

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

**Cruise Report No 11/97**

**Part I SENEGAL - THE GAMBIA**

**4 - 12 November 1997**

Centre de Recherches Océanographiques de Dakar-Thiaroye  
Dakar, Senegal

Department of Fisheries  
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Institute of Marine Research  
Bergen, Norway

CRUISE REPORTS 'DR FRIDTJOF NANSEN'

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**SENEGAL - THE GAMBIA**

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by

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**Bergen, 1997**

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## CHAPTER 1 INTRODUCTION

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### 1.1 OBJECTIVES 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 1997. 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 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°35' N and 14°50' N.

The time allocated for this part of the survey, off Senegal and The Gambia, was 8 days.

### 1.2 PARTICIPATION

Members of the scientific teams were:

Centre de Recherches Océanographiques de Dakar-Thiaroy, Senegal:  
Abdoulaye SARRE, Ibrahima SOW and Mor SYLLA

Senegalese Navy:  
Souleymane GUEYE

Department of Fisheries, The Gambia:  
Juldeh JALLOW (4-8/11) and Asberr N. MENDY (4-8/11)

Centre National de Recherches Océanographiques et des Pêches, Mauritania:  
Dah Ould ALIOUNE (10/11-16/12) and Mohammed Ould MAHFOUD (10-18/11)

Institute of Marine Research , Norway:  
Reidar TORESEN, Oddgeir ALVHEIM, Guillermo BURGOS, Ingve FJELDSTAD and Tore MØRK.

### 1.3 NARRATIVE

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

The survey started off Casamance on November 4 with systematic parallel course tracks spaced about 10 NM apart. To cover the whole distribution area of pelagic fish, the shelf was covered from the 15 m isobath and offshore to beyond the 200 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 up to Cape Vert before a call was made on Dakar on November 8, to change crew and let the participants from the Gambia disembark and the ones from Mauritania come onboard.

The shelf from Cape Vert to St. Louis was surveyed from November 10 to 12.

The hydrographic profile off The Gambia was occupied on November 6 and that off Cape Vert on November 10.

### 1.4 METHODS

All catches were sampled for composition by weight and numbers of each species. The length frequency distributions of the target species were taken in all the stations where they were present. Total fish length was measured. Individual weight was calculated as  $w=al^3$ , assuming isometric growth. The complete records of fishing stations are shown in Annex I.

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.

The acoustic biomass estimates were based on the integration technique. The Bergen Integrator (BEI) was used for analysis and allocation of  $S_A$  - values. This system does not underestimate dense schools close to the bottom as some times may have happened with the EK500 used in the 1992 surveys.

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:

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

or in the form

$$C_F = 1.26 \cdot 10^6 \cdot L^2$$

where L is total length and  $C_F$  is the fish conversion factor. The following formula was used to calculate the density of fish in numbers/NM<sup>2</sup> in each length group:

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

where

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

$S_A$  = mean integrator value

$p_i$  = proportion of fish in length group i

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

The integrator outputs were split on 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) carangids and associated species (chub mackerel, hairtails and barracudas).

The above equations show that the conversion from  $S_{\lambda}$ -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 are geographically segregated. When no segregation occurs the various length distributions are pooled together with equal importance. Otherwise, when the size distribution varies with the sampling site, 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.

A systematic approach to a) divide the  $S_{\lambda}$ -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 mean back scattering strength ( $\rho/S_{\lambda}$ ) of each length frequency distribution of the target species is calculated and summed.
- The mean  $S_{\lambda}$ -value allocated to the category of fish is divided between the species in the same ratio as their relative contribution to the mean back scattering strength in the sample.
- For each species, the length distributions in an area are pooled by using the ratio between the allocated  $S_{\lambda}$ -value (the five mile value at the trawl station of the sample) and the mean back scattering strength as the weighting factor. If the size distribution is geographically uniform (not significantly different), the samples can be pooled together with equal importance.
- The pooled length distribution is used together with the mean  $S_{\lambda}$ -value to calculate the density (numbers per square NM) by length groups, for each area, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area.
- The numbers are converted to biomass using the estimated weight at length.

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 were applied.

Annex II gives a description of the instruments and the fishing gear used.

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

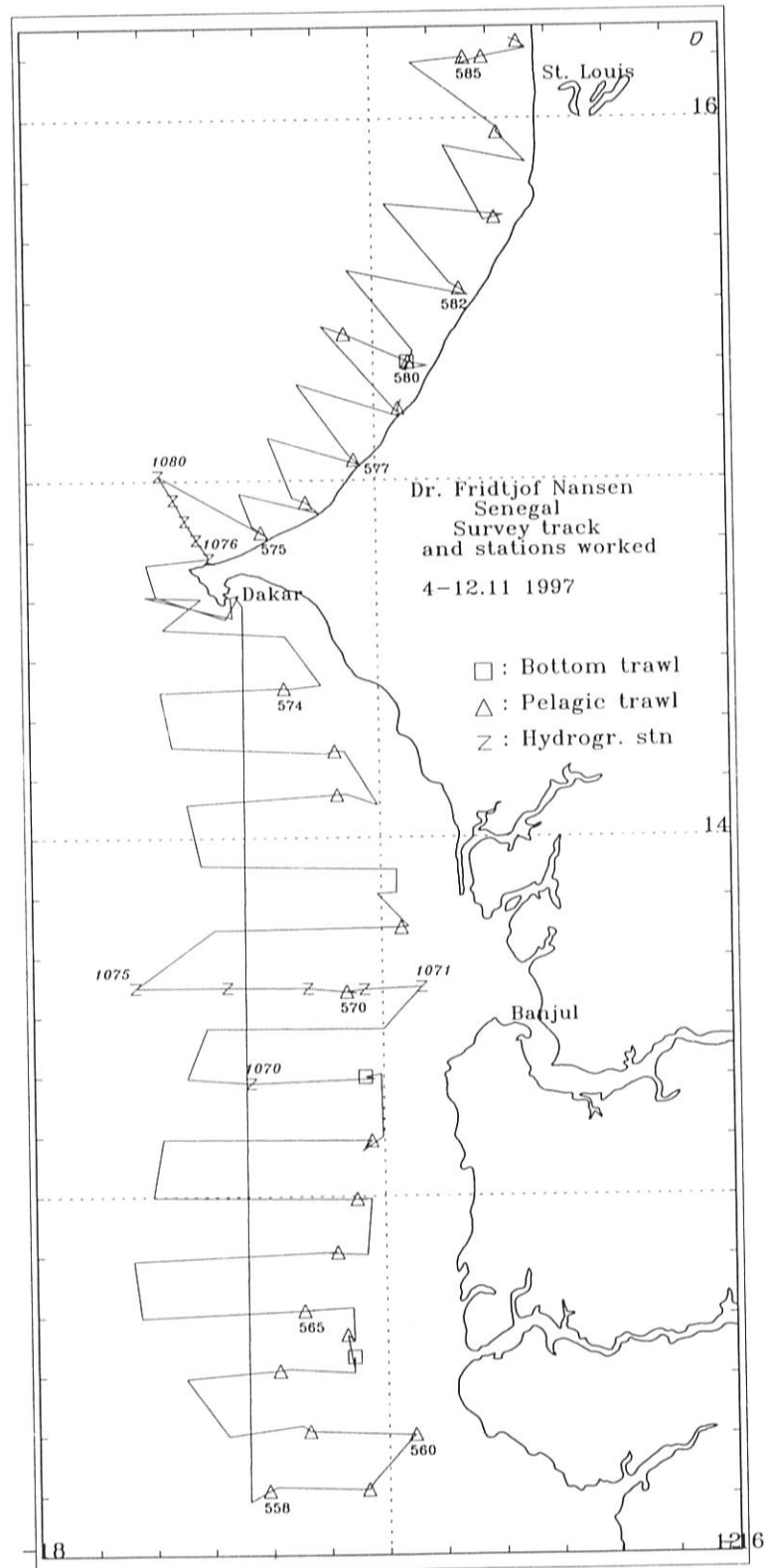


Figure 1 Course tracks with fishing and hydrographic stations; Casamance to St. Louis.



## 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.

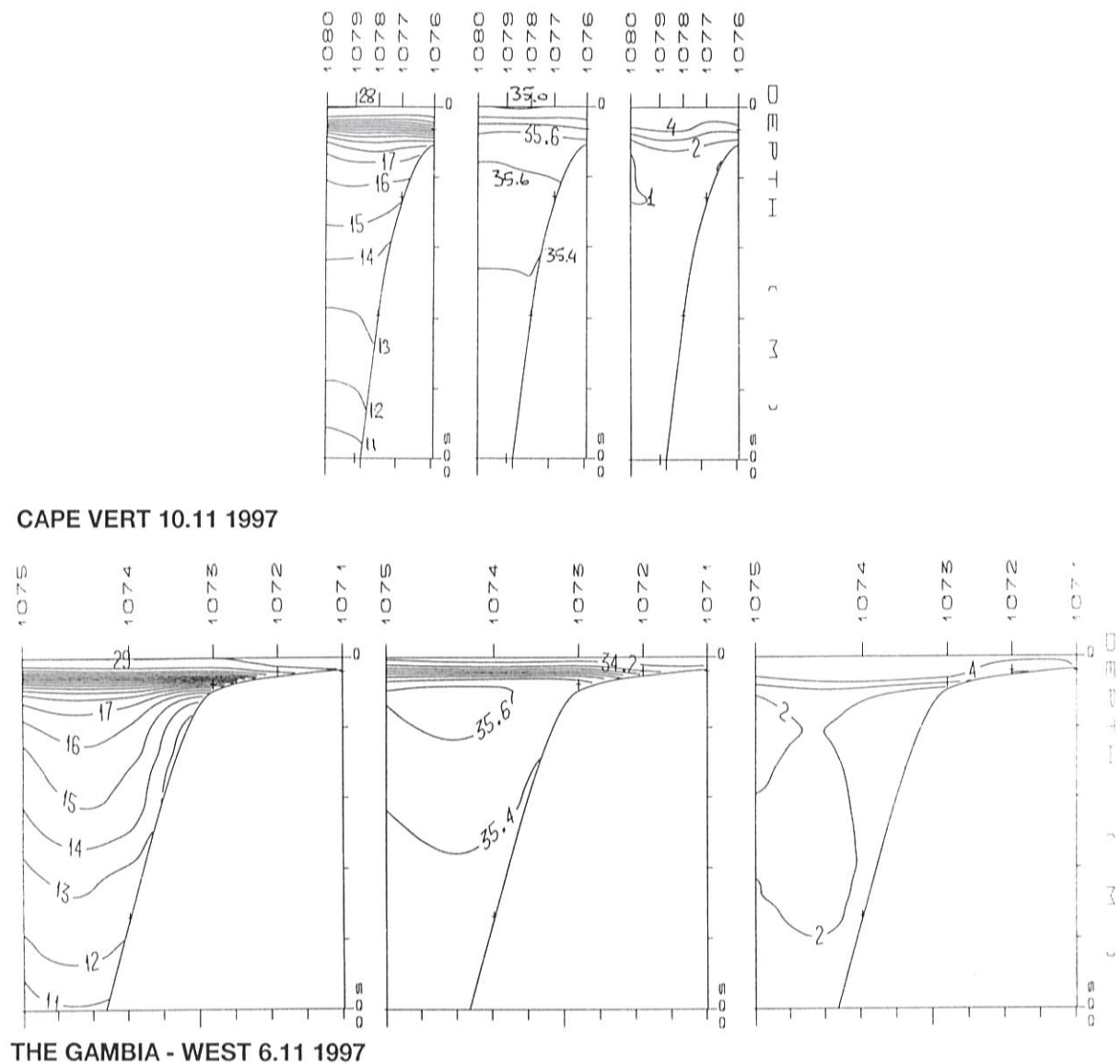


Figure 2 Hydrographic profiles with distribution of temperature, salinity and oxygen.

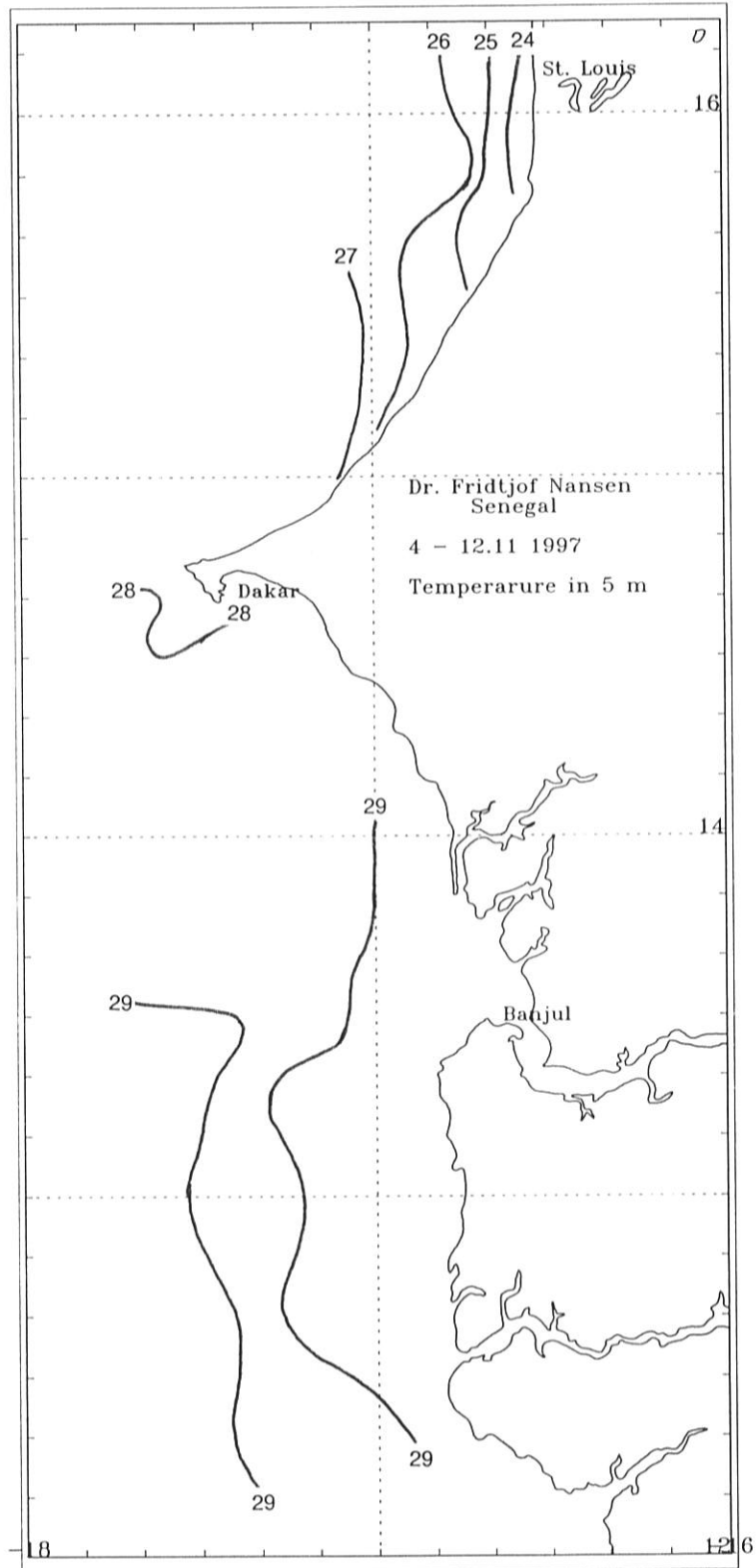


Figure 3 Sea surface temperature; Casamance to St. Louis.

The distribution of surface temperature and the profile The Gambia-West show that there was a stable surface layer with a temperature of 28-29°C over the whole shelf south of Dakar. North of Cape Vert there was a trend of decreasing temperature towards the shore, with a decline from 27°C over the entire shelf just north of Cape Vert to 24°C close to the shore off St. Louis.

## 2.2 THE CASAMANCE SHELF

Figures 4 and 5 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, about 20-30 NM west of the river mouth, there was a 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 (85%) *Sardinella maderensis*. The modal size was 22 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 51 000 tonnes (Table 1).

Other pelagic fish were found in various densities, and over a wider area than the sardinellas, see Figure 5. The trawl samples indicated that these consisted of bumper, false scad, lookdown, barracudas, two-colour jack and hairtails, with the bumper as the dominating species. The estimated biomass of this group of fish was 70 000 tonnes.

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

Flat sardinella	Round sardinella	Carangids etc.
44	7	70

## 2.3 THE GAMBIAN SHELF

The school area of sardinella found inshore 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 90% dominance of round sardinella (*Sardinella aurita*) with a small proportion of flat sardinella (*S. maderensis*). The pooled length composition of the round sardinella had a mode of 26 cm, see Annex III. The stock length compositions by numbers and weight are shown in Annex IV.

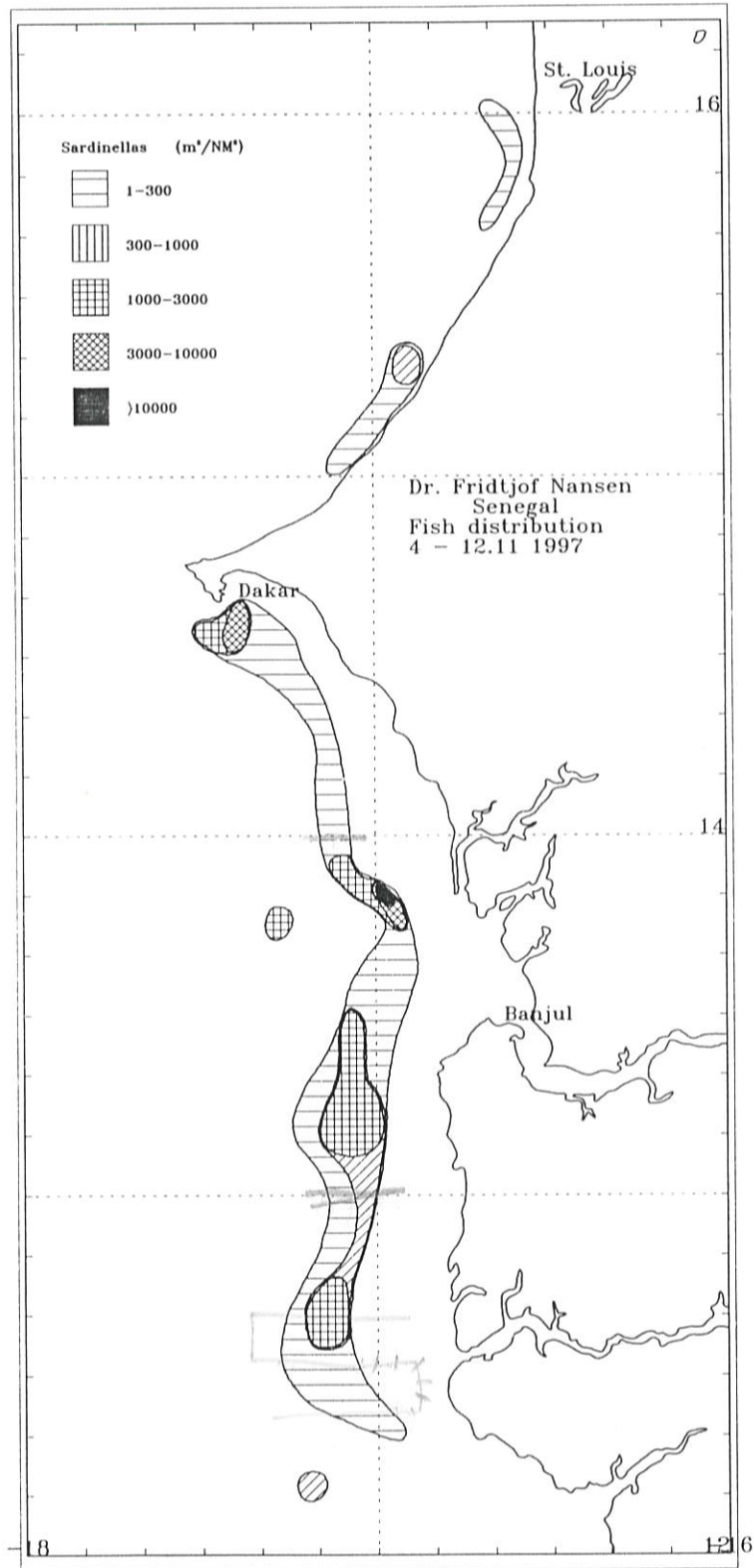


Figure 4 Distribution of sardinellas; Casamance to St. Louis.

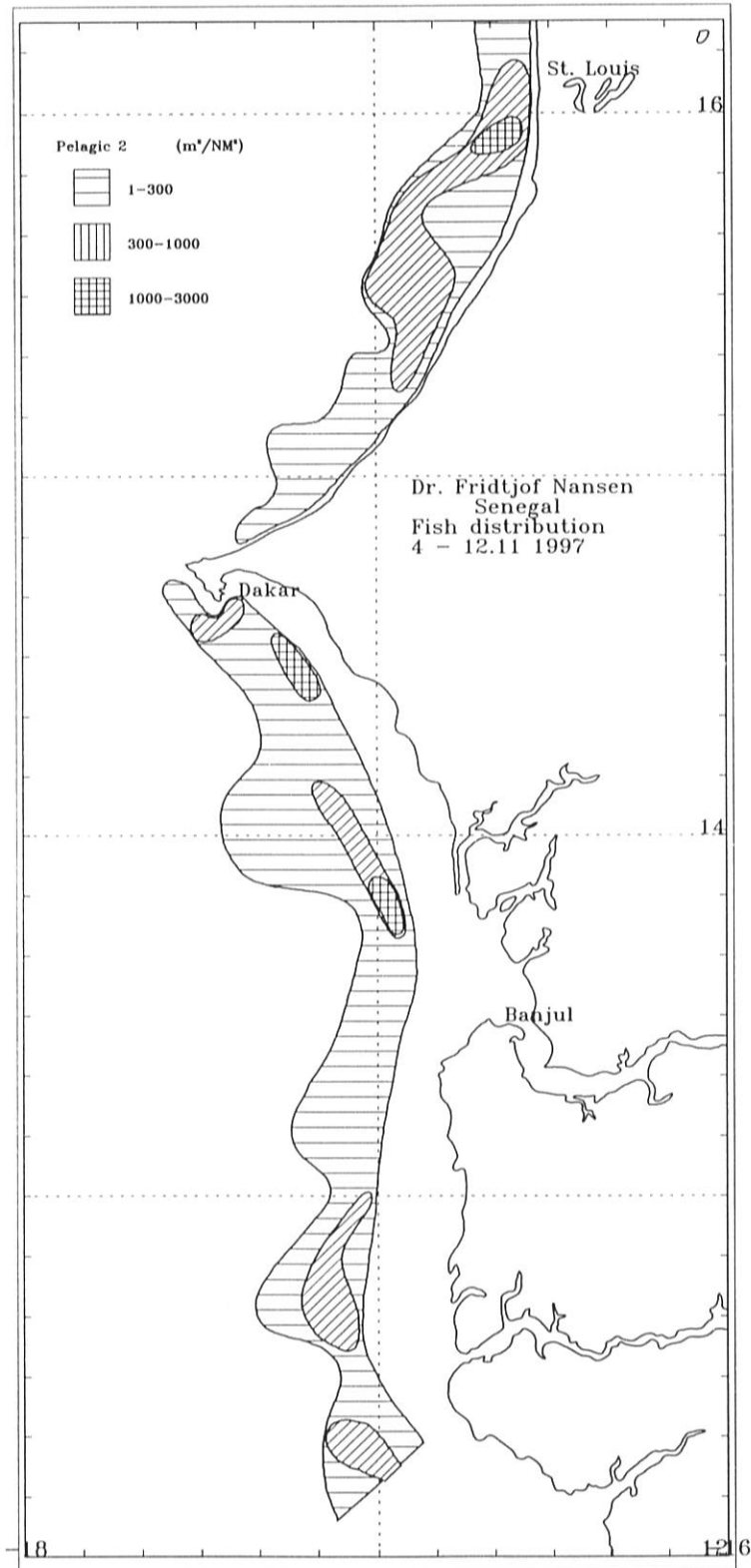


Figure 5 Distribution of carangids and associated species; Casamance to St. Louis.

Table 2 shows that the biomass estimates of the sardinellas amounted to 98 000 tonnes, of which 88 000 tonnes were round sardinella.

Carangids and associated species were found in the same area and also here somewhat to the offshore side of the sardinella school area (Figure 5).

Catches of this group consisted mainly of bumper, false scad, West African Spanish mackerel and barracudas. The biomass was estimated at 15 000 tonnes.

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

Flat sardinella	Round sardinella	Carangids etc.
10	88	15

## 2.4 THE GAMBIAN BORDER - CAPE VERT

The school area off the Gambia continued northwards to Cape Vert (Figure 4). The greatest densities was found between 25 and 40 m depth. Table 3 shows the biomass estimates for the two sardinella species that summed up to 135 000 tonnes. Flat sardinella dominated the estimated biomass in the area by 75%.

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

Also here, the carangids and associated pelagic fish were distributed over most of the area with the highest concentrations outside the Saloum River, see Figure 5. Again bumper was caught in most of the trawl samples, and false scad appeared with some high catch rates. It is notable that hardly any horse mackerel *Trachurus trecae* was caught south of Dakar. The biomass of the carangids and associated pelagic fish was estimated at about 71 000 tonnes (Table 3).

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

Flat sardinella	Round sardinella	Carangids etc.
100	35	71

## 2.5 CAPE VERT - ST. LOUIS

On this part of the shelf sardinellas were found in very low inshore concentrations, between Cayar and some 25 NM northwards (Figure 4). The samples showed an allmost 50/50% distribution between the two species. The modal length of the round sardinella was 33 cm while that of flat sardinella was 25 cm, see Annex III. The biomass of the sardinellas was estimated at 11 000 tonnes (Table 4).

Carangids and associated pelagic fish were mainly found on the offshore side of the sardinella distribution all the way from Cape Vert to St. Louis (Figure 5). The catches consisted also here of bumper, false scad, lookdown and hairtails. The biomass estimate was 98 000 tonnes.

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

Flat sardinella	Round sardinella	Carangids etc.
5	6	98

## CHAPTER 3 OVERVIEW AND SUMMARY OF RESULTS

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The survey was conducted successfully in the period November 4 to November 12 with a course track of about 1 175 NM and 27 fishing stations.

The hydrographical data showed a stable surface layer for the whole shelf in the south, but with declining surface temperatures towards the coast from about Dakar northwards.

### Pelagic fish

Sardinellas were found in a continuous belt along the inshore shelf from Casamance in the south to Cap Vert (Figure 4). High densities were found in the area off The Gambia, west of the Saloum river and in the Baie de Goree. In The Gambia, flat sardinella dominated, while further north, the round sardinella was the dominating species. All in all, the two sardinella species were found in almost equal amounts. Very low concentrations of the two sardinella species were found inshore between Cayar and St. Louis.

The distribution of carangids and associated species formed a band along the coast mostly on the offshore side of the sardinella areas, but still on the inner shelf, mainly inside the isobath of 50 m (Figure 5). South of Cape Vert the catches of this group consisted of bumper, false scad, barracudas and hairtails. Horse mackerel was hardly present. The catches north of Cape Vert were also dominated by bumper with the additional presence of little tunny, pompano and hairtail.

An overview of the estimates of biomass of the main groups of pelagic fish based on the echo integration data is shown in Table 5. The total biomass of sardinellas was thus 295 000 tonnes and of carangids and associated species about 254 000 tonnes.

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

	Flat sardinella	Round sardinella	Carangids etc.
St. Louis-Cape Vert	5	6	98
Cape Vert-Gambia	100	35	71
Gambia	10	88	15
Casamance	44	7	70
Total	159	136	254



Table 6 lists biomass estimates of sardinellas and carangids and associated species from previous 'Dr. Fridtjof Nansen' surveys of this shelf region. Large-scale latitudinal movements of pelagic fish between West Sahara and Guinea Bissau are well known and November is still within the season of northern distribution. Compared with the Sept/81 and NovDec/86 surveys the estimate of 295 000 tonnes of sardinellas from the current survey is still somewhat low. The carangid estimate of 254 000 tonnes is at the level of the estimate in 1995 and about half of last years estimate of 526 000 tonnes.

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

Survey:	Sardinellas	Carangids etc.
AprMay-81	210	570
Sept -81	360	*
FebMar-82	40	90
NovDec-86	330	170
FebMar-92	1 530	690
NovDec-95	760	220
NovDec-96	231	526

\* Not available

# Annex I Records of fishing stations

PROJECT STATION: 558

DATE: 5/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1211 Long W 1721

TIME	:00:27:42	00:54:19	27 (min)	Purpose code: 1
LOG	:1492.72	1494.09	1.35	Area code :
FDEPTH:	5	5		GearCond.code:
BDEPTH:	184	140		Validity code:
Towing dir: 90° Wire out: 120 m Speed: 30 kn*10				

Sorted: 2 Kg Total catch: 2.01 CATCH/HOUR: 4.47

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
MYCTOPHIDAE	3.09	5280	69.13
SQUONOO	0.84	309	18.79
Bregmaceros sp.	0.29	202	6.49
OMMASTREPHIDAE	0.22	2	4.92
Trichiurus lepturus	0.02	2	0.45
<b>Total</b>	<b>4.46</b>	<b>99.78</b>	

PROJECT STATION: 559

DATE: 5/11/97 GEAR TYPE: PT No:5 POSITION:Lat N 1211 Long W 1704

TIME	:02:57:26	03:34:03	37 (min)	Purpose code: 1
LOG	:1510.95	1512.44	1.47	Area code :
FDEPTH:	18	17		GearCond.code:
BDEPTH:	18	17		Validity code:
Towing dir: 45° Wire out: 130 m Speed: 30 kn*10				

Sorted: 78 Kg Total catch: 140.23 CATCH/HOUR: 227.40

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chloroscombrus chrysurus	61.62	670	27.10
Ilisha africana	57.57	1643	25.32
Hemicaranx bicolor	43.78	294	19.25
Sphyræna quachancho	25.86	41	11.37
Brachydeuterus auritus	25.46	425	11.20
Elops lacerta	5.32	13	2.34
Nematopalaemon hastatus	4.05	20270	1.78
Trichiurus lepturus	3.31	590	1.46
Caranx crysos	0.39	6	0.17
Penaeus notialis	0.03	10	0.01
<b>Total</b>	<b>227.39</b>	<b>100.00</b>	

PROJECT STATION: 560

DATE: 5/11/97 GEAR TYPE: PT No:5 POSITION:Lat N 1220 Long W 1655

TIME	:05:04:23	05:34:40	30 (min)	Purpose code: 1
LOG	:1525.32	1526.78	1.44	Area code :
FDEPTH:	18	20		GearCond.code:
BDEPTH:	18	20		Validity code:
Towing dir: 270° Wire out: 130 m Speed: 30 kn*10				

Sorted: 29 Kg Total catch: 29.06 CATCH/HOUR: 58.12

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Ilisha africana	16.98	2208	29.22
Sphyræna quachancho	14.64	32	25.19
Brachydeuterus auritus	12.00	234	20.65
Chloroscombrus chrysurus	7.80	108	13.42
Sardinella maderensis	2.04	36	3.51
Caranx senegallus	1.42	6	2.44
Elops lacerta	1.18	2	2.03
Hemicaranx bicolor	0.84	6	1.45
Galeoides decadactylus	0.50	6	0.86
Trichiurus lepturus	0.46	32	0.79
Penaeus notialis	0.20	18	0.34
Alectis alexandrinus	0.06	4	0.10
<b>Total</b>	<b>58.12</b>	<b>100.00</b>	

PROJECT STATION: 561

DATE: 5/11/97 GEAR TYPE: PT No:1 POSITION:Lat N 1221 Long W 1714

TIME	:07:52:47	08:20:40	28 (min)	Purpose code: 1
LOG	:1544.64	1546.22	1.58	Area code :
FDEPTH:	0	0		GearCond.code:
BDEPTH:	26	28		Validity code:
Towing dir: 290° Wire out: 150 m Speed: 35 kn*10				

Sorted: 10 Kg Total catch: 9.63 CATCH/HOUR: 20.64

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Scomberomorus tritor	16.82	6	81.49
Caranx senegallus	2.06	4	9.98
Echeneis naucrates	1.76	13	8.53
<b>Total</b>	<b>20.64</b>	<b>100.00</b>	

PROJECT STATION: 562

DATE: 5/11/97 GEAR TYPE: PT No:7 POSITION:Lat N 1231 Long W 1719

TIME	:12:17:15	12:48:37	31 (min)	Purpose code: 1
LOG	:1587.57	1589.18	1.57	Area code :
FDEPTH:	5	5		GearCond.code:
BDEPTH:	25	23		Validity code:
Towing dir: 90° Wire out: 300 m Speed: 30 kn*10				

Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION: 563

DATE: 5/11/97 GEAR TYPE: BT No:1 POSITION:Lat N 1233 Long W 1706

TIME	:14:36:18	15:08:12	32 (min)	Purpose code: 1
LOG	:1604.26	1606.01	1.72	Area code :
FDEPTH:	15	15		GearCond.code:
BDEPTH:	15	15		Validity code:
Towing dir: 185° Wire out: 200 m Speed: 30 kn*10				

Sorted: 9 Kg Total catch: 9.49 CATCH/HOUR: 17.79

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chloroscombrus chrysurus	9.66	259	54.30
Brachydeuterus auritus	1.58	17	8.88
Eucinostomus melanopterus	1.52	19	8.54
Echeneis naucrates	1.22	6	6.86
Brachydeuterus auritus Juv.	1.11	218	6.24
Decapterus rhonchus	1.05	30	5.90
Caranx senegallus	0.77	4	4.33
Sardinella maderensis	0.47	9	2.64
Galeoides decadactylus	0.26	2	1.46
Callinectes pallidus	0.17	4	0.96
<b>Total</b>	<b>17.81</b>	<b>100.11</b>	

PROJECT STATION: 564

DATE: 5/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1237 Long W 1707

TIME	:16:16:39	16:52:11	36 (min)	Purpose code: 1
LOG	:1614.55	1616.50	1.60	Area code :
FDEPTH:	0	0		GearCond.code: 8
BDEPTH:	15	14		Validity code: 4
Towing dir: 185° Wire out: 180 m Speed: 33 kn*10				

Sorted: 66 Kg Total catch: 218.40 CATCH/HOUR: 364.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Sardinella maderensis	216.72	2832	59.54
Chloroscombrus chrysurus	91.58	2740	25.16
Brachydeuterus auritus	44.63	683	12.26
Scomberomorus tritor	3.55	3	0.98
Caranx crysos	3.32	2	0.91
Hemiramphus brasiliensis	2.22	58	0.64
Sardinella aurita	1.00	?	0.27
Sphyræna quachancho	0.98	3	0.27
<b>Total</b>	<b>364.00</b>	<b>100.00</b>	

PROJECT STATION: 565

DATE: 5/11/97 GEAR TYPE: PT No:1 POSITION:Lat N 1241 Long W 1714

TIME	:10:54:01	19:20:52	27 (min)	Purpose code: 1
LOG	:1633.62	1635.19	1.55	Area code :
FDEPTH:	5	5		GearCond.code:
BDEPTH:	23	21		Validity code:
Towing dir: 90° Wire out: 160 m Speed: 40 kn*10				

Sorted: 61 Kg Total catch: 299.37 CATCH/HOUR: 665.27

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Brachydeuterus auritus	596.67	11202	89.69
Ilisha africana	25.89	2047	3.89
Galeoides decadactylus	11.56	78	1.74
Chloroscombrus chrysurus	9.89	144	1.45
Selene dorsalis	8.89	178	1.34
Sphyræna quachancho	6.67	33	1.00
Sardinella aurita	3.07	11	0.46
Trachinotus ovatus	2.00	11	0.30
Sardinella maderensis	0.64	4	0.10
<b>Total</b>	<b>665.28</b>	<b>100.01</b>	

PROJECT STATION: 566

DATE: 6/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1251 Long W 1708

TIME	:02:24:01	02:52:37	29 (min)	Purpose code: 1
LOG	:1713.53	1715.11	1.54	Area code :
FDEPTH:	0	0		GearCond.code:
BDEPTH:	23	26		Validity code:
Towing dir: 270° Wire out: 200 m Speed: 30 kn*10				

Sorted: 94 Kg Total catch: 4530.20 CATCH/HOUR: 9372.83

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight numbers		
Chloroscombrus chrysurus	6584.28	167537	70.25
Brachydeuterus auritus	1886.90	30687	20.13
Sardinella maderensis	685.24	13903	7.31
Selene dorsalis	96.41	2086	1.03
Sardinella aurita	49.66	199	0.53
Pomadourys peroteti	32.69	99	0.15
Ilisha africana	12.83	695	0.14
Decapterus rhonchus	10.97	298	0.12
Galeoides decadactylus	9.91	99	0.11
Penaeus notialis	3.91	195	0.04
<b>Total</b>	<b>9172.84</b>	<b>100.01</b>	

PROJECT STATION: 567  
 DATE: 6/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1260 Long W 1705  
 start stop duration  
 TIME :05:37:35 06:06:29 29 (min) Purpose code: 1  
 LOG :1737.50 1739.10 1.57 Area code : 1  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 22 20 Validity code:  
 Towing dir: 90° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 66 Kg Total catch: 440.83 CATCH/HOUR: 912.06

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	344.69	11797	37.79	1133
Brachydeuterus auritus	279.52	3494	30.65	1134
Sardinella maderensis	189.72	6370	20.80	1131
Decapterus rhonchus	72.99	2487	8.00	1132
Sardinella aurita	12.60	130	1.38	1130
Sardinella aurita	8.34	46	0.91	1129
Galeoides decadactylus	2.75	101	0.30	
Penaeus notialis	0.87	43	0.10	
Sepia sp.	0.29	29	0.03	
Penaeus kerathurus	0.29	14	0.03	
Total	912.06		99.99	

PROJECT STATION: 571  
 DATE: 7/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1345 Long W 1657  
 start stop duration  
 TIME :12:48:43 13:05:35 17 (min) Purpose code: 1  
 LOG :2039.57 2040.31 0.76 Area code : 1  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 18 19 Validity code:  
 Towing dir: 270° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 69 Kg Total catch: 124.69 CATCH/HOUR: 440.08

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	317.65	13482	72.18	1151
Brachydeuterus auritus	39.04	791	8.87	1152
Scomberomorus tritor	33.35	35	7.58	
Sardinella maderensis	22.80	339	5.18	1150
Trachinotus ovatus	15.14	81	3.44	
Decapterus rhonchus	4.73	346	1.07	1153
Sardinella aurita	4.09	21	0.93	1149
Echeneis naucrates	1.45	4	0.33	
Hemiramphus brasiliensis	1.13	35	0.26	
Dentex congensis	0.35	7	0.08	
Selene dorsalis	0.35	7	0.08	
Total	440.08		100.00	

PROJECT STATION: 568  
 DATE: 6/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1309 Long W 1702  
 start stop duration  
 TIME :13:58:44 14:39:34 41 (min) Purpose code: 1  
 LOG :1824.74 1827.35 2.38 Area code : 1  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 21 24 Validity code:  
 Towing dir: 270° Wire out: 200 m Speed: 38 kn\*10  
 Sorted: 65 Kg Total catch: 260.80 CATCH/HOUR: 381.66

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	304.98	1774	79.91	1136
Scomberomorus tritor	27.51	18	7.21	
Sardinella maderensis	20.37	240	5.34	1135
Chloroscombrus chrysurus	16.57	357	4.34	1137
Brachydeuterus auritus	12.23	146	3.20	1138
Total	381.66		100.00	

PROJECT STATION: 572  
 DATE: 7/11/97 GEAR TYPE: PT No:1 POSITION:Lat N 1407 Long W 1707  
 start stop duration  
 TIME :21:28:01 21:53:45 26 (min) Purpose code: 1  
 LOG :2128.33 2129.91 1.52 Area code : 1  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 27 24 Validity code:  
 Towing dir: 70° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 64 Kg Total catch: 963.00 CATCH/HOUR: 2222.31

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	1938.46		87.23	
Pomatomus saltatrix	64.38	35	2.90	
Decapterus rhonchus	33.92	1765	1.53	1156
Pomadasy peroteti	33.23	69	1.50	
Pomadasy rogeri	32.54	35	1.46	
Selene dorsalis	32.19	104	1.45	
Sardinella maderensis	31.85	312	1.43	1154
Decapterus punctatus	26.31	969	1.18	1155
Trachinotus ovatus	20.42	69	0.92	
Pomadasy incisus	9.00	35	0.40	
Total	2222.30		100.00	

PROJECT STATION: 569  
 DATE: 6/11/97 GEAR TYPE: BT No:1 POSITION:Lat N 1320 Long W 1703  
 start stop duration  
 TIME :16:47:44 17:22:56 35 (min) Purpose code: 1  
 LOG :1847.23 1848.97 1.60 Area code : 1  
 FDEPTH: 23 20 GearCond.code: 9  
 BDEPTH: 23 20 Validity code: 4  
 Towing dir: 270° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 61 Kg Total catch: 302.87 CATCH/HOUR: 519.21

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	300.00	4008	57.78	1142
Chloroscombrus chrysurus	148.71	2962	28.64	1141
Sardinella maderensis	15.69	463	3.02	1139
Pagrus caeruleostictus	11.57	43	2.23	
Decapterus rhonchus	10.63	574	2.05	1140
Pomadasy jubelini	8.40	17	1.62	
Scomberomorus tritor	6.60	9	1.27	
Alectis alexandrinus	4.46	9	0.86	
Galeoides decadactylus	3.43	34	0.66	
Sepia officinalis hierredda	2.91	9	0.56	
Penaeus notialis	1.83	99	0.35	
Eucinostomus melanopterus	1.63	17	0.31	
Pseudupeneus prayensis	1.54	43	0.30	
Selene dorsalis	0.94	17	0.18	
Pomadasy incisus	0.86	9	0.17	
Total	519.20		100.00	

PROJECT STATION: 573  
 DATE: 8/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1415 Long W 1708  
 start stop duration  
 TIME :00:15:41 00:45:42 30 (min) Purpose code: 1  
 LOG :2148.64 2150.08 1.42 Area code : 1  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 25 29 Validity code:  
 Towing dir: 270° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 64 Kg Total catch: 96.56 CATCH/HOUR: 193.12

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	105.30	4246	54.53	1160
Decapterus punctatus	21.58	904	11.17	1159
Sardinella aurita	14.46	1882	7.50	1158
Carcharhinus limbatus	13.18	12	6.82	
Sardinella maderensis	9.06	162	4.69	1157
Pomadasy jubelini	6.42	46	3.32	
Rachycentron canadum	5.70	4	2.95	
Sphyrna quachancho	4.26	16	2.21	
Hemiramphus brasiliensis	3.16	76	1.64	
Pomadasy incisus	2.68	22	1.39	
Dactylopterus volitans	1.80	4	0.93	
Arius heudeloti	1.36	6	0.70	
Penaeus notialis	1.32	72	0.68	
Lagocephalus laevigatus	0.70	4	0.36	
Chloroscombrus chrysurus	0.60	6	0.31	
Pagellus bellottii	0.58	10	0.30	
Chilomycterus spinosus mauret.	0.30	4	0.16	
Eucinostomus melanopterus	0.24	4	0.12	
Penaeus kerathurus	0.18	6	0.09	
Fodiator acutus	0.18	6	0.09	
Fistularia tabacaria	0.04	6	0.02	
Total	193.12		99.98	

PROJECT STATION: 570  
 DATE: 7/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1334 Long W 1706  
 start stop duration  
 TIME :03:06:16 03:36:46 31 (min) Purpose code: 1  
 LOG :1946.97 1948.57 1.58 Area code : 1  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 34 31 Validity code:  
 Towing dir: 90° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 105 Kg Total catch: 104.99 CATCH/HOUR: 203.21

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Pomadasy jubelini	121.16	453	59.62	
Brachydeuterus auritus	19.35	197	9.52	1148
Decapterus rhonchus	18.70	623	9.20	1145
Sphyrna quachancho	11.15	27	5.49	
Sardinella aurita	7.86	105	3.87	1143
Sardinella maderensis	6.08	35	2.99	1144
Carcharhinus limbatus	4.39	4	2.16	
Chloroscombrus chrysurus	4.05	37	1.99	1147
Pomadasy peroteti	2.11	6	1.04	
Selene dorsalis	1.63	14	0.80	
Lagocephalus laevigatus	1.16	2	0.57	
Arius heudeloti	0.91	2	0.45	
Galeoides decadactylus	0.85	4	0.42	
Pomadasy incisus	0.83	4	0.41	
Decapterus punctatus	0.77	37	0.38	1146
Selar crumenophthalmus	0.70	2	0.34	
Trachinotus ovatus	0.50	2	0.25	
Eucinostomus melanopterus	0.43	4	0.21	
Alectis alexandrinus	0.33	2	0.16	
Penaeus notialis	0.19	23	0.09	
Pseudupeneus prayensis	0.06	2	0.03	
Penaeus kerathurus	0.02	2	0.01	
Total	203.23		100.00	

PROJECT STATION: 574  
 DATE: 8/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1425 Long W 1716  
 start stop duration  
 TIME :06:02:28 06:15:48 13 (min) Purpose code: 1  
 LOG :2206.74 2207.48 0.73 Area code : 1  
 FDEPTH: 0 5 GearCond.code:  
 BDEPTH: 42 41 Validity code:  
 Towing dir: 90° Wire out: 200 m Speed: 40 kn\*10  
 Sorted: 9 Kg Total catch: 8.91 CATCH/HOUR: 41.12

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	10.48	78	25.49	1162
Sphyrna sphyraena	7.94	28	19.31	
Hemiramphus brasiliensis	6.09	42	14.81	
Sardinella aurita	5.58	111	13.57	1161
Scomber japonicus	5.35	42	13.01	1164
Trachurus trecae	4.48	46	10.89	1163
Euthynnus alletteratus	0.92	5	2.24	
Decapterus punctatus	0.28	9	0.68	
Total	41.12		100.00	



PROJECT STATION: 584  
 DATE:12/11/97 GEAR TYPE: PT No:2 POSITION:Lat N 1558  
 TIME :09:16:48 09:28:43 12 (min) Purpose code: 1  
 LOG :2664.11 2664.82 0.70 Area code : 1  
 FDEPTH: 20 20 GearCond.code:  
 BDEPTH: 39 39 Validity code:  
 Towing dir: 15° Wire out: 100 m Speed: 40 kn\*10  
 Sorted: 25 Kg Total catch: 25.14 CATCH/HOUR: 125.70

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Trachinotus ovatus	49.50	180	39.38	1188
Brachydeuterus auritus	28.85	2690	22.95	
Chloroscombrus chrysurus	21.90	170	17.42	1189
Sardinella maderensis	6.60	65	5.25	1187
Trichiurus lepturus	5.20	45	4.14	
Decapterus rhonchus	3.75	5	2.98	
Selene dorsalis	3.55	75	2.82	
Ilisha africana	3.35	635	2.67	
Sarda sarda	1.05	5	0.84	
Pseudolithus senegalensis	1.00	5	0.80	
Trachurus trecae	0.55	15	0.44	
Pteroscion peli	0.30	20	0.24	
Galeoides decadactylus	0.10	5	0.08	
Total	125.70		100.01	

PROJECT STATION: 585  
 DATE:12/11/97 GEAR TYPE: PT No:2 POSITION:Lat N 1610  
 TIME :12:53:27 13:03:14 10 (min) Purpose code: 1  
 LOG :2695.70 2697.00 1.30 Area code : 2  
 FDEPTH: 50 50 GearCond.code: 9  
 BDEPTH: 84 85 Validity code:  
 Towing dir: 263° Wire out: 150 m Speed: 30 kn\*10  
 Sorted: 93 Kg Total catch: 1698.57 CATCH/HOUR: 10191.42

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	9947.40	68190	97.61	1190
Decapterus rhonchus	169.20	438	1.66	1191
Trachurus trecae	39.60	3738	0.39	1192
Loligo vulgaris	26.40	108	0.26	
Sphoeroides spengleri	8.82	108	0.09	
Total	10191.42		100.01	

PROJECT STATION: 586  
 DATE:12/11/97 GEAR TYPE: PT No:2 POSITION:Lat N 1610  
 TIME :14:15:00 14:30:00 15 (min) Purpose code: 1  
 LOG :2703.00 2705.00 2.00 Area code : 2  
 FDEPTH: 30 30 GearCond.code:  
 BDEPTH: 65 70 Validity code:  
 Towing dir: 265° Wire out: 100 m Speed: 35 kn\*10  
 Sorted: 7 Kg Total catch: 7.00 CATCH/HOUR: 28.00

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Trachinotus ovatus	40.00	113	142.86	1193
Sarda sarda	6.20	7	22.14	
Chilomycterus reticulatus	0.47	7	1.68	
Total	46.67		166.68	

PROJECT STATION: 587  
 DATE:12/11/97 GEAR TYPE: PT No:2 POSITION:Lat N 1613  
 TIME :16:05:16 16:34:01 29 (min) Purpose code: 1  
 LOG :2715.86 2717.20 1.31 Area code : 2  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 27 36 Validity code:  
 Towing dir: 300° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 86 Kg Total catch: 85.95 CATCH/HOUR: 177.83

SPECIES	CATCH/HOUR		OF TOT. C	SAMP
	weight	numbers		
Fomadasys peroteti	53.59	190	30.14	
Brachydeuterus auritus	29.90	844	16.81	1196
Alectis alexandrinus	25.34	37	14.25	1194
Selene dorsalis	21.10	428	11.87	1195
Trichiurus lepturus	9.02	85	5.07	
Sepia officinalis hierreda	6.83	17	3.84	
Sphyræna guachancho	5.50	64	3.09	
Fagellus bellottii	4.41	17	2.48	
Fomadasys incisus	3.87	17	2.18	
Pteroscion peli	3.31	48	1.86	
Pseudolithus senegalensis	3.29	10	1.85	
Sardinella maderensis	2.94		1.65	
Galeoides decadactylus	2.46	25	1.38	
DIODONTIDAE	2.15	10	1.21	
Scomberomorus tritor	1.41	2	0.79	
Campogramma glaycos	1.26	4	0.71	
Lagocephalus laevigatus	0.43	4	0.24	
Sardinella aurita	0.41	2	0.23	
Chloroscombrus chrysurus	0.33	2	0.19	
Penaeus notialis	0.14	4	0.08	
Trachurus trecae	0.12	2	0.07	
Total	177.81		99.99	

## Annex II Description of instruments and fishing gear used

The Simrad EK-500, 38 kHz 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 echo 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 38 kHz were as follows:

<b>Transceiver-1 menu</b>	Transducer depth	0.0 m
	Absorbtion coeff.	10 dB/km
	Pulse length	medium
	Bandwidth	wide
	Max Power	2000 W
	2-way beam angle	-21.0 dB
	SV transducer gain	28.0 dB
	TS transducer gain	27.9 dB
	Angle sensitivity	21.9
	3 dB beamwidth	6.8 deg
	Alongship offset	0.00 deg
	Athwardship offset	0.04 deg
<b>Display menu</b>	Echogram	1
	Bottom range	12 m
	Bottom start	10 m
	TVG	20 log R
	SV Colour minimum	-67 dB
	TS Colour minimum	-50 dB
<b>Printer settings</b>	Range	0-100 or 0-250 m
	TVG	20 log R
	Sv Colour minimum	-72 dB
<b>Bottom detection menu</b>		-50 dB

A calibration experiment using a standard copper sphere, performed in Baia dos Tigres 15 June 1995 gave the following results :

Sv Transducer gain 28.1 dB

Ts Transducer gain 28.0 dB

### **Hydrography**

Conductivity, temperature, density and dissolved oxygen were sampled regularly at CTD stations with a Seabird 911+ CTD sonde. The salinity is computed from the data on conductivity by the software retrieving data from the sensors.

### **Fishing gear**

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

# F/F Dr. Fridtjof Nansen

OVER/UNDER/SIDER

OVERDEL:  
50 STK 11' PLASTKULER

UNDERDEL:  
14 M/M VIRE OMSP. MED  
14 M/M BLYTAU  
+ KJETTING.

TOTAL VEKT UNDER 400 KG.

SIDER.

1/2 HOGG 5,00 MTR  
STRF. 6,00 MTR  
ARM 6,00 MTR  
TAMP 2,60 MTR  
TOT. 36,00 MTR  
22 M/M Ø COMB. TAU

1/2 HOGG 4,00 MTR  
STRF. 6,00 MTR  
ARM 22,40 MTR  
TAMP 2,60 MTR  
TOT. 35,00 MTR  
28 M/M Ø  
FL. DANLINE

MASKER TRAAD LENGDE MASKER  
M/M NR. I MTR. I EVING

3200.0 240 22.4 4

3200.0 240 32.0 4 9.5L

1620.0 160 13.0 4

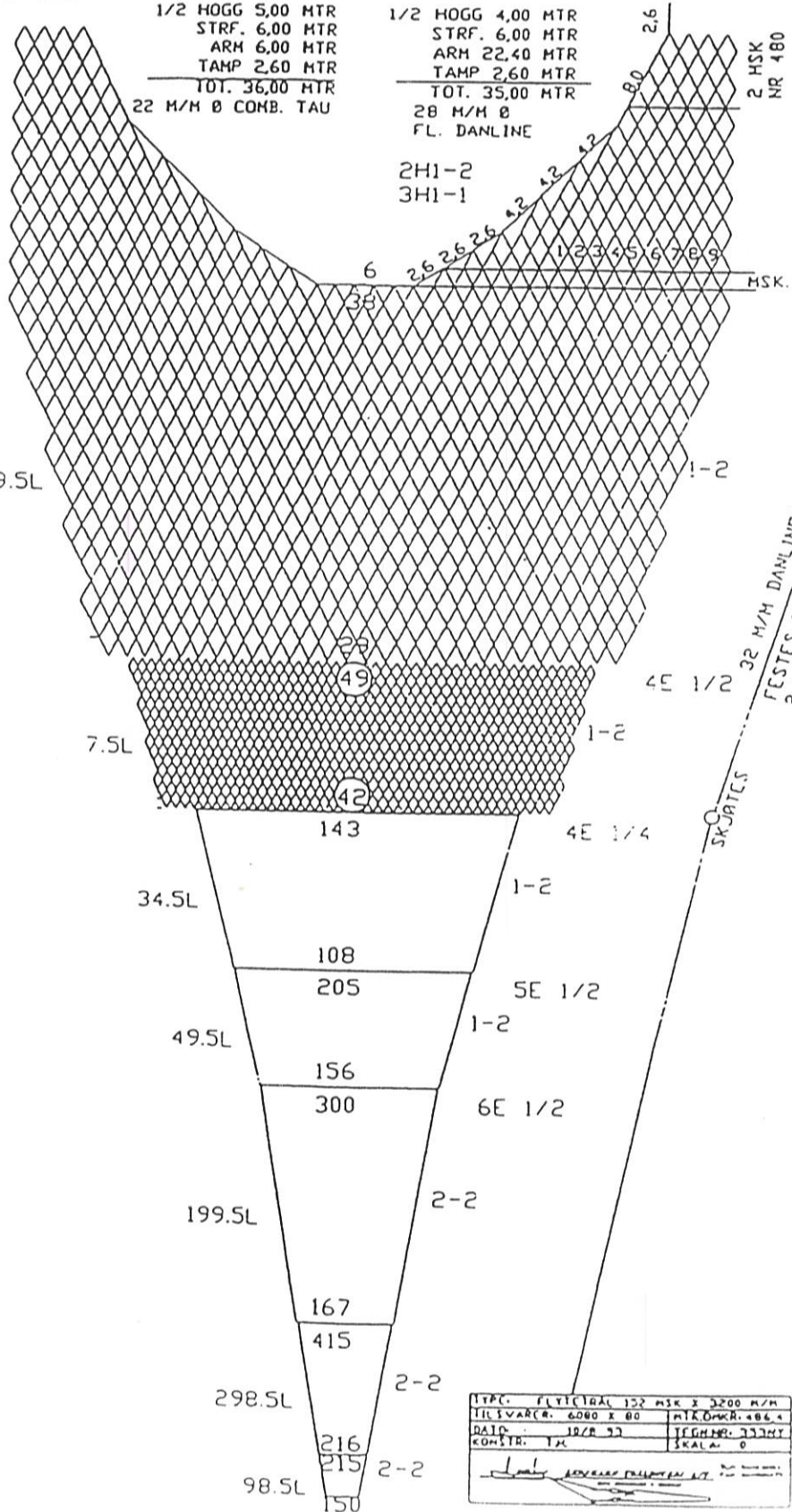
400.0 48 14.0 4

200.0 32 10.00 4

100.0 24 20.0 4

38.0 12 11.4 4

38.0 18 3.76 4



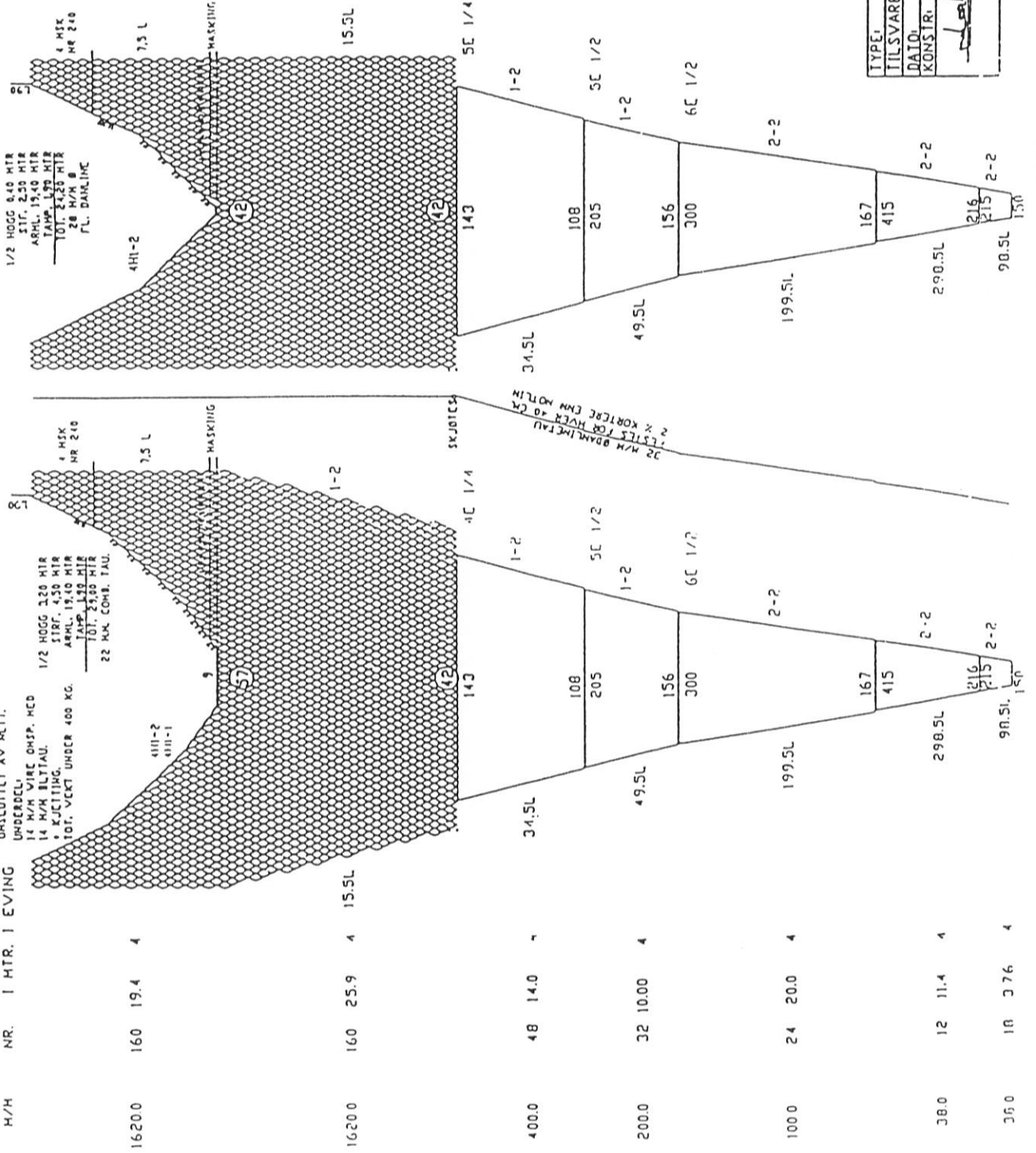
ITPC.	FLYTELAL 132 MSK X 3200 M/M	
ILLSVARER.	6000 X 80	MTR ØMSK. 484
DAID.	18/8 92	IFGHNR. 33347
KOMITE.	TK	SKALA 0



# F/F Dr. Fridtjof Nansen

SIDER

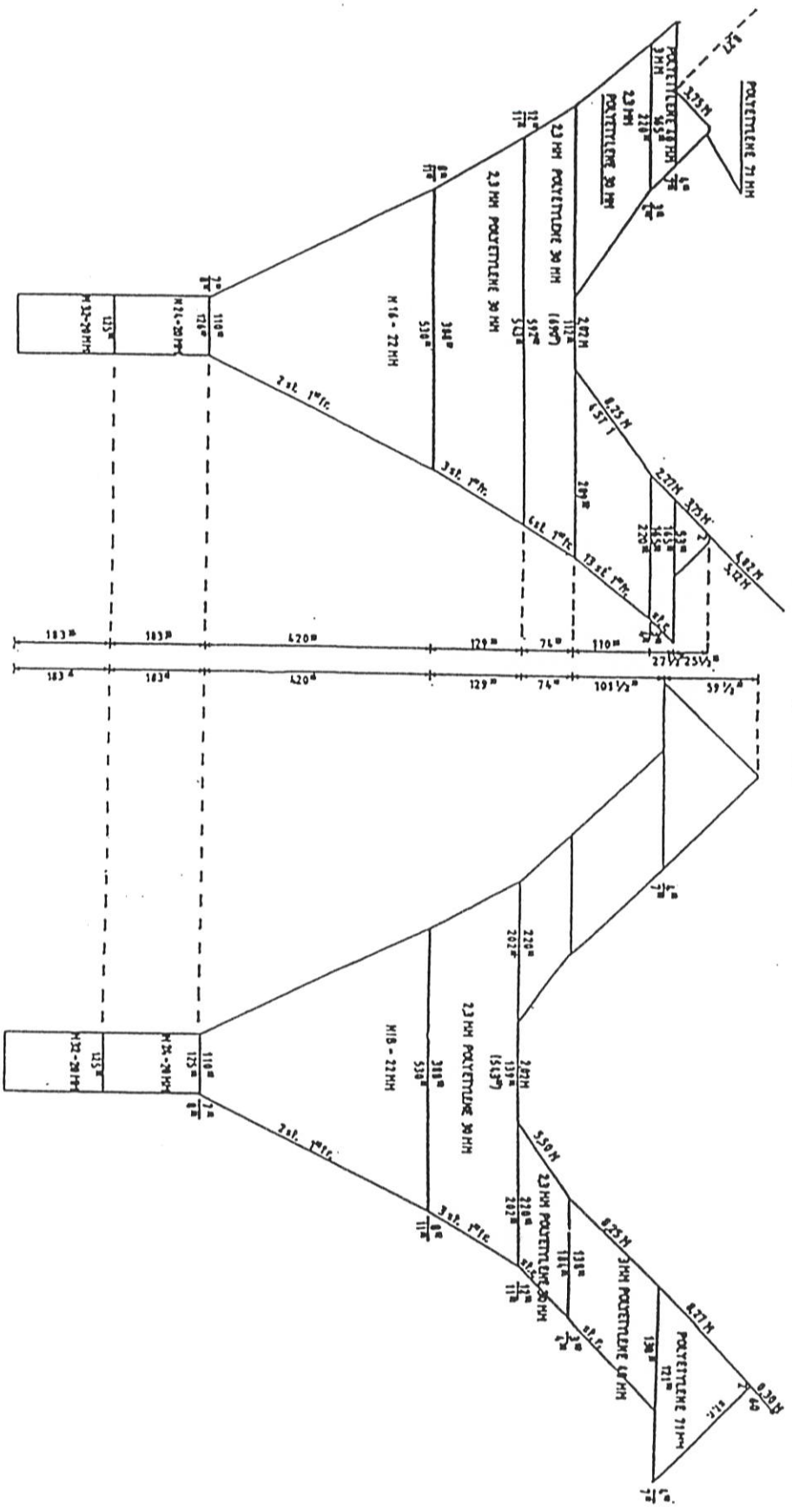
HASKER TRAAD LENGDE HASKER  
H/H NR. I MTR. I EVING



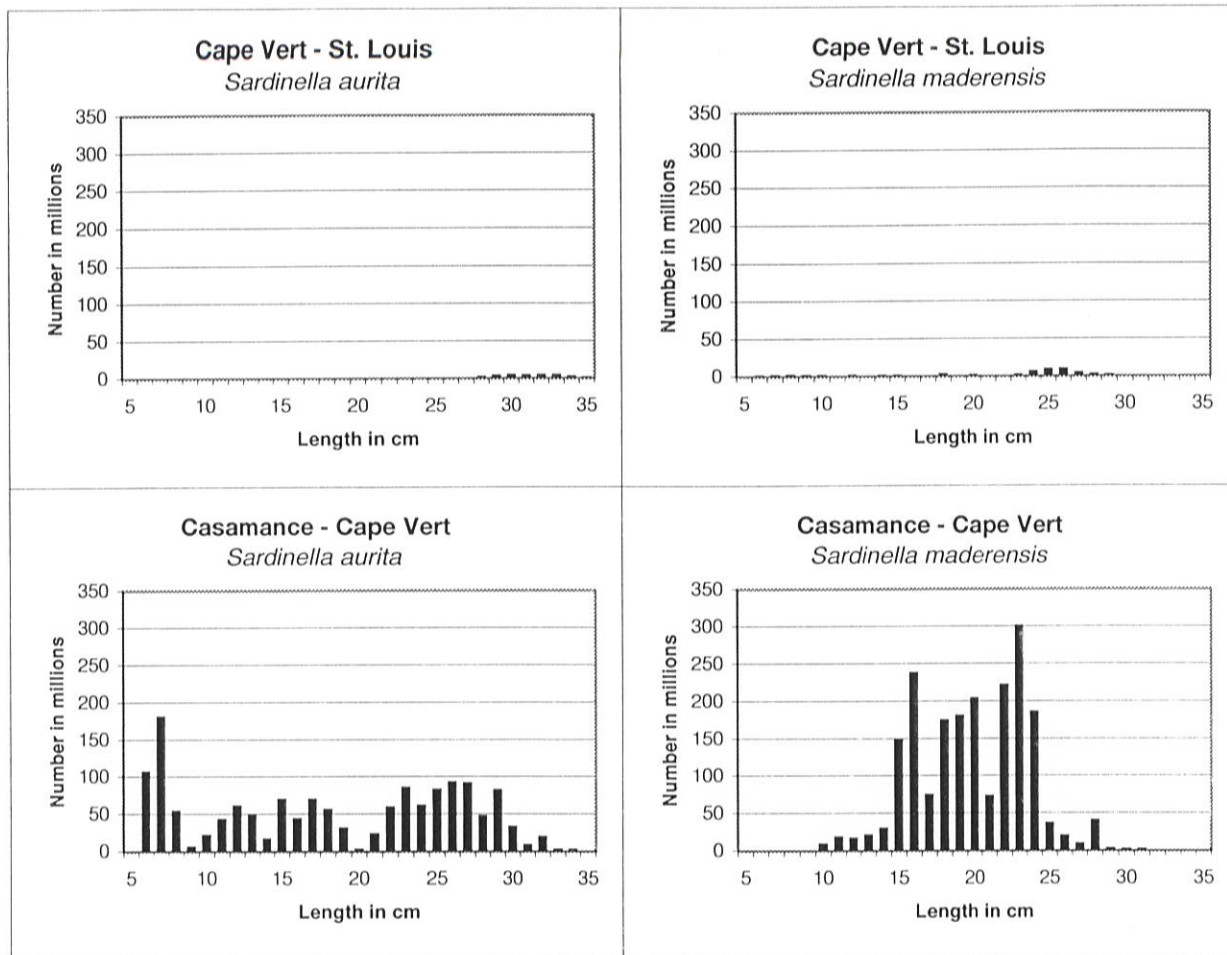
TYPE:	FLYTETRAL 198	MSK X 1620	H/H
TILSVARER:	4010	X 80	MTR.ØMKR. 320
DAIO:	23/6	93	TEGNNR. 510
KONSTR:	T-H		SKALA: 1:0

JORDANSK FLYTETRAL 1/2 (198-11-1111)

Bottom trawl: High opening shrimp and fish trawl with net headline 31m (floatline), foot-rope 47m, gear with 12 cm diameter roller disks, 40 m sweeps, estimated headline height 6m and distance between wings during towing 18-20m.



### Annex III Pooled length distributions by species and regions



## Annex IV Stock length distribution by numbers and weight

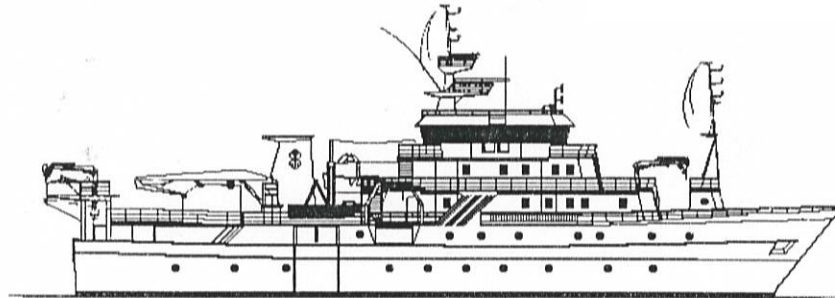
### *Sardinella aurita*

Length cm	N (millions)					Biomass (1000 tonnes)				
	St. Louis- Cap Vert	Cap Vert- Gambia	Gambia	Casa- mance	TOTAL	St. Louis- Cap Vert	Cap Vert- Gambia	Gambia	Casa- mance	TOTAL
5										
6		105.7			105.7		0.3			0.3
7		179.9	0.7		180.7		0.7	0.0		0.7
8		53.0	0.5		53.5		0.3	0.0		0.3
9		5.4	0.2		5.6		0.0	0.0		0.0
10		21.2	0.2		21.5		0.2	0.0		0.2
11		42.3			42.3		0.6			0.6
12		58.6	1.5		60.1		1.0	0.0		1.0
13		47.9	1.0		48.8		1.0	0.0		1.0
14		15.9	0.2		16.2		0.4	0.0		0.4
15		69.3			69.3		2.2			2.2
16		41.9	1.2		43.1		1.6	0.0		1.7
17		69.3			69.3		3.2			3.2
18		55.4			55.4		3.1			3.1
19		27.7	2.3	0.6	30.6		1.8	0.1	0.0	2.0
20			2.0		2.0			0.2		0.2
21		0.3	21.9	0.6	22.8		0.0	1.9	0.1	2.0
22		28.4	29.3	0.7	58.3		2.8	2.9	0.1	5.8
23		19.0	64.8	0.7	84.5		2.1	7.3	0.1	9.5
24		14.3	46.4	0.1	60.8		1.8	5.9	0.0	7.8
25		13.9	67.7	0.4	82.0		2.0	9.8	0.1	11.8
26	0.2	13.9	77.7	0.0	91.9	0.0	2.3	12.6	0.0	14.9
27	0.2	18.7	71.6	0.2	90.7	0.0	3.4	13.0	0.0	16.4
28	1.2	0.1	41.1	5.5	47.8	0.2	0.0	8.3	1.1	9.6
29	2.8	18.7	57.1	5.5	84.2	0.6	4.2	12.8	1.2	18.8
30	3.9	0.1	27.0	5.4	36.5	1.0	0.0	6.7	1.3	9.0
31	3.4	0	8.2	0.1	11.7	0.9		2.2	0.0	3.2
32	3.8	0	8.4	10.9	23.1	1.1		2.5	3.2	6.9
33	3.7	0	2.0		5.7	1.2		0.7		1.9
34	1.5	0	2.0		3.5	0.5		0.7	0	1.3
35	0.5	0			0.5	0.2			0	0.2
TOTAL	21.1	920.8	535.3	30.8	1508.0	5.9	35.1	87.6	7.3	135.9

## Annex IV continued

### *Sardinella maderensis*

Length cm	N (millions)					Biomass (1000 tonnes)				
	St. Louis- Cap Vert	Cap Vert- Gambia	Gambia	Casa- mance	TOTAL	St. Louis- Cap Vert	Cap Vert- Gambia	Gambia	Casa- mance	TOTAL
5										
6	0.2				0.2	0.0				0.0
7	1.0				1.0	0.0				0.0
8	1.2				1.2	0.0				0.0
9	0.7				0.7	0.0				0.0
10	0.8		0.6	8.0	9.4	0.0		0.0	0.1	0.1
11	0.1		1.9	15.9	17.9	0.0		0.0	0.2	0.2
12	0.8	2.1	8.8	5.2	16.9	0.0	0.0	0.1	0.1	0.3
13		4.3	15.0	1.1	20.4		0.1	0.3	0.0	0.4
14	0.4	7.8	17.3	4.5	30.0	0.0	0.2	0.4	0.1	0.8
15	0.4	121.2	14.9	12.6	149.1	0.0	3.7	0.5	0.4	4.6
16		215.4	12.5	9.5	237.4		8.0	0.5	0.4	8.9
17		40.2	10.6	23.3	74.0		1.8	0.5	1.0	3.3
18	2.0	130.6	15.8	27.6	176.0	0.1	6.9	0.8	1.4	9.2
19		111.9	4.6	63.7	180.2		6.9	0.3	3.9	11.1
20	0.8	130.6	7.2	65.7	204.2	0.1	9.3	0.5	4.7	14.6
21			8.2	64.1	72.3			0.7	5.3	6.0
22		97.2	20.3	103.6	221.1		9.2	1.9	9.8	20.9
23	1.2	190.6	14.3	95.1	301.3	0.1	20.5	1.5	10.2	32.4
24	5.5	153.3	5.9	26.0	190.8	0.7	18.7	0.7	3.2	23.3
25	8.7	18.7	3.7	13.5	44.6	1.2	2.6	0.5	1.9	6.1
26	9.1	19.4			28.5	1.4	3.0			4.4
27	3.6	2.9	0.3	5.3	12.2	0.6	0.5	0.0	0.9	2.1
28	1.5	39.3	0.3		41.1	0.3	7.6	0.0		7.9
29	0.8	1.1	1.0		2.9	0.2	0.2	0.2		0.6
30	0.1	0.9	0.5		1.5	0.0	0.2	0.1		0.4
31	0.2	0.9	0.5		1.6	0.0	0.2	0.1		0.4
32										
33										
34										
35										
<b>TOTAL</b>	<b>39.2</b>	<b>1288.5</b>	<b>164.0</b>	<b>544.6</b>	<b>2036.3</b>	<b>4.8</b>	<b>99.7</b>	<b>9.9</b>	<b>43.6</b>	<b>158.0</b>



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

*Cruise Report No 11/97*

**Part II MAURITANIA**

**12 - 18 November 1997**

CRUISE REPORT "DR FRIDTJOF NANSEN"

**SURVEY OF THE PELAGIC FISH RESOURCES  
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**Part II  
MAURITANIA  
12 - 18 November 1997**

by

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Bergen, 1997**

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## CHAPTER 1 INTRODUCTION

---

### 1.1 OBJECTIVES OF THE CRUISE

The defined general objectives were to estimate and map the distribution and biomass 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 1997.

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 mackerel *Trachurus 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 was 6 days.

### 1.2 PARTICIPATION

Members of the scientific teams were:

Centre National de Recherches Océanographiques et des Pêches, Mauritania:  
Dah Ould ALIOUNE (10/11-16/12) and Mohammed Ould MAHFOUD (10-18/11)

Centre de Recherches Océanographiques de Dakar-Thiaroy, Senegal:  
Abdoulaye SARRE, Ibrahima SOW and Mor SYLLA

Senegalese Navy:  
Souleymane GUEYE

Institute of Marine Research , Norway:  
Reidar TORESEN, Oddgeir ALVHEIM, Guillermo BURGOS, Ingve FJELDSTAD and Tore MØRK.

### **1.3 NARRATIVE**

After getting onboard the Mauritanian scientific team in Dakar on 10 November and surveying the Senegalese shelf from Cape Vert to St. Louis, the survey of the Mauritanian shelf started on 12 November. Figure 1 shows the survey tracks and the fishing and hydrographical stations. Systematic triangular transects were run with about 12 NM distance between the end points. *Sardinella* was found over the inner shelf in a nearly continuous belt northward to Cape Timiris.

The hydrographic profile at 16°40' N was sampled on 13 November, at 18°00' N on 14 at 19°00' N on 16 at 20°00' N on 17 and off Cape Blanc on 21 November.

The survey was terminated in Nouadhibou on 18 November.

### **1.4 METHODS**

All catches were sampled for composition by weight and numbers of each species. The length frequency distributions of the target species were taken in all stations where they were present. Total fish length was measured. Individual weight was calculated as  $w=al^3$ , assuming isometric growth. The complete records of fishing stations are shown in Annex I.

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

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

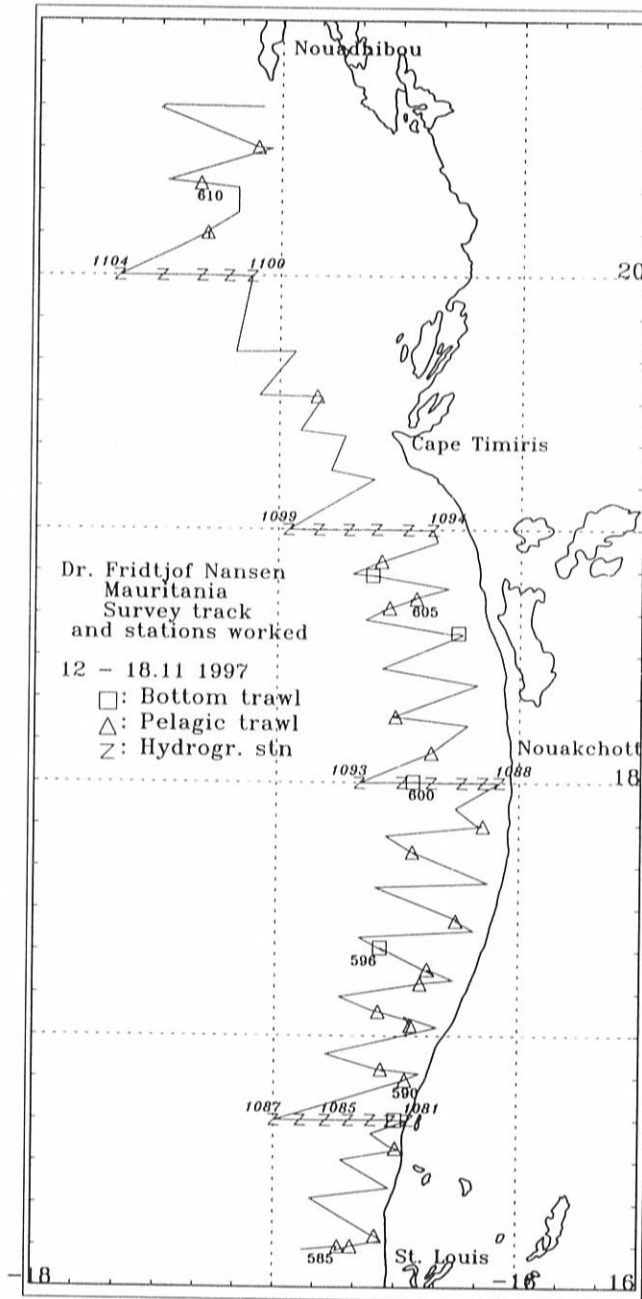


Figure 1 Course track and fishing and hydrographic stations.

The acoustic biomass estimates were based on the integration technique. The Bergen Integrator (BEI) was used for analysis and allocation of  $S_A$ -values. This system does not underestimate dense schools close to the bottom as may have happened with the EK500 used in the 1992 surveys.

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:

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

or in the form

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

where  $L$  is total length and  $C_F$  is the fish conversion factor. The following formula was used to calculate the density of fish in numbers/ $\text{NM}^2$  in each length group:

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

where

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

$S_A$  = mean integrator value

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

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

The integrator outputs were split on fish groups using a combination of behaviour pattern as deduced from echo diagrams, the BEI analysis and catch composition. Three groups were used for Mauritania: 1) sardinellas 2) horse mackerels and 3) carangids and associated species (chub mackerel, hairtails and barracudas).

The above equations 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 are geographically segregated. When no segregation occurs the various length distributions are pooled together with equal importance. Otherwise, when the size distribution varies with the sampling site, 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.

A systematic approach to a) divide the  $S_{\lambda}$ -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 mean back scattering strength ( $\rho/S_{\lambda}$ ) of each length frequency distribution of the target species is calculated and summed.
- The mean  $S_{\lambda}$ -value allocated to the category of fish is divided between the species in the same ratio as their relative contribution to the mean back scattering strength in the sample.
- For each species, the length distributions in an area are pooled by using the ratio between the allocated  $S_{\lambda}$ -value (the five mile value at the trawl station of the sample) and the mean back scattering strength as the weighting factor. If the size distribution is geographically uniform (not significantly different), the samples can be pooled together with equal importance.
- The pooled length distribution is used together with the mean  $S_{\lambda}$ -value to calculate the density (numbers per square NM) by length groups, for each area, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area.
- The numbers are converted to biomass using the estimated weight at length.

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 was applied.

Annex II gives a description of the instruments and the fishing gear used.

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

## CHAPTER 2 SURVEY RESULTS

---

### 2.1 HYDROGRAPHY

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

The distribution of surface temperature showed that over the shelf from St. Louis to Cape Timiris there was a decrease offshore from 26°C to 24°C off Nouakchott. There was a further decline to 19°C off Cape Timiris. Near the coast, however, there was in general lower temperatures than offshore. In the southern limit of the surveyed area, the inshore temperature was measured at about 24°C decreasing northwards to 20-21°C off Cape Timiris.

Between Cape Timiris and Cape Blanc, the surface temperature was low inshore, 19-20°C, increasing offshore to 22-23°C. On the next phase of the survey a hydrographic section will be worked at Cape Blanc.

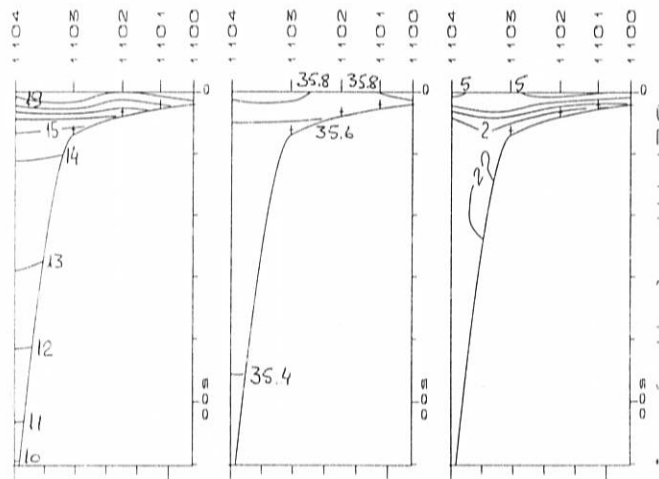
All hydrographic profiles showed a sharp thermocline.

### 2.2 PELAGIC FISH ON THE SHELF FROM ST. LOUIS TO CAPE TIMIRIS

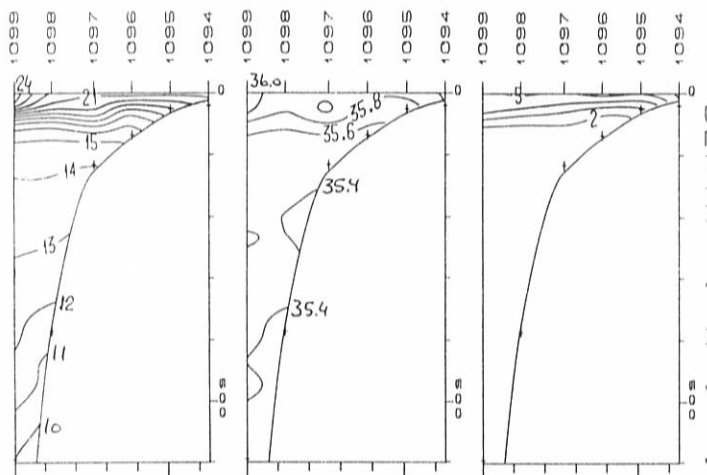
Figures 4, 5 and 6 show the distribution of the main groups of pelagic fish by contoured acoustic densities for the whole shelf of Mauritania.

Sardinellas were found over the inner shelf in a nearly continuous belt along the entire coast from St. Louis to some 20 NM south of Cape Timiris, see Figure 4. Particularly dense school areas were located between about 17°50' N and 18°50' N. In addition, more offshore aggregations were found between 18°45' N - about 19°00' N and off Nouakchott.

## CAP BLANC 21.11 1997

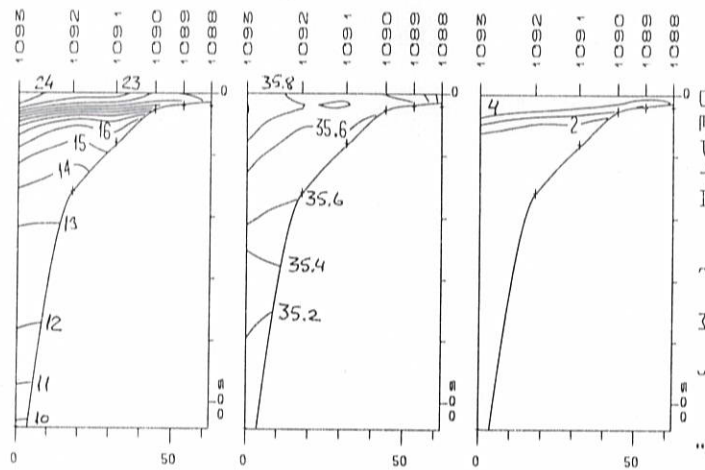


## 20°00 N 17.11 1997

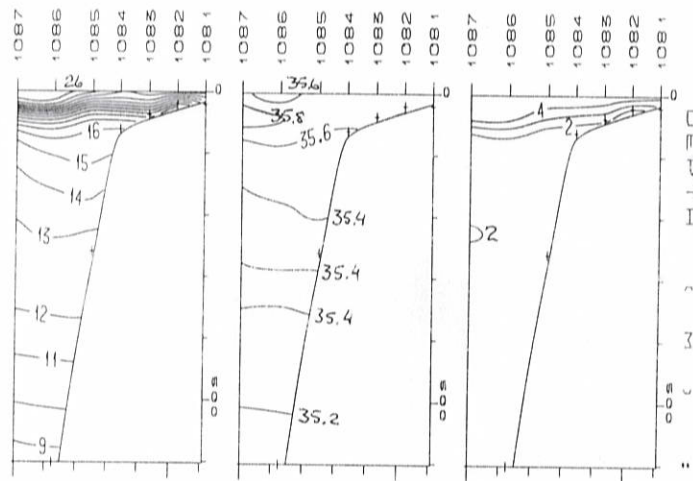


## 19°00 N 16.11 1997

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



18°00' N 14.11 1997



16°40' N 13.11 1997

Figure 2. continued.

The samples showed consistent large sizes of both sardinella species south of Cap Timiris with a modal length of 34 cm for round sardinella and 31 cm flat sardinella, see Annex III. The stock length compositions by numbers and weight are shown in Annex IV.

Table 1 gives the biomass estimates of sardinellas for this shelf based on their size composition in the area of sampling. The total estimate was 1.2 million tonnes of which 54% was flat- and 46% round sardinella.



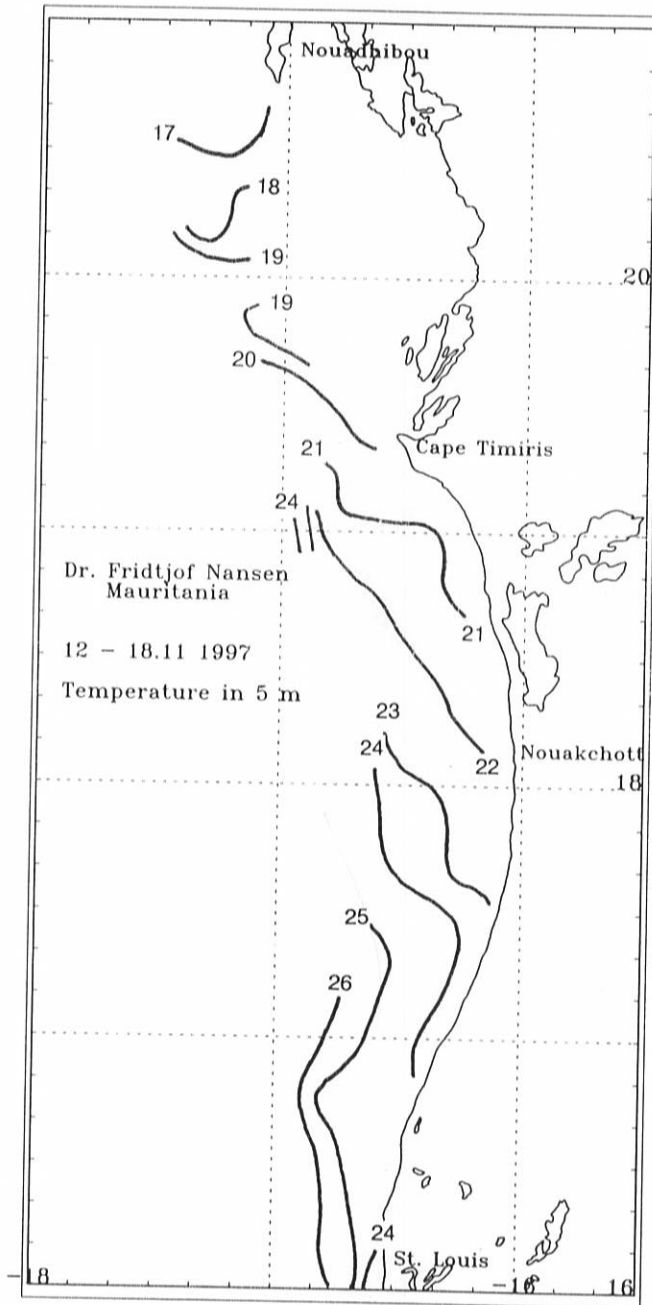


Figure 3 Sea surface temperature.

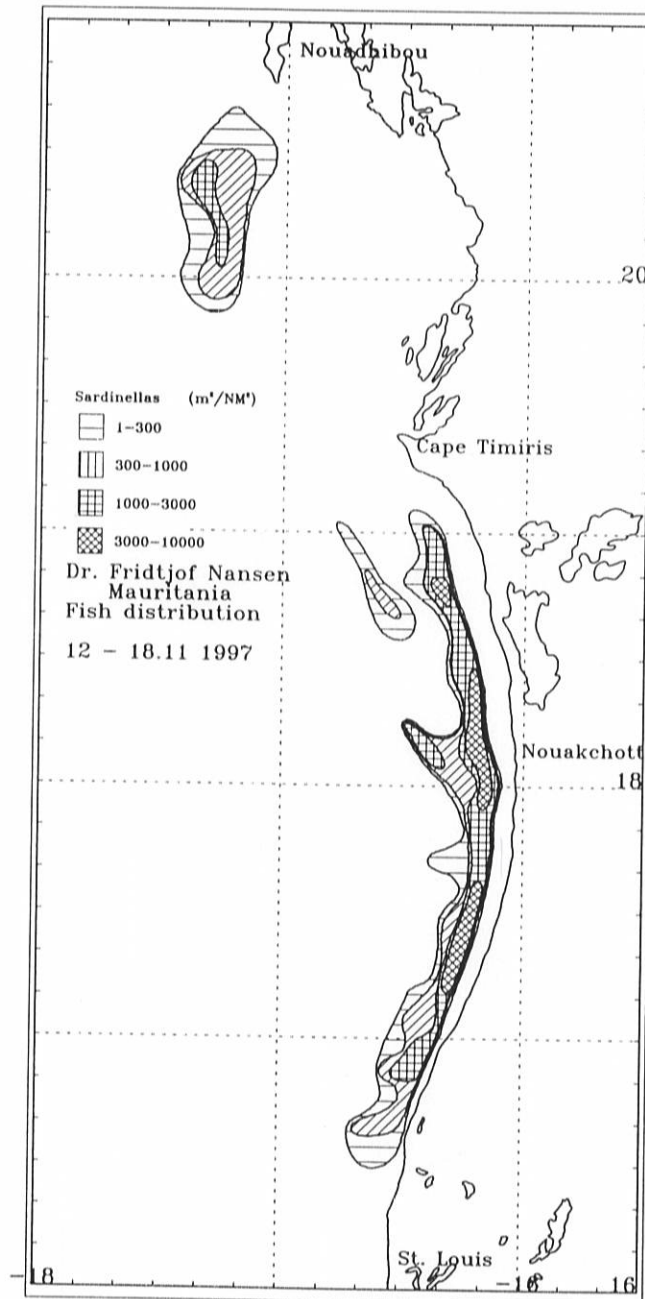


Figure 4 Distribution of sardinellas.

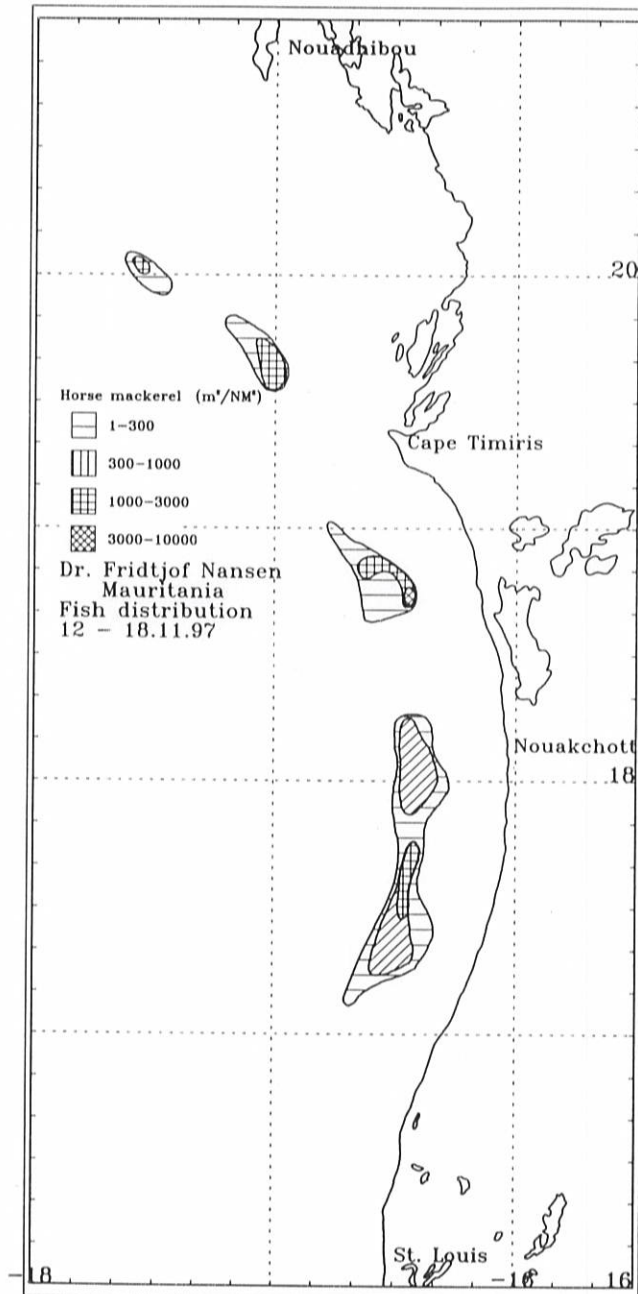


Figure 5 Distribution of horse mackerels.

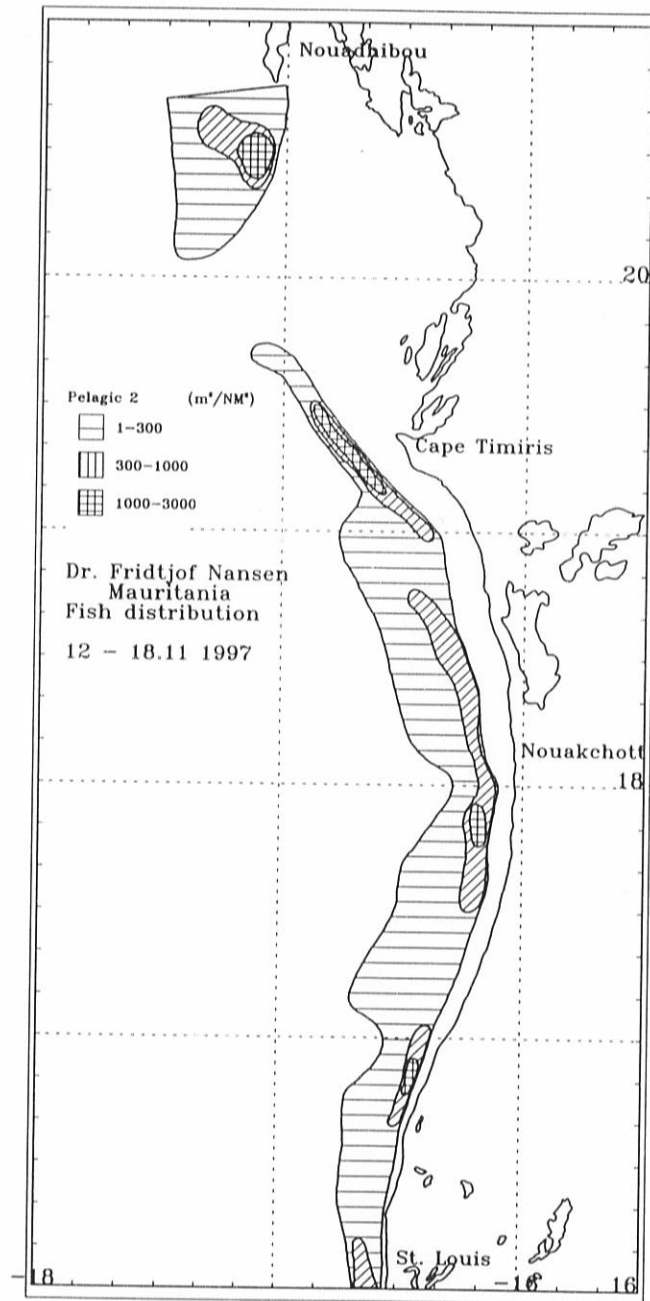


Figure 6 Distribution of carangids and associated species.

The distribution of horse mackerel is shown in Figure 5. Horse mackerel occurred in two concentrations; a larger one between 17°10'N and 18°20'N and a smaller between 18°50'N - 19°00'N. The aggregations were found at the edge of the shelf, close to the bottom at depths around 150-200 m. The biomass was estimated at 144 000 tonnes. The horse mackerel were mostly *Trachurus trecae* and this species dominated the estimated biomass by 92%. *T. trachurus* were observed only in very few samples during this survey. Three modal lengths were observed in the total length distribution of horse mackerel, namely 13, 24 and 35 cm.

Figure 6 shows the distribution of the mixed group which took the form of a continuous belt of various densities on the entire shelf. The total biomass was estimated at 283 000 tonnes. The samples from the distributional areas consisted of bumper, false scad, West African Spanish mackerel, Atlantic bonito, pompano with small amounts of chub mackerel, *Scomber japonicus* and barracudas. By weighting the relative proportions in the samples by the density in the sampling area the composition of the most important ones were as follows:

Bumper	32%
Scad	31%
W.A.S. mackerel	25%
Atlantic bonito	7%
Pompano	5%

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

Flat sardinella	Round sardinella	Horse mackerels	Carangids etc.
653	547	144	283

### 2.3 PELAGIC FISH ON THE SHELF FROM CAPE TIMIRIS TO CAPE BLANC

Some 60 NM north of Cape Timiris (at about 20°15'N-20°35'N) a school area of rather high densities of juvenile sardinellas were recorded. Both flat and round sardinella were present, but round sardinella dominated with modal length of 7 cm.

The aggregations of juvenile sardinella and carangids were not included in the biomass estimates of the respective groups. This is because their main distributional areas are thought to lie in shallow inshore waters which could not be covered by the survey. The patches which

were surveyed would only represent incidental unknown parts of the total abundance of the juvenile stocks.

Only a few specimens of adult sardinella were caught in the trawl catches in this area but no registrations were done by the echo sounder system, thus, no estimate of sardinellas is made here.

Horse mackerel were registered in two smaller areas at the outer parts of the shelf. The aggregations which were rather sparse consisted of small sized (modal length 11 cm) *Trachurus trecae* and were estimated at 20 000 tonnes.

Limited patches of anchovy were recorded and identified in a few locations mostly in shallow water inshore and often mixed with juvenile sardinellas and carangids.

The carangids and associated species were found as a continuous belt of low density shoals all the way to Cape Blanc. An area of higher density was delineated in the same area where the juvenile sardinellas were found, some 60 NM north of Cape Timiris, see Figure 4.

The catches of this group consisted mainly of barracuda, false scad, Spanish mackerel and bluefish (*Pomatomus saltatrix*). The biomass was estimated at 412 000 tonnes.

## CHAPTER 3 OVERVIEW AND SUMMARY OF RESULTS

---

The survey was conducted successfully in the period 12 to 18 November with a course track of 2 150 NM and 28 fishing stations (Figure 1).

The hydrographical data showed lowered surface temperatures inshore between St. Louis and Cape Timiris with upward slanting isotherms shorewards from about 50 m depth.

Mainly adult sardinella were found in high density between St. Louis and Cape Timiris, while juveniles were found in the area between Cape Timiris and Cape Blanc (Figure 4). Horse mackerels were found in medium density in two areas; one extending from off Nouakchott and southwards and the second some 40 NM north of Nouakchott (Figure 5). Carangids (not including horse mackerel) and associated species occurred in low densities all along the shelf, with patches of high density areas (Figure 6).

The total biomass of sardinella was estimated at 1 200 000 tonnes with 54% flat and 46% round sardinella, that of horse mackerel at 164 000 tonnes and that of the carangids and associated species at 660 000 tonnes, see Table 2.

Table 2 Summary of biomass estimates of pelagic fish, Mauritania. 1 000 tonnes.

	Flat sardinella	Round sardinella	Horse mackerel	Carangids etc.
St. Louis-Cape Timiris	653	547	144	247
Cape Timiris-Cape Blanc	0	0	20	413
Total	653	547	164	660

Table 3 lists biomass estimates of sardinella and carangids and associated species from previous 'Dr Fridtjof Nansen' surveys of this shelf region. Compared with the surveys from the same season: NovDec/86, NovDec/95 and NovDec/96, the estimate of 1 200 000 tonnes of sardinella from the current survey is high but lower than the estimates in the two previous years. The carangid estimate of 660 000 tonnes is higher than that from NovDec/96, and the highest ever estimated in this period of the year in Mauritania.

Table 3 Biomass estimates from previous 'Dr Fridtjof Nansen' surveys of the Mauritanian shelf, 1 000 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	1780	190
NovDec-96	1405	400

\* Not available





DATE:13/11/97 GEAR TYPE: PT No:2 PROJECT STATION: 593  
start stop duration POSITION:Lat N 1706 Long W 1634  
TIME :23:12:00 23:42:00 31 (min) Purpose code: 1  
LOG :2968.40 2970.10 1.70 Area code : 2  
FDEPTH: 5 5 GearCond.code:  
BDEPTH: 99 103 Validity code:  
Towing dir: 290° Wire out: 150 m Speed: 35 kn\*10

Sorted: 84 Kg Total catch: 84.55 CATCH/HOUR: 163.65

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	128.81	457	78.71	
Trachinotus ovatus	10.47	23	6.40	1214
Echeneis naucrates	8.79	17	5.37	
Sarda sarda	8.40	6	5.13	
Sepiella ornata	4.82	536	2.95	
Liza ramada	2.36	2	1.44	
Total	163.65		100.00	

DATE:14/11/97 GEAR TYPE: PT No:1 PROJECT STATION: 597  
start stop duration POSITION:Lat N 1727 Long W 1615  
TIME :16:11:55 16:20:14 8 (min) Purpose code: 1  
LOG :3097.39 3097.81 0.41 Area code : 2  
FDEPTH: 20 20 GearCond.code:  
BDEPTH: 43 42 Validity code:  
Towing dir: 31° Wire out: 200 m Speed: 32 kn\*10

Sorted: 12 Kg Total catch: 12.80 CATCH/HOUR: 96.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	69.00	128	71.88	
Chloroscombrus chrysurus	15.98	53	16.65	
Sardinella aurita	5.40	15	5.63	
Decapterus rhonchus	2.40	8	2.50	
Pagellus bellottii	1.88	8	1.96	
Boops boops	1.35	8	1.41	
Total	96.01		100.03	

DATE:14/11/97 GEAR TYPE: PT No:2 PROJECT STATION: 594  
start stop duration POSITION:Lat N 1712 Long W 1624  
TIME :02:54:00 03:16:00 22 (min) Purpose code: 1  
LOG :3000.34 3001.45 1.11 Area code : 2  
FDEPTH: 5 5 GearCond.code:  
BDEPTH: 59 66 Validity code:  
Towing dir: 287° Wire out: 200 m Speed: 35 kn\*10

Sorted: 100 Kg Total catch: 467.26 CATCH/HOUR: 1274.35

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	1107.82	2779	86.93	1215
Sardinella maderensis	116.45	458	9.14	1216
Loligo vulgaris	15.03	63	1.18	
Sarda sarda	15.03	14	1.18	
Campogramma glaycos	6.63	14	0.52	
Euthynnus alletteratus	4.58	14	0.36	
Sphyræna sphyraena	2.92	14	0.23	
Selene dorsalis	2.81	14	0.22	
Scomber japonicus	2.45	14	0.19	
Trachurus trecae	0.63	14	0.05	
Total	1274.35		100.00	

DATE:14/11/97 GEAR TYPE: PT No:2 PROJECT STATION: 595  
start stop duration POSITION:Lat N 1716 Long W 1622  
TIME :05:48:07 06:23:12 35 (min) Purpose code: 1  
LOG :3021.14 3023.36 2.19 Area code : 2  
FDEPTH: 10 10 GearCond.code:  
BDEPTH: 59 46 Validity code:  
Towing dir: 118° Wire out: 200 m Speed: 34 kn\*10

Sorted: 151 Kg Total catch: 331.95 CATCH/HOUR: 569.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	177.60	494	31.21	1217
Sarda sarda	151.20	79	26.57	
Sardinella maderensis	126.86	528	22.29	1218
Trachurus trecae	54.51	2357	9.58	1219
Lagocephalus laevigatus	13.30	117	2.34	
Campogramma glaycos	9.46	14	1.66	
Loligo vulgaris	9.19	171	1.61	
Scomber japonicus	7.34	55	1.29	
Selene dorsalis	5.14	21	0.90	
Auxis thazard	3.14	9	0.55	
Decapterus rhonchus	2.88	7	0.51	
Sepia officinalis hierredda	2.74	14	0.48	
Trichiurus lepturus	2.61	14	0.46	
Alloteuthis africana	1.58		0.28	
Sphyræna sphyraena	1.51	7	0.27	
Total	569.06		100.00	

DATE:14/11/97 GEAR TYPE: BT No: PROJECT STATION: 596  
start stop duration POSITION:Lat N 1721 Long W 1634  
TIME :08:32:30 09:02:33 30 (min) Purpose code: 1  
LOG :3041.93 3043.46 1.50 Area code : 2  
FDEPTH: 136 124 GearCond.code:  
BDEPTH: 136 124 Validity code:  
Towing dir: 110° Wire out: 500 m Speed: 30 kn\*10

Sorted: 65 Kg Total catch: 861.30 CATCH/HOUR: 1722.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1307.50	67512	75.90	1221
Merluccius polli	71.00	1050	4.12	
Chlorophthalmus atlanticus	70.50	6256	4.09	
Trachurus trecae	62.60	96	3.63	1220
Dentex macrophthalmus	62.50	300	3.63	
Synagrops microlepis	48.50	4558	3.16	
Trichiurus lepturus	23.00	650	2.82	
Pterothrissus belloci	10.50	400	1.34	
Scorpaena normani	7.50	50	0.61	
Scorpaena stephanica	2.00	450	0.44	
GOBIIDAE	1.50	300	0.12	
Parapenaeus longirostris	1.50	300	0.09	
Capros aper	1.00	100	0.06	
Total	1722.60		100.01	

DATE:14/11/97 GEAR TYPE: PT No:2 PROJECT STATION: 598  
start stop duration POSITION:Lat N 1744 Long W 1626  
TIME :23:23:06 23:53:42 31 (min) Purpose code: 1  
LOG :3168.90 3170.53 1.63 Area code : 2  
FDEPTH: 70 80 GearCond.code:  
BDEPTH: 105 104 Validity code:  
Towing dir: 109° Wire out: 200 m Speed: 35 kn\*10

Sorted: 12 Kg Total catch: 12.09 CATCH/HOUR: 23.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	12.77	21	54.57	
Trachurus trecae	9.00	50	38.46	1222
Campogramma glaycos	1.01	2	4.32	
Sardinella aurita	0.62	2	2.65	
Total	23.40		100.00	

DATE:15/11/97 GEAR TYPE: PT No:1 PROJECT STATION: 599  
start stop duration POSITION:Lat N 1750 Long W 1609  
TIME :03:41:32 04:13:12 32 (min) Purpose code: 1  
LOG :3207.93 3209.65 1.68 Area code : 2  
FDEPTH: 5 5 GearCond.code:  
BDEPTH: 23 30 Validity code:  
Towing dir: 290° Wire out: 200 m Speed: 33 kn\*10

Sorted: 137 Kg Total catch: 1912.26 CATCH/HOUR: 3585.49

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	937.13	3439	26.14	1224
Brachydeuterus auritus	842.63	6221	23.50	1227
Sardinella aurita	605.06	1785	16.88	1223
Decapterus rhonchus	582.75	2993	16.25	1226
Pomadasys incisus	145.43	656	4.06	
Trachurus trecae	109.99	1234	3.07	1225
Diplodus puntazzo	74.29	79	2.07	
Pomadasys peroteti	58.28	131	1.63	
Chloroscombrus chrysurus	45.15	289	1.26	
Liza ramada	44.89	26	1.25	
Stromateus fiatola	35.18	53	0.98	
Pomadasys rogeri	27.56	26	0.77	
Pomatomus saltatrix	27.30	26	0.76	
Pagellus bellottii	23.63	105	0.66	
Sphyræna guachancho	14.70	26	0.41	
Argyrosomus regius	6.04	26	0.17	
Scomber japonicus	3.41	26	0.10	
Penaeus notialis	1.05	53	0.03	
Loligo vulgaris	1.05	26	0.03	
Total	3585.52		100.02	

DATE:15/11/97 GEAR TYPE: BT No: PROJECT STATION: 600  
start stop duration POSITION:Lat N 1800 Long W 1626  
TIME :09:36:23 10:07:18 31 (min) Purpose code: 1  
LOG :3251.71 3253.22 1.52 Area code : 2  
FDEPTH: 107 106 GearCond.code:  
BDEPTH: 107 106 Validity code:  
Towing dir: 90° Wire out: 400 m Speed: 30 kn\*10

Sorted: 37 Kg Total catch: 620.75 CATCH/HOUR: 1201.45

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	882.58	33180	73.46	1229
Dentex macrophthalmus	225.29	929	18.75	
Spicara alta	26.71	929	2.22	
Zeus faber	22.45	116	1.87	
Pagellus acarne	13.55	39	1.13	
Trachurus trecae	11.90	21	0.99	1228
GOBIIDAE	5.42	890	0.45	
Dentex maroccanus	5.03	116	0.42	
Cronius ruber	3.10	348	0.26	
Todarodes sagittatus	1.94	116	0.16	
Merluccius polli	1.55	39	0.13	
Synagrops microlepis	1.16	116	0.10	
Sardinella aurita	0.77	39	0.06	
Total	1201.45		100.00	

DATE:15/11/97 GEAR TYPE: PT No:2 PROJECT STATION: 601  
start stop duration POSITION:Lat N 1807 Long W 1622  
TIME :14:23:28 14:55:00 32 (min) Purpose code: 1  
LOG :3290.10 3292.60 2.50 Area code : 2  
FDEPTH: 25 25 GearCond.code:  
BDEPTH: 61 61 Validity code:  
Towing dir: 258° Wire out: 150 m Speed: 35 kn\*10

Sorted: 4 Kg Total catch: 4.89 CATCH/HOUR: 9.17

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	7.20	21	78.52	1230
Sarda sarda	1.97	4	21.48	
Total	9.17		100.00	

PROJECT STATION: 602  
 DATE:15/11/97 GEAR TYPE: PT No:2 POSITION:Lat N 1816  
 start stop duration Long W 1631  
 TIME :18:42:11 18:55:21 13 (min) Purpose code: 1  
 LOG :3325.68 3326.43 0.75 Area code : 2  
 FDEPTH: 20 20 GearCond.code:  
 BDEPTH: 154 137 Validity code:  
 Towing dir: 105° Wire out: 100 m Speed: 40 kn\*10  
 Sorted: 72 Kg Total catch: 499.88 CATCH/HOUR: 2307.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	1874.45	4708	81.25	1231
MYCTOPHIDAE	174.83	128211	7.58	
Trichiurus lepturus	152.31	383	6.60	
Sardinella maderensis	76.48	245	3.31	1232
Sarda sarda	29.08	14	1.26	
Total	2307.15		100.00	

PROJECT STATION: 603  
 DATE:16/11/97 GEAR TYPE: BT No:1 POSITION:Lat N 1835  
 start stop duration Long W 1615  
 TIME :01:49:19 02:22:20 33 (min) Purpose code: 1  
 LOG :3397.21 3399.01 1.80 Area code : 2  
 FDEPTH: 19 26 GearCond.code:  
 BDEPTH: 19 26 Validity code:  
 Towing dir: 278° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 225 Kg Total catch: 225.03 CATCH/HOUR: 409.15

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Liza ramada	202.82	104	49.57	
Sardinella maderensis	84.20	275	20.58	1235
Sardinella aurita	65.71	165	16.06	1233
Trichiurus lepturus	25.64	36	6.27	
Decapterus rhonchus	8.35	45	2.04	1237
Loligo vulgaris	5.25	15	1.28	
Trachurus trecae	4.58	87	1.12	1236
Pomadasy s rogeri	3.65	4	0.89	
Diplodus puntazzo	2.93	4	0.72	
Chloroscomorus chrysurus	2.13	9	0.52	
Pomadasy s incisus	1.15	5	0.28	
Trachinotus ovatus	0.91	2	0.22	
Sphyrana sphyraena	0.51	2	0.12	
Sardinella aurita	0.44	44	0.11	1234
Lagocephalus laevigatus	0.31	2	0.08	
Engraulis encrasicolus	0.31	84	0.08	1238
Scomber japonicus	0.27	2	0.07	
Total	409.16		100.01	

PROJECT STATION: 604  
 DATE:16/11/97 GEAR TYPE: PT No:1 POSITION:Lat N 1841  
 start stop duration Long W 1632  
 TIME :05:56:04 06:26:44 31 (min) Purpose code: 1  
 LOG :3430.38 3432.55 2.13 Area code : 2  
 FDEPTH: 20 15 GearCond.code:  
 BDEPTH: 100 136 Validity code:  
 Towing dir: 250° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 77 Kg Total catch: 1003.15 CATCH/HOUR: 1941.58

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	1814.52	4587	93.46	1239
Sardinella maderensis	85.65	232	4.41	1240
Trichiurus lepturus	21.19	29	1.09	
Sarda sarda	16.16	6	0.83	
Campogramma glaycos	4.06	4	0.21	
Total	1941.58		100.00	

PROJECT STATION: 605  
 DATE:16/11/97 GEAR TYPE: PT No:2 POSITION:Lat N 1844  
 start stop duration Long W 1626  
 TIME :08:12:07 08:37:43 26 (min) Purpose code: 1  
 LOG :3444.67 3446.19 1.49 Area code : 2  
 FDEPTH: 30 50 GearCond.code:  
 BDEPTH: 64 72 Validity code:  
 Towing dir: 270° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 76 Kg Total catch: 75.77 CATCH/HOUR: 174.85

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	111.81	212	63.95	
Sardinella aurita	21.16	53	12.10	1241
Scomberomorus tritor	17.28	7	9.88	
Scomber japonicus	14.54	32	8.32	1242
Trachurus trecae	4.89	16	2.80	1243
Euthynnus alletteratus	2.72	2	1.56	
Loligo vulgaris	1.82	5	1.04	
Echeneis naucrates	0.62	2	0.35	
Total	174.84		100.00	

PROJECT STATION: 606  
 DATE:16/11/97 GEAR TYPE: BT No:1 POSITION:Lat N 1849  
 start stop duration Long W 1637  
 TIME :11:53:21 12:27:23 34 (min) Purpose code: 1  
 LOG :3477.40 3479.30 1.90 Area code : 2  
 FDEPTH: 104 103 GearCond.code:  
 BDEPTH: 104 103 Validity code:  
 Towing dir: 106° Wire out: 400 m Speed: 31 kn\*10  
 Sorted: 95 Kg Total catch: 529.29 CATCH/HOUR: 934.04

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	560.47	9776	60.00	1244
Trachurus trachurus	187.06	2647	20.03	1245
Dentex macrophthalmus	97.59	688	10.45	
Zeus faber	31.59	76	3.38	
Boops boops	24.00	111	2.57	
Merluccius senegalensis	11.35	30	1.22	
Scomber japonicus	6.88	53	0.74	
Dentex maroccanus	4.89	41	0.52	
Todaropsis eblanae	4.64	35	0.50	
Ephippion guttifer	2.29	5	0.25	
Illex coindetii	1.64	23	0.18	
Pagellus acarne	1.36	12	0.15	
Allotheutis subulata	0.18	35	0.02	
Arnoglossus imperialis	0.05	5	0.01	
Engraulis encrasicolus	0.05	5	0.01	
Total	934.04		100.03	

PROJECT STATION: 607  
 DATE:16/11/97 GEAR TYPE: PT No:5 POSITION:Lat N 1852  
 start stop duration Long W 1634  
 TIME :14:41:29 15:12:31 31 (min) Purpose code: 1  
 LOG :3497.82 3499.44 1.62 Area code : 2  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 97 94 Validity code:  
 Towing dir: 252° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 2 Kg Total catch: 2.52 CATCH/HOUR: 4.88

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	4.26	10	87.30	1246
Lagocephalus laevigatus	0.62	6	12.70	
Total	4.88		100.00	

PROJECT STATION: 608  
 DATE:17/11/97 GEAR TYPE: PT No:4 POSITION:Lat N 1932  
 start stop duration Long W 1651  
 TIME :04:35:26 04:51:09 16 (min) Purpose code: 1  
 LOG :3624.24 3625.20 0.94 Area code : 2  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 36 49 Validity code:  
 Towing dir: 268° Wire out: 200 m Speed: 32 kn\*10  
 Sorted: 293 Kg Total catch: 1789.41 CATCH/HOUR: 4635.29

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	2722.13	519679	56.30	1247
Scomberomorus tritor	811.69	240	16.79	
Stromateus fiatola	425.25	315	8.79	
Trichiurus lepturus	272.48	630	5.54	
Lichia amia	180.08	53	3.72	
Trachurus trecae	145.43	2993	3.01	1248
Trachinotus ovatus	134.93	210	2.79	
Decapterus rhonchus	107.10	315	2.21	1249
Sardinella maderensis	19.95	53	0.41	
Loligo vulgaris	14.18	105	0.29	
Sepiella ornata	2.10	158	0.04	
Total	4835.32		99.99	

PROJECT STATION: 609  
 DATE:17/11/97 GEAR TYPE: PT No:5 POSITION:Lat N 2010  
 start stop duration Long W 1718  
 TIME :17:40:18 18:06:27 26 (min) Purpose code: 1  
 LOG :3742.19 3743.70 1.45 Area code : 2  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 27 24 Validity code:  
 Towing dir: 191° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 30 Kg Total catch: 3602.30 CATCH/HOUR: 8313.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	8007.69	351305	96.33	1250
Sardinella maderensis	230.77	8308	2.78	1251
Engraulis encrasicolus	46.15	9692	0.56	1252
Scomberomorus tritor	10.62	5	0.13	
Sarda sarda	7.15	2	0.09	
Stromateus fiatola	6.00	5	0.07	
Trachinotus ovatus	4.62	7	0.06	
Total	8313.00		100.02	

PROJECT STATION: 610  
 DATE:17/11/97 GEAR TYPE: PT No:5 POSITION:Lat N 2022  
 start stop duration Long W 1720  
 TIME :21:31:17 21:39:40 8 (min) Purpose code: 1  
 LOG :3771.14 3771.49 0.35 Area code : 2  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 36 37 Validity code:  
 Towing dir: 278° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 7 Kg Total catch: 1024.50 CATCH/HOUR: 7683.75

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	6660.00	1689848	86.68	1253
Trachurus trecae	585.00	33750	7.61	1255
Engraulis encrasicolus	438.75	117000	5.71	1254
Total	7683.75		100.00	

PROJECT STATION: 611  
 DATE: 18/11/97 GEAR TYPE: PT No:4 POSITION: Lat N 2030 Long W 1706  
 TIME : 01:40:19 01:50:19 10 (min) Purpose code: 1  
 LOG : 3809.61 3810.10 0.49 Area code : 2  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 26 26 Validity code:  
 Towing dir: 290° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 322 Kg Total catch: 743.85 CATCH/HOUR: 4463.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pomatomus saltatrix	1643.70	270	36.83	
Sphyraena sphyraena	846.42	2166	18.96	
Decapterus rhonchus	721.08	2910	16.16	1259
Sardina pilchardus	289.56	2454	6.49	1261
Decapterus rhonchus	186.96	9690	4.19	1258
Diplodus bellottii	184.14	2166	4.13	
Trachurus trecae	157.92	5814	3.54	1260
Sardinella aurita	124.26	36024	2.78	1257
Stromateus fiatola	107.16	114	2.40	
Sardinella aurita	104.34	1428	2.34	1256
Loligo vulgaris	58.74	972	1.32	
Sardinella maderensis	18.24	60	0.41	
Pagellus bellottii	12.00	174	0.27	
Scomber japonicus	7.44	60	0.17	
Engraulis encrasicolus	1.14	402	0.03	1262
<b>Total</b>	<b>4463.10</b>		<b>100.02</b>	

## Annex II Description of instruments and fishing gear used

The Simrad EK-500, 38 kHz 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 echo 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 38 kHz were as follows:

<b>Transceiver-1 menu</b>	Transducer depth	0.0 m
	Absorbtion coeff.	10 dB/km
	Pulse length	medium
	Bandwidth	wide
	Max Power	2000 W
	2-way beam angle	-21.0 dB
	SV transducer gain	28.0 dB
	TS transducer gain	27.9 dB
	Angle sensitivity	21.9
	3 dB beamwidth	6.8 deg
	Alongship offset	0.00 deg
	Athwardship offset	0.04 deg
<b>Display menu</b>	Echogram	1
	Bottom range	12 m
	Bottom start	10 m
	TVG	20 log R
	SV Colour minimum	-67 dB
	TS Colour minimum	-50 dB
<b>Printer settings</b>	Range	0-100 or 0-250 m
	TVG	20 log R
	Sv Colour minimum	-72 dB
<b>Bottom detection menu</b>		-50 dB

A calibration experiment using a standard copper sphere, performed in Baia dos Tigres 15 June 1995 gave the following results :

Sv Transducer gain 28.1 dB

Ts Transducer gain 28.0 dB

### **Hydrography**

Conductivity, temperature, density and dissolved oxygen were sampled regularly at CTD stations with a Seabird 911+ CTD sonde. The salinity is computed from the data on conductivity by the software retrieving data from the sensors.

### **Fishing gear**

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

# F/F Dr. Fridtjof Nansen

OVER/UNDER/SIDER

OVERDEL:  
50 STK 11' PLASTKULER

UNDERDEL:  
14 M/M WIRE OMSP. MED  
14 M/M BLYTAU  
+ KJETTING.

TOTAL VEKT UNDER 400 KG.

SIDER.

1/2 HOGG 5,00 MTR  
STRF. 6,00 MTR  
ARM 6,00 MTR  
TAMP 2,60 MTR  
TOT. 36,00 MTR  
22 M/M Ø COMB. TAU

1/2 HOGG 4,00 MTR  
STRF. 6,00 MTR  
ARM 22,40 MTR  
TAMP 2,60 MTR  
TOT. 35,00 MTR  
28 M/M Ø  
FL. DANLINE

2H1-2  
3H1-1

MASKER TRAAD LENGDE MASKER  
M/M NR. I MTR. I EVING

3200.0 240 22.4 4

3200.0 240 32.0 4 9.5L

1620.0 160 13.0 4

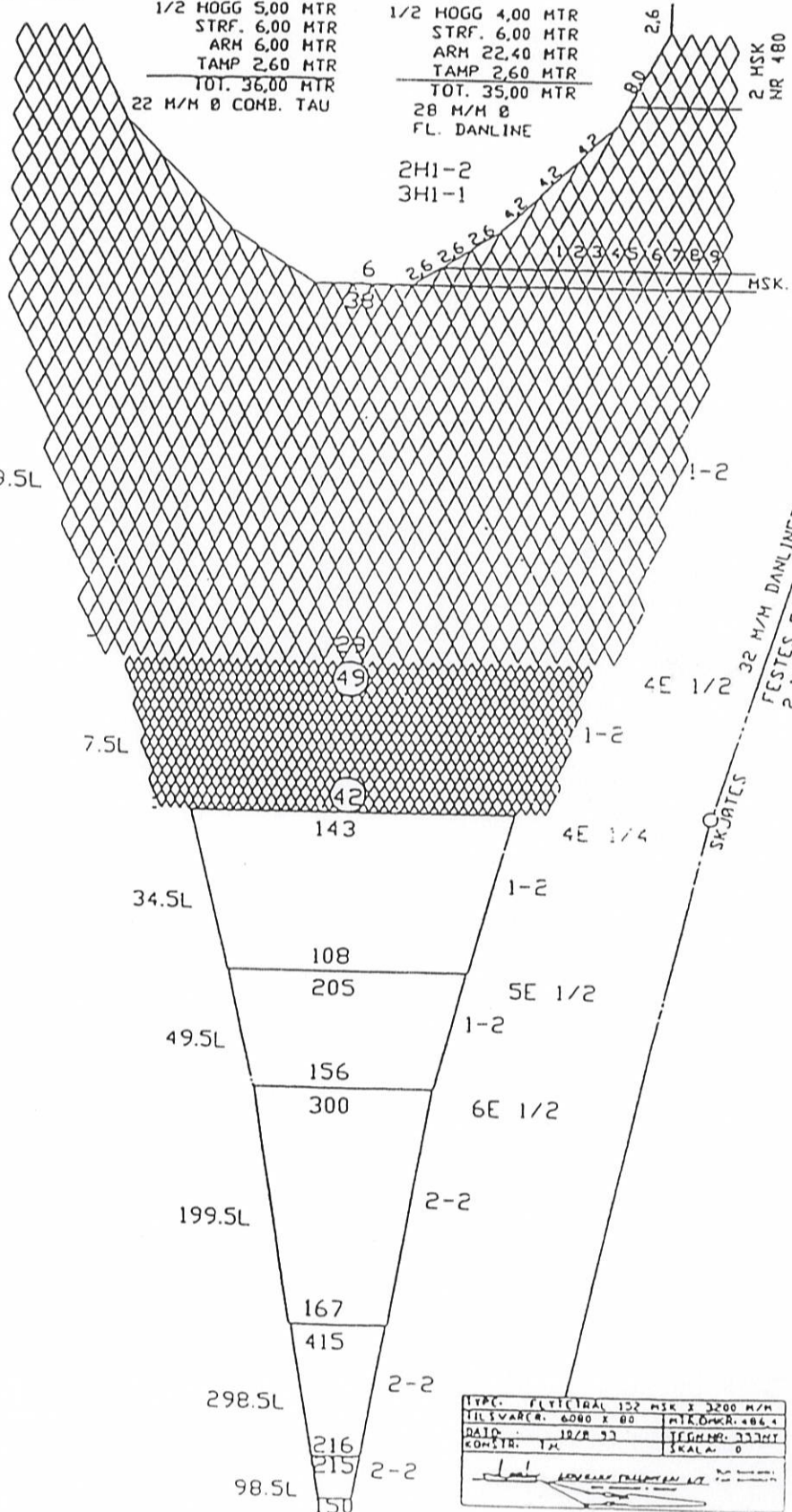
400.0 48 14.0 4

200.0 32 10.00 4

100.0 24 20.0 4

38.0 12 11.4 4

38.0 18 3.76 4



TYPE:	FLYTTORAL 152 MSK X 3200 M/M
LIL SVARER:	6080 X 80 MTK.OMSP. 486.4
DALE:	12/R 97
KONSTR.:	1 M
TEGNER:	337MY
SKALA:	0

# F/F Dr. Fridtjof Nansen

HASKER  
H/H NR. 1 MTR. 1 E'VING

TRAAD LENGDE HASKER  
160 19.4 4

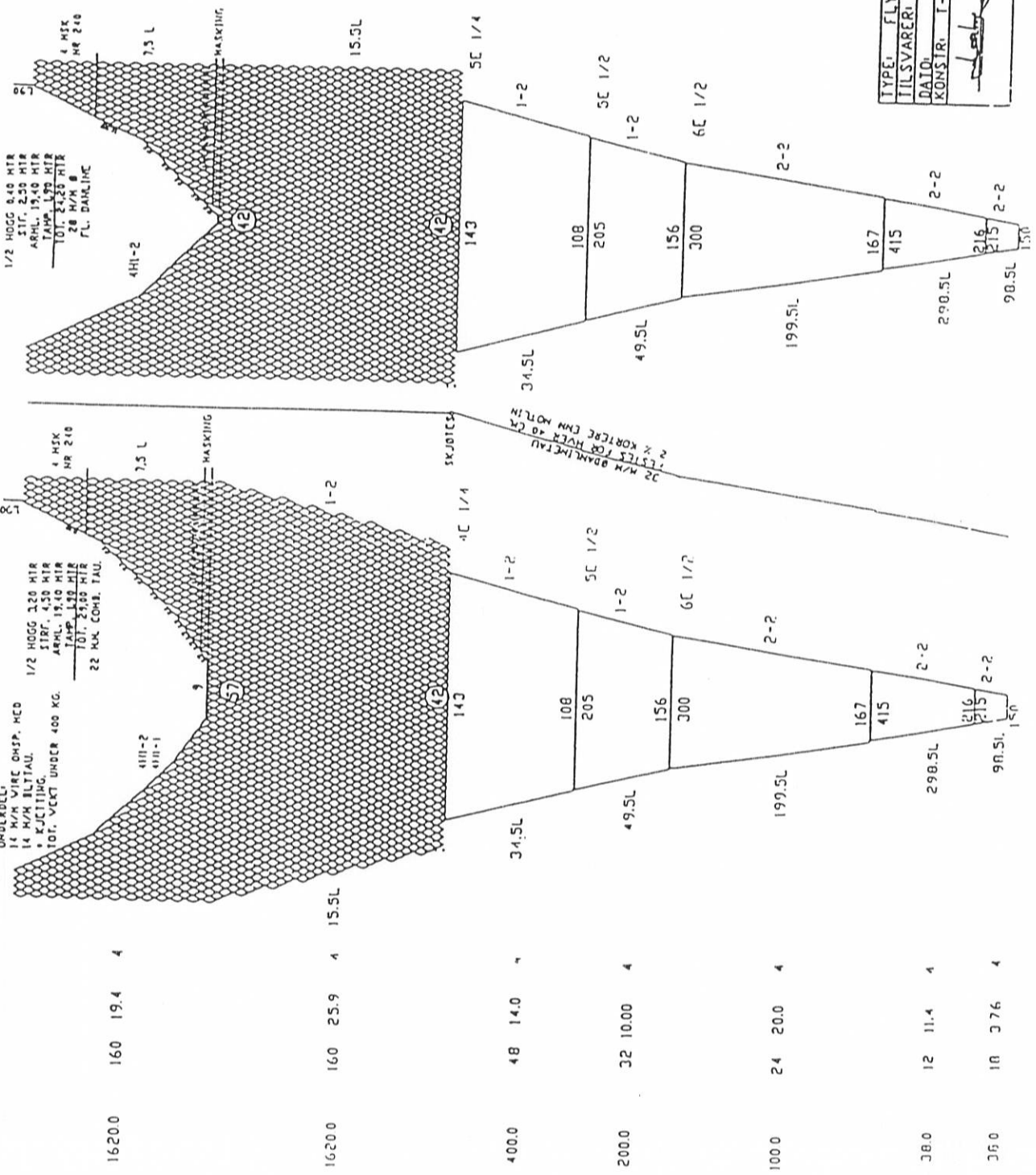
OVERØNDER

OVØRDEL,  
38 STK 11" KÅKER  
ØHØLLET AV NETT.  
UNDERØDEL,  
14 M/M VIRE ØMSP. MED  
14 M/M BLTÅL.  
KJØTTING.  
TOT. VEKT UNDER 400 KG.  
TOT. 2425 MTR  
22 M/M COMB. TÅL.

1/2 HØGG 320 MTR  
STR. 250 MTR  
ARML. 1540 MTR  
TÅP. 170 MTR  
TOT. 2425 MTR  
4 M/M Ø  
NR 240  
FL. BARKING

1/2 HØGG 640 MTR  
STR. 250 MTR  
ARML. 1540 MTR  
TÅP. 170 MTR  
TOT. 2425 MTR  
4 M/M Ø  
NR 240  
FL. BARKING

SIDER

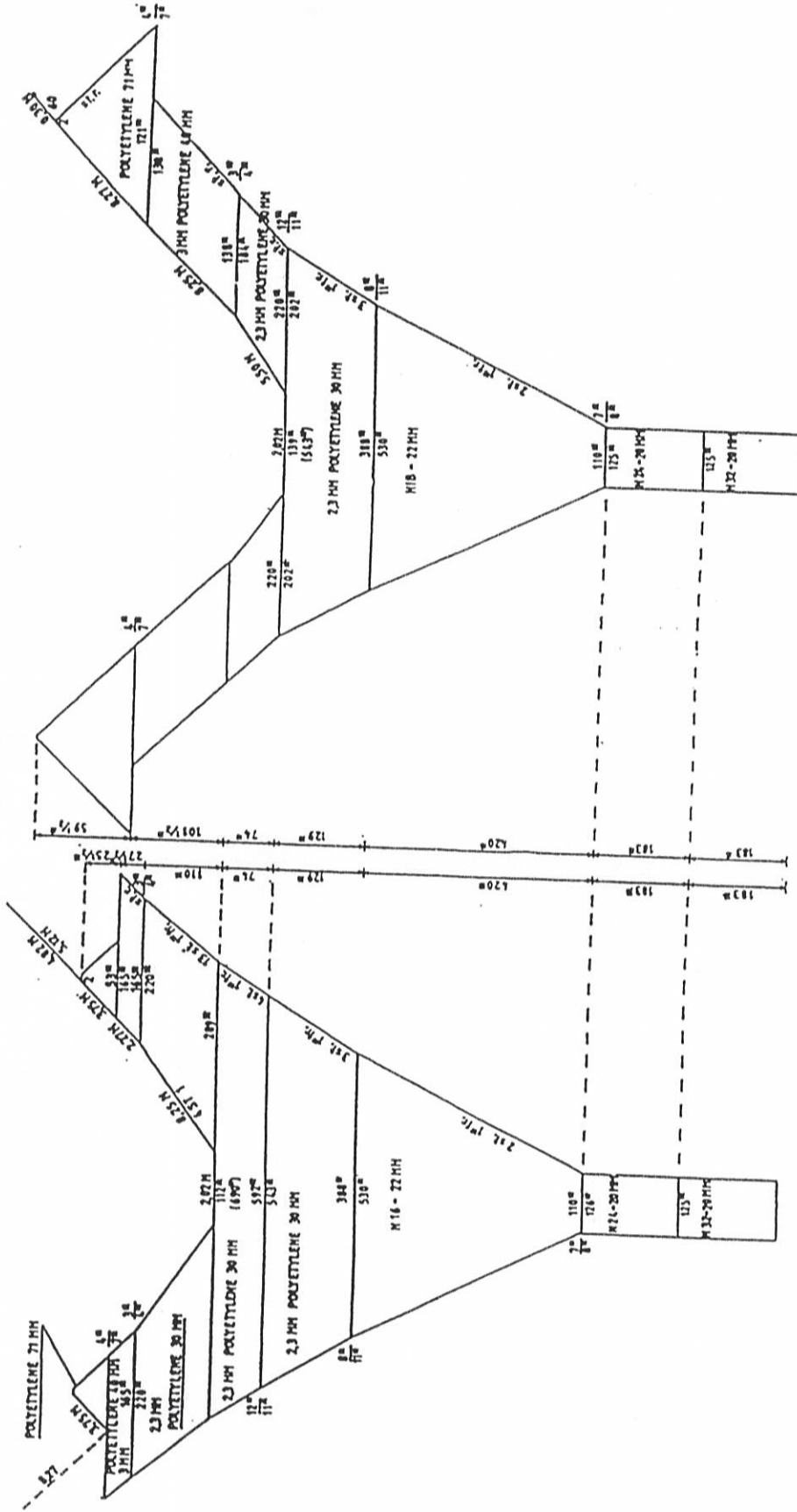


TYPE:	FLYTETRAL 198 HSK X 1620 H/H
TILSVARER:	4010 X 80 MTR.ØMTR. 320
DATE:	23/6 93
KONSTR:	T-H
TEGNER:	510
SKALA:	1:0

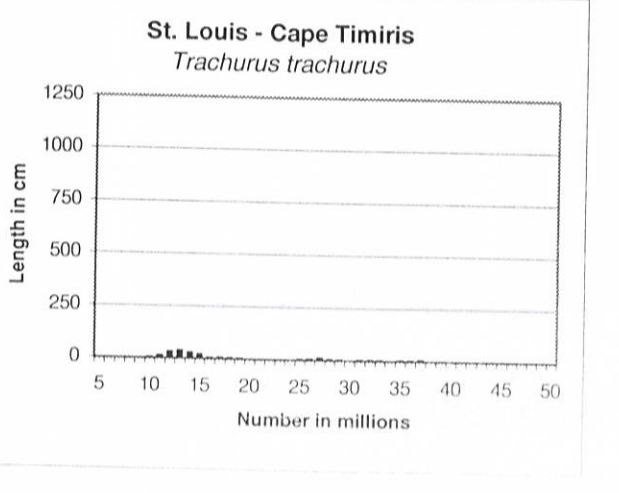
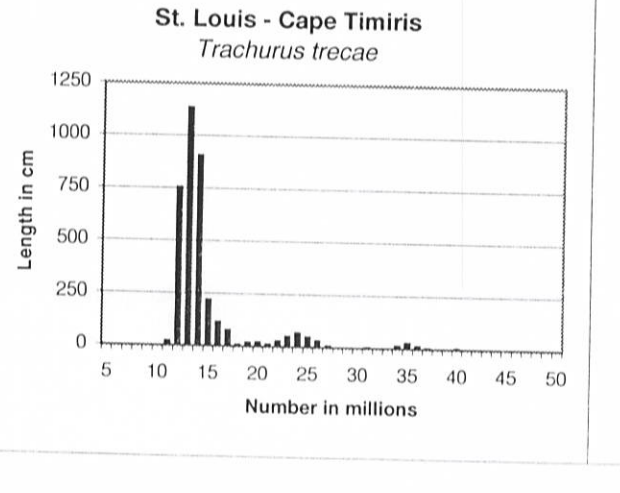
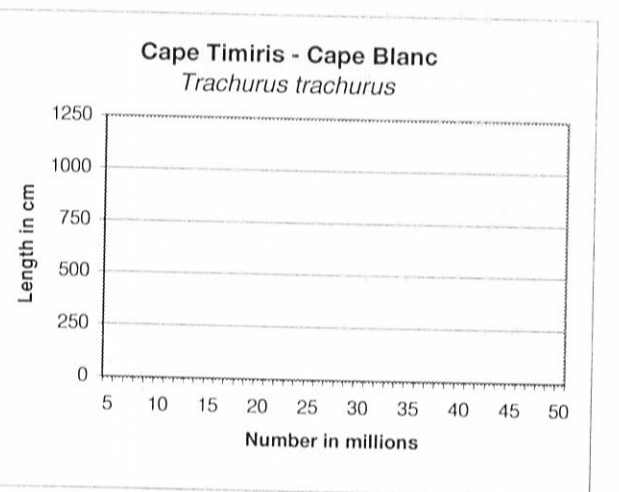
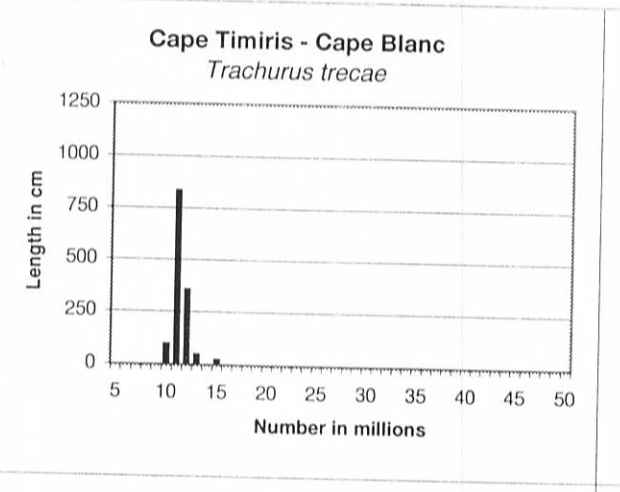
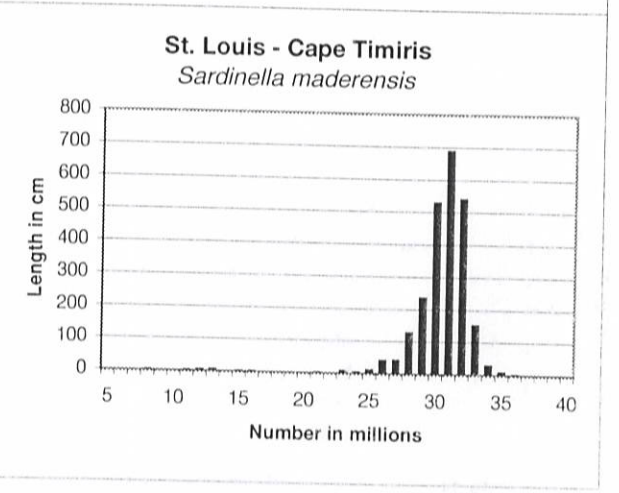
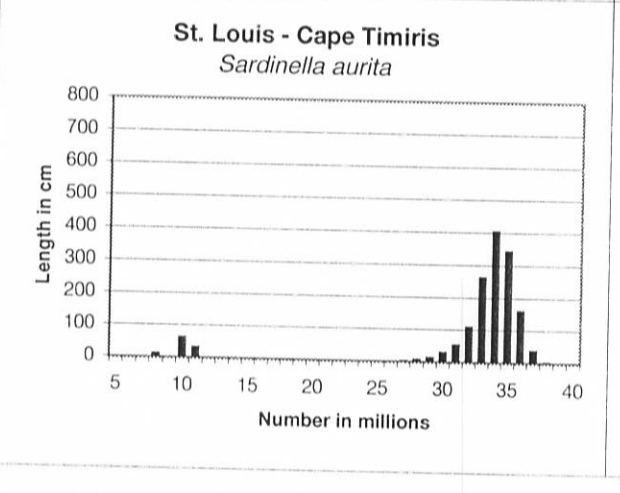
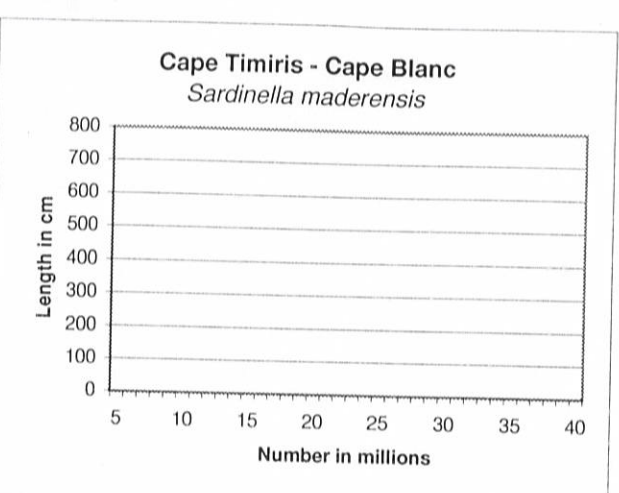
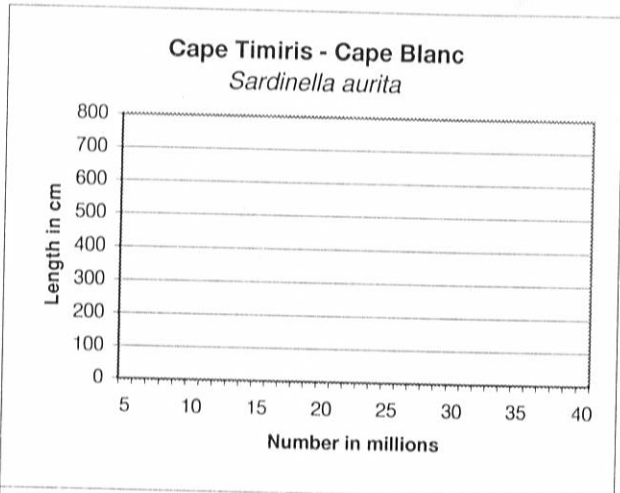




Bottom trawl: High opening shrimp and fish trawl with net headline 31m (floatline), foot-  
 rope 47m, gear with 12 cm diameter roller disks, 40 m sweeps, estimated headline height  
 6m and distance between wings during towing 18-20m.



# Annex III Pooled length distributions by species and regions



**Annex IV Biomass (in 1000 tonnes) and number (in millions)  
by length**

*Sardinella aurita*

Length cm	C. Blanc - C. Timiris		South of Cape Timiris		TOTAL	
	Biomass	Number	Biomass	Number	Biomass	Number
5						
6						
7						
8			0.1	10.2	0.1	10.2
9						
10			0.7	61.2	0.7	61.2
11			0.4	30.6	0.4	30.6
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22			0.0	0.2	0.0	0.2
23						
24						
25						
26						
27			0.2	0.9	0.2	0.9
28			1.2	5.7	1.2	5.7
29			2.7	11.4	2.7	11.4
30			7.6	28.4	7.6	28.4
31			15.4	52.3	15.4	52.3
32			34.9	108.2	34.9	108.2
33			92.4	261.3	92.4	261.3
34			155.7	403.3	155.7	403.3
35			144.4	343.4	144.4	343.4
36			72.6	158.9	72.6	158.9
37			18.1	36.6	18.1	36.6
38			0.5	0.9	0.5	0.9
39						
40						
<b>TOTAL</b>			546.9	1513.6	546.9	1513.6

## Annex IV continued

### *Sardinella maderensis*

Length cm	C. Blanc - C. Timiris		South of Cape Timiris		TOTAL	
	Biomass	Number	Biomass	Number	Biomass	Number
5						
6						
7						
8			0.0	1.3	0.0	1.3
9						
10						
11			0.0	1.3	0.0	1.3
12			0.0	2.7	0.0	2.7
13			0.1	5.4	0.1	5.4
14						
15			0.0	1.3	0.0	1.3
16			0.1	1.3	0.1	1.3
17						
18			0.0	0.2	0.0	0.2
19						
20						
21			0.1	1.3	0.1	1.3
22						
23			0.8	6.6	0.8	6.6
24			0.3	2.6	0.3	2.6
25			1.6	10.6	1.6	10.6
26			6.7	40.6	6.7	40.6
27			7.6	41.0	7.6	41.0
28			26.4	128.2	26.4	128.2
29			54.0	236.3	54.0	236.3
30			133.6	529.0	133.6	529.0
31			191.3	687.6	191.3	687.6
32			164.8	539.5	164.8	539.5
33			50.9	152.2	50.9	152.2
34			10.5	28.9	10.5	28.9
35			3.3	8.4	3.3	8.4
36			0.2	0.5	0.2	0.5
37						
38						
39						
40						
TOTAL			652.5	2426.8	652.5	2426.8

## Annex IV continued

### *Trachurus trecae*

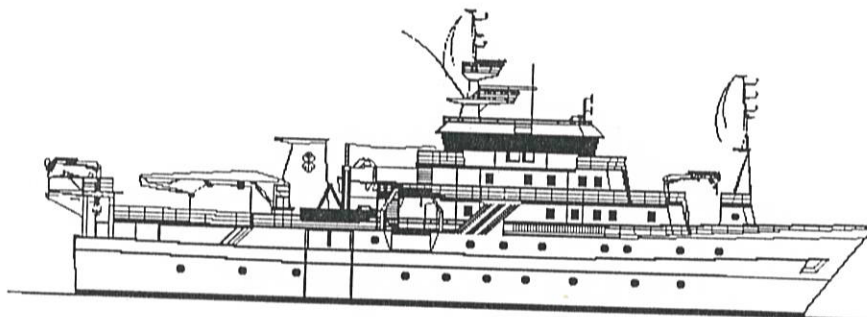
Length cm	C. Blanc - C. Timiris		South of Cape Timiris		TOTAL	
	Biomass	Number	Biomass	Number	Biomass	Number
5						
6						
7						
8						
9						
10	0.9	95.1			0.9	95.1
11	10.9	832.0	0.3	19.3	11.1	851.3
12	6.0	356.6	12.6	752.2	18.6	1108.8
13	1.0	47.5	24.0	1133.5	25.0	1181.0
14			23.7	903.9	23.7	903.9
15	0.8	23.8	7.0	219.4	7.8	243.1
16			4.4	114.1	4.4	114.1
17			3.5	75.0	3.5	75.0
18			0.4	6.4	0.4	6.4
19			1.1	17.2	1.1	17.2
20			1.4	19.3	1.4	19.3
21			0.7	8.6	0.7	8.6
22			2.5	25.8	2.5	25.8
23			5.5	49.4	5.5	49.4
24			8.4	66.6	8.4	66.6
25			6.7	47.2	6.7	47.2
26			4.8	30.1	4.8	30.1
27			1.2	6.4	1.2	6.4
28						
29						
30						
31						
32			0.6	2.1	0.6	2.1
33						
34			4.5	12.9	4.5	12.9
35			10.0	25.9	10.0	25.9
36			5.4	12.9	5.4	12.9
37			1.0	2.1	1.0	2.1
38			0.1	0.2	0.1	0.2
39			0.2	0.4	0.2	0.4
40			1.5	2.6	1.5	2.6
41			0.1	0.2	0.1	0.2
42			0.2	0.3	0.2	0.3
43			0.3	0.4	0.3	0.4
44			0.1	0.2	0.1	0.2
45			0.0	0.0	0.0	0.0
46			0.0	0.0	0.0	0.0
47						
48						
49						
50						
TOTAL	19.6	1355.0	132.2	3554.7	151.8	4909.7

# Annex IV continued

## *Trachurus trachurus*

Length cm	C. Blanc - C. Timiris		South of Cape Timiris		TOTAL	
	Biomass	Number	Biomass	Number	Biomass	Number
5						
6						
7						
8						
9						
10			0.0	1.5	0.0	1.5
11			0.1	11.4	0.1	11.4
12			0.5	29.5	0.5	29.5
13			0.7	34.8	0.7	34.8
14			0.7	26.5	0.7	26.5
15			0.5	18.2	0.5	18.2
16			0.1	3.0	0.1	3.0
17			0.2	4.5	0.2	4.5
18			0.2	3.8	0.2	3.8
19			0.1	1.5	0.1	1.5
20						
21						
22						
23			0.1	0.8	0.1	0.8
24						
25			0.2	1.5	0.2	1.5
26			0.6	3.8	0.6	3.8
27			1.5	9.1	1.5	9.1
28			0.6	3.0	0.6	3.0
29			0.3	1.5	0.3	1.5
30						
31			0.4	1.5	0.4	1.5
32			0.4	1.5	0.4	1.5
33			0.5	1.5	0.5	1.5
34			0.3	0.8	0.3	0.8
35			1.4	3.8	1.4	3.8
36			0.9	2.3	0.9	2.3
37			1.9	4.5	1.9	4.5
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
TOTAL			12.1	170.3	12.1	170.3

NORAD/FAO/UNDP GLO 92/013



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

**Cruise Report No 11/97**

**Part III MOROCCO**

**20 November- 18 December 1997**

**Institut National de Recherches Halieutiques  
Casablanca, Morocco**

**Institute of Marine Research  
Bergen, Norway**

CRUISE REPORTS 'DR. FRIDTJOF NANSEN'

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

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**Part III MOROCCO**

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## CHAPTER 1 INTRODUCTION

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### 1.1 SURVEY OBJECTIVES

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 over a period of 50 days, in November-December 1997. A similar survey in the region had been conducted in the same period in 1995 and 1996.

The specific objectives for the survey in Morocco were:

- 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. treca*, 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 correct the acoustic densities and to describe the size distributions of the target fish populations.
- To sample standard hydrographical transects for temperature, salinity and oxygen off Cap Blanc, Dakhla, Cape Bojador, Cape Juby and Cape Ghir.

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

### 1.2 PARTICIPATION

Members of the scientific teams were:

Institut National de Recherches Halieutiques, Morocco

Omar KADA, Hassan MOUSTAFID (until 16.12), Lahcen ABOUABDELLAH (until 16.12) and

Ahmed MARHOUM (until 16.12)

Institute of Marine Research, Norway:

Tore STRØMME (Cruise leader), Guillermo BURGOS, John DALEN (6.12-16.12), Oddgeir ALVHEIM (20.11-6.12), Tore MØRK, Ingve FJELDSTAD.

SIMRAD, Norway: Tore Werner HANSEN

Christian Michelsen Research (CMR), Norway: Per Erik NORDBØ

### 1.3 NARRATIVE

The survey started with departure from Nouadhibou on November 21. A hydrographic section off Cap Blanc was carried out as a completion of the previous survey in Mauritania. The shelf from Cap Blanc was covered with acoustic transects 10nm apart. Where the shelf widens between Dakhla and C. Bojador the transect distance on the outer shelf was reduced to 20 nm. Figure 1 (a-b) shows the survey tracks and the fishing and hydrographic stations. In the area of Dakhla the wind calmed for one day. As a consequence of this the sardine surfaced and was not recorded by the acoustic system. This area was resampled a day later when the normal north-east wind resumed. The vessel called on Las Palmas 29 November for refuelling and technical service. Three experts from IMR, Simrad and Christian Michelsen Research embarked to upgrade the scientific sonar system onboard. They followed the vessel to Agadir. After the call at Las Palmas and before resuming the planned course track northwards, the vessel resampled the shelf area between Cape Bojador and Cape Juby as unexpected fish aggregations were found in this area on the previous coverage a few days earlier. Between Cap Juby and 29°N the coastal areas were sampled with a dense zig-zag pattern during the day and the outer shelf during night. This strategy was chosen mainly because of the fishing activity in the coastal areas. The northern limit of the survey was reached south of Safi, when two outstanding acoustic transect lines had to be cancelled due to rough weather. The vessel called at Agadir on 16 November for meetings and disembarkation of some of the scientists. Thereafter the vessel steamed to Las Palmas where the remaining scientific crew disembarked. The weather gave favourable working conditions except for the day operating in the Safi region.

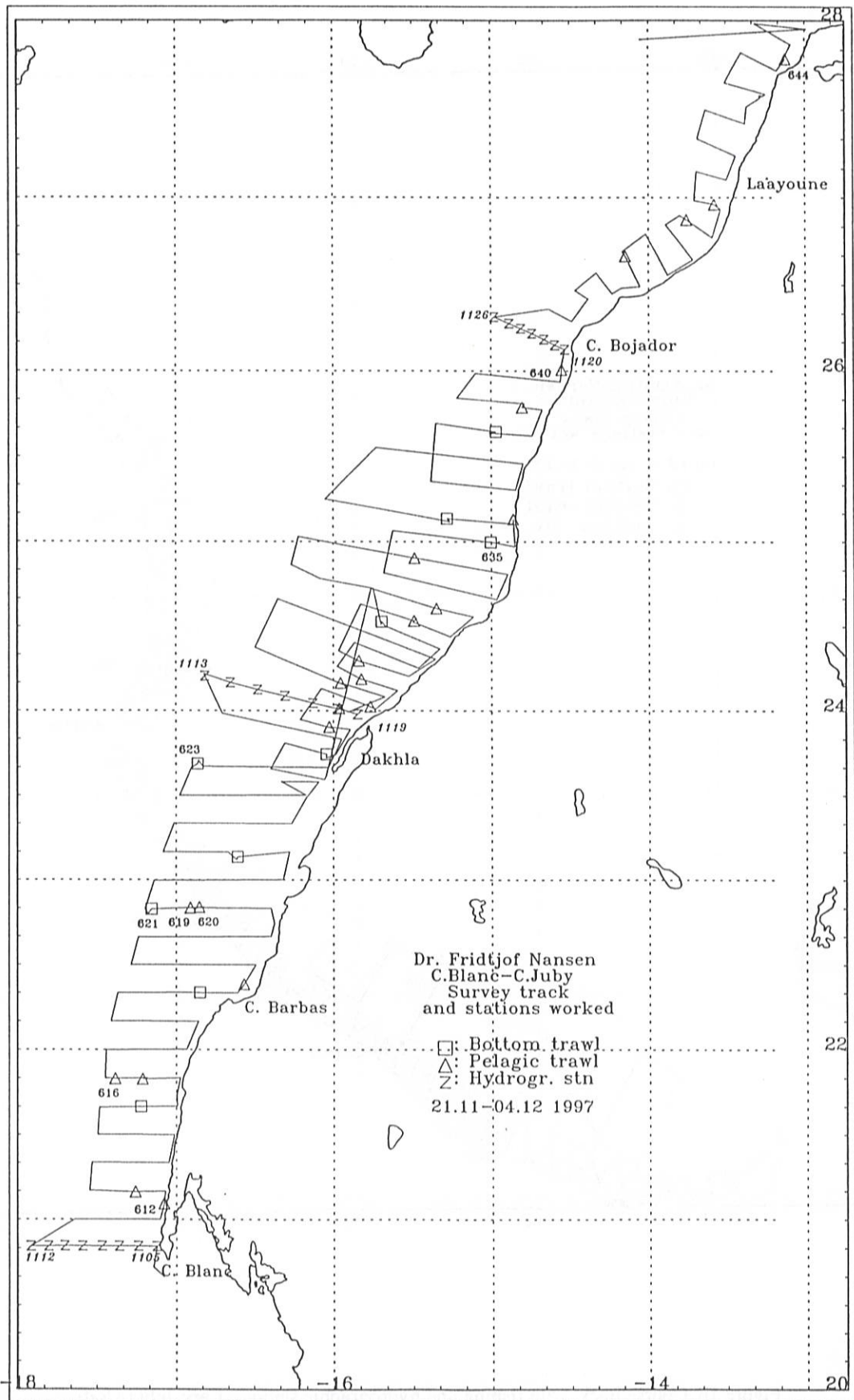


Figure 1a Course track with fishing and hydrographic stations, Cape Blanc to Cape Jubi.

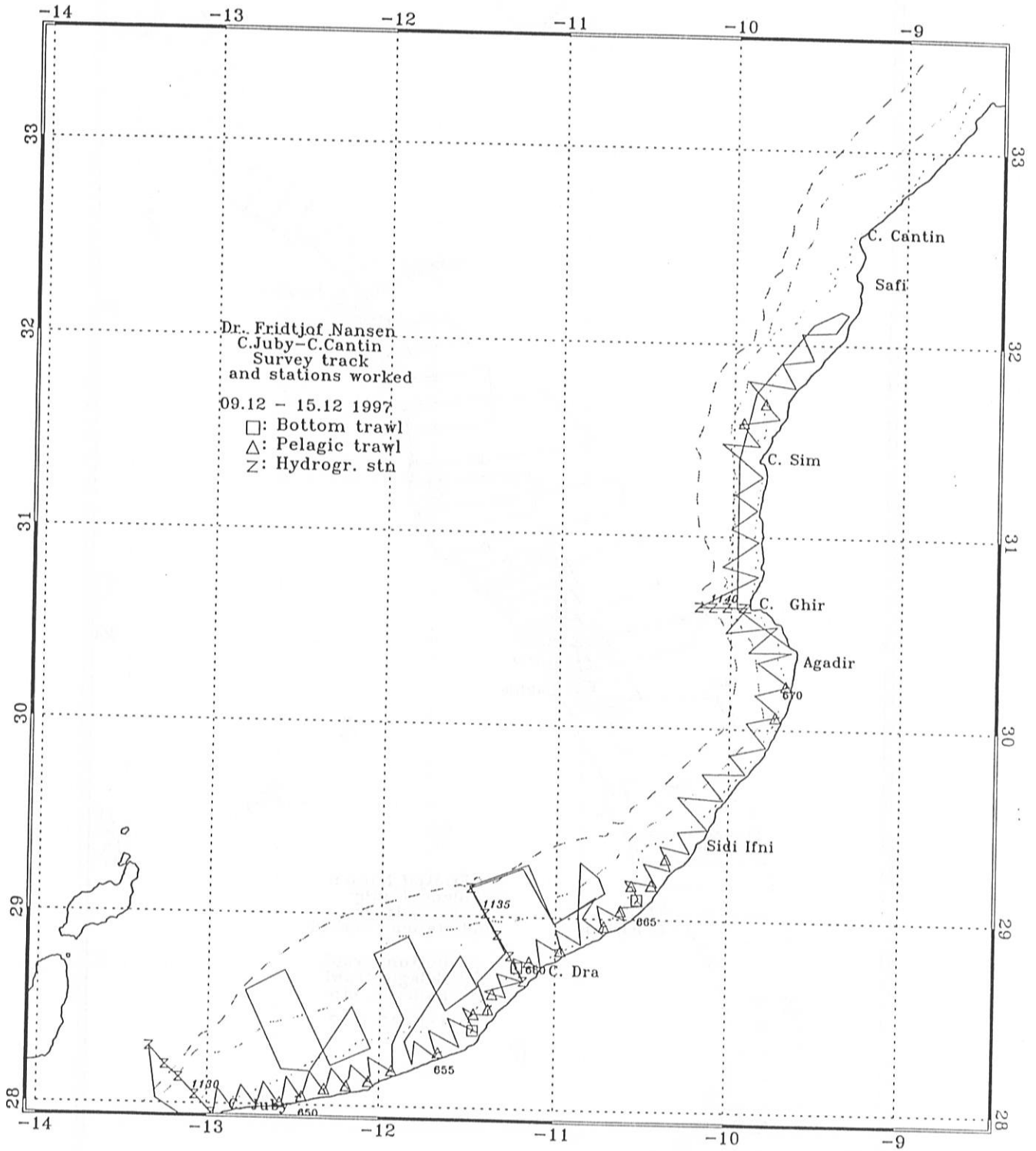


Figure 1b Course track with fishing and hydrographic stations, Cape Jubi to Safi.

## 1.4 METHODS

All catches were sampled for weight and numbers of each species. Length measurements (total body length) were taken for target species. The complete records of all fishing stations are shown in Annex II.

The surface temperature and meteorological data were logged automatically and recorded with position and bottom depth every nautical mile sailed.

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

The acoustic biomass estimates were based on the integration technique. The Bergen Integrator (BEI) was used for analysis and allocation of  $S_A$  values by species based on the composition in the trawl catches and on the characteristics of the acoustic traces. The BEI system allows a better discrimination between bottom signals and dense schools close to the bottom than the previous EK500 system used in the surveys prior to 1995.

The integrator values are plotted out in working maps and aggregations of fish are contoured, the mean integrator value of each aggregation is calculated and the areas are digitized and measured by computer software.

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:

$$TS = 20 \log L - 72$$

This is the same equation as used in previous surveys.

The biomass density in numbers/nm<sup>2</sup> of a length group  $i$  is calculated from the formula:

$$\rho_i = \frac{1}{4\pi} * \bar{s}_a \frac{n_i}{\sum_{i=\min}^{\max} n_i k_i} \quad \text{where} \quad k_i = 10^{2 \log l_i - 7.2}$$

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

$$\rho_i = 1261217 * \bar{s}_a \frac{n_i}{\sum_{i=\min}^{\max} n_i l_i^2}$$

where  $s_a$  = mean integrator value of a species within an aggregation area, in m<sup>2</sup>/nm<sup>2</sup>

$n_i$  = 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 TS equation with its constant -72. For other TS relationships the equation constant is:

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

The densities are then converted from numbers to weight by applying a condition factor for the species, obtained from the samples. Abundance, in number and weight, is obtained by multiplying the densities by the area of the aggregations. These calculations can easily be carried out in a spreadsheet where inputs are the length distribution, the mean integrator value and the area (in  $\text{nm}^2$ ).

The above equation shows that the conversion from  $S_A$ -value into number of fish is dependant on the size composition of the fish. In general there are many problems associated with getting representative length distributions when the various size classes are geographically segregated. When no segregation occurs the various length distributions are pooled together with equal importance. Otherwise, when the size distribution varies with the sampling site, 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.

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 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 the above formula. Numbers are converted to weight using the condition factor of the species. This can be calculated from the length 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 NAN-SIS software after the scientist has completed the two first steps in the above list manually. A similar analysis can also be done in Excel spreadsheet.

The two sardinellas were treated as one species during the scrutinizing process and the mean  $S_A$  values were later separated by species (*S. aurita* and *S. maderensis*) according to the catch rates and the length distributions of the two species. The same procedure was applied to the horse mackerel data.

Annex III gives a description of the instruments and the fishing gear used.

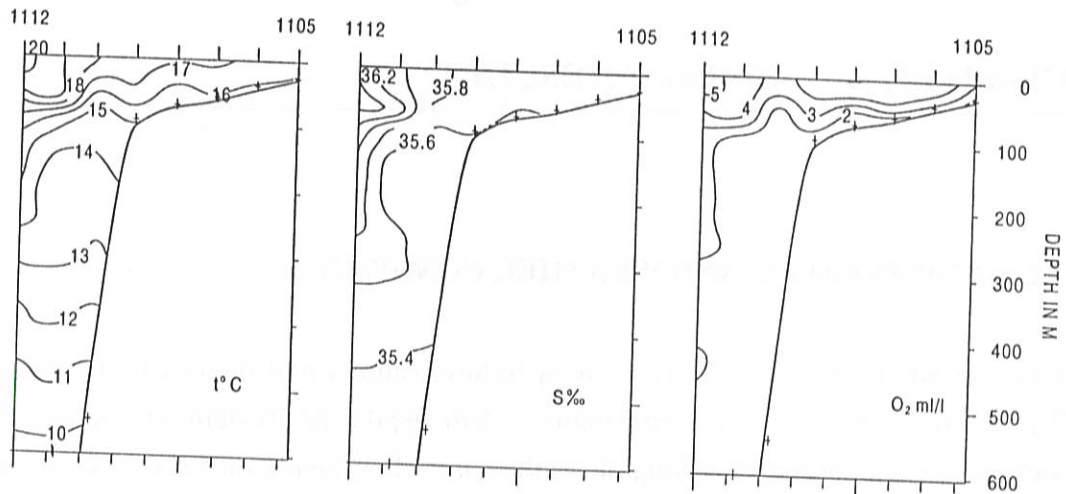
## CHAPTER 2 SURVEY RESULTS

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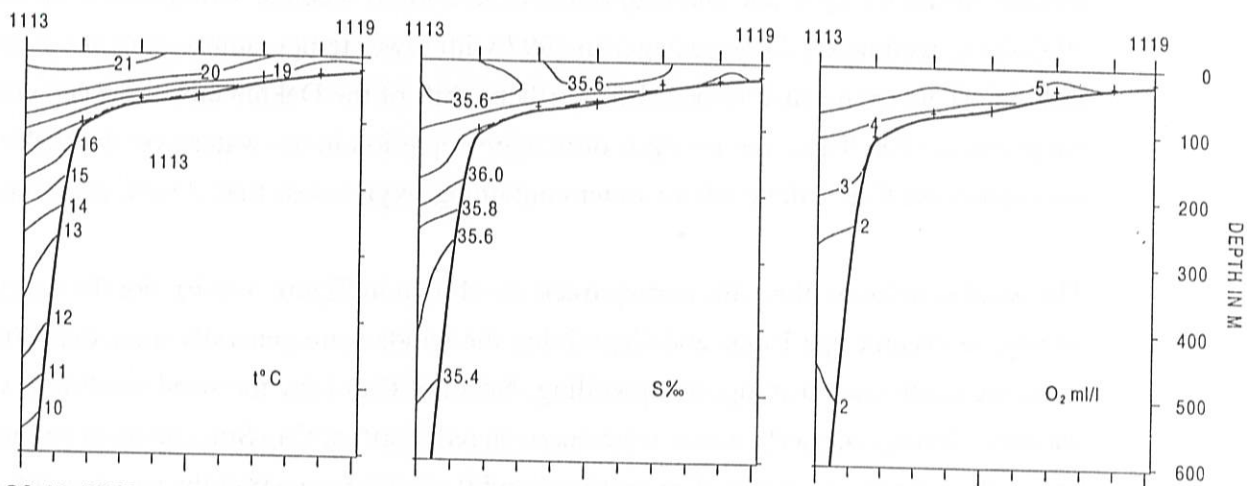
### 2.1 HYDROGRAPHY AND WEATHER CONDITIONS

Figure 2 shows the distribution of temperature, salinity and oxygen in the six sections and Figure 3 (a-b) the sea surface temperature at 5 m depth. The distribution of surface temperature well developed coastal upwelling along the coast. For the region between Cape Juby and Safi there is close similarity with the situation in 1996. Upwelling cells are located off Cape Sim and off Agadir. In the area between Cap Blanc and Cape Bojador there are strong upwelling cells located between Cap Blanc and Cap Barbas and north of Dakhla. Compared to the situation in 1996 the upwelling could be stronger in 1997 with lower temperatures along the coast north of Dakhla. There seems also to be a  $1.5^{\circ}$  northern shift of the Dakhla upwelling cell compared to the previous year. There are no signs of oxygen depletion in the water over the shelf except for the section off Cape Blanc where water containing oxygen less than 2 ml/L enter the shelf.

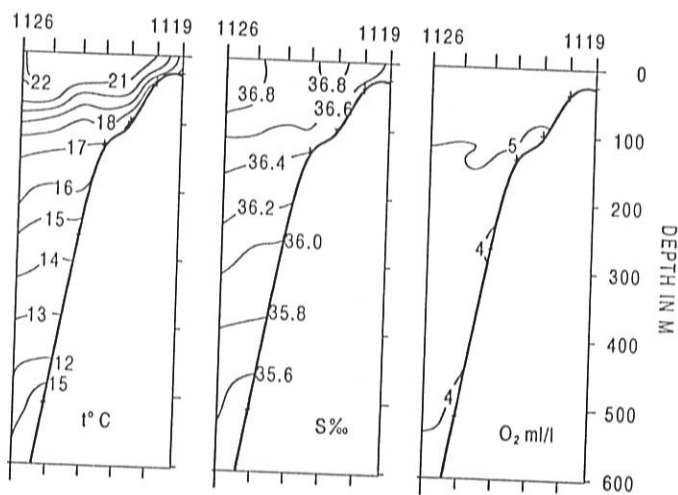
The wind conditions along the survey track are shown in Figure 4 (a-b). For the first part of the survey, between Cape Blanc and Cape Juby, the winds were generally more than 20 knots and from the north-east, driving the upwelling. North of Cap Juby the wind conditions were more variable. Strong northerly winds were encountered North of Cap Sim and up to Safi towards the end of the acoustic coverage. The weather conditions did not restrict the survey work except for the work off Safi.



Cape BLANC 21.11 1997

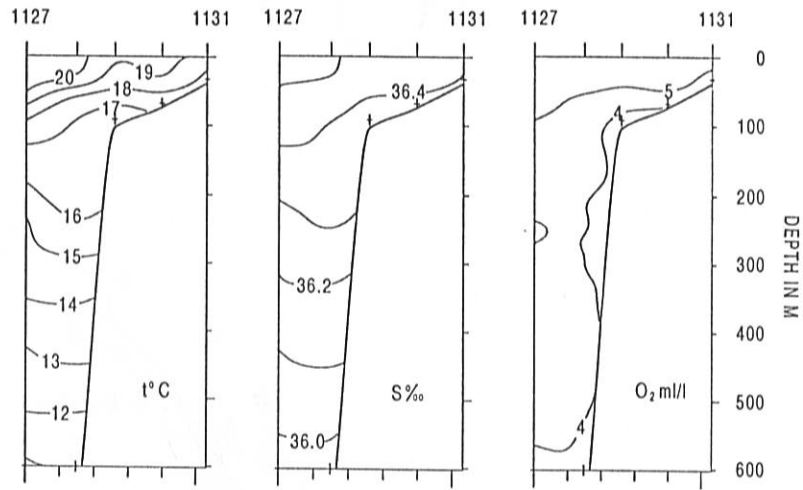


DAKHLA 26.11 1997

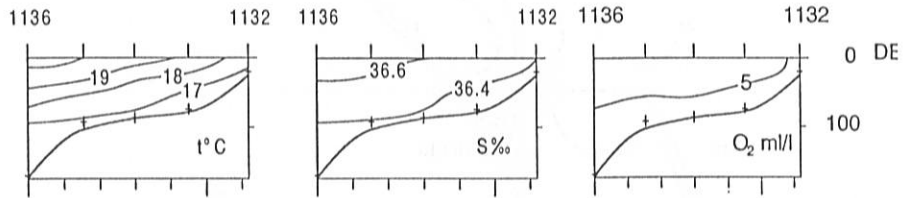


Cape BOJADOR 02.12 1997

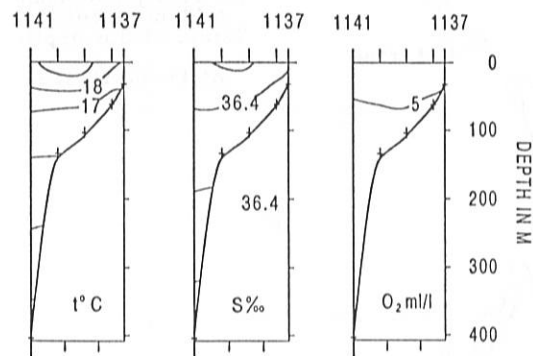
Figure 2 Hydrographic profiles with distribution of temperature, salinity and oxygen.



Cape JUBY 09.12 1997



Cap DRA 12.12 1996



Cap GHIR 14.12 1996

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

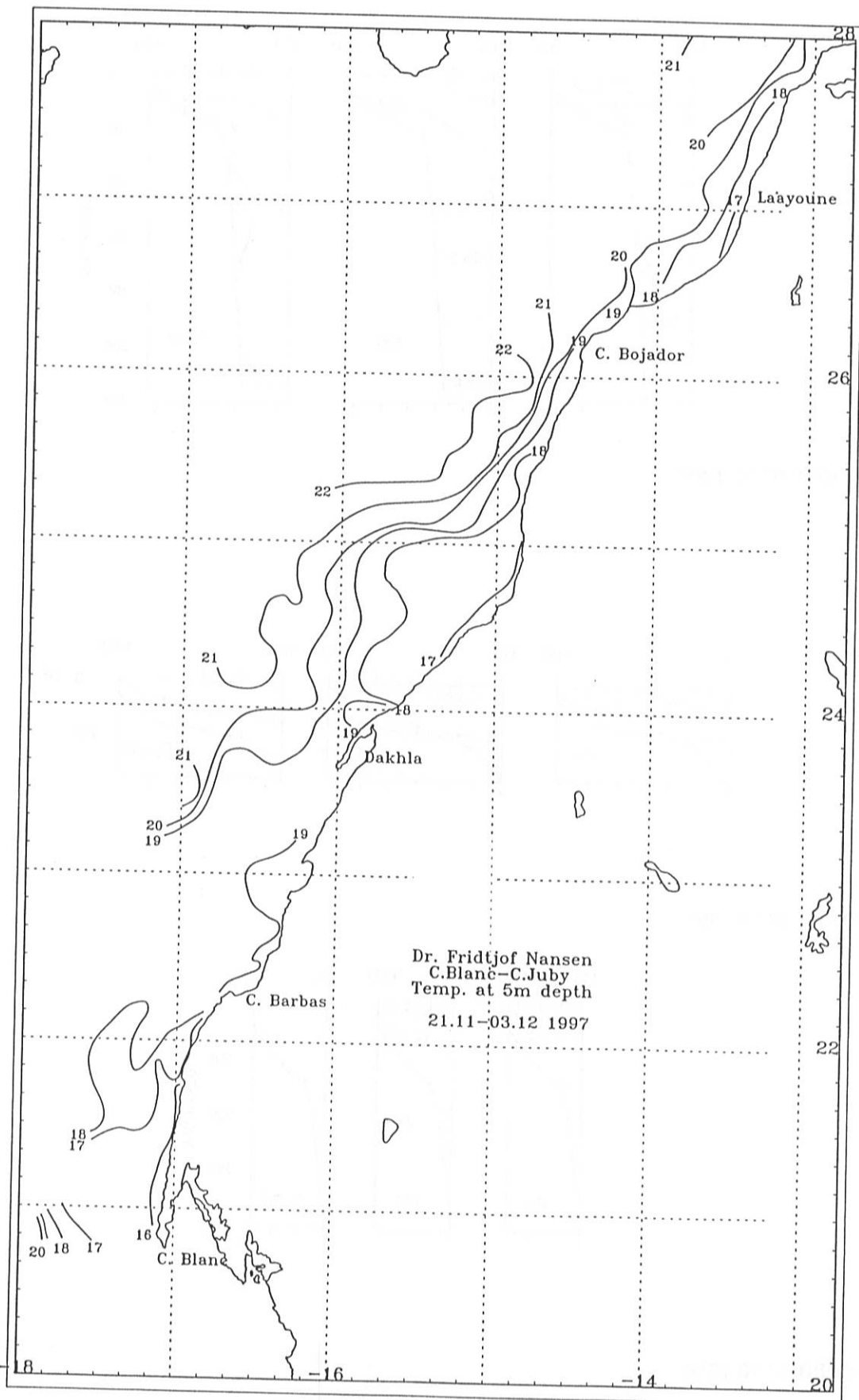


Figure 3a Sea surface temperature, Cape Blanc to Cape Jubi

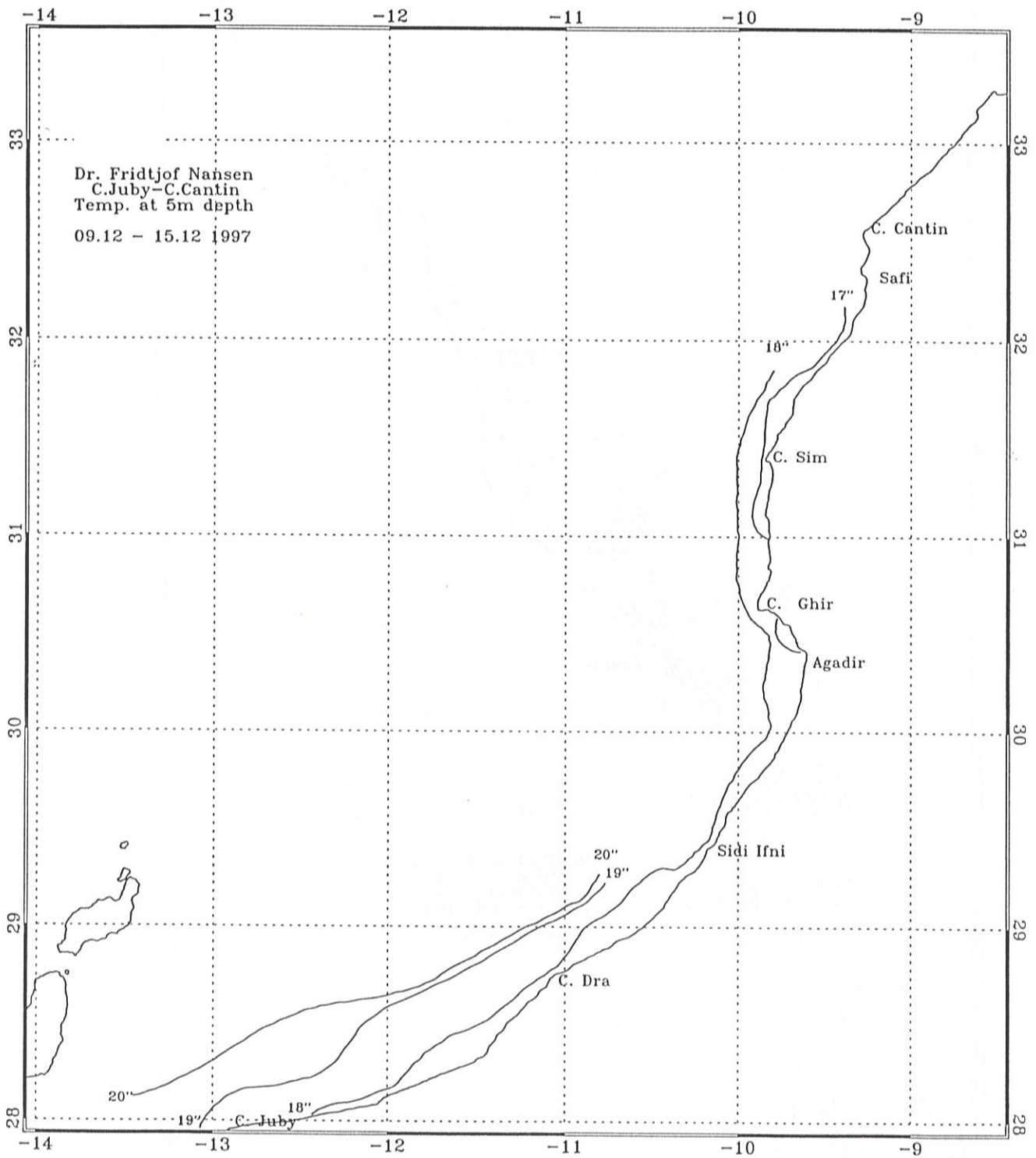


Figure 3b Sea surface temperature, Cape Jubi to Cape Cantin

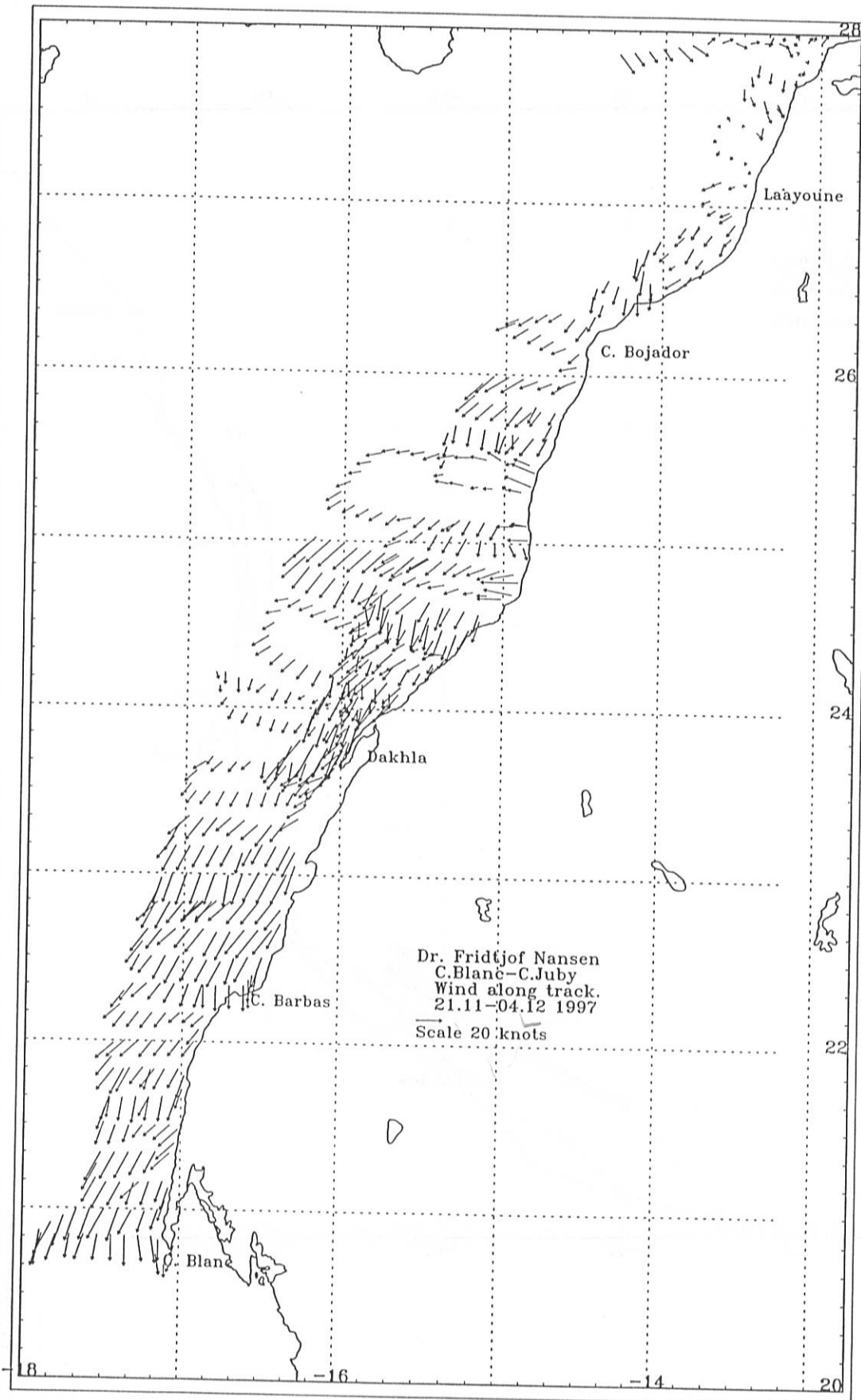


Figure 4a Wind conditions along the survey track 20 November - 4 December, Cape Blanc to Cape Juby.

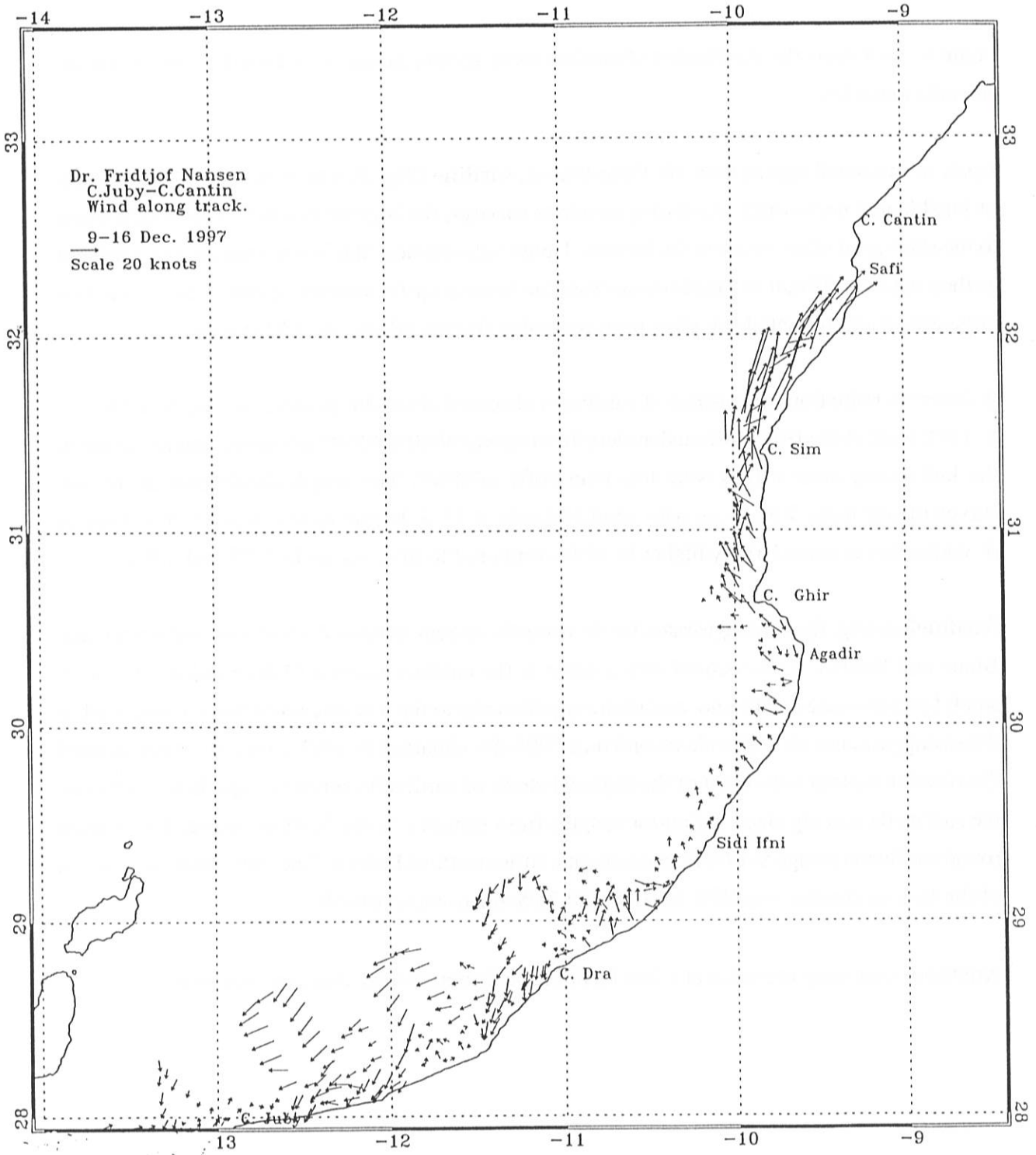


Figure 4b Wind conditions along the survey track 9-16 December, Cape Jubi to Safi.



## 2.2 PELAGIC FISH ON THE SHELF FROM CAPE BLANC TO CAPE JUBY

Figures 5 to 8 show the distribution of the four main species groups of pelagic fish by contoured acoustic densities.

Apart from a small aggregation off Cape Barbas, **sardine** (Fig. 5) was found from a little south of Dakhla and northwards. As during previous surveys, the highest densities were found close to the shore, and often close to the bottom. Dense schools near the bottom represent a problem as they may be difficult to discriminate from the bottom by the echointegrator. This loss is to a large extent compensated for when postprocessing the records by the BEI system.

A dramatic reduction in densities of sardine is observed since the previous survey in 1996. In 1996 most of the fish was found as densities beyond 3000  $m^2/NM^2$  integrator values, while in the last survey most values were less than 3000  $m^2/NM^2$ . The length distribution in the last survey ranged from 7 to 27 cm with modal lengths at 11.5, 14 and 20 cm, figure 9. The fraction of young fish is considerably higher in 1997 compared to the surveys in 1995 and 1996.

**Sardinellas** (Fig. 6) were registered by the acoustic system in three limited areas between Cape Blanc and Dakhla. It co-occured with sardine in the catches between Dakhla and 25° N but in small fractions only and did not contribute significantly to the acoustic recordings. Compared to the strong presence of sardinella recorded in 1996 the situation in 1997 portraits a more normal distribution pattern with most of the regional stock of sardinella south of Cape Blanc. Most of the sardinella was big sized with mean lengths from samples in the 31-36cm range. Small sized round sardinella (range 9-17cm) was caught a little north of Dakhla. The total catch proportion of the two sardinellas was 25% for flat- and 75% for round sardinella.

**Anchovy** were only recorded at a few locations and then in very scattered densities.

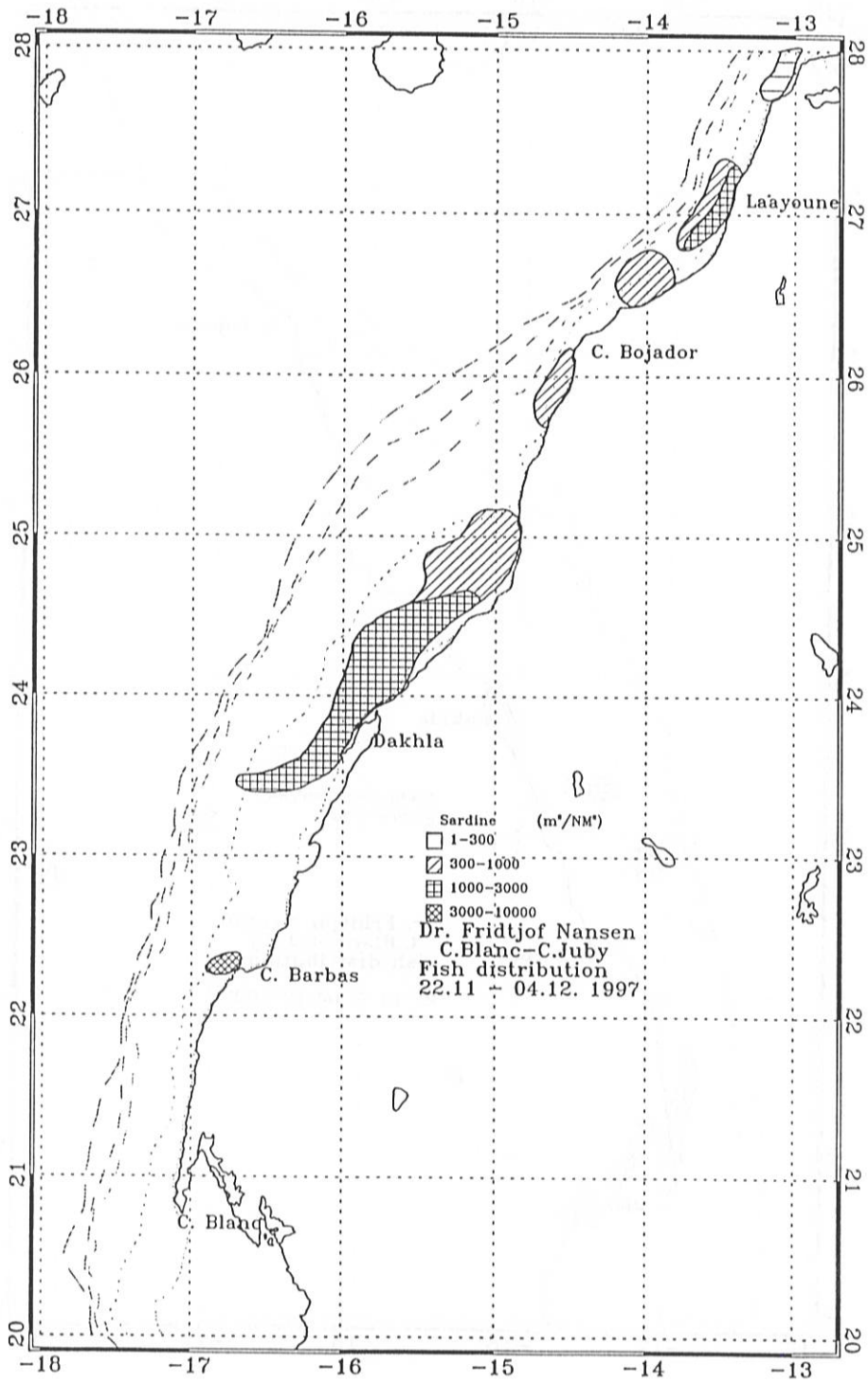


Figure 5 Distribution of sardine, Cape Blanc to Cape Juby

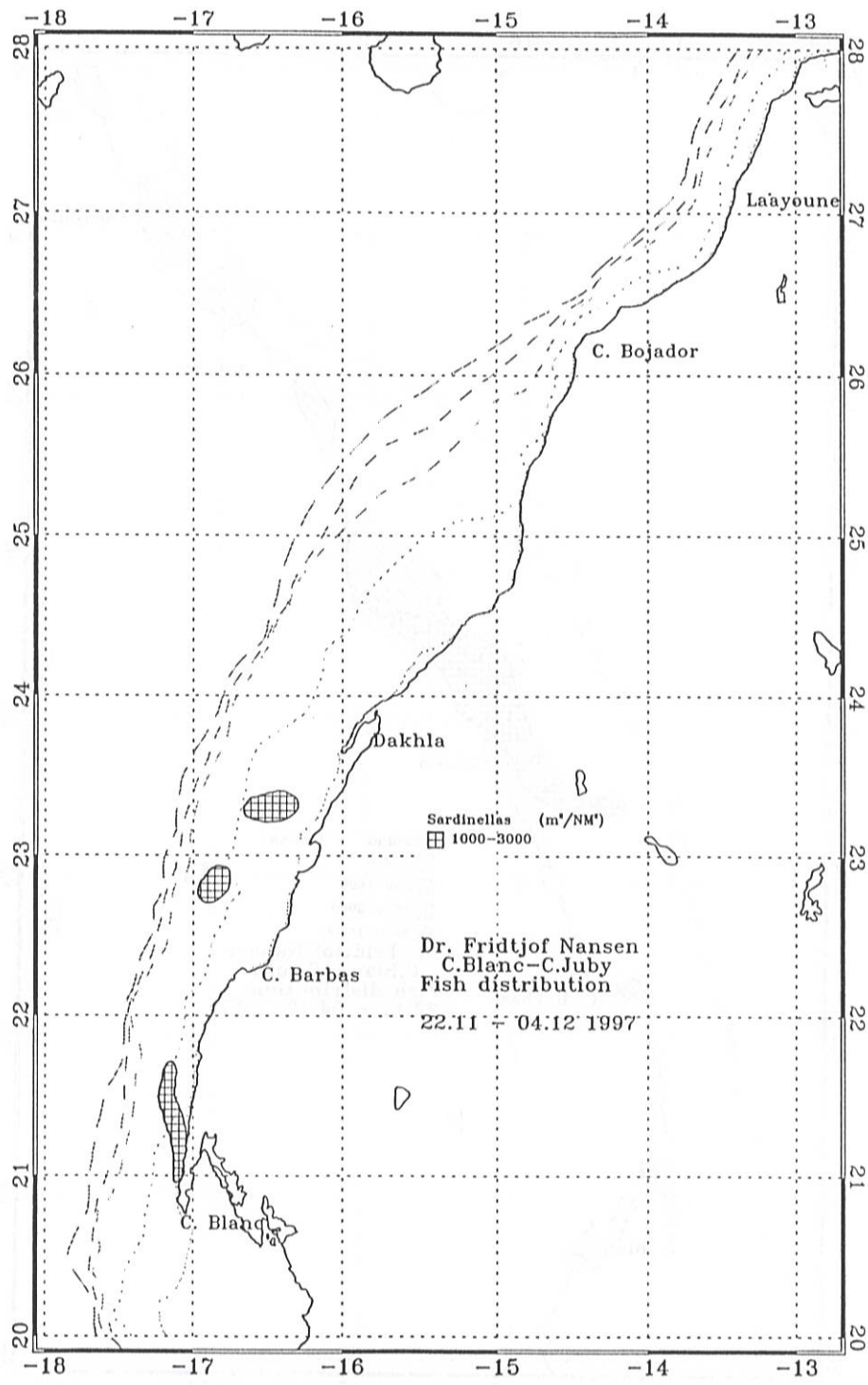


Figure 6 Distribution of sardinella, Cape Blanc to Cape Juby



Figure 7 Distribution of chub mackerel, Cape Blanc to Cape Juby

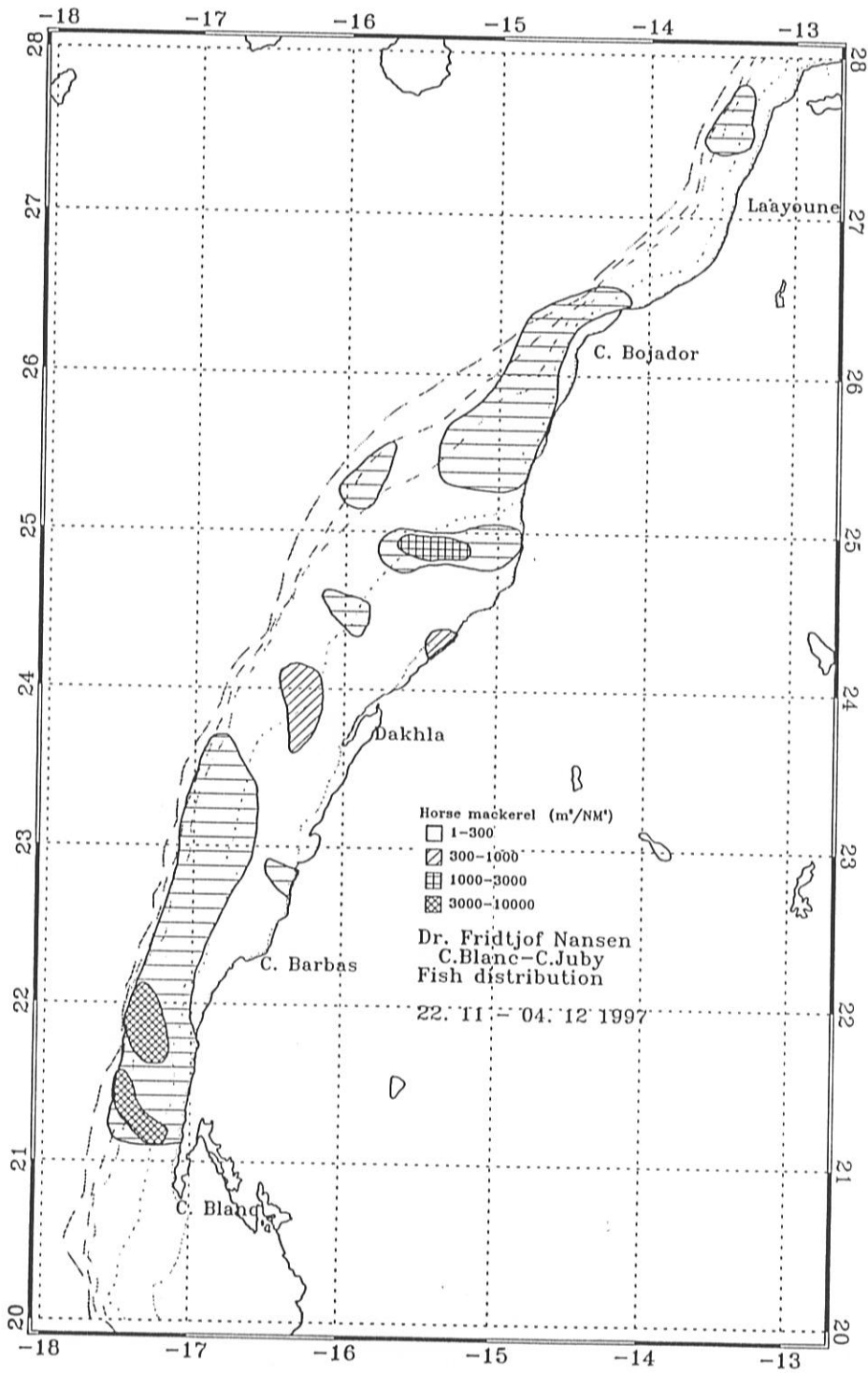


Figure 8 Distribution of horse mackerels, Cape Blanc to Cape Juby

**Horse mackerels** (*Trachurus trachurus* and *T. trecae*) (Fig. 8) were found in two dense aggregations between Cape Blanc and Cape Barbas and more scattered further north. The Cunene horse mackerel made up 45% in the samples between Cape Blanc and Cape Barbas.

## BIOMASS ESTIMATES

Detailed biomass estimates in number and weight by length groups are shown in Annex I.

The sardine was estimated to 870 thousand tonnes of which 260 thousand tonnes are in dense concentrations (1000-3000 m<sup>2</sup>/NM<sup>2</sup> integrator value). This is a drastic reduction from 1996 when 5.4 million tonnes were estimated and 4.3 million tonnes of these were found concentrated in densities with mean integrator readings beyond 10000. The length distribution is shown in Figure 9. It shows that most of the fish is small sized, in the range 11 to 15 cm., Adult sardine, bigger than 20cm, which was the dominating part of the stock in previous years, has now virtually disappeared from the shelf.

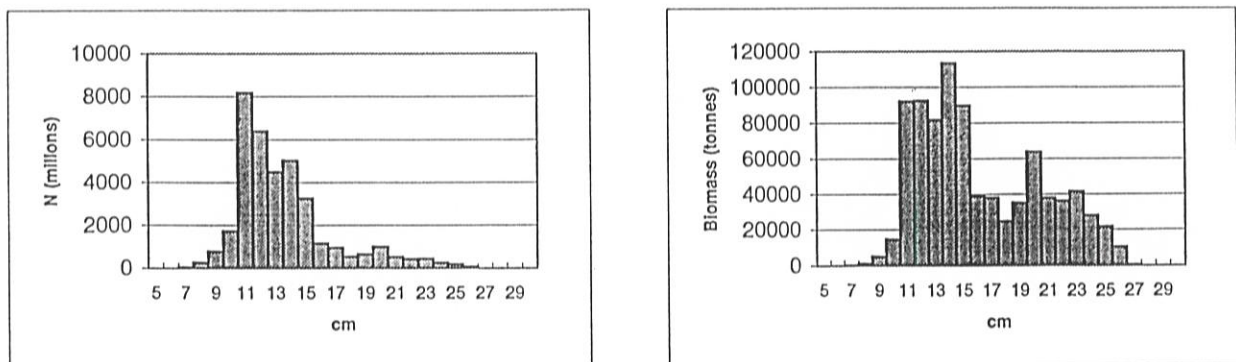


Figure 9 Length frequency distributions of sardine in numbers and biomass, Cape Blanc to Cape Jubi

Table 1 shows the estimates of sardinella and horse mackerel. The total estimate of sardinella was XXX mill. tonnes.

The total estimate of horse mackerel was 1.035 million tonnes of which about 51% was Atlantic horse mackerel. The Cunene horse mackerel was found only south of Cape Barbas.

Table 1 Cape Blanc to Cape Juby. Biomass estimates of pelagic fish, 1000 tonnes.				
Sardines	Round sardinella	Flat sardinella	Atlantic horsem.	Cunene horsem.
870	XXX	XXX	530	505

### 2.3 PELAGIC FISH ON THE SHELF FROM CAPE JUBY TO SAFI.

**Sardine** was found in most of the shallow areas in the region (Fig. 11), but in varying densities. Concentrations were located close to Tan Tan, Sidi Ifni and Agadir. In general, the pattern was much like the distribution observed the previous year. The estimated length frequency distribution (Fig.10) shows that the sardine is small sized, below 20 cm.

**Anchovy** (Fig. 12) was found in aggregation off Tan Tan, Cape Dra, Agadir and Cape Sim. The size range was 8-15 cm and mean size in the range 10-13cm.

**Horse mackerel** was found only in scattered occurrences. **Chub mackerel** (Fig. 13) was located in scattered patches along the coast, usually outside the sardine distributions. Chub mackerel was hit as bycatch in some catches but never in quantities. Neither did this species form aggregations detected by the acoustic system.)

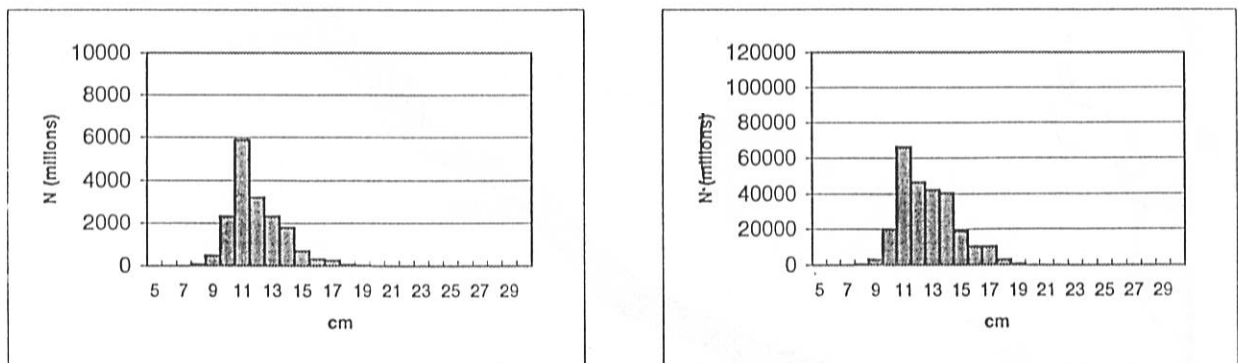


Figure 10 Length frequency distribution of sardine, Cape Juby to Cape Cantin



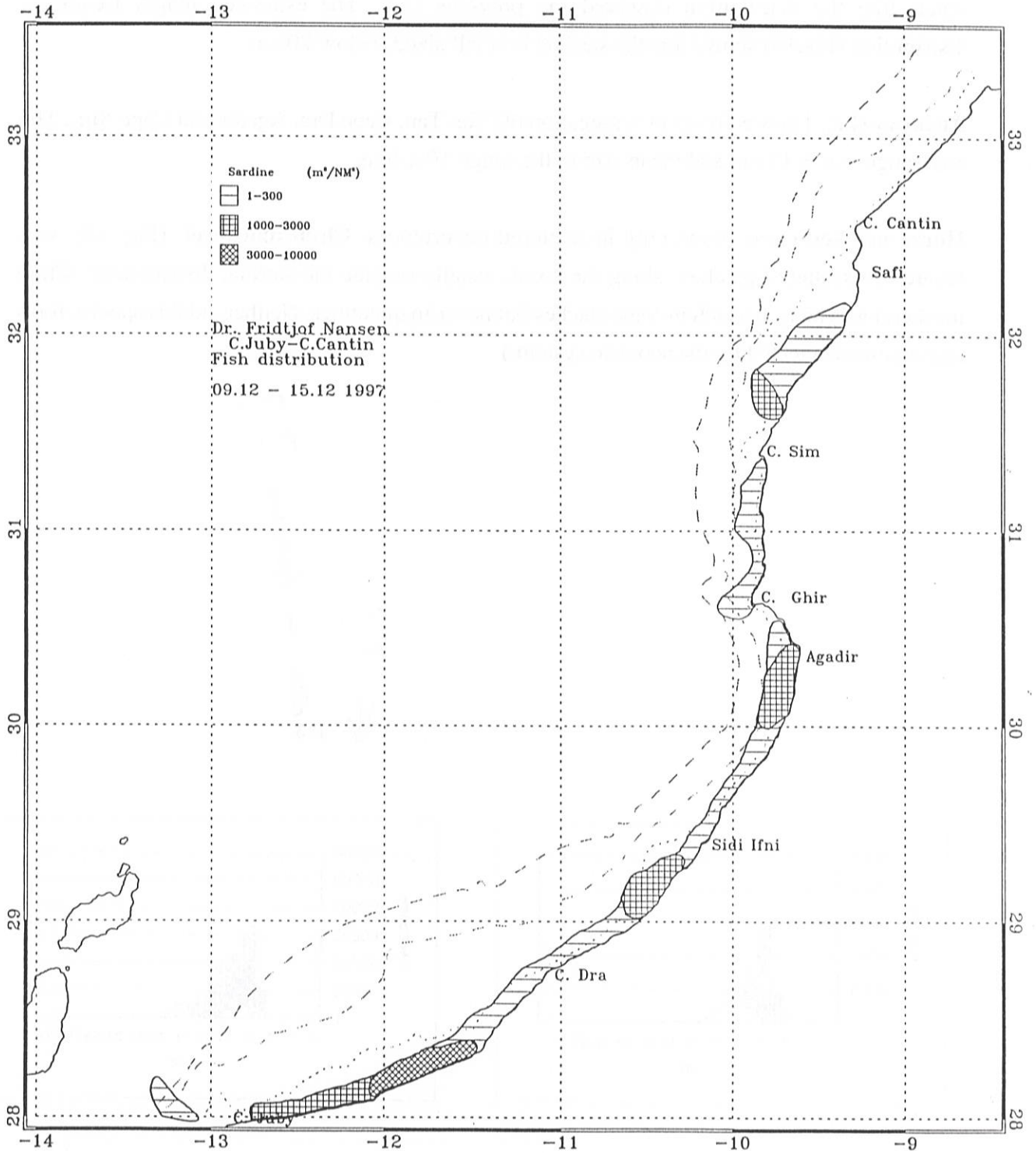


Figure 11 Distribution of sardine, Cape Juby to Cape Cantin

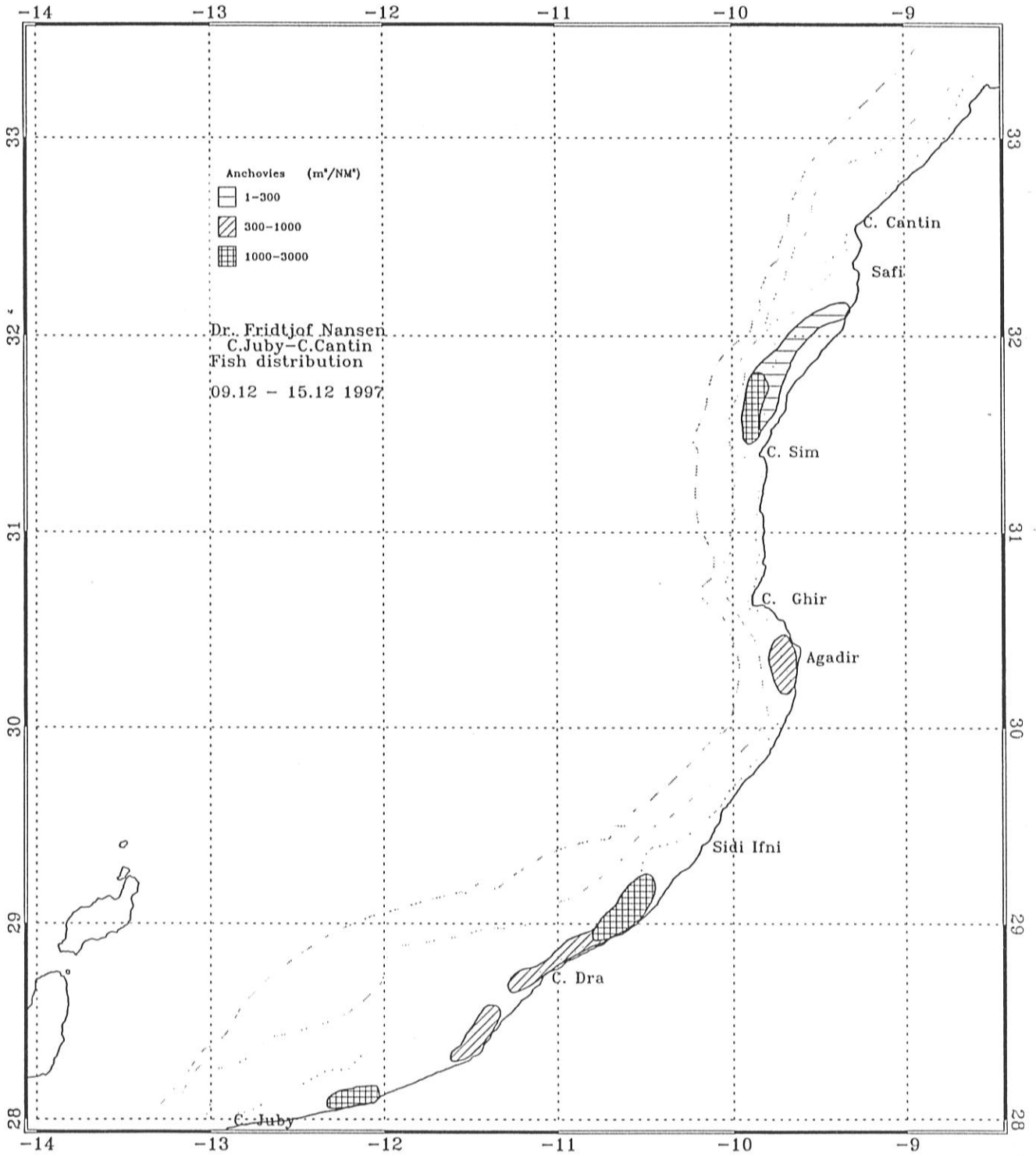


Figure 12 Distribution of anchovy, Cape Juby to Cape Cantin



Figure 13 Distribution of chub mackerel Cape Juby to Cape Cantin

## BIOMASS ESTIMATES

The **sardine** was estimated to 260 thousand tonnes, the same figure as estimated the previous year. About 250 thousand tonnes or 95 % was found in relative high densities with mean integrator values just beyond 1000 units/nm<sup>2</sup> (see map legend).

**Anchovy** was estimated to 63 thousand tonnes. Of this 42 thousand tonnes were located in high density aggregations higher than 1000 integrator units, or more than 125 tonnes per nm<sup>2</sup>.

No estimate was made for the **horse mackerel** as the registrations were too few . The species was generally scattered, with no high aggregations found that could be a target for aimed commercial fishing. The chuc mackerel is estimated to XXX thousand tonnes. This is a very rough indicative figure as the species in general was scattered and with few detected aggregations of commercial interest.

### CHAPTER 3 CONCLUDING REMARKS

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The survey was conducted successfully in the period November 20 to December 20 with a course track of 4 900 nm and 61 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 were favourable and did not put any constraints on the survey except for the last day, off Safi.

The hydrographic data show well developed upwelling along the entire coastline, and the whole shelf holds water well enriched with oxygen perhaps with an exception in the Cap Blanc area where waters of low oxygen level is close to the shelf edge. Except for the upwelling, no fronts or oceanographic barriers were observed on the shelf.

Figure 14 gives a general overview on the major aggregations of pelagic fish with rounded biomass figures. (TO BE COMPLETED)

Concentrations of sardine was found in shallow waters off Dakhla, Laâyoune, Tan Tan, Sidi Ifni and Agadir. The concentrations off Dakhla has the same distribution limit as in previous years but the densities are considerably lower than previously and the population consists mainly of young fish below 20cm. In the region between Cape Juby and Safi, the distribution pattern is much similar to previous years. The fish is small sized, less than 20cm.

Minor aggregations of round and flat sardinellas were found northwards until close to Dakhla. The few registrations of sardinellas indicate that the two stocks has again moved south of Cape Blanc, in correspondence with the traditional distribution pattern. The high densities of sardinella recorded north of Cape Blanc in 1996 should be interpreted more as an anomaly.

Horse mackerel was found in high abundance between Cape Blanc and Cape Barbas, as a continuation of the distribution recorded in Mauritania. Further north, horse mackerel was generally scattered. This confirms the general distribution pattern of the species.



Figure 14 Map of the major pelagic fish concentrations with estimated abundance (thousand tonnes), Cape Blanc to Cape Cantin.

Anchovies were found in several aggregations between Safi and Cape Juby. It was frequently mixed with the sardine

The biomass estimates are summarized in Table 2.

	C. Blanc-C. Juby	C. Juby- C. Cantin	Total
Sardines	870	260	1130
Sardinellas	XXX	0	XXX
Anchovies	0	63	63
Horse mackerel	1030	40	1070
Chub mackerel	-	-	-

Figure 15 shows the biomass estimates of sardine compared with results from previous “Dr. Fridtjof Nansen” surveys. The sardine stock between Cape Blanc and Cape Juby has undergone a dramatic change since the previous survey in 1996. The stock estimate has declined from 5.3 million tonnes to 870 thousand tonnes and the adult part of the stock has virtually vanished. There is at present no good explanation to this and a similar change has not been reported earlier. The shelf is adequately covered and it is not likely that the abundances of last year could escape between the sampling grid. Surface schooling was only observed in one area and was corrected for by resampling when the conditions changed. It is therefore assumed that the adult part of the stock has either migrated out from the investigational area i.e. away from the shelf, or that the stock has suffered a heavy mortality. The environment conditions look normal on the shelf, except that the central upwelling cell previously located south of Dakhla, now seems to have moved about 90NM northwards. One could also take note that the 2 ml/l oxycline in the hydrographic section off Cape Blanc is close to the shelf edge and that in November 1996 it was also close to the shelf edge off Dakhla (see previous cruise report). This is Central Atlantic deep water that is brought towards the surface by the upwelling process. It could be that an exceptional intensifying of the upwelling during early 1997 could have brought these watermasses into the location of the spawning stock. It must be admitted that it is rather

speculative at this point to use this as an explanation, but it could be worthwhile to follow the dynamics of the hydrographic regime through 1997 to put more light upon this. Analyses of satellite images of surface temperature from 1997 could show if the upwelling has been stronger than normal in the region. If another acoustic survey is carried out during the first half of 1998 it is strongly recommended that a dense acoustic sampling grid is used for the Dakhla region in order to check the recent findings from "Dr. Fridtjof Nansen". It is also recommended to collect more information on the the hydrographic regime.

In contrast to the stock in the Dakhla region the central stock between Cape Juby and Safi is in the later years rather stable, but at a historic low level, 260-300 thousand tonnes.

The sardinella stocks north of Cape Blanc has undergone dramatic change in the later years. It was first estimated in 1992, but only to 10 thousand tonnes, increasing to 0.95 million tonnes in 1995, and to 1.50 million tonnes in 1996. In 1997 the stock fraction is reduced to XXX thousand tonnes. It is assumed that what has been observed is a cyclic shift in the distribution of sardinella and that the stock now is back towards it normal state with it main distribution area south of Cape Blanc.

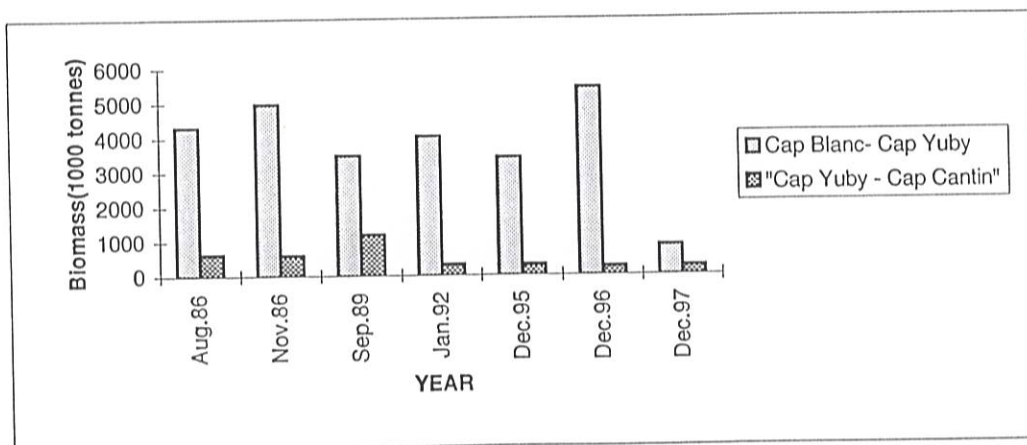


Figure 15 Sardine biomass estimates Cape Blanc-Cape Juby and Cape Juby- Cape Cantin, Dr Fridjof Nansen 1986-96



Horse mackerel estimates have increased from 120 thousand tonnes in 1992, to 340 thousand tonnes in 1995, 1.05 million tonnes in 1996, and 1.07 million tonnes in 1997. Most of the horse mackerel was located between Cape Blanc and Cape Barbas and forms an extension of the stocks in Mauritania.

## Annex I Biomass and number by length

### Sardina pilchardus

Length cm	Safi - Cap Juby		Cap Juby - Cap Blanc		Total	
	tonnes	N millions	tonnes	N millions	tonnes	N millions
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	4	106	34	106	38
8	279	61	1146	252	1425	314
9	3021	476	4952	780	7973	1257
10	19832	2315	14710	1717	34543	4032
11	66039	5868	91980	8173	158019	14041
12	46430	3212	92419	6394	138849	9607
13	42262	2321	81735	4489	123998	6811
14	40387	1790	113314	5023	153701	6813
15	19064	692	89664	3254	108728	3946
16	10381	312	38654	1163	49036	1475
17	10307	260	37897	956	48203	1215
18	3063	65	24760	528	27823	594
19	546	10	35056	639	35603	649
20	36	1	63706	999	63742	1000
21	0	0	37984	516	37984	517
22	0	0	36203	430	36203	430
23	0	0	41397	431	41397	431
24	0	0	27823	256	27823	256
25	0	0	21576	176	21576	176
26	0	0	10394	75	10394	75
27	0	0	469	3	469	3
28	0	0	0	0	0	0
29	0	0	0	0	0	0
30	0	0	0	0	0	0
Total	261649	17388	865946	36289	1127594	53677

# Annex I Records of fishing stations

DATE:22/11/97 GEAR TYPE: PT No:4 PROJECT STATION: 612  
 start stop duration POSITION:Lat N 2106  
 TIME :01:44:31 01:59:36 15 (min) Purpose code: 1 Long W 1705  
 LOG :4043.89 4044.66 0.77 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 28 28 Validity code:  
 Towing dir: 28° Wire out: 200 m Speed: 31 kn\*10

Sorted: 100 Kg Total catch: 266.88 CATCH/HOUR: 1067.52

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	476.80	1216	44.66	1263
Decapterus rhonchus	321.08	1824	30.08	1265
PCTD102	65.40	212	6.13	
Sphyræna sphyraena	64.52	172	6.04	
Trachurus trecae	50.56	288	4.74	1266
Camogramma glaycon	19.08	76	1.79	
Mustelus mustelus	17.16	12	1.61	
Stromateus fiatola	9.08	12	0.85	
Sardinella maderensis	8.96	32	0.84	1264
Sardina pilchardus	7.88	332	0.74	1267
Pteronacion pelli	7.68	84	0.72	
Diplodus bellottii	5.44	52	0.51	
Pomadasya incisus	4.48	32	0.42	
Loligo vulgaris	3.20	44	0.30	
Trichiurus lepturus	2.88	64	0.27	
Scomber japonicus	1.60	12	0.15	
Chaetodon hoefleri	1.40	12	0.13	
Penaeus notialis	0.32	12	0.03	
Total	1067.52		100.01	

DATE:22/11/97 GEAR TYPE: PT No:1 PROJECT STATION: 613  
 start stop duration POSITION:Lat N 2110  
 TIME :04:15:22 04:29:48 14 (min) Purpose code: 1 Long W 1715  
 LOG :4061.39 4062.14 0.75 Area code : 3  
 FDEPTH: 20 30 GearCond.code:  
 BDEPTH: 47 49 Validity code:  
 Towing dir: 90° Wire out: 150 m Speed: 32 kn\*10

Sorted: 93 Kg Total catch: 589.80 CATCH/HOUR: 2527.71

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	831.94	4260	32.91	
Dentex gibbosus	504.04	626	19.94	
Dentex canariensis	415.29	626	16.43	
Diplodus vulgaris	271.41	759	10.74	
Trachurus trecae	177.77	1410	7.03	1268
Spondyliosoma cantharus	100.29	489	3.97	
Trachurus trachurus	82.80	1929	3.28	1269
Boops boops	51.56	677	2.04	
Pagrus caeruleostictus	35.01	26	1.39	
Loligo vulgaris	24.43	81	0.97	
Decapterus rhonchus	22.54	81	0.89	
Pomadasya incisus	4.07	26	0.16	
Diplodus bellottii	3.00	26	0.12	
Pagellus acarne	1.89	26	0.07	
Sardina pilchardus	1.63	26	0.06	
Total	2527.67		100.00	

DATE:22/11/97 GEAR TYPE: BT No:2 PROJECT STATION: 614  
 start stop duration POSITION:Lat N 2140  
 TIME :17:35:29 17:57:11 22 (min) Purpose code: 1 Long W 1713  
 LOG :4186.78 4187.97 1.17 Area code : 3  
 FDEPTH: 66 66 GearCond.code:  
 BDEPTH: 66 66 Validity code:  
 Towing dir: 272° Wire out: 250 m Speed: 29 kn\*10

Sorted: 61 Kg Total catch: 491.60 CATCH/HOUR: 1340.73

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trachurus	604.36	14806	45.08	1270
Plectorhinchus mediterraneus	117.82	131	8.79	
Pagellus bellottii	103.85	960	7.75	
Trachurus trecae	96.65	502	7.21	1271
Scorpaena acrofa	70.25	1527	5.24	
Umbrina canariensis	69.82	240	5.21	
Dentex canariensis	60.00	196	4.48	
Loligo vulgaris	59.35	1571	4.43	
Trichiurus lepturus	41.89	44	3.12	
Dentex gibbosus	24.00	65	1.79	
Pagrus auriga	22.91	44	1.71	
Pomadasya incisus	21.82	109	1.63	
Dentex maroccanus	15.05	109	1.12	
Boops boops	7.64	109	0.57	
Merluccius senegalensis	7.20	22	0.54	
Sardina pilchardus	6.98	65	0.52	
Spondyliosoma cantharus	5.02	44	0.37	
Citharus linguatula	3.27	87	0.24	
Serranus cabrilla	2.40	65	0.18	
Chelidonichthys obscurus	0.22	22	0.02	
Zeus faber	0.22	22	0.02	
Total	1340.72		100.02	

DATE:22/11/97 GEAR TYPE: PT No:2 PROJECT STATION: 615  
 start stop duration POSITION:Lat N 2150  
 TIME :22:22:02 22:54:19 32 (min) Purpose code: 1 Long W 1713  
 LOG :4228.84 4230.73 1.86 Area code : 3  
 FDEPTH: 20 30 GearCond.code:  
 BDEPTH: 66 60 Validity code:  
 Towing dir: 77° Wire out: 100 m Speed: 35 kn\*10

Sorted: 62 Kg Total catch: 248.80 CATCH/HOUR: 466.50

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	319.50	1440	68.49	1273
Trachurus trachurus	61.88	653	13.26	1272
Loligo vulgaris	39.00	1764	8.36	
Pagellus bellottii	28.88	105	6.19	
Trichiurus lepturus	14.25	15	3.05	
Sepia officinalis hierredda	3.00	15	0.64	
Total	466.51		99.99	

DATE:23/11/97 GEAR TYPE: PT No:1 PROJECT STATION: 616  
 start stop duration POSITION:Lat N 2150  
 TIME :00:42:36 00:58:42 16 (min) Purpose code: 1 Long W 1713  
 LOG :4245.47 4246.33 0.86 Area code : 3  
 FDEPTH: 20 20 GearCond.code:  
 BDEPTH: 111 110 Validity code:  
 Towing dir: 90° Wire out: 150 m Speed: 33 kn\*10

Sorted: 20 Kg Total catch: 19.77 CATCH/HOUR: 74.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trachurus	66.00	3285	89.02	1274
Trichiurus lepturus	4.28	8	5.77	
Todarodes sagittatus	1.20	8	1.73	
GOBIIDAE	0.86	701	1.16	
Scomber japonicus	0.64	19	0.86	1275
Loligo vulgaris	0.38	4	0.51	
MYCTOPHIDAE	0.34	90	0.46	
Trachurus trecae	0.23	8	0.31	
SEPIIDAE	0.08	53	0.11	
Tylosurus crocodilus crocodil.	0.08	4	0.11	
Total	74.17		100.04	

DATE:23/11/97 GEAR TYPE: BT No:2 PROJECT STATION: 617  
 start stop duration POSITION:Lat N 2220  
 TIME :14:31:57 14:55:31 24 (min) Purpose code: 1 Long W 1651  
 LOG :4374.78 4375.99 1.21 Area code : 3  
 FDEPTH: 42 46 GearCond.code:  
 BDEPTH: 42 46 Validity code:  
 Towing dir: 270° Wire out: 185 m Speed: 29 kn\*10

Sorted: 44 Kg Total catch: 237.82 CATCH/HOUR: 594.55

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	169.00	73809	62.06	1277
Sardina pilchardus	81.45	6435	13.70	1276
Decapterus rhonchus	54.30	135	9.13	1278
Loligo vulgaris	34.50	2685	5.80	
Argyrosomus regius	16.50	15	2.78	
Spondyliosoma cantharus	12.90	30	2.17	
Dentex canariensis	8.70	15	1.46	
Zeus faber	6.50	5	1.09	
Trichiurus lepturus	5.90	198	0.99	
Umbrina canariensis	2.85	15	0.48	
Octopus vulgaris	1.80	3	0.30	
Allotheutis subulata	0.15	135	0.03	
Total	594.55		99.99	

DATE:23/11/97 GEAR TYPE: PT No:2 PROJECT STATION: 618  
 start stop duration POSITION:Lat N 1634  
 TIME :17:18:43 17:52:14 34 (min) Purpose code: 1 Long W 1634  
 LOG :4397.00 4398.74 1.72 Area code : 3  
 FDEPTH: 0 0 GearCond.code: 8  
 BDEPTH: 28 26 Validity code: 3  
 Towing dir: 216° Wire out: 200 m Speed: 30 kn\*10

Sorted: 49 Kg Total catch: 245.70 CATCH/HOUR: 433.59

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	77.65	371	17.91	1279
Dentex canariensis	75.00	194	17.30	
Diplodus vulgaris	72.35	309	16.69	
Diplodus bellottii	50.65	485	11.68	
Diplodus sargus *	30.53	53	7.04	
Sphyræna sphyraena	29.29	62	6.76	
Pagellus bellottii	21.18	79	4.88	
Pomadasya incisus	20.29		4.68	
Diplodus puntazzo	15.53	18	3.58	
Stromateus fiatola	15.00	35	3.46	
Sardinella aurita	12.35	62	2.83	
Loligo vulgaris	7.06	9	1.65	
Trachurus trecae	3.88	35	0.89	
Sardinella maderensis	1.94	18	0.45	
Spondyliosoma cantharus	0.88	9	0.20	
Total	433.58		100.00	

PROJECT STATION: 619  
 DATE: 24/11/97 GEAR TYPE: PT No:2 POSITION: Lat N 2250 Long W 1655  
 start stop duration  
 TIME : 10:08:38 10:42:02 33 (min) Purpose code: 1  
 LOG : 4554.12 4556.18 2.03 Area code : 3  
 FDEPTH: 25 25 GearCond.code:  
 BDEPTH: 58 60 Validity code:  
 Towing dir: 90° Wire out: 100 m Speed: 40 kn\*10  
 Sorted: 102 Kg Total catch: 102.10 CATCH/HOUR: 185.64

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	156.00	484	84.03	1281
Sarda sarda	24.27	13	13.07	
Sardinella aurita	5.36	13	2.89	1280
Total	185.63		99.99	

PROJECT STATION: 620  
 DATE: 24/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2250 Long W 1651  
 start stop duration  
 TIME : 11:21:13 11:51:19 30 (min) Purpose code: 1  
 LOG : 4558.36 4560.00 1.64 Area code : 3  
 FDEPTH: 20 18 GearCond.code:  
 BDEPTH: 59 57 Validity code:  
 Towing dir: 90° Wire out: 150 m Speed: 38 kn\*10  
 Sorted: 42 Kg Total catch: 41.45 CATCH/HOUR: 82.90

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	54.10	158	65.26	1283
Sarda sarda	22.30	0	26.90	
Sardinella aurita	6.50	14	7.84	1282
Total	82.90		100.00	

PROJECT STATION: 621  
 DATE: 24/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2250 Long W 1709  
 start stop duration  
 TIME : 14:16:47 15:05:28 49 (min) Purpose code: 1  
 LOG : 4581.91 4584.17 2.26 Area code : 3  
 FDEPTH: 122 137 GearCond.code:  
 BDEPTH: 122 137 Validity code:  
 Towing dir: 180° Wire out: 420 m Speed: 29 kn\*10  
 Sorted: 69 Kg Total catch: 212.79 CATCH/HOUR: 260.56

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Lepidopus caudatus	83.76	1499	32.15	
Macrorhamphosus scolopax	44.08	2204	16.92	
Trachurus trachurus	23.56	304	9.04	1284
Pagellus acarne	22.24	573	8.54	
Dentex macrophthalmus	20.57	274	7.89	
Zeus faber	20.39	36	7.83	
Ephippion guttifer	18.12	29	6.95	
Scomber japonicus	6.07	88	2.33	1285
Capros aper	5.39	465	2.07	
Merluccius senegalensis	4.02	5	1.54	
Octopus vulgaris	2.99	2	1.15	
Scorpaena normani	2.60	15	1.15	
Loligo vulgaris	2.07	10	0.79	
Callanthias ruber	2.01	108	0.77	
Serranus cabrilla	0.98	10	0.38	
Boops boops	0.88	5	0.34	
Mullus surmuletus	0.84	1	0.32	
Total	260.57		100.01	

PROJECT STATION: 622  
 DATE: 25/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2308 Long W 1636  
 start stop duration  
 TIME : 00:14:46 00:34:55 20 (min) Purpose code: 1  
 LOG : 4674.62 4675.64 1.02 Area code : 3  
 FDEPTH: 35 34 GearCond.code:  
 BDEPTH: 35 34 Validity code:  
 Towing dir: 186° Wire out: 150 m Speed: 28 kn\*10  
 Sorted: 33 Kg Total catch: 112.74 CATCH/HOUR: 338.22

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	190.20	34476	56.24	1286
Solea vulgaris	32.52	1152	9.62	
Argyrosomus regius	27.60	12	8.16	
Trachinus vipera	20.40	576	6.03	
Sepia officinalis hierredda	19.20	348	5.68	
Pagellus bellottii	8.76	264	2.59	
Chelidonichthys obscurus	6.84	324	2.02	
Sardina pilchardus	6.36	468	1.88	1287
Trachinus draco	6.06	2064	1.79	
CONGRIDAE	5.40	48	1.60	
Pomadasys incisus	4.32	36	1.28	
Arnoglossus thori	2.28	336	0.67	
Spondyllosoma cantharus	1.92	108	0.57	
Citharus linguatula	1.92	48	0.57	
OPHIDIIDAE	1.44	60	0.43	
Diplodus bellottii	1.20	12	0.35	
SYNGNATHIDAE	0.96	12	0.28	
Pagellus acarne	0.84	36	0.25	
Total	338.22		100.01	

PROJECT STATION: 623  
 DATE: 25/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2341 Long W 1652  
 start stop duration  
 TIME : 18:54:56 19:15:30 21 (min) Purpose code: 1  
 LOG : 4858.48 4859.69 1.20 Area code : 3  
 FDEPTH: 168 134 GearCond.code:  
 BDEPTH: 168 134 Validity code:  
 Towing dir: 10° Wire out: 650 m Speed: 30 kn\*10  
 Sorted: 63 Kg Total catch: 146.03 CATCH/HOUR: 417.23

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex macrophthalmus	210.37	1657	50.42	
Dentex maroccanus	47.86	200	11.47	
Lepidopus caudatus	38.37	534	9.20	
Trachurus trachurus	21.63	320	5.18	1288
Macrorhamphosus scolopax	21.09	760	5.05	
Merluccius senegalensis	19.09	71	4.58	
Lepidotrigla carolae	15.86	660	3.80	
Umbrina canariensis	10.86	14	2.60	
MYCTOPHIDAE	9.23		2.21	
Pagellus acarne	6.43	23	1.54	
Zenopsis conchifer	4.23	23	1.01	
Scomber japonicus	2.77	29	0.66	
Capros aper	2.51	100	0.60	
OPHICHTHIDAE	1.80	37	0.43	
OPHIDIIDAE	1.09	51	0.26	
Raja mantagui	1.09	3	0.26	
Solea vulgaris	1.00	14	0.24	
Trachurus mediterraneus	0.74	3	0.18	
Erythrocles monodi	0.71	9	0.17	
Trachinus draco	0.43	9	0.10	
Arnoglossus imperialis	0.09	23	0.02	
Total	417.25		99.98	

PROJECT STATION: 624  
 DATE: 26/11/97 GEAR TYPE: PT No:5 POSITION: Lat N 2401 Long W 1558  
 start stop duration  
 TIME : 15:35:31 16:01:01 26 (min) Purpose code: 1  
 LOG : 5043.03 5044.33 1.25 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 31 31 Validity code:  
 Towing dir: 11° Wire out: 200 m Speed: 32 kn\*10  
 Sorted: 41 Kg Total catch: 5748.40 CATCH/HOUR: 13265.54

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	13165.38	220338	99.24	1289
Sardinella aurita	71.08	4200	0.54	
Diplodus bellottii	16.15	323	0.12	
Scomber japonicus	12.92	323	0.10	
Total	13265.53		100.00	

PROJECT STATION: 625  
 DATE: 26/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2410 Long W 1557  
 start stop duration  
 TIME : 21:08:04 21:58:26 50 (min) Purpose code: 1  
 LOG : 5084.05 5087.05 2.97 Area code : 3  
 FDEPTH: 10 5 GearCond.code:  
 BDEPTH: 36 34 Validity code:  
 Towing dir: 110° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 69 Kg Total catch: 1371.40 CATCH/HOUR: 1645.68

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1497.60	56411	91.00	1290
Sardinella aurita	64.32	504	3.91	1291
Pagellus bellottii	30.24	168	1.84	
Diplodus bellottii	29.04	336	1.76	
Trachinus draco	6.48	192	0.39	
Trachurus trachurus	5.28	48	0.32	
Pomadasys incisus	4.80	24	0.29	
Loligo vulgaris	2.88	24	0.18	
Mullus surmuletus	1.68	24	0.10	
Sepia sp.	1.44	96	0.09	
Chelidonichthys obscurus	0.96	24	0.05	
Scomber japonicus	0.72	24	0.04	
Engraulis encrasicolus	0.24	48	0.01	
Total	1645.68		99.99	

PROJECT STATION: 626  
 DATE: 27/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2418 Long W 1550  
 start stop duration  
 TIME : 13:52:09 14:24:53 33 (min) Purpose code: 1  
 LOG : 5238.82 5240.78 1.96 Area code : 3  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 33 33 Validity code:  
 Towing dir: 116° Wire out: 150 m Speed: 36 kn\*10  
 Sorted: 8 Kg Total catch: 8.46 CATCH/HOUR: 15.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	11.24	47	73.08	1292
Belone svetovidovi	1.87	42	12.16	
Sarda sarda	1.58	4	10.27	
Sardinella maderensis	0.56	4	3.64	
Sardina pilchardus	0.13	2	0.85	
Total	15.38		100.00	

PROJECT STATION: 627  
 DATE: 27/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2432 Long W 1529  
 start stop duration Purpose code: 1  
 TIME :19:37:28 19:59:11 22 (min) Area code : 3  
 LOG :5289.96 5291.39 1.41 GearCond.code:  
 FDEPTH: 10 8 Validity code:  
 BDEPTH: 29 29  
 Towing dir: 40° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 67 Kg Total catch: 1341.80 CATCH/HOUR: 3659.45

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	3234.55	45698	88.39	1293
Scomber japonicus	280.36	1192	7.66	1294
Sardinella aurita	105.27	164	2.88	
Sardinella maderensis	15.82	55	0.43	
Pomadasy incisus	14.73	55	0.40	
Trachurus trachurus	8.73	55	0.24	
<b>Total</b>	<b>3659.46</b>		<b>100.00</b>	

PROJECT STATION: 632  
 DATE: 29/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2411 Long W 1550  
 start stop duration Purpose code: 1  
 TIME :04:52:16 04:56:33 4 (min) Area code : 3  
 LOG :5580.56 5580.83 0.27 GearCond.code:  
 FDEPTH: 10 10 Validity code:  
 BDEPTH: 29 29  
 Towing dir: 117° Wire out: 130 m Speed: 38 kn\*10  
 Sorted: 103 Kg Total catch: 2058.20 CATCH/HOUR: 30873.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	30585.00	445500	99.07	1105
Scomber japonicus	126.00	2100	0.41	
Sardinella aurita	114.00	300	0.37	
Pomadasy incisus	30.00	300	0.10	
Diplodus bellottii	18.00	300	0.06	
<b>Total</b>	<b>30873.00</b>		<b>100.01</b>	

PROJECT STATION: 628  
 DATE: 28/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2436 Long W 1521  
 start stop duration Purpose code: 1  
 TIME :00:30:03 00:39:43 10 (min) Area code : 3  
 LOG :5334.60 5335.18 0.58 GearCond.code:  
 FDEPTH: 15 15 Validity code:  
 BDEPTH: 30 30  
 Towing dir: 98° Wire out: 150 m Speed: 38 kn\*10  
 Sorted: 88 Kg Total catch: 917.84 CATCH/HOUR: 5507.04

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	5164.80	76428	93.79	1295
Scomber japonicus	231.00	1716	4.19	1296
Pagellus bellottii	39.60	198	0.72	
Trichurus lepturus	29.40	6	0.53	
Pomadasy incisus	24.42	132	0.44	
Trachurus trachurus	17.82	132	0.32	
<b>Total</b>	<b>5507.04</b>		<b>99.99</b>	

PROJECT STATION: 633  
 DATE: 29/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2432 Long W 1542  
 start stop duration Purpose code: 1  
 TIME :13:58:52 14:20:17 21 (min) Area code : 3  
 LOG :5660.51 5661.65 1.08 GearCond.code:  
 FDEPTH: 35 35 Validity code:  
 BDEPTH: 35 35  
 Towing dir: 167° Wire out: 150 m Speed: 30 kn\*10  
 Sorted: 117 Kg Total catch: 3385.72 CATCH/HOUR: 9673.49

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	9504.00	321797	98.25	1306
Pagellus bellottii	56.57	203	0.58	
Pomadasy incisus	52.80	203	0.55	
Trichurus lepturus	18.43	6	0.19	
Pomatomus saltatrix	17.43	3	0.18	
Diplodus puntazzo	8.23	6	0.09	
Trachurus trachurus	6.60	94	0.07	
Engraulis encrasicolus	4.71	471	0.05	
Trachinus draco	2.83	94	0.03	
Microchirus boscanion	1.89	189	0.02	
<b>Total</b>	<b>9673.49</b>		<b>100.01</b>	

PROJECT STATION: 629  
 DATE: 28/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2345 Long W 1603  
 start stop duration Purpose code: 1  
 TIME :14:14:34 14:34:30 20 (min) Area code : 3  
 LOG :5477.74 5478.96 1.22 GearCond.code:  
 FDEPTH: 29 27 Validity code:  
 BDEPTH: 29 27  
 Towing dir: 182° Wire out: 130 m Speed: 34 kn\*10  
 Sorted: 64 Kg Total catch: 891.61 CATCH/HOUR: 2674.83

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1260.00	27888	47.11	1297
Diplodus bellottii	968.10	13482	36.19	
Sardinella aurita	120.54	10584	4.51	1298
Pomadasy incisus	120.12	1176	4.49	
Argyrosomus reglus	107.52	126	4.02	
Pagellus acarne	31.08	420	1.16	
Trachurus trachurus	28.14	420	1.05	1299
Camogramma glaycos	10.08	42	0.38	
Loligo vulgaris	9.24	168	0.35	
Pagellus bellottii	6.30	84	0.24	
Solea vulgaris	4.20	84	0.16	
Scomber japonicus	3.78	84	0.14	
Spondyliosoma cantharus	3.36	126	0.13	
Trachinus draco	1.68	42	0.06	
Ballistes capriscus	0.69	3	0.03	
<b>Total</b>	<b>2674.83</b>		<b>100.02</b>	

PROJECT STATION: 634  
 DATE: 30/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2454 Long W 1529  
 start stop duration Purpose code: 1  
 TIME :01:42:52 01:52:12 9 (min) Area code : 3  
 LOG :5760.06 5760.70 0.64 GearCond.code:  
 FDEPTH: 20 20 Validity code:  
 BDEPTH: 43 44  
 Towing dir: 282° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 81 Kg Total catch: 642.01 CATCH/HOUR: 4280.07

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4059.00	226740	94.83	1307
Pagellus bellottii	147.00	960	3.43	
Trichurus lepturus	40.00	33	0.93	
Scomber japonicus	15.40	187	0.36	1309
Diplodus puntazzo	11.80	7	0.28	
Trachurus trachurus	6.87	53	0.16	1308
<b>Total</b>	<b>4280.07</b>		<b>99.99</b>	

PROJECT STATION: 630  
 DATE: 28/11/97 GEAR TYPE: PT No:2 POSITION: Lat N 2354 Long W 1602  
 start stop duration Purpose code: 1  
 TIME :17:51:23 18:09:54 19 (min) Area code : 3  
 LOG :5503.42 5504.72 1.28 GearCond.code:  
 FDEPTH: 10 10 Validity code:  
 BDEPTH: 32 24  
 Towing dir: 104° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 39 Kg Total catch: 39.98 CATCH/HOUR: 126.25

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sarda sarda	63.16	60	50.03	1303
Sardinella aurita	25.48	92	20.18	1300
Sardinella maderensis	19.93	76	15.79	1301
Scomber japonicus	17.68	79	14.00	1302
<b>Total</b>	<b>126.25</b>		<b>100.00</b>	

PROJECT STATION: 635  
 DATE: 30/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2460 Long W 1560  
 start stop duration Purpose code: 1  
 TIME :15:25:52 15:55:55 30 (min) Area code : 3  
 LOG :5895.93 5897.49 1.53 GearCond.code:  
 FDEPTH: 41 40 Validity code:  
 BDEPTH: 41 40  
 Towing dir: 102° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION: 631  
 DATE: 29/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2401 Long W 1546  
 start stop duration Purpose code: 1  
 TIME :00:26:55 00:34:28 8 (min) Area code : 3  
 LOG :5551.72 5552.22 0.50 GearCond.code:  
 FDEPTH: 0 0 Validity code:  
 BDEPTH: 24 24  
 Towing dir: 290° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 101 Kg Total catch: 2112.23 CATCH/HOUR: 15841.73

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	15238.50	153405	96.19	1304
Decapterus rhonchus	176.40	945	1.11	
Sardinella aurita	168.53	630	1.06	
Diplodus bellottii	130.73	2048	0.83	
Sardinella maderensis	127.58	473	0.81	
<b>Total</b>	<b>15841.74</b>		<b>100.00</b>	

PROJECT STATION: 636  
 DATE: 30/11/97 GEAR TYPE: PT No:1 POSITION: Lat N 2508 Long W 1452  
 start stop duration Purpose code: 1  
 TIME :18:11:11 18:40:15 29 (min) Area code : 2  
 LOG :5916.56 5918.16 1.58 GearCond.code:  
 FDEPTH: 10 20 Validity code:  
 BDEPTH: 42 44  
 Towing dir: 185° Wire out: 150 m Speed: 40 kn\*10  
 Sorted: 93 Kg Total catch: 361.26 CATCH/HOUR: 747.43

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	654.31	74845	87.54	1310
Lepidopus caudatus	46.66	21	6.24	
Pomadasy incisus	7.76	62	1.04	
Pagellus bellottii	7.76	62	1.04	
Zeus faber	7.16	4	0.96	
Diplodus bellottii	6.83	114	0.91	
Sarda sarda	5.90	10	0.79	
Trachurus trachurus	3.10	10	0.41	
Serranus scriba	2.90	10	0.39	
Trachinus draco	2.48	10	0.33	
Diplodus vulgaris	1.45	10	0.19	
SOLEIDAE	0.83	31	0.11	
Scorpaena scrofa	0.31	10	0.04	
<b>Total</b>	<b>747.45</b>		<b>99.99</b>	

PROJECT STATION: 637  
 DATE: 30/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2508 Long W 1517  
 start stop duration  
 TIME :21:12:26 21:41:54 29 (min) Purpose code: 1  
 LOG :5942.89 5944.49 1.57 Area code : 3  
 FDEPTH: 55 50 GearCond.code:  
 BDEPTH: 55 50 Validity code:  
 Towing dir: 104° Wire out: 250 m Speed: 30 kn\*10  
 Sorted: 72 Kg Total catch: 72.33 CATCH/HOUR: 149.65

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chelidonichthys obscurus	67.34	1183	45.00	
Trachinus draco	18.41	221	12.30	
Pomadasya incisus	17.48	87	11.68	
OPHICHTHIDAE	7.97	64	5.33	
Pagellus acarne	6.62	41	4.42	
Trichiurus lepturus	6.21	4	4.15	
Pagellus bellottii	4.39	37	2.93	
Mullus surmuletus	4.18	35	2.79	
Octopus vulgaris	2.69	2	1.80	
Monochirus sp.	2.57	319	1.72	
Loligo vulgaris	2.48	4	1.66	
Trachurus trachurus	1.88	19	1.26	1311
Umbrina canariensis	1.76	8	1.18	
Plectorhinchus mediterraneus	1.68	2	1.12	
Trachurus trecae	1.24	2	0.83	
Spondyliosoma cantharus	1.22	4	0.82	
Microchirus sp.	0.43	6	0.29	
Boops boops	0.41	8	0.27	
Scomber japonicus	0.25	4	0.17	
Arnoglossus imperialis	0.23	19	0.15	
Belone svetovidovi	0.21	2	0.14	
<b>Total</b>	<b>149.65</b>		<b>100.01</b>	

PROJECT STATION: 638  
 DATE: 1/12/97 GEAR TYPE: BT No:2 POSITION: Lat N 2539 Long W 1458  
 start stop duration  
 TIME :17:40:41 18:20:24 40 (min) Purpose code: 1  
 LOG :6149.88 6152.34 2.38 Area code : 2  
 FDEPTH: 90 90 GearCond.code:  
 BDEPTH: 90 90 Validity code:  
 Towing dir: 275° Wire out: 350 m Speed: 28 kn\*10  
 Sorted: 5 Kg Total catch: 5.19 CATCH/HOUR: 7.79

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chelidonichthys obscurus	4.11	69	52.76	
Pagellus bellottii	1.79	12	22.98	
Pagellus acarne	1.01	6	12.97	
Trachinus radiatus	0.89	2	11.42	
<b>Total</b>	<b>7.80</b>		<b>100.13</b>	

PROJECT STATION: 639  
 DATE: 1/12/97 GEAR TYPE: PT No:2 POSITION: Lat N 2547 Long W 1448  
 start stop duration  
 TIME :22:16:13 22:46:05 30 (min) Purpose code: 1  
 LOG :6190.95 6192.51 1.51 Area code : 3  
 FDEPTH: 60 55 GearCond.code:  
 BDEPTH: 85 87 Validity code:  
 Towing dir: 30° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 62 Kg Total catch: 61.69 CATCH/HOUR: 123.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Mola mola	54.00	18	43.77	
Pagellus bellottii	30.00	128	24.32	
Trichiurus lepturus	12.40	10	10.05	
Lepidopus caudatus	12.10	8	9.81	
Pagellus acarne	7.14	34	5.79	
Loligo vulgaris	3.90	2	3.16	
Diplodus sargus *	1.24	2	1.01	
Scomber japonicus	1.08	22	0.88	1313
Trachurus trachurus	0.90	6	0.73	
Chelidonichthys obscurus	0.40	2	0.32	
Engraulis encrasicolus	0.22	24	0.18	1312
<b>Total</b>	<b>123.38</b>		<b>100.02</b>	

PROJECT STATION: 640  
 DATE: 2/12/97 GEAR TYPE: PT No:1 POSITION: Lat N 2600 Long W 1433  
 start stop duration  
 TIME :05:34:55 06:05:46 31 (min) Purpose code: 1  
 LOG :6261.40 6262.96 1.56 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 30 37 Validity code:  
 Towing dir: 5° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 38 Kg Total catch: 384.80 CATCH/HOUR: 744.77

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	220.65	20334	29.63	1314
Diplodus sargus *	139.35	1026	18.71	
Trachurus trachurus	91.94	619	12.34	1316
Engraulis encrasicolus	70.26	19134	9.43	1315
Trichiurus lepturus	64.26	39	8.63	
Loligo vulgaris	52.65	406	7.07	
Diplodus puntazzo	27.48	39	3.69	
Sarda sarda	26.32	58	3.53	
Sepia officinalis hierredda	19.16	77	2.57	
Pomadasya incisus	14.32	135	1.92	
Scomber japonicus	9.68	39	1.30	
Campogramma glaycos	5.42	19	0.73	
Belone svetovidovi	1.55	19	0.21	
Diplodus bellottii	0.97	19	0.13	
Mullus surmuletus	0.39	19	0.05	
Boops boops	0.39	19	0.05	
<b>Total</b>	<b>744.79</b>		<b>99.99</b>	

PROJECT STATION: 641  
 DATE: 2/12/97 GEAR TYPE: PT No:2 POSITION: Lat N 2640 Long W 1409  
 start stop duration  
 TIME :19:07:19 19:37:30 30 (min) Purpose code: 1  
 LOG :6383.27 6384.80 1.52 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 91 87 Validity code:  
 Towing dir: 153° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 75 Kg Total catch: 1117.50 CATCH/HOUR: 2235.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2233.50	68012	99.93	1317
Scomber japonicus	1.50	30	0.07	
MYCTOPHIDAE	0.00	30		
<b>Total</b>	<b>2235.00</b>		<b>100.00</b>	

PROJECT STATION: 637  
 DATE: 30/11/97 GEAR TYPE: BT No:2 POSITION: Lat N 2508 Long W 1517  
 start stop duration  
 TIME :21:12:26 21:41:54 29 (min) Purpose code: 1  
 LOG :5942.89 5944.49 1.57 Area code : 3  
 FDEPTH: 55 50 GearCond.code:  
 BDEPTH: 55 50 Validity code:  
 Towing dir: 104° Wire out: 250 m Speed: 30 kn\*10  
 Sorted: 72 Kg Total catch: 72.33 CATCH/HOUR: 149.65

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chelidonichthys obscurus	67.34	1183	45.00	
Trachinus draco	18.41	221	12.30	
Pomadasya incisus	17.48	87	11.68	
OPHICHTHIDAE	7.97	64	5.33	
Pagellus acarne	6.62	41	4.42	
Trichiurus lepturus	6.21	4	4.15	
Pagellus bellottii	4.39	37	2.93	
Mullus surmuletus	4.18	35	2.79	
Octopus vulgaris	2.69	2	1.80	
Monochirus sp.	2.57	319	1.72	
Loligo vulgaris	2.48	4	1.66	
Trachurus trachurus	1.88	19	1.26	1311
Umbrina canariensis	1.76	8	1.18	
Plectorhinchus mediterraneus	1.68	2	1.12	
Trachurus trecae	1.24	2	0.83	
Spondyliosoma cantharus	1.22	4	0.82	
Microchirus sp.	0.43	6	0.29	
Boops boops	0.41	8	0.27	
Scomber japonicus	0.25	4	0.17	
Arnoglossus imperialis	0.23	19	0.15	
Belone svetovidovi	0.21	2	0.14	
<b>Total</b>	<b>149.65</b>		<b>100.01</b>	

PROJECT STATION: 638  
 DATE: 1/12/97 GEAR TYPE: BT No:2 POSITION: Lat N 2539 Long W 1458  
 start stop duration  
 TIME :17:40:41 18:20:24 40 (min) Purpose code: 1  
 LOG :6149.88 6152.34 2.38 Area code : 2  
 FDEPTH: 90 90 GearCond.code:  
 BDEPTH: 90 90 Validity code:  
 Towing dir: 275° Wire out: 350 m Speed: 28 kn\*10  
 Sorted: 5 Kg Total catch: 5.19 CATCH/HOUR: 7.79

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chelidonichthys obscurus	4.11	69	52.76	
Pagellus bellottii	1.79	12	22.98	
Pagellus acarne	1.01	6	12.97	
Trachinus radiatus	0.89	2	11.42	
<b>Total</b>	<b>7.80</b>		<b>100.13</b>	

PROJECT STATION: 639  
 DATE: 1/12/97 GEAR TYPE: PT No:2 POSITION: Lat N 2547 Long W 1448  
 start stop duration  
 TIME :22:16:13 22:46:05 30 (min) Purpose code: 1  
 LOG :6190.95 6192.51 1.51 Area code : 3  
 FDEPTH: 60 55 GearCond.code:  
 BDEPTH: 85 87 Validity code:  
 Towing dir: 30° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 62 Kg Total catch: 61.69 CATCH/HOUR: 123.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Mola mola	54.00	18	43.77	
Pagellus bellottii	30.00	128	24.32	
Trichiurus lepturus	12.40	10	10.05	
Lepidopus caudatus	12.10	8	9.81	
Pagellus acarne	7.14	34	5.79	
Loligo vulgaris	3.90	2	3.16	
Diplodus sargus *	1.24	2	1.01	
Scomber japonicus	1.08	22	0.88	1313
Trachurus trachurus	0.90	6	0.73	
Chelidonichthys obscurus	0.40	2	0.32	
Engraulis encrasicolus	0.22	24	0.18	1312
<b>Total</b>	<b>123.38</b>		<b>100.02</b>	

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Mola mola	54.00	18	43.77	
Pagellus bellottii	30.00	128	24.32	
Trichiurus lepturus	12.40	10	10.05	
Lepidopus caudatus	12.10	8	9.81	
Pagellus acarne	7.14	34	5.79	
Loligo vulgaris	3.90	2	3.16	
Diplodus sargus *	1.24	2	1.01	
Scomber japonicus	1.08	22	0.88	1313
Trachurus trachurus	0.90	6	0.73	
Chelidonichthys obscurus	0.40	2	0.32	
Engraulis encrasicolus	0.22	24	0.18	1312
<b>Total</b>	<b>123.38</b>		<b>100.02</b>	

DATE: 2/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 640  
 start stop duration POSITION:Lat N 2600  
 TIME :05:34:55 06:05:46 31 (min) Purpose code: 1 Long W 1433  
 LOG :6261.40 6262.96 1.56 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 30 37 Validity code:  
 Towing dir: 5° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 38 Kg Total catch: 384.80 CATCH/HOUR: 744.77

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	220.65	20334	29.63	1314
Diplodus sargus *	139.35	1026	18.71	
Trachurus trachurus	91.94	619	12.34	1316
Engraulis encrasicolus	70.26	19134	9.43	1315
Trichurus lepturus	64.26	39	8.63	
Loligo vulgaris	52.65	406	7.07	
Diplodus puntazzo	27.48	39	3.69	
Sarda sarda	26.32	58	3.53	
Sepia officinalis hierredda	19.16	77	2.57	
Pomadasys incisus	14.32	135	1.92	
Scomber japonicus	9.68	39	1.30	
Camogramma glaycos	5.42	19	0.73	
Belone svetovidovi	1.55	19	0.21	
Diplodus bellottii	0.97	19	0.13	
Mullus surmuletus	0.39	19	0.05	
Boops boops	0.39	19	0.05	
Total	744.79		99.99	

DATE: 2/12/97 GEAR TYPE: PT No:2 PROJECT STATION: 641  
 start stop duration POSITION:Lat N 2640  
 TIME :19:07:19 19:37:30 30 (min) Purpose code: 1 Long W 1409  
 LOG :6383.27 6384.80 1.52 Area code : 3  
 FDEPTH: 0 0 GearCond.code:  
 BDEPTH: 91 87 Validity code:  
 Towing dir: 153° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 75 Kg Total catch: 1117.50 CATCH/HOUR: 2235.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2233.50	68012	99.93	1317
Scomber japonicus	1.50	30	0.07	
MYCTOPHIDAE	0.00	30		
Total	2235.00		100.00	

DATE: 3/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 642  
 start stop duration POSITION:Lat N 2652  
 TIME :02:04:19 02:17:32 13 (min) Purpose code: 1 Long W 1346  
 LOG :6451.62 6452.43 0.80 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 95 99 Validity code:  
 Towing dir: 303° Wire out: 200 m Speed: 33 kn\*10  
 Sorted: 72 Kg Total catch: 503.08 CATCH/HOUR: 2321.91

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2305.15	90720	99.28	1318
Engraulis encrasicolus	10.34	1002	0.45	1319
Scomber japonicus	6.42	65	0.28	
Total	2321.91		100.01	

DATE: 3/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 643  
 start stop duration POSITION:Lat N 2658  
 TIME :05:22:00 05:37:00 15 (min) Purpose code: 1 Long W 1335  
 LOG :6481.20 6481.90 0.70 Area code : 3  
 FDEPTH: 15 30 GearCond.code:  
 BDEPTH: 70 70 Validity code:  
 Towing dir: 150° Wire out: m Speed: 30 kn\*10  
 Sorted: 36 Kg Total catch: 546.15 CATCH/HOUR: 2184.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2160.00	155004	98.87	1320
Engraulis encrasicolus	24.60	5340	1.13	1321
Total	2184.60		100.00	

DATE: 3/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 644  
 start stop duration POSITION:Lat N 2747  
 TIME :20:23:26 20:53:45 30 (min) Purpose code: 1 Long W 1307  
 LOG :6624.93 6626.86 1.92 Area code : 3  
 FDEPTH: 8 10 GearCond.code:  
 BDEPTH: 29 32 Validity code:  
 Towing dir: 220° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 36 Kg Total catch: 177.55 CATCH/HOUR: 355.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	180.50	21722	50.83	1322
Engraulis encrasicolus	124.00	30422	34.92	1323
Pomadasys incisus	12.60	180	3.55	
Scomber japonicus	11.90	110	3.35	1324
Loligo vulgaris	10.10	320	2.84	
Pagellus bellottii	4.60	200	1.30	
Sarda sarda	4.20	10	1.18	
Belone svetovidovi	4.00	70	1.13	
Trachurus trachurus	2.80	40	0.79	
Boops boops	0.40	40	0.11	
Total	355.10		100.00	

DATE: 8/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 645  
 start stop duration POSITION:Lat N 2650  
 TIME :08:26:32 08:39:53 13 (min) Purpose code: 1 Long W 1333  
 LOG :7047.36 7048.26 0.89 Area code : 3  
 FDEPTH: 3 3 GearCond.code:  
 BDEPTH: 21 20 Validity code:  
 Towing dir: 195° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 10 Kg Total catch: 2536.54 CATCH/HOUR: 11707.11

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	10943.26	546485	93.48	1325
Engraulis encrasicolus	385.75	52389	3.30	1326
Lithognathus mormyrus	355.43	674	3.04	
Pomadasys incisus	11.77	166	0.10	
Sardinella aurita	5.03	166	0.04	
Scomber japonicus	2.54	5	0.02	
Loligo vulgaris	2.03	18	0.02	
	1.29	18	0.01	
Total	11707.10		100.01	

DATE: 8/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 646  
 start stop duration POSITION:Lat N 2720  
 TIME :15:39:04 15:45:22 6 (min) Purpose code: 1 Long W 1326  
 LOG :7116.55 7117.00 0.44 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 37 33 Validity code:  
 Towing dir: 106° Wire out: 180 m Speed: 40 kn\*10  
 Sorted: 2 Kg Total catch: 2.09 CATCH/HOUR: 20.90

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Belone svetovidovi	12.50	30	59.81	
Liza ramada	8.40	10	40.19	
Total	20.90		100.00	

DATE: 8/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 647  
 start stop duration POSITION:Lat N 2731  
 TIME :20:06:22 20:19:43 13 (min) Purpose code: 1 Long W 1322  
 LOG :7159.44 7160.30 0.85 Area code : 3  
 FDEPTH: 10 15 GearCond.code:  
 BDEPTH: 49 53 Validity code:  
 Towing dir: 280° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 5 Kg Total catch: 1000.00 CATCH/HOUR: 4615.39

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4554.00	276245	98.67	1327
Scomber japonicus	37.25	489	0.81	1329
Sardinella aurita	20.77	1038	0.45	
Engraulis encrasicolus	3.05	1034	0.07	1328
Total	4615.07		100.00	

DATE: 9/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 648  
 start stop duration POSITION:Lat N 2750  
 TIME :00:45:24 00:59:03 14 (min) Purpose code: 1 Long W 1317  
 LOG :7203.08 7203.97 0.87 Area code : 3  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 85 79 Validity code:  
 Towing dir: 95° Wire out: 200 m Speed: 40 kn\*10  
 Sorted: 8 Kg Total catch: 633.68 CATCH/HOUR: 2715.77

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2430.86	127200	89.51	1330
Scomber japonicus	198.51	7474	7.31	1332
Engraulis encrasicolus	86.40	10629	3.18	1331
Total	2715.77		100.00	

DATE: 9/12/97 GEAR TYPE: PT No:7 PROJECT STATION: 649  
 start stop duration POSITION:Lat N 2801  
 TIME :15:07:16 15:21:18 14 (min) Purpose code: 1 Long W 1234  
 LOG :7334.35 7335.15 0.78 Area code : 3  
 FDEPTH: 5 5 GearCond.code:  
 BDEPTH: 20 21 Validity code:  
 Towing dir: 75° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 40 Kg Total catch: 145.38 CATCH/HOUR: 623.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	315.04	60009	50.56	1333
Sardinella aurita	248.57	660	39.90	1336
Sardinella aurita	38.53	2010	6.18	1335
Sphyrna zygaena	12.86	4	2.06	
Sardinella maderensis	3.94	13	0.63	
Scomber japonicus	2.06	13	0.33	
Camogramma glaycos	1.24	4	0.20	
Engraulis encrasicolus	0.81	326	0.13	1334
Total	623.05		99.99	

PROJECT STATION: 650

DATE: 9/12/97 GEAR TYPE: PT No:4 POSITION: Lat N 2803  
 start stop duration Long W 1227  
 TIME :17:32:33 18:02:24 30 (min) Purpose code: 1  
 LOG :7355.16 7357.08 1.89 Area code : 3  
 FDEPTH: 15 5 GearCond.code:  
 BDEPTH: 26 26 Validity code:  
 Towing dir: 261° Wire out: 160 m Speed: 35 kn\*10  
 Sorted: 6 Kg Total catch: 6.06 CATCH/HOUR: 12.12

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	11.72	866	96.70	1337
Scomber japonicus	0.40	2	3.30	
Total	12.12		100.00	

PROJECT STATION: 651  
 DATE:10/12/97 GEAR TYPE: PT No:1 POSITION: Lat N 2805  
 start stop duration Long W 1219  
 TIME :08:37:09 08:44:40 8 (min) Purpose code: 1  
 LOG :7515.19 7515.59 0.39 Area code : 3  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 31 31 Validity code:  
 Towing dir: 245° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 81 Kg Total catch: 799.99 CATCH/HOUR: 5999.93

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	3375.00	303750	56.25	1338
Engraulis encrasicolus	1695.60	272993	28.26	1339
Trichiurus lepturus	866.18	488	14.44	
Sarda sarda	46.13	23	0.77	
Campogramma glaycos	17.03	23	0.28	
Total	5999.94		100.00	

PROJECT STATION: 652  
 DATE:10/12/97 GEAR TYPE: PT No:1 POSITION: Lat N 2806  
 start stop duration Long W 1211  
 TIME :11:42:55 11:59:16 16 (min) Purpose code: 1  
 LOG :7540.37 7541.35 0.96 Area code : 3  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 29 30 Validity code:  
 Towing dir: 260° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 120 Kg Total catch: 525.87 CATCH/HOUR: 1972.01

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichiurus lepturus	959.96	900	48.68	
Sardina pilchardus	652.73	72041	33.10	1340
Engraulis encrasicolus	356.18	64110	18.06	1341
Sparus aurata	2.48	4	0.13	
Pagellus acarne	0.68	4	0.03	
Total	1972.03		100.00	

PROJECT STATION: 653  
 DATE:10/12/97 GEAR TYPE: PT No:1 POSITION: Lat N 2808  
 start stop duration Long W 1204  
 TIME :14:16:52 14:27:33 11 (min) Purpose code: 1  
 LOG :7562.49 7563.25 0.74 Area code : 3  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 27 27 Validity code:  
 Towing dir: 250° Wire out: 140 m Speed: 35 kn\*10  
 Sorted: 48 Kg Total catch: 296.26 CATCH/HOUR: 1615.96

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1346.18	116149	83.31	1342
Engraulis encrasicolus	203.78	32187	12.61	1343
Scomber japonicus	48.00	131	2.97	1344
Sarda sarda	10.96	5	0.68	
Trichiurus lepturus	7.04	5	0.44	
Total	1615.96		100.01	

PROJECT STATION: 654  
 DATE:10/12/97 GEAR TYPE: BT No: POSITION: Lat N 1307  
 start stop duration Long W 1720  
 TIME :17:25:43 17:26:05 (min) Purpose code: 1  
 LOG :8862.58 8862.65 0.09 Area code : 3  
 FDEPTH: 47 48 GearCond.code:  
 BDEPTH: 47 48 Validity code:  
 Towing dir: ° Wire out: 450 m Speed: 420 kn\*10  
 Sorted: 108 Kg Total catch: 1403.40 CATCH/HOUR: 84204.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	79920.00	8051220	94.91	1345
Trichiurus lepturus	4284.00	2400	5.09	
Total	84204.00		100.00	

PROJECT STATION: 655  
 DATE:11/12/97 GEAR TYPE: PT No:1 POSITION: Lat N 2817  
 start stop duration Long W 1140  
 TIME :09:07:53 09:29:12 21 (min) Purpose code: 1  
 LOG :7747.13 7748.52 1.38 Area code : 3  
 FDEPTH: 10 10 GearCond.code:  
 BDEPTH: 34 33 Validity code:  
 Towing dir: 70° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 75 Kg Total catch: 199.98 CATCH/HOUR: 571.37

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	538.00	39991	94.16	1346
Scomber japonicus	32.49	326	5.69	1347
Engraulis encrasicolus	0.60	74	0.11	
Sardinella aurita	0.29	20	0.05	
Total	571.38		100.01	

PROJECT STATION: 656  
 DATE:11/12/97 GEAR TYPE: BT No:2 POSITION: Lat N 2824  
 start stop duration Long W 1128  
 TIME :13:48:24 14:00:56 13 (min) Purpose code: 1  
 LOG :7791.99 7792.58 0.57 Area code : 3  
 FDEPTH: 29 30 GearCond.code:  
 BDEPTH: 29 30 Validity code:  
 Towing dir: 337° Wire out: 160 m Speed: 30 kn\*10  
 Sorted: 40 Kg Total catch: 964.14 CATCH/HOUR: 4445.88

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	3118.00	311800	74.56	1349
Sardina pilchardus	990.00	47880	22.25	1348
Trachurus trachurus	55.20	2760	1.24	1351
Scomber japonicus	51.60	2040	1.16	1350
Solea vulgaris	11.08	332	0.25	
Pagellus bellottii	9.60	240	0.22	
Sardinella aurita (Juvenile)	6.00	160	0.13	
Pomadourus incisus	4.80	120	0.11	
Total	4446.28		99.92	

PROJECT STATION: 657  
 DATE:11/12/97 GEAR TYPE: PT No:4 POSITION: Lat N 2830  
 start stop duration Long W 1128  
 TIME :15:46:52 16:06:48 20 (min) Purpose code: 1  
 LOG :7807.23 7808.52 1.28 Area code : 3  
 FDEPTH: 50 5 GearCond.code:  
 BDEPTH: 47 48 Validity code:  
 Towing dir: 223° Wire out: 150 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				

PROJECT STATION: 658  
 DATE:11/12/97 GEAR TYPE: 00 No:1 POSITION: Lat N 2831  
 start stop duration Long W 1123  
 TIME :17:52:41 18:22:24 30 (min) Purpose code: 1  
 LOG :7820.88 7822.67 1.78 Area code : 3  
 FDEPTH: 10 8 GearCond.code:  
 BDEPTH: 27 28 Validity code:  
 Towing dir: 47° Wire out: 120 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 19.52 CATCH/HOUR: 39.04

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Lepidopus caudatus	36.10	18	92.47	
Allotheutis subulata	1.24	244	3.18	
Engraulis encrasicolus	1.10	92	2.82	1352
Scomber japonicus	0.60	20	1.54	
Total	39.04		100.01	

PROJECT STATION: 659  
 DATE:12/12/97 GEAR TYPE: PT No:1 POSITION: Lat N 2850  
 start stop duration Long W 1058  
 TIME :09:49:04 10:09:57 21 (min) Purpose code: 1  
 LOG :7990.04 7991.16 1.07 Area code : 3  
 FDEPTH: 35 35 GearCond.code:  
 BDEPTH: 50 55 Validity code:  
 Towing dir: 50° Wire out: 200 m Speed: 33 kn\*10  
 Sorted: 70 Kg Total catch: 282.05 CATCH/HOUR: 805.86

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	476.57	75414	59.14	1354
Lepidopus caudatus	171.43	109	21.27	
Sardina pilchardus	127.29	12303	15.80	1353
Sarda sarda	16.71	11	2.07	
Chelidonichthys lucerna	11.00	49	1.37	
Pagellus acarne	2.86	6	0.35	
Total	805.86		100.00	

PROJECT STATION: 660  
 DATE:12/12/97 GEAR TYPE: PT No:1 POSITION: Lat N 2845  
 start stop duration Long W 1109  
 TIME :14:04:11 14:16:48 13 (min) Purpose code: 1  
 LOG :8027.57 8028.36 0.76 Area code : 3  
 FDEPTH: 35 35 GearCond.code:  
 BDEPTH: 62 61 Validity code:  
 Towing dir: 80° Wire out: 150 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				



DATE:12/12/97 GEAR TYPE: BT No:2 PROJECT STATION: 661  
 start stop duration POSITION:Lat N 2844  
 TIME :15:57:46 16:10:19 13 (min) Purpose code: 1  
 LOG :8042.01 8042.68 0.65 Area code : 3  
 FDEPTH: 60 61 GearCond.code:  
 BDEPTH: 60 61 Validity code:  
 Towing dir: 270° Wire out: 250 m Speed: 30 kn\*10  
 Sorted: Kg Total catch: 211.52 CATCH/HOUR: 976.25

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	509.58	31320	52.20	1356
Lepidopus caudatus	245.31	143	25.13	
Scomber japonicus	102.92	2289	10.54	1358
Trachurus trachurus	39.60	1417	4.06	1357
Sardina pilchardus	39.00	812	3.99	1355
Pagellus acarne	15.42	111	1.58	
Allotheutis subulata	10.29	1786	1.05	
Liza ramada	9.55	9	0.98	
Loligo vulgaris	1.94	23	0.20	
Pagellus bellottii	1.25	14	0.13	
Chelidonichthys lucerna	0.78	5	0.08	
Merluccius merluccius	0.60	5	0.06	
Total	976.24		100.00	

DATE:12/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 662  
 start stop duration POSITION:Lat N 2036  
 TIME :19:13:50 19:29:26 16 (min) Purpose code: 1  
 LOG :8071.59 8072.49 0.88 Area code : 3  
 FDEPTH: 10 15 GearCond.code:  
 BDEPTH: 42 36 Validity code:  
 Towing dir: 100° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 73 Kg Total catch: 1999.99 CATCH/HOUR: 7499.96

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	6120.11	204994	81.60	1359
Scomber japonicus	1317.23	42375	17.56	1360
Lepidopus caudatus	62.63	30	0.84	
Total	7499.97		100.00	

DATE:13/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 663  
 start stop duration POSITION:Lat N 2858  
 TIME :08:12:57 08:31:09 18 (min) Purpose code: 1  
 LOG :8197.07 8198.17 1.06 Area code : 3  
 FDEPTH: 25 25 GearCond.code:  
 BDEPTH: 45 42 Validity code:  
 Towing dir: 70° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 37 Kg Total catch: 242.13 CATCH/HOUR: 807.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	480.00	45600	59.47	1362
Pagellus acarne	209.60	600	25.97	
Sardina pilchardus	60.20	2440	7.46	1361
Lepidopus caudatus	48.33	43	5.99	
Scomber japonicus	8.97	130	1.11	1363
Total	807.10		100.00	

DATE:13/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 664  
 start stop duration POSITION:Lat N 2903  
 TIME :11:18:10 11:39:28 21 (min) Purpose code: 1  
 LOG :8225.36 8226.50 1.13 Area code : 3  
 FDEPTH: 25 40 GearCond.code:  
 BDEPTH: 50 55 Validity code:  
 Towing dir: 329° Wire out: 220 m Speed: 35 kn\*10  
 Sorted: 39 Kg Total catch: 1591.50 CATCH/HOUR: 4547.14

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4068.57	186514	89.48	1364
Engraulis encrasicolus	369.14	51429	8.12	1365
Pagellus acarne	58.29	114	1.28	
Lepidopus caudatus	36.00	29	0.79	
Chelidonichthys lucerna	11.71	20	0.26	
Trachurus trachurus	3.43	114	0.08	
Total	4547.14		100.01	

DATE:13/12/97 GEAR TYPE: BT No: PROJECT STATION: 665  
 start stop duration POSITION:Lat N 2906  
 TIME :13:31:10 13:49:07 18 (min) Purpose code: 1  
 LOG :8243.68 8244.53 0.84 Area code : 3  
 FDEPTH: 38 38 GearCond.code:  
 BDEPTH: 38 38 Validity code:  
 Towing dir: 220° Wire out: 200 m Speed: 30 kn\*10  
 Sorted: 42 Kg Total catch: 1597.02 CATCH/HOUR: 5323.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4585.33	208553	86.14	1366
Engraulis encrasicolus	643.47	109797	12.09	1367
Diplodus sargus *	22.81	20	0.43	
Trachurus trachurus	21.50	1393	0.40	1368
Pomadasys incisus	16.47	253	0.31	
Allotheutis subulata	13.93	3927	0.26	
Lepidopus caudatus	13.33	7	0.25	
Pagellus acarne	5.07	253	0.10	
Octopus vulgaris	1.43	7	0.03	
Total	5323.36		100.01	

DATE:13/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 666  
 start stop duration POSITION:Lat N 2911  
 TIME :15:11:17 15:21:41 10 (min) Purpose code: 1  
 LOG :8255.95 8256.53 0.56 Area code : 3  
 FDEPTH: 35 35 GearCond.code:  
 BDEPTH: 53 54 Validity code:  
 Towing dir: 227° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 45 Kg Total catch: 1784.63 CATCH/HOUR: 10707.78

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	6913.80	631260	64.57	1370
Sardina pilchardus	3753.60	162486	35.05	1369
Lepidopus caudatus	23.10	12	0.22	
Pagellus erythrinus	16.98	12	0.16	
Scomber japonicus	0.30	6		
Total	10707.78		100.00	

DATE:13/12/97 GEAR TYPE: PT No:4 PROJECT STATION: 667  
 start stop duration POSITION:Lat N 2911  
 TIME :17:15:00 17:31:44 17 (min) Purpose code: 1  
 LOG :8271.43 8271.48 0.05 Area code : 3  
 FDEPTH: 55 5 GearCond.code:  
 BDEPTH: 36 36 Validity code:  
 Towing dir: 110° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 74 Kg Total catch: 1718.10 CATCH/HOUR: 6063.88

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	5844.71	290936	96.39	1371
Engraulis encrasicolus	187.52	25864	3.09	1372
Scomber japonicus	31.66	568	0.52	
Total	6063.89		100.00	

DATE:13/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 668  
 start stop duration POSITION:Lat N 2919  
 TIME :20:15:07 20:32:45 18 (min) Purpose code: 1  
 LOG :8297.47 8298.57 1.09 Area code : 3  
 FDEPTH: 10 15 GearCond.code:  
 BDEPTH: 37 36 Validity code:  
 Towing dir: 154° Wire out: 150 m Speed: 35 kn\*10  
 Sorted: 72 Kg Total catch: 366.51 CATCH/HOUR: 1221.70

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1073.33	29100	87.86	1373
Engraulis encrasicolus	101.67	7983	8.32	1374
Scomber japonicus	25.00	317	2.05	1375
Liza ramada	10.40	13	0.85	
Lepidopus caudatus	5.33	3	0.44	
Belone svetovidovi	3.50	3	0.29	
Loligo vulgaris	2.50	67	0.20	
Total	1221.73		100.01	

DATE:14/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 669  
 start stop duration POSITION:Lat N 3004  
 TIME :08:49:22 09:09:12 20 (min) Purpose code: 1  
 LOG :8426.50 8427.65 1.13 Area code : 3  
 FDEPTH: 20 20 GearCond.code:  
 BDEPTH: 48 48 Validity code:  
 Towing dir: ° Wire out: 3 m Speed: kn\*10  
 Sorted: 67 Kg Total catch: 485.97 CATCH/HOUR: 1457.91

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1273.35	53892	87.34	1376
Lepidopus caudatus	141.90	75	9.73	
Engraulis encrasicolus	30.99	4326	2.13	1377
Chelidonichthys lastoviza	4.32	24	0.30	
Diplodus sargus *	3.78	3	0.26	
Sarda sarda	3.57	3	0.24	
Total	1457.91		100.00	

DATE:14/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 670  
 start stop duration POSITION:Lat N 3013  
 TIME :11:53:54 11:59:01 5 (min) Purpose code: 1  
 LOG :8453.55 8453.83 0.27 Area code : 3  
 FDEPTH: 35 35 GearCond.code:  
 BDEPTH: 50 51 Validity code:  
 Towing dir: 200° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 40 Kg Total catch: 3029.36 CATCH/HOUR: 36352.32

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	24806.40	1548576	68.24	1378
Engraulis encrasicolus	11445.60	2119488	31.49	1379
Scomber japonicus	100.32	912	0.28	
Total	36352.32		100.01	

DATE:15/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 671  
 POSITION:Lat N 3136  
 start stop duration Long W 957  
 TIME :09:41:06 10:10:36 30 (min) Purpose code: 1  
 LOG :8671.24 8672.95 1.68 Area code : 3  
 FDEPTH: 40 45 GearCond.code:  
 BDEPTH: 75 85 Validity code:  
 Towing dir: 240° Wire out: 250 m Speed: 35 kn\*10  
 Sorted: Kg Total catch: 111.03 CATCH/HOUR: 222.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	171.20	12606	77.10	1380
Lepidopus caudatus	49.60	36	22.34	
Sardina pilchardus	0.54	18	0.24	
Trachurus trachurus	0.52	2	0.23	
Scomber japonicus	0.20	2	0.09	
Total	222.06		100.00	

DATE:15/12/97 GEAR TYPE: PT No:1 PROJECT STATION: 672  
 POSITION:Lat N 3142  
 start stop duration Long W 949  
 TIME :12:42:45 12:51:40 9 (min) Purpose code: 1  
 LOG :8695.61 8696.22 0.61 Area code : 3  
 FDEPTH: 15 15 GearCond.code:  
 BDEPTH: 39 39 Validity code:  
 Towing dir: 30° Wire out: 200 m Speed: 35 kn\*10  
 Sorted: 39 Kg Total catch: 2488.50 CATCH/HOUR: 16590.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	10038.00	521640	60.51	1381
Engraulis encrasicolus	6510.00	505680	39.24	1382
Scomber japonicus	42.00	420	0.25	
Total	16590.00		100.00	

### Annex III Instruments and fishing gear used

The Simrad EK-500/38kHz scientific sounder was used during the survey for fish abundance estimation. The Bergen Echo Integrator system (BEI) was used to scrutinize the acoustic records from the 38kHz echo sounder, and to allocate integrator values to fish species.

The details of the settings of the 38kHz echo sounder were as follows:

#### Tranceiver-1 menu (38 kHz lowering keel)

Transducer depth	5.00 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	27.54 dB
TS transducer gain	27.54 dB
Angle sensitivity	21.9
3 dB beamwidth	6.8 dg
Alongship offset	0.02"
Athwardship offset	0.08 "

#### Display menu

Echogram	1 (38 kHz)
Bottom range	10 m
Bottom range start	5 m
Sv colour min	-67 dB

### Printer- menu

Echogram	1 (38 kHz)
Range	100, 250 and 500 m
Range start	0
Bottom range	10 m
Bottom range start	5 m
Sv colour min	-63 dB
TVG	20 log R

**Bottom detection menu** Minimum level -45 dB

### Fishing gear

The vessel has two different sized "Åkrahavn" pelagic trawls and one 'Gisund super bottom trawl'. All three trawls were used during the survey.

The bottom trawl has a headline of 31 m, footrope of 47 m and 20 mm meshsize in the codend with an inner net of 10 mm meshsize. The estimated opening is 6 m (observed 5.7) and distance between wings during towing about 18 m. The sweeps are 40 m long. The trawl is equipped with a 12" rubber bobbins gear. The doors are of 'Thyborøn' combi type, 7.81 m<sup>2</sup>, 1670 kg, their distance while trawling about 46 m in average.

The pelagic trawl is equipped with a trawleye that provides information on the trawl opening and the distance of the footrope to the bottom.