

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

Part I

**SENEGAL - THE GAMBIA
31st October – 09th November 2006**

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

**Institute of Marine Research
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CRUISE REPORTS 'DR FRIDTJOF NANSEN'

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by

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Bergen, 2006**

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CHAPTER 1 INTRODUCTION

1.1 Objective of the cruise

The general objectives of the survey were to estimate biomass and map the distribution of the small pelagic fish resources off NW Africa (Mauritania, Morocco, Senegal and The Gambia) by hydro-acoustic methods and describe the hydrographic conditions in the region over a period of 50 days, from 31st October to 20th December 2006. For Senegal and The Gambia the agreed objectives were as follows:

- To map the distribution and estimate the biomass for the main small pelagic fish using hydro-acoustic methods. The species of interest were: sardinellas (*Sardinella aurita*) and (*Sardinella maderensis*), horse mackerel (*T. trecae*), false scad (*Decapterus rhonchus*), and anchovy (*Engraulis encrasicolus*).
- To identify and describe the size distribution of the target fish populations by midwater and bottom trawl sampling and process the catches by recording weight and number by species.
- Collect biological data and otoliths of the main target species, especially *Sardinella aurita*, *S. maderensis* and *T. trecae*.
- To collect hydrographical data of temperature, salinity and oxygen on fixed transects with approximately one degree interdistance, and additional measurements at the 50 m and 200 m isobath every 20 NM.
- To train local participants in acoustic survey methodology including fish identification and sampling, scrutinizing of echograms, hydrographic sampling and abundance estimation.

The time allocated for this part of the survey, off Senegal and The Gambia, was 9 days.

1.2 Participation

Participating scientists were:

Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT), Senegal:

Abdoulaye Sarre (Senegalese team leader), Ibrahima Sow, Mor Sylla and Cheikh Ndour

Fisheries Department (FD), The Gambia:

Ebou Mass Mbye (Gambian team leader), Malick Samba and Filly Sanneh

Institut Mauritanien de Recherches Océanographiques et des Pêches (CNROP), Mauritania:

Ould Vally Yeslem

Institut National de Recherche Halieutique (INRH), Morocco:

Lahcen Aboubdelah

Institute of Marine Research (IMR), Norway:

Jens-Otto Krakstad (Cruise Leader), Magne Olsen, Thor Egil Johansson, Ole Sverre Fossheim and Åsmund Skålevik.

Food and Agriculture Organization of The United Nations (FAO), Rome.

Merete Tandstad

1.3 Narrative

The survey started on the 31/10/2006 from Dakar, Senegal at 15:00 GMT (GMT=local time). The vessel left port to collect bunker until 22:00 (GMT). The survey started at the border between Guinea Bissau and Senegal (240 degree on Cape Roxo, Casamance) at 14:00 the following day. The southern border between Senegal and The Gambia (270° at 13°03'N) was reached on the 3/11 at 09:30, while the northern border of The Gambia (270° at 13°35'5''N) was crossed on the 4/11, at 19:20. Cape Vert was reach on the 6/11 at 08:40, before the survey ended at St Louis at the border to Mauritania on the 8/11 at 09:00 and the vessel returned to port in Dakar on the 8/11 at 18:00.

The course track and fishing stations are shown in Figure 1, while Table 1 show survey effort during the survey, including number of trawl stations and CTD casts.

During all surveys in the region a common strategy has been adapted with systematic parallel course tracks spaced 10 NM (nautical miles) apart, perpendicular to the depth isobaths. To cover the whole distribution area of pelagic fish, the shelf was covered from the 15 m isobath and offshore to the 500 m isobath. Trawling was done irregularly, either to identify echo registrations or to check ‘blindly’ if fish were mixed with the plankton in the upper layers of the water column. Pelagic trawl with floats was often used to catch fish close to the surface. A smaller pelagic trawl or the bottom trawl with floats was used for sampling pelagic fish in shallow waters (depth less than 25 m).

Four crossshelf hydrographic transects were carried out, at Casamance, off The Gambia, at Cape Vert and at south of St. Louis.

All data collected during the survey were made available to the participants.

Table 1. Summary of survey effort by regions, including number of demersal (BT) and pelagic (PT) trawl hauls, CTD casts, and distance surveyed (log), disregarding the steaming from Cape Vert to Casamance and from St. Louis to Cape Vert (log).

Area	BT	PT	Total trawls	CTD casts	Plankton stations	Log (NM)
Casamance to St. Louis	14	24	38	54	2	1288

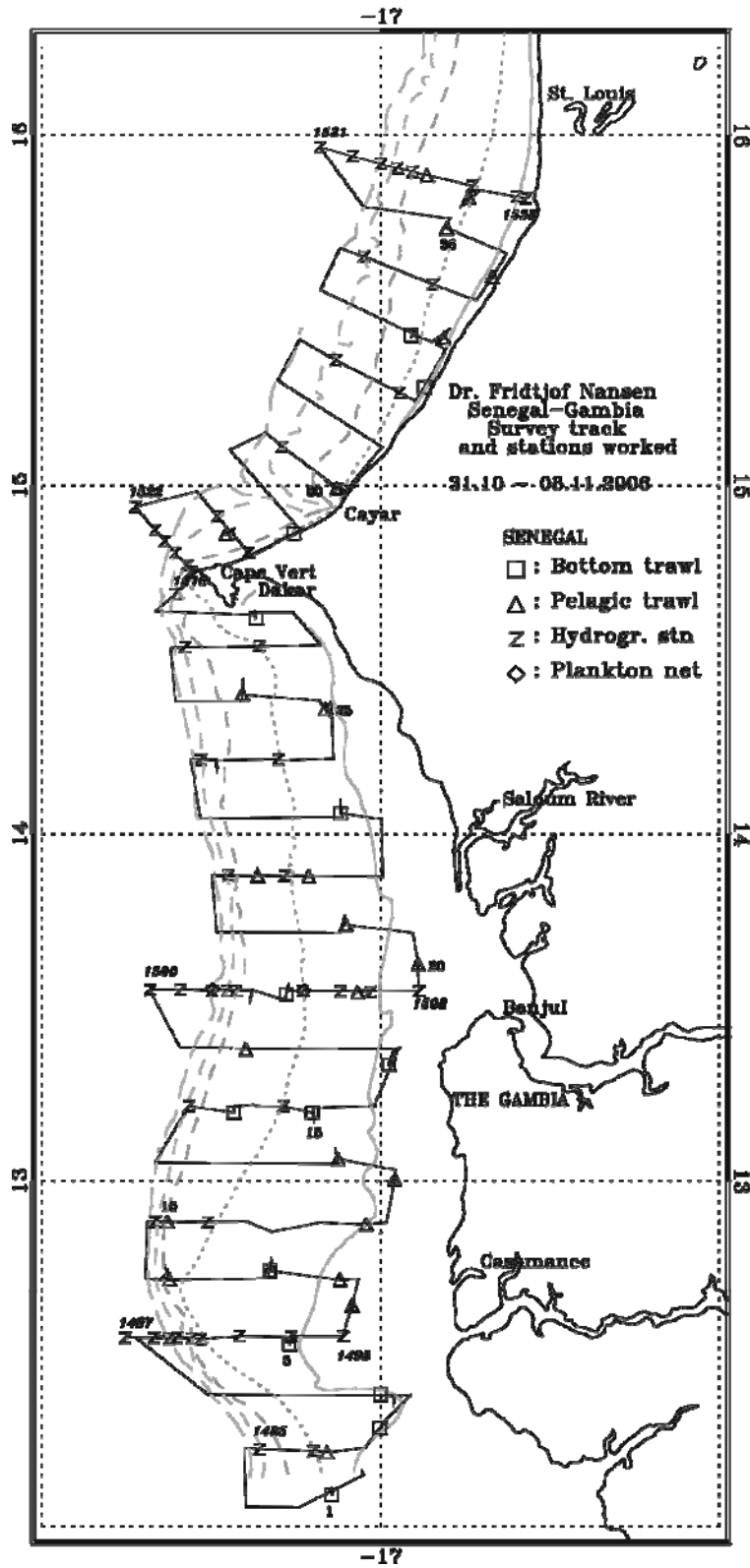


Figure 1. Course tracks with fishing and hydrographical stations; Casamance to St. Louis.

CHAPTER 2 METHODS

2.1 Environmental Data

CTD-profiling

A Seabird 911+ CTD probe was used to obtain vertical profiles of the temperature, salinity and oxygen. Real time logging was carried out using the PC based Seabird Seasave Software. CTD casts were conducted along the cruise track in transects at about every one degree latitude and at fixed stations every 50 m and 200 m depth every 20 NM. The casts were stopped a few meters above the bottom, and at a maximum of 500 m depth. The oxygen and salinity sensors on the CTD have traditionally been very stable and no calibration of the sensors was attempted during the survey.

Meteorological observations

Meteorological data logged from the Aanderaa meteorological station included wind direction and speed, air temperature, incident solar intensity and sea surface temperature (SST). All data were stored in the new NanSis database with one-minute resolution.

Thermosalinograph

The SBE 21 Seacat thermosalinograph was running routinely during the survey. Obtaining samples of sea surface salinity and relative temperature (5 m depth) every 10 sec during the survey.

Current speed and direction measurements (ADCP)

The ship-born Acoustic Doppler Current Profiler (ADCP) from RD Instruments was running throughout the survey. The ADCP was set to external trigger, triggered by the ER 60 system. The depth cell interval set to 3 m and the number of cells was set to 120.

2.2 Trawl sampling

Fish sampling was carried out using two different sized pelagic trawls, and a bottom trawl. The small pelagic trawl or the bottom trawl with floats was used for sampling the pelagic fish in shallow waters (depth less than 25 m), floats were also used for surface trawls (trawl depth < 20 m). Annex II gives a description of the instruments and the fishing gear used.

All catches were sampled to determine species composition by weight and numbers. Species identification was based on the FAO Species Identification Guides. Length frequency distributions, by total fish length (TL) in cm (measured to the nearest cm below), of the selected target species were recorded at all stations where they were present.

Individual weight measurements were taken regularly to estimate the condition factor in the length-weight relationship:

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

Other biological parameters collected included sex, maturity and gonad weight. Otoliths were extracted from *Sardinella aurita* and *Sardinella maderensis*, mounted on black slides and embedded in a synthetic resin (EUKITT). A summary of the biological samples is provided in Annex III.

For the estimation of biomass a fixed condition factor of 0.96 was applied for the two sardinella species and *Trachurus trecae*. This factor was compared to the specific condition factors obtained from the samples as described above. For carangids and associated species, an overall average length of 23 cm and a condition factor of 0.88 was applied. The target groups used for Senegal and The Gambia can be found in Table 2, while the complete records of fishing stations and catches are shown in Annex I.

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 used.

Table 2. Allocation of acoustic densities to taxii. Note that for the groups of sardinella, horse mackerel, and sardine all encountered species are listed, while only examples are listed for the remaining groups.

Group	Taxon	Species	
Sardinella	<i>Sardinella</i> sp.	<i>S. aurita</i> <i>S. maderensis</i>	
Sardine	<i>Sardina</i>	<i>S. pilchardus</i>	
Anchovy	<i>Engraulis</i>	<i>Engraulis encrasicolus</i>	
Horse mackerels	<i>Trachurus</i> sp.	<i>T. trecae</i> <i>T. trachurus</i>	
	<i>Decapterus</i>	<i>Decapterus rhonchus</i>	
Pelagic species 1	Clupeidae ₁	<i>Ilisha africana</i> <i>Ethmalosa fimbriata</i>	
		Pelagic species 2	Carangidae ₂
Scombridae	<i>Euthynnus alletteratus</i> <i>Sarda sarda</i> <i>Scomber japonicus</i>		
	Sphyraenidae		
Others			
Big eye grunt		<i>Brachydeuterus auritus</i>	
Other demersal species	Demersal families		
Mesopelagic species	Myctophidae ₃		
	Other mesopelagic fish		
Plankton	Calanoidae	<i>Calanus</i> sp.	
	Euphausiidae	<i>Meganyctiphanes</i> sp.	
	Other plankton		

₁: other than *Sardina* sp and *Sardinella* sp.; ₂: other than *Trachurus* sp and *Decapterus rhonchus*;

2.3 Acoustic sampling

A SIMRAD ER60 Echosounder was used with the settings as shown in Annex II. The Bergen Integrator (BEI) was used for analysis and allocation of the integrated s_A -values to the individual specified target groups by 5 NM intervals. The allocation of values to target groups was based on a combination of a visual scrutiny of the behaviour pattern as deduced from echo diagrams, the BEI analysis, and the catch compositions.

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

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

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

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

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

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

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

where

ρ_i = density of fish in length group i

s_A = mean integrator value

p_i = proportion of fish in length group i

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

target species, and

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

The integrator outputs were split in fish groups using a combination of behaviour pattern as deduced from echo diagrams, the BEI analysis and catch composition as described below. The following main target groups were used for Senegal and The Gambia: 1) sardinellas, 2) horse mackerel, 3) carangids and associated species. In addition 4) scombrids, 5) Clupeids other than sardinella and 6) demersal fish were also scrutinized as non-target groups.

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

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

For a region representing a distribution of a target-specie, the following basic data are needed for the estimation of abundance;

- 1) the average s_A -value for the region,
- 2) the surface (usually square nautical miles, NM^2), and
- 3) a representative length distribution of the fish in the region.

If the targeted fish is a mixture of more than one species, for example sardinellas, a representative distribution of the two, within the region, as shown in the trawl catches, are used. A length distribution representing the number of the two species for each catch will have to be calculated. Thereafter, these distributions have to be normalized to a unit number (usually 100) so they are equally weighted.

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

The samples of the species in the category (e.g. sardinellas) are respectively pooled together with equal importance (normalized).

The mean back scattering strength (ρ/s_A) of each length frequency distribution of the target species is calculated and summed. This is automatically done in the Excel spread-sheet made available for acoustic abundance estimation onboard RV “Dr. Fridtjof Nansen”, provided the data are punched in this sheet.

The mean s_A -value allocated to the category of fish in the region is divided between the species in the same ratio as their relative contribution to the mean back scattering strength of the length groups in the sample representing the region

The pooled length distribution is used, together with the mean s_A -value, to calculate the density (numbers per square NM) by length groups and species, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area. The numbers are then converted to biomass using the estimated weight at length.

CHAPTER 3 SURVEY RESULTS

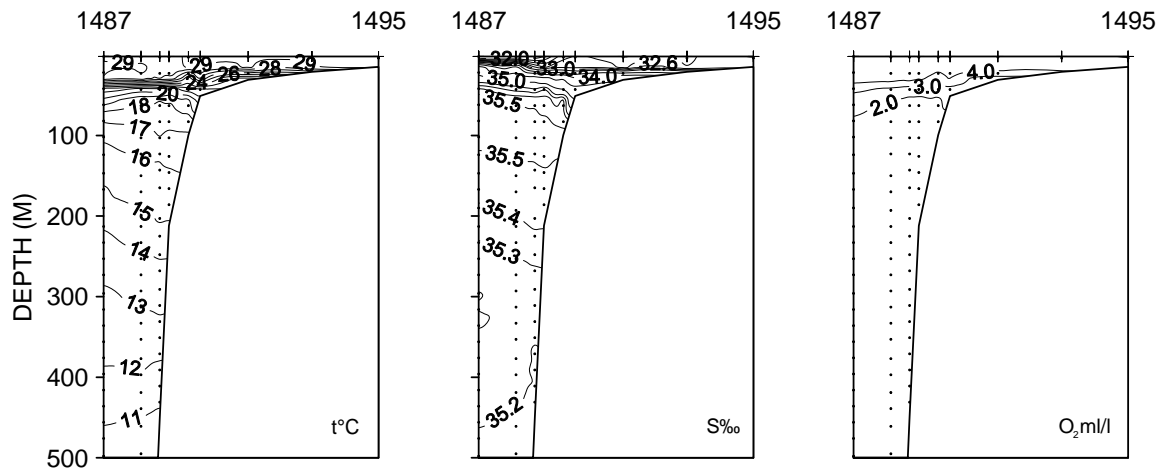
3.1 Hydrography

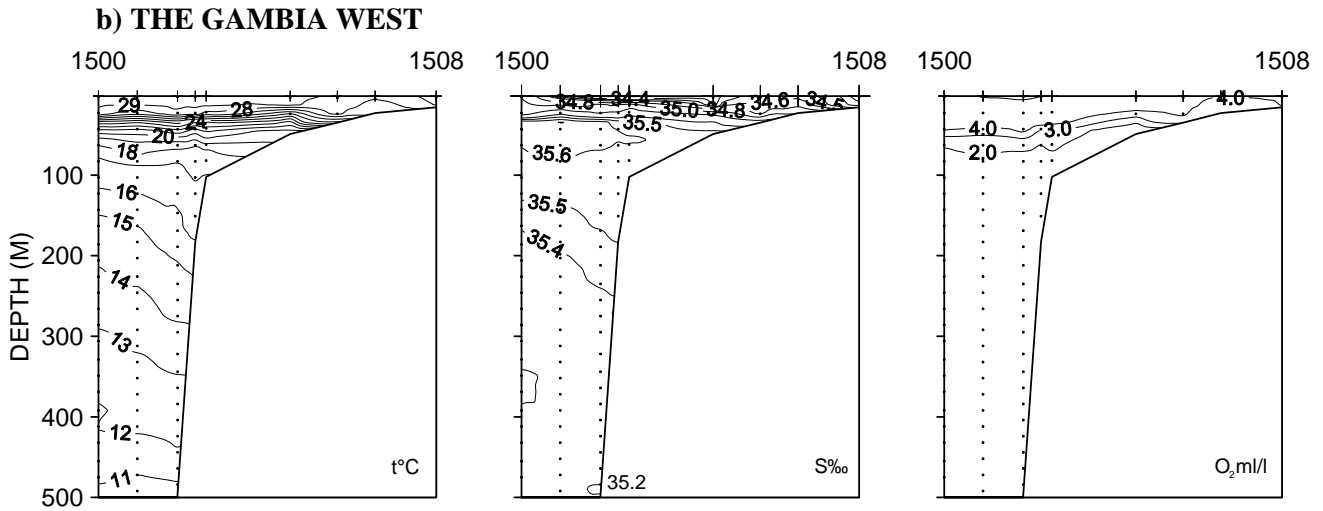
Hydrographical data was collected on fixed CTD stations to 500 m depth and from the Thermosalinograph and the Aanderaa weather station that continuously collect sea surface temperature, wind speed and direction, solar radiation, etc. during the survey.

Cross shelf hydrographical profiles

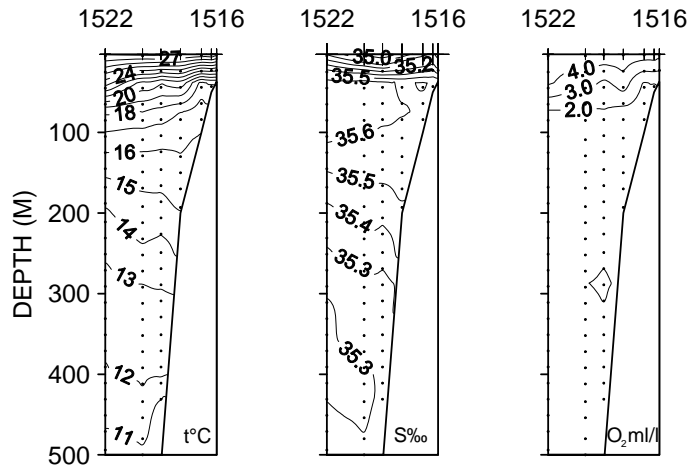
Figure 2 shows the distribution of temperature, salinity and oxygen from the four hydrographical transects collected during the survey. The temperature layers were clearly stratified on the shelf south of Cape Vert, with warm surface waters and a thermocline around 50 m depth. A minimum temperature of 11°C was observed around 500 m depth. Slightly more mixed conditions were experienced inshore at St. Louis. The salinity profiles showed lower salinity surface waters, particularly in the offshore in the Casamance area, and with less fresh water influence off The Gambia and Cape Vert. Lower salinity values were also experienced in surface waters off St. Louis due to river runoff from the border river. Maximum salinities were experienced at the shelf break around 50 m depth, with maximum salinities between 35.6 PSU below the Salinocline. Salinity around 500 m was around 35.2 PSU. The water masses in the survey area was well oxygenated with oxygen concentrations in the surface layer >4 ml O₂/l decreasing to 2.0 ml/l oxygen between 50 – 100 m depth.

a) CASAMANCE





c) CAPE VERT



d) ST. LOUIS – SOUTH

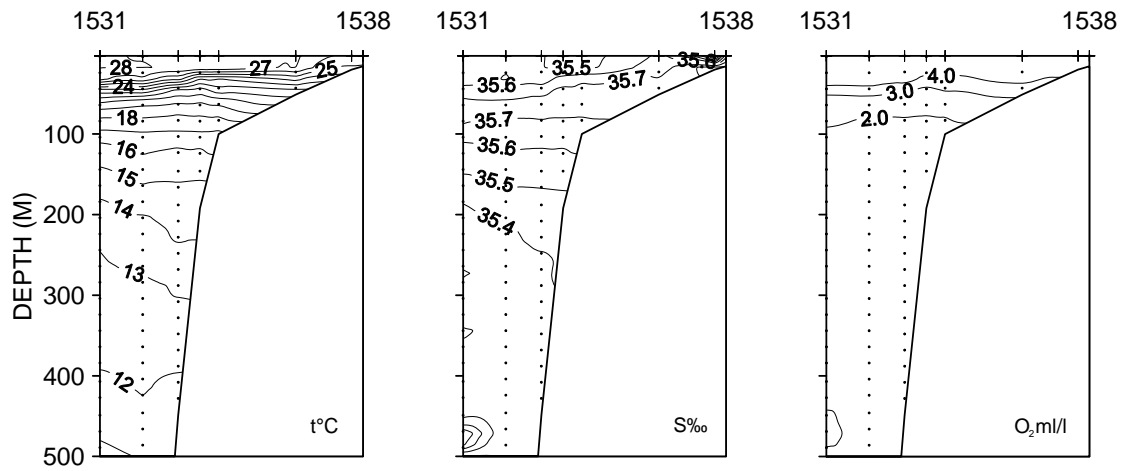


Figure 2. Hydrographical profiles with distribution of temperature, salinity and oxygen off a), Casamance, b) The Gambia, c) Cape Vert, and d) St. Louis - South

Along shelf profiles

Along shelf profiles of temperature was created from the 200 m depth CTD stations collected at every 20 NM during the survey. Only the temperature plots are shown in Figure 3. The figures show the relatively stable water masses on the shelf south of Dakar, with a thermocline and temperature drop from 28 to 20 °C visible around 50 m depth. Also visible is the slightly cooler surface water masses on the Casamance shelf and the relatively higher sea surface temperature off Gambia. The thermocline was slightly less pronounced North of Dakar between St. Louis and Cape Vert. Typical surface temperature was >28°C close to Cape Vert, decreasing slightly northwards. Bottom temperatures were < 15 °C along the shelf.

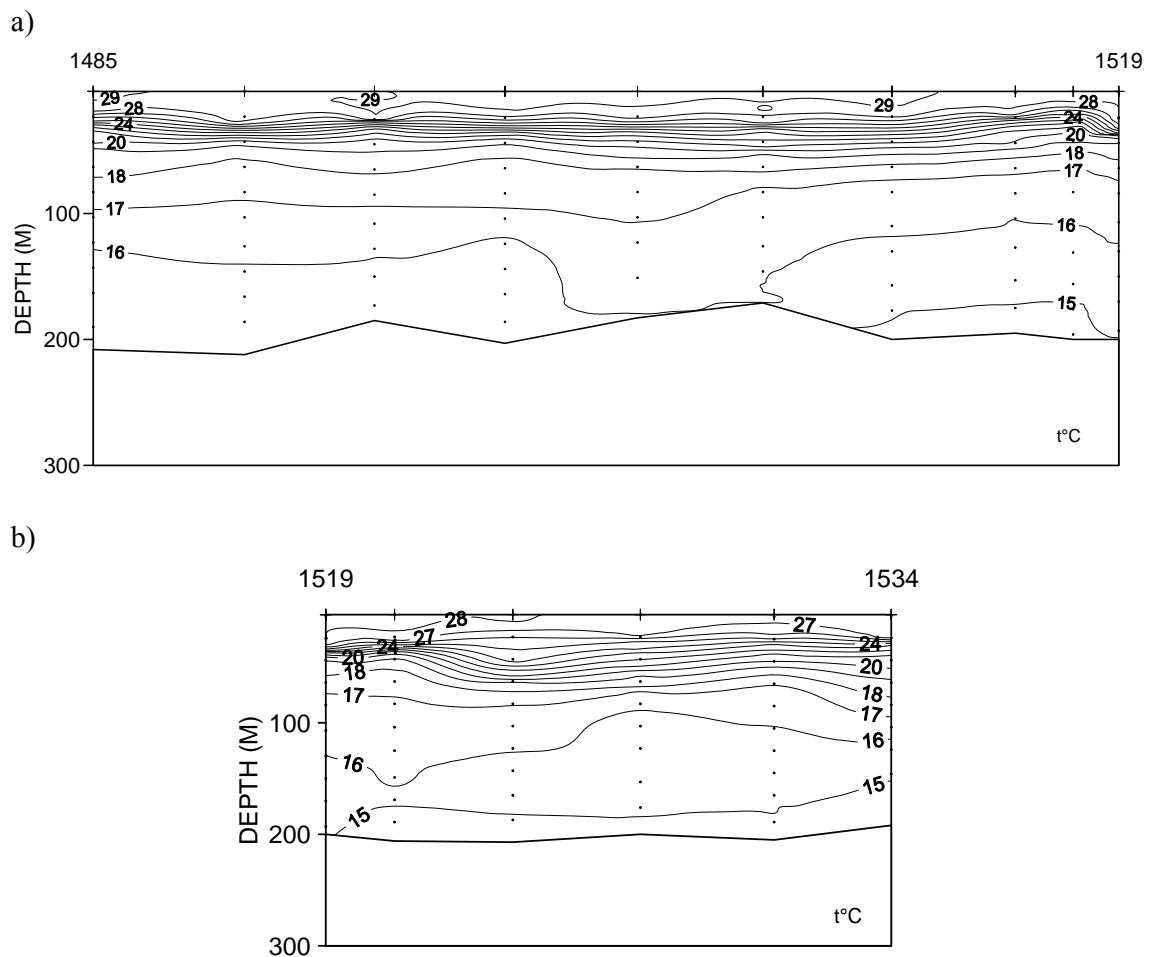


Figure 3. Alongshelf temperature at 200 m depth from a) Casamance to Cape Vert b) Cape Vert to St. Lois.

Sea surface temperature, salinity and wind direction

Figure 4 illustrates the sea surface temperature at 5 m depth, Figure 5 shows the sea surface salinity at the same depth, while Figure 6 show the wind direction and wind speed during the survey of Senegal and The Gambia.

The sea surface water masses on the main part of the Casamance shelf was dominated by temperatures warmer than 29°C, with filaments of water masses with temperatures >29.5°C. A region offshore at Casamance with surface temperatures <29°C corresponded with very low salinity waters probably originating from river discharge further south in Guinea Bissau. Sea Surface Temperatures (SST) declined steadily towards Cape Vert with SST around 28°C around Dakar. North of Cape Vert temperatures decreased but offshore SST around 28°C was found North of Cayar Canyon, with colder water masses inshore along the coast. The temperature dropped further to <27°C off St. Louis. Surface temperatures in 2004 and 2005 were in general slightly warmer along the shelf of Senegal during the survey compared to what was observed this year.

The Sea Surface Salinity (SSS) on the Casamance shelf ranged from < 31.5 PSU offshore in an smaller area to 33 PSU in the northern part of this region. The SSS isolines was oriented across the shelf, and a large increase in SSS was observed while crossing the southern border to The Gambia, and continued to increase to >35 PSU around Dakar. The 34.5 PSU isoline corresponded roughly with SST's of 29°C. The salinity in the northern part of the survey area typically showed values around 35.5PSU but with reduced SSS around St. Louis where local river discharge reduce the salinity to <34.5PSU. Compared to last year higher SSS was experienced over most of the survey area, but the survey report from 2005 refers to heavy rain before the survey as the reason for unusually low SSS that year. Thus, salinity levels are rather typical this year.

Calm conditions with little wind was experienced over the whole survey area. Typical wind direction was from Northeast. The conditions were favourable for acoustic surveying throughout the survey.

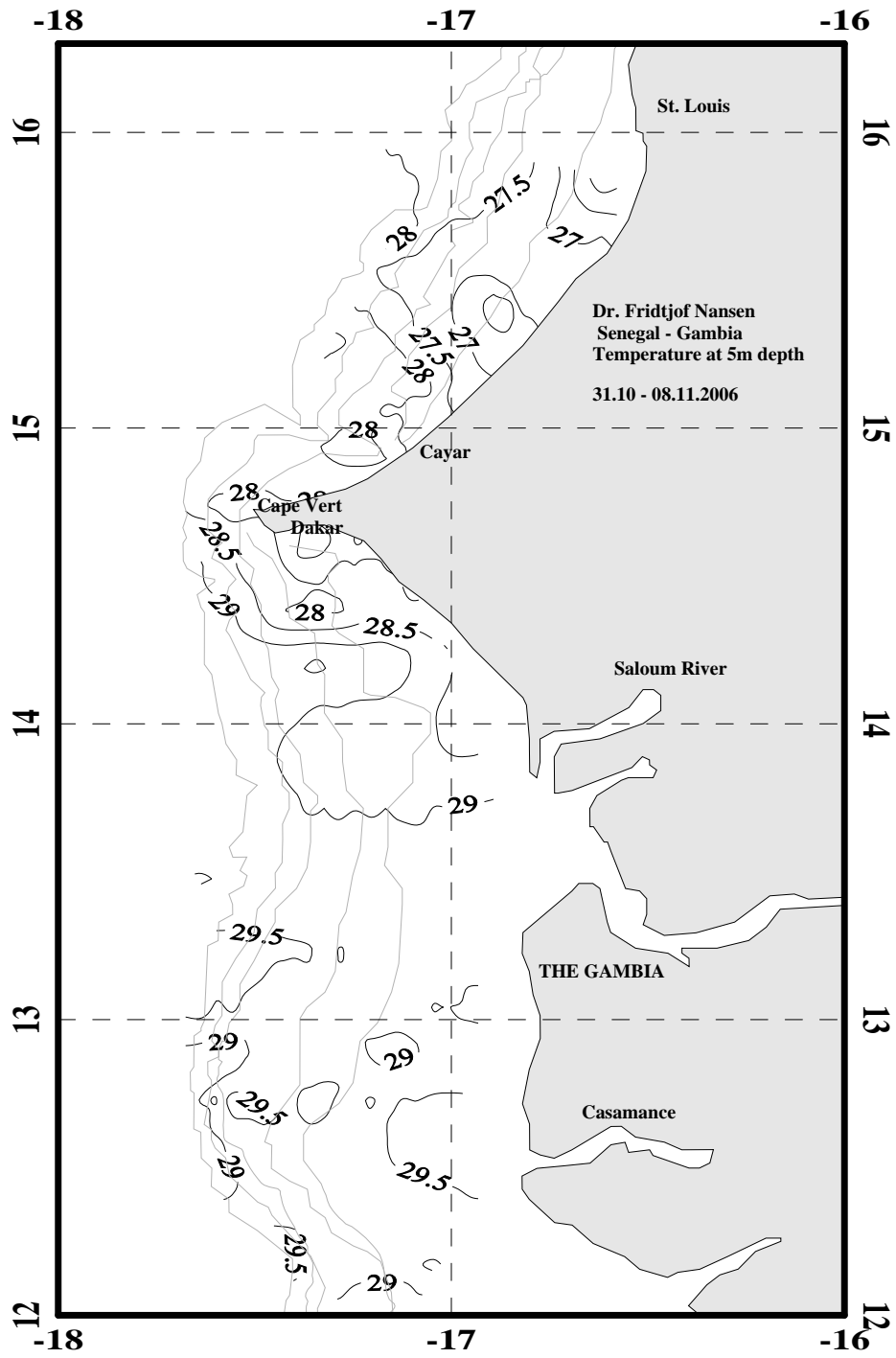


Figure 4. Sea surface temperature; Casamance to St. Louis.

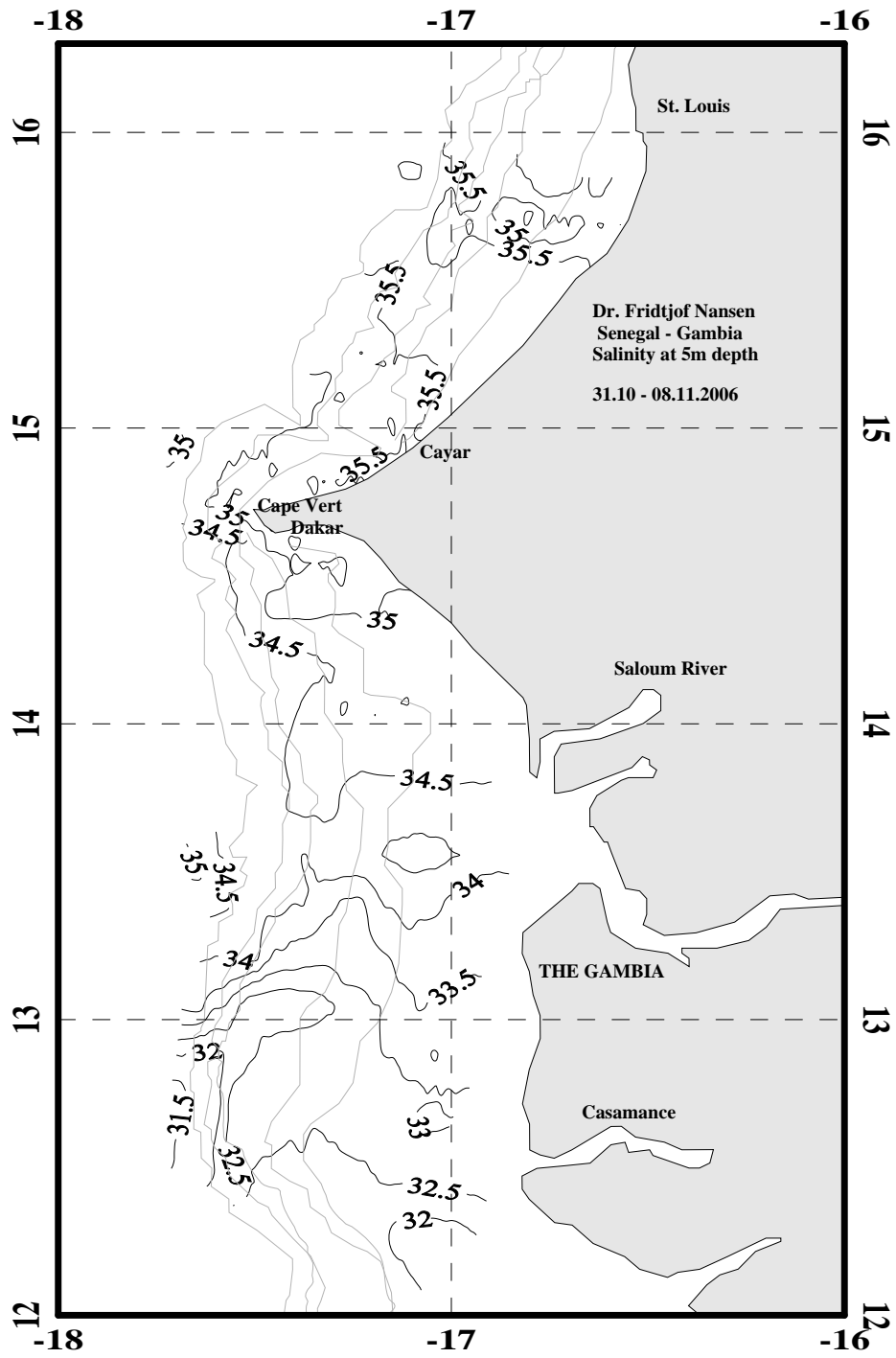


Figure 5. Sea surface salinity; Casamance to St. Louis.

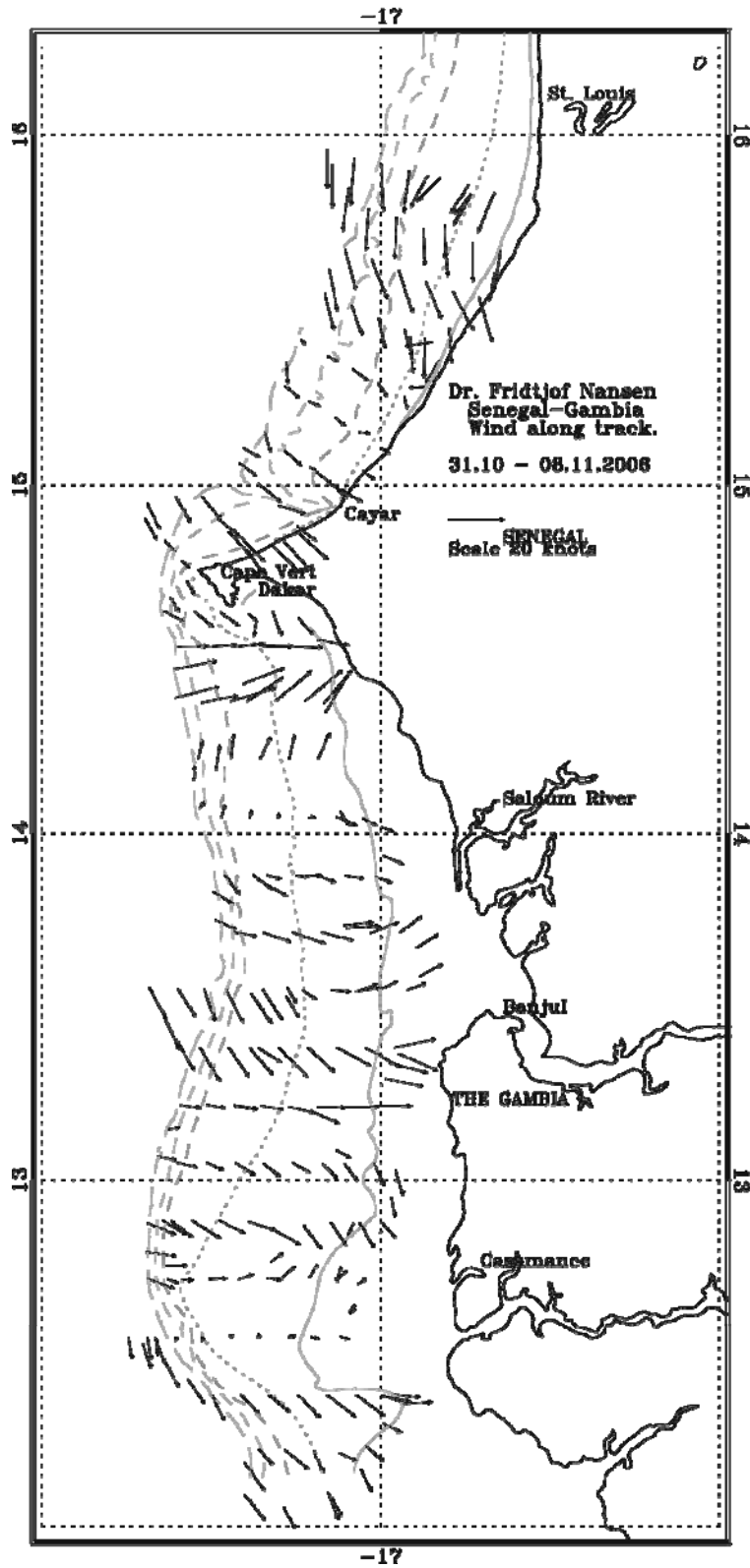


Figure 6. Wind speed and direction; Casamance to St. Louis.

3.2 The Casamance shelf

Distribution maps illustrating the acoustic densities of the main groups of pelagic fish encountered during the survey of Senegal and The Gambia are seen in Figure 7, Figure 8, Figure 9, Figure 10, and Figure 11 representing sardinella, P1, horse mackerel, P2 and mackerel respectively.

Sardinella was distributed on the inner shelf, inshore of the 50 m isobath, with decreasing abundance further from the coast. The distribution ended before the border to Guinea Bissau, while it continued into The Gambia in the northern part of the shelf, Figure 7. The region was as usual dominated by *Sardinella maderensis*, with *S. aurita* contributed approximately 25% to the biomass.

The size distribution of *S. aurita* in the area were bimodal, with modal peaks at 26 and 28 cm (total length) while the size distribution of several *S. maderensis* showed several modes. A juvenile cohort of modal size 6 cm was observed, together with adult fish ranging from 19 to 27 cm, and a main mode of 24 cm. Estimated number and biomass by length-groups can be found in Annex IV. The total biomass of sardinellas in the area was estimated to be 213 thousand tons, Table 3. Of this 53 thousand tons were *S. aurita*, while 160 thousand tons were *S. maderensis*. In 2005 the total biomass of sardinellas in the area was estimated to be 220 thousand tons, of this 9% were *S. aurita*.

Clupeid fish species other than sardinella was less abundant on the shelf of Casamance this year compared to last year. Only small concentrations of P1, and only *Ilisha africana* was found on the shelf, <1 thousand tons were estimated in the area, Figure 8.

Very little horse mackerel are usually found in the Casamance area. During the past three surveys no *Trachurus trecae* was found, while this years an estimate of 1 thousand tons was obtained, distributed on the shelf break around 100 m depth. The average size of the horse mackerel in the area was 20 cm. *Decapterus rhonchus* were not found in the region this year, last year the biomass of *D. rhonchus* was 3.3 tons.

Other pelagic fish (P2) were covering large parts of the shelf, similar to what is experienced most years. In general carangids, hairtails and barracudas were found in the area, Table 4. The most frequently found species in the catches were *Selene dorsalis*, *Chloroscombrus chrysurus*, and *Trichiurus lepturus* was the most abundant of the P2 species while *Sphyræna guachancho* was frequent in the catches but less abundant. The species were well mixed with sardinellas where their distribution overlapped, Figure 10. The estimated biomass of the other

pelagic fish group was 61 thousand tons compared to 59 000 tonnes in 2005. It is also important to note that the most abundant species in the trawl catches from the region both in weight and frequency of occurrence was *Brachydauterus auritus*. No estimate was made of this species.

This year a separate estimate was made for the Scombridae due to the impression that the abundance of the species *Scomber japonicus* has increased in the survey area. The species is therefore not included in the P2 estimate as has been common practice in Senegal in previous years. One catch of the Scombridae *Scomberomorus tritor* were made on the shelf break at the border between Senegal and Guinea Bissau, but none of the target species *S. japonicus*. No Scombridae were identified acoustically and no estimate was made for the area, Figure 11.

Table 3. Casamance. Biomass estimates of pelagic fish, thousand tons.

<i>S. maderensis</i>	<i>S. aurita</i>	Horse mackerel	Carangids etc.
160	53	1	61

Table 4. Catch by stations sorted by groups (in kg/hour)

Station	Gear depth	Clupeids	Carangids	Scombrids	Hairtails	Barracuda	Other	Total
1	38	0	86.6	2.5	91.2	1.9	208.5	390.6
2	0	11.2	22.8	25.7	2.3	11.7	42.1	115.8
3	20.5	22	0	0	8.6	0	691.8	722.3
4	10	210	8.5	0	5.1	11	71.7	306.2
5	21	2	11.9	0	0	0	145.3	159.1
6	15	25	38.8	0	0	0	0	63.8
7	15	0.5	101.2	1.5	14.1	33.7	933.2	1084.2
8	10	119.8	198.8	43.4	0	33.3	77.1	472.4
9	27.5	0	107.4	664.6	0.9	0	60.2	833.1
10	50	0	6.1	0	0	0	43.9	50
11	10	505.5	89.7	1.4	0	2.3	6.7	605.7
Mean	19.7	81.4	61.1	67.2	11.1	8.5	19.7	436.7

3.3 The Gambian shelf

The distribution of sardinellas from the Casamance area continued into Gambian waters with dense concentrations of both sardinella species between the coast and 50 m bottom depth. Another area with *S. aurita* was found further offshore between 50-100 m bottom depth,

Figure 4. Overall, *S. maderensis*, dominating in biomass by 84%. The total estimate of sardinellas in The Gambian waters during the survey was 119 thousand tons, Table 5. This comprised of 100 thousand tons of *S. maderensis* and 19 thousand tons of *S. aurita*. In 2005 a total of 261 thousand tons were found (72% *S. maderensis*) while the estimate in 2004 was 128 thousand tons, illustrating that the proportion of the sardinella stock found in Gambian waters fluctuates considerably due to migration of the two species within the greater region of Senegal and Gambia. The modal length of *S. maderensis* in The Gambian region during this survey was 23 cm while catches of *S. aurita* showed a modal peak at 19 cm. The estimated numbers and biomass by length-groups can be found in Annex IV.

No other Clupeid species (P1) were found in the area.

Trachurus trecae was found on the shelf break at 100 m depth extending inshore towards the 50 m isobath, while the *Decapterus rhonchus* typically had a more shallow distribution often found inshore of the 50 m isobath. An area with generally low fish density was found on the midshelf around 50 m depth, and no horse mackerel or False scad was found in this area except in the northern part of The Gambia where some *T. trecae* was encountered, Figure 9. The total estimate for The Gambia was 14 thousand tons. Of this, 3 thousand tons (21%) was *T. trecae* while 11 thousand tons of the total estimate comprised of *D. rhonchus*, Table 5. The abundance of the two species in 2005 was low with an estimated biomass of 0.8 thousand tons of *Trachurus trecae*, and 3.6 thousand tons of *D. rhonchus*. The size distribution of *T. trecae* in the area consisted of three modal peaks at 18, 22 and 26 cm respectively, while *D. rhonchus* in the area consisted of relatively large fish with modal peaks at 26, 28 and 30 cm.

The mackerel, *Scomber japonicus* was found in low density in a small distribution area on the midshelf around 50 m depth, Figure 11. No abundance estimate was calculated

Carangids and associated species were found in low density widely distributed over the whole Gambian shelf, Figure 10. The catches of this group were dominated by *Chloroscombrus chrysurus* while *Selene dorsalis* was frequently caught but far less abundant. The biomass was estimated at 20 thousand tons. In 2005 a total of 55.8 thousand tons were found in the area.

Table 5. The Gambia. Biomass estimates of pelagic fish, thousand tons.

<i>S. maderensis</i>	<i>S. aurita</i>	Horse mackerel	Carangids etc.
100	19	14	20

Table 6. Catch by stations sorted by groups (in kg/hour)

Station	Gear depth	Clupeids	Carangids	Scombrids	Hairtails	Barracuda	Other	Total
12	10	137.5	611.5	0	7.2	0	78.3	834.5
13	5	286.1	3917.6	0	0	14.3	778.3	4996.3
14	71	0	255	18.9	0	0	363.4	637.2
15	39	1.2	22.9	0	0	0	130.5	154.6
16	18	348.2	449.8	0	0	17.8	712.8	1528.5
17	49	961.7	265.7	24.9	0	0	1.1	1253.5
18	62	0	40.4	0	0	0	451.6	492
19	15	0	1365.6	0	0	0	168.7	1534.3
Mean	33.6	216.8	866	5.5	0.9	4	33.6	1428.9

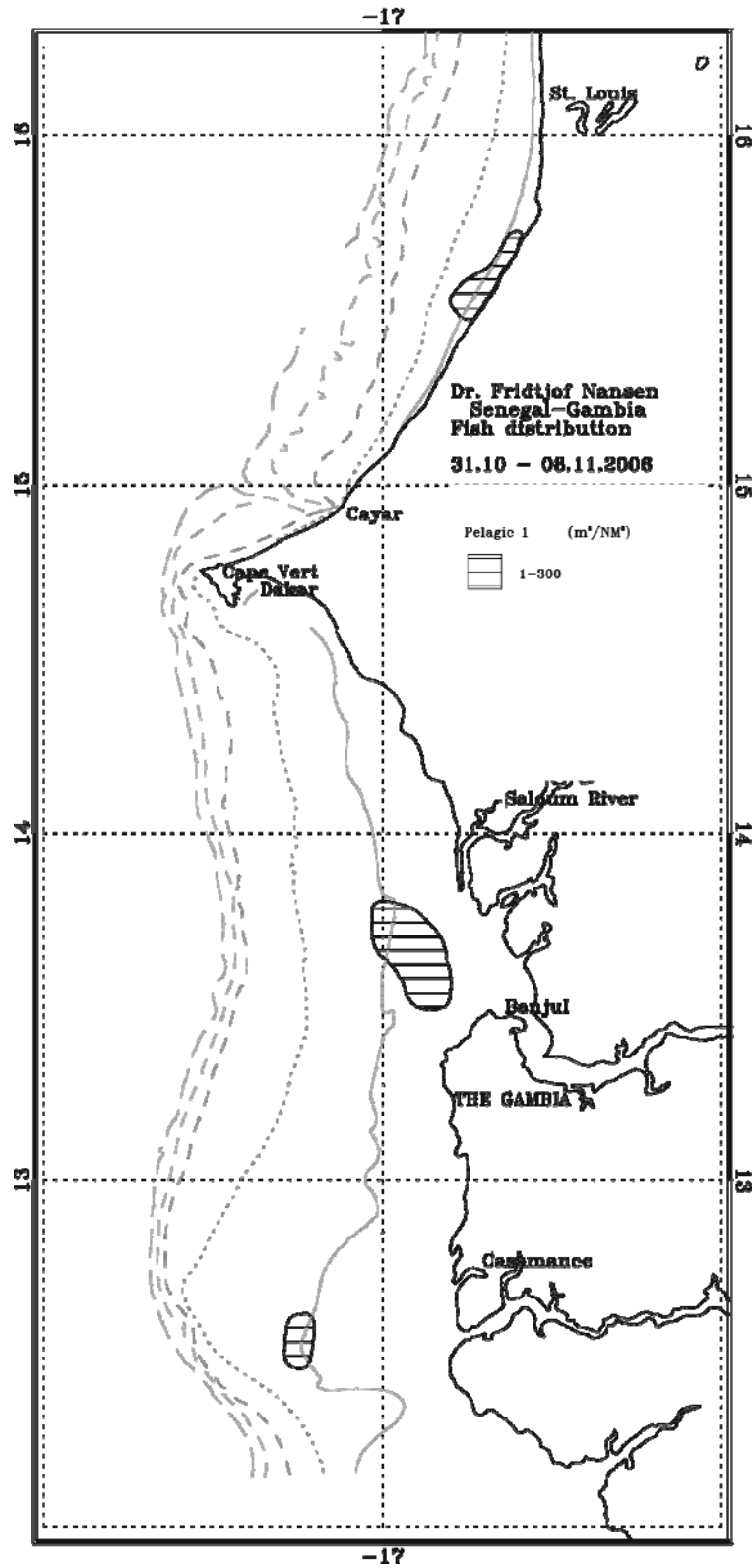


Figure 8. Distribution of clupeoid species other than sardinella; Casamance to St. Louis

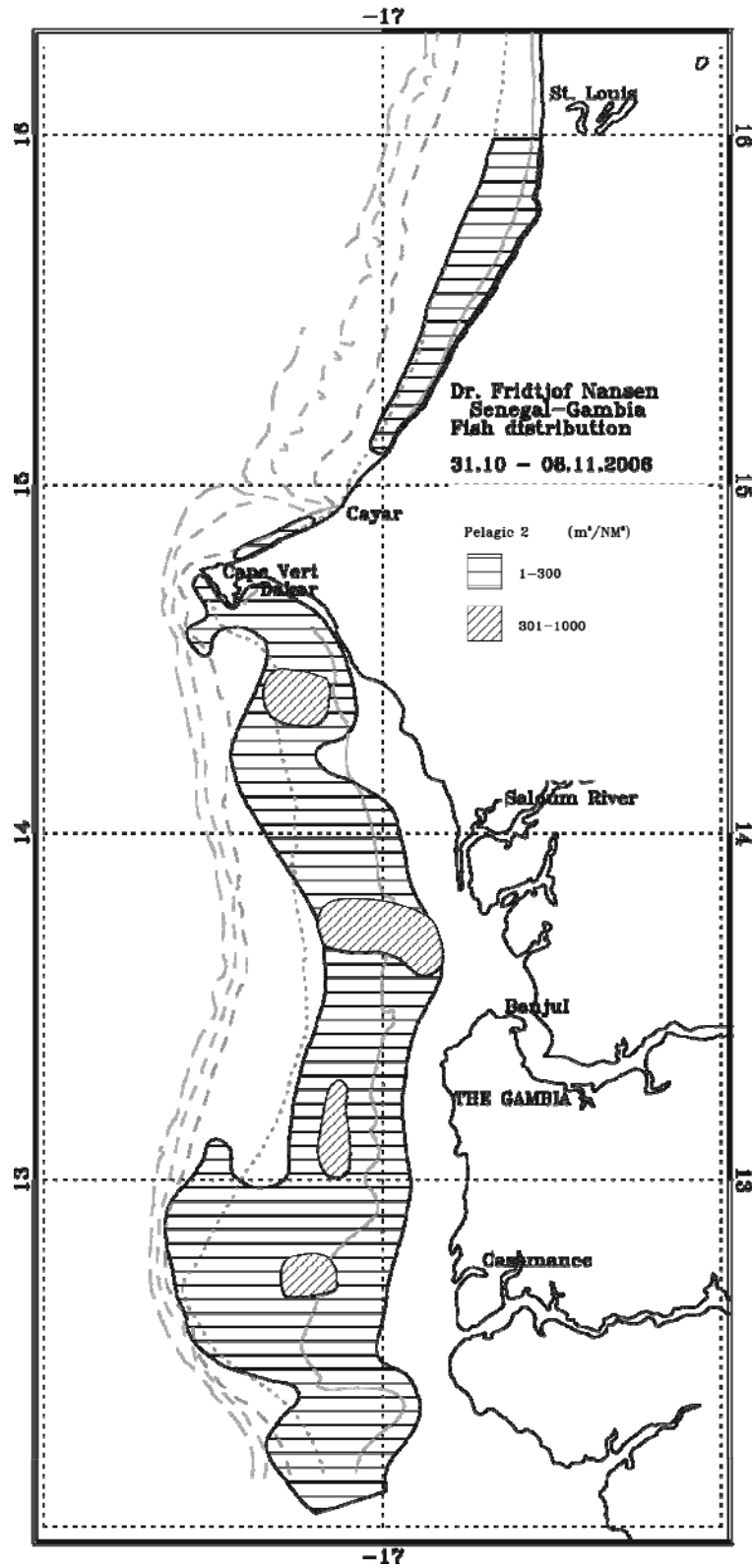


Figure 10. Distribution of carangids and associated species; Casamance to St. Louis

3.4 The Gambian border - Cape Vert

Sardinella was distributed in two almost continuous areas between The Gambian border and Cape Vert. The denser part of the concentrations was typically found between 20 – 50 m, extending further offshore close to Cape Vert depth. Lower fish concentrations were found on the edges of the distribution area at > 50 m depth and < 20 m depth, Figure 7. Table 7 shows the biomass estimates of the two sardinella species. *S. maderensis* was the most dominant of the two species contributing 67% of the total biomass of 343 thousand tons. Of this, the biomass of *S. maderensis* was estimated to be 230 thousand tons while 113 thousand tons of *S. aurita* was found. In 2005 *S. aurita* dominated in the region. An abundance of 191 thousand tons of *S. aurita* was estimated from the total biomass estimate of 339 thousand tons of Sardinellas.

Pooled length compositions of samples from *S. maderensis* showed modal peaks at 15 cm, 17 cm, 25 cm and 29 cm, while the *S. aurita* had modal peaks at 16 cm, 27 cm and 30 cm. Estimated number and biomass by length-groups are found in Annex IV.

A large distribution area with relatively high density of *Ethmalosa fimbriata* was found outside River Gambia, Figure 8. Smaller concentrations of *Ilisha africana* were found in the same area. The total estimate of P1 species between The Gambia and Cape Vert waters was estimated to 28 000 tons.

The combined distribution of *Trachurus trecae* and *Decapterus rhonchus* extended from The Gambia to Cape Vert, mainly between 50 and 100 m depth, but extending further inshore close to Gambia. *T. trecae* was as usual distributed mainly in the deeper parts of this area with main concentration on the outer shelf, with occasional denser concentrations. The species mixed with *D. rhonchus* before the latter became dominant in the inner part of the distribution area, Figure 9. The total biomass was estimated at 62 thousand tons, of this *T. trecae* contributed 12 thousand tonnes and *D. rhonchus* with 50 thousand tons. In 2005 12 thousand tonnes of horse mackerels was estimated in the area, of this *T. trecae* contributed with 7 thousand tonnes. The size distribution of *T. trecae* showed one modal peak at 20 cm, while the *D. rhonchus* showed two modal peaks, at 25 and 29 cm.

The mackerel, *Scomber japonicus* was found in two low density areas between 50 m and 100 m bottom depth within the region, Figure 11. The total biomass in the region was estimated to be 4.4 thousand tons. The size distribution of the *S. japonicus* was unimodal, with a modal peak at 25 cm.

As during previous years in the other regions south of Cape Vert, carangids and associated pelagic species were distributed over most of the shelf from less than 20 m depth and offshore to between 50 and 100 m depth. The dominating specie in this group was the same as in The Gambian waters, *Chloroscombrus chrysurus* while *Selene dorsalis* was frequently caught but far less abundant. Figure 6 and Table 8. The carangids and associated pelagic fish species were very scattered in the region, and the biomass was estimated at about 77 thousand tonnes, Table 7, compared to the 26 thousand and 79 thousand tons estimated in 2005 and 2004 respectively.

Table 7. The Gambia border to Cape Vert. Biomass estimates of pelagic fish, thousand tons.

<i>S. maderensis</i>	<i>S. aurita</i>	<i>Trachurus trecae</i>	Carangids etc.
230	113	62	77

Table 8. Catch by stations sorted by groups (in kg/hour)

Station	Gear depth	Clupeids	Carangids	Scombrids	Hairtails	Barracuda	Other	Total
20	5	2793.6	350.6	3.8	5.8	5.1	65.3	3224.2
21	10	209.7	2337.6	0	0	0	435.4	2982.7
22	51.5	5.1	1073.4	34.5	0	0	14.1	1127.1
23	22.5	50.5	62.7	8.4	0	0	12.8	134.3
24	29	3	1688.9	0	0	0	104.5	1796.4
25	5	934.6	1953.7	29.8	0	43.7	814.8	3776.6
26	31	182.8	23.5	28	0	1.5	4.5	240.4
27	31	2.4	5.3	0	0	0	495.5	503.2
28	112.5	0	0	0	0	0	1.1	1.1
29	35.5	0	178.1	3.1	0	0	331.1	512.3
Mean	33.3	418.2	767.4	10.8	0.6	5	33.3	1429.8

3.5 Cape Vert - St. Louis

Sardinellas were distributed in low concentrations along the inner shelf (<15 to ~30 m depth) in the region between Cape Vert and St. Louis. This area was dominated with *S. maderensis*. Another distribution area of *S. aurita* was found further offshore between 50 to 100 m depth in the northern part of the region. Figure 7. The biomass of sardinella was estimated to be 37 thousand tons, of this 65% was *S. aurita*, Table 9. The size distribution of *S. maderensis* was wide ranging from 6 to 29 cm, with modal peaks around 10 cm, 16 cm, 18 cm, 21 cm, 25 cm and 28 cm. The *S. aurita* showed a similar wide size distribution, with modal peaks at 9 cm,

15 cm, 18 cm, 24 and 27 cm. The 2005 estimate of sardinella in the region was 8 thousand tons, all of which was *S. maderensis*.

The distribution of other Clupeids in the region was scarce, but a small concentration of *Ilisha africana* was found close to the coast south of St. Levis, Figure 8. The biomass was estimated to be 3 hundred tons.

The *Trachurus trecae* and *Decapterus rhonchus* were found mixed in one continues region from south of the Cayar canyon to St. Louis. The distribution extended from approximately 100 m depth to between 50 and 20 m bottom depth, and typically *T. trecae* was distributed in the deeper parts of this area while *D. rhonchus* had a more inshore distribution. *T. trecae* in the region had four modal peaks, at 10 cm 13 cm, 22 cm and 27 cm respectively while *D. rhonchus* showed one modal peaks at 30 cm. The total abundance of the two species in the region this year was estimated to be 40 thousand tons. Of this *T. trecae* represented 75% with an estimated biomass of 30 thousand tonnes, while *D. rhonchus* was found to be 10 thousand tons. In 2005 the biomass of *T. trecae* and *D. rhonchus* was estimated to be 73 thousand and 24 thousand tons respectively.

A small distribution area of *Scomber japonicus* was found in the northern part of the survey area around 50 m depth. The distribution continued into Mauritania, Figure 11. *S. japonicus* in the area had a narrow size distribution, with a modal peak at 28 cm An estimated biomass of 6 hundred tons was found in the region.

Carangids other than horse mackerels and associated pelagic fish species (P2) were found along most of the northern coast between 50 m depth and inshore. A small gap in the distribution area was experienced around Cayar. The dominant species in the catches were *Chloroscombrus chrysurus*, *Selene dorsalis* and *Trichiurus lepturus* and the biomass was estimated to be 11 thousand tons, the same as in 2005.

Table 9. Cape Vert to St. Louis. Biomass estimates of pelagic fish, thousand tons.

<i>S. maderensis</i>	<i>S. aurita</i>	Horse mackerels	Carangids etc.
13	24	40	11

Table 10. Catch by stations sorted by groups (in kg/hour)

Station	Gear depth	Clupeids	Carangids	Scombrids	Hairtails	Barracuda	Other	Total
30	30	44.8	456.1	11	0	0.8	5.3	517.9
31	22	118.7	708.7	0	184.1	2.5	1501.8	2515.8
32	10	3	33.4	0	19.7	5.1	72.6	133.8
33	61.5	0	367.4	0	0	5.8	7252.7	7626
34	5	137.9	287.8	0	33.8	0	128.8	588.3
35	41	5.1	121	1.7	6	0	597.9	731.6
36	31.5	34.1	1537.4	49.4	0	0	5.2	1626.1
37	38	33.2	108.6	102.4	31	3.9	28.7	307.8
Mean	29.9	47	452.5	20.6	34.3	2.3	29.9	1755.8

CHAPTER 4 OVERVIEW AND SUMMARY OF RESULTS

The survey was conducted successfully from 31st October to 9th November, covering a course track of approximately 1288 NM, excluding the steaming to, and from the survey area and the port of Dakar. A total of 38 fishing stations and 54 CTD casts were established together with 2 plankton stations.

Like in 2005, relatively stable hydrographical conditions were seen over most of the survey area. A surface layer with SST around 29°C and a thermocline at approximately 50 m depth was observed for the whole shelf south of Cape Vert, with a slight decrease of surface temperature further north. SST was cooler than last year in the whole area. The surface waters were influenced by freshwater discharge from the nearby rivers on the Casamance shelf, and south of St. Louis, but surface salinity was otherwise around 35 PSU and higher than last year when heavy rain and increased river discharge before the survey reduced the surface salinity considerably. The shelf was well oxygenated in the whole survey area.

The main concentration area for sardinella was the shelf south of Dakar to Casamance including The Gambia where 95% of the biomass was found. The sardinella was relatively evenly distributed in the region with main concentrations around the 20 m isobath. The rest of the biomass, 5 %, was found in a narrow band along the coast around the 20 m isobath between Cayar and St. Louis, and in a small concentration offshore at St. Louis, Figure 7. As usual *S. aurita* was more predominant in deeper and more saline waters than *S. maderensis*. The total biomass of sardinella was estimated to be 713 thousand tons, of these 504 thousand tons, 71%, represents *S. maderensis*. In 2004 and 2005 the total biomass in Senegal and The Gambia combined was estimated to be 819 and 828 thousand tons respectively. The biomass has declined slightly in the area since last year but still seems to stay at a relatively high level.

Horse mackerels including the false scad *Decapterus rhonchus* were found in a more or less continuous low density area between the border between Senegal and Gambia at Casamance and past Cape Vert up to St. Louis. The main concentrations of *Trachurus trecae* in the survey area was typically along the shelf break, while *D. rhonchus* became more dominant further inshore. The distribution extended inshore to the 20 m isobath outside The Gambia, and in the region north of Dakar, Figure 9. The total estimate of *T. trecae* was 45.7 thousand tonnes, or 39% of the total, while the biomass of the *D. rhonchus* was estimated to be 70.8 thousand tons (61%). In 2005 the total estimate of *T. trecae* was 81 thousand tonnes, or 69% of the total, while the biomass of the *D. rhonchus* was estimated to be 36 thousand

tons. The distribution of *T. trecae* this year was wider and further south compared with last year. The main concentration area was north of Cape Vert where 65% of the biomass was found, however, in 2005 90% of the *T. trecae* was found in this area. The main distribution of *D. rhonchus* this year was between Cape Vert and The Gambia, with 71% of the total. In 2005 the main distribution area was further north. The variability in distribution observed for both species may be due to changes in temperatures as the temperature on the shelf this year was cooler than in 2005.

The ‘P2’s’, were distributed over most of the shelf in low densities, Figure 10. By far the most important species in this group was *Chloroscombrus chrysurus*, while *Selene dorsalis*, *Trichiurus lepturus* and *Sphyræna guachancho* were common but generally showed lower catch rates. The total biomass of this group was estimated at approximately 169 thousand tons, compared with 115 thousand tons in 2005. The species in this group was mixed with dense concentrations of plankton, other pelagic fish species and in particular the *Brachydeuterus auritus*.

An overview of the acoustic biomass estimates of the main groups of pelagic fish is shown in Table 11, and the geographical distribution and abundance of main species can be found in Figure 12. The total biomass of sardinellas was thus 712 thousand tonnes, horse mackerels 117 thousand tons and carangids and associated species 169 thousand tons, in addition to this 5 thousand tons of *Scomber japonicus* and 30 thousand tons of clupeid fish other than sardinella was estimated.

Table 11. Summary of biomass estimates of pelagic fish, Senegal and The Gambia. Values in tonnes.

	<i>S. maderensis</i>	<i>S. aurita</i>	Horse mackerel	Carangids etc.
St. Louis-Cape Vert	13	24	40	11
Cape Vert - The Gambia	230	113	62	77
The Gambia	100	19	14	20
Casamance	160	53	1	61
Total	504	209	117	169

Table 12 lists biomass estimates of sardinellas and carangids (including *Trachurus trecae* and *Decapterus rhonchus*) and associated species from the “Dr. Fridtjof Nansen” surveys of the shelf region.

Large-scale latitudinal movements of pelagic fish between West Sahara and Guinea Bissau are well known, and in the summer the sardinellas should be concentrated in Senegal and The Gambia for spawning. The biomass estimate of sardinella decreased with 14% this year.

However the biomass fits well within the time series of sardinella abundance since 1996. The stock seems to be relatively stable. The species composition of the two species was also similar to last year.

The estimate of *Trachurus trecae* from this year was 46 thousand tons. This estimate was almost half of what was found in 2005, 81 thousand tons, and also lower than the 76 thousand tons estimated in 2004. The proportion of *T. trecae* in Senegalese and Gambian waters seems to be variable and seasonal, and an overview of the stock seems only possible when you look at the biomass estimates for the whole region together. The biomass of *Decapterus rhonchus* was 71 thousand tons this year while in 2005 the biomass was estimated to be 36 thousand tons. However when looking at the total estimate of all carangids and associated species within the surveyed region, Table 19, a more stable picture emerges. During the October-November surveys this combined estimate has showed a consistent development from year to year. It is currently showing a small increase from the estimated 231 thousand tons last year, which was the lowest estimate during the last 10 years.

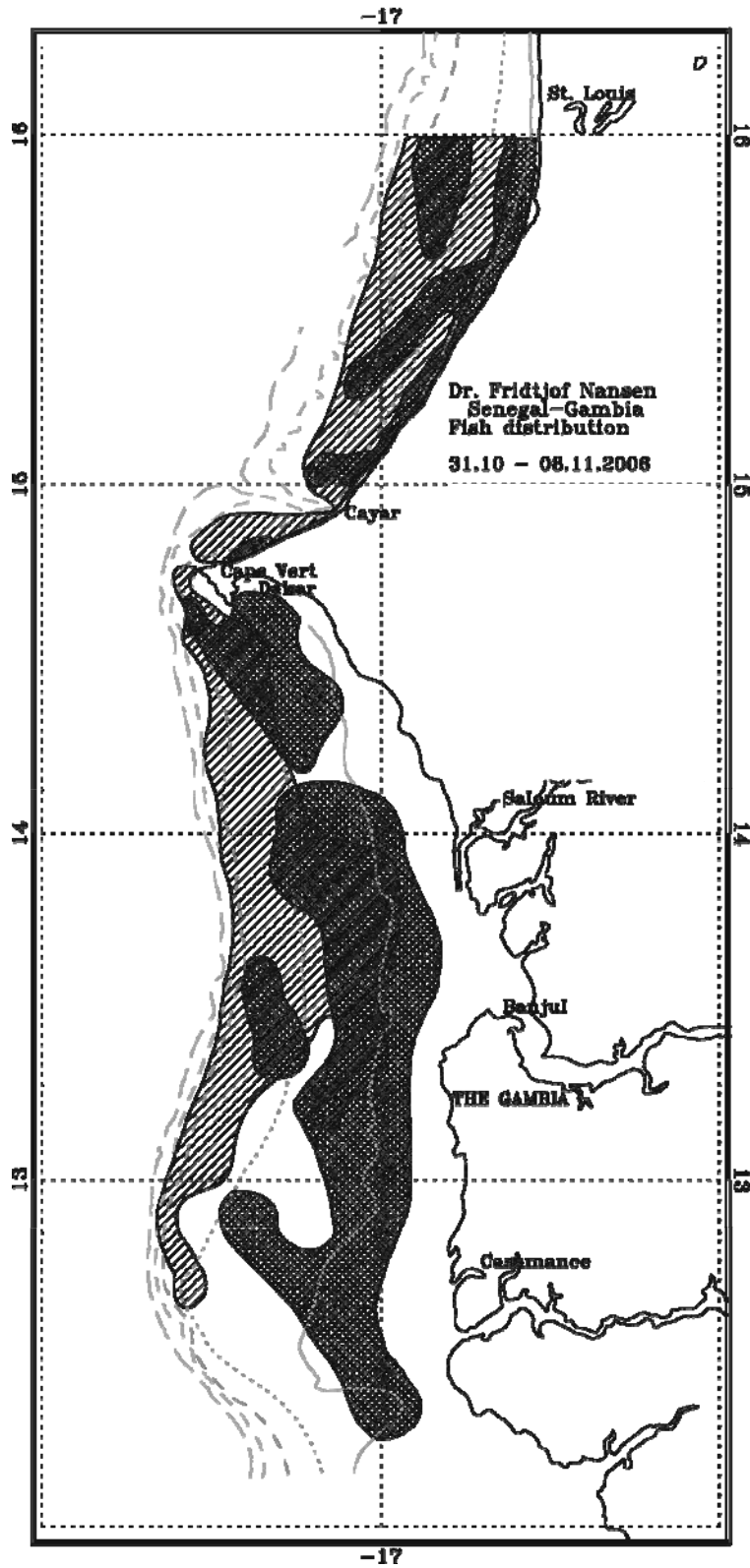


Figure 12. Major pelagic fish concentrations with estimated biomass (tonnes), Senegal and The Gambia.

Table 12. Biomass estimates from previous 'Dr Fridtjof Nansen' surveys of Senegal - The Gambia shelf in thousand tons.

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	230	530
NovDec-97	300	250
NovDec-98	390	340
NovDec-99	1 390	470
NovDec-00	300	540
JunJul-01	410	230
NovDec-01	430	480
JunJul-02	600	430
NovDec-02	910	260
JunJul-03	670	610
NovDec-03	597	319
NovDec-04	819	289
NovDec-05	828	231
NovDec-06	712	291

* *Trachurus trecae*, other carangids and associated species (P2)

** Not available

References

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

MacLennan, D. N. and Simmons E. J. (1992). Fisheries Acoustics. Chapman and Hall.325p.

Annex I Records of fishing stations

<p>R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 1 DATE : 01.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 12°5.40 Lon W 17°8.59 start stop duration Purpose : 1 TIME : 14:29:24 14:47:45 18.4 (min) Region : 1330 LOG : 9906.13 9907.15 1.0 Gear cond.: 0 FDEPTH: 38 38 Validity: 0 BDEPTH: 38 38 Towing dir.: 4° Wire out : 120 m Speed : 3.3 kn Sorted : 0 Total catch: 119.47 Catch/hour: 390.64</p>									
<p>SPECIES CATCH/HOUR % OF TOT. C SAMP weight numbers Trichurus lepturus 91.23 402 23.35 1 Selene dorsalis 80.93 454 20.72 Galeoides decadactylus 61.80 245 15.82 Arius heudeloti 55.59 118 14.23 Brachydeuterus auritus 36.29 461 9.29 Pteroscion peli 18.47 209 4.73 Stromateus fiatola 17.99 43 4.58 Pseudotolithus typus 12.26 3 3.14 Caranx senegalus 5.62 7 1.44 Ellops lacerta 4.58 10 1.17 Scomberomorus tripor 2.45 3 0.63 Sphyræna guachancho 1.36 7 0.48 Pseudonophis semicinctus 0.65 3 0.17 Cynoponticus ferox 0.65 3 0.17 Penaeus notialis 0.36 29 0.09 Total 390.64 100.00</p>									
<p>R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 5 DATE : 02.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 12°31.51 Lon W 17°16.13 start stop duration Purpose : 1 TIME : 13:02:07 13:31:34 29.5 (min) Region : 1330 LOG : 75.73 77.31 1.6 Gear cond.: 0 FDEPTH: 21 21 Validity: 0 BDEPTH: 21 21 Towing dir.: 4° Wire out : 100 m Speed : 3.2 kn Sorted : 0 Total catch: 78.11 Catch/hour: 159.14</p>									
<p>SPECIES CATCH/HOUR % OF TOT. C SAMP weight numbers Pomadasys incisus 82.82 625 52.04 Rachycentron canadum 36.06 4 22.66 Alectis alexandrinus 11.92 33 7.49 Epi n ephelus aeneus 7.40 6 4.65 Pagrus caeruleostictus 5.56 16 3.50 Balistes punctatus 3.02 2 1.89 Drepane africana 2.57 2 1.61 Pseudupeneus prayensis 2.30 14 1.45 Sardinella maderensis 1.96 12 1.23 ACANTHURI DAE 1.81 4 1.14 Epi n ephelus alexandrinus * 1.49 2 0.93 Zonobatus shoemii 1.12 2 0.70 Parapristipoma octolineatum 0.61 2 0.38 Brachydeuterus auritus 0.51 249 0.32 Total 159.14 100.00</p>									
<p>R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 2 DATE : 01.11.2006 GEAR TYPE: PT NO: 5 POSITION: Lat N 12°12.86 Lon W 17°9.50 start stop duration Purpose : 1 TIME : 19:59:30 20:30:57 31.5 (min) Region : 1330 LOG : 9949.75 9951.32 1.6 Gear cond.: 0 FDEPTH: 0 0 Validity: 0 BDEPTH: 38 32 Towing dir.: 90° Wire out : 120 m Speed : 3.0 kn Sorted : 0 Total catch: 60.71 Catch/hour: 115.82</p>									
<p>SPECIES CATCH/HOUR % OF TOT. C SAMP weight numbers Scomberomorus tripor 25.66 29 22.15 Galeoides decadactylus 12.46 27 10.76 Sphyræna guachancho 11.73 25 10.13 Selene dorsalis 11.47 88 9.90 Stromateus fiatola 11.39 25 9.83 Illisha africana 11.16 191 9.64 Alectis alexandrinus 7.80 17 6.74 Brachydeuterus auritus 5.99 78 5.17 Ellops lacerta 5.32 11 4.60 Sphyrna lewini 5.15 2 4.45 Trachinotus ovatus 2.98 10 2.57 Trichurus lepturus 2.31 143 1.99 Arius heudeloti 1.22 2 1.05 Bregmaceros sp. 0.57 7555 0.49 Selar crumenophthalmus 0.57 2 0.49 Sepiella ornata 0.02 34 0.02 Sardinella maderensis 0.02 2 0.02 Total 115.82 100.00</p>									
<p>R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 7 DATE : 02.11.2006 GEAR TYPE: PT NO: 7 POSITION: Lat N 12°42.91 Lon W 17°7.21 start stop duration Purpose : 1 TIME : 17:22:12 17:42:02 19.8 (min) Region : 1330 LOG : 108.09 109.37 1.3 Gear cond.: 0 FDEPTH: 15 15 Validity: 0 BDEPTH: 19 18 Towing dir.: 90° Wire out : 0 m Speed : 3.9 kn Sorted : 32 Total catch: 358.50 Catch/hour: 1084.17</p>									
<p>SPECIES CATCH/HOUR % OF TOT. C SAMP weight numbers Brachydeuterus auritus 872.48 10222 80.47 10 Chiroscobrus chrysurus 99.80 1270 9.21 Sardinella maderensis 34.32 79 3.17 Sphyræna guachancho 33.72 73 3.11 Pomadasys peroteti 23.14 48 2.13 Trichurus lepturus 14.06 36 1.30 Pomadasys jubelini 2.24 9 0.21 Scomberomorus tripor 1.48 3 0.14 Arius parkii 1.06 3 0.10 Trachinotus ovatus 0.79 6 0.07 Decapterus rhonchus 0.60 3 0.06 Sardinella maderensis 0.48 3 0.04 Total 1084.17 100.00</p>									
<p>R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 3 DATE : 01.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 12°17.02 Lon W 17°0.14 start stop duration Purpose : 1 TIME : 21:56:49 22:32:57 36.1 (min) Region : 1330 LOG : 9961.05 9962.98 1.9 Gear cond.: 0 FDEPTH: 20 21 Validity: 0 BDEPTH: 20 21 Towing dir.: 42° Wire out : 150 m Speed : 3.2 kn Sorted : 57 Total catch: 434.96 Catch/hour: 722.32</p>									
<p>SPECIES CATCH/HOUR % OF TOT. C SAMP weight numbers Arius heudeloti 306.39 1807 42.42 Brachydeuterus auritus 218.58 3301 30.26 JELLYFISH 122.44 711 16.95 Galeoides decadactylus 27.90 100 3.86 Illisha africana 19.81 2068 2.74 Trichurus lepturus 8.60 623 1.19 Parapneustes atlantica 4.12 2579 0.57 Pseudotolithus typus 2.51 40 0.35 Portunus validus 2.24 10 0.31 Sardinella maderensis 2.14 18 0.30 Conger conger 2.13 3 0.29 Torpedo marmorata 1.30 2 0.18 Penaeus notialis 1.00 50 0.14 Pseudonophis semicinctus 1.00 2 0.14 Cynoglossus senegalensis 0.65 5 0.09 Pteroscion peli 0.50 63 0.07 Sepiella ornata 0.38 63 0.05 Argyrosomus regius 0.33 2 0.05 Callinectes marginatus 0.30 2 0.04 NOMEIAE 0.02 2 0.00 Total 722.32 100.00</p>									
<p>R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 4 DATE : 02.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 12°22.76 Lon W 17°0.02 start stop duration Purpose : 1 TIME : 00:26:02 00:45:25 19.4 (min) Region : 1330 LOG : 9979.24 9980.33 1.1 Gear cond.: 0 FDEPTH: 10 10 Validity: 0 BDEPTH: 22 22 Towing dir.: 90° Wire out : 100 m Speed : 3.4 kn Sorted : 49 Total catch: 98.90 Catch/hour: 306.19</p>									
<p>SPECIES CATCH/HOUR % OF TOT. C SAMP weight numbers Sardinella maderensis 204.33 1746 66.73 6 Brachydeuterus auritus 63.22 879 20.65 Sphyræna guachancho 10.96 25 3.58 Selene dorsalis 7.99 241 2.61 Arius heudeloti 6.32 31 2.06 Illisha africana 5.63 334 1.84 Trichurus lepturus 5.08 433 1.66 Galeoides decadactylus 1.30 6 0.42 Penaeus notialis 0.87 68 0.28 Chiroscobrus chrysurus 0.50 6 0.16 Total 472.41 100.00</p>									
<p>R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 8 DATE : 02.11.2006 GEAR TYPE: PT NO: 4 POSITION: Lat N 12°44.61 Lon W 17°19.58 start stop duration Purpose : 1 TIME : 19:37:24 20:08:43 31.3 (min) Region : 1330 LOG : 125.73 127.33 1.6 Gear cond.: 0 FDEPTH: 10 10 Validity: 0 BDEPTH: 32 34 Towing dir.: 360° Wire out : 100 m Speed : 3.1 kn Sorted : 62 Total catch: 246.52 Catch/hour: 472.41</p>									
<p>SPECIES CATCH/HOUR % OF TOT. C SAMP weight numbers Sardinella maderensis 113.45 950 24.01 11 Selene dorsalis 101.56 782 21.50 Alectis alexandrinus 52.51 46 11.11 Brachydeuterus auritus 49.44 452 10.47 Scomberomorus tripor 43.39 61 9.18 Sphyræna guachancho 33.34 77 7.06 Selar crumenophthalmus 22.84 84 4.84 Caranx senegalus 11.11 15 2.35 Plectorhynchus mediterraneus 8.36 15 1.77 Pagrus caeruleostictus 6.52 15 1.38 Galeoides decadactylus 4.37 8 0.92 Trachinotus ovatus 4.29 15 0.91 Ellops lacerta 4.22 8 0.89 Engraulis encrasicolus 4.14 1916 0.88 Decapterus punctatus 2.76 291 0.58 13 Decapterus rhonchus 2.61 8 0.55 Sardinella maderensis, juvenile 2.22 1165 0.47 12 Pomadasys incisus 1.76 8 0.37 Pagelius bellottii 1.61 8 0.34 Chiroscobrus chrysurus 1.07 8 0.23 Alectis africana 0.54 192 0.11 Penaeus notialis 0.31 15 0.06 Total 472.41 100.00</p>									

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 9
 DATE : 02.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 12°43.02
 start stop duration Purpose : 1
 TIME : 23:05:19 23:35:25 30.1 (min) Region : 1330
 LOG : 153.68 155.80 2.1 Gear cond.: 0
 FDEPTH: 25 30 Validity : 0
 BDEPTH: 62 74 Speed : 4.2 kn
 Towing dir.: 320° Wire out : 100 m Catch/hour: 833.15
 Sorted : 68 Total catch: 418.10

SPECIES	weight	numbers	% OF TOT. C	SAMP
Scomber japonicus	662.37	6026	79.50	15
Trachurus trecae	63.85	897	7.66	14
Ariomma bondi	59.78	1136	7.18	
Selene dorsalis	27.86	24	3.34	
Caranx carangus	15.74	12	1.89	
Sarda sarda	1.65	2	0.20	
Trichiurus lepturus	0.94	2	0.11	
Euthynnus alletteratus	0.54	2	0.06	
Todarodes sagittatus	0.42	2	0.05	
Total	833.15		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 10
 DATE : 03.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 12°52.97
 start stop duration Purpose : 1
 TIME : 02:12:49 02:42:40 29.9 (min) Region : 1330
 LOG : 177.76 179.62 1.9 Gear cond.: 0
 FDEPTH: 91 148 Validity : 0
 BDEPTH: 91 148 Speed : 3.7 kn
 Towing dir.: 270° Wire out : 150 m Catch/hour: 50.03
 Sorted : 0 Total catch: 24.89

SPECIES	weight	numbers	% OF TOT. C	SAMP
APOGONI DAE	43.42	25741	86.78	
Selene dorsalis	2.91	24	5.83	
Caranx carangus	2.59	2	5.18	
Trachurus trecae	0.62	32	1.25	
Ariomma bondi	0.42	28	0.84	
Illex coindetii	0.04	14	0.08	
Lestidium sp.	0.02	16	0.04	
Total	50.03		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 11
 DATE : 03.11.2006 GEAR TYPE: PT NO: 7 POSITION: Lat N 12°52.50
 start stop duration Purpose : 1
 TIME : 07:05:45 07:36:52 31.1 (min) Region : 1330
 LOG : 219.78 221.42 1.6 Gear cond.: 0
 FDEPTH: 10 10 Validity : 0
 BDEPTH: 21 21 Speed : 3.2 kn
 Towing dir.: 270° Wire out : 150 m Catch/hour: 605.73
 Sorted : 66 Total catch: 314.17

SPECIES	weight	numbers	% OF TOT. C	SAMP
Sardinella auriata	348.01	2024	57.45	16
Sardinella maderensis	157.52	1475	26.01	17
Chloroscombrus chrysurus	83.35	1126	13.76	
Brachydeuterus auriatus	6.69	73	1.10	
Decapterus rhonchus	3.93	17	0.65	
Selene dorsalis	2.47	37	0.41	
Sphyraena guanchancho	2.31	8	0.38	
Scomberomorus tripor	1.45	2	0.24	
Total	605.73		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 12
 DATE : 03.11.2006 GEAR TYPE: PT NO: 7 POSITION: Lat N 13°0.36
 start stop duration Purpose : 1
 TIME : 09:21:41 09:52:36 30.9 (min) Region : 1400
 LOG : 235.59 237.19 1.6 Gear cond.: 0
 FDEPTH: 10 10 Validity : 0
 BDEPTH: 18 17 Speed : 3.1 kn
 Towing dir.: 9° Wire out : 150 m Catch/hour: 834.47
 Sorted : 61 Total catch: 429.89

SPECIES	weight	numbers	% OF TOT. C	SAMP
Chloroscombrus chrysurus	611.45	9702	73.27	
Sardinella maderensis	122.97	1073	14.74	18
Brachydeuterus auriatus	70.66	870	8.47	
Sardinella auriata	14.54	82	1.74	
Trichiurus lepturus	7.18	19	0.86	
Elops lacerta	5.03	14	0.60	
Galeoides decadactylus	1.36	14	0.16	
Rhizoprionodon acutus	1.28	2	0.15	
Total	834.47		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 13
 DATE : 03.11.2006 GEAR TYPE: PT NO: 4 POSITION: Lat N 13°3.79
 start stop duration Purpose : 1
 TIME : 11:22:27 11:51:44 29.3 (min) Region : 1400
 LOG : 249.08 250.77 1.7 Gear cond.: 0
 FDEPTH: 5 5 Validity : 0
 BDEPTH: 29 30 Speed : 3.5 kn
 Towing dir.: 18° Wire out : 150 m Catch/hour: 4996.31
 Sorted : 122 Total catch: 2438.20

SPECIES	weight	numbers	% OF TOT. C	SAMP
Chloroscombrus chrysurus	3756.15	40744	75.18	
Brachydeuterus auriatus	700.41	8295	14.02	
Sardinella maderensis	279.51	2746	5.59	19
Selene dorsalis	65.98	697	1.32	
Pomadasys incisus	52.46	287	1.05	
Trachinotus ovatus	46.72	246	0.94	
Decapterus rhonchus	38.52	205	0.77	
Sphyraena guanchancho	14.34	41	0.29	
Pagrus caeruleostictus	11.48	41	0.23	
Selene dorsalis	10.25	41	0.21	
Pagrus crumenophthalmus	7.79	41	0.16	
Sardinella auriata	6.56	82	0.13	
Priacanthus arenatus	6.15	41	0.12	
Total	4996.31		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 14
 DATE : 03.11.2006 GEAR TYPE: BT NO: 14 POSITION: Lat N 13°11.85
 start stop duration Purpose : 1
 TIME : 18:39:20 19:02:02 22.3 (min) Region : 1400
 LOG : 310.86 312.00 1.1 Gear cond.: 0
 FDEPTH: 70 72 Validity : 0
 BDEPTH: 70 72 Speed : 3.0 kn
 Towing dir.: 180° Wire out : 210 m Catch/hour: 637.24
 Sorted : 55 Total catch: 236.63

SPECIES	weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	245.06	2047	38.46	20
Pomadasys incisus	217.59	1443	34.15	
Boops boops	42.66	431	6.69	
Pagrus caeruleostictus	31.02	259	4.87	
Fistularia petimba	22.89	100	3.59	
Scomber japonicus	18.85	132	2.96	21
Scorpaena scrofa	11.42	151	1.79	
Priacanthus arenatus	11.42	75	1.79	
Umbri na canariensis	11.42	22	1.79	
Decapterus rhonchus	9.91	32	1.56	
Pseudupeneus prayensis	7.43	43	1.17	
Scyliarides herklotsii	2.69	3	0.42	
Chelidoniichthys capensis	2.69	43	0.42	
Penaeus notialis	1.62	32	0.35	
Parapristigaster octolineatus	0.35	3	0.05	
Saurida brasiliensis	0.22	32	0.03	
Total	637.24		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 15
 DATE : 03.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 13°11.81
 start stop duration Purpose : 1
 TIME : 20:59:20 21:31:45 32.4 (min) Region : 1400
 LOG : 327.12 328.74 1.6 Gear cond.: 0
 FDEPTH: 40 38 Validity : 0
 BDEPTH: 40 38 Speed : 3.0 kn
 Towing dir.: 160° Wire out : 150 m Catch/hour: 154.55
 Sorted : 0 Total catch: 83.51

SPECIES	weight	numbers	% OF TOT. C	SAMP
Pomadasys incisus	44.88	285	29.04	
Pseudupeneus prayensis	22.02	268	14.25	
Decapterus rhonchus	19.25	716	12.45	22
Pagrus caeruleostictus	17.05	65	11.03	
Pagrus caeruleostictus	9.33	46	6.04	
Decapterus volitans	6.16	26	3.92	
Fistularia petimba	6.11	56	3.95	
Plectorhynchus mediterraneus	5.87	30	3.80	
Epinepheles aeneus	4.65	2	3.01	
Alectis alexandrinus	3.48	2	2.25	
Conger conger	2.50	19	1.62	
Arius heudeloti	1.78	4	1.15	
Sardinella maderensis	1.18	7	0.77	
Citharus linguatula	1.17	13	0.75	
Brutula barbata	1.11	2	0.72	
Trachinus draco	1.07	24	0.69	
Dicologlossa hexophthalma	0.91	11	0.59	
Nicholsina usta	0.89	4	0.57	
Epinopion guttifer	0.87	2	0.56	
Penaeus kerathurus	0.87	22	0.56	
Epinepheles gorensis	0.61	2	0.40	
Chelidoniichthys gabonensis	0.54	4	0.35	
Chaetodon hoefleri	0.43	2	0.28	
Parapristigaster octolineatus	0.39	2	0.25	
Penaeus notialis	0.26	13	0.17	
Spherooides spengleri	0.24	6	0.16	
Serranus scriba	0.24	2	0.16	
Bothus podas africanus	0.22	6	0.14	
Decapterus punctatus	0.19	12	0.14	
Dicologlossa cuneata	0.15	4	0.10	
Boops boops	0.13	6	0.08	
Serranus cabrilla	0.04	2	0.02	
Total	154.55		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 16
 DATE : 04.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 13°20.18
 start stop duration Purpose : 1
 TIME : 00:53:50 01:13:20 19.5 (min) Region : 1400
 LOG : 360.15 361.12 1.0 Gear cond.: 0
 FDEPTH: 18 18 Validity : 0
 BDEPTH: 18 18 Speed : 3.0 kn
 Towing dir.: 20° Wire out : 100 m Catch/hour: 1528.49
 Sorted : 58 Total catch: 496.76

SPECIES	weight	numbers	% OF TOT. C	SAMP
Chloroscombrus chrysurus	399.23	95	26.12	
Brachydeuterus auriatus	283.85	3046	18.57	
Sardinella maderensis	242.31	2283	15.85	23
Galeoides decadactylus	194.98	1591	12.76	
Pomadasys jubelini	172.46	520	11.28	
Sardinella auriata	69.69	415	4.56	
Ilisa africana	36.00	1292	2.36	
Eucinostomus melanopterus	26.52	31	1.74	
Decapterus rhonchus	24.71	92	1.62	
Alectis alexandrinus	20.77	138	1.36	
Sphyraena guanchancho	17.75	46	1.16	
Echeneis naucrates	10.15	22	0.66	
Albula vulpes	8.25	15	0.54	
Arius heudeloti	6.46	22	0.42	
Chaetodontes gorensis	4.83	22	0.32	
Pomadasys incisus	4.37	22	0.29	
Caranx senegalensis	2.98	22	0.20	
Selene dorsalis	2.06	22	0.13	
Arnoglossus imperialis	0.46	22	0.03	
Engraulis encrasicolus	0.22	46	0.01	
Trachinocephalus myops	0.22	22	0.01	
Penaeus kerathurus	0.22	22	0.01	
Total	1528.49		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 17
 DATE : 04.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 13°22.83
 start stop duration Purpose : 1
 TIME : 04:33:31 04:52:52 19.3 (min) Region : 1400
 LOG : 390.68 392.04 1.4 Gear cond.: 0
 FDEPTH: 58 40 Validity : 0
 BDEPTH: 78 72 Speed : 4.2 kn
 Towing dir.: 80° Wire out : 120 m Catch/hour: 1253.55
 Sorted : 34 Total catch: 404.06

SPECIES	weight	numbers	% OF TOT. C	SAMP
Sardinella auriata	961.74	18651	76.72	24
Trachurus trecae	236.71	4989	18.88	25
Caranx crysos	29.04	37	2.32	
Scomber japonicus	24.94	261	1.99	
Saurida brasiliensis	1.12	112	0.09	
Total	1253.55		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 18
 DATE : 04.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 13°32.34
 start stop duration Lon W 17°16.67
 TIME : 13:51:29 14:21:16 Purpose : 1
 LOG : 452.06 453.56 1.5 Region : 1400
 FDEPTH: 63 61 Gear cond.: 0
 BDEPTH: 63 61 Validity : 0
 Towing dir.: 10° Wire out : 190 m Speed : 3.0 kn
 Sorted : 61 Total catch: 244.20 Catch/hour: 492.01

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	403.76	3071	82.06	26
Decapterus rhonchus	32.72	129	6.65	
Pomadasys incisus	17.49	137	3.55	
Brachydeuterus aurius	14.26	161	2.90	
Boops boops	10.88	81	2.21	
Trachurus trecae	4.27	24	0.87	
Selene dorsalis	3.38	24	0.69	
Priacanthus arenatus	2.34	24	0.48	
Fistularia petimba	1.93	16	0.39	
Pseudupeneus prayensis	0.97	8	0.20	
Total	492.01		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 19
 DATE : 04.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 13°32.69
 start stop duration Lon W 17°4.09
 TIME : 17:09:56 17:15:38 Purpose : 1
 LOG : 472.81 473.16 0.4 Region : 1400
 FDEPTH: 15 15 Gear cond.: 0
 BDEPTH: 30 31 Validity : 0
 Towing dir.: 270° Wire out : 77 m Speed : 3.7 kn
 Sorted : 29 Total catch: 145.50 Catch/hour: 1534.27

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	1344.46	16714	87.63	27
Brachydeuterus aurius	168.72	1898	11.00	
Decapterus rhonchus	11.07	53	0.72	
Selene dorsalis	10.02	105	0.65	
Total	1534.27		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 20
 DATE : 04.11.2006 GEAR TYPE: PT NO: 7 POSITION: Lat N 13°37.59
 start stop duration Lon W 16°53.36
 TIME : 19:24:30 19:45:20 Purpose : 1
 LOG : 490.34 491.36 1.0 Region : 1320
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 18 16 Validity : 0
 Towing dir.: 360° Wire out : 150 m Speed : 2.9 kn
 Sorted : 61 Total catch: 1119.00 Catch/hour: 3223.24

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Ethmalosa fibriata	2006.24	16574	62.24	28
Sardinella maderensis	714.35	15295	22.16	29
Chloroscombrus chrysurus	346.38	7302	10.75	
Sardinella auriata	65.01	639	2.02	
Brachydeuterus aurius	22.90	374	0.71	
Rhizophronon acutus	19.99	23	0.62	
Pomadasys jubelini	11.72	55	0.36	
Penaus notialis	9.59	320	0.30	
Illisa africana	7.98	1599	0.25	
Trichiurus lepturus	5.76	17	0.18	
Sphyræna guanchancho	5.07	6	0.16	
Selene dorsalis	4.26	55	0.13	
Scomberomorus tripor	3.80	6	0.12	
Stromateus fiatola	1.12	6	0.03	
Total	3224.19		100.03	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 21
 DATE : 04.11.2006 GEAR TYPE: PT NO: 4 POSITION: Lat N 13°44.32
 start stop duration Lon W 17°6.17
 TIME : 21:47:22 22:19:36 Purpose : 1
 LOG : 508.69 510.37 1.7 Region : 1320
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 34 34 Validity : 0
 Towing dir.: 360° Wire out : 120 m Speed : 3.1 kn
 Sorted : 71 Total catch: 1602.22 Catch/hour: 2982.72

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	1957.87	25359	65.64	30
Decapterus rhonchus	265.84	1476	8.91	
Pomadasys incisus	214.35	1562	7.19	
Sardinella maderensis	187.76	1646	6.30	31
Arius heudeloti	106.75	380	3.58	
Pomadasys jubelini	59.50	169	1.99	
Selene dorsalis	46.00	590	1.54	
Priacanthus arenatus	38.81	380	1.30	
Alectis alexandrinus	38.81	43	1.30	
Selar crumenophthalmus	29.12	84	0.98	
Sardinella auriata	21.95	169	0.74	
Pagellus bellottii	11.39	84	0.38	
Chilomycterus spinosus mauret.	4.58	2	0.15	
Total	2982.72		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 22
 DATE : 05.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 13°52.81
 start stop duration Lon W 17°21.81
 TIME : 03:44:22 03:54:59 Purpose : 1
 LOG : 558.73 559.38 0.7 Region : 1320
 FDEPTH: 50 53 Gear cond.: 0
 BDEPTH: 73 69 Validity : 0
 Towing dir.: 5° Wire out : 150 m Speed : 3.7 kn
 Sorted : 33 Total catch: 199.50 Catch/hour: 1127.12

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1073.45	15153	95.24	32
Scomber japonicus	34.46	237	3.06	
Boops boops	14.12	169	1.25	
Sardinella auriata	5.08	34	0.45	
Total	1127.12		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 23
 DATE : 05.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 13°52.70
 start stop duration Lon W 17°12.75
 TIME : 05:40:44 06:09:27 Purpose : 1
 LOG : 572.48 574.08 1.6 Region : 1320
 FDEPTH: 27 18 Gear cond.: 0
 BDEPTH: 43 47 Validity : 0
 Towing dir.: 270° Wire out : 90 m Speed : 3.3 kn
 Sorted : 64 Total catch: 64.33 Catch/hour: 134.35

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	58.79	317	43.76	35
Sardinella maderensis	31.22	447	23.24	34
Sardinella auriata	19.32	194	14.38	33
Pomadasys incisus	8.65	58	6.44	
Scomber japonicus	8.37	56	6.23	36
Trachurus trecae	2.23	13	1.66	
Pagellus bellottii	1.65	10	1.23	
Selene dorsalis	1.29	8	0.96	
Chelidichthys gabonensis	1.07	13	0.79	
Trachinus draco	0.73	4	0.54	
Chloroscombrus chrysurus	0.36	2	0.26	
Pseudupeneus prayensis	0.23	2	0.17	
Dicologlossa cuneata	0.23	2	0.17	
Priacanthus arenatus	0.21	2	0.16	
Total	134.35		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 24
 DATE : 05.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 14°3.56
 start stop duration Lon W 17°7.08
 TIME : 09:50:13 10:16:11 Purpose : 1
 LOG : 607.86 609.25 1.4 Region : 1320
 FDEPTH: 30 28 Gear cond.: 0
 BDEPTH: 30 28 Validity : 0
 Towing dir.: 0° Wire out : 150 m Speed : 3.2 kn
 Sorted : 63 Total catch: 777.56 Catch/hour: 1796.44

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	1670.39	21736	92.98	39
Pagrus caeruleostictus	39.16	183	2.18	
Pomadasys incisus	16.63	111	0.93	
Decapterus rhonchus	14.69	83	0.82	
Priacanthus arenatus	14.42	111	0.80	
Fistularia petimba	11.37	83	0.63	
Brachydeuterus aurius	5.89	55	0.33	
Rhizophronon acutus	4.20	5	0.23	
Eucinostomus melanopterus	3.33	28	0.19	
Selar crumenophthalmus	2.13	28	0.19	
Sardinella maderensis	2.06	25	0.11	37
Plectorhynchus mediterraneus	1.99	7	0.11	
Brachydeuterus aurius	1.94	28	0.11	
Epinephelus aeneus	1.78	2	0.10	
Selene dorsalis	1.66	28	0.09	
Lithognathus mormyrus	1.18	2	0.07	
Acanthurus monroviae	1.09	2	0.06	
Sardinella auriata	0.97	18	0.05	38
Pagellus bellottii	0.88	7	0.05	
Dentex canariensis	0.69	2	0.04	
Total	1796.44		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 25
 DATE : 05.11.2006 GEAR TYPE: PT NO: 4 POSITION: Lat N 14°21.63
 start stop duration Lon W 17°9.77
 TIME : 19:10:23 19:33:28 Purpose : 1
 LOG : 693.56 694.87 1.3 Region : 1320
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 27 25 Validity : 0
 Towing dir.: 160° Wire out : 150 m Speed : 3.4 kn
 Sorted : 91 Total catch: 1452.73 Catch/hour: 3776.59

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	1551.47	14101	41.08	40
Sardinella auriata	811.09	4451	21.48	40
Pomadasys incisus	409.71	2912	10.85	
Decapterus rhonchus	279.51	1581	7.40	41
Priacanthus arenatus	233.76	2205	6.19	
Sardinella maderensis	123.54	832	3.27	42
Selene dorsalis	121.87	915	3.23	
Pagellus bellottii	54.07	416	1.43	
Brachydeuterus aurius	46.17	458	1.22	
Sphyræna guanchancho	43.67	83	1.16	
Pagrus caeruleostictus	35.36	208	0.94	
Scomberomorus tripor	24.54	42	0.65	
Plectorhynchus mediterraneus	23.71	83	0.63	
Dactylopterus volitans	6.66	42	0.18	
Sarda sarda	5.23	3	0.14	
Eucinostomus melanopterus	3.33	42	0.09	
Fistularia petimba	2.08	42	0.06	
Decapterus punctatus	0.83	42	0.02	
Total	3776.59		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 26
 DATE : 05.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 14°24.07
 start stop duration Lon W 17°24.50
 TIME : 21:48:52 22:17:27 Purpose : 1
 LOG : 714.03 715.91 1.9 Region : 1320
 FDEPTH: 84 28 Gear cond.: 0
 BDEPTH: 80 79 Validity : 0
 Towing dir.: 355° Wire out : 122 m Speed : 4.0 kn
 Sorted : 114 Total catch: 114.49 Catch/hour: 240.36

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella auriata	158.19	1312	65.81	46
Scomber japonicus	28.03	218	11.66	43
Sardinella maderensis	24.56	136	10.22	45
Trachurus trecae	22.99	397	9.56	44
Rhizophronon acutus	4.53	2	1.89	
Sphyræna guanchancho	1.51	4	0.63	
Caranx crysos	0.55	2	0.23	
Total	240.36		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 27
 DATE : 06.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 14°37.20
 start stop duration Purpose : 1
 TIME : 05:44:59 06:09:30 24.5 (min) Region : 1320
 LOG : 784.18 785.43 1.3 Gear cond.: 0
 FDEPTH: 32 30 Val id it y : 0
 BDEPTH: 32 30 Speed : 3.1 kn
 Towing dir.: 348° Wire out : 120 m
 Sorted : 58 Total catch: 205.63 Catch/hour: 503.17

SPECIES	weight	numbers	% OF TOT. C	SAMP
Plectorhynchus mediterraneus	297.60	771	59.15	
Pagrus caeruleostictus	77.84	404	15.47	
Pseudupeneus prayensis	22.61	695	4.49	
Pomadasys incisus	16.96	95	3.37	
Onaetodon hoefleri	14.73	95	2.93	
Pagellus bellottii	11.89	113	2.36	
Priacanthus arenatus	11.75	78	2.33	
Dentex canariensis	9.76	24	1.94	
Aluterus punctata	7.02	10	1.40	
Scorpaena stephanica	6.24	69	1.24	
Decapterus punctatus	5.31	404	1.06	
Syacium micrum	3.60	137	0.71	
Fistularia petimba	2.84	34	0.56	
Sardinella aurata	2.40	247	0.48	
Sepia officinalis hierredda	2.96	2	0.39	
Trachinocephalus myops	1.71	44	0.34	
Rajamiraletus	1.39	5	0.28	
Dactylopterus volitans	1.37	7	0.27	
Brachydeuterus aurius	1.37	7	0.27	
Saurida brasiliensis	1.27	411	0.25	
Diplotoglossa cuneata	0.86	27	0.17	
Diplodus bellottii	0.78	10	0.16	
Spondylosoma cantharus	0.69	7	0.14	
Diplodus vulgaris	0.61	10	0.12	
Grammolites gruvelli	0.51	17	0.10	
Cepolapauiciradiatus	0.10	10	0.02	
Total	503.17		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 28
 DATE : 06.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 14°51.64
 start stop duration Purpose : 1
 TIME : 15:44:32 16:14:03 29.5 (min) Region : 1320
 LOG : 855.29 856.86 1.6 Gear cond.: 0
 FDEPTH: 110 115 Val id it y : 0
 BDEPTH: 127 129 Speed : 3.2 kn
 Towing dir.: 54° Wire out : 300 m
 Sorted : 0 Total catch: 0.55 Catch/hour: 1.12

SPECIES	weight	numbers	% OF TOT. C	SAMP
Sphaeroides pachgaster	1.12	2	100.00	
Total	1.12		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 29
 DATE : 06.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 14°51.70
 start stop duration Purpose : 1
 TIME : 18:47:38 19:19:15 31.6 (min) Region : 1320
 LOG : 875.52 877.36 1.8 Gear cond.: 0
 FDEPTH: 35 36 Val id it y : 0
 BDEPTH: 35 36 Speed : 3.5 kn
 Towing dir.: 238° Wire out : 150 m
 Sorted : 55 Total catch: 269.97 Catch/hour: 512.28

SPECIES	weight	numbers	% OF TOT. C	SAMP
Decapterus rhonchus	131.50	581	25.67	48
Priacanthus arenatus	105.31	505	20.56	
Pomadasys incisus	48.96	524	9.56	
Chelidoniichthys gabonensis	44.29	512	8.65	
Pagellus bellottii	40.76	1082	7.96	
Dactylopterus volitans	40.42	250	7.89	
Pseudupeneus prayensis	38.48	615	7.51	
Trachurus trecae	31.99	342	6.25	47
Decapterus punctatus	13.43	205	2.62	
Lithognathus mormyrus	6.49	34	1.27	
Trachinocephalus myops	4.44	11	0.87	
Scomber japonicus	3.07	23	0.60	
Selene dorsalis	1.14	11	0.22	
Aluterus punctata	1.08	2	0.21	
Bothus podas africanus	0.91	11	0.18	
Total	512.28		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 30
 DATE : 07.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 14°59.44
 start stop duration Purpose : 1
 TIME : 00:50:25 01:24:09 33.7 (min) Region : 1310
 LOG : 926.31 928.42 2.1 Gear cond.: 0
 FDEPTH: 30 30 Val id it y : 0
 BDEPTH: 56 94 Speed : 3.8 kn
 Towing dir.: 300° Wire out : 0 m
 Sorted : 36 Total catch: 291.16 Catch/hour: 517.92

SPECIES	weight	numbers	% OF TOT. C	SAMP
Trachurus trecae	456.09	19910	88.06	49
Sardinella aurata	43.55	441	8.41	50
Scomber japonicus	10.96	128	2.12	
Brachydeuterus aurius	5.27	43	1.02	
Sardiniplichardus	1.28	28	0.25	
Sphyraena guanchancho	0.78	2	0.15	
Total	517.92		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 31
 DATE : 07.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 15°16.83
 start stop duration Purpose : 1
 TIME : 08:51:06 09:24:17 33.2 (min) Region : 1310
 LOG : 997.96 1000.04 2.1 Gear cond.: 0
 FDEPTH: 23 21 Val id it y : 0
 BDEPTH: 23 21 Speed : 3.8 kn
 Towing dir.: 29° Wire out : 120 m
 Sorted : 90 Total catch: 1391.21 Catch/hour: 2515.75

SPECIES	weight	numbers	% OF TOT. C	SAMP
Pomadasys peroteti	1294.88	5434	51.47	
Selene dorsalis	486.62	4631	19.34	
Chloroscombrus chrysurus	622.10	1664	8.83	53
Trichurus lepturus	184.10	1720	7.32	
Lilisha africana	112.03	4658	4.45	54
Galioides decadactylus	71.81	582	2.85	
Brachydeuterus aurius	49.06	389	1.95	
Pterosciopelid	30.22	582	1.20	
Pseudotolithus typus	23.92	29	0.95	
Lithognathus mormyrus	14.12	56	0.56	
Penaeus notialis	13.04	193	0.52	
Sardinella maderensis	3.33	306	0.13	52
Sardinella aurata	3.33	443	0.13	51
Drepane africana	2.04	56	0.12	
Sphyraena guanchancho	2.50	56	0.10	
Cynoglossus senegalensis	1.66	27	0.07	
Total	2515.75		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 32
 DATE : 07.11.2006 GEAR TYPE: PT NO: 7 POSITION: Lat N 15°25.34
 start stop duration Purpose : 1
 TIME : 10:45:28 11:16:20 30.9 (min) Region : 1310
 LOG : 1011.06 1012.69 1.6 Gear cond.: 0
 FDEPTH: 10 10 Val id it y : 0
 BDEPTH: 24 23 Speed : 3.2 kn
 Towing dir.: 30° Wire out : 150 m
 Sorted : 0 Total catch: 68.85 Catch/hour: 133.82

SPECIES	weight	numbers	% OF TOT. C	SAMP
Stromateus fiatola	48.59	60	36.31	
Chloroscombrus chrysurus	21.57	297	16.12	56
Pomadasys peroteti	20.12	80	15.03	
Trichurus lepturus	19.73	138	14.74	
Selene dorsalis	10.03	86	7.49	
Sphyraena guanchancho	5.07	14	3.79	
Brachydeuterus aurius	3.50	33	2.61	
Sardinella maderensis	2.49	16	1.86	55
Trachinotus ovatus	1.36	14	1.02	
Sardinella aurata	0.54	2	0.41	
Selar crumenophthalmus	0.43	2	0.32	
Pterosciopelid	0.39	6	0.29	
Total	133.82		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 33
 DATE : 07.11.2006 GEAR TYPE: BT NO: 19 POSITION: Lat N 15°25.68
 start stop duration Purpose : 1
 TIME : 12:37:20 13:02:59 25.7 (min) Region : 1310
 LOG : 1023.37 1024.76 1.4 Gear cond.: 0
 FDEPTH: 63 60 Val id it y : 0
 BDEPTH: 63 60 Speed : 3.3 kn
 Towing dir.: 30° Wire out : 205 m
 Sorted : 10 Total catch: 3260.10 Catch/hour: 7625.96

SPECIES	weight	numbers	% OF TOT. C	SAMP
JELLYFISH	693.36	1520	90.93	
Trachurus trecae	337.78	370	4.43	57
Brachydeuterus aurius	230.39	1747	3.02	
Pagellus bellottii	53.05	454	0.70	
Alectis alexandrinus	24.33	16	0.32	
Fistularia petimba	14.88	65	0.20	
Boops boops	10.99	129	0.14	
Sphyraena guanchancho	5.80	129	0.08	
Hemirhamphus intermedius	5.31	65	0.07	
Pomadasys peroteti	5.12	12	0.07	
Pseudupeneus prayensis	3.23	65	0.04	
Loligo vulgaris	0.73	2	0.01	
Total	7625.96		100.00	

R/V "DR. FRI DTJOF NANSEN" SURVEY: 2006411 STATION: 34
 DATE : 07.11.2006 GEAR TYPE: PT NO: 7 POSITION: Lat N 15°35.71
 start stop duration Purpose : 1
 TIME : 19:25:33 19:56:38 31.1 (min) Region : 1310
 LOG : 1082.18 1083.84 1.7 Gear cond.: 0
 FDEPTH: 5 5 Val id it y : 0
 BDEPTH: 16 17 Speed : 3.2 kn
 Towing dir.: 32° Wire out : 150 m
 Sorted : 68 Total catch: 304.76 Catch/hour: 588.34

SPECIES	weight	numbers	% OF TOT. C	SAMP
Chloroscombrus chrysurus	276.64	1558	47.02	
JELLYFISH	81.08	392	12.78	
Lilisha africana	74.90	1164	12.73	59
Trichurus lepturus	33.78	313	5.74	
Sardinella maderensis	24.71	303	4.20	
Galioides decadactylus	19.50	69	3.31	60
Engraulis encrasiolus	19.21	1170	3.26	58
Sardinella maderensis juvenile	19.11	6658	3.25	61
Pomadasys peroteti	17.72	52	3.01	
Selene dorsalis	8.88	62	1.51	
Brachydeuterus aurius	6.25	52	1.06	
Fistularia petimba	3.47	27	0.59	
Selar crumenophthalmus	2.26	10	0.38	
Penaeus notialis	0.35	27	0.06	
Sepia officinalis hierredda	0.27	10	0.05	
Alouteuthis africana	0.19	79	0.03	
Total	588.34		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 35
 DATE : 07.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 15°44.07
 start stop duration Purpose : 1
 TIME : 21:51:20 22:23:24 32.1 (min) Lon W 16°48.34
 LOG : 1099.17 1100.96 1.8 Region : 1310
 FDEPTH: 40 42 Gear cond.: 0
 BDEPTH: 60 61 Validity : 0
 Towing dir.: 20° Wire out : 150 m Speed : 3.3 kn
 Sorted : 60 Total catch: 391.18 Catch/hour: 731.63

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	374.44	3320	51.18	
J E L L Y F I S H	215.18	524	29.41	
Trachurus trecae	120.95	1375	16.53	62
Trichiurus lepturus	5.97	86	0.82	
Pagellus bellottii	5.48	62	0.75	
Sardinella maderensis	5.11	86	0.70	63
Boops boops	2.19	24	0.30	
Scomber japonicus	1.70	13	0.23	
Saurida brasiliensis	0.62	183	0.08	
Total	731.63		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 36
 DATE : 08.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 15°53.12
 start stop duration Purpose : 1
 TIME : 04:47:41 04:56:55 9.2 (min) Lon W 16°51.79
 LOG : 1153.19 1153.81 0.6 Region : 1310
 FDEPTH: 35 28 Gear cond.: 0
 BDEPTH: 90 92 Validity : 0
 Towing dir.: 281° Wire out : 100 m Speed : 4.0 kn
 Sorted : 50 Total catch: 250.15 Catch/hour: 1626.11

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1537.38	71473	94.54	65
Sardinella aurita	32.50	455	2.00	64
Auxis thazard	31.53	228	1.94	
Scomber japonicus	17.88	228	1.10	
Dactylopterus volitans	5.20	33	0.32	
Sardinia pilchardus	1.63	65	0.10	
Total	1626.11		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 37
 DATE : 08.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 15°49.39
 start stop duration Purpose : 1
 TIME : 06:58:03 07:23:57 25.9 (min) Lon W 16°44.41
 LOG : 1168.69 1170.41 1.7 Region : 1310
 FDEPTH: 34 42 Gear cond.: 0
 BDEPTH: 51 53 Validity : 0
 Towing dir.: 225° Wire out : 120 m Speed : 4.0 kn
 Sorted : 54 Total catch: 132.86 Catch/hour: 307.78

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	102.42	521	33.28	66
Trachurus trecae	71.68	392	23.29	67
Sardinella aurita	33.20	192	10.79	68
Trichiurus lepturus	30.97	292	10.06	
Chirocentrus chrysurus	17.19	37	5.58	
Brachydeuterus auritus	16.19	130	5.26	
Alectis alexandrinus	9.61	7	3.12	
Selene dorsalis	7.55	83	2.45	
Sphyrna lewini	6.86	2	2.23	
Sphyrna guachancho	3.92	9	1.27	
Rhizoprionodon acutus	3.22	2	1.05	
Caranx crysos	2.59	12	0.84	
Pomadasys peroteti	2.39	7	0.78	
Total	307.78		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY: 2006411 STATION: 38
 DATE : 12.11.2006 GEAR TYPE: PT NO: 1 POSITION: Lat N 16°10.92
 start stop duration Purpose : 1
 TIME : 03:26:25 03:56:30 30.1 (min) Lon W 16°37.83
 LOG : 1436.53 1438.48 2.0 Region : 1220
 FDEPTH: 23 30 Gear cond.: 0
 BDEPTH: 47 45 Validity : 0
 Towing dir.: 10° Wire out : 85 m Speed : 3.9 kn
 Sorted : 61 Total catch: 344.58 Catch/hour: 687.33

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	389.78	3928	56.71	
Sardinella maderensis	84.26	4081	12.26	70
J E L L Y F I S H	73.84	78	10.74	
Stromateus fiatola	65.94	100	9.59	
Trachurus trecae	31.72	1997	4.61	
Rhizoprionodon acutus	13.36	6	1.94	69
Selene dorsalis	7.36	122	1.07	
Arius parkii	7.02	12	1.02	
Decapterus rhonchus	3.95	12	0.57	
Penaeus notialis	3.95	297	0.57	
Trichiurus lepturus	2.85	22	0.41	
Trachinotus ovatus	2.09	12	0.30	
Echeneis naucrates	1.20	12	0.17	
Total	687.33		100.00	

Annex II Description of instruments and fishing gear

The Simrad ER-60, 38 kHz scientific echosounder was used for abundance estimation during the survey, in addition data from the 18 kHz, 120 kHz and 200 kHz transducers were recorded for possible future multifrequency target identification. The Bergen Echo Integrator system (BEI) recorded the hydroacoustic data and was used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data were stored to tape and brought back to IMR for storing. The last calibration of all transducers prior to the survey was conducted in Baia dos Elefantes, Angola 6/10-2006.

The details of the settings of the echosounders were as follows:

Transceiver ES18-11

Transducer depth	5.5 m
Absorption coeff.	2.2 dB/km
Pulse length	1.024 ms
Bandwidth	1.57 kHz
Max power (used)	2000 Watt (2000 W)
2-way beam angle	-17.0 dB
SV transducer gain	22.57 dB
TS transducer gain	22.4 dB
Angle sensitivity	13.9
3 dB beamwidth along.	11.6
3 dB beamwidth athw.	11.41
Alongship offset	0.11
Athwardship offset	-0.02

Transceiver ES38-B

Transducer depth	5.5 m
Absorption coeff.	8.7 dB/km
Pulse length	1.024 ms
Bandwidth	2.43 kHz
Max power (used)	4000 Watt (2000 W)
2-way beam angle	-20.6 dB
SV transducer gain	25.87 dB
TS transducer gain	26.5 dB
Angle sensitivity	21.9
3 dB beamwidth along.	6.89
3 dB beamwidth athw.	6.92
Alongship offset	0.11
Athwardship offset	0.03

Transceiver ES120-7

Transducer depth	5.5 m
Absorption coeff.	44.5 dB/km
Pulse length	1.024 ms
Bandwidth	3.03 kHz
Max power (used)	500 Watt (250 W)
2-way beam angle	-20.8 dB
SV transducer gain	25.33 dB
TS transducer gain	25.7 dB
Angle sensitivity	21.0
3 dB beamwidth along.	7.20
3 dB beamwidth athw.	7.15
Alongship offset	0.09
Athwardship offset	0.03

Transceiver ES200-7

Transducer depth	5.5 m
Absorption coeff.	66.9 dB/km
Pulse length	1.024 ms
Bandwidth	3.09 kHz
Max power (used)	300 Watt (120 W)
2-way beam angle	-20.7 dB
SV transducer gain	24.25 dB
TS transducer gain	27.0 dB
Angle sensitivity	23.00
3 dB beamwidth along.	6.87
3 dB beamwidth athw.	7.01
Alongship offset	- 0.07
Athwardship offset	0.25

Bottom detection menu

Minimum level -50 dB

Fishing gear

The vessel has three different sized four-panel 'Åkrahavn' pelagic trawls and one 'Gisund super bottom trawl'. The two smallest pelagic trawls and the demersal trawl were used during the survey. The smallest pelagic trawl has 10-12 m vertical opening under normal operation, whereas the intermediate sized trawl has 15-18 m opening.

The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m² and weigh 2000 kg. The door spreading is about 45 m when using restraining rope. Trawling was

conducted for species identification only and no restraining rope was therefore used during the survey.

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

The pelagic trawls are equipped with a trawl eye that provides information about the trawl opening and the distance of the footrope to the bottom. A pressure sensor is used to show the depth on the headline.

Annex III Summary of biological samples

Table 1 below provides an overview of some of the main results from the biological sampling. The biological sampling focused on the three main species: *Sardinella maderensis*, *S.aurita* and *Trachurus trecae* but some samples were also taken for other pelagic species such as *Decapterus rhonchus*, *Scomber japonicus* and *Ethmalosa fimbriata*.

A total of 637 individuals were measured to obtain the parameters of the length-weight relationship and condition factor whereas 621 individuals were analysed for maturity. The maturity scale of Fonteneau (ask Mor for reference) was used to determine the maturity stage. A total of 158 otoliths were extracted from the two sardinella species.

The results show that the condition factor (CF) obtained from the samples for the two sardinellas combined and *Trachurus trecae* was 0.86. This is somewhat lower than the fixed condition factor used for the biomass estimations. The plots of the length-weight relationships from the onboard measurement of length (Total length, cm) and weight (g) for *Sardinella maderensis*, *S.aurita* and *Trachurus trecae* are shown in Figure 1.

For *S.maderensis* and *Trachurus trecae* the number of females were slightly higher than males, 51% and 49% respectively. *Decapterus rhochus* and *Scomber japonicus* also had a higher occurrence of females than males. *S.aurita* and *Ethmalosa fimbriata* on the other hand had higher numbers of males than females. For *S.aurita* the ratio was 57% male versus 41% female, 2% could not be determined. For the five species sampled most of the fish were in a pre-spawning phase (i.e. maturity stage I or II) except for male *S.aurita* where the mature fish constituted about 69% of the total.

Table 1: Summary statistics Senegal and The Gambia

SENEGAL AND GAMBIA							Length-Weight relationship				Sex ratio (%)	
Species	N	N. Otoliths	C.F.	St.Dev.	Min Length (cm)	Max Length (cm)	a	b	R ²	F	M	ind
2 <i>Sardinella aurita</i>	125	78	0.84	0.19	6.5	32.7	0.007	3.05	0.99	41	57	2
3 <i>Trachurus trecae</i> *	176	n.a.	0.86	0.06	9.3	30.6	0.0124	2.88	0.99	51	49	
4 <i>Decapterus rhonchus</i>	60	n.a.	0.90	0.04	24	33	0.039	2.55	0.94	68	32	
5 <i>Scomber japonicus</i>	34	n.a.	0.90	0.05	19.6	29	0.0076	3.06	0.97	62	38	
5 <i>Ethmalosa fimbriata</i>	30	n.a.	1.04	0.08	19.2	27.2	0.0023	3.48	0.98	47	53	
Total N. of species	5											
Total N. of Individuals	637											

*For maturity analyzes, N=181 for *S.maderensis* and N=140 for *T.trecae* .

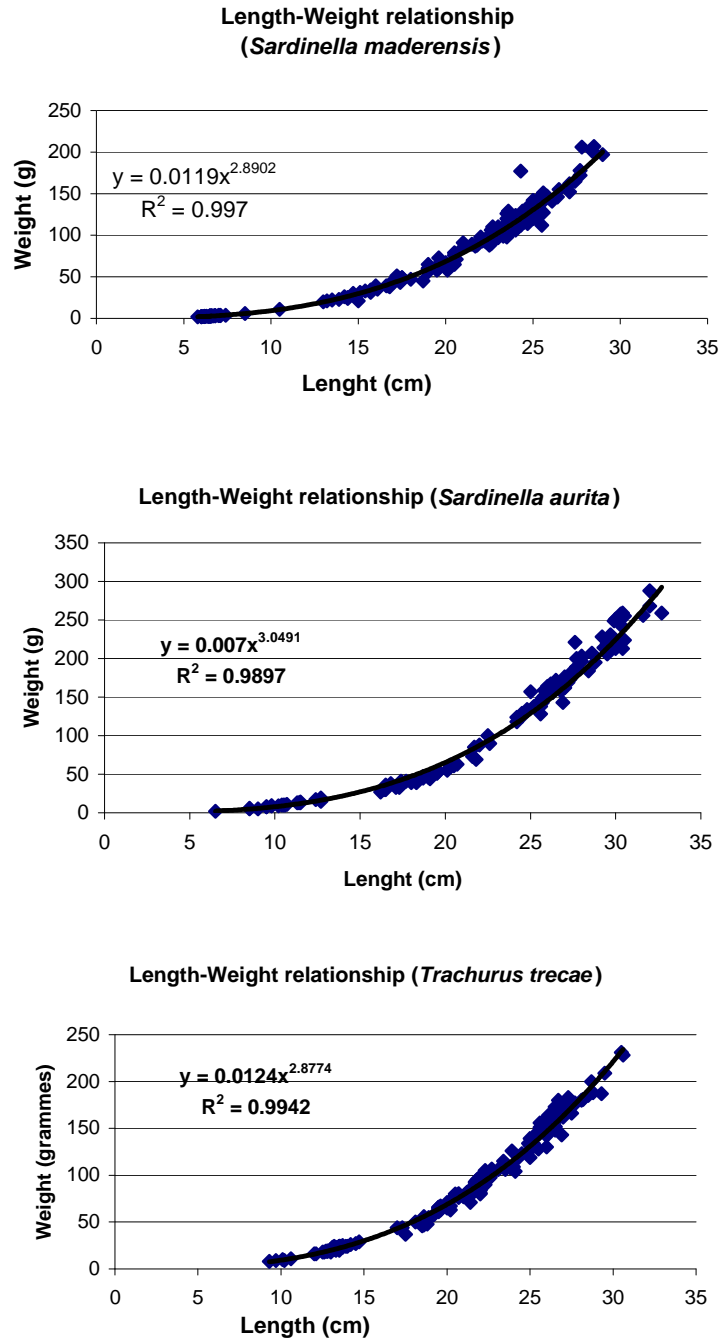


Figure 1: Scatter plots of fish weight versus fish length for a) *Sardinella maderensis*, b) *Sardinella aurita* and c) *Trachurus trecae*. Fitted regressions also shown.

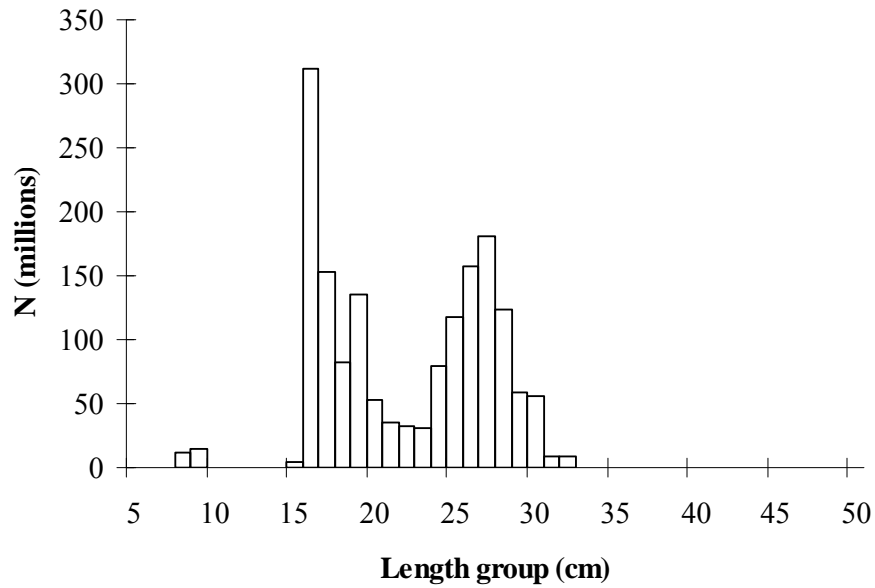
Plankton sampling

Two plankton stations were collected off The Gambia on special request from The Gambian scientists onboard. The samples were collected by oblique hauls with the WP2 plankton net to a depth of 50 m. The stations were visually examined and the main taxa identified onboard. Table 1. gives an overview of the main species identified in the two samples.

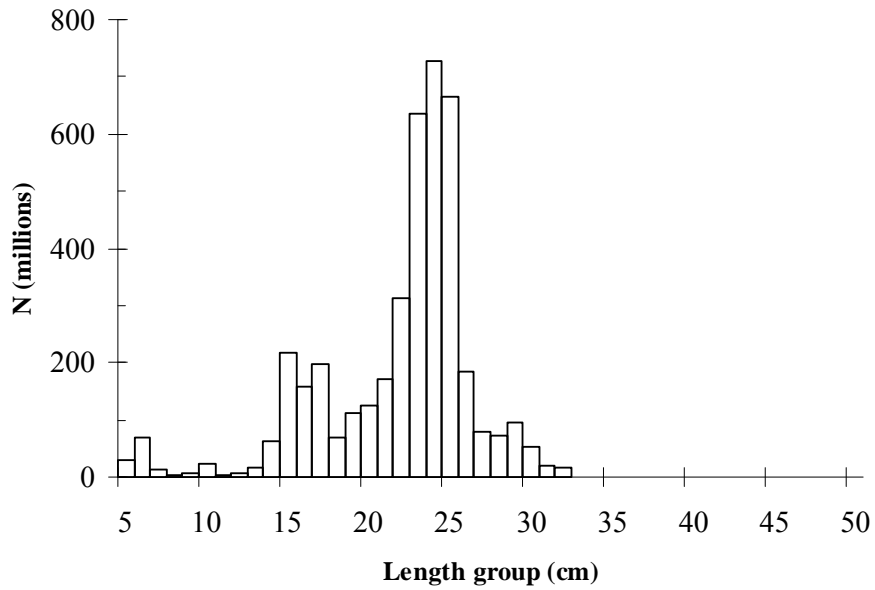
Table 1. Main zoo plankton taxa identified in the two plankton samples

Species	Station	
	500 m	50 m
COPEPODA		
Bathycalanus pseudotypicus	X	X
Calanus australis	X	
Candacia vericans	X	X
Tomopteris nationalis	X	X
Heterorhabdus vipera	X	X
Arietellus simplex	X	X
Temora discandata	X	X
Oncaea scottodicarloi	X	X
Sapphirina auronitens sinuicauda	X	
Pjylopus nodus	X	X
MYCEDACAE		
Boreomysis insolita		X
Browmaniella brasiliensis		X
Siriela thopsoni		X
AMPHIPODA		
Phtisica marina		X
EUPHAUSIACEA		
Euphausia longirostris		X
CHAETOGNATHA		
Xenokrohnia sp.		X
APPENDICULARIA		
Oikopleura fusiforms		X
Oikopleura cophocerca		X

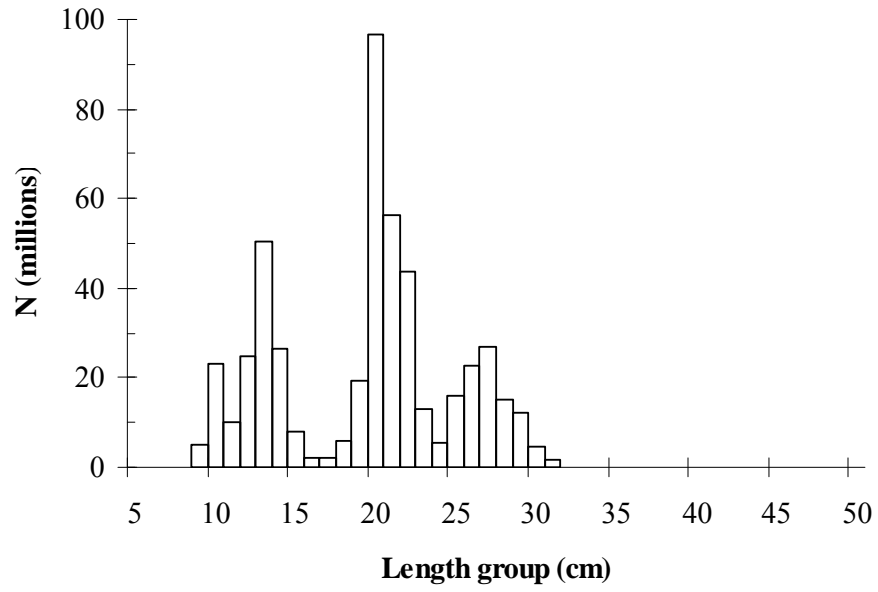
Annex IV Pooled length distributions by species



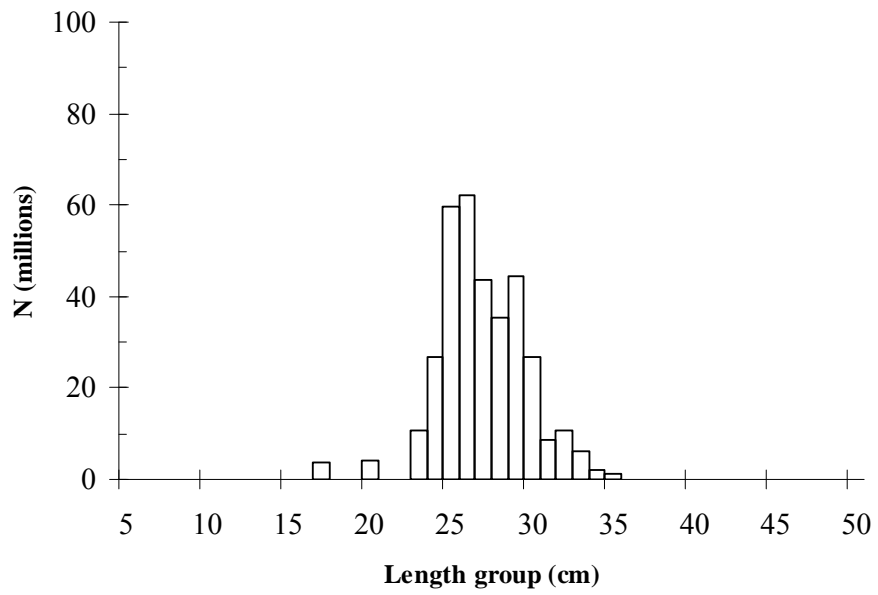
Sardinella aurita October – November 2005



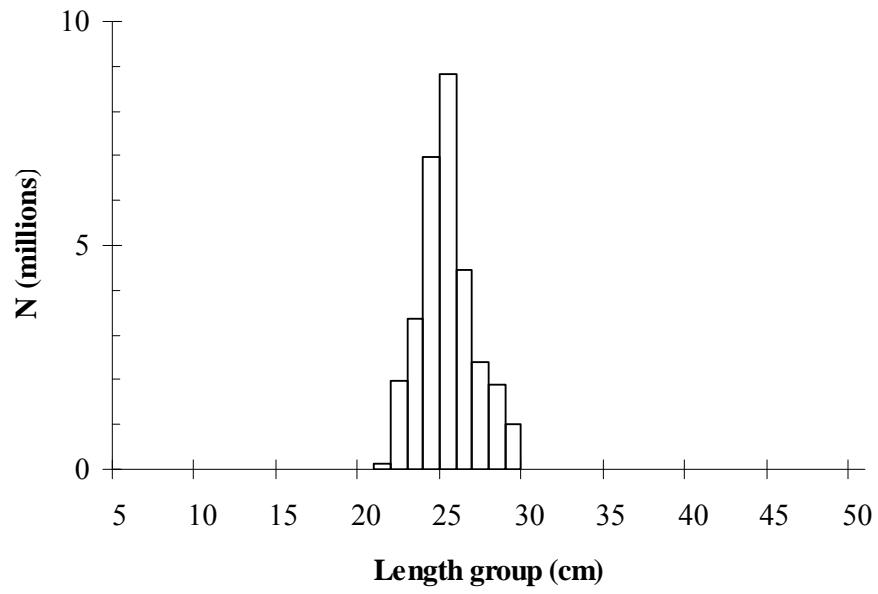
Sardinella maderensis October – November 2005



Trachurus trecae October – November 2006



Decapterus rhouinchus October – November 2006



Scomber japonicus October – November 2006

Annex V Estimated number and biomass by length-group and sectors

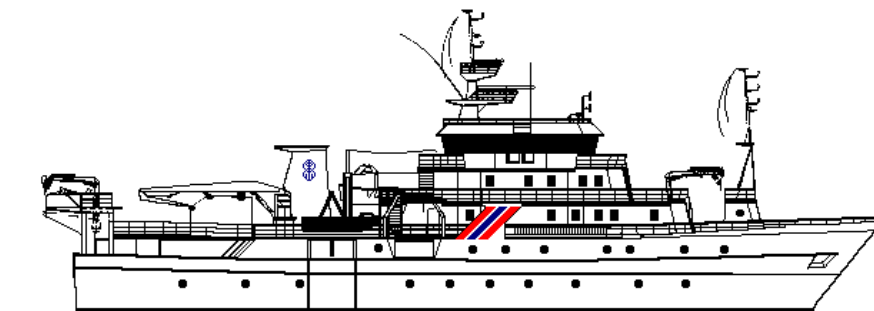
Round sardinella (*Sardinella aurita*): October-November 2006

Flat sardinella (*Sardinella maderensis*): October-November 2006

Cunene horse mackerel (*Trachurus trecae*): October-November 2006

False scad (*Decapterus rhonchus*): October-November 2006

Annex V Regional Estimates, October – December 2006



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

Part II

MAURITANIA

10 November - 21 November 2006

**Institut Mauritanien de Recherches Océanographiques et des Pêches
Nouadhibou, Mauritania**

**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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by

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Bergen, 2007

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CHAPTER 1 INTRODUCTION

1.1 Objective of the cruise

The general objectives of the survey were to estimate biomass and map the distribution of the 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 2006. For Mauritania the agreed objectives were as follows:

- To map the distribution and estimate the biomass for the main small pelagic fish using hydro-acoustic methods. The species of interest were: sardinellas (*Sardinella aurita*) and (*Sardinella maderensis*), sardine (*Sardina pilchardus*) horse mackerels (*Trachurus trachurus*) and (*T. trecae*), false scad (*Decapterus rhonchus*), and anchovy (*Engraulis encrasicolus*) and chub mackerel (*Scomber japonicus*).
- 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.
- Collect biological data and otoliths of the main target species, especially *sardina pilchardus*, *Sardinella aurita*, *Sardinella maderensis* and *T. trecae*.
- To sample standard hydrographical transects for temperature, salinity and oxygen at every degree latitude, at about 17°00'N, 18°00'N, 19°00'N, 20°00'N and off Cape Blanc.
- To train local participants in acoustic survey methodology including fish identification and sampling, scrutinizing of echograms, acoustic abundance estimation and hydrographic sampling.

The time originally allocated for this part of the survey, off Mauritania, was 8 days.

1.2 Participation

Participating scientists until the crew change on the 18th November were:

Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), Mauritania:

Abdoulaye Waguè (Team Leader Mauritania), Nema Ould Cheikh Mohamed Abdallah, Ould Vally Yeslem, Abou Ciré Ball, Sidi Ould Hadramy and Mohamed Ahmed Ould Taleb

Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT), Senegal:

Abdoulaye Sarre, Ibrahima Sow and Mor Sylla

Department of Fisheries (FD), The Gambia:

Ebou MBye

Institut National de Recherche Halieutique (INRH), Morocco:

Lahcen Aboubdelah

Institute of Marine Research (IMR), Norway:

Jens-Otto Krakstad (Cruise leader), Magne Olsen, Thor Egil Johannson and Ole Sverre Fossheim

Participating scientists after the 18th November can be found in part three of this cruise report.

1.3 Narrative

The vessel departed from Dakar 12:00, (UTC = Local time), on the 11th November after a 1 ½ day delay due to a late coming plane with ship crew. The survey off Mauritania started the same day at the border between Senegal and Mauritania at St. Louis (16°00'N) at 22:30 UTC. Cape Timiris was reached on the 16th at 16:00. Due to the late departure from Dakar the vessel had to return to Nouakchott for a change of scientists before the end of the survey off Mauritania. The vessel left the survey area on the 17th November at 17:00. The vessel arrived at Nouakchott on the 18th at 09:00 in the morning and departed again on the 19th November at 09:00. The survey was resumed the following day at 00:20 in the morning. The survey of Mauritania ended on the when the vessel crossed the border to West Sahara at Cape Blanc on the 21st November at 04:00.

The survey in Mauritania followed the standardized survey outline agreed in the Survey planning meeting and used for all the pelagic surveys in the region of North West Africa. The survey followed systematic parallel course tracks spaced about 10 NM (nautical miles) apart, perpendicular to the depth isobaths. To cover the whole distribution area of pelagic fish, the

shelf was covered from the >15 m isobath and offshore to the 500 m isobath. Trawling was done irregularly, either to identify echo registrations or to check ‘blindly’ if fish were mixed with the plankton in the upper layers of the water column. Pelagic trawl with floats was often used to catch fish close to the surface. A smaller pelagic trawl or the bottom trawl with floats was used for sampling pelagic fish in very shallow waters (depth less than 25 m).

Course track and fishing stations are shown in Figure 1, while Table 1 show survey effort during the survey, including number of trawl stations and CTD casts. All data collected during the survey were made available to the participants.

Five transects with hydrographic profiles were carried out, at 17°00’ N, 18°00’N - at Nouakchott, 19°00’ - south of Cape Timiris, 20°00’N outside Banc D’arguin, and at 20°50’ N - Cape Blanc.

Table 1. Summary of survey effort by regions, including number of demersal (BT) and pelagic (PT) trawl hauls, CTD casts, and distance surveyed disregarding the steaming to and from the survey area (log).

Area	BT	PT	Total trawls	CTD casts	Log (nm)
St. Louis to Cape Blanc	5	26	31	62	1256

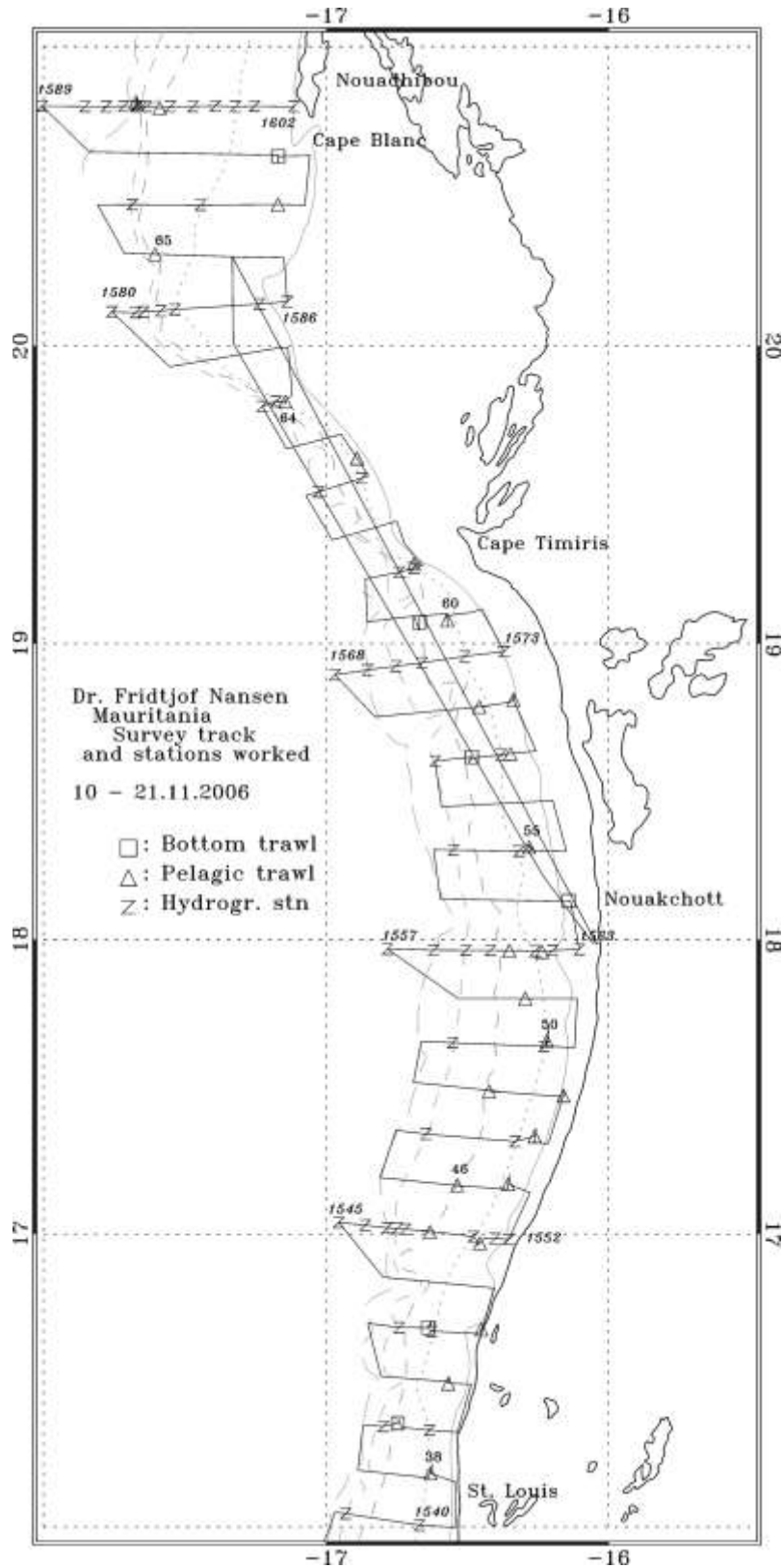


Figure 1. Course tracks with fishing and hydrographic stations; St. Louis to Cape Blanc

CHAPTER 2 METHODS

2.1 Environmental Data

CTD-profiling

A Seabird 911+ CTD probe was used to obtain vertical profiles of the temperature, salinity and oxygen. Real time logging was carried out using the PC based Seabird Seasave Software. CTD casts were conducted along the cruise track in transects at about every one degree latitude and at fixed stations every 50 m and 200 m depth every 20 NM. The casts were stopped a few meters above the bottom, and at a maximum of 500 m depth. No calibration of the salinity or oxygen sensor was attempted during the survey.

Meteorological observations

Meteorological data logged from the Aanderaa meteorological station included wind direction and speed, air temperature, incident solar intensity and sea surface temperature (SST). All data were averaged by unit distance sailed (1 NM).

Thermosalinograph

The SBE 21 Seacat thermosalinograph was running routinely during the survey. Obtaining samples of sea surface salinity and relative temperature (5 m depth) every 10 sec during the survey.

Current speed and direction measurements (ADCP)

The ship-born Acoustic Doppler Current Profiler (ADCP) from RD Instruments was running throughout the survey. The ADCP was set to external trigger, triggered by the ER 60 system. The depth cell interval set to 3 m and the number of cells was set to 120.

2.2 Trawl sampling

Fish sampling was carried out using two different sized pelagic trawls, and a bottom trawl. The small pelagic trawl or the bottom trawl with floats was used for sampling the pelagic fish in shallow waters (depth less than 25 m), floats was also used for surface trawls (trawl depth < 20 m). Annex II gives a description of the instruments and the fishing gear used.

All catches were sampled to determine species composition by weight and numbers. Species identification was based on the FAO Species Identification Guides. Length frequency

distributions, by total fish length in cm (measured to the nearest cm below), of the selected target species were recorded at all stations where they were present.

Individual weight measurements were taken regularly to estimate the condition factor in the length-weight relationship:

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

Other biological parameters collected included sex, maturity and gonad weight. Otoliths were extracted from *Sardinella aurita* and *Sardinella maderensis*, mounted on black slides and embedded in a synthetic resin (EUKITT). A summary of the biological samples is provided in Annex III.

For the estimation of the biomass of carangids and associated species, an overall average length of 23 cm and a condition factor of 0.88 (to calculate the mean length of this length group) were applied. The target groups used for Mauritania can be found in Table 2, while the complete records of fishing stations and catches are shown in Annex I.

Table 2. Allocation of acoustic densities to taxii. Note that for the groups of sardinella, horse mackerel, and sardine all encountered species are listed, while only examples are listed for the remaining groups.

Group	Taxon	Species	
Sardinella	<i>Sardinella</i> sp.	<i>S. aurita</i> <i>S. maderensis</i>	
Sardine	<i>Sardina</i>	<i>S. pilchardus</i>	
Anchovy	<i>Engraulis</i>	<i>Engraulis encrasicolus</i>	
Horse mackerels	<i>Trachurus</i> sp.	<i>T. trecae</i> <i>T. trachurus</i>	
	<i>Decapterus</i>	<i>Decapterus rhonchus</i>	
Pelagic species 1	Clupeidae ₁	<i>Ilisha africana</i> <i>Ethmalosa fimbriata</i>	
		Pelagic species 2	Carangidae ₂
Scombridae	<i>Euthynnus alletteratus</i> <i>Sarda sarda</i> <i>Scomber japonicus</i>		
	Sphyraenidae		
Others			
Big eye grunt		<i>Brachydeuterus auritus</i>	
Other demersal species	Demersal families		
Mesopelagic species	Myctophidae ₃		
	Other mesopelagic fish		
Plankton	Calanoidae	<i>Calanus</i> sp.	
	Euphausiidae	<i>Meganyciophanes</i> sp.	
	Other plankton		

₁: other than *Sardina* sp and *Sardinella* sp.; ₂: other than *Trachurus* sp and *Decapterus rhonchus*.;

2.3 Acoustic sampling

Acoustic recordings were collected with ER 60 Echosounders, with settings as shown in Annex II. A sphere calibration of all frequencies was conducted in Baia dos Tigres, Angola prior to the survey. Four frequencies 18 kHz, 38 kHz, 120 kHz and 200 kHz were logged. All abundance estimation was based on data from the 38 kHz transducer. The Bergen Integrator (BEI) was used for analysis and allocation of the integrated s_A -values to the individual specified target groups by 5 NM intervals. The allocation of values to target groups was based on a combination of a visual scrutiny of the behaviour pattern as deduced from echo diagrams, the BEI analysis, and the catch compositions.

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

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

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

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

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

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

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

were

ρ_i = density of fish in length group i

s_A = mean integrator value

p_i = proportion of fish in length group i

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

target species, and

C_{Fi} = reciprocal back scattering cross section (σ_{bs}^{-1}) of a fish in length group i .

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

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

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

For a region representing a distribution of a target-specie, the following basic data are needed for the estimation of abundance;

- 1) the average s_A -value for the region,
- 2) the surface (usually square nautical miles, NM^2), and
- 3) a representative length distribution of the fish in the region.

If the targeted fish is a mixture of more than one species, for example sardinellas, a representative distribution of the two, within the region, as shown in the trawl catches, are used. A length distribution representing the number of the two species for each catch will have to be calculated. Thereafter, these distributions have to be normalized to a unit number (usually 100) so they are equally weighted.

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

The samples of the species in the category (e.g. sardinellas) are respectively pooled together with equal importance (normalized).

The mean back scattering strength (ρ/s_A) of each length frequency distribution of the target species is calculated and summed. This is automatically done in the Excel spread-sheet made available for acoustic abundance estimation onboard RV "Dr. Fridtjof Nansen", provided the data are punched in this sheet.

The mean s_A -value allocated to the category of fish in the region is divided between the species in the same ratio as their relative contribution to the mean back scattering strength of the length groups in the sample representing the region

The pooled length distribution is used, together with the mean s_A -value, to calculate the density (numbers per square NM) by length groups and species, using the above formula. The total number by length group in the area is obtained by multiplying each number by the area. The numbers are then converted to biomass using the estimated weight at length.

CHAPTER 3 SURVEY RESULTS

3.1 Hydrography

Hydrographical data was collected on fixed CTD stations to 500 m depth, the thermosalinograph and from the Aanderaa weather station that continuously collect sea surface temperature, wind speed and direction, solar radiation etc. during the survey.

Cross shelf hydrographical profiles

Figure 2 shows the distribution of temperature, salinity and oxygen from the five hydrographical transects collected during the survey.

At 17°00 N , The temperature decreased from surface to the bottom and varied between 26 to 11°C at 500 m. The Oxygen in the surface is around 4 and decline until 1,5 ml/l at 400 m depth.

The salinity was very high in the surface waters (36 PSU) and decreased until 35,4 at 400 m. The thermocline was around 100 m depth.

At 18°00, the transect of temperature was normal between 26 on surface and 11°C at 500 m depth. It is important to note that the shallow waters were around 24°C near the surface. The salinity varied between 36 in the surface to 35.4 PSU at 400 m depth.

The oxygen shown the same mass water between 100 and 300m with 1.6ml/l. The surface waters were very oxygenated around 4 ml/l.

In this transect 19°00 N , the temperature of the surface waters was around 24°C and decreased vertically until 11°C at 500 m depth. The salinity decreased in the same way of the temperature between 36,5 PSU in the surface to 35,4 PSU at 500 m depth. The concentration of oxygen was more important in the surface layers (< 80 m) about 3 to 5 ml/l than the deeper layers (> 100 m) where the concentration was less than 2 ml/l .

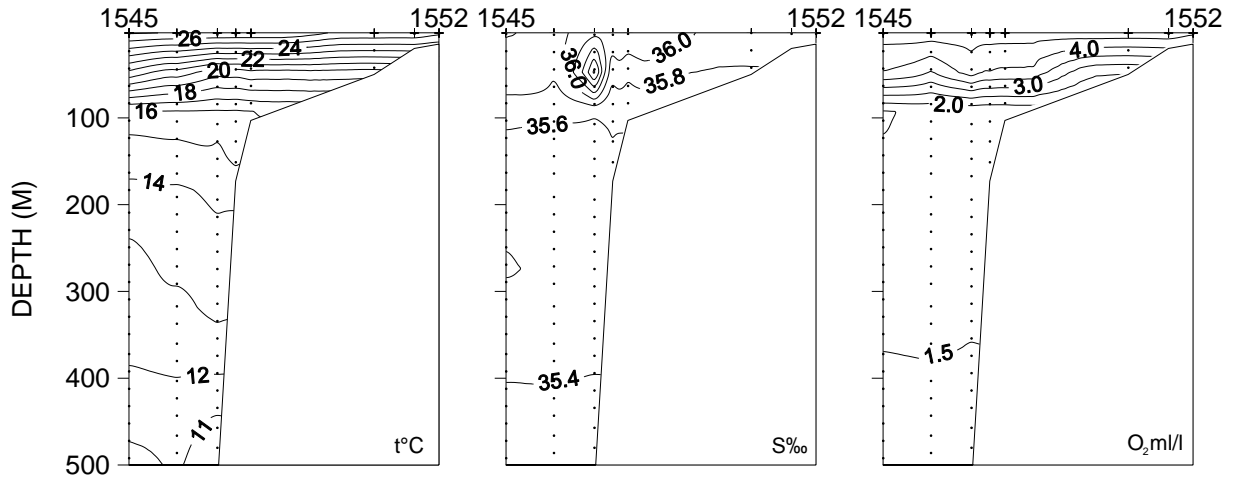
In this transect 20°00 N , the surface layer was very colder than the previous transects and the offshore waters it should be an upwelling area. It is verified with the profile of oxygen which was very rich 5 ml/l . The salinity in the surface was 36 PSU.

The surface waters showed an increase in water temperature from the coast and offshore, and a decrease from profile to profile northwards. The profiles at 17°N, 18°N and 19°N show a clear stratification around 50 m depth and minimum temperatures around $<12^{\circ}\text{C}$ was measured at 500 m depth. The 19°N line and to a larger extent the line at 20°N show clear indications of an upwelling situation with colder water masses from below the thermocline extending up on the inner shelf, while the line at Cape Blanc show well mixed water conditions without any clear thermocline. Cooler water masses (17°C) are observed on the inner shelf and warmer temperatures offshore (21°C). Minimum temperatures around 11°C is observed offshore at 500 m depth.

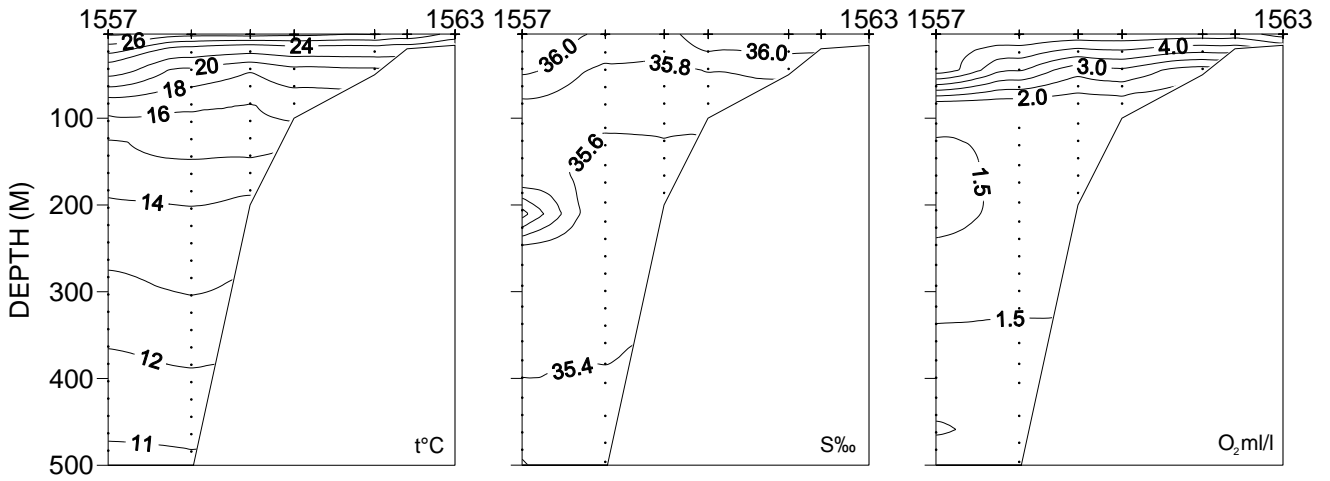
The salinity profiles generally show a gradual decreases in salinity with depth, with minimum levels around 250 m depth. The surface waters at the 17°N line is influenced by fresh water along the coast extending offshore towards the 100 m depth station. The rest of the survey area has sea surface salinity around 35.9‰. Particularly the cross shelf transect around 20°N shows clear signs of upwelling with deepening of the salinocline offshore and water been pushed up the shelf. Well-mixed water masses are observed at Cape Blank with salinity ranging from 36.1‰ offshore in the surface waters and 35.8‰ inshore. A salinity level of 35.4‰ is observed offshore at 500 m depth as in the rest of the survey area.

All the CTD transects show well oxygenated waters, with approximately >4 ml/l O_2 in the surface water, declining to 2 ml/l O_2 at approximately 70 m depth.

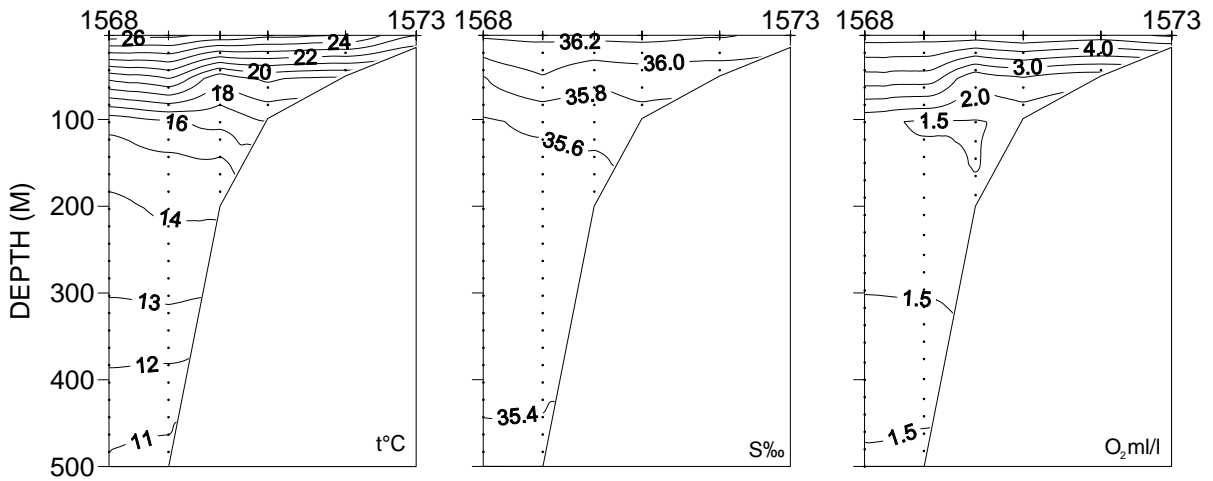
17°00'N



18°00'N **Nouakchott**



19°00'N



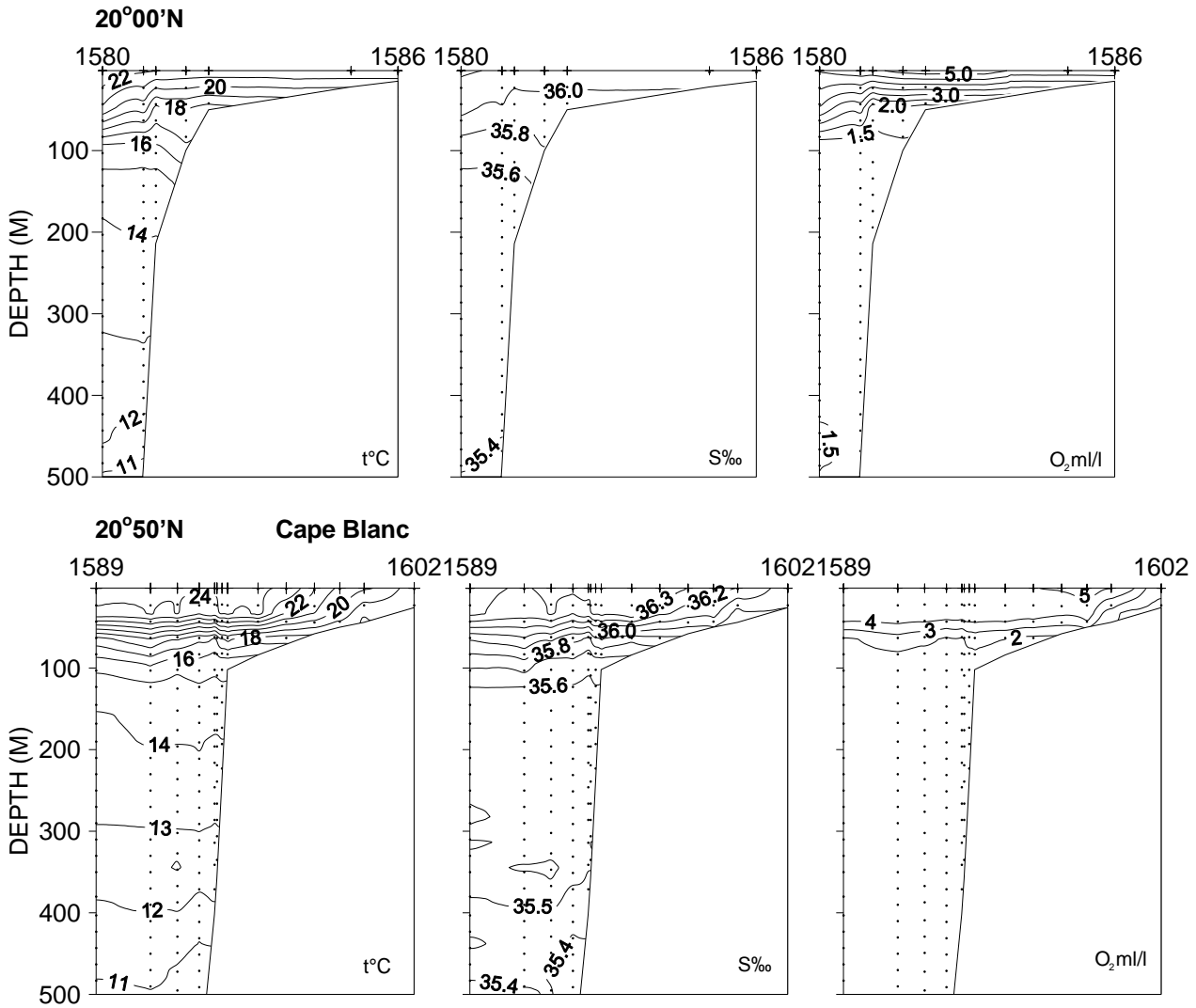


Figure 2. Hydrographical profiles with distribution of temperature, salinity and oxygen

Sea surface temperature and wind direction

Figure 3 shows the sea surface temperature at 5 m of depth.

The distribution of temperature (Fig.) showed that this parameter was decreased, when we live the south to north and It's varied between 28° C (at south) to 24°C at Cap timiris. The inshore waters were very colder than the offshore. It was the beginning of upwelling. The distribution of salinity (Fig.) varied contrarily of the temperature because it was increased from south to north (between 35 to 36 PSU)..

The southern part of Mauritania was characterized by relatively warm water masses, with surface water temperatures $>28^{\circ}\text{C}$ offshore, and $<26^{\circ}\text{C}$ inshore. At Nouakchott temperatures were slightly cooler than last year, approximately 1°C in the surface layer, both in shallow and deeper waters. Further north between Nouakchott and Cape Timiris even cooler water masses with a water temperatures $<22^{\circ}\text{C}$ was observed along the coast, dropping to $<21^{\circ}\text{C}$ at Cape Timiris. Off the shelf break, water temperatures are typically 25°C in this region. A strong thermal front can be observed off Cape Timiris where offshore waters dropping from $>25^{\circ}\text{C}$ to $<21^{\circ}\text{C}$. The wider shelf between Cape Timiris and Cape Blanc showed gradually colder water masses with water masses with temperatures $<20^{\circ}\text{C}$ experienced over most of the inner shelf. Another frontal region can be seen south west of Cape Blanc with temperatures dropping from $>23^{\circ}\text{C}$ to $<19^{\circ}\text{C}$. Temperatures were similar to last year but with stronger frontal zones evident in the region this year.

The sea surface salinity recorded at 5 m depth is presented in

Figure 5 show the wind direction and wind speed during the survey of Mauritania. The wind came from north and northwest in the whole survey area. Off Sr. Louis and around Cape Timiris more variable winds were experienced, with the wind direction often coming from northeast turning to east. The conditions were favourable for acoustic surveying throughout the survey.

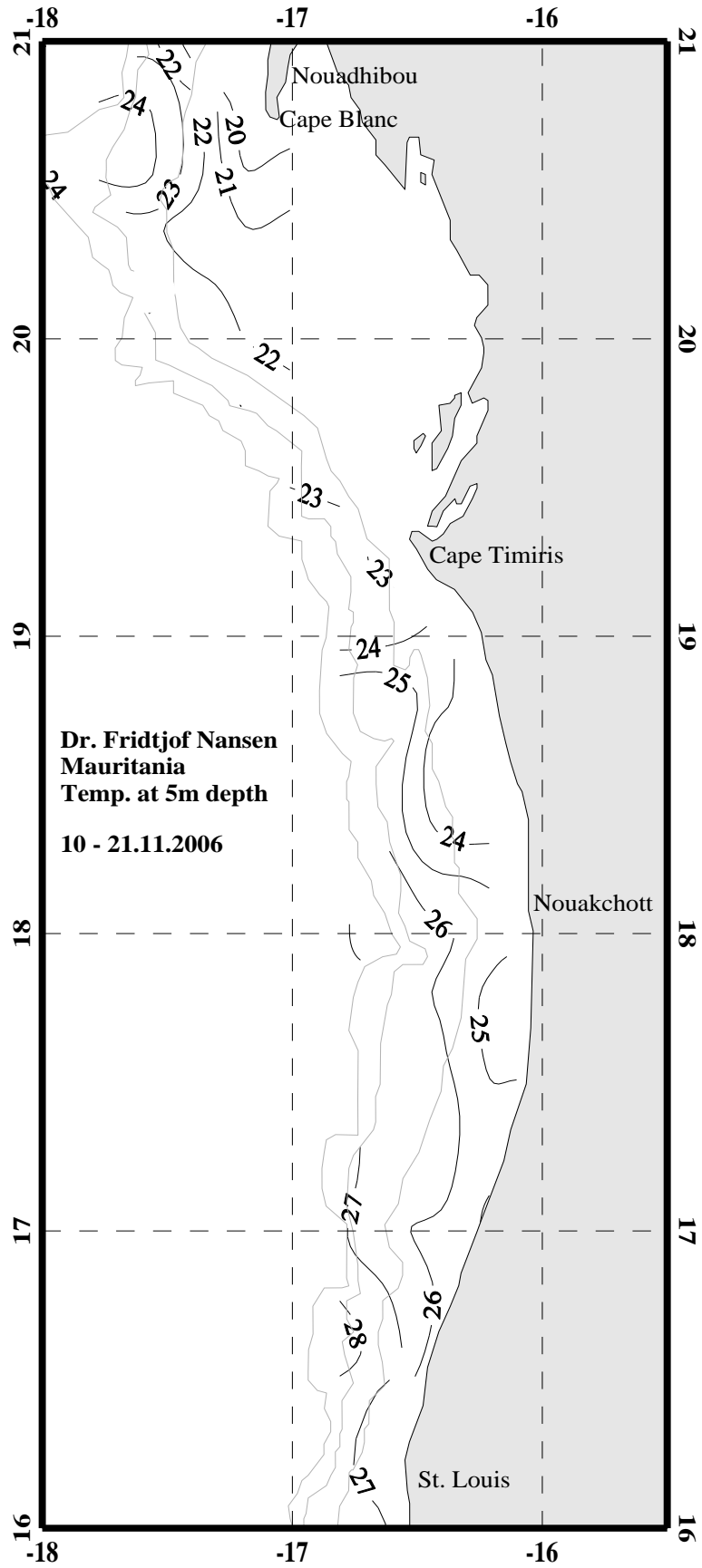


Figure 3. Sea surface temperature; St. Louis to Cape Blanc

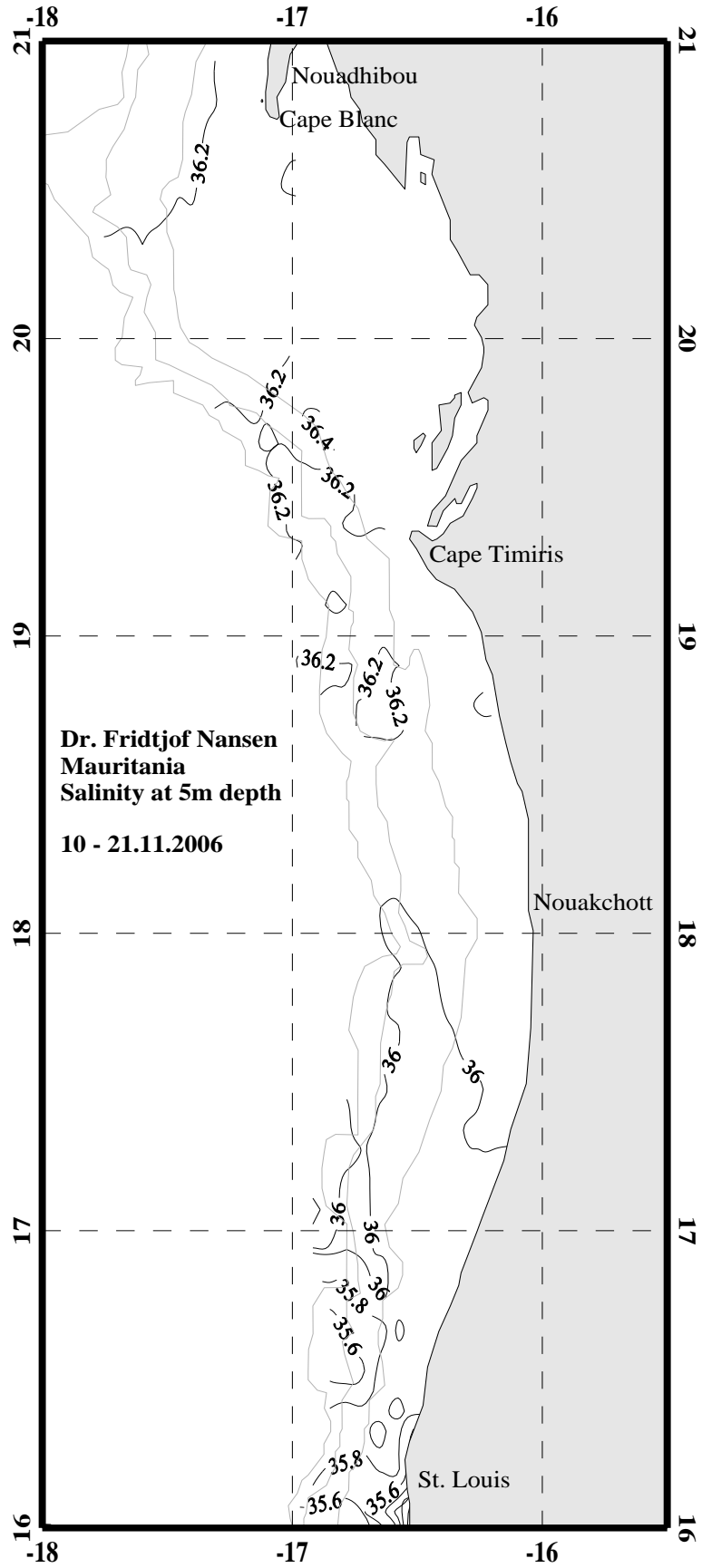


Figure 4 Sea surface salinity; St. Louis to Cape Blanc

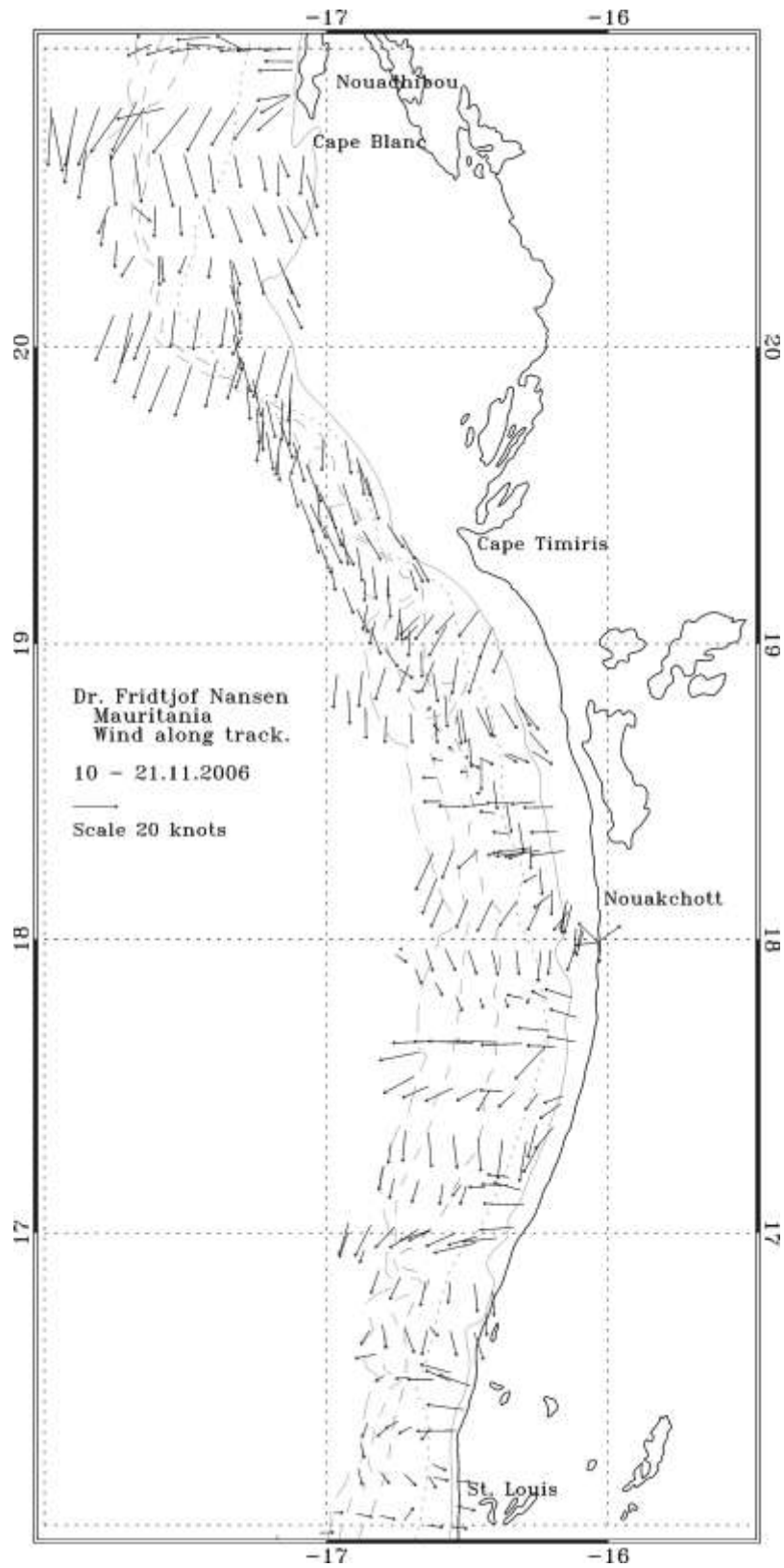


Figure 5. Wind speed and direction; St. Louis to Cape Blanc

3.2 St. Louis to Cape Timiris

The main groups of pelagic fish for the shelf of Mauritania illustrated with contoured acoustic densities are seen in Figure 6 to Figure 10. Estimated number and biomass by length-groups of the main pelagic species can be found in Annex IV.

Sardinella was found in a more or less continuous distribution between the border to Senegal at St. Louis, past Cape Timiris and Cape Blanc, continuing both north and south of the survey area. A small break in the distribution was experienced around 20°N. The highest concentration areas were mainly found deeper than 20 m depth, with lower concentrations further inshore and only few recordings of *Sardinella* deeper than 50 m depth, Figure 6. Both species of sardinella were found in the region between St. Louis and Cape Timiris but *S. maderensis* dominated with a biomass of 661 thousand tons compared with 203 thousand tons of *S. aurita*, Table 3. Last year the biomass of *S. aurita* in this region was estimated to be 6 thousand tons, while the biomass of *S. maderensis* was estimated at 302 thousand tons. At least four modal peaks at 7 cm, 13 cm, 18 cm and 25 cm length could be identified for *Sardinella maderensis*, with several cohorts occurring jointly for fish >20 cm. Catches of *S. aurita* was less regular and consequently fewer length frequencies were available. A few juvenile fish with a modal peak of 6 cm were caught, while the dominating part of the biomass was fish with modal peak of 31 cm.

The distribution of *Trachurus trecae* were continuous in a low-density area from <20 m to >100 m depth between St. Louis and Cape Timiris. The southernmost part of the distribution extended into the territorial waters of Senegal. Slightly higher concentrations were as typically observed found both at the shelf break and close inshore around the “shallow break” at 30 m depth, Figure 7. *Decapterus rhonchus* was mixed with the *T. trecae*, within its distribution area, but typically with main concentrations somewhat more shallow. The schools were mixed with plankton and other pelagic species inshore, particularly in the south of the distribution area. Four modal peaks at 9 cm, 13 cm, 19 cm and 32 cm could be observed in the length distribution of *T. trecae*. The larger *T. trecae* was as usually found on the shelf break, while the other cohorts were mainly found further inshore. The length distribution observed in the catches of *D. rhonchus* showed a modal peak at 15 cm, 19 cm, 24 cm and 28 cm. The biomass of *T. trecae* in the area was estimated to be 46 thousand tons, while 75 thousand tons of *D. rhonchus* was found. Last year roughly 58 thousand tons of *T. trecae* was found in this area, while 49 thousand tons of *D. rhonchus* was found

As usual the sardine (*Sardina pilchardus*) was found in an area south of Cape Timiris. The concentrations were medium to very high but the distribution area was relatively small, with

main concentrations distributed around the 20 m isobath. Highest densities were recorded between transects and the uncertainty in the estimate is considered relatively high. Like last year only mature fish, modal peak at 25 cm, were found in this area. The total biomass was estimated to be 33 thousand tons, excluding between transect values. Including these values increased the abundance estimate to close to 200 000 tons. Last year high abundance of sardine was found south of Cape Timiris, with an estimated biomass of 1 088 thousand tons.

Anchovy (*Engraulis encrasicolus*) were not found south of Cape Timiris.

Other pelagic fish (P2) were found in low concentrations over large parts of the shelf from around 15 m to >50 m bottom depth, Figure 9. The P2's were not found further offshore than the 100 m isobath, with the exception of smaller catches with *Trichiurus lepturus*. In general both carangids other than horse mackerel, scombrids, hairtails and barracudas were found in the area, Table 4. The trawl catches were dominated by *Chloroscombrus chrysurus* and *Trichiurus lepturus*. The P2 species were well mixed with the sardinellas and horse mackerel in the areas where their distribution overlapped. The estimated biomass of this group of fish was 37 thousand tonnes compared with 62 thousand tonnes last year.

Table 3. St.Louis – Cape Timiris. Biomass estimates of pelagic fish, thousand tonnes.

<i>S. maderensis</i>	<i>S. aurita</i>	<i>Sardina pilchardus</i>	Horse mackerels	Carangids etc.
661	203	33	121	37

Table 4. Catch by stations sorted by groups (in kg/hour) St. Louis – Cape Blanc

Station	Gear depth	Clupeids	Carangids	Scombrids	Hairtails	Barracuda	Other	Total
38	26.5	84.3	45.1	0	2.9	0	555.1	687.3
39	96	0	313.8	0	116.2	0	42.6	472.7
40	19.5	1.7	22.9	0	0	0	0	24.6
41	57	0	248.5	0	6.3	0.2	953.2	1208.3
42	5	37.4	22.8	0	2	0	20.7	82.9
43	27.5	0	132.5	0	33.2	0	13.4	179
44	22.5	3.6	3948	9.2	6.9	0	0	3967.7
45	22	0	6.4	0	0	0	2.3	8.6
46	57.5	0	0	0	0	0	68.8	68.8
47	10	0	2896.2	0	0	0	2947.7	5843.9
48	5	121.7	376.8	0	13.9	7.3	56.6	576.3
49	35	0	6	0	106.2	0	0.5	112.7
50	24.5	2.8	43.2	0	0	0	2	48.1
51	37.5	0	0	0	0	0	0	0
52	25	0	1071.4	0	0	0	33.4	1104.8
53	10	2018.2	362	4.7	0	32.4	11.7	2429
54	5	48.8	329.5	0	66.5	13.6	141.9	600.3
55	17	90.2	4.4	17.9	0	0	2.5	115
56	84	0	6999.5	0	6.4	0	7.4	7013.2
57	17.5	162.2	3.9	2.8	0	0	0.9	169.8
58	10	950.6	1071.2	0	6.2	5.1	204.8	2237.9
59	10	14.7	71.3	1	7.5	0	13.8	108.2
60	37.5	2	0	0	0	0	0	2
61	115.5	0	111.7	0	8.4	0	97.4	217.6
62	15	82.2	148.4	6.3	0	0	92.1	329
Mean	31.7	144.8	729.4	1.7	15.3	2.3	31.7	1104.3

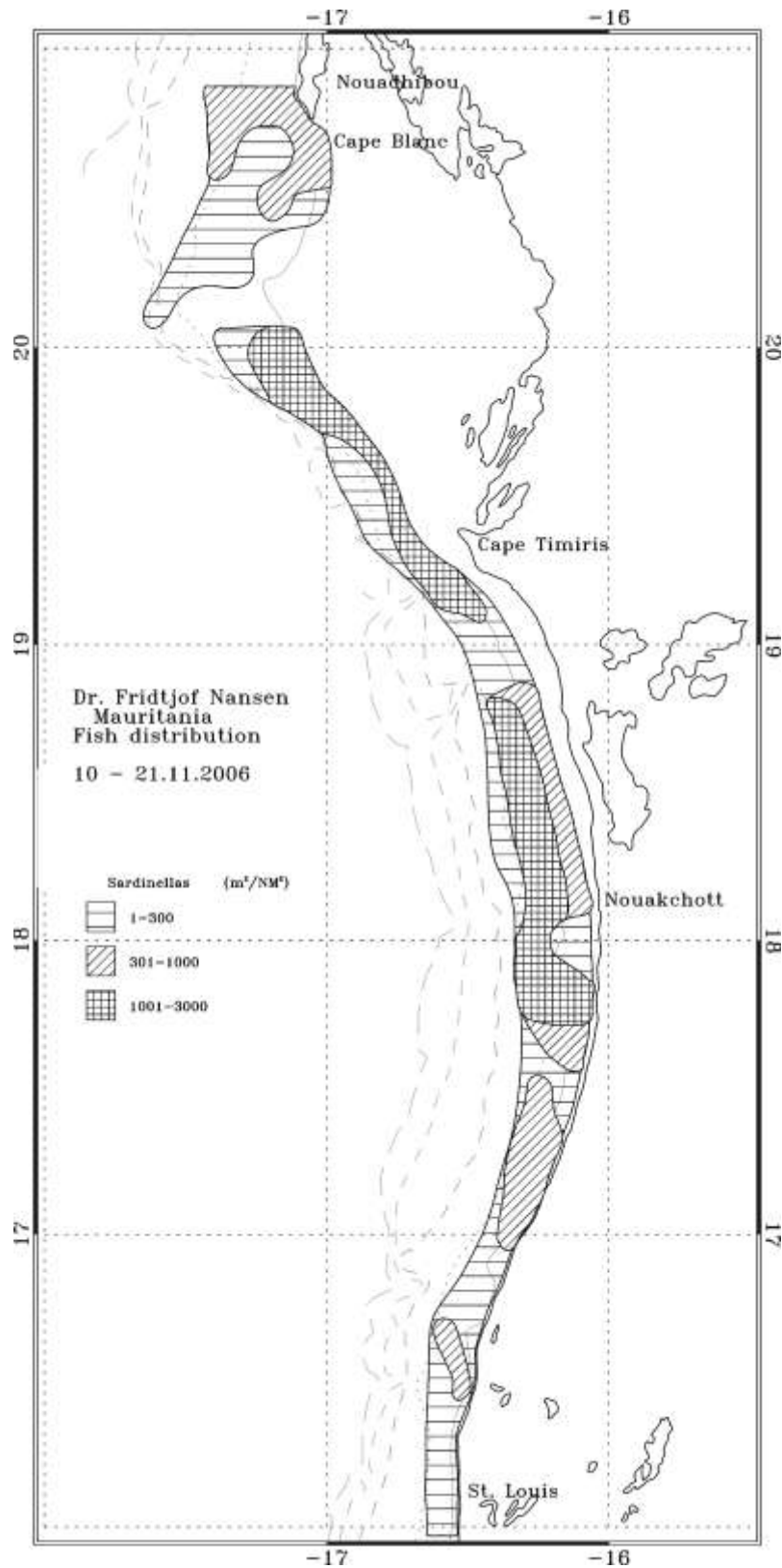


Figure 6. Distribution of sardinellas; St. Louis to Cape Blanc

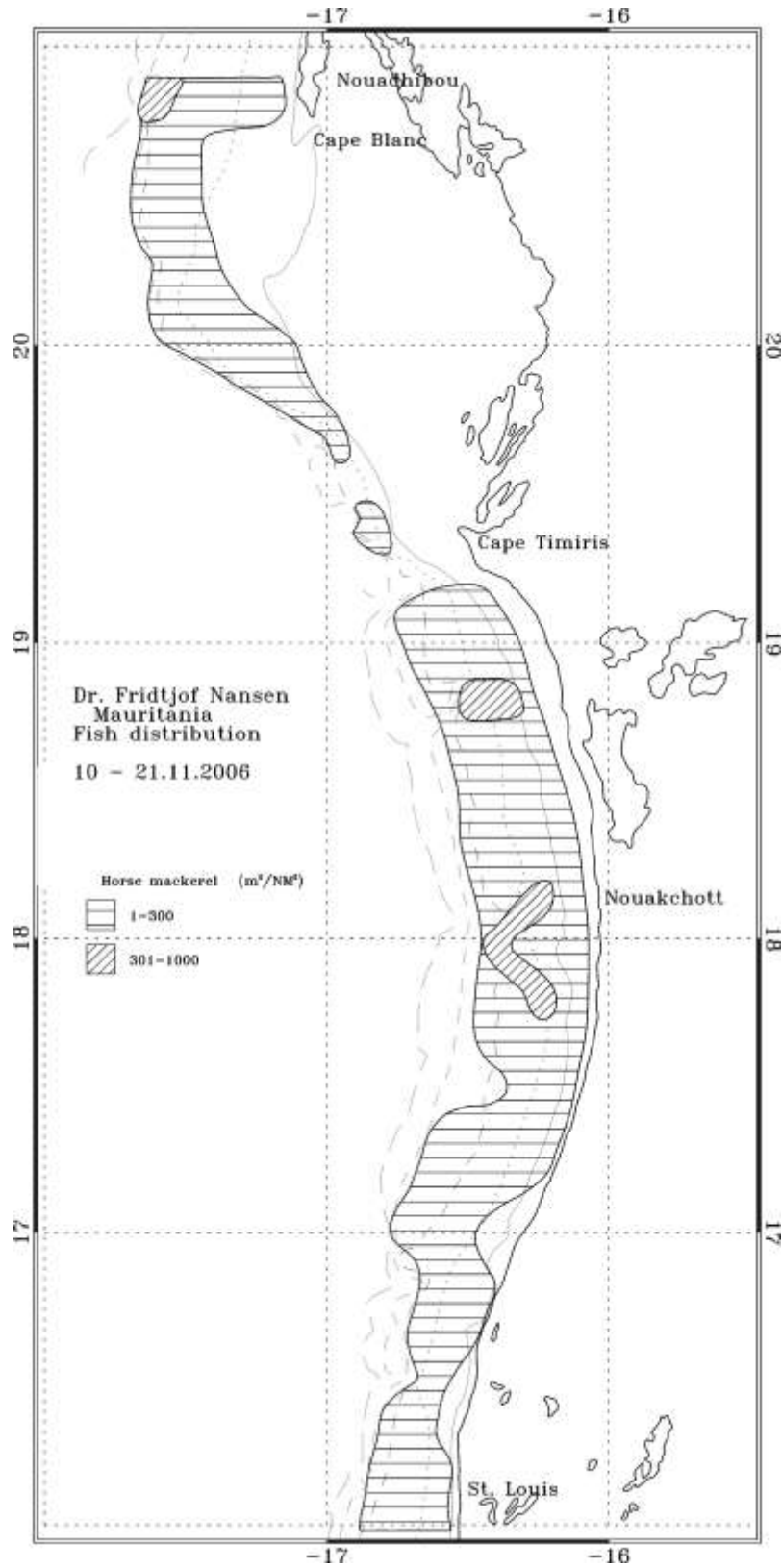


Figure 7. Horse mackerels; St. Louis to Cape Blanc

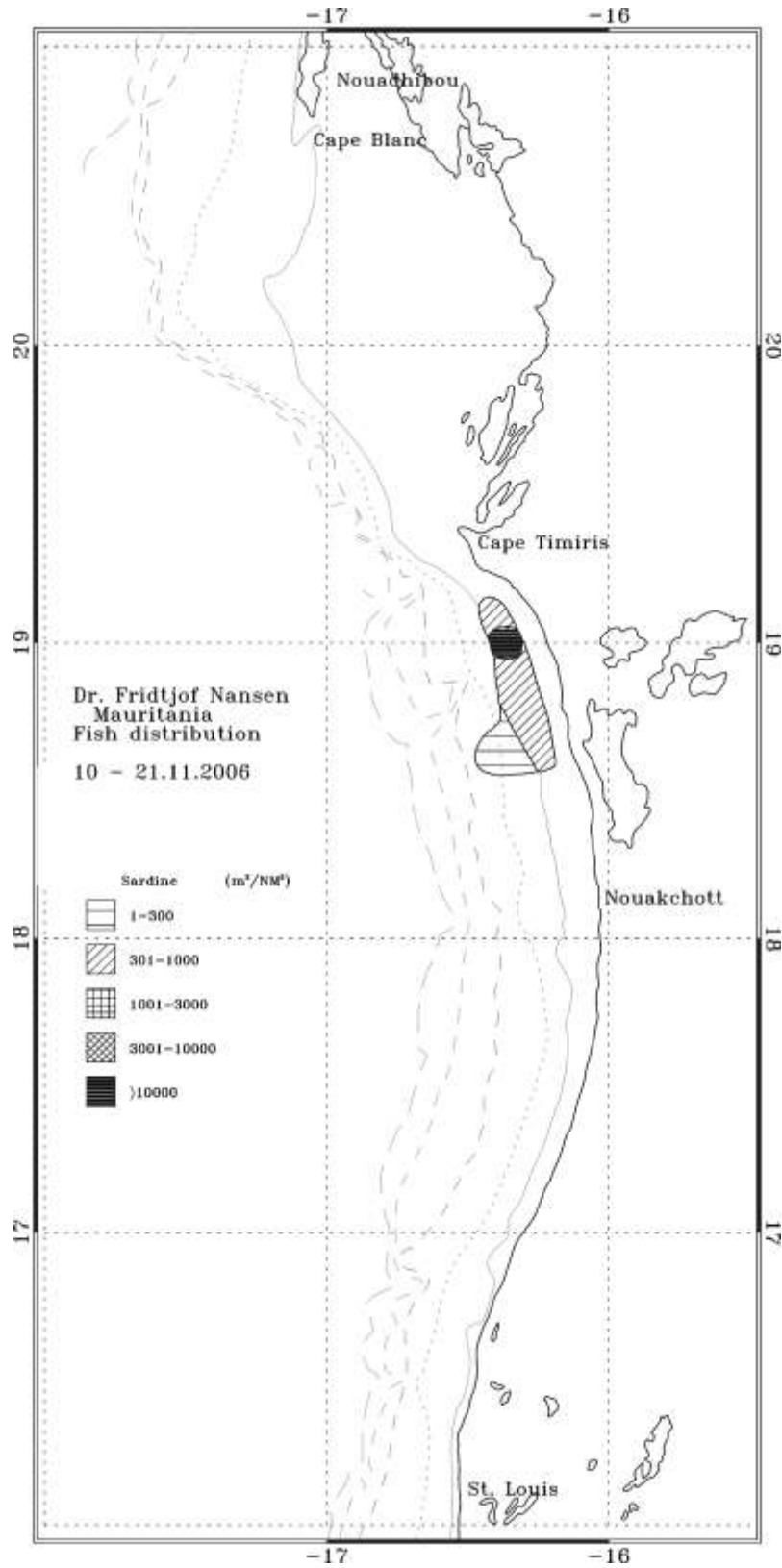


Figure 8. Sardine, St. Louis to Cape Blanc

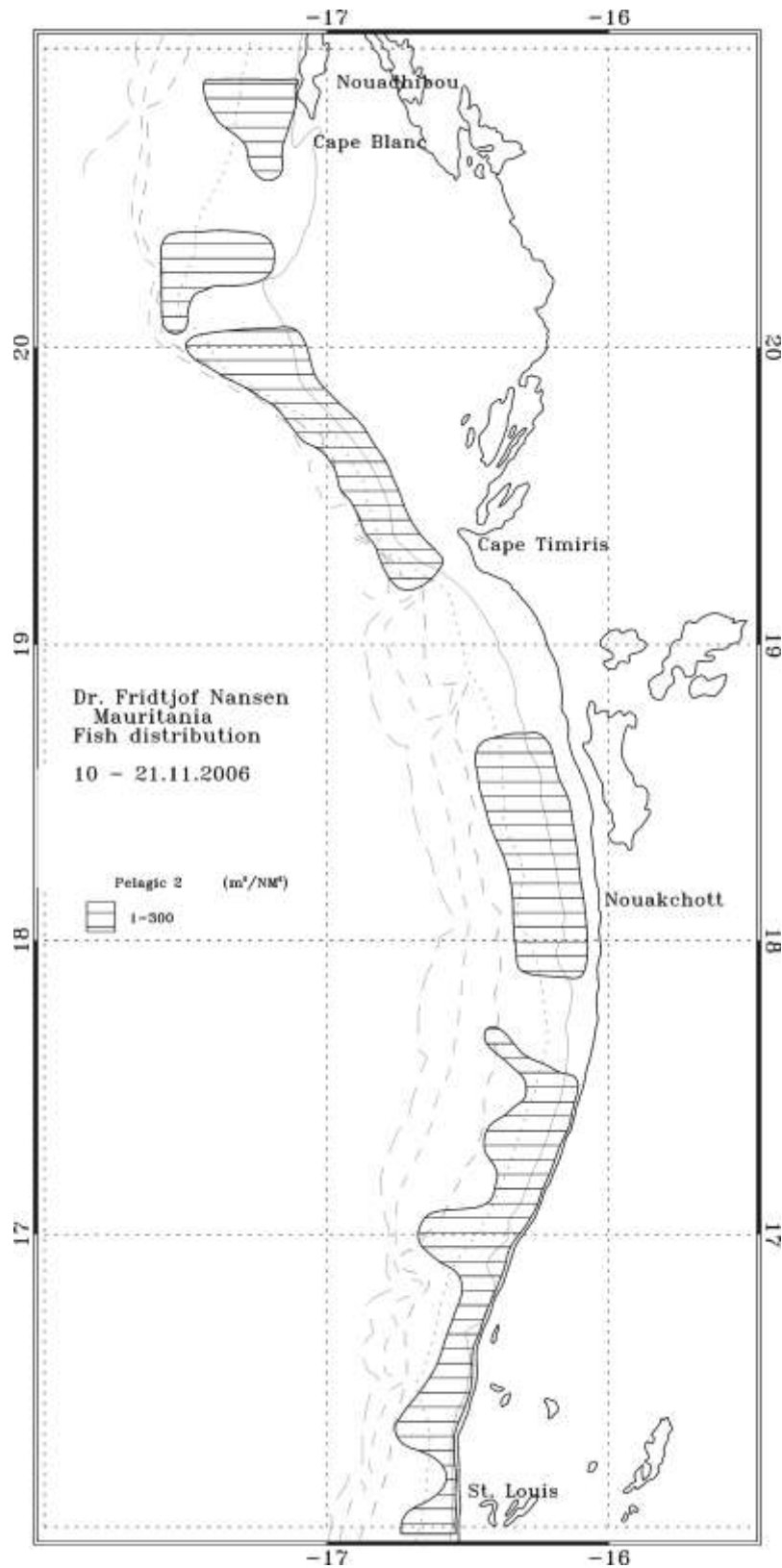


Figure 9. Carangids and associated species; St. Louis to Cape Blanc

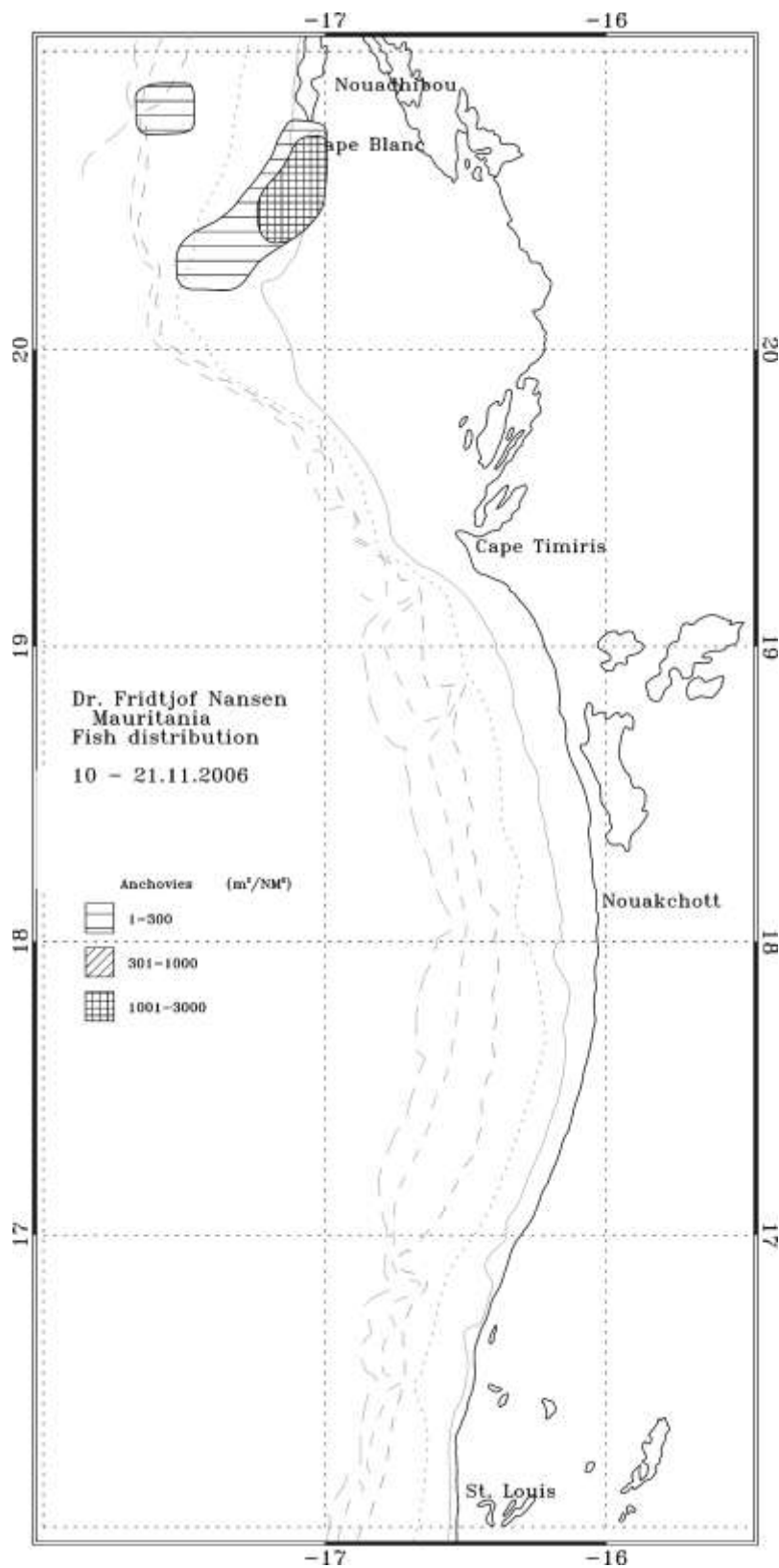


Figure 10. Distribution of Anchovy; St. Louis to Cape Blanc

3.3 Cape Timiris – Cape Blanc

The shelf region between Cape Timiris and Cape Blanc is known as a very productive area for pelagic fish. However the abundance this year was considerably less than in 2005 and main fish concentrations was found north and south of this area.

The distribution of sardinellas continued north of Cape Timiris and further north of the survey area at Cape Blanc from less than 20 m depth to and deeper than the 50 m isobath, Figure 6. A break in the fish concentrations was experienced around 20°N. *S. maderensis* was the most dominant of the two species and distributed in the whole region, while *S. aurita* was almost absent in the area. The total estimate of sardinellas between Cape Timiris and Cape Blanc during this survey was 355 thousand tons, of this 352 thousand tons were *S. maderensis* Table 5. Last year a total of 293 thousand tons of sardinellas was found in the area. This comprised of 68 thousand tons of *S. maderensis* and 225 thousand tons of *S. aurita*. The *S. maderensis* were found in the area showed two modal peaks at 7 cm and 25 cm, while the *S. aurita* in the area were juvenile fish with a modal peak at 6 cm. The estimated number and biomass by length-groups are in Annex IV.

Sardine (*Sardina pilchardus*) was not found between Cape Timiris and Cape Blanc, Last year the biomass of sardine in this region was estimated to be 1.1 million tons.

Anchovy (*Engraulis encrasicolus*) were found between 20 m and 50 m bottom depth in medium to very low concentrations north of 20°00'N to the border, Figure 10. The size of the fish in the area was between 6 and 11 cm with a modal peak at 6 cm and 8 cm. The abundance was estimated to 34 thousand tons. Last year 98 thousand tons of anchovy was estimated in the same region.

Cunene and Atlantic horse mackerel are frequently found mixed in the region between Cape Blanc and Cape Timiris, and also *Decapterus rhonchus* is normally found in the region. However, the last two years, only *Trachurus trecae* has been found between Cape Timiris and Cape Blanc. The Cunene horse mackerel was found between 20 m depth to the shelf break around 100 m depth on the southern part of the area, while the distribution in the northern part did only briefly go shallower than 50 m depth, Figure 7. A total of 39 thousand tons of Cunene horse mackerel was found in the area, Table 5. Last year the estimated biomass was 92 thousand tons, also consisting only of *T. trecae*. The size distribution of the horse mackerel showed four different modal peaks at 13 cm, 19 cm, 32 cm and 34 cm. The estimated number and biomass by length-groups can be found in Annex IV.

Carangids and associated species were found patchily in low density on the shelf between 20 and 50 m depth from Cape Timiris and northwards. Figure 9. *Chloroscombrus chrysurus* and *Trichiurus lepturus* dominated the group by weight. The biomass estimate of this group was 10 thousand tons, last year 3 thousand tons was estimated in the same area, Table 5.

Table 5. Cape Timiris – Cape Blanc. Biomass estimates of pelagic fish, thousand tons.

<i>S. maderensis</i>	<i>S. aurita</i>	<i>Sardina pilchardus</i>	<i>Engraulis encrasicolus</i>	Horse mackerels	Carangids etc.
352	3	0	34	39	10

Station	Gear depth	Clupeids	Carangids	Scombrids	Hairtails	Barracuda	Other	Total
63	19.5	3450.1	0	0	147.8	0	127.9	3725.9
64	15	3749.8	288.6	27.2	16.2	0	115.5	4197.4
65	17	0	210.7	1456.7	0	0	0	1667.4
66	20	5167.2	0	0	0	0	144.6	5311.8
67	35	16.4	4.8	9.3	0	0	1	31.4
68	21	0	39.4	39.4	5.7	0	277	361.4
69	27.5	516.2	1348.4	0	0	0	0	1864.6
Mean	22.1	1842.8	270.3	218.9	24.2	0.0	95.1	2451.4

Table 6. Catch by stations sorted by groups (in kg/hour) Cape Timiris – Cape Blanc

CHAPTER 4 OVERVIEW AND SUMMARY OF RESULTS

The survey was conducted successfully from 11th to 21st November. A change of scientific crew in Nouakchott was experienced in the middle of the survey due to the delayed departure from Dakar, however this did probably not affect the survey results as the break was done in an area of little or no fish. The survey covered a course track of approximately 1 256 NM excluding the travel to and from the survey area. A total of 31 fishing stations and 62 CTD casts were established.

The hydrographical data showed similar temperatures to those observed last year but with more pronounced frontal zones off Cape Timiris and Cape Blanc. Cold water masses <20°C was present in the northernmost part of the survey area around Cape Blanc and inshore of 20 m depth on Banc D'arguin, Figure 3. The major part of the Mauritanian shelf showed stable salinity levels around 35.9‰ – 36.0‰ while some freshwater influence was visible inshore off St. Louis due to river run-off.

Sardinellas were generally found along the whole shelf of Mauritania, between 15 m depth and offshore to approximately 50 m bottom depth, Figure 6. As usually observed in Mauritania the biomass was dominated by *S. maderensis*. The proportion, 83%, was similar to what was observed last year (88%). 65% of the total sardinella biomass of 1.2 million tons was found south of Cape Timiris,

Table 7. The abundance of sardinella in Mauritanian waters has increased since the estimate in November 2002 were only 320 tons of sardinella were found until the estimate last year when 1.5 million tons were found. In 2005 only 601 thousand tons of sardinella was estimated in the area while this year 1.2 million tons was recorded, Table 8. Large fluctuations have been experienced during the last 10 years of annual surveys in Mauritanian waters, and the major discrepancy between the last two observation points may be explained by temporal shift in distribution making less sardinella available in the survey area last year, possibly linked to the exceptional large abundance of sardine in the Cape Blanc region last year.

Sardines were only found inshore in shallow waters in the area off Cape Timiris, Figure 7. The total biomass was estimated to be 33 thousand tons. Last year a considerable biomass of 2.2 million tons was recorded. The major discrepancy between these two observation points may be explained both by temporal shift in distribution making more sardine available in the survey area last year, and a abundance decrease that at least partly was due to a decrease recorded in the sardine stock both this and last year (see part three of the survey report).

Anchovy was found on the northern part of the shelf off Banc D'arguin, Figure 9. The biomass was estimated to be 33 thousand tons. The abundance of anchovy is fluctuating considerable both regionally and within Mauritania, in 2005 98 thousand tons of anchovy was found in the same area. Prior to 2005 there was several years since last time any major concentrations of this species found in the region during the November survey.

The distribution of Cunene horse mackerel and false scad off Mauritania formed an almost continuous band, with a small break in the distribution around Cape Timiris. The distribution of the two species was continuous from the shelf break to 20 m depth with false scad most dominant in the inshore part of the distribution area, Figure 7. The abundance of false scad south of Cape Timiris was 75 thousand tons while none was found north of this. The total abundance estimate of Cunene horse mackerel was 85 thousand tons, 54% of this was found south of Cape Timiris. In 2005 149 000 tons was found. As in 2005 no Atlantic horse mackerel was found in Mauritania. The horse mackerels are the most valuable of the small pelagic fish species in this region and the abundance in Mauritania is lower than it has been in many years, and still decreasing. However, looking at the regional estimate we can see that the main abundance of both *Trachurus trecae* and *T. trachurus* is found north of the Mauritanian border (Annex V), and there is probably little reason for concern.

Other carangids and associated species were distributed in several low concentration areas over most of the shelf along the whole coast of Mauritania, Figure 9. The main species of P2 in the catches was *Trichiurus lepturus*, and *Chloroscombrus chrysurus*. The main groups of

species in the catches can be found in Table 4 and 6. The total biomass was estimated at approximately 47 thousand tons, of this 78% was found south of Cape Timiris.

An overview of the acoustic biomass estimates of the main groups of pelagic fish is shown in

Table 7, and their corresponding geographical distribution in Figure 11. The total biomass of sardinellas was thus 1219 thousand tons, sardine was estimated to be 33 thousand tons, anchovy 34 thousand tons, horse mackerels 160 thousand tons and carangids and associated species 47 thousand tons. Table 8 Show the time series of acoustic abundance surveys with Dr. Fridtjof Nansen in the Mauritanian region. The estimates for sardinella and a combined estimate for horse mackerel and the P2 species are presented.

Table 7. Summary of biomass estimates of pelagic fish, Mauritania. thousand tons / Résumé des biomasses de pélagiques en Mauritanie, en milliers de tonnes.

	<i>Sardinella maderensis</i>	<i>Sardinella aurita</i>	<i>Sardina pilchardus</i>	<i>Engraulis encrasicolus</i>	Horse mackerels	Carangids etc.
St. Louis – Cape Timiris	661	203	33	0	121	37
Cape Timiris – Cape Blanc	352	3	0	34	39	10
Total	1013	206	33	34	160	47

Table 8. Biomass estimates from the ‘Dr. Fridtjof Nansen’ surveys of the Mauritanian shelf, thousand tons / Biomasses estimées par le ‘Dr. Fridtjof Nansen’ sur les cotes de la Mauritanie, en milliers de tonnes.

Survey:	Sardinellas	Carangids etc.
AprMay-81	20	370
Sept -81	75	*
FebMar -82	50	470
NovDec-86	300	540
FebMar-92	1 970	190
NovDec-95	1 780	190
NovDec-96	1 400	400
NovDec-97	1 200	660
NovDec-98	1 130	280
NovDec-99	740	560
NovDec-00	930	1 040
June -01	570	670
NovDec-01	230	370
June -02	930	1 130
NovDec-02	320	440
June - 03	890	620
Nov - 03	1 287	400
Nov - 04	1 548	231
Nov - 05	601	263
Nov - 06	1 219	207

* Not available

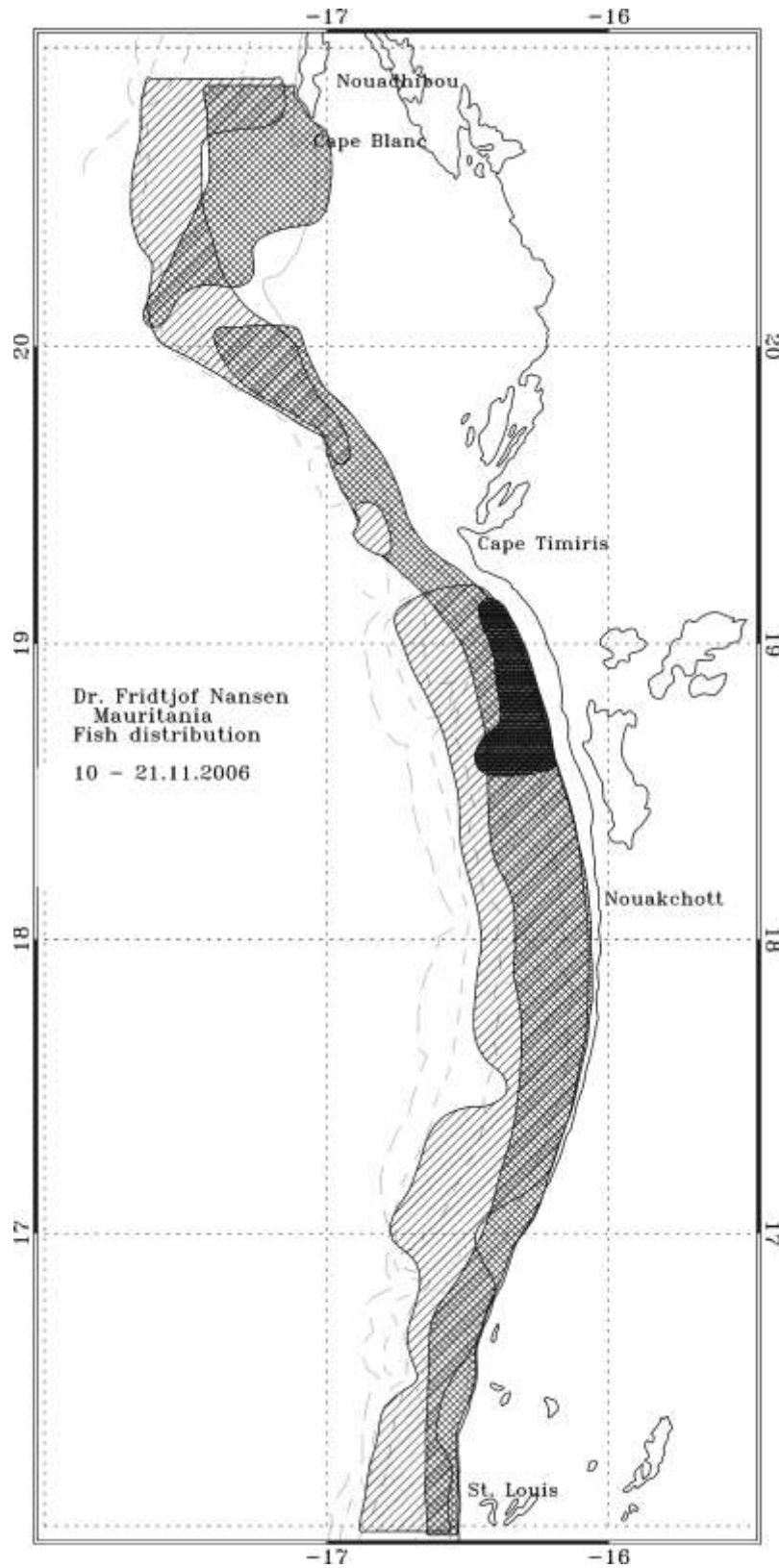


Figure 11. Major pelagic fish concentrations with estimated biomass (tonnes), Mauritania / Concentrations principales des poissons pélagiques et biomasses estimées (tonnes), Mauritanie.

RÉSUMÉ

La campagne a été conduite avec succès durant la période du 10 au 19 novembre selon un parcours d'une longueur approximative de 1680 milles nautiques. Au total, 45 stations de pêche de contrôle et 56 stations CTD ont été réalisées.

Les données hydrographiques révèlent des températures similaires à celles observées l'année dernière mais avec des fronts plus prononcés au large de Cap Timiris et Cap Blanc. Des masses d'eaux <math> < 20^{\circ}\text{C}</math> étaient présentes au nord de la zone couverte autour de Cap de Blanc et près de la côte, sur les fonds de 20m au niveau du Banc D'arguin, Figure 3. La grande majorité des eaux couvertes en Mauritanie montre une stabilité de la salinité autour de 35.9‰ – 36.0‰ tandis qu'une influence d'eaux douces était perçue au large de St. Louis due au fleuve à ce niveau.

Les sardinelles ont été rencontrées en général sur toute la côte, entre 15m de profondeur vers approximativement 50m de profondeur, Figure 6. Comme c'est le cas souvent en Mauritanie, les *S. Maderensis* ont prédominé. La proportion, de 88%, est similaire à celle observée l'année dernière. 52% de la biomasse des deux espèces étaient trouvés au sud de Cap Timiris avec une densité généralement plus faible, surtout au sud, que celle observée l'année dernière.

Les sardines ont été rencontrées sur la côte dans les petits fonds à Cap Timiris, en bancs moins denses entre Cap Timiris et Cap Blanc et en fortes concentrations autour de Cap Blanc, Figure 7. Le total de la biomasse en Mauritanie est estimée à 2.2 millions de tonnes, parmi les records de biomasses enregistrées en Mauritanie en cette période de l'année. Autour de 50% de cette biomasse a été trouvée au large de Cap Timiris tandis que le reste était trouvé au nord de cette zone.

L'anchois a été rencontré dans des proportions relativement denses sur la côte autour du Banc D'arguin, Figure 9. L'abondance des anchois fluctue considérablement d'une région à une autre et voici plusieurs années depuis la dernière fois que des concentrations aussi denses ont été rencontrées dans la région en novembre.

Quatre zones de distribution de faible densité, étalées pratiquement sur une bande continue, constituent l'aire de répartition des chinchards noirs et des chinchards jaunes en Mauritanie. La distribution des deux espèces était continue depuis la limite du plateau continental jusqu'à l'isobathe des 20 m avec une prédominance des chinchards jaunes vers la côte, Figure 7. La biomasse des chinchards jaunes au sud du Cap Timiris était de 49 milles tonnes alors qu'aucune trace n'a été rencontrée au nord de cette zone. La biomasse totale des chinchards noirs est évaluée à 149 milles tonnes, 39% de celle-ci a été trouvée au sud de Cap Timiris.

Seules quelques traces de *T. Trachurus* ont été trouvées en Mauritanie cette année et aucune estimation n'a été faite pour cette espèce.

Les autres carangidés et espèces associées sont régulièrement distribués sur toute la côte jusqu'à 20°N, avec de moindres densités, Figure 9. Les principales espèces de P2 dans les captures étaient le *Trichiurus lepturus*, et le *Chloroscombrus chrysurus*, tandis que les *Brachydeuterus auritus*, *Stromateus fiatola* et les *Lagocephalus laevigatus* ont été fréquemment capturées sur la côte au sud de Cap Timiris. Les groupes principaux d'espèces dans les captures sont figurés Table 4 et 6. La biomasse totale est estimée approximativement à 65 milles tonnes, dont 62 milles tonnes au sud de Cap Timiris.

Le tableau 7 ci-dessous résume la biomasse pour chaque groupe de pélagiques ; la répartition géographique et l'abondance de ces espèces sont présentées en figure 10. Ainsi, la biomasse totale des sardinelles s'élève à 601 milles tonnes, celle des sardines à 2.2 milles tonnes, celle des anchois à 98 milles tonnes, celles de chinchards à 198 milles tonnes et les carangidés et espèces associées sont estimées à 65 milles tonnes.

L'abondance des sardinelles en Mauritanie a augmenté notablement depuis les estimations de novembre 2002 où seulement 320 milles tonnes de sardinelles ont été trouvées jusqu'aux estimations de l'année dernière où 1.5 million tonnes ont été trouvées, Table 8. Cette année une biomasse de 601 milles tonnes de sardinelles a été estimée. D'importantes fluctuations ont été observées durant les 10 dernières années de campagne annuelle en Mauritanie. La raison réelle n'est pas très claire mais les sardinelles et les sardines se mélangent quand elles co-existent, leur séparation est généralement difficile et ceci peut affecter les estimations. Cette année on assiste à une forte diminution des sardinelles tandis que la tendance inverse est observée pour les sardines. Bien que les estimations dans le rapport soient considérées comme les meilleures possibles, les nombres doivent toutefois être manipulés avec précaution. C'est aussi probable que des sardinelles soient localisées sur la côte dans les fonds inférieurs à 15 m et qu'elles ne soient pas prises en compte dans cette étude.

Cette année 149 milles tonnes de *Trachurus trecae* ont été trouvées, ceci représente une hausse par rapport aux 74 milles tonnes observés l'année dernière. En plus, la biomasse des *Decapterus rhonchus* a été estimée à 49 milles tonnes. L'année dernière 9 milles tonnes de *Trachurus trachurus* ont été trouvées en Mauritanie tandis que cette année seules quelques traces ont été enregistrées.

Les chinchards sont les petits pélagiques les plus valeureuses dans cette région et leur abondance en Mauritanie est inférieure à celle d'il y a plusieurs années, et elle continue de

chuter. Cependant, en regardant l'évaluation régionale nous pouvons voir que la principale abondance de *Trachurus trecae* et *T. trachurus* est trouvée à la frontière nord de la Mauritanie, et il y a probablement peu raison de s'inquiéter à ce propos

References

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MacLennan, D. N. and Simmons E. J. (1992). Fisheries Acoustics. Chapman and Hall.325p.

Annex I Records of fishing stations

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 38
 DATE :12/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 16°10.92
 start stop duration Lon W 16°37.83
 TIME :03:26:25 03:56:30 30.1 (min) Purpose : 1
 LOG : 1436.53 1438.48 2.0 Region : 1220
 FDEPTH: 23 30 Gear cond.: 0
 BDEPTH: 47 45 Validity : 0
 Towing dir: 10° Wire out : 85 m Speed : 3.9 kn
 Sorted : 61 Total catch: 344.58 Catch/hour: 687.33

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	389.78	3928	56.71	
Sardinella maderensis	84.26	4081	12.26	70
J E L L Y F I S H	73.84	78	10.74	
Stromateus fiatola	65.94	100	9.59	
Trachurus trecae	31.72	1997	4.61	69
Rhizoprionodon acutus	13.36	16	1.94	
Selene dorsalis	7.36	122	1.07	
Arius parkii	7.02	12	1.02	
Decapterus rhonchus	3.95	12	0.57	
Penaeus notialis	3.95	297	0.57	
Trichiurus lepturus	2.85	22	0.41	
Trachinotus ovatus	2.09	12	0.30	
Echeneis naucrates	1.20	12	0.17	
Total	687.33		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 39
 DATE :12/11/2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 16°21.21
 start stop duration Lon W 16°44.82
 TIME :08:29:01 08:48:19 19.3 (min) Purpose : 1
 LOG : 1477.97 1478.78 0.8 Region : 1220
 FDEPTH: 97 95 Gear cond.: 0
 BDEPTH: 97 95 Validity : 0
 Towing dir: 95° Wire out : 320 m Speed : 2.5 kn
 Sorted : 30 Total catch: 152.12 Catch/hour: 472.67

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	116.21	2035	66.39	71
Trichiurus lepturus	9.48	513	2.00	
Loligo vulgaris	9.69	47	2.05	
Boops boops	8.30	22	1.76	
Merluccius polli	6.21	31	1.31	
Brachydeuterus auritus	3.29	16	0.70	
Zeus faber	2.98	3	0.63	
Priacanthus arenatus	1.62	16	0.34	
Illex coindetii	1.06	9	0.22	
Total	472.67		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 40
 DATE :12/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 16°29.37
 start stop duration Lon W 16°34.08
 TIME :12:19:28 12:42:20 22.9 (min) Purpose : 1
 LOG : 1511.07 1512.48 1.4 Region : 1220
 FDEPTH: 17 22 Gear cond.: 0
 BDEPTH: 30 30 Validity : 0
 Towing dir: 10° Wire out : 60 m Speed : 3.7 kn
 Sorted : 9 Total catch: 9.38 Catch/hour: 24.62

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachinotus ovatus	17.45	89	70.90	
Alectis alexandrinus	5.43	18	22.07	
Sardinella maderensis	1.73	21	7.04	72
Total	24.62		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 41
 DATE :12/11/2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 16°40.78
 start stop duration Lon W 16°38.35
 TIME :17:18:59 17:49:16 30.3 (min) Purpose : 1
 LOG : 1554.07 1555.71 1.6 Region : 1220
 FDEPTH: 56 58 Gear cond.: 0
 BDEPTH: 56 58 Validity : 0
 Towing dir: 10° Wire out : 180 m Speed : 3.3 kn
 Sorted : 91 Total catch: 609.78 Catch/hour: 1208.28

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Priacanthus arenatus	673.71	6434	55.76	
Trachurus trecae	186.26	5350	15.42	73
Loligo vulgaris	115.44	436	9.55	
Pomadasys incisus	108.98	515	9.02	
Decapterus rhonchus	43.59	145	3.61	74
Pageillus bellottii	23.78	159	1.97	
Brachydeuterus auritus	20.21	133	1.67	
Alectis alexandrinus	14.86	6	1.23	
Stromateus fiatola	11.10	26	0.92	
Trichiurus lepturus	6.34	79	0.52	
Chloroscombrus chrysurus	2.38	14	0.20	
Selene dorsalis	1.39	14	0.11	
Sphyræna sphyraena	0.24	2	0.02	
Total	1208.28		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 42
 DATE :12/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 16°40.49
 start stop duration Lon W 16°27.02
 TIME :19:36:44 20:10:40 33.9 (min) Purpose : 1
 LOG : 1570.16 1571.82 1.7 Region : 1220
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 18 17 Validity : 0
 Towing dir: 17° Wire out : 150 m Speed : 2.9 kn
 Sorted : 47 Total catch: 46.89 Catch/hour: 82.89

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	31.38	127	37.85	75
Alectis alexandrinus	15.98	64	19.28	
Leptocharias smithii	9.76	11	11.77	
Stromateus fiatola	5.60	16	6.76	
Sardinella aurita	4.38	16	5.29	76
Trachurus trecae	3.98	21	4.80	
Trichiurus lepturus	2.02	21	2.43	
Sardinella maderensis	1.66	148	2.00	
Selar crumenophthalmus	1.54	5	1.86	
Penaeus notialis	1.47	173	1.77	
Pomadasys peroteti	0.97	4	1.17	
Trachurus trecae	0.83	27	1.00	
Sepia officinalis hierredda	0.78	2	0.94	
Echeneis naucrates	0.74	2	0.90	
Brachydeuterus auritus	0.55	269	0.66	
Priacanthus arenatus	0.41	4	0.49	
Chloroscombrus chrysurus	0.39	4	0.47	
Lagocephalus laevigatus	0.28	2	0.34	
Pseudupeneus prayensis	0.14	2	0.17	
Caranx senegalus	0.07	2	0.09	
Total	82.93		100.04	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 43
 DATE :13/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 17°0.43
 start stop duration Lon W 16°37.95
 TIME :04:23:23 04:53:41 30.3 (min) Purpose : 1
 LOG : 1638.07 1639.90 1.8 Region : 1220
 FDEPTH: 30 25 Gear cond.: 0
 BDEPTH: 98 102 Validity : 0
 Towing dir: 276° Wire out : 70 m Speed : 3.6 kn
 Sorted : 25 Total catch: 90.40 Catch/hour: 179.01

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	132.48	8691	74.00	77
Trichiurus lepturus	33.17	125	18.53	
J E L L Y F I S H	11.70	12	6.54	
Saurida brasiliensis	1.66	570	0.93	
Total	179.01		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 44
 DATE :13/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 16°58.07
 start stop duration Lon W 16°27.36
 TIME :07:01:28 07:15:14 13.8 (min) Purpose : 1
 LOG : 1655.65 1656.52 0.9 Region : 1220
 FDEPTH: 22 23 Gear cond.: 0
 BDEPTH: 34 37 Validity : 0
 Towing dir: 230° Wire out : 110 m Speed : 3.8 kn
 Sorted : 60 Total catch: 910.58 Catch/hour: 3967.67

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	3899.78	23856	98.29	
Trachurus trecae	28.06	126	0.71	79
Decapterus rhonchus	20.13	83	0.51	78
Euthynnus alletteratus	9.19	9	0.23	
Trichiurus lepturus	6.93	22	0.17	
Sardinella maderensis	3.57	17	0.09	
Total	3967.67		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 45
 DATE :13/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 17°10.16
 start stop duration Lon W 16°21.35
 TIME :10:36:33 11:06:49 30.3 (min) Purpose : 1
 LOG : 1681.78 1683.86 2.1 Region : 1220
 FDEPTH: 24 20 Gear cond.: 0
 BDEPTH: 39 42 Validity : 0
 Towing dir: 3° Wire out : 100 m Speed : 4.1 kn
 Sorted : 4 Total catch: 4.35 Catch/hour: 8.62

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Alectis alexandrinus	2.97	10	34.48	
Chloroscombrus chrysurus	2.66	16	30.80	
J E L L Y F I S H	1.53	2	17.70	
Trachurus trachurus	0.73	2	8.51	
Brachydeuterus auritus	0.73	6	8.51	
Total	8.62		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 46
 DATE :13/11/2006 GEAR TYPE: PT NO: 2 POSITION:Lat N 17°9.93
 start stop duration Lon W 16°32.19
 TIME :13:08:02 13:28:06 20.1 (min) Purpose : 1
 LOG : 1701.10 1702.36 1.3 Region : 1220
 FDEPTH: 50 65 Gear cond.: 0
 BDEPTH: 99 92 Validity : 0
 Towing dir: 99° Wire out : 215 m Speed : 3.8 kn
 Sorted : 23 Total catch: 23.02 Catch/hour: 68.82

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
J E L L Y F I S H	80.54	45	87.97	
sea cucumbers	8.22	212	11.95	
Sepiella ornata	0.06	6	0.09	
Total	68.82		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 47
 DATE :13/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 17°19.92
 start stop duration Lon W 16°15.71
 TIME :20:00:39 20:30:22 29.7 (min) Purpose : 1
 LOG : 1760.77 1762.45 1.7 Region : 1220
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 32 34 Validity : 0
 Towing dir: 10° Wire out : 150 m Speed : 3.4 kn
 Sorted : 96 Total catch: 2894.70 Catch/hour: 5843.94

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Brachydeuterus auritus	2552.83	25888	43.68	
Chloroscombrus chrysurus	2131.90	1605	36.48	
Trachurus trecae	542.06	8423	9.28	80
Decapterus rhonchus	182.30	727	3.12	81
Pomadasys incisus	145.36	908	2.49	
Pagellus bellottii	101.75	848	1.74	
Pomadasys peroteti	61.78	242	1.06	
Artius heudeloti	40.58	182	0.69	
Alectis alexandrinus	24.83	61	0.42	
Sepia officinalis hierredda	19.99	121	0.34	
Selene dorsalis	15.14	242	0.26	
Penaeus notialis	13.93	969	0.24	
Chelidonichtys gabonensis	5.45	61	0.09	
Boops boops	3.63	187	0.06	
Pseudupeneus prayensis	2.42	61	0.04	
Total	5843.94		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 48
 DATE :13/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 17°28.25
 start stop duration Lon W 16°9.60
 TIME :23:10:05 23:28:03 18.0 (min) Purpose : 1
 LOG : 1779.94 1780.95 1.0 Region : 1220
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 17 17 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.4 kn
 Sorted : 34 Total catch: 172.86 Catch/hour: 577.16

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	273.79	2235	47.44	
Decapterus rhonchus	103.01	634	17.85	82
Ilisha africana	75.46	1068	13.07	
Sardinella maderensis	41.90	167	7.26	
Brachydeuterus auritus	33.39	2755	5.79	
Trichurus lepturus	13.86	67	2.40	
Stromateus fiatola	12.69	33	2.20	
Sphyræna guachancho	7.35	17	1.27	
Sardinella aurita	4.34	17	0.75	
Pomadasys peroteti	3.04	7	0.53	
Pteroscion pelli	2.67	17	0.46	
Penaeus notialis	2.00	117	0.35	
Pagellus bellottii	2.00	17	0.35	
Sardinella maderensis	0.83	67	0.14	0
Galeoides decadactylus	0.83	17	0.14	
Total	577.16		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 49
 DATE :14/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 17°29.13
 start stop duration Lon W 16°25.39
 TIME :01:52:39 02:23:13 30.6 (min) Purpose : 1
 LOG : 1800.23 1802.27 2.0 Region : 1220
 FDEPTH: 40 30 Gear cond.: 0
 BDEPTH: 97 84 Validity : 0
 Towing dir: 95° Wire out : 105 m Speed : 4.0 kn
 Sorted : 57 Total catch: 57.41 Catch/hour: 112.68

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trichurus lepturus	106.18	451	94.23	
Trachurus trecae	6.01	338	5.33	83
Saurida brasiliensis	0.45	114	0.40	
Alloteuthis subulata	0.04	27	0.03	
Total	112.68		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 50
 DATE :14/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 17°39.42
 start stop duration Lon W 16°13.14
 TIME :08:32:41 09:20:50 48.2 (min) Purpose : 1
 LOG : 1855.18 1858.17 3.0 Region : 1220
 FDEPTH: 25 24 Gear cond.: 0
 BDEPTH: 43 41 Validity : 0
 Towing dir: 100° Wire out : 120 m Speed : 3.7 kn
 Sorted : 0 Total catch: 38.60 Catch/hour: 48.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	39.75	194	82.64	84
Trachinotus ovatus	3.08	10	6.40	
Sardinella maderensis	2.42	10	5.03	85
Stromateus fiatola	2.04	4	4.25	
Sardinella aurita	0.41	1	0.85	
Chloroscombrus chrysurus	0.40	2	0.83	
Total	48.10		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 51
 DATE :14/11/2006 GEAR TYPE: PT NO: 2 POSITION:Lat N 17°48.05
 start stop duration Lon W 16°17.73
 TIME :12:39:44 13:05:05 25.4 (min) Purpose : 1
 LOG : 1890.35 1892.00 1.7 Region : 1220
 FDEPTH: 35 40 Gear cond.: 0
 BDEPTH: 72 65 Validity : 0
 Towing dir: 90° Wire out : 140 m Speed : 3.9 kn
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
N O C A T C H	0.00	0	0.00	
Total	0.00		0.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 52
 DATE :14/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 17°57.77
 start stop duration Lon W 16°21.09
 TIME :20:21:08 20:54:03 32.9 (min) Purpose : 1
 LOG : 1953.54 1955.87 2.3 Region : 1220
 FDEPTH: 25 25 Gear cond.: 0
 BDEPTH: 82 73 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.2 kn
 Sorted : 30 Total catch: 606.15 Catch/hour: 1104.77

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1069.87	48629	96.84	86
Saurida brasiliensis	18.23	4848	1.65	
Lagocephalus laevigatus	9.33	24	0.84	
Artius heudeloti	5.81	4	0.53	
Trachinotus ovatus	1.53	4	0.14	
Total	1104.77		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 53
 DATE :14/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 17°57.54
 start stop duration Lon W 16°14.19
 TIME :22:04:32 22:09:49 5.3 (min) Purpose : 1
 LOG : 1962.31 1962.54 0.2 Region : 1220
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 30 32 Validity : 0
 Towing dir: 90° Wire out : 120 m Speed : 2.6 kn
 Sorted : 35 Total catch: 213.75 Catch/hour: 2428.98

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	1571.59	18443	64.70	88
Sardinella aurita	433.64	1500	17.85	87
Chloroscombrus chrysurus	285.00	1909	11.73	
Trachurus trecae	46.36	545	1.91	
Sphyræna guachancho	32.39	91	1.33	
Decapterus rhonchus	30.68	208	1.26	
Sardinella pilchardus	12.95	68	0.53	
Lagocephalus laevigatus	6.93	23	0.29	
Scomber japonicus	4.66	23	0.19	
Priacanthus arenatus	3.07	23	0.13	
Loligo vulgaris	1.70	11	0.07	
Total	2428.98		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 54
 DATE :15/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 18°7.88
 start stop duration Lon W 16°8.52
 TIME :00:57:18 01:27:20 30.0 (min) Purpose : 1
 LOG : 1984.75 1986.38 1.6 Region : 1220
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 17 20 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.3 kn
 Sorted : 59 Total catch: 300.45 Catch/hour: 600.30

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	317.84	2238	52.95	89
Brachydeuterus auritus	104.30	3856	17.37	
Trichurus lepturus	66.51	18	11.08	
Sardinella maderensis	33.55	1493	5.59	91
Sardinella aurita	15.28	54	2.55	90
Sphyræna guachancho	13.63	82	2.27	
Pomadasys incisus	6.57	36	1.10	
Stromateus fiatola	6.21	18	1.04	
Pagellus bellottii	9.03	54	0.84	
Pomadasys rogeri	4.96	10	0.83	
Pomadasys jubelini	4.86	10	0.81	
Sphyrna lewini	4.70	2	0.78	
Trachurus trecae	4.42	64	0.74	
Alectis alexandrinus	4.32	10	0.72	
Selene dorsalis	1.72	18	0.29	
Rhizoprionodon acutus	1.54	2	0.26	
Pisodonophis semicinctus	1.36	2	0.23	
Priacanthus arenatus	1.26	10	0.21	
Chloroscombrus chrysurus	1.18	10	0.20	
Penaeus notialis	0.72	90	0.12	
Galeoides decadactylus	0.36	10	0.06	
Total	600.30		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 55
 DATE :15/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 18°18.79
 start stop duration Lon W 16°16.88
 TIME :08:15:42 08:25:57 10.3 (min) Purpose : 1
 LOG : 2045.21 2045.90 0.7 Region : 1220
 FDEPTH: 17 17 Gear cond.: 0
 BDEPTH: 31 33 Validity : 0
 Towing dir: 342° Wire out : 100 m Speed : 4.0 kn
 Sorted : 0 Total catch: 19.65 Catch/hour: 115.02

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	81.25	357	70.64	93
Sarda sarda	11.24	12	9.77	
Sardinella aurita	8.96	35	7.79	94
Scomber japonicus	6.67	47	5.80	95
Pagellus bellottii	2.46	18	2.14	
Selene dorsalis	2.11	35	1.83	
Trachinotus ovatus	1.52	6	1.32	
Trachurus trecae	0.82	18	0.71	
Total	115.02		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 56
 DATE :15/11/2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 18°37.07
 start stop duration Lon W 16°29.11
 TIME :15:10:47 15:37:43 26.9 (min) Purpose : 1
 LOG : 2108.82 2110.30 1.5 Region : 1220
 FDEPTH: 81 87 Gear cond.: 0
 BDEPTH: 81 87 Validity : 0
 Towing dir: 180° Wire out : 265 m Speed : 3.3 kn
 Sorted : 37 Total catch: 3147.77 Catch/hour: 7013.23

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	6999.48	385907	99.80	96
Trichurus lepturus	6.37	9	0.09	
Capros aper	3.74	561	0.05	
Zeus faber	3.39	2	0.05	
Todarodes sagittatus	0.13	4	0.00	
Boops boops	0.11	2	0.00	
Total	7013.23		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 57
 DATE :15/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 18°37.76
 start stop duration Lon W 16°20.88
 TIME :17:21:11 17:31:26 10.3 (min) Purpose : 1
 LOG : 2122.77 2123.45 0.7 Region : 1220
 FDEPTH: 20 15 Gear cond.: 0
 BDEPTH: 39 43 Validity : 0
 Towing dir: 265° Wire out : 65 m Speed : 4.0 kn
 Sorted : 29 Total catch: 29.01 Catch/hour: 169.81

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	153.37	620	90.31	97
Sardina pilchardus	6.20	35	3.65	98
Camogramma glaycos	3.92	6	2.31	
Scomber japonicus	2.81	12	1.65	
Sardinella aurita	2.63	6	1.55	
Scorpaena stephanica	0.88	6	0.52	
Total	169.81		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 58
 DATE :15/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 18°48.75
 start stop duration Lon W 16°20.23
 TIME :19:56:19 20:17:06 20.8 (min) Purpose : 1
 LOG : 2144.22 2145.42 1.2 Region : 1220
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 20 20 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.5 kn
 Sorted : 61 Total catch: 775.07 Catch/hour: 2237.93

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Decapterus rhonchus	1008.77	14472	45.08	101
Sardina pilchardus	889.66	5414	39.75	99
Brachydeuterus auritus	112.95	829	5.05	
Trachurus trecae	62.43	973	2.79	100
Pomadasys incisus	37.16	251	1.66	
Sardinella aurita	36.81	217	1.65	
Sardinella maderensis	24.17	107	1.08	
Dasyatis sp.	13.57	6	0.61	
Arius heudeloti	9.38	35	0.42	
Lagocephalus laevis	7.22	14	0.32	
Sepia officinalis hierredda	7.07	9	0.32	
Trichiurus lepturus	6.21	17	0.28	
Sphyræna guachancho	5.05	35	0.23	
Penaeus kerathurus	4.33	107	0.19	
Pagellus bellottii	3.46	35	0.15	
Pseudupeneus prayensis	2.51	35	0.11	
BOOPS BOOPS	2.51	72	0.11	
Pomadasys peroteti	2.43	3	0.11	
Plectorhynchus mediterraneus	1.27	3	0.06	
Dentex maroccanus	0.95	3	0.04	
Total	2237.93		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 59
 DATE :15/11/2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 18°47.25
 start stop duration Lon W 16°27.49
 TIME :21:42:15 22:13:17 31.0 (min) Purpose : 1
 LOG : 2156.58 2158.32 1.7 Region : 1220
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 72 46 Validity : 0
 Towing dir: 80° Wire out : 150 m Speed : 3.4 kn
 Sorted : 57 Total catch: 56.57 Catch/hour: 109.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	71.25	2255	65.14	103
Sardinella aurita	14.04	39	12.83	102
Trichiurus lepturus	7.46	12	6.82	
Saurida brasiliensis	5.22	180	4.77	
Mugil cephalus	3.09	2	2.83	
J E L L Y F I S H	1.62	2	1.48	
Synagrops microlepis	1.45	178	1.33	
Mugil capurrii	1.41	2	1.29	
Scomber japonicus	0.97	10	0.88	
Alloteuthis africana	0.85	669	0.78	
Sardina pilchardus	0.64	4	0.58	
Brachydeuterus auritus	0.08	8	0.07	
Penaeus notialis	0.06	2	0.05	
Sphyræna guachancho	0.04	4	0.04	
Selene dorsalis	0.02	4	0.02	
Sphoeroides spengleri	0.02	2	0.02	
Total	108.22		98.94	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 60
 DATE :16/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 19°4.82
 start stop duration Lon W 16°34.25
 TIME :08:50:40 09:10:33 19.9 (min) Purpose : 1
 LOG : 2247.59 2248.77 1.2 Region : 1220
 FDEPTH: 38 37 Gear cond.: 0
 BDEPTH: 61 62 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.5 kn
 Sorted : 0 Total catch: 0.77 Catch/hour: 2.32

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	1.96	6	84.42	
Sphyræna sphyraena	0.33	3	14.29	
Dentex macrophthalmus	0.03	3	1.30	
Total	2.32		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 61
 DATE :16/11/2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 19°4.27
 start stop duration Lon W 16°40.17
 TIME :10:49:12 11:18:38 29.4 (min) Purpose : 1
 LOG : 2261.59 2263.13 1.5 Region : 1220
 FDEPTH: 118 113 Gear cond.: 0
 BDEPTH: 118 113 Validity : 0
 Towing dir: 0° Wire out : 360 m Speed : 3.1 kn
 Sorted : 35 Total catch: 106.71 Catch/hour: 217.55

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	111.74	673	51.36	104
J E L L Y F I S H	72.23	746	33.20	
Zenopsis conchifer	9.91	67	4.55	
Trichiurus lepturus	8.38	31	3.85	
Mugil capurrii	5.50	6	2.53	
Merluccius polli	3.24	18	1.49	
Todaropsis eblanae	2.26	135	1.04	
Octopus vulgaris	1.30	2	0.60	
Dentex angolensis	1.04	8	0.48	
Scorpaena scrofa	0.77	4	0.36	
Zeus faber	0.43	2	0.20	
Microchirus boscanion	0.31	12	0.14	
Serranus cabrilla	0.18	2	0.08	
Capros aper	0.10	6	0.05	
Pontinus kuhlii	0.08	2	0.04	
Lesueurigobius sanzoi	0.06	6	0.03	
Total	217.55		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 62
 DATE :16/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 19°16.15
 start stop duration Lon W 16°41.36
 TIME :15:27:34 15:41:38 14.1 (min) Purpose : 1
 LOG : 2297.63 2298.45 0.8 Region : 1220
 FDEPTH: 15 15 Gear cond.: 0
 BDEPTH: 28 24 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.5 kn
 Sorted : 0 Total catch: 77.15 Catch/hour: 329.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chloroscombrus chrysurus	148.40	1190	45.11	105
Sardinella maderensis	81.02	448	24.63	
Pomadasys incisus	44.56	192	13.55	
Diplodus cervinus cervinus	34.33	34	10.43	
Spondyliosoma cantharus	7.25	21	2.20	
Scomberomorus tritor	6.27	4	1.91	
Argyrosomus regius	5.97	4	1.81	
Sardinella aurita	1.19	4	0.36	
Total	329.00		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 63
 DATE :16/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 19°37.44
 start stop duration Lon W 16°53.45
 TIME :22:30:36 22:42:22 11.8 (min) Purpose : 1
 LOG : 2357.38 2358.19 0.8 Region : 1210
 FDEPTH: 20 19 Gear cond.: 0
 BDEPTH: 30 31 Validity : 0
 Towing dir: 0° Wire out : 130 m Speed : 4.2 kn
 Sorted : 731 Total catch: 730.79 Catch/hour: 3725.35

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	3395.07	14376	91.13	106
Trichiurus lepturus	147.83	816	3.97	
Rhizoponodon acutus	110.62	31	2.97	
Sardinella aurita	55.06	204	1.48	
Synagrops microlepis	8.16	306	0.22	
Sepia officinalis hierredda	7.70	10	0.21	
Penaeus notialis	1.43	61	0.04	
Total	3725.86		100.01	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 64
 DATE :17/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 19°48.82
 start stop duration Lon W 17°8.66
 TIME :03:34:44 03:40:17 5.6 (min) Purpose : 1
 LOG : 2396.89 2397.24 0.4 Region : 1210
 FDEPTH: 15 15 Gear cond.: 0
 BDEPTH: 19 20 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.7 kn
 Sorted : 65 Total catch: 388.26 Catch/hour: 4197.41

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	3713.51	30941	88.47	107
Trachurus trecae	249.73	5449	5.95	108
Pomadasys incisus	82.38	389	1.96	
Chloroscombrus chrysurus	38.92	324	0.93	
Sardinella aurita	29.84	195	0.71	
Scomber japonicus	27.24	195	0.65	
Trichiurus lepturus	16.22	519	0.39	
Lagocephalus lagocephalus	15.57	65	0.37	
Pagellus bellottii	11.68	195	0.28	
Engraulis encrasicolus	6.49	1362	0.15	
Penaeus notialis	5.84	324	0.14	
Total	4197.41		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 65
 DATE :20/11/2006 GEAR TYPE: PT NO: 2 POSITION:Lat N 20°18.46
 start stop duration Lon W 17°36.36
 TIME :02:11:21 02:24:18 13.0 (min) Purpose : 1
 LOG : 2848.95 2849.74 0.8 Region : 1210
 FDEPTH: 15 19 Gear cond.: 0
 BDEPTH: 93 90 Validity : 0
 Towing dir: 0° Wire out : 95 m Speed : 3.7 kn
 Sorted : 30 Total catch: 359.90 Catch/hour: 1667.49

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	1456.68	13636	87.36	109
Trachurus trecae	210.72	10175	12.64	110
Total	1667.40		99.99	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 66
 DATE :20/11/2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 20°28.42
 start stop duration Lon W 17°10.22
 TIME :09:13:29 09:14:19 0.8 (min) Purpose : 1
 LOG : 2909.27 2909.40 0.1 Region : 1210
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 31 31 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 9.0 kn
 Sorted : 10 Total catch: 73.48 Catch/hour: 5311.81

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	2783.13	689711	52.40	112
Sardinella maderensis	2236.63	769663	42.11	111
Sardinella maderensis	147.47	867	2.78	113
Stromateus fiatola	144.58	145	2.72	
Total	5311.81		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 67
 DATE :20/11/2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 20°38.00
 start stop duration Lon W 17°10.02
 TIME :11:53:23 12:13:52 20.0 (min) Purpose : 1
 LOG : 2933.71 2934.92 1.2 Region : 1210
 FDEPTH: 35 35 Gear cond.: 0
 BDEPTH: 35 35 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.5 kn
 Sorted : 10 Total catch: 10.47 Catch/hour: 31.41

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	12.66	13293	40.31	114
Scomberomorus tritor	9.27	3	29.51	
Trachinotus ovatus	3.66	9	11.65	
Sardina pilchardus	2.37	15	7.55	116
Chloroscombrus chrysurus	1.11	9	3.53	
Sardinella maderensis	0.69	6	2.20	
Engraulis encrasicolus	0.63	198	2.01	115
Diplodus bellottii	0.54	9	1.72	
Pomadasys incisus	0.24	3	0.76	
Pageillus bellottii	0.24	3	0.76	
Total	31.41		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 68
 DATE :20/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 20°48.92
 start stop duration Lon W 17°40.40
 TIME :21:45:15 21:59:34 14.3 (min) Purpose : 1
 LOG : 3010.56 3011.44 0.9 Region : 1122
 FDEPTH: 20 22 Gear cond.: 0
 BDEPTH: 382 317 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.7 kn
 Sorted : 4 Total catch: 86.26 Catch/hour: 361.42

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
MYCTOPHIDAE	263.55	218744	72.92	
Trachurus trecae	39.39	520	10.90	117
Scomber japonicus	39.39	348	10.90	118
Trachipterus sp.	8.04	4	2.23	
Lepidopus caudatus	5.70	285	1.58	
Synagrops microlepis	2.14	71	0.59	
Brama brama	1.80	4	0.50	
PARALEPIDIDAE	1.42	71	0.39	
Total	361.42		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 69
 DATE :20/11/2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 20°47.72
 start stop duration Lon W 17°35.42
 TIME :23:48:38 23:51:30 2.9 (min) Purpose : 1
 LOG : 3019.42 3019.62 0.2 Region : 1122
 FDEPTH: 30 25 Gear cond.: 0
 BDEPTH: 96 96 Validity : 0
 Towing dir: 0° Wire out : 130 m Speed : 4.2 kn
 Sorted : 30 Total catch: 89.19 Catch/hour: 1864.60

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	1348.43	123240	72.32	119
Engraulis encrasicolus	516.17	30920	27.68	120
Total	1864.60		100.00	

Annex II Description of instruments and fishing gear

The Simrad ER-60, 38 kHz scientific echosounder was used for abundance estimation during the survey, in addition data from the 18 kHz, 120 kHz and 200 kHz transducers were recorded for possible future multifrequency target identification. The Bergen Echo Integrator system (BEI) recorded the hydroacoustic data and was used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data were stored to tape and brought back to IMR for storing. The last calibration of all transducers prior to the survey was conducted in Baia dos Elefantes, Angola 6/10-2006.

The details of the settings of the echosounders were as follows:

Transceiver ES18-11

Transducer depth	5.5 m
Absorption coeff.	2.2 dB/km
Pulse length	1.024 ms
Bandwidth	1.57 kHz
Max power (used)	2000 Watt (2000 W)
2-way beam angle	-17.0 dB
SV transducer gain	22.57 dB
TS transducer gain	22.4 dB
Angle sensitivity	13.9
3 dB beamwidth along.	11.6
3 dB beamwidth athw.	11.41
Alongship offset	0.11
Athwardship offset	-0.02

Transceiver ES38-B

Transducer depth	5.5 m
Absorption coeff.	8.7 dB/km
Pulse length	1.024 ms
Bandwidth	2.43 kHz
Max power (used)	4000 Watt (2000 W)
2-way beam angle	-20.6 dB
SV transducer gain	25.87 dB
TS transducer gain	26.5 dB
Angle sensitivity	21.9
3 dB beamwidth along.	6.89
3 dB beamwidth athw.	6.92
Alongship offset	0.11
Athwardship offset	0.03

Transceiver ES120-7

Transducer depth	5.5 m
Absorption coeff.	44.5 dB/km
Pulse length	1.024 ms
Bandwidth	3.03 kHz
Max power (used)	500 Watt (250 W)
2-way beam angle	-20.8 dB
SV transducer gain	25.33 dB
TS transducer gain	25.7 dB
Angle sensitivity	21.0
3 dB beamwidth along.	7.20
3 dB beamwidth athw.	7.15
Alongship offset	0.09
Athwardship offset	0.03

Transceiver ES200-7

Transducer depth	5.5 m
Absorption coeff.	66.9 dB/km
Pulse length	1.024 ms
Bandwidth	3.09 kHz
Max power (used)	300 Watt (120 W)
2-way beam angle	-20.7 dB
SV transducer gain	24.25 dB
TS transducer gain	27.0 dB
Angle sensitivity	23.00
3 dB beamwidth along.	6.87
3 dB beamwidth athw.	7.01
Alongship offset	- 0.07
Athwardship offset	0.25

Bottom detection menu

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

Fishing gear

The vessel has three different sized four-panel 'Åkrahamn' pelagic trawls and one 'Gisund super bottom trawl'. The two smallest pelagic trawls and the demersal trawl were used during the survey. The smallest pelagic trawl has 10-12 m vertical opening under normal operation, whereas the intermediate sized trawl has 15-18 m opening.

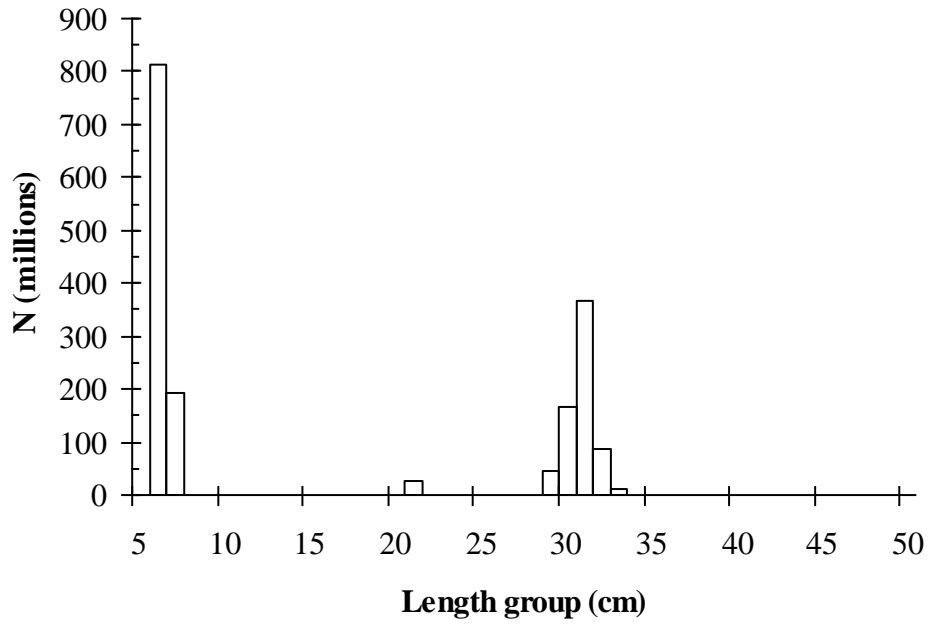
The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m² and weigh 2000 kg. The door spreading is about 45 m when using restraining rope. Trawling was

conducted for species identification only and no restraining rope was therefore used during the survey.

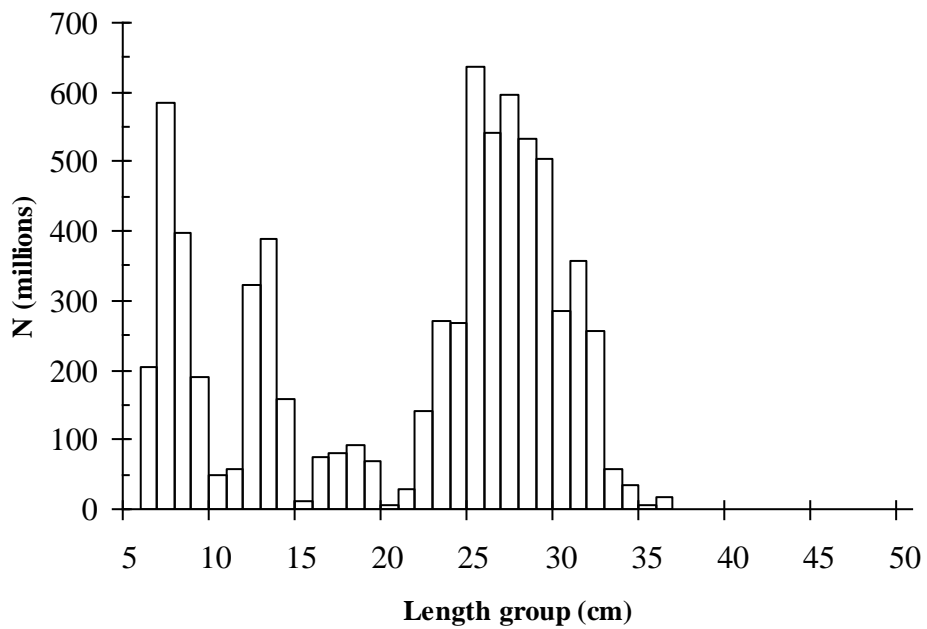
The SCANMAR system was used during all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their distance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

The pelagic trawls are equipped with a trawl eye that provides information about the trawl opening and the distance of the footrope to the bottom. A pressure sensor is used to show the depth on the headline.

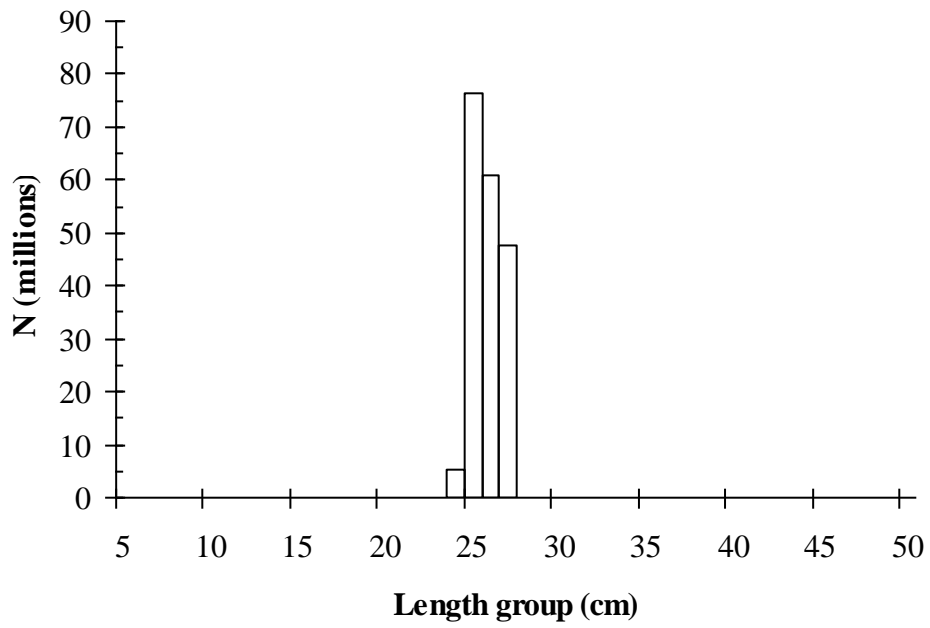
Annex III. Pooled length distribution by species and region



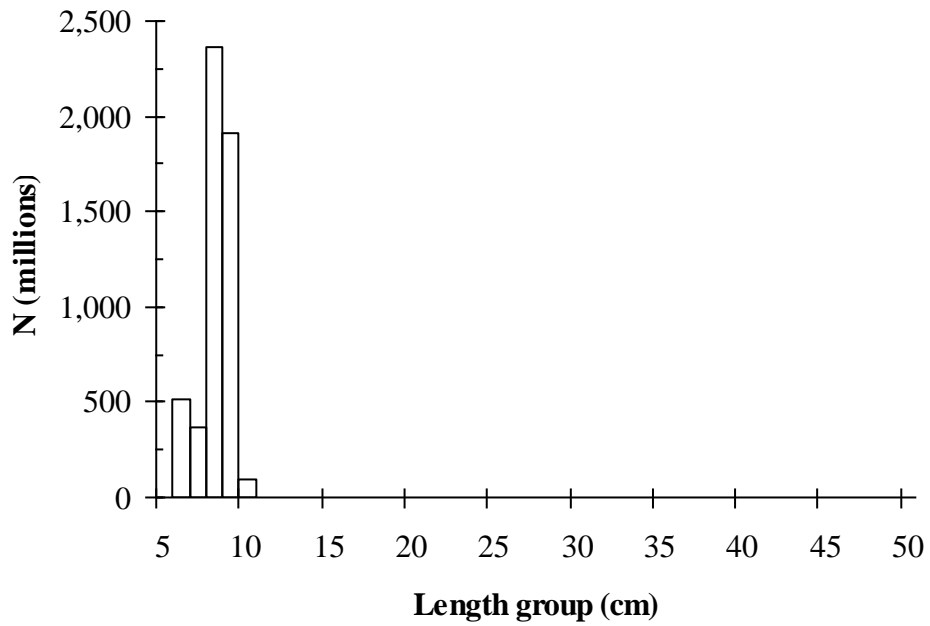
Round sardinella (*Sardinella aurita*) November 2006



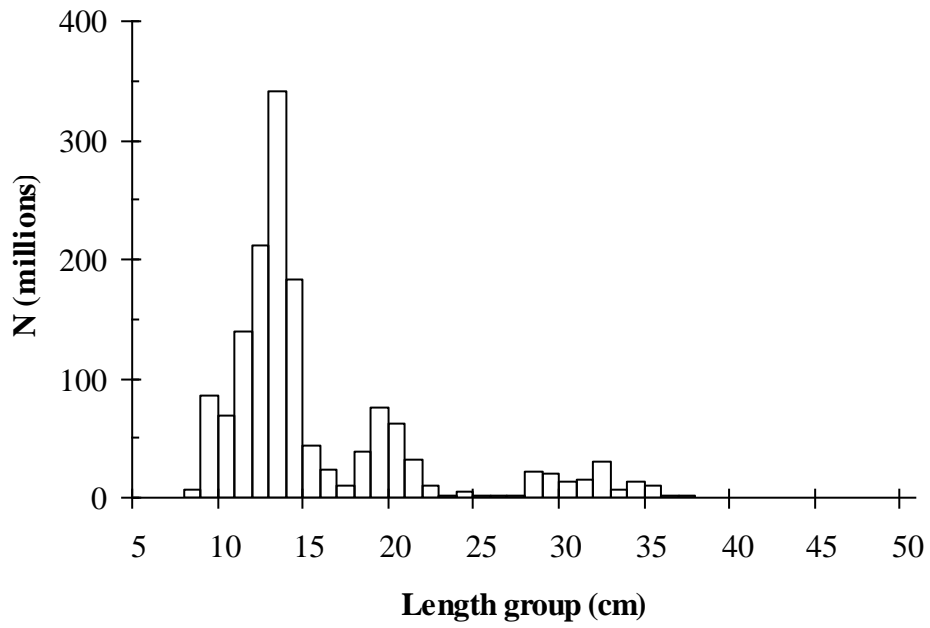
Flat sardinella (*Sardinella maderensis*) November 2006



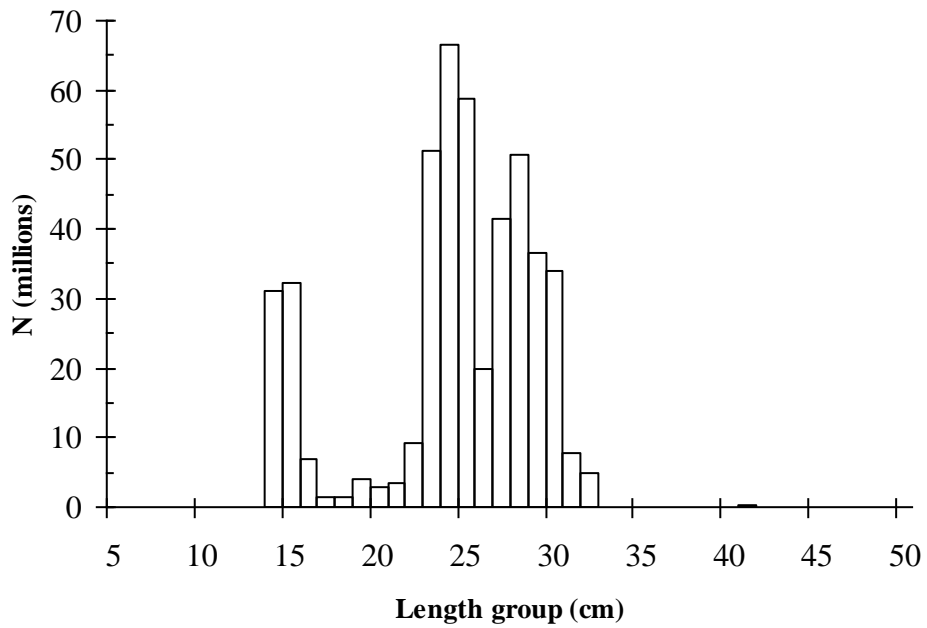
Sardine (*Sardina pilchardus*) November 2006



Anchovy (*Engraulis encrasicolus*) November 2006



Cunene horse mackerel (*Trachurus trecae*) November 2006



False Scad (*Decapterus rhonchus*) November 2006

Annex IV. Estimated number and biomass by length-group and sectors

Round sardinella (*Sardinella aurita*) November 2006

Numbers in millions

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6		812.6	812.6
7		191.2	191.2
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21	27.0		27.0
22			
23			
24			
25			
26			
27			
28	1.8		1.8
29	43.5		43.5
30	166.0		166.0
31	368.1		368.1
32	88.2		88.2
33	10.4		10.4
34	1.8		1.8
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	706.9	1,003.8	1,710.6

Biomass in tonnes

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6		2.1	0,2
7		0.8	0,1
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21	2.6		0,3
22			
23			
24			
25			
26			
27			
28	0.4		0,0
29	10.7		1,1
30	45.2		4,5
31	110.5		11,0
32	29.1		2,9
33	3.7		0,4
34	0.7		0,1
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	203	3	206

Flat sardinella (*Sardinella maderensis*) November 2006

Numbers in millions

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6		205.9	205.9
7	28.2	557.6	585.8
8	244.5	154.4	398.9
9	147.3	42.9	190.2
10	33.1	17.2	50.2
11	49.7	8.6	58.2
12	307.9	14.0	321.9
13	380.7	8.6	389.3
14	159.4		159.4
15	12.6		12.6
16	75.7		75.7
17	82.0		82.0
18	91.5		91.5
19	69.4		69.4
20	6.3		6.3
21	22.8	5.4	28.2
22	40.3	100.5	140.8
23	76.8	194.9	271.8
24	6.3	260.3	266.6
25	14.3	623.2	637.5
26	98.0	443.0	541.0
27	271.4	323.6	595.0
28	433.3	100.9	534.2
29	488.1	17.2	505.3
30	282.6	3.4	286.0
31	357.4		357.4
32	253.0	3.4	256.4
33	58.6		58.6
34	32.2	3.4	35.7
35	7.0		7.0
36	14.4	3.4	17.8
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	4,144.8	3,092.0	7,236.7

Biomass in tonnes

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6		0.5	0.1
7	0.1	2.3	0.2
8	1.4	0.9	0.2
9	1.2	0.4	0.2
10	0.4	0.2	0.1
11	0.7	0.1	0.1
12	5.8	0.3	0.6
13	9.0	0.2	0.9
14	4.7		0.5
15	0.5		0.0
16	3.3		0.3
17	4.2		0.4
18	5.6		0.6
19	4.9		0.5
20	0.5		0.1
21	2.2	0.5	0.3
22	4.4	11.0	1.5
23	9.6	24.3	3.4
24	0.9	36.7	3.8
25	2.3	99.2	10.1
26	17.5	79.1	9.7
27	54.2	64.6	11.9
28	96.3	22.4	11.9
29	120.3	4.2	12.5
30	77.0	0.9	7.8
31	107.2		10.7
32	83.4	1.1	8.5
33	21.1		2.1
34	12.7	1.4	1.4
35	3.0		0.3
36	6.7	1.6	0.8
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	661	352	1,013

Sardine (*Sardina pilchardus*) November 2006

Numbers in millions

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24	5.3		5.3
25	76.6		76.6
26	60.7		60.7
27	47.5		47.5
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	190.1		190.1

Biomass in tonnes

Length cm	St. Louis - Cape	Cape Timiris - Cape Blanc	TOTAL
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24	0.7		1
25	12.2		12
26	10.8		11
27	9.5		9
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	33		33

Anchovy (*Engraulis encrasicolus*) November 2006

Numbers in millions

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6		517.4	517.4
7		370.8	370.8
8		2,360.7	2,360.7
9		1,912.4	1,912.4
10		92.2	92.2
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total		5,253.4	5,253.4

Biomass in tonnes

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6		1.4	1
7		1.5	2
8		13.9	14
9		15.7	16
10		1.0	1
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total		34	34

Cunene horse mackerel (*Trachurus trecae*) November 2006

Numbers in millions

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6			
7			
8	7.0		7.0
9	86.2		86.2
10	68.9		68.9
11	106.0	34.1	140.1
12	124.8	87.5	212.2
13	209.5	130.9	340.4
14	140.1	42.8	182.9
15	24.9	18.4	43.3
16	11.8	12.5	24.3
17	8.6	1.8	10.4
18	20.5	18.4	39.0
19	47.7	28.6	76.4
20	51.0	10.7	61.7
21	24.9	7.2	32.1
22	8.7	1.8	10.5
23	0.9		0.9
24	4.3		4.3
25	1.4		1.4
26		1.8	1.8
27	2.2		2.2
28	21.9		21.9
29	17.5	2.1	19.7
30	6.6	6.4	13.0
31	8.8	6.4	15.2
32	4.4	25.6	29.9
33	2.2	4.3	6.5
34		12.8	12.8
35		10.7	10.7
36		2.1	2.1
37		2.1	2.1
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	1,010.8	468.9	1,479.7

Biomass in tonnes

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6			
7			
8	0.0		0.0
9	0.7		0.1
10	0.8		0.1
11	1.5	0.5	0.2
12	2.3	1.6	0.4
13	4.9	3.1	0.8
14	4.1	1.3	0.5
15	0.9	0.7	0.2
16	0.5	0.5	0.1
17	0.4	0.1	0.1
18	1.2	1.1	0.2
19	3.4	2.0	0.5
20	4.2	0.9	0.5
21	2.4	0.7	0.3
22	1.0	0.2	0.1
23	0.1		0.0
24	0.6		0.1
25	0.2		0.0
26		0.3	0.0
27	0.4		0.0
28	4.9		0.5
29	4.3	0.5	0.5
30	1.8	1.7	0.4
31	2.6	1.9	0.5
32	1.4	8.4	1.0
33	0.8	1.5	0.2
34		5.0	0.5
35		4.6	0.5
36		1.0	0.1
37		1.1	0.1
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	46	39	85

False Scad (*Decapterus rhonchus*) November 2006

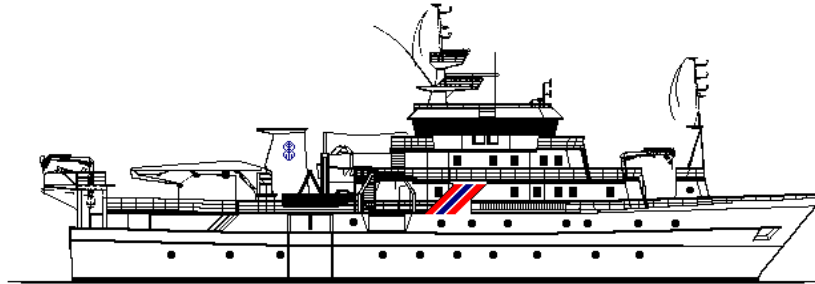
Numbers in millions

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6			
7			
8			
9			
10			
11			
12			
13			
14	31.0		31.0
15	32.3		32.3
16	7.0		7.0
17	1.4		1.4
18	1.4		1.4
19	4.2		4.2
20	2.8		2.8
21	3.5		3.5
22	9.1		9.1
23	51.3		51.3
24	66.5		66.5
25	58.8		58.8
26	19.9		19.9
27	41.5		41.5
28	50.6		50.6
29	36.6		36.6
30	34.1		34.1
31	7.9		7.9
32	4.9		4.9
33			
34			
35			
36			
37			
38			
39			
40			
41	0.2		0.2
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	465.1		465.1

Biomass in tonnes

Length cm	St. Louis - Cape Timiris	Cape Timiris - Cape Blanc	TOTAL
5			
6			
7			
8			
9			
10			
11			
12			
13			
14	0.9		0.1
15	1.2		0.1
16	0.3		0.0
17	0.1		0.0
18	0.1		0.0
19	0.3		0.0
20	0.2		0.0
21	0.3		0.0
22	1.0		0.1
23	6.4		0.6
24	9.4		0.9
25	9.4		0.9
26	3.6		0.4
27	8.3		0.8
28	11.3		1.1
29	9.0		0.9
30	9.3		0.9
31	2.4		0.2
32	1.6		0.2
33			
34			
35			
36			
37			
38			
39			
40			
41	0.2		0.0
42			
43			
44			
45			
46			
47			
48			
49			
50			
Total	75		75

Annex V Regional Estimates, October – December 2005



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

Part III

**Cape Blanc – Cape Sim
19 November - 16 December 2006**

CRUISE REPORT "DR FRIDTJOF NANSEN"

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

Part III

**Cape Blanc – Cape Sim
19 November - 16 December 2006**

by

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Bergen, 2006**

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CHAPTER 1 INTRODUCTION

1.1 Survey objectives

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

- To map the distribution and estimate the biomass of the main small pelagic fish species using hydroacoustic methods. The species of interest were: sardine *Sardina pilchardus*, sardinellas *Sardinella aurita*, *S. maderensis*, chub mackerel *Scomber japonicus*, horse mackerel *Trachurus trachurus*, *T. trecae*, and anchovy *Engraulis encrasicolus*.
- To identify acoustic targets by midwater and bottom trawl sampling and process the catches by recording weight and number by species. For the target species, length frequencies are taken to describe the size distribution.
- To collect otoliths of sardine and sardinella, and training in age determination.
- To sample standard hydrographical transects for temperature, salinity and oxygen off Cape Blanc, Dakhla, Cape Bojador, Cape Juby, Cape Dra and Cape Ghir.

In addition:

- To intercalibrate with RV *Al Amir Moulay Abdallah* between Cape Blanc and Cape Juby.

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

1.2 Participation

Members of the scientific teams were:

Institut National de Recherche Halieutique, Morocco:

Najib CHAROUKI (team leader), Lahcen ABOUABDELLAH, Abdelkarim KALMOUNI, Azeddine RAMZI and Mohamed ELHILALI.

Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), Mauritania:
Abou Ciré BALL.

Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT), Senegal:
Abdoulaye SARRE.

Institute of Marine Research, Norway (IMR):

Tore Strømme (cruise leader), Oddgeir ALVHEIM, Thor Egil JOHANSSON (until 03 December), Tore MØRK (from 03 December), Ole Sverre FOSSHEIM (until 03 December) and Terje HOVLAND (from 03 December).

1.3 Narrative

Figures 1a-b show the cruise track and the stations worked during the survey. The vessel departed from Nouakchott on 19 November, starting the sampling work 50 nautical miles (NM) south off Cape Blanc to finish about 36 hours work belonging to the preceding survey in Mauritania. The hydrographic transect off Cape Blanc was worked on 20 November. The survey proceeded northwards to about 50 NM southwest off Cape Bojador with an acoustic sampling grid with a transect distance 10 NM apart, covering the shelf and slope down until about 200 m bottom depth (Figure 1a). The survey was interrupted with a call at Las Palmas 2-4 December for refuelling. The survey resumed about 40 NM southwest off Cape Bojador in the early morning of 5 December. The sampling continued northwards in a zigzag pattern towards Cape Juby. Northwards from Cape Juby the inner shelf between Cape Juby and 30°N was covered with a zigzag pattern (Figure 1b). From 20 NM south off Agadir the survey proceeded northwards with a survey track perpendicular to the coast, transecting the whole shelf. The northern limit of the survey, at Cape Sim, was reached on 15 December. The vessel called on Agadir 15-16 December for disembarking local scientists and change of crew. The vessel then steamed to Las Palmas where she arrived on 18 December.

Due to rough weather in the period 9-12 December the vessel had to ride the storm for about two days, and it was thus not possible to reach the intended northern limit of the survey at Cap Cantin within time allocated.

Intercalibration with the Moroccan research vessel *Al Amir Moulay Abdallah* started on 21 November and the two vessels worked in tandem from Cape Blanc to south off Cape Bojador when Dr. Fridtjof Nansen departed for Las Palmas.

Standard hydrographical sections were sampled at Cape Blanc, Cape Barbas, off Dakhla, at Cape Bojador, Cape Juby, Cape Dra and Cape Ghir. Two alongshore-hydrographical sections were worked in bottom depths of 50 and 200 m between Cape Blanc and Lacraa. In addition a hydrographical section was worked off Lacraa.

Except for the rough period 9-12 December the weather was favourable and put no serious constraints on the sampling work.

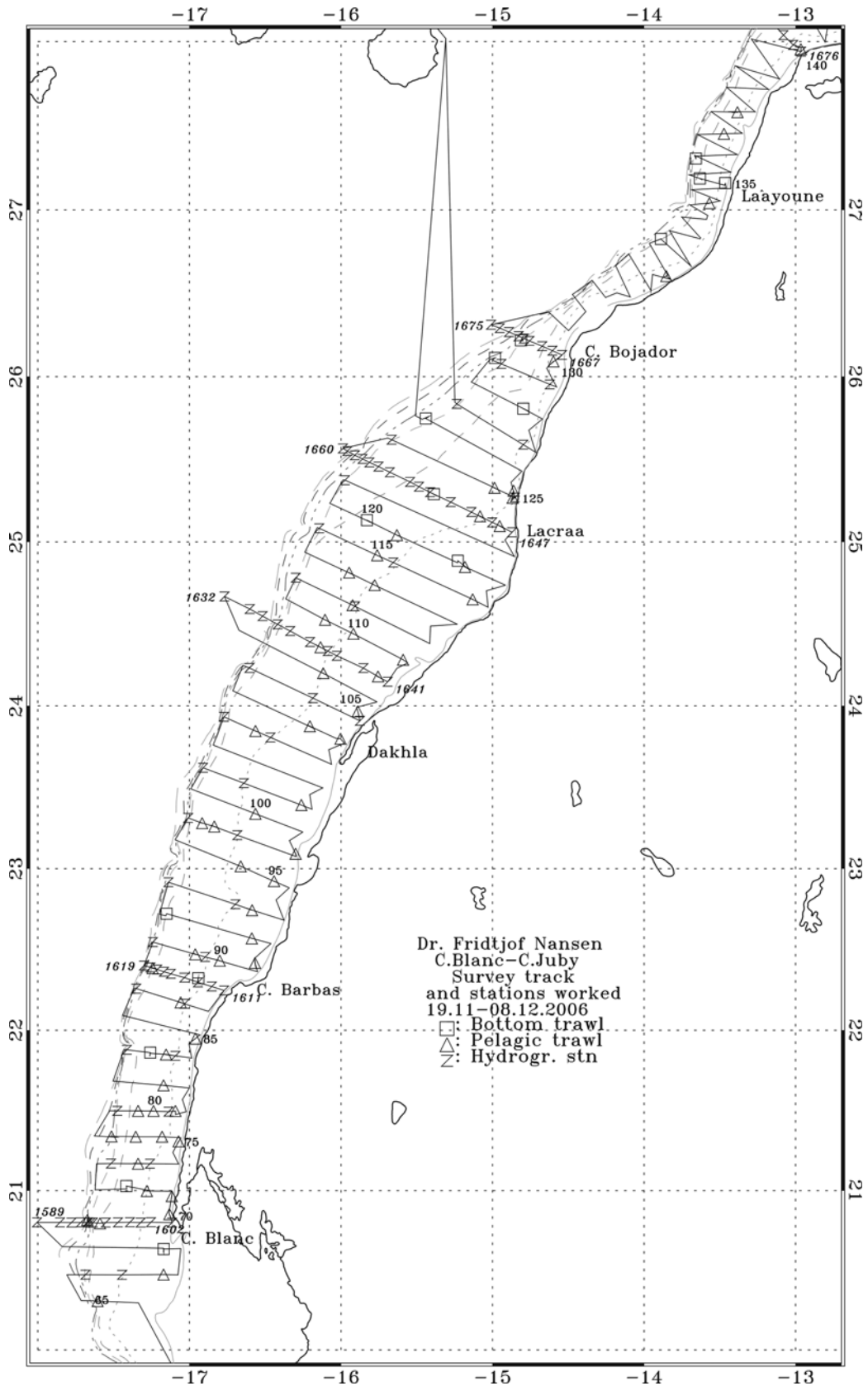


Figure 1a. Course track with fishing and hydrographic stations, Cape Blanc to Cape Juby. Depth contours at 20 m, 50 m, 100 m, 200 m and 500 m are indicated.

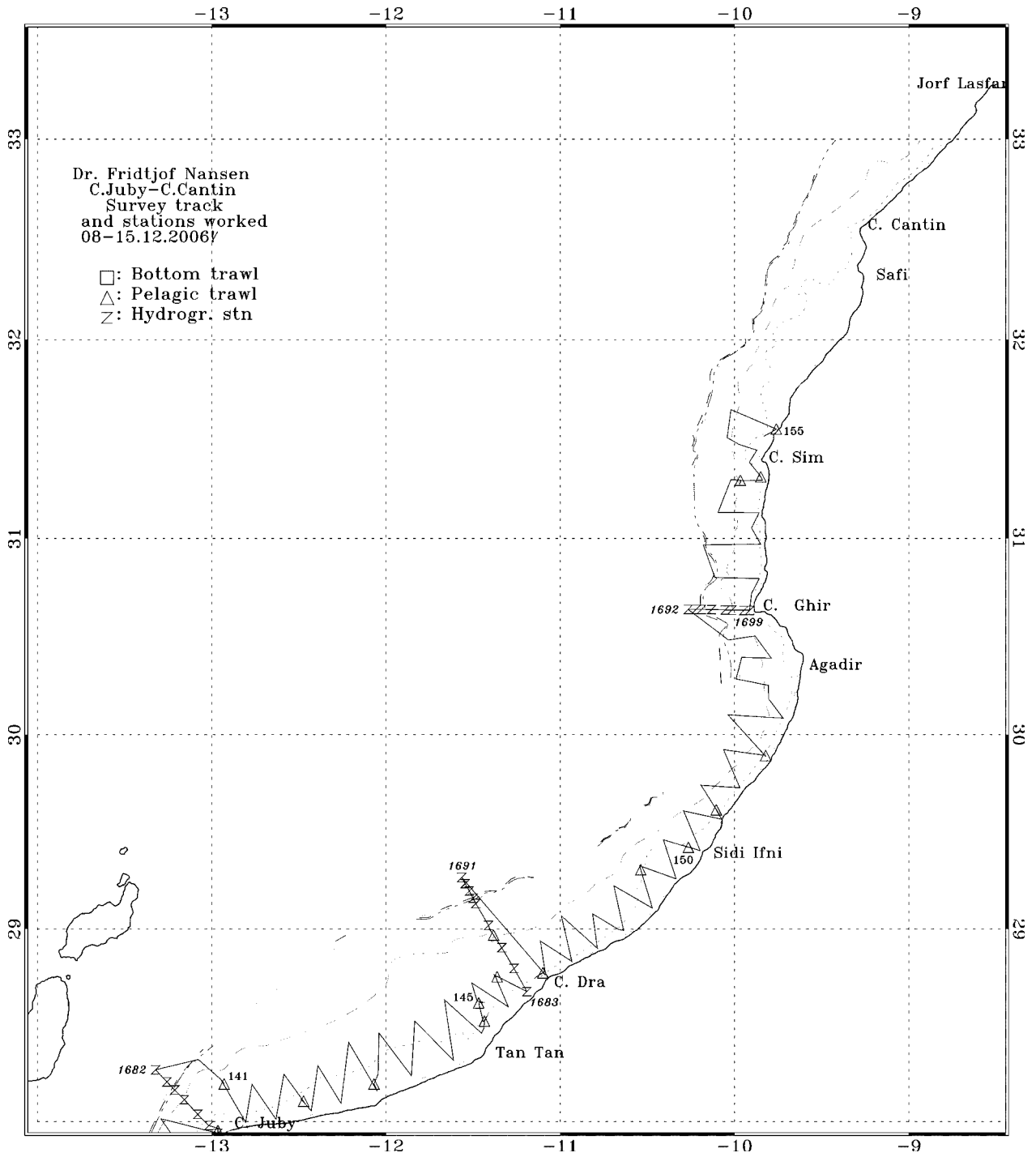


Figure 1b. Course track with fishing and hydrographic stations, Cape Juby to Cape Sim. Depth contours as in Fig. 1a.

1.4 Methods

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

Environmental Data

Meteorological observations including wind direction and speed, air temperature, solar radiation and sea surface temperature (SST) were automatically logged and recorded with position and bottom depth every nautical mile sailed using an Aanderaa meteorological station. Sea surface salinity (SSS) was obtained by means of a Seabird 21 thermosalinograph measuring the engine intake water from a depth of 5 meters. The raw salinity data, which this instrument stores at a high sampling rate of one data cycle per second were prior to the analysis reduced to 0.5 nautical mile spatial averages. Vertical profiles of temperature, salinity and oxygen were recorded with a Seabird 911+ CTD probe. Real time plotting and logging was done using the customised Seabird Seasave software installed on a PC. The profiles were in general taken down to a few meters above the bottom. In deep stations, however, data logging was interrupted at 500 m. Niskin bottles were triggered for water samples, one near the surface and one near the bottom, in order to calibrate the oxygen and salinity sensors. The water samples were analysed for dissolved oxygen using the Winkler method, and for salinity using a Guildline Portasal salinometer mod. 8410.

Biological Sampling

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

The following target groups were used for Morocco:

- 1) Sardine (European pilchard *Sardina pilchardus*),
- 2) Sardinellas (flat sardinella *Sardinella maderensis* and round sardinella *S. aurita*),
- 3) Anchovy (European anchovy *Engraulis encrasicolus*),
- 4) Horse mackerels (Atlantic horse mackerel *Trachurus trachurus*, Cunene horse mackerel *T. trecae* and also including false scad *Caranx rhonchus*),
- 5) Mackerels (chub mackerel *Scomber japonicus*)

- 6) Other pelagic scombrids, carangids and associated species (such as *Auxis* sp., *Caranx* sp. and largehead hairtail *Trichiurus lepturus*), BEI group PEL2
 7) Other demersal species (such as Sparidae, Haemulidae and Merluccidae).

Acoustic Sampling

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

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

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

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

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

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

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

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

where ρ_i = density (n/NM^2) of fish in length group i
 s_A = mean integrator value (m^2/NM^2)
 p_i = proportion of fish in length group i

$\sum_{i=1}^n \frac{p_i}{C_{Fi}}$ = the relative back scattering cross section (m²) of the length frequency sample of the target species, and

C_{Fi} = reciprocal back scattering cross section (σ_{bs}^{-1}) of a fish in length group i

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

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

where s_A = mean integrator value of a species within an aggregation area, in m²/NM²

n_i = frequency count of length group i in a pooled representative sample from the distribution area.

l_i = mid length of fish in length group i .

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

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

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

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

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

The specific condition factors obtained from the samples and applied for this survey were: 0.82 for sardine, 0.94 for *S. aurita*, 0.97 for *S. maderensis*, 0.54 for *Engraulis encrasicolus* and 0.84 for horse mackerel and chub mackerel.

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

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

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

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

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

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

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

CHAPTER 2 SURVEY RESULTS

2.1 Hydrographic conditions

2.1.1 *Wind conditions*

The wind observations showed conditions typical off northwest Africa during November-December. During this period, the position of the pressure front between Azores High and Sahara Low is located off Western Sahara. The strongest winds are expected over the area of the strongest seasonal pressure gradients, located between 21° and 28°N. Figure 2a demonstrates that this was indeed the case. Between Cape Blanc and Cape Jubi the wind stress was oriented alongshore resulting in upwelling favorable conditions near the coast. Further north, from C. Juby to C. Dra (Figure 2b) the strong northeasterly wind was also observed, but its orientation relative of the coastline was onshore, not favorable to upwelling. To the north of Cape Dra the observed wind subsided, consistent with the seasonal expectation for this area. A signature an easterly wind, presumably associated with a Saharan dust storm event, was observed in the inshore area off Lacraa (Figure 2a). A shorter and weaker event of a similar nature may have taken place further south, off Cape Blanc.

2.1.2 *Along-track-sea surface temperature.*

Maps of the sea surface temperature from along-track measurements at a 5 m depth are shown in Figure 3a and 3b. In the southern portion of the survey area, the surface temperature exceeded 20°C, except in the inshore areas. Active upwelling regions were manifested by areas of water colder than 19°C, observed between C. Blanc and C. Barbas, south of Lacraa and along the Laayoune coast. The observed temperature ranges were higher from those typically observed during the previous surveys. The highest surface temperatures (> 23°C) occurred within an eddy-like region located offshore between Lacraa and C. Bojador. The 21°C isotherm on the outer perimeter of this structure closely followed the shape of the local bathymetry. This region of warm water is a fixed hydrographic feature, observed during all surveys with RV Dr. F. Nansen. The fixed position of this warm water region appear to be controlled by the local bathymetry forcing the warm Canary Current to depart from the African coast at this location.

In the northern portion of the survey area (Figure 3b), the distribution of temperature exhibited a strong meridional gradient, with a temperature drop from a 20°C off C. Juby to less than 17°C north off Agadir. This cooling of the sea surface appears to be caused by the seasonal minimum of the sun radiation and maximum of vertical mixing due to increased number of storm events during winter. This is a large-scale seasonal process, associated with the higher latitudes and more temperate climate off the northern Moroccan coast and is not related to the coastal upwelling process. Figure 3b suggests that the region of the seasonal cooling in December 2007 extended northwards of Sidi Ifni. Just south of Sidi Ifni, however, a localized coastal cooling, suggestive of an active upwelling cell was clearly observed (Figure 3b). An upwelling favorable alongshore wind was absent (cf. Figure 2b), but wind patterns over the neighboring area were characterized by a strong zonal gradient of the largely meridional wind. Such a wind field configuration results in an increase of the cyclonic curl of the wind. The upwelling observed to

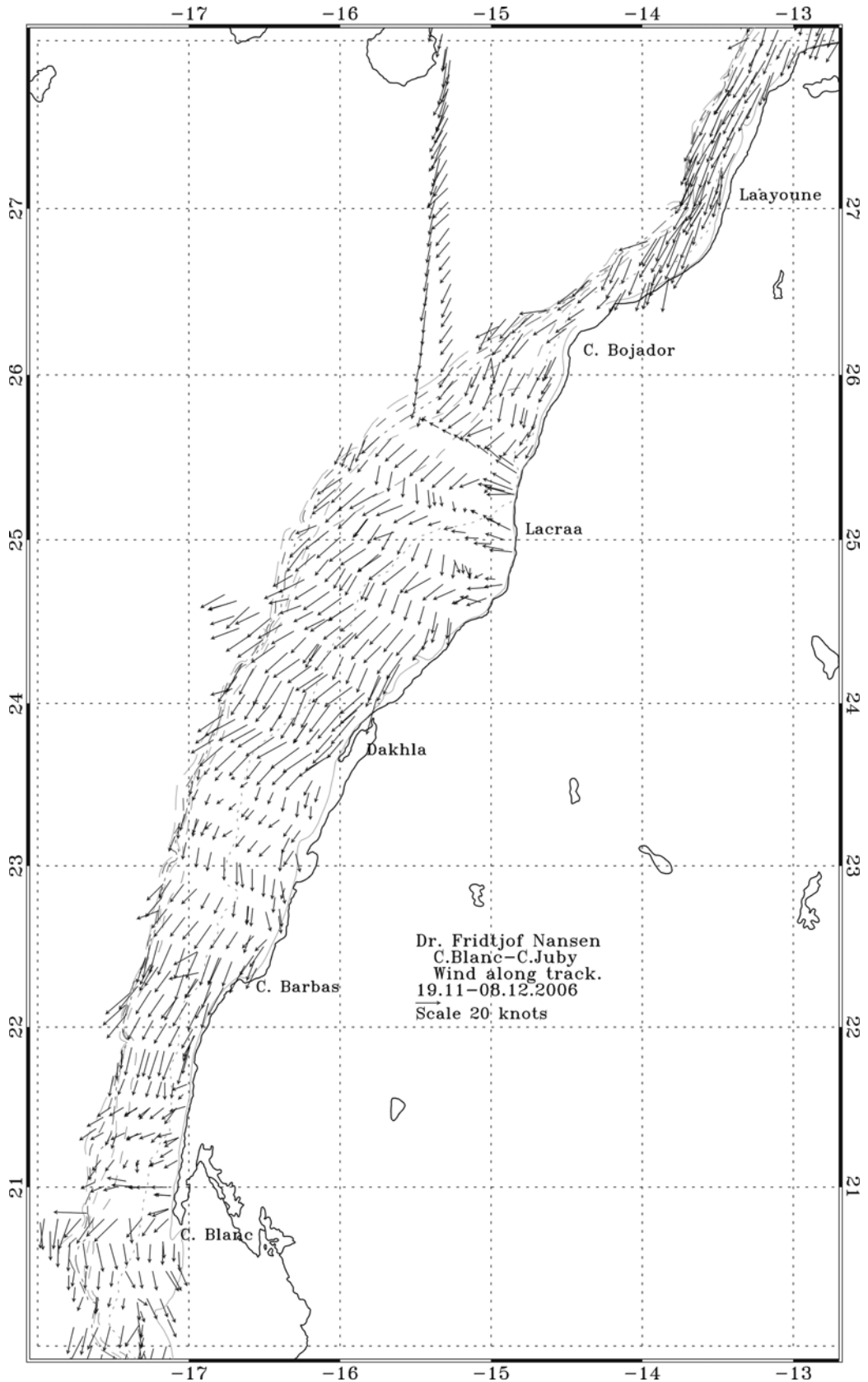


Figure 2a. Wind conditions along the survey, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

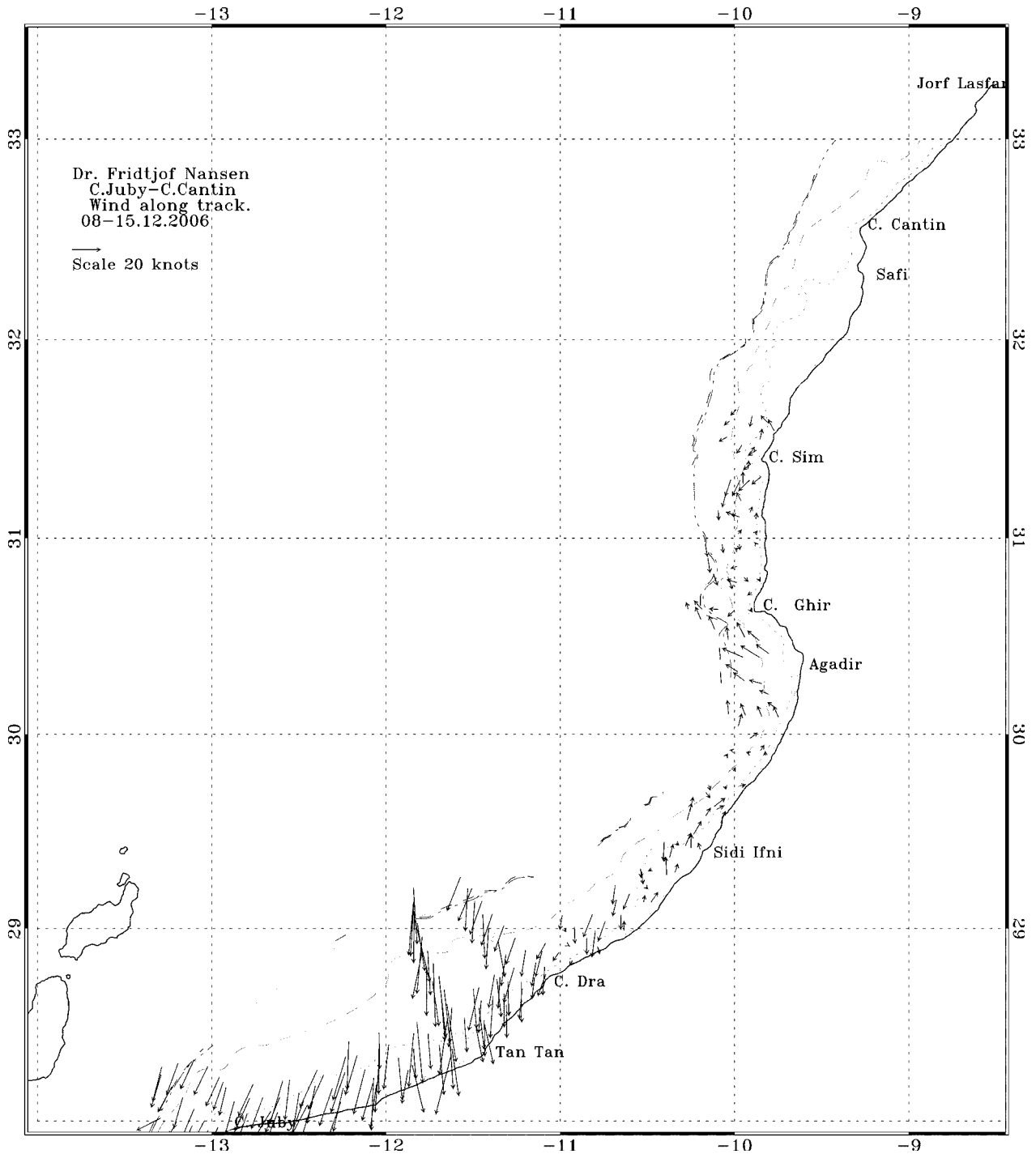


Figure 2b. Wind conditions along the survey, Cape Juby to Cape Sim. Depth contours as in Fig. 1a.

the south of Sidi Ifni upwelling was thus probably maintained by this wind curl (Ekman pumping) rather than by the offshore transport associated with an alongshore wind (Ekman transport).

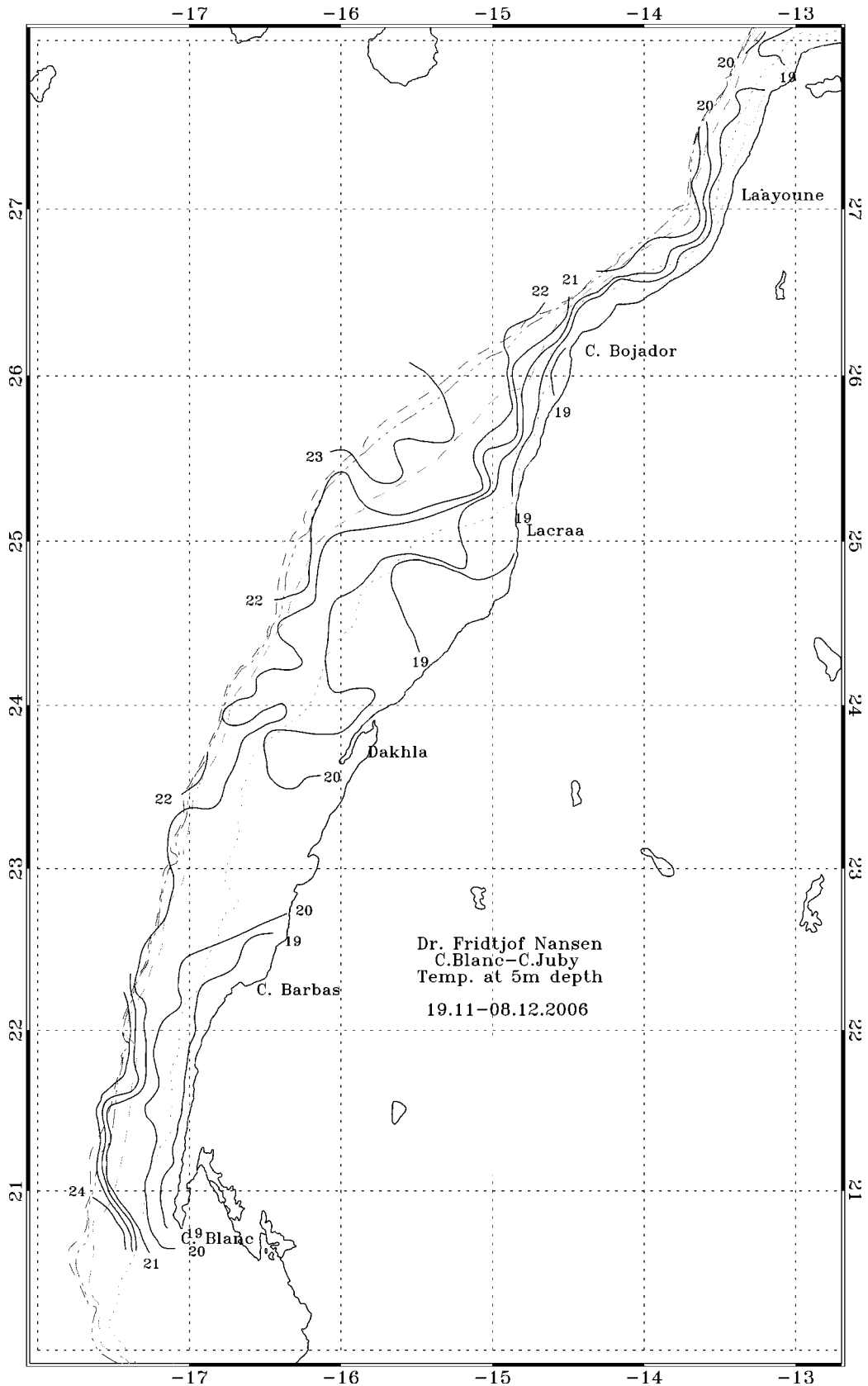


Figure 3a Sea surface temperature (at 5 m depth), Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

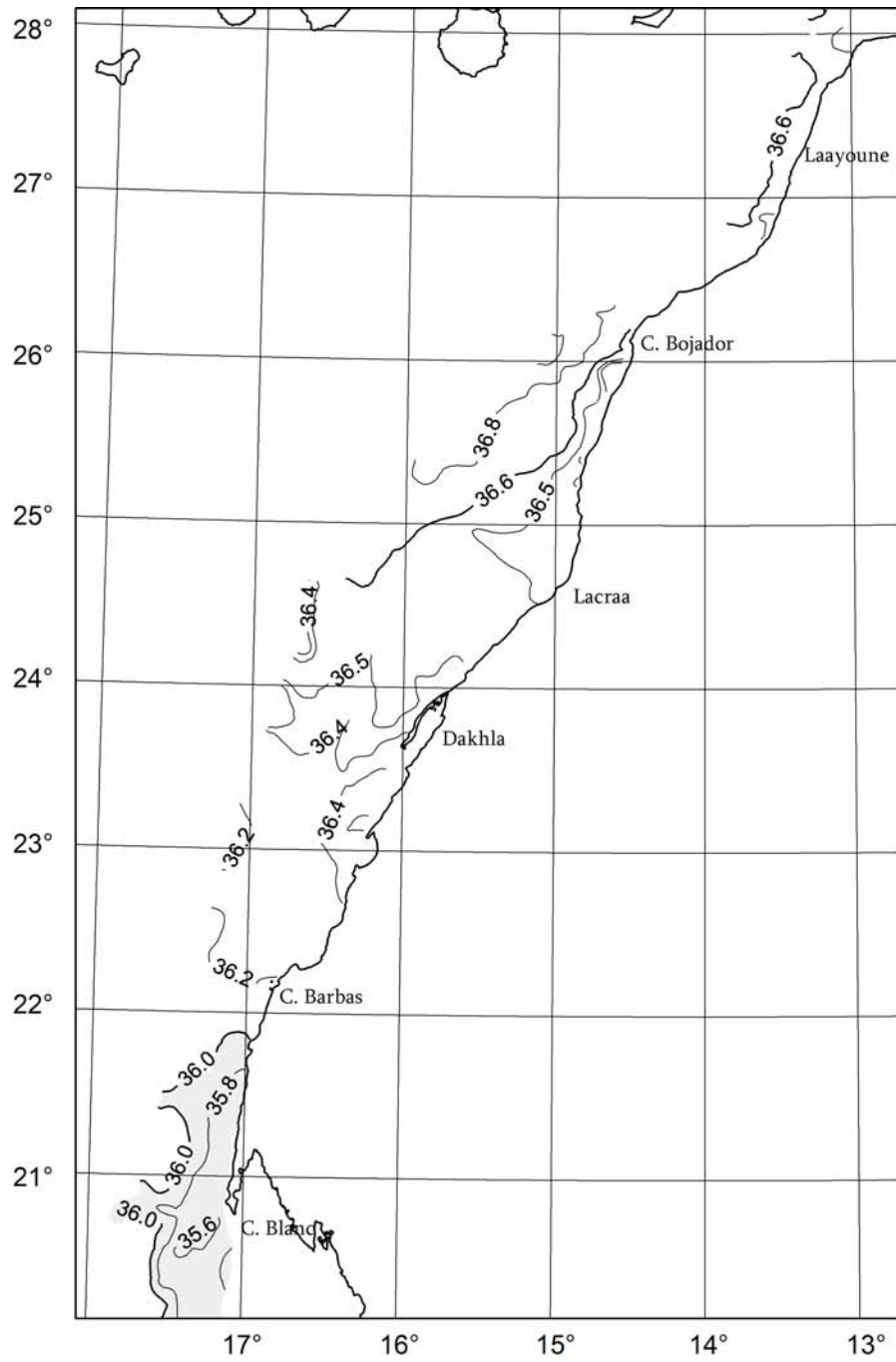


Figure 3b Sea surface salinity (at 5 m depth), Cape Blanc to Cape Juby.

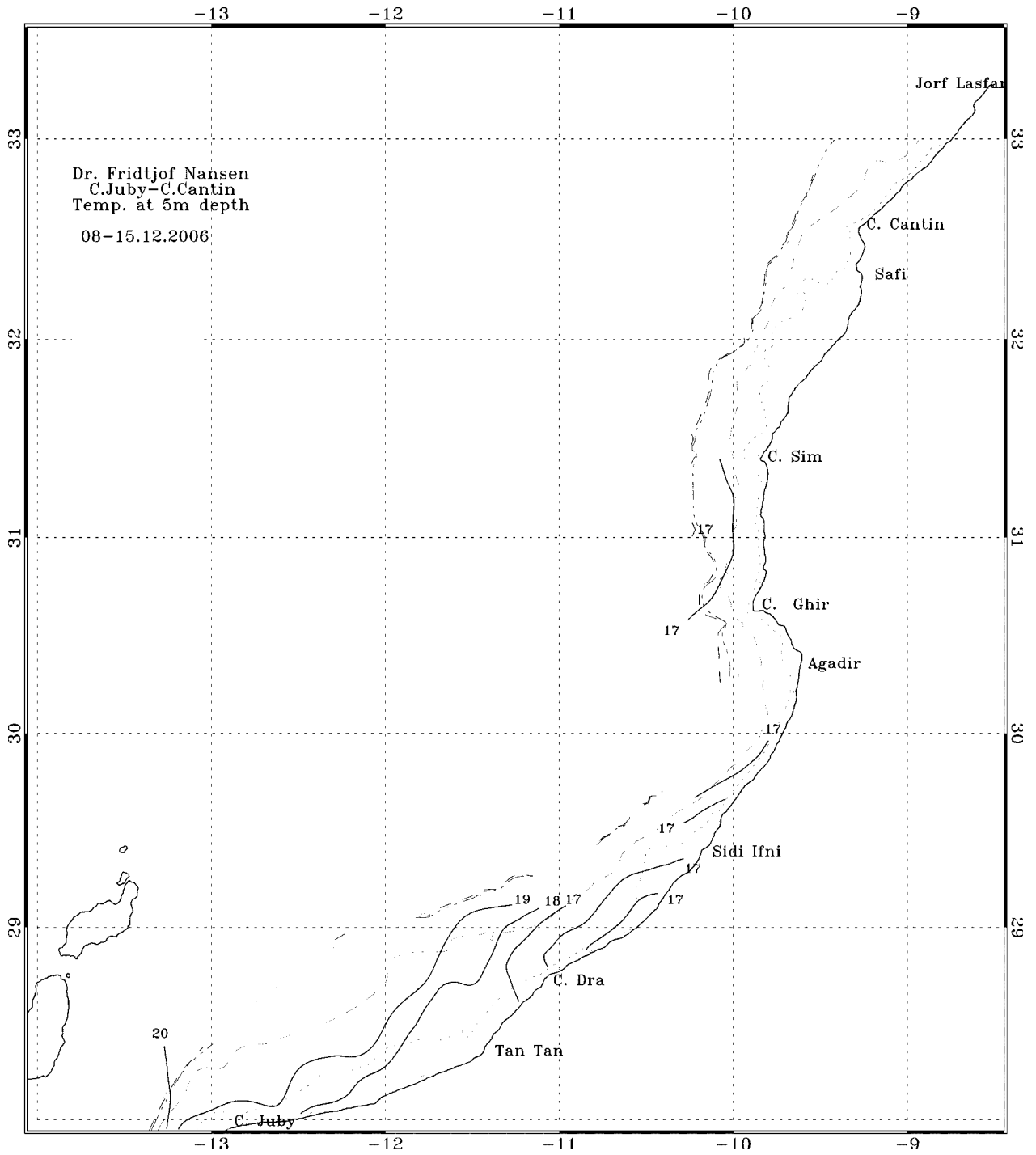


Figure 3c. Sea surface temperature (at 5 m depth), Cape Juby to Cape Sim. Depth contours as in Fig. 1a.

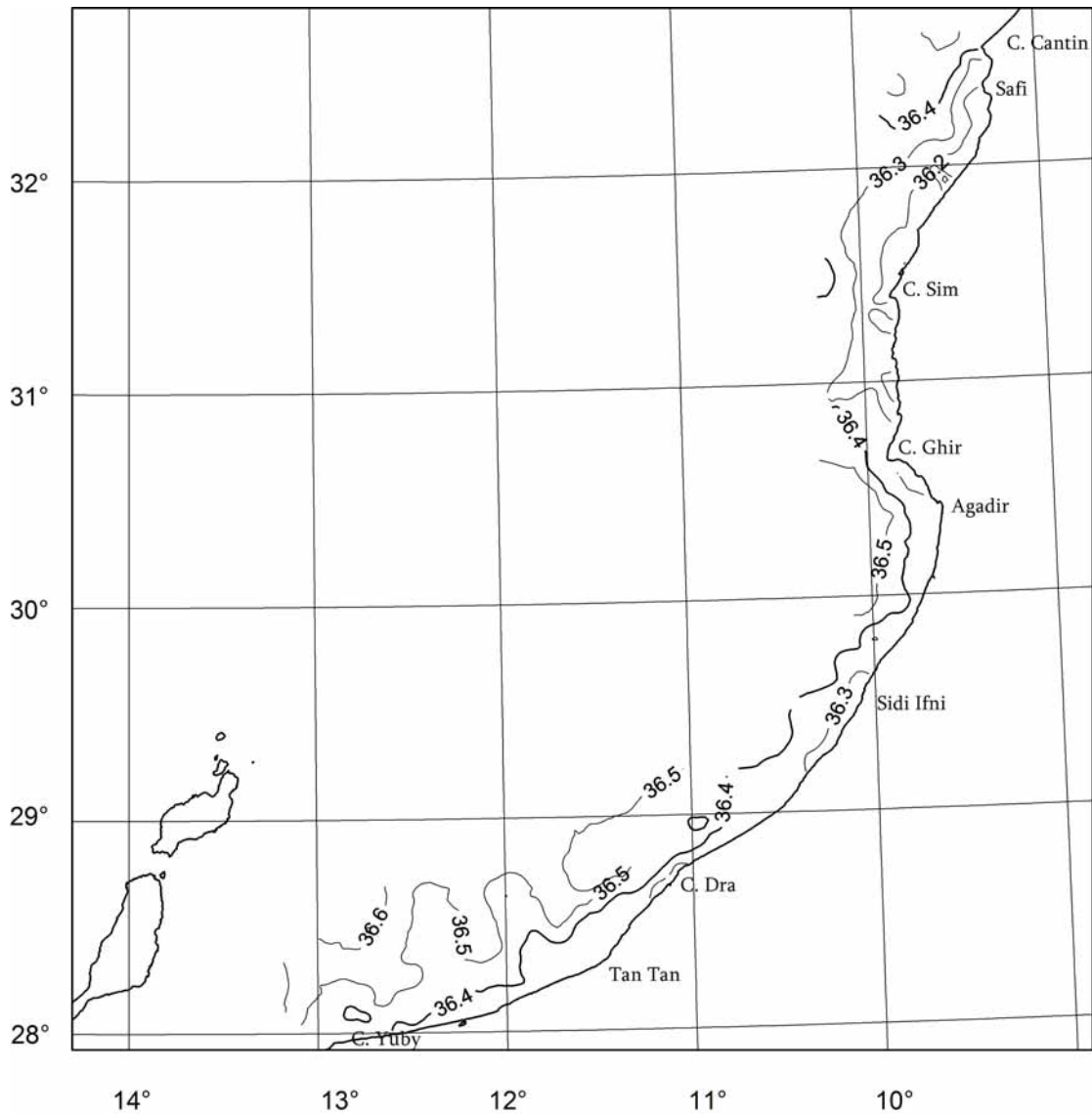


Figure 3d. Sea surface salinity (at 5 m depth), Cape Juby to Cape Sim.

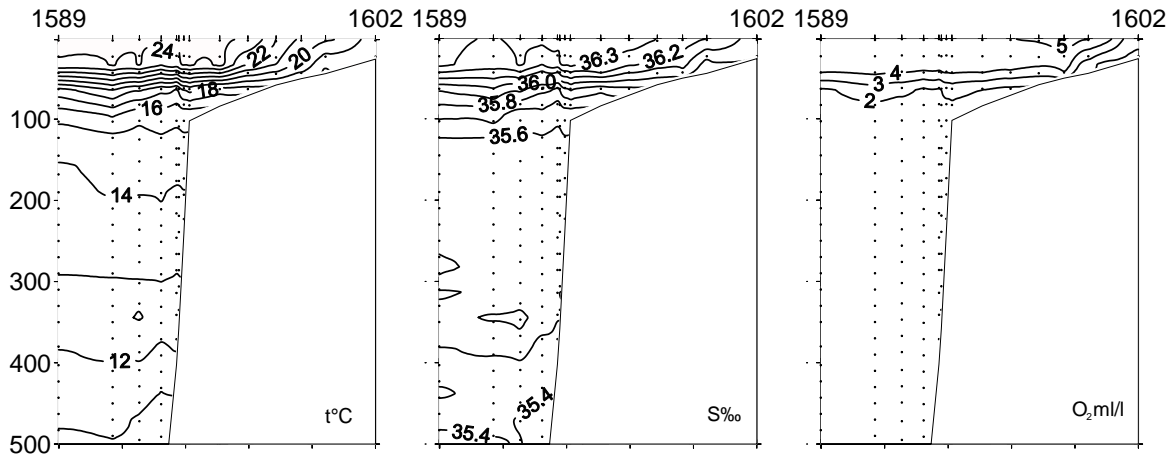
2.1.3 Hydrography

The southern region (Figure 2a and 3a) is located at the major oceanographic boundary separating the subtropical and tropical north Atlantic. The Canary Current in the north carries warm, high salinity and relatively high oxygen waters to the south. In the south, an opposite circulation cell associated with the equatorial current systems carries northwards relatively colder (except of the sea surface), less saline and oxygen poor water masses. Along the African coast the main current system is modulated by the seasonal cycle of the trade winds and the associated coastal upwelling. The confluence between the north and south Atlantic water masses takes place between C. Blank and C. Bojador. The hydrographic sections occupied along the 50 and 200 m isobaths from Lacraa to Cape Blanc (Figure 5) demonstrate this confluence zone as observed during the survey. The subsurface water masses of the tropical origin, characterized by salinity < 36 and oxygen < 2 ml/l dominated the upper slope in the depth range of the shelf-break at about

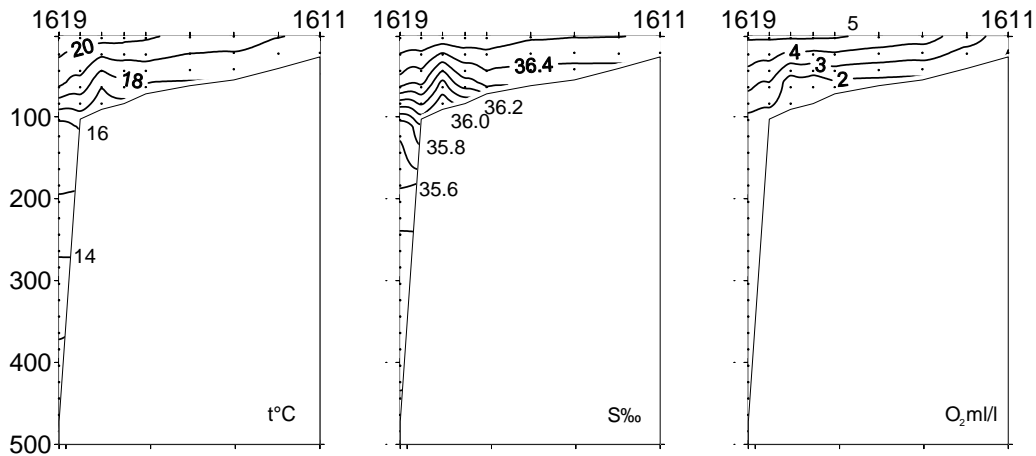
120 m and below (Figure 5a). However, the core the tropical water mass is rather narrow, confined in its cross-shelf extent to vicinity of the steep slope region (Figure 4c); the water column further offshore is dominated by the warmer, more saline and high oxygen water mass of the north Atlantic origin. Over the shelf, the north Atlantic water mass dominates the entire region from Dakhla to C. Blanc (Figure 5b). There is thus a contrast in the characteristics of the water masses along the slope and on the shelf, presumably caused by the two opposing transport mechanisms: an equatorward upwelling inducted flow over the shelf and a compensational poleward flow along the upper slope. The influence of the tropical water masses on the coastal zone diminishes to the north of Dakhla (Figure 5). Further north, off Lacraa (Figure 4d) the signature of low salinity and poor-oxygen signature of the south Atlantic water vanishes from the water column.

The shapes of the alongshore temperature and oxygen distributions at 50 m elevate (Figure 5b), highlighting a presence of a strong upwelling center located just south of C. Barbas. This a persistent seasonal feature observed during all surveys with RV Dr. Nansen. The presence of the strong upwelling in this area during autumn and winter is confirmed by high *chlorophyll a* levels observed from space (not shown). This upwelling cell appears to mark the major border between the two major pelagic stocks in the area: sardines and sardinellas as it coincides with the southern extent of the first and the northern extend of the latter stock. The temperature, salinity and oxygen distributions across the C. Barbas section (Figure 4) demonstrate the vertical structure of this upwelling. The isolines of all properties are tilted upwards, indicating an uplift of the low salinity and oxygen-poor (nutrient-rich) subsurface water masses from the upper slope towards inshore. There is a secondary elevation of the isolines, located further offshore, highlighting a secondary upwelling, presumably associated with a jet current just above the shelf-break. Off Dakhla (Figure 4c), the shelf-break upwelling dominates, whereas the inshore areas exhibit a well-mixed water column with the temperature, salinity and oxygen ranges suggestive of its north Atlantic origin.

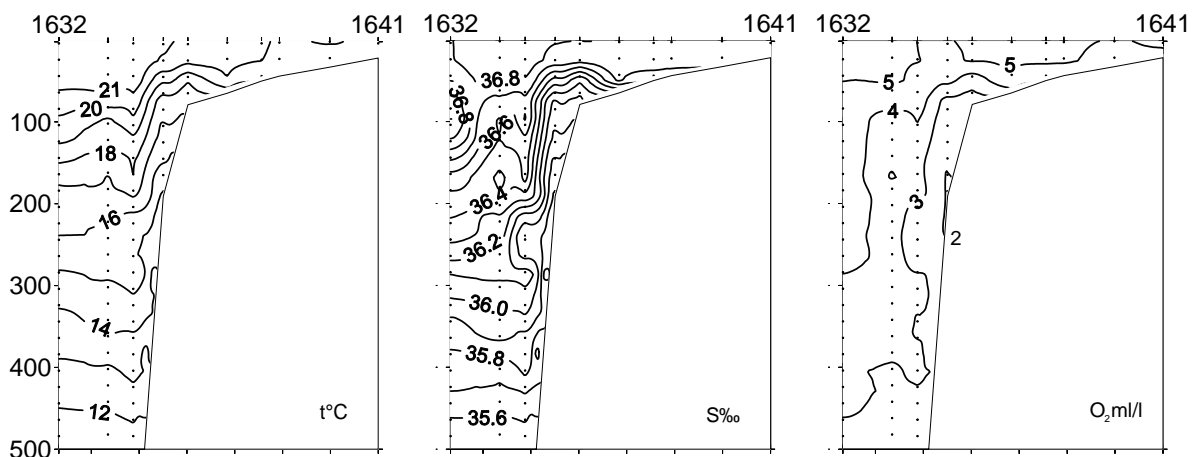
The sections occupied in the northern part of the survey area (Figure 4 f-h) are characterized by a very weak vertical stratification, extending over the shelf. The water column is entirely dominated by the high salinity and oxygen-rich water masses of the north Atlantic origin. The observed vertical structure supports the observations that the seasonal cooling rather than upwelling are the source of the low temperatures in the surface layer along the coast observed during the survey to north of Sidi Ifni (see Section 2.2.2).



a) Cape Blanc – 20-21.11.2006

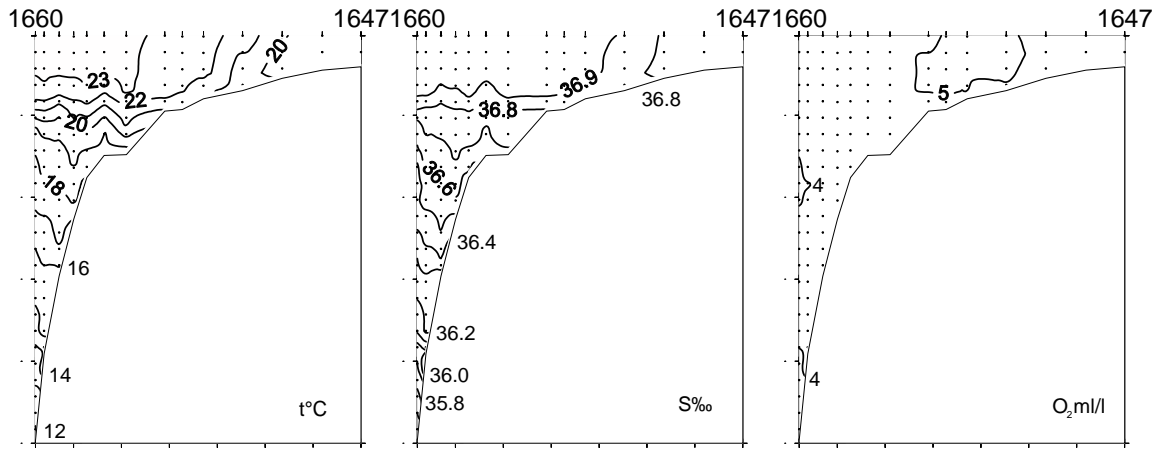


b) Cape Barbas – 23.11.2006

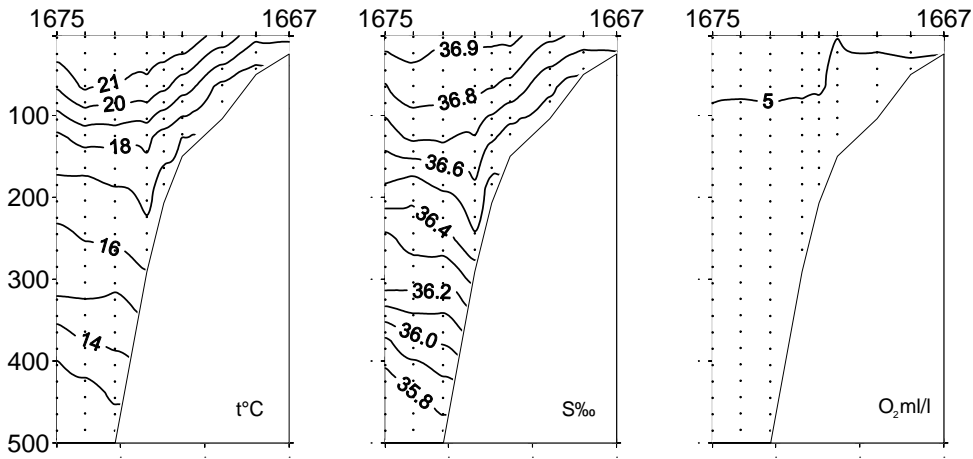


c) Dakhla – 27.11.2006

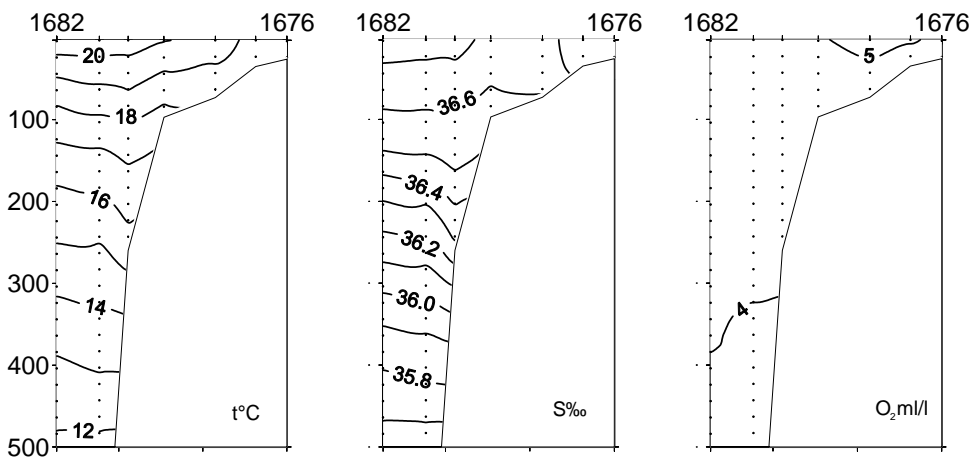
Figure 4. Hydrographic sections with distribution of temperature, salinity and oxygen.



d) Lacraa – 30.11.2006

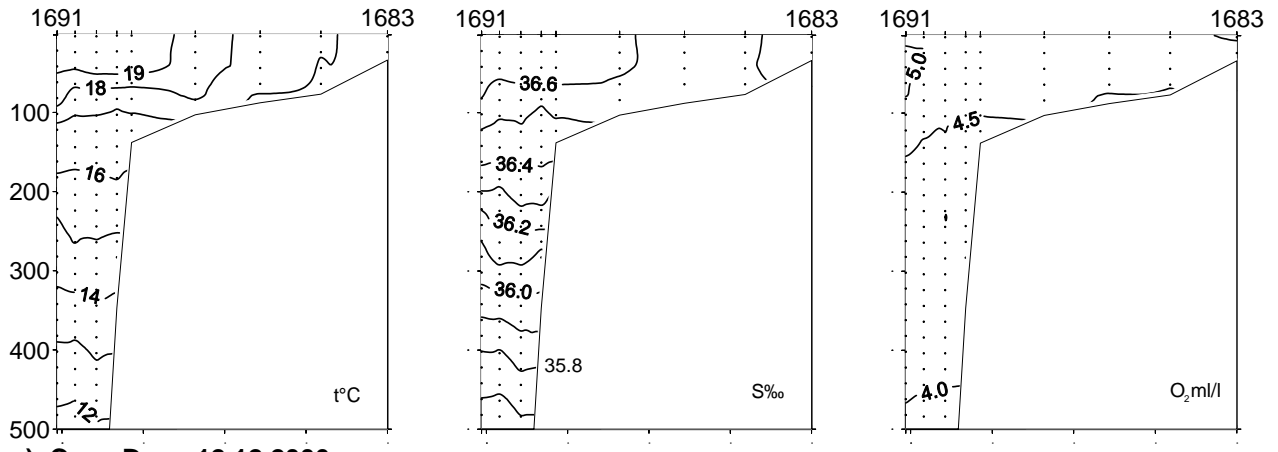


e) Cape Bojador – 05-06.12.2006

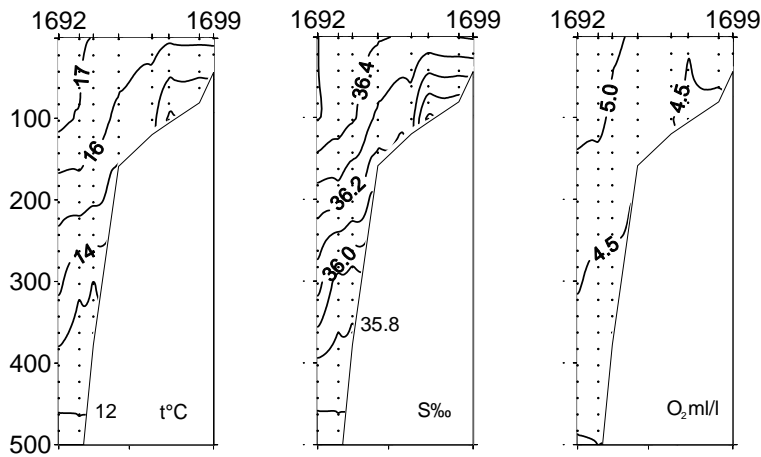


f) Cape Juby – 08.12.2006

Figure 4. (continued)



g) Cape Dra – 12.12.2006



h) Cape Ghir – 14.12.2006

Figure 4. (continued)

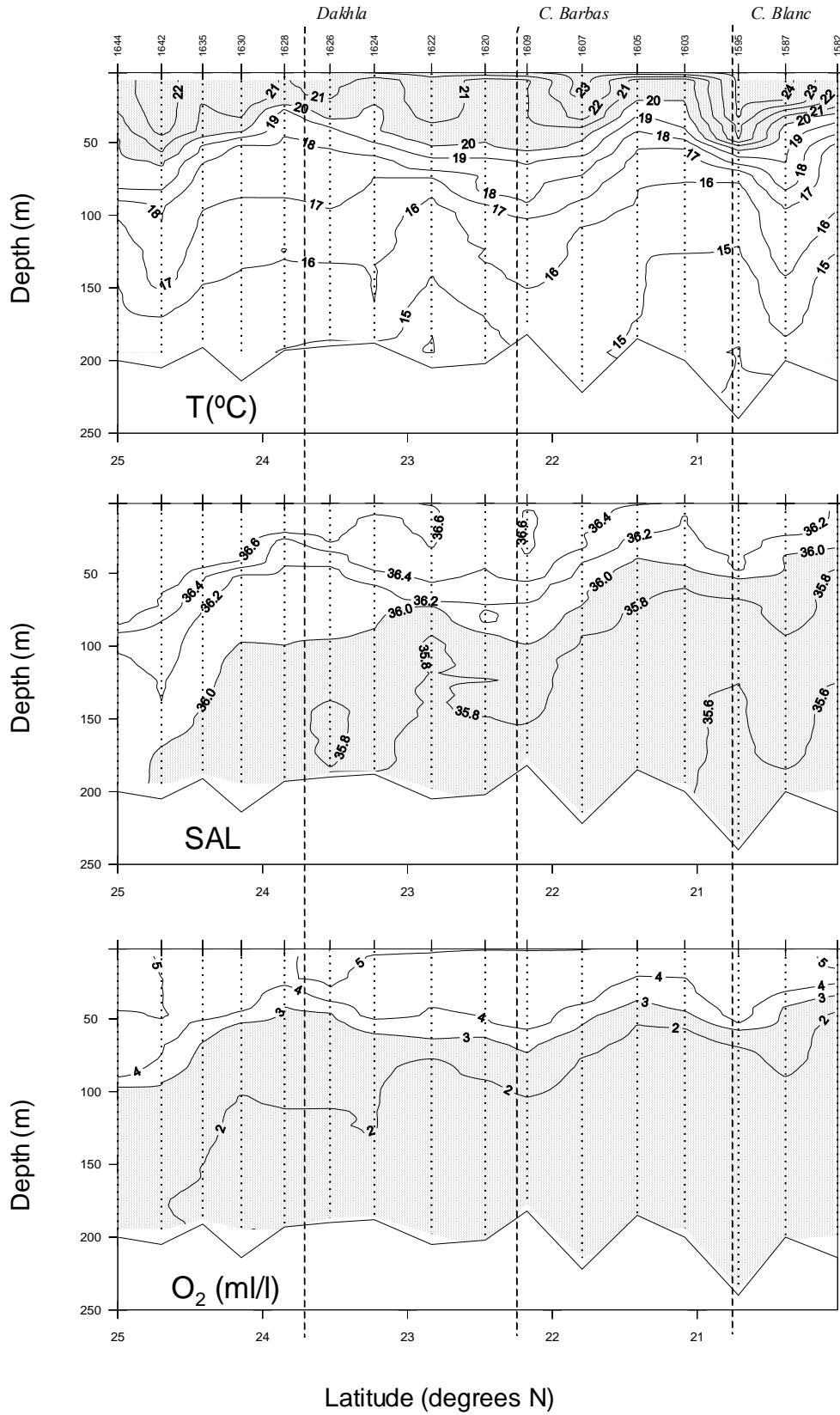


Figure 5a Distribution of temperature, salinity and oxygen along 200 depth contour between 21 and 25°N.

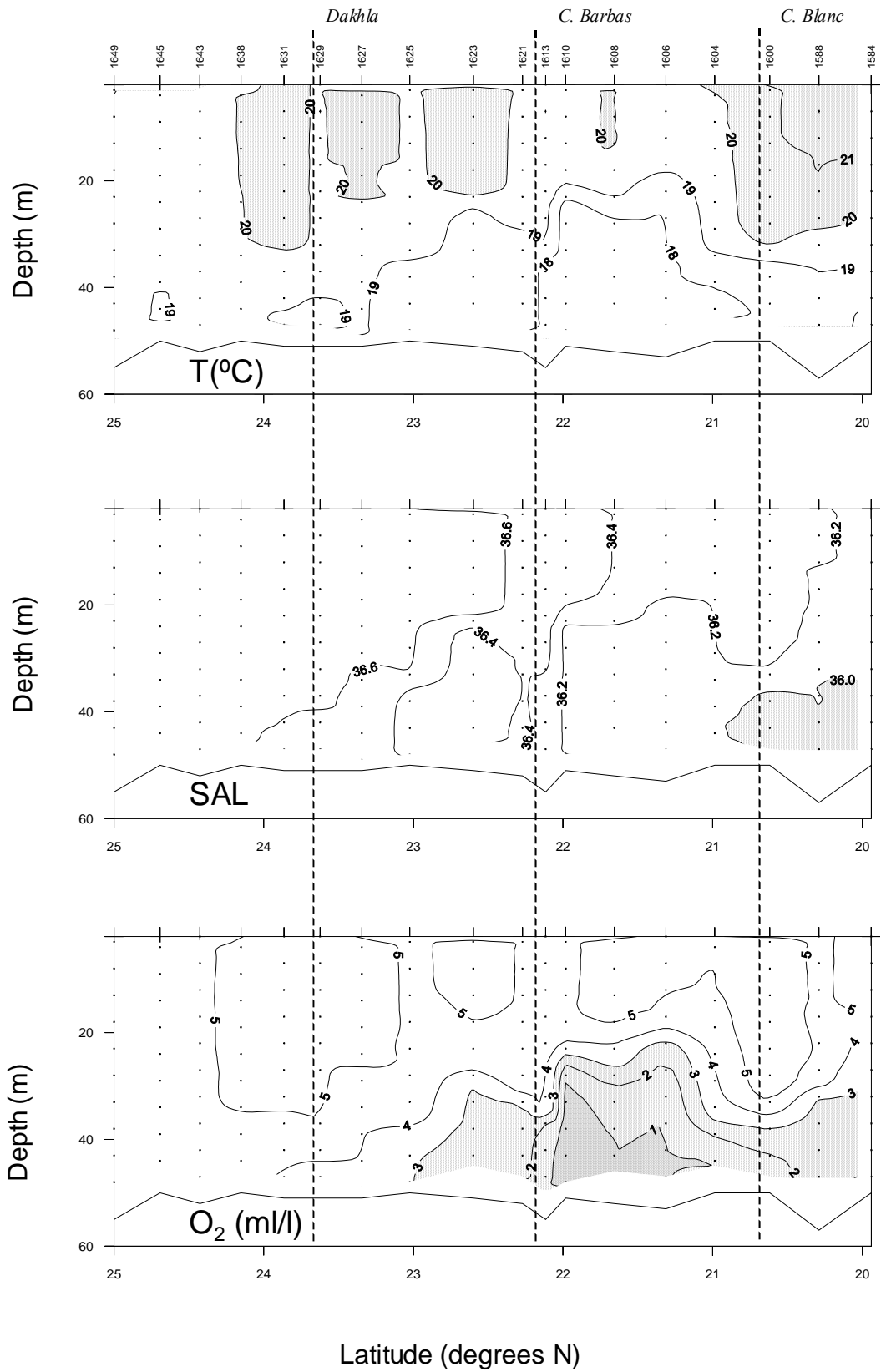


Figure 5b Distribution of temperature, salinity and oxygen along 50 m depth contour between 21 and 25°N.

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

Figures 6 to 10 show the distribution of the main groups of pelagic fish by contoured acoustic densities.

Sardine, *Sardina pilchardus*, was found almost without interruption between Cape Blanc and Cape Juby, Figure 6. The highest densities were found between Cape Barbas and Cape Bojador. Between Cape Barbas and Lacraa the sardine is occupying most of the shelf. Moderate quantities of juvenile sardine were recorded at the outer shelf between Cape Blanc and Dakhla. The length distribution in the stock Cape Blanc- Cape Bojador is shown in Figure 11a. Recruitment of fish below 18cm seems to be weak. Between Cape Bojador and Cape Juby sardine registrations were considerably less dense as compared to previous surveys. These aggregations consisted of a mixture of young and old fish, Figure 11b.

Sardinellas (*Sardinella aurita* and *S. maderensis*) formed a major aggregation between Cape Blanc and 23°N. Further north recordings were only scattered, Figure 7. Between Cape Blanc and Cape Barbas there was a mixing of *S. maderensis* and *S. aurita* while further north the catch was dominated by *S. aurita*.

Anchovies (*Engraulis encrasicolus*) were found scattered at the outer shelf between Cape Blanc and Cape Barbas, while it was common in the region between Cape Bojador and Cape Juby, Figure 8. It seems like the anchovy has been expanding in the latter area, probably benefiting from the low abundance of sardine there.

Horse mackerels (*Trachurus trachurus* and *T. trecae*) were common at the outer shelf between Cape Blanc and Dakhla, Figure 9. These aggregations were mainly consisting of *T. trecae*. Further north, between Dakhla and Cape Bojador, the horse mackerel were found scattered on the outer shelf, registrations mainly made up of *T. trachurus*. Horse mackerel were also recorded off Laayoune, but only at low densities, Figure 9.

Chub mackerel (*Scomber japonicus*) was recorded almost continuously from Cape Blanc to Cape Juby, with the highest densities at the outer shelf, Figure 10. The overall picture indicates a stock in expansion. Due to the low acoustic target strength of the species the true abundance is probably considerably higher than indicated in the maps.

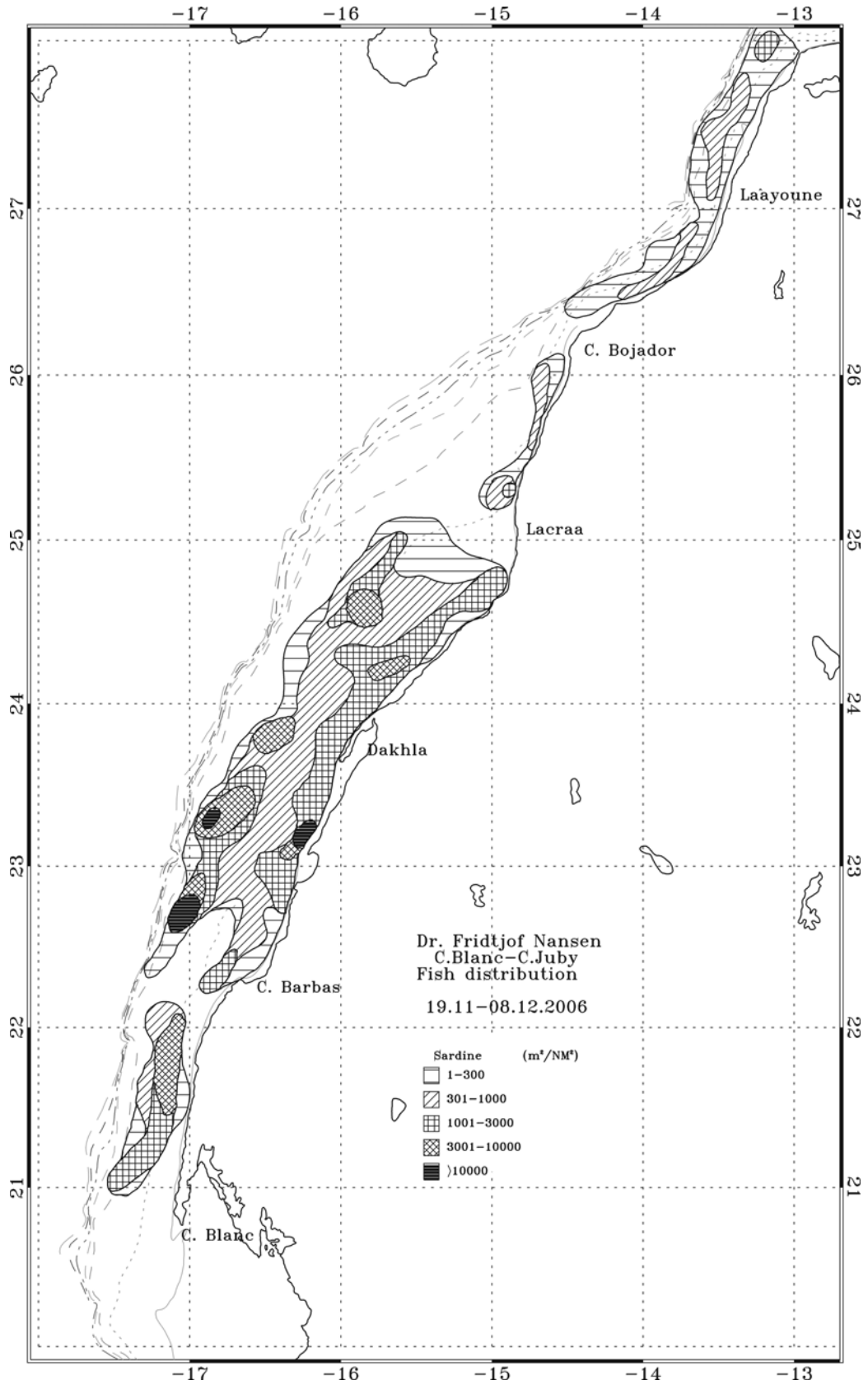


Figure 6. Distribution of sardine, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

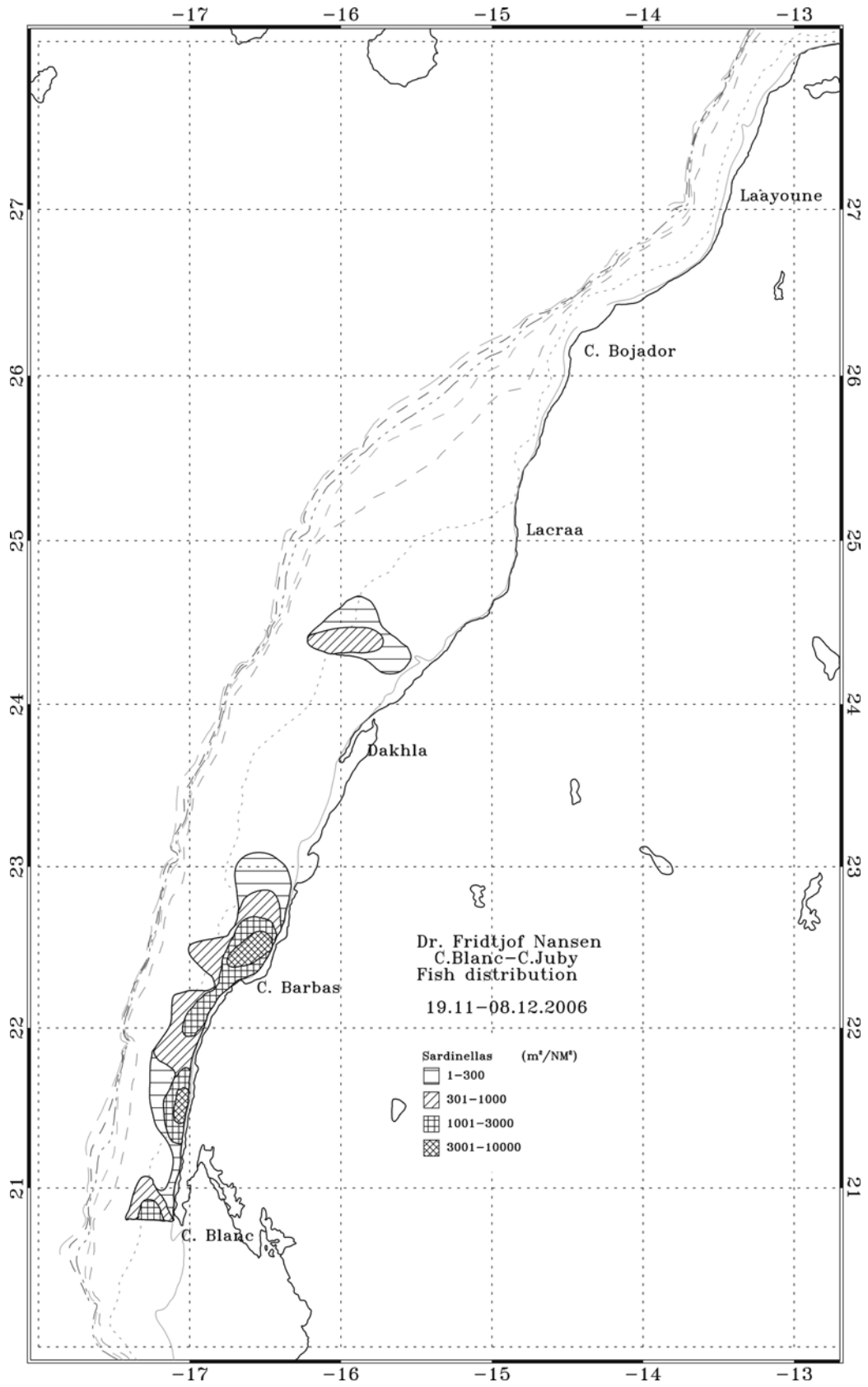


Figure 7. Distribution of sardinella, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

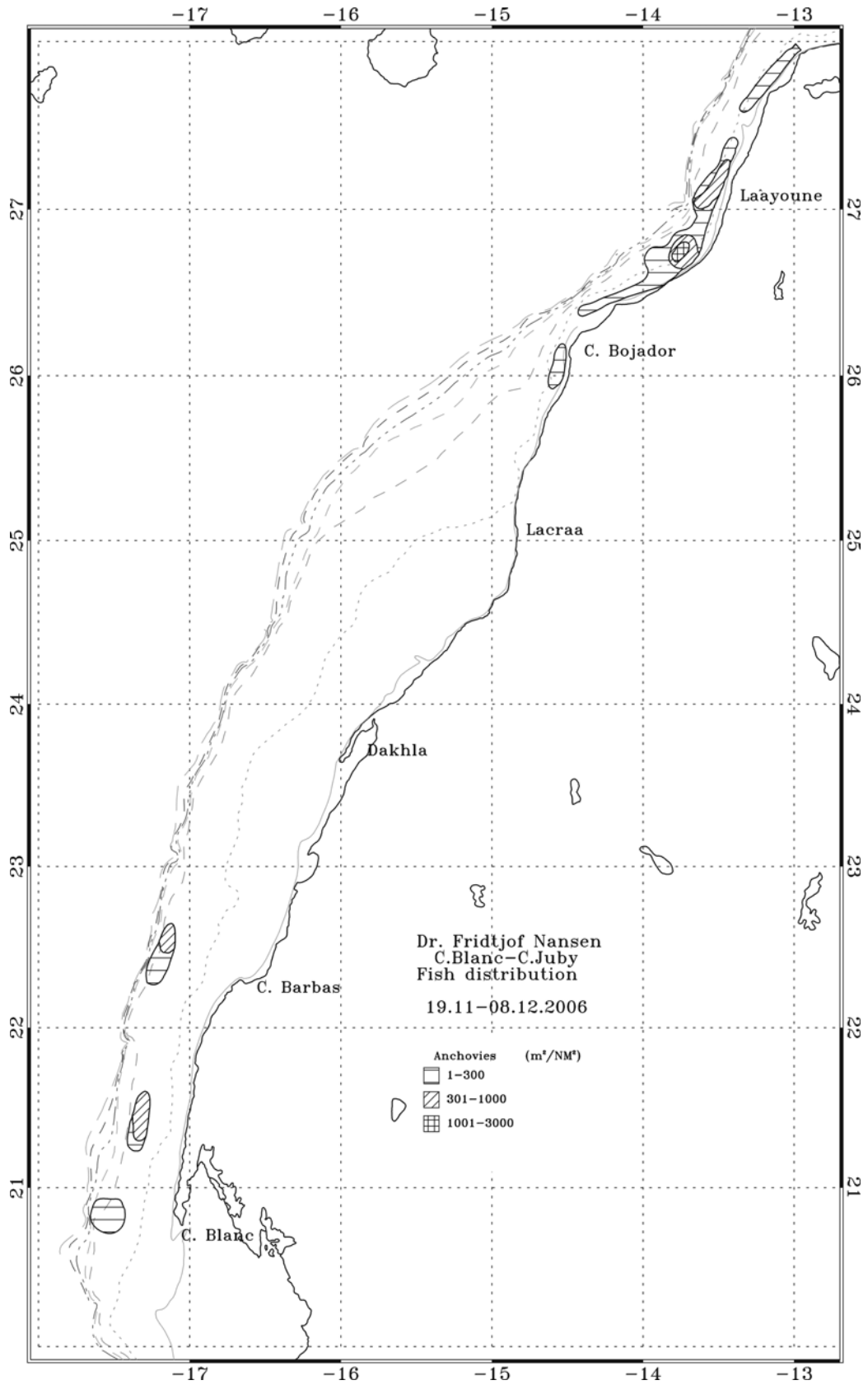


Figure 8. Distribution of anchovy, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

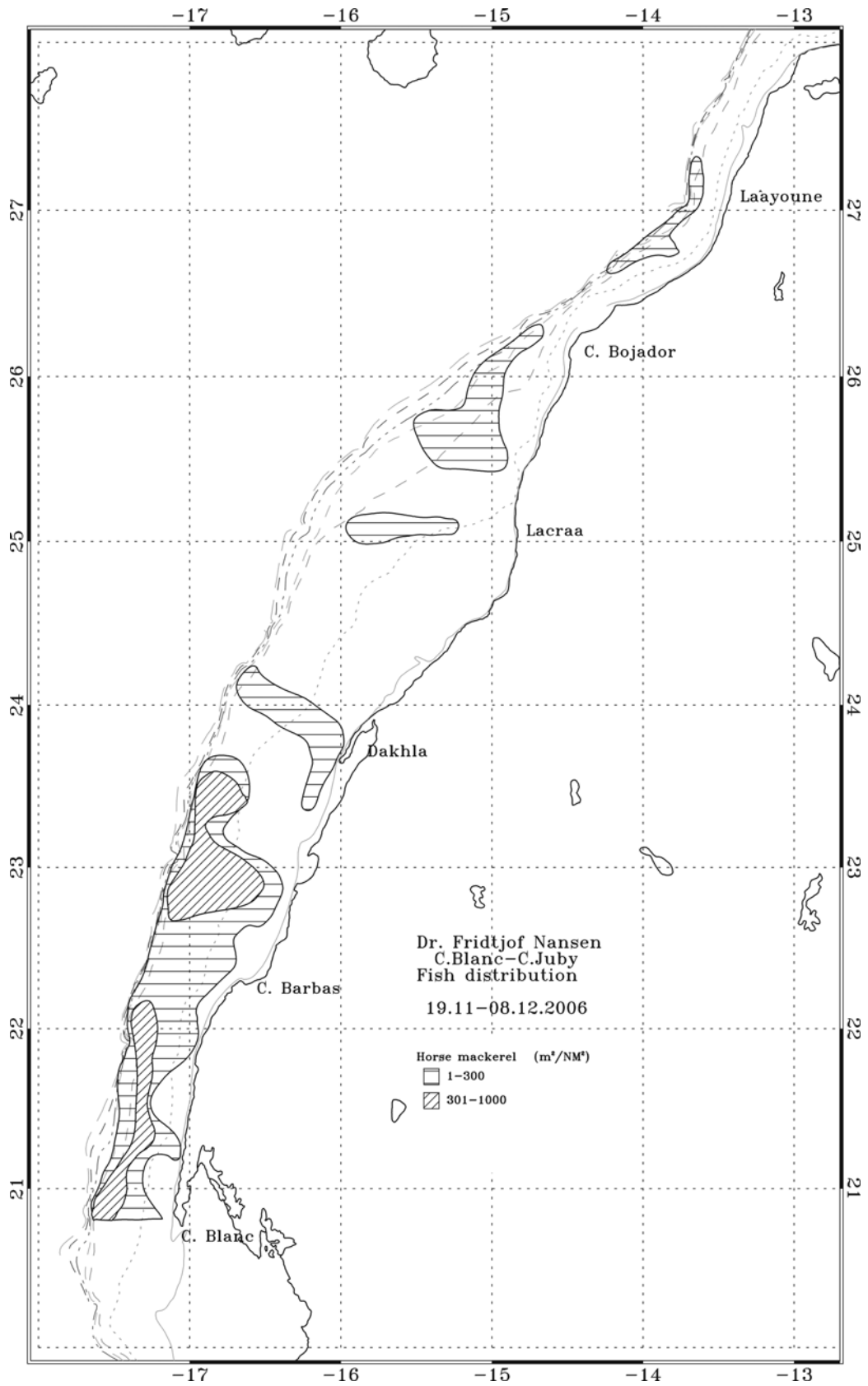


Figure 9. Distribution of horse mackerel, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

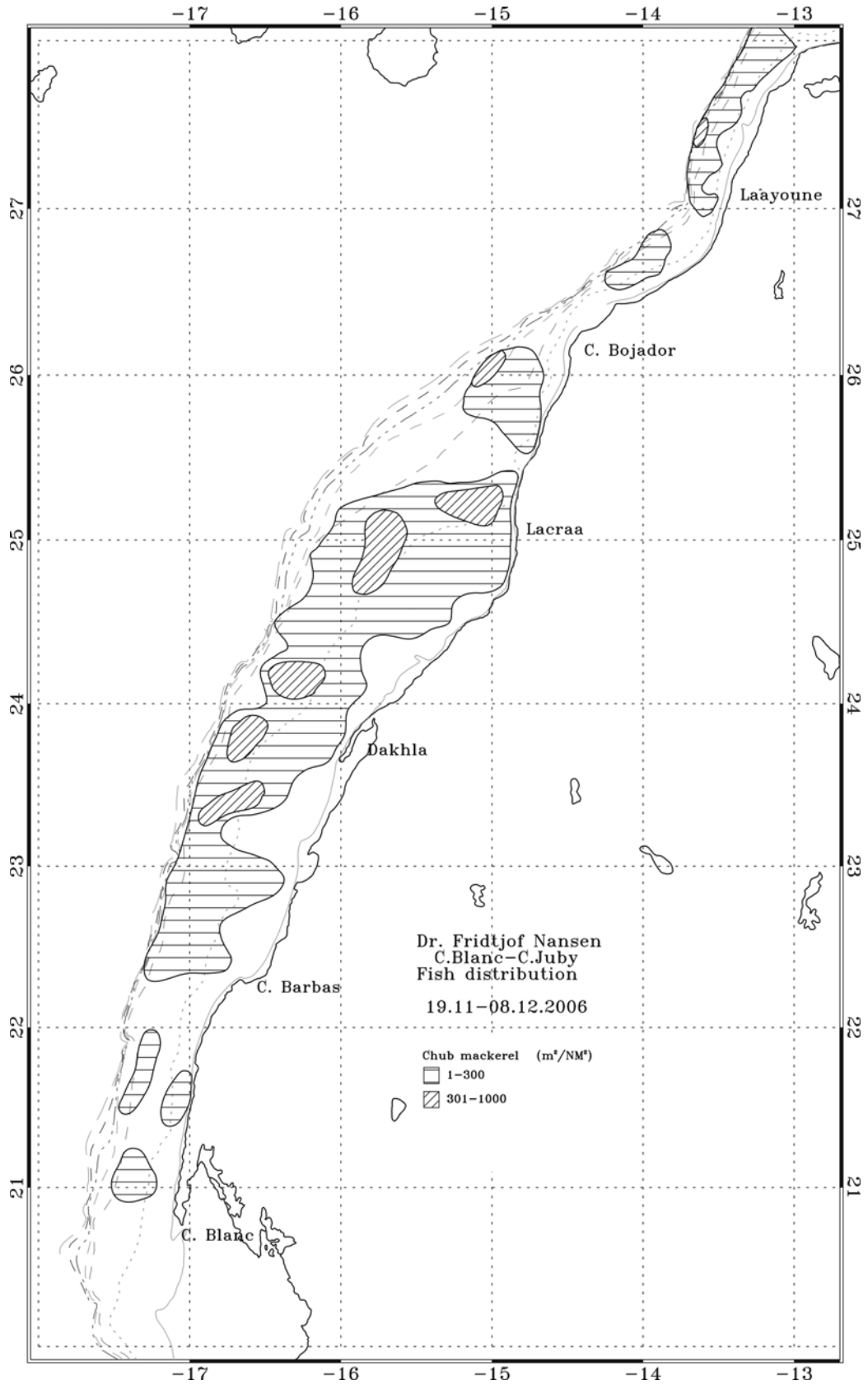


Figure 10. Distribution of chub mackerel, Cape Blanc to Cape Juby. Depth contours as in Fig. 1a.

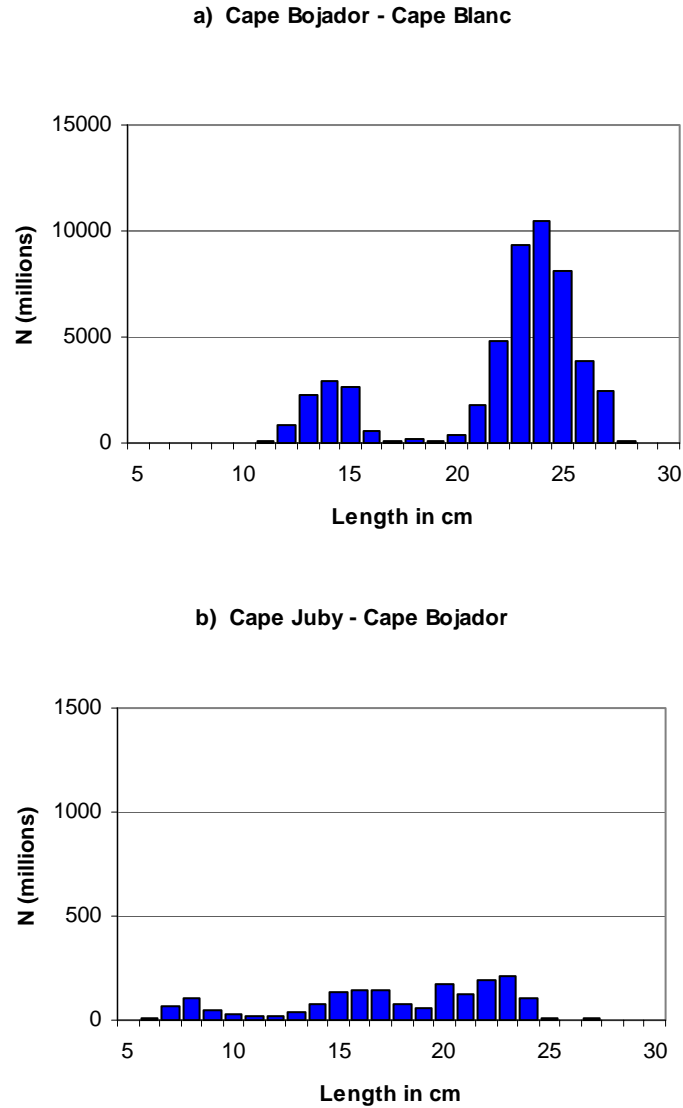


Figure 11. Length frequency distributions sardine Cape Blanc to Cape Juby.

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

Sardine was recorded in three patches in the coastal area from Cape Juby to Cape Sim, Figure 12. Generally the recordings were poor with the highest densities south of Agadir. No registrations were recorded off Cape Dra and Sidi Ifni. The aggregations consist mainly of a young cohort with mode around 15, Figure 15.

Anchovy was common between Cape Juby and Cape Dra, Figure 13.

Chub mackerel was found all along the coast from Cape Juby to Agadir, generally in low densities, Figure 14. A dense patch was found off Sidi Ifni.

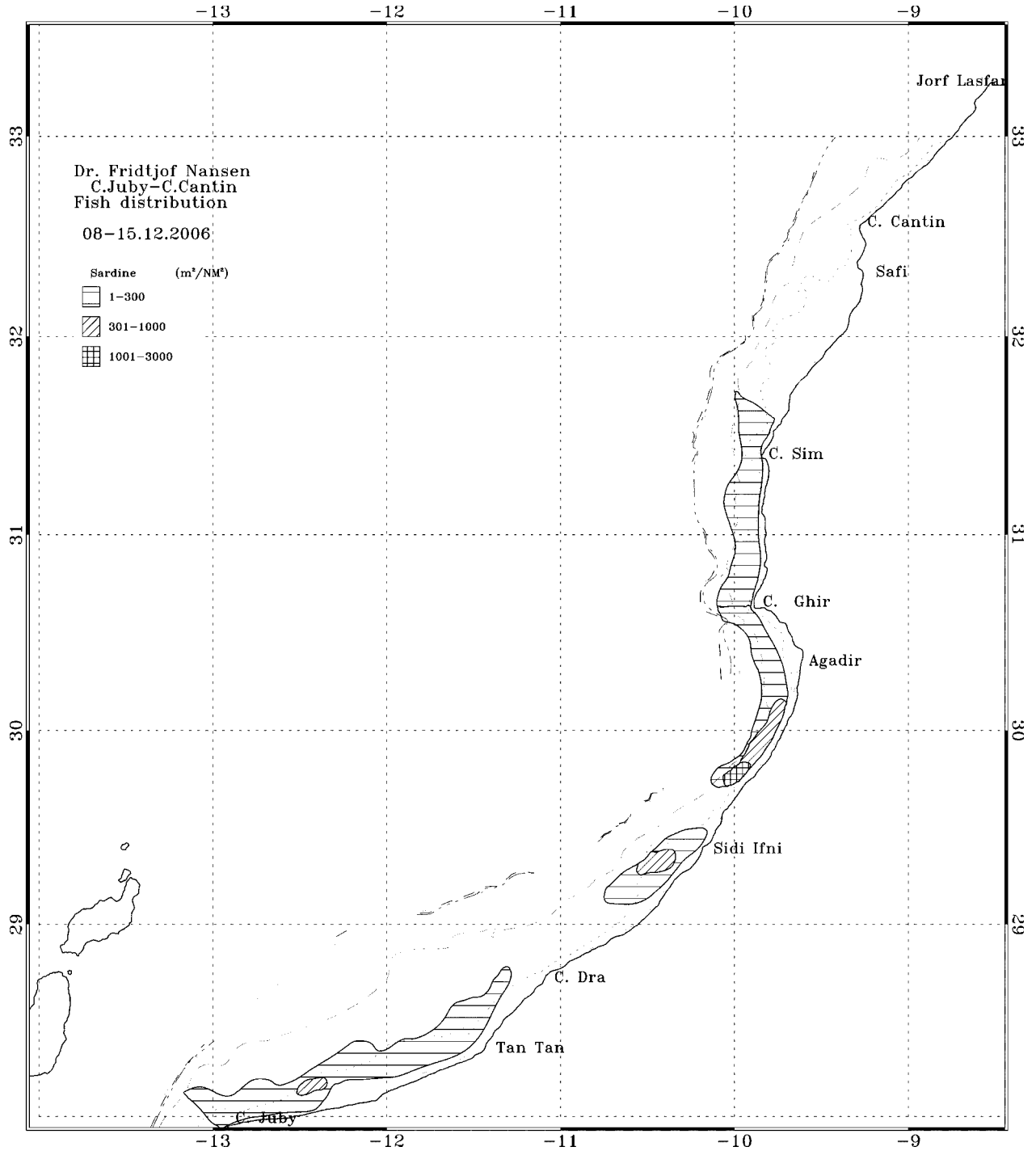


Figure 12. Distribution of sardine, Cape Juby to Cape Sim. Depth contours as in Fig. 1a.

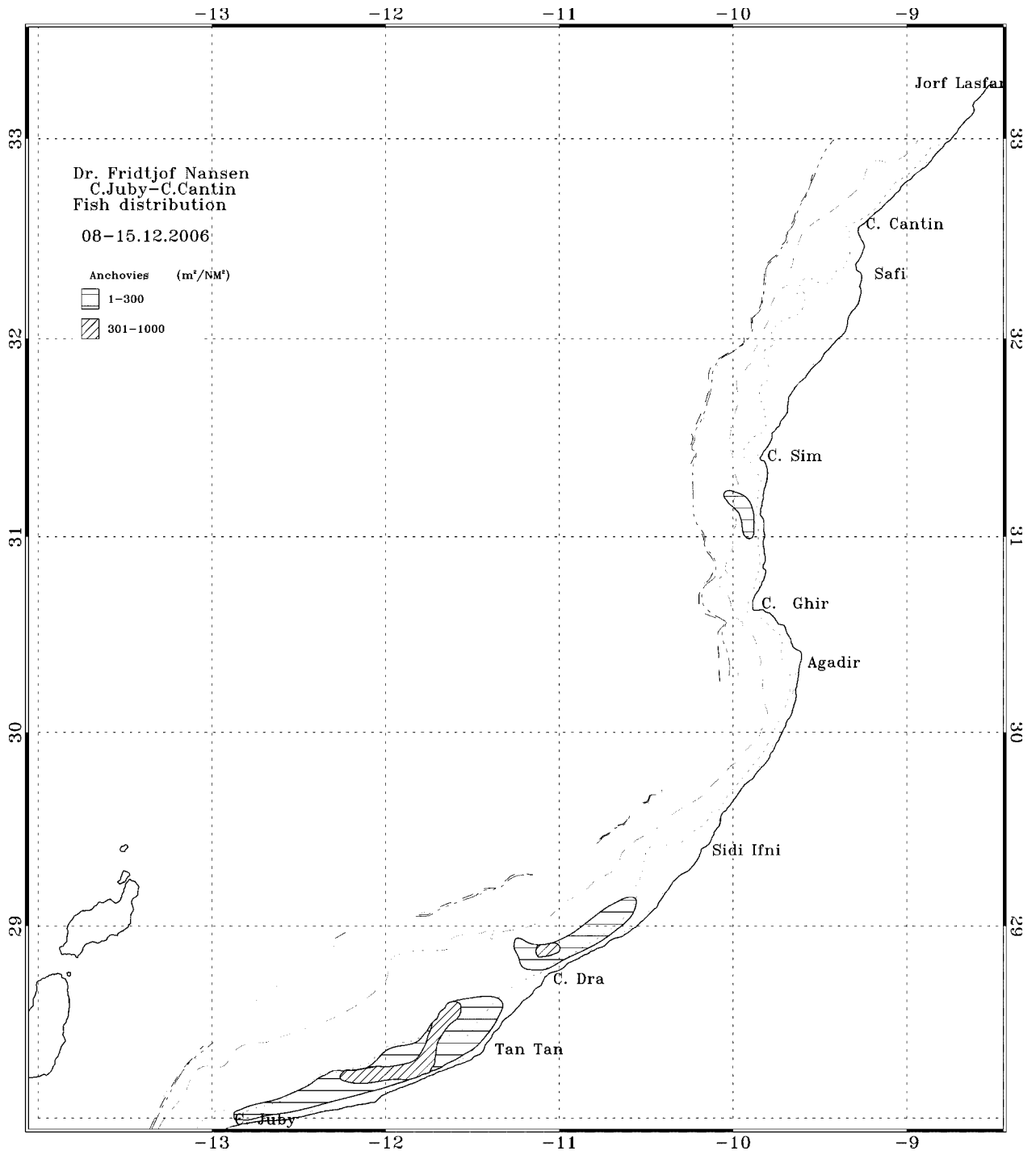


Figure 13. Distribution of anchovy, Cape Juby to Cape Sim. Depth contours as in Fig. 1a.

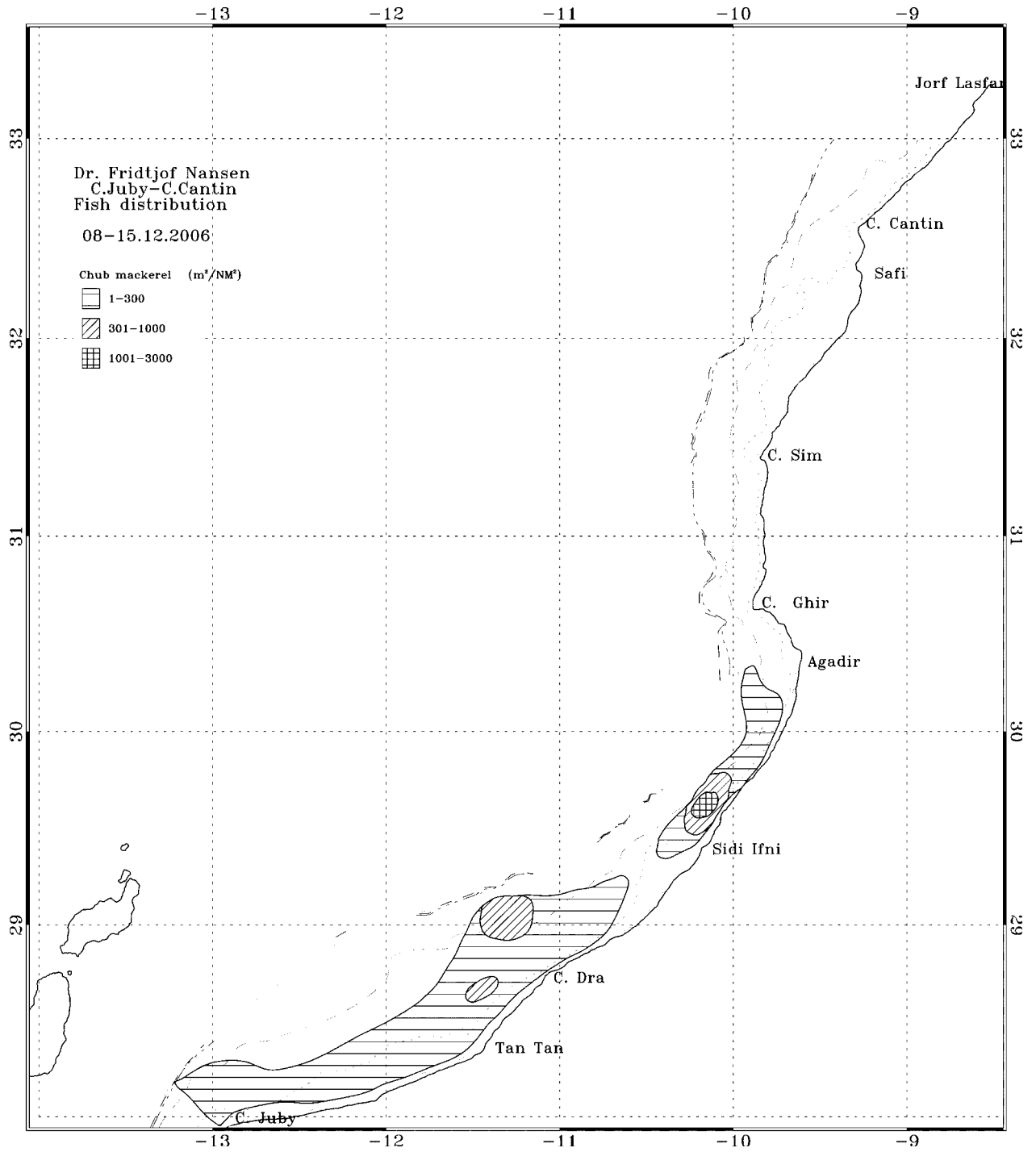


Figure 14. Distribution of chub mackerel, Cape Juby to Cape Sim. Depth contours as in Fig. 1a.

Recordings of **horse mackerel** were very few and scattered, figure 15.

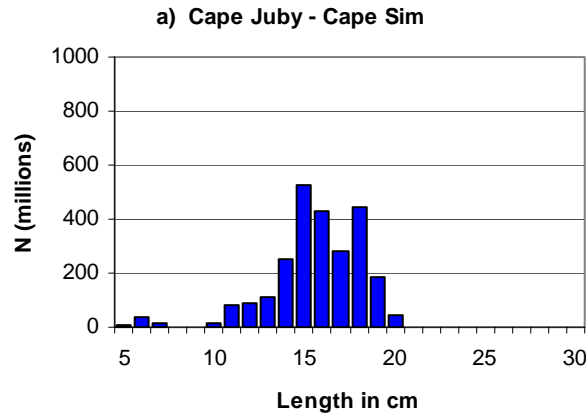


Figure 15. Length frequency distribution of sardine Cape Juby to Cape Sim.

2.4 Biomass estimates

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

Cape Blanc – Cape Bojador

The **sardine** was estimated to 3.5 million tonnes, which is a considerable decline from the XXX million tonnes estimated one year earlier. This year the abundance of sardine in Mauritania was insignificant. The length distribution is earlier shown in Figure 11. The major share of the fish in terms of biomass consists of older fish. Compared with earlier years, the development in the “adult” part of the stock (i.e. fish >19cm) is:

Survey	Thousand tonnes	Million fish
November-December 1996	4 600	47 400
November-December 1997	240	2 900
November-December 1998	340	3 400
November-December 1999	1 000	11 500
November-December 2000	1 260	13 200
May-June 2001*	1 975	22 500
November-December 2001	3 200	32 000
May-June 2002*	2 100	21 400
November-December 2002	3 700	35 500
June 2003*	5 580	59 300
November-December 2003*	4 370	43 600
November-December 2004*	5 720	51 900
November- December 2005*	7 630	68 300
November- December 2006	3 130	27 600

* Including sardine in Mauritania

In one year the adult stock has been reduced to almost 40% of the earlier estimate both in number and in biomass. The main cause of this is probably the infection that hit the stock in 2005 and continues to decimate it, see below. At present, the recruitment to the stock remain low. The young fish (<20 cm) constitute only of about 10 billion fish, slightly below 14 billion estimated in the two previous years. The future of the stock seems very much dependent on the next recruitment.

Sardinella was estimated to roughly 1.24 million tonnes of which 710 and 530 thousand tonnes are round and flat sardinella respectively, Annex I. The main part of the fish is located between Cape Blanc and Cape Barbas.

Anchovies were estimated to 25 thousand tonnes. The previous year scattered recordings only made up 10 thousand tonnes, Annex I.

The two species of **horse mackerel** combined was estimated to 310 thousand tonnes (Annex I), of which roughly 40 thousand tonnes and 270 thousand tonnes were Atlantic and Cunene horse mackerel respectively. The corresponding figures last year were 140 and 980 thousand tonnes respectively. Young fish of Cunene horse mackerel (11-22 cm) constitute about 35% of the total biomass and gives some growth potential to the stock. The species are also distributed south of Cape Blanc into Mauritania and Senegal and estimated there to xxx thousand tonnes, Annex IV.

Chub mackerel were estimated to about 330 thousand tonnes, a steady increase in biomass from 150 thousand tonnes in 2005 through 240 thousand in 2005., Annex I. It should be noted that the chub mackerel has a small swimming bladder, and thus low target strength (TS). In lack of reliable target strength for chub mackerel, the TS for sardine has been applied in the estimates. The estimates are therefore probably solid underestimates.

Cape Bojador – Cape Juby

Estimated **sardine** in this region is 110 thousand tonnes compared to XXX thousand tonnes in 2004. This region was not surveyed in 2005.

Cape Juby – Cape Cantin

The **sardine** is estimated to 90 thousand tonnes, a considerable reduction to the 840 thousand tonnes estimated in the previous survey in December 2004. The abundance in numbers is about 2.5 billion compared to the 15 billion in 2004. The main part of the biomass (84%) is made up of young fish less than 19 cm length, Annex I.

Anchovies were estimated to only 16 thousand tonnes, about 50% of the 32 thousand estimated in 2004.

Chub mackerel was estimated to 100 thousand tonnes, while the estimates in 2004 was 340 thousand tonnes. One should take note that these estimates should be treated as relative figures. The chub mackerel is probably under-estimated due to the low but uncertain target strength of the species.

Region	Sardines	Round sardinella	Flat sardinella	Atlantic horse mackerel	Cunene horse mackerel	Chub mackerel	Anchovy
Cape Sim-Cape Juby	90	-	-	-	-	100	16
Cape Juby-Cape Bojador	110	-	-	3	-	15	13
Cape Bojador-Cape Blanc	3 390	714	530	37	270	315	12
Totals	3590	714	530	40	270	430	41

2.5 Infectious disease in the Dakhla sardine stock

During the survey in 2005 it was soon noted that significant part of the trawl samples of sardine had visual signs of a disease that gave blood spotted lesions on the skin, often close to the fins, on the operculum or in the eye. Soon it was established a procedure where the percentage of infected fish was recorded at each station. Figure 16 shows that the disease in 2005 seems to spread out from a centre south-west of Dakhla, with a geographical range S-N from 22°30' N to 25°30' and extending most of the shelf, particularly offshore from the centre. In 2006, figure 17, the disease has spread further south to 21°10', now with three centres of diffusion, while the 2005 centre location now has no signs of the disease. It should also be noted that in 2006 the infection stays closer to the shore and has not infected the fish at the outer part of the shelf.

Figure 18a shows the composed length distribution in the samples with visual signs of the disease as compared to the total population in the area. The pooling of the samples is weighted with the acoustic biomass indices. It shows that the infection is mainly in the older part of the population. By presenting the mean infection rate by length, Figure 18b, it is shown that the biggest or rather the oldest fish is hit strongest.

From a biological perspective this seems to be a clear case of density dependent regulatory mechanism in an old stock with low fishing pressure and relatively few top predators. In such a stock, when utilising its ecological niche to its maximum extent, it will become vulnerable to sudden changes in the environmental conditions, such as less plankton for food or less spatial habitat due to decrease in the strength of the upwelling. This will at the same time concentrate the fish in higher densities close to the shore in the smaller upwelling cell. Especially the old part of the stock with a weakened immune system then becomes vulnerable to infectious disease that soon can have a self-propelling exponential character. This seems to be the case for the Dakhla stock in the last year and is the main explanation for the recent drastic decimation of the stock.

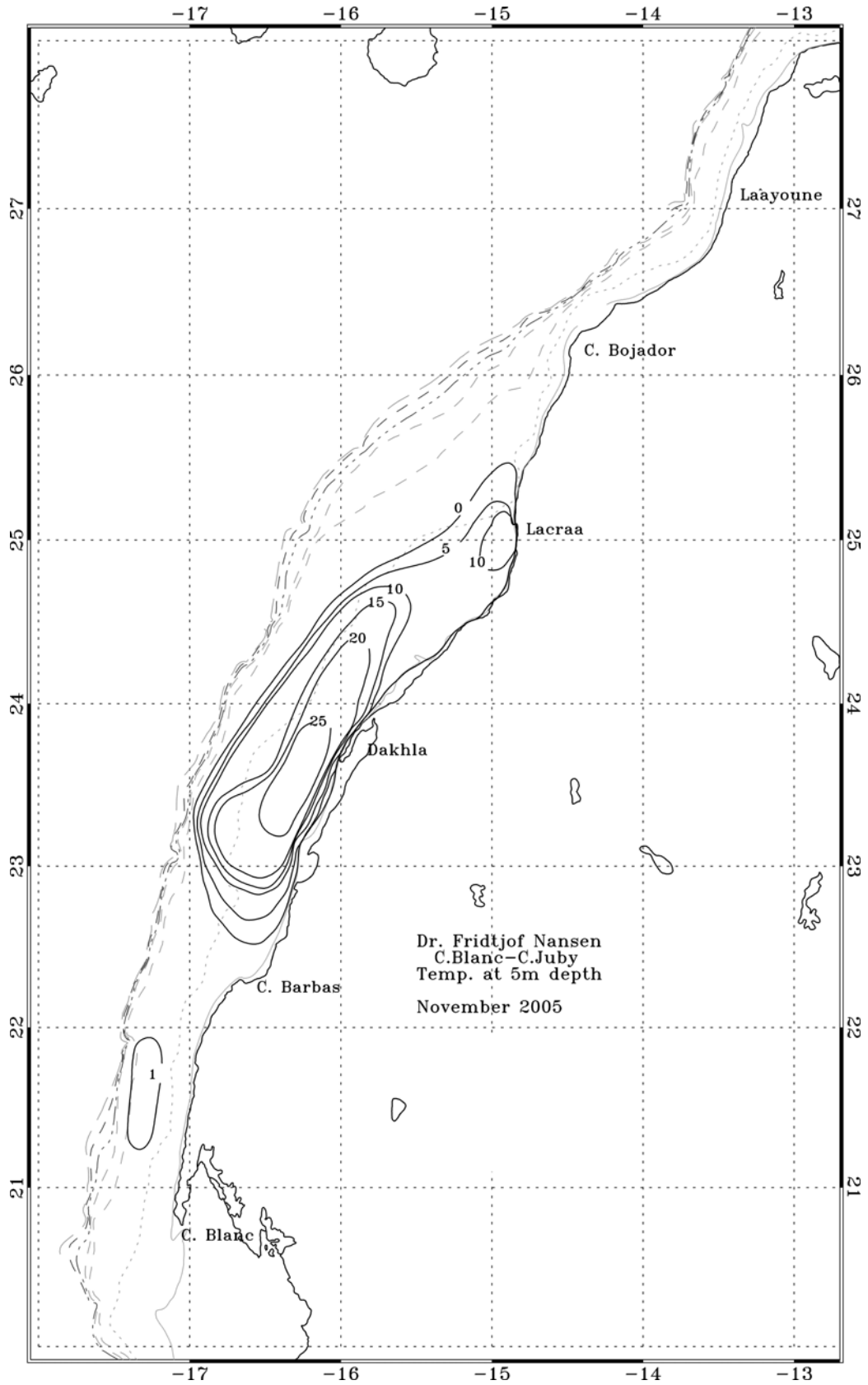


Figure 16. Geographical percent distribution of fish with visual signs of disease in November 2005.

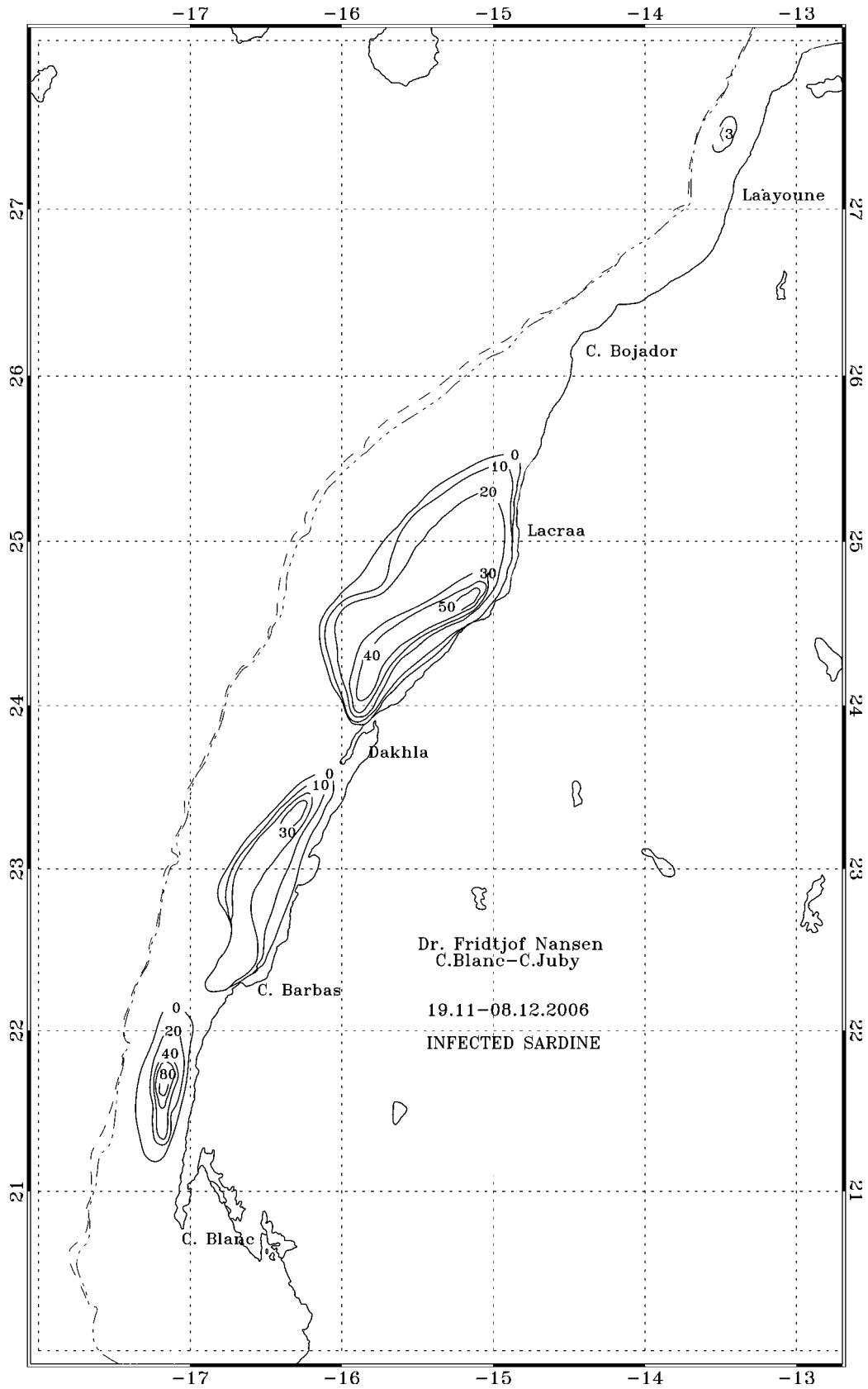


Figure 17. Geographical percent distribution of fish with visual signs of disease in November 2006.

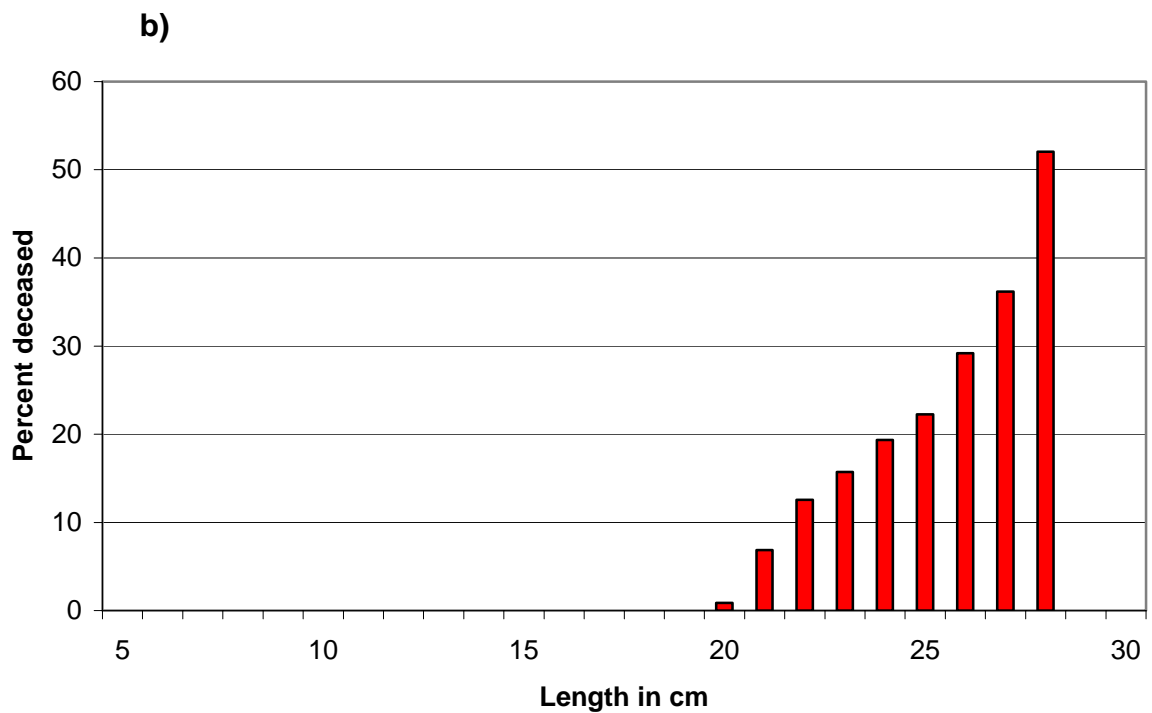
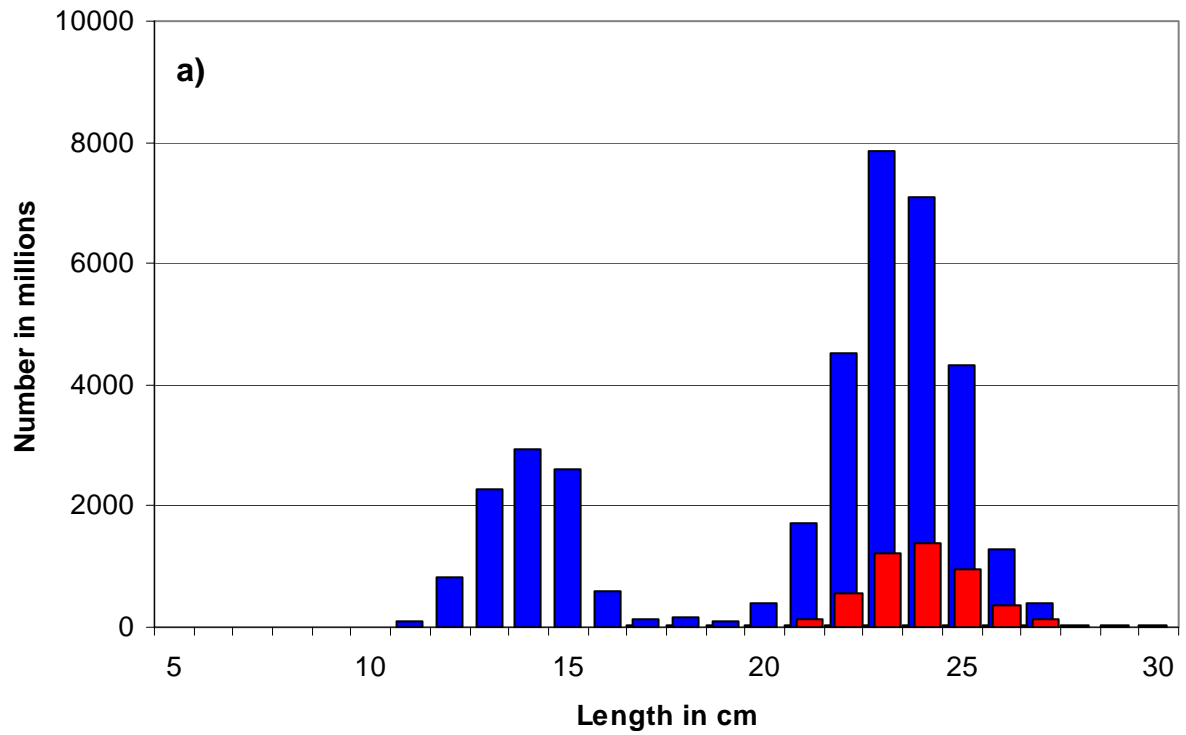


Figure 18. a) Length distribution in the population of fish with signs of disease as compared with the total population. b) Percent infected fish by length classes, as percentage of the total population.

CHAPTER 3 CONCLUDING REMARKS

(Meteorological and hydrographic conditions to be completed)

Figure 19 gives a general overview on the major aggregations of pelagic fish with rounded biomass figures. The biomass estimates are also summarised in Table 1.

Adult **sardine** in the southern region are distributed in the coastal areas between Cape Blanc and Cape Bojador, while the young fish is located close to the shelf edge. Only insignificant quantities were found south of Cape Blanc in the preceding survey in Mauritania. About 18% of the adult sardine has visual signs of infection, most probably from bacteria. The biomass of sardine between Cape Blanc and Cape Bojador is reduced to 3.4 million tonnes, compared to the 8 million tonnes estimated in 2005. It is assumed that most of the decrease is due to the infectious disease which also was recorded during the November survey 2005. It is assumed that the disease will further decrease the adult stock in the coming year. The young sardine, living in a separate location does not have any signs of infection. Recruitment seems to be moderate with 9.7 billion fish. Sardine in the region Cape Bojador-Cape Juby is estimated to 100 thousand tonnes, a considerable decrease from the 430 thousand tonnes estimated in 2004. Further north, the stock between Cape Juby and Cape Sim is estimated to only 90 thousand tonnes, again a considerable reduction from the 840 thousand tonnes two years earlier. Recruitment seems to be poor with only 2.5 billion fish less than 19cm.

Sardinellas were mainly recorded in the Cape Blanc - Cape Barbas area, but also in a small patch north of Dakhla. The biomass was estimated to 1.2 million tonnes.

Anchovies were only estimated to 40 thousand tonnes, mainly off Layoune and Tan Tan.

Horse mackerels were forming dense aggregations on the outer shelf from Cape Blanc to off Dakhla, but also in less dense patches further north. The combined estimate of the two species of horse mackerel is 310 thousand tonnes of which 270 thousand tonnes is Cunene horse mackerel south of Dakhla.

Chub mackerel is on a relatively high level. The biomass index is 430 thousand tonnes of which 320 thousand tonnes is between Cape Blanc and Cape Bojador and 100 thousand tonnes between Cape Juby and Cape Sim,

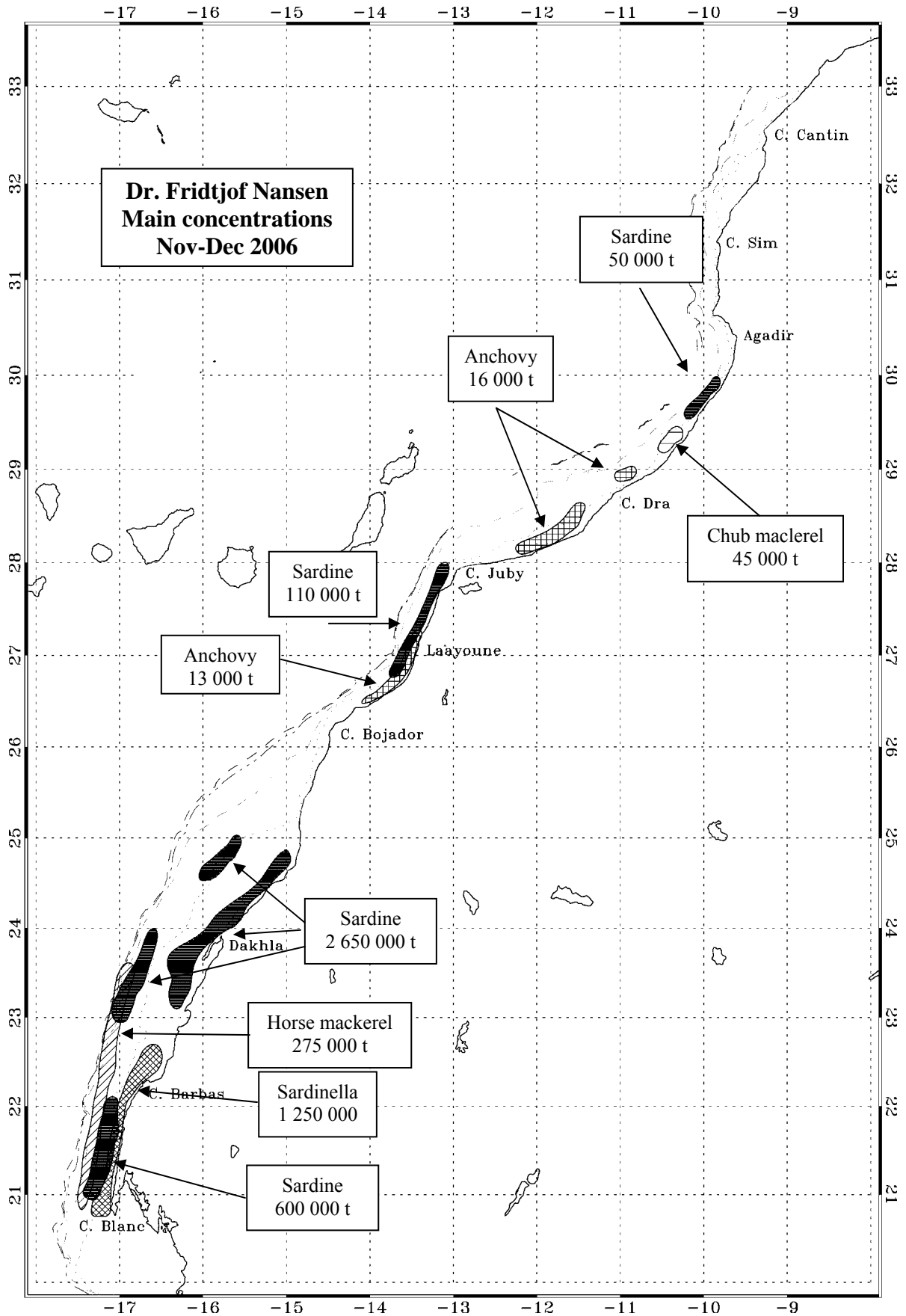


Figure 19. Map of the major pelagic fish concentrations with estimated abundance (tonnes), Cape Blanc to Cape Sim.

Trends 1995-2006, sardine

Figure 20 shows the biomass estimates of sardine compared with results from previous *Dr. Fridtjof Nansen* surveys. Figure 21 shows the biomass figures 1995-2005 by length classes. Both figures show the gradual rebuilding of the southern stock since its sudden collapse in 1997. The rebuild has culminated with the 8 million tonnes in 2005 and with a drastic reduction during 2006 to present 3.5 million tonnes. It is assumed that the southern stock will be further decimated during 2007 as the epidemic is still running. The recruitment level is relative poor, Figure 18 bottom left, and the near future of the stock is probably very much dependent upon a successful spawning during spring 2007. In hindsight it is probably correct to assume that a considerable increased fishing in the years 2000-2005 would have decimated the stock to a more optimal level less vulnerable to density dependent regulating mechanisms such as the infectious disease recorded since 2005.

The central stock between Cape Juby and Cape Sim is now on its smallest level recorded since 1986. The present estimate of 90 thousand tonnes is only 14% of the pre-2006 average of 650 thousand tonnes. The small fish, less than 20 cm, continue to dominate the central stock and recruitment in 2006 seems to be record low, Figure 18 top left. The picture of this stock is however not complete as it was unfortunately not time to survey the area between Cape Sim and Cape Cantin and this area could hold some fish as well. The general picture nonetheless is of a stock that could already be close to a collapse and tight regulatory measures combined with repeated surveys should be applied soonest.

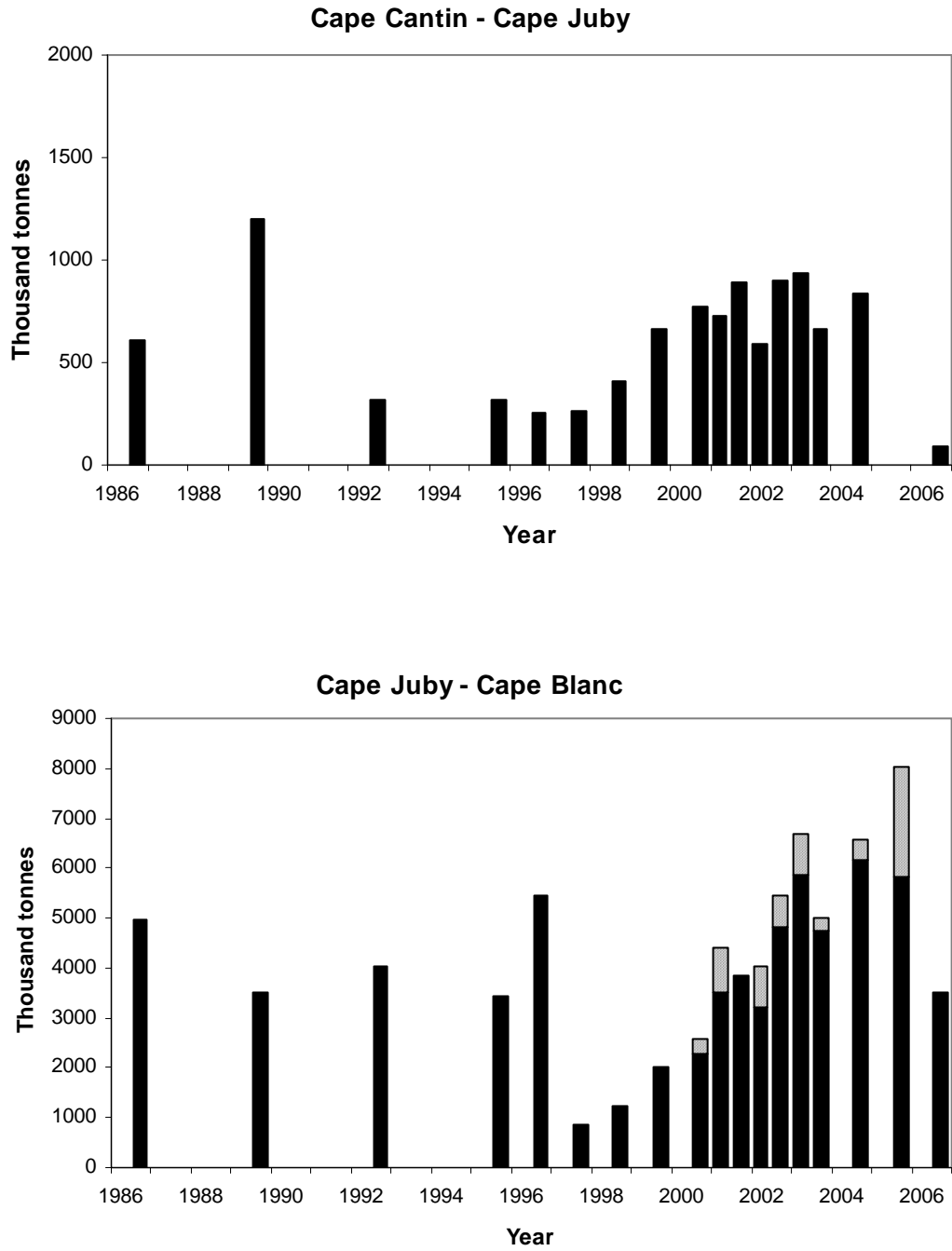


Figure 20. Sardine biomass estimates Cape Cantin-Cape Juby and Cape Juby-Cape Blanc. Sardine south off Cape Blanc hatched. *Dr. Fridtjof Nansen* 1986-2006. Note: coverage in 2005 only from Cape Bojador and southwards, and in 2006 only from Cape Sim and southwards.

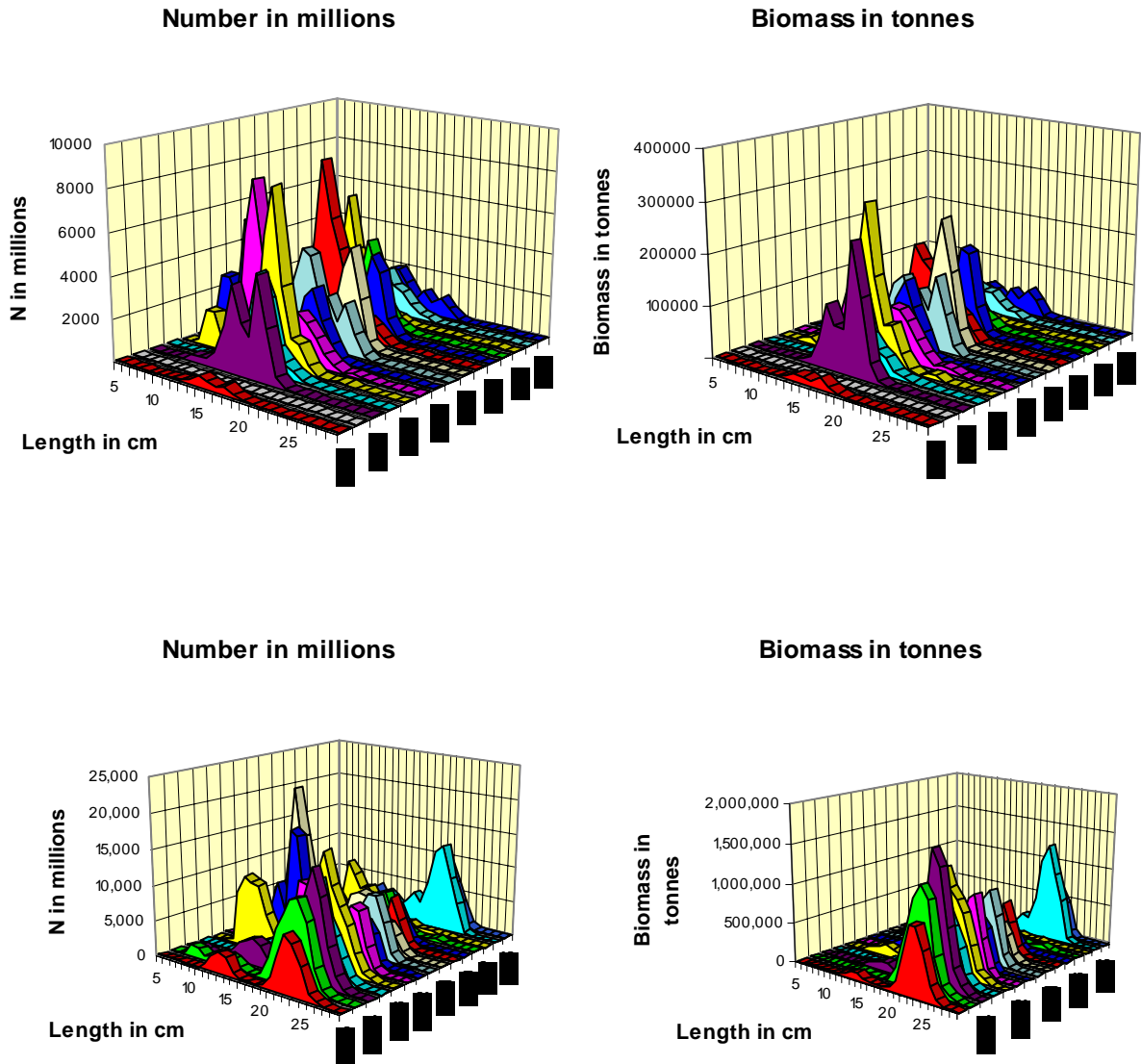


Figure 21. Numbers and biomass by length class, 1995-2006. Cape Juby - Cape Cantin (top) and Cape Blanc - Cape Juby (bottom).

Annex I Biomass and number by fish length class

Sardine (*Sardina pilchardus*), November 2006

Numbers in millions

Length cm	C. Sim- C. Ghir	C. Ghir- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5	8				8
6	38		11		49
7	12		65		76
8	2		105		107
9	1	2	47		50
10	1	11	24		36
11	5	73	16	113	208
12	10	76	21	819	927
13	23	6	38	2,272	2,418
14	34	217	76	2,922	3,248
15	53	474	139	2,603	3,269
16	41	388	147	579	1,155
17	28	252	140	116	535
18	11	431	74	162	679
19	5	178	60	104	347
20	1	43	175	411	630
21			126	1,718	1,844
22		2	193	4,518	4,712
23		3	208	7,866	8,077
24			109	7,082	7,191
25			12	4,321	4,333
26			4	1,290	1,294
27			6	381	387
28				7	7
29					
30					
Total	273	2,237	1,795	37,284	41,588

Biomass in tonnes

Length cm	C. Sim- C. Ghir	C. Ghir- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5	10				10
6	86		25		111
7	40		224		264
8	10		528		538
9	9	11	329		350
10	9	107	230		346
11	66	915	198	1,414	2,593
12	164	1,216	340	13,124	14,845
13	457	1,727	764	45,833	48,782
14	845	5,435	1,889	73,036	81,206
15	1,609	14,484	4,243	79,494	99,829
16	1,510	14,308	5,424	21,318	42,560
17	1,229	11,062	6,142	5,079	23,512
18	583	22,377	3,837	8,436	35,234
19	322	10,847	3,634	6,311	21,115
20	66	3,029	12,340	29,050	44,485
21			10,274	139,977	150,251
22		151	18,032	421,960	440,142
23		343	22,138	837,055	859,536
24			13,127	854,076	867,203
25			1,699	587,502	589,200
26			663	196,797	197,461
27			994	64,997	65,991
28				1,403	1,403
29					
30					
Total	7,016	86,014	107,073	3,386,863	3,586,965

Annex I continued

Round sardinella (*Sardinella aurita*), November 2006

Numbers in millions

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20			6.0	6.0
21			23.7	23.7
22			45.8	45.8
23			140.5	140.5
24			370.5	370.5
25			400.1	400.1
26			267.9	267.9
27			452.0	452.0
28			412.4	412.4
29			279.3	279.3
30			122.6	122.6
31			64.4	64.4
32			106.1	106.1
33			125.1	125.1
34			101.1	101.1
35			139.2	139.2
36			83.8	83.8
37			32.2	32.2
38			4.3	4.3
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total			3,176.8	3,176.8

Biomass in tonnes

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20			485	485
21			2,212	2,212
22			4,904	4,904
23			17,144	17,144
24			51,214	51,214
25			62,358	62,358
26			46,855	46,855
27			88,358	88,358
28			89,731	89,731
29			67,404	67,404
30			32,698	32,698
31			18,910	18,910
32			34,246	34,246
33			44,198	44,198
34			39,027	39,027
35			58,523	58,523
36			38,291	38,291
37			15,978	15,978
38			2,325	2,325
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total			714,862	714,862

Annex I continued

Flat sardinella (*Sardinella maderensis*), November 2006

Numbers in millions

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10			4.7	4.7
11			9.4	9.4
12			18.9	18.9
13			9.4	9.4
14				
15				
16				
17				
18				
19				
20				
21				
22			12.4	12.4
23			27.9	27.9
24			120.2	120.2
25			536.3	536.3
26			814.9	814.9
27			667.8	667.8
28			318.0	318.0
29			184.1	184.1
30			51.1	51.1
31			11.0	11.0
32			12.4	12.4
33				
34				
35			6.3	6.3
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total			2,804.8	2,804.8

Biomass in tonnes

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10			53	53
11			139	139
12			357	357
13			225	225
14				
15				
16				
17				
18				
19				
20				
21				
22			1,366	1,366
23			3,513	3,513
24			17,150	17,150
25			86,263	86,263
26			147,103	147,103
27			134,706	134,706
28			71,404	71,404
29			45,843	45,843
30			14,072	14,072
31			3,330	3,330
32			4,118	4,118
33				
34				
35			2,720	2,720
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total			532,363	532,363

Annex I continued

Anchovy (*Engraulis encrasicolus*), November 2006

Numbers in millions

Length cm	C. Sim- C. Ghir	C. Ghir- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5	3.3				3.3
6			74.7		74.7
7	0.2	104.1	512.0	3.3	619.6
8	0.2	282.4	212.7	23.0	518.3
9	0.2	271.0	485.2	9.9	766.3
10	0.2	85.4	160.7	15.7	262.0
11	0.4	72.9	353.8	111.9	538.9
12	0.4	411.5	365.6	294.9	1,072.4
13	1.0	371.1	51.8	409.0	832.9
14	1.4	137.5		139.8	278.7
15	0.2	22.9	19.0		42.1
16		2.9			2.9
17					
18					
19					
20					
Total	7.4	1,761.7	2,235.6	1,007.4	5,012.0

Biomass in tonnes

Length cm	C. Sim- C. Ghir	C. Ghir- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5	3				3
6			111		111
7	0	237	1,166	7	1,411
8	1	937	705	76	1,719
9	1	1,255	2,247	46	3,548
10	1	534	1,004	98	1,638
11	3	598	2,906	919	4,426
12	4	4,340	3,856	3,110	11,310
13	13	4,930	689	5,434	11,065
14	23	2,264		2,302	4,589
15	4	460	382		846
16		71			71
17					
18					
19					
20					
Total	53	15,626	13,066	11,992	40,737

Annex I continued

Atlantic horse mackerel (*Trachurus trachurus*), November 2006

Numbers in millions

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9			5.9	5.9
10			269.7	269.7
11			194.8	194.8
12			93.7	93.7
13			213.4	213.4
14			87.6	87.6
15		0.9	28.3	29.2
16			3.9	3.9
17		0.9	16.6	17.5
18		3.0	39.5	42.5
19		14.0	28.3	42.4
20		11.6	22.8	34.4
21		4.6	34.3	38.9
22		4.6	49.9	54.5
23		0.9	35.9	36.9
24			22.5	22.5
25			9.3	9.3
26			3.2	3.2
27			2.3	2.3
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total		40.6	1,161.9	1,202.5

Biomass in tonnes

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9			42	42
10			2,623	2,623
11			2,489	2,489
12			1,537	1,537
13			4,410	4,410
14			2,244	2,244
15		29	886	914
16			146	146
17		42	747	789
18		159	2,101	2,260
19		875	1,766	2,640
20		836	1,652	2,489
21		385	2,866	3,251
22		441	4,774	5,215
23		101	3,918	4,019
24			2,774	2,774
25			1,289	1,289
26			498	498
27			401	401
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total		2,868	37,163	40,031

Annex I continued

Cunene horse mackerel (*Trachurus trecae*), November 2006

Numbers in millions

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10			63.9	63.9
11			120.4	120.4
12			406.0	406.0
13			511.6	511.6
14			86.6	86.6
15			125.4	125.4
16			137.6	137.6
17			236.8	236.8
18			360.8	360.8
19			179.3	179.3
20			108.6	108.6
21			99.7	99.7
22			120.0	120.0
23			137.3	137.3
24			77.8	77.8
25			130.2	130.2
26			230.3	230.3
27			181.2	181.2
28			137.5	137.5
29			67.1	67.1
30			11.5	11.5
31			23.1	23.1
32			23.1	23.1
33			10.9	10.9
34				
35				
36			5.1	5.1
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total			3,592.0	3,592.0

Biomass in tonnes

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10			621	621
11			1,538	1,538
12			6,661	6,661
13			10,574	10,574
14			2,218	2,218
15			3,922	3,922
16			5,192	5,192
17			10,659	10,659
18			19,187	19,187
19			11,170	11,170
20			7,862	7,862
21			8,321	8,321
22			11,484	11,484
23			14,969	14,969
24			9,609	9,609
25			18,135	18,135
26			36,008	36,008
27			31,658	31,658
28			26,740	26,740
29			14,471	14,471
30			2,752	2,752
31			6,064	6,064
32			6,660	6,660
33			3,450	3,450
34				
35				
36			2,103	2,103
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total			272,026	272,026

Annex I continued

Chub mackerel (*Scomber japonicus*), November 2006

Numbers in millions

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10				
11	1.6			1.6
12		5.9	31.1	37.0
13	12.7	68.5	193.5	274.7
14	41.4	90.1	295.2	426.7
15	322.1	55.5	321.6	699.2
16	346.6	31.8	605.5	983.9
17	191.3	77.8	767.6	1,036.7
18	200.3	29.3	524.8	754.5
19	267.9	14.4	348.3	630.6
20	271.8	12.0	293.7	577.5
21	89.3	0.5	300.0	389.8
22	49.7		268.1	317.8
23	23.6		171.1	194.7
24	17.8	1.1	115.6	134.5
25	1.8	1.1	126.2	129.1
26	2.0	1.1	95.8	98.9
27			112.5	112.5
28			59.2	59.2
29			35.9	35.9
30			44.4	44.4
31	3.7		6.4	10.1
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total	1,843.5	389.1	4,716.8	6,949.3

Biomass in tonnes

Length cm	C. Sim- C. Juby	C. Juby- C. Bojador	C. Bojador- C. Blanc	TOTAL
5				
6				
7				
8				
9				
10				
11	20			20
12		97	511	608
13	263	1,416	3,998	5,677
14	1,060	2,307	7,560	10,927
15	10,074	1,735	10,060	21,870
16	13,078	1,200	22,849	37,126
17	8,610	3,504	34,558	46,672
18	10,655	1,561	27,914	40,129
19	16,684	900	21,692	39,275
20	19,672	869	21,253	41,794
21	7,455	38	25,048	32,541
22	4,752		25,652	30,404
23	2,574		18,651	21,225
24	2,203	132	14,284	16,619
25	248	149	17,584	17,980
26	311	167	14,980	15,458
27			19,649	19,649
28			11,521	11,521
29			7,750	7,750
30			10,574	10,574
31	967		1,692	2,660
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
Total	98,626	14,074	317,780	430,481

Annex II Records of fishing stations

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 70
 DATE :21.11.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 20°51.18
 start stop duration Lon W 17°7.93
 TIME :04:46:57 05:06:44 19.8 (min) Purpose : 1
 LOG : 3053.14 3054.33 1.2 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 31 24 Validity : 0
 Towing dir: 0° Wire out : 130 m Speed : 3.6 kn
 Sorted : 25 Total catch: 167.21 Catch/hour: 507.21

Scorpaena stephanica 2.31 40 0.62
 Serranus cabrilla 2.31 40 0.62
 Octopus vulgaris 2.09 3 0.57
 Capros aper 1.94 117 0.52
 Monolele microstoma 1.54 117 0.42
 Engraulis encrasicolus 0.77 40 0.21
 Microchirus boscanion 0.40 40 0.11
 Total 369.10 100.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	164.71	910	32.47	121
Sardinella maderensis	119.76	655	23.61	122
Decapterus rhonchus	76.80	510	15.14	
Diplodus bellottii	64.91	3652	12.80	
Diplodus sargus *	22.60	42	4.46	
Trachurus trecae	11.83	91	2.33	
Raja asterias	9.74	9	1.92	
Lagocephalus laevigatus	8.80	9	1.73	
Pomadasy incisus	7.80	27	1.54	
Stromateus fiatola	4.88	9	0.96	
Diplodus vulgaris	4.13	6	0.81	
Sepia officinalis hierredda	4.13	58	0.81	
Arius heudeloti	1.46	3	0.29	
Campogramma glaycos	1.18	3	0.23	
Loligo vulgaris	1.12	3	0.22	
Dentex canariensis	1.09	6	0.22	
Plectorhynchus mediterraneus	0.88	3	0.17	
Penaeus notialis	0.46	6	0.09	
Boops boops	0.39	3	0.08	
Dicologlossa cuneata	0.27	3	0.05	
Trichiurus lepturus	0.27	3	0.05	
Total	507.21		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 74
 DATE :21.11.2006 GEAR TYPE: PT NO: 2 POSITION:Lat N 21°10.13
 start stop duration Lon W 17°20.29
 TIME :15:37:01 16:04:06 27.1 (min) Purpose : 1
 LOG : 3137.51 3139.30 1.8 Region : 1122
 FDEPTH: 20 27 Gear cond.: 0
 BDEPTH: 68 78 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 4.0 kn
 Sorted : 34 Total catch: 3370.00 Catch/hour: 7466.77

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	7466.77	235968	100.00	129
Total	7466.77		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 75
 DATE :21.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 21°18.46
 start stop duration Lon W 17°4.29
 TIME :19:50:13 20:05:47 15.6 (min) Purpose : 1
 LOG : 3168.88 3169.88 1.0 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 32 35 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 53 Total catch: 425.56 Catch/hour: 1639.92

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	949.40	6763	57.89	132
Sardinella maderensis	462.43	3033	28.20	131
Trachurus trecae	105.47	952	6.43	130
Trichiurus lepturus	78.61	154	4.79	
Magellus bellottii	11.75	54	0.72	
Mustelus mustelus	7.21	4	0.44	
Sepia officinalis hierredda	6.71	27	0.41	
Raja miraletus	6.28	12	0.38	
Loligo vulgaris	3.97	12	0.24	
Halobatrachus didactylus	1.77	4	0.11	
Torpedo torpedo	1.46	4	0.09	
Conger conger	1.35	4	0.08	
Dentex canariensis	1.27	8	0.08	
Penaeus notialis	1.23	19	0.08	
Aspitrigla obscura	0.54	4	0.03	
Umbra canariensis	0.31	4	0.02	
Dicologlossa cuneata	0.15	4	0.01	
Total	1639.92		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 71
 DATE :21.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 20°57.93
 start stop duration Lon W 17°6.96
 TIME :06:42:43 06:55:24 12.7 (min) Purpose : 1
 LOG : 3065.44 3066.27 0.8 Region : 1122
 FDEPTH: 15 15 Gear cond.: 0
 BDEPTH: 29 30 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 62 Total catch: 6216.67 Catch/hour: 29416.42

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	24700.32	148580	83.97	123
Decapterus rhonchus	941.64	4732	3.20	
Argyrosomus regius	856.47	2366	2.91	
Trichiurus lepturus	842.27	1893	2.86	
Diplodus sargus *	544.16	946	1.85	
Arius parkii	331.23	946	1.13	
Trachurus trecae	288.64	2366	0.98	
Pomadasy incisus	264.98	946	0.90	
Sphyræna guachancho	170.35	473	0.58	
Pteroscion pelli	146.69	1420	0.50	
Selene dorsalis	118.30	473	0.40	
Diplodus bellottii	80.44	473	0.27	
Chloroscombrus chrysurus	66.25	473	0.23	
GYMNURIDAE	56.78	5	0.19	
Dicentrarchus punctatus	4.50	9	0.02	
Magellus bellottii	3.41	9	0.01	
Total	29416.42		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 76
 DATE :21.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°20.22
 start stop duration Lon W 17°10.79
 TIME :21:38:30 21:44:20 5.8 (min) Purpose : 1
 LOG : 3182.42 3182.85 0.4 Region : 1122
 FDEPTH: 20 18 Gear cond.: 0
 BDEPTH: 58 58 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.4 kn
 Sorted : 66 Total catch: 65.97 Catch/hour: 678.94

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	634.48	4364	93.45	134
Trachurus trecae	26.04	309	3.84	133
Trichiurus lepturus	4.84	10	0.71	
Sardinella maderensis	3.70	21	0.55	
Sardinella aurita	3.60	21	0.53	
Belone belone gracilis	1.54	10	0.23	
Sepia officinalis hierredda	1.34	31	0.20	
Spherooides spengleri	1.34	31	0.20	
Loligo vulgaris	1.13	62	0.17	
Saurida brasiliensis	0.72	144	0.11	
Alloteuthis subulata	0.10	21	0.02	
Magellus bellottii	0.10	10	0.02	
Total	678.94		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 72
 DATE :21.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 20°59.88
 start stop duration Lon W 17°16.84
 TIME :08:52:55 09:13:14 20.3 (min) Purpose : 1
 LOG : 3082.40 3083.82 1.4 Region : 1122
 FDEPTH: 27 30 Gear cond.: 0
 BDEPTH: 50 47 Validity : 0
 Towing dir: 0° Wire out : 130 m Speed : 4.2 kn
 Sorted : 0 Total catch: 5.88 Catch/hour: 17.36

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	12.11	53	69.73	124
J E L Y F I S H	4.55	3	26.19	
Decapterus rhonchus	0.71	3	4.08	
Total	17.36		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 73
 DATE :21.11.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 21°1.70
 start stop duration Lon W 17°24.93
 TIME :10:54:22 11:13:53 19.5 (min) Purpose : 1
 LOG : 3097.51 3098.54 1.0 Region : 1122
 FDEPTH: 77 77 Gear cond.: 0
 BDEPTH: 77 76 Validity : 0
 Towing dir: 0° Wire out : 250 m Speed : 3.2 kn
 Sorted : 60 Total catch: 120.08 Catch/hour: 369.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	227.06	11066	61.52	125
Sardina pilchardus	76.84	3111	20.82	128
Scomber japonicus	34.58	1076	9.37	127
Trachurus trachurus	14.60	1116	3.96	126
Loligo vulgaris	4.67	61	1.27	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 77
 DATE :21.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°20.21
 start stop duration Lon W 17°21.26
 TIME :23:26:34 23:31:21 4.8 (min) Purpose : 1
 LOG : 3195.96 3196.36 0.4 Region : 1122
 FDEPTH: 20 18 Gear cond.: 0
 BDEPTH: 74 70 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 5.0 kn
 Sorted : 18 Total catch: 73.67 Catch/hour: 924.73

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trecae	434.81	23448	47.02	135
Engraulis encrasicolus	292.22	28017	31.60	138
Sardina pilchardus	90.38	3414	9.77	139
Trachurus trachurus	84.35	6678	9.12	136

Scomber japonicus	19.08	615	2.06	137
Spondyliosoma cantharus	3.89	13	0.42	
Total	924.73		100.00	

Trachurus trecae	270.80	9773	53.60	147
Trachurus trachurus	186.84	7383	36.98	146
Scomber japonicus	25.72	1044	5.09	148
Loligo vulgaris	8.17	45	1.62	
Zeus faber	4.84	3	0.96	
Dentex macrophthalmus	1.97	227	0.39	
Serranus cabrilla	1.66	121	0.33	
Cepola macrophthalma	1.66	45	0.33	
Pagellus bellottii	1.21	6	0.24	
Dentex gibbosus	0.91	30	0.18	
Microchirus boscanion	0.61	30	0.12	
Monoleone microstoma	0.45	45	0.09	
Trachinus draco	0.36	3	0.07	
Total	505.20		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 78
 DATE :22.11.2006 GEAR TYPE: PT NO: 2 POSITION:Lat N 21°20.31
 start stop duration Lon W 17°30.89
 TIME :01:24:40 01:53:59 29.3 (min) Purpose : 1
 LOG : 3209.12 3210.98 1.9 Region : 1122
 FDEPTH: 15 25 Gear cond.: 0
 BDEPTH: 307 189 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.8 kn
 Sorted : 32 Total catch: 96.15 Catch/hour: 196.76

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
MYCTOPHIDAE	196.76	134920	100.00	
Total	196.76		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 84
 DATE :22.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°50.95
 start stop duration Lon W 17°9.24
 TIME :20:00:43 20:07:30 6.8 (min) Purpose : 1
 LOG : 3356.47 3356.97 0.5 Region : 1122
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 55 57 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.5 kn
 Sorted : 31 Total catch: 131.96 Catch/hour: 1164.35

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1068.35	9000	91.76	149
Sardinella maderensis	70.59	362	6.06	150
Trachurus trecae	14.82	71	1.27	
Trichiurus lepturus	5.56	9	0.48	
Sardinella aurita	5.03	18	0.43	
Total	1164.35		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 79
 DATE :22.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°29.88
 start stop duration Lon W 17°20.29
 TIME :05:49:28 06:03:49 14.4 (min) Purpose : 1
 LOG : 3244.00 3244.95 1.0 Region : 1122
 FDEPTH: 20 23 Gear cond.: 0
 BDEPTH: 81 85 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 4.0 kn
 Sorted : 18 Total catch: 54.78 Catch/hour: 229.05

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	137.35	10762	59.97	140
Sardina pilchardus	78.27	2810	34.17	141
Trachurus trecae	10.03	426	4.38	142
Scomber japonicus	2.51	63	1.10	
Trachurus trachurus	0.88	38	0.38	
Total	229.05		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 85
 DATE :22.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 21°56.91
 start stop duration Lon W 16°57.56
 TIME :23:00:00 23:11:45 11.7 (min) Purpose : 1
 LOG : 3380.00 3380.86 0.9 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 31 32 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.3 kn
 Sorted : 60 Total catch: 474.14 Catch/hour: 2431.49

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella aurita	1457.69	4503	59.95	152
Pomadasys incisus	317.33	1000	13.05	
Trachurus trecae	149.64	1426	6.15	151
Diplodus bellottii	146.15	1462	6.01	
Pteroscion pelli	50.00	538	2.06	
Sepia officinalis hierredda	47.44	246	1.95	
Pagellus bellottii	44.62	190	1.83	
Ethmalosa fimbriata	44.62	77	1.83	
Decapterus rhonchus	42.31	190	1.74	
Diplodus sargus *	31.79	41	1.31	
Argyrosomus regius	21.74	46	0.89	
Diplodus vulgaris	14.87	21	0.61	
Halobatrachus didactylus	13.49	36	0.55	
Dasyatis marmorata	13.44	5	0.55	
Arius parkii	12.31	36	0.51	
Umbina canariensis	10.77	36	0.44	
Gymnura altavela	4.31	5	0.18	
Torpedo torpedo	4.15	5	0.17	
Dentex maroccanus	2.92	10	0.12	
Loligo vulgaris	1.03	15	0.04	
Penaeus notialis	0.87	10	0.04	
Total	2431.49		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 80
 DATE :22.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°29.85
 start stop duration Lon W 17°14.20
 TIME :07:27:53 08:04:25 36.5 (min) Purpose : 1
 LOG : 3254.95 3256.88 1.9 Region : 1122
 FDEPTH: 30 40 Gear cond.: 0
 BDEPTH: 65 65 Validity : 0
 Towing dir: 0° Wire out : 175 m Speed : 3.2 kn
 Sorted : 34 Total catch: 238.12 Catch/hour: 391.11

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	384.01	2955	98.19	143
Sardinella aurita	6.32	34	1.62	
Scomber japonicus	0.77	3	0.20	
Total	391.11		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 81
 DATE :22.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°29.85
 start stop duration Lon W 17°5.52
 TIME :09:33:18 10:10:34 37.3 (min) Purpose : 1
 LOG : 3269.13 3271.71 2.6 Region : 1122
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 42 42 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.2 kn
 Sorted : 29 Total catch: 28.62 Catch/hour: 46.07

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	38.48	235	83.51	144
Sardinella aurita	3.19	14	6.92	
Sardina pilchardus	2.59	19	5.63	
Dentex canariensis	0.98	0	2.13	
Scomber japonicus	0.84	3	1.82	
Total	46.07		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 86
 DATE :23.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°10.39
 start stop duration Lon W 17°9.46
 TIME :06:18:41 06:32:31 13.8 (min) Purpose : 1
 LOG : 3445.63 3446.61 1.0 Region : 1122
 FDEPTH: 20 25 Gear cond.: 0
 BDEPTH: 58 59 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.2 kn
 Sorted : 20 Total catch: 19.79 Catch/hour: 85.86

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardinella maderensis	54.58	282	63.57	154
Sardinella aurita	23.21	69	27.03	153
Trichiurus lepturus	6.07	4	7.07	
Decapterus rhonchus	1.08	4	1.26	
Sepia officinalis hierredda	0.43	9	0.51	
Trachurus trecae	0.43	9	0.51	
Spherooides spengleri	0.04	4	0.05	
Total	85.86		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 82
 DATE :22.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 21°39.42
 start stop duration Lon W 17°10.24
 TIME :12:49:13 13:16:58 27.8 (min) Purpose : 1
 LOG : 3297.66 3299.48 1.8 Region : 1122
 FDEPTH: 25 35 Gear cond.: 0
 BDEPTH: 60 54 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 38 Total catch: 37.94 Catch/hour: 82.03

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	79.57	610	97.00	145
Sardinella maderensis	2.46	15	3.00	
Total	82.03		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 87
 DATE :23.11.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 22°19.38
 start stop duration Lon W 16°56.48
 TIME :11:31:55 12:01:29 29.6 (min) Purpose : 1
 LOG : 3486.04 3487.51 1.5 Region : 1122
 FDEPTH: 56 56 Gear cond.: 0
 BDEPTH: 56 56 Validity : 0
 Towing dir: 0° Wire out : 195 m Speed : 3.0 kn
 Sorted : 33 Total catch: 175.85 Catch/hour: 356.81

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	154.21	690	43.22	
Trachurus trecae	73.55	335	20.61	155
Dentex macrophthalmus	36.62	436	10.26	
Pomadasys incisus	21.51	101	6.03	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 83
 DATE :22.11.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 21°51.63
 start stop duration Lon W 17°15.48
 TIME :18:24:56 18:44:46 19.8 (min) Purpose : 1
 LOG : 3345.77 3346.90 1.1 Region : 1122
 FDEPTH: 61 64 Gear cond.: 0
 BDEPTH: 61 64 Validity : 0
 Towing dir: 0° Wire out : 240 m Speed : 3.4 kn
 Sorted : 32 Total catch: 166.97 Catch/hour: 505.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		

Dentex canariensis	19.48	61	5.46
Alloteuthis subulata	18.87	5245	5.29
Zeus faber	12.80	12	3.59
Trachurus trachurus	8.52	81	2.39
Loligo vulgaris	4.46	12	1.25
Diplodus vulgaris	4.06	8	1.14
Halobatrachus didactylus	2.72	4	0.76
Total	356.81		100.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Sardinella aurita	3644.04	16734	91.64
Sardina pilchardus	233.39	1982	5.87
Sardinella maderensis	56.15	330	1.41
Trachurus trecae	42.94	661	1.08
Total	3976.51		100.00

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 88
 DATE :23.11.2006 GEAR TYPE: PT NO: 2 POSITION:Lat N 22°23.11
 start stop duration Lon W 17°14.57
 TIME :15:22:40 15:47:45 25.1 (min) Purpose : 1
 LOG : 3508.54 3510.07 1.5 Region : 1122
 FDEPTH: 55 65 Gear cond.: 0
 BDEPTH: 94 92 Validity : 0
 Towing dir: 0° Wire out : 300 m Speed : 3.7 kn
 Sorted : 29 Total catch: 288.50 Catch/hour: 690.19

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 93
 DATE :24.11.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 22°43.33
 start stop duration Lon W 17°9.02
 TIME :08:46:04 09:01:57 15.9 (min) Purpose : 1
 LOG : 3644.69 3645.51 0.8 Region : 1122
 FDEPTH: 102 103 Gear cond.: 0
 BDEPTH: 102 103 Validity : 0
 Towing dir: 0° Wire out : 370 m Speed : 3.1 kn
 Sorted : 34 Total catch: 979.35 Catch/hour: 3700.31

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Trachurus trecae	368.42	19713	53.38
Scomber japonicus	177.75	9163	25.75
Engraulis encrasicolus	74.64	5239	10.81
Sardina pilchardus	69.38	3612	10.05
Total	690.19		100.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Trachurus trachurus	1555.16	75113	42.03
Trachurus trecae	1028.31	22746	27.79
Scomber japonicus	943.68	46972	25.50
Dentex maroccanus	61.36	952	1.66
Sardina pilchardus	44.43	2539	1.20
Spherooides pachgaster	33.93	53	0.92
Mola mola	12.66	4	0.34
Zeus faber	9.90	11	0.27
Trichiurus lepturus	8.46	106	0.23
Pagellus acarne	1.36	8	0.04
Capros aper	1.06	106	0.03
Total	3700.31		100.00

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 89
 DATE :23.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°28.25
 start stop duration Lon W 16°57.65
 TIME :20:20:44 20:35:36 14.9 (min) Purpose : 1
 LOG : 3545.06 3546.00 1.0 Region : 1122
 FDEPTH: 39 39 Gear cond.: 0
 BDEPTH: 59 59 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.8 kn
 Sorted : 12 Total catch: 11.59 Catch/hour: 46.77

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 94
 DATE :24.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°44.60
 start stop duration Lon W 16°35.19
 TIME :14:45:46 15:15:59 30.2 (min) Purpose : 1
 LOG : 3697.99 3700.05 2.1 Region : 1122
 FDEPTH: 15 17 Gear cond.: 0
 BDEPTH: 42 47 Validity : 0
 Towing dir: 0° Wire out : 75 m Speed : 4.1 kn
 Sorted : 9 Total catch: 9.11 Catch/hour: 18.09

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Scomber japonicus	17.35	121	37.10
Sardinella aurita	15.70	69	33.56
Trachurus trecae	4.96	48	10.61
Trichiurus lepturus	3.19	4	6.82
Sardinella maderensis	2.10	12	4.49
Ophichthus sp.	2.02	4	4.31
Pagellus bellottii	1.21	4	2.59
Sepia officinalis hierreda	0.08	4	0.17
Sardina pilchardus	0.08	4	0.17
Solenocera africana	0.04	4	0.09
Cepola macrophthalma	0.04	12	0.09
Total	46.77		100.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Sardinella maderensis	14.49	83	80.13
Sardinella aurita	1.91	6	10.54
Sardina pilchardus	0.97	8	5.38
Trachurus trecae	0.46	4	2.52
Scomber japonicus	0.26	2	1.43
Total	18.09		100.00

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 90
 DATE :23.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°25.89
 start stop duration Lon W 16°47.99
 TIME :22:25:59 22:50:21 24.4 (min) Purpose : 1
 LOG : 3559.74 3561.27 1.5 Region : 1122
 FDEPTH: 30 33 Gear cond.: 0
 BDEPTH: 45 48 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
 Sorted : 15 Total catch: 14.92 Catch/hour: 36.73

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 95
 DATE :24.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 22°55.39
 start stop duration Lon W 16°26.47
 TIME :19:18:53 19:27:53 9.0 (min) Purpose : 1
 LOG : 3738.43 3739.00 0.6 Region : 1122
 FDEPTH: 5 6 Gear cond.: 0
 BDEPTH: 30 32 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
 Sorted : 34 Total catch: 508.59 Catch/hour: 3390.60

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Trachurus trecae	12.38	76	33.71
Pagellus bellottii	10.93	295	29.76
Pomadasys incisus	5.54	25	15.08
Diplodus vulgaris	2.44	5	6.64
Spondyliosoma cantharus	1.65	2	4.49
Sardinella aurita	1.55	10	4.22
Sardinella maderensis	0.94	5	2.55
Scomber japonicus	0.59	5	1.61
Sepia officinalis hierreda	0.44	10	1.21
Alloteuthis subulata	0.27	34	0.74
Total	36.73		100.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Sardina pilchardus	2730.00	22600	80.52
Sardinella maderensis	233.00	1300	6.87
Trachurus trecae	185.00	3200	5.46
Decapterus rhonchus	53.00	300	1.56
Diplodus bellottii	50.00	400	1.47
Scomber japonicus	42.00	400	1.24
Pomadasys incisus	36.00	200	1.06
Arius parkii	25.60	33	0.76
Sardinella aurita	24.00	100	0.71
Pagellus bellottii	12.00	100	0.35
Total	3390.60		100.00

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 91
 DATE :24.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°25.04
 start stop duration Lon W 16°34.03
 TIME :01:20:47 01:41:21 20.6 (min) Purpose : 1
 LOG : 3583.62 3584.80 1.2 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 33 30 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.4 kn
 Sorted : 33 Total catch: 6636.00 Catch/hour: 19356.34

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 96
 DATE :24.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 23°0.89
 start stop duration Lon W 16°39.69
 TIME :21:47:14 21:52:53 5.7 (min) Purpose : 1
 LOG : 3755.99 3756.36 0.4 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 43 43 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 33 Total catch: 718.52 Catch/hour: 7630.30

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Sardinella aurita	18901.31	83974	97.65
Decapterus rhonchus	233.35	1167	1.21
Sardina pilchardus	134.18	1103	0.69
Diplodus bellottii	46.67	583	0.24
Trachurus trachurus	40.84	583	0.21
Total	19356.34		100.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Sardina pilchardus	7268.18	58365	95.25
Trachurus trecae	203.26	3972	2.66
Sardinella aurita	144.85	701	1.90
Scomber japonicus	14.02	234	0.18
Total	7630.30		100.00

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 92
 DATE :24.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 22°34.17
 start stop duration Lon W 16°35.29
 TIME :04:19:03 04:21:14 2.2 (min) Purpose : 1
 LOG : 3606.59 3606.74 0.1 Region : 1122
 FDEPTH: 15 10 Gear cond.: 0
 BDEPTH: 38 37 Validity : 0
 Towing dir: 0° Wire out : 65 m Speed : 4.0 kn
 Sorted : 36 Total catch: 144.48 Catch/hour: 3976.51

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 97
 DATE :25.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 23°16.82
 start stop duration Lon W 16°54.94
 TIME :03:13:45 03:33:11 19.4 (min) Purpose : 1
 LOG : 3802.84 3804.16 1.3 Region : 1122
 FDEPTH: 15 21 Gear cond.: 0
 BDEPTH: 78 81 Validity : 0
 Towing dir: 0° Wire out : 85 m Speed : 4.1 kn
 Sorted : 22 Total catch: 22.05 Catch/hour: 68.09

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	20.41	513	29.98	176
Trachurus trachurus	17.82	1714	26.17	177
Sardina pilchardus	12.51	479	18.37	175
Trachurus trecae	12.41	448	18.23	178
Mola mola	4.94	3	7.26	
Total	68.09		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 98
 DATE :25.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 23°15.59
 start stop duration Lon W 16°50.16
 TIME :04:49:30 05:06:37 17.1 (min) Purpose : 1
 LOG : 3813.28 3814.42 1.1 Region : 1122
 FDEPTH: 20 25 Gear cond.: 0
 BDEPTH: 64 66 Validity : 0
 Towing dir: 0° Wire out : 85 m Speed : 4.0 kn
 Sorted : 31 Total catch: 156.50 Catch/hour: 548.48

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	548.48	4907	100.00	179
Total	548.48		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 99
 DATE :25.11.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 23°5.51
 start stop duration Lon W 16°17.93
 TIME :09:14:37 09:21:30 6.9 (min) Purpose : 1
 LOG : 3851.66 3852.11 0.5 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 28 27 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 1 Total catch: 0.74 Catch/hour: 6.45

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	6.45	61	100.00	
Total	6.45		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 100
 DATE :25.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 23°20.29
 start stop duration Lon W 16°33.85
 TIME :13:23:17 13:24:19 1.0 (min) Purpose : 1
 LOG : 3886.55 3886.68 0.1 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 40 40 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 7.5 kn
 Sorted : 34 Total catch: 67.19 Catch/hour: 3913.98

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2178.64	19223	55.66	180
Scomber japonicus	1730.10	15845	44.20	181
Belone belone gracilis	5.24	58	0.13	
Total	3913.98		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 101
 DATE :25.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 23°23.55
 start stop duration Lon W 16°15.65
 TIME :21:41:50 21:50:08 8.3 (min) Purpose : 1
 LOG : 3959.87 3960.44 0.6 Region : 1122
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 26 26 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.1 kn
 Sorted : 34 Total catch: 710.78 Catch/hour: 5138.17

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4261.45	35465	82.94	182
Diplodus sargus *	650.60	477	12.66	
Pomadasy incisus	65.06	260	1.27	
Trachurus trecae	49.45	520	0.96	
Pagellus bellottii	46.84	260	0.91	
Diplodus bellottii	37.73	390	0.73	
Scomber japonicus	19.52	260	0.38	
Octopus vulgaris	4.84	7	0.09	
Sepia officinalis hierredda	2.67	7	0.05	
Total	5138.17		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 102
 DATE :26.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 23°50.82
 start stop duration Lon W 16°33.85
 TIME :06:45:19 06:48:20 3.0 (min) Purpose : 1
 LOG : 4044.29 4044.50 0.2 Region : 1122
 FDEPTH: 25 25 Gear cond.: 0
 BDEPTH: 67 66 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.3 kn
 Sorted : 30 Total catch: 540.54 Catch/hour: 10739.21

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	10556.82	249258	98.30	183
Sardina pilchardus	143.05	3576	1.33	
Sardinella maderensis	23.84	99	0.22	
Loligo vulgaris	15.50	60	0.14	
Total	10739.21		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 103
 DATE :26.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 23°47.95
 start stop duration Lon W 16°0.16
 TIME :12:13:27 12:43:04 29.6 (min) Purpose : 1

LOG : 4091.10 4092.84 1.7 Region : 1122
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 28 28 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.5 kn
 Sorted : 31 Total catch: 960.93 Catch/hour: 1946.52

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1375.83	12519	70.68	184
Trachurus trecae	240.65	3768	12.36	185
Scomber japonicus	111.21	1094	5.71	
Pomadasy incisus	47.40	243	2.44	
Pagellus bellottii	44.36	122	2.28	
Diplodus bellottii	39.50	425	2.03	
Plectorhinchus mediterraneus	33.83	28	1.74	
Trachurus trachurus	32.82	486	1.69	
Decapterus rhonchus	10.33	61	0.53	
Spondyliosoma cantharus	6.08	122	0.31	
Diplodus sargus *	2.53	2	0.13	
Campogramma glaycos	0.91	2	0.05	
Loligo vulgaris	0.57	2	0.03	
Lithognathus mormyrus	0.51	2	0.03	
Total	1946.52		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 104
 DATE :26.11.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 23°52.56
 start stop duration Lon W 16°12.32
 TIME :14:15:37 14:35:49 20.2 (min) Purpose : 1
 LOG : 4105.23 4106.41 1.2 Region : 1122
 FDEPTH: 30 33 Gear cond.: 0
 BDEPTH: 42 40 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.5 kn
 Sorted : 32 Total catch: 321.58 Catch/hour: 955.19

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	845.05	7545	88.47	186
Trachurus trecae	26.44	475	2.77	
Pomadasy incisus	21.09	119	2.21	
Trachurus trachurus	16.04	208	1.68	
Pagellus bellottii	14.26	59	1.49	
Pagellus acarne	10.99	119	1.15	
Diplodus vulgaris	9.15	15	0.96	
Spondyliosoma cantharus	8.91	30	0.93	
Boops boops	3.27	59	0.34	
Total	955.19		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 105
 DATE :27.11.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 23°58.04
 start stop duration Lon W 15°53.29
 TIME :00:27:34 00:35:22 7.8 (min) Purpose : 1
 LOG : 4200.52 4200.94 0.4 Region : 1122
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 26 26 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.2 kn
 Sorted : 30 Total catch: 740.75 Catch/hour: 5698.08

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	5675.00	58077	99.60	187
Trachurus trecae	23.08	385	0.40	
Total	5698.08		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 106
 DATE :27.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°12.03
 start stop duration Lon W 16°7.01
 TIME :04:15:52 04:20:01 4.2 (min) Purpose : 1
 LOG : 4233.73 4234.01 0.3 Region : 1122
 FDEPTH: 15 17 Gear cond.: 0
 BDEPTH: 48 46 Validity : 0
 Towing dir: 0° Wire out : 65 m Speed : 4.0 kn
 Sorted : 29 Total catch: 730.75 Catch/hour: 10565.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	5371.08	50602	50.84	188
Scomber japonicus	5168.67	88916	48.92	189
Pagellus acarne	25.30	361	0.24	
Total	10565.06		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 107
 DATE :27.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°21.54
 start stop duration Lon W 16°8.07
 TIME :15:47:36 16:16:33 29.0 (min) Purpose : 1
 LOG : 4330.66 4332.44 1.8 Region : 1122
 FDEPTH: 20 32 Gear cond.: 0
 BDEPTH: 59 62 Validity : 0
 Towing dir: 0° Wire out : 115 m Speed : 3.7 kn
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
NOCATCH	0.00	0	0.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 108
 DATE :27.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 24°10.82
 start stop duration Lon W 15°45.29
 TIME :19:55:16 20:08:20 13.1 (min) Purpose : 1
 LOG : 4361.22 4361.84 0.6 Region : 1122
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 26 26 Validity : 0
 Towing dir: 0° Wire out : 121 m Speed : 2.8 kn
 Sorted : 31 Total catch: 629.22 Catch/hour: 2888.54

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2143.84	20144	74.22	190
Diplodus bellottii	291.05	4407	10.08	
Pagellus bellottii	123.03	551	4.26	
Pomadasy incisus	115.68	735	4.00	
Trachurus trecae	55.09	1010	1.91	
Argyrosomus regius	49.81	5	1.72	
Trachurus trachurus	32.13	826	1.11	
Dasysatis centroura	29.29	5	1.01	
Aspitrigla obscura	22.95	184	0.79	
Mullus surmuletus	15.61	92	0.54	
Scomber japonicus	7.35	92	0.25	
Sepia officinalis hierredda	2.71	5	0.09	
Total	2888.54		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 109
 DATE :27.11.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 24°16.97
 start stop duration Lon W 15°35.41
 TIME :22:29:43 22:32:52 3.2 (min) Purpose : 1
 LOG : 4380.13 4380.34 0.2 Region : 1122
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 22 22 Validity : 0
 Towing dir: 0° Wire out : 129 m Speed : 4.0 kn
 Sorted : 31 Total catch: 123.36 Catch/hour: 2349.71

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2151.62	19371	91.57	191
Sardinella aurita	186.67	1448	7.94	192
Diplodus sargus *	11.43	19	0.49	
Total	2349.71		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 110
 DATE :28.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°26.46
 start stop duration Lon W 15°55.08
 TIME :01:19:32 01:24:38 5.1 (min) Purpose : 1
 LOG : 4403.33 4403.67 0.3 Region : 1122
 FDEPTH: 18 20 Gear cond.: 0
 BDEPTH: 46 46 Validity : 0
 Towing dir: 0° Wire out : 85 m Speed : 4.0 kn
 Sorted : 33 Total catch: 474.30 Catch/hour: 5580.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2539.41	23118	45.51	193
Sardinella aurita	2505.88	20824	44.91	195
Scomber japonicus	481.76	7059	8.63	194
Trachurus trachurus	31.76	506	0.57	
Trachurus trecae	21.18	353	0.38	
Total	5580.00		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 111
 DATE :28.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°31.60
 start stop duration Lon W 16°6.30
 TIME :03:10:39 03:15:46 5.1 (min) Purpose : 1
 LOG : 4418.46 4418.81 0.4 Region : 1122
 FDEPTH: 19 23 Gear cond.: 0
 BDEPTH: 63 62 Validity : 0
 Towing dir: 0° Wire out : 85 m Speed : 4.1 kn
 Sorted : 32 Total catch: 386.40 Catch/hour: 4528.13

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	3913.59	38812	86.43	197
Scomber japonicus	562.50	8156	12.42	196
Sardinella aurita	52.03	281	1.15	
Total	4528.13		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 112
 DATE :28.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°36.95
 start stop duration Lon W 15°55.38
 TIME :09:16:02 09:26:07 10.1 (min) Purpose : 1
 LOG : 4471.29 4472.04 0.8 Region : 1122
 FDEPTH: 30 30 Gear cond.: 0
 BDEPTH: 55 56 Validity : 0
 Towing dir: 0° Wire out : 140 m Speed : 4.5 kn
 Sorted : 31 Total catch: 773.75 Catch/hour: 4605.65

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4360.12	41375	94.67	198
Scomber japonicus	123.51	2083	2.68	199
Sardinella aurita	122.02	1042	2.65	
Total	4605.65		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 113
 DATE :28.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 24°44.25
 start stop duration Lon W 15°46.65
 TIME :19:15:08 19:17:40 2.5 (min) Purpose : 1
 LOG : 4557.26 4557.40 0.1 Region : 1122
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 45 45 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.3 kn
 Sorted : 31 Total catch: 187.44 Catch/hour: 4445.22

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4396.84	43257	98.91	200
Scomber japonicus	48.38	996	1.09	
Total	4445.22		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 114
 DATE :28.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°48.84
 start stop duration Lon W 15°56.74
 TIME :21:12:01 21:40:09 28.1 (min) Purpose : 1
 LOG : 4572.15 4573.88 1.7 Region : 1122
 FDEPTH: 30 30 Gear cond.: 0
 BDEPTH: 68 65 Validity : 0
 Towing dir: 0° Wire out : 160 m Speed : 3.7 kn
 Sorted : 32 Total catch: 63.23 Catch/hour: 134.87

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	75.51	2169	55.99	201
Sardina pilchardus	58.87	702	43.65	202
Trachurus trecae	0.38	4	0.28	
Belone belone gracilis	0.11	2	0.08	
Total	134.87		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 115
 DATE :29.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°55.15
 start stop duration Lon W 15°45.64
 TIME :04:17:23 04:47:33 30.2 (min) Purpose : 1
 LOG : 4633.15 4635.16 2.0 Region : 1122
 FDEPTH: 25 20 Gear cond.: 0
 BDEPTH: 65 63 Validity : 0
 Towing dir: 0° Wire out : 115 m Speed : 4.0 kn
 Sorted : 27 Total catch: 107.32 Catch/hour: 213.43

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	194.90	3834	91.32	203
Sardina pilchardus	18.53	231	8.68	204
Total	213.43		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 116
 DATE :29.11.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 24°39.07
 start stop duration Lon W 15°07.88
 TIME :09:24:55 09:29:41 4.8 (min) Purpose : 1
 LOG : 4674.11 4674.42 0.3 Region : 1122
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 28 28 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
 Sorted : 34 Total catch: 677.40 Catch/hour: 8520.75

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	8276.73	76922	97.14	205
Pomadasy incisus	105.66	755	1.24	
Scomber japonicus	90.57	503	1.06	
Spondyliosoma cantharus	30.19	252	0.35	
Diplodus bellottii	17.61	252	0.21	
Total	8520.75		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 117
 DATE :29.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 24°50.89
 start stop duration Lon W 15°10.89
 TIME :14:18:39 14:47:10 28.5 (min) Purpose : 1
 LOG : 4715.52 4717.43 1.9 Region : 1122
 FDEPTH: 15 12 Gear cond.: 0
 BDEPTH: 34 34 Validity : 0
 Towing dir: 0° Wire out : 85 m Speed : 4.0 kn
 Sorted : 6 Total catch: 5.90 Catch/hour: 12.41

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	12.41	88	100.00	206
Total	12.41		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 118
 DATE :29.11.2006 GEAR TYPE: PT NO: 19 POSITION:Lat N 24°53.16
 start stop duration Lon W 15°13.73
 TIME :16:06:23 16:21:06 14.7 (min) Purpose : 1
 LOG : 4728.42 4729.19 0.8 Region : 1122
 FDEPTH: 35 37 Gear cond.: 0
 BDEPTH: 35 37 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.1 kn
 Sorted : 29 Total catch: 745.46 Catch/hour: 3038.56

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	1005.77	10871	33.10	
Scomber japonicus	651.15	15004	21.43	207
Diplodus vulgaris	555.37	19871	18.28	
Pomadasy incisus	456.52	2853	15.02	
Plectorhynchus mediterraneus	81.52	102	2.68	
Mullus surmuletus	78.46	306	2.58	
Dentex canariensis	62.16	306	2.05	
Trachurus trachurus	48.91	611	1.61	
Pagellus erythrinus	31.59	306	1.04	
Spondyliosoma cantharus	30.57	306	1.01	
Loligo vulgaris	13.49	53	0.44	
Pagrus auriga	11.58	12	0.38	
Diplodus cervinus cervinus	5.62	8	0.19	
Boops boops	3.06	102	0.10	
Sparus aurata	2.77	4	0.09	
Total	3038.56		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 119
 DATE :29.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°2.51
 start stop duration Lon W 15°37.87
 TIME :19:06:26 19:21:26 15.0 (min) Purpose : 1
 LOG : 4755.70 4756.57 0.9 Region : 1122
 FDEPTH: 35 37 Gear cond.: 0
 BDEPTH: 68 68 Validity : 0

Towing dir: 0° Wire out : 170 m Speed : 3.5 kn
Sorted : 31 Total catch: 461.85 Catch/hour: 1847.40

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	1512.00	33272	81.84	209
Sardina pilchardus	327.00	3540	17.70	208
Sardinella aurita	8.40	60	0.45	
Total	1847.40		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 120
DATE :29.11.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 25°7.93
Lon W 15°49.69
start stop duration
TIME :21:18:22 21:42:35 24.2 (min) Purpose : 1
LOG : 4772.59 4773.64 1.1 Region : 1122
FDEPTH: 86 83 Gear cond.: 0
BDEPTH: 86 83 Validity : 0
Towing dir: 0° Wire out : 330 m Speed : 2.6 kn
Sorted : 21 Total catch: 58.04 Catch/hour: 143.78

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus acarne	68.94	359	47.95	
Trachurus trachurus	30.64	409	21.31	211
Aspitrigla obscura	8.67	144	6.03	
Dentex macrophthalmus	8.37	372	5.82	
Spherooides pachgaster	8.18	17	5.69	
Scomber japonicus	6.56	181	4.57	210
Octopus vulgaris	3.72	2	2.58	
Pagellus erythrinus	2.92	124	2.03	
Pagellus bellottii	2.68	20	1.86	
Pomadasys incisus	0.99	7	0.69	
Trachinus draco	0.87	12	0.60	
Loligo vulgaris	0.35	2	0.24	
Trachinus radiatus	0.32	25	0.22	
Sepiella ornata	0.32	62	0.22	
Microchirus boscanion	0.12	7	0.09	
Dentex gibbosus	0.12	7	0.09	
Total	143.78		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 121
DATE :30.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°5.81
Lon W 14°57.15
start stop duration
TIME :10:40:44 11:02:34 21.8 (min) Purpose : 1
LOG : 4886.62 4888.09 1.5 Region : 1122
FDEPTH: 15 17 Gear cond.: 0
BDEPTH: 43 41 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 4.1 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
N O C A T C H	0.00	0	0.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 122
DATE :30.11.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°9.37
Lon W 15°4.95
start stop duration
TIME :12:47:56 13:07:06 19.2 (min) Purpose : 1
LOG : 4900.44 4901.74 1.3 Region : 1122
FDEPTH: 26 25 Gear cond.: 0
BDEPTH: 52 51 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 4.1 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
N O C A T C H	0.00	0	0.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 123
DATE :30.11.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 25°17.40
Lon W 15°23.19
start stop duration
TIME :15:52:59 16:18:56 26.0 (min) Purpose : 1
LOG : 4924.81 4926.14 1.3 Region : 1122
FDEPTH: 77 78 Gear cond.: 0
BDEPTH: 77 78 Validity : 0
Towing dir: 0° Wire out : 250 m Speed : 3.1 kn
Sorted : 3 Total catch: 3.25 Catch/hour: 7.51

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus erythrinus	5.34	1112	71.08	
Dentex macrophthalmus	2.08	363	27.69	
Scomber japonicus	0.09	2	1.23	
Total	7.51		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 124
DATE :01.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°19.69
Lon W 14°59.18
start stop duration
TIME :05:08:41 05:19:40 11.0 (min) Purpose : 1
LOG : 5027.56 5028.29 0.7 Region : 1122
FDEPTH: 20 26 Gear cond.: 0
BDEPTH: 60 63 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.9 kn
Sorted : 32 Total catch: 633.20 Catch/hour: 3460.11

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2613.11	24590	75.52	213
Scomber japonicus	846.99	18361	24.48	212
Total	3460.11		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 125

DATE :01.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°16.04
Lon W 14°51.99
start stop duration
TIME :07:13:15 07:23:15 10.0 (min) Purpose : 1
LOG : 5041.04 5041.72 0.7 Region : 1122
FDEPTH: 25 30 Gear cond.: 0
BDEPTH: 53 53 Validity : 0
Towing dir: 0° Wire out : 129 m Speed : 4.1 kn
Sorted : 42 Total catch: 41.75 Catch/hour: 250.50

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	216.90	6840	86.59	214
Sardina pilchardus	19.14	270	7.64	215
Trachurus trachurus	14.46	306	5.77	216
Total	250.50		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 126
DATE :01.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 25°18.64
Lon W 14°51.63
start stop duration
TIME :08:44:50 09:00:48 16.0 (min) Purpose : 1
LOG : 5049.70 5050.76 1.1 Region : 1122
FDEPTH: 25 29 Gear cond.: 0
BDEPTH: 56 54 Validity : 0
Towing dir: 0° Wire out : 155 m Speed : 4.0 kn
Sorted : 32 Total catch: 133.64 Catch/hour: 502.09

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	386.68	3772	77.01	217
Scomber japonicus	90.92	2126	18.11	218
Trachurus trachurus	23.67	8	4.71	
Spondyliosoma cantharus	0.83	4	0.16	
Total	502.09		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 127
DATE :01.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 25°44.85
Lon W 15°26.41
start stop duration
TIME :14:41:42 15:11:29 29.8 (min) Purpose : 1
LOG : 5104.68 5106.05 1.4 Region : 1122
FDEPTH: 233 236 Gear cond.: 0
BDEPTH: 233 236 Validity : 0
Towing dir: 0° Wire out : 580 m Speed : 2.8 kn
Sorted : 19 Total catch: 19.42 Catch/hour: 39.13

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus trachurus	18.21	214	46.55	219
Dentex macrophthalmus	8.58	91	21.94	
Zeus faber	6.04	6	15.45	
Spherooides pachgaster	3.87	2	9.89	
Dentex maroccanus	1.41	24	3.60	
Scomber japonicus	0.60	12	1.54	
Alloteuthis subulata	0.16	50	0.41	
Capros aper	0.16	4	0.41	
Macrorhamphosus scolopax	0.08	10	0.21	
Total	39.13		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 128
DATE :05.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 25°48.41
Lon W 14°47.79
start stop duration
TIME :12:42:15 13:12:31 30.3 (min) Purpose : 1
LOG : 5460.72 5462.35 1.6 Region : 1122
FDEPTH: 86 82 Gear cond.: 0
BDEPTH: 86 82 Validity : 0
Towing dir: 0° Wire out : 275 m Speed : 3.2 kn
Sorted : 0 Total catch: 0.73 Catch/hour: 1.45

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Spondyliosoma cantharus	0.61	2	42.47	
Pagellus bellottii	0.32	2	21.92	
Scomber japonicus	0.18	2	12.33	
Sardina pilchardus	0.18	2	12.33	
Aspitrigla obscura	0.16	2	10.96	
Total	1.45		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 129
DATE :05.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 26°6.77
Lon W 14°59.01
start stop duration
TIME :17:28:59 17:54:24 25.4 (min) Purpose : 1
LOG : 5501.85 5503.14 1.3 Region : 1121
FDEPTH: 278 279 Gear cond.: 0
BDEPTH: 278 279 Validity : 0
Towing dir: 0° Wire out : 680 m Speed : 3.0 kn
Sorted : 31 Total catch: 657.18 Catch/hour: 1551.17

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	906.37	12814	58.43	220
Trachurus trachurus	302.12	2832	19.48	221
Dentex macrophthalmus	111.88	661	7.21	
Capros aper	93.00	2313	6.00	
Dentex maroccanus	60.90	425	3.93	
Meniscus conchifer	35.88	7	2.31	
Merluccius senegalensis	11.31	19	0.73	
Zeus faber	9.77	7	0.63	
Spherooides pachgaster	6.16	5	0.40	
Macrorhamphosus scolopax	5.19	236	0.33	
Anthias anthias	2.83	94	0.18	
Polyprion americanus	2.53	2	0.16	
Aulopus filamentosus	1.89	2	0.12	
Mullus surmuletus	1.35	2	0.09	
Total	1551.17		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 130
 DATE :05.12.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 26°5.47
 start stop duration Lon W 14°35.86
 TIME :22:36:24 22:55:51 19.5 (min) Purpose : 1
 LOG : 5542.68 5544.00 1.3 Region : 1121
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 33 36 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.1 km
 Sorted : 3 Total catch: 2.73 Catch/hour: 8.42

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Zeus faber	5.43	3	64.47	
Sardina pilchardus	1.91	19	22.71	
Lepidopus caudatus	0.62	3	7.33	
Engraulis encrasicolus	0.34	99	4.03	222
Belone belone gracilis	0.12	3	1.47	
Total	8.42		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 131
 DATE :06.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 26°13.13
 start stop duration Lon W 14°48.72
 TIME :02:41:23 03:12:13 30.8 (min) Purpose : 1
 LOG : 5570.67 5572.26 1.6 Region : 1121
 FDEPTH: 221 228 Gear cond.: 0
 BDEPTH: 221 228 Validity : 0
 Towing dir: 0° Wire out : 560 m Speed : 3.1 km
 Sorted : 27 Total catch: 101.72 Catch/hour: 197.90

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dentex maroccanus	76.52	840	38.66	
Trachurus trachurus	43.37	560	21.91	
Spherooides pachgaster	23.35	16	11.80	
Dentex macrophthalms	21.77	484	11.00	
Zeus faber	8.31	6	4.20	
Merluccius merluccius	5.66	12	2.86	
Illex coindetii	5.08	18	2.57	
Scomber japonicus	3.97	29	2.01	
Lepidotrigla carolae	3.39	228	1.71	
Umbrina canariensis	1.95	4	0.98	
Aspitrigla obscura	1.81	12	0.91	
Citharus linguatula	0.88	76	0.44	
Macrorhamphosus scolopax	0.64	35	0.32	
Conger conger	0.41	23	0.21	
Belone belone gracilis	0.35	6	0.18	
Sepia orbignyana	0.23	12	0.12	
Trachinus pellegrini	0.12	6	0.06	
Total	197.78		99.94	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 132
 DATE :06.12.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 26°36.24
 start stop duration Lon W 13°51.18
 TIME :18:51:32 19:00:26 8.9 (min) Purpose : 1
 LOG : 5712.87 5713.55 0.7 Region : 1121
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 42 41 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.6 km
 Sorted : 35 Total catch: 176.14 Catch/hour: 1187.46

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	1127.53	11191	94.95	226
Scomber japonicus	27.64	1416	2.33	225
Engraulis encrasicolus	18.54	4955	1.56	224
Camogramma graycos	6.40	20	0.54	
Trachurus trecae	4.04	67	0.34	
Liza aurata	3.30	7	0.28	
Total	1187.46		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 133
 DATE :06.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 26°49.57
 start stop duration Lon W 13°53.34
 TIME :21:47:22 22:09:53 22.5 (min) Purpose : 1
 LOG : 5736.89 5738.04 1.1 Region : 1121
 FDEPTH: 98 97 Gear cond.: 0
 BDEPTH: 98 97 Validity : 0
 Towing dir: 0° Wire out : 370 m Speed : 3.1 km
 Sorted : 30 Total catch: 155.38 Catch/hour: 413.98

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus acarne	188.90	959	45.63	
Dentex maroccanus	102.04	893	24.65	
Trachurus trachurus	40.63	653	9.81	228
Scomber japonicus	36.77	1545	8.88	227
Dentex macrophthalms	25.04	293	6.05	
Boops boops	7.33	67	1.77	
Zeus faber	3.04	3	0.73	
MYCTOPHIDAE	2.80	666	0.68	
Zenopsis conchifer	1.39	3	0.33	
Merluccius merluccius	1.39	8	0.33	
Loligo vulgaris	1.17	3	0.28	
Octopus vulgaris	1.17	3	0.28	
Diplodus vulgaris	0.83	3	0.20	
Trachinus pellegrini	0.80	27	0.19	
Serranus cabrilla	0.59	3	0.14	
Raja miraletus	0.21	3	0.05	
Total	414.09		100.03	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 134
 DATE :07.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°2.39
 start stop duration Lon W 13°34.14
 TIME :07:02:55 07:06:19 3.4 (min) Purpose : 1
 LOG : 5819.09 5819.33 0.2 Region : 1121
 FDEPTH: 39 35 Gear cond.: 0

BDEPTH: 69 69 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 4.2 km
 Sorted : 12 Total catch: 115.60 Catch/hour: 2040.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	1844.12	186776	90.40	230
Scomber japonicus	158.82	8647	7.79	229
Sardina pilchardus	37.06	1588	1.82	
Total	2040.00		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 135
 DATE :07.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 27°9.55
 start stop duration Lon W 13°27.84
 TIME :11:08:06 11:20:15 12.2 (min) Purpose : 1
 LOG : 5852.73 5853.54 0.8 Region : 1121
 FDEPTH: 28 29 Gear cond.: 0
 BDEPTH: 28 29 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 4.0 km
 Sorted : 31 Total catch: 155.54 Catch/hour: 768.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	462.96	126765	60.27	231
Diplodus bellottii	247.90	5259	32.27	
Pomadasys incisus	28.40	469	3.70	
Sardina pilchardus	21.48	3580	2.80	232
Alloteuthis subulata	3.95	716	0.51	
Diplodus vulgaris	1.58	5	0.21	
Dentex gibbosus	0.94	5	0.12	
Umbrina canariensis	0.89	10	0.12	
Total	768.10		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 136
 DATE :07.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 27°11.26
 start stop duration Lon W 13°37.90
 TIME :12:50:36 13:06:19 15.7 (min) Purpose : 1
 LOG : 5865.30 5866.19 0.9 Region : 1121
 FDEPTH: 95 91 Gear cond.: 0
 BDEPTH: 95 91 Validity : 0
 Towing dir: 0° Wire out : 285 m Speed : 3.4 km
 Sorted : 32 Total catch: 1377.10 Catch/hour: 4877.48

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	1004.43	33943	67.98	236
Dentex macrophthalms	137.40	916	9.30	
Sardina pilchardus	120.00	1786	8.12	233
Trachurus trachurus	69.62	1008	4.71	234
Pagellus acarne	29.77	229	2.01	
Umbrina canariensis	26.11	137	1.77	
Spondyliosoma cantharus	25.65	137	1.74	
Dentex maroccanus	21.07	183	1.43	
Diplodus vulgaris	13.28	46	0.90	
Mullus surmuletus	10.99	46	0.74	
Engraulis encrasicolus	9.16	504	0.62	235
Boops boops	5.50	46	0.37	
Pagellus erythrinus	1.76	4	0.12	
Anthias anthias	1.37	92	0.09	
Zeus faber	1.37	8	0.09	
Total	1477.48		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 137
 DATE :07.12.2006 GEAR TYPE: BT NO: 19 POSITION:Lat N 27°18.36
 start stop duration Lon W 13°39.52
 TIME :17:45:52 18:03:16 17.4 (min) Purpose : 1
 LOG : 5908.98 5909.87 0.9 Region : 1121
 FDEPTH: 106 104 Gear cond.: 0
 BDEPTH: 106 104 Validity : 0
 Towing dir: 0° Wire out : 325 m Speed : 3.1 km
 Sorted : 32 Total catch: 1289.13 Catch/hour: 4445.28

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	3862.07	93941	86.88	238
Sardina pilchardus	488.28	6069	10.98	237
Pagellus acarne	33.10	138	0.74	
Boops boops	19.31	138	0.43	
Aspitrigla obscura	15.17	138	0.34	
Dentex macrophthalms	13.79	138	0.31	
Spherooides pachgaster	8.72	14	0.20	
Zeus faber	4.83	3	0.11	
Total	4445.28		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 138
 DATE :07.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°27.22
 start stop duration Lon W 13°28.37
 TIME :22:47:13 23:01:08 13.9 (min) Purpose : 1
 LOG : 5952.52 5953.41 0.9 Region : 1121
 FDEPTH: 20 33 Gear cond.: 0
 BDEPTH: 76 76 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.8 km
 Sorted : 33 Total catch: 166.45 Catch/hour: 717.46

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	704.09	10254	98.14	239
Scomber japonicus	12.28	409	1.71	
Engraulis encrasicolus	1.08	65	0.15	
Total	717.46		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 139
 DATE :08.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 27°34.89
 start stop duration Lon W 13°23.01

TIME :02:47:13 03:14:19 27.1 (min) Purpose : 1
 LOG : 5986.86 5988.64 1.8 Region : 1121
 FDEPTH: 25 30 Gear cond.: 0
 BDEPTH: 67 81 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 23 Total catch: 46.72 Catch/hour: 103.44

Trachurus trachurus 0.44 22 0.49
 Boops boops 0.11 5 0.12
 Total 89.72 100.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	70.85	1395	68.49	240
Scomber japonicus	32.32	2010	31.25	241
Engraulis encrasicolus	0.27	22	0.26	
Total	103.44		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 145
 DATE :11.12.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 28°37.07
 start stop duration Lon W 11°28.07
 TIME :16:46:04 17:15:48 29.7 (min) Purpose : 1
 LOG : 6497.99 6499.33 1.3 Region : 1110
 FDEPTH: 50 40 Gear cond.: 0
 BDEPTH: 65 66 Validity : 0
 Towing dir: 0° Wire out : 200 m Speed : 2.7 kn
 Sorted : 22 Total catch: 89.84 Catch/hour: 181.31

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	147.73	5677	81.48	254
Pagellus acarne	13.16	32	7.26	
Sardina pilchardus	10.41	363	5.74	255
Engraulis encrasicolus	10.01	1066	5.52	256
Total	181.31		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 140
 DATE :08.12.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 27°57.29
 start stop duration Lon W 12°57.91
 TIME :14:41:37 14:52:05 10.5 (min) Purpose : 1
 LOG : 6094.23 6094.91 0.7 Region : 1121
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 38 40 Validity : 0
 Towing dir: 0° Wire out : 95 m Speed : 3.9 kn
 Sorted : 33 Total catch: 98.29 Catch/hour: 563.27

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	503.72	17570	89.43	244
Scomber japonicus	34.56	1066	6.13	243
Engraulis encrasicolus	21.32	3215	3.78	242
Trachurus trachurus	1.89	17	0.34	
Sardinella maderensis	1.78	6	0.32	
Total	563.27		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 146
 DATE :11.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°45.26
 start stop duration Lon W 11°21.75
 TIME :22:45:48 23:06:11 20.4 (min) Purpose : 1
 LOG : 6535.07 6536.35 1.3 Region : 1110
 FDEPTH: 55 50 Gear cond.: 0
 BDEPTH: 77 76 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 3.8 kn
 Sorted : 29 Total catch: 60.36 Catch/hour: 177.70

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	119.82	4154	67.43	258
Scomber japonicus	46.99	1660	26.44	257
Diplodus vulgaris	3.18	15	1.79	
Engraulis encrasicolus	2.77	153	1.56	259
Zeus faber	1.77	3	0.99	
Pagellus bellottii	1.68	6	0.94	
Pagellus acarne	1.50	6	0.84	
Total	177.70		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 141
 DATE :08.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°11.85
 start stop duration Lon W 12°55.71
 TIME :22:00:39 22:26:08 25.5 (min) Purpose : 1
 LOG : 6149.50 6151.05 1.6 Region : 1110
 FDEPTH: 35 45 Gear cond.: 0
 BDEPTH: 64 85 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.6 kn
 Sorted : 31 Total catch: 93.36 Catch/hour: 219.76

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	213.26	4275	97.04	245
Spondyliosoma cantharus	4.94	35	2.25	
Sardina pilchardus	1.55	49	0.71	
Total	219.76		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 147
 DATE :12.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°58.15
 start stop duration Lon W 11°22.97
 TIME :04:04:57 04:34:48 29.9 (min) Purpose : 1
 LOG : 6571.39 6573.13 1.7 Region : 1110
 FDEPTH: 55 60 Gear cond.: 0
 BDEPTH: 97 103 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 3.5 kn
 Sorted : 2 Total catch: 2.13 Catch/hour: 4.28

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	4.26	125	99.53	260
Scomber japonicus	0.02	2	0.47	
Total	4.28		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 142
 DATE :09.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°6.45
 start stop duration Lon W 12°28.37
 TIME :06:13:31 06:22:31 9.0 (min) Purpose : 1
 LOG : 6220.09 6220.68 0.6 Region : 1110
 FDEPTH: 30 20 Gear cond.: 0
 BDEPTH: 44 46 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 4.0 kn
 Sorted : 35 Total catch: 352.40 Catch/hour: 2349.33

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	2193.33	71267	93.36	246
Engraulis encrasicolus	128.00	32000	5.45	247
Scomber japonicus	28.00	533	1.19	
Total	2349.33		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 148
 DATE :12.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°46.42
 start stop duration Lon W 11°6.03
 TIME :14:18:19 14:48:21 30.0 (min) Purpose : 1
 LOG : 6635.85 6638.18 2.3 Region : 1110
 FDEPTH: 17 22 Gear cond.: 0
 BDEPTH: 57 53 Validity : 0
 Towing dir: 0° Wire out : 75 m Speed : 4.7 kn
 Sorted : 23 Total catch: 23.27 Catch/hour: 46.48

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	22.47	1929	48.35	261
Scomber japonicus	17.92	356	38.55	262
Torpedo marmorata	2.48	2	5.33	
Sardina pilchardus	2.06	76	4.43	263
Trachurus trachurus	0.74	22	1.59	
Alloteuthis subulata	0.66	250	1.42	
Pagellus acarne	0.08	4	0.17	
Dicologlossa cuneata	0.02	2	0.04	
Sardinella aurita	0.02	4	0.04	
Sepiella ornata	0.02	12	0.04	
Merluccius merluccius	0.01	2	0.02	
Total	46.47		99.98	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 143
 DATE :09.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°11.85
 start stop duration Lon W 12°4.12
 TIME :17:09:41 17:33:30 24.5 (min) Purpose : 1
 LOG : 6295.90 6297.90 2.0 Region : 1110
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 42 46 Validity : 0
 Towing dir: 0° Wire out : 80 m Speed : 4.4 kn
 Sorted : 34 Total catch: 76.32 Catch/hour: 186.91

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	82.29	1680	44.03	248
Engraulis encrasicolus	63.67	13423	34.07	250
Pagellus acarne	21.06	64	11.27	
Sardina pilchardus	18.61	1007	9.96	249
Sardinella aurita	1.08	10	0.58	
Diplodus bellottii	0.20	2	0.10	
Total	186.91		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 149
 DATE :13.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 29°18.41
 start stop duration Lon W 10°32.29
 TIME :03:52:36 04:00:37 8.0 (min) Purpose : 1
 LOG : 6758.54 6759.08 0.6 Region : 1110
 FDEPTH: 20 25 Gear cond.: 0
 BDEPTH: 53 53 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.1 kn
 Sorted : 28 Total catch: 141.80 Catch/hour: 1060.85

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	972.57	26521	91.68	264
Scomber japonicus	87.91	2207	8.29	265
Engraulis encrasicolus	0.37	7	0.04	
Total	1060.85		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 144
 DATE :11.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 28°31.41
 start stop duration Lon W 11°26.11
 TIME :14:45:00 15:18:03 33.1 (min) Purpose : 1
 LOG : 6487.19 6488.92 1.7 Region : 1110
 FDEPTH: 20 25 Gear cond.: 0
 BDEPTH: 44 48 Validity : 0
 Towing dir: 0° Wire out : 115 m Speed : 3.1 kn
 Sorted : 16 Total catch: 49.42 Catch/hour: 89.72

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Engraulis encrasicolus	74.89	7102	83.47	253
Scomber japonicus	7.52	152	8.38	251
Diplodus puntazzo	3.18	2	3.54	
Sardina pilchardus	3.16	147	3.52	252
Alloteuthis subulata	0.44	131	0.49	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 150

DATE :13.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 29°25.34
 start stop duration Lon W 10°15.94
 TIME :08:24:12 08:51:29 27.3 (min) Purpose : 1
 LOG : 6796.84 6798.71 1.9 Region : 1110
 FDEPTH: 27 33 Gear cond.: 0
 BDEPTH: 47 51 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.1 kn
 Sorted : 25 Total catch: 24.90 Catch/hour: 54.75

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Scomber japonicus	42.32	1306	77.31	266
Sardina pilchardus	12.18	281	22.25	267
Engraulis encrasicolus	0.24	13	0.44	
Total	54.75		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 151
 DATE :13.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 29°36.92
 start stop duration Lon W 10°6.32
 TIME :13:11:23 13:33:04 21.7 (min) Purpose : 1
 LOG : 6835.98 6837.40 1.4 Region : 1110
 FDEPTH: 35 38 Gear cond.: 0
 BDEPTH: 57 50 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
NOCATCH	0.00	0	0.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 152
 DATE :13.12.2006 GEAR TYPE: PT NO: 7 POSITION:Lat N 29°53.62
 start stop duration Lon W 9°49.33
 TIME :18:54:39 18:57:56 3.3 (min) Purpose : 1
 LOG : 6887.31 6887.55 0.2 Region : 1110
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 47 47 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 4.4 kn
 Sorted : 28 Total catch: 28.11 Catch/hour: 514.21

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	468.29	9768	91.07	269
Scomber japonicus	38.05	567	7.40	270
Engraulis encrasicolus	5.12	512	1.00	271
Alloteuthis subulata	2.74	787	0.53	
Total	514.21		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 153
 DATE :14.12.2006 GEAR TYPE: PT NO: 1 POSITION:Lat N 31°17.61
 start stop duration Lon W 9°58.02
 TIME :19:43:02 19:55:58 12.9 (min) Purpose : 1
 LOG : 7101.01 7101.89 0.9 Region : 1110
 FDEPTH: 40 39 Gear cond.: 0
 BDEPTH: 97 101 Validity : 0
 Towing dir: 0° Wire out : 200 m Speed : 4.1 kn
 Sorted : 2 Total catch: 2.13 Catch/hour: 9.88

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Parapenaeus longirostris	7.23	5453	73.24	
GOBIIDAE	1.67	1614	16.90	
Sepiella rondeleti	0.28	255	2.82	
Alloteuthis subulata	0.28	60	2.82	
Sepia officinalis hierredda	0.23	19	2.35	
Engraulis encrasicolus	0.14	14	1.41	
Merluccius merluccius	0.05	9	0.47	
Total	9.88		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 154
 DATE :14.12.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 31°18.63
 start stop duration Lon W 9°50.96
 TIME :21:20:46 21:41:54 21.1 (min) Purpose : 1
 LOG : 7111.12 7112.48 1.4 Region : 1110
 FDEPTH: 5 5 Gear cond.: 0
 BDEPTH: 53 53 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.9 kn
 Sorted : 19 Total catch: 19.45 Catch/hour: 55.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Diplodus sargus *	17.88	14	32.39	
Merluccius merluccius	14.67	1081	26.58	
Sardina pilchardus	5.88	162	10.64	274
Trachurus trachurus	4.48	9	8.12	275
C R A B S	4.23	324	7.66	
Alloteuthis subulata	2.75	1447	4.99	
GOBIIDAE	1.50	1995	2.72	
Sepiella rondeleti	0.99	474	1.80	
Scomber japonicus	0.85	9	1.54	
Trachurus trachurus	0.74	352	1.34	272
Parapenaeus longirostris	0.62	184	1.13	
Engraulis encrasicolus	0.48	48	0.87	273
Sepia officinalis hierredda	0.11	3	0.21	
Total	55.20		100.00	

R/V "DR. FRIDTJOF NANSEN" SURVEY:2006411 STATION: 155
 DATE :15.12.2006 GEAR TYPE: PT NO: 4 POSITION:Lat N 31°33.14
 start stop duration Lon W 9°45.69
 TIME :02:29:32 02:55:25 25.9 (min) Purpose : 1
 LOG : 7155.15 7156.82 1.7 Region : 1110
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 28 36 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.9 kn
 Sorted : 46 Total catch: 45.81 Catch/hour: 106.16

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sardina pilchardus	46.35	1474	43.66	276
Sarpa salpa	29.20	60	27.50	
C R A B S	5.84	445	5.50	
Merluccius merluccius	4.08	35	3.84	
Boops boops	3.82	44	3.60	
Sardina pilchardus	3.34	1244	3.14	277
Parapandalus narval	2.04	730	1.92	
Dicologlossa cuneata	2.02	35	1.90	
Trachurus trachurus	2.02	28	1.90	280
Alloteuthis subulata	1.85	679	1.75	
Sepia officinalis hierredda	1.67	2	1.57	
Spondylisoma cantharus	0.76	2	0.72	
Trachurus trachurus, juvenile	0.65	491	0.61	279
Scomber scombrus	0.63	5	0.59	
Diplodus vulgaris	0.53	5	0.50	
Engraulis encrasicolus	0.44	46	0.41	278
Mullus surmuletus	0.19	2	0.17	
Pagellus acarne	0.16	2	0.15	
Penaeus kerathurus	0.12	5	0.11	
Trachinus pellegrini	0.09	28	0.09	
Sepiella ornata	0.09	46	0.09	
Parapenaeus longirostris	0.09	28	0.09	
GOBIIDAE	0.09	65	0.09	
Monoleme microstoma	0.07	7	0.07	
Loligo vulgaris	0.02	2	0.02	
Total	106.16		100.00	

Annex III Description of instruments and fishing gear

The Simrad ER-60, 38 kHz scientific echosounder was used for abundance estimation during the survey, in addition data from the 18 kHz, 120 kHz and 200 kHz transducers were recorded for possible future multifrequency target identification. The Bergen Echo Integrator system (BEI) recorded the hydroacoustic data and was used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data were stored to tape and brought back to IMR for storing. The last calibration of all transducers prior to the survey was conducted in Baia dos Elefantes, Angola 6/10-2006.

The details of the settings of the echosounders were as follows:

Transceiver ES18-11

Transducer depth	5.5 m
Absorption coeff.	2.2 dB/km
Pulse length	1.024 ms
Bandwidth	1.57 kHz
Max power (used)	2000 Watt (2000 W)
2-way beam angle	-17.0 dB
SV transducer gain	22.57 dB
TS transducer gain	22.4 dB
Angle sensitivity	13.9
3 dB beamwidth along.	11.6
3 dB beamwidth athw.	11.41
Alongship offset	0.11
Athwardship offset	-0.02

Transceiver ES38-B

Transducer depth	5.5 m
Absorption coeff.	8.7 dB/km
Pulse length	1.024 ms
Bandwidth	2.43 kHz
Max power (used)	4000 Watt (2000 W)
2-way beam angle	-20.6 dB
SV transducer gain	25.87 dB
TS transducer gain	26.5 dB
Angle sensitivity	21.9
3 dB beamwidth along.	6.89
3 dB beamwidth athw.	6.92
Alongship offset	0.11
Athwardship offset	0.03

Transceiver ES120-7

Transducer depth	5.5 m
Absorption coeff.	44.5 dB/km
Pulse length	1.024 ms
Bandwidth	3.03 kHz
Max power (used)	500 Watt (250 W)
2-way beam angle	-20.8 dB
SV transducer gain	25.33 dB
TS transducer gain	25.7 dB
Angle sensitivity	21.0
3 dB beamwidth along.	7.20
3 dB beamwidth athw.	7.15
Alongship offset	0.09
Athwardship offset	0.03

Transceiver ES200-7

Transducer depth	5.5 m
Absorption coeff.	66.9 dB/km
Pulse length	1.024 ms
Bandwidth	3.09 kHz
Max power (used)	300 Watt (120 W)
2-way beam angle	-20.7 dB
SV transducer gain	24.25 dB
TS transducer gain	27.0 dB
Angle sensitivity	23.00
3 dB beamwidth along.	6.87
3 dB beamwidth athw.	7.01
Alongship offset	- 0.07
Athwardship offset	0.25

Bottom detection menu

Minimum level -50 dB

Fishing gear

The vessel has three different sized four-panel 'Åkrahavn' pelagic trawls and one 'Gisund super bottom trawl'. The two smallest pelagic trawls and the demersal trawl were used during the survey. The smallest pelagic trawl has 10-12 m vertical opening under normal operation, whereas the intermediate sized trawl has 15-18 m opening.

The bottom trawl has a 31 m headline and a 47 m footrope fitted with a 12" rubber bobbins gear. The codend has 20 mm meshes, and has an inner net with 10 mm mesh size. The vertical opening is about 5.5 m. The distance between the wing tips is about 18 m during towing. The sweeps are 40 m long. The trawl doors are 'Thyborøen' combi, 8 m² and weigh 2000 kg. The door spreading is about 45 m when using restraining rope. Trawling was

conducted for species identification only and no restraining rope was therefore used during the survey.

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

The pelagic trawls are equipped with a trawl eye that provides information about the trawl opening and the distance of the footrope to the bottom. A pressure sensor is used to show the depth on the headline.