

**SURVEY OF THE PELAGIC FISH RESOURCES OFF  
NORTH WEST AFRICA**

**Part I SENEGAL - THE GAMBIA**

**29 October - 8 November 2001**

**Centre de Recherches Océanographiques de Dakar-Thiaroye  
Dakar, Senegal**

**Institute of Marine Research  
Bergen, Norway**

**Department of Fisheries  
Banjul, The Gambia**

CRUISE REPORTS 'DR FRIDTJOF

NANSEN'

**SURVEY OF THE PELAGIC FISH RESOURCES OFF  
NORTH WEST AFRICA**

**Part I**

**SENEGAL - THE GAMBIA**  
**29 October - 8 November 2001**

by

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**Bergen, 2002**

## TABLE OF CONTENTS

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CHAPTER 1	INTRODUCTION.....	1
1.1	Objectives of the cruise.....	1
1.2	Participation .....	1
1.3	Narrative.....	2
1.4	Methods.....	2
CHAPTER 2	SURVEY RESULTS.....	8
2.1	Hydrography .....	8
2.2	The Casamance shelf .....	10
2.3	The Gambian shelf.....	11
2.4	The Gambian border - Cape Vert.....	15
2.5	Cape Vert - St. Louis .....	16
CHAPTER 3	OVERVIEW AND SUMMARY OF RESULTS.....	17
Annex I	Records of fishing stations	
Annex II	Description of instruments and fishing gear used	
Annex III	Pooled length distributions by species and regions	
Annex IV	Stock length distributions by numbers and weight	

## CHAPTER 1 INTRODUCTION

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### 1.1 Objective of the cruise

The general objectives were to estimate the biomass and map the distribution of small pelagic fish stocks off NW Africa (Morocco, Mauritania, Senegal and the Gambia) by hydro-acoustic methods and describe the hydrographic conditions there over a period of 50 days, in October-December 2001. For Senegal and the Gambia the agreed objectives were:

- To map the distribution and estimate the biomass for the main small pelagic fish using hydroacoustic methods. The species of interest were: sardinella *Sardinella aurita*, *Sardinella maderensis*, horse mackerel *Trachurus trachurus* and *T. trecae*, false scad *Decapterus rhonchus*, and anchovy *Engraulis encrasicolus*.
- To identify and describe the size distribution of the target fish populations by midwater and bottom trawl sampling and process the catches by recording weight and number by species.
- To sample standard hydrographical transects for temperature, salinity and oxygen at about 13°40' N and 14°50' N.

The time allocated for this part of the survey, off Senegal and the Gambia, was 10 days.

### 1.2 Participation

Members of the scientific teams were:

Centre de Recherches Océanographiques de Dakar-Thiaroy, Senegal:

Abdoulaye SARRE, Mor SYLLA, Mamadou SANE and Ibrahima SOW

Department of Fisheries, the Gambia:

Ousmann Mass JOBE, Solomon TAMOH and Juldah JALLOW,

Institute of Marine Research, Norway:

Reidar TORESEN, Magne OLSEN, Tore MØRK and Thor Egil JOHANSSON

### **1.3 Narrative**

The course tracks with the fishing and hydrographical stations are shown in Figure 1.

The survey started off Casamance on October the 29 with systematic parallel course tracks spaced about 10 NM (nautical miles) apart. To cover the whole distribution area of pelagic fish, the shelf was covered from the 15 m isobath and offshore to the 500 m isobath. Trawling was done irregularly, either to identify echo registrations or to check 'blindly' if fish were mixed with the plankton in the upper layers of the water column. In the latter case, pelagic trawl with floats was often used. A smaller pelagic trawl or the bottom trawl with floats was used for sampling the pelagic fish in very shallow waters (depth less than 25 m). The shelf was covered to about 30 NM (nautical miles) south of St. Louis. There we had to finish and return to Dakar, due to unexpected reasons. During the 7 November, the vessel made a second survey of the inner shelf between Dakar and the Gambia to study the variations in acoustic abundance estimation of small pelagic fish, and to shed light on the local migration of sardinella. This part of the survey will be reported later in a special report. The survey was finished in Dakar November 8.

The hydrographic profile off the Gambia was carried out on November 2 and that off Cape Vert on November 4.

### **1.4 Methods**

#### *Environmental Data*

Surface temperature and meteorological data from a weather station were logged automatically and recorded with position and bottom depth every nautical mile sailed.

Hydrographic profiles were collected with a CTD sonde and temperature, salinity, and pressure (depth) were logged by the Seabird Software. From these data series, records were selected from standard depths and presented in figures.

#### *Biological sampling*

Biological sampling of the fish was carried out using trawls. A pelagic trawl with floats was often used. A smaller pelagic trawl or the bottom trawl with floats was used for sampling the pelagic fish in very shallow waters (depth less than 25 m). Annex II gives a description of the instruments and the fishing gear used. All catches were sampled for composition by weight and numbers of each species caught. Species identification was based on the FAO Species Guides. Length frequency distributions, by total fish length in cm, of the selected target species were

taken in all the stations where they were present. Individual weight measurements were taken regularly to estimate the condition factor in the length-weight relationship:

$$\bar{w} = \frac{cond}{100} \cdot L^3$$

The specific condition factors obtained from the samples and applied for this survey were: 0.96 for sardinellas and horse mackerels.

For the estimation of the biomass of carangids and associated species, an overall average length of 23 cm and a condition factor of 0.88 (to calculate the mean length of this length group) were applied.

All data on fishing stations and fish length sampling were made available to the participants on diskettes.

The complete records of fishing stations are shown in Annex I.

The following target groups were used for Senegal:

- 1) Sardinellas (flat sardinella *Sardinella maderensis* and round sardinella *S. aurita*),
- 2) Horse mackerels (Cunene horse mackerel *Trachurus trecae*, round scad *Decapterus punctatus*, and false scad *Decapterus rhonchus*),
- 3) Other pelagic carangids and associated species (Atlantic bumper *Chloroscombrus chrysurus*, African lookdown *Selene dorsalis*, chub mackerel *Scomber japonicus*, largehead hairtail, *Trichiurus lepturus*, and barracudas *Sphyræna* spp.),
- 4) Other demersal species (such as bigeye grunt *Brachydeuterus auritus*, Sparidae and Haemulidae), and
- 5) Other clupeids such as West African ilisha *Ilisha africana*.

*Acoustic sampling*

A SIMRAD EK500 Echosounder was used with the settings as shown in Annex II. The Bergen Integrator (BEI) was used for analysis and allocation of the integrated  $s_A$ -values to the individual specified target groups by 5 NM intervals. The allocation of values to target groups was based on a combination of a visual scrutiny of the behaviour pattern as deduced from echo diagrams, the BEI analysis, and the catch compositions.

In cases where the target category of fish contains more than one species (sardinellas and horse mackerels), the mean  $s_A$ -value allocated to the category is divided between the species in the same ratio as their contribution to the mean back scattering strength in the length frequency samples.

The following target strength (TS) function was applied to convert  $s_A$ -values (mean integrator value for a given species or group of species in a specified area) to number of fish:

$$TS = 20 \log L - 72 \text{ dB}$$

Which can be converted (see Toresen *et al.* 1998 for details) to the area form (scattering cross sections of acoustic targets):

$$C_{Fi} = 1.26 \cdot 10^6 \cdot L^{-2}$$

where  $L$  is total length in 1 cm length group  $i$  and  $C_{Fi}$  ( $\text{m}^{-2}$ ) is the reciprocal back scattering strength, or so-called fish conversion factor. In order to split and convert the allocated  $s_A$ -values ( $\text{m}^2/\text{NM}^2$ ) to fish densities (numbers per length group per  $\text{NM}^2$ ), the following formula was used:

$$\rho_i = s_A \cdot \frac{p_i}{\sum_{i=1}^n \frac{p_i}{C_{Fi}}}$$

where

$\rho_i$  = density of fish in length group  $i$

$s_A$  = mean integrator value

$p_i$  = proportion of fish in length group  $i$

$$\sum_{i=1}^n \frac{P_i}{C_{Fi}} = \text{the relative back scattering cross section (m}^2\text{) of the length frequency sample of the target species, and}$$

$$C_{fi} = \text{reciprocal back scattering cross section } (\sigma_{bs}^{-1}) \text{ of a fish in length group } i.$$

The integrator outputs were split in fish groups using a combination of behaviour pattern as deduced from echo diagrams, the BEI analysis and catch composition as described below. The following groups were used for Senegal: 1) sardinellas, 2) horse mackerels, 3) carangids and associated species, and 4) demersal fish.

The above equations show that the conversion from  $s_A$ -values to number of fish is dependent on the length composition of the fish. It is therefore important to get representative length distributions from the stock in the whole distribution area.

When the size classes (of e.g. young fish and older fish) are well mixed, the various length distributions can be pooled together with equal importance. Otherwise, when the size classes are segregated, the total distribution area has to be post-stratified, according to the length distributions, and separate estimates are made for the regions containing fish with equal size.

For a region representing a distribution of a target-species, the following basic data are needed for the estimation of abundance; 1) the average  $s_A$ -value for the region, 2) the surface (usually  $\text{NM}^2$ ), and 3) a representative length distribution of the fish in the region. If the targeted fish is a mixture of more than one species, for example sardinellas, a representative distribution of the two, within the region, as shown in the trawl catches, are used. A length distribution representing the number of the two species for each catch will have to be calculated. Thereafter, these distributions have to be normalized to a unit number (usually 100) so they are equally weighted.

A systematic approach to a) divide the  $s_A$ -value between species in a category of fish (e.g. *Sardinella aurita* and *S. maderensis*) and b) produce pooled length distributions of a target species for use in the above equation and c) calculate the biomass estimates for a region, is obtained through the following procedure:

- The samples of the species in the category (e.g. sardinellas) are respectively pooled together with equal importance (normalized).
- The mean back scattering strength ( $\rho/s_A$ ) of each length frequency distribution of the target species is calculated and summed. This is automatically done in the Excel



spreadsheet made available for acoustic abundance estimation onboard R/V “Dr. Fridtjof Nansen”, provided the data are punched in this sheet.

- The mean  $s_A$ -value allocated to the category of fish in the region is divided between the species in the same ratio as their relative contribution to the mean back scattering strength of the length groups in the sample representing the region (also automatically done in the Excel spread-sheet given that the  $s_A$ -value for the region is punched into the sheet).
- The pooled length distribution is used, together with the mean  $s_A$ -value, to calculate the density (numbers per square NM) by length groups and species, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area. (This is done in the Excel spreadsheet, given that the area of the region is punched into the sheet).
- The numbers are converted to biomass using the estimated weight at length. (Done in the Excel sheet if the condition factor is punched).

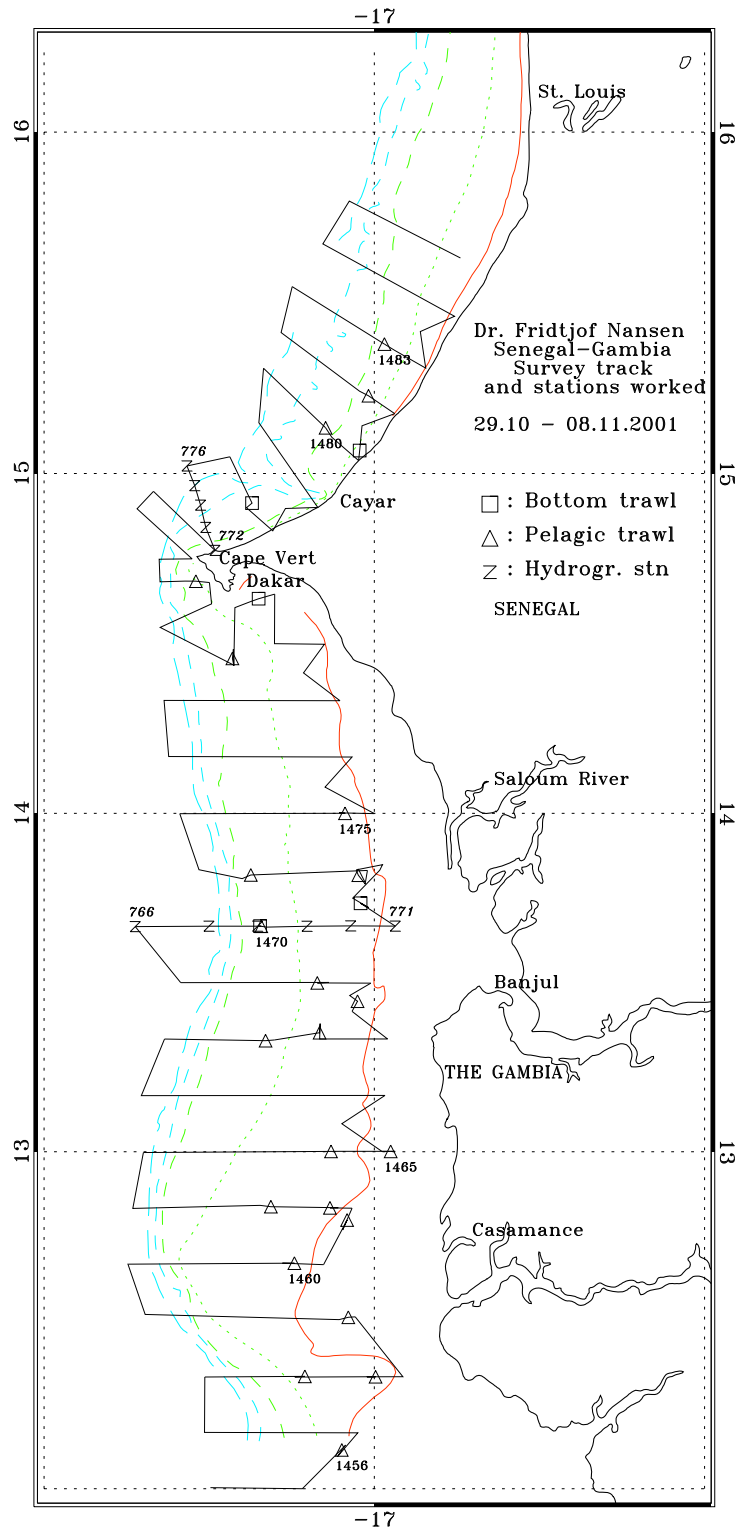
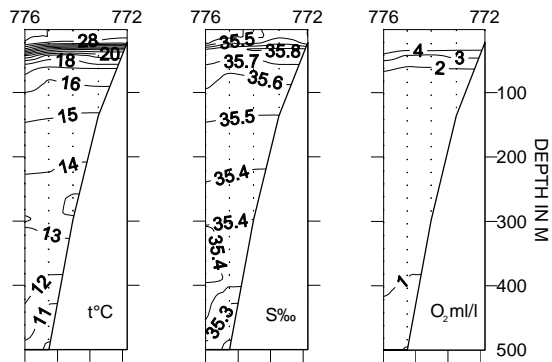


Figure 1 Course tracks with fishing and hydrographic stations; Casamance to St. Louis

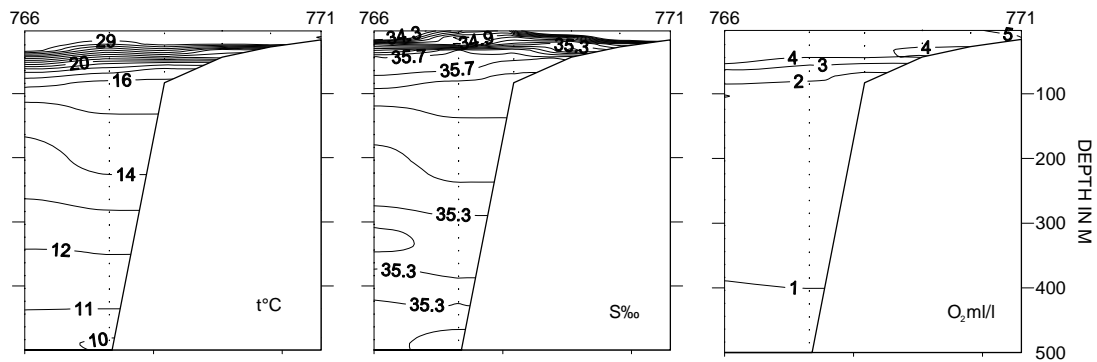
## CHAPTER 2 SURVEY RESULTS

### 2.1 Hydrography

Figure 2 shows the distribution of temperature, salinity and oxygen in the two profiles and Figure 3 the sea surface temperature at 5 m of depth.



CAPE VERT 02.11 2001



THE GAMBIA - WEST 04.11 2001

Figure 2 Hydrographic profiles with distribution of temperature, salinity and oxygen.

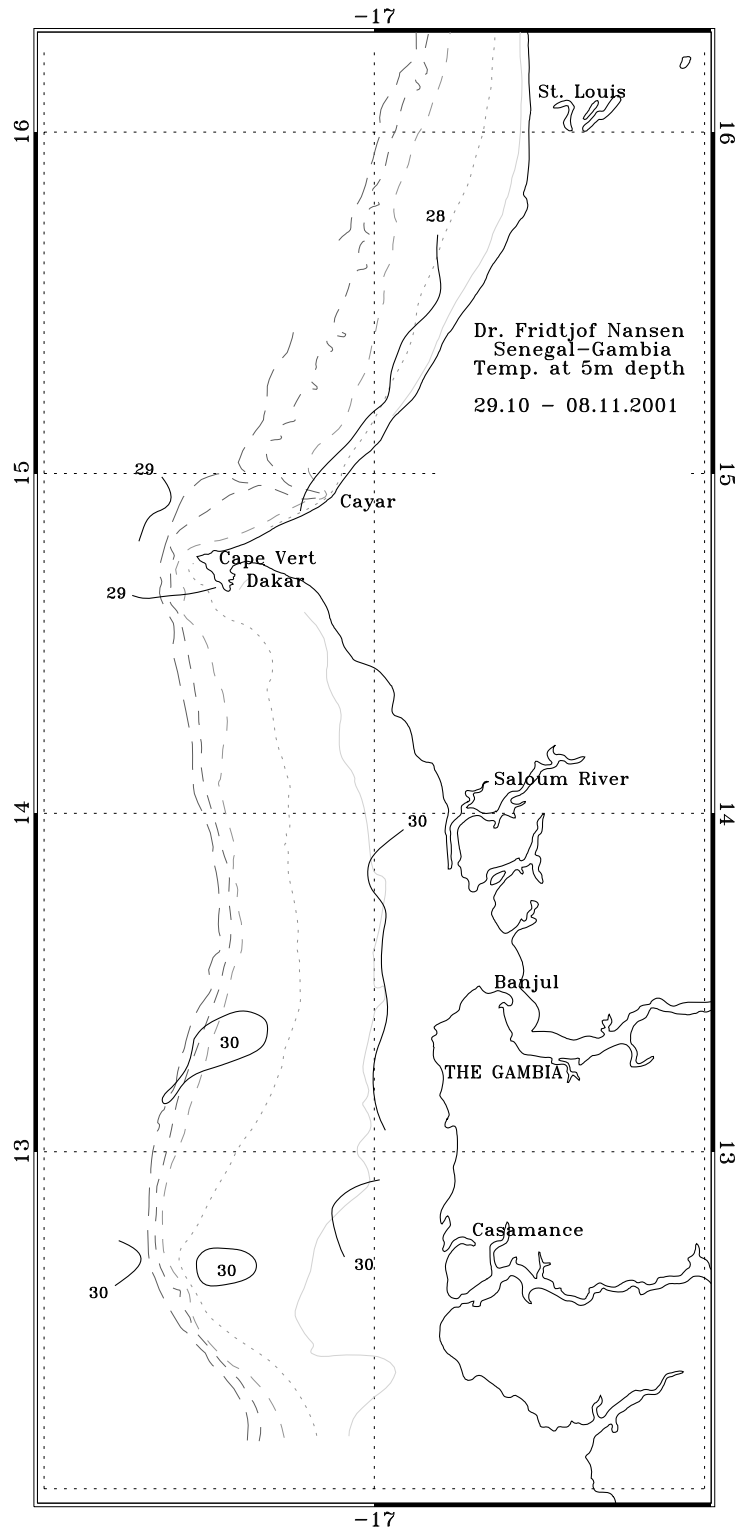


Figure 3 Sea surface temperature; Casamance to St. Louis.

The distribution of surface temperature and the profile the Gambia-west show that there was a stable surface layer with a temperature of 29-30 °C over the whole shelf south of Dakar. North of Cape Vert there was a stable surface layer with a temperature of 27-29 °C. Both profiles show that there is a profound hydrographic cline in about 20 m depth.

## 2.2 The Casamance shelf

Figures 4, 5 and 6 show the distributions of the main groups of pelagic fish by contoured acoustic densities for the whole shelf of Senegal and the Gambia.

Off the Casamance coast, there was a continuous school area of sardinella of medium and high density in shallow waters, mostly inside the 25 m depth line (Figure 4). The samples from this aggregation were predominantly (95%) *Sardinella maderensis*. The modal size was 23 and 26 cm (total length). The size composition is shown in Annex III, and the stock length compositions by numbers and weight in Annex IV. The total biomass of sardinellas in the area was estimated at 87 000 tonnes, Table 1.

Small concentrations of horse mackerel, *Trachurus trecae*, were found at the outer shelf of Casamance. It consisted of medium sized fish with modal length of 21 cm. The biomass was estimated at 8 000 tonnes, Table 1.

Other pelagic fish were found in rather low densities, but over a wider area than the sardinellas, see Figure 6. The trawl samples indicated that these consisted of bumper, lookdown and barracudas with the bumper as the dominating species. The estimated biomass of this group of fish was 134 000 tonnes.

Table 1. Casamance. Biomass estimates of pelagic fish, 1 000 tonnes.

Flat sardinella	Round sardinella	Horse mackerels	Carangids etc
83	4	8	134

## 2.3 The Gambian shelf

The school area of sardinella found off Casamance continued northwards off the Gambia, Figure 4. The highest concentrations were recorded as a medium to high-density area some 20 NM off the coast. The samples showed a 61% dominance of round sardinella, *Sardinella aurita*, with a smaller proportion of flat sardinella, *S. maderensis*. The pooled length composition

of the round sardinella had a modal length of 17 cm, see Annex III. The stock length compositions by numbers and weight are shown in Annex IV.

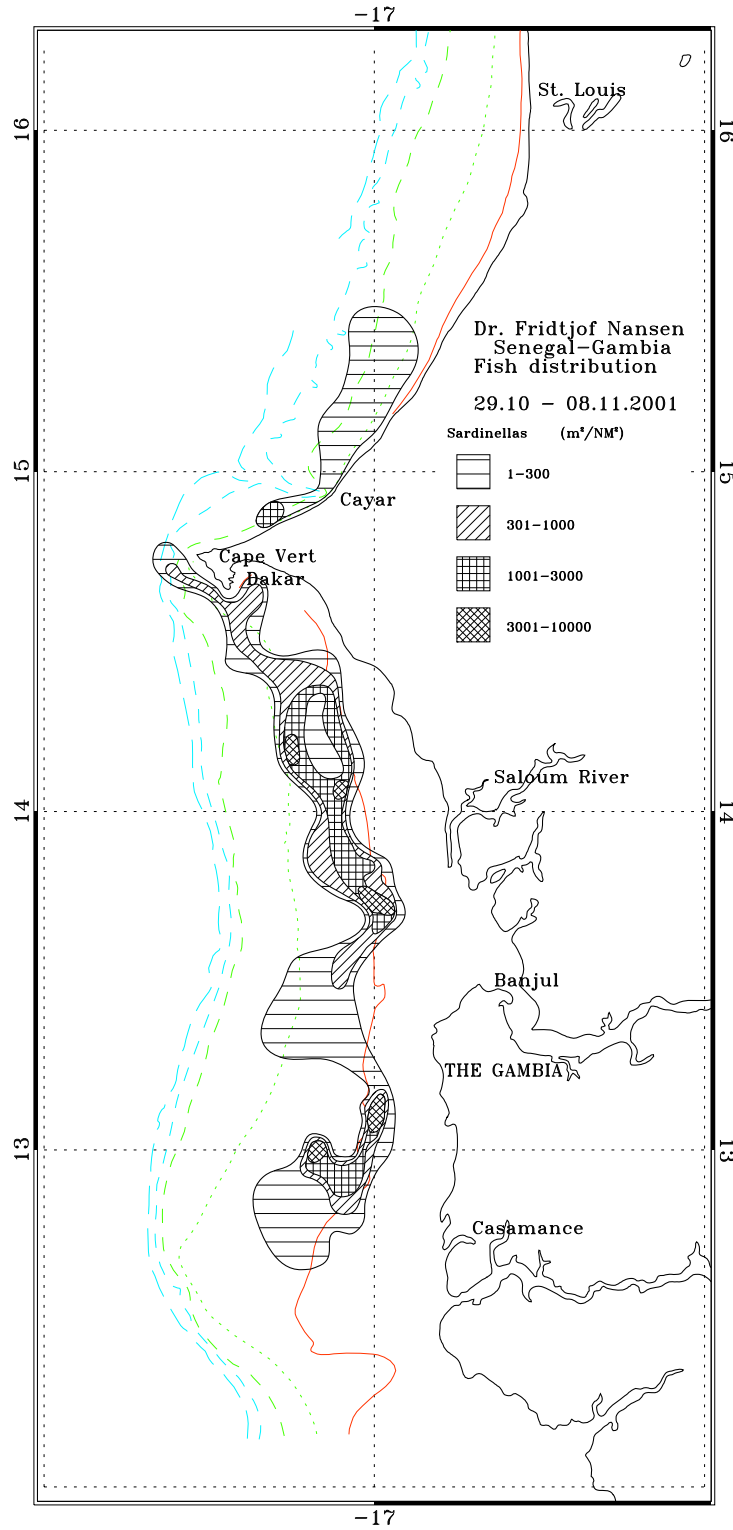


Figure 4 Distribution of sardinellas; Casamance to St. Louis.

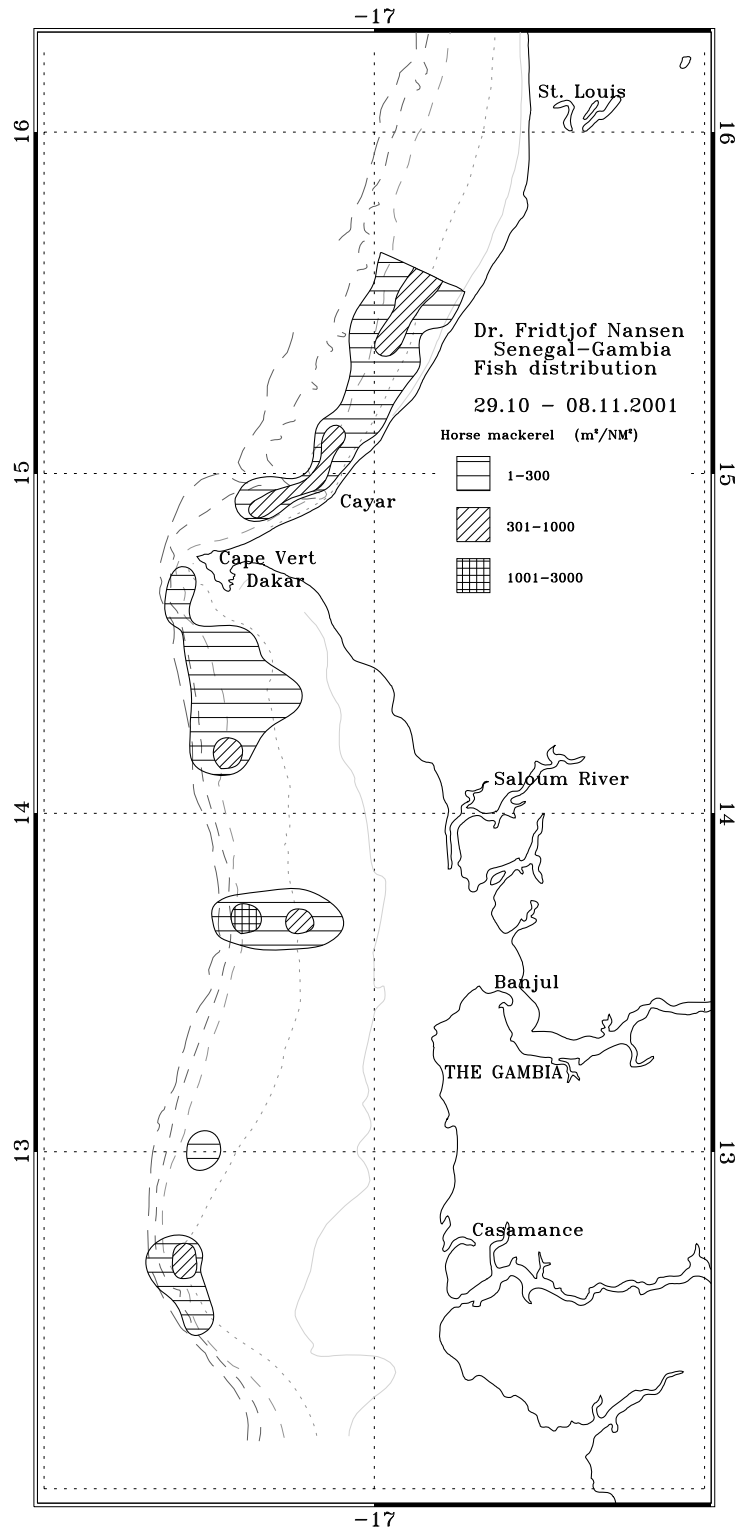


Figure 5 Horse mackerels; Casamance to St. Louis.

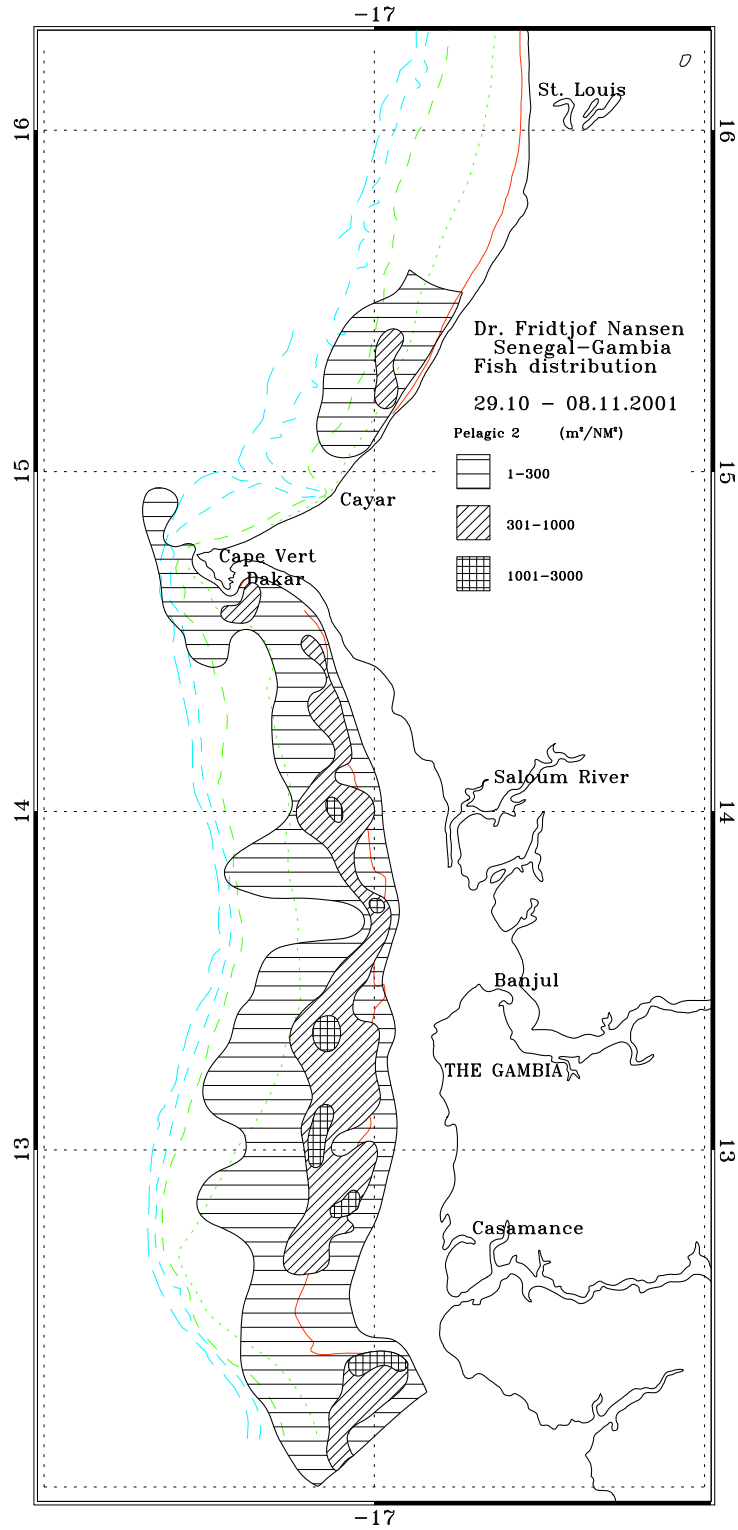


Figure 6. Carangids and associated species; Casamance to St. Louis



Table 2 shows that the biomass estimates of the sardinellas amounted to 54 000 tonnes, of which 33 000 tonnes were round sardinella.

No horse mackerels were found in the Gambia during this survey.

Carangids and associated species were found widely distributed over the inner shelf, Figure 6. Catches of this group consisted mainly of bumper, African lookdown and barracudas. The biomass was estimated to about 110 000 tonnes.

Table 2. The Gambia. Biomass estimates of pelagic fish, 1 000 tonnes.

Flat sardinella	Round sardinella	Horse mackerels	Carangids etc.
21	33	0	111

#### 2.4 The Gambian border - Cape Vert

Sardinellas were distributed from the outlet of the Saloum River to Dakar, Figure 4. The greatest densities were found some 20 NM southwest of the outlet of Saloum River. Table 3 shows the biomass estimates for the two sardinella species that summed up to 291 000 tonnes. Flat sardinella dominated the estimated biomass in the area by 55%.

Pooled length compositions of samples showed that the flat sardinella had a modal length of 8 and 23 cm while the round sardinella had modal lengths of 20, 22 and 30 cm, see Annex III. Stock size compositions by numbers and weight are shown in Annex IV.

The horse mackerels in this area were distributed in two main areas, one some 30 NM west of the outlet of the Saloum River and the other south of Cape Vert, Figure 5. The total biomass was estimated at some 81 000 tonnes of which 96% were Atlantic horse mackerel, *Trachurus trecae*. The modal length of the horse mackerel in this area was 21 cm.

Also here, the carangids and associated pelagic fish, were distributed over most of the area with the highest concentrations between the Saloum River and Dakar, see Figure 5. Again, bumper was caught in most of the trawl samples. The biomass of the carangids and associated pelagic fish was estimated at about 85 000 tonnes, Table 3.

Table 3. The Gambia border to Cape Vert. Biomass estimates of pelagic fish, 1 000 tonnes.

Flat sardinella 159	Round sardinella 132	Horse mackerels 81	Carangids etc. 85
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## 2.5 Cape Vert - St. Louis

Sardinella were distributed inshore along the coast, from about 10 NM northeast of Cape Vert to about 30 NM north of Cayar, Figure 4. Only small flat sardinella were found, with a modal length of 8 cm. The total biomass was estimated at 2 000 tonnes.

Horse mackerel were found at low to medium densities along the inner shelf in an area extending from about 10 NM north of Dakar to the point where the survey was finished (some 40 NM north of Cayar, Figure 5). The total biomass was estimated at 39 000 tonnes, and the catches consisted of Atlantic horse mackerel only. The modal length was 22 cm.

Carangids and associated pelagic fish were mainly found in an area from some 10 NM north of Cayar and northwards to the finish of the survey. A smaller aggregation was found off Cape Vert, Figure 6. The catches consisted also here of bumper and African lookdown. The biomass estimate was 17 000 tonnes.

Table 4. Cape Vert to St. Louis. Biomass estimates of pelagic fish, 1 000 tonnes.

Flat sardinella 2	Round sardinella -	Horse mackerels 39	Carangids etc. 17
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### CHAPTER 3 OVERVIEW AND SUMMARY OF RESULTS

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The survey was conducted successfully in the period October 29 to November 8 with a course track of about 1 500 NM and 28 fishing stations. The fact that the survey had to be terminated before the total area was covered has probably minimal effect on the total estimates of the various species.

The hydrographical data showed a stable surface layer for the whole shelf, on average one degree colder north of Dakar than to the south of this city.

Sardinellas were found in two main areas; one long distribution extending from Casamance to Cape Vert and another at the coast near Cayar, Figure 4. High densities were found in the southernmost parts of the Gambia and to the west of the outlet of the Saloum River. Flat sardinella dominated in all areas, except in the Gambia.

Horse mackerels were found in two main areas; one south off Dakar, and the other north of Dakar. In addition horse mackerels were found at the outer shelf west of Saloum River and southwards, Figure 5.

South of Cape Vert, the carangids and associated species were distributed over most of the shelf at rather low to medium densities, Figure 5. The catches of this group consisted of bumper, barracudas and hairtails. North of Cape Vert, the carangids were distributed over the shelf in the northernmost part of the region.

An overview of the acoustic estimates of biomass of the main groups of pelagic fish is shown in Table 5. The total biomass of sardinellas was thus 434 000 tonnes, horse mackerels – 128 000 tonnes and of carangids and associated species - 347 000 tonnes.

Table 5. Summary of biomass estimates of pelagic fish, Senegal and the Gambia. 1 000 tonnes.

	Flat sardinella	Round sardinella	Horse mackerels	Carangids etc.
St. Louis-Cape Vert	2	-	39	17
Cape Vert-Gambia	159	132	81	85
Gambia	21	33	-	111
Casamance	83	4	8	134
Total	265	169	128	347

Table 6 lists biomass estimates of sardinellas and carangids (including the horse mackerels) and associated species from the 'Dr. Fridtjof Nansen' surveys of this shelf region. Large-scale latitudinal movements of pelagic fish between West Sahara and Guinea Bissau are well known. Compared with the November-December estimates in earlier years, this years estimate of 434 000 tonnes of sardinellas is higher than those of the years 2000, 1998, 1997 and 1996. The carangid estimate of 475 000 tonnes is at the same level as the estimates in 2000 and 1999.

Table 6. Biomass estimates from previous 'Dr Fridtjof Nansen' surveys of the Senegal-the Gambia shelf. 1 000 tonnes.

Survey:	Sardinellas	Carangids etc. *
1981 Apr-May	210	570
1981 Sept	360	**
1982 Feb-Mar	40	90
1986 Nov-Dec	330	170
1992 Feb-Mar	1 530	690
1995 Nov-Dec	760	220
1996 Nov-Dec	231	526
1997 Nov-Dec	295	254
1998 Nov-Dec	388	344
1999 Nov-Dec	1 385	467
2000 Nov-Dec	270	489
2001 Jun-Jul	411	229
2001 Nov-Dec	434	475

\* Horse mackerels and other carangids

\*\* Not available

## References

Toresen, R., Gjørseter, H., and Barros, P. 1998. The acoustic method as used in the abundance estimation of capelin (*Mallotus villosus* Müller) and herring (*Clupea harengus* Linné) in the Barents Sea. Fisheries Research 34 (1998) 27-37.

# Annex I Records of fishing stations

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1456  
 DATE:31/10/01 GEAR TYPE: PT No:7 POSITION:Lat N 1207 Long W 1706  
 start stop duration  
 TIME :18:54:54 19:25:06 30 (min) Purpose code: 1  
 LOG :4256.52 4257.96 1.43 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 22 26 Validity code:  
 Towing dir: 260ø Wire out: 260 m Speed: 30 kn\*10  
 Sorted: 61 Kg Total catch: 142.16 CATCH/HOUR: 284.32

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Brachydeuterus auritus	95.20 1352	33.48	
Sphyræna guanchancho	41.60 84	14.63	
Chloroscombrus chrysurus	27.20 184	9.57	
Galeoides decadactylus	26.40 88	9.29	
Ilisha africana	25.60 1024	9.00	
Selene dorsalis	17.20 8	6.05	
Scomberomorus tritor	16.80 14	5.91	
Hemicarax bicolor	15.20 112	5.35	
Stromateus fiatola	10.00 18	3.52	
Sardinella maderensis	4.00 224	1.41	
Arius parkii	2.40 8	0.84	
Trichurus lepturus	2.40 152	0.84	
Parapenaeus longirostris	0.16 16	0.06	
Sepiella ornata	0.08 8	0.03	
Chloroscombrus Juvenile	0.08 192	0.03	
<b>Total</b>	<b>284.32</b>	<b>100.01</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1457  
 DATE:31/10/01 GEAR TYPE: PT No:7 POSITION:Lat N 1220 Long W 1713  
 start stop duration  
 TIME :02:00:51 02:30:37 30 (min) Purpose code: 1  
 LOG :4322.99 4324.80 1.79 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 26 36 Validity code:  
 Towing dir: 270ø Wire out: 160 m Speed: 35 kn\*10  
 Sorted: 8 Kg Total catch: 7.94 CATCH/HOUR: 15.88

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Selene dorsalis	6.70 40	42.19	
Orcynopsis unicolor	5.70 2	35.89	
Scomberomorus tritor	1.60 2	10.08	
Caranx senegalus	1.00 2	6.30	
Engraulis encrasicolus	0.40 346	2.52	
Sardinella maderensis	0.28 2	1.76	
Sphyræna guanchancho	0.20 2	1.26	
<b>Total</b>	<b>15.88</b>	<b>100.00</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1459  
 DATE:31/10/01 GEAR TYPE: PT No:7 POSITION:Lat N 1220 Long W 1700  
 start stop duration  
 TIME :04:31:25 05:01:17 30 (min) Purpose code: 1  
 LOG :4341.09 4342.65 1.32 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 24 26 Validity code:  
 Towing dir: 270ø Wire out: 160 m Speed: 32 kn\*10  
 Sorted: 31 Kg Total catch: 952.35 CATCH/HOUR: 1904.70

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chloroscombrus chrysurus	1216.00 15600	63.84	
Sphyræna guanchancho	653.60 644	34.32	
Galeoides decadactylus	12.00 44	0.63	
Scomberomorus tritor	8.20 8	0.43	
Sardinella maderensis	7.10 64	0.37	2511
Brachydeuterus auritus	6.00 80	0.32	
Stromateus fiatola	1.20 2	0.06	
Trachinotus ovatus	0.60 4	0.03	
<b>Total</b>	<b>1904.70</b>	<b>100.00</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1459  
 DATE:31/10/01 GEAR TYPE: PT No:7 POSITION:Lat N 1231 Long W 1705  
 start stop duration  
 TIME :07:32:37 08:03:29 31 (min) Purpose code: 1  
 LOG :4365.58 4367.28 1.68 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 15 17 Validity code:  
 Towing dir: 270ø Wire out: 260 m Speed: 30 kn\*10  
 Sorted: 12 Kg Total catch: 11.50 CATCH/HOUR: 22.26

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Scomberomorus tritor	9.64 10	43.31	
Sphyræna guanchancho	6.87 10	30.86	
Engraulis encrasicolus	2.19 2810	9.84	
Rhizoprionodon acutus	1.43 2	6.42	
Caranx senegalus	1.37 2	6.15	
Sardinella maderensis	0.46 4	2.07	
Echeneis naucrates	0.19 2	0.85	
Callinectes pallidus	0.10 4	0.45	
<b>Total</b>	<b>22.25</b>	<b>99.95</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1460  
 DATE:31/10/01 GEAR TYPE: PT No:7 POSITION:Lat N 1240 Long W 1715  
 start stop duration  
 TIME :15:16:10 15:52:26 36 (min) Purpose code: 1  
 LOG :4442.91 4445.05 2.13 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 23 25 Validity code:  
 Towing dir: 270ø Wire out: 160 m Speed: 34 kn\*10  
 Sorted: Kg Total catch: 0.26 CATCH/HOUR: 0.43

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Trachinotus ovatus	0.43 2	100.00	
<b>Total</b>	<b>0.43</b>	<b>100.00</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1461  
 DATE:31/10/01 GEAR TYPE: PT No:7 POSITION:Lat N 1248 Long W 1705  
 start stop duration  
 TIME :19:14:29 19:44:10 30 (min) Purpose code: 1  
 LOG :4464.03 4465.97 1.93 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 19 19 Validity code:  
 Towing dir: 202ø Wire out: 260 m Speed: 30 kn\*10  
 Sorted: 38 Kg Total catch: 130.20 CATCH/HOUR: 260.40

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Ilisha africana	132.00 35160	50.69	
Chloroscombrus chrysurus	51.60 824	19.82	
Sardinella maderensis	42.60 404	16.36	2512
Brachydeuterus auritus	20.80 336	7.96	
Galeoides decadactylus	6.80 52	2.61	
Sphyræna guanchancho	2.56 10	0.98	
Decapterus rhonchus	1.48 4	0.57	
Selene dorsalis	1.04 16	0.40	
Arius latiscutatus	0.66 2	0.25	
Sardinella aurita	0.46 2	0.18	
Parapenaeus longirostris	0.32 32	0.12	
Penaeus kerathurus	0.08 8	0.03	
<b>Total</b>	<b>260.40</b>	<b>100.00</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1462  
 DATE:31/10/01 GEAR TYPE: PT No:7 POSITION:Lat N 1250 Long W 1708  
 start stop duration  
 TIME :20:00:32 21:40:13 30 (min) Purpose code: 1  
 LOG :4476.83 4478.30 1.45 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 22 21 Validity code:  
 Towing dir: 90ø Wire out: 260 m Speed: 30 kn\*10  
 Sorted: 58 Kg Total catch: 1055.00 CATCH/HOUR: 2110.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chloroscombrus chrysurus	843.60 11866	39.98	
Brachydeuterus auritus	836.60 12320	39.65	
Sardinella maderensis	244.60 2486	11.59	2513
Sardinella aurita	77.00 526	3.65	
Decapterus rhonchus	34.00 176	1.61	
Galeoides decadactylus	30.20 70	1.43	
Arius latiscutatus	14.40 36	0.68	
Sphyræna guanchancho	13.00 40	0.62	
Pomadasys rogeri	11.20 36	0.53	
Trichurus lepturus	4.60 36	0.22	
Parapenaeus longirostris	0.80 36	0.04	
<b>Total</b>	<b>2110.00</b>	<b>100.00</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1463  
 DATE:31/10/01 GEAR TYPE: PT No:6 POSITION:Lat N 1250 Long W 1719  
 start stop duration  
 TIME :23:24:55 23:55:57 31 (min) Purpose code: 1  
 LOG :4491.56 4493.49 1.90 Area code : 4  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 35 38 Validity code:  
 Towing dir: 270ø Wire out: 160 m Speed: 30 kn\*10  
 Sorted: 47 Kg Total catch: 47.42 CATCH/HOUR: 91.78

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardinella maderensis	15.53 105	18.01	2514
Scomberomorus tritor	12.48 10	13.60	
Sphyræna guanchancho	11.42 15	12.44	
Stromateus fiatola	10.65 12	11.60	
Sphyrna sp.	9.39 4	10.23	
Selene dorsalis	7.18 39	7.82	
Pomadasys rogeri	5.48 4	5.97	
Caranx crysos	3.29 4	3.58	
Decapterus rhonchus	2.71 8	2.95	
Galeoides decadactylus	2.63 4	2.87	
Alectis alexandrinus	2.61 8	2.84	
Arius latiscutatus	1.55 4	1.69	
Selar crumenophthalmus	1.10 4	1.20	
Pomadasys jubelini	1.06 2	1.15	
Alloteuthis africana	0.99 128	1.08	
Saurida brasiliensis	0.97 165	1.06	
Decapterus punctatus	0.79 45	0.86	
Chloroscombrus chrysurus	0.75 4	0.82	
Trachurus trecae	0.19 6	0.21	
<b>Total</b>	<b>91.77</b>	<b>99.98</b>	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1464  
 DATE: 1/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1320  
 start stop duration Long W 1708  
 TIME :06:39:40 07:10:28 31 (min) Purpose code: 1  
 LOG :4560.01 4561.57 1.54 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 25 24 Validity code:  
 Towing dir: 90° Wire out: 260 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: CATCH/HOUR:

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

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1465  
 DATE: 1/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1300  
 start stop duration Long W 1657  
 TIME :08:45:16 09:15:53 31 (min) Purpose code: 1  
 LOG :4572.23 4573.80 1.54 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 17 19 Validity code:  
 Towing dir: 270° Wire out: 280 m Speed: 30 kn\*10  
 Sorted: 67 Kg Total catch: 574.37 CATCH/HOUR: 1111.68

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Brachydeuterus auritus	704.13	10744	63.34
Sardinella maderensis	233.61	3242	21.01
Galeoides decadactylus	110.32	149	9.92
Chloroscombrus chrysurus	39.48	1053	3.55
Sphyrna lewini	12.29	4	1.11
Caranx crysos	3.74	19	0.34
Ilisha africana	3.14	83	0.28
Sardinella aurita	2.81	33	0.25
Sphyrna guachancho	2.30	17	0.21
Total	1111.82		100.01

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1466  
 DATE: 1/11/01 GEAR TYPE: PT No:6 POSITION:Lat N 1320  
 start stop duration Long W 1720  
 TIME :18:46:34 19:16:44 30 (min) Purpose code: 1  
 LOG :4666.01 4667.63 1.59 Area code : 5  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 61 55 Validity code:  
 Towing dir: 90° Wire out: 150 m Speed: 30 kn\*10  
 Sorted: 20 Kg Total catch: 20.41 CATCH/HOUR: 40.82

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardinella aurita	38.50	274	94.32
Echeneis naucrates	1.10	8	2.69
Sardinella maderensis	0.48	2	1.18
Sphyrna guachancho	0.42	2	1.03
Selene dorsalis	0.28	2	0.69
Remora sp.	0.04	2	0.10
Total	40.82		100.01

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1467  
 DATE: 1/11/01 GEAR TYPE: PT No:6 POSITION:Lat N 1321  
 start stop duration Long W 1710  
 TIME :20:01:03 20:01:20 30 (min) Purpose code: 1  
 LOG :4676.23 4677.85 1.61 Area code : 5  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 40 40 Validity code:  
 Towing dir: 90° Wire out: 150 m Speed: 30 kn\*10  
 Sorted: 95 Kg Total catch: 3712.48 CATCH/HOUR: 7424.96

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chloroscombrus chrysurus	5188.00	48800	69.87
Brachydeuterus auritus	772.00	10240	10.40
Sardinella aurita	341.60	2800	4.60
Sardinella maderensis	294.40	2080	3.97
Sarpa salpa	220.80	240	2.97
Arius parkii	191.20	240	2.58
Pomadasys incisus	190.40	1200	2.56
Sphyrna guachancho	137.60	320	1.85
Lagocephalus laevis	34.40	80	0.46
Dactylopterus volitans	18.40	80	0.25
Decapterus rhonchus	16.16	880	0.22
Pagellus bellottii	12.80	80	0.17
Selene dorsalis	7.20	80	0.10
Total	7424.96		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1468  
 DATE: 2/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1327  
 start stop duration Long W 1703  
 TIME :00:00:12 00:30:15 30 (min) Purpose code: 1  
 LOG :4704.71 4706.42 1.71 Area code : 5  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 26 29 Validity code:  
 Towing dir: 315° Wire out: 250 m Speed: 34 kn\*10  
 Sorted: Kg Total catch: 0.21 CATCH/HOUR: 0.42

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Brachydeuterus auritus	0.26	4	61.90
Remora remora	0.16	2	38.10
Total	0.42		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1469  
 DATE: 2/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1330  
 start stop duration Long W 1710  
 TIME :02:30:14 03:01:07 31 (min) Purpose code: 1  
 LOG :4723.06 4725.08 2.00 Area code : 5  
 FDEPTH: 25 25 GearCond.code:  
 BDEPTH: 41 37 Validity code:  
 Towing dir: 90° Wire out: 90 m Speed: 35 kn\*10  
 Sorted: 70 Kg Total catch: 698.60 CATCH/HOUR: 1352.13

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Brachydeuterus auritus	464.52	6058	34.35
Chloroscombrus chrysurus	339.68	3019	25.12
Sardinella maderensis	254.52	1955	18.82
Sardinella aurita	119.03	929	8.80
Caranx crysos	104.52	135	7.73
Pomadasys incisus	27.48	174	2.03
Arius parkii	13.16	19	0.97
Selene dorsalis	11.81	97	0.87
Pagellus bellottii	7.74	58	0.57
Selar crumenophthalmus	5.81	19	0.43
Sphyrna guachancho	3.87	19	0.29
Total	1352.14		99.98

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1470  
 DATE: 2/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1340  
 start stop duration Long W 1721  
 TIME :10:55:41 11:04:25 9 (min) Purpose code: 1  
 LOG :4792.52 4793.08 0.54 Area code : 4  
 FDEPTH: 49 58 GearCond.code:  
 BDEPTH: 76 82 Validity code:  
 Towing dir: 270° Wire out: 150 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: CATCH/HOUR:

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

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1471  
 DATE: 2/11/01 GEAR TYPE: BT No: POSITION:Lat N 1340  
 start stop duration Long W 1721  
 TIME :11:38:50 12:05:28 27 (min) Purpose code: 1  
 LOG :4795.08 4796.26 1.17 Area code : 4  
 FDEPTH: 79 69 GearCond.code:  
 BDEPTH: 79 69 Validity code:  
 Towing dir: 90° Wire out: 240 m Speed: 30 kn\*10  
 Sorted: 27 Kg Total catch: 208.32 CATCH/HOUR: 462.93

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Trachurus trecae	390.11	4599	84.27
Boops boops	35.93	560	7.76
Pagellus bellottii	8.11	87	1.75
Fistularia petimba	7.44	16	1.61
Sepia officinalis hierredda	3.98	9	0.86
Plectorhinchus mediterraneus	3.56	11	0.77
Raja miraletus	3.22	4	0.70
Priacanthus arenatus	1.78	4	0.38
Chaetodon hoefleri	1.67	11	0.36
Sparus pagrus pagrus *	1.44	7	0.31
Chelidonichthys capensis	1.33	16	0.29
Spondyllosoma cantharus	1.22	4	0.26
Scorpaena stephanica	0.78	9	0.17
Pagrus caeruleostictus	0.78	2	0.17
Dentex canariensis	0.67	2	0.14
Umbrina canariensis	0.56	2	0.12
Illex coindetii	0.33	2	0.07
C R A B S	0.02	4	
Total	462.93		99.99

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1472  
 DATE: 2/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1344  
 start stop duration Long W 1702  
 TIME :15:58:49 16:28:34 30 (min) Purpose code: 1  
 LOG :4828.28 4829.91 1.62 Area code : 4  
 FDEPTH: 25 22 GearCond.code:  
 BDEPTH: 25 22 Validity code:  
 Towing dir: 120° Wire out: 110 m Speed: 31 kn\*10  
 Sorted: 98 Kg Total catch: 391.32 CATCH/HOUR: 782.64

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Pomadasys incisus	196.00	2168	25.04
Chloroscombrus chrysurus	188.00	3432	24.02
Pseudupeneus prayensis	80.40	824	10.27
Sardinella aurita	77.20	648	9.86
Brachydeuterus auritus	67.60	1160	8.64
Decapterus rhonchus	52.80	736	6.75
Sardinella maderensis	31.20	360	3.99
Plectorhinchus mediterraneus	28.00	312	3.58
Pagellus bellottii	27.60	248	3.53
Selar crumenophthalmus	8.80	128	1.12
Acanthurus monroviae	4.40	16	0.56
Epinephelus aeneus	3.00	2	0.38
Lithognathus mormyrus	2.80	8	0.36
Eucinostomus melanopterus	2.80	24	0.36
Dactylopterus volitans	2.40	8	0.31
Sparus caeruleostictus *	2.04	8	0.26
Sparus pagrus pagrus *	2.00	8	0.26
Selene dorsalis	1.60	16	0.20
PLATYRHINIDAE	1.60	2	0.20
Remora remora	1.20	8	0.15
Dentex canariensis	1.20	8	0.15
Total	782.64		99.99

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1473  
 DATE: 2/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1349  
 start stop duration  
 TIME :19:46:57 20:22:48 36 (min) Purpose code: 1  
 LOG :4848.52 4850.54 1.96 Area code : 4  
 FDEPTH: 10 10 GearCond.code: 4  
 BDEPTH: 27 25 Validity code:  
 Towing dir: 170ø Wire out: 260 m Speed: 30 kn\*10

Sorted: 85 Kg Total catch: 966.03 CATCH/HOUR: 1610.05

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella maderensis	630.00	5600	39.13
Chloroscombrus chrysurus	429.33	6393	26.67
Brachydeuterus auritus	201.83	3173	12.54
Sardinella aurita	162.17	793	10.07
Selar crumenophthalmus	74.67	23	4.64
Arius parkii	53.43	70	3.32
Pomadasyd jubelini	24.08	93	1.50
Albula vulpes	11.43	23	0.71
Penaeus kerathurus	10.03	70	0.62
Decapterus rhonchus	4.67	23	0.29
Pomadasyd rogeri	3.45	8	0.21
Eucinostomus melanopterus	2.33	23	0.14
Galeoides decadactylus	1.92	3	0.12
Selene dorsalis	0.70	23	0.04
Total	1610.04		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1474  
 DATE: 2/11/01 GEAR TYPE: PT No:6 POSITION:Lat N 1349  
 start stop duration  
 TIME :23:12:33 23:43:29 31 (min) Purpose code:  
 LOG :4874.85 4876.52 1.65 Area code :  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 89 93 Validity code:  
 Towing dir: 270ø Wire out: 150 m Speed: 30 kn\*10

Sorted: 5 Kg Total catch: 4.99 CATCH/HOUR: 9.66

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
MYCTOPHIDAE	5.26	1800	54.45
Ariomma bondi	1.30	41	13.46
Trichurus lepturus	0.75	2	7.76
POGONIDAE	0.54	91	5.59
Spherooides pachgaster	0.48	2	4.97
Saurida brasiliensis	0.46	223	4.76
Sardinella aurita	0.45	8	4.66
PARALPHEIDAE	0.39	2	4.04
Sepiella ornata	0.02	2	0.21
Total	9.65		99.90

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1475  
 DATE: 3/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1400  
 start stop duration  
 TIME :04:54:03 05:14:15 20 (min) Purpose code: 1  
 LOG :4925.72 4926.80 1.02 Area code : 4  
 FDEPTH: 20 22 GearCond.code:  
 BDEPTH: 27 30 Validity code:  
 Towing dir: 270ø Wire out: 80 m Speed: 35 kn\*10

Sorted: 63 Kg Total catch: 939.75 CATCH/HOUR: 2819.25

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Chloroscombrus chrysurus	1473.75	34605	52.27
Sardinella maderensis	839.25	8595	29.77
Sardinella aurita	400.50	3060	14.21
Brachydeuterus auritus	85.50	1530	3.03
Galeoides decadactylus	20.25	90	0.72
Total	2819.25		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1476  
 DATE: 3/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1438  
 start stop duration  
 TIME :18:39:37 19:10:52 31 (min) Purpose code: 1  
 LOG :5061.77 5063.38 1.60 Area code : 4  
 FDEPTH: 32 32 GearCond.code:  
 BDEPTH: 32 32 Validity code:  
 Towing dir: 252ø Wire out: 120 m Speed: 30 kn\*10

Sorted: 60 Kg Total catch: 960.62 CATCH/HOUR: 1859.26

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Pomadasyd jubelini	769.55	1858	41.39
Brachydeuterus auritus	610.06	9476	32.81
Selene dorsalis	107.77	650	5.80
Sparus caeruleostictus *	45.21	828	2.43
Sphyaena guachancho	41.50	62	2.23
Lithognathus mormyrus	36.85	93	1.98
Chloroscombrus chrysurus	33.14	341	1.78
Pagellus bellottii	30.97	248	1.67
Chaetodon hoefleri	24.46	186	1.32
Galeoides decadactylus	22.92	124	1.23
Pseudupeneus prayensis	20.75	186	1.12
Selar crumenophthalmus	17.96	186	0.97
Pomadasyd incisus	17.65	124	0.95
Scorpaena stephanica	16.10	186	0.87
Sphyaena sphyaena	13.94	62	0.75
Sardinella maderensis	8.05	186	0.43
Fistularia petimba	7.12	31	0.38
Boops boops	6.50	403	0.35
Penaeus notialis	6.00	116	0.32
Loligo vulgaris	4.80	4	0.26
Sardinella aurita	3.72	62	0.20
Serranus scriba	3.41	31	0.18
Syacium micrurum	3.10	62	0.17
Synodus synodus	2.79	31	0.15
Chelidonichthys capensis	2.48	31	0.13
Lutjanus fulgens	1.55	62	0.08
Spherooides marmoratus	1.24	31	0.07
Total	1859.59		100.07

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1477  
 DATE: 3/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 1427

start stop duration  
 TIME :21:06:15 21:36:10 30 (min) Purpose code: 1  
 LOG :5077.93 5079.58 1.64 Area code : 4  
 FDEPTH: 10 10 GearCond.code: 4  
 BDEPTH: 83 80 Validity code:  
 Towing dir: 360ø Wire out: 150 m Speed: 30 kn\*10

Sorted: 28 Kg Total catch: 97.51 CATCH/HOUR: 195.02

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella aurita	114.80	1834	58.87
Trachurus trachurus	79.10	3780	40.56
Scomber japonicus	0.84	8	8.43
Sepiella ornata	0.14	8	0.07
Saurida brasiliensis	0.14	8	0.07
Total	195.02		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1478  
 DATE: 4/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1441  
 start stop duration  
 TIME :01:31:05 02:01:07 30 (min) Purpose code: 1  
 LOG :5115.78 5117.71 1.92 Area code : 4  
 FDEPTH: 10 10 GearCond.code: 4  
 BDEPTH: 53 66 Validity code:  
 Towing dir: 270ø Wire out: 160 m Speed: 35 kn\*10

Sorted: 46 Kg Total catch: 45.82 CATCH/HOUR: 91.64

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Sardinella maderensis	69.60	13146	75.95
Carcharhinus limbatus	7.50	2	8.13
MYCTOPHIDAE	6.44	1896	7.03
Todarodes sagittatus	2.80	1036	3.06
Decapterus rhonchus	2.60	78	2.84
Sphyaena guachancho	1.80	12	1.96
Selar crumenophthalmus	0.60	10	0.65
Scomber japonicus	0.20	2	0.22
Sepiella ornata	0.10	8	0.11
Total	91.64		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1479  
 DATE: 4/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1455  
 start stop duration  
 TIME :12:31:19 12:53:36 22 (min) Purpose code: 1  
 LOG :5204.30 5205.58 1.26 Area code : 4  
 FDEPTH: 130 130 GearCond.code:  
 BDEPTH: 130 130 Validity code:  
 Towing dir: 210ø Wire out: 480 m Speed: 31 kn\*10

Sorted: 43 Kg Total catch: 291.87 CATCH/HOUR: 796.01

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Dentex angolensis	450.27	6665	56.57
Trachurus trecae	294.27	2995	36.97
Squatinia oculata	27.68	3	3.48
Merluccius senegalensis	14.73	52	1.85
Boops boops	5.32	52	0.67
Zeus faber	1.42	16	0.18
Ariomma bondi	0.71	16	0.09
Pontinus kuhlii	0.71	16	0.09
Trachurus trachurus	0.55	16	0.07
Antigonia capros	0.35	35	0.04
Total	796.01		100.01

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1480  
 DATE: 4/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 1508  
 start stop duration  
 TIME :19:46:54 20:16:54 30 (min) Purpose code: 1  
 LOG :5266.65 5268.62 1.99 Area code : 4  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 100 100 Validity code:  
 Towing dir: 135ø Wire out: 150 m Speed: 30 kn\*10

Sorted: 31 Kg Total catch: 417.55 CATCH/HOUR: 835.10

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Trachurus trecae, juvenile	486.20	17576	58.22
Sardinella maderensis - Juv.	174.20	23608	20.86
Euthynnus alletteratus	54.08	442	6.48
Saurida brasiliensis	43.68	6942	5.23
Sardinella aurita	40.56	442	4.86
Bregmaceros sp.	20.00	52000	2.39
Scomber japonicus	6.50	26	0.78
Ariomma bondi	6.24	182	0.75
Illex coindetii	3.12	26	0.37
Priacanthus arenatus	0.52	26	0.06
Total	835.10		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1481  
 DATE: 4/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1504  
 start stop duration  
 TIME :21:47:53 22:47:53 30 (min) Purpose code: 1  
 LOG :5279.76 5281.60 1.84 Area code : 4  
 FDEPTH: 37 37 GearCond.code:  
 BDEPTH: 37 35 Validity code:  
 Towing dir: 220ø Wire out: 150 m Speed: 30 kn\*10

Sorted: 7 Kg Total catch: 253.55 CATCH/HOUR: 507.10

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Brachydeuterus auritus	372.00	3192	73.36
Trichurus lepturus	72.80	350	14.36
Boops boops	27.30	140	5.38
Chloroscombrus chrysurus	14.00	70	2.76
Decapterus rhonchus	13.30	70	2.62
Pomadasyd incisus	6.30	70	1.24
Parapenaeus longirostris	1.40	70	0.28
Total	507.10		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1482  
 DATE: 5/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 1514  
 start stop duration  
 TIME :00:21:51 00:51:38 30 (min) Purpose code: 1  
 LOG :5300.70 5302.46 1.75 Area code : 4

FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 82 96 Validity code:  
 Towing dir: 0 Wire out: 160 m Speed: 34 kn\*10  
 Sorted: 13 Kg Total catch: 12.95 CATCH/HOUR: 25.90

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Saurida brasiliensis	6.64	1388	25.64	
Trichiurus lepturus	4.82	74	18.61	
Brachydeuterus auritus	4.52	32	17.45	
Trachurus trecae	4.06	112	15.68	
Selene dorsalis	1.58	22	6.10	
Sardinella maderensis	1.10	94	4.25	
Decapterus rhonchus	0.80	6	3.09	
Decapterus punctatus	0.54	24	2.08	
Alloteuthis africana	0.52	312	2.01	
Trachinotus ovatus	0.50	2	1.93	
Ilisha africana	0.28	2	1.08	
Ariomma bondi	0.28	6	1.08	
Illex coindetii	0.16	2	0.62	
Sphyræna guachancho	0.08	4	0.31	
Sepiella ornata	0.02	2	0.08	
Total	25.90		100.01	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1483  
 DATE: 5/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1523  
 start stop duration Long W 1658  
 TIME :05:36:55 06:08:38 32 (min) Purpose code: 1  
 LOG :5347.28 5349.39 2.11 Area code : 4  
 FDEPTH: 40 42 GearCond.code:  
 BDEPTH: 85 65 Validity code:  
 Towing dir: 1220 Wire out: 120 m Speed: 30 kn\*10  
 Sorted: 58 Kg Total catch: 58.66 CATCH/HOUR: 109.99

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	41.81	413	38.01	
Chloroscombrus chrysurus	36.00	197	32.73	
Brachydeuterus auritus	22.41	184	20.37	
Sardinella aurita	3.56	32	3.24	
Sardinella maderensis	1.91	11	1.74	
Trichiurus lepturus	1.74	4	1.58	
Saurida brasiliensis	1.74	375	1.58	
Illex coindetii	0.58	92	0.53	
Lagocephalus laevisgatus	0.17	2	0.15	
Decapterus rhonchus	0.06	6	0.05	
Total	109.98		99.98	



## Annex II Instruments and fishing gear used

The Simrad EK-500, 38kHz echo scientific sounder was used during the survey for fish abundance estimation. The Bergen Echo Integrator system (BEI) logging the echogram raw data from the sounder, was used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data was stored to tape, and a backup of the database of scrutinized data, stored. The details of the settings of the 38kHz where as follows:

<b>Transceiver-1 menu</b>	Transducer depth	5.5 - 7.5 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	27.16 dB
	TS transducer gain	27.26 dB
	Angle sensitivity	21.9
	3 dB beamwidth Along.	7.1°
	3 dB beamwidth Athw.	6.9°
	Alongship offset	0.07°
	Athwardship offset	0.03°
<b>Display menu</b>	Echogram	1
	Bottom range	10 m
	Bottom range start	9 m
	TVG	20 log R
	Sv colour min	-67 dB
	TS Colour minimum	-60 dB
	<b>Printer- menu</b>	Range
TVG		20 log R
Sv colour min		-60 dB
<b>Bottom detection menu</b>	Minimum level	-40 dB

A calibration experiment using a standard wolfram carbide sphere, performed off Langstrand, Walvis Bay 8 September 2001 gave the following results:

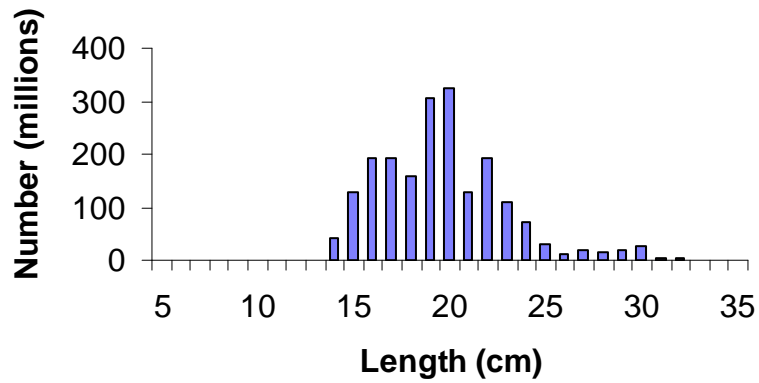
Sv Transducer gain 27.16 dB  
Ts Transducer gain 27.26 dB

### Fishing gear

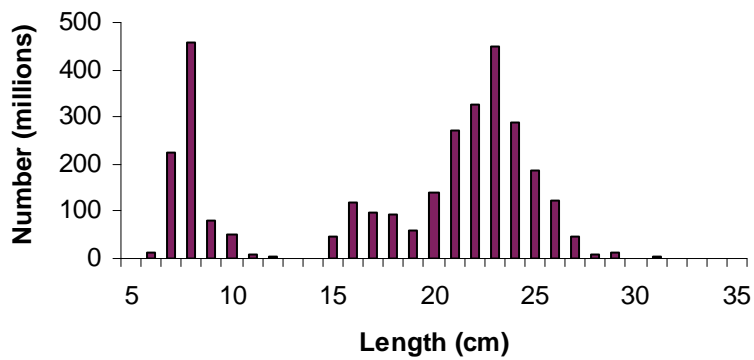
The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super" bottom trawl. For all trawls, the Tyborøn, 7.8m<sup>2</sup> (1670 kg) trawl doors were used.

## Annex III Pooled length distribution by species and regions

**Casamance - Cap Vert**  
*Sardinella aurita*

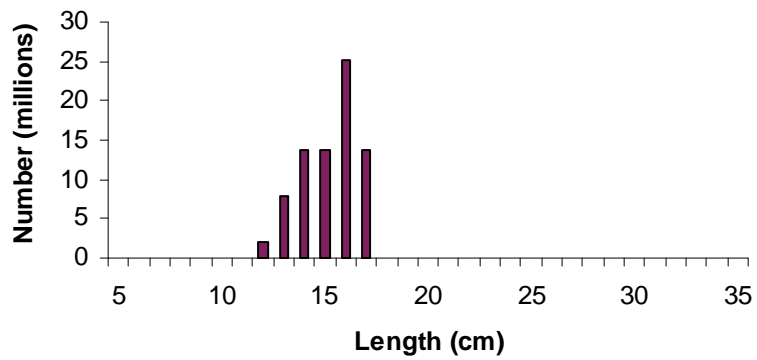


**Casamance - Cap Vert**  
*Sardinella maderensis*

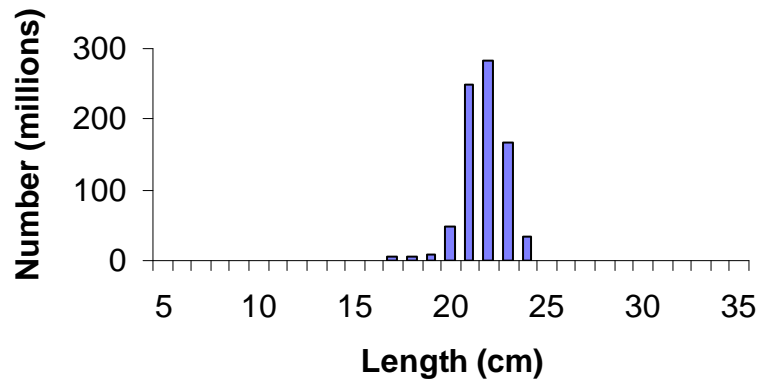


## Annex III continued

### Casamance - Cap Vert *Decapterus sp.*



### Casamance - Cap Vert *Trachurus trecae*



## Annex IV Stock length distribution by numbers and weight

*Sardinella aurita*

Length cm	N (millions)					Biomass (tonnes)				
	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL
5										
6										
7										
8										
9										
10										
11										
12										
13										
14			41 916		41 916			1 227		1 227
15		18 042	110 902		128 944		645	3 965		4 610
16			193 993		193 993			8 366		8 366
17		9 021	184 712		193 733		464	9 503		9 968
18		51 760	108 478		160 238		3 146	6 594		9 740
19		278 173	28 780		306 953		19 801	2 049		21 850
20		314 033	10 543		324 576		25 972	872		26 844
21		125 990	2 636		128 626		12 021	251		12 272
22		187 491	2 636	2 849	192 976		20 502	288	312	21 102
23		107 033		2 849	109 882		13 335		355	13 690
24		68 244		4 273	72 517		9 635		603	10 238
25		27 859		1 424	29 283		4 435		227	4 661
26		9 752		1 424	11 177		1 742		254	1 997
27		16 399		2 849	19 248		3 274		569	3 843
28		14 095		2 849	16 944		3 132		633	3 765
29		18 571		1 424	19 995		4 577		351	4 928
30		23 313		2 849	26 162		6 350		776	7 126
31		4 609			4 609		1 383			1 383
32		4 876			4 876		1 607			1 607
33										
34										
35										
TOTAL		1 279 262	684 595	22 792	1 986 649		132 021	33 115	4 080	169 216

## Annex IV Continued

*Sardinella maderensis*

Length cm	N (millions)					Biomass (tonnes)				
	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL
5										
6		11 344			11 344		30			30
7	6 847	219 313			226 160	28	888			916
8	102 702	355 439			458 141	605	2 096			2 701
9	34 234	45 375			79 609	282	373			655
10	51 351				51 351	571				571
11	10 270				10 270	150				150
12	3 423				3 423	64				64
13										
14										
15			46 839		46 839			1 674		1 674
16			117 635		117 635			5 073		5 073
17			97 453		97 453			5 014		5 014
18			83 985	7 962	91 947			5 105	484	5 589
19		14 102	39 569	6 445	60 116		1 004	2 817	459	4 279
20		68 875	4 847	64 728	138 449		5 696	401	5 353	11 450
21		178 666	8 343	86 074	273 083		17 046	796	8 212	26 054
22		239 893		86 596	326 489		26 232		9 469	35 702
23		337 545		111 801	449 346		42 054		13 929	55 983
24		192 636		95 489	288 124		27 196		13 481	40 677
25		140 500		48 048	188 548		22 365		7 648	30 013
26		46 436		75 409	121 845		8 296		13 472	21 768
27		16 886		30 295	47 181		3 371		6 048	9 420
28				9 667	9 667				2 148	2 148
29		8 780		4 834	13 613		2 164		1 191	3 355
30										
31				2 417	2 417				725	725
32										
33										
34										
35										
TOTAL	208 828	1 875 790	398 672	629 763	3 113 053	1 700	158 812	20 880	82 621	264 012

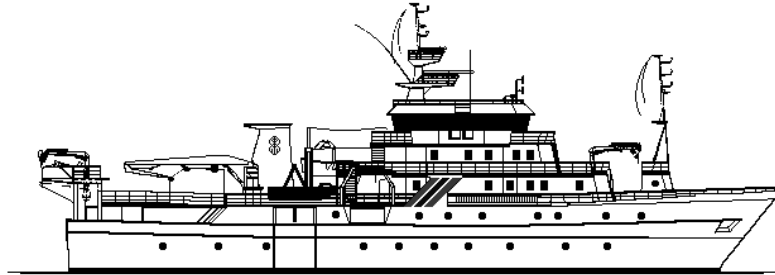
## Annex IV Continued

### *Trachurus trecae*

Length cm	N (millions)					Biomass (tonnes)				
	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL
15										
16										
17		3 064		1 329	4 393		158		68	226
18		3 064		1 329	4 393		186		81	267
19		6 128		2 657	8 785		436		189	625
20	5 475	30 448		11 958	47 881	453	2 971		989	4 413
21	71 170	135 388		42 518	249 076	6 790	19 707		4 057	30 554
22	147 814	117 388		17 273	282 474	16 163	29 000		1 889	47 052
23	104 017	60 705		2 657	167 379	12 959	20 522		331	33 813
24	21 898	11 490			33 388	3 092	4 714			7 805
25										
TOTAL	350 374	367 674		79 721	797 768	39 457	77 694		7 604	124 755

### *Decapterus sp.*

Length cm	N (millions)					Biomass (tonnes)				
	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL	St. Louis- Cape Vert	Cape Vert- Gambia	Gambia	Casa- mance	TOTAL
10										
11										
12		1 944			1 944		36			36
13		7 776			7 776		184			184
14		13 608			13 608		398			398
15		13 608			13 608		486			486
16		25 271			25 271		1 090			1 090
17		13 608			13 608		700			700
18										
TOTAL		75 813			75 813		2 895			2 895



**SURVEY OF THE PELAGIC FISH RESOURCES  
OFF NORTH WEST AFRICA**

**Part II MAURITANIA**

**10 - 17 November 2001**

CRUISE REPORTS 'DR FRIDTJOF NANSEN'

**SURVEY OF THE PELAGIC FISH RESOURCES  
NORTH WEST AFRICA**

**Part II**

**MAURITANIA  
10 - 17 November 2001**

by

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**Institute of Marine Research  
Bergen, 2001**



## **TABLE OF CONTENTS**

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CHAPTER 1	INTRODUCTION.....	1
1.1	Objectives of the cruise.....	1
1.2	Participation.....	1
1.3	Narrative .....	2
1.4	Methods .....	2
CHAPTER 2	SURVEY RESULTS .....	7
2.1	Weather conditions and hydrography.....	7
2.2	Pelagic fish on the shelf from St. Louis to Cape Timiris .....	11
2.3	Pelagic fish on the shelf from Cape Timiris to Cape Blanc .....	17
CHAPTER 3	OVERVIEW AND SUMMARY OF RESULTS .....	18
ANNEX I	Records of fishing stations	
ANNEX II	Instruments and fishing gear used	
ANNEX III	Pooled length distribution by species and regions	
ANNEX IV	Stock length distribution by numbers and weight	

## CHAPTER 1 INTRODUCTION

---

### 1.1 Objective of the cruise

The general objectives were to estimate the biomass and map the distribution of small pelagic fish stocks off NW Africa (Morocco, Mauritania, Senegal and the Gambia) by hydro-acoustic methods and describe the hydrographic conditions there over a period of 50 days, in November-December 2001. For Mauritania the agreed objectives were:

- To map the distribution and estimate the biomass of the main small pelagic fish using hydroacoustic methods. The species of interest are: sardine *Sardina pilchardus*, sardinella *Sardinella aurita*, *S. maderensis*, horse mackerels *Trachurus trachurus* and *T. trecae*, false scad *Decapterus rhonchus*, and anchovy *Engraulis encrasicolus*.
- To identify and describe the size distribution of the target fish populations by midwater and bottom trawl sampling and process the catches by recording weight and number by species.
- To sample standard hydrographical transects for temperature, salinity and oxygen at about 16°40' N, 18°00' N, 19°00' N, 20°00' N and off Cape Blanc.

The time allocated for this part of the survey, off Mauritania, was 10 days.

### 1.2 Participation

Members of the scientific teams were:

Institut Mauritanien de Recherches Océanographiques et des Pêches, Mauritania:

Bambaye Ould HAMADI, Diallo IBRA, Cheikh Tijane DIOP and Ebuye Ould SIDINA

Centre de Recherches Océanographiques de Dakar-Thiaroy, Senegal:

Mor SYLLA

Department of Fisheries, the Gambia:

Juldah JALLOW

Institute of Marine Research, Norway:

Reidar TORESEN, Magne OLSEN, Tore MØRK and Thor Egil JOHANSEN

### 1.3 Narrative

After embarking of scientists from Mauritania, Senegal and the Gambia, the survey of the Mauritanian shelf started on November the 10, at the border between Mauritania and Senegal, with systematic parallel course tracks spaced about 10 NM (nautical miles) apart. To cover the whole distribution area of pelagic fish, the shelf was covered from the 15 m isobath and offshore to the 500 m isobath. Trawling was done irregularly, either to identify echo registrations or to check 'blindly' if fish were mixed with the plankton in the upper layers of the water column. In the latter case, pelagic trawl with floats was often used. A smaller pelagic trawl or the bottom trawl with floats was used for sampling the pelagic fish in very shallow waters (depth less than 25 m). The shelf was covered northwards to Cape Blanc before a call was made in Nouakchott on November 17, to let participants from Senegal, the Gambia and Mauritania disembark and scientists from Morocco come onboard.

The hydrographic profile at 16°40' N was sampled on 10 November, at 18°00' N on 13 at 19°00' N on 14 at 20°00' N on 15 and off Cape Blanc on the part of the survey covering Morocco.

The survey was terminated in Nouakchott on 17 November.

### 1.4 Methods

#### *Environmental Data*

Surface temperature and meteorological data from a weather station were logged automatically and recorded with position and bottom depth every nautical mile sailed.

Hydrographic profiles were collected with a CTD sonde and temperature, salinity, and pressure (depth) were logged by the Seabird Software. From these data series, records were selected from standard depths and presented in figures.

#### *Biological sampling*

Biological sampling of the fish was carried out using trawls. A pelagic trawl with floats was often used. A smaller pelagic trawl or the bottom trawl with floats was used for sampling the pelagic fish in very shallow waters (depth less than 25 m). Annex II gives a description of the instruments and the fishing gear used. All catches were sampled for composition by weight and numbers of each species caught. Species identification was based on the FAO Species Guides. Length frequency distributions, by total fish length in cm, of the selected target species were taken in all the stations where they were present. Individual weight measurements were taken regularly to estimate the condition factor in the length-weight relationship:

$$\bar{w} = \frac{cond}{100} \cdot L^3$$

The specific condition factors obtained from the samples and applied for this survey were: 0.96 for sardinellas and horse mackerels, and 0.54 for anchovy.

For the estimation of the biomass of carangids and associated species, an overall average length of 23 cm and a condition factor of 0.88 (to calculate the mean length of this length group) were applied.

All data on fishing stations and fish length sampling were made available to the participants on diskettes.

The complete records of fishing stations are shown in Annex I.

The following target groups were used for Mauritania:

- 1) Sardinellas (flat sardinella *Sardinella maderensis* and round sardinella *S. aurita*),
- 2) Horse mackerels (Atlantic horse mackerel *Trachurus trachurus*, Cunene horse mackerel *Trachurus trecae*, and false scad *Decapterus rhonchus*),
- 3) Chub mackerel *Scomber japonicus*
- 4) Other pelagic carangids and associated species (Atlantic bumper *Chloroscombrus chrysurus*, African lookdown *Selene dorsalis*, largehead hairtail *Trichiurus lepturus*, and barracudas *Sphyraena* spp.),
- 5) Other demersal species (such as bigeye grunt *Brachydeuterus auritus*, Sparidae and Haemulidae), and
- 6) Other clupeids such as West African ilisha *Ilisha africana*.

#### *Acoustic sampling*

A SIMRAD EK500 Echo-sounder was used with the settings as shown in Annex II. The Bergen Integrator (BEI) was used for analysis and allocation of the integrated  $s_A$ -values to the individual specified target groups by 5 NM intervals. The allocation of values to target groups was based on a combination of a visual scrutiny of the behaviour pattern as deduced from echo diagrams, the BEI analysis, and the catch compositions.

In cases where the target category of fish contains more than one species (sardinellas and horse mackerels), the mean  $s_A$ -value allocated to the category is divided between the species in the

same ratio as their contribution to the mean back scattering strength in the length frequency samples.

The following target strength (TS) function was applied to convert  $s_A$ -values (mean integrator value for a given species or group of species in a specified area) to number of fish:

$$TS = 20 \log L - 72 \text{ dB}$$

Which can be converted (see Toresen *et al.* 1998 for details) to the area form (scattering cross sections of acoustic targets):

$$C_{Fi} = 1.26 \cdot 10^6 \cdot L^{-2}$$

where  $L$  is total length in 1 cm length group  $i$  and  $C_{Fi}$  ( $\text{m}^{-2}$ ) is the reciprocal back scattering strength, or so-called fish conversion factor.

In order to split and convert the allocated  $s_A$ -values ( $\text{m}^2/\text{NM}^2$ ) to fish densities (numbers per length group per  $\text{NM}^2$ ), the following formula was used:

$$\rho_i = S_A \cdot \frac{p_i}{\sum_{i=1}^n \frac{p_i}{C_{Fi}}}$$

where

$\rho_i$  = density of fish in length group  $i$

$s_A$  = mean integrator value

$p_i$  = proportion of fish in length group  $i$

$\sum_{i=1}^n \frac{p_i}{C_{Fi}}$  = the relative back scattering cross section ( $\text{m}^2$ ) of the length frequency

sample of the target species, and

$C_{fi}$  = reciprocal back scattering cross section ( $\sigma_{bs}^{-1}$ ) of a fish in length group  $i$ .

The integrator outputs were split in fish groups using a combination of behaviour pattern as deduced from echo diagrams, the BEI analysis and catch composition as described below. The following groups were used for Mauritania: 1) sardinellas, 2) horse mackerels, 3) carangids and associated species, and 4) demersal fish.

The above equations show that the conversion from  $s_A$ -values to number of fish is dependent on the length composition of the fish. It is therefore important to get representative length distributions from the stock in the whole distribution area.

When the size classes (of e.g. young fish and older fish) are well mixed, the various length distributions can be pooled together with equal importance. Otherwise, when the size classes are segregated, the total distribution area has to be post-stratified, according to the length distributions, and separate estimates are made for the regions containing fish with equal size.

A systematic approach to a) divide the  $s_A$ -value between species in a category of fish (e.g. *Sardinella aurita* and *S. maderensis*) and b) produce pooled length distributions of a target species for use in the above equation and c) calculate the biomass estimates for a region, is obtained through the following procedure:

- The samples of the species in the category (e.g. sardinellas) are respectively pooled together with equal importance (normalized). A sample of 60 flat sardinella in one sample will have equal importance to 30 fish in another sample and not the double weight in accordance with the number of fish in the sample.
- The mean back scattering strength ( $\rho/s_A$ ) of each length frequency distribution of the target species is calculated and summed. This is automatically done if the length distributions are punched into an Excel spreadsheet prepared for the estimation of the abundance of fish (made available onboard “Dr. Fridtjof Nansen”).
- The mean  $s_A$ -value allocated to the category of fish in the region is divided between the species in the same ratio as their relative contribution to the mean back scattering strength of the length groups in the sample (also automatically done in the Excel spreadsheet given that the  $s_A$ -value for the region is punched into the sheet).
- The pooled length distribution is used, together with the mean  $s_A$ -value, to calculate the density (numbers per square NM) by length groups and species, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area. (This is done in the Excel spreadsheet, given that the area of the region is punched into the sheet).
- The numbers are converted to biomass using the estimated weight at length. (Done in the Excel sheet if the condition factor is punched).

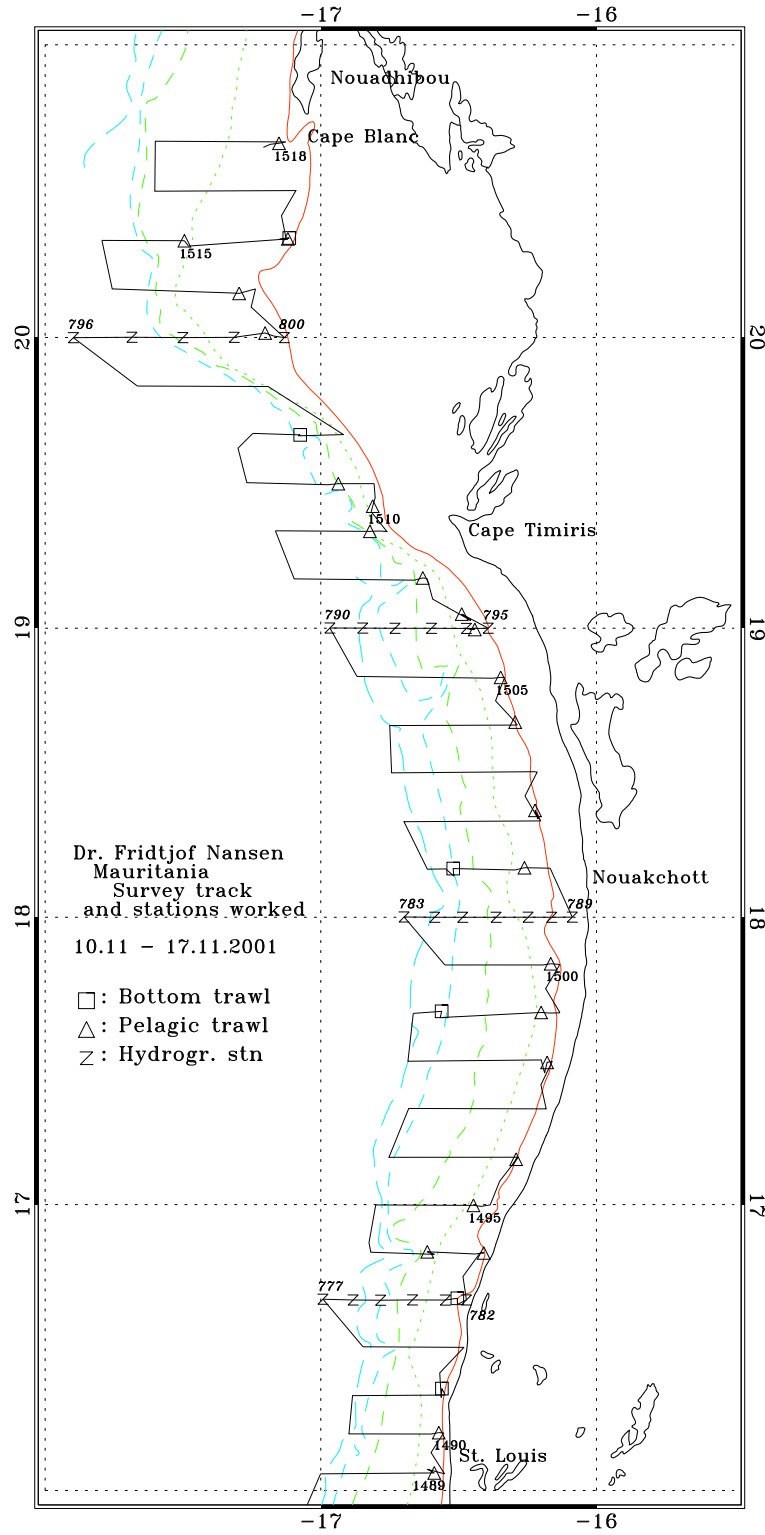


Figure 1 Course track and fishing and hydrographic stations

## CHAPTER 2 SURVEY RESULTS

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### 2.1 Weather conditions and hydrography

#### *Wind conditions*

Distribution of wind speed and direction recorded along the survey track is presented in Figure 2. The predominant wind direction was from north. The wind velocities were uniform along this whole coastline region with average speed 20 m/s.

#### *Hydrography*

Figure 3 shows the distribution of sea surface temperature along the survey track. The temperature was significantly higher this year than in previous years. The general pattern south of Cape Timiris was a temperature of 25-27 °C off shore, decreasing to 22-24 °C inshore.

North of Cape Timiris to Cape Blanc, the distribution of sea surface temperature is affected by the persistence of the upwelling waters from the north with temperatures <19 °C off Cape Blanc.

Figure 4 shows the distribution of temperature, salinity and oxygen in the five profiles.



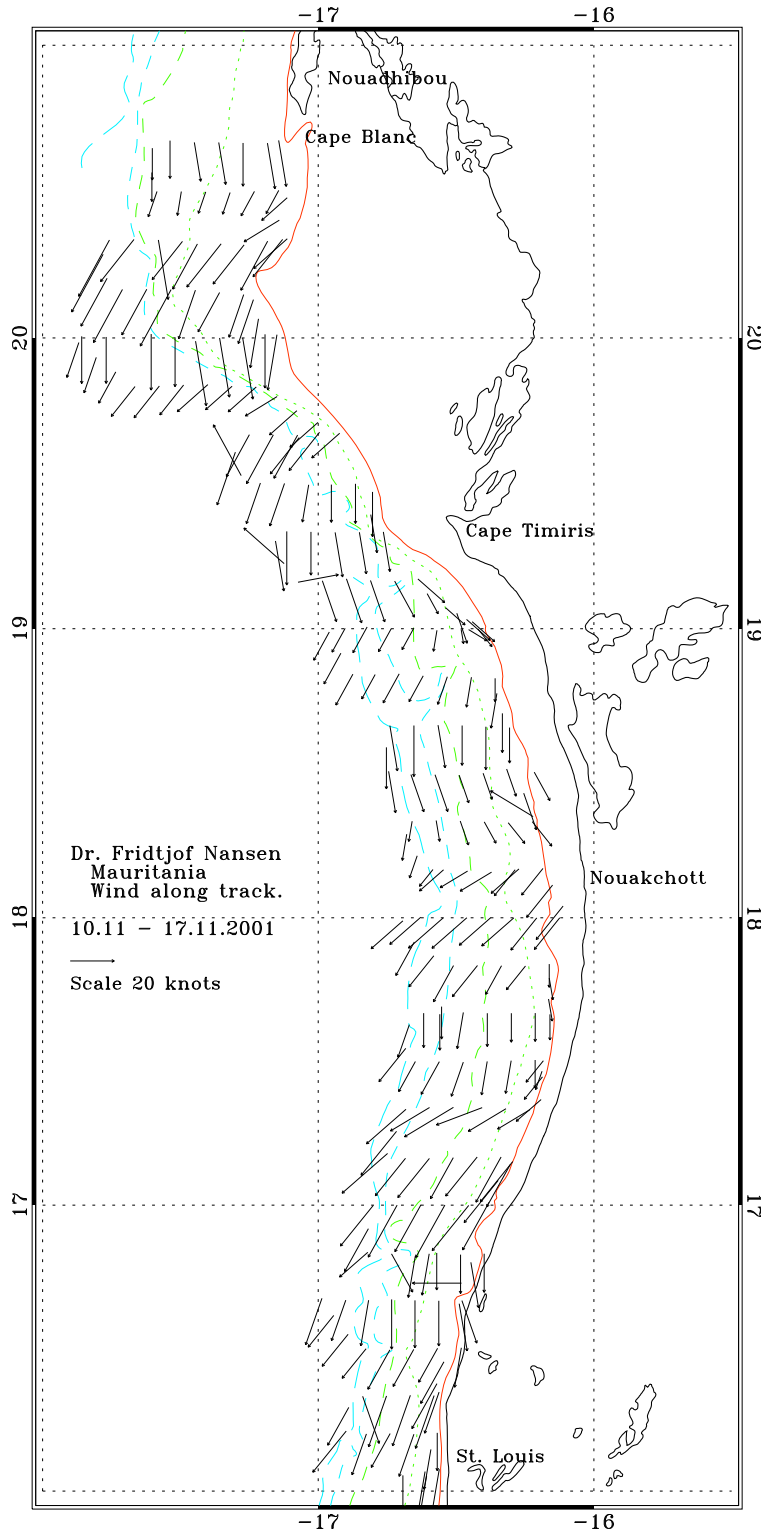


Figure 2 Wind conditions along the survey track.

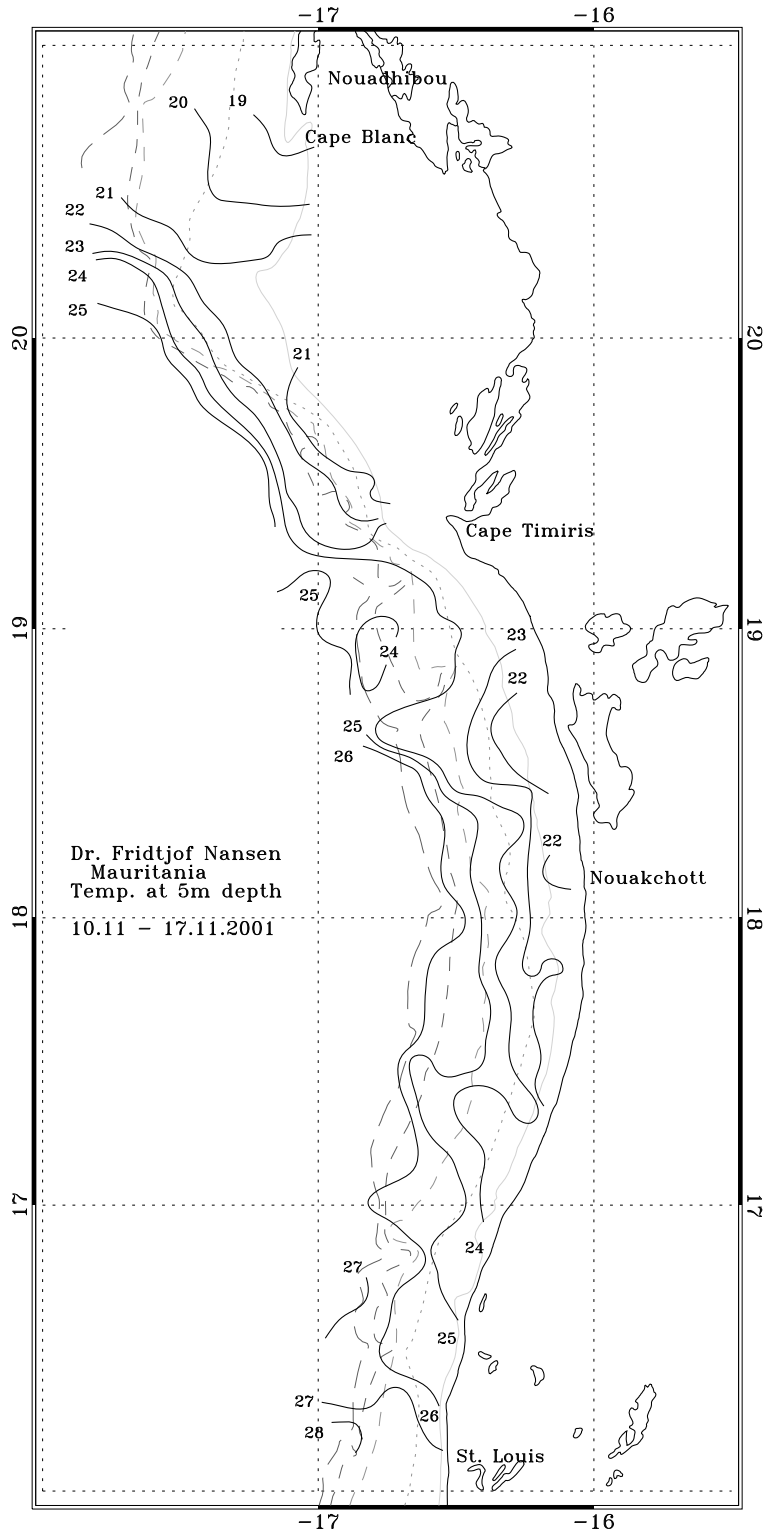


Figure 3 Sea surface temperature.

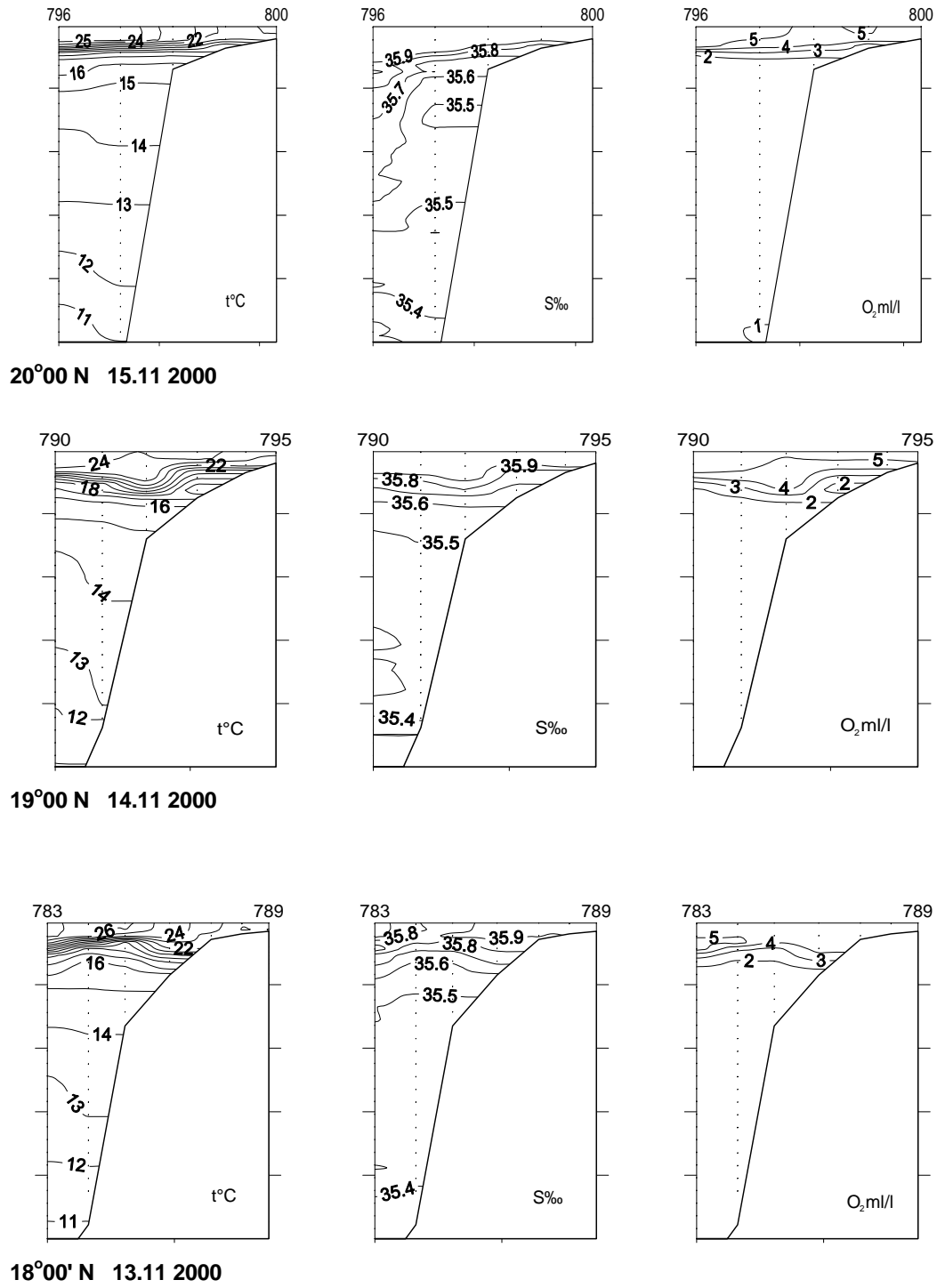


Figure 4. Hydrographic profiles with distribution of temperature, salinity and oxygen

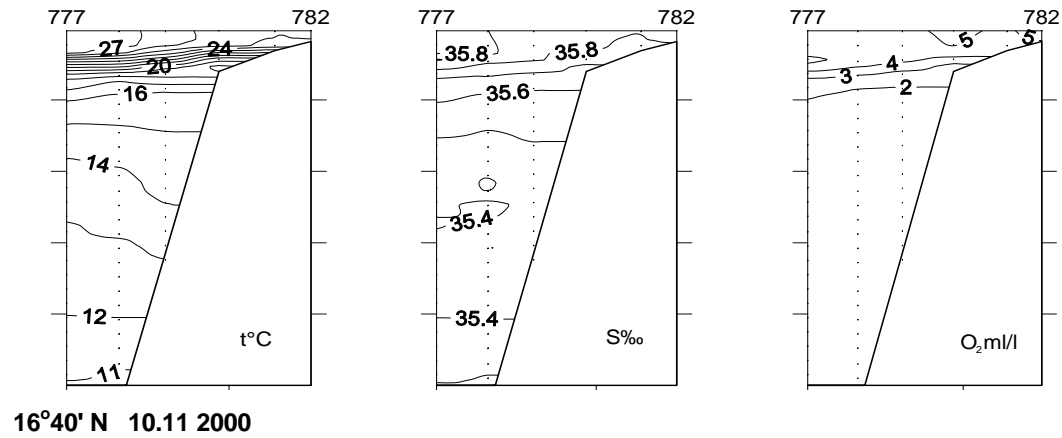


Figure 4. continued.

## 2.2 Pelagic fish on the shelf from St. Louis to Cape Timiris

Figure 5 shows the distribution of sardinellas on the shelf of Mauritania.

Sardinellas were found over the inner shelf in a nearly continuous belt along the coast from about 16°20'N to about 19°10'N, see Figure 5. In an area off Nouakchott and about 15 NM to north and south, no sardinella were found. Particularly dense school areas were located between about 16°20'N, at 17°30' N, and at about 19°00'N.

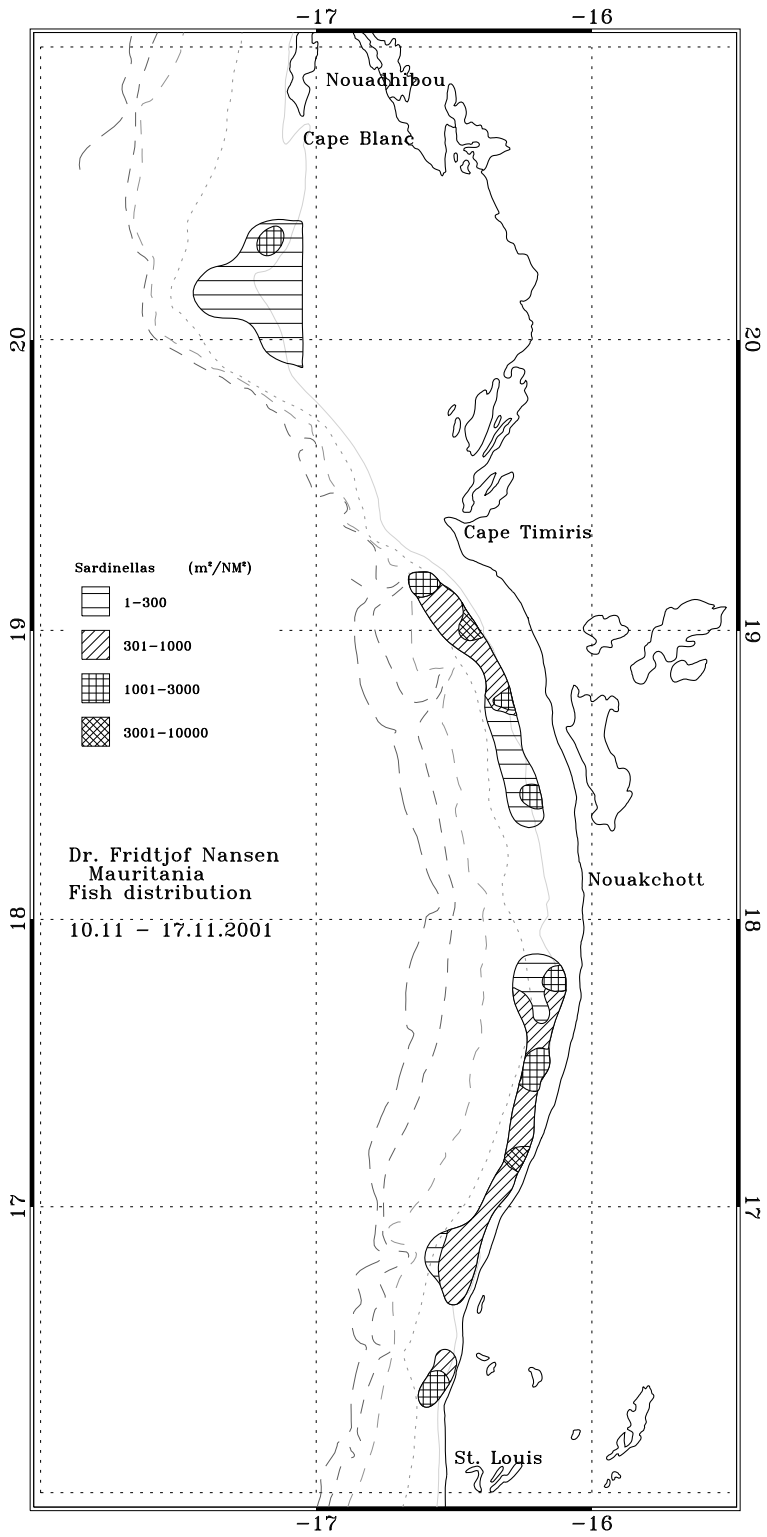


Figure 5 Distribution of sardinellas.

The samples showed sardinellas of varying size, the round sardinella south of Cape Timiris with modal lengths of 26 and 36 cm, while the flat sardinella had modal lengths of 11, 16, 27 and 33 cm. The size composition of the estimates is shown in Annex III, and the stock length composition by numbers and weight in Annex IV. The total biomass of sardinellas in the area was estimated at 200 000 tonnes, Table 1, of which flat sardinella dominated by 72 %.

Table 1. Biomass estimates (1000 tonnes) of pelagic fish, St. Louis to Cape Timiris.

Flat sardinella	Round sardinella	Horse mackerels	Other Carangids etc.
145	55	60	117

The distribution of horse mackerels is shown in Figure 6. Horse mackerels occurred in two main concentrations with rather low densities; one between 16°50'N - 17°10'N, and another between 18°20'N and 18°50'N. In addition, a few smaller concentrations were found. The densest concentrations in the main aggregations were found at about 17°00'N. The main aggregations were found at the edge of the shelf, and at daytime the fish were found close to the bottom at depths around 50-120 m. The biomass was estimated at 60 000 tonnes. The horse mackerels were only false scad, *Decapterus ronchus*.

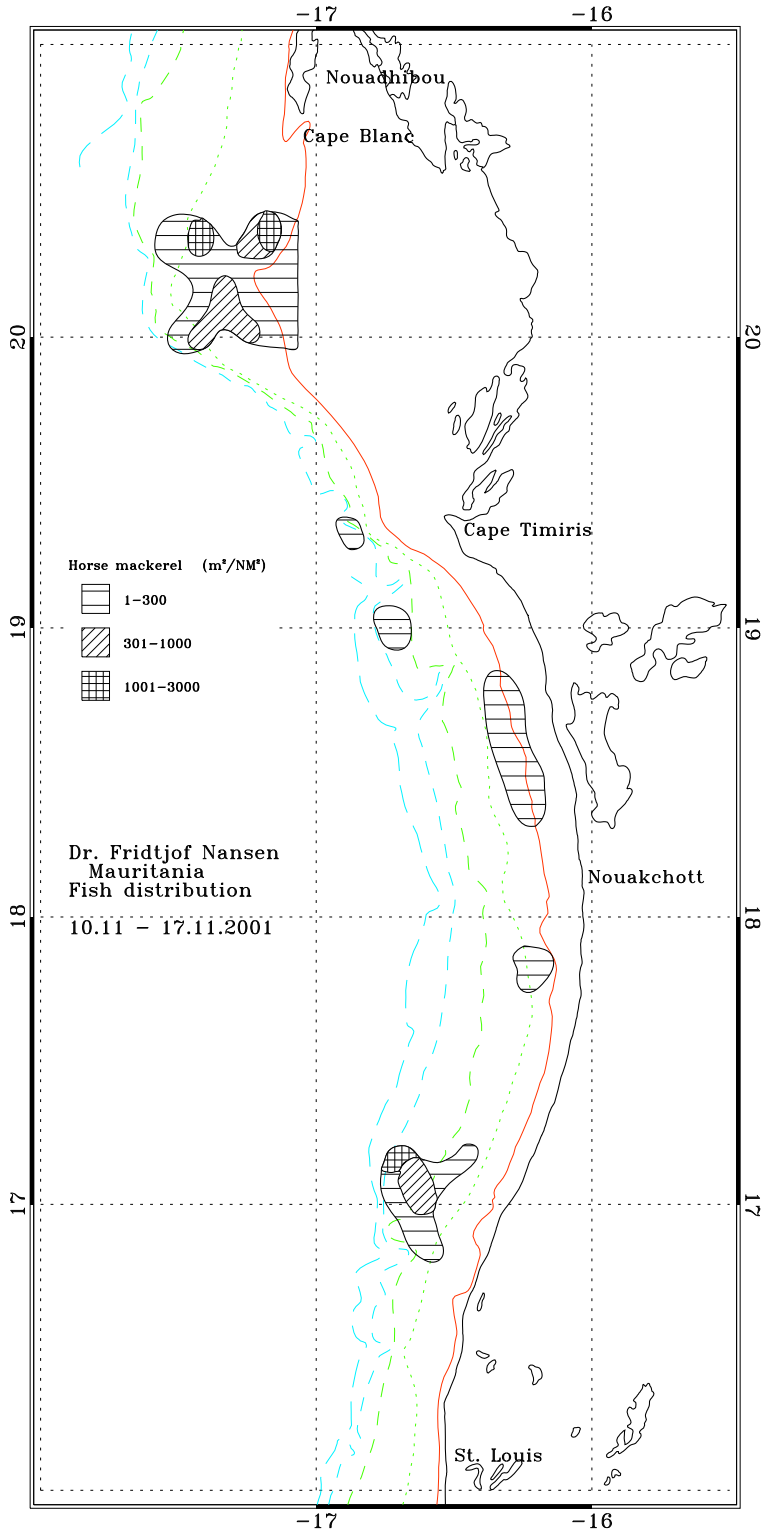


Figure 6 Distribution of horse mackerels.

Four modal lengths were observed in the total length distribution of *Decapterus ronchus*, namely 14, 18, 27 and 32 cm. The biomass was estimated at 60 000 tonnes, Table 1. The size composition of false scad is shown in Annex III, and the stock length composition by numbers and weight in Annex IV.

Figure 7 shows the distribution of the other carangids and associated species, which took the form of a continuous belt of various densities on the entire shelf, except for a small area some 20 NM south of Nouakchott, where no carangids were found. The total biomass was estimated at 117 000 tonnes. The samples from the distributional areas consisted of bumper, West African Spanish mackerel, Atlantic bonito, pompano with small amounts of barracudas.



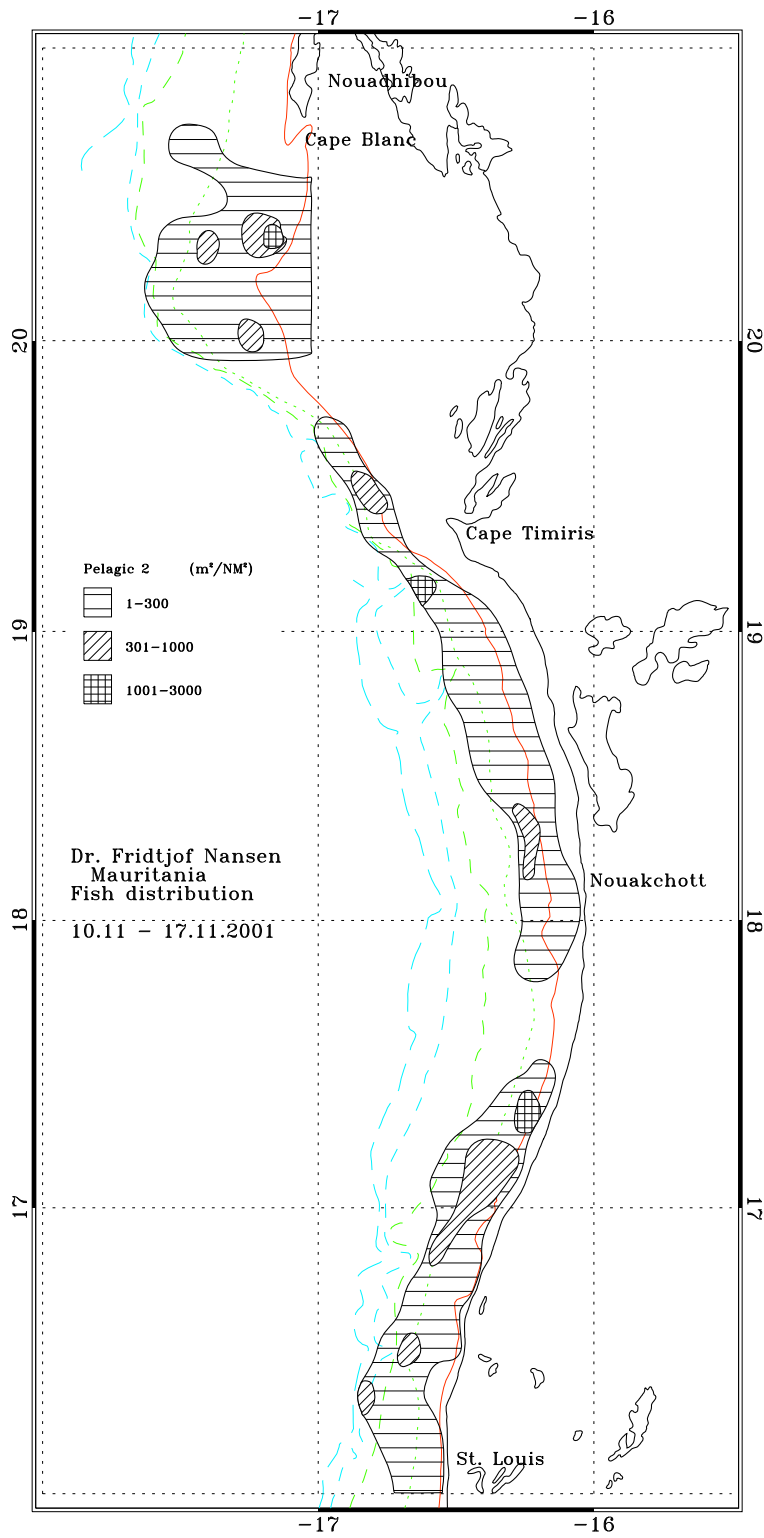


Figure 7 Distribution of carangids and associated species.

### 2.3 Pelagic fish on the shelf from Cape Timiris to Cape Blanc

Aggregations of juvenile fish are often found in the area between Cape Timiris and Cape Blanc, and this year, sardinella, horse mackerels and anchovy were present.

However, the estimate of small fish in the area must be regarded as uncertain and low because the area, Banc d'Arguin cannot be covered by the vessel. It is believed that a lot of juvenile fish is distributed there.

Round sardinella were found in an aggregation of schools between 20°00'N and 20°25'N, Figure 5. The concentrations were not very dense and the estimate was thus, only some 26 000 tonnes, Table 2. The modal lengths of the sardinella were 9, 15, 18 and 21 cm. It is believed that the coverage of sardinella in this area is not complete as there may be fish in the shallow waters of Banc d'Arguin.

Horse mackerel were recorded in an area between 20°00'N and 20°25'N, Figure 6. The aggregations consisted of both *Trachurus trecae* and *Decapterus ronchus*, estimated at 4 000 and 110 000 tonnes respectively (Table 2). The modal lengths of *Trachurus trecae* were 7, and 12 cm, while the medium size of the false scad, *Decapterus ronchus* were 14, 18, 23 and 28 cm.

Some anchovy were present in the catches on the northern part of the shelf, off Cap Blanc. And a few anchovy schools could be identified on the echograms. These were estimated at a biomass 9 000 tonnes with a modal length 8 cm.

The carangids and associated species were found in two main concentrations, one from Cape Timiris and some 30 NM northwards along the shelf, and the other, on the shelf from about 20°00'N to about 20°40'N, Figure 7. The concentrations were estimated at 75 000 tonnes. The catches of this group consisted mainly of *Trichiurus lepturus*, *Scomberomorus tritor*, and bluefish, *Pomatomus saltatrix*.

Table 2. Biomass estimates (1000 tonnes) of pelagic fish, CapeTimiris – Cape Blanc.

Flat sardinella	Round sardinella	Horse mackerels	Other Carangids etc
-	27	114	75

### **CHAPTER 3      OVERVIEW AND SUMMARY OF RESULTS**

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The survey was conducted successfully in the period 10 to 17 November with a course track of 1400 NM and 30 fishing stations, Figure 1.

The hydrographical data show that the temperature is higher than the long-term mean.

Mainly adult sardinella were found between St. Louis and Cape Timiris, Figure 5. Horse mackerels were found in low densities in three main areas, the largest one north of Cape Timiris, Figure 6. Carangids (not including horse mackerel) and associated species occurred in low densities all along the shelf, with patches of high-density areas, Figure 7.

The total biomass of sardinella was estimated at 227 000 tonnes (64% flat and 36% round sardinella), that of horse mackerels at 174 000 tonnes and that of the carangids and associated species at 192 000 tonnes, see Table 3.

Table 3 Summary of biomass estimates (1 000 tonnes) of pelagic fish, Mauritania.

	Flat sardinella	Round sardinella	Horse mackerel	Carangids etc.
St. Louis-Cape Timiris	145	55	60	117
Cape Timiris-Cape Blanc	-	27	114	75
Total	145	82	174	192

Table 3 lists biomass estimates of sardinella and carangids and associated species from previous 'Dr Fridtjof Nansen' surveys of this shelf region. Compared earlier November-December surveys the estimate of 227 000 tonnes of sardinella from the current survey is the lowest on record since 1995. The carangid estimate (including horse mackerels) of 366 000 tonnes is also low when comparing with the available time series.

Table 3 Biomass estimates from 'Dr Fridtjof Nansen' surveys of the Mauritanian shelf, thousand tonnes.

Survey:	Sardinellas	Carangids etc.
AprMay-81	20	370
Sept -81	75	*
FebMar -82	50	470
NovDec-86	300	540
FebMar-92	1970	190
NovDec-95	178	190
NovDec-96	1405	400
NovDec-97	1200	660
NovDec-98	1125	284
NovDec-99	742	559
NovDec-00	920	1038
JunJul -01	572	665
NovDec-01	227	366

\* Not available

### References:

Toresen, R., Gjøsæter, H., and Barros P. 1998. The acoustic method as used in the abundance estimation of capelin (*Mallotus villosus* Müller) and herring (*Clupea harengus* Linné) in the Barents Sea. Fisheries Research 34 (1998) 27-37.

# Annex I Records of fishing stations

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1489  
 DATE:10/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1604 Long W 1635  
 start stop duration  
 TIME :23:30:25 23:59:26 29 (min) Purpose code: 1  
 LOG :5929.32 5931.00 1.65 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 29 37 Validity code:  
 Towing dir: 300ø Wire out: 150 m Speed: 30 kn\*10  
 Sorted: 88 Kg Total catch: 88.25 CATCH/HOUR: 182.59

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Selene dorsalis	134.79	399	73.82
Ilisha africana	21.10	246	11.56
Brachydeuterus auritus	18.62	182	10.20
Sardinella maderensis	2.77	85	1.52
Sepia officinalis hierredda	1.10	2	0.60
Caranx senegalus	1.01	2	0.55
Sphyræna guanchcho	0.91	52	0.50
Trachinotus ovatus	0.83	2	0.45
Alectis alexandrinus	0.66	2	0.36
Trichiurus lepturus	0.48	4	0.26
Engraulis encrasicolus	0.10	50	0.05
Parapeneus longirostris	0.06	10	0.03
Chloroscombrus chrysurus	0.06	2	0.03
Alloteuthis sp.	0.02	2	0.01
Total	182.51		99.94

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1490  
 DATE:11/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1612 Long W 1634  
 start stop duration  
 TIME :01:49:18 02:19:05 30 (min) Purpose code: 1  
 LOG :5947.23 5948.85 1.59 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 24 36 Validity code:  
 Towing dir: 270ø Wire out: 150 m Speed: 30 kn\*10  
 Sorted: 32 Kg Total catch: 254.80 CATCH/HOUR: 509.60

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Brachydeuterus auritus	200.00	2992	39.25
Ilisha africana	168.00	4016	32.97
Chloroscombrus chrysurus	98.40	736	19.31
Pomadasy peroteti	17.28	80	3.39
Trichiurus lepturus	13.76	96	2.70
Sardinella maderensis	4.64	544	0.91
Selene dorsalis	4.64	112	0.91
Sepia officinalis hierredda	1.92	2	0.38
Parapeneus longirostris	0.80	48	0.16
Sphyræna guanchcho	0.16	16	0.03
Total	509.60		100.01

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1491  
 DATE:11/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1621 Long W 1634  
 start stop duration  
 TIME :07:00:15 07:29:59 30 (min) Purpose code: 1  
 LOG :5996.38 5998.27 1.89 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 22 20 Validity code:  
 Towing dir: 180ø Wire out: 110 m Speed: 30 kn\*10  
 Sorted: 50 Kg Total catch: 49.98 CATCH/HOUR: 99.96

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardinella maderensis	60.40	364	60.42
Sardinella maderensis	37.00	178	37.01
Scomber japonicus	1.98	4	1.98
Chloroscombrus chrysurus	0.58	4	0.58
Total	99.96		99.99

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1492  
 DATE:11/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1640 Long W 1630  
 start stop duration  
 TIME :16:22:10 16:42:51 21 (min) Purpose code: 1  
 LOG :6079.22 6080.49 1.26 Area code : 3  
 FDEPTH: 20 21 GearCond.code:  
 BDEPTH: 20 21 Validity code:  
 Towing dir: 90ø Wire out: 120 m Speed: 32 kn\*10  
 Sorted: 66 Kg Total catch: 261.65 CATCH/HOUR: 747.57

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardinella maderensis - Juv.	158.09	12486	21.15
Pomadasy peroteti	145.23	1037	19.43
Alectis alexandrinus	143.46	180	19.19
Rhizoprionodon acutus	117.00	120	15.65
Decapterus rhonchus	30.00	171	4.01
Aluteras punctata	25.71	57	3.44
Pomadasy rogeri	24.77	37	3.31
Pomadasy incisus	22.86	163	3.06
Sardinella maderensis	22.37	114	2.99
Pagellus bellottii	17.14	171	2.29
Trachinotus ovatus	15.71	200	2.10
Caranx crysos	5.71	37	0.76
Sparus caeruleostictus *	5.71	20	0.76
Sphyræna sphyraena	5.23	20	0.70
Pseudupeneus prayensis	3.34	49	0.45
Sardinella aurita	2.86	20	0.38
Fistularia petimba	1.43	29	0.19
Euclinostomus melanopterus	0.94	9	0.13
Total	747.56		99.99

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1493  
 DATE:11/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1650 Long W 1625  
 start stop duration  
 TIME :19:22:22 19:52:32 30 (min) Purpose code: 1  
 LOG :6097.64 6099.44 1.79 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 21 21 Validity code:  
 Towing dir: 270ø Wire out: 120 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: 313.71 CATCH/HOUR: 627.42

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Rhinoptera marginata	354.90	92	56.56
Decapterus rhonchus	49.20	172	7.84
Pomadasy jubelini	42.90	196	6.84
Trichiurus lepturus	41.50	194	6.61
Ilisha africana	38.20	462	6.09
Brachydeuterus auritus	17.30	1828	2.76
Sardinella maderensis	15.90	66	2.53
Pomadasy incisus	10.70	58	1.71
Stromateus fiatola	10.30	22	1.64
Selene dorsalis	9.20	74	1.47
Galeoides decadactylus	9.00	90	1.43
Sepia officinalis hierredda	7.50	24	1.20
Alectis alexandrinus	4.80	4	0.77
Scomberomorus tritor	3.60	2	0.57
Liza aurata	2.90	4	0.46
Dasyatis marmorata	2.50	2	0.40
Leptocharias smithii	2.00	2	0.32
Lagocephalus lagocephalus	1.70	6	0.27
Sphyræna guanchcho	1.10	8	0.18
GERREIDAE	0.90	8	0.14
Caranx hippos	0.50	2	0.08
Sardinella maderensis - Juv.	0.40	30	0.06
Chloroscombrus chrysurus	0.30	2	0.05
Penaeus notialis	0.10	10	0.02
Penaeus kerathurus	0.02	2	
Total	627.42		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1494  
 DATE:11/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1650 Long W 1637  
 start stop duration  
 TIME :21:09:57 21:40:15 30 (min) Purpose code: 1  
 LOG :6111.00 6112.61 1.58 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 74 57 Validity code:  
 Towing dir: 90ø Wire out: 130 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: 148.92 CATCH/HOUR: 297.84

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Trichiurus lepturus	141.00	3276	47.34
Decapterus rhonchus	69.50	412	23.37
Sardinella maderensis	25.20	854	8.46
Sardinella aurita	19.80	150	6.65
Sphyræna guanchcho	14.70	132	4.94
Trachinotus ovatus	9.60	42	3.22
Selene dorsalis	6.60	78	2.22
Trachurus trecae	4.50	114	1.51
Scomber japonicus	2.40	12	0.81
Stromateus fiatola	1.80	6	0.60
Pomadasy incisus	1.50	6	0.50
Ilisha africana	0.90	6	0.30
Boops boops	0.12	6	0.04
Chlorophthalmus atlanticus	0.06	6	0.02
Penaeus notialis	0.06	6	0.02
Total	297.84		100.00

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1495  
 DATE:12/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1700 Long W 1627  
 start stop duration  
 TIME :02:05:28 02:35:04 30 (min) Purpose code: 1  
 LOG :6157.46 6159.13 1.66 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 39 28 Validity code:  
 Towing dir: 90ø Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 66 Kg Total catch: 824.02 CATCH/HOUR: 1648.04

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chloroscombrus chrysurus	1445.00	11470	87.68
Brachydeuterus auritus	71.20	576	4.32
Sardinella aurita	38.60	250	2.34
Sardinella maderensis - Juv.	31.50	850	1.91
Selene dorsalis	19.50	176	1.18
Trachurus trecae	12.50	74	0.76
Sardinella maderensis	11.00	76	0.67
Dactylopterus volitans	8.74	26	0.53
Trichiurus lepturus	6.00	26	0.36
Trichiurus lepturus	6.00	26	0.36
Boops boops	4.00	300	0.24
Total	1654.04		100.35

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1496  
 DATE:12/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1710  
 start stop duration  
 TIME :04:24:58 04:54:49 30 (min) Purpose code: 1  
 LOG :6173.82 6175.49 1.66 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 20 21 Validity code:  
 Towing dir: 220° Wire out: 150 m Speed: 34 kn\*10  
 Sorted: 28 Kg Total catch: 571.16 CATCH/HOUR: 1142.32

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Brachydeuterus auritus	528.00	47.20	
Sardinella maderensis	214.00	18.73	2347
Chloroscombrus chrysurus	192.00	16.81	
Decapterus rhonchus	62.40	5.46	
Pagellus bellottii	25.60	2.24	
Trichiurus lepturus	19.60	1.72	
Sparus caeruleostictus *	18.00	1.58	
Caranx senegalensis	14.40	1.26	
Galeoides decadactylus	12.80	1.12	
Ilisha africana	11.60	1.02	
Brachydeuterus auritus Juv.	8.80	0.77	
Selene dorsalis	8.80	0.77	
Dasyatis marmorata	7.14	0.63	
Stromateus fiatola	5.86	0.51	
Sphyræna guanchancho	4.40	0.39	
Rhizoprionodon acutus	4.32	0.38	
Arius heudeloti	2.20	0.19	
Penaeus notialis	1.20	0.11	
Boops boops	0.80	0.07	
Penaeus kerathurus	0.40	0.04	
Total	1142.32	100.02	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1500  
 DATE:13/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1750  
 start stop duration  
 TIME :00:01:26 00:31:11 30 (min) Purpose code: 1  
 LOG :6358.23 6359.89 1.63 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 26 37 Validity code:  
 Towing dir: 270° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 32 Kg Total catch: 212.31 CATCH/HOUR: 424.62

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Decapterus rhonchus	137.20	868	32.31
Brachydeuterus auritus	109.76	924	25.85
Sardinella maderensis	72.10	322	16.98
Selene dorsalis	23.10	602	5.44
Brachydeuterus auritus Juv.	22.12	1372	5.21
Alectis alexandrinus	10.00	8	2.36
Sardinella aurita	9.66	42	2.27
Pomadasys rogeri	9.52	28	2.24
Penaeus notialis	6.66	140	1.57
Sphyræna sphyraena	4.20	14	0.99
Arius heudeloti	3.60	2	0.85
Sardinella maderensis - Juv.	3.36	70	0.79
Mugil cephalus	2.60	2	0.61
Pagellus bellottii	2.10	14	0.49
Rhizoprionodon acutus	1.90	2	0.45
Sepia officinalis hierredda	1.82	14	0.43
Pseudupeneus prayensis	1.68	28	0.40
Trichiurus lepturus	1.12	28	0.26
Mugil capurrii	1.00	2	0.24
Penaeus kerathurus	0.84	82	0.20
Loligo vulgaris	0.28	2	0.07
Total	424.62	100.01	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1497  
 DATE:12/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1730  
 start stop duration  
 TIME :13:15:13 13:49:48 35 (min) Purpose code: 1  
 LOG :6261.14 6263.48 2.26 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 23 23 Validity code:  
 Towing dir: 170° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 55 Kg Total catch: 55.78 CATCH/HOUR: 95.62

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Sardinella maderensis	72.26	314	75.57
Sardinella aurita	9.50	31	9.94
Sardinella maderensis - Juv.	8.83	226	9.23
Trachinotus ovatus	1.46	9	1.53
Sardinella aurita - Juveniles	1.37	29	1.43
Chloroscombrus chrysurus	1.05	9	1.10
Caranx senegalensis	0.70	2	0.73
Decapterus rhonchus	0.39	2	0.41
Decapterus punctatus	0.07	3	0.07
Total	95.63	100.01	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1501  
 DATE:13/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1810  
 start stop duration  
 TIME :10:43:19 11:12:20 29 (min) Purpose code: 1  
 LOG :6451.57 6453.57 1.98 Area code : 3  
 FDEPTH: 25 25 GearCond.code:  
 BDEPTH: 40 45 Validity code:  
 Towing dir: 270° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 1 Kg Total catch: 1.12 CATCH/HOUR: 2.32

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Trachinotus ovatus	2.32	6	100.00
Total	2.32	100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1502  
 DATE:13/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1810  
 start stop duration  
 TIME :13:01:30 13:31:13 30 (min) Purpose code: 1  
 LOG :6471.27 6472.85 1.57 Area code : 3  
 FDEPTH: 187 193 GearCond.code:  
 BDEPTH: 187 193 Validity code:  
 Towing dir: 175° Wire out: 600 m Speed: 30 kn\*10  
 Sorted: 56 Kg Total catch: 283.79 CATCH/HOUR: 567.58

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Chlorophthalmus atlanticus	157.50	11326	27.75
Trichiurus lepturus	119.00	224	20.97
Merluccius polli	112.46	1174	19.81
Synagrops microlepis	89.74	8974	15.81
Trachurus trachurus	33.50	72	5.90
Zenopsis conchifer	32.92	96	5.80
Pontinus kuhlii	8.54	1344	1.50
Pterothrissus belloci	5.60	42	0.99
Zeus faber	2.94	28	0.52
GALATHEIDAE	1.68	392	0.30
Illex coindetii	1.12	14	0.20
Dentex macropthalmus	0.90	2	0.16
Antigonia capros	0.70	42	0.12
Parapenaeus longirostris	0.56	112	0.10
Malacocephalus occidentalis	0.42	14	0.07
Total	567.58	100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1503  
 DATE:13/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1822  
 start stop duration  
 TIME :19:04:38 19:33:12 29 (min) Purpose code: 1  
 LOG :6524.33 6526.22 1.90 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 20 21 Validity code:  
 Towing dir: 160° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: Kg Total catch: 21.87 CATCH/HOUR: 45.25

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Pomadasys incisus	6.83	41	15.09
Decapterus rhonchus	6.74	50	14.90
Sardinella aurita	6.66	23	14.72
Brachydeuterus auritus	6.56	58	14.50
Mugil capurrii	3.95	2	8.73
Chloroscombrus chrysurus	3.70	19	8.18
Sardinella maderensis	3.10	14	6.85
Pomadasys rogeri	1.66	2	3.67
Trachinotus ovatus	1.24	6	2.74
Loligo vulgaris	1.18	12	2.61
Arygocampus regius	1.06	2	2.34
Pomadasys jubelini	0.77	2	1.70
Chlorophthalmus atlanticus	0.68	58	1.50
Sphyræna sphyraena	0.50	2	1.10
Synagrops microlepis	0.21	2	0.46
Zenopsis conchifer	0.12	4	0.27
Scorpaena elongata	0.08	10	0.18
GALATHEIDAE	0.08	19	0.18
Penaeus notialis	0.06	4	0.13
Exocoetus volitans	0.04	2	0.09
Pseudupeneus prayensis	0.02	2	0.04
Total	45.24	99.98	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1498  
 DATE:12/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1740  
 start stop duration  
 TIME :18:39:39 19:09:05 29 (min) Purpose code: 1  
 LOG :6314.80 6316.13 1.34 Area code : 3  
 FDEPTH: 215 217 GearCond.code: 1  
 BDEPTH: 215 217 Validity code: 1  
 Towing dir: 190° Wire out: 660 m Speed: 30 kn\*10  
 Sorted: 24 Kg Total catch: 3038.15 CATCH/HOUR: 6285.83

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Hyperoglyphe mosellii	5242.76	557	83.41
Epinephelus caninus	296.38	10	4.72
Scorpaena elongata	253.55	466	4.03
Scorpaena sp.	190.24	993	3.03
Gephyroberyx darwini	52.45	155	0.83
Epigonus telescopus	51.21	559	0.81
Brotula barbata	39.10	31	0.62
Trichiurus lepturus	23.90	62	0.38
Spicara alta	21.72	31	0.35
Chlorophthalmus atlanticus	20.79	590	0.33
Dentex angolensis	20.17	31	0.32
Synagrops microlepis	19.86	2359	0.32
Dentex macropthalmus	18.31	93	0.29
Umbrina canariensis	18.00	31	0.29
Bembrops heterurus	5.59	62	0.09
Merluccius senegalensis	5.28	155	0.08
Parapenaeus longirostris	4.97	869	0.08
Monolene microstoma	1.55	31	0.02
Total	6285.83	100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1499  
 DATE:12/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1740  
 start stop duration  
 TIME :21:45:59 22:15:04 29 (min) Purpose code: 1  
 LOG :6340.57 6342.30 1.70 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 42 30 Validity code:  
 Towing dir: 90° Wire out: 130 m Speed: 30 kn\*10  
 Sorted: 30 Kg Total catch: 93.00 CATCH/HOUR: 192.41

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight	numbers		
Sardinella maderensis	61.51	317	31.97
Chloroscombrus chrysurus	34.88	267	18.13
Sardinella maderensis - Juv.	31.78	782	16.52
Sardinella aurita	27.31	106	14.19
Brachydeuterus auritus	17.88	441	9.29
Selene dorsalis	7.32	168	3.80
Decapterus rhonchus	3.41	19	1.77
Rhizoprionodon acutus	3.21	2	1.67
Sphyræna guanchancho	2.73	12	1.42
Sepia officinalis hierredda	1.26	4	0.65
Dactylopterus volitans	0.37	6	0.19
Dactylopterus volitans	0.37	6	0.19
Monolene microstoma	0.31	6	0.16
Trichiurus lepturus	0.31	12	0.16
Callionymus sp.	0.12	6	0.06
Total	192.77	100.17	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1504  
 DATE:14/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1841  
 start stop duration Long W 1618  
 TIME :03:07:26 03:37:14 30 (min) Purpose code: 1  
 LOG :6606.02 6607.66 1.62 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 19 23 Validity code:  
 Towing dir: 316ø Wire out: 140 m Speed: 35 kn\*10

Sorted: 28 Kg Total catch: 300.62 CATCH/HOUR: 601.24

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Diplodus puntazzo	190.10	226	11.62	
Decapterus rhonchus	135.10	1722	22.47	2359
Sardinella aurita	110.60	336	18.40	2358
Penaeus kerathurus	43.40	126	7.22	
Sardinella maderensis	43.40	126	7.22	
Pomadasy inciscus	15.12	84	2.51	
Penaeus notialis	14.14	518	2.35	
Brachydeuterus auritus	11.20	70	1.86	
Mugil cephalus	8.70	4	1.45	
Pseudupeneus prayensis	5.74	14	0.95	
Dactylopterus volitans	5.32	42	0.88	
Pagellus bellottii	5.18	28	0.86	
Boops boops	3.78	42	0.63	
Scomber japonicus	3.08	14	0.51	
Selene dorsalis	2.80	14	0.47	
Lagocephalus laevigatus	2.70	2	0.45	
Pisodonophis semicinctus	0.60	2	0.10	
Trichiurus lepturus	0.28	14	0.05	
Total	601.24		100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1505  
 DATE:14/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1850  
 start stop duration Long W 1621  
 TIME :04:58:37 05:28:09 30 (min) Purpose code: 1  
 LOG :6618.37 6620.09 1.70 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 21 26 Validity code:  
 Towing dir: 270ø Wire out: 140 m Speed: 35 kn\*10

Sorted: 31 Kg Total catch: 115.57 CATCH/HOUR: 231.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	68.70	234	29.72	2361
Decapterus rhonchus	65.10	2178	28.16	2362
Sardinella aurita	26.46	72	11.45	2360
Trichiurus lepturus	24.90	66	10.77	
Brachydeuterus auritus	16.08	96	6.96	
Diplodus puntazzo	12.00	14	5.19	
Pomadasy inciscus	6.12	30	2.65	
Sepia officinalis hierredda	2.18	4	0.94	
Dactylopterus volitans	1.98	18	0.86	
Pomadasy rogeri	1.94	2	0.84	
Argyrosomus regius	1.30	2	0.56	
Arius heudeloti	1.02	2	0.44	
Penaeus notialis	1.02	78	0.44	
Pseudupeneus prayensis	0.90	12	0.39	
Pagellus bellottii	0.84	12	0.36	
Boops boops	0.42	12	0.18	
OMMASTREPHIDAE	0.18	54	0.08	
Total	231.14		99.99	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1506  
 DATE:14/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1900  
 start stop duration Long W 1626  
 TIME :13:27:53 13:58:19 30 (min) Purpose code: 1  
 LOG :6693.24 6695.12 1.85 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 29 34 Validity code:  
 Towing dir: 90ø Wire out: 140 m Speed: 35 kn\*10

Sorted: Kg Total catch: CATCH/HOUR:

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

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1507  
 DATE:14/11/01 GEAR TYPE: PT No:3 POSITION:Lat N 1903  
 start stop duration Long W 1629  
 TIME :15:45:28 16:13:10 28 (min) Purpose code: 1  
 LOG :6709.55 6711.90 2.30 Area code : 3  
 FDEPTH: 18 18 GearCond.code:  
 BDEPTH: 35 29 Validity code:  
 Towing dir: 110ø Wire out: 140 m Speed: 51 kn\*10

Sorted: 28 Kg Total catch: 27.86 CATCH/HOUR: 59.70

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	46.61	131	78.07	2364
Scomber japonicus	10.39	47	17.40	2363
Sardinella aurita	1.95	4	3.27	
Campogramma glaycos	0.73	2	1.22	
Sepiella ornata	0.02	4	0.03	
Total	59.70		99.99	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1508  
 DATE:14/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1910  
 start stop duration Long W 1638  
 TIME :19:22:51 19:51:16 28 (min) Purpose code: 1  
 LOG :6728.51 6730.35 1.83 Area code : 3  
 FDEPTH: 25 25 GearCond.code:  
 BDEPTH: 77 101 Validity code:  
 Towing dir: 270ø Wire out: 130 m Speed: 40 kn\*10

Sorted: 68 Kg Total catch: 68.03 CATCH/HOUR: 145.78

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	68.68	193	47.11	2365
MYCTOPHIDAE	47.89	11106	32.85	
Trichiurus lepturus	18.21	101	12.49	
Sardinella aurita	10.01	28	6.87	
Scomber japonicus	0.49	2	0.34	
Trachurus trachurus	0.26	13	0.18	
Saurida brasiliensis	0.09	13	0.06	
Sepia bertheloti	0.06	4	0.04	
Illex coindetii	0.04	4	0.03	
Synagrops microlepis	0.02	4	0.01	
Sycyonia galecta	0.02	2	0.01	
Total	145.77		99.99	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1509  
 DATE:15/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1920  
 start stop duration Long W 1649  
 TIME :00:58:11 01:28:19 30 (min) Purpose code: 1  
 LOG :6785.65 6787.55 1.88 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 54 37 Validity code:  
 Towing dir: 90ø Wire out: 150 m Speed: 38 kn\*10

Sorted: 38 Kg Total catch: 131.70 CATCH/HOUR: 263.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Lagocephalus laevigatus	225.00	348	85.42	
Trichiurus lepturus	27.80	122	10.55	
MYCTOPHIDAE	5.10	2682	1.94	
Campogramma glaycos	3.04	10	1.15	
Uzaspis secunda	1.96	4	0.74	
Saurida brasiliensis	0.36	96	0.4	
OMMASTREPHIDAE	0.08	102	0.03	
Sepiella ornata	0.06	6	0.02	
Total	263.40		99.99	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1510  
 DATE:15/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 1925  
 start stop duration Long W 1649  
 TIME :02:27:37 02:57:29 30 (min) Purpose code: 1  
 LOG :6795.87 6797.69 1.81 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 28 27 Validity code:  
 Towing dir: 14ø Wire out: 150 m Speed: 35 kn\*10

Sorted: 27 Kg Total catch: 118.92 CATCH/HOUR: 237.84

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	200.00	904	84.09	
Engraulis encrasicolus	11.76	2352	4.94	
Pomadasy jubelini	6.50	10	2.73	
Sardinella maderensis	5.92	16	2.49	
Selene dorsalis	4.24	24	1.78	
Trichiurus lepturus	2.86	14	1.20	
Stromateus fiatola	2.22	2	0.93	
Campogramma glaycos	1.48	4	0.62	
Decapterus rhonchus	1.12	4	0.47	
Sphyræna sphyraena	1.10	4	0.46	
Alloteuthis africana	0.16	64	0.07	
Sardinella aurita - Juveniles	0.16	24	0.07	
OMMASTREPHIDAE	0.10	48	0.04	
Sepiella ornata	0.08	8	0.03	
Saurida brasiliensis	0.08	96	0.03	
Sepia officinalis hierredda	0.06	2	0.03	
Total	237.84		99.98	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1511  
 DATE:15/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 1930  
 start stop duration Long W 1656  
 TIME :04:12:32 04:42:03 30 (min) Purpose code: 1  
 LOG :6808.10 6810.19 2.09 Area code : 3  
 FDEPTH: 20 20 GearCond.code:  
 BDEPTH: 101 101 Validity code:  
 Towing dir: 270ø Wire out: 46 m Speed: 46 kn\*10

Sorted: 28 Kg Total catch: 84.47 CATCH/HOUR: 168.94

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	152.90	1698	90.51	
MYCTOPHIDAE	11.58	3360	6.85	
Lagocephalus laevigatus	1.24	2	0.73	
Scomber japonicus	0.98	4	0.58	
Trachurus trecae	0.92	2	0.54	
Saurida brasiliensis	0.42	98	0.25	
MACROURIDAE	0.30	30	0.18	
Parapandalus narval	0.30	318	0.18	
Illex coindetii	0.18	48	0.11	
Sepiella ornata	0.12	18	0.07	
Total	168.94		100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1512  
 DATE:15/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 1940  
 start stop duration Long W 1704  
 TIME :09:12:51 09:20:57 8 (min) Purpose code: 1  
 LOG :6852.59 6853.02 0.43 Area code : 3  
 FDEPTH: 142 154 GearCond.code:  
 BDEPTH: 142 154 Validity code:  
 Towing dir: 270ø Wire out: 420 m Speed: 30 kn\*10

Sorted: Kg Total catch: 37.98 CATCH/HOUR: 284.85

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Umbriina canariensis	219.38	608	77.02	
Merluccius merluccius	15.08	53	5.29	
Chloroscombrus chrysurus	14.40	60	5.06	
Trichiurus lepturus	13.58	83	4.77	
Sphyraena sphyraena	6.68	8	2.35	
Saurida brasiliensis	3.90	113	1.37	
Synagrops microlepis	3.75	285	1.32	
Pterothrissus belloci	3.68	8	1.29	
Engraulis encrasicolus	3.53	98	1.24	
Trachurus trecae	0.38	8	0.13	
Hymenocephalus italicus	0.30	15	0.11	
Dicologlossa cuneata	0.15	8	0.05	
Capros aper	0.08	15	0.03	
Total	284.89		100.03	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1513  
 DATE:15/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2001  
 start stop duration Long W 1712  
 TIME :21:06:42 21:35:01 28 (min) Purpose code: 1  
 LOG :6969.45 6971.33 1.87 Area code : 3  
 FDEPTH: 10 10 GearCond.code: 1  
 BDEPTH: 26 25 Validity code: 1  
 Towing dir: 90ø Wire out: 120 m Speed: 30 kn\*10

Sorted: 26 Kg Total catch: 150.76 CATCH/HOUR: 323.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	158.57	2871	49.08	2368
Rhizoprionodon acutus	32.57	64	10.08	
Brachydeuterus auritus	30.43	2177	9.42	
Scomberomorus tritor	27.86	11	8.62	
Engraulis encrasicolus	19.29	2871	5.97	2366
Sphyraena zygaena	17.68	2	5.47	
Sphyraena sphyraena	10.71	51	3.32	
Lagocephalus laevisgatus	9.64	6	2.98	
Sardinella aurita - Juveniles	9.00	986	2.79	2367
Arius heudeloti	3.75	2	1.16	
Pomadasy s rogeri	2.14	2	0.66	
Loligo vulgaris	0.86	6	0.27	
Pomadasy incisus	0.54	2	0.17	
Penaeus notialis	0.02	2	0.01	
Total	323.06		100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1514  
 DATE:16/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2009  
 start stop duration Long W 1718  
 TIME :00:14:59 00:44:43 30 (min) Purpose code: 1  
 LOG :6991.47 6993.11 1.62 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 25 26 Validity code:  
 Towing dir: 270ø Wire out: 150 m Speed: 35 kn\*10

Sorted: 33 Kg Total catch: 67.07 CATCH/HOUR: 134.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	51.60	800	38.47	
Sardinella aurita	32.08	2608	23.92	2369
Arius heudeloti	20.24	44	15.09	
Brachydeuterus auritus Juv.	8.16	524	6.08	
Pomadasy incisus	7.00	24	5.22	
Pomadasy rogeri	3.28	4	2.45	
Dactylopterus volitans	3.04	8	2.27	
Sepia officinalis hierredda	2.86	4	2.13	
Galeoides decadactylus	1.92	68	1.43	
Engraulis encrasicolus	1.84	1224	1.37	
Pagellus bellottii	1.56	68	1.16	
Trichiurus lepturus	0.32	8	0.24	
Diplodus bellottii	0.16	4	0.12	
Sepiella ornata	0.04	4	0.03	
Chloroscombrus chrysurus	0.04	8	0.03	
Total	134.14		100.01	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1515  
 DATE:16/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2020  
 start stop duration Long W 1730  
 TIME :05:51:00 06:19:35 29 (min) Purpose code: 1  
 LOG :7044.84 7046.60 1.38 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 54 50 Validity code:  
 Towing dir: 90ø Wire out: 145 m Speed: 40 kn\*10

Sorted: Kg Total catch: 46.65 CATCH/HOUR: 96.52

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	33.62	66	34.83	
Trachurus trecae	29.38	1531	30.44	2370
Coryphaena equiselis	16.97	2	17.58	
Sepia officinalis hierredda	12.10	12	12.54	
Alloteuthis africana	10.34	439	10.71	
Sepia bertheloti	0.83	25	0.86	
Saurida brasiliensis	0.41	8	0.42	
Chilomycterus sp.	0.21	2	0.22	
Total	103.86		107.60	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1516  
 DATE:16/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2020  
 start stop duration Long W 1707  
 TIME :08:52:29 09:23:03 31 (min) Purpose code: 1  
 LOG :7069.46 7071.15 1.67 Area code : 3  
 FDEPTH: 10 10 GearCond.code: 1  
 BDEPTH: 20 21 Validity code: 1  
 Towing dir: 270ø Wire out: 125 m Speed: 40 kn\*10

Sorted: 4 Kg Total catch: 83.50 CATCH/HOUR: 161.61

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomberomorus tritor	71.32	27	44.13	
J E L L Y F I S H	62.90	1161	38.92	
Chloroscombrus Juvenile	20.52	17644	12.70	
Arius heudeloti	5.32	12	3.29	
Trachurus trecae, juvenile	1.16	561	0.72	
Sepiella ornata	0.39	39	0.24	
Total	161.61		100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1517  
 DATE:16/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 2020  
 start stop duration Long W 1707  
 TIME :10:04:48 10:18:49 14 (min) Purpose code: 1  
 LOG :7075.14 7075.80 0.65 Area code : 3  
 FDEPTH: 20 21 GearCond.code:  
 BDEPTH: 20 21 Validity code:  
 Towing dir: 270ø Wire out: 90 m Speed: 30 kn\*10

Sorted: 587 Kg Total catch: 1173.77 CATCH/HOUR: 5030.44

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L L Y F I S H	4493.87	14229	89.33	
Scomberomorus tritor	408.00	219	8.11	
Chloroscombrus Juvenile	108.00	83829	2.15	
Trachurus trecae, juvenile	8.57	1371	0.17	90
Sardinella aurita - Juveniles	6.86	5829	0.14	
Engraulis encrasicolus	5.14	5657	0.10	
Total	5030.44		100.00	

DR. FRIDTJOF NANSEN PROJECT:W3 PROJECT STATION:1518  
 DATE:16/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2040  
 start stop duration Long W 1709  
 TIME :19:15:56 19:45:01 29 (min) Purpose code: 1  
 LOG :7160.03 7161.79 1.76 Area code : 3  
 FDEPTH: 10 10 GearCond.code: 1  
 BDEPTH: 31 36 Validity code: 1  
 Towing dir: 270ø Wire out: 125 m Speed: 40 kn\*10

Sorted: 2 Kg Total catch: 26.37 CATCH/HOUR: 54.56

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	26.69	149	48.92	2371
Engraulis encrasicolus	18.46	5662	33.83	2373
Loligo vulgaris	3.93	12	7.20	
Sardinella aurita - Juveniles	2.13	693	3.90	2372
Arius heudeloti	1.12	2	2.05	
Campogramma glaycos	0.93	2	1.70	
Scomber japonicus	0.64	2	1.17	
Sepia officinalis hierredda	0.56	4	1.03	
Trachurus trecae, juvenile	0.10	43	0.18	
Total	54.56		99.98	



## Annex II Instruments and fishing gear used

The Simrad EK-500, 38kHz echo scientific sounder was used during the survey for fish abundance estimation. The Bergen Echo Integrator system (BEI) logging the echogram raw data from the sounder, was used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data was stored to tape, and a backup of the database of scrutinized data, stored. The details of the settings of the 38kHz where as follows:

<b>Transceiver-1 menu</b>	Transducer depth	5.5 - 7.5 m
	Absorbtion coeff.	10 dB/km
	Pulse length	medium (1ms)
	Bandwidth	wide
	Max power	2000 Watt
	2-way beam angle	-21.0 dB
	SV transducer gain	27.16 dB
	TS transducer gain	27.26 dB
	Angle sensitivity	21.9
	3 dB beamwidth Along.	7.1°
	3 dB beamwidth Athw.	6.9°
	Alongship offset	0.07°
	Athwardship offset	0.03°
<b>Display menu</b>	Echogram	1
	Bottom range	10 m
	Bottom range start	9 m
	TVG	20 log R
	Sv colour min	-67 dB
	TS Colour minimum	-60 dB
	<b>Printer- menu</b>	Range
TVG		20 log R
Sv colour min		-60 dB
<b>Bottom detection menu</b>	Minimum level	-40 dB

A calibration experiment using a standard wolfram carbide sphere, performed off Langstrand, Walvis Bay 8 Sept. 2001 gave the following results:

Sv Transducer gain 27.16 dB  
Ts Transducer gain 27.26 dB

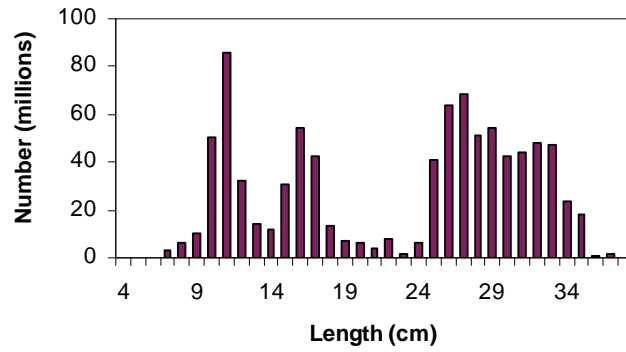
### Fishing gear

The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super" bottom trawl. For all trawls, the Tyborøn, 7.8m<sup>2</sup> (1670 kg) trawl doors were used.

# ANNEX III Pooled length distribution by species and regions

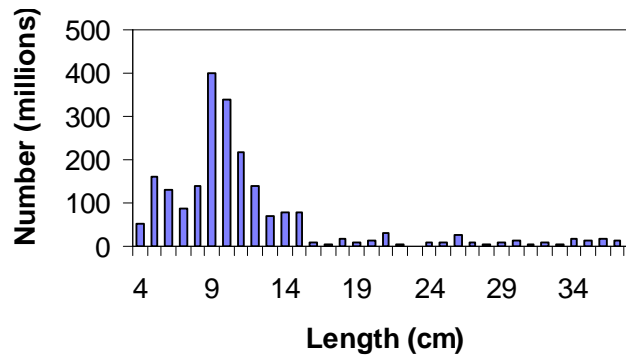
## St. Louis - Cape Blanc

*Sardinella maderensis*



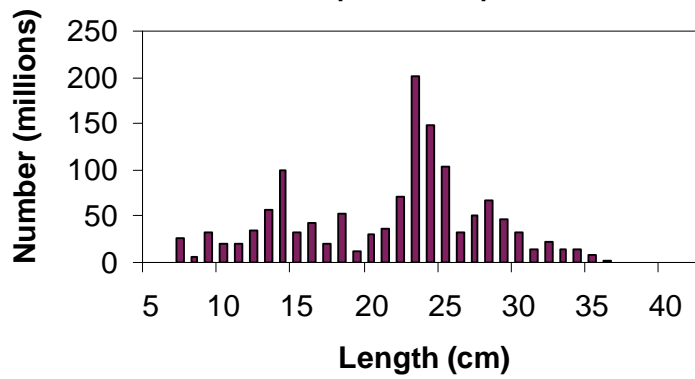
## St. Louis - Cape Blanc

*Sardinella aurita*

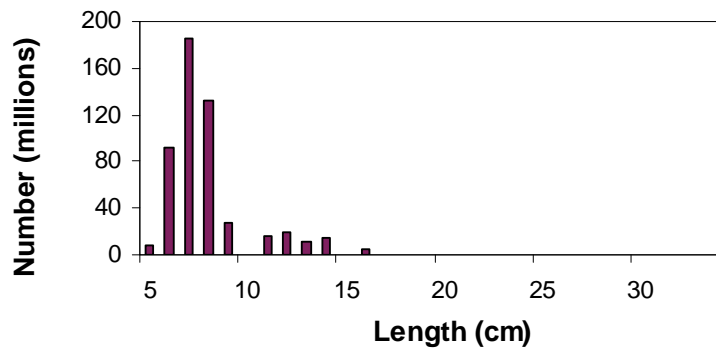


## ANNEX III continued

### St. Louis - Cap Timiris *Decapterus sp.*



### St. Louis - Cape Blanc *Trachurus trachurus*



## Annex IV Estimates of numbers and weight by length.

Mauritania 11-2001

*Sardinella aurita*

Length cm	N (thousands)			Biomass (tonnes)		
	St.Louis- Cape Timiris	Cape Timiris- Cape Blanc	TOTAL	St.Louis- Cape Timiris	Cape Timiris- Cape Blanc	TOTAL
4		50 178	50 178		44	44
5		160 569	160 569		256	256
6		130 462	130 462		344	344
7		85 084	85 084		345	345
8		140 934	140 934		831	831
9		399 677	399 677		3 290	3 290
10		340 336	340 336		3 782	3 782
11		217 291	217 291		3 173	3 173
12		137 007	137 007		2 569	2 569
13		68 504	68 504		1 618	1 618
14		78 539	78 539		2 299	2 299
15		78 539	78 539		2 808	2 808
16	290	10 036	10 325	12	433	445
17	2 316		2 316	119		119
18	2 027	16 580	18 607	123	1 008	1 131
19	290	8 290	8 580	21	590	611
20	5 348	8 290	13 638	442	686	1 128
21	2 413	26 616	29 029	230	2 539	2 770
22	5 780		5 780	632		632
23	1 206		1 206	150		150
24	9 418		9 418	1 330		1 330
25	10 121		10 121	1 611		1 611
26	25 664		25 664	4 585		4 585
27	7 928		7 928	1 583		1 583
28	5 729		5 729	1 273		1 273
29	7 296		7 296	1 798		1 798
30	11 729		11 729	3 195		3 195
31	4 631		4 631	1 390		1 390
32	10 406		10 406	3 429		3 429
33	6 519		6 519	2 353		2 353
34	16 876		16 876	6 653		6 653
35	11 758		11 758	5 050		5 050
36	19 343		19 343	9 030		9 030
37	13 646		13 646	6 908		6 908
38	6 444		6 444	3 530		3 530
39						
TOTAL	147 742	1 906 754	2 054 496	55 447	26 569	82 016

## Annex IV continued

Mauritania 11-2001

*Sardinella maderensis*

Length cm	N (thousands)			Biomass (tonnes)		
	St. Louis- Cape Timiris	Cape Timiris- Cape Blanc	TOTAL	St. Louis- Cape Timiris	Cape Timiris Cape Blanc	TOTAL
4						
5						
6						
7	3 071		3 071	12		12
8	6 141		6 141	36		36
9	10 494		10 494	86		86
10	50 451		50 451	561		561
11	86 133		86 133	1 258		1 258
12	32 484		32 484	609		609
13	14 417		14 417	341		341
14	11 700		11 700	342		342
15	30 846		30 846	1 103		1 103
16	54 145		54 145	2 335		2 335
17	42 609		42 609	2 192		2 192
18	13 200		13 200	802		802
19	7 096		7 096	505		505
20	5 976		5 976	494		494
21	3 896		3 896	372		372
22	7 585		7 585	829		829
23	1 590		1 590	198		198
24	5 942		5 942	839		839
25	41 187		41 187	6 556		6 556
26	63 636		63 636	11 369		11 369
27	68 265		68 265	13 629		13 629
28	51 133		51 133	11 363		11 363
29	54 577		54 577	13 451		13 451
30	42 507		42 507	11 578		11 578
31	43 763		43 763	13 131		13 131
32	47 903		47 903	15 787		15 787
33	47 327		47 327	17 081		17 081
34	23 398		23 398	9 224		9 224
35	18 253		18 253	7 839		7 839
36	1 109		1 109	518		518
37	1 362		1 362	689		689
38						
39						
40						
TOTAL	889 725		889 725	145 130		143 923

## Annex IV continued

Mauritania 2001

*Decapterus sp.*

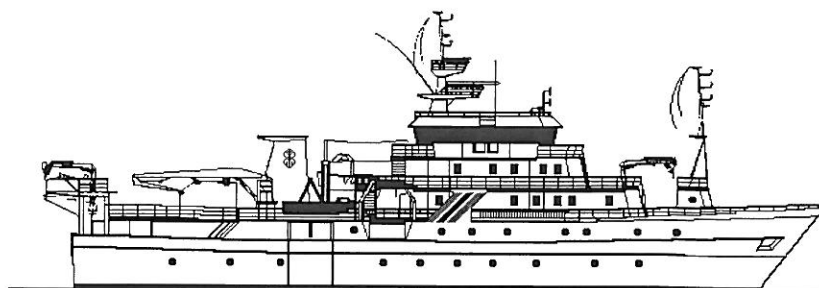
Length cm	N (thousands)			Biomass (tonnes)		
	St. Louis- Cape Timiris	Cape Timiris- Cape Blanc	TOTAL	St. Louis- Cape Timiris	Cape Timiris- Cape Blanc	TOTAL
5						
6						
7		26 569	26 569		108	108
8		6 642	6 642		39	39
9		33 212	33 212		273	273
10		19 927	19 927		221	221
11		19 927	19 927		291	291
12	2 283	33 212	35 494	43	623	666
13	18 015	39 854	57 869	426	941	1 367
14	33 885	66 423	100 308	992	1 944	2 936
15	12 216	19 927	32 142	437	712	1 149
16	8 699	33 212	41 911	375	1 432	1 807
17	7 558	13 285	20 842	389	683	1 072
18	26 581	26 569	53 150	1 616	1 615	3 231
19	5 053	6 642	11 695	360	473	832
20	10 059	19 927	29 986	832	1 648	2 480
21	3 252	33 212	36 463	310	3 169	3 479
22	3 298	67 963	71 261	361	7 432	7 792
23	13 187	188 873	202 059	1 643	23 531	25 174
24	16 265	131 113	147 379	2 296	18 510	20 807
25	15 868	88 179	104 047	2 526	14 036	16 562
26	18 329	14 825	33 153	3 274	2 648	5 923
27	21 351	29 650	51 001	4 263	5 920	10 182
28	8 705	59 299	68 005	1 935	13 178	15 113
29	17 444	29 650	47 094	4 299	7 307	11 607
30	18 130	14 825	32 955	4 938	4 038	8 976
31	15 173		15 173	4 553		4 553
32	22 908		22 908	7 549		7 549
33	14 250		14 250	5 143		5 143
34	13 944		13 944	5 497		5 497
35	8 964		8 964	3 850		3 850
36	2 988		2 988	1 395		1 395
37	996		996	504		504
38						
39	996		996	589		589
40						
TOTAL	340 396	956 492	1 296 888	60 394	110 354	170 748

## Annex IV continued

Mauritania 11- 2001

*Trachurus trachurus*

Length cm	N (thousands)			Biomass (tonnes)		
	St. Louis- Cape Timiris	Cape Timiris- Cape Blanc	TOTAL	St. Louis- Cape Timiris	Cape Timiris- Cape Blanc	TOTAL
5		8 294	8 294		13	13
6		91 233	91 233		241	241
7		185 231	185 231		750	750
8		132 703	132 703		782	782
9		27 646	27 646		228	228
10						
11		16 588	16 588		242	242
12		19 352	19 352		363	363
13		11 059	11 059		261	261
14		13 823	13 823		405	405
15						
16		5 529	5 529		238	238
17						
TOTAL		511 458	511 458		3 523	3 523



**SURVEY OF THE PELAGIC FISH RESOURCES  
OFF NORTH WEST AFRICA**

**Part III MOROCCO**

**17 November - 18 December 2001**



**CRUISE REPORT "DR FRIDTJOF NANSEN"**

**SURVEY OF THE PELAGIC FISH RESOURCES  
NORTH WEST AFRICA**

**Part III MOROCCO**

**17 November-18 December 2001**

by

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**Institute of Marine Research  
Bergen, 2001**

## TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION .....	1
1.1 Survey objectives .....	1
1.2 Participation .....	1
1.3 Narrative.....	2
1.4 Methods.....	5
CHAPTER 2 SURVEY RESULTS .....	10
2.1 Hydrographic conditions .....	10
2.2 Distribution of pelagic fish on the shelf from Cape Blanc to Cape Juby.....	19
2.3 Distribution of pelagic fish on the shelf from Cape Juby to Cape Cantin .....	25
2.4 Biomass estimates .....	29
CHAPTER 3 CONCLUDING REMARKS .....	32
RESUMÉ ET CONCLUSION (En Francais).....	37
ANNEX I Biomass and number by length	
ANNEX II Records of fishing stations	
ANNEX III Instruments and fishing gear used	

# CHAPTER 1 INTRODUCTION

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## 1.1 Survey objectives

The specific objectives for the survey in Morocco were, as for the previous surveys:

- To map the distribution and estimate the biomass of the main small pelagic fish species using hydroacoustic methods. The species of interest were: sardine *Sardina pilchardus*, sardinellas *Sardinella aurita*, *S. maderensis*, chub mackerel *Scomber japonicus*, horse mackerel *Trachurus trachurus*, *T. trecae*, and anchovy *Engraulis encrasicolus*.
- To identify acoustic targets by midwater and bottom trawl sampling and process the catches by recording weight and number by species. For the target species, length frequencies are taken to describe the size distribution.
- As a pilot project: to collect otolithes of sardine and read these during the survey. (This objective was not realized, as personnel for reading otolithes were not available at departure.)
- To sample standard hydrographical transects for temperature, salinity and oxygen off Cape Blanc, Dakhla, Cape Bojador, Cape Juby, Cape Dra and Cape Ghir.
- To intercalibrate with the R/V *Al Amir Moulay Abdallah* in an area of sardine concentrations.

The time allocated for this part of the survey was 27 working days.

## 1.2 Participation

Members of the scientific teams were:

Institut National de Recherche Halieutiques, Morocco:

Mustafa CHBANI (team leader), Hamou HABOUZ, Lachen ABOUABDELLAH, Rachid ZIANI, and Said SEMMOUMI

Centre National de Recherches Océanographiques et des Peches, Mauritania: Cheik Tijane DIOP.

Institute of Marine Research, Norway (IMR):

Tore STRØMME (cruise leader), Marek OSTROWSKI (3-19 Dec.), Oddgeir ALVHEIM, Tore MØRK, and Thor Egil JOHANSSON.

### 1.3 Narrative

Figure 1 shows the cruise track and the stations worked during the survey. The vessel departed from Nouakchott on November 17, steaming north to Cape Blanc from where the sampling work started. The survey proceeded northwards with an acoustic sampling grid with a transect distance 10 nautical miles (NM) apart, covering the shelf and slope down until about 200 m bottom depth. The sardine in the Dakhla region had a more offshore distribution than usual and it was not necessary to resurvey the near-shore areas with a finer grid as on preceding surveys. The sampling continued north to Cape Juby where the survey was interrupted with a call at Las Palmas 1-4 December for refuelling and change of crew. The survey proceeded northwards from Cape Juby covering the inner shelf between Cape Juby and 30°N with a zigzag pattern during the day, while the outer shelf was covered during night time with a more open grid, (Figure1b). At Cape Dra the vessel met the Moroccan research vessel '*Al Amir Moulay Abdallah*' for intercalibration work. The two vessels worked in tandem from Cape Dra to Agadir, continuing the standard acoustic survey. Off Agadir there was a stop for exchange of data and scientists. The survey proceeded northwards with a survey track perpendicular to the coast, transecting the whole shelf. The northern limit of the survey, off Safi, was reached on 11 December. The vessel then steamed south to the Tan Tan region. The shallow areas (20-50 m) between Cape Dra and Agadir were re-surveyed, as much fish here was located close to the surface during the initial and main coverage. The vessel called on Agadir on 15 December for a meeting with representatives from INRH, Casablanca, and for disembarking local scientist. The vessel arrived on Las Palmas 18 December.

Standard hydrographical sections were sampled at Cape Blanc, off Dakhla, at Cape Bojador, Cape Juby, Cape Dra, and Cape Ghir.

The weather was favourable during most of the survey, and it put no constraints on the sampling work.

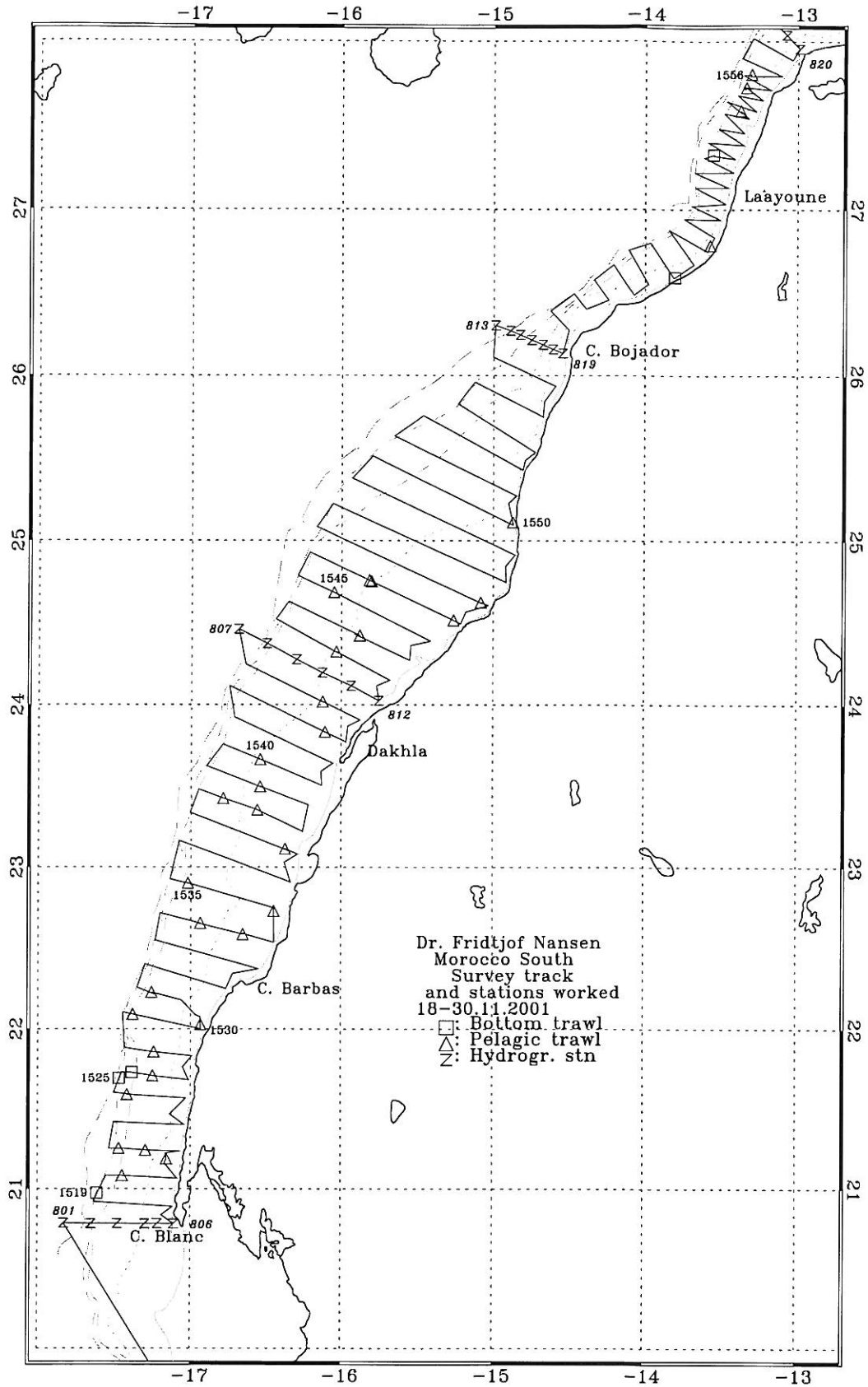


Figure 1a Course track with fishing and hydrographic stations, Cape Blanc to Cape Juby. Depth contours at 20 m, 50 m, 100 m, 200 m and 500 m are indicated.

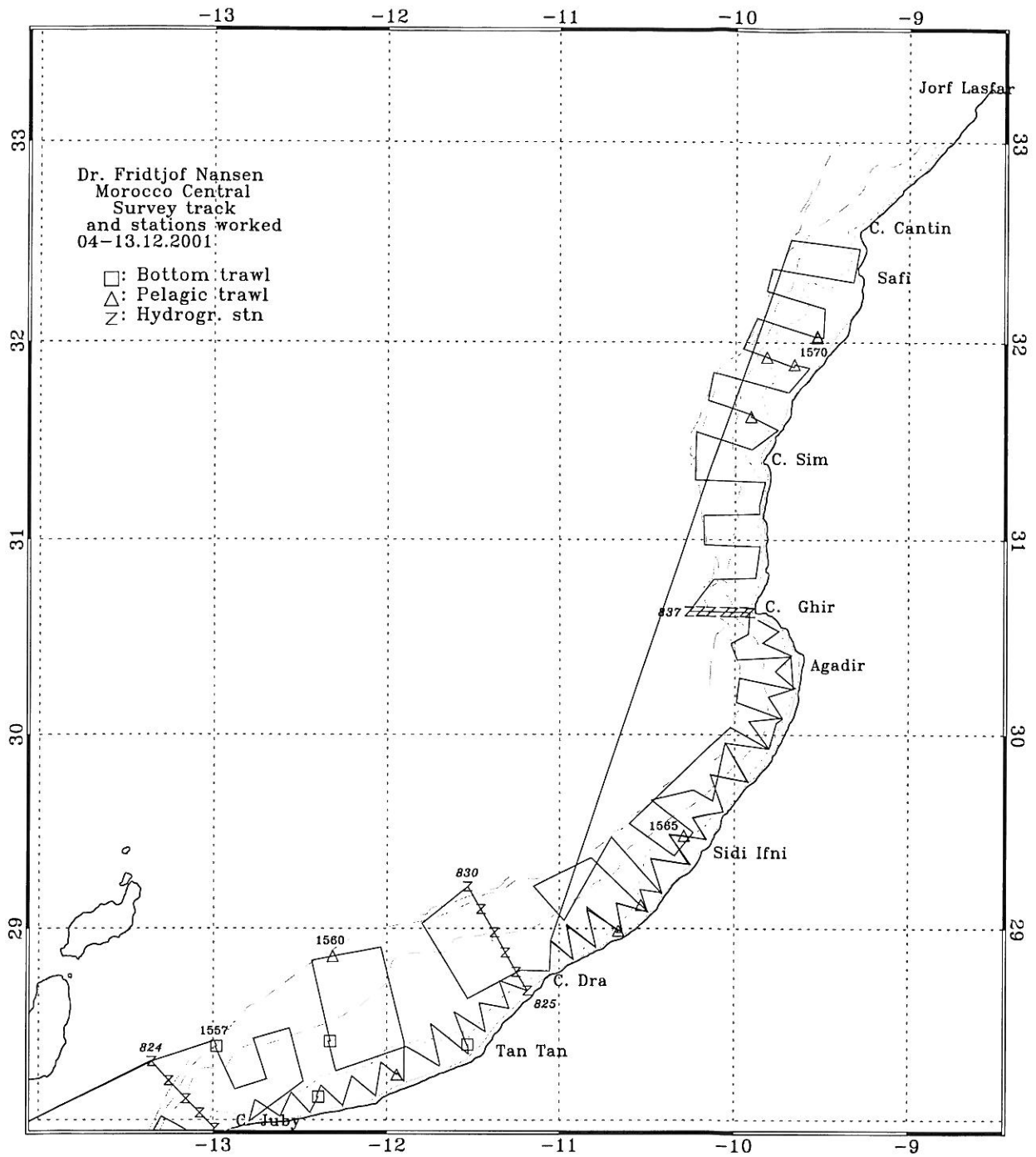


Figure 1b Course track with fishing and hydrographic stations, Cape Juby to Cape Cantin. Depth contours as in Fig. 1a.

## 1.4 Methods

The cruise followed the standard methods established for the regional surveys:

### *Environmental Data*

Meteorological observations including wind direction and speed, air temperature, solar radiation and sea surface temperature (SST) were automatically logged and recorded with position and bottom depth every nautical mile sailed using an Aanderaa meteorological station. CTD-stations were recorded at the standard hydrographic transects. A Seabird 911+ CTD probe was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the customised Seabird Seasave software installed on a PC. The profiles were in general taken down to a few meters above the bottom. In deep stations, however, data logging was interrupted at 500 m. Niskin bottles were triggered for water samples, one near the surface and one near the bottom, in order to calibrate the oxygen and salinity sensors. The water samples were analysed for dissolved oxygen using the Winkler method, and for salinity using a Guildline Portasal salinometer mod. 8410.

### *Biological Sampling*

Biological sampling of the fish was carried out using trawls. A pelagic trawl with floats was often used. A smaller pelagic trawl or the bottom trawl with floats was used for sampling the pelagic fish in very shallow waters (depth less than 25 m). Annex II gives a description of the instruments and the fishing gear used. All catches were sampled for composition by weight and numbers of each species caught. Species identification was based on the FAO Species Guides. Length frequency distributions, by total fish length in cm, of the selected target species were taken in all the stations where they were present. The complete records of fishing stations are shown in Annex I.

As a pilot study for a forthcoming regional project on age determination of sardine and sardinella, sardine otoliths were collected and preserved for later reading ashore. No personnel were available for reading the otoliths during the survey.

The following target groups were used for Morocco:

- 1) Sardine (European pilchard *Sardina pilchardus*),
- 2) Sardinellas (flat sardinella *Sardinella maderensis* and round sardinella *S. aurita*),
- 3) Anchovy (European anchovy *Engraulis encrasicolus*),

- 4) Horse mackerels (Atlantic horse mackerel *Trachurus trachurus*, Cunene horse mackerel *T. trecae* and also including false scad *Decapterus rhonchus*),
- 5) Mackerels (chub mackerel *Scomber japonicus*),
- 6) Other pelagic scombrids, carangids and associated species (such as *Auxis* sp., *Caranx* sp. and largehead hairtail *Trichiurus lepturus*), BEI group PEL2
- 7) Other demersal species (such as Sparidae, Haemulidae and Merluccidae).

### *Acoustic Sampling*

A SIMRAD EK500 Echosounder was used and the echograms were stored on both paper and files. The acoustic biomass estimates were based on the integration technique. The Bergen Echo Integrator (BEI) was used for analysis and allocation of the integrated  $s_A$ -values (average area back scattering coefficient in  $m^2/NM$ ) to the individual specified target groups, usually by 5 NM intervals. Where bottom detection was poor and where fish schools were located very close to the bottom, the bottom echo was sealed off from the fish registrations by manual contouring. The splitting and allocation of the integrator outputs ( $s_A$ -values) was based on a combination of a visual scrutiny of species characteristics as deduced from echo diagrams, the BEI analysis, and the catch compositions.

In cases where the target category of fish contains more than one species (sardinellas and horse mackerels), the mean  $s_A$ -value allocated to the category is divided between the species in the same ratio as their relative contribution to the mean back scattering strength in the length frequency samples.

The following target strength (TS) function was applied to convert allocated  $s_A$ -values (average integrator value, or area back scattering coefficient for a given species or group of species in a specified area) to number of fish:

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

which can be converted (see Toresen *et al.* 1998 for details) to the area form (scattering cross sections of acoustic targets):

$$C_{Fi} = 1.26 \cdot 10^6 \cdot L_i^{-2} \quad (2)$$

where  $L_i$  is total length in 1 cm length group  $i$  and  $C_{Fi}$  ( $m^{-2}$ ) is the reciprocal back scattering cross section, or so-called fish conversion factor. In order to split and convert the allocated  $s_A$ -values ( $m^2/NM^2$ ) to fish densities (numbers per length group per  $NM^2$ ), the following formula was used:

$$\rho_i = s_A \cdot \frac{P_i}{\sum_{i=1}^n \frac{P_i}{C_{Fi}}} \quad (3)$$



where  $\rho_i$  = density (n/NM<sup>2</sup>) of fish in length group  $i$   
 $s_A$  = mean integrator value (m<sup>2</sup>/NM<sup>2</sup>)  
 $p_i$  = proportion of fish in length group  $i$   
 $\sum_{i=1}^n \frac{p_i}{C_{Fi}}$  = the relative back scattering cross section (m<sup>2</sup>) of the length frequency sample of the target species, and  
 $C_{Fi}$  = reciprocal back scattering cross section ( $\Phi_{bs}^{-1}$ ) of a fish in length group  $i$

For TS= 20log L- be 72 the formula can further simplified into:

$$\rho_i = 1261217 * s_A \frac{n_i}{\sum_{i=min}^{max} n_i l_i^2} \quad (4)$$

where  $s_A$  = mean integrator value of a species within an aggregation area, in m<sup>2</sup>/NM  
 $n_i$  = frequency count of length group  $i$  in a pooled representative sample from the distribution area.  
 $l_i$  = mid length of fish in length group  $i$ .

The constant 1261217 incorporates the offset constant -72 in equation (1). For other TS relationships the equation constant becomes as in box. The table is presented to facilitate a recalculation in case more accurate TS measurements are provided in the future:

TS constant	Equation constant
-74	1998895
-73	1587779
-72	1261217
-71	1001821
-70	795774
-69	632106
-68	502099

Using equation (4), the pooled length distribution is used together with the mean  $s_A$ -value to calculate the density by length groups for each observed area with fish aggregations. The total number, by length groups, in an area is obtained by multiplying the densities with the distribution area. Areas were calculated on the maps by using a digital planimeter (Tamaya Planix 7).

The number of fish was converted to biomass by length group using the estimated weight at length from the length-weight relationship:

$$\bar{w} = \frac{cond}{100} * L^3 \quad (3)$$

The specific condition factors obtained from the samples and applied for this survey were: 0.82 for sardine, 0.94 for *S. aurita*, 0.97 for *S. maderensis* and 0.84 for horse mackerel.

Finally the total biomass estimate is obtained by summing the biomass by length group and areas within each sector of the survey.

Equations (1), (2) and (3) show that the conversion from  $s_A$ -value to number of fish is dependent on the length composition of the fish. In general there are many problems associated with getting representative length distributions when the various size classes mix with varying proportions between neighbouring stations. When the size classes are well and homogeneously mixed in an area, the various length distributions are pooled together with equal importance. In areas where fish size-groups are well segregated, separate estimates are made for each group. Otherwise, when the size distribution varies from sample to sample, a weighting factor is applied that takes into account the density at the location. In most cases, the mean acoustic density at the location of the sample is the most representative index of this fish density.

For the estimation of the biomass of target group 3) carangids and associated species, an overall average length of 23 cm and a condition factor of 0.88 (to calculate mean weight of this length group) were applied.

A systematic approach to a) produce pooled length distributions of a target species for use in the above equation and b) calculate the biomass estimates for a region, are obtained through the following procedure:

- Each trawl station gets an integrator value as a density index for the sampling site.
- Representative length distributions are selected from all the collected samples of a fish aggregation.
- The mean back scattering strength of a fish in each of these length frequency distributions is calculated.
- The selected length distributions are then pooled using the ratio between the allocated  $s_A$ -value and the mean back scattering strength as the weighting factor. (If the size distribution is geographically uniform the three steps mentioned above can be skipped and the samples are pooled together with equal importance.)
- The pooled length distribution is used together with the mean  $s_A$ -value to calculate the biomass in numbers by length groups, for each area in the map, using formula (4) above. Numbers are converted to weight using the condition factor of the species. This can be calculated from the length samples where the total weight of the sample is recorded, or from individual biological samples.
- Biomass is calculated as the product of the density and the area of the aggregation, and finally the area-related biomass values in a region are summed together.

The necessary calculations are done in spreadsheets after the scientist has completed the two first steps in the above list manually.

All data on fishing stations and fish length sampling were made available to the participants from the local research institutes on diskettes.

## CHAPTER 2 SURVEY RESULTS

---

### 2.1 Hydrographic conditions

The weather conditions in the Northeast Atlantic during autumn and early winter are dominated by the southward migration of the trade wind system, resulting in the relaxation of the alongshore wind, responsible for driving coastal upwelling along the Moroccan coast. The results of the oceanographic observations conducted during the survey adhered to this general pattern, but also detected several notable departures from the typical winter conditions.

#### *Wind conditions*

The northeasterly, upwelling favorable winds persisted along the most of the southern part of the survey area, (Figure 2a). The daily mean wind velocities varied from 5 to 11 m/s. The notable exception was observed to the north of Cape Blanc where a day-lasting event of the unusually calm conditions was recorded, dominated by a westerly wind with velocity less than 2 m/s.

The wind conditions encountered in the northern part of the survey area (Figure 2b) displayed the two distinct wind patterns: from Cape Juby to Cape Ghir and from Cape Ghir to Cape Cantin. Between Cape Juby and Sidi Ifni, moderate northeasterly winds with average daily mean velocities of 6 m/s were dominant. However, also the stronger, small-scale wind reversals from SE with the velocity of 10 m/s were recorded inshore in this area. Between Sidi Ifni and Cape Cantin, the survey encountered a strong wind event blowing from the southern sectors (SSE to SSW). The average wind speed reached 11m/s, which was comparable to the wind velocity observed north of Dakhla.

#### *Sea surface temperature*

Distributions of sea surface temperature are depicted in Figure 3a for the southern region and in Figure 3b for the northern region, respectively. In the south, the SST observations indicated for an occurrence of a warm temperature anomaly. The temperature in the shelf typically oscillated around 20°C. The cold-water signatures, which typically mark the location the perennial upwelling cells were absent (Dakhla) or reduced in strength (Cape Blanc). The only visible upwelling cell was observed more northwards, at 24°45'N, whereby it was marked by a drop in temperature below 18°C. On average, the SST values observed during this survey in the

south were about 2 degrees higher from those recorded during the previous winter survey in December 2000.

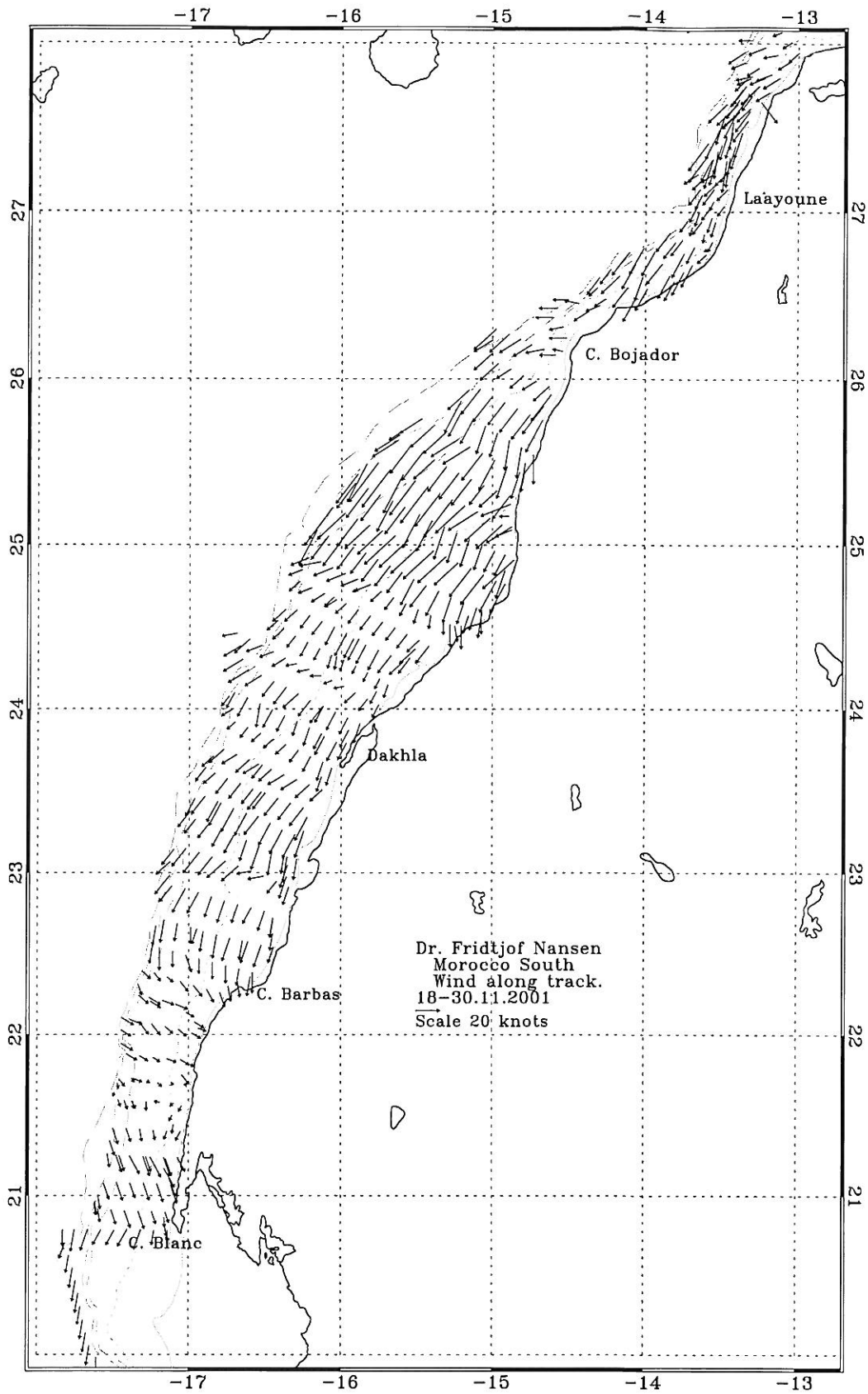


Figure 2a Wind conditions along the survey, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

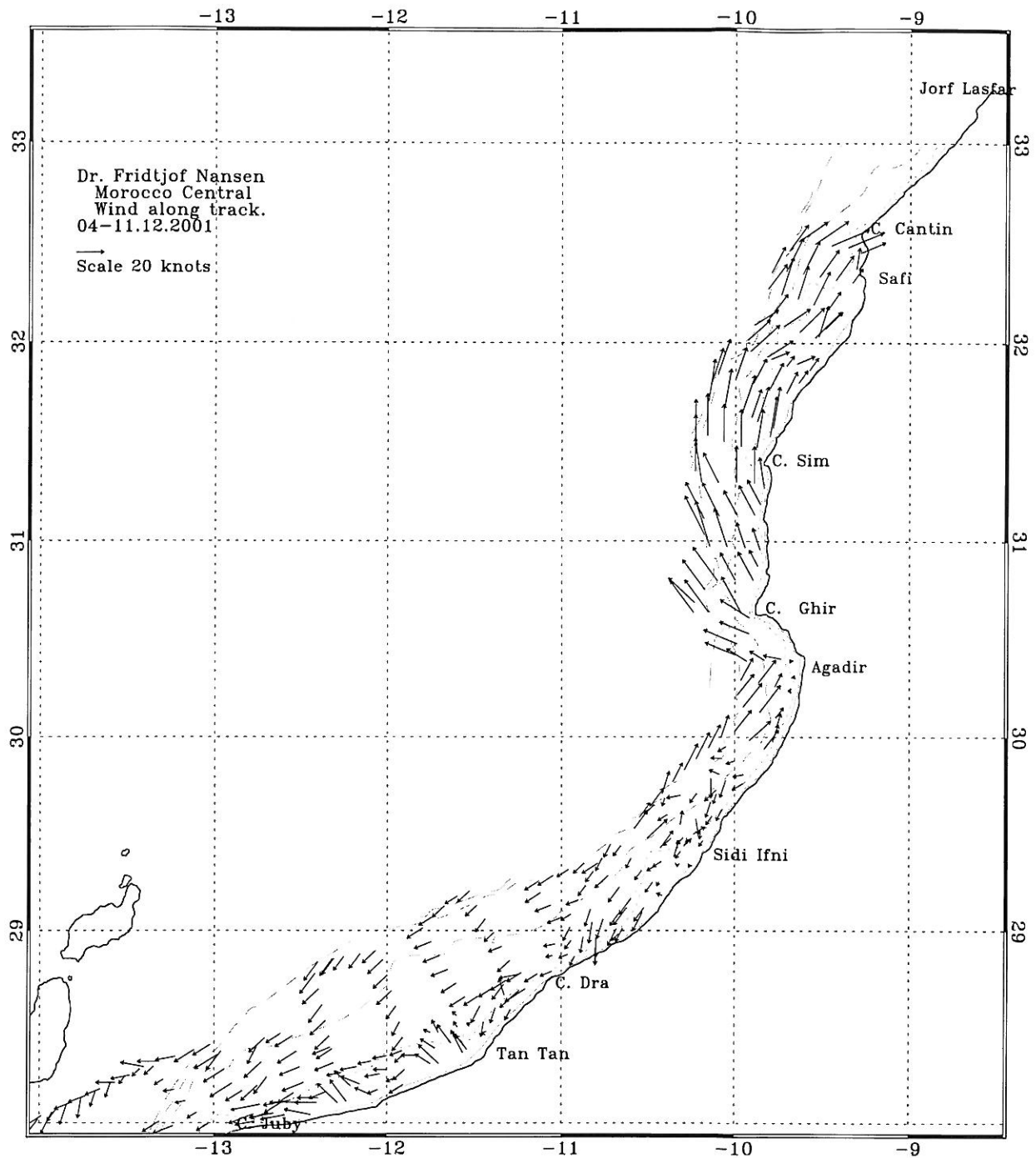


Figure 2b Wind conditions along the survey, Cape Juby to Cape Cantin. Depth contours as in Fig. 1a.

In the northern part of the survey area (Figure 3b), the SST distribution revealed the presence of the colder water belts ( $T < 18^\circ$ ), located inshore and with broad alongshore extent between Cape Juby and Sidi Ifni, off Agadir and between Cape Sim and Cape Cantin. This distribution pattern reflected the typical seasonal condition for this region, recorded also during previous winter surveys with

Dr. Fridtjof Nansen. Thus, the 2001 observation in the north did not detected, contrary to the SST observed in the south, a significant departure from the long-term normal conditions.

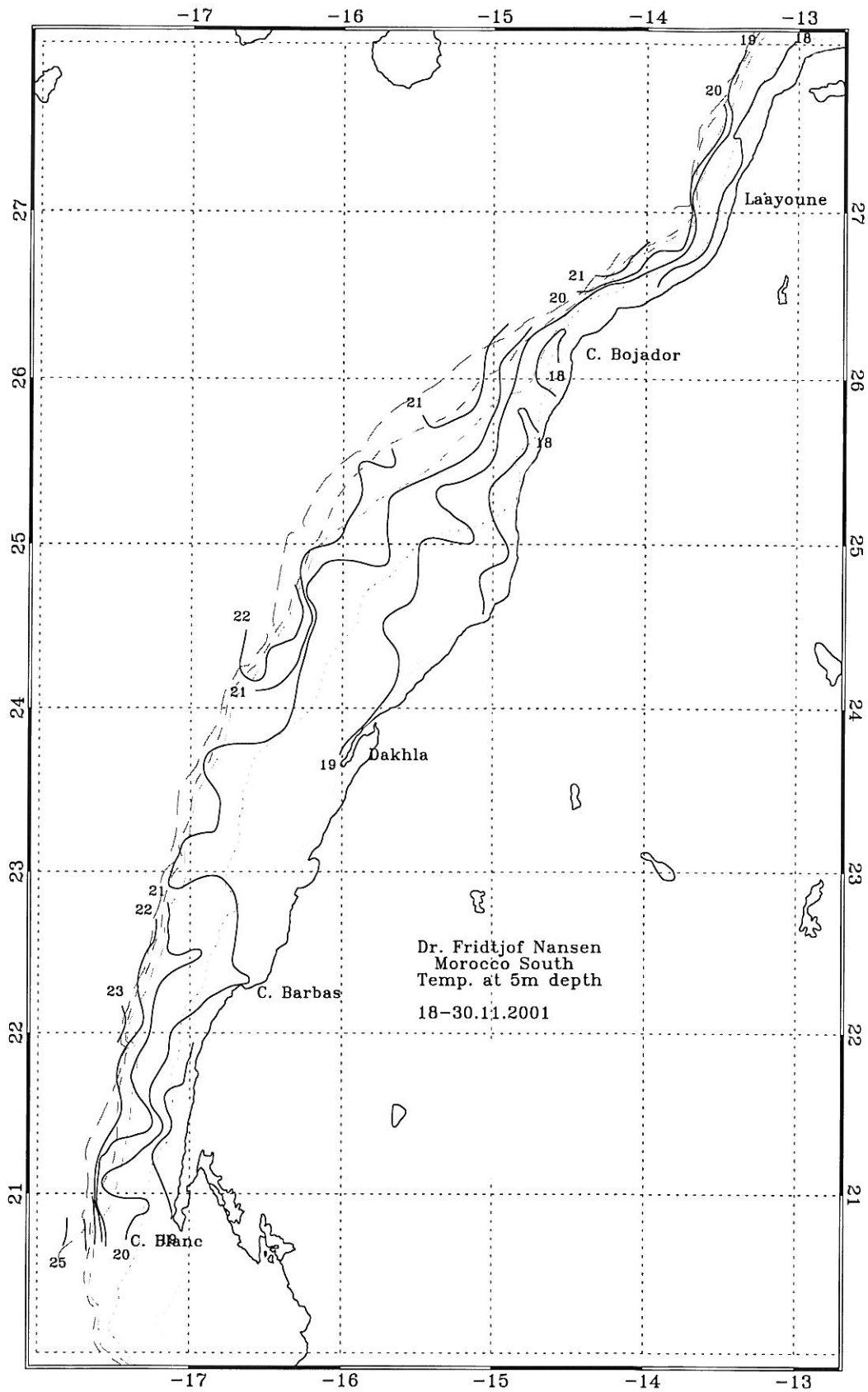


Figure 3a Sea surface temperature (at 5m depth), Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

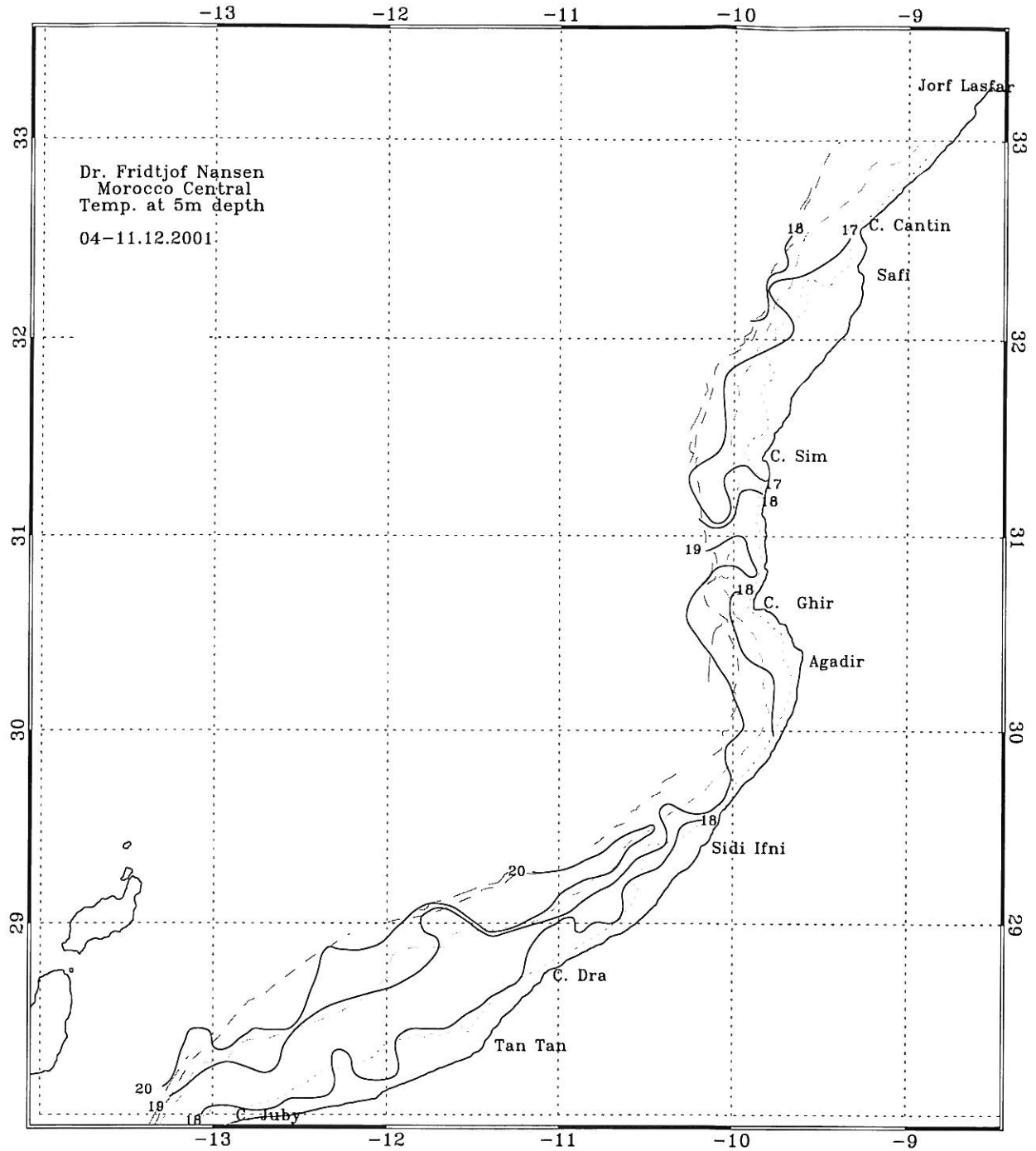


Figure 3b Sea surface temperature (at 5m depth), Cape Juby to Cape Cantin. Depth contours as in Fig. 1a.

### *Vertical distribution of seawater properties*

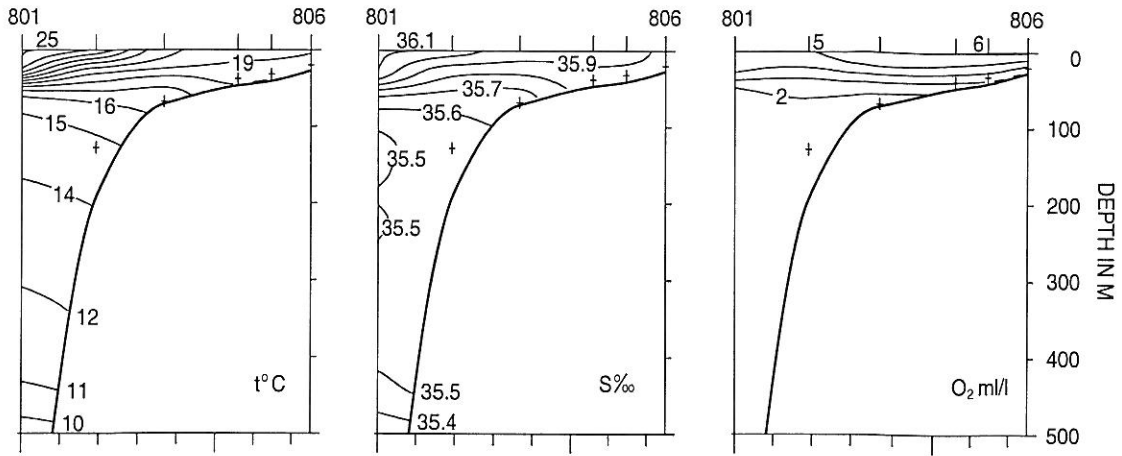
Vertical stratification of the water column was observed along the six sections, depicted in Figure 4. The locations of the sections are shown in Figure 1a and 1b.



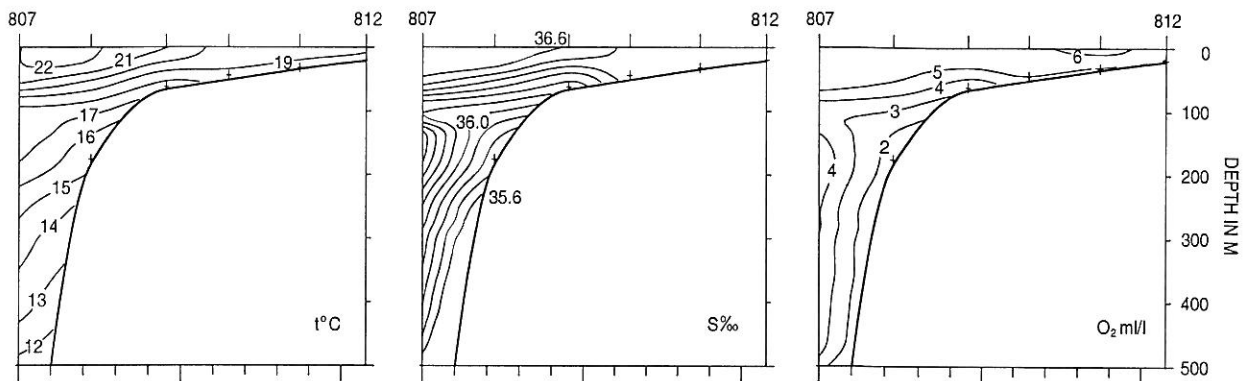
In the southern portion of the survey area, between Cape Blanc and Dakhla, hydrographic conditions at the surface were dominated by the two major water masses: (1) the warm and high-salinity water of the North Atlantic and Mediterranean origin, surrounding the shelf from the north and the west; and (2) also warm, but less saline and with significantly shallower pycnocline, the water of the Tropical Atlantic origin, advancing along the shelf from the south. The conditions typical to the Tropical Atlantic clearly dominated the T, S and O distributions along the Cape Blanc section (Figure 4). These were manifested by a strong stratification, with the top mixed layer and a shallow pycnocline at the depth of 30 m. Across the pycnocline temperature dropped below 19°C, salinity dropped below 35.9 and oxygen decreased from 5 to 3 ml/l. However, the gradual, simultaneous increase in temperature and salinity along the section towards the west indicated an increasing influence of the surface waters of the North Atlantic origin. On the offshore end of the section, the warm and high-salinity core of the southwestwards flowing Canary Current, the origin of this water mass, was clearly detectable. To the north, off Dakhla section, the surface waters of the North Atlantic origin dominated the hydrography on the shelf. The Canary current surface water was located at about 50 - 55 NM offshore, while its properties:  $T > 19^{\circ}\text{C}$ ,  $S > 36.3$  radiated into the inshore areas. Typically, vertical stratification during winter off Dakhla, due to upwelling, would tend to disappear inshore whereas the horizontal density gradient would be strong across the whole shelf. During this survey, however, the vertical stratification was well marked and the horizontal gradient was weak. Such pattern, apparently coupled to the observed relaxation of wind in this region, manifested a rather atypical reduction in upwelling intensity during the time of the survey.

The hydrographic conditions off Cape Bojador were entirely coupled to the Canary Current system. In this location, the steep continental slope and narrow shelf zone cause the core of the Canary Current to flow within the 20 NM from the coastline, injecting the high temperature and salinity water to the inshore areas. Still, during typical winters, a ribbon of colder water, brought to surface by upwelling would be typically detectable within the 5 to 10 NM from the coastline. During the 2001 survey, the presence of the upwelled water inshore was not clearly detected.

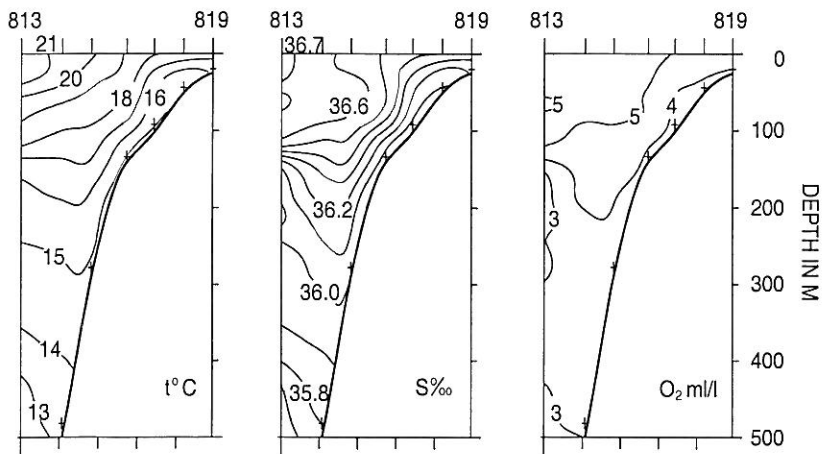
The hydrographic conditions observed on the sections located in the northern part of the survey area (Cape Juby, Cape Dra and Cape Ghir) were less anomalous with respect to the typical winter conditions (Figure 4). While the temperature and salinity of the water masses offshore were higher than usual, the inshore waters remained in the typical range for winters ( $T > 17$  and  $< 18^{\circ}\text{C}$ , and  $S = 36.3$ ), most probably due to the persisting upwelling induced uplift of the north Atlantic central water mass to the coastal areas. One exception was observed inshore off the Cape Ghir section, where the subsurface isotherms of less than  $17^{\circ}\text{C}$  were gently downsloping towards the coastline, manifesting thus a weak downwelling process. The occurrence of a downwelling process at this location was consistent with the expected effect of the observed southeasterly wind event in this area.



Cape Blanc – 19.11.2001

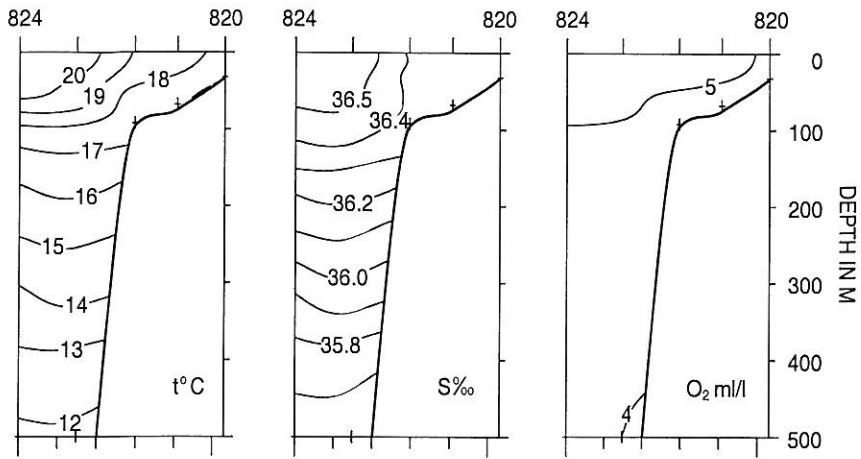


Dakhla – 24.11.2001

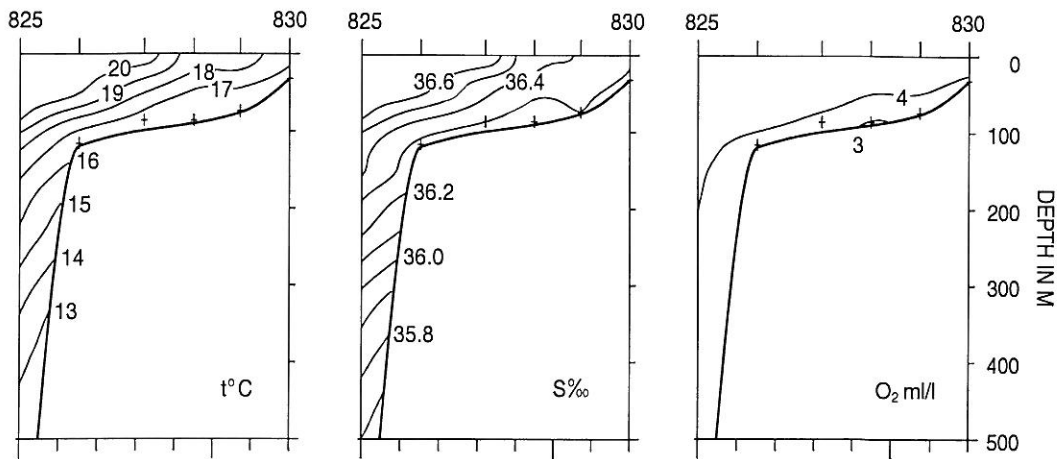


Cape Bojador – 28.11.2001

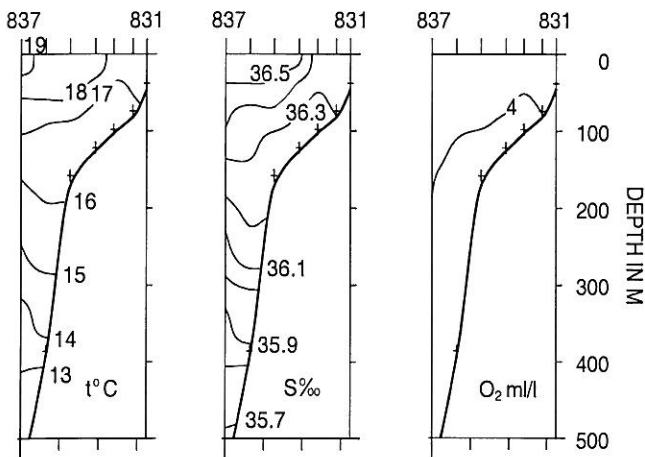
Figure 4 Hydrographic sections with distribution of temperature, salinity and oxygen.



**Cape Juby – 30.11.2001**



**Cape Dra – 06.12.2001**



**Cape Ghir – 09.12.2001**

Figure 4 (continued)

### *Coastal currents*

The measurements of vertical profiles of the sea current were performed using the Acoustic Doppler Current Profiler (ADCP) at the locations of the hydrographic stations (Figure 1a and 1b). The results pertaining to the shelf in the depth range between 60-100 m for each hydrographic section are depicted in Figure 5. The results reveal the four distinct current patterns on the shelf.

- 1 Cape Blanc section. A weak poleward current bringing the tropical surface water from the south to the area.
- 2 Dakhla and Cape Bojador sections. Equatorward flow associated with the Canary Current. The strong current at Cape Bojador, reaching 60 cm/s near the surface.
- 3 Cape Juby and Cape Dra. A weak current. Due to the shape of the coastline, the currents are directed towards SWW, which is not fully represented by the equatorward component shown in Figure 5. The westward component of the current (not shown in Figure 5) was however equally low.
- 4 Cape Ghir. The poleward component of the current in the range of  $V=20$  cm/s near the surface.

The current structure shown in Figure 5, complements the information found from the analysis of the hydrographic sections. By combining these data, the two regions with environmental conditions favorable to the retention and enrichment may be identified.

1. Cape Blanc – Dakhla. The frontal region between the tropical Atlantic and the Canary Current domains.
2. Cape Juby to Cape Ghir. A region with quiescent current conditions yet enriched inshore by an ongoing upwelling process.

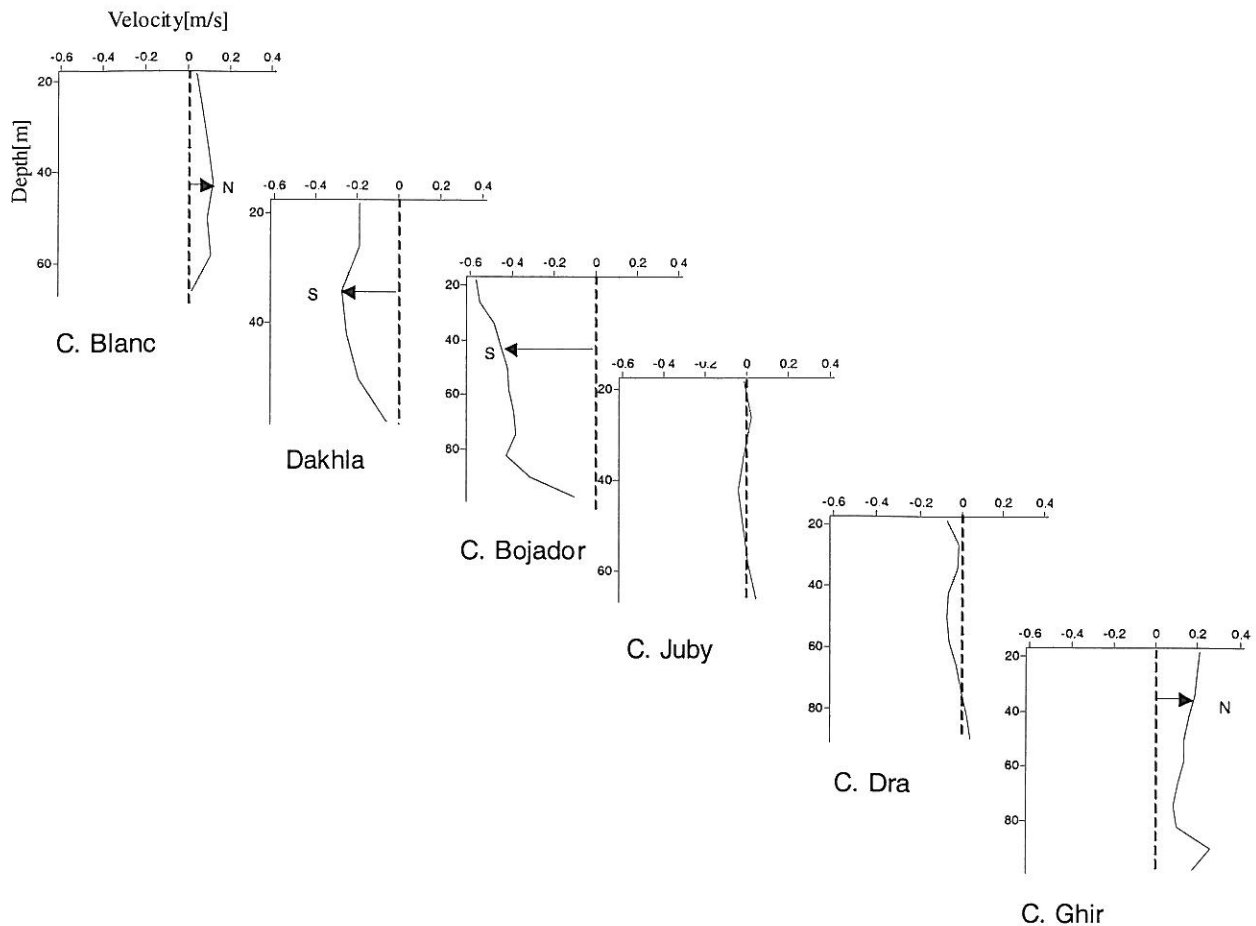


Figure 5 Vertical distribution of the North-South component of the sea current at a depth between 60 and 80m at the locations of hydrographic sections, collected during the survey. Current speed given in m/s.

## 2.2 Distribution of pelagic fish on the shelf from Cape Blanc to Cape Juby.

Figures 6 to 9 show the distribution of the main groups of pelagic fish by contoured acoustic densities.

**Sardine**, *Sardina pilchardus*, was found in dense concentrations between 21°30' N and 25° N, Figure 6. The gravity point of the distribution, consisting mainly of adult fish, is more southward as compared to previous surveys at same season, when usually most of the adult fish is located from Dakhla and northwards. Recordings of fish of length less than 20 cm were sparse (Figure 10a) and encountered only in the vicinity of Cape Barbas. This indicates a rather poor recruitment of sardine for this year. The very high concentrations of young sardine reported in the June survey this year is reduced to a small fraction. This fish was then mainly located south of

Cape Barbas and with very rich concentrations also extending south of Cape Blanc. In the area between Cape Bojador and Cape Juby sardine was recorded in high abundance close to the shore. These aggregations consist only of young fish less than 20 cm (Figure 10b).

**Sardinellas** (*Sardinella aurita* and *S. maderensis*) were found in the south, from about 23°N and southwards. It formed three aggregations (Figure 7), but the distribution extends southwards into Mauritania as well. Some young fish (<11-16cm) were found in the shallow waters north of Cape Barbas, but the main part recorded is adult fish, bigger than 30 cm.

**Horse mackerels** (*Trachurus trachurus* and *T. trecae*) were common between Cape Blanc and Cape Barbas, with the same general distribution feature as last year, but at lower abundance. Horse mackerel were also recorded further north to Cape Bojador, but only in patches, (Figure 8).

**Chub mackerel** (*Scomber japonicus*) was recorded at the outer shelf in the southern part, Figure 8. Densest registrations were found southwest of Dakhla.

**Anchovy** (*Engraulis encrasicolus*) were encountered at one event forming a single patch in the vicinity of Cape Blanc (no figure).

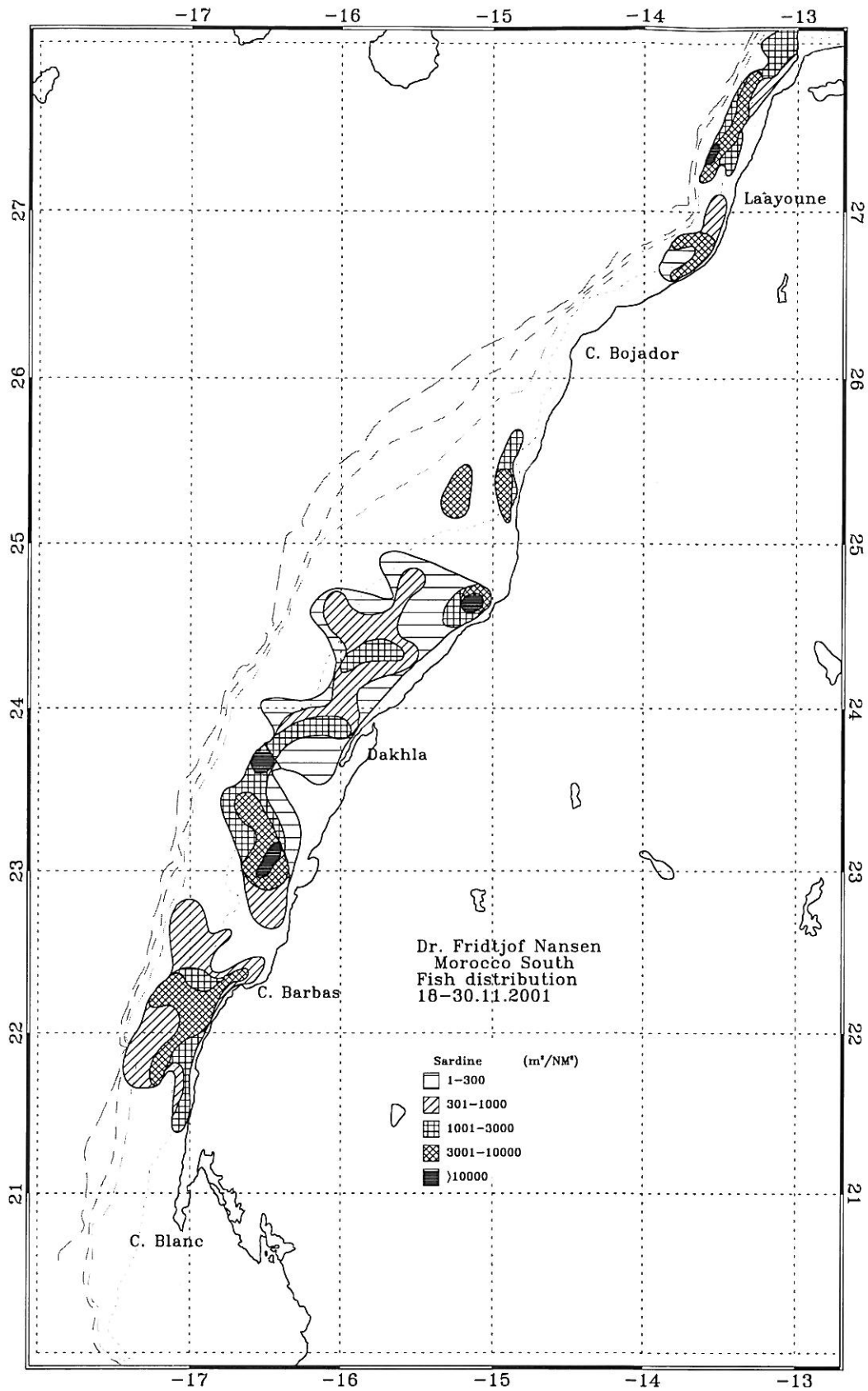


Figure 6 Distribution of sardine, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

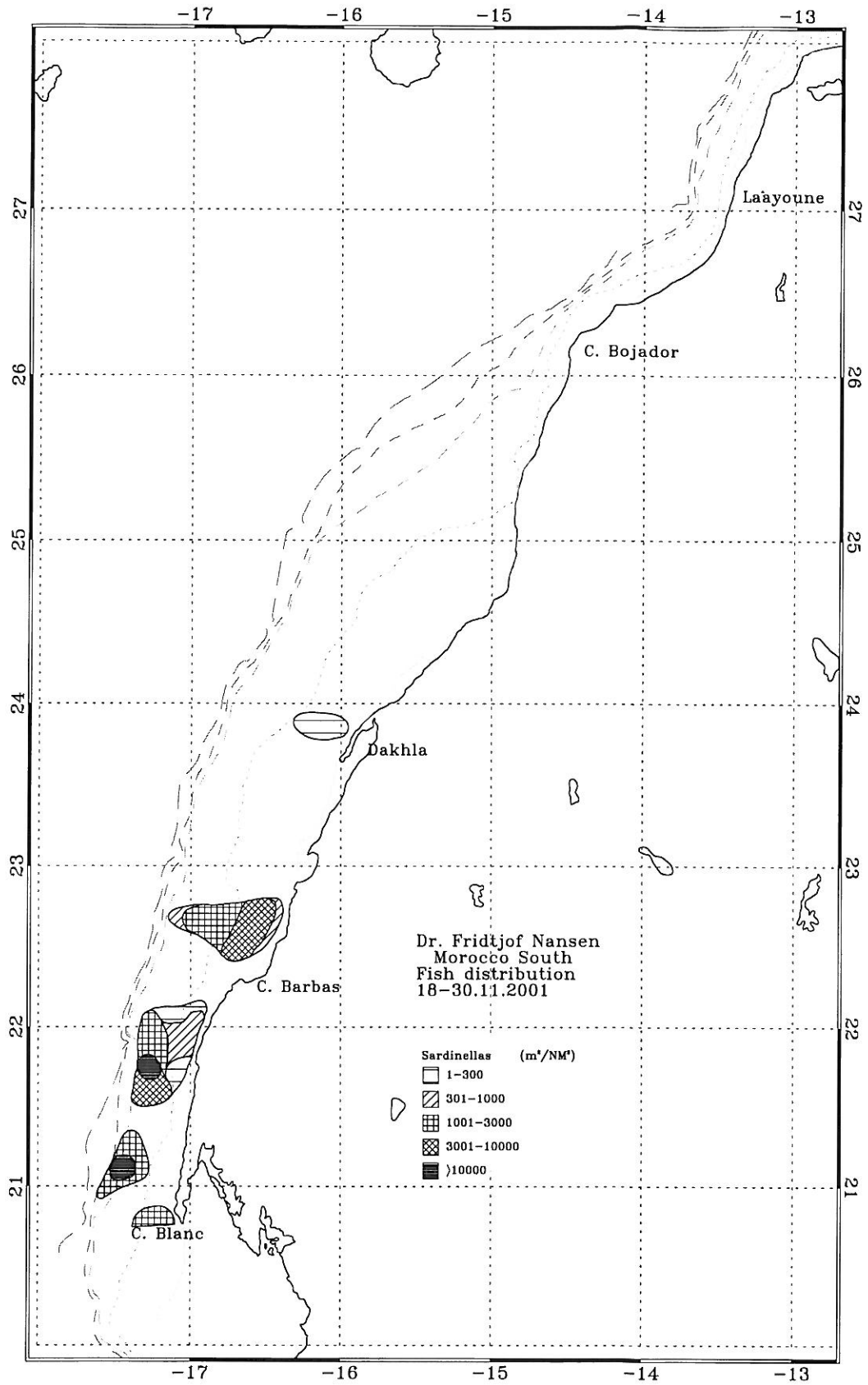


Figure 7 Distribution of sardinella, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.



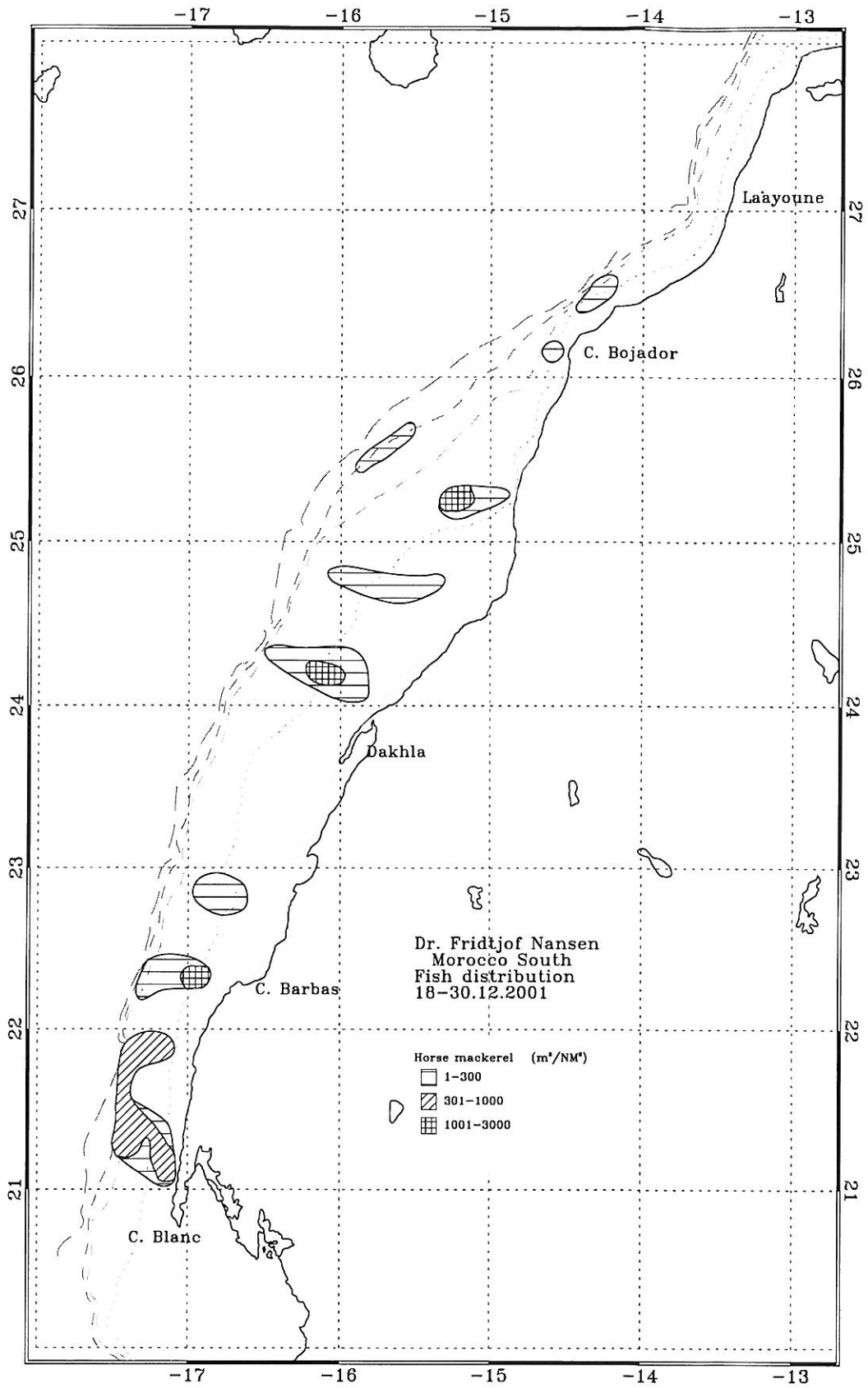


Figure 8 Distribution of horse mackerel, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

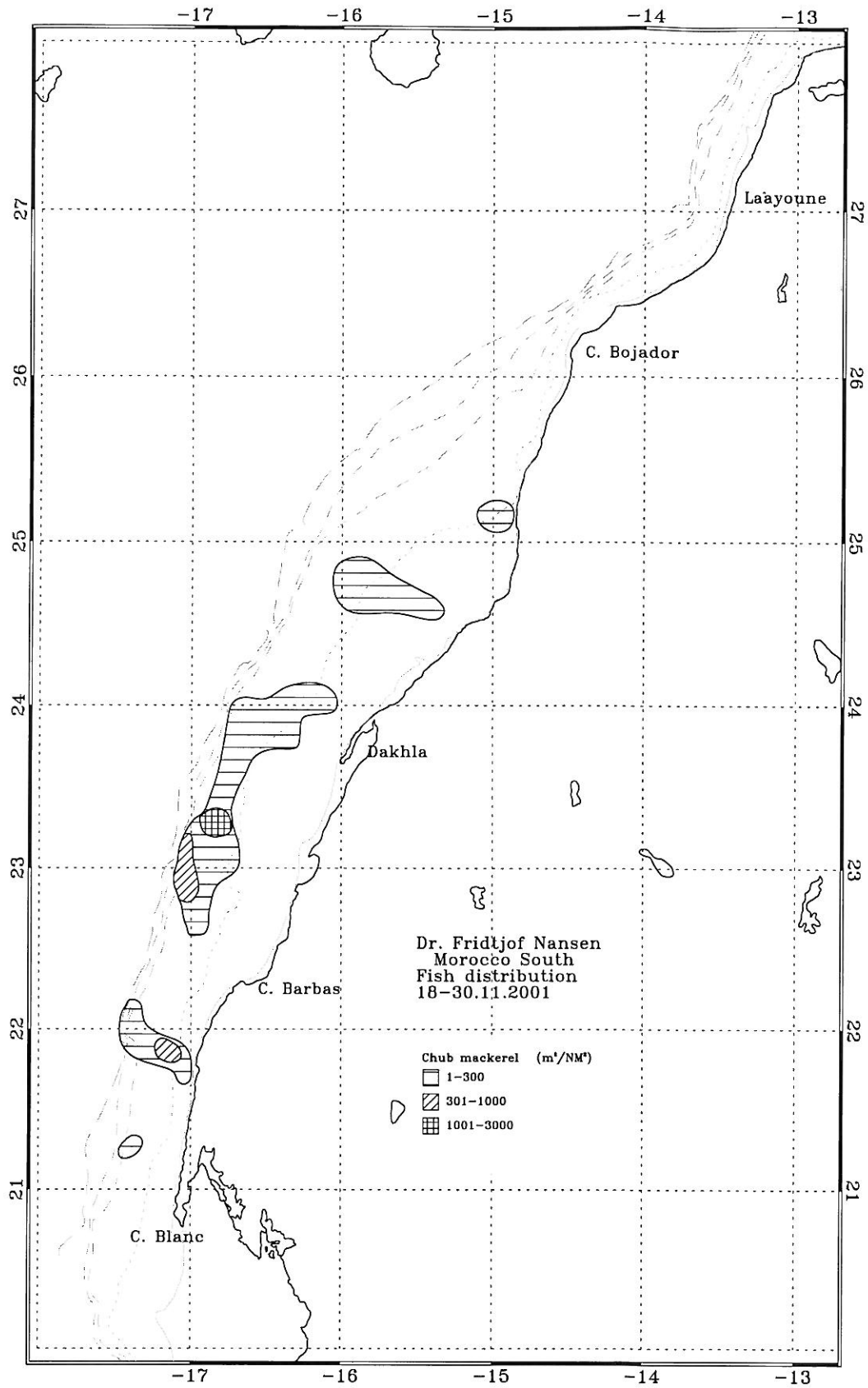


Figure 9 Distribution of chub mackerel, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

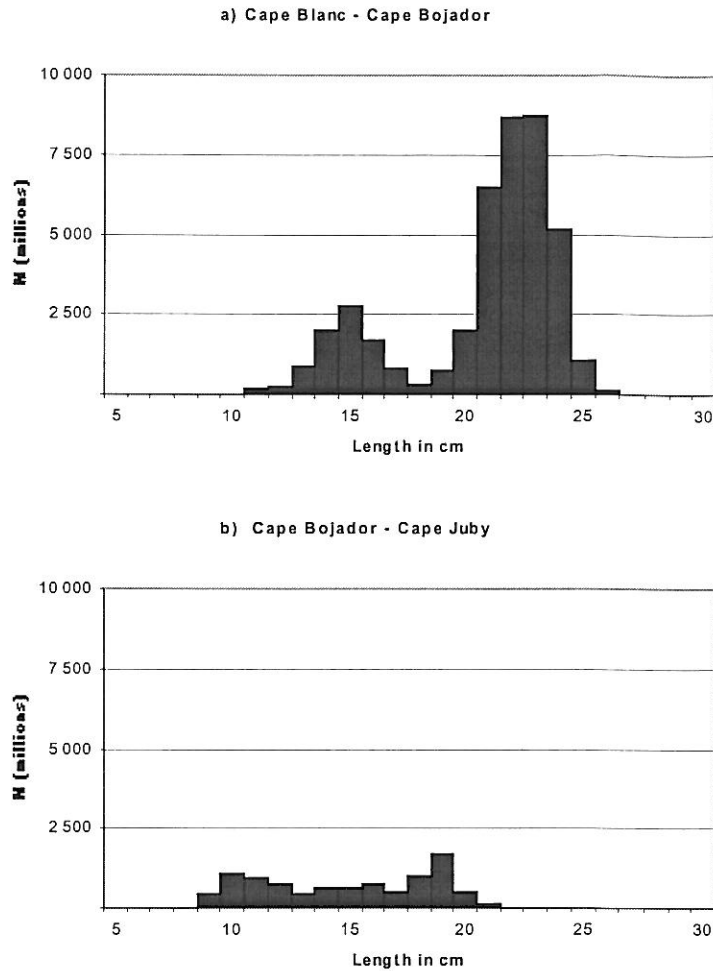


Figure 10 Length frequency distributions sardine Cape Blanc to Cape Juby.

### 2.3 Distribution of pelagic fish on the shelf from Cape Juby to Cape Cantin.

**Sardine** was registered in dense concentrations from Cape Juby to around Sidi Ifni, Figure 11. It was much absent in the Agadir area but again abundant with a bigger patch south of Safi. The aggregations consist mainly of two younger cohorts with modes around 11 and 17cm, Figure 14. The latter cohort was observed in June as well, then at around 10cm modal length.

**Anchovy** was few and far between during this survey (Figure 12), in contrast to earlier years, but in line with the finding in June this year. The anchovy generally seems to be in a period of low abundance.

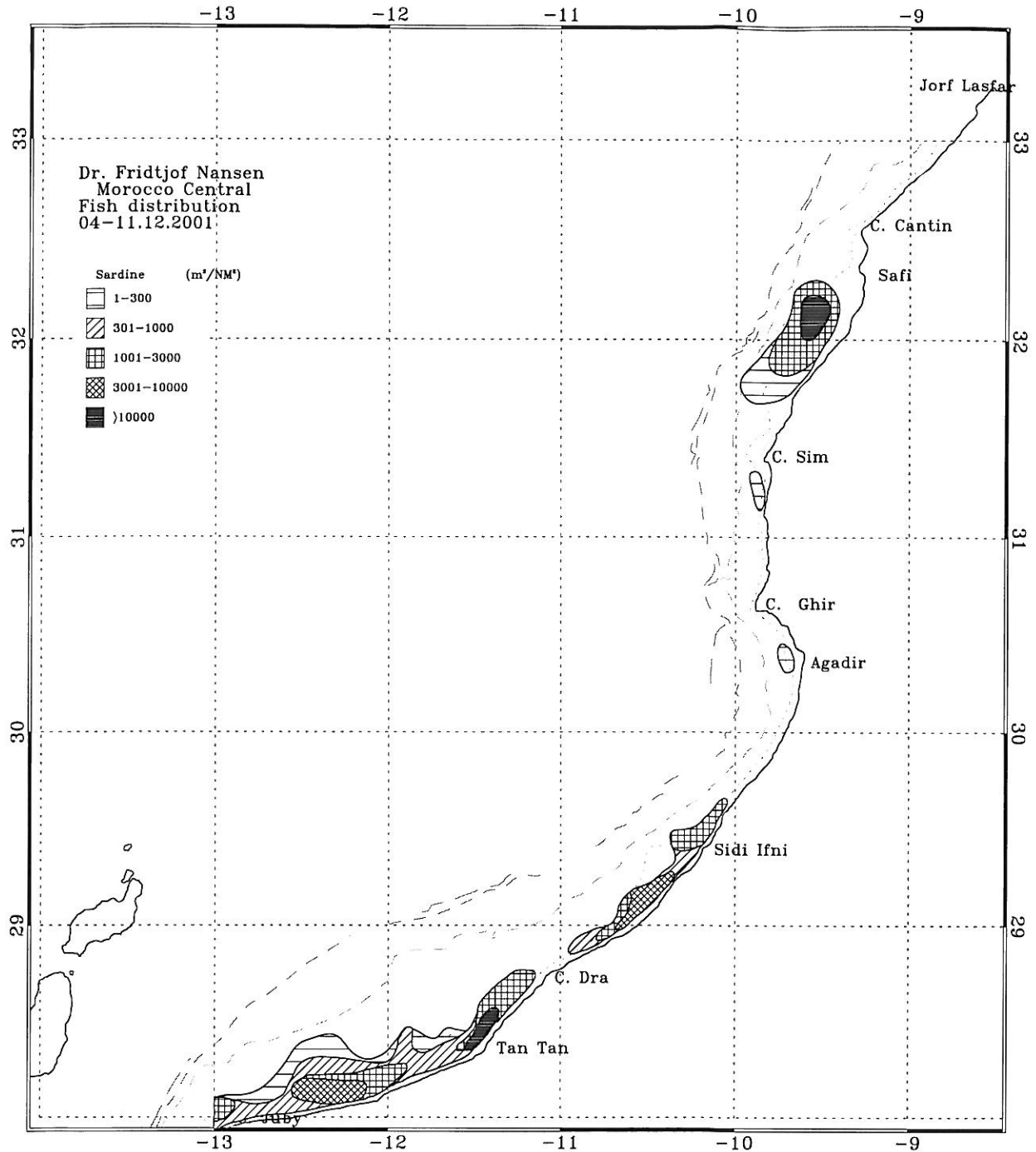


Figure 11 Distribution of sardine, Cape Juby to Cape Cantin. Depth contours as in Fig. 1a.

Recordings of **horse mackerel** were very few while **chub mackerel** was more common but with higher densities only in the area south of Safi, Figure 13.

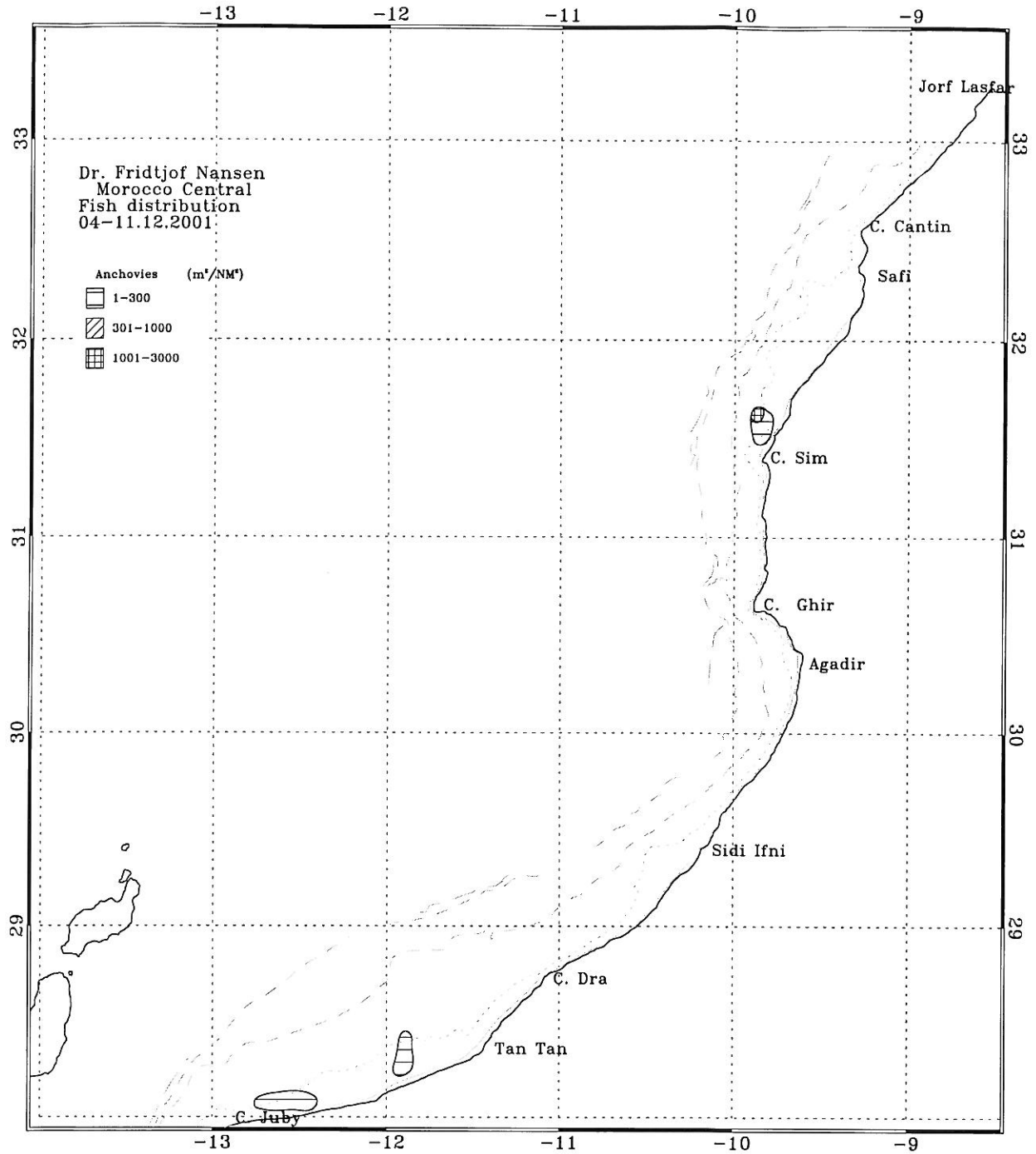


Figure 12 Distribution of anchovy, Cape Juby to Cape Cantin. Depth contours as in Fig. 1a.

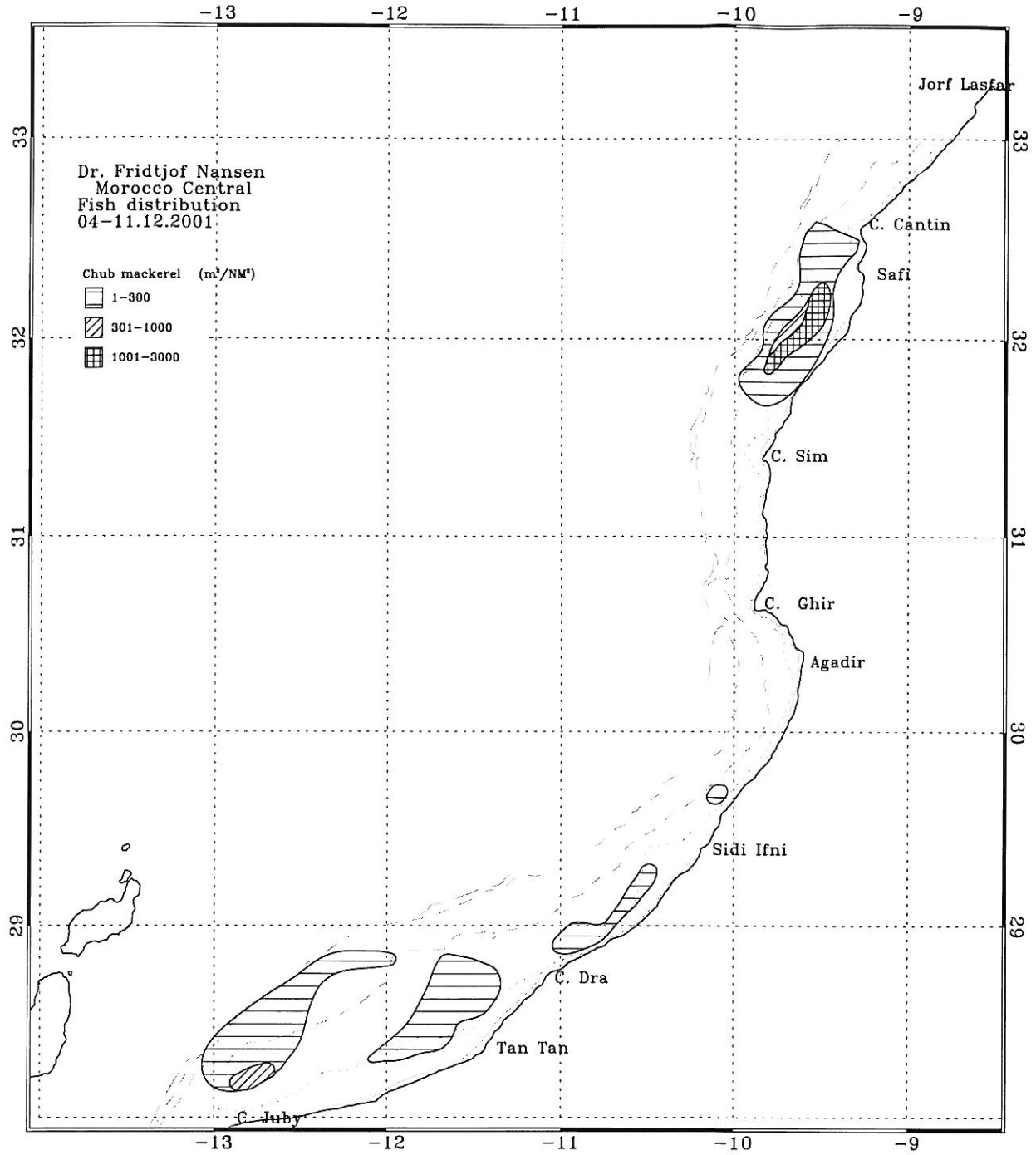


Figure 13 Distribution of chub mackerel, Cape Juby to Cape Cantin. Depth contours as in Fig. 1a.

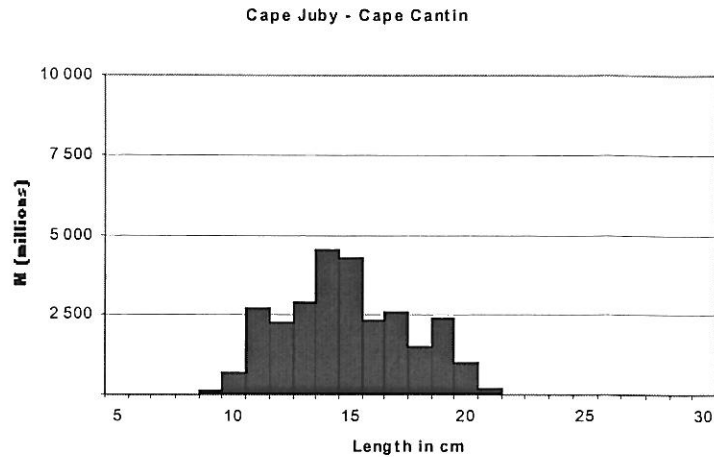


Figure 14 Length frequency distribution of sardine Cape Juby to Cape Cantin.

## 2.4 Biomass estimates

A summary on biomass estimates is given in Table 1 below. More detailed biomass estimates in number and weight by length groups are shown in Annex I.

### *Cape Blanc-Cape Bojador*

The **sardine** was estimated to 3.5 million tonnes, slightly 20% more than the 2.9 million estimated in June. However, if the sardine in Mauritania in June is included, the biomass is since June reduced 8% from 3.8 million tonnes. The length distribution is earlier shown in Figure 10. Most of the fish in terms of biomass now consist of older fish. Compared with earlier years, the development in the “adult” part of the stock (i.e. fish >19 cm) is:

1996:	4 600 000 tonnes	47 400 mill fish
1997:	240 000 tonnes	2 900 mill fish
1998:	340 000 tonnes	3 400 mill fish
1999:	1 000 000 tonnes	13 700 mill fish
2000:	1 260 000 tonnes	13 200 mill fish
June 2001*:	1 975 000 tonnes	22 500 mill fish
2001:	3 200 000 tonnes	32 000 mill fish

\* including sardine in Mauritania

The strong increase during the last half year is in part due to intrinsic growth in the adult population, but mainly due to recruitment of a very strong year class into the adult stage, as can be seen from the about 70% increase in number abundance in the above table. The young fish (<20 cm) constitute only about 10 billion fish. As a rough recruitment index this is a rather low number.

**Sardinella** was estimated to roughly 2.5 million tonnes of which 1.5 and 1.0 million are round and flat sardinella respectively. The fish is located between Cape Blanc and 24°N and seems to constitute most of the regional stock of sardinellas. In the preceding survey in Senegal and Mauritania only 650 000 tonnes of sardinella were estimated in total, see Annex I.

The two species of **horse mackerel** combined was estimated to 340 000 tonnes, of which about roughly 100 000 and 240 000 were Atlantic and Cunene horse mackerel respectively. The Cunene horse mackerel forms a major part of the stock, distributed mainly south of Cape Barbas.

#### *Cape Bojador-Cape Juby*

Estimated **sardine** in this region is since June reduced from 600 000 to 330 000 tonnes. Compared with the November survey the last year the biomass is also down from about 600 000 tonnes. The reduction has been especially hard in the adult biomass and what remains in this area seems to be mainly young fish, less than 20 cm.

#### **Cape Juby – Cape Cantin**

The **sardine** is estimated to 890 000 tonnes, a slight increase from 770 000 tonnes of December 2000. The abundance in numbers is stable, 29 and 28 billion in 2000 and 2001 respectively. The fish in the size range 15-20 cm has been reduced since last year but generally younger recruits seems to be of the same level as earlier. (Annex I). The area between Cape Dra and Agadir was surveyed twice as some surface schooling occurred during the first coverage. The biomass estimates from the two coverages were 147 000 and 155 000 tonnes respectively.

**Anchovies** was estimated to only 5 000 tonnes, a drastic reduction from the 100 000 tonnes estimate in 2000, but in line with the 7 000 tonnes estimated earlier in May this year. Anchovies are known from many parts of the world to undergo large-scale natural fluctuations, and the stock in this region seems at present to be in its low phase.



Table 1 Morocco. Summary of biomass estimates of pelagic fish, 1000 tonnes.

Region	Sardines	Round sardinella	Flat sardinella	Atlantic horse mackerel	Cunene horse mackerel	Chub mackerel	Anchovy
Cape Blanc- Cape Bojador	3 520	1 500	1 000	100	240	170	3
Cape Bojador- Cape Juby	330	0	0	0	0	0	0
Cape Juby- Cape Cantin	890	0	0	25	0	140	5
Totals	4 740	1 500	1 000	125	240	310	8

## CHAPTER 3 CONCLUDING REMARKS

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The survey was conducted successfully in the period 17<sup>th</sup> November to 18<sup>th</sup> December with an acoustic course track of 4700 NM and 52 fishing stations. The limits of the school areas of the sardine, anchovy and horse mackerel are thought to have been well determined and the main areas adequately sampled. The weather conditions did not put any constraints on the survey work.

The oceanographic observations conducted during the survey, indicate a warmer conditions than those observed during previous winter surveys, particularly in the southern part of the survey area. The sea surface temperature inshore between Cape Blanc and Cape Bojador was 2°C higher than in November/December 2000. An influx of tropical surface water from the tropical Atlantic was observed to the north of Cape Blanc. This phenomenon might have caused the northward shift of northern boundary of the tropical ecosystem, which in turn may account for the observed presence of the sardinella stocks north of Cape Blanc.

Figure 15 gives a general overview on the major aggregations of pelagic fish with rounded biomass figures. The biomass estimates are also summarised in Table 1.

Generally the sardine in the southern region has a more southern distribution pattern as normal for the season; the main part of the stock is found south of Dakhla and juveniles are generally lacking in the region. The biomass of sardine between Cape Blanc and Cape Bojador has increased from 2.0 million tonnes in November/December 2000 to 3.5 million during the last survey. Only 320 000 tonnes of the present stock is juvenile fish. It is not expected major growth in the adult stock during 2002, as the stock, because of its size structure, already has realized its growth potential. Further growth will have to come from future strong recruitment. Sardine in the region Cape Bojador-Cape Juby is estimated to 330 000 tonnes, nearly half of the size of December 2000. This area holds considerable amount of young fish that will grow during 2002 if not decimated too hard by fishing. Further north, the stock between Cape Juby and Cape Cantin is estimated to 890 000 tonnes, an increase from 770 000 tonnes in November 2000 or 730 000 in June this year. The recent growth is attributed to 240 000 tonnes recorded off Safi while the sub-stock Cape Juby-Agadir has declined. Recruitment seems now to be stronger than reported from the June survey and is slightly below normal.

Most part of the northwest African stock of sardinellas was recorded between Cape Blanc and 23°N during the survey. They formed dense schools, and seemed to be objects of a strong fishing pressure in the southern part. The biomass was estimated to 2.5 million tonnes while the

remaining part of the stock in Senegal and Mauritania was estimated from the preceding surveys in these waters to 650 000 tonnes.

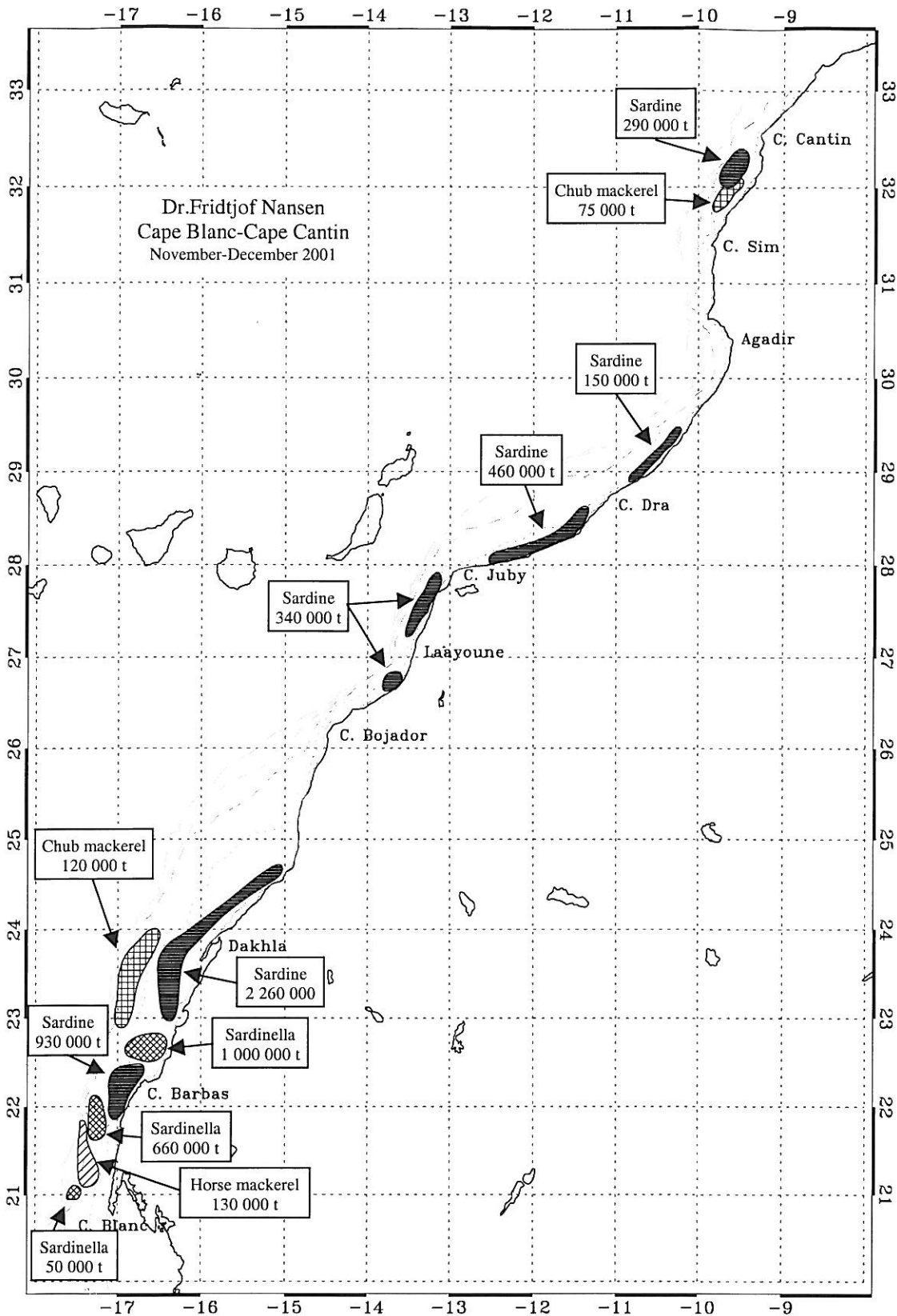


Figure 15. Map of the major pelagic fish concentrations with estimated abundance (tonnes), Cape Blanc to Cape Cantin.

Horse mackerel was forming aggregations between Cape Blanc and Cape Barbas and was else found in scattered patches in the whole survey area. The combined estimate of the two species of horse mackerel is 365 000 tonnes of which 240 000 tonnes is Cunene horse mackerel south of Cape Barbas.

Anchovy registrations were poor, less than 8 000 tonnes, and the stock seems to be in a very low state at the moment. The stock has been in steady decline since its high level of 400 000 tonnes in 1998. Anchovies and sardines compete to a large extent in the same niche in the ecosystem and the low level of anchovies could be associated with the high level of the sardine in the later years.

### **Trends 1995-2001, sardine**

Figure 16 shows the biomass estimates of sardine compared with results from previous “Dr. Fridtjof Nansen” surveys. Figure 17 shows the biomass figures 1995-2001 by length classes. Both figures display that the stock between Cape Blanc and Cape Juby, has shown a remarkably steady recover from its drastic decline observed at the end of 1997. However, if 900 000 tonnes of sardine recorded in Mauritania in June is included, the stock development seems to have culminated during the last half year. The high number of juveniles in the central stock, recorded in June 2001 (Figure 17), has been heavily reduced during the last 5 months and the recruiting part of the stock is now at a rather low level. For this reason there is not expected further intrinsic growth in the southern sardine population in the forthcoming year. The reason for the heavy decimation of juveniles since June is unknown, but it is possible that intensive fishing activities in the area around Cape Blanc have had its effect on the juveniles. Cross checks with capture statistics could clarify this issue better.

Small fish, as observed in the later years, dominates the central stock between Cape Juby and Safi. The level of the stock is about the same as observed in November 2000 and in June 2001. The abundance in the area Cape Juby – Cape Dra has been reduced since the two previous surveys. This is however compensated by an increase in the abundance in the waters off Safi. Due to the relative high fishing pressure, the central stock will continue to be dependent of steady good recruitment, as there is no buffer from presence of older year-classes.

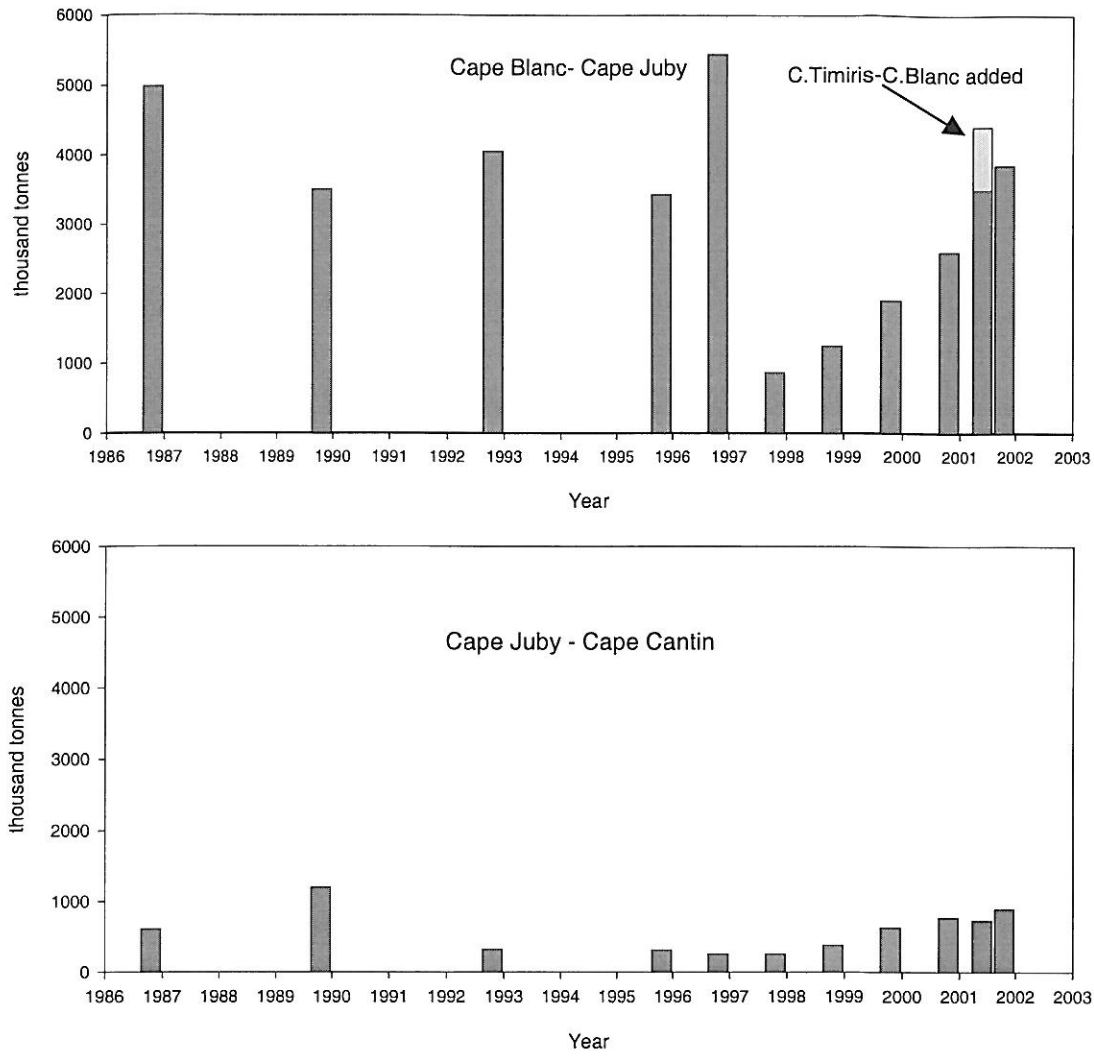


Figure 16 Sardine biomass estimates Cape Blanc-Cape Juby and Cape Juby- Cape Cantin, Dr. Fridtjof Nansen 1986-2001.

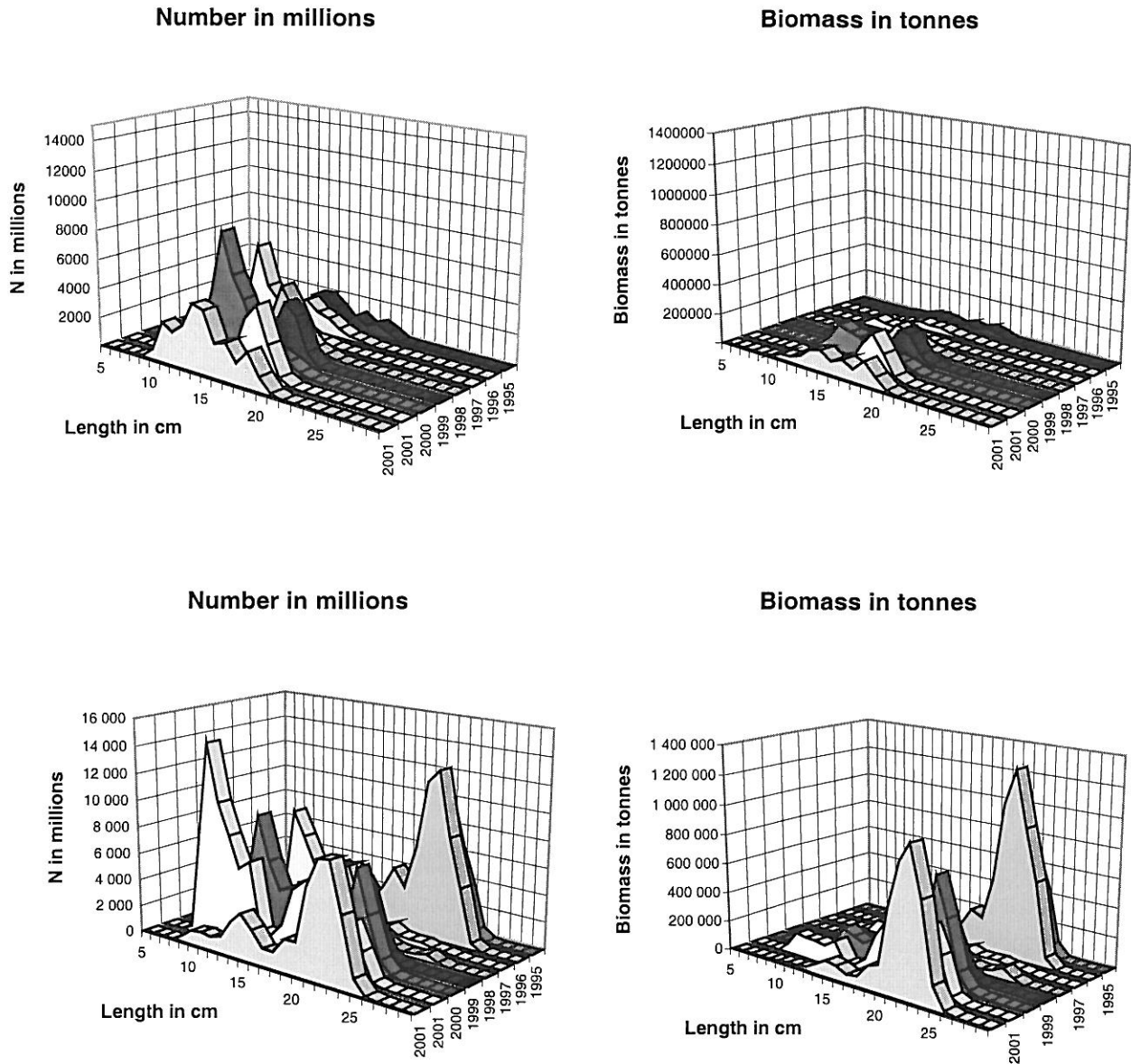


Figure 17. Numbers and biomass by length class, 1995-2001. Cape Juby - Cape Cantin (top) and Cape Blanc - Cape Juby (bottom).

## RESUMÉ

La campagne a été conduite avec succès durant la période du 17 Novembre au 18 Décembre 2001, suivant un schéma de prospection acoustique de 4700 miles nautiques et 52 stations de pêche de contrôle. Les bancs de sardine, anchois, chinchards, ont été bien déterminés et délimités et leurs principales zones adéquatement échantillonnées. Les travaux pendant cette campagne n'ont pas subi de contraintes majeures par les conditions météorologiques.

Les observations météorologiques conduites durant cette prospection indiquent un réchauffement des eaux par rapport aux conditions observées durant les précédentes campagnes, particulièrement dans la partie sud de la prospection. La température superficielle des eaux côtières a été de 2 degrés centigrades supérieure à celles de Novembre/Décembre 2000. Un flux superficiel des eaux tropicales atlantiques a été observé vers le nord du Cap Blanc, ce phénomène pourrait causer le déplacement (northward shift) vers le nord, de la limite nord de l'écosystème pélagique, qui pourrait par conséquent, expliquer la présence des stocks de sardinelles au nord du Cap Blanc .

Une vision générale des majeures concentrations des poissons pélagiques, avec des valeurs de biomasses arrondies, est présentée dans la figure 15. Les estimations de biomasse sont également résumées dans la tableau 1.

Dans la zone sud, la distribution de la sardine est plus méridionale que dans le schéma normal de distribution pendant cette saison; la partie la plus importante se trouve au sud de Dakhla, avec une absence de juvéniles dans cette région. La biomasse de sardine entre Cap Blanc et Cap Bojador a augmenté de 2.0 million de tonnes en Novembre/Décembre 2000 à 3.5 million durant cette dernière campagne, dont seulement 320 mille tonnes sont des juvéniles.

Il n'est pas prévu de croissance majeure du stock durant 2002, étant donné que les structures de taille ont déjà réalisé le potentiel de croissance. D'avantage de croissance devrait provenir d'un fort recrutement future. La biomasse de sardine est estimée à 330 mille tonnes dans la région Cap Bojador-Cap Juby, près de la moitié de sa taille en Décembre 2000, cette région comporte une quantité considérable de jeunes poissons qui grandiront durant 2002 s'ils ne sont pas durement décimés par la pêche.

Plus au nord, le stock entre Cap Juby et Cap Cantin est estimé à 890 mille tonnes, en augmentation des 770 mille tonnes en Novembre/Décembre 2000 et 730 mille tonnes en Juin dernier. Cette récente croissance est attribuée aux 240 mille tonnes détectées au niveau de Safi, alors que la partie du stock entre Agadir et Cap Juby a diminué. Le recrutement semble actuellement plus fort que durant la campagne de Juin mais reste légèrement en dessous de la normale.

La plupart des stocks nord-ouest africains de sardinelles ont été détectés, pendant cette campagne, entre Cap Blanc et 24° N. Ils sont formés de bancs très denses et semblent être l'objet d'une forte

pression de pêche dans leur partie sud . Leurs biomasses est estimée à 2.5 million de tonnes, alors que la partie restante du stock dans les eaux du Sénégal et en Mauritanie a été estimée lors des précédentes campagnes à 650 mille tonnes.

Les chinchards étaient regroupés en bancs entre Cape Blanc et Cap Barbas, ils étaient dispersés en petits agrégats sur toute la zone prospectée. L'estimation combinée de la biomasse des deux espèces était de 365 mille tonnes dont 240 mille tonnes de chinchard noir au sud du Cap Barbas.

Les faibles détections d'anchois ont enregistré une biomasse de moins de 8 000 tonnes. Le stock semble être dans un très faible état en ce moment, il est en déclin progressif depuis son plus haut niveau atteint en 1998. L'anchois et la sardine sont dans une grande mesure compétiteurs de la même niche de l'écosystème pélagique et le faible niveau du stock d'anchois pourrait être associé avec la récupération du stock de la sardine depuis 1998.

### **Tendances du stock sardinier pendant la période 1995-2001**

La figure 16 montre les estimations de la biomasse de la sardine, comparées avec les précédentes évaluations effectuées lors des campagnes à bord du 'Dr. Fridtjof Nansen', les évaluations de la biomasse par classe de taille sont présentées sur la figure 17. Les deux figures montrent que le stock entre Cap Blanc et Cap Juby présente une remarquable reconstitution progressive depuis sa chute observée à la fin de 1997. Par ailleurs, si les 900 milles tonnes rencontrées dans les eaux mauritaniennes en Juin sont incluses, le niveau de ce stock semble avoir culminé durant ce dernier semestre.

Le grand nombre de juvéniles du stock enregistré en Juin 2001 (Figure 17) a été lourdement réduit durant ces cinq derniers mois et la partie des nouvelles recrues est plutôt à un bas niveau; Pour cette raison, une croissance intrinsèque de la population du stock sud durant l'année prochaine pas prévisible.

La raison de cette forte décimation des juvéniles depuis Juin dernier reste toujours inconnue, mais, il est possible que l'activité de pêche intensive que connaît la région autour du Cap Blanc a eu son effet sur les juvéniles. Une analyse croisée avec les statistiques de capture, pourrait mieux élucider cette question.

Les poissons de petites taille observés durant ces dernières années dominant le stock entre Cap Juby et Safi. Le niveau du stock est presque au même niveau qu'en Novembre 2000 et Juin 2001. L'abondance dans la zone Cap Juby-Cap Dra a été réduite depuis les deux campagnes précédentes, elle est toutefois compensée par un accroissement d'abondance dans les eaux de la région de Safi. Le stock central continuera d'être dépendant d'un bon recrutement stable, d'autant qu'il n'y a pas de capacité d'effet tampon à partir des classes d'ages supérieures.



## Annex I Biomass and number by fish length class

*Sardine (Sardina pilchardus)*

**MOROCCO & MAURITANIA November-December 2001**

Length cm	C.Juby-C.Cantin		C.Bojador-C.Juby		C.Blanc-C.Bojador		C.Timiris-C.Blanc		Total	
	tonnes	N millions	tonnes	N millions	tonnes	N millions	tonnes	N millions	tonnes	N millions
5										
6										
7										
8										
9	679	97	3 221	458					3 901	555
10	6 725	708	9 869	1 040	267	28			16 861	1 776
11	33 941	2 722	12 094	970	2 546	204			48 580	3 895
12	36 631	2 287	12 246	765	4 100	256			52 976	3 308
13	58 813	2 915	9 142	453	17 287	857			85 243	4 225
14	113 526	4 541	15 795	632	49 632	1 985			178 953	7 158
15	131 166	4 295	19 967	654	84 357	2 763			235 491	7 712
16	85 145	2 312	28 353	770	61 706	1 675			175 204	4 756
17	112 798	2 567	21 043	479	36 373	828			170 214	3 873
18	77 460	1 492	52 306	1 007	15 204	293			144 969	2 792
19	146 368	2 407	103 359	1 700	45 893	755			295 620	4 862
20	73 090	1 035	33 664	477	140 599	1 990			247 353	3 501
21	15 390	189	8 466	104	525 494	6 448			549 350	6 741
22			869	9	810 712	8 680			811 581	8 689
23			1 485	14	931 746	8 755			933 231	8 769
24			2 805	23	624 689	5 180			627 493	5 204
25					148 026	1 089			148 026	1 089
26					19 332	127			19 332	127
27					3 152	18			3 152	18
28										
29										
30										
<b>Total</b>	<b>891 732</b>	<b>27 567</b>	<b>334 684</b>	<b>9 554</b>	<b>3 521 113</b>	<b>41 931</b>			<b>4 747 530</b>	<b>79 052</b>

Round sardinella (*Sardinella aurita*)

## SENEGAL - THE GAMBIA - MAURITANIA - MOROCCO 2001

Length cm	Number in millions				Biomass in tonnes			
	Senegal	Mauritania	Morocco	Total	Senegal	Mauritania	Morocco	Total
4		50.2		50.2		44		
5		160.6		160.6		256		256
6		130.5		130.5		344		344
7		85.1		85.1		345		345
8		140.9		140.9		831		831
9		399.7		399.7		3 290		3 290
10		340.3		340.3		3 782		3 782
11		217.3	78.1	295.4		3 173	1 117	4 290
12		137.0	234.4	371.4		2 569	4 304	6 873
13		68.5	273.5	342.0		1 618	6 325	7 943
14	41.9	78.5	625.1	745.6	1 227	2 299	17 915	21 440
15	128.9	78.5	507.9	715.4	4 610	2 808	17 780	25 197
16	194.0	10.3	273.5	477.8	8 366	445	11 549	20 360
17	193.7	2.3		196.0	9 968	119		10 087
18	160.2	18.6		178.8	9 740	1 131		10 871
19	307.0	8.6		315.5	21 850	611		22 461
20	324.6	13.6		338.2	26 844	1 128		27 972
21	128.6	29.0		157.7	12 272	2 770		15 042
22	193.0	5.8	47.2	245.9	21 102	632	5 050	26 784
23	109.9	1.2	113.2	224.3	13 690	150	13 809	27 649
24	72.5	9.4	56.6	138.5	10 238	1 330	7 824	19 391
25	29.3	10.1	18.9	58.3	4 661	1 611	2 941	9 213
26	11.2	25.7	18.9	55.7	1 997	4 585	3 300	9 882
27	19.2	7.9	28.3	55.5	3 843	1 583	5 532	10 958
28	16.9	5.7	72.1	94.8	3 765	1 273	15 688	20 726
29	20.0	7.3	227.1	254.3	4 928	1 798	54 793	61 519
30	26.2	11.7	215.7	253.5	7 126	3 195	57 516	67 837
31	4.6	4.6	530.9	540.2	1 383	1 390	155 987	158 760
32	4.9	10.4	701.1	716.4	1 607	3 429	226 225	231 261
33		6.5	793.1	799.6		2 353	280 288	282 641
34		16.9	562.3	579.1		6 653	217 029	223 682
35		11.8	424.1	435.9		5 050	178 362	183 412
36		19.3	278.6	297.9		9 030	127 326	136 355
37		13.6	191.0	204.7		6 908	94 689	101 598
38		6.4	73.2	79.7		3 530	39 288	42 818
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
Total	1 986.6	2 144.1	6 344.7	10 475.5	169 216	82 060	1 544 636	1 795 868

Flat sardinella (*Sardinella maderensis*)

## SENEGAL - THE GAMBIA - MAURITANIA - MOROCCO 2001

Length cm	Number in millions				Biomass in tonnes			
	Senegal	Mauritania	Morocco	Total	Senegal	Mauritania	Morocco	Total
5								
6	11.3			11.3	30			30
7	226.2	3.1		229.2	916	12		928
8	458.1	6.1		464.3	2 701	36		2 737
9	79.6	10.5		90.1	655	86		742
10	51.4	50.5		101.8	571	561		1 131
11	10.3	86.1		96.4	150	1 258		1 408
12	3.4	32.5		35.9	64	609		673
13		14.4		14.4		341		341
14		11.7		11.7		342		342
15	46.8	30.8		77.7	1 674	1 103		2 777
16	117.6	54.1		171.8	5 073	2 335		7 408
17	97.5	42.6		140.1	5 014	2 192		7 206
18	91.9	13.2		105.1	5 589	802		6 391
19	60.1	7.1		67.2	4 279	505		4 784
20	138.4	6.0		144.4	11 450	494		11 945
21	273.1	3.9		277.0	26 054	372		26 426
22	326.5	7.6		334.1	35 702	829		36 531
23	449.3	1.6		450.9	55 983	198		56 181
24	288.1	5.9		294.1	40 677	839		41 516
25	188.5	41.2	24.9	254.7	30 013	6 556	4 013	40 582
26	121.8	63.6	74.8	260.3	21 768	11 369	13 511	46 647
27	47.2	68.3	474.0	589.5	9 420	13 629	95 625	118 674
28	9.7	51.1	495.7	556.5	2 148	11 363	111 302	124 814
29	13.6	54.6	300.6	368.8	3 355	13 451	74 851	91 657
30		42.5	260.3	302.9		11 578	71 651	83 229
31	2.4	43.8	126.0	172.2	725	13 131	38 198	52 055
32		47.9	396.6	444.5		15 787	132 062	147 848
33		47.3	372.8	420.1		17 081	135 938	153 019
34		23.4	581.9	605.3		9 224	231 774	240 998
35		18.3	91.4	109.7		7 839	39 685	47 525
36		1.1	112.6	113.7		518	53 098	53 616
37		1.4		1.4		689		689
38			29.4	29.4			16 299	16 299
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
Total	3113.1	892.2	3341.1	7346.4	264 012	145 130	1 018 009	1 427 152

Anchovy (*Engraulis encrasicolus*)

## MOROCCO 2001

Length cm	C.Juby-C.Cantin		C.Blanc-C.Juby		Total	
	tonnes	N millions	tonnes	N millions	tonnes	N millions
5						
6	43	29.3			43	29.3
7	186	81.7			186	81.7
8	80	24.1	64	19.3	144	43.4
9	16	3.4	685	148.0	701	151.5
10	11	1.7	1 308	209.2	1 318	210.9
11	198	24.1	793	96.5	991	120.6
12	587	55.7	34	3.2	621	58.9
13	1 918	144.4			1 918	144.4
14	1 339	81.3			1 339	81.3
15	368	18.3			368	18.3
16						
17						
18						
19						
20						
Total	4747	464.0	2 884	476.3	7 630	940.3

Atlantic horse mackerel (*Trachurus trachurus*)

## MOROCCO 2001

Length cm	C.Juby-C.Cantin		C.Blanc-C.Juby		Total	
	tonnes	N millions	tonnes	N millions	tonnes	N millions
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17			5 796	121.3	5 796	121.3
18	281	7.3	29 271	519.5	29 552	526.8
19	6 246	139.0	34 207	519.5	40 453	658.5
20	10 673	204.8	10 199	133.6	20 873	338.4
21	4 828	80.5	2 610	29.7	7 438	110.1
22	2 008	29.3	1 493	14.8	3 501	44.1
23	1 142	14.6	576	5.0	1 718	19.7
24			2 572	19.9	2 572	19.9
25			367	2.5	367	2.5
26			3 245	19.9	3 245	19.9
27			459	2.5	459	2.5
28						
29						
30			1 246	5.0	1 246	5.0
31			1 371	5.0	1 371	5.0
32			1 504	5.0	1 504	5.0
33			1 645	5.0	1 645	5.0
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
Total	25 179	475.4	96 561	1 408.4	121 740	1 883.9

Cunene horse mackerel (*Trachurus trecae*)

## SENEGAL - THE GAMBIA - MAURITANIA - MOROCCO 2001

Length cm	Number in millions				Biomass in tonnes			
	Senegal	Mauritania	Morocco	Total	Senegal	Mauritania	Morocco	Total
5		8.3		8.3		13		13
6		91.2		91.2		241		241
7		185.2		185.2		750		750
8		132.7		132.7		782		782
9		27.6		27.6		228		228
10								
11		16.6		16.6		242		242
12		19.4		19.4		363		363
13		11.1		11.1		261		261
14		13.8		13.8		405		405
15								
16		5.5		5.5		238		238
17	4.4			4.4	226			226
18	4.4		18.4	22.8	267		486	753
19	8.8			8.8	625			625
20	47.9		18.4	66.3	4 413		658	5 071
21	249.1		18.4	267.5	30 554		758	31 312
22	282.5		18.4	300.9	47 052		867	47 919
23	167.4		202.6	370.0	33 813		10 850	44 662
24	33.4		378.7	412.1	7 805		22 942	30 748
25			710.5	710.5			48 454	48 454
26			803.4	803.4			61 390	61 390
27			457.0	457.0			38 972	38 972
28			243.0	243.0			23 035	23 035
29			64.1	64.1			6 729	6 729
30			125.3	125.3			14 511	14 511
31			36.8	36.8			4 696	4 696
32								
33			18.4	18.4			2 817	2 817
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
Total	797.8	511.5	3 113.7	4 422.9	124 755	3 523	237 166	365 444

Chub mackerel (*Scomber japonicus*)

## MOROCCO 2001

Length cm	C.Juby-C.Cantin		C.Bojador-C.Juby		C.Blanc-C.Bojador		Total	
	tonnes	N millions	tonnes	N millions	tonnes	N millions	tonnes	N millions
5								
6								
7								
8								
9								
10								
11								
12								
13					109	4.9	109	4.9
14	132	4.8			134	4.9	267	9.7
15	645	19.3					645	19.3
16	1 553	38.7					1 553	38.7
17	9 009	188.5					9 009	188.5
18	8 169	145.0			1 656	29.4	9 825	174.4
19	16 308	247.7			2 884	43.8	19 191	291.5
20	22 242	291.3			12 457	163.2	34 699	454.5
21	21 641	246.2			15 485	176.2	37 126	422.3
22	18 997	188.9			9 263	92.1	28 260	281.0
23	7 876	68.9			14 340	125.4	22 217	194.2
24	7 486	57.9			13 726	106.1	21 213	163.9
25	3 413	23.4			10 262	70.5	13 675	93.9
26	11 170	68.4			5 686	34.8	16 856	103.3
27	2 881	15.8			28 832	158.3	31 714	174.1
28					30 256	149.4	30 256	149.4
29	3 793	16.9			6 831	30.5	10 624	47.4
30	1 151	4.7			2 767	11.2	3 918	15.8
31	4 606	16.9			6 244	22.9	10 849	39.8
32					4 305	14.4	4 305	14.4
33					1 570	4.8	1 570	4.8
34								
35								
36								
37					1 096	2.4	1 096	2.4
38								
39								
40								
Total	141 073	1 643.3			167 903	1 245.1	308 976	2 888.4





# Annex 2 Records of fishing stations

PROJECT STATION:1519  
 DATE:19/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 2058  
 start stop duration Long W 1737  
 TIME :17:10:35 17:46:51 36 (min) Purpose code: 1  
 LOG :7652.52 7654.38 1.85 Area code : 2  
 FDEPTH: 198 183 GearCond.code:  
 BDEPTH: 198 183 Validity code:  
 Towing dir: 200° Wire out: 650 m Speed: 30 kn\*10  
 Sorted: 68 Kg Total catch: 2403.32 CATCH/HOUR: 4005.53

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Helicolenus dactylopterus	2738.75	68213	68.37	
Merluccius polli	220.50	583	5.50	
Chlorophthalmus atlanticus	153.42	7818	3.83	
Octopus vulgaris	146.42	117	3.66	
Capros aper	145.25	6703	3.63	
Zeus faber	132.42	117	3.31	
Scomber japonicus	115.50	117	2.88	
Galeus melastomus	105.00	758	2.62	
Trachurus trecae	81.08	233	2.02	
Sardinella aurita	47.25	117	1.18	
Merluccius senegalensis	23.92	58	0.60	
Scorpaena elongata	23.33	117	0.58	
Illex coindetii	21.00	117	0.52	
MYCTOPHIDAE	16.92	11600	0.42	
Trachurus trachurus	14.58	58	0.36	
Echelus myrus	14.58	58	0.36	
Coelorinchus coelorhincus	1.75	117	0.04	
Synagrops microlepis	1.17	233	0.03	
Parapandalus narval	0.82	1458	0.02	
PORTUNIDAE	0.62	58	0.02	
Malacocephalus occidentalis	0.58	58	0.01	
SCYLLARIDAE	0.35	933	0.01	
Sepiella ornata	0.33	58	0.01	
<b>Total</b>	<b>4005.54</b>		<b>99.98</b>	

PROJECT STATION:1520  
 DATE:19/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2105  
 start stop duration Long W 1727  
 TIME :19:35:30 19:45:21 10 (min) Purpose code: 1  
 LOG :7670.40 7671.07 0.65 Area code : 2  
 FDEPTH: 25 25 GearCond.code:  
 BDEPTH: 88 84 Validity code:  
 Towing dir: 90° Wire out: 130 m Speed: 40 kn\*10  
 Sorted: 30 Kg Total catch: 450.75 CATCH/HOUR: 2704.50

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	2430.00	6480	89.85	2574
Sardinella aurita	157.50	360	5.82	
Scomber japonicus	94.50	180	3.49	
Trachurus trecae	22.50	90	0.83	
<b>Total</b>	<b>2704.50</b>		<b>99.99</b>	

PROJECT STATION:1521  
 DATE:19/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2111  
 start stop duration Long W 1709  
 TIME :22:39:21 23:09:25 30 (min) Purpose code: 1  
 LOG :7700.18 7702.30 2.12 Area code : 2  
 FDEPTH: 40 40 GearCond.code:  
 BDEPTH: 44 44 Validity code:  
 Towing dir: 350° Wire out: 125 m Speed: 30 kn\*10  
 Sorted: 46 Kg Total catch: 366.11 CATCH/HOUR: 732.22

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	289.60	1888	39.55	2575
Sarda sarda	160.80	48	21.96	
Engraulis encrasicolus	152.80	23232	20.87	2576
Decapterus rhonchus	38.40	96	5.24	
Stromateus fiatola	24.00	32	3.28	
Diplodus bellottii	24.00	272	3.28	
Trachurus trachurus	14.40	304	1.97	
Raja miraletus	12.00	16	1.64	
Spondyliosoma cantharus	11.20	96	1.53	
Loligo vulgaris	4.80	240	0.66	
Sepiella ornata	0.22	32	0.03	
<b>Total</b>	<b>732.22</b>		<b>100.01</b>	

PROJECT STATION:1522  
 DATE:20/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2114  
 start stop duration Long W 1718  
 TIME :01:13:32 01:46:41 33 (min) Purpose code: 1  
 LOG :7723.12 7725.43 2.27 Area code : 2  
 FDEPTH: 30 30 GearCond.code:  
 BDEPTH: 65 55 Validity code:  
 Towing dir: 90° Wire out: 160 m Speed: 43 kn\*10  
 Sorted: 57 Kg Total catch: 392.24 CATCH/HOUR: 713.16

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pomatomus saltatrix	680.00	327	95.35	
Trachurus trecae	33.16	182	4.65	2577
<b>Total</b>	<b>713.16</b>		<b>100.00</b>	

PROJECT STATION:1523  
 DATE:20/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2115  
 start stop duration Long W 1728  
 TIME :03:27:27 03:47:25 20 (min) Purpose code: 1  
 LOG :7740.58 7742.10 1.47 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 109 102 Validity code:  
 Towing dir: 95° Wire out: 160 m Speed: 45 kn\*10  
 Sorted: 64 Kg Total catch: 123.22 CATCH/HOUR: 369.66

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	342.00	960	92.52	2579
Scomber japonicus	14.22	60	3.85	2578
Sardinella maderensis	13.44	54	3.64	2580
<b>Total</b>	<b>369.66</b>		<b>100.01</b>	

PROJECT STATION:1524  
 DATE:20/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2135  
 start stop duration Long W 1725  
 TIME :11:28:59 12:10:54 42 (min) Purpose code: 1  
 LOG :7824.22 7826.85 2.61 Area code : 2  
 FDEPTH: 80 80 GearCond.code:  
 BDEPTH: 105 94 Validity code:  
 Towing dir: 90° Wire out: 300 m Speed: 40 kn\*10  
 Sorted: 16 Kg Total catch: 16.50 CATCH/HOUR: 23.57

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sarda sarda	20.00	16	84.85	
Scomber japonicus	3.57	6	15.15	
<b>Total</b>	<b>23.57</b>		<b>100.00</b>	

PROJECT STATION:1525  
 DATE:20/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 2142  
 start stop duration Long W 1728  
 TIME :14:03:49 14:24:58 21 (min) Purpose code: 1  
 LOG :7844.19 7845.25 1.05 Area code : 2  
 FDEPTH: 220 243 GearCond.code:  
 BDEPTH: 220 243 Validity code:  
 Towing dir: 200° Wire out: 730 m Speed: 30 kn\*10  
 Sorted: 50 Kg Total catch: 992.40 CATCH/HOUR: 2835.43

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius senegalensis	1308.57	2057	46.15	
Helicolenus dactylopterus	922.86	15714	32.55	
Zenopsis conchifer	308.00	286	10.86	
Pagellus acarne	142.29	457	5.02	
Galeus polli	72.57	971	2.56	
Trachurus trachurus	60.00	343	2.12	
Dentex macrophthalmus	13.71	57	0.48	
Chlorophthalmus atlanticus	7.43	286	0.26	
<b>Total</b>	<b>2835.43</b>		<b>100.00</b>	

PROJECT STATION:1526  
 DATE:20/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 2144  
 start stop duration Long W 1723  
 TIME :15:41:28 16:01:03 20 (min) Purpose code: 1  
 LOG :7855.06 7856.07 1.06 Area code : 2  
 FDEPTH: 107 108 GearCond.code:  
 BDEPTH: 107 108 Validity code:  
 Towing dir: 270° Wire out: 400 m Speed: 30 kn\*10  
 Sorted: 57 Kg Total catch: 1995.35 CATCH/HOUR: 5986.05

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2703.75	22365	45.17	2581
Trachurus trecae	2577.75	19071	43.06	2583
Lepidopus caudatus	354.90	5364	5.93	
Trachurus trachurus	349.65	1785	5.84	2582
<b>Total</b>	<b>5986.05</b>		<b>100.00</b>	

PROJECT STATION:1527  
 DATE:20/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2143  
 start stop duration Long W 1715  
 TIME :17:31:20 17:46:35 15 (min) Purpose code: 1  
 LOG :7867.66 7868.88 1.19 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 68 67 Validity code:  
 Towing dir: 272° Wire out: 250 m Speed: 47 kn\*10  
 Sorted: 5 Kg Total catch: 5.07 CATCH/HOUR: 20.28

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Liza ramada	13.40	8	66.07	
Sardinella aurita	4.20	12	20.71	
Campogramma glaynos	2.68	4	13.21	
<b>Total</b>	<b>20.28</b>		<b>99.99</b>	

PROJECT STATION:1528  
 DATE:20/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2152 Long W 1714  
 start stop duration  
 TIME :21:33:35 21:59:08 26 (min) Purpose code: 1  
 LOG :7909.61 7911.21 1.57 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 63 64 Validity code:  
 Towing dir: 270° Wire out: 130 m Speed: 40 kn\*10  
 Sorted: 70 Kg Total catch: 5273.40 CATCH/HOUR: 12169.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	817.31	7358	66.70	2584
Sardinella aurita	2543.08	7269	20.90	2586
Scomber japonicus	1254.81	4327	10.31	2585
Trachurus trecae	185.19	1385	1.52	
Auxis thazard	69.23	173	0.57	
Total	12169.62		100.00	

PROJECT STATION:1529  
 DATE:21/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2206 Long W 1723  
 start stop duration  
 TIME :00:54:31 01:08:23 14 (min) Purpose code: 1  
 LOG :7938.77 7939.57 0.77 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 98 110 Validity code:  
 Towing dir: 282° Wire out: 150 m Speed: 37 kn\*10  
 Sorted: 35 Kg Total catch: 86.89 CATCH/HOUR: 372.39

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
MYCTOPHIDAE	253.93	1929857	68.19	
Scomber japonicus	78.17	630	20.99	2587
Isurus oxyrinchus	40.29	4	10.82	
Total	372.39		100.00	

PROJECT STATION:1530  
 DATE:21/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2202 Long W 1656  
 start stop duration  
 TIME :03:54:53 04:01:29 7 (min) Purpose code: 1  
 LOG :7968.30 7968.76 0.44 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 32 34 Validity code:  
 Towing dir: 352° Wire out: 130 m Speed: 40 kn\*10  
 Sorted: 54 Kg Total catch: 107.04 CATCH/HOUR: 917.49

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	540.00	2383	58.86	2590
Sardinella aurita	168.34	960	18.35	2589
Sardina pilchardus	113.14	3343	12.33	2588
Camponotus glycos	39.43	86	4.30	
Decapterus rhonchus	25.71	240	2.80	
Pomatomus saltatrix	12.86	17	1.40	
Sepia officinalis hierredda	8.57	34	0.93	
Trachurus trachurus	5.14	103	0.56	
Trachurus trecae	2.57	86	0.28	
Loligo vulgaris	1.71	51	0.19	
Total	917.47		100.00	

PROJECT STATION:1531  
 DATE:21/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2214 Long W 1715  
 start stop duration  
 TIME :07:00:10 07:20:23 20 (min) Purpose code: 1  
 LOG :7995.95 7997.26 1.31 Area code : 2  
 FDEPTH: 30 30 GearCond.code:  
 BDEPTH: 86 77 Validity code:  
 Towing dir: 110° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 7 Kg Total catch: 4374.00 CATCH/HOUR: 13122.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	13122.00	132858	100.00	2591
Total	13122.00		100.00	

PROJECT STATION:1532  
 DATE:21/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2239 Long W 1656  
 start stop duration  
 TIME :19:56:47 20:14:31 18 (min) Purpose code: 1  
 LOG :8128.47 8129.60 1.12 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 58 59 Validity code:  
 Towing dir: 280° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 34 Kg Total catch: 1020.60 CATCH/HOUR: 3402.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	1513.00	3500	44.47	2592
Sardinella maderensis	1111.00	3400	32.66	2593
Sardina pilchardus	560.00	5800	16.46	2594
Scomber japonicus	191.00	1000	5.61	
Trachurus trecae	23.00	200	0.68	
Trachurus trachurus	4.00	100	0.12	
Total	3402.00		100.00	

PROJECT STATION:1533  
 DATE:21/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2235 Long W 1639  
 start stop duration  
 TIME :22:37:22 22:45:22 8 (min) Purpose code: 1  
 LOG :8149.43 8149.91 0.49 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 43 39 Validity code:  
 Towing dir: 310° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 33 Kg Total catch: 835.00 CATCH/HOUR: 6262.50

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	5490.00	249375	87.66	2595
Decapterus rhonchus	609.38	2438	9.73	
Trachurus trecae	121.88	750	1.95	
Engraulis encrasicolus	35.63	3938	0.57	
Loligo vulgaris	5.63	188	0.09	
Total	6262.52		100.00	

PROJECT STATION:1534  
 DATE:22/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2244 Long W 1627  
 start stop duration  
 TIME :01:45:19 02:02:23 17 (min) Purpose code: 1  
 LOG :8176.56 8177.61 1.05 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 35 35 Validity code:  
 Towing dir: 180° Wire out: 140 m Speed: 35 kn\*10  
 Sorted: 29 Kg Total catch: 863.70 CATCH/HOUR: 3048.35

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2837.65	46588	93.09	2596
Sardinella aurita	138.71	5506	4.55	2597
Sardinella maderensis	28.59	106	0.94	
Decapterus rhonchus	23.29	212	0.76	
Trachurus trachurus	8.47	106	0.28	
Sepia officinalis hierredda	6.35	106	0.21	
Engraulis encrasicolus	5.29	635	0.17	
Total	3048.35		100.00	

PROJECT STATION:1535  
 DATE:22/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2254 Long W 1701  
 start stop duration  
 TIME :05:31:24 05:46:08 15 (min) Purpose code: 1  
 LOG :8213.75 8214.72 0.95 Area code : 2  
 FDEPTH: 50 50 GearCond.code:  
 BDEPTH: 89 96 Validity code:  
 Towing dir: 285° Wire out: 200 m Speed: 40 kn\*10  
 Sorted: 9 Kg Total catch: 9.20 CATCH/HOUR: 36.80

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	34.20	268	92.93	2598
SOLEIDAE	1.40	312	3.80	
Allotheutis subulata	0.68	328	1.85	
Sepia officinalis hierredda	0.28	100	0.76	
GOBIIDAE	0.16	160	0.43	
TRIGLIDAE	0.08	60	0.22	
Total	36.80		99.99	

PROJECT STATION:1536  
 DATE:22/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2307 Long W 1627  
 start stop duration  
 TIME :14:10:06 14:32:25 22 (min) Purpose code: 1  
 LOG :8300.25 8301.80 1.54 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 29 27 Validity code:  
 Towing dir: 110° Wire out: 150 m Speed: 44 kn\*10  
 Sorted: 31 Kg Total catch: 9165.00 CATCH/HOUR: 24995.46

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	24995.46	280636	100.00	2599
Total	24995.46		100.00	

PROJECT STATION:1537  
 DATE:22/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2321 Long W 1647  
 start stop duration  
 TIME :20:37:21 20:47:11 10 (min) Purpose code: 1  
 LOG :8362.88 8363.53 0.63 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 65 64 Validity code:  
 Towing dir: 295° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 31 Kg Total catch: 788.75 CATCH/HOUR: 4732.50

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4387.50	43200	92.71	2600
Trichiurus lepturus	225.00	150	4.75	
Scomber japonicus	91.50	600	1.93	
Trachurus trachurus	28.50	750	0.60	
Total	4732.50		99.99	

PROJECT STATION:1538  
 DATE:22/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2321 Long W 1634  
 start stop duration  
 TIME :22:34:20 22:41:21 7 (min) Purpose code: 1  
 LOG :8379.04 8379.48 0.43 Area code : 2  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 35 37 Validity code:  
 Towing dir: 112° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 31 Kg Total catch: 945.42 CATCH/HOUR: 8103.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	7328.57	115200	90.44	2601
Scomber japonicus	480.86	3857	5.93	
Decapterus rhonchus	216.00	2511	2.67	2602
Trachurus trachurus	28.29	514	0.35	
Trachurus trecae	20.57	257	0.25	
Loligo vulgaris	14.06	43	0.17	
Myliobatis aquila	10.29	9	0.13	
Engraulis encrasicolus	5.14	514	0.06	
Total	8103.78		100.00	

PROJECT STATION:1539  
 DATE:23/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2330 Long W 1632  
 start stop duration  
 TIME :03:42:15 03:56:00 14 (min) Purpose code: 1  
 LOG :8429.30 8430.29 0.98 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 38 39 Validity code:  
 Towing dir: 110° Wire out: 140 m Speed: 43 kn\*10  
 Sorted: 32 Kg Total catch: 386.64 CATCH/HOUR: 1657.03

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1607.14	19127	96.99	2603
Scomber japonicus	48.86	39	2.95	
Trachurus trachurus	1.03	51	0.06	
Total	1657.03		100.00	

PROJECT STATION:1540  
 DATE:23/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2340  
 start stop duration Long W 1632  
 TIME :08:48:10 09:07:16 19 (min) Purpose code: 1  
 LOG :8481.15 8482.48 1.30 Area code : 2  
 FDEPTH: 30 30 GearCond.code:  
 BDEPTH: 45 47 Validity code:  
 Towing dir: 290° Wire out: 120 m Speed: 40 kn\*10

Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION:1546  
 DATE:25/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2445  
 start stop duration Long W 1548  
 TIME :11:27:29 11:42:26 15 (min) Purpose code: 1  
 LOG :8997.31 8998.44 1.12 Area code : 2  
 FDEPTH: 40 30 GearCond.code:  
 BDEPTH: 49 53 Validity code:  
 Towing dir: 295° Wire out: 120 m Speed: 40 kn\*10

Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION:1541  
 DATE:23/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2350  
 start stop duration Long W 1606  
 TIME :21:12:34 21:21:20 9 (min) Purpose code: 1  
 LOG :8612.91 8613.47 0.55 Area code : 2  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 34 34 Validity code:  
 Towing dir: 295° Wire out: 120 m Speed: 40 kn\*10

Sorted: 67 Kg Total catch: 2330.30 CATCH/HOUR: 15535.33

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardina pilchardus	14571.67	125080	93.80
Sardinella aurita	700.00	2100	4.51
Sardinella maderensis	182.00	700	1.17
Scomber japonicus	46.67	233	0.30
Trachurus trecae	35.00	233	0.23
Total	15535.34		100.01

PROJECT STATION:1547  
 DATE:25/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2445  
 start stop duration Long W 1549  
 TIME :12:10:53 12:37:28 27 (min) Purpose code: 1  
 LOG :8999.86 9001.65 1.78 Area code : 2  
 FDEPTH: 30 30 GearCond.code:  
 BDEPTH: 52 47 Validity code:  
 Towing dir: 116° Wire out: 250 m Speed: 45 kn\*10

Sorted: Kg Total catch: 65.34 CATCH/HOUR: 145.20

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Boops boops	53.67	809	36.96
Trachurus trachurus	44.56	764	30.69
Scomber japonicus	43.44	369	29.92
Pagellus erythrinus	2.18	2	1.50
Spondyllosoma cantharus	0.64	2	0.44
Sardina pilchardus	0.40	7	0.28
Sardinella aurita	0.29	4	0.20
Total	145.18		99.99

PROJECT STATION:1542  
 DATE:24/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2401  
 start stop duration Long W 1607  
 TIME :01:28:59 01:36:40 8 (min) Purpose code: 1  
 LOG :8652.17 8652.75 0.57 Area code : 2  
 FDEPTH: 20 20 GearCond.code:  
 BDEPTH: 44 39 Validity code:  
 Towing dir: 118° Wire out: 130 m Speed: 45 kn\*10

Sorted: 31 Kg Total catch: 124.32 CATCH/HOUR: 932.40

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardina pilchardus	831.00	8400	89.12
Scomber japonicus	90.00	450	9.65
Trachurus trecae	11.40	120	1.22
Total	932.40		99.99

PROJECT STATION:1548  
 DATE:25/11/01 GEAR TYPE: PT No:7 POSITION:Lat N 2431  
 start stop duration Long W 1516  
 TIME :16:04:31 16:36:39 32 (min) Purpose code: 1  
 LOG :9035.89 9037.95 2.04 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 23 24 Validity code:  
 Towing dir: 300° Wire out: 150 m Speed: 36 kn\*10

Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION:1543  
 DATE:24/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2419  
 start stop duration Long W 1602  
 TIME :15:44:29 16:01:08 17 (min) Purpose code: 1  
 LOG :8794.88 8796.08 1.18 Area code : 2  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 45 44 Validity code:  
 Towing dir: 118° Wire out: 140 m Speed: 45 kn\*10

Sorted: 31 Kg Total catch: 244.40 CATCH/HOUR: 862.59

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardina pilchardus	862.59	9939	100.00
Total	862.59		100.00

PROJECT STATION:1549  
 DATE:25/11/01 GEAR TYPE: PT No:4 POSITION:Lat N 2405  
 start stop duration Long W 1507  
 TIME :19:02:27 19:14:43 12 (min) Purpose code: 1  
 LOG :9061.42 9062.23 0.80 Area code : 2  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 24 26 Validity code:  
 Towing dir: 110° Wire out: 120 m Speed: 40 kn\*10

Sorted: 66 Kg Total catch: 6641.73 CATCH/HOUR: 33208.65

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardina pilchardus	32025.00	301000	96.44
Scomber japonicus	575.00	2500	1.73
Pomadour incisus	245.00	1500	0.74
Diplodus bellottii	215.00	3000	0.65
Trachurus trecae	85.00	500	0.26
Decapterus rhonchus	60.00	1000	0.18
Scomber japonicus	3.65	5	0.01
Total	33208.65		100.01

PROJECT STATION:1544  
 DATE:24/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2425  
 start stop duration Long W 1553  
 TIME :22:09:43 22:39:31 30 (min) Purpose code: 1  
 LOG :8861.94 8863.95 2.00 Area code : 2  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 39 45 Validity code:  
 Towing dir: 295° Wire out: 120 m Speed: 40 kn\*10

Sorted: 31 Kg Total catch: 372.00 CATCH/HOUR: 744.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Trichiurus lepturus	434.20	170	58.36
Sardina pilchardus	308.00	4780	41.40
Sepia officinalis hierredda	1.20	2	0.16
Loligo vulgaris	0.60	2	0.08
Total	744.00		100.00

PROJECT STATION:1550  
 DATE:27/11/01 GEAR TYPE: PT No:3 POSITION:Lat N 2507  
 start stop duration Long W 1452  
 TIME :03:04:55 03:16:01 11 (min) Purpose code: 1  
 LOG :9356.52 9357.50 0.96 Area code : 2  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 42 46 Validity code:  
 Towing dir: 160° Wire out: 140 m Speed: 48 kn\*10

Sorted: 31 Kg Total catch: 303.20 CATCH/HOUR: 1653.82

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardina pilchardus	1647.27	17073	99.60
Scomber japonicus	6.55	16	0.40
Total	1653.82		100.00

PROJECT STATION:1545  
 DATE:25/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2441  
 start stop duration Long W 1603  
 TIME :05:54:11 06:15:05 21 (min) Purpose code: 1  
 LOG :8941.98 8943.47 1.48 Area code : 2  
 FDEPTH: 40 40 GearCond.code:  
 BDEPTH: 68 64 Validity code:  
 Towing dir: 119° Wire out: 160 m Speed: 40 kn\*10

Sorted: Kg Total catch: 1.98 CATCH/HOUR: 5.66

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Scomber japonicus	4.11	46	72.61
Sardina pilchardus	1.00	17	17.67
Dicologlossa hexophthalma	0.40	6	7.07
Sepia orbignyana	0.06	3	1.06
Rossia macrosomia	0.06	3	1.06
GOBIIDAE	0.03	54	0.53
Total	5.66		100.00

PROJECT STATION:1551  
 DATE:28/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 2636  
 start stop duration Long W 1349  
 TIME :20:38:08 20:41:17 3 (min) Purpose code: 1  
 LOG :9754.60 9754.76 0.16 Area code : 2  
 FDEPTH: 30 31 GearCond.code:  
 BDEPTH: 30 31 Validity code:  
 Towing dir: 50° Wire out: 100 m Speed: 30 kn\*10

Sorted: 31 Kg Total catch: 94.50 CATCH/HOUR: 1890.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardina pilchardus	1857.00	117780	98.25
Scomber japonicus	12.60	60	0.67
Loligo vulgaris	9.00	60	0.48
Trachurus trachurus	6.60	60	0.35
Diplodus bellottii	2.40	60	0.13
Allotheutis subulata	1.20	420	0.06
Engraulis encrasicolus	1.20	180	0.06
Total	1890.00		100.00

PROJECT STATION:1552  
 DATE:29/11/01 GEAR TYPE: PT No:6 POSITION:Lat N 2647 Long W 1335  
 start stop duration  
 TIME :00:51:48 01:05:18 14 (min) Purpose code: 1  
 LOG : 9798.67 9799.58 0.91 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 42 41 Validity code:  
 Towing dir: 207° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 30 Kg Total catch: 754.85 CATCH/HOUR: 3235.07

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	3214.29	358179	99.36	2615
Camprogamma glaycos	8.79	9	0.27	
Sarda sarda	6.64	4	0.21	
Loligo vulgaris	5.36	9	0.17	
Total	3235.08		100.01	

PROJECT STATION:1553  
 DATE:29/11/01 GEAR TYPE: BT No:2 POSITION:Lat N 2720 Long W 1334  
 start stop duration  
 TIME :13:15:49 13:20:58 5 (min) Purpose code: 1  
 LOG : 9927.82 9928.12 0.29 Area code : 2  
 FDEPTH: 85 84 GearCond.code:  
 BDEPTH: 85 84 Validity code:  
 Towing dir: 190° Wire out: 330 m Speed: 30 kn\*10  
 Sorted: 33 Kg Total catch: 487.50 CATCH/HOUR: 5850.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	5814.00	161820	99.38	2616
Dentex macrophthalmus	18.00	900	0.31	
Scomber japonicus	10.80	180	0.18	
Trachurus trachurus	7.20	180	0.12	
Total	5850.00		99.99	

PROJECT STATION:1554  
 DATE:29/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2735 Long W 1323  
 start stop duration  
 TIME :21:32:34 21:46:59 14 (min) Purpose code: 1  
 LOG : 9.52 10.58 1.05 Area code : 2  
 FDEPTH: 30 30 GearCond.code:  
 BDEPTH: 68 59 Validity code:  
 Towing dir: 140° Wire out: 130 m Speed: 30 kn\*10  
 Sorted: 33 Kg Total catch: 243.29 CATCH/HOUR: 1042.67

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	998.40	17250	95.75	2617
Diplodus vulgaris	33.21	116	3.19	
Scomber japonicus	6.60	90	0.63	
Pagellus erythrinus	4.46	13	0.43	
Total	1042.67		100.00	

PROJECT STATION:1555  
 DATE:30/11/01 GEAR TYPE: PT No:3 POSITION:Lat N 2744 Long W 1321  
 start stop duration  
 TIME :02:56:02 03:08:13 12 (min) Purpose code: 1  
 LOG : 60.92 61.78 0.85 Area code : 2  
 FDEPTH: 60 60 GearCond.code:  
 BDEPTH: 81 81 Validity code:  
 Towing dir: 215° Wire out: 250 m Speed: 45 kn\*10  
 Sorted: 30 Kg Total catch: 302.82 CATCH/HOUR: 1514.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1500.00	52450	99.07	2618
Scomber japonicus	11.00	150	0.73	
Sardinella aurita	3.10	50	0.20	
Total	1514.10		100.00	

PROJECT STATION:1556  
 DATE:30/11/01 GEAR TYPE: PT No:1 POSITION:Lat N 2748 Long W 1318  
 start stop duration  
 TIME :06:11:58 06:24:33 13 (min) Purpose code: 1  
 LOG : 90.72 91.66 0.94 Area code : 2  
 FDEPTH: 60 60 GearCond.code:  
 BDEPTH: 84 83 Validity code:  
 Towing dir: 220° Wire out: 210 m Speed: 40 kn\*10  
 Sorted: 31 Kg Total catch: 93.00 CATCH/HOUR: 429.23

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	429.23	7283	100.00	2619
Total	429.23		100.00	

PROJECT STATION:1557  
 DATE: 5/12/01 GEAR TYPE: BT No:2 POSITION:Lat N 2823 Long W 1259  
 start stop duration  
 TIME :02:09:50 02:17:59 8 (min) Purpose code: 1  
 LOG : 451.54 451.95 0.41 Area code : 1  
 FDEPTH: 105 105 GearCond.code:  
 BDEPTH: 105 105 Validity code:  
 Towing dir: 250° Wire out: 400 m Speed: 30 kn\*10  
 Sorted: 33 Kg Total catch: 159.29 CATCH/HOUR: 1194.68

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	689.10	12810	57.68	2620
Argyrosomus regius	162.00	8	13.56	
Mola mola	132.75	60	11.11	
Dentex macrophthalmus	40.43	1575	3.38	
Pagellus acarne	38.85	210	3.25	
MYCTOPHIDAE	24.98	2805	2.09	
Zeus faber	24.30	8	2.03	
Dentex maroccanus	23.63	233	1.98	
Trachinus draco	18.60	653	1.56	
Scorpaena elongata	12.00	8	1.00	
Trachurus trachurus	7.65	128	0.64	
Macrorhamphosus scolopax	6.30	600	0.53	
Lepidotrigla sp.	5.03	735	0.42	
Mullus barbatus	3.98	23	0.33	
Microchirus variegatus	1.35	233	0.11	
Citharus linguatula	1.35	105	0.11	
Aspitrigla obscura	1.05	23	0.09	
Sepia officinalis hierredda	0.83	53	0.07	
Rossia macroscmia	0.53	53	0.04	
Total	1194.71		99.98	

PROJECT STATION:1558  
 DATE: 5/12/01 GEAR TYPE: BT No:2 POSITION:Lat N 2807 Long W 1223  
 start stop duration  
 TIME :13:42:43 13:55:16 13 (min) Purpose code: 1  
 LOG : 582.04 582.73 0.69 Area code : 1  
 FDEPTH: 42 42 GearCond.code:  
 BDEPTH: 42 42 Validity code:  
 Towing dir: 260° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 72 Kg Total catch: 1619.96 CATCH/HOUR: 7476.74

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	7368.92	287488	98.56	2621
Scomber japonicus	52.94	309	0.71	
Pagellus acarne	34.25	102	0.46	
Engraulis encrasicolus	7.25	1038	0.10	
Diplodus bellottii	5.17	208	0.07	
Octopus vulgaris	3.14	5	0.04	
Loligo vulgaris	2.91	5	0.04	
Allotheutis subulata	2.08	517	0.03	
Total	7476.66		100.01	

PROJECT STATION:1559  
 DATE: 5/12/01 GEAR TYPE: 00 No:1 POSITION:Lat N 2814 Long W 1157  
 start stop duration  
 TIME :18:56:16 19:05:04 9 (min) Purpose code: 1  
 LOG : 633.91 634.48 0.56 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 42 42 Validity code:  
 Towing dir: 10° Wire out: 120 m Speed: 30 kn\*10  
 Sorted: 32 Kg Total catch: 64.78 CATCH/HOUR: 431.87

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	392.00	30707	90.77	2622
Scomber japonicus	18.27	93	4.23	
Engraulis encrasicolus	11.87	3067	2.75	2623
Stromateus fiatola	8.00	27	1.85	
Allotheutis subulata	1.73	320	0.40	
Total	431.87		100.00	

PROJECT STATION:1560  
 DATE: 6/12/01 GEAR TYPE: PT No:4 POSITION:Lat N 2851 Long W 1219  
 start stop duration  
 TIME :01:13:55 01:39:38 26 (min) Purpose code: 1  
 LOG : 699.45 701.07 1.59 Area code : 1  
 FDEPTH: 70 70 GearCond.code:  
 BDEPTH: 117 115 Validity code:  
 Towing dir: 80° Wire out: 320 m Speed: 40 kn\*10  
 Sorted: 22 Kg Total catch: 22.02 CATCH/HOUR: 50.82

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	43.15	376	84.91	2624
Mola mola	6.92	2	13.62	
MYCTOPHIDAE	0.55	115	1.08	
Trachurus trachurus	0.18	2	0.35	
Total	50.80		99.96	

PROJECT STATION:1561  
 DATE: 6/12/01 GEAR TYPE: BT No:1 POSITION:Lat N 2825 Long W 1219  
 start stop duration  
 TIME :05:33:57 05:40:00 6 (min) Purpose code: 1  
 LOG : 742.51 742.90 0.52 Area code : 1  
 FDEPTH: 63 63 GearCond.code:  
 BDEPTH: 63 63 Validity code:  
 Towing dir: 270° Wire out: 240 m Speed: 30 kn\*10  
 Sorted: 45 Kg Total catch: 45.44 CATCH/HOUR: 454.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	133.50	2310	29.38	2626
Pagellus acarne	110.00	500	24.21	
Trachurus trachurus	104.00	1080	22.89	2625
Dentex macrophthalmus	39.00	270	8.58	
Zeus faber	24.50	10	5.39	
Diplodus vulgaris	10.20	40	2.24	
Pagellus erythrinus	10.10	30	2.22	
Umbra canariensis	6.00	10	1.32	
Scomber japonicus	4.60	60	1.01	
Spondyliosoma cantharus	3.60	20	0.79	
Loligo vulgaris	3.10	20	0.68	
Mullus barbatus	2.50	10	0.55	
Boops boops	1.70	30	0.37	
Scorpaena elongata	0.60	10	0.13	
Trisopterus luscus	0.50	10	0.11	
Scorpaena scrofa	0.50	10	0.11	
Total	454.40		99.98	

PROJECT STATION:1562  
 DATE: 6/12/01 GEAR TYPE: BT No:2 POSITION:Lat N 2824 Long W 1132  
 start stop duration  
 TIME :13:02:51 13:08:01 5 (min) Purpose code: 1  
 LOG : 821.11 821.39 0.28 Area code : 1  
 FDEPTH: 43 45 GearCond.code:  
 BDEPTH: 43 45 Validity code:  
 Towing dir: 243° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 70 Kg Total catch: 1318.89 CATCH/HOUR: 15826.68

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	13419.00	387240	84.79	
Argyrosomus regius	957.00	132	6.05	
Diplodus vulgaris	436.80	2100	2.76	
Trachurus trachurus	294.00	5880	1.86	
Diplodus bellottii	258.24	3780	1.63	
Pagellus acarne	140.64	420	0.89	
Loligo vulgaris	126.00	840	0.80	
Umbrina canariensis	83.40	96	0.53	
Pomadasys incisus	42.00	420	0.27	
Trachurus trecae	31.92	1044	0.20	
Zeus faber	22.20	12	0.14	
Plectorhinchus mediterraneus	15.36	12	0.10	
Total	15826.56		100.02	

PROJECT STATION:1563  
 DATE: 7/12/01 GEAR TYPE: PT No:3 POSITION:Lat N 2859 Long W 1040  
 start stop duration  
 TIME :15:40:54 15:53:13 12 (min) Purpose code: 1  
 LOG :1063.40 1064.32 0.89 Area code : 1  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 39 39 Validity code:  
 Towing dir: 240° Wire out: 160 m Speed: 47 kn\*10  
 Sorted: 71 Kg Total catch: 5395.35 CATCH/HOUR: 26976.75

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	26976.75	1135500	100.00	2628
Total	26976.75		100.00	

PROJECT STATION:1564  
 DATE: 7/12/01 GEAR TYPE: PT No:4 POSITION:Lat N 2907 Long W 1032  
 start stop duration  
 TIME :18:41:48 18:51:31 10 (min) Purpose code: 1  
 LOG :1089.51 1090.11 0.60 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 40 44 Validity code:  
 Towing dir: 315° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 40 Kg Total catch: 2345.76 CATCH/HOUR: 14074.56

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	14020.50	639990	99.62	2629
Scomber japonicus	23.40	390	0.17	
Lepidopus caudatus	12.78	6	0.09	
Loligo vulgaris	6.60	6	0.05	
Pagellus acarne	5.82	12	0.04	
Trachurus trachurus	5.46	1170	0.04	
Total	14074.56		100.01	

PROJECT STATION:1565  
 DATE: 8/12/01 GEAR TYPE: PT No:3 POSITION:Lat N 2929 Long W 1017  
 start stop duration  
 TIME :11:51:51 11:54:49 3 (min) Purpose code: 1  
 LOG :1241.68 1241.90 0.21 Area code : 1  
 FDEPTH: 20 20 GearCond.code:  
 BDEPTH: 53 54 Validity code:  
 Towing dir: 275° Wire out: 110 m Speed: 40 kn\*10  
 Sorted: 37 Kg Total catch: 918.75 CATCH/HOUR: 18375.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	18375.00	559760	100.00	2630
Total	18375.00		100.00	

PROJECT STATION:1566  
 DATE:10/12/01 GEAR TYPE: PT No:4 POSITION:Lat N 3137 Long W 955  
 start stop duration  
 TIME :14:40:54 14:51:03 10 (min) Purpose code: 1  
 LOG :1713.78 1714.48 0.69 Area code : 1  
 FDEPTH: 40 40 GearCond.code:  
 BDEPTH: 83 81 Validity code:  
 Towing dir: 30° Wire out: 200 m Speed: 40 kn\*10  
 Sorted: 37 Kg Total catch: 750.60 CATCH/HOUR: 4503.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	4200.00	240000	93.26	2632
Sardina pilchardus	279.60	8640	6.21	2631
Scomber scombrus	24.00	480	0.53	
Total	4503.60		100.00	

PROJECT STATION:1567  
 DATE:10/12/01 GEAR TYPE: PT No:1 POSITION:Lat N 3153 Long W 940  
 start stop duration  
 TIME :21:13:25 21:27:02 14 (min) Purpose code: 1  
 LOG :1775.03 1775.86 0.83 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 40 39 Validity code:  
 Towing dir: 192° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 32 Kg Total catch: 220.01 CATCH/HOUR: 942.90

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	856.50	53100	90.84	2634
Scomber japonicus	61.50	660	6.52	2635
Engraulis encrasicolus	15.30	1230	1.62	2633
Allotheutis subulata	4.80	1140	0.51	
Octopus vulgaris	4.80	4	0.51	
Total	942.90		100.00	

PROJECT STATION:1568  
 DATE:10/12/01 GEAR TYPE: PT No:4 POSITION:Lat N 3156 Long W 950  
 start stop duration  
 TIME :23:00:18 23:10:53 11 (min) Purpose code: 1  
 LOG :1786.50 1787.21 0.70 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 43 47 Validity code:  
 Towing dir: 110° Wire out: 120 m Speed: 40 kn\*10  
 Sorted: 31 Kg Total catch: 213.85 CATCH/HOUR: 1166.45

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	618.55	12524	53.03	2636
Scomber japonicus	547.91	7178	46.97	2637
Total	1166.46		100.00	

PROJECT STATION:1569  
 DATE:11/12/01 GEAR TYPE: PT No:6 POSITION:Lat N 3202 Long W 932  
 start stop duration  
 TIME :03:39:43 03:48:22 9 (min) Purpose code: 1  
 LOG :1826.47 1827.04 0.56 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 35 35 Validity code:  
 Towing dir: 290° Wire out: 140 m Speed: 40 kn\*10  
 Sorted: Kg Total catch: 0.05 CATCH/HOUR: 0.33

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	0.33	7	100.00	
Total	0.33		100.00	

PROJECT STATION:1570  
 DATE:11/12/01 GEAR TYPE: PT No:6 POSITION:Lat N 3202 Long W 932  
 start stop duration  
 TIME :04:19:56 04:33:50 14 (min) Purpose code: 1  
 LOG :1828.94 1829.68 0.70 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 35 34 Validity code:  
 Towing dir: 120° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 37 Kg Total catch: 112.53 CATCH/HOUR: 482.27

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	462.60	14121	95.92	2638
Diplodus vulgaris	10.41	26	2.16	
Scomber japonicus	9.26	180	1.92	
Total	482.27		100.00	



### Annex III Instruments and fishing gear used

The Simrad EK-500, 38kHz echo scientific sounder was used during the survey for fish abundance estimation. The Bergen Echo Integrator system (BEI) logging the echogram raw data from the sounder, was used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data was stored to tape, and a backup of the database of scrutinized data, stored. The details of the settings of the 38kHz where as follows:

<b>Transceiver-1 menu</b>	Transducer depth	5.5 - 7.5 m
	Absorbtion coeff.	10 dB/km
	Pulse length	medium (1ms)
	Bandwidth	wide
	Max power	2000 Watt
	2-way beam angle	-21.0 dB
	SV transducer gain	27.45 dB
	TS transducer gain	27.65 dB
	Angle sensitivity	21.9
	3 dB beamwidth	6.8°
	Alongship offset	-0.03°
Athwardship offset	0.06°	
<b>Display menu</b>	Echogram	1
	Bottom range	10 m
	Bottom range start	10 m
	TVG	20 log R
	Sv colour min	-67 dB
	TS Colour minimum	-60 dB
<b>Printer- menu</b>	Range	0 - 50 or 0 -100 m and 100 - 350m
	TVG	20 log R
	Sv colour min	-63 dB
<b>Bottom detection menu</b>	Minimum level	-40 dB

A calibration experiment using a standard copper sphere, performed off Langstrand, Walvis Bay 19 April 2001 gave the following results:

Sv Transducer gain 27.37 dB  
Ts Transducer gain 27.49 dB

#### Fishing gear

The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super" bottom trawl. For all trawls, the Tyborøn, 7.8m<sup>2</sup> (1670 kg) trawl doors were used. Complete drawings of the trawls used are included.