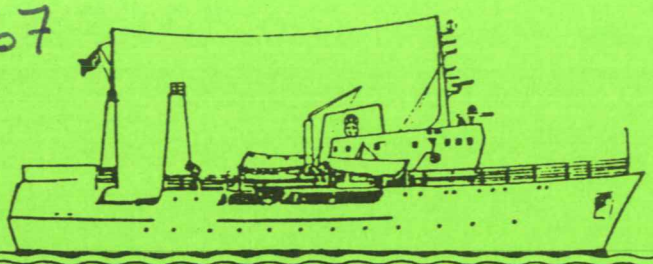


Reports on Surveys with the
R/V Dr Fridtjof Nansen

NORAD/UNDP/FAO

PROGRAMME GLO/82/001

CRUISE REPORT
"DR. FRIDTJOF NANSEN"

FISHERIES RESOURCES SURVEY
PAKISTAN

5 - 16 SEPTEMBER 1983

ODD NAKKEN

OCTOBER 1983

Institute of Marine Research, Bergen

INTRODUCTION

Under the UNDP/FAO Global Programme (GLO/82/001) the fishery research vessel "Dr. Fridtjof Nansen" is scheduled to carry out several surveys in the North Arabian Sea during 1983-84.

R/V "Dr. Fridtjof Nansen" is placed at the disposal of UNDP/FAO by NORAD (Norwegian Agency of International Development) and the Institute of Marine Research, Bergen, Norway is responsible for carrying out the research programme in cooperation with local scientists.

The first cruise in Pakistan waters under this project was carried out in September 1983. The vessel left Karachi on 5 September at 1700 hours and the cruise was terminated at Karachi on 16 September at 2000 hours.

Scientific staff

From the Institute of Marine Research, Bergen:

O. Nakken (cruise leader), G.H.P. de Bruin, S. Myklevoll, T. Solberg, K. Strømsnes, H. Abrahamsen, T. Mørk.

From Marine Fisheries Department, Karachi:

Mohammad Arshad, Mohammad Arif.

Objectives

To carry out an acoustic survey of Pakistan waters; mapping the distribution and measuring the abundance of pelagic, demersal and mesopelagic fish.

NARRATIVE

The investigations started at the Iranian border on 6 September and were finished off the Indus delta on 16 September. The area was covered with transects about 10-15 nautical miles

apart, from the 15-20 m contour line out to 5-10 nautical miles off the slope of the continental shelf (Figure 1).

The distance sailed and the number of stations worked were as follows:

Sailing distance:	2000 nautical miles
Hydrographic stations:	17
Pelagic trawl hauls:	13
Bottom trawl hauls:	44

Weather conditions were excellent. Instruments and gears functioned satisfactorily.

RESULTS

Hydrography

Figures 2-5 show the distribution of temperature, salinity, density and oxygen contents in the four hydrographic sections (Figure 1). In the upper 100 m there is a tendency that the isolines are at greater depths offshore than at the coast, indicating an anti-cyclonic movement of the offshore water masses. In all sections, water masses of low oxygen contents, 1-2 ml/l cover substantial parts of the continental shelf. Along the Makran coast the 2 ml/l isoline was observed at depths between 20 and 30 m, while off the Indus delta (Sind coast) waters of oxygen contents less than 2 ml/l were found at 15 m at the innermost station. The effect of the freshwater outflow from the River Indus was observed at the three innermost stations in Section IV (Figure 5). A similar salinity distribution, but much less pronounced, was found at the innermost station in Sonmiany Bay (Figure 4). The transition between the "Indus water" and the oceanic water was sharp and was easily determined from the colour contrasts at the surface; the Indus water being green-yellowish in colour while the oceanic water was deep blue. This transition could be seen at the innermost parts of all the transects off southern Sind.

Pelagic fish

Figure 6 shows the distribution of pelagic fish. The fish was distributed on the shelf areas, and no recordings of pelagic fish were made further offshore. In general the recordings were very scattered. Dense concentrations were observed at five localities, all with very limited extensions. At the Makran coast the predominant species was rainbow sardine (Dussumieria acuta). The fish occurred in scattering layers and small schools in daytime at depths between 20-40 m, just off the bottom. During nighttime it was observed both as scattering layers and small schools at the surface. It ranged in length from 18-20 cm. Catch rates of rainbow sardines up to 3.7 tonnes per hour were obtained in pelagic night hauls.

Other pelagic fish species were scarce in the Makran area, but scads (Decapterus spp.) and hardtail scad (Megalaspis cordyla) were caught in limited numbers at some few trawl stations.

Off Sind concentrations of pelagic fish were found in three localities (Figure 6). At the inner end of the Indus Swatch very dense recordings of anchovy (Stolephorus sp.) were obtained in mixture with juvenile rainbow sardine. The fish was distributed in large schools or scattering layers at depths between surface and 20 m over 30-40 m bottom depth, but the extension of the area was limited to 2-3 square nautical miles. Quantities of bottom fishes - rays, sharks, grunts and croakers - were feeding on these concentrations.

Scattering layers and small schools of rainbow sardine, ranging from 10-20 cm in length, were observed in two localities off Sind at bottom depths between 60 and 80 m. During the day the fish occurred in small schools close to the bottom, at night it dispersed into a scattering layer at 30-40 m depth. In the Sind area the maximum catch rate of pelagic fish was about 500 kg per hour in the pelagic trawl.

Bottom fish

The distribution of bottom fish is shown in Figure 7. Relatively dense patches were observed several places along the Makran coast while the recordings off Sind were more scattered. At the Makran coast the concentrations of bottom fishes were predominated by hairtails (Trichiurus lepturus and Lepturacanthus savala) which made up the bulk of the catches in the area. The hairtails were observed as weak scattering layers both at the bottom and in midwater over bottom depths ranging from 25-30 m to the edge of the shelf. Grunts (Pomadasys sp.) and croakers (Epinephelus spp.) were also frequently caught in the bottom trawl hauls but in significantly less quantities than hairtails. Catch rates up to 6 tonnes per hour trawling were experienced.

Off Sind, both the recordings and the catches of bottom fish were more variable than at the Makran coast. In most of the investigated area the abundance was found to be low, and dense patches of fish were found only at two localities, in southern Sonmiany Bay and at the inner end of the Indus Swatch. In Sonmiany Bay catfish was the predominant scatterer, while small-sized croakers and grunts together with hairtails and rays made up the bulk of the catches off the Indus delta. Catch rates up to 16 tonnes per hour were obtained in bottom trawl hauls. On the outer banks off Sind, catch rates were low and variable and the threadfin bream (Nemipterus japonicus) was a major constituent.

Mesopelagic fish

Recordings of mesopelagic fish (Figure 8) were made at and off the edge of the continental shelf in the entire area. The fish showed the usual daily migration pattern: small schools and scattering layers at depths of 150 m or more in daytime and a scattering layer in the upper 50 m during the night. The recordings were mainly scattered and the catch rates were low. Lantern fish (Myctophidae) was predominant in the mesopelagic fish layer.

Plankton

In most of the shelf areas planktonic scatterers contributed the major part of the total echo abundance (the integrated echo energy) (Figure 9). Jellyfish and krill (Euphausiids) were probably the main contributors. Planktonic scattering layers were observed in all depths both during day and night at densitites which to a great extent made it impossible to obtain reliable integration values of scattered fish. The planktonic layers showed no systematic differences in back scattering strength at the echo sounder frequencies 38 kHz and 120 kHz.

At the eastern Makran coast and in Sonmiany Bay the trawl hauls indicated that krill was a major constituent of the planktonic biomass, while different kinds of jellyfish were caught in quantities off Sind.

Surface observations

Figure 10 shows the surface observations which were made. Large whales were spotted off the eastern coast of Makran, probably feeding on the quantities of krill in that area. Dolphins were observed at the outer end of the transects off Sind.

Due to bioluminescence, surface schooling fish could easily be spotted also at nighttime. In the offshore part of the southernmost transect a strange occurrence of bioluminescence was observed. At a distance it looked like waves of light moving at the sea surface at a high speed, 10-20 times the speed of the vessel (10 knots). The phenomenon was obviously caused by bioluminescence originating from sources which were situated 1-3 m apart. All these sources within a 10-30 m wide belt were triggered on and off with a short time delay from one side to the belt to the other, thus giving the impression of "waves of light" propagating through the water. The pulsations were quite regular, 95-100 per minute, and observed over a distance of 3-4 nautical miles. The observation was made between 0100 and 0200 hours local time. The sea was almost calm with a

small swell of 1-1.5 m height from southwest. It seems unlikely that the regular periodic "behaviour" of the phenomenon could be caused by the observed sea state or other physical factors. More likely the bioluminescence itself enabled the organisms to adjust their flash frequency and phase in order to strengthen the light intensity. Plankton samples from a Juday net hauled in the surface layers were preserved for later analysis.

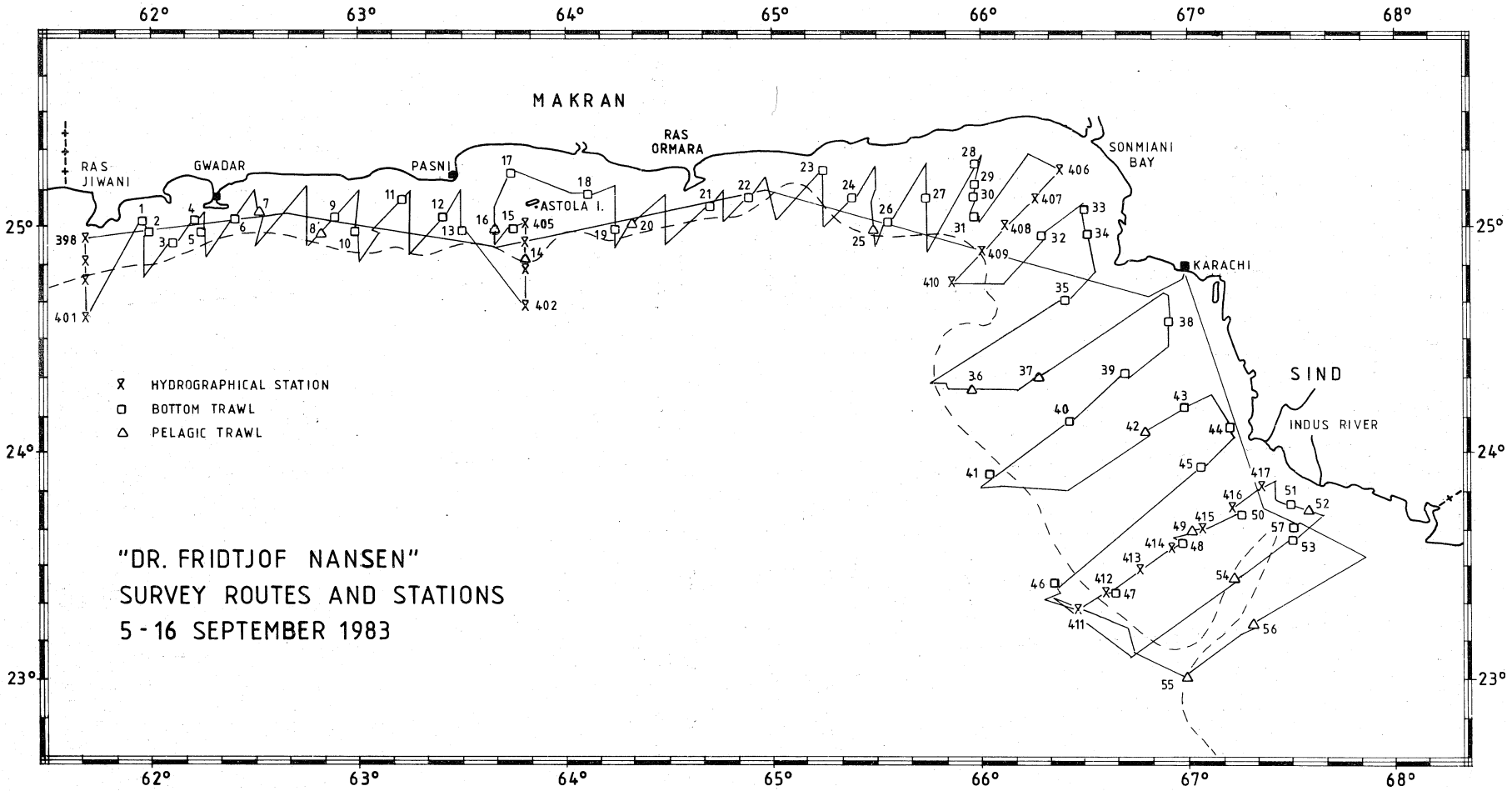


Fig. 1. Survey routes and stations. "Dr. Fridtjof Nansen"s fisheries resources survey, Pakistan, 5-16 September 1983.

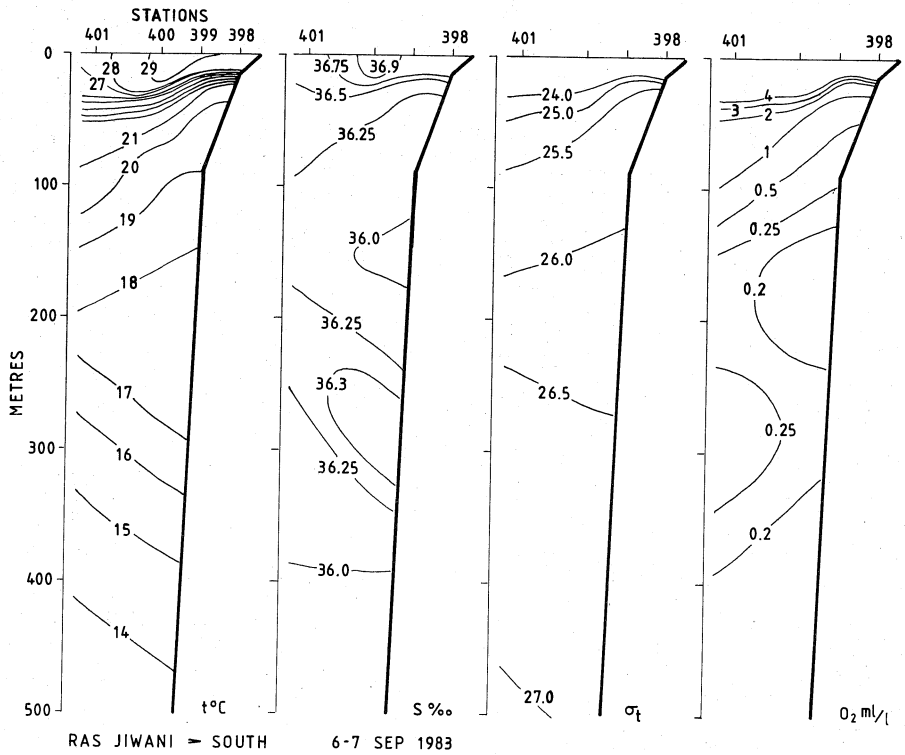


Fig. 2. Section I: Ras Jiwani - South, 6-7 September 1983. Temperature, salinity, density and oxygen contents.

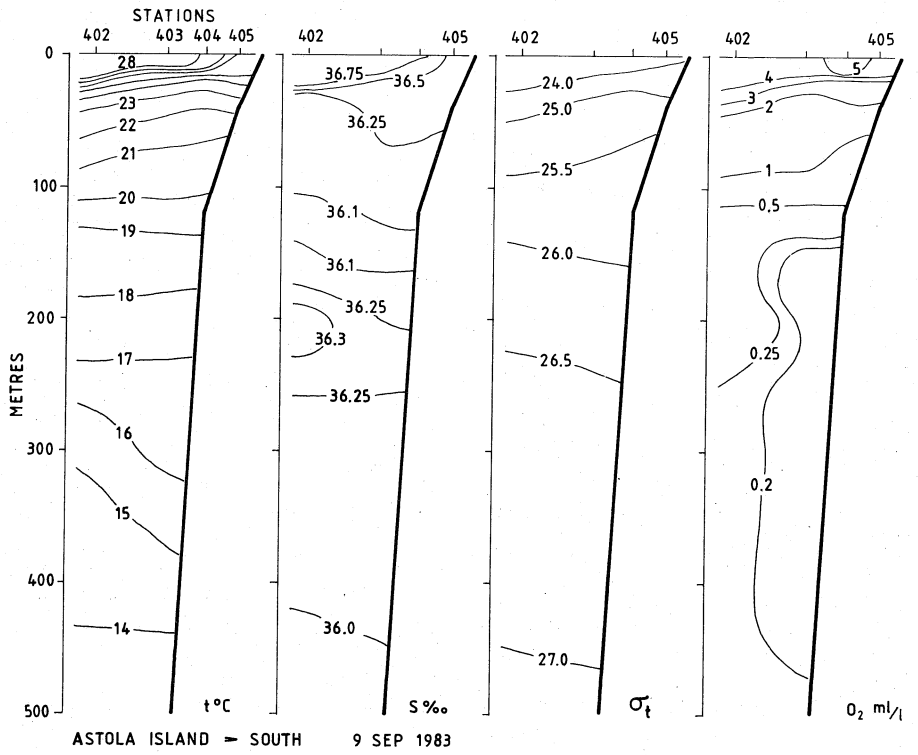


Fig. 3. Section II: Astola Isl. - South, 9 September 1983. Temperature, salinity, density and oxygen contents.

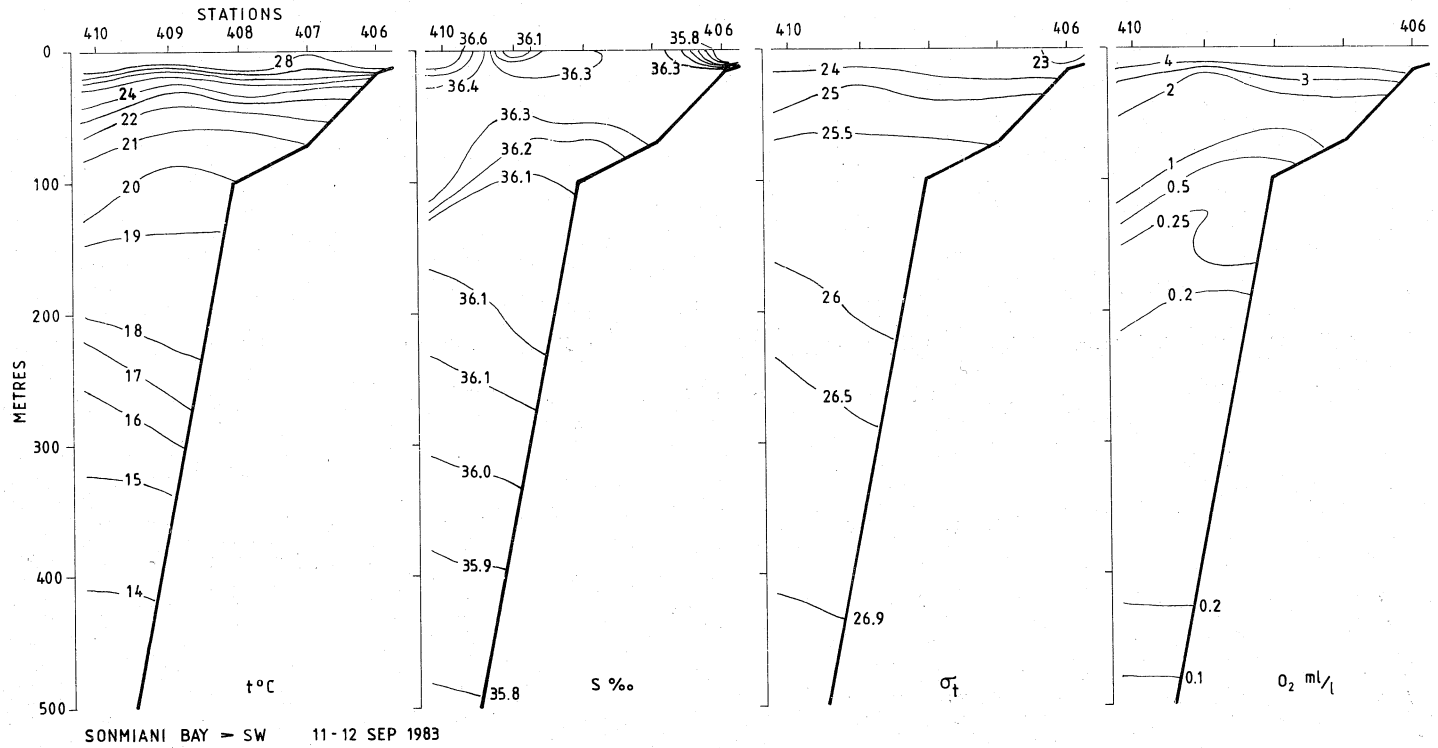


Fig. 4. Section III: Sonmiani Bay - SW, 11-12 September 1983. Tempreature, salinity, density and oxygen contents.

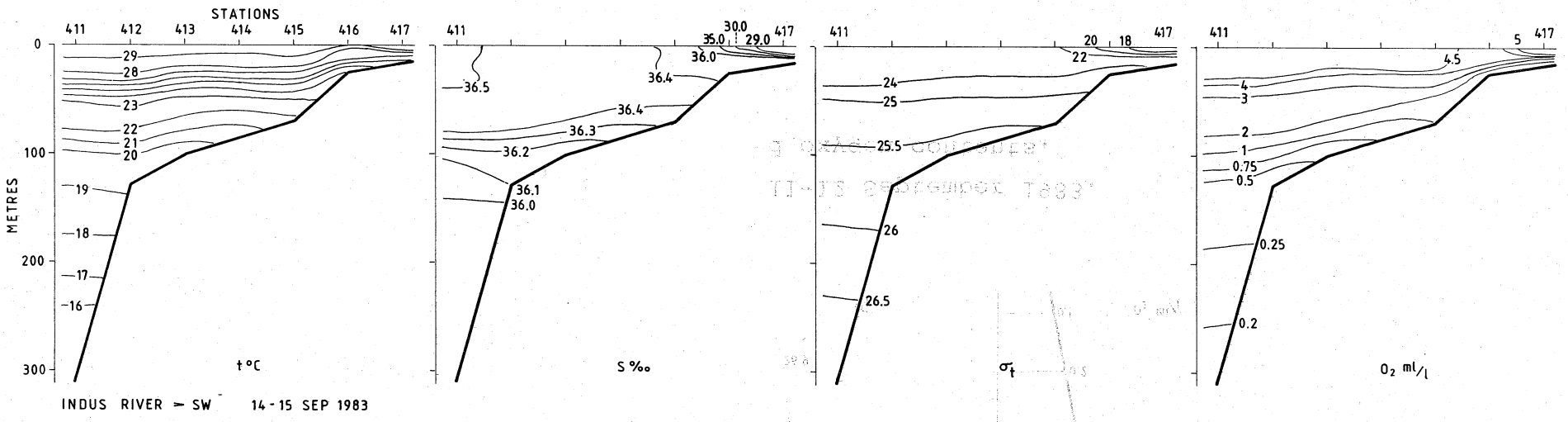


Fig. 5. Section IV: Indus River - SW, 14-15 September 1983. Temperature, salinity, density and oxygen contents.

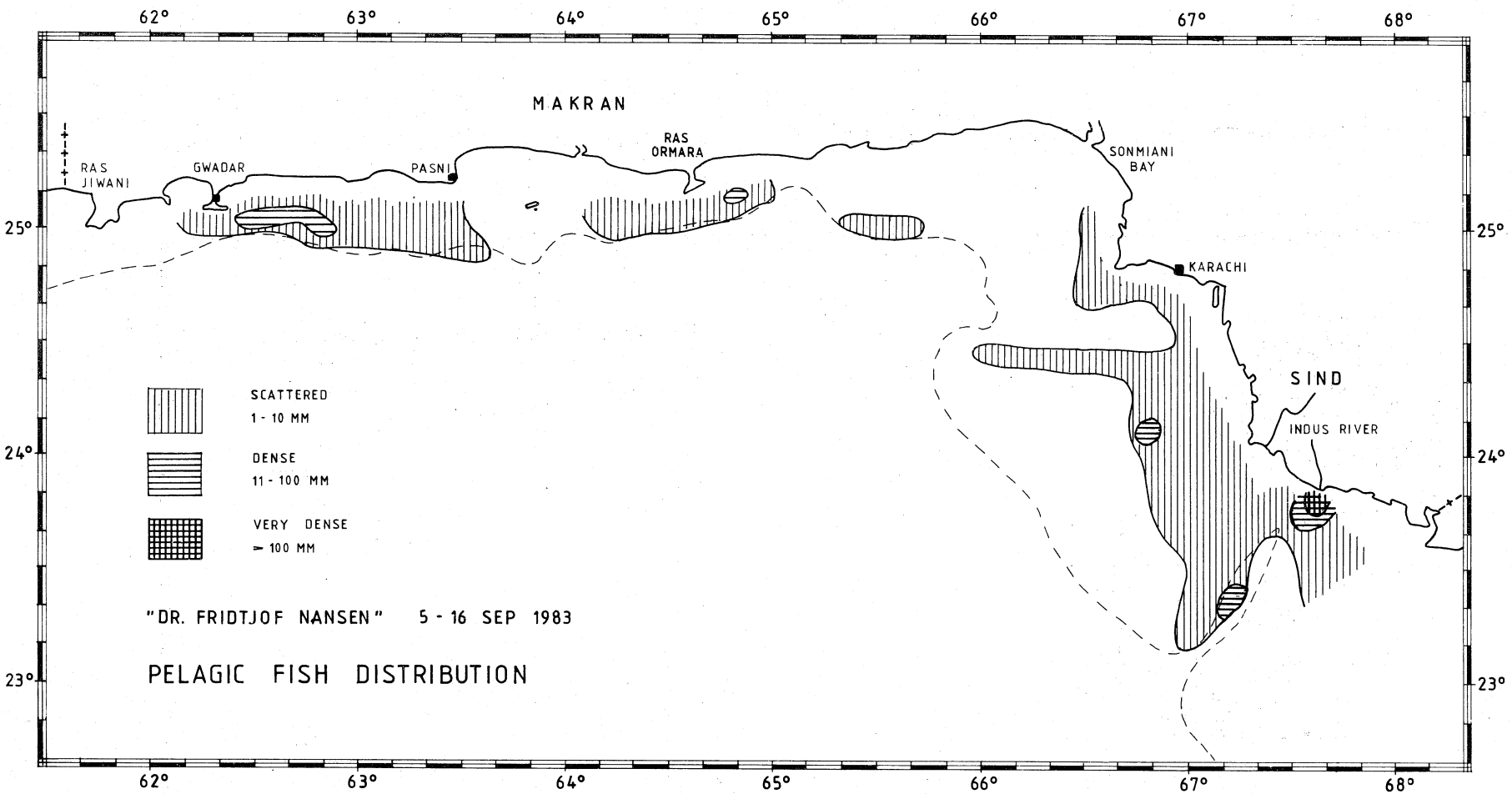


Fig. 6. Pelagic fish distribution. "Dr. Fridtjof Nansen"s fisheries resources survey, Pakistan, 5-16 September 1983.

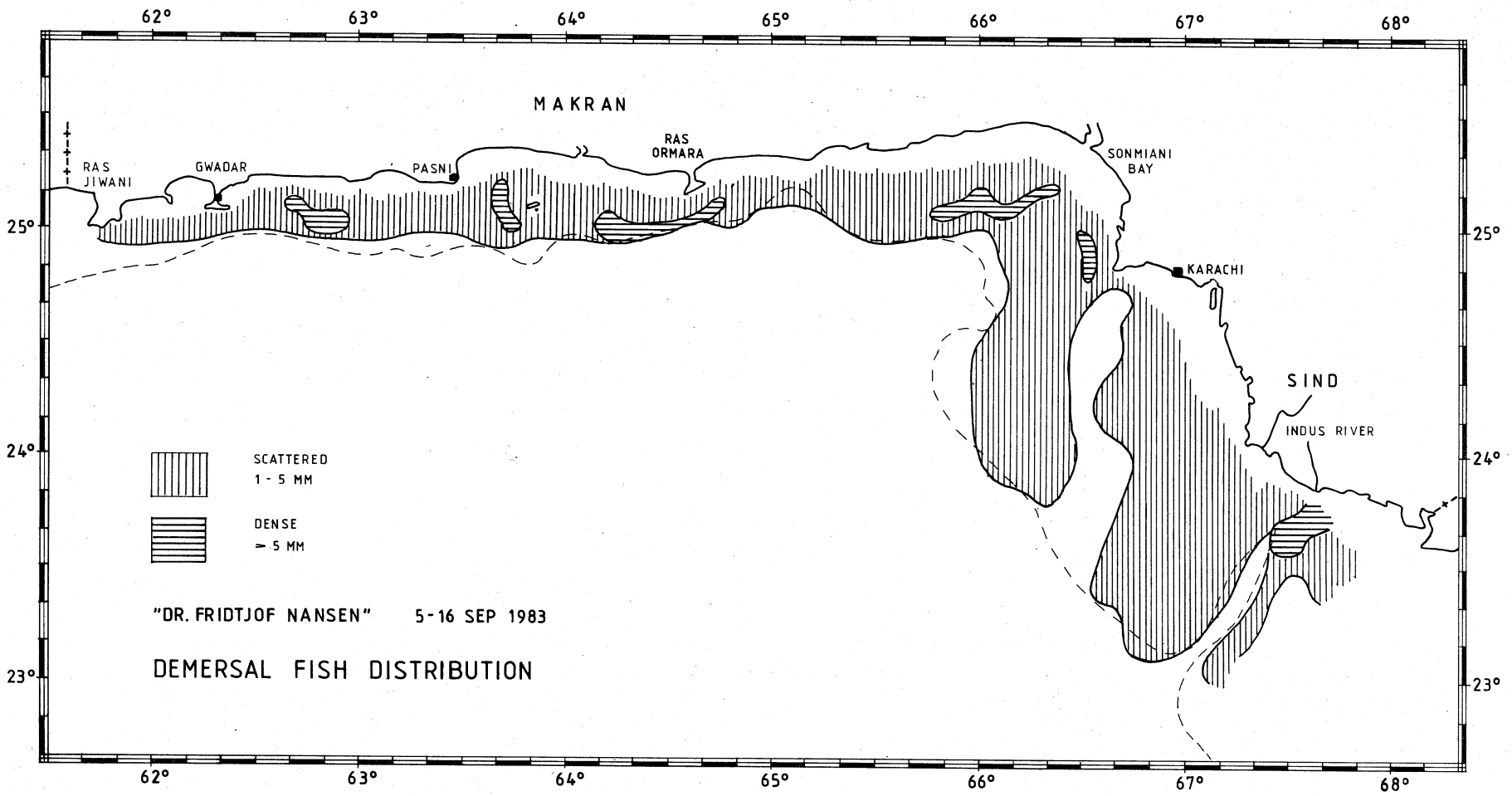


Fig. 7. Demersal fish distribution. "Dr. Fridtjof Nansen"s fisheries resources survey, Pakistan, 5-16 September 1983.

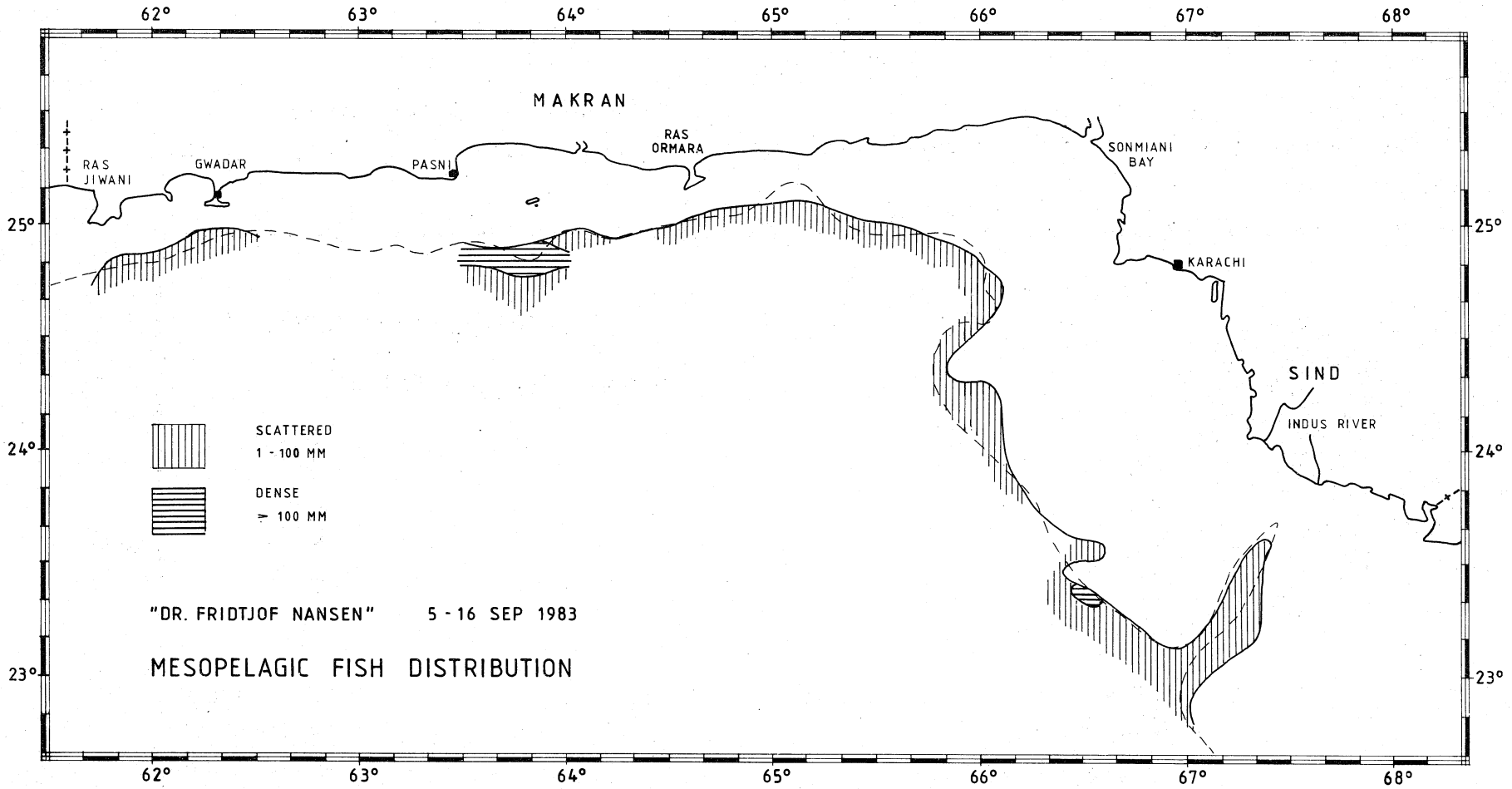


Fig. 8. Mesopelagic fish distribution. "Dr. Fridtjof Nansen"s fisheries resources survey, Pakistan, 5-16 September 1983.

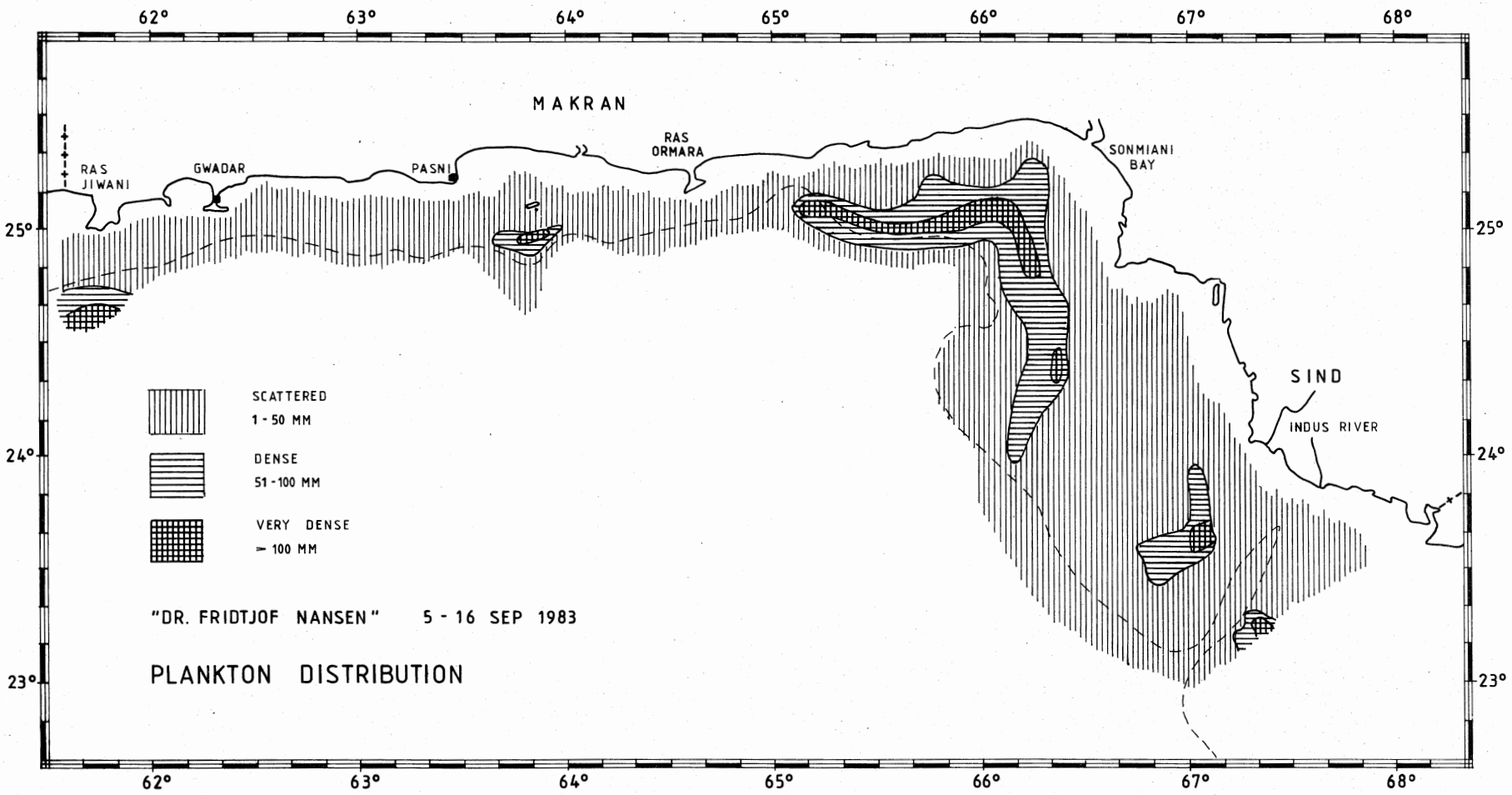


Fig. 9. Plankton distribution. "Dr. Fridtjof Nansen"s fisheries resources survey, Pakistan, 5-16 September 1983.

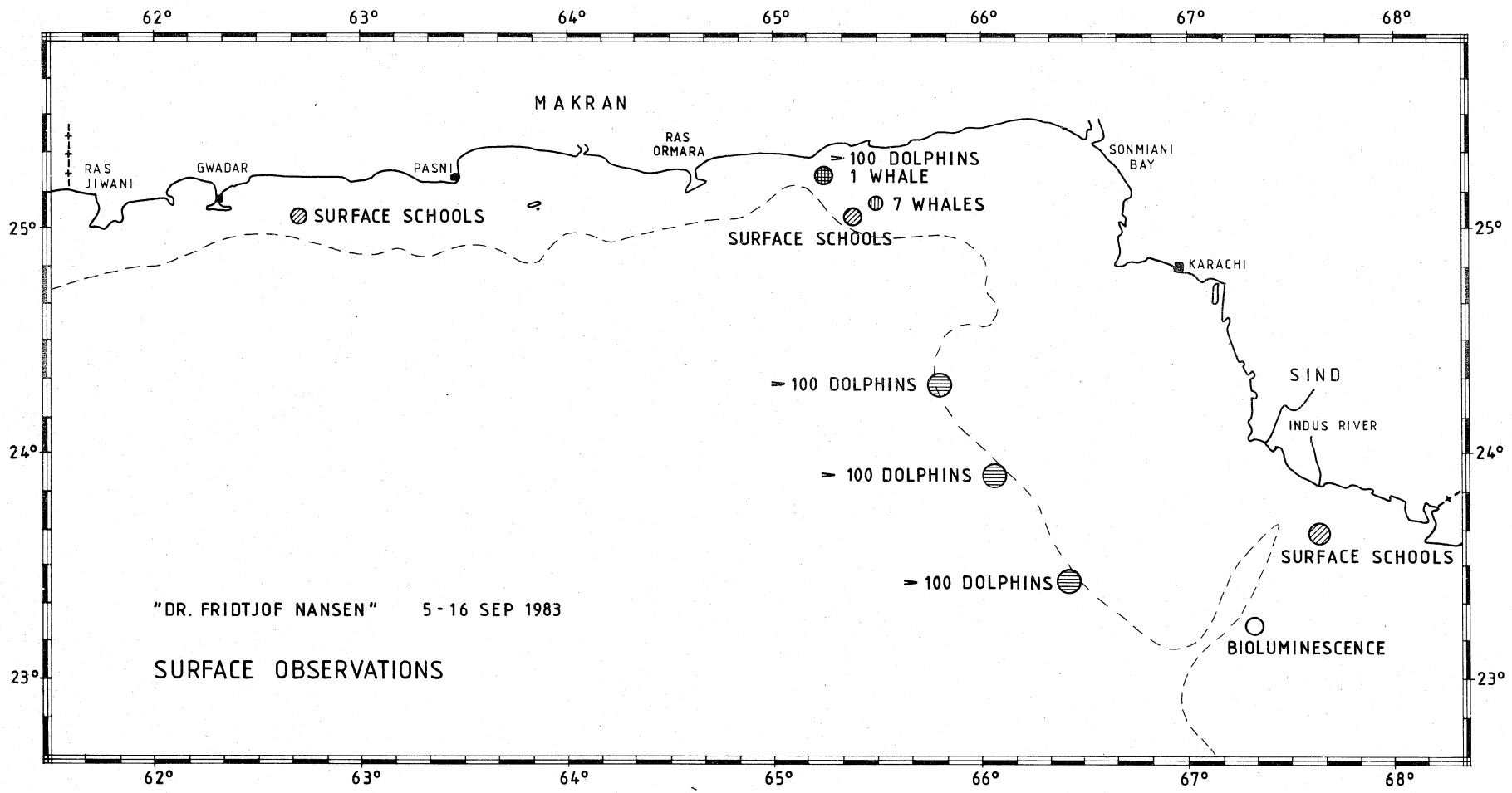


Fig. 10. Surface observations. "Dr. Fridtjof Nansen"s fisheries resources survey, Pakistan, 5-16 September 1983.

ANNEX I : Details of fishing stations with dominant species.

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) %
07.09	0640	1	BT	25	25	N25 01'	E061 58'	331,3	662,6	Lepturacanthus savala	382,40	57,7
										DASYATIDAE	92,40	13,9
										Pomadasys hasta	86,40	13,0
										Arius sp	48,40	7,3
07.09	0830	2	BT	47	47	N24 59'	E062 01'	68,9	137,8	Lepturacanthus savala	52,00	37,7
										Sepia pharaonis	36,60	26,5
										Rhizoprionodon acutus	22,60	16,4
										Epinephelus undulosus	16,80	12,1
07.09	1150	3	BT	80	80	N24 56'	E062 06'	44,5	89,0	Otolithoides biauritus	41,00	46,0
										Lepturacanthus savala	10,80	12,1
										Arius sp	7,20	8,0
										SEPIIDAE	6,00	6,7
										JELLYFISH	10,00	11,2
07.09	1335	4	BT	19	19	N25 02'	E062 11'	153,9	307,8	Pomadasys hasta	98,60	32,0
										Rhinoptera sp.	42,80	13,9
										Lutjanus argentimaculatus	30,60	9,9
										Acanthopagrus sp.	26,00	8,4
07.09	1515	5	BT	37	37	N24 59'	E062 14'	143,5	287,0	Pomadasys hasta	119,00	41,4
										Lepturacanthus savala	94,40	32,8
										Gymnura sp.	23,20	8,0
										Rhizoprionodon acutus	19,20	6,6
07.09	1820	6	BT	28	28	N25 03'	E062 24'	34,0	68,0	Arius sp	28,00	41,1
										Rhinoptera sp.	20,00	29,4
										Lepturacanthus savala	14,20	20,8
										SHRIMPS	4,40	6,4
07.09	2125	7	PT	40	10	N25 04'	E062 30'	966,6	1933,2	Dussumieria acuta	1800,00	93,1
										Lepturacanthus savala	80,00	4,1
										Rhizoprionodon acutus	31,40	1,6
08.09	0325	8	PT	40	10	N24 59'	E062 49'	2174,0	4348,0	Dussumieria acuta	3720,00	85,5
										Decapterus russelli	560,00	12,8
08.09	0505	9	BT	22	22	N25 03'	E062 53'	1220,1	2440,2	Nibea albida	1560,00	63,9
										MURAENESOCIDAE	180,00	7,3
										Gymnura sp.	141,20	5,7
										Otolithes ruber	100,70	4,1
08.09	0825	10	BT	38	38	N24 59'	E062 57'	3156,1	6312,2	Lepturacanthus savala	6000,00	95,0

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) %
08.09	1225	11	BT	15	15	N25 08'	E063 13'	76,1	152,2	Gymnura sp.	72,00	47,3
										Lepturacanthus savala	40,00	26,2
										Epinephelus diacanthus	30,00	19,7
										Arius sp	7,60	4,9
08.09	1705	12	BT	20	20	N25 03'	E063 25'	138,9	277,8	Lepturacanthus savala	120,00	43,1
										Arius sp	83,80	30,1
										Carangoides talamparoides	12,50	4,4
										Argyrops spinifer	11,90	4,2
08.09	1945	13	BT	34	34	N24 59'	E063 29'	1590,3	3180,6	JELLYFISH	3000,00	94,3
										Lepturacanthus savala	74,92	2,3
09.09	0405	14	PT	>500	30	N24 49'	E063 49'	420,0	840,0	MYCTOPHIDAE	840,00	100,0
09.09	0805	15	BT	68	68	N24 59'	E063 46'	617,8	1235,6	Pennahia sp.	664,00	53,7
										Lepturacanthus savala	564,00	45,6
09.09	1005	16	PT	80	20	N24 58'	E063 40'	10,0	20,0	JELLYFISH	20,00	100,0
09.09	1225	17	BT	12	12	N25 15'	E063 45'	594,5	1189,0	Arius sp	348,00	29,2
										Acanthopagrus sp.	238,00	20,0
										Lepturacanthus savala	192,00	16,1
										Gymnura sp.	140,00	11,7
09.09	1550	18	BT	12	12	N25 09'	E064 07'	46,6	93,2	MURAENESOXIDAE	60,00	64,3
										Lepturacanthus savala	40,00	42,9
										Gymnura sp.	28,00	30,0
										Arius sp	6,20	6,6
09.09	1855	19	BT	25	25	N24 59'	E064 15'	525,7	1051,4	SCIAENIDAE	100,00	9,5
										Parapenaeopsis stylifera	86,40	8,2
										Epinephelus diacanthus	69,00	6,5
										Argyrops spinifer	49,00	4,6
										JELLYFISH	566,00	53,6
09.09	2105	20	PT	19	10	N25 01'	E064 20'	3333,6	6667,2	Lepturacanthus savala	6000,00	89,9
										Krill	300,00	4,4
										Scomberoides commersonianus	130,80	1,9
										Megalaspis cordyla	130,40	1,9
10.09	0315	21	BT	16	16	N25 06'	E064 42'	198,8	397,6	Arius sp	120,00	30,1
										MURAENESOXIDAE	80,00	20,1
										Otolithes ruber	72,00	18,1
										Gymnura sp.	50,00	12,5

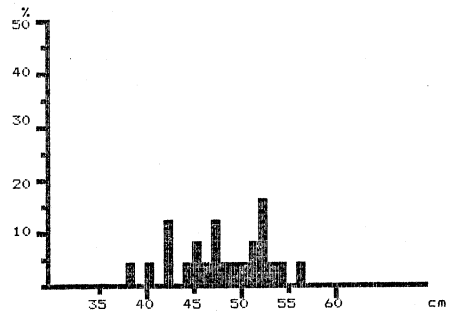
DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
10.09	0650	22	BT	27	27	N25 08'	E064 54'	290,2	580,4	Lepturacanthus savala	326,80	56,6
										Argyrops spinifer	124,00	21,3
										Pomadasys hasta	69,00	11,8
										Dasyatis sp	16,00	2,7
10.09	1135	23	BT	17	17	N25 15'	E065 15'	29,5	59,0	Gymnura sp.	19,40	32,8
										Otolithes ruber	10,80	18,3
										Rhinoptera sp.	6,80	11,5
										Pomadasys hasta	6,40	10,8
										Parapenaeopsis stylifera	6,00	10,1
10.09	1455	24	BT	23	23	N25 09'	E065 24'	104,7	209,4	Lepturacanthus savala	140,00	66,8
										Nibea albida	29,20	13,9
										Pomadasys hasta	8,00	3,8
										Krill	10,00	4,7
10.09	1955	25	PT	200	70	N25 00'	E063 30'	165,0	330,0	Lepturacanthus savala	330,00	100,0
10.09	2205	26	BT	33	33	N25 01'	E065 32'	87,9	16,7	Trichiurus lepturus	6,49	38,8
										Arius sp	5,85	35,0
										Otolithes ruber	,81	4,8
										Saurida tumbil	,75	4,4
11.09	0145	27	BT	24	24	N25 07'	E065 45'	56,7	113,4	Arius sp	41,40	36,5
										Otolithes ruber	33,20	29,2
										Otolithes ruber	15,00	13,2
										Argyrops spinifer	8,20	7,2
11.09	0645	28	BT	14	14	N25 17'	E065 59'	165,0	330,0	Trichiurus lepturus	224,80	68,1
										Lactarius lactarius	73,60	22,3
										Pomadasys hasta	12,40	3,7
										Arius sp	6,30	1,9
11.09	0855	29	BT	35	35	N25 12'	E065 58'	4553,4	9106,8	Trichiurus lepturus	9000,00	98,3
11.09	1015	30	BT	65	65	N25 08'	E065 58'	2554,6	5109,2	Trichiurus lepturus	5000,00	97,8
11.09	1410	31	BT	97	97	N25 03'	E065 58'	673,0	1346,0	SCIAENIDAE	1300,00	96,5
										Nemipterus japonicus	46,00	3,4
12.09	0440	32	BT	70	70	N24 57'	E066 19'	187,4	374,8	Nemipterus japonicus	135,00	36,0
										SCIAENIDAE	105,00	28,0
										Saurida tumbil	75,00	20,0
										Trichiurus lepturus	22,60	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) %
12.09	0740	33	BT	38	38	N24 04'	E066 31'	181,4	362,8	Trichiurus lepturus	271,20	74,7
										Lactarius lactarius	52,80	14,5
										Pomadasys hasta	20,40	5,6
										Gymnura sp.	4,40	1,2
12.09	0930	34	BT	31	31	N24 58'	E066 32'	1265,4	2530,8	Arius sp	2000,00	79,0
										Pomadasys hasta	202,80	8,0
										Trichiurus lepturus	50,00	1,9
										Pomadasys opercularis	38,00	1,5
12.09	1355	35	BT	73	73	N24 40'	E066 25'	71,9	143,8	Trichiurus lepturus	56,00	38,9
										Nemipterus japonicus	37,00	25,7
										Sphyraena obtusata	18,00	12,5
										Leiognathus sp	13,80	9,5
12.09	1950	36	PT	115	10	N24 17'	E065 58'	140,0	280,0	MYCTOPHIDAE	242,00	86,4
										Sphyraena obtusata	25,60	9,1
										Champsodon sp.	7,20	2,5
										Echeneis sp	4,40	1,5
12.09	2245	37	PT	74	55	N24 21'	E066 17'	1001,5	2003,0	Nemipterus japonicus	400,00	19,9
										JELLYFISH	1600,00	79,8
13.09	0415	38	BT	22	22	N24 36'	E066 55'	181,8	363,6	Pomadasys hasta	157,50	43,3
										Argyrosomus hololepidotus	32,80	9,0
										Sciaenidae. unidentified	27,00	7,4
										Protonibea diacanthus	26,20	7,2
13.09	0715	39	BT	77	77	N24 21'	E066 43'	110,1	220,2	Trichiurus lepturus	216,80	98,4
13.09	1015	40	BT	87	87	N24 08'	E066 26'	106,1	212,2	Trichiurus lepturus	196,00	92,3
										Ariomma indica	4,60	2,1
										Nemipterus japonicus	4,40	2,0
										Seriolina nigrofasciata	3,10	1,4
13.09	1410	41	BT	244	244	N23 55'	E066 03'	213,0	426,0	Champsodon sp.	352,00	82,6
										Synagrops adeni	52,00	12,2
										SCIAENIDAE	19,20	4,5
13.09	2050	42	PT	57	20	N24 05'	E066 49'	169,2	338,4	Dussumieria acuta	210,00	62,0
										Sardinella sindensis	22,50	6,6
										JUVENILE FISHES	15,00	4,4
										JELLYFISH	87,00	25,7

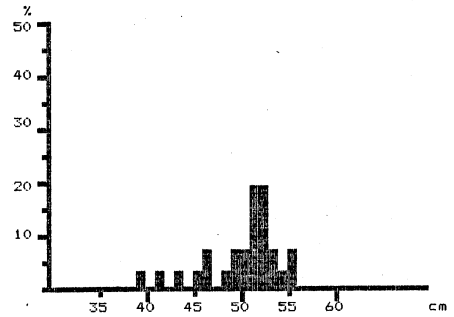
DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION LATIT.	POSITION LONGIT.	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	WEIGTH (KG) %
13.09	2305	43	BT	44	44	N24 13'	E066 59'	141,1	282,2	Apogon sp	65,00	23,0
										Polynemus sp.	60,00	21,2
										Psettodes erumei	24,00	8,5
										Metapenaeus monoceros	20,00	7,0
14.09	0155	44	BT	16	16	N24 08'	E067 12'	36,8	73,6	SHRIMPS	20,00	27,1
										Otolithes ruber	19,20	26,0
										Umbrina sp.	10,00	13,5
										Trichiurus lepturus	6,00	8,1
14.09	0455	45	BT	40	40	N23 56'	E067 04'	500,4	1501,2	Pomadasys maculatus	597,60	39,8
										Sciaenidae. unidentified	352,80	23,5
										Psettodes erumei	216,00	14,3
										Johnieops sp.	158,40	10,5
14.09	1110	46	BT	299	299	N23 25'	E066 22'	32,4	64,8	Champsodon sp.	28,20	43,5
										Nibea albida	17,00	26,2
										Harpodon nehereus	12,40	19,1
										Panulirus polyphagus	2,00	3,0
14.09	1600	47	BT	124	124	N23 25'	E066 38'	78,0	156,0	Nemipterus sp.	76,00	48,7
										Pennahia argentata	54,00	34,6
										Acropoma japonicum	12,60	8,0
										Champsodon sp.	7,80	5,0
14.09	2000	48	BT	83	83	N23 36'	E066 58'	487,2	974,4	Nemipterus japonicus	754,80	77,4
										PLATYCEPHALIDAE	73,10	7,5
										Lepidotrigla sp	42,50	4,3
										SEPIIDAE	27,20	2,7
14.09	2145	49	PT	69	10	N23 40'	E067 04'	246,4	492,8	Leiognathus sp	467,20	94,8
										Decapterus russelli	22,56	4,5
15.09	0030	50	BT	27	27	N23 45'	E067 15'	231,6	463,2	Pomadasys maculatus	286,00	61,7
										SHRIMPS	24,00	5,1
										Otolithes ruber	50,40	10,8
										Pomadasys hasta	16,40	3,5
15.09	0440	51	BT	18	18	N23 47'	E067 30'	144,6	289,2	SCIAENIDAE	104,00	35,9
										Argyrosomus hololepidotus	75,40	26,0
										Johnieops sp.	22,80	7,8
										Pomadasys hasta	15,00	5,1

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) %
15.09	0635	52	PT	24	15	N23 45'	E067 35'	365,4	730,8	Stolephorus sp	346,50	47,4
										Dussumieria acuta	157,50	21,5
										Rhizoprionodon oligolinx	102,00	13,9
										Pomadasys hasta	88,80	12,1
										Trichiurus lepturus	78,00	10,6
15.09	0855	53	BT	57	57	N23 37'	E067 29'	8000,0	16000,0	Dasyatis sp	4000,00	25,0
										Trichiurus lepturus	2400,00	15,0
										Pomadasys hasta	2400,00	15,0
										Johnieops sp.	1600,00	10,0
15.09	1230	54	PT	82	64	N23 22'	E067 13'	1,3	2,6	Saurida undosquamis	1,00	38,4
										Ariomma indica	,60	23,0
										C E P H A L O P O D A	,40	15,3
										Decapterus sp.	,04	1,5
15.09	2215	55	PT	89	1	N23 01'	E066 58'	6,1	12,2	MYCTOPHIDAE	11,00	90,1
										Sphyraena obtusata	,40	3,2
										Champsodon sp.	,30	2,4
										Decapterus Macarellus	,20	1,6
16.09	0240	56	PT	31	16	N23 15'	E067 20'	139,8	279,6	Trichiurus lepturus	18,00	6,4
										Lactarius lactarius	12,00	4,2
										Sphyraena obtusata	7,20	2,5
										JELLYFISH	240,00	85,8
16.09	0915	57	BT	43	43	N23 40'	E067 31'	7980,0	15960,0	Otolithes cuvieri	3164,00	19,8
										Pomadasys maculatus	2618,00	16,4
										Pomadasys hasta	2100,00	13,1
										Polynemus sp.	1414,00	8,8

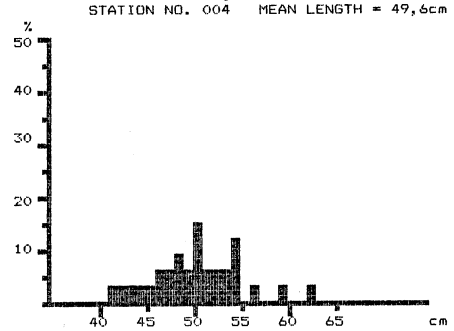
ANNEX II : Length frequency distributions of some important species.



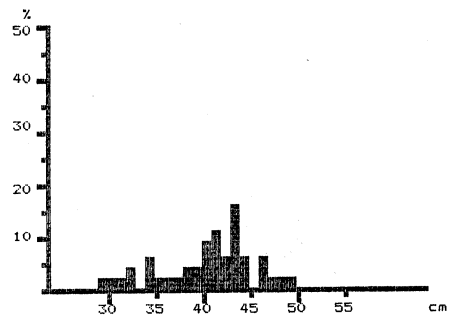
Pomadasys hasta
STATION NO. 001 MEAN LENGTH = 47,7cm N= 24



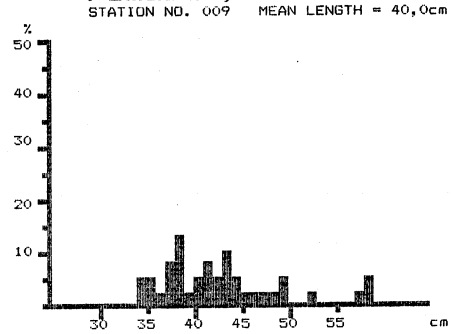
Pomadasys hasta
STATION NO. 004 MEAN LENGTH = 49,6cm N= 26



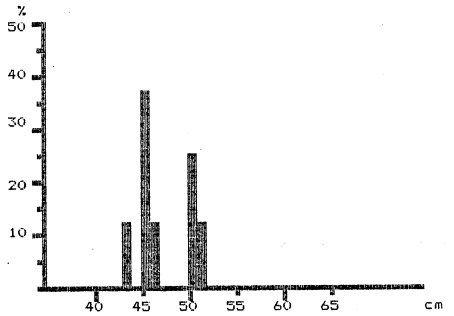
Pomadasys hasta
STATION NO. 005 MEAN LENGTH = 49,9cm N= 32



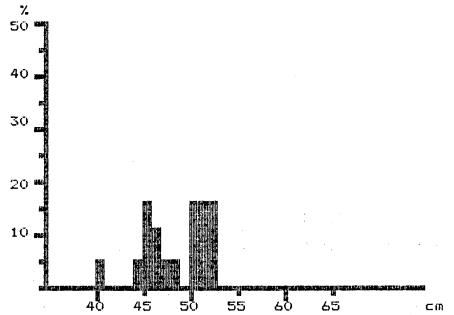
Pomadasys hasta
STATION NO. 009 MEAN LENGTH = 40,0cm N= 43



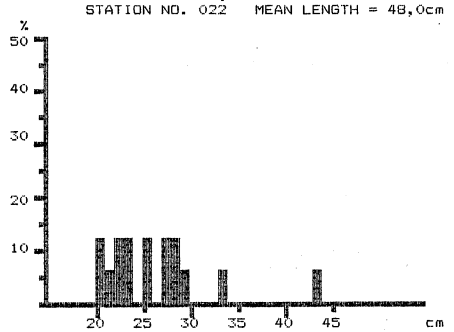
Pomadasys hasta
STATION NO. 017 MEAN LENGTH = 42,4cm N= 37



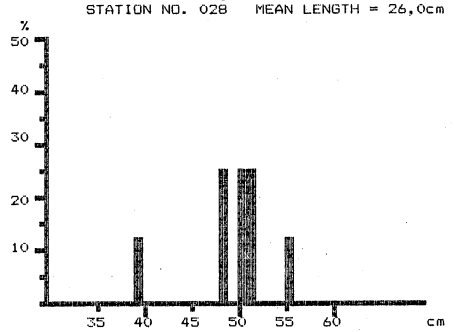
Pomadasys hasta
STATION NO. 019 MEAN LENGTH = 46,8cm N= 8



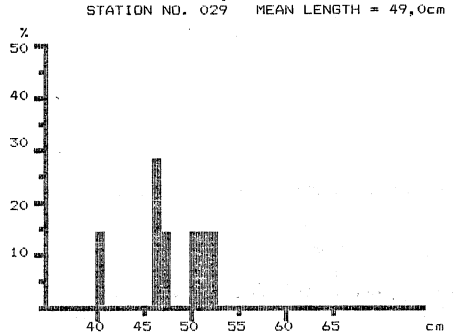
Pomadasys hasta
STATION NO. 022 MEAN LENGTH = 48,0cm N= 18



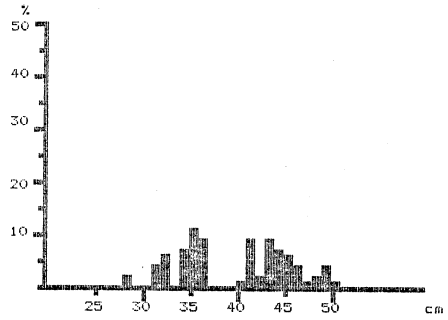
Pomadasys hasta
STATION NO. 028 MEAN LENGTH = 26,0cm N= 16



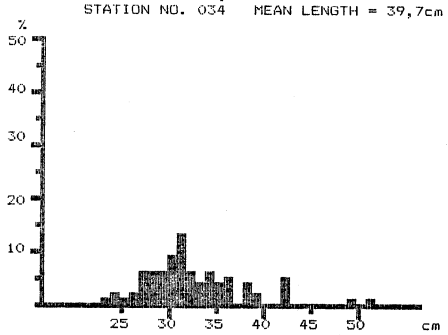
Pomadasys hasta
STATION NO. 029 MEAN LENGTH = 49,0cm N= 8



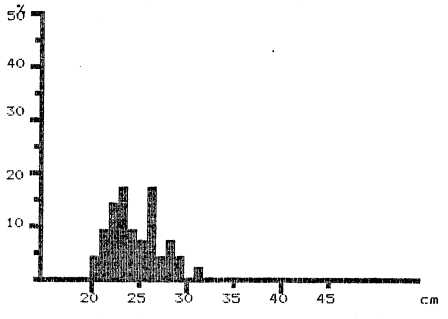
Pomadasys hasta
STATION NO. 033 MEAN LENGTH = 47,4cm N= 7



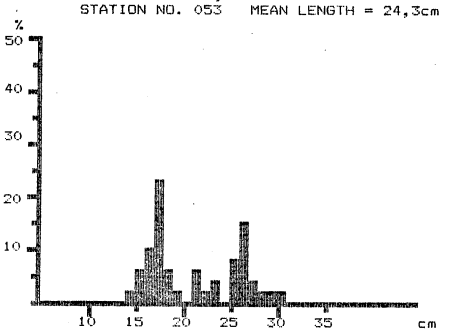
Pomadasys hasta
STATION NO. 034 MEAN LENGTH = 39,7cm N= 106



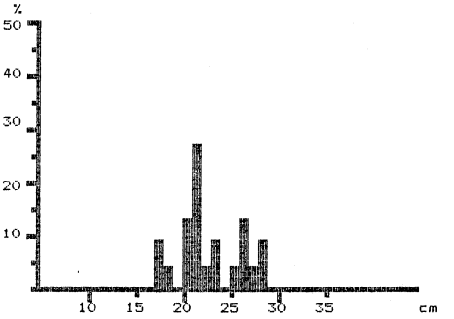
Pomadasys hasta
STATION NO. 038 MEAN LENGTH = 32,9cm N= 125



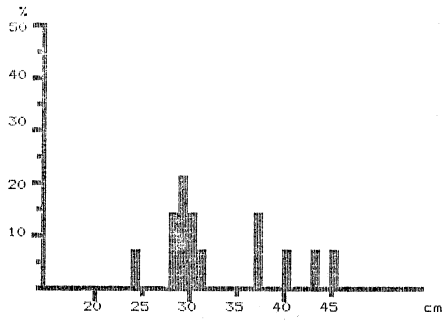
Pomadasys hasta
STATION NO. 053 MEAN LENGTH = 24,3cm N= 41



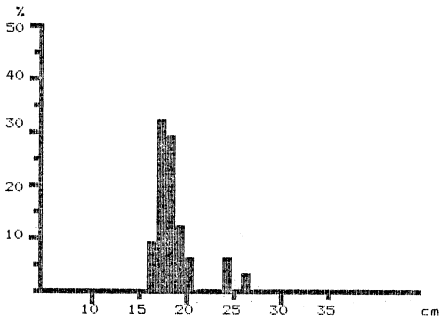
Pomadasys hasta
STATION NO. 057 MEAN LENGTH = 20,7cm N= 46



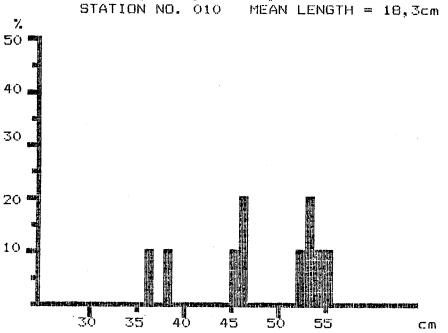
Pampus argenteus
STATION NO. 017 MEAN LENGTH = 22,3cm N= 22



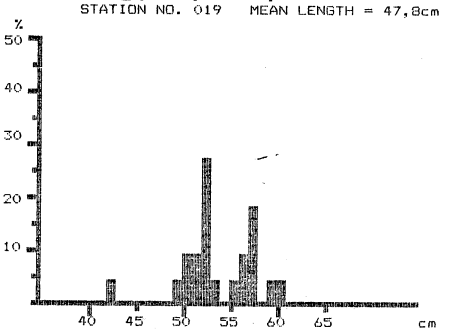
Argyrops spinifer
STATION NO. 009 MEAN LENGTH = 32,8cm N= 14



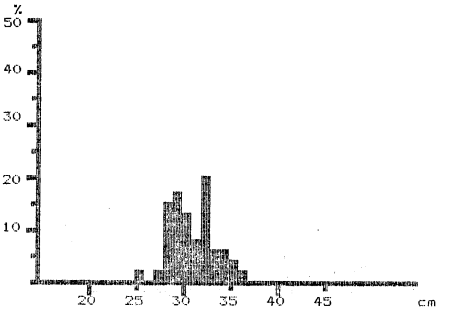
Argyrops spinifer
STATION NO. 010 MEAN LENGTH = 18,3cm N= 31



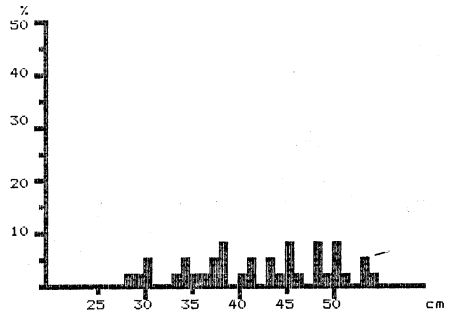
Argyrops spinifer
STATION NO. 019 MEAN LENGTH = 47,8cm N= 10



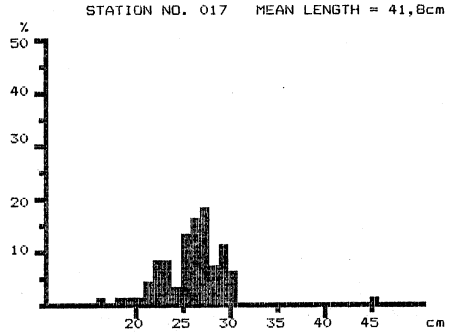
Argyrops spinifer
STATION NO. 022 MEAN LENGTH = 53,2cm N= 22



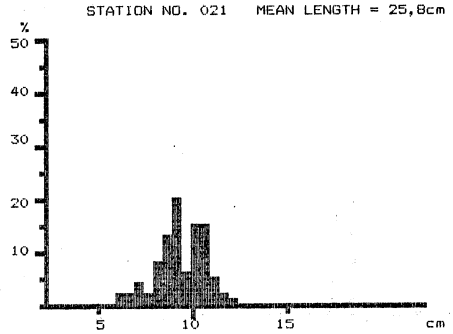
Argyrops spinifer
STATION NO. 030 MEAN LENGTH = 30,6cm N= 45



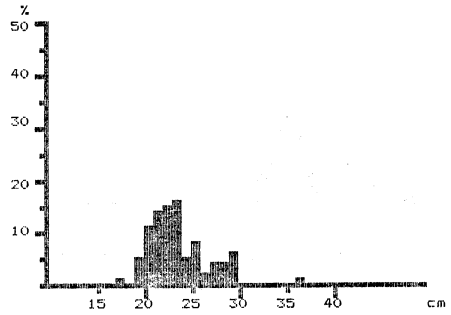
Otholithes ruber
STATION NO. 017 MEAN LENGTH = 41,8cm N= 35



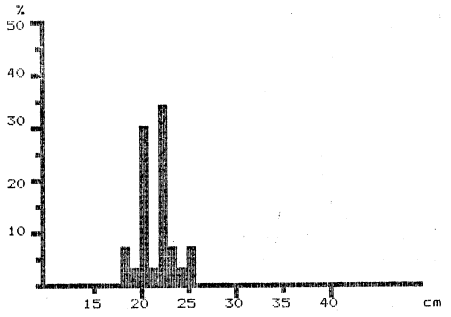
Otholithes ruber
STATION NO. 021 MEAN LENGTH = 25,8cm N= 99



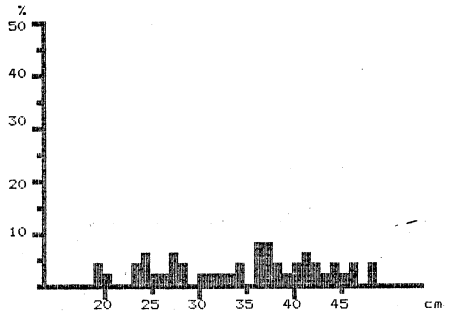
Otholithes ruber
STATION NO. 023 MEAN LENGTH = 9,2cm N= 192



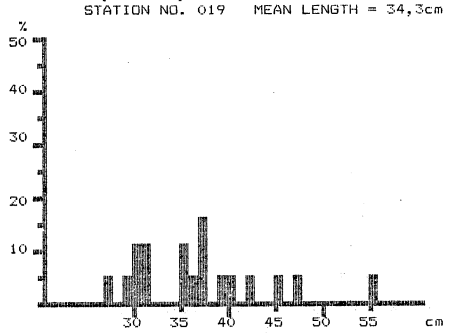
Otholithes ruber
STATION NO. 027 MEAN LENGTH = 23,2cm N= 112



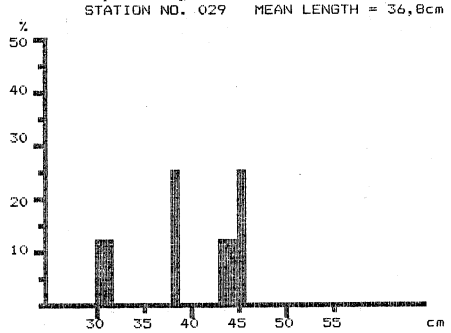
Epinephelus diacanthus
STATION NO. 003 MEAN LENGTH = 21,3cm N= 26



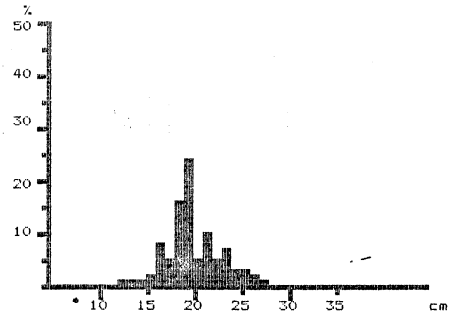
Epinephelus diacanthus
STATION NO. 019 MEAN LENGTH = 34,3cm N= 47



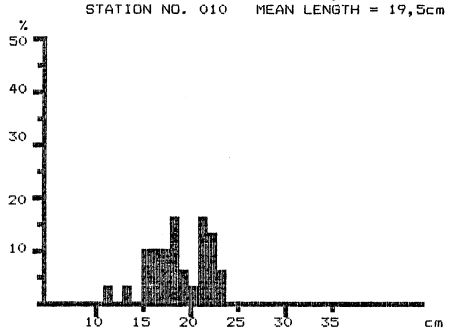
Epinephelus diacanthus
STATION NO. 029 MEAN LENGTH = 36,8cm N= 18



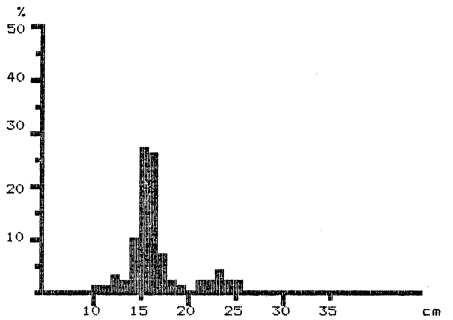
Epinephelus diacanthus
STATION NO. 030 MEAN LENGTH = 39,2cm N= 8



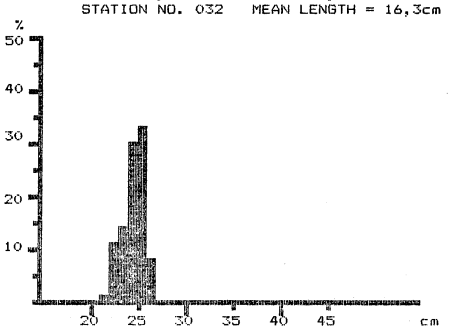
Nemipterus japonicus
STATION NO. 010 MEAN LENGTH = 19,5cm N= 91



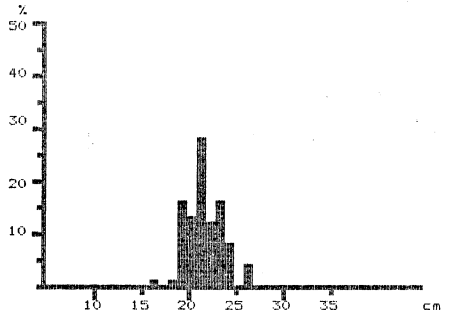
Nemipterus japonicus
STATION NO. 015 MEAN LENGTH = 18,5cm N= 30



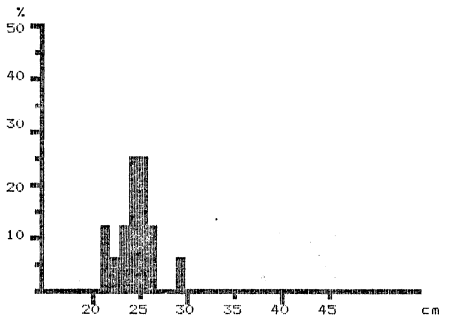
Nemipterus japonicus
STATION NO. 032 MEAN LENGTH = 16,3cm N= 137



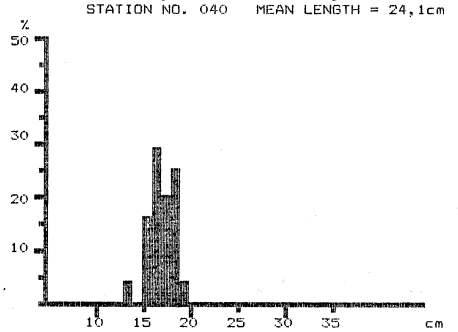
Nemipterus japonicus
STATION NO. 035 MEAN LENGTH = 24,0cm N= 103



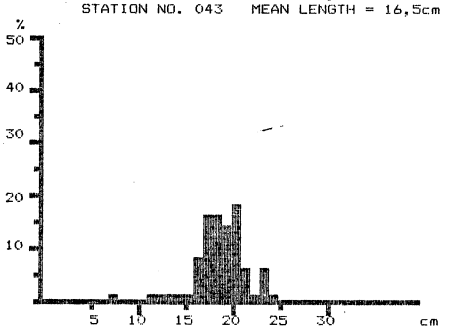
Nemipterus japonicus
STATION NO. 037 MEAN LENGTH = 21,3cm N= 75



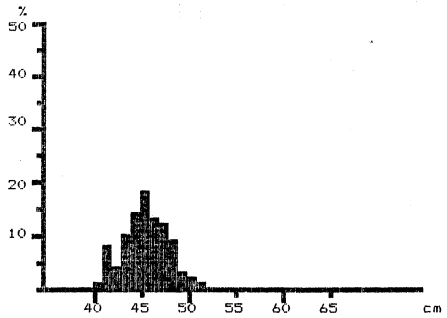
Nemipterus japonicus
STATION NO. 040 MEAN LENGTH = 24,1cm N= 16



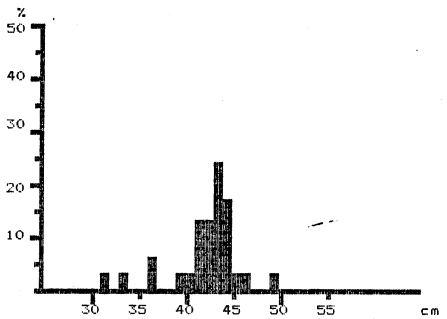
Nemipterus japonicus
STATION NO. 043 MEAN LENGTH = 16,5cm N= 24



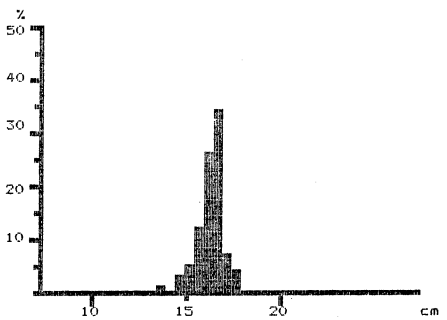
Nemipterus japonicus
STATION NO. 048 MEAN LENGTH = 18,2cm N= 61



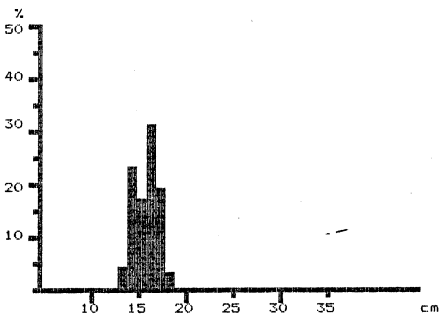
Megalaspis cordyla
STATION NO. 020 MEAN LENGTH = 45,1cm N= 87



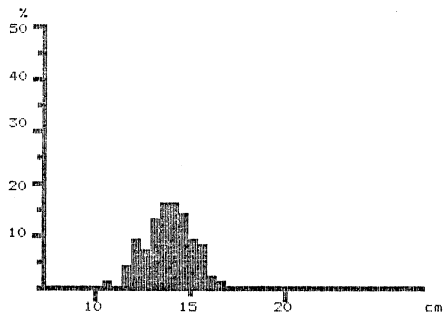
Megalaspis cordyla
STATION NO. 034 MEAN LENGTH = 41,6cm N= 29



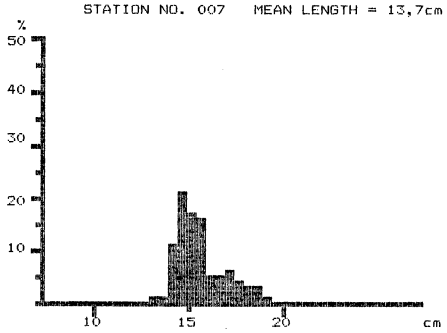
Decapterus russelli
STATION NO. 008 MEAN LENGTH = 16,0cm N= 109



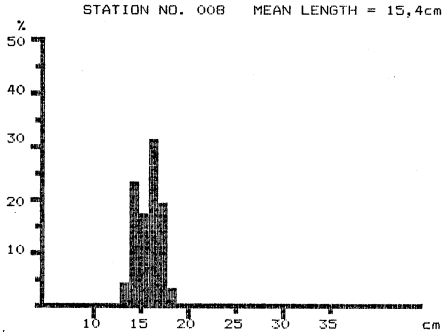
Sardinella sindensis
STATION NO. 042 MEAN LENGTH = 15,4cm N= 63



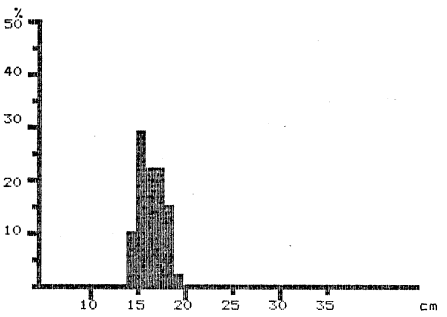
Dussumieria acuta
STATION NO. 007 MEAN LENGTH = 13,7cm N= 100



Dussumieria acuta
STATION NO. 008 MEAN LENGTH = 15,4cm N= 126



Dussumieria acuta
STATION NO. 042 MEAN LENGTH = 15,4cm N= 63



Dussumieria acuta
STATION NO. 042 MEAN LENGTH = 16,0cm N= 100

ANNEX III

Settings and performance of acoustic instruments

Echo sounders and integrators:

Frequency	38 kHz	120 kHz
Basic range (m)	0-100 / 0-250 + 250	0-100
Bandwidth	3.0 kHz	3 kHz
Pulse length	0.6 msec	0.6 msec
TVG and gain	20 logR -20 dB	20 logR 0 dB
Recorder gain	7	2
Transmitter power	1822 W	298 W
Transducer dimension (ceramic)	8^{o} x 8^{o} 30 x 30 cm	10^{o} circular
Discriminator	4-7	5-6
Source level + voltage response	137.8 dB	114.9 dB
Measured	August 1983	August 1983
Integrator threshold	A: 1	0.5
	B: 1	0.5
Integrator gain	A: 20 dB x 10	10 dB x 10
	B: 20 dB x 10	10 dB x 10
Depth intervals (m)	A: 4-50	4-50
	B: 50-250 (varying with depth)	50-100
Bottom stop	On	On

Sonar:

Sonar S 109 was used for pelagic school counting. The beam was fixed 90^{o} starboard with 5^{o} tilt. Schools within 50-150 m range were counted.

ANNEX IV

Fishing gear

Bottom trawl:

High opening shrimp and fish trawl with rubber bobbins of 50 cm diametre. Headrope 41 m. Opening height during trawling approximately 6 m. Mesh size in the wings 40 mm, gradually reduced to 20 mm in the cod end.

Pelagic trawl:

Capelin trawl with four equal panels, approximately 30 x 30 m at opening. Height during trawling varying between 12 and 15 m, the larger when trawling with extra floats at the surface. Mesh size at cod end 20 mm.

The pelagic trawl is monitored with a cable connected net sonde.