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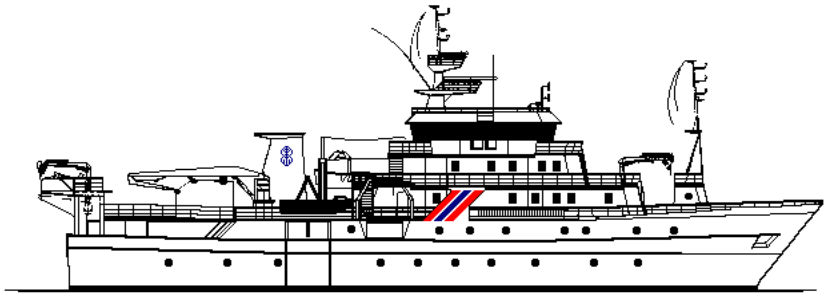

# BCLME SURVEY NO.2 2004

SURVEYS OF THE PELAGIC FISH RESOURCES OF CONGO, GABON AND Cabinda, ANGOLA, 15 JULY – 28 JULY 2004

BCLME Sardinella Recruitment studies

By

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## EXECUTIVE SUMMARY

The main focus of this survey was to estimate the abundance and identify spawning areas of sardinella, and particularly *Sardinella aurita* in the region. Surveys in Congo and Gabon previous to 1996 had reported juvenile sardinella of both species in the region. This survey showed similar results, and although the results from the plankton hauls are yet to be analysed for sardinella eggs and larvae, it seems reasonable to conclude preliminary that this region is important as a spawning area for sardinella, and especially for the *S. aurita*. The biomass of both species of sardinella was the highest ever recorded in the region (See chapter 4), however the surface sea water this year was particularly cold (seen from the long time series of surveys with Dr. Fridtjof Nansen in Angola), and the Angolan survey of the pelagic resources that followed this survey showed that the biomass of sardinella in Angola was shifted somewhat north from their usual position. Although the method and equipment used to assess the stock has changed between 1985 and today, the trend is still clear, and may indicate that sardinella has become more abundant in the area during the period. Over a period of years, the sardinella stock in Angola has fluctuated without any apparent trend, and juvenile fish are absent or few in the estimates. It seems clear from this survey that the sardinella stock is divided between Congo, Gabon, DRC and Angola, with the main spawning areas in Gabon, and that the stock is migrating past the Congo River estuarine. Any attempt to get reliable estimates of this stock requires the area between Cabinda and Gabon to be surveyed frequently.

**List of Abbreviations**

| | |
|---|---|
| ADCP: | Acoustic Doppler Current Profiler |
| BCLME: | Benguela Current Large Marine Ecosystem |
| BEI: | Bergen Echo Integrator |
| CTD: | Current Temperature Density measurer |
| dB: | Decibel |
| FAO: | Food and Agriculture Organization of the United Nations |
| GCLME: | Guinea Current Large Marine Ecosystem |
| IIM: | Instituto de Investigação Marinha, Luanda, Angola |
| IMR: | Institute of Marine Research, Bergen, Norway |
| NM: | Nautical Mile (1852 m) |
| SBE: | Seabird Electronics |

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ANNEX
I Records of fishing stations
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# 1 Introduction

## 1.1 Objectives

This pelagic survey covers the region from Port Gentil, Gabon to Congo River, Angola (Cabinda region) and is aimed at monitoring and estimating the abundance of the pelagic fish resources of the region with special emphasis on the Sardinella species and their spawning areas. The survey is partly funded by BCLME and is carried out in cooperation with Gabon, Congo, the Democratic Republic of Congo, the Nansen Programme at IMR and the NORAD-FAO Project: International Cooperation with the Nansen Programme. Fisheries Management and Marine Environment (GCP/INT/730/NOR). Several previous surveys by the Nansen programme covered the region off Congo and Gabon, and the shelf off Cabinda, Angola. Four surveys covered the seasonal differences in demersal and pelagic fish stocks in Congo and Gabon in 1985 (see IMR 1986), and several surveys followed, the latest one covering Congo and Gabon in August 1996. The Cabinda region has previously been covered as part of the Nansen program cooperation with Angola, and surveys has been conducted in this region frequently from 1985, however, no surveys covered the region after 1996 because of the high oil exploration activity. Previous surveys divided the region into Congo and Gabon in one survey, while the Cabinda region was included in the survey of Angola, in the coverage from Cabinda to Luanda.

The main objectives of the survey were the following:

- To estimate the abundance and to map the distribution of the main commercially important pelagic and semi-pelagic fish species, with special emphasis on the two sardinella species *Sardinella aurita* and S. *maderensis*.

- To study the biological condition of the main species, including length weight-relationships and reproductive stages.

- To collect depth stratified samples of zoo-, ichthyo- and phytoplankton in order to determine sardinella egg distribution, and zoo- and phytoplankton compositions and densities. The distribution and aggregation patterns of sardinella will be correlated with plankton distributions and hydrographical and meteorological conditions.

- 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 and plankton sampling along acoustical and hydrographical transect lines.

- On-the-job training of local participants on the main survey routines, including using NAN-SIS and Hydrobase software, scrutinizing acoustical data using BEI, and producing acoustic biomass estimates.

## 1.2 Participation

The scientific staffs participating were:

From Instituto de Investigação Marinha, Luanda, Angola:
N'Kosi Luyeye (Project Leader), Wasa Mesella Domingos André, Alice Mulamba de Lima Chicunga, Enoque Cangajo, Nilsa Maria da Silva Alves and Stianete Fernanda Arcanjo da Cunha Antonio (Student of Agostinho Neto University)

From Institute of Marine Research, Bergen, Norway:
Jens-Otto Krakstad (Cruise Leader), Elisabeth Lundsør, Tor Egil Johansson and Ole Sverre Fossheim

From Direction Générale de la Pêche et de l'Aquaculture, Congo:
Claude Benoít Atsango, Pierre Mpandou and Jean Samba

From Pêcheries Industrielles du Congo, Democratic Republic of Congo:
Manara Kamitenga

From Direction Générale de la Pêche et de l'Aquaculture, Gabon:
Jean de Dieu Doumambila, Jean Gabriel Goussilou and Jean de Dieu Lewembe

From Nigerian Institute for Oceanography and Marine Research, Lagos, Nigeria:
Catherine Isebor, (GCLME-representative)

## 1.3 Narrative

The vessel departed Port Gentil, Gabon on the 15 July 2004 at 14:50 UTC (Local time –1) and steamed north to 00°10'S where the survey started at 18:25 the same day. A systematic

survey track with equally spaced transect lines (10 nautical miles apart) perpendicular to the coast was followed for the duration of the survey.

The coast of Gabon was covered from the 15 July to the 22 July at 18:45 UTC, before the vessel entered the territorial waters of Congo and continued the survey in their territorial waters until the 24th July when the border to Cabinda in Angola was reached at 10:40 UTC. The region of Cabinda was then surveyed until the vessel arrived at the end of the survey transects at the Congo River and the border between Angola and The Democratic Republic of the Congo (DRC) on the 26th July. The outlet of the Congo River was thereafter surveyed with an extensive survey grid and monitored with CTD´s to monitor the flow of freshwater from the river mouth. The vessels then steamed to Luanda where it arrived in the morning on the 27th of July.

The sampling trawls, including the small pelagic trawl, the mid-sized (15 m vertical opening) pelagic trawl and the demersal trawl (5 m), were used during the survey. The acoustic transducers (18, 38 and 120 kHz, split beam, EK500 1 and 200 kHz, single beam, EK500 2) were logging hydro acoustic data continuously during the survey.

The acoustic transects generally cover a depth range of 20 - 500 m, but some lines were extended to about 1 000 m depth to check for deeper distributions of sardinella and horse mackerel. The shallowest part of the shelf in the Cabinda region is partly inaccessible for trawling due to oil platforms and wells.

Zooplankton samples were obtained using HydroBios multinet plankton sampler, and phytoplankton samples were collected with Niskin bottles attached to the CTD rosette. Samples were taken at CTD station of 50 and 20 m bottom depth.

### 1.4 Survey effort

Figure 1 shows the cruise tracks with fishing and hydrographic stations for the Gabon, Congo and Cabinda, Angola. Table 1 summarizes the survey effort by regions.

Table 1. Summary of survey effort by regions, including number of demersal (BT) and pelagic (PT) trawl hauls, CTD casts, Multinet stations (2-5 zooplankton samples per station) and distance surveyed (log), disregarding the steaming from, Port Gentil and the start of the survey, and from Congo River to Luanda (log).

| Area | BT | PT | Total trawls | CTD casts | Multinet stations | Log (NM) |
|---|---|---|---|---|---|---|
| Gabon | 8 | 26 | 34 | 48 | 17 | 1279 |
| Congo | 0 | 6 | 6 | 11 | 4 | 266 |
| Angola | 0 | 4 | 4 | 38 | 3 | 300 |
| DRC | 0 | 1 | 1 | 7 | 2 | 20 |
| Total | 8 | 37 | 45 | 104 | 26 | 1861 |

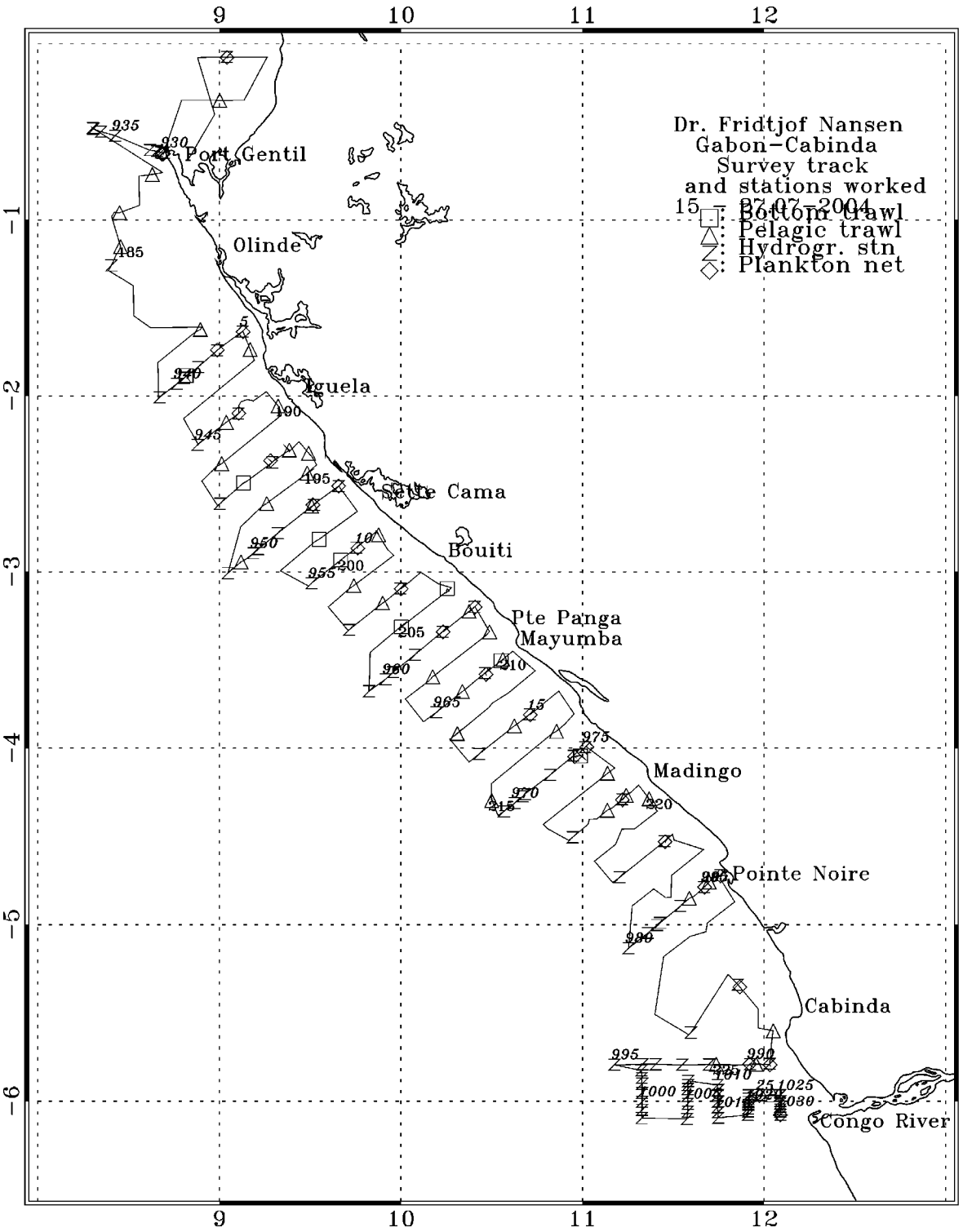



Figure 1. Course track with fishing, plankton and hydrographic stations

# 2 Methods

## 2.1 Hydrographic sampling

### 2.1.1 CTD profiles

A Seabird 911+ CTD probe was used to obtain vertical profiles of the temperature, salinity and oxygen. Real time logging was carried out using the PC based Seabird Seasave software. CTD casts were conducted along the cruise track in transects at CTD lines with 60 NM distance and on every 2nd transect at 200 and 50 m depth. The casts were stopped a few meters above the bottom, and at a maximum of 500 m depth. No water samples for calibration were collected, but water was collected for phytoplankton samples using Niskin bottles at CTD stations of 50 and 20 m bottom depth.

An oxygen calibration was conducted on the 10th of July during the survey of the eastern Gulf of Guinea, 24 samples out of 24 were accepted for the calibration. A linear regression gave the following formula for correcting the oxygen values:

$O_2 = O_{2ctd}\ 1.\ 2376 - 0.3524$

The calibration was applied for all oxygen samples during this survey.

For the salinity, the analyses of 25 April 2004 were applied. The average differences between the salinometer and CTD values are generally very small and the CTD values were accepted.

### 2.1.2 Termosalinograph

A new SBE 21 Seacat Thermosalinograph was installed during the survey of the eastern Gulf of Guinea. The thermosalinograph was running routinely from the 21th June 00:00, midnight. Temperature comparisons between the CTD at 5 m depth and the thermosalinograph showed temperatures 0.25 – 0.3°C warmer for the thermosalinograph because of heating in the pipes. This will be corrected by another temperature sensor mounted on the water inlet at a later stage.

Factory calibration settings of the salinity sensor were applied during the survey.

### 2.1.3 Current speed and direction measurements (ADCP)

The ship-born ADCP was not in function and no data was logged during the survey.

### 2.1.4 Meteorological observations

Wind direction and speed, air temperature, global radiation and sea surface temperature (5 m depth) were logged automatically every nautical mile on an Aanderaa meteorological station.

## 2.2 Fish sampling

Records of individual catches are given in Annex I. All trawl catches were sampled for species composition by weights and numbers. A brief description and illustrations of the sampling trawls are provided in Annex IV.

Length frequencies of all target species, measured to the nearest 1 cm below, were collected, and biological samples were obtained for sardinella and horse mackerel. Total length and body weight were determined to the nearest 0.1 cm and 0.1 g below, respectively. Sex and reproductive stages were determined by means of macroscopic examination, scoring each fish according to the five-point classification scale first proposed by Holden and Raitt (1974), Table 2.

From these parameters simple parameters as length/weight relationships and condition factors were calculated as part of the training programme onboard Dr. fridtjof Nansen. More throughout analyses of the data will be conducted as part of the BCLME project on Recruitment studies of sardinella which this survey is a part of.

The condition factor was calculated in its simplest form as:

$$\text{Cond. factor} = W/L^3 * 100 \qquad 1)$$

The condition factor gives information on how fat the fish is, and as such, the 'health' of the fish or the ecosystem, and can be used in a number of comparative analyses to help understanding the biology of the species. See for instance Kreiner *et al* (2001). Data from this survey should as part of the LMR/CF/03/11 be compared with data collected during Angolan acoustic surveys and if available, previous surveys in Gabon and Congo.

Table 2. The five-point gonad maturity scale proposed for partial spawners by Holden and Raitt (1974).

| Stage | Maturity status | Description |
|---|---|---|
| **I** | Immature | Ovary and testis lengths about 1/3rd of body cavity length. Ovaries pinkish, translucent; testis whitish. Ova not visible to the naked eye. |
| **II** | Maturing virgin and recovering spent | Ovary and testis about ½ length of body cavity length. Ovary pinkish, translucent; testis whitish, more or less symmetrical. Ova not visible to the naked eye. |
| **III** | Ripening | Ovary and testis about 2/3rds length of body cavity length. Ovary pinkish-yellow colour with granular appearance, testis whitish to creamy. No transparent ova visible. |
| **IV** | Ripe | Ovary and testis from 2/3rds to full length of body cavity. Ovary orange-pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova visible. Testis whitish to creamy, soft. |
| **V** | Spent | Ovary and testis shrunken to about ½ length of body cavity. Walls loose. Ovary may contain remnants of disintegrating opaque and ripe ova, darkened or translucent. Testis bloodshot and slack. |

## 2.3 Plankton sampling

### 2.3.1 Zooplankton

The zooplankton communities in the main distribution area of horse mackerel and on selected localities within the sardinella core areas were sampled in order to map the prey availability. The sampling was conducted by means of HydroBios multinet, enabling up to five depth-specific samples in one deployment. Each net (mesh size: 405 µm) was fitted with a flowmeter for estimation of sample volume. A Scanmar depth sensor gave real-time information of the depth. Nets were opened and closed remotely from the bridge of the vessel. All samples were fixed in 4 - 5% formaldehyde. The samples will be stored at IIM in Luanda and analysed as part of the ongoing BCLME project on sardinella, LMR/CF/03/11.

### 2.3.2 Phytoplankton

Phytoplankton samples were collected using Niskin water samplers mounted in a circular array on the CTD probe. Samples were taken at CTD stations of 50 m and 20 m bottom

depth. On the 50 m station four samples were collected, at 50, 35, 20 and 5 m depth while two samples at 5 and 20 m depth were collected on the station at 20 m depth. All samples were fixed in 4-5% formaldehyde. The samples will be stored at IIM in Luanda and analysed as part of the ongoing BCLME project on sardinella, LMR/CF/03/11.

## 2.4 Acoustic sampling

### 2.4.1 Equipment

The acoustic recordings were conducted using two Simrad EK 500 echosounders (Bodholt *et al*. 1989) running keel mounted transducers at nominal operating frequencies of 18, 38, 120 kHz (EK500 1) and 200 kHz (EK500 2). The previous calibration of the 38 kHz transducer was conducted off Dakar in November 2003. No calibration was attempted during this survey do to lack of suitable localities for such exercises. A calibration is planed during the upcoming survey of the pelagic resources in Angola and a re-computation of the data will be conducted if discrepancies between the calibrations are discovered.

Acoustic raw-data was logged on the Sun-Unix based BEI (Knudsen 1990) version 2000. The technical specifications and operational settings of the echosounders used during the survey are given in Annex IV.

### 2.4.2 Allocation of acoustic energy to target taxii

The acoustic data were scrutinized using the post-processing module of the BEI software. Scatters were displayed at 38 kHz, standardized to 5 NM echograms with 1,000 pings (horizontal) by 500 bins (vertical). The mean 5 NM area backscattering coefficients $s_A$ ($m^2/NM^2$) was allocated to a predefined set of taxii on the basis of established echogram features. Acoustic groups and respective taxi 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 taxii. Note that for 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. madarensis* |
| Horse mackerel | *Trachurus* sp. | *T. trecae* |
| Big-eye grunt | | *Brachydeuterus auritus* |
| Pelagic species 1 | Clupeiformes[1] | *Ilisha africana* |
| | | *Engraulis encrasicolus* |
| Pelagic species [2] | Carangidae[2] | *Selene dorsalis* |
| | | *Chloroscombrus chrysurus* |
| | | *Decapterus rhonchus* |
| | | *Seriola carpenteri* |
| | Scombridae | *Auxis thazard* |
| | | *Sarda sarda* |
| | | *Scomber japonicus* |
| | Sphyraenidae | Sphyraena guachancho |
| | Others | *Trichiurus lepturus* |
| | | *Lepidopus caudatus* |
| Other demersal species | Sparidae[3] | *Dentex angolensis* |
| | | *D. macrophthalmus* |
| | | *D. congoensis* |
| | | *D. canariensis* |
| | | *D. barnardi* |
| | | *Pagellus bellottii* |
| | | *Sparus caeruleostictus* |
| | | *S. pagrus africanus* |
| | Other taxii | *Saurida brasiliensis* |
| | | *Arioma bondi* |
| | | *Pomadasys incisus* |
| | | *Galeoides decadactylus* |
| Mesopelagic species | Myctophidae[3] | *Diaphus dumerili* |
| | Other mesopelagic fish | *Trachinocephalus myops* |
| Plankton | Calanoidae | *Calanus* sp. |
| | Euphausiidae | *Meganyctiphanes sp.* |
| | Other plankton | |

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

2.5 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:

$$TS = 20 \log L - 72 \text{ (dB)} \quad (2)$$

or,

$$C_F = \frac{10^{7.2}}{4\pi} \cdot L^{-2} \quad (3)$$

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 regressing the log-length (total) against total weight. Separate length-weight relationships were worked for each region, pooling all data within each region.

The boundaries of encountered fish aggregations (post strata) were determined by means of contouring within the inner and outer zero-value limits of the transect lines. The strata contours were digitised using a CalBoard III digitising board / Atlas Draw v. 2.03 PC based software. Distribution plots and aerial calculations on the strata were carried out using IDL 5.6 for MS Windows. Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories: 1: $s_A$ = 0-300; 2: $s_A$ = 300-1 000; 3: $s_A$ = 1 000-3 000; 4: $s_A$ > 3 000.

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

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

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

where:

| | | |
|---|---|---|
| $\rho_i$ | = | 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 $L_i$. |

# 3 Oceanographic conditions

## 3.1 Wind conditions

Calm wind conditions were observed in the survey region with stronger wind in the region around Port Gentil. The wind direction was predominantly from South East with winds from the south in the northernmost part of the survey area (Figure 2). The top wind velocities rarely exceeded 8 knots (4.1 m/s) for most of the survey, except around Port Gentil where wind around 14-15 knots was experienced. The sea was calm and conditions good for acoustic surveying throughout the survey period.

## 3.2 Surface temperature distribution

The sea surface temperature (5m depth) is shown in Figure 3. In general the temperature was somewhat cooler than experienced during previous surveys this time of the year in the region. The large-scale distribution was dominated by a steady decrease in temperature along the northern part of the coast of Gabon from 25 to 22°C, with isolines perpendicular to the coast. The southern part of Gabon showed very turbulent waters with several pockets with changing water temperature and pools of colder water confined to the inshore areas. The southern part of the survey area, Congo, the Cabinda region of Angola and the Congo River region was highly influenced by surface waters from the Congo River delta. The temperature isolines were alongshore with the coolest temperatures close to the coast of Cabinda.

The sea surface salinity (5 m depth) from the thermosalinograph is shown in figure 4. The salinity was relatively stable (on a large scale) in the northern part of the survey area, with slightly lower salinity on the shelf north of Port Gentil. In the southern part of the survey area a rapid drop in sea surface salinity is observed, depicting the river plume of the Congo River. The river flow is clearly turning north in offshore waters, creating a front between the saline oceanic water masses and the river water masses. A similar situation can be seen inshore with more saline water masses close to the coast between point Noire and Cabinda.

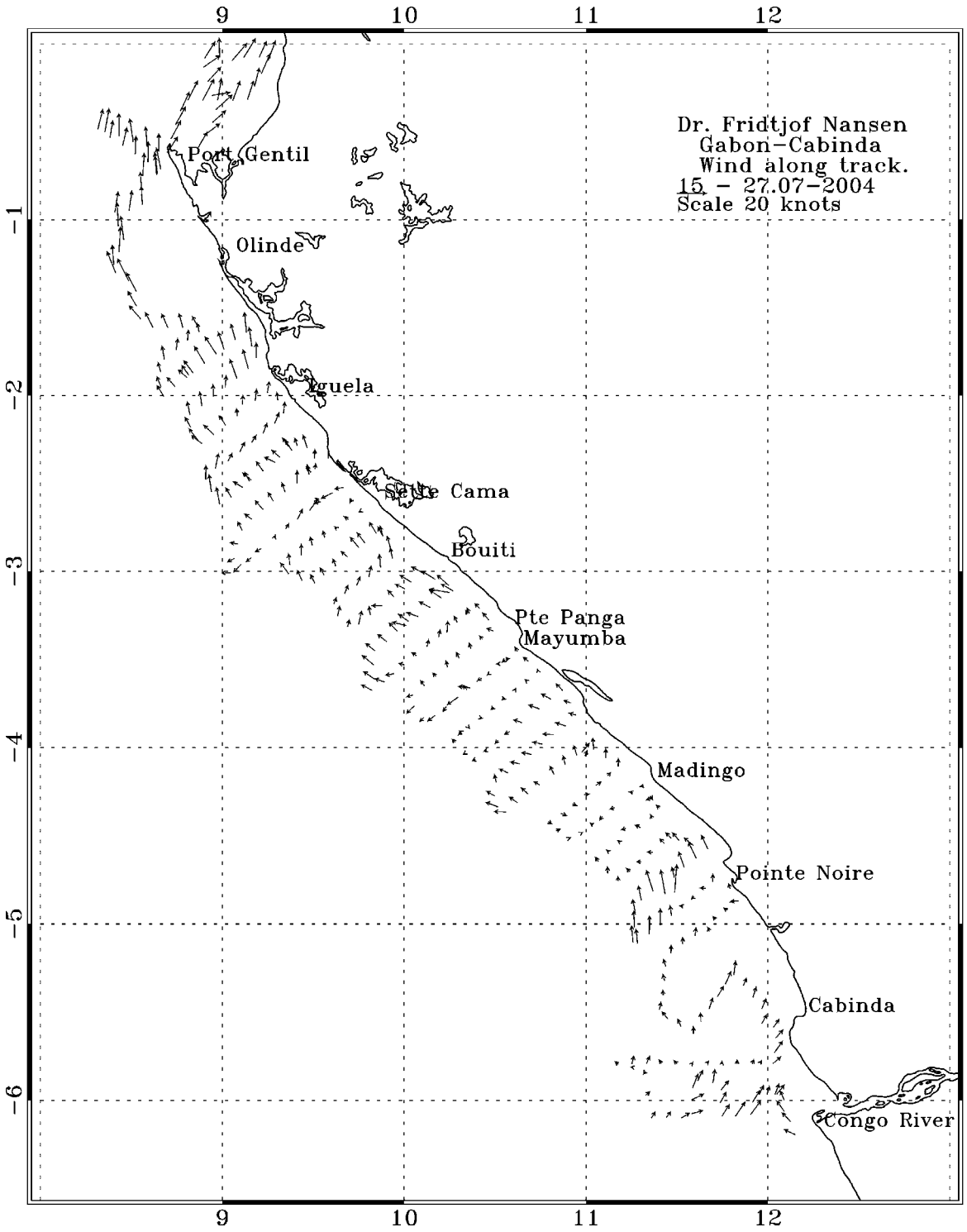



Figure 2. Distribution of wind velocities along the survey track

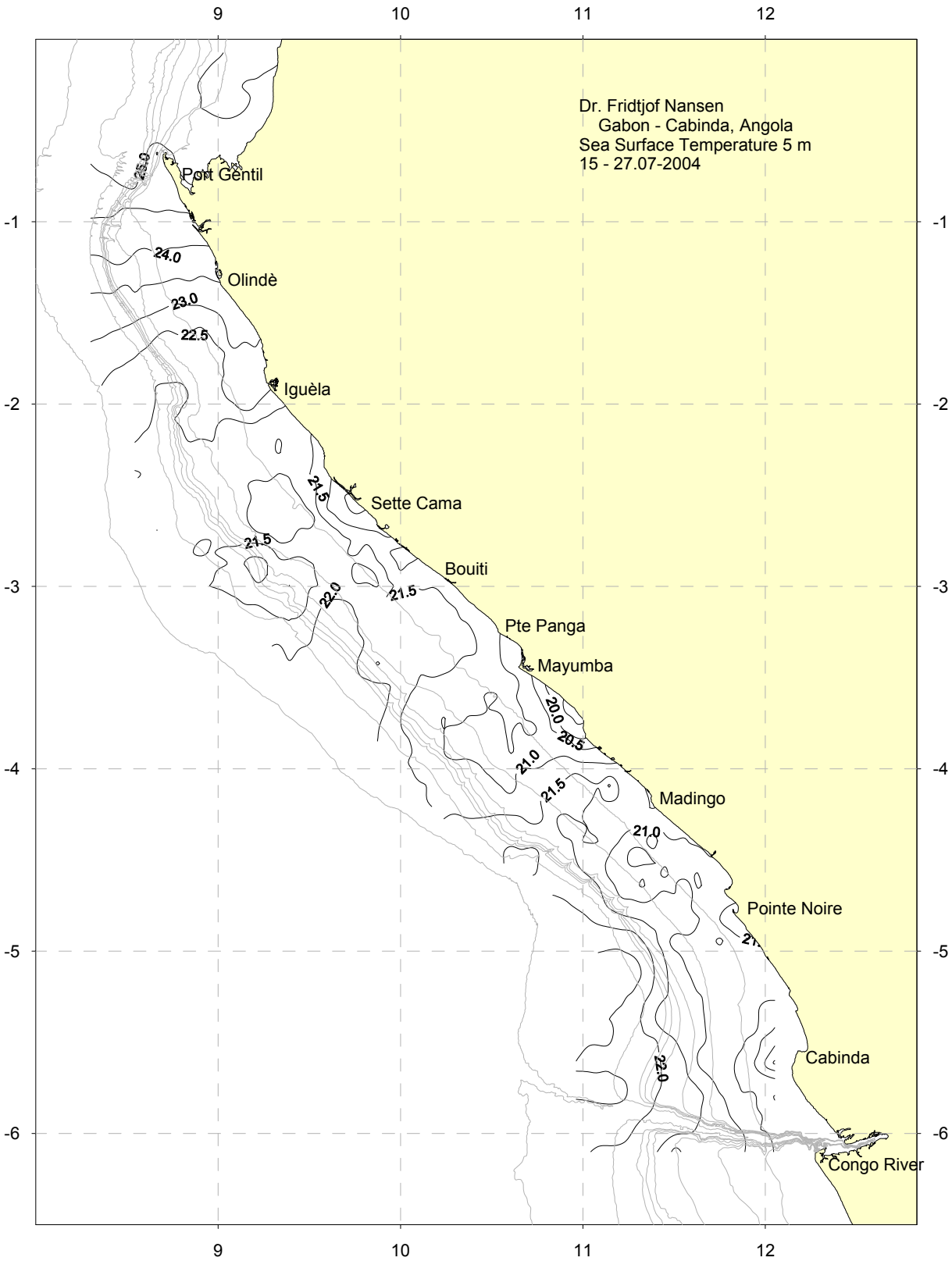



Figure 3. Distribution of sea surface temperatures at 5 m depth

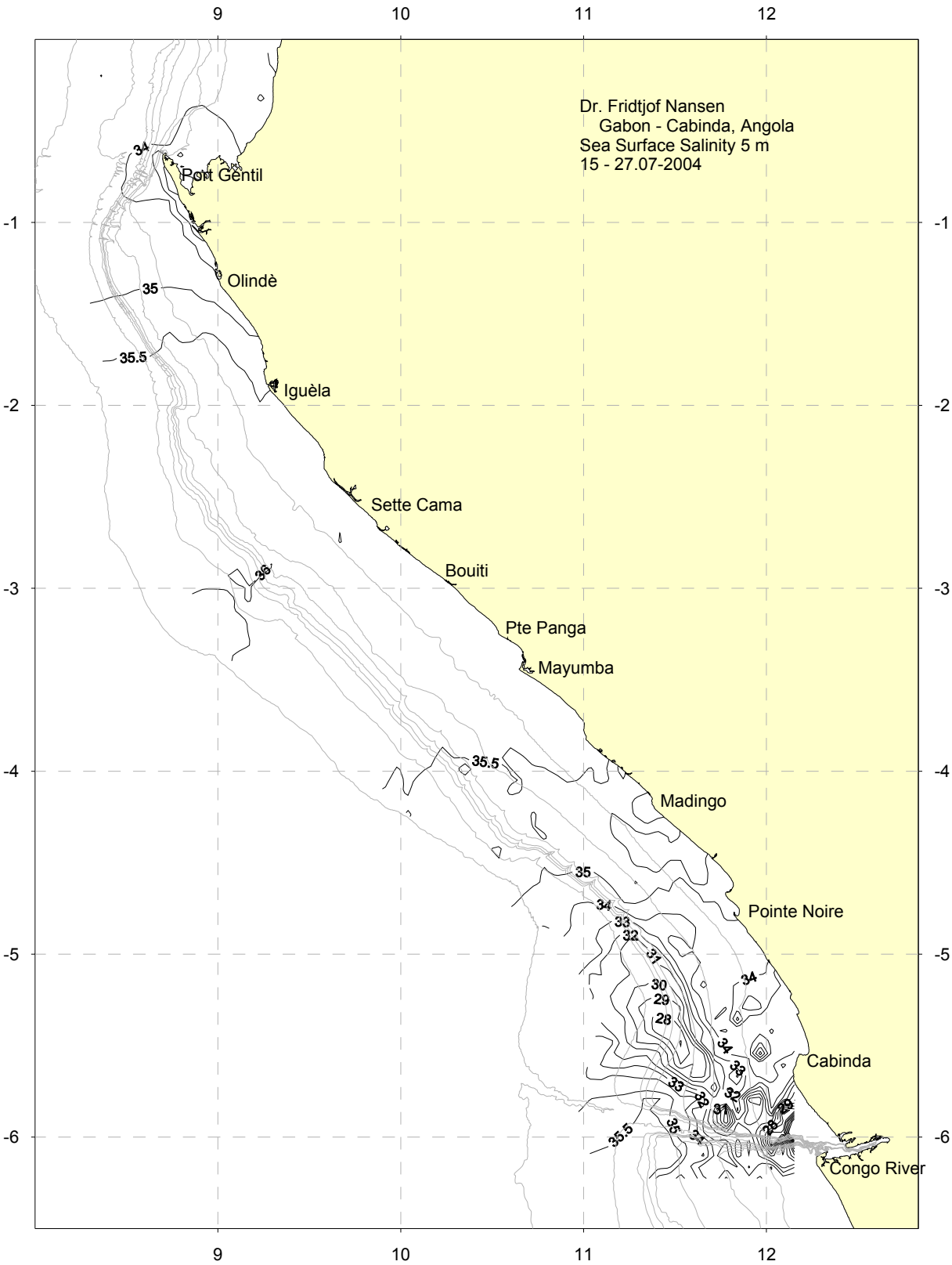



Figure 4. Distribution of sea surface salinity at 5 m depth

### 3.3 Hydrographical Sections

The hydrographical sections of temperature, salinity and oxygen are demonstrated in Figures 5a-g. In order to better reveal the hydrographic patterns observed each section is presented using the same horizontal size. The reader is referred to the map of the survey track, Figure 1, to orientate on the proportions between the extents of the presented sections. The positions noted at each section refer to the CTD station at 20 m depth.

Section off **Cape Lopez**, 00°37'2''S

A very steep shelf characterizes the section. During the austral summer two major costal currents meet in this region. The South Equatorial current brings low salinity costal waters southwards and offshore while the Congo current brings low salinity waters from the Congo estuary northwards. Both these currents are less strong during the winter months. The surface waters were coldest inshore on this section with temperatures around 24.7°C at 5 m depth at the 20 m station, increasing to 25.2°C at the outermost station at 1500 m bottom depth. A thermocline is visible at 30 m depth, with temperatures decreasing to 16°C offshore and 18°C inshore, before the temperature decreased evenly to a minimum of 7.7°C at 500 m depth. The lowest salinities inshore were recorded inshore on the stations at 20 and 50 m depth, with 32.8 psu at 5 m depth. The salinity increased offshore to 34.1 psu. A salinocline with salinity maximum corresponded with the thermocline at 30 m, before the salinity decreased to 34.7 at 500 m. The oxygen also showed a similar situation, with an $O_2$ Maximum at 30 m. The surface layers were well oxygenated, and the $O_2$ decreasing to a minimum of 1.1 ml $O_2$/l at 350 m before a subsequent small increase in deeper waters.

Section off **Iguèla**, 01°37'7''S

The shelf off Cape Lopez is generally relatively wide with a pronounced shelf break at around 120 m depth. The surface water temperature was slightly warmer inshore than offshore, (23.25°C- 22.01°C). The thermocline at around 20 m depth was less pronounced than on the previous section, with a temperature drop to approximately 17 °C before the temperature dropped steadily to 7.25°C at 500 m depth. The salinity profile showed slightly less saline waters inshore, with 35.07 psu, than offshore, 35.77 psu. Salinity maximum was visible at 20 m depth corresponding with the thermocline. A minimum was found at 500 m depth with salinity of 34.67 psu. The water column was well oxygenated with highest $O_2$ measured at the surface offshore, 5.2 ml/l $O_2$, and a minimum at 350 m before a small increase in deeper waters.

Section off **Sette Cama**, 02°30'6''S

The section of Sette Cama showed no pronounced thermocline in the offshore stations, and was markedly cooler than the previous section with surface temperature of 20.78°C. The inshore stations, particularly the 50 m station showed warmer surface waters, with temperature of 22.17°C at 5 m depth. The salinity also showed higher salinity offshore (36.03) than on the previous section and a drop in salinity especially on the 500 m station. The oxygen profile was similar to the previous section.

Section off **Pte. Panga**, 03°11'9''S

The section of Pte. Panga showed no pronounced thermocline, the surface temperature was warmer than on the previous section with surface temperatures of 22.49°C at the deepest station and 20.97 at the 20 m station. The salinity showed a gradual decrease in salinity from 15 meter depth and slightly lower salinity above this. The bottom shelf waters showed generally lower oxygen than on all the previous stations with $O_2$ values <2.5 ml/l. Surface waters were well oxygenated.

Section off **Madingo**, 03°59.6''S

The surface waters were slightly warmer than on the previous section and with a thin surface layer, ~8 m, of slightly lower surface salinity than in the deeper layer. High dissolved oxygen concentrations were found in the surface waters along this section, while the bottom waters on the shelf showed <2.5 ml/l $O_2$ at the 50 m station and <2 ml/l at the 100 m station. The properties of the water in the surface layer suggest that it was influenced by the water discharge from the Congo River.

Sections at **Pointe Noire**, 04°43.2''S

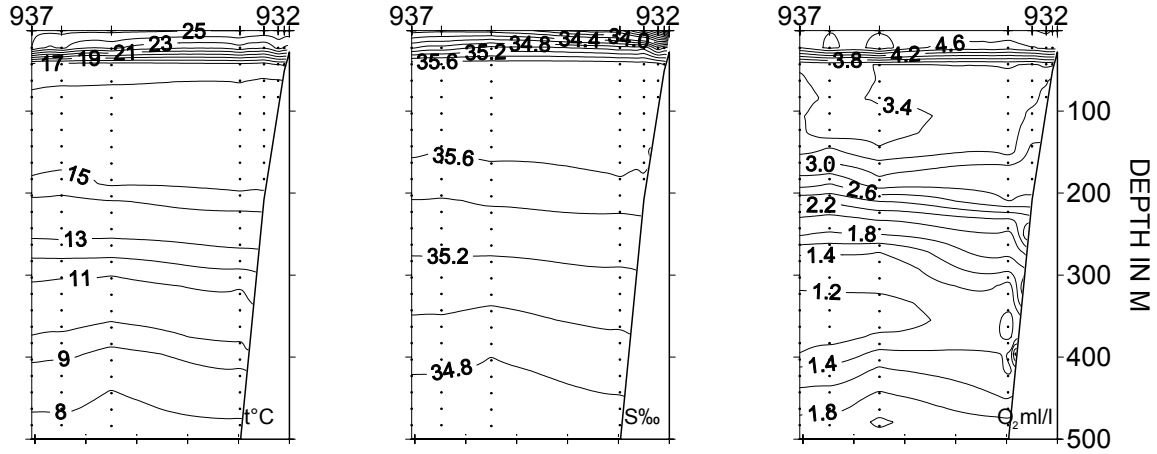
The presence of the Congo River discharge became more obvious on this section with a clear salinocline at <10 m depth, especially prominent in the offshore waters. Temperatures declined steadily from the surface. The surface layers were reasonably well oxygenated while the bottom shelf waters showed <2ml/l oxygen at 100 m depth, and >1 ml/l at the 20 m station.

Section off **Cabinda**, 05°47.5''S

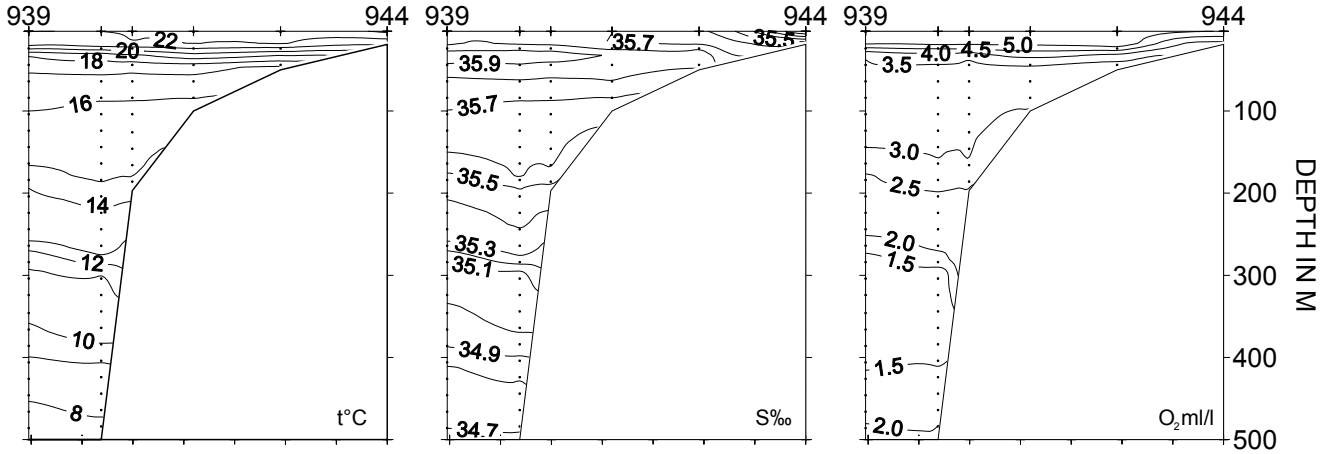
The section was located just north of the mouth of Congo River, along the northern edge of the steep underwater canyon. During the winter season, discharge of fresh water to the sea

by the river is expected to be at its lowest. The surface salinity was relatively high, 35.20 psu, on the inshore station at 25 m depth. However on the stations at 50 m and 100 m bottom depth, a much more pronounced salinocline was visible in the upper 5-10 m, with salinity between 30 and 25 psu. Temperatures were similar to the previous section with highest temperatures in the offshore waters. The surface waters were well oxygenated, but bottom oxygen was relatively low, between 1.5 and 2 ml/l from the coast to 100 m bottom depth, and below 1.5 ml/l in deeper waters.

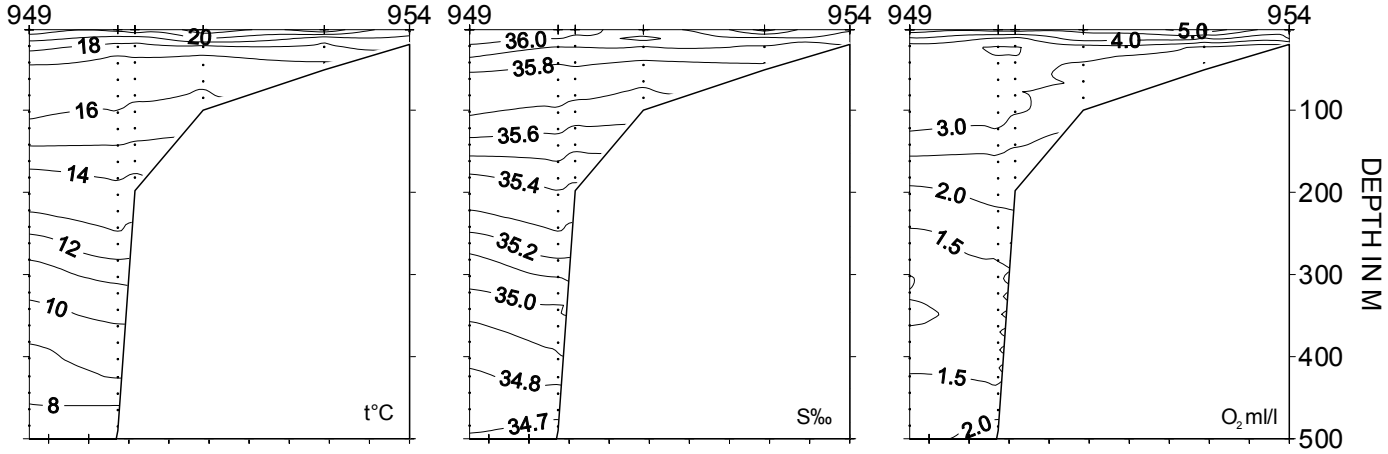
a) Cape Lopez



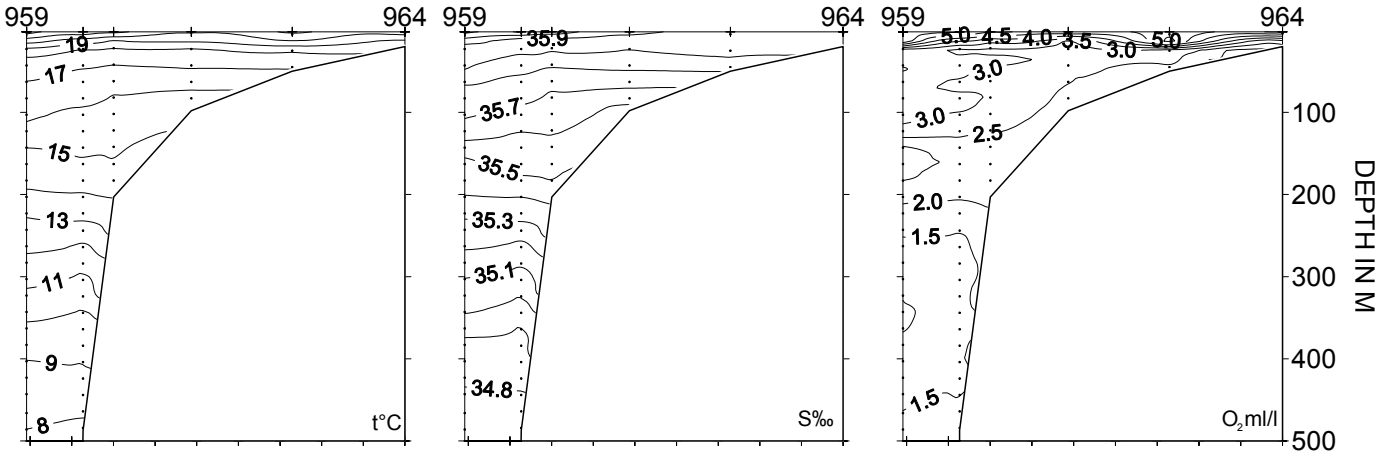

b) Iguèla



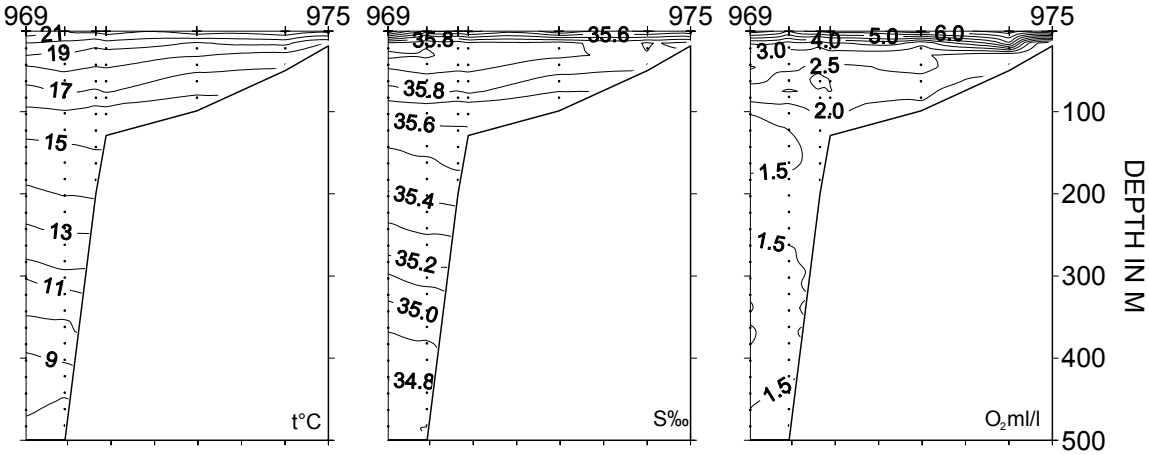
c) Sette Cama



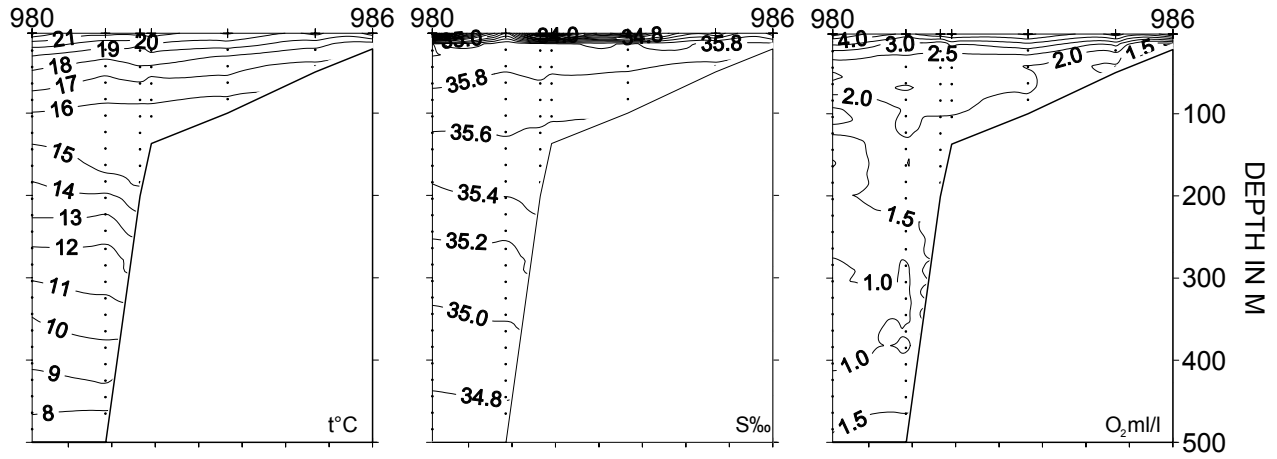

d) Pte. Panga




e) Madingo



f) Pointe Noire




g) Cabinda

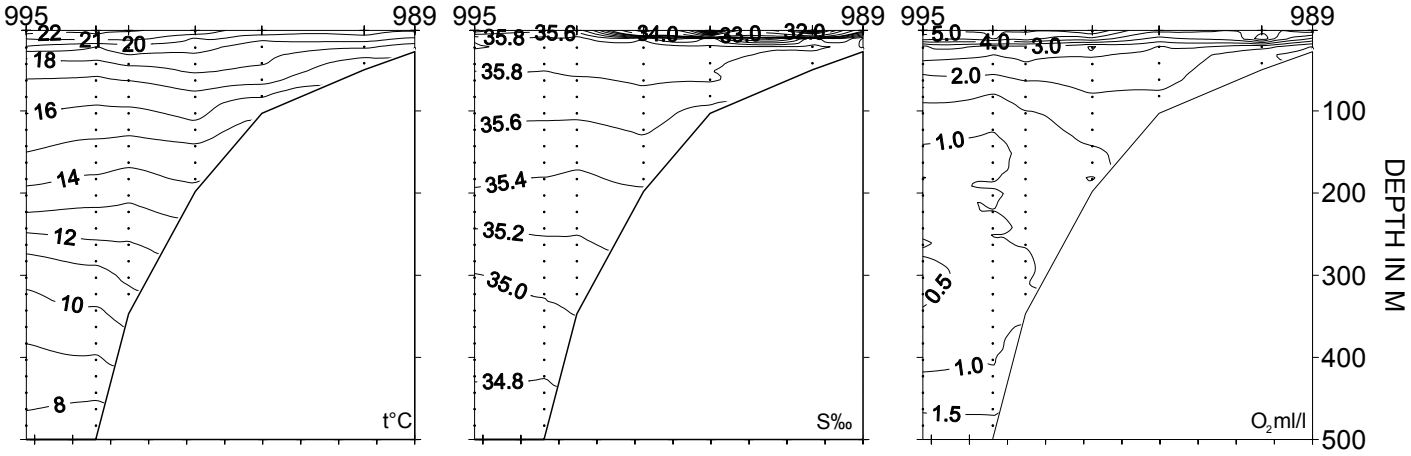



Figure 5. Vertical sections of temperature salinity and oxygen in the survey area, a) off Cape Lopez, b) off Iguèla, c) off Sette Cama, d) off Pte. Panga, e) off Madingo, f) off Pointe Noire, and g) off Cabinda

# 4 Distribution, Size composition and biomass estimates

## 4.1 Gabon – Angola

The biomass estimates described in this section are compared with previous biomass estimates from the surveys of Gabon-Congo conducted between 1985 and 1995, the first four survey conducted by IMR was conducted in 1985 (IMR 1986) and looked particularly at seasonal changes in fish distribution and abundance. These surveys showed among other things that the biomass of sardinella is highest in this region during the winter season. The reader should keep in mind that the geographical area covered during those surveys is not identical to the one surveyed during this survey, were the Cabinda area in Angola has been included. However looking at the distribution maps, no substantial amounts of fish have been found south of the border between Congo and Angola, the Cabinda region, this year. This discrepancy is therefore of less importance.

Several regions inside the survey area were restricted because of oil exploration activities. As a consequence the area around Olinde in Gabon was not surveyed while the Cabinda area in Angola was only partly surveyed. Some pelagic fish, and in particular sardinella might have been missed inshore in these areas. Sardinella was found on both sides of the restricted area in Olinde, while only very low concentrations were found in the vicinity of Cabinda. The closed areas have been omitted from the abundance calculations.

### Sardinella

The sardinella, *Sardinella maderensis* and *S. aurita,* were distributed along the coast in mixed schools in most of the survey area. These schools were occasionally extending into deeper waters. The northern part of the survey area was slightly more dominated by *S. aurita* while sardinella in the Congo River area was more dominated by *S. maderensis*. The fish was generally more dispersed and found in more scattered schools than what is typical for sardinella (Figure 6). This may be due to the turbulent water masses experienced in the region, or possibly the generally colder than usual water temperature. Typically, the sardinella was schooling near the surface during daytime, and formed loose aggregations at night. Sardinella is hard to sample during dense schooling and most samples are therefore obtained at night.

Figure 7 shows the length frequency distribution of S. *maderensis* and S. *aurita*. Relatively large juvenile cohorts are visible for both species. The S. *maderensis* ranged from 6 cm to 34 cm total length, Several modal peaks was visible in the distribution, one juvenile cohort can

be seen with a peak at 7 cm, and another peak at 12 cm mainly representing 1+ year old fish. Another modal peak at 27 cm represents several adult year classes. The length distribution of S. *aurita* shows a juvenile cohort at 8 cm, and another modal peak at 12 cm. Two cohorts of adult fish are represented with a modal peak at 24 cm and 29 cm. The high prevalence of fish < 10 cm of both species in the region suggest that these have been spawned in this area earlier this year.

The biomass of sardinella was estimated at 360 thousand tonnes. Of this, about 195 thousand tonnes was S. *maderensis* while 165 thousand tonnes was S. *aurita* (Table 8). This is a substantial increase since the previous surveys in Congo and Gabon in august 1994 and 1995. During those surveys the biomass was estimated to be 154 thousand tonnes and 172 thousand tonnes respectively. In 1994, 66% of this biomass was found to be *S. aurita* and 34% was *S. maderensis*, while this proportion was different in 1995 with 31% *S. aurita* and 69% *S. maderensis*.

The splitting between species is, however, very sensitive to sampling intensity in the overlapping zone, while the total estimate should be more robust. Figure 8 shows the cumulative distribution of the biomass for both species. The bulk of the biomass (85 %) of S. *maderensis*, consisted of individuals > 20 cm while only 54% of the biomass of S. *aurita* was > 20 cm.

The four surveys conducted in 1985 showed that the abundance increased substantially during the cold season, indicating a northward migration from Angola (IMR 1986). It should be noted that 2004 was a particularly cold year and the Angolan survey of the pelagic resources that followed this survey showed that the biomass of sardinella in Angola was shifted somewhat north from their usual position.

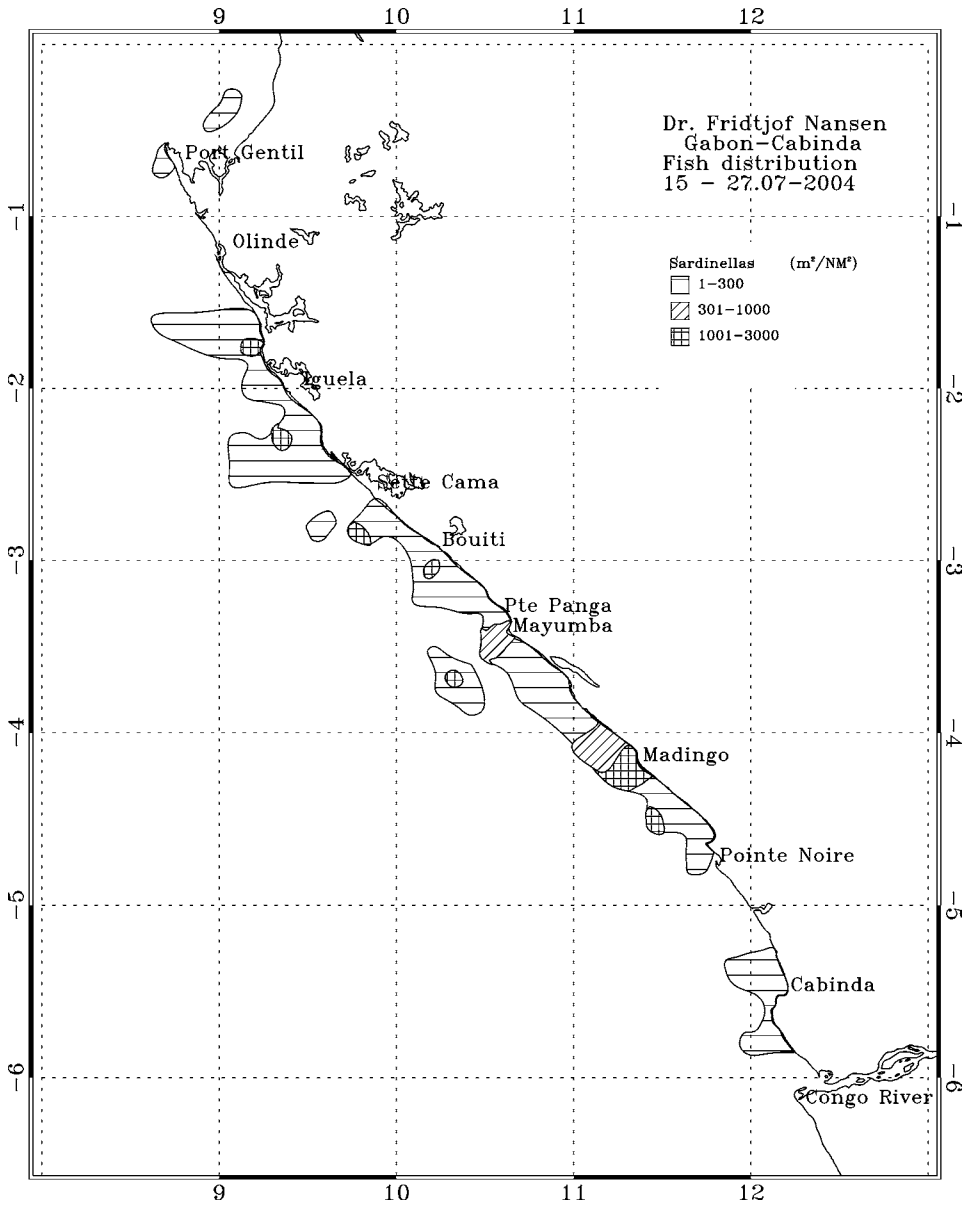



Figure 6. Distribution of *Sardinella aurita* and *S. maderensis*, Gabon to Cabinda, Angola

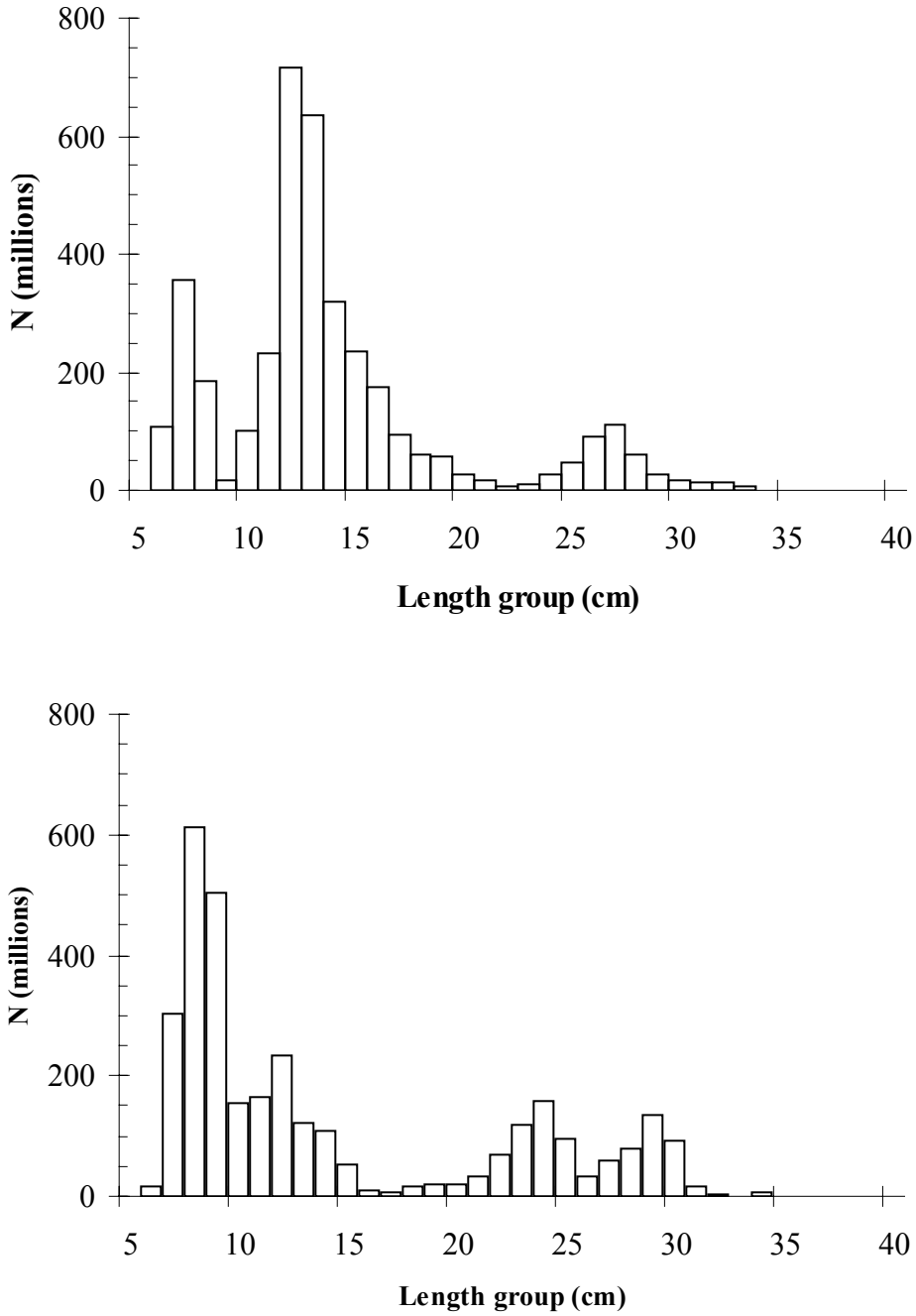



Figure 7. Total length distribution of *Sardinella maderensis* (a) and *S. aurita* (b)

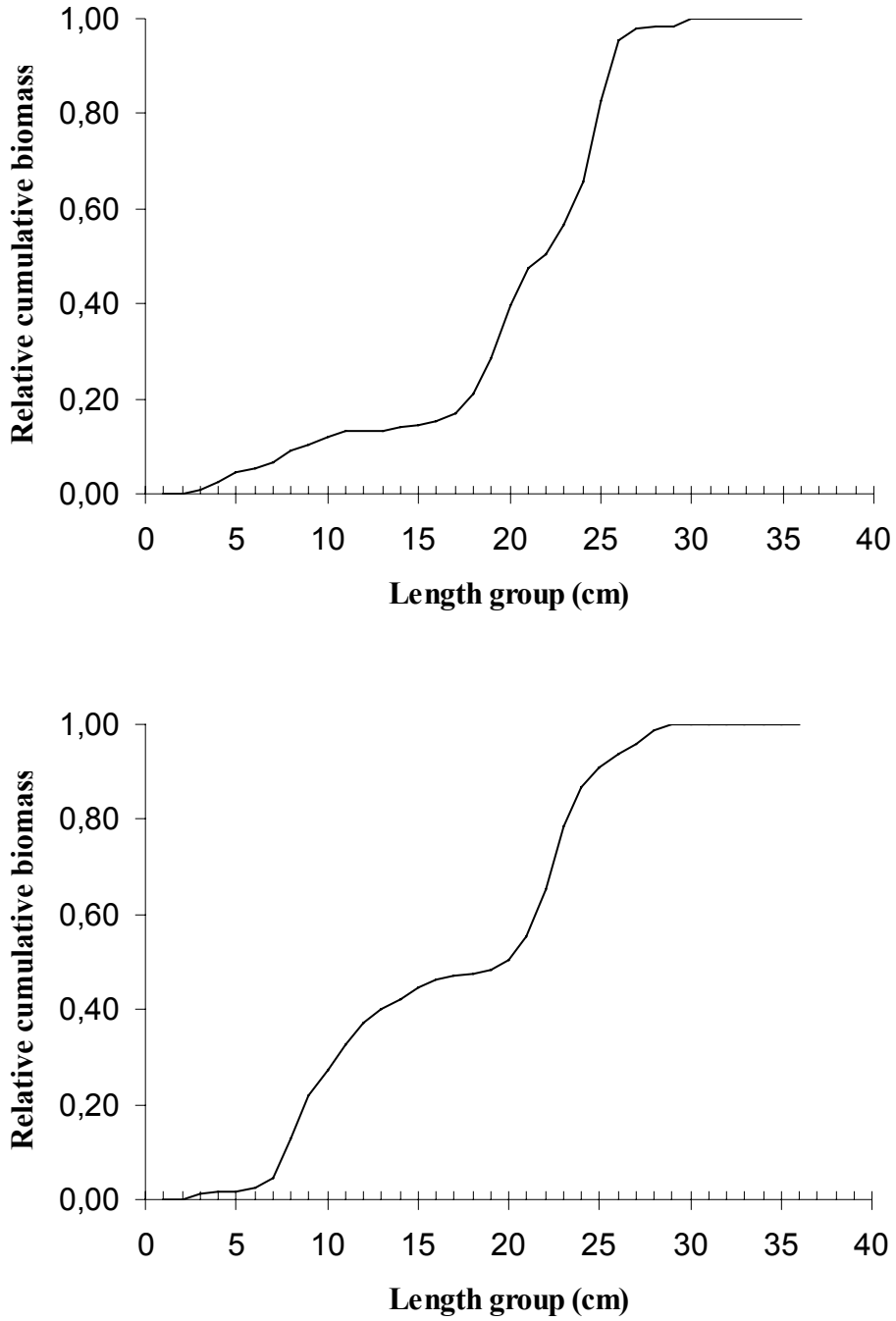



Figure 8. Relative cumulative biomass *Sardinella maderensis* (a) and S. *aurita* (b), Gabon to Cabinda, Angola

Biological data of sardinella species

A summary indicating the number of biological samples collected during the survey can be found in table 4. Special attention was paid to the sex and maturity stages of *Sardinella aurita* and *S. maderensis* and these parameters were only recorded for these species.

There was an overrepresentation of males in the catches of sardinella. Males was also slightly over represented in catches during hydro acoustic surveys in Angola between 2002 and 2004, however this may be a sampling artefact and should be interpreted with caution.

The condition factor for *S. aurita* and *S. maderensis* collected during the survey was 0.86 and 0.89 respectively. For comparison the condition factor for sardinellas collected during the survey off Angola that followed this was substantially higher, 0.94 for *S. aurita*, and 0.91 for *S. maderensis* respectively, Indicating that the fish collected off Angola was more well fed than those found during the present survey. Further analyses of the condition factor will be conducted as part of the project on sardinella LMR/CF/03/11 which this survey is a part of.

The maturity stages of sardinella are illustrated in Figure 9. Sardinella in all maturity stages were found during the survey. The majority of the adult fish found during the survey was maturing, 41% female, and 45% male *S. maderensis*, and 57% female and 65% male *S. aurita* respectively. All together 30% of female *S. maderensis* were either ready to spawn (stage 4) or had already spawned (stage 5), while 20 % of the males were in the same two categories. Fifteen percent of *S. aurita* were found to be mature (stage 4) while the percentage of males in the same group were only 1 percent. However males were over represented in stage five, as 24% of the males had spent gonads while only six percent of the females were in the same group.

Further analyses after the survey should divide the samples into regions and relate maturity stages of sardinella to regions were egg and larvae were found in zooplankton hauls during the survey.

Table 4. Summary of biological samples from the main species during the survey

| Species | # Samples | Cond. Factor | St. Dev | Min Length | Max Length | Female %[1] | Male %[1] |
|---|---|---|---|---|---|---|---|
| *Sardinella aurita* | 809 | 0.86 | 0.10 | 5.5 | 33.2 | 34.0 | 66.0 |
| *S. maderensis* | 711 | 0.89 | 0.07 | 6.5 | 33.5 | 44.8 | 55.2 |
| *Trachurus trecae* | 481 | 0.99 | 0.06 | 9.5 | 29.5 | | |
| *Decapterus rhonchus* | 60 | - | - | 7.6 | 20.5 | | |
| *Engraulis encrasicolus* | 60 | 0.75 | 0.05 | 10.0 | 12.3 | | |
| *Scomber japonicus* | 129 | 0.80 | 0.08 | 7.1 | 26.2 | | |

[1] Excluding juvenile fish, maturity stage 1 because of the difficulty of determine the sex of immature sardinella.

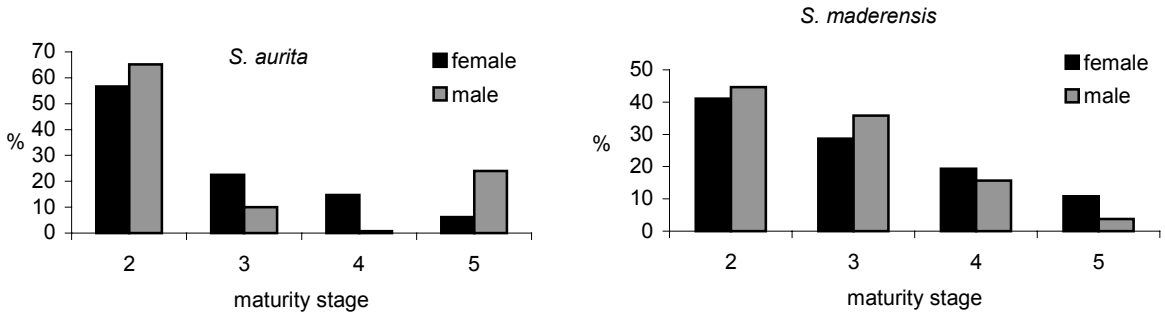



Figure 9. Maturity stage of male and females of *S. aurita* and *S. maderensis* as determined during the survey.

Length weight relationships for sardinella and other target species can be found in Annex II. These data are not directly used during the survey as a set length – weight relationship with a slope and intercept of 0.96 and 3.00 is used for sardinella to convert number of fish to biomass in tonnes.

Cunene horse mackerel

The Cunene horse mackerel, *T. trecae,* was found in the southern region of Gabon in scattered in three relatively small, low density ($s_A$< 300) areas (Figure 10) from the coast to the shelf break. The region where the horse mackerel was found was the same as during the surveys in 1994 and 1995.

Figure 11 shows the length frequency distribution of horse mackerel for the region. The major part of the fish found was one year old, with a modal peak around 12 cm. The total estimated biomass of *T. trecae* was 11 thousand tonnes, Table 6. This is around the same level as the biomass estimates in 1994 and 1995, 11 thousand tonnes and 19 thousand tonnes respectively. 100% of the biomass was below 20 cm, Figure 12.

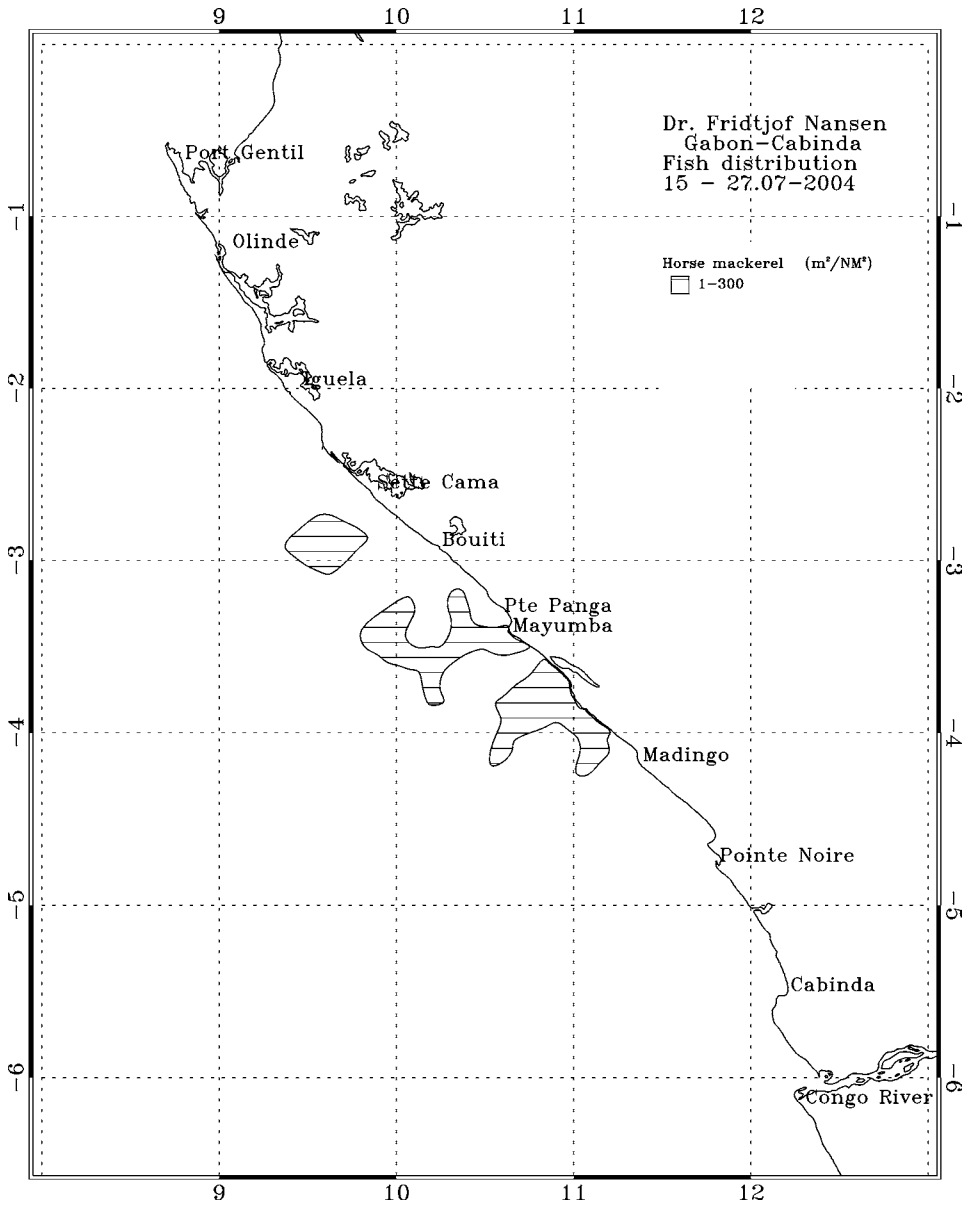



Figure 10. Distribution of Cunene horse mackerel (*Trachurus trecae*), Gabon to Cabinda, Angola

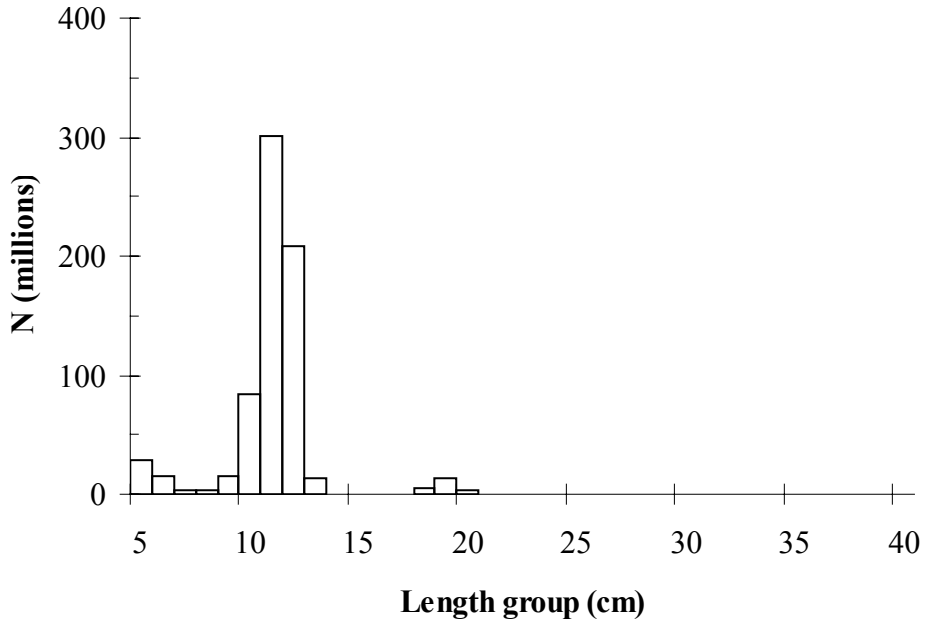



Figure 11. Total length distribution of Cunene horse mackerel (*Trachurus trecae*), Gabon to Cabinda, Angola

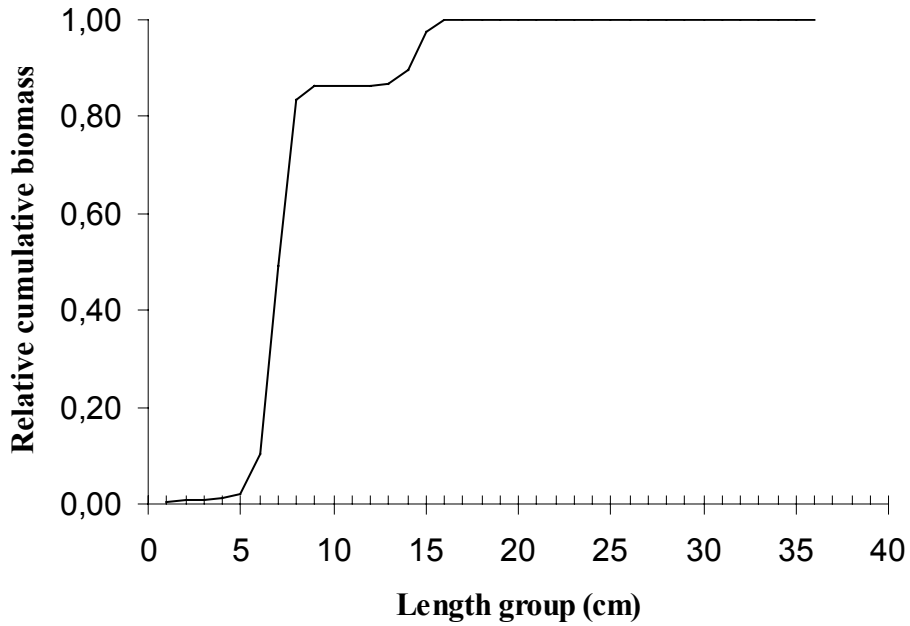



Figure 12. Cumulative percentage biomass by length group, *Trachurus trecae*, Gabon to Cabinda, Angola

Other pelagic species

Pelagic species Group 1

Catches of pelagic species group 1 was low. A few Ilisha africana were encountered in the area around Port Gentil and in the Congo River area, but were not abundant enough for abundance calculations.

Pelagic species Group 2

This category, which includes members of the family Carangidae (other than *Trachurus* sp.), Scombridae, Sphyraenidae and *Trichiurus lepturus*, was found in 6 regions along the whole shelf in low concentrations (Figure 13). The hairtail (*T. lepturus*), *Decapterus rhonchus* and *Selene dorsalis* were the dominant species groups (Table 5).

The biomass estimate, 69 thousand tonnes (Table 6) of this category of fish was based on an average length of 23 cm and a condition factor equal to 0.88. No comparisons with previous estimates were available.

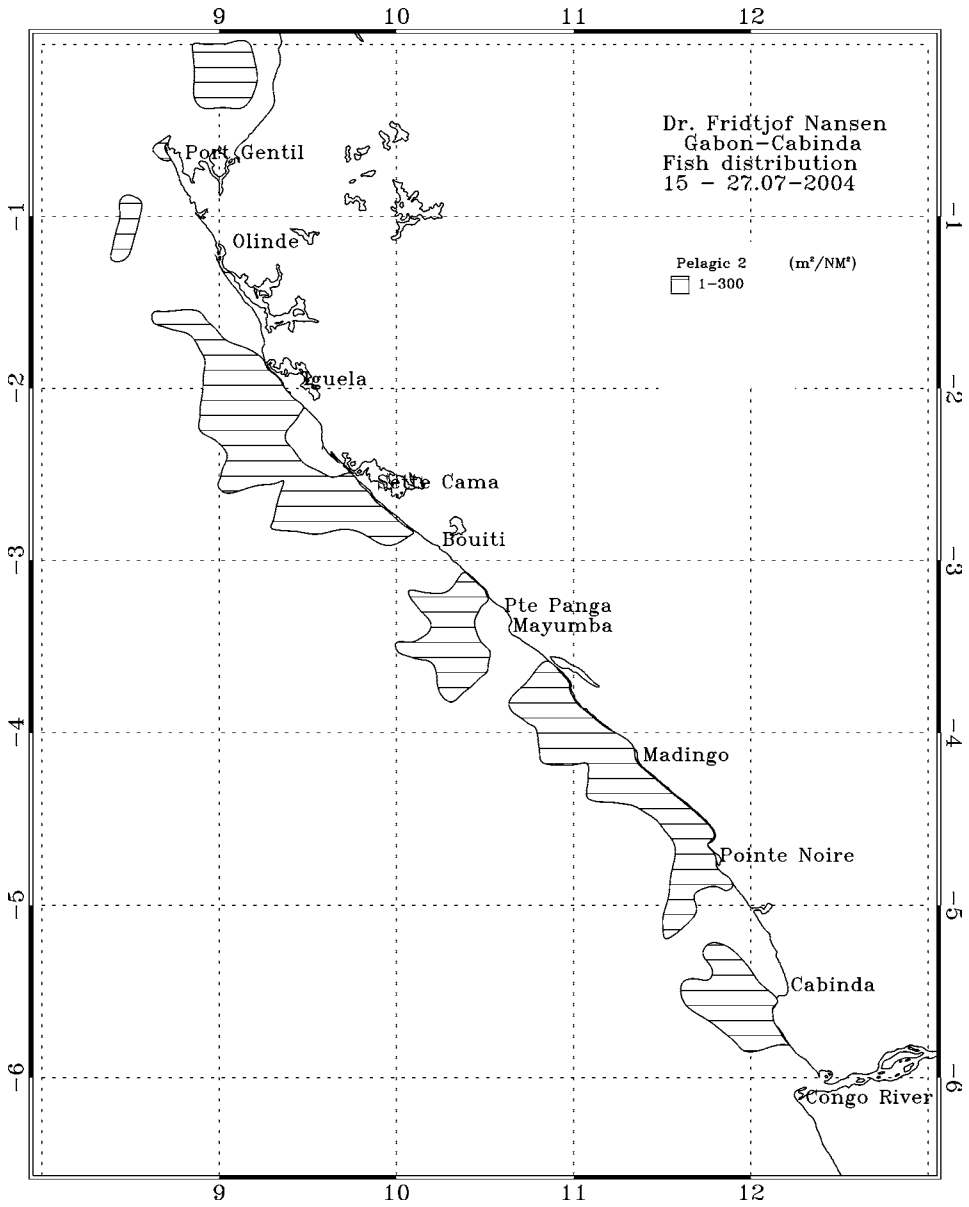



Figure 13. Distribution of other pelagic species 2, Gabon to Cabinda, Angola

Table 5. Catch rates (kg/h) of the main groups of pelagic fish, Gabon to Cabinda, Angola divided by region, a) Gabon, b) Congo and c) Cabinda, Angola and Democratic republic of Congo (DRC)

a) Gabon

| ST.NO. | DEP. | Trawl | Clupeids | Carangids | Scombrids | Hairtails | Barracudas | Other | Sum |
|---|---|---|---|---|---|---|---|---|---|
| 182 | 0 | PT | 5.7 | 76.5 | 2.6 | 0.0 | 0.0 | 90.0 | 174.8 |
| 183 | 10 | PT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.7 | 12.7 |
| 184 | 0 | PT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.3 | 7.3 |
| 185 | 0 | PT | 0.0 | 3.3 | 20.4 | 0.0 | 0.0 | 812.8 | 836.4 |
| 186 | 0 | PT | 284.8 | 67.7 | 46.3 | 0.0 | 0.0 | 10.4 | 409.2 |
| 187 | 124 | BT | 0.0 | 12.3 | 3.6 | 0.0 | 0.0 | 5 014.6 | 5 030.5 |
| 188 | 10 | PT | 67.5 | 0.5 | 30.4 | 0.0 | 3.4 | 0.2 | 102.1 |
| 189 | 0 | PT | 1.4 | 14.3 | 0.6 | 10.4 | 0.0 | 5.1 | 31.8 |
| 190 | 0 | PT | 2.2 | 1.7 | 0.0 | 0.0 | 2.4 | 15.2 | 21.4 |
| 191 | 0 | PT | 0.0 | 0.0 | 7.5 | 2.5 | 0.0 | 64.3 | 74.4 |
| 192 | 87 | BT | 649.1 | 112.1 | 3 481.3 | 0.0 | 0.0 | 6 252.4 | 10 495.0 |
| 193 | 10 | PT | 80.4 | 0.0 | 1.7 | 0.0 | 0.0 | 0.3 | 82.5 |
| 194 | 0 | PT | 0.0 | 0.0 | 8.5 | 0.0 | 0.0 | 0.1 | 8.6 |
| 195 | 10 | PT | 166.1 | 0.0 | 1.7 | 0.0 | 0.0 | 0.1 | 167.9 |
| 196 | 0 | PT | 0.0 | 0.7 | 0.6 | 0.0 | 0.0 | 148.4 | 149.7 |
| 197 | 10 | PT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18.4 | 18.4 |
| 198 | 0 | PT | 0.4 | 11.6 | 2.6 | 0.0 | 0.0 | 13.7 | 28.3 |
| 199 | 80 | BT | 10.9 | 66.7 | 11.4 | 0.0 | 0.0 | 230.4 | 319.4 |
| 200 | 75 | BT | 38.3 | 128.5 | 9.5 | 0.0 | 0.0 | 568.5 | 744.8 |
| 201 | 0 | PT | 11.4 | 14.7 | 0.0 | 0.0 | 24.8 | 218.6 | 269.5 |
| 202 | 25 | PT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 67.1 | 67.1 |
| 203 | 0 | PT | 0.0 | 13.6 | 0.1 | 5.7 | 0.0 | 121.7 | 141.1 |
| 204 | 25 | BT | 21.7 | 1.5 | 0.0 | 40.8 | 120.0 | 852.4 | 1 036.4 |
| 205 | 82 | BT | 0.0 | 42.6 | 0.1 | 0.0 | 4.3 | 202.3 | 249.2 |
| 206 | 5 | PT | 233.8 | 37.6 | 0.2 | 5.1 | 35.4 | 728.1 | 1 040.0 |
| 207 | 10 | PT | 0.0 | 0.0 | 0.0 | 0.0 | 8.7 | 393.2 | 401.8 |
| 208 | 0 | PT | 340.8 | 81.1 | 41.2 | 12.1 | 0.0 | 44.3 | 519.4 |
| 209 | 10 | PT | 0.0 | 0.0 | 4.3 | 0.0 | 0.0 | 1.6 | 5.9 |
| 210 | 20 | PT | 95.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 95.4 |
| 211 | 37 | BT | 773.8 | 1 280.2 | 13.5 | 0.0 | 0.0 | 7 580.2 | 9 647.7 |
| 212 | 35 | PT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 174.6 | 174.6 |
| 213 | 0 | PT | 0.0 | 1.2 | 0.0 | 257.0 | 0.0 | 6.6 | 264.9 |
| 214 | 0 | PT | 56.2 | 4.3 | 2.3 | 0.9 | 0.0 | 16.2 | 80.0 |
| MEAN | 20.2 | | 97.9 | 68.0 | 127.3 | 11.5 | 6.9 | 808.9 | 1 120.5 |
| % | | | 8.7 | 6.1 | 11.4 | 1.0 | 0.6 | 72.2 | 100.0 |

b) Congo

| ST.NO. | DEP. | | Clupeids | Carangids | Scombrids | Hairtails | Barracudas | Other | Total |
|---|---|---|---|---|---|---|---|---|---|
| 215 | 120 | PT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 96.4 | 96.43 |
| 216 | 41 | BT | 0.0 | 11.9 | 0.0 | 231.0 | 0.0 | 975.5 | 1 218.4 |
| 217 | 0 | PT | 827.4 | 15.7 | 0.0 | 17.6 | 32.9 | 181.7 | 1 075.3 |
| 218 | 0 | PT | 0.0 | 19.8 | 0.0 | 0.8 | 0.0 | 341.9 | 362.4 |
| 219 | 0 | PT | 1 451.4 | 0.0 | 21.0 | 0.0 | 60.8 | 0.0 | 1 533.2 |
| 220 | 10 | PT | 1 450.3 | 32.7 | 0.0 | 86.9 | 0.0 | 247.7 | 1 817.6 |
| 221 | 0 | PT | 0.0 | 4.8 | 0.0 | 9.5 | 0.0 | 145.7 | 160.0 |
| 222 | 0 | PT | 0.0 | 0.0 | 0.0 | 365.4 | 0.0 | 601.3 | 966.7 |
| MEAN | 7.3 | | 532.7 | 12.1 | 3.0 | 101.6 | 13.4 | 356.3 | 1 019.1 |
| % | | | 52.3 | 1.2 | 0.3 | 10.0 | 1.3 | 35.0 | 100.0 |

c) Cabinda, Angola and DRC

| ST.NO. | DEP. | | Clupeids | Carangids | Scombrids | Hairtails | Barracudas | Other | Total |
|---|---|---|---|---|---|---|---|---|---|
| 223 | 0 | PT | 0.2 | 0.3 | 0.0 | 16.1 | 0.0 | 23.7 | 40.2 |
| 224 | 10 | PT | 79.0 | 0.0 | 1.3 | 28.6 | 53.0 | 124.6 | 286.6 |
| 225 | 0 | PT | 179.7 | 5.1 | 0.0 | 49.2 | 0.0 | 17.7 | 251.7 |
| 226 | 0 | PT | 21.5 | 24.8 | 0.0 | 93.9 | 0.0 | 28.1 | 168.3 |
| MEAN | 4.3 | | 86.3 | 1.8 | 0.5 | 31.3 | 17.7 | 55.3 | 192.8 |
| % | | | 44.8 | 0.9 | 0.2 | 16.2 | 9.2 | 28.7 | 100.0 |

Table 6. Biomass estimates July 2004, Port Gentil – Congo River

| Species | Biomass (tonnes) |
|---|---|
| *Sardinella aurita* | 165 000 |
| *S. maderensis* | 195 000 |
| *Trachurus trecae* | 11 000 |
| Other pelagic fish (P2) | 69 000 |

## 5 Conclusions and management considerations

The present survey is the first Dr. Fridtjof Nansen survey in the region since 1996, and the first covering the region between Port Gentil and Congo River in one survey. However, several previous surveys have covered the shelf off Congo and Gabon. Four surveys covered the seasonal differences in demersal and pelagic fish stocks in Congo and Gabon in 1985 (see IMR 1986), and several surveys followed, the latest one covering Congo and Gabon in August 1996. The Cabinda region has previously been covered as part of the

Nansen program cooperation with Angola, and surveys has been conducted in this region frequently from 1985, however, no surveys covered the region after 1996 because of the high oil exploration activity. The main focus of this survey was to estimate the abundance and identify spawning areas of sardinella, and particularly *Sardinella aurita*. Surveys in Congo and Gabon previous to 1996 had reported juvenile sardinella of both species in the region, while surveys in Angola rarely reports juvenile sardinella.

Distribution and abundance of sardinellas

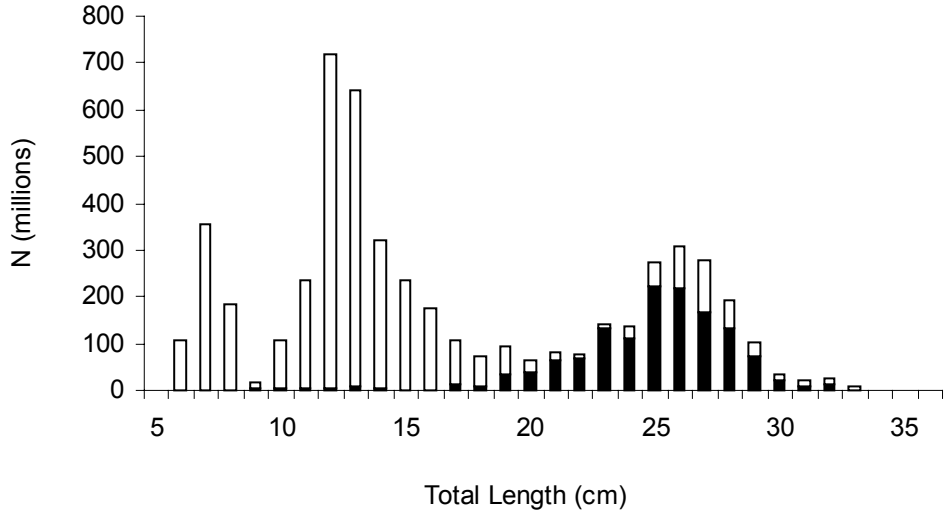
This survey found the highest abundance of *S. aurita* and *S. maderensis* ever reported in the Congo – Gabon region. The biomass was estimated to be 360 thousand tonnes, compared with 172 thousand tonnes in 1996. However, the sea surface temperature was unusual cold and it was observed during the survey of the pelagic resources in Angola, which followed immediately after this survey, that the distribution of sardinella and other pelagic species was shifted northwards because of this colder environmental situation. The abundance of sardinella in Angola, 362 thousand tonnes, was also lower than in 2003, and it may be that the increased abundance of sardinellas seen in the region between Congo and Cabinda is a consequence of a shift in distribution. The total biomass of Sardinella between Port Gentil in Gabon and Tiger Bay in Angola was estimated to be 722 thousand tonnes, of this 52% was estimated to be *S. aurita*, Table 7.

The combined length distribution obtained from the surveys in Gabon-Cabinda, and Angola, Figure 14, strongly suggests for both sardinella species that the sardinella found during the two surveys belong to the same stock migrating across the region. This further illustrates that the Congo River at least in parts of the year does not seem be a major barrier for pelagic fish species.

Figure 14 also illustrates that the juvenile cohorts, of both *Sardinella maderensis* and *S. aurita*, are found in the area between Gabon to Cabinda, while the adult part of the biomass is mainly found off Angola. This strongly support the general concept that the Congo – Gabon region is a nursery area for both sardinella species. We still know little about the exact spawning areas of the sardinella, but analyses of the sardinella eggs and larvae found in zooplankton samples collected during the present survey and the following survey off Angola, should give more insight into this. These will be analysed as part of the ongoing LMR/CF/03/11.

The results from the survey clearly illustrates that the stocks of both sardinella species are shared between Gongo, Gabon and Angola, and strongly suggest that any attempt to get reliable abundance estimates of the sardinella populations in the region between Port Gentil in Gabon and Tiger Bay in Angola requires regional approach in the survey, involving all countries in the region.

a) *Sardinella aurita*




b) *S. maderensis*

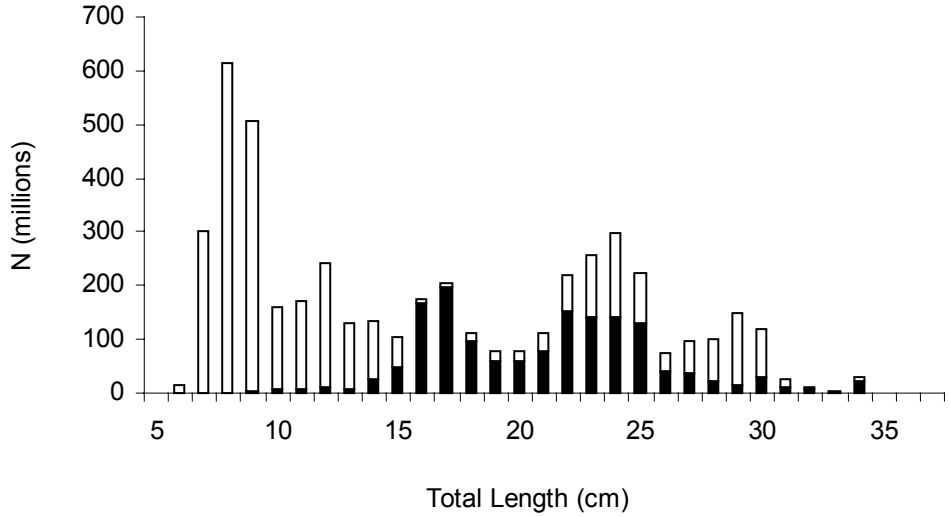



Figure 14. The combined length distribution of the stock of a) *Sardinella aurita* and b) *S. maderensis* found during this present BCLME survey (white bars) and the following survey of the pelagic fish resources off Angola (black bars).

Table 7. Total regional abundance estimate of the two sardinella species from the survey from Gabon to Cabinda (BCL2) and Angola (ANG2) 2004. Al numbers in thousand tonnes.

| Species | BCL 2 2004 | ANG 2 2004 | Regional estimate |
|---|---|---|---|
| *S. aurita* | 165 | 209 | 374 |
| *S. maderensis* | 195 | 153 | 348 |
| Total | 360 | 362 | 722 |

Effect of pollution from the Cabinda oil fields.

As part of the survey the oilfields of the Cabinda region were covered. This has reportedly been an important area for sardinella spawning, and one of the last pelagic surveys off Cabinda reported spawning sardinella of both species in the area (Anon 1994). During the present survey surface oil pollution was observed heading offshore and northwards carried by the current from the Congo River, crossing the national border to Congo. Few acoustic targets were recorded within Cabinda region, while sardinella was reported north and south of the oil fields. A more thorough research in the Cabinda region requires very close cooperation with the oil companies, in order to determine the impact of the oil exploitation activities on the marine resources. This could then lead to a policy of minimal impact, where the oil industry and fishing activities can coexist; a challenge of the future.

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# Annex I Records of fishing stations

PROJECT STATION: 182
DATE:16/ 7/04 GEAR TYPE: PT No: 1 POSITION:Lat S 19
start stop duration Long E 900
TIME :00:35:39 01:05:36 30 (min) Purpose code: 3
LOG :2080.36 2082.12 1.71 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 43 60 Validity code:
Towing dir: 270ø Wire out: 120 m Speed: 35 kn*10

Sorted: 64 Kg Total catch: 87.45 CATCH/HOUR: 174.90

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Decapterus rhonchus | 76.50 | 4060 | 43.74 | 301 |
| Rachycentron canadum | 73.10 | 2 | 41.80 | |
| Cypselurus sp. | 9.40 | 778 | 5.37 | |
| Ariomma bondi | 6.62 | 306 | 3.79 | |
| Sardinella aurita | 4.60 | 198 | 2.63 | 300 |
| Scomber japonicus | 2.62 | 56 | 1.50 | |
| Engraulis encrasicolus | 1.00 | 138 | 0.57 | 302 |
| Dactylopterus volitans | 0.60 | 4 | 0.34 | |
| SEPIIDAE | 0.20 | 2 | 0.11 | |
| Sardinella aurita - Juveniles | 0.12 | 56 | 0.07 | |
| Pseudupeneus prayensis | 0.04 | 8 | 0.02 | |
| Total | 174.80 | | 99.94 | |

PROJECT STATION: 183
DATE:16/ 7/04 GEAR TYPE: PT No: 1 POSITION:Lat S 45
start stop duration Long E 838
TIME :13:21:10 15:00:55 23 (min) Purpose code: 3
LOG :2178.87 2180.24 1.32 Area code : 8
FDEPTH: 10 10 GearCond.code:
BDEPTH: 267 37 Validity code:
Towing dir: 75ø Wire out: 140 m Speed: 36 kn*10

Sorted: Kg Total catch: 4.85 CATCH/HOUR: 12.65

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sphyrna couardi | 9.91 | 3 | 78.34 | |
| Euthynnus alletteratus | 2.74 | 8 | 21.66 | |
| Total | 12.65 | | 100.00 | |

PROJECT STATION: 184
DATE:16/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 58
start stop duration Long E 827
TIME :17:42:24 18:12:12 30 (min) Purpose code: 3
LOG :2204.40 2206.13 1.63 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 116 398 Validity code:
Towing dir: 262ø Wire out: 140 m Speed: 34 kn*10

Sorted: Kg Total catch: 3.65 CATCH/HOUR: 7.30

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Illex coindetii | 3.76 | 20 | 51.51 | |
| Illex sp. | 1.82 | 1504 | 24.93 | |
| Cubiceps sp. | 1.34 | 44 | 18.36 | |
| GONOSTOMATIDAE | 0.24 | 274 | 3.29 | |
| Ariomma melanum | 0.12 | 18 | 1.64 | |
| UNIDENTIFIED FISH | 0.02 | 10 | 0.27 | |
| Total | 7.30 | | 100.00 | |

PROJECT STATION: 185
DATE:16/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 109
start stop duration Long E 827
TIME :19:56:29 20:28:45 32 (min) Purpose code: 3
LOG :2219.42 2221.26 1.78 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 109 115 Validity code:
Towing dir: 206ø Wire out: 140 m Speed: 35 kn*10

Sorted: 61 Kg Total catch: 446.10 CATCH/HOUR: 836.44

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Ariomma bondi | 809.25 | 23484 | 96.75 | |
| Scomber japonicus | 20.40 | 478 | 2.44 | 303 |
| Priacanthus arenatus | 3.51 | 69 | 0.42 | |
| Caranx crysos | 3.28 | 4 | 0.39 | |
| Total | 836.44 | | 100.00 | |

PROJECT STATION: 186
DATE:17/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 137
start stop duration Long E 854
TIME :02:24:07 02:54:06 30 (min) Purpose code: 3
LOG :2275.40 2277.25 1.83 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 53 62 Validity code:
Towing dir: 230ø Wire out: 140 m Speed: 36 kn*10

Sorted: 336 Kg Total catch: 204.36 CATCH/HOUR: 408.72

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella aurita | 274.40 | 17206 | 67.14 | 304 |
| Decapterus rhonchus | 65.80 | 3556 | 16.10 | 306 |
| Scomber japonicus | 42.42 | 714 | 10.38 | 305 |
| Engraulis encrasicolus | 10.36 | 1134 | 2.53 | 307 |
| Sepia officinalis hierredda | 4.32 | 6 | 1.06 | |
| Boops boops | 4.20 | 714 | 1.03 | |
| Scomberomorus tritor | 3.90 | 2 | 0.95 | |
| Hemicaranx bicolor | 1.88 | 2 | 0.46 | |
| Ariomma bondi | 1.12 | 42 | 0.27 | |
| Illex coindetii | 0.50 | 4 | 0.12 | |
| Brachydeuterus auritus | 0.18 | 2 | 0.04 | |
| Priacanthus arenatus | 0.06 | 4 | 0.01 | |
| Sepiella ornata | 0.04 | 2 | 0.01 | |
| Total | 409.18 | | 100.10 | |

PROJECT STATION: 187
DATE:17/ 7/04 GEAR TYPE: BT No:15 POSITION:Lat S 153
start stop duration Long E 849
TIME :08:21:02 08:21:37 24 (min) Purpose code: 3
LOG :2322.00 2323.25 1.24 Area code : 8
FDEPTH: 125 123 GearCond.code:
BDEPTH: 125 123 Validity code:
Towing dir: 125ø Wire out: 370 m Speed: 31 kn*10

Sorted: 59 Kg Total catch: 2012.20 CATCH/HOUR: 5030.50

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Spicara alta | 2191.88 | 48300 | 43.57 | |
| Erythrocles monodi | 1548.75 | 20738 | 30.79 | |
| Boops boops | 805.00 | 16188 | 16.00 | |
| Dentex congoensis | 367.50 | 6475 | 7.31 | |
| Umbrina canariensis | 32.38 | 88 | 0.64 | |
| Lagocephalus laevigatus | 31.50 | 175 | 0.63 | |
| Priacanthus arenatus | 21.00 | 88 | 0.42 | |
| Trachurus trecae | 12.25 | 175 | 0.24 | |
| Sepiella ornata | 8.75 | 88 | 0.17 | |
| Lepidotrigla carolae | 7.88 | 175 | 0.16 | |
| Sarda sarda | 3.63 | 3 | 0.07 | |
| Total | 5030.52 | | 100.00 | |

PROJECT STATION: 188
DATE:17/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 144
start stop duration Long E 910
TIME :14:05:22 14:35:43 30 (min) Purpose code: 3
LOG :2358.88 2360.86 1.98 Area code : 8
FDEPTH: 10 10 GearCond.code:
BDEPTH: 20 20 Validity code:
Towing dir: 160ø Wire out: 200 m Speed: 38 kn*10

Sorted: Kg Total catch: 51.04 CATCH/HOUR: 102.08

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella maderensis | 67.50 | 666 | 66.12 | 308 |
| Scomberomorus tritor | 30.40 | 38 | 29.78 | |
| Sphyraena guachancho | 3.44 | 10 | 3.37 | |
| Chloroscombrus chrysurus | 0.52 | 6 | 0.51 | |
| Sepiella ornata | 0.22 | 10 | 0.22 | |
| Total | 102.08 | | 100.00 | |

PROJECT STATION: 189

DATE:17/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 209
start stop duration Long E 902
TIME :16:40:20 20:00:36 29 (min) Purpose code: 3
LOG :2418.64 2420.32 1.67 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 71 66 Validity code:
Towing dir: 50ø Wire out: 140 m Speed: 35 kn*10

Sorted: Kg Total catch: 15.35 CATCH/HOUR: 31.76

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Decapterus punctatus | 14.34 | 766 | 45.15 | 309 |
| Trichiurus lepturus | 10.39 | 23 | 32.71 | |
| Saurida brasiliensis | 1.41 | 174 | 4.44 | |
| Lagocephalus laevigatus | 1.39 | 8 | 4.38 | |
| Sardinella aurita | 1.37 | 85 | 4.31 | 310 |
| Ariomma bondi | 1.10 | 21 | 3.46 | |
| Scomber japonicus | 0.60 | 10 | 1.89 | |
| Sepia officinalis hierredda | 0.54 | 10 | 1.70 | |
| Boops boops | 0.27 | 43 | 0.85 | |
| Priacanthus arenatus | 0.19 | 6 | 0.60 | |
| Alloteuthis africana | 0.17 | 97 | 0.54 | |
| Echelus myrus | 0.02 | 2 | 0.06 | |
| Trachurus trecae | 0.00 | 4 | | |
| Total | 31.79 | | 100.09 | |

PROJECT STATION: 190

DATE:18/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 204
start stop duration Long E 919
TIME :00:46:32 01:16:25 30 (min) Purpose code: 3
LOG :2444.19 2446.08 1.87 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 16 16 Validity code:
Towing dir: 150ø Wire out: 210 m Speed: 37 kn*10

Sorted: Kg Total catch: 10.71 CATCH/HOUR: 21.42

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Pomadasys incisus | 12.84 | 2446 | 59.94 | |
| Sphyraena guachancho | 2.44 | 134 | 11.39 | |
| Sardinella maderensis - Juv. | 1.78 | 364 | 8.31 | 311 |
| Decapterus rhonchus | 1.18 | 216 | 5.51 | |
| Sepia juveniles | 1.00 | 188 | 4.67 | |
| Priacanthus arenatus | 0.74 | 10 | 3.45 | |
| Engraulis encrasicolus | 0.34 | 92 | 1.59 | |
| Pseudupeneus prayensis | 0.28 | 2 | 1.31 | |
| Selene dorsalis | 0.26 | 16 | 1.21 | |
| Decapterus macarellus | 0.22 | 22 | 1.03 | |
| Galeoides decadactylus | 0.10 | 10 | 0.47 | |
| Sepiella ornata | 0.08 | 4 | 0.37 | |
| Ilisha africana | 0.06 | 2 | 0.28 | |
| Eucinostomus melanopterus | 0.06 | 2 | 0.28 | |
| Sepia officinalis hierredda | 0.04 | 2 | 0.19 | |
| Penaeus kerathurus | 0.02 | 8 | 0.09 | |
| Total | 21.44 | | 100.09 | |

PROJECT STATION: 191

DATE:18/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 223
start stop duration Long E 901
TIME :04:07:59 04:37:56 30 (min) Purpose code: 3
LOG :2473.47 2475.44 1.94 Area code : 3
FDEPTH: 0 0 GearCond.code: 3
BDEPTH: 107 127 Validity code: 3
Towing dir: 230ø Wire out: 155 m Speed: 39 kn*10

Sorted: Kg Total catch: 37.18 CATCH/HOUR: 74.36

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Saurida brasiliensis | 31.12 | 5960 | 41.85 | |
| Ariomma bondi | 30.50 | 1256 | 41.02 | |
| Auxis rochei | 4.52 | 24 | 6.08 | |
| Sarda sarda | 2.98 | 2 | 4.01 | |
| Trichiurus lepturus | 2.50 | 4 | 3.36 | |
| Echeneis naucrates | 1.76 | 2 | 2.37 | |
| Illex coindetii | 0.94 | 2 | 1.26 | |
| Pseudupeneus prayensis | 0.02 | 10 | 0.03 | |
| Selene dorsalis | 0.02 | 16 | 0.03 | |
| Total | 74.36 | | 100.01 | |

PROJECT STATION: 192

DATE:18/ 7/04 GEAR TYPE: BT No:15 POSITION:Lat S 230
start stop duration Long E 908
TIME :08:52:47 09:02:06 9 (min) Purpose code: 3
LOG :2508.22 2508.71 0.48 Area code : 8
FDEPTH: 86 88 GearCond.code:
BDEPTH: 86 88 Validity code:
Towing dir: 230ø Wire out: 250 m Speed: 30 kn*10

Sorted: 89 Kg Total catch: 1574.07 CATCH/HOUR: 10493.80

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Boops boops | 4885.33 | 109620 | 46.55 | |
| Scomber japonicus | 3481.33 | 103367 | 33.18 | 312 |
| Ariomma bondi | 1339.33 | 34100 | 12.76 | |
| Sardinella aurita | 649.00 | 23127 | 6.18 | 313 |
| Decapterus rhonchus | 90.87 | 3653 | 0.87 | 314 |
| Trachurus trecae | 21.27 | 1533 | 0.20 | 315 |
| Priacanthus arenatus | 6.33 | 93 | 0.06 | |
| Dentex congoensis | 5.33 | 53 | 0.05 | |
| Torpedo torpedo | 3.40 | 7 | 0.03 | |
| Dentex angolensis | 3.20 | 73 | 0.03 | |
| Illex coindetii | 1.93 | 20 | 0.02 | |
| Sepiella ornata | 1.80 | 13 | 0.02 | |
| Zeus faber | 1.53 | 7 | 0.01 | |
| Sphoeroides pachgaster | 1.40 | 7 | 0.01 | |
| Fistularia petimba | 1.20 | 13 | 0.01 | |
| Lagocephalus lagocephalus | 1.20 | 7 | 0.01 | |
| Citharus linguatula | 0.33 | 7 | | |
| Engraulis encrasicolus | 0.13 | 7 | | |
| Lepidotrigla carolae | 0.07 | 20 | | |
| Total | 10494.98 | | 99.99 | |

PROJECT STATION: 193

DATE:18/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 218
start stop duration Long E 923
TIME :12:37:13 13:07:48 31 (min) Purpose code: 3
LOG :2533.85 2535.81 1.88 Area code : 8
FDEPTH: 10 10 GearCond.code:
BDEPTH: 27 27 Validity code:
Towing dir: 330ø Wire out: 280 m Speed: 39 kn*10

Sorted: Kg Total catch: 42.61 CATCH/HOUR: 82.47

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella maderensis | 64.35 | 490 | 78.03 | 317 |
| Sardinella aurita | 16.06 | 114 | 19.47 | 316 |
| Scomberomorus tritor | 1.74 | 2 | 2.11 | |
| Fistularia petimba | 0.31 | 2 | 0.38 | |
| Total | 82.46 | | 99.99 | |

PROJECT STATION: 194

DATE:18/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 220
start stop duration Long E 930
TIME :14:42:22 15:12:18 30 (min) Purpose code: 3
LOG :2549.33 2551.24 1.47 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 22 21 Validity code:
Towing dir: 144ø Wire out: 220 m Speed: 39 kn*10

Sorted: Kg Total catch: 4.30 CATCH/HOUR: 8.60

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Scomberomorus tritor | 8.54 | 14 | 99.30 | |
| Sepiella ornata | 0.06 | 2 | 0.70 | |
| Total | 8.60 | | 100.00 | |

PROJECT STATION: 195

DATE:18/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 226
start stop duration Long E 929
TIME :15:00:21 16:40:26 30 (min) Purpose code: 3
LOG :2561.66 2563.49 1.82 Area code : 8
FDEPTH: 10 10 GearCond.code: 3
BDEPTH: 34 30 Validity code:
Towing dir: 50ø Wire out: 210 m Speed: 30 kn*10

Sorted: Kg Total catch: 83.97 CATCH/HOUR: 167.94

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella aurita | 165.90 | 8134 | 98.79 | 318 |
| Scomberomorus tritor | 1.68 | 2 | 1.00 | |
| Sardinella maderensis | 0.24 | 2 | 0.14 | |
| Sepiella ornata | 0.12 | 4 | 0.07 | |
| Total | 167.94 | | 100.00 | |

PROJECT STATION: 196

DATE:18/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 237
start stop duration Long E 916
TIME :18:20:35 18:21:37 29 (min) Purpose code: 3
LOG :2583.37 2585.18 1.78 Area code : 8
FDEPTH: 0 0 GearCond.code: 3
BDEPTH: 83 84 Validity code:
Towing dir: 230ø Wire out: 150 m Speed: 35 kn*10

Sorted: Kg Total catch: 72.34 CATCH/HOUR: 149.67

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Priacanthus arenatus | 61.03 | 1196 | 40.78 | |
| Saurida brasiliensis | 41.17 | 7699 | 27.51 | |
| Ariomma bondi | 16.88 | 703 | 11.28 | |
| Brachydeuterus auritus | 14.98 | 223 | 10.01 | |
| Sepiella ornata | 13.59 | 261 | 9.08 | |
| Decapterus rhonchus | 0.68 | 35 | 0.45 | 319 |
| Scomber japonicus | 0.58 | 17 | 0.39 | |
| Lagocephalus lagocephalus | 0.39 | 2 | 0.26 | |
| Boops boops | 0.27 | 29 | 0.18 | |
| Dactylopterus volitans | 0.08 | 10 | 0.05 | |
| Total | 149.65 | | 99.99 | |

PROJECT STATION: 197

DATE:19/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 257
start stop duration Long E 907
TIME :23:45:47 00:15:22 30 (min) Purpose code: 3
LOG :2618.38 2620.20 1.79 Area code : 8
FDEPTH: 10 10 GearCond.code:
BDEPTH: 823 807 Validity code:
Towing dir: 50ø Wire out: 150 m Speed: 35 kn*10

Sorted: Kg Total catch: 9.19 CATCH/HOUR: 18.38

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| MYCTOPHIDAE | 17.50 | 12986 | 95.21 | |
| Illex coindetii | 0.52 | 42 | 2.83 | |
| Engraulis encrasicolus | 0.16 | 24 | 0.87 | |
| GEMPYLIDAE | 0.14 | 14 | 0.76 | |
| Selene dorsalis, juveniles | 0.04 | 4 | 0.22 | |
| FISTULARIIDAE | 0.02 | 26 | 0.11 | |
| Total | 18.38 | | 100.00 | |

PROJECT STATION: 198

DATE:19/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 238
start stop duration Long E 931
TIME :04:15:51 04:45:54 30 (min) Purpose code: 3
LOG :2650.33 2652.17 1.83 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 53 48 Validity code:
Towing dir: 50ø Wire out: 150 m Speed: 36 kn*10

Sorted: Kg Total catch: 14.16 CATCH/HOUR: 28.32

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Decapterus rhonchus | 11.56 | 706 | 40.82 | 320 |
| MYCTOPHIDAE | 6.78 | 3594 | 23.94 | |
| Stromateus fiatola | 5.32 | 8 | 18.79 | |
| Scomber japonicus | 2.60 | 80 | 9.18 | |
| Sepiella ornata | 0.82 | 18 | 2.90 | |
| Illex coindetii | 0.42 | 14 | 1.48 | |
| Sardinella aurita | 0.38 | 12 | 1.34 | |
| Alloteuthis africana | 0.20 | 46 | 0.71 | |
| NEMICHTHYIDAE | 0.10 | 46 | 0.35 | |
| GEMPYLIDAE | 0.08 | 6 | 0.28 | |
| Engraulis encrasicolus | 0.06 | 2 | 0.21 | |
| Total | 28.32 | | 100.00 | |

PROJECT STATION: 199

DATE:19/ 7/04 GEAR TYPE: BT No:15 POSITION:Lat S 249
start stop duration Long E 933
TIME :10:16:37 10:46:08 30 (min) Purpose code: 3
LOG :2694.04 2695.62 1.56 Area code : 8
FDEPTH: 77 83 GearCond.code:
BDEPTH: 77 83 Validity code:
Towing dir: 230ø Wire out: 240 m Speed: 30 kn*10

Sorted: Kg Total catch: 159.71 CATCH/HOUR: 319.42

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Pagellus bellottii | 144.24 | 1040 | 45.16 | |
| Trachurus trecae, juvenile | 66.74 | 750 | 20.89 | 323 |
| Boops boops | 21.60 | 2220 | 6.76 | |
| Dentex canariensis | 12.24 | 26 | 3.83 | |
| Scomber japonicus | 11.40 | 376 | 3.57 | 321 |
| Mustelus mustelus | 10.60 | 4 | 3.32 | |
| Spicara alta | 9.30 | 1136 | 2.91 | |
| Sardinella aurita | 8.40 | 520 | 2.63 | 322 |
| Sepia officinalis hierredda | 7.82 | 34 | 2.45 | |
| Alloteuthis africana | 4.40 | 1176 | 1.38 | |
| Ariomma bondi | 4.24 | 180 | 1.33 | |
| Zeus faber | 2.72 | 4 | 0.85 | |
| Pagrus caeruleostictus | 2.60 | 6 | 0.81 | |
| Engraulis encrasicolus | 2.50 | 206 | 0.78 | 324 |
| Pseudupeneus prayensis | 1.84 | 16 | 0.58 | |
| Lepidotrigla carolae | 1.60 | 36 | 0.50 | |
| Fistularia petimba | 1.48 | 6 | 0.46 | |
| Saurida brasiliensis | 1.30 | 150 | 0.41 | |
| Lepidotrigla cadmani | 1.20 | 20 | 0.38 | |
| Priacanthus arenatus | 0.94 | 10 | 0.29 | |
| Lagocephalus laevigatus | 0.76 | 2 | 0.24 | |
| Illex coindetii | 0.60 | 6 | 0.19 | |
| Torpedo torpedo | 0.56 | 2 | 0.18 | |
| Sphoeroides pachgaster | 0.34 | 2 | 0.11 | |
| Total | 319.42 | | 100.01 | |

PROJECT STATION: 200

DATE:19/ 7/04 GEAR TYPE: BT No: POSITION:Lat S 256
start stop duration Long E 940
TIME :15:04:31 15:34:25 30 (min) Purpose code: 3
LOG :2736.43 2737.95 1.51 Area code : 8
FDEPTH: 79 70 GearCond.code:
BDEPTH: 79 70 Validity code:
Towing dir: 50ø Wire out: 240 m Speed: 30 kn*10

Sorted: 111 Kg Total catch: 372.42 CATCH/HOUR: 744.84

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Chromis cadenati | 199.60 | 1850 | 26.80 | |
| Trachurus trecae | 128.46 | 9278 | 17.25 | |
| Ariomma bondi | 115.98 | 6760 | 15.57 | |
| Boops boops | 59.44 | 6106 | 7.98 | |
| Dentex canariensis | 54.90 | 74 | 7.37 | |
| Engraulis encrasicolus | 34.86 | 2804 | 4.68 | 325 |
| Epinephelus aeneus | 22.40 | 4 | 3.01 | |
| Umbrina canariensis | 17.84 | 36 | 2.40 | |
| Pagellus bellottii | 17.62 | 528 | 2.37 | |
| Pseudupeneus prayensis | 16.40 | 118 | 2.20 | |
| Dasyatis marmorata | 11.90 | 8 | 1.60 | |
| Scomber japonicus | 9.54 | 286 | 1.28 | 326 |
| Pagrus caeruleostictus | 9.46 | 14 | 1.27 | |
| Zeus faber | 9.18 | 22 | 1.23 | |
| Lutjanus fulgens | 6.60 | 8 | 0.89 | |
| Raja miraletus | 6.60 | 8 | 0.89 | |
| Fistularia petimba | 5.50 | 22 | 0.74 | |
| Pagrus auriga | 4.92 | 8 | 0.66 | |
| Sardinella maderensis - Juv. | 3.44 | 242 | 0.46 | 327 |
| Rhinobatos albomaculatus | 3.32 | 2 | 0.45 | |
| Chaetodon hoefleri | 1.84 | 14 | 0.25 | |
| Sargocentron hastatus | 1.32 | 8 | 0.18 | |
| Alloteuthis africana | 1.24 | 514 | 0.17 | |
| Saurida brasiliensis | 1.24 | 102 | 0.17 | |
| Priacanthus arenatus | 0.66 | 14 | 0.09 | |
| Spicara alta | 0.58 | 110 | 0.08 | |
| Total | 744.84 | | 100.04 | |

PROJECT STATION: 201

DATE:19/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 247
start stop duration Long E 953
TIME :18:42:25 19:04:19 22 (min) Purpose code: 3
LOG :2758.68 2759.98 1.26 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 22 21 Validity code:
Towing dir: 330ø Wire out: 150 m Speed: 35 kn*10

Sorted: Kg Total catch: 98.83 CATCH/HOUR: 269.54

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Brachydeuterus auritus | 91.36 | 23847 | 33.89 | |
| Lutjanus fulgens | 35.59 | 106 | 13.20 | |
| Chaetodipterus goreensis | 35.05 | 106 | 13.00 | |
| Sphyraena guachancho | 24.82 | 101 | 9.21 | |
| Dentex gibbosus | 23.18 | 55 | 8.60 | |
| Decapterus rhonchus | 14.43 | 2073 | 5.35 | 329 |
| Galeoides decadactylus | 10.34 | 155 | 3.84 | |
| Sepia officinalis hierredda | 8.18 | 8 | 3.03 | |
| Ilisha africana | 7.42 | 327 | 2.75 | |
| Pagellus bellottii | 5.26 | 38 | 1.95 | |
| Sardinella maderensis - Juv. | 4.01 | 685 | 1.49 | 328 |
| Stromateus fiatola | 2.75 | 5 | 1.02 | |
| Pagrus caeruleostictus | 2.13 | 3 | 0.79 | |
| Lutjanus dentatus | 0.98 | 3 | 0.36 | |
| POMACENTRIDAE | 0.71 | 38 | 0.26 | |
| Eucinostomus melanopterus | 0.68 | 8 | 0.25 | |
| Diplodus fasciatus | 0.49 | 63 | 0.18 | |
| Sepiella ornata | 0.49 | 11 | 0.18 | |
| Arius heudeloti | 0.38 | 3 | 0.14 | |
| APOGONIDAE | 0.30 | 134 | 0.11 | |
| Selene dorsalis | 0.27 | 11 | 0.10 | |
| Pseudupeneus prayensis | 0.19 | 22 | 0.07 | |
| Penaeus notialis | 0.19 | 5 | 0.07 | |
| Pteroscion peli | 0.14 | 3 | 0.05 | |
| Sparus aurata | 0.11 | 14 | 0.04 | |
| Parapenaeus longirostris | 0.05 | 8 | 0.02 | |
| Penaeus kerathurus | 0.03 | 3 | 0.01 | |
| Total | 269.53 | | 99.96 | |

PROJECT STATION: 202

DATE:19/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 305
start stop duration Long E 944
TIME :22:17:52 22:47:35 30 (min) Purpose code: 3
LOG :2787.90 2789.89 1.98 Area code : 8
FDEPTH: 20 30 GearCond.code:
BDEPTH: 88 96 Validity code:
Towing dir: 230ø Wire out: 150 m Speed: 40 kn*10

Sorted: Kg Total catch: 33.56 CATCH/HOUR: 67.12

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Saurida brasiliensis | 65.00 | 12072 | 96.84 | |
| Sepiella ornata | 2.08 | 46 | 3.10 | |
| Penaeus notialis | 0.04 | 78 | 0.06 | |
| Total | 67.12 | | 100.00 | |

PROJECT STATION: 203

DATE:20/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 311
start stop duration Long E 954
TIME :02:40:45 03:10:20 30 (min) Purpose code: 3
LOG :2824.73 2826.54 1.77 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 77 69 Validity code:
Towing dir: 50ø Wire out: 140 m Speed: 37 kn*10

Sorted: Kg Total catch: 70.54 CATCH/HOUR: 141.08

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Saurida brasiliensis | 73.60 | 13226 | 52.17 | |
| Ariomma bondi | 36.60 | 1650 | 25.94 | |
| Trachurus trecae, juvenile | 13.60 | 1018 | 9.64 | 330 |
| Trichiurus lepturus | 5.68 | 20 | 4.03 | |
| Alloteuthis africana | 5.12 | 1748 | 3.63 | |
| Sepiella ornata | 2.82 | 68 | 2.00 | |
| Lagocephalus laevigatus | 1.52 | 8 | 1.08 | |
| Sepia officinalis hierredda | 1.20 | 2 | 0.85 | |
| Echeneis naucrates | 0.80 | 2 | 0.57 | |
| Scomber japonicus | 0.08 | 2 | 0.06 | |
| Priacanthus arenatus | 0.06 | 4 | 0.04 | |
| Total | 141.08 | | 100.01 | |

PROJECT STATION: 204

DATE:20/ 7/04 GEAR TYPE: BT No:15 POSITION:Lat S 306
start stop duration Long E 1015
TIME :07:32:04 07:51:55 20 (min) Purpose code: 3
LOG :2861.82 2862.89 1.06 Area code : 8
FDEPTH: 25 25 GearCond.code:
BDEPTH: 25 25 Validity code:
Towing dir: 130ø Wire out: 130 m Speed: 32 kn*10

Sorted: 144 Kg Total catch: 345.57 CATCH/HOUR: 1036.71

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Brachydeuterus auritus | 720.30 | 16371 | 69.48 | |
| Sphyraena guachancho | 120.00 | 906 | 11.58 | |
| Trichiurus lepturus | 40.80 | 1263 | 3.94 | |
| Pagellus bellottii | 30.90 | 273 | 2.98 | |
| Sardinella aurita - Juveniles | 21.69 | 1284 | 2.09 | 331 |
| Pomadasys incisus | 20.40 | 120 | 1.97 | |
| Pseudotolithus brachygnathus | 16.50 | 15 | 1.59 | |
| Epinephelus aeneus | 13.80 | 6 | 1.33 | |
| Paragaleus pectoralis | 9.75 | 3 | 0.94 | |
| Chaetodipterus goreensis | 7.83 | 24 | 0.76 | |
| Pagrus caeruleostictus | 7.23 | 24 | 0.70 | |
| Galeoides decadactylus | 3.96 | 24 | 0.38 | |
| Pomadasys jubelini | 3.36 | 6 | 0.32 | |
| Pteroscion peli | 3.33 | 51 | 0.32 | |
| Balistes capriscus | 2.73 | 3 | 0.26 | |
| Sepia officinalis hierredda | 2.55 | 3 | 0.25 | |
| Balistes punctatus | 1.95 | 3 | 0.19 | |
| Pseudupeneus prayensis | 1.86 | 15 | 0.18 | |
| Diplodus vulgaris | 1.80 | 3 | 0.17 | |
| Selene dorsalis | 1.53 | 114 | 0.15 | |
| Arius heudeloti | 1.41 | 3 | 0.14 | |
| Raja clavata | 1.17 | 3 | 0.11 | |
| Pomadasys peroteti | 1.08 | 3 | 0.10 | |
| Lagocephalus laevigatus | 0.51 | 3 | 0.05 | |
| Total | 1036.44 | | 99.98 | |

PROJECT STATION: 205

DATE:20/ 7/04 GEAR TYPE: BT No:15 POSITION:Lat S 319
start stop duration Long E 1000
TIME :10:24:52 10:54:53 30 (min) Purpose code: 3
LOG :2885.77 2887.43 1.65 Area code : 8
FDEPTH: 85 78 GearCond.code:
BDEPTH: 85 78 Validity code:
Towing dir: 50ø Wire out: 255 m Speed: 32 kn*10

Sorted: Kg Total catch: 124.62 CATCH/HOUR: 249.24

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Pagellus bellottii | 70.20 | 600 | 28.17 | |
| Trachurus trecae | 42.60 | 2646 | 17.09 | 332 |
| Saurida brasiliensis | 38.10 | 8332 | 15.29 | |
| Epinephelus aeneus | 37.30 | 4 | 14.97 | |
| Dentex canariensis | 16.44 | 24 | 6.60 | |
| Paragaleus pectoralis | 11.60 | 4 | 4.65 | |
| Alloteuthis africana | 7.38 | 1692 | 2.96 | |
| Sepia officinalis hierredda | 6.30 | 36 | 2.53 | |
| Sepia sp. | 4.98 | 6 | 2.00 | |
| Sphyraena guachancho | 4.28 | 32 | 1.72 | |
| Chromis cadenati | 3.10 | 18 | 1.24 | |
| Pagrus pagrus | 2.80 | 2 | 1.12 | |
| Priacanthus arenatus | 1.48 | 6 | 0.59 | |
| Chaetodon hoefleri | 1.04 | 6 | 0.42 | |
| Zeus faber | 0.88 | 2 | 0.35 | |
| Fistularia petimba | 0.68 | 4 | 0.27 | |
| Scomber japonicus | 0.08 | 8 | 0.03 | |
| Total | 249.24 | | 100.00 | |

PROJECT STATION: 206

DATE:20/ 7/04 GEAR TYPE: PT No: 3 POSITION:Lat S 313
start stop duration Long E 1023
TIME :20:36:14 20:55:19 19 (min) Purpose code: 3
LOG :2966.12 2967.35 1.22 Area code : 8
FDEPTH: 5 5 GearCond.code:
BDEPTH: 27 30 Validity code:
Towing dir: 130ø Wire out: 130 m Speed: 39 kn*10

Sorted: 66 Kg Total catch: 329.35 CATCH/HOUR: 1040.05

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Brachydeuterus auritus | 615.00 | 119889 | 59.13 | |
| Sardinella aurita | 166.26 | 5542 | 15.99 | 333 |
| Sepia officinalis hierredda | 112.89 | 158 | 10.85 | |
| Sardinella maderensis | 58.42 | 4042 | 5.62 | 335 |
| Sphyraena guachancho | 35.37 | 789 | 3.40 | |
| Trachurus trecae | 29.68 | 2416 | 2.85 | |
| Sardinella aurita - Juveniles | 9.00 | 2975 | 0.87 | 334 |
| Decapterus rhonchus | 7.89 | 837 | 0.76 | |
| Trichiurus lepturus | 5.05 | 174 | 0.49 | |
| Sepiella ornata | 0.16 | 16 | 0.02 | |
| Scomber japonicus | 0.16 | 32 | 0.02 | |
| Engraulis encrasicolus | 0.16 | 95 | 0.02 | |
| Total | 1040.04 | | 100.02 | |

PROJECT STATION: 207

DATE:20/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 320
start stop duration Long E 1029
TIME :23:13:25 23:46:19 33 (min) Purpose code: 3
LOG :2983.17 2985.16 1.94 Area code : 8
FDEPTH: 10 10 GearCond.code:
BDEPTH: 25 30 Validity code:
Towing dir: 230ø Wire out: 200 m Speed: 35 kn*10

Sorted: 54 Kg Total catch: 221.00 CATCH/HOUR: 401.82

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Brachydeuterus auritus | 385.45 | 52400 | 95.93 | |
| Sphyraena guachancho | 8.65 | 276 | 2.15 | |
| Sepia officinalis hierredda | 6.18 | 5 | 1.54 | |
| Sepiella ornata | 1.53 | 36 | 0.38 | |
| Total | 401.81 | | 100.00 | |

PROJECT STATION: 208

DATE:21/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 336
start stop duration Long E 1010
TIME :02:13:20 02:44:18 31 (min) Purpose code: 3
LOG :3007.91 3009.81 1.85 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 104 112 Validity code:
Towing dir: 230ø Wire out: 140 m Speed: 36 kn*10

Sorted: 99 Kg Total catch: 268.38 CATCH/HOUR: 519.45

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella maderensis | 291.60 | 1281 | 56.14 | 337 |
| Caranx crysos | 52.26 | 62 | 10.06 | |
| Sardinella aurita | 49.18 | 163 | 9.47 | 336 |
| Trachurus trecae, juvenile | 28.84 | 910 | 5.55 | 338 |
| Euthynnus alletteratus | 21.52 | 37 | 4.14 | |
| Trichiurus lepturus | 12.08 | 21 | 2.33 | |
| Sarda sarda | 12.02 | 15 | 2.31 | |
| Hemiramphus balao | 11.92 | 99 | 2.29 | |
| Sepiella ornata | 11.90 | 314 | 2.29 | |
| Saurida brasiliensis | 10.76 | 4380 | 2.07 | |
| Scomber japonicus | 7.26 | 21 | 1.40 | |
| Lagocephalus laevigatus | 7.10 | 15 | 1.37 | |
| Illex coindetii | 1.76 | 292 | 0.34 | |
| Ariomma bondi | 0.89 | 43 | 0.17 | |
| SCOMBRIDAE | 0.35 | 15 | 0.07 | |
| Total | 519.44 | | 100.00 | |

PROJECT STATION: 209

DATE:21/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 341
start stop duration Long E 1020
TIME :07:07:06 07:51:13 44 (min) Purpose code: 3
LOG :3048.63 3051.60 0.39 Area code : 8
FDEPTH: 10 10 GearCond.code:
BDEPTH: 87 86 Validity code:
Towing dir: 230ø Wire out: 160 m Speed: 39 kn*10

Sorted: Kg Total catch: 4.31 CATCH/HOUR: 5.88

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sarda sarda | 4.30 | 3 | 73.13 | |
| Sepiella ornata | 1.57 | 38 | 26.70 | |
| Selene dorsalis | 0.01 | 5 | 0.17 | |
| Total | 5.88 | | 100.00 | |

PROJECT STATION: 210

DATE:21/ 7/04 GEAR TYPE: PT No: 1 POSITION:Lat S 330
start stop duration Long E 1034
TIME :10:54:37 11:24:19 30 (min) Purpose code: 3
LOG :3072.46 3074.35 1.89 Area code : 8
FDEPTH: 15 25 GearCond.code:
BDEPTH: 36 40 Validity code:
Towing dir: 230ø Wire out: 110 m Speed: 37 kn*10

Sorted: 32 Kg Total catch: 47.68 CATCH/HOUR: 95.36

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella aurita | 76.00 | 4200 | 79.70 | 340 |
| Sardinella maderensis | 19.36 | 730 | 20.30 | 339 |
| Total | 95.36 | | 100.00 | |

PROJECT STATION: 211

DATE:21/ 7/04 GEAR TYPE: BT No:15 POSITION:Lat S 330
start stop duration Long E 1033
TIME :12:08:09 12:33:03 25 (min) Purpose code: 3
LOG :3077.45 3078.80 1.34 Area code : 8
FDEPTH: 38 35 GearCond.code:
BDEPTH: 38 35 Validity code:
Towing dir: 50ø Wire out: 150 m Speed: 32 kn*10

Sorted: 85 Kg Total catch: 4019.00 CATCH/HOUR: 9645.60

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Brachydeuterus auritus Juv. | 7501.20 | 804377 | 77.77 | |
| Trachurus trecae, juvenile | 1280.16 | 101407 | 13.27 | 343 |
| Sardinella aurita | 676.80 | 49745 | 7.02 | 342 |
| Sardinella maderensis | 97.01 | 4850 | 1.01 | 341 |
| Pagellus bellottii | 57.53 | 7219 | 0.60 | |
| Scomber japonicus | 13.54 | 564 | 0.14 | |
| Alloteuthis africana | 11.28 | 2707 | 0.12 | |
| Pseudupeneus prayensis | 5.64 | 113 | 0.06 | |
| Priacanthus arenatus | 4.51 | 113 | 0.05 | |
| Total | 9647.67 | | 100.04 | |

PROJECT STATION: 212

DATE:21/ 7/04 GEAR TYPE: PT No: 1 POSITION:Lat S 355
start stop duration Long E 1019
TIME :17:33:24 18:00:53 27 (min) Purpose code: 3
LOG :3127.89 3129.72 1.82 Area code : 8
FDEPTH: 35 28 GearCond.code:
BDEPTH: 217 118 Validity code:
Towing dir: 50ø Wire out: 150 m Speed: 40 kn*10

Sorted: Kg Total catch: 78.57 CATCH/HOUR: 174.60

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| MYCTOPHIDAE | 147.33 | 78364 | 84.38 | |
| Trichiurus lepturus | 23.33 | 67 | 13.36 | |
| Euthynnus alletteratus | 1.80 | 2 | 1.03 | |
| Pentheroscion mbizi | 1.11 | 40 | 0.64 | |
| Illex coindetii | 0.44 | 36 | 0.25 | |
| PARALEPIDIDAE | 0.27 | 22 | 0.15 | |
| Ariomma melanum | 0.27 | 4 | 0.15 | |
| Zenopsis conchifer | 0.04 | 4 | 0.02 | |
| Total | 174.59 | | 99.98 | |

PROJECT STATION: 213

DATE:21/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 352
start stop duration Long E 1038
TIME :22:37:58 23:07:57 30 (min) Purpose code: 3
LOG :3166.36 3168.07 1.70 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 78 71 Validity code:
Towing dir: 50ø Wire out: 145 m Speed: 34 kn*10

Sorted: 84 Kg Total catch: 132.43 CATCH/HOUR: 264.86

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Trichiurus lepturus | 257.00 | 874 | 97.03 | |
| Sepia officinalis hierredda | 2.00 | 2 | 0.76 | |
| Illex coindetii | 1.88 | 538 | 0.71 | |
| Sepiella ornata | 1.30 | 36 | 0.49 | |
| Trachurus trecae | 1.24 | 20 | 0.47 | |
| Saurida brasiliensis | 0.66 | 224 | 0.25 | |
| Lagocephalus laevigatus | 0.46 | 2 | 0.17 | |
| Priacanthus arenatus | 0.32 | 4 | 0.12 | |
| Total | 264.86 | | 100.00 | |

PROJECT STATION: 214

DATE:22/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 354
start stop duration Long E 1051
TIME :03:54:54 04:25:09 30 (min) Purpose code: 3
LOG :3205.52 3207.38 1.83 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 40 48 Validity code:
Towing dir: 230ø Wire out: 150 m Speed: 36 kn*10

Sorted: Kg Total catch: 39.98 CATCH/HOUR: 79.96

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Engraulis encrasicolus | 53.00 | 5564 | 66.28 | |
| Ommastrephes pteropus | 5.46 | 2238 | 6.83 | |
| Rhizoprionodon acutus | 4.86 | 2 | 6.08 | |
| Sardinella aurita - Juveniles | 3.20 | 1216 | 4.00 | 346 |
| Sepia juveniles | 2.86 | 2050 | 3.58 | |
| Trachurus trecae, juvenile | 1.78 | 356 | 2.23 | 345 |
| Selene dorsalis | 1.78 | 28 | 2.23 | |
| Scomber japonicus | 1.40 | 144 | 1.75 | 344 |
| Stromateus fiatola | 1.30 | 2 | 1.63 | |
| Trichiurus lepturus | 0.94 | 140 | 1.18 | |
| Acanthocybium solandri | 0.92 | 28 | 1.15 | |
| Alloteuthis africana | 0.90 | 206 | 1.13 | |
| Trachurus trecae | 0.72 | 8 | 0.90 | |
| Sepiella ornata | 0.48 | 10 | 0.60 | |
| Brachydeuterus auritus | 0.18 | 18 | 0.23 | |
| Lagocephalus laevigatus | 0.06 | 4 | 0.08 | |
| SEPIOLIDAE | 0.06 | 14 | 0.08 | |
| Saurida brasiliensis | 0.06 | 18 | 0.08 | |
| Total | 79.96 | | 100.04 | |

PROJECT STATION: 215

DATE:22/ 7/04 GEAR TYPE: PT No: 1 POSITION:Lat S 418
start stop duration Long E 1030
TIME :08:06:30 08:27:05 21 (min) Purpose code: 3
LOG :3241.60 3242.78 1.18 Area code : 8
FDEPTH: 120 152 GearCond.code:
BDEPTH: 1005 866 Validity code:
Towing dir: 358ø Wire out: 450 m Speed: 35 kn*10

Sorted: Kg Total catch: 33.75 CATCH/HOUR: 96.43

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| MYCTOPHIDAE | 96.43 | 165306 | 100.00 | |
| Total | 96.43 | | 100.00 | |

PROJECT STATION: 216

DATE:22/ 7/04 GEAR TYPE: BT No:15 POSITION:Lat S 403
start stop duration Long E 1059
TIME :15:21:11 15:51:06 30 (min) Purpose code: 3
LOG :3288.68 3290.23 1.55 Area code : 8
FDEPTH: 41 40 GearCond.code:
BDEPTH: 41 40 Validity code:
Towing dir: 130ø Wire out: 160 m Speed: 31 kn*10

Sorted: 121 Kg Total catch: 609.21 CATCH/HOUR: 1218.42

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Brachydeuterus auritus | 649.80 | 28224 | 53.33 | |
| Trichiurus lepturus | 231.00 | 4692 | 18.96 | |
| Pteroscion peli | 177.00 | 6864 | 14.53 | |
| Paragaleus pectoralis | 27.20 | 12 | 2.23 | |
| Pentheroscion mbizi | 20.98 | 252 | 1.72 | |
| Pseudotolithus brachygnathus | 20.16 | 72 | 1.65 | |
| Schedophilus pemarco | 16.32 | 84 | 1.34 | |
| Ephippion guttifer | 15.48 | 12 | 1.27 | |
| Raja miraletus | 12.24 | 24 | 1.00 | |
| Trachurus trecae, juvenile | 11.52 | 900 | 0.95 | 347 |
| Sepiella ornata | 11.28 | 924 | 0.93 | |
| Penaeus notialis | 10.48 | 324 | 0.86 | |
| Arius sp. | 6.06 | 8 | 0.50 | |
| Rhinobatos albomaculatus | 3.02 | 2 | 0.25 | |
| Sepia officinalis hierredda | 2.52 | 36 | 0.21 | |
| Lolligoncula mercatoris | 1.44 | 420 | 0.12 | |
| Parapenaeopsis atlantica | 0.72 | 228 | 0.06 | |
| Pseudupeneus prayensis | 0.36 | 12 | 0.03 | |
| Umbrina canariensis | 0.36 | 12 | 0.03 | |
| Hemicaranx bicolor | 0.12 | 12 | 0.01 | |
| Selene dorsalis | 0.12 | 12 | 0.01 | |
| Chloroscombrus chrysurus | 0.12 | 24 | 0.01 | |
| Penaeus sp. | 0.12 | 4 | 0.01 | |
| Total | 1218.42 | | 100.01 | |

PROJECT STATION: 217

DATE:22/ 7/04 GEAR TYPE: PT No: 4 POSITION:Lat S 409
start stop duration Long E 1108
TIME :18:45:13 19:17:46 33 (min) Purpose code: 3
LOG :3312.35 3314.17 1.80 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 32 40 Validity code:
Towing dir: 230ø Wire out: 140 m Speed: 33 kn*10

Sorted: 114 Kg Total catch: 588.52 CATCH/HOUR: 1070.04

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella aurita - Juveniles | 761.13 | 21480 | 71.13 | |
| Brachydeuterus auritus | 171.27 | 15567 | 16.01 | |
| Sphyraena afra | 32.91 | 2 | 3.08 | |
| Sardinella aurita | 25.96 | 371 | 2.43 | 351 |
| Sardinella maderensis | 20.40 | 295 | 1.91 | 349 |
| Trichiurus lepturus | 17.56 | 687 | 1.64 | |
| Sardinella maderensis - Juv. | 16.15 | 1222 | 1.51 | 348 |
| Trachurus trecae, juvenile | 15.71 | 1145 | 1.47 | 350 |
| Sepiella ornata | 5.45 | 33 | 0.51 | |
| Pteroscion peli | 5.02 | 98 | 0.47 | |
| Engraulis encrasicolus | 3.71 | 11 | 0.35 | |
| Total | 1075.27 | | 100.51 | |

PROJECT STATION: 218

DATE:23/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 421
start stop duration Long E 1108
TIME :01:07:16 01:37:18 30 (min) Purpose code: 3
LOG :3367.59 3369.40 1.77 Area code : 9
FDEPTH: 0 0 GearCond.code:
BDEPTH: 82 73 Validity code:
Towing dir: 50ø Wire out: 150 m Speed: 36 kn*10

Sorted: Kg Total catch: 181.20 CATCH/HOUR: 362.40

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Mobula rochebrunei | 330.00 | 6 | 91.06 | |
| Caranx crysos | 19.76 | 16 | 5.45 | |
| Saurida brasiliensis | 4.22 | 690 | 1.16 | |
| Sepia bertheloti | 3.40 | 1546 | 0.94 | |
| Sepiella ornata | 2.28 | 48 | 0.63 | |
| Echeneis naucrates | 1.32 | 6 | 0.36 | |
| Trichiurus lepturus | 0.76 | 2 | 0.21 | |
| Octopus vulgaris | 0.44 | 2 | 0.12 | |
| Remora remora | 0.22 | 8 | 0.06 | |
| Total | 362.40 | | 99.99 | |

PROJECT STATION: 219

DATE:23/ 7/04 GEAR TYPE: PT No: 1 POSITION:Lat S 416
start stop duration Long E 1114
TIME :03:19:49 03:50:05 30 (min) Purpose code: 3
LOG :3377.81 3379.68 1.82 Area code : 9
FDEPTH: 0 0 GearCond.code:
BDEPTH: 39 32 Validity code:
Towing dir: 50ø Wire out: 150 m Speed: 37 kn*10

Sorted: 164 Kg Total catch: 766.62 CATCH/HOUR: 1533.24

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella aurita | 1207.80 | 6370 | 78.77 | 353 |
| Sardinella maderensis | 229.90 | 3586 | 14.99 | 352 |
| Sphyraena afra | 60.80 | 4 | 3.97 | |
| Scomber japonicus | 21.00 | 188 | 1.37 | |
| Sardinella maderensis - Juv. | 11.88 | 2256 | 0.77 | 354 |
| Sardinella aurita - Juveniles | 1.86 | 154 | 0.12 | |
| Total | 1533.24 | | 99.99 | |

PROJECT STATION: 220

DATE:23/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 417
start stop duration Long E 1122
TIME :05:28:10 05:48:43 21 (min) Purpose code: 3
LOG :3391.88 3393.06 1.16 Area code : 9
FDEPTH: 10 10 GearCond.code:
BDEPTH: 21 21 Validity code:
Towing dir: 320ø Wire out: 170 m Speed: 35 kn*10

Sorted: 127 Kg Total catch: 636.16 CATCH/HOUR: 1817.60

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella aurita | 1410.86 | 15137 | 77.62 | 357 |
| Trichiurus lepturus | 86.91 | 2811 | 4.78 | |
| Stromateus fiatola | 74.06 | 189 | 4.07 | |
| Brachydeuterus auritus | 57.94 | 1234 | 3.19 | |
| Rhizoprionodon acutus | 37.71 | 23 | 2.07 | |
| Sardinella maderensis | 26.91 | 4766 | 1.48 | 356 |
| Raja miraletus | 13.71 | 17 | 0.75 | |
| Chloroscombrus chrysurus | 13.49 | 137 | 0.74 | |
| Schedophilus pemarco | 13.03 | 34 | 0.72 | |
| Selene dorsalis | 11.83 | 566 | 0.65 | |
| Arius latiscutatus | 9.94 | 3 | 0.55 | |
| Pteroscion peli | 9.09 | 69 | 0.50 | |
| Sardinella maderensis - Juv. | 8.91 | 2829 | 0.49 | 355 |
| Arius gigas | 8.91 | 6 | 0.49 | |
| Sepiella ornata | 8.23 | 86 | 0.45 | |
| Trachurus trecae | 7.37 | 34 | 0.41 | |
| Arius parkii | 5.40 | 3 | 0.30 | |
| Sepia officinalis hierredda | 4.60 | 3 | 0.25 | |
| Arius heudeloti | 4.57 | 6 | 0.25 | |
| Ilisha africana | 3.60 | 206 | 0.20 | |
| Lagocephalus laevigatus | 0.51 | 17 | 0.03 | |
| Total | 1817.58 | | 99.99 | |

PROJECT STATION: 221

DATE:24/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 451
start stop duration Long E 1135
TIME :00:45:19 01:16:10 31 (min) Purpose code: 3
LOG :3558.53 3560.45 1.87 Area code : 9
FDEPTH: 0 0 GearCond.code:
BDEPTH: 79 70 Validity code:
Towing dir: 50ø Wire out: 140 m Speed: 37 kn*10

Sorted: Kg Total catch: 82.67 CATCH/HOUR: 160.01

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Mobula sp. | 135.48 | 2 | 84.67 | |
| Trichiurus lepturus | 9.52 | 343 | 5.95 | |
| Caranx crysos | 4.82 | 4 | 3.01 | |
| Sepiella ornata | 3.85 | 97 | 2.41 | |
| Sepia bertheloti | 3.72 | 681 | 2.32 | |
| Saurida brasiliensis | 2.59 | 486 | 1.62 | |
| Hippocampus sp. | 0.02 | 2 | 0.01 | |
| Total | 160.00 | | 99.99 | |

PROJECT STATION: 222

DATE:24/ 7/04 GEAR TYPE: PT No: 1 POSITION:Lat S 446
start stop duration Long E 1142
TIME :03:02:43 03:32:29 30 (min) Purpose code: 3
LOG :3569.14 3571.01 1.77 Area code : 9
FDEPTH: 0 0 GearCond.code:
BDEPTH: 41 35 Validity code:
Towing dir: 50ø Wire out: 150 m Speed: 36 kn*10

Sorted: 61 Kg Total catch: 483.33 CATCH/HOUR: 966.66

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Mobula sp. | 600.00 | 8 | 62.07 | |
| Trichiurus lepturus | 365.40 | 4060 | 37.80 | |
| Sepiella ornata | 1.08 | 60 | 0.11 | |
| Echeneis naucrates | 0.18 | 6 | 0.02 | |
| Total | 966.66 | | 100.00 | |

PROJECT STATION: 223

DATE:24/ 7/04 GEAR TYPE: PT No: 7 POSITION:Lat S 536
start stop duration Long E 1203
TIME :18:30:14 18:59:57 30 (min) Purpose code: 3
LOG :3701.26 3702.95 1.69 Area code : 8
FDEPTH: 0 0 GearCond.code:
BDEPTH: 24 24 Validity code:
Towing dir: 187ø Wire out: 150 m Speed: 33 kn*10

Sorted: Kg Total catch: 20.10 CATCH/HOUR: 40.20

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Trichiurus lepturus | 16.08 | 284 | 40.00 | |
| Sepia juveniles | 14.18 | 2666 | 35.27 | |
| J E L L Y F I S H | 4.52 | 6 | 11.24 | |
| Sepiella ornata | 2.64 | 164 | 6.57 | |
| Stromateus fiatola | 1.44 | 6 | 3.58 | |
| Brachydeuterus auritus | 0.46 | 12 | 1.14 | |
| Schedophilus pemarco | 0.44 | 2 | 1.09 | |
| Trachurus trecae | 0.28 | 2 | 0.70 | |
| Ilisha africana | 0.16 | 4 | 0.40 | |
| Total | 40.20 | | 99.99 | |

PROJECT STATION: 224

DATE:24/ 7/04 GEAR TYPE: PT No: 6 POSITION:Lat S 548
start stop duration Long E 1157
TIME :21:28:59 21:58:07 29 (min) Purpose code: 3
LOG :3719.58 3721.22 1.63 Area code : 4
FDEPTH: 10 10 GearCond.code:
BDEPTH: 43 38 Validity code:
Towing dir: 90ø Wire out: 150 m Speed: 33 kn*10

Sorted: Kg Total catch: 138.50 CATCH/HOUR: 286.55

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella maderensis | 64.76 | 850 | 22.60 | 359 |
| Nematopalaemon hastatus | 63.41 | 321598 | 22.13 | |
| Sphyraena afra | 52.97 | 2 | 18.49 | |
| Pentheroscion mbizi | 31.97 | 815 | 11.16 | |
| Trichiurus lepturus | 28.55 | 701 | 9.96 | |
| Sardinella aurita | 14.28 | 271 | 4.98 | 358 |
| Stromateus fiatola | 12.60 | 25 | 4.40 | |
| Sphyrna couardi | 11.90 | 2 | 4.15 | |
| Sepiella ornata | 3.37 | 91 | 1.18 | |
| Scomber japonicus | 1.34 | 10 | 0.47 | |
| Sepia officinalis hierredda | 1.14 | 33 | 0.40 | |
| Penaeus notialis | 0.14 | 2 | 0.05 | |
| Remora remora | 0.10 | 4 | 0.03 | |
| Selene dorsalis | 0.02 | 2 | 0.01 | |
| Total | 286.55 | | 100.01 | |

PROJECT STATION: 225

DATE:25/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 548
start stop duration Long E 1144
TIME :00:49:43 01:20:04 30 (min) Purpose code: 3
LOG :3739.60 3741.54 1.89 Area code : 4
FDEPTH: 0 0 GearCond.code:
BDEPTH: 91 101 Validity code:
Towing dir: 169ø Wire out: 150 m Speed: 38 kn*10

Sorted: Kg Total catch: 125.85 CATCH/HOUR: 251.70

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Sardinella maderensis | 179.70 | 908 | 71.39 | 360 |
| Trichiurus lepturus | 49.20 | 678 | 19.55 | |
| Pentheroscion mbizi | 15.58 | 3652 | 6.19 | |
| Selene dorsalis | 3.14 | 24 | 1.25 | |
| Caranx crysos | 1.74 | 2 | 0.69 | |
| Saurida brasiliensis | 1.12 | 210 | 0.44 | |
| Sepiella ornata | 0.60 | 16 | 0.24 | |
| Chloroscombrus chrysurus | 0.26 | 2 | 0.10 | |
| Remora remora | 0.24 | 2 | 0.10 | |
| BREGMACEROTIDAE | 0.12 | 10 | 0.05 | |
| Total | 251.70 | | 100.00 | |

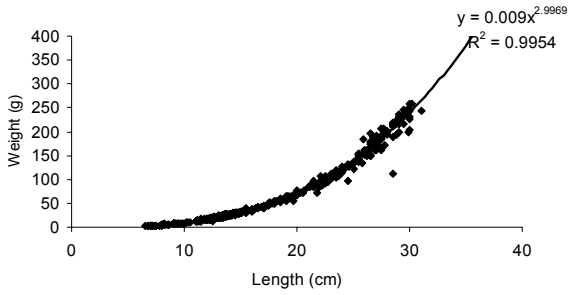
R/V "DR. FRIDTJOF NANSEN" PROJECT:G3 PROJECT STATION: 226

DATE:26/ 7/04 GEAR TYPE: PT No: 2 POSITION:Lat S 558
start stop duration Long E 1203
TIME :02:29:07 02:59:07 30 (min) Purpose code: 3
LOG :3884.01 3885.95 1.90 Area code : 4
FDEPTH: 0 0 GearCond.code:
BDEPTH: 36 42 Validity code:
Towing dir: 270ø Wire out: 150 m Speed: 38 kn*10

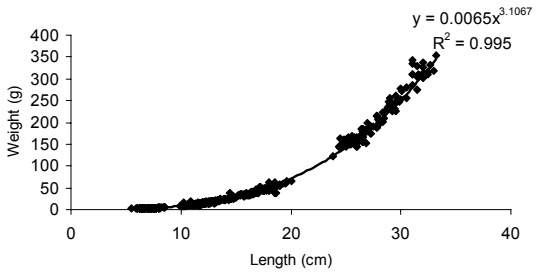
Sorted: Kg Total catch: 84.16 CATCH/HOUR: 168.32

| SPECIES | CATCH/HOUR weight | numbers | % OF TOT. C | SAMP |
|---|---|---|---|---|
| Trichiurus lepturus | 93.90 | 972 | 55.79 | |
| Selene dorsalis | 21.10 | 108 | 12.54 | |
| Sardinella maderensis | 16.90 | 110 | 10.04 | 361 |
| Pentheroscion mbizi | 16.78 | 926 | 9.97 | |
| Arius heudeloti | 7.40 | 2 | 4.40 | |
| Sepiella ornata | 4.04 | 120 | 2.40 | |
| Trachurus trecae | 3.70 | 16 | 2.20 | |
| Stromateus fiatola | 2.72 | 4 | 1.62 | |
| Saurida brasiliensis | 0.82 | 132 | 0.49 | |
| Sepia officinalis hierredda | 0.48 | 244 | 0.29 | |
| Ilisha africana | 0.38 | 4 | 0.23 | |
| BREGMACEROTIDAE | 0.10 | 136 | 0.06 | |
| Total | 168.32 | | 100.03 | |

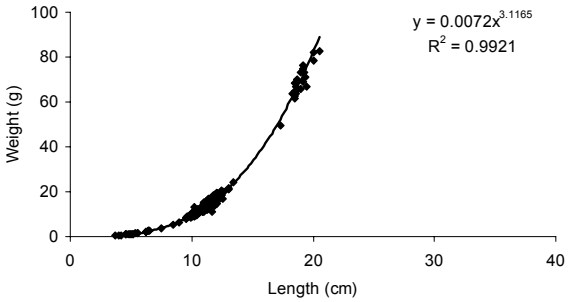
# Annex II Biological parameters of target species



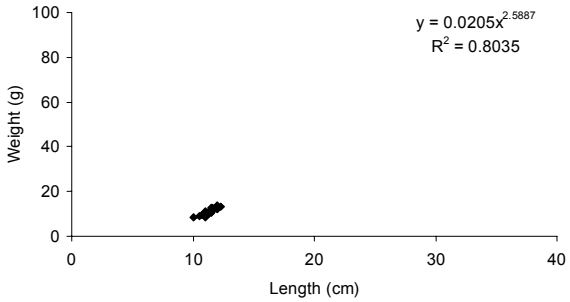

*Sardinella maderensis*



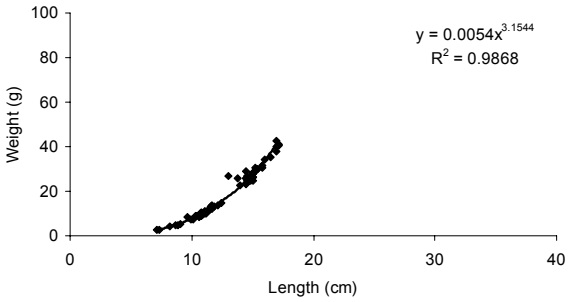

*Sardinella aurita*




*Trachurus trecae*




*Engraulis encrasicolus*




*Scomber japonicus*

Figure IV a) Length-weight relationship for target species

# Annex III Plankton sampling

Summary of phytoplankton samples taken in the area covered (Gabon, Congo, RDC and Cabinda-Angola) during the sardinella recruitment survey from 15-26 July 2004. All samples are stored in Luanda and will be analysed as part of the ongoing BCLME project on sardinella that this survey is a part of.

| N° | CTD Station | N° of Samples | Depth (m) |
|---|---|---|---|
| 1 | 0938 | 3 | 16-50 |
| 2 | 0943 | 4 | 05-50 |
| 3 | 0944 | 2 | 05-15 |
| 4 | 0946 | 4 | 05-50 |
| 5 | 0948 | 4 | 04-50 |
| 6 | 0950 | 4 | 06-50 |
| 7 | 0951 | 4 | 06-50 |
| 8 | 0952 | 4 | 06-52 |
| 9 | 0953 | 3 | 06-36 |
| 10 | 0954 | 2 | 05-18 |
| 11 | 0955 | 4 | 08-50 |
| 12 | 0956 | 3 | 05-37 |
| 13 | 0957 | 4 | 05-51 |
| 14 | 0958 | 4 | 08-44 |
| 15 | 0959 | 4 | 07-51 |
| 16 | 0960 | 4 | 05-51 |
| 17 | 0961 | 4 | 07-51 |
| 18 | 0962 | 3 | 05-36 |
| 19 | 0963 | 4 | 05-46 |
| 20 | 0964 | 2 | 05-18 |
| 21 | 0965 | 3 | 06-36 |
| 22 | 0966 | 4 | 06-47 |
| 23 | 0968 | 4 | 08-40 |
| 24 | 0974 | 4 | 06-43 |
| 25 | 0975 | 2 | 07-14 |
| 26 | 0977 | 4 | 06-41 |
| 27 | 0979 | 3 | 21-42 |
| 28 | 0985 | 4 | 06-42 |
| 29 | 0986 | 2 | 07-15 |
| 30 | 0988 | 3 | 21-43 |
| 31 | 0989 | 1 | 23 |
| 32 | 0990 | 3 | 07-36 |
| 33 | 1024 | 4 | 07-44 |

| | | | |
|---|---|---|---|
| 34 | 1031 | 4 | 07-41 |

Summary of zooplankton samples taken in the area covered (Gabon, Congo, RDC and Cabinda-Angola) during the sardinella recruitment survey from 15-26 July 2004. All samples are stored in Luanda and will be analysed as part of the ongoing BCLME project on sardinella that this survey is a part of.

| DATE | CTD Station | Station | Coordinate | | N° of samples | Net number | Depth (m) |
|---|---|---|---|---|---|---|---|
| | | | LAT. | LONG. | | | |
| 15.07.04 | 924 | 01 | S 0º 04. 75 | E 9º 02. 6 | 5 | 1 | 50 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 00 |
| 16.07.04 | 930 | 02 | S 0º 37. 48 | E 8º 41. 49 | 5 | 1 | 16 – 15 |
| | | | | | | 2 | 15 – 10 |
| | | | | | | 3 | 10 – 05 |
| | | | | | | 4 | 05 - 01 |
| | | | | | | 5 | 01 - 00 |
| 16.07.04 | 931 | 03 | S 0º 37. 217 | E 8º 41. 225 | 5 | 1 | 50 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 00 |
| 17.07.04 | 943 | 04 | S 1º 44. 318 | E 8º 59. 285 | 5 | 1 | 44 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 8 |
| | | | | | | 5 | 08 – 00 |
| 17.07.04 | 944 | 05 | S 1º 38. 174 | E 9º 07. 831 | 5 | 1 | 16 – 15 |
| | | | | | | 2 | 15 – 10 |
| | | | | | | 3 | 10 – 05 |
| | | | | | | 4 | 05 – 02 |
| | | | | | | 5 | 02 – 00 |
| 17.07.04 | 946 | 06 | S 2º 05. 987 | E 9º 06. 499 | 5 | 1 | 48,5 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 0 |
| 18.07.04 | 949 | 07 | S 2º 22. 550 | E 9º 17. 337 | 5 | 1 | 45 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 0 |
| 19.07.04 | 953 | 08 | S 2º 37. 162 | E 9º 30. 91 | 5 | 1 | 47 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | 5 | 10 – 0 |
| 19.07.04 | 954 | 09 | S 2º 30. 666 | E 9º 39. 449 | 2 | 1 | 15 – 10 |
| | | | | | | 2 | 10 – 0 |
| 19.07.04 | 956 | 10 | S 2º 52. 031 | E 9º 45. 776 | 5 | 1 | 45 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 19 |
| | | | | | | 4 | 19 – 10 |
| | | | | | | 5 | 10 – 0 |
| 20.07.04 | 958 | 11 | S 3º 05.763 | E 10º 00. 054 | 5 | 1 | 45 –40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 19 |
| | | | | | | 4 | 19 – 10 |
| | | | | | | 5 | 10 – 0 |
| 20.07.04 | 963 | 12 | S 3º 20. 467 | E 10º 13. 994 | 5 | 1 | 46 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 0 |
| 20.07.04 | 964 | 13 | S 3º 12. 080 | E 10º 24. 587 | 2 | 1 | 18 – 10 |
| | | | | | | 2 | 10 – 0 |
| 22.07.04 | 966 | 14 | S 3º 34. 727 | E 10º 27. 974 | 5 | 1 | 48 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 0 |
| 22.07.04 | 968 | 15 | S 3º 48. 655 | E 10º 42. 733 | 5 | 1 | 45 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 0 |
| 22.07.04 | 974 | 16 | S 4º 02. 522 | E 10º 57. 245 | 5 | 1 | 46 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 0 |
| 22.07.04 | 975 | 17 | S 3º 59. 606 | E 11º 01. 382 | 2 | 1 | 16 – 10 |
| | | | | | | 2 | 10 – 0 |
| 23.07.04 | 977 | 18 | S 4º 17. 588 | E 11º 13. 253 | 5 | 1 | 45 – 37 |
| | | | | | | 2 | 37 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 00 |
| 23.07.04 | 979 | 19 | S 4º 31. 742 | E 11º 27. 242 | 5 | 1 | 45 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24.07.04 | 985 | 20 | S 4º 47. 275 | E 11º 40. 368 | 5 | 1 | 45 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 00 |
| 24.07.04 | 986 | 21 | S 4º 43. 390 | E 11º 45. 577 | 2 | 1 | 15 – 10 |
| | | | | | | 2 | 10 – 00 |
| 24.07.04 | 988 | 22 | S 5º 21. 246 | E 11º 52. 063 | 5 | 1 | 45 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 – 10 |
| | | | | | | 5 | 10 – 00 |
| 24.07.04 | 989 | 23 | S 5º 47. 678 | E 12º 02.018 | 5 | 1 | 25 – 20 |
| | | | | | | 2 | 20 –10 |
| | | | | | | 3 | 10 – 00 |
| 24.07.04 | 990 | 24 | S 5º 47. 664 | E 11º 55.521 | 5 | 1 | 45 – 39 |
| | | | | | | 2 | 39 –30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 –10 |
| | | | | | | 5 | 10 – 0 |
| 26.07.04 | 1024 | 25 | S 5º 58. 086 | E 11º 58. 506 | 5 | 1 | 45 – 40 |
| | | | | | | 2 | 40 – 30 |
| | | | | | | 3 | 30 – 20 |
| | | | | | | 4 | 20 –10 |
| | | | | | | 5 | 10 – 0 |
| 26.07.04 | 1031 | 26 | S 6º 04. 706 | E 12º 05. 561 | 4 | 1 | 34 – 30 |
| | | | | | | 2 | 30 – 20 |
| | | | | | | 3 | 20 – 10 |
| | | | | | | 4 | 10 – 00 |

# Annex IV Instruments and fishing gear used

The Simrad EK-500, 38kHz scientific echosounder was used for abundance estimation during the survey, in addition data from the 18 kHz, 120 kHz and 200 kHz transducers where logged for possible future multifrequency target estimation. The BEI were logging the echogram raw data from the sounder and used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data were stored to tape, and a backup of the database of scrutinized data, stored. The details of the settings of the echosounders were as follows:

**Transceiver 1 menu**

| | |
|---|---|
| Transducer depth | 5.5 m |
| Absorption coeff. | 10 dB/km |
| Pulse length | medium (1ms) |
| Bandwidth | wide |
| Max power | 2000 Watt |
| 2-way beam angle | -21.0 dB |
| SV transducer gain | 26.98 dB |
| TS transducer gain | 27.15 dB |
| Angle sensitivity | 21.9 |
| 3 dB beamwidth along. | 6.8° |
| 3 dB beamwidth athw. | 6.7° |
| Alongship offset | -0.07° |
| Athwardship offset | 0.07° |

**Transceiver 2 menu**

| | |
|---|---|
| Transducer depth | 5.5 m |
| Absorption coeff. | 38 dB/km |
| Pulse length | long (1ms) |
| Bandwidth | narrow |
| Max power | 1000 Watt |
| 2-way beam angle | -20.6 dB |
| SV transducer gain | 25.69 dB |
| TS transducer gain | 25.99 dB |
| Angle sensitivity | 21.0 |
| 3 dB beamwidth along. | 7.2° |
| 3 dB beamwidth athw. | 7.3° |
| Alongship offset | -0.04° |
| Athwardship offset | -0.43° |

**Transceiver 3 menu**

| | |
|---|---|
| Transducer depth | 5.5 m |
| Absorption coeff. | 3 dB/km |
| Pulse length | short (0.7ms) |
| Bandwidth | wide |
| Max power | 2000 Watt |
| 2-way beam angle | -17.2 dB |
| SV transducer gain | 23.73 dB |
| TS transducer gain | 23.45 dB |
| Angle sensitivity | 13.9 |
| 3 dB beamwidth along. | 11.1° |
| 3 dB beamwidth athw. | 11.0° |
| Alongship offset | -0.21° |
| Athwardship offset | 0.09° |

**Transceiver 4 menu**

| | |
|---|---|
| Transducer depth | 5.5 m |
| Absorption coeff. | 53 dB/km |
| Pulse length | long (0.6ms) |
| Bandwidth | narrow |
| Max power | 1000 Watt |
| 2-way beam angle | -20.5 dB |
| SV transducer gain | 24.08 dB |
| TS transducer gain | 24.80 dB |
| Angle sensitivity | 0.0 |
| 3 dB beamwidth along. | 0.0° |
| 3 dB beamwidth athw. | 0.0° |
| Alongship offset - | 0.00° |
| Athwardship offset | 0.00° |

**Display menu**

| | |
|---|---|
| Echogram | 1 |
| Bottom range | 15 m |
| Bottom range start | 10 m |
| TVG | 20 log R |
| Sv colour min - | 67 dB |
| TS Colour minimum | -65 dB |

**Printer- menu**

| | |
|---|---|
| Range | 0-50, 0-100, 0-150, 0-250 or 0-500 m |
| TVG | 20 log R |
| Sv colour min | -60 dB |

**Bottom detection menu**

| | |
|---|---|
| Minimum level | -50 dB |

**Calibration**

The 38 kHz transducer was calibrated 08.11.2003, Dakar, Senegal.

The 120 kHz transducer was calibrated 18.03.2004, Baia dos Elephantes, Angola.

The 18 kHz and 200kHz transducer was calibrated 17.08.2003, Langstrand, Namibia.

**Fishing gear**

The vessel has two different sized "Aakrahamn" pelagic trawls and one "Gisund super" bottom trawl. For all trawls, the Thyborøen, 7.8m² (1670 kg) trawl doors were used.

The bottom trawl has a headline of 31 m, footrope 47 m and mesh size of 20 mm in the codend with an inner net with mesh size of 10 mm. The estimated opening is 6 m (observed 5.7) and distance between wings during towing about 18 m. The sweeps are 40 m long. The trawl is equipped with a 12" rubber bobbins gear. The doors are of Thyborøen combi type, 7.81 $m^2$, 1670 kg, their distance while trawling about was 45 - 55 m in average, depending on the depth (least distance at low depths). This distance can be kept constant (about 50 m) at all depths by the use of a 9.5 m strap between the wires at 130 m distance from the doors, normally applied at depths greater than 80 m. On the present survey, however, the strap was not applied because most of the trawl hauls were made in shallower waters.

The SCANMAR system was used on all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their distance and a height sensor is fitted to the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

The pelagic trawl can be equipped with a trawl eye that provides information on the trawl opening and the distance of the footrope to the bottom.