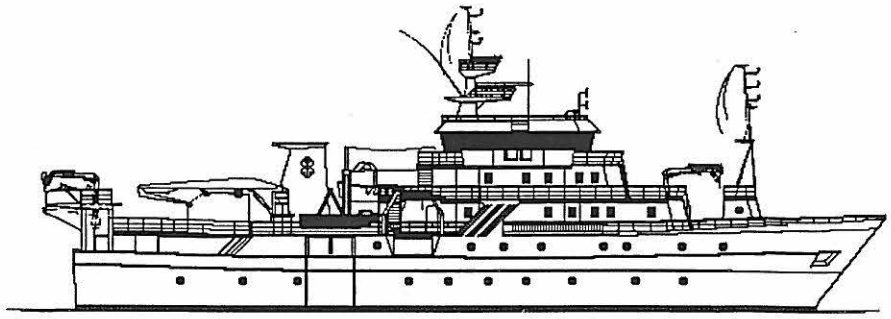

SURVEYS OF FISH RESOURCES OF NAMIBIA

Cruise Report No 2/97

Survey of the horse mackerel resources

10 - 29 June 1997

Ministry of Fisheries & Resources
Swakopmund, Namibia

Institute of Marine Research
Bergen, Norway

CRUISE REPORT "DR. FRIDTJOF NANSEN"

SURVEYS OF THE FISH RESOURCES OF NAMIBIA

Cruise Report No 3/97

Survey of the horse mackerel resources

10 - 29 June 1997

by

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CHAPTER 1 INTRODUCTION

1.1 Objectives

1. Carry out a hydro-acoustic survey on the pelagic and mid-water horse mackerel (*Trachurus capensis*), to:

   determine the abundance and spatial and vertical distribution of the exploited stock

   determine the size composition of the stock

   obtain length-weight relationships

   obtain biological information (sex ratio, reproductive stages and gonad weight)

2. Determine size composition and distribution of the other small pelagic species (pilchard, anchovy and round herring). In addition the size composition and distribution other demersal species such as hake as well as the distribution of alfonsino were also recorded during the survey.

3. Collect data on the basic oceanographic parameters per degree latitude, namely:

   temperature

   dissolved oxygen

   salinity

1.2 Participation

The scientific staff from the National Marine Information and Research Centre (NatMIRC), Swakopmund, Namibia were:

Ekkehard KLINGELHOEFFER (Team leader), Bernhard VASKE, Niels LETH, Justina SHIFIDI, Michael EVENSON, Theopelus KAIRUA and Shaun WELLS.

The scientific staff from the Institute of Marine Research (IMR), Bergen, Norway, were:

Johannes HAMRE (Cruise leader), Oddgeir ALVHEIM, Martin DAHL and Jarle KRISTIANSEN.

1.3 Schedule

The RV 'Dr. Fridtjof Nansen' left Walvis Bay at 17h00 on 10 June 1997 and steamed south-west to 26°00' S. From Walvis Bay on the way south the survey was initiated and the integrator values were recorded. The first CTD line commenced offshore at 26°00' S, 130 NM from the coast at a bottom depth of 2100 m.

The survey followed a systematic parallel grid of 20 nautical miles (NM) apart for the offshore regions from 26°00' S to 21°00' S. For the inshore region at less than 100 m bottom depth a survey grid of systematic square tracks was used. In the region between 21°00' S and 17°15' S the same grid pattern was used except that the distance between the offshore grid lines was reduced from 20 NM to 15 NM (Figure 1a).

The RV 'Dr. Fridtjof Nansen' arrived in Walvis Bay on 10 June. A total of 4200 NM were steamed.

1.4 Survey effort

The course track with the trawl stations and CTD stations is presented in Figure 1a and b. The number of hauls and CTD stations by area and gear type are listed in Table 1 below.

Table 1: Number of CTD and trawls stations, June 1997 survey.

Area	Bottom trawls (Bt)	Pelagic trawls (Pt)	Trawl failure (Bt)	Trawl failure (Pt)	Total no. of trawls	CTD stations
26°00'-21°00'	14	15	1	1	31	38
21°00'-17°15'	24	26	0	0	50	33
TOTAL	38	41	1	1	81	61

1.5 Survey design

To determine whether adult horse mackerel had migrated further offshore south of Walvis Bay, the initial survey was designed as follows:

* to proceed from Walvis Bay in a south westerly direction to a position 130 NM offshore to a latitude of 26°00' S at a bottom depth of 2100 m.

With the above survey design it was therefore possible to cover a large offshore area south of Walvis Bay.

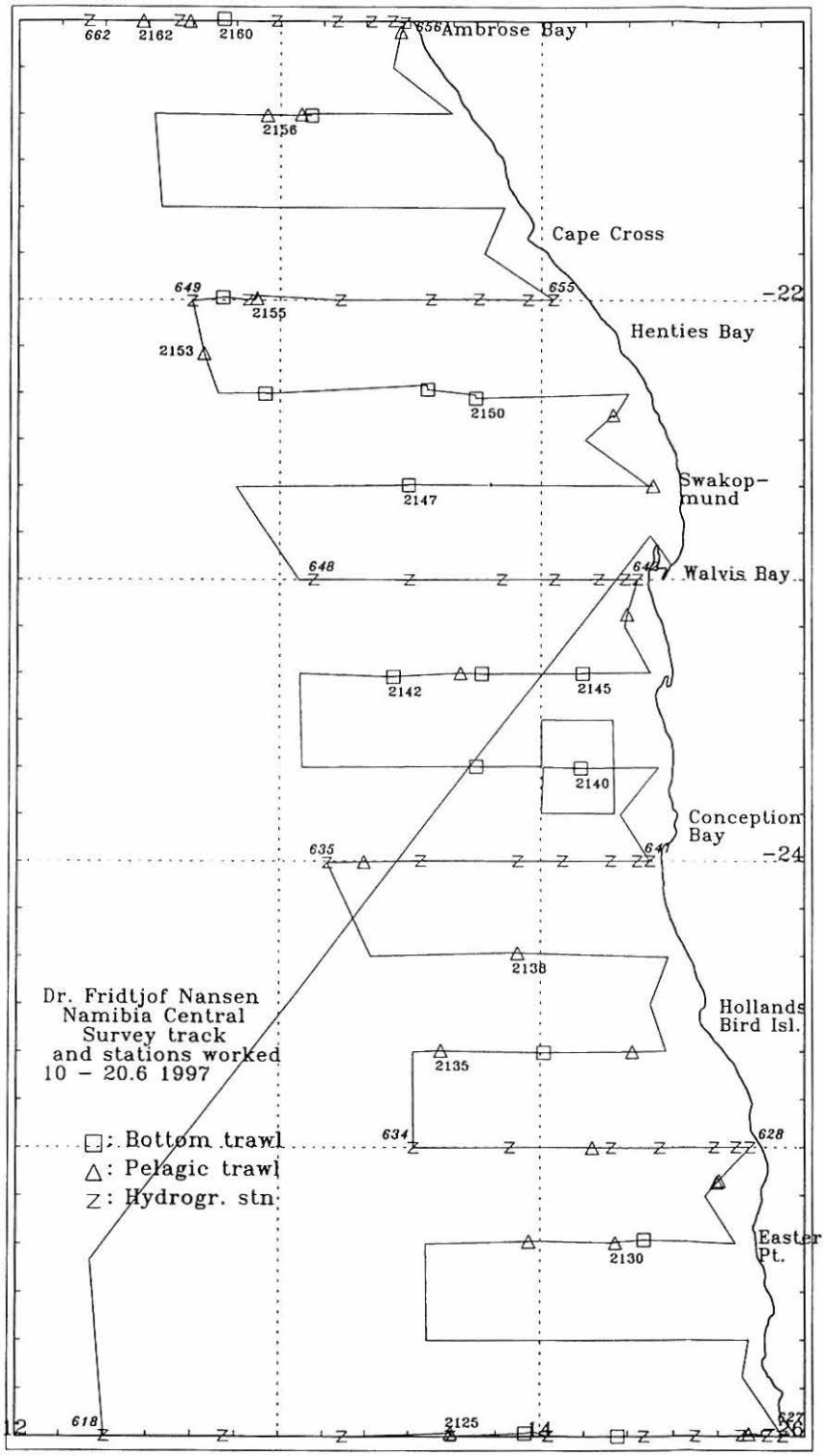


Figure 1a. Course track and fishing stations, Dolphin Head to Ambrose Bay.

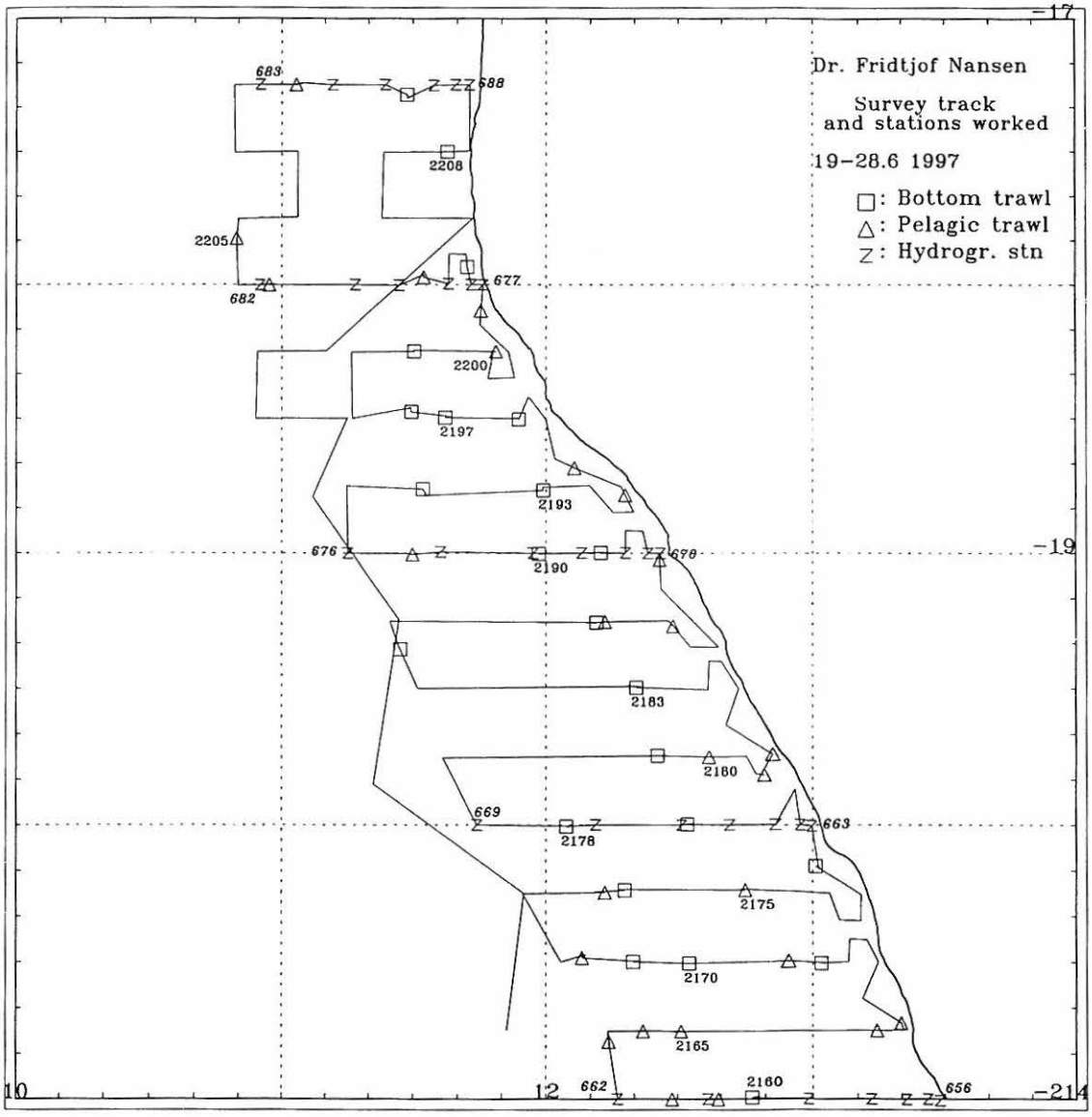


Figure 1b. Course track and fishing stations, Ambrose Bay to Cunene River.

CHAPTER 2 METHODS

2.1 Hydrographic sampling

2.1.1 Hydrography

A Seabird 911+ CTD probe was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. A total of 61 CTD stations were worked along 10 hydrographic sections from 26°00' S to 17°15' S (Annex II). At each degree latitude CTD stations were carried out at the following distances from the coast: 2, 5, 10, 20, 30, 50 and 70 NM, except at the 18°00' S and 17°15' S CTD line only five stations were taken i.e. 2 - 50 NM. Additional three offshore stations were included at 26°00' S (Annex 2) and Figures 1a - b. At each station two 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, these samples were analysed for dissolved oxygen using the Winkler method and salinity using a PORTASAL mod. 8410 salinometer.

Sea temperature at 5 m depth was recorded continuously during the cruise (Annex II).

2.2 Distribution and abundance estimation

2.2.1 Survey area

The limits of the survey area were determined from the previous data of pelagic and mid-water fish distribution, i.e. the area from the Lüderitz upwelling cell (26°00' S) to the border between Namibia and Angola (17°15' S) was surveyed. The survey followed a systematic parallel grid of 20 NM apart from 26°00' to 21°00' S and 15 NM apart from 21°00' to 17°15' S, due to the greater abundance of horse mackerel in the region north of 21°00' S. The inshore area of the survey was limited to approximately 2 NM from the coast. At less than 100 m bottom depth a survey grid of systematic square tracks (Figures 1a - b) was used to obtain a better coverage of the inshore juvenile horse mackerel. On average the offshore area surveyed extended to a bottom depth of close to the 600 m isobath. However, between 17°15' S and close to 19°00' S the survey was extended further offshore to a bottom depth up to 3000 m.

To allow comparison with previous pelagic fish surveys, the distribution maps are provided for the following two major regions:

26°00' to 21°00' S	Dolphin Head to Ambrose Bay
21°00' to 17°15' S	Ambrose Bay to Cunene River

The course tracks with the trawling and CTD stations for the two regions are shown in Figures 1a-b, respectively.

2.2.2 Acoustic methodology

A description of the acoustic instruments and their standard settings are given in Annex I, including a description of the fishing gear used.

An acoustic echo-integration system provided measurements of fish densities, averaged over 5 NM distances. The acoustic unit measured by this calibrated echo- integrator system is the area backscattering coefficient, S_A.

The scrutinising process of the Bergen Echo Integrator, BEI, was used to partition integrator data to species or species groups by separating echo recordings horizontally or vertically. Integrator data from fish targets were allocated to the following groups on the basis of trawl sampling and acoustic character, as recognised from the echo recordings:

Juvenile horse mackerel (≤ 21 cm)
Juvenile and maturing horse mackerel (≥ 21 cm)
Pelagic 1 (pilchard, anchovy and round herring)
Pilchard
Pelagic mix
Gobies
Other demersal species (mainly juvenile hake)
Plankton and mesopelagic
Mesopelagic
Alfonsino (*Beryx splendens*)
Dentex

For consistency with the calculations in previous acoustic surveys the horse mackerel above 21 cm has been classified a maturing/adult and those fish less than or equal to 20 cm as juveniles. Maps containing these integrator data were drawn for horse mackerel, juvenile hake and clupeoid fishes and from these records the distribution of the fish was indicated .

Areas of fish distribution were divided into smaller units if significant differences were observed in the density of the fish and the average lengths of the fish in a specific area. The average S_A-values within an unit were then obtained by averaging all data measured during the coverage of that area, excluding those values obtained between the course line. The area was calculated in cm^2 with a planimeter and converted to NM^2.

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

$$TS = 20 \log L - 72 \quad [dB]$$

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

where L is the length of the fish, expressed in centimetres and C_F the conversion factor. This target strength to size relationship has been used for a number of fish species (horse mackerel, pilchard, anchovy and round herring), although originally derivated from earlier measurements of North Sea herring. Experiments in the past have been carried out to determine the validity of the target strength presently used for the Cape horse mackerel. The target strength of the North Sea herring will however, be used until a more specific target strength for horse mackerel is determined.

The number of fish in each length frequency group (cm) in an area was calculated by applying the following formula:

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

where
- N_i = number of fish in length group i
- A = area in NM^2
- S_A = mean integrator value in the area
- P_i = proportion of fish in length group i in samples from the area
- C_{Fi} = fish conversion factor for length group i

The number per length group was then summed and the total number of fish obtained. The total biomass of fish was computed using the mean weight per length group obtained from trawl samples.

2.2.3 Biological sampling

Trawl sampling strategy

A representative sample of one to three baskets was taken from each trawl catch depending on the size and composition of the total catch. To ensure that the sample is representative the catch was well mixed. The random sample was then used in order to determine the species composition and the size composition.

The procedures to determine the size composition for all commercial species were as follows:

- Total length (Lt):
  100 horse mackerel per sample for total length
  50 fish per sample for: pilchard, anchovy, round herring, orange roughy and hake
- Measurement:
  Recorded to the nearest 1.0 cm below for both the pelagic species (horse mackerel, round herring, anchovy and pilchard) and hake.
- Weight:
  Total weight of measured fish sampled in kg

Biological data (horse mackerel)

Biological data were collected for the target species, Cape horse mackerel and included the following parameters:

- Size composition:

  10 fish per cm class were recorded to the nearest 1 mm below;

- Fish weight:

  Total and gutted weight of 10 fish per cm class were recorded to the nearest 1 mg below;

- Reproductive stages and sex determination:

  The seven stage category as listed in Annex IX was used to describe the reproductive stage of the horse mackerel;

Sex identification was classified as: Juvenile (0), Male (1), Female (2)

- Gonad weight:

  Ovary and testes weight of 10 fish per cm class were recorded to the nearest 1 mg below;

- Otolith sampling:

  Five fish per cm class

  Both otoliths of the fish were collected

  Otoliths were stored in envelopes

  Only the station number and numerical number was recorded on the envelope. The numerical number used on the envelope corresponded to the numerical number on a work sheet containing the biological information listed above;

Processing of biological data

Due to the scarcity of horse mackerel south of 21°00' S size composition, length weight, maturity stages and sex ratio were pooled for the area 26°00' S- 21°00' S. All horse mackerel data for the area north of 21°00' S were pooled per two degree where the horse mackerel was found to occur in a greater abundance. Size composition:

- Size composition

Size frequency data and trawl station data were entered onto the NAN-SIS data base, for all station i.e. 2125 - 2208. Total length frequency distributions for the inshore (30 - 200 m), offshore (200-600 m) and far offshore (2000 -3000 m) areas (Figure 6) as well as for sub areas according to Latitude (Annex III) have been calculated using the S_A values as weighting factors for combining length samples for individual trawl stations.

Size composition of the other pelagic (pilchard) and demersal (hake), were pooled by simple adding of all stations in which pilchard and hake were recorded (Annex VI).

- Length\weight relationship:

The length/weight relationship of horse mackerel was pooled per two degree latitude for the area north of 21°00' S. The total length/total weight relationships for the horse mackerel were calculated by fitting power curves to the weight-length regressions (Annex VII). Observed weight by length groups (cm) was used in the biomass calculation.

All length/weight data was processed on Microsoft Excel spreadsheets.

CHAPTER 3 RESULTS

3.1 Hydrography

The results of the CTD measurements are shown in Annex II.

An upwelling structure is clearly seen in the vertical sections of temperature and oxygen. The salinity in the upper layer was quite homogenous.

Salinity values ranged from 35.0 in the south (26°00' S) to 35.6 in the north (17°15' S) which are typically characteristics of cold and slightly warmer water masses.

In the oxygen sections a minimum with values below 1 ml/l was observed at sea bottom along the entire shelf. However, it seems to appear throughout the shelf area that oxygen minimum layer (i.e. below 1 ml/l) was less than 50 m thick, with bottom values between 0.5 and 1 ml/l.

The horizontal distribution of surface temperature (Figure 2a-b) confirm strong upwelling along the entire coast, with SST near the coast was 12 - 13°C (12°C in the extreme south), increasing to only 15°C near the Cunene River some 70 NM from the coast.

3.2 Distribution

The distribution patterns of the horse mackerel and clupeoid fishes (pilchard, round herring and anchovy) are shown in Figures 3a-b and 4a-b. The scale used in the distribution charts to illustrate different levels of density is presented in absolute acoustic units, which is the mean integrator value S_A for a given area.

Juvenile horse mackerel (≤ 21 cm) were recorded in inshore waters forming shoals from near the surface to bottom The juvenile/maturing horse mackerel ≥21 cm was found more offshore on the shelf at intermediate depths. In a far offshore region north of 18°30' S between 2000 - 3000 m bottom depth, a new distribution area of maturing horse mackerel was discovered. This component had a modal length of 26 cm and occurred in a narrow band of some 10 NM wide, extending from 18°30' S to the Angola border (Figure 3 b), where the survey could not be extended into southern Angola.

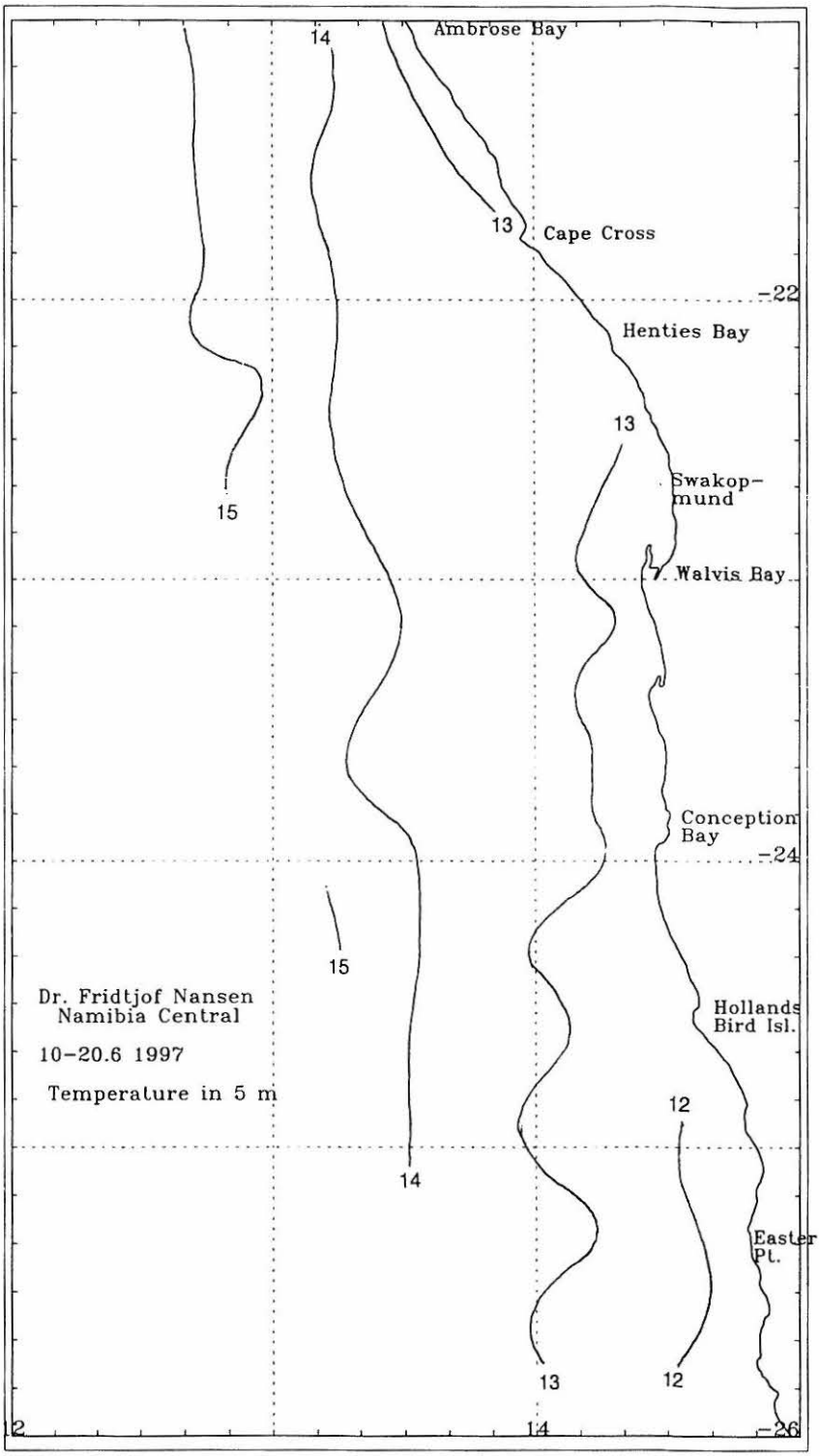


Figure 2a Distribution of sea temperature at 5 m depth: 26 °00' to 21°00' S.

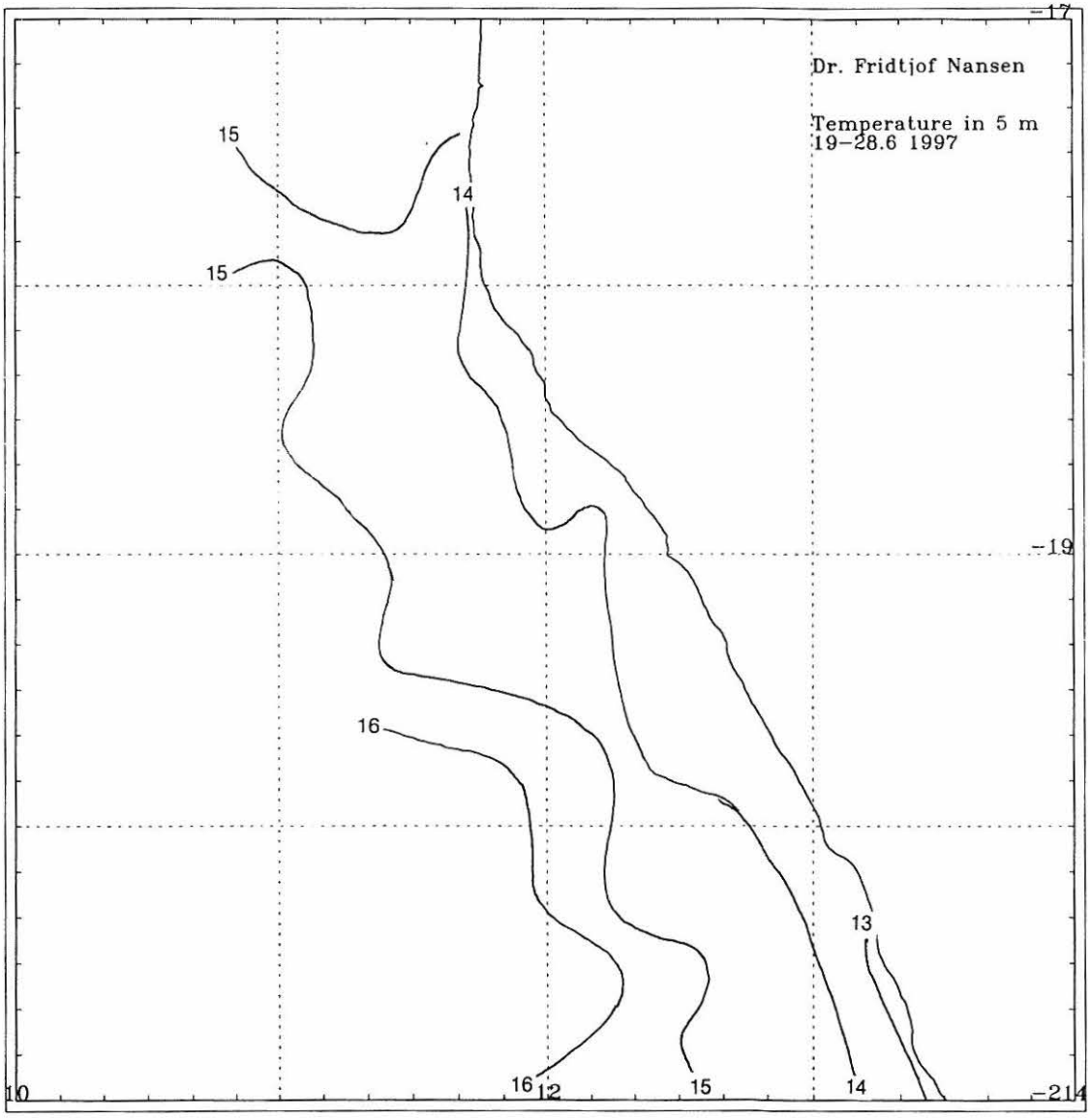


Figure 2b Distribution of sea temperature at 5 m dept: 21°00' to 17°15' S.

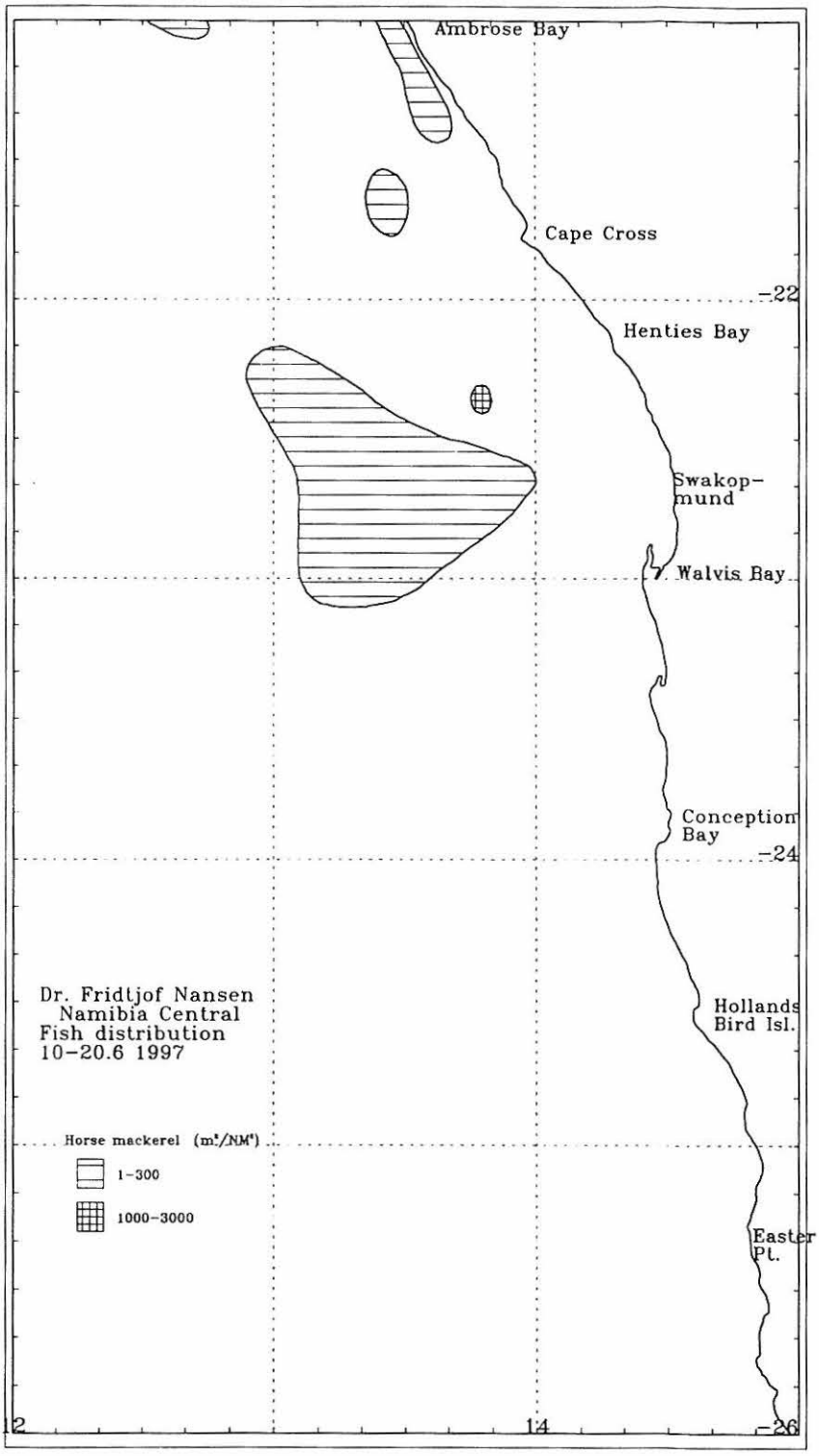


Figure 3a Distribution of horse mackerel, Dolphin Head to Ambrose Bay.

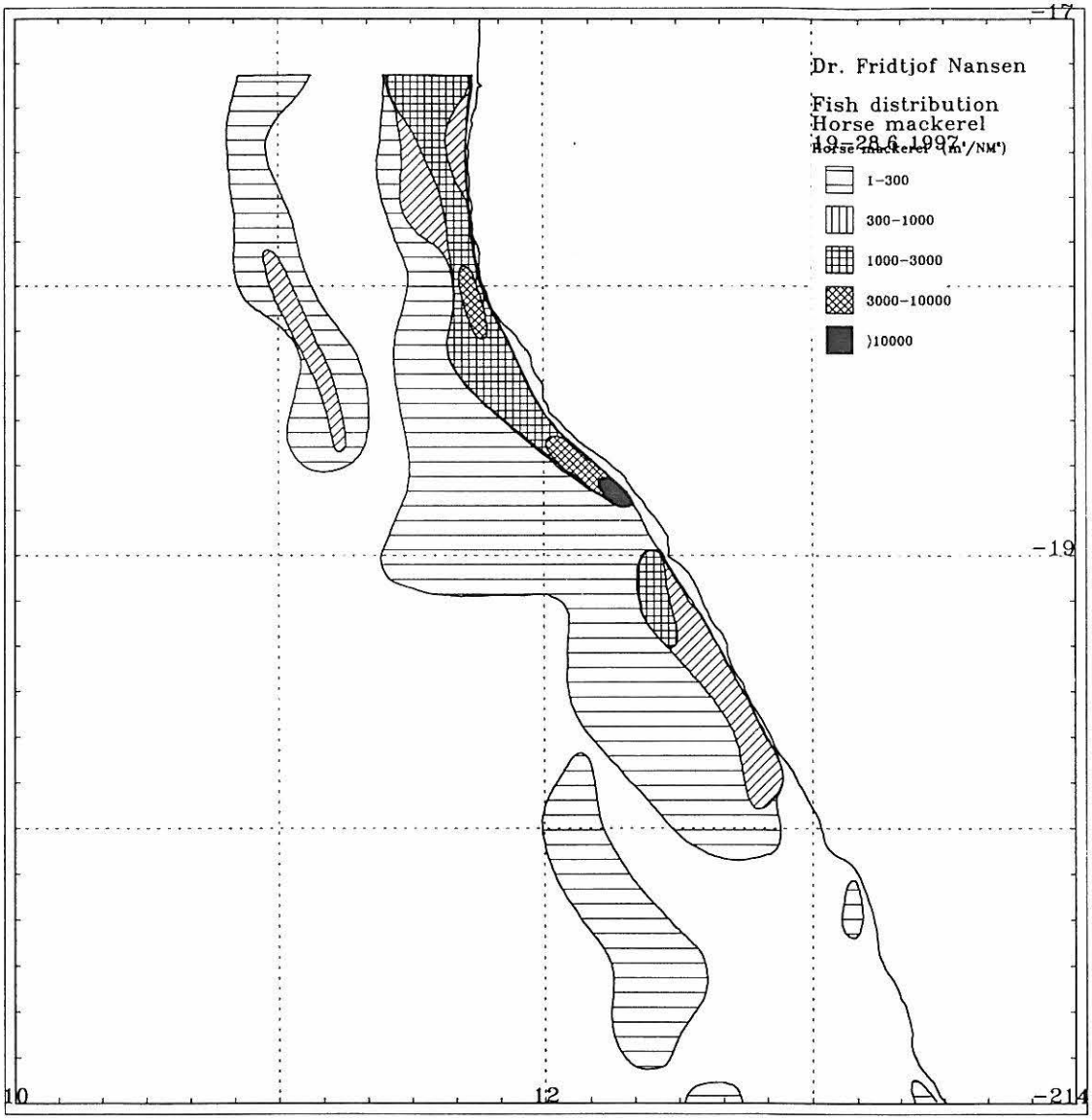


Figure 3a Distribution of horse mackerel, Dolphin Head to Ambrose Bay.

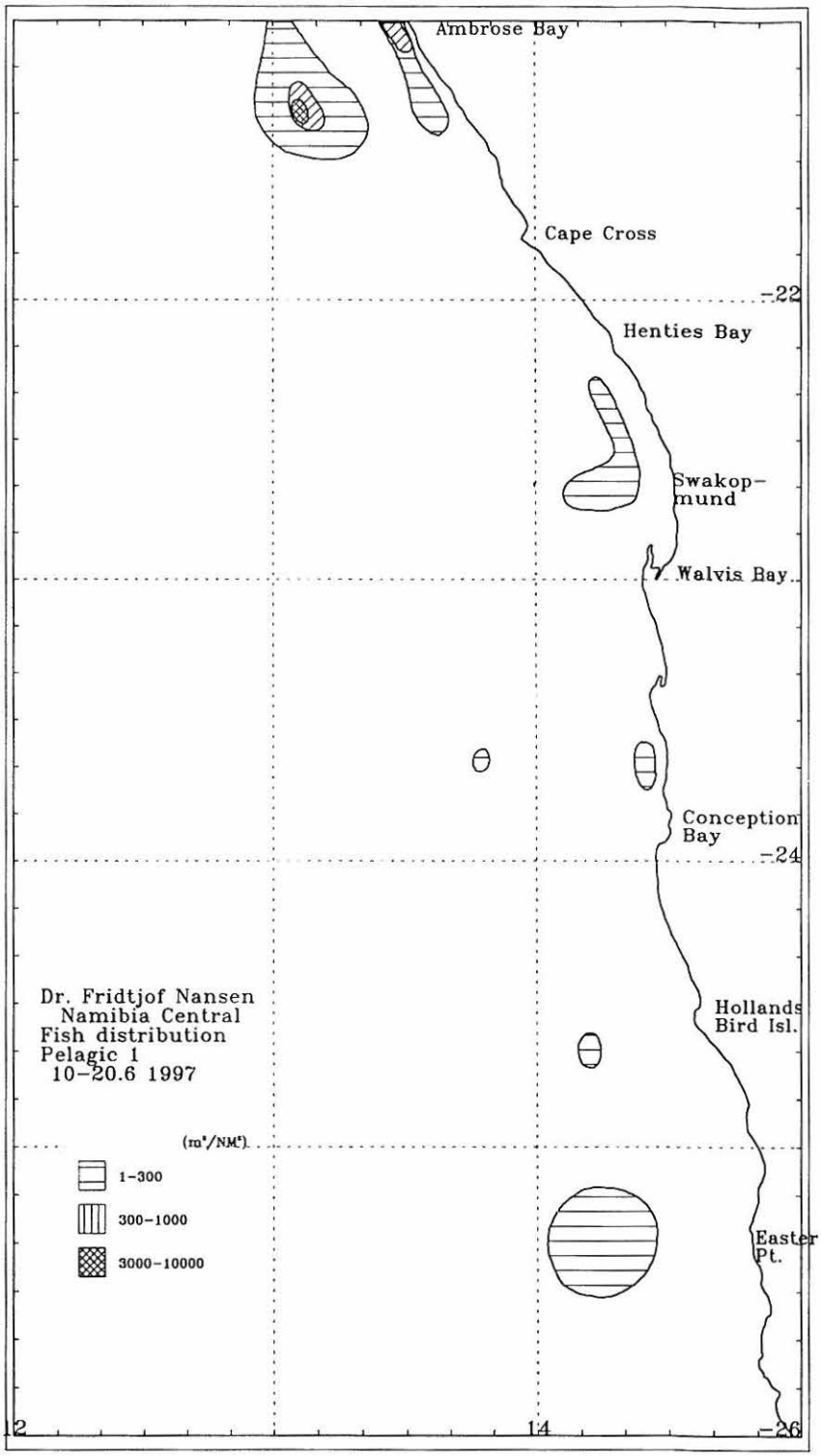


Figure 4a Distribution of pelagic 1, Dolphin Head to Ambrose Bay.

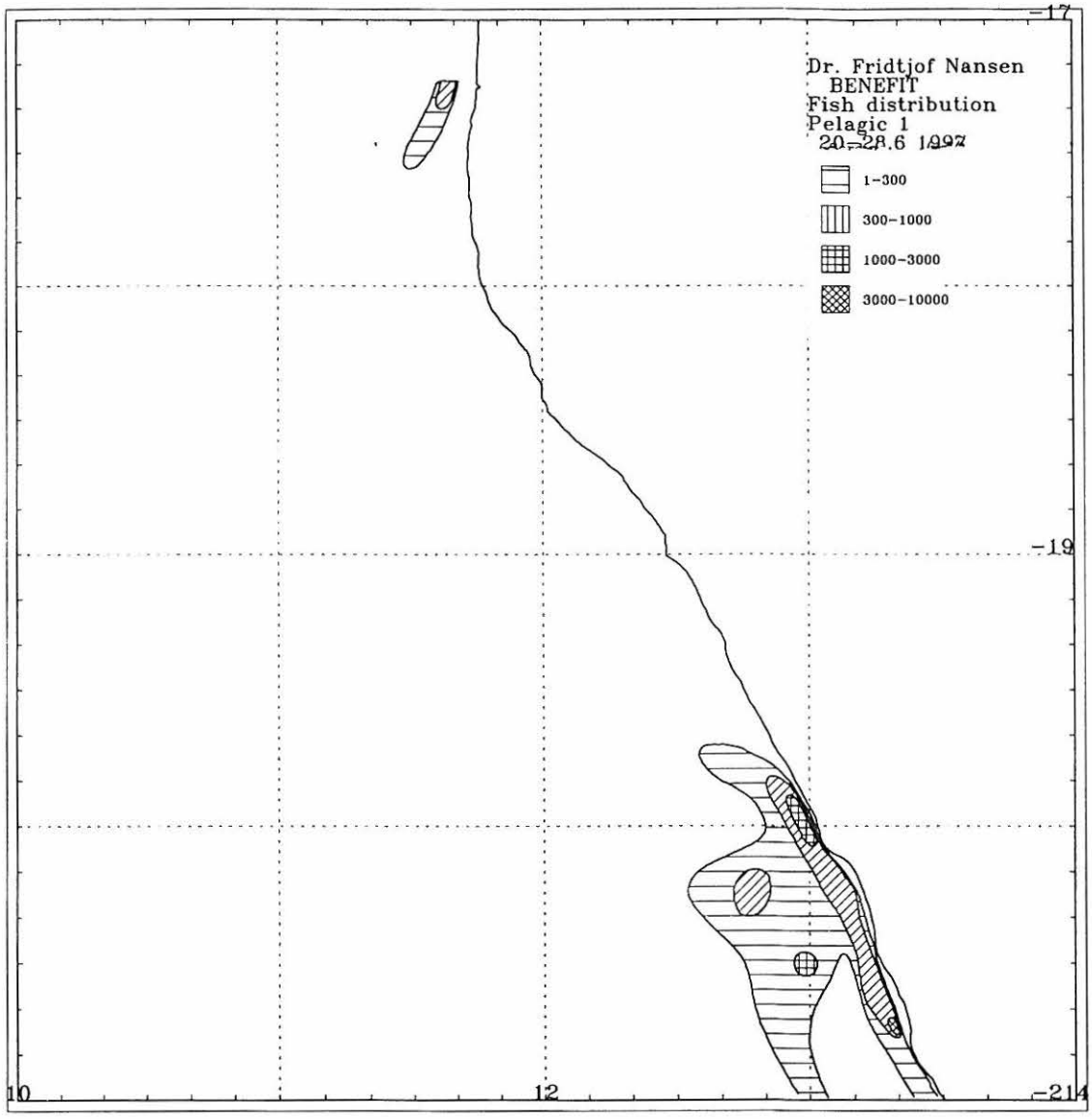


Figure 4b Distribution of pelagic 1, Ambrose Bay to Cunene River.

3.2.1 Dolphin Head to Ambrose Bay

Only two small shoals of juvenile horse mackerel of mean length of 9.7 cm were recorded inshore namely at Swakopmund and north of Cape Cross. In both cases the densities were low i.e. below S_A 100.

The only large area of adult horse mackerel recorded was offshore from Walvis Bay with a mean length of 27.6 cm. No adult horse mackerel were reordered in the area south of Walvis Bay up to 26°00' S. Two smaller shoals were found near Cape Cross and Henties Bay at bottom depth of about 250 m with a mean length of 24.9 cm. However, due to the small area and the low density its contribution to the biomass was small.

Total biomass estimate for the southern area i.e. Dolphin head to Ambrose Bay was 48 000 tonnes compared to 250 000 tonnes in the June 1996 acoustic survey.

Small shoals of clupeoid fishes in low concentration were only recorded in the Swakopmund and Henties Bay area.

The distribution of juvenile hake with a size range of 17 - 24 cm was recorded extensively in the inshore regions (Figure 5a).

3.2.2 Ambrose Bay to Cunene River

Small juvenile horse mackerel (≤ 20 cm) were found mainly inshore along the entire northern Namibian coast from 20°00' S to the Cunene River. The size composition is shown in Figure 6 (a). Two dominant modal lengths were found to occur at lengths of 9 cm and 17 cm respectively. Approximately two thirds of the stock biomass was found in this inshore area or some 500 000 tonnes.

The size composition of the horse mackerel in the offshore area (Figure 6) shows two cohorts with modal lengths of 12 cm and 19 cm. The stock of this medium size fish was estimated to 130 000 tonnes.

The discovery of horse mackerel in upper water column in the far offshore region between 2000 - 3000 m bottom depth north of 18°30' S is a distribution area which has not been recorded in the previous acoustic surveys by the RV Dr Fridtjof Nansen, initialized in 1990.

This component consists of maturing fish, with modal length of 26 cm and the distribution appears to extend into Angolan waters. The stock biomass was estimated to 55 000 tonnes.

High density of fish were also found inshore at 17°15' S on the border to Angola which indicates that the juvenile Cape horse mackerel distribution also extends into Namibian waters.

The general distribution pattern is as observed in previous surveys. The small size juveniles are found inshore (30 - 200 m) whereas the larger juvenile and maturing fish are distributed offshore between 200 - 500 m depth. This means that the horse mackerel move into deeper waters by increasing age. The discovery of maturing horse mackerel far offshore at 2000 - 3000 m bottom depth is in accordance with this general migration pattern and indicates that an eventual spawning migration towards south (as suggested in the June 1996 survey report) may start in the border area of Angola and run southwards in deep waters off the shelf.

Clupeoid fishes were sparsely distributed between Ambrose Bay and the Cunene River (Figure 4b).

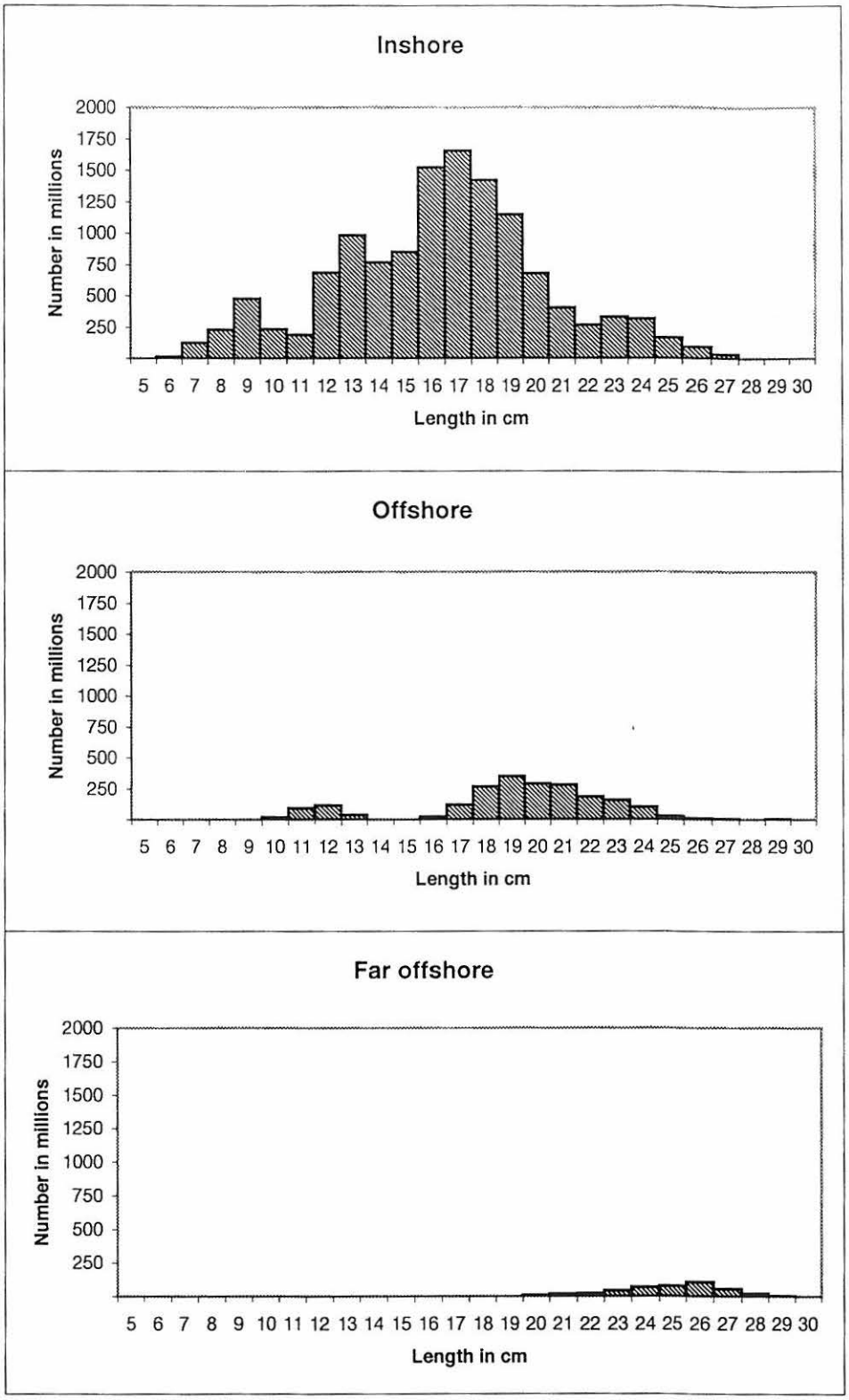


Figure 6 Size distribution (number of fish) of horse mackerel per depth region in the total survey area.

3.3 Abundance

The total estimated biomass of horse mackerel, juveniles (≤ 20 cm) and juvenile/maturing (≥21 cm), found in Namibian waters during the 1997 survey is given in the following Table 2. For the reason of comparison, the biomass estimates from acoustic surveys since 1994 are also included in that table. Abundance estimates in numbers per length group and selected subareas as well as the corresponding biomass figures are provided in Annex III.

Table 2: Summary of biomass estimates of horse mackerel per area (in 1000 tonnes) for 1994 -1997.

Juveniles ≤ 20 cm	**1994**	**1995**	**1996**	**1997**
Easter Point - Ambrose Bay	94	243	108	400
Ambrose Bay - Cunene River	1 108	481	579	428
Cunene River - Tombua	58	41	no survey	no survey
Sub total < 20 cm	1 260	765	687	428
Juvenile/maturing ≥ 21 cm				
Easter Point - Ambrose Bay	7	252	146	51
Ambrose Bay - Cunene River	224	431	141	303
Cunene River - Tombua	3	55	no survey	no survey
Sub total > 20 cm	234	738	287	354
Total	**1 494**	**1 503**	**974**	**782**

The total biomass of horse mackerel in 1997 was estimated at about 780 000 tonnes compared with 970 000 tonnes obtained during the RV 'Dr. Fridtjof Nansen' survey in June 1996. The juvenile stock comprised about 430 000 tonnes and the juvenile/maturing part was estimated to be approximately 350 000 tonnes compared to 690 000 tonnes and 290 000 tonnes in 1996 respectively.

The reduction in the juvenile stock is even more dramatic when expressed in number of fish as shown (Figure 7). The juveniles below 15 cm, which represent the recruitment to the stock, is according to this Figure dramatically reduced from 1996 to 1997. In case that this years survey has covered the total distribution area of the recruiting stock it is reason to conclude that the horse mackerel stock will suffer from recruitment failure to the offshore fishery in the coming years. The downward trend in recruitment level is obvious since 1994 (Table 2), when the biomass of juveniles below 21 cm was estimated at 1.2 million tonnes, or some three times the present recruitment level.

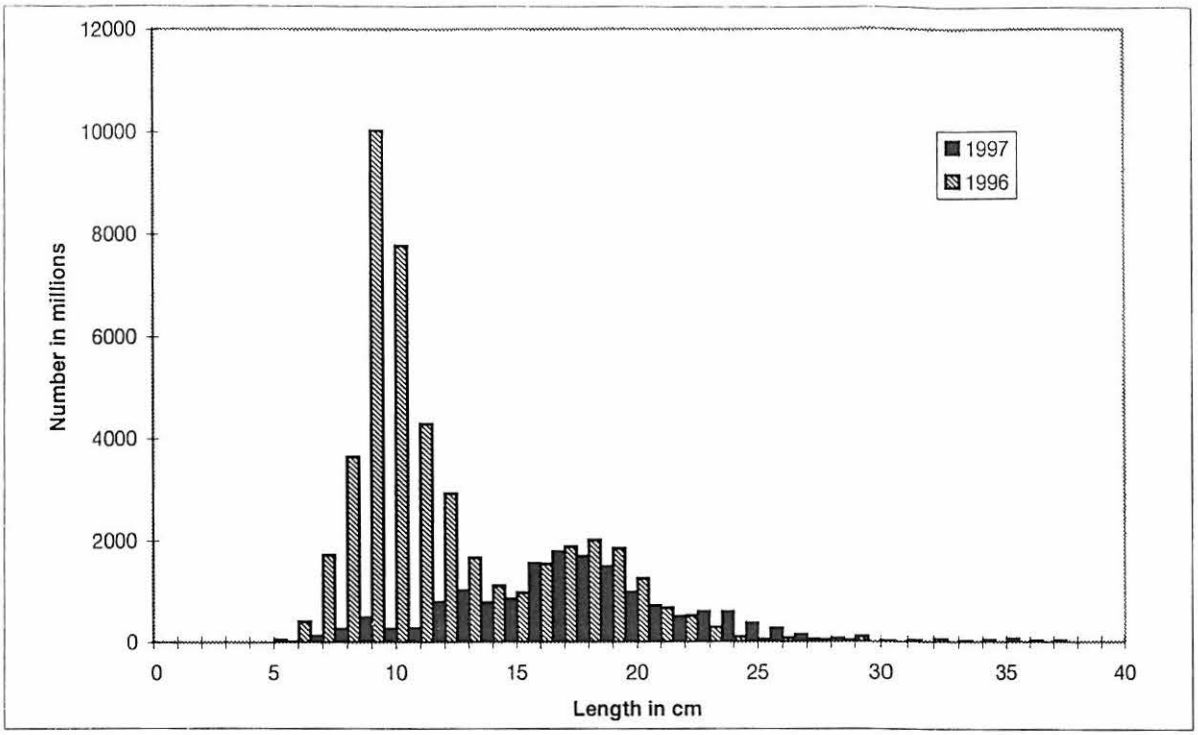


Figure 7 Size distribution for horse mackerel in numbers (millions) obtained from surveys 1996 and 1997.

The Table 2 also shows a clear decreasing trend in the stock of juvenile/maturing fish above 20 cm for the area south of Ambrose Bay, whereas the stock above 20 cm in the northern area has fluctuated around the present level of 300 000 tonnes.

3.4 Biological analysis of fish

3.4.1 Length-frequency

The length frequency distributions of the horse mackerel were divided into three regions: (inshore < 200 m; offshore 200 - 600 m; far offshore 600 - 3000 m;) and are presented in Figure 6 and Annex III.

Length data of pilchard, round herring and hake are presented in Annex VI. Two modal peaks in the pilchard stock surveyed between north of 21°00' is evident, namely one modal peak at 10 cm and one peak at 21 cm. The length range for the round herring was between 9 and 18 cm with a modal peak at 11 cm and 16 cm. Hake sampled mainly from the bottom trawls ranged from 12 cm to 58 cm with two modal peaks at 18 cm and 26 cm.

3.4.2 Length-weight relationship

Length-weight data (total weight and gutted weight) were divided into three regions: 26°00' - 21°00' S; 21°00' - 19°00' S and 19°00 S - 17°15' S and are presented in Annex VII; these three regions again were pooled :17°15' S to 26°00' S. The correlation coefficient for total weight, r^2 (0.994) and gutted weight r^2 (0.9922) shows that the data fit well to the length-weight relationship curves.

The actual mean weights per length group estimated from the length weight relationship have been used to calculate the total biomass per area.

3.4.3 Reproductive status

Results were tabulated for the Cape horse mackerel and presented according to the following regions: 26°00' - 21°00' S; 21°00' - 19°00' S and 19°00 S - 17°15' S;The following conclusions can be made:

1 The sex ratio: The greater portion of the stock in all three regions was comprised of females. Similar results were obtained during the June 1995 and 1996 hydro-acoustic survey.

2 Spawning: As was expected, no spawning was recorded amongst the adult stock throughout the region.

CHAPTER 4 CONCLUDING REMARKS

In general, conditions were favourable for surveying the inshore and offshore horse mackerel stock acoustically. Weather conditions were acceptable (Figure 8) and the inshore and the offshore horse mackerel seemed to be distributed within the transducer range both day and night.

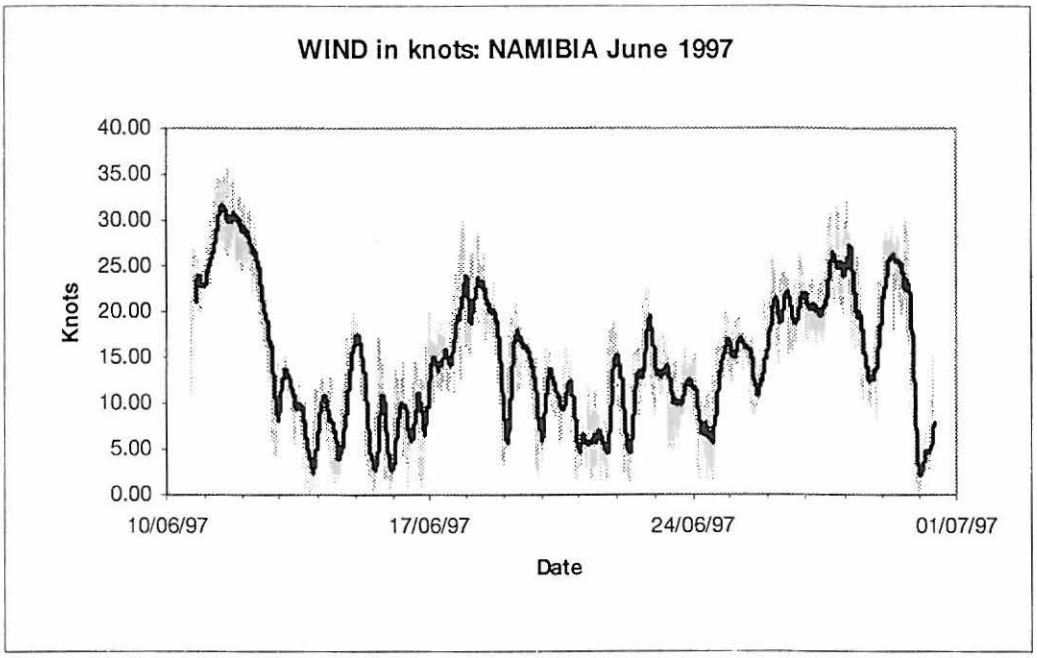


Figure 8 Wind speed (knots) for June 1997 survey.

Dense concentrations of jellyfish occurred, particularly in the southern region and localised areas in the north. These hampered trawling in some cases, but less than last year, and only two trawls had to be interrupted because of high concentrations of jelly fishes.

The horse mackerel stock in the northern Benguela system has since 1989 been assessed by acoustic method, the estimates ranging between 0.8 mill. tonnes and 2.1 mill. tonnes (Table 3). The present estimate of 800 000 tonnes is the lowest of these values.

Table 3 Biomass estimates of horse mackerel, 1990 to 1997, in the northern Benguela system (1 000 tonnes).

Survey	Vessel	Horse mackerel
December 1989	Ocher (USSR)	1 200
March 1990	Nansen	1 200
June 1990	Nansen	1 700
March 1991	Nansen	1 300
November 1991	Nansen/Benguela	1 400
June 1992	Nansen/Benguela	2 100
June 1994	Benguela	1 500
June 1995	Nansen	1 500
June 1996	Nansen	1 000
June 1997	Nansen	800

From the results on abundance and size distribution it is evident that the horse mackerel stock has been considerably reduced in recent years, particularly from 1995 - 1997. This phenomenon can, according to Table 2, be explained by reduced recruitment since 1994, or/and increased exploitation of the small juveniles in inshore waters. This seems to have affected the stock of medium sized fish in offshore waters, especially in the area south of Ambrose Bay. The offshore horse mackerel fishery may have contributed to this trend of decreasing stock size. Judging from Figure 7 it is reason to expect a pronounced decline in the abundance of offshore horse mackerel also in the area north of Ambrose Bay in 1998.

In the 1996 survey report, the lack of the adult horse mackerel in northern Namibian waters gave rise to the hypothesis that the fish migrate out of this area when reaching maturity i.e. at a length of 24 cm and above. It was further suggested that the maturing fish might migrate southward to spawn and that the post-spawners did not return to northern Namibian water.

The discovery of the component of the maturing horse mackerel in the far offshore waters of northern Namibia strongly supports this hypothesis. Although no movement of the fish has been registered the distribution and density pattern of this component indicate that these are pre-spawners migrating southwards to spawn. The observation do also indicate that this migration may start in Angolan waters, probably south of Tombua, which is supposed to be the boarder area of the most northern distribution of the Cape horse mackerel stock. In order to be able to assess the state of the stock and the exploitation, it is essential to know the total distribution and abundance of the spawners. It is felt that the discovery of the far offshore component of the maturing horse mackerel during the present survey forms a valuable basis for future research on the life pattern and abundance of the adult stock.

It is therefore recommended that increased effort should be allocated to the research on the horse mackerel in the Namibian and Angolan waters in order to improve the knowledge of the total distribution and abundance of the stock.

Annex I Instruments and fishing gear

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

Transceiver-1 menu

Transducer depth	5-7 m
Absorption coeff.	10 dB/km
Pulse length	medium
Bandwidth	wide
Max. power	2 000 W
Angle sensitivity	21.9
2-way beam angle	-21.0 dB
SV transducer gain	28.1 dB
TS transducer gain	28.0 dB
3 dB Beamwidth	6.8 deg
Alongship offset	0.00 deg
Athwardship offset	0.04 deg

Display menu

Echogram	1
Bottom range	12 m
Bottom start	10 m
TVG	20 log R
SV Colour minimum	-72 dB
TS Colour minimum	-65 dB

Printer settings

Range	0-100, 0-250 m, 0-500 m
TVG	20 log R
Sv Colour minimum	-72 dB

Bottom detection menu

Minimum level	-45 dB

FISHING GEAR

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

F/F Dr. Fridtjof Nansen

OVER/UNDER/SIDER

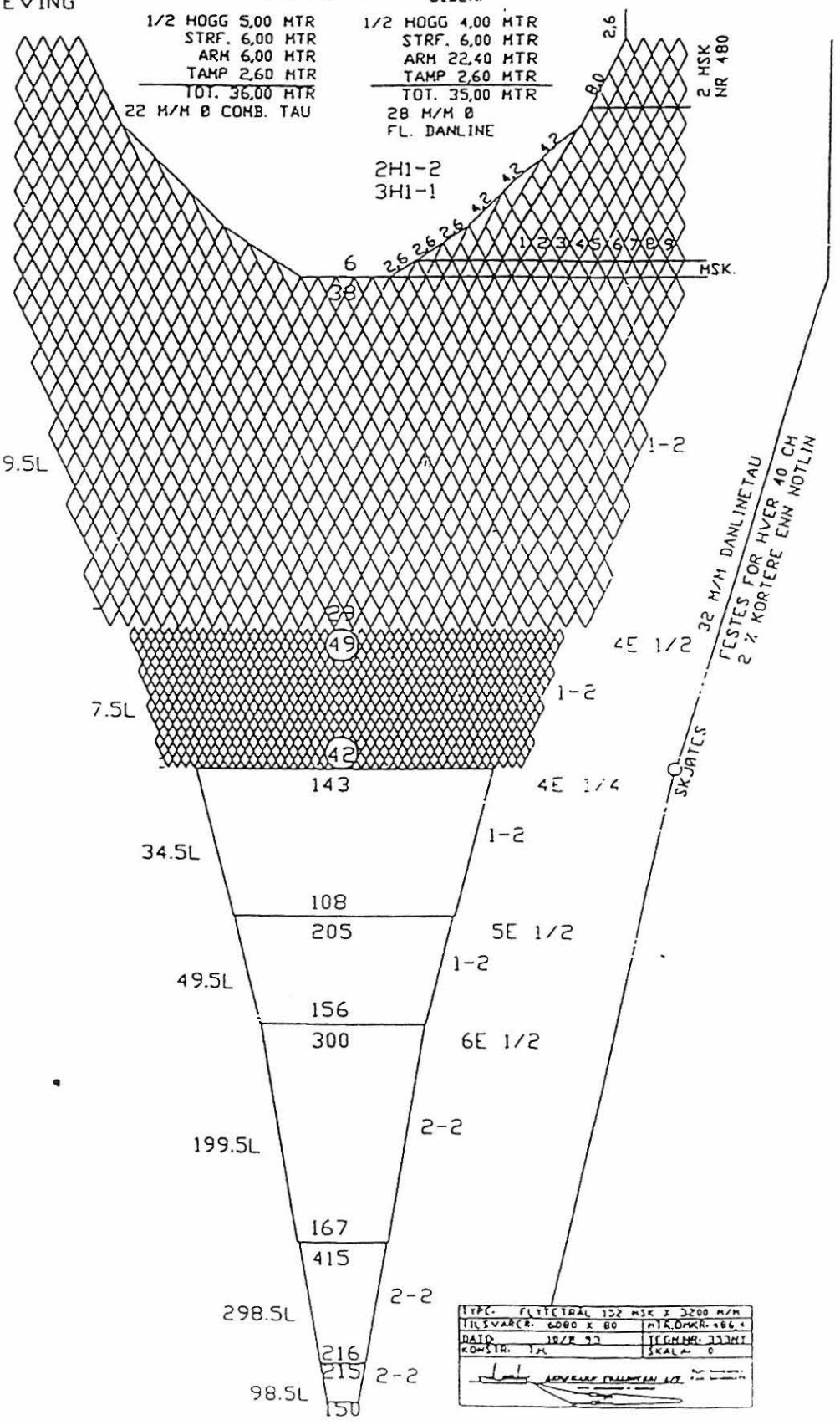
OVERDEL:
50 STK 11" PLASTKULER

UNDERDEL
14 M/M WIRE OMSP. MED
14 M/M BLYTAU
4 KJETTING.
TOTAL VEKT UNDER 400 KG.

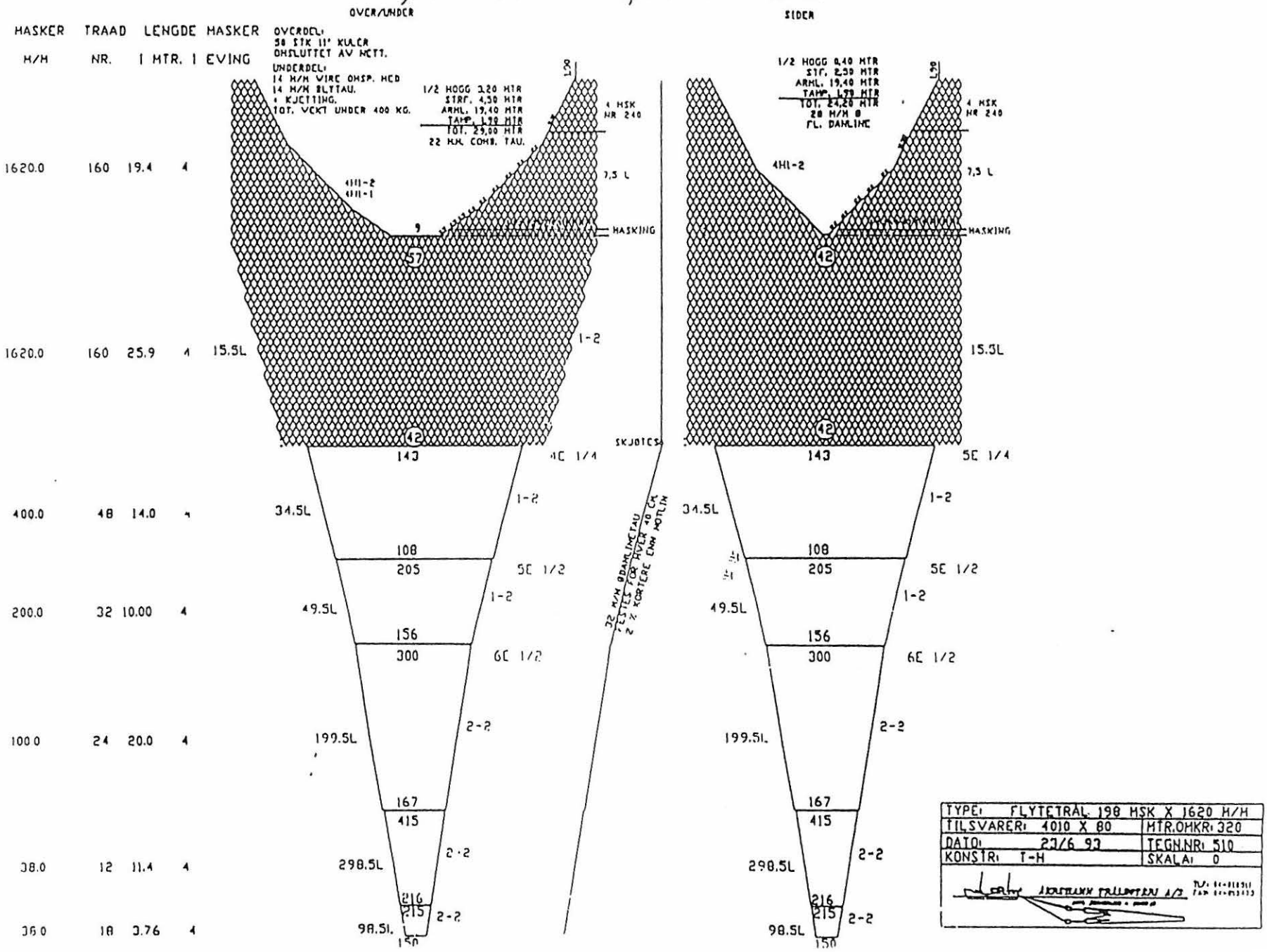
MASKER M/M	TRAAD NR.	LENGDE I MTR.	MASKER I EVING	
3200.0	240	22.4	4	
3200.0	240	32.0	4	9.5L
1620.0	160	13.0	4	7.5L
400.0	48	14.0	4	34.5L
200.0	32	10.00	4	49.5L
100.0	24	20.0	4	199.5L
38.0	12	11.4	4	298.5L
38.0	18	3.76	4	98.5L

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

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

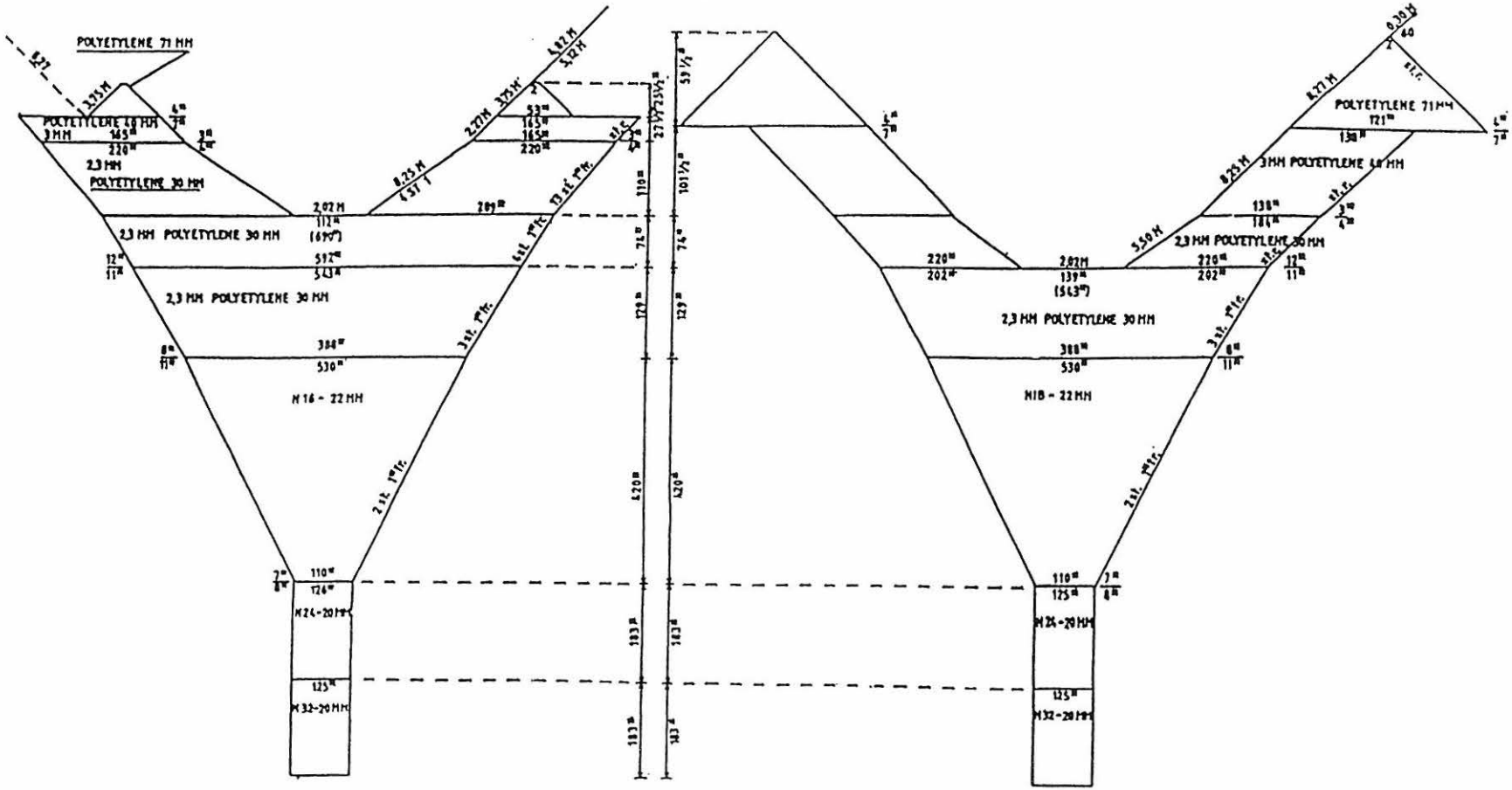


F/F Dr. Fridtjof Nansen

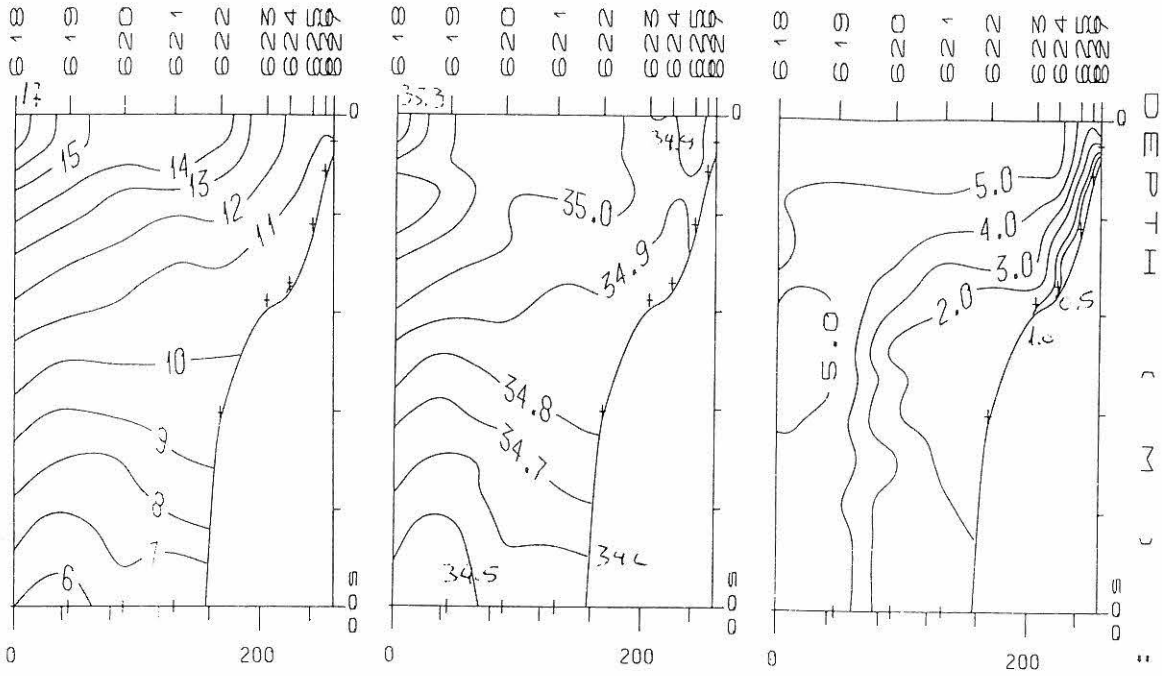


TYPE:	FLYTETRÅL 198 MSK X 1620 M/M		
TILSVARER:	4010 X 80	MTR.OMKR:	320
DATO:	22/6 93	TEGN.NR:	510
KONSTR:	T-H	SKALA:	0

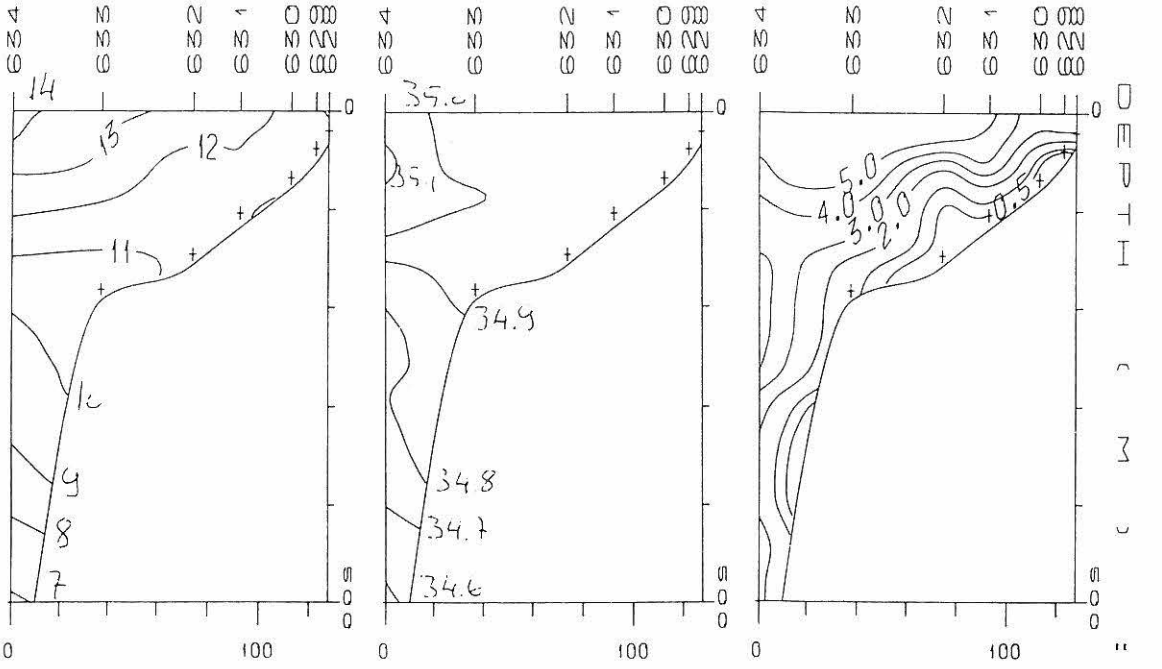
Bottom trawl: High opening shrimp and fish trawl with net headline 31m (floatline), foot-rope 47m, gear with 12 cm diameter roller disks, 40 m sweeps, estimated headline hight 6m and distance between wings during towing 18-20m.



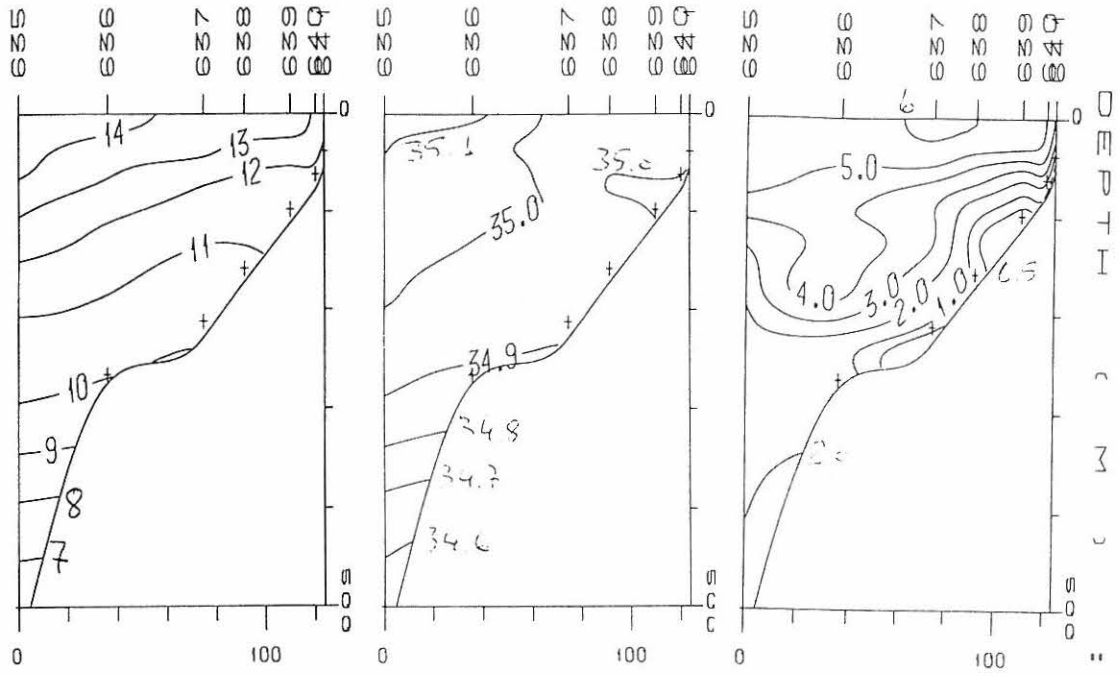
Annex II Hydrographic profiles and distribution of near surface environmental parameters



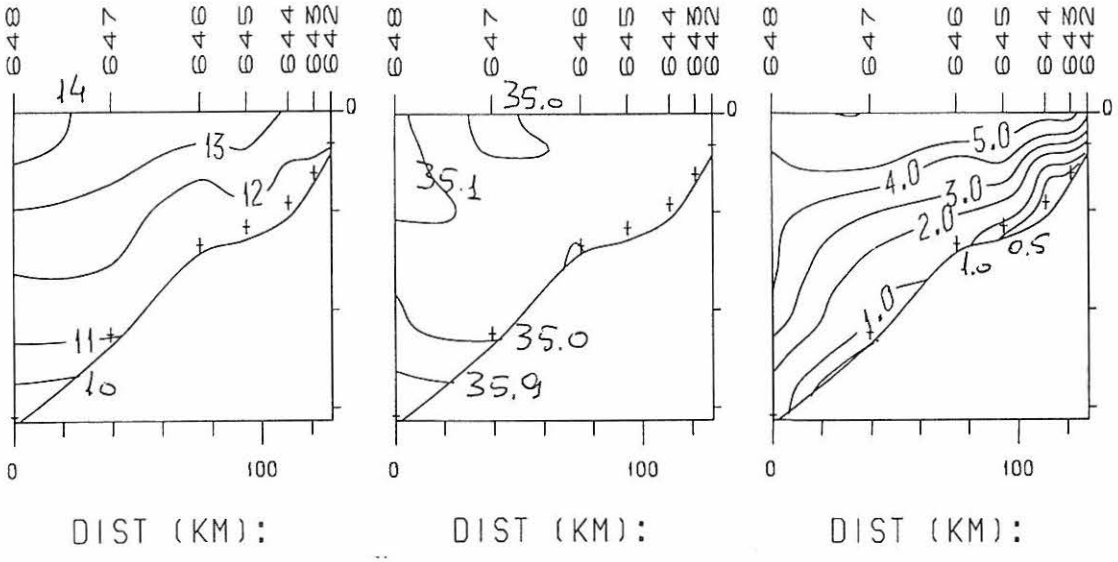
26°00'S **11-12.06 1997** **Temperature, salinity and oxygen profiles**



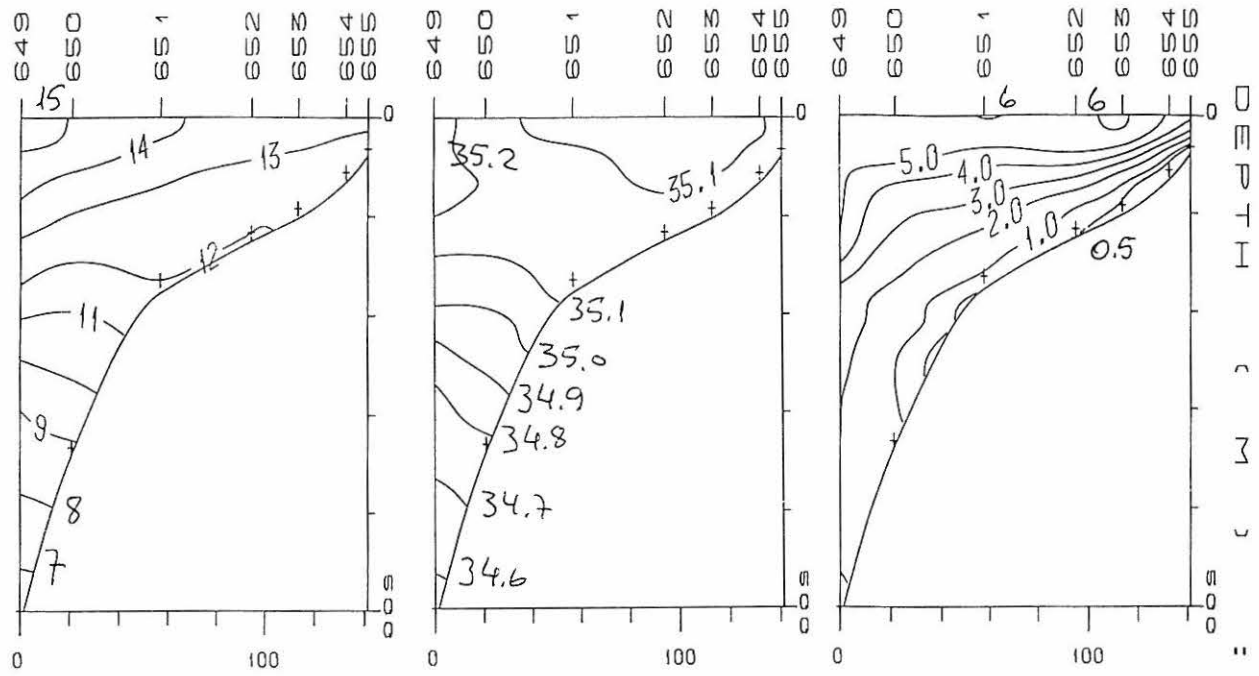
25°00'S **13-14.06 1997** **Temperature, salinity and oxygen profiles**



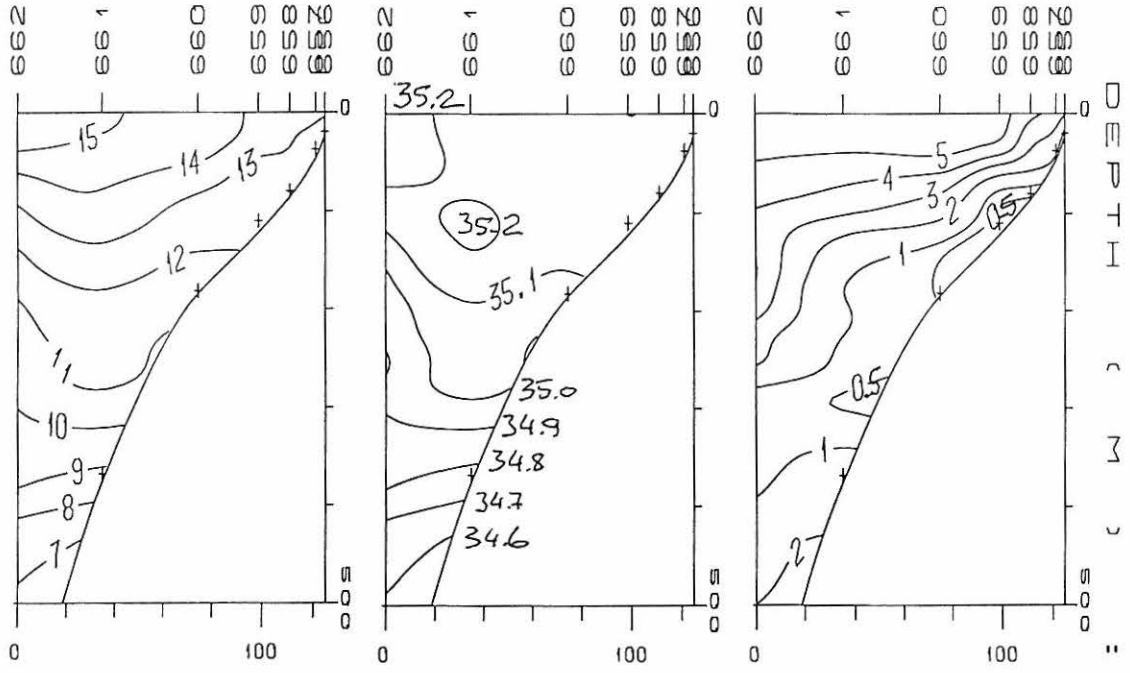
24°00'S 15.06 1997 Temperature, salinity and oxygen profiles



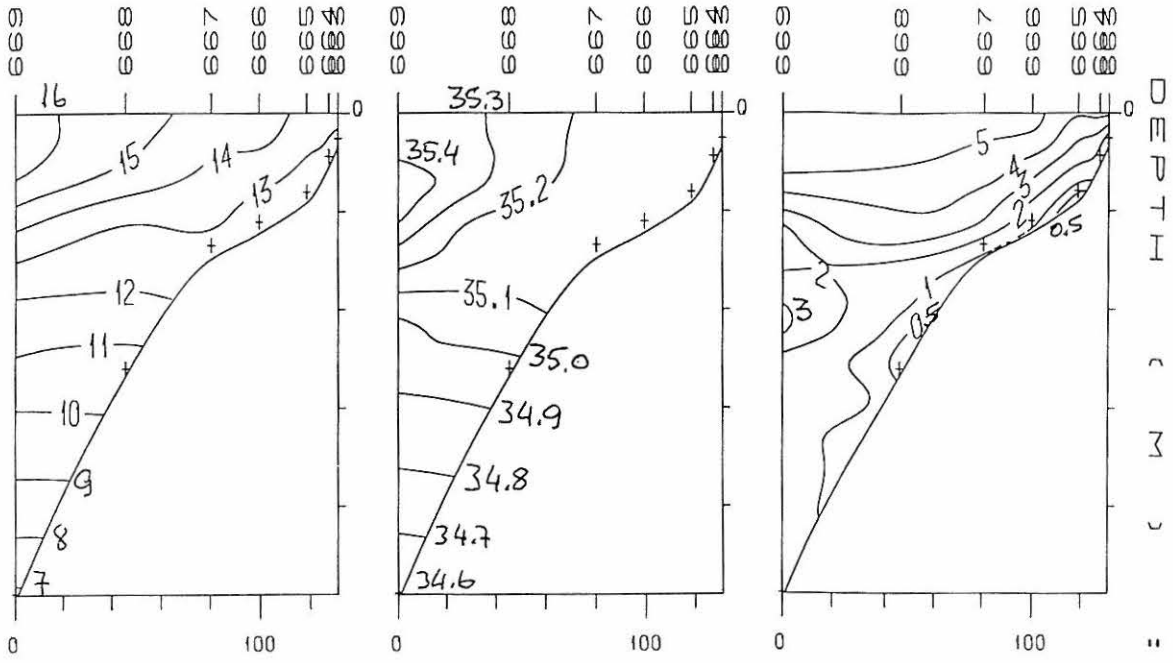
23°00'S 16-17.06 1997 Temperature, salinity and oxygen profiles



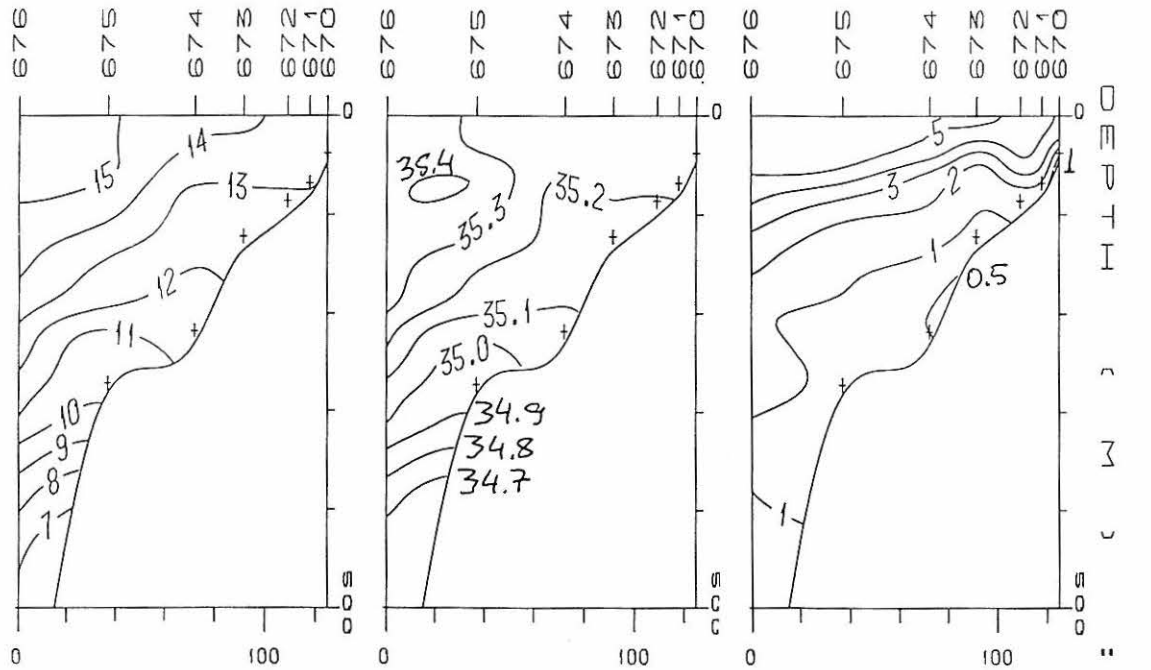
22°00'S 18.06 1997 Temperature, salinity and oxygen profiles



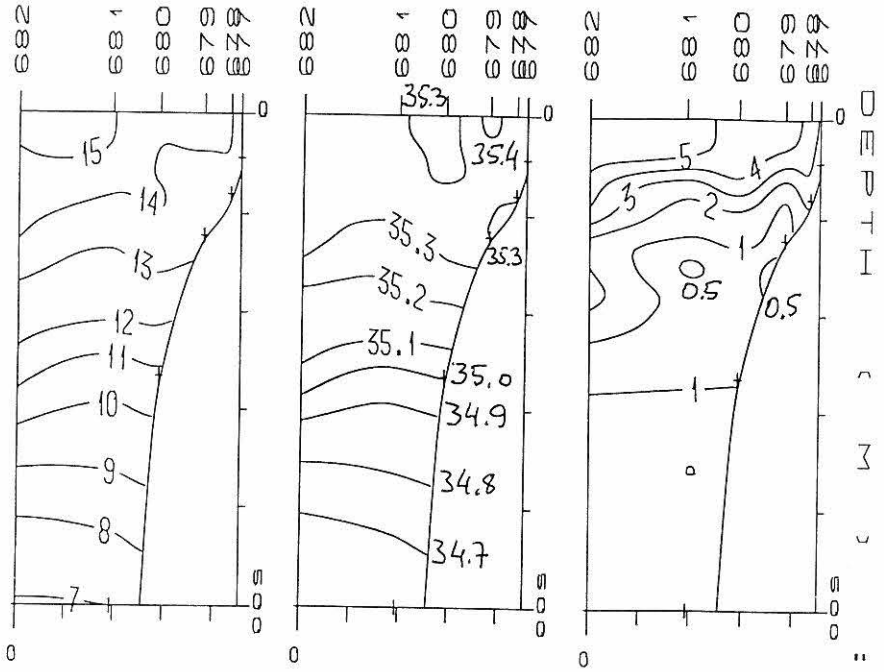
21°00'S 20.06 1997 Temperature, salinity and oxygen profiles



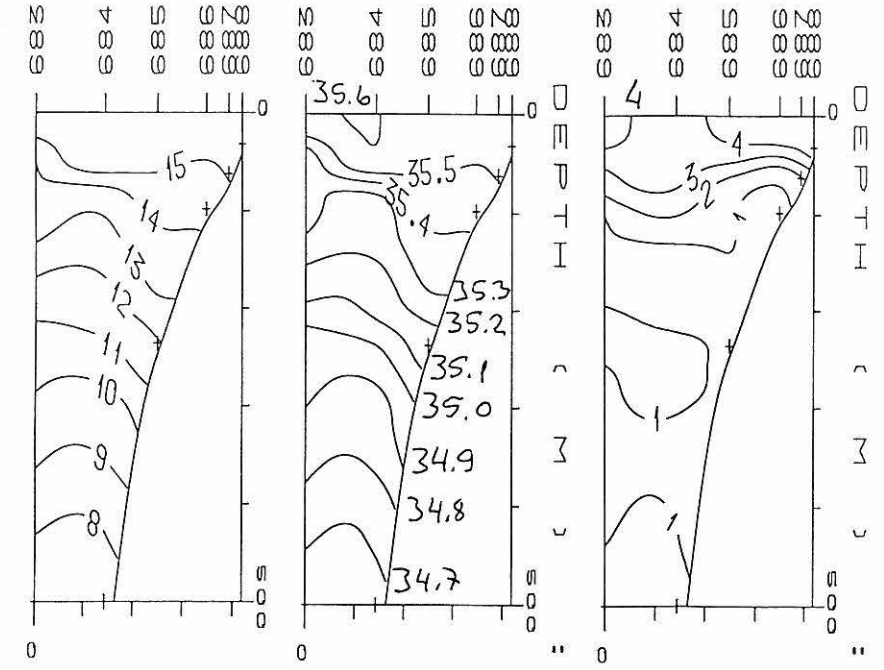
20°00'S **22-23.06 1997** **Temperature, salinity and oxygen profiles**



19°00'S **24-25.06 1997** **Temperature, salinity and oxygen profiles**



18°00'S 26.06 1997 Temperature, salinity and oxygen profiles



17°15'S 27.06 1997 Temperature, salinity and oxygen profiles

Annex III Biomass, weight and number of fish

		Offshore						Inshore				Offshore		Far offshore		
Area		22°10'-23°10'	22°15'-22°25'	21°30'-21°40'	21°00'-21°30'	20°55'-21°05'	19°55'-20°50'	20°10'-20°20'	19°10'-19°50'	17°50'-19°10'	17°15'-17°55'	19°10'-20°10'	17°50'-19°10'	17°15'-18°25'	18°25'-18°40'	Total
Size of area (NM²)		1859	25	101	191	94	838	45	348	666	750	1601	2477	894	201	
Mean S_A value (m²/NM²)		32	3684	225	23	111	96	135	583	2878	1177	195	139	172	320	
Biomass juveniles (<21cm)		0.0	0.0	0.0	0.4	0.0	0.2	1.0	30.1	200.6	137.4	21.9	36.1	0.5	0.0	428.2
Biomass maturing (≥21cm)		17.3	23.5	5.8	0.0	4.1	20.7	0.0	0.0	148.5	10.3	38.4	30.3	37.9	16.6	353.4
Total biomass (1000 tonnes)		17.3	23.5	5.8	0.4	4.1	20.9	1.0	30.1	349.1	147.7	60.3	66.4	38.4	16.6	781.6
No. of fish per length class (mill.)	5															
	6									12						12
	7									123						123
	8				37					231						268
	9				14					479		2				495
	10				14				5	168	63	18				268
	11								25	78	84	93				280
	12								84	453	147	114				797
	13							3	171	602	209	35				1020
	14							9	198	466	105					777
	15							6	178	398	272					854
	16								214	605	703		25			1546
	17							3	121	658	877	3	115			1777
	18							6	67	745	609	18	248			1692
	19							3	9	701	435	99	248	1		1495
	20						3		4	560	116	200	90	8		981
	21	5	6	1			8			335	68	150	128	17	1	719
	22	7	9	2			18			218	47	106	78	17	4	506
	23	7	32	8			21			314	16	102	53	33	8	593
	24	8	58	14			27	0		316		64	39	51	16	592
	25	9	41	10			28			165		14	15	54	24	360
	26	8	24	6			21			93			9	70	37	270
	27	14	13	3			11			31			6	35	20	134
	28	11	2	0			5						2	13	8	41
	29	9	2	0			2						3	4	1	20
	30	4					1									5
	31	1					0									2
	32	3					3									6
	33	2				1	1									4
	34	1				0	1									3
	35	4				1	1									6
	36	1				1										2
	37	0				2	1									4
	38	0				1	1									2
	39	0				2	1									3
	40	0				1										2
	41															
Sum		97	186	46	66	9	154	29	1076	7750	3750	1016	1057	303	120	15659

Annex IV Summary of trawl stations

Trawl number	Latitude (°S)	Longitude (°E)	Bottom depth (m)	Fishing depth (m)	Catch by species (% of total catch)					Total catch (kg)
					Trach. c.	*Sardin. o.*	*Engrau. c.*	*Etrum. w.*	*Merluc. c.*	
2125	25.59	13.40	516	140						24.7
2126	25.59	13.57	339	339					39.2	341.5
2127	26.00	14.18	216	216					100.0	750.0
2128	26.00	14.47	94	45					3.3	199.7
2129	25.20	13.57	223	165					1.0	28.8
2130	25.20	14.17	175	130		11.5		88.5		119.0
2131	25.19	14.24	152	152						0.0
2132	25.07	14.40	77	0						0.0
2133	25.07	14.40	79	0						2.0
2134	25.00	14.12	168	40					98.9	1.8
2135	24.40	13.37	406	180						19.3
2136	24.40	14.01	154	154	<0.1				99.4	1774.4
2137	24.40	14.21	110	20						0.0
2138	24.19	13.55	260	108					4.5	8.9
2139	24.00	13.20	315	90						36.7
2140	23.40	14.09	148	148					100.0	5000.0
2141	23.40	13.45	194	194					88.6	111.7
2142	23.21	13.26	257	257	1.1				81.8	582.9
2143	23.20	13.42	160	90						25.5
2144	23.20	13.47	162	162	0.3				94.7	219.7
2145	23.20	14.09	124	124					100.0	516.0
2146	23.07	14.20	70	28						205.0
2147	22.40	13.30	211	211	24.4				74.3	250.5
2148	22.40	14.26	42	17	2.2	13.8	73.9	10.2		25.5
2149	22.25	14.16	51	25	0.1				0.3	60.2
2150	22.21	13.45	127	127	95.2				4.7	573.8
2151	22.19	13.34	139	139					95.1	420.3
2152	22.20	12.57	286	286	25.8				62.2	250.5
2153	22.11	12.43	553	180						81.6
2154	21.59	12.47	346	346					2.5	1386.0
2155	21.60	12.55	334	250	1.1					36.9
2156	21.20	12.57	267	200					99.8	241.5
2157	21.20	13.07	151	151	<0.1				99.2	492.1
2158	21.20	13.05	156	25		100.0				652.0
2159	21.02	13.58	42	17	4.6	47.1	13.8	34.6		220.8
2160	20.60	12.47	319	319	0.6				77.3	226.5
2161	21.00	12.39	366	200	82.8					16.3
2162	21.00	12.29	447	300						37.8
2163	20.47	12.14	543	250						0.5
2164	20.45	12.22	372	150						23.5
2165	20.45	12.31	330	230					54.1	7.8
2166	20.45	13.14	96	20					100.0	856.0
2167	20.43	13.20	32	5	0.5	57.8	41.8			969.9
2168	20.30	13.02	119	119					100.0	230.3
2169	20.30	12.55	130	98		97.9		2.1		232.1
2170	20.30	12.33	286	286	10.2				62.7	27.2
2171	20.30	12.20	307	307	38.6				36.8	301.6
2172	20.29	12.08	370	300						27.2
2173	20.15	12.13	289	200	20.7				63.0	124.1
2174	20.14	12.18	277	277	83.0				12.0	257.4
2175	20.14	12.45	132	80	<0.1	18.7	0.4	80.9		279.6
2176	20.09	13.01	73	73	63.1				36.9	218.3
2177	19.60	12.32	145	145	26.9				69.0	100.9
2178	20.00	12.05	308	308	1.7				42.1	147.3
2179	19.45	12.25	150	150	24.9				74.5	255.6
2180	19.45	12.37	115	50				98.5		181.2
2181	19.49	12.50	75	45	84.0			13.6	1.6	57.2
2182	19.44	12.51	41	25	100.0					73.2

Trawl number	Latitude (°S)	Longitude (°E)	Bottom depth (m)	Fishing depth (m)	Catch by species (% of total catch)					Total catch (kg)
					Trach. c.	*Sardin. o.*	*Engrau. c.*	*Etrum. w.*	*Merluc. c.*	
2183	19.30	12.20	140	140	23.1				76.8	239.9
2184	19.21	11.27	544	544						867.0
2185	19.15	12.11	180	180	41.3				54.7	187.6
2186	19.15	12.13	160	25	99.4			0.6		442.6
2187	19.16	12.29	99	55	99.7					550.6
2188	19.02	12.26	60	55	100.0					1750.0
2189	19.00	12.12	119	119	37.1				62.5	1163.5
2190	19.00	11.58	221	221	14.0				80.6	67.3
2191	19.00	11.30	299	5						21.9
2192	18.46	11.32	254	254	10.4				27.0	834.0
2193	18.46	11.59	130	130	21.8				77.9	163.0
2194	18.47	12.18	37	30	100.0					622.0
2195	18.41	12.06	60	50	94.1					432.4
2196	18.30	11.54	104	104	65.0				34.7	305.3
2197	18.30	11.37	195	195	12.4				75.2	335.0
2198	18.29	11.30	274	274	0.1				47.5	901.8
2199	18.15	11.30	291	291	2.5				91.4	58.9
2200	18.15	11.49	74	40	99.2				0.8	227.8
2201	18.06	11.45	81	20	100.0					201.8
2202	17.56	11.42	95	95	64.9				30.4	568.4
2203	17.58	11.32	212	150	4.1				23.0	13.1
2204	18.00	10.57	2500	110	91.3					34.3
2205	17.50	10.49	1800	180	93.1					263.0
2206	17.15	11.03	-	180	16.6					50.5
2207	17.17	11.29	162	162	60.5				13.1	2185.5
2208	17.30	11.38	109	109	48.6		0.2		9.4	528.7

Annex V Records of fishing stations

PROJECT STATION: 2125

DATE: 12/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2559

	start	stop	duration			
					Long E	1340
TIME	06:41:53	06:55:52	14 (min)	Purpose code:	1	
LOG	8915.29	8916.23	0.97	Area code :	1	
FDEPTH:	140	110		GearCond.code:		
BDEPTH:	516	530		Validity code:		

Towing dir: 330° Wire out: 400 m Speed: 35 kn*10

Sorted: 25 Kg Total catch: 24.65 CATCH/HOUR: 105.64

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	105.64	105643	100.00	
Total	105.64		100.00	

PROJECT STATION: 2126

DATE: 12/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 2559

	start	stop	duration			
					Long E	1357
TIME	10:15:13	10:46:26	31 (min)	Purpose code:	1	
LOG	8937.82	8939.68	1.60	Area code :	1	
FDEPTH:	339	330		GearCond.code:		
BDEPTH:	339	330		Validity code:		

Towing dir: 90° Wire out: 1100 m Speed: 30 kn*10

Sorted: 57 Kg Total catch: 341.52 CATCH/HOUR: 661.01

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	258.97	581	39.18	
Coelorinchus fasciatus	135.87	3904	20.55	
Schedophilus huttoni	78.97	46	11.95	
Lophius vomerinus	52.95	35	8.01	
Helicolenus dactylopterus	50.63	465	7.66	
Todarodes sagittatus	27.87	93	4.22	
Bathynectes piperitus	15.91	795	2.41	
MYCTOPHIDAE	14.86		2.25	
Krill	11.61		1.76	
Nezumia sp.	7.08	221	1.07	
Galeus polli	3.72	23	0.56	
Squilla sp.	2.44	139	0.37	
Synagrops microlepis	0.12	12	0.02	
Total	661.00		100.01	

PROJECT STATION: 2127

DATE: 12/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 2600

	start	stop	duration			
					Long E	1418
TIME	13:56:37	14:04:32	8 (min)	Purpose code:	1	
LOG	8964.26	8964.65	0.44	Area code :	1	
FDEPTH:	214	218		GearCond.code:	9	
BDEPTH:	214	218		Validity code:		

Towing dir: 270° Wire out: 600 m Speed: 30 kn*10

Sorted: 7 Kg Total catch: 750.00 CATCH/HOUR: 5625.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	5625.00	129675	100.00	7420
Total	5625.00		100.00	

PROJECT STATION: 2128

DATE: 12/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2600

	start	stop	duration			
					Long E	1447
TIME	18:07:09	18:28:04	21 (min)	Purpose code:	1	
LOG	8995.87	8997.30	1.31	Area code :	1	
FDEPTH:	50	40		GearCond.code:		
BDEPTH:	103	85		Validity code:		

Towing dir: 90° Wire out: 150 m Speed: 35 kn*10

Sorted: 25 Kg Total catch: 199.69 CATCH/HOUR: 570.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	551.57	45963	96.68	
Merluccius capensis	18.97	666	3.32	7421
Aequorea aequorea	0.00	1143		
Chrysaora sp	0.00	13714		
Total	570.54		100.00	

PROJECT STATION: 2129

DATE: 13/ 6/97 GEAR TYPE: PT No: POSITION: Lat S 2520

	start	stop	duration			
					Long E	1357
TIME	08:05:23	08:17:10	12 (min)	Purpose code:	1	
LOG	9140.14	9140.81	0.65	Area code :	1	
FDEPTH:	160	170		GearCond.code:		
BDEPTH:	224	222		Validity code:		

Towing dir: 90° Wire out: 400 m Speed: 34 kn*10

Sorted: 1 Kg Total catch: 28.80 CATCH/HOUR: 144.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	78.20	97750	54.31	
MYCTOPHIDAE	51.25	102500	35.59	
Lepidopus caudatus	7.75	40	5.38	
Krill	5.40	18720	3.75	
Merluccius capensis	1.40	25	0.97	
Chrysaora sp	0.00	55		
Total	144.00		100.00	

PROJECT STATION: 2130

DATE: 13/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2520

	start	stop	duration			
					Long E	1417
TIME	11:01:16	11:25:40	24 (min)	Purpose code:	1	
LOG	9162.54	9163.82	1.22	Area code :	1	
FDEPTH:	130	130		GearCond.code:	1	
BDEPTH:	171	179		Validity code:	1	

Towing dir: 270° Wire out: 660 m Speed: 30 kn*10

Sorted: 66 Kg Total catch: 118.95 CATCH/HOUR: 297.38

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	263.25	5160	88.52	7422
Sardinops ocellatus	34.13	423	11.48	7423
Aequorea aequorea	0.00	1500		
Total	297.38		100.00	

PROJECT STATION: 2131

DATE: 13/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 2519

	start	stop	duration			
					Long E	1424
TIME	13:01:51	13:10:08	8 (min)	Purpose code:	1	
LOG	9175.49	9175.90	0.39	Area code :	1	
FDEPTH:	152	153		GearCond.code:	8	
BDEPTH:	152	153		Validity code:	9	

Towing dir: 270° Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION: 2132

DATE: 13/ 6/97 GEAR TYPE: PT No: 4 POSITION: Lat S 2507

	start	stop	duration			
					Long E	1440
TIME	17:49:30	17:52:29	3 (min)	Purpose code:	1	
LOG	9215.47	9215.63	0.14	Area code :	1	
FDEPTH:	0	0		GearCond.code:	3	
BDEPTH:	77	78		Validity code:		

Towing dir: 224° Wire out: 140 m Speed: 30 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora sp	0.00	24000		
Total				

PROJECT STATION: 2133

DATE: 13/ 6/97 GEAR TYPE: PT No.4 POSITION: Lat S 2507

	start	stop	duration			
					Long E	1440
TIME	18:42:29	18:46:45	4 (min)	Purpose code:	1	
LOG	9218.56	9218.79	0.24	Area code :	1	
FDEPTH:	0	0		GearCond.code:	1	
BDEPTH:	80	79		Validity code:	1	

Towing dir: 44° Wire out: 140 m Speed: 35 kn*10

Sorted: 1 Kg Total catch: 2.00 CATCH/HOUR: 30.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	30.00	38775	100.00	
Chrysaora sp	0.00	1350		
Total	30.00		100.00	

PROJECT STATION: 2134

DATE: 14/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 2500

	start	stop	duration			
					Long E	1412
TIME	00:07:52	00:27:36	20 (min)	Purpose code:	1	
LOG	9262.91	9264.20	1.32	Area code :	1	
FDEPTH:	30	50		GearCond.code:	9	
BDEPTH:	167	169		Validity code:	1	

Towing dir: 270° Wire out: 250 m Speed: 45 kn*10

Sorted: 2 Kg Total catch: 1.83 CATCH/HOUR: 5.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	5.43	123	98.91	
Lepidopus caudatus	0.06	3	1.09	
J E L L Y F I S H	0.00	2400		
Total	5.49		100.00	

PROJECT STATION: 2135

DATE: 14/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2440

	start	stop	duration			
					Long E	1337
TIME	07:46:42	08:09:43	23 (min)	Purpose code:	1	
LOG	9331.83	9333.17	1.22	Area code :	1	
FDEPTH:	160	200		GearCond.code:	6	
BDEPTH:	404	408		Validity code:	4	

Towing dir: 270° Wire out: 530 m Speed: 34 kn*10

Sorted: 19 Kg Total catch: 19.25 CATCH/HOUR: 50.22

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	50.22	33477	100.00	
Chrysaora sp	0.00	8		
Total	50.22		100.00	

PROJECT STATION: 2136

DATE: 14/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2440
start stop duration Long E 1401
TIME :11:08:28 11:18:34 10 (min) Purpose code: 1
LOG :9360.69 9361.25 0.50 Area code : 2
FDEPTH: 154 154 GearCond.code: 1
BDEPTH: 154 154 Validity code: 1
Towing dir: 270° Wire out: 500 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 1774.42 CATCH/HOUR: 10646.52

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	10584.00	278526	99.41	
Callorhinchus capensis	20.70	6	0.19	
Austroglossus microlepis	5.10	12	0.05	
Trachurus capensis	2.82	18	0.03	7424
Aequorea aequorea	0.00	480		
Total	10612.62		99.68	

PROJECT STATION: 2137

DATE: 14/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2440
start stop duration Long E 1421
TIME :14:04:11 14:04:55 1 (min) Purpose code: 1
LOG :9383.99 9384.12 0.13 Area code : 2
FDEPTH: 20 20 GearCond.code: 9
BDEPTH: 110 109 Validity code: 9
Towing dir: 270° Wire out: 50 m Speed: 40 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Chrysaora sp.	0.00	300000		
Total				

PROJECT STATION: 2138

DATE: 14/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2419
start stop duration Long E 1355
TIME :19:53:16 19:56:41 3 (min) Purpose code: 1
LOG :9445.83 9446.05 0.20 Area code : 2
FDEPTH: 100 115 GearCond.code: 1
BDEPTH: 259 261 Validity code: 1
Towing dir: 270° Wire out: 300 m Speed: 35 kn*10

Sorted: 5 Kg Total catch: 8.88 CATCH/HOUR: 177.60

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Centrolophus niger	69.60	20	39.19	
Lampanyctodes hectoris	46.00	27060	25.90	
Maurolicus muelleri	33.00	41260	18.58	
Krill	11.00	22160	6.19	
Symbolophorus boops	10.00	1180	5.63	
Merluccius capensis	8.00	160	4.50	
Aequorea aequorea	0.00	20000		
Total	177.60		99.99	

PROJECT STATION: 2139

DATE: 15/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2400
start stop duration Long E 1320
TIME :02:46:45 02:47:30 1 (min) Purpose code: 1
LOG :9514.44 9514.46 0.01 Area code : 2
FDEPTH: 90 90 GearCond.code: 9
BDEPTH: 314 315 Validity code: 4
Towing dir: 270° Wire out: 400 m Speed: 40 kn*10

Sorted: 37 Kg Total catch: 36.70 CATCH/HOUR: 2202.00

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Maurolicus muelleri	1500.00		68.12	
Krill	420.00		19.07	
TRACHIPTERIDAE	279.00	60	12.67	
Total	2199.00		99.86	

PROJECT STATION: 2140

DATE: 15/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2340
start stop duration Long E 1409
TIME :14:14:14 14:17:20 3 (min) Purpose code: 1
LOG :9625.49 9625.66 0.14 Area code : 2
FDEPTH: 148 148 GearCond.code: 9
BDEPTH: 148 148 Validity code: 1
Towing dir: 90° Wire out: 500 m Speed: 30 kn*10

Sorted: 50 Kg Total catch: 5000.00 CATCH/HOUR: 100000.00

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	99999.80	1887100	100.00	7425
Chrysaora sp.	0.00	20000		
Aequorea aequorea	0.00	300000		
Total	99999.80		100.00	

PROJECT STATION: 2141

DATE: 15/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2340
start stop duration Long E 1345
TIME :23:43:36 23:56:31 13 (min) Purpose code: 1
LOG :9723.31 9723.98 0.62 Area code : 2
FDEPTH: 194 196 GearCond.code: 9
BDEPTH: 194 196 Validity code: 1
Towing dir: 270° Wire out: 600 m Speed: 30 kn*10

Sorted: 46 Kg Total catch: 111.65 CATCH/HOUR: 515.31

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	442.62	2322	85.89	7426
Pterothrissus belloci	29.54	268	5.73	
Coelorinchus fasciatus	24.60	337	4.77	
Merluccius capensis	13.71	5	2.66	7427
Sufflogobius bibarbatus	4.06	369	0.79	
Lepidopus caudatus	0.78	5	0.15	
Aequorea aequorea	0.00	46154		
Chrysaora sp.	0.00	4154		
Total	515.31		99.99	

PROJECT STATION: 2142

DATE: 16/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2321
start stop duration Long E 1326
TIME :07:47:16 08:17:15 30 (min) Purpose code: 1
LOG :9806.87 9808.33 1.41 Area code : 2
FDEPTH: 257 276 GearCond.code: 1
BDEPTH: 257 276 Validity code: 1
Towing dir: 270° Wire out: 800 m Speed: 30 kn*10

Sorted: 65 Kg Total catch: 582.90 CATCH/HOUR: 1165.80

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	906.10	9302	77.72	7429
Galeus polli	120.70	2944	10.35	
Merluccius capensis	47.80	36	4.10	7428
Coelorinchus fasciatus	32.14	5978	2.76	
Chlorophthalmus atlanticus	25.34	1480	2.17	
Trachurus capensis	13.00	76	1.12	7434
Lepidopus caudatus	9.86	52	0.85	
Lophius vomerinus	6.42	6	0.55	
Helicolenus dactylopterus	2.38	238	0.20	
Todarodes sagittatus	1.60	4	0.14	
Beryx splendens	0.46	2	0.04	
Total	1165.80		100.00	

PROJECT STATION: 2143

DATE: 16/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2320
start stop duration Long E 1342
TIME :10:45:22 10:48:50 3 (min) Purpose code: 1
LOG :9828.36 9828.52 0.16 Area code : 1
FDEPTH: 90 110 GearCond.code: 1
BDEPTH: 160 160 Validity code: 1
Towing dir: 270° Wire out: 300 m Speed: 30 kn*10

Sorted: 13 Kg Total catch: 25.52 CATCH/HOUR: 510.40

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Maurolicus muelleri	322.40	268660	63.17	
Thyrsites atun	188.00	80	36.83	
Aequorea aequorea	0.00	20000		
Chrysaora sp.	0.00	1200		
Total	510.40		100.00	

PROJECT STATION: 2144

DATE: 16/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2320
start stop duration Long E 1347
TIME :12:06:50 12:13:09 6 (min) Purpose code: 1
LOG :9837.53 9837.86 0.30 Area code : 2
FDEPTH: 162 163 GearCond.code: 9
BDEPTH: 162 163 Validity code: 1
Towing dir: 270° Wire out: 550 m Speed: 30 kn*10

Sorted: 121 Kg Total catch: 219.68 CATCH/HOUR: 2196.80

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	1137.50	8900	51.78	7430
Merluccius capensis	942.90	650	42.92	7431
Coelorinchus fasciatus	50.50	50	2.30	
Chelidonichthys capensis	28.50	50	1.30	
Lophius vomerinus	16.60	10	0.76	
Pterothrissus belloci	9.50	50	0.43	
Trachurus capensis	5.80	50	0.26	7432
Sufflogobius bibarbatus	2.00	300	0.09	
Lepidopus caudatus	2.00	10	0.09	
Galeus polli	1.50	50	0.07	
Aequorea aequorea	0.00	400000		
Chrysaora sp.	0.00	10000		
Total	2196.80		100.00	

PROJECT STATION: 2145

DATE: 16/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2320
start stop duration Long E 1409
TIME :15:03:47 15:11:48 8 (min) Purpose code: 1
LOG :9862.84 9863.28 0.41 Area code : 2
FDEPTH: 124 125 GearCond.code: 1
BDEPTH: 124 125 Validity code: 1
Towing dir: 270° Wire out: 370 m Speed: 30 kn*10

Sorted: 30 Kg Total catch: 516.00 CATCH/HOUR: 3870.00

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	3870.00	87750	100.00	7433
Aequorea aequorea	0.00	90000		
Chrysaora sp.	0.00	2700		
Total	3870.00		100.00	

PROJECT STATION: 2146

DATE: 16/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2307
start stop duration Long E 1420
TIME :18:34:41 18:47:00 12 (min) Purpose code: 1
LOG :9894.61 9895.33 0.62 Area code : 2
FDEPTH: 28 28 GearCond.code: 1
BDEPTH: 69 71 Validity code: 1
Towing dir: 195° Wire out: 100 m Speed: 35 kn*10

Sorted: 5 Kg Total catch: 205.00 CATCH/HOUR: 1025.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chelidonichthys capensis	1000.00	22265	97.56	
Sufflogobius bibarbatus	25.00	3330	2.44	
Chrysaora sp	0.00	90000		
Total	1025.00		100.00	

PROJECT STATION: 2147

DATE: 17/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2240
start stop duration Long E 1330
TIME :10:07:16 10:27:42 20 (min) Purpose code: 1
LOG : 46.62 47.65 0.94 Area code : 1
FDEPTH: 211 224 GearCond.code:
BDEPTH: 211 224 Validity code:
Towing dir: 270° Wire out: 700 m Speed: 30 kn*10

Sorted: 113 Kg Total catch: 250.51 CATCH/HOUR: 751.53

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	542.40	3822	72.17	7435
Trachurus capensis	181.89	834	24.20	7437
Merluccius capensis	15.60	6	2.08	7436
Coelorinchus fasciatus	6.36	96	0.85	
Sufflogobius bibarbatus	1.68	180	0.22	
Aequorea aequorea	0.00	37500		
Chrysaora sp.	0.00	3375		
Total	747.93		99.52	

PROJECT STATION: 2148

DATE: 17/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2240
start stop duration Long E 1426
TIME :15:57:21 16:15:24 18 (min) Purpose code: 1
LOG : 106.24 107.37 1.05 Area code : 2
FDEPTH: 39 45 GearCond.code: 1
BDEPTH: 17 17 Validity code: 1
Towing dir: 270° Wire out: 85 m Speed: 35 kn*10

Sorted: 5 Kg Total catch: 25.45 CATCH/HOUR: 84.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis capensis	62.67	833	73.88	7441
Sardinops ocellatus	11.67	1117	13.76	7438
Etrumeus whiteheadi	8.67	867	10.22	7439
Trachurus capensis	1.83	217	2.16	7440
Total	84.84		100.02	

PROJECT STATION: 2149

DATE: 17/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2225
start stop duration Long E 1416
TIME :19:05:40 19:16:16 11 (min) Purpose code: 1
LOG : 134.41 135.12 0.65 Area code : 2
FDEPTH: 25 25 GearCond.code: 1
BDEPTH: 51 52 Validity code: 1
Towing dir: 171° Wire out: 100 m Speed: 31 kn*10

Sorted: 3 Kg Total catch: 60.21 CATCH/HOUR: 328.42

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	327.27	148762	99.65	
Merluccius capensis	0.87	115	0.26	
Trachurus capensis	0.27	38	0.08	
Aequorea aequorea	0.00	16364		
Total	328.41		99.99	

PROJECT STATION: 2150

DATE: 17/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2221
start stop duration Long E 1345
TIME :23:39:29 23:52:39 13 (min) Purpose code: 1
LOG : 180.60 181.35 0.72 Area code : 2
FDEPTH: 127 115 GearCond.code: 1
BDEPTH: 127 115 Validity code: 1
Towing dir: 360° Wire out: 400 m Speed: 30 kn*10

Sorted: 57 Kg Total catch: 573.80 CATCH/HOUR: 2648.31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2520.00	19246	95.16	7442
Merluccius capensis	124.15	831	4.69	7443
Todarodes sagittatus	4.15	46	0.16	
Chrysaora sp	0.00	831		
Total	2648.30		100.01	

PROJECT STATION: 2151

DATE: 18/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2219
start stop duration Long E 1334
TIME :01:37:13 01:56:41 19 (min) Purpose code: 1
LOG : 195.26 196.17 1.01 Area code : 2
FDEPTH: 139 140 GearCond.code:
BDEPTH: 139 140 Validity code:
Towing dir: 360° Wire out: 450 m Speed: 30 kn*10

Sorted: 54 Kg Total catch: 420.28 CATCH/HOUR: 1327.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	1261.89	8763	95.08	7444
Chelidonichthys capensis	26.53	76	2.00	
Lopihus vomerinus, juveniles	18.19	126	1.37	
Lepidopus caudatus	7.83	202	0.59	
Callorhinchus capensis	4.93	3	0.37	
Pterothrissus belloci	4.80	25	0.36	
Sufflogobius bibarbatus	3.03	657	0.23	
Chrysaora sp.	0.00	789		
Total	1327.20		100.00	

PROJECT STATION: 2152

DATE: 18/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2220
start stop duration Long E 1257
TIME :05:52:46 06:23:52 31 (min) Purpose code: 1
LOG : 236.19 237.81 1.61 Area code : 2
FDEPTH: 295 286 GearCond.code: 1
BDEPTH: 295 286 Validity code: 1
Towing dir: 90° Wire out: 950 m Speed: 30 kn*10

Sorted: 84 Kg Total catch: 503.70 CATCH/HOUR: 974.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	332.71	279	34.13	7447
Merluccius capensis	274.06	3248	28.11	7446
Trachurus capensis	252.00	1295	25.85	7445
Chlorophthalmus atlanticus	47.85	2257	4.91	
Helicolenus dactylopterus	42.27	886	4.34	
Coelorinchus fasciatus	13.82	325	1.42	
Lepidopus caudatus	5.81	23	0.60	
Todarodes sagittatus	4.65	12	0.48	
Galeus polli	1.51	35	0.15	
Synagrops microlepis	0.23	12	0.02	
Total	974.91		100.01	

PROJECT STATION: 2153

DATE: 18/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2211
start stop duration Long E 1243
TIME :09:32:54 09:37:02 4 (min) Purpose code: 1
LOG : 264.06 264.28 0.20 Area code : 1
FDEPTH: 180 180 GearCond.code: 1
BDEPTH: 553 555 Validity code: 1
Towing dir: 165° Wire out: 900 m Speed: 30 kn*10

Sorted: 10 Kg Total catch: 81.60 CATCH/HOUR: 1224.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	1125.00	803565	91.91	
Thyrsites atun	99.00	30	8.09	
Total	1224.00		100.00	

PROJECT STATION: 2154

DATE: 18/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2159
start stop duration Long E 1247
TIME :13:12:28 13:15:24 3 (min) Purpose code: 1
LOG : 289.93 290.07 0.13 Area code : 2
FDEPTH: 346 345 GearCond.code: 9
BDEPTH: 346 345 Validity code: 1
Towing dir: 360° Wire out: 1030 m Speed: 30 kn*10

Sorted: 39 Kg Total catch: 1386.01 CATCH/HOUR: 27720.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Beryx splendens	23440.00	72800	84.56	
Merluccius capensis	2160.00	3600	7.79	
Helicolenus dactylopterus	784.00	7200	2.83	
Merluccius paradoxus	696.00	1600	2.51	
Todaropsis eblanae	288.00	800	1.04	
Trachipterus jacksonensis	88.20	20	0.32	
Chlorophthalmus atlanticus	88.00	2400	0.32	
Galeus polli	32.00	1600	0.12	
Total	27576.20		99.49	

PROJECT STATION: 2155

DATE: 18/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2160
start stop duration Long E 1255
TIME :15:43:00 15:53:46 11 (min) Purpose code: 1
LOG : 304.71 305.36 0.64 Area code : 2
FDEPTH: 250 250 GearCond.code: 1
BDEPTH: 334 334 Validity code: 1
Towing dir: 335° Wire out: 820 m Speed: 40 kn*10

Sorted: 7 Kg Total catch: 36.90 CATCH/HOUR: 201.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	171.27	86067	85.09	
Brama brama	27.71	22	13.77	
Trachurus capensis	2.29	5	1.14	
Chrysaora sp	0.00	982		
Total	201.27		100.00	

PROJECT STATION: 2156

DATE: 19/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 2120
start stop duration Long E 1257
TIME : 14:11:33 14:29:35 18 (min) Purpose code: 1
LOG : 534.11 535.04 0.99 Area code : 2
FDEPTH: 200 200 GearCond.code: 1
BDEPTH: 267 279 Validity code: 1
Towing dir: 270° Wire out: 700 m Speed: 40 kn*10

Sorted: 25 Kg Total catch: 241.50 CATCH/HOUR: 805.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	803.33	13900	99.79	7448
Brama brama	1.67	3	0.21	
Aequorea aequorea	0.00	10000		
Chrysaora sp.	0.00	300		
Total	805.00		100.00	

PROJECT STATION: 2157

DATE: 19/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2120
start stop duration Long E 1307
TIME : 16:25:52 16:56:41 31 (min) Purpose code: 1
LOG : 550.00 551.61 1.61 Area code : 2
FDEPTH: 151 157 GearCond.code: 1
BDEPTH: 151 157 Validity code: 1
Towing dir: 270° Wire out: 500 m Speed: 30 kn*10

Sorted: 35 Kg Total catch: 492.08 CATCH/HOUR: 952.41

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	944.52	16285	99.17	7449
Beryx splendens	7.70	31	0.81	
Trachurus capensis	0.19	2	0.02	
Total	952.41		100.00	

PROJECT STATION: 2158

DATE: 19/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2120
start stop duration Long E 1305
TIME : 17:47:53 18:08:24 21 (min) Purpose code: 1
LOG : 554.13 555.51 1.28 Area code : 2
FDEPTH: 25 25 GearCond.code: 1
BDEPTH: 156 156 Validity code: 1
Towing dir: 90° Wire out: 100 m Speed: 35 kn*10

Sorted: 35 Kg Total catch: 652.00 CATCH/HOUR: 1862.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	1862.86	24837	100.00	7450
Chrysaora sp.	0.00	857		
Total	1862.86		100.00	

PROJECT STATION: 2159

DATE: 20/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2102
start stop duration Long E 1328
TIME : 00:02:50 00:05.29 3 (min) Purpose code: 1
LOG : 616.41 616.58 0.15 Area code : 2
FDEPTH: 20 15 GearCond.code: 1
BDEPTH: 42 41 Validity code: 1
Towing dir: 40° Wire out: 4 m Speed: 40 kn*10

Sorted: 18 Kg Total catch: 220.80 CATCH/HOUR: 4416.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	2078.40	190560	47.07	7453
Etrumeus whiteheadi	1528.80	95280	34.62	7454
Engraulis capensis	607.20	95520	13.75	7451
Trachurus capensis	201.60	25920	4.57	7452
Total	4416.00		100.01	

PROJECT STATION: 2160

DATE: 20/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2060
start stop duration Long E 1247
TIME : 05:53:25 06:25.15 32 (min) Purpose code: 1
LOG : 665.90 667.64 1.63 Area code : 2
FDEPTH: 319 304 GearCond.code: 1
BDEPTH: 319 304 Validity code: 1
Towing dir: 90° Wire out: 1000 m Speed: 30 kn*10

Sorted: 60 Kg Total catch: 226.45 CATCH/HOUR: 424.59

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	328.13	510	77.28	7455
Schedophilus huttoni	69.19	208	16.30	
Todarodes sagittatus	5.08	9	1.20	
Genypterus capensis	4.24	2	1.00	
Lophius vomerinus	3.86	4	0.91	
Coelorinchus fasciatus	3.75	131	0.88	
Trachurus capensis	2.63	17	0.62	7456
Austroglossus microlepis	2.53	2	0.60	
Dentex macrophthalmus	2.21	6	0.52	
Chlorophthalmus atlanticus	0.94	38	0.22	
Helicolenus dactylopterus	0.94	4	0.22	
Sufflogobius bibarbatus	0.47	103	0.11	
Trigla lyra	0.45	2	0.11	
Synagrops microlepis	0.19	9	0.04	
Chrysaora sp.	0.00	563		
Total	424.61		100.01	

PROJECT STATION: 2161

DATE: 20/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2100
start stop duration Long E 1239
TIME : 08:21:34 08:46:02 24 (min) Purpose code: 1
LOG : 681.01 682.22 1.10 Area code : 2
FDEPTH: 200 150 GearCond.code: 1
BDEPTH: 366 361 Validity code: 1
Towing dir: 90° Wire out: 600 m Speed: 35 kn*10

Sorted: 16 Kg Total catch: 16.30 CATCH/HOUR: 40.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	33.75	68	82.82	7457
Brama brama	7.00	5	17.18	
Chrysaora sp.	0.00	750		
Total	40.75		100.00	

PROJECT STATION: 2162

DATE: 20/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2100
start stop duration Long E 1229
TIME : 11:10:14 11:39:56 30 (min) Purpose code: 1
LOG : 699.14 701.18 1.85 Area code : 2
FDEPTH: 300 300 GearCond.code: 1
BDEPTH: 447 420 Validity code: 1
Towing dir: 90° Wire out: 1000 m Speed: 45 kn*10

Sorted: 11 Kg Total catch: 37.80 CATCH/HOUR: 75.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lampanyctodes hectoris	71.20	49444	94.18	
Brama brama	4.40	4	5.82	
Aequorea aequorea	0.00	600		
Chrysaora sp.	0.00	180		
Total	75.60		100.00	

PROJECT STATION: 2163

DATE: 20/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2047
start stop duration Long E 1214
TIME : 15:50:13 16:24:18 34 (min) Purpose code: 1
LOG : 735.81 737.88 2.03 Area code : 3
FDEPTH: 250 250 GearCond.code: 1
BDEPTH: 543 569 Validity code: 1
Towing dir: 182° Wire out: 900 m Speed: 40 kn*10

Sorted: 1 Kg Total catch: 0.50 CATCH/HOUR: 0.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	0.88		100.00	
Total	0.88		100.00	

PROJECT STATION: 2164

DATE: 20/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2045
start stop duration Long E 1222
TIME : 18:40:13 19:07:04 27 (min) Purpose code: 1
LOG : 754.95 756.36 1.42 Area code : 2
FDEPTH: 150 200 GearCond.code: 3
BDEPTH: 372 391 Validity code: 1
Towing dir: 270° Wire out: 500 m Speed: 35 kn*10

Sorted: 4 Kg Total catch: 23.42 CATCH/HOUR: 52.04

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	34.22	72149	65.76	
MYCTOPHIDAE	11.33	4073	21.77	
Zeus capensis	4.24	7	8.15	
Histioteuthis reversa	2.02	33	3.88	
Hoplostethus melanopus	0.22	2	0.42	
Total	52.03		99.98	

PROJECT STATION: 2165

DATE: 20/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2045
start stop duration Long E 1231
TIME : 21:12:19 21:41:38 29 (min) Purpose code: 1
LOG : 772.16 773.79 1.64 Area code : 2
FDEPTH: 230 230 GearCond.code: 1
BDEPTH: 330 329 Validity code: 1
Towing dir: 270° Wire out: 750 m Speed: 34 kn*10

Sorted: 8 Kg Total catch: 7.84 CATCH/HOUR: 16.22

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	8.77	217	54.07	7458
Dentex macrophthalmus	7.45	23	45.93	
Aequorea aequorea	0.00	414		
Chrysaora sp.	0.00	50		
Total	16.22		100.00	

PROJECT STATION: 2166

DATE: 21/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 2045
start stop duration Long E 1314
TIME : 02:46:24 02:51:20 5 (min) Purpose code: 1
LOG : 822.93 823.25 0.32 Area code : 3
FDEPTH: 20 18 GearCond.code: 1
BDEPTH: 96 98 Validity code: 1
Towing dir: 270° Wire out: 150 m Speed: 40 kn*10

Sorted: 28 Kg Total catch: 855.96 CATCH/HOUR: 10271.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	10270.80	1316760	99.99	7459
Total	10270.80		99.99	

PROJECT STATION: 2167

DATE: 21/ 6/97 GEAR TYPE: PT No: 7 POSITION: Lat S 2043
start stop duration Long E 1320
TIME :04:17:01 04:19:54 3 (min) Purpose code: 1
LOG : 832.85 833.01 0.15 Area code : 3
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 31 30 Validity code: 1
Towing dir: 302° Wire out: 150 m Speed: 30 kn*10

Sorted: 4 Kg Total catch: 969.90 CATCH/HOUR: 19398.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	11207.40	1174760	57.78	7460
Engraulis capensis	8101.40	1440240	41.76	7461
Trachurus capensis	89.20	8920	0.46	7462
Total	19398.00		100.00	

PROJECT STATION: 2168

DATE: 21/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2030
start stop duration Long E 1302
TIME :08:52:12 09:11:27 19 (min) Purpose code: 1
LOG : 876.38 877.42 1.04 Area code : 3
FDEPTH: 119 115 GearCond.code: 1
BDEPTH: 119 115 Validity code: 1
Towing dir: 90° Wire out: 400 m Speed: 30 kn*10

Sorted: 33 Kg Total catch: 230.30 CATCH/HOUR: 727.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	727.26	15455	100.00	7463
Chrysaora sp.	0.00	1326		
Total	727.26		100.00	

PROJECT STATION: 2169

DATE: 21/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2030
start stop duration Long E 1255
TIME :11:34:10 11:44:39 10 (min) Purpose code: 1
LOG : 890.61 891.26 0.60 Area code : 3
FDEPTH: 98 95 GearCond.code: 1
BDEPTH: 130 134 Validity code: 1
Towing dir: 270° Wire out: 320 m Speed: 40 kn*10

Sorted: 33 Kg Total catch: 232.05 CATCH/HOUR: 1392.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	1363.32	19404	97.92	7464
Etrumeus whiteheadi	28.98	1428	2.08	7465
Aequorea aequorea	0.00	288000		
Chrysaora sp.	0.00	8640		
Total	1392.30		100.00	

PROJECT STATION: 2170

DATE: 21/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2030
start stop duration Long E 1233
TIME :14:40:03 14:44:34 5 (min) Purpose code: 1
LOG : 916.25 916.34 0.09 Area code : 3
FDEPTH: 286 286 GearCond.code: 1
BDEPTH: 286 286 Validity code: 1
Towing dir: 90° Wire out: 900 m Speed: 35 kn*10

Sorted: 27 Kg Total catch: 27.19 CATCH/HOUR: 326.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	204.60	1956	62.71	7467
Dentex macrophthalmus	67.20	264	20.60	
Trachurus capensis	33.12	216	10.15	7466
Pterothrissus belloci	10.32	252	3.16	
Lophius vomerinus	8.76	24	2.68	
Sufflogobius bibarbatus	1.92	264	0.59	
Coelorinchus fasciatus	0.36	12	0.11	
Aequorea aequorea	0.00	36000		
Chrysaora sp.	0.00	1080		
Total	326.28		100.00	

PROJECT STATION: 2171

DATE: 21/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2030
start stop duration Long E 1220
TIME :17:04:40 17:34:16 30 (min) Purpose code: 1
LOG : 935.45 936.90 1.52 Area code : 3
FDEPTH: 307 304 GearCond.code: 1
BDEPTH: 307 304 Validity code: 1
Towing dir: 90° Wire out: 1000 m Speed: 30 kn*10

Sorted: 92 Kg Total catch: 301.63 CATCH/HOUR: 603.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	233.00	1534	38.62	7469
Merluccius capensis	221.80	438	36.77	7468
Chlorophthalmus atlanticus	111.60	5554	18.50	
Todarodes sagittatus	13.60	40	2.25	
Pterothrissus belloci	10.60	52	1.76	
Dentex macrophthalmus	8.40	26	1.39	
Coelorinchus fasciatus	3.20	40	0.53	
Helicolenus dactylopterus	0.66	14	0.11	
Trigla lyra	0.40	6	0.07	
Total	603.26		100.00	

PROJECT STATION: 2172

DATE: 21/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2029
start stop duration Long E 1208
TIME :19:40:32 20:00:14 20 (min) Purpose code: 1
LOG : 954.20 955.18 1.03 Area code : 3
FDEPTH: 300 750 GearCond.code: 1
BDEPTH: 370 348 Validity code: 1
Towing dir: 45° Wire out: 200 m Speed: 34 kn*10

Sorted: 27 Kg Total catch: 27.20 CATCH/HOUR: 81.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	68.10	56757	83.46	
Brama brama	13.50	15	16.54	
Total	81.60		100.00	

PROJECT STATION: 2173

DATE: 22/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 2015
start stop duration Long E 1213
TIME :01:05:19 01:44:11 39 (min) Purpose code: 1
LOG :1002.97 1005.34 2.31 Area code : 3
FDEPTH: 200 270 GearCond.code: 1
BDEPTH: 289 297 Validity code: 1
Towing dir: 270° Wire out: 900 m Speed: 40 kn*10

Sorted: 49 Kg Total catch: 124.05 CATCH/HOUR: 190.85

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	120.31	1662	63.04	7471
Trachurus capensis	39.46	197	20.68	7470
Dentex macrophthalmus	18.65	55	9.77	
Merluccius capensis	9.62	11	5.04	7472
Synagrops microlepis	1.23	80	0.64	
Brama brama	0.97	2	0.51	
Chlorophthalmus atlanticus	0.37	62	0.19	
Todarodes sagittatus	0.25	6	0.13	
Total	190.86		100.00	

PROJECT STATION: 2174

DATE: 22/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2014
start stop duration Long E 1218
TIME :03:25:38 03:46:42 21 (min) Purpose code: 1
LOG :1016.97 1018.07 1.16 Area code : 3
FDEPTH: 277 279 GearCond.code: 1
BDEPTH: 277 279 Validity code: 1
Towing dir: 270° Wire out: 900 m Speed: 35 kn*10

Sorted: 50 Kg Total catch: 257.39 CATCH/HOUR: 735.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	610.29	4160	82.99	7473
Merluccius capensis	56.29	60	7.65	7474
Merluccius capensis	31.77	206	4.32	7475
Pterothrissus belloci	15.80	183	2.15	
Todarodes sagittatus	9.83	23	1.34	
Dentex macrophthalmus	9.60	23	1.31	
Lophius vomerinus	1.37	23	0.19	
Sufflogobius bibarbatus	0.46	23	0.06	
Total	735.41		100.01	

PROJECT STATION: 2175

DATE: 22/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2014
start stop duration Long E 1245
TIME :07:24:52 07:40:51 16 (min) Purpose code: 1
LOG :1051.05 1051.99 1.00 Area code : 3
FDEPTH: 50 110 GearCond.code: 1
BDEPTH: 112 132 Validity code: 1
Towing dir: 90° Wire out: 400 m Speed: 40 kn*10

Sorted: 47 Kg Total catch: 279.60 CATCH/HOUR: 1048.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	848.25	42413	80.90	7477
Sardinops ocellatus	195.75	3930	18.67	7476
Engraulis capensis	4.28	225	0.41	7479
Trachurus capensis	0.23	135	0.02	7478
Total	1048.51		100.00	

PROJECT STATION: 2176

DATE: 22/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2009
start stop duration Long E 1301
TIME :12:54:15 13:21:28 27 (min) Purpose code: 1
LOG :1103.17 1104.57 1.07 Area code : 3
FDEPTH: 73 67 GearCond.code: 1
BDEPTH: 73 67 Validity code: 1
Towing dir: 123° Wire out: 300 m Speed: 30 kn*10

Sorted: 24 Kg Total catch: 218.34 CATCH/HOUR: 485.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	306.00	7140	63.07	7481
Merluccius capensis	179.00	5300	36.89	7480
Sufflogobius bibarbatus	0.20	20	0.04	
Chrysaora sp.	0.00	1333		
Total	485.20		100.00	

PROJECT STATION: 2177

DATE: 22/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 1960
start stop duration Long E 1232
TIME :19:26:55 19:56:41 30 (min) Purpose code: 1
LOG :1160.33 1162.23 1.47 Area code : 3
FDEPTH: 145 140 GearCond code: 1
BDEPTH: 145 140 Validity code: 1
Towing dir: 90° Wire out: 550 m Speed: 30 kn*10

Sorted: 65 Kg Total catch: 100.89 CATCH/HOUR: 201.78

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	139.20	1544	68.99	7482
Trachurus capensis	54.20	700	26.86	7483
Chelidonichthys queketti	3.82	8	1.89	
Callorhinchus capensis	3.04	2	1.51	
Todarodes sagittatus	0.78	2	0.39	
Sufflogobius bibarbatus	0.74	1216	0.37	
Total	201.78		100.01	

PROJECT STATION: 2178

DATE: 23/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2000
start stop duration Long E 1205
TIME :23:43:00 00:01:08 18 (min) Purpose code: 1
LOG :1195.83 1196.82 0.89 Area code : 3
FDEPTH: 308 303 GearCond code: 1
BDEPTH: 308 303 Validity code: 1
Towing dir: 90° Wire out: 1000 m Speed: 30 kn*10

Sorted: 37 Kg Total catch: 147.25 CATCH/HOUR: 490.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	206.67	1000	42.11	7485
Pterothrissus belloci	186.67	1250	38.03	
Myliobatis aquila	26.50	3	5.40	
Dentex macrophthalmus	22.67	83	4.62	
Lophius vomerinus	21.67	33	4.41	
Sufflogobius bibarbatus	9.00	1083	1.83	
Trachurus capensis	8.50	60	1.73	7484
Solenocera africana	4.33	917	0.88	
Todarodes sagittatus	2.50	67	0.51	
Trigla lyra	1.83	17	0.37	
Chlorophthalmus atlanticus	0.50	33	0.10	
Total	490.84		99.99	

PROJECT STATION: 2179

DATE: 23/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 1945
start stop duration Long E 1225
TIME :08:48:37 09:09:12 21 (min) Purpose code: 1
LOG :1288.10 1289.14 1.07 Area code : 3
FDEPTH: 145 150 GearCond code: 1
BDEPTH: 145 150 Validity code: 1
Towing dir: 270° Wire out: 550 m Speed: 30 kn*10

Sorted: 52 Kg Total catch: 255.60 CATCH/HOUR: 730.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	544.29	12094	74.53	7486
Trachurus capensis	181.43	2951	24.84	7487
Todarodes sagittatus	3.60	11	0.49	
Squalus megalops	1.00	3	0.14	
Chrysaora sp.	0.00	1029		
Total	730.32		100.00	

PROJECT STATION: 2180

DATE: 23/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 1945
start stop duration Long E 1237
TIME :11:05:40 11:10:49 5 (min) Purpose code: 1
LOG :1305.69 1305.95 0.23 Area code : 3
FDEPTH: 50 70 GearCond code: 1
BDEPTH: 115 116 Validity code: 1
Towing dir: 270° Wire out: 170 m Speed: 35 kn*10

Sorted: 25 Kg Total catch: 181.20 CATCH/HOUR: 2174.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	2140.80	130308	98.45	7488
Thyrsites atun	33.60	12	1.55	
Aequorea aequorea	0.00	16416		
Total	2174.40		100.00	

PROJECT STATION: 2181

DATE: 23/ 6/97 GEAR TYPE: PT No: 7 POSITION: Lat S 1949
start stop duration Long E 1250
TIME :13:23:17 13:37:56 15 (min) Purpose code: 1
LOG :1325.46 1326.19 0.64 Area code : 3
FDEPTH: 45 79 GearCond code: 1
BDEPTH: 75 79 Validity code: 1
Towing dir: 270° Wire out: 200 m Speed: 30 kn*10

Sorted: 11 Kg Total catch: 57.18 CATCH/HOUR: 228.72

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	192.00	5160	83.95	7489
Etrumeus whiteheadi	31.00	2900	13.55	7490
Merluccius capensis	3.60	80	1.57	
Galeichthys feliceps	2.12	4	0.93	
Aequorea aequorea	0.00	36000		
Chrysaora sp.	0.00	360		
Total	228.72		100.00	

PROJECT STATION: 2182

DATE: 23/ 6/97 GEAR TYPE: PT No: 7 POSITION: Lat S 1944
start stop duration Long E 1251
TIME :14:56:42 15:09:38 13 (min) Purpose code: 1
LOG :1336.55 1337.26 0.72 Area code : 3
FDEPTH: 25 38 GearCond code: 1
BDEPTH: 41 46 Validity code: 1
Towing dir: 300° Wire out: 120 m Speed: 30 kn*10

Sorted: 18 Kg Total catch: 73.20 CATCH/HOUR: 337.85

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	337.85	12743	100.00	7491
Aequorea aequorea	0.00	900		
Chrysaora sp.	0.00	83		
Total	337.85		100.00	

PROJECT STATION: 2183

DATE: 23/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 1930
start stop duration Long E 1220
TIME :20:42:57 21:02:58 20 (min) Purpose code: 1
LOG :1394.09 1395.21 1.01 Area code : 3
FDEPTH: 140 141 GearCond code: 1
BDEPTH: 140 141 Validity code: 1
Towing dir: 90° Wire out: 550 m Speed: 30 kn*10

Sorted: 48 Kg Total catch: 239.90 CATCH/HOUR: 719.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	552.90	6567	76.82	7492
Trachurus capensis	166.50	2601	23.13	7493
Sufflogobius bibarbatus	0.30	45	0.04	
Chrysaora sp.	0.00	1080		
Total	719.70		99.99	

PROJECT STATION: 2184

DATE: 24/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1921
start stop duration Long E 1127
TIME :03:03:40 03:35:10 32 (min) Purpose code: 1
LOG :1456.83 1458.30 1.59 Area code : 3
FDEPTH: 544 0 GearCond code: 1
BDEPTH: 544 Validity code: 1
Towing dir: 338° Wire out: 1550 m Speed: 30 kn*10

Sorted: 85 Kg Total catch: 867.01 CATCH/HOUR: 1625.64

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius paradoxus	693.75	1013	42.68	7494
Trachyrincus scabrus	562.50	2475	34.60	
Todarodes sagittatus	127.50	300	7.84	
Raja straeleni	88.13	113	5.42	
Deania calcea	48.38	13	2.98	
Hoplostethus cadenati	25.13	1538	1.55	
Lophius vomerinus	15.90	4	0.98	
Helicolenus dactylopterus	15.56	900	0.96	
Nezumia sp.	15.34	7408	0.94	
Selachophidium guentheri	10.13	188	0.62	
Deepwater fish mixture	6.38		0.39	
Epigonus denticulatus	5.63	225	0.35	
Ebinania costaecanarie	5.25	75	0.32	
Neoharriotta pinnata	3.47	2	0.21	
Lycoteuthis diadema	2.63	38	0.16	
Total	1625.68		100.00	

PROJECT STATION: 2185

DATE: 24/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1915
start stop duration Long E 1211
TIME :08:56:25 08:57:36 1 (min) Purpose code: 1
LOG :1512.30 1512.36 0.09 Area code : 3
FDEPTH: 180 181 GearCond code: 1
BDEPTH: 180 181 Validity code:
Towing dir: 270° Wire out: 600 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 187.63 CATCH/HOUR: 11257.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	6156.00	65460	54.68	7496
Trachurus capensis	4644.00	58680	41.25	7495
Dentex macrophthalmus	378.00	2880	3.36	
BATRACHOIDIDAE	72.00	360	0.64	
Squalus megalops	7.80	60	0.07	
Aequorea aequorea	0.00	420000		
Chrysaora sp.	0.00	12600		
Total	11257.80		100.00	

PROJECT STATION: 2186

DATE: 24/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 1915
start stop duration Long E 1213
TIME :09:59:02 10:08:57 10 (min) Purpose code: 1
LOG :1517.46 1518.00 0.55 Area code : 3
FDEPTH: 25 50 GearCond code: 1
BDEPTH: 160 167 Validity code: 1
Towing dir: 270° Wire out: 150 m Speed: 35 kn*10

Sorted: 22 Kg Total catch: 442.60 CATCH/HOUR: 2655.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2640.00	156216	99.41	7497
Etrumeus whiteheadi	15.60	240	0.59	
Aequorea aequorea	0.00	36000		
Total	2655.60		100.00	

PROJECT STATION: 2187

DATE: 24/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 1916
start stop duration Long E 1229
TIME :12:23:37 12:38:25 15 (min) Purpose code: 1
LOG :1538.41 1539.24 0.82 Area code : 3
FDEPTH: 50 55 GearCond code: 1
BDEPTH: 99 100 Validity code: 1
Towing dir: 330° Wire out: 170 m Speed: 35 kn*10

Sorted: 29 Kg Total catch: 550.61 CATCH/HOUR: 2202.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2196.00	68216	99.71	7498
Callorhinchus capensis	6.44	4	0.29	
Aequorea aequorea	0.00	24000		
Chrysaora sp	0.00	720		
Total	2202.44		100.00	

PROJECT STATION: 2188

DATE: 24/ 6/97 GEAR TYPE: PT No: 7 POSITION: Lat S 1902
start stop duration Long E 1226
TIME :16:42:56 16:52:01 9 (min) Purpose code: 1
LOG :1581.62 1582.18 0.50 Area code : 3
FDEPTH: 55 40 GearCond.code: 9
BDEPTH: 60 64 Validity code: 1
Towing dir: 180° Wire out: 170 m Speed: 35 kn*10

Sorted: 31 Kg Total catch: 1750.00 CATCH/HOUR: 11666.67

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	11666.67	238093	100.00	7499
Total	11666.67		100.00	

PROJECT STATION: 2189

DATE: 24/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1860
start stop duration Long E 1212
TIME :20:10:18 20:24:38 14 (min) Purpose code: 1
LOG :1611.28 1612.11 0.72 Area code : 3
FDEPTH: 119 115 GearCond code: 1
BDEPTH: 119 115 Validity code: 1
Towing dir: 90° Wire out: 450 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 1163.45 CATCH/HOUR: 4986.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	3115.93	48686	62.49	7500
Trachurus capensis	1855.29	28766	37.21	7501
Chelidonichthys capensis	6.34	159	0.13	
Sufflogobius bibarbatus	4.76	476	0.10	
Austroglossus microlepis	2.66	4	0.05	
Galeichthys feliceps	1.24	4	0.02	
Total	4986.22		100.00	

PROJECT STATION: 2190

DATE: 24/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1900
start stop duration Long E 1158
TIME :22:30:40 22:45:51 15 (min) Purpose code: 1
LOG :1629.67 1630.51 0.71 Area code : 3
FDEPTH: 221 214 GearCond.code: 1
BDEPTH: 221 214 Validity code: 1
Towing dir: 90° Wire out: 650 m Speed: 30 kn*10

Sorted: 21 Kg Total catch: 67.30 CATCH/HOUR: 269.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Merluccius capensis	217.00	3404	80.61	7503
Trachurus capensis	37.80	376	14.04	7502
Pterothrissus belloci	7.00	80	2.60	
Dentex macrophthalmus	7.00	60	2.60	
Sufflogobius bibarbatus	0.40	80	0.15	
Aequorea aequorea	0.00	14400		
Chrysaora sp	0.00	432		
Total	269.20		100.00	

PROJECT STATION: 2191

DATE: 25/ 6/97 GEAR TYPE: PT No: 6 POSITION: Lat S 1900
start stop duration Long E 1130
TIME :02:25:08 02:45:09 20 (min) Purpose code: 1
LOG :1663.13 1664.31 1.10 Area code : 3
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 299 325 Validity code: 1
Towing dir: 270° Wire out: 150 m Speed: 35 kn*10

Sorted: 21 Kg Total catch: 21.92 CATCH/HOUR: 65.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	21.00	105000	31.93	
MYCTOPHIDAE	21.00	10851	31.93	
Brama brama	10.14	15	15.42	
Prionace glauca	10.05	3	15.28	
Thyrsites atun	3.57	3	5.43	
Total	65.76		99.99	

PROJECT STATION: 2192

DATE: 25/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1846
start stop duration Long E 1132
TIME :07:52:28 08:24:24 32 (min) Purpose code: 1
LOG :1712.79 1714.66 1.58 Area code : 3
FDEPTH: 254 255 GearCond.code: 1
BDEPTH: 254 255 Validity code: 1
Towing dir: 160° Wire out: 800 m Speed: 30 kn*10

Sorted: 90 Kg Total catch: 834.02 CATCH/HOUR: 1563.79

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	486.51	2355	31.11	
Merluccius capensis	422.87	4359	27.04	7505
Pterothrissus belloci	191.81	2981	12.27	
Trachurus capensis	162.17	1277	10.37	7504
Helicolenus dactylopterus	152.59	2348	9.76	
Deepwater fish mixture	126.43		8.08	
Todarodes sagittatus	19.01	88	1.22	
RAJIDAE	1.43	2	0.09	
C R A B S	0.53	36	0.03	
Trigla lyra	0.45	2	0.03	
Total	1563.80		100.00	

PROJECT STATION: 2193

DATE: 25/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1846
start stop duration Long E 1159
TIME :11:28:44 11:42:56 14 (min) Purpose code: 1
LOG :1745.00 1745.69 0.71 Area code : 3
FDEPTH: 130 129 GearCond.code: 9
BDEPTH: 130 129 Validity code: 1
Towing dir: 340° Wire out: 450 m Speed: 30 kn*10

Sorted: 16 Kg Total catch: 163.02 CATCH/HOUR: 698.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	544.29	10367	77.90	7506
Trachurus capensis	152.14	2700	21.78	7507
Galeichthys feliceps	2.01	4	0.29	
Sufflogobius bibarbatus	0.21	43	0.03	
Aequorea aequorea	0.00	4114		
Chrysaora sp	0.00	244		
Total	698.65		100.00	

PROJECT STATION: 2194

DATE: 25/ 6/97 GEAR TYPE: PT No: 7 POSITION: Lat S 1847
start stop duration Long E 1218
TIME :14:45:01 14:55:15 10 (min) Purpose code: 1
LOG :1776.40 1776.99 0.48 Area code : 3
FDEPTH: 30 32 GearCond code: 1
BDEPTH: 37 38 Validity code: 1
Towing dir: 156° Wire out: 120 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 622.00 CATCH/HOUR: 3732.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3732.00	78906	100.00	7508
Aequorea aequorea	0.00	1800		
Chrysaora sp	0.00	108		
Total	3732.00		100.00	

PROJECT STATION: 2195

DATE: 25/ 6/97 GEAR TYPE: PT No: 7 POSITION: Lat S 1841
start stop duration Long E 1206
TIME :16:48:39 16:55:46 7 (min) Purpose code: 1
LOG :1795.40 1795.75 0.34 Area code : 3
FDEPTH: 50 50 GearCond.code: 1
BDEPTH: 60 63 Validity code: 1
Towing dir: 305° Wire out: 170 m Speed: 30 kn*10

Sorted: 57 Kg Total catch: 432.40 CATCH/HOUR: 3706.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3487.71	31560	94.10	7509
Thyrsites atun	218.57	77	5.90	
Total	3706.28		100.00	

PROJECT STATION: 2196

DATE: 25/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1830
start stop duration Long E 1154
TIME :19:48:30 19:51:08 3 (min) Purpose code: 1
LOG :1824.49 1824.64 0.15 Area code : 3
FDEPTH: 104 103 GearCond.code: 1
BDEPTH: 104 103 Validity code: 1
Towing dir: 20° Wire out: 400 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 305.27 CATCH/HOUR: 6105.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3970.00	88220	65.02	7510
Merluccius capensis	2120.00	37200	34.72	7511
Galeichthys feliceps	10.00	60	0.16	
Chelidonichthys capensis	5.40	20	0.09	
Aequorea aequorea	0.00	155200		
Total	6105.40		99.99	

PROJECT STATION: 2197

DATE: 25/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1830
start stop duration Long E 1137
TIME : 21:51:13 22:12:19 21 (min) Purpose code: 1
LOG : 1844.02 1845.17 1.10 Area code : 3
FDEPTH: 195 189 GearCond.code: 1
BDEPTH: 195 189 Validity code: 1
Towing dir: 90° Wire out: 700 m Speed: 30 kn*10

Sorted: 56 Kg Total catch: 335.02 CATCH/HOUR: 957.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	720.00	8666	75.22	7513
Trachurus capensis	118.29	1166	12.36	7512
Dentex macrophthalmus	108.86	826	11.37	
Synagrops microlepis	5.49	806	0.57	
Todarodes sagittatus	3.77	17	0.39	
Trigla lyra	0.80	3	0.08	
Chrysaora sp	0.00	514		
Total	957.21		99.99	

PROJECT STATION: 2198

DATE: 25/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1829
start stop duration Long E 1130
TIME : 23:33:38 23:51:35 18 (min) Purpose code: 1
LOG : 1856.15 1857.03 0.93 Area code : 3
FDEPTH: 274 281 GearCond.code: 9
BDEPTH: 274 281 Validity code: 1
Towing dir: 360° Wire out: 850 m Speed: 30 kn*10

Sorted: 60 Kg Total catch: 901.81 CATCH/HOUR: 3006.03

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	1427.50	3000	47.49	7514
Helicolenus dactylopterus	700.00	104577	23.29	
Chlorophthalmus atlanticus	525.00	20000	17.46	
Pterothrissus belloci	85.50	600	2.84	
Galeus polli	78.00	300	2.59	
Todarodes sagittatus	71.50	150	2.38	
Dentex macrophthalmus	42.50	150	1.41	
Trigla lyra	37.00	700	1.23	
Coelorinchus fasciatus	28.00	1050	0.93	
MYCTOPHIDAE	5.50	1450	0.18	
Trachurus capensis	2.53	17	0.08	7515
Nezumia sp.	2.00	150	0.07	
Solenocera africana	1.00	450	0.03	
Total	3006.03		99.98	

PROJECT STATION: 2199

DATE: 26/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1815
start stop duration Long E 1130
TIME : 04:40:39 04:44:56 4 (min) Purpose code: 1
LOG : 1906.49 1906.70 0.23 Area code : 6
FDEPTH: 291 293 GearCond.code: 9
BDEPTH: 291 293 Validity code: 1
Towing dir: 15° Wire out: 900 m Speed: 30 kn*10

Sorted: 21 Kg Total catch: 58.94 CATCH/HOUR: 884.10

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	807.75	3195	91.36	7517
Trachurus capensis	21.75	150	2.46	7516
Coelorinchus fasciatus	15.75	180	1.78	
Helicolenus dactylopterus	13.95	495	1.58	
Pterothrissus belloci	7.65	45	0.87	
Chlorophthalmus atlanticus	7.65	270	0.87	
Dentex macrophthalmus	3.60	15	0.41	
Trigla lyra	3.30	15	0.37	
Nezumia sp.	1.35	45	0.15	
MYCTOPHIDAE	0.90	720	0.10	
Synagrops microlepis	0.45	45	0.05	
Aequorea aequorea	0.00	15000		
Total	884.10		100.00	

PROJECT STATION: 2200

DATE: 26/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 1815
start stop duration Long E 1149
TIME : 00:00:18 00:00:27 9 (min) Purpose code: 1
LOG : 1929.03 1929.54 0.52 Area code : 3
FDEPTH: 40 60 GearCond.code: 9
BDEPTH: 74 81 Validity code: 1
Towing dir: 260° Wire out: 150 m Speed: 30 kn*10

Sorted: 28 Kg Total catch: 227.76 CATCH/HOUR: 1518.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1506.67	40180	99.23	7518
Merluccius capensis	11.73	107	0.77	
Chrysaora sp	0.00	220		
Total	1518.40		100.00	

PROJECT STATION: 2201

DATE: 26/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 1806
start stop duration Long E 1145
TIME : 01:40:44 01:40:55 11 (min) Purpose code: 1
LOG : 1963.55 1964.35 0.71 Area code : 3
FDEPTH: 20 20 GearCond.code: 1
BDEPTH: 81 79 Validity code: 1
Towing dir: 185° Wire out: 100 m Speed: 40 kn*10

Sorted: 1 Kg Total catch: 201.80 CATCH/HOUR: 1100.73

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1100.73	148598	100.00	7519
Chrysaora sp	0.00	545		
Total	1100.73		100.00	

PROJECT STATION: 2202

DATE: 26/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1756
start stop duration Long E 1142
TIME : 01:40:07 01:40:15 8 (min) Purpose code: 1
LOG : 1981.04 1981.45 0.35 Area code : 3
FDEPTH: 95 95 GearCond.code: 1
BDEPTH: 95 95 Validity code: 1
Towing dir: 95° Wire out: 350 m Speed: 30 kn*10

Sorted: 26 Kg Total catch: 568.35 CATCH/HOUR: 4262.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2767.50	66150	64.92	7521
Merluccius capensis	1293.75	19800	30.35	7520
Dentex macrophthalmus	186.75	4275	4.38	
Trigla lyra	13.13	900	0.31	
Galeichthys feliceps	1.50	8	0.04	
Aequorea aequorea	0.00	6075		
Chrysaora sp.	0.00	570		
Total	4262.63		100.00	

PROJECT STATION: 2203

DATE: 26/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 1758
start stop duration Long E 1132
TIME : 15:54:32 16:06:36 12 (min) Purpose code: 1
LOG : 2004.89 2005.55 0.57 Area code : 3
FDEPTH: 150 170 GearCond.code: 1
BDEPTH: 212 212 Validity code: 1
Towing dir: 360° Wire out: 550 m Speed: 35 kn*10

Sorted: 4 Kg Total catch: 13.05 CATCH/HOUR: 65.25

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Brama brama	21.00	30	32.18	
Thyrsites atun	15.60	15	23.91	
Merluccius capensis	15.00	300	22.99	7522
Galeichthys feliceps	9.75	15	14.94	
Trachurus capensis	2.70	45	4.14	7523
MYCTOPHIDAE	0.60	120	0.92	
Synagrops microlepis	0.60	105	0.92	
Aequorea aequorea	0.00	1960000		
Chrysaora sp	0.00	1200		
Total	65.25		100.00	

PROJECT STATION: 2204

DATE: 26/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 1800
start stop duration Long E 1057
TIME : 21:08:47 21:28:56 20 (min) Purpose code: 1
LOG : 2048.14 2049.21 0.94 Area code : 3
FDEPTH: 110 150 GearCond.code: 1
BDEPTH: 2500 2500 Validity code: 1
Towing dir: 90° Wire out: 300 m Speed: 35 kn*10

Sorted: 34 Kg Total catch: 34.27 CATCH/HOUR: 102.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	93.90	648	91.33	7524
TRACHIPTERIDAE	5.40	3	5.25	
MYCTOPHIDAE	2.82	1059	2.74	
Todarodes sagittatus	0.69	24	0.67	
Aequorea aequorea	0.00	12903		
Total	102.81		99.99	

PROJECT STATION: 2205

DATE: 27/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 1750
start stop duration Long E 1049
TIME : 00:35:48 00:50:44 15 (min) Purpose code: 1
LOG : 2074.15 2075.04 0.82 Area code : 3
FDEPTH: 180 180 GearCond.code: 1
BDEPTH: 1800 1800 Validity code: 1
Towing dir: 166° Wire out: 600 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 262.96 CATCH/HOUR: 1051.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	979.20	6464	93.09	7525
MYCTOPHIDAE	57.92	18112	5.51	
Tetragonurus cuvieri	6.72	32	0.64	
Todarodes sagittatus	5.12	448	0.49	
Krill	2.24	3456	0.21	
PARALEPIDIDAE	0.64	64	0.06	
J E L L Y F I S H	0.00	120		
Total	1051.84		100.00	

PROJECT STATION: 2206

DATE: 27/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 1715
start stop duration Long E 1103
TIME : 09:12:34 09:20:40 8 (min) Purpose code: 1
LOG : 2161.26 2161.72 0.38 Area code : 3
FDEPTH: 180 180 GearCond.code: 1
BDEPTH: - - Validity code: 1
Towing dir: 270° Wire out: 600 m Speed: 40 kn*10

Sorted: 15 Kg Total catch: 50.51 CATCH/HOUR: 378.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	197.40	70500	52.11	
Krill	65.55	133395	17.30	
Trachurus capensis	63.00	458	16.63	7526
Todarodes sagittatus	50.78	1343	13.40	
PARALEPIDIDAE	2.10	210	0.55	
Aequorea aequorea	0.00	3525		
Total	378.83		99.99	

PROJECT STATION: 2207

DATE: 27/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1717

start stop duration Long E 1129

TIME : 14:04.21 14:19.25 15 (min) Purpose code: 1

LOG : 2191.11 2191.85 0.74 Area code : 3

FDEPTH: 162 164 GearCond code: 9

BDEPTH: 162 164 Validity code: 1

Towing dir: 180° Wire out: 550 m Speed: 30 kn*10

Sorted: 30 Kg Total catch: 2185.52 CATCH/HOUR: 8742.08

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	5292.00	100120	60.53	7529
Dentex macrophthalmus	2156.00	19040	24.66	
Merluccius capensis	1036.00	17920	11.85	7527
Merluccius capensis	115.28	160	1.32	7528
Synagrops microlepis	72.80	8400	0.83	
Pterothrissus belloci	50.40	560	0.58	
Trigla lyra	19.60	280	0.22	
Total	8742.08		99.99	

PROJECT STATION: 2208

DATE: 27/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1730

start stop duration Long E 1138

TIME : 18:38.20 18:49.11 11 (min) Purpose code: 1

LOG : 2229.34 2229.99 0.58 Area code : 3

FDEPTH: 109 116 GearCond code: 1

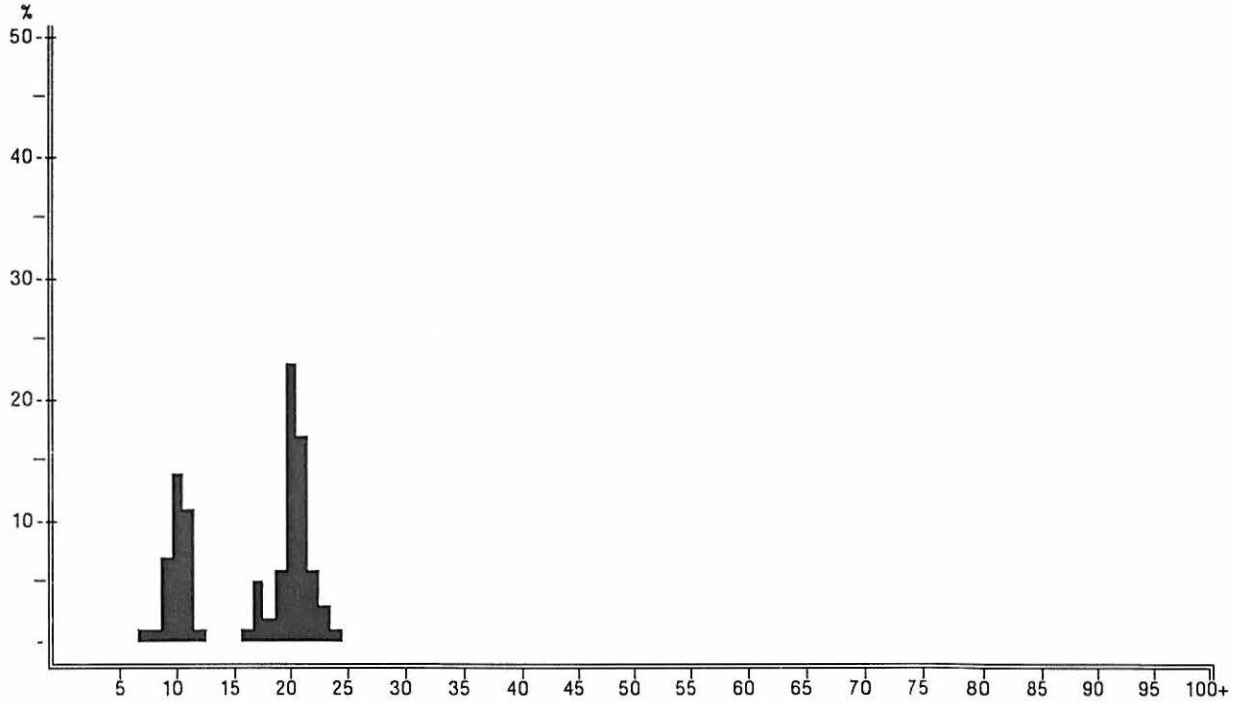
BDEPTH: 109 116 Validity code: 1

Towing dir: 270° Wire out: 400 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 528.66 CATCH/HOUR: 2883.60

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	1400.18	44029	48.56	7531
Dentex macrophthalmus	1140.55	16140	39.55	
Merluccius capensis	270.55	3355	9.38	7530
Pterothrissus belloci	65.84	1020	2.28	
Engraulis capensis	5.56	464	0.19	
Cynoglossus zanzibarensis	0.93	93	0.03	
Total	2883.61		99.99	

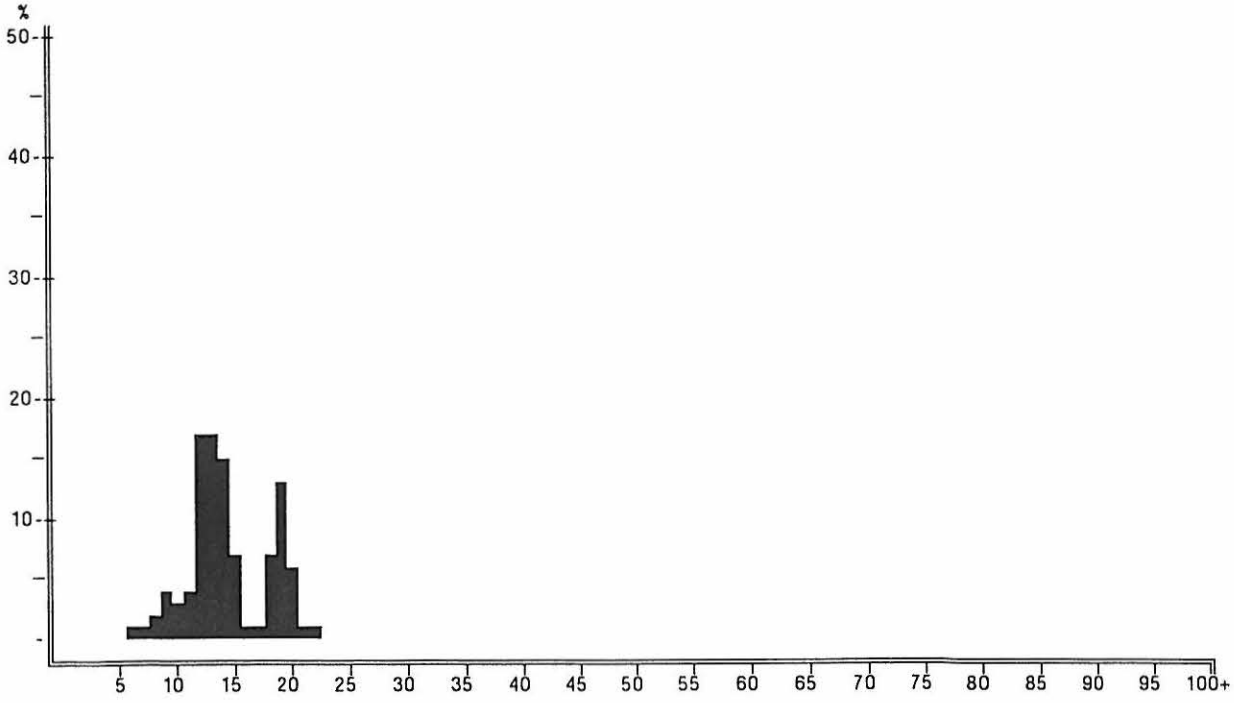
ANNEX VI Size Distribution



Sardinops ocellatus

Pooled sample (simple adding).

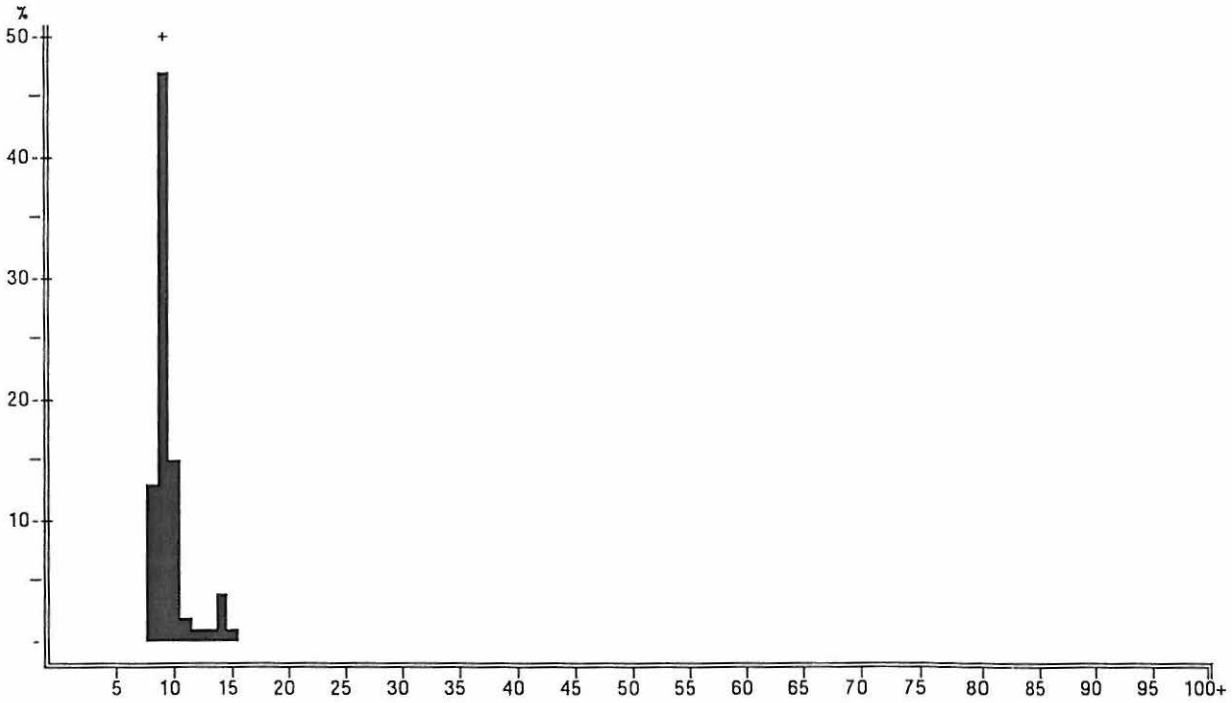
MEAN LENGTH = 17.11cm N= 557
NUMBER OF SUBSAMPLES : 7
SAMPLES FOUND BETWEEN ST. NO.2130 AND 2175.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2208 .



Etrumeus whiteheadi

Pooled sample (simple adding).

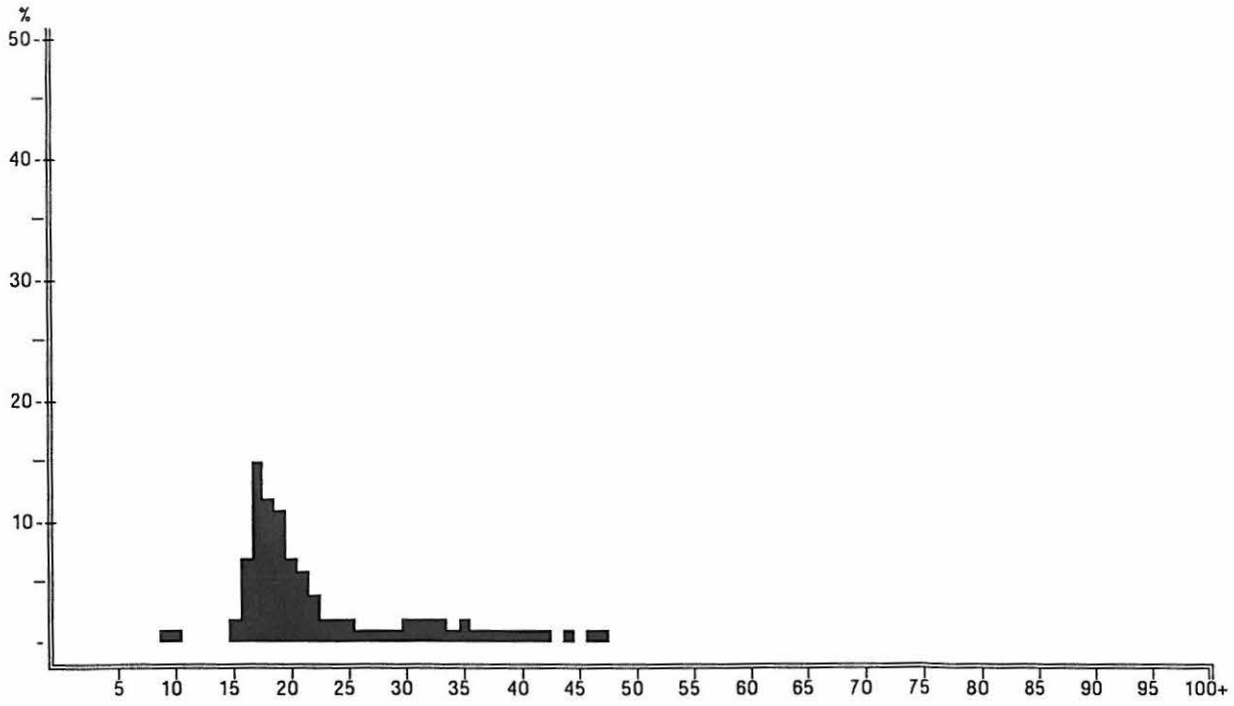
MEAN LENGTH = 14.82cm N= 399
NUMBER OF SUBSAMPLES : 7
SAMPLES FOUND BETWEEN ST. NO.2130 AND 2181.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2208 .



Engraulis capensis

Pooled sample (simple adding).

MEAN LENGTH = 9.90cm N= 157
NUMBER OF SUBSAMPLES : 4
SAMPLES FOUND BETWEEN ST. NO.2148 AND 2175.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2208 .



Merluccius capensis

Pooled sample (simple adding).

MEAN LENGTH = 24.74cm N= 2906
NUMBER OF SUBSAMPLES : 45
SAMPLES FOUND BETWEEN ST. NO.2127 AND 2208.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2228 .

Annex VII Length-weight relationships

Area: 26°00' S - 21°00' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	1.13	1.02	0.9020	0.8163
6	0	1.93	1.76	0.8915	0.8159
7	0	3.03	2.80	0.8827	0.8155
8	4	4.48	4.17	0.8752	0.8152
9	10	6.33	5.94	0.8686	0.8150
10	10	8.63	8.15	0.8628	0.8147
11	2	11.41	10.84	0.8575	0.8145
12	0	14.74	14.07	0.8528	0.8143
13	0	18.64	17.89	0.8484	0.8141
14	0	23.17	22.34	0.8444	0.8140
15	0	28.37	27.47	0.8406	0.8138
16	0	34.29	33.33	0.8372	0.8137
17	0	40.97	39.97	0.8339	0.8135
18	0	48.46	47.44	0.8309	0.8134
19	0	56.79	55.78	0.8280	0.8133
20	1	66.02	65.05	0.8253	0.8132
21	0	76.19	75.30	0.8227	0.8130
22	6	87.34	86.56	0.8203	0.8129
23	11	99.52	98.90	0.8179	0.8128
24	12	112.76	112.35	0.8157	0.8127
25	20	127.12	126.98	0.8136	0.8126
26	10	142.63	142.81	0.8115	0.8126
27	12	159.35	159.92	0.8096	0.8125
28	7	177.30	178.33	0.8077	0.8124
29	12	196.54	198.11	0.8059	0.8123
30	10	217.11	219.30	0.8041	0.8122
31	5	239.05	241.95	0.8024	0.8122
32	3	262.40	266.10	0.8008	0.8121
33	4	287.21	291.81	0.7992	0.8120
34	5	313.52	319.13	0.7977	0.8119
35	8	341.37	348.09	0.7962	0.8119
36	6	370.81	378.76	0.7948	0.8118
37	4	401.87	411.18	0.7934	0.8118
38	6	434.60	445.39	0.7920	0.8117
39	2	469.04	481.45	0.7907	0.8116
40	5	505.23	519.41	0.7894	0.8116
41	2	543.22	559.31	0.7882	0.8115
42	1	583.04	601.20	0.7870	0.8115
43	1	624.74	645.13	0.7858	0.8114
44	0	668.36	691.15	0.7846	0.8114
45	0	713.95	739.30	0.7835	0.8113

W(total) = q * L(i)^ b; q = 0.01, b = 2.935

W(gutted) = q * L(i)^ b; q = 0.0082, b = 2.972

Annex VII Length-weight relationships

SUMMARY OF ALL STATIONS

Area: 26°00' S - 17°15' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	1.00	0.88	0.7975	0.7027
6	1	1.73	1.52	0.7995	0.7053
7	10	2.75	2.43	0.8012	0.7075
8	14	4.11	3.63	0.8027	0.7095
9	13	5.86	5.18	0.8040	0.7112
10	17	8.05	7.13	0.8052	0.7127
11	17	10.73	9.50	0.8062	0.7141
12	21	13.95	12.36	0.8072	0.7154
13	18	17.75	15.74	0.8081	0.7165
14	18	22.20	19.69	0.8089	0.7176
15	19	27.33	24.25	0.8097	0.7186
16	18	33.19	29.47	0.8104	0.7196
17	27	39.85	35.40	0.8111	0.7205
18	26	47.34	42.07	0.8117	0.7213
19	26	55.72	49.53	0.8123	0.7221
20	21	65.03	57.83	0.8129	0.7229
21	19	75.34	67.01	0.8135	0.7236
22	23	86.67	77.12	0.8140	0.7243
23	21	99.10	88.20	0.8145	0.7249
24	27	112.66	100.30	0.8150	0.7255
25	25	127.41	113.46	0.8154	0.7262
26	26	143.40	127.73	0.8159	0.7267
27	27	160.67	143.15	0.8163	0.7273
28	18	179.28	159.77	0.8167	0.7278
29	10	199.28	177.64	0.8171	0.7284
30	4	220.72	196.79	0.8175	0.7289
31	6	243.65	217.28	0.8179	0.7293
32	1	268.11	239.15	0.8182	0.7298
33	7	294.17	262.44	0.8186	0.7303
34	4	321.86	287.20	0.8189	0.7307
35	9	351.24	313.48	0.8192	0.7312
36	7	382.37	341.32	0.8195	0.7316
37	4	415.28	370.77	0.8199	0.7320
38	10	450.04	401.87	0.8202	0.7324
39	6	486.68	434.67	0.8204	0.7328
40	6	525.27	469.21	0.8207	0.7331
41	3	565.85	505.55	0.8210	0.7335
42	0	608.48	543.71	0.8213	0.7339
43	0	653.19	583.76	0.8216	0.7342
44	0	700.06	625.74	0.8218	0.7346
45	0	749.11	669.69	0.8221	0.7349

W(total) = q * L(i)^ b; q = 0.0075, b = 3.0138

W(gutted) = q * L(i)^ b; q = 0.0068, b = 3.0204

Annex VII Length-weight relationships

Area: 21°00' S -19°00' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	0.94	0.89	0.7509	0.7089
6	0	1.63	1.54	0.7557	0.7135
7	0	2.61	2.46	0.7597	0.7174
8	0	3.91	3.69	0.7633	0.7207
9	1	5.59	5.28	0.7664	0.7237
10	7	7.69	7.26	0.7692	0.7264
11	10	10.27	9.70	0.7718	0.7288
12	11	13.38	12.63	0.7741	0.7311
13	10	17.06	16.11	0.7763	0.7331
14	10	21.36	20.17	0.7783	0.7350
15	12	26.33	24.87	0.7802	0.7368
16	10	32.03	30.25	0.7819	0.7385
17	11	38.50	36.36	0.7836	0.7401
18	7	45.79	43.25	0.7851	0.7415
19	11	53.95	50.96	0.7866	0.7429
20	9	63.04	59.54	0.7880	0.7443
21	9	73.10	69.05	0.7894	0.7456
22	10	84.19	79.52	0.7906	0.7468
23	10	96.35	91.00	0.7919	0.7479
24	11	109.63	103.55	0.7930	0.7491
25	10	124.09	117.21	0.7942	0.7501
26	10	139.77	132.03	0.7952	0.7512
27	10	156.73	148.05	0.7963	0.7522
28	10	175.02	165.33	0.7973	0.7531
29	7	194.69	183.91	0.7983	0.7541
30	3	215.79	203.84	0.7992	0.7550
31	6	238.37	225.17	0.8001	0.7558
32	1	262.47	247.95	0.8010	0.7567
33	7	288.17	272.22	0.8019	0.7575
34	4	315.49	298.03	0.8027	0.7583
35	9	344.51	325.44	0.8035	0.7591
36	7	375.25	354.49	0.8043	0.7598
37	4	407.79	385.23	0.8051	0.7605
38	10	442.17	417.71	0.8058	0.7612
39	6	478.43	451.98	0.8065	0.7619
40	6	516.64	488.08	0.8073	0.7626
41	3	556.85	526.06	0.8079	0.7633
42	0	599.09	565.98	0.8086	0.7639
43	0	643.44	607.88	0.8093	0.7646
44	0	689.94	651.81	0.8099	0.7652
45	0	738.63	697.81	0.8106	0.7658

W(total) = q * L(i)^ b; q = 0.0071, b = 3.0348

W(gutted) = q * L(i)^ b; q = 0.0067, b = 3.0351

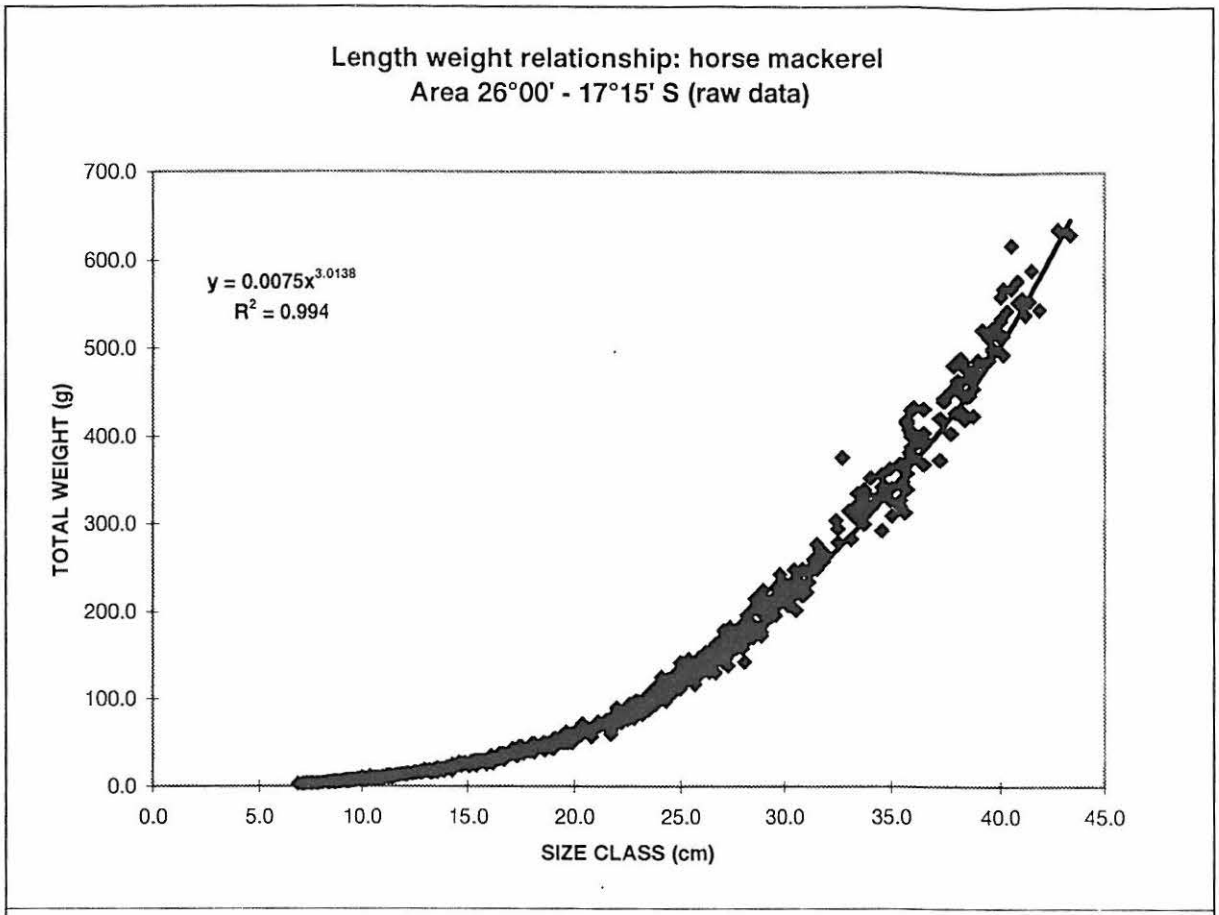
Annex VII Length-weight relationships

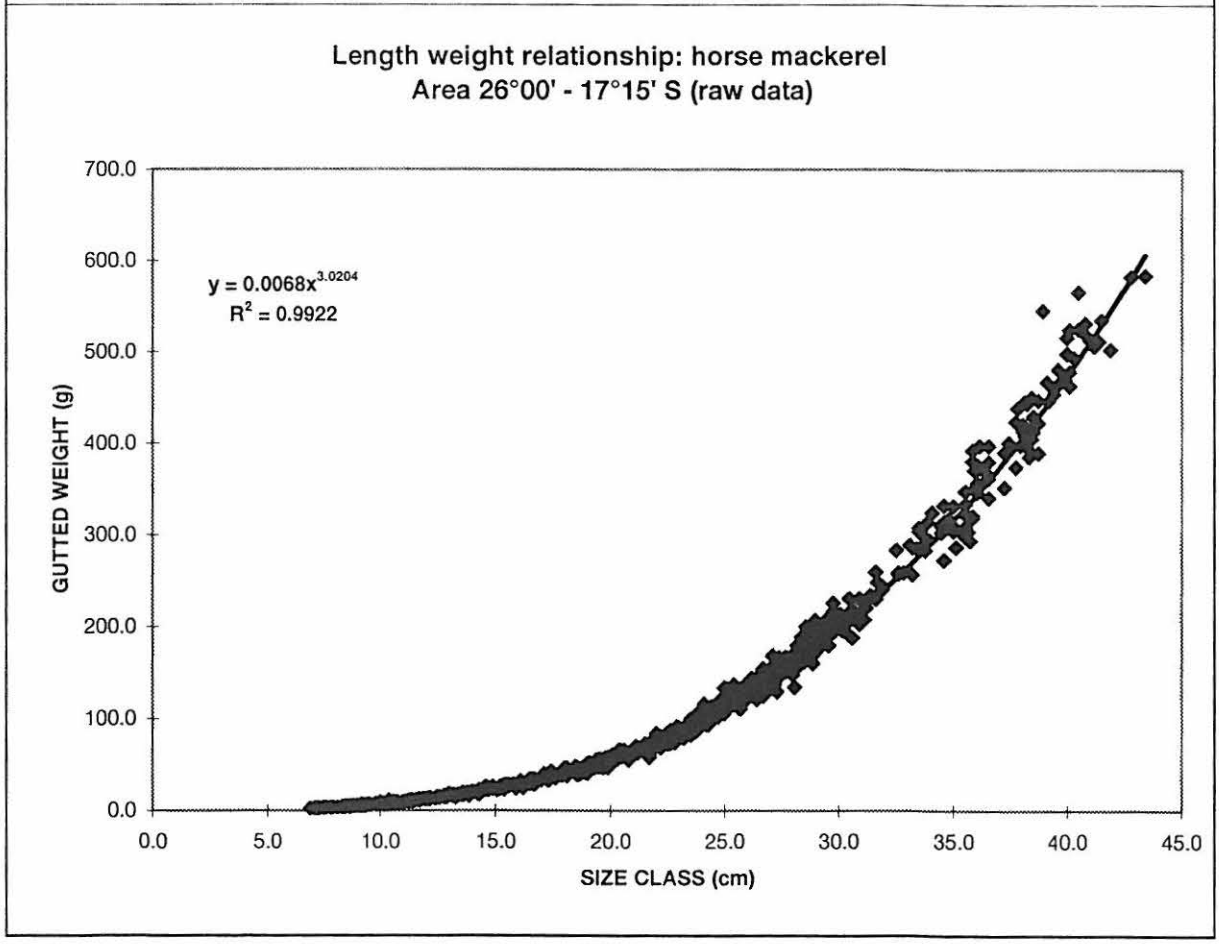
Area: 19°00' S -17°15' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	0.97	0.90	0.7758	0.7166
6	1	1.67	1.54	0.7720	0.7140
7	10	2.64	2.44	0.7688	0.7118
8	10	3.92	3.63	0.7661	0.7099
9	12	5.57	5.16	0.7637	0.7082
10	10	7.62	7.07	0.7615	0.7067
11	7	10.11	9.39	0.7596	0.7053
12	10	13.10	12.17	0.7578	0.7041
13	8	16.61	15.44	0.7562	0.7030
14	8	20.71	19.26	0.7547	0.7020
15	7	25.42	23.66	0.7533	0.7010
16	8	30.80	28.68	0.7520	0.7001
17	16	36.89	34.35	0.7508	0.6992
18	19	43.72	40.73	0.7496	0.6984
19	15	51.34	47.85	0.7485	0.6977
20	12	59.80	55.76	0.7475	0.6970
21	10	69.14	64.48	0.7465	0.6963
22	13	79.39	74.07	0.7456	0.6956
23	11	90.61	84.56	0.7447	0.6950
24	16	102.83	96.00	0.7439	0.6944
25	15	116.10	108.42	0.7431	0.6939
26	16	130.46	121.86	0.7423	0.6933
27	17	145.95	136.36	0.7415	0.6928
28	8	162.62	151.97	0.7408	0.6923
29	3	180.50	168.72	0.7401	0.6918
30	1	199.65	186.66	0.7394	0.6913
31	0	220.09	205.82	0.7388	0.6909
32	0	241.88	226.24	0.7382	0.6904
33	0	265.05	247.97	0.7375	0.6900
34	0	289.65	271.04	0.7370	0.6896
35	0	315.72	295.50	0.7364	0.6892
36	0	343.31	321.38	0.7358	0.6888
37	0	372.45	348.72	0.7353	0.6884
38	0	403.18	377.56	0.7348	0.6881
39	0	435.55	407.95	0.7343	0.6877
40	0	469.60	439.92	0.7338	0.6874
41	0	505.38	473.51	0.7333	0.6870
42	0	542.91	508.76	0.7328	0.6867
43	0	582.26	545.72	0.7323	0.6864
44	0	623.45	584.41	0.7319	0.6861
45	0	666.53	624.89	0.7314	0.6858

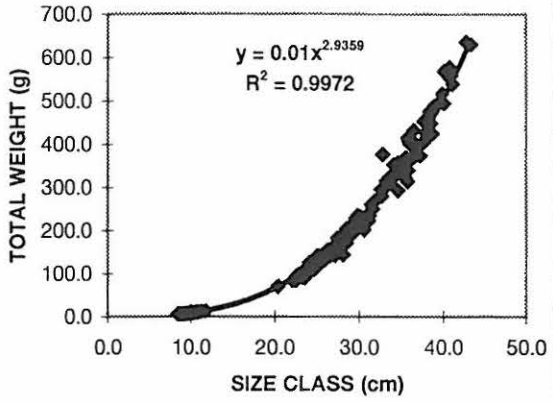
W(total) = q * L(i)^ b; q = 0.0081, b = 2.9732

W(gutted) = q * L(i)^ b; q = 0.0074, b = 2.98

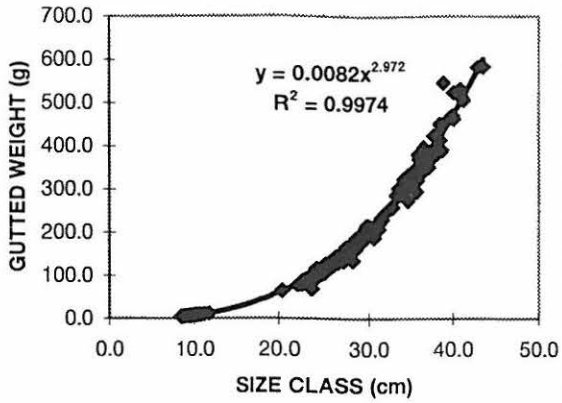

Length weight relationship: horse mackerel
Area 26°00' - 17°15' S (raw data)
y = 0.0075x^3.0138
R² = 0.994
TOTAL WEIGHT (g)
SIZE CLASS (cm)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


Length weight relationship: horse mackerel
Area 26°00' - 17°15' S (raw data)
y = 0.0068x^3.0204
R² = 0.9922
GUTTED WEIGHT (g)
SIZE CLASS (cm)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

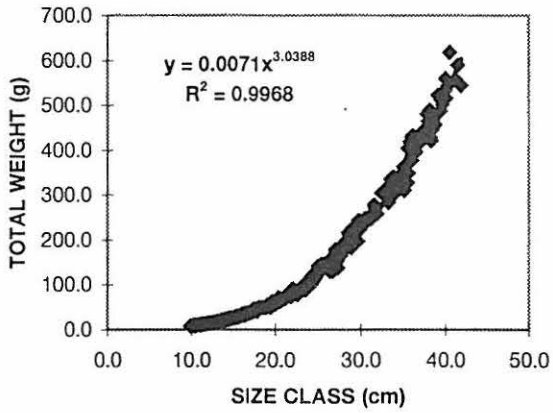
Lenght weight relationship: horse mackerel: Area 26°00' - 21°00' S (raw data)



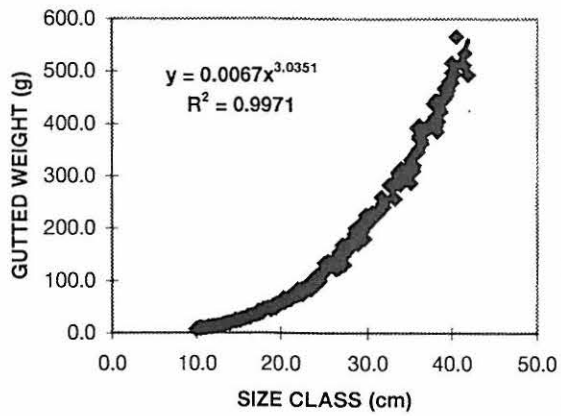
Length weight relationship:horse mackerel: Area 26°00' - 21°00' S (raw data)



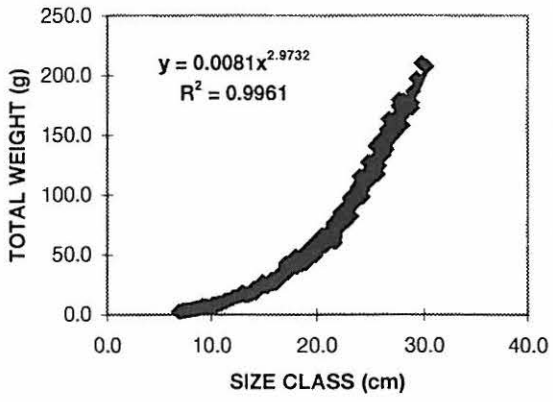
Length weight relationship: horse mackerel: Area 21°00' - 19°00' S (raw data)



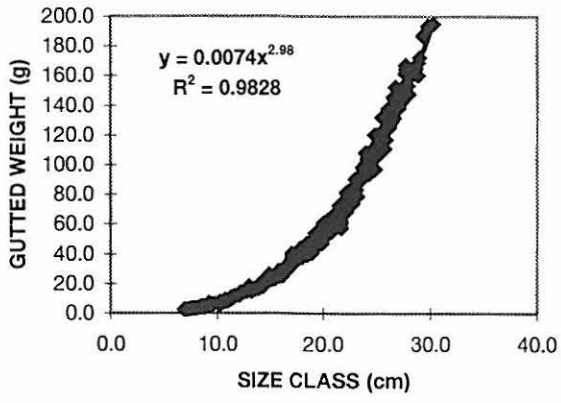
Length weight relationship : horse mackerel: Area 21°00' - 19°00' S (raw data)



Length weight relationship: horse mackerel : Area 19°00' - 17°15' S (raw data)



Lenght weight relationship: horse mackerel: Area19°00' - 17°15' S (raw data)



Annex VIII Reproductive Status

Area: 17°15' S - 26°00' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentage of fish per maturity stage						
			Lowest	Higest	1	2	3	4	5	6	7
< 6	2	1	2	2	100						
6 - 6.9	3	10	2	4	100						
7 -7.9	5	14	4	6	100						
8 - 8.9	7	23	5	8	100						
9 - 9.9	9	26	6	11	96						4
10 - 10.9	18	19	8	136	100						
11 - 11.9	14	21	10	17	100						
12 - 12.9	18	18	14	21	100						
13 - 13.9	23	18	18	27	100						
14 - 14.9	27	19	21	29	100						
15 - 15.9	33	18	26	37	94	6					
16 - 16.9	44	28	35	160	21	79					
17 - 17.9	46	30	39	51	20	67	13				
18 - 18.9	54	25	42	62	4	88	4				4
19 - 19.9	62	22	52	71	5	68	18	5			5
20 - 20.9	72	18	64	79		61	28				11
21 - 21.9	84	29	73	98		31	41				28
22 - 22.9	104	32	82	290		9	75				16
23 - 23.9	115	38	98	144		11	42	3	3		42
24 - 24.9	130	45	112	147		7	58	4			31
25 -25.9	147	36	130	163			47	6			47
26 - 26.9	163	38	138	182		5	53	3			39
27 - 27.9	184	25	143	215			60	4			36
28 - 28.9	207	23	123	243		4	43	13			39
29 - 29.9	224	14	202	249			43				57
30 - 30.9	253	11	222	277			36				64
31 - 31.9	292	3	276	304			67				33
32 - 32.9	313	12	277	339			67		8		25
33 - 33.9	334	9	293	357			78			11	11
34 - 34.9	361	16	310	418			38	19		6	38
35 - 35.9	400	13	368	432			62	23			15
36 - 36.9	430	8	373	481			13	38		25	25
37 - 37.9	459	16	420	488			75	19		3	3
38 - 38.9	505	8	483	524			50	25	13	6	7
39 -39.9	542	11	460	618			55	36		5	5
40 -40.9	557	5	538	589			80	20			
41 - 41.9	635	1	635	635			100				
42 -42.9	630	1	630	630			100				

Area: 17°15' S - 18°46' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentage of fish per maturity stage						
			Lowest	Higest	1	2	3	4	5	6	7
< 6	2	1	2	2	100						
6 - 6.9	3	10	2	4	100						
7 -7.9	5	10	4	5	100						
8 - 8.9	6	12	5	7	100						
9 - 9.9	8	10	6	9	100						
10 - 10.9	11	7	8	12	100						
11 - 11.9	14	10	10	17	100						
12 - 12.9	17	8	14	19	100						
13 - 13.9	22	8	18	27	100						
14 - 14.9	26	7	23	29	100						
15 - 15.9	31	8	26	35	100						
16 - 16.9	45	17	35	160	29	71					
17 - 17.9	45	19	39	50	26	53	21				
18 - 18.9	52	15	42	60	7	87					7
19 - 19.9	60	12	52	66		83	8	8			
20 - 20.9	71	9	64	76		78	22				
21 - 21.9	81	13	73	89		31	46				23
22 - 22.9	95	11	82	106		18	73				9
23 - 23.9	112	16	98	127		6	50	6			38
24 - 24.9	126	15	112	143			60	7			33
25 -25.9	146	16	137	163			31	13			56
26 - 26.9	162	16	148	179		6	56	6			31
27 - 27.9	174	8	158	179			50	13			38
28 -28.9	198	3	186	210							100
29 - 29.9	207	1	207	207							100

Area: 18°46' S - 21°00' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentages of fish per maturity stage						
			Lowest	Higest	1	2	3	4	5	6	7
8 - 8.9	8	1	8	8	100						
9 - 9.9	9	7	8	11	100						
10 - 10.9	12	10	10	14	100						
11 - 11.9	15	11	13	16	100						
12 - 12.9	19	10	16	21	100						
13 - 13.9	23	10	19	27	100						
14 - 14.9	28	12	21	29	100						
15 - 15.9	34	10	31	37	90	10					
16 - 16.9	41	11	36	46	9	91					
17 - 17.9	49	11	46	51	9	91					
18 - 18.9	57	10	54	62		90	10				
19 - 19.9	63	9	56	71	11	56	33				
20 - 20.9	74	9	68	79		44	33				23
21 - 21.9	83	9	78	87		44	56				
22 - 22.9	97	10	88	105			90				10
23 - 23.9	118	9	100	144		11	44		12		33
24 - 24.9	140	9	131	147		22	56				22
25 -25.9	149	8	130	161			50				50
26 - 26.9	167	8	153	178		13	75				13
27 - 27.9	197	8	183	209			75				25
28 - 28.9	206	8	123	243			38	38			25
29 - 29.9	245	3	239	249			67				33
30 - 30.9	259	6	246	277			50				50
31 - 31.9	304	1	304	304			100				
32 - 32.9	318	7	283	339			71			14	15
33 - 33.9	339	4	328	343			75				25
34 - 34.9	361	8	310	418			38	38		12	12
35 - 35.9	402	7	376	432			43	43		14	
36 - 36.9	446	4	420	481				50		25	25
37 - 37.9	457	10	420	488			70	20		10	
38 - 38.9	505	6	483	524			50	33		17	
39 -39.9	534	6	460	618			50	50			
40 -40.9	562	3	544	589			67	33			

Area: 21°00' S - 26°00' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentage of fish per maturity stage						
			Lowest	Highest	1	2	3	4	5	6	7
< 8	5	4	5	6	100						
8 - 8.9	7	10	6	8	100						
9 - 9.9	9	9	8	10	89						11
10 - 10.9	74	2	12	136	100						
19 -19.9	69	1	69	69							100
21 - 21.9	90	7	83	98		14	14				71
22 - 22.5	119	11	91	290		9	64				27
23 - 23.5	117	13	105	131		15	31				54
24 - 24.9	128	21	114	141		5	57	5			33
25 - 25.9	147	12	130	161			67				33
26 - 26.9	161	14	138	182			36				64
27 - 27.9	183	9	143	215			56				44
28 - 28.9	210	12	192	234		8	58				33
29 - 29.9	219	10	202	231			40				60
30 - 30.9	247	5	222	268			20				80
31 - 31.9	286	2	276	295			50				50
32 - 32.9	307	5	277	323			60		20		20
33 - 33.9	331	5	293	357			80				20
34 - 34.9	361	8	313	415			38			12	50
35 - 35.9	399	6	368	431			83				17
36 - 36.9	414	4	373	451			25	25			50
37 - 37.9	462	6	424	488			83	17			
38 - 38.9	507	2	498	515			50		50		
39 - 39.9	552	5	494	577			60	20			20
40 - 40.9	548	2	538	558			100				
41 - 41.9	635	1	635	635			100				
42 - 42.9	630	1	630	630			100				

Annex IX Maturity stages

The following seven stage scale was used in the investigation to determine reproductive stage of the horse mackerel during the **1997 June** hydro-acoustic horse mackerel survey. Horse mackerel stages accxording to Hecht (1976) and modified in 1997.

JUVENILE/IMMATURE/SUB-ADULTS

0 **UNKNOWN**
Damaged fish; decayed.

1 **JUVENILE**
Not able to distinguish between male or female.
Approximately: 0.1 - 14cm fish.

2 **IMMATURE**
Gonads are very small, less than half the body cavity length, and flattened or tubular ie. thin and thread-like. The colour of the gonads is translucent. Sexes easy to distinguish. Approximately: 14 - 20cm fish.
Ovaries: Light orange gelatinous mass. Cannot sea eggs with the naked eye.
Testes: Translucent-white; thin, elongate balloon-like.

ADULT FISH

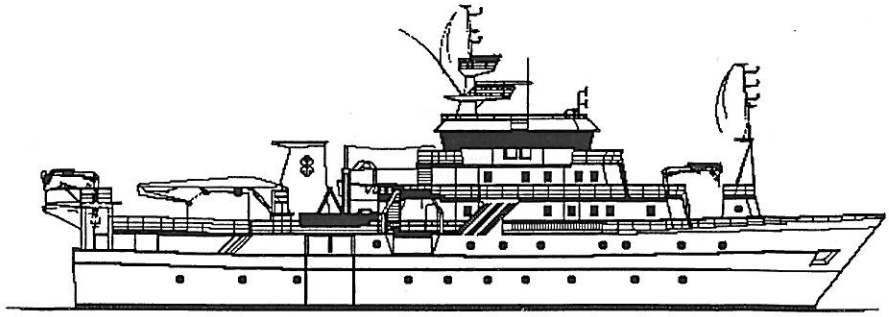
3 **RECOVERING\INACTIVE**
Gonads are slightly larger than stage 2, approximately half of body cavity length, but still generally flat. Colour more pronounced.
Ovaries: Pale reddish tint back to orange colour.
Testes: Creamy-white colour and very flat (lobe like) with sharp edges.

4 **MATURING**
Gonads longer than half body cavity length and becoming cylindrical.
Ovaries: Individual eggs clearly visible. Colour orange. Blood vessels marked. Spindle shaped.
Testes: White to cream/testes more swollen. Spindle shaped.

5 **RIPE**
Gonads very large, virtually filling body cavity, even causing distension of bdomen.
Ovaries: Individual eggs almost 0.5 mm or larger and lightly elongated. Ovary sac breaks realising eggs. Colour is a dark orange.
Testes: Cream, releases milt when punctured.

6 **SPAWNING\RUNNING**
Eggs or milt released through vent during handling ie. running.
Ovaries: Ovary is dark orange and greatly swollen. Could also be partly spent.
Testis: External appearance changes from smooth structure to white and knob-like. Swollen to partly spent.

7 **SPENT**
Ovaries: Gonads flattened, but still elongated. Very blood-shot (dark red). Few eggs remaining appear grey\brown.
Testis: The testis are deflated and grey in colour.



SURVEYS OF FISH RESOURCES OF NAMIBIA

Cruise Report No 2/97

Survey of the horse mackerel resources

10 - 29 June 1997

Ministry of Fisheries & Resources
Swakopmund, Namibia

Institute of Marine Research
Bergen, Norway

CRUISE REPORT "DR. FRIDTJOF NANSEN"

SURVEYS OF THE FISH RESOURCES OF NAMIBIA

Cruise Report No 3/97

Survey of the horse mackerel resources

10 - 29 June 1997

by

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TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION

1.1 Objectives

1. Carry out a hydro-acoustic survey on the pelagic and mid-water horse mackerel (*Trachurus capensis*), to:

   determine the abundance and spatial and vertical distribution of the exploited stock

   determine the size composition of the stock

   obtain length-weight relationships

   obtain biological information (sex ratio, reproductive stages and gonad weight)

2. Determine size composition and distribution of the other small pelagic species (pilchard, anchovy and round herring). In addition the size composition and distribution other demersal species such as hake as well as the distribution of alfonsino were also recorded during the survey.

3. Collect data on the basic oceanographic parameters per degree latitude, namely:

   temperature

   dissolved oxygen

   salinity

1.2 Participation

The scientific staff from the National Marine Information and Research Centre (NatMIRC), Swakopmund, Namibia were:

Ekkehard KLINGELHOEFFER (Team leader), Bernhard VASKE, Niels LETH, Justina SHIFIDI, Michael EVENSON, Theopelus KAIRUA and Shaun WELLS.

The scientific staff from the Institute of Marine Research (IMR), Bergen, Norway, were:

Johannes HAMRE (Cruise leader), Oddgeir ALVHEIM, Martin DAHL and Jarle KRISTIANSEN.

1.3 Schedule

The RV 'Dr. Fridtjof Nansen' left Walvis Bay at 17h00 on 10 June 1997 and steamed south-west to 26°00' S. From Walvis Bay on the way south the survey was initiated and the integrator values were recorded. The first CTD line commenced offshore at 26°00' S, 130 NM from the coast at a bottom depth of 2100 m.

The survey followed a systematic parallel grid of 20 nautical miles (NM) apart for the offshore regions from 26°00' S to 21°00' S. For the inshore region at less than 100 m bottom depth a survey grid of systematic square tracks was used. In the region between 21°00' S and 17°15' S the same grid pattern was used except that the distance between the offshore grid lines was reduced from 20 NM to 15 NM (Figure 1a).

The RV 'Dr. Fridtjof Nansen' arrived in Walvis Bay on 10 June. A total of 4200 NM were steamed.

1.4 Survey effort

The course track with the trawl stations and CTD stations is presented in Figure 1a and b. The number of hauls and CTD stations by area and gear type are listed in Table 1 below.

Table 1: Number of CTD and trawls stations, June 1997 survey.

Area	Bottom trawls (Bt)	Pelagic trawls (Pt)	Trawl failure (Bt)	Trawl failure (Pt)	Total no. of trawls	CTD stations
26°00'-21°00'	14	15	1	1	31	38
21°00'-17°15'	24	26	0	0	50	33
TOTAL	38	41	1	1	81	61

1.5 Survey design

To determine whether adult horse mackerel had migrated further offshore south of Walvis Bay, the initial survey was designed as follows:

* to proceed from Walvis Bay in a south westerly direction to a position 130 NM offshore to a latitude of 26°00' S at a bottom depth of 2100 m.

With the above survey design it was therefore possible to cover a large offshore area south of Walvis Bay.

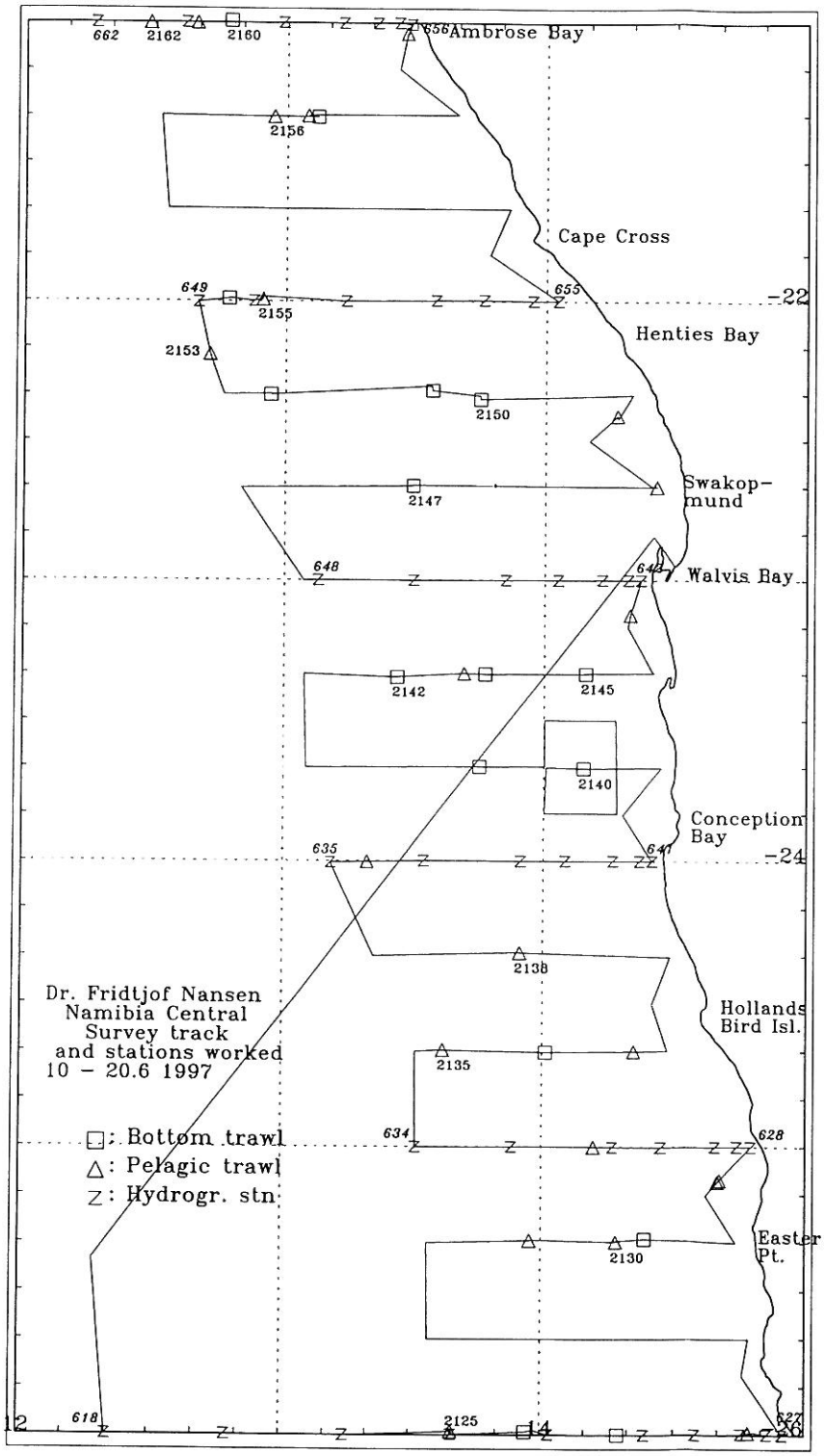


Figure 1a. Course track and fishing stations, Dolphin Head to Ambrose Bay.

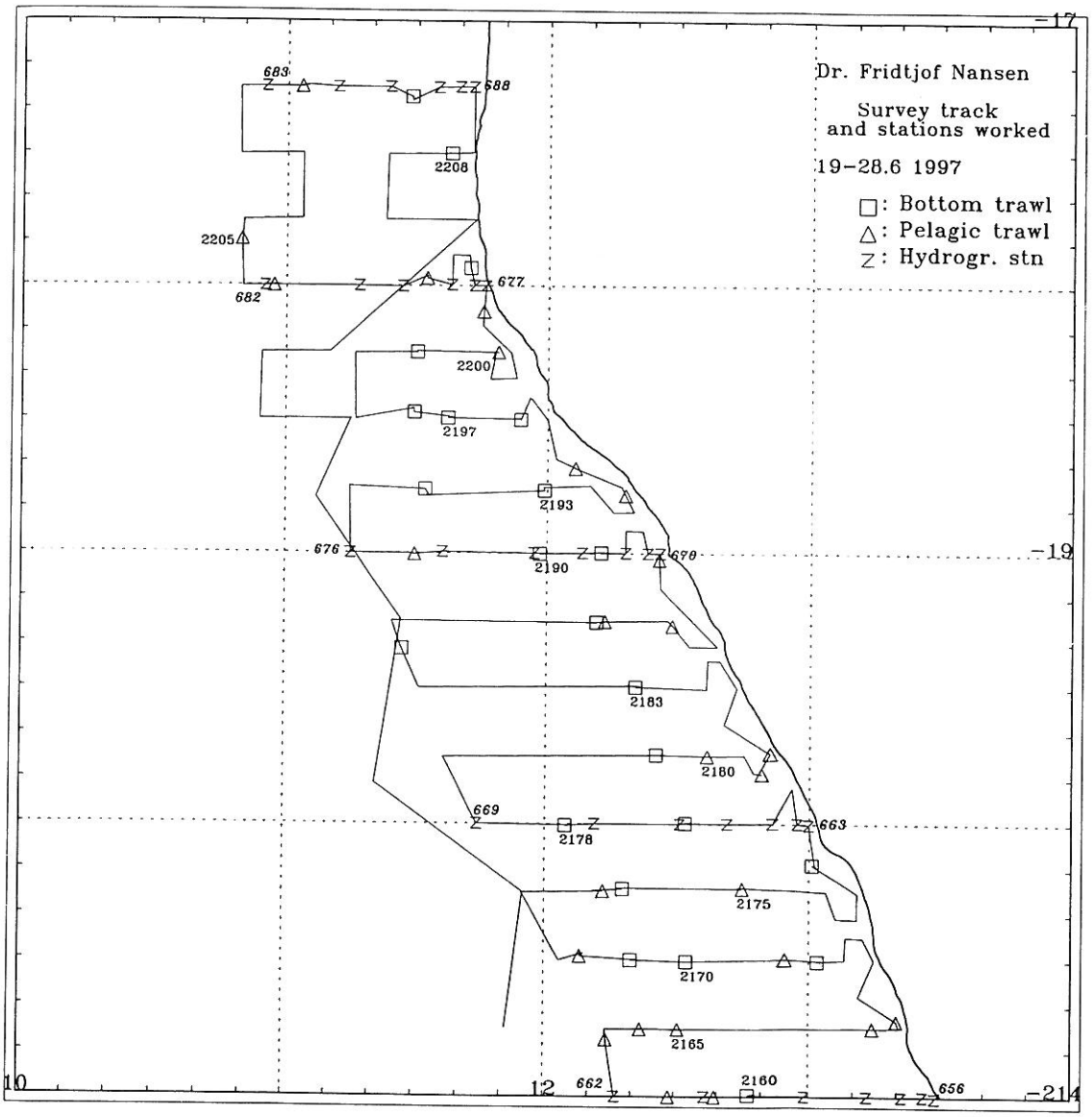


Figure 1b. Course track and fishing stations, Ambrose Bay to Cunene River.

CHAPTER 2 METHODS

2.1 Hydrographic sampling

2.1.1 Hydrography

A Seabird 911+ CTD probe was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. A total of 61 CTD stations were worked along 10 hydrographic sections from 26°00' S to 17°15' S (Annex II). At each degree latitude CTD stations were carried out at the following distances from the coast: 2, 5, 10, 20, 30, 50 and 70 NM, except at the 18°00' S and 17°15' S CTD line only five stations were taken i.e. 2 - 50 NM. Additional three offshore stations were included at 26°00' S (Annex 2) and Figures 1a - b. At each station two 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, these samples were analysed for dissolved oxygen using the Winkler method and salinity using a PORTASAL mod. 8410 salinometer.

Sea temperature at 5 m depth was recorded continuously during the cruise (Annex II).

2.2 Distribution and abundance estimation

2.2.1 Survey area

The limits of the survey area were determined from the previous data of pelagic and mid-water fish distribution, i.e. the area from the Lüderitz upwelling cell (26°00' S) to the border between Namibia and Angola (17°15' S) was surveyed. The survey followed a systematic parallel grid of 20 NM apart from 26°00' to 21°00' S and 15 NM apart from 21°00' to 17°15' S, due to the greater abundance of horse mackerel in the region north of 21°00' S. The inshore area of the survey was limited to approximately 2 NM from the coast. At less than 100 m bottom depth a survey grid of systematic square tracks (Figures 1a - b) was used to obtain a better coverage of the inshore juvenile horse mackerel. On average the offshore area surveyed extended to a bottom depth of close to the 600 m isobath. However, between 17°15' S and close to 19°00' S the survey was extended further offshore to a bottom depth up to 3000 m.

To allow comparison with previous pelagic fish surveys, the distribution maps are provided for the following two major regions:

26°00' to 21°00' S	Dolphin Head to Ambrose Bay
21°00' to 17°15' S	Ambrose Bay to Cunene River

The course tracks with the trawling and CTD stations for the two regions are shown in Figures 1a-b, respectively.

2.2.2 Acoustic methodology

A description of the acoustic instruments and their standard settings are given in Annex I, including a description of the fishing gear used.

An acoustic echo-integration system provided measurements of fish densities, averaged over 5 NM distances. The acoustic unit measured by this calibrated echo- integrator system is the area backscattering coefficient, S_A.

The scrutinising process of the Bergen Echo Integrator, BEI, was used to partition integrator data to species or species groups by separating echo recordings horizontally or vertically. Integrator data from fish targets were allocated to the following groups on the basis of trawl sampling and acoustic character, as recognised from the echo recordings:

Juvenile horse mackerel (≤ 21 cm)
Juvenile and maturing horse mackerel (≥ 21 cm)
Pelagic 1 (pilchard, anchovy and round herring)
Pilchard
Pelagic mix
Gobies
Other demersal species (mainly juvenile hake)
Plankton and mesopelagic
Mesopelagic
Alfonsino (*Beryx splendens*)
Dentex

For consistency with the calculations in previous acoustic surveys the horse mackerel above 21 cm has been classified a maturing/adult and those fish less than or equal to 20 cm as juveniles. Maps containing these integrator data were drawn for horse mackerel, juvenile hake and clupeoid fishes and from these records the distribution of the fish was indicated .

Areas of fish distribution were divided into smaller units if significant differences were observed in the density of the fish and the average lengths of the fish in a specific area. The average S_A-values within an unit were then obtained by averaging all data measured during the coverage of that area, excluding those values obtained between the course line. The area was calculated in cm^2 with a planimeter and converted to NM^2.

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

$$TS = 20 \log L - 72 \quad [dB]$$

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

where L is the length of the fish, expressed in centimetres and C_F the conversion factor. This target strength to size relationship has been used for a number of fish species (horse mackerel, pilchard, anchovy and round herring), although originally derivated from earlier measurements of North Sea herring. Experiments in the past have been carried out to determine the validity of the target strength presently used for the Cape horse mackerel. The target strength of the North Sea herring will however, be used until a more specific target strength for horse mackerel is determined.

The number of fish in each length frequency group (cm) in an area was calculated by applying the following formula:

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

where
- N_i = number of fish in length group i
- A = area in NM^2
- S_A = mean integrator value in the area
- P_i = proportion of fish in length group i in samples from the area
- C_{Fi} = fish conversion factor for length group i

The number per length group was then summed and the total number of fish obtained. The total biomass of fish was computed using the mean weight per length group obtained from trawl samples.

2.2.3 Biological sampling

Trawl sampling strategy

A representative sample of one to three baskets was taken from each trawl catch depending on the size and composition of the total catch. To ensure that the sample is representative the catch was well mixed. The random sample was then used in order to determine the species composition and the size composition.

The procedures to determine the size composition for all commercial species were as follows:

- Total length (Lt):
  100 horse mackerel per sample for total length
  50 fish per sample for: pilchard, anchovy, round herring, orange roughy and hake
- Measurement:
  Recorded to the nearest 1.0 cm below for both the pelagic species (horse mackerel, round herring, anchovy and pilchard) and hake.
- Weight:
  Total weight of measured fish sampled in kg

Biological data (horse mackerel)

Biological data were collected for the target species, Cape horse mackerel and included the following parameters:

- Size composition:

  10 fish per cm class were recorded to the nearest 1 mm below;

- Fish weight:

  Total and gutted weight of 10 fish per cm class were recorded to the nearest 1 mg below;

- Reproductive stages and sex determination:

  The seven stage category as listed in Annex IX was used to describe the reproductive stage of the horse mackerel;

Sex identification was classified as: Juvenile (0), Male (1), Female (2)

- Gonad weight:

  Ovary and testes weight of 10 fish per cm class were recorded to the nearest 1 mg below;

- Otolith sampling:

  Five fish per cm class

  Both otoliths of the fish were collected

  Otoliths were stored in envelopes

  Only the station number and numerical number was recorded on the envelope. The numerical number used on the envelope corresponded to the numerical number on a work sheet containing the biological information listed above;

Processing of biological data

Due to the scarcity of horse mackerel south of 21°00' S size composition, length weight, maturity stages and sex ratio were pooled for the area 26°00' S- 21°00' S. All horse mackerel data for the area north of 21°00' S were pooled per two degree where the horse mackerel was found to occur in a greater abundance. Size composition:

- Size composition

Size frequency data and trawl station data were entered onto the NAN-SIS data base, for all station i.e. 2125 - 2208. Total length frequency distributions for the inshore (30 - 200 m), offshore (200-600 m) and far offshore (2000 -3000 m) areas (Figure 6) as well as for sub areas according to Latitude (Annex III) have been calculated using the S_A values as weighting factors for combining length samples for individual trawl stations.

Size composition of the other pelagic (pilchard) and demersal (hake), were pooled by simple adding of all stations in which pilchard and hake were recorded (Annex VI).

- Length\weight relationship:

The length/weight relationship of horse mackerel was pooled per two degree latitude for the area north of 21°00' S. The total length/total weight relationships for the horse mackerel were calculated by fitting power curves to the weight-length regressions (Annex VII). Observed weight by length groups (cm) was used in the biomass calculation.

All length/weight data was processed on Microsoft Excel spreadsheets.

CHAPTER 3 RESULTS

3.1 Hydrography

The results of the CTD measurements are shown in Annex II.

An upwelling structure is clearly seen in the vertical sections of temperature and oxygen. The salinity in the upper layer was quite homogenous.

Salinity values ranged from 35.0 in the south (26°00' S) to 35.6 in the north (17°15' S) which are typically characteristics of cold and slightly warmer water masses.

In the oxygen sections a minimum with values below 1 ml/l was observed at sea bottom along the entire shelf. However, it seems to appear throughout the shelf area that oxygen minimum layer (i.e. below 1 ml/l) was less than 50 m thick, with bottom values between 0.5 and 1 ml/l.

The horizontal distribution of surface temperature (Figure 2a-b) confirm strong upwelling along the entire coast, with SST near the coast was 12 - 13°C (12°C in the extreme south), increasing to only 15°C near the Cunene River some 70 NM from the coast.

3.2 Distribution

The distribution patterns of the horse mackerel and clupeoid fishes (pilchard, round herring and anchovy) are shown in Figures 3a-b and 4a-b. The scale used in the distribution charts to illustrate different levels of density is presented in absolute acoustic units, which is the mean integrator value S_A for a given area.

Juvenile horse mackerel (≤ 21 cm) were recorded in inshore waters forming shoals from near the surface to bottom The juvenile/maturing horse mackerel ≥21 cm was found more offshore on the shelf at intermediate depths. In a far offshore region north of 18°30' S between 2000 - 3000 m bottom depth, a new distribution area of maturing horse mackerel was discovered. This component had a modal length of 26 cm and occurred in a narrow band of some 10 NM wide, extending from 18°30' S to the Angola border (Figure 3 b), where the survey could not be extended into southern Angola.

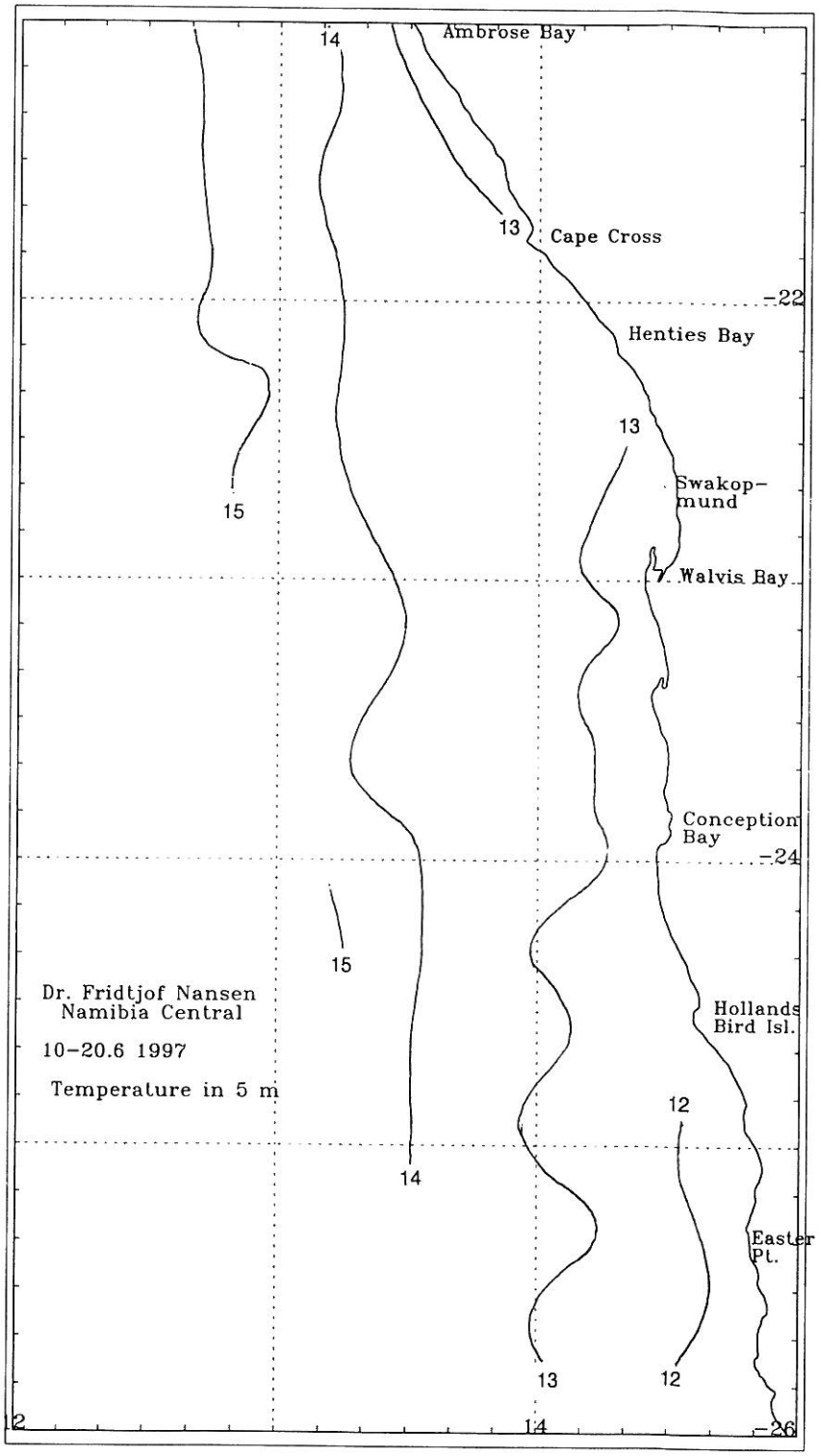


Figure 2a Distribution of sea temperature at 5 m depth: 26 °00' to 21°00' S.

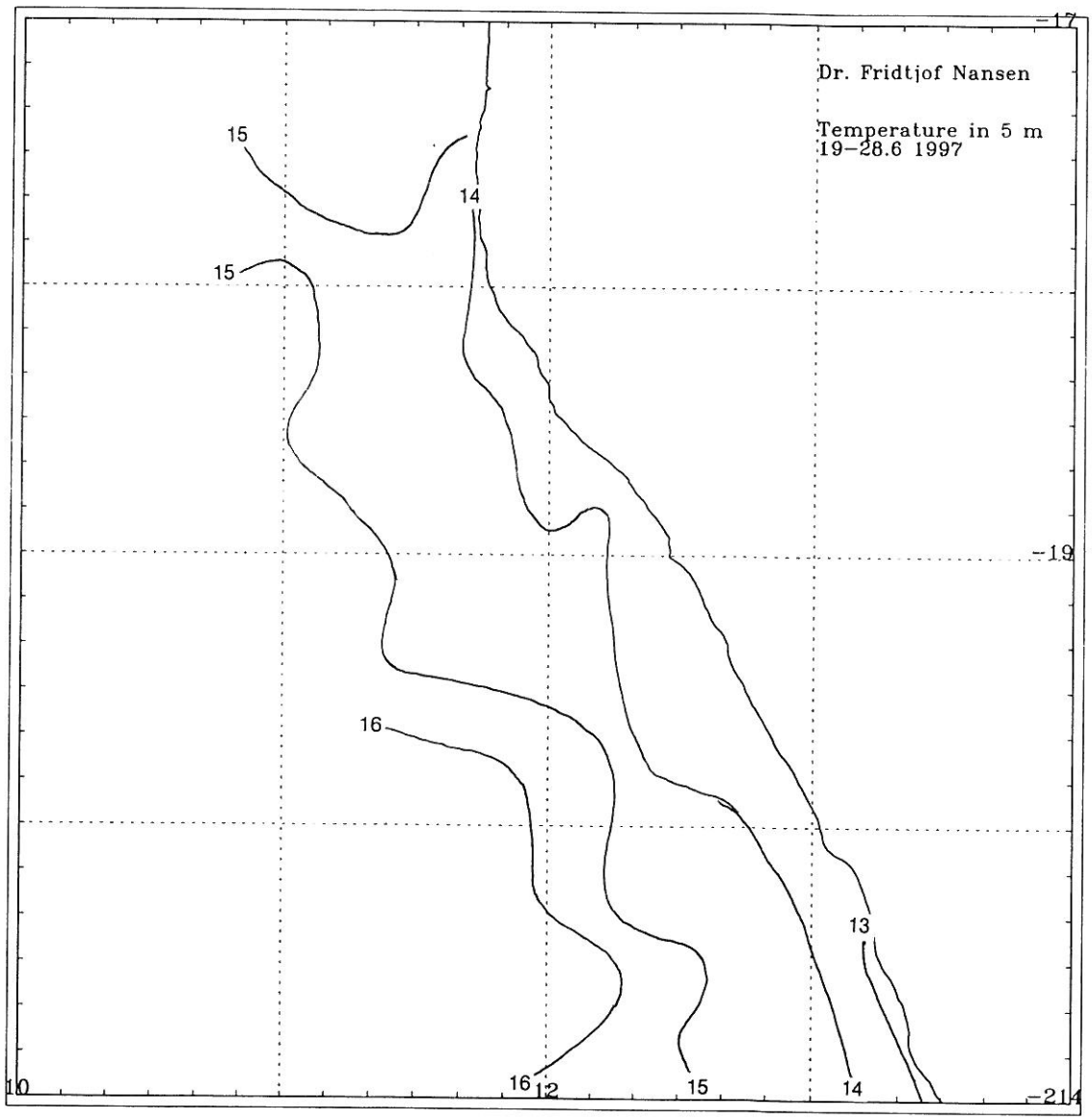


Figure 2b Distribution of sea temperature at 5 m dept: 21°00' to 17°15' S.

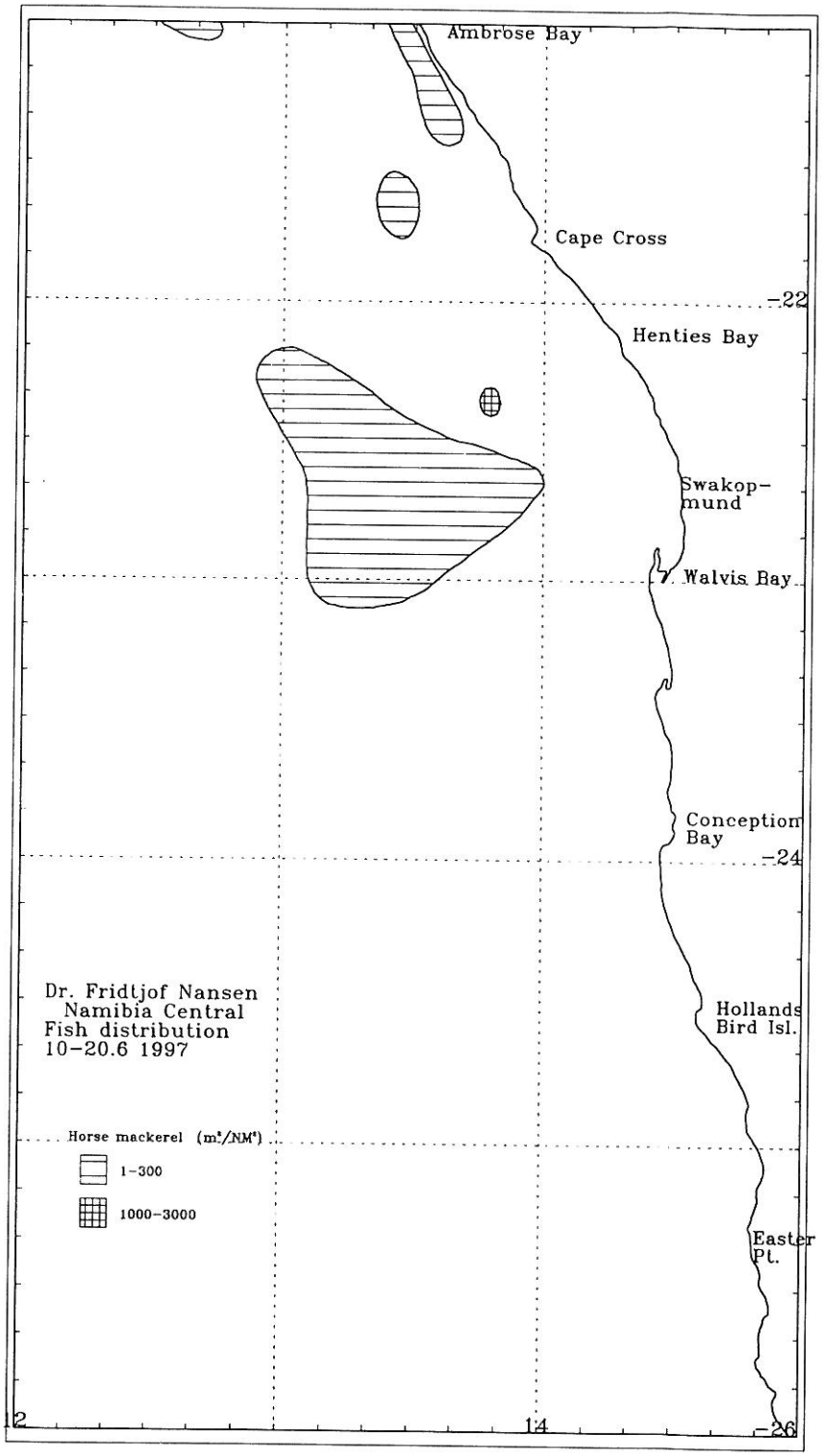


Figure 3a Distribution of horse mackerel, Dolphin Head to Ambrose Bay.

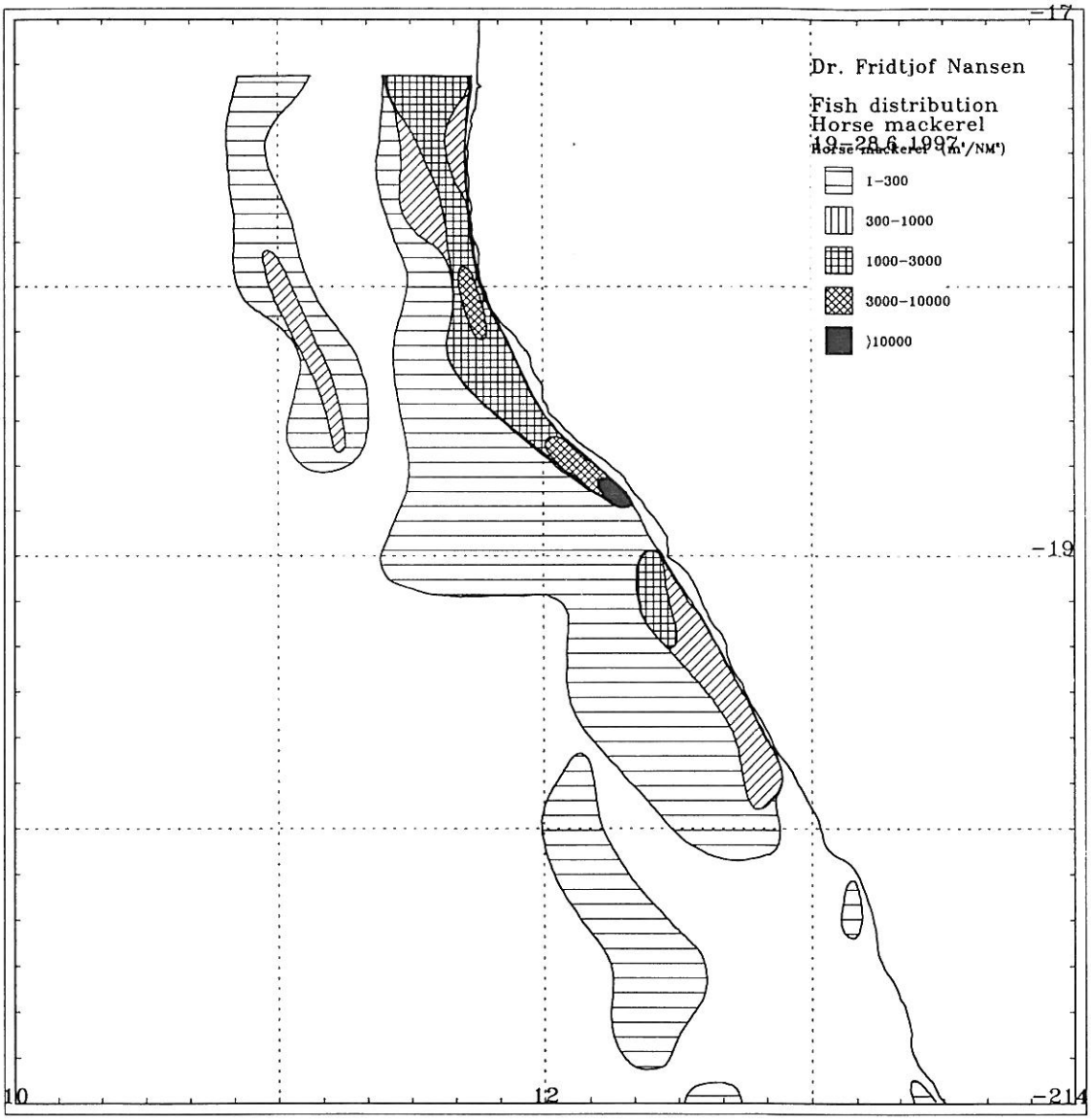


Figure 3a Distribution of horse mackerel, Dolphin Head to Ambrose Bay.

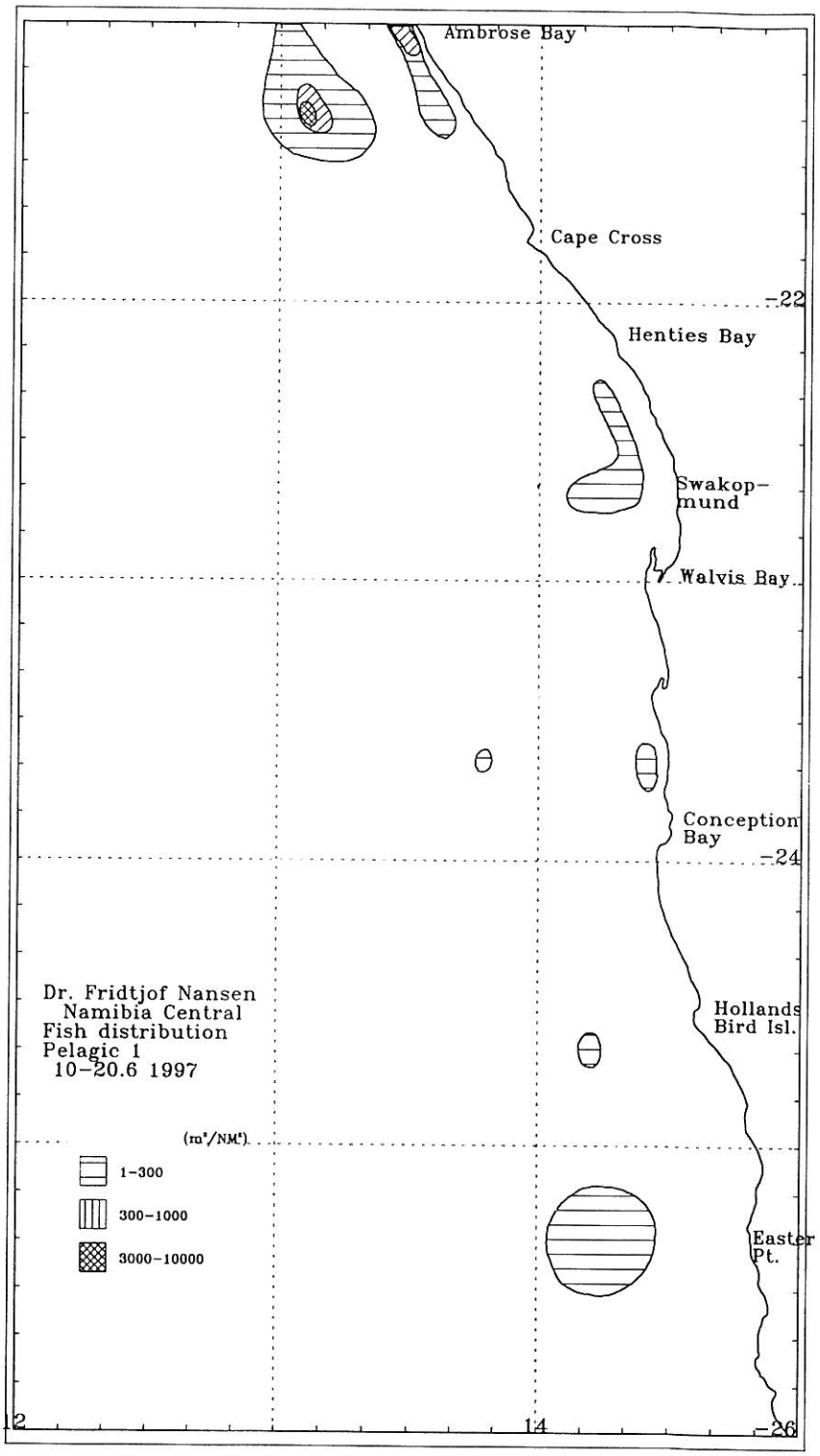


Figure 4a Distribution of pelagic 1, Dolphin Head to Ambrose Bay.

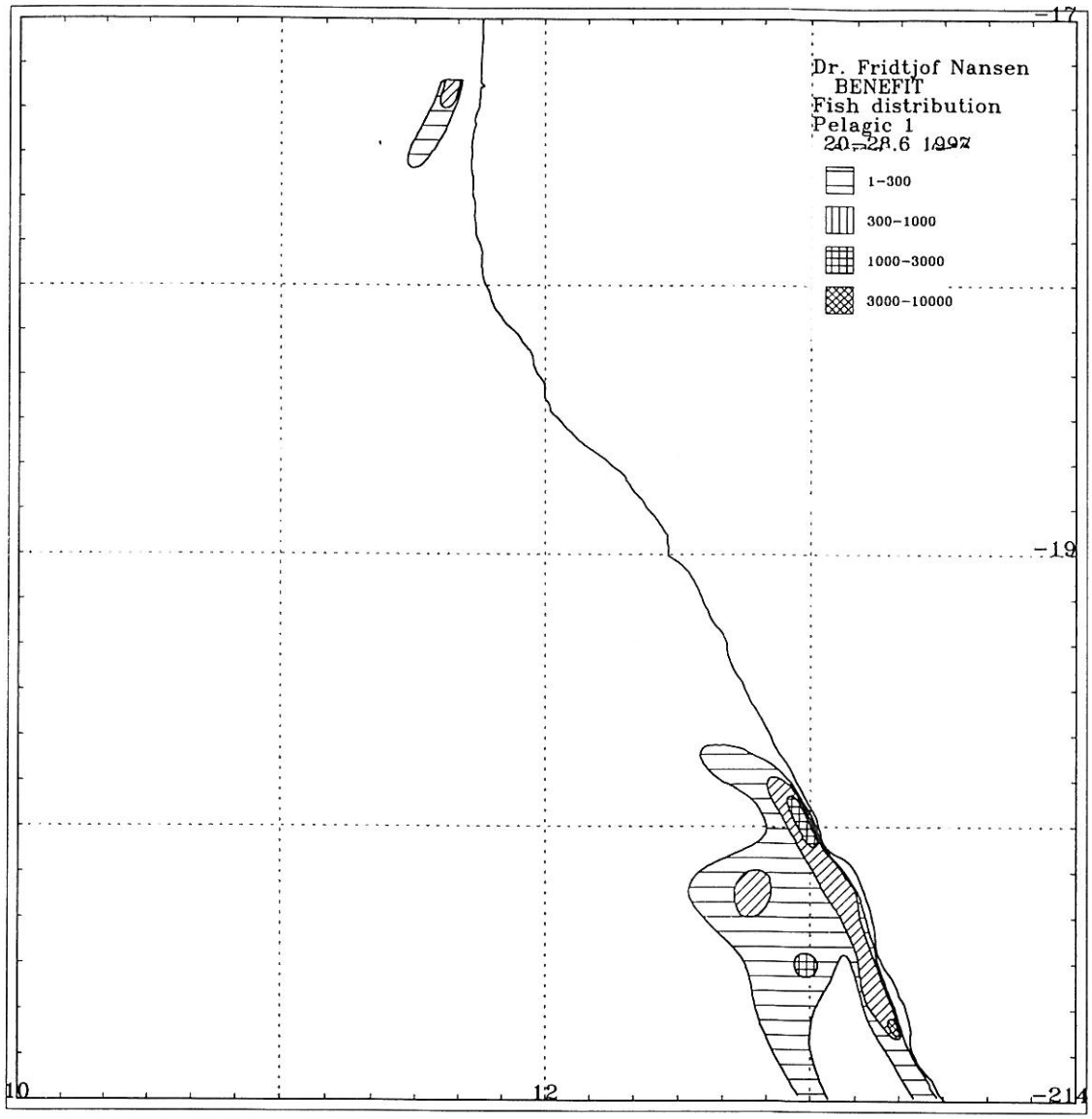


Figure 4b Distribution of pelagic 1, Ambrose Bay to Cunene River.

3.2.1 Dolphin Head to Ambrose Bay

Only two small shoals of juvenile horse mackerel of mean length of 9.7 cm were recorded inshore namely at Swakopmund and north of Cape Cross. In both cases the densities were low i.e. below S_A 100.

The only large area of adult horse mackerel recorded was offshore from Walvis Bay with a mean length of 27.6 cm. No adult horse mackerel were reordered in the area south of Walvis Bay up to 26°00' S. Two smaller shoals were found near Cape Cross and Henties Bay at bottom depth of about 250 m with a mean length of 24.9 cm. However, due to the small area and the low density its contribution to the biomass was small.

Total biomass estimate for the southern area i.e. Dolphin head to Ambrose Bay was 48 000 tonnes compared to 250 000 tonnes in the June 1996 acoustic survey.

Small shoals of clupeoid fishes in low concentration were only recorded in the Swakopmund and Henties Bay area.

The distribution of juvenile hake with a size range of 17 - 24 cm was recorded extensively in the inshore regions (Figure 5a).

3.2.2 Ambrose Bay to Cunene River

Small juvenile horse mackerel (≤ 20 cm) were found mainly inshore along the entire northern Namibian coast from 20°00' S to the Cunene River. The size composition is shown in Figure 6 (a). Two dominant modal lengths were found to occur at lengths of 9 cm and 17 cm respectively. Approximately two thirds of the stock biomass was found in this inshore area or some 500 000 tonnes.

The size composition of the horse mackerel in the offshore area (Figure 6) shows two cohorts with modal lengths of 12 cm and 19 cm. The stock of this medium size fish was estimated to 130 000 tonnes.

The discovery of horse mackerel in upper water column in the far offshore region between 2000 - 3000 m bottom depth north of 18°30' S is a distribution area which has not been recorded in the previous acoustic surveys by the RV Dr Fridtjof Nansen, initialized in 1990.

This component consists of maturing fish, with modal length of 26 cm and the distribution appears to extend into Angolan waters. The stock biomass was estimated to 55 000 tonnes.

High density of fish were also found inshore at 17°15' S on the border to Angola which indicates that the juvenile Cape horse mackerel distribution also extends into Namibian waters.

The general distribution pattern is as observed in previous surveys. The small size juveniles are found inshore (30 - 200 m) whereas the larger juvenile and maturing fish are distributed offshore between 200 - 500 m depth. This means that the horse mackerel move into deeper waters by increasing age. The discovery of maturing horse mackerel far offshore at 2000 - 3000 m bottom depth is in accordance with this general migration pattern and indicates that an eventual spawning migration towards south (as suggested in the June 1996 survey report) may start in the border area of Angola and run southwards in deep waters off the shelf.

Clupeoid fishes were sparsely distributed between Ambrose Bay and the Cunene River (Figure 4b).

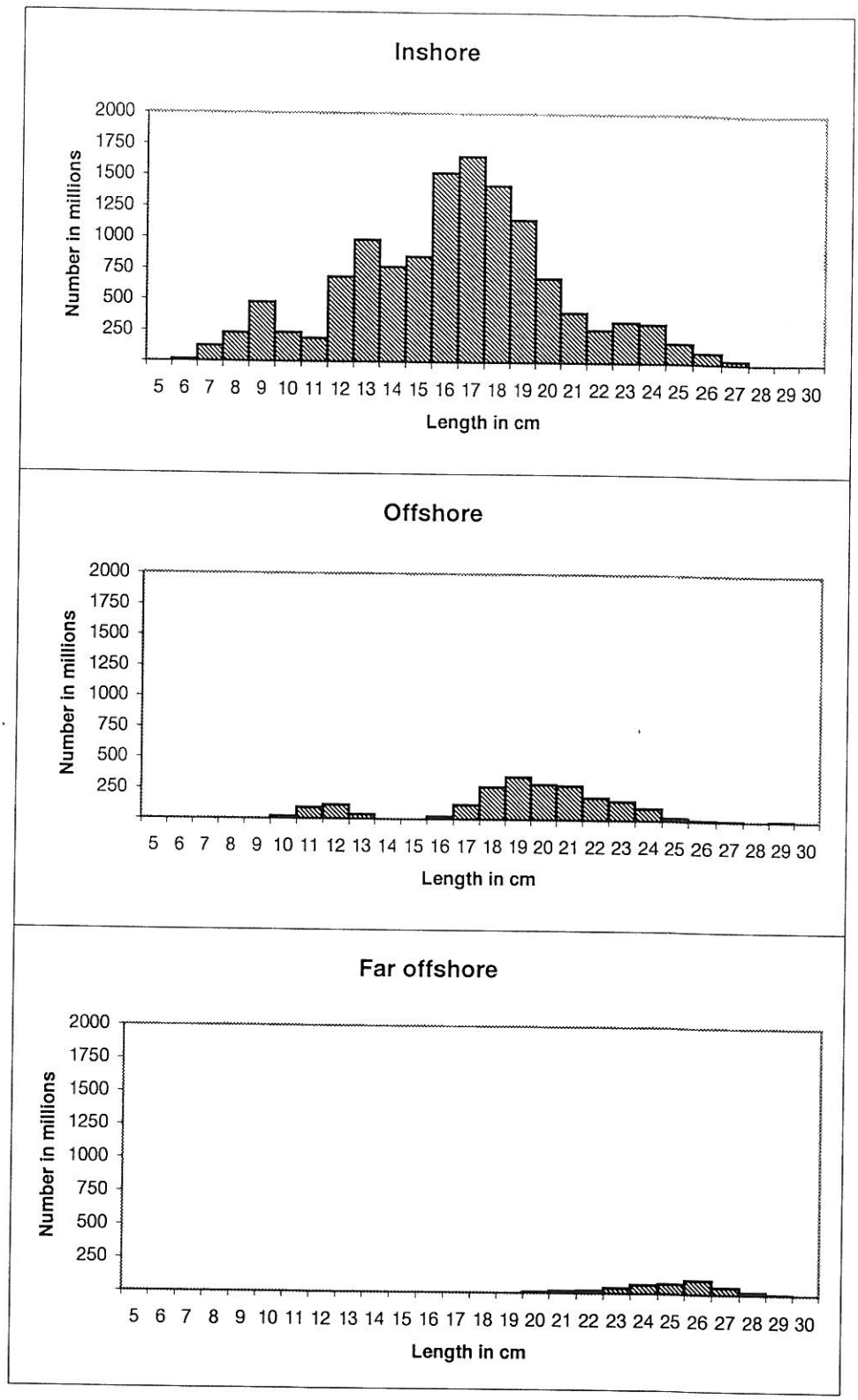


Figure 6 Size distribution (number of fish) of horse mackerel per depth region in the total survey area.

3.3 Abundance

The total estimated biomass of horse mackerel, juveniles (≤ 20 cm) and juvenile/maturing (≥21 cm), found in Namibian waters during the 1997 survey is given in the following Table 2. For the reason of comparison, the biomass estimates from acoustic surveys since 1994 are also included in that table. Abundance estimates in numbers per length group and selected subareas as well as the corresponding biomass figures are provided in Annex III.

Table 2: Summary of biomass estimates of horse mackerel per area (in 1000 tonnes) for 1994 -1997.

Juveniles ≤ 20 cm	**1994**	**1995**	**1996**	**1997**
Easter Point - Ambrose Bay	94	243	108	400
Ambrose Bay - Cunene River	1 108	481	579	428
Cunene River - Tombua	58	41	no survey	no survey
Sub total < 20 cm	1 260	765	687	428
Juvenile/maturing ≥ 21 cm				
Easter Point - Ambrose Bay	7	252	146	51
Ambrose Bay - Cunene River	224	431	141	303
Cunene River - Tombua	3	55	no survey	no survey
Sub total > 20 cm	234	738	287	354
Total	**1 494**	**1 503**	**974**	**782**

The total biomass of horse mackerel in 1997 was estimated at about 780 000 tonnes compared with 970 000 tonnes obtained during the RV 'Dr. Fridtjof Nansen' survey in June 1996. The juvenile stock comprised about 430 000 tonnes and the juvenile/maturing part was estimated to be approximately 350 000 tonnes compared to 690 000 tonnes and 290 000 tonnes in 1996 respectively.

The reduction in the juvenile stock is even more dramatic when expressed in number of fish as shown (Figure 7). The juveniles below 15 cm, which represent the recruitment to the stock, is according to this Figure dramatically reduced from 1996 to 1997. In case that this years survey has covered the total distribution area of the recruiting stock it is reason to conclude that the horse mackerel stock will suffer from recruitment failure to the offshore fishery in the coming years. The downward trend in recruitment level is obvious since 1994 (Table 2), when the biomass of juveniles below 21 cm was estimated at 1.2 million tonnes, or some three times the present recruitment level.

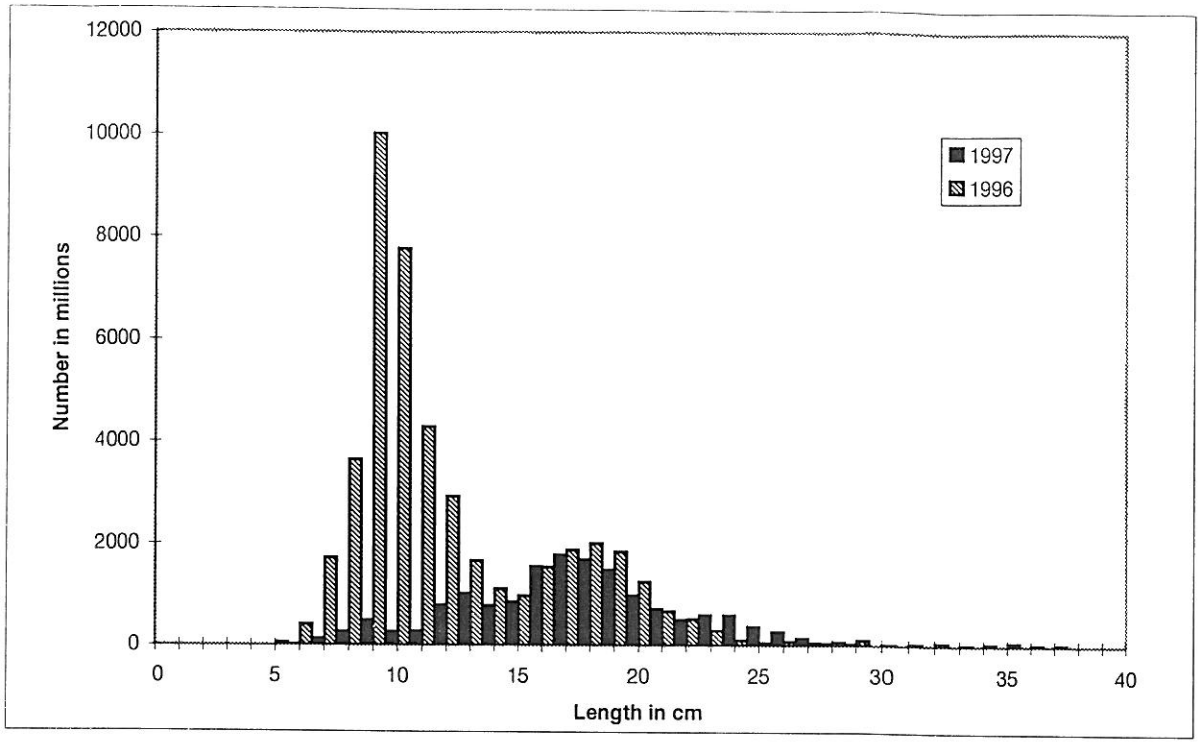


Figure 7 Size distribution for horse mackerel in numbers (millions) obtained from surveys 1996 and 1997.

The Table 2 also shows a clear decreasing trend in the stock of juvenile/maturing fish above 20 cm for the area south of Ambrose Bay, whereas the stock above 20 cm in the northern area has fluctuated around the present level of 300 000 tonnes.

3.4 Biological analysis of fish

3.4.1 Length-frequency

The length frequency distributions of the horse mackerel were divided into three regions: (inshore < 200 m; offshore 200 - 600 m; far offshore 600 - 3000 m;) and are presented in Figure 6 and Annex III.

Length data of pilchard, round herring and hake are presented in Annex VI. Two modal peaks in the pilchard stock surveyed between north of 21°00' is evident, namely one modal peak at 10 cm and one peak at 21 cm. The length range for the round herring was between 9 and 18 cm with a modal peak at 11 cm and 16 cm. Hake sampled mainly from the bottom trawls ranged from 12 cm to 58 cm with two modal peaks at 18 cm and 26 cm.

3.4.2 Length-weight relationship

Length-weight data (total weight and gutted weight) were divided into three regions: 26°00' - 21°00' S; 21°00' - 19°00' S and 19°00 S - 17°15' S and are presented in Annex VII; these three regions again were pooled :17°15' S to 26°00' S. The correlation coefficient for total weight, r^2 (0.994) and gutted weight r^2 (0.9922) shows that the data fit well to the length-weight relationship curves.

The actual mean weights per length group estimated from the length weight relationship have been used to calculate the total biomass per area.

3.4.3 Reproductive status

Results were tabulated for the Cape horse mackerel and presented according to the following regions: 26°00' - 21°00' S; 21°00' - 19°00' S and 19°00 S - 17°15' S;The following conclusions can be made:

1 The sex ratio: The greater portion of the stock in all three regions was comprised of females. Similar results were obtained during the June 1995 and 1996 hydro-acoustic survey.

2 Spawning: As was expected, no spawning was recorded amongst the adult stock throughout the region.

CHAPTER 4 CONCLUDING REMARKS

In general, conditions were favourable for surveying the inshore and offshore horse mackerel stock acoustically. Weather conditions were acceptable (Figure 8) and the inshore and the offshore horse mackerel seemed to be distributed within the transducer range both day and night.

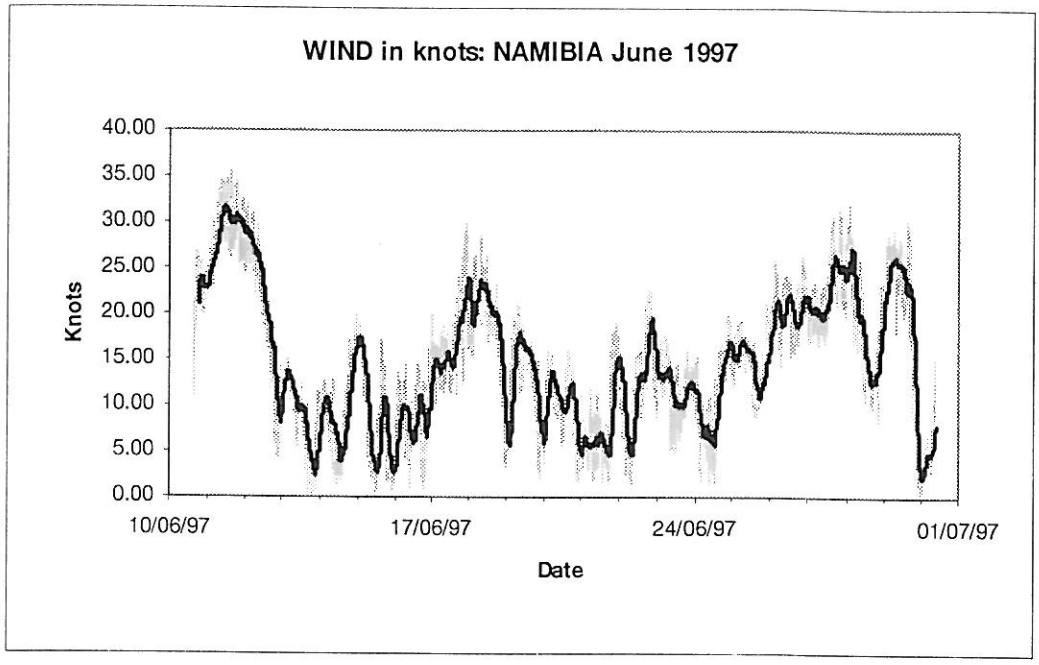


Figure 8 Wind speed (knots) for June 1997 survey.

Dense concentrations of jellyfish occurred, particularly in the southern region and localised areas in the north. These hampered trawling in some cases, but less than last year, and only two trawls had to be interrupted because of high concentrations of jelly fishes.

The horse mackerel stock in the northern Benguela system has since 1989 been assessed by acoustic method, the estimates ranging between 0.8 mill. tonnes and 2.1 mill. tonnes (Table 3). The present estimate of 800 000 tonnes is the lowest of these values.

Table 3 Biomass estimates of horse mackerel, 1990 to 1997, in the northern Benguela system (1 000 tonnes).

Survey	Vessel	Horse mackerel
December 1989	Ocher (USSR)	1 200
March 1990	Nansen	1 200
June 1990	Nansen	1 700
March 1991	Nansen	1 300
November 1991	Nansen/Benguela	1 400
June 1992	Nansen/Benguela	2 100
June 1994	Benguela	1 500
June 1995	Nansen	1 500
June 1996	Nansen	1 000
June 1997	Nansen	800

From the results on abundance and size distribution it is evident that the horse mackerel stock has been considerably reduced in recent years, particularly from 1995 - 1997. This phenomenon can, according to Table 2, be explained by reduced recruitment since 1994, or/and increased exploitation of the small juveniles in inshore waters. This seems to have affected the stock of medium sized fish in offshore waters, especially in the area south of Ambrose Bay. The offshore horse mackerel fishery may have contributed to this trend of decreasing stock size. Judging from Figure 7 it is reason to expect a pronounced decline in the abundance of offshore horse mackerel also in the area north of Ambrose Bay in 1998.

In the 1996 survey report, the lack of the adult horse mackerel in northern Namibian waters gave rise to the hypothesis that the fish migrate out of this area when reaching maturity i.e. at a length of 24 cm and above. It was further suggested that the maturing fish might migrate southward to spawn and that the post-spawners did not return to northern Namibian water.

The discovery of the component of the maturing horse mackerel in the far offshore waters of northern Namibia strongly supports this hypothesis. Although no movement of the fish has been registered the distribution and density pattern of this component indicate that these are pre-spawners migrating southwards to spawn. The observation do also indicate that this migration may start in Angolan waters, probably south of Tombua, which is supposed to be the boarder area of the most northern distribution of the Cape horse mackerel stock. In order to be able to assess the state of the stock and the exploitation, it is essential to know the total distribution and abundance of the spawners. It is felt that the discovery of the far offshore component of the maturing horse mackerel during the present survey forms a valuable basis for future research on the life pattern and abundance of the adult stock.

It is therefore recommended that increased effort should be allocated to the research on the horse mackerel in the Namibian and Angolan waters in order to improve the knowledge of the total distribution and abundance of the stock.

Annex I Instruments and fishing gear

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

Transceiver-1 menu

Transducer depth	5-7 m
Absorption coeff.	10 dB/km
Pulse length	medium
Bandwidth	wide
Max. power	2 000 W
Angle sensitivity	21.9
2-way beam angle	-21.0 dB
SV transducer gain	28.1 dB
TS transducer gain	28.0 dB
3 dB Beamwidth	6.8 deg
Alongship offset	0.00 deg
Athwardship offset	0.04 deg

Display menu

Echogram	1
Bottom range	12 m
Bottom start	10 m
TVG	20 log R
SV Colour minimum	-72 dB
TS Colour minimum	-65 dB

Printer settings

Range	0-100, 0-250 m, 0-500 m
TVG	20 log R
Sv Colour minimum	-72 dB

Bottom detection menu

Minimum level	-45 dB

FISHING GEAR

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

F/F Dr. Fridtjof Nansen

OVER/UNDER/SIDER

OVERDEL:
50 STK 11" PLASTKULER

UNDERDEL
14 M/M WIRE OMSP. MED
14 M/M BLYTAU
4 KJETTING.
TOTAL VEKT UNDER 400 KG.

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

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

MASKER M/M	TRAAD NR.	LENGDE MASKER I MTR.	I EVING	
3200.0	240	22.4	4	
3200.0	240	32.0	4	9.5L
1620.0	160	13.0	4	7.5L
400.0	48	14.0	4	34.5L
200.0	32	10.00	4	49.5L
100.0	24	20.0	4	199.5L
38.0	12	11.4	4	298.5L
38.0	18	3.76	4	98.5L

2H1-2
3H1-1

2,6 8,0 4,2 4,2 4,2 2,6 2,6 6

2 HSK NR 480

1 2 3 4 5 6 7 8 9

MSK.

38

1-2

49

45 1/2

32 M/M DANLINETAU
FESTES FOR HVER 10 CM
2 K KORTERE ENN NOTLIN

1-2

42

143

4E 1/4

SKJATES

1-2

108

205

5E 1/2

1-2

156

300

6E 1/2

2-2

167

415

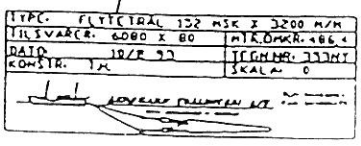
2-2

216

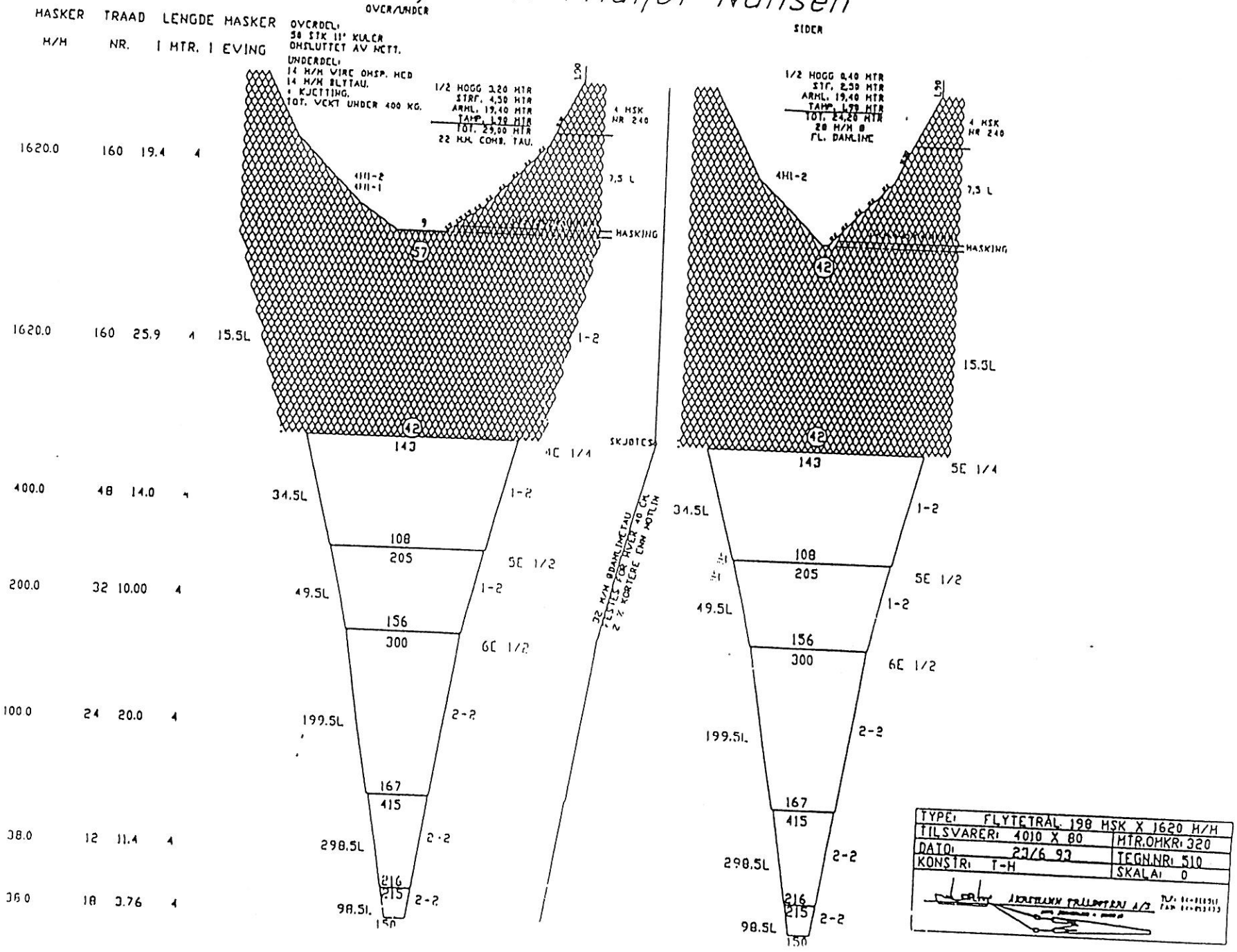
215

2-2

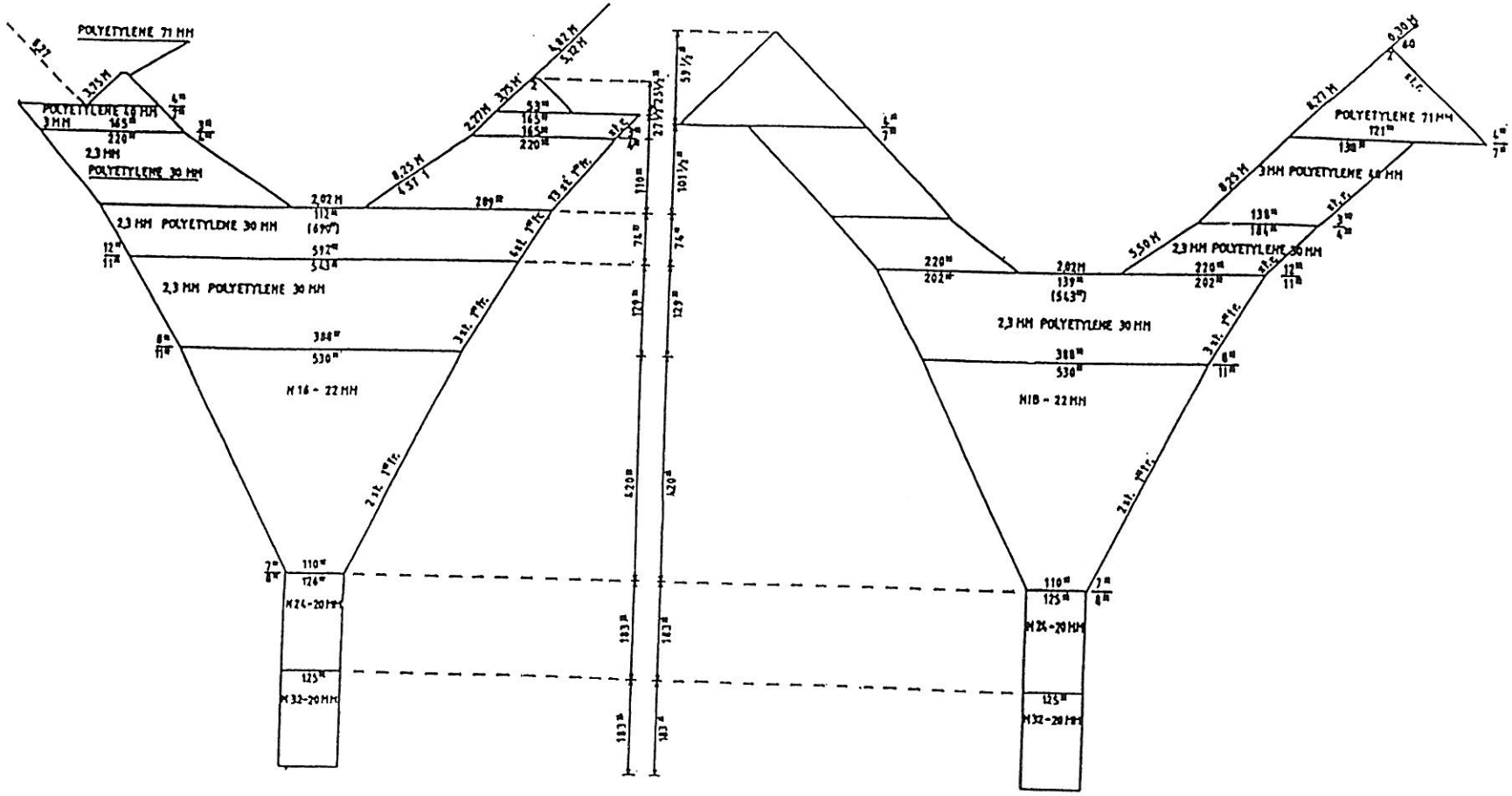
150



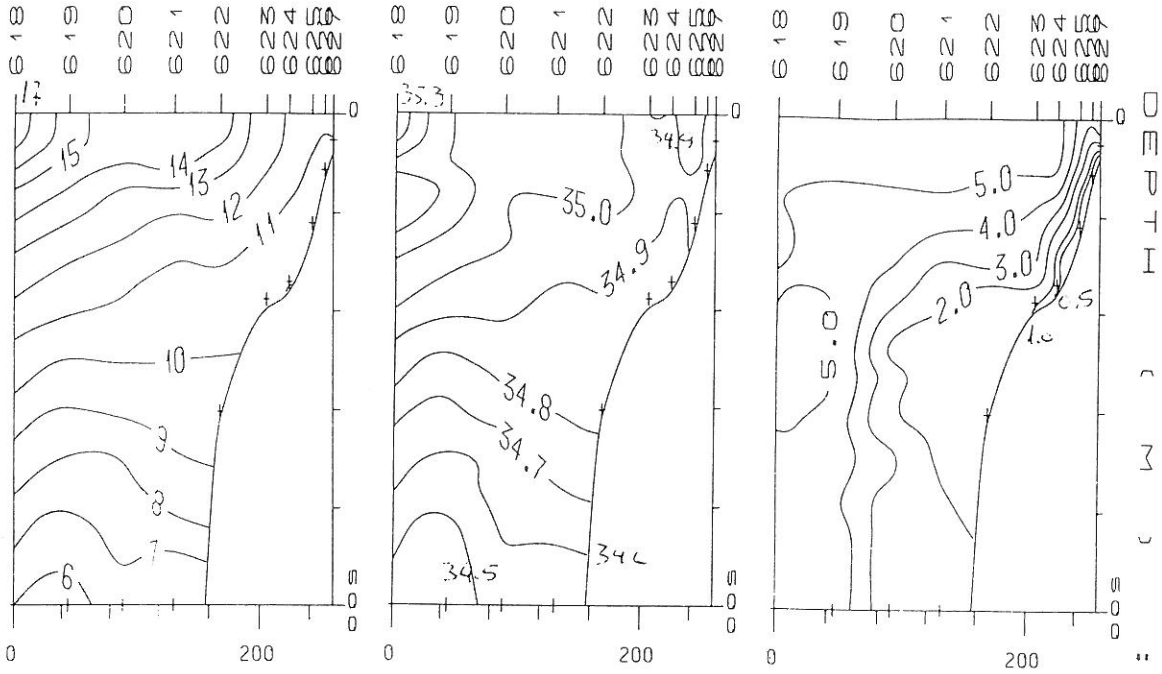
F/F Dr. Fridtjof Nansen



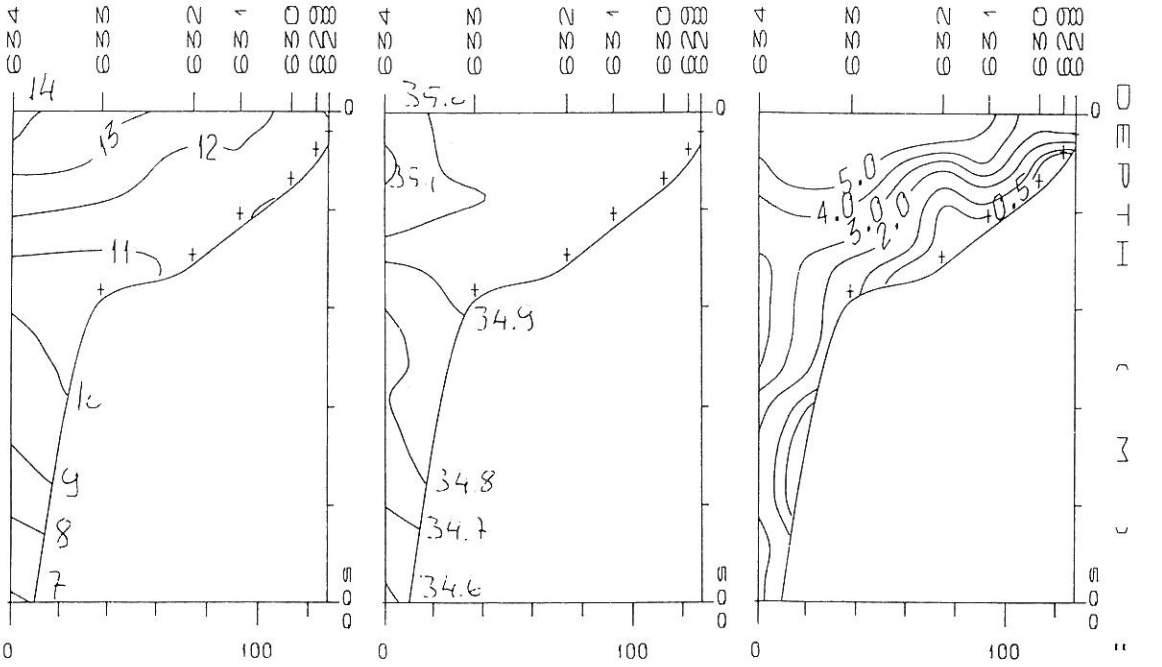
Bottom trawl: High opening shrimp and fish trawl with net headline 31m (floatline), foot-rope 47m, gear with 12 cm diameter roller disks, 40 m sweeps, estimated headline hight 6m and distance between wings during towing 18-20m.



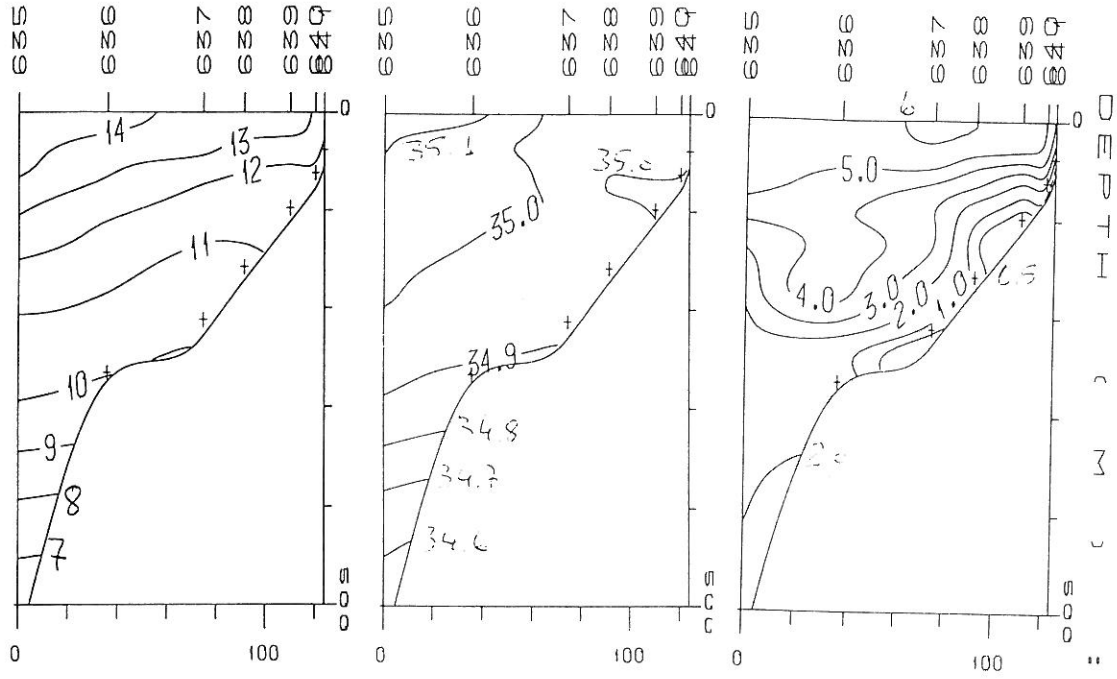
Annex II Hydrographic profiles and distribution of near surface environmental parameters



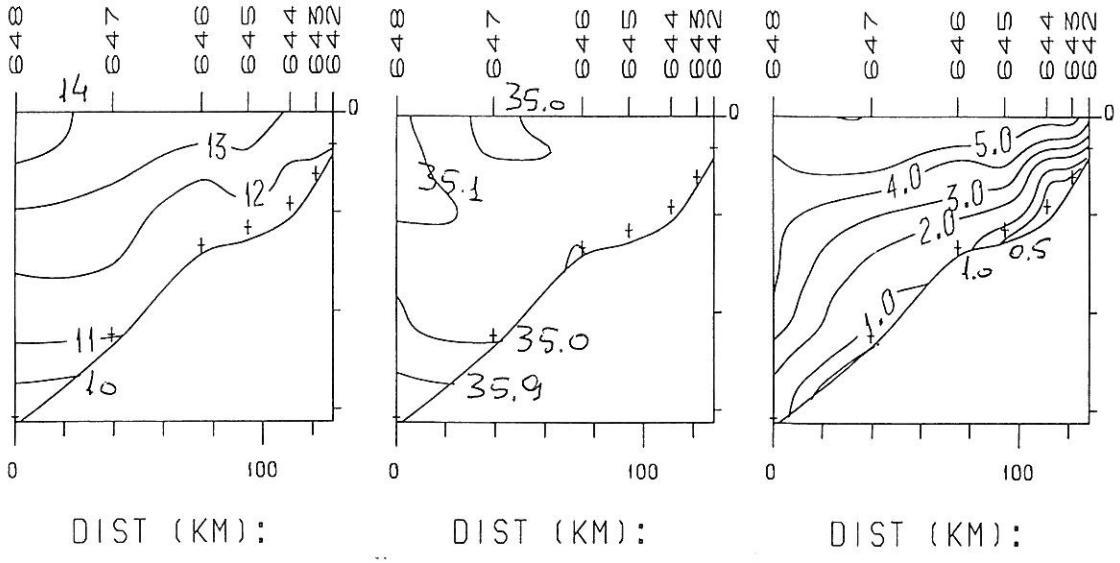
26°00'S **11-12.06 1997** **Temperature, salinity and oxygen profiles**



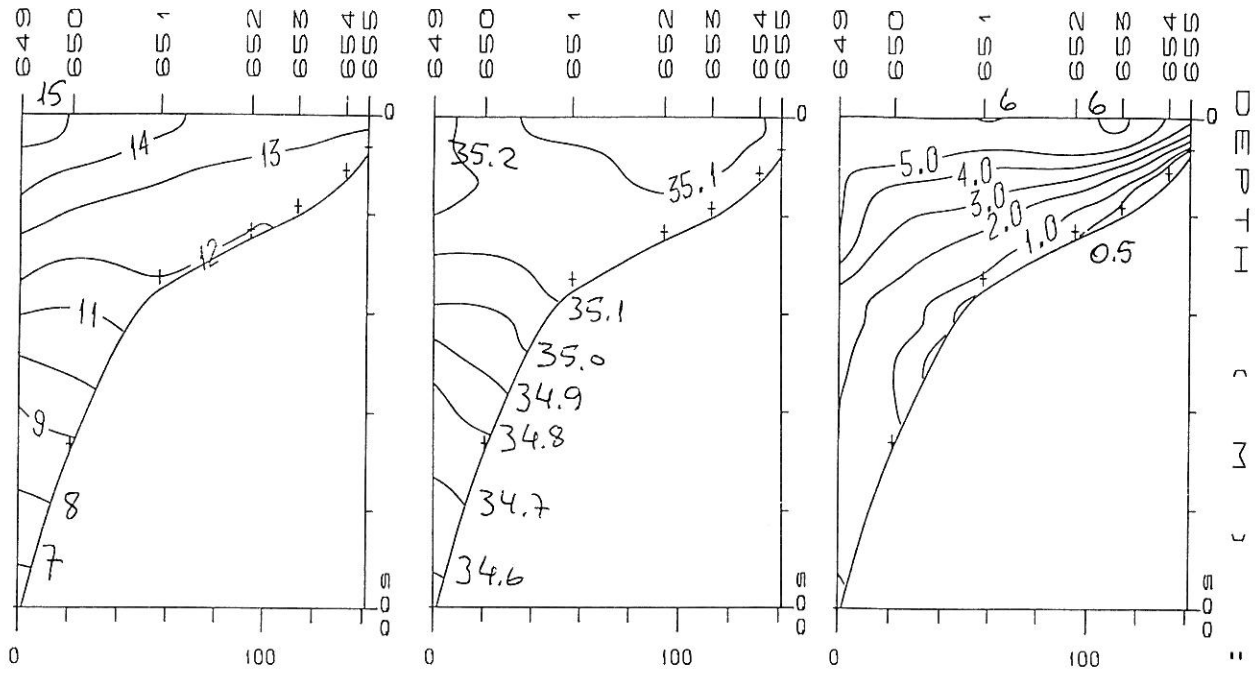
25°00'S **13-14.06 1997** **Temperature, salinity and oxygen profiles**



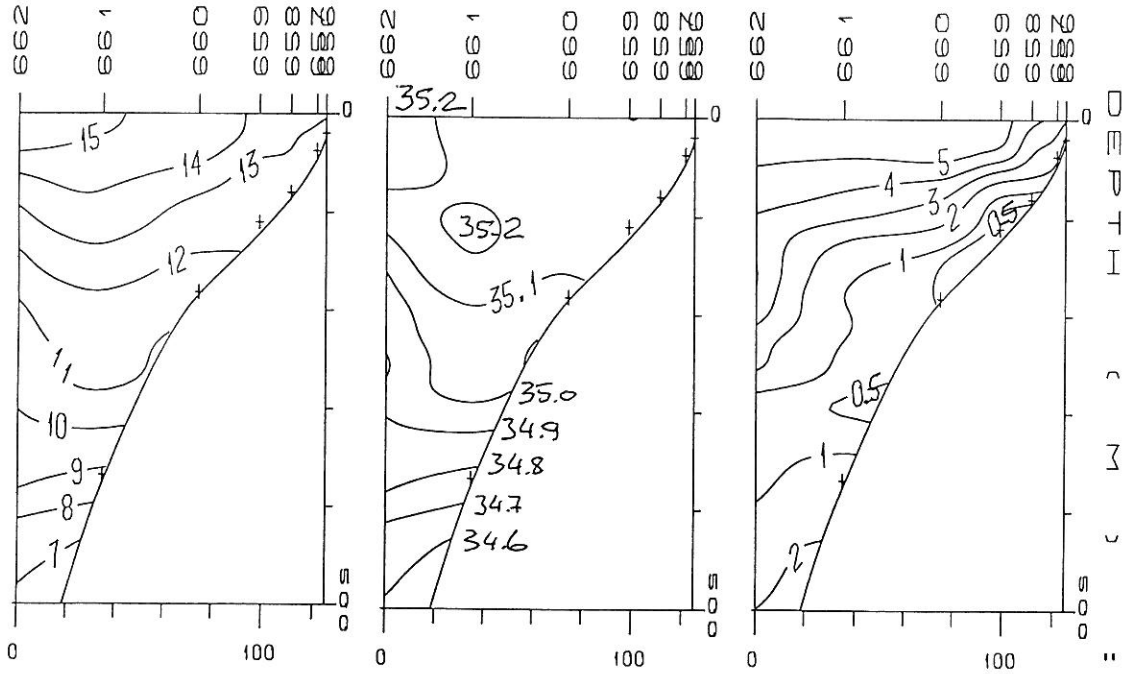
24°00'S **15.06 1997** **Temperature, salinity and oxygen profiles**



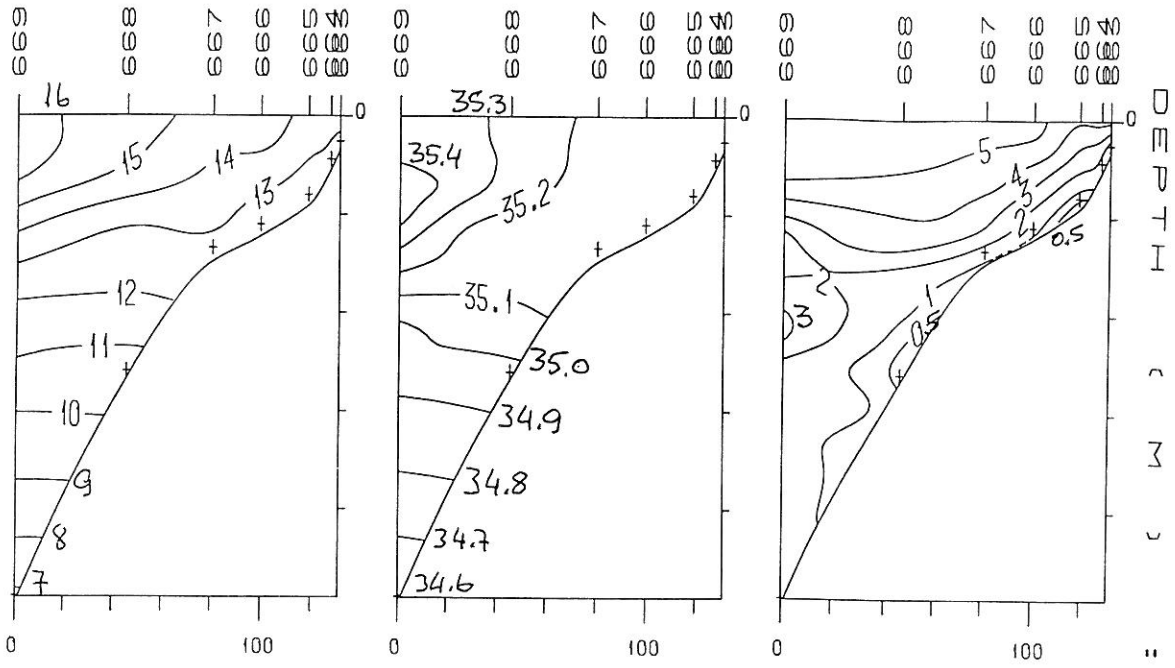
23°00'S **16-17.06 1997** **Temperature, salinity and oxygen profiles**



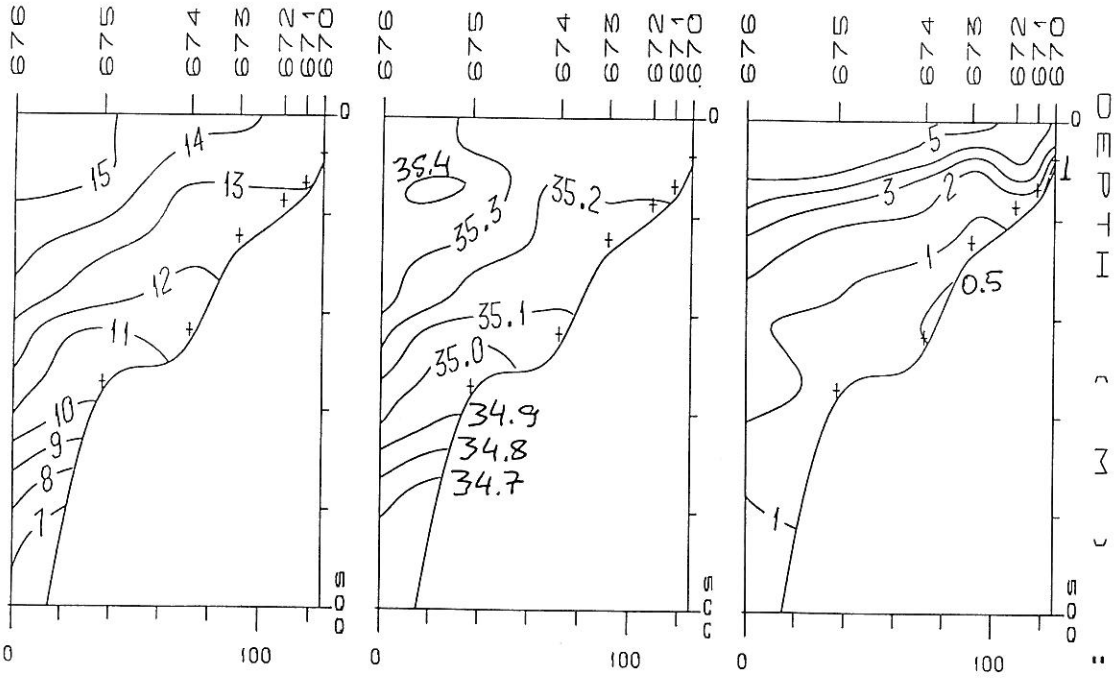
22°00'S 18.06 1997 Temperature, salinity and oxygen profiles



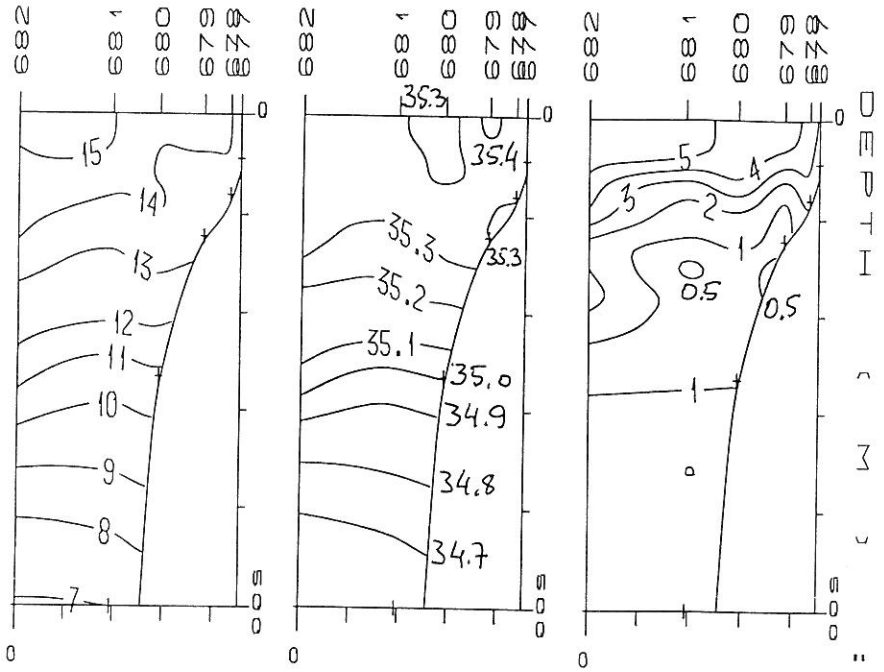
21°00'S 20.06 1997 Temperature, salinity and oxygen profiles



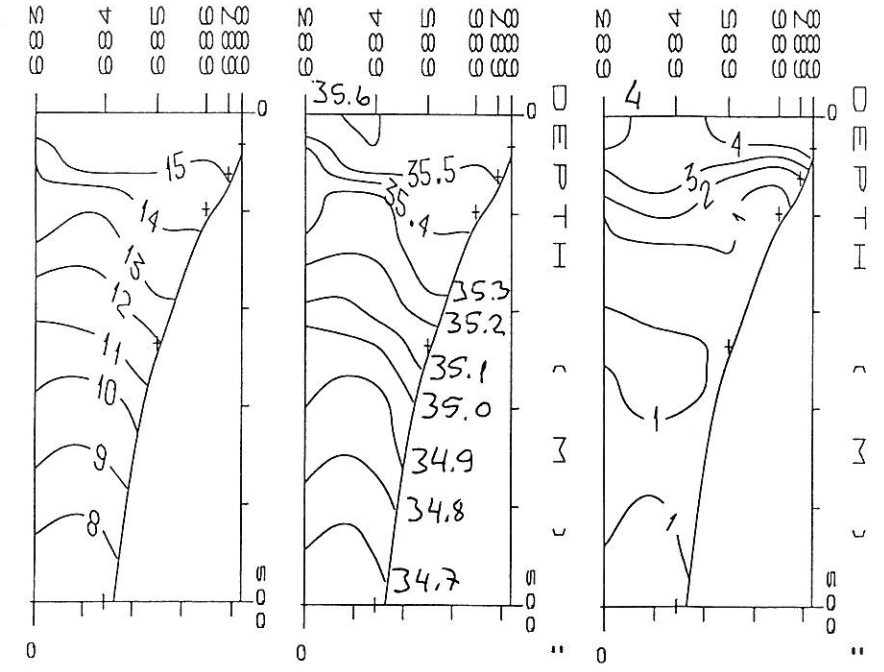
20°00'S **22-23.06 1997** **Temperature, salinity and oxygen profiles**



19°00'S **24-25.06 1997** **Temperature, salinity and oxygen profiles**



18°00'S 26.06 1997 Temperature, salinity and oxygen profiles



17°15'S 27.06 1997 Temperature, salinity and oxygen profiles

Annex III Biomass, weight and number of fish

		Offshore						Inshore				Offshore		Far offshore		
Area		22°10'-23°10'	22°15'-22°25'	21°30'-21°40'	21°00'-21°30'	20°55'-21°05'	19°55'-20°50'	20°10'-20°20'	19°10'-19°50'	17°50'-19°10'	17°15'-17°55'	19°10'-20°10'	17°50'-19°10'	17°15'-18°25'	18°25'-18°40'	Total
Size of area (NM²)		1859	25	101	191	94	838	45	348	666	750	1601	2477	894	201	
Mean S_A value (m²/NM²)		32	3684	225	23	111	96	135	583	2878	1177	195	139	172	320	
Biomass juveniles (<21cm)		0.0	0.0	0.0	0.4	0.0	0.2	1.0	30.1	200.6	137.4	21.9	36.1	0.5	0.0	428.2
Biomass maturing (≥21cm)		17.3	23.5	5.8	0.0	4.1	20.7	0.0	0.0	148.5	10.3	38.4	30.3	37.9	16.6	353.4
Total biomass (1000 tonnes)		17.3	23.5	5.8	0.4	4.1	20.9	1.0	30.1	349.1	147.7	60.3	66.4	38.4	16.6	781.6
No. of fish per length class (mill.)	5															
	6									12						12
	7									123						123
	8				37					231						268
	9				14					479		2				495
	10				14				5	168	63	18				268
	11								25	78	84	93				280
	12								84	453	147	114				797
	13							3	171	602	209	35				1020
	14							9	198	466	105					777
	15							6	178	398	272					854
	16								214	605	703		25			1546
	17							3	121	658	877	3	115			1777
	18							6	67	745	609	18	248			1692
	19							3	9	701	435	99	248	1		1495
	20						3		4	560	116	200	90	8		981
	21	5	6	1			8			335	68	150	128	17	1	719
	22	7	9	2			18			218	47	106	78	17	4	506
	23	7	32	8			21			314	16	102	53	33	8	593
	24	8	58	14			27	0		316		64	39	51	16	592
	25	9	41	10			28			165		14	15	54	24	360
	26	8	24	6			21			93			9	70	37	270
	27	14	13	3			11			31			6	35	20	134
	28	11	2	0			5						2	13	8	41
	29	9	2	0			2						3	4	1	20
	30	4					1									5
	31	1					0									2
	32	3					3									6
	33	2				1	1									4
	34	1				0	1									3
	35	4				1	1									6
	36	1				1										2
	37	0				2	1									4
	38	0				1	1									2
	39	0				2	1									3
	40	0				1										2
	41															
Sum		97	186	46	66	9	154	29	1076	7750	3750	1016	1057	303	120	15659

Annex IV Summary of trawl stations

Trawl number	Latitude (°S)	Longitude (°E)	Bottom depth (m)	Fishing depth (m)	Catch by species (% of total catch)					Total catch (kg)
					Trach. c.	*Sardin. o.*	*Engrau. c.*	*Etrum. w.*	*Merluc. c.*	
2125	25.59	13.40	516	140						24.7
2126	25.59	13.57	339	339					39.2	341.5
2127	26.00	14.18	216	216					100.0	750.0
2128	26.00	14.47	94	45					3.3	199.7
2129	25.20	13.57	223	165					1.0	28.8
2130	25.20	14.17	175	130		11.5		88.5		119.0
2131	25.19	14.24	152	152						0.0
2132	25.07	14.40	77	0						0.0
2133	25.07	14.40	79	0						2.0
2134	25.00	14.12	168	40					98.9	1.8
2135	24.40	13.37	406	180						19.3
2136	24.40	14.01	154	154	<0.1				99.4	1774.4
2137	24.40	14.21	110	20						0.0
2138	24.19	13.55	260	108					4.5	8.9
2139	24.00	13.20	315	90						36.7
2140	23.40	14.09	148	148					100.0	5000.0
2141	23.40	13.45	194	194					88.6	111.7
2142	23.21	13.26	257	257	1.1				81.8	582.9
2143	23.20	13.42	160	90						25.5
2144	23.20	13.47	162	162	0.3				94.7	219.7
2145	23.20	14.09	124	124					100.0	516.0
2146	23.07	14.20	70	28						205.0
2147	22.40	13.30	211	211	24.4				74.3	250.5
2148	22.40	14.26	42	17	2.2	13.8	73.9	10.2		25.5
2149	22.25	14.16	51	25	0.1				0.3	60.2
2150	22.21	13.45	127	127	95.2				4.7	573.8
2151	22.19	13.34	139	139					95.1	420.3
2152	22.20	12.57	286	286	25.8				62.2	250.5
2153	22.11	12.43	553	180						81.6
2154	21.59	12.47	346	346					2.5	1386.0
2155	21.60	12.55	334	250	1.1					36.9
2156	21.20	12.57	267	200					99.8	241.5
2157	21.20	13.07	151	151	<0.1				99.2	492.1
2158	21.20	13.05	156	25		100.0				652.0
2159	21.02	13.58	42	17	4.6	47.1	13.8	34.6		220.8
2160	20.60	12.47	319	319	0.6				77.3	226.5
2161	21.00	12.39	366	200	82.8					16.3
2162	21.00	12.29	447	300						37.8
2163	20.47	12.14	543	250						0.5
2164	20.45	12.22	372	150						23.5
2165	20.45	12.31	330	230					54.1	7.8
2166	20.45	13.14	96	20					100.0	856.0
2167	20.43	13.20	32	5	0.5	57.8	41.8			969.9
2168	20.30	13.02	119	119					100.0	230.3
2169	20.30	12.55	130	98		97.9		2.1		232.1
2170	20.30	12.33	286	286	10.2				62.7	27.2
2171	20.30	12.20	307	307	38.6				36.8	301.6
2172	20.29	12.08	370	300						27.2
2173	20.15	12.13	289	200	20.7				63.0	124.1
2174	20.14	12.18	277	277	83.0				12.0	257.4
2175	20.14	12.45	132	80	<0.1	18.7	0.4	80.9		279.6
2176	20.09	13.01	73	73	63.1				36.9	218.3
2177	19.60	12.32	145	145	26.9				69.0	100.9
2178	20.00	12.05	308	308	1.7				42.1	147.3
2179	19.45	12.25	150	150	24.9				74.5	255.6
2180	19.45	12.37	115	50				98.5		181.2
2181	19.49	12.50	75	45	84.0			13.6	1.6	57.2
2182	19.44	12.51	41	25	100.0					73.2

Trawl number	Latitude (°S)	Longitude (°E)	Bottom depth (m)	Fishing depth (m)	Catch by species (% of total catch)					Total catch (kg)
					Trach. c.	*Sardin. o.*	*Engrau. c.*	*Etrum. w.*	*Merluc. c.*	
2183	19.30	12.20	140	140	23.1				76.8	239.9
2184	19.21	11.27	544	544						867.0
2185	19.15	12.11	180	180	41.3				54.7	187.6
2186	19.15	12.13	160	25	99.4			0.6		442.6
2187	19.16	12.29	99	55	99.7					550.6
2188	19.02	12.26	60	55	100.0					1750.0
2189	19.00	12.12	119	119	37.1				62.5	1163.5
2190	19.00	11.58	221	221	14.0				80.6	67.3
2191	19.00	11.30	299	5						21.9
2192	18.46	11.32	254	254	10.4				27.0	834.0
2193	18.46	11.59	130	130	21.8				77.9	163.0
2194	18.47	12.18	37	30	100.0					622.0
2195	18.41	12.06	60	50	94.1					432.4
2196	18.30	11.54	104	104	65.0				34.7	305.3
2197	18.30	11.37	195	195	12.4				75.2	335.0
2198	18.29	11.30	274	274	0.1				47.5	901.8
2199	18.15	11.30	291	291	2.5				91.4	58.9
2200	18.15	11.49	74	40	99.2				0.8	227.8
2201	18.06	11.45	81	20	100.0					201.8
2202	17.56	11.42	95	95	64.9				30.4	568.4
2203	17.58	11.32	212	150	4.1				23.0	13.1
2204	18.00	10.57	2500	110	91.3					34.3
2205	17.50	10.49	1800	180	93.1					263.0
2206	17.15	11.03	-	180	16.6					50.5
2207	17.17	11.29	162	162	60.5				13.1	2185.5
2208	17.30	11.38	109	109	48.6		0.2		9.4	528.7

Annex V Records of fishing stations

PROJECT STATION:2125
DATE:12/ 6/97 GEAR TYPE: PT No:1 POSITION:Lat S 2559
start stop duration Long E 1340
TIME :06:41:53 06:55.52 14 (min) Purpose code: 1
LOG :8915.29 8916.23 0.97 Area code : 1
FDEPTH: 140 110 GearCond.code:
BDEPTH: 516 530 Validity code:
Towing dir: 330° Wire out: 400 m Speed: 35 kn*10

Sorted: 25 Kg Total catch: 24.65 CATCH/HOUR: 105.64

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	105.64	105643	100.00	
Total	105.64		100.00	

PROJECT STATION:2126
DATE:12/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 2559
start stop duration Long E 1357
TIME :10:15:13 10:46:26 31 (min) Purpose code: 1
LOG :8937.82 8939.68 1.60 Area code : 1
FDEPTH: 339 330 GearCond.code:
BDEPTH: 339 330 Validity code:
Towing dir: 90° Wire out:1100 m Speed: 30 kn*10

Sorted: 57 Kg Total catch: 341.52 CATCH/HOUR: 661.01

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	258.97	581	39.18	
Coelorinchus fasciatus	135.87	3904	20.55	
Schedophilus huttoni	78.97	46	11.95	
Lophius vomerinus	52.95	35	8.01	
Helicolenus dactylopterus	50.63	465	7.66	
Todarodes sagittatus	27.87	93	4.22	
Bathynectes piperitus	15.91	795	2.41	
MYCTOPHIDAE	14.86		2.25	
Krill	11.61		1.76	
Nezumia sp.	7.08	221	1.07	
Galeus polli	3.72	23	0.56	
Squilla sp.	2.44	139	0.37	
Synagrops microlepis	0.12	12	0.02	
Total	661.00		100.01	

PROJECT STATION:2127
DATE:12/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 2600
start stop duration Long E 1418
TIME :13:56:37 14:04:32 8 (min) Purpose code: 1
LOG :8964.26 8964.65 0.44 Area code : 1
FDEPTH: 214 218 GearCond.code: 9
BDEPTH: 214 218 Validity code:
Towing dir: 270° Wire out: 600 m Speed: 30 kn*10

Sorted: 7 Kg Total catch: 750.00 CATCH/HOUR: 5625.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	5625.00	129675	100.00	7420
Total	5625.00		100.00	

PROJECT STATION:2128
DATE:12/ 6/97 GEAR TYPE: PT No:1 POSITION:Lat S 2600
start stop duration Long E 1447
TIME :18:07:09 18:28:04 21 (min) Purpose code: 1
LOG :8995.87 8997.30 1.31 Area code : 1
FDEPTH: 50 40 GearCond.code:
BDEPTH: 103 85 Validity code:
Towing dir: 90° Wire out: 150 m Speed: 35 kn*10

Sorted: 25 Kg Total catch: 199.69 CATCH/HOUR: 570.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	551.57	45963	96.68	
Merluccius capensis	18.97	666	3.32	7421
Aequorea aequorea	0.00	1143		
Chrysaora sp.	0.00	13714		
Total	570.54		100.00	

PROJECT STATION:2129
DATE:13/ 6/97 GEAR TYPE: PT No: POSITION:Lat S 2520
start stop duration Long E 1357
TIME :08:05:23 08:17:10 12 (min) Purpose code: 1
LOG :9140.14 9140.81 0.65 Area code : 1
FDEPTH: 160 170 GearCond.code:
BDEPTH: 224 222 Validity code:
Towing dir: 90° Wire out: 400 m Speed: 34 kn*10

Sorted: 1 Kg Total catch: 28.80 CATCH/HOUR: 144.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	78.20	97750	54.31	
MYCTOPHIDAE	51.25	102500	35.59	
Lepidopus caudatus	7.75	40	5.38	
Krill	5.40	18720	3.75	
Merluccius capensis	1.40	25	0.97	
Chrysaora sp.	0.00	55		
Total	144.00		100.00	

PROJECT STATION:2130
DATE:13/ 6/97 GEAR TYPE: PT No:2 POSITION:Lat S 2520
start stop duration Long E 1417
TIME :11:01:16 11:25:40 24 (min) Purpose code: 1
LOG :9162.54 9163.82 1.22 Area code : 1
FDEPTH: 130 130 GearCond.code: 1
BDEPTH: 171 179 Validity code: 1
Towing dir: 270° Wire out: 660 m Speed: 30 kn*10

Sorted: 66 Kg Total catch: 118.95 CATCH/HOUR: 297.38

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	263.25	5160	88.52	7422
Sardinops ocellatus	34.13	423	11.48	7423
Aequorea aequorea	0.00	1500		
Total	297.38		100.00	

PROJECT STATION:2131
DATE:13/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 2519
start stop duration Long E 1424
TIME :13:01:51 13:10:08 8 (min) Purpose code: 1
LOG :9175.49 9175.90 0.39 Area code : 1
FDEPTH: 152 153 GearCond.code: 8
BDEPTH: 152 153 Validity code: 9
Towing dir: 270° Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

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

PROJECT STATION:2132
DATE:13/ 6/97 GEAR TYPE: PT No:4 POSITION:Lat S 2507
start stop duration Long E 1440
TIME :17:49:30 17:52:29 3 (min) Purpose code: 1
LOG :9215.47 9215.63 0.14 Area code : 1
FDEPTH: 0 0 GearCond.code: 3
BDEPTH: 77 78 Validity code:
Towing dir: 224° Wire out: 140 m Speed: 30 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora sp.	0.00	24000		
Total				

PROJECT STATION:2133
DATE:13/ 6/97 GEAR TYPE: PT No:4 POSITION:Lat S 2507
start stop duration Long E 1440
TIME :18:42:29 18:46:45 4 (min) Purpose code: 1
LOG :9218.56 9218.79 0.24 Area code : 1
FDEPTH: 0 0 GearCond.code: 1
BDEPTH: 80 79 Validity code: 1
Towing dir: 44° Wire out: 140 m Speed: 35 kn*10

Sorted: 1 Kg Total catch: 2.00 CATCH/HOUR: 30.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	30.00	38775	100.00	
Chrysaora sp.	0.00	1350		
Total	30.00		100.00	

PROJECT STATION:2134
DATE:14/ 6/97 GEAR TYPE: PT No:5 POSITION:Lat S 2500
start stop duration Long E 1412
TIME :00:07:52 00:27:36 20 (min) Purpose code: 1
LOG :9262.91 9264.20 1.32 Area code : 1
FDEPTH: 30 50 GearCond.code: 9
BDEPTH: 167 169 Validity code: 1
Towing dir: 270° Wire out: 250 m Speed: 45 kn*10

Sorted: 2 Kg Total catch: 1.83 CATCH/HOUR: 5.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	5.43	123	98.91	
Lepidopus caudatus	0.06	3	1.09	
J E L L Y F I S H	0.00	2400		
Total	5.49		100.00	

PROJECT STATION:2135
DATE:14/ 6/97 GEAR TYPE: PT No:2 POSITION:Lat S 2440
start stop duration Long E 1337
TIME :07:46:42 08:09:43 23 (min) Purpose code: 1
LOG :9331.83 9333.17 1.22 Area code : 1
FDEPTH: 160 200 GearCond.code: 6
BDEPTH: 404 408 Validity code: 4
Towing dir: 270° Wire out: 530 m Speed: 34 kn*10

Sorted: 19 Kg Total catch: 19.25 CATCH/HOUR: 50.22

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	50.22	33477	100.00	
Chrysaora sp.	0.00	8		
Total	50.22		100.00	

PROJECT STATION: 2136

DATE: 14/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2440
start stop duration Long E 1401
TIME :11:08:28 11:18:34 10 (min) Purpose code: 1
LOG :9360.69 9361.25 0.50 Area code : 2
FDEPTH: 154 154 GearCond.code: 1
BDEPTH: 154 154 Validity code: 1
Towing dir: 270° Wire out: 500 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 1774.42 CATCH/HOUR: 10646.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	10584.00	278526	99.41	
Callorhinchus capensis	20.70	6	0.19	
Austroglossus microlepis	5.10	12	0.05	
Trachurus capensis	2.82	18	0.03	7424
Aequorea aequorea	0.00	480		
Total	10612.62		99.68	

PROJECT STATION: 2137

DATE: 14/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2440
start stop duration Long E 1421
TIME :14:04:11 14:04:55 1 (min) Purpose code: 1
LOG :9383.99 9384.12 0.13 Area code : 2
FDEPTH: 20 20 GearCond.code: 9
BDEPTH: 110 109 Validity code: 9
Towing dir: 270° Wire out: 50 m Speed: 40 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora sp.	0.00	300000		
Total				

PROJECT STATION: 2138

DATE: 14/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2419
start stop duration Long E 1355
TIME :19:53:16 19:56:41 3 (min) Purpose code: 1
LOG :9445.83 9446.05 0.20 Area code : 2
FDEPTH: 100 115 GearCond.code: 1
BDEPTH: 259 261 Validity code: 1
Towing dir: 270° Wire out: 300 m Speed: 35 kn*10

Sorted: 5 Kg Total catch: 8.88 CATCH/HOUR: 177.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Centrolophus niger	69.60	20	39.19	
Lampanyctodes hectoris	46.00	27060	25.90	
Maurolicus muelleri	33.00	41260	18.58	
Krill	11.00	22160	6.19	
Symbolophorus boops	10.00	1180	5.63	
Merluccius capensis	8.00	160	4.50	
Aequorea aequorea	0.00	20000		
Total	177.60		99.99	

PROJECT STATION: 2139

DATE: 15/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2400
start stop duration Long E 1320
TIME :02:46:45 02:47:30 1 (min) Purpose code: 1
LOG :9514.44 9514.46 0.01 Area code : 2
FDEPTH: 90 90 GearCond.code: 9
BDEPTH: 314 315 Validity code: 4
Towing dir: 270° Wire out: 400 m Speed: 40 kn*10

Sorted: 37 Kg Total catch: 36.70 CATCH/HOUR: 2202.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	1500.00		68.12	
Krill	420.00		19.07	
TRACHIPTERIDAE	279.00	60	12.67	
Total	2199.00		99.86	

PROJECT STATION: 2140

DATE: 15/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2340
start stop duration Long E 1409
TIME :14:14:14 14:17:20 3 (min) Purpose code: 1
LOG :9625.49 9625.66 0.14 Area code : 2
FDEPTH: 148 148 GearCond.code: 9
BDEPTH: 148 148 Validity code: 1
Towing dir: 90° Wire out: 500 m Speed: 30 kn*10

Sorted: 50 Kg Total catch: 5000.00 CATCH/HOUR: 100000.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	99999.80	1887100	100.00	7425
Chrysaora sp.	0.00	20000		
Aequorea aequorea	0.00	300000		
Total	99999.80		100.00	

PROJECT STATION: 2141

DATE: 15/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2340
start stop duration Long E 1345
TIME :23:43:36 23:56:31 13 (min) Purpose code: 1
LOG :9723.31 9723.98 0.62 Area code : 2
FDEPTH: 194 196 GearCond.code: 9
BDEPTH: 194 196 Validity code: 1
Towing dir: 270° Wire out: 600 m Speed: 30 kn*10

Sorted: 46 Kg Total catch: 111.65 CATCH/HOUR: 515.31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	442.62	2322	85.89	7426
Pterothrissus belloci	29.54	268	5.73	
Coelorinchus fasciatus	24.60	337	4.77	
Merluccius capensis	13.71	5	2.66	7427
Sufflogobius bibarbatus	4.06	369	0.79	
Lepidopus caudatus	0.78	5	0.15	
Aequorea aequorea	0.00	46154		
Chrysaora sp.	0.00	4154		
Total	515.31		99.99	

PROJECT STATION: 2142

DATE: 16/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2321
start stop duration Long E 1326
TIME :07:47:16 08:17:15 30 (min) Purpose code: 1
LOG :9806.87 9808.33 1.41 Area code : 2
FDEPTH: 257 276 GearCond.code: 1
BDEPTH: 257 276 Validity code: 1
Towing dir: 270° Wire out: 800 m Speed: 30 kn*10

Sorted: 65 Kg Total catch: 582.90 CATCH/HOUR: 1165.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	906.10	9302	77.72	7429
Galeus polli	120.70	2944	10.35	
Merluccius capensis	47.80	36	4.10	7428
Coelorinchus fasciatus	32.14	5978	2.76	
Chlorophthalmus atlanticus	25.34	1480	2.17	
Trachurus capensis	13.00	76	1.12	7434
Lepidopus caudatus	9.86	52	0.85	
Lophius vomerinus	6.42	6	0.55	
Helicolenus dactylopterus	2.38	238	0.20	
Todarodes sagittatus	1.60	4	0.14	
Beryx splendens	0.46	2	0.04	
Total	1165.80		100.00	

PROJECT STATION: 2143

DATE: 16/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2320
start stop duration Long E 1342
TIME :10:45:22 10:48:50 3 (min) Purpose code: 1
LOG :9828.36 9828.52 0.16 Area code : 1
FDEPTH: 90 110 GearCond.code: 1
BDEPTH: 160 160 Validity code: 1
Towing dir: 270° Wire out: 300 m Speed: 30 kn*10

Sorted: 13 Kg Total catch: 25.52 CATCH/HOUR: 510.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	322.40	268660	63.17	
Thyrsites atun	188.00	80	36.83	
Aequorea aequorea	0.00	20000		
Chrysaora sp.	0.00	1200		
Total	510.40		100.00	

PROJECT STATION: 2144

DATE: 16/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2320
start stop duration Long E 1347
TIME :12:06:50 12:13:09 6 (min) Purpose code: 1
LOG :9837.53 9837.86 0.30 Area code : 2
FDEPTH: 162 163 GearCond.code: 9
BDEPTH: 162 163 Validity code: 1
Towing dir: 270° Wire out: 550 m Speed: 30 kn*10

Sorted: 121 Kg Total catch: 219.68 CATCH/HOUR: 2196.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	1137.50	8900	51.78	7430
Merluccius capensis	942.90	650	42.92	7431
Coelorinchus fasciatus	50.50	50	2.30	
Chelidonichthys capensis	28.50	50	1.30	
Lophius vomerinus	16.60	10	0.76	
Pterothrissus belloci	9.50	50	0.43	
Trachurus capensis	5.80	50	0.26	7432
Sufflogobius bibarbatus	2.00	300	0.09	
Lepidopus caudatus	2.00	10	0.09	
Galeus polli	1.50	50	0.07	
Aequorea aequorea	0.00	400000		
Chrysaora sp.	0.00	10000		
Total	2196.80		100.00	

PROJECT STATION: 2145

DATE: 16/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2320
start stop duration Long E 1409
TIME :15:03:47 15:11:48 8 (min) Purpose code: 1
LOG :9862.84 9863.28 0.41 Area code : 2
FDEPTH: 124 125 GearCond.code: 1
BDEPTH: 124 125 Validity code: 1
Towing dir: 270° Wire out: 370 m Speed: 30 kn*10

Sorted: 30 Kg Total catch: 516.00 CATCH/HOUR: 3870.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Merluccius capensis	3870.00	87750	100.00	7433
Aequorea aequorea	0.00	90000		
Chrysaora sp.	0.00	2700		
Total	3870.00		100.00	

PROJECT STATION:2146

DATE:16/ 6/97 GEAR TYPE: PT No:1 POSITION:Lat S 2307
start stop duration Long E 1420
TIME :18:34:41 18:47:00 12 (min) Purpose code: 1
LOG :9894.61 9895.33 0.62 Area code : 2
FDEPTH: 28 28 GearCond.code: 1
BDEPTH: 69 71 Validity code: 1
Towing dir: 195° Wire out: 100 m Speed: 35 kn*10

Sorted: 5 Kg Total catch: 205.00 CATCH/HOUR: 1025.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chelidonichthys capensis	1000.00	22265	97.56	
Sufflogobius bibarbatus	25.00	3330	2.44	
Chrysaora sp	0.00	90000		
Total	1025.00		100.00	

PROJECT STATION:2147

DATE:17/ 6/97 GEAR TYPE: BT No: POSITION:Lat S 2240
start stop duration Long E 1330
TIME :10:07:16 10:27:42 20 (min) Purpose code: 1
LOG : 46.62 47.65 0.94 Area code : 1
FDEPTH: 211 224 GearCond.code:
BDEPTH: 211 224 Validity code:
Towing dir: 270° Wire out: 700 m Speed: 30 kn*10

Sorted: 113 Kg Total catch: 250.51 CATCH/HOUR: 751.53

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	542.40	3822	72.17	7435
Trachurus capensis	181.89	834	24.20	7437
Merluccius capensis	15.60	6	2.08	7436
Coelorinchus fasciatus	6.36	96	0.85	
Sufflogobius bibarbatus	1.68	180	0.22	
Aequorea aequorea	0.00	37500		
Chrysaora sp.	0.00	3375		
Total	747.93		99.52	

PROJECT STATION:2148

DATE:17/ 6/97 GEAR TYPE: BT No: POSITION:Lat S 2240
start stop duration Long E 1426
TIME :15:57:21 16:15:24 18 (min) Purpose code: 1
LOG : 106.24 107.37 1.05 Area code : 2
FDEPTH: 39 45 GearCond.code: 1
BDEPTH: 17 17 Validity code: 1
Towing dir: 270° Wire out: 85 m Speed: 35 kn*10

Sorted: 5 Kg Total catch: 25.45 CATCH/HOUR: 84.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Engraulis capensis	62.67	833	73.88	7441
Sardinops ocellatus	11.67	1117	13.76	7438
Etrumeus whiteheadi	8.67	867	10.22	7439
Trachurus capensis	1.83	217	2.16	7440
Total	84.84		100.02	

PROJECT STATION:2149

DATE:17/ 6/97 GEAR TYPE: PT No:1 POSITION:Lat S 2225
start stop duration Long E 1416
TIME :19:05:40 19:16:16 11 (min) Purpose code: 1
LOG : 134.41 135.12 0.65 Area code : 2
FDEPTH: 25 25 GearCond.code: 1
BDEPTH: 51 52 Validity code: 1
Towing dir: 171° Wire out: 100 m Speed: 31 kn*10

Sorted: 3 Kg Total catch: 60.21 CATCH/HOUR: 328.42

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	327.27	148762	99.65	
Merluccius capensis	0.87	115	0.26	
Trachurus capensis	0.27	38	0.08	
Aequorea aequorea	0.00	16364		
Total	328.41		99.99	

PROJECT STATION:2150

DATE:17/ 6/97 GEAR TYPE: BT No: POSITION:Lat S 2221
start stop duration Long E 1345
TIME :23:39:29 23:52:39 13 (min) Purpose code: 1
LOG : 180.60 181.35 0.72 Area code : 2
FDEPTH: 127 115 GearCond.code: 1
BDEPTH: 127 115 Validity code: 1
Towing dir: 360° Wire out: 400 m Speed: 30 kn*10

Sorted: 57 Kg Total catch: 573.80 CATCH/HOUR: 2648.31

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2520.00	19246	95.16	7442
Merluccius capensis	124.15	831	4.69	7443
Todarodes sagittatus	4.15	46	0.16	
Chrysaora sp	0.00	831		
Total	2648.30		100.01	

PROJECT STATION:2151

DATE:18/ 6/97 GEAR TYPE: BT No: POSITION:Lat S 2219
start stop duration Long E 1334
TIME :01:37:13 01:56:41 19 (min) Purpose code: 1
LOG : 195.26 196.17 1.01 Area code : 2
FDEPTH: 139 140 GearCond.code:
BDEPTH: 139 140 Validity code:
Towing dir: 360° Wire out: 450 m Speed: 30 kn*10

Sorted: 54 Kg Total catch: 420.28 CATCH/HOUR: 1327.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	1261.89	8763	95.08	7444
Chelidonichthys capensis	26.53	76	2.00	
Lopihus vomerinus, juveniles	18.19	126	1.37	
Lepidopus caudatus	7.83	202	0.59	
Callorhinchus capensis	4.93	3	0.37	
Pterothrissus belloci	4.80	25	0.36	
Sufflogobius bibarbatus	3.03	657	0.23	
Chrysaora sp.	0.00	789		
Total	1327.20		100.00	

PROJECT STATION:2152

DATE:18/ 6/97 GEAR TYPE: BT No: POSITION:Lat S 2220
start stop duration Long E 1257
TIME :05:52:46 06:23:52 31 (min) Purpose code: 1
LOG : 236.19 237.81 1.61 Area code : 2
FDEPTH: 295 286 GearCond.code: 1
BDEPTH: 295 286 Validity code: 1
Towing dir: 90° Wire out: 950 m Speed: 30 kn*10

Sorted: 84 Kg Total catch: 503.70 CATCH/HOUR: 974.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	332.71	279	34.13	7447
Merluccius capensis	274.06	3248	28.11	7446
Trachurus capensis	252.00	1295	25.85	7445
Chlorophthalmus atlanticus	47.85	2257	4.91	
Helicolenus dactylopterus	42.27	886	4.34	
Coelorinchus fasciatus	13.82	325	1.42	
Lepidopus caudatus	5.81	23	0.60	
Todarodes sagittatus	4.65	12	0.48	
Galeus polli	1.51	35	0.15	
Synagrops microlepis	0.23	12	0.02	
Total	974.91		100.01	

PROJECT STATION:2153

DATE:18/ 6/97 GEAR TYPE: PT No:2 POSITION:Lat S 2211
start stop duration Long E 1243
TIME :09:32:54 09:37:02 4 (min) Purpose code: 1
LOG : 264.06 264.28 0.20 Area code : 1
FDEPTH: 180 180 GearCond.code: 1
BDEPTH: 553 555 Validity code: 1
Towing dir: 165° Wire out: 900 m Speed: 30 kn*10

Sorted: 10 Kg Total catch: 81.60 CATCH/HOUR: 1224.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	1125.00	803565	91.91	
Thyrsites atun	99.00	30	8.09	
Total	1224.00		100.00	

PROJECT STATION:2154

DATE:18/ 6/97 GEAR TYPE: BT No: POSITION:Lat S 2159
start stop duration Long E 1247
TIME :13:12:28 13:15:24 3 (min) Purpose code: 1
LOG : 289.93 290.07 0.13 Area code : 2
FDEPTH: 346 345 GearCond.code: 9
BDEPTH: 346 345 Validity code: 1
Towing dir: 360° Wire out:1030 m Speed: 30 kn*10

Sorted: 39 Kg Total catch: 1386.01 CATCH/HOUR: 27720.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Beryx splendens	23440.00	72800	84.56	
Merluccius capensis	2160.00	3600	7.79	
Helicolenus dactylopterus	784.00	7200	2.83	
Merluccius paradoxus	696.00	1600	2.51	
Todaropsis eblanae	288.00	800	1.04	
Trachipterus jacksonensis	88.20	20	0.32	
Chlorophthalmus atlanticus	88.00	2400	0.32	
Galeus polli	32.00	1600	0.12	
Total	27576.20		99.49	

PROJECT STATION:2155

DATE:18/ 6/97 GEAR TYPE: PT No:2 POSITION:Lat S 2160
start stop duration Long E 1255
TIME :15:43:00 15:53:46 11 (min) Purpose code: 1
LOG : 304.71 305.36 0.64 Area code : 2
FDEPTH: 250 250 GearCond.code: 1
BDEPTH: 334 334 Validity code: 1
Towing dir: 335° Wire out: 820 m Speed: 40 kn*10

Sorted: 7 Kg Total catch: 36.90 CATCH/HOUR: 201.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	171.27	86067	85.09	
Brama brama	27.71	22	13.77	
Trachurus capensis	2.29	5	1.14	
Chrysaora sp.	0.00	982		
Total	201.27		100.00	

PROJECT STATION: 2156

DATE: 19/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 2120
start stop duration Long E 1257
TIME : 14:11:33 14:29:35 18 (min) Purpose code: 1
LOG : 534.11 535.04 0.99 Area code : 2
FDEPTH: 200 200 GearCond.code: 1
BDEPTH: 267 279 Validity code: 1
Towing dir: 270° Wire out: 700 m Speed: 40 kn*10

Sorted: 25 Kg Total catch: 241.50 CATCH/HOUR: 805.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	803.33	13900	99.79	7448
Brama brama	1.67	3	0.21	
Aequorea aequorea	0.00	10000		
Chrysaora sp.	0.00	300		
Total	805.00		100.00	

PROJECT STATION: 2157

DATE: 19/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2120
start stop duration Long E 1307
TIME : 16:25:52 16:56:41 31 (min) Purpose code: 1
LOG : 550.00 551.61 1.61 Area code : 2
FDEPTH: 151 157 GearCond.code: 1
BDEPTH: 151 157 Validity code: 1
Towing dir: 270° Wire out: 500 m Speed: 30 kn*10

Sorted: 35 Kg Total catch: 492.08 CATCH/HOUR: 952.41

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	944.52	16285	99.17	7449
Beryx splendens	7.70	31	0.81	
Trachurus capensis	0.19	2	0.02	
Total	952.41		100.00	

PROJECT STATION: 2158

DATE: 19/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2120
start stop duration Long E 1305
TIME : 17:47:53 18:08:24 21 (min) Purpose code: 1
LOG : 554.13 555.51 1.28 Area code : 2
FDEPTH: 25 25 GearCond.code: 1
BDEPTH: 156 156 Validity code: 1
Towing dir: 90° Wire out: 100 m Speed: 35 kn*10

Sorted: 32 Kg Total catch: 652.00 CATCH/HOUR: 1862.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	1862.86	24837	100.00	7450
Chrysaora sp.	0.00	857		
Total	1862.86		100.00	

PROJECT STATION: 2159

DATE: 20/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2102
start stop duration Long E 1328
TIME : 00:02:50 00:05:29 3 (min) Purpose code: 1
LOG : 616.41 616.58 0.15 Area code : 2
FDEPTH: 20 15 GearCond.code: 1
BDEPTH: 42 41 Validity code: 1
Towing dir: 40° Wire out: 4 m Speed: 40 kn*10

Sorted: 18 Kg Total catch: 220.80 CATCH/HOUR: 4416.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	2078.40	190560	47.07	7453
Etrumeus whiteheadi	1528.80	95280	34.62	7454
Engraulis capensis	607.20	95520	13.75	7451
Trachurus capensis	201.60	25920	4.57	7452
Total	4416.00		100.01	

PROJECT STATION: 2160

DATE: 20/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2060
start stop duration Long E 1247
TIME : 05:53:25 06:25:15 32 (min) Purpose code: 1
LOG : 665.90 667.64 1.63 Area code : 2
FDEPTH: 319 304 GearCond.code: 1
BDEPTH: 319 304 Validity code: 1
Towing dir: 90° Wire out: 1000 m Speed: 30 kn*10

Sorted: 60 Kg Total catch: 226.45 CATCH/HOUR: 424.59

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	328.13	510	77.28	7455
Schedophilus huttoni	69.19	208	16.30	
Todarodes sagittatus	5.08	9	1.20	
Genypterus capensis	4.24	2	1.00	
Lophius vomerinus	3.86	4	0.91	
Coelorinchus fasciatus	3.75	131	0.88	
Trachurus capensis	2.63	17	0.62	7456
Austroglossus microlepis	2.53	2	0.60	
Dentex macrophthalmus	2.21	6	0.52	
Chlorophthalmus atlanticus	0.94	38	0.22	
Helicolenus dactylopterus	0.94	4	0.22	
Sufflogobius bibarbatus	0.47	103	0.11	
Trigla lyra	0.45	2	0.11	
Synagrops microlepis	0.19	9	0.04	
Chrysaora sp.	0.00	563		
Total	424.61		100.01	

PROJECT STATION: 2161

DATE: 20/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2100
start stop duration Long E 1239
TIME : 08:21:34 08:46:02 24 (min) Purpose code: 1
LOG : 681.01 682.22 1.10 Area code : 2
FDEPTH: 200 150 GearCond.code: 1
BDEPTH: 366 361 Validity code: 1
Towing dir: 90° Wire out: 600 m Speed: 35 kn*10

Sorted: 16 Kg Total catch: 16.30 CATCH/HOUR: 40.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	33.75	68	82.82	7457
Brama brama	7.00	5	17.18	
Chrysaora sp.	0.00	750		
Total	40.75		100.00	

PROJECT STATION: 2162

DATE: 20/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2100
start stop duration Long E 1229
TIME : 11:10:14 11:39:56 30 (min) Purpose code: 1
LOG : 699.14 701.18 1.85 Area code : 2
FDEPTH: 300 300 GearCond.code: 1
BDEPTH: 447 420 Validity code: 1
Towing dir: 90° Wire out: 1000 m Speed: 45 kn*10

Sorted: 11 Kg Total catch: 37.80 CATCH/HOUR: 75.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Lampanyctodes hectoris	71.20	49444	94.18	
Brama brama	4.40	4	5.82	
Aequorea aequorea	0.00	600		
Chrysaora sp.	0.00	180		
Total	75.60		100.00	

PROJECT STATION: 2163

DATE: 20/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2047
start stop duration Long E 1214
TIME : 15:50:13 16:24:18 34 (min) Purpose code: 1
LOG : 735.81 737.88 2.03 Area code : 3
FDEPTH: 250 250 GearCond.code: 1
BDEPTH: 543 569 Validity code: 1
Towing dir: 182° Wire out: 900 m Speed: 40 kn*10

Sorted: 1 Kg Total catch: 0.50 CATCH/HOUR: 0.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	0.88		100.00	
Total	0.88		100.00	

PROJECT STATION: 2164

DATE: 20/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2045
start stop duration Long E 1222
TIME : 18:40:13 19:07:04 27 (min) Purpose code: 1
LOG : 754.95 756.36 1.42 Area code : 2
FDEPTH: 150 200 GearCond.code: 3
BDEPTH: 372 391 Validity code: 1
Towing dir: 270° Wire out: 500 m Speed: 35 kn*10

Sorted: 4 Kg Total catch: 23.42 CATCH/HOUR: 52.04

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	34.22	72149	65.76	
MYCTOPHIDAE	11.33	4073	21.77	
Zeus capensis	4.24	7	8.15	
Histioteuthis reversa	2.02	33	3.88	
Hoplostethus melanopus	0.22	2	0.42	
Total	52.03		99.98	

PROJECT STATION: 2165

DATE: 20/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2045
start stop duration Long E 1231
TIME : 21:12:19 21:41:38 29 (min) Purpose code: 1
LOG : 772.16 773.79 1.64 Area code : 2
FDEPTH: 230 230 GearCond.code: 1
BDEPTH: 330 329 Validity code: 1
Towing dir: 270° Wire out: 750 m Speed: 34 kn*10

Sorted: 8 Kg Total catch: 7.84 CATCH/HOUR: 16.22

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	8.77	217	54.07	7458
Dentex macrophthalmus	7.45	23	45.93	
Aequorea aequorea	0.00	414		
Chrysaora sp.	0.00	50		
Total	16.22		100.00	

PROJECT STATION: 2166

DATE: 21/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 2045
start stop duration Long E 1314
TIME : 02:46:24 02:51:20 5 (min) Purpose code: 1
LOG : 822.93 823.25 0.32 Area code : 3
FDEPTH: 20 18 GearCond.code: 1
BDEPTH: 96 98 Validity code: 1
Towing dir: 270° Wire out: 150 m Speed: 40 kn*10

Sorted: 28 Kg Total catch: 855.96 CATCH/HOUR: 10271.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	10270.80	1316760	99.99	7459
Total	10270.80		99.99	

PROJECT STATION: 2167

DATE: 21/ 6/97 GEAR TYPE: PT No: 7 POSITION: Lat S 2043
start stop duration Long E 1320
TIME :04:17:01 04:19:54 3 (min) Purpose code: 1
LOG : 832.85 833.01 0.15 Area code : 3
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 31 30 Validity code: 1
Towing dir: 302° Wire out: 150 m Speed: 30 kn*10

Sorted: 4 Kg Total catch: 969.90 CATCH/HOUR: 19398.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	11207.40	1174760	57.78	7460
Engraulis capensis	8101.40	1440240	41.76	7461
Trachurus capensis	89.20	8920	0.46	7462
Total	19398.00		100.00	

PROJECT STATION: 2168

DATE: 21/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2030
start stop duration Long E 1302
TIME :08:52:12 09:11:27 19 (min) Purpose code: 1
LOG : 876.38 877.42 1.04 Area code : 3
FDEPTH: 119 115 GearCond.code: 1
BDEPTH: 119 115 Validity code: 1
Towing dir: 90° Wire out: 400 m Speed: 30 kn*10

Sorted: 33 Kg Total catch: 230.30 CATCH/HOUR: 727.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	727.26	15455	100.00	7463
Chrysaora sp.	0.00	1326		
Total	727.26		100.00	

PROJECT STATION: 2169

DATE: 21/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2030
start stop duration Long E 1255
TIME :11:34:10 11:44:39 10 (min) Purpose code: 1
LOG : 890.61 891.26 0.60 Area code : 3
FDEPTH: 98 95 GearCond.code: 1
BDEPTH: 130 134 Validity code: 1
Towing dir: 270° Wire out: 320 m Speed: 40 kn*10

Sorted: 33 Kg Total catch: 232.05 CATCH/HOUR: 1392.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	1363.32	19404	97.92	7464
Etrumeus whiteheadi	28.98	1428	2.08	7465
Aequorea aequorea	0.00	288000		
Chrysaora sp.	0.00	8640		
Total	1392.30		100.00	

PROJECT STATION: 2170

DATE: 21/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2030
start stop duration Long E 1233
TIME :14:40:03 14:44:34 5 (min) Purpose code: 1
LOG : 916.25 916.34 0.09 Area code : 3
FDEPTH: 286 286 GearCond.code: 1
BDEPTH: 286 286 Validity code: 1
Towing dir: 90° Wire out: 900 m Speed: 35 kn*10

Sorted: 27 Kg Total catch: 27.19 CATCH/HOUR: 326.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	204.60	1956	62.71	7467
Dentex macrophthalmus	67.20	264	20.60	
Trachurus capensis	33.12	216	10.15	7466
Pterothrissus belloci	10.32	252	3.16	
Lophius vomerinus	8.76	24	2.68	
Sufflogobius bibarbatus	1.92	264	0.59	
Coelorinchus fasciatus	0.36	12	0.11	
Aequorea aequorea	0.00	36000		
Chrysaora sp.	0.00	1080		
Total	326.28		100.00	

PROJECT STATION: 2171

DATE: 21/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2030
start stop duration Long E 1220
TIME :17:04:40 17:34:16 30 (min) Purpose code: 1
LOG : 935.45 936.90 1.52 Area code : 3
FDEPTH: 307 304 GearCond.code: 1
BDEPTH: 307 304 Validity code: 1
Towing dir: 90° Wire out: 1000 m Speed: 30 kn*10

Sorted: 92 Kg Total catch: 301.63 CATCH/HOUR: 603.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	233.00	1534	38.62	7469
Merluccius capensis	221.80	438	36.77	7468
Chlorophthalmus atlanticus	111.60	5554	18.50	
Todarodes sagittatus	13.60	40	2.25	
Pterothrissus belloci	10.60	52	1.76	
Dentex macrophthalmus	8.40	26	1.39	
Coelorinchus fasciatus	3.20	40	0.53	
Helicolenus dactylopterus	0.66	14	0.11	
Trigla lyra	0.40	6	0.07	
Total	603.26		100.00	

PROJECT STATION: 2172

DATE: 21/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 2029
start stop duration Long E 1208
TIME :19:40:32 20:00:14 20 (min) Purpose code: 1
LOG : 954.20 955.18 1.03 Area code : 3
FDEPTH: 300 750 GearCond.code: 1
BDEPTH: 370 348 Validity code: 1
Towing dir: 45° Wire out: 200 m Speed: 34 kn*10

Sorted: 27 Kg Total catch: 27.20 CATCH/HOUR: 81.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	68.10	56757	83.46	
Brama brama	13.50	15	16.54	
Total	81.60		100.00	

PROJECT STATION: 2173

DATE: 22/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 2015
start stop duration Long E 1213
TIME :01:05:19 01:44:11 39 (min) Purpose code: 1
LOG :1002.97 1005.34 2.31 Area code : 3
FDEPTH: 200 270 GearCond.code: 1
BDEPTH: 289 297 Validity code: 1
Towing dir: 270° Wire out: 900 m Speed: 40 kn*10

Sorted: 49 Kg Total catch: 124.05 CATCH/HOUR: 190.85

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	120.31	1662	63.04	7471
Trachurus capensis	39.46	197	20.68	7470
Dentex macrophthalmus	18.65	55	9.77	
Merluccius capensis	9.62	11	5.04	7472
Synagrops microlepis	1.23	80	0.64	
Brama brama	0.97	2	0.51	
Chlorophthalmus atlanticus	0.37	62	0.19	
Todarodes sagittatus	0.25	6	0.13	
Total	190.86		100.00	

PROJECT STATION: 2174

DATE: 22/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2014
start stop duration Long E 1218
TIME :03:25:38 03:46:42 21 (min) Purpose code: 1
LOG :1016.97 1018.07 1.16 Area code : 3
FDEPTH: 277 279 GearCond.code: 1
BDEPTH: 277 279 Validity code: 1
Towing dir: 270° Wire out: 900 m Speed: 35 kn*10

Sorted: 50 Kg Total catch: 257.39 CATCH/HOUR: 735.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	610.29	4160	82.99	7473
Merluccius capensis	56.29	60	7.65	7474
Merluccius capensis	31.77	206	4.32	7475
Pterothrissus belloci	15.80	183	2.15	
Todarodes sagittatus	9.83	23	1.34	
Dentex macrophthalmus	9.60	23	1.31	
Lophius vomerinus	1.37	23	0.19	
Sufflogobius bibarbatus	0.46	23	0.06	
Total	735.41		100.01	

PROJECT STATION: 2175

DATE: 22/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 2014
start stop duration Long E 1245
TIME :07:24:52 07:40:51 16 (min) Purpose code: 1
LOG :1051.05 1051.99 1.00 Area code : 3
FDEPTH: 50 110 GearCond.code: 1
BDEPTH: 112 132 Validity code: 1
Towing dir: 90° Wire out: 400 m Speed: 40 kn*10

Sorted: 47 Kg Total catch: 279.60 CATCH/HOUR: 1048.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	848.25	42413	80.90	7477
Sardinops ocellatus	195.75	3930	18.67	7476
Engraulis capensis	4.28	225	0.41	7479
Trachurus capensis	0.23	135	0.02	7478
Total	1048.51		100.00	

PROJECT STATION: 2176

DATE: 22/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2009
start stop duration Long E 1301
TIME :12:54:15 13:21:28 27 (min) Purpose code: 1
LOG :1103.17 1104.57 1.07 Area code : 3
FDEPTH: 73 67 GearCond.code: 1
BDEPTH: 73 67 Validity code: 1
Towing dir: 123° Wire out: 300 m Speed: 30 kn*10

Sorted: 24 Kg Total catch: 218.34 CATCH/HOUR: 485.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	306.00	7140	63.07	7481
Merluccius capensis	179.00	5300	36.89	7480
Sufflogobius bibarbatus	0.20	20	0.04	
Chrysaora sp.	0.00	1333		
Total	485.20		100.00	

PROJECT STATION: 2177

DATE: 22/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 1960
start stop duration Long E 1232
TIME :19:26:55 19:56:41 30 (min) Purpose code: 1
LOG :1160.33 1162.23 1.47 Area code : 3
FDEPTH: 145 140 GearCond.code: 1
BDEPTH: 145 140 Validity code: 1
Towing dir: 90° Wire out: 550 m Speed: 30 kn*10

Sorted: 65 Kg Total catch: 100.89 CATCH/HOUR: 201.78

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	139.20	1544	68.99	7482
Trachurus capensis	54.20	700	26.86	7483
Chelidonichthys queketti	3.82	8	1.89	
Callorhinchus capensis	3.04	2	1.51	
Todarodes sagittatus	0.78	2	0.39	
Sufflogobius bibarbatus	0.74	1216	0.37	
Total	201.78		100.01	

PROJECT STATION: 2178

DATE: 23/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 2000
start stop duration Long E 1205
TIME :23:43:00 00:01:08 18 (min) Purpose code: 1
LOG :1195.83 1196.82 0.89 Area code : 3
FDEPTH: 308 303 GearCond.code: 1
BDEPTH: 308 303 Validity code: 1
Towing dir: 90° Wire out:1000 m Speed: 30 kn*10

Sorted: 37 Kg Total catch: 147.25 CATCH/HOUR: 490.83

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	206.67	1000	42.11	7485
Pterothrissus belloci	186.67	1250	38.03	
Myliobatis aquila	26.50	3	5.40	
Dentex macrophthalmus	22.67	83	4.62	
Lophius vomerinus	21.67	33	4.41	
Sufflogobius bibarbatus	9.00	1083	1.83	
Trachurus capensis	8.50	60	1.73	7484
Solenocera africana	4.33	917	0.88	
Todarodes sagittatus	2.50	67	0.51	
Trigla lyra	1.83	17	0.37	
Chlorophthalmus atlanticus	0.50	33	0.10	
Total	490.84		99.99	

PROJECT STATION: 2179

DATE: 23/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 1945
start stop duration Long E 1225
TIME :08:48:37 09:09:12 21 (min) Purpose code: 1
LOG :1288.10 1289.14 1.07 Area code : 3
FDEPTH: 145 150 GearCond.code: 1
BDEPTH: 145 150 Validity code: 1
Towing dir: 270° Wire out: 550 m Speed: 30 kn*10

Sorted: 52 Kg Total catch: 255.60 CATCH/HOUR: 730.29

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	544.29	12094	74.53	7486
Trachurus capensis	181.43	2951	24.84	7487
Todarodes sagittatus	3.60	11	0.49	
Squalus megalops	1.00	3	0.14	
Chrysaora sp.	0.00	1029		
Total	730.32		100.00	

PROJECT STATION: 2180

DATE: 23/ 6/97 GEAR TYPE: PT No:1 POSITION: Lat S 1945
start stop duration Long E 1237
TIME :11:05:40 11:10:49 5 (min) Purpose code: 1
LOG :1305.69 1305.95 0.23 Area code : 3
FDEPTH: 50 70 GearCond.code: 1
BDEPTH: 115 116 Validity code: 1
Towing dir: 270° Wire out: 170 m Speed: 35 kn*10

Sorted: 25 Kg Total catch: 181.20 CATCH/HOUR: 2174.40

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	2140.80	130308	98.45	7488
Thyrsites atun	33.60	12	1.55	
Aequorea aequorea	0.00	16416		
Total	2174.40		100.00	

PROJECT STATION: 2181

DATE: 23/ 6/97 GEAR TYPE: PT No:7 POSITION: Lat S 1949
start stop duration Long E 1250
TIME :13:23:17 13:37:56 15 (min) Purpose code: 1
LOG :1325.46 1326.19 0.64 Area code : 3
FDEPTH: 45 79 GearCond.code: 1
BDEPTH: 75 79 Validity code: 1
Towing dir: 270° Wire out: 200 m Speed: 30 kn*10

Sorted: 11 Kg Total catch: 57.18 CATCH/HOUR: 228.72

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	192.00	5160	83.95	7489
Etrumeus whiteheadi	31.00	2900	13.55	7490
Merluccius capensis	3.60	80	1.57	
Galeichthys feliceps	2.12	4	0.93	
Aequorea aequorea	0.00	36000		
Chrysaora sp.	0.00	360		
Total	228.72		100.00	

PROJECT STATION: 2182

DATE: 23/ 6/97 GEAR TYPE: PT No:7 POSITION: Lat S 1944
start stop duration Long E 1251
TIME :14:56:42 15:09:38 13 (min) Purpose code: 1
LOG :1336.55 1337.26 0.72 Area code : 3
FDEPTH: 25 38 GearCond.code: 1
BDEPTH: 41 46 Validity code: 1
Towing dir: 300° Wire out: 120 m Speed: 30 kn*10

Sorted: 18 Kg Total catch: 73.20 CATCH/HOUR: 337.85

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	337.85	12743	100.00	7491
Aequorea aequorea	0.00	900		
Chrysaora sp.	0.00	83		
Total	337.85		100.00	

PROJECT STATION: 2183

DATE: 23/ 6/97 GEAR TYPE: BT No: POSITION: Lat S 1930
start stop duration Long E 1220
TIME :20:42:57 21:02:58 20 (min) Purpose code: 1
LOG :1394.09 1395.21 1.01 Area code : 3
FDEPTH: 140 141 GearCond.code: 1
BDEPTH: 140 141 Validity code: 1
Towing dir: 90° Wire out: 550 m Speed: 30 kn*10

Sorted: 48 Kg Total catch: 239.90 CATCH/HOUR: 719.70

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	552.90	6567	76.82	7492
Trachurus capensis	166.50	2601	23.13	7493
Sufflogobius bibarbatus	0.30	45	0.04	
Chrysaora sp.	0.00	1080		
Total	719.70		99.99	

PROJECT STATION: 2184

DATE: 24/ 6/97 GEAR TYPE: BT No:2 POSITION: Lat S 1921
start stop duration Long E 1127
TIME :03:03:40 03:35:10 32 (min) Purpose code: 1
LOG :1456.83 1458.30 1.59 Area code : 3
FDEPTH: 544 0 GearCond.code: 1
BDEPTH: 544 Validity code: 1
Towing dir: 338° Wire out:1550 m Speed: 30 kn*10

Sorted: 85 Kg Total catch: 867.01 CATCH/HOUR: 1625.64

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius paradoxus	693.75	1013	42.68	7494
Trachyrincus scabrus	562.50	2475	34.60	
Todarodes sagittatus	127.50	300	7.84	
Raja straeleni	88.13	113	5.42	
Deania calcea	48.38	13	2.98	
Hoplostethus cadenati	25.13	1538	1.55	
Lophius vomerinus	15.90	4	0.98	
Helicolenus dactylopterus	15.56	900	0.96	
Nezumia sp.	15.34	7408	0.94	
Selachophidium guentheri	10.13	188	0.62	
Deepwater fish mixture	6.38		0.39	
Epigonus denticulatus	5.63	225	0.35	
Ebinania costaecanarie	5.25	75	0.32	
Neoharriotta pinnata	3.47	2	0.21	
Lycoteuthis diadema	2.63	38	0.16	
Total	1625.68		100.00	

PROJECT STATION: 2185

DATE: 24/ 6/97 GEAR TYPE: BT No:2 POSITION: Lat S 1915
start stop duration Long E 1211
TIME :08:56:25 08:57:36 1 (min) Purpose code: 1
LOG :1512.30 1512.36 0.09 Area code : 3
FDEPTH: 180 181 GearCond.code: 1
BDEPTH: 180 181 Validity code:
Towing dir: 270° Wire out: 600 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 187.63 CATCH/HOUR: 11257.80

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Merluccius capensis	6156.00	65460	54.68	7496
Trachurus capensis	4644.00	58680	41.25	7495
Dentex macrophthalmus	378.00	2880	3.36	
BATRACHOIDIDAE	72.00	360	0.64	
Squalus megalops	7.80	60	0.07	
Aequorea aequorea	0.00	420000		
Chrysaora sp.	0.00	12600		
Total	11257.80		100.00	

PROJECT STATION: 2186

DATE: 24/ 6/97 GEAR TYPE: PT No:1 POSITION: Lat S 1915
start stop duration Long E 1213
TIME :09:59:02 10:08:57 10 (min) Purpose code: 1
LOG :1517.46 1518.00 0.55 Area code : 3
FDEPTH: 25 50 GearCond.code: 1
BDEPTH: 160 167 Validity code: 1
Towing dir: 270° Wire out: 150 m Speed: 35 kn*10

Sorted: 22 Kg Total catch: 442.60 CATCH/HOUR: 2655.60

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Trachurus capensis	2640.00	156216	99.41	7497
Etrumeus whiteheadi	15.60	240	0.59	
Aequorea aequorea	0.00	36000		
Total	2655.60		100.00	

PROJECT STATION:2187

DATE:24/ 6/97 GEAR TYPE: PT No:1 POSITION:Lat S 1916
start stop duration Long E 1229
TIME :12:23:37 12:38:25 15 (min) Purpose code: 1
LOG :1538.41 1539.24 0.82 Area code : 3
FDEPTH: 50 55 GearCond.code: 1
BDEPTH: 99 100 Validity code: 1
Towing dir: 330° Wire out: 170 m Speed: 35 kn*10

Sorted: 29 Kg Total catch: 550.61 CATCH/HOUR: 2202.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2196.00	68216	99.71	7498
Callorhinchus capensis	6.44	4	0.29	
Aequorea aequorea	0.00	24000		
Chrysaora sp	0.00	720		
Total	2202.44		100.00	

PROJECT STATION:2188

DATE:24/ 6/97 GEAR TYPE: PT No:7 POSITION:Lat S 1902
start stop duration Long E 1226
TIME :16:42:56 16:52:01 9 (min) Purpose code: 1
LOG :1581.62 1582.18 0.50 Area code : 3
FDEPTH: 55 40 GearCond.code: 9
BDEPTH: 60 64 Validity code: 1
Towing dir: 180° Wire out: 170 m Speed: 35 kn*10

Sorted: 31 Kg Total catch: 1750.00 CATCH/HOUR: 11666.67

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	11666.67	238093	100.00	7499
Total	11666.67		100.00	

PROJECT STATION:2189

DATE:24/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 1860
start stop duration Long E 1212
TIME :20:10:18 20:24:38 14 (min) Purpose code: 1
LOG :1611.28 1612.11 0.72 Area code : 3
FDEPTH: 119 115 GearCond code: 1
BDEPTH: 119 115 Validity code: 1
Towing dir: 90° Wire out: 450 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 1163.45 CATCH/HOUR: 4986.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	3115.93	48686	62.49	7500
Trachurus capensis	1855.29	28766	37.21	7501
Chelidonichthys capensis	6.34	159	0.13	
Sufflogobius bibarbatus	4.76	476	0.10	
Austroglossus microlepis	2.66	4	0.05	
Galeichthys feliceps	1.24	4	0.02	
Total	4986.22		100.00	

PROJECT STATION:2190

DATE:24/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 1900
start stop duration Long E 1158
TIME :22:30:40 22:45:51 15 (min) Purpose code: 1
LOG :1629.67 1630.51 0.71 Area code : 3
FDEPTH: 221 214 GearCond.code: 1
BDEPTH: 221 214 Validity code: 1
Towing dir: 90° Wire out: 650 m Speed: 30 kn*10

Sorted: 21 Kg Total catch: 67.30 CATCH/HOUR: 269.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	217.00	3404	80.61	7503
Trachurus capensis	37.80	376	14.04	7502
Pterothrissus belloci	7.00	80	2.60	
Dentex macrophthalmus	7.00	60	2.60	
Sufflogobius bibarbatus	0.40	80	0.15	
Aequorea aequorea	0.00	14400		
Chrysaora sp	0.00	432		
Total	269.20		100.00	

PROJECT STATION:2191

DATE:25/ 6/97 GEAR TYPE: PT No:6 POSITION:Lat S 1900
start stop duration Long E 1130
TIME :02:25:08 02:45:09 20 (min) Purpose code: 1
LOG :1663.13 1664.31 1.10 Area code : 3
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 299 325 Validity code: 1
Towing dir: 270° Wire out: 150 m Speed: 35 kn*10

Sorted: 21 Kg Total catch: 21.92 CATCH/HOUR: 65.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	21.00	105000	31.93	
MYCTOPHIDAE	21.00	10851	31.93	
Brama brama	10.14	15	15.42	
Prionace glauca	10.05	3	15.28	
Thyrsites atun	3.57	3	5.43	
Total	65.76		99.99	

PROJECT STATION:2192

DATE:25/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 1846
start stop duration Long E 1132
TIME :07:52:28 08:24:24 32 (min) Purpose code: 1
LOG :1712.79 1714.66 1.58 Area code : 3
FDEPTH: 254 255 GearCond.code: 1
BDEPTH: 254 255 Validity code: 1
Towing dir: 160° Wire out: 800 m Speed: 30 kn*10

Sorted: 90 Kg Total catch: 834.02 CATCH/HOUR: 1563.79

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	486.51	2355	31.11	
Merluccius capensis	422.87	4359	27.04	7505
Pterothrissus belloci	191.81	2981	12.27	
Trachurus capensis	162.17	1277	10.37	7504
Helicolenus dactylopterus	152.59	2348	9.76	
Deepwater fish mixture	126.43		8.08	
Todarodes sagittatus	19.01	88	1.22	
RAJIDAE	1.43	2	0.09	
C R A B S	0.53	36	0.03	
Trigla lyra	0.45	2	0.03	
Total	1563.80		100.00	

PROJECT STATION:2193

DATE:25/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 1846
start stop duration Long E 1159
TIME :11:28:44 11:42:56 14 (min) Purpose code: 1
LOG :1745.00 1745.69 0.71 Area code : 3
FDEPTH: 130 129 GearCond.code: 9
BDEPTH: 130 129 Validity code: 1
Towing dir: 340° Wire out: 450 m Speed: 30 kn*10

Sorted: 16 Kg Total catch: 163.02 CATCH/HOUR: 698.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	544.29	10367	77.90	7506
Trachurus capensis	152.14	2700	21.78	7507
Galeichthys feliceps	2.01	4	0.29	
Sufflogobius bibarbatus	0.21	43	0.03	
Aequorea aequorea	0.00	4114		
Chrysaora sp	0.00	244		
Total	698.65		100.00	

PROJECT STATION:2194

DATE:25/ 6/97 GEAR TYPE: PT No:7 POSITION:Lat S 1847
start stop duration Long E 1218
TIME :14:45:01 14:55:15 10 (min) Purpose code: 1
LOG :1776.40 1776.99 0.48 Area code : 3
FDEPTH: 30 32 GearCond.code: 1
BDEPTH: 37 38 Validity code: 1
Towing dir: 156° Wire out: 120 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 622.00 CATCH/HOUR: 3732.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3732.00	78906	100.00	7508
Aequorea aequorea	0.00	1800		
Chrysaora sp	0.00	108		
Total	3732.00		100.00	

PROJECT STATION:2195

DATE:25/ 6/97 GEAR TYPE: PT No:7 POSITION:Lat S 1841
start stop duration Long E 1206
TIME :16:48:39 16:55:46 7 (min) Purpose code: 1
LOG :1795.40 1795.75 0.34 Area code : 3
FDEPTH: 50 50 GearCond.code: 1
BDEPTH: 60 63 Validity code: 1
Towing dir: 305° Wire out: 170 m Speed: 30 kn*10

Sorted: 57 Kg Total catch: 432.40 CATCH/HOUR: 3706.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3487.71	31560	94.10	7509
Thyrsites atun	218.57	77	5.90	
Total	3706.28		100.00	

PROJECT STATION:2196

DATE:25/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 1830
start stop duration Long E 1154
TIME :19:48:30 19:51:08 3 (min) Purpose code: 1
LOG :1824.49 1824.64 0.15 Area code : 3
FDEPTH: 104 103 GearCond.code: 1
BDEPTH: 104 103 Validity code: 1
Towing dir: 20° Wire out: 400 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 305.27 CATCH/HOUR: 6105.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3970.00	88220	65.02	7510
Merluccius capensis	2120.00	37200	34.72	7511
Galeichthys feliceps	10.00	60	0.16	
Chelidonichthys capensis	5.40	20	0.09	
Aequorea aequorea	0.00	155200		
Total	6105.40		99.99	

PROJECT STATION: 2197

DATE: 25/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1830
start stop duration Long E 1137
TIME :21:51:13 22:12:19 21 (min) Purpose code: 1
LOG :1844.02 1845.17 1.10 Area code : 3
FDEPTH: 195 189 GearCond.code: 1
BDEPTH: 195 189 Validity code: 1
Towing dir: 90° Wire out: 700 m Speed: 30 kn*10

Sorted: 56 Kg Total catch: 335.02 CATCH/HOUR: 957.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Merluccius capensis	720.00	8666	75.22	7513
Trachurus capensis	118.29	1166	12.36	7512
Dentex macrophthalmus	108.86	826	11.37	
Synagrops microlepis	5.49	806	0.57	
Todarodes sagittatus	3.77	17	0.39	
Trigla lyra	0.80	3	0.08	
Chrysaora sp.	0.00	514		
Total	957.21		99.99	

PROJECT STATION: 2198

DATE: 25/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1829
start stop duration Long E 1130
TIME :23:33:38 23:51:35 18 (min) Purpose code: 1
LOG :1856.15 1857.03 0.93 Area code : 3
FDEPTH: 274 281 GearCond.code: 9
BDEPTH: 274 281 Validity code: 1
Towing dir: 360° Wire out: 850 m Speed: 30 kn*10

Sorted: 60 Kg Total catch: 901.81 CATCH/HOUR: 3006.03

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Merluccius capensis	1427.50	3000	47.49	7514
Helicolenus dactylopterus	700.00	104577	23.29	
Chlorophthalmus atlanticus	525.00	20000	17.46	
Pterothrissus belloci	85.50	600	2.84	
Galeus polli	78.00	300	2.59	
Todarodes sagittatus	71.50	150	2.38	
Dentex macrophthalmus	42.50	150	1.41	
Trigla lyra	37.00	700	1.23	
Coelorinchus fasciatus	28.00	1050	0.93	
MYCTOPHIDAE	5.50	1450	0.18	
Trachurus capensis	2.53	17	0.08	7515
Nezumia sp.	2.00	150	0.07	
Solenocera africana	1.00	450	0.03	
Total	3006.03		99.98	

PROJECT STATION: 2199

DATE: 26/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1815
start stop duration Long E 1130
TIME :04:40:39 04:44:56 4 (min) Purpose code: 1
LOG :1906.49 1906.70 0.23 Area code : 6
FDEPTH: 291 293 GearCond.code: 9
BDEPTH: 291 293 Validity code: 1
Towing dir: 15° Wire out: 900 m Speed: 30 kn*10

Sorted: 21 Kg Total catch: 58.94 CATCH/HOUR: 884.10

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	807.75	3195	91.36	7517
Trachurus capensis	21.75	150	2.46	7516
Coelorinchus fasciatus	15.75	180	1.78	
Helicolenus dactylopterus	13.95	495	1.58	
Pterothrissus belloci	7.65	45	0.87	
Chlorophthalmus atlanticus	7.65	270	0.87	
Dentex macrophthalmus	3.60	15	0.41	
Trigla lyra	3.30	15	0.37	
Nezumia sp.	1.35	45	0.15	
MYCTOPHIDAE	0.90	720	0.10	
Synagrops microlepis	0.45	45	0.05	
Aequorea aequorea	0.00	15000		
Total	884.10		100.00	

PROJECT STATION: 2200

DATE: 26/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 1815
start stop duration Long E 1149
TIME :00:00:18 00:00:27 9 (min) Purpose code: 1
LOG :1929.03 1929.54 0.52 Area code : 3
FDEPTH: 40 60 GearCond.code: 9
BDEPTH: 74 81 Validity code: 1
Towing dir: 260° Wire out: 150 m Speed: 30 kn*10

Sorted: 28 Kg Total catch: 227.76 CATCH/HOUR: 1518.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1506.67	40180	99.23	7518
Merluccius capensis	11.73	107	0.77	
Chrysaora sp.	0.00	220		
Total	1518.40		100.00	

PROJECT STATION: 2201

DATE: 26/ 6/97 GEAR TYPE: PT No: 1 POSITION: Lat S 1806
start stop duration Long E 1145
TIME :01:40:44 01:40:55 11 (min) Purpose code: 1
LOG :1963.55 1964.35 0.71 Area code : 3
FDEPTH: 20 20 GearCond.code: 1
BDEPTH: 81 79 Validity code: 1
Towing dir: 185° Wire out: 100 m Speed: 40 kn*10

Sorted: 1 Kg Total catch: 201.80 CATCH/HOUR: 1100.73

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Trachurus capensis	1100.73	148598	100.00	7519
Chrysaora sp.	0.00	545		
Total	1100.73		100.00	

PROJECT STATION: 2202

DATE: 26/ 6/97 GEAR TYPE: BT No: 2 POSITION: Lat S 1756
start stop duration Long E 1142
TIME :01:40:07 01:40:15 8 (min) Purpose code: 1
LOG :1981.04 1981.45 0.35 Area code : 3
FDEPTH: 95 95 GearCond.code: 1
BDEPTH: 95 95 Validity code: 1
Towing dir: 95° Wire out: 350 m Speed: 30 kn*10

Sorted: 26 Kg Total catch: 568.35 CATCH/HOUR: 4262.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Trachurus capensis	2767.50	66150	64.92	7521
Merluccius capensis	1293.75	19800	30.35	7520
Dentex macrophthalmus	186.75	4275	4.38	
Trigla lyra	13.13	900	0.31	
Galeichthys feliceps	1.50	8	0.04	
Aequorea aequorea	0.00	6075		
Chrysaora sp.	0.00	570		
Total	4262.63		100.00	

PROJECT STATION: 2203

DATE: 26/ 6/97 GEAR TYPE: PT No: 5 POSITION: Lat S 1758
start stop duration Long E 1132
TIME :15:54:32 16:06:36 12 (min) Purpose code: 1
LOG :2004.89 2005.55 0.57 Area code : 3
FDEPTH: 150 170 GearCond.code: 1
BDEPTH: 212 212 Validity code: 1
Towing dir: 360° Wire out: 550 m Speed: 35 kn*10

Sorted: 4 Kg Total catch: 13.05 CATCH/HOUR: 65.25

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Brama brama	21.00	30	32.18	
Thyrsites atun	15.60	15	23.91	
Merluccius capensis	15.00	300	22.99	7522
Galeichthys feliceps	9.75	15	14.94	
Trachurus capensis	2.70	45	4.14	7523
MYCTOPHIDAE	0.60	120	0.92	
Synagrops microlepis	0.60	105	0.92	
Aequorea aequorea	0.00	1960000		
Chrysaora sp.	0.00	1200		
Total	65.25		100.00	

PROJECT STATION: 2204

DATE: 26/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 1800
start stop duration Long E 1057
TIME :21:08:47 21:28:56 20 (min) Purpose code: 1
LOG :2048.14 2049.21 0.94 Area code : 3
FDEPTH: 110 150 GearCond.code: 1
BDEPTH: 2500 2500 Validity code: 1
Towing dir: 90° Wire out: 300 m Speed: 35 kn*10

Sorted: 34 Kg Total catch: 34.27 CATCH/HOUR: 102.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Trachurus capensis	93.90	648	91.33	7524
TRACHIPTERIDAE	5.40	3	5.25	
MYCTOPHIDAE	2.82	1059	2.74	
Todarodes sagittatus	0.69	24	0.67	
Aequorea aequorea	0.00	12903		
Total	102.81		99.99	

PROJECT STATION: 2205

DATE: 27/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 1750
start stop duration Long E 1049
TIME :00:35:48 00:50:44 15 (min) Purpose code: 1
LOG :2074.15 2075.04 0.82 Area code : 3
FDEPTH: 180 180 GearCond.code: 1
BDEPTH: 1800 1800 Validity code: 1
Towing dir: 166° Wire out: 600 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 262.96 CATCH/HOUR: 1051.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
Trachurus capensis	979.20	6464	93.09	7525
MYCTOPHIDAE	57.92	18112	5.51	
Tetragonurus cuvieri	6.72	32	0.64	
Todarodes sagittatus	5.12	448	0.49	
krill	2.24	3456	0.21	
PARALEPIDIDAE	0.64	64	0.06	
J E L L Y F I S H	0.00	120		
Total	1051.84		100.00	

PROJECT STATION: 2206

DATE: 27/ 6/97 GEAR TYPE: PT No: 2 POSITION: Lat S 1715
start stop duration Long E 1103
TIME :09:12:34 09:20:40 8 (min) Purpose code: 1
LOG :2161.26 2161.72 0.38 Area code : 3
FDEPTH: 180 180 GearCond.code: 1
BDEPTH: - - Validity code: 1
Towing dir: 270° Wire out: 600 m Speed: 40 kn*10

Sorted: 15 Kg Total catch: 50.51 CATCH/HOUR: 378.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT C	SAMP
MYCTOPHIDAE	197.40	70500	52.11	
Krill	65.55	133395	17.30	
Trachurus capensis	63.00	458	16.63	7526
Todarodes sagittatus	50.78	1343	13.40	
PARALEPIDIDAE	2.10	210	0.55	
Aequorea aequorea	0.00	3525		
Total	378.83		99.99	

PROJECT STATION:2207

DATE:27/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 1717

start stop duration Long E 1129

TIME :14:04:21 14:19:25 15 (min) Purpose code: 1

LOG :2191.11 2191.85 0.74 Area code : 3

FDEPTH: 162 164 GearCond.code: 9

BDEPTH: 162 164 Validity code: 1

Towing dir: 180° Wire out: 550 m Speed: 30 kn*10

Sorted: 30 Kg Total catch: 2185.52 CATCH/HOUR: 8742.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	5292.00	100120	60.53	7529
Dentex macrophthalmus	2156.00	19040	24.66	
Merluccius capensis	1036.00	17920	11.85	7527
Merluccius capensis	115.28	160	1.32	7528
Synagrops microlepis	72.80	8400	0.83	
Pterothrissus belloci	50.40	560	0.58	
Trigla lyra	19.60	280	0.22	
Total	8742.08		99.99	

PROJECT STATION:2208

DATE:27/ 6/97 GEAR TYPE: BT No:2 POSITION:Lat S 1730

start stop duration Long E 1138

TIME :18:38:20 18:49:11 11 (min) Purpose code: 1

LOG :2229.34 2229.99 0.58 Area code : 3

FDEPTH: 109 116 GearCond.code: 1

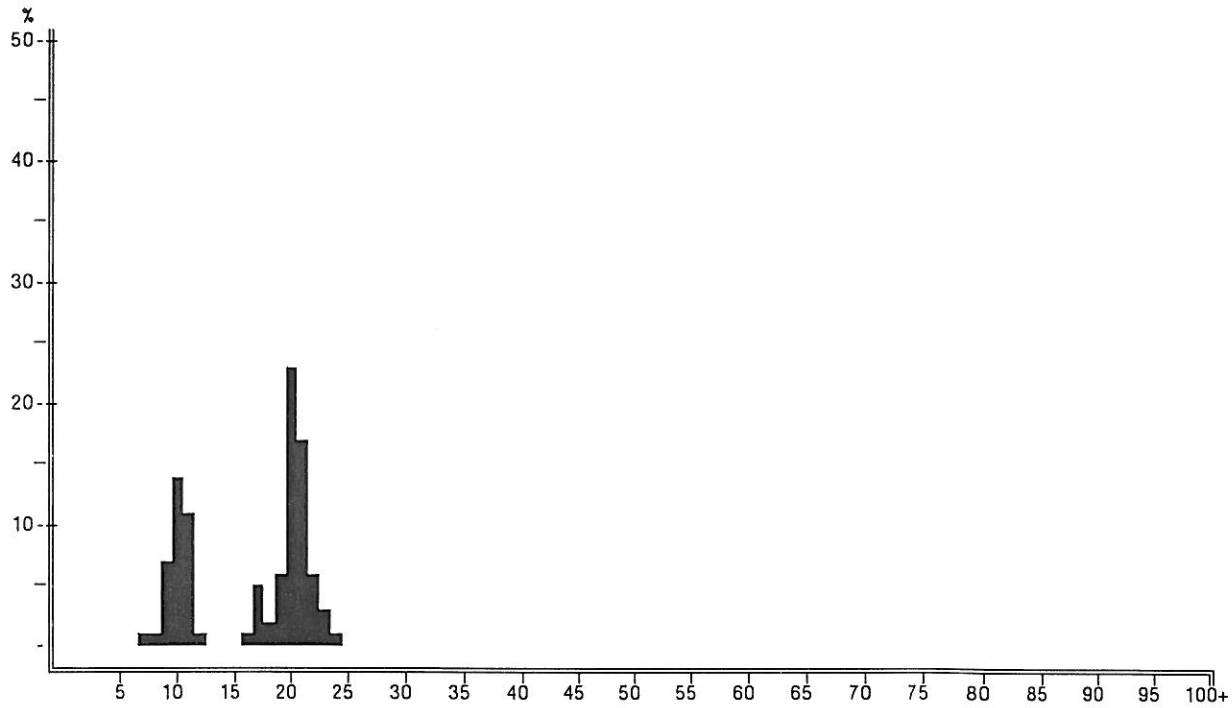
BDEPTH: 109 116 Validity code: 1

Towing dir: 270° Wire out: 400 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 528.66 CATCH/HOUR: 2883.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1400.18	44029	48.56	7531
Dentex macrophthalmus	1140.55	16140	39.55	
Merluccius capensis	270.55	3355	9.38	7530
Pterothrissus belloci	65.84	1020	2.28	
Engraulis capensis	5.56	464	0.19	
Cynoglossus zanzibarensis	0.93	93	0.03	
Total	2883.61		99.99	

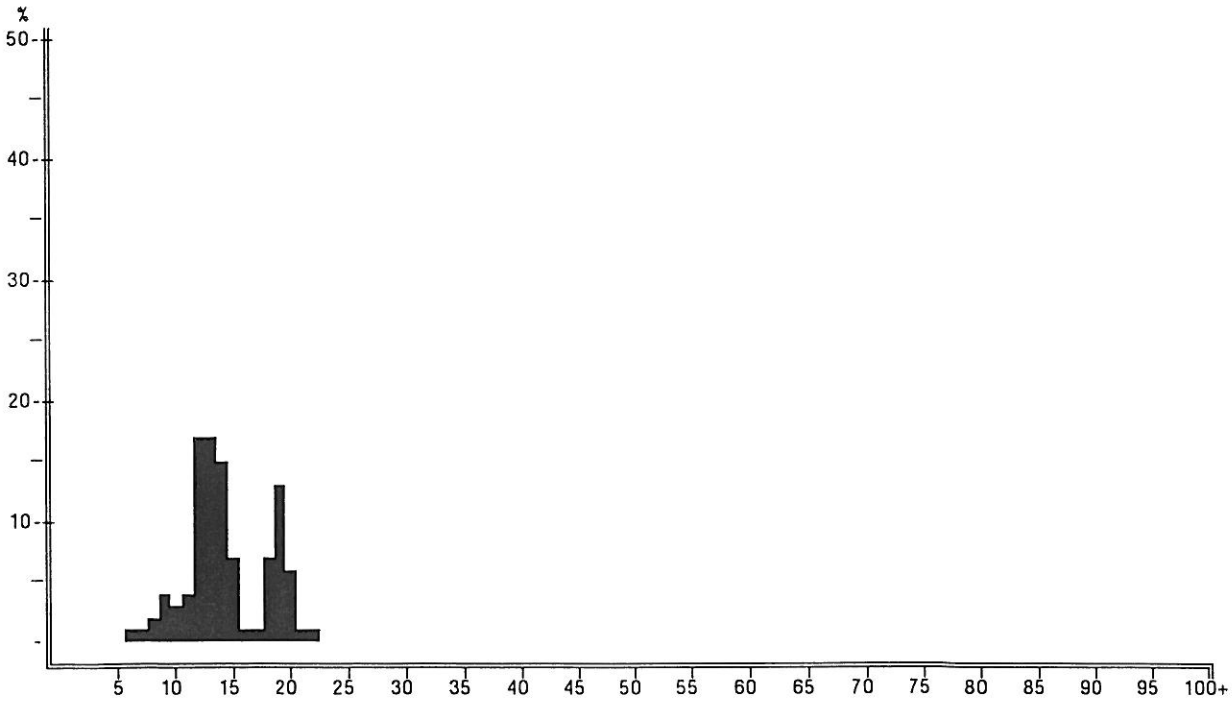
ANNEX VI Size Distribution



Sardinops ocellatus

Pooled sample (simple adding).

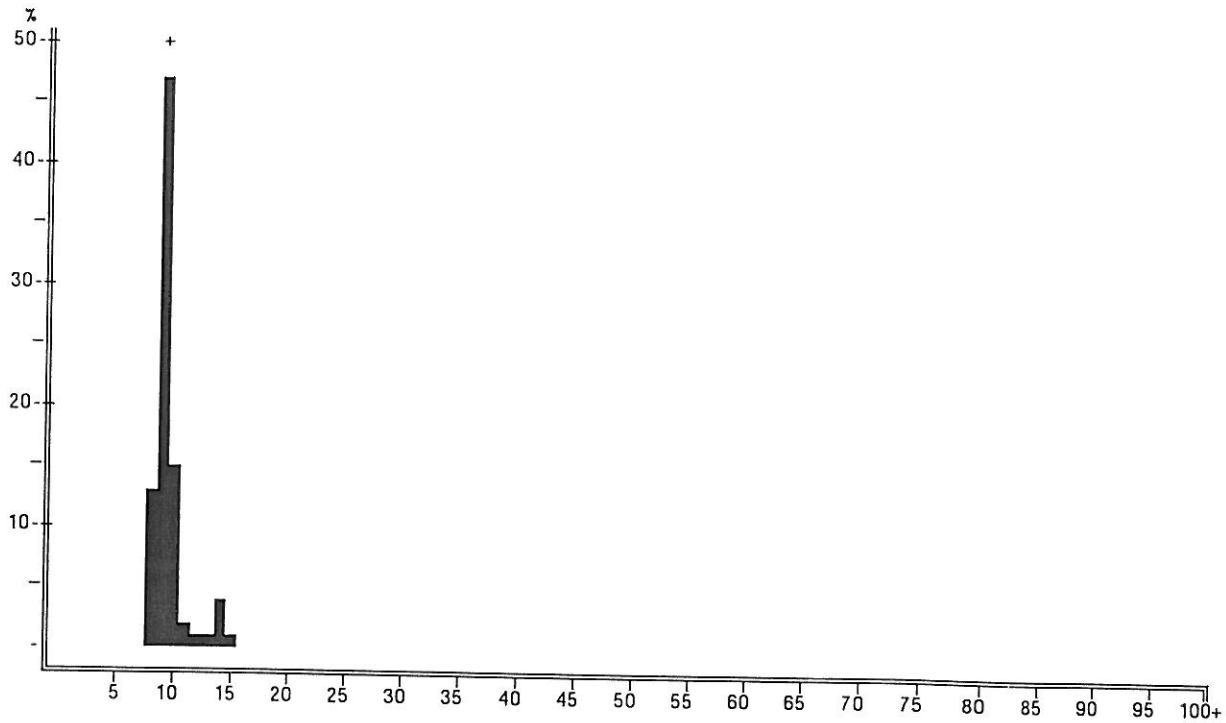
MEAN LENGTH = 17.11cm N= 557
NUMBER OF SUBSAMPLES : 7
SAMPLES FOUND BETWEEN ST. NO.2130 AND 2175.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2208 .



Etrumeus whiteheadi

Pooled sample (simple adding).

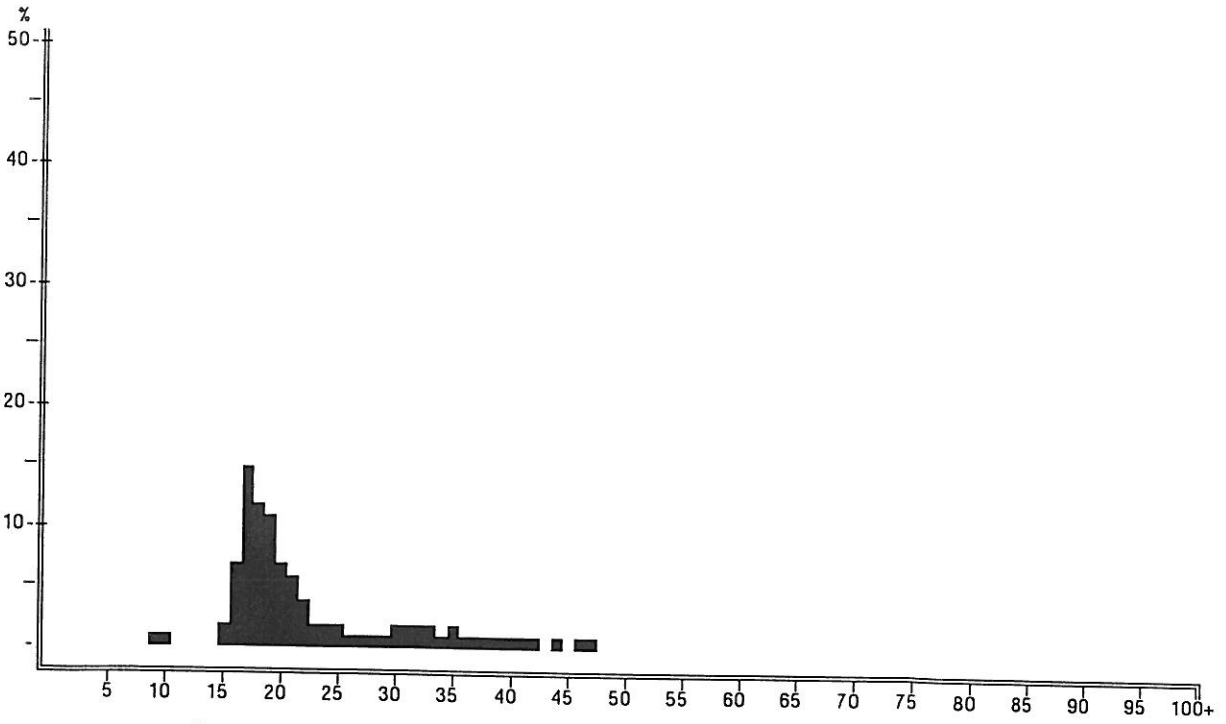
MEAN LENGTH = 14.82cm N= 399
NUMBER OF SUBSAMPLES : 7
SAMPLES FOUND BETWEEN ST. NO.2130 AND 2181.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2208 .



Engraulis capensis

Pooled sample (simple adding).

MEAN LENGTH = 9.90cm N= 157
NUMBER OF SUBSAMPLES : 4
SAMPLES FOUND BETWEEN ST. NO.2148 AND 2175.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2208 .



Merluccius capensis

Pooled sample (simple adding).

MEAN LENGTH = 24.74cm N= 2906
NUMBER OF SUBSAMPLES : 45
SAMPLES FOUND BETWEEN ST. NO.2127 AND 2208.
SAMPLES SEARCHED BETWEEN ST. NO.2125 AND 2228 .

Annex VII Length-weight relationships

Area: 26°00' S - 21°00' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	1.13	1.02	0.9020	0.8163
6	0	1.93	1.76	0.8915	0.8159
7	0	3.03	2.80	0.8827	0.8155
8	4	4.48	4.17	0.8752	0.8152
9	10	6.33	5.94	0.8686	0.8150
10	10	8.63	8.15	0.8628	0.8147
11	2	11.41	10.84	0.8575	0.8145
12	0	14.74	14.07	0.8528	0.8143
13	0	18.64	17.89	0.8484	0.8141
14	0	23.17	22.34	0.8444	0.8140
15	0	28.37	27.47	0.8406	0.8138
16	0	34.29	33.33	0.8372	0.8137
17	0	40.97	39.97	0.8339	0.8135
18	0	48.46	47.44	0.8309	0.8134
19	0	56.79	55.78	0.8280	0.8133
20	1	66.02	65.05	0.8253	0.8132
21	0	76.19	75.30	0.8227	0.8130
22	6	87.34	86.56	0.8203	0.8129
23	11	99.52	98.90	0.8179	0.8128
24	12	112.76	112.35	0.8157	0.8127
25	20	127.12	126.98	0.8136	0.8126
26	10	142.63	142.81	0.8115	0.8126
27	12	159.35	159.92	0.8096	0.8125
28	7	177.30	178.33	0.8077	0.8124
29	12	196.54	198.11	0.8059	0.8123
30	10	217.11	219.30	0.8041	0.8122
31	5	239.05	241.95	0.8024	0.8122
32	3	262.40	266.10	0.8008	0.8121
33	4	287.21	291.81	0.7992	0.8120
34	5	313.52	319.13	0.7977	0.8119
35	8	341.37	348.09	0.7962	0.8119
36	6	370.81	378.76	0.7948	0.8118
37	4	401.87	411.18	0.7934	0.8118
38	6	434.60	445.39	0.7920	0.8117
39	2	469.04	481.45	0.7907	0.8116
40	5	505.23	519.41	0.7894	0.8116
41	2	543.22	559.31	0.7882	0.8115
42	1	583.04	601.20	0.7870	0.8115
43	1	624.74	645.13	0.7858	0.8114
44	0	668.36	691.15	0.7846	0.8114
45	0	713.95	739.30	0.7835	0.8113

W(total) = q * L(i)^ b; q = 0.01, b = 2.935

W(gutted) = q * L(i)^ b; q = 0.0082, b = 2.972

Annex VII Length-weight relationships

SUMMARY OF ALL STATIONS

Area: 26°00' S - 17°15' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	1.00	0.88	0.7975	0.7027
6	1	1.73	1.52	0.7995	0.7053
7	10	2.75	2.43	0.8012	0.7075
8	14	4.11	3.63	0.8027	0.7095
9	13	5.86	5.18	0.8040	0.7112
10	17	8.05	7.13	0.8052	0.7127
11	17	10.73	9.50	0.8062	0.7141
12	21	13.95	12.36	0.8072	0.7154
13	18	17.75	15.74	0.8081	0.7165
14	18	22.20	19.69	0.8089	0.7176
15	19	27.33	24.25	0.8097	0.7186
16	18	33.19	29.47	0.8104	0.7196
17	27	39.85	35.40	0.8111	0.7205
18	26	47.34	42.07	0.8117	0.7213
19	26	55.72	49.53	0.8123	0.7221
20	21	65.03	57.83	0.8129	0.7229
21	19	75.34	67.01	0.8135	0.7236
22	23	86.67	77.12	0.8140	0.7243
23	21	99.10	88.20	0.8145	0.7249
24	27	112.66	100.30	0.8150	0.7255
25	25	127.41	113.46	0.8154	0.7262
26	26	143.40	127.73	0.8159	0.7267
27	27	160.67	143.15	0.8163	0.7273
28	18	179.28	159.77	0.8167	0.7278
29	10	199.28	177.64	0.8171	0.7284
30	4	220.72	196.79	0.8175	0.7289
31	6	243.65	217.28	0.8179	0.7293
32	1	268.11	239.15	0.8182	0.7298
33	7	294.17	262.44	0.8186	0.7303
34	4	321.86	287.20	0.8189	0.7307
35	9	351.24	313.48	0.8192	0.7312
36	7	382.37	341.32	0.8195	0.7316
37	4	415.28	370.77	0.8199	0.7320
38	10	450.04	401.87	0.8202	0.7324
39	6	486.68	434.67	0.8204	0.7328
40	6	525.27	469.21	0.8207	0.7331
41	3	565.85	505.55	0.8210	0.7335
42	0	608.48	543.71	0.8213	0.7339
43	0	653.19	583.76	0.8216	0.7342
44	0	700.06	625.74	0.8218	0.7346
45	0	749.11	669.69	0.8221	0.7349

W(total) = q * L(i)^ b; q = 0.0075, b = 3.0138

W(gutted) = q * L(i)^ b; q = 0.0068, b = 3.0204

Annex VII Length-weight relationships

Area: 21°00' S -19°00' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	0.94	0.89	0.7509	0.7089
6	0	1.63	1.54	0.7557	0.7135
7	0	2.61	2.46	0.7597	0.7174
8	0	3.91	3.69	0.7633	0.7207
9	1	5.59	5.28	0.7664	0.7237
10	7	7.69	7.26	0.7692	0.7264
11	10	10.27	9.70	0.7718	0.7288
12	11	13.38	12.63	0.7741	0.7311
13	10	17.06	16.11	0.7763	0.7331
14	10	21.36	20.17	0.7783	0.7350
15	12	26.33	24.87	0.7802	0.7368
16	10	32.03	30.25	0.7819	0.7385
17	11	38.50	36.36	0.7836	0.7401
18	7	45.79	43.25	0.7851	0.7415
19	11	53.95	50.96	0.7866	0.7429
20	9	63.04	59.54	0.7880	0.7443
21	9	73.10	69.05	0.7894	0.7456
22	10	84.19	79.52	0.7906	0.7468
23	10	96.35	91.00	0.7919	0.7479
24	11	109.63	103.55	0.7930	0.7491
25	10	124.09	117.21	0.7942	0.7501
26	10	139.77	132.03	0.7952	0.7512
27	10	156.73	148.05	0.7963	0.7522
28	10	175.02	165.33	0.7973	0.7531
29	7	194.69	183.91	0.7983	0.7541
30	3	215.79	203.84	0.7992	0.7550
31	6	238.37	225.17	0.8001	0.7558
32	1	262.47	247.95	0.8010	0.7567
33	7	288.17	272.22	0.8019	0.7575
34	4	315.49	298.03	0.8027	0.7583
35	9	344.51	325.44	0.8035	0.7591
36	7	375.25	354.49	0.8043	0.7598
37	4	407.79	385.23	0.8051	0.7605
38	10	442.17	417.71	0.8058	0.7612
39	6	478.43	451.98	0.8065	0.7619
40	6	516.64	488.08	0.8073	0.7626
41	3	556.85	526.06	0.8079	0.7633
42	0	599.09	565.98	0.8086	0.7639
43	0	643.44	607.88	0.8093	0.7646
44	0	689.94	651.81	0.8099	0.7652
45	0	738.63	697.81	0.8106	0.7658

W(total) = q * L(i)^ b; q = 0.0071, b = 3.0348

W(gutted) = q * L(i)^ b; q = 0.0067, b = 3.0351

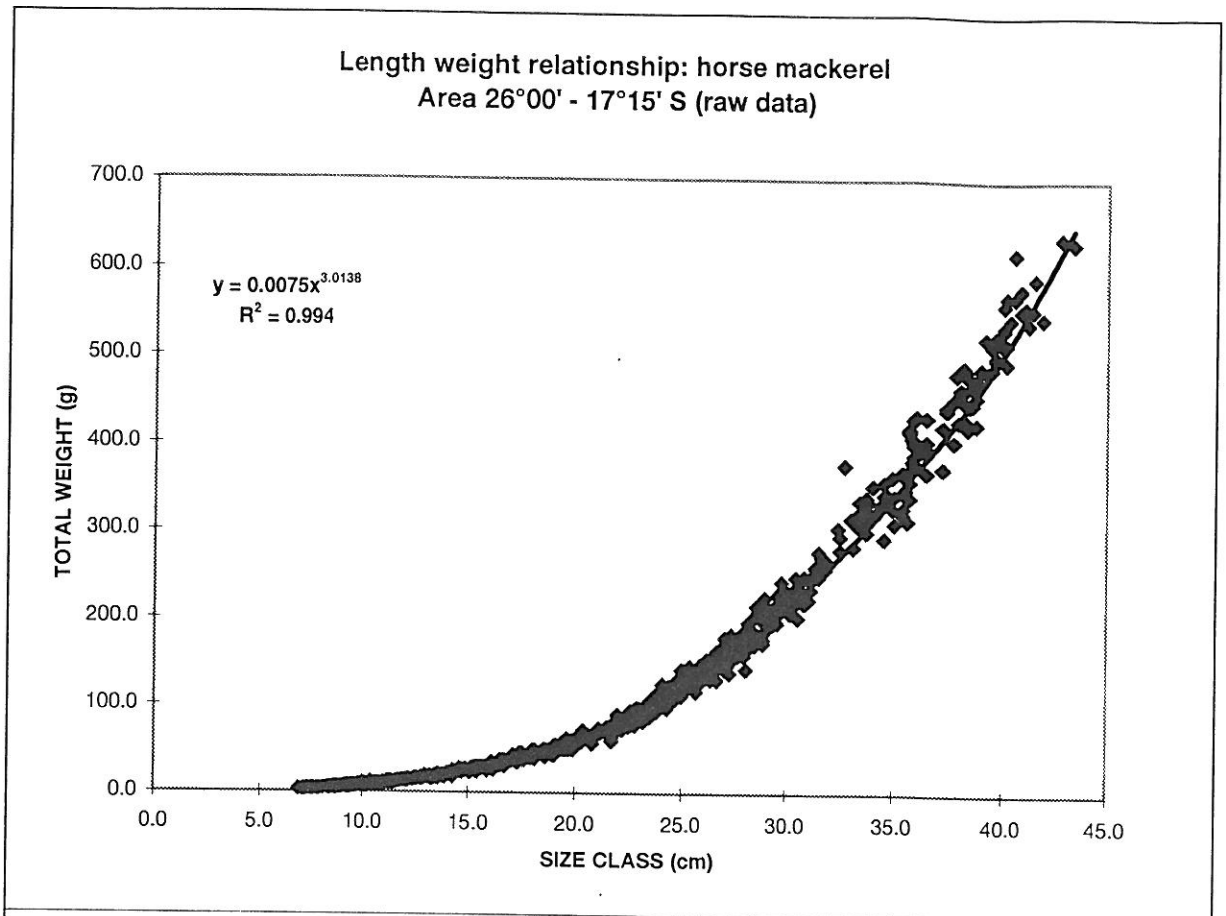
Annex VII Length-weight relationships

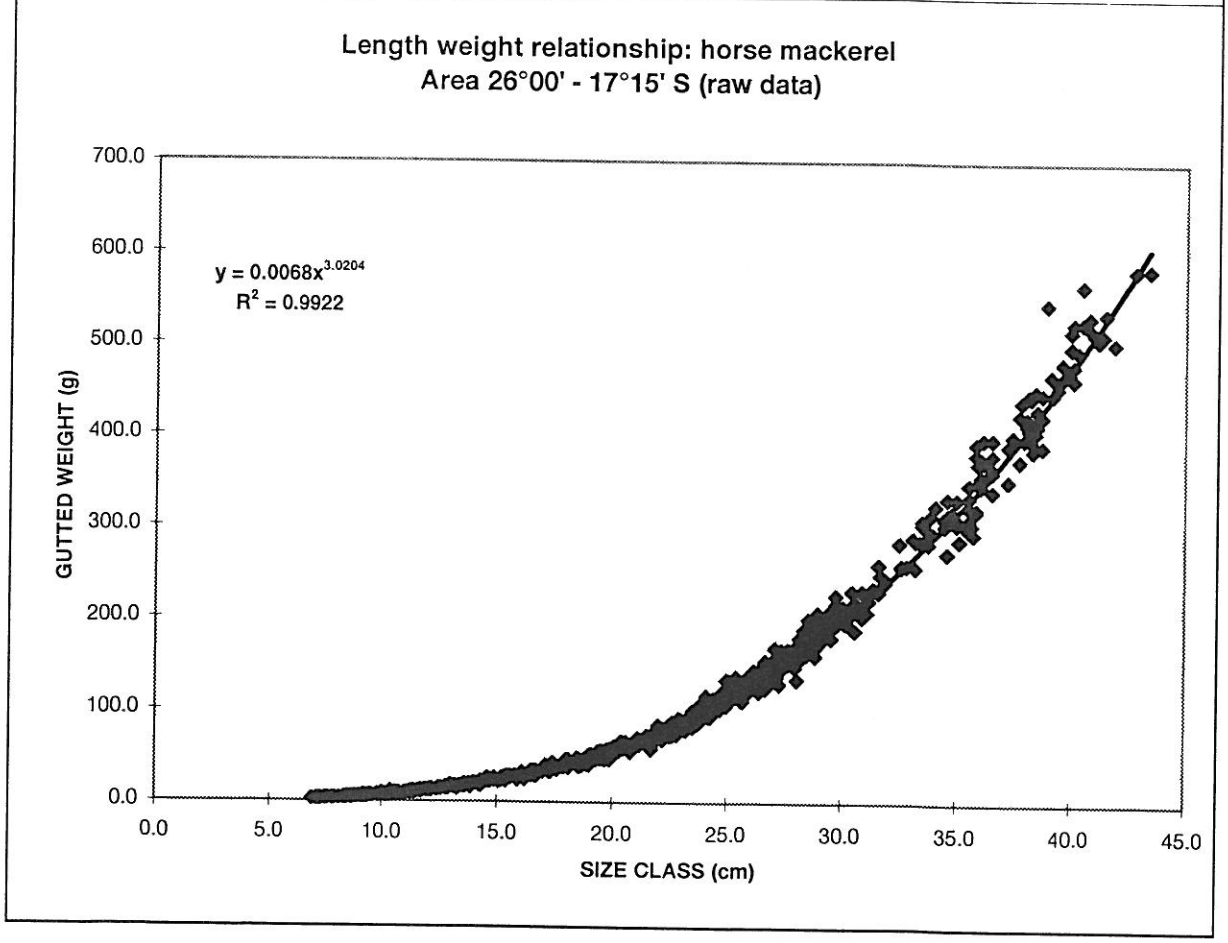
Area: 19°00' S -17°15' S

Length (cm)	No. of fish sampled	Total weight (g)	Gutted weight (g)	Condition factor total weight	Condition factor gutted weight
5	0	0.97	0.90	0.7758	0.7166
6	1	1.67	1.54	0.7720	0.7140
7	10	2.64	2.44	0.7688	0.7118
8	10	3.92	3.63	0.7661	0.7099
9	12	5.57	5.16	0.7637	0.7082
10	10	7.62	7.07	0.7615	0.7067
11	7	10.11	9.39	0.7596	0.7053
12	10	13.10	12.17	0.7578	0.7041
13	8	16.61	15.44	0.7562	0.7030
14	8	20.71	19.26	0.7547	0.7020
15	7	25.42	23.66	0.7533	0.7010
16	8	30.80	28.68	0.7520	0.7001
17	16	36.89	34.35	0.7508	0.6992
18	19	43.72	40.73	0.7496	0.6984
19	15	51.34	47.85	0.7485	0.6977
20	12	59.80	55.76	0.7475	0.6970
21	10	69.14	64.48	0.7465	0.6963
22	13	79.39	74.07	0.7456	0.6956
23	11	90.61	84.56	0.7447	0.6950
24	16	102.83	96.00	0.7439	0.6944
25	15	116.10	108.42	0.7431	0.6939
26	16	130.46	121.86	0.7423	0.6933
27	17	145.95	136.36	0.7415	0.6928
28	8	162.62	151.97	0.7408	0.6923
29	3	180.50	168.72	0.7401	0.6918
30	1	199.65	186.66	0.7394	0.6913
31	0	220.09	205.82	0.7388	0.6909
32	0	241.88	226.24	0.7382	0.6904
33	0	265.05	247.97	0.7375	0.6900
34	0	289.65	271.04	0.7370	0.6896
35	0	315.72	295.50	0.7364	0.6892
36	0	343.31	321.38	0.7358	0.6888
37	0	372.45	348.72	0.7353	0.6884
38	0	403.18	377.56	0.7348	0.6881
39	0	435.55	407.95	0.7343	0.6877
40	0	469.60	439.92	0.7338	0.6874
41	0	505.38	473.51	0.7333	0.6870
42	0	542.91	508.76	0.7328	0.6867
43	0	582.26	545.72	0.7323	0.6864
44	0	623.45	584.41	0.7319	0.6861
45	0	666.53	624.89	0.7314	0.6858

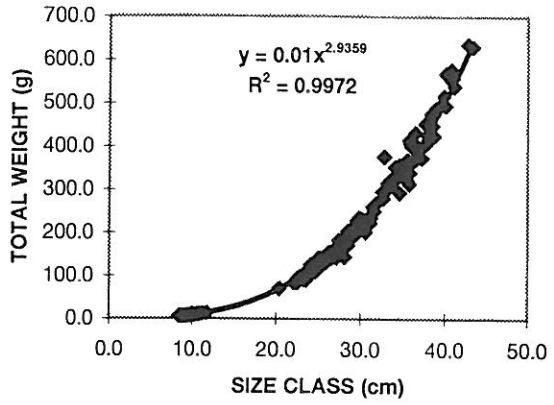
W(total) = q * L(i)^ b; q = 0.0081, b = 2.9732

W(gutted) = q * L(i)^ b; q = 0.0074, b = 2.98

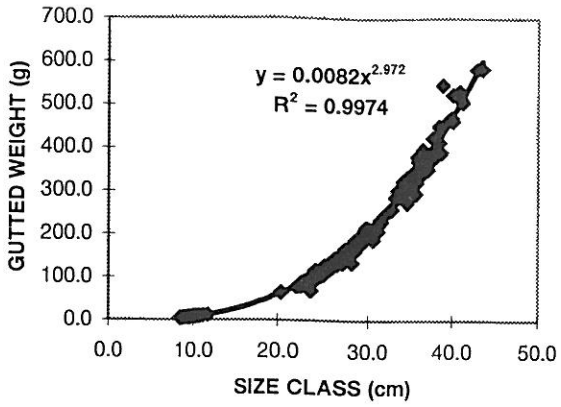

Length weight relationship: horse mackerel
Area 26°00' - 17°15' S (raw data)
y = 0.0075x^3.0138
R² = 0.994
TOTAL WEIGHT (g)
SIZE CLASS (cm)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


Length weight relationship: horse mackerel
Area 26°00' - 17°15' S (raw data)
y = 0.0068x^3.0204
R² = 0.9922
GUTTED WEIGHT (g)
SIZE CLASS (cm)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

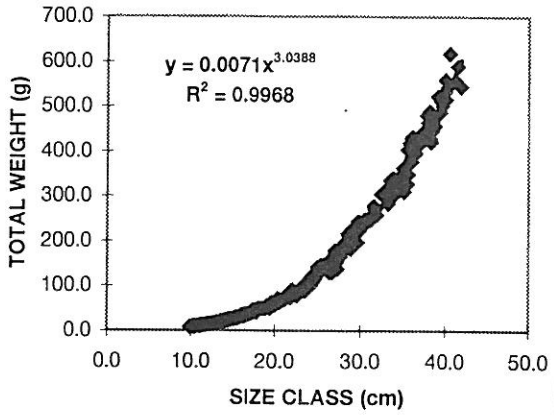
Lenght weight relationship: horse mackerel: Area 26°00' - 21°00' S (raw data)



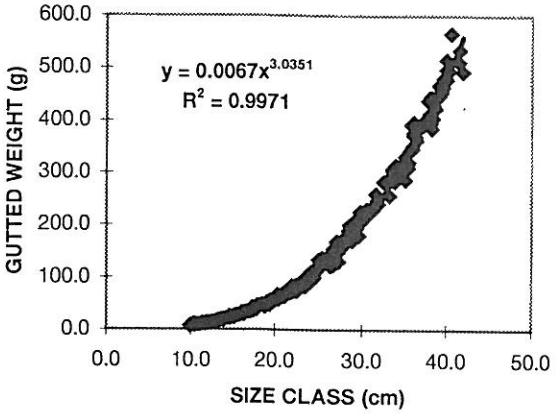
Length weight relationship:horse mackerel: Area 26°00' - 21°00' S (raw data)



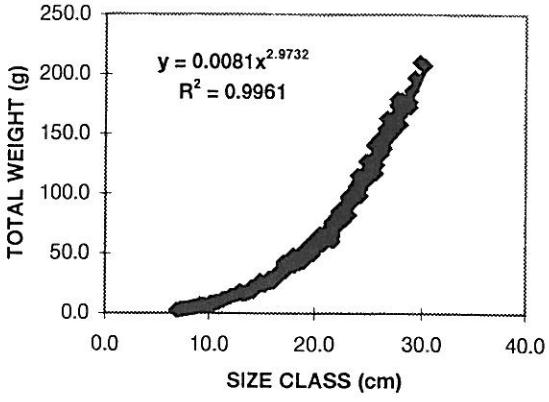
Length weight relationship: horse mackerel: Area 21°00' - 19°00' S (raw data)



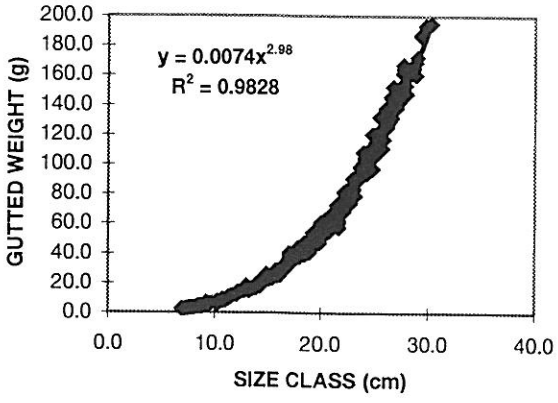
Length weight relationship : horse mackerel: Area 21°00' - 19°00' S (raw data)



Length weight relationship: horse mackerel : Area 19°00' - 17°15' S (raw data)



Lenght weight relationship: horse mackerel: Area19°00' - 17°15' S (raw data)



Annex VIII Reproductive Status

Area: 17°15' S - 26°00' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentage of fish per maturity stage						
			Lowest	Higest	1	2	3	4	5	6	7
< 6	2	1	2	2	100						
6 - 6.9	3	10	2	4	100						
7 -7.9	5	14	4	6	100						
8 - 8.9	7	23	5	8	100						
9 - 9.9	9	26	6	11	96						4
10 - 10.9	18	19	8	136	100						
11 - 11.9	14	21	10	17	100						
12 - 12.9	18	18	14	21	100						
13 - 13.9	23	18	18	27	100						
14 - 14.9	27	19	21	29	100						
15 - 15.9	33	18	26	37	94	6					
16 - 16.9	44	28	35	160	21	79					
17 - 17.9	46	30	39	51	20	67	13				
18 - 18.9	54	25	42	62	4	88	4				4
19 - 19.9	62	22	52	71	5	68	18	5			5
20 - 20.9	72	18	64	79		61	28				11
21 - 21.9	84	29	73	98		31	41				28
22 - 22.9	104	32	82	290		9	75				16
23 - 23.9	115	38	98	144		11	42	3	3		42
24 - 24.9	130	45	112	147		7	58	4			31
25 -25.9	147	36	130	163			47	6			47
26 - 26.9	163	38	138	182		5	53	3			39
27 - 27.9	184	25	143	215			60	4			36
28 - 28.9	207	23	123	243		4	43	13			39
29 - 29.9	224	14	202	249			43				57
30 - 30.9	253	11	222	277			36				64
31 - 31.9	292	3	276	304			67				33
32 - 32.9	313	12	277	339			67		8		25
33 - 33.9	334	9	293	357			78			11	11
34 - 34.9	361	16	310	418			38	19		6	38
35 - 35.9	400	13	368	432			62	23			15
36 - 36.9	430	8	373	481			13	38		25	25
37 - 37.9	459	16	420	488			75	19		3	3
38 - 38.9	505	8	483	524			50	25	13	6	7
39 -39.9	542	11	460	618			55	36		5	5
40 -40.9	557	5	538	589			80	20			
41 - 41.9	635	1	635	635			100				
42 -42.9	630	1	630	630			100				

Area: 17°15' S - 18°46' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentage of fish per maturity stage						
			Lowest	Higest	1	2	3	4	5	6	7
< 6	2	1	2	2	100						
6 - 6.9	3	10	2	4	100						
7 -7.9	5	10	4	5	100						
8 - 8.9	6	12	5	7	100						
9 - 9.9	8	10	6	9	100						
10 - 10.9	11	7	8	12	100						
11 - 11.9	14	10	10	17	100						
12 - 12.9	17	8	14	19	100						
13 - 13.9	22	8	18	27	100						
14 - 14.9	26	7	23	29	100						
15 - 15.9	31	8	26	35	100						
16 - 16.9	45	17	35	160	29	71					
17 - 17.9	45	19	39	50	26	53	21				
18 - 18.9	52	15	42	60	7	87					7
19 - 19.9	60	12	52	66		83	8	8			
20 - 20.9	71	9	64	76		78	22				
21 - 21.9	81	13	73	89		31	46				23
22 - 22.9	95	11	82	106		18	73				9
23 - 23.9	112	16	98	127		6	50	6			38
24 - 24.9	126	15	112	143			60	7			33
25 -25.9	146	16	137	163			31	13			56
26 - 26.9	162	16	148	179		6	56	6			31
27 - 27.9	174	8	158	179			50	13			38
28 -28.9	198	3	186	210							100
29 - 29.9	207	1	207	207							100

Area: 18°46' S - 21°00' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentages of fish per maturity stage						
			Lowest	Higest	1	2	3	4	5	6	7
8 - 8.9	8	1	8	8	100						
9 - 9.9	9	7	8	11	100						
10 - 10.9	12	10	10	14	100						
11 - 11.9	15	11	13	16	100						
12 - 12.9	19	10	16	21	100						
13 - 13.9	23	10	19	27	100						
14 - 14.9	28	12	21	29	100						
15 - 15.9	34	10	31	37	90	10					
16 - 16.9	41	11	36	46	9	91					
17 - 17.9	49	11	46	51	9	91					
18 - 18.9	57	10	54	62		90	10				
19 - 19.9	63	9	56	71	11	56	33				
20 - 20.9	74	9	68	79		44	33				23
21 - 21.9	83	9	78	87		44	56				
22 - 22.9	97	10	88	105			90				10
23 - 23.9	118	9	100	144		11	44		12		33
24 - 24.9	140	9	131	147		22	56				22
25 -25.9	149	8	130	161			50				50
26 - 26.9	167	8	153	178		13	75				13
27 - 27.9	197	8	183	209			75				25
28 - 28.9	206	8	123	243			38	38			25
29 - 29.9	245	3	239	249			67				33
30 - 30.9	259	6	246	277			50				50
31 - 31.9	304	1	304	304			100				
32 - 32.9	318	7	283	339			71			14	15
33 - 33.9	339	4	328	343			75				25
34 - 34.9	361	8	310	418			38	38		12	12
35 - 35.9	402	7	376	432			43	43		14	
36 - 36.9	446	4	420	481				50		25	25
37 - 37.9	457	10	420	488			70	20		10	
38 - 38.9	505	6	483	524			50	33		17	
39 -39.9	534	6	460	618			50	50			
40 -40.9	562	3	544	589			67	33			

Area: 21°00' S - 26°00' S

Length class (cm)	Mean weight (g)	No. of fish	Weight range		Percentage of fish per maturity stage						
			Lowest	Highest	1	2	3	4	5	6	7
< 8	5	4	5	6	100						
8 - 8.9	7	10	6	8	100						
9 - 9.9	9	9	8	10	89						11
10 - 10.9	74	2	12	136	100						
19 -19.9	69	1	69	69							100
21 - 21.9	90	7	83	98		14	14				71
22 - 22.5	119	11	91	290		9	64				27
23 - 23.5	117	13	105	131		15	31				54
24 - 24.9	128	21	114	141		5	57	5			33
25 - 25.9	147	12	130	161			67				33
26 - 26.9	161	14	138	182			36				64
27 - 27.9	183	9	143	215			56				44
28 - 28.9	210	12	192	234		8	58				33
29 - 29.9	219	10	202	231			40				60
30 - 30.9	247	5	222	268			20				80
31 - 31.9	286	2	276	295			50				50
32 - 32.9	307	5	277	323			60		20		20
33 - 33.9	331	5	293	357			80				20
34 - 34.9	361	8	313	415			38			12	50
35 - 35.9	399	6	368	431			83				17
36 - 36.9	414	4	373	451			25	25			50
37 - 37.9	462	6	424	488			83	17			
38 - 38.9	507	2	498	515			50		50		
39 - 39.9	552	5	494	577			60	20			20
40 - 40.9	548	2	538	558			100				
41 - 41.9	635	1	635	635			100				
42 - 42.9	630	1	630	630			100				

Annex IX Maturity stages

The following seven stage scale was used in the investigation to determine reproductive stage of the horse mackerel during the **1997 June** hydro-acoustic horse mackerel survey. Horse mackerel stages accxording to Hecht (1976) and modified in 1997.

JUVENILE/IMMATURE/SUB-ADULTS

0 **UNKNOWN**
Damaged fish; decayed.

1 **JUVENILE**
Not able to distinguish between male or female.
Approximately: 0.1 - 14cm fish.

2 **IMMATURE**
Gonads are very small, less than half the body cavity length, and flattened or tubular ie. thin and thread-like. The colour of the gonads is translucent. Sexes easy to distinguish. Approximately: 14 - 20cm fish.
Ovaries: Light orange gelatinous mass. Cannot sea eggs with the naked eye.
Testes: Translucent-white; thin, elongate balloon-like.

ADULT FISH

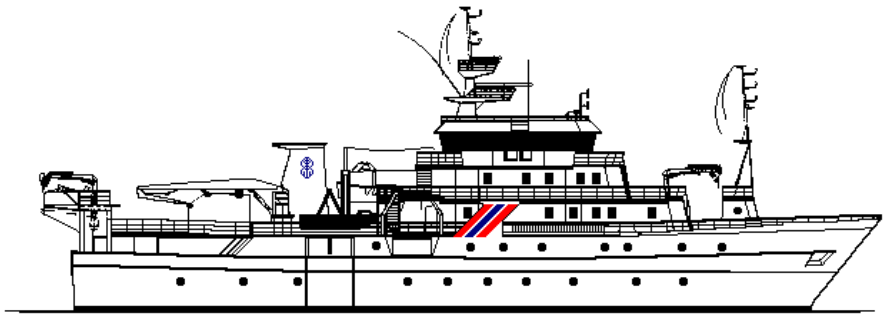
3 **RECOVERING\INACTIVE**
Gonads are slightly larger than stage 2, approximately half of body cavity length, but still generally flat. Colour more pronounced.
Ovaries: Pale reddish tint back to orange colour.
Testes: Creamy-white colour and very flat (lobe like) with sharp edges.

4 **MATURING**
Gonads longer than half body cavity length and becoming cylindrical.
Ovaries: Individual eggs clearly visible. Colour orange. Blood vessels marked. Spindle shaped.
Testes: White to cream/testes more swollen. Spindle shaped.

5 **RIPE**
Gonads very large, virtually filling body cavity, even causing distension of bdomen.
Ovaries: Individual eggs almost 0.5 mm or larger and lightly elongated. Ovary sac breaks realising eggs. Colour is a dark orange.
Testes: Cream, releases milt when punctured.

6 **SPAWNING\RUNNING**
Eggs or milt released through vent during handling ie. running.
Ovaries: Ovary is dark orange and greatly swollen. Could also be partly spent.
Testis: External appearance changes from smooth structure to white and knob-like. Swollen to partly spent.

7 **SPENT**
Ovaries: Gonads flattened, but still elongated. Very blood-shot (dark red). Few eggs remaining appear grey\brown.
Testis: The testis are deflated and grey in colour.



SURVEYS OF FISH RESOURCES OF NAMIBIA

Cruise Report No 3/97

Survey of the Valdivia Bank
2 - 14 July 1997

Ministry of Fisheries & Resources
Swakopmund, Namibia

Institute of Marine Research
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SURVEYS OF THE FISH RESOURCES OF NAMIBIA

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Survey of the Valdivia Bank
2 - 14 July 1997

by

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CHAPTER 1 INTRODUCTION

1.1 Objectives

The Valdivia Bank consists of a complex series of peaks and troughs, with pinnacles of rock rising from more than 2000 m depth to within 23 m of the surface.

The area has characteristics which suggest that it has a good potential for offshore fisheries resources such as orange roughy, alfonsino, tuna, billfish and other migratory offshore species. It may also be an important nursery area for various species.

The main objectives are listed below:

1. As the bathymetry is based on a rather coarse data set, a detailed mapping of the seamounts was planned.

2. The hydrographic structure of the region, especially around the seamounts, was a central objective, with special reference to food production, (up- and downwelling, eddies and gyres).

3. The sampling of nutrients was planned in order to get a picture of the biological processes taken place in the investigation area.

4. Eggs and larvae were sampled to learn about the regions importance as a spawning and nursery area.

5. Trawling for fish on targets, based on the acoustic echosystem, was planned for identification of species.

1.2 Participation

The scientific staff from the National Marine Information Centre (NatMIRC), Swakopmund, Namibia were:

Alan KEMP, Gerhard OECHSLIN and Anja RISSER

The Scientific staff from the Institute of Marine Research (IMR) in Bergen, Norway were:

Oddgeir ALVHEIM, Martin DAHL, Tor GAMMELSRØD and
Jarle KRISTIANSEN.

In addition, we had a guest investigator from Instituto Investigação Pesqueira (IIP), Angola Luanda:

Vianda L. L. FILIPE

1.3 Schedule

The RV 'Dr. Fridtjof Nansen left Walvis Bay at 16h00 on July 2 1997 and steamed west towards the survey area. The first CTD stations was taken at 24°S, 7°E after about 40 hours steaming. On the way the meteorological and sea surface temperature were recorded, as well as the bottom depth. The acoustic integrator system was also activated.

After having completed the first CTD section the wind picked up to gale force, preventing us from station work for a period of about 24 hours.

The main survey area was in the area 23°S to 26°30'S, 4°30'E to 8°30E.

The vessel returned to Walvis Bay on July 14. A total of 2200 NM were steamed.

1.4 Survey effort

The course track with CTD stations, Bongo trawls and fish trawling stations are shown in Fig. 1. A total of 41 CTD stations, 24 Bongo hauls and 2 pelagic trawl hauls were worked.

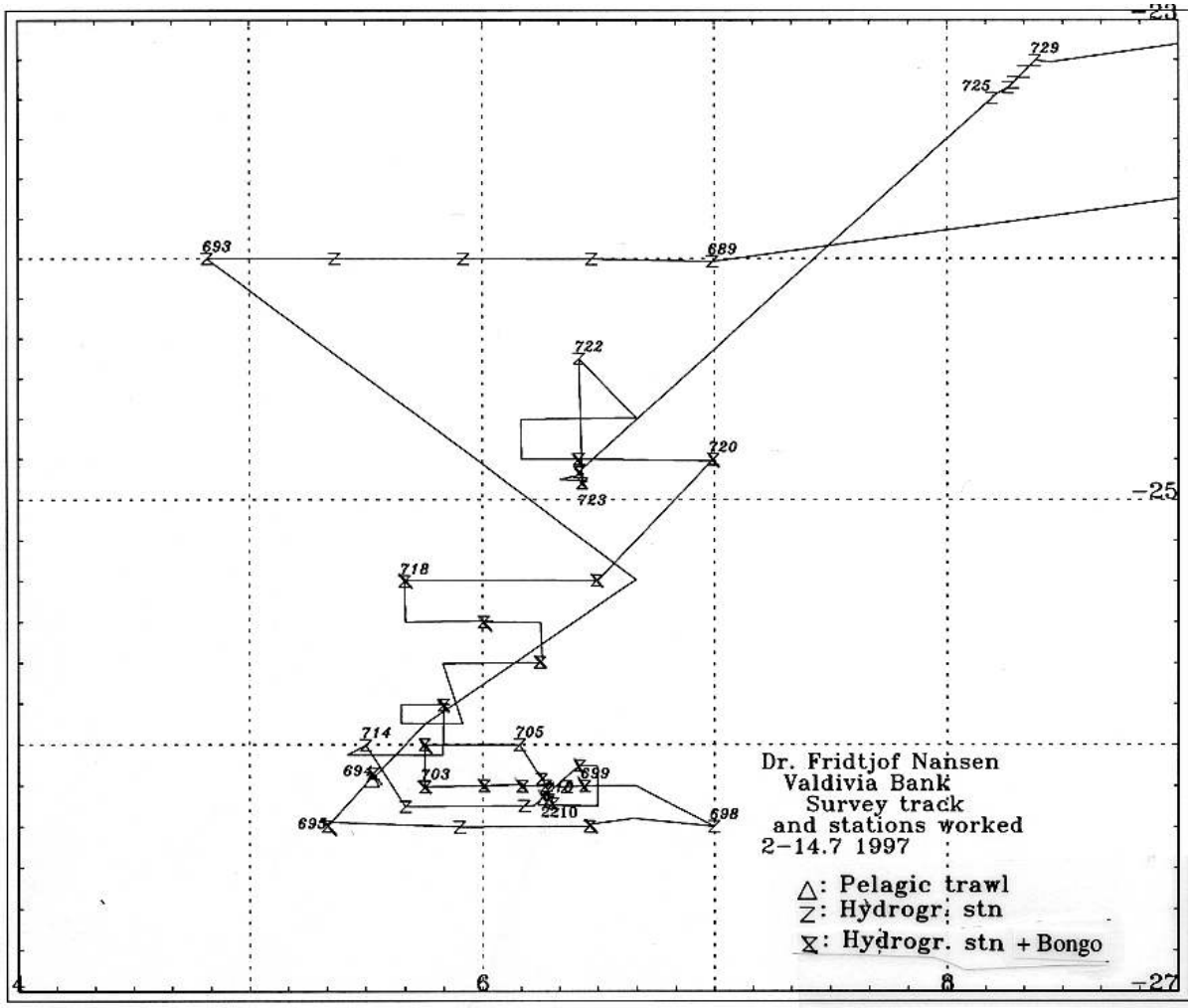

Figure 1 Course tracks and stations.

CHAPTER 2 METHODS

2.1 Bathymetry

The 18 kHz echo sounder was recording the bottom continuously by setting the range according to depth. Depths were stored on file for every nautical mile (nm). In addition paper copies of the recordings are available for detailed studies of the bottom profile. Also the 38 kHz echosounder was running continuously. The depth range was usually 0-500 m, but sometimes set to 0-1000 or 0-1500 m. Both the 18 kHz and the 38 kHz were continuously logged to the Bergen Integrator System.

Ships positions were determined with the GPS navigation system.

The bathymetry data were transferred to UMS format using a program developed onboard earlier (Floen, 1997). The actual bottom values were printed on the map using the UMS program. In addition the isobaths were marked using the contour device in UMS. The final isobaths were then drawn by hand.

2.2 Hydrography

A Seabird 911+ CTD probe was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. The stations were organised in large scale sections to reveal the general hydrographic structure, and detailed studies near the seamounts, for station map, see Fig. 1. The profiles were taken down to a few meters above the bottom, but not deeper than 1500 m due to the capacity of the CTD cable.

Up to 11 Niskin bottles were triggered for water samples on each station for calibration samples of temperature and salinity, and for nutrient determination.

The samples were analysed for salinity using a Guildline Portasal salinometer, and the oxygen content was determined using the Winkler method. These results were used to calibrate the CTD values.

For oxygen we did not obtain a good calibration, because the narrow range of the oxygen values, and some problems with the Winkler method. We therefore used the calibration obtained just prior to the present cruise, which was obtained using 187 samples. A linear regression gave the following formula for correcting the oxygen values:

$$O_2 = O_{2CTD} * 0.928 + 0.302$$

The standard deviation of the oxygen calibration was 0.154.

For salinity 60 calibration samples were used. The average difference between laboratory and CTD values was -0.007 (CTD too low) with a standard deviation of 0.0094. Since the difference was less than the standard deviation, salinity values from the CTD were accepted without corrections.

ADCP current measurements

A ship borne Acoustic Doppler Current Profiler (ADCP) from RD Instruments was activated on every CTD station. The ADCP was set to ping every 8 seconds, the depth cell was chosen to 8 m and the number of cells to 50. As a routine the data was stored on files.

The ADCP data was transferred to the UMS format (Underway Mapping System, Zauner, 1993), by the ADCP2UMS program developed onboard earlier (Dahl, 1996). The data was analysed and presented using the PC software UMS supported by Sea Fisheries Research Institute, Cape Town, South Africa.

Meteorological observations

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

The data were transferred to UMS format using a program developed onboard earlier (Floen, 1997). The data were presented using the UMS program package (Zauner 1993).

2.3 Nutrient sampling

Nutrient samples were taken at every CTD station for the following depths (in m): near surface (5), 30, 100, 250, 500, 750, 1 000, near bottom (but not deeper than 1500 m).

Samples were collected from the Niskin bottles into 15 ml Falcon tubes and immediately frozen. It was not deemed necessary to filter the samples as plankton concentrations in oceanic waters are generally low. The 286 samples that were taken will be analysed for silicate, phosphate, nitrate, nitrite and ammonia with the Bran & Luebbe TRAACS 800 Auto Analyser at the laboratory in Swakopmund.

2.4 Plankton sampling

Deck hose pump

An attempt was made to sample for fish eggs using the fire hose on the aft deck. This procedure has been successfully used in South Africa for the sampling of pilchard eggs. The fire hose is directed into a CalVET net and, at set times, a sample is taken. Unfortunately the fire hose on the Nansen is too strong (30 m^3 per hour), and all samples collected were broken up, making it difficult to identify. This method was aborted after 4 stations.

Bongo sampling

The Bongo net was fitted with a 180 micron net and a 375 micron net. The 180 micron net was fitted with an uncalibrated flowmeter. Calibration of this flowmeter is to be done at NatMIRC after the cruise. A depressor was used as a weight for the Bongo. The SCANMAR was attached to the Bongo wire for depth determination. The SCANMAR was not very successful at the beginning, but all the problems were sorted out after a few days. This proved to be a very successful method of determining the sampling depth of the Bongo. All samples were preserved in approximately 5% Formalin, for further microscopic analysis.

It was decided to sample only on or near sea mounts. Bongos where done both at night and during the day to a maximum depth of around 450 m, or as close to the bottom as possible during shallower stations. Stations took up to 1 hour to complete.

2.5 Fish sampling

The bottom conditions were very rough in the whole investigated area and bottom trawling was not possible without risking a total damage with the light gear used on 'Dr. Fridtjof Nansen'. In addition fish recordings on the echo sounder were very small.

CHAPTER 3 RESULTS

3.1 Bottom topography

The results of the bottom tracking are shown in Fig. 2. For comparison the same area from the navigation map is shown in Fig. 3. On Fig. 3 the cruise track is also shown.

A comparison of Figs. 2 and 3 clearly show that show great discrepancies in the bottom contours. For example we crossed the positions, according to the navigational map (Fig.3), of five seamounts shallower than 238 m which were not found. The most shallow area (250 m) was found in the SE corner of our investigation area. For the purpose of the cruise we named this 'Gunnars Hat'[1]. Another important investigation area was a bank with minimum depth was found to be 583 m. We named this 'Swakop Hill'[1] (see Fig. 2).

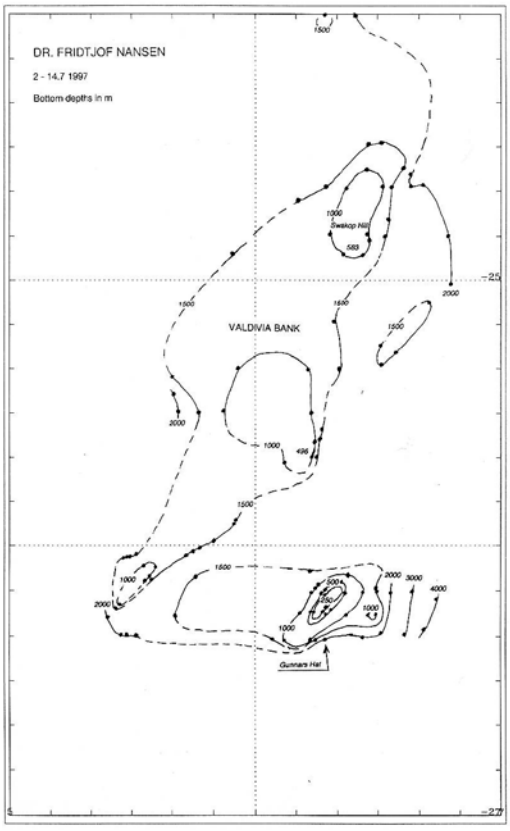

Fig.2 Bathymetric chart based on the recordings obtained during the cruise

[1] The name Gunnars Hat was chosen in memory of Gunnar Sætersdal who created the Nansen Programme. The name Swakop Hill was motivated from the fact that there are very few hills in Swakopmund, and we thought they deserved one.

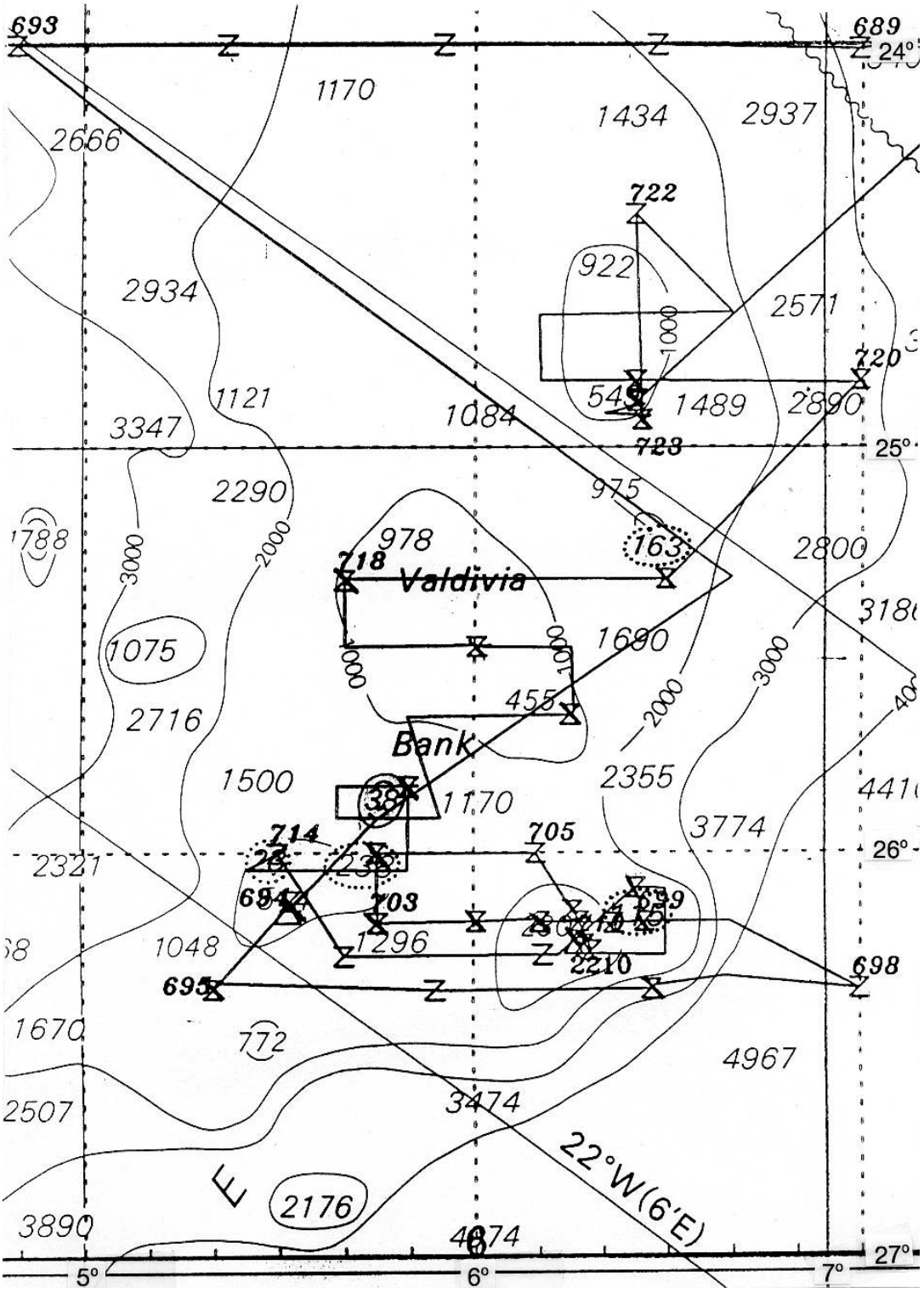

Fig.3 Details from the Navigation map No 4204, South African Hydrographic Office, 1974

The bottom profile of Gunnars Hat is shown in Fig.4. This profile was obtained when crossing the Hat from CTD station 711 towards SW (see Fig.1). The profile is very

characteristic with steep gardients leading up to a remarkably flat plateau at about 225 m depth.

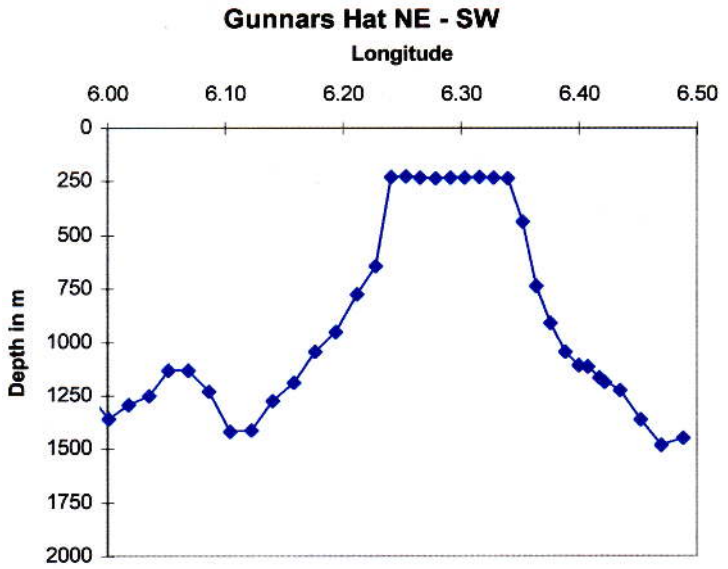

Fig.4. Bottom profile of Gunnars Hat obtained crossing NE – SW. The distance between the dots is 1 nm.

The Swakop Hill bottom profile is shown in Fig.5 obtained steaming from CTD station 720 (see Fig.1) towards west. Again a relative flat area was observed surrounded by steep hillsides.

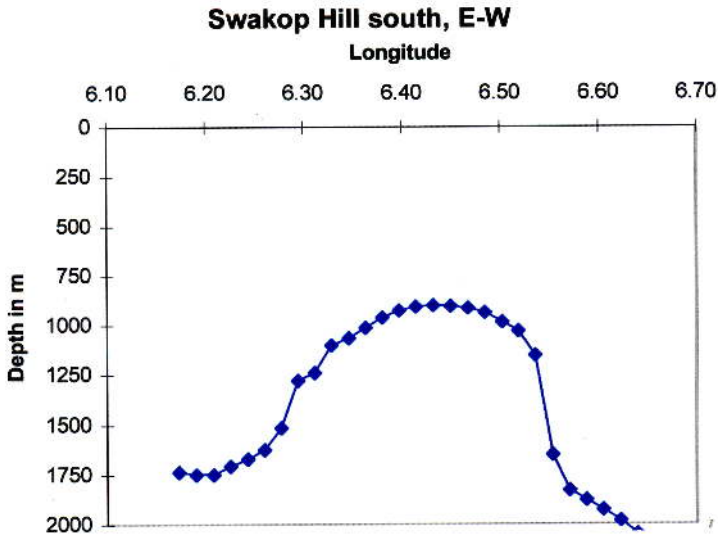

Fig.5 Bottom profile of Swakop Hill obtained crossing E-W. The distance between the dots is 1nm.

3.2 Oceanography

CTD measurements

The large scale water mass structure is revealed in two vertical sections (Figs. 6 and 7), one an E-W section in the northern part of the investigation area, and one oblique section running from the SW corner to NE corner of the investigation area, for positions see Fig. 1. Note that the horizontal scale is different for the two sections. Both sections show that for the temperature as well as the salinity the structure was rather flat. The Antarctic Intermediate water is recognised as a salinity minimum (S<34.4 ‰) at about 700 m depth. The oxygen concentration was around 4 to 5 ml/l in most of the area.

The vertical profiles of two stations (Stns. 697 and 708) show that the upper 100 m was well mixed (Fig. 8). Below the mixed layer a salinity and oxygen maximum was observed. At some of the stations a small, but noticeable maximum was also seen in the temperature profile at the bottom of the mixed layer, an example was station 708, (Fig. 8b).

Due to the deep mixed layer, very little structure was found in the horizontal distribution of the parameters at the surface. These are therefore not shown. However, the horizontal distribution of temperature and salinity at 100 m, (Figs. 9 and 10) show structure reflecting variations in the mixed layer depth. Such structure seems to be most pronounced above the seamounts.

Detailed investigations were performed around the seamounts. Vertical sections crossing the Ewing Seamount, the Swakop Hill and Gunnars Hat are shown in Figs. 11, 12 and 11, respectively. Note that both vertical and horizontal scales are different for these three figures. The effect of the seamounts on the water structure is readily seen, especially at Gunnars Hat, which comes up to about 225 m depth. Here the isotherms and isohalines clearly show a dome structure. The isolines are tilted upwards towards the mountain, both deeper than the mountain top, and above the seamount (Fig. 13). At Gunnars Hat this structure is readily seen all the way to the surface by a salinity minimum (S<35.5 ‰) situated just above the seamount (Fig. 13).

Even at the other seamounts the influence of the seamounts are noticeable. At the Swakop Hill, which has a minimum depth of about 550 m, the dome structure is clearly seen all the way to the thermocline. At the Ewing Seamount, which only comes up to about 800 m depth, the influence of the bottom seems to be restricted to below 400 m depth, where an undulating shape of the isolines may be noticed.

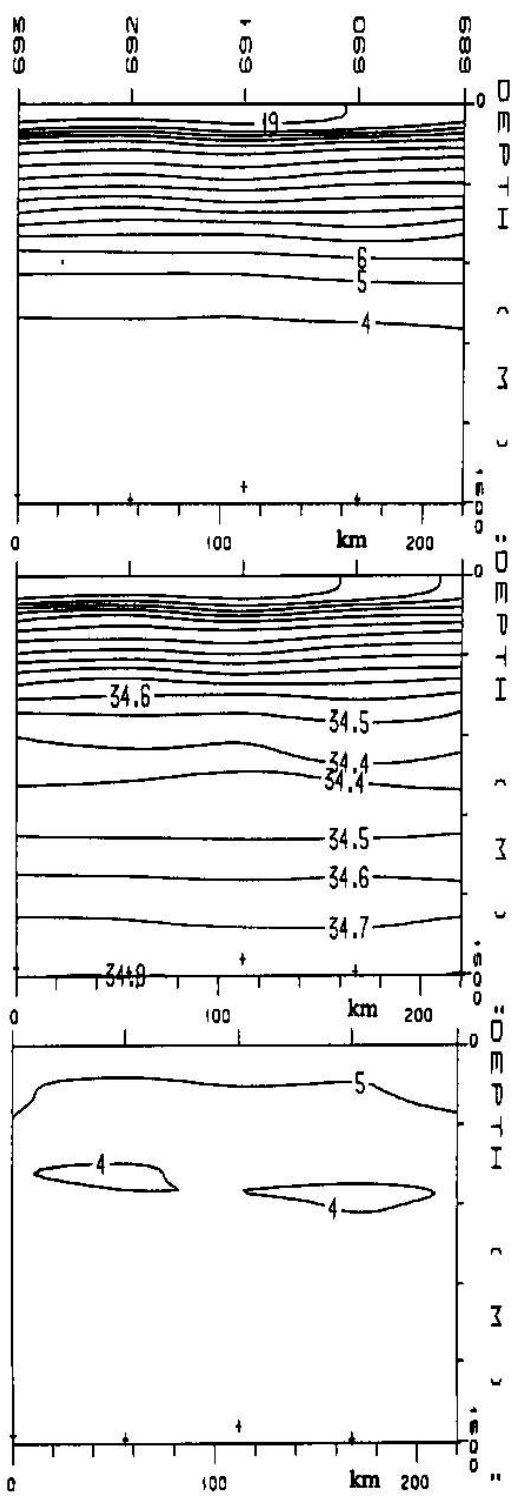

Fig.6 Vertical section in the northern part of the area, a) temperature b)salinity and c)oxygen

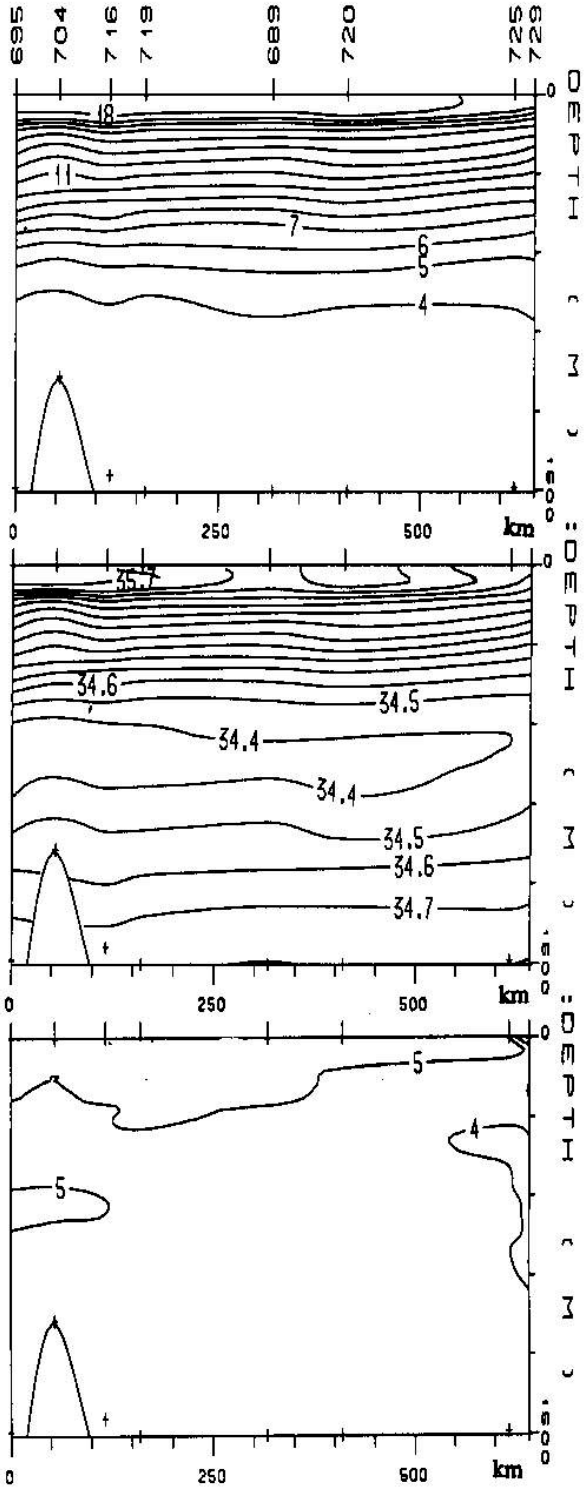

Fig.7 Vertical section crossing the investigation investigation area oblique a)temperature b) salinity and c) oxygen

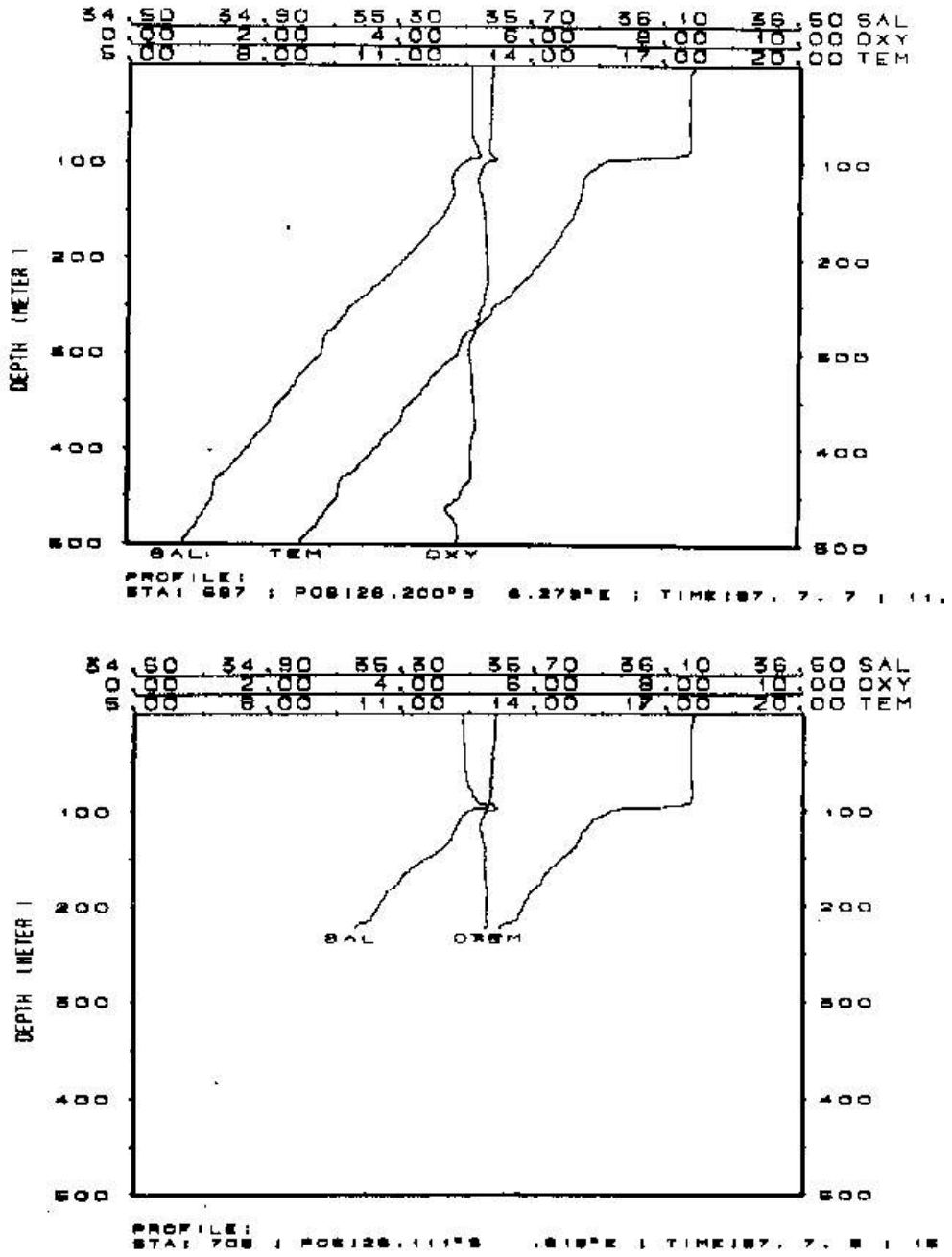

Fig.8 Profiles of temperature, salinity and oxygen at a) Station 697, b) Station 708

Also included in Figs 11-13 are the calculated geostrophic velocities, using the surface as a reference level. It may be noticed that above the seamounts there are strong horizontal shears in the velocity structure. This is particular clear at Gunnars Hat. The current structure just above the Hat indicate a strong anticyclonic circulation, while the general circulation further out from the seamount is cyclonic, and still strong.

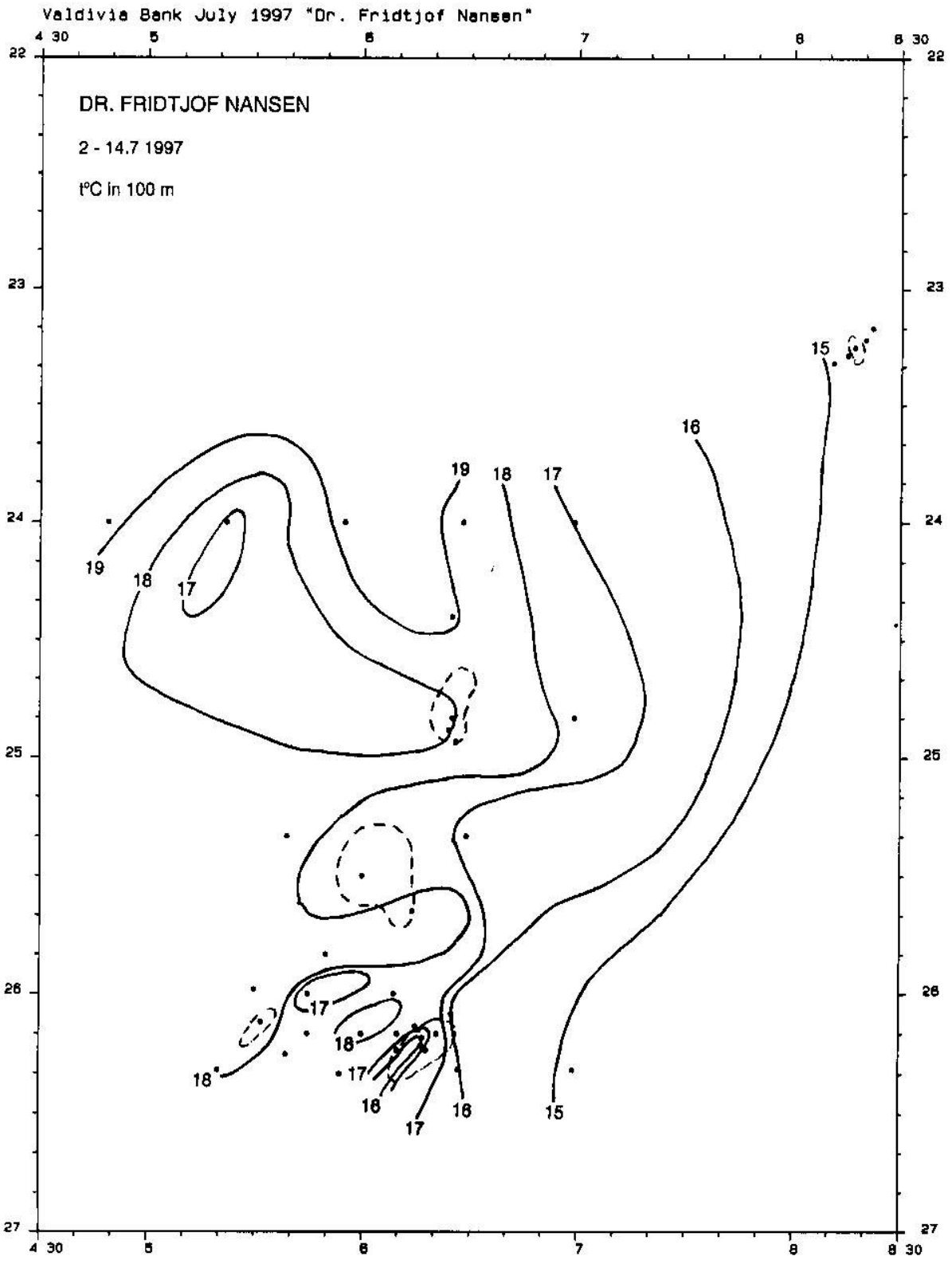

Fig.8 Profiles of temperature, salinity and oxygen at a) Station 697, b) Station 708

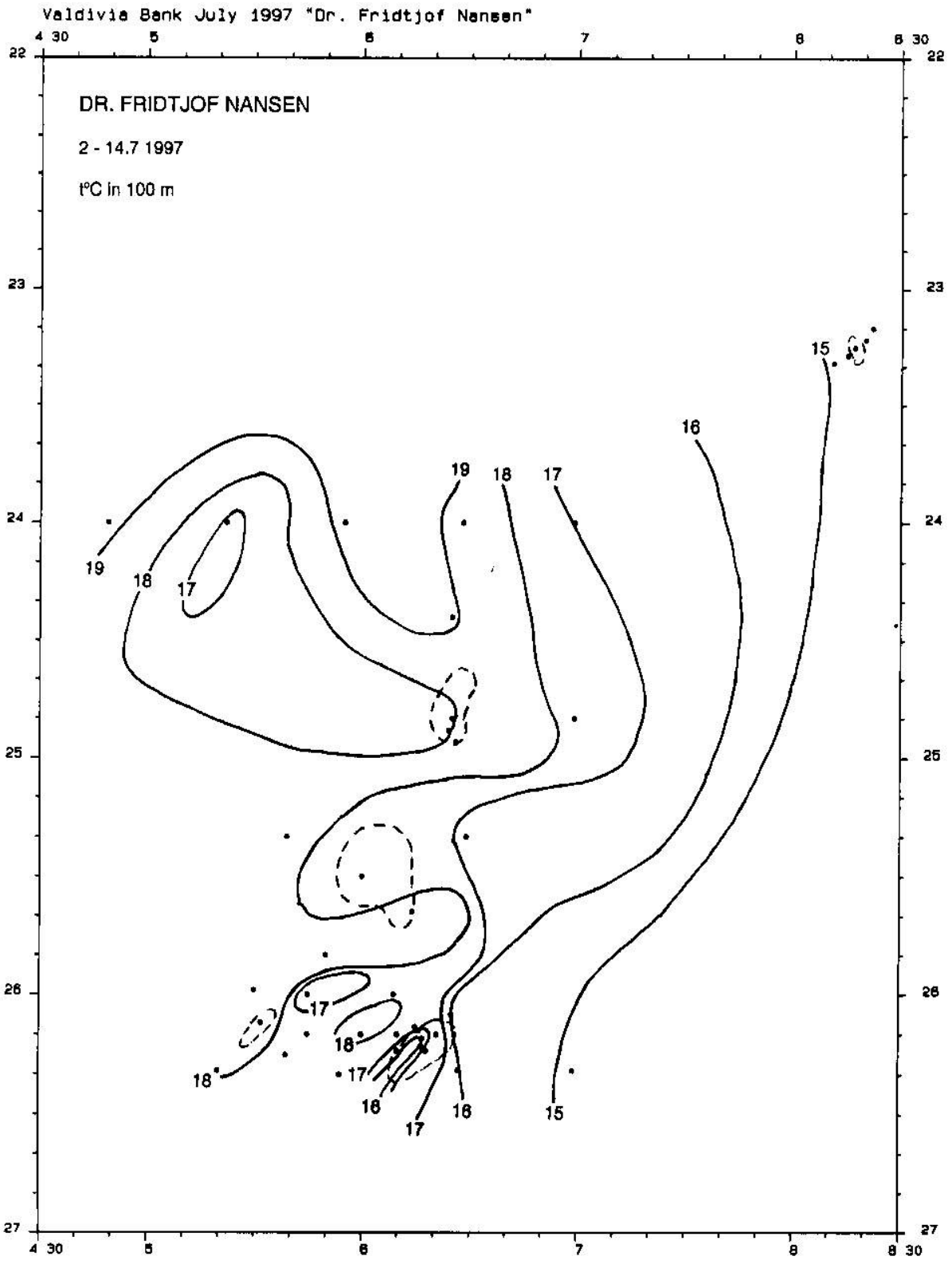

Fig.9 Horizontal distribution of temperature at 100m depth. Dotted lines indicate the 1000m isobath

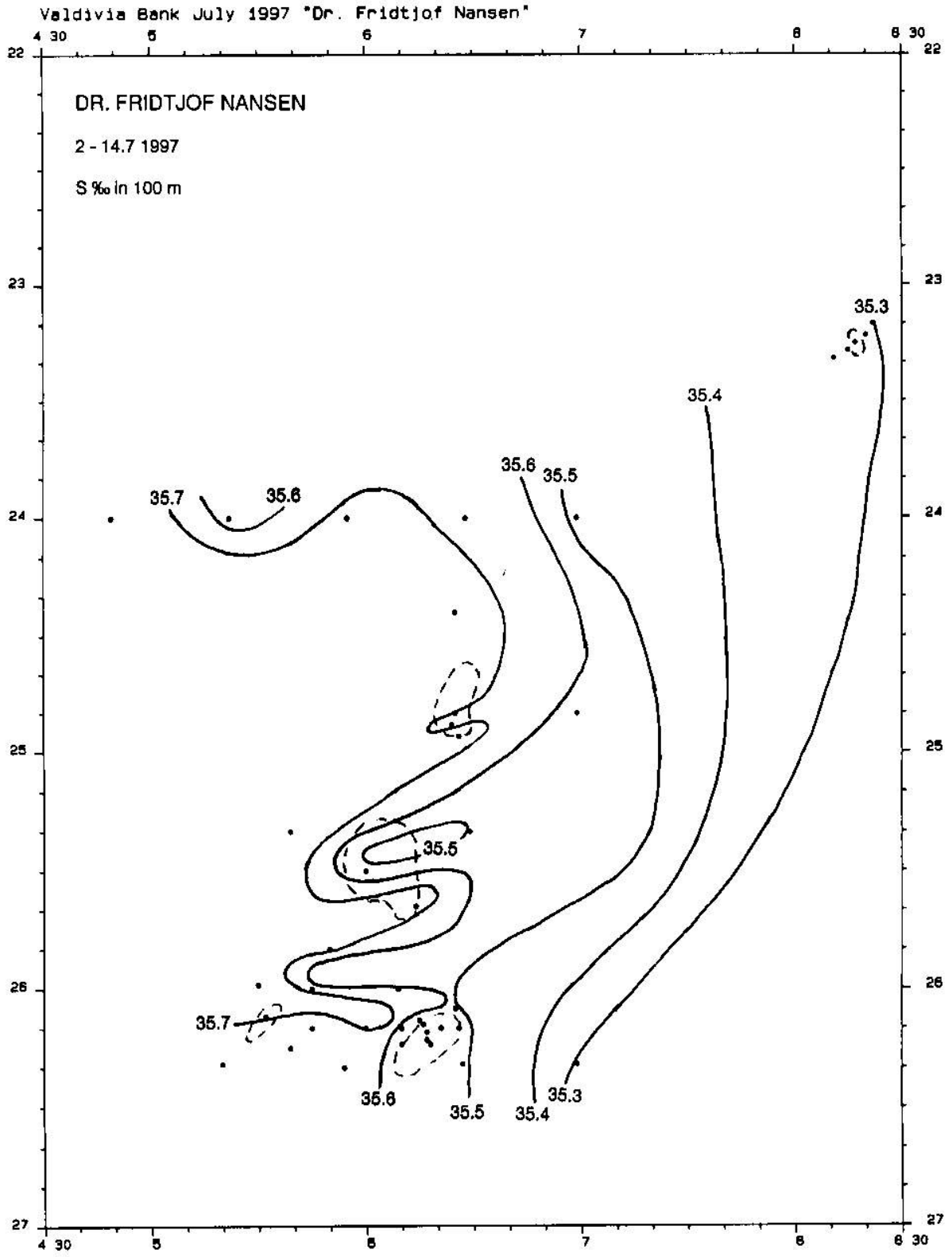

Fig.10 Horizontal distribution of salinity at 100m depth. Dotted lines indicate the 1000m isobath

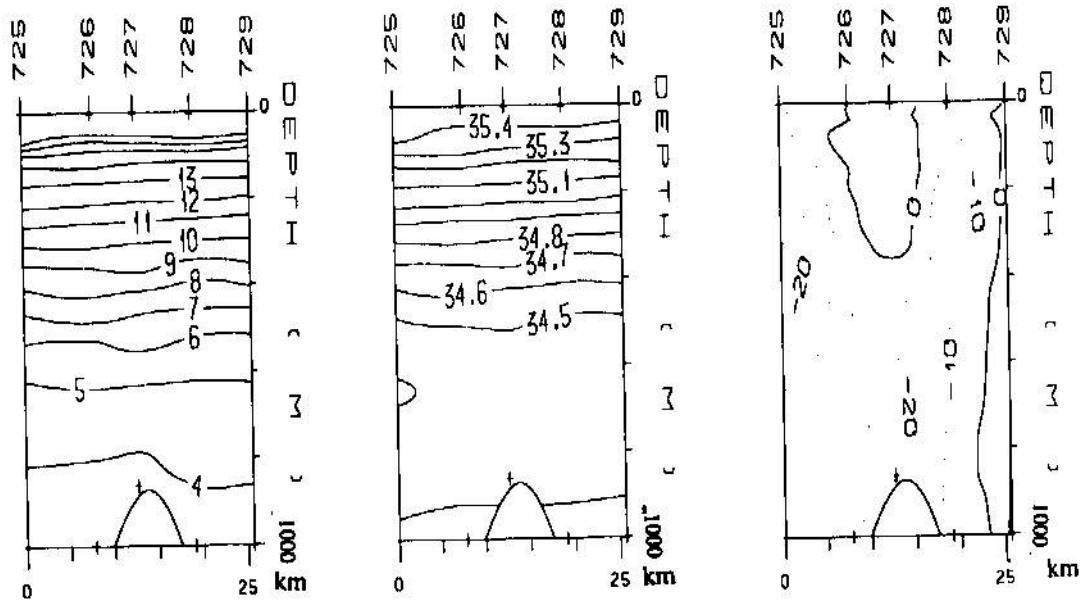

Fig.11 Vertical section of a) temperature b) salinity and c) geostrophic velocity near Ewing Seamount

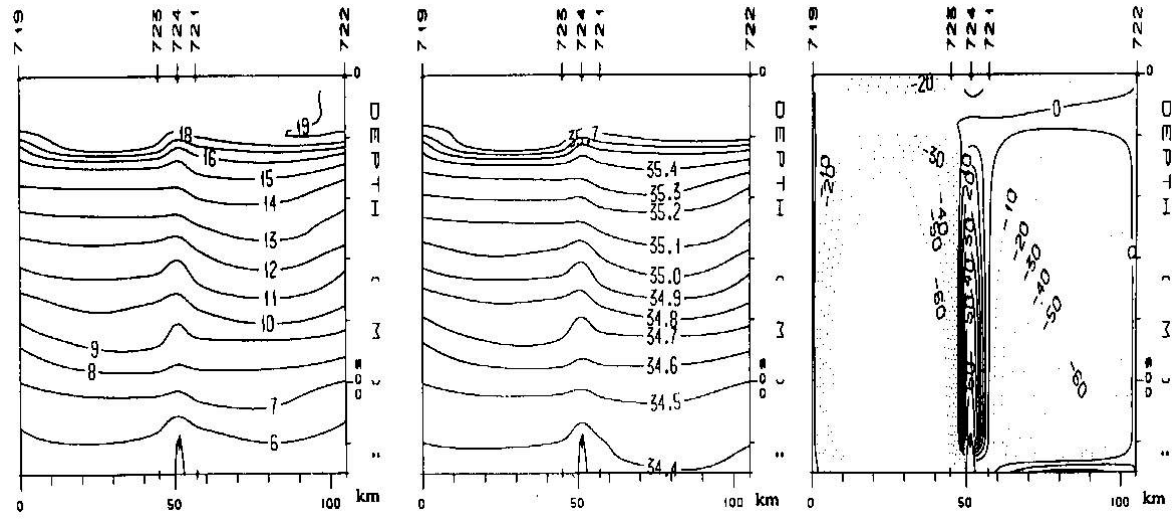

Fig.12 Vertical section of a) temperature b) salinity and c) geostrophic velocity near Swakop Hill

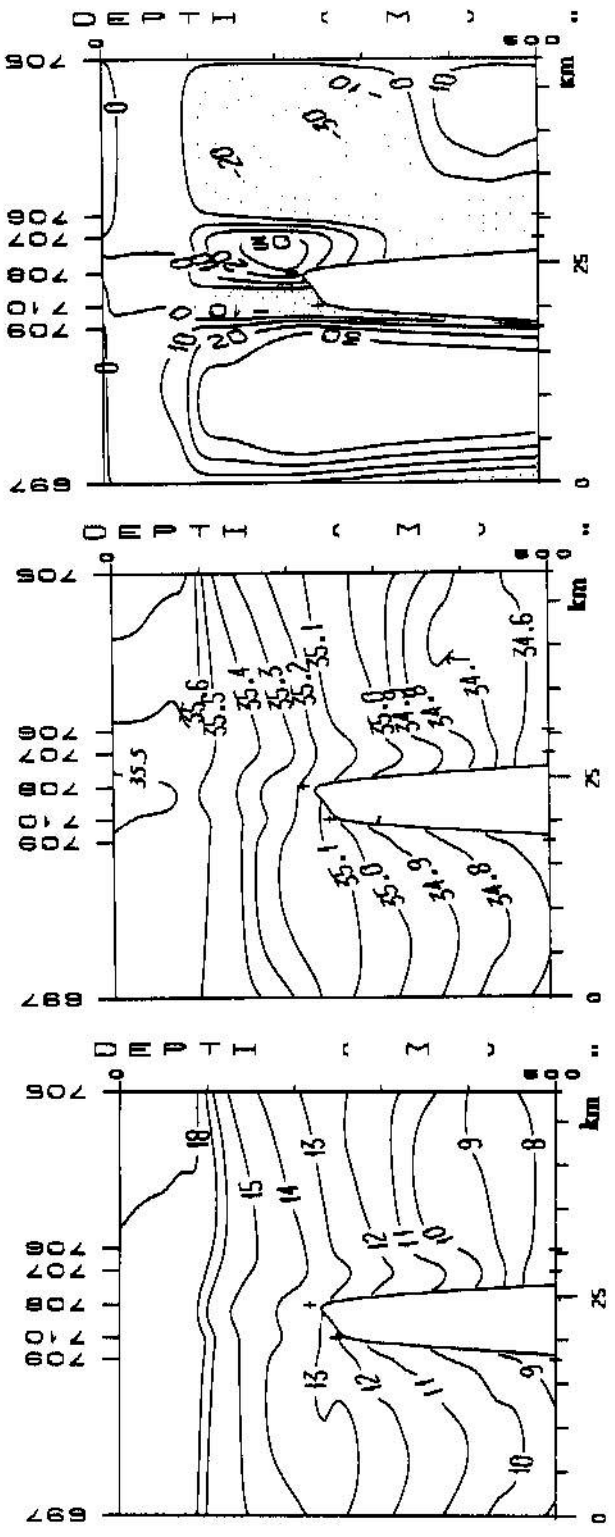

Fig.13 Vertical section of a) temperature b) salinity and c) geostrophic velocity near Gunnar's Hat

ADCP current measurements

The results of the ADCP registrations are shown in Fig. 14a and b for the currents above the thermocline (at 18 m and 34 m depth) and in Fig. 14c at 122 m depth, which is below the thermocline. All the measurements obtained are shown. Because the great bottom depth almost all the current measurements were obtained using navigation, not bottom track as reference. The recently installed Seapath system, which measures and corrects for the ships own movements, was unfortunately not functioning.

The immediate impression from Fig. 14 is a rather patchy picture. However, some structure emerges. At 18 m depth the prevailing currents seem to be between N and E. This layer is probably influenced by the wind, which was from SSW throughout the cruise (Fig. 15).

Deeper down the general impression is that there are not large differences in currents across the thermocline. Although patchy, the general picture is the same at these two levels. However, more analysis is needed to clearify this point.

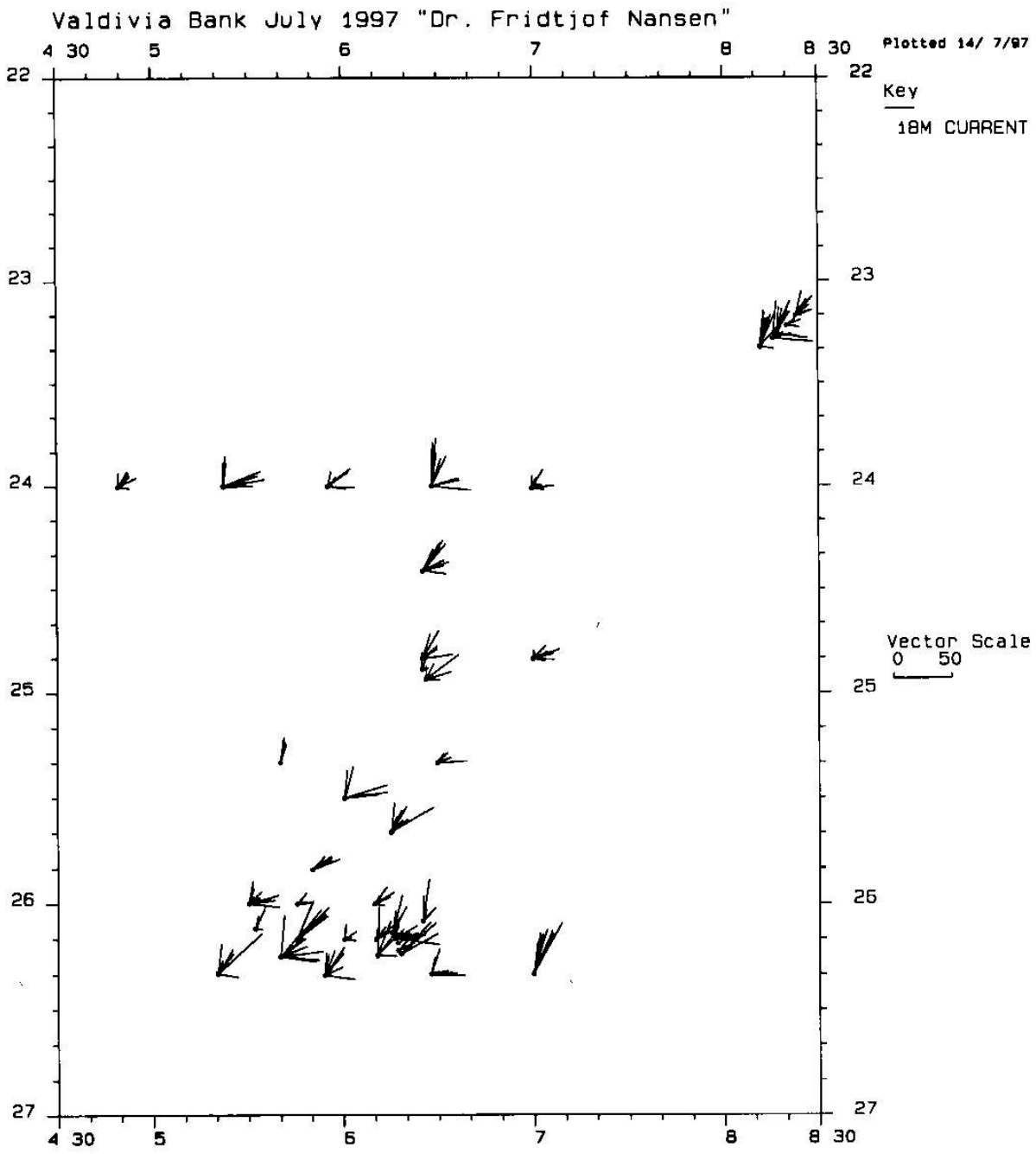

Fig. 14a Results from the ADCP current measurements at 18m depth.

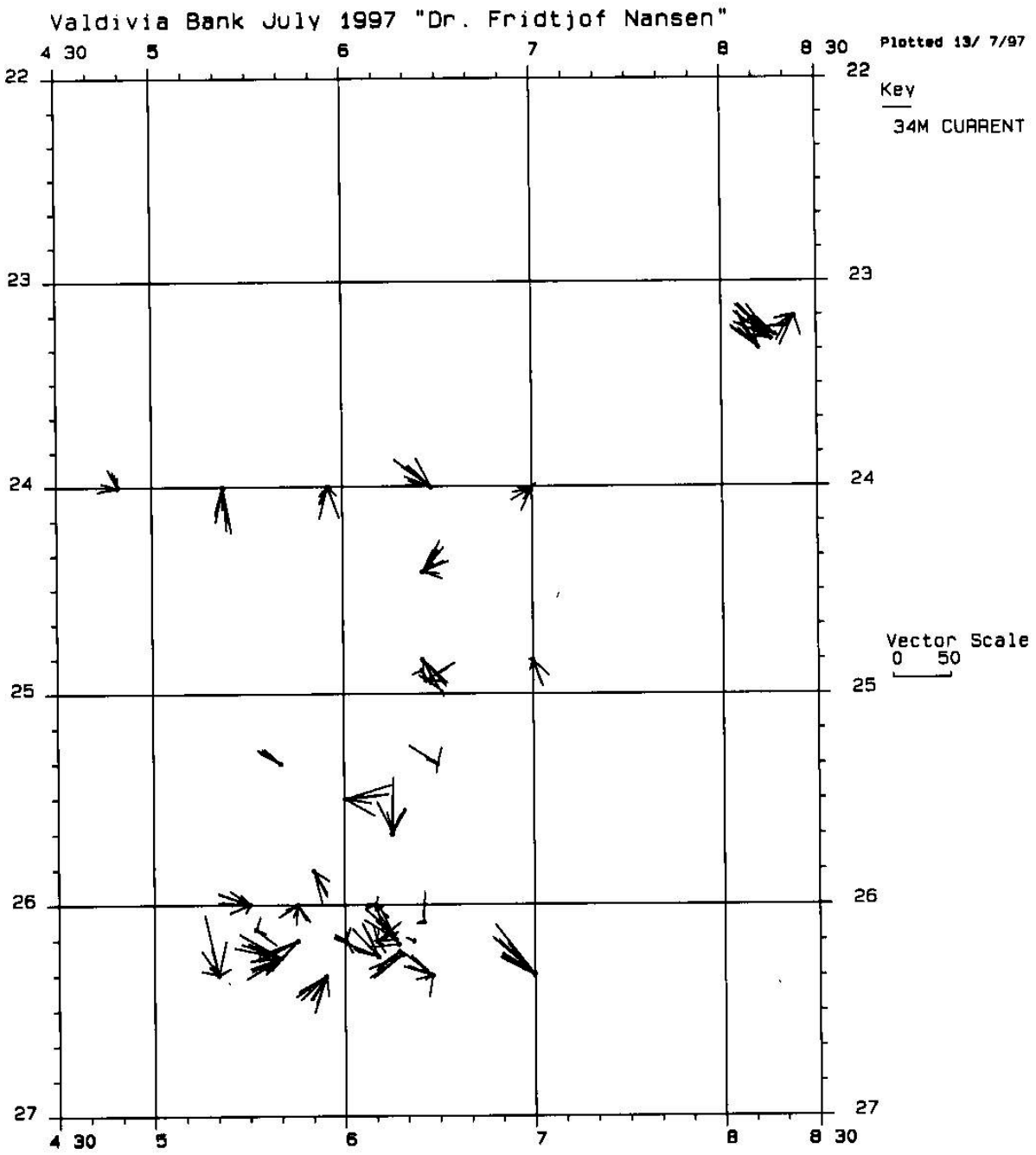

Fig. 14b Results from the ADCP current measurements at 34m depth.

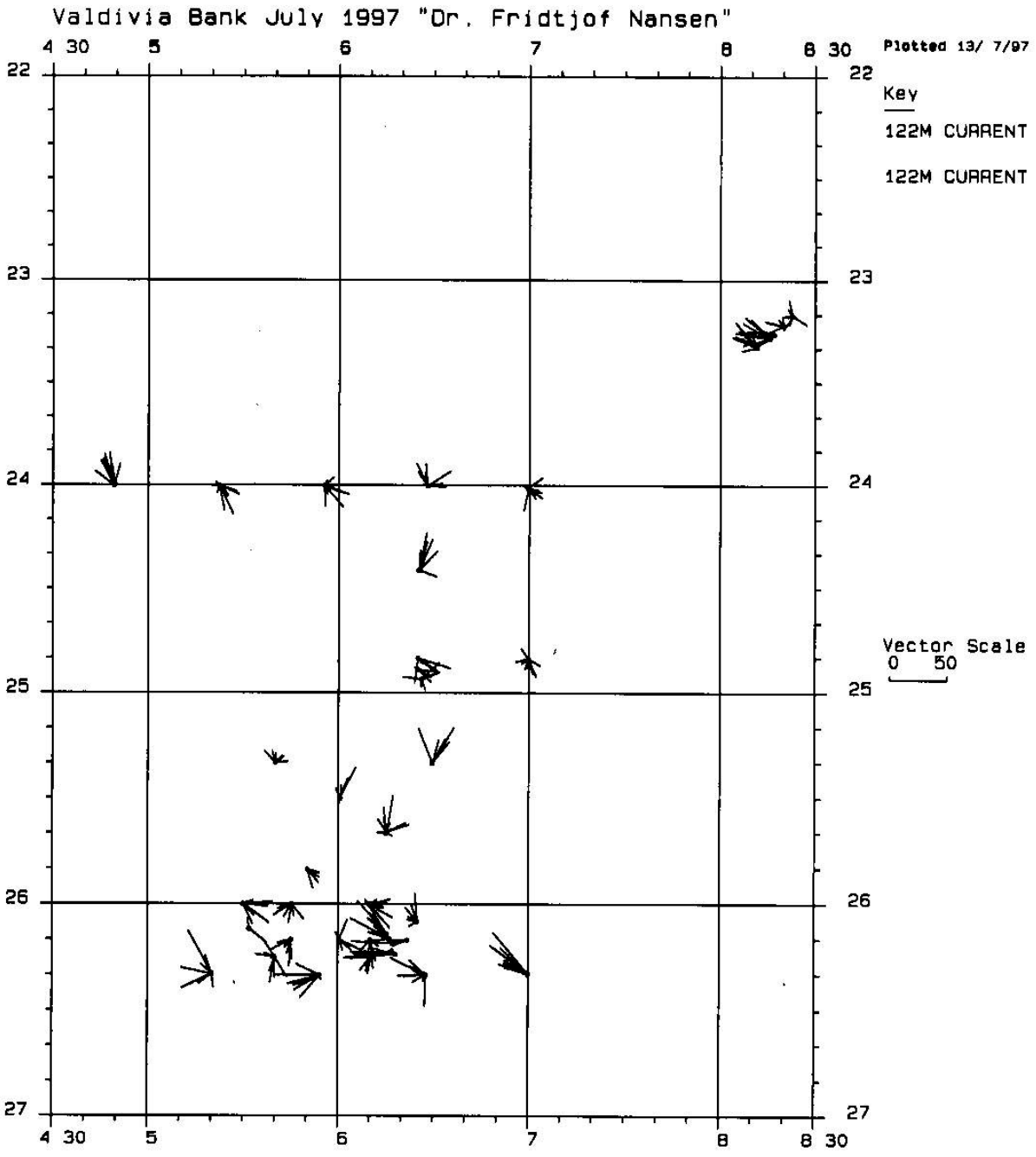

Fig. 14c Results from the ADCP current measurements at 122m depth.

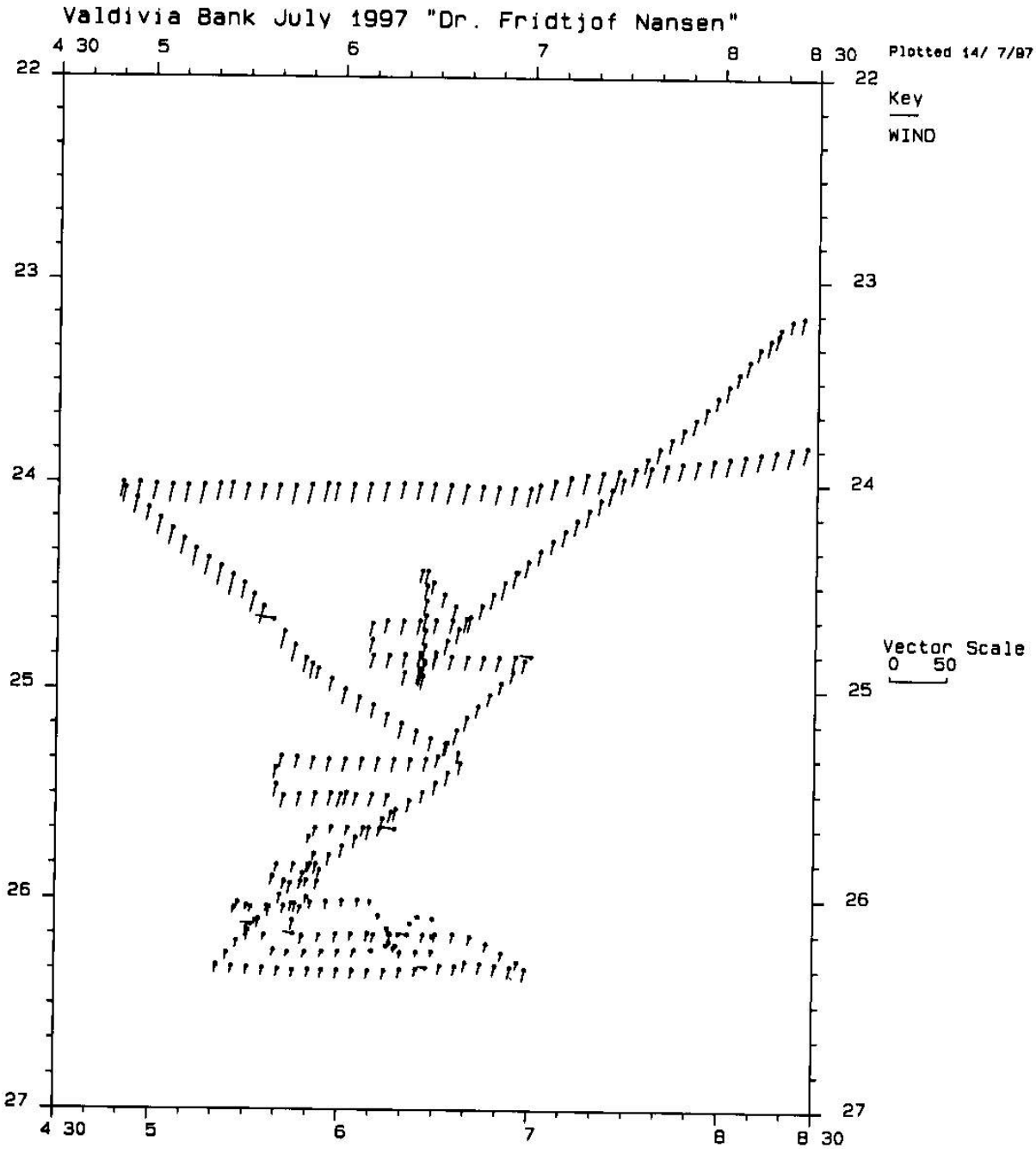

Fig. 15 Wind measurements (knots) obtained during the cruise.

3.3 Nutrients

The samples will be analysed in Swakopmund in the end of July.

(**Anja)**

3.4 Plankton

It soon became evident that the samples contained a high number of fish larvae on the Valdivia Bank, the species of which will be determined at a later stage. The abundance of these larvae was greater during the night time stations than during the day. Orange roughy eggs were not observed, but this will have to be confirmed microscopically at a later stage. Both phytoplankton and zooplankton were abundant. Zooplankton comprising mainly Euphausids and small Copepods. Lobster larvae (Phyllosoma) was also present in many of the samples. The species of lobster is still unknown.

The presence of many different species of fish larvae throughout the survey area, both day and night, could suggest that the Valdivia Bank and the Ewing Seamount is an important nursery area for these specific species.

The samples will be analysed at a later stage (**Alan**)

3.5 Fish

The first pelagic haul were made on shoals in the south-western part of the investigated area. Only a large oilfish (*Ruvettus pretiosus*), a few alfonsinos (*Beryx splendens*) and some lanternfish were caught. The shoaling fish seemed to be fast swimmers avoiding the trawl.

The second haul was done near the bottom on Gunnars Hat during night-time on recordings of single fish. Only some few Cape bonnetmouth (*Emmelichthys nitidus*), alfonsinos, silver scabbardfish (*Lepidopus caudatus*), snoek (*Thyrsites atun*) and some lanternfish.

A Spanish trawler was operating on the southern part of Valdivia Bank. They reported catch of alfonsino and "blackfish", but no orange roughy.

CHAPTER 4 PRELIMINARY DISCUSSION

4.1 Do the seamounts exist?

During the survey we passed the position of five seamounts marked on the navigation map with depths ranging from 163 m to 23 m below the surface, see Fig. 3). None of these were found in the positions indicated. They may therefore be located elsewhere, or, they may not be existing at all. Often in earlier times the navigation was not so accurate as our GPS system. There is therefore still possible that the seamounts exist, but in different positions.

A comparison with our results (Fig. 2) and the navigation map (Fig. 3), showed large discrepancies. We also did a comparison with the GEBCO Digital Atlas (Meirion et al 1994). That comparison was much closer. Also in the GEBCO atlas the 5 seamounts are absent.

4.2 The Valdivia Bank as a nursery area?

The preliminary results from the Bongo hauls indicate that the region investigated may be an important nursery area for various species. The reason for this may be found in the hydrographic structure around the seamounts. As noticed in Chapter 3 the seamounts seem to influence the water masses around is and above it. At Gunnars Hat (Fig. 11), which was the most shallow area investigated, this structure was particularly clear. The cylonic gyre around the seamount may be due to a so called Taylor Column (Taylor, 1923). The ambient currents may flow around the Taylor Column, while the water within the Column will be trapped. Thus one of the conditions in ‘Bakuns Triad’ (Bakun, 1996) for survival of species at an early stage, namely retention, seems to be fulfilled.

The lifting of the thermocline above the mountain top may transport nutrient rich water into the photic zone. In addition the strong anticyclonic circulation around the seamounts, see Fig. 11 for a clear example on Gunnars Hat, will create strong friction layers near the bottom. In this layer, often called Ekman layer, the current is slowed down, and therefore the Coriolis force will be to small to balance the pressure force. A transport out from the seamount in the bottom layer will therefore take place. This will in turn set up a vertical circulation which may transport nutrient rich water in to the stagnant area. This is the second condition in ‘Bakuns triad’, the enrichment.

The rich catches of larvae, and maybe eggs in the Bongo hawls indicate that the Valdivia Bank is an important nursery area for various species. The fact that the hydrographic structure around the seamounts seem to fulfill two of the three conditions in ‘Bakuns triad’ for survival of species at an early life stage, namely retention and enrichment supprt this hyphothesis.

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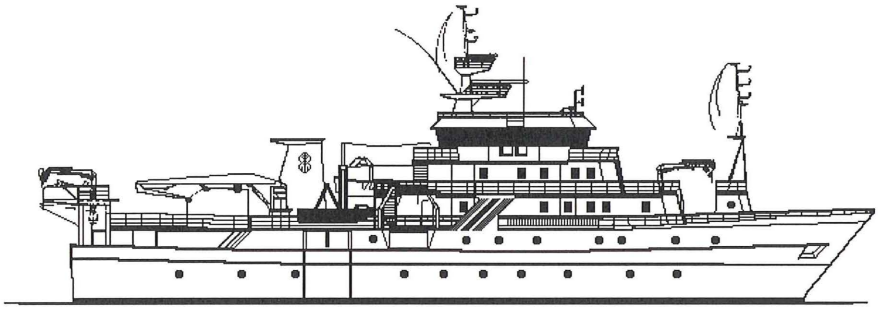

SURVEYS OF FISH RESOURCES OF NAMIBIA

Cruise Report No 4/97

Orange roughy survey
15 July - 1 August 1997

Ministry of Fisheries & Resources
Swakopmund, Namibia

Institute of Marine Research
Bergen, Norway

SURVEYS OF THE FISH RESOURCES OF NAMIBIA

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Orange roughy survey
15 July - 1 August 1997

by

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ABSTRACT

The first biomass assessment survey on orange roughy in Namibian waters took place from 16.July to 1.August 1997. The survey was conducted with the RV Dr. Fridtjof Nansen and FV Southern Aquarius. The objectives of the survey were to determine the distribution, mean density and abundance of orange roughy on three of the known fishing grounds (Johnies, Frankies, and Rix) and in areas adjacent to the aggregations. Further, a suitable methodology for abundance estimations using acoustics was to be determined, including to establish if hull mounted transducers are suitable for surveying deep water species in Namibia.

The acoustic surveying in Namibia was undertaken by the RV Dr. Fridtjof Nansen. Johnies and parts of Frankies were surveyed 4 times and Rix 3 times. Biological sampling was conducted by trawling, including 94 bottom trawls with the Southern Aquarius and 8 pelagic and 9 bottom trawls with the RV Dr. Fridtjof Nansen. Comparative trawls showed that catches from the FV Southern Aquarius were dominated by larger species like orange roughy, hake, sharks, and *Caelorinchus* sp., while catches from RV Dr. Fridtjof Nansen also contained smaller species like *Nezumia* sp., H. *dactylopterus* , and small eels.

Orange roughy made up 97.6 %, 97.3%, and 88.4% respectively of the catches for Johnies, Frankies, and Rix. The proportion of orange roughy in the catches decreased when moving away from the central areas of the fishing grounds. The sex ratio in the catches varied between coverage's of the grounds, with Johnies having the proportion of 65% and 66%, Frankies 47% and 72%, and Rix 45% males. 50% maturity occurred at a standard length of approximately 25 cm on all grounds. The highest proportion of running and spent fish was found at Rix and Frankies, while highest proportion of spent females was at Rix. There were differences in the development of the maturity stages between the first and second coverage of Johnies and Frankies. The proportion of ripe males on Johnies increased between the coverage's, while the proportion of spent fish increased for both males and females in the second coverage of Frankies.

Three different methodologies for biomass assessment were used. Targeted acoustics indicated a biomass in the aggregations of all three grounds of approximately 50 000 t, while trawl sample based acoustics estimated the biomass at 50 000 t for Johnies and Frankies. Random trawls gave a swept area biomass estimate of 90 000 t for Johnies and Frankies. The targeted acoustic biomass estimate gives a minimum estimate for the orange roughy in Namibian waters.

The limitations of the different methods are discussed, and emphasis is put on the value of the survey data as relative estimates indicating stock changes over the years rather than absolute estimations of biomass.

The use of a submerged transducer (towed body) had certain advantages providing useful additional information, but the method has severe financial, time, and operating implications which favored the use of hull and keel mounted transducer in future surveys.

The survey was considered a success, with repeated coverage's of the grounds, close cooperation between fishing and research vessel, and efficient utilization of the technical equipment and scientific knowledge available.

CHAPTER 1 INTRODUCTION

1.1 Objectives

As no acoustic research has previously been conducted on orange roughy aggregations in Namibia, the objectives detailed below were tentative and accordingly had to be adapted as the survey progressed.

This survey had a number of objectives, of which the first was considered of primary importance:

1) To determine the distribution, mean density and abundance of orange roughy at two, possibly three, of the known spawning aggregations.
2) To estimate the density, and hence abundance, of orange roughy in areas outside of the aggregations.

The next objectives were also considered of crucial importance, and the first was to be addressed before objectives 1) and 2) could be answered:

3) To determine a suitable methodology to determine orange roughy abundance using acoustics combined with trawling.
4) To establish if hull-mounted transducers are suitable for surveying deep-water species, or if towed transducers will be required.

Two aspects pertaining to objectives 3) and 4) that needed specific investigation if possible were:

5) To investigate the target strength properties of orange roughy and, if suitable distributions are found, other deep-water species of potential commercial importance.
6) To estimate the amount of fish in the bottom shadow zone and investigate methods to reduce this bias.

Data collected during the above work would also be analysed:

7) To investigate the spatial and temporal variability in density of each aggregation, both horizontally and vertically.

Data would also be collected:

8) To determine length-frequency, length-weight relationship and maturity parameters of each aggregation.
9) To collect stomach contents, otoliths and tissue samples for later analysis.
10) To monitor the oceanographic conditions at the aggregations, specifically of profiles of temperature, salinity and dissolved oxygen.

In addition to the above work on orange roughy, similar experiments were to be conducted on alfonsino, and possible other deep-water species, if suitable distributions were found and time permitted.

1.2 Participation

The scientific staff from the National Marine Information and Research Centre (NatMIRC), Swakopmund, Namibia were:

Dave BOYER, Malcolm CLARK, Inge FOSSEN, Rudy KLOSER, Bjørn STAALESEN, Arved STABY, and Jamy TRAUT

The Scientific staff from the Institute of Marine Research (IMR) in Bergen, Norway was:

Martin DAHL, Ingvar HUSE, Jarle KRISTIANSEN and Jan-Tore ØVREDAL.

From GENDOR Fishing: Michael FRAHM, Alan REES and Chris DELCARME

The fish sampling team on "Southern Aquarius" consisted of:

Johnie GAMATHAM, John SACHEUS, John KOITA and Asser SHIGWEDHA

1.3 Cruise schedule

The RV "Dr. Fridtjof Nansen" left Walvis Bay at 16h00 on 16 July 1997 and anchored near Pelican Point for calibration of the FOCUS 38 kHz transducer. At 23h30 the course was set towards the orange roughy ground Johnies with arrival on 18 July at 03h00, when the first acoustic coverage started. Survey activities were discontinued at 20h00 on 31 July at Rix, and the ship returned to Walvis Bay on the morning of 1 August after having steamed a total of 2740 nm.

1.4 Survey activities

A map of the area is shown in Figure 1. A total of 19 CTD stations, 8 pelagic and 9 bottom trawl hauls were worked from RV Dr. Fridtjof Nansen. In addition the FV Southern Aquarius carried out 94 bottom hauls and caught a total of 377 tonnes of orange roughy. Detailed maps of the three investigated areas (Johnies, Frankies, and Rix) are given in Figure 2. Two initial acoustic coverage's with hull mounted 18 kHz and drop keel mounted 38 kHz transducers were carried out at Johnies, in addition to a detailed study with the FOCUS 400 acoustic platform towed at 380 m in the central high density area. After having carried out a similar investigation of Frankies, the Johnies area was covered one final time. On Frankies, two initial acoustic coverage's were carried out, in addition to detailed acoustic surveys with the FOCUS at the three localities; Three Sisters, Frankies Flats and 21 Jump Street. Additionally the Three Sisters area was covered one more time, and after the final coverage at Johnies, Frankies was covered one final time. At Rix three acoustic coverages were carried out after finalizing the work in the two other areas.

Table 1. Summary of surveys by area

Ground	Survey number	Depth range (m)	Latitudinal range (deg/min)
Johnies (Hull mounted)	1	500-900	26°10 - 26°30
Johnies (Hull mounted)	2	500-900	26°17 - 26°25
Johnies (Hull mounted + towed)	3	500-900	26°17 - 26°25
Johnies (Hull mounted)	4	500-900	26°11 - 26°28
Frankies (Hull mounted + towed)	1	500-900	24°18 - 24°48
3 Sisters (Hull mounted + towed)	2	650-850	24°39 - 24°41
Frankies Flats (Hull mounted + towed)	2	500-700	24°31 - 24°35
21 Jump Str. (Hull mounted + towed)	2	500-700	24°23 - 24°26
3 Sisters (Hull mounted)	3	650-850	24°39 - 24°41
Frankies (Hull mounted)	4	500-900	24°18 - 24°48
Rix (Hull mounted)	1	500-1000	22°21 - 22°39
Rix (Hull mounted)	2	500-1000	22°28 - 22°36
Rix (Hull mounted)	3	500-900	22°28 - 22°36

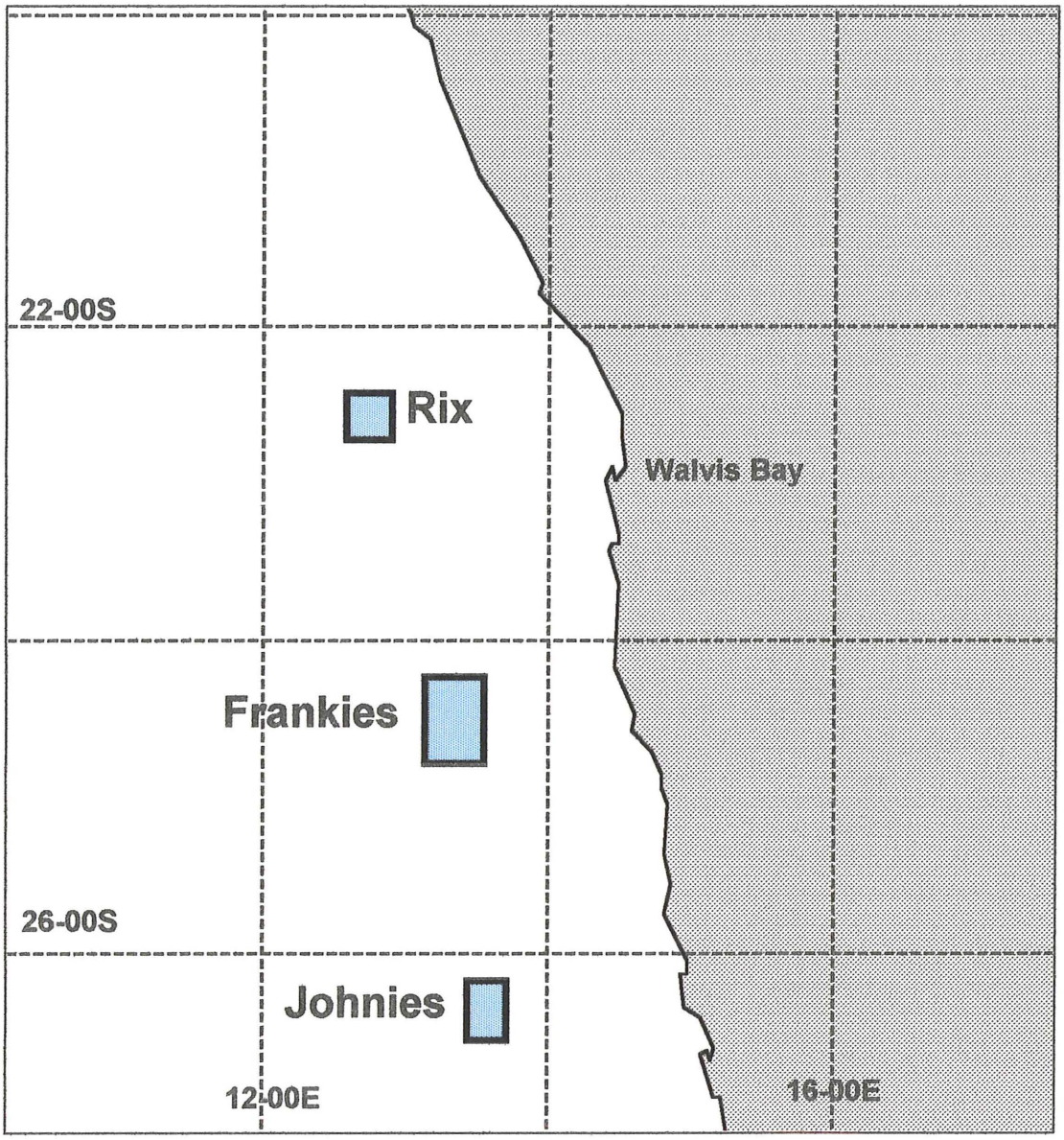


Figure 1:
General locality map of the areas covered during the orange roughy survey, July 1997.

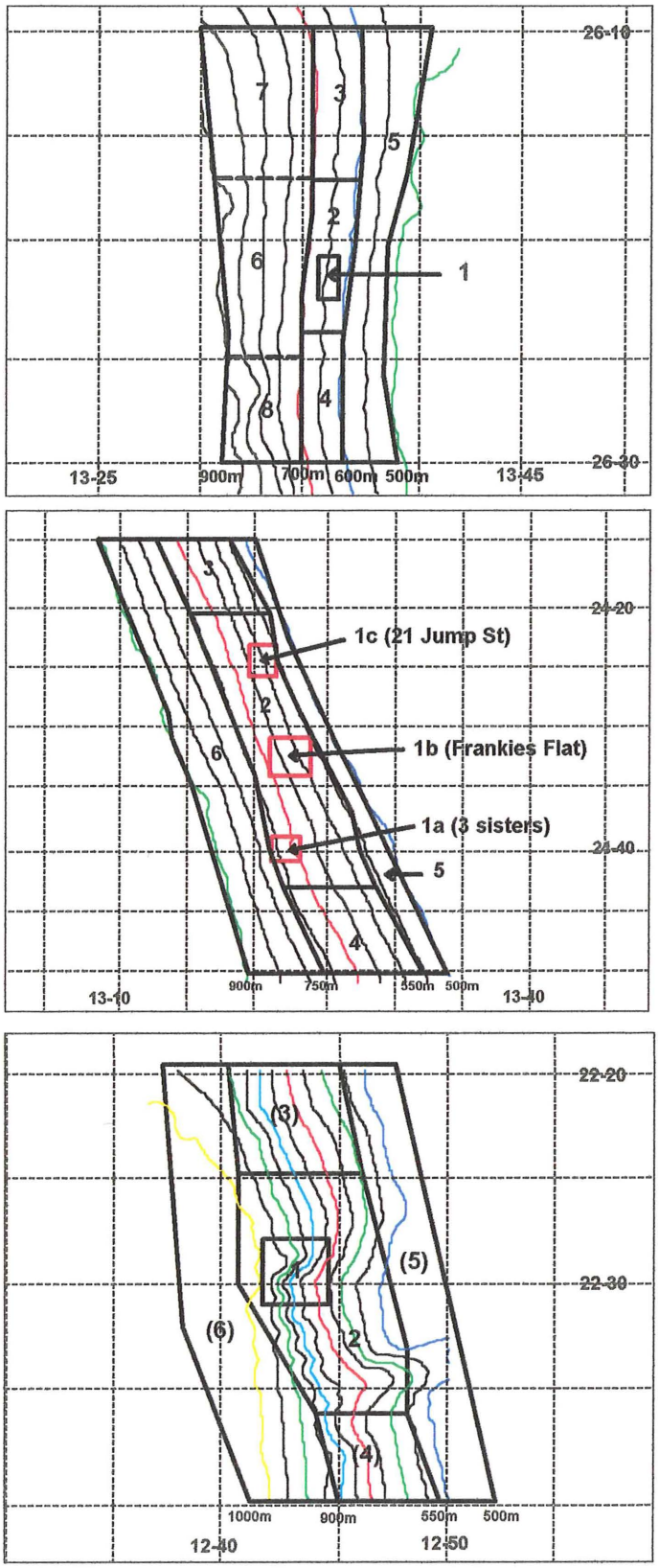


Figure 2. Strata boundaries, numbers, and depth contours used for surveys of Johnies (top), Frankies (middle), and Rix (lower). (Note only strata 1 and 2 were fished at Rix)

CHAPTER 2 MATERIALS AND METHODS

2.1 Hydrography and meteorology

A cross array of 5 (3 for Frankies) east-west plus 2 additional north-south CTD stations was carried out in the central locations of the three areas. Temperature, salinity and oxygen were measured. Wind speeds and directions were also recorded throughout the cruise. Sound velocity was calculated from CTD temperature profiles. Sound bubble absorption during different weather conditions was calculated using the Bergen Echo Integrator.

2.2 Trawl sampling

In survey planning, it was recognized that orange roughy distributions would likely be patchy and have different densities in different areas and depths. In order to reduce possible variation and optimize the survey and sampling effort, each ground was divided into six strata. There was a core region (stratum 1) where high catch rates by commercial vessels had been recorded and then a surrounding buffer zone (stratum 2) where small aggregations might be expected, with variable catch rates. Additional strata were wrapped around these, both north and south at the known optimal depth range (strata 3 and 4), as well as shallower (stratum 5) and deeper (stratum 6). This was done to ensure that the total likely area of orange roughy distribution was covered, and to minimize the risk of later finding aggregations outside the survey area. This preliminary stratification was based on a combination of the distribution of Gendor's catch and effort data for the 1995 and 1996 spawning seasons, and consultation between NatMIRC and Gendor staff. The strata were adapted once the survey commenced and improved knowledge of bathymetry was obtained (Figure 2).

The "Southern Aquarius", a 56 m commercial stern trawler was required to conduct a combination of random and directed tows on each ground that was surveyed.

The FV Southern Aquarius deployed a standard deep water net throughout the survey. The net has a 6 m headline height when towed at 3 knots. A combination of 100 m sweeps and 50 m bridles were used. A Furuno CN-22 net sonde was deployed on the headline to record gear depth and bottom temperature, as well as fish entering the net.

The random tows were designed to provide insight into the geographical distribution of orange roughy on each ground and the species composition in each stratum. The positions of the random tows were generated by a randomisation programme applied to each stratum. A pre-determined number of random trawls had to be conducted in each stratum. The direction was to be along the depth contour where practical, but the skipper's discretion and the nature of the bottom also determined the direction of each tow. The duration of each trawl was approximately 20 minutes or 1 nautical mile on the bottom at a towing speed of 3 knots.

A series of directed tows were conducted to provide species composition information on specific marks recorded by the RV Dr. Fridtjof Nansen's Simrad EK500 scientific echo-sounders.

In planning for the survey, identification of small fish on the bottom was recognized as important for identifying and separating acoustic backscatter of other (non-target) species. The FV Southern Aquarius took small mesh netting to make up a fine-mesh liner for the cod-end. However, this netting was found to be rotten, and could not be used during the survey. Therefore, it was probable that the trawl poorly sampled small sized, or thin-shaped, fish species. On three occasions, trawls were conducted along a very similar path by FV Southern Aquarius and RV Dr. Fridtjof Nansen to examine if different species were caught, and whether trawl catches by the former might not represent true species composition and size frequencies.

The catches from all trawls were sorted by species. Length frequency, sex and maturity data were collected for orange roughy, oreo dories and hake, while only length frequency data was collected for the other species. The total number sampled, the sample weight and total weight of each species sampled was recorded. The detailed biological sampling strategy is appended (see appendix 8).

The catch and effort, and biological information for each trawl was captured on standard NatMIRC data sheets. The information was transferred to the RV Dr. Fridtjof Nansen where it was entered into various spreadsheets for analysis.

2.3 Acoustics

Acoustic surveying was conducted continuously throughout the cruise. The separate coverage's were run with east-west transects, for most coverage's in a semi-randomized stratified design with average spacing within strata. Strata were pre-selected, partly based on prior knowledge of fishing effort and hence expected fish density, and partly on depth. Average transect spacing varied between 0.5 nm. for high density strata and 2.0 nm for the fringe strata. Four acoustic coverage's were carried out at Johnies, including a detailed study of the central high density area. On Frankies, two complete acoustic coverage's were carried out, in addition to detailed acoustic surveys at the three localities; Three Sisters, Frankies Flats and 21 Jump Street. Additionally the Three Sisters locality was covered one more time. At Rix three acoustic coverage's were carried out.

2.3.1 Hardware

RV Dr. Fridtjof Nansen was equipped with two Simrad EK 500 echosounders. During this survey they were recording at 18 and 38 kHz respectively. The 18 kHz transducer was hull mounted and had an opening angle of 10.9 °, while the 38 kHz transducer had an opening angle of 6.8 ° and was mounted on a lifting keel which was positioned 2.5 m below the hull throughout the survey. Echosounder settings are listed in Appendix II. The echosounders were calibrated one month before the survey. The sounders were recording and logging at 500 m range, at Johnies and Frankies between 400 and 900 m and at Rix from 500 to 1000 m.

The Focus 400 is a remotely controlled towed vehicle which can operate down to 400 m depth at a speed of 3 knots. Pitch and roll can be observed and logged, and the depth of the vehicle can be controlled manually or maintained in autopilot mode. The Focus was equipped with a Simrad EY 500 Echosounder connected to a Simrad ES38D pressure compensated split-beam transducer (6.8 ° angle). The EY 500 was remotely controlled via a serial port from a PC on the vessel. The PC also displayed the EY 500 echogram in real time

via the serial line. The raw data from the echosounder were logged on a PC-server via Ethernet. Both the serial line and Ethernet were established on an existing taxi system running via the fiber optic link to the Focus. The raw data files from the EY 500 were converted, and integrated and scrutinized on the Bergen Echo Integration system (BEI). The Focus echosounder was calibrated in Walvis Bay harbour at the start of the cruise. The Focus was deployed for the third survey at Johnies and for the second survey at Frankies mostly at 380 m depth during the surveys.

2.3.2 Data processing

The Bergen Echo Integrator (BEI) was used to integrate acoustic backscattering (S_A), and to scrutinize the echograms in 5 nm units. The threshold used during scrutinization was 76 dB. Shoals of orange roughy were identified based on prior knowledge and targeted trawls, and isolated in a layer drawn only to contain the shoals, towards the bottom channel. All scrutinized data was stored in the BEI database with a resolution of 0.1 nm horizontally and 10 m vertically. Relevant data was then extracted, and exported to Excel and MatLab for post processing. During post processing S_A values of the 10 m bottom channel directly underneath each orange roughy shoal were assumed to be orange roughy and were added to each shoal using the 0.1 nm values to get the total S_A value for the shoal.

The following relations were applied to convert S_A-values (mean integrator value per unit area) to numbers of fish:

$$TS = 10 \log (\sigma/4\pi) = 20 \log L - 81 \quad [dB]$$

$$\sigma = 1/(10^7 * L^{-2})$$

$$n = S_A * A * (1/\sigma) = S_A * A * 10^7 * L^{-2}$$

where TS is the average acoustic target strength of one individual fish, L is the length of the fish, expressed in centimeters, σ is the backscattering cross section of a single fish and A is the area of the strata in question. The TS used originates from investigations carried out in Tasmania (Kloser et al. 1997). No correction for absorption has been applied, therefore S_A values need to be divided by a factor of 1.11, as recommended by Francis and Garrison (1982). The amount of backscattering (σ) of other species was derived from the proportion of that species frequency and their specific TS.

2.4 Assessment methodology

As this was an initial effort in a new area four assessment methodologies were tested with the aim to suggest recommendations for one methodology to be used in subsequent investigations at the end of the cruise. The first method, targeted acoustics, did not include trawl data except for identification of orange roughy concentrations. On the other hand, the swept area method did not rely on acoustics at all. The two other methods both required a combination of trawl data and acoustic data.

2.4.1 Targeted acoustics

This method summed together all acoustic recordings positively identified as orange roughy and converted them to numbers of fish and eventually to biomass. Shoals were identified and isolated during scrutinization, and the S_A values in the 10 m bottom channel underneath the shoals were assumed to be orange roughy, and were added to the shoals. No stratification of area was applied as all identified recordings are added together.

2.4.2 Trawl sample based acoustics

In this method all the S_A values in the 10 m bottom channel for each stratum were added to the identified orange roughy shoals above the bottom channel, and the S_A values were allocated to species according to the species composition from the weighted trawl catches in each stratum.

2.4.3 Swept area

Biomass indices were calculated for the survey area from random trawl data using standard area-swept methodology (after Francis 1981). Biomass, and its standard error, was calculated from the following formulae:

$$B = \sum (X_i a_i) / cb$$

$$S_B = \sqrt{(\sum s_i^2 \, a_i^2)} / c^2 b^2$$

where B is biomass (t), X_i is the mean catch rate (kg.km^{-1}) in stratum i, a_i is the area of stratum i (km^2), b is the width swept by the trawl gear, c is the catchability coefficient (an

estimate of the proportion of fish available to be caught by the net), S_B is the standard error of the biomass, s_i is the standard error of X_i.

The coefficient of variation (*c.v.*) is a measure of the precision of the biomass estimate, and is calculated by:

$$c.v. = S_B / B * 100$$

Strata areas were defined once detailed bathymetry was confirmed, and random trawl stations were generated. The mean catch rate from trawls (note target trawls were not included) was applied to the area of these strata. A minimum of two trawls per stratum was required. No correction is made for possible herding by the trawl gear, or escapement of fish from the path of the trawl. It is assumed that all fish in the water column above the trawl path are caught by the gear (i.e. $c = 1$) The effective area of bottom swept by the trawl (b) has been taken as the distance between the wing-ends. It is not known if this is an appropriate width measurement, but is widely used in New Zealand trawl surveys (where relative biomass is calculated) on the basis that when a school of fish is encountered on or near the bottom there is little escape reaction. However, it is likely that catchability may vary with bottom type and fish density, but this is not considered here. The wing-end spread of the FV Southern Aquarius is estimated at 15m.

Six strata were typically assigned to each area.

Johnies:	1	High density area, defined by latitude and longitude
	2	Buffer zone, 600 - 700m
	3	North area, 600-700m
	4	South area, 600-700m
	5	Inside stratum, 500-600m
	6	Outside stratum, 700-900m

Stratum 6 was subsequently subdivided into 3 areas (stratum 6 middle, 7 north, 8 south) to represent more appropriately the distribution of fish. Several large trawl catches were taken in the central region, and acoustic data suggested lower fish abundance in northern and southern regions. Because most trawling at that stage had taken place only in the central region, it was felt acceptable to create two new strata to the north and south, and retain the existing trawl results.

Frankies	1	High density areas:	Three Sisters (650-800m)
			Frankies Flat (550-700m)
			21 Jump St (550-650m)
	2	Buffer zone, 550-700m	
	3	North area, 550-700m	
	4	South area, 550-700m	
	5	Inside stratum, 500-550m	
	6	Outside stratum, 700-900m	

Due to time constraints, Rix was not sampled adequately by stratified random trawling. Some random trawls were carried out in strata 1 and 2, but these have not been considered in any swept-area analysis.

2.4.4 Acoustics/swept area

This method takes the biomass results from method 1, based on identified schools of orange roughy, and adds to it the biomass estimated from trawls over the area of low fish density where trawling may be a more effective sampling tool than acoustics.

The area-swept method is used as described above, with the difference that strata areas were recalculated to exclude that assigned to schools by the acoustic method. A check was made on whether random trawls encountered such schools, and if so these were excluded from the analysis.

2.4.5 Calculation of Variance

The mean and variance for the data presented in the report is as per Simmonds et al (1992), and is summarized as follows:

The working area is divided into H strata, each one with a surface of A_h.
s^2 = variance of the sample
s = standard deviation

1. The transect Sa values were calculated from a sum of the 0.1 nm values of each strata.

2. The mean for each strata was calculated by obtaining a mean (weighted by transect length) of the transect data.

$$W_i = \frac{l_l}{\bar{l}} \qquad \overline{y_h} = \frac{1}{n_h}\sum_{i_h}^{n_h}\frac{y_{ih}W_i}{l_l}$$

3. The variance for the strata was obtained by obtaining a variance on the transect means.

$$s_h^2 = \frac{1}{(n_h - 1)}\sum_{i_h=1}^{n_h}(y_{lh} - \overline{y_h})^2$$

4. The biomass for the survey was based on obtaining a sum of the mean * area for each stratum.

$$Bst = \sum_{h=1}^{H}\overline{y_h} * A_h$$

5. The variances of the strata is obtained by:

$$Var(\overline{y_{st}}) = \sum_{h=1}^{H}(\frac{A_h}{A})^2\frac{s_h^2}{n}$$

6. The variance for the survey biomass was calculated from the variance of the stratum and the total area.

$$Var(B_{st}) = A^2 * Var(\overline{y}_{st})$$

7. The *sigma* TS was derived from the proportion of the species F_s and their individual TS_s values according to:

$$SigmaTS = \sum_{s=1}^{n}(F_s * 4\Pi * 10^{\frac{TS_s}{10}})$$

2.5 Biological analyses

The methodology followed during biological sampling is outlined in appendix

a) Length frequency distribution

Length frequency data has been weighted by the proportion of each trawl sampled to represent the total catch. They have not been further scaled by stratum biomass at this stage.

b) Reproductive stages

These follow the system commonly used in New Zealand and Australia after Pankhurst *et al* (1987):

Stage	**Female**	**Male**
1	Immature/resting	Immature/resting
2	Early maturation	Early maturation
3	Maturation	Maturation
4	Ripe	Ripe/running ripe
5	Running ripe	Spent
6	Spent	

In these analyses, data were not weighted by catch.

CHAPTER 3 RESULTS

3.1 Hydrography and meteorology

Temperature, salinity, and oxygen profiles are given in **App. 1** for Johnies, **App. 2** for Frankies and **App. 3** for Rix. Wind speeds for the cruise period are given in **App. 4** while graphs of sound velocity and absorption (measured at Johnies) are given in **App. 5** and **6** respectively.

3.2 Trawl sampling

Trawls by FV Southern Aquarius were spread throughout the wider survey areas to define the distribution of spawning orange roughy, and as a further check that the areas of high catch rates were being covered by the acoustic surveys.

Johnies and Frankies were fished on two occasions and Rix once:

Area	**Period**	**Date**
Johnies:	1	18 - 20 July
	2	25 - 27 July
Frankies:	1	21 - 24 July
	2	27 - 29 July
Rix:	1	30 - 31 July

3.2.1 Catch composition

The orange roughy catch was about 97% of the total. The catch of orange roughy and the other main species or groups is summarized in Table 2:

Table 2. Total catch of the main groups of fish (in kg)

Species	Johnies	Frankies	Rix
Orange roughy	223 600 (97.6%)	113 598 (97.3%)	44 772 (88.4%)
Deepwater hake	1 484 (0.6%)	1 575 (1.3%)	312 (0.6%)
Oreos	2 935 (1.3%)	179 (0.1%)	1 492 (2.9%)
Sharks[1]	881 (0.4%)	1 092 (0.9%)	2 710 (5.3%)
Rat-tails[2]	422 (0.2%)	235 (0.2%)	71 (0.1%)
Total catch	229 061 kg	116 781 kg	50 600 kg

[1] Primarily *Deania calcea, Etmopterus sp(?baxteri), Centroscymnus crepidater*
[2] Primarily *Caelorinchus ?braueri, Nezumia micronychodon*

3.2.2 Comparative trawls

To obtain an impression of how the trawl selection varied between the two vessels, 3 comparative trawls were conducted. Two of the hauls were conducted initially by the FV Southern Aquarius, then the RV Dr. Fridtjof Nansen trawled along the same track some hours later. The third haul was taken simultaneously with the two vessels 2 cables apart. During this trawl the belly of the RV Dr. Fridtjof Nansen's net was badly torn, but the size of the catch, in comparison to the FV Southern Aquarius suggested that little fish had been lost. The major species by weight in each haul are presented in Table 3.

Large differences between the species composition of each vessel's catches were evident. The catches from FV Southern Aquarius were dominated by relatively large species like hake (*M. paradoxus*), sharks, orange roughy and *Caelorinchus* sp. In the catches from RV Dr. Fridtjof Nansen, smaller species, like *Nezumia* sp., *H. dactylopterus*, *D. pallidus* and various eels, also contributed to a significant part of the catch. There seemed therefore to be relatively clear differences in the size-selection of the two trawl gears due to differences in mesh-size. This was also reflected in the length-frequencies of orange roughy and hake in the trawls. The main proportion of orange roughy in the RV Dr. Fridtjof Nansen catches were found in the length-groups between 10-16 cm. In contrast, a more evenly distribution was recorded from the FV Southern Aquarius, mainly in the 14-24 cm range. Hake with a total length between 49 and 56 cm dominated the RV Dr. Fridtjof Nansen catches, while no particular length-group seems to dominate in the catches from "Southern

Aquarius". In addition, smaller individuals of orange roughy and hake were caught by the RV Dr. Fridtjof Nansen.

The major differences in the catches it is believed have been caused by the differences in mesh-size. However, differences in the length distribution of some species such as hake was likely to be partly due to the differences in trawl performance rather than just the selection inside the trawl, particularly to bottom contact. The RV Dr. Fridtjof Nansen gear, which was fitted with 30cm bobbins was likely to be able to follow the bottom more closely then the trawl used by FV Southern Aquarius which had 53 cm rock-hoppers on the foot-rope. Therefore, species believed to live in a close relationship with the bottom were more likely to be retained by the RV Dr. Fridtjof Nansen trawl, while semi benthic species such as hake were more likely to be captured by FV Southern Aquarius.

The low number of hauls, and differences in time of trawling, mean that quantitative applications of the results would not be possible.

Table 3. Catch by weight of the major species in comparative trawls

Haul No. 1 position 26°25 S - 13°35 E							
SA-2				**FN-2212**			
	kg	Count	Percentage		kg	Count	Percentage
Hake	32.9	23	50.3	*Caelorinchus* sp.	156.6	462	40.2
Caelorinchus sp.	11.8	52	18.1	Sharks	77.25	81	19.8
Sharks	9.6	7	14.6	Nezumia	45.3		11.6
O. roughy	5.2	18	8.0	O. roughy	44.7	391	11.5
Nezumia	2.0	18	3.0	WOE	24.0	186	6.2
OEO	1.9	16	2.9	*S. guentheri*	7.8	72	2.0
Other fishes	2.1		3.1	Other fishes	34.4		8.8
Total catch	65.0			Total catch	390.0		

Haul No. 2 position 24°24S - 13°14.5 E							
S_A – 113				**FN – 2225**			
	kg	Count	Percentage		kg	Count	Percentage
Hake	24.0	17	41.2	Hake	306.0	279	71.2
Sharks	21.3	14	36.6	Nezumia	49.6	150	11.5
O. roughy	5.4	29	9.3	Bassango	24.7	40	5.8
WOE	4.0	30	6.9	Sharks	22.4		5.2
Caelorinchus sp.	2.6	15	4.5	*H.dactylopterus*	20.0	103	4.7
Nezumia	0.9	6	1.6	O. roughy	7.0	10	1.6
Total catch	58.0			Other fishes	45.4		10.6
				Total catch	475.0		

Haul No. 3 position 24°24S - 13°22 E							
SA – 114				**FN – 2226**			
	kg	Count	Percentage		kg	Count	Percentage
Hake	282.5		80.4	Hake	90.0	68	37.0
O. roughy	32.0		9.1	Sharks	25.7	13	10.6
Sharks	26.4		7.5	Nezumia	25.6	294	10.5
Caelorinchus sp.	2.1		0.6	*Caelorinchus* sp.	22.9	120	9.4
OEO	0.5		0.1	O. roughy	22.2	211	9.1
Other fishes	8.1		2.3	*Dicrolene pallidus*	17.2	278	7.1
Total catch	344.0			Other fishes	39.5		16.3
				Total catch	243.0		

3.2.3 Distribution of orange roughy

Orange roughy occurred throughout each of the survey areas:

1) Johnies

High catch rates were recorded in the central region of the Johnies area (Figure 3), in strata 1, 2, and 6. Catches were small outside a band of latitude from 26°20' to 26°25'. There were no indications of other aggregations within the survey area.

The distribution of catch was very similar between the two periods when Johnies was surveyed, possibly indicating that fish were not moving around. Patches of fish in stratum 1, as well as to the south and west in stratum 2, and on the inside of stratum 6, were found in both surveys. Figure 3 illustrates that catch rates remained similar in between these two periods, both within and between strata.

In addition to catches of orange roughy being small away from the central area, the proportion in the outer trawls was generally low (Figure 3). Orange roughy dominated the catch in strata 1, 2 and the middle part of 6, but other species formed the bulk of catches in shallower (stratum 5) and in northern and southern regions.

Most large catches occurred in strata 1 and 2, which are bounded by depths of 600-700m (Figure 4). However, stratum 6, which covered a depth range of 700 to 900m, also had two tows with high catch rates. These were at depths of 750 - 780m (Figure 4). Generally, orange roughy were shallower at Johnies than at Frankies or Rix.

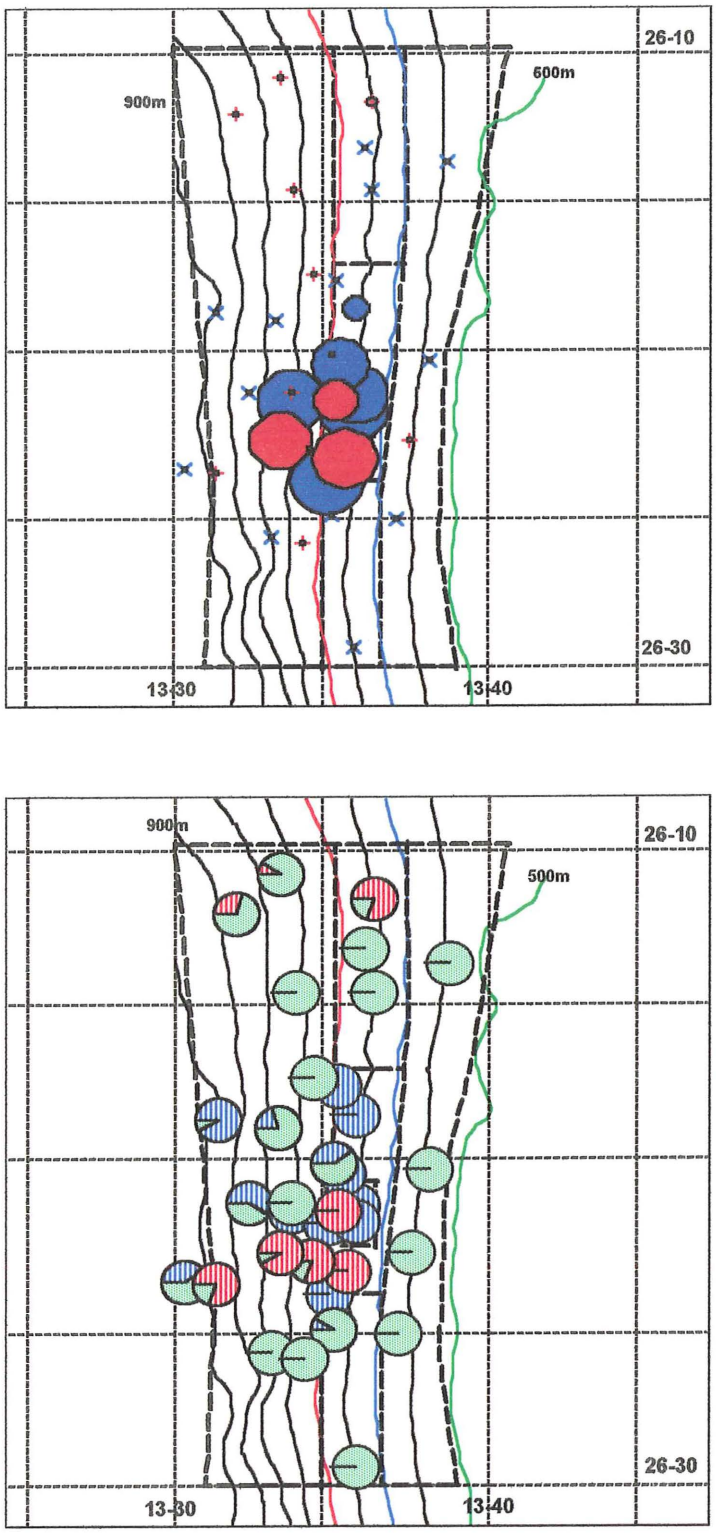


Figure 3: Trawl station positions and relative catch rates (maximum circle size = 45t per mile) of orange roughy on Johnnies, (upper) (blue = first period, red = second survey period); and trawl catch composition of orange roughy and other species (lower) (blue and red are first and second periods, orange roughy; green = other species).

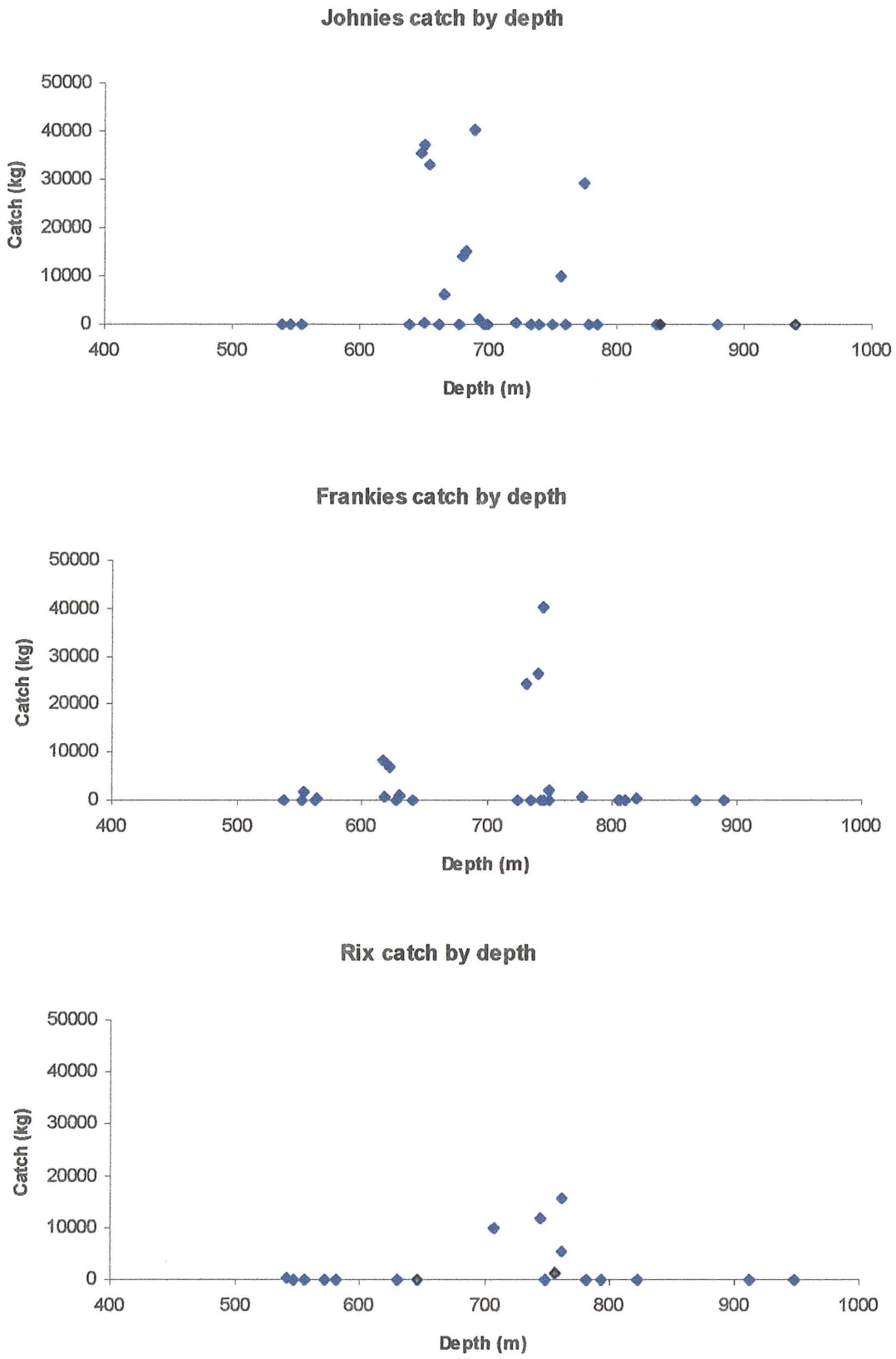


Figure 4: Plots of orange roughy catch by depth for trawls on Johnies, Frankies, and Rix grounds during the research survey.

2) Frankies

Trawls were carried out over the area of Frankies from depths of 500m to 900m (Figure 5). High catch rates of orange roughy were restricted to two areas - Three Sisters in the south, and Frankies Flat in the central part of the survey area. This pattern was the same during both periods when Frankies was surveyed. Catches were low over the rest of the region.

Around Three Sisters and Frankies Flat, orange roughy dominated the catch (Figure 5). The outer areas, and even the ground in between the main features, had little orange roughy, and trawls were dominated by other species. Such polarization may indicate that there is little movement of fish between the features, and that once fish have aggregated to spawn, they remain near that location.

There was a narrow depth range of large catches (Figure 4). Those from the Three Sisters were at 700 - 750m, while at Frankies Flat depths were 620 - 630m.

3) Rix

Trawls were carried out in the central area of Rix between 550m and 950m (Figure 6). Most recorded small catches of orange roughy, but several in an area to the northwest (known as 'North Bank') had relatively high catch rates. This region was also where the catch was dominated by orange roughy, rather than by other species.

The trawls with large catches occurred at depths of 700m to 750m (Figure 4).

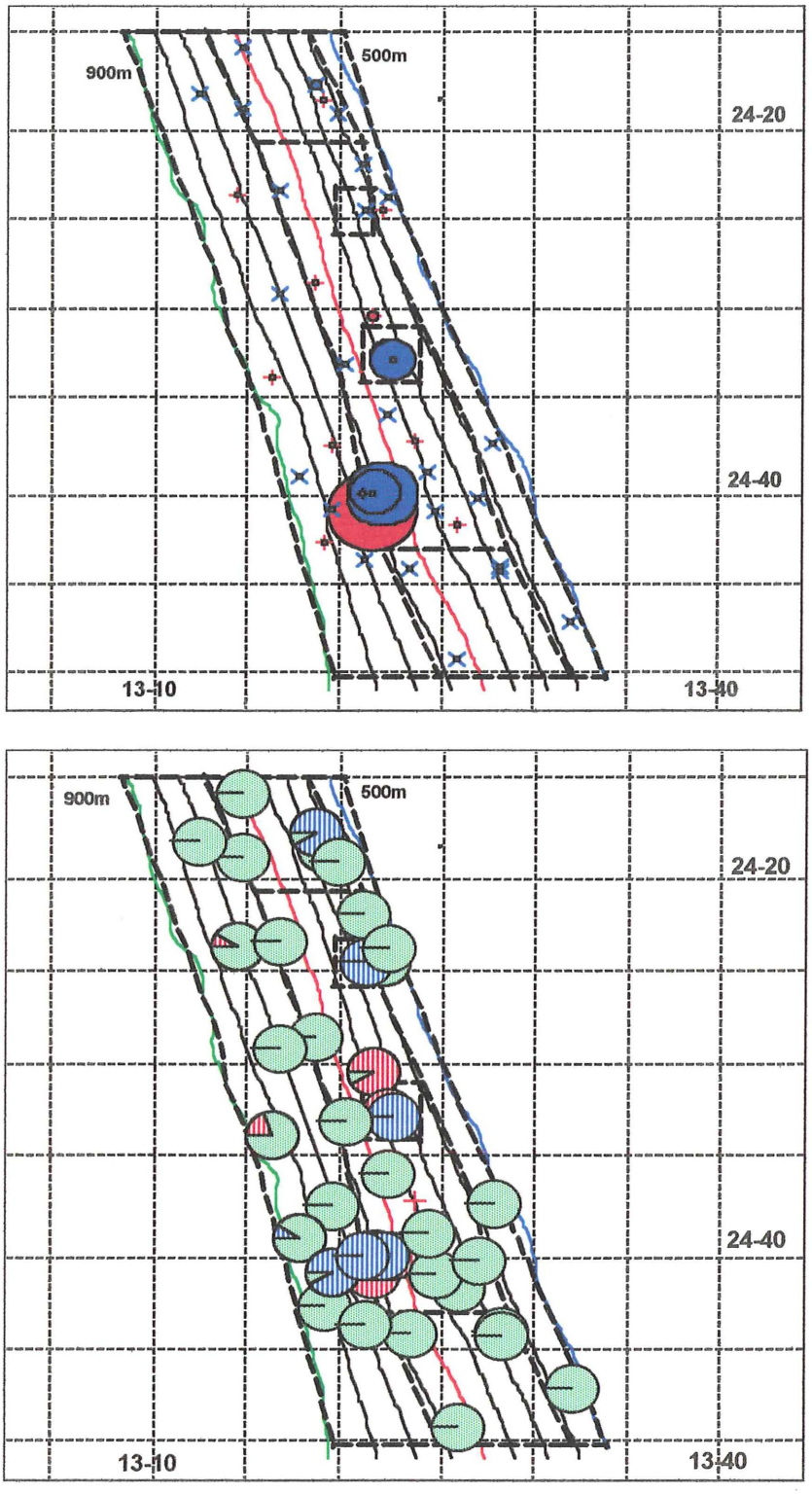


Figure 5: Trawl station positions and relative catch rates (maximum circle size = 68t per mile) of orange roughy on Frankies (upper) (blue x = first period, red + = second period); and trawl catch composition of orange roughy and other species (lower) (blue and red are first and second periods for orange roughy; green = other species).

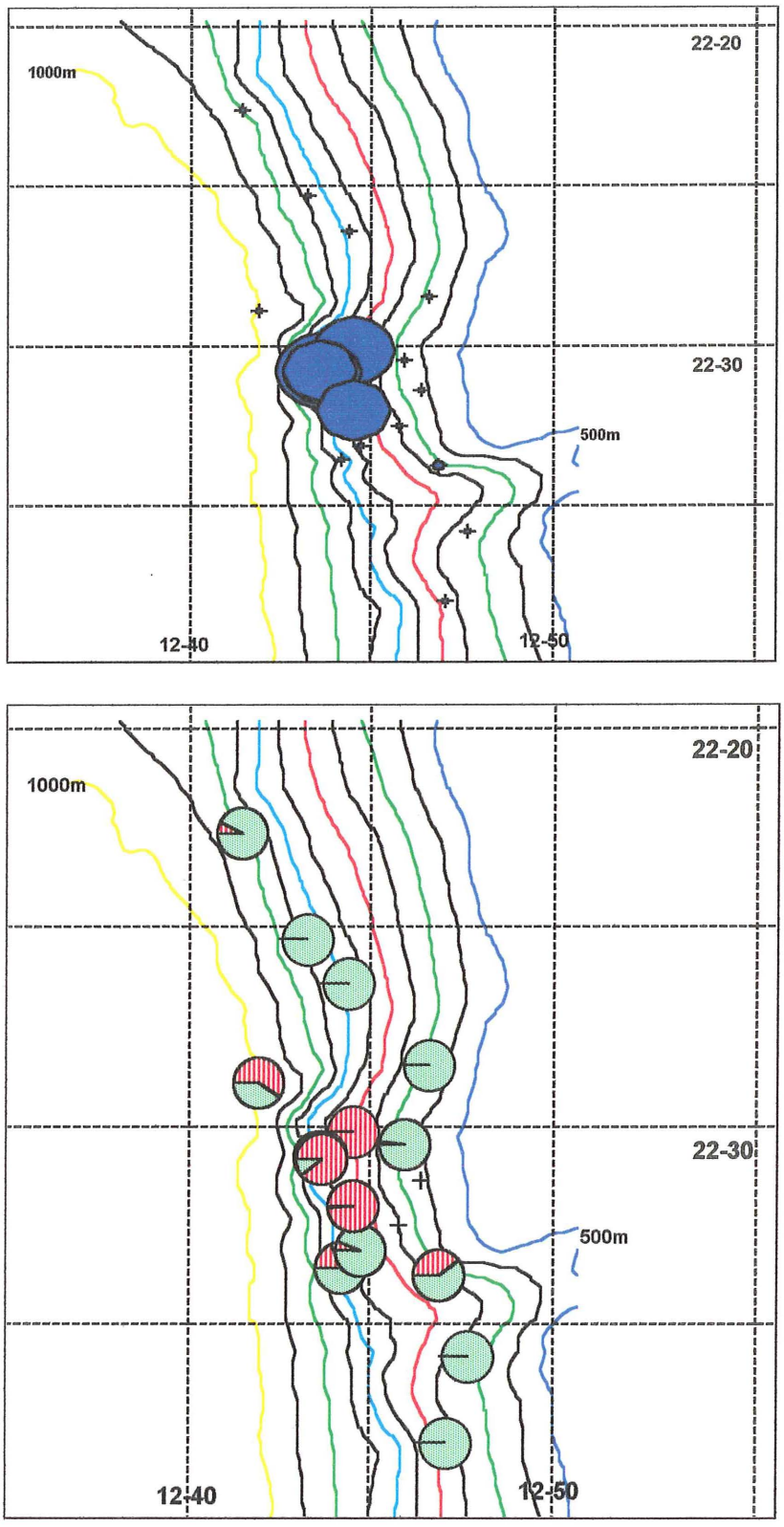


Figure 6:
Trawl station positions and relative catch rates (maximum circle size = 20t per mile) of orange roughy on Rix (upper); and trawl catch composition of orange roughy (red stripe) and other species (green dot) (lower).

3.2.4 Length frequencies

The length frequencies and mean lengths of orange roughy are presented in Figures 7 to 9 and table 4. A slight increase in the mean length of orange roughy was observed from Johnies in the south, to Rix, the northernmost ground covered during the survey.

At Johnies, fish were generally between 18 and 35 cm standard length, with a mean length of 26.5 cm and a modal peak at about 28 cm. At Frankies, a higher proportion of smaller Orange roughy were encountered with fish as little as 8 cm readily caught with the commercial fishing gear. The mean length of orange roughy on this ground was 27.90 cm with a modal peak at 28 cm. The fish at Rix were generally between 19 and 37 cm with a mean length of 27.87 cm and a modal peak at 29 cm.

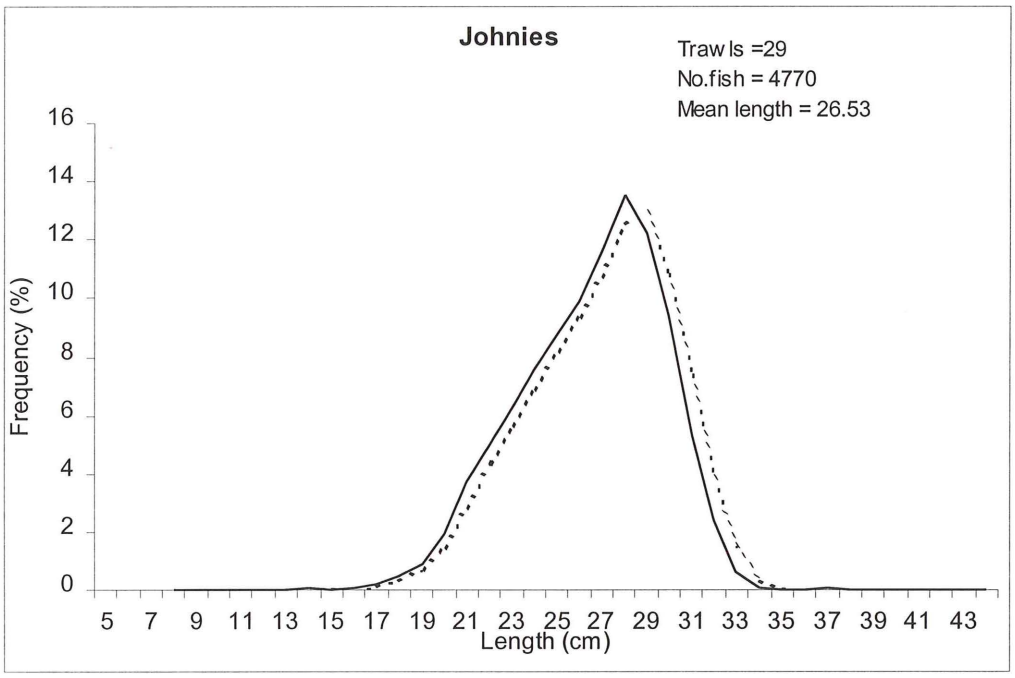


Figure 7. Length frequency distribution of orange roughy from Johnies (both sexes combined, std. length to nearest cm, weighted to catch).

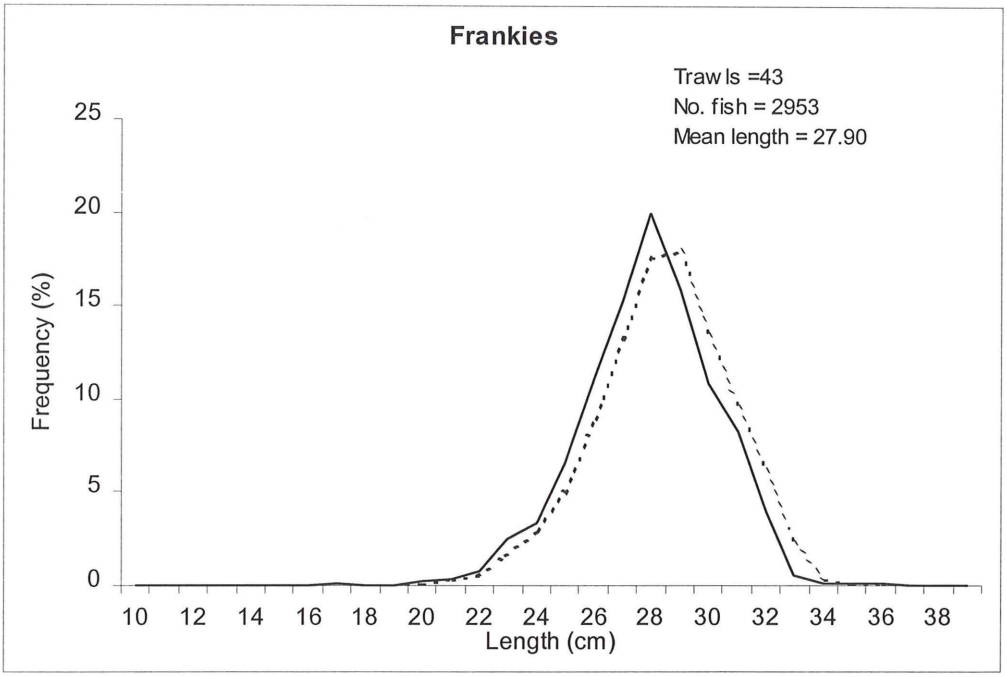


Figure 8. Length frequency distribution of orange roughy from Frankies (both sexes combined, std. length to nearest cm, weighted to catch).

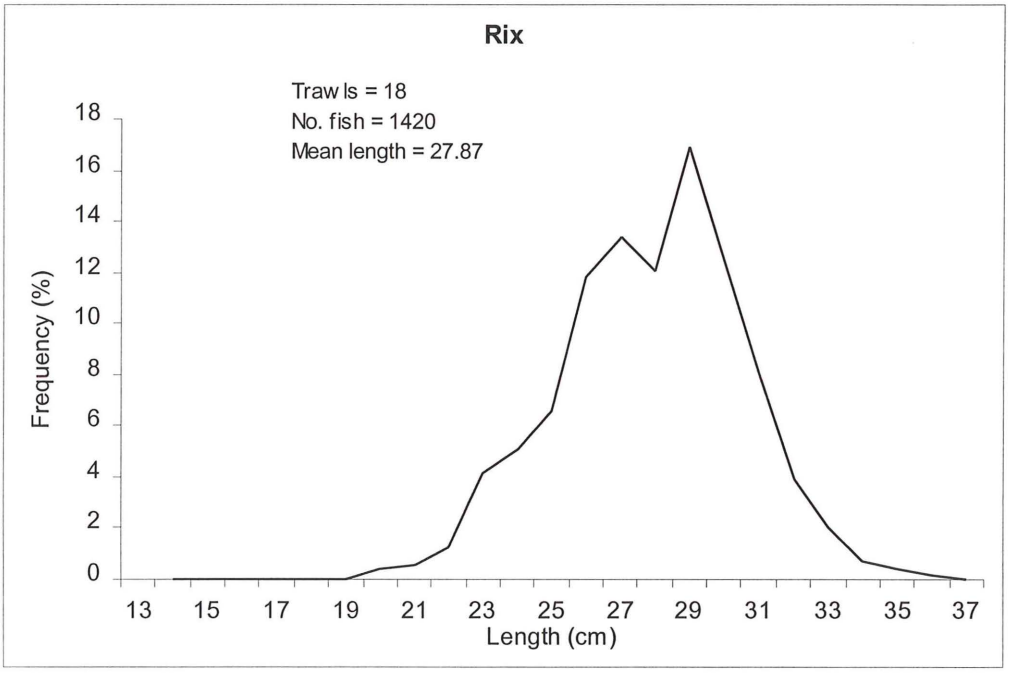


Figure 9. Length frequency distribution of orange roughy from Rix (both sexes combined, std length to nearest cm, weighted to catch).

Table 4. Mean (standard) length of orange roughy in cm by area and stratum

Stratum	Area		
	Johnies	Frankies	Rix [1]
1	26.99	27.89	-
2	26.34	27.32	-
3	24.04	28.18	-
4	17.60	20.00	-
5	17.17	-	-
6	26.53	18.65	-
Overall mean length	26.53	27.90	27.87

b) Sex ratio by area

Sex ratios varied between individual trawls, which is a common feature of orange roughy fishing. Overall sex ratios by area are summarized below in Table 5. The catches at Johnies were dominated by male fish during both survey periods, while the sex ratio swung from female dominance during the first period, to male dominance during the second. Female orange roughy were also more abundant in the catches at Rix during the period surveyed. Orange roughy are known to aggregate by sex over time, which may have contributed to these variable sex ratios between grounds and by time.

Table 5. Sex ratio (percentage males) of orange roughy by area and survey period.

Survey period	Area		
	Johnies	Frankies	Rix
1	65	47	45
2	66	72	

3.2.5 Length weight relationship

The length weight relationship of orange roughy fish on Johnies and Frankies are presented in App. 11. On Rix no individual fish were weighted, and the length weight relationship was assumed to be the same as Frankies for calculation of the target strength.

[1] No stratification was done on Rix.

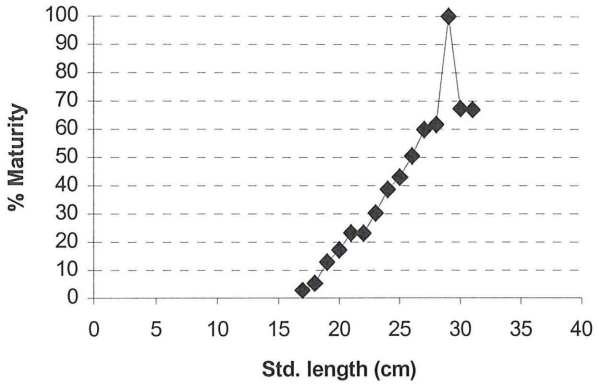
3.2.6 Reproduction

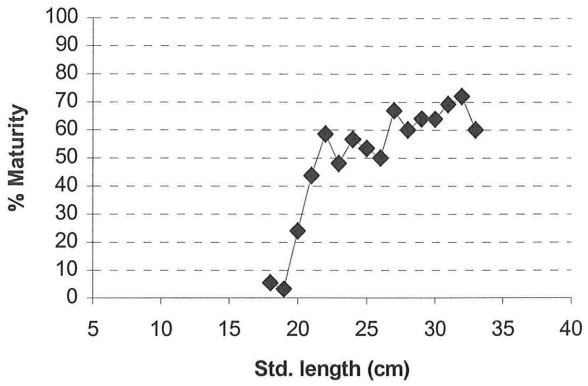
A wide range of fish sizes and maturity stages were recorded. In order to separate adult from immature fish for further analysis, fish length and gonad stage were compared to estimate mean length at maturity. Formal analysis of a maturity ogive was not undertaken, but the average proportion of mature fish at length was examined from each ground by sex. Overall, 50% maturity occurred at a fish length of about 25 cm. (Figure 10).

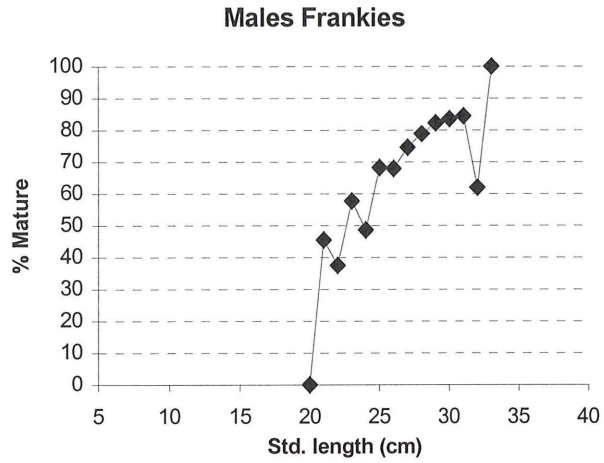
A high proportion of adult-sized orange roughy was not in spawning condition (Figure 11). Stages 1 (immature-resting) and 2 (early maturation -will not spawn this year) were frequent at both Johnies and Frankies, amounting to between 50-60% of all fish 25 cm and larger that were sampled. This analysis was simply of samples taken, and is not corrected for catch size. One might expect higher proportions of spawning fish if data were weighted, but even unadjusted the level of non-spawners is high compared with similar analyses from New Zealand spawning grounds.

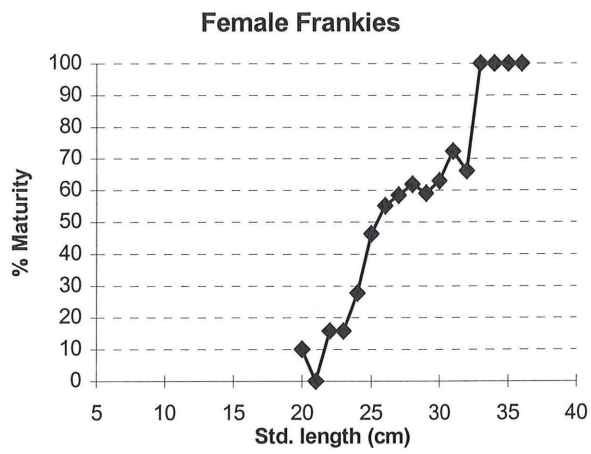
Maturing, ripe, running ripe and spent fish confirmed spawning takes place in each area (Figure 11). However, there may be some difference between grounds in the relative timing of peak spawning. Fish at Johnies were largely in maturing condition for both surveys, although there was an increase in the proportion of ripe males in the last coverage (Figure 12). Spawning was still developing, and most likely would not peak for at least several days to a week. However, at Frankies there was a marked change in gonad state between the two surveys (Figure 12). High levels of maturing fish in the first survey had dropped away, ripe and running ripe stages were common, and spent fish had reached levels of 30-40%. This implies the distribution of fish, particularly at Frankies, should have been relatively stable for spawning.

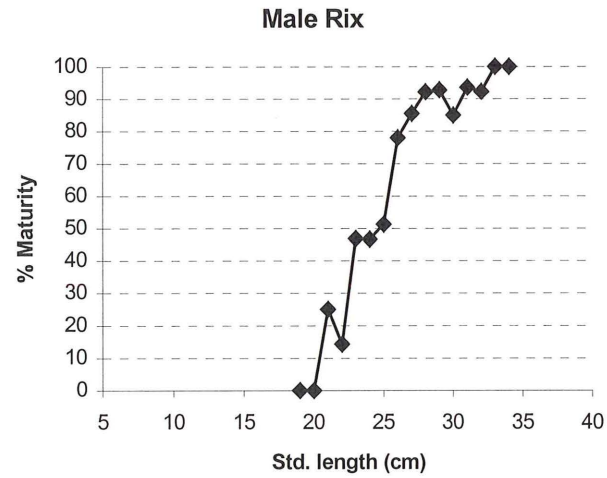
At Rix, gonad stage varied between the sexes. Most males were spent, while the majority of females sampled were in early stages of maturation (and will not spawn this year) (Figure 12). Of the fish that were mature, spawning was well advanced in comparison with the two areas further south. Between 40% and 50% of mature fish were spent (Figure 12)











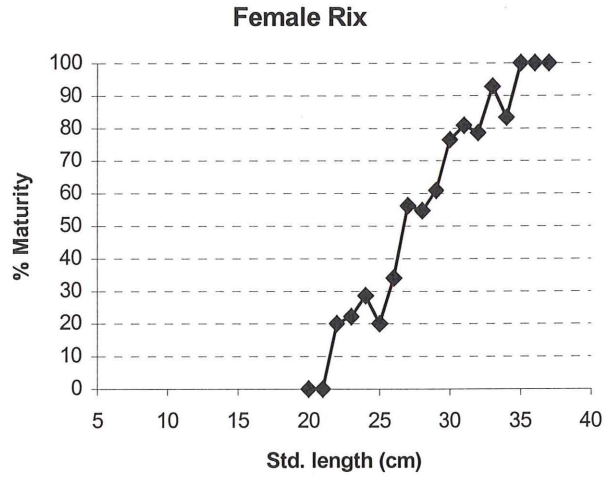


Figure 10. Maturity ogives for orange roughy of Johnies, Frankies and Rix.

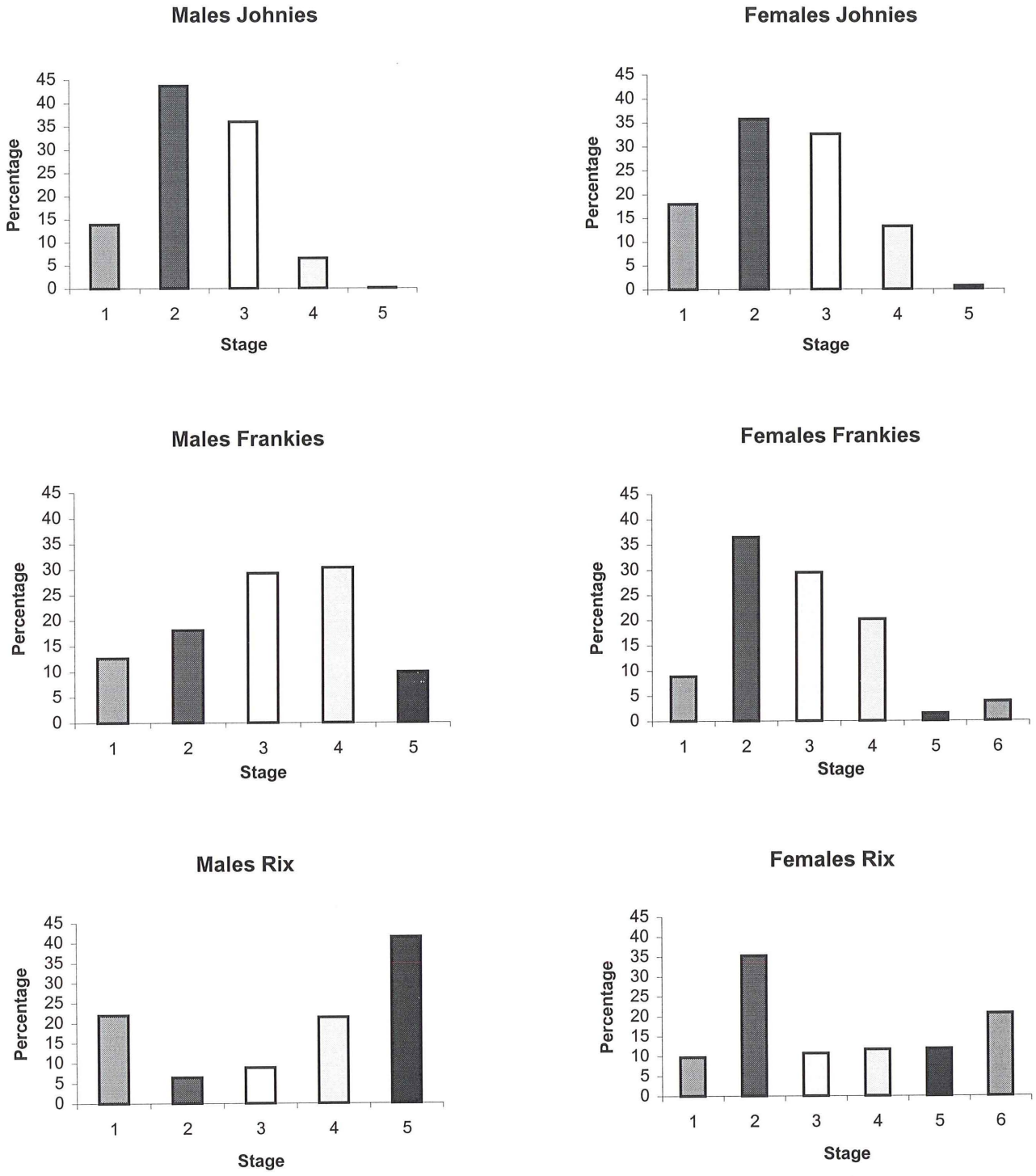


Figure 11. Gonad stage proportions of orange roughy by area (not weigthed by catch)

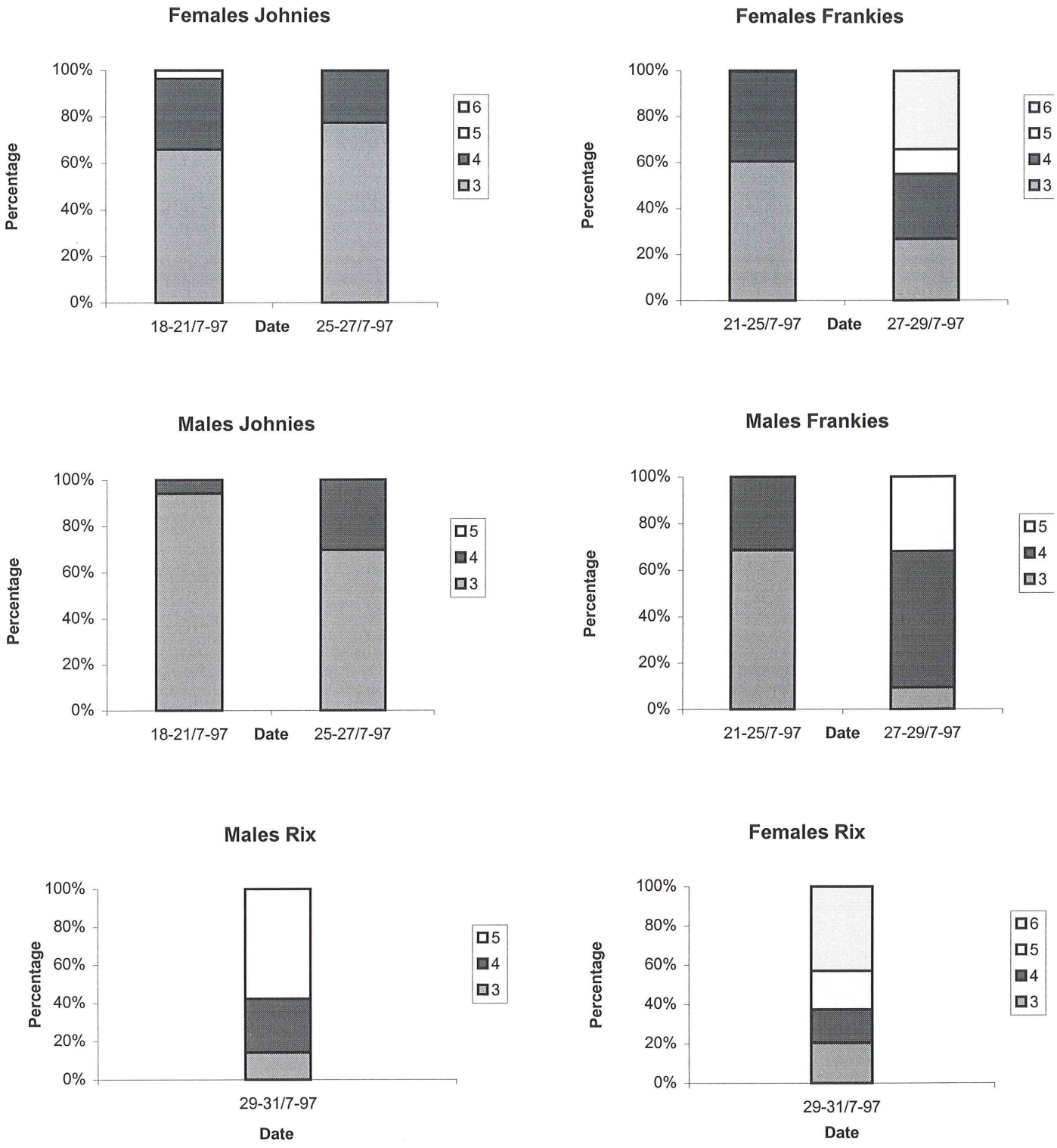


Figure 12. Gonad stage proportions (mature fish) of orange roughy for the two periods surveyed (Rix have only one coverage.)

3.3 *Biomass assessment*

3.3.1 Targeted acoustics - Johnies

This method of calculating orange roughy biomass only assessed the characteristic echoes which had been positively identified as orange roughy shoals. Mixed species and scattered distributions were not included.

The mean length of orange roughy at Johnies was assumed to be similar in all shoals; 27.0 cm. The mean weight was calculated from the length-weight relationship of

$$W = 0.1437 \times L^{2.5445} = 0.630 \text{ kg.}$$

The TS was calculated using the formula 20 log L + 81.1 and this yields a TS of -52.6 dB.

The results of all four surveys of Johnies are presented in Table 6. When the acoustic data from the towed body were analyzed it was found that the system was insufficiently stabilized causing the body to undulate. The acoustic data were considered unreliable and were therefore not included.

Table 6. Targeted acoustic biomass estimates for Johnies

Survey	Transects #	Strata area Nm^2	S_A m^2nm^{-2}	Biomass tonnes	C.V.
1	13	121	26	27 246	0.26
2	17	25	102	22 215	0.21
3	7	28	60	14 688	0.31
4	20	112	25	18 725	0.41
			Mean	20 718	0.40

The first survey covered a large area with relatively few transects, while survey 3 covered a much smaller area, but also had few transects. Due to the patchy nature of the orange roughy distribution, it was likely that these surveys sampled the shoals poorly and therefore surveys 2 and 4 were more likely to be representative of the population. The weather during survey 4 was also quite bad, probably explaining the lower estimated biomass compared to survey 2. Contour plots of the S_A values for orange roughy shoals from each survey (**App. 7**: Acoustic coverage of the grounds) clearly illustrate the highly patchy nature of these shoals and the high degree of variability between surveys.

3.3.2 Trawl sample based acoustics - Johnies

At Johnies all random trawls in each stratum were used to estimate the species composition of the bottom 10 meter depth zone. Shoals of orange roughy which extended from this zone into the adjacent mid-water region were included in this analysis. The species composition, and mean length and weight of orange roughy are shown in Table 7. The mean weight and length of the non-target species are shown in Table 8.

Strata 1 and 2 were dominated by a number of large orange roughy catches, while strata 3, 4, 5, 7* and 8* contained mixed catches with very low densities of orange roughy. The shallower strata (3,4 and 5) contained high proportions of hake, while the deeper strata (7* and 8*) had more sharks, rat-tails and oreo dories. The central part of stratum 6; 6*, contained a number of trawls with small catches of mixed species composition containing few orange roughy and two large trawls of clean roughy. This latter trawl dominated the mean species composition such that orange roughy was calculated to account for over 99% of the total biomass in this stratum. As this estimate is heavily weighted by a single trawl, it needs to be viewed with caution.

Table 7. Species composition by major groups at Johnies by total catch (No.) weighted by tow length.

							Orange roughy			Strata
Strata	Trawls #	O. roughy %	Rat-tails %	Sharks %	Hake %	Oreos %	Weight g	Length SL cm	TS dB m^2	Sigma TS m^2
1	2	100.0	0.0	0.0	0.0	0.0	630	27.0	-52.5	7.14E-05
2	6	99.8	0.1	0.0	0.0	0.1	538	25.4	-53.0	6.54E-05
3	2	3.5	12.8	4.7	68.6	10.5	639	27.1	-52.4	4.40E-03
4	2	20.9	0.0	0.0	63.1	16.1	658	27.5	-52.3	4.01E-03
5	3	1.1	30.7	21.5	44.3	2.4	643	27.2	-52.4	3.05E-03
6	10	99.2	0.4	0.2	0.1	0.3	561	25.8	-52.8	7.27E-05
6*	6	99.4	0.2	0.1	0	0.2	561	25.8	-52.8	6.80E-05
7*	2	35.6	33.8	13.7	4.2	12.7	561	25.8	-52.8	6.59E-04
8*	2	13.6	64.0	22.4	0	0	591	25.8	-52.8	5.48E-04

Strata 6*, 7* and 8* are stratum 6 after this area was post-stratified into 3 sub-strata due to the initial lack of trawl information from the northern and southern parts of the stratum.

Table 8. Mean weight and length of non-target species at Johnies

Species	Length (cm)	Weight (kg)	TS constant
Hake	55.6	1.5	-68
Oreo dories	18.2	0.2	-68
Rat-tails	31.7	0.2	-72.7
Sharks	58.1	1.3	-79

The 1st and 4th surveys covered the entire region of the Johnies grounds and are therefore analysed in this assessment. The estimated biomasses are presented in Tables 9 and 10.

Table 9. Acoustic estimation based on trawl sampling of bottom zone - Survey 1

Strata #	Transects #	Area nm^2	S_A $m^2\ nm^{-2}$	S_AVar	Biomass tonnes
1	2	1.8	213	1 400	3 394
2	5	13.3	128	5 530	13 899
3	5	16.7	109	2 585	9
4	4	10.2	79	430	28
5	14	36.5	184	7 917	16
6	6	75.6	128	6 041	21 100
	Total	154.2		Total	38446
				C.V.	0.09

Table 10. Acoustic estimation based on trawl sampling of bottom zone - Survey 4

Strata #	Transects #	Area nm^2	S_A $m^2\ nm^{-2}$	S_AVar	Biomass tonnes
1	4	1.8	121	7 732	1 930
2	11	13.3	128	16 556	13 908
3	4	16.7	76	8 144	6
4	5	10.2	40	147	14
5	11	36.5	53	1 095	4
6*	6	28.6	84	462	19 714
7*	4	30.9	53	612	494
8*	5	16.6	80	270	186
	Total	154.6		Total	36 257
				C.V.	0.11

While there is reasonable concordance between the estimates for each stratum from these two surveys, the biomass for stratum 6 needs to be handled with some care. As noted above the species composition is based largely on a single large catch of orange roughy which may

produce some considerable bias towards that species. The mean biomass of the two surveys is about 37 300 tonnes, with a C.V. of 0.19.

3.3.3 Swept area estimates - Johnies

The swept area estimate of orange roughy at Johnies, based on all the randomly placed trawls taken in each strata is presented in Table 11.

Table 11. Swept area biomass estimates for Johnies.

Strata	# trawls	Area nm^2	Mean CPUE kg/nm	Std. Dev. CPUE	Biomass tonnes
1	3	1.8	29 638.5	1 635.8	6 614.8
2	7	11.4	11 802.2	14 295.4	16 695.3
3	3	16.6	1.1	1.6	2.1
4	2	10.2	3.3	2.7	4.1
5	4	38.3	0.3	0.5	1.4
6	6	28.5	9 701.2	15 032.8	34 293.1
7	2	30.7	8.1	10.9	30.9
8	2	16.5	4.1	5.8	8.4
	Total	151.6		Total	57 650.1

Highest fish densities, and hence catch rates, were recorded in stratum 1, but the contribution of this area was less than strata 2 and 6 because of its relatively small area. Stratum 6 contributed the greatest amount to the biomass index, with a large area and moderate mean catch rate. It also, however, had a high variance. The other strata were relatively unimportant. The overall coefficient of variation of this estimate was 0.39.

This method of analyzing the available data gives remarkably similar results to the acoustic estimates that were based on the bottom trawl species composition. However, the effective area swept is unknown, and this is a direct scaling factor on the result. Again the figure from stratum 6 may be somewhat biased, as the area of the stratum is probably larger than represented by the mean catch rate. More trawling was needed in this stratum, with some restratification also appropriate in future.

3.3.4 Acoustics/swept area estimates – Johnies

With the combined acoustics/swept area method, results were taken from targeted acoustics, and combined with swept area results, but excluding stratum 1 and any shoals in other strata. There was some difficulty in deciding which trawls to exclude from this analysis. Acoustic survey one showed patches of orange roughy spread over a relatively wide area. This survey picked up all the trawls with substantial catch rates. However, by survey 4 the distribution was much tighter in stratum 1. However, good trawl catches occurred outside this area in strata 2 and 6. Examination of the position of trawls relative to the acoustic track and contour plots did not resolve the apparent differences in fish distribution from the two methods.

It was decided to take acoustic survey 1 (as having the most extensive geographical coverage), and add to it the trawl data for strata 2, 3, 4, 5, 6, 7 and 8. Trawls in the area of acoustic contours were excluded (10 tows in total). It proved difficult determining which tows were covered by the acoustic contours. Often, trawl lines were in between acoustic transects, and it was therefore somewhat subjective as to whether the acoustic values reflected the trawl catch rate. In the end, 10 trawls were removed, which was most of the tows in stratum 2.

Mean estimates are given below:

Stratum	**Acoustic**	**Trawl**
1(+other)	27246	
2		59
3		2
4		4
5		1
6		121
7		31
8		8
Total		**27441**

The combined value is dominated completely by the acoustic estimate. This either reflects that the characterisation of orange roughy schools was very good and that few fish were outside the main schools, or that our removal of trawls was overly generous. Nevertheless, even if more tows had been left in, the result would have been generally similar.

3.3.5 Targeted acoustics – Frankies

The mean lengths of orange roughy at the three major aggregations at Frankies were all somewhat different and are presented below. The mean weights were calculated from the length-weight relationship of $W = 0.0746 \times L^{2.7648}$ and the TS from the formula $20 \log L + 81.1$.

	Three Sisters	Frankies Flats	21 Jump St.
Mean Lt	27.61	28.36	28.58
Calc. wt.	0.719	0.775	0.792
TS	-52.3	-52.0	-52.0

Survey 2 covered the central region, including the three main aggregations; Three Sisters, Frankies Flats and 21 Jump St (Tables 12, 13, and 14). As the main part of the biomass of orange roughy in this region came from Three Sisters, an additional survey; 3, was conducted over this ground.

The estimates for the southern most region of Frankies; Three Sisters, are somewhat variable, largely due to the patchy distribution of orange roughy and relatively few transects in some of the surveys, and poor survey conditions in others. Survey 1 contained only three transects, while survey 4 was conducted in Force 6 to 7 weather. This caused considerable vessel, and hence transducer, movement, thus increasing the dead-zone depth.

The data for surveys 1 and 4 in the other aggregations at Frankies are also flagged as being potentially unreliable for similar reasons. These data are however presented to illustrate some of the difficulties of surveying orange roughy, and the necessity for optimal conditions.

Table 12. Targeted acoustic biomass estimates for Three Sisters (stratum 1a). The data presented in italics are not considered reliable (see text)

Survey	Transects #	Strata area Nm^2	S_A m^2nm^{-2}	Biomass tonnes	C.V.
1	*3*	*8*	*17*	*1 315*	
2 Hull	5	14	64	8 140	0.38
2 Towed	5	20	75	13 847	
3	6	10	106	10 047	0.43
4	*6*	*10*	*33*	*3 097*	*0.61*
Mean (surveys 2-hull, 2-towed & 3)				10 678	0.29

The Focus mounted towed transducer gave a larger estimate than the hull mounted transducer at Three Sisters, but not at the other two aggregations; Frankies Flats and 21 Jump St.. This was likely due, in part at least, to the reduction of the dead-zone depth in the area of relatively higher orange roughy densities, while at Frankies Flats and 21 Jump St., the density of roughy was so low that the dead-zone problem was negligible.

Table 13. Targeted acoustic biomass estimates for Frankies Flats (Stratum 1b) The data presented in italics are not considered reliable (see text)

Survey	Transects #	Area Nm^2	Total S_A m^2nm^{-2}	Biomass tonnes	C.V.
1	*3*	*12*	*19*	*2 049*	
2 Hull	7	15	8	1 064	
2 Towed	7	11	8	836	
	Mean (hull & towed)			950 t	0.17

Table 14. Targeted acoustic biomass estimates for 21 Jump Street (Stratum 1c). Data presented in italic are not considered reliable (see text)

Survey	Transects #	Area nm^2	S_A m^2nm^{-2}	Biomass tonnes	C.V.
1	*3*	*6*	*38*	2 028	
2 Hull	5	9	22	1 863	
2 Towed	5	7	17	*1 129*	
4	*5*	*5*	*21*	925	
			Mean	1 496	0.35

The combined total for the stratum 1 areas is about 13 100 t.

3.3.6 Trawl sample based acoustics – Frankies

The species composition, and mean length and weight of orange roughy at Frankies are shown in Table 15. The mean weight and length of the non-target species are shown in Table 16.

Table 15. Species composition at Frankies by total catch (No.) weighted by tow length

Strata	Trawls	O.roughy	Rat-tails	Sharks	Hake	Oreos	Orange roughy Weight	Length	TS	Strata Sigma TS
	#	%	%	%	%	%	g	SL cm	dB m^2	m^2
1a	2	99.9	0.0	0.0	0.0	0.0	719	27.6	-52.3	7.48E-05
1b	6	99.9	0.0	0.0	0.0	0.0	775	28.4	-52.0	7.89E-05
1c	2	99.9	0.0	0.0	0.0	0.0	792	28.6	-52.0	8.02E-05
2	2	81.9	0.0	8.5	9.6	0.0	686	27.1	-52.4	6.74E-04
3	3	84.7	0.0	4.1	10.8	0.0	762	28.2	-52.1	7.18E-04
4	4	0.0	0.0	40.5	59.5	0.0	748	28.0	-52.1	3.71E-03
5	4	0.0	0.0	39.5	60.5	0.0	748	28.0	-52.1	3.76E-03
6	4	42.7	0.0	26.0	31.3	0.0	402	22.4	-54.1	2.01E-03

Trawls from the main aggregations (strata 1a, 1b and 1c) indicated a species composition of pure orange roughy, while the southern 5, central 2 and deeper stratum 6 contained smaller proportions of roughy. The inshore and northern strata contained little roughy.

Table 16. Mean weight and length of non-target species at Frankies

Species	Length (cm)	Weight (kg)	TS constant
Hake	53.1	1.2	-68
Oreo dories	21.4	0.3	-68
Rat-tails	35.1	0.2	-72.7
Sharks	62	1.5	-79

Tables 17 and 18 list the results of the biomass estimates derived from allocating the bottom echoes according to the trawl catch species composition. While the two surveys gave similar estimates for each stratum, the total estimates for roughy is somewhat less than for the acoustic estimates derived from the shoal analysis.

Table 17. Acoustic estimation based on trawl sampling of bottom zone - Survey 1 of entire Frankies region.

Strata #	Transects #	Area nm^2	Total S_A $m^2 nm^{-2}$	$VarS_A$	Biomass tonnes
1a	3	5.0	33.1	435	1 578
1b	3	7.3	41.9	4	2 998
1c	3	4.1	69.2	308	2 788
2	16	98.1	46.3	778	3 788
3	3	30.1	65.7	382	1 780
4	3	43.6	29.0	13	0
5	21	71.7	78.3	2762	0
6	16	150.1	53.8	776	690
	Total	410.0		Total	13 621
				CV	0.20

Table 18. Acoustic estimation based on trawl sampling of bottom zone - Survey 4

Strata #	Transects #	Area nm^2	Total S_A $m^2 nm^{-2}$	$VarS_A$	Biomass Tonnes
1a	8	5.0	60	3212	2 866
1b	6	7.3	34	136	2 410
1c	5	4.1	80	649	3 222
2	27	98.1	36	850	2 914
3	4	30.1	39	135	1 061
4	4	43.6	31	91	0
5	30	71.7	75	6193	0
6	31	150.1	41	490	521
	Total	410.0		Total	12 994
				CV	0.14

Mean for both surveys is just over 13 300 t with a C.V. of 0.18.

3.3.7 Swept area estimates – Frankies

The swept-area estimate for Frankies indicated that the majority of this stock is in the areas of main aggregations; stratum 1, and relatively little roughy was found elsewhere (Table 19).

Table 19. Swept area biomass estimates for Frankies.

Strata	# trawls	Area nm^2	Mean CPUE kg/nm	Std.Dev. CPUE	Biomass tonnes
1	8	16.3	21 214.8	23 948.8	45 049.5
2	9	97.2	185.2	555.2	2 245.0
3	4	30.0	429.4	858.0	1 597.8
4	3	43.4	0.0	0.0	0.0
5	3	71.3	0.0	0.0	0.0
6	8	149.3	5.0	6.7	93.0
	Total	407.5		Total	48 985.3
				C.V.	0.37

The total biomass index was about 49 000t, with a CV of 0.37. Biomass was concentrated in stratum 1.

High catch rates occurred only in stratum 1, although of the three small regions included in this, 21 Jump St had small catches compared to Three Sisters and Frankies. The distribution of biomass reflects the tightly bunched nature of the trawl catches, with little evidence of fish dispersed outside the core areas. Together with the advanced stage of reproduction, this is consistent with the fish having already moved to the spawning location, with little movement over a wider area.

The trawling program was originally based on treating the three areas of stratum 1 as a single stratum. However, acoustic estimates are based on the three areas separately. Below, trawl data are analysed in this way for comparison (Table 20). However, only one trawl was carried out on 21 Jump St, and so biomass has not been calculated for this area.

Table 20. Swept area biomass estimates for Frankies, treating the three main grounds as separate strata.

Strata	# trawls	Area nm^2	Mean CPUE kg/nm	Std. Dev. CPUE	Biomass tonnes
1a	4	4.1	34 107.1	30 014.2	17 185.9
1b	3	7.3	10 972.5	10 175.9	9 872.9
1c	1	4.9	201.0	-	NA
2	9	97.2	185.2	555.2	2 245.0
3	4	30.0	429.4	858.0	1 597.8
4	3	43.4	0.0	0.0	0.0
5	3	71.3	0.0	0.0	0.0
6	8	149.3	5.0	6.7	93.0
	Total	407.5		Total	30 994.6

C.V. 0.30

The CV of this estimate is 0.30. Jump St is not included, as only one trawl was done. The catch rate of that trawl would add very little biomass to the swept area estimate because of the small area of the stratum.

3.3.8 Combined acoustics/swept-area - Frankies

For this approach, all random trawls were excluded from strata, or parts of strata, where schools of orange roughy were included in the acoustic estimate of section 3.3.5. Effectively, this takes the acoustic estimate, and adds to it the biomass from trawl strata 2, 3, 4, 5, and 6. All tows at the Three Sisters, Frankies Flat, and Jump St were removed.

No new analyses were needed for this option, as acoustic estimates for the three parts of stratum 1 are given in Tables 12, 13 and 14, and trawl values in Table 20. The mean estimates are summarised below:

Stratum	Acoustic	Trawl
1a	10678	
1b	950	
1c	1 496	
2		2 245
3		1 598
4		0
5		0
6		93
Total combined:		**17060**

It is very unclear how these estimates from different methods relate. Few marks were seen outside the main aggregations. Yet if these values are taken as absolute, it suggests that over 20% of the biomass is outside the area of main aggregation. Comparing relative estimates from the trawl survey, the proportion outside the aggregations would be more like 10%.

3.3.9 Targeted acoustic biomass for Rix

Three surveys were conducted at Rix. The first covering the entire region of core strata and surrounding area, while the final two concentrated on the core area. The differences in biomass (Table 21) are believed to reflect true survey variability of this type of methodology as the sampling rate, weather conditions and other external factors were similar for each coverage.

Table 21. Targeted acoustic biomass estimates for Rix

Survey	Transects #	Area nm^2	S_A $m^2\ nm^{-2}$	Biomass tonnes
1	23	109	20	21 524
2	16	39	27	10 392
3	13	27	62	15 902
			Mean	15 940
			CV	0.35

CHAPTER 4 DISCUSSION

4.1 Methodology

The timing of the survey is a critical issue. Orange roughy typically form dense aggregations for spawning, and are fairly synchronous in the timing of spawning activity. The extent of possible turnover on Namibian grounds is unknown, but is not thought to be an issue in several New Zealand fisheries except when intensive trawling pressure disrupts and break up schools. Given a stable spawning distribution, the problem can arise with timing if the survey is too soon before spawning (and fish are still moving into the survey area), or too late (once fish have started to emigrate).

Trawl data give two clues on whether timing was appropriate or not. The first is in the distribution of catches. Between trawl coverages of Johnies and Frankies on two occasions (separated by 4-5 days), the areas of high catch rates were very similar. Fish were taken outside the main area of aggregation at Johnies, but their position was similar between time periods. This does not rule out that fish might still be coming in from the deep, but this deeper area was covered by the acoustic survey. The distribution petered out north and south, so there was little indication of movement along the depth contour. At Frankies, the areas of high catches were very concentrated at Three Sisters and Frankies Flats, and trawls picked up few fish outside this. Again, this imply a relatively stable distribution.

The second source of data is the gonad stage information. It is generally excepted with orange roughy that the distribution is most stable at the time of spawning. At Frankies, spawning was clearly taking place with increasing numbers of running ripe fish and the appearance of spent fish. Also at Rix, spawning was taking place. At Johnies it seemed a bit earlier in development, but the increase in ripe and running stages during the survey period suggested that full spawning was getting close. It therefore seems likely that the bulk, if not all, of the spawning population was available to the survey.

4.1.1 Trawling

The trawl data were not originally intended for use in a full area-swept assessment. Their function was primarily to provide a random basis for species composition. However, the number of tows, their distribution, and the lack of gear saturation made it useful to analyse them for comparison with the acoustic results. They should therefore be interpreted carefully.

The number of tows was appreciably less than would have been done if the survey was designed for biomass estimation. This is reflected in the relatively high CV's, which would be lower if more tows were carried out, particularly in strata 2 and 6 in the Johnies area, there was undersampling by random trawls.

With increased knowledge gained during the survey, strata boundaries would in future also be revised to better reflect the heterogeneity of the orange roughy distribution. For example, the distinction between strata 1 and neighbouring 2 and 6 was perhaps not well defined. For example restratification would have reduced the area of stratum 6 to a depth of around 800 m.

Gear parameters are also critical when evaluating trawl results. The area swept is a direct scaling factor of the biomass result, and if herding or escapement occur relative to the wing-tip distance applied, then the estimate may be incorrect.

Vertical distribution is also important, as trawl gear may herd down orange roughy, which will inflate the catch rate. No marks were seen above the trawl headline during any trawls, so if this was a factor it had already occurred before the net reached the fish. It might also suggest that the fish remained well above the bottom (and were therefore not visible), or were not in very high densities, as net saturation was apparently not a major issue. Most trawls were about one nautical mile in length, and those who were shortened, because of marks on the net monitor, did not often have large catches.

However, the important point to take from the above is that trawls surveys are generally used as relative estimates, so that these sorts of factors do not matter if they remain consistent between years. If used as absolute, it must be recognised that there are numerous sources

bias, some potentially very large. Overall, though, the trawl survey technique is probably applicable to the situation observed during this survey.

The main limitations of the method when used for orange roughy are very dense aggregations requiring short tows, distributions of fish above the bottom, and fish occurring over rough ground. The second was unknown, as midwater trawl work during the survey was not extensive, and did not prove or disprove vertical extent. There were areas of foul ground, but most of the region was trawlable given appropriate trawl gear and experienced skippers.

The trawl swept-area estimates are based on all fish, not just those of recruited size. Normally, the estimate would be generated for those fish of a size of 25 cm or greater. Time constraints limited the detail able to be included. However, it makes very little difference. Large fish dominated the distributions, therefore the distribution of biomass by size is reflected in the length frequency distributions in figures 7, 8, and 9.

Trawl survey estimates in New Zealand are normally corrected by a factor (q, the catchability coefficient) to relate relative to absolute biomass. This is generally derived from a time series of data, where stock reduction analysis estimates virgin biomass, and hence the correction factor to scale relative indices to this. This parameter can vary between grounds, from 0.5 to 1.5.

At Johnies, the school acoustic technique seems to have worked very well. Trawling did not pick up signs of fish that had not been counted by the acoustics. However, some areas were classed as having schools when trawl catch rates were very low. This perhaps suggests that scrutinisation techniques in at least survey one were not adequate. At Frankies, relative proportions of fish inside and outside the key strata differed between the two methods. This could partly be due to a small number of trawls (as swept-area biomass estimates were not a major objective of the survey) not reliably describing true catch rate, or might show that on these grounds more fish can be missed by the acoustic school method. It seems appropriate to maintain both acoustic and trawl methods in the short term until more is learned about fish distribution and abundance in the area.

4.1.2 Acoustic methodology

The main questions raised concerning methods were whether a towed transducer was necessary, and what assessment methodology should be chosen for future work. From this year's survey it is quite clear that the Focus platform provided acoustic resolution which was very valuable when scrutinising the echograms. It also decreased the dead zone somewhat, but this effect was not unanimously reflected in the S_A values, probably reflecting that the orange roughy normally do not sit very hard on the bottom. In other words the towed transducer came in handy, but in most cases it could have been substituted by more target trawling. Considering the substantial effort and time consumption incurred in deploying it the justification for future use in this context is doubtful.

The 18 and 38 kHz transducers both provided valuable information, and at times it was advantageous to study the echograms from both simultaneously, particularly in order to distinguish between orange roughy and acoustic reflection from steep slopes. However, the 38 kHz provided information alone, which in most cases was sufficient. But the lifting keel proved to be a prerequisite, particularly as the winter weather of the spawning season tends to be quite rough. That, together with the low noise level of RV Dr. Fridtjof Nansen was the most important single success factors in facilitating the collection of acoustic abundance from orange roughy.

The scrutinizing process requires good knowledge of typical acoustic signatures of orange roughy. This is gained through experience, but must at all times be supported by targeted trawling. It is therefore an absolute prerequisite to carry out the survey in co-operation with a commercial fishing vessel, as the fishing as such is very specialized and demanding in terms of experience as well as gear.

In detail there are several sources of acoustic methodology errors that will influence the survey results. These can be divided into acoustic measurement, echogram interpretation and survey methodology.

4.1.2.1 Acoustic measurement

Absorption

The Simrad EK500 was set at 10dB/km absorption throughout the survey, this instrument is not able to be set at a finer resolution than 1dB/km. Absorption was measured at 9.65dB for a mean integration depth of 750m. This yields a measurement error of 0.46dB or 11%. To correct for this error all the acoustic results need to be divided by 1.11.

Threshold

A threshold of -76dB was used throughout the survey which equates to an S_A value of 10.8 m^2nm^{-2} for a 10 m layer that we used. The actual S_v noise was measured as -152dB at 1m and equates to an S_A value at 700 m of 3.3 m^2nm^{-2}. If we assume that the mean orange roughy length is 27cm with a weight of 0.63kg and a *Sigma* TS of 7.15E-5 then the noise threshold used is equivalent to 65 tonnes/nm^2. This of coarse assumes that there is no resident backscatter of small fishes and prawns that generally make up a background reverberation. This exercise does illustrate the need for caution when setting threshold levels for fish with low target strength.

Near Seabed (NS) Sampling with Acoustics

Acoustic systems are unable to resolve or detect targets that are very close to the bottom. This limitation needs to be considered when conducting any acoustic survey near the sea bed. In deep water with steep slopes with a pitching and rolling vessel the range that acoustics can sample near the sea bed greatly increases. Near bottom sampling limits of 10-20 m are experienced in the Australian orange roughy fishery that is based on seamounts with slopes of 14-17°. The grounds of Johnies and Frankies are relatively flat in comparison with slopes of less than 1.5 - 1.1° respectively. Nevertheless given the depth and the sea conditions a compensation factor is required to compensate for fish in this zone.

It is estimated that on Johnies, in good weather, the near bottom limit is between 1.5- 2.0 m. In rough weather, as experienced on Johnies in survey 4, this limit was estimated to be 3.0-4.0 m. To compensate for this zone, a knowledge of the fish distribution and hence the availability of orange roughy to the acoustic system is required. Orange roughy are associated to the bottom but schools experienced during this survey generally had the highest intensities clear of the acoustic bottom signal. This was evident with both the towed and drop keel mounted systems.

It was not possible to compensate for the NS shadow zone directly using the BEI post processing software as no algorithm has been implemented. Targeted acoustic biomass data for survey 1, Johnies, in good weather produced a biomass assessment that was 31 % higher than survey 4 in rough weather. This clearly demonstrates that compensation for the extended NS shadow zone in rough weather is required and easily achieved in post processing software. Although there may be other factors involved, such as school recognition and survey variability, the weather and near bottom sampling limit is contributing to this difference.

The NS shadow zone was increased for the drop keel system as it was mounted at a positive bow to stern tilt of 3-4°. This slope was determined by analyzing the shape of large single fish echoes. This consistent positive transducer tilt greatly increased the NS interference zone when steaming from east to west across the contours increasing the ground slope from 1.5° to 5° at Johnies. This bias was partially corrected when the vessel steamed from west to east as the tilt of the transducer could be subtracted from the ground slope and yielded an overall slope of -1.5°. The effect of the tilted transducer could also be seen at the Three Sisters ground where pronounced NS shadow zone was experienced as the vessel steamed from east to west.

Survey 2 at Sisters was also conducted in good weather with both towed body and hull mounted system yet the biomass assessments are different by a factor of 1.23. This difference may be explained, as this ground was somewhat rougher than the other grounds and approximately 3.5 m needs to be added to the vessel mounted acoustic system to compensate. A further correction to the Three Sisters data is also required to account for the

expected 1.5 - 2 m towed body NS shadow zone. This would increase the towed body results presented here by 6 - 7.5 %.

Clearly compensation for the NS shadow zone is best achieved in ping based post processing software which would in future require that either the BEI system could be changed or software from Australia be used.

The above shows the advantage of using a towed body on rough ground and, if weather conditions are poor, a stable towed body would also greatly improve the acoustic data and reduce the NS shadow zone. During this survey the weather conditions were good and if several surveys can be conducted over a restricted area containing high fish densities, a hull mounted system may be adequate. This method increases the possibility of surveying the fish when they are clear of the bottom requiring minimal Near Bottom Zone correction.

Target strength (TS)

The target strength used during the survey was the most recently published value that is being used to manage orange roughy stocks in Australia (Kloser *et al.* 1997). This mean target strength of -50dB is based on an orange roughy of mean SL of 35.8 cm. To convert this value to the smaller fish (27cm) requires a length to TS relationship. We used a 20 log SL relationship that assumes TS changes in proportion to the backscattering area of the fish. It is also possible that the target strength changes according to the weight of the fish which would assume a 30 log SL relationship. This would decrease the TS for a 27cm orange roughy from -52.4 dB to -53.6dB and hence increase the biomass by a factor of 1.32. It is unlikely that the TS is related to the length cubed given the empirical relationships that have established a length squared dependency. This aspect needs further investigation however.

The absolute value of target strength could also be open to question as the currently used New Zealand value (M. Clark, pers. comm.) is 2 dB higher than the Australian value. This would mean a reduction of all the biomass values here of a factor of 0.63. Of course the Australian value may also be on the high side but is used here as the best estimate of target

strength to date. Clearly detailed in situ target strength trials should be carried out on these smaller orange roughy during future surveys.

The target strength of smaller roughy (<18 cm) may also be higher than expected. These roughy were observed to have a small gas pocket in conjunction to the wax ester. Larger fish did not have any gas in the bladder and it was assumed that the observation was based on an actual change as the fish matured. From visual inspection it appeared that the ratio of gas to ester decreases as the length increased from 3cm to approximately 18 cm. In general, gas was always found in fish between 3cm and 10cm length.

Given the low TS of orange roughy in the biomass estimate is very sensitive to the numbers of fish with gas-filled swim bladders. The proportion of rattails, dories, and hake encountered outside the main aggregations also highlights this. A comparative trawl between the RV Dr. Fridtjof Nansen and the FV Southern Aquarius showed that the fine mesh liner of the RV Dr. Fridtjof Nansen demersal trawl retained many smaller rattail and dory fishes. This demonstrates the need for fine mesh codend liners to be used during orange roughy acoustic surveys and the difficulty of obtaining an unbiased species composition outside of the main aggregations. It must be remembered that one small rattail or dory is equivalent to about 3 - 5 orange roughy and one large hake may be equivalent to more than 60 orange roughy.

4.1.2.2 Echogram Interpretation

Acoustic sampling occurred with both vessel mounted 18 and 38 kHz echosounders and a towed (380 m) 38 kHz system. The vessels 38 kHz system was enhanced by having it mounted on a lifting keel that greatly improved its performance. In rough weather this system degraded due to vessel movement with no noticeable surface bubble layer attenuation. Due to the quiet vessel platform the 38 kHz system could be operated at 1mS pulse length greatly reducing the near seabed shadow zone. Typically a fishing vessel operates at 3-4 times this pulse length and hence 3-4 times the near seabed interference. The towed system further reduced this zone and is discussed in detail in the near seabed sampling section. The towed system also greatly enhanced our identification of roughy and non-

roughy echo's. The towed system could resolve single fish echoes from gas-filled fishes that were lightly packed and appeared on the vessel 38 kHz system as a roughy like shoal. A comparison between the vessel mounted 18 and 38 kHz systems also enabled bottom features and fish marks to be separated and identified. The 18 kHz had a wide beam (10.8°) and this showed clearly any bottom features that were difficult to interpret on the narrow (6.8°) 38 kHz system as the ground became rough as at Three Sisters or steep as at Rix's.

The interpretation of orange roughy shoals with the acoustics improved throughout the survey using the towed body, multi-frequency acoustics and targeted trawling. The targeted trawling was a valuable tool although, at times a conflict developed between the need for random trawls and targeted trawls.

4.1.2.3 Survey methodology

Targeted Acoustics

This method is the simplest to implement without elaborate post processing of the data. It assumes that all the fish are in schools and available to the acoustic. Acoustic marks were identified by trawling or with the multi-frequency and towed body systems. The simplest identification method was the trawl and has a good reality check. This method was preferred due to its simplicity, but estimates may be lower than other methods as it assumes all the fish are in schools and not dispersed. In general the results from this method were a good "reality check" of the more elaborate methods.

Acoustics based on random trawling

This is the best method in theory but the most complicated and difficult to implement, but does produce very low sampling variances on the acoustic values. Unfortunately this low sampling variance does not reflect the variance from the trawl based species allocation. With a low TS fish such as orange roughy the biomass is very sensitive to fish with gas-filled swim bladders. These fish can be underrepresented in commercial trawls due to the coarse mesh liners as demonstrated in the comparison experiment. The method is unlikely to

provide a reasonable estimate of dispersed orange roughy. The sampling CV's are low (8 - 10 %) but do not reflect the true uncertainties. It would therefore seem reasonable to get a trawl estimate outside the density orange roughy grounds.

4.2 Biology

Size structure

An examination of the length frequency distribution by area (Figures 7 to 9) shows a slight increase in the modal peak from Johnies and Frankies to Rix. This increase in size from south to north is consistent with earlier findings (Clark, 1997). A similar increase in the modal peak was not observed from Johnies to Frankies however, but an increase in the modal peak was still observed at Rix.

No marked changes are observed in the length of orange roughy sampled in winter months over the 3 years fishing period at Johnies and Rix. A larger proportion of smaller fish was observed at Frankies during the current spawning period compared to previous seasons. This may be attributed to the fact that the current data collection scheme covered areas outside the main aggregations, containing a higher proportion of smaller fish, better than sampling of targeted fishing operations do. This is more clearly shown by examining Table 4 where the greater proportion of small fish encountered in stratum 6 (both Johnies and Frankies), results in a drop in the mean length of between 3 and 5 cm when compared with the accepted high aggregation area (stratum 1).

4.3 Biomass estimates

A number of systematic biases are postulated to have caused errors in the biomass estimates. Several of the methods used relied heavily on trawling, either to provide species composition data or actual densities. The orange roughy distribution proved to be highly variable spatially, resulting in a high variance in trawl species occurrence and catch rates, especially

in strata where relatively few trawls were conducted. Either considerably more random trawls need to be taken or stratification of areas becomes of critical importance. For example, stratum 1 at Frankies was rather loosely bounded around the main aggregation, such that as fairly high catch rates were achieved, due at least in part to targeting of trawls on shoals, and the size of the area was large that the resulting biomass was probably over-estimated.

The vertical extension of orange roughy plumes potentially results in large amounts of fish passing over the head-rope, giving an under-estimate of the true density. Vertical herding of fish down into the trawl opening has, however, been observed in other roughy fisheries, and is likely to occur in Namibia. This will of course result in an over-estimate of the true abundance in the path of the net, but may at least partially compensate for the vertical extension of fish above the "6 m" depth layer.

A further problem with the trawl data, particularly for combining acoustic backscattering values to the trawl species composition, comes from mesh selection of smaller fish species. This results in an under-representation of many of the species which have gas-filled swim-bladders and hence account for much of the backscatter. As a result of this under-representation, a much larger proportion of the total S_A value will be accredited to orange roughy, yielding a higher biomass estimate than reality.

The above mentioned trawl-based problems suggests, that a method which relies entirely on acoustics may produce a more robust estimate of the relative abundance of roughy. Problems with shoal identification, as well as those discussed under the preceeding sections, need however to be addressed. Extensive targeted trawling on shoals need to be conducted to ensure correct species identification, while random trawling may also provide a useful check that hitherto uninteresting marks, which may not normally be sampled, are included in the survey.

CHAPTER 5 CONCLUSIONS

In terms of the objectives set for the survey, the following conclusions have been made.

The various methods used in this survey each had their own limitations. The targeted acoustics method, which identified shoals of orange roughy through their acoustic appearance and by trawling, may be considered to give a minimum biomass estimate (although see discussion on target strength). These estimates can also probably be considered to provide the most robust estimates.

Based on this conclusion, the relative size of each stock may be assessed as Johnies being 15% larger than Rix and 60% larger than Frankies and the total spawning stock biomass on these grounds being between 50 000 and 100 000t. This biomass occurred almost exclusively within the aggregations, with the areas outside aggregations contributing little to the total biomass on all three grounds.

The use of a transducer on a deep water towed body had certain advantages, but it's use in future surveys is probably not justified considering the effort, time and financial implication it bears. A towed transducer will however be necessary in future experimental surveys.

The occurrence of orange roughy in the Near Seabed shadow zone requires some compensation when estimating the biomass, especially during rough weather. This can be achieved in post processing software, which is not available on the RV Dr. Fridtjof Nansen. The relative flatness of the grounds on Johnies and Frankies, however, results in NS shadowing being less pronounced than is the case on steeper grounds, e.g. off New Zealand and Australia.

The target strength of orange roughy in Namibian waters is an aspect that needs further investigation especially as this parameter has such a large effect on determining the absolute abundance. It is proposed that detailed *in situ* trials be carried out in future surveys.

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Pankhurst, N.W.; McMillan, P.J.; and Tracey, D. M. 1987: Seasonal reproductive cycles in three commercially exploited fishes from the slope waters off New Zealand. *Journal of fish biology 30*: 193-211.

Francis, R.I.C.C. 1981: Stratified random trawl surveys of deepwater demersal fish stocks around New Zealand. *Fisheries Research Division occasional publication No. 21.* 30 p.

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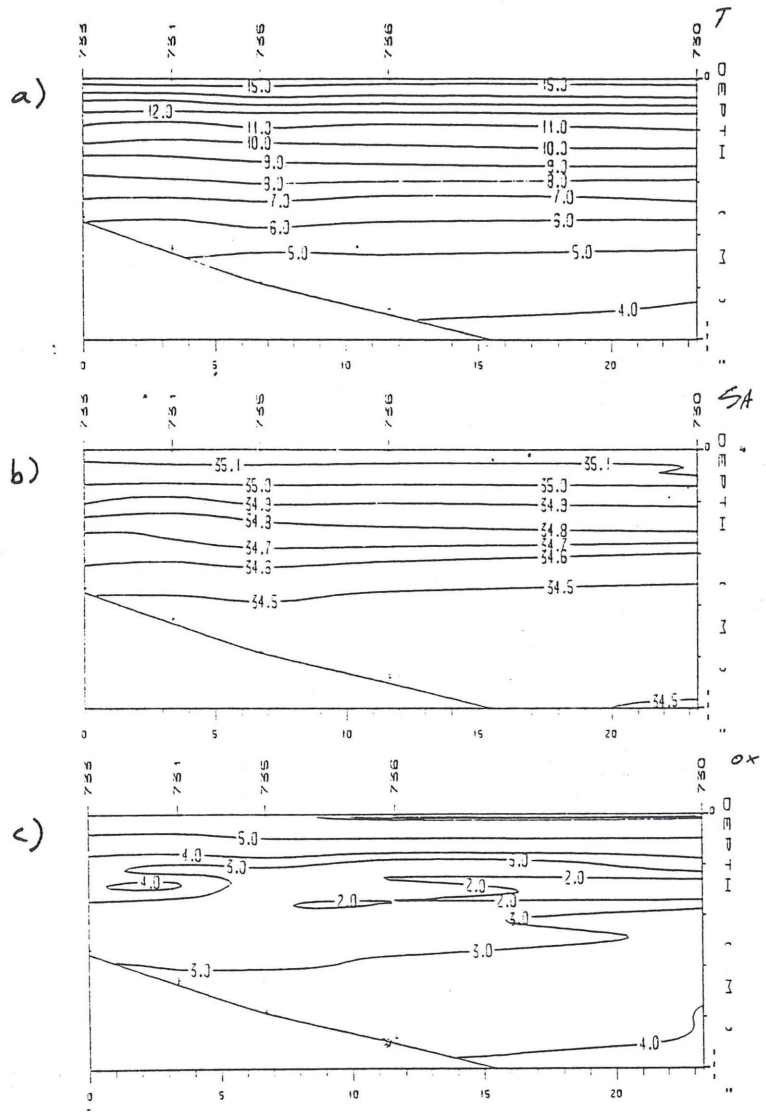
Appendix

Appendix 1 a) Temperature, b) Salinity, and c) Oxygen graphs for Johnies



TIME: JUL.20:1027 - JUL.20:1743 1997
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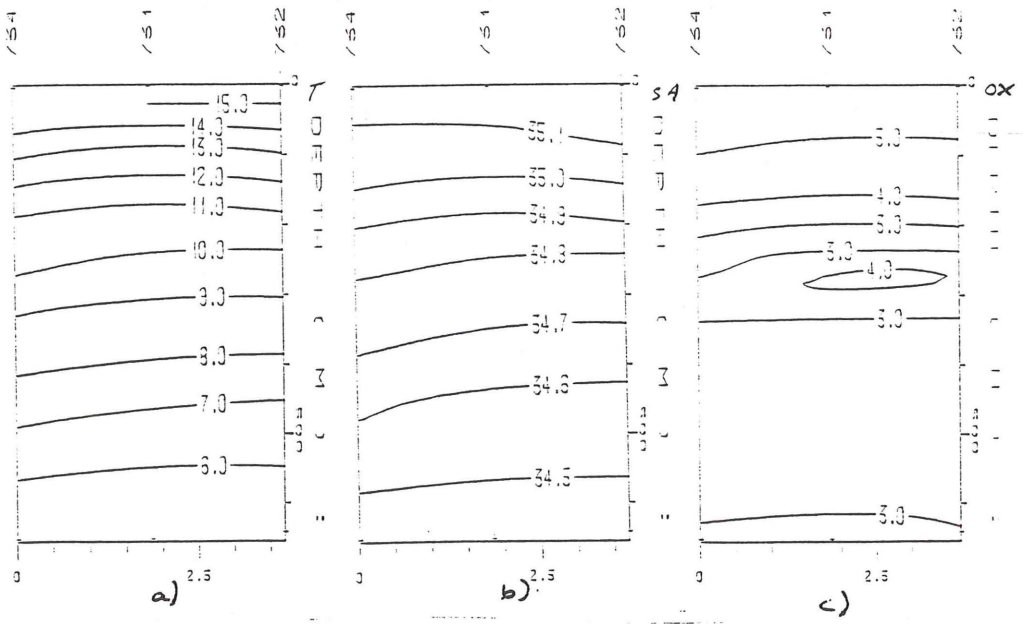
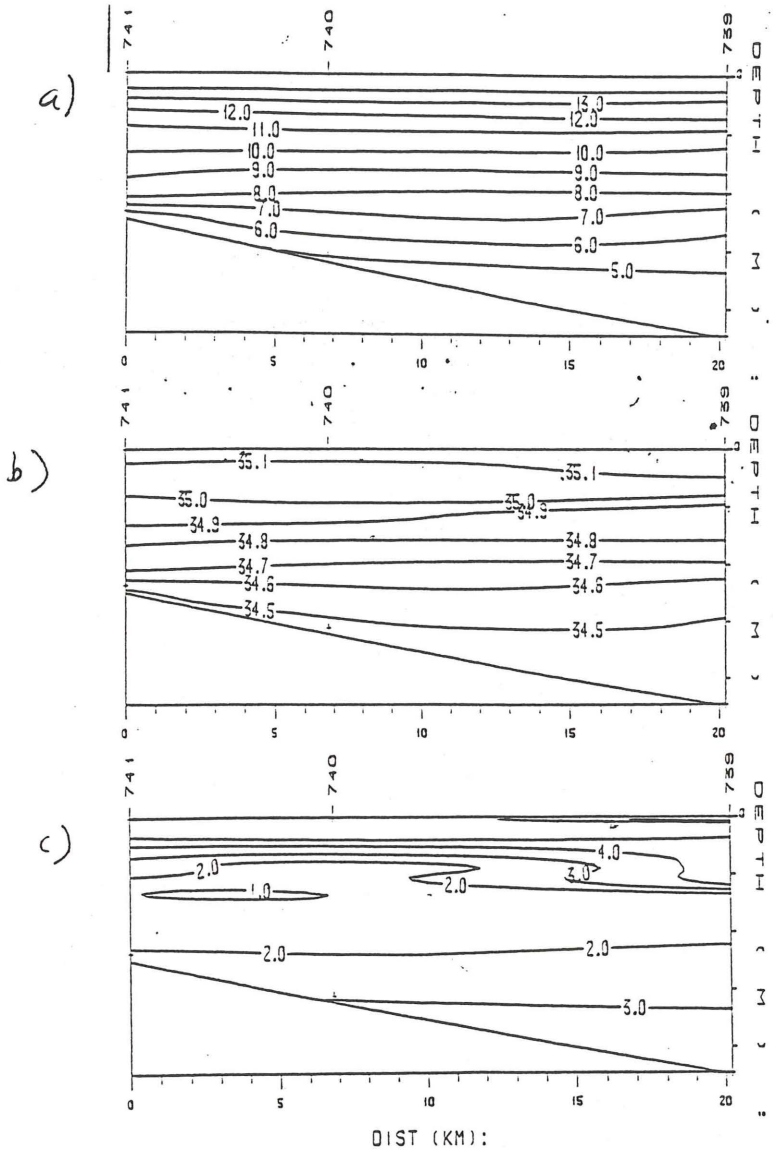
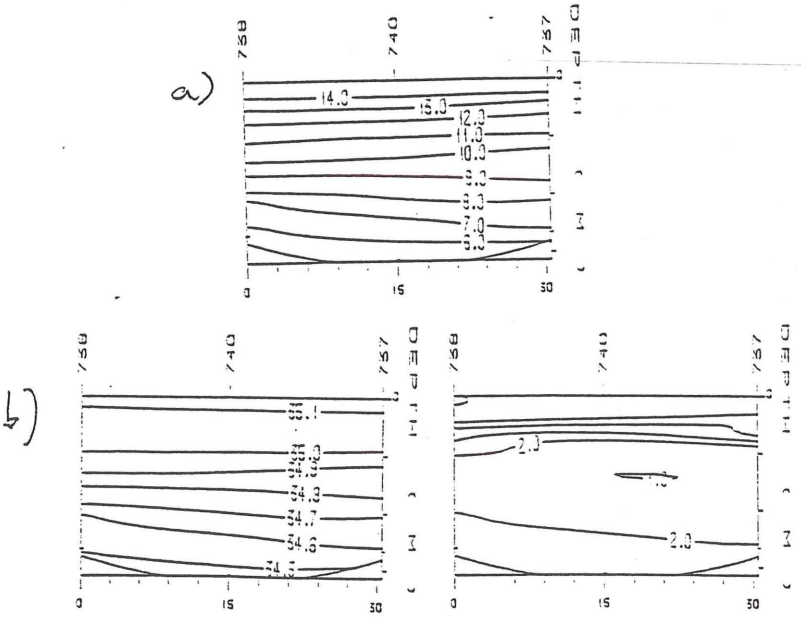


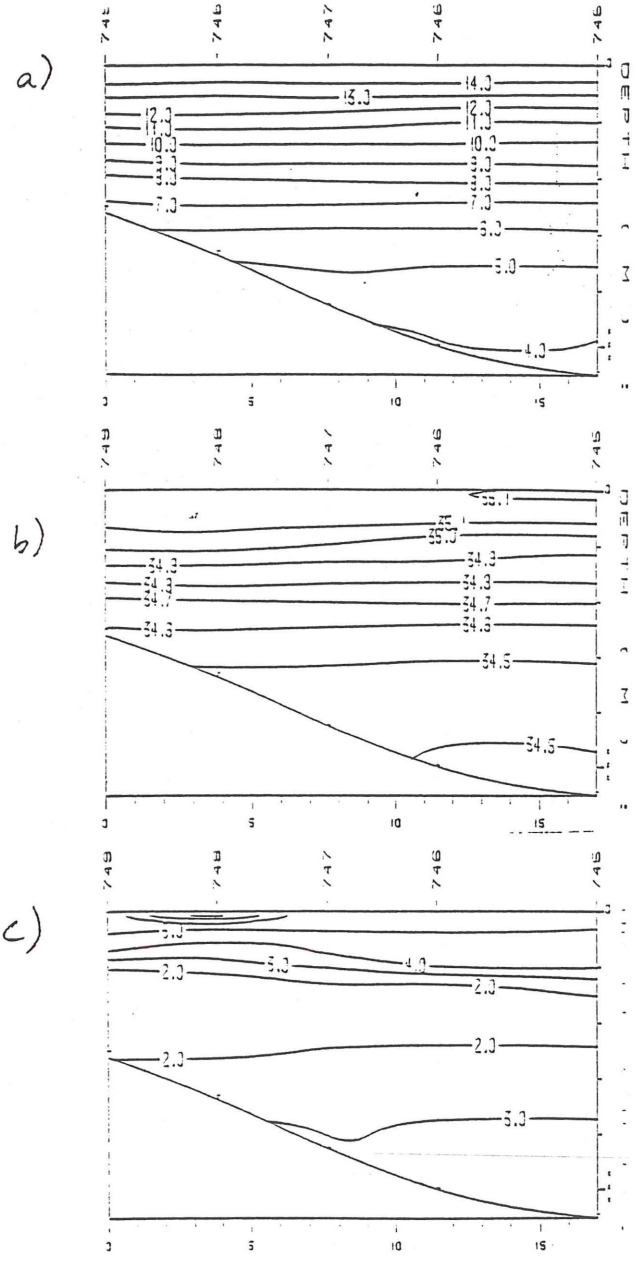
TIME: JUL.20:1432 - JUL.20:1621 1997
POS: 26.33°S 13.58°E - 26.37°S 13.58°E

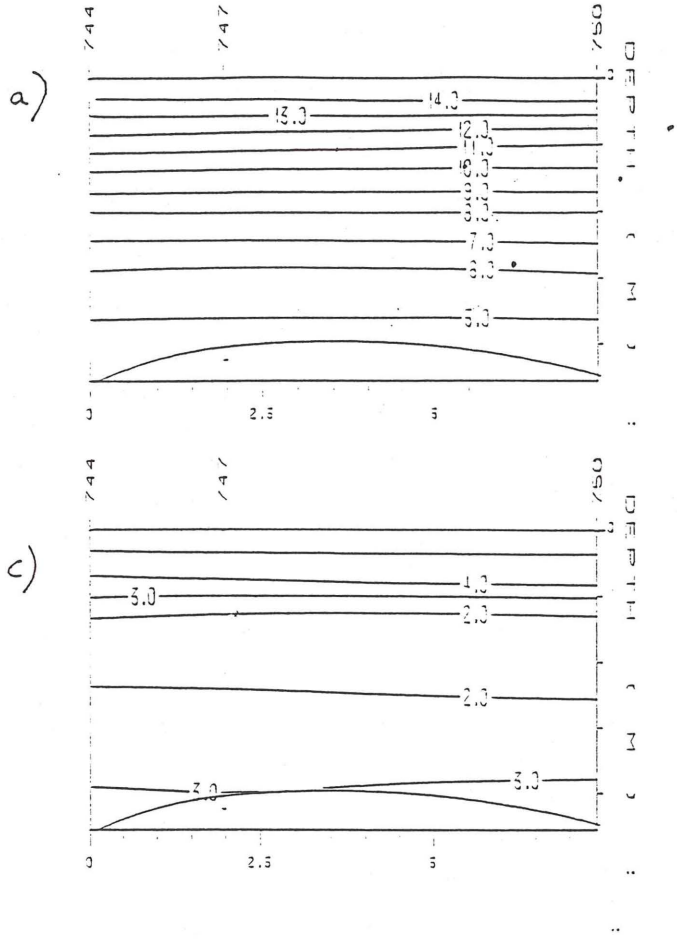
Appendix 2 a) Temperature, b) Salinity, and c) Oxygen graphs for Frankies



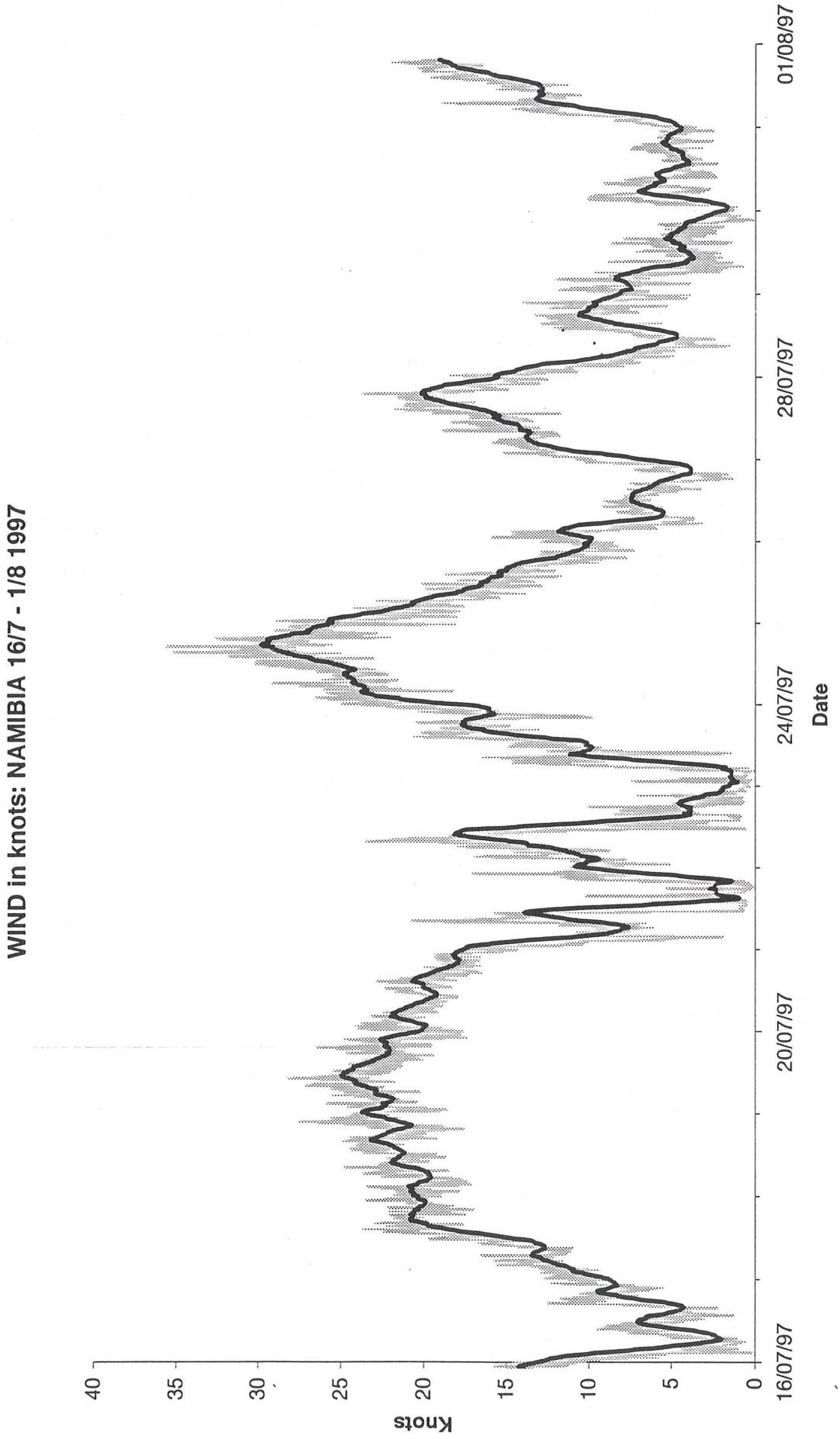


Appendix 3 a) Temperature, b) Salinity, and c) Oxygen graphs for Rix

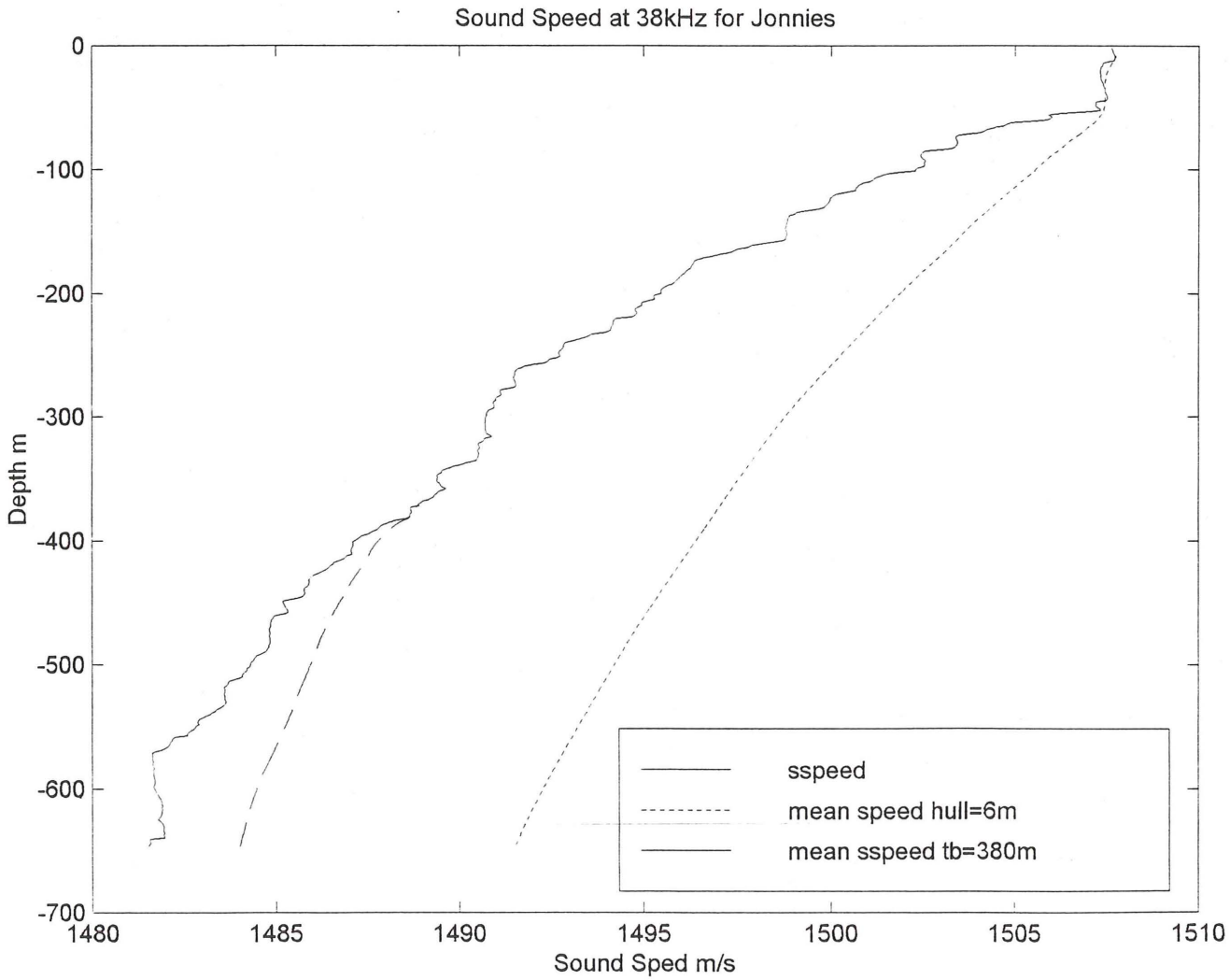




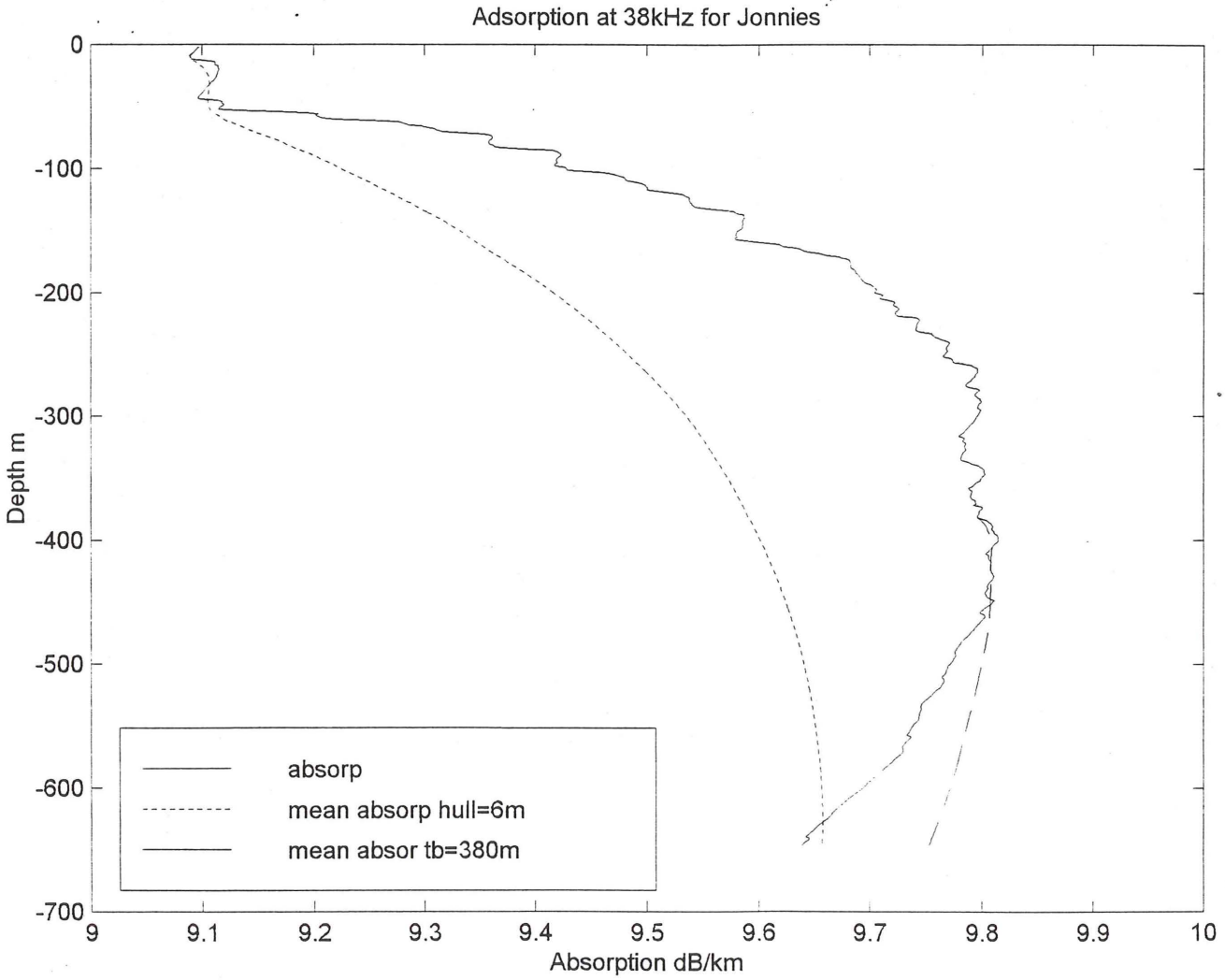
Appendix 4 Wind speeds during survey period



Appendix 5 Sound velocity graph for Johnies

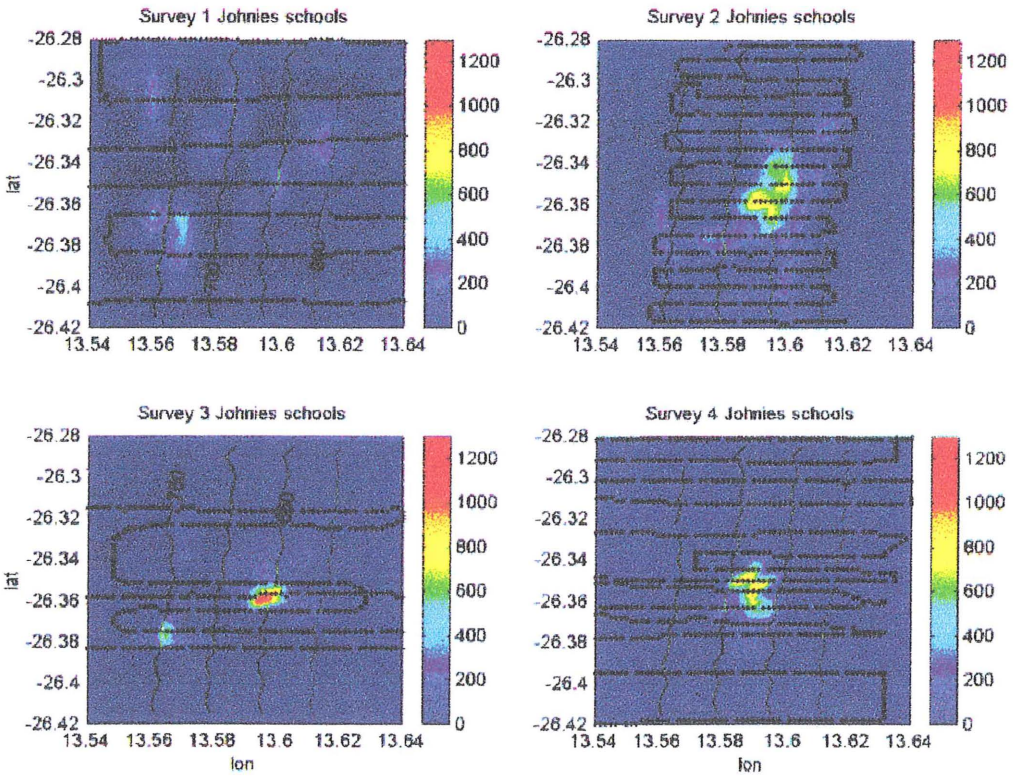


Appendix 6 Sound absorption graph for Johnies

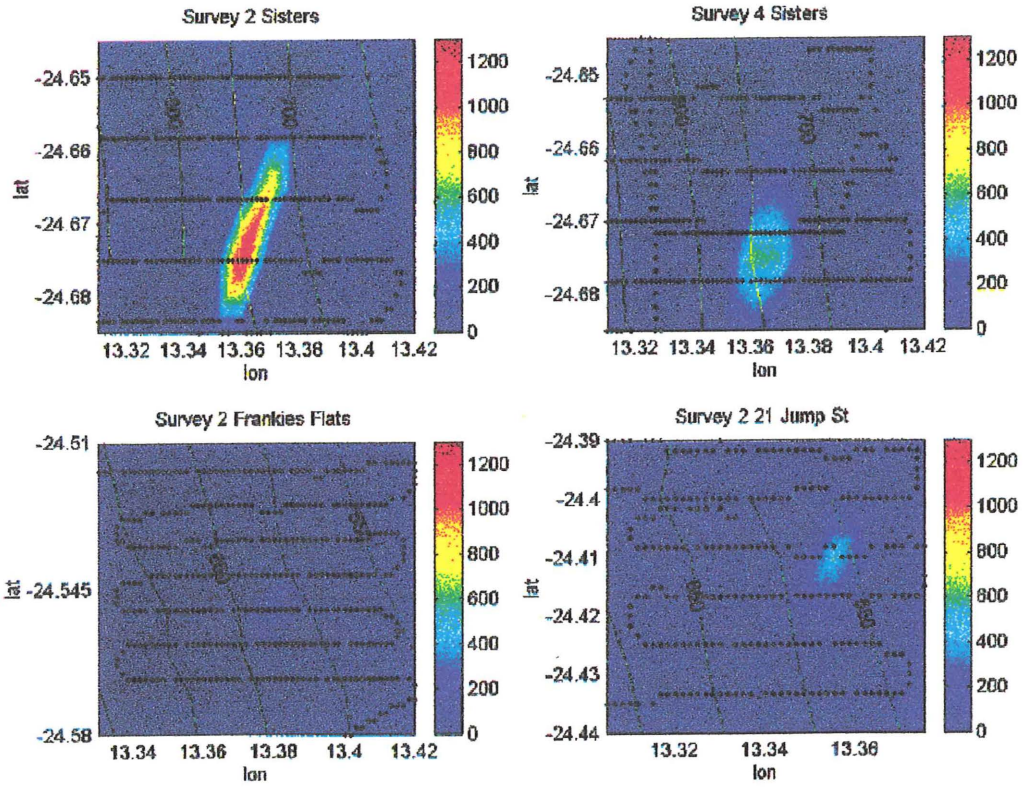


Appendix 7 Acoustic survey coverages of a) Johnies, b) Frankies, and c) Rix Maps shows the main school areas.

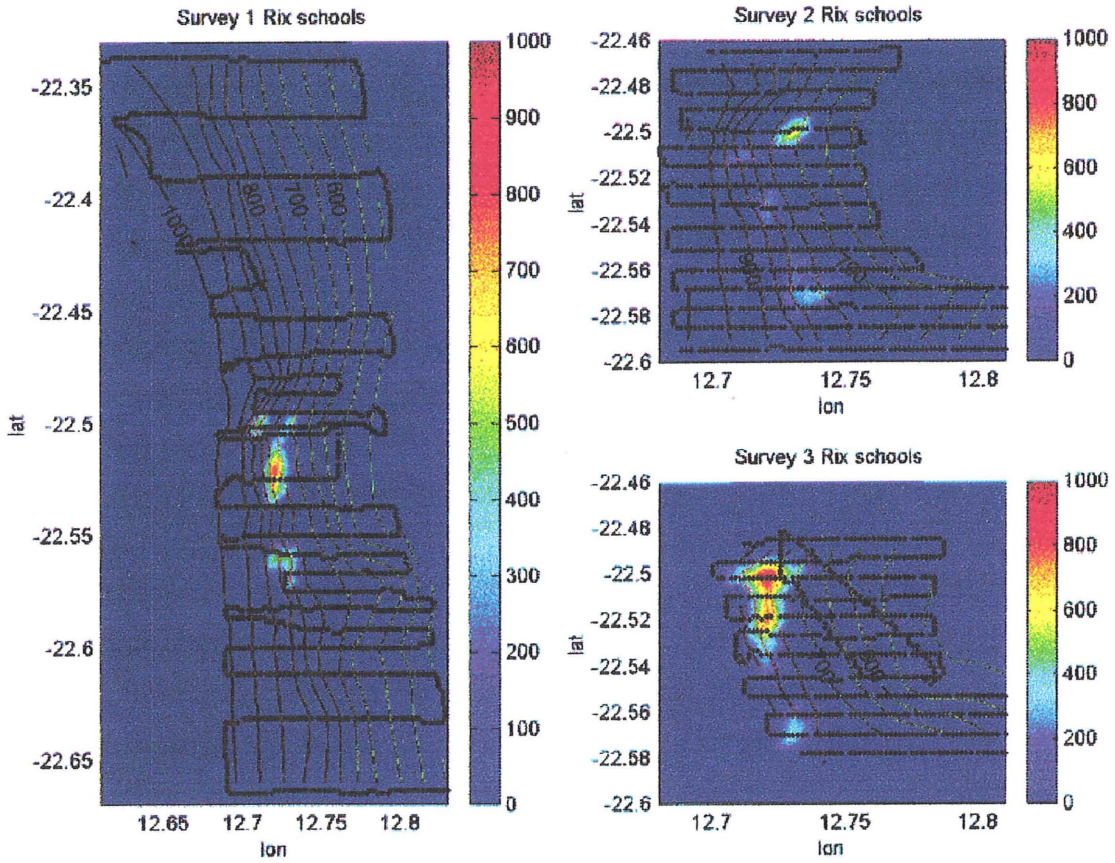
a) Johnies



b) Frankies


Survey 2 Sisters
-24.65
-24.66
-24.67
-24.68
lat
13.32 13.34 13.36 13.38 13.4 13.42
lon
1200
1000
800
600
400
200
0
Survey 4 Sisters
-24.65
-24.66
-24.67
-24.68
lat
13.32 13.34 13.36 13.38 13.4 13.42
lon
1200
1000
800
600
400
200
0
Survey 2 Frankies Flats
-24.51
-24.545
-24.58
lat
13.34 13.36 13.38 13.4 13.42
lon
1200
1000
800
600
400
200
0
Survey 2 21 Jump St
-24.39
-24.4
-24.41
-24.42
-24.43
-24.44
lat
13.32 13.34 13.36
lon
1200
1000
800
600
400
200
0

c) Rix


Survey 1 Rix schools
-22.35
-22.4
-22.45
-22.5
-22.55
-22.6
-22.65
lat
12.65
12.7
12.75
12.8
lon
1000
900
800
700
600
500
400
300
200
100
0
Survey 2 Rix schools
-22.46
-22.48
-22.5
-22.52
-22.54
-22.56
-22.58
-22.6
lat
12.7
12.75
12.8
lon
1000
800
600
400
200
0
Survey 3 Rix schools
-22.46
-22.48
-22.5
-22.52
-22.54
-22.56
-22.58
-22.6
lat
12.7
12.75
12.8
lon
1000
800
600
400
200
0

Appendix 8 Biological sampling strategy

Title: **Sampling procedure onboard vessels.**	
Author: **Bjoern Inge Staalesen**	Responsible: **Deep Water Fisheries group**
Version: **1.0**	Editing tool : **MS Word 6.0**
Due from: **12/06/97**	Filename: **Dwsample.doc**
Date of approval:	Approved by:

PURPOSE

This procedure gives a guideline in sampling of biological data from trawls of deep water fishspecies.

DEFINITIONS

Deep Water - Offshore fishing areas limited by depths of not less than 400 m and which comes under the management of the Deep Water Fisheries Committee.

Otolith- Calcified small body situated in the fish's inner ear, characterized by its microscopic growthzones used for agedetermination.

Tare- Setting the scale to zero value.

BACKGROUND

Biological sampling is a basis for collecting descriptive data for studies on the nature and development of the different fishspecies.

CRITICAL FACTORS

Biological sampling must be executed using calibrated scales, with unique marking of each sample and with consistent measuringtechnique. Any change in sampling strategy or method should be noted in the logsheet or put on as an attachment to this.

SAMPLING

Sampling deep water fishspecies can be done by one or two samplers.
If one person is sampling or time is limited, the focus should be on length frequency, weight, sex , gonadstageing and otoliths.

For Orange roughy and Alfonsino the whole sampling procedure is to be followed. For Oreo dorys, Cardinalfish and other commercially valuable species catch weight, sample weight and length and weight measurements (min. 100 fish) and gonadstageing are essential. The whole procedure is always to be followed for the main catchspecie, independent on specie.

Before sampling

Responsible	Step	Activity
Both samplers	1	Samples are collected from the trawlcatch in baskets. Each sample of the main catchspecies should contain approximately 200 fish.
One of the samplers	2	Preparation of the sampling equipment. Necessary equipment are: Logsheets, length frequency sheet, pencil, sharp knife for gutting and cutting the skullroof (get the otoliths), measuringboard (0,1 cm accuracy), tweezers, paper envelopes (for the otoliths)and a scale with steady state. Logsheets and length frequency sheet are placed in a dry area, easily available. Measuringboard is put on a table, and the scale is tared. Baskets should be available for disposals and for gutted fish.

During sampling

Responsible	Step	Activity
Sampler 1	1	**Length** is measured to the nearest 1 cm. Orange roughy is measured in standard length, Alfonsino in forklength, Oreo dories in totallength and other species according to standard methods. Whole fish is **weighed** in kilograms to the nearest 1 is measured by weighing the same fishes after being processed. Length and weight measurements should continue until a minimum of 200 fish from **each haul** are measured. **Sex, stage** (see **table 1.1**) and **gonadweight** are registered. Gonads are weighed to the nearest 1 g. Stageing continues until a number of 50 females are reached. **Stomach** is weighed to the nearest 1 g. and stomach fullness (%) is estimated.
Sampler 2	1 (simultaneously to no 1)	Logsheet is filled in with all information given by sampler 1.
Sampler 2	2	**Otoliths** (earstones) are taken out by cutting the roof of the head off with a forward cut. The otoliths become visible as two white bodies, one on each side of the median skullbone (occipital bone). Use a tweezers to pick up the otoliths, clean them in water, dry off the mucous and put them in an otolithbag with an unique recognizable marking on (Date, vessel, number, length, sex and stage). This is to be done before leaving the

		samplingarea. Otoliths should be taken as follows: 5 from catches from 0-2 mtons 10 from catches from 2-10 mtons 30 from catches larger than 10 tons

After sampling

Responsible	Step	Activity
One of the samplers	1	Collect all samples and store them for future agereading. Logsheets are completed with catchweight and sampleweight and collected in a file to be punched into the database.

Table 1.1: Stageing of Orange roughy and Oreo dories (after Pankhurst et. al.,1987).

Sex	Stage	Characteristics
Female	1	Immature or regressed; ovary clear
	2	Ovary pink or clear, small oocytes visible against the light
	3	Opaque white (Oreo dories) or orange (Orange roughy) oocytes present.
	4	Mature ovary; hyaline oocytes present
	5	Ovulated; eggs flow freely when light pressure is applied to abdomen
	6	Spent; ovary flaccid and bloody; residual eggs sometimes present in oviduct.

Male	1	Immature or regressed; testis threadlike
	2	Testis increased in size, but no milt expressible
	3	Partially spermiated; viscous milt expressible
	4	Fully spermiated; hydrated, freely flowing milt
	5	Spent; testis, "blood" or grey, no milt expressible

REFERENCES

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Pankhurst, N. W.; McMillan, P. J., and Tracey, D. M., 1987, Seasonal reproductive cycles in three commercially exploited fishes from the slope waters off New Zealand.
Journal of fish biology., 30, no. 2, pp. 193-211; 1987

Table: Summary of station and catch data from Southern Aquarius, survey trawling.

				START				FINISH				Depth		Distance	Catch Total (kg)			Species composition (kg)											
TowNo	Str	Code	Day	Lat	(min)	Lon	(min)	Lat	(min)	Lon	(min)	Start	Finish	nm	ORH	OTH	TowNo	RAT	SHA	HAK	OEO	UNI	CDL	OTH	Long(dec)	Lat(dec)	ORH	OTH	%ORH	%OTH
JOHNIES																	JOHNIES													
1	4	b	18	26	29.4	13	35.8	26	28.3	13	35.8	638	637	1.09	1.5	110.6	1	37.3	13.8	58.3	1.2				13.597	-26.490	1.5	110.6	0.0	1.0
2	4	e	18	26	25.1	13	35.1	26	24.1	13	35.2	677	673	1.01	5.2	57.3	2	13.0	9.6	32.8	1.9				13.585	-26.418	5.2	57.3	0.1	0.9
3	6	T	18	26	21.1	13	32.4	26	21.2	13	31.3	834		0.96	129.6	79.4	3		52.2		22.5	4.7			13.540	-26.352	129.6	79.4	0.6	0.4
4	1		18	26	21.8	13	35.9	26	20.5	13	35.8	647		1.27	35376.0	12.3	4		5.8	6.5					13.598	-26.363	35376.0	12.3	1.0	0.0
5	2	d	18	26	24.0	13	35.0	26	22.9	13	35.0	689	690	1.08	40333.0		5								13.583	-26.400	40333.0	0.0	1.0	0.0
6	6	d	19	26	21.4	13	33.8	26	21.1	13	33.9	757	755	0.32	5775.0	15.2	6				12.5			2.7	13.563	-26.357	5775.0	15.2	1.0	0.0
7	6	a	19	26	18.6	13	31.4	26	17.5	13	31.4	880	878	1.04	133.8	31.2	7	5.2		7.6	18.4				13.523	-26.309	133.8	31.2	0.8	0.2
8	6	c	19	26	18.8	13	33.3	26	17.7	13	33.4	785	783	1.13	29.5	96.0	8	23.3	39.8	21.9	11.0				13.555	-26.313	29.5	96.0	0.2	0.8
9	6	T	19	26	23.6	13	30.3	26	24.0	13	28.7	940		1.4	57.0	92.3	9	4.3	54.2	5.8	27.1			0.9	13.505	-26.393	57.0	92.3	0.4	0.6
10	2	c	20	26	19.9	13	35.1	26	18.9	13	35.2	700		1	34.6	106.0	10	10.2	51.5	32.6	11.7				13.585	-26.332	34.6	106.0	0.2	0.8
11	6	b	20	26	25.8	13	33.1	26	24.8	13	33.1	778	783	1		30.0	11	15.5	12.5			2.0			13.552	-26.430	0.0	30.0	0.0	1.0
12	5	a	20	26	20.1	13	38.3	26	18.9	13	38.2	545		1.21	1.2	408.5	12	50.3	91.0	255.0	2.4		7.6	2.2	13.638	-26.335	1.2	408.5	0.0	1.0
13	5		20	26	13.7	13	38.9	26	12.6	13	38.9	539		1.1	0.2	557.2	13	32.3	123.0	389.0	7.3		3.8	1.8	13.648	-26.228	0.2	557.2	0.0	1.0
14	2	I	20	26	21.8	13	34.9	26	20.7	13	35.0	693		1.1	1162.0		14								13.582	-26.363	1162.0	0.0	1.0	0.0
15	2	j	20	26	20.2	13	35.4	26	19.6	13	35.6	680	680	0.61	14184.0		15								13.590	-26.337	14184.0	0.0	1.0	0.0
16	2	h	21	26	18.4	13	35.9	26	17.3	13	35.9	666		1.1	6099.0		16								13.598	-26.307	6099.0	0.0	1.0	0.0
17	2	b	21	26	17.5	13	35.3	26	16.4	13	35.4	697	689	1.1	93.0		17			0.0					13.588	-26.292	93.0	0.0	1.0	0.0
18	3	a	21	26	14.6	13	36.4	26	13.6	13	36.4	650		1.03		94.4	18		0.0	94.4					13.607	-26.243	0.0	94.4	0.0	1.0
19	3	c	21	26	13.2	13	36.2	26	13.9	13	36.2	662		0.66	1.5	33.8	19	1.4	3.3	23.2	0.9			5.0	13.603	-26.220	1.5	33.8	0.0	1.0
20	5	f	21	26	25.2	13	37.2	26	23.5	13	37.1	570		1.69		103.2	20	36.4	20.1	41.8				4.9	13.620	-26.420	0.0	103.2	0.0	1.0
21	1		21	26	21.7	13	35.8	26	20.9	13	35.8	650		1.2	37283.0		21								13.597	-26.362	37283.0	0.0	1.0	0.0
				START				FINISH				Depth		Distance	Catch Total (kg)			Species composition (kg)											
TowNo	Str	Code	Day	Lat	(min)	Lon	(min)	Lat	(min)	Lon	(min)	Start	Finish	nm	ORH	OTH	TowNo	RAT	SHA	HAK	OEO	UNI	CDL	OTH	Long(dec)	Lat(dec)	ORH	OTH	%ORH	%OTH
FRANKIES																	FRANKIES													
22	6	c	21	24	43.7	13	21.1	24	42.6	13	20.8	805		1.1		37.7	22	6.3	6.6	23.0	0.7			1.1	13.352	-24.728	0.0	37.7	0.0	1.0
23	T		22	24	40.1	13	21.5	24	40.3	13	20.7	750		0.7	127.0	6.1	23				1.6			4.5	13.358	-24.668	127.0	6.1	1.0	0.0
24	5	d	22	24	47.0	13	31.9	24	46.0	13	31.7	514		1		52.7	24	22.2	3.2	24.5			0.8	2.0	13.532	-24.783	0.0	52.7	0.0	1.0
25	4	b	22	24	44.0	13	28.2	24	42.9	13	27.9	588		1.1		110.5	25	10.9	55.7	39.0				4.9	13.470	-24.733	0.0	110.5	0.0	1.0
26	T		22	24	41.0	13	24.8	24	39.9	13	24.9	650		1.1		31.4	26	2.3	16.1	10.2	0.2			2.7	13.413	-24.683	0.0	31.4	0.0	1.0
27	5	c	22	24	37.3	13	27.8	24	36.2	13	27.1	530		1.3		80.6	27	30.9	13.6	22.7			0.8	12.7	13.463	-24.622	0.0	80.6	0.0	1.0
28	T		22	24	35.8	13	22.4	24	36.9	13	22.7	682		1.1		18.0	28		6.3	7.6	1.7			2.5	13.373	-24.597	0.0	18.0	0.0	1.0
29	4	a	22	24	44.1	13	23.5	24	44.2	13	23.6	729		0		7.3	29	1.4		5.8	0.1				13.392	-24.735	0.0	7.3	0.0	1.0
30	4	d	22	24	49.1	13	26.0	24	48.0	13	26.7	724		1.3		27.9	30	3.7	14.6	7.5				2.2	13.433	-24.818	0.0	27.9	0.0	1.0
31	4	b	22	24	44.3	13	28.2	24	43.6	13	27.6	592		0.9		89.3	31	7.4	42.3	21.5				18.2	13.470	-24.738	0.0	89.3	0.0	1.0
32	T		22	24	40.9	13	19.4	24	41.0	13	18.9	820	780	0.4	220.0	28.9	32	0.2	14.5		14.2				13.323	-24.682	220.0	28.9	0.9	0.1
33	6	f	22	24	39.2	13	17.7	24	38.1	13	17.4	890		1.1	14.7	87.8	33	0.7	27.7		44.7			14.7	13.295	-24.653	14.7	87.8	0.1	0.9
34	1		23	24	40.0	13	21.7	24	40.2	13	20.6	731	791	1	24156.0	21.6	34		15.7		5.6			0.3	13.362	-24.667	24156.0	21.6	1.0	0.0
35	1		23	24	40.1	13	22.0	24	40.0	13	21.3	740		0.6	26488.0	0.0	35								13.367	-24.668	26488.0	0.0	1.0	0.0
36	2	e	23	24	38.9	13	24.4	24	37.7	13	24.0	641	637	1.2		139.7	36	6.6	87.1	36.7	0.4			8.9	13.407	-24.648	0.0	139.7	0.0	1.0
37	2	j	23	24	40.4	13	27.0	24	41.4	13	27.1	582	592	1		113.2	37	11.3	76.0	22.8	0.1			3.0	13.450	-24.673	0.0	113.2	0.0	1.0
38	1		24	24	32.8	13	22.6	24	32.4	13	22.4	617	619	0.4	8272.0	23.4	38	1.4	8.4	1.7				11.9	13.377	-24.547	8272.0	23.4	1.0	0.0
39	5	e	24	24	24.0	13	22.4	24	23.0	13	22.0	507	514	1.1		316.7	39	17.5	69.8	215.8			4.5	9.2	13.373	-24.400	0.0	316.7	0.0	1.0
40	T		24	24	24.7	13	21.1	24	23.4	13	21.1	564	546	1.3	484.0	3.1	40							3.1	13.352	-24.412	484.0	3.1	1.0	0.0
41	2	c	24	24	22.2	13	21.0	24	21.3	13	20.9	542	538	0.9		241.5	41	3.0	87.4	151.0				0.1	13.350	-24.370	0.0	241.5	0.0	1.0
42	3	f	24	24	19.4	13	19.7	24	18.3	13	19.0	552	552	1.2	0.5	278.9	42	15.1	129.0	134.1				0.7	13.328	-24.323	0.5	278.9	0.0	1.0
43	3	e	24	24	17.8	13	18.5	24	16.9	13	18.0	553	547	1	1716.0	216.5	43	10.7	10.4	192.0	0.6			2.8	13.308	-24.297	1716.0	216.5	0.9	0.1
44	3	d	24	24	19.2	13	14.7	24	18.3	13	14.4	746		0.9	0.6	48.7	44	3.3	30.6	11.1	0.4			3.3	13.245	-24.320	0.6	48.7	0.0	1.0
45	3	c	24	24	15.8	13	14.7	24	17.1	13	15.1	705		1.3		111.7	45	4.5	35.5	53.5	1.3			16.9	13.245	-24.263	0.0	111.7	0.0	1.0
46	6	d	24	24	18.3	13	12.4	24	19.2	13	12.8	810		0.9	1.0	87.4	46	3.9	47.4	29.9	1.9			4.3	13.207	-24.305	1.0	87.4	0.0	1.0
47	2	a	24	24	23.6	13	16.7	24	24.7	13	17.5	743		1.3	1.0	54.0	47	8.3	2.7	36.7	3.9			2.4	13.278	-24.393	1.0	54.0	0.0	1.0
48	6	b	24	24	29.2	13	16.6	24	30.1	13	17.5	805	794	1.2	1.4	58.9	48	7.0	15.1	26.4	1.2			9.2	13.277	-24.487	1.4	58.9	0.0	1.0
49	2	f	24	24	33	13	20.1	24	31.8	13	19.8	724	725	1.2	0.0	38.6	49	2.8	10.7	14.0	2.8			8.3	13.335	-24.550	0.0	38.6	0.0	1.0
50	1		24	24	32.8	13	22.6	24	31.0	13	22.4	619		1.8	700.0	4.7	50		4.7						13.377	-24.547	700.0	4.7	1.0	0.0
51	1		25	24	40.1	13	21.0	24	40.2	13	20.1	776	807	0.8	750.0	4.9	51	0.1	2.0		2.8				13.350	-24.668	750.0	4.9	1.0	0.0
				START				FINISH				Depth		Distance	Catch Total (kg)		0	Species composition (kg)											

TowNo	Str	Code	Day	Lat	(min)	Lon	(min)	Lat	(min)	Lon	(min	Start	Finish	nm	ORH	OTH
JOHNIES																
52	3	T	25	26	11.7	13	36.4	26	11.1	13	36.4	650	644	0.5	369.9	131.9
53	6	T	25	26	10.9	13	33.4	26	9.8	13	33.3	778	777	1.1	8.1	87.1
54	6N	a	25	26	12.1	13	32.0	26	10.9	13	31.9	832	826	1.2	19.0	53.2
55	6N	b	25	26	14.6	13	33.9	26	13.6	13	33.9	750	754	1	0.4	50.5
56	6M	a	26	26	17.3	13	34.5	26	16.2	13	34.4	733	741	1.1	3.2	115.5
57	6M	b	26	26	21.1	13	33.8	26	19.8	13	33.8	760	760	1.3	4.9	122.8
58	2	d	26	26	21.4	13	35.3	26	20.4	13	35.2	682	760	1	15292.2	163.8
59	2	T	26	26	23.0	13	34.4	26	21.5	13	34.5	721	724	1.5	369.0	71.1
60	6	T	26	26	23.7	13	31.3	26	22.6	13	31.3	880	890	1.1	138.6	30.8
61	6	c	26	26	22.7	13	33.4	26	21.6	13	33.2	774	789	1.1	29475.6	2767.5
62	6	sa	26	26	26.0	13	34.2	26	26.5	13	33.8	740	745	0.6	4.9	112.0
63	5	a	27	26	22.7	13	37.7	26	21.8	13	37.4	554	560	0.9	0.0	41.6
64	1		27	26	23.3	13	35.6	26	22.2	13	35.6	654	656	1.1	32990.0	13.7

TowNo	RAT	SHA	HAK	OEO	UNI	CDL	OTH	Long(dec)	Lat(dec)	ORH	OTH	%ORH	%OTH
JOHNIES													
52	1.9	40.2	25.6	60.8			3.4	13.607	-26.195	369.9	131.9	0.7	0.3
53	8.1	45.6	15.5	8.9			9.0	13.557	-26.182	8.1	87.1	0.1	0.9
54	4.8	25.8	6.5	6.3			9.8	13.533	-26.202	19.0	53.2	0.3	0.7
55	6.3	26.8	12.5	1.3			3.6	13.565	-26.243	0.4	50.5	0.0	1.0
56	35.3	47.3	27.1	2.1			3.7	13.575	-26.288	3.2	115.5	0.0	1.0
57	52.8	44.3	15.9	8.3			1.5	13.563	-26.352	4.9	122.8	0.0	1.0
58	10.4	82.8	60.0	0.5			10.1	13.588	-26.357	15292.2	163.8	1.0	0.0
59	13.8	43.1	0.0	9.0			5.2	13.573	-26.383	369.0	71.1	0.8	0.2
60	1.4	16.4	1.7	4.1			7.2	13.522	-26.395	138.6	30.8	0.8	0.2
61	0.0	30.4	21.6	2713.0			2.5	13.557	-26.378	29475.6	2767.5	0.9	0.1
62	45.5	42.2	13.9	4.3			6.1	13.570	-26.433	4.9	112.0	0.0	1.0
63	6.3	4.5	29.5	0.0			1.3	13.628	-26.378	0.0	41.6	0.0	1.0
64	3.6	7.6	0.0	0.3			2.2	13.593	-26.388	32990.0	13.7	1.0	0.0

TowNo	Str	Code	Day	START Lat	(min)	Lon	(min)	FINISH Lat	(min)	Lon	(min	Depth Start	Finish	Distance nm	Catch Total (kg) ORH	OTH
FRANKIES																
65	2	c?	27	24	41.7	13	26.0	24	40.9	13	25.5	628	632	0.92	0.0	73.1
66	6	c	27	24	42.7	13	19.0	24	41.9	13	18.9	868	862	0.8	0.9	25.9
67	6	a	28	24	37.5	13	19.4	24	36.3	13	18.9	807	809	1.25	0.2	59.5
68	2	a	28	24	37.2	13	23.8	24	36.1	13	23.5	641	643	1.1	0.0	0.0
69	T		28	24	40.1	13	22.5	24	40.1	13	22.5	750	744	0	2171.0	30.0
70	6	b	28	24	33.8	13	16.3	24	32.2	13	15.9	868	863	1.62	27.6	84.4
71	2	d	28	24	30.4	13	21.6	24	29.8	13	21.4	630	641	0.61	1016.4	72.0
72	2	h	28	24	28.6	13	18.5	24	27.5	13	18.3	735	729	1.1	0.6	71.2
73	T		28	24	18.7	13	18.9	24	17.7	13	18.5	563	563	1.05	6.1	89.3
74	6	d	28	24	23.8	13	14.4	24	24.6	13	14.8	807	804	0.9	5.4	53.0
75	T	FN	28	24	24.7	13	22.1	24	22.1	13	23.1	538	538	1.7	32.0	319.6
76	1		29	24	32.5	13	22.4	24	32.0	13	22.1	622	630	0.6	7106.0	0.0
77	1		29	24	41.0	13	21.5	24	40.2	13	20.8	745	785	0.6	40300.0	9.0

TowNo	RAT	SHA	HAK	OEO	UNI	CDL	OTH	Long(dec)	Lat(dec)	ORH	OTH	%ORH	%OTH
FRANKIES													
65	2.8	61.3	8.0	0.0			1.0	13.433	-24.695	0.0	73.1	0.0	1.0
66	0.9	7.7	12.0	5.3			?	13.317	-24.712	0.9	25.9	0.0	1.0
67	8.3	28.1	19.4	3.7			?	13.323	-24.625	0.2	59.5	0.0	1.0
68								13.397	-24.620	0.0	0.0	-	-
69				30.0				13.375	-24.668	2171.0	30.0	1.0	0.0
70	3.9	8.5	22.0	50.0			?	13.271	-24.563	27.6	84.4	0.2	0.8
71		60.8	11.0	0.2			?	13.360	-24.507	1016.4	72.0	0.9	0.1
72	6.5	30.1	33.5	1.1			?	13.308	-24.477	0.6	71.2	0.0	1.0
73	1.1	12.9	75.3				?	13.315	-24.312	6.1	89.3	0.1	0.9
74	3.5	21.4	24.0	4.1			?	13.240	-24.397	5.4	53.0	0.1	0.9
75	2.1	26.4	282.5	0.5			8.1	13.368	-24.412	32.0	319.6	0.1	0.9
76	0.0			0.0			0.0	13.373	-24.542	7106.0	0.0	1.0	0.0
77	0.0	2.2		1.0			5.8	13.358	-24.683	40300.0	9.0	1.0	0.0

TowNo	Str	Code	Day	START Lat	(min)	Lon	(min)	FINISH Lat	(min)	Lon	(min	Depth Start	Finish	Distance nm	Catch Total (kg) ORH	OTH
RIX																
78	2	d	29	22	30.7	12	43.1	22	30.4	12	43.1	762	766	0.3	5360.0	878.5
79	2	f	30	22	26.6	12	43.8	22	25.4	12	43.6	794	773	1.2	0.0	216.3
80	T		30	22	37.7	12	46.4	22	36.7	12	46.2	647	682	1	0.0	48.1
81	2	a	30	22	35.6	12	47.0	22	35.0	12	46.0	572	642	1.1	0.0	99.9
82	T		30	22	33.4	12	43.6	22	32.7	12	43.6	781	801	0.7	19.7	80.0
83	T		30	22	30.7	12	43.0	22	30.6	12	43.0	756	753	0.1	1150.0	106.2
84	2	b	30	22	30.4	12	45.3	22	29.5	12	45.1	582	580	0.9	0.9	113.1
85	2	c	30	22	28.5	12	45.9	22	27.5	12	45.5	547	605	1	0.0	191.4
86	T		30	22	22.9	12	40.9	22	21.9	12	40.8	912	906	1	3.6	47.5
87		h	30	22	25.5	12	42.7	22	26.6	12	42.7	823	832	1.1	0.0	80.2
88	T		30	22	31.3	12	45.7	22	30.6	12	44.7	556	560	1.1	0.0	0.0
89	T		30	22	32.4	12	45.1	22	31.5	12	45.0	631	638	0.9	0.0	0.0
90	T		31	22	30.8	12	43.1	22	29.6	12	42.9	761	758	1.2	15708.0	3094.3
91	T		31	22	33.6	12	46.2	22	34.5	12	45.5	542	670	1.1	415.0	597.0
92	T		31	22	33	12	44.1	22	32.1	12	43.9	748	729	0.9	56.6	191.1
93	T		31	22	31.9	12	43.9	22	32.8	12	43.4	744	731	1.0	12000.0	250.0
94	T		31	22	30.1	12	43.9	22	29.4	12	43.8	707	696	0.7	10000.0	0.0
95	T		31	22	28.9	12	41.4	22	27.8	12	41.5	949	989	1.1	18.6	40.0

TowNo	RAT	SHA	HAK	OEO	UNI	CDL	OTH	Long(dec)	Lat(dec)	ORH	OTH	%ORH	%OTH
RIX													
78	0.0	850.0	3.6	24.5			0.4	12.718	-22.512	5360.0	878.5	0.9	0.1
79	3.7	139.0	59.6	0.2			13.8	12.730	-22.443	0.0	216.3	0.0	1.0
80	2.3	18.9	13.9	1.7			11.3	12.773	-22.628	0.0	48.1	0.0	1.0
81	7.1	72.5	15.4	3.6			1.3	12.783	-22.593	0.0	99.9	0.0	1.0
82	0.9	63.4	3.6	4.8			7.3	12.727	-22.557	19.7	80.0	0.2	0.8
83	0.0	99.2	0.0	7.0			0.0	12.717	-22.512	1150.0	106.2	0.9	0.1
84	0.3	90.7	22	0.05			0.0	12.755	-22.507	0.9	113.1	0.0	1.0
85	3.6	100.85	81.8	1.5			3.7	12.765	-22.475	0.0	191.4	0.0	1.0
86	2.4	20.1	10.4	8.9			5.7	12.682	-22.382	3.6	47.5	0.1	0.9
87	7	46.4	14.8	1.8			10.2	12.712	-22.425	0.0	80.2	0.0	1.0
88	0.0	0.0	0.0	0.0			0.0	12.762	-22.522	0.0	0.0	-	-
89	0.0	0.0	0.0	0.0			0.0	12.752	-22.540	0.0	0.0	-	-
90		1050.0		1363.3			681.0	12.752	-22.540	0.0	0.0	-	-
91	1.3	47.8	66.0	21.4			460.5	12.718	-22.513	15708.0	0.0	1.0	0.0
92	0.1	129.1	16.9	1.7			43.3	12.770	-22.560	415.0	1.3	1.0	0.0
93		250.0		0.0				12.735	-22.550	56.6	0.1	1.0	0.0
94								12.732	-22.532	12000.0	0.0	1.0	0.0
95	2.4	27.0	4.3	2.2			4.2	12.732	-22.502	10000.0	0.0	1.0	0.0

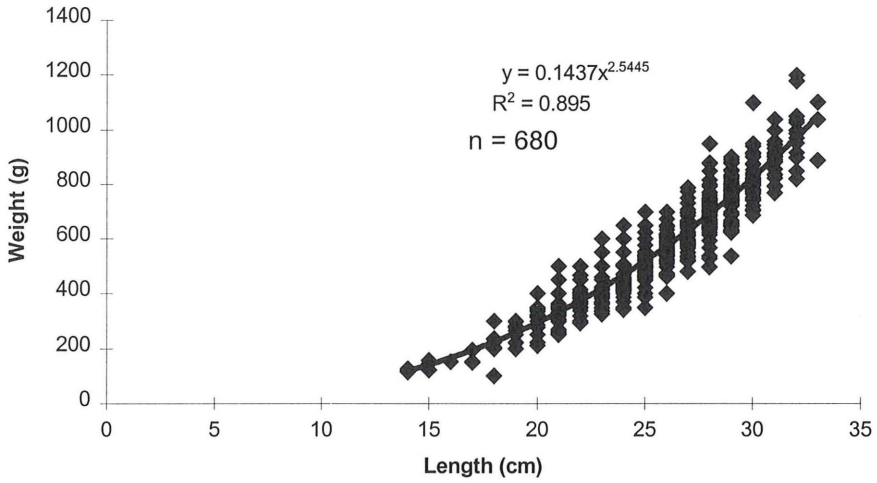
Weight in 132 and 133 are uncertain.

Table: Summary of station and catch data from "Dr Fridtjof Nansen", survey trawling.

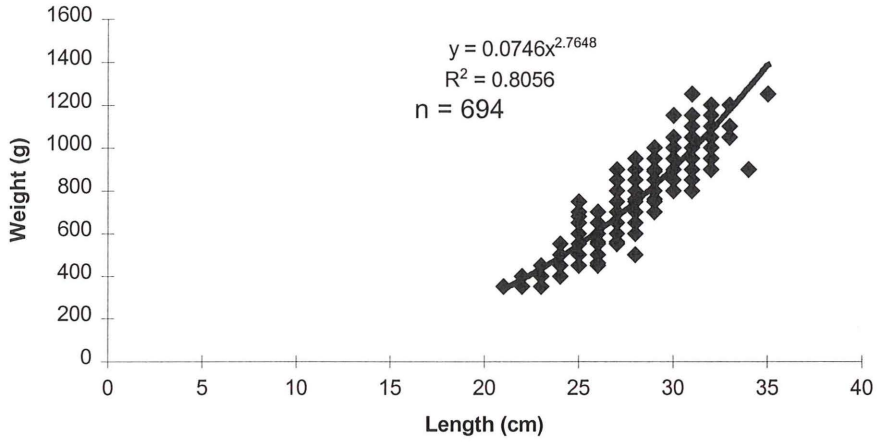
JOHNIES - 1			START					TIME		BOTTOM DEPTH		GEAR DEPTH		DISTANC	CATCH TOTAL (kg)							
TowNo	Gear Code	Day	Lat	(min)	Lon	(min)	Coarse	Start	Finish	Start	Finish	Start	Finish	nm	O.roughy	Rat-tails	Sharks	Hake	Oreos	Other	Crust.	Squids
2211	PT1	19	26	21.8	13	35.7	180	8:50	9:17	654	652	580	580	1.6	0.5	0.0	0.0	9.1	0.0	38.0	9.1	3.3
2212	BT12	20	26	24.9	13	35.1	360	13:11	13:31	680	676	680	676	1	44.7	202.8	83.1	1.3	29.6	20.5	1.1	0.5
2213	PT2	20	26	24	13	35	8	20:00	21:00	678	677	650	650	3	0.4	3.8	0.0	1.2	3.5	3.7	0.0	0.8
2219	BT		26	13.3	13	31.8									40.9	6.2	7.2	7.5	5.7	17.2		1.7
JOHNIES - 2																						
2220	BT	26	26	26.4	13	34	360	10:38	10:58	723	728	723	728	1.1	3.4	164.9	37.1	10.0	2.3	64.1	0.0	0.0
2221	BT2	26	26	28	13	31.2	360	13:51	13:54	889	888	889	888	0.2	71.0	3.4	13.0	0.0	3.2	14.8	0.0	1.2
2222	BT2	26	26	22	13	31.25	360	15:58	16:08	881	885	881	885	0.5	35.1	29.3	7.2	0.0	67.5	126.1	0.0	3.4
2223	BT10	26	26	21.9	13	32.8	15	20:18	20:28	812	807	812	807	0.6	6.6	11.5	15.9	4.5	5.0	19.2	0.0	0.7
FRANKIES - 1																						
2214	PT2	24	24	33.09	13	22.55	360	1:30	2:10	626	633	600	600	1.7	0.0	0.0	0.0	6.1	0.2	282.9	1.4	0.0
2215	BT10	24	24	38.7	13	24.1	350	7:36	7:51	647	644	647	644	0.78	0.1	11.4	14.0	11.5	0.3	11.3	0.6	0.3
2216	PT2	24	24	41.6	13	19.6	360	11:03	11:34	836	826	750	750	2.5	0.0	0.1	0.0	0.0	0.2	31.2	0.4	0.0
2217	PT2	24	24	41.30	13	19.6	180	13:07	13:34	827	780	780	780	1.5	0.6	0.1	0.0	0.0	2.8	56.0	0.6	8.4
2218	PT1	24	24	40.25	13	22.2	90	17:22	17:42	719	685	700	700	1.1	0.0	0.0	0.0	1.6	0.2	25.0	0.2	1.6
FRANKIES - 2																						
2224	PT1	28	24	31.6	13	18.7	110	8:08	8:24	762	731	130	130	0.82	0.0	0.0	0.0	0.0	0.0	45.0	0.0	0.0
2225	BT2	28	24	23.96	13	22.14	345	23:26	23:59	523	534	523	543	1.6	7.0	50.0	26.9	306.0	0.3	85.0	0.0	0.0
2226	BT2	29	24	29.7	13	14.79	345	4:28	5:01	810	801	810	801	1.2	22.2	48.5	25.5	90.0	10.5	42.2	2.3	2.0
RIX																						
2227	PT2	31	22	32	12	47	31	18:06	18:40	492	663	450	450	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 11 Length – weight relationships for Johnies and Frankies

Johnies



Frankies



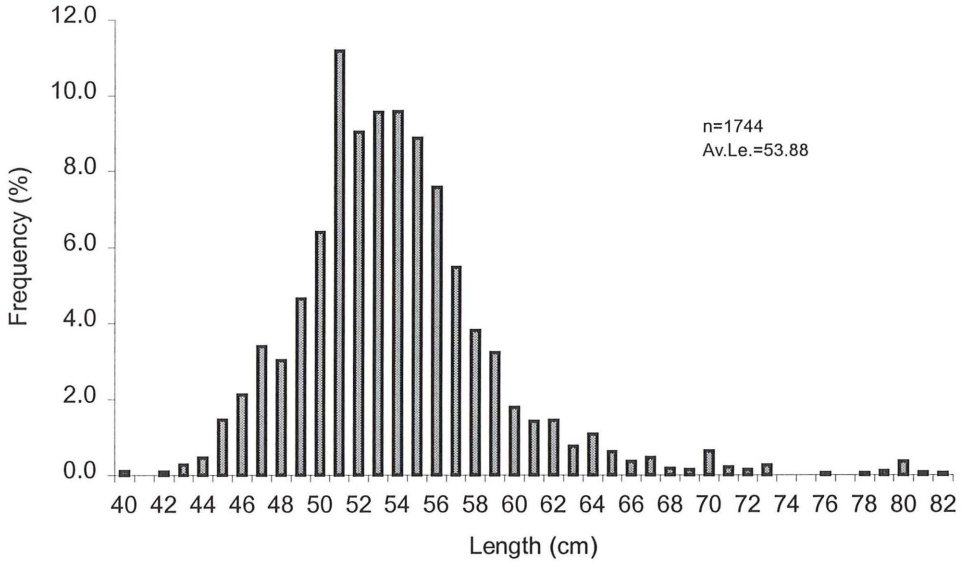
Appendix 12a) Mean length and average weight for the bycatches

	Mean length (cm)			Average weight (kg)		
	Johnnies	Frankies	Rix	Johnnies	Frankies	Rix
Oreo	28.38	21.34	32.68	0.27	0.27	0.43
Hake	55.57	53.14	51.83	1.46	1.21	1.04
Rattails	31.72	35.11	30.9	0.2	0.24	0.14
Sharks	58.09	62	58.44	1.3	1.47	1.7

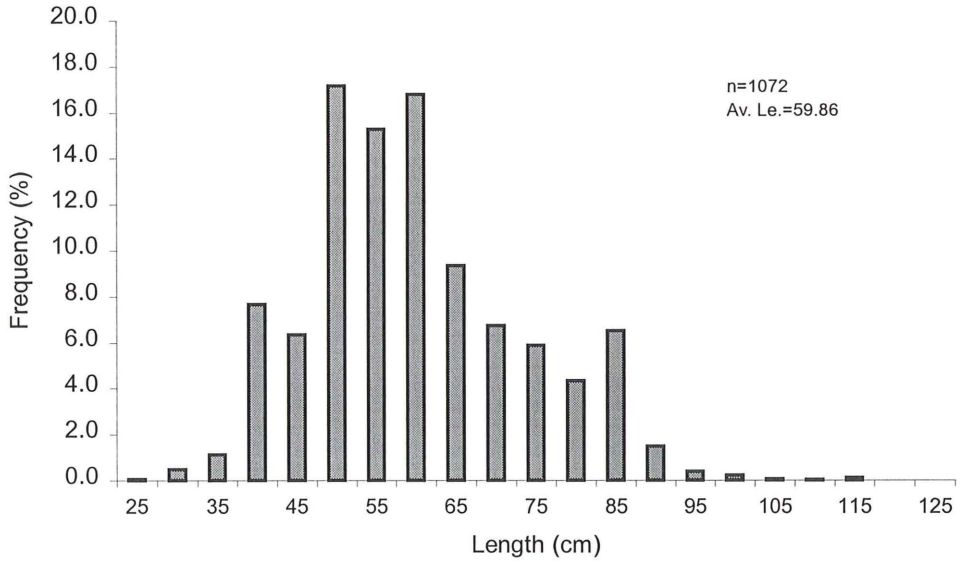
Mean length (cm) and average weight(kg) of bycatch species for three separate fishing grounds

b) Length distributions for the bycatches

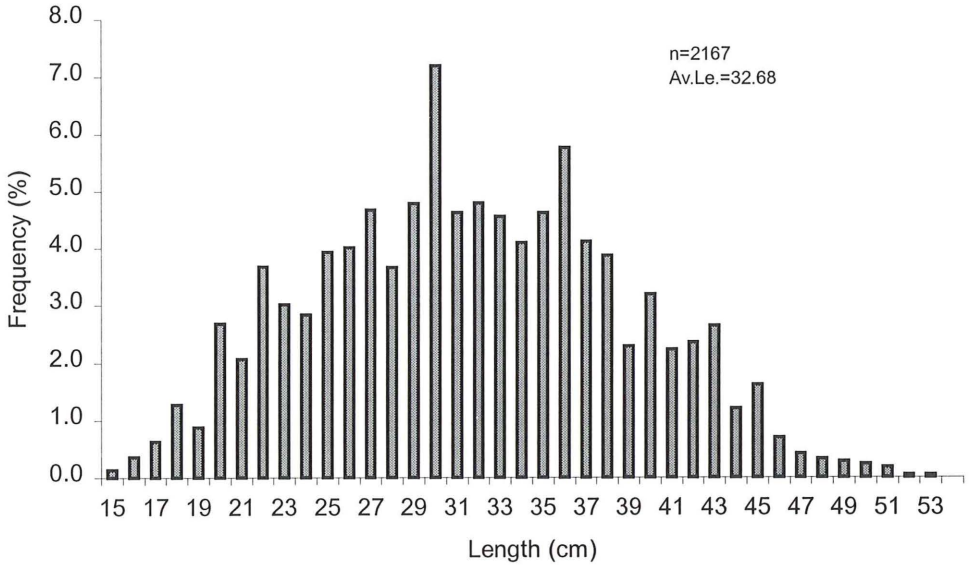
Length distribution for Hake



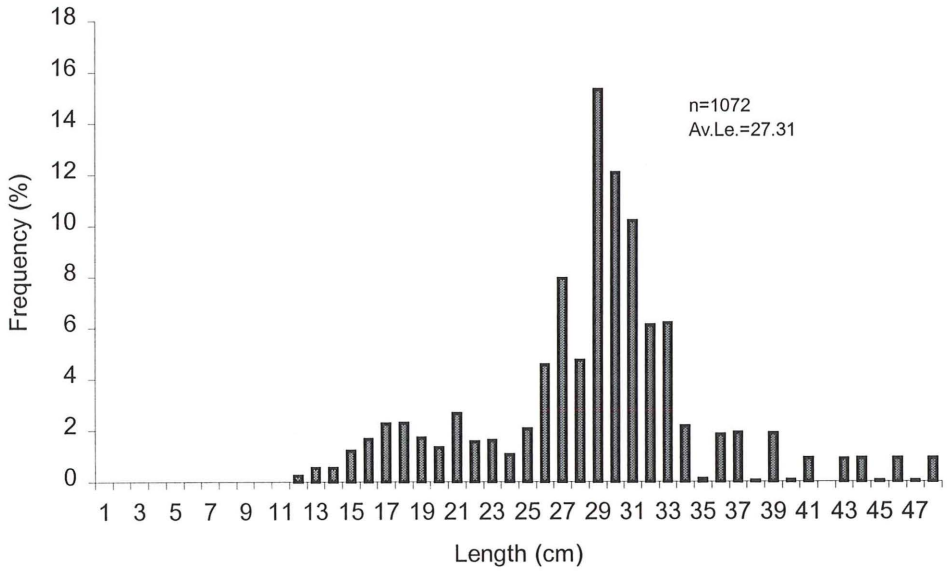
Length distribution of Sharks



Length distibution of Rattails



Length distribution for Oreo dories



Appendix 13:
Correction for bias in acoustic estimates from Dr. Fridjof Nansen survey 1997

The acoustic estimates of roughy biomass obtained from the *Nansen* were corrected for possible bias according to available information in the Cruise Report, and discussions between acoustic practitioners and survey participants at the Meeting. Input was also received from Rudy Kloser (CSIRO, Hobart) during the course of the Meeting. The decisions reached as to the likely range and maximum range of potential biases are summarised in Table 1. Note that the biases are expressed as correction factors, by which the estimates need to be multiplied. For each source of bias the error function was taken as flat over the likely range (i.e. all values between the upper and lower limits were assumed to be equally likely). Between these limits and the maximum and minimum values, the probability was assumed to decrease exponentially. The rationale for the ranges adopted is given below for each source of error.

Target strength

The likely range corresponds approximately to a ∀ 2 dB uncertainty, which is the uncertainty range quoted in Kloser et. al. (1997) for the estimate used in the survey (i.e. -50 dB for a 36 cm fish). The mid-point of the likely range was made somewhat greater than 1 in response to a comment received from R. Kloser on 28 January that from recent work he would expect the target strength of orange roughy to be lower than the value quoted in Kloser et al. 1997. On this basis he suggested increasing the minimum estimate agreed to earlier at the Meeting from 0.50 to 0.80, and increasing the lower end of the likely range from 0.60 to 0.80. Although he did not suggest increasing the upper end of the likely range (previously set at 1.6), after some discussion the Meeting agreed to increase this limit to 1.7 as a compromise between shifting the whole distribution upwards, which some favoured, and adjusting only the lower limits, which was favoured by others. Note that the minimum and maximum limits reflect additional potential error such as the uncertainty in extrapolating Kloser=s estimate to smaller fish (mean length 27 cm).

Dead zone

For all areas except 3 Sisters, it was considered that the error due to the dead zone would have been small due to the relatively flat ground. Assuming a dead zone of about 3m over the flat ground based on pulse length considerations, and noting that dead zones of the order of 30m have led to errors of about 50% in roughy estimates off Tasmania (Kloser 1996), the Meeting considered that an uncertainty of between 5 and 10 % was reasonable. For the surveys of the 3 Sisters area, where the ground is more uneven, a correction of 1.71 was applied to the estimate, based on the difference between the towed body and hull-mounted transducer estimates for Survey 2 (See Cruise Report, Table 12). The residual uncertainty after correction was assumed to be the same as in the other areas.

Calibration

The likely range of calibration error was assumed to be about 10% , which includes uncertainty regarding the Equivalent Beam Factor. This is typical for a sphere-calibrated system. Since the Beam Factor was not checked at the time of the survey, and the accuracy

of its previous measurement was unknown, it was considered prudent to set the minimum and maximum limits considerably wider (aproximately 0.5 dB) than the likely range.

Absorption

On the basis of data presented in the Cruise Report, all acoustic estimates were corrected by a factor of 0.89 to account for error in the absorption coefficient used in the EK500 software. No attempt was made to allow for uncertainty regarding this correction, although there is clearly uncertainty (probably of the order of 5%) in the theoretical expression (Francois and Garrison, 1982) used to estimate the absorption coefficient from temperature and salinity measurements.

Use of mean length

This error, which arises from estimating mean Target Strength and mean weight by substituting mean lengths into the TS/length and length/weight expressions used, was roughly estimated by Hampton (1997) at between 5 and 10 % from the pooled length distributions presented in the Cruise Report (Figs. 7, 8 and 9). The flat error distribution between 1.05 and 1.10 corrects for this error. In future surveys, the error can be avoided by estimating the mean Target Strength from the length distributions, and the mean weight by direct weighing.

Weather

Underestimation of biomass due to aeration and pitch and roll effects in bad weather were considered to be small because of the deep hull-mounted transducer on *Nansen* and the fact that data collected in bad weather were not used in the analysis. The maximum limit of 20% is a typical average effect for a large research vessel with normal hull-mounted transducers (MacLennan and Simmonds 1992).

Fish outside of schools

These estimates were based on the % of the roughy in the Johnies and Frankies areas which was outside the schools, as estimated from a comparison between the swept area and targeted acoustics results for these two areas (Cruise Report pp. 41 and 47).

Non-roughy in schools

Since the % of non-roughy in all trawls made on roughy aggregations was less than 1% throughout, this error was considered to be almost negligible, even allowing for the low Target Strength of roughy compared to many of the other species present.

Non-spawning fish

This correction factor, which centres on 1.33, accounts for roughy outside of the spawning aggregations, and therefore outside of the areas surveyed acoustically. The factors were taken from an analysis of CPUE data presented to the Meeting by Trevor Branch. (see Annexure)

Sampling error

This error, which arises purely from the fact that the survey takes a finite sample from the population, was estimated at the Meeting from the inter- transect variation in Sa values for each survey used. Where an area was surveyed more than once, the biomass was estimated from an inverse-variance weighted mean Sa value. The quoted CV is the estimated CV for all of the surveys combined, obtained by adding the variance in the biomass estimate for each of the surveys. The methodology is described in full in the Annexure.

Table 1. Correction factors for the most recent (July 1997) acoustic estimates of orange roughy in Namibian waters.

Factor	Min	Likely Range	Max
T.S.	0.80	0.80 – 1.70	2.00
Dead Zone	1.00	1.05 – 1.10	1.02
Calibration	0.80	0.90 –1.10	1.25
Absorption	0.89	0.89	0.89
Use of Mean Length	1.05	1.05 – 1.10	1.10
Weather	1.00	1.05 – 1.10	1.20
Fish Outside of Schools	1.05	1.10 – 1.20	1.30
Non-Roughy in Schools	0.90	1.00	1.00
Non-Spawning Fish	1.10	1.20 – 1.46	2.00
Sampling Error (CV)		0.13	

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