of the shelf between N'zeto and the Congo River is partly inaccessible for trawling due to oil platforms and wells. This year this region was only partially covered.

CTD sections that have been covered routinely over the past few years are included in the new, standardized survey grid. ADCP (Acoustic Doppler Current Profiler) recordings were logged continuously along specific transects of the survey track, and on CTD stations. Additional CTD and ADCP stations were added on an *ad hoc* basis every six transects. In these areas, zooplankton samples were obtained using *Hydrobios Multinet* plankton sampler.

## 1.4 Survey effort

Figure 1(a-c) shows the cruise tracks with fishing and hydrographic stations for the northern, central and southern regions, respectively. 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), disregarding the steaming from Luanda to Congo River.

Area	BT	PT	Total trawls	CTD casts	Multinet stations	Log (nm)
Pta. Palmerinhas - Congo River	8*	24	32*	58	21	1527
Benguela - Pta. Palmerinhas	14**	18	32**	116	21	1620
Cunene River - Benguela	15	15	30	85	14	1025
<b>Total</b>	<b>37</b>	<b>57</b>	<b>94</b>	<b>259</b>	<b>56</b>	<b>4172</b>

\*One BT taken for demersal purposes, not valid

\*\* Two BT taken for demersal purposes, not valid



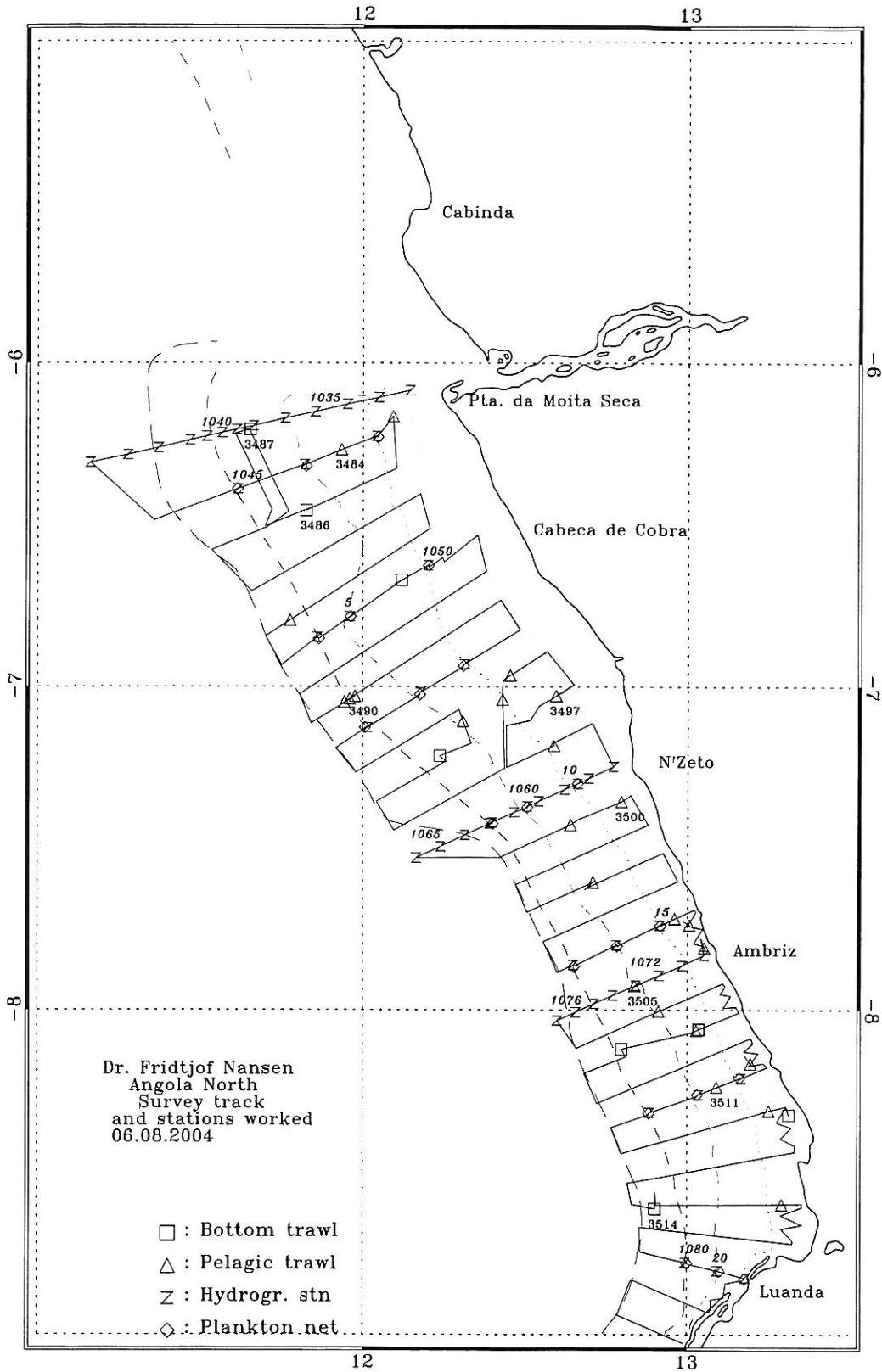


Figure 1a. Northern Angola. Course track with fishing, plankton and hydrographic stations: Pta. das Palmerinhas- Congo River. Depth contours at 20, 50, 100, 200 and 500 m are included.



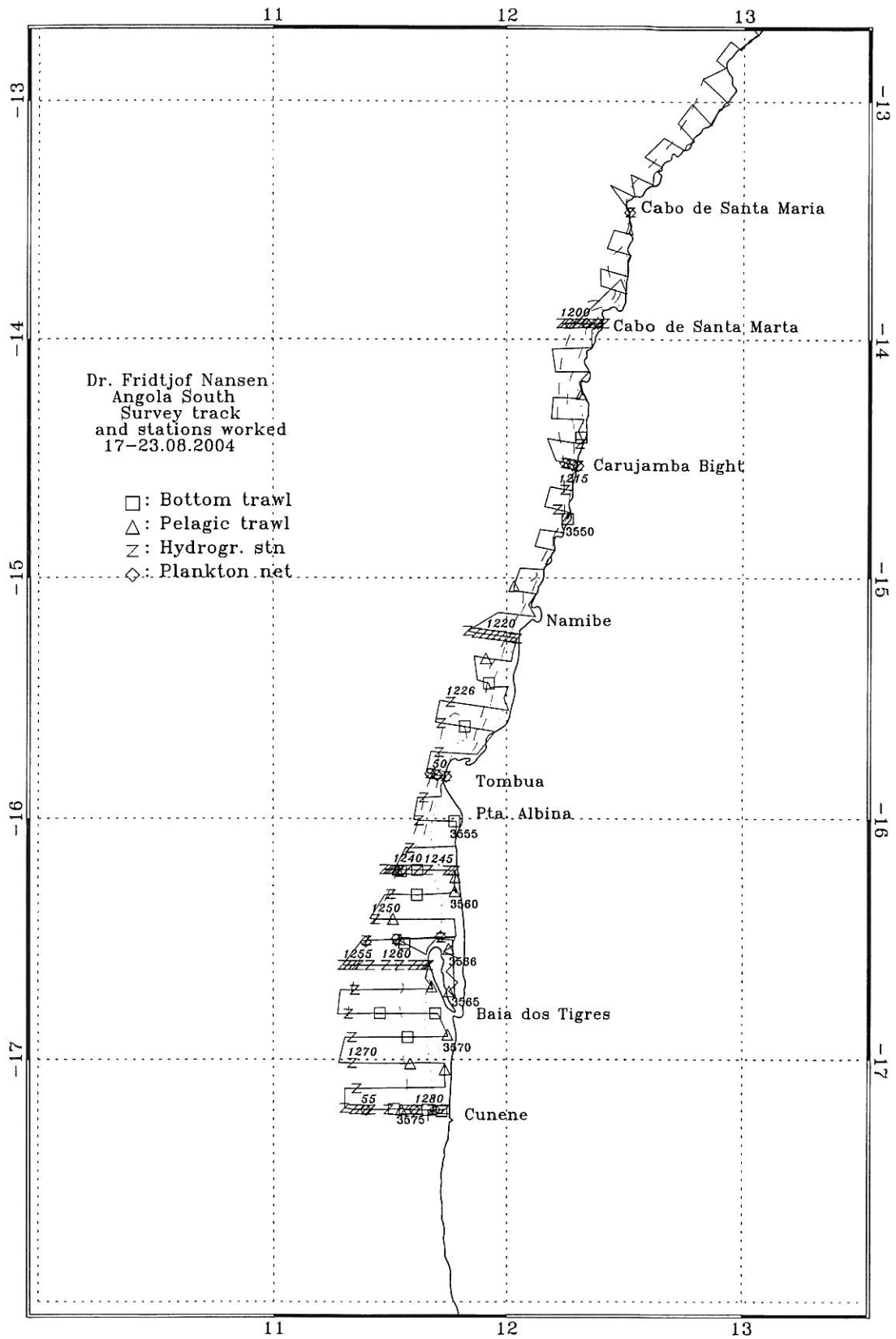


Figure 1c. Southern Angola. Course track with fishing, plankton and hydrographic stations: Cunene-Benguela. Depth contours at 20, 100 and 200 are included

## CHAPTER 2      METHODS

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### 2.1      Hydrographic sampling

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 about 20 NM distance, and *ad hoc* as necessary. The casts were stopped a few meters above the bottom, and at a maximum of 500 m depth.

Measurements were carried out on CTD stations and selected transects only, using the hull-borne Acoustic Doppler Profiler (ADCP). The ADCP was set to ping every 8 seconds, the depth bins were set to 8 m and the number of bins was 40. Data were averaged at 300 seconds intervals and stored on an IBM compatible PC using Transect v. 2.70 software.

Meteorological data logged from the Aanderaa meteorological station included wind direction and speed, air temperature, incident solar intensity and sea surface temperature (SST). All data were averaged by unit distance sailed (1 NM).

### 2.2      Fish sampling

A brief description of the sampling trawls is provided in Annex I. All trawl catches were sampled for species composition by weights and numbers. Records of catch rates are given in Annex II. Length frequencies were taken for the two species of sardinella, the two species of horse mackerel, pilchard and some species of the Carangidae family, such as African moonfish and Atlantic bumper.

Biological samples were obtained for the two species of sardinella and the two species of horse mackerel. Total length and body weight were determined to the nearest 1 cm and 1 g below, respectively. Sex and reproductive stages were determined by means of macroscopic examination, scoring each fish according to the five-point classification scale first proposed by Holden and Raitt (1974) (Table 2).

**Table 2.** The five point gonad maturity scale proposed for partial spawners by Holden and Raitt (1974). Additional information specific for Cunene horse mackerel (*Trachurus trecae*) as described by Dr. Isabel Afonso Dias during the 2001 survey are included (***bold Italic***)

Stage	Maturity status	Description
I	Immature	Ovary and testis lengths about 1/3rd of body cavity length. Ovaries pinkish, translucent; testis whitish. Ova not visible to the naked eye.  <b><i>Ovary and testis quite narrow and have a tubular shape.</i></b>
II	Maturing virgin and recovering spent	Ovary and testis about ½ length of body cavity length. Ovary pinkish, translucent; testis whitish, more or less symmetrical. Ova not visible to the naked eye.  <b><i>Ovary more opaque; small specks make gonad appear more granular. Testes develop lobules, hence loosing the tubular shape. Some recovering spent ovaries have conspicuous blood vessels.</i></b>
III	Ripening	Ovary and testis about 2/3rds length of body cavity length. Ovary pinkish-yellow colour with granular appearance, testis whitish to creamy. No transparent ova visible.  <b><i>Milt can be seen inside testes when cut. Ovaries granular due to the presence of opaque oocytes. First time spawners have very swollen gonads. Ovaries that have spawned once lose consistency, but maintain the external appearance typical for this stage.</i></b>
IV	Ripe	Ovary and testis from 2/3rds to full length of body cavity. Ovary orange-pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova visible. Testis whitish to creamy, soft.  <b><i>Ovaries jelly-like due to the presence of translucent oocytes. Gonads extrude oocytes or milt when gently pressed.</i></b>
V	Spent	Ovary and testis shrunken to about ½ length of body cavity. Walls loose. Ovary may contain remnants of disintegrating opaque and ripe ova, darkened or translucent. Testis bloodshot and slack.  <b><i>Testes may have sperm remaining in the seminal duct. Pinkish areas appear in the periphery of the testes. Ovaries bloodshot and slack.</i></b>

Stomach samples of horse mackerel were collected for further analysis at IIM, Luanda. Feeding biology will be investigated in more detail at a later stage by relating the stomach contents to recorded availability of zooplankton. Gonads and otoliths were collected for *ad-hoc* examination.

## 2.3 Plankton sampling

### *Zooplankton*

The zooplankton sampling was conducted by means of HYDROBIOS Multinet, at different depths, 50, 100 and 200 m depth in each sixth line of the survey track. Each net (405  $\mu\text{m}$  opening) was fitted with a flowmeter for estimation of sample volume. A SCANMAR depth sensor gave real-time information of the depth. Nets were opened and closed remotely from the bridge of the vessel. The samples were preserved in formalin (4%).

## 2.4 Acoustic sampling

### *Acoustic equipment*

The acoustic recordings were conducted using two Simrad EK 500 echosounders (Bodholt *et al.* 1989) running keel mounted transducers at nominal operating frequencies of 18, 38, 120 (EK500 1) and 200 kHz (EK500 2). Few locations along the Angolan coast are favourable for transceiver calibration (essentially Baía dos Tigres and Baía dos Elephantes), and therefore the survey started without *a priori* calibration. All transceivers were calibrated in Baía Farta 17 August and in Langstrand Bay 25 August.

Acoustic raw-data were logged on two different systems, the Sun-Unix based Bergen Echo Integrator (BEI) (Knudsen 1996) version 2000 and Sonardata Echolog® version 2.20.05. The technical specifications and operational settings of the Echosounder used during the survey are given in Annex IV.

### *Allocation of acoustic energy to target taxii*

The acoustic data were scrutinized using the post-processing module of the BEI software. Scatterers were displayed at 38 kHz, standardized to 5 NM echograms with 1 000 pings (horizontal) by 500 bins (vertical). The mean 5 NM area backscattering coefficients  $s_A$  ( $\text{m}^2/\text{NM}^2$ ) was allocated to a predefined set of taxii on the basis of established echogram features. The acoustic groups and their respective taxii are listed in Table 3. Ground truthing and estimation of mean length and weight were accomplished by mean of targeted pelagic and demersal trawling.

**Table 3.** Allocation of acoustic densities to taxii. Note that for the groups' sardinella, horse mackerel, big-eye grunt and pilchard all encountered species are listed, while only examples are listed for the remaining groups.

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

<sub>1</sub>: other than *Sardinops* sp.; <sub>2</sub>: other than *Trachurus* sp.; <sub>3</sub>: main taxon in-group.

*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 are presently available for the species, 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 regressing 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 a CalBoard III digitising board / Atlas Draw v. 2.03 PC based software. Distribution plots and aerial calculations on the strata were carried out using IDL 5.6 for MS Windows. 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-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 bias (positive) of including between-line values is likely smaller than the bias (negative) that would have been introduced by excluding high on-line contributions, and this bias is also counteracted by the shallow distribution pattern (partly above the integration limit) and vessel avoidance behaviour (Misund and Aglen 1992) of sardinella. 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:

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

where:

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

## CHAPTER 3 OCEANOGRAPHIC CONDITIONS

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### 3.1 Wind speed and direction

The wind observed during this year was moderate, with the velocities ranging 5-10 knots in the Northern and Central Regions and 10-20 knots in the south. Nevertheless, the wind conditions during this year were stronger and more persistent with respect to the main direction than those encountered in the past winter surveys. The dominant direction was from S and SE, typical to the seasonal intensification of the southeasterly trade winds in winter. There was a constant increase in the mean wind speed and less variance in its direction as the survey progressed from the north to the south. Figure 2.1 summarizes the wind conditions recorded along the ship track during this survey.

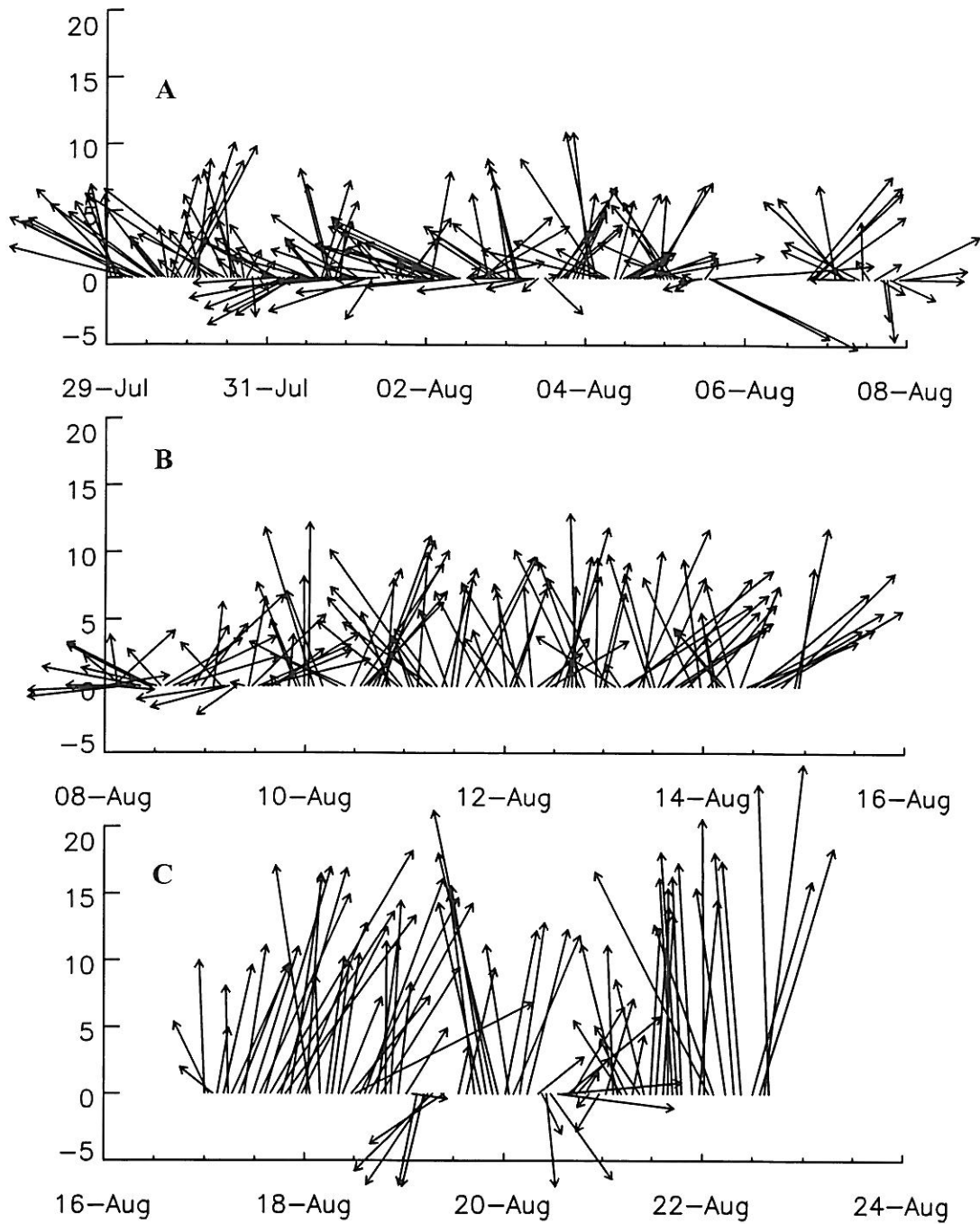
- 29 July to 7 August, the Northern Region. A moderate wind, maximum velocity 10 knots (5m/s). Directions variable, predominantly from the southern sectors (SW to SE)
- 8 to 15 August, off Central Angola. Except of the first day, the average speed of the southerly wind increases by 1–2 knots and the directional spread becomes somewhat narrower, however still oscillating broadly between SW and SE.
- 17 to 24 August, off the Southern Angola. After leaving the shelf off Benguela, sheltered from the southern winds, the ship picks up a stronger wind with less variance in the direction. Two spells of a stronger wind were encountered: from 17 to 20 and from 22 to 23 August. These events were characterized by a slight shift in the dominant direction, from SSW during the first event to SSE during the second.

### 3.2 Sea surface temperature and salinity

For the first time on the Angolan survey record, this survey has provided a continuous data on sea surface salinity (SSS). The SSS recordings were done with a new thermosalinograph SBE 21 Seacat device, recently fitted aboard the vessel. The combined Sea surface and salinity dataset opened a possibility for a better mapping of upwelling areas and description of coastal river plumes. Figures 2.2 to 2.5 depict the results obtained for the four regions along the Angola's coast:

The Northern Region, 6°-9°S (Figure 2.2): The isotherms and isohalines are oriented alongshore. Both distributions exhibit two large pools of the oceanic layer of the Tropical Surface Water (TSW), characterized by  $T > 22^{\circ}\text{C}$  and  $S > 36.0$ , which extends seaward of the shelf-break. A sharp cross-shelf front separates these water bodies from the inshore waters. A

rapid drop in salinity observed at the northern end of the survey area manifests the southern border of the Congo River plume. Its directed offshore flow is apparently guided by the river's canyon, situated just to the north of the survey region. Except of a tongue of fresher water near the coast, there are no traceable influences of the Congo River on the Angolan shelf. Figure 2.2b also reveals another large pool of low-salinity water, located near the southern end of the area. It contains the outflow waters from the Kwanza River. The strongest upwelling cell is located off Ambriz, with a drop in sea surface temperature near the coast below 18°C. Note the absence of the upwelling signature in the distribution of salinity. This discrepancy can be explained using the vertical salinity section collected off Ambriz (Figure 2.8). As the salinity from the stations located inshore of the shelf-break front varies little with depth, there must be also little difference in the sea surface salinity between the waters uplifted near the coast and those resident at the surface away from the coast.



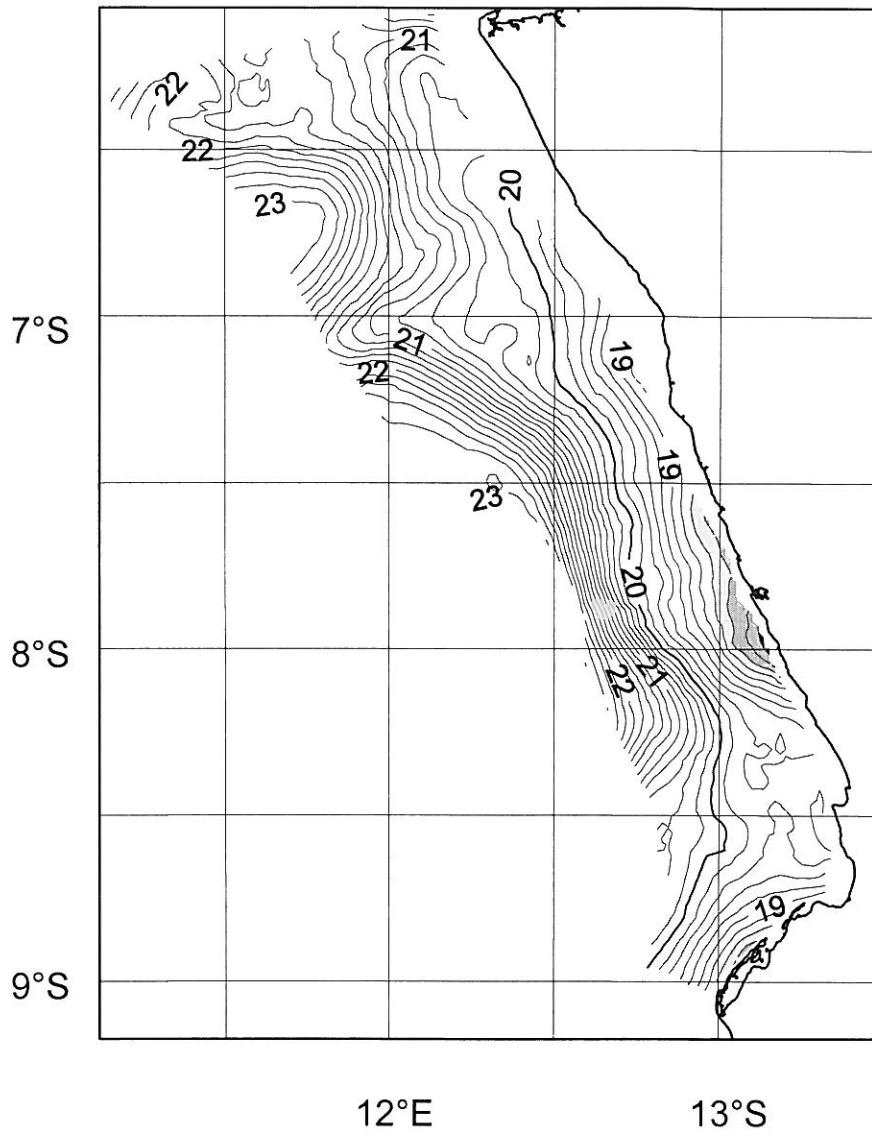
**Figure 2.1** Evolution of wind speed and direction along the survey track for the three survey areas. Panel A describes the Northern, B the Central and C the Southern survey region, respectively. The horizontal and vertical axes describe survey days and wind speed in knots, respectively.

The Central Region, 9°-12°S (Figure 2.3): The distribution of temperature exhibits a visible change in patterns across the latitude 10°30'S. To the north of this latitude, the main direction of the isotherms is perpendicular to the coast. To the south, the offshore isotherms and isohalines are parallel to the coastline. As in the case of the Northern Region, the isolines converge at the shelf-break, manifesting a shallow shelf-break front, which separates the oceanic tropical surface water layer (TSW) from well-mixed waters on the shelf. The shelf-break front is interrupted shortly over the Quicombo Bank, a shallow coastal offset located between 11° and 11°30'S. This interruption is probably due to a shallow water mixing process, which must be very intense over this flat and relatively shallow coastal offset. A stripe of cooler, inshore-entrapped water, indicative of upwelling, dominates the temperature distribution to the south of 11°S. Similarly to the Northern Region, the upwelling is not traceable in the surface salinity distribution. The regions of decreased salinity manifest the river plumes of the three main rivers along this section of the coast: the Kwanza River (9°20 S), Rio Longa (10°13 S) and River Cuvo (10°53 S). From Figure 2.3b, it is clear that all three plumes have been discharged northwards of the respective river mouths. The Kwanza River plume is the largest. It is confined to the inshore region between the river mouth and Ponta das Palmerinhas. As the direction of the coast changes at this location, the plume water is injected into the open ocean where it forms a large and probably stationary pool of brackish water located seaward of the shelf

The coast from Benguela to Tombua, 12°30'-15°50'S (Figure 2.4): Bathymetry of this region is dominated by a long section of a very narrow and steep shelf, interrupted only by two short coastal offsets located near Cabo de Santa Martha (13°53'S). To the south of the Bay of Namibe (15°10'S) the shelf broadens, to narrow once again at the southern extremity of this area, off Pta. Albina (15°50'S). The variations in the bathymetry are fully reflected in the distributions of SST and SSS. In places where the shelf is narrow and continental slope is steep the temperature and salinity are high and reflect the range of the values characteristic to the open ocean. Over the broader sections of the shelf, both the inshore temperature and salinity decrease indicate shallow water mixing process or/ and uplift of subsurface waters caused by upwelling.

The Southern Region from Ponta Albina to Cunene River 15°45'S-17°15'S (Figure 2.5): This region is located at the major ecosystem boundary between the tropical and subtropical Atlantic. The Tropical Surface Water ( $T > 17^{\circ}\text{C}$  and  $S > 35.7$ ) is traceable along the deep-water part of the surveyed region from Ponta Albina to the Tiger Bay. To the north of the Tiger Bay, the waters on the shelf are well mixed and cross-shelf gradients in temperature and salinity are low. This drastically changes to the south of the island that closes the Tiger Bay. The cross-shelf gradients increase there rapidly, revealing a major upwelling event. The low

temperature and salinity at the surface ( $T < 15^{\circ}\text{C}$  and  $S < 35.4$ ) indicate that the uplifted waters are sourced from a subsurface water mass characteristic to the subtropical Benguela domain. However, the section off Cunene River (Figure 2.16) demonstrates that this upwelling water is mixed inshore with the Cunene River plume that further decreases the inshore temperatures and salinities, thus enhancing their cross-shelf gradients.



**Figure 2.2a** Distribution of sea surface temperature off the Northern Region. 29 July to 6 August 2004.

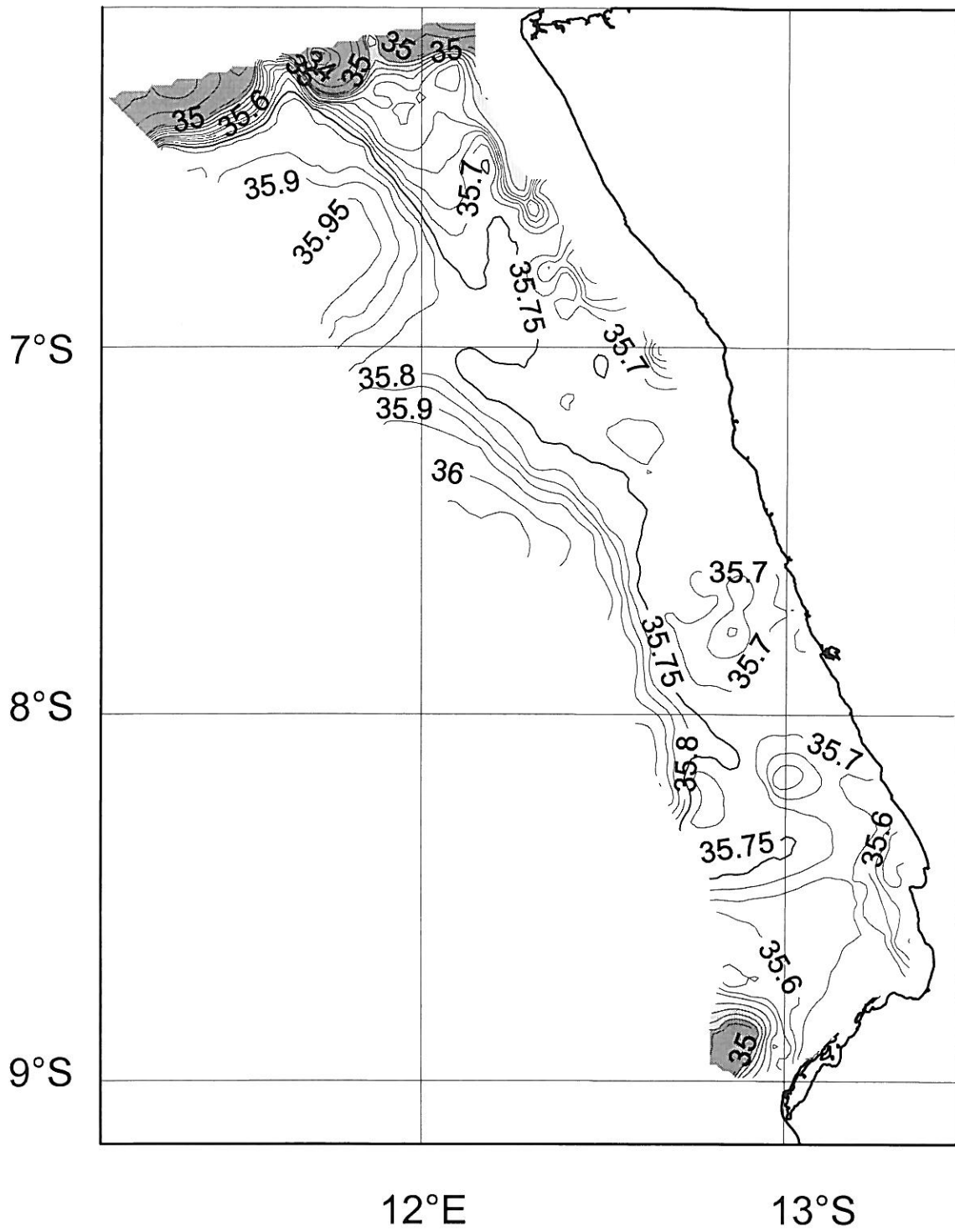
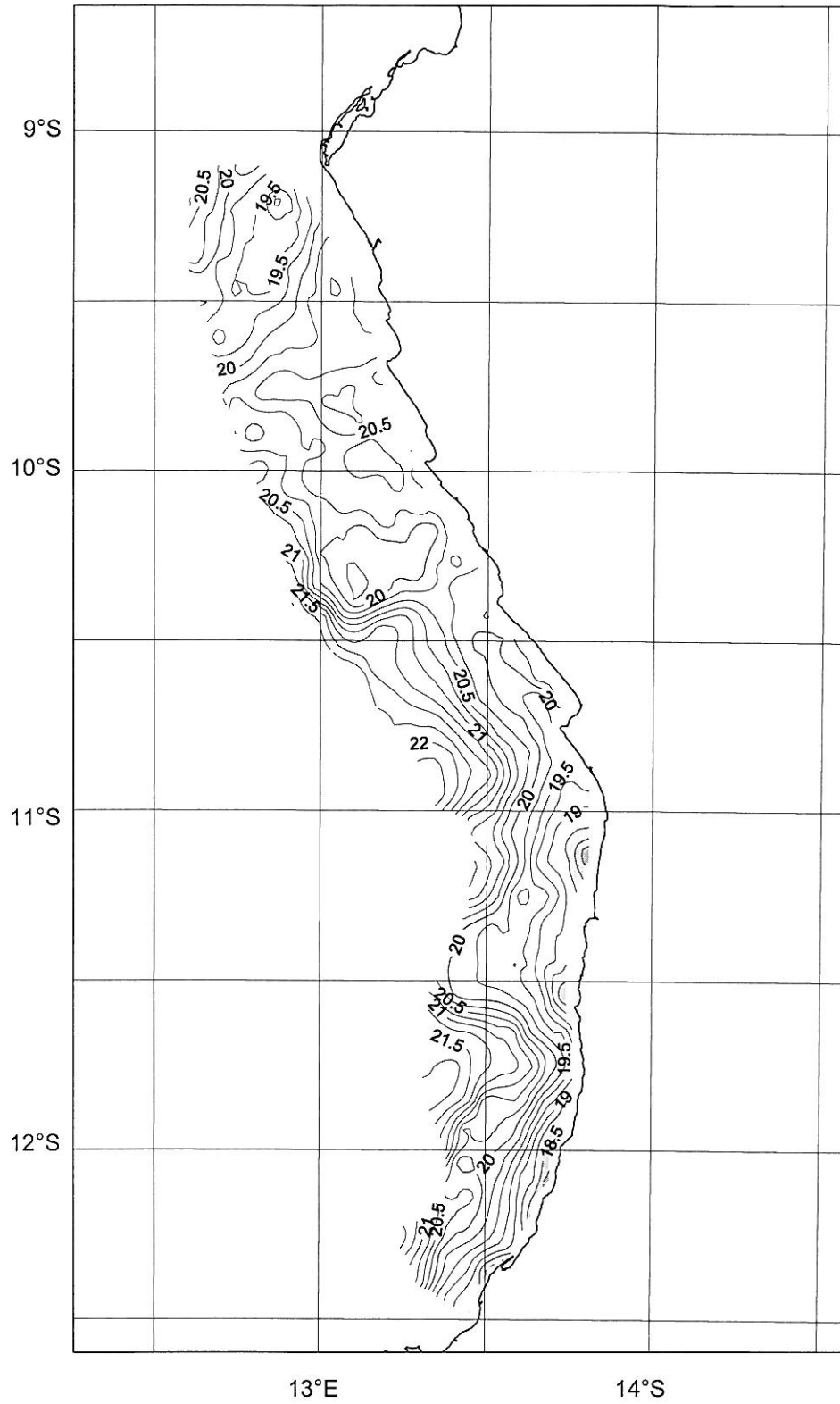


Figure 2.2b Distribution of sea surface salinity off the Northern Region. 29 July to 6 August 2004.





**Figure 2.3a.** Distribution of sea surface temperature off the Central Region, 8 to 16 August 2004.

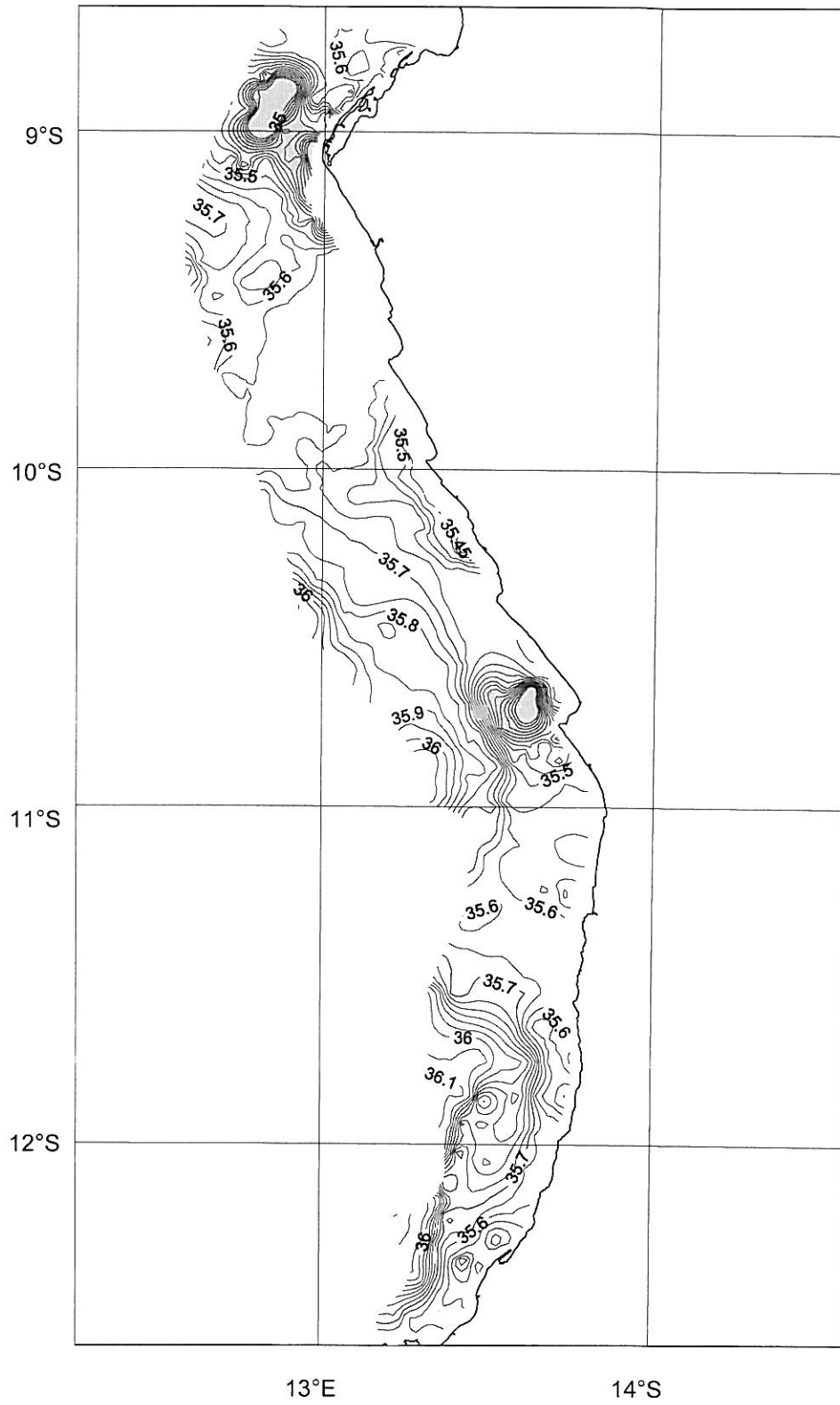


Figure 2.3b Distribution of sea surface salinity off the Central Region. 8 to 16 August 2004.

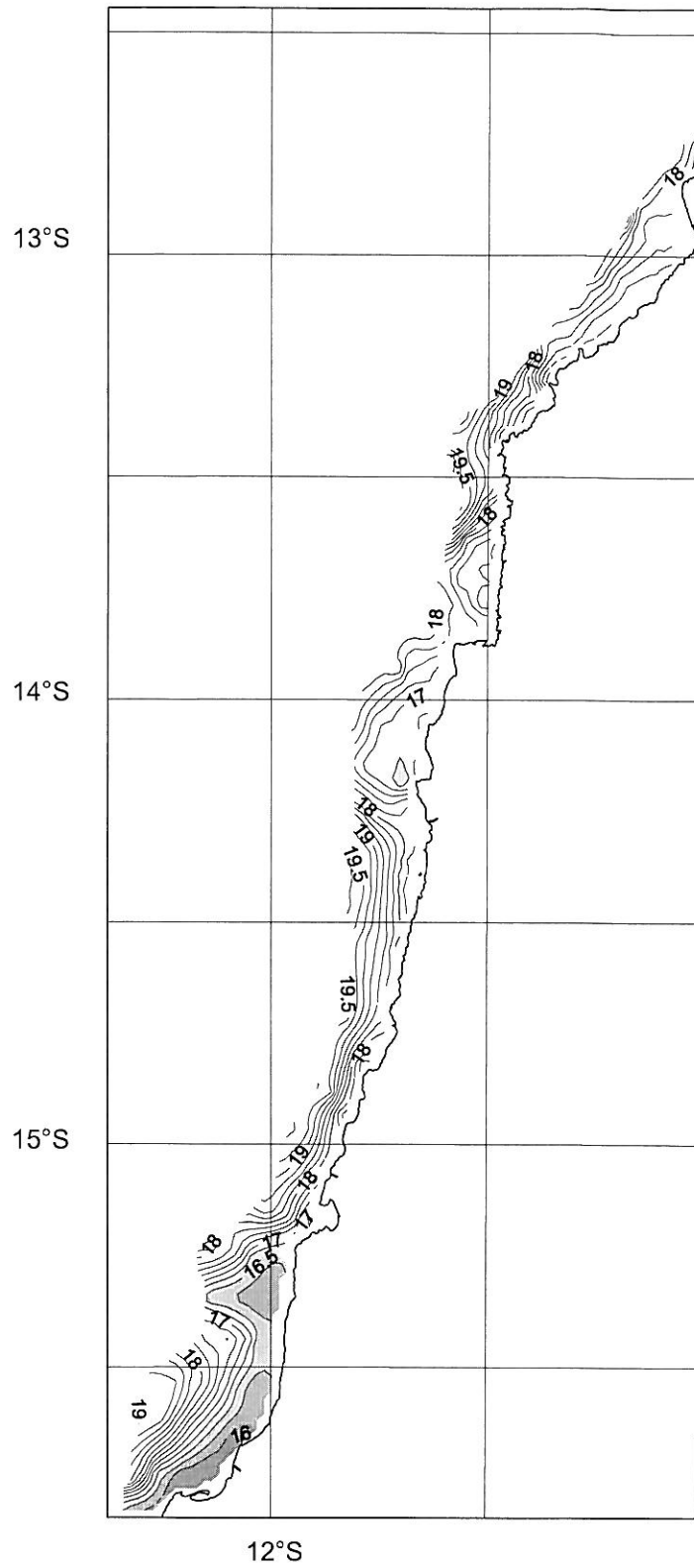
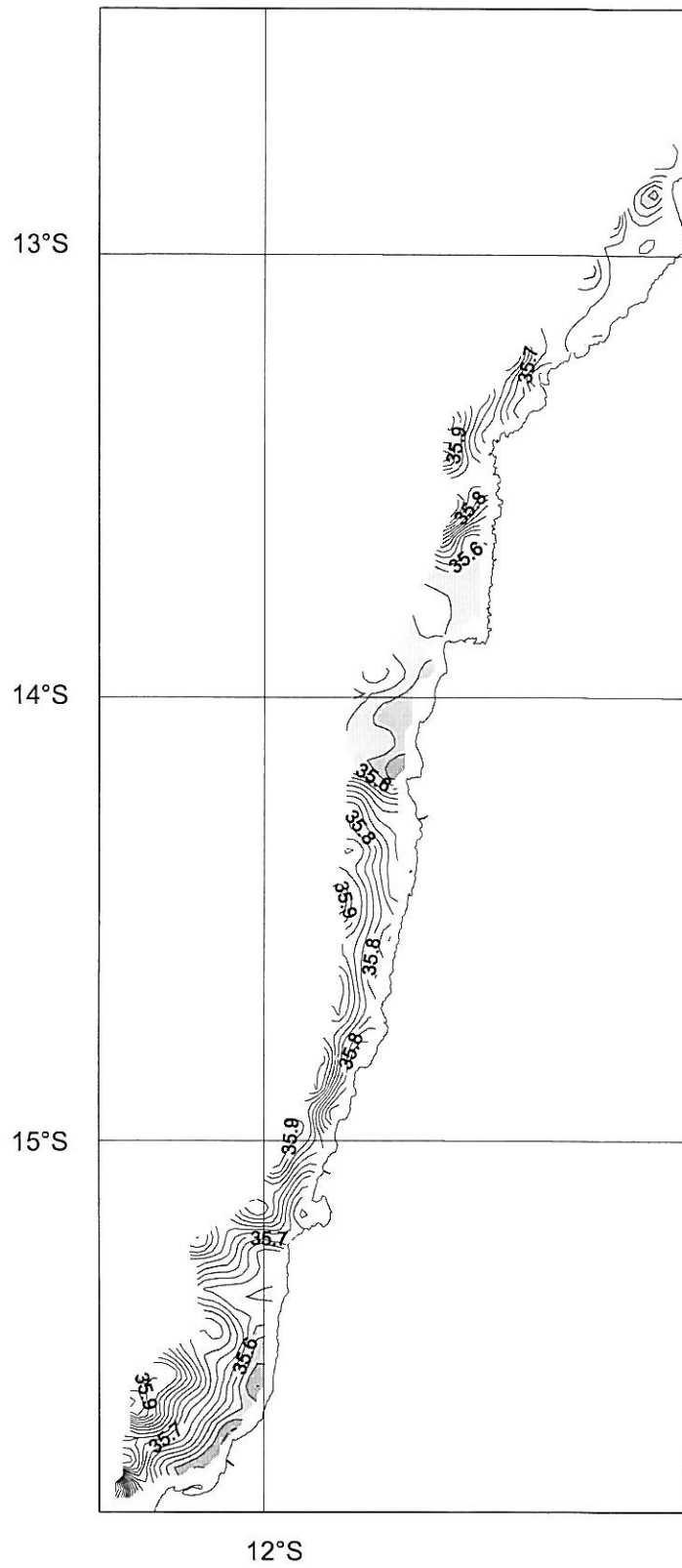
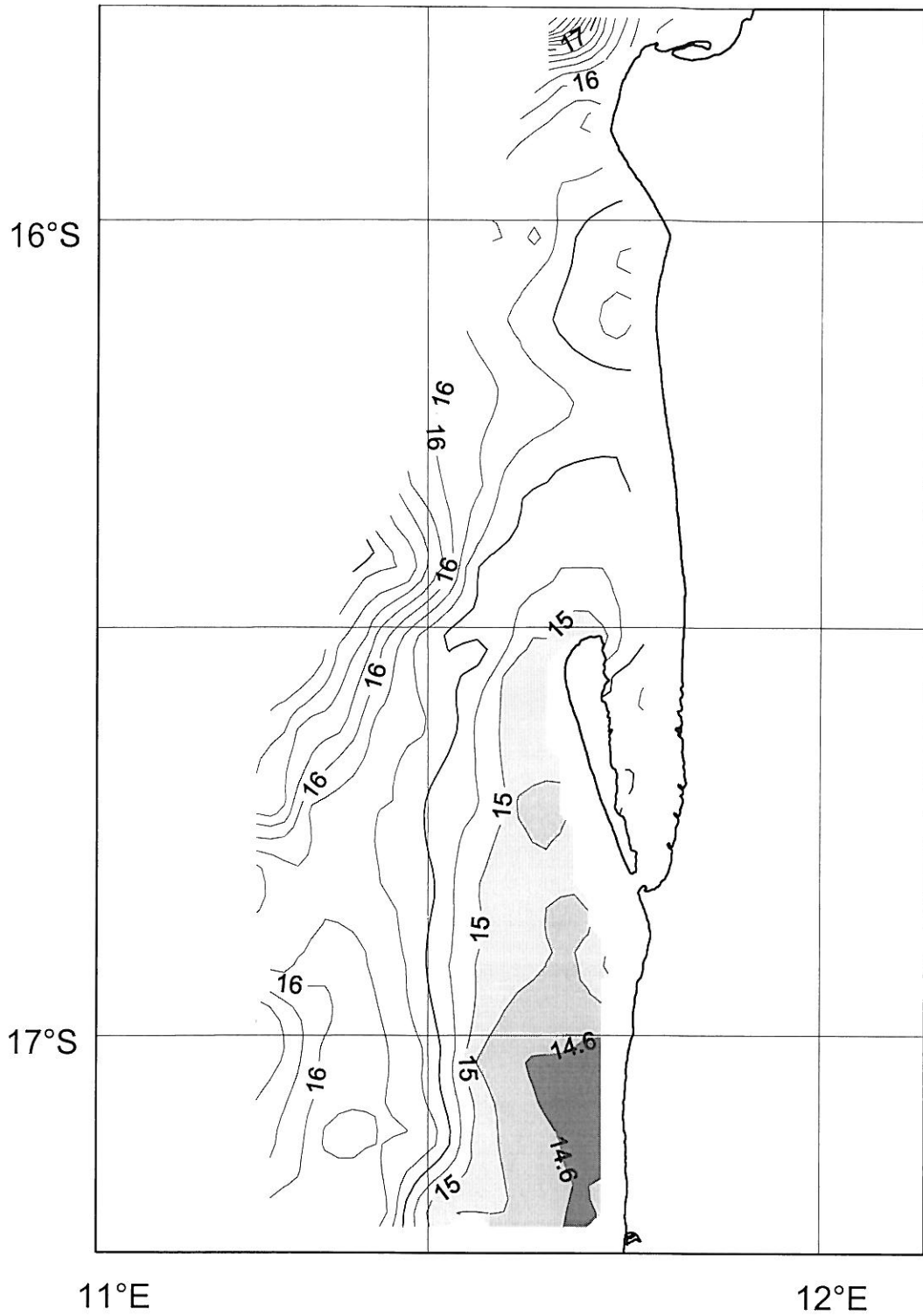


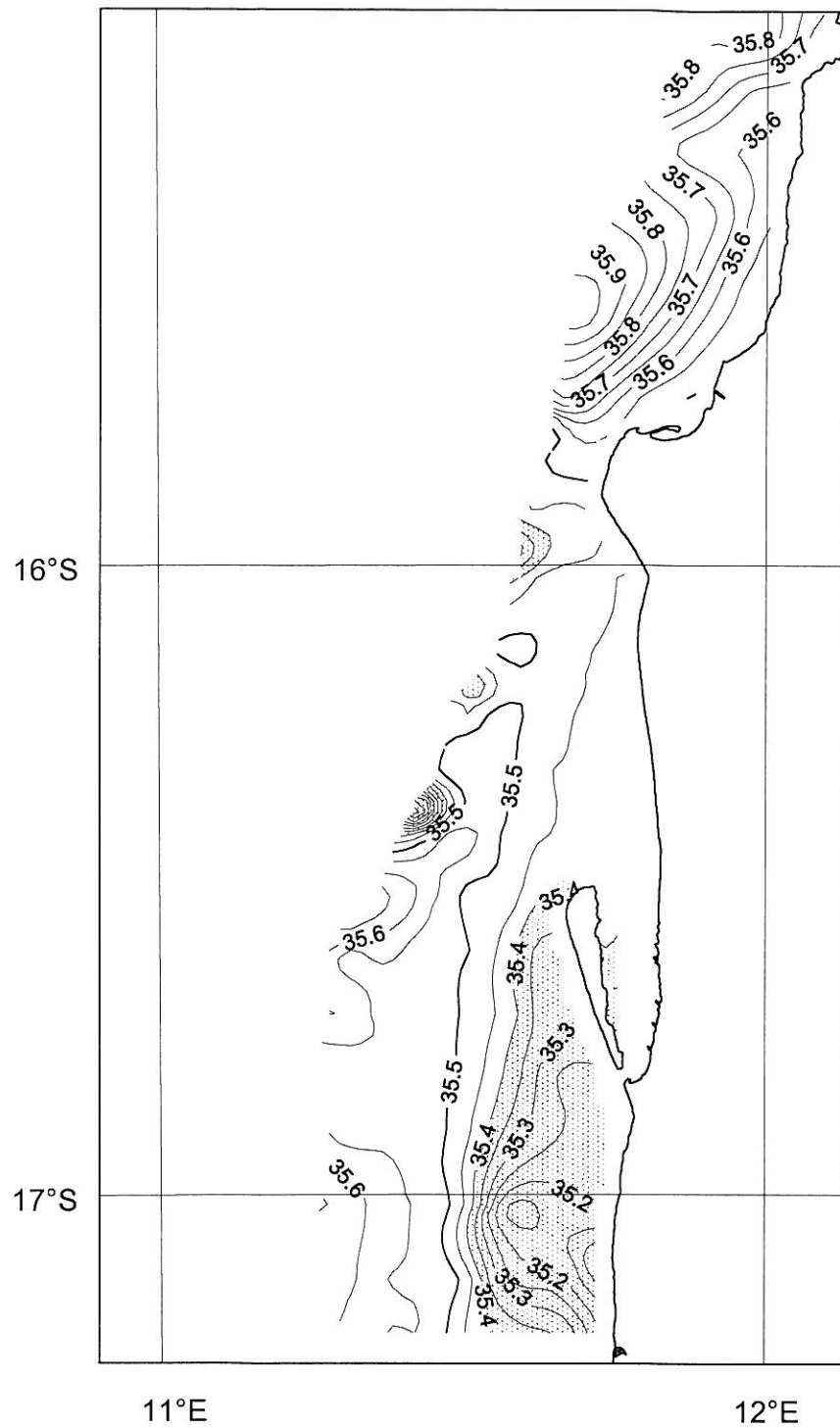
Figure 2.4a Distribution of sea surface temperature between Benguela to Tombua. 17 to 19 August 2004.



**Figure 2.4b** Distribution of sea surface salinity between Benguela to Tombua. 17 to 19 August 2004.



**Figure 2.5a** Distribution of sea surface temperature from Ponta Albuina to the Cunene River. 20 to 23 August 2004.



**Figure 2.5b** Distribution of sea surface salinity from Ponta Alquina to Cunene River. 20 to 23 August 2004.

### 3.3 Standard sections

*Section off Moita Seca* (Figure 2.6). The section located off the Congo River's mouth. Although the river discharge is reduced during the winter season, the plume of fresh water is observed above 25 m depth except at station 1035 where doming takes place with subsurface water welled up to the surface. Below this up layer the tropical water mass ( $S \geq 35.8$  psu) occupies thick layer between 25 and 40 m from offshore to about 20 NMI from the coastline, being interrupted in the dome area.

In the section of *N'zeto and Ambriz* (Figures 2.7 and 2.8) distributions of oceanographic parameters are very similar at both sections, indicating an ongoing upwelling event. The temperature close to the mouth of the Ambriz River drops to 18°C, which is a 2°C lower than for average for the winter season. At Ambriz, the oxygen section reveals an abrupt decrease to 2ml/l near the surface. The depth range from 250 m to 450 m exhibits the minimum oxygen layer (0.5 ml/l), typical for the tropical ocean.

*Section off Palmerinhas* (Figure 2.9). The salinity distribution reveals a presence of a brackish water plume with salinity  $< 35.4$  psu separated from the coast. Comparing this distribution with the sea surface temperature map (Figure 2.3b) it appears that this plume represents the main outflow of the Kwanza River heading offshore after it has detached from the coastline.

*Sections off Rio Longa, Pta. do Mor, and Lobito* (Figures 2.10 to 2.12). Salinity distributions from these sections reveal a presence of the brackish water plumes sourced by the local rivers. The offshore elevation of isolines indicates an open sea upwelling process. This last feature is best developed at Longa River section (Figure 2.10), where it exhibiting a strong shoreward tilt of isolines that suggests a presence of a coastal equator ward current.

*Sections off Namibe (15°14'S), and Praia do Navio* (Figure 2.13 and 2.14). These sections, separated by only one degree of latitude, exhibit a significant drop in the temperature in the offshore surface layer, from 18° and 16°C. Also significant, is a drop in the surface salinity by 0.2 psu and oxygen by approximately 0.5 ml/l. Such a sharp change in seawater properties marks a transition from the tropical to subtropical water mass stratification.

*Sections off Tiger Bay, and Cunene River* (Figures 2.15 and 2.16). All parameters clearly show the occurrence of coastal upwelling, as manifested by the uplift of isolines above a 100 m depth.

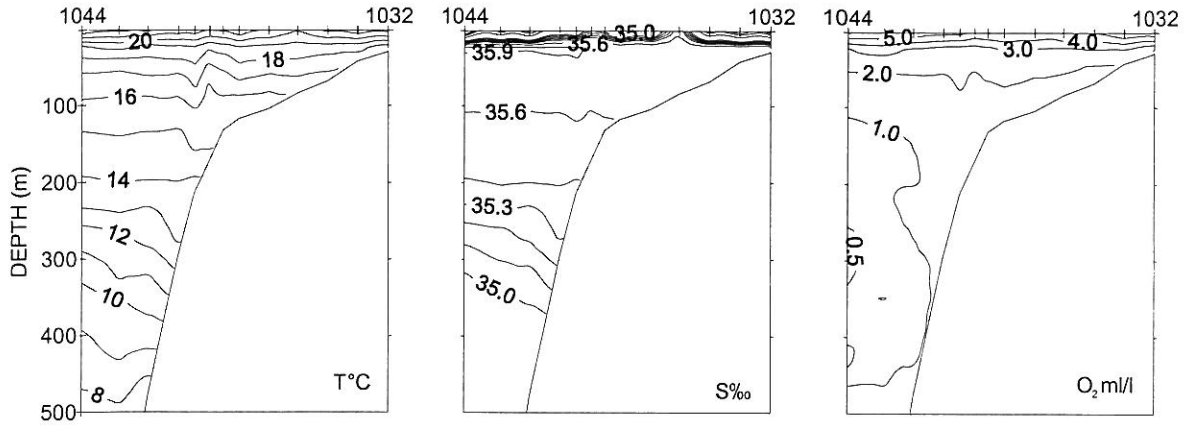


Figure 2.6 - Vertical sections: temperature, salinity and oxygen of Moita Seca.

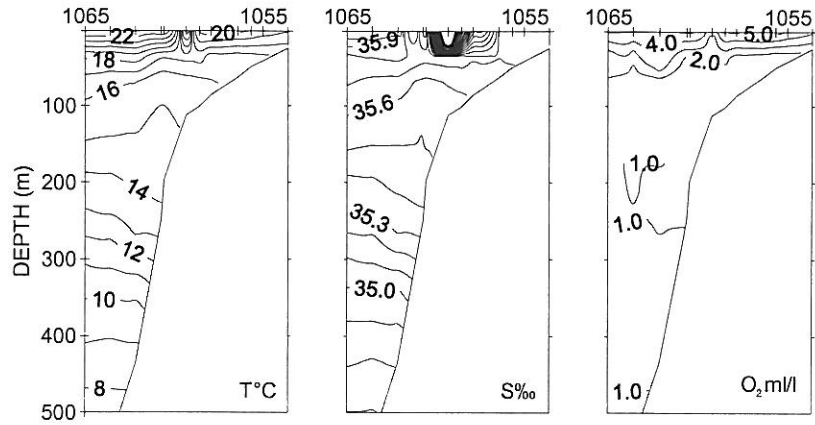


Figure 2.7 - Vertical sections: temperature, salinity and oxygen off N'zeto.

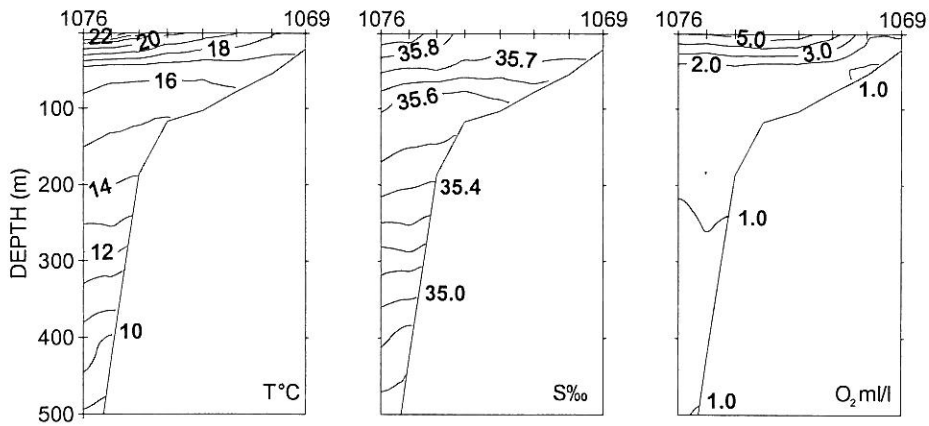


Figure 2.8 - Vertical sections: temperature, salinity, and oxygen off Ambriz.



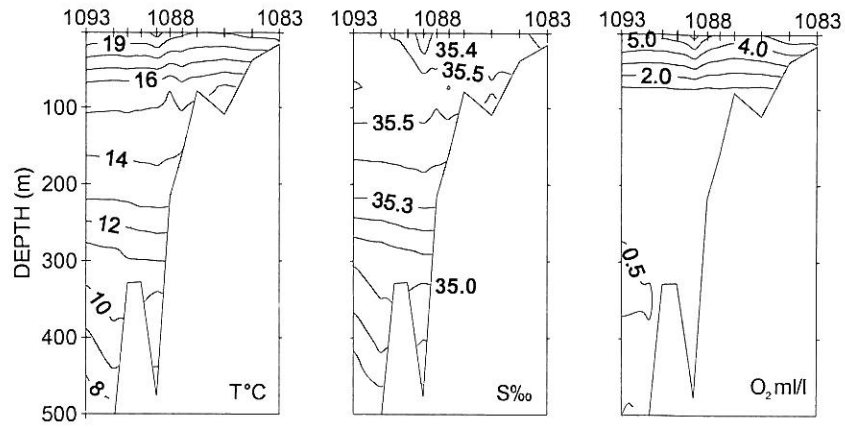


Figure 2.9 - Vertical sections: temperature, salinity and oxygen off Palmerinhas.

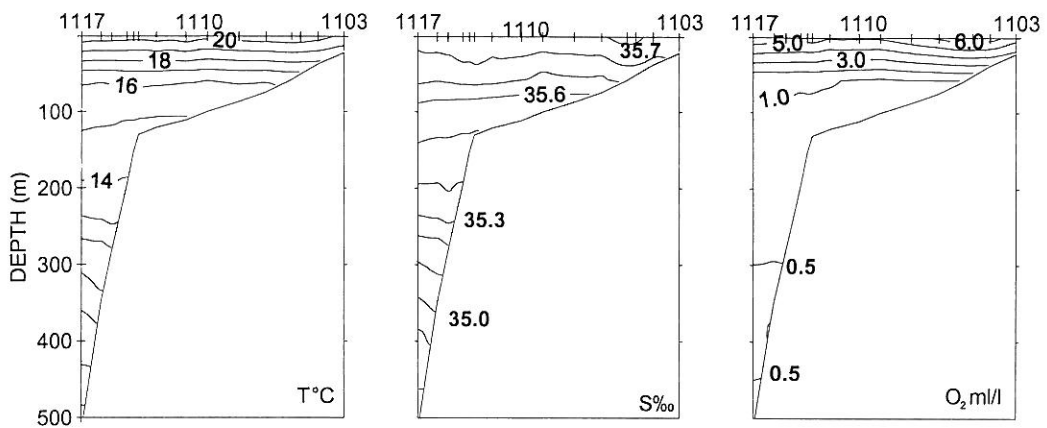


Figure 2.10 - Vertical section: temperature, salinity and oxygen off Rio Longa

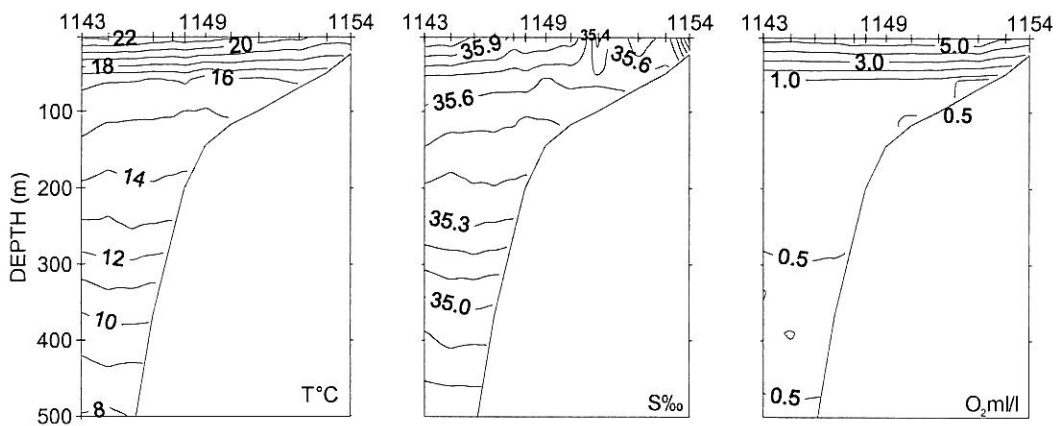


Figure 2.11 - Vertical sections: temperature, salinity and oxygen off Pta. do Morro.

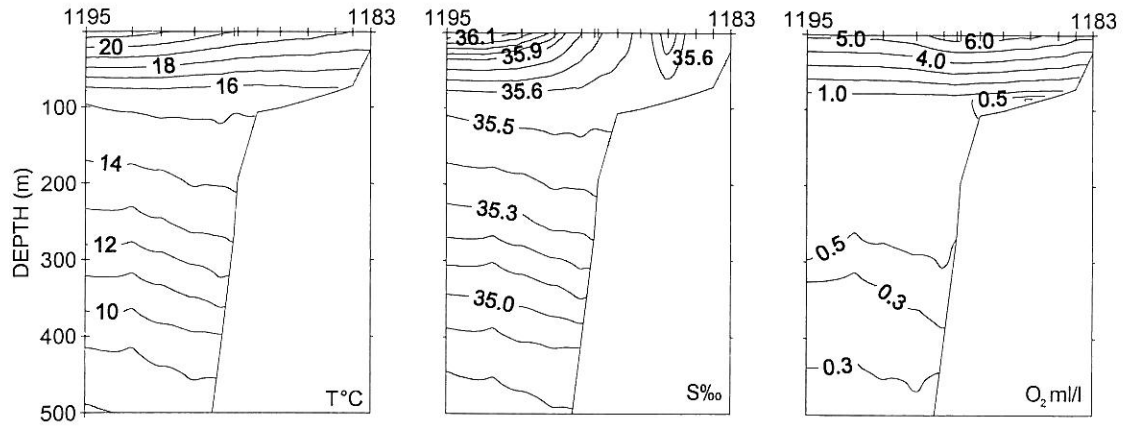


Figure 2.12 - Vertical sections: temperature, salinity and oxygen off Lobito.

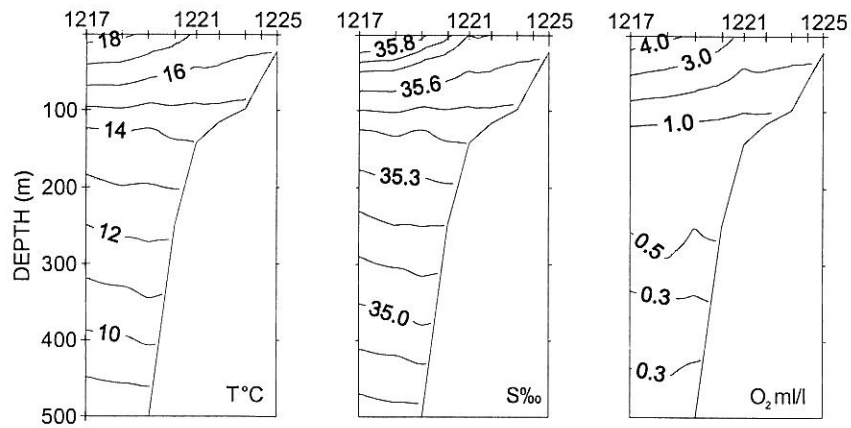


Figure 2.13 - Vertical sections: temperature, salinity and oxygen off Namibe.

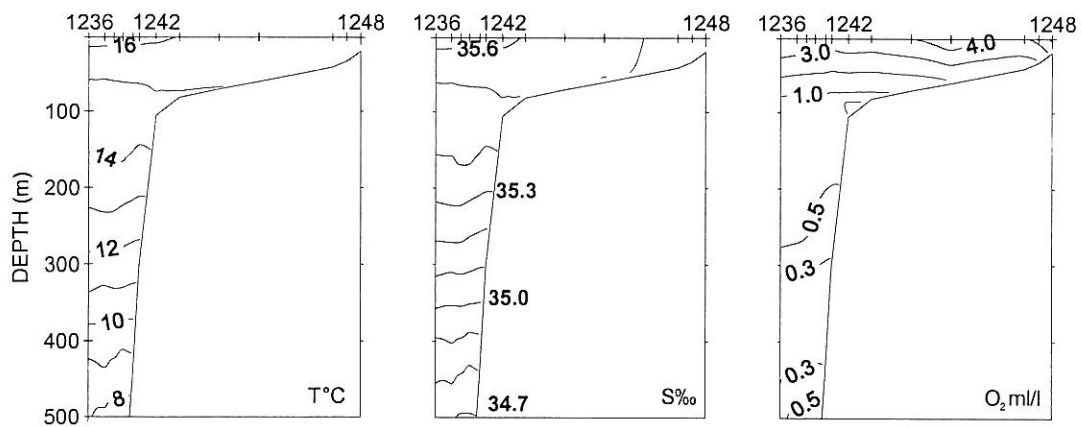


Figure 2.14 - Vertical sections: temperature, salinity and oxygen off Praia do Navio.

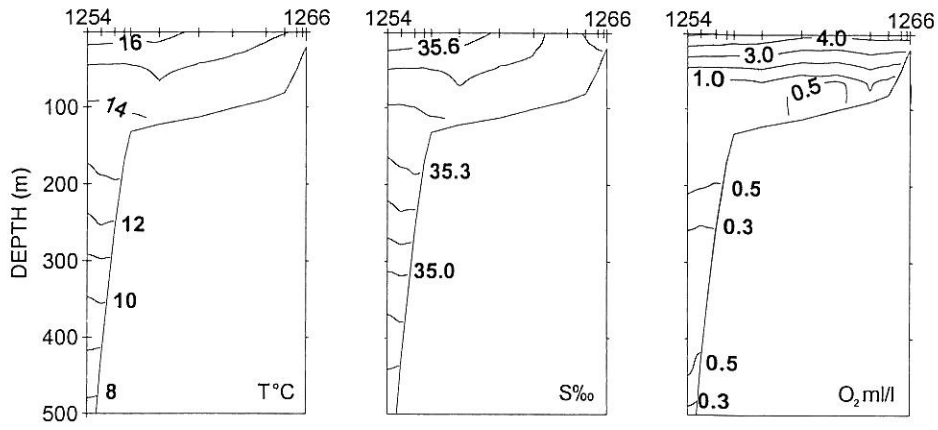


Figure 2.15 - Vertical sections: temperature, salinity and oxygen off the Tiger Bay.

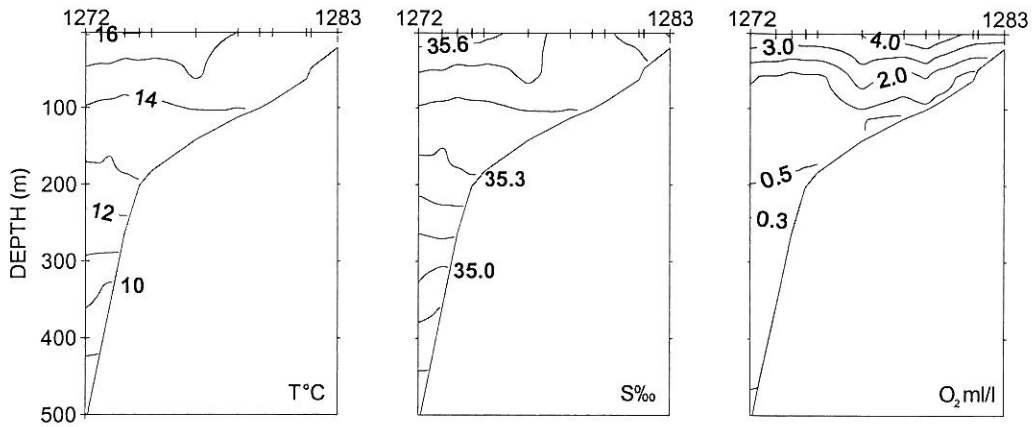
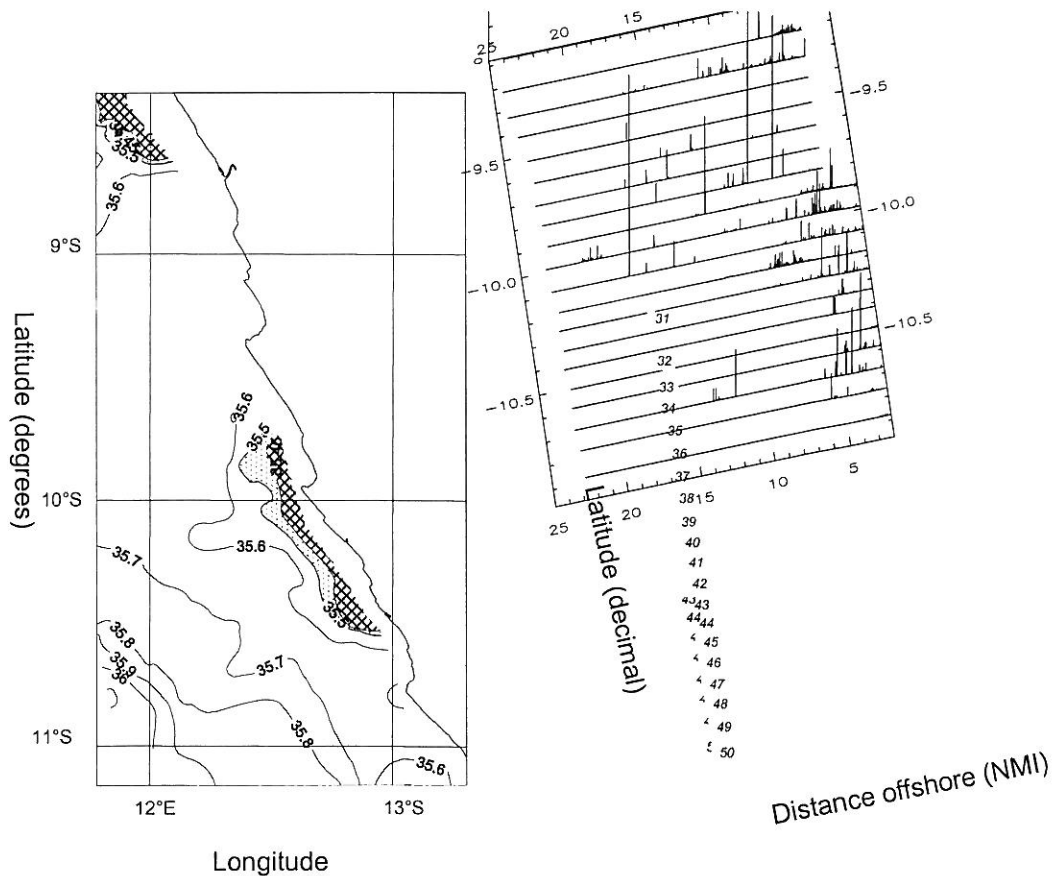


Figure 2.16 - Vertical sections: temperature, salinity and oxygen off the Cunene River

### 3.4 Impact of upwelling centers, river plumes on concentration of sardinella.

The colder sea water temperatures and stronger than average wind conditions during this year were clearly manifested in the emergence of a number of active upwelling centers along the coast, in particular off the Northern and Central Angola. These regions appeared to have influence on distribution of sardinellas, with significantly denser concentrations of fish being found in the regions of the active upwelling cells. This is demonstrated in Figure 2.17. The region of lower salinity is located between  $9^{\circ}45'$  and  $10^{\circ}30'S$  marks the extent of the Rio Longo plume. Figure 2.18 depicts position of sardinella aggregations in this region using a high-resolution echo-integrator data. The schools are densely packed and aligned within the first 5 nautical miles from the coastline in the region of the plume. Outside that region echoes from fish schools may be large, but are randomly distributed across the shelf with no clear relation to a particular depth region.



**Figures 2.17 and 2.18** A river plume and high-resolution acoustic mapping of fish. The position of Rio Longo upwelling is marked by a decrease in surface salinity within the first 5 nautical miles offshore. (Fig. 2.17). The fish echoes concentrate in the same region forming a continuous distribution across several survey lines (Fig. 2.18).

### 3.5 Summary of Oceanographic Conditions

The oceanographic conditions encountered during this survey indicate the coldest winter in the Angola's coastal ocean during this decade. The coastal temperature was lower by about 2°C from its long-term average. The wind was only moderately stronger than in the previous years, but this difference may have been sufficient for an emergence of larger number and stronger upwelling centres, which the survey encountered off the northern and central coastal regions. The stronger south-easterly winds may have also intensified an equatorial flow along the shelf, favouring transport of larvae and small fish to the north. As the oceanographic results obtained from the previous bottom fish survey in the summer, already indicated an onset of a cold anomaly, the cool conditions might have been persistent throughout the entire 2004. Thus the conditions for phytoplankton production and food concentration for small pelagic fish off the northern and central Angola might have been better than during an average winter.

## CHAPTER 4      DISTRIBUTION,      SIZE      COMPOSITION      AND BIOMASS ESTIMATES

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### 4.1      Pta. das Palmerinhas - Congo River

#### *Sardinella*

Both *Sardinella maderensis* and *S. aurita* were found throughout the northern region. Compared to last year the distribution of both sardinellas was more continuous between N'zeto and Luanda, with small areas of high density ( $S_A > 1\ 000$ ) south of Ambriz, at around 50 m depth. North of N'zeto; an additional distribution was found, with a small inshore area of high concentration. Patchy concentrations of both sardinellas were found deeper on the shelf south of N'zeto and off Ambriz.

As observed in last year's survey, sardinella was usually schooling near the surface during daytime, and formed loose aggregations at night, making hard to sample at daytime.

Figure 4 shows the length frequency distribution of *S. maderensis* and *S. aurita*. *S. maderensis* ranged from 10 to 35 cm total length (TL). The distribution shows a clear modal peak at 24 cm TL. A very small cohort of juvenile with modal peak of around 11 cm, which represents < 5% of total biomass is found in shallow waters. The length distribution for *S. aurita* shows a clear modal peak at around 26 cm TL. Other two lengths groups represented in the distribution are 13 to 15 and 17-20 cm TL.

The biomass of sardinella was estimated at 187 000 tons, which is about 30% higher than last year estimate (153 000 tons). From the total, around 105 000 tons was *S. aurita* and 82 000 tons *S. maderensis*. For both species the biomass consisted of individuals larger than 25 cm TL (Figure 5).

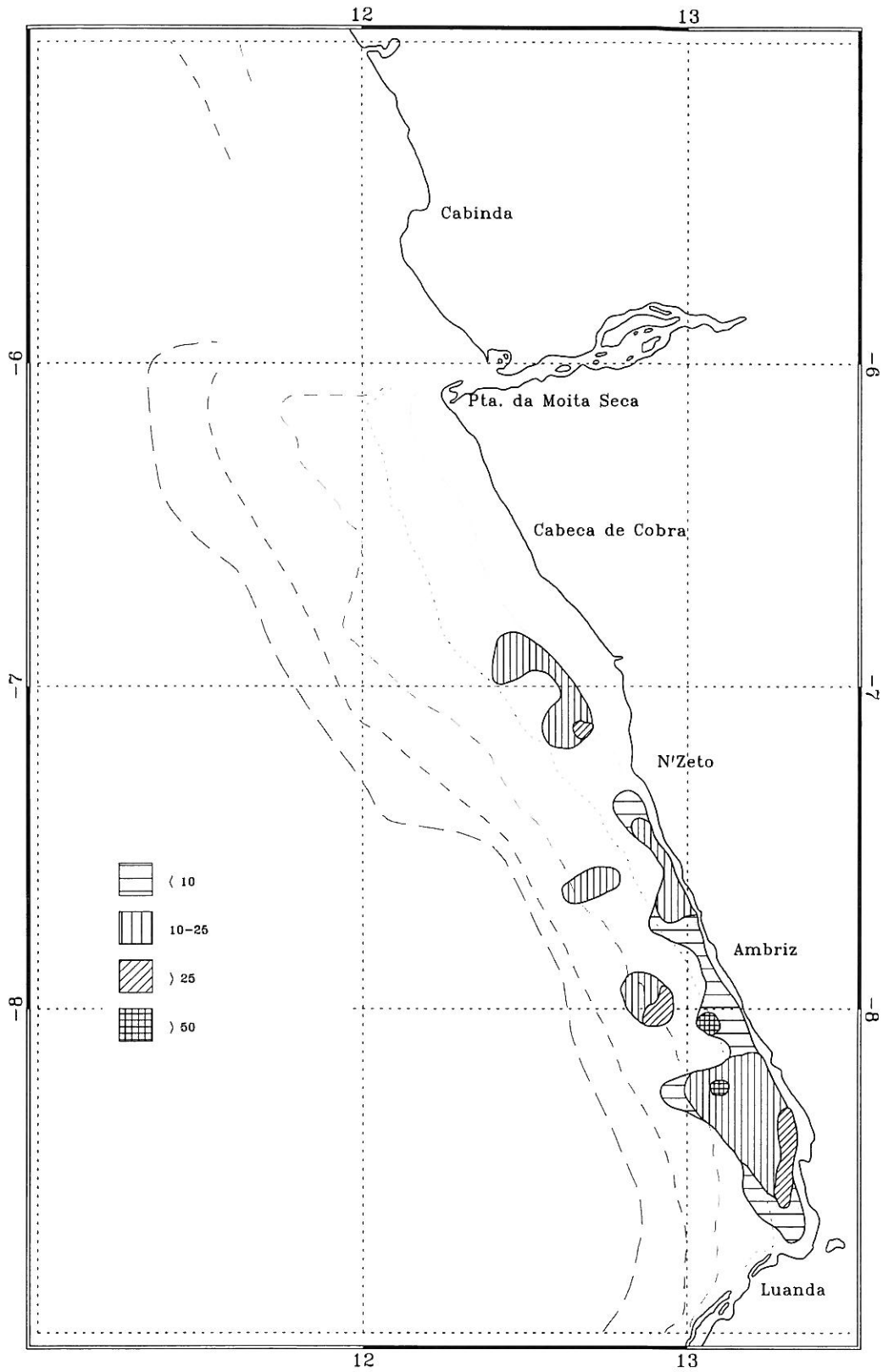
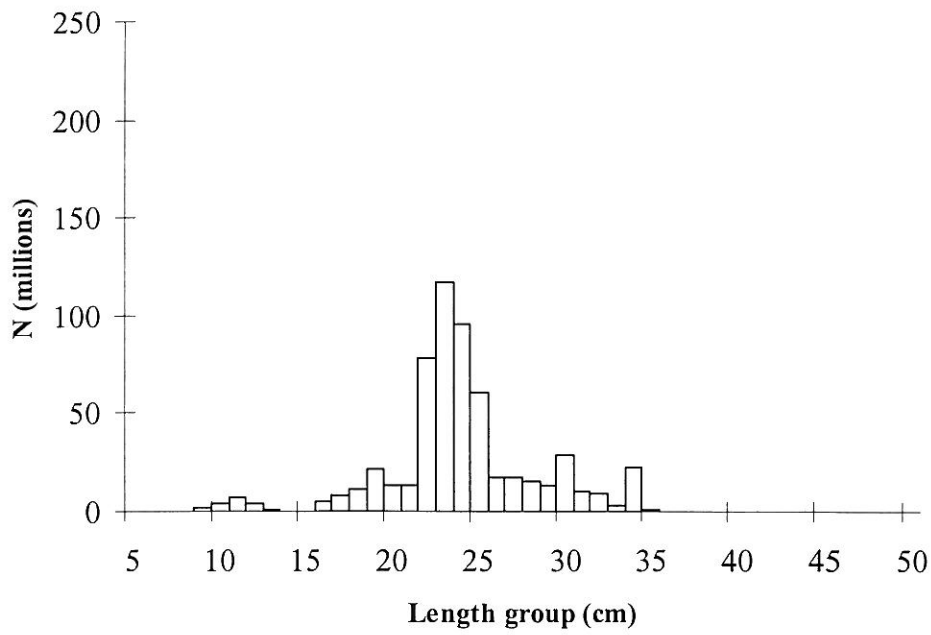
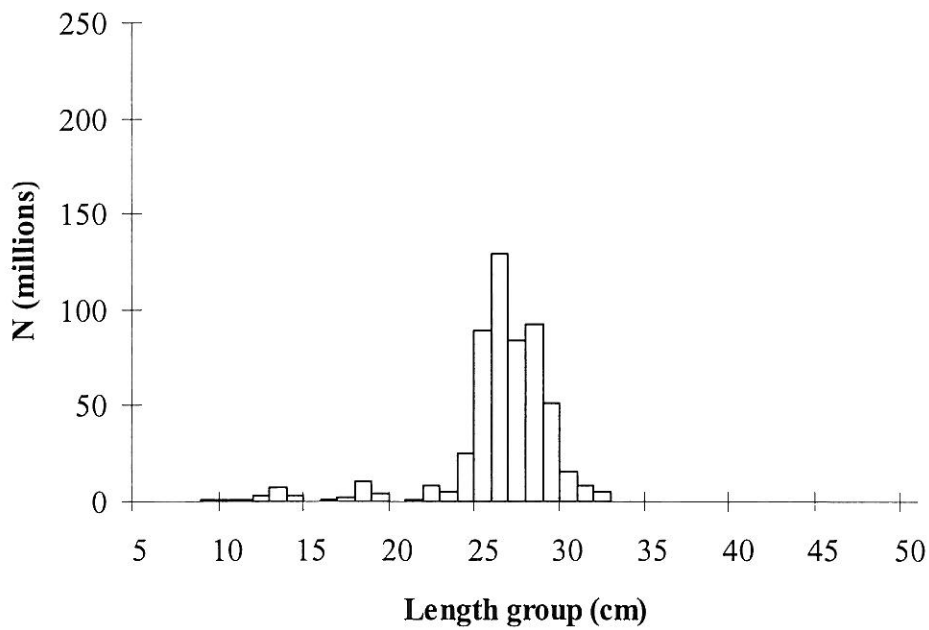
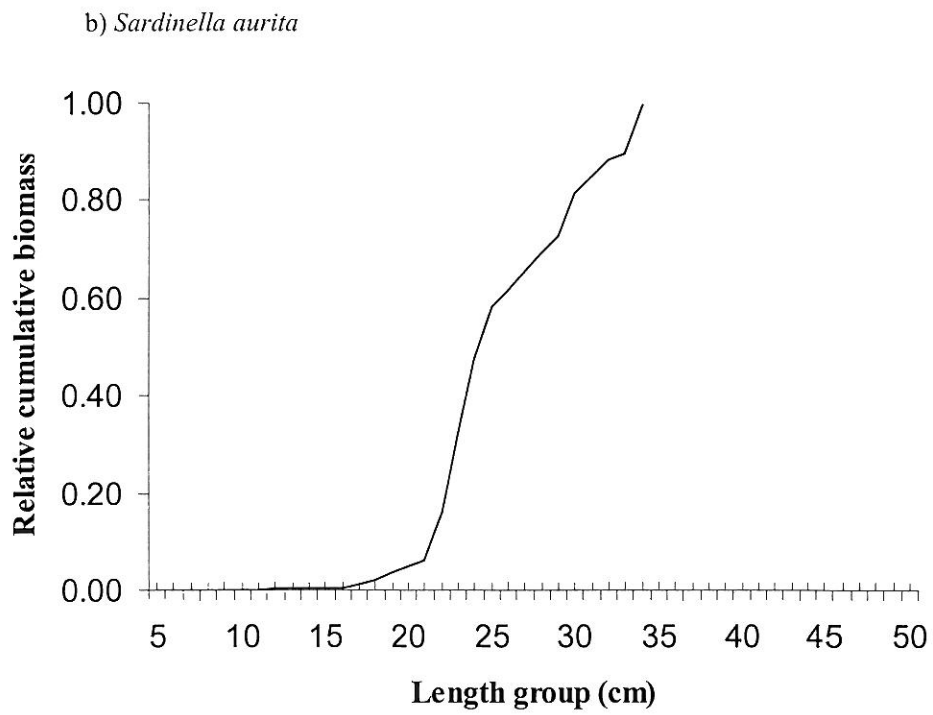
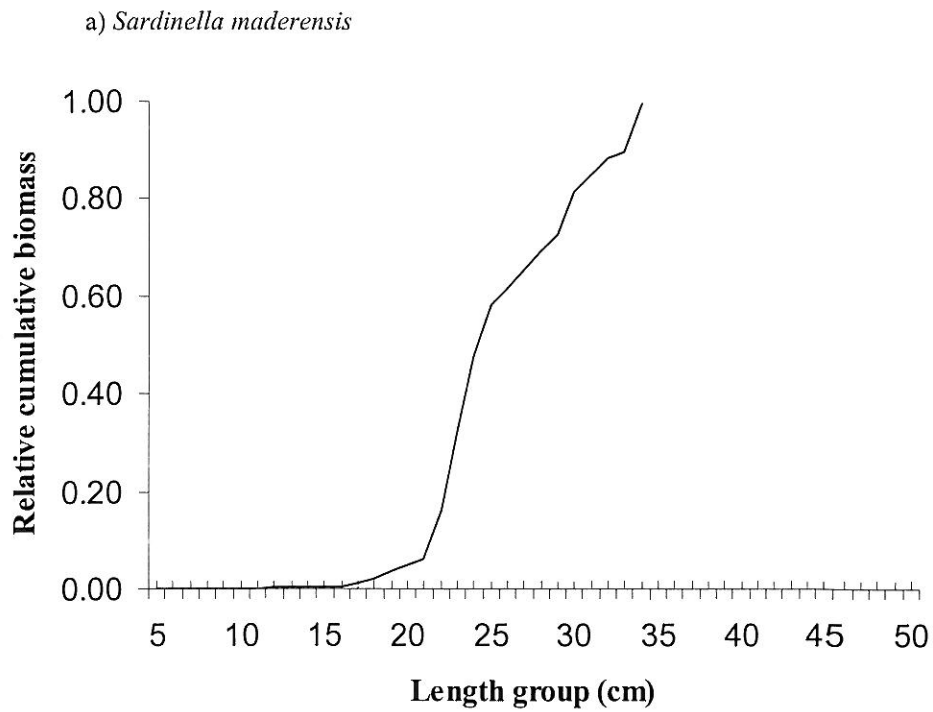


Figure 3. Northern region. Distribution of *Sardinella* spp: Pta. das Palmerinhas-Congo River. Density levels in  $m^2/NM^2$ . Depth contours as shown in Figure 1a.

a) *Sardinella maderensis*b) *Sardinella aurita*

**Figure 4.** Total length distribution of *Sardinella maderensis* (a) and *S. aurita* (b), Pta. das Palmerinhas-Congo River.





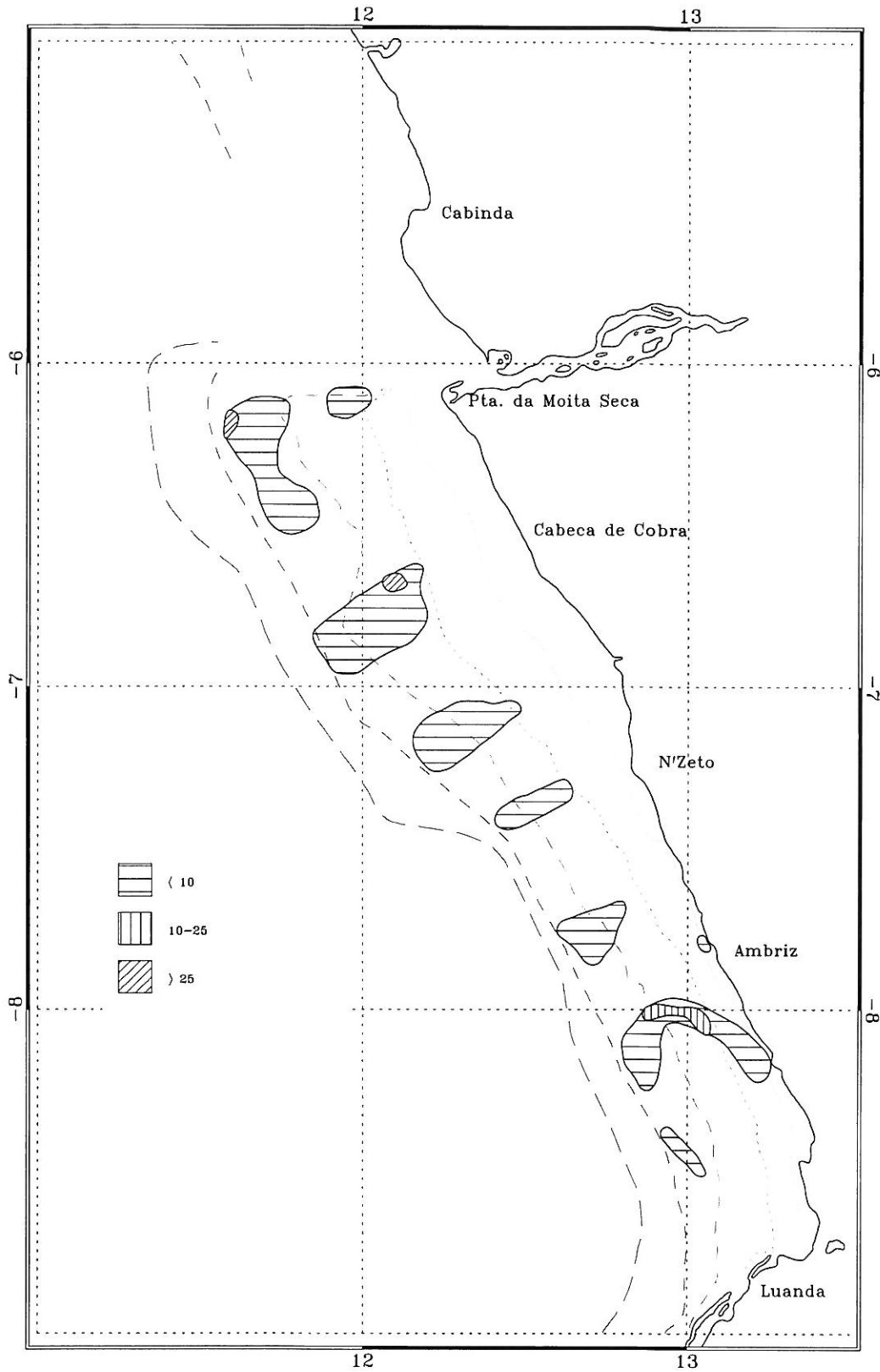
**Figure 5.** Relative cumulative biomass *Sardinella maderensis* (a) and *S. aurita* (b), Pta. das Palmerinhas-Congo River.

*Cunene horse mackerel*

The Cunene horse mackerel, *T. trecae*, was found in several patches along the shelf break between 100 and 200 m depth. Generally the densities were  $0 < s_A < 300$ . Three areas of medium-high densities were found at Cabeça da Baleia and Pta. da Moita Seca (Figure 6).

Figure 7 shows the length frequency distribution of horse mackerel for the region. The distribution shows three well-defined length groups between 10 and 15 cm TL, 15 to 21 cm TL and the adult cohort of fish larger than 28 cm TL, with modes at 11, 17 and 35 cm TL respectively. The mode around 11 cm was found spread throughout the distribution area.

The estimated biomass of *T. trecae* was 90 000 tons compared with 12 000 tons in 2003 and 31 000 tons in 2002. In previous surveys individuals were  $< 12$  cm TL, while for this year the population comprises of individuals  $> 35$  cm TL (Figure 8).



**Figure 6.** Northern region. Distribution of Cunene horse mackerel (*Trachurus trecae*): Pta. das Palmerinhas-Congo River. Density levels in  $m^2/NM^2$ . Depth contours as shown in Figure 1a.

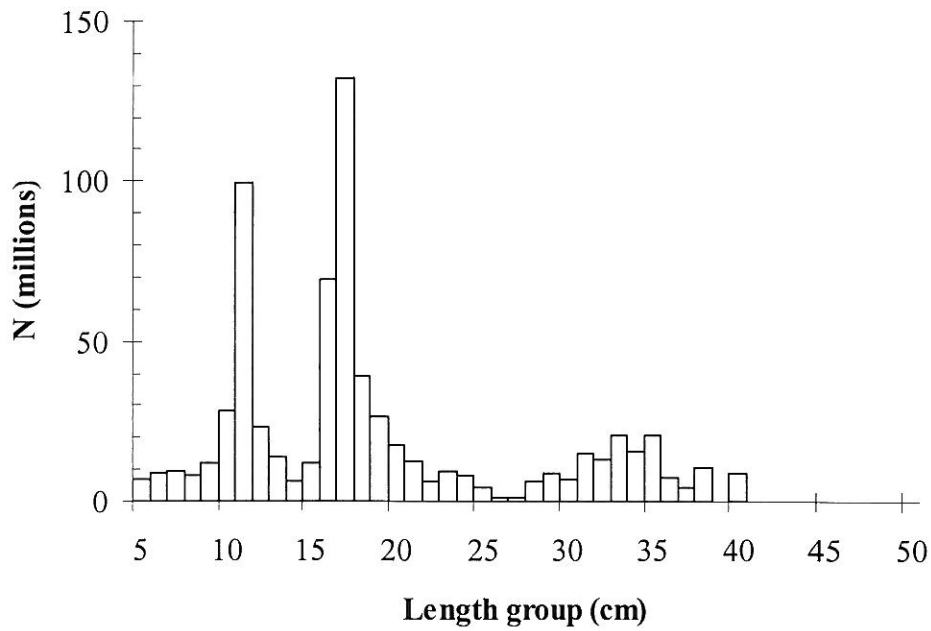


Figure 7. Total length distribution of Cunene horse mackerel (*Trachurus trecae*), Pta. das Palmerinhas-Congo River.

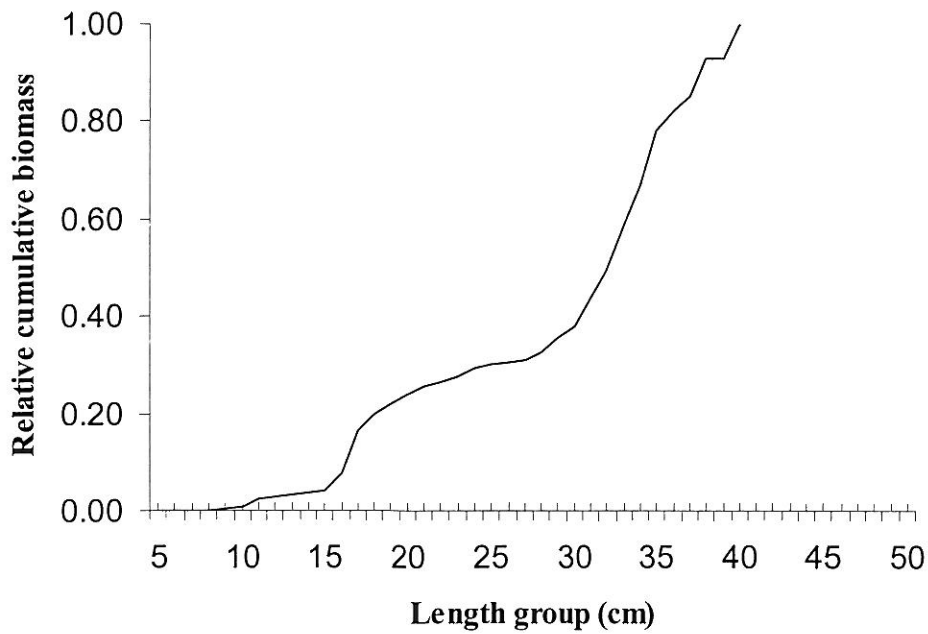


Figure 8. Cumulative percentage biomass by length group, *Trachurus trecae*. Pta. das Palmerinhas-Congo River.

*Other pelagic species*

## Pelagic species Group 1

Pelagic species group 1 was not abundant enough for estimating the biomass in the northern region.

## Pelagic species Group 2

This category, which includes members of the family Carangidae (other than *Trachurus* sp.), Scombridae, Sphyrænidae and *Trichiurus lepturus*, was found sporadically throughout the region (Table 4), and it was not possible to estimate the biomass of this group.

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

Station	Depth	Clupeids	Carangids	Scombrids	Hairtails	Barracudas	Other	Total
3484	20		0.2		0.1		64.7	65.0
3485	23				6.5		12.2	18.7
3486	114		0.5		22.7		338.5	361.8
3487	124		10.3	0.2			251.6	262.2
3488	17				20.9		254.0	274.9
3489	75		0.3				185.0	185.3
3490	100		1.0				35.4	36.4
3491	60		2.2		6.4		114.7	123.5
3492	30				14.6		470.5	485.2
3493	13		0.02				0.6	0.6
3494	143		117.8				507.0	624.8
3495	10	2.2	18.9				160.1	181.3
3496	10	1 917.0	4.3					1 921.3
3497	14	141.2	0.2	1.0			52.8	195.3
3498	0	5.5						5.5
3499	0	96.2	2.1		24.8		46.2	169.3
3500	0						101.6	101.6
3501	10	179.7	56.0	1.8	41.8		2.5	282.0
3502	10		0.9		1.2		18.1	20.3
3503	5	3 890.3	9.6		1.6		35.2	3 936.9
3504	5	28.4	7.6		11.3	1.0	149.6	198.1
3505	5	1 366.8	20.5		212.9		9.3	1 609.6
3506	10	42.5	1 082.9		193.8		14.9	1 334.2
3507	50				99.8			99.8
3508	76		1 121.0		359.3		7 758.0	9 238.4
3509	128				2.9		141.7	144.7
3510	5	22.3	1.9		1.9	0.4	144.3	171.1
3511	10	20.0		0.7	36.8		26.8	84.4
3512	10	538.1			3.3		6.2	547.7
3513	22		47.6		4.3	1.0	315.4	368.5
3514	408						376.0	376.0
3515	10	179.6	0.7		63.2		112.7	356.2
Mean	47	266.1	78.3	0.1	35.3	0.08	365.8	745.8
SD		792.3	269.6	0.3	78.5	0.2	1 356.4	
% Catch		35.6	10.5	0.02	4.7	0.01	49.0	

## 4.2 Benguela - Pta. das Palmerinhas

### *Sardinella*

*Sardinella* was found in patches throughout the region, the largest continuous distribution was found from north of Cabo Ledo to South of Pta. do Morro, with two areas of high densities inshore, north and south of Cabo São Braz (Figure 9). At Cabo São Braz and north of Lobito the distributions extended more offshore with lower densities. A very small area of high density ( $s_A > 3\ 000$ ) was recorded inshore at Lobito, with occurrence of the two species of sardinella, but dominated by *S. maderensis*.

The length distributions are presented in Figure 10 (a and b) for *S. maderensis* and *S. aurita* respectively. The size distribution of *S. maderensis* showed a dominating distributional mode at 14-19 cm TL, peaking at 17 cm and two more length groups at 20 to 23 and 24-29 cm TL with modes at 22 and 25 cm respectively. The length distribution of *S. aurita* was unimodal, with a peak around 25 cm TL. Additionally few small fish were found

The biomass for sardinella was estimated at a total of 175 000 tonnes, this is lower than the 257 000 tons found last year. From the species distributions in the catches, the biomass of *S. maderensis* was estimated at 71 000 tons, compared to 208 000 tons last year, and for *S. aurita* at 104 000 tons (67 000 tons last year). Most of the biomass comprised individuals smaller than 31 cm TL for *S. maderensis* and smaller than 30 cm TL for *S. aurita* (Figure 11).

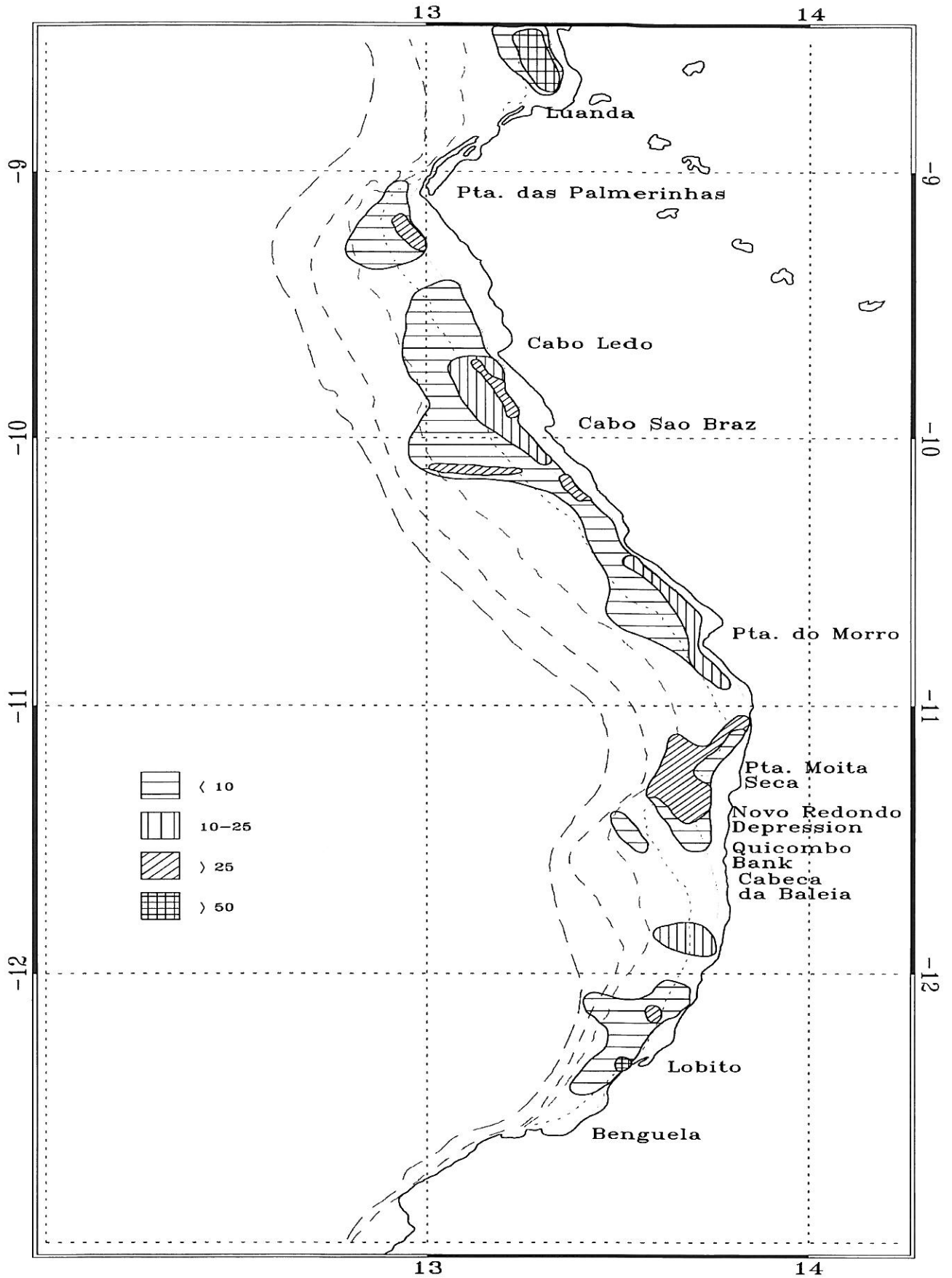
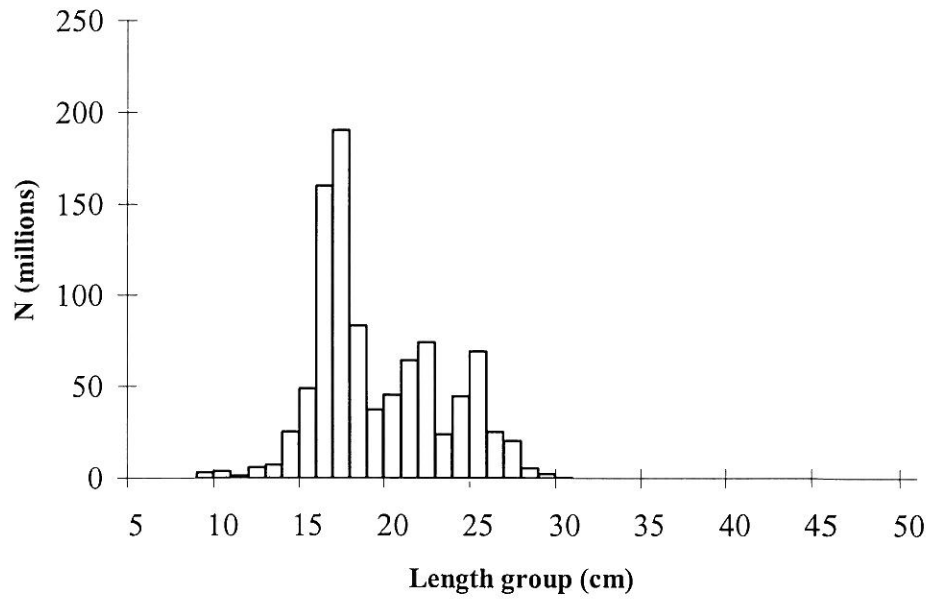
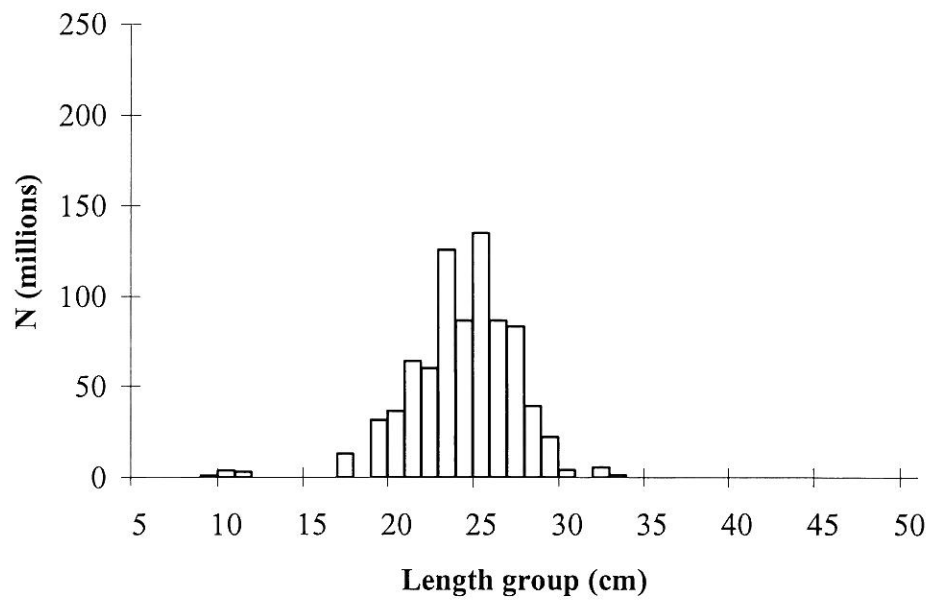


Figure 9. Central region. Distribution of *Sardinella* spp. Benguela - Pta. das Palmerinhas. Density levels in  $m^2/NM^2$ . Depth contours as shown in Figure 1a.

a) *Sardinella maderensis*b) *Sardinella aurita*

**Figure 10.** Total length distribution of *Sardinella maderensis* (a) and *S. aurita* (b). Benguela - Pta. das Palmerinhas



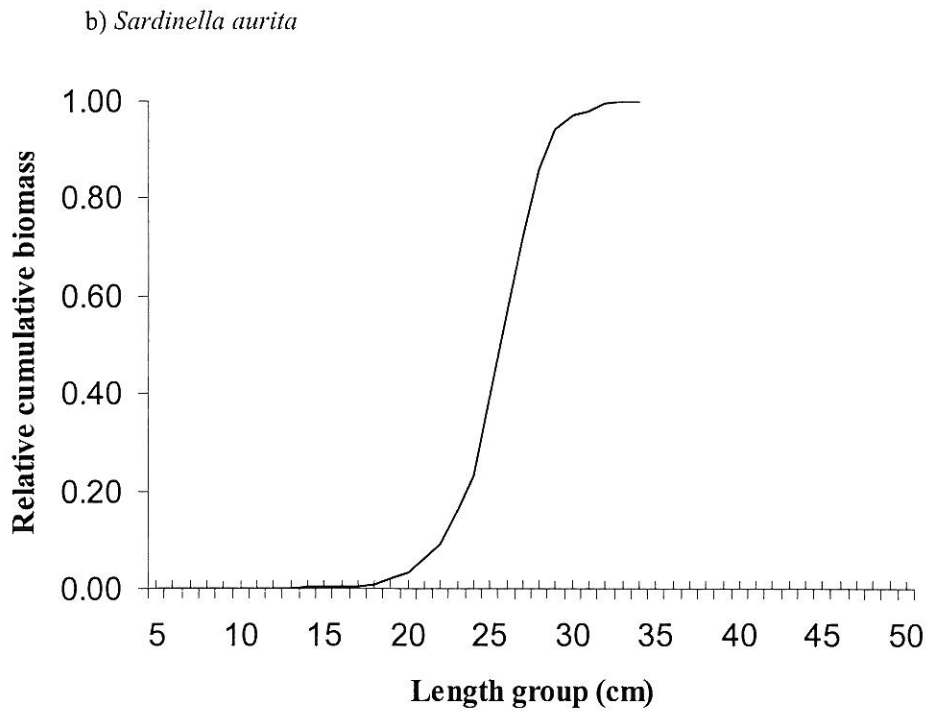
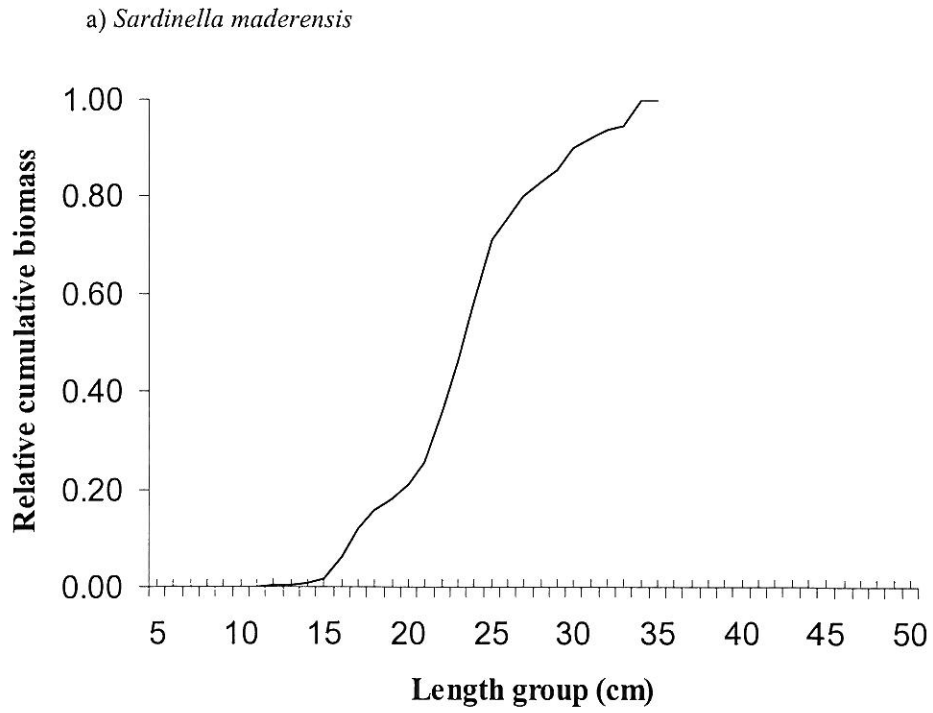


Figure 11. Relative cumulative biomass *Sardinella maderensis* (a) and *S. aurita* (b), Benguela - Pta. das Palmerinhas

*Horse mackerel*

Only *T. trecae* was encountered in this region. The distribution pattern was also patchy mostly with low densities ( $0 < s_A < 300$ ). Some areas of medium density ( $1\ 000 < s_A < 3\ 000$ ) were located, inshore south of Cabo São Braz and Pta. do Morro at around 100 m depth (Figure 12).

The total length distribution of this species shows four fairly well defined cohorts with modes at 7, 21, 29 and 36 cm TL (Figure 13). The group with modal peak of 21 cm TL could originate from the 18 cm TL group observed in last year survey. The presence of a large number of individuals  $>30$  cm TL (Figure 14) could be associated with upwelling phenomena recorded in the region, which makes the large fish more available for the acoustic measurements.

The biomass of Cunene horse mackerel was estimated at 107 000 tons. It is much higher than last year's estimate of 34 000 tons. The 2004 estimate is however the highest estimation for the area during the last three years.

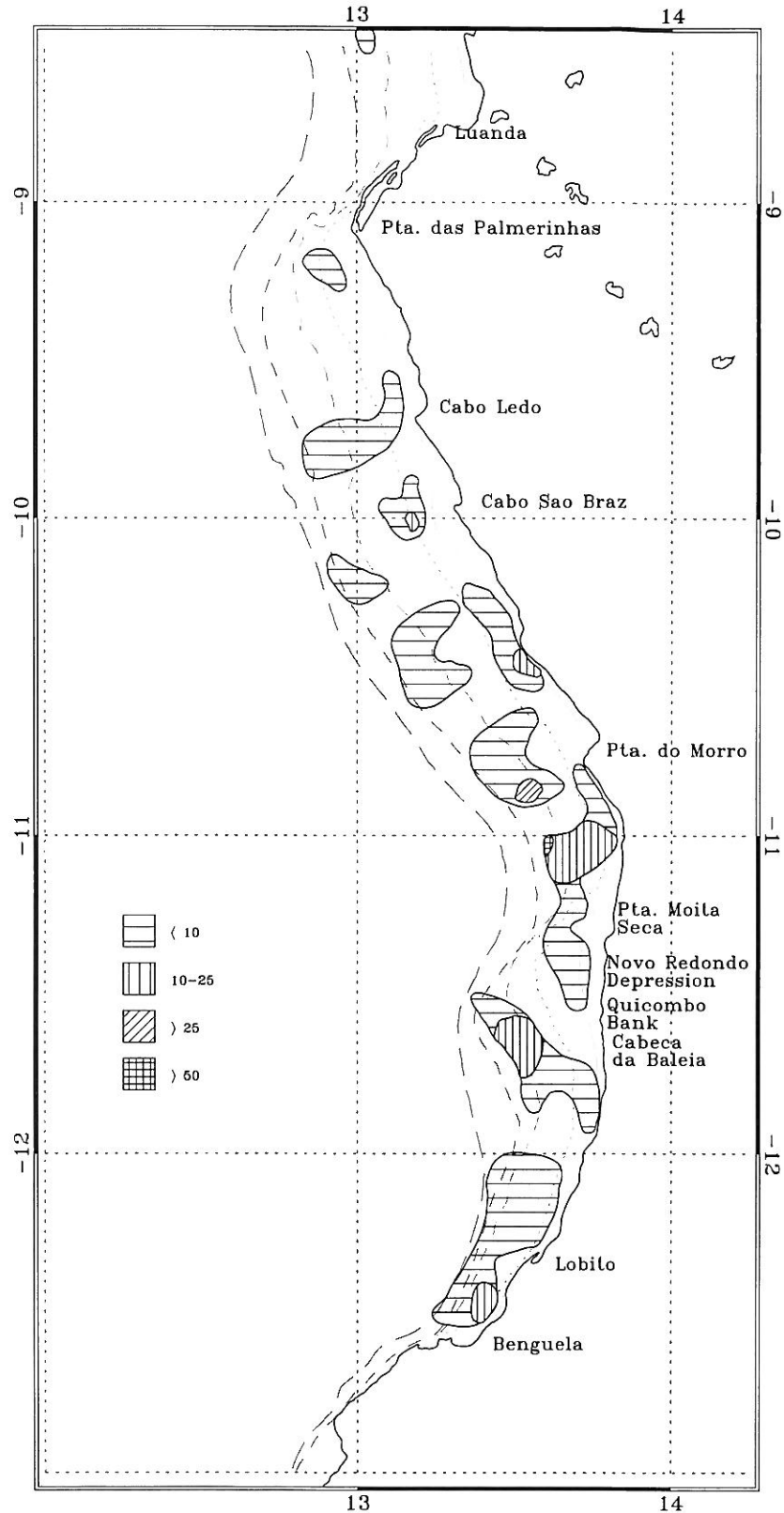


Figure 12. Central region. Distribution of horse mackerel (*Trachurus trecae*): Benguela - Pta. das Palmerinhas  
Density levels in  $m^2/NM^2$ . Depth contours as shown in Figure 1a.

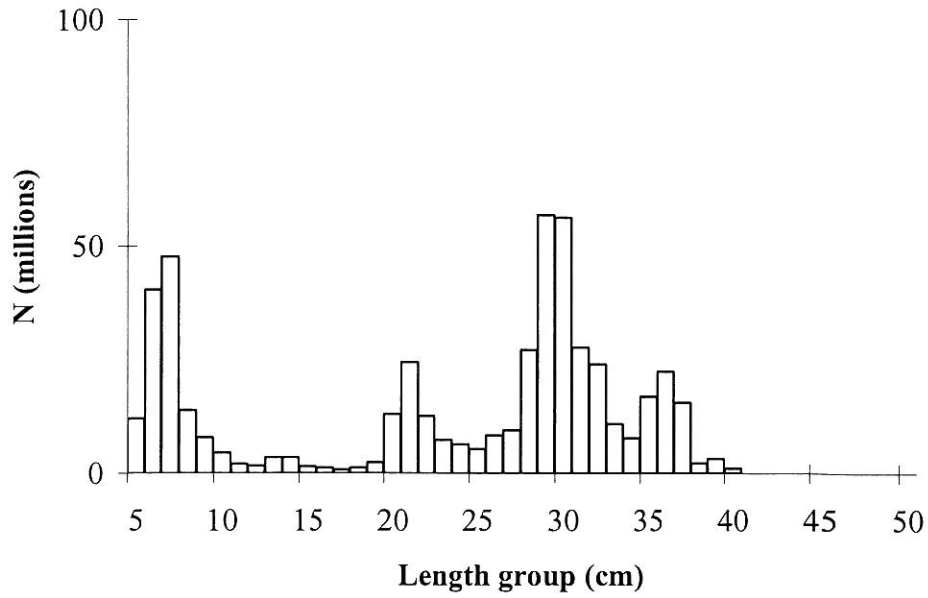


Figure 13. Total length distribution of horse mackerel (*Trachurus trecae*), Benguela - Pta. das Palmerinhas.

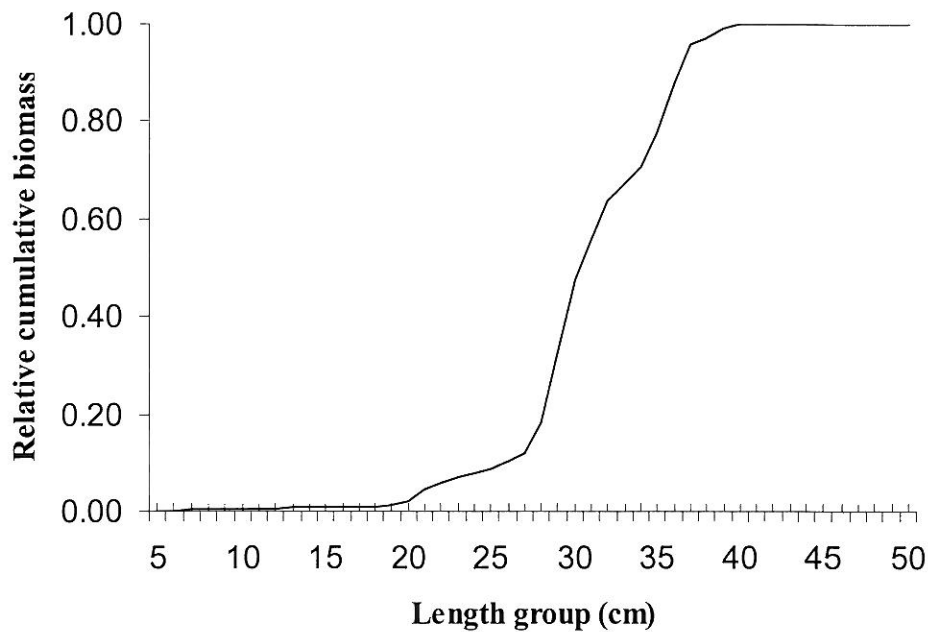


Figure 14. Relative cumulative biomass of horse mackerel (*Trachurus trecae*): Benguela - Pta. das Palmerinhas.

#### *Other pelagic species*

An overview of the main groups of other pelagic fish in the central region is given in Table 5.

### Group 1

No fish in pelagic species, group 1, were encountered in the region.

### Group 2

Pelagic fish type 2 was found in several, low-density ( $0 < s_A < 300$ ), areas from Luanda to Benguela (Figure 15). The most common species was hairtail (*Trichiurus lepturus*) and *Selene dorsalis*.

The biomass estimate, based on an average length of 30 cm TL and a condition factor equal to 0.01, was 35 000 tons compared with 46 000 tons in 2002 and 35 000 tons in 2001.

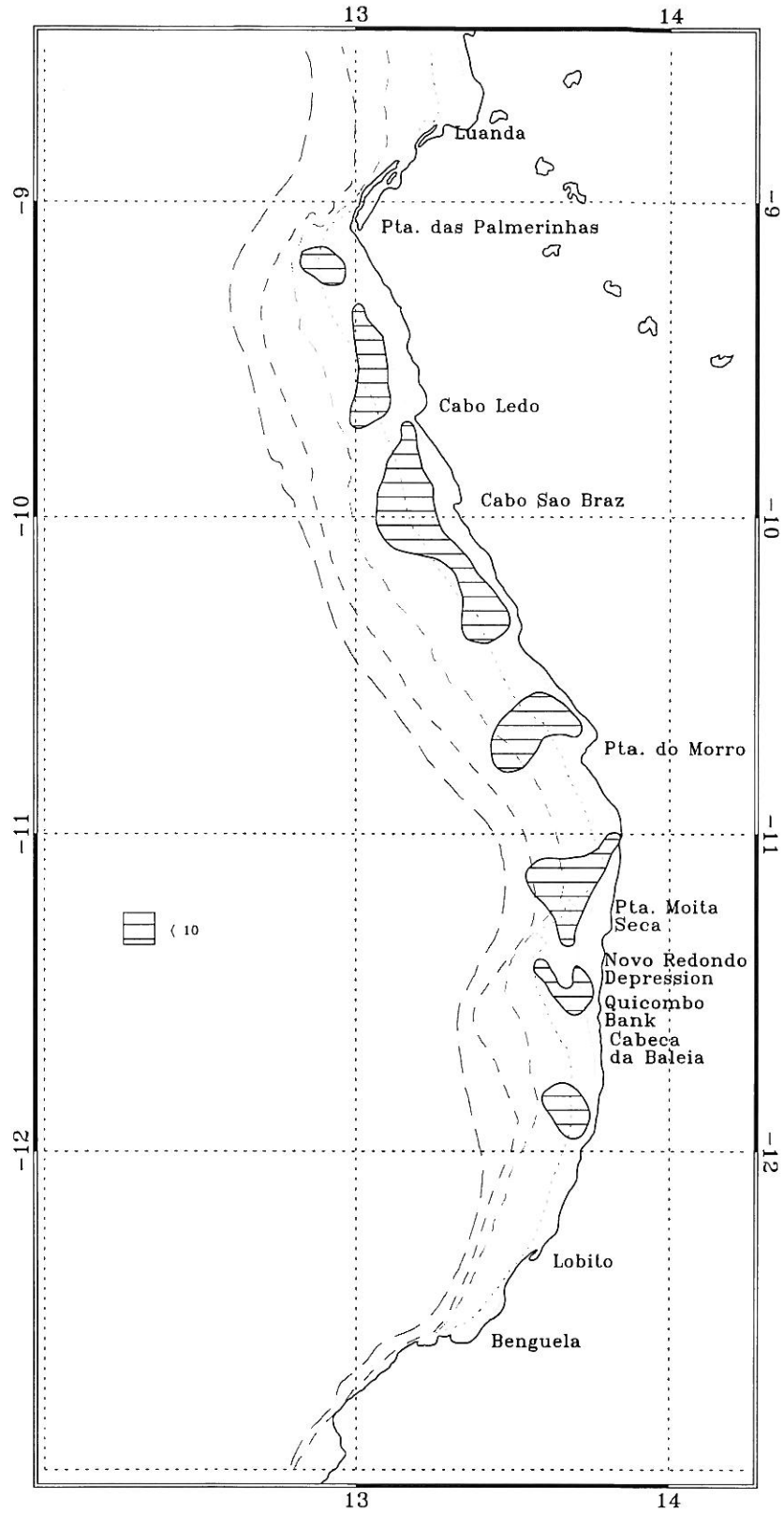


Figure 15. Central region. Distribution of other pelagic species, group 2: Benguela - Pta. das Palmerinhas. Density levels in  $m^2/NM^2$ . Depth contours as shown in Figure 1a.

**Table 5.** Catch rates (kg/h) of the main groups of pelagic fish, Benguela - Pta. das Palmerinhas.

Station	Depth	Clupeids	Carangids	Scombrids	Hairtails	Barracudas	Other	Total
3516	24	2 190.2	17 576.0				10 342.8	30 109.0
3517	35	4 598.5	26 120.8			169.0	2 834.1	33 722.5
3518	53							
3519		92.3	271.0			5.3	18.5	387.2
3520	20	2.7	12.7			0.8	50.8	67.1
3521	110		139.9				720.3	860.2
3522	91		109.5		88.2		103.6	301.3
3523	10				2.4			2.4
3524	10	392.0	29.1		15.3		208.4	644.9
3525	22	88.2	266.8					355.0
3526	45		265.6				2 959.1	3 224.7
3527	62		351.4		13.2		93.0	457.7
3528		170.8	45.4	3.3	9.6		101.3	330.6
3529	25		2.6		1.1		135.7	139.4
3530	100						170.3	170.3
3531	34		418.7		204.6		2 008.7	2 632.1
3532	23	1.3	55.8		4.6		163.8	225.6
3533	10	556.7	1.2		7.0		740.2	1 305.2
3534	10	85.3	1 318.9	30.7	202.5			1 637.5
3535	10	24.9	28.8	5.5	36.6		1 673.9	1 769.9
3536	13		3 151.8	248.8	47.3		4.6	3 452.7
3537	40		560.1					560.1
3538	36		0.3				11.7	12.1
3539	128		557.1		414.1		1 072.9	2 044.2
3540	10	42.6	58.9		8.9	380.6	202.2	693.3
3541	379				41.3		757.1	798.4
3542	145		275.4				457.7	733.1
3543	123				75.0		414.3	489.4
3544	354						521.4	521.4
3545	10	1 267.0					41.4	1 308.4
3546	10	441.5	1.0				7.0	449.6
3547	14		2 424.1	101.4	238.7		21.9	2 786.1
Mean	61.1	311.0	1 688.8	12.1	44.0	17.3	807.4	2 881.0
SD		901.0	5 443.9	46.9	93.0	72.6	1 912.4	
% Catch		10.8	58.6	0.4	1.5	0.6	28.0	

### 4.3 Benguela - Cunene

#### *Sardinella*

Both sardinellas were recorded only in one pelagic trawl (PT 3548) at south of Cabo de Santa Marta.

### *Horse mackerel*

In the southern region the pelagic environment was dominated by horse mackerel. Like in previous years, both species of horse mackerel were found: Cunene horse mackerel (*T. trecae*) a species that distributes in most of the Angolan continental shelf and the Cape horse mackerel (*T. capensis*) a species associated with the cold waters of the Benguela current. Horse mackerel was found in patches throughout the area with relative low density. ( $0 < s_A < 300$ ). From Pta. Albina to Baía dos Tigres it has a more continuous distribution, with higher densities ( $1\ 000 < s_A < 3\ 000$ ) southern of Pta. Albina and inside of Baía dos Tigres. In general, Cape horse mackerel was found dominating the slope area, while Cunene horse mackerel had a more inshore distribution.

Figure 17 shows the size distributions of horse mackerel. The length frequency distributions of the two species are very similar. *T. trecae* has a clear cohort, with a modal peak at 14 cm TL. There is also an indication of a very small adult cohort with no clear modal peak. The size distribution of *T. trachurus capensis* has cohorts with modal peaks around 10 and 16 cm TL, few fish above 20 cm TL were recorded. Last year, the southern area was also completely dominated by juveniles (<20 cm TL), for both species, with modal peaks around 18 cm TL for *T. trecae* and 15 cm TL for *T. capensis*.

The estimated biomass for horse mackerel in the southern region was 71 000 tons. The contribution from the two species was 32 000 tons for *T. trecae* and 39 000 tons for *T. trachurus capensis*. Last year the estimated biomass in this region was 123 000 tons of *T. trecae* and 133 000 tons of *T. trachurus capensis*. The reduction on biomass could be an indication that in the present year there were a northward shift on the distribution of horse mackerel due to the upwelling condition observed up north.

Figure 18 shows that 90% of the biomass of the *T. trecae* population in this area was < 24 cm TL. The *T. trachurus capensis* population in the area was entirely comprised of juveniles, <20 cm TL.



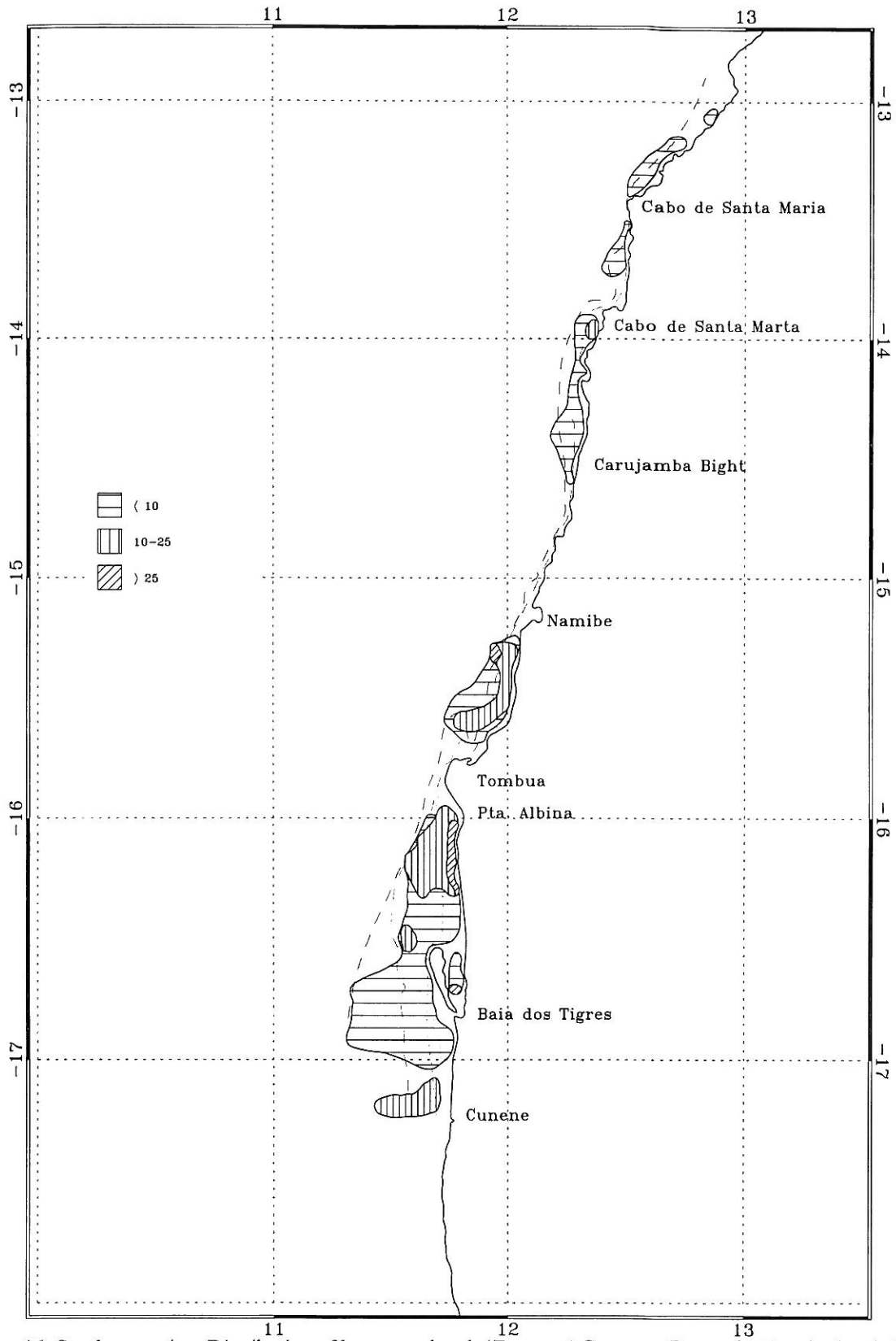


Figure 16. Southern region. Distribution of horse mackerel. (*T. trecae*):Cunene – Benguela. Density levels in  $m^2/NM^2$ . Depth contours as shown in Figure 1c.

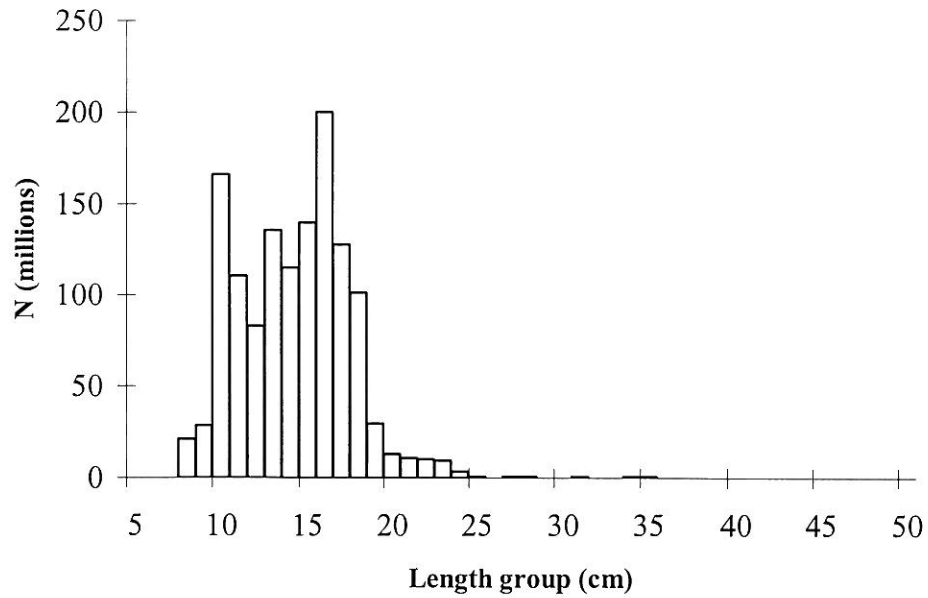
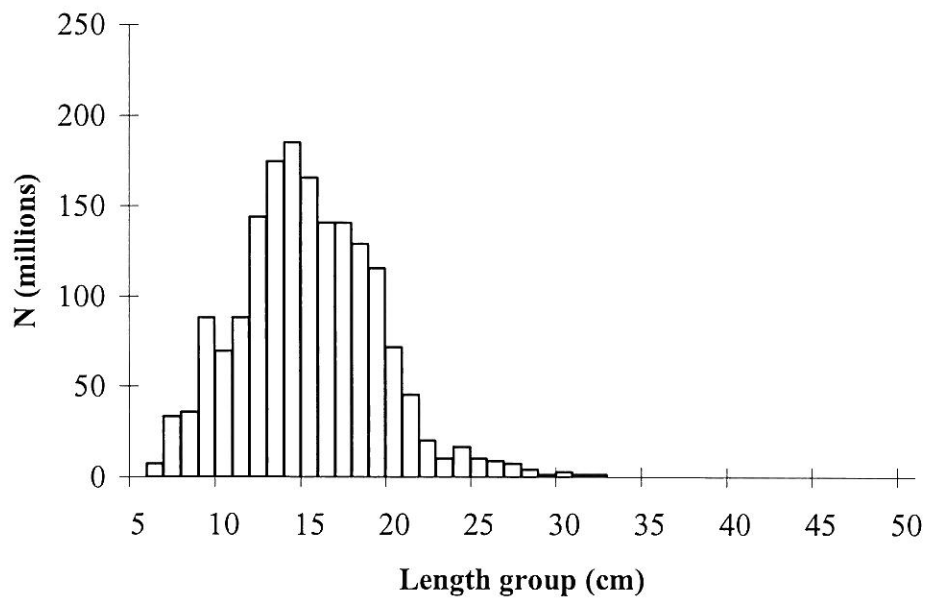
a) *Trachurus trachurus capensis*b) *Trachurus trecae*

Figure 17 Total length distributions of *Trachurus trachurus capensis* (a) and *T. trecae* (b), Benguela-Benguela.

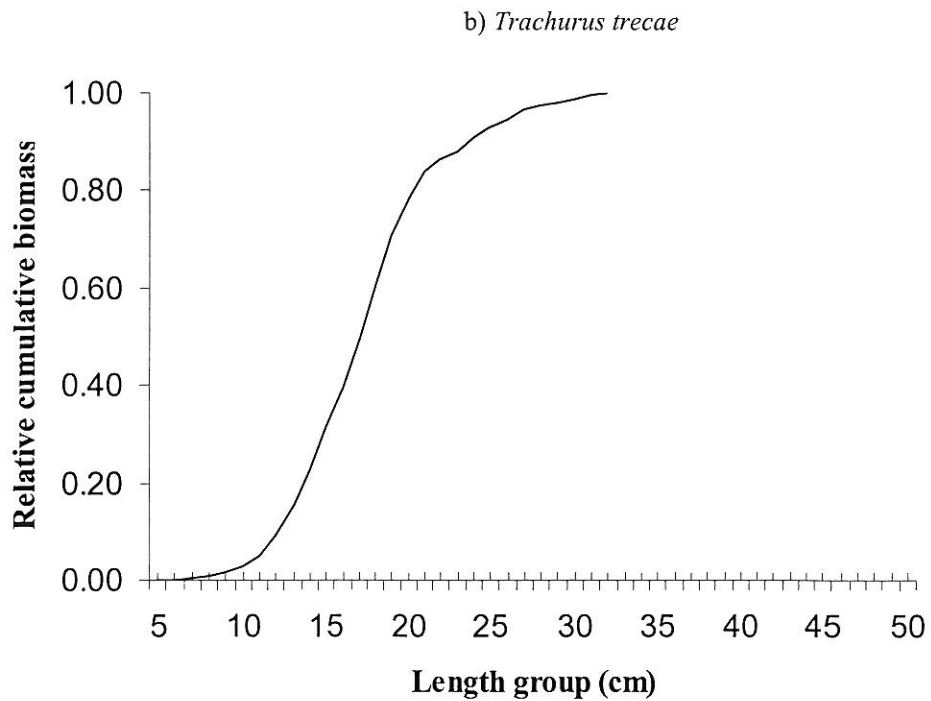
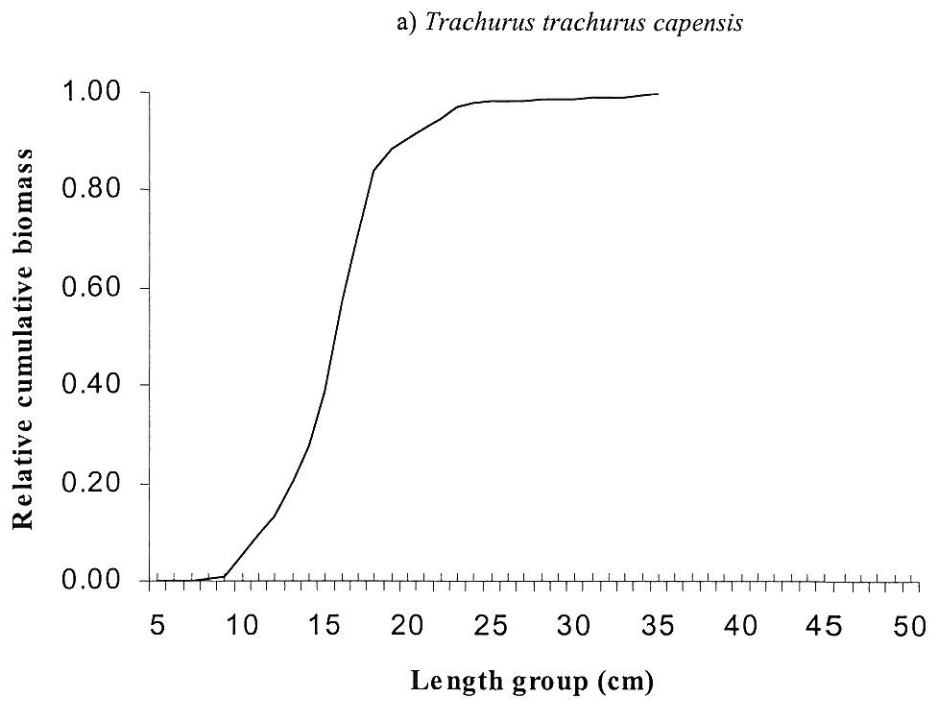


Figure 18. Relative cumulative biomass of *T. trachurus capensis* (a) and *T. trecae* (b). Benguela-Benguela.

#### Group 1

*Sardinops ocellatus* was the dominant species. It was found at Baía dos Tigres and Cunene River (Figure 19) with a high-density distribution inshore and inside of the Bay.

The length frequency distribution shows to clear cohorts with modal peaks at 12 and 24 cm TL (Figure 20).

The total biomass was estimated at 250 000 tons. Since 1995, this is the first time that such amount of pilchard has been recorded in Angolan waters.

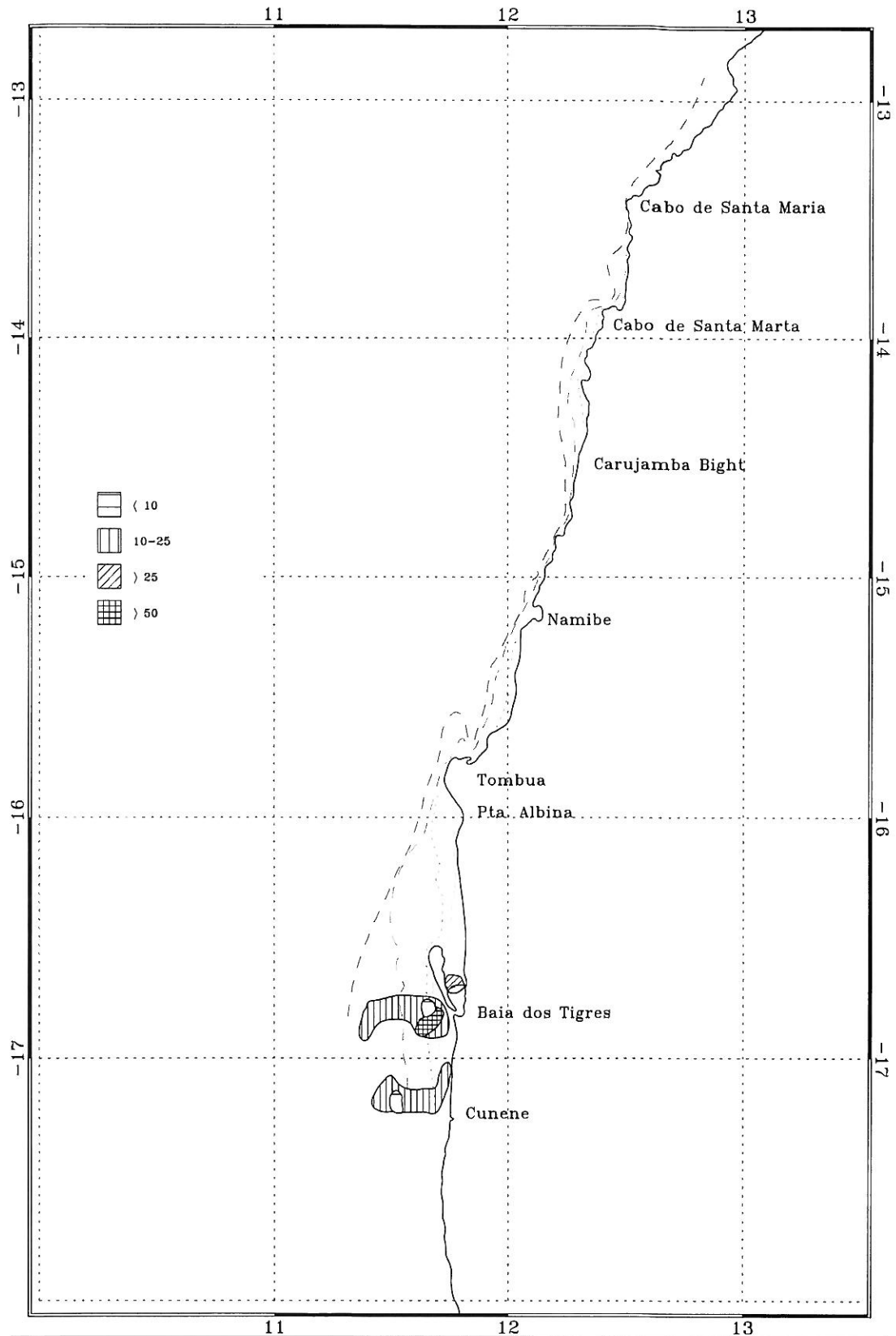


Figure 19. Southern region. Distribution of pilchard: Cunene – Benguela. Density levels in  $m^2/NM^2$ . Depth contours as shown in Figure 1c.

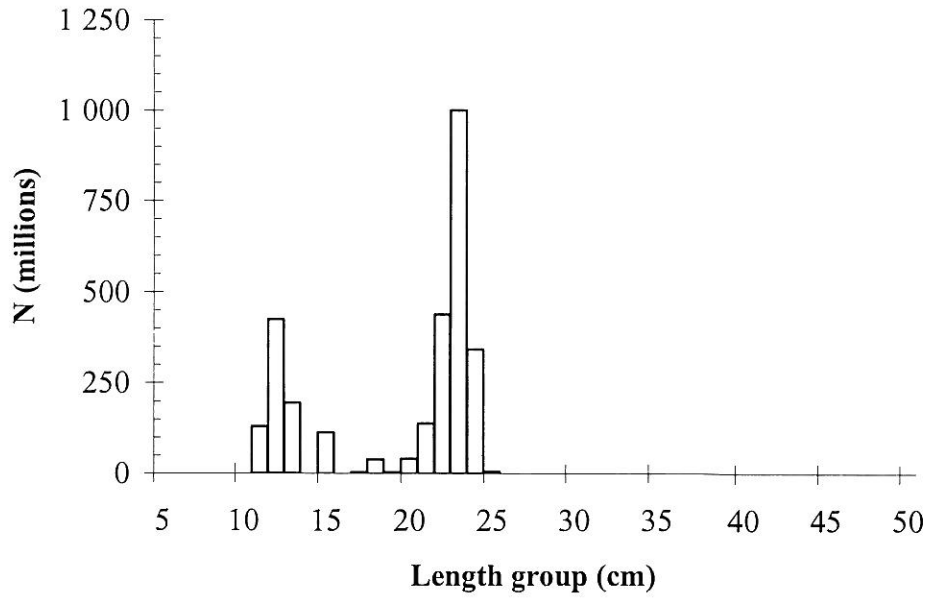


Figure 20 Total length distributions of *Sardinops ocellatus*, Cunene-Benguela.

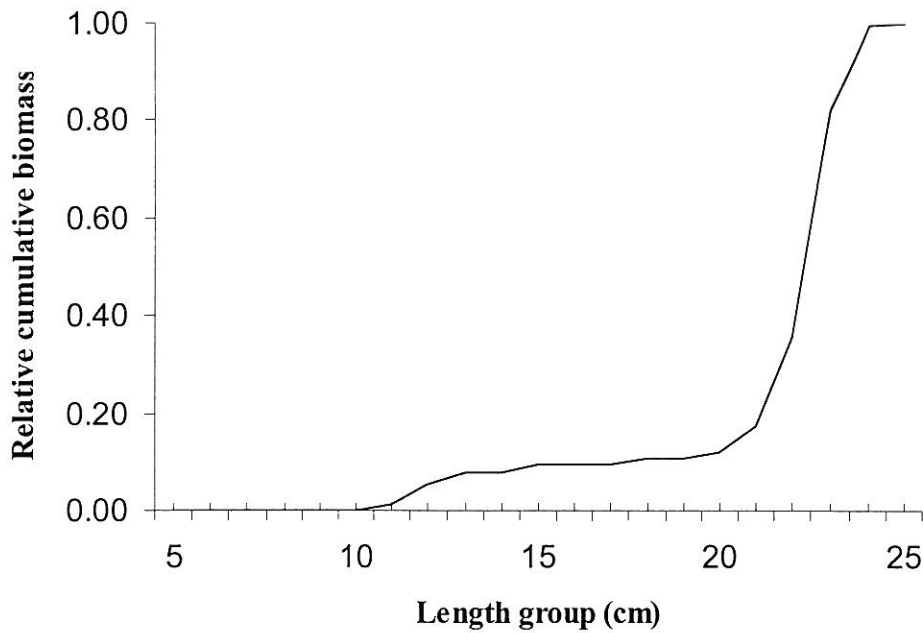


Figure 21. Relative cumulative biomass of *Sardinops ocellatus*, Cunene-Benguela

Group 2  
 No positive identification of PT2 was made in this region

## CHAPTER 5 SUMMARY OF SURVEY RESULTS

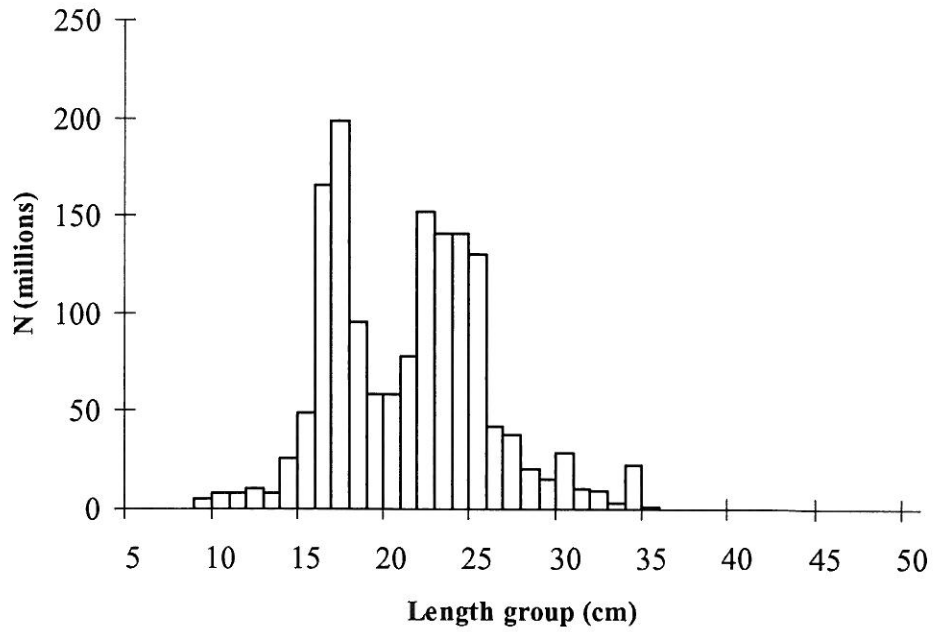
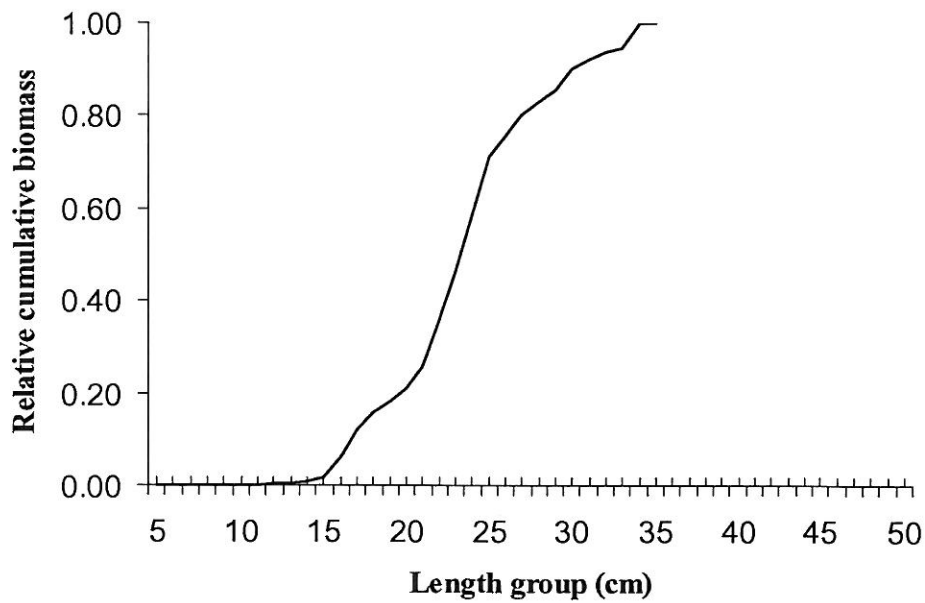
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### 5.1 Sardinella

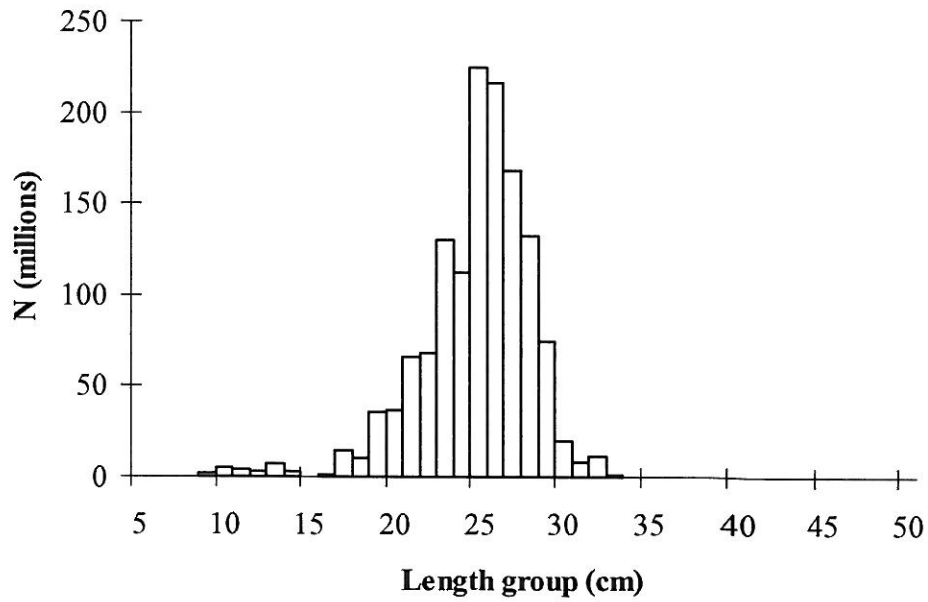
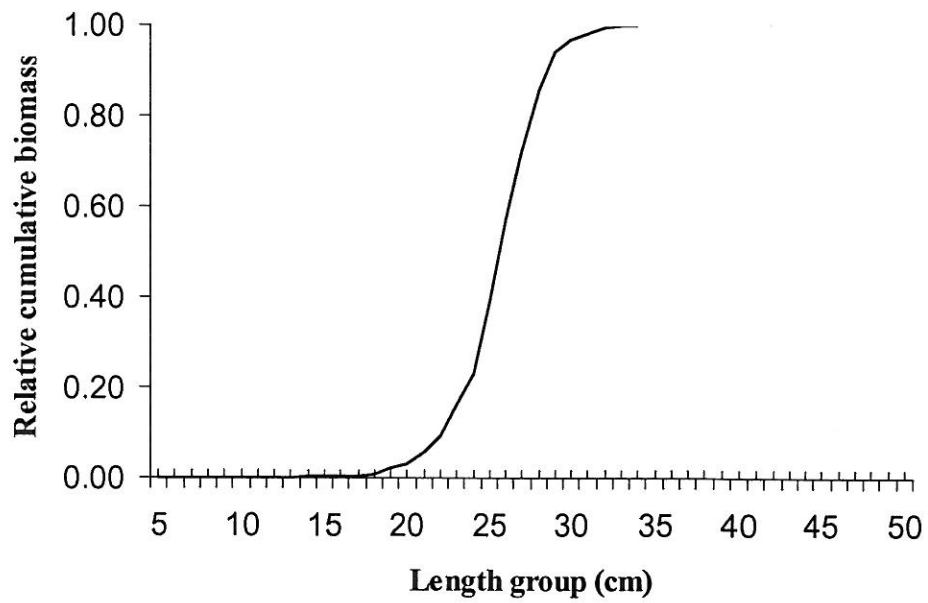
The total biomass estimate for sardinellas is 362 000 tons, which is lower than last year (432 000 tons), but within the range of previous years (Table 6). The reduction from 2003 could be attributed to changes on behaviour pattern of the species that depends in the prevailing environmental conditions. During the present survey the environmental condition were characterized by the occurrence of upwelling phenomena along the coast, with cold and low salinity waters confined to inshore areas. This feature makes the aggregation pattern of sardinella different from previous surveys. From the acoustic records it is evident that the sardinella was more dispersed throughout the distribution region. Only a few, very dense schools were recorded, making difficult to follow the day/night pattern of sardinella.

The proportion of biomass of the two sardinellas species was different from the typical pattern observed over the last 10 years. From the total biomass, around 58% was *S. aurita* and 42% *S. maderensis*, while the opposite has been the usual. This however, should not be necessarily interpreted as a signal of recovering of *S. aurita* in Angolan waters, this differences could also be associated with environmental conditions, as *S. maderensis*, is a warm water species (preferably > 23° C).

Figure 22 shows the overall length frequency distribution of the two species of sardinella. For *S. maderensis*, two well-defined cohorts with modal peaks at 17 and 22 cm TL can be seen. Following the modal progression from that of last year, the cohort with 17 cm modal length originates from last year's strong cohort of juvenile (7-10 cm TL), while the larger cohort (23 cm TL) could be from the less well-defined group of 15-20 cm TL in 2003. *S. aurita* on the other hand, shows (Figure 23) a unimodal distribution with the peak at around 25 cm TL. This cohort was, however, not defined clearly in the 2003 survey. The juvenile group represents < 5% of the total biomass.

a) Overall length distribution of *S. maderensis* in numbers.b) Relative cumulative biomass of *S. maderensis*.Figure 22. Overall length distribution (a) and relative cumulative biomass (b) of *S. maderensis*.



a) Overall length distribution of *S. aurita* by numbersb) Relative cumulative biomass of *S. aurita***Figure 23.** Overall length distribution (a) and relative cumulative biomass (b) of *S. aurita*

**Table 6** Biomass estimates of sardinellas by regions and surveys (1 000 tons).

Survey	Cunene- Benguela	Pta Palm. - Benguela	Cabinda- Pta Palm.	Benguela- Cabinda	Cunene- Cabinda
1/85	25	220	80	300	325
2/85	110	190	180	370	480
3/85	0	70	190	260	260
4/85	0	200	110	310	310
1/86	10	140	110	250	260
2/86	10	130	130	260	270
1/89	40	200	60	260	300
2/89	20	40	130	170	190
3/89	40	100	60	160	200
1/91	?	180	120	300	300
2/91	?	68	154	222	222
1/92	?	119	161	280	280
1/94	*	410	100	510	
2/94	*	245	290	535	
1/95	*	140	24	164	
2/95	?	277	297	574	574
1/96	49	175	70	245	294
2/96	0	130	233	363	363
1/97	0	195	300†	495	495
1/98	75	389	79†	468	543
3/98	0	233	159†	392	392
2/99	0	228	135†	363	363
2/2000	0	179	174†	353	353
2/2001	0	257	177†	434	434
9/2002	0	165	178	343	343
8/2003	2	277	153†	430	432
8/2004	0	175	187†	262	362

\* Not surveyed

† surveyed from Congo River- Pta. das Palmerinhas

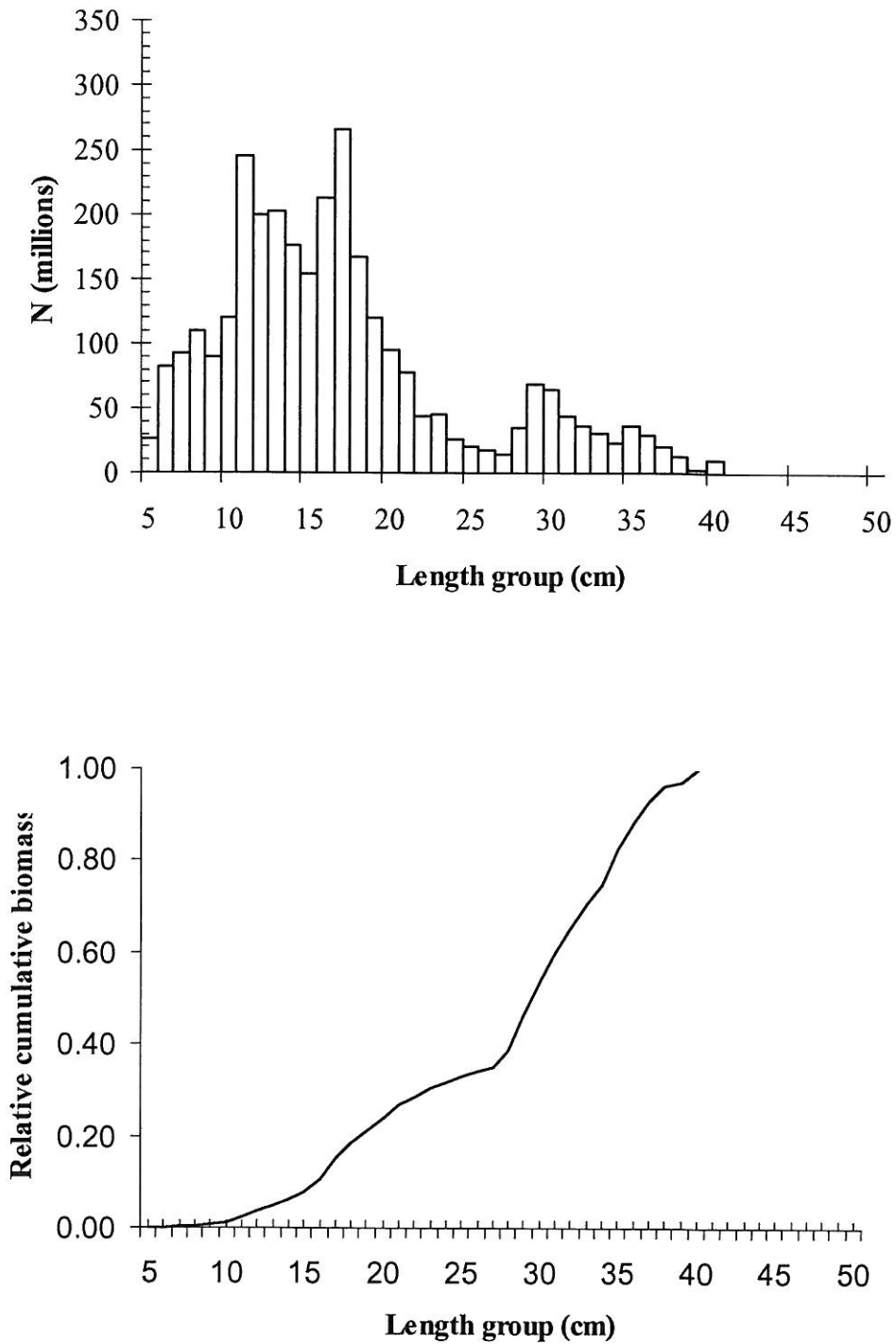
## 5.2 Cunene horse mackerel

The total biomass of horse mackerel was estimated at 258 000 tons. Cunene horse mackerel stock was estimated at a total of 219 000 tons which was higher than the last three years estimates (Table 7). However, the stock is far from the level in 2000 when 330 000 tons were estimated. It is important to point out that the 2000 estimation was already a low value compared with the levels estimated for instance in 1996 (about 500 000 tons).

The overall length distribution dominated by fish > 20 cm TL (Figure 24). However, compared to last year's distribution, it is observed an increase in the proportion of individuals > 30 cm TL, and this increase was most evident in the central region. As in previous surveys there was observed a good signal of recruitment. Growth progression could be seen with several different cohorts. Cohorts recognized in 2003 are present in 2004.

The increase in biomass of the stock is primarily associated with environmental conditions. The occurrence of upwelling phenomena throughout the Angolan coast was observed. In this condition the bias due to avoidance is much less and horse mackerel migrates from bottom habitats and into the pelagic making them more available for acoustic measurements.

During the present survey it was also observed a northward migration of horse mackerel, making the biomass estimated for the southern region much lower (71 000 tons) compare with last two years.



**Figure 24.** Overall length distributions in numbers (a) and relative cumulative biomass (b) of *T. trecae*.

**Table 7** Biomass estimates of Cunene horse mackerel by regions and surveys (1 000 tons)

Survey	Cunene- Benguela	Pta Palm. - Benguela	Cabinda- Pta Palm.	Benguela- Cabinda	Cunene- Cabinda
1/85	30	195	40	235	
3/85	50	90	40	130	265
4/85/86	100	125	20	145	180
1/89	35	55	40	95	245
3/89	170	40	35	75	130
1/91	100	80	20	100	245
2/91	100	70	30	100	200
1/92	98	86	80	166	200
1/94	*	238	1	239	264
2/94	*	130	120	250	
1/95	*	?	84	84	
					340
2/95	70	160	110	270	506
1/96	286	214	6	220	360
2/96	140	157	63	220	427
1/97	234	55	138†	193	239
1/98	163	58	18†	76	267
3/98	118	112	37†	149	321
2/99	124	129	68†	197	333
2/2000	92	178	63†	241	89
2/2001	64	22	3†	25	162
9/2002	118	13	31†	44	166
8/2003	120	34	12†	46	219

\* not surveyed

† surveyed from Congo River- Pta das Palmerinhas

### 5.3 Conclusions

In the present survey the environmental conditions were characterized by the impact of upwelling phenomena occurring throughout the Angolan coast and the intrusion of cold water inshore in the south. The range of temperatures encountered in the central and northern regions was 18 to 23°C, compared to a normal of about 21 to 25°C.

This environment affects the behaviour of the species, giving a different distribution pattern than in the previous years. From the acoustic records it was evident that the *Sardinella* was more dispersed than normal, and only a few dense schools were observed. The total biomass estimate for sardinellas (360 000 tons) was lower than last year (430 000 tons), but this may to some extent be related to the distribution pattern, with higher probabilities of not detecting targets at low densities, particularly at night.

The proportion of biomass of the two *Sardinella* species was different from the typical pattern observed over the last 10 years. From the total biomass, as much as 58 % was *S. aurita* while 42 % tons were *S. maderensis*, while *S. maderensis* usually has dominated. The observed relative increase in *S. aurita* may have been facilitated by the cold-water occurrence inshore, rather than an increase in the biomass for this species.

The total biomass of horse mackerel was estimated at 260 000 tons. The Cunene horse mackerel stock was estimated at total of 220 000 tons, which is somewhat higher than the last three years, while 40 000 tons of Cape horse mackerel was found in the southern region. The Cunene horse mackerel stock is, however, far from the level of 1996 (500 000 tons), and the potential of the stock may be even higher than this.

The overall length distribution of Cunene horse mackerel was still dominated by fish <20 cm. Compare to last year, however, a slight increase in the proportion of individuals >30 cm was found. This increase in size was more evident in the central region.

The recovery of the Cunene horse mackerel stock in Angolan waters requires that strong management measures be maintained for 2005. From a biological perspective an overall effort reduction compared to the 2004 level will be the main tool to achieve this goal.

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## ANNEX I FISHING GEAR

The vessel has three different sized four-panel 'Åkrahavn' pelagic trawls and one 'Gisund super bottom trawl'. The pelagic trawl and the demersal trawl were used during the survey. The smallest pelagic trawl has 10-12 m vertical opening under normal operation.

The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m<sup>2</sup> and weigh 2000 kg. The door spreading is about 45 m when using restraining rope.

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 a height sensor is fitted on the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

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





# ANNEX II Records of fishing stations

PROJECT STATION: 3484  
 DATE: 30/ 7/04 GEAR TYPE: PT No: 1 POSITION: Lat S 616  
 start stop duration Long E 1156  
 TIME :01:43:39 02:04:28 21 (min) Purpose code: 3  
 LOG :4383.46 4384.85 1.37 Area code : 3  
 FDEPTH: 18 21 GearCond.code: 3  
 BDEPTH: 78 83 Validity code:  
 Towing dir: 240ø Wire out: 110 m Speed: 38 kn\*10  
 Sorted: 23 Kg Total catch: 22.78 CATCH/HOUR: 65.09

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
BREGMACEROTIDAE	57.14 43429	87.79	7366
Saurida brasiliensis	7.57 909	11.63	
Trachurus trecae	0.14 6	0.22	
Trichiurus lepturus	0.14 6	0.22	
Selene dorsalis, juveniles	0.09 6	0.14	
<b>Total</b>	<b>65.08</b>	<b>100.00</b>	

PROJECT STATION: 3489  
 DATE: 31/ 7/04 GEAR TYPE: BT No: 15 POSITION: Lat S 640  
 start stop duration Long E 1207  
 TIME :09:04:49 09:35:02 30 (min) Purpose code: 3  
 LOG :4646.03 4647.61 1.55 Area code : 3  
 FDEPTH: 72 77 GearCond.code: 3  
 BDEPTH: 72 77 Validity code:  
 Towing dir: 242ø Wire out: 250 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: 92.67 CATCH/HOUR: 185.34

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
Pagellus bellottai	81.40 1054	43.92	
Dentex congoensis	69.00 1168	37.23	
Carcharhinus signatus	10.30 8	5.56	
Sepia bertheloti	7.38 12	3.98	
Zeus faber	4.20 8	2.27	
Chelidonichthys capensis	3.26 30	1.76	
Fistularia petimba	2.02 8	1.09	
Alloteuthis africana	1.88 522	1.01	
Priacanthus arenatus	1.72 4	0.93	
Brachydeuterus auritus	1.46 14	0.79	
Raja miraletus	0.94 2	0.51	
Dentex angolensis	0.50 2	0.27	
Loligo vulgaris	0.38 8	0.21	
Trachurus trecae	0.34 8	0.18	7372
Chaetodon hoefleri	0.26 2	0.14	
Saurida brasiliensis	0.16 34	0.09	
Boops boops	0.14 6	0.08	
<b>Total</b>	<b>185.34</b>	<b>100.02</b>	

PROJECT STATION: 3485  
 DATE: 30/ 7/04 GEAR TYPE: PT No: 1 POSITION: Lat S 610  
 start stop duration Long E 1206  
 TIME :05:29:35 05:40:37 11 (min) Purpose code: 3  
 LOG :4411.01 4411.71 6.75 Area code : 3  
 FDEPTH: 21 25 GearCond.code: 3  
 BDEPTH: 49 46 Validity code:  
 Towing dir: 65ø Wire out: m Speed: kn\*10  
 Sorted: 3 Kg Total catch: 3.44 CATCH/HOUR: 18.76

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
BREGMACEROTIDAE	12.05 12807	64.23	
Trichiurus lepturus	6.55 5	34.91	
Sepia officinalis hierredda	0.16 5	0.85	
<b>Total</b>	<b>18.76</b>	<b>99.99</b>	

PROJECT STATION: 3490  
 DATE: 31/ 7/04 GEAR TYPE: PT No: 1 POSITION: Lat S 702  
 start stop duration Long E 1159  
 TIME :19:26:28 19:41:30 15 (min) Purpose code: 3  
 LOG :4736.08 4736.92 0.81 Area code : 3  
 FDEPTH: 100 100 GearCond.code: 3  
 BDEPTH: 130 144 Validity code:  
 Towing dir: 240ø Wire out: 310 m Speed: 33 kn\*10  
 Sorted: Kg Total catch: 9.11 CATCH/HOUR: 36.44

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
Sepiella ornata	22.16 932	60.81	
MYCTOPHIDAE	13.24 3668	36.33	
Trachurus trecae	1.04 24	2.85	7373
<b>Total</b>	<b>36.44</b>	<b>99.99</b>	

PROJECT STATION: 3486  
 DATE: 30/ 7/04 GEAR TYPE: BT No: 15 POSITION: Lat S 627  
 start stop duration Long E 1150  
 TIME :08:12:04 08:42:11 30 (min) Purpose code: 3  
 LOG :4433.37 4434.90 1.51 Area code : 3  
 FDEPTH: 117 111 GearCond.code: 3  
 BDEPTH: 117 111 Validity code:  
 Towing dir: 65ø Wire out: 360 m Speed: 30 kn\*10  
 Sorted: 74 Kg Total catch: 180.92 CATCH/HOUR: 361.84

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
Dentex congoensis	225.80 2432	62.40	7368
Dentex angolensis	79.80 442	22.05	7369
Trichiurus lepturus	22.70 44	6.27	
Loligo vulgaris	9.38 286	2.59	
Todaropsis eblanae	6.22 138	1.72	
Raja clavata	6.02 4	1.66	
Umbrina canariensis	4.28 10	1.18	
Spicara alta	2.40 102	0.66	
Pterochirissus bellocci	2.02 14	0.56	
Priacanthus arenatus	1.80 4	0.50	
Trachurus trecae	0.58 12	0.16	7367
Boops boops	0.42 14	0.12	
Aricomma bondi	0.42 4	0.12	
<b>Total</b>	<b>361.84</b>	<b>99.99</b>	

PROJECT STATION: 3491  
 DATE: 31/ 7/04 GEAR TYPE: PT No: 1 POSITION: Lat S 702  
 start stop duration Long E 1158  
 TIME :19:46:54 20:01:57 15 (min) Purpose code: 3  
 LOG :4737.19 4738.03 0.83 Area code : 3  
 FDEPTH: 60 60 GearCond.code: 3  
 BDEPTH: 156 193 Validity code:  
 Towing dir: 240ø Wire out: 182 m Speed: 33 kn\*10  
 Sorted: Kg Total catch: 30.88 CATCH/HOUR: 123.52

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	113.80 66740	92.13	
Trichiurus lepturus	6.48 8	5.25	
Trachurus trecae	2.28 48	1.85	7374
Sepiella ornata	0.64 24	0.52	
Synagrops microlepis	0.32 20	0.26	
<b>Total</b>	<b>123.52</b>	<b>100.01</b>	

PROJECT STATION: 3487  
 DATE: 30/ 7/04 GEAR TYPE: BT No: 15 POSITION: Lat S 612  
 start stop duration Long E 1139  
 TIME :12:30:22 13:11:57 42 (min) Purpose code: 3  
 LOG :4469.82 4471.98 2.02 Area code : 3  
 FDEPTH: 119 129 GearCond.code: 3  
 BDEPTH: 119 129 Validity code:  
 Towing dir: 320ø Wire out: 360 m Speed: 31 kn\*10  
 Sorted: 184 Kg Total catch: 183.54 CATCH/HOUR: 262.20

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
Dentex congoensis	103.36 1023	39.42	
Aricomma bondi	76.43 1989	29.15	
Dentex angolensis	63.00 193	24.03	
Trachurus trecae	10.31 83	3.93	7370
Todaropsis eblanae	3.50 101	1.33	
Zenopsis conchifer	1.43 1	0.55	
Zeus faber	1.20 3	0.46	
Dentex gibbosus	0.99 1	0.38	
Chelidonichthys capensis	0.74 9	0.28	
Priacanthus arenatus	0.47 1	0.18	
Scomber japonicus	0.29 1	0.11	
Spicara alta	0.26 4	0.10	
Boops boops	0.23 4	0.09	
<b>Total</b>	<b>262.21</b>	<b>100.01</b>	

PROJECT STATION: 3492  
 DATE: 31/ 7/04 GEAR TYPE: PT No: 1 POSITION: Lat S 703  
 start stop duration Long E 1157  
 TIME :20:08:43 20:23:37 15 (min) Purpose code: 3  
 LOG :4738.40 4739.32 0.92 Area code : 3  
 FDEPTH: 30 30 GearCond.code: 3  
 BDEPTH: 214 268 Validity code:  
 Towing dir: 240ø Wire out: 100 m Speed: 37 kn\*10  
 Sorted: Kg Total catch: 121.30 CATCH/HOUR: 485.20

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	470.20 380636	96.91	
Trichiurus lepturus	14.68 28	3.03	
Sepiella ornata	0.32 8	0.07	
<b>Total</b>	<b>485.20</b>	<b>100.01</b>	

PROJECT STATION: 3488  
 DATE: 31/ 7/04 GEAR TYPE: PT No: 1 POSITION: Lat S 648  
 start stop duration Long E 1147  
 TIME :01:32:39 02:02:37 30 (min) Purpose code: 3  
 LOG :4593.81 4596.02 2.19 Area code : 3  
 FDEPTH: 20 14 GearCond.code: 3  
 BDEPTH: 315 232 Validity code:  
 Towing dir: 56ø Wire out: 90 m Speed: 42 kn\*10  
 Sorted: Kg Total catch: 137.48 CATCH/HOUR: 274.96

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	254.00 266440	92.38	
Trichiurus lepturus	20.90 30	7.60	7371
Argonauta sp.	0.06 2	0.02	
<b>Total</b>	<b>274.96</b>	<b>100.00</b>	

PROJECT STATION: 3493  
 DATE: 1/ 8/04 GEAR TYPE: PT No: 1 POSITION: Lat S 706  
 start stop duration Long E 1219  
 TIME :11:22:53 11:52:30 30 (min) Purpose code: 3  
 LOG :4864.29 4866.54 2.24 Area code : 3  
 FDEPTH: 14 12 GearCond.code: 3  
 BDEPTH: 90 88 Validity code:  
 Towing dir: 346ø Wire out: 90 m Speed: 44 kn\*10  
 Sorted: Kg Total catch: 0.33 CATCH/HOUR: 0.66

SPECIES	CATCH/HOUR weight numbers	% OF TOT. C	SAMP
Sepiella ornata	0.64 52	96.97	
Trachurus trecae, juvenile	0.02 6	3.03	7375
<b>Total</b>	<b>0.66</b>	<b>100.00</b>	

PROJECT STATION:3494  
 DATE: 1/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 713  
 start stop duration Long E 1214  
 TIME :13:57:42 14:30:08 32 (min) Purpose code: 3  
 LOG :4883.76 4885.44 1.67 Area code : 3  
 FDEPTH: 143 143 GearCond.code:  
 BDEPTH: 143 143 Validity code:  
 Towing dir: 135ø Wire out: 350 m Speed: 31 kn\*10  
 Sorted: 95 Kg Total catch: 333.24 CATCH/HOUR: 624.83

PROJECT STATION:3499  
 DATE: 2/ 8/04 GEAR TYPE: PT No: 6 POSITION:Lat S 726  
 start stop duration Long E 1239  
 TIME :19:25:40 19:55:37 30 (min) Purpose code: 3  
 LOG :5112.29 5114.06 1.72 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 76 71 Validity code:  
 Towing dir: 64ø Wire out: 150 m Speed: 36 kn\*10  
 Sorted: Kg Total catch: 84.69 CATCH/HOUR: 169.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Spicara alta	353.81	2123	56.63	
Trachurus trecae	117.81	2091	18.85	7376
Dentex angolensis	58.09	308	9.30	
Dentex congolensis	40.31	131	6.45	
Umbrina canariensis	19.50	53	3.12	
Boops boops	17.93	664	2.87	
Miracorvina angolensis	9.13	21	1.46	
Erythrocles monodi	4.80	53	0.77	
Illex coindetii	1.88	30	0.30	
Pterothrissus bellotti	1.58	13	0.25	
Total	624.84		100.00	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	53.20	194	31.41	7389
Sardinella maderensis	43.00	158	25.39	7386
Lagocephalus laevigatus	28.80	48	17.00	
Trichiurus lepturus	24.80	26	14.64	
Sepiella ornata	5.84	206	3.45	
Sepia officinalis hierredda	4.40	102	2.60	
Echeneis naucrates	2.42	4	1.43	
Loligo vulgaris	2.24	312	1.32	
Trachurus trecae	2.10	58	1.24	7387
Saurida brasiliensis	1.30	130	0.77	
Illex coindetii	1.28	246	0.76	
Total	169.38		100.01	

PROJECT STATION:3495  
 DATE: 1/ 8/04 GEAR TYPE: PT No: 3 POSITION:Lat S 702  
 start stop duration Long E 1226  
 TIME :20:41:21 21:11:08 30 (min) Purpose code: 3  
 LOG :4946.20 4947.98 1.79 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 51 56 Validity code:  
 Towing dir: 178ø Wire out: 140 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 90.65 CATCH/HOUR: 181.30

PROJECT STATION:3500  
 DATE: 2/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 721  
 start stop duration Long E 1248  
 TIME :21:08:09 21:38:06 30 (min) Purpose code: 3  
 LOG :5122.63 5124.35 1.66 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 31 22 Validity code:  
 Towing dir: 64ø Wire out: 150 m Speed: 33 kn\*10  
 Sorted: Kg Total catch: 50.81 CATCH/HOUR: 101.62

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	155.70	1112	85.88	7378
Decapterus rhonchus	12.76	16	7.04	
Trachurus trecae	6.20	22	3.42	7377
Stromateus fiatola	3.94	4	2.17	
Sardinella maderensis	2.22	6	1.22	7379
Illex coindetii	0.38	84	0.21	
Sepiella ornata	0.08	4	0.04	
Sepia officinalis hierredda	0.02	2	0.01	
Total	181.30		99.99	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L Y F I S H	93.60	94	92.11	
Elops lacerta	5.46	10	5.37	
Sepia orbignyana	1.04	6	1.02	
Boops boops	1.04	56	1.02	
Arnoglossus imperialis	0.32	24	0.31	
Bothus podas africanus	0.10	2	0.10	
Antennarius sp.	0.06	2	0.06	
Total	101.62		99.99	

PROJECT STATION:3496  
 DATE: 1/ 8/04 GEAR TYPE: PT No: 6 POSITION:Lat S 658  
 start stop duration Long E 1227  
 TIME :22:36:46 22:53:04 16 (min) Purpose code: 3  
 LOG :4958.06 4958.99 0.92 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 41 43 Validity code:  
 Towing dir: 232ø Wire out: 140 m Speed: 34 kn\*10  
 Sorted: 57 Kg Total catch: 512.37 CATCH/HOUR: 1921.39

PROJECT STATION:3501  
 DATE: 3/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 736  
 start stop duration Long E 1243  
 TIME :03:40:46 04:10:14 29 (min) Purpose code: 3  
 LOG :5179.71 5181.42 1.67 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 93 99 Validity code:  
 Towing dir: 240ø Wire out: 140 m Speed: 35 kn\*10  
 Sorted: 80 Kg Total catch: 136.30 CATCH/HOUR: 282.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	966.94	5400	50.33	7381
Sardinella aurita	950.06	4889	49.45	7380
Selene dorsalis	4.39	34	0.23	
Total	1921.39		100.01	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	173.59	732	61.56	7393
Trichiurus lepturus	41.86	64	14.84	
Decapterus rhonchus	29.09	60	10.32	7390
Trachurus trecae, juvenile	26.94	573	9.55	7391
Sardinella aurita	6.17	21	2.19	7392
Illex coindetii	2.05	176	0.73	
Scomber japonicus	1.82	4	0.65	
Saurida brasiliensis	0.29	99	0.10	
Sepia officinalis hierredda	0.21	10	0.07	
Total	282.02		100.01	

PROJECT STATION:3497  
 DATE: 2/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 702  
 start stop duration Long E 1236  
 TIME :01:42:30 02:07:37 25 (min) Purpose code: 3  
 LOG :4982.72 4984.16 1.42 Area code : 3  
 FDEPTH: 14 14 GearCond.code:  
 BDEPTH: 33 27 Validity code:  
 Towing dir: 50ø Wire out: 170 m Speed: 34 kn\*10  
 Sorted: Kg Total catch: 81.40 CATCH/HOUR: 195.36

PROJECT STATION:3502  
 DATE: 3/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 743  
 start stop duration Long E 1258  
 TIME :15:12:15 15:53:21 41 (min) Purpose code: 3  
 LOG :5269.54 5271.95 2.39 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 42 50 Validity code:  
 Towing dir: 245ø Wire out: 150 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 13.89 CATCH/HOUR: 20.33

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	74.64	365	38.21	7382
Sardinella maderensis	66.60	403	34.09	7383
J E L Y F I S H	35.16	24	18.00	
Boops boops	12.00	470	6.14	
Brachydeuterus auritus	5.66	84	2.90	7384
Scomber japonicus	1.06	12	0.54	
Decapterus rhonchus	0.24	14	0.12	
Total	195.36		100.00	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Loligo vulgaris	13.76	3982	67.68	
Stromateus fiatola	3.91	6	19.23	
Trichiurus lepturus	1.23	1	6.05	
Selene dorsalis	0.88	3	4.33	
Echeneis naucrates	0.25	1	1.23	
Sepia orbignyana	0.12	3	0.59	
Sepia officinalis hierredda	0.10	1	0.49	
Trachurus trecae, juvenile	0.09	202	0.44	7394
Total	20.34		100.04	

PROJECT STATION:3498  
 DATE: 2/ 8/04 GEAR TYPE: PT No: 6 POSITION:Lat S 711  
 start stop duration Long E 1235  
 TIME :05:47:19 06:00:19 13 (min) Purpose code: 3  
 LOG :5016.81 5017.62 0.54 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 47 46 Validity code:  
 Towing dir: 340ø Wire out: 140 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 1.20 CATCH/HOUR: 5.54

PROJECT STATION:3503  
 DATE: 3/ 8/04 GEAR TYPE: PT No: 6 POSITION:Lat S 744  
 start stop duration Long E 1300  
 TIME :17:38:37 17:48:35 10 (min) Purpose code: 3  
 LOG :5285.72 5286.35 0.42 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 32 34 Validity code:  
 Towing dir: 311ø Wire out: 120 m Speed: 38 kn\*10  
 Sorted: 94 Kg Total catch: 656.16 CATCH/HOUR: 3936.96

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	3.55	14	64.08	7385
Sardinella aurita	1.98	9	35.74	7386
Total	5.53		99.82	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	2024.40	14448	51.42	7397
Sardinella aurita	1808.40	8982	45.93	7396
Sardinella maderensis - Juv.	53.76	924	1.37	7395
Brachydeuterus auritus	28.98	756	0.74	
Selene dorsalis	9.66	168	0.25	
Sepiella ornata	6.30	84	0.16	
Ilisha africana	2.52	42	0.06	
Trichiurus lepturus	1.68	42	0.04	
Engraulis encrasicolus	1.26	42	0.03	
Total	3936.96		100.00	

PROJECT STATION:3504  
 DATE: 3/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 749  
 start stop duration Long E 1303  
 TIME :19:23:56 19:54:32 31 (min) Purpose code: 3  
 LOG :5298.01 5299.80 1.79 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 19 23 Validity code:  
 Towing dir: 345ø Wire out: 140 m Speed: 35 kn\*10  
 Sorted: 34 Kg Total catch: 102.33 CATCH/HOUR: 198.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus Juv.	135.29	14255	68.31	7400
Flissha africana	27.46	592	13.86	
Trichiurus lepturus	11.32	203	5.72	
Trachurus trecae, juvenile	6.91	708	3.49	7398
Galeoides decadactylus	6.33	186	3.20	
Elops lacerta	2.79	6	1.41	
Pteroscion pelli	2.55	81	1.29	
Pomadasya jubelini	2.38	6	1.20	
Sphyræna sphyraena	1.05	6	0.53	
Sardinella maderensis - Juv.	0.81	41	0.41	7399
Selene dorsalis	0.70	12	0.35	
Sepiella ornata	0.23	6	0.12	
Engraulis encrasicolus	0.17	6	0.09	
Parapeanaeus longirostris	0.06	6	0.03	
Total	198.05		100.01	

PROJECT STATION:3509  
 DATE: 4/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 807  
 start stop duration Long E 1248  
 TIME :13:10:23 13:40:15 30 (min) Purpose code: 3  
 LOG :5426.27 5427.83 1.56 Area code : 3  
 FDEPTH: 128 128 GearCond.code:  
 BDEPTH: 128 128 Validity code:  
 Towing dir: 145ø Wire out: 380 m Speed: 31 kn\*10  
 Sorted: Kg Total catch: 72.37 CATCH/HOUR: 144.74

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex congoensis	66.20	376	45.74	
Dentex angolensis	31.70	354	21.90	
Dentex macrophthalmus	17.20	42	11.88	
Loligo vulgaris	11.80	464	8.15	
Zeus faber	6.04	16	4.17	
Trichiurus lepturus	2.98	4	2.06	
Chelidonichthys capensis	2.52	16	1.74	
Chaetodon hoefleri	1.84	16	1.27	
Atractoscion aequidens	1.70	2	1.17	
Zenopsis conchifer	1.38	2	0.95	
Lagocephalus laevigatus	1.12	2	0.77	
Pterothrissus belloci	0.26	2	0.18	
Total	144.74		99.98	

PROJECT STATION:3505  
 DATE: 3/ 8/04 GEAR TYPE: PT No: 6 POSITION:Lat S 756  
 start stop duration Long E 1250  
 TIME :22:55:30 23:26:38 31 (min) Purpose code: 3  
 LOG :5320.50 5322.33 1.82 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 103 94 Validity code:  
 Towing dir: 55ø Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 75 Kg Total catch: 831.66 CATCH/HOUR: 1609.66

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	686.61	2768	42.66	7402
Sardinella maderensis	680.23	3279	42.26	7403
Trichiurus lepturus	212.90	490	13.23	
Decapterus rhonchus	20.23	43	1.26	
Sepia orbignyana	4.05	128	0.25	
Loligo vulgaris	3.19	255	0.20	
Synagrops microlepis	1.49	319	0.09	
Saurida brasiliensis	0.64	21	0.04	
Trachurus trecae	0.33	8	0.02	7401
Total	1609.67		100.01	

PROJECT STATION:3509  
 DATE: 4/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 807  
 start stop duration Long E 1248  
 TIME :13:10:23 13:40:15 30 (min) Purpose code: 3  
 LOG :5426.27 5427.83 1.56 Area code : 3  
 FDEPTH: 128 128 GearCond.code:  
 BDEPTH: 128 128 Validity code:  
 Towing dir: 145ø Wire out: 380 m Speed: 31 kn\*10  
 Sorted: Kg Total catch: 72.37 CATCH/HOUR: 144.74

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex congoensis	66.20	376	45.74	
Dentex angolensis	31.70	354	21.90	
Dentex macrophthalmus	17.20	42	11.88	
Loligo vulgaris	11.80	464	8.15	
Zeus faber	6.04	16	4.17	
Trichiurus lepturus	2.98	4	2.06	
Chelidonichthys capensis	2.52	16	1.74	
Chaetodon hoefleri	1.84	16	1.27	
Atractoscion aequidens	1.70	2	1.17	
Zenopsis conchifer	1.38	2	0.95	
Lagocephalus laevigatus	1.12	2	0.77	
Pterothrissus belloci	0.26	2	0.18	
Total	144.74		99.98	

PROJECT STATION:3506  
 DATE: 4/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 800  
 start stop duration Long E 1255  
 TIME :05:04:36 05:24:04 19 (min) Purpose code: 3  
 LOG :5366.29 5367.43 1.13 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 97 103 Validity code:  
 Towing dir: 250ø Wire out: 144 m Speed: 35 kn\*10  
 Sorted: 105 Kg Total catch: 422.52 CATCH/HOUR: 1334.27

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1019.37	2324	76.40	7406
Trichiurus lepturus	193.89	717	14.53	
Decapterus punctatus	56.21	114	4.21	7405
Sardinella maderensis	42.57	152	3.19	7404
Stromateus fiatola	10.23	13	0.77	
Trachinotus ovatus	7.33	13	0.55	
Sepiella ornata	4.67	215	0.35	
Total	1334.27		100.00	

PROJECT STATION:3510  
 DATE: 4/ 8/04 GEAR TYPE: PT No: 6 POSITION:Lat S 810  
 start stop duration Long E 1312  
 TIME :19:52:00 20:20:33 29 (min) Purpose code: 3  
 LOG :5485.10 5486.81 1.79 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 34 36 Validity code:  
 Towing dir: 330ø Wire out: 140 m Speed: 38 kn\*10  
 Sorted: Kg Total catch: 82.71 CATCH/HOUR: 171.12

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pomadasya jubelini	78.93	269	46.11	
Brachydeuterus auritus	38.90	1574	22.73	7410
Sardinella maderensis - Juv.	20.94	1531	12.24	7412
Penaeus notialis	11.03	298	6.45	
Stromateus fiatola	7.90	14	4.62	
Sepiella ornata	5.21	23	3.04	
Trachurus trecae, juvenile	1.97	141	1.15	7409
Trichiurus lepturus	1.97	211	1.15	
Pteroscion pelli	1.72	215	1.01	
Sardinella aurita - Juveniles	1.45	74	0.85	7411
Sphyræna sphyraena	0.46	2	0.27	
Lutjanus agennes	0.33	2	0.19	
Pseudupeneus prayensis	0.19	2	0.11	
Boops boops	0.14	2	0.08	
Total	171.14		100.02	

PROJECT STATION:3507  
 DATE: 4/ 8/04 GEAR TYPE: PT No: 3 POSITION:Lat S 804  
 start stop duration Long E 1302  
 TIME :08:21:17 10:01:18 22 (min) Purpose code: 3  
 LOG :5404.54 5405.84 1.28 Area code : 3  
 FDEPTH: 50 50 GearCond.code:  
 BDEPTH: 76 68 Validity code:  
 Towing dir: 67ø Wire out: 180 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 36.60 CATCH/HOUR: 99.82

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	99.82	330	100.00	
Total	99.82		100.00	

PROJECT STATION:3511  
 DATE: 4/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 814  
 start stop duration Long E 1305  
 TIME :23:09:44 23:40:10 30 (min) Purpose code: 3  
 LOG :5506.69 5508.48 1.77 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 76 65 Validity code:  
 Towing dir: 50ø Wire out: 140 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 42.20 CATCH/HOUR: 84.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	16.80	132	43.60	
Bregmaceros sp	18.90	18530	22.39	
Sardinella maderensis	11.18	44	13.25	7414
Sardinella aurita	8.86	36	10.50	7413
Sepiella ornata	2.92	36	3.46	
Pomadasya jubelini	2.60	8	3.08	
Loligo vulgaris	1.70	282	2.01	
Scomber japonicus	0.76	2	0.90	
Saurida brasiliensis	0.68	112	0.81	
Total	84.40		100.00	

PROJECT STATION:3508  
 DATE: 4/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 804  
 start stop duration Long E 1302  
 TIME :10:42:06 11:07:45 26 (min) Purpose code: 3  
 LOG :5407.94 5409.32 1.36 Area code : 3  
 FDEPTH: 73 79 GearCond.code:  
 BDEPTH: 73 79 Validity code:  
 Towing dir: 248ø Wire out: 210 m Speed: 31 kn\*10  
 Sorted: 88 Kg Total catch: 4003.31 CATCH/HOUR: 9238.41

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	7208.08	59926	78.02	7408
Trachurus trecae	1100.08	9953	11.91	7407
Synagrops microlepis	512.31	128656	5.55	
Trichiurus lepturus	359.31	1048	3.89	
Selene dorsalis	20.95	104	0.23	
Dentex congoensis	19.89	210	0.22	
Loligo vulgaris	9.42	3247	0.10	
Alloteuthis africana	8.38	1989	0.09	
Total	9238.42		100.01	

PROJECT STATION: 3512  
 DATE: 5/ 8/04 GEAR TYPE: PT No: 6 POSITION: Lat S 819  
 start stop duration Long E 1315  
 TIME 07:59:04 08:22:41 24 (min) Purpose code: 3  
 LOG :5572.67 5574.15 1.46 Area code : 3  
 FDEPTH: 10 10 GearCond.code: 3  
 BDEPTH: 37 44 Validity code:  
 Towing dir: 243ø Wire out: 160 m Speed: 38 kn\*10

Sorted: 62 Kg Total catch: 219.09 CATCH/HOUR: 547.73

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	415.18	3840	75.80	7416
Sardinella aurita	122.93	725	22.44	7415
Pomadasys jubelini	3.58	8	0.65	
Trichiurus lepturus	3.33	8	0.61	
Pomadasys incisus	2.28	8	0.42	
Bregmaceros sp.	0.43	568	0.08	
Total	547.73		100.00	

PROJECT STATION: 3513  
 DATE: 5/ 8/04 GEAR TYPE: BT No:15 POSITION: Lat S 819  
 start stop duration Long E 1319  
 TIME 09:43:15 10:13:28 30 (min) Purpose code: 3  
 LOG :5583.61 5585.23 1.62 Area code : 3  
 FDEPTH: 22 21 GearCond.code: 3  
 BDEPTH: 22 21 Validity code:  
 Towing dir: 343ø Wire out: 135 m Speed: 32 kn\*10

Sorted: 30 Kg Total catch: 184.26 CATCH/HOUR: 368.52

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus Juv.	257.28	17076	69.81	7419
Selene dorsalis	45.96	744	12.47	7418
Galeoides decadactylus	36.00	72	9.77	
Atractoscion aequidens	7.44	24	2.02	
Pomadasys peroteti	7.44	24	2.02	
Stromateus fiatola	6.24	36	1.69	
Trichiurus lepturus	4.32	240	1.17	
Alectis alexandrinus	1.20	36	0.33	
Sphyræna sphyraena	1.08	12	0.29	
Sepiella ornata	0.60	12	0.16	
Dactylopterus volitans	0.48	12	0.13	
Trachurus trecae, juvenile	0.48	120	0.13	7417
Total	368.52		99.99	

PROJECT STATION: 3514  
 DATE: 5/ 8/04 GEAR TYPE: \*T No:15 POSITION: Lat S 837  
 start stop duration Long E 1254  
 TIME :16:20:52 17:10:13 49 (min) Purpose code: 1  
 LOG :5642.37 5644.87 2.49 Area code : 3  
 FDEPTH: 413 403 GearCond.code: 9  
 BDEPTH: 413 403 Validity code:  
 Towing dir: 360ø Wire out: 1050 m Speed: 30 kn\*10

Sorted: 28 Kg Total catch: 307.07 CATCH/HOUR: 376.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius polli	243.12	889	64.66	
Nematocarcinus africanus	115.84	43856	30.81	
Hoplostethus cadematl	5.39	175	1.43	
Centrophorus granulosus	4.53	1	1.20	
Nezumia aequalis	2.83	54	0.75	
Lamprogrammus exultans	2.56	54	0.68	
MURAENIDAE	0.81	13	0.22	
Todaropsis eblanae	0.81	13	0.22	
Etmopterus polli	0.12	4	0.03	
Total	376.01		100.00	

PROJECT STATION: 3515  
 DATE: 5/ 8/04 GEAR TYPE: PT No: 6 POSITION: Lat S 836  
 start stop duration Long E 1318  
 TIME 20:36:41 21:06:20 30 (min) Purpose code: 3  
 LOG :5673.75 5675.61 1.82 Area code : 3  
 FDEPTH: 10 10 GearCond.code: 3  
 BDEPTH: 38 49 Validity code:  
 Towing dir: 270ø Wire out: 150 m Speed: 37 kn\*10

Sorted: 89 Kg Total catch: 178.12 CATCH/HOUR: 356.24

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	162.60	872	45.64	7423
Brachydeuterus auritus	104.80	656	29.42	7421
Trichiurus lepturus	63.20	1640	17.74	
Sardinella aurita	17.00	72	4.77	7422
Bregmaceros sp.	5.96	8344	1.67	
Synagrops microlepis	1.12	236	0.31	
Sepiella ornata	0.80	8	0.22	
Selene dorsalis	0.60	4	0.17	
Trachurus trecae, juvenile	0.12	56	0.03	7420
Saurida brasiliensis	0.04	4	0.01	
Total	356.24		99.98	

PROJECT STATION: 3516  
 DATE: 8/ 8/04 GEAR TYPE: BT No:15 POSITION: Lat S 911  
 start stop duration Long E 1256  
 TIME :07:24:26 07:35:58 12 (min) Purpose code: 3  
 LOG :5922.91 5923.59 0.67 Area code : 2  
 FDEPTH: 21 26 GearCond.code: 2  
 BDEPTH: 21 26 Validity code:  
 Towing dir: 256ø Wire out: 150 m Speed: 30 kn\*10

Sorted: 89 Kg Total catch: 6055.60 CATCH/HOUR: 30278.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	12252.50	125060	40.47	
Selene dorsalis	4985.50	15380	16.47	
Brachydeuterus auritus	4410.90	181835	14.57	
Galeoides decadactylus	3261.70	35835	10.77	
Sardinella maderensis	1264.10	19265	4.17	7425
Lithognathus mormyrus	1233.70	3720	4.07	
Pteroscion pelli	905.85	107985	2.99	
Ilisha africana	621.90	11155	2.05	
Trachurus trecae	338.00	15210	1.12	7424
Pomadasys incisus	314.35	1350	1.04	
Sardinella aurita	304.20	2700	1.00	7426
Pagellus bellottii	216.30	1350	0.71	
Sphyræna sphyraena	169.00	2265	0.56	
Total	30278.00		99.99	

PROJECT STATION: 3517  
 DATE: 8/ 8/04 GEAR TYPE: BT No:15 POSITION: Lat S 914  
 start stop duration Long E 1254  
 TIME :09:04:59 09:14:38 10 (min) Purpose code: 3  
 LOG :5933.52 5934.03 0.50 Area code : 2  
 FDEPTH: 34 36 GearCond.code: 2  
 BDEPTH: 34 36 Validity code:  
 Towing dir: 170ø Wire out: 155 m Speed: 31 kn\*10

Sorted: 65 Kg Total catch: 5592.20 CATCH/HOUR: 33553.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	23626.20	267696	70.41	
Sardinella maderensis	2722.62	29916	8.11	7428
Brachydeuterus auritus	2408.22	7248	7.18	
Selene dorsalis	2352.48	34476	7.01	
Ilisha africana	1363.86	14196	4.06	
Sardinella aurita	512.10	3552	1.53	7429
Pteroscion pelli	380.28	6594	1.13	
Trachurus trecae	142.20	708	0.42	7427
Galeoides decadactylus	45.60	510	0.14	
Total	33553.56		99.99	

PROJECT STATION: 3518  
 DATE: 8/ 8/04 GEAR TYPE: PT No: 1 POSITION: Lat S 920  
 start stop duration Long E 1249  
 TIME :13:03:08 13:19:54 37 (min) Purpose code: 3  
 LOG :5958.14 5960.50 2.36 Area code : 2  
 FDEPTH: 50 55 GearCond.code: 2  
 BDEPTH: 103 82 Validity code:  
 Towing dir: 75ø Wire out: 200 m Speed: 37 kn\*10

Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION: 3519  
 DATE: 8/ 8/04 GEAR TYPE: PT No: 6 POSITION: Lat S 924  
 start stop duration Long E 1301  
 TIME :20:34:01 21:04:22 30 (min) Purpose code: 3  
 LOG :6018.05 6019.88 1.61 Area code : 2  
 FDEPTH: 0 0 GearCond.code: 2  
 BDEPTH: 31 44 Validity code:  
 Towing dir: 220ø Wire out: 150 m Speed: 37 kn\*10

Sorted: Kg Total catch: 193.60 CATCH/HOUR: 387.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Caranx crysos	236.60	958	61.11	
Sardinella maderensis	86.90	368	22.44	7430
Trachurus trecae, juvenile	18.12	4514	4.68	7431
Alectis alexandrinus	14.90	16	3.85	
Pomadasys jubelini	9.70	10	2.51	
Sphyræna guanchancho	5.10	12	1.37	
Sepia orbignyana	4.62	6	1.19	
Engraulis encrasicolus	2.92	598	0.75	
Stromateus fiatola	2.84	4	0.73	
Sardinella maderensis	2.52	10	0.65	
Trachinotus ovatus	1.28	4	0.33	
Alloteuthis sp.	0.88	108	0.23	
Boops boops	0.52	18	0.13	
Decapterus rhonchus	0.10	2	0.03	
Total	387.20		100.00	

PROJECT STATION: 3520  
 DATE: 8/ 8/04 GEAR TYPE: PT No: 3 POSITION: Lat S 928  
 start stop duration Long E 1301  
 TIME :22:59:30 23:20:41 21 (min) Purpose code: 3  
 LOG :6034.51 6035.89 1.36 Area code : 2  
 FDEPTH: 20 20 GearCond.code: 2  
 BDEPTH: 45 34 Validity code:  
 Towing dir: 70ø Wire out: 80 m Speed: 39 kn\*10

Sorted: Kg Total catch: 23.50 CATCH/HOUR: 67.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Saurida brasiliensis	23.60	5966	35.15	
Uraspis secunda	12.74	46	18.98	
Loligo vulgaris	10.43	5717	15.53	
Alloteuthis africana	6.94	2186	10.34	
Boops boops	3.77	234	5.62	
Pagellus bellottii	3.23	794	4.81	
Sardinella maderensis - Juv.	2.71	497	4.04	
Sepia officinalis hierredda	2.09	14	3.11	
Sphyræna sphyraena	0.89	3	1.33	
Bregmaceros atlanticus	0.74	271	1.10	
Total	67.14		100.01	

PROJECT STATION: 3521  
 DATE: 9/ 8/04 GEAR TYPE: BT No:15 POSITION: Lat S 944  
 start stop duration Long E 1255  
 TIME :09:03:29 09:33:21 30 (min) Purpose code: 3  
 LOG :6124.10 6125.68 1.59 Area code : 2  
 FDEPTH: 112 107 GearCond.code: 2  
 BDEPTH: 112 107 Validity code:  
 Towing dir: 70ø Wire out: 345 m Speed: 32 kn\*10

Sorted: 57 Kg Total catch: 430.13 CATCH/HOUR: 860.26

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Synagrops microlepis	382.50	158324	44.46	
Dentex macropthalmus	275.60	1036	32.04	
Trachurus trecae	139.90	446	16.26	7432
Umbrina canariensis	31.36	50	3.65	
Dentex angolensis	7.60	24	0.88	
Todarodes sagittatus	7.36	12	0.86	
Raja miraletus	7.36	12	0.86	
Boops boops	3.50	136	0.41	
Dentex barnardi	3.24	12	0.38	
Loligo vulgaris	1.36	50	0.16	
Nematocarcinus africanus	0.36	124	0.04	
Saurida brasiliensis	0.12	12	0.01	
Total	860.26		100.01	

PROJECT STATION: 3522  
 DATE: 9/ 8/04 GEAR TYPE: BT No. POSITION: Lat S 947  
 start stop duration Long E 1300  
 TIME :14:40:13 15:10:19 30 (min) Purpose code: 3  
 LOG :6171.69 6173.24 1.54 Area code : 2  
 FDEPTH: 95 87 GearCond.code: 2  
 BDEPTH: 95 87 Validity code:  
 Towing dir: 60ø Wire out: 300 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: 150.67 CATCH/HOUR: 301.34

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	109.50	390	36.34	7433
Trichiurus lepturus	88.20	156	29.27	
Umbrina canariensis	16.60	28	5.51	
Dentex angolensis	16.10	134	5.34	
Dentex congoensis	15.00	144	4.98	
Atractoscion aequidens	10.80	6	3.58	
Alloteuthis africana	10.34	2694	3.43	
Zeus faber	5.00	22	1.66	
Rhinebatos albomaculatus	3.20	2	1.06	
Loligo vulgaris	2.66	158	0.88	
Brotula barbata	2.60	2	0.86	
Chaetodon hoeferi	2.40	20	0.80	
Dentex barnardi	2.40	12	0.80	
Todaropsis eblanae	2.34	68	0.78	
Branchiostegus semifasciatus	2.30	4	0.76	
Chelidonicichthys capensis	2.06	12	0.68	
Brachydeuterus auritus	2.00	16	0.66	
Miracorvina angolensis	1.80	2	0.60	
Raja miraletus	1.60	4	0.53	
Sepia orbignyana	1.46	6	0.48	
Torpedo marmorata	1.10	4	0.37	
Dentex macrophthalmus	0.70	4	0.23	
Pagellus bellottii	0.50	4	0.17	
Citharus linguatula	0.40	4	0.13	
Saurida brasiliensis	0.28	64	0.09	
Total		301.34		99.99

PROJECT STATION: 3523  
 DATE: 9/ 8/04 GEAR TYPE: PT No. 1 POSITION: Lat S 945  
 start stop duration Long E 1306  
 TIME :16:04:55 16:35:39 31 (min) Purpose code: 3  
 LOG :6179.09 6180.98 1.79 Area code : 2  
 FDEPTH: 10 10 GearCond.code: 2  
 BDEPTH: 56 71 Validity code:  
 Towing dir: 250ø Wire out: 150 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: 1.25 CATCH/HOUR: 2.42

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	2.42	4	100.00	
Total		2.42		100.00

PROJECT STATION: 3524  
 DATE: 9/ 8/04 GEAR TYPE: PT No. 7 POSITION: Lat S 943  
 start stop duration Long E 1310  
 TIME :18:00:02 18:30:19 30 (min) Purpose code: 3  
 LOG :6191.08 6192.97 1.79 Area code : 2  
 FDEPTH: 10 10 GearCond.code: 2  
 BDEPTH: 29 38 Validity code:  
 Towing dir: 247ø Wire out: 155 m Speed: 36 kn\*10  
 Sorted: 58 Kg Total catch: 322.49 CATCH/HOUR: 644.98

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	382.24	2190	59.26	7435
Brachydeuterus auritus	198.56	2014	30.79	
Trachurus trecae	29.16	2552	4.52	7434
Trichiurus lepturus	15.30	176	2.37	
Sardinella aurita	9.80	56	1.52	
Boops boops	5.50	132	0.85	
Sepia officinalis hierredda	4.40	22	0.68	
Total		644.96		99.99

PROJECT STATION: 3525  
 DATE: 10/ 8/04 GEAR TYPE: PT No. 6 POSITION: Lat S 957  
 start stop duration Long E 1308  
 TIME :06:11:11 06:41:36 30 (min) Purpose code: 3  
 LOG :6265.88 6267.81 1.89 Area code : 2  
 FDEPTH: 15 28 GearCond.code: 2  
 BDEPTH: 67 78 Validity code:  
 Towing dir: 250ø Wire out: 120 m Speed: 38 kn\*10  
 Sorted: 66 Kg Total catch: 177.50 CATCH/HOUR: 355.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Selene dorsalis	235.20	2388	66.25	7437
Sardinella maderensis	83.90	636	23.63	7436
Chloroscombrus chrysurus	31.60	216	8.90	
Sardinella aurita	4.38	18	1.23	7438
Total		355.08		100.01

PROJECT STATION: 3526  
 DATE: 10/ 8/04 GEAR TYPE: PT No. 5 POSITION: Lat S 955  
 start stop duration Long E 1310  
 TIME :08:23:16 08:53:13 30 (min) Purpose code: 3  
 LOG :6280.18 6281.88 1.69 Area code : 2  
 FDEPTH: 45 44 GearCond.code: 2  
 BDEPTH: 45 44 Validity code:  
 Towing dir: 160ø Wire out: 180 m Speed: 34 kn\*10  
 Sorted: 69 Kg Total catch: 1612.35 CATCH/HOUR: 3224.70

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	2777.36	26748	86.13	
Trachurus trecae	265.62	12488	8.24	7439
Pagellus bellottii	116.50	1166	3.61	
Pseudupeneus prayensis	27.50	234	0.85	
Ilex coindetii	20.50	4846	0.64	
Fistularia petimba	17.24	46	0.53	
Total		3224.72		100.00

PROJECT STATION: 3527  
 DATE: 10/ 8/04 GEAR TYPE: BT No. POSITION: Lat S 1001  
 start stop duration Long E 1310  
 TIME :12:06:53 12:25:44 19 (min) Purpose code: 3  
 LOG :6309.98 6310.99 0.97 Area code : 2  
 FDEPTH: 64 59 GearCond.code: 2  
 BDEPTH: 64 59 Validity code:  
 Towing dir: 140ø Wire out: 180 m Speed: 31 kn\*10  
 Sorted: 67 Kg Total catch: 144.95 CATCH/HOUR: 457.74

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae, juvenile	163.42	31800	35.70	7441
Trachurus trecae	132.92	891	29.04	7440
Selene dorsalis	54.13	568	11.83	
Sepia orbignyana	25.33	123	5.53	
Alloteuthis africana	18.41	5624	4.02	
Trichiurus lepturus	13.26	13	2.90	
Sparus auriga *	11.91	171	2.60	
Zeus faber	11.02	41	2.41	
Raja miraletus	5.34	6	1.17	
Chelidonicichthys capensis	4.04	47	0.88	
Brachydeuterus auritus	3.82	32	0.83	
Dentex barnardi	3.28	19	0.72	
Pseudupeneus prayensis	3.19	25	0.70	
Umbrina canariensis	2.94	19	0.64	
Pagellus bellottii	1.42	13	0.31	
Citharus linguatula	1.01	25	0.22	
Chloroscombrus chrysurus	0.95	6	0.21	
Loligo vulgaris	0.47	6	0.10	
Fistularia petimba	0.47	25	0.10	
Trachinocephalus myops	0.41	6	0.09	
Total		457.74		100.00

PROJECT STATION: 3528  
 DATE: 10/ 8/04 GEAR TYPE: PT No. 7 POSITION: Lat S 1007  
 start stop duration Long E 1319  
 TIME :18:42:06 19:12:04 30 (min) Purpose code: 3  
 LOG :6368.58 6370.43 1.50 Area code : 2  
 FDEPTH: 0 0 GearCond.code: 2  
 BDEPTH: 27 37 Validity code:  
 Towing dir: 209ø Wire out: 160 m Speed: 38 kn\*10  
 Sorted: 55 Kg Total catch: 165.30 CATCH/HOUR: 330.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	166.50	1872	50.36	7443
Brachydeuterus auritus	94.50	1728	28.58	
Selene dorsalis	21.42	436	6.48	
Trachurus trecae	14.94	498	4.52	7442
Trichiurus lepturus	9.66	180	2.92	
Trachinotus ovatus	6.54	54	1.98	
Raja miraletus	4.80	6	1.45	
Sarda sarda	3.30	12	1.00	
Sardinella aurita	3.18	18	0.96	
Chloroscombrus chrysurus	2.58	18	0.78	
Sepia orbignyana	1.62	6	0.49	
Ilisha africana	1.14	12	0.34	
Sepia officinalis hierredda	0.42	6	0.13	
Total		330.60		99.99

PROJECT STATION: 3529  
 DATE: 10/ 8/04 GEAR TYPE: PT No. 3 POSITION: Lat S 1009  
 start stop duration Long E 1316  
 TIME :20:29:18 20:59:08 30 (min) Purpose code: 3  
 LOG :6377.77 6379.72 1.93 Area code : 2  
 FDEPTH: 25 25 GearCond.code: 2  
 BDEPTH: 51 53 Validity code:  
 Towing dir: 320ø Wire out: 120 m Speed: 39 kn\*10  
 Sorted: Kg Total catch: 69.70 CATCH/HOUR: 139.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	131.32	1128	94.20	
Bregmaceros sp.	2.78	7228	1.99	
Trachurus trecae	2.64	18	1.89	7444
Sepia orbignyana	1.58	16	1.13	
Trichiurus lepturus	1.12	10	0.80	
Merluccius polli	0.02	14	0.01	
Total		139.46		100.02

PROJECT STATION: 3530  
 DATE: 11/ 8/04 GEAR TYPE: BT No. 15 POSITION: Lat S 1020  
 start stop duration Long E 1313  
 TIME :08:23:30 08:53:05 30 (min) Purpose code: 3  
 LOG :6452.75 6454.31 1.55 Area code : 2  
 FDEPTH: 97 103 GearCond.code: 2  
 BDEPTH: 97 103 Validity code:  
 Towing dir: 245ø Wire out: 300 m Speed: 33 kn\*10  
 Sorted: 21 Kg Total catch: 85.20 CATCH/HOUR: 170.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex macrophthalmus	75.20	328	44.13	
Pagellus bellottii	65.20	232	38.26	
Dentex angolensis	7.60	32	4.46	
Zeus faber	7.50	16	4.40	
Dentex barnardi	5.60	128	3.29	
Umbrina canariensis	4.96	8	2.91	
Anthias anthias	2.00	8	1.17	
Chaetodon hoeferi	1.12	8	0.66	
Nematocarcinus africanus	0.72	400	0.42	
Todaropsis eblanae	0.48	8	0.28	
Total		170.38		99.98

PROJECT STATION: 3531  
 DATE: 11/ 8/04 GEAR TYPE: BT No. POSITION: Lat S 1016  
 start stop duration Long E 1325  
 TIME 12:39:59 13:13:29 34 (min) Purpose code: 3  
 LOG 6477.63 6479.44 1.79 Area code : 2  
 FDEPTH: 34 33 GearCond code: 2  
 BDEPTH: 34 33 Validity code:  
 Towing dir: 330ø Wire out: 150 m Speed: 32 kn\*10  
 Sorted: 116 Kg Total catch: 1491.55 CATCH/HOUR: 2632.15

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	1920.00	54595	72.94	
Trachurus trecae	327.53	4110	12.44	7446
Trichiurus lepturus	204.64	4087	7.77	
Pagellus bellottii	68.21	565	2.59	
Trachurus trecae, juvenile	64.38	5668	2.45	7445
Selene dorsalis	26.88	586	1.02	
Sepia orbignyana	7.45	21	0.28	
Boops boops	4.29	67	0.16	
Pterothrissus belloci	3.16	21	0.12	
Pseudupeneus prayensis	2.93	44	0.11	
Todaropsis eblanae - juvenile	2.70	994	0.10	
Total	2632.17		99.98	

PROJECT STATION: 3535  
 DATE: 12/ 8/04 GEAR TYPE: PT No. 6 POSITION: Lat S 1049  
 start stop duration Long E 1344  
 TIME 22:34:46 23:03:48 29 (min) Purpose code: 3  
 LOG 6731.81 6733.59 1.76 Area code : 2  
 FDEPTH: 10 10 GearCond code: 2  
 BDEPTH: 35 29 Validity code:  
 Towing dir: 356ø Wire out: 150 m Speed: 38 kn\*10  
 Sorted: 113 Kg Total catch: 855.46 CATCH/HOUR: 1769.92

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	1603.70	16214	90.61	
Pomadasyss jubelini	49.18	46	2.78	
Trichiurus lepturus	36.62	155	2.07	
Trachurus trecae	28.86	356	1.63	7452
Sardinella maderensis	20.94	93	1.18	7453
Stromateus fiatola	13.80	31	0.78	
Euthymus alletteratus	5.54	2	0.31	
Galeoides decadactylus	5.42	77	0.31	
Sardinella aurita	4.03	14	0.23	
Synagrops microlepis	1.86	46	0.11	
Total	1769.95		100.01	

PROJECT STATION: 3532  
 DATE: 11/ 8/04 GEAR TYPE: PT No. 3 POSITION: Lat S 1026  
 start stop duration Long E 1328  
 TIME 21:29:28 21:59:07 30 (min) Purpose code: 3  
 LOG 6556.60 6558.55 1.94 Area code : 2  
 FDEPTH: 25 20 GearCond code: 2  
 BDEPTH: 42 41 Validity code:  
 Towing dir: 337ø Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 28 Kg Total catch: 112.84 CATCH/HOUR: 225.68

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	138.40	9248	61.33	
Trachurus trecae	31.36	192	13.90	7447
Trachurus trecae, juvenile	24.48	6560	10.85	7448
Sepia officinalis hierredda	11.92	88	5.28	
Bregmaceros sp.	6.24	8032	2.76	
Trichiurus lepturus	4.64	56	2.06	
Pomadasyss incisus	3.68	16	1.63	
Pagellus bellottii	1.44	8	0.64	
Sardinella maderensis	1.36	8	0.60	
Boops boops	1.12	24	0.50	
Alloteuthis africana	1.04	528	0.46	
Total	225.68		100.01	

PROJECT STATION: 3536  
 DATE: 11/ 8/04 GEAR TYPE: PT No. 1 POSITION: Lat S 1103  
 start stop duration Long E 1338  
 TIME 04:14:42 04:34:09 19 (min) Purpose code: 3  
 LOG 6782.18 6783.38 1.19 Area code : 2  
 FDEPTH: 13 13 GearCond code: 2  
 BDEPTH: 116 130 Validity code:  
 Towing dir: 260ø Wire out: 150 m Speed: 37 kn\*10  
 Sorted: 59 Kg Total catch: 1093.36 CATCH/HOUR: 3452.72

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	3151.83	12095	91.29	7454
Scomber japonicus	248.87	527	7.21	
Trichiurus lepturus	47.34	60	1.37	
Loligo vulgaris	4.67	60	0.14	
Total	3452.71		100.01	

PROJECT STATION: 3533  
 DATE: 12/ 8/04 GEAR TYPE: PT No. 7 POSITION: Lat S 1029  
 start stop duration Long E 1334  
 TIME 23:56:31 00:38:58 42 (min) Purpose code: 3  
 LOG 6573.88 6576.44 0.70 Area code : 2  
 FDEPTH: 10 10 GearCond code: 2  
 BDEPTH: 24 25 Validity code:  
 Towing dir: 275ø Wire out: 170 m Speed: 35 kn\*10  
 Sorted: 91 Kg Total catch: 913.70 CATCH/HOUR: 1305.29

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	628.57	9986	48.16	
Sardinella aurita	447.14	3843	34.26	7449
Sardinella maderensis	109.57	1743	8.39	7450
Pomadasyss jubelini	41.86	43	3.21	
Sepia orbignyana	30.71	14	2.35	
Arius parkii	28.86	29	2.21	
Galeoides decadactylus	8.14	14	0.62	
Trichiurus lepturus	7.00	86	0.54	
Pomadasyss incisus	2.14	14	0.16	
Trachurus trecae	1.29	14	0.10	
Total	1305.28		100.00	

PROJECT STATION: 3537  
 DATE: 13/ 8/04 GEAR TYPE: PT No. 3 POSITION: Lat S 1102  
 start stop duration Long E 1342  
 TIME 05:59:01 06:45:56 47 (min) Purpose code: 3  
 LOG 6792.95 6795.79 1.19 Area code : 2  
 FDEPTH: 30 50 GearCond code: 2  
 BDEPTH: 79 88 Validity code:  
 Towing dir: 81ø Wire out: 180 m Speed: 37 kn\*10  
 Sorted: 58 Kg Total catch: 438.70 CATCH/HOUR: 560.04

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	560.11	2298	100.01	7455
Total	560.11		100.01	

PROJECT STATION: 3533  
 DATE: 12/ 8/04 GEAR TYPE: PT No. 7 POSITION: Lat S 1029  
 start stop duration Long E 1334  
 TIME 23:56:31 00:38:58 42 (min) Purpose code: 3  
 LOG 6573.88 6576.44 0.70 Area code : 2  
 FDEPTH: 10 10 GearCond code: 2  
 BDEPTH: 24 25 Validity code:  
 Towing dir: 275ø Wire out: 170 m Speed: 35 kn\*10  
 Sorted: 91 Kg Total catch: 913.70 CATCH/HOUR: 1305.29

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	628.57	9986	48.16	
Sardinella aurita	447.14	3843	34.26	7449
Sardinella maderensis	109.57	1743	8.39	7450
Pomadasyss jubelini	41.86	43	3.21	
Sepia orbignyana	30.71	14	2.35	
Arius parkii	28.86	29	2.21	
Galeoides decadactylus	8.14	14	0.62	
Trichiurus lepturus	7.00	86	0.54	
Pomadasyss incisus	2.14	14	0.16	
Trachurus trecae	1.29	14	0.10	
Total	1305.28		100.00	

PROJECT STATION: 3538  
 DATE: 13/ 8/04 GEAR TYPE: BT No. POSITION: Lat S 1102  
 start stop duration Long E 1349  
 TIME 09:03:38 09:33:33 30 (min) Purpose code: 3  
 LOG 6812.79 6814.51 0.78 Area code : 2  
 FDEPTH: 39 33 GearCond code: 2  
 BDEPTH: 39 33 Validity code:  
 Towing dir: 350ø Wire out: 160 m Speed: 32 kn\*10  
 Sorted: Kg Total catch: 6.07 CATCH/HOUR: 12.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	11.14	76	91.76	
Trachurus trecae	0.38	4	3.13	
Squilla mantis	0.38	2	3.13	
Scorpaena angolensis	0.12	2	0.99	
Chelidonichthys capensis	0.08	2	0.66	
Paromola cuvieri	0.04	2	0.33	
Total	12.14		100.00	

PROJECT STATION: 3534  
 DATE: 12/ 8/04 GEAR TYPE: PT No. 6 POSITION: Lat S 1051  
 start stop duration Long E 1334  
 TIME 18:08:32 18:38:20 30 (min) Purpose code: 3  
 LOG 6708.54 6710.30 1.74 Area code : 2  
 FDEPTH: 10 10 GearCond code: 2  
 BDEPTH: 107 118 Validity code:  
 Towing dir: 245ø Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 60 Kg Total catch: 818.78 CATCH/HOUR: 1637.56

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1318.96	5050	80.54	7451
Trichiurus lepturus	202.50	568	12.37	
Sardinella maderensis	85.32	298	5.21	
Sarda sarda	20.52	28	1.25	
Scomber japonicus	10.26	28	0.63	
Total	1637.56		100.00	

PROJECT STATION: 3539  
 DATE: 13/ 8/04 GEAR TYPE: BT No. POSITION: Lat S 1107  
 start stop duration Long E 1337  
 TIME 12:49:32 13:20:17 31 (min) Purpose code: 3  
 LOG 6837.69 6839.27 1.57 Area code : 2  
 FDEPTH: 128 128 GearCond code: 2  
 BDEPTH: 128 128 Validity code:  
 Towing dir: 170ø Wire out: 360 m Speed: 31 kn\*10  
 Sorted: 352 Kg Total catch: 1056.18 CATCH/HOUR: 2044.22

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex macrophthalmus	733.16	3734	35.87	
Trachurus trecae	556.26	1417	27.21	7456
Trichiurus lepturus	414.19	1452	20.26	
Pterothrissus belloci	71.42	615	3.49	
Brotula barbata	68.23	81	3.34	
Dentex angolensis	63.58	314	3.11	
Umbrina canariensis	30.19	221	1.48	
Synagrops microlepis	26.71	2212	1.31	
Atractoscion aequidens	20.32	12	0.99	
Todaropsis eblanae	18.52	546	0.91	
Zeus faber	9.29	64	0.45	
Merluccius polli	7.32	395	0.36	
Branchiostegus semifasciatus	6.74	6	0.33	
Uranoscopus cadenati	5.40	41	0.26	
Parapenaeus longirostris	2.73	581	0.13	
Mycteroperca rubra	2.15	6	0.11	
Dentex barnardi	1.68	6	0.08	
Spicara alta	1.57	17	0.08	
Citharus linguatula	1.51	23	0.07	
Scorpaena normani	1.45	17	0.07	
Loligo vulgaris	0.93	17	0.05	
Trachurus capensis	0.87	6	0.04	
Total	2044.22		100.00	

PROJECT STATION: 3540  
 DATE: 14/ 8/04 GEAR TYPE: PT No: 1 POSITION: Lat S 1128  
 start stop duration Long E 1341  
 TIME : 02:08:15 02:40:21 32 (min) Purpose code: 3  
 LOG : 6945.31 6947.35 2.02 Area code : 2  
 FDEPTH: 10 10 GearCond code:  
 BDEPTH: 34 41 Validity code:  
 Towing dir: 252ø Wire out: 150 m Speed: 38 kn\*10  
 Sorted: 93 Kg Total catch: 369.77 CATCH/HOUR: 693.32

PROJECT STATION: 3544  
 DATE: 14/ 8/04 GEAR TYPE: BT No: 15 POSITION: Lat S 1145  
 start stop duration Long E 1323  
 TIME : 18:47:03 19:32:18 45 (min) Purpose code: 1  
 LOG : 7069.10 7071.42 2.32 Area code : 2  
 FDEPTH: 350 357 GearCond code:  
 BDEPTH: 350 357 Validity code: 9  
 Towing dir: 345ø Wire out: 980 m Speed: 30 kn\*10  
 Sorted: 24 Kg Total catch: 391.10 CATCH/HOUR: 521.47

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sphyræna guachancho	380.63	19	54.90	
Brachydeuterus auritus	126.09	2109	18.19	
Trachurus trecae, juvenile	45.71	15844	6.59	
Sardinella maderensis	32.34	182	4.66	7459
Sepia orbignyana	26.38	158	3.80	
Arius parkii	23.91	15	3.45	
Trachurus trecae	13.22	156	1.91	7457
Atractoscion aequidens	10.37	6	1.50	
Sardinella aurita	10.26	54	1.48	7458
Trichiurus lepturus	8.96	71	1.29	
Pomadourys incisus	6.94	34	1.00	
Alloteuthis africana	2.63	497	0.38	
Todaropsis eblanae, juvenile	1.84	628	0.27	
Chlorophthalmus agassizii	1.84	131	0.27	
Octopus vulgaris	1.18	6	0.17	
Bregmaceros sp.	1.03	332	0.15	
Total	693.33		100.01	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius polli	460.80	1579	88.37	
Nematocarcinus africanus	23.04	21184	4.42	
Lagocephalus laevigatus	18.13	1192	3.48	
Pterothrissus belloci	8.53	149	1.64	
Hymenocephalus italicus	8.11	1280	1.56	
Scorpaena normani	1.49	43	0.29	
Etmopterus polli	0.51	25	0.10	
MYCTOPHIDAE	0.43	427	0.08	
Parapanaeus longirostris	0.21	43	0.04	
Hoplostethus cadenati	0.21	235	0.04	
Total	521.46		100.02	

PROJECT STATION: 3541  
 DATE: 14/ 8/04 GEAR TYPE: BT No: POSITION: Lat S 1131  
 start stop duration Long E 1321  
 TIME : 07:21:53 08:11:02 49 (min) Purpose code: 1  
 LOG : 6985.26 6987.67 2.38 Area code : 2  
 FDEPTH: 372 386 GearCond code:  
 BDEPTH: 372 386 Validity code: 9  
 Towing dir: 201ø Wire out: 1050 m Speed: 30 kn\*10  
 Sorted: 26 Kg Total catch: 652.00 CATCH/HOUR: 798.37

PROJECT STATION: 3545  
 DATE: 15/ 8/04 GEAR TYPE: PT No: 7 POSITION: Lat S 1211  
 start stop duration Long E 1339  
 TIME : 09:54:17 10:24:24 30 (min) Purpose code: 3  
 LOG : 7177.25 7179.33 0.33 Area code : 2  
 FDEPTH: 10 10 GearCond code:  
 BDEPTH: 25 27 Validity code:  
 Towing dir: 25ø Wire out: 150 m Speed: 39 kn\*10  
 Sorted: Kg Total catch: 654.20 CATCH/HOUR: 1308.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius polli	391.84	1331	49.08	
Nematocarcinus africanus	203.63	63214	25.51	
Trichiurus lepturus	41.33	61	5.18	
Todaropsis eblanae	37.65	367	4.72	
Hoplostethus cadenati	35.82	1224	4.49	
Laemonema laureysi	32.45	520	4.06	
Hymenocephalus italicus	19.59	2051	2.45	
Pterothrissus belloci	10.71	61	1.34	
Chlorophthalmus atlanticus	8.27	122	1.04	
Parapanaeus longirostris	4.90	490	0.61	
Gonostoma denudata	3.06	61	0.38	
Todarodes angoliensis	3.06	31	0.38	
Synagropsis microlepis	2.45	122	0.31	
MYCTOPHIDAE	2.45	1010	0.31	
Halosaurus ovenii	1.22	92	0.15	
Total	798.43		100.01	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	1020.00	8420	77.96	7461
Sardinella maderensis	247.00	1760	18.88	7462
Pomatomus saltatrix	26.40	20	2.02	
Spondyliosoma cantharus	7.80	20	0.60	
Lithognathus mormyrus	7.20	20	0.55	
Total	1308.40		100.01	

PROJECT STATION: 3546  
 DATE: 15/ 8/04 GEAR TYPE: PT No: 2 POSITION: Lat S 1226  
 start stop duration Long E 1330  
 TIME : 15:27:23 15:48:46 21 (min) Purpose code: 3  
 LOG : 7226.40 7227.82 1.31 Area code : 2  
 FDEPTH: 10 10 GearCond code:  
 BDEPTH: 62 78 Validity code:  
 Towing dir: 300ø Wire out: 150 m Speed: 38 kn\*10  
 Sorted: Kg Total catch: 157.37 CATCH/HOUR: 449.63

PROJECT STATION: 3542  
 DATE: 14/ 8/04 GEAR TYPE: BT No: POSITION: Lat S 1139  
 start stop duration Long E 1324  
 TIME : 10:11:40 10:42:30 31 (min) Purpose code: 3  
 LOG : 7002.08 7004.00 0.54 Area code : 2  
 FDEPTH: 148 141 GearCond code:  
 BDEPTH: 148 141 Validity code:  
 Towing dir: 265ø Wire out: 450 m Speed: 32 kn\*10  
 Sorted: 88 Kg Total catch: 378.82 CATCH/HOUR: 733.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	415.14	1474	92.33	7463
Sardinella aurita	26.43	114	5.88	7464
JELLYFISH	7.03	214	1.56	
Trachurus trecae	1.03	3	0.23	
Total	449.63		100.00	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	275.48	641	37.57	7460
Dentex macrophthalmus	215.55	956	29.40	
Spicara alta	71.15	356	9.70	
Todaropsis eblanae	61.08	1214	8.33	
Chlorophthalmus atlanticus	31.70	1589	4.32	
Umbrina canariensis	25.20	66	3.44	
Anthias anthias	18.79	157	2.56	
Merluccius polli	8.23	106	1.12	
Zeus faber	5.73	23	0.78	
Brotula barbata	5.15	8	0.70	
Pterothrissus belloci	3.81	33	0.52	
Citharus linguatula	2.90	41	0.40	
Zenopsis conchifer	2.40	41	0.33	
Uranoscopus cadenati	2.07	8	0.28	
Chelidonichthys capensis	1.90	17	0.26	
Dentex congosensis	1.90	8	0.26	
Monolene microstoma	0.15	8	0.02	
Total	733.19		99.99	

PROJECT STATION: 3547  
 DATE: 15/ 8/04 GEAR TYPE: PT No: 2 POSITION: Lat S 1324  
 start stop duration Long E 1324  
 TIME : 23:23:39 23:53:50 30 (min) Purpose code: 3  
 LOG : 7268.65 7270.51 1.85 Area code : 2  
 FDEPTH: 14 14 GearCond code:  
 BDEPTH: 90 105 Validity code:  
 Towing dir: 300ø Wire out: 150 m Speed: 37 kn\*10  
 Sorted: 125 Kg Total catch: 1391.57 CATCH/HOUR: 2783.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	2421.10	13244	86.99	7465
Trichiurus lepturus	238.70	220	8.58	
Scomber japonicus	101.42	264	3.64	
Mola mola	21.70	4	0.78	
Saurida brasiliensis	0.22	22	0.01	
Total	2783.14		100.00	

PROJECT STATION: 3543  
 DATE: 14/ 8/04 GEAR TYPE: BT No: 15 POSITION: Lat S 1143  
 start stop duration Long E 1330  
 TIME : 16:39:03 17:09:03 30 (min) Purpose code: 3  
 LOG : 7056.02 7057.55 1.53 Area code : 2  
 FDEPTH: 122 124 GearCond code:  
 BDEPTH: 122 124 Validity code:  
 Towing dir: 170ø Wire out: 360 m Speed: 30 kn\*10  
 Sorted: 27 Kg Total catch: 244.70 CATCH/HOUR: 489.40

PROJECT STATION: 3548  
 DATE: 18/ 8/04 GEAR TYPE: PT No: 7 POSITION: Lat S 1414  
 start stop duration Long E 1219  
 TIME : 03:34:20 04:04:14 30 (min) Purpose code: 3  
 LOG : 7583.47 7585.28 1.16 Area code : 1  
 FDEPTH: 10 10 GearCond code:  
 BDEPTH: 22 27 Validity code:  
 Towing dir: 166ø Wire out: 180 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 167.73 CATCH/HOUR: 335.46

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex macrophthalmus	162.90	756	33.29	
Dentex angolensis	95.40	324	19.49	
Trichiurus lepturus	75.06	234	15.34	
Umbrina canariensis	64.08	198	13.09	
Pterothrissus belloci	23.40	198	4.78	
Citharus linguatula	15.30	216	3.13	
Chelidonichthys gabonensis	13.86	126	2.83	
MYCTOPHIDAE	8.28	432	1.69	
Zeus faber	8.28	36	1.69	
Todaropsis eblanae	7.20	162	1.47	
Sepia officinalis hierredda	3.24	18	0.66	
Branchiostegus semifasciatus	3.24	18	0.66	
Zenopsis conchifer	2.88	54	0.59	
Spicara alta	2.70	18	0.55	
Scorpaena normani	2.34	18	0.48	
Chlorophthalmus atlanticus	0.90	252	0.18	
Merluccius polli	0.36	36	0.07	
Total	489.42		99.99	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	279.80	4456	83.41	7466
Sardinella maderensis	14.70	260	4.38	7468
Brachydeuterus auritus	12.72	226	3.79	
Sardinella aurita	6.58	64	1.96	7467
Sphyræna guachancho	5.26	18	1.57	
Boops boops	3.68	48	1.10	
Pomadourys incisus	2.68	48	0.80	
Pagellus bellioctii	2.64	40	0.79	
Galeoides decadactylus	2.40	10	0.72	
Lithognathus mormyrus	2.14	14	0.64	
Pomadourys jubelini	1.52	4	0.44	
Lagocephalus laevigatus	0.98	2	0.29	
Loligo vulgaris	0.20	2	0.06	
Sardinops ocellatus	0.16	2	0.05	
Trachurus trecae, juvenile	0.02	10	0.01	
Total	335.48		100.02	



PROJECT STATION:3549  
 DATE:18/ 8/04 GEAR TYPE: BT No: POSITION:Lat S 1425  
 start stop duration Long E 1219  
 TIME 07:15:23 07:45:16 30 (min) Purpose code: 3  
 LOG :7613.88 7615.45 1.56 Area code : 1  
 FDEPTH: 84 87 GearCond.code:  
 BDEPTH: 84 87 Validity code:  
 Towing dir: 335ø Wire out: 260 m Speed: 32 kn\*10  
 Sorted: 59 Kg Total catch: 418.04 CATCH/HOUR: 836.08

PROJECT STATION:3554  
 DATE:19/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1537  
 start stop duration Long E 1149  
 TIME :17:45:29 18:15:15 30 (min) Purpose code: 1  
 LOG :7860.30 7861.89 1.57 Area code : 1  
 FDEPTH: 110 112 GearCond.code:  
 BDEPTH: 110 112 Validity code:  
 Towing dir: 278ø Wire out: 330 m Speed: 30 kn\*10  
 Sorted: 56 Kg Total catch: 2073.80 CATCH/HOUR: 4147.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	746.90	5992	89.33	7469
Dentex macrophthalms	34.58	224	4.14	
Sparus aurata	15.96	28	1.91	
Atractoscion aequidens	12.46	14	1.49	
Dentex barnardi	8.96	42	1.07	
Zeus faber	7.98	14	0.95	
Dentex canariensis	4.76	14	0.57	
Dentex angolensis	2.94	28	0.35	
Chelidonichthys capensis	1.54	14	0.18	
Total	836.08		99.99	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	2302.40	49712	55.51	7472
Trachurus trecae	506.80	4560	12.22	7473
Umbrina canariensis	506.00	2678	12.20	
Dentex macrophthalms	475.60	2316	11.47	
Spicara alta	87.60	290	2.11	
Dentex angolensis	69.50	144	1.68	
Zeus faber	63.72	72	1.54	
Spondyllosoma cantharus	47.06	72	1.13	
Pagellus bellottii	45.60	144	1.10	
Squalus megalops	35.80	68	0.86	
Argyrosomus hololepidotus	7.60	38	0.18	
Total	4147.68		100.00	

PROJECT STATION:3550  
 DATE:18/ 8/04 GEAR TYPE: BT No: POSITION:Lat S 1445  
 start stop duration Long E 1216  
 TIME :16:14:18 16:44:18 30 (min) Purpose code: 3  
 LOG :7674.33 7675.94 1.56 Area code : 1  
 FDEPTH: 95 96 GearCond.code:  
 BDEPTH: 95 96 Validity code:  
 Towing dir: 20ø Wire out: 300 m Speed: 32 kn\*10  
 Sorted: 53 Kg Total catch: 2744.31 CATCH/HOUR: 5488.62

PROJECT STATION:3555  
 DATE:20/ 8/04 GEAR TYPE: BT No: POSITION:Lat S 1601  
 start stop duration Long E 1147  
 TIME :03:49:32 03:59:13 10 (min) Purpose code: 3  
 LOG :7939.41 7939.92 0.50 Area code : 1  
 FDEPTH: 24 25 GearCond.code:  
 BDEPTH: 24 25 Validity code:  
 Towing dir: 270ø Wire out: 120 m Speed: 31 kn\*10  
 Sorted: 32 Kg Total catch: 263.11 CATCH/HOUR: 1578.66

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex macrophthalms	4635.90	36618	84.46	
Umbrina canariensis	403.92	1938	7.36	
Dasyatis margarita	347.82	204	6.34	
Squatina oculata	100.98	102	1.84	
Total	5488.62		100.00	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L L Y F I S H	751.20	4560	47.58	
Trachurus trecae	696.00	14784	44.09	7474
Pomadasyus incisus	35.52	528	2.25	
Arius parkii	24.00	48	1.52	
Sepia orbignyana	22.50	18	1.43	
Dicologlossa cuneata	19.68	864	1.25	
Trachinus armatus	6.24	240	0.40	
Atractoscion aequidens	5.76	48	0.36	
Todaropsis eblanae	4.32	96	0.27	
Umbrina canariensis	4.32	48	0.27	
Argyrosomus hololepidotus	4.32	48	0.27	
Engraulis encrasicolus	2.88	192	0.18	
Pagellus bellottii	0.96	48	0.06	
Dentex barnardi	0.48	48	0.03	
Triichurus lepturus	0.48	48	0.03	
Total	1578.66		99.99	

PROJECT STATION:3551  
 DATE:18/ 8/04 GEAR TYPE: PT No: 4 POSITION:Lat S 1502  
 start stop duration Long E 1202  
 TIME :22:28:39 22:58:06 29 (min) Purpose code: 1  
 LOG :7716.71 7718.51 1.70 Area code : 1  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 577 560 Validity code:  
 Towing dir: 15ø Wire out: 160 m Speed: 37 kn\*10  
 Sorted: 22 Kg Total catch: 70.21 CATCH/HOUR: 145.26

PROJECT STATION:3556  
 DATE:20/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 1613  
 start stop duration Long E 1132  
 TIME :08:15:09 08:32:04 17 (min) Purpose code: 3  
 LOG :7972.75 7973.83 0.90 Area code : 1  
 FDEPTH: 50 50 GearCond.code:  
 BDEPTH: 189 101 Validity code:  
 Towing dir: 15ø Wire out: 230 m Speed: 36 kn\*10  
 Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
MYCTOPHIDAE	76.03	89721	52.34	
Lagocephalus lagocephalus	29.79	62	20.51	
Small shrimps	20.17	118	13.89	
Sphyrna zygaena	9.83	2	6.77	
Sarda sarda	6.77	6	4.66	
J E L L Y F I S H	1.55	211	1.07	
Lamprogrammus exutus	1.12	6	0.77	
Total	145.26		100.01	

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

PROJECT STATION:3552  
 DATE:19/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 1520  
 start stop duration Long E 1155  
 TIME :07:42:40 08:12:10 30 (min) Purpose code: 1  
 LOG :7781.69 7783.49 1.80 Area code : 1  
 FDEPTH: 40 58 GearCond.code:  
 BDEPTH: 121 123 Validity code:  
 Towing dir: 98ø Wire out: 250 m Speed: 37 kn\*10  
 Sorted: Kg Total catch: CATCH/HOUR:

PROJECT STATION:3557  
 DATE:20/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1613  
 start stop duration Long E 1133  
 TIME :09:05:20 09:13:28 8 (min) Purpose code: 3  
 LOG :7975.50 7975.93 0.42 Area code : 1  
 FDEPTH: 102 108 GearCond.code:  
 BDEPTH: 102 108 Validity code:  
 Towing dir: 326ø Wire out: 300 m Speed: 31 kn\*10  
 Sorted: 55 Kg Total catch: 1802.15 CATCH/HOUR: 13516.13

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

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	13242.75	296783	97.98	7475
Squalus megalops	142.73	240	1.06	
Chelidonichthys capensis	45.98	240	0.34	
Trachurus trecae	45.98	488	0.34	
Dentex macrophthalms	36.30	240	0.27	
Etrumeus whiteheadi	2.40	240	0.02	
Total	13516.14		100.01	

PROJECT STATION:3553  
 DATE:19/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1526  
 start stop duration Long E 1155  
 TIME :11:11:15 11:31:13 20 (min) Purpose code: 3  
 LOG :7807.44 7808.47 1.02 Area code : 1  
 FDEPTH: 114 109 GearCond.code:  
 BDEPTH: 114 109 Validity code:  
 Towing dir: 165ø Wire out: 330 m Speed: 31 kn\*10  
 Sorted: 62 Kg Total catch: 2169.65 CATCH/HOUR: 6508.95

PROJECT STATION:3558  
 DATE:20/ 8/04 GEAR TYPE: BT No: POSITION:Lat S 1613  
 start stop duration Long E 1137  
 TIME :13:41:58 13:55:20 13 (min) Purpose code: 3  
 LOG :7990.97 7991.64 0.66 Area code : 1  
 FDEPTH: 72 73 GearCond.code:  
 BDEPTH: 72 73 Validity code:  
 Towing dir: 270ø Wire out: 240 m Speed: 30 kn\*10  
 Sorted: 60 Kg Total catch: 6058.30 CATCH/HOUR: 27961.39

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	3934.56	71052	60.45	7470
Dentex macrophthalms	1038.15	5427	15.95	
Trachurus trecae	949.71	14973	14.59	7471
Atractoscion aequidens	156.15	105	2.40	
Zeus faber	130.65	99	2.01	
Dentex barnardi	96.48	99	1.48	
Dentex congouensis	93.45	201	1.44	
Squalus megalops	49.56	66	0.76	
Anthias anthias	48.24	402	0.74	
Sparus pagrus africanus *	12.00	3	0.18	
Total	6508.95		100.00	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	16661.54	478740	59.59	7477
Trachurus capensis	10227.69	311391	36.58	7476
Dentex macrophthalms	494.12	6526	1.77	
Merluccius polli	349.62	932	1.25	
Etrumeus whiteheadi	205.11	4662	0.73	
Loligo vulgaris	23.31	466	0.08	
Total	27961.39		100.00	

PROJECT STATION:3559  
 DATE:20/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 1615  
 start stop duration Long E 1147  
 TIME :16:15:37 16:29:20 14 (min) Purpose code: 3  
 LOG :8006.32 8007.10 0.77 Area code : 1  
 FDEPTH: 10 10 GearCond code: 1  
 BDEPTH: 19 19 Validity code:  
 Towing dir: 100 Wire out: 170 m Speed: 33 kn\*10  
 Sorted: 60 Kg Total catch: 4765.18 CATCH/HOUR: 20422.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	10516.29	246549	51.49	7478
Chrysaora hyosocella	6765.60	46461	33.13	
Trachurus capensis	3103.03	193980	15.19	7479
Todarodes sp.	37.29	1354	0.18	
Total	20422.21		99.99	

PROJECT STATION:3560  
 DATE:20/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 1618  
 start stop duration Long E 1147  
 TIME :18:05:07 18:13:17 8 (min) Purpose code: 3  
 LOG :6017.71 8018.19 0.48 Area code : 1  
 FDEPTH: 5 5 GearCond code: 1  
 BDEPTH: 18 18 Validity code:  
 Towing dir: 50 Wire out: 160 m Speed: 35 kn\*10  
 Sorted: 27 Kg Total catch: 167.64 CATCH/HOUR: 1257.30

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora hyosocella	648.00	2115	51.54	
Trachurus capensis	553.50	43920	44.02	7480
Trachurus trecae	36.00	1080	2.86	7481
Arius parkii	17.55	45	1.40	
Trachinus armatus	2.25	45	0.18	
Total	1257.30		100.00	

PROJECT STATION:3561  
 DATE:20/ 8/04 GEAR TYPE: BT No: POSITION:Lat S 1619  
 start stop duration Long E 1137  
 TIME :19:51:34 20:03:12 12 (min) Purpose code: 3  
 LOG :8030.26 8030.84 0.60 Area code : 1  
 FDEPTH: 80 79 GearCond code:  
 BDEPTH: 80 79 Validity code:  
 Towing dir: 960 Wire out: 250 m Speed: 31 kn\*10  
 Sorted: 29 Kg Total catch: 1856.16 CATCH/HOUR: 9280.80

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	8668.00	335280	93.40	7482
Dentex macrophthalmus	279.40	13655	3.01	
Trachurus trecae	187.35	6350	2.02	7483
Merluccius polli	76.20	955	0.82	
Sepia officinalis hierreda	69.85	320	0.75	
Total	9280.80		100.00	

PROJECT STATION:3562  
 DATE:20/ 8/04 GEAR TYPE: PT No: 2 POSITION:Lat S 1625  
 start stop duration Long E 1131  
 TIME :23:21:14 23:51:32 30 (min) Purpose code: 3  
 LOG :8055.08 8057.00 1.90 Area code : 1  
 FDEPTH: 75 75 GearCond code:  
 BDEPTH: 93 99 Validity code:  
 Towing dir: 2700 Wire out: 250 m Speed: 38 kn\*10  
 Sorted: Kg Total catch: 3.05 CATCH/HOUR: 6.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Arius heudeloti	3.50	10	57.38	
Lepidotrigla carolae	2.38	16	39.02	
Sardinops ocellatus	0.22	2	3.61	
Total	6.10		100.01	

PROJECT STATION:3563  
 DATE:21/ 8/04 GEAR TYPE: PT No: 2 POSITION:Lat S 1630  
 start stop duration Long E 1133  
 TIME :04:50:01 05:10:18 20 (min) Purpose code: 3  
 LOG :8097.25 8098.47 1.21 Area code : 1  
 FDEPTH: 75 75 GearCond code:  
 BDEPTH: 97 94 Validity code:  
 Towing dir: 900 Wire out: 240 m Speed: 36 kn\*10  
 Sorted: 12 Kg Total catch: 107.01 CATCH/HOUR: 321.03

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora hyosocella	306.21	384	95.38	
Sepia officinalis hierreda	12.12	24	3.78	
Dasyatis margarita	2.31	3	0.72	
Chelidonichthys sp.	0.45	3	0.14	
Total	321.09		100.02	

PROJECT STATION:3564  
 DATE:21/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1631  
 start stop duration Long E 1134  
 TIME :07:39:32 08:09:08 30 (min) Purpose code: 1  
 LOG :8108.62 8110.18 1.53 Area code : 1  
 FDEPTH: 95 98 GearCond code:  
 BDEPTH: 95 98 Validity code:  
 Towing dir: 2950 Wire out: 290 m Speed: 31 kn\*10  
 Sorted: 56 Kg Total catch: 1263.78 CATCH/HOUR: 2527.56

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1097.16	5352	43.41	7484
Trachurus capensis	535.20	17662	21.17	7485
Dentex macrophthalmus	437.08	7390	17.29	
Merluccius polli	337.18	1784	13.34	
Etrumeus whiteheadi	104.36	2408	4.13	7486
Sepia orbignyana	10.80	8	0.43	
Umbrina canariensis	4.00	44	0.16	
Todaropsis eblanae	1.78	44	0.07	
Total	2527.56		100.00	

PROJECT STATION:3565  
 DATE:21/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 1643  
 start stop duration Long E 1145  
 TIME :12:06:01 12:17:59 12 (min) Purpose code: 1  
 LOG :8145.79 8146.48 0.69 Area code : 1  
 FDEPTH: 10 10 GearCond code:  
 BDEPTH: 17 18 Validity code:  
 Towing dir: 1400 Wire out: 180 m Speed: 35 kn\*10  
 Sorted: 59 Kg Total catch: 8055.74 CATCH/HOUR: 40278.70

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	32563.80	810660	80.85	7487
Sardinella aurata	4726.55	39845	11.73	7488
Decapterus rhonchus	1215.95	10990	3.02	
Pomatomus saltatrix	838.10	5495	2.06	
Chrysaora hyosocella	522.10	685	1.30	
Lithognathus mormyrus	412.20	2745	1.02	
Total	40278.70		100.00	

PROJECT STATION:3566  
 DATE:21/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 1632  
 start stop duration Long E 1145  
 TIME :14:47:15 15:00:11 13 (min) Purpose code: 1  
 LOG :8166.28 8167.03 0.75 Area code : 1  
 FDEPTH: 10 10 GearCond code:  
 BDEPTH: 21 19 Validity code:  
 Towing dir: 600 Wire out: 180 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 537.75 CATCH/HOUR: 2481.52

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora hyosocella	2481.92	2492	100.00	
Total	2481.92		100.00	

PROJECT STATION:3567  
 DATE:22/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 1642  
 start stop duration Long E 1141  
 TIME :02:08:33 02:31:05 23 (min) Purpose code: 1  
 LOG :8243.46 8244.78 1.14 Area code : 1  
 FDEPTH: 10 10 GearCond code:  
 BDEPTH: 24 25 Validity code:  
 Towing dir: 3200 Wire out: 180 m Speed: 35 kn\*10  
 Sorted: 23 Kg Total catch: 213.44 CATCH/HOUR: 556.80

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora hyosocella	547.04	2864	98.25	
Engraulis encrasicolus	8.17	918	1.47	
Arius parkii	1.20	5	0.22	
Trachurus trecae, juvenile	0.23	34	0.04	7489
Merluccius capensis	0.13	3	0.02	
Trachurus capensis, juvenile	0.03	5	0.01	
Total	556.80		100.01	

PROJECT STATION:3568  
 DATE:22/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1648  
 start stop duration Long E 1127  
 TIME :07:48:21 08:08:05 20 (min) Purpose code: 1  
 LOG :8289.29 8290.36 1.07 Area code : 1  
 FDEPTH: 122 126 GearCond code:  
 BDEPTH: 122 126 Validity code:  
 Towing dir: 2700 Wire out: 380 m Speed: 31 kn\*10  
 Sorted: 75 Kg Total catch: 3575.05 CATCH/HOUR: 10725.15

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	5339.10	135426	49.78	7491
Sardinops ocellatus	3513.60	31995	32.76	7492
Dentex macrophthalmus	1421.10	16755	13.25	
Callorhynchus capensis	294.24	144	2.74	
Trachurus trecae	121.41	2142	1.13	7493
Ommastrephes pteropus	24.27	144	0.23	
Todaropsis eblanae	11.43	144	0.11	
Total	10725.15		100.00	

PROJECT STATION:3569  
 DATE:22/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1649  
 start stop duration Long E 1142  
 TIME :10:23:55 10:44:54 21 (min) Purpose code: 1  
 LOG :8307.56 8308.74 1.18 Area code : 1  
 FDEPTH: 21 32 GearCond code:  
 BDEPTH: 21 32 Validity code:  
 Towing dir: 2700 Wire out: 140 m Speed: 35 kn\*10  
 Sorted: 64 Kg Total catch: 321.50 CATCH/HOUR: 918.57

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	400.00	871	43.55	
Chrysaora hyosocella	304.29	1786	33.13	
Trachurus trecae	94.86	3471	10.33	7495
Engraulis encrasicolus	53.14	4514	5.79	
Sardinops ocellatus	27.86	571	3.03	7494
Raja miraletus	12.00	14	1.31	
Myliobatis aquila	9.57	14	1.04	
Pomatomus saltatrix	7.43	71	0.81	
Loligo vulgaris	4.57	500	0.50	
Aequorea aequorea	3.86	71	0.42	
Trichiurus lepturus	1.00	71	0.11	
Total	918.58		100.02	

PROJECT STATION:3570  
 DATE:22/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 1654 Long E 1145  
 start stop duration  
 TIME 12:01:13 12:10:41 9 (min) Purpose code: 1  
 LOG 8318.42 8318.99 0.57 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 18 17 Validity code:  
 Towing dir: 340ø Wire out: 180 m Speed: 35 kn\*10  
 Sorted: 57 Kg Total catch: 289.41 CATCH/HOUR: 1929.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	634.33	63433	32.88	
Sardinella spp. (juv.)	491.33	42967	25.47	
Trachurus trecae	410.00	18400	21.25	7496
Sardinops ocellatus	357.67	6767	18.54	7497
Callorhynchus capensis	16.40	13	0.85	
Lithognathus mormyrus	14.67	167	0.76	
Pomatomus saltatrix	3.67	67	0.19	
Trichiurus lepturus	1.33	100	0.07	
Total		1929.40	100.01	

PROJECT STATION:3571  
 DATE:22/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1654 Long E 1134  
 start stop duration  
 TIME 14:03:59 14:33:09 29 (min) Purpose code: 1  
 LOG 8333.84 8335.39 1.54 Area code : 1  
 FDEPTH: 94 85 GearCond.code:  
 BDEPTH: 94 85 Validity code:  
 Towing dir: 90ø Wire out: 340 m Speed: 31 kn\*10  
 Sorted: 30 Kg Total catch: 1303.33 CATCH/HOUR: 2696.55

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	1930.55	60586	71.59	7499
Merluccius capensis	290.92	3114	10.79	
Trachurus trecae	265.12	8452	9.83	7498
Dentex macrophthalmus	189.50	5249	7.03	
Chelidonichthys obscurus	13.34	89	0.49	
Pterochrissus bellocci	7.12	178	0.26	
Total		2696.55	99.99	

PROJECT STATION:3572  
 DATE:22/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 1701 Long E 1135  
 start stop duration  
 TIME 20:14:01 21:16:31 63 (min) Purpose code: 1  
 LOG 8381.36 8385.30 3.94 Area code : 1  
 FDEPTH: 60 60 GearCond.code:  
 BDEPTH: 93 89 Validity code:  
 Towing dir: 270ø Wire out: 280 m Speed: 36 kn\*10  
 Sorted: 27 Kg Total catch: 69.33 CATCH/HOUR: 66.03

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
JELLYFISH	49.76	324	75.36	
Trachurus capensis	10.71	374	16.22	7500
Sepia officinalis hierredda	3.29	12	4.98	
Chelidonichthys gabonensis	1.03	3	1.56	
Merluccius capensis	0.60	5	0.91	
Zenopsis conchifer	0.48	8	0.73	
Trachurus trecae	0.14	5	0.21	
Dentex macrophthalmus	0.02	3	0.03	
Total		66.03	100.00	

PROJECT STATION:3573  
 DATE:22/ 8/04 GEAR TYPE: PT No: 7 POSITION:Lat S 1702 Long E 1144  
 start stop duration  
 TIME 22:55:15 23:26:37 31 (min) Purpose code: 1  
 LOG 8395.72 8397.29 1.56 Area code : 1  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 22 22 Validity code:  
 Towing dir: 180ø Wire out: 140 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: 10.40 CATCH/HOUR: 20.13

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	17.57	39	87.28	
Chrysaora hyosocella	1.10	2	5.46	
Sardinops ocellatus	1.08	15	5.37	
Engraulis encrasicolus	0.21	17	1.04	
Scorpaena angolensis	0.15	2	0.75	
Total		20.11	99.90	

PROJECT STATION:3574  
 DATE:23/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1712 Long E 1131  
 start stop duration  
 TIME 07:09:45 07:20:34 11 (min) Purpose code: 1  
 LOG 8448.27 8448.83 0.55 Area code : 1  
 FDEPTH: 132 135 GearCond.code:  
 BDEPTH: 132 135 Validity code:  
 Towing dir: 270ø Wire out: 400 m Speed: 31 kn\*10  
 Sorted: 55 Kg Total catch: 1701.33 CATCH/HOUR: 9279.98

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	8284.91	290825	89.28	7501
Dentex macrophthalmus	911.45	10702	9.82	
Merluccius capensis	83.62	671	0.90	
Total		9279.98	100.00	

PROJECT STATION:3575  
 DATE:23/ 8/04 GEAR TYPE: PT No: 1 POSITION:Lat S 1712 Long E 1133  
 start stop duration  
 TIME 08:40:19 08:49:37 9 (min) Purpose code: 1  
 LOG 8455.87 8456.41 0.53 Area code : 1  
 FDEPTH: 65 65 GearCond.code:  
 BDEPTH: 121 120 Validity code:  
 Towing dir: 335ø Wire out: 260 m Speed: 36 kn\*10  
 Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION:3576  
 DATE:23/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1713 Long E 1143  
 start stop duration  
 TIME 12:25:44 12:38:39 13 (min) Purpose code: 1  
 LOG 8475.75 8476.40 0.66 Area code : 1  
 FDEPTH: 32 30 GearCond.code:  
 BDEPTH: 32 30 Validity code:  
 Towing dir: 170ø Wire out: 150 m Speed: 30 kn\*10  
 Sorted: 58 Kg Total catch: 1806.23 CATCH/HOUR: 8336.45

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinops ocellatus	4163.54	43495	49.94	7502
Trachurus trecae	3662.77	130343	43.94	7503
Chelidonichthys capensis	181.71	429	2.18	
Myliobatis aquila	137.35	143	1.65	
Trichiurus lepturus	57.23	572	0.69	
Callorhynchus capensis	38.68	28	0.46	
Pomatomus saltatrix	38.63	286	0.46	
Dicologlossa cuneata	25.75	858	0.31	
Arius parkii	18.60	143	0.22	
Mustelus mustelus	6.46	9	0.08	
Merluccius capensis	5.72	143	0.07	
Total		8336.44	100.00	

PROJECT STATION:3577  
 DATE:23/ 8/04 GEAR TYPE: BT No:15 POSITION:Lat S 1713 Long E 1140  
 start stop duration  
 TIME 13:27:48 13:36:07 8 (min) Purpose code: 1  
 LOG 8482.14 8482.57 0.43 Area code : 1  
 FDEPTH: 73 73 GearCond.code:  
 BDEPTH: 73 73 Validity code:  
 Towing dir: 170ø Wire out: 270 m Speed: 31 kn\*10  
 Sorted: 31 Kg Total catch: 469.50 CATCH/HOUR: 3521.25

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	2452.50	162788	69.65	7504
JELLYFISH	990.00	5063	28.12	
Merluccius capensis	67.50	900	1.92	
Loligo vulgaris	11.25	563	0.32	
Total		3521.25	100.01	

## ANNEX III BIOMASS AND NUMBER OF FISH PER LENGTH CLASS

### Sardinella

*Sardinella maderensis*

North (Congo River to Luanda, 5°S-9°S) and, Central (Luanda to Benguela, 9°S-13°S)

Length group (cm)	North		Central	
	N	W	N	W
5				
6				
7				
8				
9	2		3	
10	4		4	
11	7	0.1	1	
12	4	0.1	6	0.1
13	1		7	0.2
14			25	0.7
15			49	1.6
16	6	0.2	160	6.3
17	8	0.4	190	9.0
18	12	0.7	84	4.7
19	22	1.4	37	2.5
20	14	1.0	45	3.5
21	14	1.2	65	5.8
22	78	7.9	74	7.6
23	117	13.4	24	2.8
24	96	12.5	45	6.0
25	61	8.9	69	10.5
26	17	2.8	26	4.3
27	17	3.1	21	3.9
28	15	3.1	6	1.2
29	13	3.0	2	0.5
30	29	7.1		0.1
31	11	2.9		
32	9	2.7		
33	3	1.1		
34	23	8.2		
35	1	0.2		
36				
Number (mill.)	583		945	
Biomass (kTons)		82.3		71.2

*Sardinella aurita*

North (Congo River to Luanda, 5°S - 9°S), and Central (Luanda to Benguela, 9°S – 13°S)

Length group (cm)	North		Central	
	N	W	N	W
5				
6				
7				
8				
9	1		1	
10	1		4	
11	1		3	
12	3	0.1		
13	7	0.2		
14	3	0.1		
15				
16	1	0.1		
17	2	0.1	13	0.6
18	11	0.7		
19	5	0.3	32	2.0
20			37	2.7
21	1	0.1	64	5.5
22	8	0.9	60	5.9
23	5	0.6	126	13.9
24	25	3.6	87	10.8
25	89	14.5	135	19.0
26	130	23.5	87	13.6
27	84	17.1	84	14.6
28	93	21.0	40	7.7
29	52	12.9	22	4.8
30	16	4.4	4	1.0
31	8	2.5		
32	5	1.8	6	1.6
33			1	0.4
34		0.1		
35				
36				
Number (mill.)	552		806	
Biomass (kTons)		104.6		104.1

*Trachurus trecae*

North (Congo River to Luanda, 5°S - 9°S), Central (Luanda to Benguela, 9°S – 13°S), and South ( Benguela to Cunene River, 13° - 17°15'S)

Length group (cm)	North		Central		South	
	N	W	N	W	N	W
5	7		12	0.02		
6	9		40	0.11	8	
7	10		48	0.19	33	0.1
8	8		14	0.08	36	0.1
9	12	0.1	8	0.06	88	0.4
10	28	0.3	4	0.05	70	0.4
11	100	1.5	2	0.03	88	0.6
12	23	0.4	2	0.03	144	1.3
13	14	0.3	4	0.08	175	2.0
14	7	0.2	4	0.10	185	2.5
15	12	0.4	2	0.05	166	2.7
16	69	3.0	1	0.05	141	2.7
17	133	6.9	1	0.04	141	3.2
18	39	2.4	1	0.07	129	3.4
19	26	1.9	2	0.17	116	3.5
20	18	1.5	13	1.06	72	2.5
21	13	1.2	24	2.28	45	1.8
22	6	0.7	13	1.35	20	0.9
23	10	1.2	7	0.90	10	0.5
24	8	1.1	6	0.89	17	0.9
25	5	0.7	5	0.85	10	0.6
26	1	0.3	8	1.46	9	0.6
27	1	0.3	10	1.86	7	0.6
28	7	1.5	27	5.90	4	0.4
29	9	2.3	57	13.71	1	0.1
30	7	2.0	56	14.98	3	0.3
31	15	4.7	28	8.12	1	0.2
32	13	4.5	24	7.73	1	0.2
33	21	7.5	11	3.87		
34	16	6.2	8	3.03		
35	21	9.0	17	7.07		
36	7	3.5	22	10.20		
37	4	2.2	16	7.71		
38	11	6.1	2	1.23		
39			3	1.92		
40	9	5.7	1	0.69		
41						
Number (mill.)	697		505		1 722	
Biomass (kTons)		79.7		98.01		32.4

*Tracurus capensis*  
 South ( Benguela to Cunene River, 13° - 17°15'S)

South		
Length group (cm)	N	W
5		
6		
7		
8	21	0.1
9	29	0.2
10	166	1.8
11	111	1.5
12	83	1.4
13	136	2.8
14	115	2.9
15	140	4.2
16	200	7.1
17	128	5.3
18	102	4.9
19	30	1.6
20	13	0.8
21	11	0.8
22	10	0.8
23	10	0.9
24	3	0.4
25	1	0.1
26		
27	1	0.1
28	1	0.1
29		
30		
31	1	0.1
32		
33		
34	1	0.2
35	1	0.2
36		
37		
38		
39		
40		
41		
Number (mill.)	1 312	
Biomass (kTons)		38.5

*Sardinops ocellatus*  
 South ( Benguela to Cunene River, 13° - 17°15'S)

South		
Length group (cm)	N	W
5		
6		
7		
8		
9		
10		
11	131	2.7
12	424	10.8
13	196	6.0
14		
15	114	4.9
16		
17	3	0.2
18	39	2.6
19	3	0.2
20	41	3.5
21	139	13.2
22	440	46.8
23	1 000	118.4
24	342	44.8
25	5	0.7
26		
Number (mill.)	2 876	
Biomass (kTons)		254.9





## ANNEX IV ACOUSTIC INSTRUMENTS

### Echo sounder

The SIMRAD EK500/38 kHz scientific sounder was used during the survey for fish abundance estimation. The lowering keel was not submerged during the survey. The Bergen Echo Integrator system (BEI) was used to scrutinise the acoustic records. The settings of 38 kHz echo sounder were as follows:

#### Tranceiver-1 menu (38 kHz, mounted in lowering keel)

Transducer depth	20.07-1508: 5.5 m (keel not submerged), 16.08-17.08: 8.0 m (subm.)
Absorption coeff.	10 dB/km
Pulse length	Medium (1 ms)
Bandwidth	Wide
Max Power	2000 Watt
2-way beam angle	-21.0 dB
Sv Transducer gain	27.37 dB
TS Transducer gain	27.49 dB
Angle sensitivity	21.9
3 dB beam width	7.0 ° along ship 6.7 ° athwardship
Along ship offset	0.14 °
Athwardship effect	-0.02 °

#### Display menu

Echogram	1 (38 kHz)
Bottom range	15 m
Bottom range start	10 m
Sv colour min	-67 dB

#### Printer menu

Echogram	1 (38 kHz)
Range	100 m, 250 m, 500 m
Range start	0
Bottom range	12 m
Bottom range start	10 m
TVG	20 log R
Sv Colour min	- 67 dB

**Bottom detection menu**      Minimum level -50 dB



## ANNEX V SHARK SAMPLING

Diana Zaera

### **Shark sampling**

This is the continuation of a sampling programme started on 2002 to improve the available information on the biology and bathymetric distribution of sharks in Angolan waters, with emphasis in deep-water sharks. Although deep-water sharks are important predators of the outer continental shelf and upper slope, they have often been overlooked in favour of species with some commercial value.

Despite this being a pelagic survey, three deep-water bottom stations (depths between 300 and 500 m) were worked out to try to confirm some observations found during the bottom survey conducted earlier this year in the same region.

At the same time we tested a revised set of keys for elasmobranches (Compagno, *per. com.*)

### **Methodology**

For biological sampling, sharks were first identified then measured, weighed, sexed, and the stage of maturation noted, the last based on the criteria described by Stehmann (1987). Stomachs were cut open, its content sorted and preys were identified to the lowest possible taxon. The liver weight was recorded in order to calculate the hepatosomatic index *HSI* (liver mass/body mass x 100). The liver mass of a shark, with its high lipid content, is a good index of the shark's condition.

The presence of open umbilical scars is assumed to indicate that juveniles have been born recently.

Since physical properties of seawater clearly influence biological events at all scales, data on depth, salinity, oxygen content and specific temperature of the water in which sharks occur, were collected from CTD stations and will be used together with data on catch rates and frequency of occurrence with other species.

### **Results**

A total of 100 individuals were caught belonging to 6 different species grouped in 4 families: Squalidae (dogfish sharks): *Etmopterus polli* (lanternshark), *Centrophorus granulosus* (gulper shark), *Squalus megalops* (shortnose spurdog); Carcharhinidae (requiem sharks): *Carcharhinus signatus* (night shark), Lamnidae: *Isurus oxyrinchus* (shortfin mako) and Sphyrnidae (hammerhead sharks): *Sphyrna zygaena* (smoothhead hammerhead shark).

During last demersal survey in Angolan waters (March 2004) we found some stations with large quantities of new free swimmers of both *E. spinax* and *E. polli*, with the umbilical scar still open, suggesting a nursery area. During this survey we sampled in three of these areas and in two of them we found small-sized individuals of *E. polli*, with either open or close umbilical scars.



## **ANNEX VI ANALYSE OF THE STATUS OF HORSE MACKEREL STOCK IN ANGOLAN WATERS**

### **Background**

Horse mackerel is a commercial important species in Angola and constitutes the main source of proteins for the Angola population. Two horse mackerel species Cunene horse mackerel (*Trachurus trecae*) and Cape horse mackerel (*Trachurus capensis*) are found in Angola. Cunene horse mackerel is distributed over most of the Angolan continental shelf while; the cape horse mackerel is associated to the cold waters of the Benguela current intruding into southern Angola during winter.

Fisheries management requires information on population size, which for horse mackerel off Angola is estimated by means of hydroacoustic surveys that have been conducted by the R/V “Dr Fridtjof Nansen” since 1985. The acoustic estimates represents the basis for setting the TAC and other management measures, and in the absence of reliable catch and CPUE data, the time series is the only means to monitor the change in the abundance of the stock.

The analysis of times series has shown that the abundance of the horse mackerel in Angola waters has fluctuated throughout the years (Figure 1), and has been at a low level for the past three years. The biomass estimated for 2003 was estimated at about 166 000 tons. At that time most of the biomass was located in the southern region (Benguela to Cunene River) and was mostly comprised of juveniles. From the results of last year’s surveys it was concluded that horse mackerel adult stock was severely declined.

Based on these results, a series of management decision were approved by the Angolan Government, with the intention to recover the stock. One of the main decisions was to reduce the fishing effort for horse mackerel, banning for one year all the midwater trawlers and establishing a one-year closed area in the southern region from 13°S to 17°S for the bottom trawlers

### **Results from the present survey**

The present survey was conducted from 28 of July to 23 of August with the objective of monitoring the abundance of the pelagic fish. The survey covered the area between south of Congo River to Cunene River, from 20 - 500 m depth. Following the established survey strategy applied since 2000.

The biomass of horse mackerel was estimated at 219 000 tons, somewhat higher than the last three years estimates, but much lower than the level estimated in 1996 of about 500 000 tons.

The overall length distribution still dominated by fish < 20 cm. However, compared to last year it is observed an increase in the proportion of individuals > 30 cm and this increase was most evident in central region. As in previous surveys there was observed a good signal of recruitment. Growth progression could be seen with several different cohorts. Cohorts recognized in 2003 are always seen in 2004.

The increase in biomass of the stock this year should not be seen necessarily as a signal of the recovering of the stock. The change in size distribution last year, only a few adults were found, and the adults caught this year were not present in last year's estimates. The observed increase in biomass is therefore primarily due to fish > 30 cm becoming available this year. The increased availability of large fish could be primarily caused by the environmental conditions. During the present survey the occurrence of upwelling phenomena throughout the Angolan coast with cold waters with low salinity confined to inshore areas. During the upwelling conditions, the bias due to avoidance is much less, in such a conditions, the horse mackerel migrates from bottom habitats and into the pelagic, making them more available for acoustic measurements.

Any management decision based on these results should be considered that this year the environmental conditions were favourable for acoustic abundance. Any increase on the effort in the horse mackerel fishery at this stage, could severely harsh the stock. The extent of upwelling phenomena observed in the Northern and Central regions is anomalous. It is necessary to point out that the level of the stock in any case is still far from the level reached in 1996, where the stock was estimated to about 500 000 tons. The potential level of the stock is unknown but could be much higher than this.

It is important also to consider that the management decisions applied for 2004 have had a positive effect on the stock. To ban the pelagic trawl fishery reduced substantially the fishing pressure and it is necessary for the recover of the stock.

## **Recommendation**

The stock of horse mackerel in Angola is still at low level; therefore it is advised to keep the 2004 level of effort. It will be necessary to establish a program for monitoring the catches from the purseiners also for 2005 in order to quantify the actual catch of this fishery.

The by catch of demersal should be quantified to be kept at a level of 10%.

**ANNEX VII PRELIMINARY MARINE MAMMALS SURVEY, OFF-  
SHORE ANGOLA, FROM LUANDA TO CUNENE RIVER, 8-24 AUGUST  
2004**

**BACKGROUND AND RATIONALE:**

Current information on marine mammals inventory, distribution, status, and spatial behaviour patterns, off-shore Angola, is scarce. Marine mammals form an important and indicative component of the marine ecosystems, and there is, therefore, a scientific interest in collecting information on these populations, as part of the efforts to compile current data on biodiversity in Angola.

One of the main defined objectives and approved activities, within the framework of UNDP Project 0001111 (ANG/02/005), of support to environmental planning, biodiversity conservation and capacity building in Angola, is the launching and establishing of community-based conservation initiatives. Marine mammals in this context are of special interest, due to their attractiveness to eco-tourists. Well-thought and carefully developed and managed eco-tourism initiatives may make use of the presence of marine-mammals close to Angola's coasts, in a manner that will secure benefit sharing with the resident fishermen communities along the coastal zone of Angola, as an alternative to the non-sustainable utilization of biodiversity.

The BCLME (Benguela Current Large Marine Ecosystem) project, funded by GEF, and implemented by UNDP and UNOPS, is a regional initiative by Angola, Namibia and South Africa, aiming to facilitate the integrated management, sustainable development and protection of this unique eastern boundary upwelling ecosystem. A sub project for the development of pilot projects with coastal community involvement, aiming to establish an effective plan for environmental management and conservation of large migratory and endangered marine species (marine-mammals, marine-birds and marine-turtles), by involving local coastal communities, was approved as part of the pilot activities of the BCLME.

This preliminary survey of marine mammals, off-shore Angola, was done as a preparatory activity for the referred BCLME sub-project, as well as within the framework of UNDP project 00011111, for a preliminary assessment of marine-mammals inventory, distribution, and visibility off-shore Angola, a preliminary feasibility assessment for a more comprehensive



marine-mammal survey, and optional future development of related eco-tourism activities, as well as for training of Angolan technicians in this study field.

The first part of this preliminary survey (north), from Luanda to Congo River, was done during 21-31.7.2003 and reported in: Ron, T. 2003. Preliminary marine mammals survey, along the northern coast line of Angola, 20-31 July 2003. In: Krakstad, J.O., et al., Survey of the Fish Resources of Angola. Institute of Marine Research, Bergen, 2003, Annex VI, 10 pp.

The second part (south), from Luanda to Cunene River, was conducted during 8-24.8.2004, and is reported hereby.

**The full report of both parts of this preliminary survey, with further data analysis, and including the annexes, maps and photographs, will be compiled and distributed later this year.**

#### **OBJECTIVES:**

- Collect preliminary data on inventory, distribution, and rough status estimations (related to a specific time of the year) of marine mammals, off-shore Angola, as part of data collection on biodiversity in Angola.
- Assess feasibility of more comprehensive data collection, with minimized costs, on marine-mammals off-shore Angola, through opportunistic data collection on board the Nansen fishing research vessel, and other vessels conducting transects off-shore Angola (for fishing research, oil explorations, etc.).
- Enable training of Angolan technicians in data-collection on marine-mammals, methodology, and species identification, with the objective that Angolan researchers would undertake to establish a long-term study and data-base, related to these species.
- Preliminary assessment of marine-mammals visibility off-shore Angola, and of feasibility of future developing of “whale-watch” eco-tourism initiatives.

#### **IMPLEMENTATION ARRANGEMENTS:**

This preliminary survey was implemented within the framework of the Nansen fishing research cruise. All costs were covered by the Nansen project, and the Nansen team has assisted with the survey. The participation in the Nansen research cruise, was mediated through the Instituto de

Investigação Marinha (IIM), the Ministry of Fisheries of Angola, who has supported the realization of this preliminary survey, as a part of the objectives of this fishing research cruise.

#### **PARTICIPANTS:**

This preliminary survey (south) was done by the UNDP biodiversity CTA and Mr. Miguel Morais, a researcher at the Faculty of Science, Agostinho Neto University, who was indicated by the National Department of Natural Resources, the Ministry of Urban Affairs and Environment. Dr. Jean-Paul Roux, Ministry of Fisheries, Namibia, has conducted a study on marine birds and marine mammals, which he will report separately, and provided help with methodology and identification. Mr. Jose Mateus da Silva, Ministry of Agriculture, Angola, participated as a trainee, of the birds study, under Dr. Roux's supervision. The Marine Research Institute (MRI), Bergen, Norway, scientific team, headed by Dr. Bjorn Erik Axelsen, the Nansen vessel team, headed by the Captain, Mr. Preben Vindene, and the IIM team, headed by Dr. Filomena Vaz Velho, provided invaluable help and advice, in all aspects.

#### **METHODOLOGY:**

**Observation platform:** fishing research vessel, Dr. F. Nansen, 56.75 m length.

**Observation time:** 8-23.8.2003, every day, except for 16.8. (vessel calibration day) from 08.00 to 18.00 (Angola time), about 60% of the time by the four observers, about 25% of the time by two observers and about 15% of the time by one observer. A total of 150 observation hours, in 15 days.

**Surveyed area:** Off-shore Angola, from Luanda (South) to Cunene River Mouth (South), along transects perpendicular to the coast, and between 11<sup>0</sup>-14<sup>0</sup> East. (Map to be annexed). Estimated width of transect is 5 km (possibility to observe cetaceans from a distance of up to around 2.5 km to each direction).

**Recording information:** observations were done with 10X42 binoculars. Information was recorded on standard Cetacean sighting forms (annexed). Complimentary information was obtained from the vessel datalog. In several occasions the boat has followed the cetaceans, for closer observations and photos. Weather and sea conditions and therefore observation conditions, were optimal throughout most of the survey. Identification and information on marine mammals, from: Jefferson. T. A., Leatherwood, S. and Webber, M.A. 1993. Marine Mammals of the World. UNEP and FAO, Rome. Marine-birds identification, by: Sinclair, I. and Ryan P. 2003. A

Comprehensive Illustrated Field Guide: Birds of Africa, South of the Sahara, Struik Publishers, Cape-Town, SA.

## RESULTS:

Eight species of Cetaceans (Order: *Cetacea*) were observed, as well as cape fur seals:

1. Humpback whale (*Megaptera novaengliae*): a baleen whale (sub-order: *Mysticeti*, family: *Balaenopteridae*). This species migrates annually along the coast line of Angola. IUCN status: Vulnerable.

Observations: 12 confirmed observations, of a total of 18 individuals in groups of 1-2, and further 5 unconfirmed observations of 7 individuals probably of this species (0.08-0.11 observations/effort hours). In latitudes 9<sup>0</sup>10'S-10<sup>0</sup>41'S and south of 14<sup>0</sup>25'S, depths: 20-280m.

2. Bryde's whale (*Balaenoptera edeni*): a baleen whale (sub-order: *Mysticeti*, family: *Balaenopteridae*). May be migrating or resident population. IUCN status: Insufficiently known.

Observations: 4 confirmed observation, of a total of 6 individuals in groups of 1-2, and further 4 unconfirmed observation of 5 individuals probably of this species (0.03-0.05 observations/effort hour). In latitudes 10<sup>0</sup>26'S-13<sup>0</sup>44'S, depths: 100-800m.

3. Short-finned pilot whale (*Globicephala macrorhynchus*): a toothed whale (sub-order: *Odontoceti*, family: *Delphinidae*). May be resident, in off-shore waters. IUCN status: Insufficiently known.

Observations: 9 observations (0.06 observations/effort hours) with estimated total of 160 individuals in groups of 6-60. In latitudes 9<sup>0</sup>48'S-15<sup>0</sup>25'S, depths: 100-1000m. 5 of the 9 observations in association with bottlenose dolphins, and one of them in association also with *Stenella sp.*

4. Bottlenose dolphin (*Tursiops truncatus*): a dolphin (sub-order: *Odontoceti*, family: *Delphinidae*). A common species. The individuals observed were of the off-shore Atlantic form. May be resident. IUCN status: Insufficiently known.

Observations: 6 observations (0.04 observations/effort hours) with estimated total of 280 individuals in groups of 8-150. In latitudes 10<sup>0</sup>52'S-15<sup>0</sup>36'S, depths: 100-300m. 5 of the 6

observations in association with pilot whales, and one of them in association also with *Stenella sp.*

5. Common dolphin (*Delphinus delphis*): a dolphin (sub-order: *Odontoceti*, family: *Delphinidae*). May be resident. IUCN status: Insufficiently known.

Observations: 2 observations of around 150 individuals each, and an estimated total of 310 individuals. In latitudes 9°10'S and 15°20'S, and depths: 20-210m.

6. Heaviside's dolphin (*Cephalorhynchus heavisidii*) a dolphin (sub-order: *Odontoceti*, family: *Delphinidae*). May be resident. IUCN status: Insufficiently known.

Observations: 2 observations of 2 and 6 individuals (total:8). Latitudes south of 16°48'S, depths: 20-120m.

7. Dusky dolphin (*Lagenorhynchus obscurus*): a dolphin (sub-order: *Odontoceti*, family: *Delphinidae*). May be a resident. IUCN status: Insufficiently known.

Observations: one observation of around 40 individuals, in latitude 16°48'S, depth: 107m.

8. *Stenella spp* (dolphins) Specific species was not confirmed. (sub-order: *Odontoceti*, family: *Delphinidae*). May be resident populations.

Observations: 3 observations of unidentified *Stenella sp.*, in groups of around 75, 120 and 11, latitudes around 10°52'S and 15°30'S, depths: 100-620m. One of the observations in association with pilot whales and bottlenose dolphins.

9. South African (Cape) fur seal (*Arctocephalus pusillus pusillus*): (order: *Carnivora*, sub-order: *Pinnipedia*, family: *Ortariidae*). This species is common and resident, with short-range migration, in southern Angola, Namibia and South Africa. IUCN status: Insufficiently known.

Observations: North of 16°S, 97 seals were observed in groups of 1-2, mostly drifting. As of 16°S and south, seals were observed most of the time, in groups of varying size, of 1-20 individuals, and during fish trawling the vessel was then usually accompanied by 1-40 seals, in several groups, feeding off the net. One seal was caught in the net, and released back to sea. A colony of around 3,000 seals was observed on the island of Baía dos Tigres. Further data analysis will be presented in the full report, as a baseline for future comparative data collection.

**Bird species observed:**

Species:	Latitude ( <sup>0</sup> S):				
	9-10	11-12	13-14	15-16	17+
Cape gannet ( <i>Sula capensis</i> )	+	+	+	+	+
White chinned petrel ( <i>Procellaria aequinoctialis</i> )	+	+	+	+	+
Sooty shearwater ( <i>Puffinus griseus</i> )	+	+		+	+
Manx shearwater ( <i>Puffinus puffinus</i> )	+		+	+	
Wilson's storm petrel ( <i>Oceanites oceanites</i> )	+	+	+	+	+
Leach's storm petrel ( <i>Oceanodroma leucorha</i> )				+	
Pintado petrel ( <i>Daption capense</i> )					+
Lesser black backed gull ( <i>Larus fuscus</i> )	+				
Cape (kelp) gull ( <i>Larus vetula</i> )	+	+	+	+	+
Grey headed gull ( <i>Larus cirrocephalus</i> )	+			+	
Sabine's gull ( <i>Xema sabini</i> )	+	+	+	+	
Common tern ( <i>Sterna hirundo</i> )	+	+	+	+	+
Royal tern ( <i>Sterna maxima</i> )	+	+		+	
Black tern ( <i>Chlidonias niger</i> )	+	+	+		
Arctic tern ( <i>Sterna paradisaea</i> )	+	+		+	
Caspian tern ( <i>Sterna caspia</i> )				+	
Subantarctic skua ( <i>Catharacta antarctica</i> )		+		+	+
Long tailed skua ( <i>Stercorarius longicaudus</i> )	+				
Pomarine skua ( <i>Stercorarius pomarinus</i> )	+	+			
Arctic (parasitic) skua ( <i>Stercorarius parasiticus</i> )		+		+	
Atlantic yellow-nosed albatross ( <i>Thalassarche chlororhynchus</i> )				+	+
Blackbrowed albatross ( <i>Thalassarche melanophris</i> )				+	
Shy albatross ( <i>Thalassarche cauta</i> )				+	
Great white pelican ( <i>Pelecanus onocrotalus</i> )		+		+	+
Cape cormorant ( <i>Phalacrocorax capensis</i> )			+	+	+
White breasted cormorant ( <i>Phalacrocorax lucidus</i> )		+	+	+	

(colonies of 50,000-100,000 on Baia dos Tigres and Iona NP coast)

Greater flamingo (*Phoenicopterus ruber*): Iona NP coast

Common swift (*Apus apus*): observed once, close to the coast, near Luanda

Palm nut vulture (*Gypohierax angolensis*): observed twice, close to the coast, near Benguela

### **Marine turtles:**

One olive ridley (*Lepidochelys olivaceae*) observed at latitude 9<sup>o</sup>20'S, with 3 more unconfirmed observations between 9<sup>o</sup>30'S and 10<sup>o</sup>30'S. Most sandy beaches, suitable for marine turtles nesting, along the coast, are occupied or readily accessible by artisanal fishermen boats, with exceptions only in the southern part of Namibe Province.

### **CONCLUSIONS:**

This preliminary survey was done mainly to assess the conditions for data collection on marine mammals, off-shore Angola, from an existing research vessel. The results demonstrate that there is clear interest in collecting information on marine mammals species, distribution and status, and indication on population dynamics over time, off-shore Angola, and this objective may be achieved at minimum costs, by use of existing vessels (in particular fishing research vessels).

### **RECOMMENDATIONS AND THE WAY FORWARD:**

1. Within the framework of establishing a data base on biodiversity in Angola, there is interest to collect information on marine mammal populations, off-shore Angola – species inventory, status, distribution, spatial behaviour and migratory patterns, and threats, as well as long-term monitoring of populations dynamics. Marine-mammal populations form an important and indicative component of the marine eco-system.
2. Long term monitoring programme of seals can also be developed, this way, and provide a basis for the developing of management programmes for this species
3. There is further specific interest in collecting information on marine-mammal populations off-shore Angola, in order to assess the feasibility of developing “whale-watch” eco-tourism initiatives (while observing the principal of benefit-sharing, with resident communities, as well as standard behavioural codes, to prevent disturbance and threat, through legal measures), in order to replace the current non-sustainable utilization of biodiversity and natural resources. The optional developing of such activities would require much further study and planning.

4. Preliminary data collection, and establishing of GIS-based data-base on marine mammal populations off-shore Angola, can be done within the framework of the “sub project for the development of pilot projects with coastal community involvement”, of the BCLME project, with the support of the Nansen project and IIM, with the leadership of Angolan researchers, for example, of ANU and the Nature Museum, in coordination with MINUA and MINPET, and with international technical and financial support.
5. Further information should be collected from interviewing artisanal fishermen and coastal communities, commercial fishermen, teams of other vessels moving off-shore Angola (for example, the petroleum industry’s vessels), etc. Complimentary data collection programmes may be developed, including aerial surveys, and observations from on-shore and off-shore platforms.
6. There should be focus on collecting information on intentional catch of marine mammals, by-catch in fishing gear, and other threats.
7. The information collected should be used to develop recommendations for conservation measures, including recommendations for improving fishing gear to minimize by-catch, legislation and enforcement, active participation of coastal resident communities, education, awareness, identification of sensitive marine and coastal areas, and recommendations for establishing marine protected areas, etc.

Tamar Ron, September 2004