

## CHAPTER 1 INTRODUCTION

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### 1.1 OBJECTIVES

The main objectives of the survey were to:

- Conduct an acoustic survey to map the distribution and estimate the abundance of the main pelagic species, i.e. sardinella, Cunene horse mackerel and other pelagic/semipelagic species;
- Describe the distribution, composition and abundance of the demersal fish stocks by a swept-area trawl programme;
- Map the general hydrographic regime by using a CTD-sonde and monitor the temperature, salt and oxygen regimes on standard profiles.

### 1.2 PARTICIPATION

From the Direction Générale de la Pêche, Brazzaville:

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From the Direction Générale de la Pêche et de l'Aquaculture, Libreville:

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### 1.3 NARRATIVE

The survey started at Pointe Noire in the afternoon 14 August 1995 with the hydrographic profile off Pointe Noire. Systematic transects, 12-13 nm apart, were sailed from close to the shore (20 m depth) to beyond the 200 m isobath. Semi-random bottom trawl hauls for swept-area estimates were made during daytime, trying to cover the different depth ranges. This was sometimes hindered by rough bottom. Pelagic trawling with mid-water trawl was mainly carried out during dark hours and echo-integration to map distribution and estimate acoustic abundance of pelagic species was carried out during both day and night time.

The shelf and slope off Congo were covered from 14 to 17 August. In the southern part, trawling on the inner shelf was limited by the presence of oil rigs and pipelines. The Gabon shelf south of the protected area off Cap Lopez was surveyed during 17 to 23 August, and the hydrographic profiles off Pointe Panga and off Iguéla were made on 19 and 23 August respectively.

The survey terminated just south of the protected area on 23 August, after which the vessel steamed southwards to Pointe Noire.

### 1.4 SURVEY EFFORT

Figure 1 shows the course tracks with fishing stations and the hydrographic profiles and Table 1 presents the number of CTD and trawl stations and the distance surveyed.

Area	CTD	PT	BT	Swept-area hauls			Distance surveyed (nm)
				0-50m	50-200m	200-400m	
Congo	19	2	20	5	9	6	380
Gabon	33	7	35	7	19	7	875
Total	52	9	55	12	28	13	1255

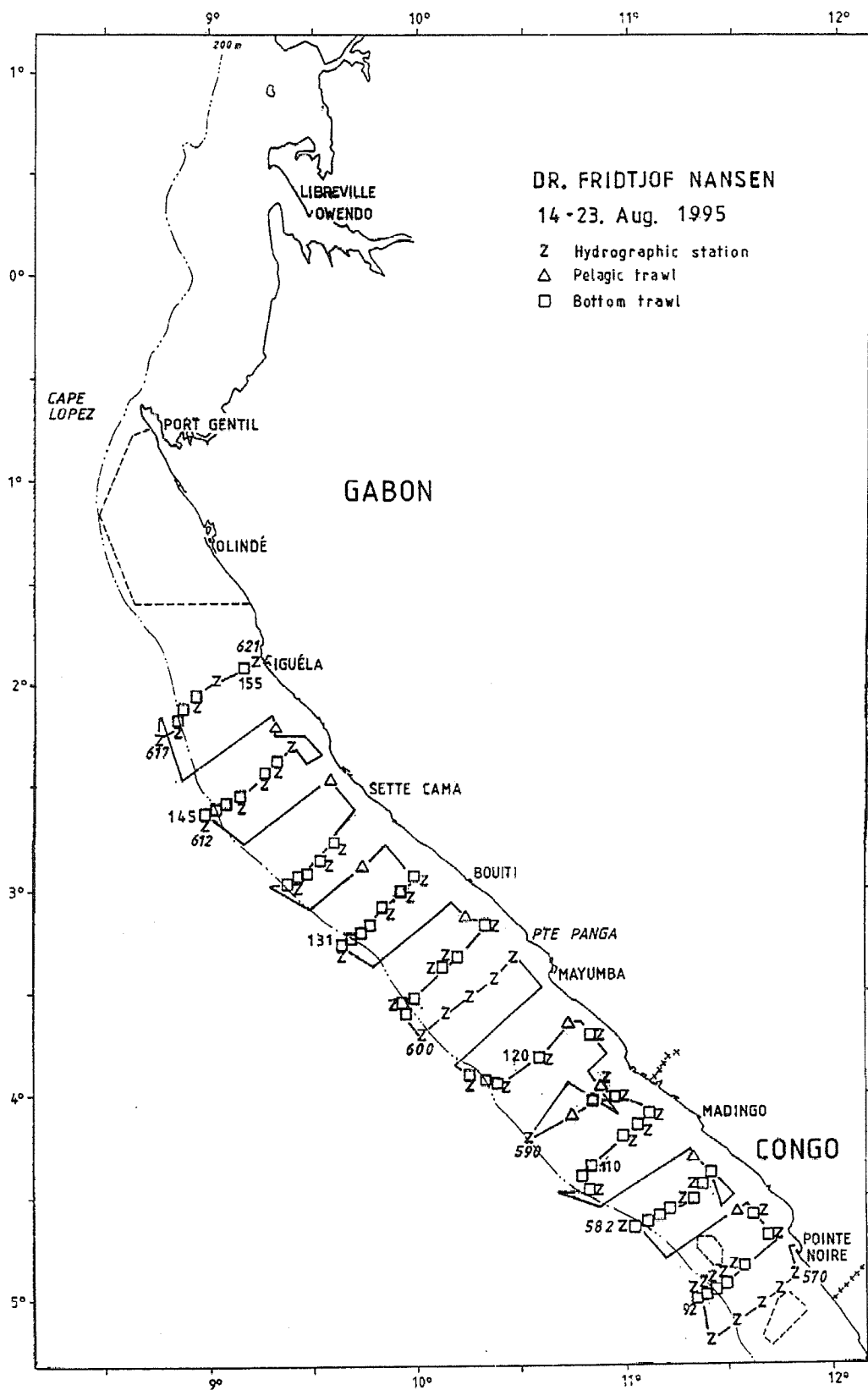


Fig. 1 Course tracks with fishing stations and CTD-stations

## CHAPTER 2 METHODS

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### 2.1 Hydrographic sampling

A Seabird 911 CTD plus was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. The profiles were taken down to a few metres above the bottom.

#### *ADCP current measurements*

A ship born Acoustic Doppler Current Profiler (ADCP) from RD Instruments was activated on every trawl and CTD station where bottom tracking was obtained, i.e. bottom depths less than about 400 m. The ADCP was set to ping every 8 seconds, the depth cell was chosen to 8 m and the number of cells to 50. As a routine the data were averaged over 300 seconds for analyses. Both the raw and averaged data were stored on files.

#### *Meteorological observations*

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

### 2.2 Fish sampling

The catches were sampled for species composition, by weight and numbers. Length distributions (total length, also for shrimp) were taken for the main species. Biological samples, i.e. length and body weight were recorded for sardinella and horse mackerel to the nearest 1 cm or 1 g below, respectively. Records of fishing stations are presented in Annex I and pooled length frequency distributions of selected species are shown in Annex II. A detailed description of the fishing gear used, the acoustic instruments and their standard settings is given in Annex IV.

*Acoustic survey*

The following target strength (TS) function was applied to convert  $S_A$ -values (mean integrator value for a given area) to number of fish (sardinella and horse mackerel):

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

or on the form

$$C_F = 1.26 \cdot 10^6 \cdot L^{-2} \quad (2)$$

where  $L$  is total length and  $C_F$  is the fish conversion factor. The following formula was used to calculate the number of fish in length groups (cm) for each fish concentration:

$$N_i = A \cdot S_A \cdot \frac{p_i}{\sum_{i=1}^n \frac{p_i}{C_{Fi}}} \quad (3)$$

where

$N_i$  = number of fish in length group  $i$

$A$  = area (naut.miles<sup>2</sup>) of fish concentration

$S_A$  = mean integrator value in area ( $A$ )

$p_i$  = proportion of fish in length group  $i$  in samples from the area

$C_{Fi}$  = fish conversion factor for length group  $i$

The number per length group ( $N_i$ ) was then summed and the total number of fish obtained:

$$N = \sum_{i=1}^n N_i \quad (4)$$

The length distribution of a given species within an area was computed by adding the length frequencies obtained in each trawl sample within the area. In the case of co-occurrence of *Sardinella aurita* and *S. maderensis* (these species cannot be separated in the echo traces), the respective contribution to the  $S_A$  value attributed to the 'sardinella' category was split using a factor obtained from their length frequency distributions and their CPUE in numbers. The biomass of fish per length group ( $B_i$ ) was calculated by applying observed mean weights per length group ( $\bar{W}_i$ ) multiplied by number of fish in the same length groups ( $N_i$ ). The total biomass in each area was obtained by summing the biomass of each length group:

$$B = \sum_{i=1}^n N_i \bar{W}_i \quad (5)$$

The number and biomass per length group in each concentration were at last summed to obtain the totals for each region.

The mean integrator values in each sampling unit ( $S_A$ -values) were divided between the following categories of fish on the basis of trawl catches and characteristics of the echo traces:

- plankton
- sardinella (*S. aurita* and *S. maderensis*)
- horse mackerel
- PEL1 (anchovies, clupeids)
- PEL2 (carangids, scombrids, barracudas and hairtail)
- big eye grunt (*Brachydeuterus auritus*)
- other demersal fish

#### *Bottom trawl survey*

Table 2 shows the areas used in the swept-area biomass estimates.

Table 2. Areas used in the swept-area biomass estimates (nm <sup>2</sup> )		
Depth stratum	Congo	Gabon
0- 50 m	750	4182
50-200 m	1770	2893

The bottom trawl has a headline of 31m (float line), footrope 47 m, estimated headline height 5 m and distance between wings during towing about 18 m. During trawling a 9.5 m long rope was fastened between the wires 130 m in front of the doors giving a constant distance between the doors of 49-50 m. All trawl hauls were monitored by SCANMAR trawl sensors (bottom contact, headline height and distance between the doors) and the actual time the trawl was fishing on the bottom was determined by help of the sensors. For conversion of catch rates to fish densities the area between the wings is assumed to be the effective fishing area i.e. the catchability coefficient  $q$  is equal to 1. There was some occurrence of both hake and sparids more than 5 m above the bottom, and this may have reduced their swept-area estimates.

## CHAPTER 3 OCEANOGRAPHIC CONDITIONS

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### 3.1 Surface distribution

The horizontal distribution of temperature and salinity are shown in Fig. 2 and 3 respectively. Temperatures range from 20° C in south at the Cabinda border to above 24° C north of Sette Cama. The salinity was lowest in the south (34.7-35.1) and the distribution seems to be influenced by a near shore current deflecting water of lower salinity northwards, possibly from the Congo River. From the Congo/Gabon border to Pointe Panga the salinity values were about 35.8 - 35.9, after which they gradually declined to 34.7 off Sette Cama.

### 3.2 Vertical sections

In the section off Pointe Noire (Fig. 4) the surface temperature was 20-21 °C, which is about the same as in August last year. The main thermocline was observed near the surface. This year only weak signs of off shore low surface salinity were observed. The oxygen distribution gives an impression of a weak upwelling situation, but the oxygen content on the shelf is not likely to limit the distribution of fish, and neither the temperature nor the salinity distribution show characteristics typical for upwelling.

In the section off Pointe Panga (Fig. 5) the thermocline was a little stronger than off Pointe Noire and it was observed at about 25 m. The surface temperature was 23 °C. Like in August 1994 the surface layer was more saline than off Pointe Noire, indicating less influence by the Congo River. The oxygen content on the bottom of the shelf was slightly higher than off Point Noire.

In the section off Iguéla (Fig. 6) the surface temperature was 24 °C and the thermocline was observed at about 10 m. It was stronger than off Pointe Panga. The surface water was less saline than off Pointe Panga, almost as low as off Pointe Noire. The oxygen content in the surface layer was slightly lower than in the two other profiles. Both the oxygen and salinity distribution give an impression of a weak upwelling situation.

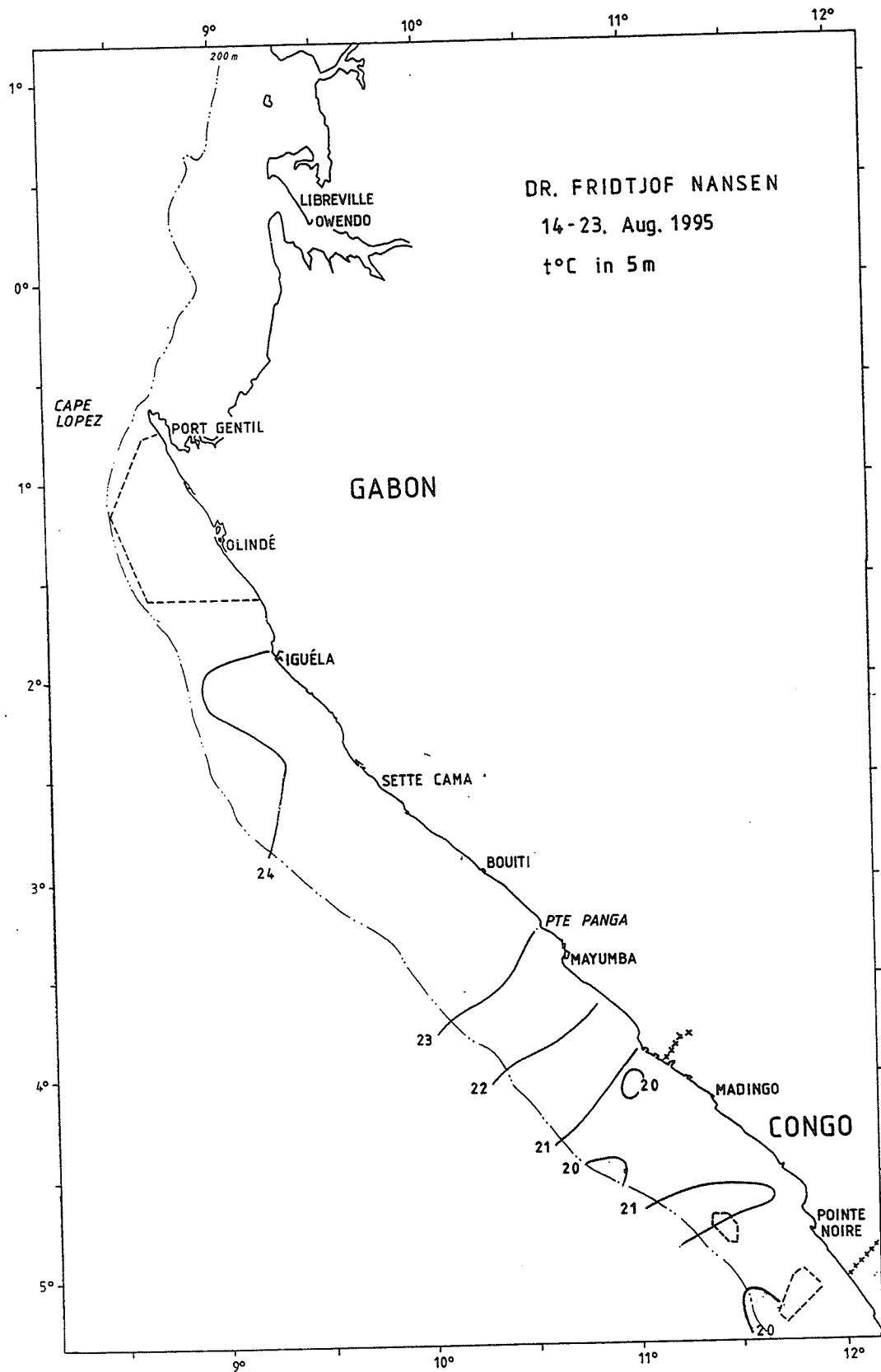


Fig. 2 Horizontal distribution of surface (5m depth) temperature, Congo - Gabon



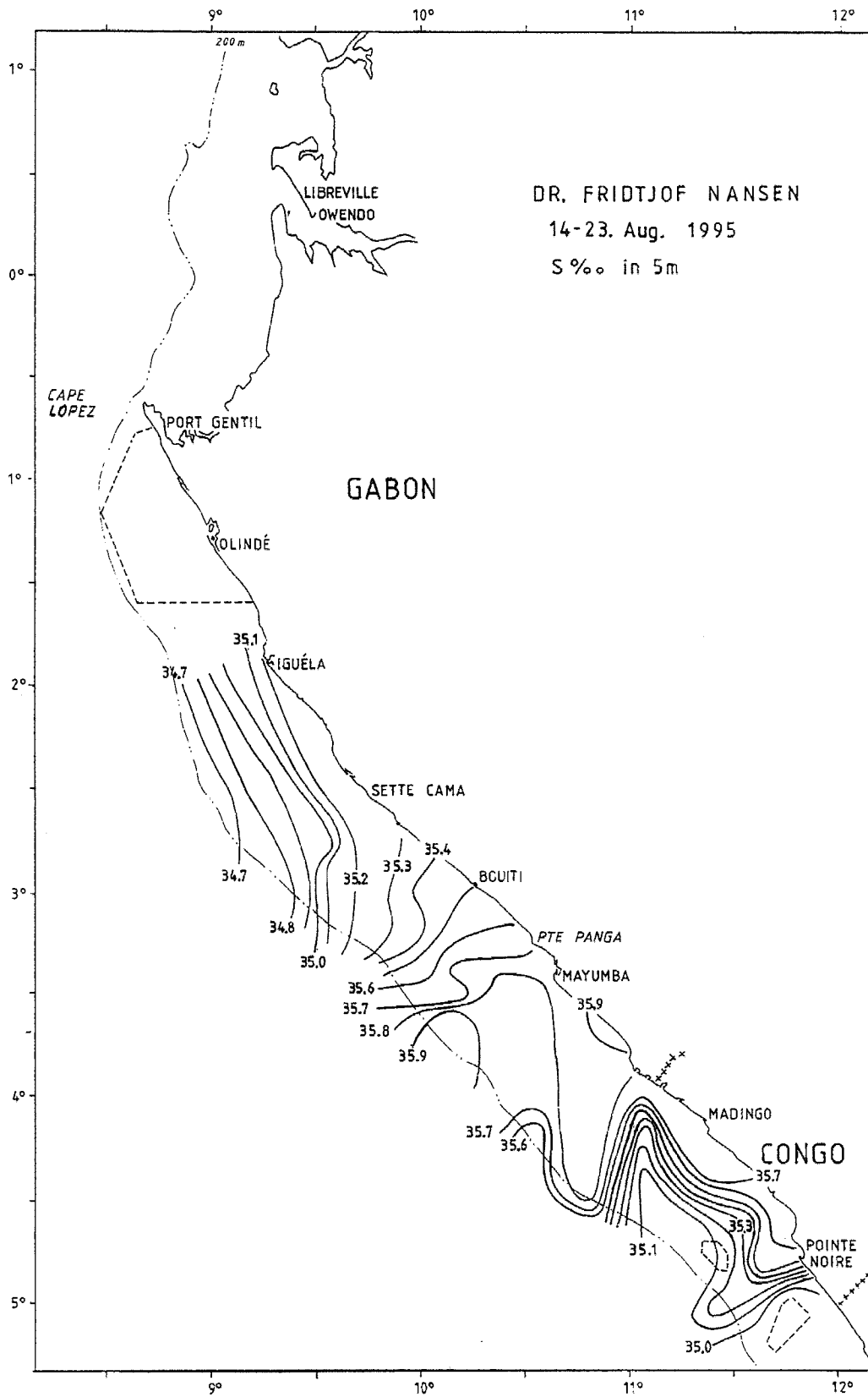


Fig. 3 Horizontal distribution of surface (5m depth) salinity, Congo - Gabon

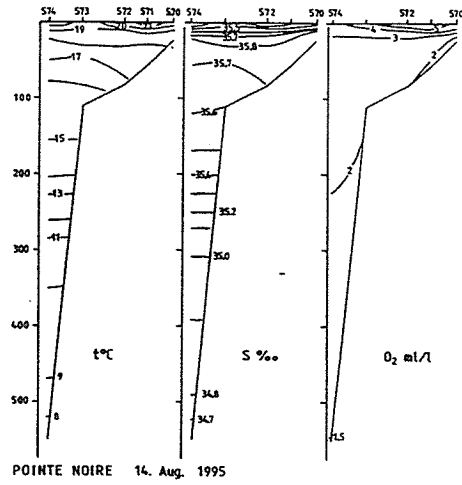


Fig. 4 Pointe Noire. Vertical sections of temperature, salinity and oxygen.

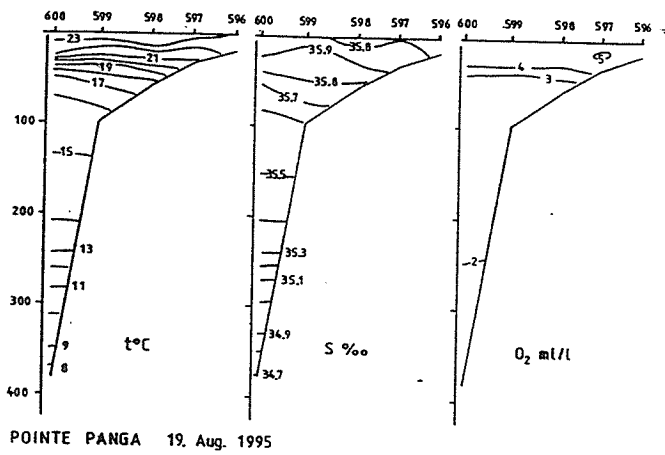


Fig. 5 Pointe Panga. Vertical sections of temperature, salinity and oxygen.

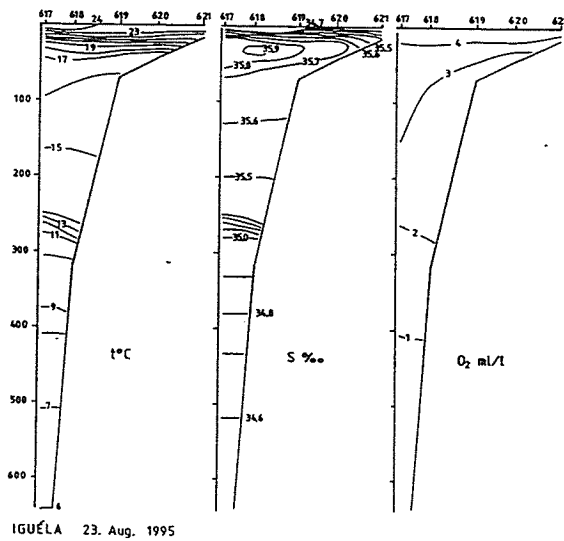


Fig.6 Iguéla. Vertical sections of temperature, salinity and oxygen

## CHAPTER 4 ACOUSTIC SURVEY: FISH DISTRIBUTION AND ABUNDANCE ESTIMATES OF PELAGIC SPECIES

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Figures 7 and 10 illustrate the distribution of sardinellas and horse mackerel respectively for the total survey area as observed with the acoustic integration system. The units of acoustic reflection are  $m^2/nm^2$ , and an arbitrary scale was used to illustrate different levels of concentration.

### 4.1 CONGO

#### Clupeids

Only *S. maderensis* (flat sardinella) was found in the Congo waters. It was distributed (Fig.7) off Pointe Noire from the middle of the shelf to beyond the slope and in shallow waters (20-30 m) along the inner shelf north of Pointe Noire to Madingo. The densest recordings were made in shallow waters. Successful trawling was done only during nighttime and both adult fish and juveniles were caught. Fig. 8 presents the estimated total length distribution of *S. maderensis* in the area. The distribution was quite similar to that estimated in August 1994, with both juvenile and adult fish, the latter being most numerous.

The total biomass of *S. maderensis* was calculated to 69 000, which is about 3 times higher than what was found in March and August 1994 (22 000 and 26 000 tonnes respectively).

*Ilisha africana* was caught in small amounts on all stations on the inner shelf of Congo. However, only low  $S_A$ -values were attributed to this species and no estimate of abundance was made.

#### Anchovy

Like last year no typical schools of *Engraulis encrasicolus* were recorded and the species was not caught in any of the trawl hauls in the area.

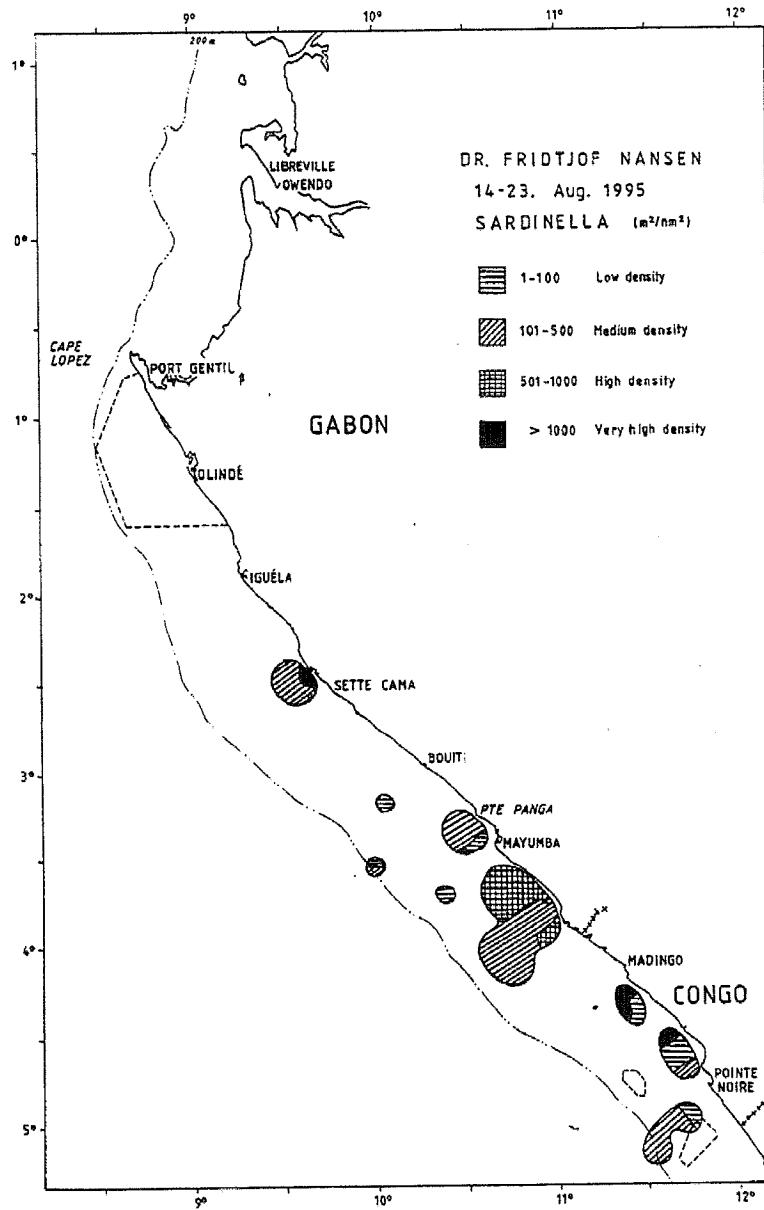


Fig. 7 Distribution and abundance of sardinellas outside Congo - Gabon

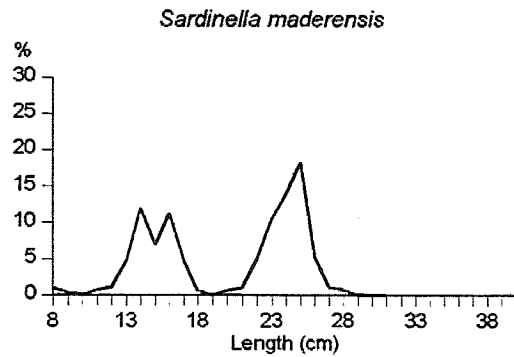


Fig. 8 Total length distributions of *Sardinella maderensis* in the Congo area.

## Cunene horse mackerel

*Trachurus trecae* was caught in small amounts on a few stations on the inner and outer shelf off Madingo. Only a low  $S_A$ -values on one 5-mile was attributed to horse mackerel and no estimate of abundance was made. Last year the biomass was estimated to 10 800 tonnes.

## P2 (carangids, scombrids, barracudas and hairtail)

*Chloroscombrus chrysurus* (Atlantic bumper), *Selene dorsalis* (lookdown) and scombrids (*Sarda sarda* and *Scomber japonicus*) were caught in some hauls both on the inner and outer part of the shelf. *Sphyraena guachancho* (barracuda) was caught on one station on the inner shelf. *Trichiurus lepturus* (hairtail) was common both in pelagic and bottom trawl hauls over the whole area, from the inner shelf to the slope beyond the 200 m isobath.  $S_A$ -values were allocated to some schools of this group on the middle and inner part of the shelf from north of Pointe Noire to the Gabon border, with the highest values off Madingo where the best catch (582 kg/h) of *C. chrysurus* was made. No estimate of abundance was made for this group.

## 4.2 GABON

### Clupeids

In the southern part of Gabon dense recordings of juvenile *S. aurita* (10-14 cm) were made on the inner part of the shelf from the Congo border to Pointe Panga (Fig. 7). On the outer shelf in the same area schools of adult sardinella were found, consisting of 73 % *S. aurita* and 27% *S. maderensis*. In the central area only scattered schools were recorded and 90 % was estimated to be adult *S. maderensis* (20-33 cm). In shallow waters on the inner shelf just north of Sette Cama dense recordings of *S. maderensis* were made. They consisted of both juveniles and adults (12-26 cm). Fig. 9 gives the estimated total length distribution of sardinellas in the Gabon area.

Separate estimates of the two species were made for the various subareas. The total biomass of *S. maderensis* was calculated to only 49 000 tonnes and the biomass of *S. aurita* was estimated to 54 000 tonnes, all together 103 000 tonnes. In March and August 1994 the total biomass of sardinellas was estimated to 100 000 and 128 000 tonnes respectively, with about 40 and 25 % *S. aurita*. The present estimate of *S. aurita* is 66% higher than the biomass found in August 1994, while that of *S. maderensis* is only 51 % of what was estimated during the previous survey. However, the total biomass estimate of sardinellas in the Congo-Gabon area is about 10 % higher than the estimate from August 1994.

*Ilisha africana* was caught on the inner shelf, most abundant off Boiti. Here a few low  $S_A$ -values were attributed to this species but no estimate of abundance was made.

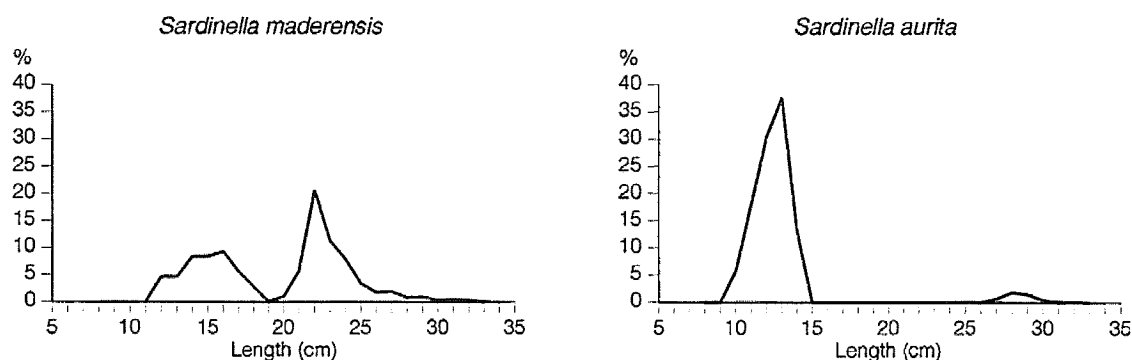


Fig. 9 Total length distribution of sardinellas in the Gabon area.

### Anchovy

Like in the Congo area no schools of *E. encrasicolus* were recorded and the species was only caught on two stations, one off Boiti and one off Iguéla.

### Cunene horse mackerel

Recordings of *Trachurus trecae* were made on the outer shelf in an area just north of the Congo border to south of Mayumba (Fig. 10). Only adults (35-39 cm) were caught in the area, while juveniles occurred in a few trawl hauls in other areas where no  $S_A$ -values were allocated to *T. trecae*. Figure 11 shows the total length distribution in the Gabon area. The biomass was estimated to 19 300 tonnes, which is 30 % higher than the estimate from August 1994.

### P2 (carangids, scombrids, barracudas and hairtail)

$S_A$ -values were allocated to schools of this group on the inner shelf from off Pointe Panga to Iguéla. Most of the recordings came from *C. chrysurus*, which was common in most hauls on the inner part of the shelf, and three large catches (600-1000 kg/h) were made between Boiti and Iguéla. *S. dorsalis* also occurred on most stations on the inner shelf. *Decapterus rhonchus* (false scad), *S. japonicus*, *S. tritor* and *S. guachancho* occurred in low numbers in some hauls in the shelf area, while *T. lepturus* was caught in higher numbers on most stations over the whole area. No estimate of abundance was made for any of the P2-species.

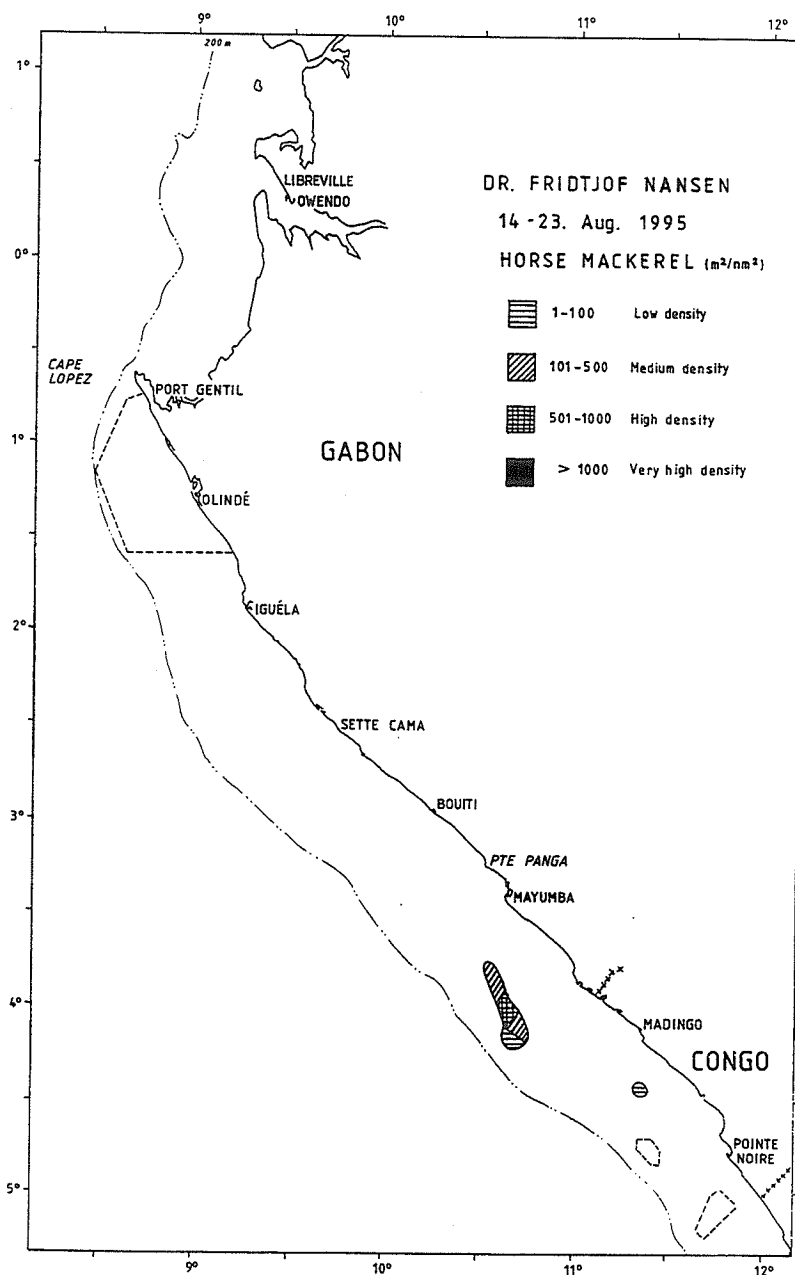


Fig. 10 Distribution and abundance of *Trachurus trecae* outside Congo - Gabon

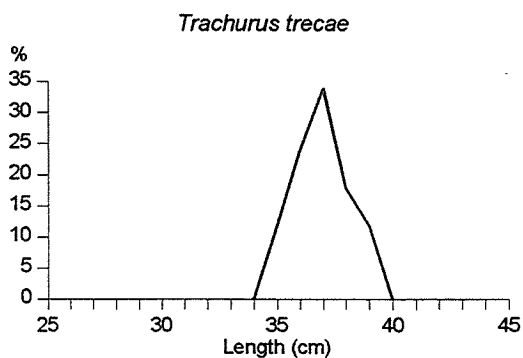


Fig. 11 Total length distribution of *Trachurus trecae* in the Gabon area.

### Review of survey estimates (sardinella and Cunene horse mackerel)

Figure 12 shows a plot of all the biomass estimates obtained through the 'Dr. Fridtjof Nansen' surveys, for sardinella in the Congo-Gabon area. Although important seasonal variability in the estimates may be observed (i.e. in 1985), the later estimates suggest an increase in the biomass of sardinellas. Small sizes were abundant both in 1994 and 1995, indicating that this area is an important nursery and recruitment ground probably for the whole sardinella stock in the region. Figure 13 shows the results obtained for the horse mackerel. Here the trend appears to be different, the biomass estimates obtained the last years being among the lowest in the time series.

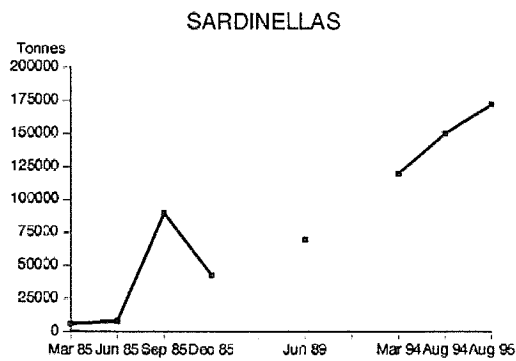


Fig. 12 Congo-Gabon. Biomass estimates for the sardinellas.

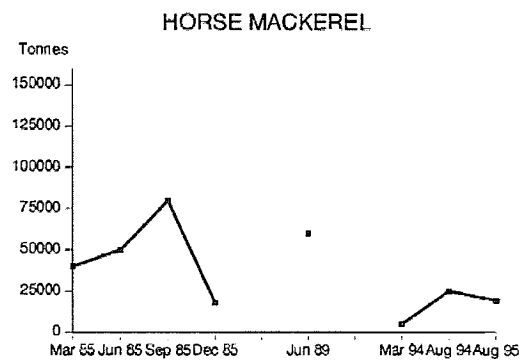


Fig. 13 Congo-Gabon. Biomass estimates for the horse mackerel.



## CHAPTER 5 TRAWL SURVEY: CATCH DISTRIBUTION, COMPOSITION AND SWEEPED AREA BIOMASS ESTIMATES OF DEMERSAL FISH

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The composition of the fish fauna on the shelf and slope changes with depth. The analyses were therefore performed for the inner shelf, down to 55 m depth, and the outer shelf from 55 m to 150 m. In addition, the slope area (150 m to 400 m) was analyzed separately. The locations of the trawl stations are shown in Fig. 1, records of the catches are presented in Annex I and pooled length distributions (weighted by the catch) of main species are shown in Annex II and III.

In the swept-area biomass estimates, only the shelf area down to 200 m has been included, divided into the depth zones 0-50 m and 50-200 m.

### 5.1 CONGO

The results of swept-area trawl stations are summarized in Tables 3 to 5. Twenty hauls were made in this area.

Table 1 shows the catch rates (kg/hour) by broad groups of species. 'Demersal' comprises the families Sciaenidae, Ariidae, Haemulidae (=Pomadasiidae), Serranidae, Sparidae, Lutjanidae and Merluccidae, while 'Pelagic' includes Engraulidae, Clupeidae, Carangidae, Scombridae, Sphyraenidae and Trichiuridae. The demersal group had the highest catch rates on the inner shelf, much higher than during the previous survey in August 1994. On the outer shelf, where the pelagic group dominated, both the pelagic and demersal group had much lower catch rates than during the previous survey. The pelagic group also dominated on the slope, and here the catch rate of both groups were higher than those obtained last year.

Like in 1994 no lobster was caught on the inner shelf in 1995, while it was common in 1989. The catch rates of shrimps were highest on the inner shelf (*Parapenaeopsis atlantica*) and on the slope (*Nematocarcinus africanus*). *Parapenaeus longirostris* was less common than during the previous survey. Sharks were caught on a few stations with catch rates somewhat lower than in

1994. Cephalopods were caught in all areas, but in highest rates on the outer shelf and on the slope, where the mean catch rate was the double of last year. Like in 1994 the most common species were *Illex coindetti* and *Sepia* spp.

Table 3. CONGO. Catch rates (kg/hour) by main groups in swept area bottom trawl hauls for the shelf and the slope.

INNER SHELF 0-55 m

ST.NO.	DEP.	Demersal	Pelagic	Sharks	Shrimps	Lobster	Other
97	24	142.40	72.90		49.00		28.70
98	23	96.70	121.30		13.80		8.60
105	35	534.00	279.00		3.00		21.60
106	21	277.76	238.28	40.00	136.92		84.28
112	38	765.64	81.76				39.98
113	19	89.70	707.40		36.90		33.14
MEAN		317.70	250.11	6.67	39.94		36.05

OUTER SHELF 55-150 m

ST.NO.	DEP.	Demersal	Pelagic	Sharks	Shrimps	Cephalopod	Other
95	110	48.02	64.00			7.98	3.04
96	74	75.66	849.38		0.42	0.38	5.12
103	124	24.50	12.10			9.58	0.74
104	65	20.16	52.56		1.64		22.82
110	117	21.36	8.94	8.72		24.92	28.56
111	72	123.86	110.50		7.50		91.30
MEAN		52.26	182.91	1.45	1.59	7.14	25.26

SLOPE 150-400 m

ST.NO.	DEP.	Demersal	Pelagic	Sharks	Shrimps	Cephalopod	Other
92	354	161.00	6.60	4.80	67.20	3.80	290.60
93	259	62.00	43.80		11.40	7.20	184.60
94	158	50.80	1.74			6.84	37.12
100	357	106.00	7.00		126.60	3.00	130.60
101	309	7.22	27.66		6.24	41.80	145.68
102	165	11.04	169.00			16.90	40.46
108	270	106.02	49.62		5.01	22.89	96.30
109	176	7.86	1121.88			42.72	4.66
MEAN		63.99	178.41	0.60	27.06	18.14	116.25

Catch rates of pelagic fish in bottom trawl hauls (Table 4) are presented to give some indication of the forms present. Like in 1994 the dominating species on the outer shelf and slope was *Trichiurus lepturus* (hairtail), and it was much more abundant than in both surveys in 1989. Among the carangids, which had the highest catch rates in the pelagic group on the inner shelf, *Trachurus trecae* (Cunene horse mackerel), *Selene dorsalis* (lookdown) and *Chloroscombrus chrysurus* (Atlantic bumper) were found on some stations on both the inner and outer shelf. Clupeids were only found on the inner shelf, where *Ilisha africana* (West African ilisha) had the highest catch rates, but also *Sardinella maderensis* (flat sardinella) occurred in small numbers in a couple of bottom hauls.

Table 4. CONGO. Catch rates (kg/hour) of main pelagic families in swept area bottom trawl hauls for the shelf and the slope.

INNER SHELF 0-55 m

ST.NO.	DEP.	Clupeids	Carangids	Barracudas	Scombrids	Hairtail	Other
97	24	17.20	0.70			55.00	220.10
98	23	18.80				102.50	119.10
105	35	4.50	177.00			97.50	558.60
106	21	111.44	3.64			123.20	538.96
112	38		42.46			39.30	805.62
113	19	41.70	584.70	30.00		51.00	159.74
MEAN		32.27	134.75	5.00		78.08	400.35

OUTER SHELF 55-150 m

ST.NO.	DEP.	Clupeids	Carangids	Barracudas	Scombrids	Hairtail	Other
95	110					64.00	59.04
96	74		126.56		0.02	722.80	81.58
103	124					12.10	34.82
104	65		5.26			47.30	44.62
110	117		0.30		4.94	3.70	83.56
111	72		29.50			81.00	222.66
MEAN			26.94		0.83	155.15	87.71

SLOPE 150-400 m

ST.NO.	DEP.	Clupeids	Carangids	Barracudas	Scombrids	Hairtail	Other
92	354					6.60	527.40
93	259					43.80	265.20
94	158					1.74	94.76
100	357					7.00	366.20
101	309					27.66	200.94
102	165		61.00			108.00	68.40
108	270					49.62	230.22
109	176		32.28			1089.60	55.24
MEAN			11.66			166.75	226.05

Table 5 shows the catch rates of demersal families. Grunts was the most common family on the inner shelf and *Brachydeuterus auritus* (bigeye grunt) was the dominating species, and the catch rates were much higher than those obtained in 1994. On the outer shelf grunts occurred on some stations but at much lower rates. Croakers was the second most important family on the inner shelf. It was more abundant than during the previous survey, while on the outer shelf and slope the catch rates were lower than those found last year. *Pentheroscion mbizi* (blackmouth croaker), *Pteroscion peli* (boe drum) and *Pseudolithus typus* (longneck croaker) were the most abundant species.

Table 5. CONGO. Catch rates (kg/hour) of main demersal families in swept area bottom trawl hauls for the shelf and the slope.

## INNER SHELF 0-55 m

ST.NO.	DEP.	Sparids	Grunts	Croakers	Groupers	Hake	Other
97	24		109.00	33.40			150.60
98	23		87.00	9.70			143.70
105	35		274.20	118.80			444.60
106	21		234.64	33.32			509.28
112	38	29.70	533.48	190.96	11.50		121.74
113	19		66.30	23.40			777.44
MEAN		4.95	217.44	68.26	1.92		357.89

## OUTER SHELF 55-150 m

ST.NO.	DEP.	Sparids	Grunts	Croakers	Groupers	Hake	Other
95	110	48.02					75.02
96	74	2.18	70.20	3.28			855.30
103	124	24.50					22.42
104	65	1.22	2.90	16.04			77.02
110	117	21.36					71.14
111	72	36.20	29.00	14.66	43.50	0.50	209.30
MEAN		22.25	17.02	5.66	7.25	0.08	218.37

## SLOPE 150-400 m

ST.NO.	DEP.	Sparids	Grunts	Croakers	Groupers	Hake	Other
92	354					161.00	373.00
93	259			0.80		61.20	247.00
94	158	28.90		21.90			45.70
100	357					106.00	267.20
101	309					7.22	221.38
102	165	11.04					226.36
108	270					100.56	179.28
109	176	7.86					1169.26
MEAN		5.98		2.84		54.50	341.15

Sparids occurred in all areas, with very low rates on the inner shelf and the slope and somewhat higher rates on the outer shelf. The catch rates on the outer shelf were lower than those obtained in 1994. *Dentex angolensis* was the most abundant species, followed by *D. congoensis* and *Pagellus bellottii* (red pandora). Mean length of *D. angolensis* was 5 cm less than in 1994.

Like in 1994 groupers were not abundant, only *Epinephelus goreensis* (dungat grouper) was found on two station (inner and outer shelf). However, these species cannot be properly evaluated by the swept area method because they mostly occur on rocky bottoms inaccessible to bottom trawl. *Merluccius polli* (Benguela hake) was found on most stations deeper than 200 m at similar catch rates as during the previous survey. *Brotula barbata* (Bearded brotula) occurred on both the outer shelf and the slope, and the abundance was about the same as found last year.

Table 6 presents the swept area estimates of mean densities based on 20 random bottom trawl hauls. Pelagic species are not included in the calculations. Like in 1989 and 1994 bigeye grunt was the species with the highest density in the 0-50 m zone, followed by *P. typus* and *Pomadasys jubelini*. In the 50-200 m zone *D. angolensis* had the highest density, while *Synagrops microlepis* and *P. mbizi* were most abundant in 1994. In the deepest zone (200-400 m) *M. polli* came out with the highest densities, followed by *Scorpaena* spp. and *N. africanus*.

Table 6. CONGO. Swept area estimates of demersal species in tonnes/nm<sup>2</sup> by depth ranges.

SPECIES NAME	SAMPLE DISTRIB. BY CATCH CLASSES Lower limits, Kg/nm					% inci- dence	Mean dens. t/nm <sup>2</sup>	Mean densities by bottom depth strata t/nm <sup>2</sup>			
	>0	10	30	100	300			1000	- 50m	50-200m	200-400m
<i>Brachydeuterus auritus</i>	3	3	2	1		45	1.91	5.81	0.37		
<i>Merluccius polli</i>	2	1	3			25	0.71			2.84	
<i>Pseudolithus typus</i>	6	1	1			40	0.39	1.27	0.02		
<i>Scorpaena</i> sp.			1			5	0.37			1.49	
<i>Nematocarcinus africanus</i>	1	1	1			15	0.32			1.30	
<i>Pomadasys jubelini</i>			1	1		10	0.31	1.04			
<i>Illex coindetii</i>	9	2				55	0.27		0.37	0.41	
<i>Dentex angolensis</i>	6	2				40	0.26	0.18	0.47		
<i>Arius parkii</i>	2		1			15	0.26	0.83		0.03	
<i>Zenopsis conchifer</i>	3	3				30	0.22		0.16	0.58	
<i>Parapenaeopsis atlantica</i>	7		1			40	0.22	0.70	0.02		
<i>Setarches guentheri</i>			1			5	0.20			0.81	
<i>Pteroscion peli</i>	5	1				30	0.19	0.63			
<i>Pterothrissus belloci</i>	2	1				15	0.19			0.76	
<i>Synagrops microlepis</i>			3			15	0.18			0.72	
S H R I M P S	4	1				25	0.17	0.54	0.01		
<i>Brotula barbata</i>	3	1				20	0.11		0.18	0.11	
<i>Spicara alta</i>	4					20	0.11		0.24		
<i>Pentanemus quinquarius</i>	6					30	0.10	0.32			
<i>Epinephelus goreensis</i>	1	1				10	0.09	0.07	0.14		
<i>Aulopus cadenati</i>	4	1				25	0.09		0.02	0.33	
MACROURIDAE	2	1				15	0.08			0.30	
<i>Argyrosomus regius</i>		1				5	0.07	0.22			
S H A R K S		1				5	0.06	0.21			
<i>Umbrina canariensis</i>	2	1				15	0.06	0.17	0.03		
<i>Pentheroscion mbizi</i>	4					20	0.06	0.02	0.12	0.01	
MURAEINIDAE	3					15	0.06	0.18			
CYNOGLOSSIDAE	2					10	0.06	0.16	0.03		
<i>Parapenaeus longirostris</i>	3					15	0.03			0.11	
<i>Aristeus varidens</i>	2					10	0.01			0.03	
Other fish							0.64	1.03	0.52	0.39	
Sum all species							7.80	13.38	2.70	10.22	
Sum Snappers											
Sum Groupers							0.09	0.07	0.14		
Sum Grunts							2.34	7.24	0.37		
Sum Croakers							0.78	2.31	0.20	0.01	
Sum Seabreams							0.35	0.18	0.66		
Sum Sharks							0.08	0.21	0.03	0.03	
Sum Rays							0.06	0.15	0.04		
Sum Squids							0.33	0.09	0.40	0.48	
Sum											
Sum commercial shrimps							0.75	1.24	0.03	1.44	

Number of stations included in analysis, total and by depth strata

20

6

9

5

The overall mean density for all demersal species was 7.8 tonnes/nm<sup>2</sup>, while in 1994 the corresponding figure was 9.7 tonnes/nm<sup>2</sup>. Compared with the results from last year the mean density was higher on the inner shelf, lower on the outer shelf and about the same on the slope. In 1985 the estimated mean density was 11.1 tonnes/nm<sup>2</sup>.

In Table 7 the densities of some important species and groups are multiplied by the area of the two shallowest depth zones (0-50 and 50-200 m). Some results from 1994 and survey II in 1989 are also given.

The summed biomass of seabreams, croakers and grunts was about the same as found in 1994 and in survey II 1989, but bigeye grunt contributed much more in 1995 and 1989 than in 1994. The total biomass of all demersal species was highest in 1994, mainly due to higher catch rates of *N. africanus*, *S. microlepis*, *Pterothrissus belloci* and other demersal species of non commercial value. The biomass of *T. trecae* estimated from swept-area hauls was only 12 % of that obtained last year, while the estimated biomass of *T. lepturus* was about the same as found in 1994.

Table 7. CONGO. Biomass estimates (tonnes) of important species/groups by depth strata.					
	0-50 m	50- 200m	Total	1994	1989
Seabreams	130	1170	1300	2240	1490
Croakers	1730	350	2080	4700	1970
Groupers	50	250	300	120	120
Grunts*	1070	-	1070	-	-
Sum dem. val.	2980	1770	4750	7060	3580
All demersal	10000	4800	14800	18700	12500
Bigeye grunt	4360	650	5010	890	3800
Horse mackerel	920	50	970	7900	
Hairtail	1850	13650	15500	15200	

\* Not including bigeye grunt.

## 5.2 GABON

The results of the swept-area trawl stations are shown in Tables 8 to 10. A total of 33 hauls were made in the Gabon area. Table 8 gives the catch rates (kg/hour) by main species groups, for the inner shelf, the outer shelf and the slope. The pelagic group had the highest catch rates on the inner shelf, slightly higher than the demersal group. The catch rates were somewhat lower than those obtained in the Congo area, but the pelagic group was more abundant now than during the previous survey. On the outer shelf the demersal group dominated, and this is the opposite of what was found in the Congo area, where the demersal group had much lower catch rates and the pelagic group had much lower. Both groups were less abundant than during the survey in August 1994. On the slope the two groups had about equal catch rates, and much lower than those found in the Congo area.

A small amount of sharks was caught in all three areas. Shrimps were much less abundant than in the Congo area, and on the slope the catch rates were considerable lower than those obtained last year. Lobsters occurred on two stations on the inner shelf, while cephalopods were caught on most stations on the outer shelf and on the slope. The catch rates were somewhat higher than those found in the Congo area, and *Illex coindetii*, *Todaropsis eblanae* and *Sepia* spp. dominated.

Table 8. GABON. Catch rates (kg/hour) by main groups in swept area bottom trawl hauls for the shelf and the slope.

### INNER SHELF 0-55 m

ST.NO.	DEP.	Demersal	Pelagic	Sharks	Shrimps	Lobster	Other
114	34	247.38	44.34	42.00	24.50		34.74
118	24	170.62	93.40	42.70	19.60		39.50
128	46	81.58	159.88			1.13	9.72
129	19	341.68	143.46	20.00		0.60	76.32
136	44	463.66	1065.46				5.04
150	43	1.40	65.00				26.78
155	28	85.04	33.70		0.72		12.28
MEAN		198.77	229.32	14.96	6.40	0.25	29.20

### OUTER SHELF 55-150 m

ST.NO.	DEP.	Demersal	Pelagic	Sharks	Shrimps	Cephalopod	Other
115	57	125.16	10.26		6.96		43.44
120	72	1471.98	95.22	62.40			46.32
121	116	155.72	15.10	26.40		7.72	28.68
125	148	36.50	87.50			122.30	36.94
126	122	312.00		10.80		10.38	28.80
127	70	3.54	50.70			20.64	9.24
134	128	78.10				3.47	35.16
135	65	12.36	45.52			44.94	2.00
141	141	106.90	4.90			4.70	52.50
142	90	4.54	3.06			1.06	6.08
146	144	35.64				1.80	152.12
147	112	881.80				31.80	326.60
148	82	4.59	0.19			6.86	2.31
149	62		0.02			1.86	0.58
153	139	10.74		17.20		119.28	214.62
154	76	30.16	0.16			6.23	14.57
MEAN		204.36	19.54	7.30	0.44	23.94	62.50

Table 8. Continued.

SLOPE 150-400 m

ST.NO.	DEP.	Demersal	Pelagic	Sharks	Shrimps	Cephalopod	Other
122	179	31.54	22.50	14.50		39.60	214.14
123	352	29.26		50.56	5.06	1.80	109.18
124	246	6.40	18.64		0.28	24.22	235.60
131	358	35.00	63.00		1.32	20.40	198.36
132	244	15.34	4.10	4.60		76.60	203.50
133	175	15.50	8.40			14.38	11.74
139	339	12.54	38.40	5.50	5.70	20.80	166.70
140	188	31.06	9.60			4.06	7.72
145	344	4.78	28.16		2.16	10.96	152.80
152	256			0.72	0.96	18.24	550.98
MEAN		18.14	19.28	7.59	1.55	23.11	185.07

Table 9 summarizes the catch rates for the main pelagic fish families in the area. Carangids dominated on the inner shelf, with *C. chrysurus* as most abundant species. It was found on most stations on the inner shelf and sometimes in large quantities. Other common species were *S. dorsalis*, *T. trecae* and *D. rhonchus*.

Table 9. GABON. Catch rates (kg/hour) of main pelagic families in swept area bottom trawl hauls for the shelf and the slope.

INNER SHELF 0-55 m

ST.NO.	DEP.	Clupeids	Carangids	Barracudas	Scombrids	Hairtail	Other
114	34		17.04			27.30	348.62
118	24	46.90	2.00			44.50	272.42
128	46	0.49	32.52		3.31	123.56	92.43
129	19	86.10	42.00	15.36			438.60
136	44	21.10	1012.82	17.64	8.24	5.46	468.90
150	43	7.40	56.30	0.56	0.74		28.18
155	28	4.32	9.54	3.80		1.60	112.48
MEAN		23.76	167.46	5.34	1.76	28.92	251.66

OUTER SHELF 55-150 m

ST.NO.	DEP.	Clupeids	Carangids	Barracudas	Scombrids	Hairtail	Other
115	57		0.96			9.30	175.56
120	72	14.52	33.00			47.70	1580.70
121	116				9.10	6.00	218.52
125	148					87.50	195.74
126	122						361.98
127	70		16.18		0.02	34.50	33.42
134	128						116.73
135	65	1.20	29.22			15.10	59.30
141	141					4.90	164.10
142	90		0.10		0.06	2.90	11.68
146	144						189.56
147	112						1240.20
148	82		0.05		0.14		13.76
149	62		0.02				2.44
153	139						361.84
154	76		0.08		0.08		50.96
MEAN		0.98	4.98		0.59	12.99	298.53



Table 9.. Continued

SLOPE 150-400 m

ST. NO.	DEP.	Clupeids	Carangids	Barracudas	Scombrids	Hairtail	Other
122	179					22.50	299.78
123	352						195.86
124	246					18.64	266.50
131	358					63.00	255.08
132	244					4.10	300.04
133	175					8.40	41.62
139	339					38.40	211.24
140	188					9.60	42.84
145	344					28.16	170.70
152	256						570.90
MEAN						19.28	235.46

Catch rates of *T. lepturus* were very low as compared to Congo, but the rates were higher than those obtained last year and it was the dominating species in the pelagic group both on the outer shelf and on the slope.

The results for the main demersal fish families, sparids, grunts, croakers, groupers and hakes, are shown in Table 10. Sparids were caught at almost all trawl stations, and like last year their mean catch rates dominated those of the other families on the outer shelf and on the slope. The catch rates were however considerable lower than those obtained in 1994. *D. congolensis* was the most common species, followed by *D. angolensis*, *D. gibbosus*, *P. bellottii* and *Boops boops*. Mean lengths were comparable to those obtained during the previous survey except for *P. bellottii*, which was more than 10 cm longer during the present survey.

Like in the Congo area and like last year grunts had the highest catch rates on the inner shelf, but the rates were somewhat lower this year. *B. auritus* was the dominating species, but also *Pomadasys* spp. occurred on several stations. Croakers was the second most important family on the inner shelf, with much higher catch rates than those obtained last year. *Umbrina canariensis* was most abundant, followed by *P. typus*, *P. senegalensis*, *P. peli* and *P. mbizi*.

Like last year the most common Serranidae was *Anthias anthias*. However, for consistency with former reports only groupers are included in the analysis. Only four single specimens were caught (*Epinephelus aeneus*) on one station. Hake (*M. polli*) had the second highest catch rates on the slope, but lower than those obtained last year and much lower than found in the Congo area. Snappers (Lutjanidae) occurred on three stations on the inner shelf in higher rates than previously.

Table 10. GABON. Catch rates (kg/hour) of main demersal families in swept area bottom trawl hauls for the shelf and the slope.

## INNER SHELF 0-55 m

ST.NO.	DEP.	Sparids	Grunts	Croakers	Groupers	Hakes	Other
114	34		122.22	63.56			207.18
118	24		64.06	99.90			201.86
128	46	13.73	16.09	3.04			219.45
129	19	67.30	119.68	124.70			270.38
136	44	56.48	407.18				1070.50
150	43	1.40					91.78
155	28	10.74	74.30				46.70
MEAN		21.38	114.79	41.60			301.12

## OUTER SHELF 55-150 m

ST.NO.	DEP.	Sparids	Grunts	Croakers	Groupers	Hakes	Other
115	57	11.10	86.70	27.36			60.66
120	72	157.38	924.00	390.60			203.94
121	116	72.32		83.40			77.90
125	148	36.50					246.74
126	122	213.90		98.10			49.98
127	70	3.54					80.58
134	128	78.10					38.63
135	65	12.36					92.46
141	141	102.30		4.60			62.10
142	90	4.54					10.20
146	144	35.64					153.92
147	112	557.60		274.00	50.20		358.40
148	82	4.59					9.36
149	62						2.46
153	139	10.74					351.10
154	76	30.16					20.96
MEAN		83.17	63.17	54.88	3.14		113.71

## SLOPE 150-400 m

ST.NO.	DEP.	Sparids	Grunts	Croakers	Groupers	Hakes	Other
122	179	25.04		6.50			290.74
123	352					29.26	166.60
124	246	4.42				1.98	278.74
131	358					35.00	283.08
132	244	15.34					288.80
133	175	15.50					34.52
139	339					12.54	237.10
140	188	31.06					21.38
145	344					4.78	194.08
152	256						570.90
MEAN		9.14		0.65		8.36	236.59

Table 11 presents the swept-area estimates of mean densities based on 33 random bottom trawl hauls. Most pelagic species are not included in the calculations. Like previous years and like in the Congo area *B. auritus* had the highest density in the 0-50 m zone, followed by *P. typus*. *B. auritus* also had the highest density in the 50-200 m zone, followed by *D. congoensis* and *U. canariensis*. In the deeper waters *Chlorophthalmus atlanticus* was the most important, followed by *Zenion hololepis*. Among the shrimps, *P. atlantica* and *P. longirostris* were most common, but the densities were low.

The mean density of all demersal species was 8.7 tonnes/nm<sup>2</sup>. This is a little higher than what was found in the Congo area, but lower than the result from last year in all depth zones, when the overall mean density was 11.6 tonnes/nm<sup>2</sup>. In survey II 1989 the mean density for Gabon was only 4.7 tonnes/nm<sup>2</sup>, but all demersal species of non commercial value may not have been included. The mean density found in 1985 was at about the same level as what found in 1994..

Table 11. GABON. Swept-area estimates of demersal species in tonnes/nm<sup>2</sup> by depth range

SPECIES NAME	SAMPLE DISTRIB. BY CATCH CLASSES					% inci- dence	Mean dens. t/nm <sup>2</sup>	Mean densities by bottom depth strata t/nm <sup>2</sup>				
	Lower limits, Kg/nm							- 50m	50-200m	200-400m	400-600m	
	>0	10	30	100	300	1000						
Brachydeuterus auritus	2	3	1	1	1		24	1.64	3.07	1.71		
Chlorophthalmus atlanticus		3	5				24	0.91		0.12	3.94	
Dentex congoensis	8	4	3				45	0.72		1.24	0.01	
Umbrina canariensis	1	1	3				15	0.59		1.02		
Spicara alta	10	1	1				36	0.41		0.71		
Illex coindetii	18	2	1				64	0.36			0.45	0.48
Boops boops	8			1			27	0.33	0.04	0.56		
Pseudolithus senegalensis	1	1	1				9	0.32	0.28	0.45		
Antigonia capros	5		2				21	0.30		0.52		
Squalus megalops	7	4					33	0.26	0.44	0.20	0.27	
Dentex angolensis	9	3					36	0.21	0.25	0.24	0.09	
Zenion hololepis			1					0.19			0.91	
Pseudolithus typus	1	3					12	0.15	0.71			
Todaropsis ablanae	16	2					55	0.14		0.13	0.30	
Pagellus bellottii	10	1					33	0.14	0.39	0.10		
Dentex gibbosus	4	2					18	0.13	0.03	0.22		
Alloteuthis africana	6	1					21	0.11	0.20	0.12		
Pomadasys jubelini		2					6	0.11	0.49			
Ariomma bondi	9	1					30	0.11		0.17	0.04	
Setarches guentheri	2	1					9	0.09			0.43	
Eumunida squamifera	1	1					6	0.09		0.01	0.41	
Aulopus cadenati	10						30	0.09		0.02	0.34	
Galeoides decadactylus	3	1					12	0.08	0.34	0.01		
Merluccius polli	4	1					15	0.08			0.39	
Synagrops microlepis	5	1					18	0.08		0.02	0.34	
Pentheroscion mbizi	2	1					9	0.07	0.19	0.05		
Arius parkii	1	1					6	0.06	0.29			
Epinephelus aeneus		1					3	0.05		0.09		
Anthias anthias	4						12	0.05		0.09		
S H R I M P S	2						6	0.02	0.09		0.01	
Parapenaeus longirostris	6						18	0.01			0.06	
Parapenaeopsis atlantica	3						9	0.01	0.03	0.01		
Shrimps, small, non comm.	1						3	0.01	0.06			
Penaeus kerathurus	1						3					
Penaeus notialis	1						3					
Other fish								0.74	1.20	0.57	0.83	
Sum all species								8.66	8.10	8.83	8.85	
Sum Snappers								0.08	0.38			
Sum Groupers								0.05		0.09		
Sum Grunts								1.81	3.71	1.76		
Sum Croakers								1.15	1.28	1.54		
Sum Seabreams								1.60	0.72	2.47	0.10	
Sum Sharks								0.28	0.44	0.22	0.30	
Sum Rays								0.03	0.02	0.03	0.08	
Sum Squids								0.67	0.22	0.76	0.84	
Sum												
Sum commercial shrimps								0.04	0.12	0.01	0.07	

Number of stations included in analysis, total and by depth strata

33

7

19

7

In Table 12 the densities of some important species and groups are multiplied by the area of the two shallowest depth zones (0-50 and 50-200 m). Some results from survey II 1989 are also given.

The summed biomass of valuable groups was 20 % lower than in 1994 because the biomass of seabreams was more than halved. The total biomass of all demersal species was also somewhat lower than in 1994 but almost the double of what was found in 1989, mainly due to higher catch rates of *B. auritus*.

	0-50 m	50- 200m	Total	1994	1989
Seabreams	3010	7150	10160	26400	17000
Croakers	5350	4450	9800	4100	350
Groupers	-	260	260	-	600
Snappers	1590	-	1590	-	800
Grunts*	2680	140	2820	-	600
Sum dem. val.	12630	12000	24630	30600	19350
All demersal	33900	25500	59400	79600	34100
Bigeye grunt	12850	4950	17800	32700	2900
Horse mackerel	-	230	230	8300	
Hairtail	3800	1200	5000	1100	

\* Not including bigeye grunt.