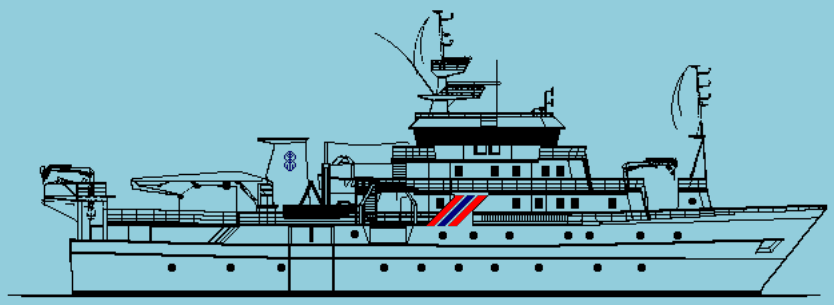


SURVEYS OF THE FISH RESOURCES OF ANGOLA

Cruise Report No 1/2011

Survey of the Pelagic Resources
19 February – 20 March 2011

Institute of Marine Research
IMR, Bergen, Norway

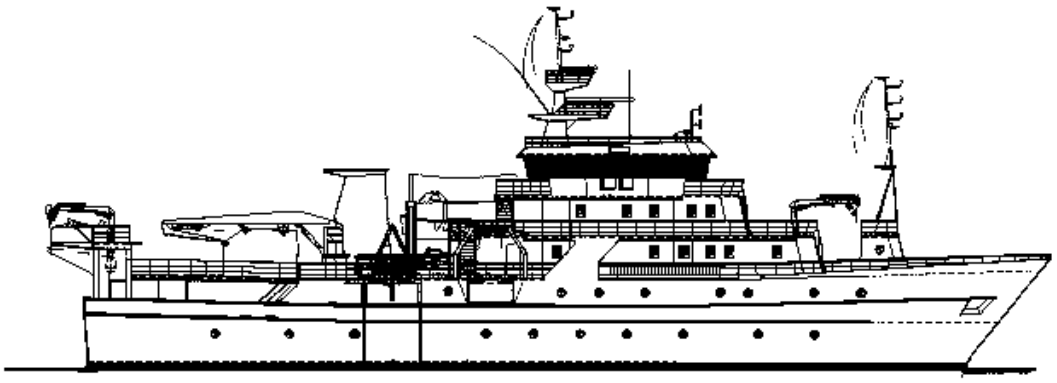
Instituto Naconal de Investigação Pesqueira
INIP, Luanda, Angola

THE EAF-NANSEN PROJECT

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

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

January 1985	-	June 1986	(6 surveys)
January 1989	-	December 1989	(3 surveys)
May 1991	-	September 1992	(3 surveys)
January 1994	-	March 2011	(19 surveys)



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Survey of the pelagic resources
19 February – 20 March 2011

by

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Bergen, 2011

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CHAPTER 1 INTRODUCTION

1.1 Objectives

This survey is part of the time series of the pelagic living resources, aiming at monitoring the pelagic fish resources of Angola. The first surveys of the pelagic resources were carried out in 1985, with surveys both during winter and summer. The next surveys were carried out in 1986 and 1989 (summer surveys), before the time series of the winter surveys commenced in 1991. With the exception of 1993 (no survey) and 1997 (summer survey only) the winter time series has been carried out without interruption from 1991 to 2010.

For 2011, two surveys are planned for both the winter and summer seasons in order to investigate the intra-annual variation (seasonal variation) in the distribution and estimated abundance of the pelagic species. Previously, the only years with concurrent surveys in the winter and summer were 1985, 1995 and 1998.

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

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

The specific objectives of the present survey were:

- To estimate the abundance and map the distribution of the main commercially important pelagic and semi-pelagic fish species in Angolan waters, including the two sardinella species *Sardinella aurita* and *Sardinella maderensis*, the Cunene horse mackerel *Trachurus trecae*, the Cape horse mackerel *Trachurus capensis* and other clupeid and carangid pelagic species.

- To collect stomachs from both horse mackerel species for analyses of diet composition.

- To collect stomachs and otoliths from both sardinellas species for analyses of diet composition and length-age relationships.

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

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

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

- To collect seal scats from the breeding fur seal colonies (with pups) in the Tiger Bay area in order to study their diet composition as basis for subsequent evaluations of their impact on the fish communities in the region.

1.2 Participation

The scientific staff consisted of:

From INIP, Luanda:

19.02-01.03: António BARRADAS (Co-cruise leader), Quilanda FIDEL, Henriette Lutuba NSILULU, Francisco de ALMEIDA, Eusébio dos SANTOS and Geraldina SALVADOR.

02.03-20.03: António BARRADAS (Co-cruise leader), Quilanda FIDEL, Henriette Lutuba NSILULU, Francisco de ALMEIDA, Eusébio dos SANTOS, Geraldina SALVADOR, Pedro PANZO and Wsaso ANDRÉ.

From IMR, Bergen:

19.02-01.03: Bjørn Erik AXELSEN (Cruise leader), Diana ZAERA, Tore MØRK and Ole Sverre FOSSHEIM.

02.03-20.03: Diana ZAERA (Cruise leader), Tore MØRK, Ole Sverre FOSSHEIM.

1.3 Narrative

Due to some repairs, carried on in Walvis Bay, the survey started one and a half day later than planned. The vessel departed Walvis Bay on the 19th of February at 06:00 UTC and steamed northwards to the Cunene River where the survey started with the hydrographical section (off Cunene River) at 20:00 UTC on February the 20th.

The survey area is divided into three standard regions:

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

The Southern region was completed on the 27th (22:00 UTC) of February. The ship steamed to Luanda on February 28th for a scheduled crew change the 2nd of March. The survey didn't restart until the 8th at 10:00 UTC, due to visa related problems.

The vessel steamed southwards from Luanda to the start position, reaching Baía Farta on March 9th (12:00 UTC). The central region was then completed the 15th at 03:30 UTC.

The Northern region, up to the Congo River, was covered in the period March 15th (03:30 UTC) to the 19th (13:00 UTC), when the survey was completed. The vessel steamed the same day towards Pointe Noire, docking in at 08:00 (UTC) on the 20th March.

The standardized systematic survey track introduced in 2002 consisting of pseudo-parallel acoustic transect lines perpendicular to the coast line with equally spaced transect lines (6 nautical miles, NM, apart) was followed during the survey for the southern and central areas. However, due to time constrain problems, the northern area was covered with transect lines 10 NM apart. The Cabinda region could not be included in the survey coverage due to the stricter enforcement of regulations implied by the oil companies in the area since 2009.

1.4 Survey effort

Figure 1(a-c) shows the cruise tracks with fishing, plankton and hydrographical stations for the northern, central and southern regions of Angola. The sampling trawls, including the small (10 m vertical opening), the mid-sized (15 m vertical opening) pelagic trawls and the demersal trawl (5 m), were used during the survey. Table 1 summarizes the survey effort by regions. It is important to mention that due to lack of time and in order to be able to cover acoustically the whole survey area, it was necessary, for both the central and northern regions, to reduce the number of CTD casts and eliminate the multinet stations.

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

Area	BT	PT	Total Trawls	CTD casts	Multinet stations	Log (NM)
Cunene River-Elephant Bay	6	10	16	111	42	1135.3
Elephant Bay -Pta. Palmerinhas	5	9	14	40		1710.7
Pta. Palmerinhas-Congo River	2	5	7	19		930.5
Total	13	24	37	170	42	3776.5

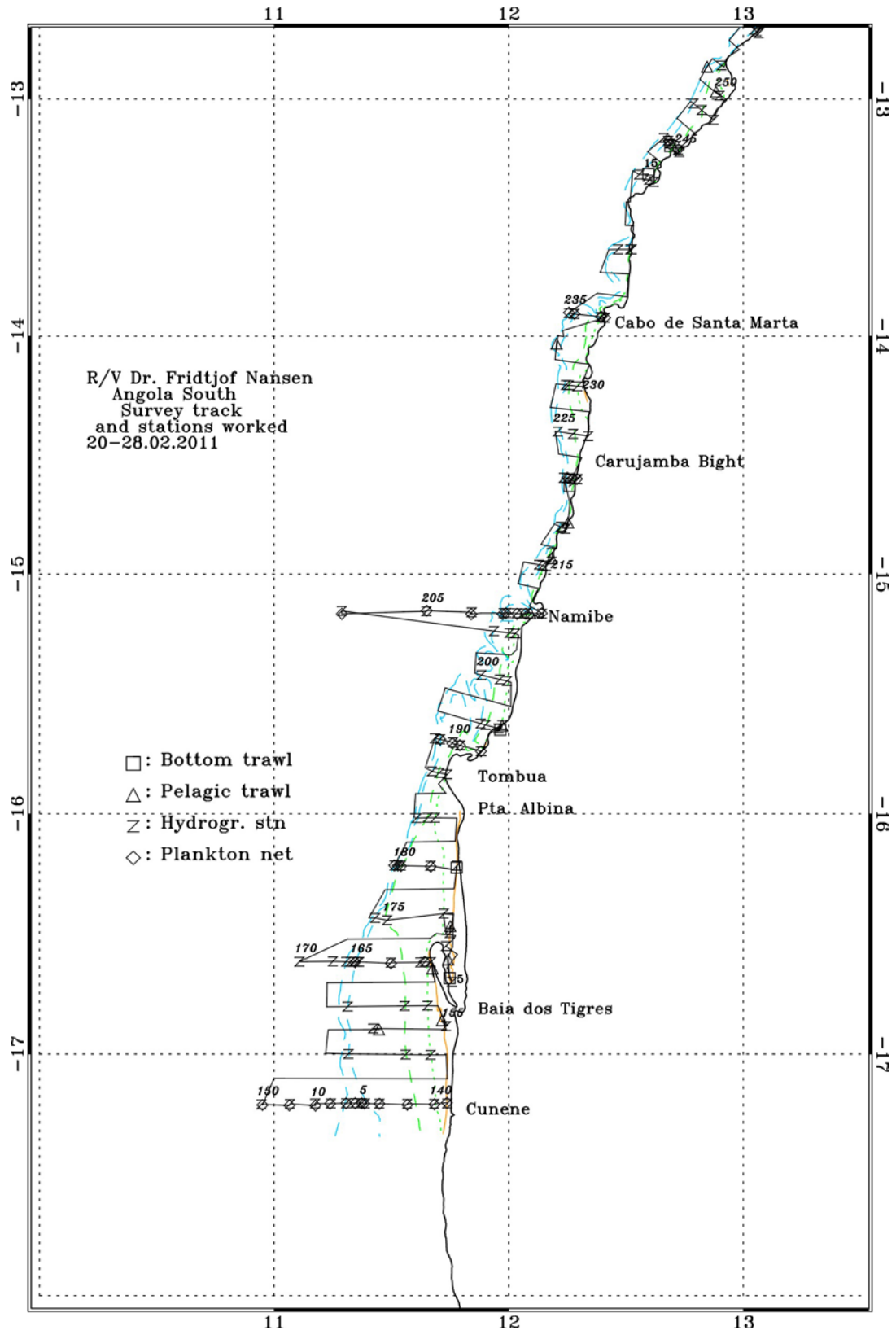


Figure 1a. Course track with fishing, plankton and hydrographical stations, Cunene River – Baía dos Elefantes (13°S). Depth contours at 20, 50, 100, 200, and 500 m.

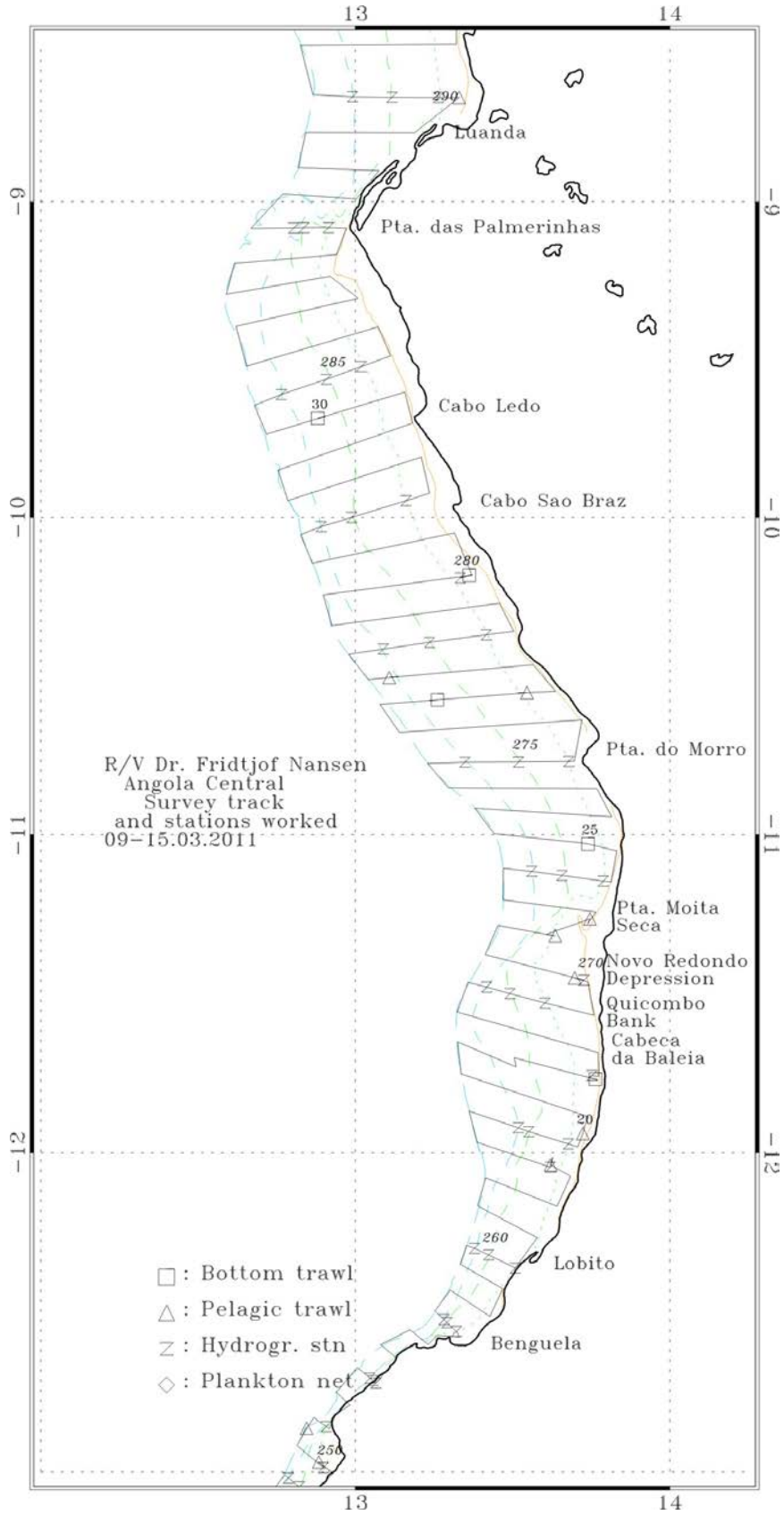


Figure 1b. Course track with fishing, plankton and hydrographical stations, Baía dos Elefantes (13°S) - Pta. das Palmerinhas (9°S). Depth contours at 20, 50, 100, 200, and 500 m.

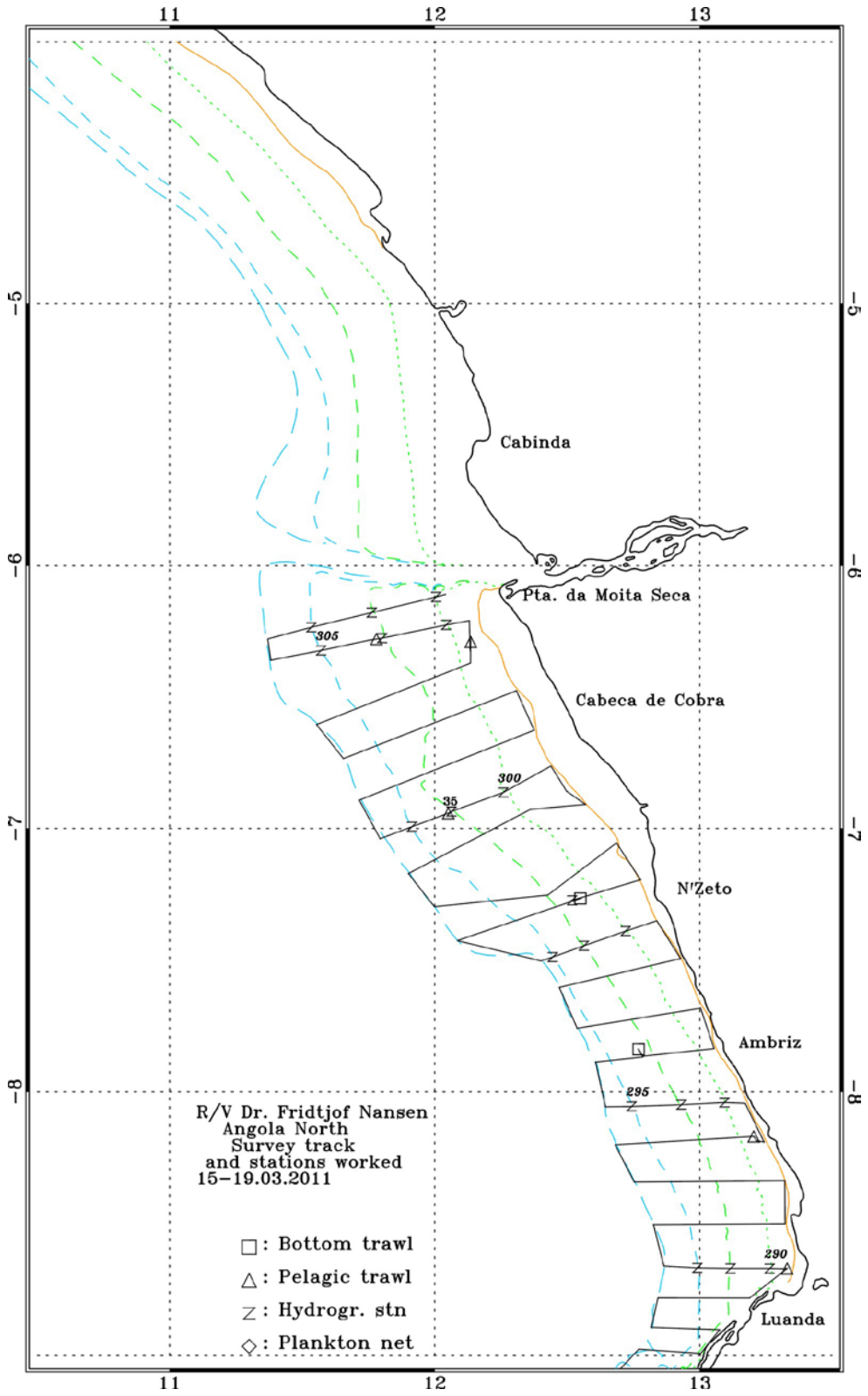


Figure 1c. Course track with fishing, plankton and hydrographical stations, Cunene – Pta. Das Palmerinhas (9°S). Depth contours at 10, 20, 50, 100, 200 and 500 m.

CHAPTER 2 METHODS

2.1 Hydrographical sampling

CTD

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

INIP had defined four monitoring lines: Namibe, Lobito, Luanda and Congo River, but only the one off Namibe could be carried out due to severe time constrains. For the same reason, no standard or biological transects were carried out neither in the central nor in the northern region.

Attached to the CTD was also a Chelsea fluorometer of the type Mk III Aquatrack. It measures chlorophyll A in microgram per litre with an uncertainty of 3%. Factory slope and offset was 0.921 and -0.02.

In order to calibrate the oxygen and salinity sensors, water samples were taken and analysed for dissolved oxygen using the Winkler method and for salinity using a Guideline Portasal salinometer.

Of a total of 97 samples taken for calibration purposes, 87 were accepted for oxygen calibration, and 80 for salinity. Figure 2 (a and b) shows the results of the calibration. No further adjustments were made on the CTD data

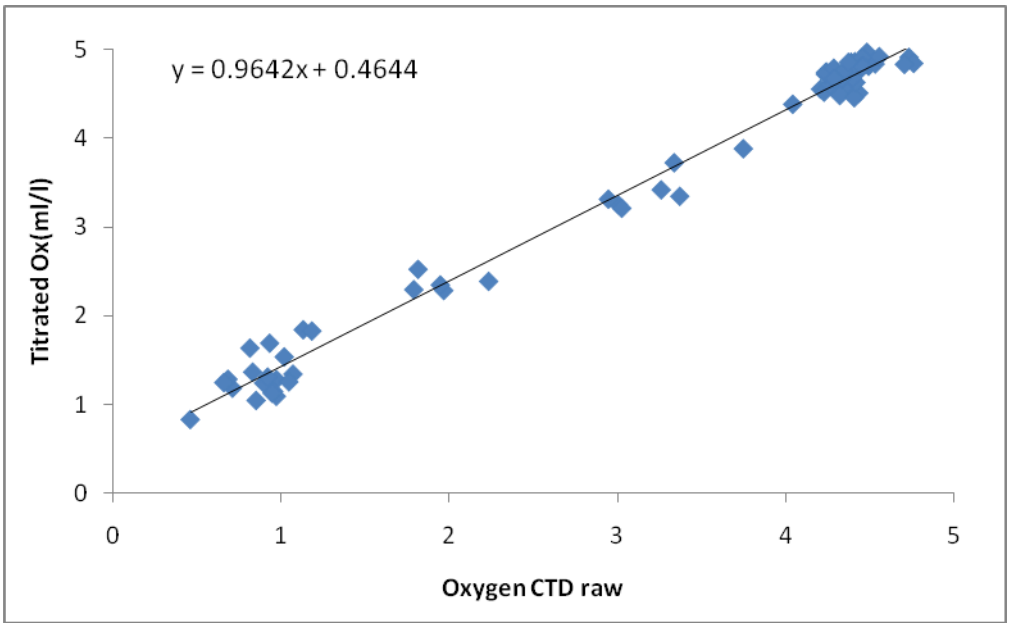


Figure 2a. Linear regression of the Winkler determined oxygen concentration. $R^2 = 0.9886$

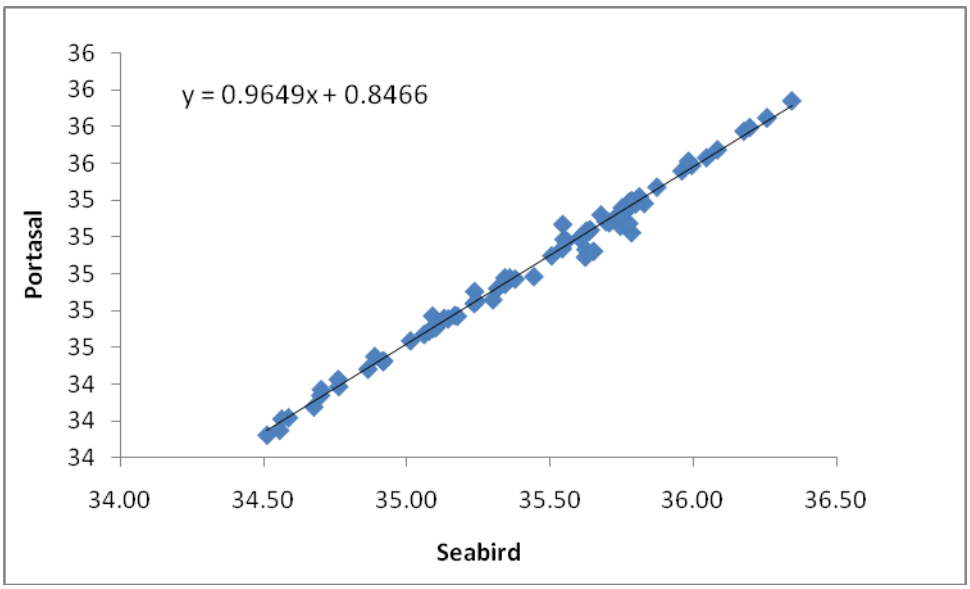


Figure 2b. Linear regression of the salinometer determined salinity concentration. $R^2 = 0.9915$

Thermosalinograph

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

Current speed and direction measurements (ADCP)

A vessel-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments was run continuously during the survey in broadband mode shallower than about 400 m and in narrow band mode in deeper waters. The frequency of the VMADCP is 150 kHz, and data were averaged and stored in 3 m or 4 m vertical bins. All data were stored on files for post survey processing.

Meteorological observations

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

2.2 Fish sampling

A brief description of the fishing gear is provided in Annex IV. All trawl catches were sampled for species composition by weights and numbers. Records of catch rates are given in Annex I. Total length (TL) frequencies were taken for the commercial pelagic species such as sardinella, horse mackerel, sardine, round herring, anchovy and tuna species, *Brachydeuterus auritus* and demersal species, mainly *Dentex spp*.

Biological samples were obtained for sardinella, horse mackerel, *Sardinops ocellatus*, *Etrumeus whiteheadi*, *Engraulis encrasicolus*, *Selene dorsalis* and *Chloroscombrus chrysurus*. Total length (TL) 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 six-point classification scale first proposed by INIP (Table 2).

Table 2. Adapted scale by INIP for the classification of maturity stage for both horse mackerel and sardinella in Angola (partial spawners).

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

Stomach samples of horse mackerel and both sardinellas were collected for further analysis at INIP, Luanda. Feeding biology will be investigated in more details at a later stage by relating the stomach contents to recorded availability of zooplankton. In addition otoliths and gills were collected from *Sardinella aurita* and *S. maderensis*.

2.3 Plankton sampling

Phytoplankton

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

Zooplankton

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

2.4 Acoustic sampling

Acoustic equipment

Acoustic data were recorded using a Simrad ER60 scientific echo sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38, 120 and 200 kHz. The survey was started without *a priori* calibration.

Acoustic data were logged and post-processed using the latest acoustic data post-processing software, the Large Scale Survey System (LSSS) Version 1.25. The technical specifications and operational settings of the echo sounder used during the survey are given in Annex IV.

Allocation of acoustic energy to species group

The acoustic data were scrutinized using the LSSS version 1. 25. Scatters were displayed at 38 kHz. The mean 5 nautical miles (NM) area backscattering coefficient s_A (m^2/NM^2) was allocated to a predefined set of species groups on the basis of established echogram features. Acoustic groups and respective species are listed in Table 3. Ground truthing and estimation of mean length and weight were accomplished by means of targeted pelagic and demersal trawling.

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

Group	Taxon	Species
Sardinella	*Sardinella* sp.	*S. aurita*
		S. maderensis
Horse mackerel	*Trachurus* sp.	*T. trecae*
		T. trachurus capensis
Pilchard	Sardinops	*S. ocellatus*
Big-eye grunt		*Brachydeuterus auritus*
Pelagic species 1	Clupeiformes[1]	*Ilisha africana*
		Etrumeus whiteheadi
		Engraulis encrasicolus
Pelagic species 2	Carangidae[2]	*Selene dorsalis*
		Chloroscombrus chrysurus
		Decapterus rhonchus
		Seriola carpenteri
	Scombridae	*Auxis thazard*
		Sarda sarda
		Scomber japonicus
	Sphyraenidae	*Sphyraena guachancho*
	Others	*Trichiurus lepturus*
		Lepidopus caudatus
Other demersal species	Sparidae[3]	*Dentex angolensis*
		D. macrophthalmus
		D. congoensis
		D. canariensis
		D. barnardi
		Pagellus bellottii
		Sparus caeruleostictus
		S. pagrus africanus
	Other taxii	*Saurida brasiliensis*
		Arioma bondi
		Pomadasys incisus
		Galeoides decadactylus
Mesopelagic species	Myctophidae$_3$	*Diaphus dumerili*
	Other mesopelagic fish	*Trachinocephalus myops*
Plankton	Calanoidae	*Calanus* sp**.**
	Euphausiidae	*Meganyctiphanes sp.*
	Other plankton	

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

Estimation of biomass

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

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

or

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

where C_F is the conversion factor from acoustic density to fish biomass and L is the mean total fish length. This target strength function was originally established for North Sea herring, but has later been attributed to clupeids in general (Foote *et al*., 1986; Foote, 1987).

No specific target strength relations presently are available for the species at hand, and equation (2) has therefore been applied consequently for all targeted species in this time series. The biomass was calculated by multiplying the number of fish by the expected length at weight, estimated by regression of the log-length (total) against total weight. Separate length-weight relationships were worked for each region (north, central, south), pooling all data within each region.

The boundaries of encountered fish aggregations (post strata) were determined by means of contouring within the inner and outer zero-value limits of the transect lines. The strata contours were digitised using Nansis Maptool Version 1.51. Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories: 1: s_A = 0-300; 2: s_A = 301-1 000; 3: s_A = 1 001-3 000; 4: s_A > 3 001 (m^2/NM^2).

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

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

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

where:

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

CHAPTER 3 OCEANOGRAPHIC CONDITIONS

3.1 Surface distribution

Wind, sea surface temperature (SST, 5m depth), sea surface salinity (SSS, 5m depth) and sea surface fluorescence (SSF, 5m depth), were continuously recorded during the survey. Figures 3 to 6 show the horizontal distribution of these parameters respectively.

Southern region

It is not unusual to find strong winds in this region during these months. Around Baía dos Tigres the wind had a north direction and an average velocity of around 15 m/s (30 knots) (Figure 3a). Northwards the wind changed direction and its intensity decreased substantially (the velocity could be as low as 5 m/s).

Figure 4a shows a decrease in water temperature from north (28°C at Cabo de Santa Maria) to south (21°C at Cunene River) with a warm pocket (29°C) off Cabo de Santa Marta. Around Baía dos Tigres the isolines appear closer than in the rest of the region, which may indicate the location of the Angola-Benguela front.

Higher salinity values (36) were found off Baía dos Tigres decreasing from Tombwa (35.8) to Cabo de Santa Maria (35.2) (Figure 5a). The same feature was observed for fluorescence, values were highest (0.3-0.7µ/l) southernmost being lower to the coast northwards (0.1µ/l) (Figure 6a). Figures 4a, 5a and 6a seem to show an hydrographic front north of Baía dos Tigres

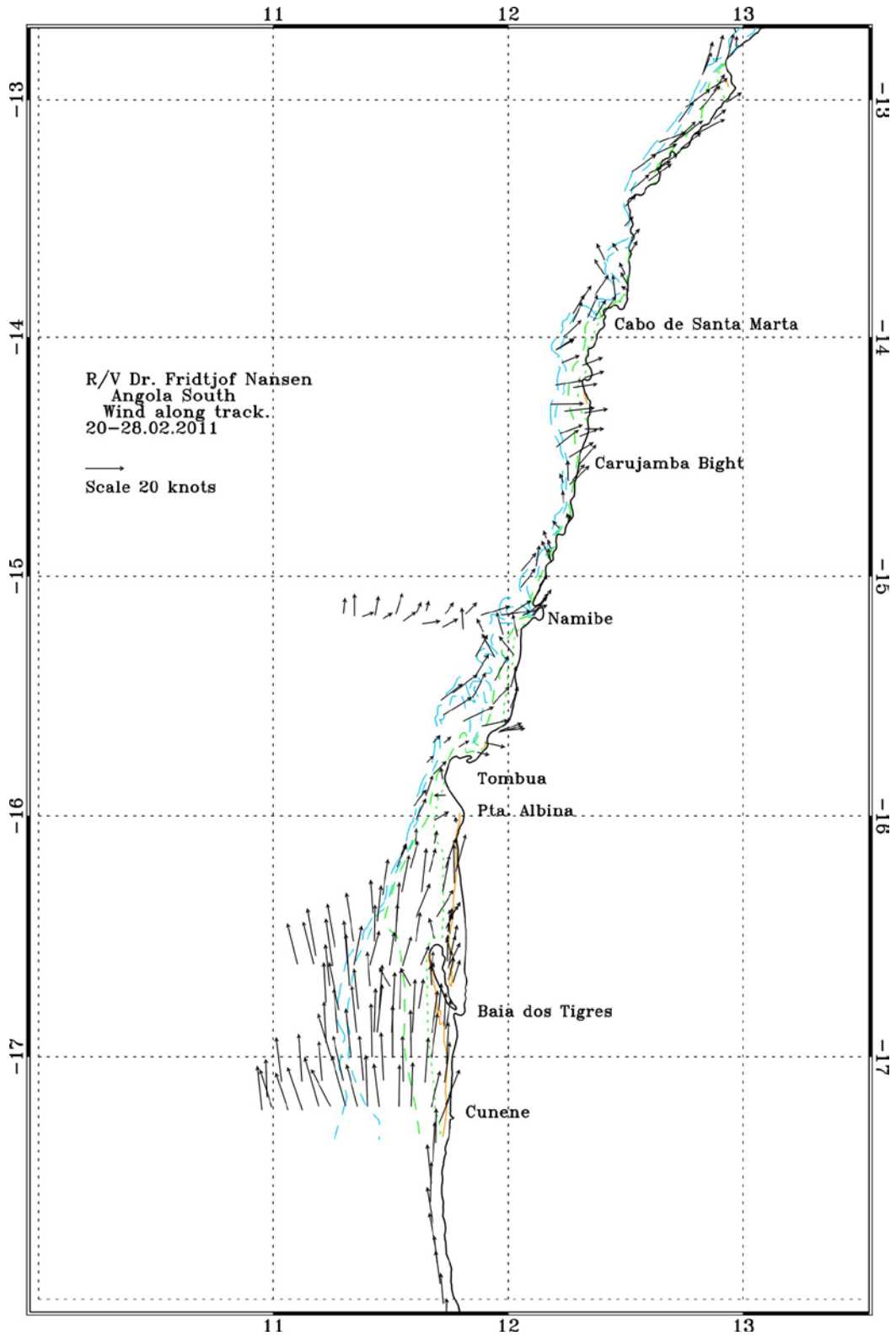


Figure 3a. Distribution of wind velocities along the survey track for the southern region. Depth contours at 10, 20, 50, 100, 200 and 500 m.

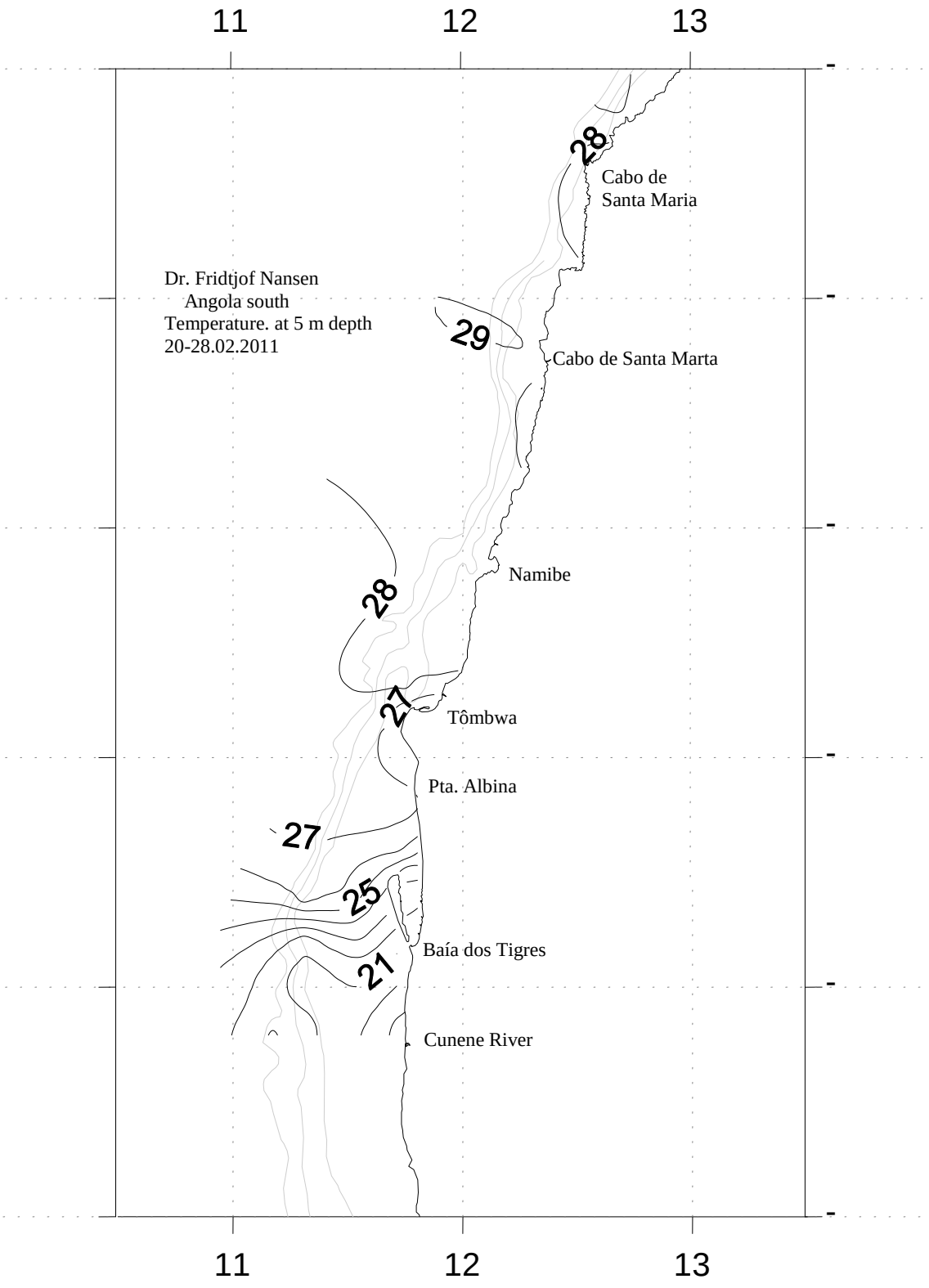
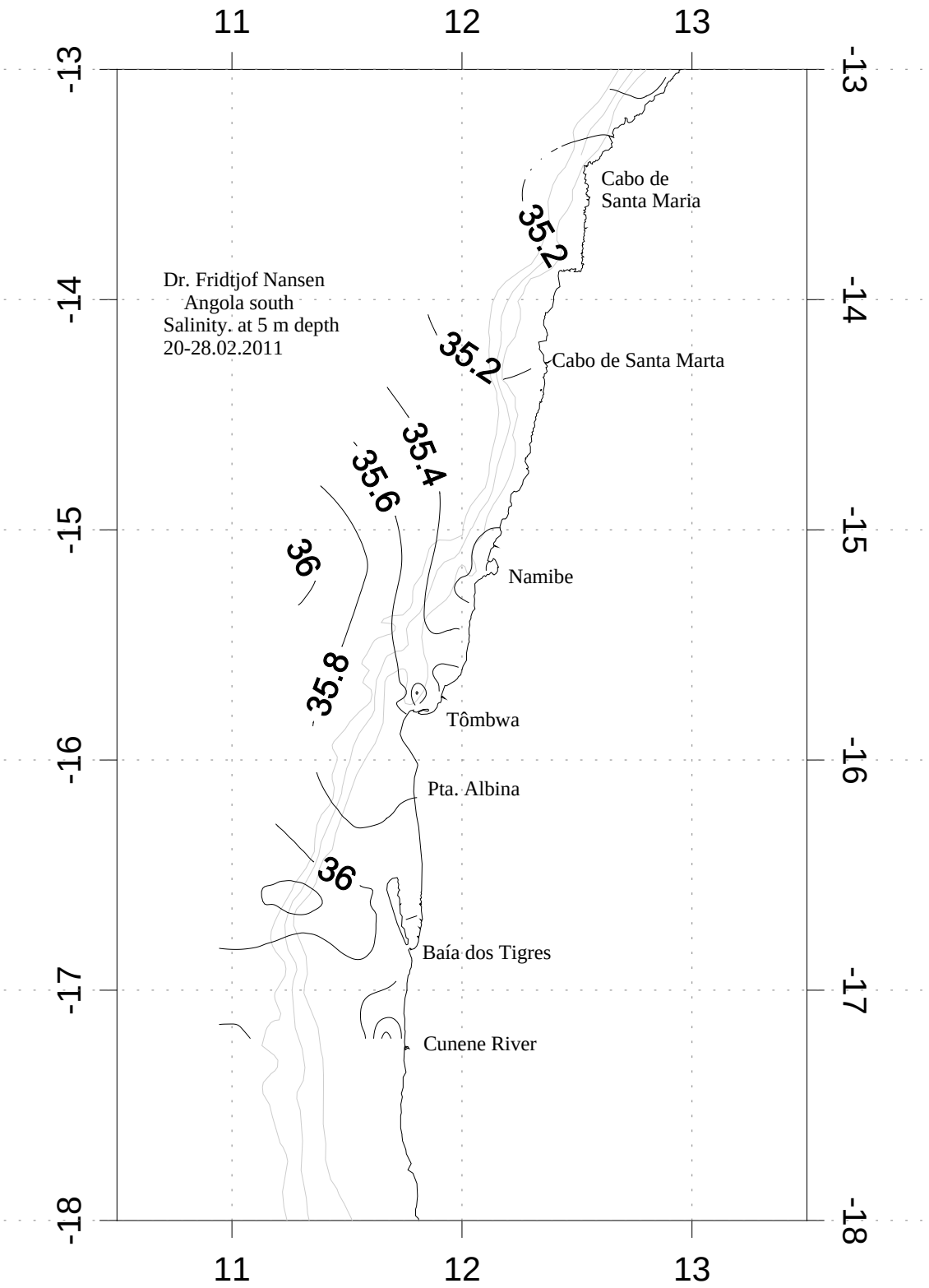
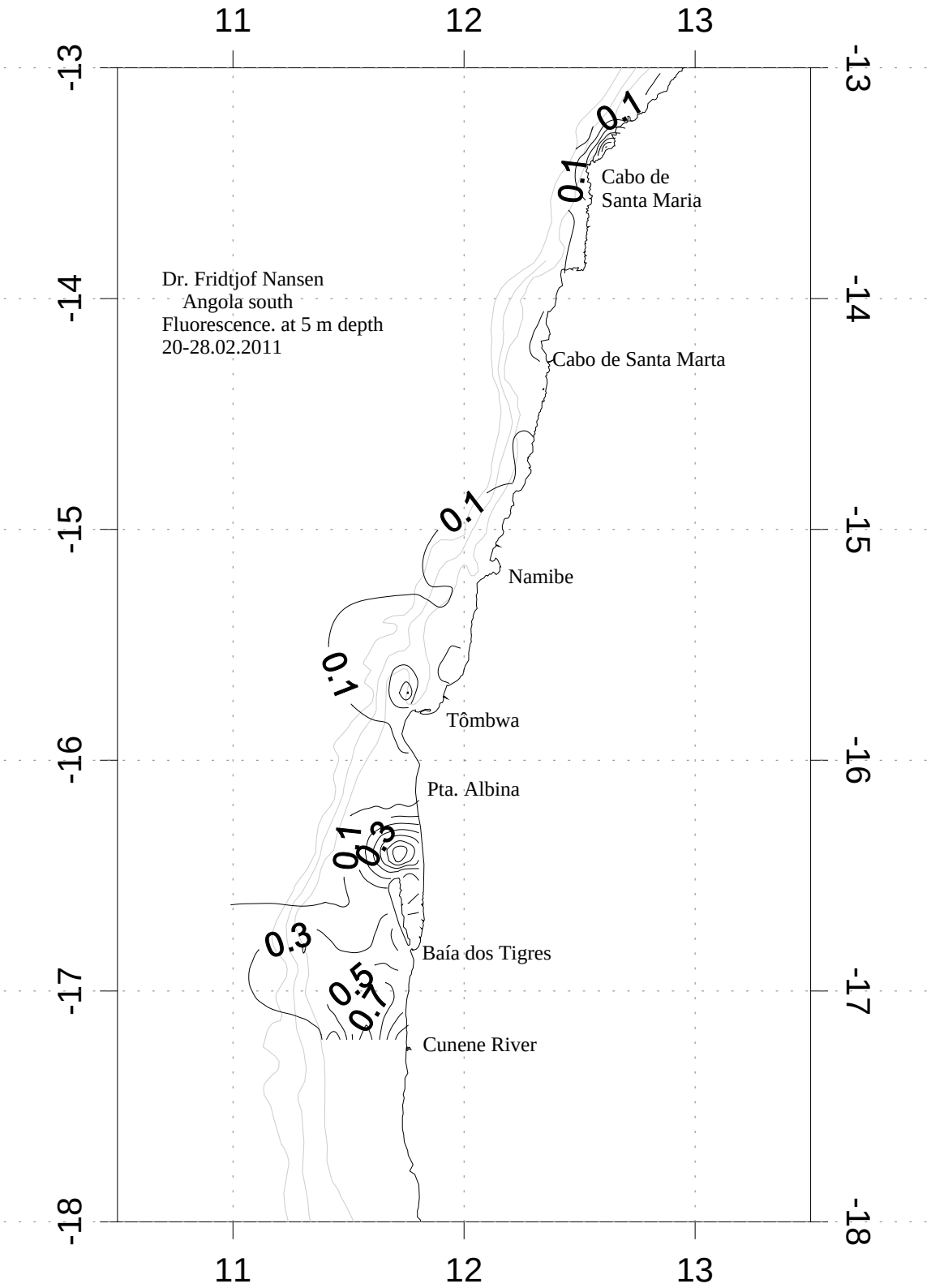


Figure 4a. Distribution of water temperatures at 5m depth in the southern region. Depth contours at 20, 50, 100, 200, and 500m.



Fgure 5a. Distribution of salinity at 5m depth in the southern region. Depth contours at 20, 50, 100, 200, and 500m.



Fgure 6a. Distribution of fluorescence at 5m depth in the southern region. Depth contours at 20, 50, 100, 200, and 500m.

Central region

In this region the wind was very variable both in strength and direction (Figure 3b). The wind blew westerly (around 20 knots) off Benguela and Lobito, with less intensity and predominantly south-westerly around Quicombo, and from Pta. do Morro and up to Pta. das Palmerinhas the wind was strong (sometimes > 20 knots) and had multiple directions. Towards Luanda wind intensity decreased considerably (around 10 knots).

Surface warm water temperature was found throughout the region with a difference of 0.5ºC between the coast (29.5ºC) and offshore (30ºC) (Figure 4b). The 29ºC isoline south Pta. das Palmerinhas could be associated with the rainy season. In general surface temperature in this region was high

Although surface salinity was low, its values were higher than those in the northern area and lower than on the south, ranging between 33.2 and 34.2, with the highest values more offshore and pockets along the coast (Figure 5b). The low salinity values might be associated with the rainy season.

In general, low values of fluorescence (0.08-0.18 µg/l) were found in the entire region (Figure 6b). The highest value was found in a pocket off Lobito (0.14 – 0.18µg/l), probably caused by the discharge of nearby rivers.

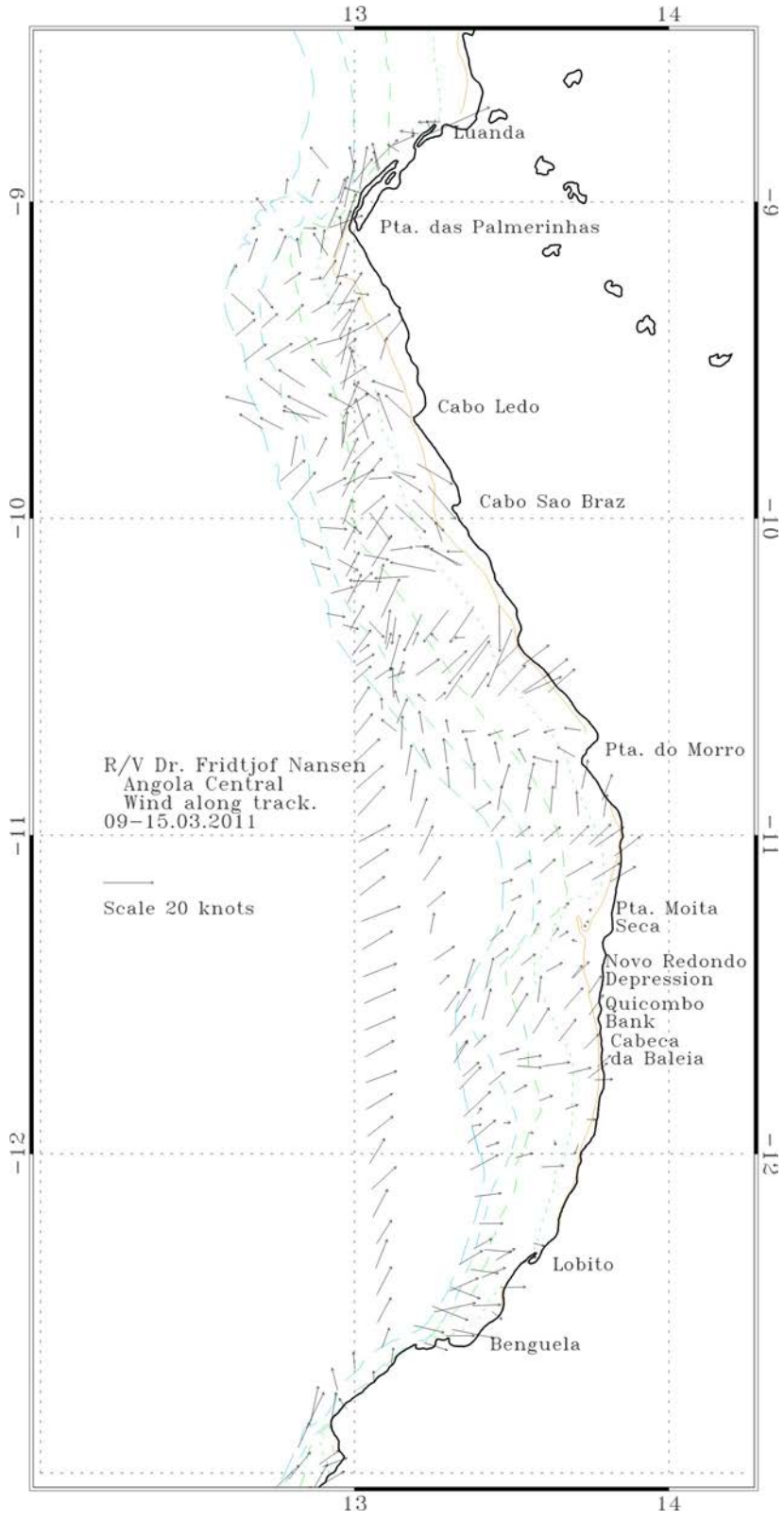


Figure 3b. Distribution of wind velocities along the survey track for the central region. Depth contours at 20, 50, 100, 200, and 500m.

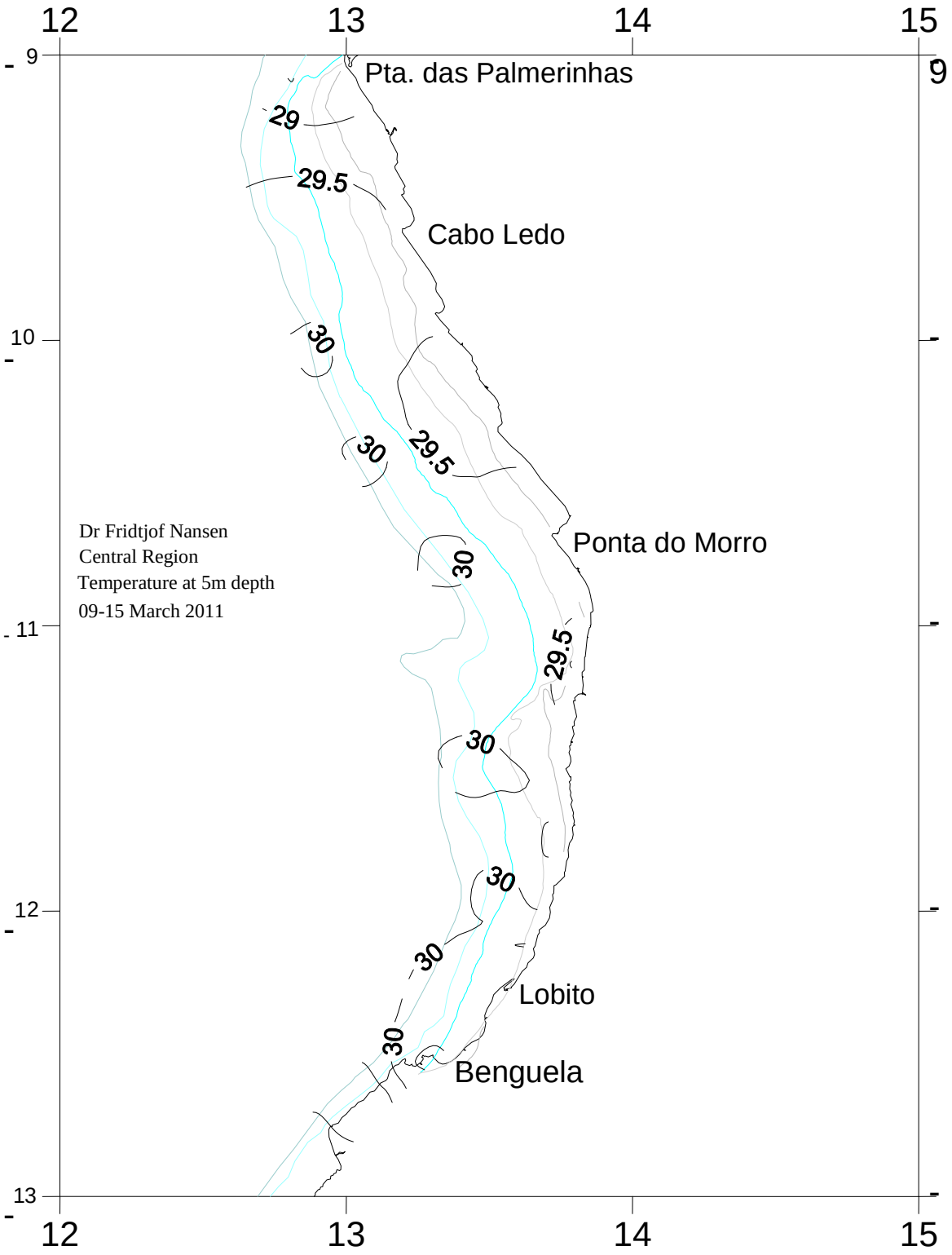


Figure 4b. Distribution of water temperatures at 5m depth in the central region. Depth contours at 20, 50, 100, 200, and 500m.

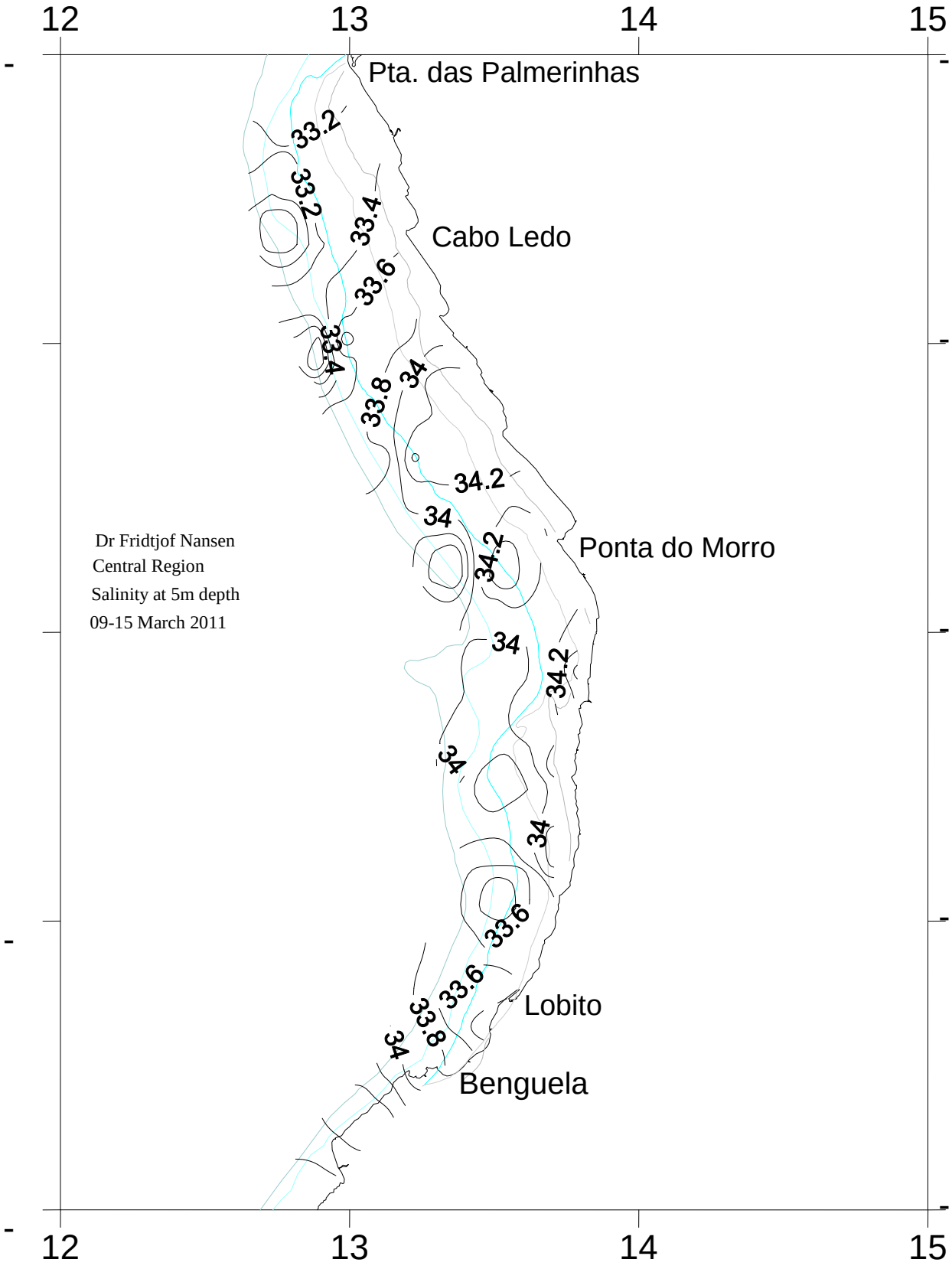


Figure 5b. Distribution of salinity at 5m depth in the central region. Depth contours at 20, 50, 100, 200, and 500m.

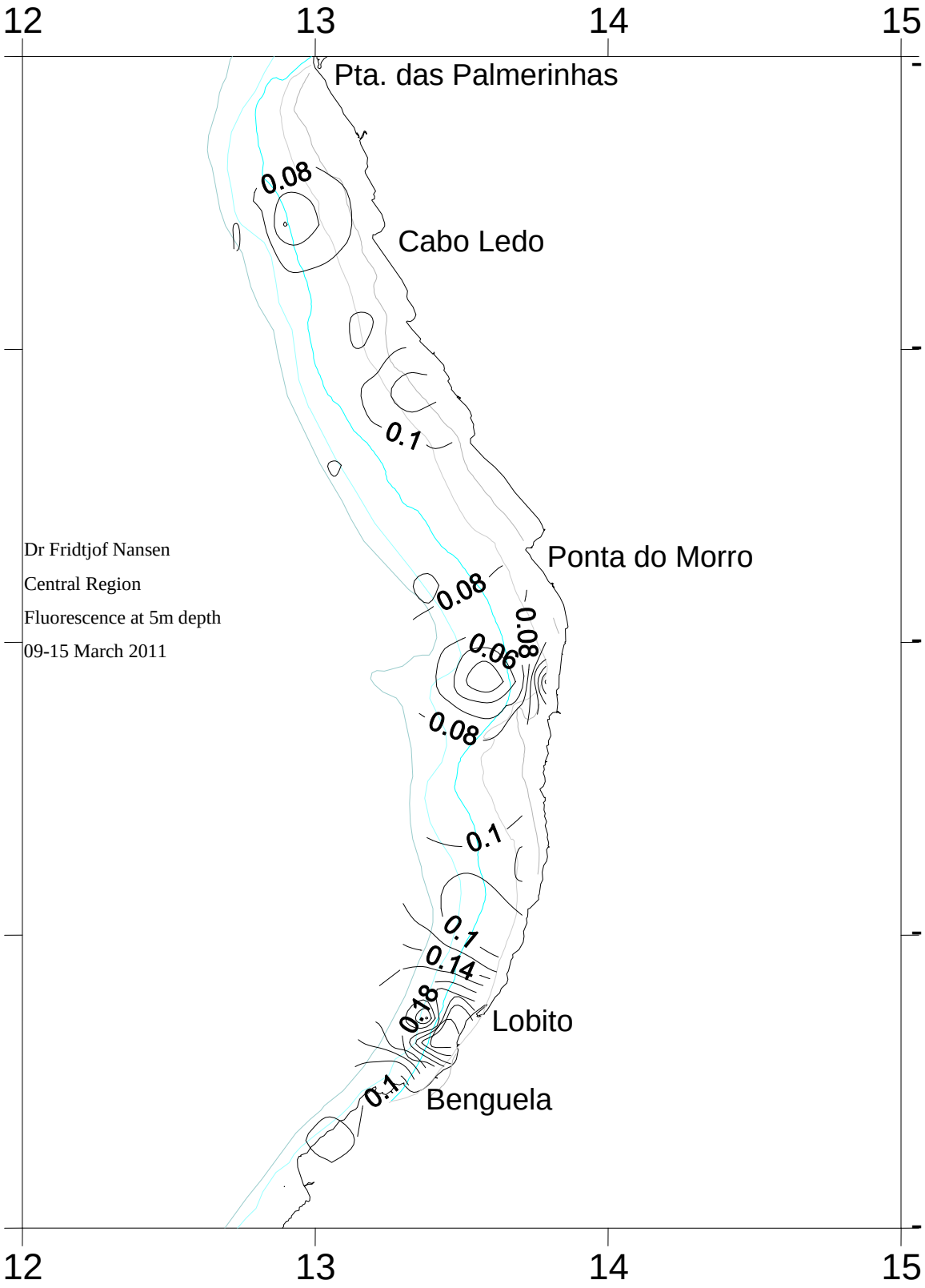


Figure 6b. Distribution of fluorescence at 5m depth in the central region. Depth contours at 20, 50, 100, 200, and 500m.

Northern region

The region could be divided in two according to the prevailing wind direction: the northernmost part with northerly winds and the southern part with southerly blowing winds (Figure 3c). Off N'zeto it can be observed a front-like wind, where winds meet, here the wind was very weak (< 5 knots).

Surface water temperature gradually increased southwards varying from 27.5ºC at the mouth of Congo River and up to 29ºC off Luanda (Figure 4c). It was found a weak pocket off N'zeto.

The distribution of sea surface salinity shows the influence of a fresh water surface layer originated in the Congo River, defining a north-south horizontal gradient (Figure 5c), with higher salinity values towards the south.

Surface fluorescence (Figure 6c) shows higher values than in the central area, ranging between 0.1 and 0.45 µg/l. There seems to be a decreasing gradient from north to south and off N'zeto it was observed a high concentration fluorescence pocket (0.451µg/l), probably because it is the less disturbed area.

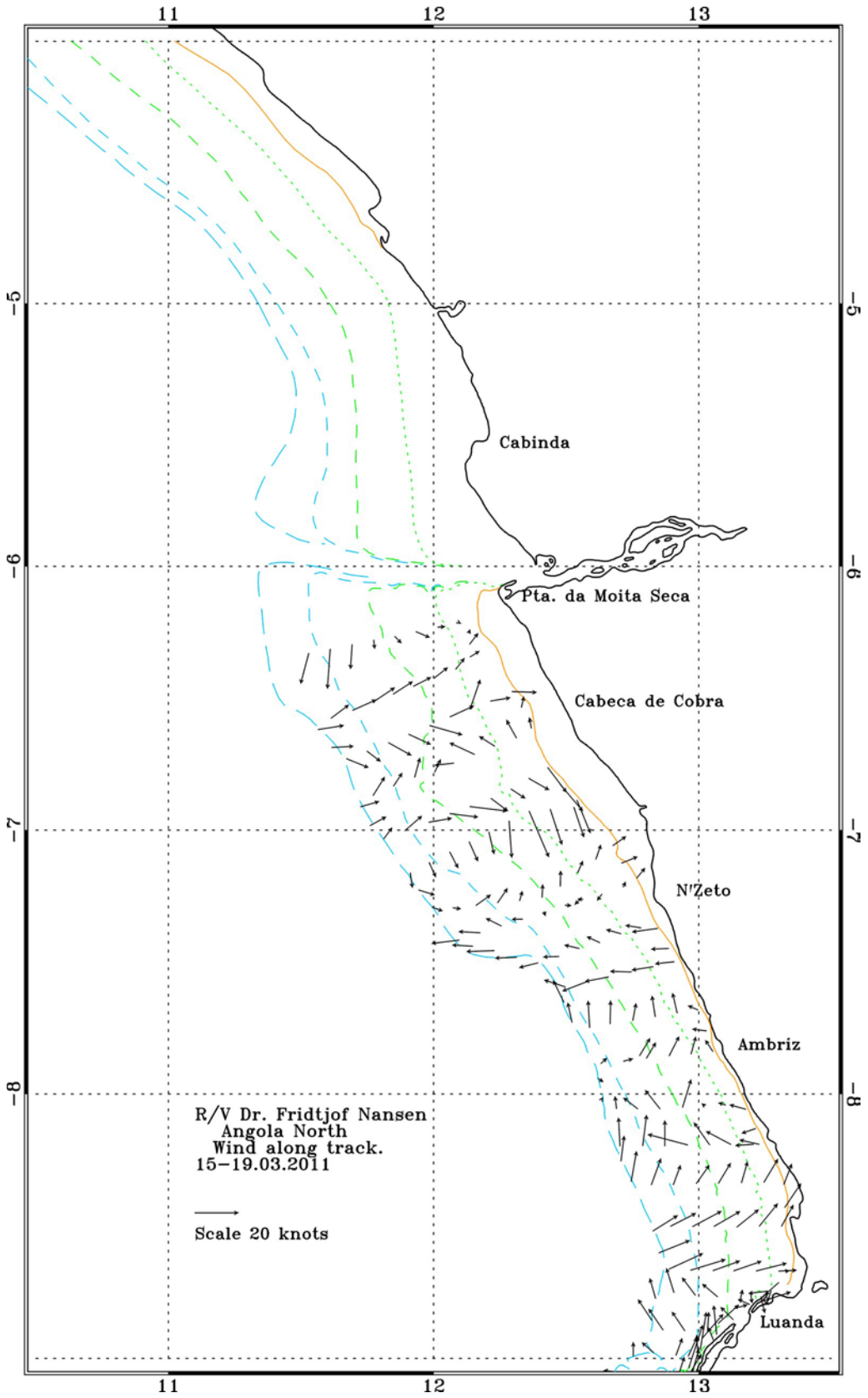


Figure 3c. Distribution of wind velocities along the survey track for the northern region. Depth contours at 20, 50, 100, 200, and 500m.

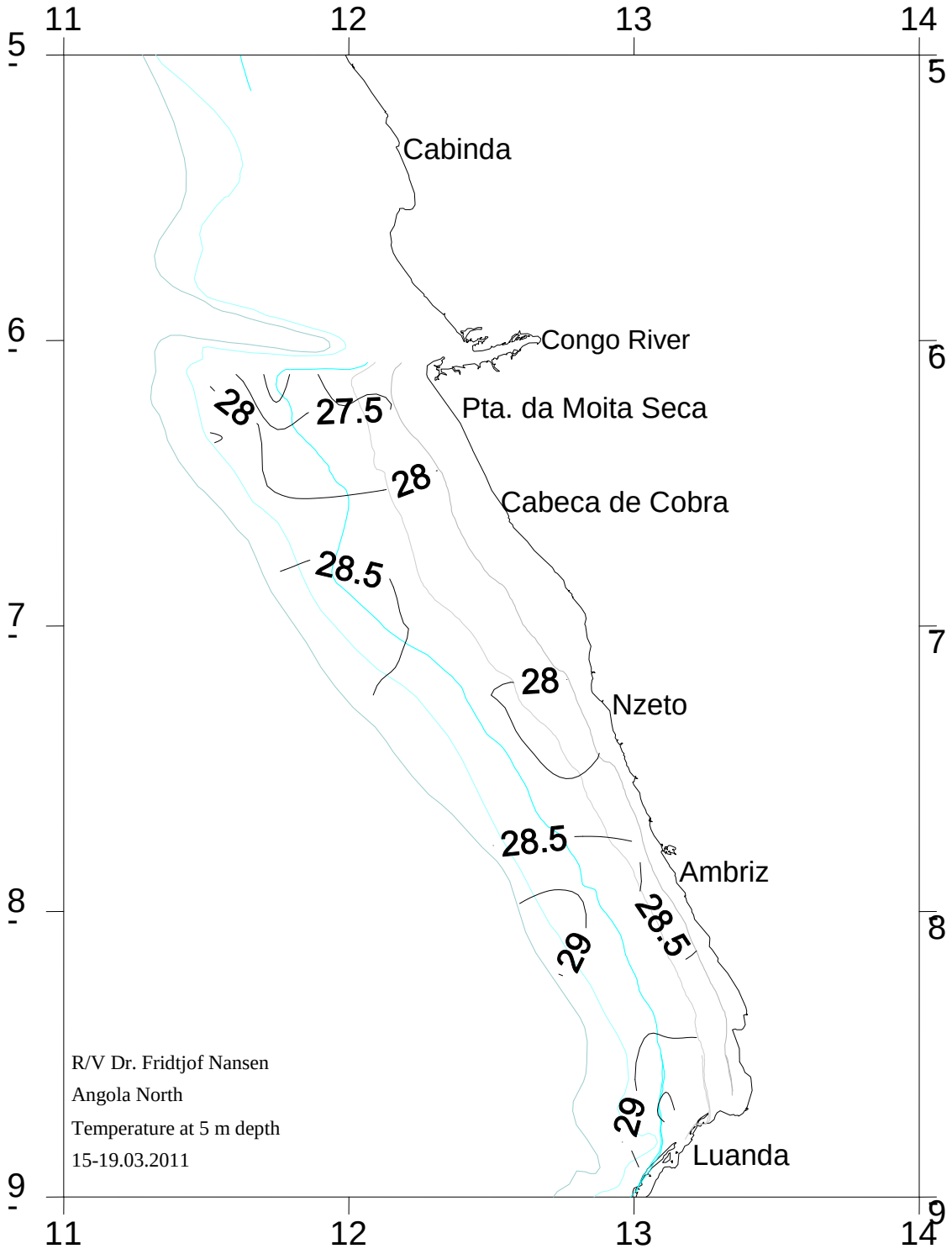


Figure 4c. Distribution of water temperatures at 5m depth in the northern region. Depth contours at 20, 50, 100, 200, and 500m.

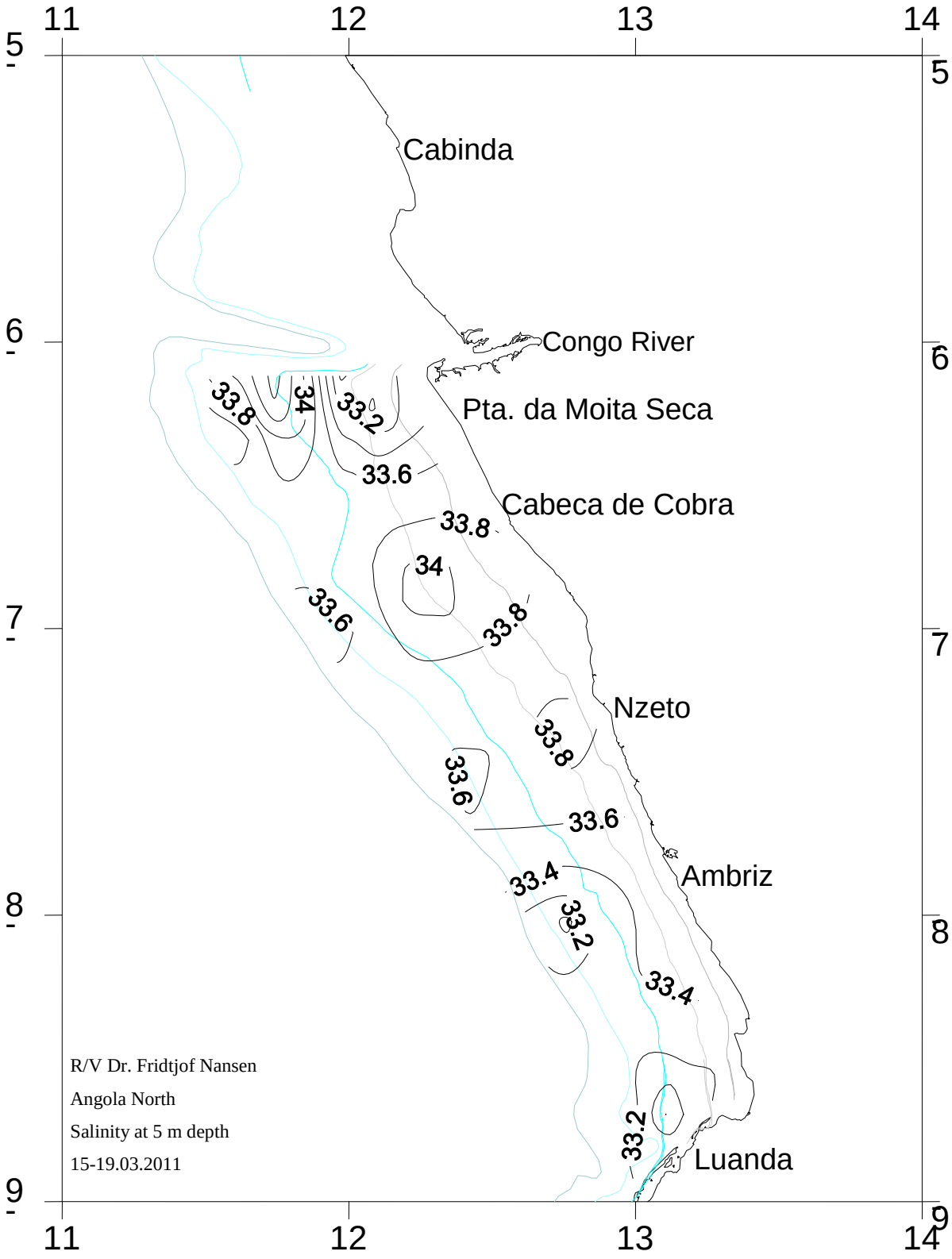


Figure 5c. Distribution of salinity at 5m depth in the northern region. Depth contours at 20, 50, 100, 200, and 500m.

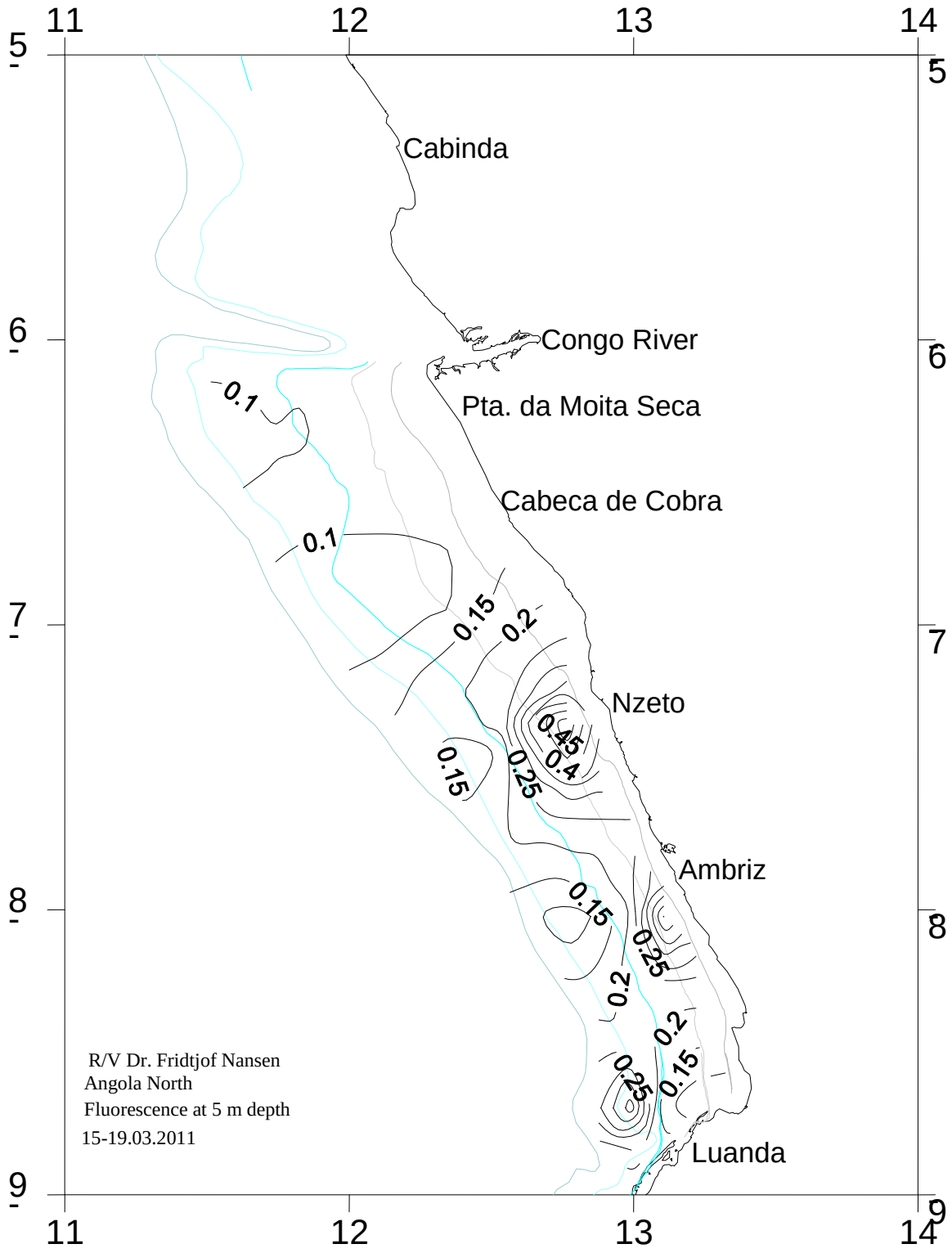


Figure 6c. Distribution of fluorescence at 5m depth in the northern region. Depth contours at 20, 50, 100, 200, and 500m.

3.2 Standard sections

Southern Region

Figure 7(a-h) shows the vertical distribution of temperature, salinity, oxygen dissolved and fluorescence in the southern region. In all sections, it can be observed a stratified water column, probably with the exception of the Cunene and Namibe sections.

At the Cunene River section the isolines slightly bend upwards towards the coast resulting in that the shelf is dominated by cold, high salinity water.

In the Baía dos Tigres section although it shows a stable stratified water column, two water masses seem to meet along the shelf. Here as in the previous section, the shelf is dominated by cold, high salinity water.

The Namibe section, as the Cunene, doesn't show a fully stratified water column. This could be due to the outflow influence of local rivers.

The surface temperature in the area ranged between 19 and 28ºC, decreasing to 8-9ºC at 500m depth. Salinity values were higher at the surface (>35), oxygen content in the first 100m of the water column was over the 2 ml/l in most sections, and fluorescence values were constant along the area (between 01 and 0.5 µg/l) with the exception of the Namibe section, which showed higher values (>1µg/l).

Due to lack of time there were no standard or monitoring sections taken neither in the central nor in the northern region.

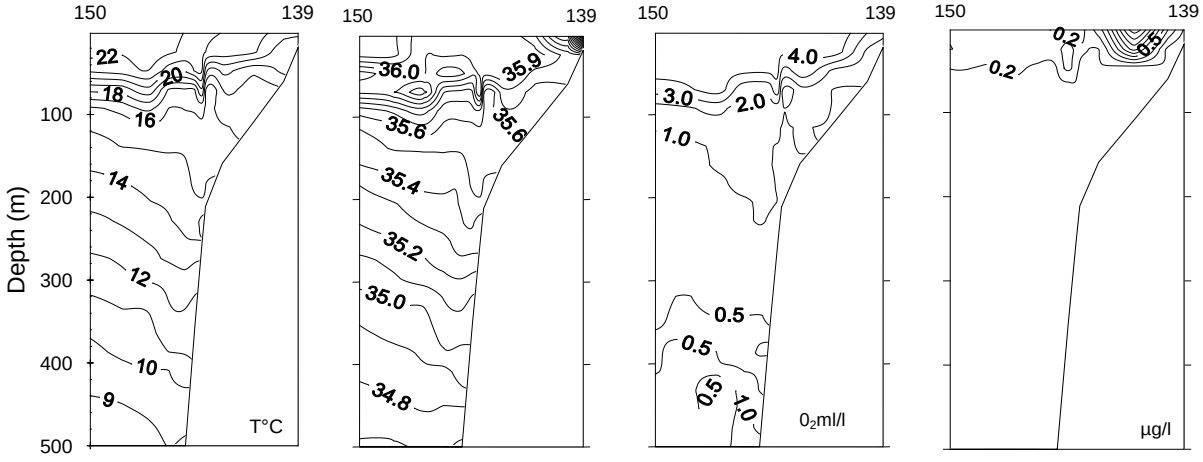


Figure 7a. Vertical sections of temperature, salinity, oxygen and fluorescence off Cunene River.

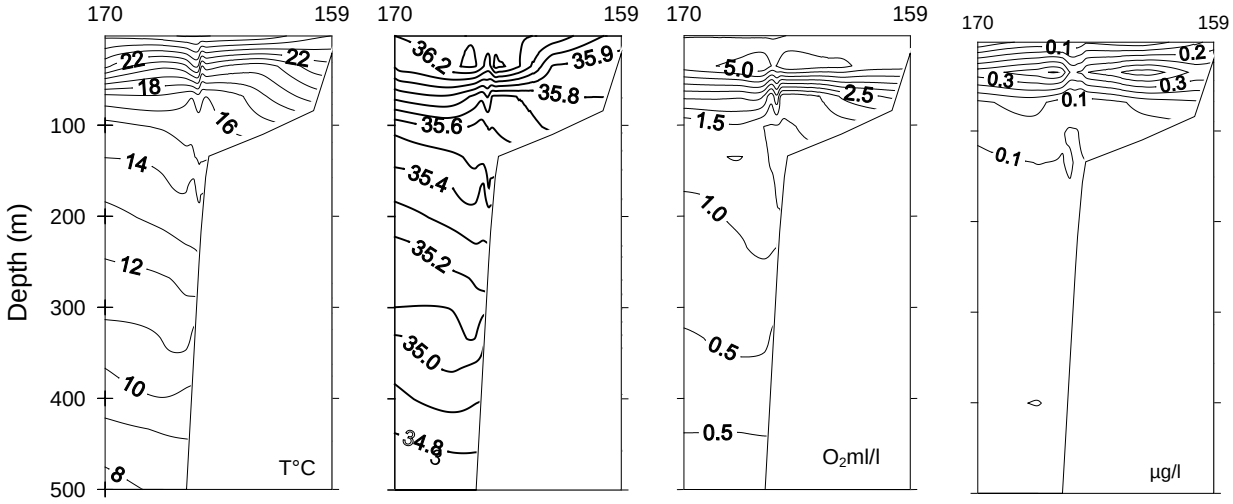


Figure 7b Vertical sections of temperature, salinity, oxygen and fluorescence off Baía dos Tigres

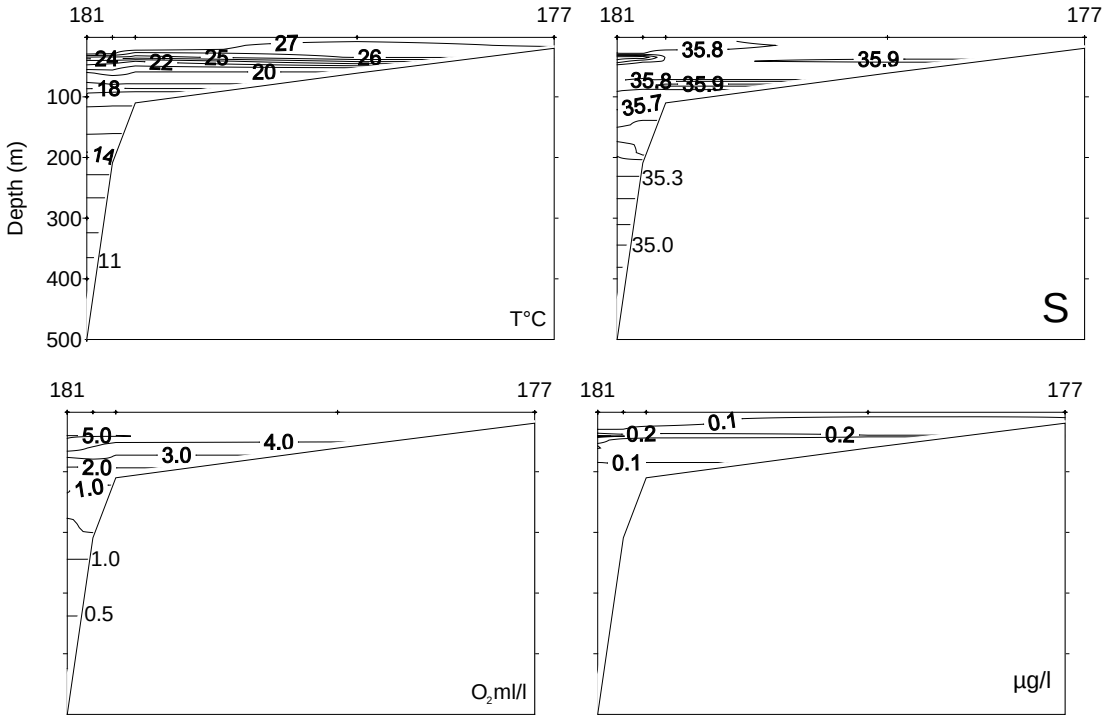


Figure 7c Vertical sections of temperature, salinity, oxygen and fluorescence off North Tiger Bank.

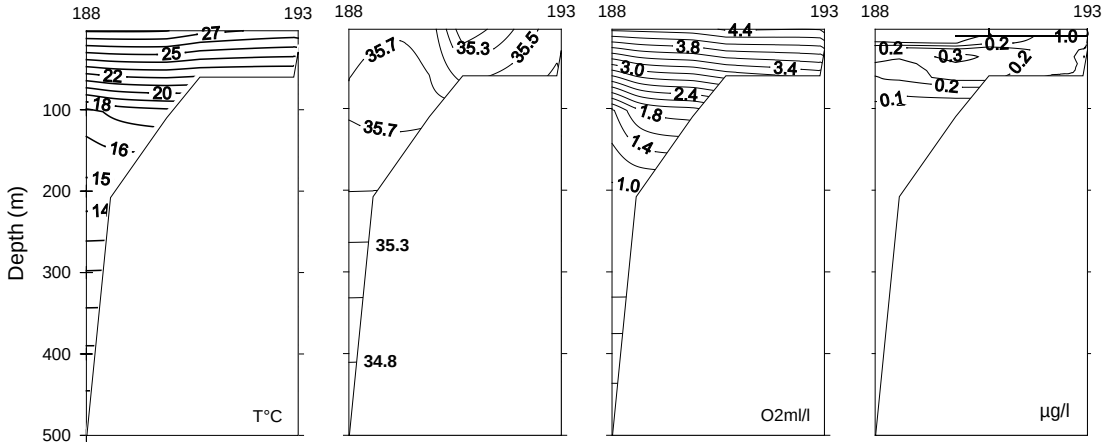


Figure 7d Vertical sections of temperature, salinity, oxygen and fluorescence off Tombua.

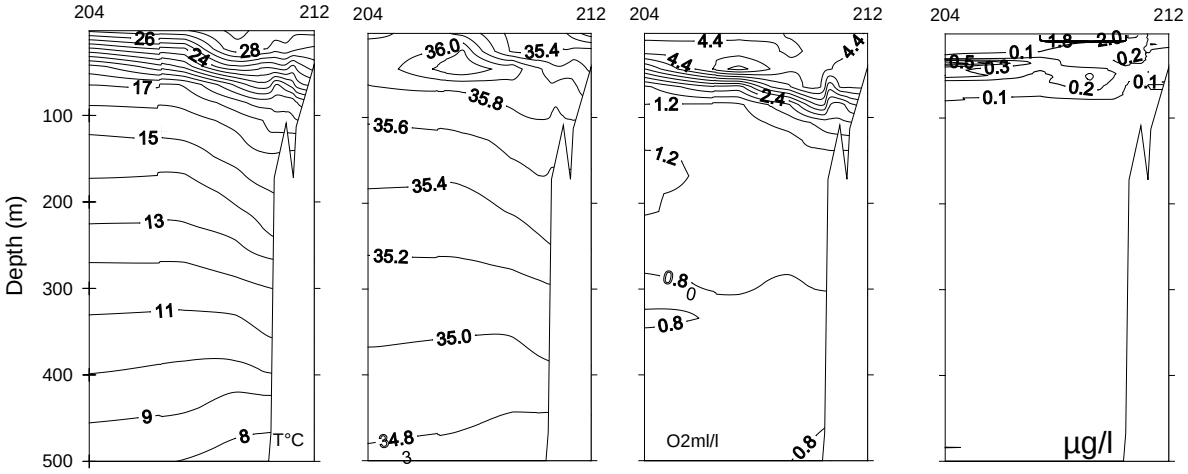


Figure 7e . Vertical sections of temperature, salinity, oxygen and fluorescence off Namibe.

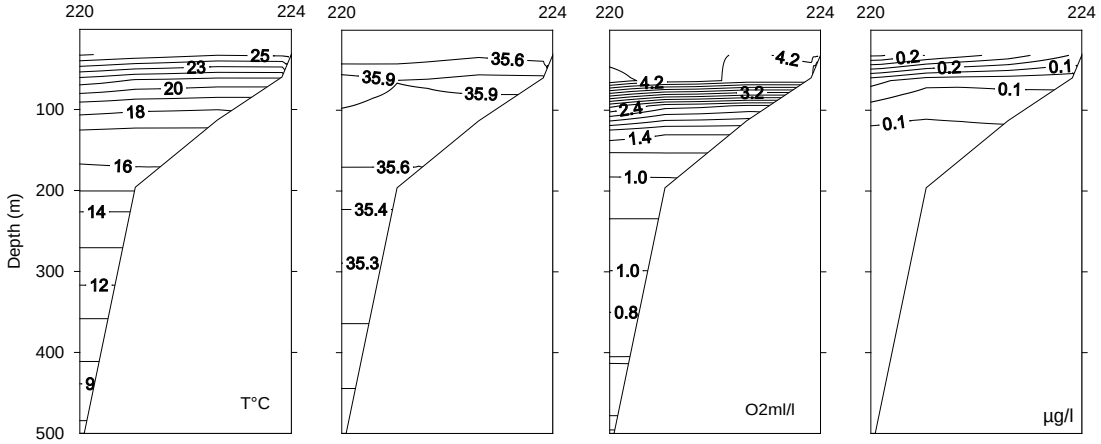


Figure 7f. Vertical sections of temperature, salinity, oxygen and fluorescence off Carujamba.

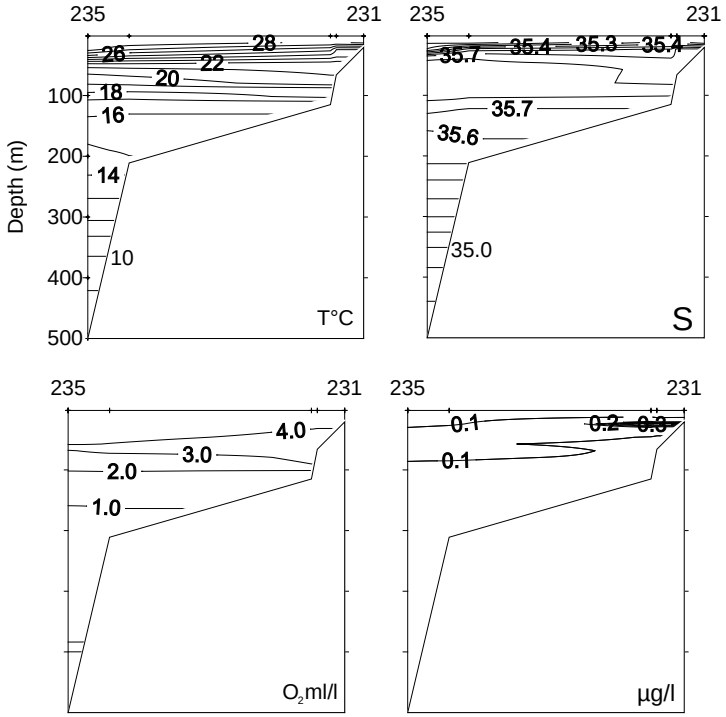


Figure 7g. Vertical sections of temperature, salinity, oxygen and fluorescence off Cabo de Santa Marta.

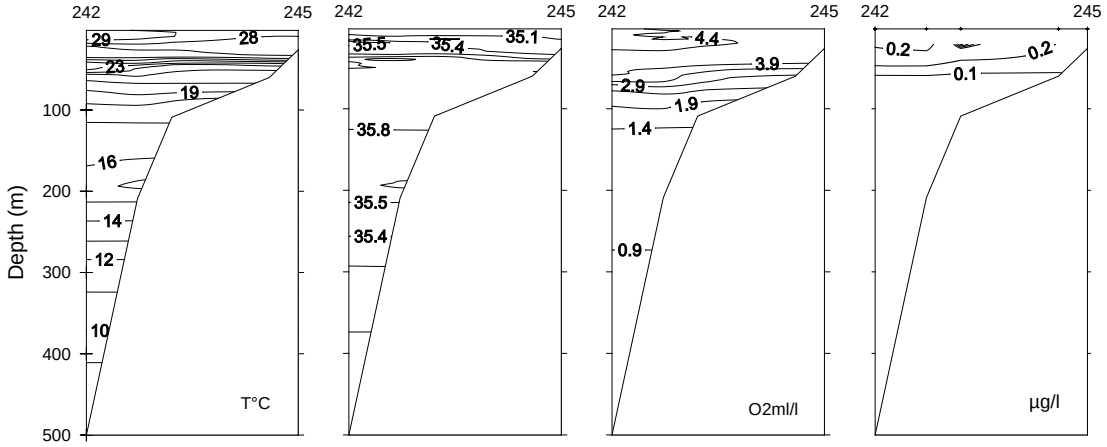


Figure 7h. Vertical sections of temperature, salinity, oxygen and fluorescence off Baía dos Elefantes.

CHAPTER 4 DISTRIBUTION, SIZE COMPOSITION AND BIOMASS ESTIMATES

4.1 Cunene River-Benguela

Sardinella

Both Sardinella species, *Sardinella maderensis* and *S. aurita*, were found throughout the south region from Baía dos Tigres to south of Baía dos Elephants (Figure 8). *S. aurita* was the dominating species, contributing with around 70% to the total biomass. The distribution was more or less continuous, with medium high density areas (1 001>s_A>3 000 m^2/NM^2) south of Pta. Albina and off Namibe, high density aggregations (3 001>s_A>10 000 m^2/NM^2) inside Baía dos Tigres and north of Tômbwa and one small very high density aggregation (s_A>10 000 m^2/NM^2) south of Baía dos Elephants. *Sardinella spp* was never caught deeper than 150 m.

Figure 9 shows the sardinella's length frequency distribution. *S. maderensis* shows two well defined cohorts. The first cohort (11-15 cm total length, TL) has a modal peak at around 13 cm TL, while the second (24-34cm TL) at 31 cm TL. The length frequency distribution of *S. aurita* shows three clear cohorts, with modes at 16, 23 and 30 cm TL.

The estimated total biomass for the two sardinella species was 95 600 tonnes (the biomass estimated in 1998 was of 75 000 tonnes), *S. maderensis* contributed with 28 100 tonnes (30%) while *S. aurita* with 67 500 tonnes (70%). During the last pelagic survey carried out during the summer months (1988), it was *S. maderensis* the most abundant of the two species, contributing with 80% to the total biomass.

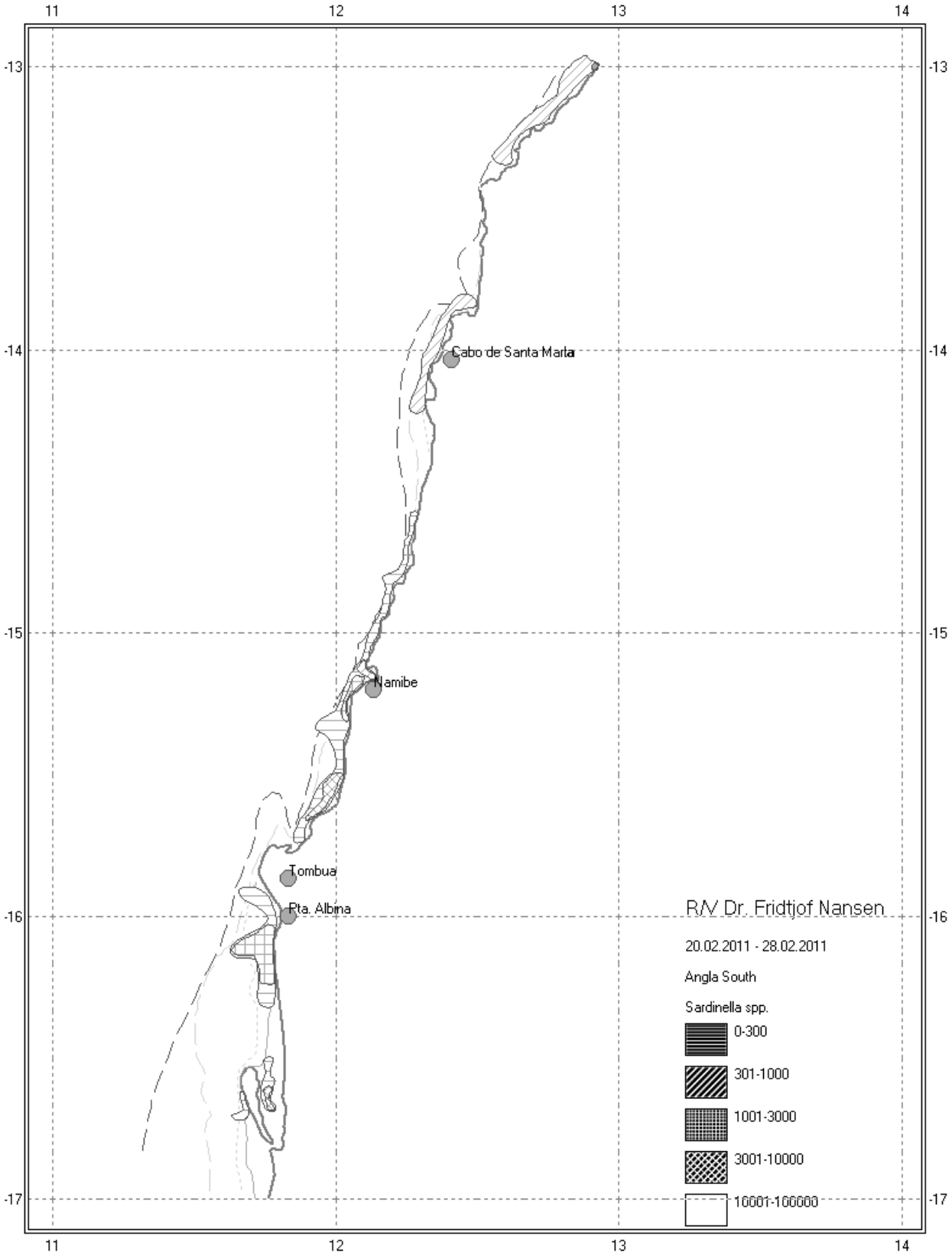


Figure 8 Distribution of Sardinella spp. Cunene River-Benguela. Depth contours at 10, 20, 50, 100, 200 and 500 m.

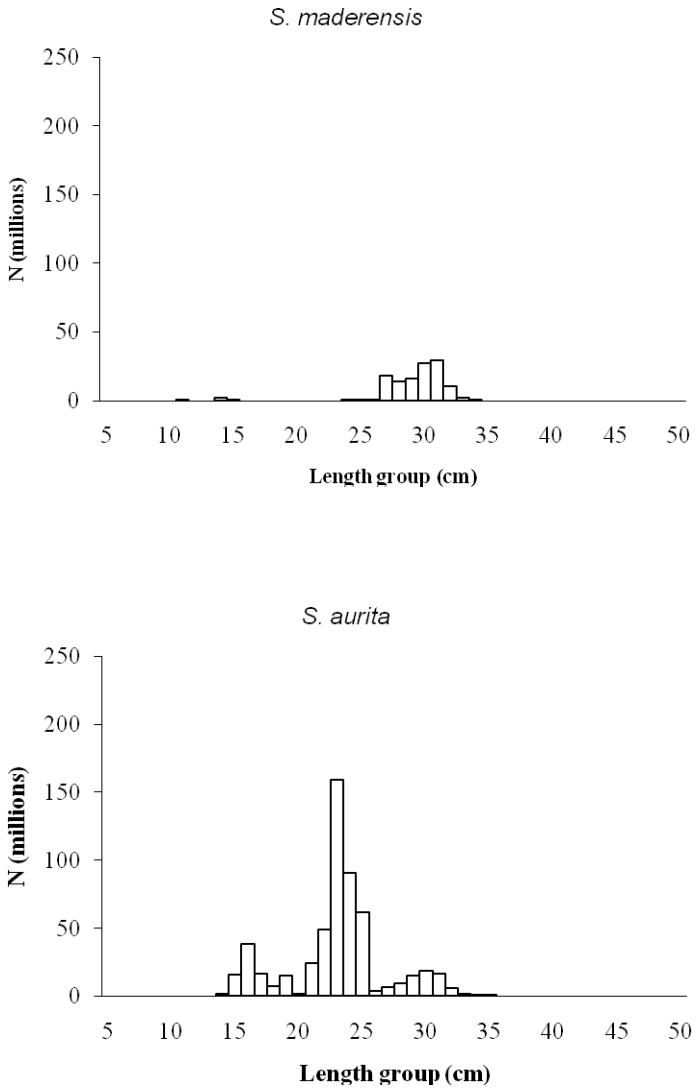


Figure 9. Total length distribution of Sardinella maderensis and *Sardinella aurita* Cunene River-Benguela

Horse mackerel

Of the two species of horse mackerel, the Cape horse mackerel *Trachurus capensis* and the Cunene horse mackerel *Trachurus trecae* were found in the area, *T. trecae* was by far the most abundant species. *T. capensis* was found only in one station. This can be explained by the fact that this species is associated with the cold waters of the Benguela current and this year the water front was found around Baía dos Tigres, in southern most area of the Angolan coast.

Cunene horse mackerel presented a more or less continuous distribution throughout the southern region (Figure 10) with areas of low densities ($1 > s_A < 300$ m^2/NM^2). A small high density area ($3\,001 > s_A < 10\,000$ m^2/NM^2) was found inshore north off Namibe.

Figure 11 shows the length frequency distribution of the Cunene horse mackerel. It has three well defined modes, peaking at about 8, 16 and 22 cm TL. Small fish (13 cm TL) were only caught in those stations shallower than 100 m (Figure 12), 58% of the biomass was comprised of individuals smaller than 21 cm TL (Figure 13). The total biomass of *T. trecae* in the south was estimated at 55 300 tonnes, which is far less than the last estimated (163 000 tonnes) during the same months.

It is important to remember that the biomass of these two species should not be evaluated without considering the seasonal fluctuations of the Angola-Benguela front position and the upwelling intensity in the region. This year, as described before, there was no sign of strong superficial upwelling and the Angola-Benguela front was located further south than during the winter months. These two facts combined can have prevented the Cape horse mackerel to enter into Angolan waters.

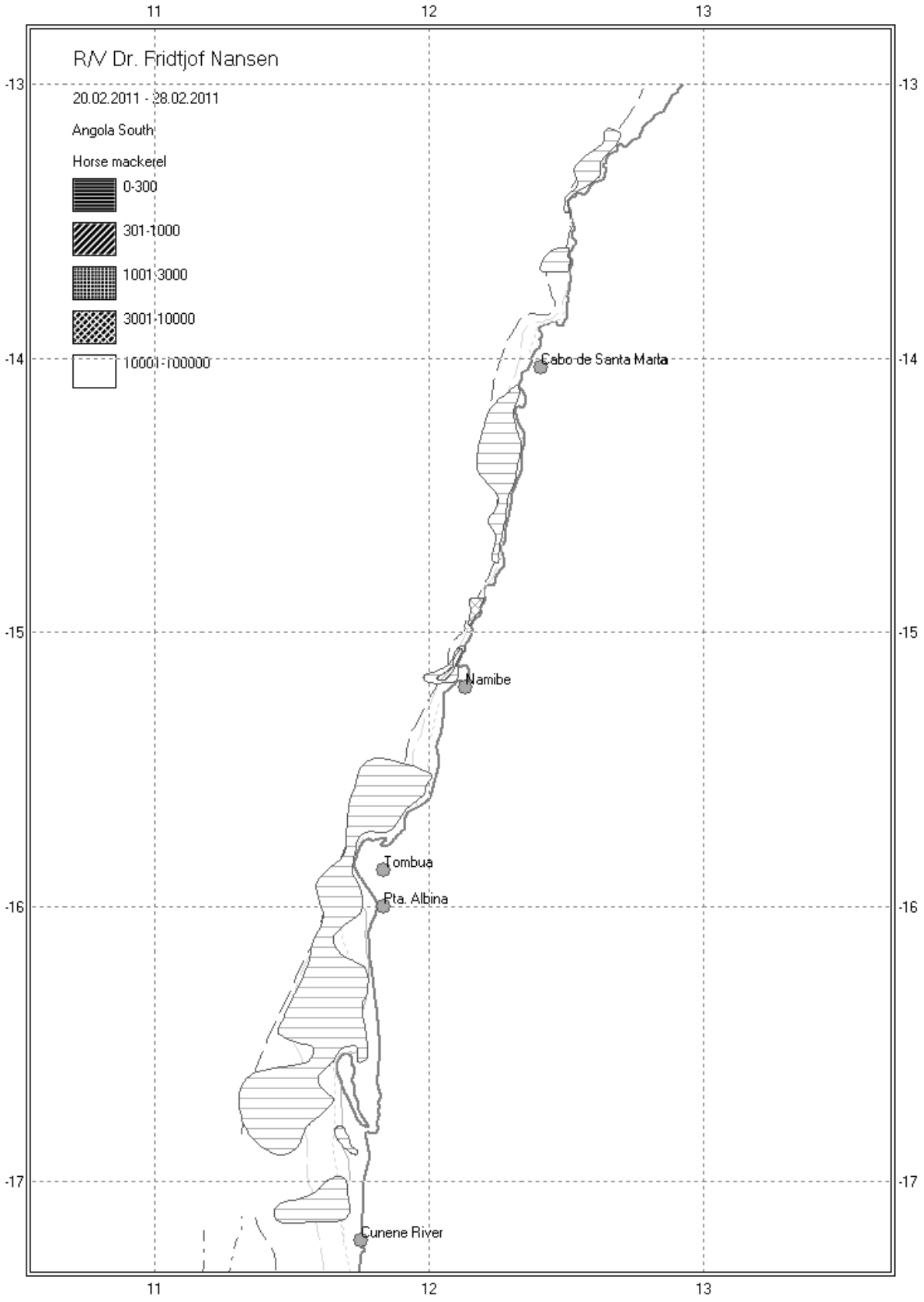


Figure 10. Distribution of Cunene horse mackerel. Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 m.

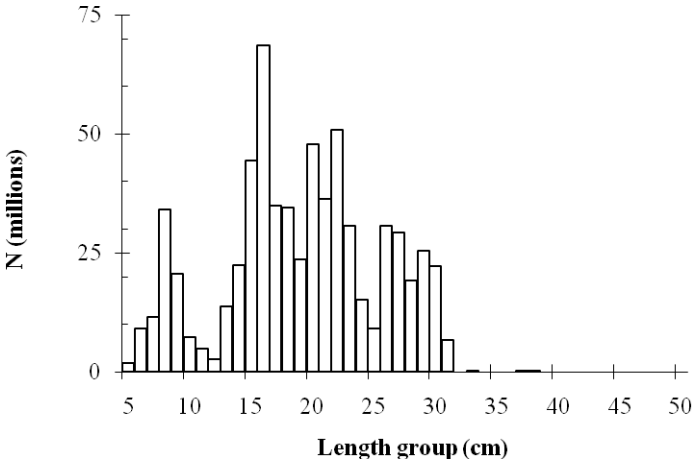


Figure 11 Total length distributions of *Trachurus trecae* Cunene River- Benguela

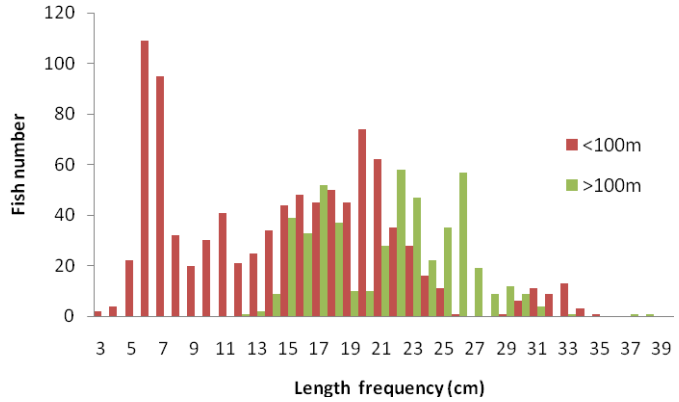


Figure 12 Length distributions of Cunene horse mackerel (*Trachurus trecae*) by depths strata, Cunene River-Benguela

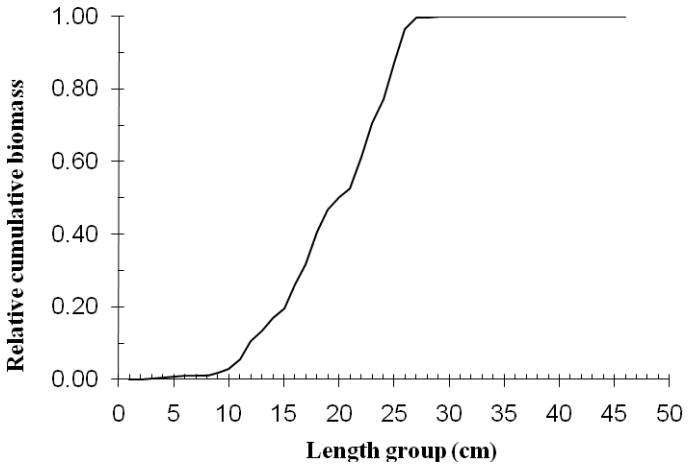


Figure 13. Relative cummulative biomass of Cunene horse mackerel, *T. trecae*

Other species

Species belonging to the pelagic 1 group (*e.g.* round herring, *Etrumeus whiteheadi*, and anchovy, *Engraulis encrasicolus*) were found scattered along the southern coast in six areas, all of low density ($0 > s_A > 300$). Figure 14 shows the distribution map. The biomass for this group was calculated to be around 12 000 tonnes.

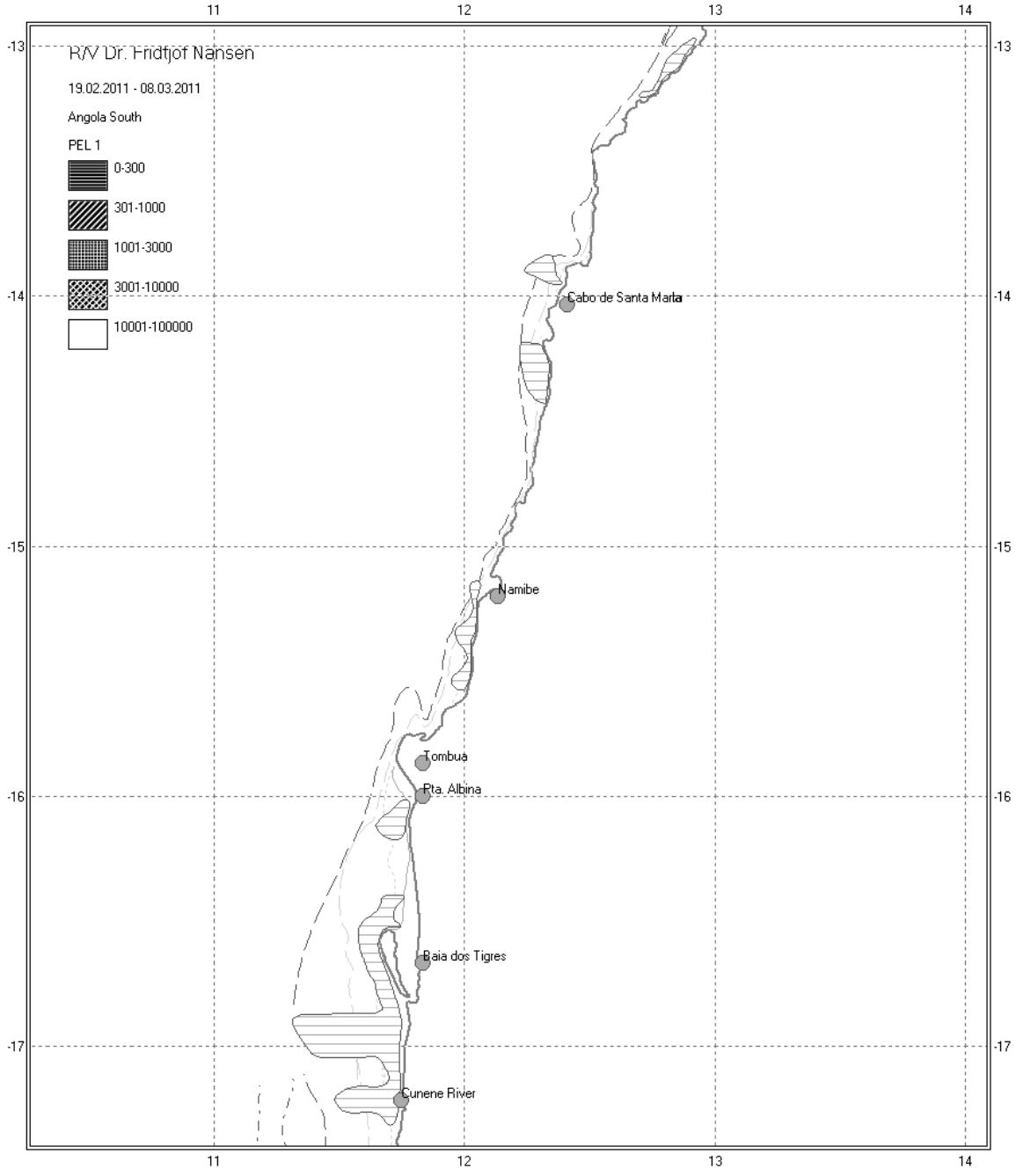


Figure 14. Distribution of Pelagic species group 1. Benguela–Cunene. Depth contours at 10, 20, 50, 100, 200 and 500 m.

As for the group of pelagic 2, they were scarce and caught in small quantities. The most common species found were *Decapterus rhonchus* and *Trichiurus lepturus*. No biomass was calculated and no distribution map is presented.

Table 4 shows the catch rates of the main pelagic groups caught in the area.

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

Station	Gear depth	Barracuda	Carangids	Clupeoids	Hairtails	Horse mackerel	*Sardinella spp*	Scombrids	Other	Total
1	65					28.7			9.5	38.2
2	10			45		162.1	1502.4	1.1	30.7	1741.3
3	10		6.5				86.7		24.6	117.7
4	10					384.9	2193.3	0.9	32.7	2611.8
5	23				11.2	1682			4468.6	6161.8
6	10					12	27.6		66.6	106.1
7	20.5		1.7			1329.8	1121.8		468	2921.3
8	10									
9	32		6.7			428	25.8		813.7	1274.3
10	27.5		2.7		10.5		333.4		0.8	347.5
11	35					2896.8	301.2		6.3	3204.3
12	30				1.8	4.5	306.3		8.8	321.5
13	116				11.7	189.6			604.9	806.2
14	10								75.5	75.5
15	116.5				30.2	620	5		1609.4	2264.7
16	105.5								370.1	370.1
Mean	41.4		1.2	3	4.4	515.9	393.6	0.1	567.6	1485.8
Std dev	39.7		2.3	11.6	8.5	835.6	671.2	0.4	1168.5	1717.6
% Catch	2.8		0.1	0.2	0.3	34.7	26.5		38.2	

4.2 Benguela-Pta. das Palmerinhas

Sardinella

Sardinella was found in the area in a rather patchy distribution, mainly in areas of low densities ($1<s_A<300$ m^2/NM^2) (Figure 15). Around Baía Farta there was a small inshore high-density area ($3\ 001<S_A<10\ 0000 m^2/NM^2$), while off Ponta da Moita Seca another area of medium-low density ($301<S_A<1\ 000 m^2/NM^2$) was detected. Comparing our results with those of last year winter survey, it seems to follow the same distribution pattern, with the highest density areas located around the same areas. The main difference might be in the depth distribution; it seems that during this summer survey fish were located closer to the coast (less offshore) than during the winter surveys, but the same distribution as compared with the 1998 survey.

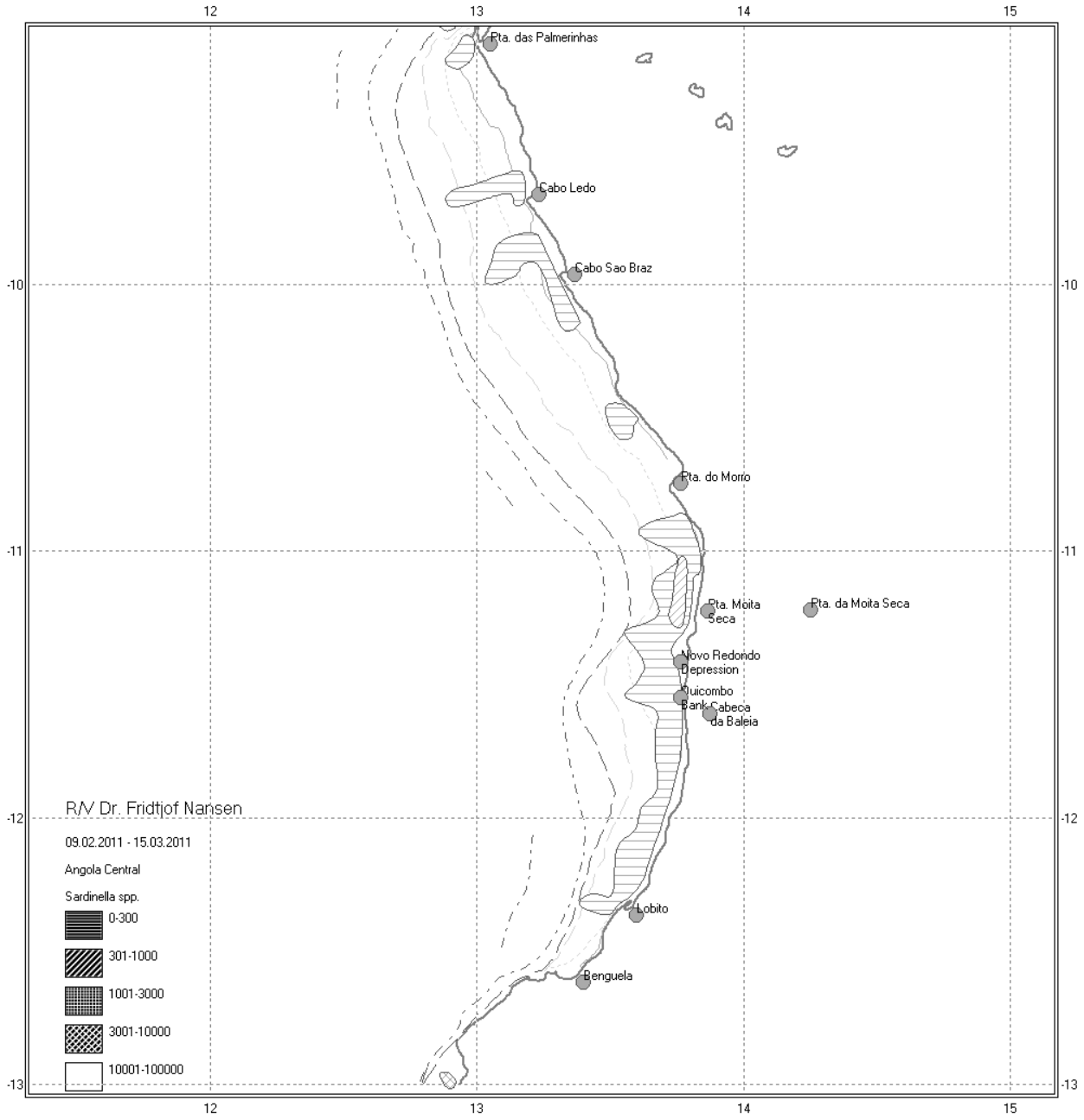


Figure 15. Distribution of *Sardinella* spp. Benguela-Pta. das Palmerinhas. Depth contours at 20, 50, 100 and 200 m.

The distribution of *S. maderensis* was dominated by adults (>21 cm TL) with a modal peak at around 28 cm TL. The length distribution showed four cohorts, peaking at 10, 17, 23 and 28 cm TL (Figure 16). The length distribution of *S. aurita* also showed four modal peaks at 18, 23, 26 and 31 cm TL, being the 23 cm TL cohort the dominant one. During this survey we didn't observe any signal of recruitment for *S. aurita* in this region.

The biomass for both sardinellas was estimated at 68 500 tonnes, where *S. maderensis* dominating and contributing with 58% (39 800 tonnes) and *S. aurita* with 42% (28 700 tonnes). These figures are less than those estimated during the 1998 survey, when the total Sardinella biomass was calculated in 389 000 tonnes (106 000 for *S. aurita* and 283 000 for *S. maderensis*)

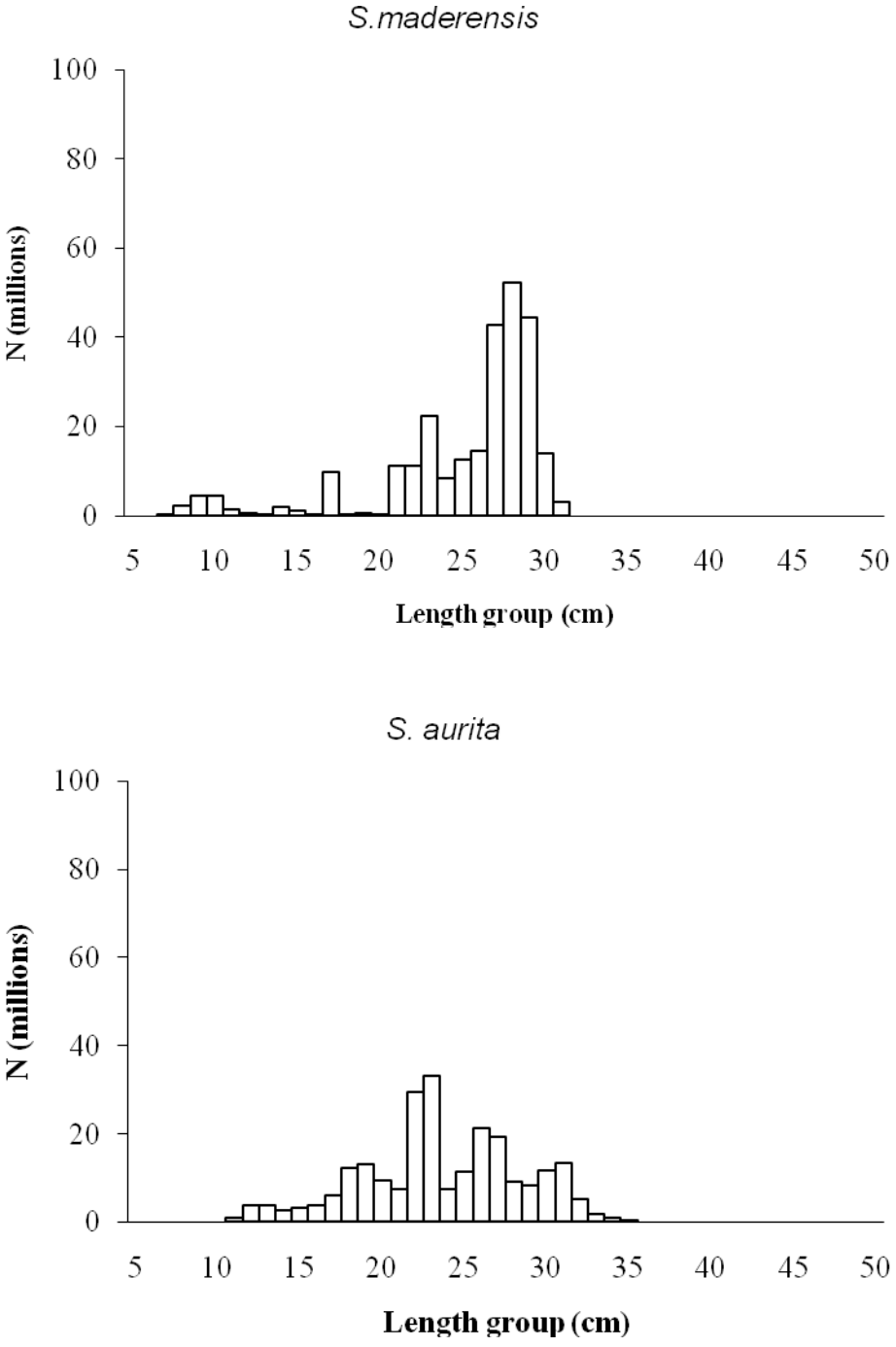


Figure 16. Total length distribution of *Sardinella maderensis* and *S. aurita* Benguela-Pta. das Palmerinhas.

Horse mackerel

The only species of horse mackerel found in this region was the Cunene horse mackerel (*T. trecae*). It was found throughout the area in low densities patches (s_A< 300 m^2/NM^2) mainly offshore, except off Ponta do Morro where it was observed close to the coast (Figure 17).

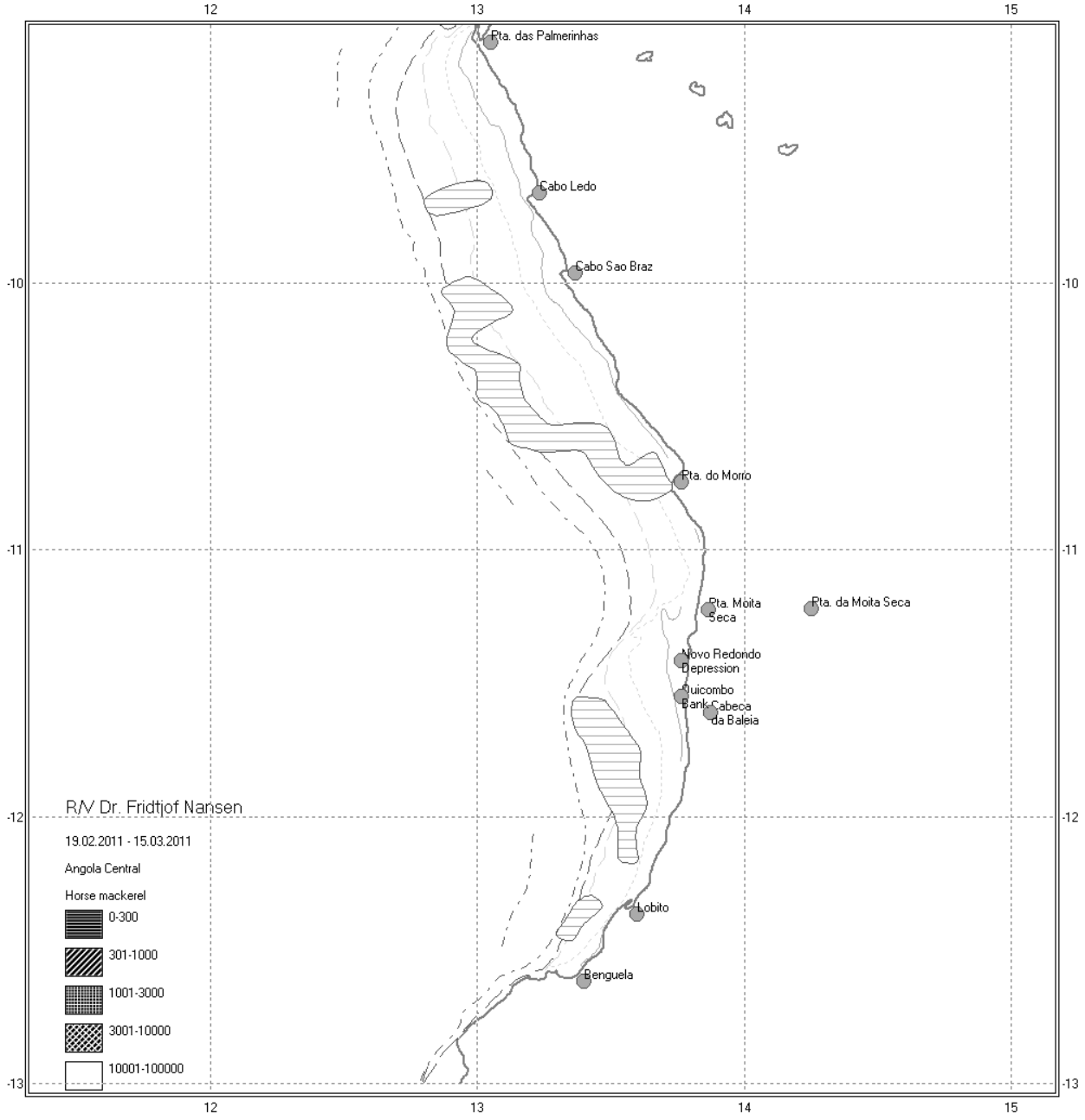


Figure 17. Distribution of Cunene horse mackerel (*Trachurus trecae*) Benguela-Pta. das Palmerinhas. Depth contours at 20, 50, 100 and 200 m.

Figure 18 shows the total length frequency distribution. The population has three well defined cohorts, with the main peaks around 10, 14 and 25 cm TL. The smallest sizes (TL < 11 cm) were found at depths shallower than 100 meters (Figure 19).

The biomass of Cunene horse mackerel was estimated at 12 600 tons, 80% of the biomass was comprised of individuals smaller than 21cm TL (Figure 20). During the last summer pelagic survey (1998) the biomass calculated was of 58 000 tonnes.

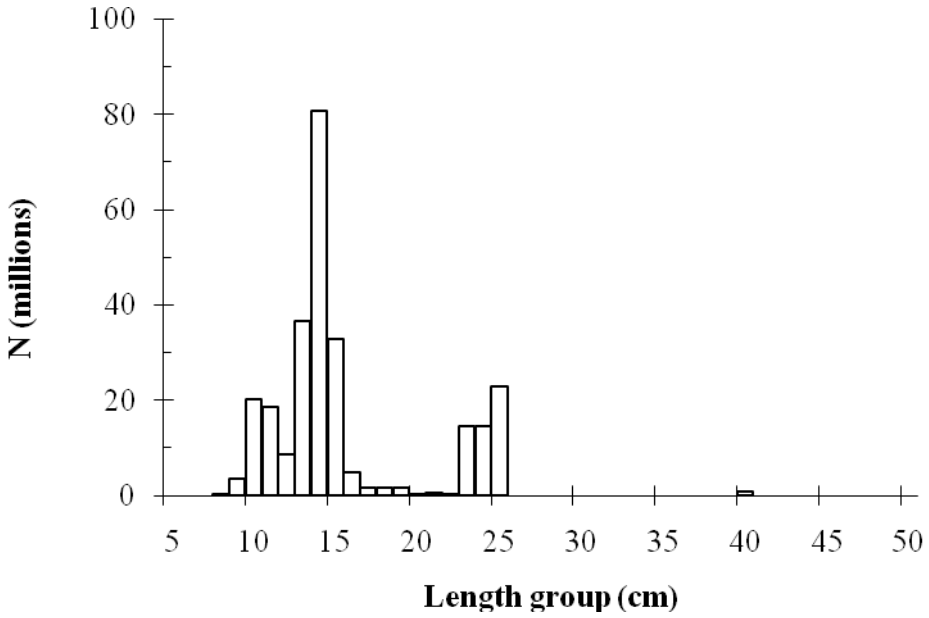


Figure 18. Total length distribution of Cunene horse mackerel (*Trachurus trecae*), Benguela-Pta. das Palmerinhas.

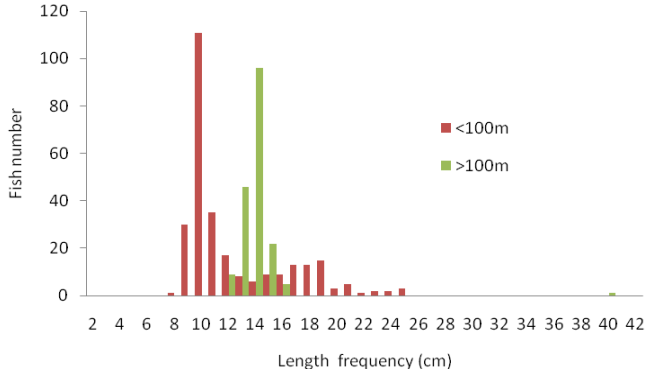


Figure 19. Length distribution (simple adding) of Cunene horse mackerel (*Trachurus trecae*) by depths strata Benguela-Pta. das Palmerinhas.

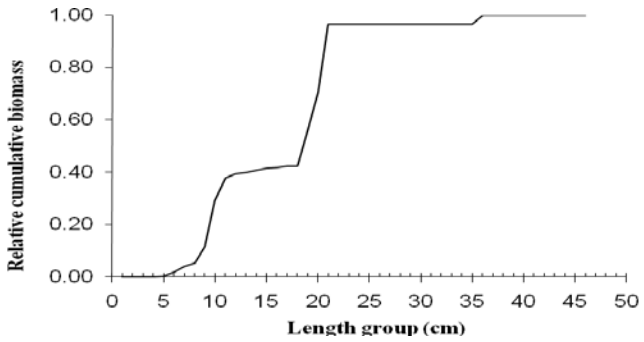


Figure 20. Relative cummulative biomass of Cunene horse mackerel, *T. trecae*

Other pelagic species

Pelagic species Group 1

This group was found in the region with a continuous low density distribution ($1<s_A<300$ m^2/NM^2) (Figure 21). The most common species within the group belonged to the Clupeiformes (*i.e. Ilisha africana*) (Table 5). The biomass estimated for this group was 54 638 tonnes.

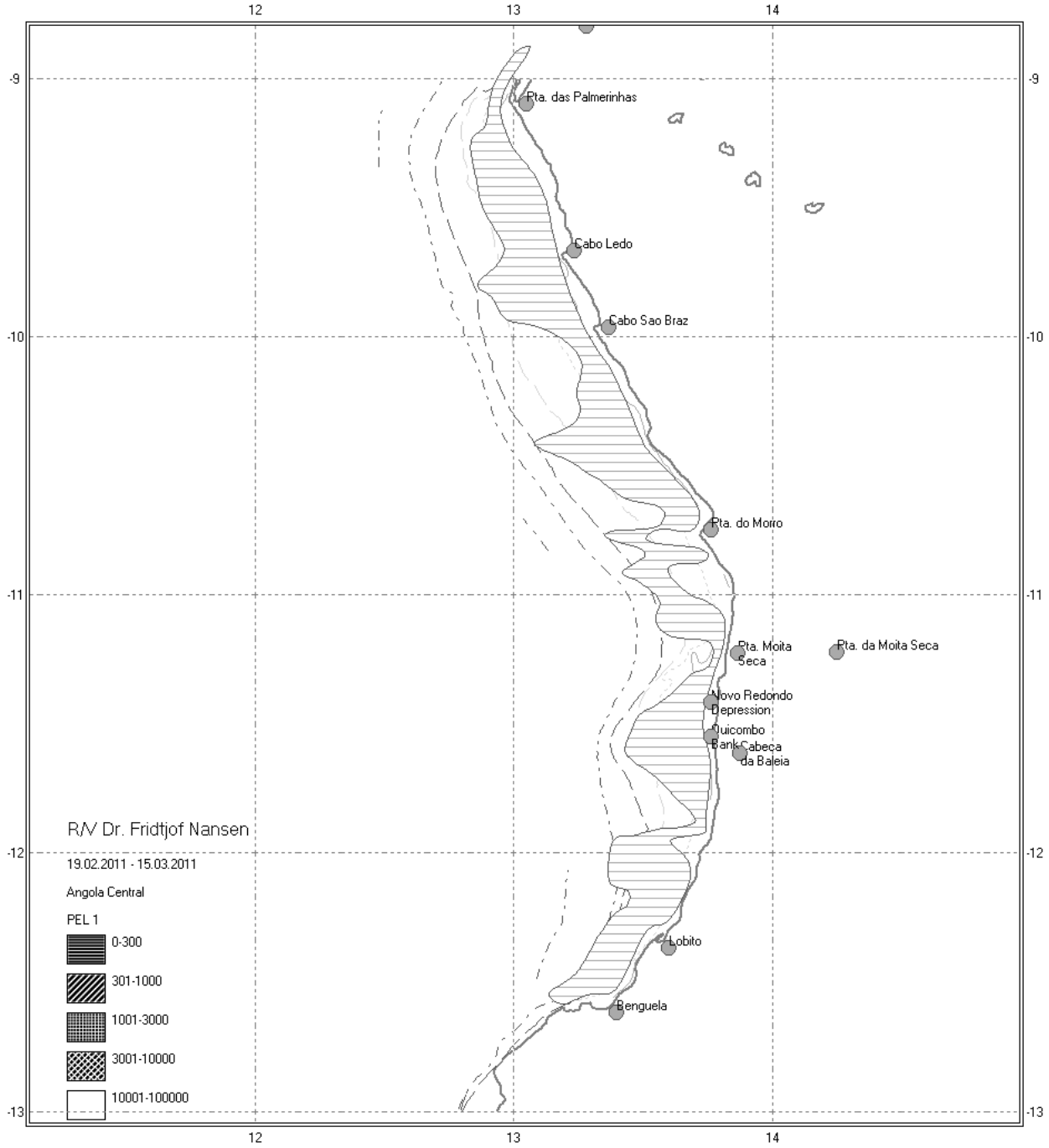


Figure 21. Distribution of pelagic species group 1, Benguela-Pta. das Palmerinhas. Depth contours at 20, 50, 100 and 200 m.

Pelagic species Group 2

This group was found in low densities patches ($1<s_A<300$ m^2/NM^2) along the center region (Figure 22). The most common species were the hairtails (*Trichiurs lepturus*) and species belonging to the Carangids (*Selene dorsalis*, *Chloroscombrus chrysurus* and *Decapterus rhonchus*) (Table 5). The biomass for this group was estimated at 2 642 tonnes which is also lower than the one reported in 1998 (92 000 tonnes).

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

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

Station	Gear depth	Barracuda	Carangids	Clupeoids	Hairtails	Horse mackerel	*Sardinella spp*	Scombrids	Other	Total
17	38	2.2	9.0		43.2		375.2		9.8	439.6
18	35								15069.8	15069.8
19	28	0.1		0.2		1.7	542.3	10.3	0.7	555.2
20	0		1.6				857.7		43.0	902.3
21	28	43.0	63.8	15.5	4.0		4.2	1.9	386.3	518.6
22	10	46.3	31.2	23.3	1.6		132.3		426.6	661.3
23	33									
24	0						0.6	72.0	6.4	79.1
25	68	0.6	15.1		2.7	14.8	26.7		275.4	335.4
26	129					0.4			160.5	160.9
27	26						0.7			0.7
28	32								38.8	38.8
29	26	18.1	24.1	296.6	70.9	0.6	2.8		1189.5	1602.5
30	116		23.2		195.4	89.8			616.2	924.5
Mean	41	7.9	12.0	24.0	22.7	7.7	138.8	6.0	1301.6	1520.6
Std dev		16.3	18.5	78.8	54.0	24.0	265.9	19.2	3976.9	3925.4
%Catch		0.5	0.8	1.6	1.5	0.5	9.1	0.4	85.6	

4.3 Pta. Palmerinhas - Congo River

Sardinella

Sardinella was found patchy distributed in the northern region (Figure 23). Although most of the patches showed low densities ($0<s_A<300$ m^2/NM^2), we found a medium-low density area ($301<s_A<1\ 000$ m^2/NM^2) between north from Luanda and south off Ambriz, and a small medium-high density area ($1\ 001<s_A<3\ 000$ m^2/NM^2) north off N'zeto.

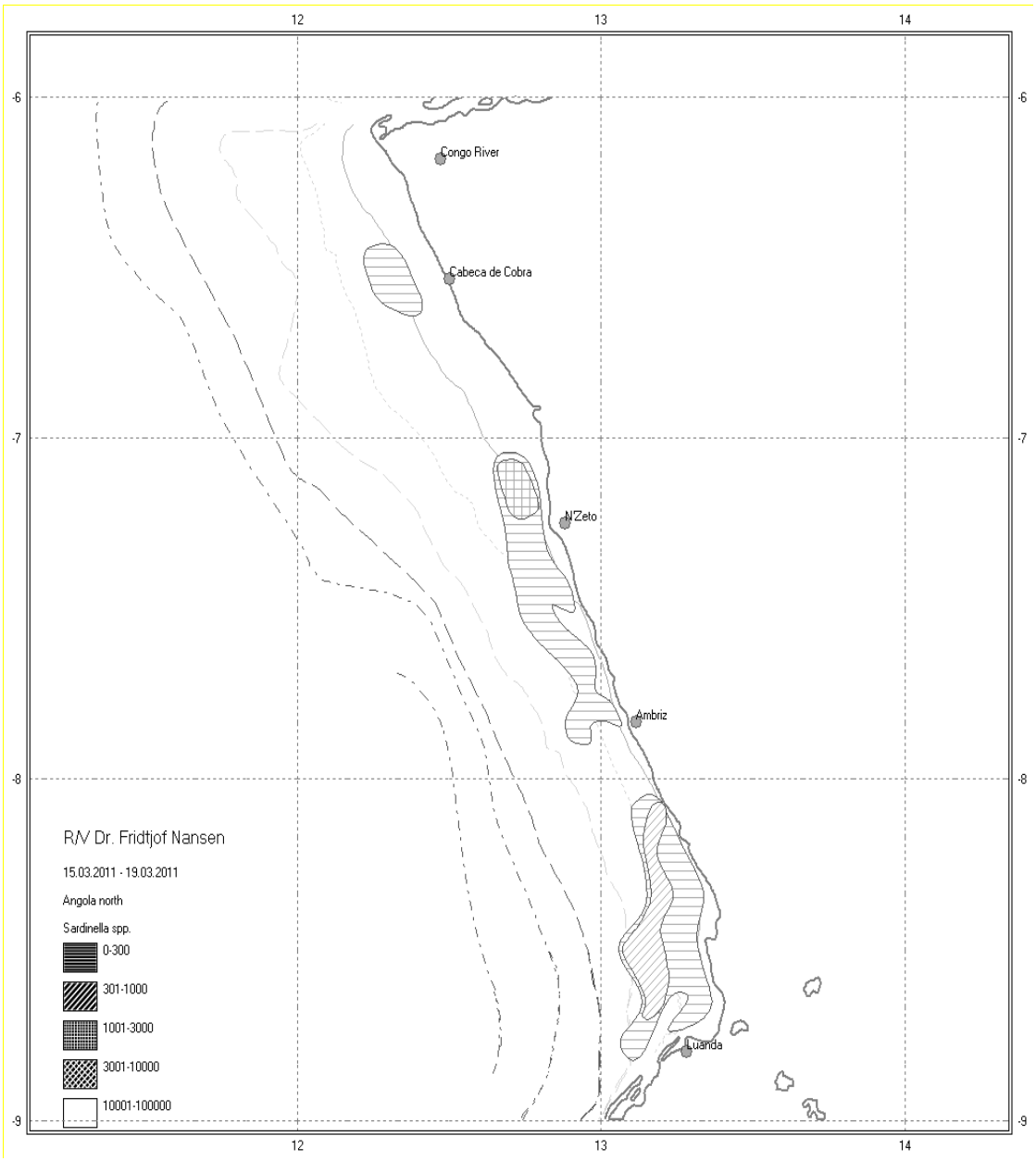


Figure 23. Distribution of *Sardinella* spp. Pta. das Palmerinhas-Congo River. Depth contours at 20, 50, 100, 200, and 500m.

The length distribution of the sardinellas in the region is shown in Figure 24. The size distribution for both species shows a unimodal distribution, with a modal peak around 27 cm TL for *S. maderensis* and at around 24 cm TL for *S. aurita*.

The estimated biomass for this region was 95 700 tonnes, with *S. maderensis* dominating the total biomass and contributing with 63% (60 400 tonnes), while *S. aurita* contributed with 37 % (35 300 tonnes). These estimates are higher than those of 1998 (65 000 tonnes of *S. maderensis* and 14 000 of *S. aurita*).

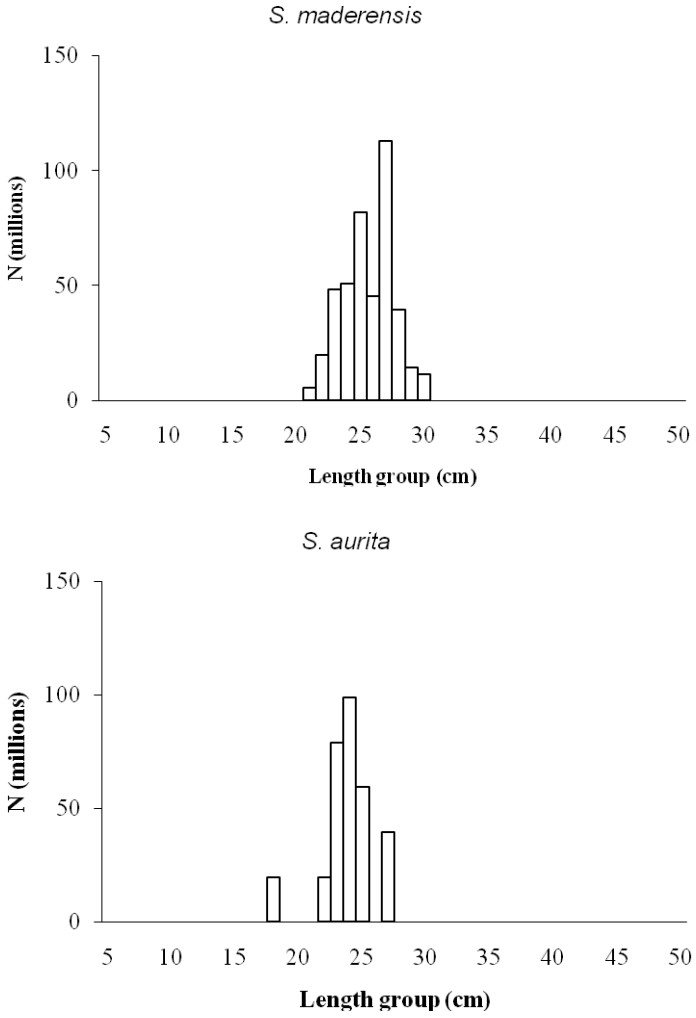


Figure 24. Total length distribution of *Sardinella maderensis* and *S. aurita*, Pta. das Palmerinhas-Congo River.

Horse mackerel

Cunene horse mackerel, *T. trecae,* was the only species of horse mackerel in the area. It was found in two low-densities areas ($0<S_A<300$ m^2/NM^2) located offshore Ambriz and Cabeça da Cobra (Figure 25). The Cunene horse mackerel was primarily caught in bottom trawls mixed with demersal species.

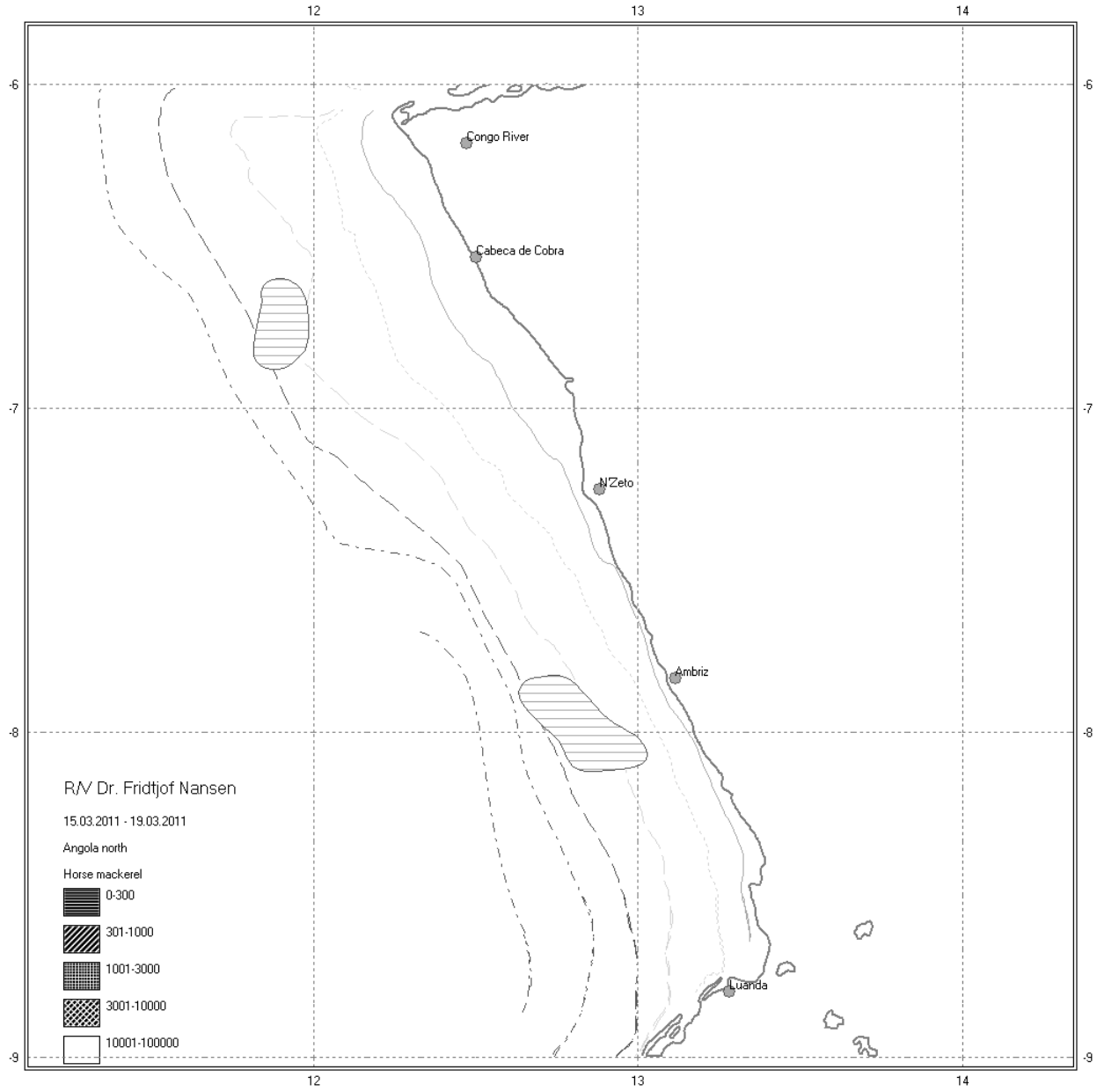


Figure 25. Distribution of Cunene horse mackerel (*Trachurus trecae*), Pta. das Palmerinhas-Congo River. Depth contours at 20, 50, 100, 200, and 500m.

The size distribution of Cunene horse mackerel showed two modes, one at about 12 cm TL and another at 22 cm TL (Figure 26). Young fish dominated the samples and all fish, both juveniles and adults, were caught at depths beyond the 100 m (Figure 27).

The acoustic densities were too low as to yield a valid biomass estimate for this species. The same situation was observed during the winter surveys both in 2008 and 2009. This observation, together with a reduction on size structure of Cunene horse mackerel population size in this region, might indicate that the stock is at a critical level. The biomass estimated in 1998 for the species was also low (18 000 tonnes)

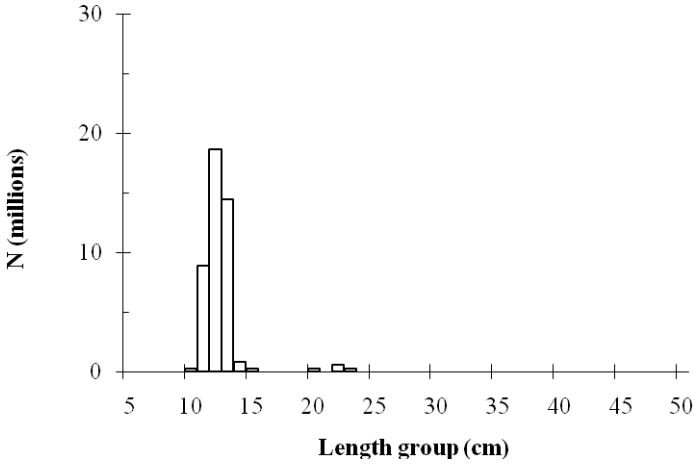


Figure 26. Total length frequency distribution of Cunene horse mackerel, Pta. das Palmerinhas-Congo River

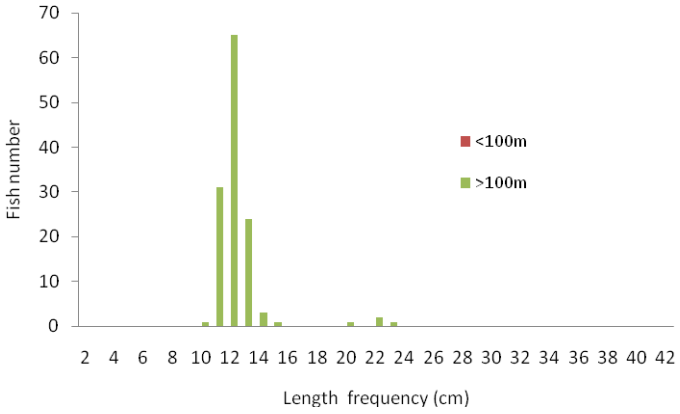


Figure 27 Length distribution (simple adding) of Cunene horse mackerel (*Trachurus trecae*) by depths strata, Pta. das Palmerinhas-Congo River (depths > 100 and <100 m)

Pelagic species Group 1

This group was continuously distributed in a low density area ($0<S_A<300$ m^2/NM^2) from Pta. das Palmerinhas to south off Cabeça da Cobra (Fig. 28) The biomass in the area, based on an average

fish size of 30 cm TL and an average condition factor of 0.01, was estimated to be 31 161

Figure 28. Distribution of pelagic 1 group, Pta. das Palmerinhas-Congo River. Depth contours at 20, 50, 100, 200, and 500m.

Pelagic species Group 2

This group was found in two low-density areas ($0<S_A<300$ m^2/NM^2), one located between Pta. das Palmerinhas and N'zeto, and the other one between south off Cabeça de Cobra and south of Congo River (Figure 29). Carangids (*e.g. Chloroscombrus chrysurus* and *Selene dorsalis*) was the dominant group (Table 6), followed by hairtails (*Trichiurus lepturus*) and barracudas (*i.e. Sphyraena guachancho*). The biomass for the groups was estimated to be 31 738 tonnes.

Figure 29. Distribution of Pelagic 2, Pta. das Palmerinhas-Congo River. Depth contours at 20, 50, 100, 200 and 500m.

Table 6. Catch rates (kg/h) of the main groups of pelagic fish, Pta das Palmerinhas-Congo River.

Station	Gear depth	Barracuda	Carangids	Clupeoids	Hairtails	Horse mackerel	*Sardinella spp.*	Scombrids	Other	Total
31	17.5	33.8	54.2				0.9	9.3	0.9	99.1
32	5	15	61.3				40.2	6.8		123.2
33	110		64		16.8	9.7			710	800.5
34	71		2.9		150.9				5.7	159.5
35					1.2	0.1		1.9	1.4	4.6
36	10	0.2	4.6						0.3	5
37					0.8			2.2	0.2	3.3
Mean	30.5	7	26.7		24.2	1.4	5.9	2.9	102.7	170.8
Std dev	42.9	13.1	31.2		56.2	3.7	15.1	3.7	267.8	285
%Catch		4.1	15.6		14.2	0.8	3.5	1.7	60.1	

CHAPTER 5 SUMMARY OF SURVEY RESULTS

Oceanographic conditions this year seem to differ from those found in previous years during the same season. This year the registrations show abnormal high temperatures and lower salinity values. This combination can be the cause that pelagic species appeared to be more dispersed and thus less available to acoustic estimation.

5.1 Sardinella

The estimated biomass of sardinella shows a cyclically fluctuating pattern throughout the time series (Figure 30). This is commonly found in pelagic species, usually reflecting actual changes in abundance but also variation in the availability of the surveyed populations, often caused by changes in the environmental conditions. The total biomass estimate for sardinellas was 259 800 tonnes. Although this result is not directly comparable with those of previous years, due to the season in which the survey has taken place, the trend follows the same downwards pattern. Nevertheless, the biomass calculated this year as compared with the one estimated during the last summer survey. This trend warrants for some caution in the management of these stocks. It is therefore now important to follow the landings of these stocks carefully, and the development of the biomass levels over the next years should be followed closely. At this point in time, it is not advisable to increase the fishing pressure on these stocks.

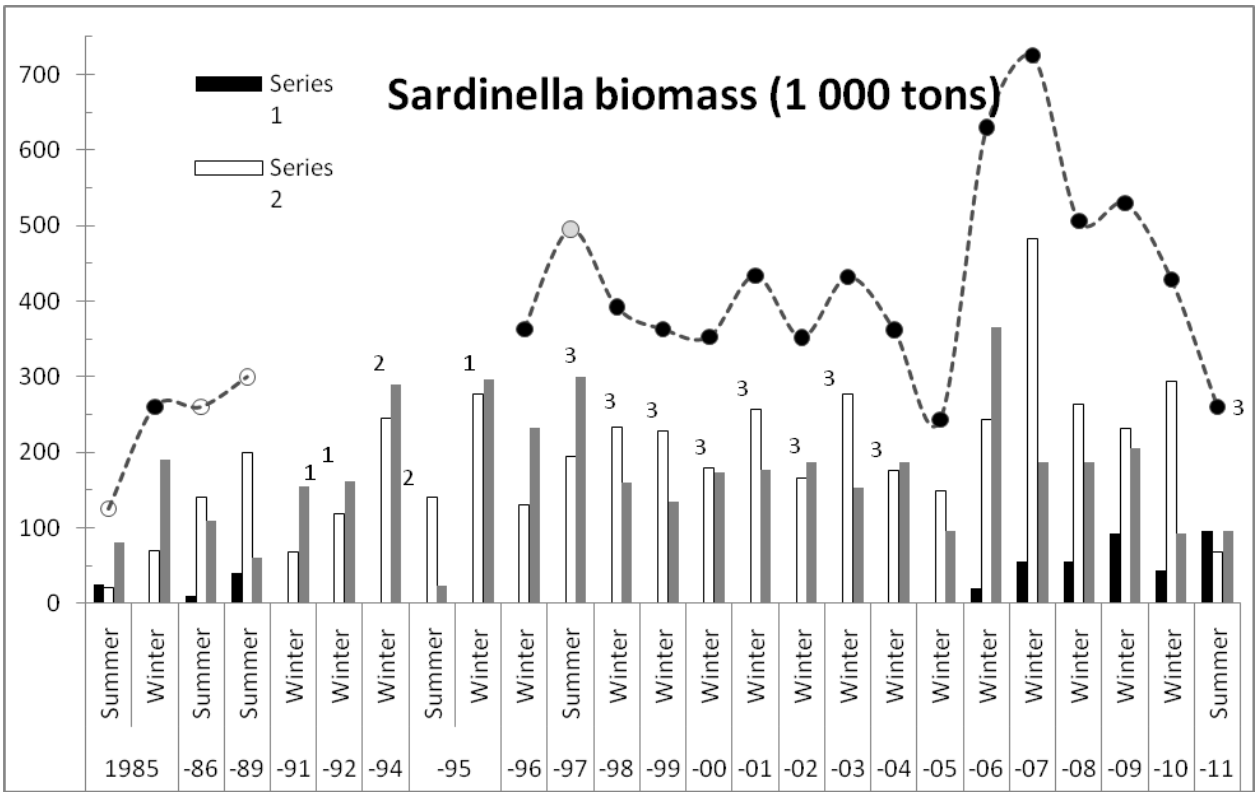
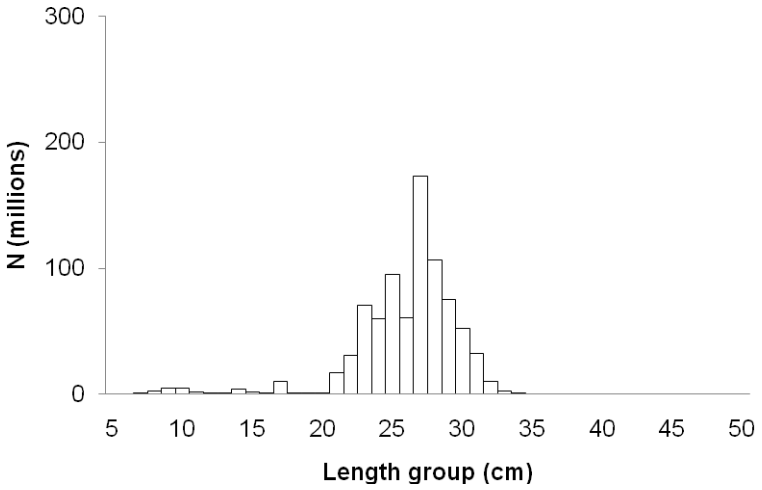


Figure 30 Biomass estimates of *Sardinella spp*. by regions and surveys (1 000 tons). 1: Data error (Southern region); 2: Southern region not surveyed; 3: Cabinda not surveyed.

During the present survey both species of *Sardinella* contributed almost equally to the total biomass. By regions, *S. aurita* dominated in the south while *S. maderensis* both in the center and north regions.

The overall length frequency distributions were dominated by adult cohorts (Figure 31). The distribution of *S. maderensis* shows well-defined cohorts with modal peaks around 10, 17 and 27 cm total length. For *S. aurita*, the distribution showed three modal peaks at 16, 23 and 30 cm TL.

a) *S. maderensis.*



a) *S. aurita.*

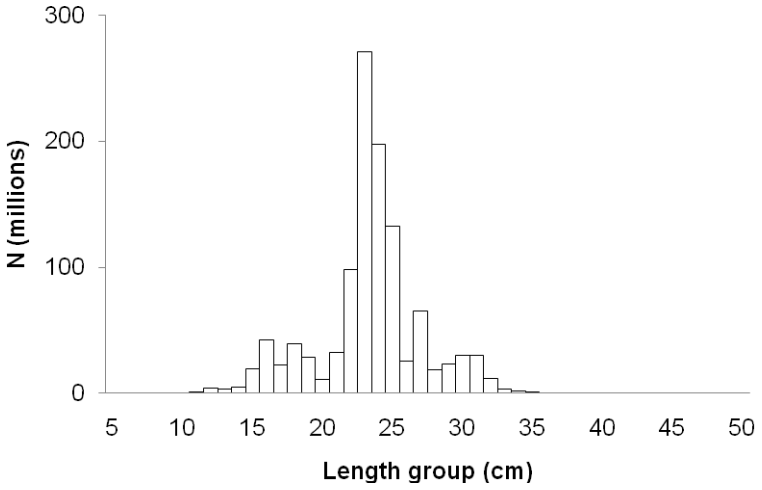


Figure 31. Overall total length distribution of *S. maderensis* (a) and *S. aurita* (b*)*.

5.2 Cunene horse mackerel

The total biomass of Cunene horse mackerel was estimated at 68 800 tonnes. This is a low estimate in the time series, although not directly comparable with previous years, due to the season when the present survey took place (Figure 32). Although the last pelagic survey carried out in the summer took place more than 10 years ago, when comparing both species' biomass estimates we can observe that this year's estimate is by far lower.

The bulk of the biomass was found in the southern region (55 000 tonnes, representing around 80% of the total biomass). The biomass level in the central region was low (12 600 tonnes) while in the northern region the level was too low as to have a reliable estimate. An interesting observation during the present survey is that the horse mackerel was mainly caught in the bottom and was observed to remain there and not lifting as in other years.

The current Cunene horse mackerel biomass is very low, and at the same level as in 2008 (winter survey).

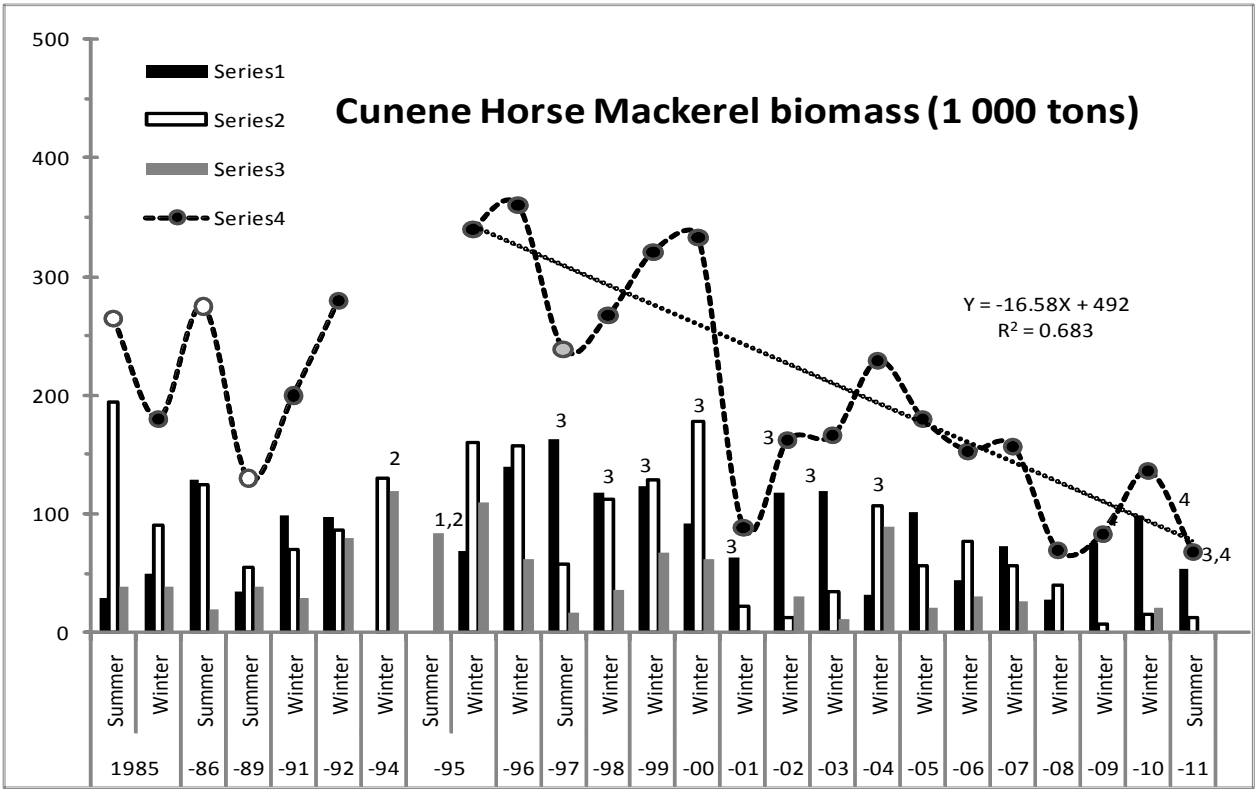


Figure 32 Biomass estimates of Cunene horse mackerel by regions and surveys (1 000 tons). 1 Data error (Central and Northern Regions); 2: Southern region not surveyed; 3: Cabinda not surveyed; 4: Fish density too low to estimate abundance (Northern Region).

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

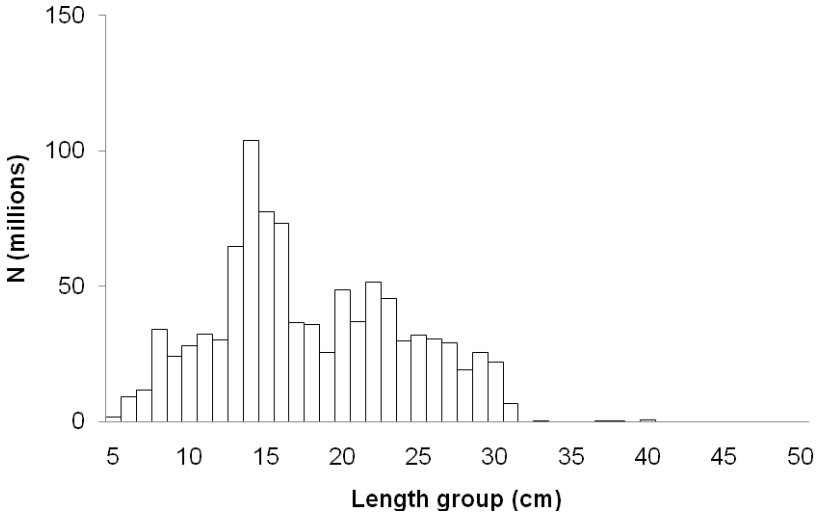


Figure 33. Overall total length distribution of the Cunene horse mackerel, *Trachurus trecae*.

Prior to any conclusion, the results from this survey should be confronted with those from the coming winter pelagic survey.

During the present survey no upwelling in the south was observed and the Angolan-Benguela front (ABF) was located around Baía dos Tigres in the southern part of the south region. This could have prevented the offshore migration of the Cunene horse mackerel, resulting in a less availability of the fish during this period. The actual position of the ABF might have prevented the Cunene horse mackerel to migrate from Namibian into Angolan waters.

Other biological references also clearly indicate that the Cunene horse mackerel stock is still under considerable pressure. From the reference year 1996, the length distributions have been shifting towards smaller fish, indicating high fishing pressure on the adult stock (Figure 33). In addition to this, estimates for the last years have shown clear indications of recruitment failure

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

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ANNEX I. FISHING STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 1
DATE :21.02.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 16°53.83
start stop duration Lon E 11°26.85
TIME :23:29:16 23:47:57 18.7 (min) Purpose : 1
LOG : 6989.95 6990.93 1.0 Region : 4050
FDEPTH: 80 50 Gear cond.: 0
BDEPTH: 121 125 Validity : 0
Towing dir: 0° Wire out : 240 m Speed : 3.1 kn
Sorted : 12 Total catch: 11.90 Catch/hour: 38.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	28.73	132	75.21	2
Chelidonichthys capensis	5.30	16	13.87	
Dentex macrophthalmus	3.69	45	9.66	1
Lagocephalus laevigatus	0.48	3	1.26	
Total	38.20		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 2
DATE :22.02.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°51.53
start stop duration Lon E 11°42.96
TIME :02:36:01 03:06:04 30.0 (min) Purpose : 1
LOG : 7013.50 7015.26 1.8 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 20 19 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.5 kn
Sorted : 122 Total catch: 871.80 Catch/hour: 1741.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	1502.36	20593	86.28	5
Trachurus trecae	162.09	12753	9.31	3
Engraulis encrasicolus	43.84	14525	2.52	
Pomatomus saltatrix	16.57	585	0.95	
J E L L Y F I S H	6.28	86	0.36	
Pagellus bellottii	3.57	300	0.20	
Lagocephalus laevigatus	3.29	58	0.19	
Scomber japonicus	1.14	14	0.07	4
Etrumeus whiteheadi	1.14	86	0.07	
Loligo vulgaris	0.57	28	0.03	
UNIDENTIFIED FISH	0.29	14	0.02	
Atractoscion aequidens	0.14	14	0.01	
Total	1741.27		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 3
DATE :22.02.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°38.62
start stop duration Lon E 11°40.53
TIME :11:30:24 12:00:29 30.1 (min) Purpose : 1
LOG : 7086.87 7088.60 1.7 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 19 22 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.5 kn
Sorted : 59 Total catch: 59.03 Catch/hour: 117.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	86.67	602	73.61	6
Sphyrna zygaena	15.26	10	12.96	
Decapterus rhonchus	6.48	16	5.51	7
Pomatomus saltatrix	4.75	14	4.03	
J E L L Y F I S H	4.59	46	3.90	
Total	117.75		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 4
DATE :23.02.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°28.05
start stop duration Lon E 11°45.06
TIME :01:43:54 02:14:06 30.2 (min) Purpose : 1
LOG : 7177.97 7179.75 1.8 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 22 20 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.5 kn
Sorted : 113 Total catch: 1314.63 Catch/hour: 2611.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	2187.10	13458	83.74	9
Trachurus trecae	384.87	7236	14.74	8
Lagocephalus laevigatus	32.03	507	1.23	
Sardinella maderensis	6.22	24	0.24	10
Scomber japonicus	0.92	24	0.04	
J E L L Y F I S H	0.69	24	0.03	
Total	2611.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 5
DATE :23.02.2011 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°41.08
start stop duration Lon E 11°44.88
TIME :09:08:58 09:19:30 10.5 (min) Purpose : 1
LOG : 7215.84 7216.37 0.5 Region : 4050
FDEPTH: 23 23 Gear cond.: 0
BDEPTH: 23 23 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.0 kn
Sorted : 82 Total catch: 1082.43 Catch/hour: 6161.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
B I V A L V E S	2785.39	1208647	45.20	
Trachurus trecae	1645.39	35932	26.70	11
P O L Y C H A E T A	1260.34	168125	20.45	
Atractoscion aequidens	305.41	1497	4.96	13
Dicologoglossa cuneata	107.02	5163	1.74	
Trachurus capensis	36.66	1645	0.59	12
Trichiurus lepturus	11.21	74	0.18	
Umbrina canariensis	5.24	296	0.08	
Dentex barnardi	2.22	74	0.04	
UNIDENTIFIED FISH	2.22	148	0.04	
Lagocephalus laevigatus	0.74	74	0.01	
Total	6161.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 6
DATE :23.02.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°36.37
start stop duration Lon E 11°44.50
TIME :10:40:20 11:17:57 37.6 (min) Purpose : 1
LOG : 7222.70 7224.87 2.2 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 25 24 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.5 kn
Sorted : 67 Total catch: 66.55 Catch/hour: 106.14

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYLIOBATIDAE	40.19	48	37.87	
Sardinella aurita	27.59	238	26.00	14
Trachurus trecae	11.96	88	11.27	15
Stromateus fiatola	8.93	10	8.41	
Pomatomus saltatrix	8.76	27	8.25	
Sphyrna zygaena	7.74	6	7.29	
Raja miraletus	0.97	2	0.92	
Total	106.14		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 7
DATE :23.02.2011 GEAR TYPE: BT NO: 21 POSITION:Lat S 16°13.49
start stop duration Lon E 11°46.67
TIME :19:29:11 19:39:13 10.0 (min) Purpose : 1
LOG : 7296.75 7297.33 0.6 Region : 4050
FDEPTH: 21 20 Gear cond.: 0
BDEPTH: 21 20 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.5 kn
Sorted : 84 Total catch: 488.35 Catch/hour: 2921.31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	1329.81	20800	45.52	16
Sardinella aurita	1121.81	8800	38.40	17
Pagellus bellottii	138.78	16744	4.75	18
Spondyliosoma cantharus	89.31	1908	3.06	
Sepia orbignyana	49.59	90	1.70	
Dasyatis margarita	38.52	36	1.32	
Pomadasys incisus	35.47	341	1.21	
Boops boops	27.28	718	0.93	
Chelidonichthys capensis	26.62	646	0.91	
Lagocephalus laevigatus	26.26	305	0.90	
MYLIOBATIDAE	11.25	36	0.38	
Trachinus radiatus	6.82	36	0.23	
Trachinus armatus	6.46	173	0.22	
Mustelus mustelus	4.79	12	0.16	
Cynoponticus ferox	4.07	36	0.14	
Fistularia petimba	2.75	66	0.09	
Decapterus rhonchus	1.70	36	0.06	
Total	2921.31		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 8
DATE :24.02.2011 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°37.88
start stop duration Lon E 11°58.37
TIME :14:05:37 14:39:06 33.5 (min) Purpose : 1
LOG : 7416.66 7418.77 2.1 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 32 43 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 9
DATE :24.02.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 15°38.97
start stop duration Lon E 11°57.83
TIME :15:12:27 15:26:34 14.1 (min) Purpose : 1
LOG : 7420.68 7421.48 0.8 Region : 4050
FDEPTH: 33 31 Gear cond.: 0
BDEPTH: 33 31 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.4 kn
Sorted : 136 Total catch: 299.66 Catch/hour: 1274.25

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	427.99	6221	33.59	19
Lithognathus mormyrus	314.33	1582	24.67	
Dentex barnardi	130.50	1539	10.24	
Pomadasys jubelini	124.89	532	9.80	
Pagellus bellottii	100.10	1539	7.86	
Pomadasys incisus	79.99	940	6.28	
Octopus vulgaris	26.57	17	2.09	
Sardinella aurita	25.82	757	2.03	20
Lagocephalus laevigatus	11.88	204	0.93	
Decapterus rhonchus	6.74	30	0.53	
Pseudupeneus prayensis	4.77	38	0.37	
Citharus linguatula	4.58	132	0.36	
Atractoscion aequidens	4.40	9	0.35	
Pomatomus saltatrix	3.74	9	0.29	
Spondyliosoma cantharus	3.37	30	0.26	
Chelidonichthys capensis	2.06	47	0.16	
Pontinus accraensis	1.22	9	0.10	
Torpedo torpedo	0.75	9	0.06	
Fistularia petimba	0.47	9	0.04	
Dicologoglossa cuneata	0.09	9	0.01	
Total	1274.25		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 10
DATE :25.02.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 15°9.78
start stop duration Lon E 12°5.49
TIME :18:46:17 19:01:07 14.8 (min) Purpose : 1
LOG : 7603.71 7604.64 0.9 Region : 4050
FDEPTH: 25 30 Gear cond.: 0
BDEPTH: 140 109 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.8 kn
Sorted : 0 Total catch: 85.94 Catch/hour: 347.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	233.29	902	67.14	21
Sardinella aurita	100.07	501	28.80	22
Trichiurus lepturus	10.51	142	3.03	
Selene dorsalis	2.75	32	0.79	23
MYCTOPHIDAE	0.85	303	0.24	
Total	347.47		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 11
DATE :26.02.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 14°56.01
start stop duration Lon E 12°10.97
TIME :00:40:57 00:53:57 13.0 (min) Purpose : 1
LOG : 7643.32 7644.10 0.8 Region : 4050
FDEPTH: 30 40 Gear cond.: 0
BDEPTH: 47 41 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.6 kn
Sorted : 111 Total catch: 694.81 Catch/hour: 3204.35

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	2896.79	10953	90.40	24
Sardinella aurita	301.20	1960	9.40	25
Boops boops	6.34	60	0.20	
Total	3204.33		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 12
DATE :26.02.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 14°47.02
start stop duration Lon E 12°15.20
TIME :04:02:50 04:14:13 11.4 (min) Purpose : 1
LOG : 7663.79 7664.55 0.8 Region : 4050
FDEPTH: 35 25 Gear cond.: 0
BDEPTH: 61 48 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 4.0 kn
Sorted : 61 Total catch: 60.92 Catch/hour: 321.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	221.37	2633	68.86	26
Sardinella maderensis	84.96	338	26.43	27
Lagocephalus laevigatus	4.59	5	1.43	
Trachurus trecae	4.54	58	1.41	28
Trachinotus ovatus	4.17	11	1.30	
Trichiurus lepturus	1.85	5	0.57	
Total	321.48		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 13
DATE :26.02.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 14°37.89
start stop duration Lon E 12°15.57
TIME :09:23:36 09:44:58 21.4 (min) Purpose : 1
LOG : 7692.19 7693.23 1.0 Region : 4050
FDEPTH: 119 113 Gear cond.: 0
BDEPTH: 119 113 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 2.9 kn
Sorted : 144 Total catch: 287.00 Catch/hour: 806.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	189.61	2017	23.52	29
Dentex macrophthalmus	158.99	1230	19.72	30
Dentex angolensis	85.67	365	10.63	31
Dentex barnardi	58.15	685	7.21	
Chelidonichthys capensis	55.34	365	6.86	
Spicara alta	41.57	174	5.16	
Umbrina canariensis	41.01	163	5.09	
Lepidotrigla carolae	35.96	21	4.46	
Squatina oculata	28.09	22	3.48	
Zeus faber	25.17	39	3.12	
Pagrus africanus	25.06	17	3.11	
Trichiurus lepturus	11.69	28	1.45	
Pagellus bellottii natalensis	10.51	96	1.30	
Atractoscion aequidens	8.09	11	1.00	
Citharus linguatula	5.17	157	0.64	
Lagocephalus laevigatus	4.78	17	0.59	
Raja miraletus	4.21	6	0.52	
Perulibatrachus elminensis	3.60	11	0.45	
Anthias anthias	3.37	73	0.42	
Boops boops	2.81	22	0.35	
B I V A L V E S	2.70	309	0.33	
Sepia orbignyana	1.97	6	0.24	
Spondyliosoma cantharus	1.74	6	0.22	
Saurida brasiliensis	0.56	169	0.07	
Calappa pelii	0.22	6	0.03	
Syacium micrurum	0.17	6	0.02	
Total	806.18		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 14
DATE :26.02.2011 GEAR TYPE: PT NO: 4 POSITION:Lat S 14°1.93
start stop duration Lon E 12°12.22
TIME :18:38:45 18:59:14 20.5 (min) Purpose : 1
LOG : 7770.54 7771.87 1.3 Region : 4050
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 342 356 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
Sorted : 26 Total catch: 25.80 Catch/hour: 75.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	75.40	85959	99.81	
Loligo vulgaris	0.15	9	0.19	
Total	75.55		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 15
DATE :27.02.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 13°19.02
start stop duration Lon E 12°35.72
TIME :10:44:17 11:23:12 38.9 (min) Purpose : 1
LOG : 7884.99 7886.93 1.9 Region : 4050
FDEPTH: 117 116 Gear cond.: 0
BDEPTH: 117 116 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.0 kn
Sorted : 195 Total catch: 1469.05 Catch/hour: 2264.72

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	1039.27	7212	45.89	35
Trachurus trecae	620.03	7011	27.38	32
Umbrina canariensis	251.55	913	11.11	36
Chelidonichthys gabonensis	87.27	742	3.85	
Dentex angolensis	46.20	159	2.04	34
Squatina oculata	43.01	15	1.90	
Dentex barnardi	32.74	57	1.45	
Trichiurus lepturus	30.23	114	1.33	
Citharus linguatula	20.53	365	0.91	
Octopus vulgaris	18.02	23	0.80	
Lagocephalus laevigatus	17.11	34	0.76	
Zeus faber	16.88	23	0.75	
Trigla lyra	10.72	57	0.47	
Pagellus bellottii	9.47	46	0.42	
Boops boops	5.13	80	0.23	
Sardinella maderensis	2.74	11	0.12	
Brotula barbata	2.40	11	0.11	
Sardinella aurita	2.28	46	0.10	33
Peristedion cataphractum	2.28	23	0.10	
Syacium micrurum	2.17	68	0.10	
Perulibatrachus elminensis	1.48	11	0.07	
Pontinus accraensis	1.37	11	0.06	
Sepia orbignyana	1.14	46	0.05	
Anthias anthias	0.68	11	0.03	
Total	2264.72		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 16
DATE :27.02.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 13°11.89
start stop duration Lon E 12°41.28
TIME :16:03:05 16:23:38 20.6 (min) Purpose : 1
LOG : 7912.59 7913.62 1.0 Region : 4050
FDEPTH: 108 103 Gear cond.: 0
BDEPTH: 108 103 Validity : 0
Towing dir: 0° Wire out : 270 m Speed : 3.0 kn
Sorted : 0 Total catch: 126.83 Catch/hour: 370.13

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	152.04	922	41.08	37
Dasyatis marmorata	44.65	6	12.06	
Zeus faber	27.43	35	7.41	
Umbrina canariensis	19.55	67	5.28	39
Raja miraletus	19.44	23	5.25	
Pagellus bellottii	15.03	90	4.06	
Chelidonichthys gabonensis	13.86	140	3.75	
Lagocephalus laevigatus	11.96	20	3.23	
Octopus vulgaris	11.56	12	3.12	
Pontinus accraensis	8.05	47	2.18	
Synagrops microlepis	7.70	3327	2.08	
Brotula barbata	5.98	6	1.62	
Dentex angolensis	5.89	29	1.59	38
Raja clavata	4.29	3	1.16	
Perulibatrachus elminensis	3.85	29	1.04	
Branchiostegus semifasciatus *	2.71	3	0.73	
Scorpaena normani	2.60	6	0.70	
Torpedo torpedo	2.19	3	0.59	
Dicologoglossa hexophthalma	2.04	3	0.55	
Erythrocles monodi	1.66	12	0.45	
Sepia orbignyana	1.34	61	0.36	
Anthias anthias	1.31	18	0.35	
Dentex barnardi	0.99	3	0.27	
Alloteuthis africana	0.90	350	0.24	
Citharus linguatula	0.76	67	0.20	
Chelidonichthys capensis	0.70	6	0.19	
Trigla lyra	0.64	3	0.17	
Zenopsis conchifer	0.47	9	0.13	
Perestedion cataphractum *	0.44	3	0.12	
Boops boops	0.06	3	0.02	
Total	370.13		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 17
DATE :27.02.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 12°58.14
start stop duration Lon E 12°53.03
TIME :22:42:03 22:58:38 16.6 (min) Purpose : 1
LOG : 7954.64 7955.61 1.0 Region : 4040
FDEPTH: 35 41 Gear cond.: 0
BDEPTH: 68 62 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.5 kn
Sorted : 0 Total catch: 121.54 Catch/hour: 439.57

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	340.51	1367	77.46	40
Trichiurus lepturus	43.22	195	9.83	
Sardinella maderensis	34.72	195	7.90	41
Selene dorsalis	9.04	36	2.06	42
MYCTOPHIDAE	4.45	2170	1.01	
Pomatomus saltatrix	4.05	4	0.92	
Sphyraena guachancho	2.24	282	0.51	
Saurida brasiliensis	0.87	90	0.20	
Alloteuthis africana	0.47	166	0.11	
Total	439.57		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 18
DATE :28.02.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 12°51.78
start stop duration Lon E 12°50.71
TIME :00:44:19 01:04:54 20.6 (min) Purpose : 1
LOG : 7967.27 7968.54 1.3 Region : 4040
FDEPTH: 37 33 Gear cond.: 0
BDEPTH: 461 487 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.7 kn
Sorted : 0 Total catch: 5171.44 Catch/hour: 15069.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	15053.91	23298	99.89	
Illex coindetii	10.61	26	0.07	
Trachipterus trachypterus	5.25	6	0.03	
Total	15069.76		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 18
DATE :28.02.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 12°51.78
start stop duration Lon E 12°50.71
TIME :00:44:19 01:04:54 20.6 (min) Purpose : 1
LOG : 7967.27 7968.54 1.3 Region : 4040
FDEPTH: 37 33 Gear cond.: 0
BDEPTH: 461 487 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.7 kn
Sorted : 0 Total catch: 5171.44 Catch/hour: 15069.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	15053.91	23298	99.89	
Illex coindetii	10.61	26	0.07	
Trachipterus trachypterus	5.25	6	0.03	
Total	15069.76		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 19
DATE :10.03.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 12°2.28
start stop duration Lon E 13°37.26
TIME :01:26:27 01:56:07 29.7 (min) Purpose : 1
LOG : 8626.50 8628.00 1.5 Region : 4040
FDEPTH: 30 25 Gear cond.: 0
BDEPTH: 68 66 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.1 kn
Sorted : 0 Total catch: 274.54 Catch/hour: 555.19

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	481.29	2961	86.69	43
Sardinella maderensis	60.97	362	10.98	44
Scomber japonicus	10.31	53	1.86	46
Trachurus trecae	1.70	18	0.31	45
Brachydeuterus auritus	0.51	53	0.09	
Ilisha africana	0.16	2	0.03	
Saurida brasiliensis	0.12	99	0.02	
Sphyraena guachancho	0.08	2	0.01	
Lagocephalus laevigatus	0.04	0	0.01	
Total	555.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 20
DATE :10.03.2011 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°56.38
start stop duration Lon E 13°43.43
TIME :07:53:54 08:23:25 29.5 (min) Purpose : 1
LOG : 8672.23 8673.66 1.4 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 28 29 Validity : 0
Towing dir: 0° Wire out : 85 m Speed : 2.9 kn
Sorted : 127 Total catch: 443.95 Catch/hour: 902.34

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	854.02	11439	94.65	47
Trachinotus ovatus	43.05	307	4.77	49
Sardinella maderensis	3.70	43	0.41	48
Chloroscombrus chrysurus	1.57	14	0.17	
Total	902.34		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 21
DATE :10.03.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 11°46.14
start stop duration Lon E 13°45.84
TIME :15:49:53 16:15:35 25.7 (min) Purpose : 1
LOG : 8743.86 8745.25 1.4 Region : 4040
FDEPTH: 24 32 Gear cond.: 0
BDEPTH: 24 32 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.2 kn
Sorted : 90 Total catch: 222.14 Catch/hour: 518.61

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	142.58	10777	27.49	54
Pomadasys incisus	75.71	1177	14.60	
Galeoides decadactylus	54.23	640	10.46	
Sphyraena guachancho	42.96	360	8.28	
Pseudupeneus prayensis	38.66	549	7.45	
Alectis alexandrinus	31.17	12	6.01	
Ilisha africana	15.53	289	2.99	55
Selene dorsalis	15.15	602	2.92	53
Lagocephalus laevigatus	11.49	103	2.21	
Dasyatis margarita	10.53	21	2.03	
Pseudotolithus senegalensis	10.48	33	2.02	
Sepia orbignyana	8.80	21	1.70	
Chloroscombrus chrysurus	8.33	194	1.61	52
Eucinostomus melanopterus	7.19	65	1.39	
Decapterus rhonchus	6.19	161	1.19	56
Ephippion guttifer	5.11	5	0.99	
Citharus linguatula	4.18	128	0.81	
Trichiurus lepturus	3.97	21	0.77	
Caranx crysos	2.96	42	0.57	
Chilomycterus spinosus mauret.	2.78	5	0.54	
Arius parkii	2.73	5	0.53	
Balistes sp.	2.57	16	0.50	
Sardinella aurita	2.19	82	0.42	51
Grammoplites gruveli	2.19	33	0.42	
Sardinella maderensis	1.98	166	0.38	50
Scomberomorus tritor	1.91	2	0.37	
Pteroscion peli	1.49	21	0.29	
Torpedo nobiliana	1.24	5	0.24	
Dasyatis marmorata	0.91	5	0.18	
Argyrosomus hololepidotus	0.82	5	0.16	
Dentex barnardi	0.68	12	0.13	
Epinephelus aeneus	0.58	5	0.11	
Squilla mantis	0.42	12	0.08	
Dicologoglossa cuneata	0.33	5	0.06	
Rypticus saponaceus	0.33	5	0.06	
Torpedo torpedo	0.12	5	0.02	
Fistularia petimba	0.12	5	0.02	
Total	518.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 22
DATE :11.03.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 11°27.05
start stop duration Lon E 13°41.85
TIME :01:04:35 01:34:12 29.6 (min) Purpose : 1
LOG : 8820.91 8822.40 1.5 Region : 4040
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 28 23 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.0 kn
Sorted : 91 Total catch: 326.56 Catch/hour: 661.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	421.72	7618	63.77	57
Sardinella aurita	87.48	2711	13.23	58
Sphyraena guachancho	46.29	160	7.00	
Sardinella maderensis	44.83	2624	6.78	59
Chloroscombrus chrysurus	24.28	247	3.67	61
Ilisha africana	23.25	962	3.52	
Selene dorsalis	5.98	269	0.90	60
Eucinostomus melanopterus	3.64	36	0.55	
Trichiurus lepturus	1.60	14	0.24	
Pomadasys rogeri	1.24	8	0.19	
Caranx crysos	0.95	8	0.14	
Total	661.27		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 23
DATE :11.03.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 11°19.12
start stop duration Lon E 13°38.16
TIME :06:00:45 06:34:05 33.3 (min) Purpose : 1
LOG : 8861.32 8863.06 1.7 Region : 4040
FDEPTH: 26 40 Gear cond.: 0
BDEPTH: 45 54 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.1 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

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

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 24
DATE :11.03.2011 GEAR TYPE: PT NO: 4 POSITION:Lat S 11°15.92
start stop duration Lon E 13°44.76
TIME :08:31:26 08:49:56 18.5 (min) Purpose : 1
LOG : 8879.57 8880.57 1.0 Region : 4040
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 23 24 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.2 kn
Sorted : 24 Total catch: 24.40 Catch/hour: 79.09

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Scomberomorus tritor	45.22	52	57.17	63
Euthynnus alletteratus	24.64	26	31.15	65
Trachinotus ovatus	5.51	29	6.97	62
Sarda sarda	2.17	3	2.75	64
G A S T R O P O D S	0.91	16	1.15	
Sardinella aurita	0.65	6	0.82	66
Total	79.09		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 25
DATE :11.03.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 11°1.75
start stop duration Lon E 13°44.38
TIME :16:40:43 17:10:25 29.7 (min) Purpose : 1
LOG : 8946.18 8947.75 1.6 Region : 4040
FDEPTH: 63 72 Gear cond.: 0
BDEPTH: 63 72 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 3.2 kn
Sorted : 166 Total catch: 166.10 Catch/hour: 335.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	142.68	4905	42.53	67
Raja miraletus	23.43	75	6.98	
Sardinella aurita	22.52	141	6.71	69
GOBIIDAE	15.75	2193	4.70	
Selene dorsalis	15.15	202	4.52	68
Trachurus trecae	14.84	549	4.43	71
Pseudotolithus senegalensis	11.51	22	3.43	
Rhinobatos albomaculatus	9.90	4	2.95	
Pagellus bellottii	8.78	63	2.62	72
Citharus linguatula	7.47	214	2.23	
Octopus vulgaris	7.31	12	2.18	
Umbrina canariensis	6.46	95	1.93	
Dentex angolensis	5.45	77	1.63	73
Dentex barnardi	4.64	107	1.38	
Brotula barbata	4.22	34	1.26	
Sardinella maderensis	4.16	24	1.24	70
Grammoplites gruveli	3.53	46	1.05	
Pomadasys incisus	3.43	16	1.02	
Lagocephalus laevigatus	3.21	18	0.96	
Trichiurus lepturus	2.73	12	0.81	
Argyrosomus hololepidotus	2.63	18	0.78	
Sepia orbignyana	2.00	30	0.60	
Fistularia petimba	1.84	6	0.55	
Pterothrissus belloci	1.68	38	0.50	
Torpedo marmorata	1.41	4	0.42	
Dicologoglossa hexophthalma	1.31	22	0.39	
Torpedo torpedo	1.17	2	0.35	
Serranus accraensis	1.15	18	0.34	
Dicologoglossa cuneata	0.71	6	0.21	
Scorpaena normani	0.69	28	0.20	
Pseudupeneus prayensis	0.67	20	0.20	
Sphyraena guachancho	0.61	8	0.18	
Zeus faber	0.44	4	0.13	
G A S T R O P O D S	0.40	34	0.12	
Scorpaena scrofa	0.32	4	0.10	
Antennarius sp.	0.30	14	0.09	
Chilomycterus spinosus mauret.	0.28	2	0.08	
Parapenaeus longirostris	0.26	81	0.08	
Bathyuroconger vicinus	0.14	2	0.04	
Calappa pelii	0.14	2	0.04	
Alloteuthis africana	0.08	38	0.02	
Monolene microstoma	0.02	2	0.01	
Total	335.44		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 26
DATE :12.03.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 10°34.52
start stop duration Lon E 13°15.67
TIME :12:10:57 12:41:07 30.2 (min) Purpose : 1
LOG : 9124.91 9126.51 1.6 Region : 4040
FDEPTH: 126 131 Gear cond.: 0
BDEPTH: 126 131 Validity : 0
Towing dir: 0° Wire out : 330 m Speed : 3.2 kn
Sorted : 81 Total catch: 80.88 Catch/hour: 160.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex angolensis	88.03	460	54.71	74
Trigla lyra	28.45	213	17.68	
Brotula barbata	8.95	8	5.56	
Citharus linguatula	6.74	153	4.19	
Zenopsis conchifer	4.69	8	2.92	
Peristedion cataphractum	3.88	74	2.41	
Sepia orbignyana	3.76	107	2.34	
Pagellus bellottii	2.39	12	1.48	
Dentex barnardi	2.19	8	1.36	
Zeus faber	2.05	8	1.27	
Lagocephalus laevigatus	1.61	4	1.00	
Uranoscopus polli	1.57	10	0.98	
Octopus vulgaris	1.45	2	0.90	
Syacium micrurum	1.29	44	0.80	
Bembrops greyi	1.09	12	0.68	
Pterothrissus belloci	0.66	4	0.41	
Pontinus accraensis	0.50	2	0.31	
Trachurus trecae	0.40	12	0.25	75
Spicara alta	0.40	10	0.25	
Loligo vulgaris	0.30	12	0.19	
Saurida brasiliensis	0.24	88	0.15	
Dentex macrophthalmus	0.20	2	0.12	
Monolene microstoma	0.06	4	0.04	
Total	160.90		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 27
DATE :12.03.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°33.17
start stop duration Lon E 13°32.73
TIME :15:09:34 15:37:35 28.0 (min) Purpose : 1
LOG : 9146.71 9148.40 1.7 Region : 4040
FDEPTH: 22 29 Gear cond.: 0
BDEPTH: 44 51 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.6 kn
Sorted : 0 Total catch: 0.34 Catch/hour: 0.73

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella maderensis	0.73	4	0.00	76

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 28
DATE :12.03.2011 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°30.29
start stop duration Lon E 13°6.45
TIME :20:34:50 21:05:21 30.5 (min) Purpose : 1
LOG : 9193.24 9195.03 1.8 Region : 4040
FDEPTH: 25 38 Gear cond.: 0
BDEPTH: 285 183 Validity : 0
Towing dir: 0° Wire out : 85 m Speed : 3.5 kn
Sorted : 20 Total catch: 19.75 Catch/hour: 38.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	32.04	38571	82.53	
E C H I N O D E R M A T A	5.86	438	15.09	
J E L L Y F I S H	0.53	18	1.37	
Synagrops microlepis	0.35	47	0.91	
Lestidium atlanticum	0.04	4	0.10	
Total	38.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 29
DATE :13.03.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 10°8.52
start stop duration Lon E 13°21.74
TIME :10:16:36 10:42:35 26.0 (min) Purpose : 1
LOG : 9313.03 9314.47 1.4 Region : 4040
FDEPTH: 24 28 Gear cond.: 0
BDEPTH: 24 28 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.3 kn
Sorted : 91 Total catch: 693.88 Catch/hour: 1602.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	754.73	9249	47.10	77
Ilisha africana	296.63	6374	18.51	80
Galeoides decadactylus	181.66	1194	11.34	
Pseudotolithus senegalensis	86.00	351	5.37	
Trichiurus lepturus	70.91	194	4.42	
Pomadasys incisus	67.22	790	4.19	
Pteroscion peli	52.30	878	3.26	
Pomadasys rogeri	27.56	69	1.72	
Sphyraena guachancho	18.08	88	1.13	
Selene dorsalis	15.09	176	0.94	81
Chloroscombrus chrysurus	8.78	88	0.55	
Penaeus notialis	7.72	2476	0.48	
Arius parkii	5.75	12	0.36	
Umbrina canariensis	4.91	69	0.31	
Sardinella maderensis	2.82	16	0.18	79
Pentanemus quinquarius	1.58	53	0.10	
Trachurus trecae	0.55	5	0.03	78
Selar crumenophthalmus	0.18	2	0.01	
Total	1602.50		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 30
DATE :14.03.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 9°41.17
start stop duration Lon E 12°52.81
TIME :05:22:33 05:53:06 30.5 (min) Purpose : 1
LOG : 9479.37 9480.98 1.6 Region : 4040
FDEPTH: 119 113 Gear cond.: 0
BDEPTH: 119 113 Validity : 0
Towing dir: 0° Wire out : 310 m Speed : 3.2 kn
Sorted : 471 Total catch: 470.58 Catch/hour: 924.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Umbrina canariensis	225.05	350	24.34	85
Trichiurus lepturus	195.36	456	21.13	
Trachurus trecae	89.78	2861	9.71	82
Chelidonichthys capensis	83.30	580	9.01	
Dentex angolensis	53.44	436	5.78	86
Boops boops	42.53	1000	4.60	
Brachydeuterus auritus	27.90	177	3.02	84
G A S T R O P O D S	25.28	1713	2.73	
Selene dorsalis	23.18	67	2.51	83
Sepia orbignyana	17.58	61	1.90	
Brotula barbata	14.83	10	1.60	
Dentex barnardi	14.34	45	1.55	
Chelidonichthys gabonensis	13.26	77	1.43	
Grammoplites gruveli	12.77	132	1.38	
Raja miraletus	10.81	18	1.17	
Pagellus bellottii	9.33	92	1.01	87
Dentex congoensis	8.45	81	0.91	
Citharus linguatula	8.37	149	0.91	
Uranoscopus polli	6.84	28	0.74	
Peristedion cataphractum	4.32	51	0.47	
Pterothrissus belloci	4.32	24	0.47	
Cynoponticus ferox	4.03	2	0.44	
Lagocephalus laevigatus	3.93	4	0.43	
Lophiodes kempi	2.71	10	0.29	
Scorpaena angolensis	2.55	8	0.28	
Saurida brasiliensis	2.42	415	0.26	
Zenopsis conchifer	2.36	2	0.26	
Scorpaena normani	1.94	18	0.21	
Dentex macrophthalmus	1.93	12	0.21	
Illex coindetii	1.93	51	0.21	
Branchiostegus semifasciatus *	1.67	2	0.18	
Monolene microstoma	1.49	88	0.16	
Zeus faber	1.38	4	0.15	
Alloteuthis africana	1.24	338	0.13	
Torpedo torpedo	0.94	2	0.10	
Octopus vulgaris	0.88	8	0.10	
Chaetodon hoefleri	0.65	4	0.07	
Anthias anthias	0.45	10	0.05	
Dicologoglossa hexophthalma	0.39	8	0.04	
Syacium micrurum	0.24	33	0.03	
Invertebrate	0.14	2	0.01	
Cepola pauciradiatus	0.12	6	0.01	
Spicara alta	0.04	2	0.00	
Calappa pelii	0.04	4	0.00	
Total	924.52		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 31
DATE :15.03.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 8°40.20
start stop duration Lon E 13°19.81
TIME :12:07:15 12:27:01 19.8 (min) Purpose : 1
LOG : 9756.11 9757.32 1.2 Region : 4054
FDEPTH: 15 20 Gear cond.: 0
BDEPTH: 31 38 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.7 kn
Sorted : 33 Total catch: 32.65 Catch/hour: 99.09

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chloroscombrus chrysurus	54.17	525	54.67	89
Sphyraena guachancho	33.84	85	34.15	
Scomberomorus tritor	9.26	6	9.34	90
Sardinella maderensis	0.94	6	0.95	88
G A S T R O P O D S	0.88	118	0.89	
Total	99.09		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 32
DATE :16.03.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 8°10.16
start stop duration Lon E 13°12.22
TIME :05:09:54 05:34:55 25.0 (min) Purpose : 1
LOG : 9911.00 9912.21 1.2 Region : 4054
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 31 30 Validity : 0
Towing dir: 0° Wire out : 95 m Speed : 2.9 kn
Sorted : 51 Total catch: 51.38 Catch/hour: 123.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chloroscombrus chrysurus	61.27	573	49.73	93
Sardinella maderensis	35.97	269	29.19	91
Sphyraena guachancho	14.99	26	12.16	
Scomberomorus tritor	6.76	7	5.49	94
Sardinella aurita	4.22	38	3.43	92
Total	123.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 33
DATE :16.03.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 7°50.36
start stop duration Lon E 12°46.16
TIME :13:20:04 13:41:00 20.9 (min) Purpose : 1
LOG : 9980.27 9981.38 1.1 Region : 4054
FDEPTH: 110 110 Gear cond.: 0
BDEPTH: 110 110 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.2 kn
Sorted : 279 Total catch: 279.39 Catch/hour: 800.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brachydeuterus auritus	438.25	3728	54.74	101
Selene dorsalis	64.04	166	8.00	98
Dentex congoensis	62.46	751	7.80	99
Dentex angolensis	57.45	436	7.18	100
Trigla lyra	56.45	436	7.05	
Trichiurus lepturus	16.76	20	2.09	
Citharus linguatula	13.18	375	1.65	
Dentex barnardi	12.58	40	1.57	96
Trachurus trecae	9.74	370	1.22	95
Pagellus bellottii	8.08	143	1.01	97
Squatina oculata	7.45	3	0.93	
Octopus vulgaris	6.93	14	0.87	
Pontinus accraensis	6.56	11	0.82	
Uranoscopus polli	6.30	29	0.79	
Raja miraletus	6.25	9	0.78	
Chelidonichthys gabonensis	4.47	23	0.56	
Sepia orbignyana	4.21	95	0.53	
Brotula barbata	3.78	3	0.47	
Torpedo marmorata	3.41	3	0.43	
Lagocephalus laevigatus	2.72	3	0.34	
Spicara alta	2.32	80	0.29	
Chaetodon hoefleri	1.95	11	0.24	
Saurida brasiliensis	1.58	467	0.20	
Fistularia petimba	1.20	3	0.15	
Scorpaena normani	0.89	9	0.11	
Pterothrissus belloci	0.54	3	0.07	
B I V A L V E S	0.43	77	0.05	
G A S T R O P O D S	0.26	37	0.03	
Illex coindetii	0.17	3	0.02	
Monolene microstoma	0.09	3	0.01	
URCHINS	0.03	3	0.00	
Total	800.54		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 34
DATE :17.03.2011 GEAR TYPE: BT NO: 24 POSITION:Lat S 7°15.96
start stop duration Lon E 12°33.00
TIME :09:14:48 09:42:58 28.2 (min) Purpose : 1
LOG : 163.81 165.36 1.5 Region : 4054
FDEPTH: 66 76 Gear cond.: 0
BDEPTH: 66 76 Validity : 0
Towing dir: 0° Wire out : 190 m Speed : 3.3 kn
Sorted : 75 Total catch: 74.89 Catch/hour: 159.51

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trichiurus lepturus	150.91	322	94.61	
J E L L Y F I S H	3.13	4	1.96	
Caranx crysos	1.92	2	1.20	
Pagrus caeruleostictus	1.32	4	0.83	
Seriola carpenteri	0.96	2	0.60	
Trachinus radiatus	0.68	4	0.43	
Pagellus bellottii	0.36	6	0.23	
Dentex congoensis	0.15	2	0.09	
B I V A L V E S	0.04	13	0.03	
G A S T R O P O D S	0.04	4	0.03	
Total	159.51		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 35
DATE :18.03.2011 GEAR TYPE: PT NO: 4 POSITION:Lat S 6°56.52
start stop duration Lon E 12°3.10
TIME :04:06:34 04:36:13 29.6 (min) Purpose : 1
LOG : 328.69 330.11 1.4 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 105 109 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 2.9 kn
Sorted : 2 Total catch: 2.27 Catch/hour: 4.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Auxis thazard	1.86	2	40.53	
Saurida brasiliensis	1.36	1777	29.52	
Trichiurus lepturus	1.23	2	26.87	
Ariomma bondi	0.08	2	1.76	
Trachurus trecae	0.06	2	1.32	102
Total	4.60		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 36
DATE :18.03.2011 GEAR TYPE: PT NO: 7 POSITION:Lat S 6°17.37
start stop duration Lon E 12°8.15
TIME :23:38:04 00:08:22 30.3 (min) Purpose : 1
LOG : 503.60 505.10 1.5 Region : 4054
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 37 40 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.0 kn
Sorted : 3 Total catch: 2.54 Catch/hour: 5.03

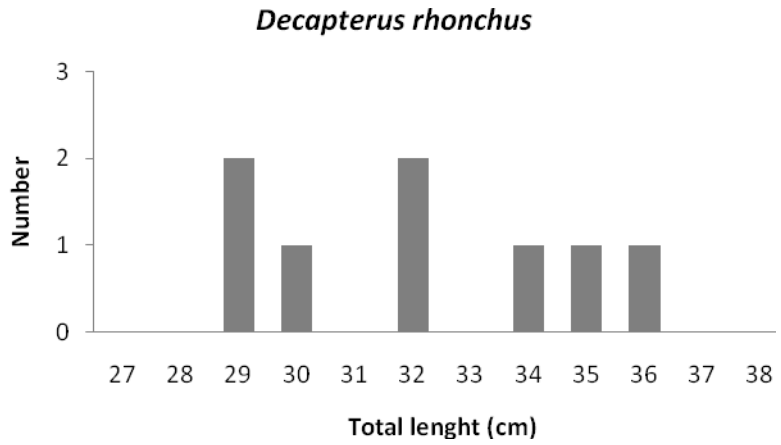
SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Decapterus rhonchus	1.86	55	37.01	103
Caranx crysos	1.50	2	29.92	
Selene dorsalis	0.99	2	19.69	
Decapterus punctatus	0.20	8	3.94	104
Sphyraena guachancho	0.16	10	3.15	
Saurida brasiliensis	0.14	44	2.76	
Brachydeuterus auritus	0.14	4	2.76	
Illex coindetii	0.04	12	0.79	
Total	5.03		100.00	

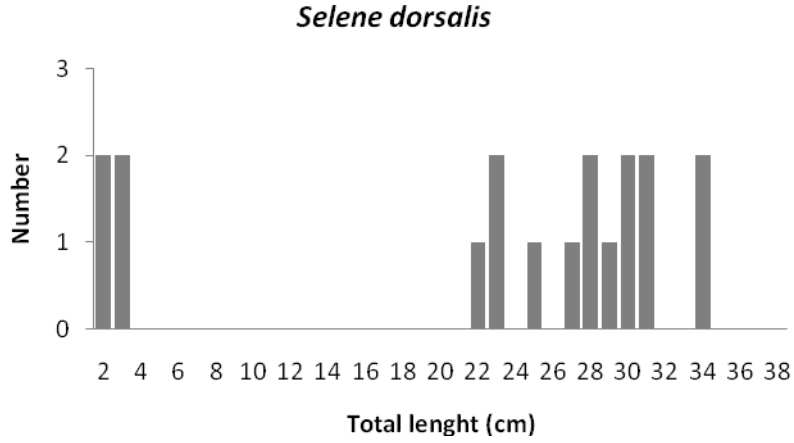
R/V Dr. Fridtjof Nansen SURVEY:2011402 STATION: 37
DATE :19.03.2011 GEAR TYPE: PT NO: 4 POSITION:Lat S 6°16.77
start stop duration Lon E 11°46.78
TIME :04:11:24 04:41:20 29.9 (min) Purpose : 1
LOG : 533.69 535.27 1.6 Region : 4054
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 109 111 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.2 kn
Sorted : 2 Total catch: 1.66 Catch/hour: 3.33

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Auxis thazard	2.25	8	67.47	105
Trichiurus lepturus	0.84	2	25.30	
Ariomma bondi	0.16	6	4.82	
Saurida brasiliensis	0.08	30	2.41	
Total	3.33		100.00	

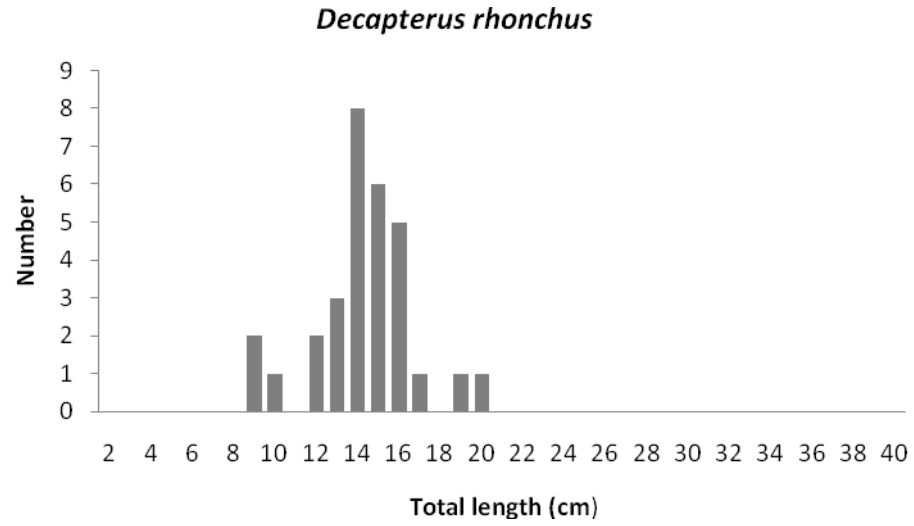
ANNEX II. LENGTH FREQUENCY OF THE MOST COMMON PELAGIC SPECIES

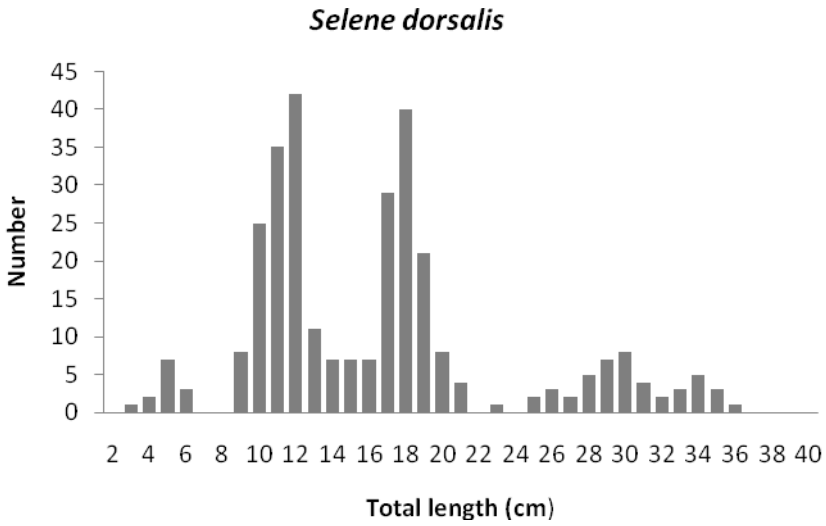
Angola South: Cunene River – Benguela

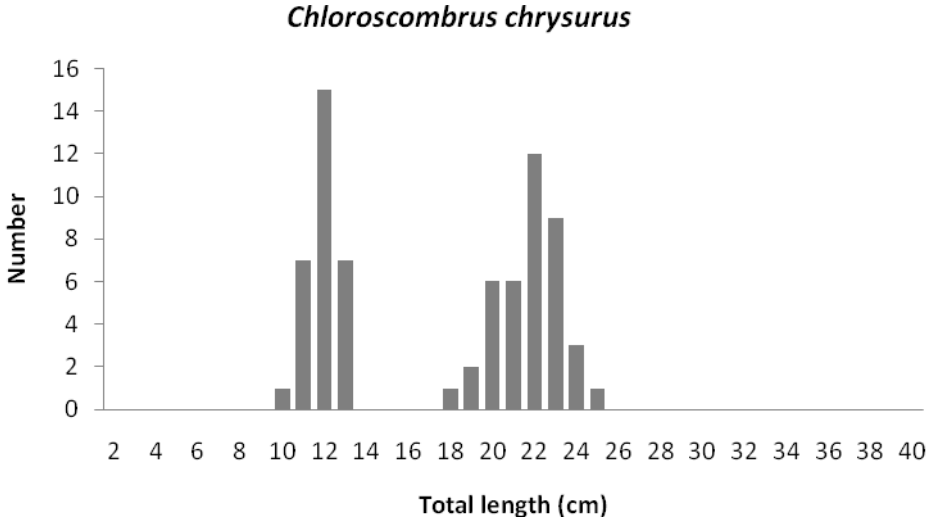


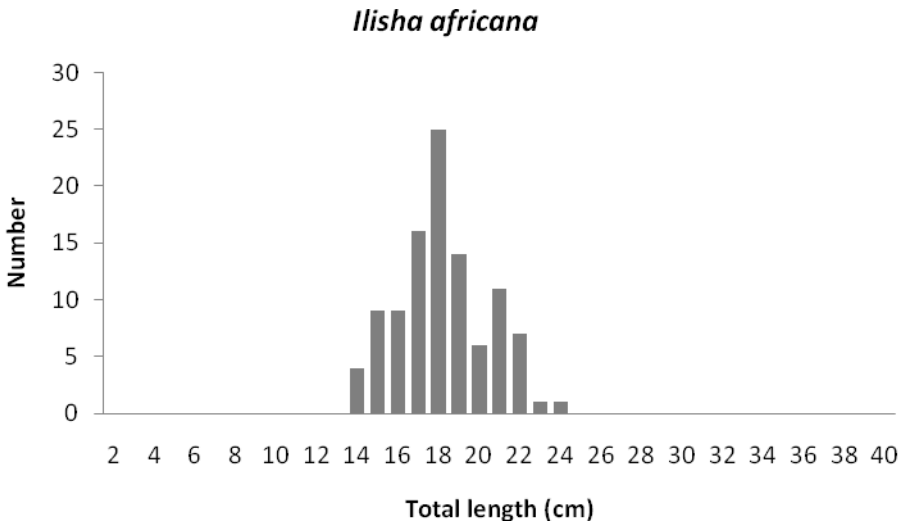


Angola Central: Benguela – Pta. Palmerinhas

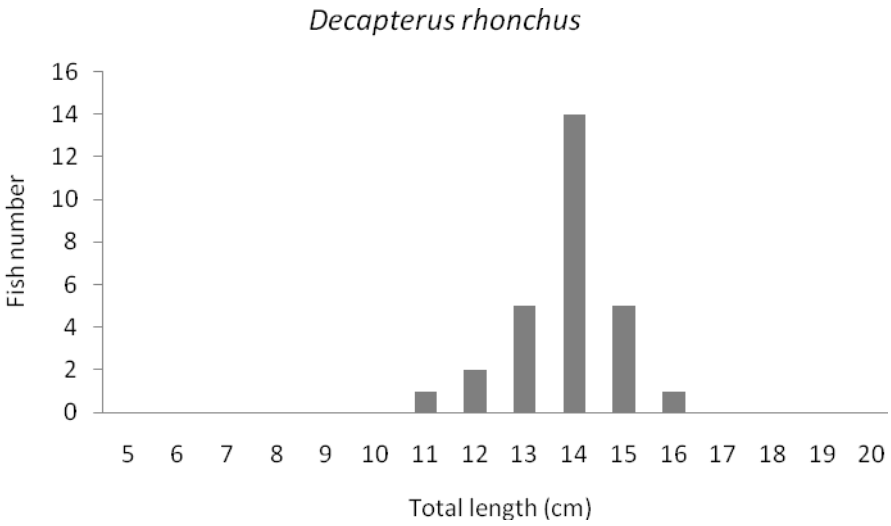


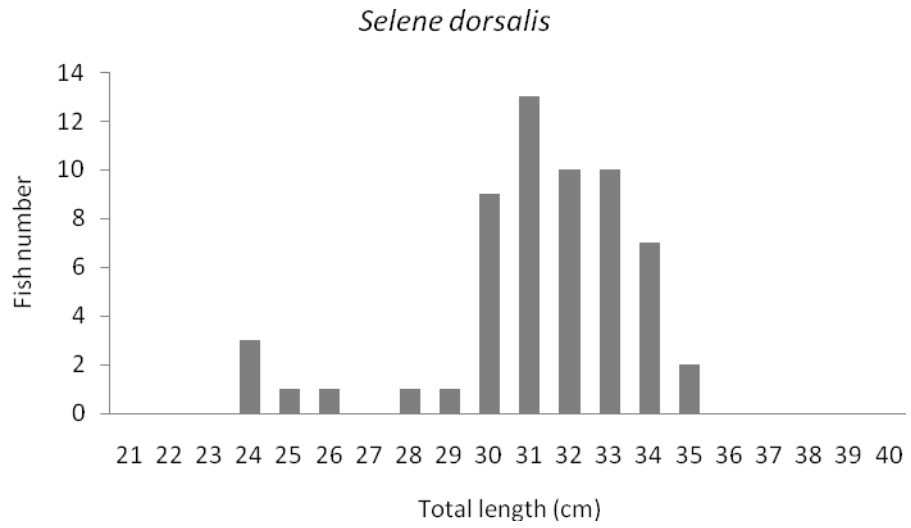


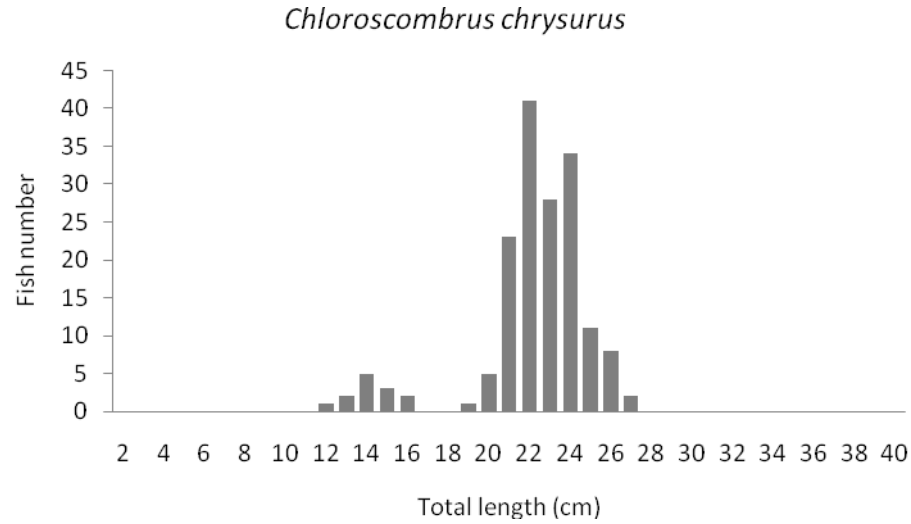




Angola North: Pta. Palmerinhas - Congo River




Selene dorsalis
Fish number
0
2
4
6
8
10
12
14
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Total length (cm)


Chloroscombrus chrysurus
Fish number
0
5
10
15
20
25
30
35
40
45
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Total length (cm)

ANNEX III BIOMASS AND NUMBER PER LENGTH GROUP

Table of Sardinella biomass (1 000 tons) estimated from acoustic indexes from surveys with research vessel Dr. Fridtof Nansen from 1985-2011.

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

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

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

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

1 Data error (Central and Northern Regions)

2 Southern region not surveyed

3 Cabinda not surveyed

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

5 Estimates reported together with previous report

ANNEX IV INSTRUMENTS AND FISHING GEAR USED

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

Standard sphere calibrations were carried out using 38.1 mm diameter tungsten carbide sphere for 18, 38, 120 and 200 kHz. The last calibrations took place 23.07.2010 at Baía dos Elefantes. The details of the settings of the 38 kHz echo sounder where as follows:

Transceiver-2 menu (38 kHz)

Transducer depth	5.50/7.0 m
Absorption coefficient	8.7 dB/km
Pulse length	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2-way beam angle	-20,6dB
Gain	25.99 dB
SA correction	-0.59 dB
Angle sensitivity	21.9
3 dB beam width	6.74º along ship
	6.77º athwart ship
Along ship offset	0.13º
Athwart ship offset	0.04º

Bottom detection menu

Minimum level	-45 dB

Fishing gear

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

The bottom trawl has a headline of 31 m, footrope 47 m and 20 mm mesh size in the cod end with an inner net of 10 mm mesh size. The trawl height was about 4.5 m and distance between wings during towing about 21 m. The sweeps are 40 m long. The trawl is equipped with a 12" rubber bobbins gear. New doors are 'Thyborøn' combi type, 7.41 m^2, 1720 kg. These have been in use onboard since 19.02.08.

The SCANMAR system was used on all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their distance, and the trawl was equipped with a trawl eye that provides information about the trawl opening. A catch sensor on the cod-end indicated the size of the catch.