Marine Fisheries Resources Survey
Demersal Trawling BGD/80/025/CR9

Survey Cruise Report No. 9, February 17 - February 24, 1985

By T F White
FAO Senior Fisheries Biologist

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SUMMARY

Nighttime trawling was conducted on 44 randomly selected stations, ranging in depth from 25 to 97 metres, with an average overall catch rate of 108 kg/30 minutes trawling. The density decreased progressively between the shallow and deeper waters, the mean catch rate in the 21-30 metre depth zone being nearly twenty times that of the deepest zone.

The most abundant species in the total catch were the catfish (Family Ariidae), Japanese threadfin bream, *Nemipterus japonicus,* jewfish (Family Sciaenidae), lizard fish, *Saurida spp.* and the blotched grunter, *Pomadasys maculatus.* "Pelagic" species of fish, such as the scads, mackerels, shads, sardines etc were virtually absent.

Penaeid prawns represented 5,8% of the total catch.

The overall demersal biomass calculated for the survey area was 181,000 m. t. although caution should be applied to any interpretation of this result, due to the large associated variance,

The estimate of prawn biomass was 9,300 m. t,

Bathythermograph profiles indicated a pronounced thermocline at 40-50 metres depth.

CRUISE DETAILS

Cruise No.	:	10
Duration	;	7 days from February 17 - 24, 1985
No. of trawl stations completed	;	44
Cruise Leader	:	Mr Wahidun Nabi Chowdhury
Biologists	:	Md Humayun Khan
		Md Nasiruddin Sada
		Md Gulam Mustafa
Research Assistant	:	Abul Kalam Azad

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1 INTRODUCTION

In order to understand more about the abundance and distribution of the living marine resources within the Bangladesh continental shelf, the Bangladesh Government, with the assistance of FAO, commenced a comprehensive survey programme in September 1984.

Between September 1984 and the end of January, 1985 seven survey cruises were conducted to investigate the abundance and distribution of the demersal and pelagic resources, using a 32m research vessel and a high opening, demersal fish/shrimp trawl (see BGD/80/025/CR 1-7). All trawling carried out during these first cruise was conducted during the day, as it had been found during previous surveys that catch rates and species composition of the catch varied between day and night, due principally to the vertical migrations of certain species.

It was therefore decided to conduct two cruises trawling at night in order to qualify and quantify this difference between day and night catches. The commercial trawler fleet operates on a 24 hours basis. Commercial catch rates and particularly the species composition of their catches, were therefore not directly comparable with the previous survey results. Cruises No. 9 and 10 were planned for this purpose. This report covers the results from cruise No 10 (Note cruise No. 7 was not a survey cruise and no report exists for this cruise).

2. MATERIAL AND METHODS

2.1 THE SURVEY AREA AND SELECTION OF TRAWL STATIONS

The survey area extended from the 10 metre depth contour in the north and east to the 200 metre depth contour in the south. A line drawn at 45° from the southern tip of St. Martins Island was considered to approximate the Bangladesh/Burmese marine border in the south east. In the west, the survey area extended to the Bangladesh/Indian marine border, but in practice no trawling was conducted west of the eastern edge of the "swatch of no ground". The survey area, together with the 10, 20, 30, 51, 100 and 200 metre depth contours is outlined on all Figures used in this report.

Fifty trawl stations were selected prior to the cruise on a random basis covering the entire survey area. Stations ranged in depth from 25 to 97 metres. The survey area and selected stations are shown on Figure 1.

Although the survey area theoretically extended to the 200 metre depth contour, previous surveys conducted on the shelf had indicated very low catch rates in depths below 80 metres or so, In order to maximise the amount of information obtained from the areas of interest to the commercial fleet, the deepest haul conducted during this survey was limited to 97 metres.

The most practical cruise track to cover these stations was selected by the captain of the research vessel in consultation with the cruise leader.

2.2 THE VESSEL AND GEAR

The survey vessel, the R/V "Anusandhani" is a 32.4 metre "multipurpose" research vessel, although principally designed for stern trawling, constructed in Japan in 1979. Details of the vessel are provided in Appendix A.

The trawl net used was an Engel high opening fish/shrimp trawl with a cod-end mesh size of 32mm. Details of the fishing gear are provided in Appendix B.

A Furuno FUV-11 echo sounder was run continuously throughout the survey cruise. In addition, a Furuno FH-103 sonar was operated occasionally when steaming in water deeper than 50 metres. The sonar beam was set at an angle of 10° and swept a forward area between 30° to port and 30° to starboard at an average beam range of 800 metres.

Surface water temperatures were recorded at all stations using a 0-50°C thermometer and bucket.

2.3 TREATMENT OF THE CATCH

All trawling was conducted at night between 1800 hrs and 0600 hrs. All hauls were of 30 minutes duration, the time commencing when the net reached the bottom, as determined by the net-sonde and terminating when hauling commenced. If trawls were discontinued within 15 minutes of shooting, they were considered invalid and the results discarded.

The catch was sorted into species and each weighed separately to the nearest 0.25 kg. In the event that the catch in a particular haul exceeded 500 kgs (approximately) then it was subjectively subdivided into two equal portions, one of which was sorted and the results then doubled. If the number of individuals of any species present in the catch was less than around 20 then the numbers of that species in the haul was counted in order to calculate the average weight of that species. If the number was greater than this, then a weighed sample was usually taken for length/frequency measurement and the average weight calculated in this manner.

In any event, samples of 50-200 fish were selected randomly for length measurement for most species in the catch, where the species were clearly indentifiable. As the taxonomy of the catfish (Family Ariidae) and jewfish (Family Sciaenidae) was confused, no length measurements were made for these two Families. Lengths were in cms, fork length.

2.4 DATA ANALYSIS

All data were recorded on proforma sheets which are shown in Appendix C. A Hewlett Packard 86B microcomputer was used to store and analyse the catch, length frequency and oceanographic data, using programmes written specifically for the purpose. From these data, density and biomass estimates were calculated as described in Section 3.4

For the analysis of the length frequency data, the survey area was subdivided into eight zones, as shown on Figure 2. For each species, samples taken from within the same zone were pooled and a single histogram produced for that zone. The histograms were then plotted into the maps of the survey area on the position where the samples were taken.

3 RESULTS

3.1 GENERAL

Forty four of the fifty randomly selected stations were successfully trawled. The remaining stations were found to be untrawlable due to the presence of large numbers of gill net vessels in the area, particularly in the 10-20 metre depth zone along the east coast.

The following is a summary of the stations successfully trawled by depth zone. The positions of these stations are shown on Figure 1.

Depth zone	No. of successful hauls
10-20 metres	0
21-30 ,,	3
31-50 ,,	5
51-100 ,,	36
100+ ,,	0
Total :	44

3.2 DISTRIBUTION AND ABUNDANCE OF THE MAJOR SPECIES IN THE CATCH

Table 1 below lists all Families or species groups caught during the survey cruise in order of their contribution to the combined total catch of the 44 stations. Their percentage contribution to the total catch of each depth zone is also illustrated on this Table. It may be seen that while some Families may have contributed relatively little to the overall catch they may have made up a significant proportion of the catch of a particular depth zone.

"Trash" here is defined as small fishes, which because of their size or variety could not be identified/sorted with reasonable accurancy, together with sponges, molluscs, small crustaceans etc.

TABLE 1

Percentage composition of the catch by family for each depth zone and for the total survey area. These are listed in order of occurrence in the total catch.

FAMILY	DEPTH ZONE (METRES)					TOTAL %
	10-20	21-30	31-50	51-100	101-200	
ARIIDAE (Catfish)		44.84	4.39	2.74		21.46
NEMIPTERIDAE (Threadfin bream)			2.89	41.12		16.05
SCIAENIDAE (Jewfish)		5.07	20.64	18.81		13.14
SYNODONTIDAE (Lizard fish)		8.02	7.28	7.15		7.55
HAEMULIDAE (Grunts, Sweetlips)		16.89	.02	0.17		7.45

FAMILY	DEPTH ZONE (METRES)					TOTAL %
	10-20	21-30	31-50	51-100	101-200	
CRUSTACEANS (Prawns)		5.87	12.77	2.40		5.84
Trash Fish		4.01	10.97	4.36		5.43
PRIACANTHIDAE (Bulls Eyes)				12.65		4.77
MULLIDAE (Goat fish)		1.06	21.74	.15		4.54
CRUSTACEANS (Others)		.46	.20	6.17		2.57
TERAPONIDAE (Terapon Perches)		5.19				2.27
TETROADONTIDAE (Puffer fish)		4.10		.29		1.90
TRICHIURIDAE (Hairtail)		.76	6.14	.10		1.15
GERREIDAE (Mojarras)		.51	1.15	.88		.77
CARCHARHINIDAE (Sharks)		3.99				.74
APOGONIDAE (Cardinal fish)		10	2.99			.60
LUTJANIDAE (Snappers)		.93				.41
CARANGIDAE (Jacks, Scads, Trevallies etc)		.23	.20	.68		.39
FISTULARIIDAE (Flutemouths, Cornet fishes)		.13	.30	.64		.35
BOTHIDAE (Flounders)		.42	.36	.26		.35
Sharks, Rays mixed		.06	.70	.39		.28
CEPHALAPODA (Squid, Cuttlefish Octopus)		.06	.50	.29		.23
CLUPEIDAE (Herrings, Sardines, Shads etc,)		.17	.80			.22
EXOECITIDAE		.42				.28
CYNOGLOSSIDAE (Tongue Soles)				.44		.17

FAMILY	DEPTH ZONE (METRES)					TOTAL %
	10-20	21-30	31-50	51-100	101-200	
MURAENESOCIDAE (Pike Eels)		.04	.50	.09		.16
EPHIPPIDAE (Spadefishes)		.34	.04			.16
POLYNEMIDAE (Threadfins)		.17	.42			.15
SCOMBRIDAE (Mackerels and tunas)			.40			.07
LEIOGNATHIDAE (Ponyfish)			.14	.10		.06
SPARIDAE (Sea breams)			.20	.05		.06
ENGRAULIDAE (Anchovies)		.08				.04
DREPANIDAE		.08				.04
LACTARIIDAE (False Trevallies)			.10			.02
STROMATEIDAE (Pomfrets)		.04				.02
SERRANIDAE (Groupers)				.05		.02
ARIOMMATIDAE				.03		.01
PLATYCEPHALIDAE (Flat head)			.06			.01
MENIDAE (Moon Fish)			.02			.00
Total :		100%	100%	100%		100%

3.2.1 Bathymetric distribution

The average catch rates obtained during the survey are shown on Table 2. The "range" is 2 Standard Errors of the mean. The species composition of the catches in each depth zone are shown on Table 1.

TABLE 2

Depth zone (metre)	Average catch rate (Kg/30 minutes haul)	Range	No. of hauls
10-20	—	—	0
21-30	531	3,161	3
31-50	103	56	5
51-100	28	54	36
100+	—	—	0
Average	108	251	
			Total : 44

3.2.1.1 21-30 metre depth zone

Only three hauls were conducted in this depth zone for an average catch rate of 531 kg/30 minutes trawling, although the catches from these three hauls were quite dissimilar.

Nearly half of the catch (45%) consisted of catfish (Family Ariidae) and a further 17% of the blotched grunter, *Pomadasys maculatus*, this latter having no commercial value. Lizard fish, *Saurida spp.* contributed a further 8% to the total catch.

Penaeid prawns represented nearly 6% of the total.

3.2.1.2 31-50 metre depth zone

The average catch rate in this depth zone was 103 kg/30 minutes trawling, only 20% of the rate in the shallower waters.

The composition of the catch was different from that in the shallower water ; 20% of the catch consisting of jewfish (Family Sciaenidae) and a similar percentage of goatfish, *Upeneus sulphureus*, both of which had been poorly represented in the shallower catches.

Lizard fish were once again present (7% of the catch) but despite their relative abundance their catch rate was lower in this zone than in the shallower waters.

3.2.1.3 51-100 metres depth zone

The majority of the hauls were conducted in this depth zone. The average catch rate was only 28 kg/30 minutes trawling, only 5% of that in the 21-30 metre depth zone and 27% of that in the 31-50 metre depth zone.

41% of the total catch consisted of Japanese threadfin bream, *Nemipterus japonicus*, which were virtually absent from the other zones, Jewfish were again well represented with 19% of the catch, as were lizard fish (7%). Bulls eye, *Priacanthus sp.* were caught only in this depth zone and represented 13% of the total catch. "Spider" crabs, which have no commercial value represented 6% of the catch.

3.2.1.4 Summary - Bathymetric distribution

A noticable feature of the survey results was the large reduction in catch rates with increasing depth, from an average catch rate of 531 kg/30 minutes trawling in the shallowest zone to only 28 kg/30 minutes trawling in the deepest.

Few species extended over the entire bathymetric range. Some exceptions were the lizard fish and to a lesser degree catfish, jewfish and penaeid prawns. Generally however, the catches from each depth zone were dominated by one or two species/ Families. e.g. catfish in the 21-30 metre depth zone, or bulls eye in the 51-100 metre zone.

The relationship between the depth of trawling and catch rates for all species combined and for specific species or Families are illustrated on the following designated Figures :

	Figures
Total catch (all species combined)	3
Catfish (Family Ariidae)	4
Jewfish (Family Sciaenidae)	5
Japanese threadfin bream (*Nemipterus japonicus*)	6
Lizard fish *(Saurida spp.)*	7
Goat fish *(Upeneus sulphureus)*	8
Bulls eye, *(Priacanthus sp.)*	9
Penaeid prawns	10
Brown shrimp *(Metapenaeus monoceros)*	11

3.2.2 Geographical distribution

Catch rates obtained at the 44 survey stations are shown on Figure 13 plotted according to the locations of the respective stations. Catch rates have been arbitrarily subdivided into four categories, viz under 50,51-100, 101-200 and greater then 200 kg/30 minutes trawling. This Figure provides a general overview of the distribution of the demersal stock over the survey area.

As described in Section 3,2.1.4, the highest catches were made in the shallower waters. Of these, the higher catches were made in the northern and western sectors of the survey area, those along the eastern shallow area being uniformly low (Figure 13).

3.3 DISTRIBUTION AND ABUNDANCE OF MOST COMMON SPECIES IN THE CATCH

The following species/Families were most common in the survey catch. Not all are considered to be commercially important, although determination of which species have commercially importance and which do not must be subjective, influenced by the fish marketing situation in Bangladesh and the acceptability of these species on export markets. The size and type of the fish are both important factors to be considered.

This does not imply that other species not mentioned would not have some retail value, or at least be suitable for reduction to fish meal. However because of their size, abundance, or type it is considered that most trawler operators would consider them uneconomic to sort and handle and would discard them as "trash". The amount of fish considered as "trash" by this definition would be considerably higher than that categorised as "trash" on Table 1 on the basis of sorting during our survey activities.

3.3.1 Family Ariidae (Catfish)

Catfish represented 21% of the overall survey catch and 45% of the catch in the 21-30 metre depth zone. They were present in most hauls made in depths less than 70 metre (Figure 4). Most of the catfish landed during the survey cruise were caught during one haul made in 28 metres of water in the north central part of the survey area which yielded 480 kg (Figures 4 and 13).

As a result of this exceptional haul, the average catch rate of catfish in the 21-30 metre depth zone was 342 kg/30 minutes trawling. The overall average catch rate was 48 kg/ 30 minutes trawling.

Local markets in Bangladesh do not discriminate between the various species of catfish. Price is determined essentially by size (and condition), generally being somewhat higher for the larger (30cm and above) fish. Most of the catfish landed during this cruise were "large" fish, in excess of 300 grams and are readily marketable in Bangladesh.

3.3.2 Family Sciaenidae (jewfish)

At least four separate "types" of jewfish are recognized on the Bangladesh markets (although these do not represent four species). In general, size is the main criterion for price in the local markets, not species. No attempt was made to differentiate between species in the survey catches.

Jewfish represented 13% of the total survey catch, with an average catch rate of 6.6. kg/30 minutes trawling. They were present in all hauls made in depths less than 50 metres (Figure 5) and one exceptional haul in 80 metres which yielded over 140 kg. The average catch rate in depths less than 50 metres was approximately 20 kg/30 minutes trawling.

Practically all jewfish were caught in the north eastern sector of the survey area (Figure 14).

More than half of the jewfish caught were less then 15 cm in length, and many were less then 10 cm. Thus, although this Family contributed nearly 19% of the catch in the 21-30 metre zone and 25% of the catch in the 31-50 metre zone, they are of limited economic value due to their relatively small size. Jewfish of all sizes are marketable in Bangladesh, but prices offered for the smaller fish are generally very low.

3.3.3 Family Nemipteridae (threadfin bream)

Although present in many of the shallow water hauls, Japanese threadfin bream. *Nemipterus japonicus* were most abundant in depths greater than 60 metres (Figure 6). They represented 41% of the total catch in the 51-100 metre depth zone, although the average catch rate in this zone was only 5.4 kg/30 minutes trawling.

The threadfin bream were concentrated in two discrete sectors of the survey area, in the west and in the east central areas (Figure 15). The fish in the western sector were on average smaller (mean length 13.5 cm) than those in the east central area (mean length 21 cm) (Figure 21).

Thredfin bream are rarely encountered in the Bangladesh markets, principally because they occur in depths beyond the range of the traditional fishing gears and even the "usual" trawling depths of the prawn trawlers. Fish greater than about 20cm or so in length could probably be sold overseas.

3.3.4 Family Synodotidae (lizard fish)

Lizard fish, principally *Saurida elongata* and *S. tumbil* were present in practically all hauls made during the survey cruise in depths less than 90 metres (Figure 7). The highest catches were made in the shallower waters, although there was no apparent pattern to their distribution throughout the overall survey area (Figure 16).

The average overall catch rate was 6.7 kg/30 minutes trawling, but reached 36 kg/30 minutes trawling in the 21-30 metre depth zone.

As is apparent from Figure 22, lizard fish (in this case *S. tumbil*) varied considerable in length from about 10 to 37 cm.

Lizard fish are not common in Bangladesh markets, as they are not commonly caught in the Hilsa gill nets. Larger fish are saleable on export markets.

3.3.5 Family Mullidae (goat fish)

Goatfish (*Upeneus sulphureus*) were quite sharply restricted to depths less than about 40 metres (Figure 8). The average catch rate in the 31-50 metre depth zone was 33 kg/30 minutes trawling, although from Figure 8 it is apparent that this rate is actually related to the 31-40 metre depth range.

There was no obvious pattern to the distribution of goatfish over the survey area; most of the catch was produced in just two hauls which were over 100km apart (Figure 17). The goatfish were uniform in size throughout the survey area, having a mean length of around 10-12cm (Figure 23). Although goatfish are popular in some European markets, fish of this size may be difficult to sell.

3.3.6 Family Priacanthidae (bulls eye)

Bulls eye (*Priacanthus sp.*) were distinctly limited to those hauls made in depths greater than 80 metres (Figure 9). They represented 13% of the catch in the 51-100 metre depth zone. Despite this relatively high proportion however the average catch rate was only 2.5 kg/30 minutes trawling.

There was no obvious pattern to the distribution of these fish over the survey area (Figure 18).

3.3.7 Penaeid prawns

Penaeid prawns are the most valuable marine resource in the Bay of Bengal and form the basis of the present Bangladesh marine trawl fishery. The survey cruise was not designed specifically to investigate prawns. The net is designed to catch both prawns and fish and the duration of the hauls was only 30 minutes. Commercial trawlers use low profile nets, which although not necessarily catching more prawns than the net used during the survey, would certainly catch less fish. However, in spite of the shorter hauls, different gear etc. the results do provide a relative insight into the abundance and distribution of penaeid prawns over the survey are. The major species captured were *Metapenaeus spp. Penaeus monodom, P. semisulcatus* and *Parapenaeopsis sculptilis.*

Penaeid prawns represented 5.8% of the total catch during the survey cruise, although this rose to 12.8% in the 31-50 metre depth zone. Prawns were present in all hauls made in depths less than 70 metres, the catch rates decreasing with depth (Figure 10). Catches below 70 metres depth were on average less than 2 kg/30 minutes trawling. The average catch rate in the 21-30 metre depth zone was 24.5 kg/30 minutes trawling and in the 31-50 metre zone, 12.9 kg/30 minutes trawling.

Of the several species caught, the most abundant was the brown shrimp *M. monoceros.* They were genarally restricted to the 35 to 65 metre depth range, being absent in both deeper or shallower hauls (Figure 11). The average catch rate of this species in the 31-50 metre depth zone was 9.4 kg/30 minutes trawling.

The shallower catches consisted mainly of *P. sculptilis,* a species of lesser commercial importance.

Penaeid prawns were distributed throughout the entire shallow water areas of the survey area (Figure 19), although it is apparent from Figure 20 that *M. monoceros* were concentrated in the eastern sector.

3.3.8 Other species

The above list does not exhaust the total number of species/Families that were landed during the survey. Others are shown on Table 1.

Length frequency distributions for the silver lined grunter, *Pomadasys hasta* and the spade fish, *Ephippus orbis* are shown on Figures 24 and 25 respectively.

4 STOCK STANDING ESTIMATION

An estimate of the standing stock present in each of the above depth strata and for the total survey area was made using the "swept area" method. The results are presented on Table 3.

In order to reduce the variance, geometric, rather than arithmetic means were used for these analyses (described by Pauly in the report prepared from the FAO Marine Fisheries Resources Survey and Exploratory Fishing Project in Burma FI/DP/BUR/77/003, Field Document 6)

An escapement factor of 50% was used for the calculation of biomass i. e. it was assumed that 50% of the fish in the path of the net avoided capture by escaping through or around the net. Trawls were generally conducted against the current whenever possible at the same engine revolutions and propeller pitch. The average trawling speed was calculated to be 3.0 knots.

As the majority of the catch consisted of "true" demersal species and generally small fish, the "herding" effect of the warps was considered negligible. Thus the average distance between the trawl wing tips, rather than the distance between the otter boards was used for the biomass calculations. This distance was 18.0 metres on average. Using this value, the area swept by the net during a 30 minute trawl was calculated to be 0.111km^2.

TABLE 3

Total Density and Biomass

Depth zone (Metres)	Area (Km^2)	Density (Kg/Km^2)	Density Range	Biomass (M.T.)	Range Biomass	No. of Hauls
10-20	6,861	—	—	—	—	0
21-30	3,369	9,557	56,856	71,550	425,666	3
31-50	3,400	1,849	1,011	13,973	7,637	5
51-100	17,710	501	980	19,701	38,569	36
101-200	10,880	—	—	—	—	0
Total/Average	42,220	1,934	4,520	181,484	245,863	44

Note the large variances associated with the calculations for the separate strata. This is of course expected when so few hauls are used for these determinations. In spite of this shortcoming, it would appear that the greatest density of fish and also greatest biomass occurs in the 21-30 metre depth zone. The lowest density, and least biomass occurs in the 51-100 metre zone.

The overall stratified biomass estimate is 181,000 m. t. $\pm$ 246,000 m. t,. i. e. between 0 and 477,000 m. t. Note, that as no hauls were conducted in either the 10-20 metre or 100 + metre depth zones, it was not possible to calculate the biomass in these zones. It was therefore assumed that the density in these two zones was the average of the density in the other three zones where trawling did occur. From the results, it is apparent that this assumption will most probably underestimate the true density in the 10-20 metre depth zone, which is probably higher than the average and overestimale the true density in the deepest zone as this is probably lower than the average.

Nevertheless, the result of the biomass calculation is of little practical use for stock assessment purposes in any event, due to the large associated variance.

Prawns demand special attention, as they are of considerable economic importance to Bangladesh. Density and biomass calculations are set out on Table 4 below.

TABLE 4

Density and Biomass—Penaeid prawns

Depth zone (Metres)	Area (Km^2)	Density (Kg/km^2)	Density Range	Biomass (M.T.)	Range Biomass	No. of Haul
10-20	6,861	—	—	—	—	0
21-30	3,369	440	359	3,296	2,684	3
31-50	3,400	232	69	1,754	523	5
51-100	17,710	9	2	362	69	36
101-200	10,880	—	—	—	—	0
Total/Average	42,220	99	29	9,334	1,567	44

The greatest biomass occurs in the 21-30 metre depth zone, and the least in the 51-100 metre zone. The same assumption concerning the biomass in the unsurveyed zones was made here as with the total catch, described above. Taking this into consideration, the estimated biomass of penaeid prawns over the total survey area was calculated to be 9,300 m.t, $\pm$ 1,500 m. t. i. e. between 7,800 and 10,800 m. t,

Discussion about the potential yield of fish and shrimp that could be extracted on a sustained basis from these stocks will be postponed until a later report. The above estimations of density and biomass should be used with caution, in view of the relatively small number of hauls involved and assumptions made during calculations.

5 PELAGIC FISH

The sonar was operated only intermittently during the survey due to the practical problems of maintaining watches at night. The echo sounder was run continuously. As the vessel was either anchored during daylight or drifting there was little opportunity for observing surface schools.

No schools were observed on the sonar. The echo sounder however recorded concentrations of fish and plankton in mid water at "interfaces" between water bodies. The fish rarely concentrated sufficiently at these interfaces to form dense schools, but nevertheless were identifible as discreet aggregations. This phenomenon was observed during cruise No. 9 (Cruise Report BGD/80/025/CR-8).

Many species of fish, particularly, "pelagic" species are known to make vertical migrations through the water between day and night, usually rising from the bottom at night and returning at morning. This migration was reflected in the catches, where practically no Carangids (scad), Scombrids (mackerels and tuna), Clupeids (shads, herrings, etc.) anchovies or sardines were caught. These species/Families in fact represented only around 1% of the total catch.

6 OCEANOGRAPHY

Oceanography per se was not intended to be a major research activity of the survey programme. Nevertheless, as the distribution and abundance of fish in the survey area were likely to be influenced by the seasonal discharge from the rivers during the monsoons and change in water circulation pattern, certain basic parameters were measured.

Surface temperatures was recorded at all stations. These measurements are shown on Table 5 below. They ranged between 23.6°C to 24.4°C.

TABLE 5

Surface water temperature measurements
(see also Figure 46)

Date	Latitude		Longitude		Surface temp,
	Deg.	Min	Deg.	Min	(Deg C)
170285	21	04	90	21	24.0
170285	20	50	91	22	24.6
170285	20	44	91	23	24.8

TABLE 5 (CONTD)

Date	Latitude Deg.	Min.	Longitude Deg.	Min.	Surface temp. (Deg C)
180285	21	04	91	00	23.6
180285	21	08	90	27	24.0
180285	21	02	90	31	24.6
180285	20	59	90	29	24.0
190285	20	58	90	20	24.4
190285	21	04	90	11	24.2
190285	21	04	89	54	25.0
190285	21	08	89	57	24.6
190285	21	11	90	01	24.2
190285	21	18	89	48	24.6
190285	21	11	89	40	24.6
200285	21	08	89	40	24.6
200285	21	03	89	45	25.0
200285	21	01	89	37	24.8
200285	21	01	89	52	24.8
200285	20	56	89	55	25.4
200285	20	58	90	05	25.0
200285	20	56	90	09	25.0
210285	20	46	90	29	25.0
210285	20	47	90	32	24.4
210285	20	44	90	35	24.4
210285	20	35	90	34	25.0
210285	20	37	90	59	24.8
210285	20	26	91	05	24.8
220285	20	24	91	04	25.0
220285	20	28	91	15	24.8
220285	20	37	91	10	24.8
220285	20	32	91	28	25.4
220285	20	22	91	25	25.2
220285	20	17	91	27	24.8
220285	20	15	91	28	25.4
230285	20	16	91	39	25.0
230285	20	24	91	49	24.4
230285	20	25	91	52	24.6

Date	Latitude		Longitude		Surface Temp
	Deg.	Min	Deg.	Min	(Deg. C)
230285	20	31	91	52	24.4
230285	20	40	91	47	24.6
230285	20	39	91	50	24.6
230285	20	51	91	45	24.6
240285	20	53	91	52	24.8
240285	20	56	91	53	24.4
240285	21	01	91	43	24.4

Bathythermograph profiles for five stations are shown on Figure 26. It would appear that a distinct thermocline was present at approximately 40-50 metres depth, temperature generally constant above it and decreasing rapidly below. This could explain the considerable decrease in biomass below the 50 metre depth contour, described above.

8. COMPARISON WITH OTHER CRUISE RESULTS.

The results of this survey cruise can be compared with those of Cruise No. 9 (Cruise Report BGD/80/025/CR-8), the only other night trawl survey cruise conducted during this series. Cruise No. 9 was conducted between January 31st and February 11th, 1985.

The overall biomass estimates are similar (220,000 m.t. and 181,000 m.t.) and both have large variances. The relationship between the catch rate, density and depth was far more pronounced during this cruise than during Cruise No. 9. "Pelagic" species were absent from the catches during both cruises.

In general, the species composition of the catches, both within specific strata and in the total catch were similar, Catfish and threadfin bream dominated the overall catches in both cases. However, some species exhibuted differences. For instance, jewfish were slightly more abundant (on a percentage basis) during this cruise than during the other while other species, such as the grunters were less abundant. Spike fish, *Triacanthus brevirostris* which had represented 33% of the catch of the 21-30 metre depth zone during Cruise No. 9 were entirely absent during this cruise.

Penaeid prawns were more abundant during this cruise than during cruise No. 9 (estimated total biomass 9,300 m.t. versus 3,704 m.t.), although this difference may simply reflect the depth distribution of the hauls during each cruise, rather than any real difference in abundance.

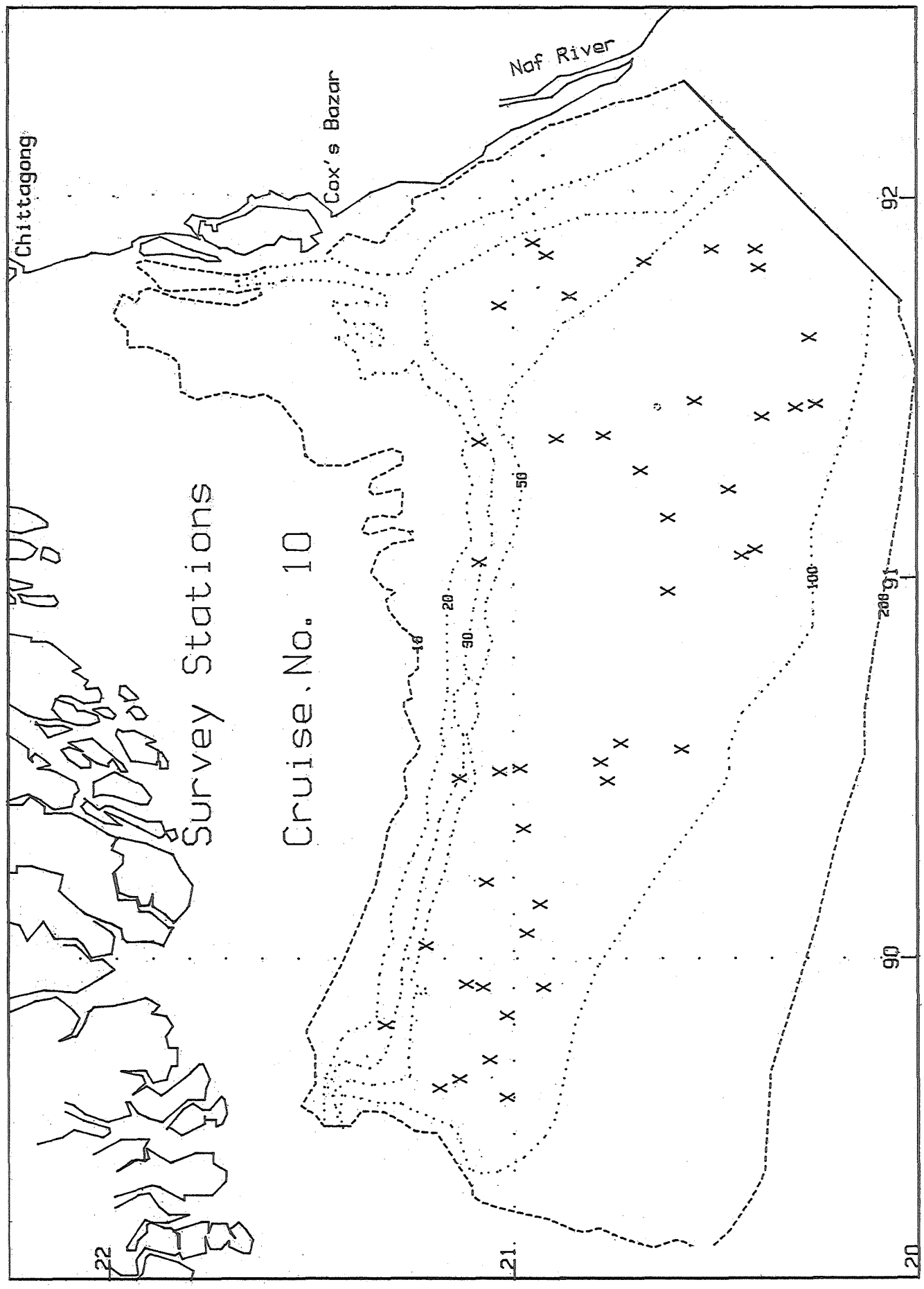

Chittagong
Cox's Bazar
Naf River
Survey Stations
Cruise No. 10
10
20
50
100
200
22
21
90
91
92

FIG. 1

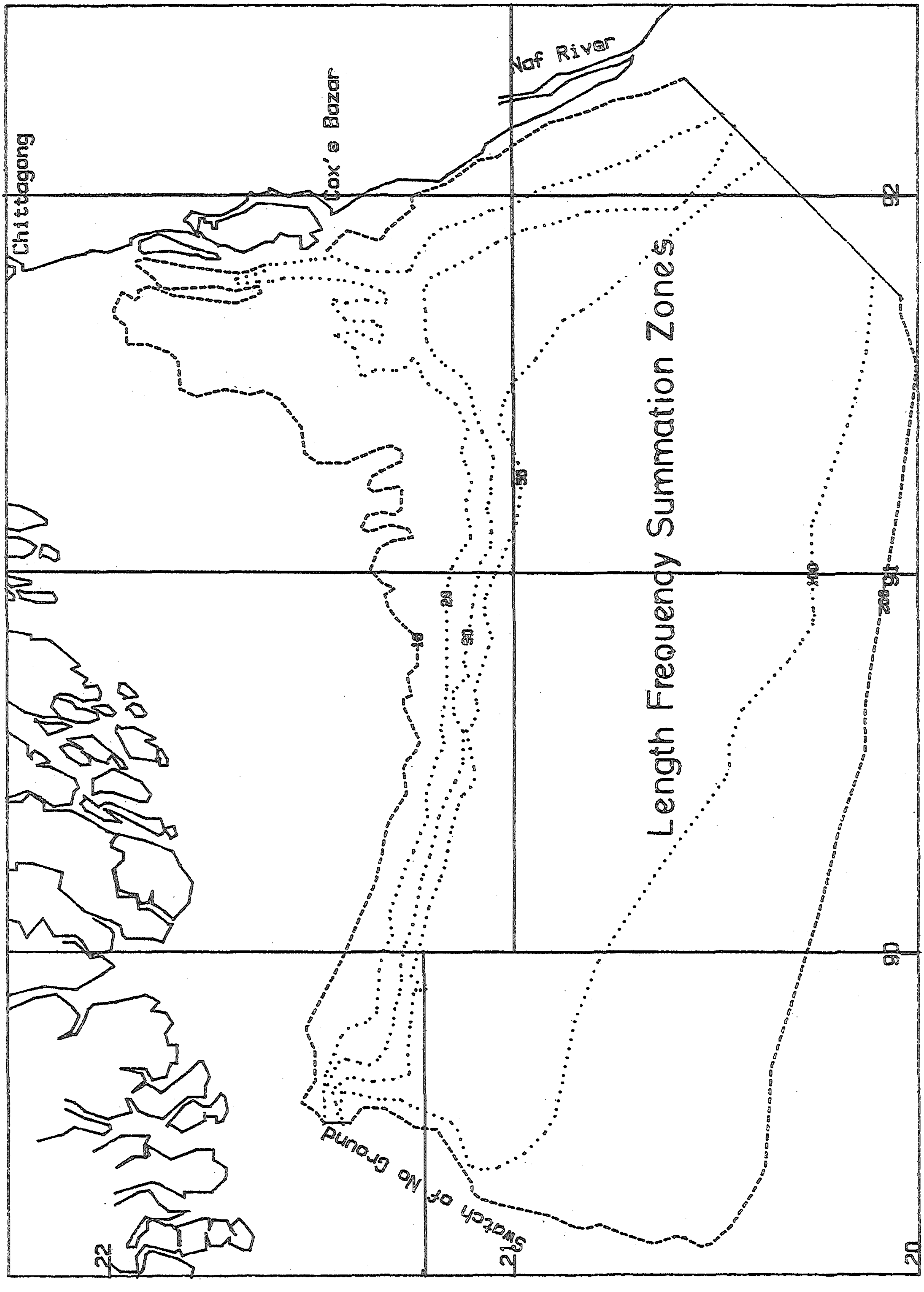

Chittagong
Cox's Bazar
Naf River
Length Frequency Summation Zones
Swatch of No Ground
92
91
90
22
21
20
10
20
50
50
100
200

FIG. 2

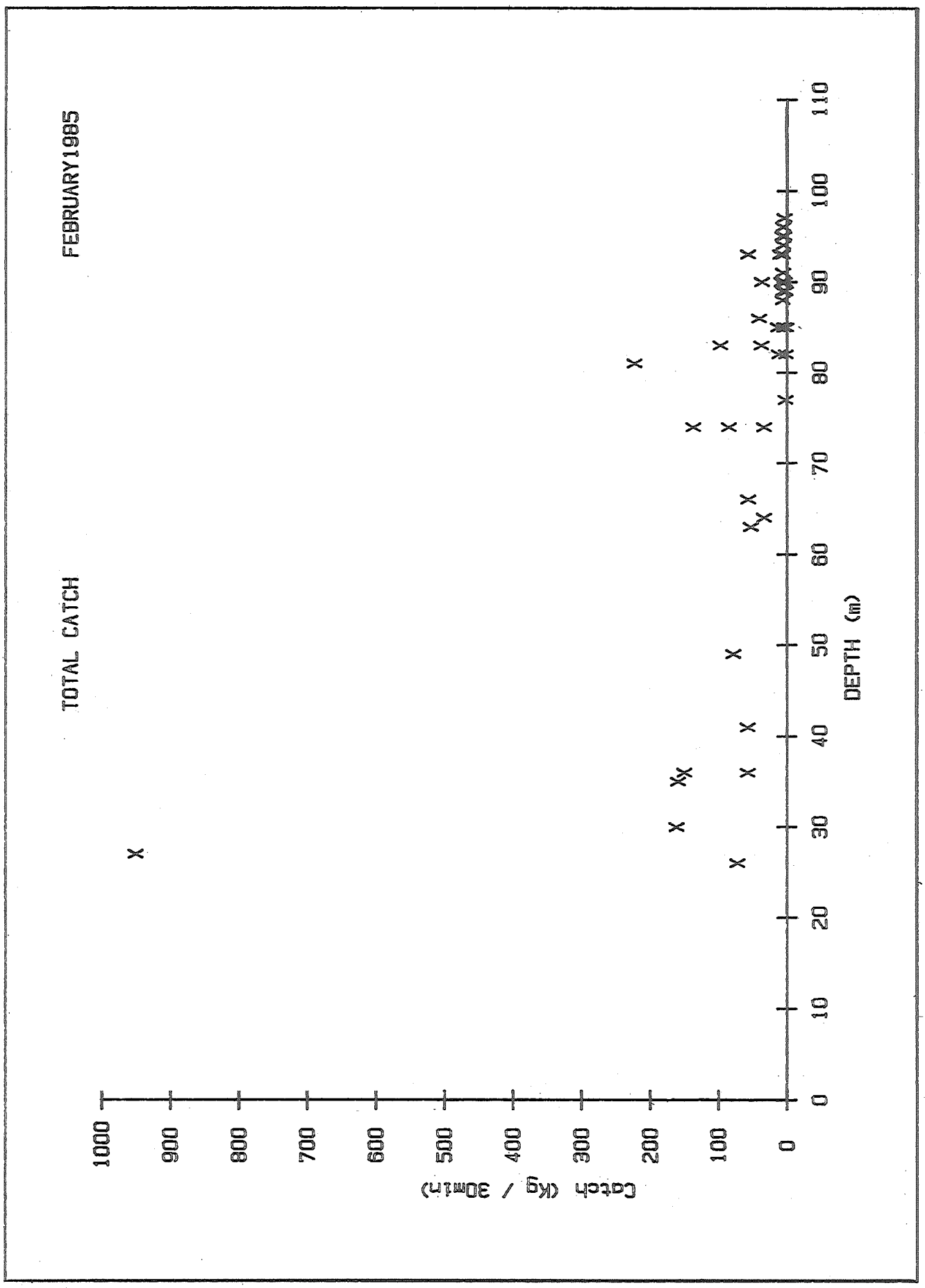

FEBRUARY1985
TOTAL CATCH
Catch (kg / 30min)
1000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
110
DEPTH (m)

FIG. 3

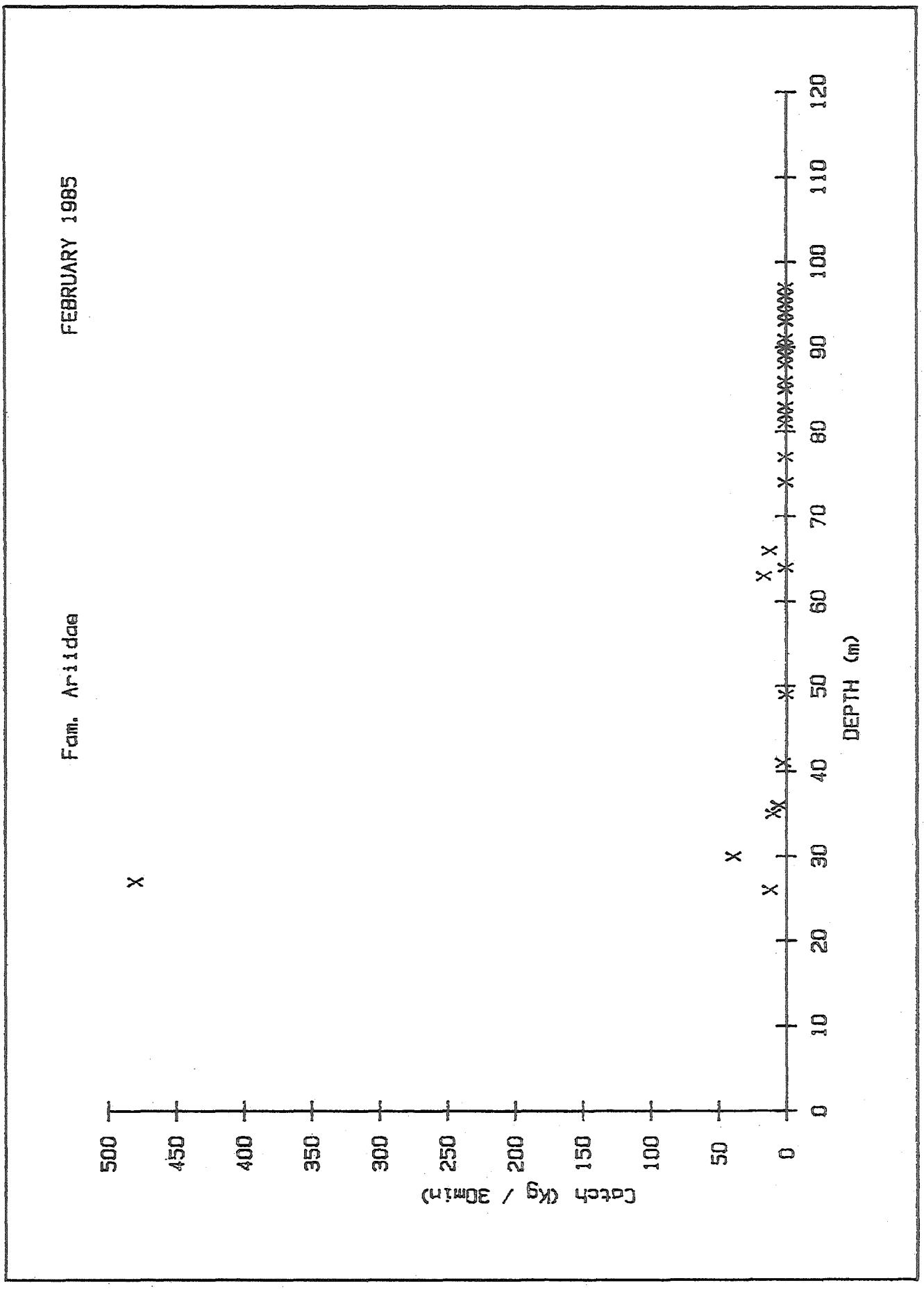

FEBRUARY 1985
Fam. Ariidae
Catch (Kg / 30min)
500
450
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
110
120
DEPTH (m)

FIG. 4

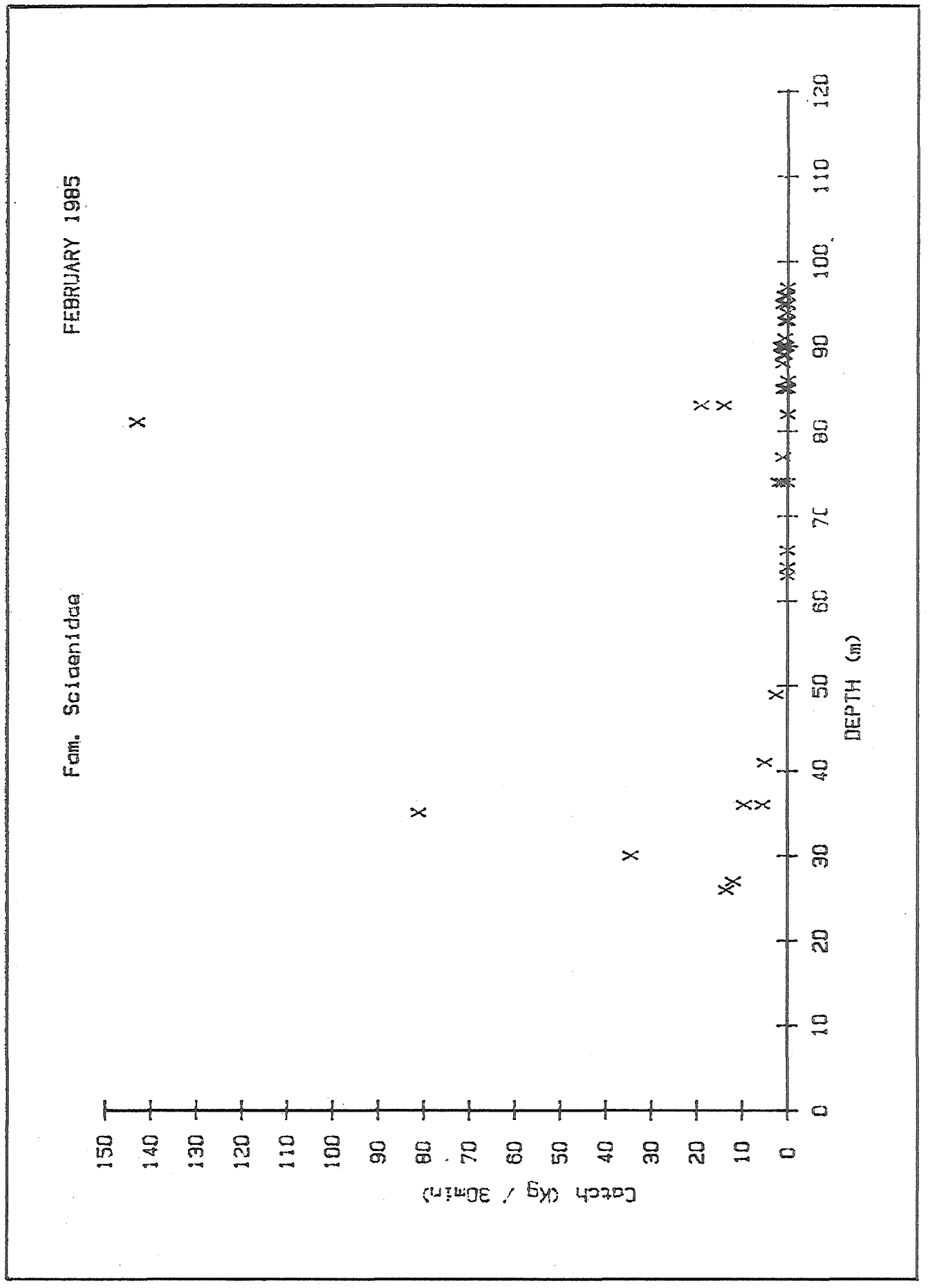

Fam. Sciaenidae
FEBRUARY 1985
Catch (kg / 30min)
DEPTH (m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

FIG. 5

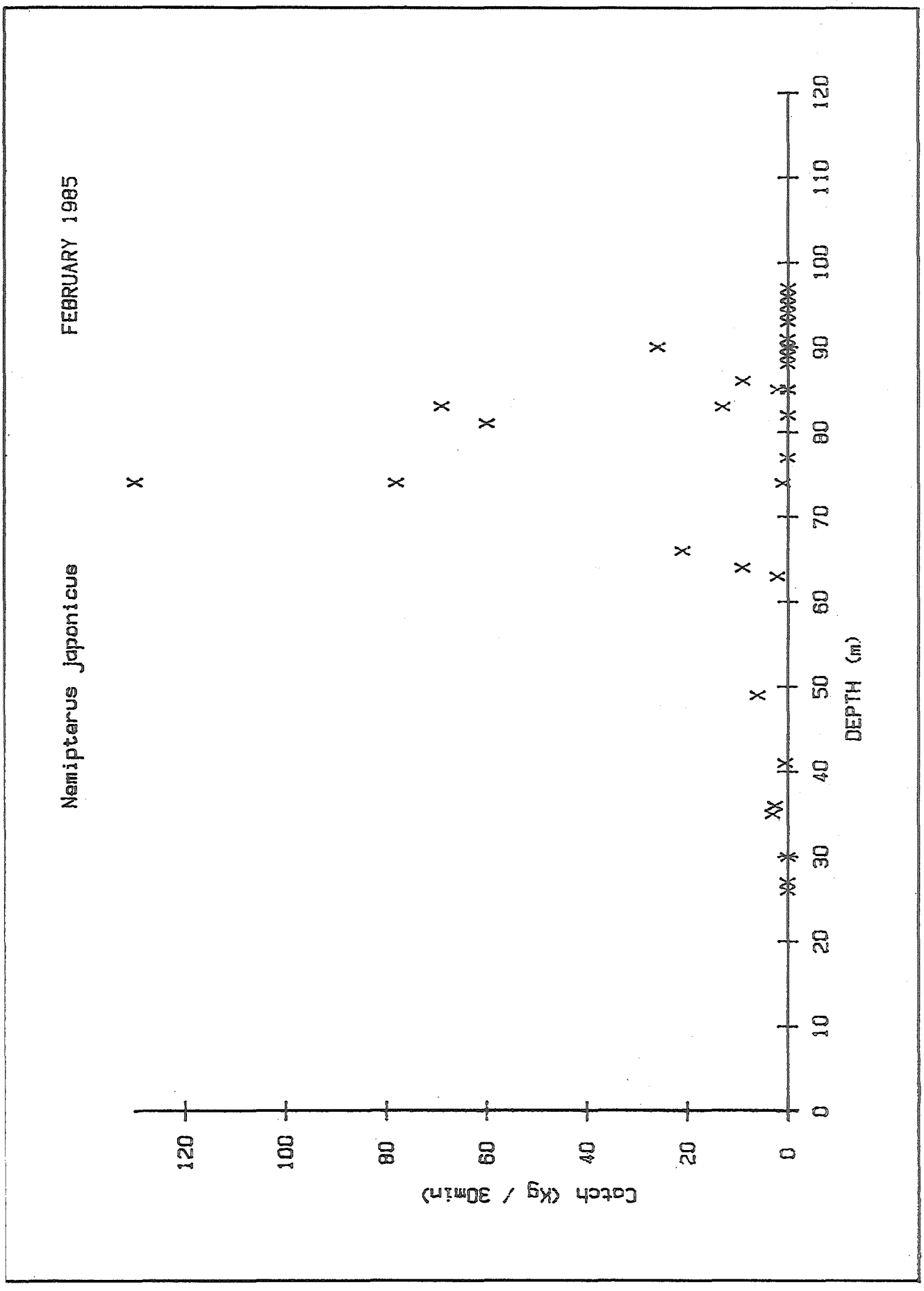

Nemipterus japonicus
FEBRUARY 1985
Catch (Kg / 30min)
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
100
110
120
DEPTH (m)

FIG. 6

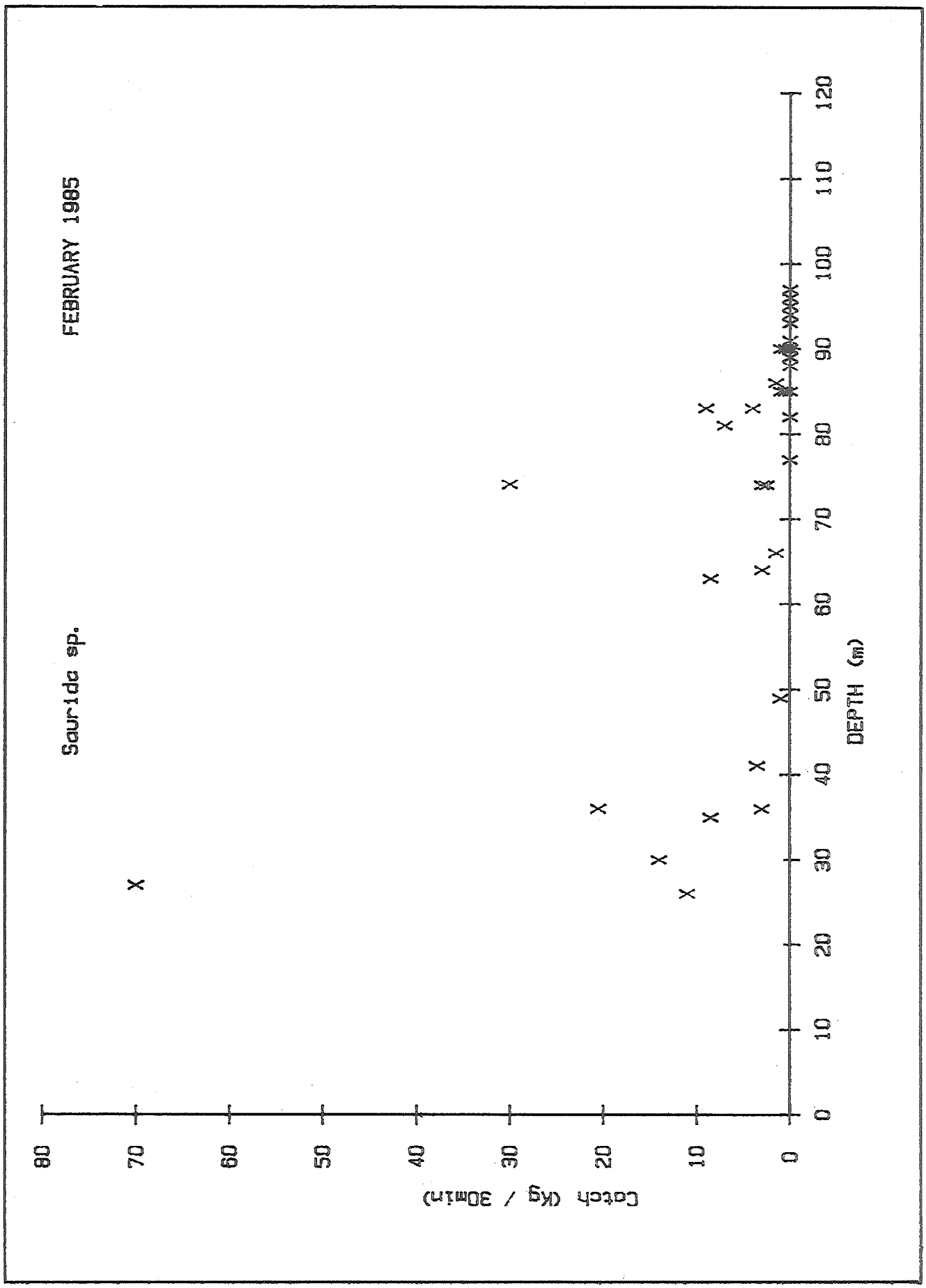

FEBRUARY 1985
Saurida sp.
Catch (kg / 30min)
0
10
20
30
40
50
60
70
80
DEPTH (m)
0
10
20
30
40
50
60
70
80
90
100
110
120

FIG. 7

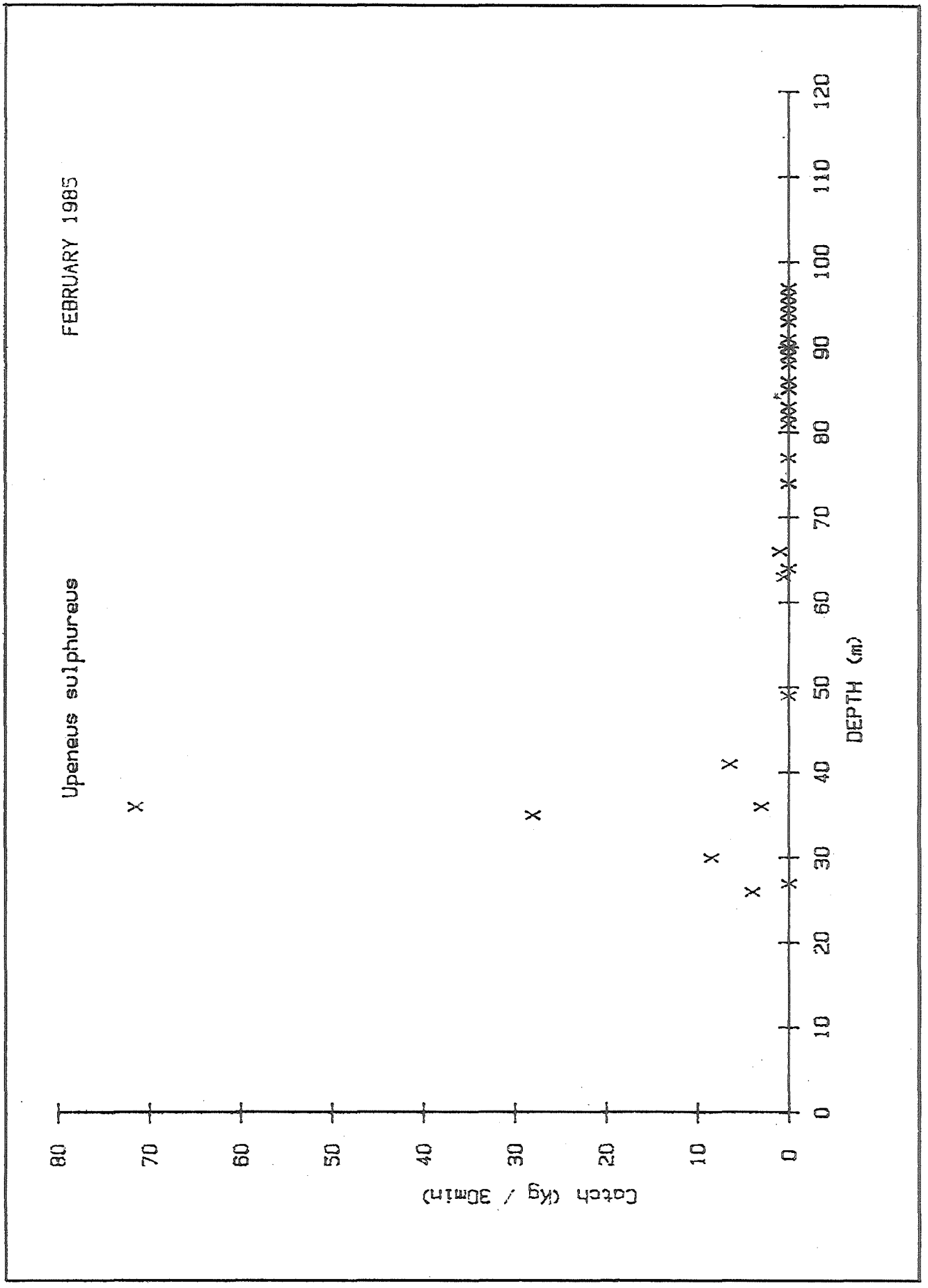

Upeneus sulphureus
FEBRUARY 1985
Catch (kg / 30min)
DEPTH (m)
0
10
20
30
40
50
60
70
80
90
100
110
120

FIG. 8

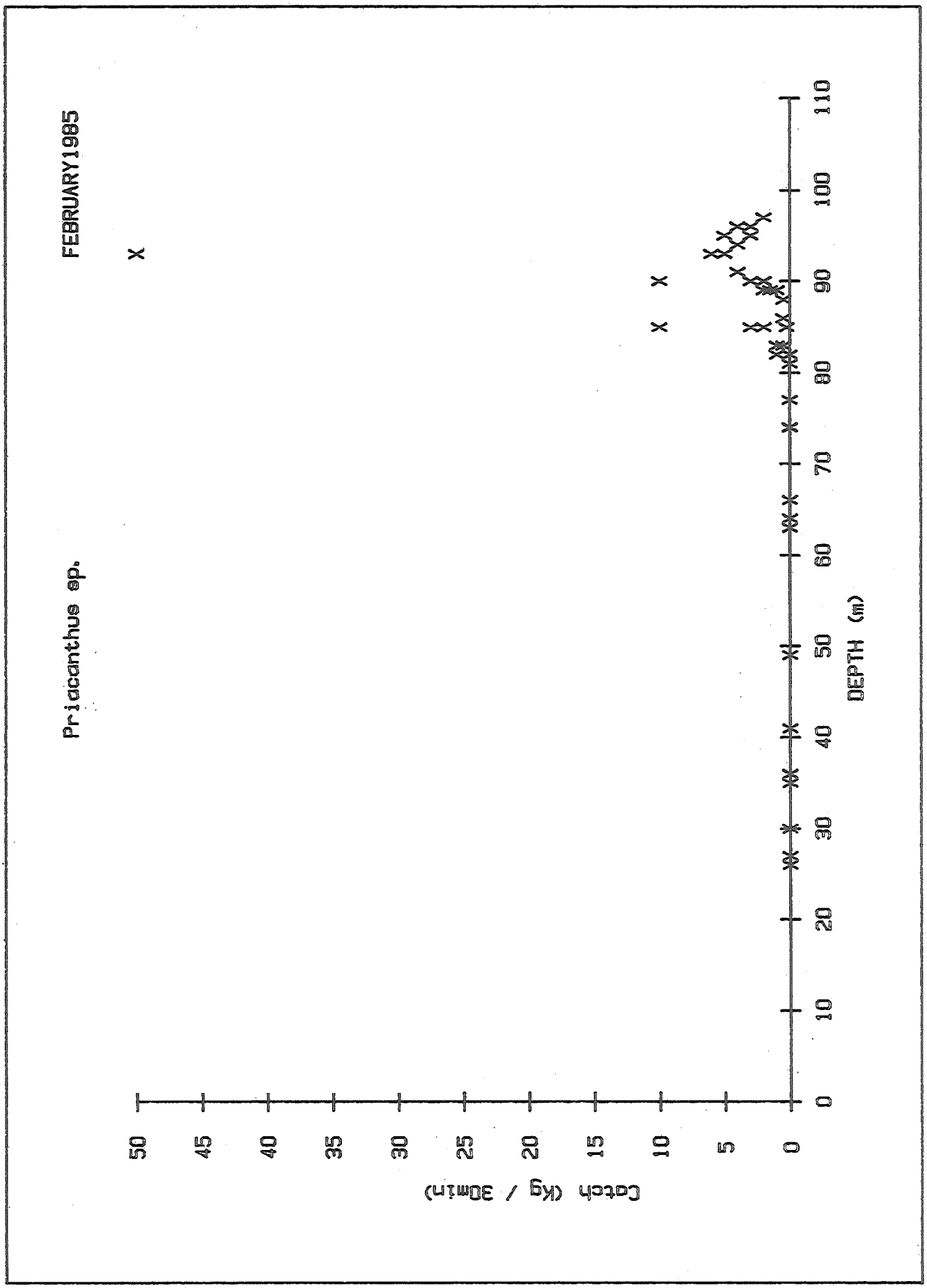

FEBRUARY1985
Priacanthus sp.
Catch (kg / 30min)
0
5
10
15
20
25
30
35
40
45
50
DEPTH (m)
0
10
20
30
40
50
60
70
80
90
100
110

FIG.9

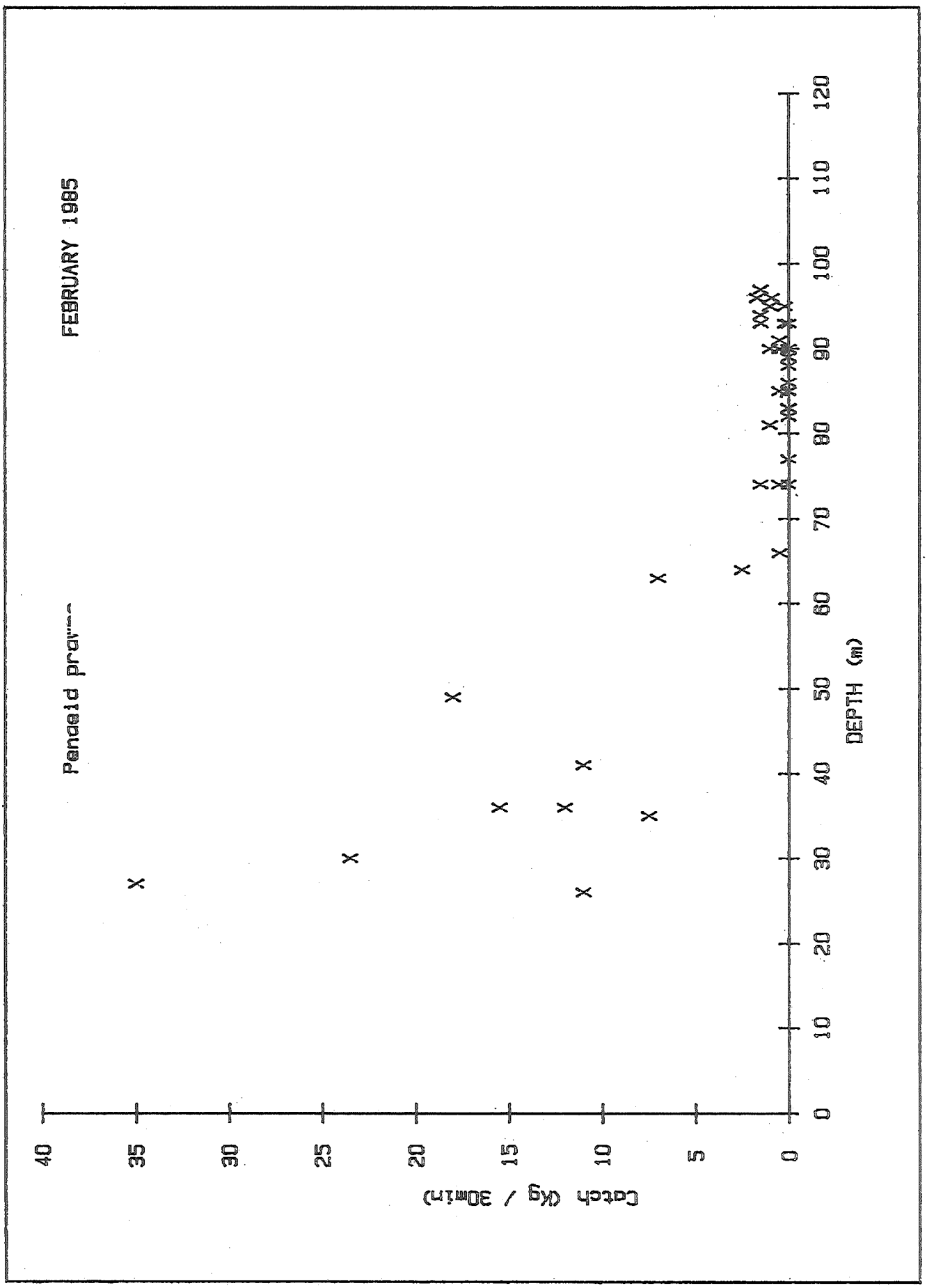

FEBRUARY 1985
Pandalid prawns
Catch (kg / 30min)
DEPTH (m)
0
5
10
15
20
25
30
35
40
0
10
20
30
40
50
60
70
80
90
100
110
120

FIG.10

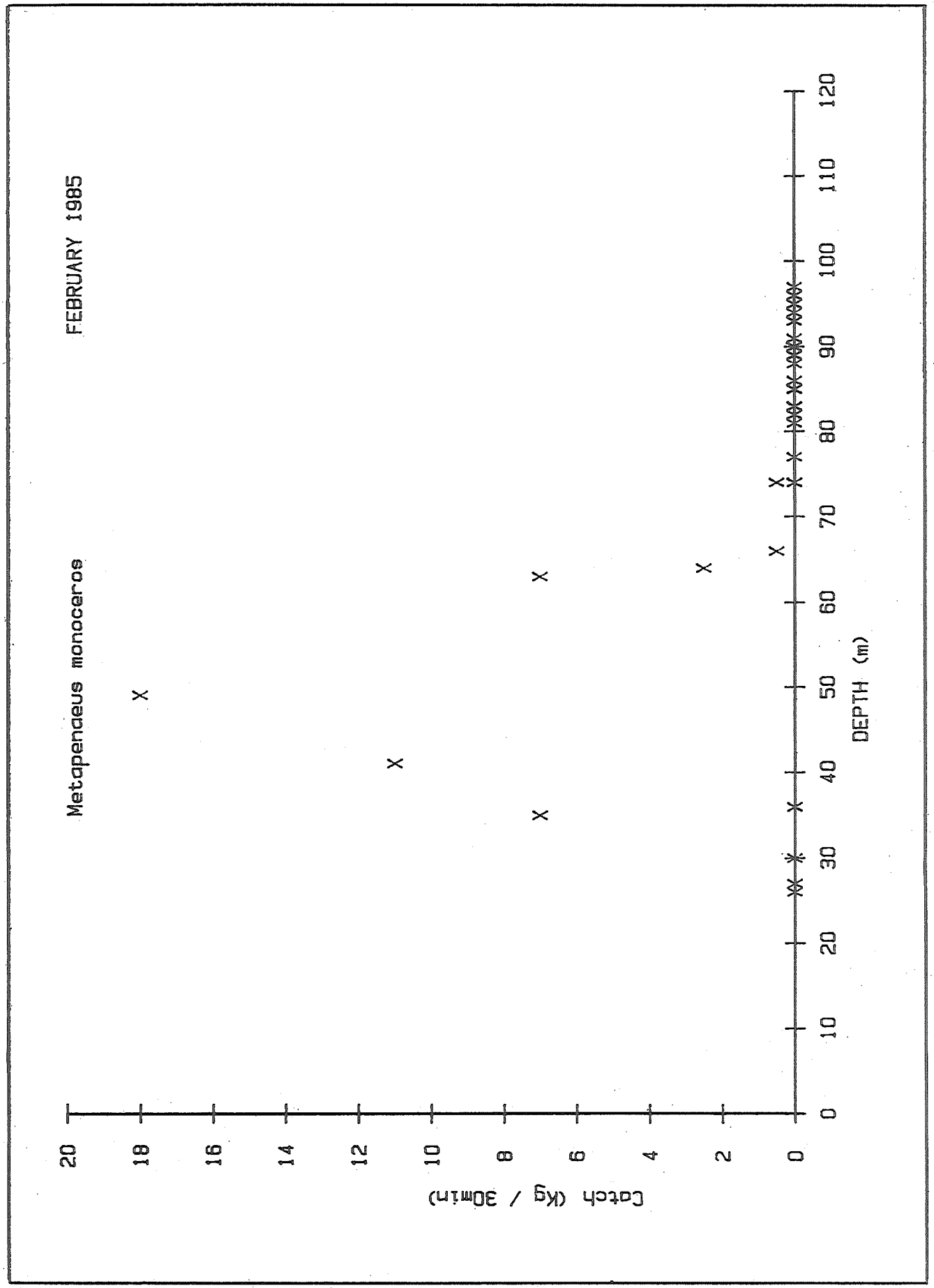

Metapenaeus monoceros
FEBRUARY 1985
Catch (Kg / 30min)
DEPTH (m)
0
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60
70
80
90
100
110
120

FIG. 11

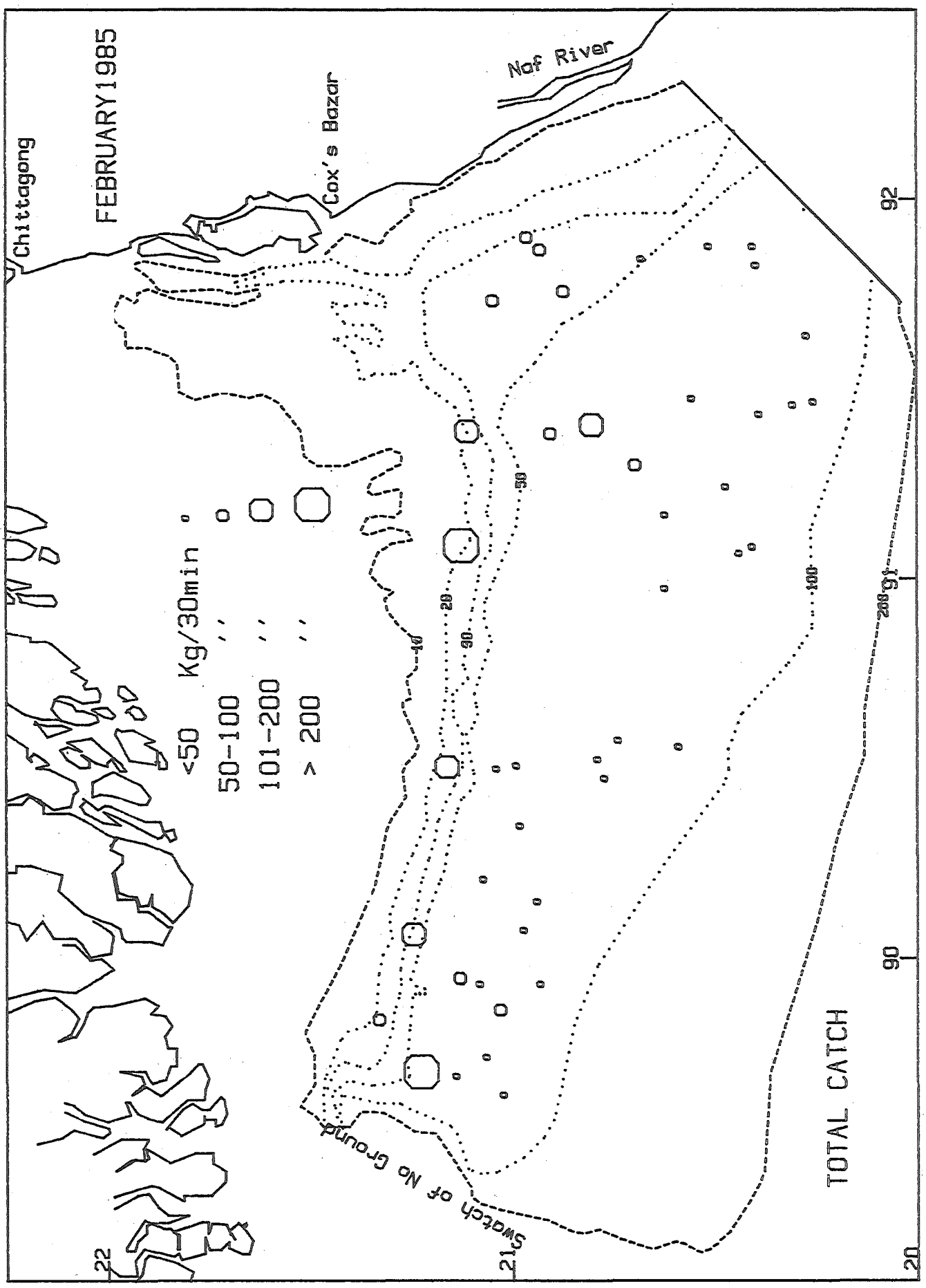

FEBRUARY1985
Chittagong
Cox's Bazar
Naf River
<50 Kg/30min
50-100 ,,
101-200 ,,
> 200 ,,
Swatch of No Ground
TOTAL CATCH
22
21
20
90
91
92
10
20
30
50
100
200

FIG.12

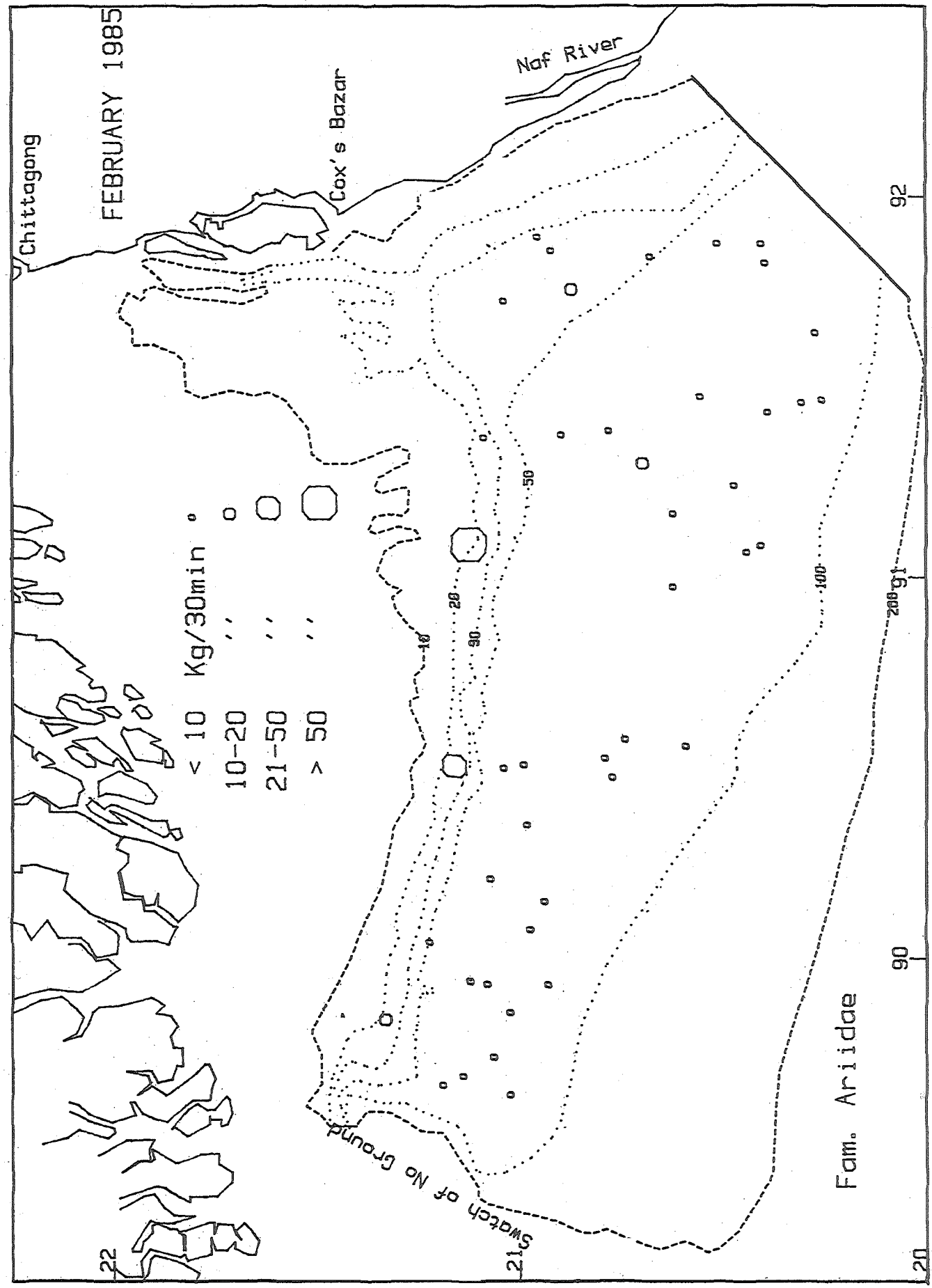

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
< 10 Kg/30min
10-20 ,,
21-50 ,,
> 50 ,,
Swatch of No Ground
Fam. Ariidae
22
21
20
92
90
10
20
50
100
200m

FIG.13

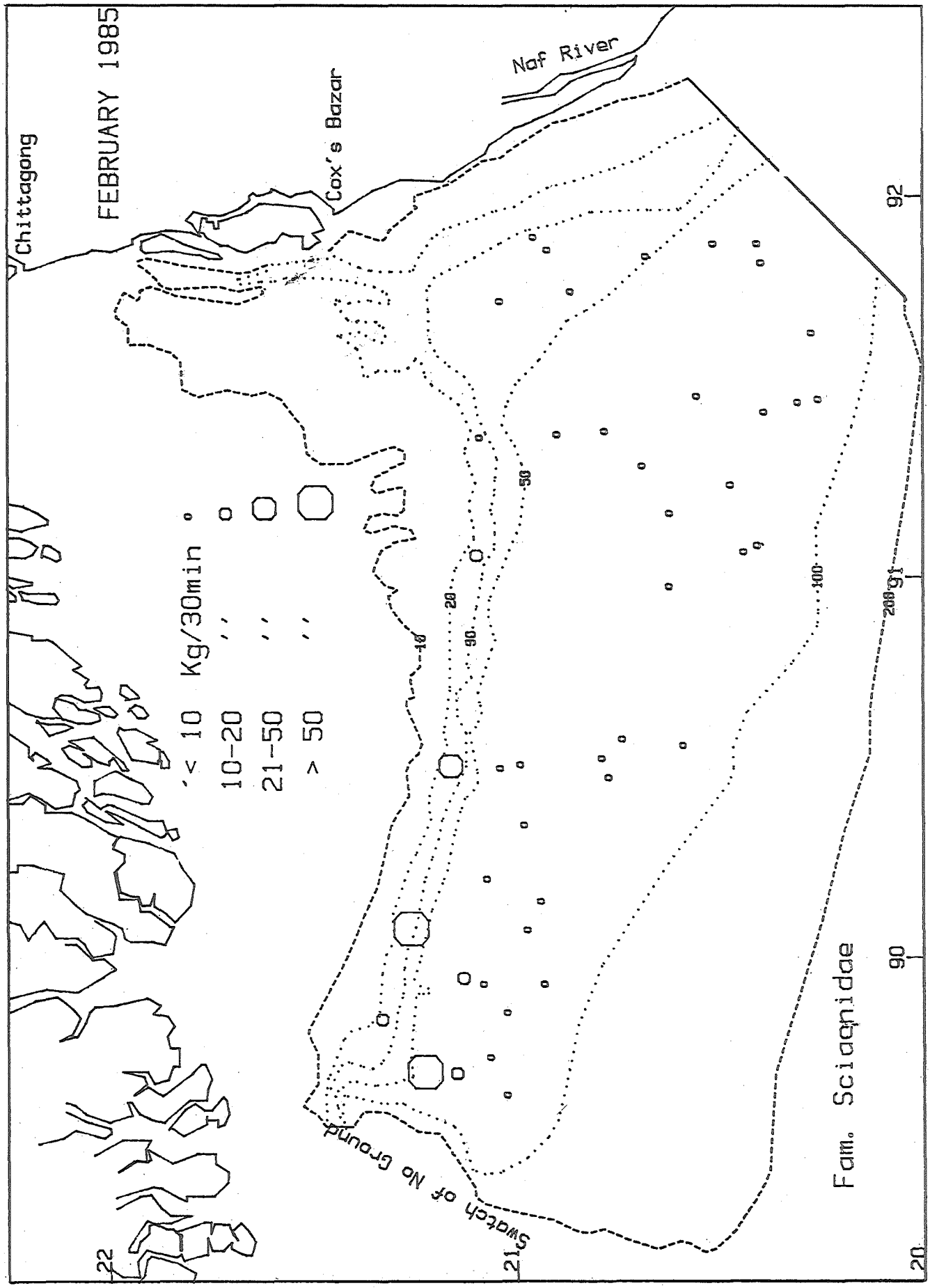

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
< 10 Kg/30min
10-20 ,,
21-50 ,,
> 50 ,,
Swatch of No Ground
Fam. Sciaenidae
22
21
20
90
91
92
10
20
50
100
200

FIG. 14

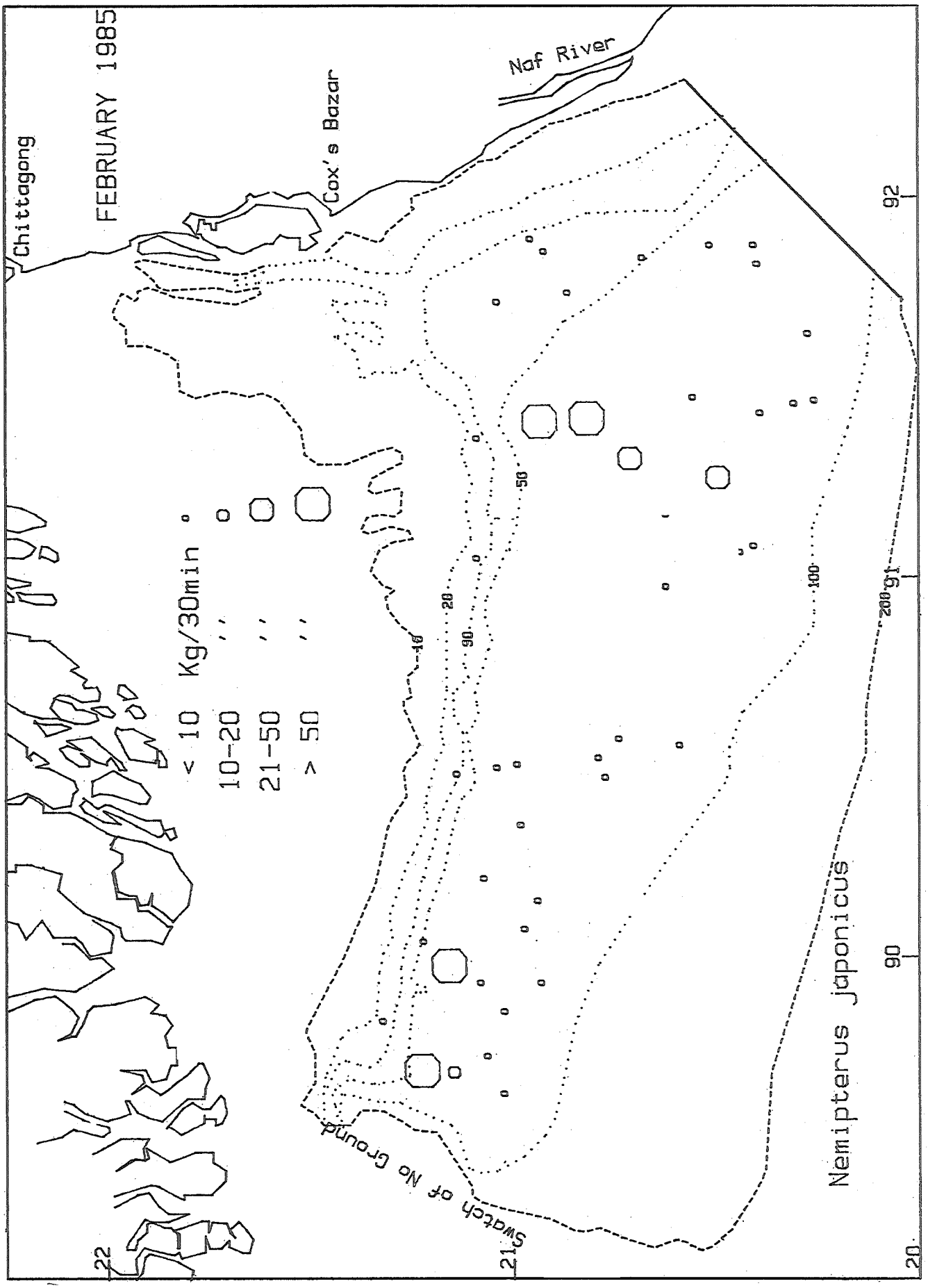

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
< 10 Kg/30min
10-20 ,,
21-50 ,,
> 50 ,,
Swatch of No Ground
Nemipterus japonicus
20
21
22
90
91
92
10
20
50
100
200

FIG. 15

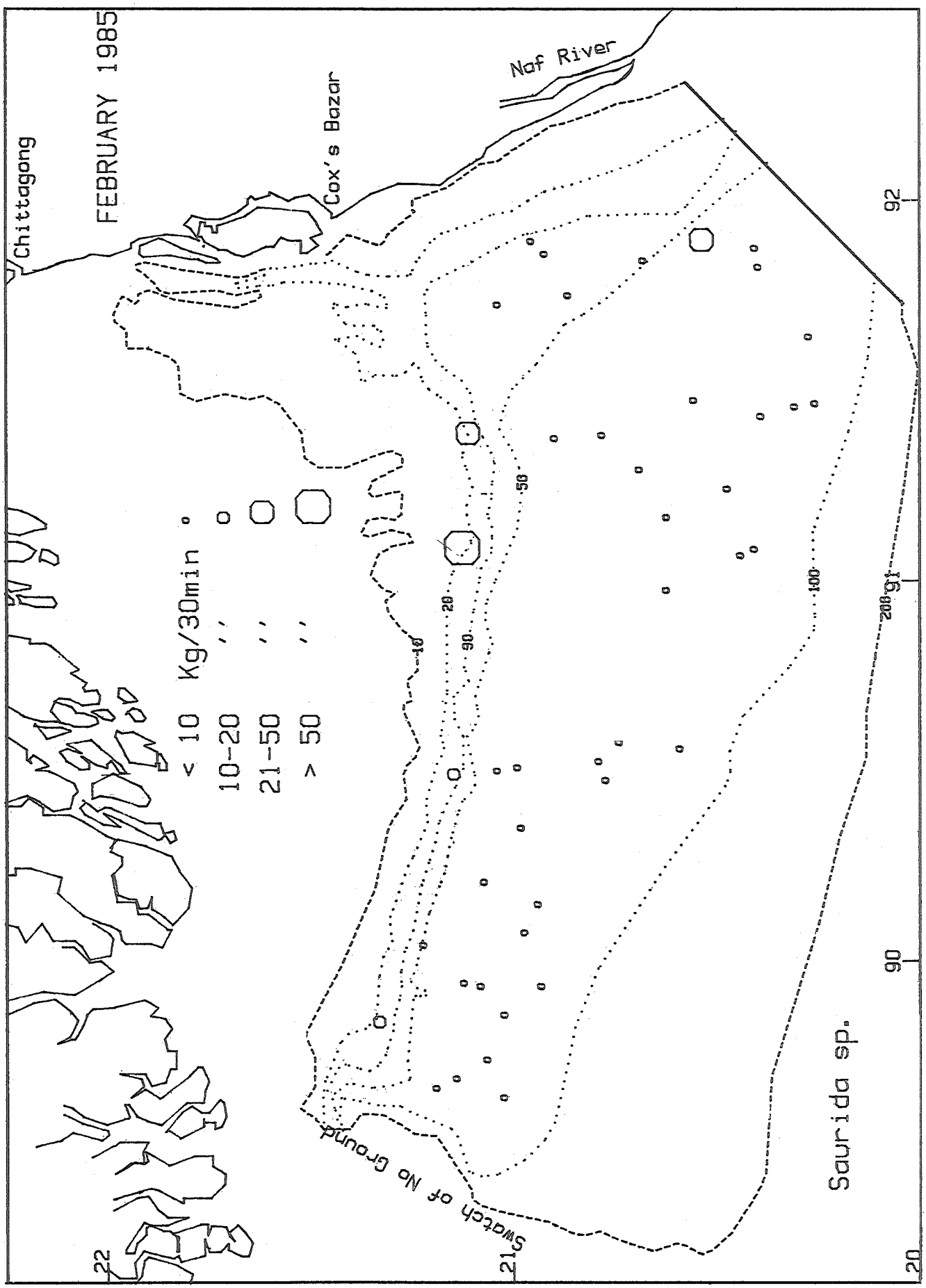

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
< 10 Kg/30min
10-20 ''
21-50 ''
> 50 ''
10
20
50
100
200
91
92
90
21
22
20
Swatch of No Ground
Saurida sp.

FIG.16

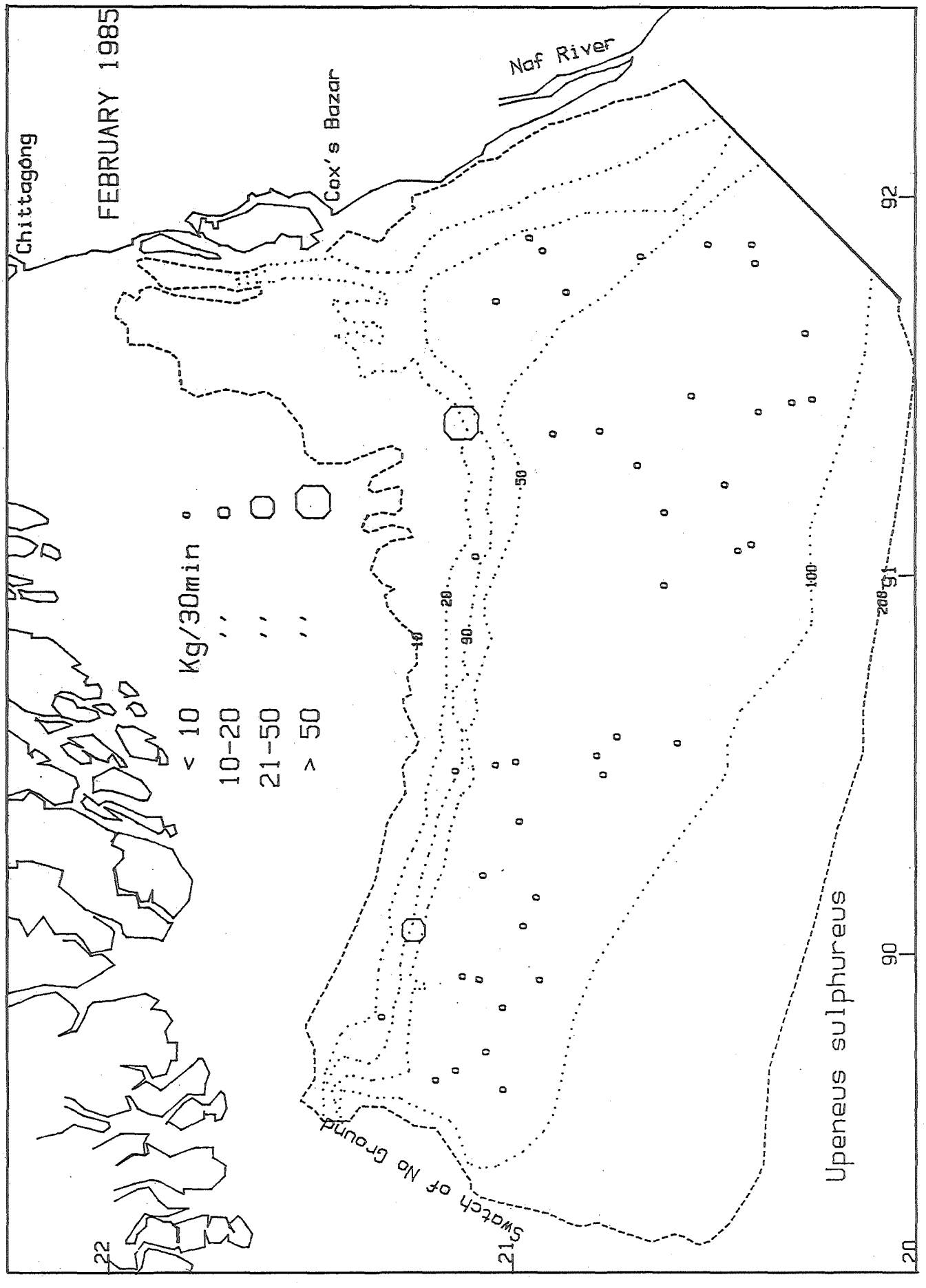

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
< 10 Kg/30min
10-20 ,,
21-50 ,,
> 50 ,,
10
20
50
100
200
Swatch of No Ground
Upeneus sulphureus
22
21
20
92
91
90

FIG. 17

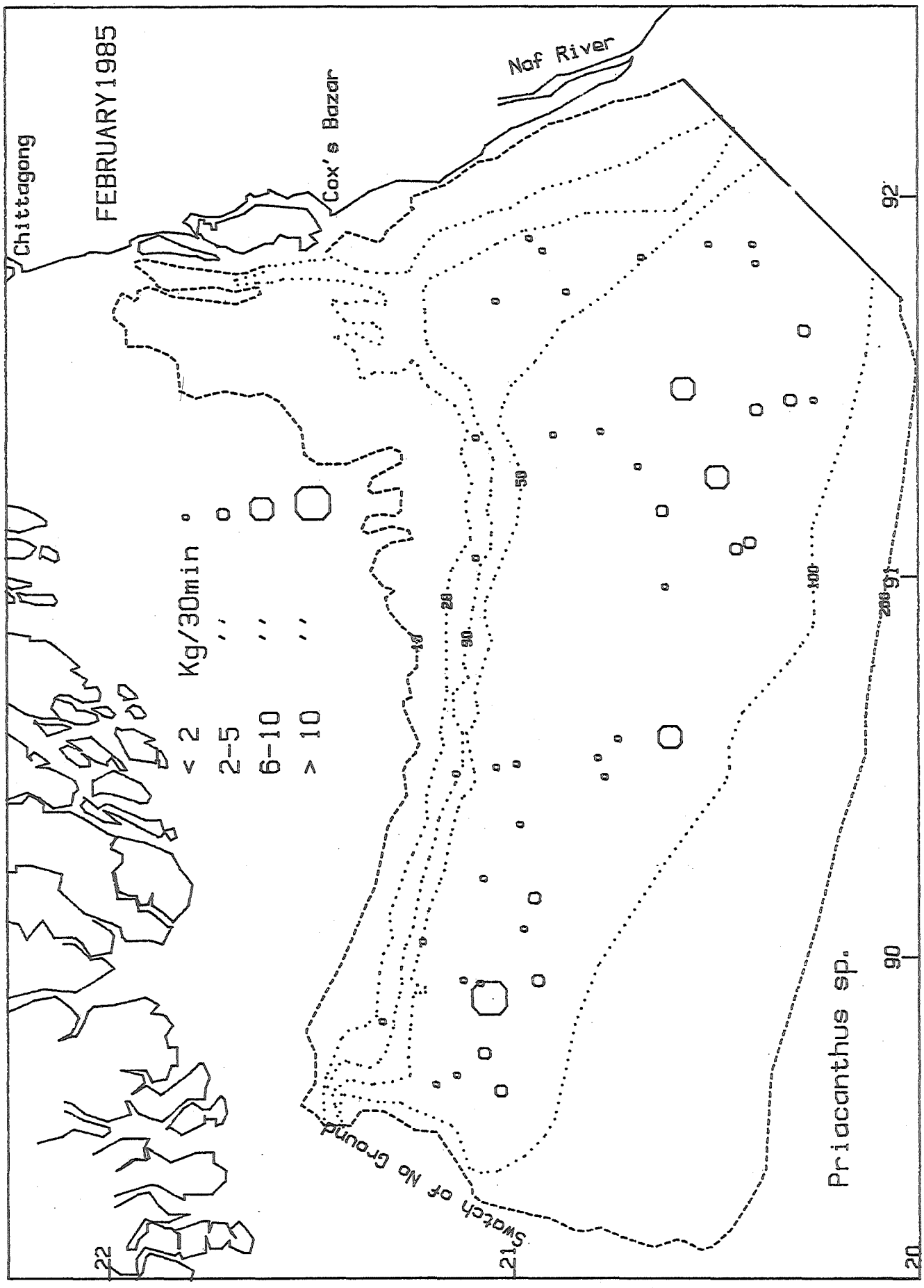

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
< 2 Kg/30min
2-5 ''
6-10 ''
> 10 ''
10
20
50
90
100
200
Priacanthus sp.
Swatch of No Ground
22
21
20
90
91
92

FIG. 18

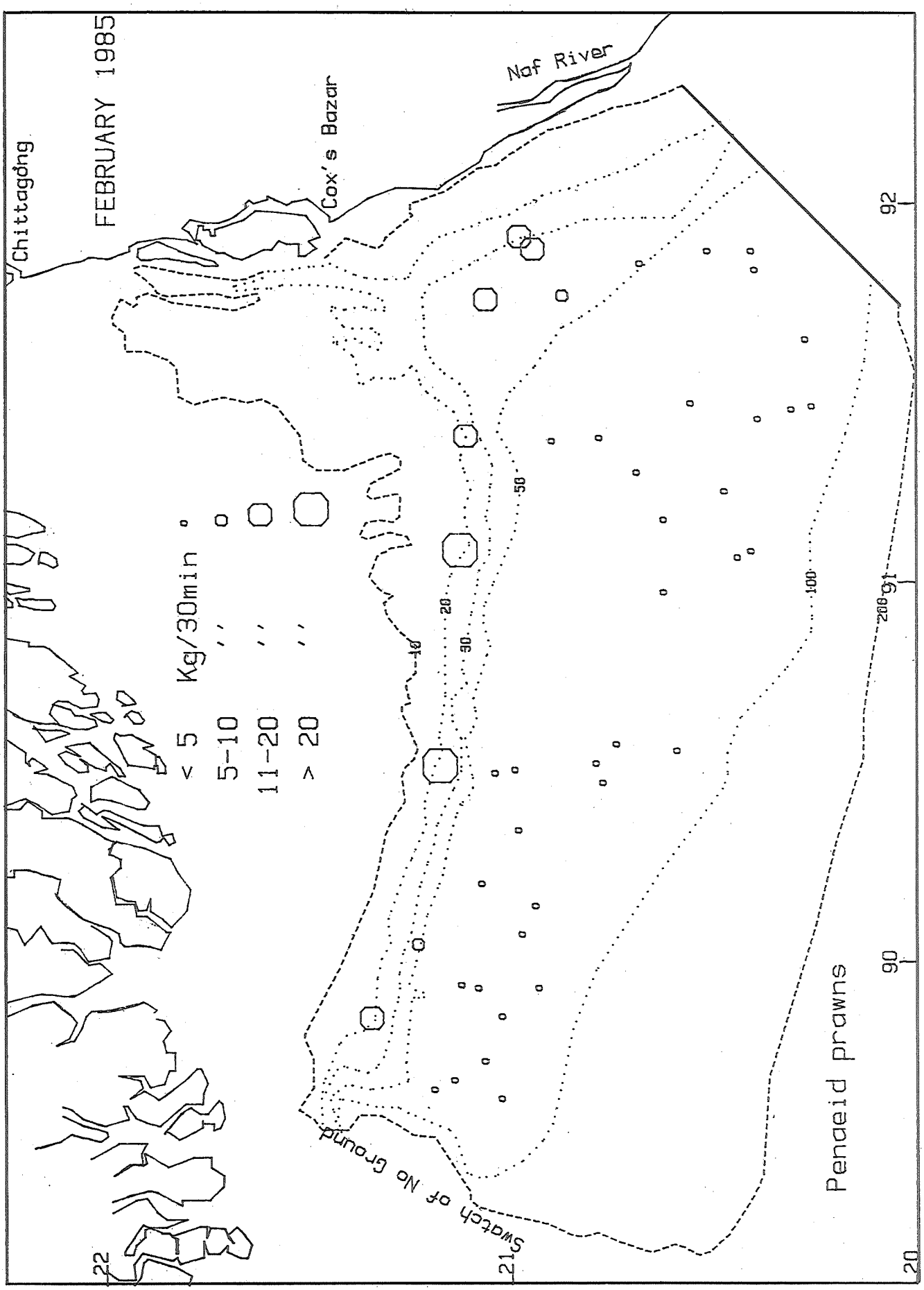

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
Kg/30min
< 5
5-10
11-20
> 20
10
20
50
100
200
Swatch of No Ground
Pendeid prawns
22
21
20
92
91
90

FIG.19

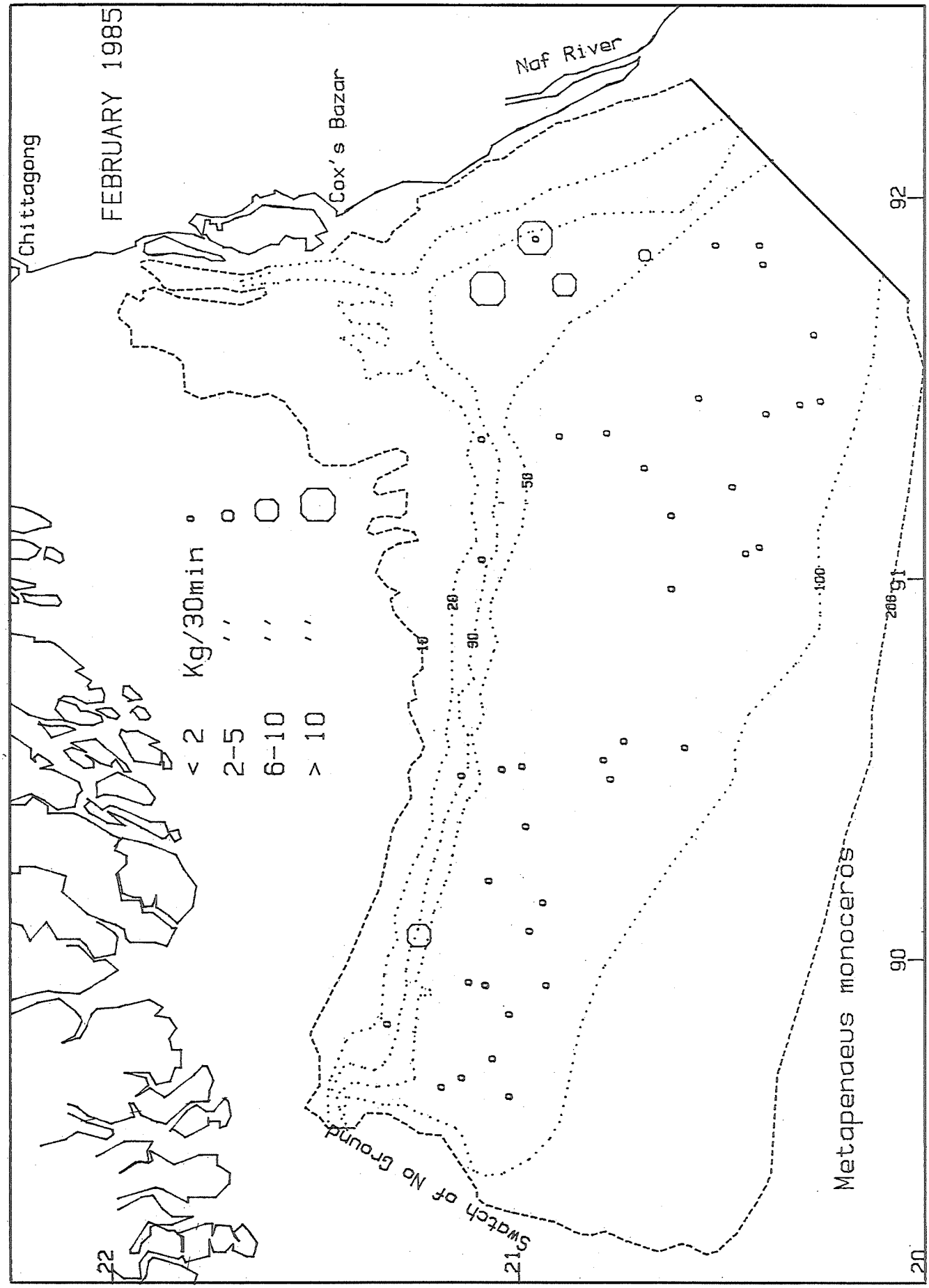

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
< 2 Kg/30min
2-5 ''
6-10 ''
> 10 ''
Swatch of No Ground
Metapenaeus monoceros
22
21
20
91
92
90
10
20
50
90
100
200

FIG. 20

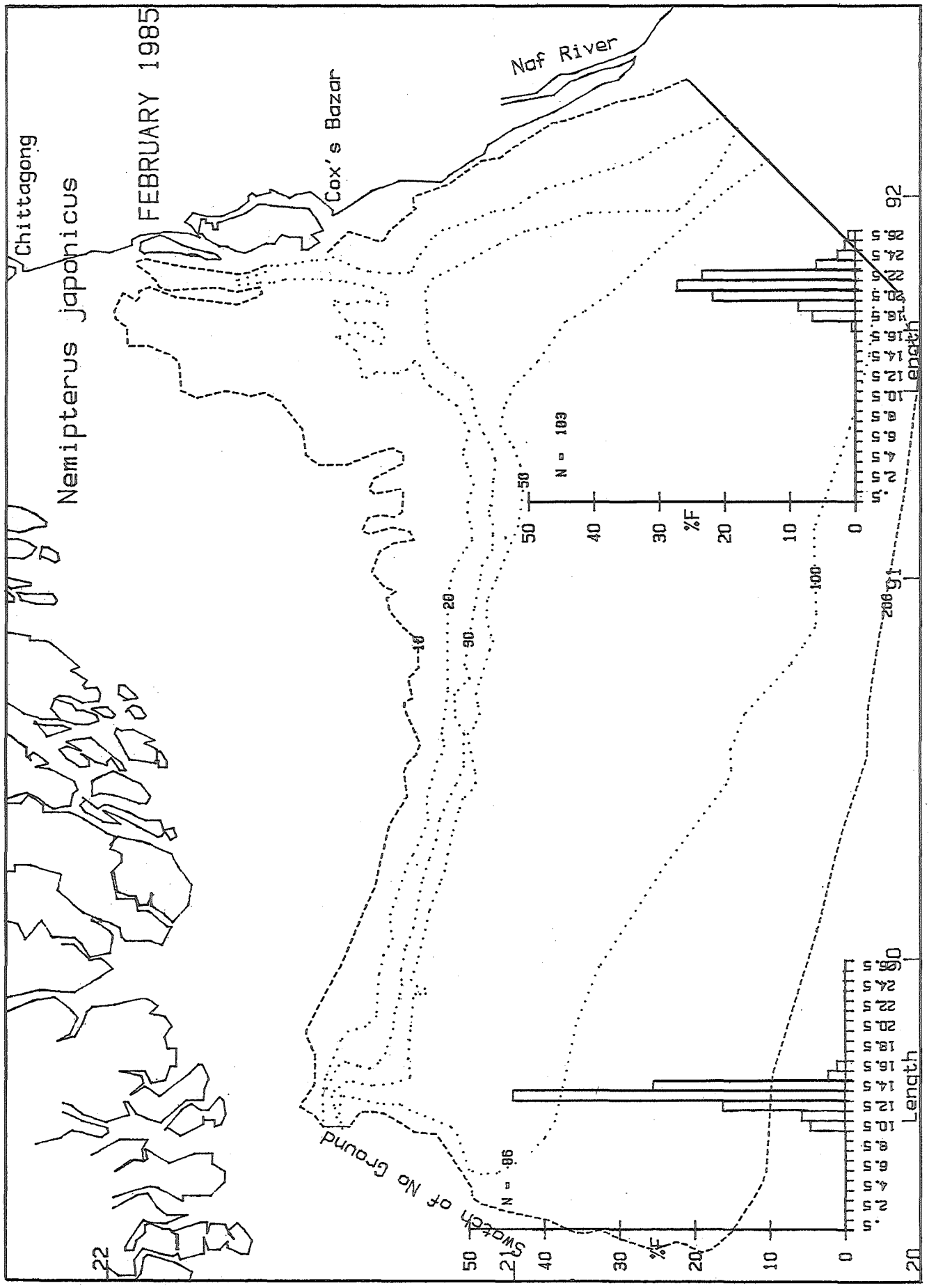

Chittagong
Nemipterus japonicus
FEBRUARY 1985
Cox's Bazar
Naf River
Swatch of No Ground
N = 183
N = 86
%F
Length
22
21
20

FIG. 21

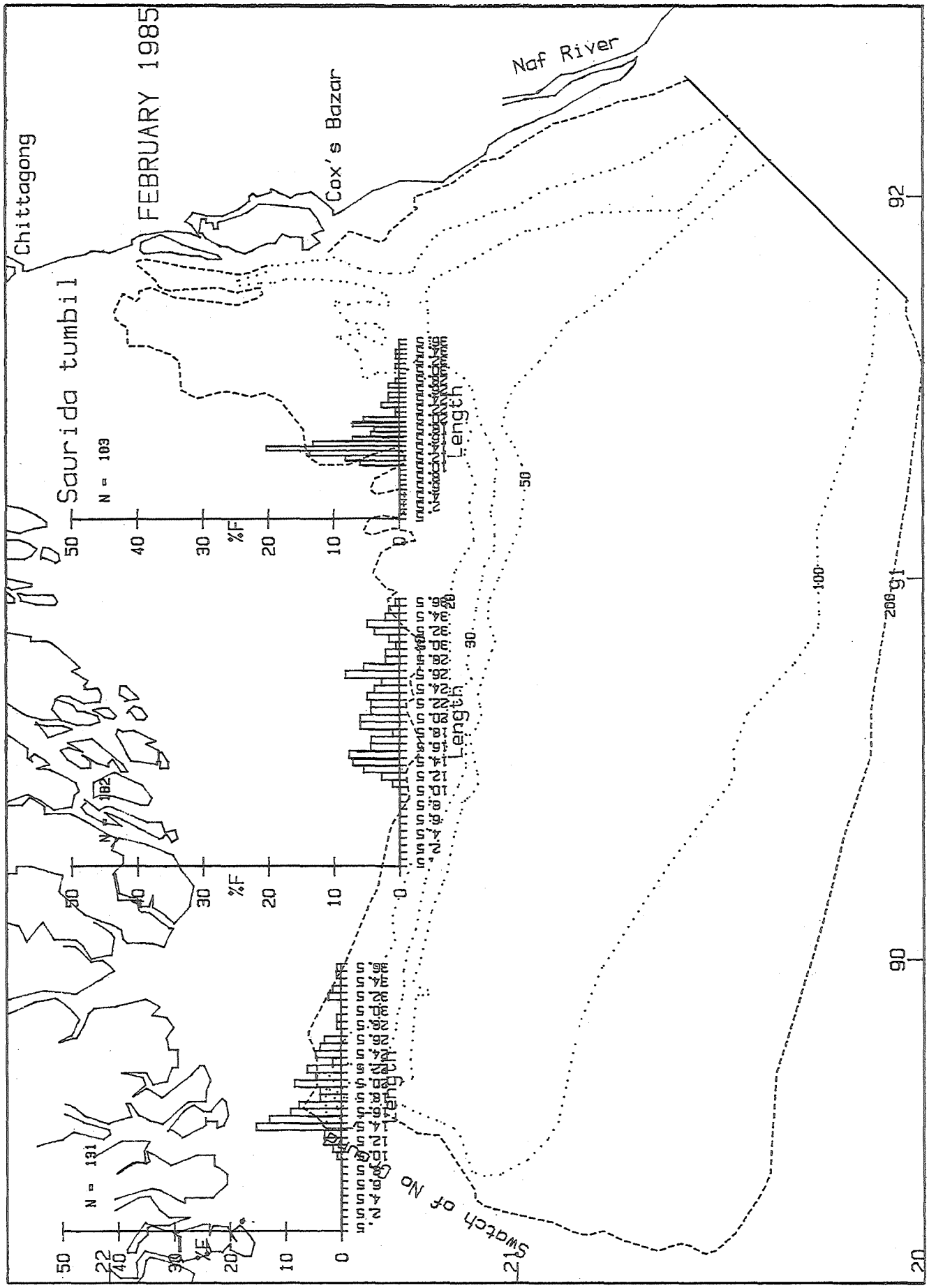

FEBRUARY 1985
Chittagong
Cox's Bazar
Naf River
Saurida tumbil
N = 103
%F
Length
N = 131
Swatch of No
50
100
200
90
91
92
20
21
22

FIG. 22

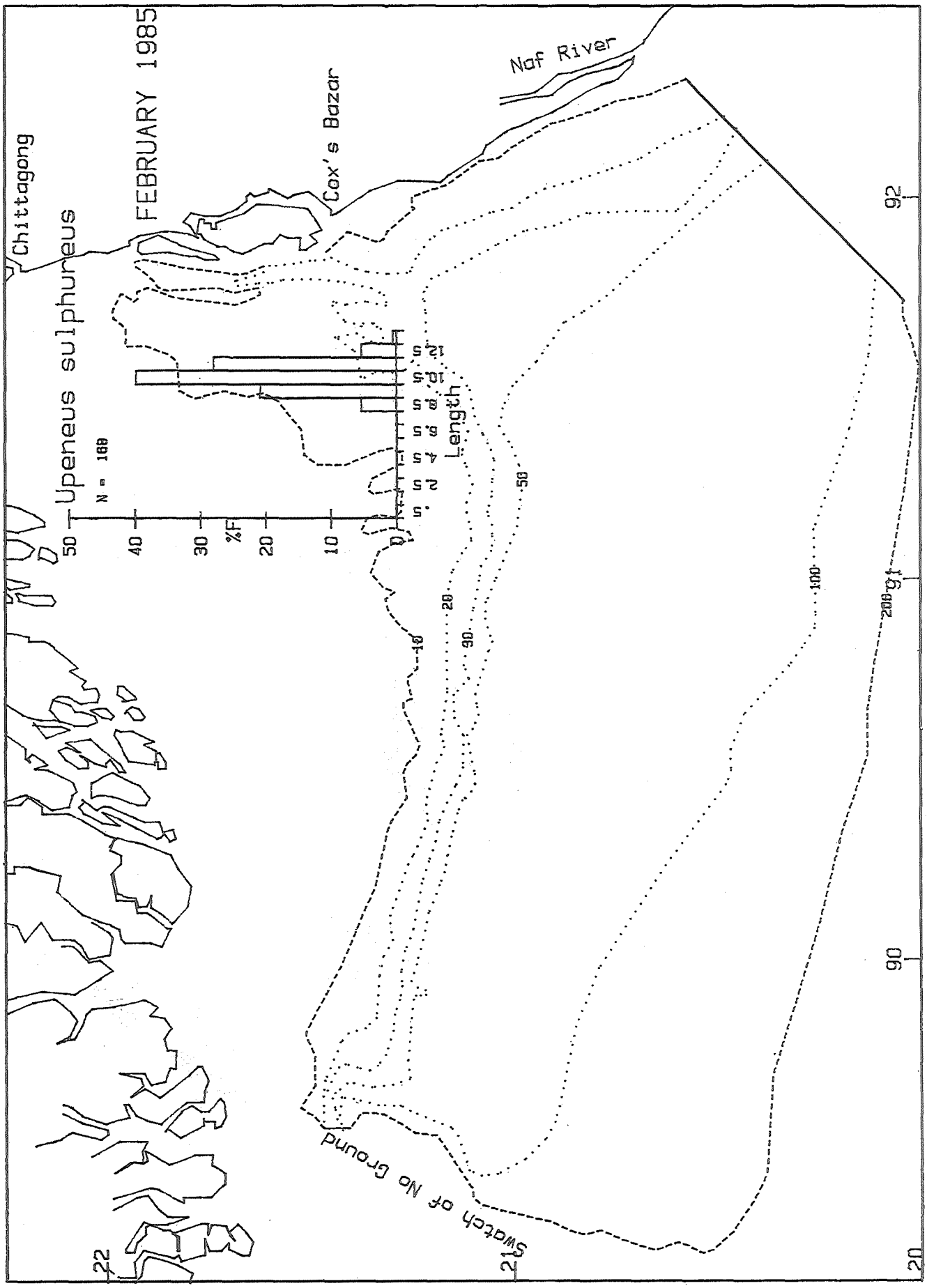

Chittagong
FEBRUARY 1985
Upeneus sulphureus
Cox's Bazar
Naf River
N = 160
%F
Length
Swatch of No Ground
22
21
20
92
90
gt

FIG. 23

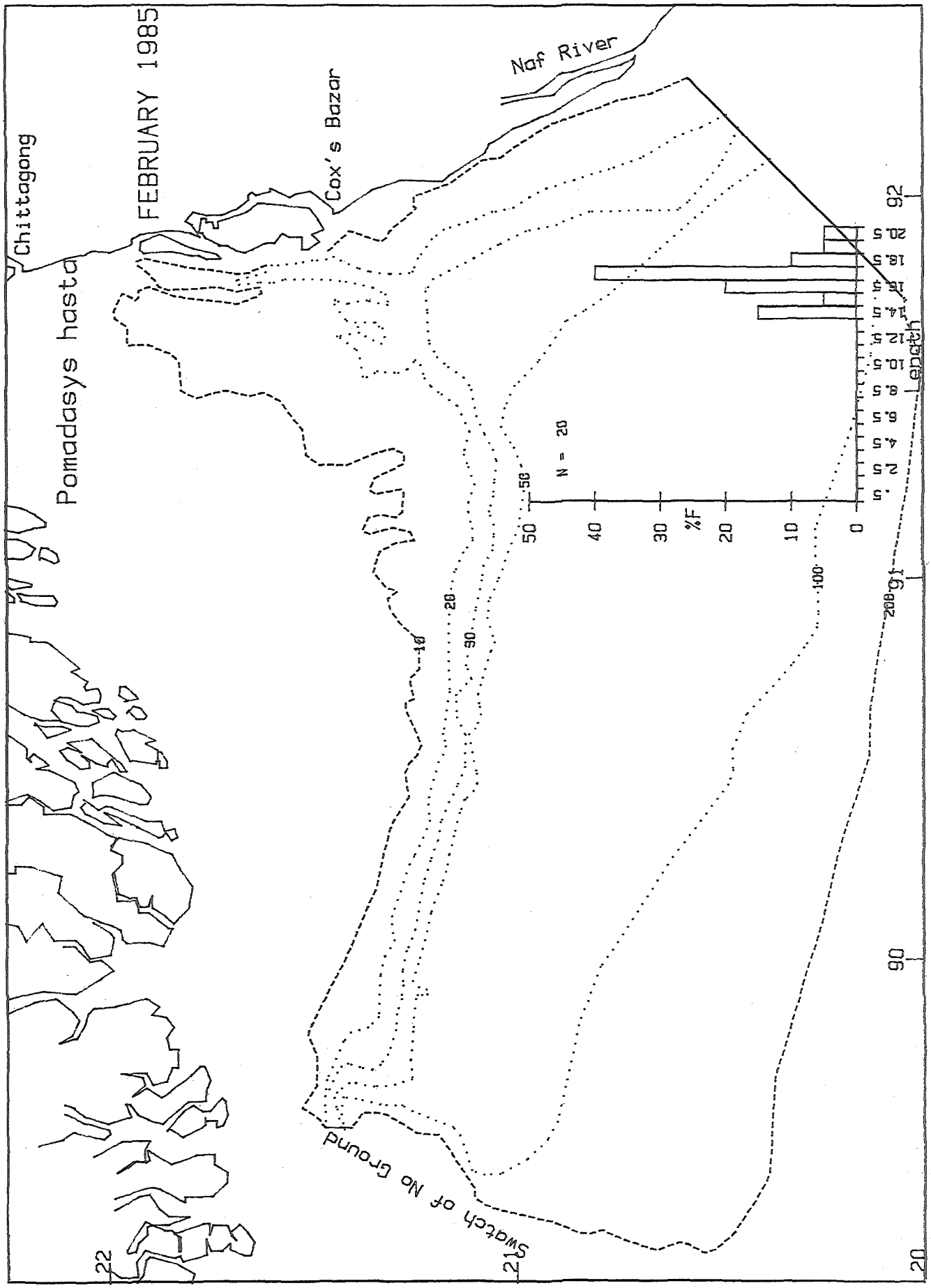

FEBRUARY 1985
Chittagong
Pomadasys hasta
Cox's Bazar
Naf River
Swatch of No Ground
N = 20
%F
Length
22
21
20
91
92
90

FIG. 24

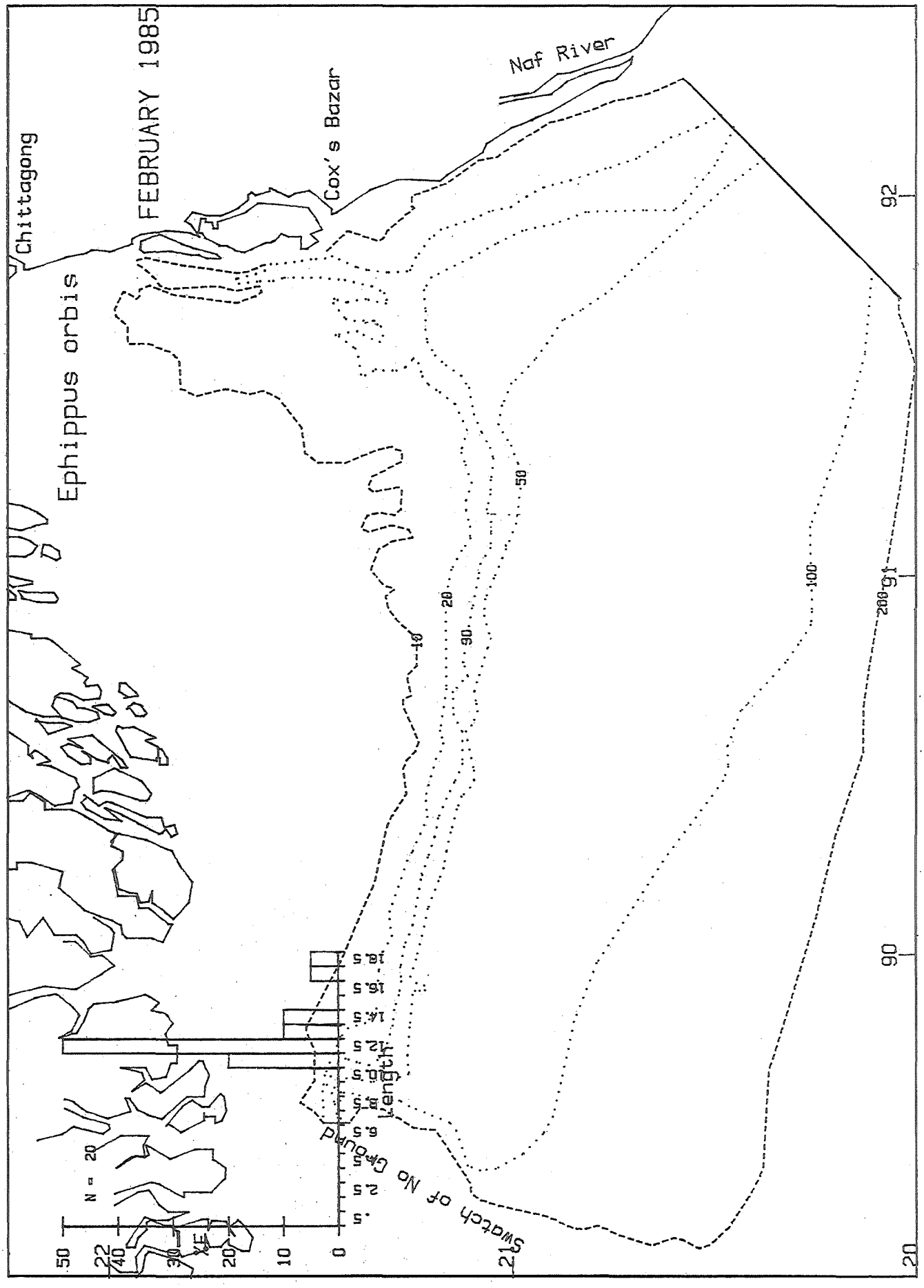

Chittagong
FEBRUARY 1985
Ephippus orbis
Cox's Bazar
Naf River
Swatch of No Ground
Length
N = 20
XE
50
22
40
30
20
10
0
.5
2.5
6.5
8.5
12.5
14.5
16.5
18.5
10
20
50
90
100
200
91
92
90
21
20

FIG. 25

Bathythermograph Profiles
FEBRUARY 1985

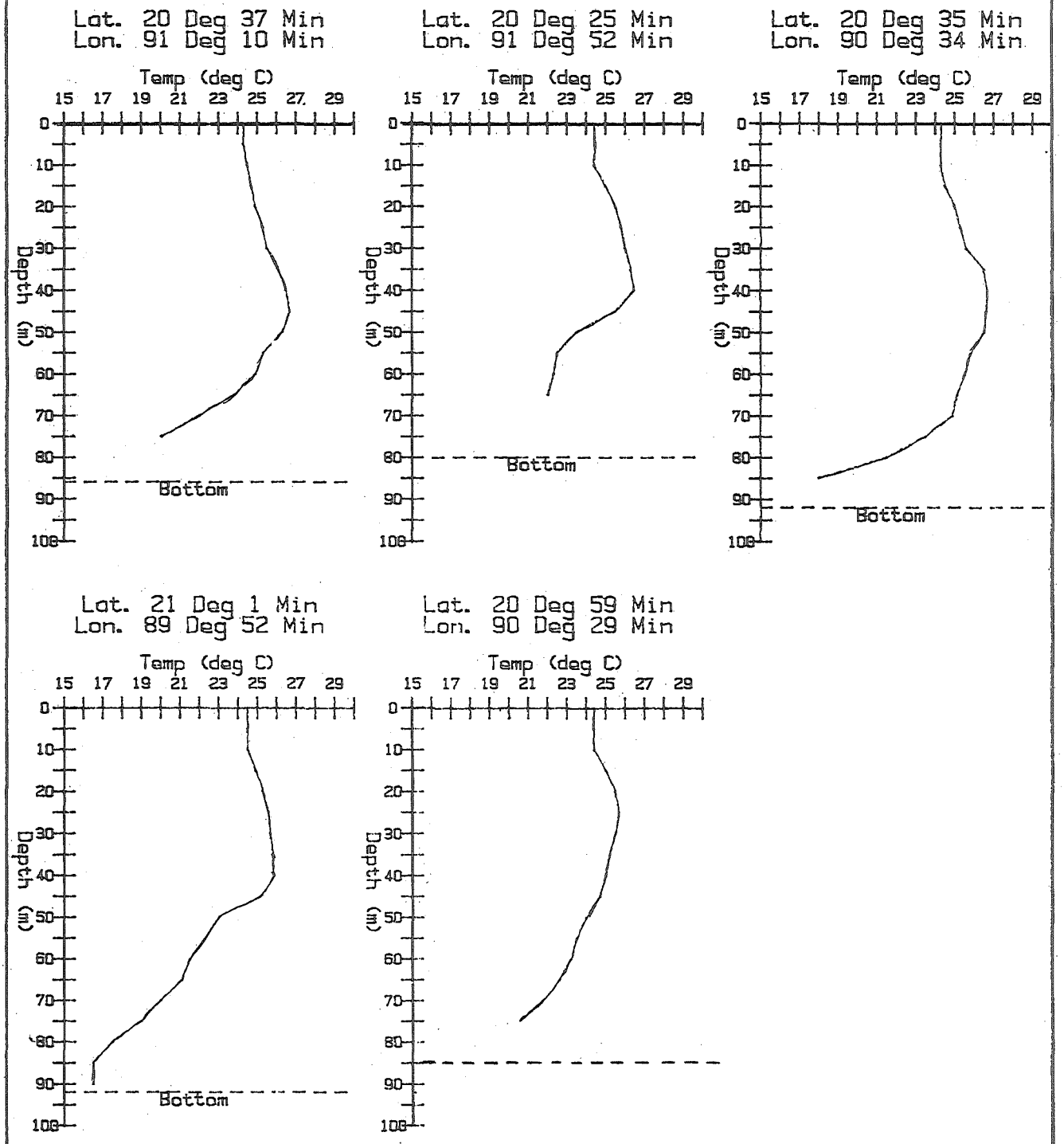
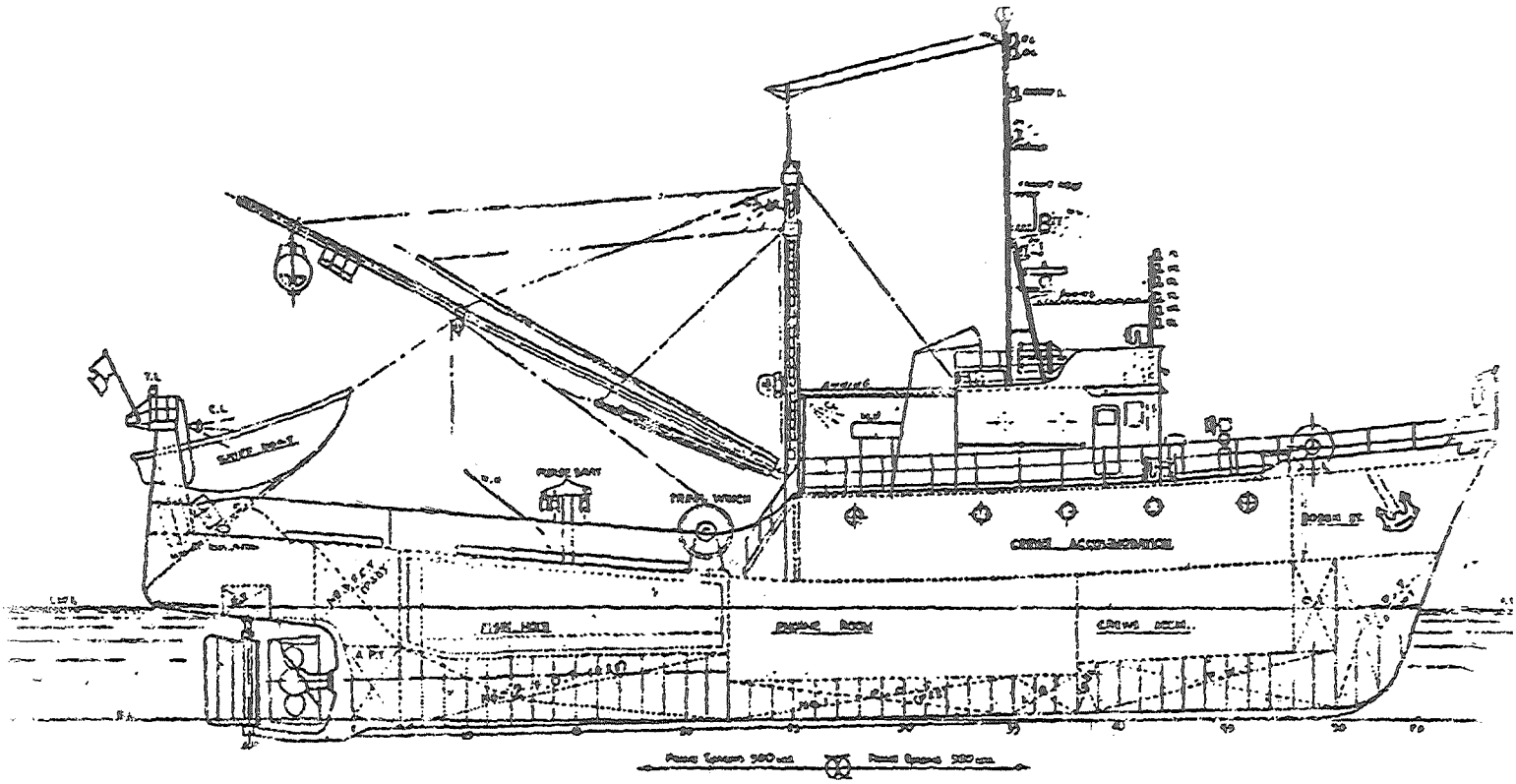


FIG. 2E

APPENDIX A
RESEARCH VESSEL R/V "ANUSANDHANI"



Principal Dimension

Length Overall	32.40M
Length B.P.	28.00M
Breadth Mld	7.50M
Depth Mld	3.30M
Gross Tonnage	221.16 G.T.
Main Engine	900 PS
Max Trial SP	12.44km

Capacity

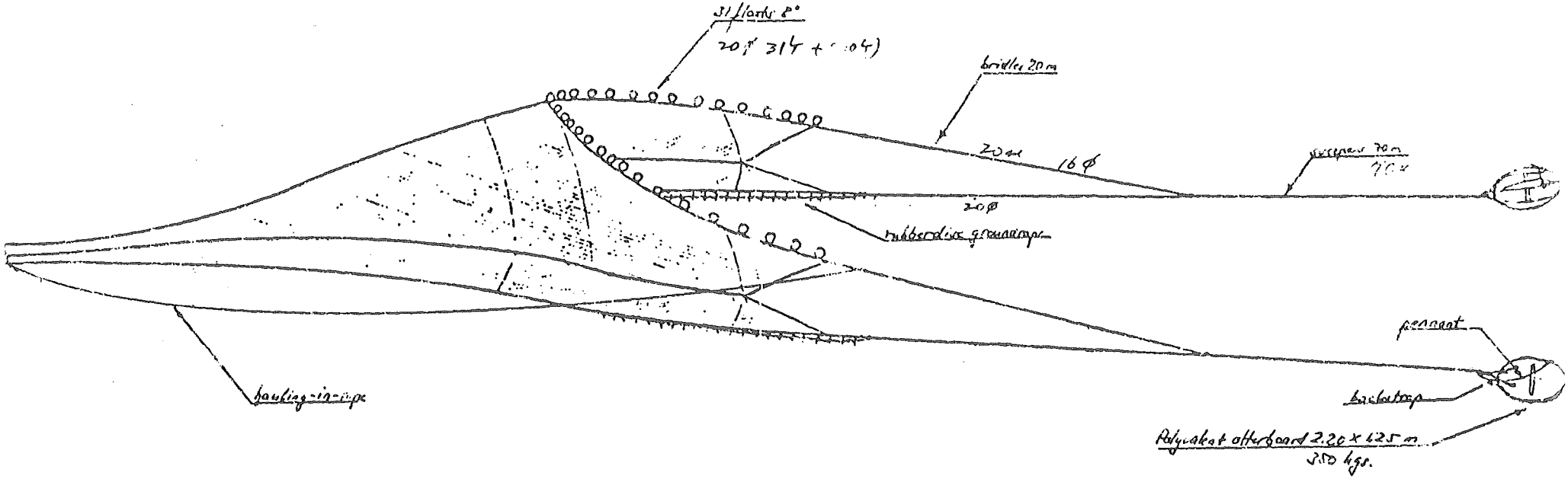
Fish Hold	73.67 M²
Fuel Oil	88.22 M²
Fresh water	34.53 M²
Freezing Room	11.17 M²

Complements

Officer	6P
Crew	12P
Scientists	4P
Total	22

APPENDIX B
ENGEL HIGH OPENING BOTTOM TRAWL

GENERAL ARRANGEMENT FOR ENGEL 486 MESH HIGH OPENING BOTTOM TRAWL



1. Headline 57.50 metres P. P. Combination wire rope 12mm dia with steel core

2. Footrope 66.30 mtrs. P. P. Combination wire rope 14mm dia with steel core

   RUBBER disc Groundrope 5 × 13, 10 mtrs.

APPENDIX C
SURVEY LOG SHEETS

MARINE FISHERIES RESEARCH, MANAGEMENT AND DEVELOPMENT PROJECT (BGD/80/025)

FISHING LOG

DAY	MONTH	YEAR

CRUISE NUMBER	
STATION NUMBER	
SURVEY POSITION NUMBER	

VESSEL NAME			
GEAR TYPE		COD END MESH SIZE	

LOCAL TIME

LATITUDE AND LONGITUDE

TIME SHOT	TIME HAULED	DIRECTION	BOTTOM DEPTH (m)		FISHING DEPTH (m)		POSITION OF SHOOTING		POSITION OF HAULING		DISTANCE TRAVELLED N.M.
		°	S	H	S	H	° ' N	° ' E	° ' N	° ' E	

DECCA Readings Shooting			DECCA Readings Hauling		
R	G	P	R	G	P

SAMPLE BASKETS	
TOTAL BASKETS	

HAUL VALIDITY

FOR VALID HAUL ENTER 1 FOR NON-VALID HAUL ENTER 0	

COMPOSITION OF TOTAL CATCH

SPECIES	CODE	NUMBER	WEIGHT (kg)

SPECIES	CODE	NUMBER	WEIGHT (kg)

REMARKS: (DETAILS OF GEAR DAMAGE ETC.)

SAMPLE TOTAL WT (kg)	

SCIENTIST I/C .....

LENGTH FREQUENCY SHEET

VESSEL NAME		CRUISE NUMBER		HAUL NUMBER		STATION NUMBER		DATE	DAY	MON	YEAR

		SPECIES		
CM	TICK	SPECIES CODE		TOTAL
0	0			
1	2			
2	4			
3	6			
4	8			
5	0			
6	2			
7	4			
8	6			
9	8			
0	0			
1	2			
2	4			
3	6			
4	8			
5	0			
6	2			
7	4			
8	6			
9	8			
0	0			
1	2			
2	4			
3	6			
4	8			
5	0			
6	2			
7	4			
8	6			
9	8			
0	0			
1	2			
2	4			
3	6			
4	8			
5	0			
6	2			
7	4			
8	6			
9	8			
0	0			

TOTAL CATCH OF THIS SPECIES		SAMPLE (IN SAME UNITS AS TOTAL CATCH)	

CM	TICK	SPECIES CODE		TOTAL

MARINE FISHERIES RESEARCH, MANAGEMENT AND DEVELOPMENT PROJECT (BGD/80/025)

BIOLOGICAL SAMPLING SHEET

sheet ..... of .....

SPECIES		VESSEL NAME		NUMBER OF SAMPLE		DATE SAMPLED	DAY	MONTH	YEAR

CRUISE NUMBER		STATION NUMBER		HAUL NUMBER	

FISH No.	LENGTH (mm)	WEIGHT (g)	SEX M. or F.	MATURITY	AGE			REMARKS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
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SCIENTIST I/C .....

MARINE FISHERIES RESEARCH, MANAGEMENT AND DEVELOPMENT PROJECT (BGD/80/025)

BIOLOGICAL SAMPLING SHEET

sheet ..... of .....

SPECIES		VESSEL NAME		NUMBER OF SAMPLE		DATE SAMPLED	DAY	MONTH	YEAR

CRUISE NUMBER		STATION NUMBER		HAUL NUMBER	

FISH No.	LENGTH (mm)	WEIGHT (g)	SEX M. or F.	MATURITY	AGE			REMARKS
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