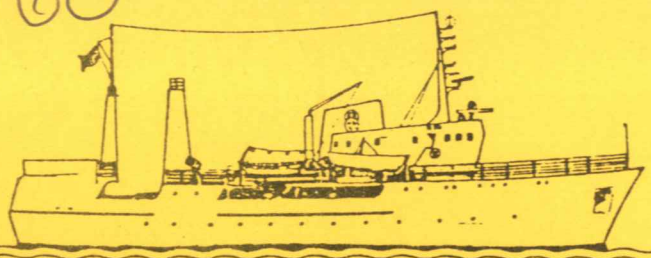

Reports on Surveys with the
R/V Dr Fridtjof Nansen

UNDP/FAO PROGRAMME GLO/82/001

CRUISE REPORT
"DR. FRIDTJOF NANSEN"

SECOND SURVEY OF THE ABUNDANCE AND DISTRIBUTION OF THE FISH RESOURCES OFF OMAN

7 Nov - 11 Dec 1983

BY
T. STRØMME AND S. TILSETH

BERGEN
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Institute of Marine Research, Bergen

INTRODUCTION

The fishery research vessel "Dr. Fridtjof Nansen" belongs to the Norwegian Agency for International Development (NORAD), and was designed and built for scientific and exploratory investigations of fishery resources of developing countries.The Institute of Marine Research, Bergen, is responsible for the scientific programme and the operation of the vessel.

By an agreement between the Ministry of Agriculture and Fisheries, Oman and UNDP/FAO and NORAD the vessel is scheduled to work in Omani waters in four periods during 1983 and 1984. The vessel has already conducted a survey in February-March 1983 from which two separate reports have been issued. The present report covers the second survey in the series, carried out in the period 7 November - 11 December 1983. Two surveys are planned for 1984, in April and in August/September. The work is funded by NORAD and UNDP/FAO.

The vessel had earlier carried out five acoustic surveys in Omani waters under a FAO programme for the North Arabian Sea in 1975-76. The present series of surveys is thus a follow-up of the previous work.

The main objectives were:

Acoustic survey of the small pelagic fish resources on the shelf off Oman.

Trawl survey of the demersal fish resources in the 20-200m bottom depth zone with intensive trawl sampling.

Acoustic survey of the mesopelagic resources in the Gulf of Oman, Omani EEZ.

Studies on the spawning biology of the mesopelagic fish Benthosema pterotum, distribution and estimation of the mesopelagic fish biomass.

Charting of the main hydrographic conditions of Omani waters in 8 transects.

The scientific staff was:

From the Institute of Marine Research, Bergen:
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Ali Saleh Harassy

NARRATIVE.

The survey started from Muscat on 8 November and the first two days were used to survey the shelf north from Muscat. Thereafter the vessel covered the Omani EEZ of the Oman Gulf south to Ras al Hadd with acoustical transects and four hydrographic sections. During this work the vessel stopped on two occasions to carry out 24-hour site studies on the behaviour and spawning biology of the mesopelagic fish. This work included detailed studies on the vertical migration pattern, net sampling for eggs and larvae and trawl sampling for stomach content analysis , swim bladder anatomy and a delta C 13 analysis of Benthosema pterotum.

The vessel called on Muscat from 17-19 November and thereafter set out to survey the shelf south of Ras al Hadd. The shelf was covered southwards between the 20-300m depth limits with acoustical transects. Bottom and pelagic trawling were carried out whenever identification of the acoustic targets was required. In addition unaimed trawling was carried out in randomly selected locations in order to assess the biomass by means of the swept area method.

Four hydrographic sections were worked south of Ras al Hadd and the surface temperature was continuously recorded by a thermograph.

The main covering of the shelf was completed by the southern border on 6 December. After a call on Salalah the same day the vessel

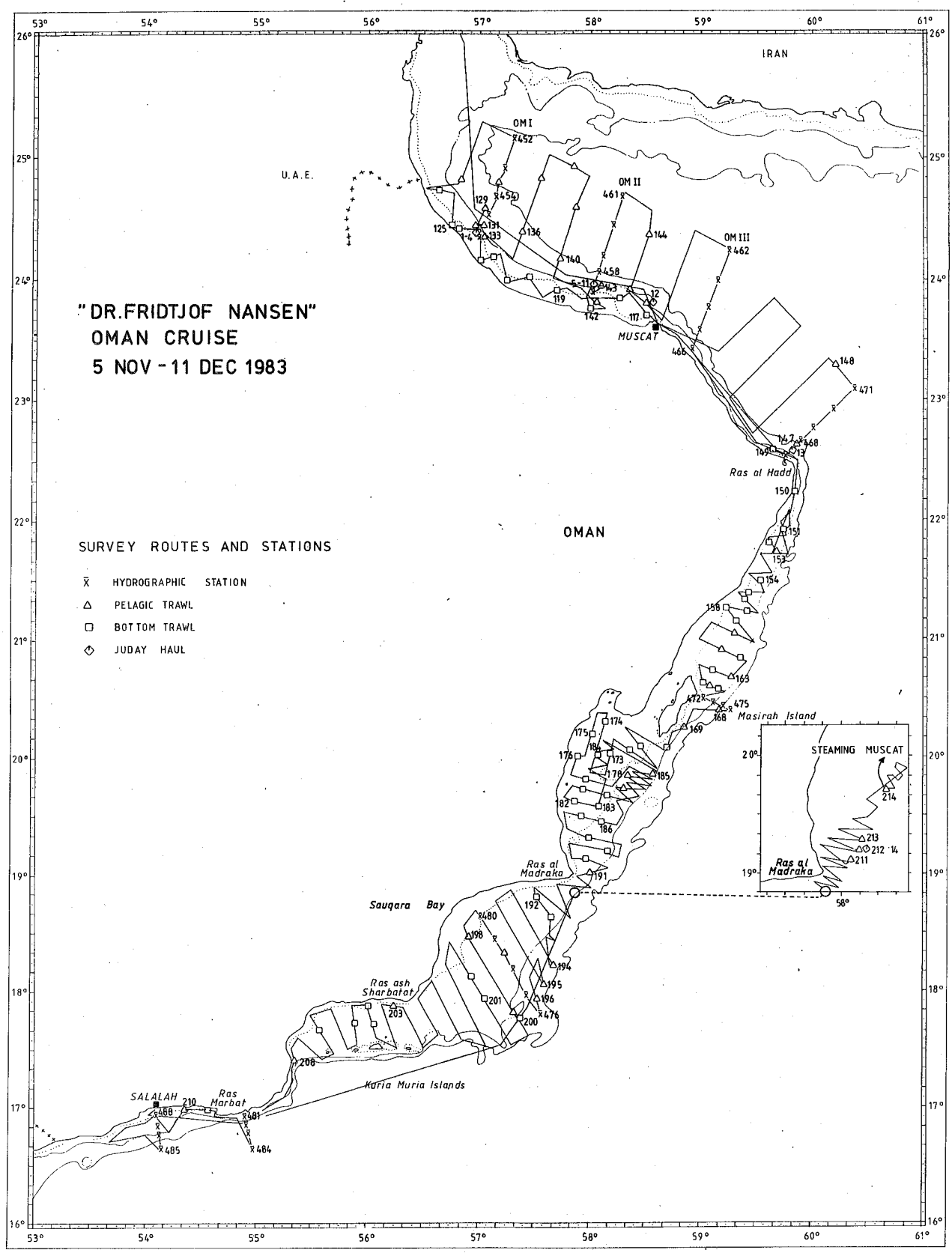

Figure 1. Cruise track and stations worked.

returned to the area off Ras al Madraka where very high densities of horsemackerel were recorded during the southward coverage. A second survey was carried out on these resources in order to improve the accuracy of the acoustic estimates.

The vessel then steamed for a final call on Muscat on 11 December, and left the same day for a one month layup in Dubai.

The cruise track together with trawl stations and hydrographic stations are given in Figure 1.

HYDROGRAPHY

The Oman part of the Gulf was covered with three hydrographic sections (Figures 1 and 2) and from Ras al Hadd to Salalah five sections were laid perpendicular to the coast(Figures 1 and 3). The sections are overlapping the ones worked out during the February-March survey 1983.

The hydrography in the Gulf during the present survey was dominated by a strong thermocline between 30 and 70m depth. The depth of the mixed surface layer was about 50m on the section close to the Strait of Hormuz (OMANGULF I,Figure3) and only 25m deep on the section off Ras al Hadd . As appears in Figure 2 there was only a slight stratification in salinity.

The deeper watermasses were partly influenced by water probably originating in the Persian Gulf. This is most evident on Section I and II where a core of high salinity water was observed between 160 and 300m depth. This watermass can also be seen on Section III between 225 and 325m depth, but not clearly traced on the section off Ras al Hadd (Figure 3).

The influence of the Persian Gulf water is also demonstrated in Figure 4 which shows a core of water with higher temperature and salinity at 250m depth. This watermass follows the continental slope along the coast of Oman, indicating also the direction of the current in the Oman Gulf. This is also seen in the surface water and in water-

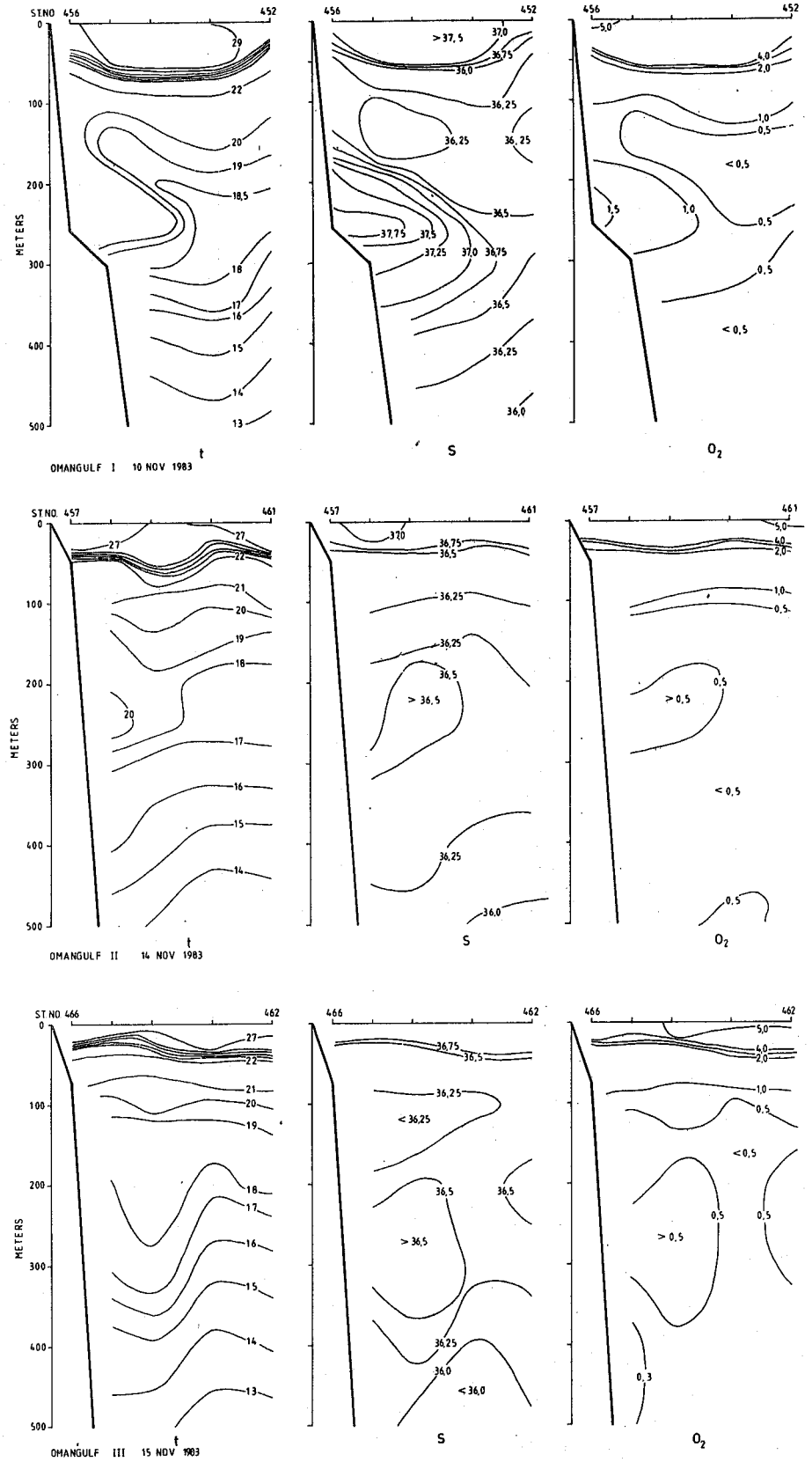

Figure 2. The hydrographical sections in the Gulf of Oman.

masses at 50m depth. From these figures there seems to be a discontinuety in the watermasses and in the direction of the current in the area between Ras al Hadd and Section III just off Muscat. This should

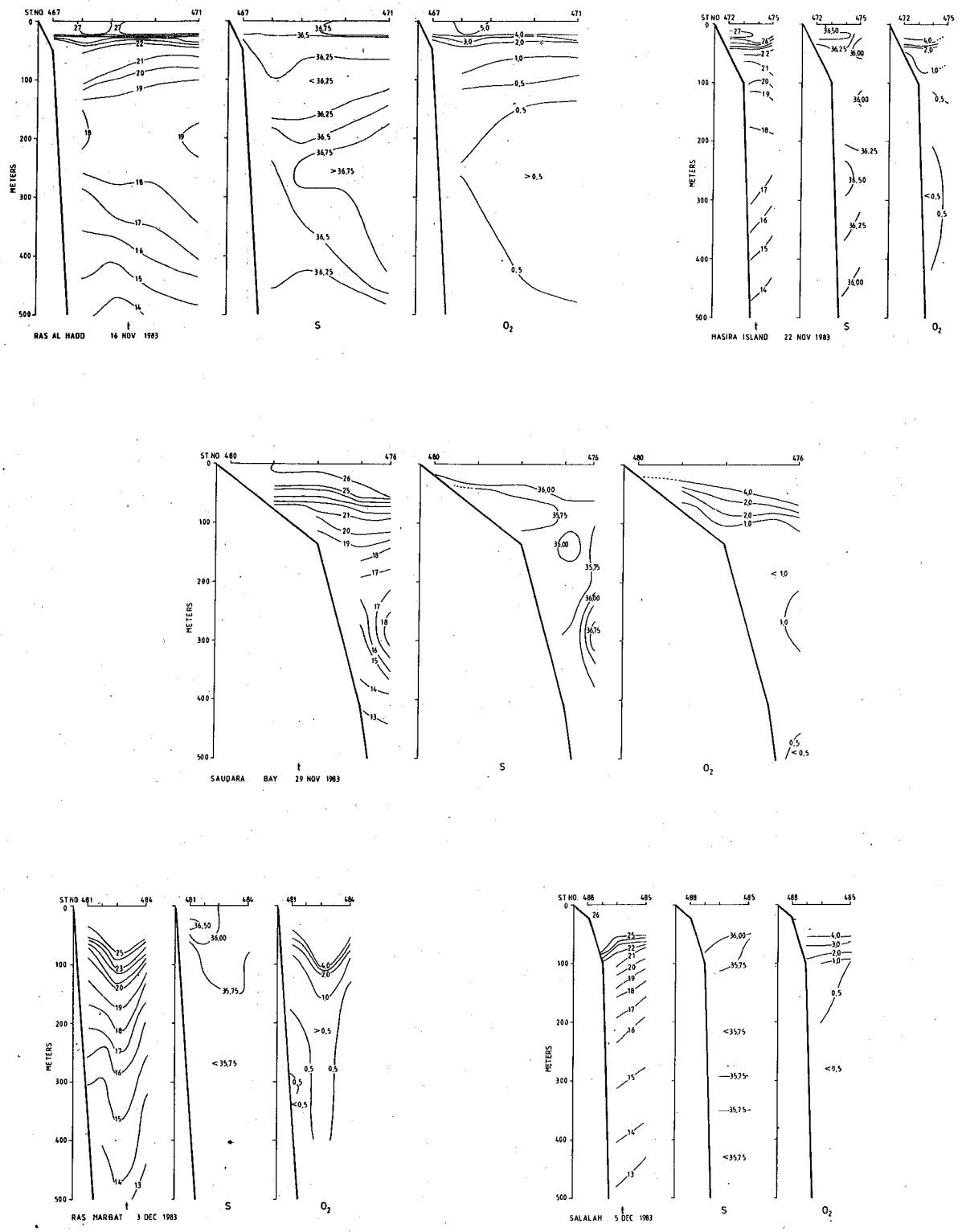

Figure 3. The hydrographical sections from Ras al Hadd- Salalah.

be investigated closer, and a section should be laid out between Section III and Section Ras al Hadd on the next cruise.

The hydrographic features of the watermasses along the Oman coast from Ras al Hadd to Salalah are shown in Figure 3.. The watermasses off Ras al Hadd and Masira Island are dominated by the strong thermo-

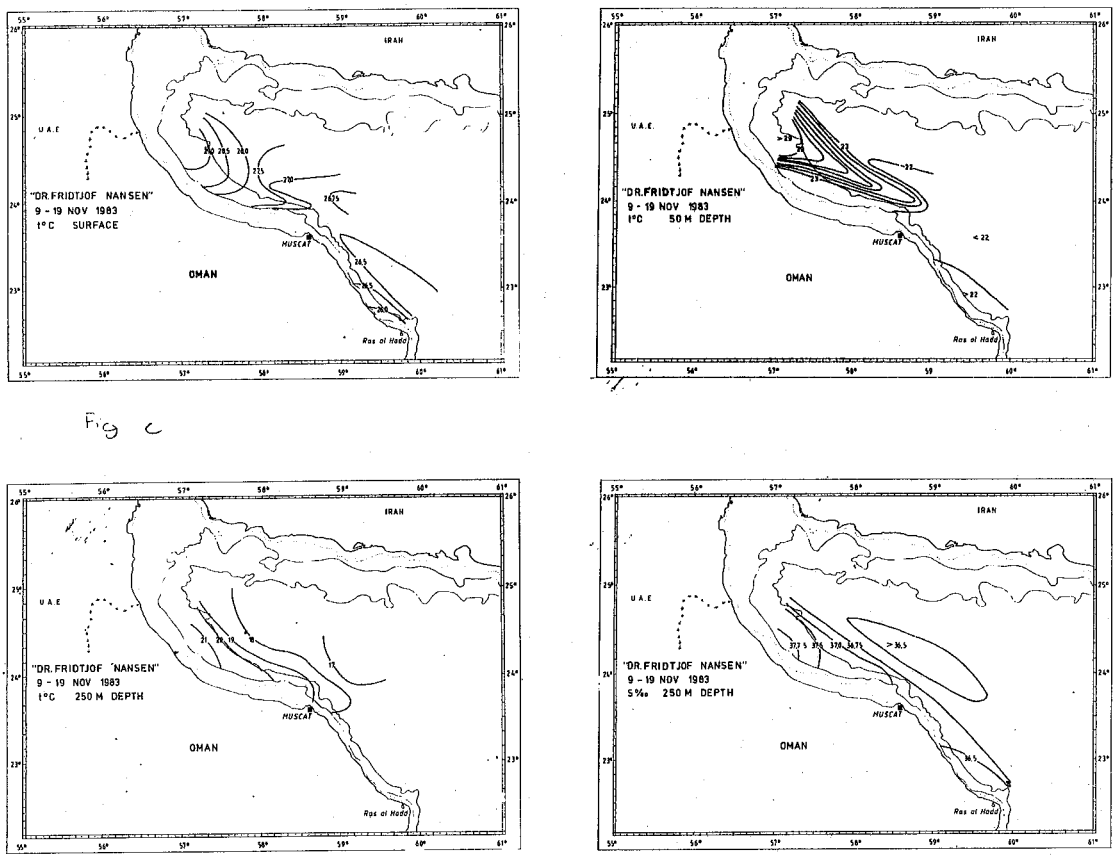

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Figure 4. Horisontal distributions of temperature and salinity in the Gulf of Oman.

cline in the upper 25 - 50m depth. In Sauquara bay and off Ras Marbat, however, the gradient in the thermocline is more continous over a greater depth range from 50 to 110m depth.

The distribution of salinity in these areas paralell that of the temperature with only a slight stratification in the upper surface layers which also was the case in the Gulf of Oman.

As during the previous Oman survey the 1 ml/L oxygen limit is located around 100m depth, except off Ras Marbat where it is located at 150m.

The sections perpendicular to the coast from Ras al Hadd and southwards (Figure 3) generally reflect the post-monsoon conditions and show no upwelling along the coast. The section off Ras Marbat slightly blurs this picture as some upwelling in the deeper watermasses is indicated there. This is assumed to be a local phenomenon caused by interaction between the watercurrents and the protruding landmasses, and does not manifest at the surface (Figure 3).

ACOUSTIC SURVEY, SMALL PELAGIC FISH

The 38 kHz system connected to the echo integrators was used to record the distribution and abundance of small pelagic fish, of demersal fish down to 200m bottom depth and of mesopelagic fish on and off the continental slope. The 120 kHz system was used only as an additional aid in identification and interpretation of the echo traces.

The output from the integrators is expressed in millimeters on graph paper and represents indices of abundance of fish and plankton. The integrator output is separated into plankton and fish according to the echo trace characteristics and the trawl samples.

Figures 5 and 6 show the results obtained during the present survey of small pelagic and demersal fish. Here four levels of fish density are given; very scattered (1-9mm), slightly aggregated (10-24mm), dense (25-99mm) and very dense (>99mm). In areas with high productivity integrator readings up to 10mm are considered representative of a scattered distribution of fish.

The estimates of biomass are (in thousand tonnes):

	Small pelagic	Demersal	Total
North of Ras al Hadd	11	13	24
Ras al Hadd - Masira	115	11	126
Masira Bank	872	12	884
Sauqara & Kuria Muria Banks	420	25	445
Ras al Marbat and westwards	49	1	50
Total	1467	62	1529

The total estimates are thus about 1.5 million tonnes of small pelagi fish and 62 thousand tonnes of other fish. The demersal fish group is acoustically detected only in scattered distributions and despite imprecision the abundance estimates are considered low. Furthermore when both small pelagic and demersal species occur together in low densities misallocation betweem the two groups can easily be made.

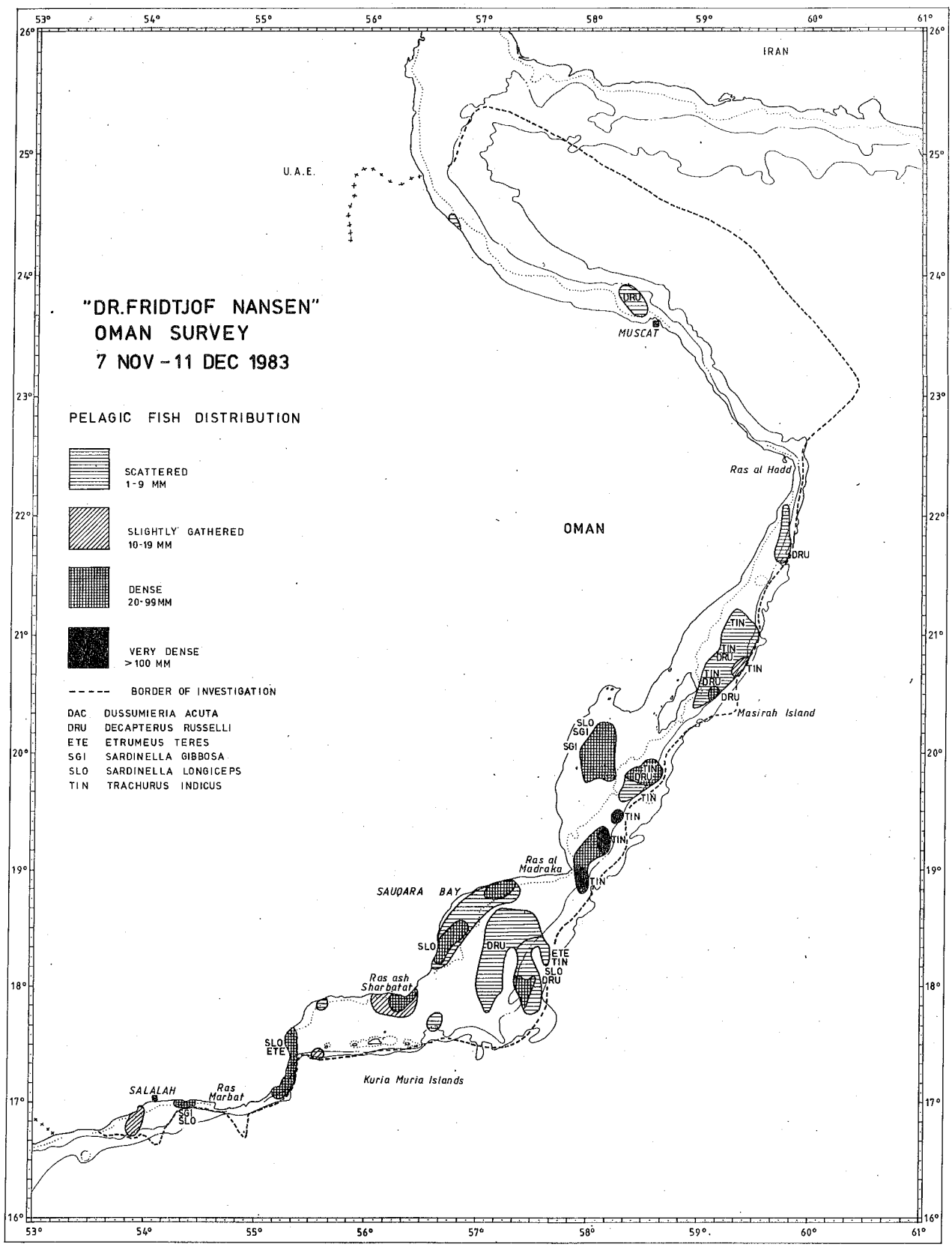


Figure 5. Distribution of small pelagic fish. Echo-intensity by levels of integrator deflection.

During this survey this applies especially to the resources on the Sauqara and Kuria Muria Banks. The demersal group, consisting mostly of demersal or semi-demersal species, is believed to be more accurately assessed by the swept area method (next chapter).

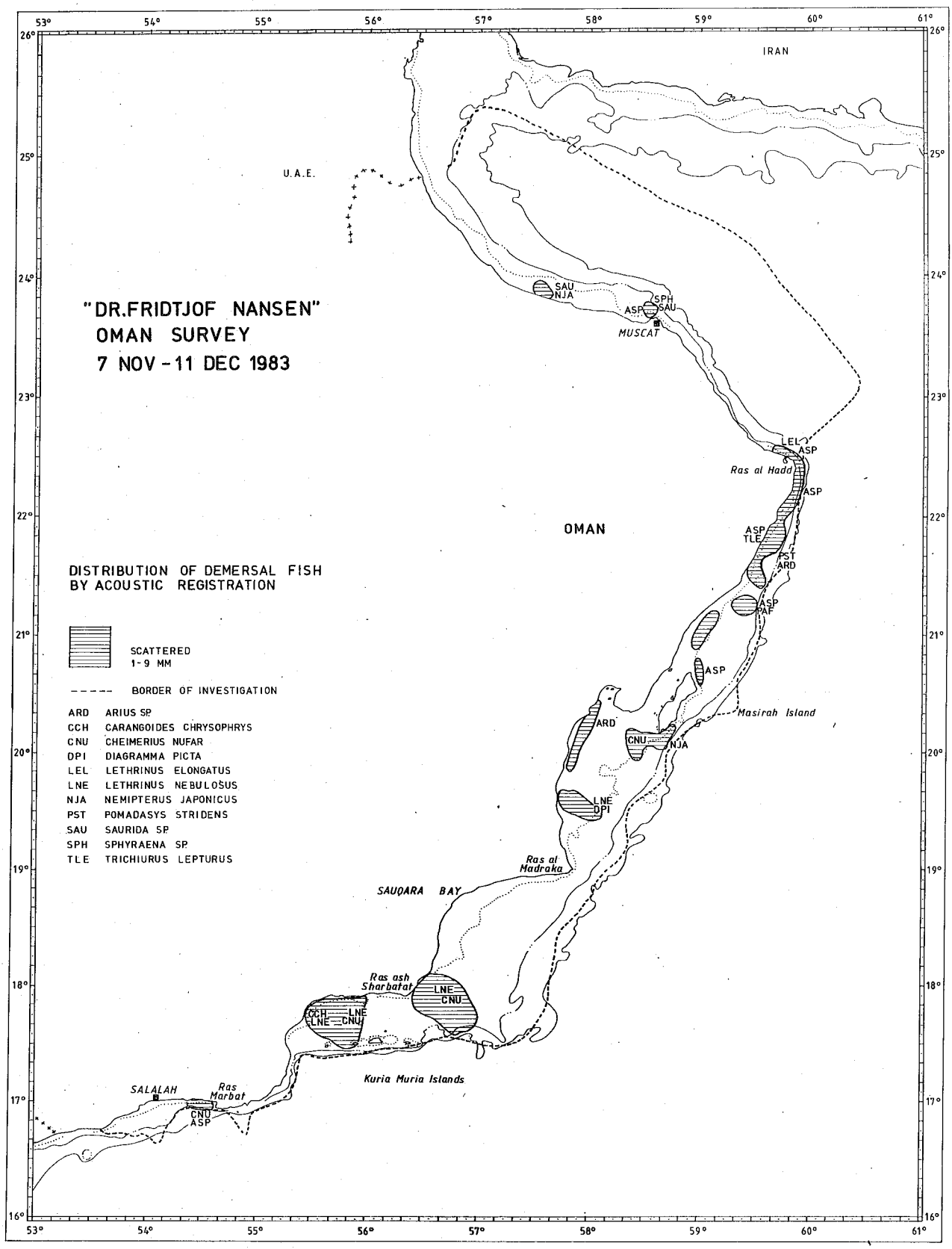


Figure 6. The distribution of "demersal" fish. Echo-intensity by levels of integrator deflection.

Among the dominant pelagic species the clupeids (Sardinella gibbosa and S. longiceps) usually formed aggregates separate from the carangids (Trachurus indicus and Decapterus russelli). The separate estimates

for these two groups give 727 thousand tonnes of clupeids and 739 thousand tonnes of carangids.

From the March-83 survey the biomass estimates were (in thousand tonnes)

	Small pelagic	Demersal	Total
Ras al Hadd - Masira	150	50	200
Masira Bank	600	25	625
Sauquara & Kuria Muria Banks	250	160	410
Total	1000	235	1235

A substantial increase in biomass of small pelagic fish is thus observed.

R/V "Dr. Fridtjof Nansen" has carried out five acoustic surveys in Omani waters during 1975-76. The biomass estimates for the area from Ras al Hadd southward (in thousand tonnes) are

		Pelagic	Demersal
Cruise 1&2	Apr-May -75	80	110
Cruise 3	Oct-Nov -75	820	115
Cruise 4	Feb-Mar -76	570	40
Cruise 5	May-Jun -76	480	125
Cruise 6	Aug-Sep -76	530	125
Mean of all surveys		~500	~100
Mean of four most consistent estimates		600	120

In the years 1975-76 the biomass seemed to consist of 600 thousand tonnes of pelagic and 120 thousand tonnes of demersal fish. The estimates from the last surveys are considerably higher and may indicate that there has been a gradual increase in biomass. It should also be observed that the highest estimates in this series were obtained during the October-November -75 survey. Together with the estimates from the present survey this could indicate an annual peak in the pelagic resources in the fourth quarter.

THE TRAWL SURVEY

During the survey 98 trawl hauls were carried out, of which 40 were with bottom trawl. Of these all except two were selected by random location and thus form a series of data which may be used to estimate the density of fish by the so-called "swept area method". Assuming that all fish within the wings of the bottom trawl were caught the following estimates by location were obtained.

	Ras al Hadd-Masira	Masira Bank	Sauquara & Kuria Muria Banks
Number of fully completed hauls	14	14	10
Mean total catch (kg/hour)	618	1186	380
Estimated density(tonnes/sq.nm)	21	36	12
Shelf area (sq. nm)	2800	3500	5850
Estimated biomass (thousand tonnes)	59	127	74
From the Feb-Mar -83 survey:			
Estimated biomass (thousand tonnes)	100	45	135

In the above figures the small pelagic clupeids and carangids have been excluded from the catches when present and the estimates thus represent the "non-pelagic" species.

The relatively low number of stations makes the estimates vulnerable to statistical variance, especially on the regional level. The high densities on the Masira Bank during the recent survey are influenced by a very high catch on one station. The same applies to the March estimates from the Ras al Hadd - Masira region and thus we cannot conclude that any real changes have occurred in the abundance of demersal fish. By comparing the totals the sampling variance has less effect on the estimates; the total figures are 260 and 280 thousand tonnes for the recent and the earlier surveys respectively, i.e. practically the same amount.

FISH DISTRIBUTION BY SPECIES

The catch data with main species are given in Annex I.

The dominant pelagic species are Trachurus indicus, Decapterus russelli, Sardinella gibbosa and S. longiceps. Etrumeres teres, Dussumieria acuta and Scomber japonicus were also common, but in much lesser abundances.

In the region north of Ras al Hadd the pelagic resources were scarce. Off Muscat a scattered distribution of Decapterus russelli was observed (Figure 5).

From Ras al Hadd south to Masira Island the small pelagics resources were made up of Decapterus russelli and Trachurus indicus, mainly in scattered distributions. Two small aggregations were observed near the shelf edge (Figure 5).

On the Masira bank the outer part was dominated by dense registrations of Trachurus indicus while the inner part held considerable resources of Sardinella gibbosa and Sardinella longiceps with an element of juvenile Trachurus indicus.

In Sauqara Bay the shallow areas showed dense registrations of Sardinella longiceps while the outer part had mostly a scattered distribution of a mixture of Decapterus russelli, Trachurus indicus Etrumeus teres and Sardinella longiceps.

Further westwards the small pelagic resources were made up of clupeoid resources; Sardinella longiceps, S. gibbosa and Etrumeus teres (Figure 5).

Dominating demersal species were Lethrinus nebulosus, Cheimerius nufar and Argyrops spinifer. Frequent in the catches, although in lesser quantities, were Nemipterus japonicus, Ephinephelus diacanthus, Arius thalassinus and Lepidotrigla bentuviae.

Tables 1-4 give catch data by family in bottom trawl sorted according to catch groups and bottom depth strata. Table 1 deals with the hauls north of Muscat, Table 2 from Ras al Hadd to Masira Island, Table 3 the Masira Bank and Table 4 with the Sauquara and Kuria Muria Banks.

Table 1. Distribution of catches in bottom trawl by family and bottom depth strata on shelf north of Muscat.

FAMILY	Number of hauls in catch groups (kg/hour)					% incidence in tot. no. of hauls	Mean c. of c. >1kg	% of total catch	MEAN CATCH IN BOTTOM DEPTH STRATA (Kg/hour)			
	1-9	10-49	50-199	200-499	>500				<20m	20- 50m	50-200m	>200m
Carangidae	3	4	2	0	1	100	235.1	36	.0	44.6	520.8	.0
Synodontidae	4	1	4	0	1	100	124.6	19	.0	157.0	76.1	.0
Sphyraenidae	5	4	0	1	0	100	62.8	10	.0	21.2	125.2	.0
Nemipteridae	1	4	3	0	0	80	56.7	7	.0	35.4	60.2	.0
Lutjanidae	2	2	1	0	0	50	46.6	4	.0	34.2	6.9	.0
Squids	3	5	2	0	0	100	23.3	4	.0	24.0	22.3	.0
Pomadasyidae	1	1	2	0	0	40	50.5	3	.0	28.7	7.5	.0
Sparidae	4	2	2	0	0	80	23.0	3	.0	13.4	25.8	.0
Drepanidae	0	1	1	0	0	20	49.4	2	.0	16.5	.0	.0
Lethrinidae	2	2	1	0	0	50	30.4	2	.0	19.1	9.2	.0
Ariommidae	2	1	0	0	0	30	10.7	1	.0	5.2	.3	.0
Fistularidae	4	1	0	0	0	50	6.6	1	.0	1.5	6.0	.0
Leiognathidae	0	2	0	0	0	20	29.5	1	.0	9.8	.0	.0
Monocanthidae	2	1	0	0	0	30	10.0	1	.0	4.2	1.2	.0
Mullidae	1	3	0	0	0	40	19.0	1	.0	6.6	9.2	.0
Muraenesocidae	0	2	0	0	0	20	25.8	1	.0	5.5	4.7	.0
Plathycephal.	4	2	0	0	0	60	13.5	1	.0	6.5	10.4	.0
Psettodiae	2	2	0	0	0	40	13.6	1	.0	9.1	.0	.0
Rays	1	0	1	0	0	20	38.4	1	.0	12.8	.0	.0
Sciaenidae	0	1	0	0	0	10	35.0	1	.0	.0	8.8	.0
Scombridae	1	1	0	0	0	20	14.5	1	.0	4.7	.3	.0
Sharks	1	2	0	0	0	30	19.5	1	.0	.0	14.6	.0
Other fish							10.1	1				
MEAN OF TOTAL CATCHES							649.9		.0	467.4	923.6	.0
NUMBER OF HAULS		10 TOTAL							0	6	4	0

Table 2. Distribution of catches in bottom trawl by family and bottom depth strata on shelf from Ras al Hadd to Masira Island.

FAMILY	Number of hauls in catch groups (kg/hour)					% incidence in tot. no. of hauls	Mean c. of c. >1kg	% of total catch	MEAN CATCH IN BOTTOM DEPTH STRATA (kg/hour)			
	1-9	10-49	50-199	200-499	>500				<20m	20- 50m	50-200m	>200m
Sparidae	1	5	1	1	3	85	293.0	38	.0	371.3	142.1	.0
Carangidae	2	2	7	0	1	92	123.0	17	.0	52.9	165.5	.0
Nemipteridae	4	2	2	0	1	69	123.8	13	.0	1.8	157.7	.0
Ariidae	3	2	1	0	1	54	149.0	12	.0	171.5	2.0	.0
Pomadasyidae	2	2	3	1	0	62	101.6	10	.0	111.3	20.7	.0
Trichiuridae	0	0	1	1	0	15	167.1	4	.0	55.7	.0	.0
Lethrinidae	1	1	1	0	0	23	36.0	1	.0	8.3	8.3	.0
Serranidae	2	2	0	0	0	31	12.0	1	.0	3.9	3.5	.0
Sphyraenidae	2	0	1	0	0	23	30.3	1	.0	13.4	1.5	.0
Synodontidae	2	4	0	0	0	46	19.7	1	.0	4.5	13.0	.0
Triglidae	3	2	0	0	0	39	15.4	1	.0	5.0	6.7	.0
Other fish							10.4	1				
MEAN OF TOTAL CATCHES							660.0		.0	820.2	522.8	.0
NUMBER OF HAULS		13 TOTAL							0	6	7	0

Table 3. Distribution of catches in bottom trawl by family and bottom depth strata on Masira Bank

FAMILY	Number of hauls in catch groups (kg/hour) 1-9	10-49	50-199	200-499	>500	% incidence in tot. no. of hauls	Mean c. of c. >1kg	% of total catch	MEAN CATCH IN BOTTOM DEPTH STRATA (kg/hour) <20m	20- 50m	50-200m	>200m
Sciaenidae	0	1	0	0	1	13	4612.2	40	1535.7	2.1	.0	.0
Carangidae	0	3	5	1	2	73	664.3	32	113.5	18.9	1632.8	.0
Ariidae	3	3	2	0	1	60	154.4	6	219.5	14.5	.0	.0
Rays	0	2	1	2	1	40	225.8	6	202.4	28.0	.0	.0
Lethrinidae	0	0	2	0	1	20	391.1	5	176.7	22.6	.0	.0
Triglidae	0	0	0	0	1	7	708.4	3	.0	141.7	.0	.0
nemiteridae	2	1	1	1	0	33	91.3	2	15.3	.0	91.2	.0
Sparidae	2	1	2	1	0	40	79.3	2	28.4	61.0	.0	.0
Pomadasyidae	1	1	2	0	0	27	67.4	1	28.2	20.1	.0	.0
Sharks	1	1	1	0	0	20	75.1	1	36.5	1.2	.0	.0
Squids	2	3	0	0	0	33	21.4	1	8.4	11.4	.0	.0
Other fish							35.4	2				
MEAN OF TOTAL CATCHES							1548.1		2420.6	359.0	1725.7	.0
NUMBER OF HAULS		15 TOTAL							6	5	4	0

Table 4. Distribution of catches in bottom trawl by family and bottom depth strata on Sauqara and Kuria Muria Banks.

FAMILY	Number of hauls in catch groups (kg/hour) 1-9	10-49	50-199	200-499	>500	% incidence in tot. no. of hauls	Mean c. of c. >1kg	% of total catch	MEAN CATCH IN BOTTOM DEPTH STRATA (kg/hour) <20m	20- 50m	50-200m	>200m
Carangidae	2	3	1	0	1	70	896.3	64	.0	62.8	1014.3	.0
Lethrinidae	0	0	3	2	0	50	193.5	10	.0	105.3	108.6	.0
Sparidae	0	1	3	2	0	60	145.5	9	.0	102.4	94.3	.0
Serranidae	1	3	2	0	0	60	63.1	4	.0	33.2	46.5	.0
Champsodontidae	0	0	0	1	0	10	230.4	2	.0	.0	.0	230.4
Ophidiidae	0	0	1	0	0	10	144.0	2	.0	.0	.0	144.0
Squids	1	0	1	0	0	20	78.8	2	.0	49.7	1.4	.0
Ariidae	0	1	0	0	0	10	48.2	1	.0	16.1	.0	.0
Centrolophidae	0	0	1	0	0	10	67.2	1	.0	.0	.0	67.2
Lutjanidae	0	3	0	0	0	30	26.0	1	.0	11.6	7.2	.0
Monacanthidae	0	3	0	0	0	30	15.6	1	.0	11.5	2.0	.0
Nemipteridae	0	1	1	0	0	20	33.2	1	.0	17.3	2.4	.0
Pomadasyidae	0	2	0	0	0	20	25.6	1	.0	17.1	.0	.0
Synodontidae	0	1	1	0	0	20	50.7	1	.0	.0	16.9	.0
Triglidae	0	1	1	0	0	20	46.0	1	.0	.0	6.0	56.0
Other fish							22.5	2				
MEAN OF TOTAL CATCHES							980.2		.0	467.5	1305.4	566.8
NUMBER OF HAULS		10 TOTAL							0	3	6	1

Pelagic trawling carried out with the research vessel is mainly carried out to identify the acoustic registations and the catches do not reflect the quantities that could be expected in a commercial fishery where gear and engine power are optimalized. With this borne in mind table 5 gives catch distributions of the pelagic hauls carried out on the Masira Bank.

Table 5. Distribution of catches in pelagic trawl by family and bottom depth strata on Masira Bank.

FAMILY	Number of hauls in catch groups (kg/hour) 1-9	10-49	50-199	200-499	>500	% incidence in tot. no. of hauls	Mean c. of c. >1kg	% of total catch	MEAN CATCH IN BOTTOM DEPTH STRATA (kg/hour) <20m	20- 50m	50-200m	>200m
Carangidae	1	0	2	0	6	90	3574.5	93	.0	345.9	4447.5	.0
Sphyraenidae	1	0	1	0	1	30	404.1	4	.0	37.5	157.1	.0
Clupeidae	0	0	1	0	1	20	360.4	2	.0	240.3	.0	.0
Sharks	0	0	0	1	0	10	247.8	1	.0	82.6	.0	.0
Other fish							21.6	0				
MEAN OF TOTAL CATCHES							3456.7		.0	755.4	4614.5	.0
NUMBER OF HAULS			10 TOTAL						0	3	7	0

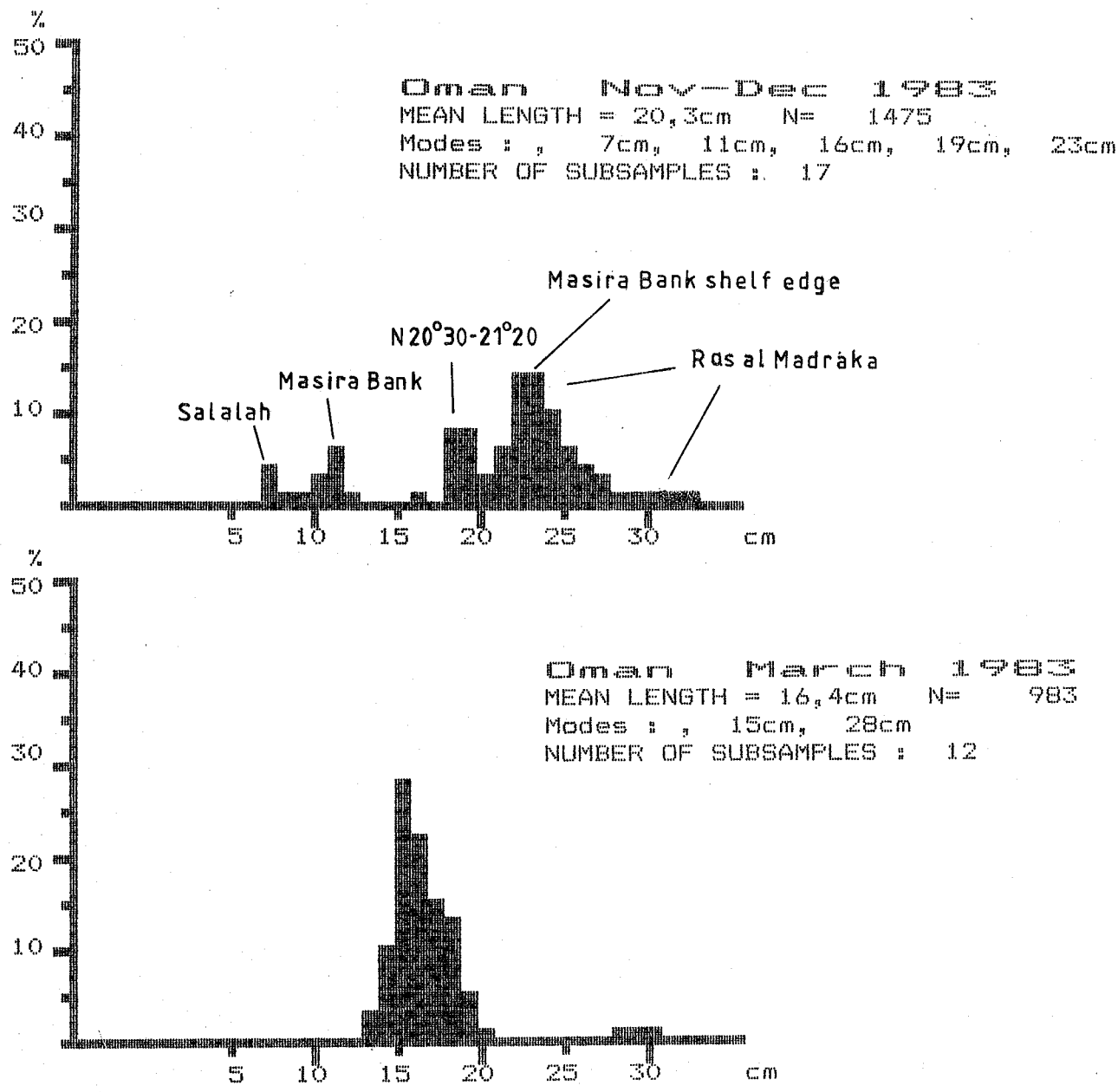


Figure 7. Trachurus indicus (pooled data)

Length distributions from samples of the dominating pelagic species are given in Annex II. Figures 7 and 8 show the pooled length frequency distributions from the statistically unweighted samples of Trachurus indicus and Decapterus russelli. The corresponding distributions from the March 1983 survey are included in the figures for comparison. From Figure 7 it will be seen that in Trachurus indicus the modal length in March corresponds to the 23 cm modal

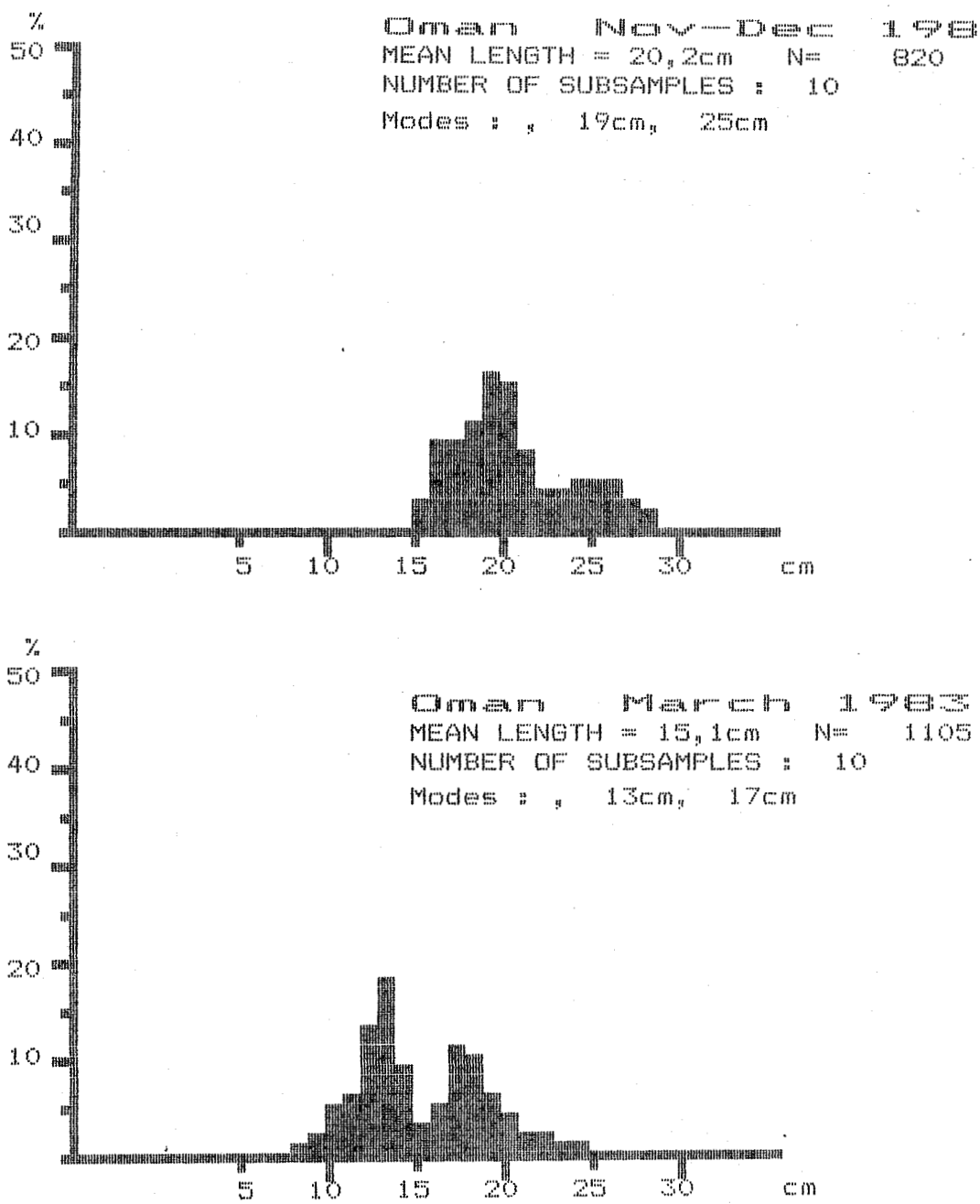


Figure 8. Decapterus russelli

(pooled data)

length in December, thus indicating an average growth of 8 cm in 9 months. Juvenile fish in the range of 7-12 cm are observed in December. These are not yet recruited to the main stock near the shelf edge off Masira Bank, but form separate aggregations in shallower waters on Masira Bank and a little east of Salalah. All specimens bigger than 30 cm were caught near Ras al Madraka. The length frequency distribution of Decapterus russelli was observed with two modes in March; 13 and 17cm, and these have increased to 19 and 25cm respectively in the last survey, giving an average growth of 6 and 8cm respectively. As the peaks in the length distribution do not seem to indicate any location dependent growth, two annual spawning periods could be suggested. Longer time periods of data will reveal this pattern more clearly, and in addition to the data gathered from the Fridtjof Nansen surveys the analysis on growth and spawning periods of would benefit from simple length frequency measurements of samples taken locally on a monthly basis. We consider this especially important for the dominating short living small pelagic species.

MESOPELAGIC FISH

The Oman portion of the Gulf of Oman was surveyed from the UAE border to Ras al Hadd between November 9-19, 1983.

The mesopelagic fish are found off the continental shelf in waters deeper than 100 m. During previous surveys in the Gulf of Oman two sound-scattering layers were usually observed during both daytime and nighttime, with a typical depth distribution as presented in Table 6.

Table 6. Depth distribution of the mesopelagic fish layers in The Gulf of Oman.

Time	Layer	Depth	Vertical extension
Day	DI	150	40
	DII	250	80
Night	NI	50	70
	NII	225	70

During the present survey DI, DII and NI, NII were only observed in a few areas close to the continental slope in the inner part of the Gulf and north of Muscat (see Fig. 9). The average integrator deflection of the DI layer was 136 mm/n.mile and only 7 mm/n.mile for NII layer in areas where these layers were observed. However, in the main part of the surveyed area only one layer was found and was identified as DII at daytime and NI at night. The distribution of the mesopelagic fish in these layers is presented in Fig 9.

To estimate the amount of mesopelagic fish in the upper mixed layer, the recordings of plankton during daytime in the same or a nearby area were subtracted. The average echo abundances are shown in Table 7 where they are compared to the results of the surveys in February and March 1983.

Table 7. Echo abundance (mm integrator deflection)in the Gulf of Oman from the present survey compared to the surveys in February and March 1983.

	DAY			NIGHT		
Survey	No. five n. miles	DII mean	SD	No. five n. miles	NI mean	SD
Feb. W 58 E	25	232	145	40	94	73
E 58 E	50	135	151	25	113	91
Mar. W 58 E	26	119	88	31	100	40
E 58 E	36	67	91	25	61	40
Nov. W 58 E	27	272	222	31	89	37
E 58 E	34	104	70	19	66	19

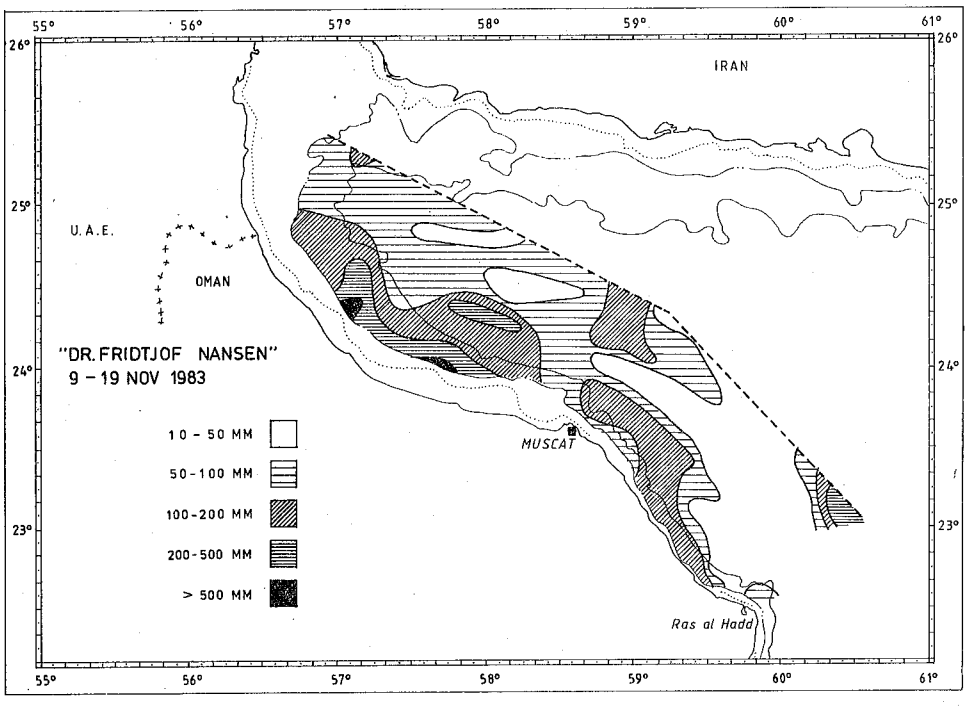


Figure 9. Distribution of mesopelagic fish. Echo intensity by levels of integrator deflection.

The echo abundance was converted to biomass using the equation

$$B = CL\bar{M}A$$

where B is biomass in tonnes, C is the conversion factor estimated for small pelagic fishes as 0.6L and L is standard length in cm (here a fish length of 3.5 cm was used). M is the average integrator deflection in mm/n. mile and A is the area in square n. miles.

The area of the inner part of the Gulf (W of 58 E 7000 sq. n. miles and the outer part (E of 58 E) to 15000 sq. n. miles. The results are compared to those from February and March 1983 and are presented in Table 8.

Table 8. Estimated biomass of mesopelagic fish in the Gulf of Oman in February, March and November 1983 (million tonnes).

	DAY	NIGHT	AVERAGE
Feb.	9,6	6,4	8,0
Mar.	5,6	3,8	4,7
Nov.	5,8	2,7	4,3

Gjøsæter and Tilseth (1983) proposed that the average value of 6,4 mill.tonnes probably gave the best estimate of the total biomass in the Gulf of Oman in February-March 1983. They based their calculations on the assumption that the cruise tracks provided a representative coverage of the whole Gulf including the Iranian waters. During the present survey the same cruise tracks were repeated and the biomass calculated according to Gjøsæter and Tilseth (1983). The variance of the estimates from the present survey was at about the same level as that from the surveys in February and March. The average standard length of the fish, however, was only 2,8 cm compared to 3,5 cm in February - March which gives 2,1 mill.tonnes lower average biomass for November.

From a fisheries point of view, a nearly absent DI layer during the present survey would indicate areas of lower catch than in February-March as fishing trials gave the best results in the presence of this layer (Scharfe, 1983).

During previous cruises carried out in 1981 by Aglen et al. (1981) and 1983 by Gjøsæter and Tilseth (1983) day recordings were higher than night recordings, as was the case during the present survey (see Table 8). This could be caused by some of the fish lying close enough to the surface to escape detection.

The fish became more concentrated during full moon, confirming previous observations. Under such conditions and with the addition of artificial lights good catches of mesopelagic fish could be made (Gjøsæter and Tilseth, 1983).

During the present survey Juday net (80 cm in diam, 375 um mesh size) hauls were taken to identify the spawning areas of mesopelagic fish (Benthosoma pterotum). Eggs were, however, only found in one haul (see Fig. 10) and at extremely low density. The density of larvae in the area was also significantly lower than in February-March and consequently the month of November does not seem to be an important spawning period.

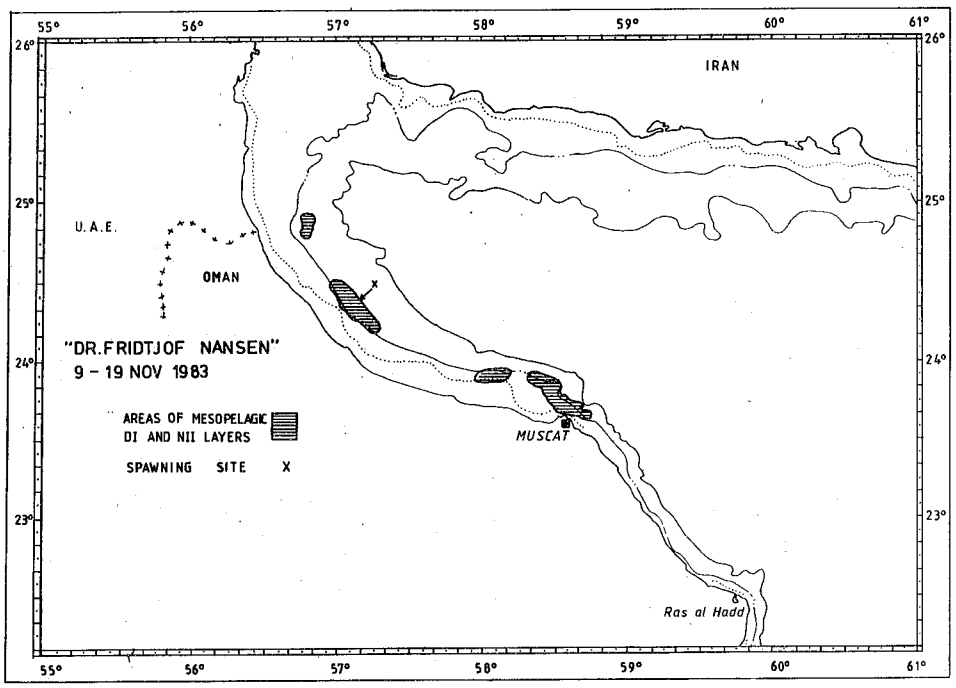


Figure 10. Distribution of the DI and NII layers.

Gear codes: BT = Bottom trawl, PT = Pelagic trawl

APPENDIX I

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
08.11	1715	117	BT	71	71	N23 44'	E058 30'	1347,0	2694,0	Decapterus russelli	1936,00	71,8
										Spyraena putnamiae	452,00	16,7
										Saurida undosquamis	106,00	3,9
										Argyrops spinifer	70,00	2,5
08.11	2020	118	BT	59	59	N28 49'	E058 13'	282,7	565,4	Saurida tumbil	176,26	31,1
										Nemipterus japonicus	87,38	15,4
										SEPIIDAE	52,50	9,2
										Nemipterus bleekeri	43,50	7,6
09.11	0110	119	BT	44	44	N23 54'	E057 42'	639,9	1279,8	Saurida tumbil	812,00	63,4
										Nemipterus sp.	147,00	11,4
										SEPIIDAE	53,90	4,2
										Upeneus sulphureus	36,40	2,8
09.11	0550	120	BT	39	39	N24 02'	E057 25'	116,0	232,0	Saurida tumbil	59,40	25,6
										SEPIIDAE	39,00	16,8
										Leiognathus fasciatus	33,00	14,2
										Lutjanus lutjanus	18,00	7,7
09.11	0800	121	BT	34	34	N24 00'	E057 14'	81,6	163,2	Saurida tumbil	52,00	31,8
										Drepane punctata	44,20	27,0
										Argyrops filamentosus	8,70	5,3
										Plectorhynchus sp.	8,00	4,9
										Psettodes erumei	24,00	14,7
09.11	1045	122	BT	57	57	N24 12'	E057 07'	108,0	216,0	Spyraena putnamiae	40,00	18,5
										Carangoides malabaricus	123,60	57,2
										SEPIIDAE	13,80	6,3
										Nemipterus sp.	11,00	5,0
09.11	1240	123	BT	20	20	N24 08'	E056 58'	243,1	486,2	MYLIOBATINAE	57,60	11,8
										Drepane longmana	54,60	11,2
										Diagramma picta	44,40	9,1
										Lethrinus sp.	38,40	7,8
09.11	1540	124	BT	46	46	N24 26'	E056 51'	97,2	194,4	Spyraena putnamiae	39,60	20,3
										Rastrelliger kanagurta	28,00	14,4
										Arioma indica	24,00	12,3
										Carangoides malabaricus	23,20	11,9
09.11	1715	125	BT	33	33	N24 29'	E056 45'	187,0	448,8	Argyrops spinifer	60,48	13,4
										Diagramma picta	56,16	12,5
										Lutjanus lutjanus	76,08	16,9
										Lethrinus miniatus	25,68	5,7
09.11	2010	126	BT	100	100	N24 45'	E056 40'	109,6	219,2	Nemipterus japonicus	66,00	30,1
										SCIAENIDAE	35,00	15,9
										Parupeneus sp.	16,80	7,6
										SEPIIDAE	15,00	6,8

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
10.11	0000	127	PT	310	50	N24 50'	E056 50'	80,0	160,0	MYCTOPHIDAE	151,20	94,5
										Trichiurus lepturus	8,80	5,5
10.11	0920	128	PT	>500	300	N24 47'	E057 09'	22,2	44,4	MYCTOPHIDAE	40,00	90,0
										Trichiurus lepturus	,80	1,8
										LOLIGINIDAE	3,00	6,7
										Decapterus russelli	,60	1,3
10.11	1300	129	PT	372	260	N24 34'	E057 03'	20,8	41,6	Trichiurus lepturus	4,00	9,6
										SALPS	1,00	2,4
										LOLIGINIDAE	,50	1,2
										MYCTOPHIDAE	36,00	86,5
10.11	1515	130	PT	292	125	N24 05'	E057 00'	60,0	120,0	MYCTOPHIDAE	120,00	100,0
10.11	1935	131	PT	300	50	N24 27'	E057 02'	125,0	250,0	MYCTOPHIDAE	250,00	100,0
10.11	2350	132	PT	292	40	N24 27'	E056 59'	360,0	720,0	MYCTOPHIDAE	720,00	100,0
11.11	0450	133	PT	275	50	N24 21'	E057 03'	330,0	660,0	MYCTOPHIDAE	660,00	100,0
11.11	1005	134	PT	287	250	N24 27'	E056 59'	41,0	82,0	MYCTOPHIDAE	82,00	100,0
11.11	1125	135	PT	292	175	N24 27'	E056 59'	902,0	1804,0	MYCTOPHIDAE	1800,00	99,7
11.11	1850	136	PT	>500	45	N24 23'	E057 23'	66,0	132,0	MYCTOPHIDAE	132,00	100,0
11.11	2215	137	PT	>500	40	N24 49'	E057 34'	55,0	110,0	MYCTOPHIDAE	110,00	100,0
12.11	0145	138	PT	>500	20	N24 54'	E057 51'	16,0	32,0	MYCTOPHIDAE	12,60	39,3
										Selar crumenophthalmus	7,60	23,7
										JELLYFISH	5,00	15,6
										Trichiurus lepturus	2,00	6,2
12.11	0455	139	PT	>500	25	N24 35'	E057 52'	15,4	30,8	Selar crumenophthalmus	9,80	31,8
										Cubiceps sp.	15,80	51,2
										Sardinella longiceps	4,00	12,9
										SCOMBRIDAE	,60	1,9
12.11	0825	140	PT	>500	340	N24 11'	E057 43'	10,8	21,6	MYCTOPHIDAE	16,40	75,9
										Selar crumenophthalmus	2,40	11,1
										Sardinella longiceps	,60	2,7
										Lestidium sp.	,50	2,3

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
12.11	1305	141	PT	22	1	N23 48'	E058 01'	1,0	2,0	JELLYFISH	2,00	100,0
12.11	1535	142	BT	18	18	N23 46'	E058 00'	181,4	362,8	Saurida tumbil	81,20	22,3
										Gerres filamentosus	49,80	13,7
										Gnathanodon speciosus	37,80	10,4
										R A Y S	36,00	9,9
13.11	1015	143	PT	370	280	N23 56'	E058 05'	21,3	42,6	MYCTOPHIDAE	38,00	89,2
										LOLIGINIDAE	2,80	6,5
										Trichiurus lepturus	1,80	4,2
14.11	1840	144	PT	>500	30	N24 22'	E058 32'	233,0	466,0	MYCTOPHIDAE	409,60	87,8
										Cubiceps sp.	56,40	12,1
14.11	2245	145	PT	410	225	N23 54'	E058 23'	25,0	50,0	MYCTOPHIDAE	50,00	100,0
15.11	0200	146	PT	>500	225	N23 48'	E058 32'	19,8	39,6	MYCTOPHIDAE	1,40	3,5
										Trichiurus lepturus	23,40	59,0
										Trachinocephalus sp.	11,90	30,0
										Cubiceps sp.	,80	2,0
16.11	0430	147	PT	>500	25	N22 37'	E059 51'	34,3	68,6	MYCTOPHIDAE	44,00	64,1
										Cubiceps sp.	9,60	13,9
										Saurida tumbil	9,60	13,9
										Selar crumenophthalmus	3,80	5,5
16.11	1315	148	PT	>500	290	N23 17'	E060 11'	9,6	19,2	MYCTOPHIDAE	12,40	64,5
										Cubiceps sp.	4,00	20,8
										C E P H A L O P O D A	1,20	6,2
										Sphyraena obtusata	,60	3,1
20.11	0615	149	BT	49	49	N22 35'	E059 41'	574,2	1148,4	Lethrinus elongatus	448,60	39,0
										Argyrops spinifer	229,80	20,0
										Sphyraena africana	151,80	13,2
										Lethrinus nebulosus	94,20	8,2
20.11	0945	150	BT	39	39	N22 14'	E059 50'	823,3	1646,6	Argyrops spinifer	1440,00	87,4
										Sphyraena africana	57,20	3,4
										Carangoides chrysophrys	55,60	3,3
										Gnathanodon speciosus	27,00	1,6
20.11	1420	151	BT	52	52	N21 55'	E059 45'	639,4	1278,8	Argyrops spinifer	441,60	34,5
										Trichiurus lepturus	247,20	19,3
										Lethrinus nebulosus	44,00	3,4
										Pomadasys stridens	152,00	11,8
20.11	1705	152	BT	35	35	N21 49'	E059 38'	744,6	1489,2	Pomadasys stridens	377,40	25,3
										Arius thalassinus	832,00	55,8
										Trichiurus lepturus	87,00	5,8
										Argyrops spinifer	117,20	7,8

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
20.11	1940	153	PT	110	65	N21 43'	E059 41'	132,6	265,2	Decapterus russelli	265,20	100,0
21.11	0620	154	BT	61	61	N21 29'	E059 32'	757,1	1514,2	Argyrops spinifer	445,40	29,4
										Trachurus indicus	385,40	25,4
										Decapterus russelli	206,00	13,6
										Nemipterus japonicus	130,20	8,5
21.11	0845	155	BT	51	51	N21 24'	E059 26'	20,3	40,6	Argyrops spinifer	25,60	63,0
										Nemipterus japonicus	6,80	16,7
										Pomadasys stridens	4,00	9,8
										Pagellus affinis	2,70	6,6
21.11	1045	156	BT	53	53	N21 21'	E059 23'	33,4	66,8	Argyrops spinifer	31,00	46,4
										Trachurus indicus	11,20	16,7
										Carangoides chrysophrys	9,40	14,0
										Megalaspis cordyla	5,40	8,0
21.11	1325	157	BT	66	66	N21 14'	E059 25'	254,8	509,6	Argyrops spinifer	158,60	31,1
										Pagellus affinis	121,80	23,9
										Trachurus indicus	105,80	20,7
										Decapterus russelli	34,50	6,7
21.11	1545	158	BT	24	24	N21 16'	E059 13'	174,8	349,6	Arius tenuispinis	155,00	44,3
										Pomadasys opercularis	90,00	25,7
										Argyrops spinifer	35,20	10,0
										Lepidotrigla bentuviai	30,00	8,5
21.11	1725	159	BT	61	61	N21 09'	E059 19'	109,6	219,2	Trachurus indicus	118,80	54,1
										Pomadasys stridens	85,20	38,8
										Nemipterus japonicus	3,60	1,6
										Arius tenuispinis	9,60	4,3
21.11	2125	160	PT	72	62	N21 03'	E059 17'	1020,0	2040,0	Trachurus indicus	2040,00	100,0
22.11	0210	161	PT	65	40	N20 55'	E059 10'	1199,7	2399,4	Pomadasys stridens	1586,80	66,1
										Trachurus indicus	677,20	28,2
										Decapterus russelli	116,00	4,8
22.11	0615	162	BT	104	104	N20 49'	E059 21'	82,4	164,8	Decapterus russelli	84,60	51,3
										Saurida undosquamis	39,20	23,7
										Pagellus affinis	19,80	12,0
										Nemipterus japonicus	11,60	7,0
22.11	0855	163	PT	114	100	N20 40'	E059 16'	2,6	5,2	Trachurus indicus	5,20	100,0
22.11	1115	164	BT	70	70	N20 44'	E059 05'	454,3	908,6	Nemipterus japonicus	803,00	88,3
										Trachurus indicus	105,60	11,6

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT. LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
22.11	1420	165	BT	54	54	N20 38' E059 01'	45,1	90,2	JELLYFISH	30,00	33,2
									Argyrops spinifer	31,60	35,0
									Arius thalassinus	14,20	15,7
									Pagellus affinis	8,80	9,7
22.11	1600	166	PT	82	58	N20 36' E059 05'	1159,7	2319,4	Trachurus indicus	1657,80	71,4
									Decapterus russelli	594,00	25,6
									Nemipterus japonicus	64,80	2,7
22.11	1735	167	BT	98	98	N20 35' E059 09'	151,2	302,4	Nemipterus japonicus	130,00	42,9
									Decapterus russelli	97,00	32,0
									Lepidotrigla omanensis	34,00	11,2
									Saurida undosquamis	19,00	6,2
23.11	0030	168	PT	>500	18	N20 23' E059 08'	720,0	1440,0	MYCTOPHIDAE	1440,00	100,0
23.11	0445	169	PT	72	50	N20 15' E058 50'	60,0	120,0	Nemipterus japonicus	120,00	100,0
23.11	0730	170	BT	78	78	N20 05' E058 40'	91,7	366,8	Nemipterus japonicus	363,60	99,1
23.11	1240	171	BT	42	42	N20 02' E058 30'	653,5	1307,0	Lepidotrigla bentuviai	708,40	54,2
									Cheimerius nufar	226,80	17,3
									Carangoides chrysophrys	60,40	4,6
									Epinephelus diacanthus	57,20	4,3
									RHINOBATIDAE	140,00	10,7
23.11	1610	172	BT	18	18	N20 03' E058 21'	358,3	716,6	RHINOBATIDAE	560,00	78,1
									Scomberoides commersonianus	30,00	4,1
									Arius thalassinus	30,00	4,1
									Carangoides chrysophrys	28,40	3,9
23.11	1925	173	PT	24	1	N20 02' E058 10'	323,0	646,0	Sardinella gibbosa	444,80	68,8
									Sardinella longiceps	104,00	16,0
									Megalaspis cordyla	45,20	6,9
									Alepes vari	16,20	2,5
24.11	0700	174	BT	17	17	N20 19' E058 07'	4877,4	9754,8	Argyrosomus hololepidotus	9214,00	94,4
									Scomberoides commersonianus	284,20	2,9
									Arius thalassinus	144,60	1,4
24.11	0955	175	BT	15	15	N20 12' E058 01'	349,3	698,6	Arius thalassinus	190,80	27,3
									CARCHARHINIDAE	185,00	26,4
									Triacanthus biaculeatus	69,60	9,9
									Trachurus indicus	60,00	8,5
24.11	1235	176	BT	20	20	N20 01' E057 53'	2,4	70,5	Trachurus indicus	51,00	72,3
									Alepes vari	7,50	10,6
									Pomadasys maculatus	7,50	10,6
									Pomadasys stridens	4,50	6,3

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
24.11	1450	177	BT	21	21	N19 49'	E057 58'	722,6	1445,2	Arius thalassinus	951,60	65,8
										R A Y S	400,00	27,6
										Alepes vari	52,00	3,5
										Argyrops spinifer	30,80	2,1
24.11	2140	178	PT	40	30	N19 50'	E058 20'	505,6	1011,2	Trachurus indicus	672,20	66,4
										Decapterus russelli	169,00	16,7
										Carangoides malabaricus	49,40	4,8
										Lepidotrigla sp	48,20	4,7
25.11	0230	179	PT	40	22	N19 44'	E058 17'	3976,3	7952,6	Trachurus indicus	6852,60	86,1
										Sphyraena africana	1100,00	13,8
25.11	0705	180	BT	27	27	N19 41'	E058 08'	4,4	8,8	Arius tenuispinis	8,80	100,0
25.11	0920	181	BT	22	22	N19 43'	E027 27'	140,4	280,8	Arius tenuispinis	182,40	64,9
										Arius thalassinus	45,60	16,2
										Alepes vari	44,80	15,9
										MOBULIDAE	8,00	2,8
25.11	1220	182	BT	21	21	N19 37'	E057 51'	40,0	80,0	Sepia sp	40,00	50,0
										Arius sp	40,00	50,0
25.11	1455	183	BT	22	22	N19 34'	E058 03'	159,5	319,0	Diagramma picta	100,40	31,4
										Lethrinus nebulosus	60,00	18,8
										Argyrops spinifer	44,00	13,7
										Cheimerius nufar	26,00	8,1
25.11	2110	184	PT	26	1	N20 00'	E058 03'	304,5	608,9	Spyraena putnamiae	107,60	17,6
										Sardinella gibbosa	144,00	23,6
										Trachurus indicus	64,00	10,5
										CARCHARHINIDAE	247,80	40,6
26.11	0420	185	PT	113	60	N19 51'	E058 33'	,0	,0	N O C A T C H	,00	,0
26.11	1425	186	BT	55	55	N19 26'	E058 06'	,0	,0	N O C A T C H	,00	,0
26.11	1645	187	BT	20	20	N19 29'	E057 54'	919,1	1838,2	Lethrinus nebulosus	1046,60	56,9
										R A Y S	200,00	10,8
										Diagramma picta	147,60	8,0
										Scolopsis taeniatus	69,00	3,7
27.11	0725	188	BT	57	57	N19 19'	E057 59'	40,0	80,0	Sarda orientalis	31,00	38,7
										Sepia sp	16,80	21,0
										Carangoides chrysophrys	9,00	11,2
										Cookeolus boops	4,80	6,0

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
27.11	1155	189	BT	105	105	N19 12'	E058 08'	1447,3	2894,6	Trachurus indicus	2890,00	99,8
27.11	1605	190	BT	65	65	N19 07'	E057 57'	1820,7	3641,4	Trachurus indicus	3641,40	100,0
27.11	2115	191	PT	87	40	N18 58'	E057 57'	10000,0	20000,0	Trachurus indicus	20000,00	100,0
28.11	0755	192	BT	43	43	N18 50'	E057 31'	292,6	585,2	Cheimerius nufar	161,80	27,6
										Sepia sp	149,00	25,4
										Lethrinus nebulosus	129,60	22,1
										Argyrops filamentosus	39,60	6,7
28.11	1030	193	BT	87	87	N18 38'	E058 38'	1,6	3,2	Champsodon sp.	,80	25,0
										Pteridotrigla hemisticata	,80	25,0
										Cookeolus boops	,50	15,6
										SEPIIDAE	,40	12,5
										Sphyraena obtusata	,40	12,5
28.11	1600	194	PT	>500	35	N18 13'	E057 39'	3,0	6,0	CRABS	6,00	100,0
29.11	0425	195	PT	>500	50	N18 02'	E057 35'	3,3	6,6	MYCTOPHIDAE	3,00	45,4
										Etrumeus teres	1,00	15,1
										Sardinella longiceps	,80	12,1
										Synodus sp.	,80	12,1
29.11	0950	196	PT	>500	40	N17 54'	E057 31'	1,8	3,6	Etrumeus teres	1,40	38,8
										Trachurus indicus	,90	25,0
										Sardinella longiceps	,60	16,6
										Decapterus russelli	,60	16,6
29.11	1730	197	BT	84	84	N18 20'	E057 13'	3077,8	6155,6	Decapterus russelli	6000,00	97,4
										Saurida undosquamis	84,00	1,3
29.11	2335	198	PT	20	1	N18 27'	E056 56'	128,4	256,8	Sardinella longiceps	118,60	46,1
										Triacanthus biaculeatus	60,00	23,3
										R A Y S	40,00	15,5
										Arius thalassinus	18,50	7,2
30.11	0525	199	PT	245	45	N17 49'	E057 18'	209,1	836,4	APOGONIDAE	824,00	98,5
										Echeneis naucrates	9,60	1,1
30.11	0720	200	BT	356	356	N17 45'	E057 22'	283,4	566,8	Champsodon sp.	230,40	40,6
										OPHIDIIDAE	144,00	25,4
										Psenopsis cyanea	67,20	11,8
										Pteridotrigla hemisticata	56,00	9,8
30.11	1300	201	BT	74	74	N17 56'	E057 03'	123,9	247,8	Cheimerius nufar	82,60	33,3
										Argyrops filamentosus	46,00	18,5
										Epinephelus diacanthus	33,20	13,3
										Carangoides equula	24,00	9,6

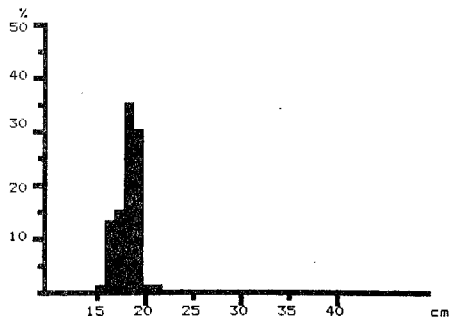
DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT. LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
30.11	1545	202	BT	32	32	N18 07' E056 56'	113,4	453,6	Lethrinus nebulosus	72,00	15,8
									Cheimerius nufar	55,60	12,2
									Parascolopsis eriomma	46,80	10,3
									Epinephelus sp	40,00	8,8
01.12	2330	203	PT	48	10	N17 53' E056 13'	46,7	93,4	R A Y S	40,00	42,8
									Sardinella longiceps	24,00	25,6
									Arius thalassinus	17,20	18,4
									Etrumeus teres	5,40	5,7
02.12	0625	204	BT	55	55	N17 44' E056 03'	206,2	412,4	Lethrinus nebulosus	259,00	62,8
									Cheimerius nufar	90,20	21,8
									Lutjanus coccineus	16,00	3,8
									Epinephelus sp	14,00	3,3
02.12	0830	205	BT	63	63	N17 54' E056 00'	,0	,0	N O C A T C H	,00	,0
02.12	1115	206	BT	54	54	N17 44' E055 52'	168,9	1013,4	Lethrinus nebulosus	392,40	38,7
									Cheimerius nufar	300,60	29,6
									Epinephelus sp	125,40	12,3
									Epinephelus chlorostigma	74,40	7,3
02.12	1740	207	BT	49	49	N17 41' E055 34'	181,8	363,6	Carangoides chrysophrys	132,00	36,3
									Lethrinus nebulosus	78,40	21,5
									Arius thalassinus	48,20	13,2
									Plectorhynchus schotaf	39,20	10,7
03.12	0005	208	PT	170	20	N17 24' E055 19'	101,0	202,0	Sardinella longiceps	153,00	75,7
									Etrumeus teres	32,40	16,0
									Arius thalassinus	13,40	6,6
04.12	1615	209	BT	54	54	N17 00' E054 35'	494,9	989,8	Cheimerius nufar	474,60	47,9
									Argyrops spinifer	121,40	12,2
									Epinephelus diacanthus	66,80	6,7
									Arius thalassinus	58,40	5,9
04.12	1835	210	PT	24	1	N17 00' E054 22'	258,0	516,0	Sardinella gibbosa	310,00	60,0
									Sardinella longiceps	90,00	17,4
									Sphyraena obtusata	62,00	12,0
									Trachurus indicus	20,00	3,8
08.12	1150	211	PT	118	80	N19 07' E058 06'	16,6	7,3	Scomber japonicus	4,88	66,8
									Trachurus indicus	2,42	33,1
08.12	1925	212	PT	137	120	N19 11' E058 09'	608,0	2432,0	Trachurus indicus	2368,00	97,3
									Lepidotrigla bentuviai	25,60	1,0
									Pteridotrigla hemisticata	38,40	1,5

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
09.12	0855	213	PT	95	85	N19 19'	E058 10'	1063,0	1063,0	Trachurus indicus	1063,00	100,0
10.12	0000	214	PT	98	90	N19 43'	E058 25'	495,0	846,4	Trachurus indicus	846,45	100,0

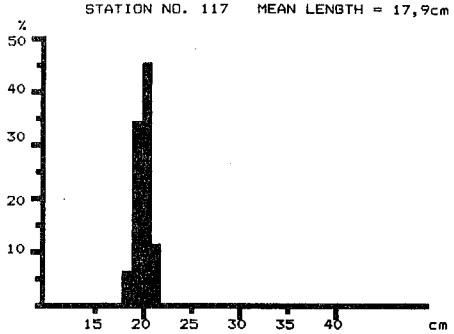
APPENDIX II

Length frequency distributions of some important species.

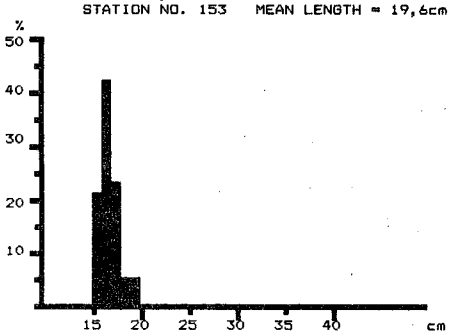
CARANGIDAE



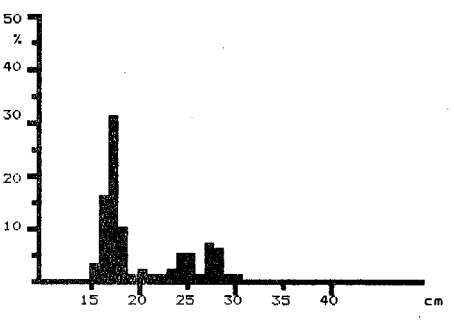
Decapterus russelli
STATION NO. 117 MEAN LENGTH = 17,9cm N= 112



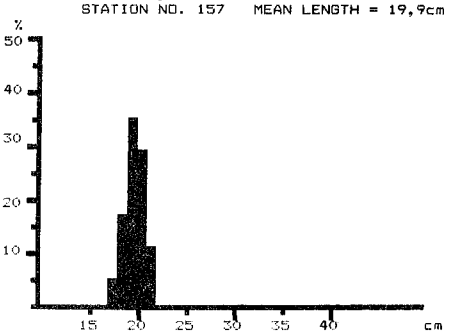
Decapterus russelli
STATION NO. 153 MEAN LENGTH = 19,6cm N= 101



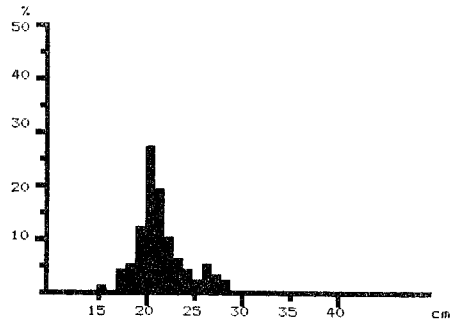
Decapterus russelli
STATION NO. 154 MEAN LENGTH = 16,3cm N= 102



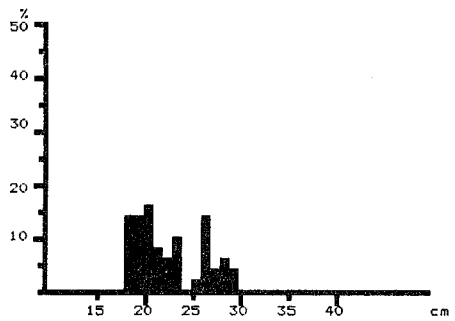
Decapterus russelli
STATION NO. 157 MEAN LENGTH = 19,9cm N= 77



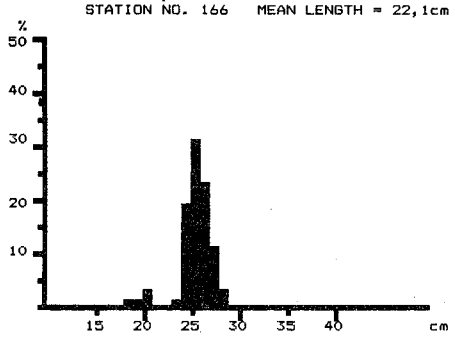
Decapterus russelli
STATION NO. 161 MEAN LENGTH = 19,2cm N= 17



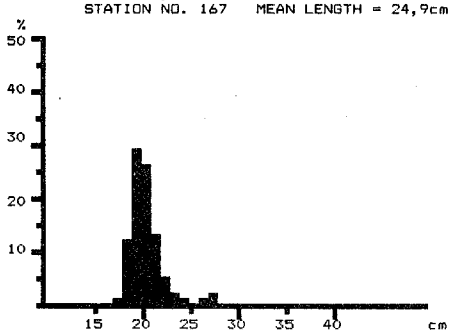
Decapterus russelli
STATION NO. 162 MEAN LENGTH = 21,1cm N= 100



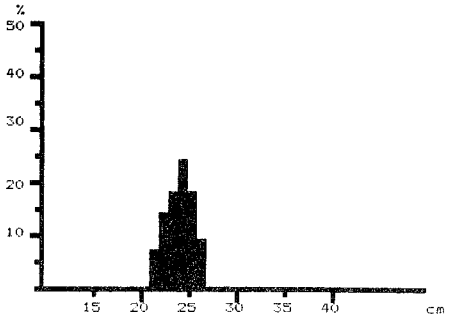
Decapterus russelli
STATION NO. 166 MEAN LENGTH = 22,1cm N= 49



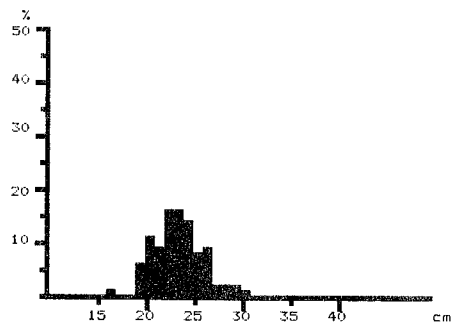
Decapterus russelli
STATION NO. 167 MEAN LENGTH = 24,9cm N= 51



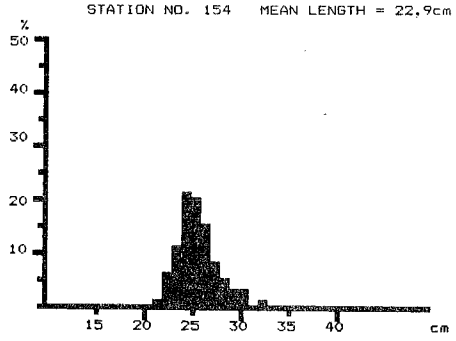
Decapterus russelli
STATION NO. 178 MEAN LENGTH = 20,2cm N= 110



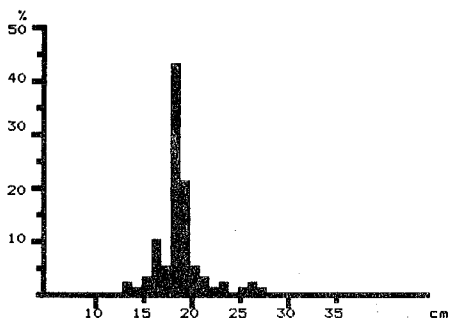
Decapterus russelli
STATION NO. 197 MEAN LENGTH = 23,7cm N= 101



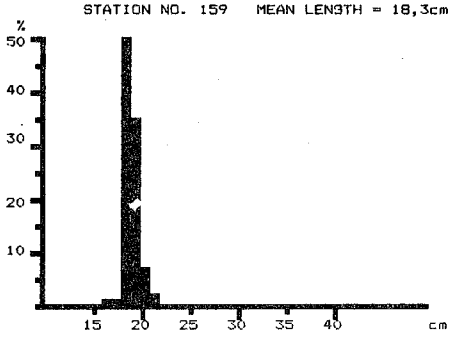
Trachurus indicus
STATION NO. 154 MEAN LENGTH = 22,9cm N= 97



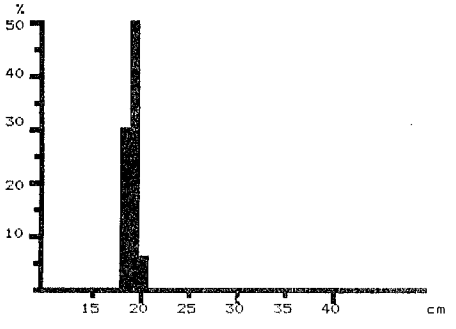
Trachurus indicus
STATION NO. 157 MEAN LENGTH = 25,2cm N= 118



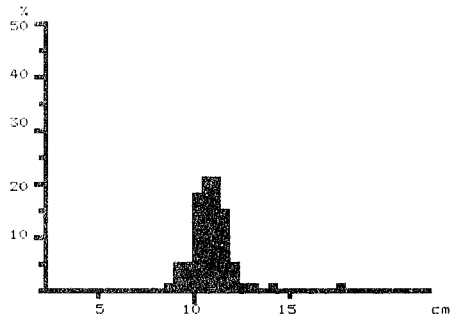
Trachurus indicus
STATION NO. 159 MEAN LENGTH = 18,3cm N= 100



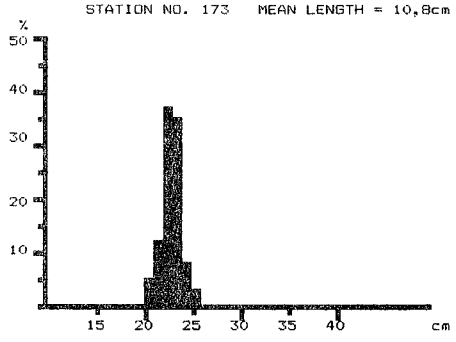
Trachurus indicus
STATION NO. 160 MEAN LENGTH = 18,5cm N= 96



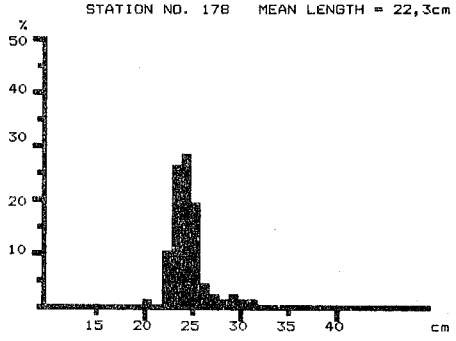
Trachurus indicus
STATION NO. 166 MEAN LENGTH = 18,7cm N= 75



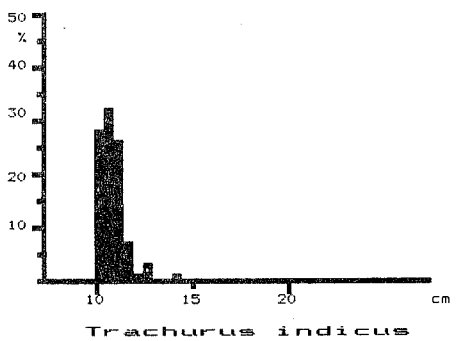
Trachurus indicus
STATION NO. 173 MEAN LENGTH = 10,8cm N= 60



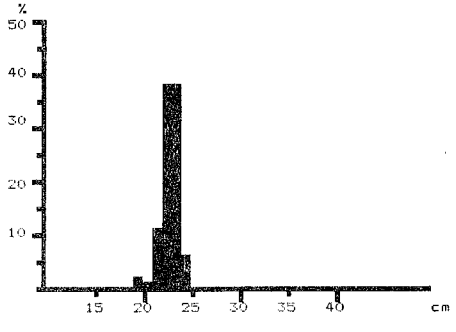
Trachurus indicus
STATION NO. 178 MEAN LENGTH = 22,3cm N= 100



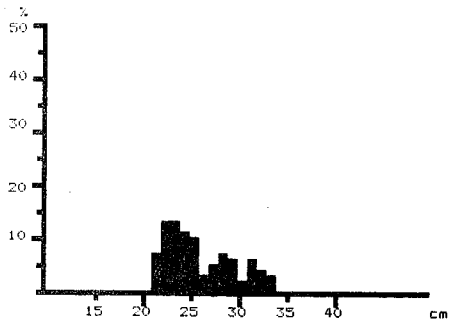
Trachurus indicus
STATION NO. 179 MEAN LENGTH = 24,1cm N= 83



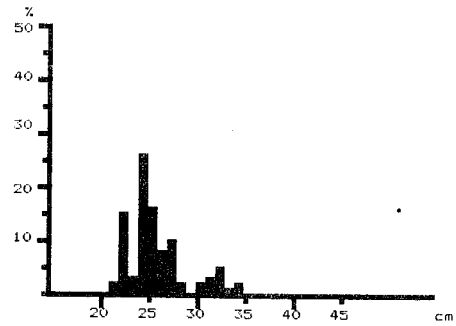
Trachurus indicus
STATION NO. 184 MEAN LENGTH = 10,6cm N= 95



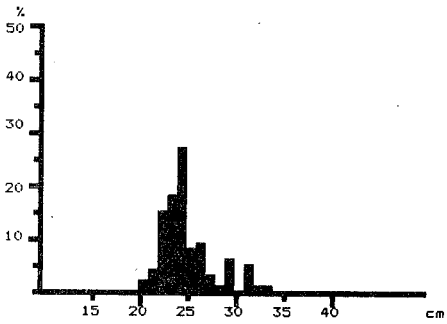
Trachurus indicus
STATION NO. 189 MEAN LENGTH = 22,2cm N= 77



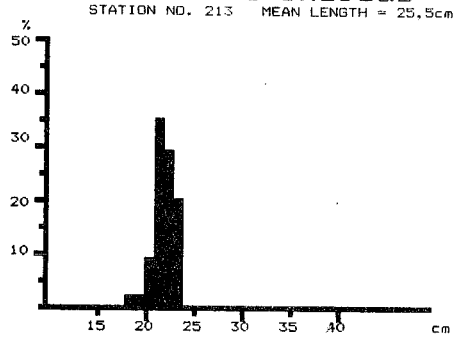
Trachurus indicus
STATION NO. 190 MEAN LENGTH = 25,7cm N= 110



Trachurus indicus
STATION NO. 213 MEAN LENGTH = 25,5cm N= 80

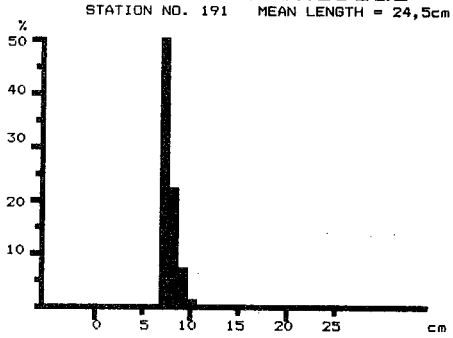


Trachurus indicus
STATION NO. 191 MEAN LENGTH = 24,5cm N= 100

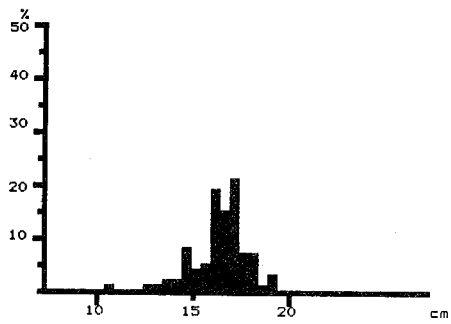


Trachurus indicus
STATION NO. 214 MEAN LENGTH = 21,4cm N= 84

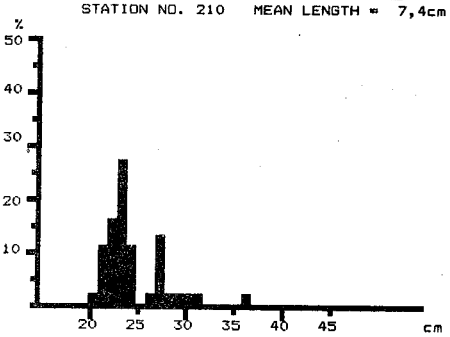
CLUPEIDAE



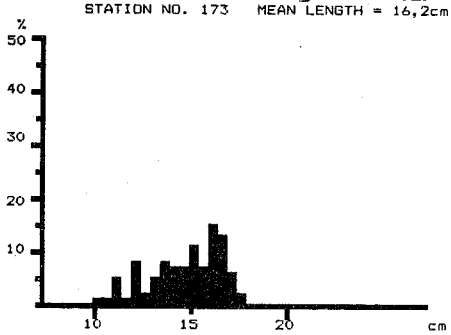
Trachurus indicus
STATION NO. 210 MEAN LENGTH = 7,4cm N= 95



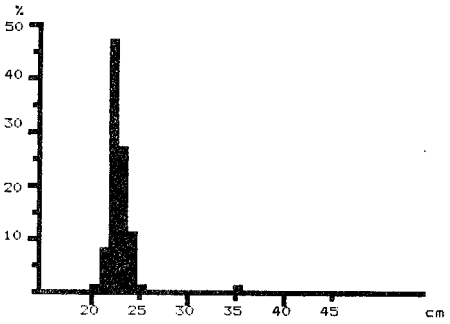
Sardinella gibbosa
STATION NO. 173 MEAN LENGTH = 16,2cm N= 97



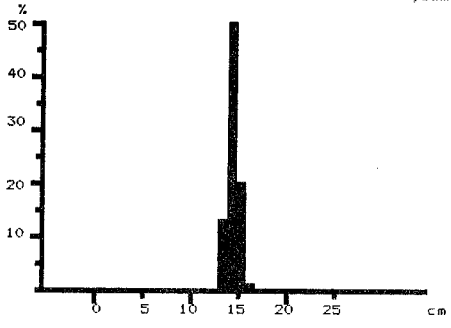
Trachurus indicus
STATION NO. 211 MEAN LENGTH = 24,3cm N= 36



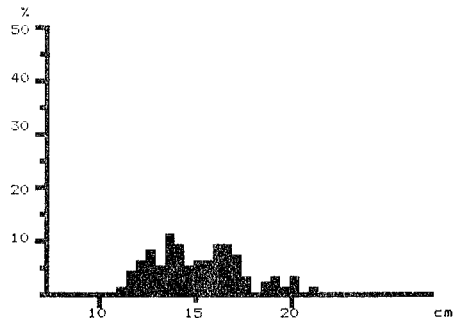
Sardinella gibbosa
STATION NO. 184 MEAN LENGTH = 14,6cm N= 99



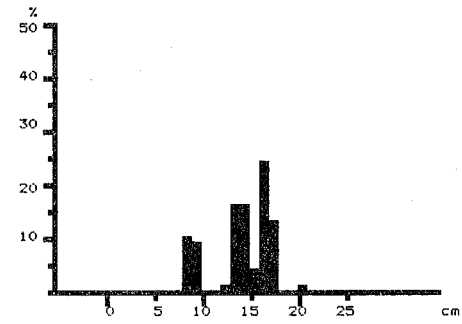
Trachurus indicus
STATION NO. 212 MEAN LENGTH = 22,6cm N= 69



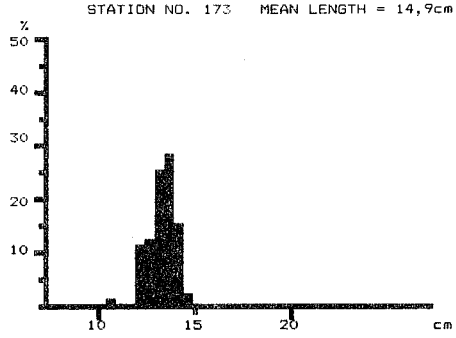
Sardinella gibbosa
STATION NO. 210 MEAN LENGTH = 14,0cm N= 98



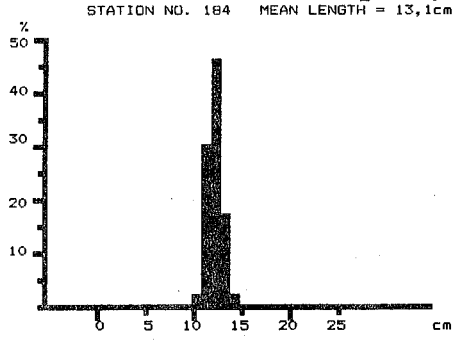
Sardinella longiceps
STATION NO. 173 MEAN LENGTH = 14,9cm N= 99



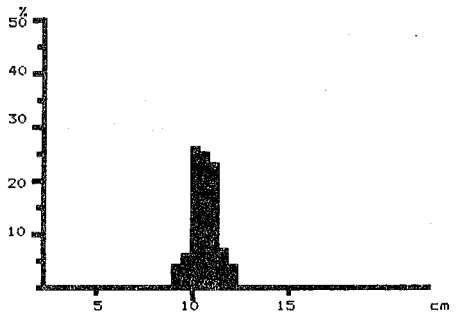
Sardinella longiceps
STATION NO. 210 MEAN LENGTH = 13,7cm N= 125



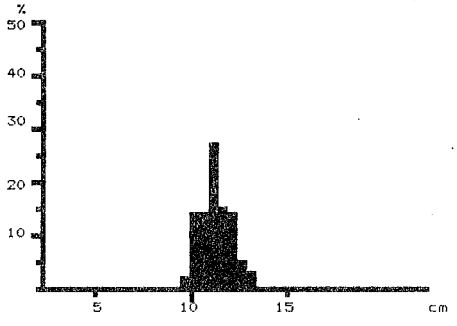
Sardinella longiceps
STATION NO. 184 MEAN LENGTH = 13,1cm N= 105



Sardinella longiceps
STATION NO. 198 MEAN LENGTH = 11,8cm N= 108



Sardinella longiceps
STATION NO. 203 MEAN LENGTH = 10,4cm N= 105



Sardinella longiceps
STATION NO. 208 MEAN LENGTH = 11,0cm N= 127