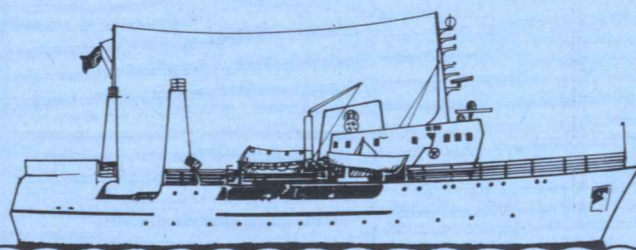


**JOINT NORAD/MOÇAMBIQUE/FAO PROJECT
TO INVESTIGATE THE FISH RESOURCES
OFF THE COAST OF MOÇAMBIQUE**

**cruise report no.4 of
R/V «DR. FRIDTJOF NANSEN»**

APRIL — JUNE 1978



**Sub-contractor: Institute of Marine Research
Bergen-Norway**

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INTRODUCTION

This report covers the fourth cruise of R/V "Dr. Fridtjof Nansen" to survey the fish resources off Mozambique. The main objectives of this survey have been described in Cruise Report nos 1 and 3. The reports are preliminary and a final report on the project will follow.

NARRATIVE

Departure : Maputo, 4 April 1978
Arrival : Maputo, 19 June 1978
Ports of call: Beira, 20-23 April
Beira, 8-13 May
Maputo, 29 May - 1 June
Durban, 15-18 June.

Captain : Nils Kleppe (To 10 May)
Gunnar Haugland (From 10 May)

Scientific staff: O. Nakken (To 10 May), R.P. Silva (4 April - 10 May and 1-19 June), R.A. Lund, T. Thomassen, O. Martinsen, M. Francisco (4-20 April), L.R.S. Amado (4 April - 10 May), M.A. Balate (1-19 June), X.L.E. Manussa (1-19 June), R. Sætre (From 10 May). A. Silva (From 10 May).

INSTRUMENTS AND METHODS

The instruments and methods applied are described in Cruise Reports nos 1-3. On this coverage more effort was put into use of fish pots than on previous cruises.

RESULTS

Survey routes, fishing stations and hydrographic stations are shown in Figs. 1a and 1b. Details of the fishing stations are given in Table 1, while Table 2 gives the length distri-

bution of the most important species. Table 3 gives the carapace length distribution of crustacea and Table 4 the catches of crustacea as percentage of total catch.

Hydrography

Figs. 13-14 shows the surface temperature and salinity observed during this cruise. The highest values, around 30°C, were observed in the northern part decreasing to 22°-24°C off Maputo. Due to large fresh water outflow, low surface salinity was observed in the nearshore zone near the mouths of the main rivers. The depth of the homogenous layer or the depth to the thermocline was about 25 m in the northern area and about 100 m off Maputo (Fig. 15). There was an increase seaward from 10 m to 50-75 m at Sofala Bank. Figs. 2-5 show the hydrographic sections off the Zambezi delta. As can be seen, the influence of the fresh water runoff was noticeable down to about 50 m.

The vertical distribution of temperature, salinity and dissolved oxygen in the six fixed hydrographic sections appear in Figs. 6-12.

Pelagic fish

The distribution of the echo recordings is shown in Fig. 14. As on the previous cruises, these recordings were confined to the shelf area. North of 17°S the recordings were insignificant. The recordings at St. Lazarus Bank were most likely from a carangid species 25-35 cm long, also observed as small schools at the surface. Unfortunately it was not possible to identify the recordings due to rough bottom and shallow water.

From about 17°S the pelagic fish recordings increased southward. North of the Zambezi River they were dominated by orangemouth thryssa (Thryssa vitrirostris) and Indian pellona

(Pellona ditchella). Both species were observed as small schools and as a layer close to the bottom from the shallowest depths to about 35-40 m. The length distribution indicates a bimodal distribution for both species. The smallest fish were immature and the rest in maturity stage 3 or higher. In deeper water, 40-80 m, round and layang scad (Decapterus macrosoma and D. maruadsi) were observed as small schools close to the bottom during daytime and as a layer in 10-20 m depths during night-time. The scad were mostly immature.

On the rest of the Sofala Bank area the pelagic recordings were dominated by buccaneer anchovy (Stolephorus buccaneri) and Indian pellona (Pellona ditchella). The Indian pellona as observed farther north, were found in small schools and as a layer at depths up to 40 m. The anchovy were mainly observed at bottom depths of 25 to 65 m with a concentration over 30-40 m depths. The length was between 4 and 7 cm. In the same area, surface schools of spanish mackerel (Scomberomorus commerson) was observed feeding on the anchovy.

From the Sofala Bank to about 25°S the pelagic recordings consisted mainly of horse mackerel (Decapterus spp.) and barracuda (Spyraena spp.). As also observed on previous cruises porcupine fish (Didodon maculifer) contributed to the readings off Inhambane. Round herring (Etrumeus teres) 17-21 cm were observed at about 23°S and also at the Boa Paz Bank at 150 m depths during daytime. Smaller recordings of this species were also made at about 26°30'S. In the rest of Delagoa Bay the pelagic recordings were made up of Engraulidae (Stolephorus buccaneri, Thryssa vitrirostris and T. setirostris), Carangidae (Trachurus trachurus, Carangoides malabaricus) and Indian driftfish (Arionna indica).

0-group fish

Small schools and layers of 0-group fish were observed from

Cabo Delgado to Sofala Bank. The recording were concentrated in the upper 70-80 m and the highest density was found off Nacala. The most abundant species seemed to be horse mackerel (Decapterus sp.) Scombrida sp. and Siganus sp..

Demersal fish

Fig. 13 shows the demersal fish recordings. Except for at St. Lazarus Bank the recordings were scattered. At this bank the two-spot red snapper (Lutjanus bohar) dominated. The same species was also observed off Angoche. Between Angoche and Sofala Bank the main species were croakers (Otolithes ruber, Johnius belangeri), grunts (Pomadasys hasta), ponyfish (Leiognathus sp.) and some catfish (Arius sp.).

From Sofala Bank to Delagoa Bay the catches were mostly sea breams (Argyrops spinifer, Sparus major, Evynis cardinalis and Polysteganus coeruleopunctatus) at depths between 50 and 150 m. At greater depths crocodile fish (Peristedion adeni) were dominant.

Mesopelagic fish

The distribution of mesopelagic fish appears in Fig. 15. Pelagic trawl catches during the night at depths of more than 150 m were dominated by lantern fish (Myctophidae). A more diverse species composition occurred in bottom trawls from deeper waters. The highest abundance of mesopelagic fish was along the continental slope. Along most of the coast, a scattering layer along the bottom between 300 and 350 m was a characteristic feature. Besides lanternfish this layer mainly consisted of Psenes indicus, Neoscombrops annectens, Cubiceps natalensis and snake mackerel (Thyrstoides marleyi). Even at night-time lantern fish were caught in this layer, so it is obvious that not all Myctophidae species migrate to the surface during this time.

Pots

In Table 5 are presented data on the pots fishing stations. The best catches amounted to 25 kg/pot. As different types of pots were used in the same setting, and the fish avoided some of these the average catch rate could probably be increased by about 20%. Fairly good catches were obtained at the St. Lazarus Bank at 15-20 m and off Bazaruto Island at 85 m.

Plankton

The average echo abundance (in mm deflection per nautical mile) attributed to plankton and fish larvae is shown in Fig. 16. The recordings outside the shelf also included a minor contribution from mesopelagic fish which was difficult to separate from plankton recordings during night-time. As also observed previously the highest values were observed along the shelf edge. In the northern area the recordings were low and increased southwards. South of Sofala Bank the relative abundance was in general, higher than on the previous coverage.

The wet displacement volumes of plankton along the hydrographic sections are shown in Figs. 17 and 18. Compared with the results from the previous cruise, these values seem to be slightly higher.

Table 1. Record of fishing operations.

BT : Bottom trawl, PL: Pelagic trawl, GN: Gill net, LL: Long line, HL: Hand line, P: Pots.

Fish names: J.L.B. Smith, Sea Fishes of Southern Africa and FAO Species Identification Sheets for Fishery Purposes.

Date	Time Start GMT	St no	Gear type	Bottom depth m	Gear depth m	Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
						South	East			
9.4	0749	82	PL	1300	90	10°41'	40°55'	< 1	< 1	<u>Scombridae</u> sp.
9.4	1655	83	PL	1200	20	11°26'	40°50'	3	3	Lantern fish <u>Myctophum</u> 2 spp
10.4	0735	84	PL	2200	50	11°42'	41°20'	< 1	< 1	0-group fish
11.4	0430	85	PL	1700	40	12°12'	41°19'	1	1	0-group fish
11.4	1025	86	P	18	18	12°14'	41°25.5'	150		Two spot red snapper <u>Lutjanus bohar</u> (78)
11.4	1035	87	P	19-20	19-20	12°14'	41°25'	96		Two spot red snapper <u>Lutjanus bohar</u> (49)
11.4	1045	88	P	15-16	15-16	12°14'	41°24.5'	71		Two spot red snapper <u>Lutjanus bohar</u> (30)
11.4	1105	89	P	22-21	22-21	12°14'	41°23'	105		Two spot red snapper <u>Lutjanus bohar</u> (31)
11.4	1500	90	HL	23	23	12°14'	41°23'	198		Two spot red snapper <u>Lutjanus bohar</u> (174)
12.4	1940	91	PL	2200	0	13°00'	40°57'	2	2	Lantern fish <u>Myctophidae</u> sp. (1)
13.4	1430	92	PL	1000	100-75	14°07'	40°49'	< 1	2	Lantern fish <u>Myctophidae</u> sp. (0.4)
13.4	2120	93	PL	370	0	14°41'	40°52'	2	2	Medusa (1.5), Squids (0.3), Lantern fish <u>Myctophidae</u> sp. (0.1)
14.4	0750	94	PL	700	25	15°09'	40°39'	5	10	0-group fish <u>Siganus</u> sp., <u>Thunnus</u> sp. <u>Scomber</u> sp., <u>Decapterus</u> sp.
14.4	1437	95	PL	700	13-27	15°43'	40°36'	< 1	< 1	0-group fish <u>Siganus</u> sp., <u>Decapterus</u> sp. Squids.
14.4	2000	96	PL	800	55	16°00'	40°25'	40	40	Lantern fish <u>Myctophidae</u> (30) Krill <u>Euphausiids</u> (5)

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom Gear		Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
				depth m	depth m	South	East			
15.4	0530	97	P	20	20	16°18'	40°05'	1		Emperor <u>Lethrinus variegatus</u> (1)
15.4	0540	98	P	18-22	18-22	16°18'	40°05'	3		Two spot red snapper <u>Lutjanus bohar</u>
17.4	0715	99	PL	800	40-25	16°42'	40°58'	4	4	Medusa (3), 0-group fish <u>Scombridae</u> , <u>Carangidae</u>
17.4	1832	100	PL	537	0-12	16°50'	39°30'	15	15	Lantern fish <u>Myctophidae</u> (10), 0-group fish <u>Decapterus</u> sp.
18.4	0535	101	BT	13-15	13-15	17°11'	38°36'	139	139	Brushtooth lizard fish <u>Saurida</u> <u>undosquamis</u> (26), Indian mackerel <u>Rastrelliger kanagurta</u> (13), Malabar <u>cavalla</u> <u>Carangoides malabaricus</u> (11), Pugnose pongfish <u>Secutor insidiator</u> (8) Indian pellona <u>Pellona ditchela</u> (7)
18.4	0934	102	BT	36	36	17°27'	38°18'	174	174	Brushtooth lizardfish <u>Saurida</u> <u>undosquamis</u> (74), Yellow goatfish <u>Upeneus sulphureus</u> (19), Goldband goat fish <u>Upeneus moluccensis</u> (15)
18.4	1506	103	BT	23	23	17°30'	38°03'	135	135	Yellowstriped goatfish <u>Upeneus</u> <u>vittatus</u> (25) Orangemouth <u>thryssa</u> <u>Thryssa vittrirostrus</u> (19) Pugnose pony- fish <u>Secutor insidiator</u> (14), Indian pellona <u>Pellona ditchela</u> (9), Lined Silver grunt <u>Pomadasya hasta</u> (8)
23.4	1450	104	HL	21-20	0-1	19°46'	35°19'	16	16	Streaked Spanish mackerel <u>Scom-</u> <u>beromorus lineolatus</u> (16).

(Table 1 Continued)

Date	Time Start GMT	St no	Gear type	Bottom depth m	Gear depth m	Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
						South	East			
25.4	0035	105	BT	12	12	17°38'	37°40'	86	86	Tigertoothed croaker <u>Otolithes ruber</u> (48), Belanger croaker <u>Johnius belangerii</u> (10), Skates (11), Jumbo tiger prawn <u>Penaeus monodon</u> (4), White prawn <u>Penaeus indicus</u> (5)
25.4	0825	106	BT	20	20	17°55'	37°13'	213	213	Largeheadhairtail <u>Trichiurus lepturus</u> (28), Tiger-toothed croaker <u>Otolithes ruber</u> (19), Orangemouth thryssa <u>Thryssa vitrirostris</u> (24), Indian pellona <u>Pellona ditchela</u> (15), White prawn <u>Penaeus indicus</u> (15).
25.4	1655	107	GN	35	0	18°07'	37°17'	91		Cobia <u>Rachycentron canadus</u> (38) Silky shark <u>Carcharhinus falciformis</u> (18) Black tipped shark <u>Carcharbiticus maculipinnis</u> (17).
26.4	0740	108	BT	20	20	18°20'	36°52'	97	97	Catfish <u>Arius</u> sp. (16), Orangemouth thryssa <u>Thryssa vitrirostris</u> (12), Indian pellona <u>Pellona ditchela</u> (13) Black pomfret <u>Formio niger</u> (10), White prawn <u>Penaeus indicus</u> (7).
26.4	1304	109	BT	25	25	18°31'	36°49'	244	244	Largehead hairtail <u>Trichiurus lepturus</u> (60), Catfish <u>Arius</u> sp. (46), Jellyfish (50), Sharks <u>Carcharhinus</u> sp. (22), White prawn <u>Penaeus indicus</u> (10), Orangemouth thryssa <u>Thryssa vitrirostris</u> (12), Crabs <u>Lagocephalidae</u> sp. (8)
28.4	1016	110	BT	76	76	18°27'	37°17'	182	182	Layang scad <u>Decapterus macrosoma</u> (30) Round scad <u>Decapterus maruadsi</u> (15)

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom Gear		Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
				depth m	depth m	South	East			
28.4	2120	111	PL	61	53	18°37'	37°13'	44	88	Round scad <u>Decapterus maruadsi</u> (29), <u>Emmelichthys sp.</u> (8), <u>Bigeye scad</u> <u>Selar crumenophthalmus</u> (4)
29.4	0327	112	BT	20	20	18°40'	37°00'	38	46	<u>Orangemouth thryssa</u> <u>Thryssa vitrirostris</u> (15).
30.4	1109	113	BT	27	27	18°47'	36°42'	241	241	<u>Indian pellona Pellona ditchela</u> (60) <u>Orangemouth thryssa</u> <u>Thryssa vitrirostris</u> (48), <u>Largehead hairtail</u> <u>Trichiurus</u> <u>lepturus</u> (25), <u>White prawn</u> <u>Penaeus in-</u> <u>dicus</u> (34), <u>Brown prawn</u> <u>Metapenaeus</u> <u>monoceros</u> (8)
30.4	1527	114	PL	35	15-25	18°54'	36°51'	164	220	<u>Indian pellona Pellona ditchela</u> (135) <u>Narrow barred</u> <u>Spanish mackerel</u> <u>Scombero-</u> <u>morus commerson</u> (10)
30.4	1730	115	PL	38	8	18°54'	36°57'	92	92	<u>Anchovy</u> <u>Stolephorus sp.</u> (40), <u>Narrow</u> <u>barred</u> <u>Spanish mackerel</u> <u>Scomberomorus</u> <u>commerson</u> (23) <u>Slender ponyfish</u> <u>Leiognatus elongatus</u> (10)
1.5	0900	116	BT	58	58	19°11'	36°47'	724	724	<u>Yellowstriped goatfish</u> <u>Upeneus vitta-</u> <u>tus</u> (324), <u>Obtuse barracuda</u> <u>Sphyraena</u> <u>obtusata</u> <u>Indian pellona Pellona</u> <u>ditchela</u> (55), <u>Orangemouth thryssa</u> <u>Thryssa vitrirostris</u> (34), <u>Lined silver</u> <u>grunt</u> <u>Pomadasyss hasta</u> (58), <u>Longnose</u> <u>cavalla</u> <u>Carangoides chrysophrys</u> (48) <u>Largehead hairtail</u> <u>Trichiurus lepturus</u> (31).
1.5	1203	117	GN	65	0	19°08'	36°41'	689	689	<u>Brouze shark</u> <u>Carcharhinus ahenea</u> (548), <u>Black tipped shark</u> <u>C. limbatus</u> (90).

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom Gear		Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
				depth m	depth m	South	East			
1.5	1735	118	PL	33	15-20	19°02'	36°36'	256	512	Anchovy <u>Stolephorus</u> sp. (217) Rainbow sardine <u>Dussumieria acuta</u> (8) Indian pellona <u>Pellona ditchela</u> (7)
2.5	0635	119	PL	41	10-15	19°10'	36°24'	114	228	Anchovy <u>Stolephorus</u> sp. (10), Djeddaba crevalle <u>Alepes djeddaba</u> (4)
2.5	1830	120	PL	40	22	19°25'	36°23'	100	200	Anchovy <u>Stolephorus</u> sp. (45), Indian mackerel <u>Rastrelliger kanagaruta</u> (25)
3.5	0126	121	PL	30	23	19°12'	35°56'	73	146	Anchovy <u>Stolephorus</u> sp. (19), Orangemouth thryssa <u>Thryssa vitriro-</u> <u>stris</u> (14), Indian pellona <u>Pellona</u> <u>ditchela</u> (12)
3.5	0720	122	BT	20	20	19°22'	35°50'	110	220	Indian pellona <u>Pellona ditchella</u> (104), Blacktail sardinella <u>Sardinella melanura</u> (5)
4.5	0655	123	BT	27	27	19°40'	35°54'	97	224	Pugnose ponyfish <u>Secutor insidiator</u> (48), yellow striped goatfish <u>Upeneus</u> <u>vittatus</u> (8), Obtuse barracuda <u>Sphyraena obtusata</u> (9), Rainbow sardine <u>Dussumiera acuta</u> (3)
4.5	1100	124	BT	20	20	19°25'	35°39'	811	811	Indian pellona <u>Pellona ditchela</u> (540) Orangemouth thryssa <u>Thryssa vitrirostris</u> (84), Tigertoothed croacker <u>Otolithes</u> <u>ruber</u> (31), Obtuse barracuda <u>Sphyraena</u> <u>obtusata</u> (19), Black-tipped shark <u>Carcharhinus maculipinnis</u> (29), Bronze Shark <u>C. ahena</u> (17), Pugnose ponyfish <u>Secutor insidiator</u> (18).
4.5	1640	125	PL	24	38	19°45'	35°42'	285	570	Goldstriped sardinella <u>Sardinella gib-</u> <u>bosa</u> (158), Round scad <u>Decapterus maru-</u> <u>adsi</u> (60), Anchovy <u>Stolephorus</u> sp. (22) Obtuse barracuda <u>S. obtusata</u> (14)

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom Gear		Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
				depth m	depth m	South	East			
5.5	0750	126	P	35	35	19°32'	36°14'	8		Bloodsnapper <u>Lutjanus sanguineus</u> (4) Crabs (3), <u>Delagoa threadfin bream</u> <u>Nemipterus delagoa</u> (1)
5.5	0755	127	P	36	36	19°32'	36°14'	9		Crabs (3), Triggfish <u>Balistes</u> sp. (3), <u>Delagoa threadfin bream</u> <u>N. delagoa</u> (2).
5.5	0805	128	P	36	36	19°32'	36°14'	20		<u>Delagoa threadfin bream</u> <u>N. delagoa</u> (5), Crabs (3).
5.5	0810	129	P	36	36	19°32'	36°14'	5		<u>Delagoa threadfin bream</u> <u>N. delagoa</u> (2), Crabs (2).
14.5	0630	130	PL	58	20	20°04'	36°08'	1	1	O-group fish <u>Scomberomorus</u> spp, <u>Decap-</u> <u>terus</u> sp, <u>Stolephorus</u> sp, <u>Balistes</u> sp.
14.5	1040	131	PL	57	20	20°00'	36°01'	3	4	O-group fish <u>Stolephorus</u> sp., <u>Decapterus</u> sp., <u>Scomberomorus</u> sp. <u>Squids</u> , <u>Medusa</u> .
15.5	0535	132	PL	32	0	20°23'	35°40'	1	2	<u>Buccaneer anchovy</u> <u>Stolephorus buc-</u> <u>caneeri</u> (1)
15.5	133	133	HL	0	0	20°13'	34°58'	5		Eastern little tuna <u>Euthynnus affinis</u> (5)
15.5	1445	134	PL	17	0	20°18'	35°06'	6	8	<u>Buccaneer anchovy</u> <u>S. buccaneeri</u> (2) <u>Brushtooth lizardfish</u> <u>Saurida undos-</u> <u>quamis</u> (2)
15.5	2220	135	BT	53	53	20°46'	35°44'	11	11	Lantern fish <u>Myctophidae</u> sp. (3) Round scad <u>Decapterus maruadsi</u> (3) Obtuse barracuda <u>Sphyræna obtusata</u> (1) Bluntnose lizardfish <u>Trachinocephalus</u> <u>myops</u> (1)

(Table 1. Continued)

Date	Time		St no	Gear type	Bottom depth m	Gear depth m	Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
	Start GMT						South	East			
16.5	07 50		136	BT	56	56	20°57'	35°37'	26	26	Brushtooth lizardfish <u>Saurida undosquamis</u> (19)
16.5	1140		137	PL	691	180	21°02'	35°48'	84	90	Lanternfish <u>Myctophidae</u> spp. (9) Sharks (75)
17.5	0445		138	P	201	201	21°26'	35°33'	10		Sharks <u>Squalidae</u> spp. ()
17.5	0455		139	P	100	100	21°26'	35°32'	119		Longspine seabream <u>Argyrops spinifer</u> (72), Snappers <u>Lutjanidae</u> spp. (30).
17.5	0505		140	P	50	50	21°26'	35°32'	2		Crabs <u>Portunidae</u> (1)
17.5	0510		141	P	19	19	21°26'	35°31.5'	3		Crabs <u>Portunidae</u> (2)
19.5	1835		142	BT	349	349	21°57'	35°39'	< 1	1	
19.5	2135		143	BT	288	288	21°58'	35°38'	80	160	Brushtooth lizardfish <u>Saurida undosquamis</u> (12), Lanternfishes <u>Myctophidae</u> spp. (21), <u>Neoscombrops annectens</u> (10) Cuttlefish (7)
20.5	0313		144	PL	80-90	50	22°16'	35°34'	< 1	1	Squids, Medusae
20.5	1300		145	BT	200	200	22°36'	35°39'	0	0	No catch
21.5	1300		146	BT	230	230	23°06'	35°44'	15	15	Siilsmelt <u>Argentina sphyraena</u> (10), Silver Brushtooth lizardfish <u>Saurida undosquamis</u> (7), Crocodile fish <u>Peristedion adeni</u> (9), <u>Cubiceps</u> sp. (4), Squids (11)
21.5	1516		147	PL	190	0	23°10'	35°32'	< 1	1	
21.5	2152		148	BT	99-113	99-113	23°16'	35°38'	14	14	Obtuse barracuda <u>Sphyraena obtusata</u> (4), Boxfish <u>Tetrosomus concatenatus</u> (4), <u>Monocentris japonicus</u> (1).
22.5	0655		149	BT	26	26	23°28'	35°28'	0	0	No catch

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom Gear		Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
				depth m	depth m	South	East			
22.5	0825	150	BT	24	24	23°30'	35°28'	80	96	Round scad <u>Decapterus maruadsi</u> (36), Slender ponyfish <u>Leiognathus elongatus</u> (17),
25.5	1905	151	BT	265	265	26°34'	33°02'	90	90	Lantern fish <u>Myctophidae</u> sp. (42).
26.5	0710	152	BT	460-477	460-477	26°13'	33°13'	80	80	Lantern fish <u>Myctophidae</u> sp. (8) Cuttlefish (10), <u>Shrimps Caridea</u> sp. (12)
27.5	0430	153	P	202-186	202-186	25°20'	33°34'	24	24	Silver seabream <u>Sparus major</u> (24)
27.5	0450	154	P	90-109	90-109	25°19'	33°34'	26	26	Silver seabream <u>Sparus major</u> (4), Cardinal seabream <u>Ewynis cardinalis</u> (8),
27.5	0510	155	P	48-60	48-60	25°18'	33°33'	11	11	Cardinal seabream <u>E. cardinalis</u> (2), Malabar cavalla <u>Carangoides malabaricus</u> (4)
27.5	0545	156	P	21-24	21-24	25°15'	33°32'	18	18	Greasy grouper <u>Epinephelus tauvina</u> (12) Southern meager <u>Argyrosomus hololepidotus</u> (5)
2.6	2050	157	PL	1200	10	25°07'	35°38'	5	10	Lantern fish <u>Myctophidae</u> sp. (5),
3.6	0750	158	PL	69-80	10	23°15'	35°38'	1	1	Mixed fish fry.
3.6	1229	159	P	20-23	20-23	22°41'	35°33'	6	6	Blod-spot swimming crab <u>Lupa sanguinolenta</u> (6)
3.6	1254	160	P	55-61	55-61	22°41'	35°35'	4	4	Long spine seabream <u>Argyrops filamentosus</u> (2) Seabream <u>Polysteganus coeruleopunctatus</u>
3.6	1306	161	P	111-118	111-118	22°41'	35°37'	4	4	Shovel nosed lobster <u>Scyllarides</u> sp. (1)

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom Gear depth		Position		Total catch per hour	Catch	Dominant species (total catch, kg)
				m	m	South	East			
3.6	1515	163	BT	85	85	22°36'	35°37'	105	158	Sea bream <u>Chrysolephus lophus</u> (37), Double bar goatfish <u>Parupeneus bifasciatus</u> (12), Longspine seabreams <u>Argyrops filamentosus</u> (12), <u>A. spinifer</u> (9), Red sea bream <u>Pagellus natalensis</u> (5) <u>Bigeye Priacanthus hamrur</u> (6)
3.6	1650	164	PL	87	15-40	22°39'	35°37'	29	43	Round herring <u>Etrumeus teres</u> (18), Squids (10).
4.6	1342	165	P	45	45	23°27'	35°34'	0		No catch
4.6	1415	166	P	100	100	23°27'	35°38'	0		No catch
4.6	1446	167	P	200	200	23°27'	35°42'	40		Sea bream <u>Polysteganus coeruleopunctatus</u> (15), Grouper <u>Epinephelus</u> sp. (21).
4.6	1514	168	P	300	300	23°27'	35°41'	4		Shark (4)
4.6	1645	169	PL	115	100-95	23°23'	35°39'	205	400	Round scad <u>Decapterus maruadsi</u> (200)
5.6	1450	170	PL	200	15-55	23°40'	35°38'	152	203	Porcupine fish <u>Diodon maculifer</u> (100), Sharks <u>Carcharhinus falciformes</u> (50) Crabs <u>Raninidae</u> (7)
6.6	0435	171	P	51-56	51-56	24°14'	35°28'	10		No catch
6.6	0455	172	P	100	100	24°14'	35°30'	0		No catch
6.6	0515	173	P	150	150	24°14'	35°33'	0		No catch
6.6	0535	174	P	200	200	24°14'	35°35'	6		Shovel nosed lobster <u>Scyllaridae</u> sp. (4).
6.6	0715	175	BT	224-219	224-219	24°18'	35°34'	115	115	<u>Peristedion adeni</u> (32), Indian drift-fish <u>Arioma indica</u> (9), Shovel nosed lobster <u>Scyllaridae</u> (7), Spiny dogfish <u>Squalus acanthias</u> (48)

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom Gear		Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
				depth m	depth m	South	East			
6.6	1925	176	BT	280- 302	280- 302	24°54'	35°22'	48	48	Lantern fish <u>Myctophidae</u> (7), <u>Driphus elucens</u> (7), <u>Brushtooth lizardfish</u> <u>Saurida undosquamis</u> (5), <u>Neoscom-</u> <u>brops annectens</u> (5), <u>Cuttlefish</u> (8), Mixed fish fry.
7.6	0325	177	PL	75	45	24°21'	35°24'	4	1	
7.6	1645	178	BT	73	73	24°53'	35°10'	3	3	<u>Squalidae</u> sp. (2)
8.6	0005	179	PL	24	0	24°51'	34°45'	221	442	Orangemouth thryssa <u>Thryssa vitrirostris</u> (97), Longjaw thryssa <u>Thryssa setiros-</u> <u>tris</u> (90).
8.6	0620	180	BT	156- 145	146- 145	25°07'	35°07'	500	500	Round herring <u>Etrumeus teres</u> (393), Croacker <u>Sciaena</u> sp. (45).
8.6	1305	181	BT	72- 81	72- 81	25°03'	34°43'	1000	857	Goldband goatfish <u>Upeneus moluccensis</u> (324), Malaber cavalla <u>Carangoides</u> <u>malabaricus</u> (210), Indian driftfish <u>Arioma indica</u> (152), Flower prawn <u>Pena-</u> <u>eus japonicus</u> (30).
8.6	1950	182	FL	170-137	10	25°14'	34°33,5'	8	16	Lantern fish <u>Myctophidae</u> (7).
8.6	2110	183	BT	172- 199	172- 199	25°17,5'	34°34'	110	220	Belanger's croacker <u>Johnius belangerii</u> (28), Cardinal fish <u>Apogonidae</u> sp. (23) Brushtooth lizardfish <u>Saurida undos-</u> <u>quamis</u> (13)
8.6	1050	184	PL	46	0	25°11'	33°49'	5	10	Mixed fish fry, Medusa, Squids.
9.6	1411	185	P	46	46	25°12'	33°42'	1	1	
9.6	1444	186	P	96- 102	96- 102	25°16'	33°43'	4	4	Groupers <u>Epinephelus</u> sp. (4)
9.6	1454	187	P	162- 182	162- 182	25°18'	33°44'	17	17	Seabream <u>Polysteganus coeruleopunctatus</u> (10)

(Table 1. Continued)

Date	Time Start GMT	St no	Gear type	Bottom depth m	Gear depth m	Position		Total catch kg	Catch per hour kg	Dominant species (total catch, kg)
						South	East			
9.6	1745	188	BT	108- 98	108- 98	25°14.5'	33°49'	20	20	Brushtooth lizardfish <u>Saurida undosquamis</u> (3), Indian driftfish <u>Arioma indica</u> (5)
10.6	0345	189	LL	125- 131	125- 131	25°06'	33°53'	100		Milk shark <u>Rhizoprionodon acutus</u> (51)
10.6	1124	190	P	46	46	25°23'	33°22'	17		Grouper <u>Epinephelus tauvina</u> (11)
10.6	1141	191	P	109- 137	109- 137	25°23'	33°23'	2		Triggerfish (2)
10.6	1159	192	P	177- 203	177- 203	25°21'	33°22'	24		Shovel nosed lobster <u>Scyllaridae</u> sp. (20).
11.6	1305	193	PL	146	75	25°53'	33°07'	20	30	Krill (20).
11.6	1550	194	P	50	50	26°03'	33°01'	0		
11.6	1610	195	P	100- 110	100- 110	26°03'	33°03'	14		Sunfish <u>Cheimerius nufar</u> (8)
11.6	1620	196	P	159- 174	159- 174	26°03'	33°04'	45		Spiny dogfish <u>Squalus acanthias</u> (36), Seabream <u>Polysteganus coeruleopunctatus</u> (7).
11.6	1655	197	BT	318- 370	318- 370	26°03,5'	33°05'	130	130	Lantern fish <u>Myctophidae</u> sp. (21), <u>Neoscombrops annectens</u> (8), Spiny dogfish <u>Squalus acanthias</u> (36), Spiny lobster <u>Palinurus delagoae</u> (25).
12.6	0340	198	LL	100-110		26°06'	33°03'	11		Sharks <u>Carcharhinus</u> sp. (11)
12.6	1054	199	P	300	300	26°27'	33°05'			Gear lost
12.6	1105	200	P	280	280	26°27'	33°04'			
12.6	1126	201	P	178	178	26°27'	33°02'			
12.6	1520	202	BT308-295	308-295	26°37'	33°04'				
12.6	1520	202	BT308-295	308-295	26°37'	33°04'	80	80	Lantern fish <u>Myctophidae</u> sp. (27), Spiny lobster <u>Palinurus delagoae</u> (12).	
13.6	0320	203	LL	142	142	26°25'	33°01'	0		No catch

Table 4. Crustaceans - catches as percentage of total catch by bottom trawl. Shrimps (S) and lobsters (L) (Including shovel-nosed lobster and crayfish (Nephrops)).

St.no.	Depth m	Total catch per hour (kg)	Shrimps and lobster catch/ hour (kg)	%
101	13	139	7 (S)	5.0
105	13	86	11 (S)	12.0
106	20	213	21 (S)	10.0
108	20	97	11 (S)	10.6
109	24	244	16 (S)	6.6
113	27	241	44 (S)	18.3
123	27	224	3 (L)	1.3
124	20	811	1.3 (S)	0.2
152	460	80	1.2 (L)	1.5
"	"	"	11.5 (S)	14.4
175	224	115	7.0 (L)	6.1
176	280	48	1.6 (S)	3.3
181	72	1000	30.0 (S)	3.0
183	172	110	5.0 (L)	4.5
"	"	"	2.5 (S)	2.3
197	300	130	25.0 (L)	19.2
202	300	80	12.0 (L)	15.0
"	"	80	.4 (S)	0.5

Table 5. Average catches per pot.

Fishing Station no.	Depth m	Average catch per pot - kg	Dominant species
86	18	25	Snapper <u>Lutjanus bohar</u>
87	20	19	Snapper <u>Lutjanus bohar</u>
88	15	15	Snapper <u>Lutjanus bohar</u>
89	22	17	Snapper <u>Lutjanus bohar</u>
97	20	41	Scavenger <u>Lethrinus variegatus</u>
98	20	<1	Snapper <u>Lutjanus bohar</u>
126	35	2	Snapper <u>Lutjanus sanguineus</u> , Crabs
127	37	2	Crabs, Threadfin bream <u>Nemipterus delagoa</u>
128	35	4	<u>Rachycentron canadus</u> , Threadfin bream
129	37	1	Threadfin bream <u>Nemipterus delagoa</u>
138	195	41	Shovelnose lobster <u>Scyllaridae</u> , Crabs
139	85	24	Seabream <u>Argyrops spinifer</u> , Snappers
140	45	41	Crabs
141	19	41	Crabs
153	195	5	Silver seabream <u>Sparus major</u>
154	100	5	Silver seabream, Cardinal seabream <u>Eynniss cardinalis</u>
155	55	2	Cardinal seabream, Silver seabream Sharks
156	22	3	Greasy grouper <u>Epinephelus tauvina</u>
159	22	2	Blood-spot swimming crab
160	58	41	Scavenger <u>Lethrinus nebulosus</u>
161	115	1	Seabreams <u>Argyrops filamentosus</u> , <u>Polysteganus coeruleopunctatus</u>
162	156	<1	Shovelnose lobster <u>Scyllaridae</u>

Table 5 Continued.

Fishing station no	Depth m	Average catch per pot - kg	Dominant species
165	45	< 1	Crabs
166	102	0	No catch
167	200	8	Grouper <u>Epinephelus</u> sp., Seabream <u>Polysteganus</u> <u>coeruleopunctus</u>
168	300	1	Sharks, Crabs
171	56	2	Crabs, Lobster <u>P. ornatus</u>
172	100	0	No catch
173	152	< 1	Shovelnose lobster
174	200	2	Shovelnose lobster <u>Palinurus</u> <u>delagoa</u>
185	46	< 1	Malabar cavalla, Grunter
186	98	1	Grouper <u>Epinephelus</u> sp.
187	172	4	Seabream <u>Polysteganus</u> <u>coe-</u> <u>ruleopunctus</u>
190	45	3	Snapper <u>Lutjanus</u> <u>sanguineus</u> , Grouper
191	122	< 1	Triggerfish
192	180	5	Shovelnose lobster
194	50	0	No catch
195	105	3	<u>Cheimereius</u> <u>nufar</u> , seabream
196	167	9	Sharks, seabreams

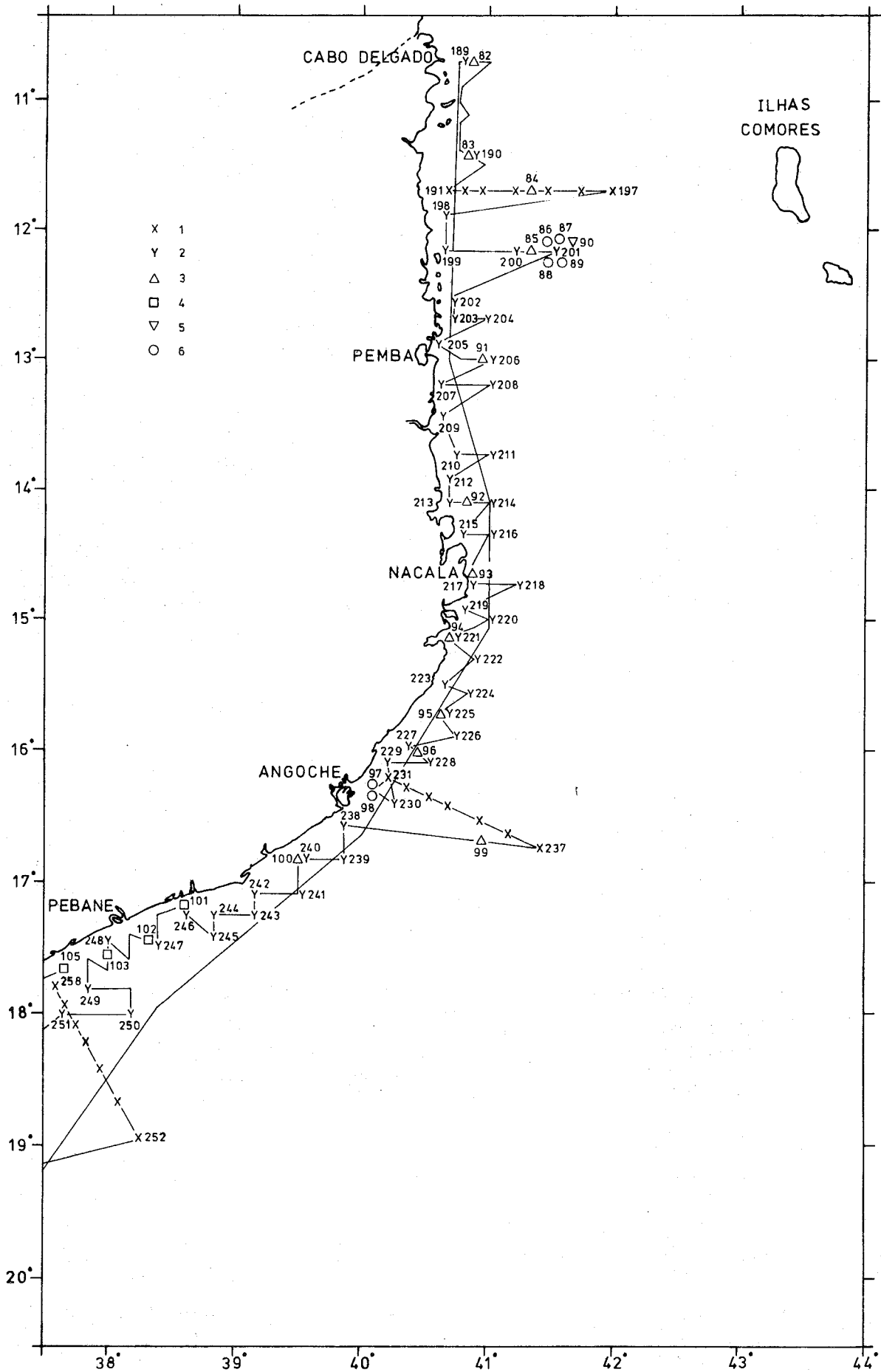


Fig. 1a. Survey routes and stations - northern part.

- 1) Hydrographic station
- 2) Bathythermograph station
- 3) Pelagic trawl
- 4) Bottom trawl
- 5) Handline
- 6) Pots
- 7) Long-line
- 8) Gill net.

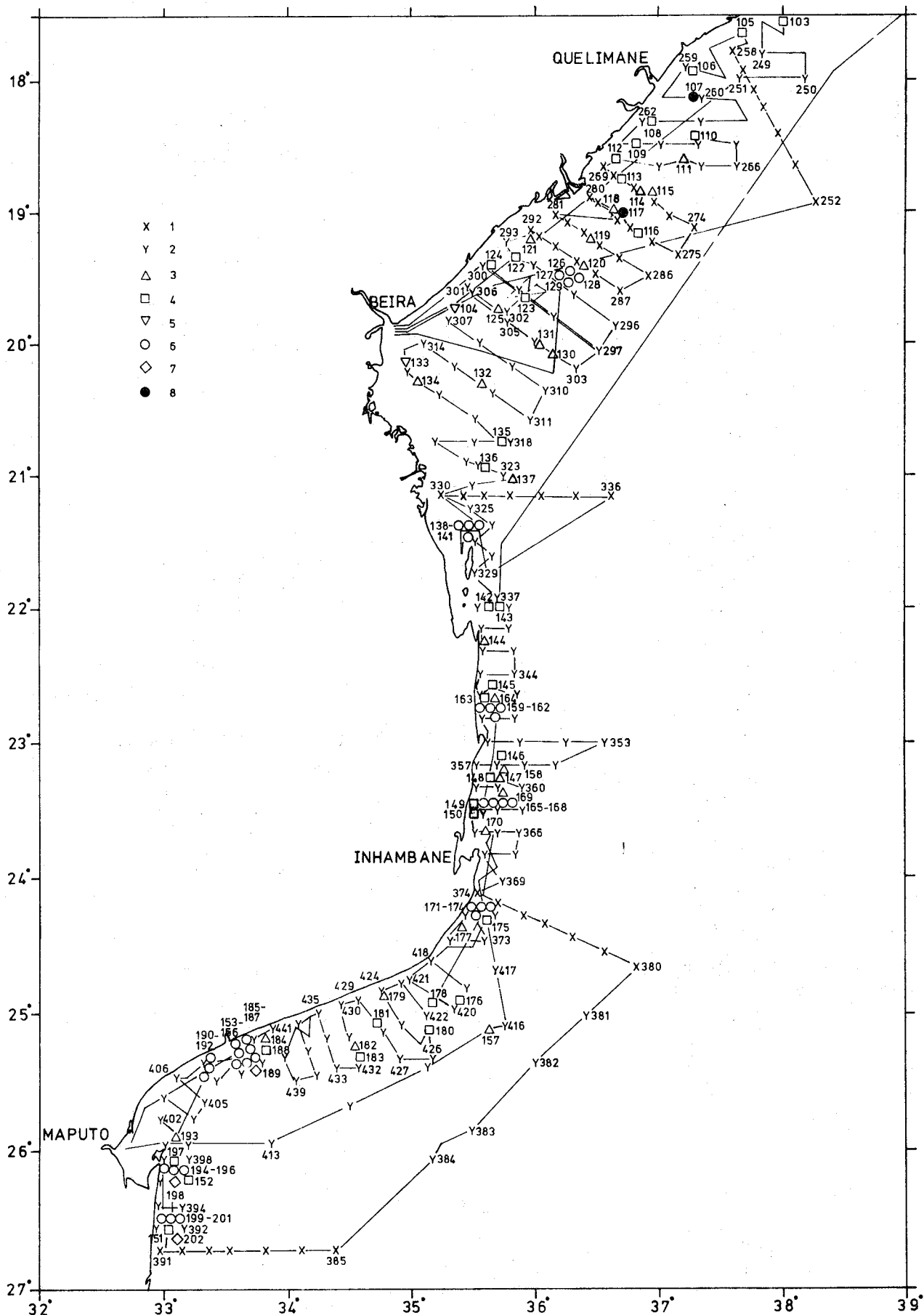


Fig. 1b. Survey routes and stations - southern part.

- 1) Hydrographic station
- 2) Bathythermograph station
- 3) Pelagic trawl
- 4) Bottom trawl
- 5) Handline
- 6) Pots
- 7) Long-line
- 8) Gill net.

ZAMBEZI SECTION I 30 APRIL - 1 MAY 1978

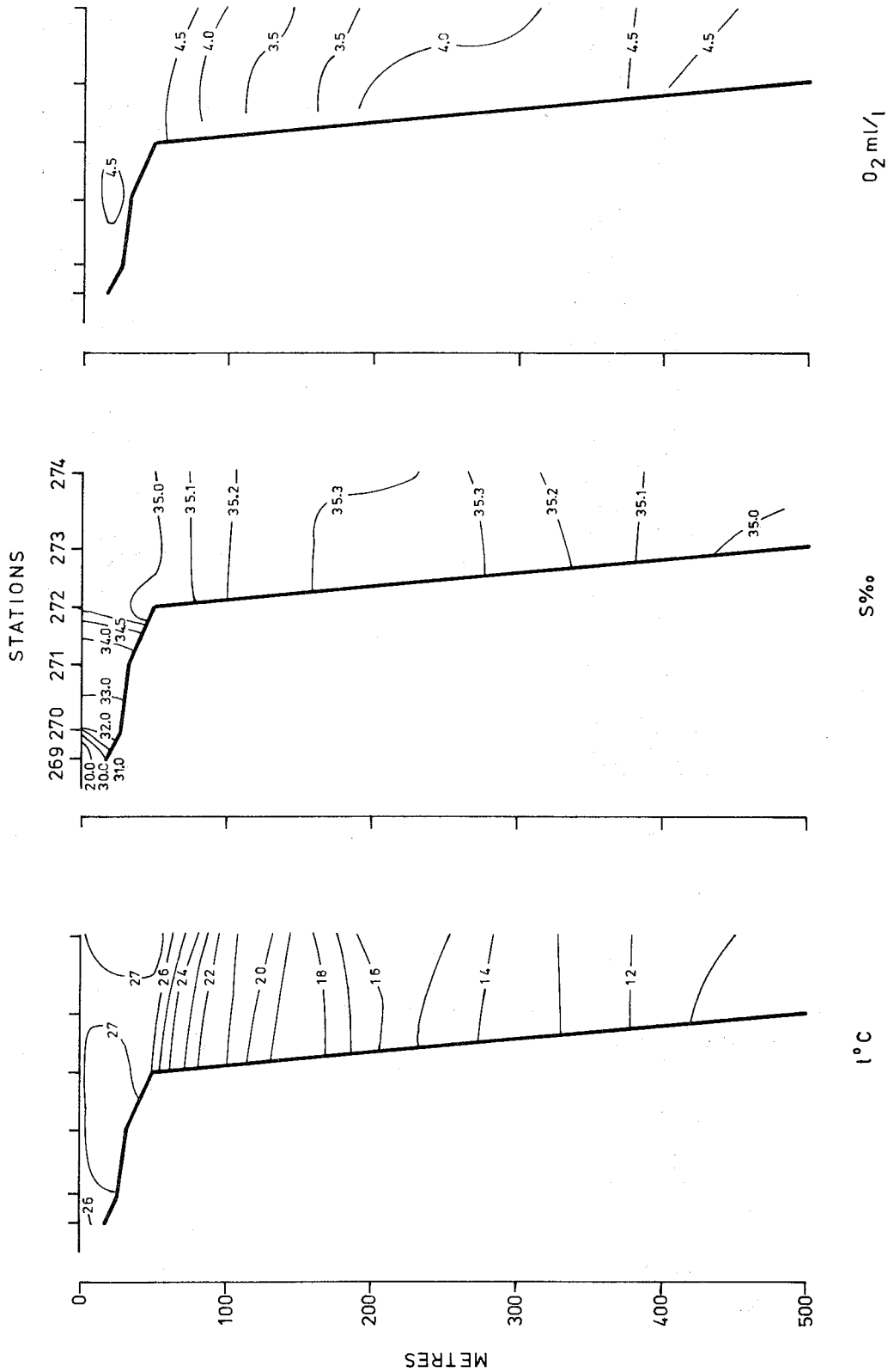


Fig. 2. Zambezi section I. Vertical distribution of temperature, salinity and dissolved oxygen.

ZAMBEZI SECTION II 1 MAY 1978

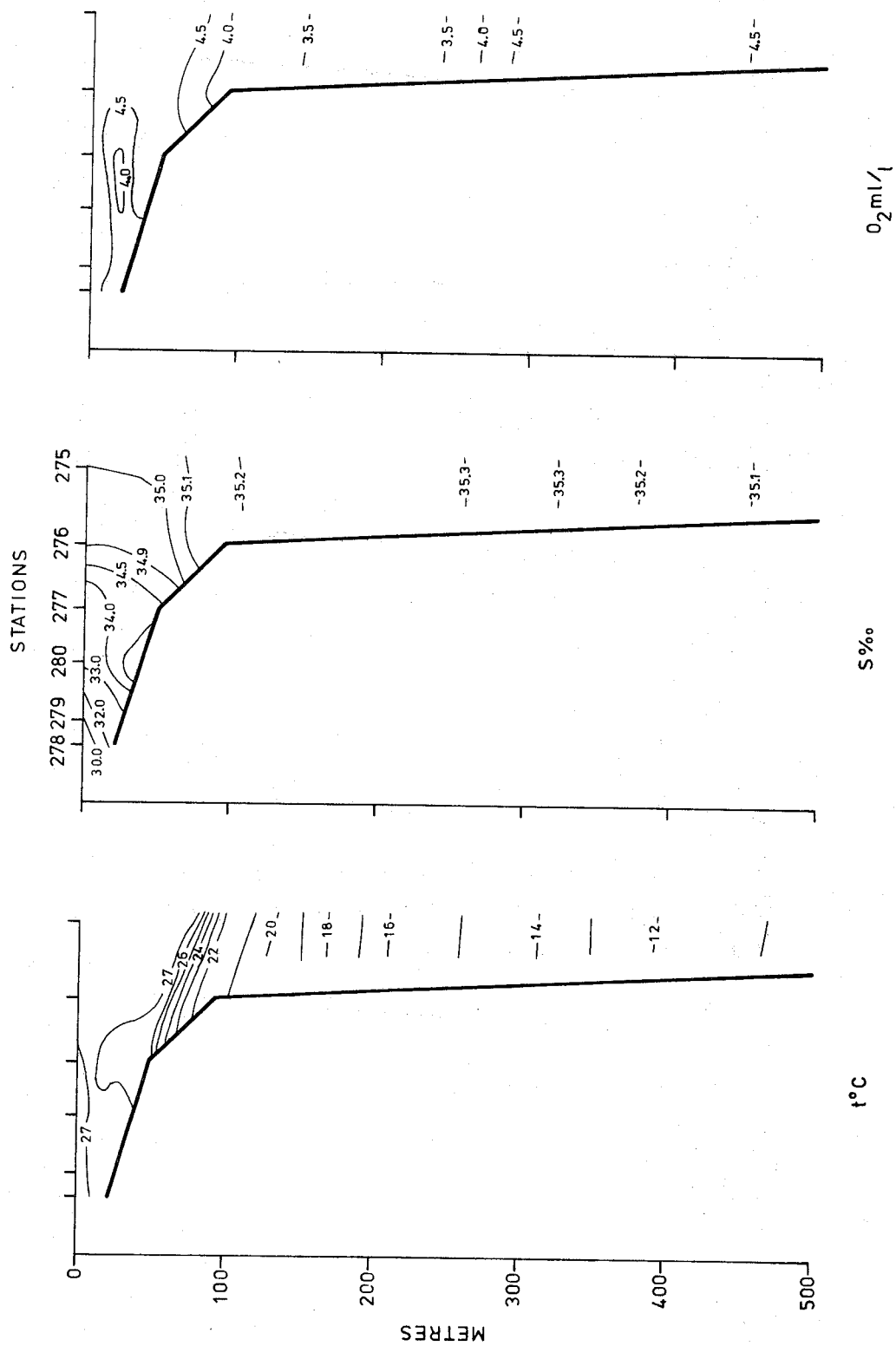


Fig. 3. Zambezi section II. Vertical distribution of temperature, salinity and dissolved oxygen.

ZAMBEZI SECTION III 2 MAY 1978

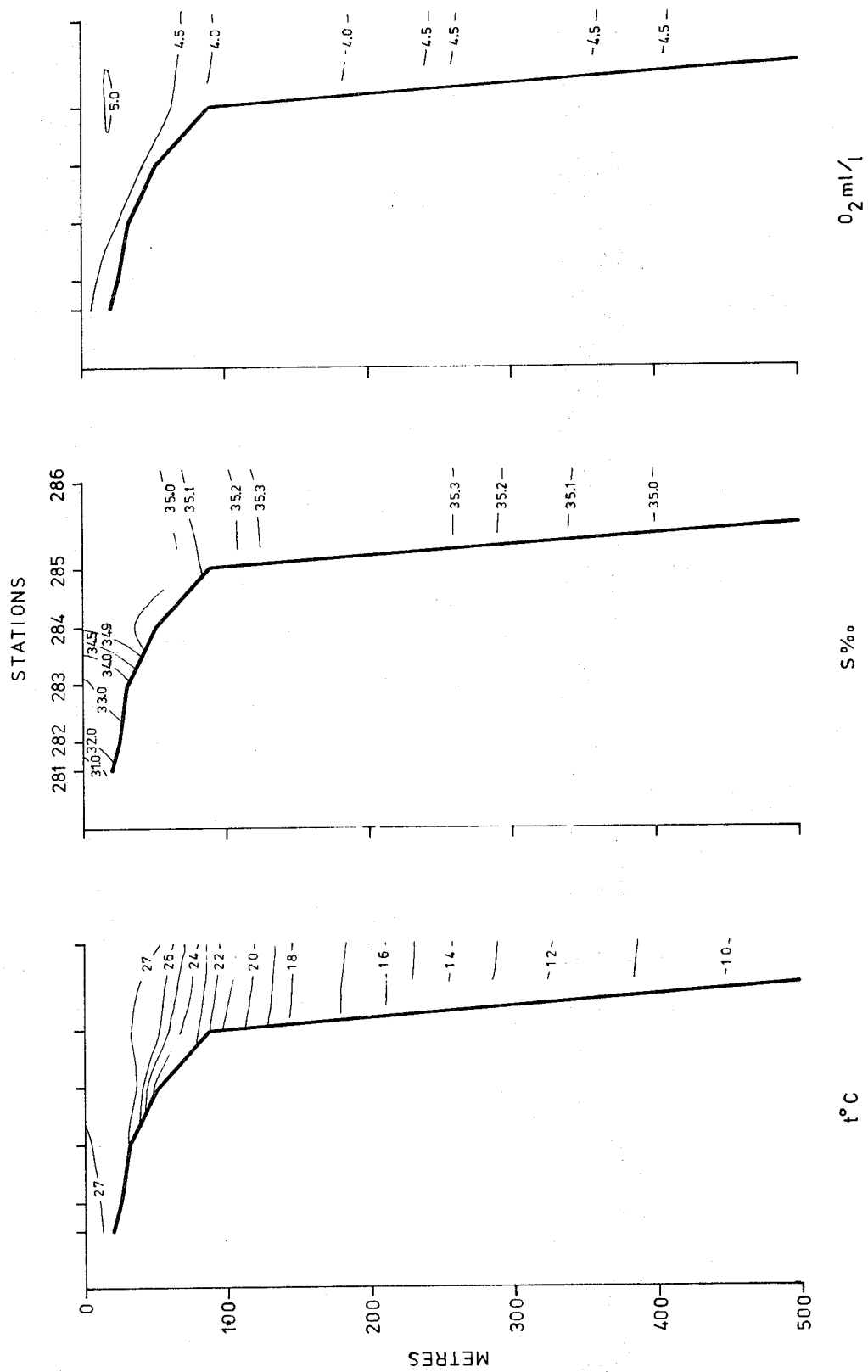


Fig. 4. Zambezi section III. Vertical distribution of temperature, salinity and dissolved oxygen.

ZAMBEZI SECTION IV 2-3 MAY 1978

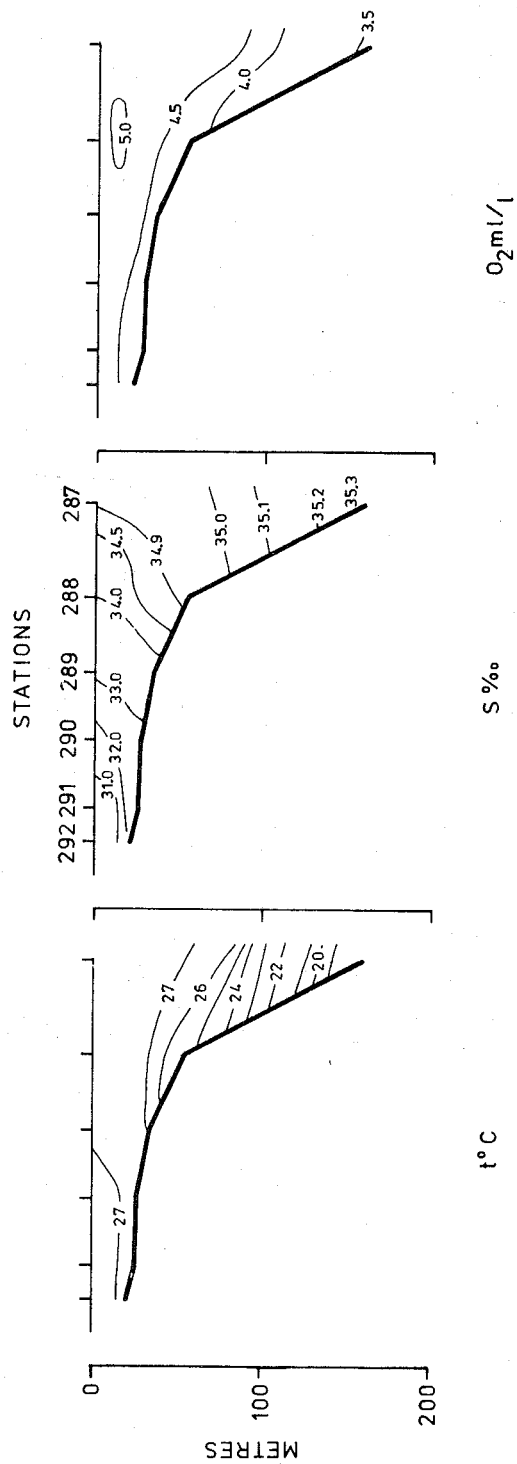


Fig. 5. Zambezi section IV. Vertical distribution of temperature, salinity and dissolved oxygen.

SECTION I 9-10 APRIL 1978

STATIONS

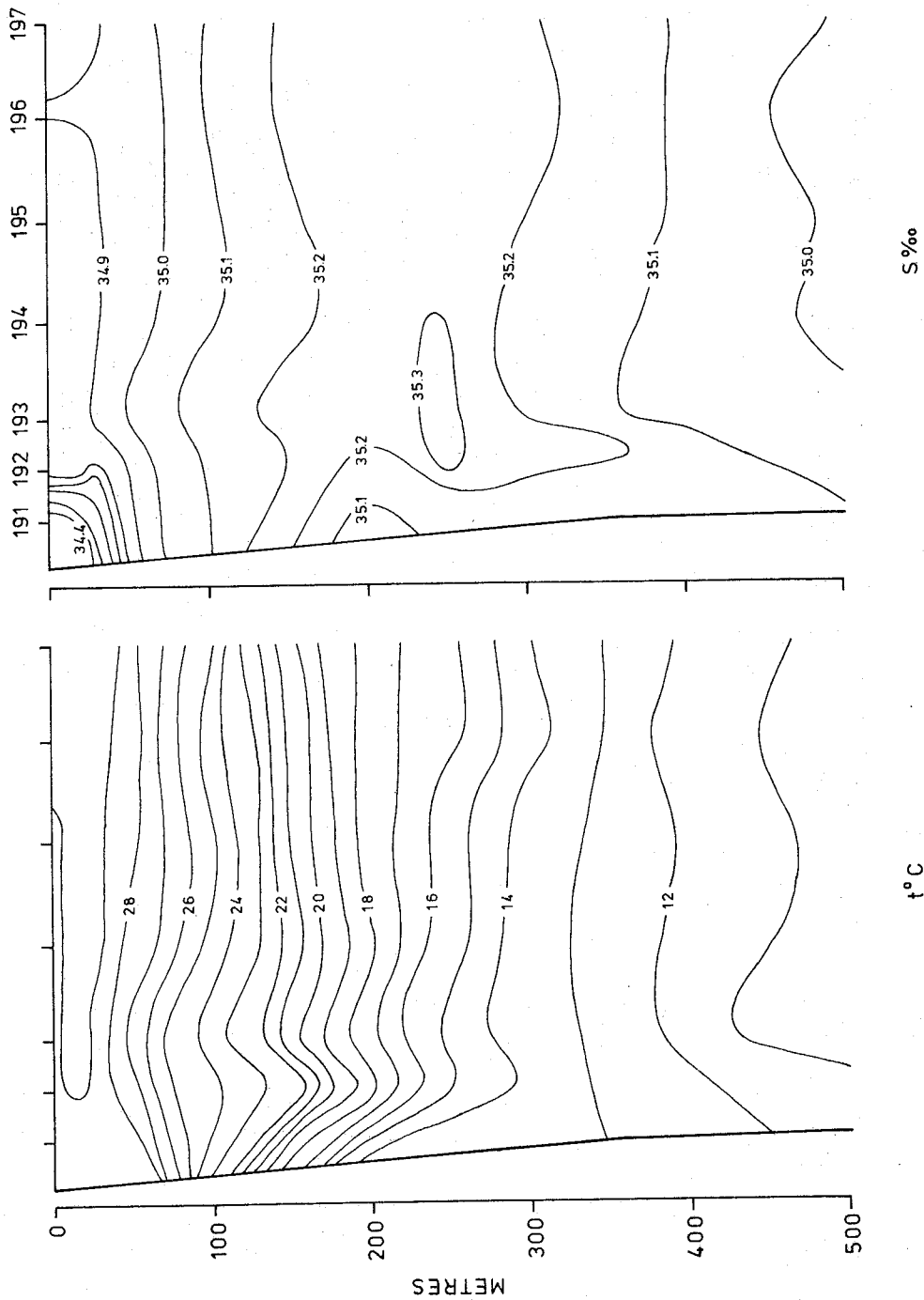


Fig. 6. Section I. Vertical distribution of temperature, salinity and dissolved oxygen.

SECTION II 16-17 APRIL 1978

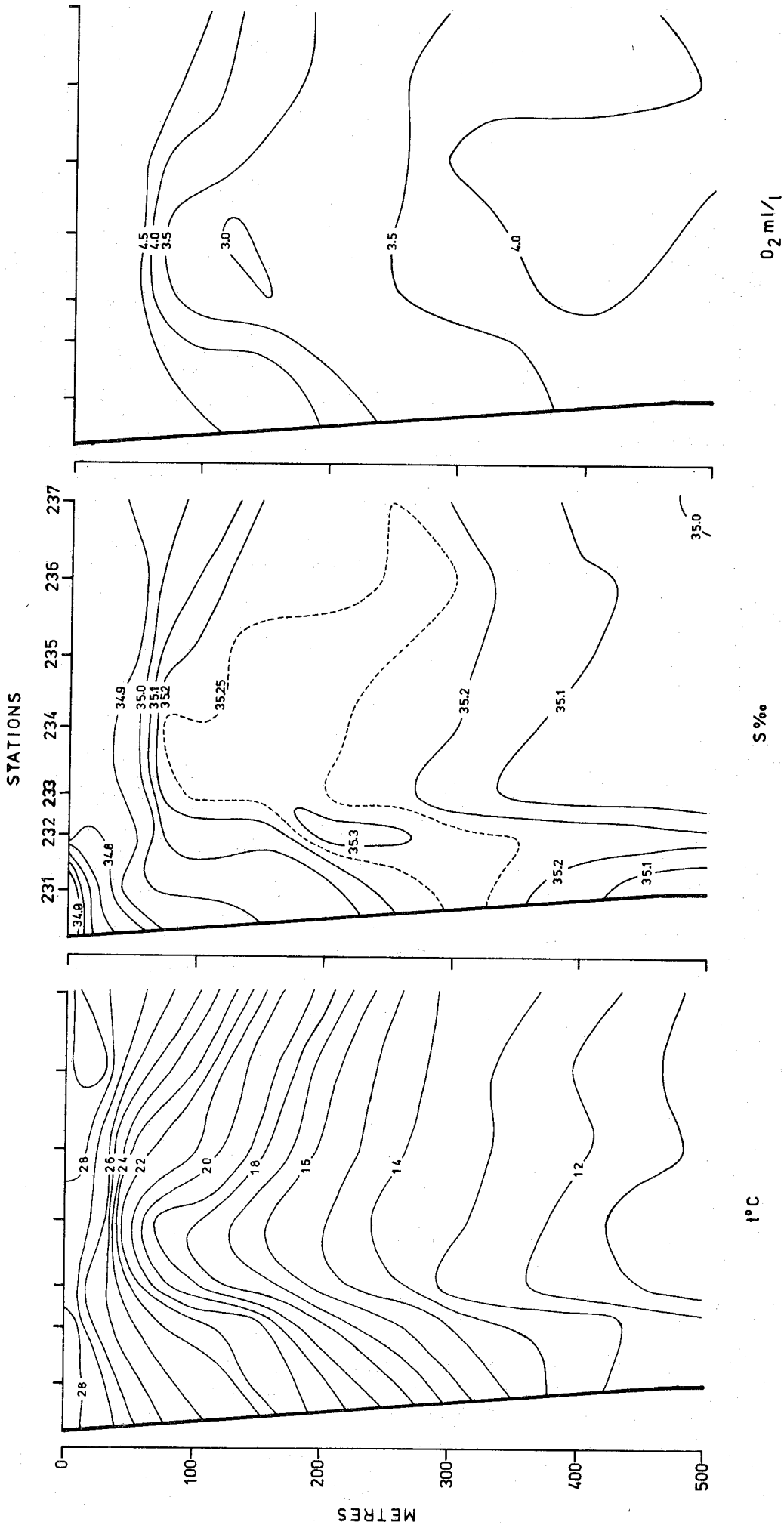


Fig. 7. Section II. Vertical distribution of temperature, salinity and dissolved oxygen.

SECTION III 24 APRIL 1978

STATIONS

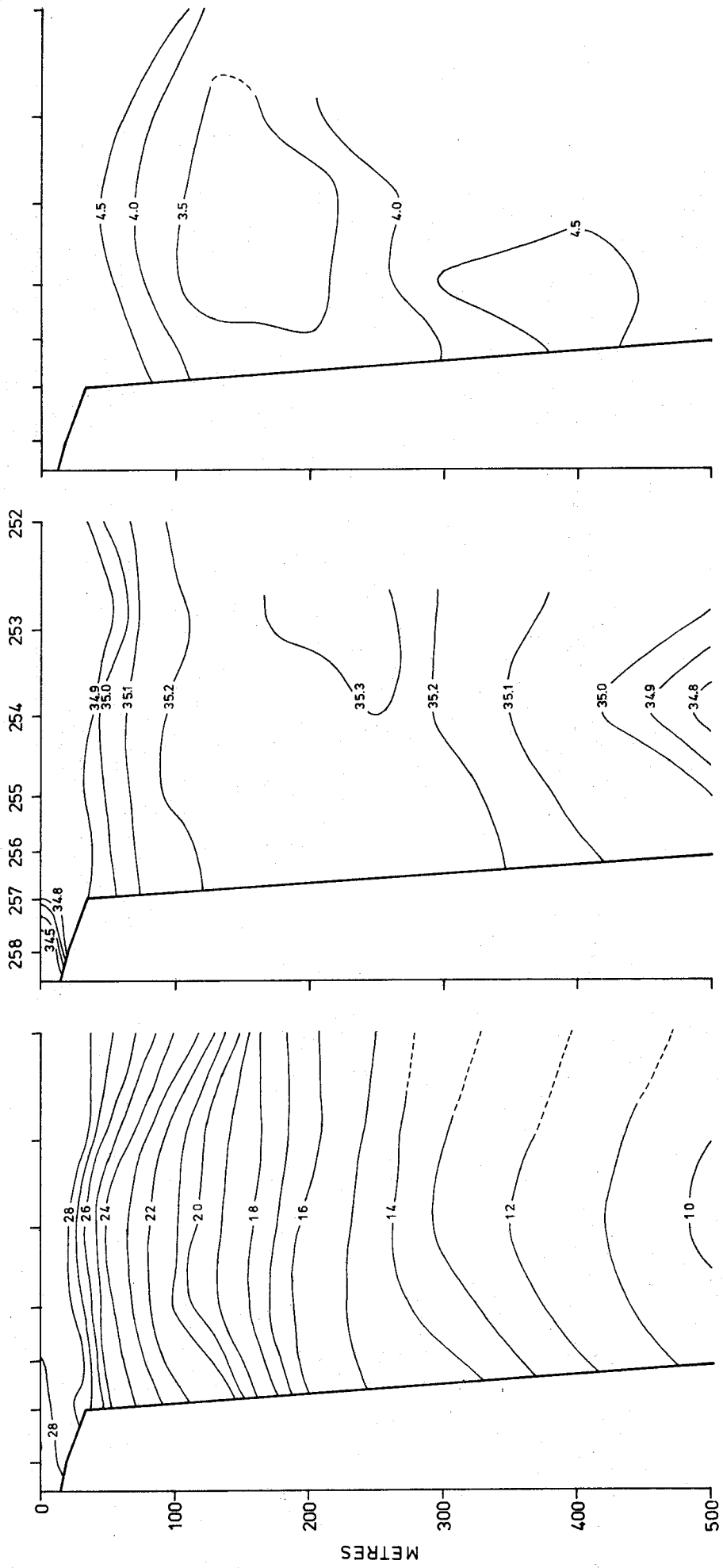


Fig. 8. Section III. Vertical distribution of temperature, salinity and dissolved oxygen.

SECTION IV 18-19 MAY 1978

STATIONS

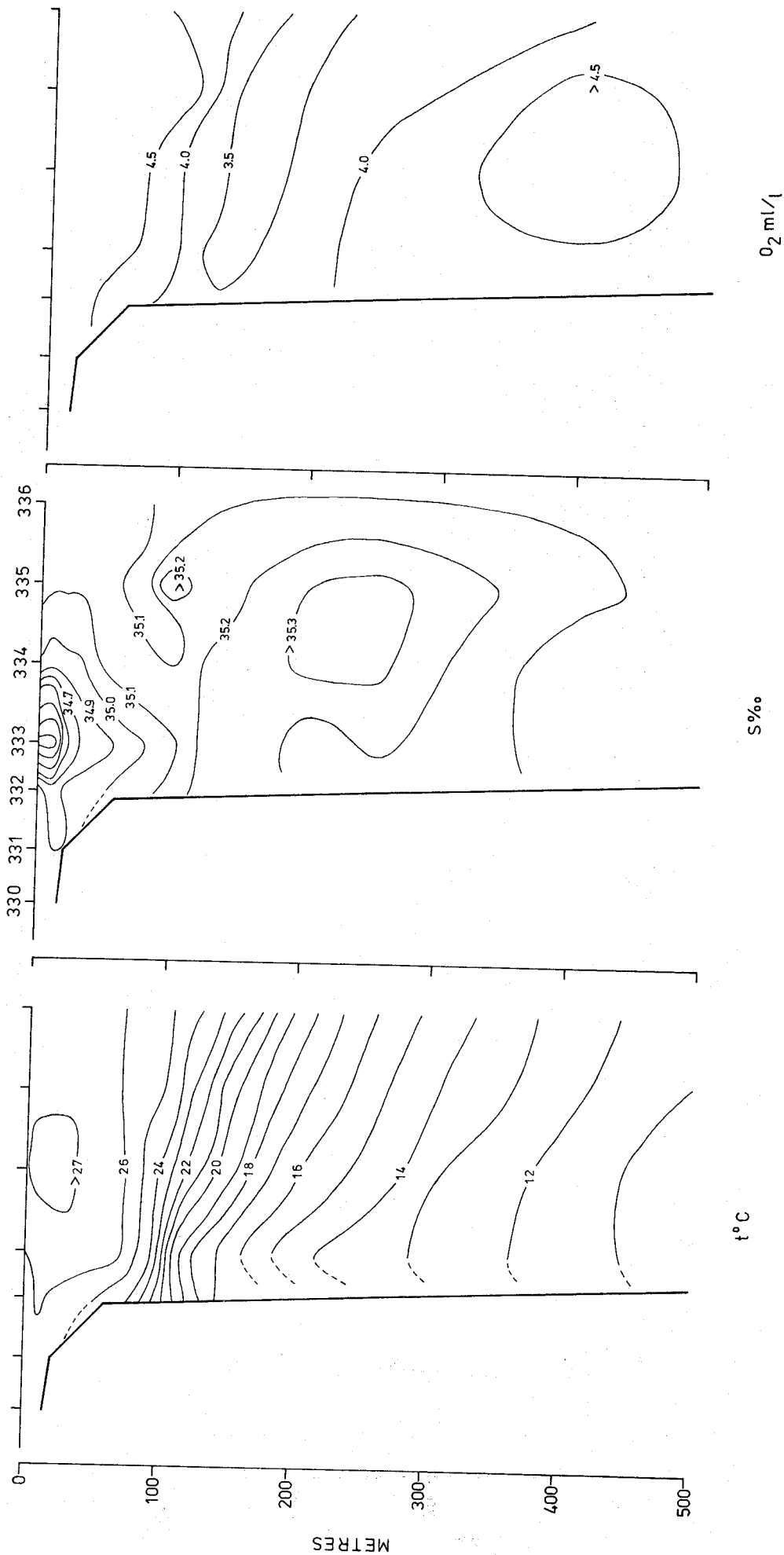
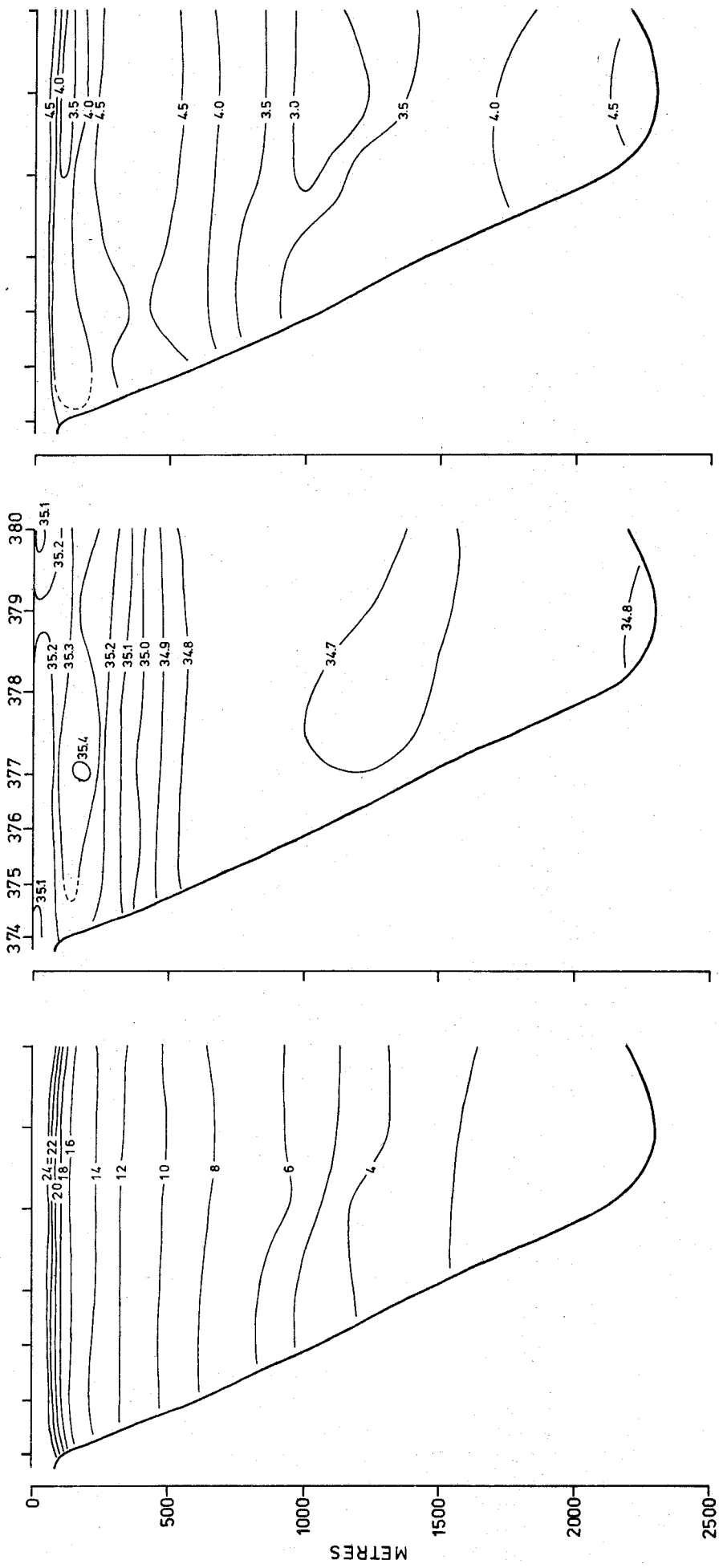


Fig. 9. Section IV. Vertical distribution of temperature, salinity and dissolved oxygen.

SECTION V 23-24 MAY 1978

STATIONS



t°C

S‰

O₂ ml/l

Fig. 10. Section V. Vertical distribution of temperature, salinity and oxygen - 0 m - bottom.

SECTION V 23-24 MAY 1978

STATIONS

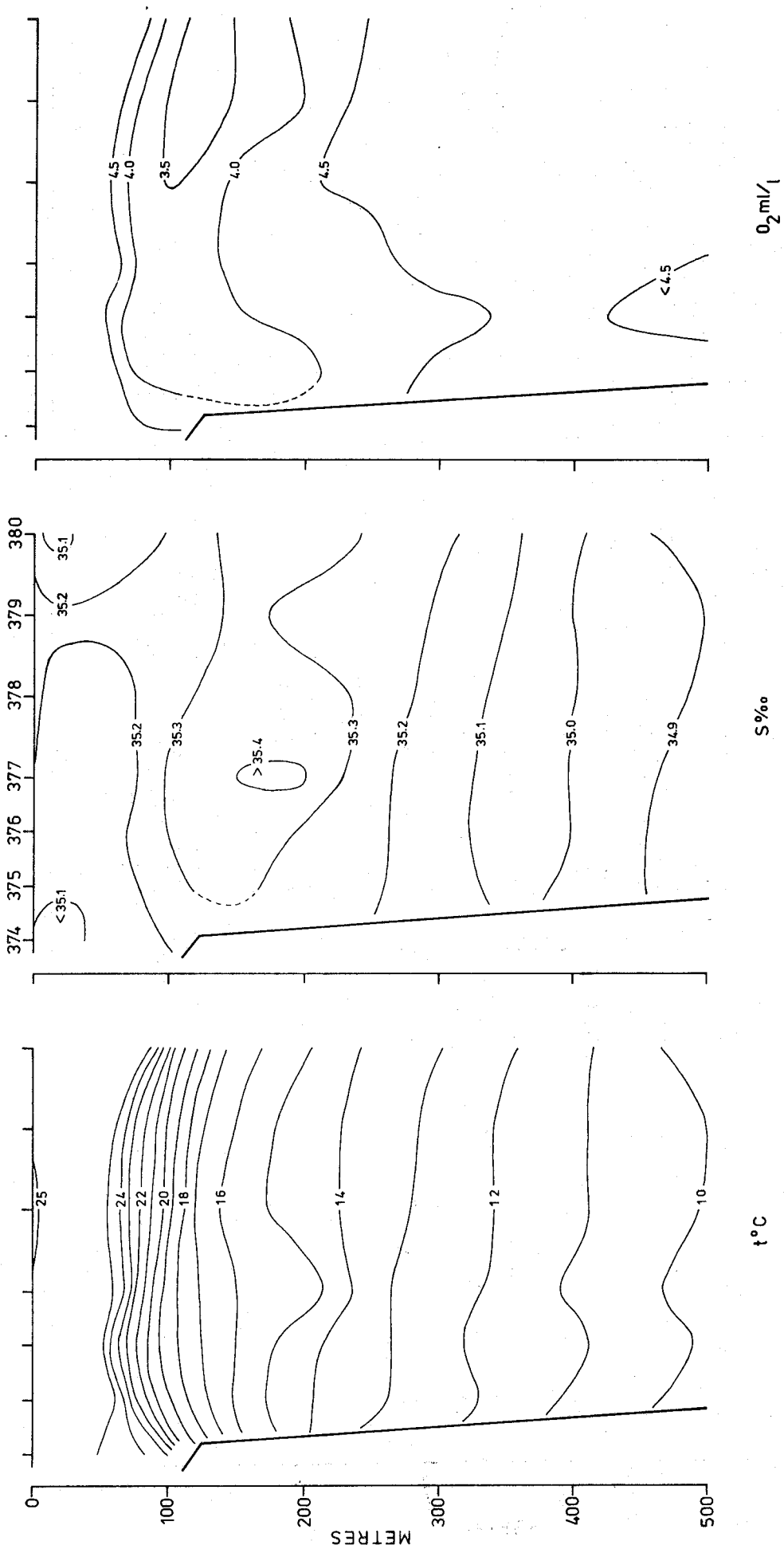


Fig. 11. Section V. Vertical distribution of temperature, salinity and dissolved oxygen - 0 - 500 m.

SECTION VI 25 MAY 1978

STATIONS

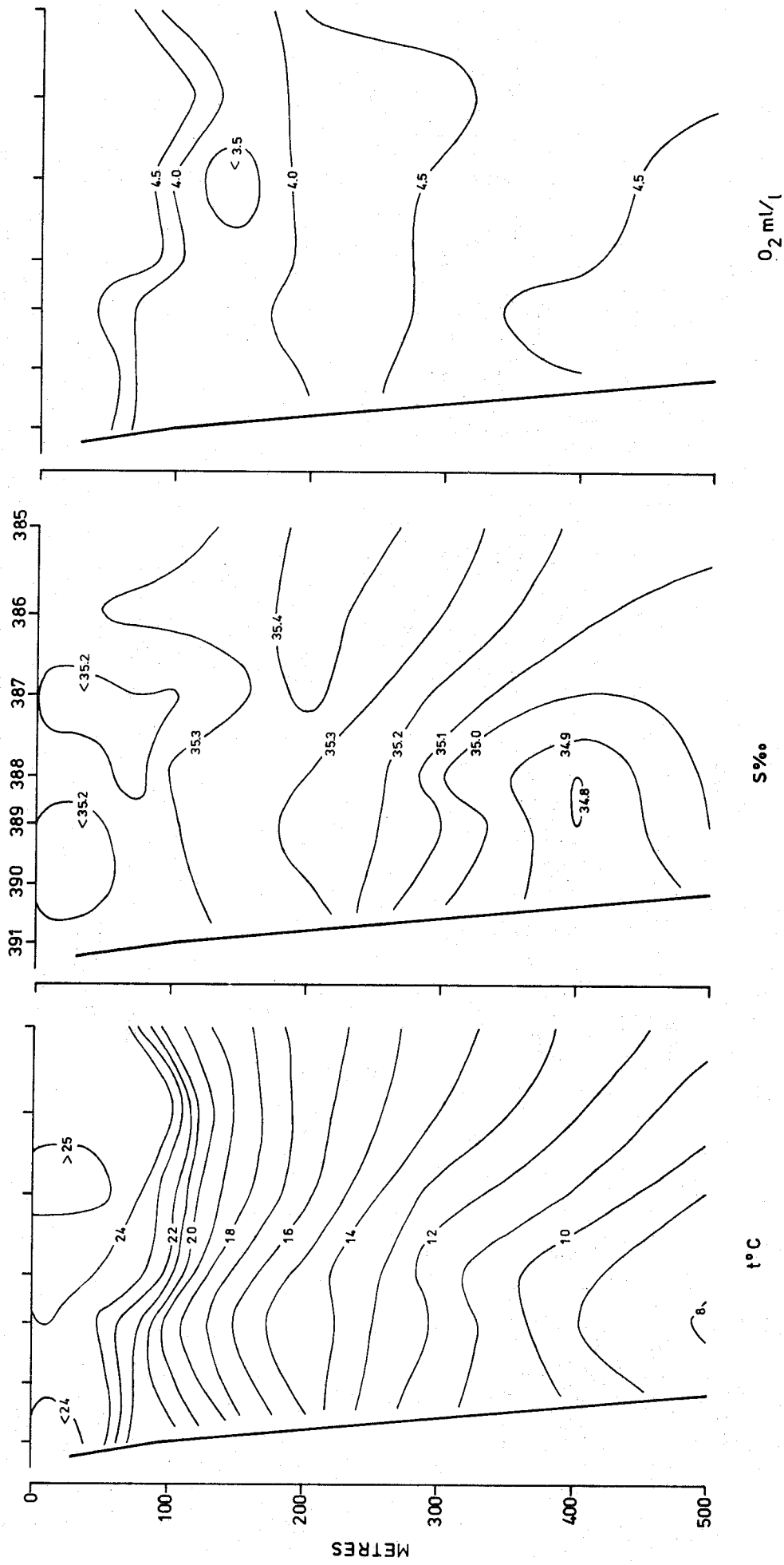


Fig. 12. Section VI. Vertical distribution of temperature, salinity and dissolved oxygen.

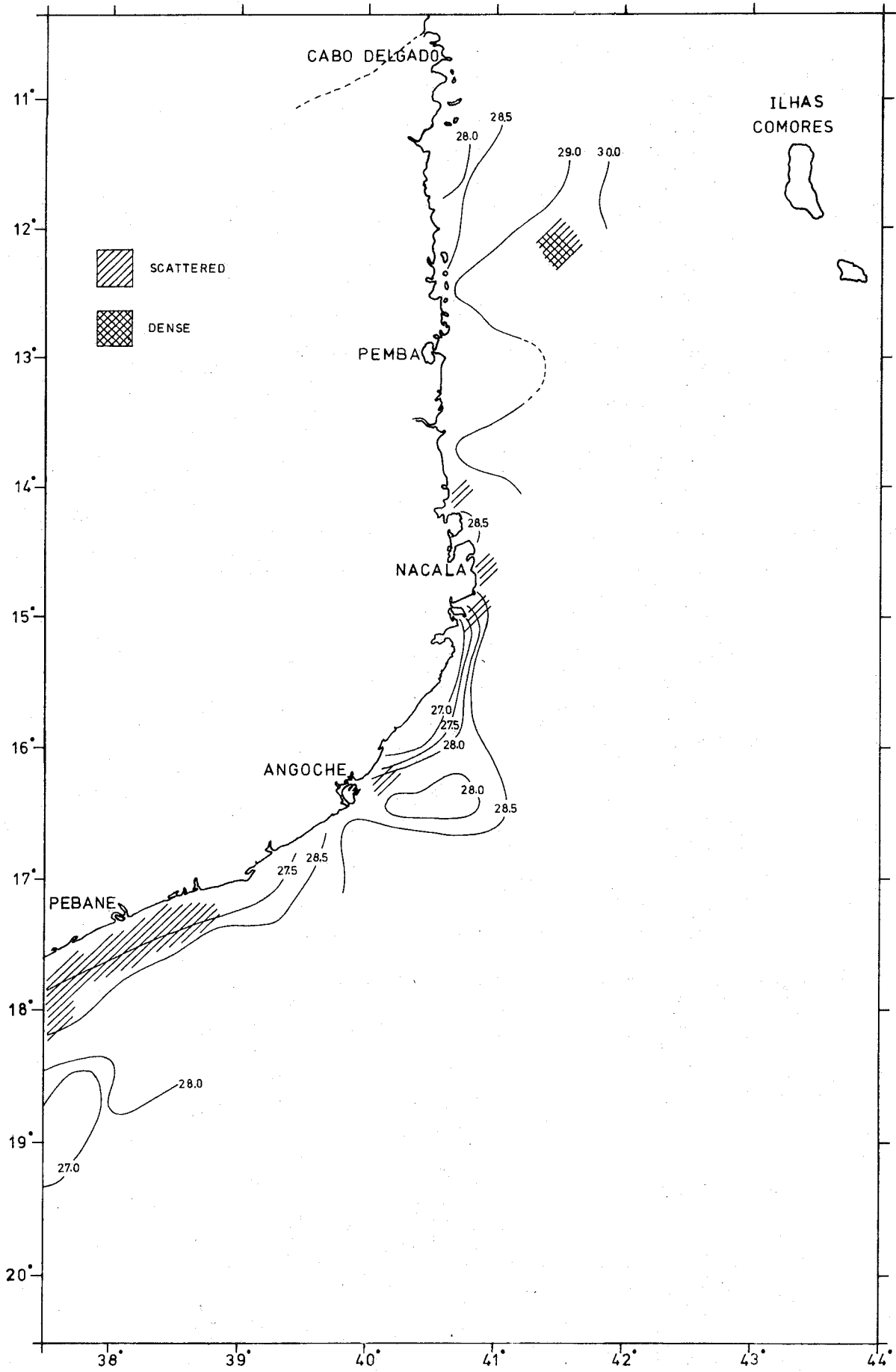


Fig. 13a. Demersal fish recordings and surface temperature - northern area.

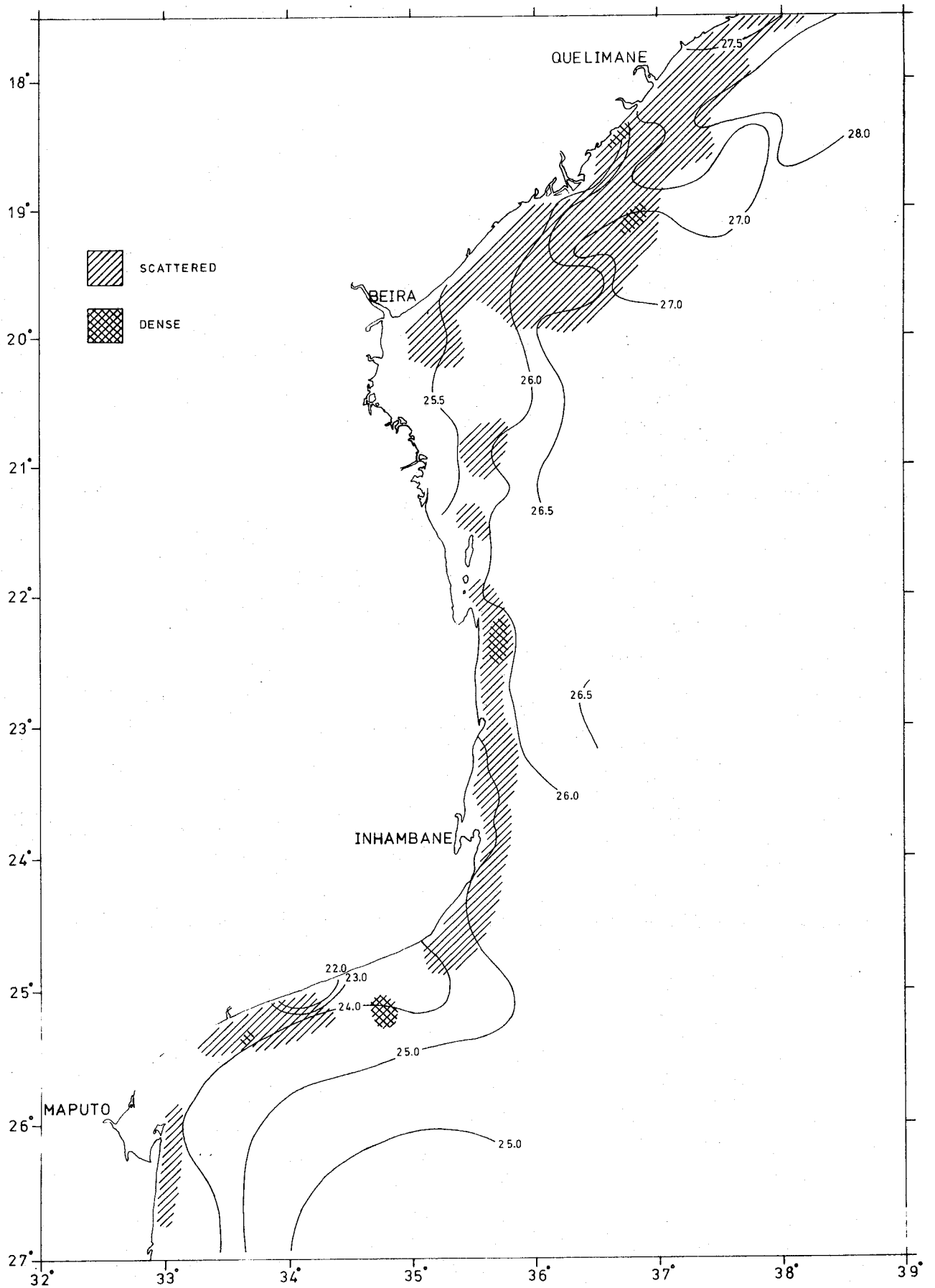


Fig. 13b. Demersal fish recordings and surface temperature - southern area.

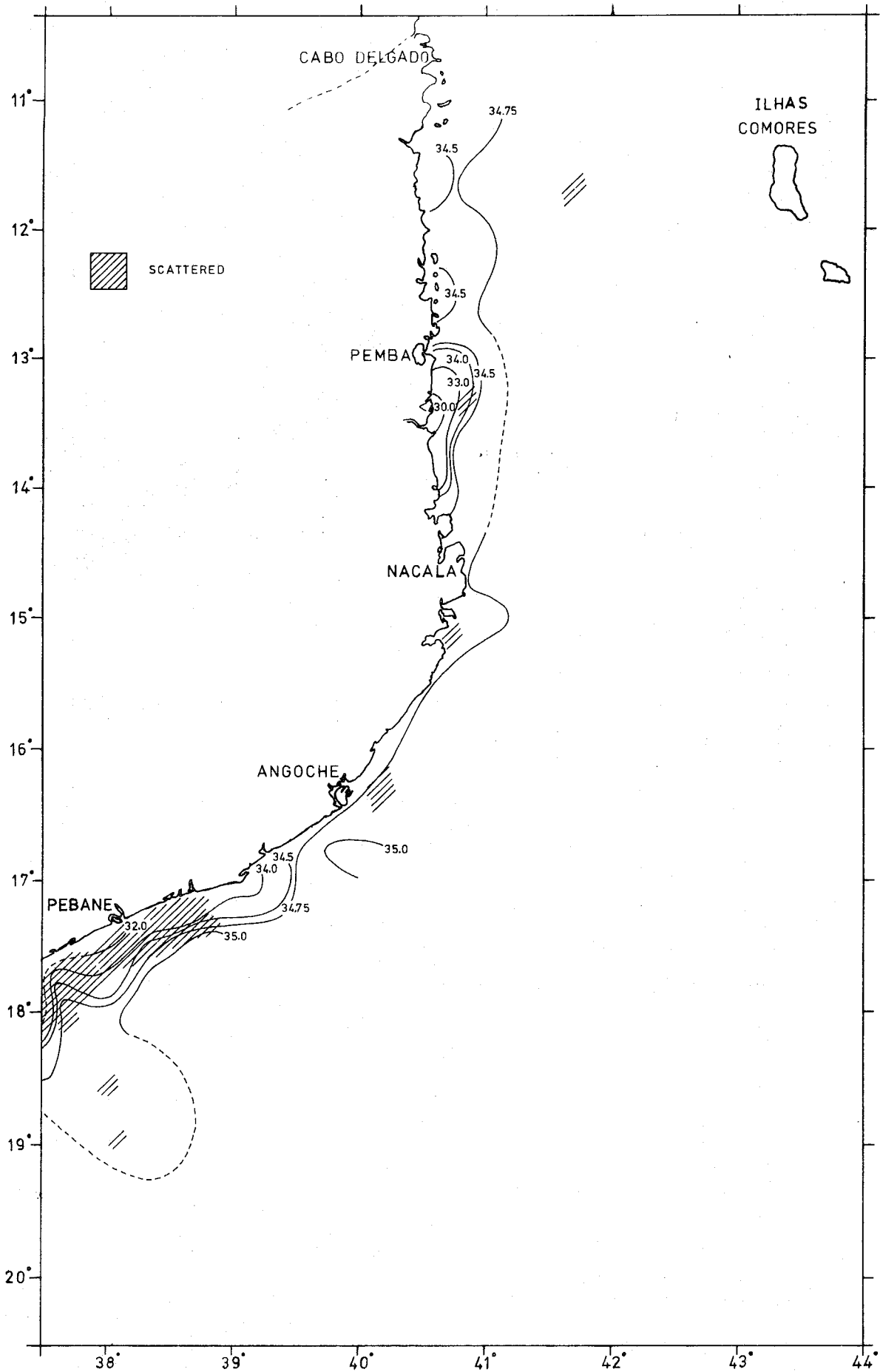


Fig. 14a. Pelagic fish recordings and surface salinity - northern part.

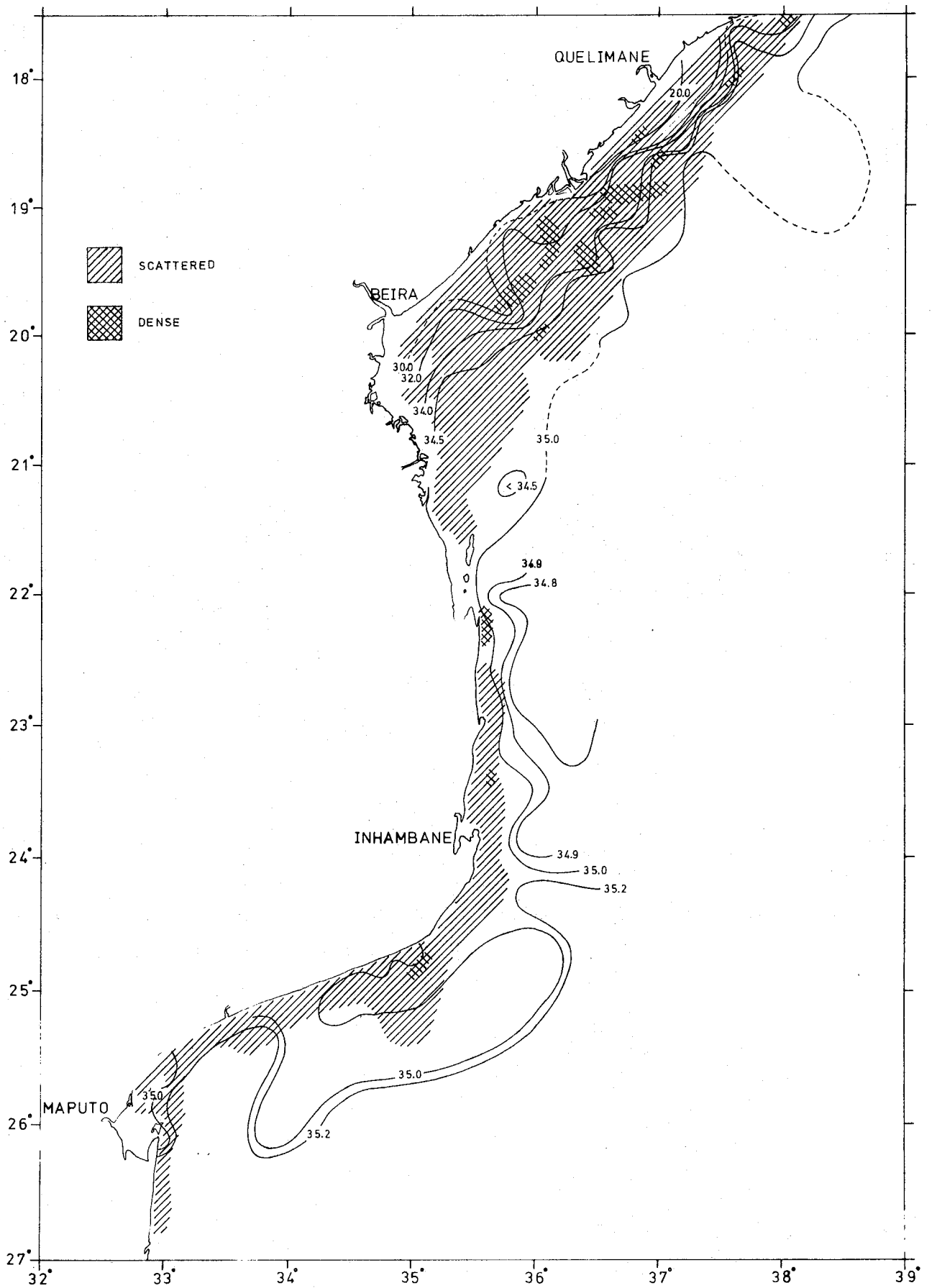


Fig. 14b. Pelagic fish recordings and surface salinity - southern part.

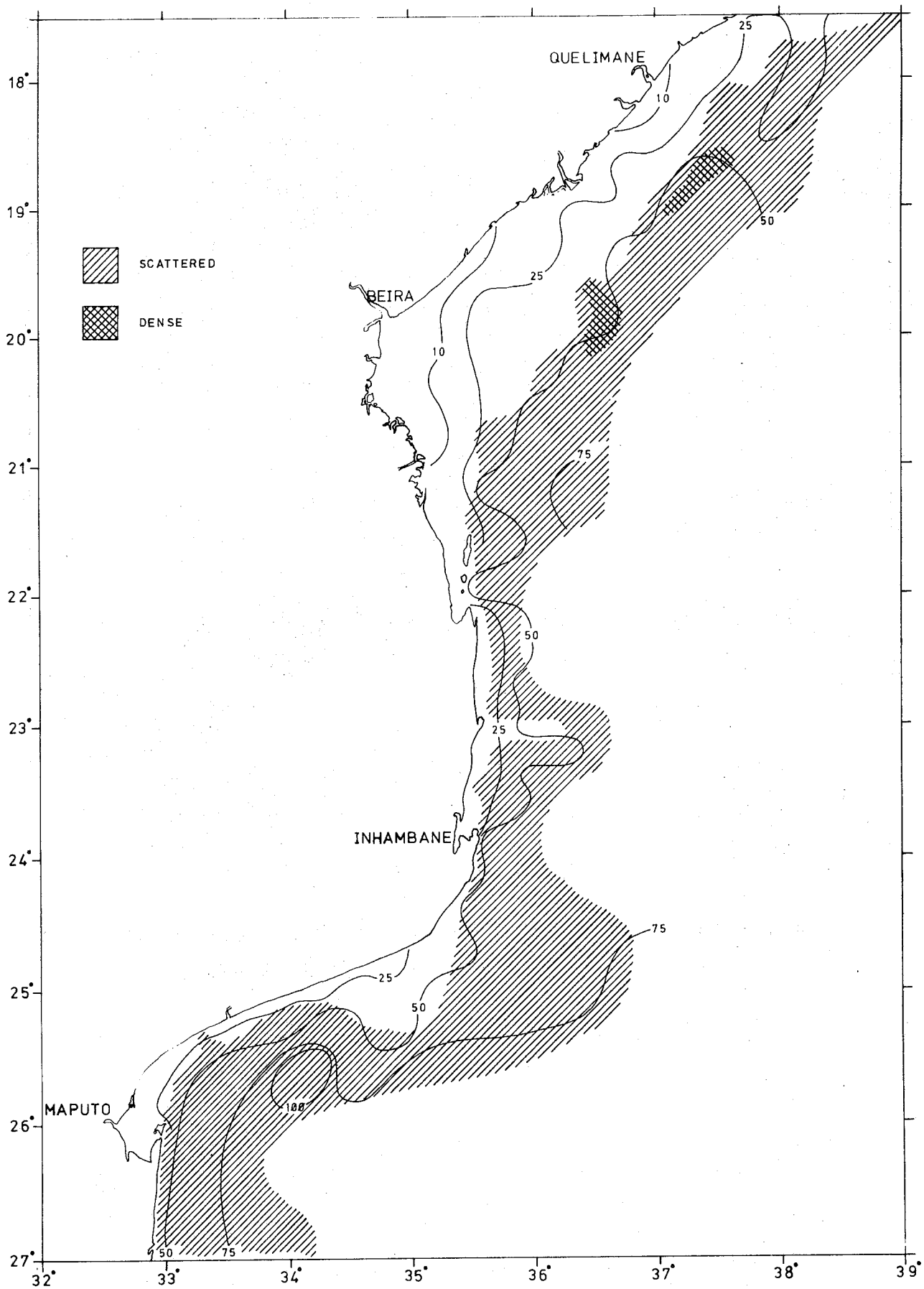


Fig. 15a. Mesopelagic fish recordings and depth of the homogeneous layer - southern area.

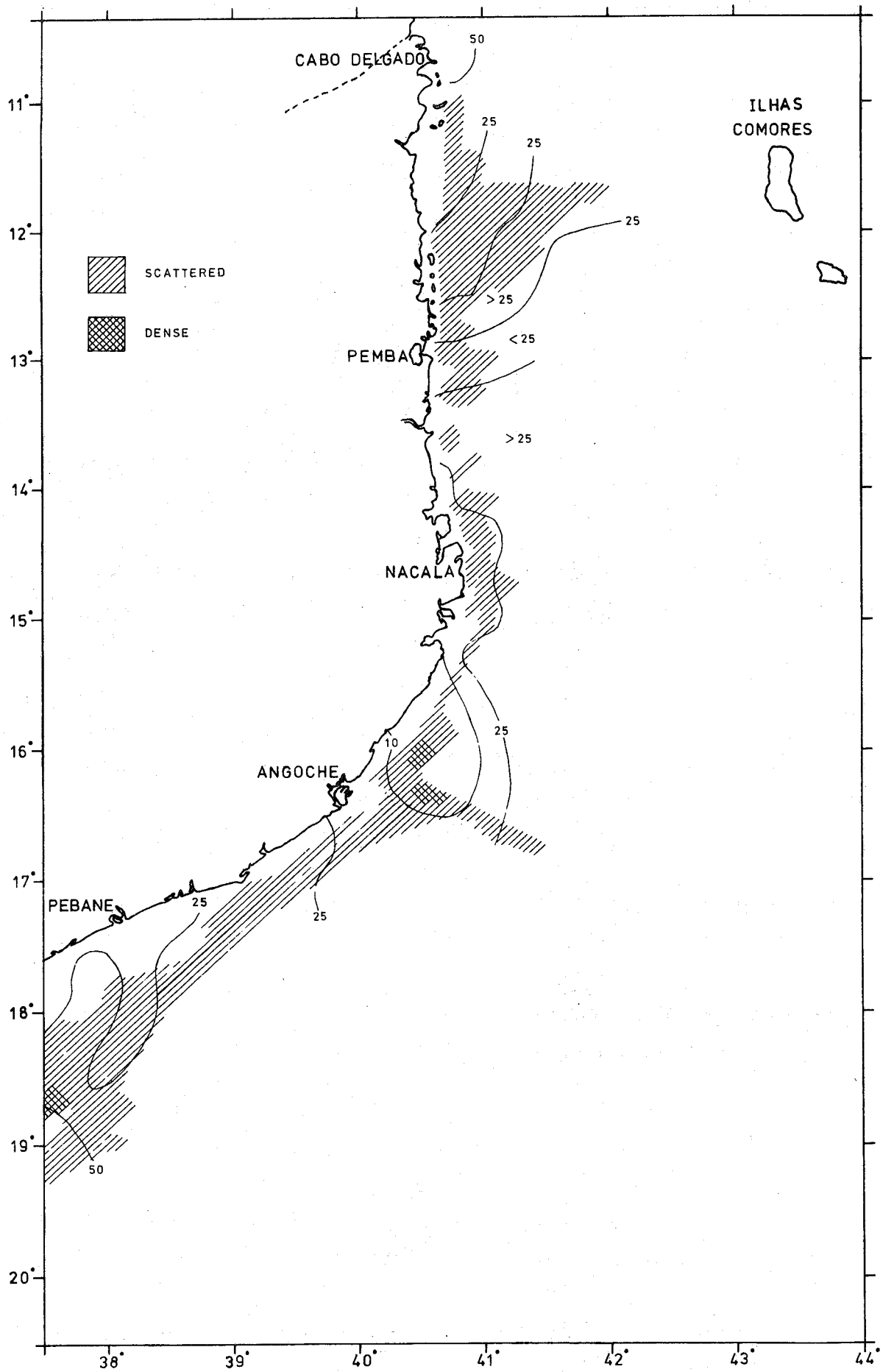


Fig. 15b. Mesopelagic fish recordings and depth of the homogeneous layer - northern part.

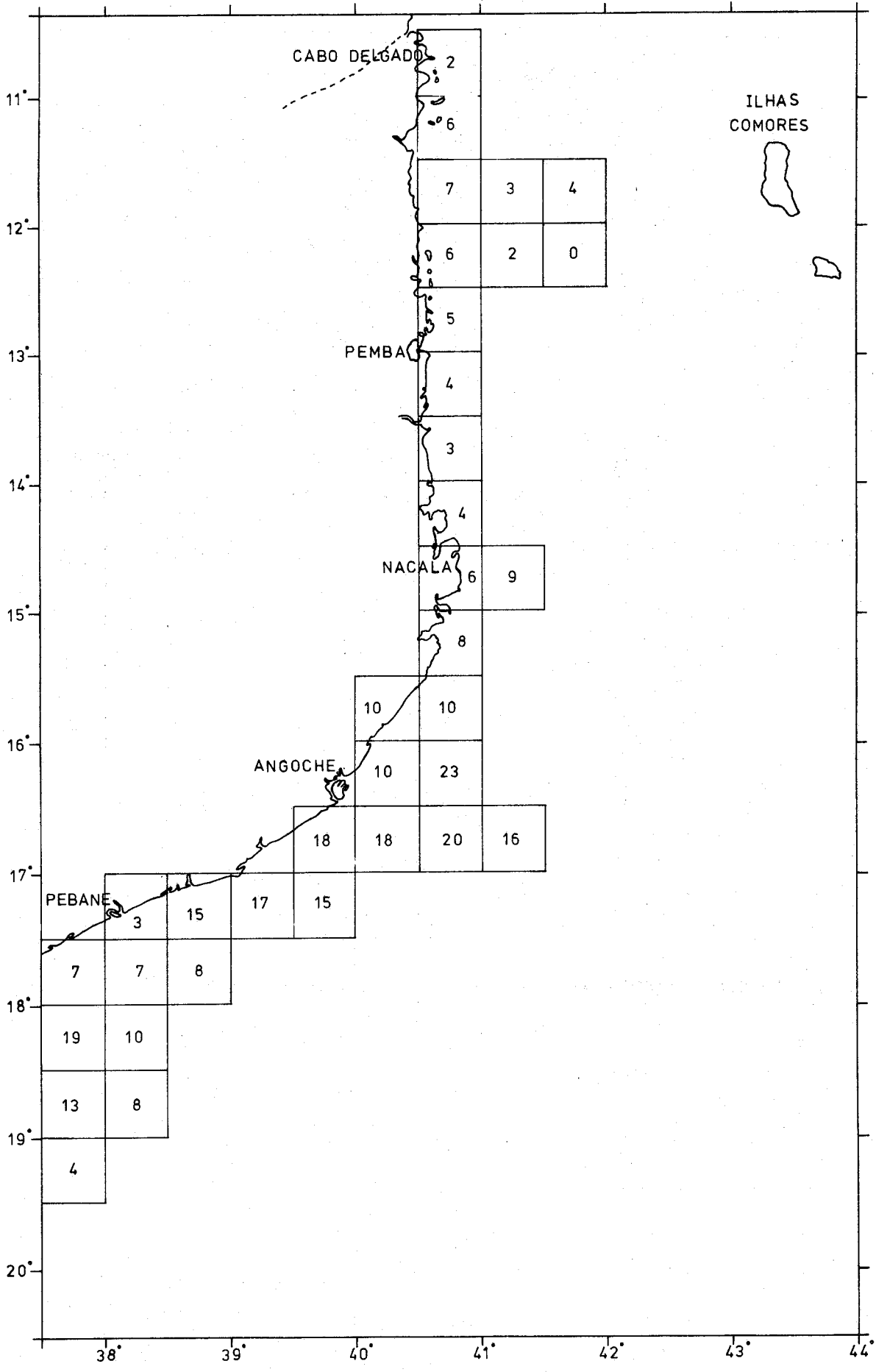


Fig. 16 a. Average echo abundance of plankton - northern area.

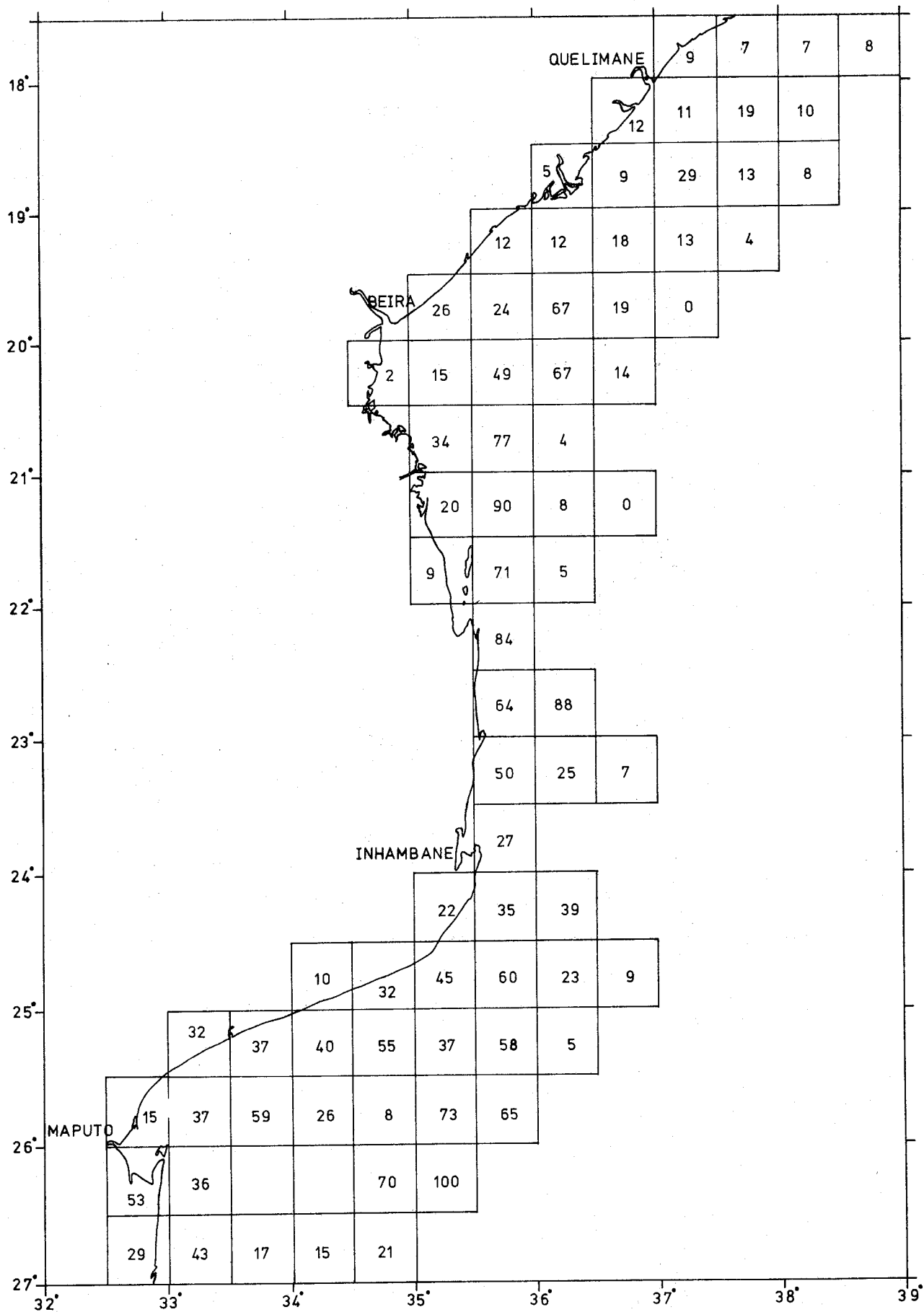


Fig. 16b. Average echo abundance of plankton - southern area.

ZAMBEZI

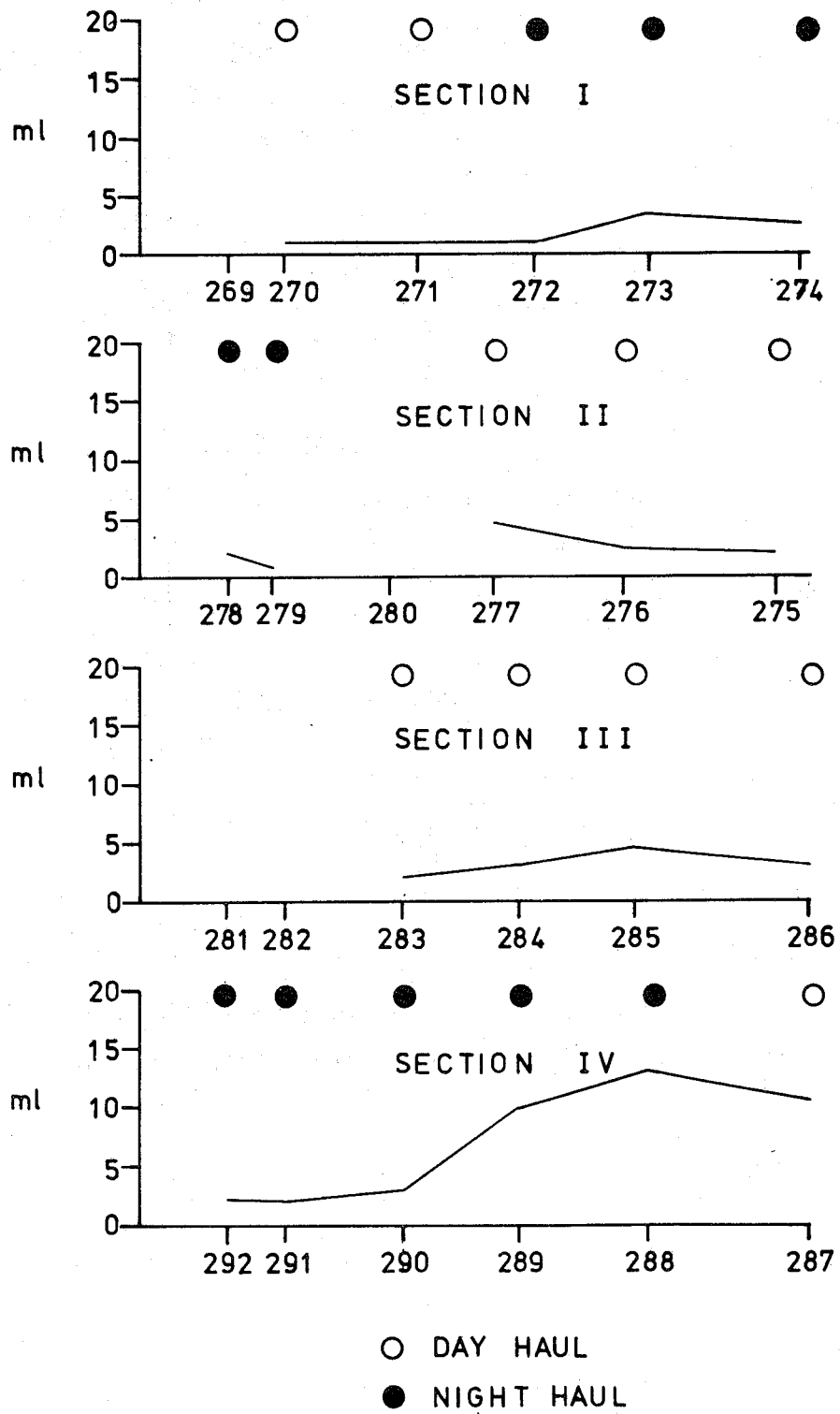


Fig. 17. Wet displacement volume of plankton at the hydrographical sections off the Zambezi River.

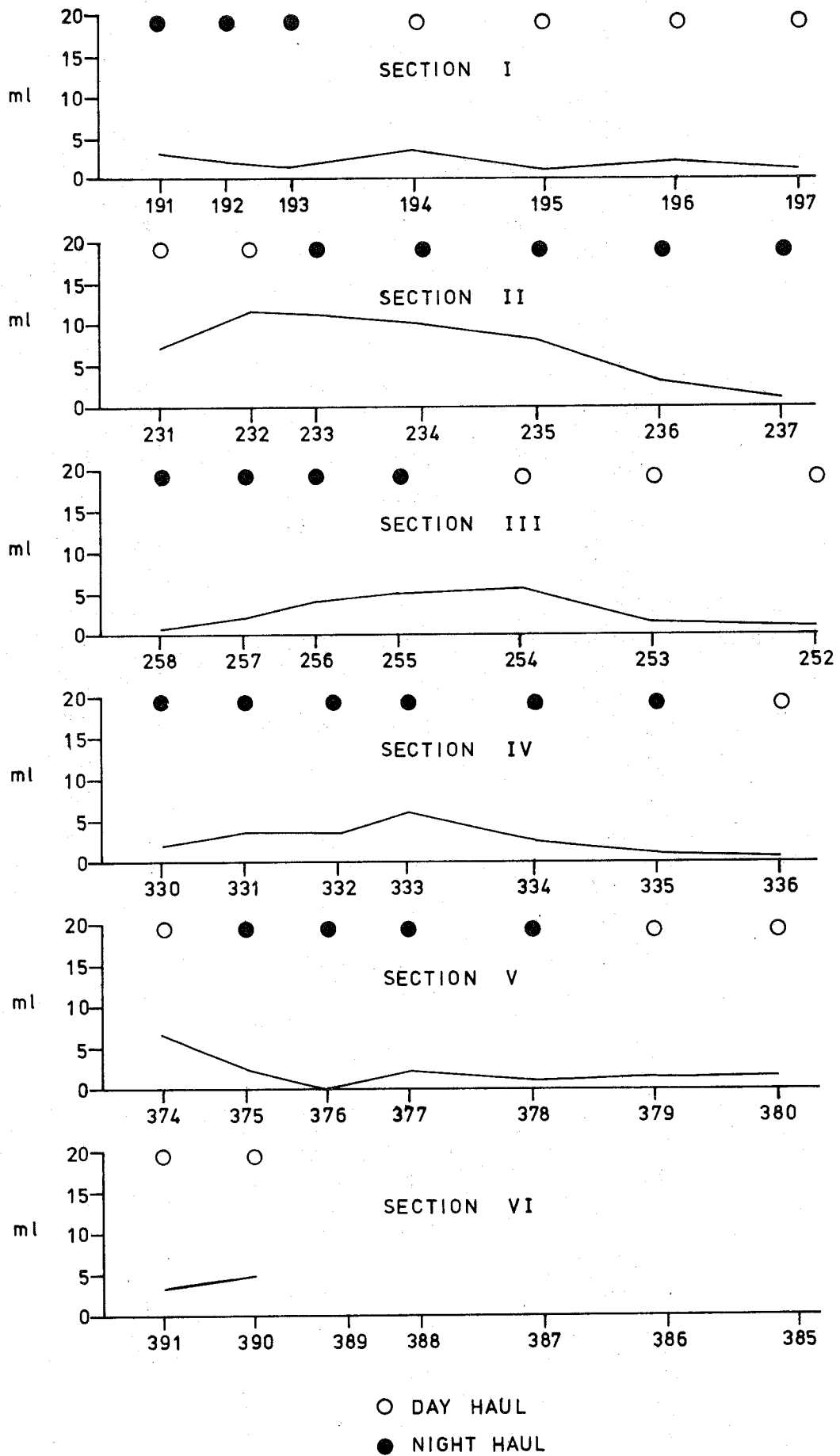


Fig. 18. Wet displacement volume of plankton at the hydrographical section off the Zambezi River.