

CHAPTER 1 INTRODUCTION

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:
 - * sardinella
 - * Cunene horse mackerel
 - * 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 to monitor the temperature, salt and oxygen regimes on standard profiles.

1.2 PARTICIPATION

From the Direction Générale de la Pêche, Brazzaville:

Appolinaire NGOUEMBE, André BITOUMBA and Blaise EBONKOLI.

From the Centre ORSTOM, Pointe Noire:

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From the Direction des Pêches Maritimes, Libreville:

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From the FAO Fisheries Department, Rome:

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1.3 NARRATIVE

The survey started at Pointe Noire in the morning of 20 August 1994 with the hydrographic profile off Pointe Noire. Systematic transects, about 10 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. A few deep water hauls on the slope were carried out during dark hours. Pelagic trawling with mid-water trawl 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 20 to 23 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 23 to 30 August, and the hydrographic profiles off Pointe Panga and off Iguéla were made on 25 and 30 August respectively.

The survey terminated just south of the protected area on 30 August. Thereafter the vessel steamed southwards to Pointe Noire.

1.4 SURVEY EFFORT

Figure 1 shows the course tracks with fishing stations and the hydrographic profiles.

The number of hauls can be summarized as follows:

	Pelagic hauls	Bottom hauls	Distance surveyed
Congo	3	14	370 nm
Gabon	10	41	1 050 nm

The total number of CTD stations was 15.

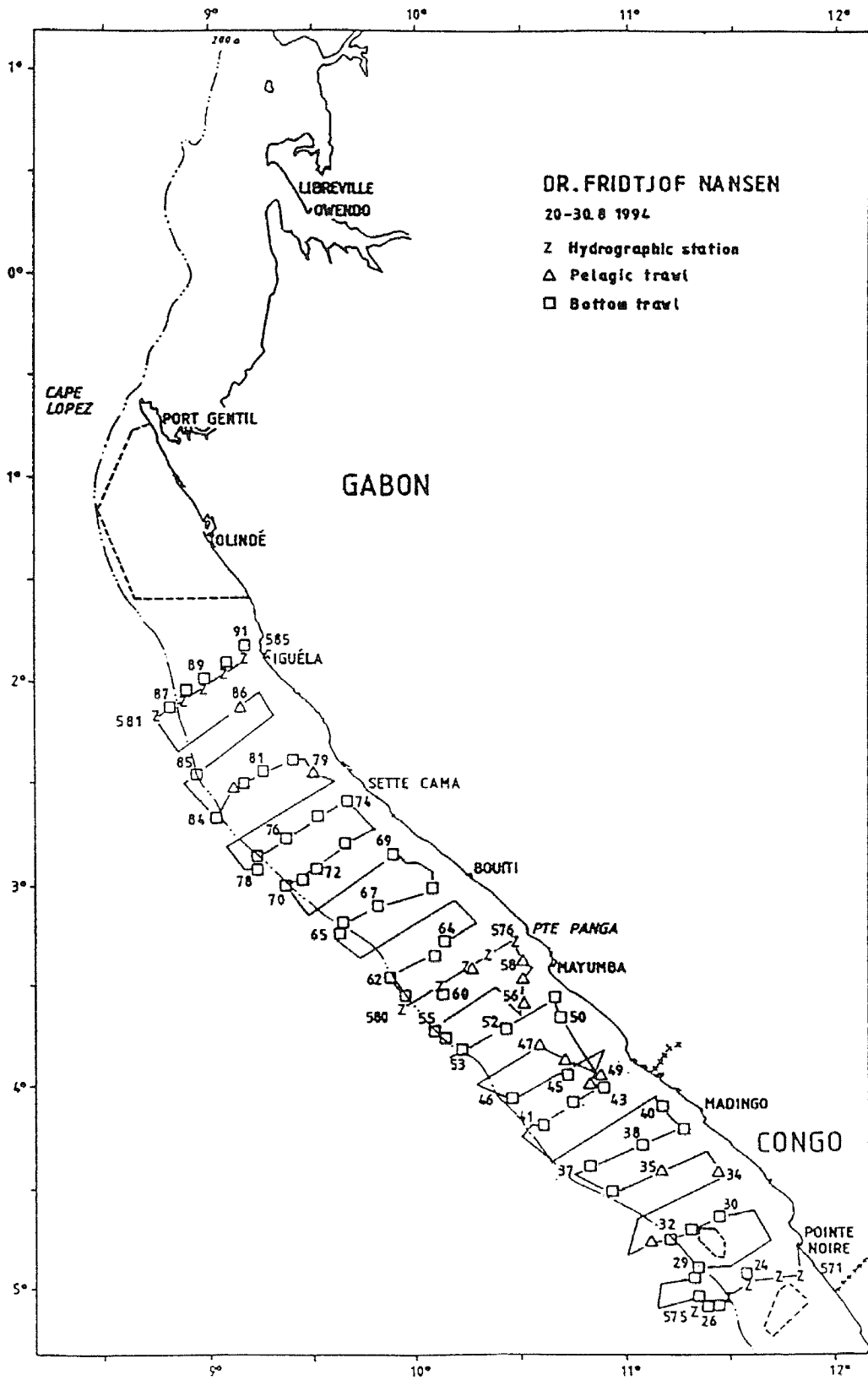


Fig. 1 Course tracks, fishing stations and hydrographic profiles.

1.5 METHODS

The catches were sampled for species composition, by weight and numbers. Length distributions (total length, also for shrimp) were taken of the main species, and biological samples, i.e. length, weight, sex and maturity stages were taken of sardinellas (*Sardinella maderensis* and *S. aurita*) and Cunene horse mackerel (*Trachurus trecae*).

A description of the acoustic instruments and their standard settings is given in Annex IV.

The following target strength (TS) function was applied to convert S_A -values to number of fish (sardinellas and horse mackerel):

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

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

where L is total length. The following formula was programmed into Excel (5.0) sheets to calculate the number of fish in length groups (cm) in subareas within each region:

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

where:

- N_i = number of fish in length group i
- A = area in nm^2
- S_A = mean integrator value in the subarea
- p_i = proportion of fish in length group i in samples from the subarea
- C_{Fi} = fish conversion factor (formula 2) applying the length of fish in length group i

The number per length group were then summed and the total number of fish obtained. The biomass of fish was calculated applying calculated average weight per length group, multiplied by the number of fish in the same length groups. The number and biomass per length group in the subareas were at last summed to obtain the total number and biomass per length group in each region.

The S_A -values were divided among the following categories of fish on the basis of trawl catches and characteristics of the echotraces:

- plankton
- sardinella
- horse mackerel
- PEL1 (anchovies, clupeids)
- PEL2 (carangids, scombrids, barracudas and hairtails)
- bigeye grunt (*Brachydeuterus auritus*)
- demersal fish

In the trawl survey programme all catches were sampled for composition by weight and numbers by species. The bottom trawl has a headline of 31 m (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 150 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 with improved accuracy. For conversion of catch rates to fish densities the area between the wings is assumed to be the effective fishing area. The catchability coefficient was considered to be equal to 1. With the new vessel a new trawl gear was introduced with smaller bobbins. This gear gives better bottom contact and higher catch rates for some bottom dwelling species (e.g. monk and sole). For other species (e.g. hake) the new gear is assumed to have no difference in performance. The trawl, warp and wire dimensions are as with the former vessel (see Annex IV for details). The length of a haul, recorded as distance over bottom was measured by doppler log on the bottom.

The problem of mid-water occurrence of demersal species and its effect on the swept-area assessments have been covered in cruise reports from Namibia (hake-surveys). Based on the acoustic registrations of demersal species during the present survey, mid-water occurrence constituted only a minor problem in the Congo - Gabon area.

The following areas (nm^2) are used in the swept-area biomass estimates:

	Congo	Gabon
0- 50 m	750	4 182
50-200 m	1 770	2 893

CHAPTER 2 HYDROGRAPHY

2.1 INSTRUMENTS AND METHODS

Continuous profiles of temperature, salinity and oxygen were obtained with a Seabird 911 CTD Plus system. The data were recorded in real time on a PC on board, using the Seabird SEASAVE software. As a routine the profiles were taken down to a few meters above the bottom, and two NISKIN bottles were triggered for water samples. These were usually taken near the bottom and near the surface (typically at about 5 m depth), and samples were taken for analysis of oxygen and salinity.

2.2 RESULTS

Vertical sections

In the section off Pointe Noire (Fig. 2) the surface temperature was 21-22°C, which is about 6-7°C lower than in March this year. Like in March the main thermocline was observed near the surface. Also now some signs of off shore low surface salinity were observed, with values below 32 psu (not shown in Fig. 2). This may be related to the Congo Current, which during winter flows westwards off the shelf and merges seawards with the South Equatorial Current. The oxygen distribution gives an impression of an upwelling situation, with low oxygen water penetrating up on the shelf. However, neither the temperature nor the salinity distribution show characteristics typical for upwelling. The oxygen content on the shelf is not likely to limit the distribution of fish.

In the section off Pointe Panga (Fig. 3) the thermocline was a little weaker than off Pointe Noire and the surface temperature was 22°C. The surface layer was more saline, indicating less influence by the Congo River. No subsurface salinity maximum was observed and the water was well stratified. The oxygen content on the shelf was slightly higher than off Point Noire.

In the section off Iguéla (Fig. 4) the surface temperature was 24°C and the thermocline was observed at about 25 m. It was a little stronger than off Pointe Panga. The surface water was less saline than off Pointe Panga, but the salinity was not as low as off Pointe Noire. The oxygen content in the surface layer was slightly lower than in the two other profiles. Like in the section off Pointe Panga both the isotherms, isohalines and the isolines for oxygen were near horizontal, indicating less dynamic activity in this region than off Pointe Noire.

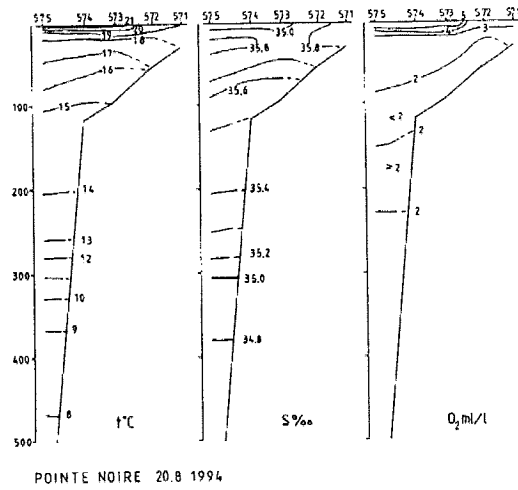


Fig. 2 Pointe Noire. Vertical sections of temperature, salinity and oxygen.

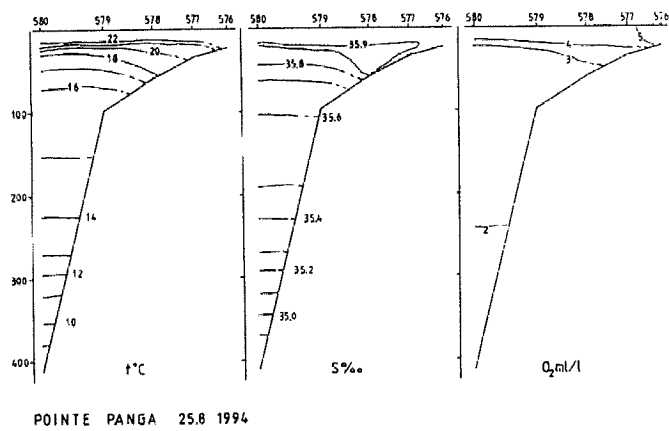


Fig. 3 Pointe Panga. Vertical sections of temperature, salinity and oxygen.

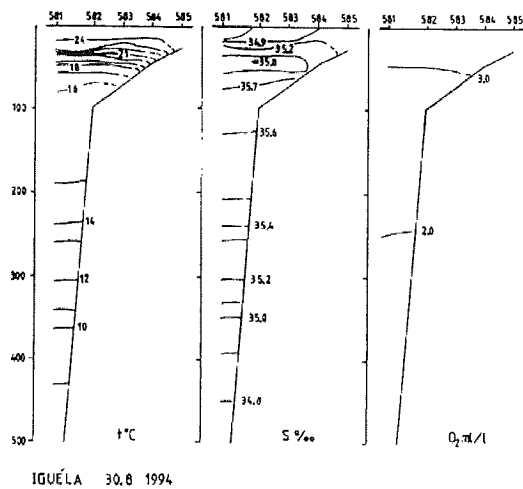


Fig. 4 Iguéla. Vertical sections of temperature, salinity and oxygen.

CHAPTER 3 ACOUSTIC SURVEY: FISH DISTRIBUTION AND ABUNDANCE ESTIMATES OF PELAGIC SPECIES

Figures 5 and 7 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 $0.1 \cdot \text{m}^2/\text{nm}^2$, and an arbitrary scale has been used to illustrate different levels of concentration. The length distributions used in the acoustic estimates are weighted by the acoustic index (S_A -values on the 5-mile where the sample was taken). The weight by length group used to calculate the biomasses were determined by applying estimated condition factors (CF=0.90 for *S. maderensis*, CF=0.83 for *S. aurita* and CF=0.94 for *T. trecae*).

3.1 CONGO

Clupeids

Sardinellas were distributed (Fig. 5) over the whole northern part of the Congo shelf to Mayumba (Gabon), with some scattered recordings off Pointe Noire, most of them over deep water. The densest recordings were made in shallow waters. Successful trawling was done only during nighttime. *S. maderensis* (flat sardinella) consisted of mainly adult fish, while *S. aurita* (round sardinella) had a higher proportion of juveniles (Fig. 6).

Both combined and separate estimates of the two sardinella species were made for the Congo area. The total biomass was calculated to 24 000 and 26 000 tonnes by the first and second method respectively, and about 25% of the biomass was *S. aurita*. The total biomass is slightly higher than what was found in March 1994 (22 000 tonnes), and about the double of what was measured in survey II 1989.

Ilisha africana was only caught in small amounts on three stations on the inner shelf of Northern Congo and no estimate of abundance was made for this species.

Anchovy

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

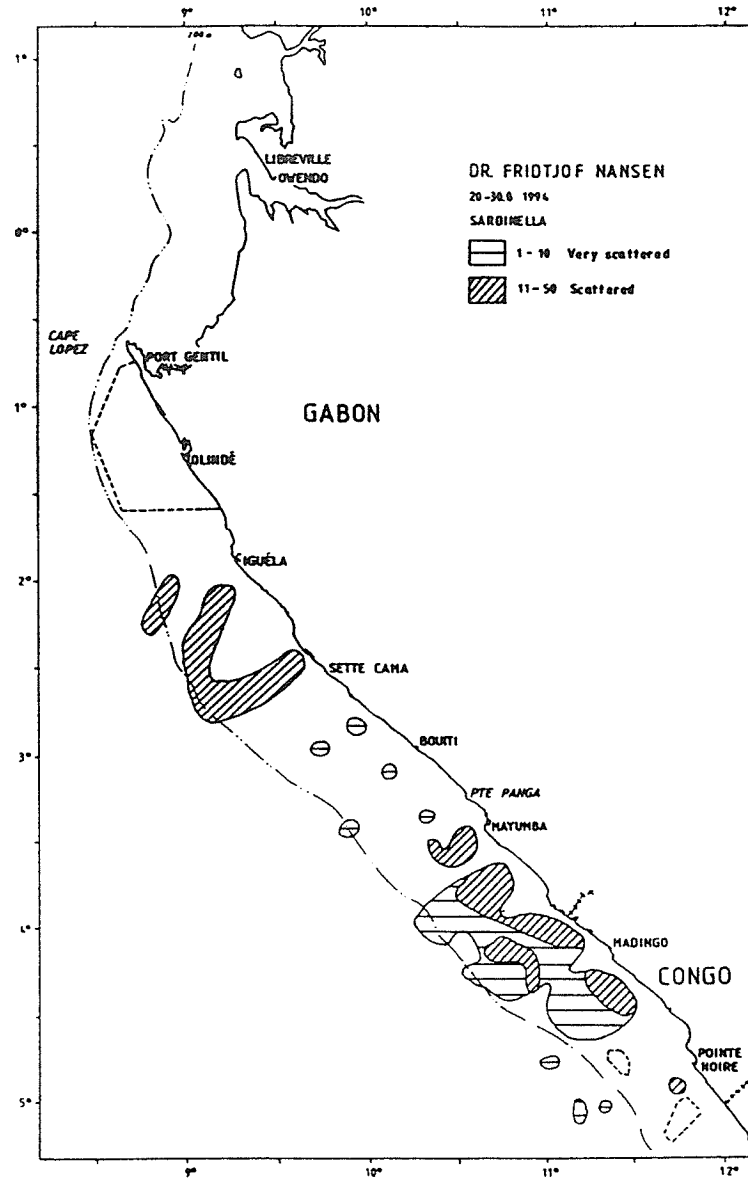


Fig. 5 Distribution and abundance of sardinellas outside Congo - Gabon

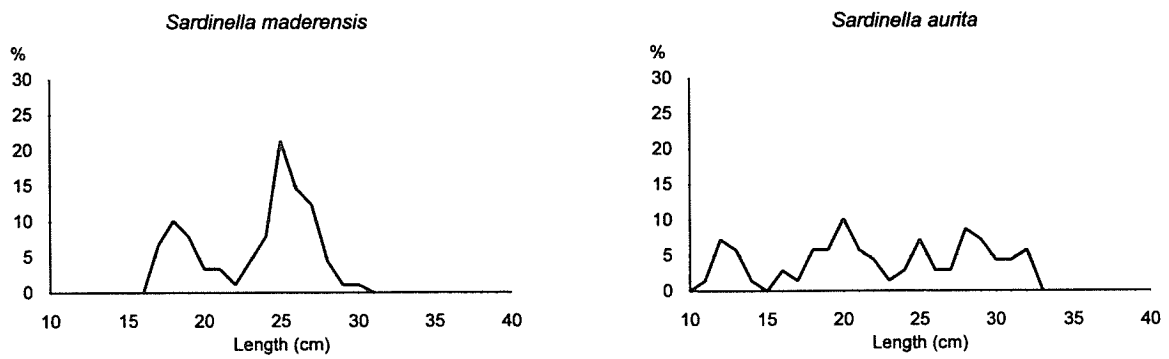


Fig. 6 Total length distributions of sardinellas in the Congo area.

Horse mackerel

Trachurus trecae was recorded over a large area off Pointe Noire, from the middle of the shelf and out to the 200 m isobath (Fig. 7). In addition some scattered schools were recorded on the inner and outer shelf near the Gabon border. Almost all of the horse mackerel in this area was adult fish (Fig. 8). The biomass was estimated to 10 800 tonnes.

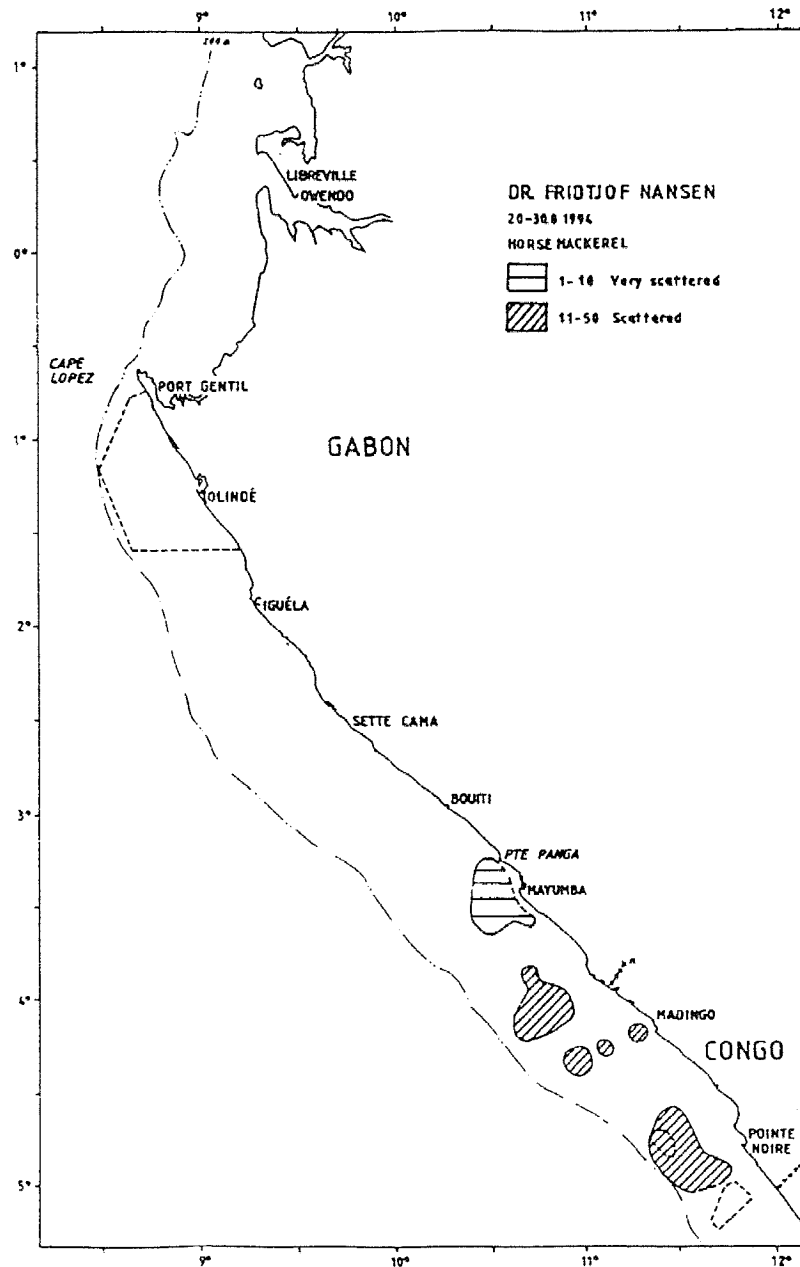


Fig. 7 Distribution and abundance of *Trachurus trecae* outside Congo - Gabon

P2 (carangids, scombrids, barracudas and hairtails)

Chloroscombrus chrysurus (Atlantic bumper) and *Selene dorsalis* (lookdown) were common in most hauls on the inner part of the shelf, while scombrids were not present. *Sphyraena guachancho* (barracuda) was caught in small numbers 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 outer shelf and slope off Pointe Noire, but no estimate of abundance was made.

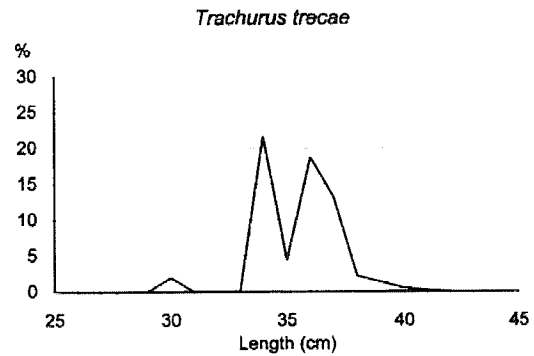


Fig. 8 Total length distribution of *Trachurus trecae* in the Congo area.

3.2 GABON

Clupeids

In the southern part of Gabon sardinellas were distributed over the whole shelf from Mayumba and into Congo (Fig. 5). The densest recordings were made on the inner part of the shelf. About 25% of the sardinella in this area was *S. aurita*, both juvenile (11-14 cm) and adult fish, while all the *S. maderensis* were larger than 16 cm. In the central area of Gabon, from Mayumba to Sette Cama, only scattered schools were recorded. 83% was estimated to be *S. maderensis* with lengths from 13 to 27 cm. In the north, from Sette Cama to Iguéla, sardinellas were again recorded over larger areas, from the inner shelf and out over the slope. 32% was estimated to be *S. aurita*, both juveniles (8-10 cm) and adults, while the *S. maderensis* consisted of fish from 17 to 25 cm. Successful trawling was done only during nighttime. Fig. 9 gives a total length distribution of sardinellas in the Gabon area.

Separate estimates of the two species were made for all three subareas. The total biomass of *S. maderensis* was calculated to 95 500 tonnes and the biomass of *S. aurita* was estimated to 32 500 tonnes, all together 128 000 tonnes. In March this year the total biomass of sardinellas was

estimated to 100 000 tonnes, with about 40% *S. aurita*. The present estimate of *S. maderensis* is more than 50% higher than the one made in March, while that of *S. aurita* is quite similar.

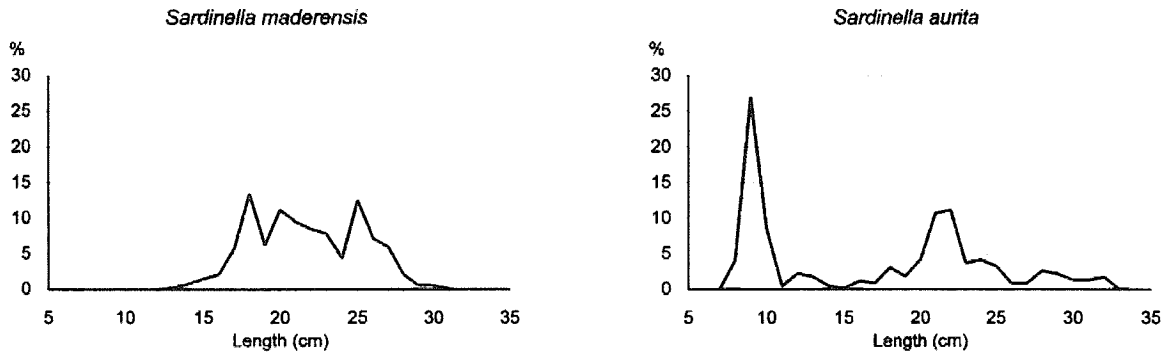


Fig. 9 Total length distribution of sardinellas in the Gabon area.

Anchovy

A few *E. encrasicolus* were caught on a couple of stations on the inner shelf just north of the Congo border. Some more were caught on one station in shallow waters off Sette Cama, where schools were detected and some low S_A -values were allocated, but no estimate of abundance was made. The length was 8-10 cm.

Horse mackerel

Scattered recordings of *Trachurus trecae* were recorded on the outer shelf in an area just north of the Congo border and in shallow waters between Mayumba and Pointe Panga (Fig. 7). Both juvenile and adult mackerels were caught in both areas. Figure 10 shows the total length distribution in the Gabon area. The biomass was estimated to 14 700 tonnes.

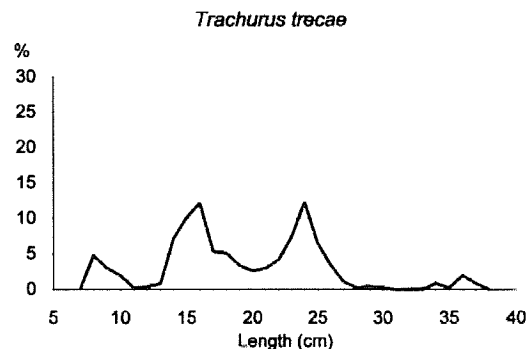


Fig. 10 Total length distribution of *Trachurus trecae* in the Gabon area.

P2 (carangids, scombrids, barracudas and hairtails)

Like in the Congo area *Chloroscombrus chrysurus* (Atlantic bumper) and *Selene dorsalis* (lookdown) were common in most hauls on the inner part of the shelf. *Decapterus rhonchus* (false scad) was also present in several inner shelf hauls between Boiti and Iguéla, and most of the S_A -values allocated to the P2-group in this area came from schools of *D. rhonchus*. *Scomber japonicus* was caught on many stations in the whole area, while *Scomberomorus tritor* only occurred on one inner shelf station. *Sphyraena guachancho* was common on the inner shelf north to Sette Cama, while *Trichiurus lepturus* was caught over the whole area. No estimate of abundance was made for any of the P2-species.

Review of survey estimates (Sardinella and horse mackerel)

Figure 11 shows a plot of all the biomass estimates obtained through the 'Dr. Fridtjof Nansen' surveys, for sardinella in the Congo-Gabon region. 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. In particular, the results obtained in both 1994 surveys are quite consistent with the results obtained off Angola. While only large sizes dominated off Angola, small sizes dominated off Congo Gabon in March and were also well represented in September. This indicates that this area is an important nursery and recruitment ground probably for the whole sardinella stock. Figure 12 shows the results obtained for the horse mackerel. Here the trend appears to be different, the biomass estimates obtained this year being among the lowest in the time series.

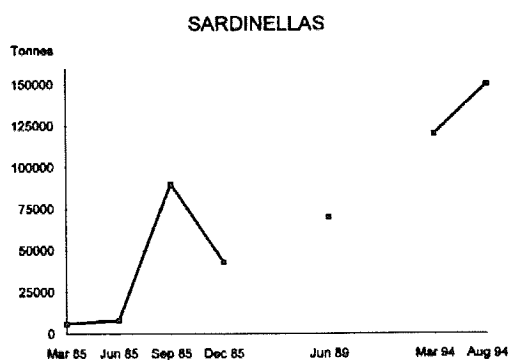


Fig. 11 Congo-Gabon. Biomass estimates for the sardinellas.

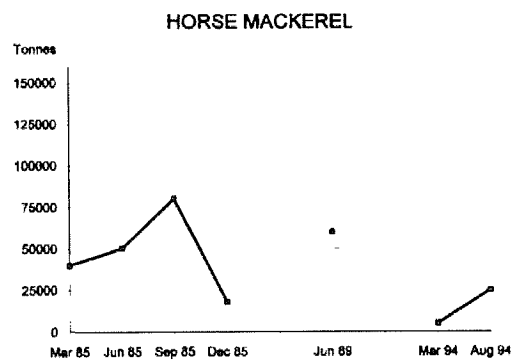


Fig. 12 Congo-Gabon. Biomass estimates for the horse mackerel.