Marine Fisheries Resources Survey
Demersal Trawling BGD/80/025/CR2

Survey Cruise Report No. 2 October 3-13, 1984

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SUMMARY

Daylight trawling was conducted on forty five randomly selected stations at depths between 10 and 105 metres with an average catch rate of 113 kgm/30 minutes haul. Catch rates were highest in shallow water (10-20 metres) and decreased with depth, the greatest change occuring at around 50 metres. The most prolific species were Indian mackerel *(Rastrelliger kanagurta)*, jewfish (Family Sciaenidae), catfish (Family Ariidae) and rays, which together made up more than 50% of the total weight of the catch.

The majority of the fish landed during the survey were of little commercial value, due to their type or size.

The overall demersal biomass calculated for the survey area was between 100,000 and 180,000 metric tonnes, of which around 1700 to 5500 metric tonnes was prawns.

Many surface schools of pelagic fish were observed in the survey area, and several large catches of "pelagic" fish were made, particularly in the deeper waters.

Large numbers of trawlers, particularly the "Thai" trawlers were observed fishing during the survey period. Surface drift gill net vessels were operating in most shallow water areas and in the east, in deeper water as well.

At this time of the year, the entire survey area is still influenced by the fresh water river discharge which undoubtedly influences the type and distribution of species present.

In general, the results abtained from this cruise were similar to those of the first cruise in September, although the catches of so-called "pelagic" fish were much higher.

CRUISE DETAILS

Cruise No.	: 2
Duration	: 10 days from October 3-13, 1984
No. of trawl stations completed	: 45
Cruise Leader	: Dr T F White, FAO Team Leader
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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.

Initially, the investigations concentrated on the demersal resources, which were surveyed using a 32m research vessel with a high opening, demersal fish/shrimp trawl. A series of cruises were planned to cover both the summer monsoon (April-September) and winter (October-March) periods. Due to the widespread influence of the monsoon discharge of the Ganges/Brahmaputra river system into the northern Bay of Bengal it was important that the survey be conducted during both seasons.

This report covers the second of a series of cruises conducted over the winter period.

2. MATERIALS 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, 50, 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 15 to 105 metres. The survey area and selected stations are shown on Figure 1.

Previous trawl, surveys conducted in these waters had found very low catch rates in waters deeper than about 80 metres. In order to maximise the information obtained from this second cruise, it was decided to exclude the 100-200 metre depth zone from this survey. Thus the survey area actually extended from the 10 to the 100 metre not the 200 metre depth contours (two hauls were made in 105 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 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.

A retrievable bathythermograph, manufactured by Ogawa Seiki Co. Ltd. Japan was used to take temperature profiles at selected stations. Secchi disc transparencies and surface water temperatures were taken at most stations.

2.3 TREATMENT OF THE CATCH

Stations were only trawled during daylight in order to avoid any possible bias in catch rates due to day/night variations in abundance. All hauls were of 30 minutes duration, the time commencing when the net reached 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 seperately to the nearest 0.25 kgm. In the event that the 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 identifiable. As the taxonomy of the catfish (Family Ariidae) and jewfish (Family Sciaenidae) was confused, no length measurements were made for these two Families.

2.4 DATA ANALYSIS

All data were recorded on proforma sheets which are shown in Appendix C. A Hewlet 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 calculate 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 positions where the samples were taken.

3. RESULTS

3.1 GENERAL

Forty Five of the fifty randomly selected stations were trawled successfully. One haul was aborted after only 10 minutes of trawling after the echo sounder indicated the presence of rough bottom ahead. Four other stations were found to be untrawlable due to the presence of large numbers of gill and/or stake net operators in the near vicinity. Most of the aborted stations were in depths less than 20 metres.

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

Depte zone	No. of successful Hauls
10-20 metres	2
21-30 ,,	3
31-50 ,,	3
51-100 ,,	35
100+ ,,	2
Total :	45

Bathythermograph profiles were taken at five stations, and secchi disc and surface water temperature readings taken on forty stations.

3.2 DISTRIBUTION AND ABUNDANCE OF THE MAJOR SPECIES

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 45 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 significiant proportion of the catch of a particular depth zone.

"Trash" here is defined as small fishes, which because of their size and 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 occurence in the total catch.

FAMILY	DEPTH ZONE					TOTAL
	10-20	21-30	31-50	51-100	101-200	
SCOMBRIDAE (Mackerels and tunas)	.13		.92	39.81		27.41
SCIAENIDAE (Jewfish)	14.49	28.23	38.34	2.71		9.70
Skates and Rays	42.55	21.12		3.10	.38	8.01
ARIIDE (Catfish)	16.89	4.70	4.57	8.13	1.14	7.94
CLUPEIDAE, Herrings, Sardines, Shads etc	3.06	26.31	2.96	2.57	35.15	6.27

FAMILY	DEPTH ZONE					TOTAL
	10-20	21-30	31-50	51-100	101-200	
TRICHIURIDAE (Hairtail)		.48	8.20	7.30	2.40	5.87
MULLIDAE (Goat fish)			.95	6.33	1.51	4.47
SYNODONTIDAE (Lizard fish)		.05	1.64	5.12	8.70	3.91
Trash Fish	4.52	1.54	2.80	3.28	.84	3.07
CEPHALAPODA (Squid, Cuttlefish)	.07		.72	4.00	8.58	3.06
NEMIPTERIDAE (Threadfin Bream)			.59	3.61	7.36	2.74
LEIOGNATHIDAE (Pony Fish)	1.73	.96	6.13	2.22		2.33
Shrimp	2.53	2.50	3.26	2.08		2.21
ENGRAULIDAE (Anchovies)	2.26	1.34	5.47	1.36		1.76
CARANGIDAE, (Jacks, Scads, Trevallies ete.)	.27	.05	1.58	1.04	11.65	1.22
STROMATEIDAE (Pomfrets)	.27	1.97	2.62	.87		1.08
SPHYRAENIDAE (Barracudas)			1.48	.89	3.32	.84
CARCHARHINIDAE (Sharks)	.13	2.69		.72		.81
HARPODONTIDAE (Bombay-duck)		.10	7.83	.06		.76
Mixed Fish		2.30		.73		.76
ARIOMMIDAE		.10		.23	14.38	.58
LACTARIIDAE (False Trevallies)			5.97	.02		.55
MENIDAE (Moon Fish)				.79		.54
LUTJANIDAE (Snappers)	.80	1.15	.06	.36		.45
POMADASYIDAE (Grunts, Sweetlips)	.80	1.06	.23	.33		.43
PRIACANTHIDAE (Big Eye)				.50	2.78	.43
SERRANIDAE (Groupers)	1.99			.40		.43

FAMILY	DEPTH ZONE					TOTAL
	10-20	21-30	31-50	51-100	101-200	
BOTHIDAE (Flounders)	.13	.38	1.67	.13		.30
CRUSTACEANS (Others)	2.13	.67		.03		.27
CHIROCENTRIDAE (Wolf Herring)			1.31	.20		.25
SCORPIONIDAE (Scorpion Fish)	2.79					.23
DREPANIDAE (Sicklefishes)		1.73				.20
FORMIONIDAE (Black Pomfrets)				.26		.18
RACHYCENTRIDAE (Cobia)				.15	1.82	.15
TRIACANTHIDAE	.53			.13		.14
GERREIDAE (Mojarras)	1.20	.10		.01		.11
FISTULARIIDAE (Pipe Fish)				.11		.08
SPARIDAE (Sea Breams)	.40		.11	.05		.07
THERAPONIDAE (Therapons)	.07			.08		.06
MURAENESOCIDAE (Pike Congers)		.38		.02		.05
PLATYCEPHALIDAE (Flat Head)				.06		.04
BALISTIDAE (File Fish, Trigger Fish)				.04		.03
CYNOGLOSSIDAE (Tongue Soles)			.36			.03
POLYNEMIDAE (Threadfins)	.07	.05	.24			.03
TETROADONTIDAE (Puffer Fish)	.13			.01		.02
TRIGLIDAE				.03		.02
ATHERINIDAE				.03		.02
SILLAGINIDAE (Whiting)	.07	.05				.01

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 is shown on Table 1.

TABLE 2

Depth zone (Metre)	Average catch rate (kgm/30 minute haul)	Range	No. of Hauls
10-20	192	89	2
21-30	183	176	3
31-50	140	49	3
51-100	79	33	35
100+	88	293	2
Average	113	55	
		Total:	45

3.2.10. 11-20 Metre depth zone

Trawling was only conducted on two of the six stations selected in this zone due to the activities of gill and stake net fishermen over most of the area. The average catch rate was 192 kgm/30 minutes trawling.

Practically half of the catch (42%) consisted of rays (mainly Genus Dasyatis). A further 32% consisted of catfish (Family Ariidae) and jewfish (Family Sciaenidae) (17% and 15% respectively).

No other Family individually contributed more than 3% of the remaining catch from this zone. Thus, nearly three quarters of the catch consisting of just three Families, the rays, catfish and jewfish, the remainder consisting of a further twenty or so Families.

3.2.1.2 21-30 metre depth zone

Three trawls were conducted in this zone for an average catch rate of 183 kgm/30 minutes trawling. However the amount of fish caught between these three hauls was quite variable as is apparent on Table 2.

Jewfish, clupeids and rays were the three most abundant groups in the catch, contributing 28%, 26% and 21% respectively of the total. The clupeids were represented mainly by the ilisha shad, *Ilisha megaloptera* and *I. filigera* (approximately equal numbers of each species) with lesser quantities of *Raconda russeliana.*

Catfish, which were abundant in the shallower water catches represented only 5% of the catch of this depth zone.

No other Family individually represented more than 2% of the catch. Thus, as in the 10-20 metre zone, three Families contributed three quarters of the catch.

3.2.1.3 31-50 metres depth zone

Three hauls were made in this zone for an average catch rate of 140 kgm/30 minutes trawling. Catches were less variable than in the shallower waters.

38% of the catch consisted of jewfish. However, the species composition of the remainder of the catch was quite dissimilar to that of the shallower waters, the main species being hairtail, *Lepturacanthus savala* (8%), Bombay duck, *Harpodon nehereus*, (8%) and false trevallies, *Lactarius lactarius*, (6%), all of which were practically absent from the shallow water catches. Rays were absent entirely and catfish represented less than 5% of the catch.

Other species which were represented in this depth zone, (although not in any significiant quantity), were the barracuda, *Sphyraena obtusata*, lizard fish *Saurida spp*, and pony fish, *Leiognathus spp*.

3.2.1.4 51-100 metre depth zone

Thirty five hauls were made in this depth zone for an average catch rate of 79 kgm/30 minutes trawling. 40% of the catch consisted of the Indian mackerel, *Rastrelliger kanagurta*, although this figure is somewhat misleading, as the majority of these mackerel were landed in just two hauls, one of which exceeded 1000 kgm. Nevertheless, lesser quantities were found in many of other hauls in this depth zone, which was of some significiance as they are generally considered to be a pelagic species. They were generally absent from the shallower water catches.

Catfish, hairtail, lizard fish and goat fish were present in almost equal amounts, together representing a further 28% of the catch. While the first three of these species were previously represented in the shallower water catches, goatfish were not. Similarly threadfin bream, *Nemipterus japonicus* and cuttlefish began to appear in the catches in these deeper waters, being practically absent from catches made below 50 metres.

As in all other depth zones, several other Families were represented, but not individually contributing more than 2-3% to the total catch.

3.2.1.5 101-200 metre depth zone

Two hauls were conducted in this depth zone, although the deepest of these was only in 105 metres. The average catch rate for these two hauls was 88 kgm/30 minutes trawling, however as is apparent on Table 2, the two catches were quite dissimilar.

27% of the catch consisted of the rainbow sardine, *Dussumiera acuta*. The average catch rate was 70 kgm/30 minutes trawling. This species was also present in the 51-100 metre zone, but in insignificiant quantities, the average catch rate being less than 1 kgm/30 minutes trawling. As with the Indian mackerel (which was not represented in the two catches in this zone), sardines are generally considered a pelagic species and their presence in the two hauls is somewhat surprising.

The second most abundant species, representing 14% of the catch was the barracuda, *Sphyraena obtusata*. Note however that although this species represented a relatively significiant percentage of the total catch, the average catch rate was only 2.4kgm/30 minutes trawling.

Other species occuring in "significiant" quantities were round scad, *Decapterus maraudsi* (12%) (usually considered a pelagic species), lizard fish (9%), cuttlefish (9%) and threadfin bream (7%).

The remainder of the catch was made up of lesser quantites of five or six other species.

3.2.1.6 Summary - bathymetric distribution

There was a decline in overall catch rates when descending from the shallow to deeper water, which is typical of coastal demersal catches elsewhere in the world. Catch rates in waters deeper than around 50 metres were approximately half those of the waters less than 50 metres in depth although there was no appreciable difference between the catch rates made within the 10-50 metre depth zone,
Catches in depths less than 50 metres were dominated by jewfish and rays (although the latter were absent in depths greater than 30 metres), and to a lesser extent, catfish, ilisha shad, hairtails and Bombay duck. With the exception of the hairtail, the other species were practically absent from the deeper water catches, Instead, the dominant species were the Indian mackerel and the rainbow sardine, two species generally associated with surface waters. Cuttlefish, lizard fish and threadfin bream were also present, although in lesser amounts.

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

	Figure
Total catch (all species combined)	3
Catfish (Family Ariidae)	4
Jewfish (Family Sciaenidae)	5
Skates and rays	6
Carangids (Family Carangidae)	7
Hard tailed scad *(Megalaspis cordyla)*	8
Round scad *(Decapterus maraudsi)*	9
Lizard fish *(Saurida spp.)*	10
Ilisha shad *(Ilisha spp.)*	11
Threadfin bream *(Nemipterus japonicus)*	12
White pomfret *(Pampus argenteus)*	13
Chinese pomfret *(Pampus chinensis)*	14
Silver lined grunter *(Pomadasys hasta)*	15
Hairtail (Family Trichiuridae)	16
Cuttlefish	17
Goatfish *(Upeneus sulphureus)*	18
Penaeid prawns	19
Barracuda *(Sphyraena obtusata)*	20

3.2.2 Geographical distribution

Total catch rates obtained at the 45 survey stations are shown on Figure 21 plotted according to the locations of the respective stations. Catch rates have been arbitrarily subdivided into four categories; viz. under 10, 11-50, 51-100 and greater then 100 kgm/30 minutes haul. This Figure provides a general overview of the distribution of the demersal stock over the survey area.

As discussed above, the highest density of fish is found in the shallower waters. The few large catches in the deeper water shown on Figure 21 are mainly the "pelagic" species, Indian mackerel, sardines and scad. Catches in the shallower waters were not significiantly different between those made on the "eastern" coast (Cox's Bazar to the Naf River) or those off the "northern" coastal area (89°-91°E longitude). In the waters deeper than 50 metres, there was no apparent difference in catch rates descending from the 50 to the 100 metre depth contour and moving from east to west across the zone.

Although no significiant difference were found in total catch rates within any particular depth zone from one place to another, the species composition of the catches made in these areas did differ in many cases, as discussed below:

3.3 DISTRIBUTION AND ABUNDANCE OF COMMERCIALLY IMPORTANT SPECIES

Determination of which species have commercial 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.

On this basis, the Families/species below were considered of more or less economic importance. 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 Scombridae (Mackerels and Tunas)

The most abundant representative of this Family captured during the survey was the Indian mackerel, *Rastrelliger kanagurta.* This species represented 40% of the total catch of the 51-100 metre depth zone, due principally to several relatively large hauls, one of which exceeded 1000 kgm for 30 minutes trawling and several others of 100-500 kgm. Overall however, the average catch rate in this zone was only 5.7 kgm/30 minutes trawling. There was no indication on the echo sounder of the presence of these fish in schools near the bottom during trawling when these large hauls were made.

The fish were remarkably uniform in size (Figure 37) with a mean length of 20.5cm.

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 criteria for price in the local markets not species. No attempt was made to differentiate between species in the survey catches.

The highest catches of jewfish occured in the shallow waters, particularly in the 21-30 metre depth zone, where the average rate was 300 kgm/30 minutes trawling. Catch rates dropped to less than 1 kgm/30 minutes trawling in depths greater than 50-60 metres (Figure 5). The distribution of catch rates over the survey area are illustrated on Figure 22.

Approximately 80% of the catch of jewfish consisted of fish less than 15 cm in length and of these, many were less than 10 cm. Thus, although jewfish contributed nearly 20% of the overall survey catch (46% of the catch in the 31-50m zone), they are of limited economic importance due to their small size. Jewfish of all sizes are marketable in Bangladesh, but prices offered for the small sized fish are generally unattractive.

3.3.3 Family Ariidae (Catfish)

Local markets in Bangladesh do not discriminate between the various species of this Family. Price is again determined essentially by size (and condition), generally being somewhat higher for the larger (30cm and above) fish.

In general, catfish were caught in all depth zones (Figure 4), although catches were quite variable. The average overall catch rate was 11 kgm/30 minutes trawling. There was no apparent pattern in the distribution of catfish over the survey area (Figure 23).

3.3.4 Skates and Rays

Despite their significiant contribution to the overall survey catch (8% of the total and 43% of the catch in the 10-20 metre zone), skates and rays have little market value in Bangladesh (or elsewhere), except as a low value dried product,

All catches were made along the eastern side of the survey area (Figure 24) and practically all in depths less then 25 metres (Figure 6). The average catch rate was approximately 60 kgm/30 minutes trawling.

3.3.5 Family Carangidae (Scads, trevallies)

Although Carangids are a higher valued group of fish, the average catch rate (all species combined) during the survey was only 3.5 kgm/30 minutes trawling. The majority of the Carangids were round scad, *Decapterus maraudsi* with lesser quantities of hard tailed scad. *Megalaspis cordyla* and big eye scad, *Selar spp.*

Round scad were caught only in the deeper waters (Figure 9). while hard tailed scad were generally landed in all depths over the survey area (Figure 8).

The average length of both species was 18-20cm (Figures 38 and 39).

3.3.6 Family Clupeidae (Shads, sardines)

Ilisha shad, *Ilisha filigera* and *I. megaloptera* were caught throughout the entire survey area in all depths, (Figures 11 and 26), although the highest catch rate (6.7 kgm/ 30 minutes trawling) occurred in the 21-30 metre depth zone. The average length of *I. filigera* was around 22cm (Figure 40).

Both hauls made in the 101-200 metre zone yielded large quantities of rainbow sardine, *Dussumieria acuta*. The average catch rate was approximately 70 kgm/30 minutes trawling. The fish were uniform in length with a mean size of 16.5cms. (Figure 41).

3.3.7 Family Trichiuridae (Hairtails)

Hairtail *Lepturacanthus savala* were encountered in most hauls throughout the survey area (Figure 27), although the highest individual catches were made in depths greater than 80 metres (Figure 16). The overall average catch rate was 3.7 kgm/30 minutes trawling, although it reached nearly 13 kgm/30 minute trawling in the 31-50 metre zone.

The size of these fish was quite variable, there being more than one age class present in the catches, and ranged from around 18cm to 90cm (Figure 42).

Hairtail are usually dried and have a ready market in Bangladesh and overseas.

3.3.8 Family Mullidae (Goat fish)

Goatfish, *Upeneus sulphureus* were encountered in most hauls made in depths greater than 50 metres (Figure 18 and 28). The average catch rate in the 51-100 metre depth zone was 5 kgm/30 minutes trawling.

Goatfish are rarely found on Bangladesh markets and it is unlikely that an export market could be developed for this species due to their small size. The average length was only around 10 cm and the maximum rarely exceeded 15cm. (Figure 43). Thus although goatfish represented around 4.5% of the total survey catch, it is unlikely that they can ever achieve any significant economic importance.

3.3.9 Family Syncdontidae (Lizard fish)

Lizard fish, principally *Saurida elongata* but including *S. tumbil* were distributed widely throughout the survey area in waters deeper than 60 metres. (Figures 10 and 29). The average catch rate was approximately 4 kgm/30 minutes trawling.

From the length frequency distribution illustrated on Figure 44, it is apparent that more than 75% of these fish (in number) caught during the survey were less than 20 cm in length and around 40-50% (in number) were less than 10cm. Thus, although relatively abundant (4% of the total catch), most were too small to have any economic importance.

3.3.10 Families Stromatidae and Formionidae (Pomfret)

White, Chinese and black, pomfret, *(Pampus argenteus. P. chinensis* and *Formio niger)* are valuable species both in Bangladesh and on overseas markets. White and Chinese pomfret were caught in all depths over the survey area, although the highest average catch rates were obtained in the 21-50 metre depth zone (Figures 13,30 and 14,31). However, in spite of their widespread distribution, catch rates for both species were very low, averaging only 2 kgm/30 minutes trawling. Black pomfret were rarely encountered.

The average size of the white pomfret was approximately 22 cm (Figure 45).

3.3.11 Cuttlefish

Cuttlefish represented 8% of the total catch from the 101-200 metre zone and 3% of the overall survey catch. They were present in most hauls made in depths greater than 50 metres, particularly those deeper than 70 metres. (Figures 17 and 32). Catch rates in the 51-100 metre zone averaged 3 kgm/30 minutes trawling and in the 101-200 metre zone, 6.1 kgm/30 minutes trawling.

Cuttlefish have practically no market value in Bangladesh, although small quantities of dried product are sold. The individuals caught during the survey were quite large, on average 200-500 gms in weight and although the above catch rates are insufficient to support an economically viable cuttlefish fishery, they could provide a valuable export by-product to the shrimp fishery.

3.3.12 Family Penaeidae (Penaeid Prawns)

Penaeid prawns are the most valuable marine resource in the Bay of Bengal and are the basis for the present Bangladesh marine trawl fishery. The demersal trawl used during this survey was not designed specifically for prawns and thus the catch rates obtained are not considered indicative of potential commercial catch rates. Also catch rates of penaeid prawns are usually higher at night than during daylight and as our trawling was restricted to daylight, lower catch rates could be expected on average than those of commercial trawlers which fish 24 hours per day. The catch rates do however illustrate the relative abundance and distribution of penaeid prawns throughout the survey area. The major species captured were *Metapenaeus spp. Penaeus monodon, P. semisulcatus* and *Parapenaeopsis sculptilis.*

Prawns were encountered at all depths, although the higest average catch rates (4.8.-5.5 kgm/30 minutes trawling) occurred in the waters less than 50 metres deep (Figure 19). The highest concentrations of prawns were encountered in the north west section of the survey area and along the eastern side, off the Elephant Point area (Figure 33). Approximately 20 "Thai" and 5-10 "shrimp" trawlers were observed operating in the former area and two of each "type" of trawler in the latter area during the time of the survey.

3.3.13 Other Species

The above list does not exhaust the total number of species caught during the survey cruise that have, or could have commercial importance. For example, some good catches

of threadfin bream, *Nemipterus japonicus* were made in the deeper water (Figures 12 and 34), but the average size of these fish was only 10-15cm (Figure 46) and thus of little commercial value. Similary, the obtuse barracuda, *Sphyraena obtusata* was often encountered in the deeper water catches throughout the survey area (Figures 20 and 35), but catch rates were less than 2 kgm/30 minutes trawling. Other species which have some commercial value but which were only caught in limited quantities were the silver lined grunter, *Pomadasys hasta* (Figures 15 and 36) and Bombay duck, *Harpodon nehereus.*

Length frequency histograms for some other species are listed on the designated Figures below. These are in addition to those species referred to in the text above.

Species	Figure
Obtuse barracuda *(Sphyraena obtusata)*	47
Big eye *(Priacanthus sp.)*	48
Grunter *(Pomadasys maculatus)*	49
Bombay duck *(Harpodon nehereus)*	50
Moon fish *(Mene maculata)*	51
Sole *(Cynoglossus sp.)*	52
Cobia *(Rachycentron canadus)*	53

4 STANDING STOCK 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 below.

In order to reduce the variance, geometric, rather than arithmetic means were used for these analysis (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 were captured and/or escaped through the net meshes. 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 these values, the area swept by the net during a 30 minutes trawl was calculated to be 0.111 km^2. Some large catches of "pelagic" species were made during the survey and in these cases, the "herding" effect of the warps may have effected the catches. In these few cases, the biomass estimations for these species in particular and by extension the total biomass also will be somewhat over estimated.

TABLE 3

Total Density and Biomass

Depth zone (metres)	Area (Km2)	Density (Kgm/Km2)	Density Range	Biomass (M.T.)	Range Biomass	No. of Hauls
10-20	6,861	7,691	3,539	52,769	24,282	2
21-30	3,369	7,333	7,045	24,705	23,733	3
31-50	3,400	5,602	1,966	19,049	6,686	3
51-100	17,710	3,141	1,320	55,626	23,388	35
101-200	10,880	3,519	11,699	38,289	127,287	2
Total/Average	42,220	4,511	2,198	190,438	92,812	45

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 10-20 metre depth zone. The lowest density, but not the least biomass due to the larger/area, occurs in the 51-100 metre zone.

The overall stratified biomass estimate is 190,000 ∓ 90,000 m.t. i.e. between 100,000 and 180,000 m.t. However, as discussed above, the bulk of this biomass consists of either very small or otherwise non important species. If one subjectively adds the proportions of "useful" fish from Table 1, then the biomass of "commercial" species is around 65% of the total, i.e. between 65,000 and 117,000 m.t. This estimate will vary considerably, depending upon one's definition of "commercial" but the above estimate is probably generous under any criteria.

Prawns demand special attention as they are of considerable economic importance to Bangladesh. The average density of penaeid prawns is similar in the three shallower water zones, 10-20, 21-30 and 31-50 metres, being approximately 200 kgm/km^2. Due to the difference in area that these zones occupy, the highest biomass is found in the 10-20 and 51-100 metre depth zones. The total biomass estimate for the whole survey area was 3600 ∓ 1900 m.t. i.e. between 1700 and 5500 m.t.

TABLE 4

Density and Biomass - Penaeid Prawns

Depth zone (metres)	Area (Km2)	Density (kgm/km2)	Density Range	Biomass (M.T.)	Range Biomass	No. of hauls
10-20	6,861	194	92	632	632	2
21-30	3,369	220	861	742	2,900	3
31-50	3,400	191	352	650	1,196	3
51-100	17,710	52	26	916	469	35
101-200	10,880	0	0	0	0	2
Total/Average	42,220	86	44	3,635	1,867	45

Discussion about the potential yield of fish and shrimp that could be extracted on a sustained basis from these stocks will be postponed until all cruises in the winter series are completed and a more comprehensive set of data are available upon which to base such a calculation. The above estimations of density, biomass etc should be used with caution, in view of the relatively small number of hauls involved.

5 PELAGIC FISH

The sonar was operated continuously while cruising between stations in water deeper than 50 metres. In shallower waters, bottom reflections make interpretation of the echo difficult. In addition the fish finder/echo sounder was run continuously throughout the entire cruise.

No schools were observed on the sonar and very few, small schools were observed with the echo sounder, and these latter unusually close to the bottom. The species comprising these schools could not be determined.

Many extensive schools of fish were visually observed on the surface over deeper water in both the eastern and western side of the survey area (see Figure 54) In places, birds were diving on the fish and larger fish were also seen feeding on them. The fish appeared to be relatively small, 20cm or so in length, and were tentatively identified as Indian mackerel, although at least some of the schools could have been scad or sardines on the basis of the trawl catches in these areas. None of the schools could be detected with the soner, suggesting that they were distributed close to the surface.

The presence of large quantities of "pelagic" species in the demersal trawl catches, particularly in the deep water has already been discussed above. It has been suggested by some that these fish may have been caught while the net was being hauled, but this is very unlikely as no mid-water schools were observed on the sonar or fish finder that could explain their regular occurance in such large quantities in the demersal trawl.

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 seasonable monsoonal discharge of the river systems in particular, it was considered useful to measure certain parameters.

Turbidity was measured at nearly all stations. The results are plotted on Figure 55 and shown on Table 5.

Surface water over the "central" section of the survey area was extremely turbid, (at least as far as to the 100 metre depth contour, which was the limit of our observations), visibility generally being less than 3 or 4 metres. In all areas north of Cox's Bazar, the visibility was usually less then 0.5 metres. In the east, "marine" water extended up along the coast to the vicinity of Elephant Point. The visibility/transparency of the water 30 miles west of the Naf River was up to 30 metres (Table 5.) An unusual feature was the area of clearer water in the north west section of the survey area. This was not present during the first survey cruise in September.

It would appear that the counterclockwise circulation pattern proposed after the first cruise (Cruise Report BGD/80/025-CR1) was still operating although perhaps less strongly. Flow from the rivers was less deflected to the west, instead flowing more southwards across the survey area.

Surface (10-50cm) water temperatures were also measured at several stations. The results are shown on Table 5. In addition, temperature/depth profiles were recorded at selected stations using a retrievable bathythermograph. The instrument could not be used effectively in depths under 50 metres. These profiles are illustrated on Figure 56.

Surface water temperatures ranged from 29.2°C to 32.2°C. No distinct pattern was observed in the B.T. profiles (Figure 56) and no pronounced thermocline was present. In general, temperatures declined with depth, temperatures at 60-80 metres being some 3-5 degrees cooler than at the surface. These results suggest that the waters over the survey area are well mixed with little stratification between the brackish river discharge and the "marine" water of the Bay.

TABLE 5

Secchi disc and surface water temperature measurements
(see also Figure 54)

Date	Latitude		Longitude		Surface temp	Secchi
	Deg.	Min	Deg.	Min	(deg C)	depth (m.)
121084	20	57	92	2	29.8	9.0
121084	20	56	92	3	29.8	9.5
111084	21	6	91	43	30.2	13.0
111084	20	53	91	35	29.8	18.0
111084	20	40	91	48	30.0	15.0
111084	20	53	91	40	30.0	21.0
111084	20	41	92	2	30.1	14.0
111084	20	34	92	6	29.8	14.0
101084	20	25	91	53	30.6	
101084	20	25	91	54	30.6	16.0
101084	20	22	91	51	31.4	23.5
101084	20	28	91	30	29.8	25.5
101084	20	29	91	31	29.8	25.5
091084	20	16	91	15	30.0	
091084	20	32	91	4	32.0	3.5
091084	20	33	91	3	31.8	2.5
091084	20	40	90	59	31.5	2.5
091084	20	22	90	59	29.4	12.0
081084	20	24	90	53	31.6	
081084	20	24	90	57	31.5	6.0
081084	20	27	90	40	32.2	4.5
091084	20	41	90	58	32.2	2.0
081084	20	31	90	27	31.2	4.5

TABLE CONTD. 5.

Date	Latitude Deg.	Min	Longitude Deg.	Min	Surface temp (Deg C)	Secchi depth(m.)
071084	20	41	90	11	31.2	
071084	20	52	90	14	32.0	4.5
071084	21	6	90	00	30.7	4.5
071084	21	6	89	49	30.2	13.0
071084	21	7	89	39	29.4	20.1
061084	21	7	89	42	29.6	14.0
061084	21	21	89	58	29.4	2.0
061084	21	19	89	42	29.8	2.0
051084	20	56	90	30	30.0	4.8
051084	21	5	90	18	30.0	4.4
061084	21	13	90	1	29.2	13.5
061084	21	13	90	4	29.4	14.0
051084	20	53	90	33	29.8	5.6
051084	21	7	90	12	29.9	9.0
121084	21	10	91	55	30.0	
121084	21	1	92	4	30.0	10.0

7 OTHER OBSERVATION

Trawlers were observed operating in both the eastern and western sides of the survey area (Figure 54). Approximately 20-25 trawlers were operating in the western side in 40-60 metres of water. Although the majority of these vessels were so called "Thai" trawlers, this area corresponded with the area of highest survey shrimp catches, and there is little doubt that shrimp were the target species.

Only four trawlers were observed on the eastern side and these were also "Thai" trawlers.

Extensive surface schools of fish were observed while travelling between survey stations, particularly over deeper water. As discussed above, although the identification of these fish could not be verified, it is most likely that they were Indian mackerel, *Rasterlliger kanagurta*. The locations of these schools are also shown on Figure 54.

Drift gill net vessels were operating in most of the shallow waters less than about 20 metres in depth, particularly in the Cox's Bazar area and southwards to Elephant Point.

8 COMPARISON WITH OTHER CRUISE RESULTS

A similar survey cruise was conducted in the same area between September 15th and 25th. (See Cruise Report BGD/80/025-CRI). In general, the results of the two cruises were similar. The same three groups of fish, the catfish, jewfish and rays, dominated the catches, particularly in the inshore waters. There was no significiant difference in the bathometric or geographic distribution of the overall stock or of individual species. The so-called "pelagic" species, such as the Indian mackerel, scads and sardines were more abundant in the deeper water catches during this cruise than during the first cruise and many more surface schools were observed.

The overall biomass had declined from a mean of 246,000 m.t. to 190,000 m.t. between the two cruises, although no significiance should be attached to this due to the relatively small numbers of hauls made during each cruise. Conversely the mean biomass of shrimp appeared to have risen slightly from 3000 m.t. to 3600 m.t., but again similar caution should applied.

The counterclockwise circulation pattern observed during the first cruise still appeared to be operating, but perhaps less strongly and the water over the survey area appeared to be more throughly mixed and less stratified than before. Overall, the water appeared less turbid.

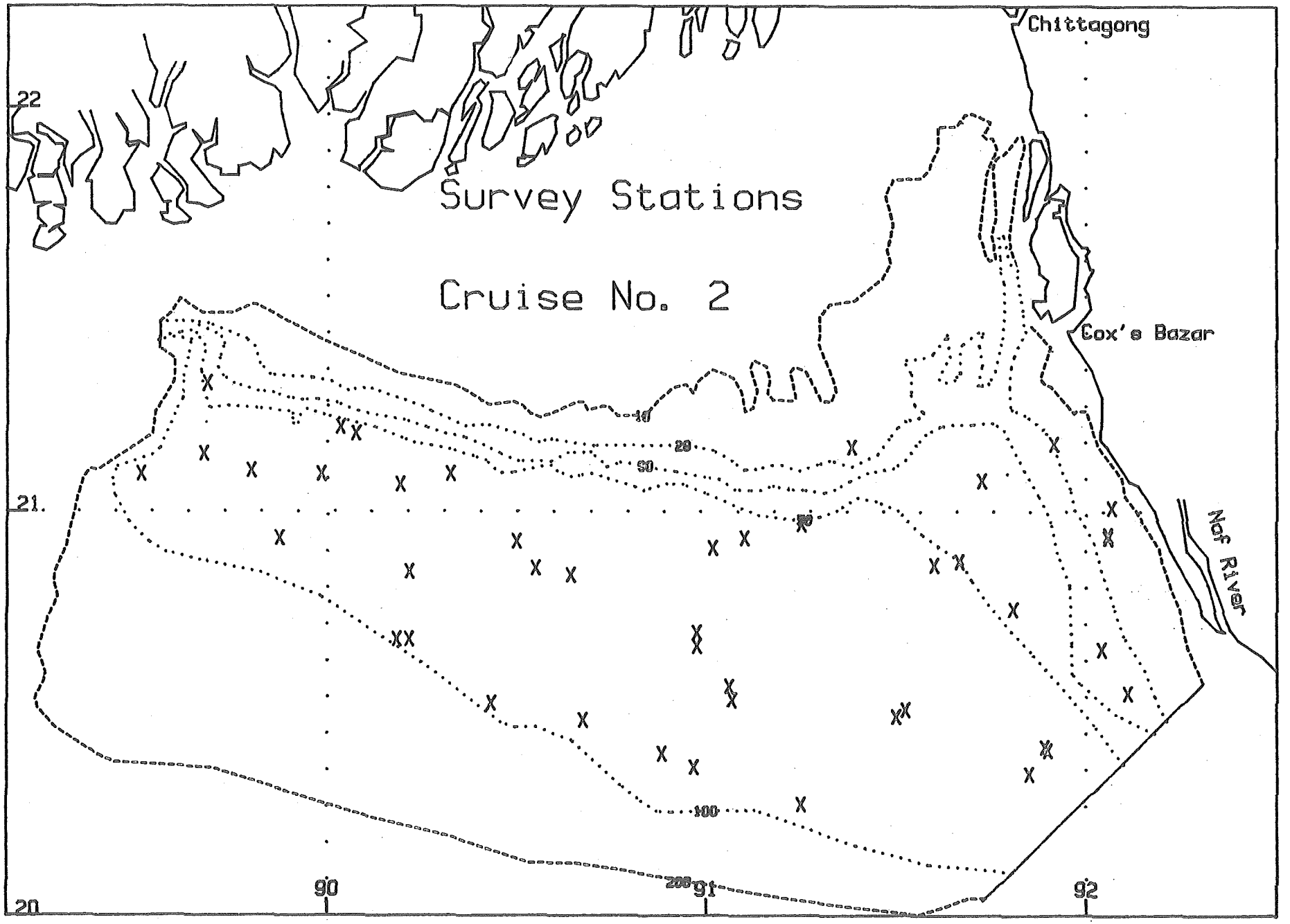

Survey Stations
Cruise No. 2
Chittagong
Cox's Bazar
Naf River
22
21.
20
90
91
92
10
20
30
50
100
200

FIG. 1

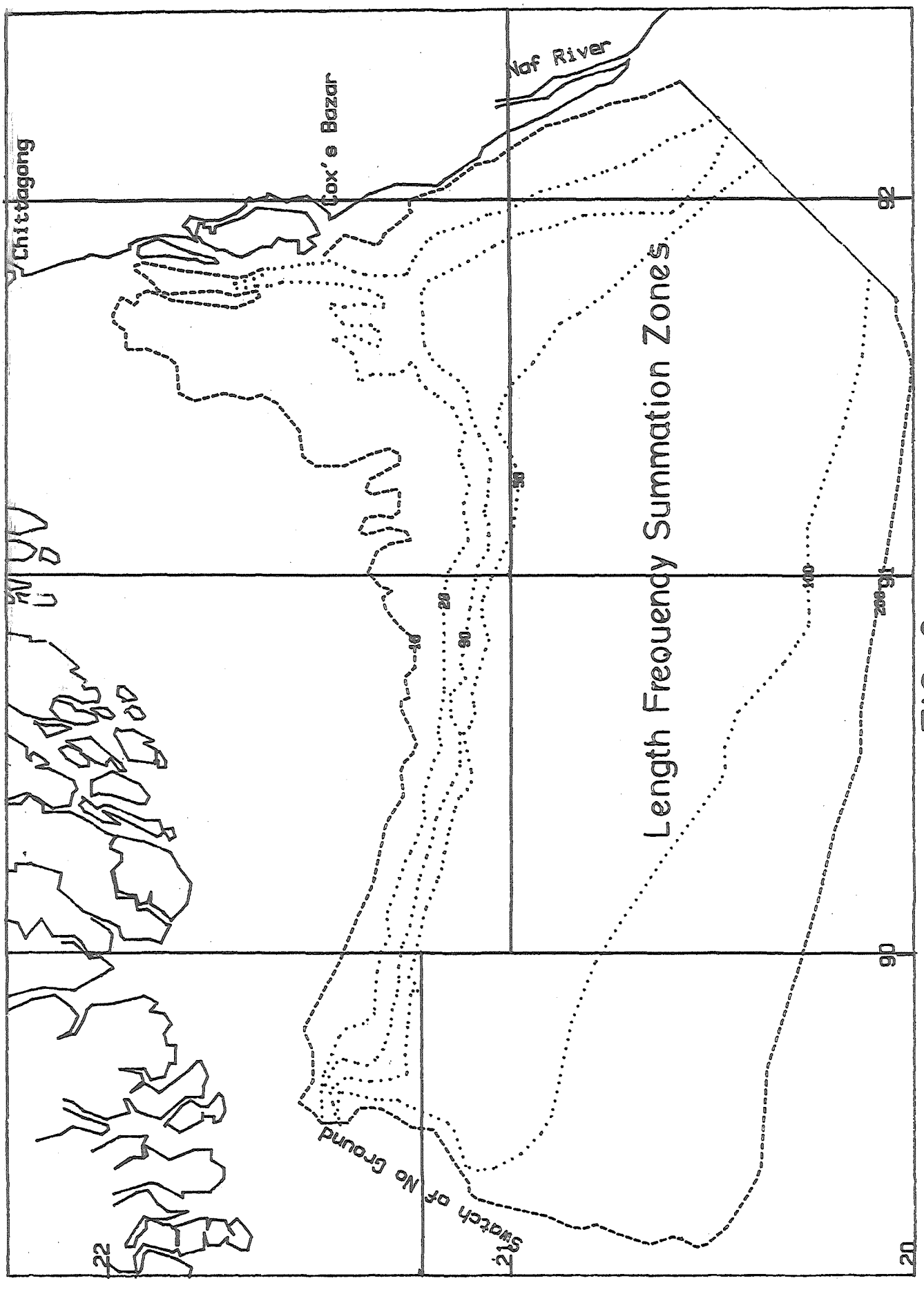

Length Frequency Summation Zones
Chittagong
Cox's Bazar
Naf River
Swatch of No Ground
92
90
88
22
20
50
100
200

FIG. 2

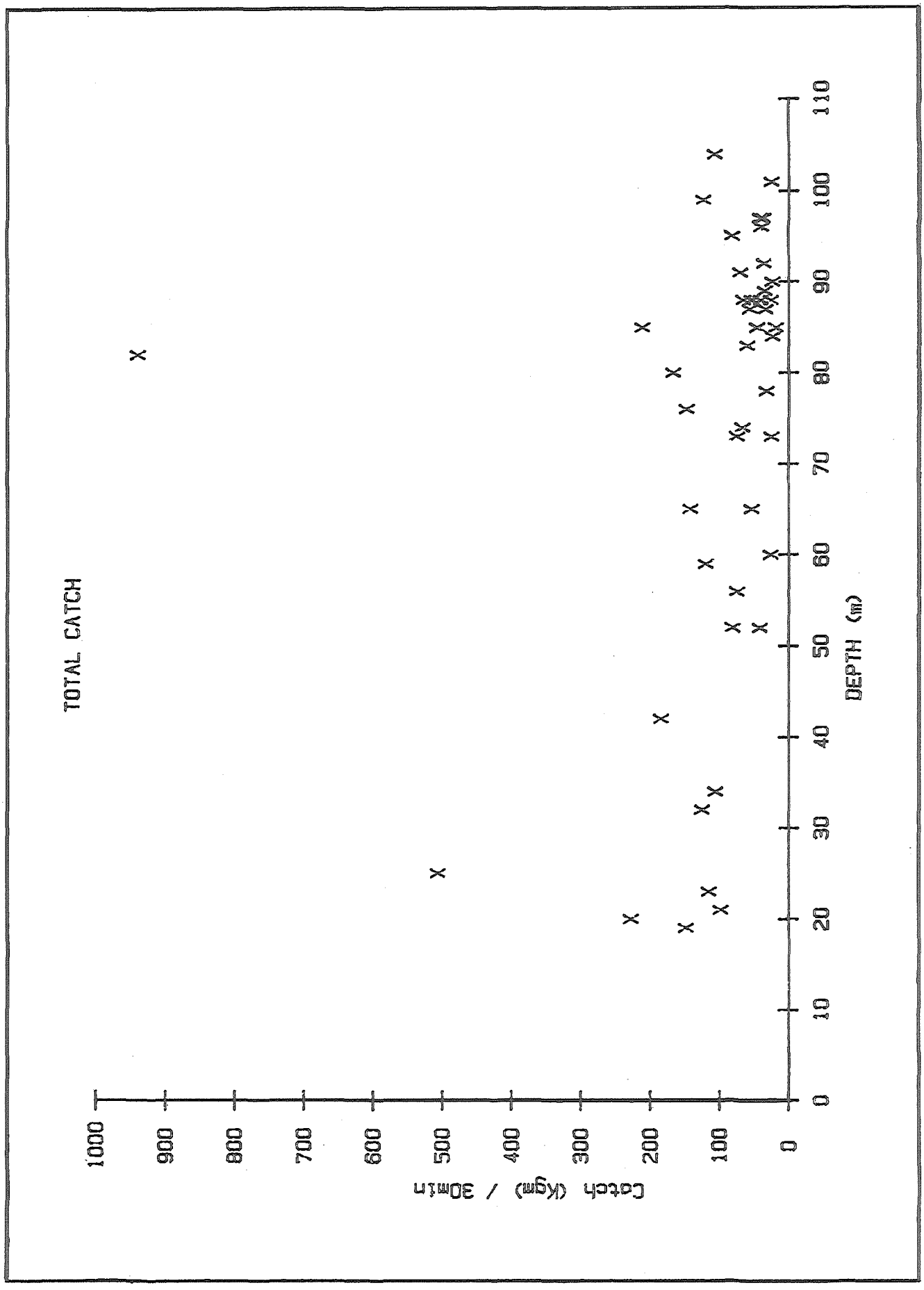

TOTAL CATCH
Catch (kgm) / 30min
1000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
110
DEPTH (m)

FIG. 3

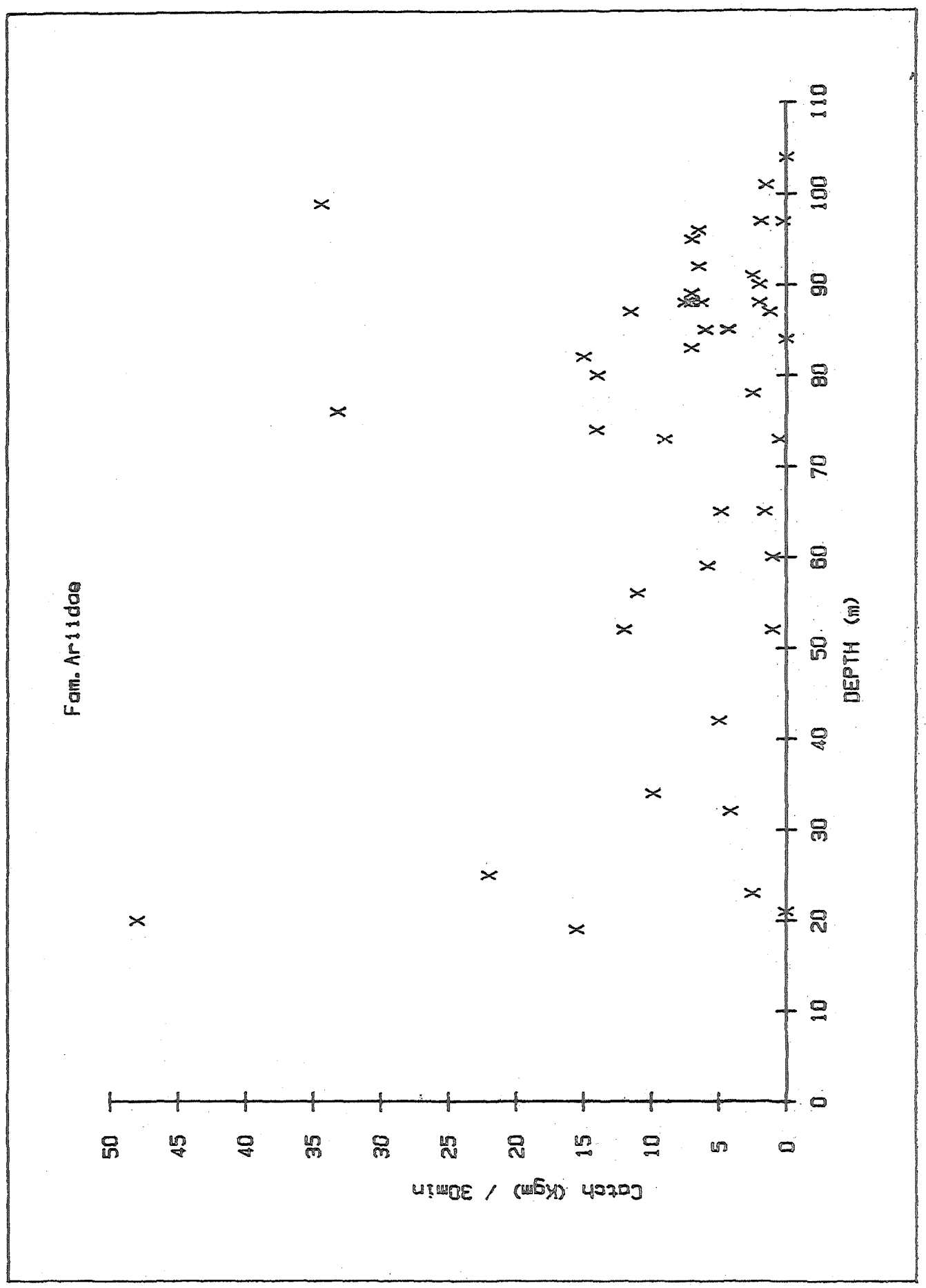

Fam. Arididae
Catch (Kgm) / 30min
DEPTH (m)
0
5
10
15
20
25
30
35
40
45
50
0
10
20
30
40
50
60
70
80
90
100
110

FIG. 4

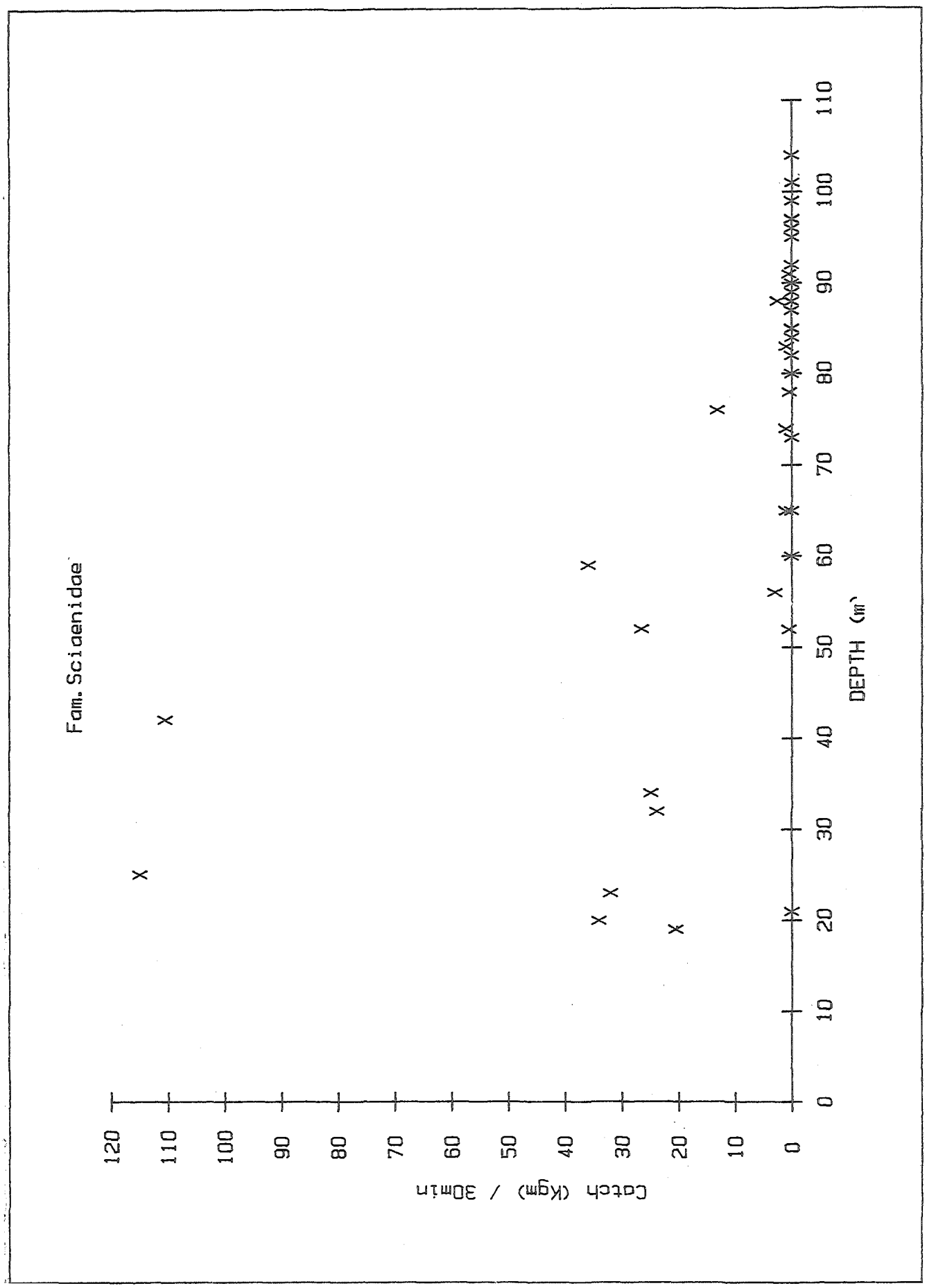

Fam. Sciaenidae
Catch (Kgm) / 30min
DEPTH (m)
0
10
20
30
40
50
60
70
80
90
100
110
120

FIG. 5

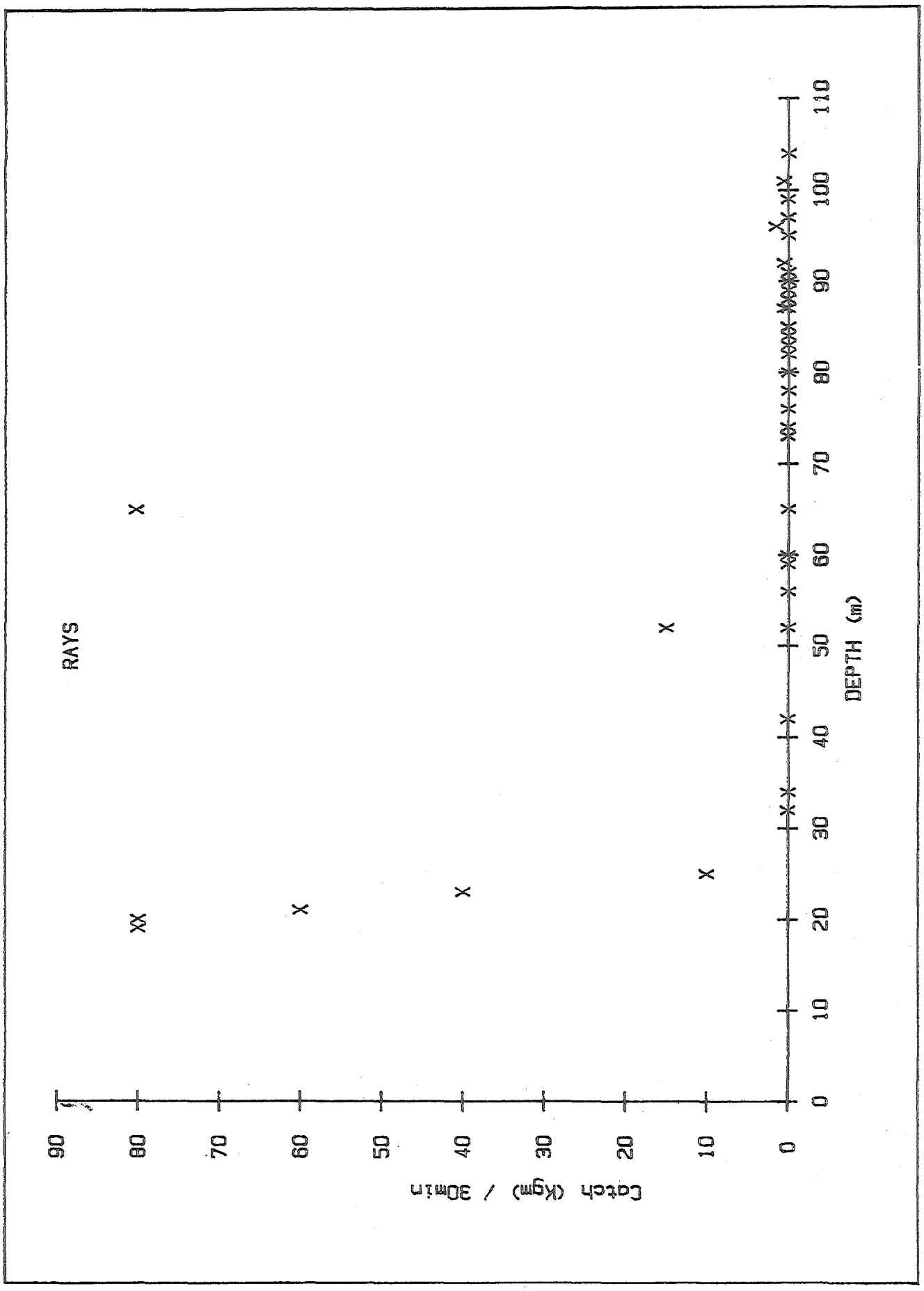


FIG. 6

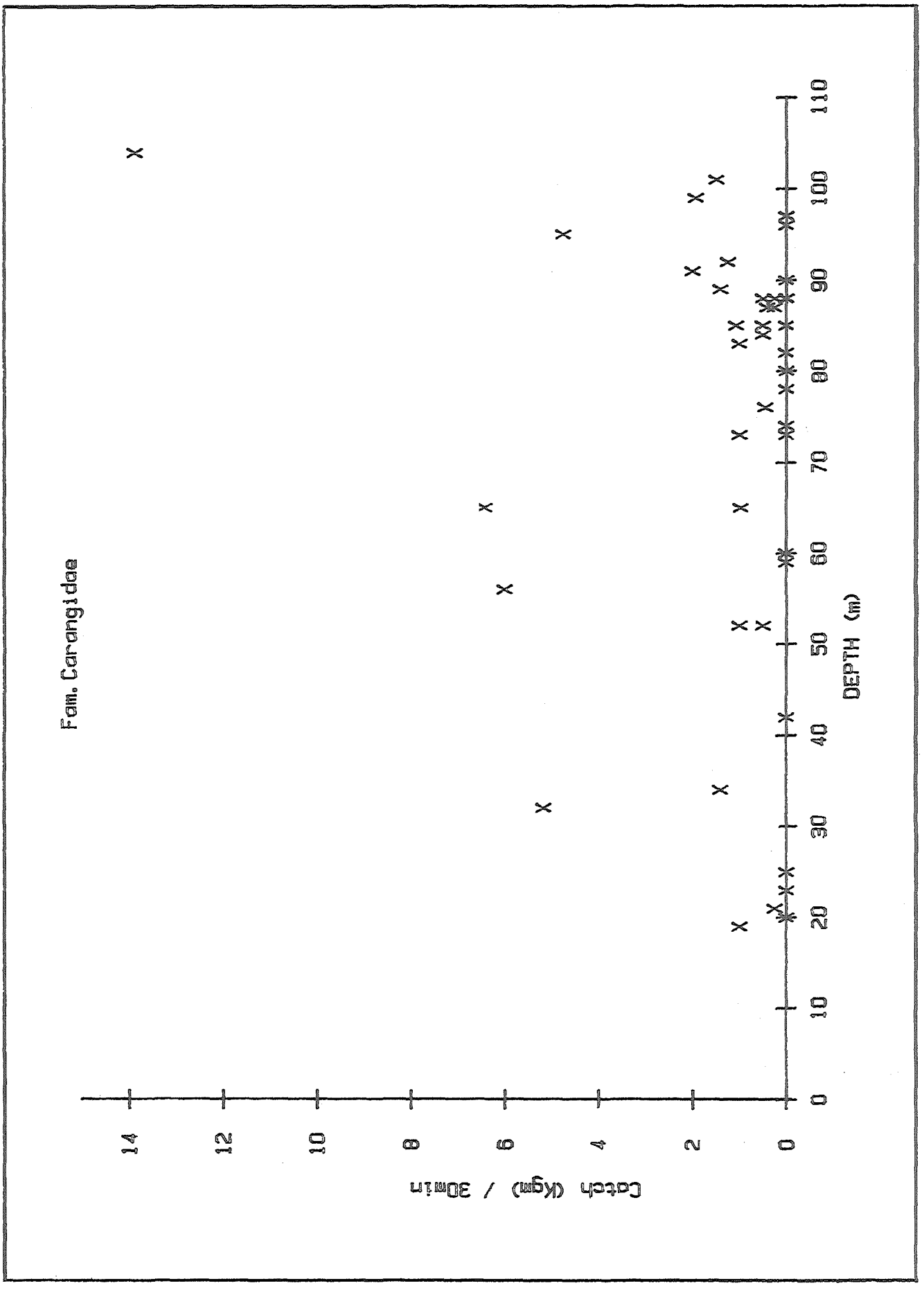

Fam. Carangidae
Catch (Kgm) / 30min
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
80
90
100
110
DEPTH (m)

FIG. 7

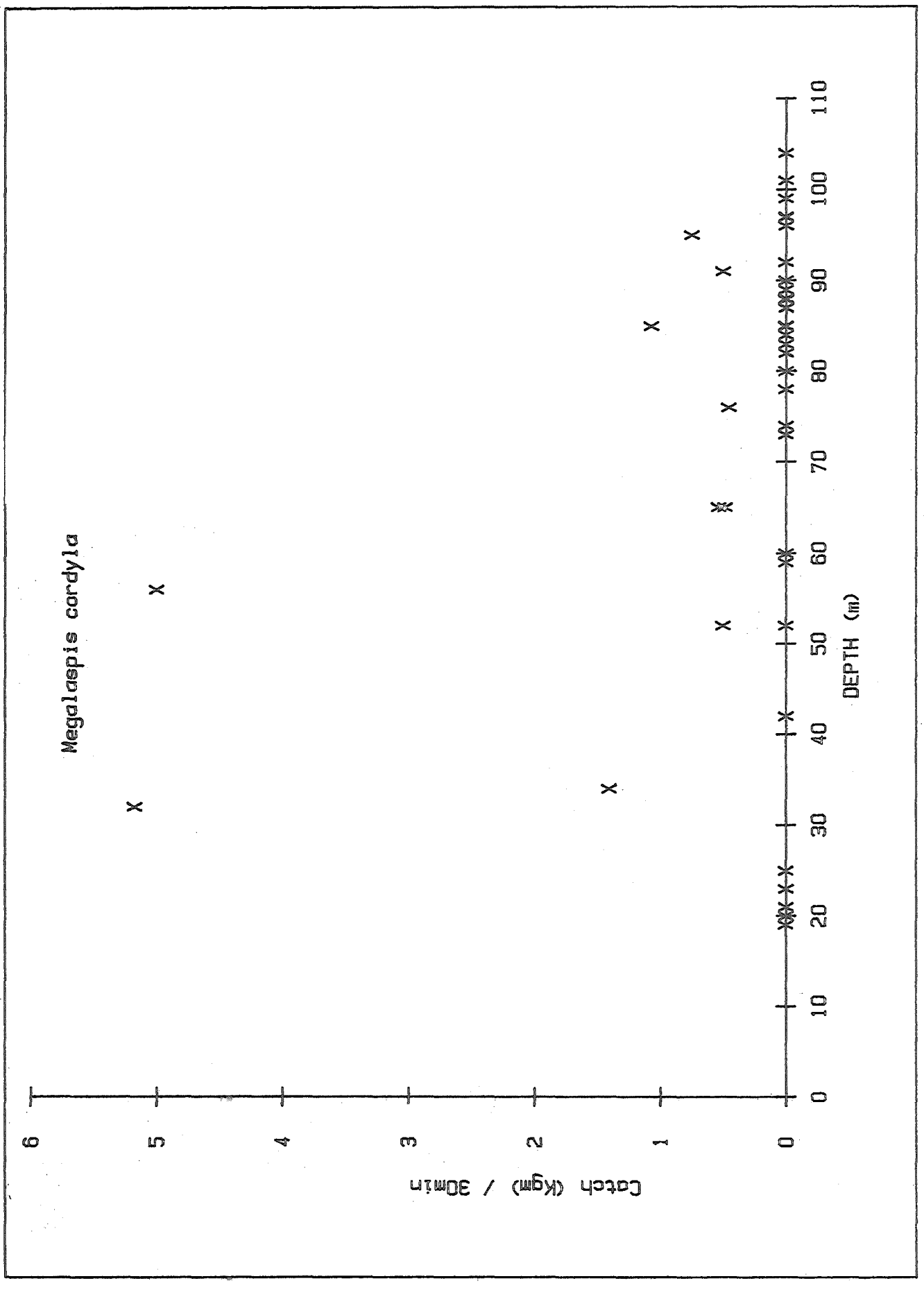

Megalaspis cordyla
Catch (Kgm) / 30min
DEPTH (m)
0
1
2
3
4
5
6
0
10
20
30
40
50
60
70
80
90
100
110

FIG. 8

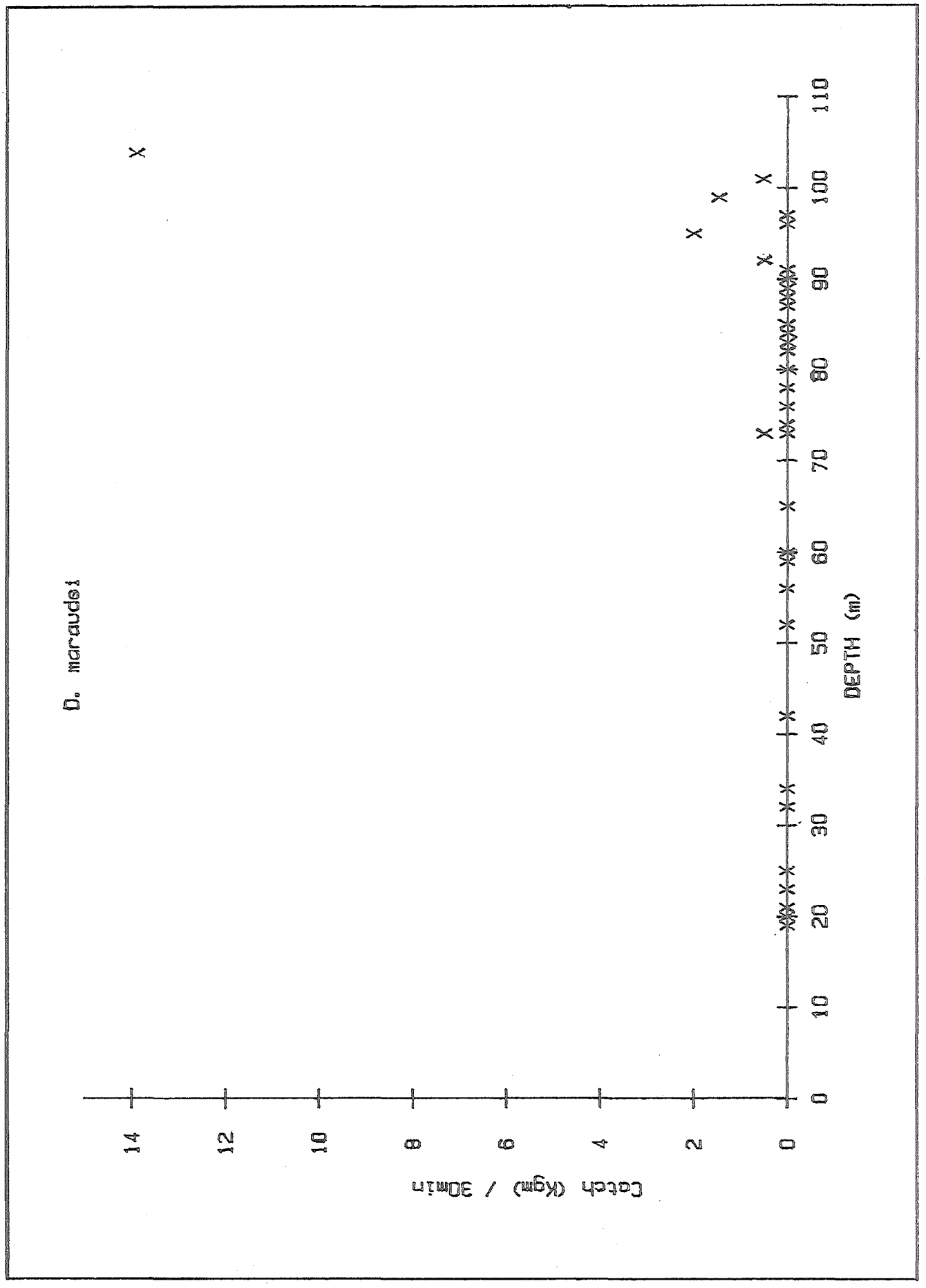

D. maraudei
Catch (kgm) / 30min
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
80
90
100
110
DEPTH (m)

FIG. 9

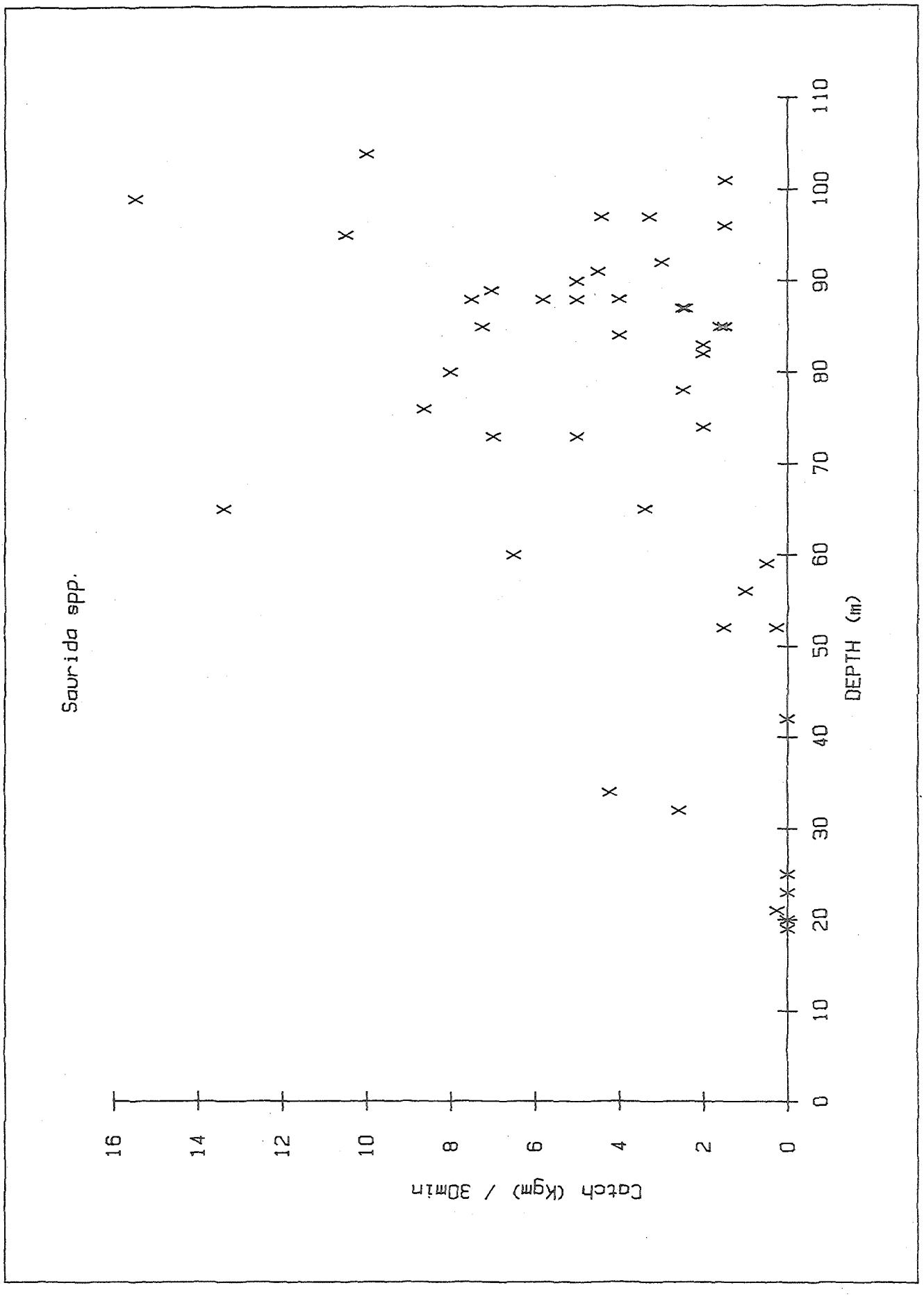

Saurida spp.
Catch (Kgm) / 30min
DEPTH (m)
0
2
4
6
8
10
12
14
16
0
10
20
30
40
50
60
70
80
90
100
110

FIG.10

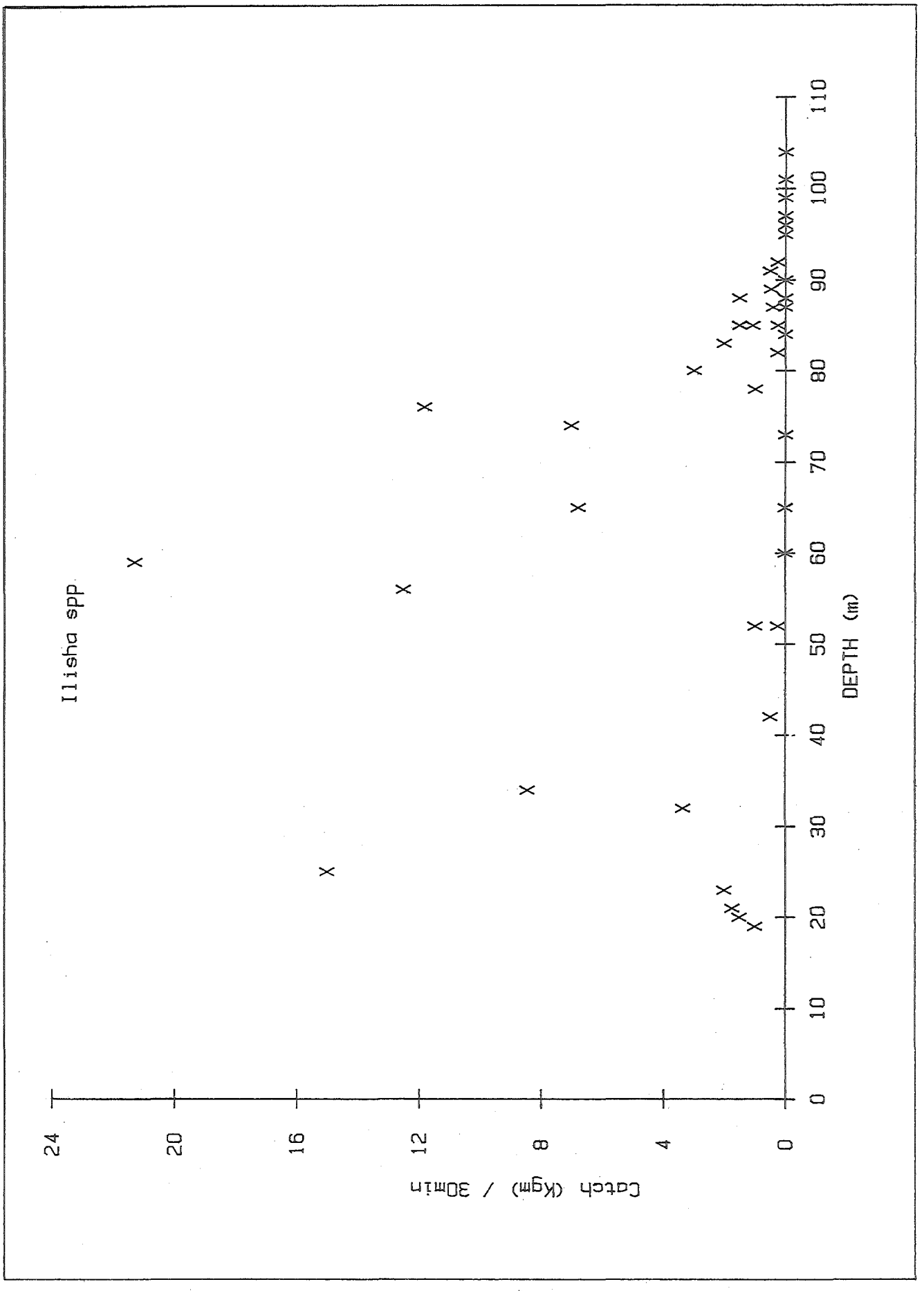

Ilisha spp
Catch (Kgm) / 30min
DEPTH (m)
0
4
8
12
16
20
24
0
10
20
30
40
50
60
70
80
90
100
110

FIG.11

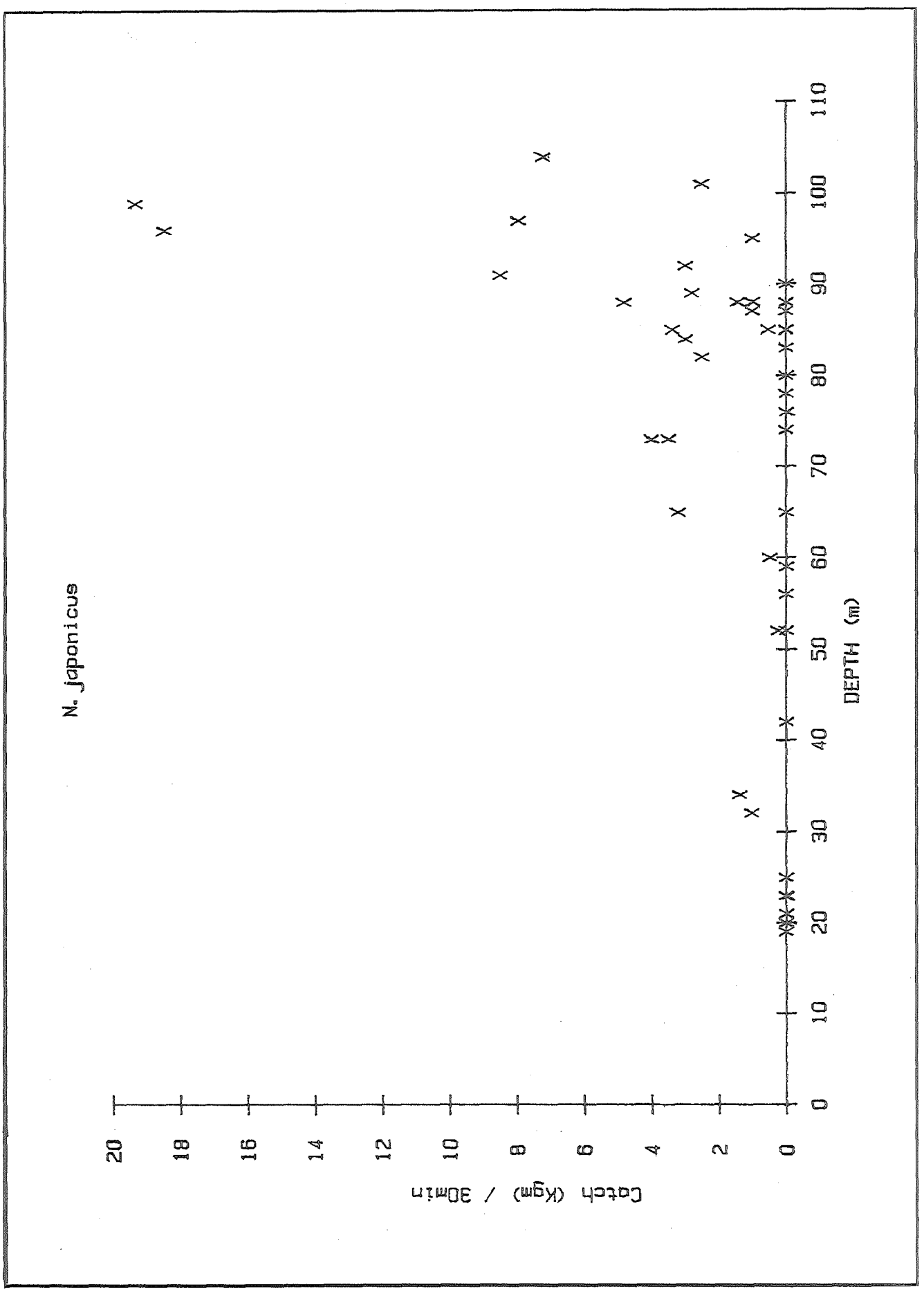

N. japonicus
Catch (Kgm) / 30min
DEPTH (m)
0
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60
70
80
90
100
110

FIG.12

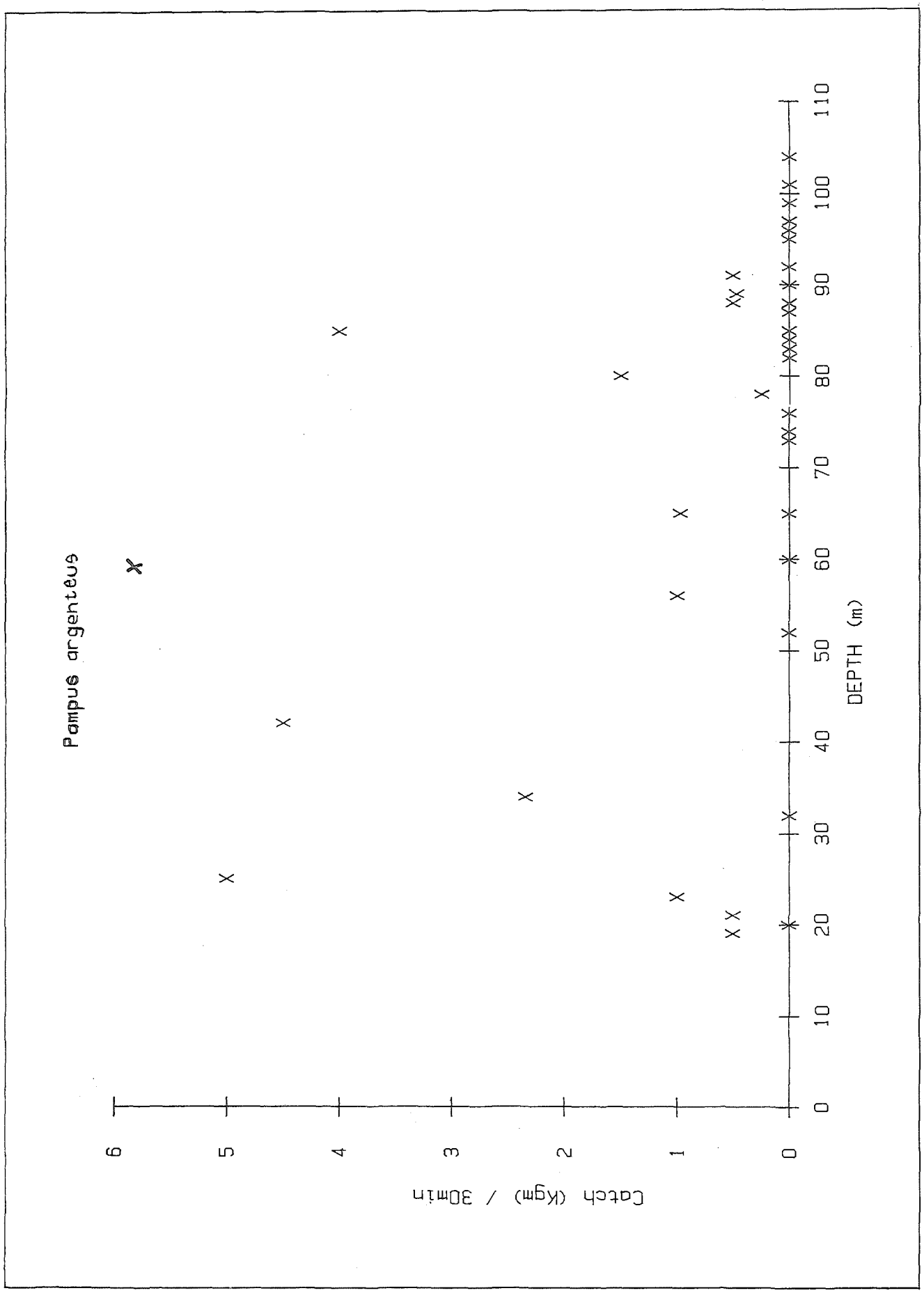

Pampus argenteus
Catch (Kgm) / 30min
DEPTH (m)
0
1
2
3
4
5
6
0
10
20
30
40
50
60
70
80
90
100
110

FIG.13

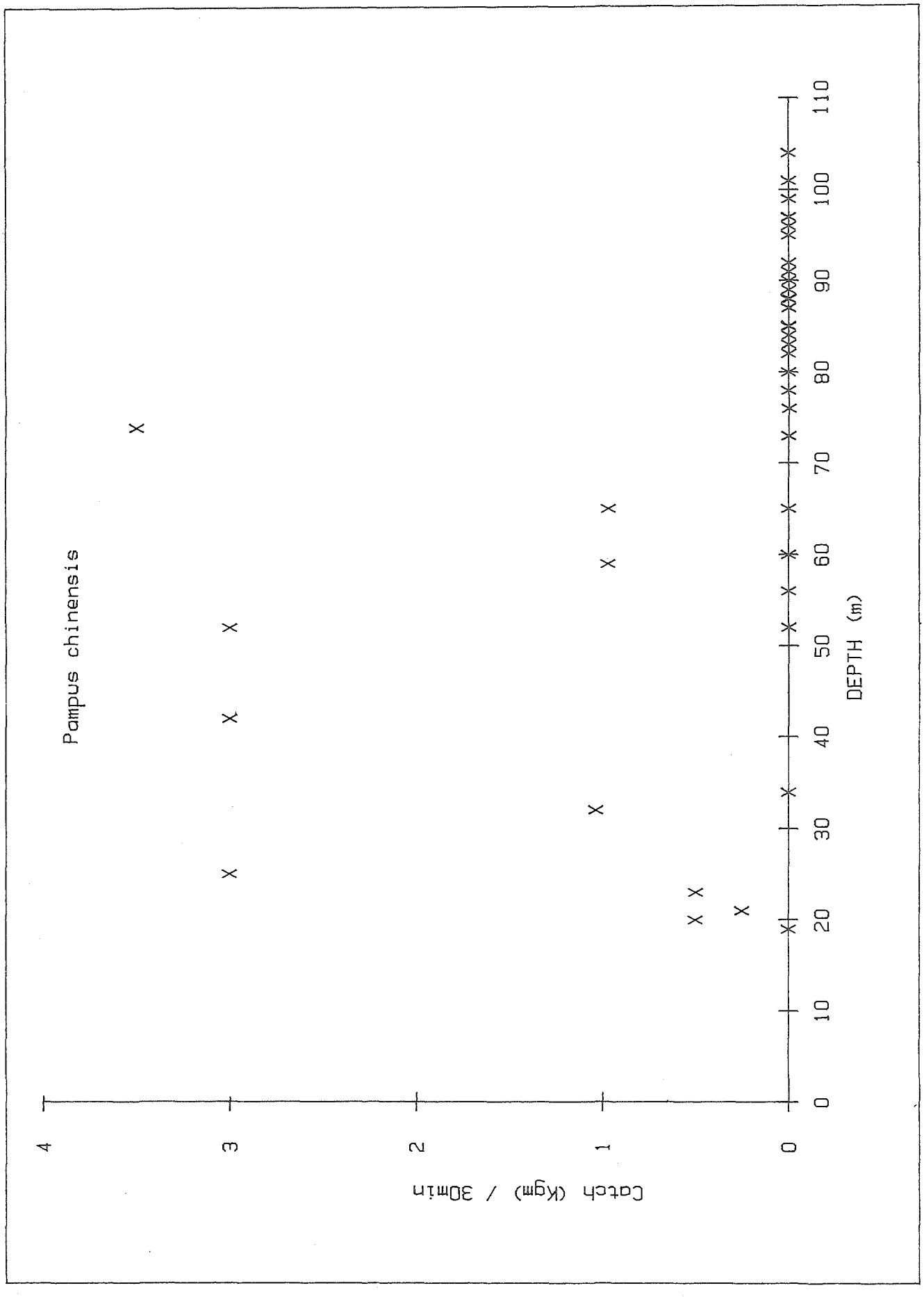

Pampus chinensis
Catch (Kgm) / 30min
DEPTH (m)
0
1
2
3
4
0
10
20
30
40
50
60
70
80
90
100
110

FIG. 14

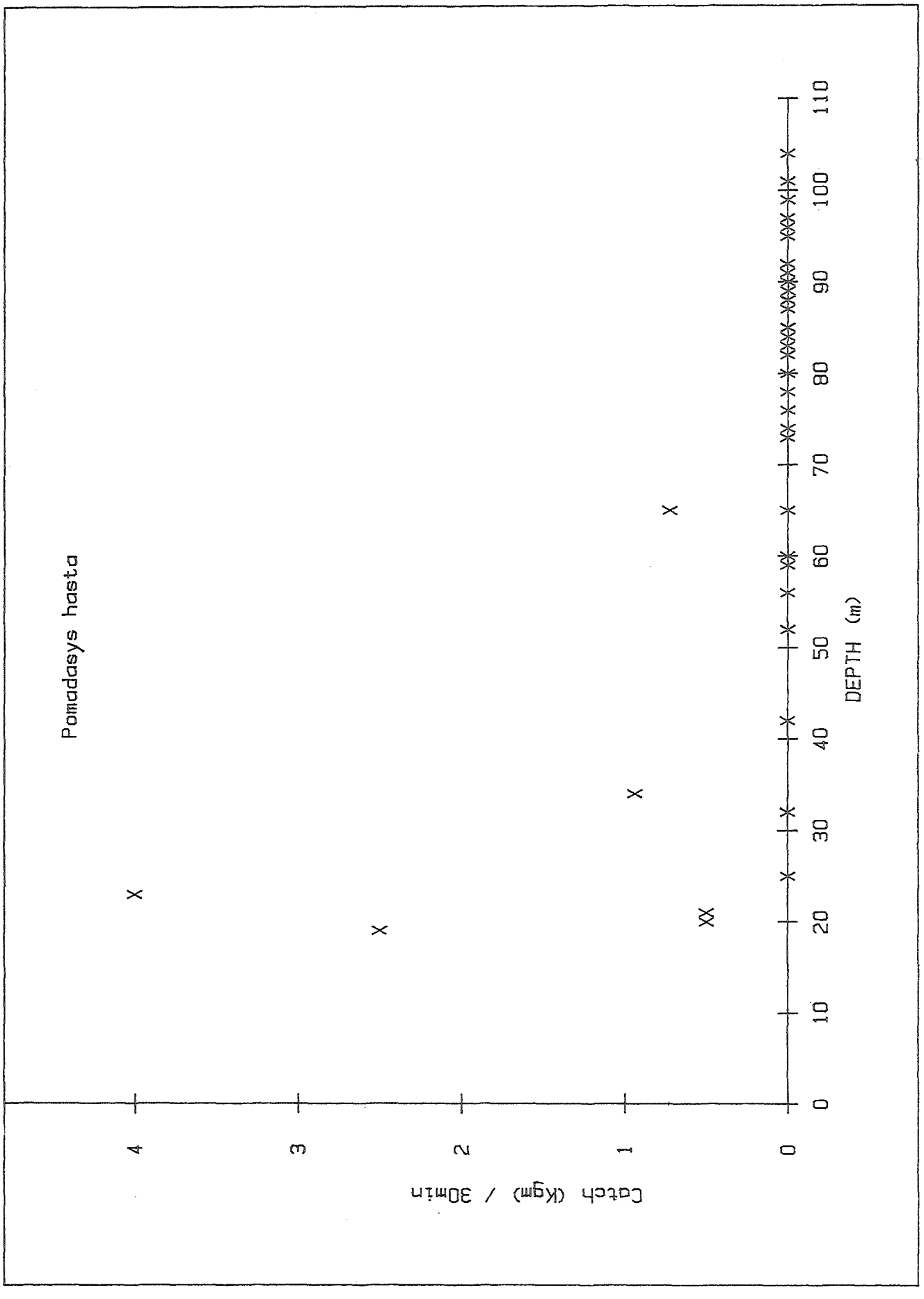

Pomadasys hasta
Catch (Kgm) / 30min
0
1
2
3
4
0
10
20
30
40
50
60
70
80
90
100
110
DEPTH (m)

FIG. 15

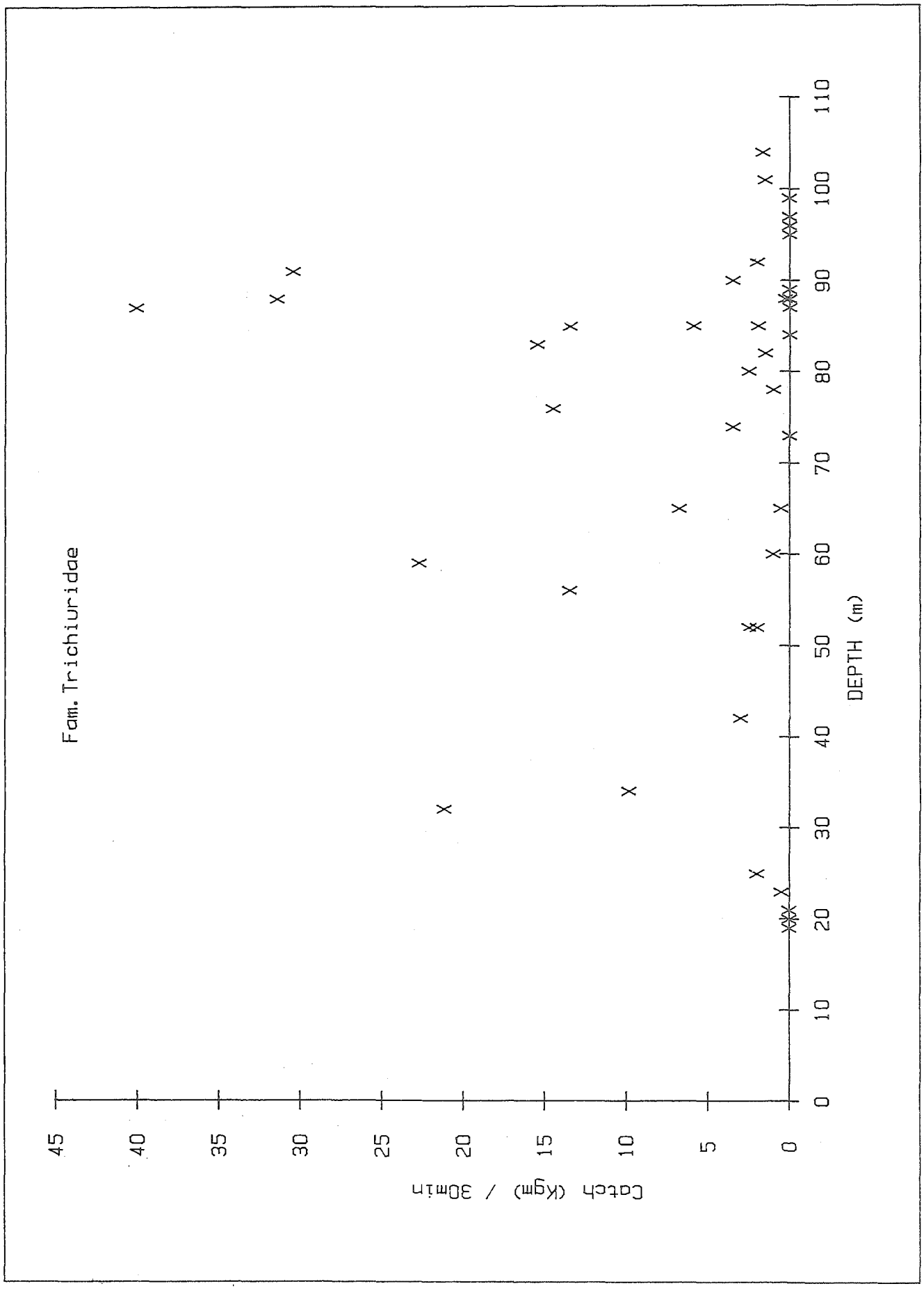

Fam.Trichiuridae
Catch (Kgm) / 30min
DEPTH (m)
0
5
10
15
20
25
30
35
40
45
0
10
20
30
40
50
60
70
80
90
100
110

FIG.16

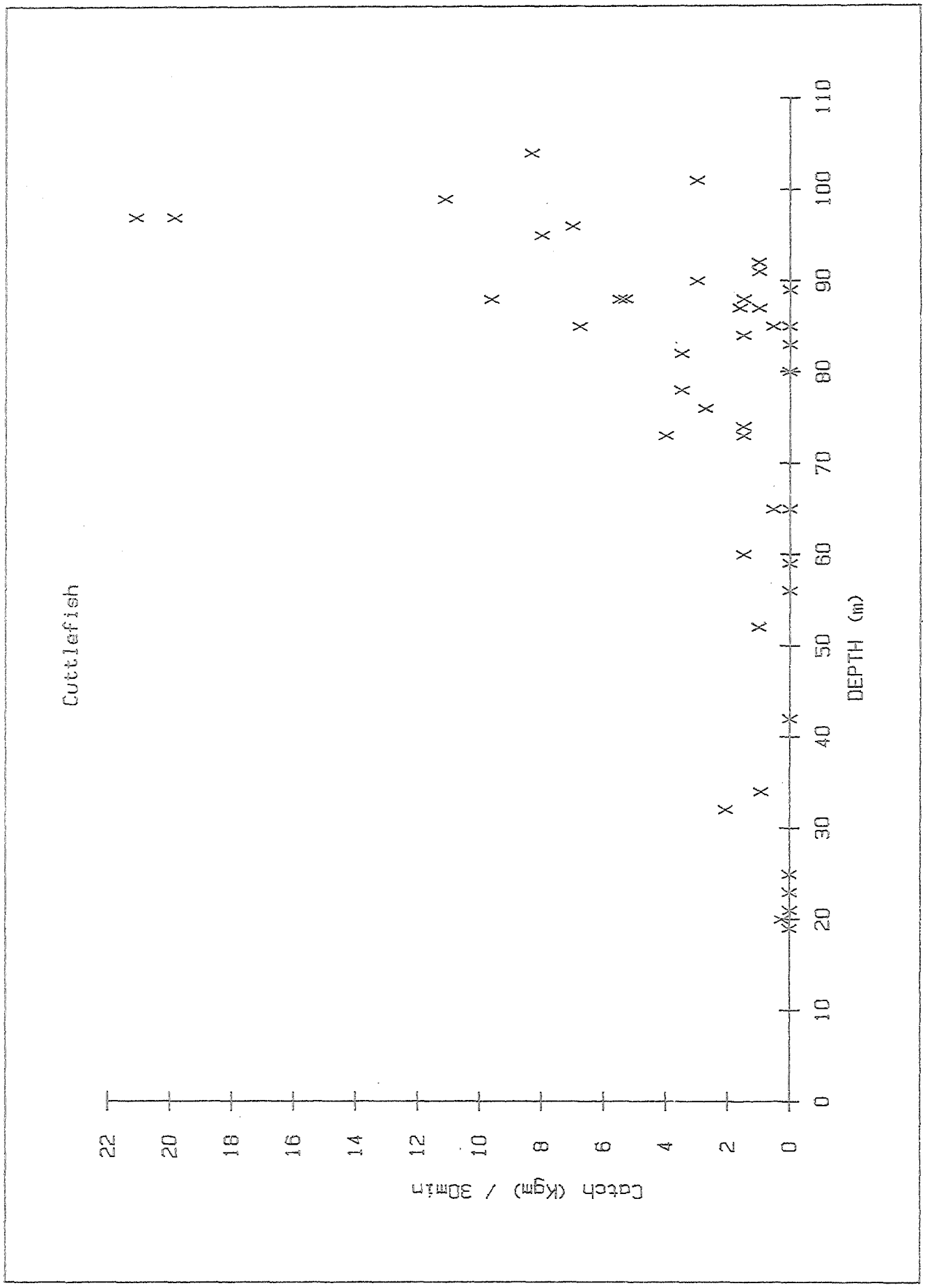

Cuttlefish
Catch (Kgm) / 30min
DEPTH (m)
0
2
4
6
8
10
12
14
16
18
20
22
0
10
20
30
40
50
60
70
80
90
100
110

FIG. 17

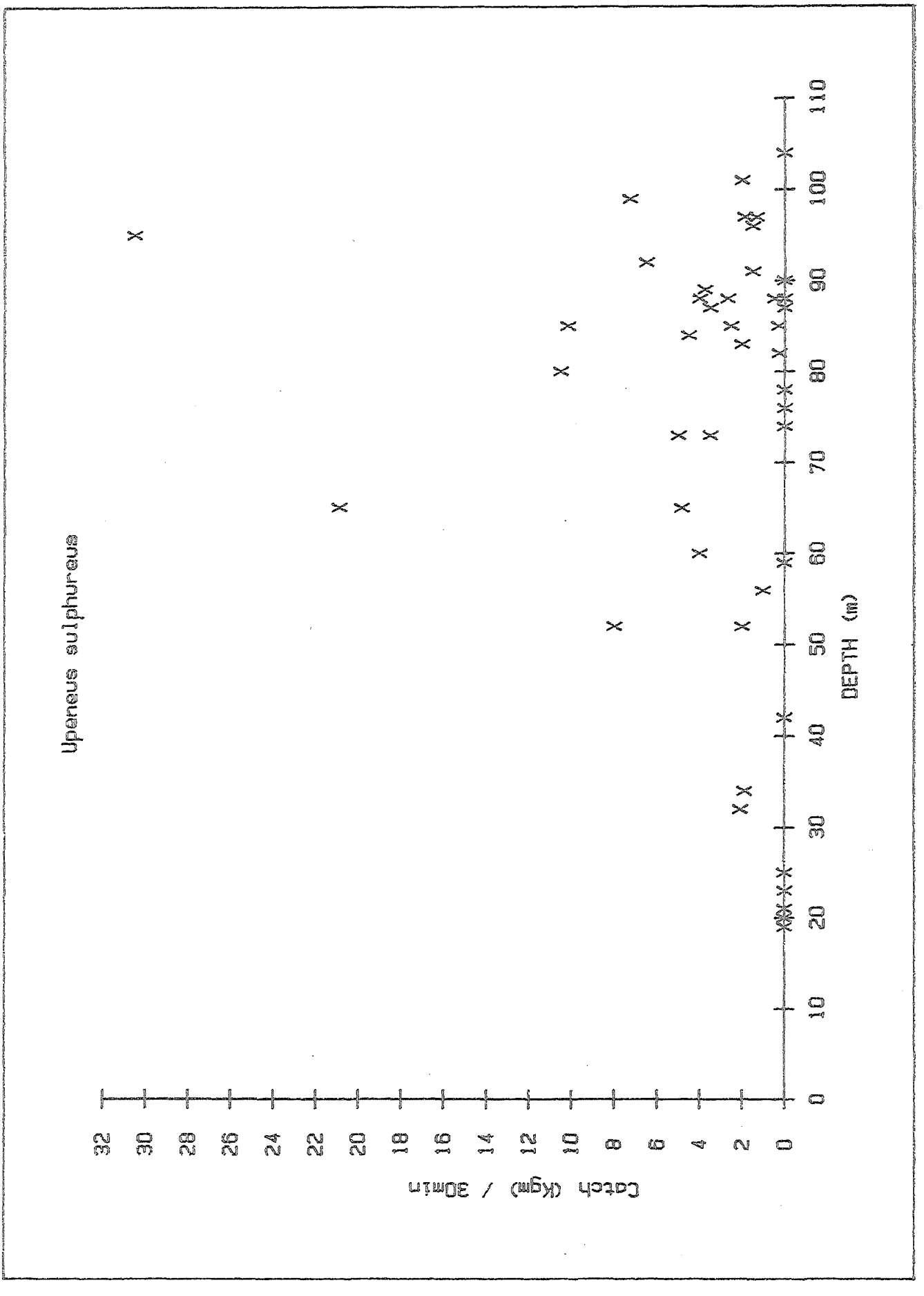

Upeneus sulphureus
Catch (kgm) / 30min
DEPTH (m)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
0
10
20
30
40
50
60
70
80
90
100
110

FIG. 18

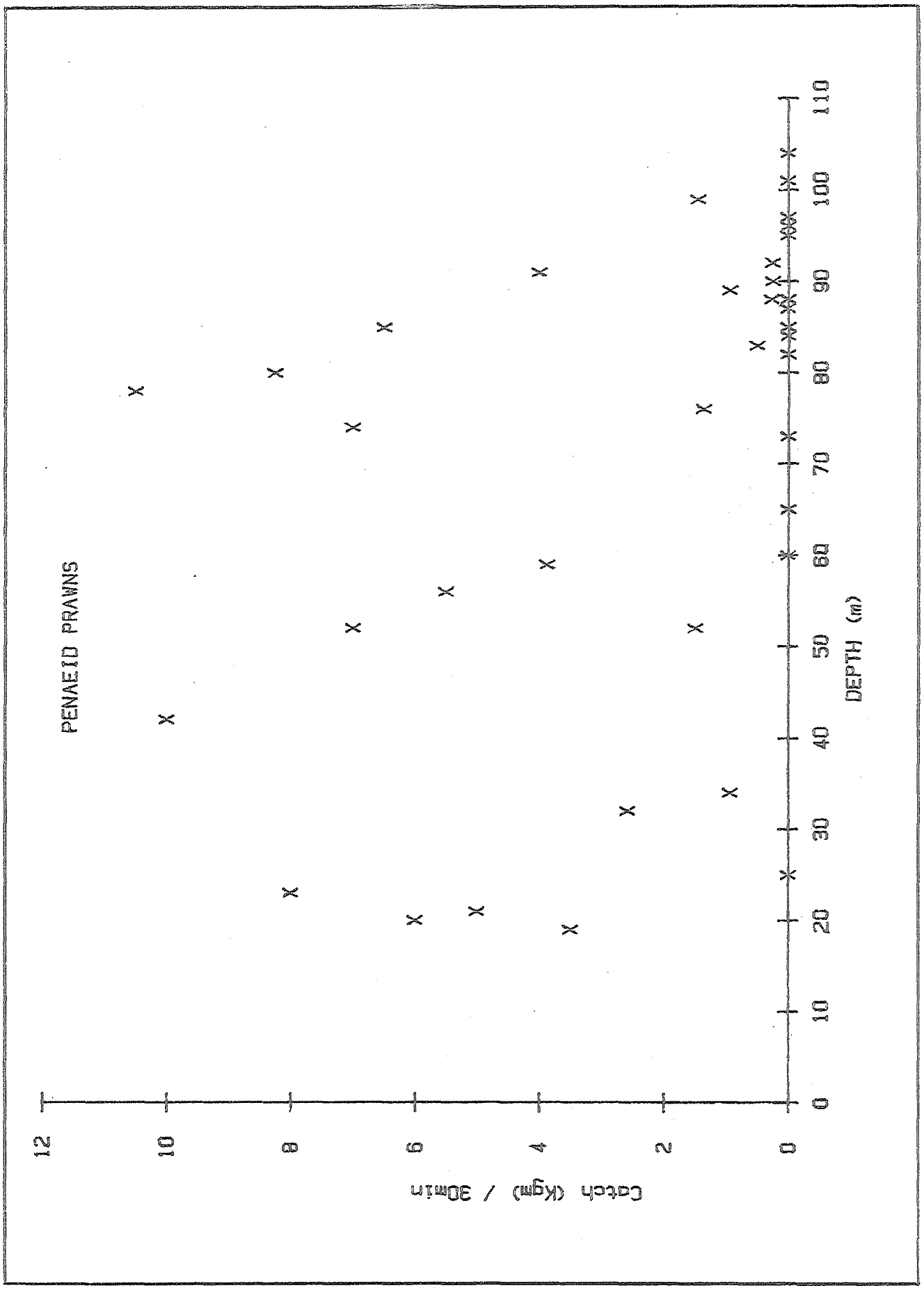

PENAEID PRAWNS
Catch (kgm) / 30min
DEPTH (m)
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
90
100
110

FIG.19

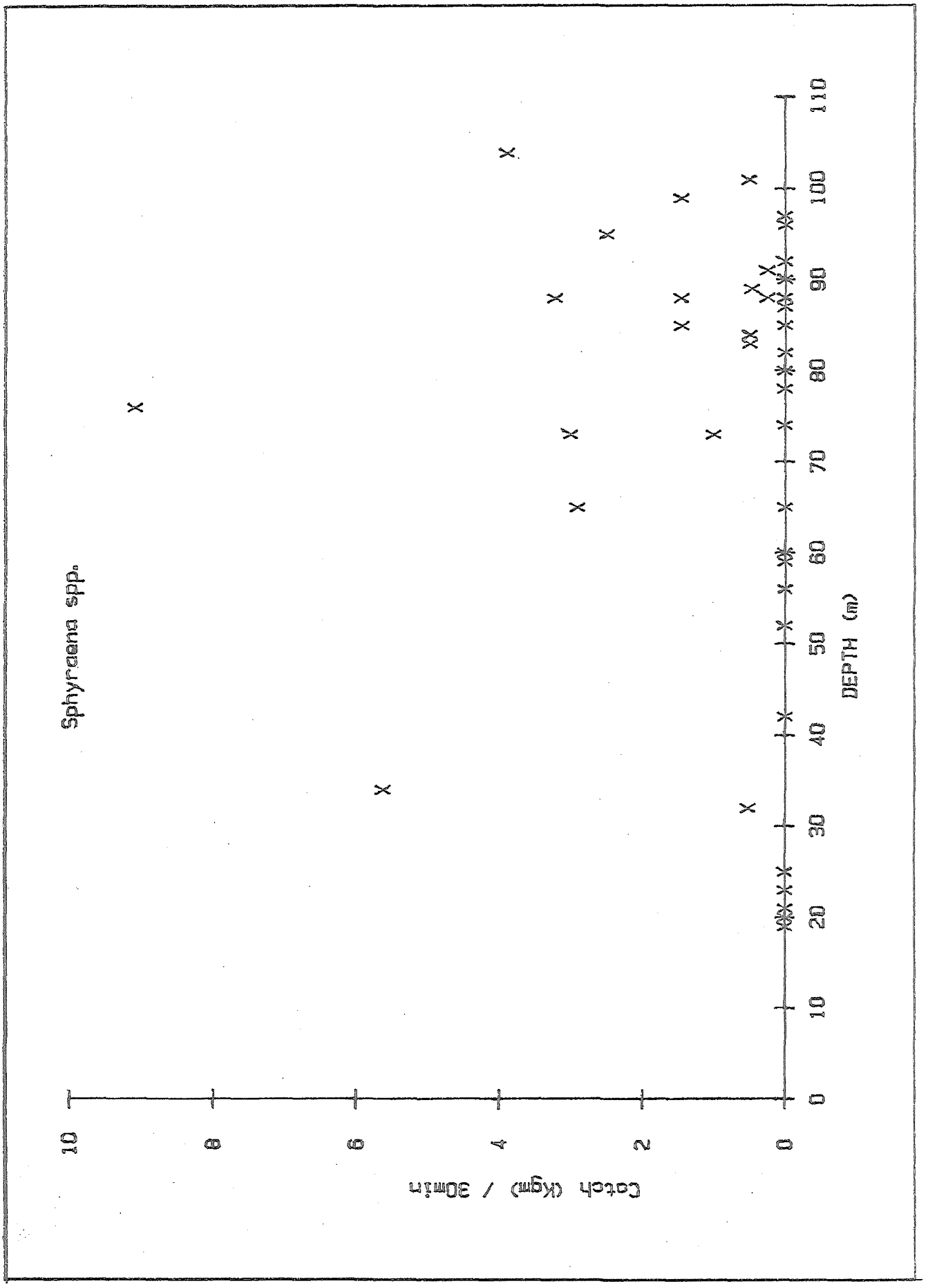

Sphyraena spp.
Catch (kgm) / 30min
0
2
4
6
8
10
DEPTH (m)
0
10
20
30
40
50
60
70
80
90
100
110

FIG.20

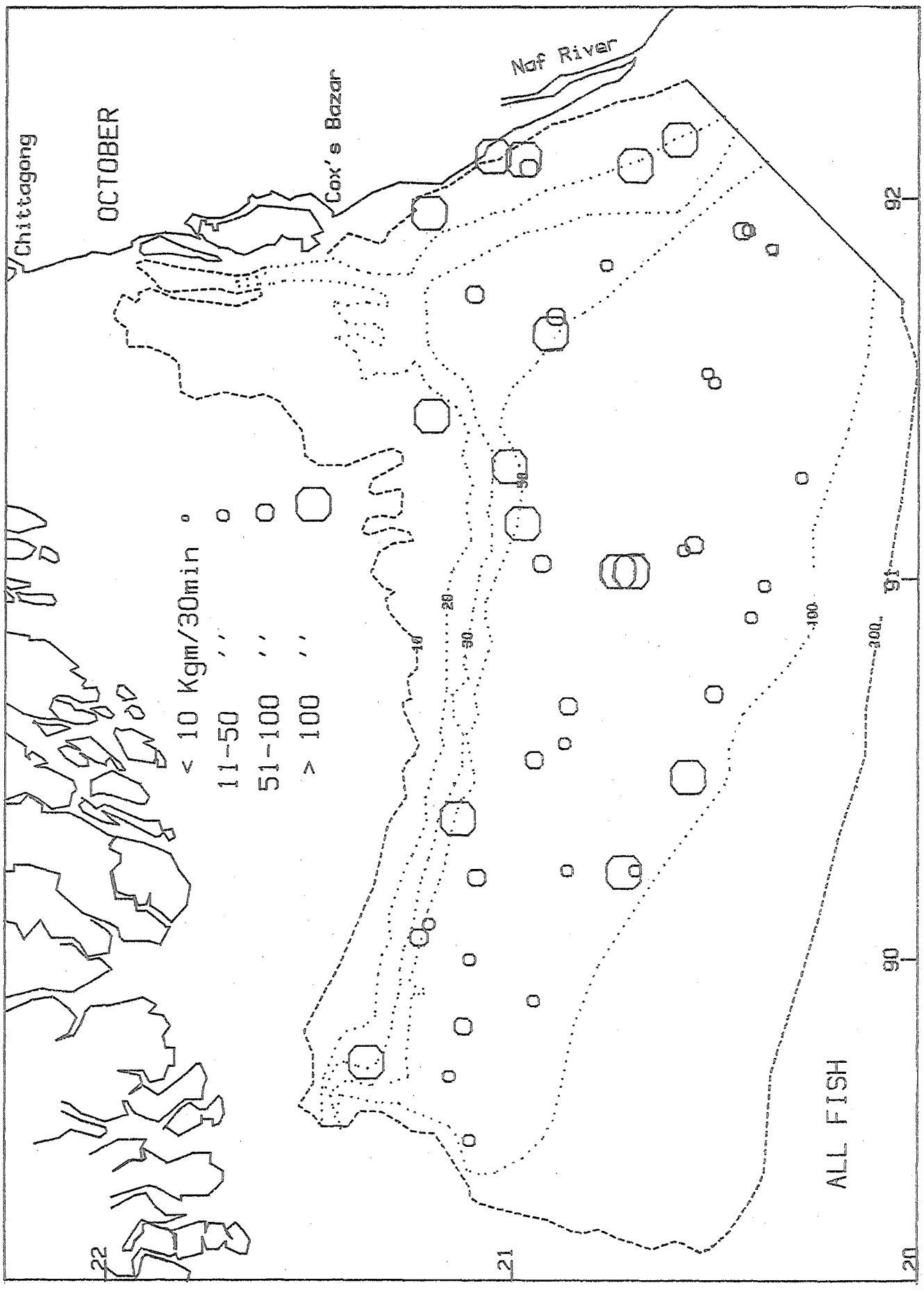

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 10 Kgm/30min
11-50 ''
51-100 ''
> 100 ''
10
20
50
100
200
ALL FISH
22
21
20
90
91
92

FIG. 21

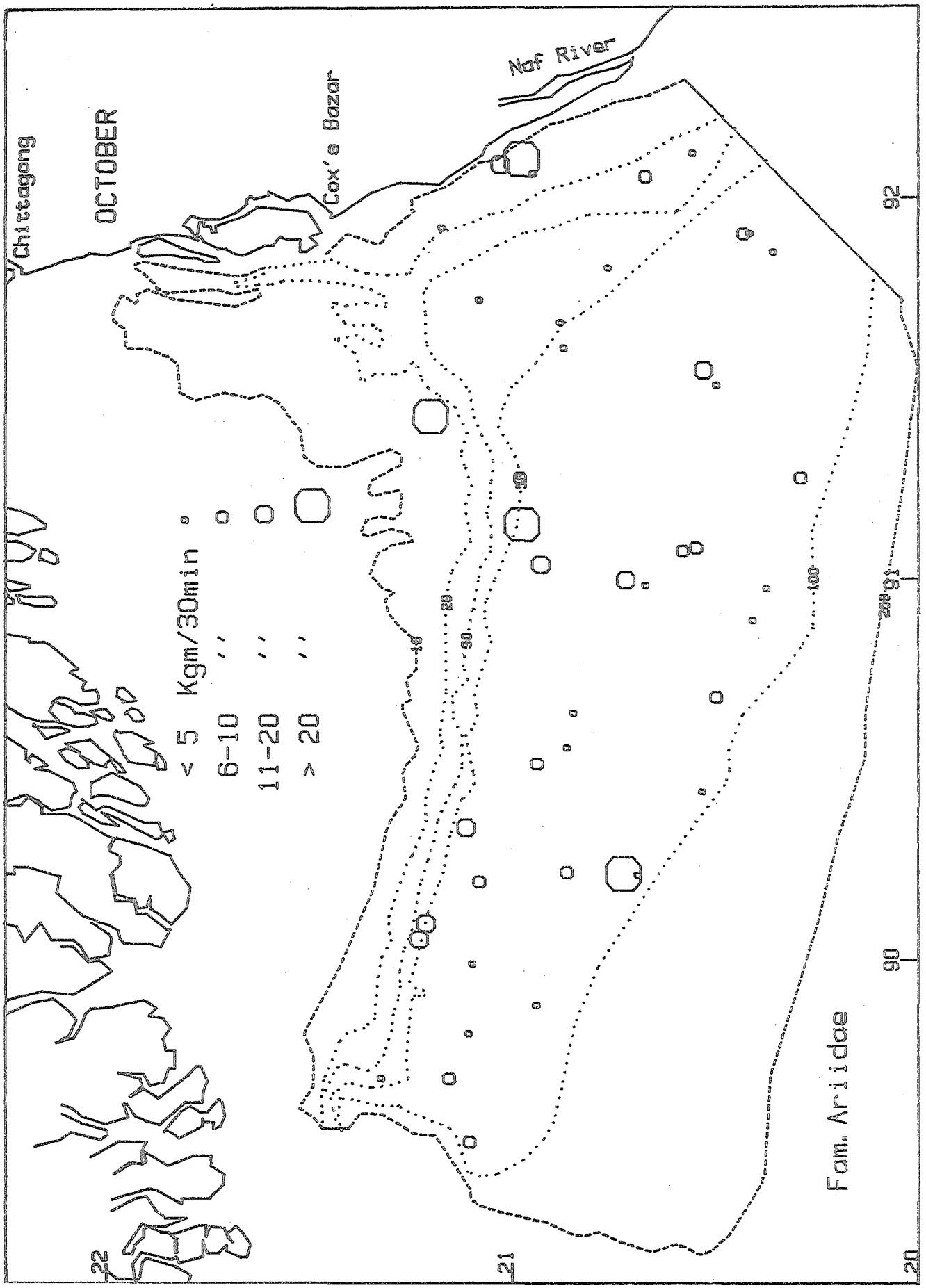

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 5 Kgm/30min
6-10 ''
11-20 ''
> 20 ''
Fam. Ariidae
22
21
20
92
91
90
10
20
30
50
100
200

FIG. 22

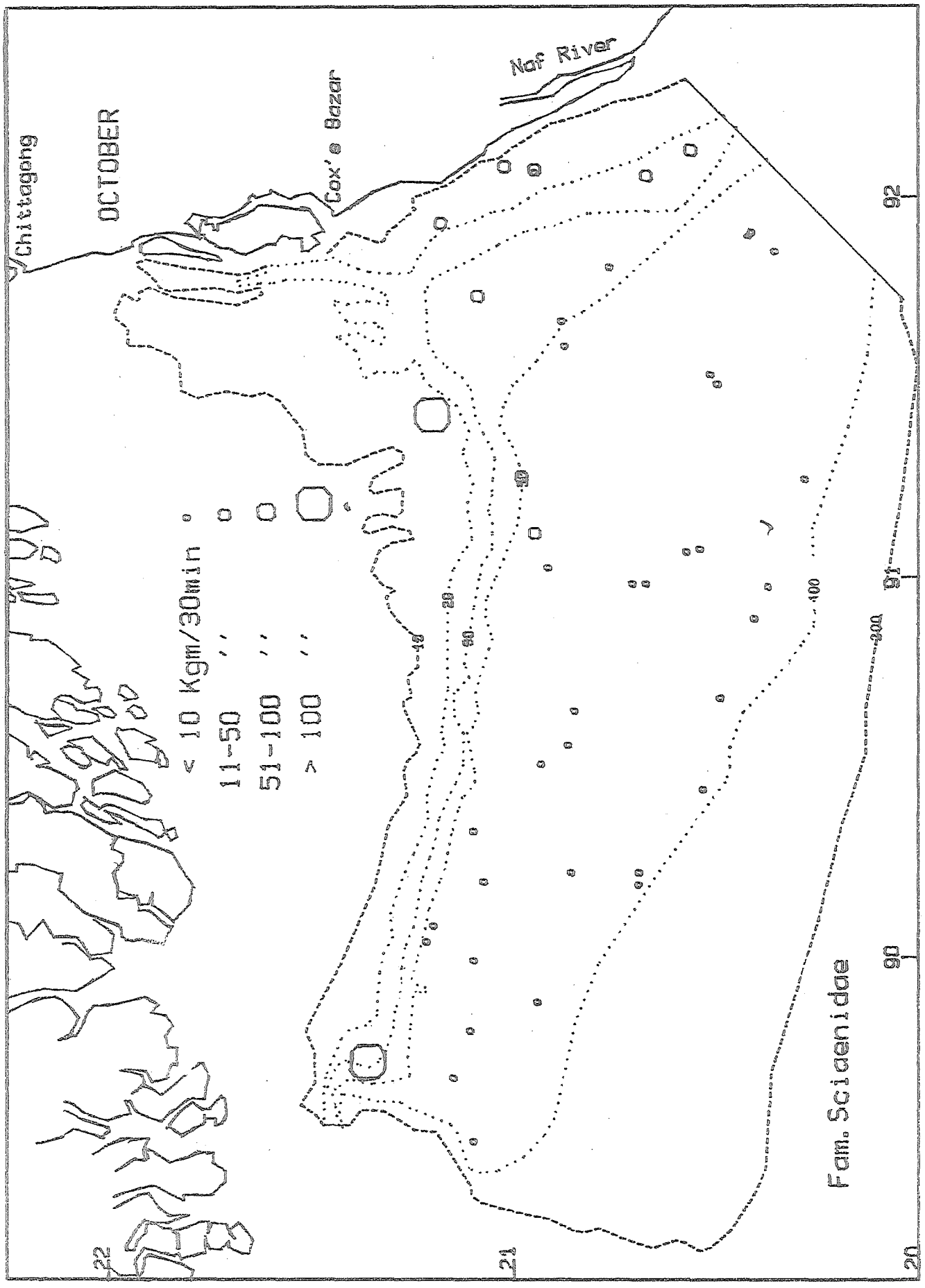

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 10 Kgm/30min
11-50 ''
51-100 ''
> 100 ''
Fam. Sciaenidae
22
21
20
92
91
90
40
60
100
200

FIG. 23

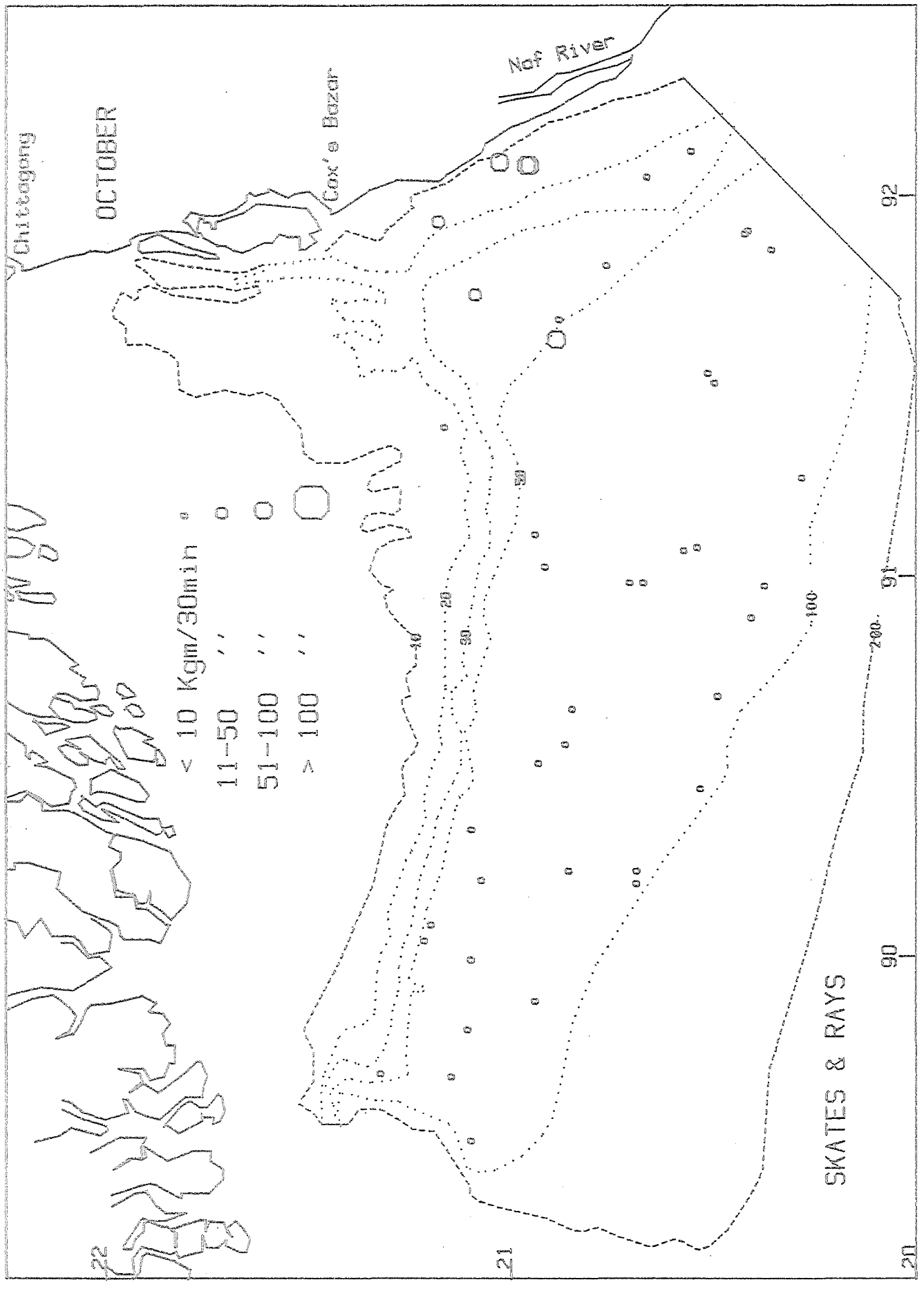

OCTOBER
Chittagong
Cox's Bazar
Naf River
< 10 Kgm/30min
11-50 ''
51-100 ''
> 100 ''
SKATES & RAYS
22
21
20
90
91
92
10
20
50
100
200

FIG. 24

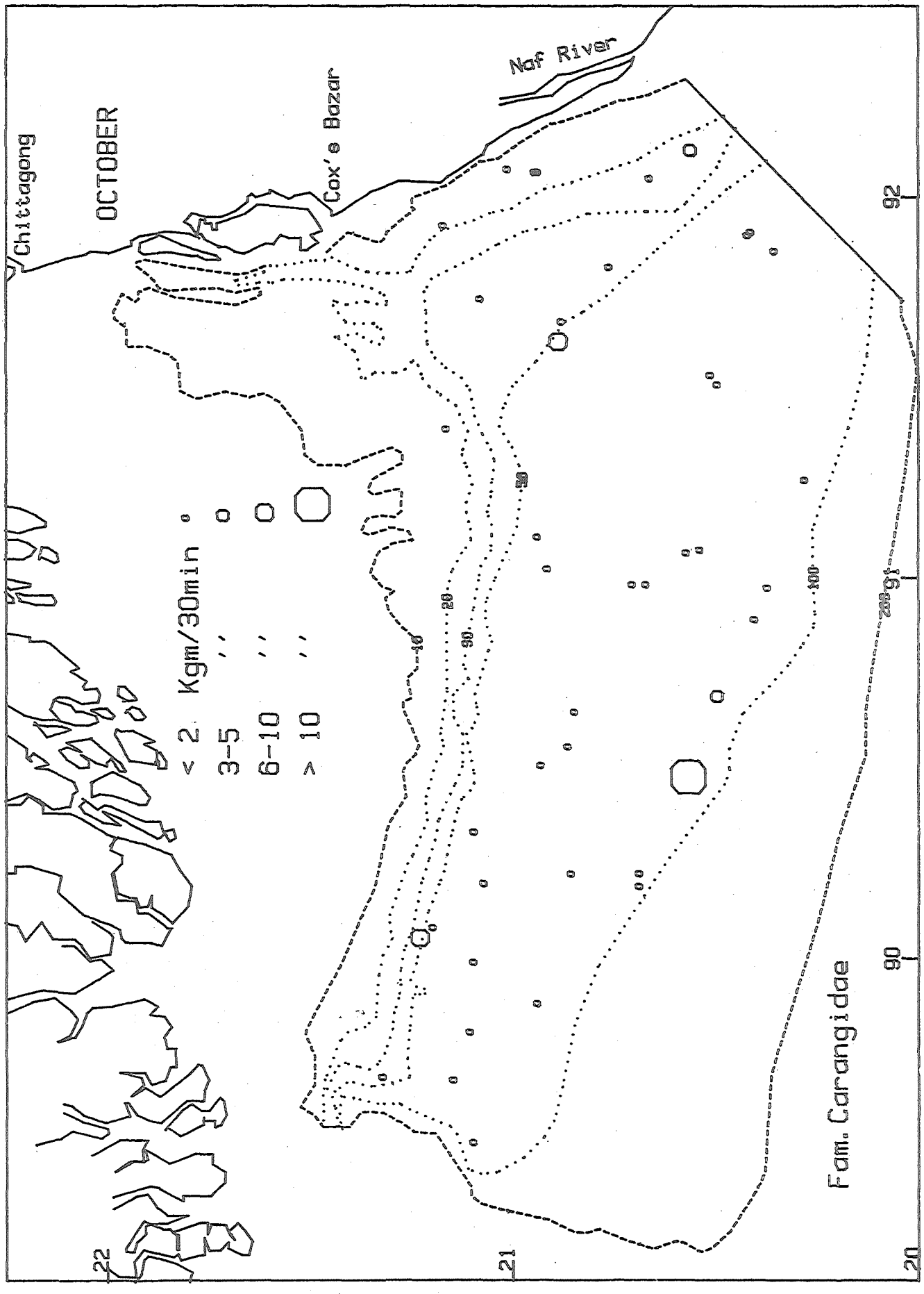

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 2 Kgm/30min
3-5 ,,
6-10 ,,
> 10 ,,
Fam. Carangidae
22
21
20
92
91
90
10
20
30
50
100
200

FIG. 25

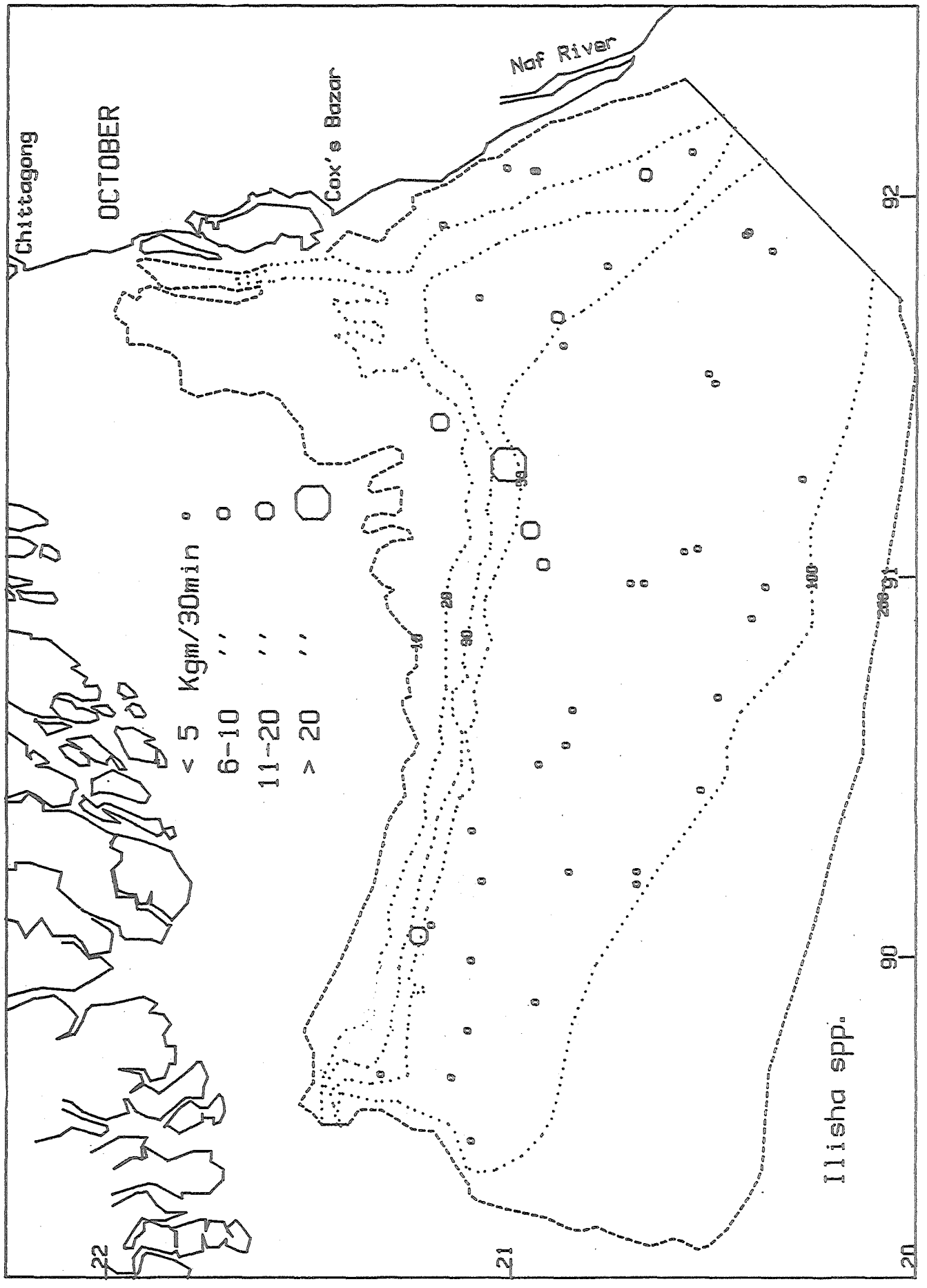

Chittagong
OCTOBER
Cox's Bazar
Nof River
< 5 Kgm/30min
6-10 ''
11-20 ''
> 20 ''
Ilisha spp.
22
21
20
90
91
92

FIG. 26

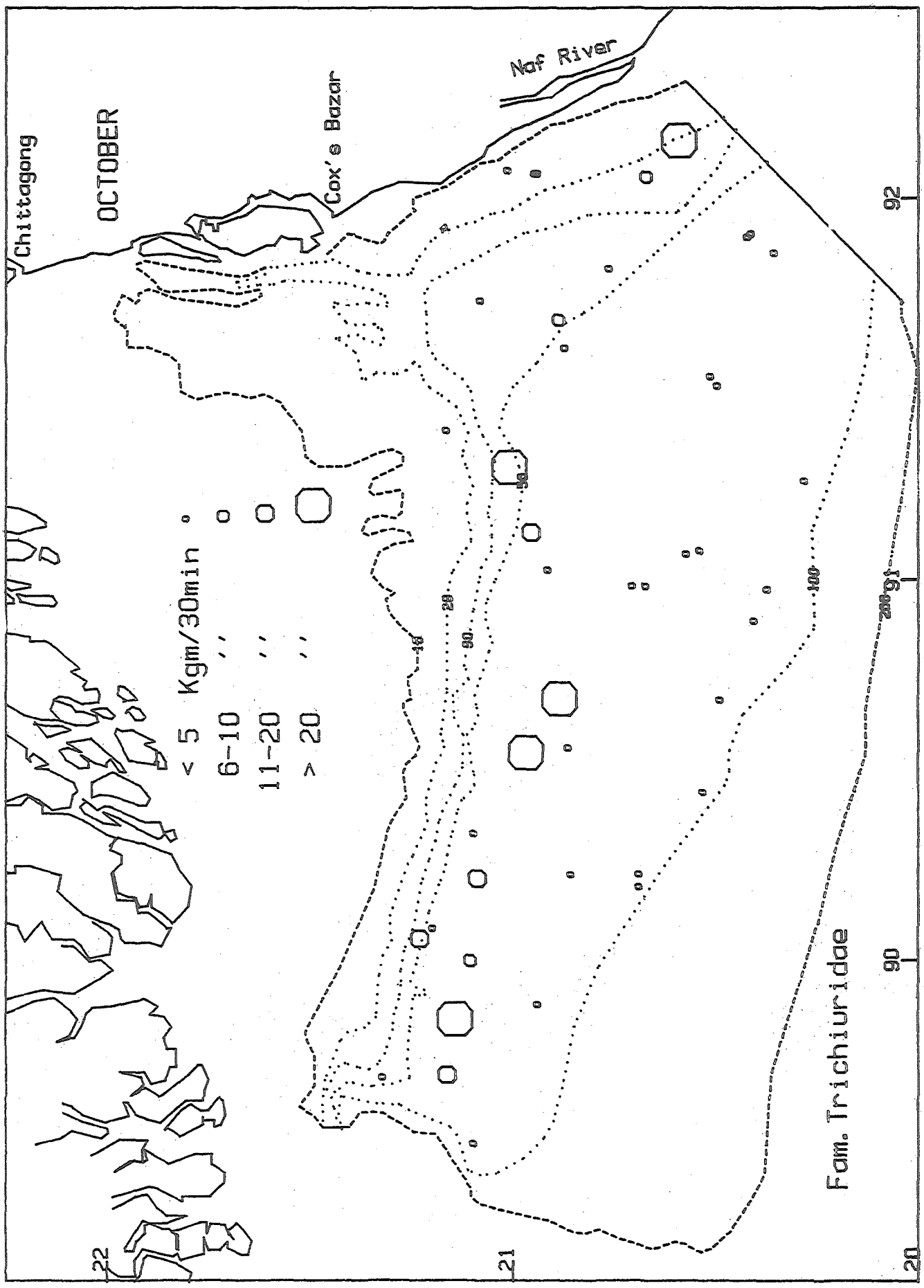

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 5 Kgm/30min
6-10 ''
11-20 ''
> 20 ''
Fam. Trichiuridae
22
21
20
90
92

FIG. 27

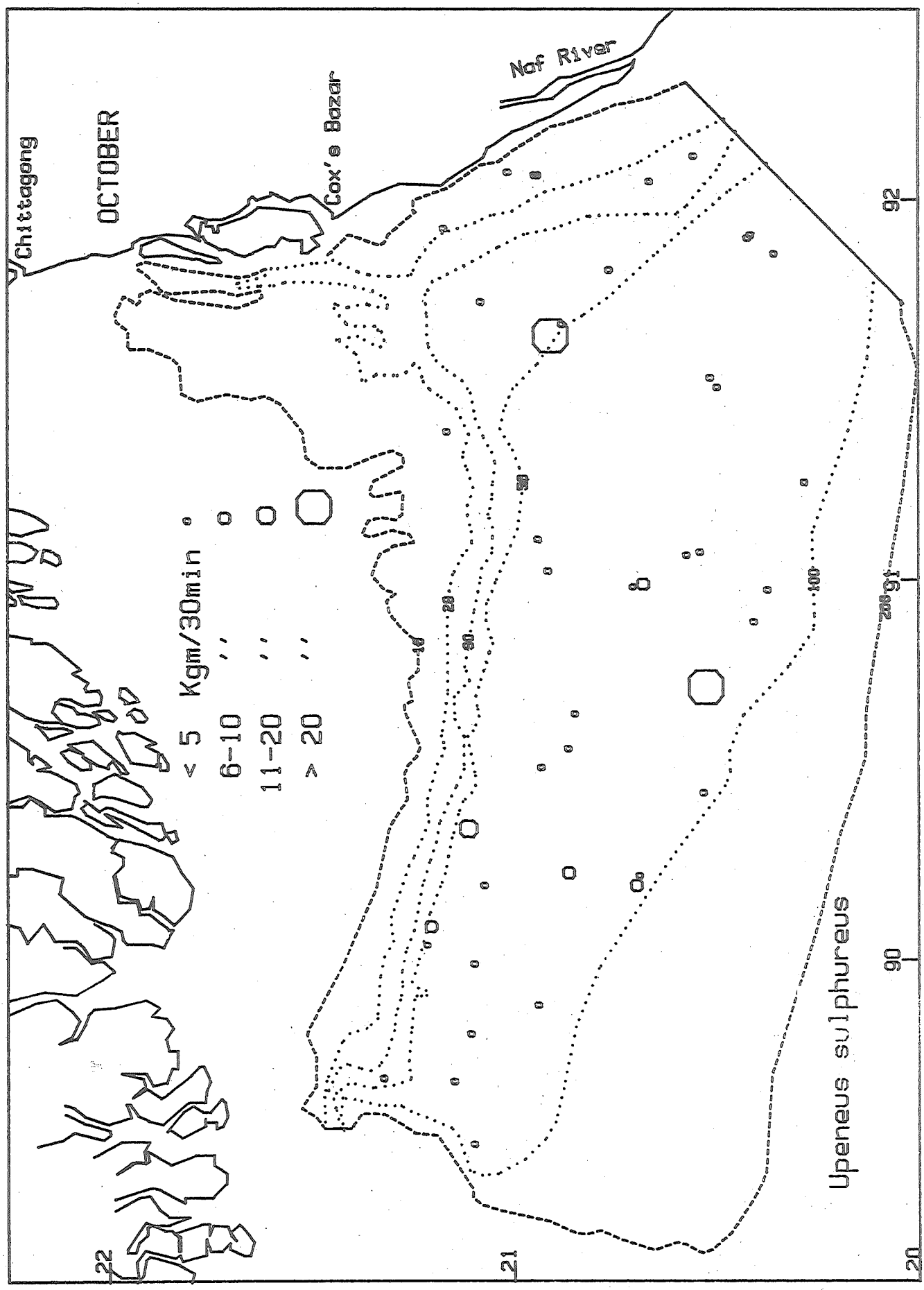

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 5 Kgm/30min
6-10 ''
11-20 ''
> 20 ''
Upeneus sulphureus
92
91
90
21
20
22

FIG. 28

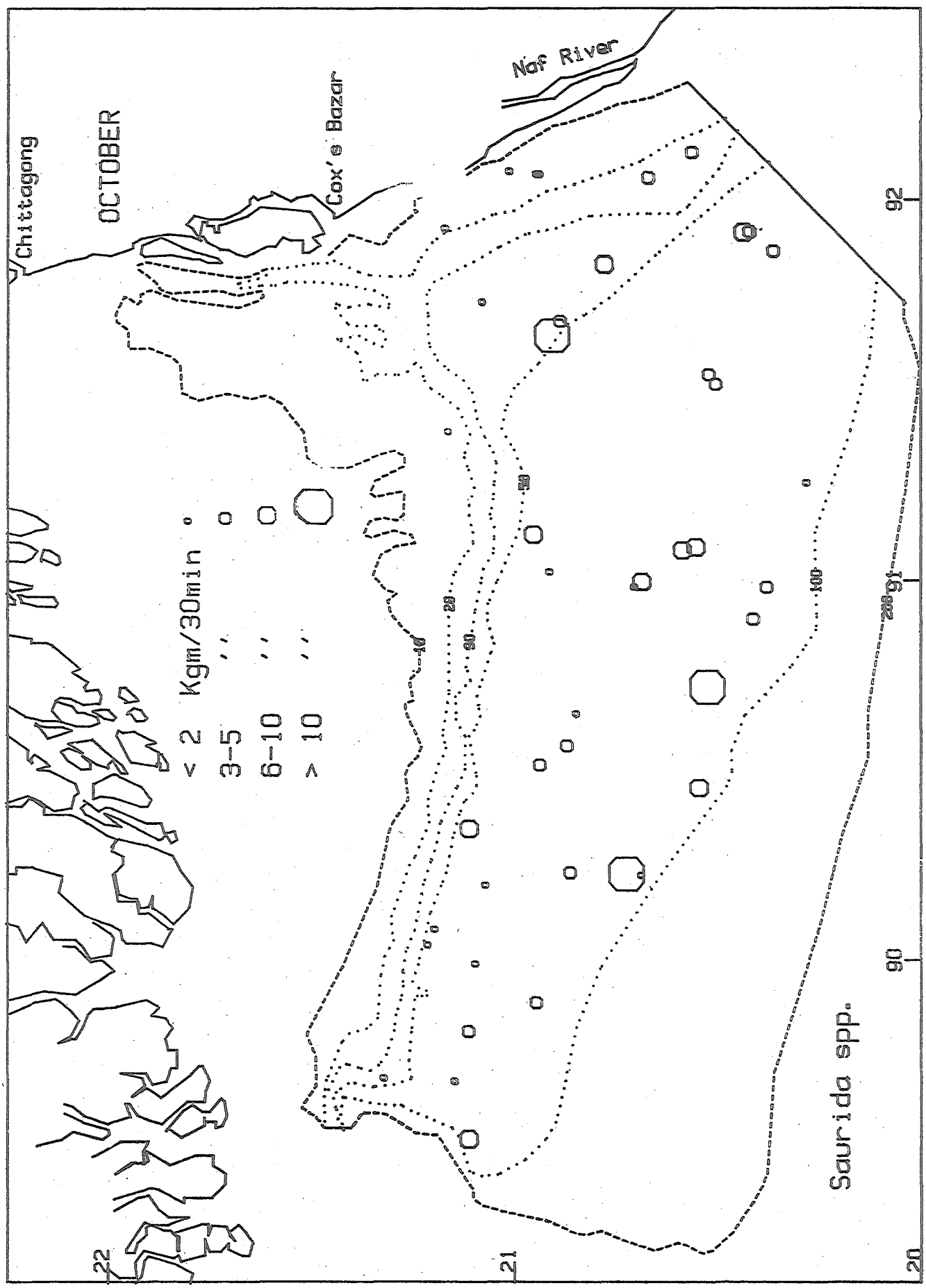

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 2 Kgm/30min
3-5 ''
6-10 ''
> 10 ''
Saurida spp.
22
21
20
90
91
92

FIG.29

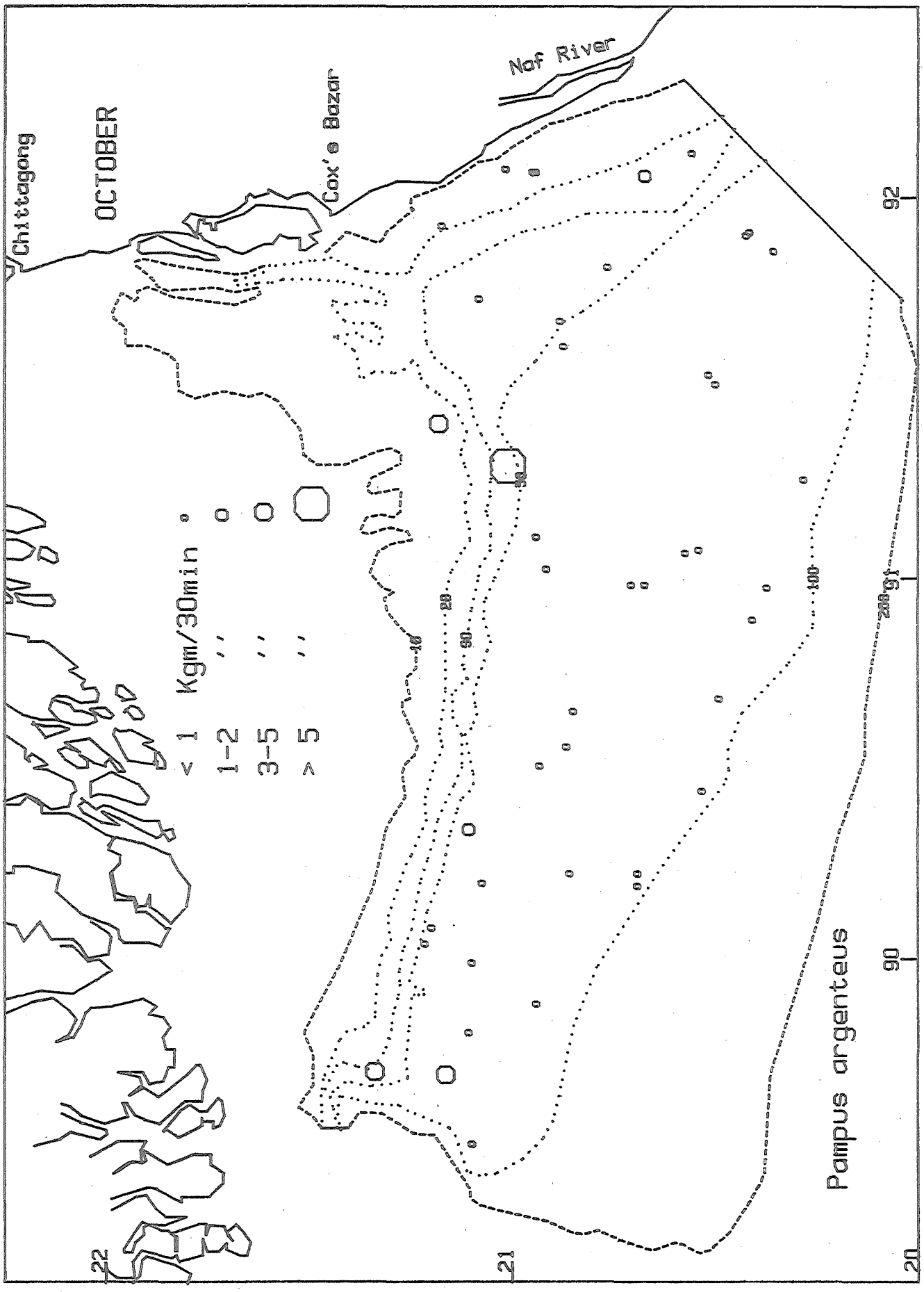

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 1 Kgm/30min
1-2 ''
3-5 ''
> 5 ''
10
20
50
100
200
Pampus argenteus
22
21
20
91
92

FIG.30

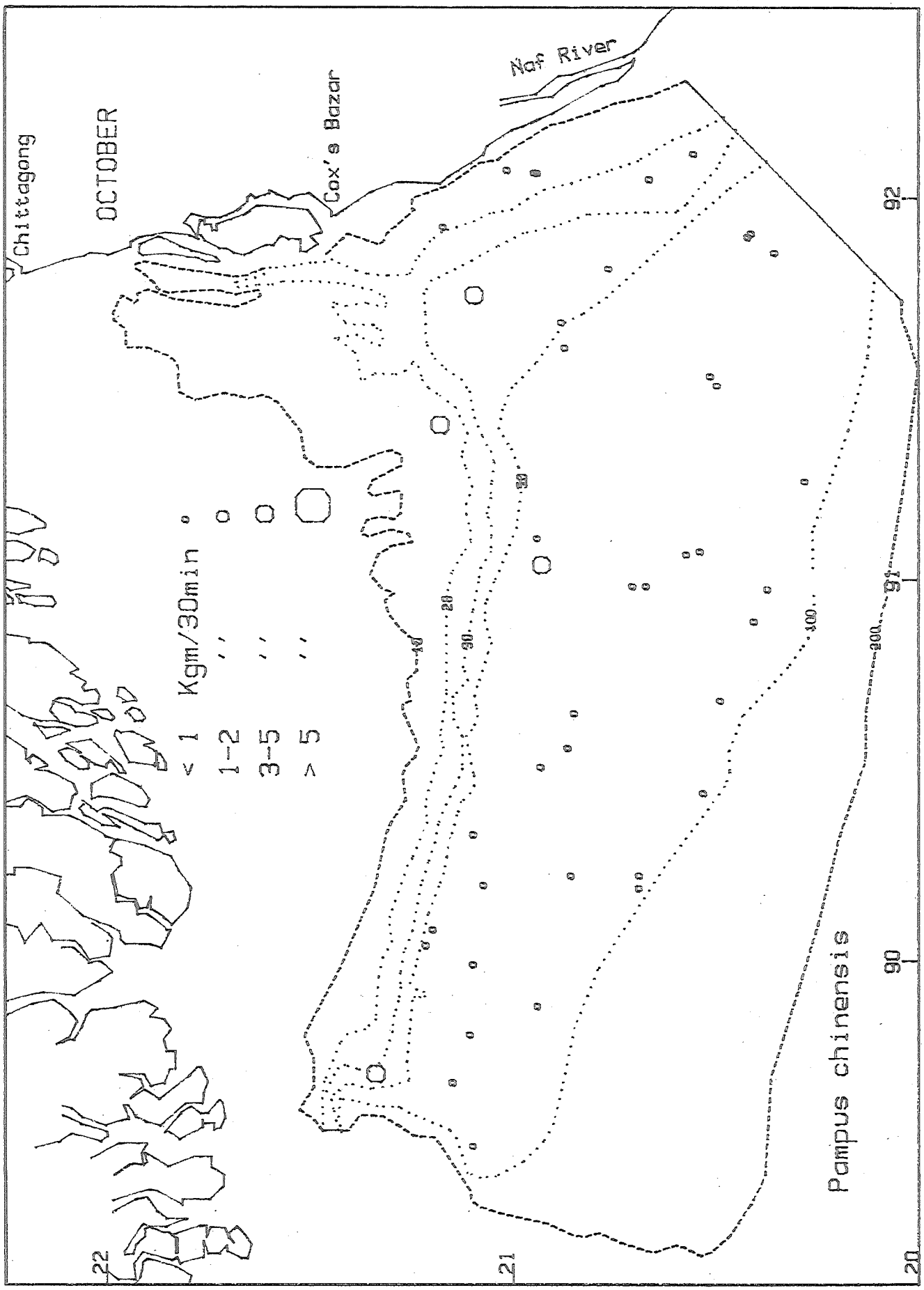

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 1 Kgm/30min
1-2 ''
3-5 ''
> 5 ''
Pampus chinensis
22
21
20
90
91
92
10
20
30
50
100
200

FIG. 31

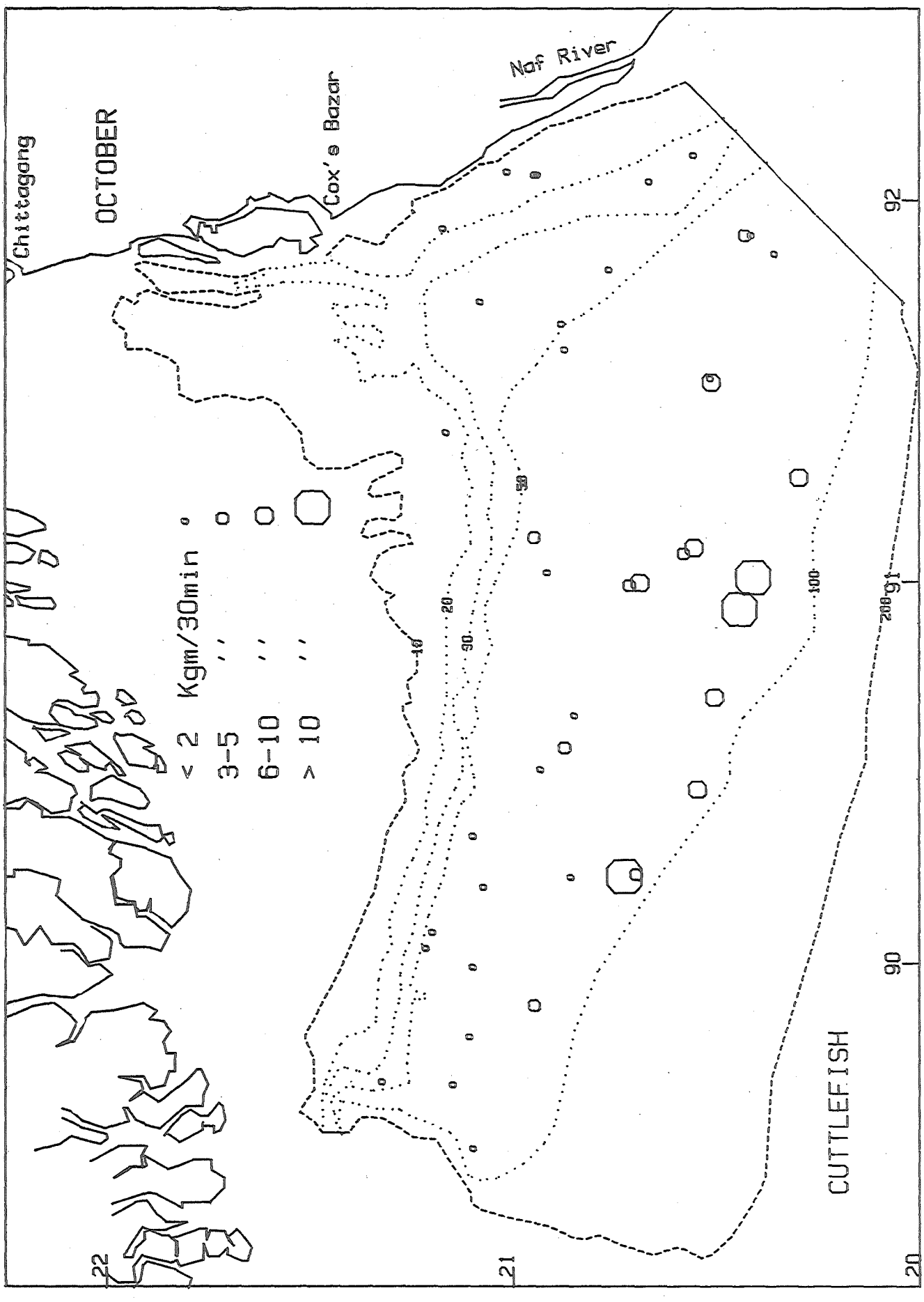

Chittagang
OCTOBER
Cox's Bazar
Naf River
< 2 Kgm/30min
3-5 ''
6-10 ''
> 10 ''
10
20
30
50
100
200
91
92
90
21
22
CUTTLEFISH

FIG.32

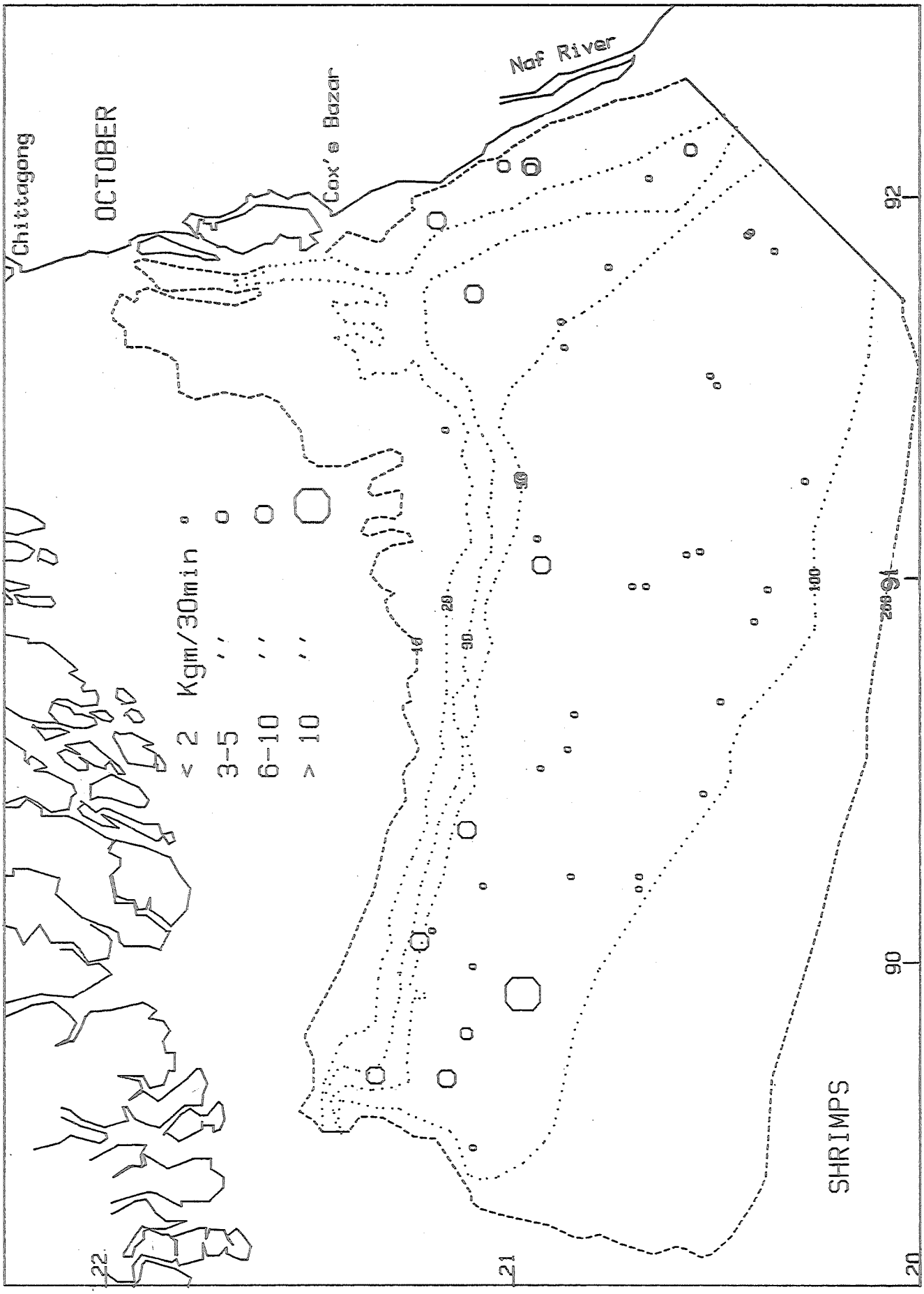

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 2 Kgm/30min
3-5 " "
6-10 " "
> 10 " "
SHRIMPS
22
21
20
90
91
92

FIG. 33

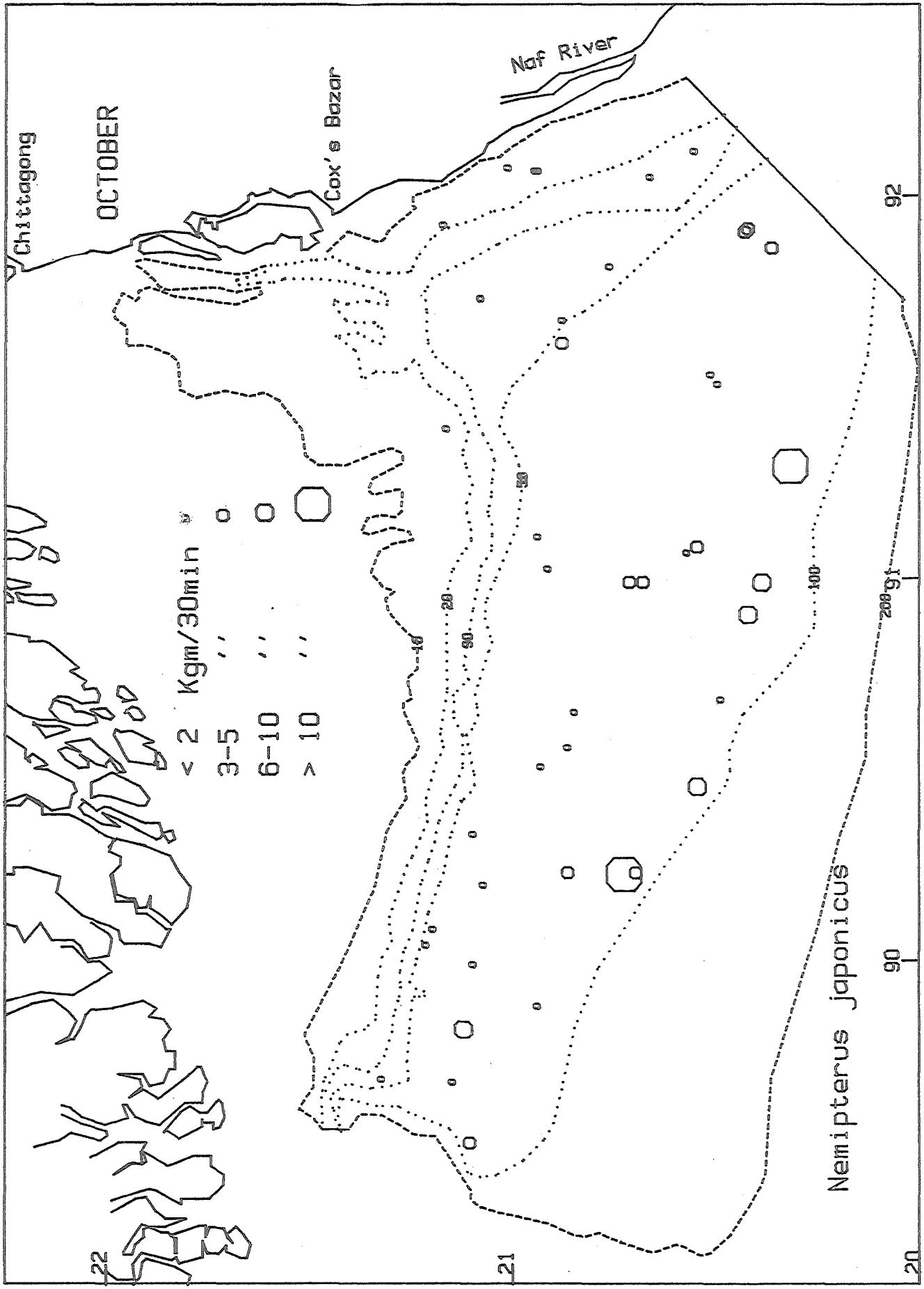

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 2 Kgm/30min
3-5 " "
6-10 " "
> 10 " "
Nemipterus japonicus
22
21
20
90
91
92
10
20
50
100
200

FIG. 34

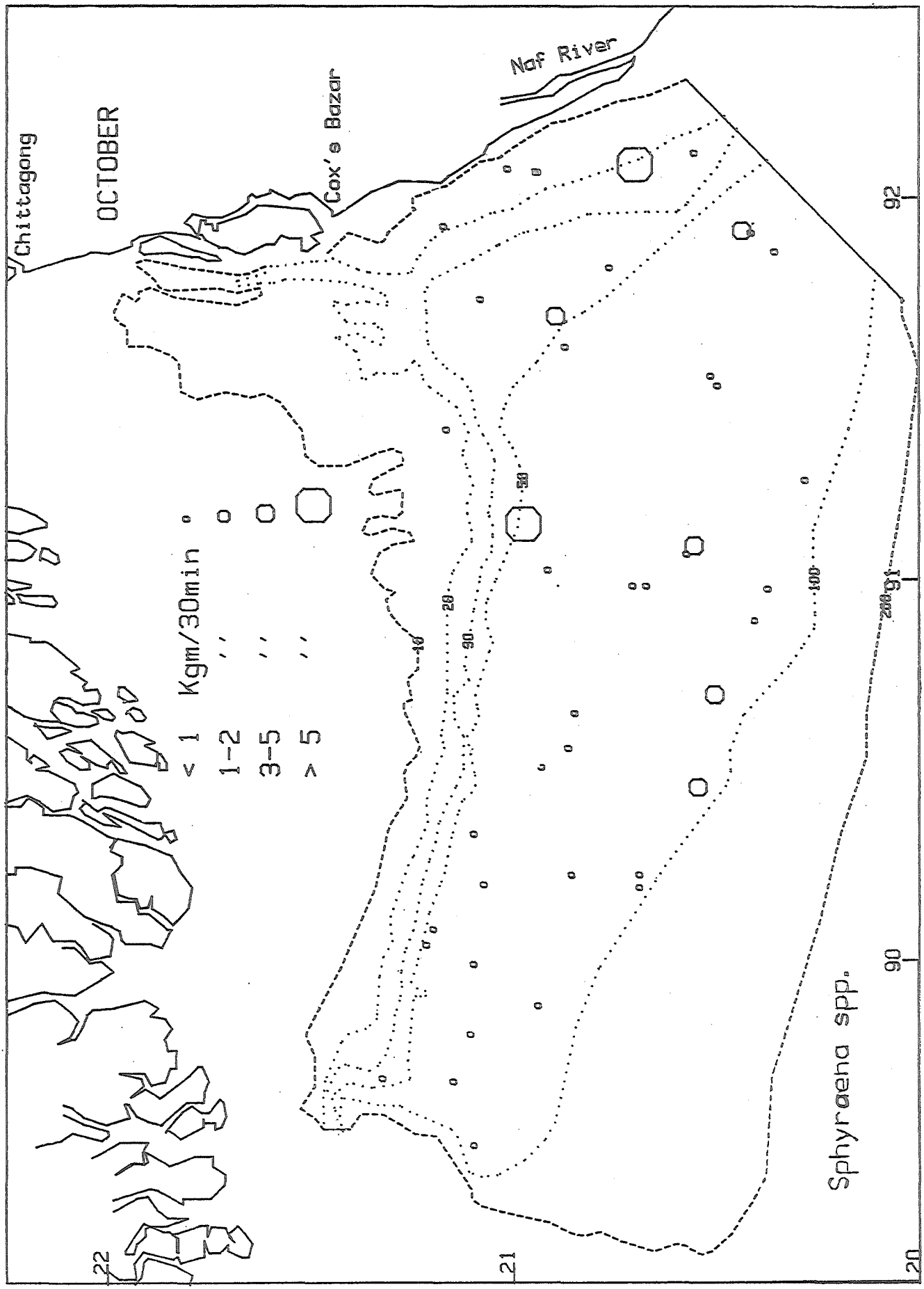

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 1 Kgm/30min
1-2 ,,
3-5 ,,
> 5 ,,
10
20
50
100
200
Sphyraena spp.
22
21
20
92
91
90

FIG. 35

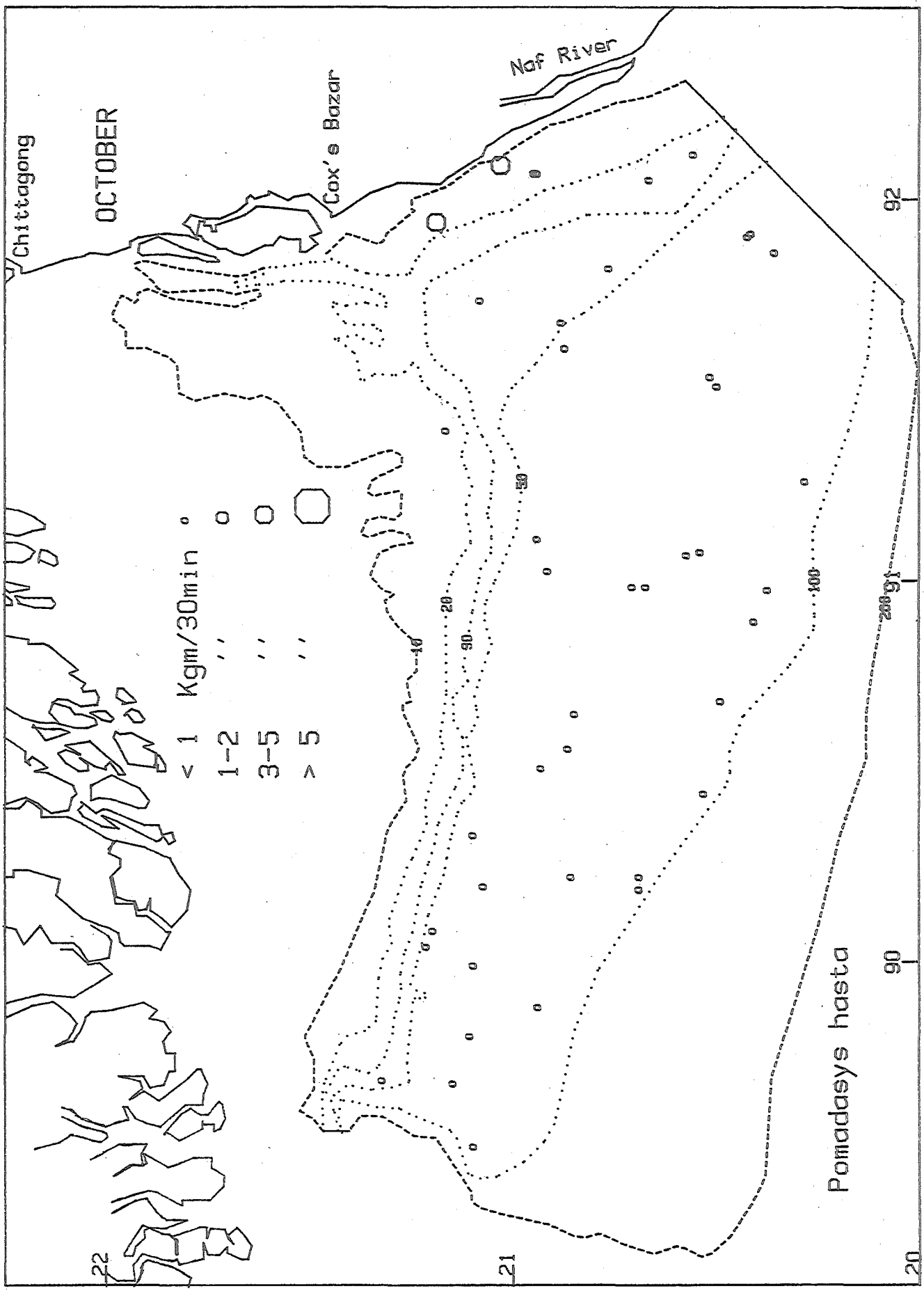

Chittagong
OCTOBER
Cox's Bazar
Naf River
< 1 Kgm/30min
1-2 ''
3-5 ''
> 5 ''
10
20
50
100
200
Pomadasys hasta
22
21
20
92
91
90

FIG. 36

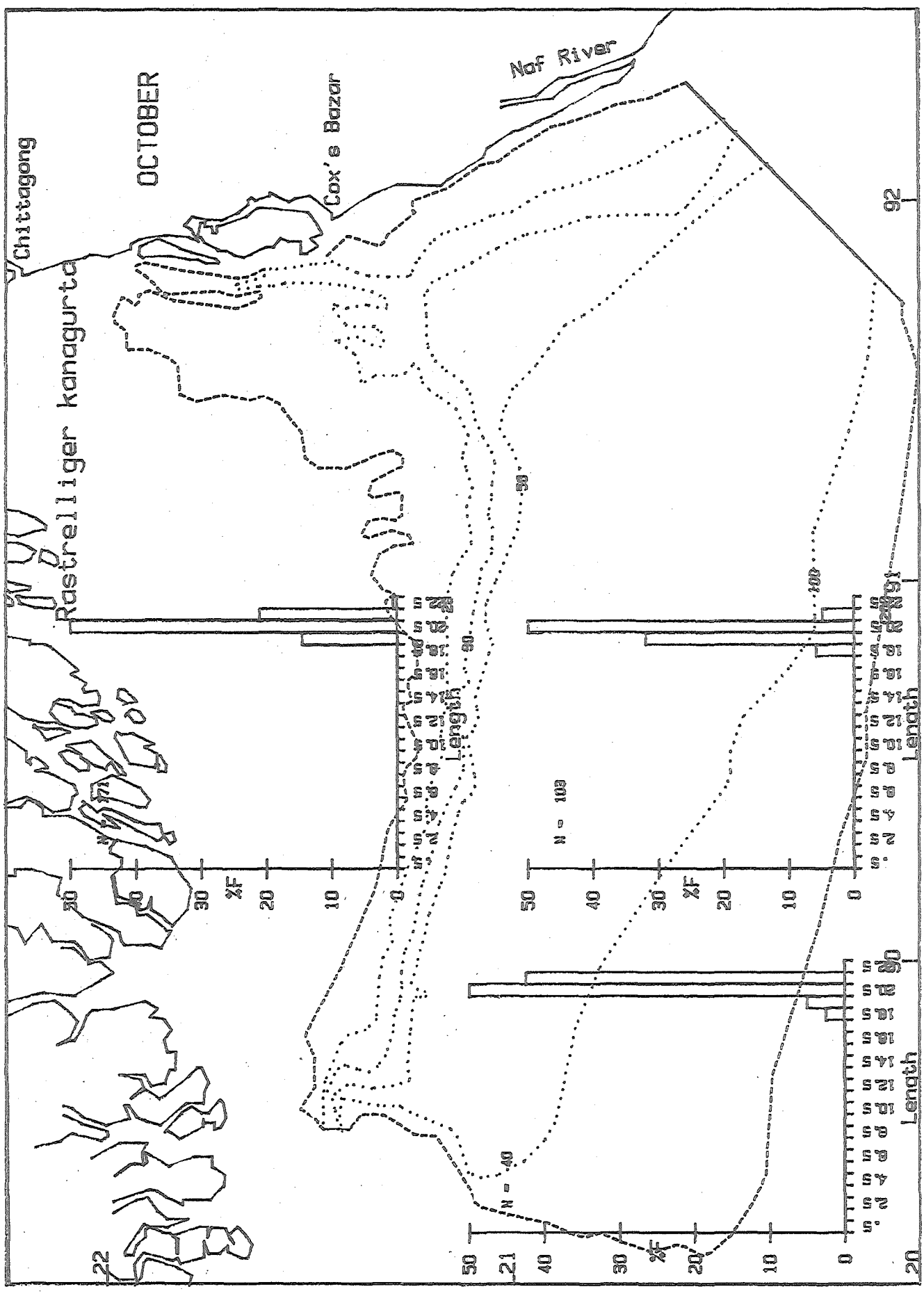

Chittagong
OCTOBER
Cox's Bazar
Naf River
Rastrelliger kanagurta
N = 103
N = 40
%F
Length

FIG. 37

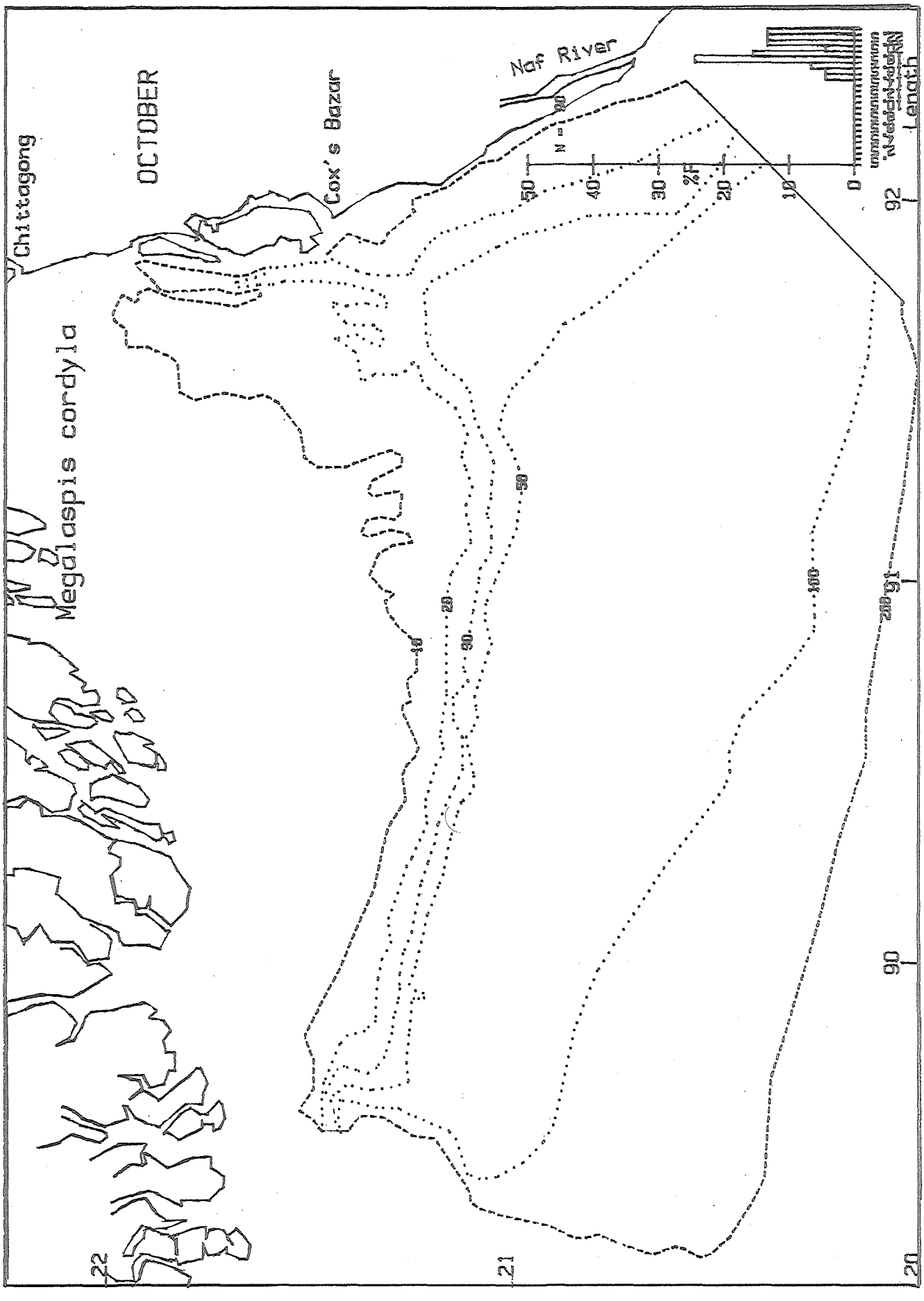

Chittagong
OCTOBER
Cox's Bazar
Naf River
Megalaspis cordyla
N
%F
Length
22
21
20
92
90
91

FIG. 38

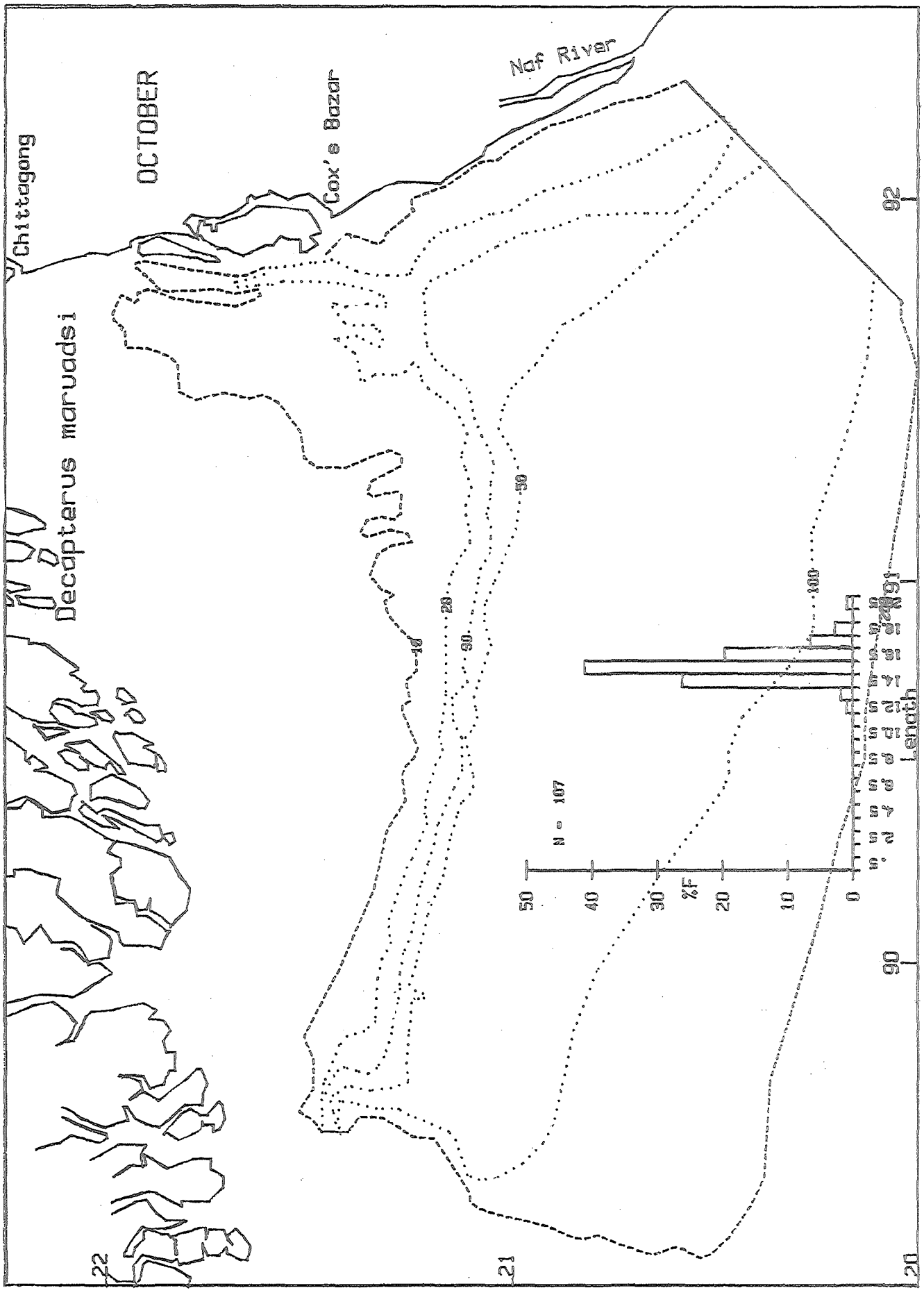

Chittagong
OCTOBER
Cox's Bazar
Naf River
Decapterus maruadsi
22
21
20
90
92
10
20
30
50
100
N = 107
%F
Length

FIG. 39

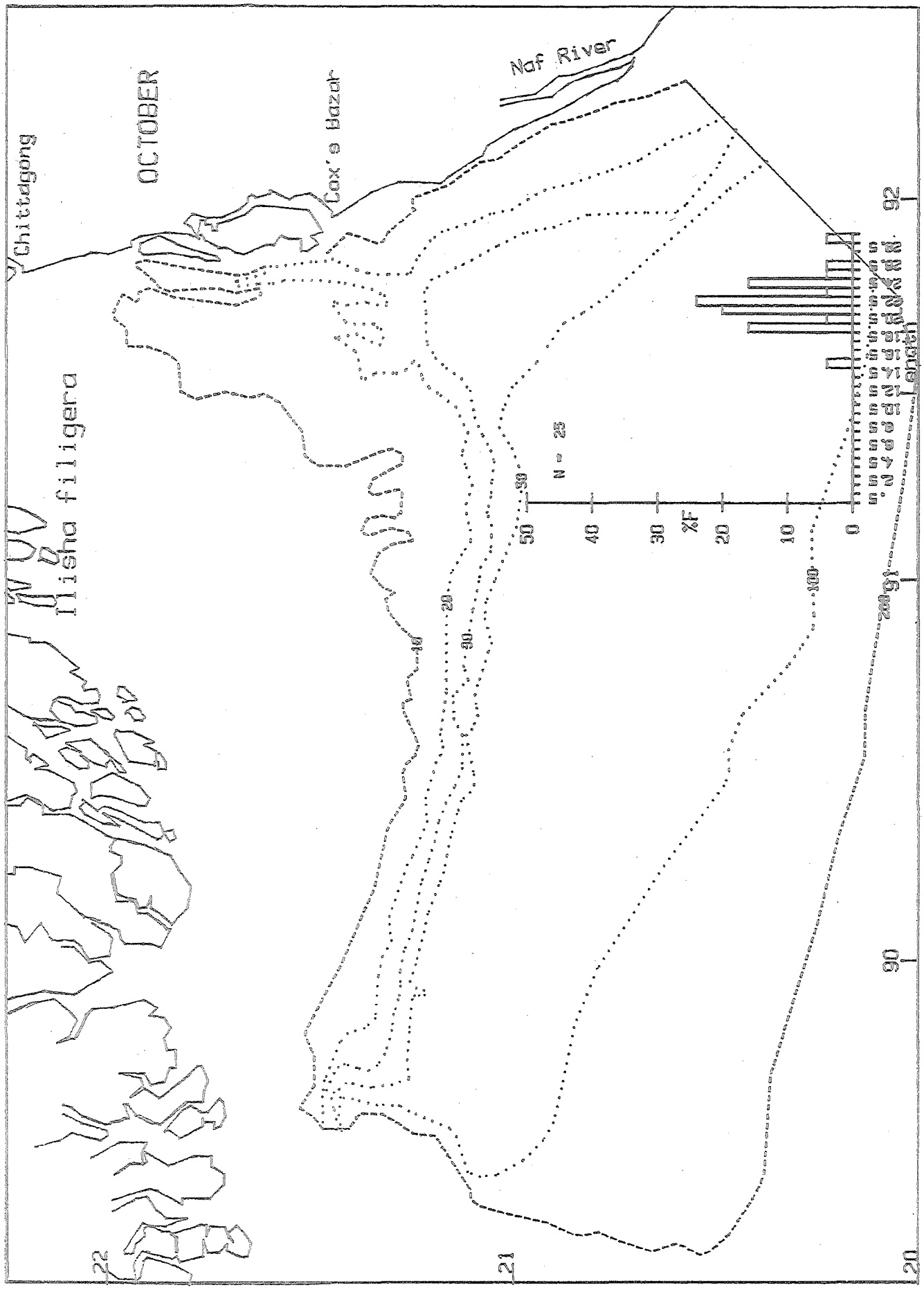

Chittagong
OCTOBER
Cox's Bazar
Naf River
Ilisha filigera
N = 25
%F
50
40
30
20
10
0
20
30
100
22
21
90
92
20

FIG. 40

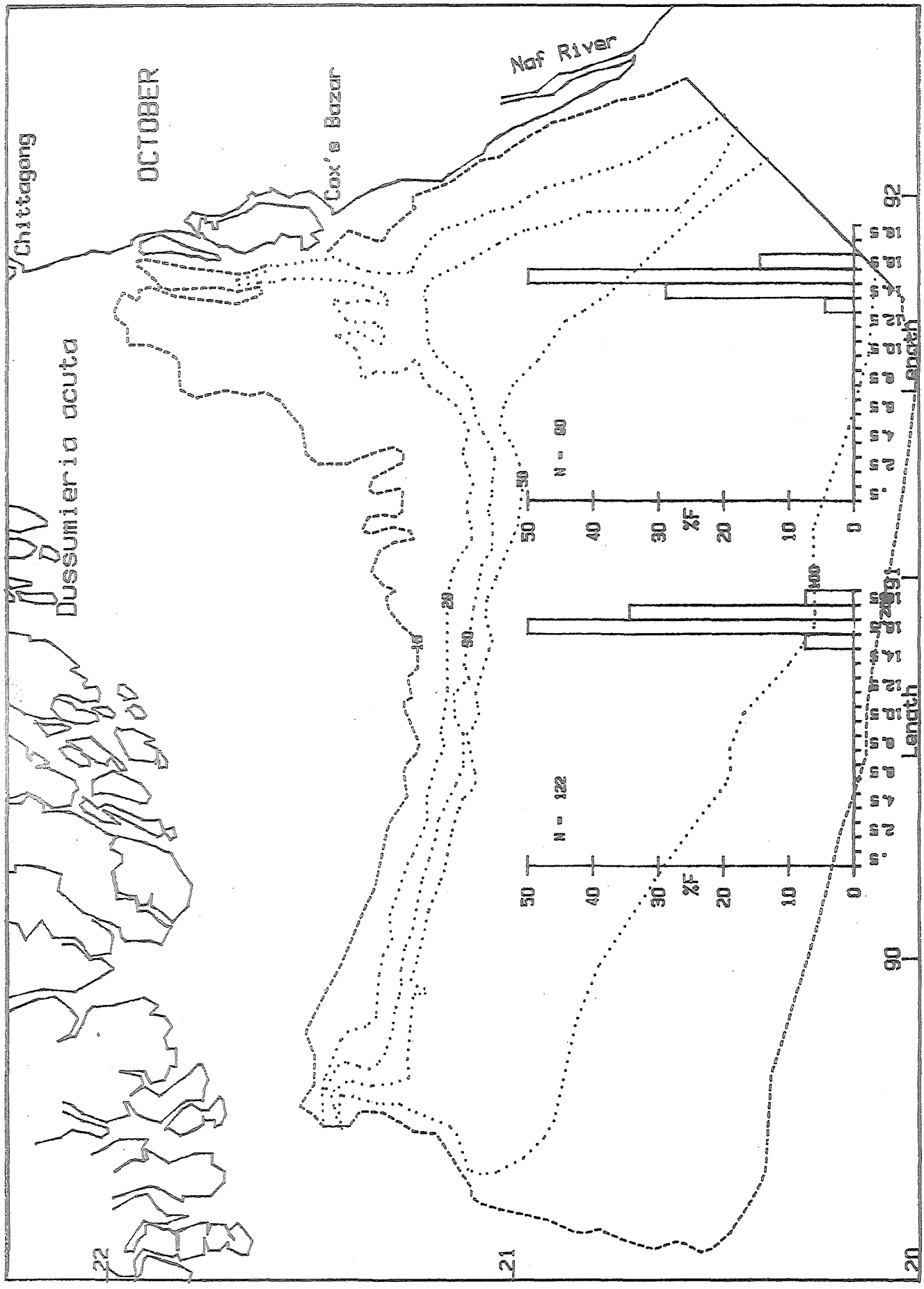

Chittagong
OCTOBER
Cox's Bazar
Naf River
Dussumieria acuta
N = 122
N = 89
%F
Length
22
21
20
90
92

FIG. 41

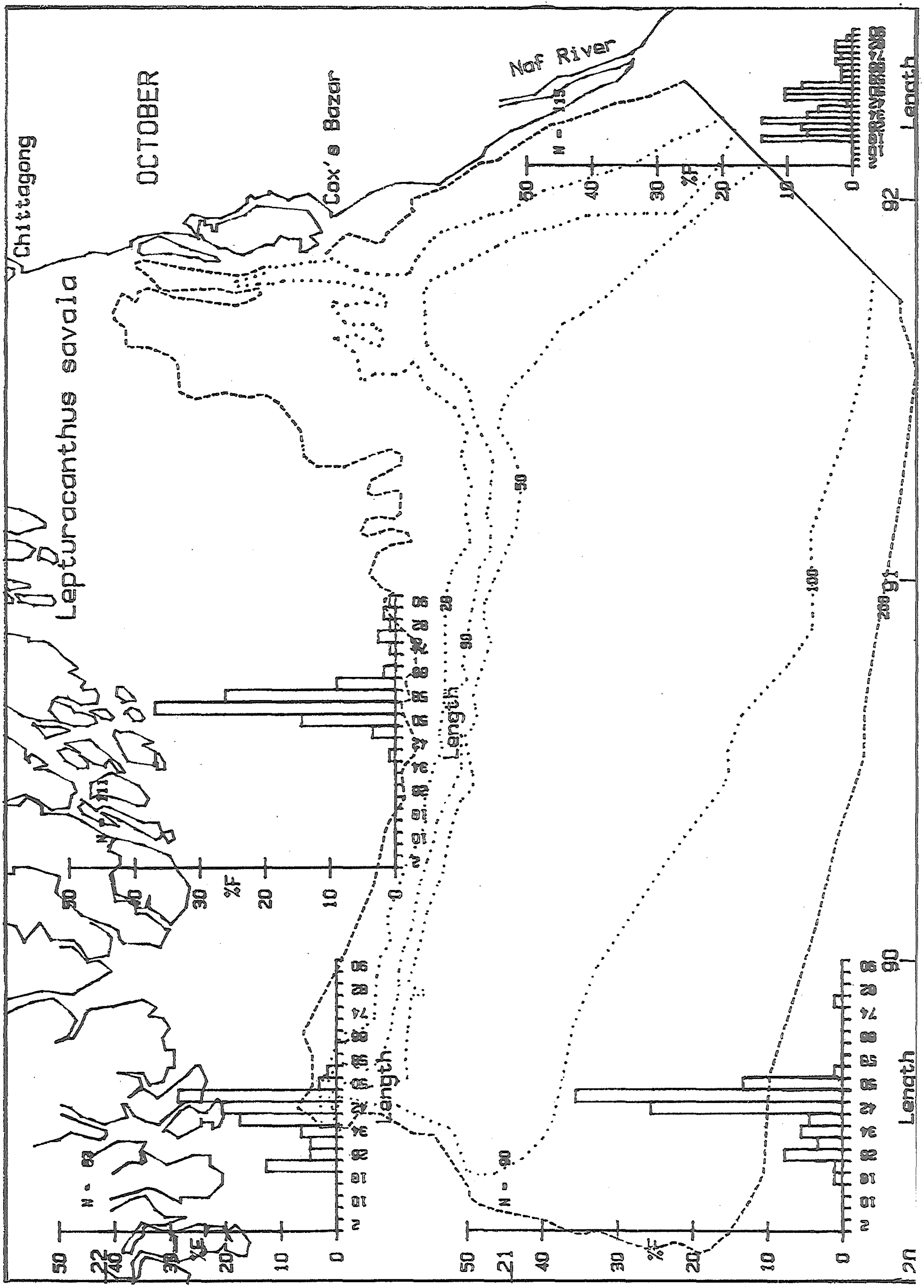

Lepturacanthus savala
OCTOBER
Chittagong
Cox's Bazar
Naf River
%F
Length
90
91
92

FIG. 42

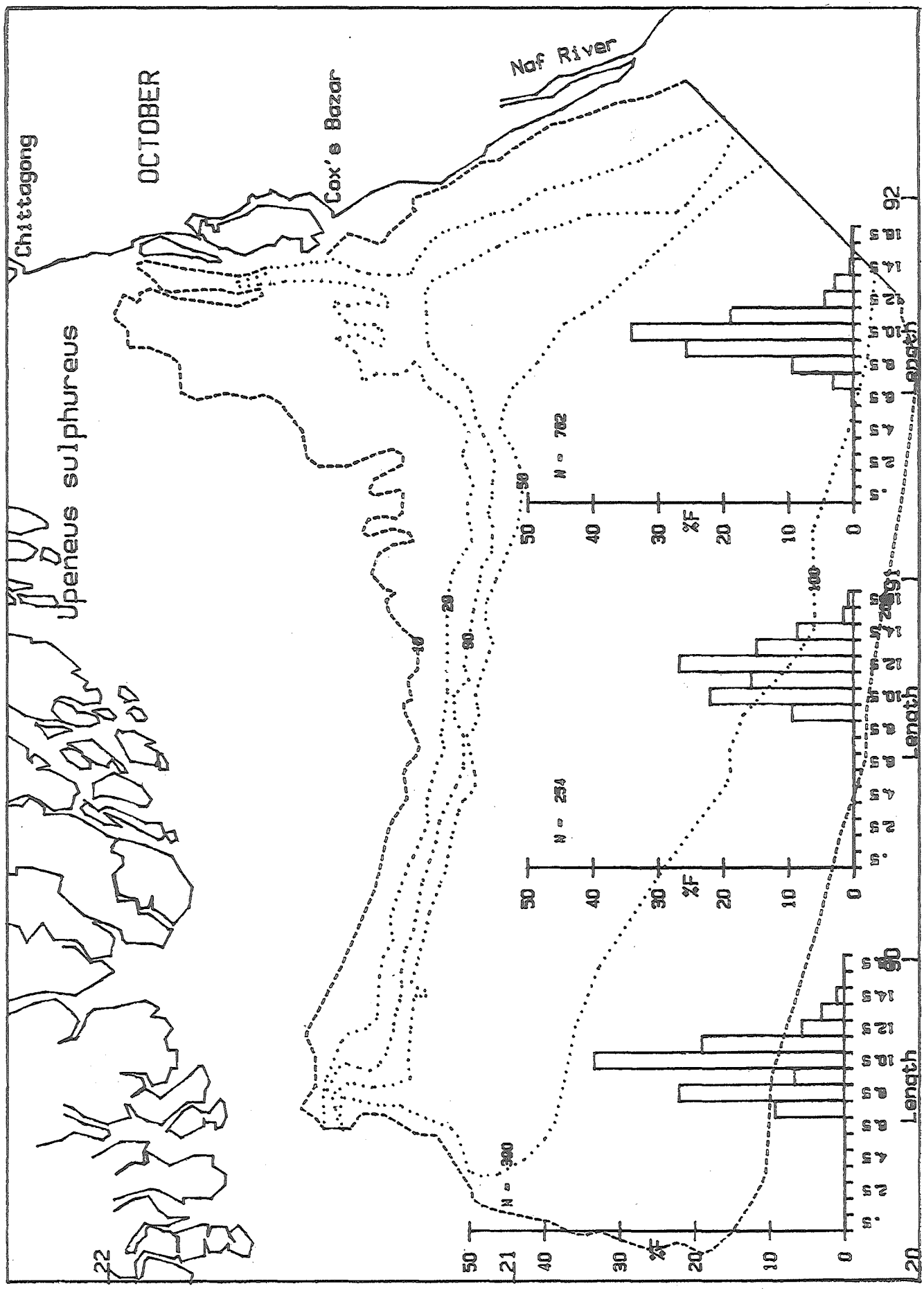

Chittagong
OCTOBER
Cox's Bazar
Naf River
Upeneus sulphureus
N = 300
N = 234
N = 702
%F
Length

FIG. 43

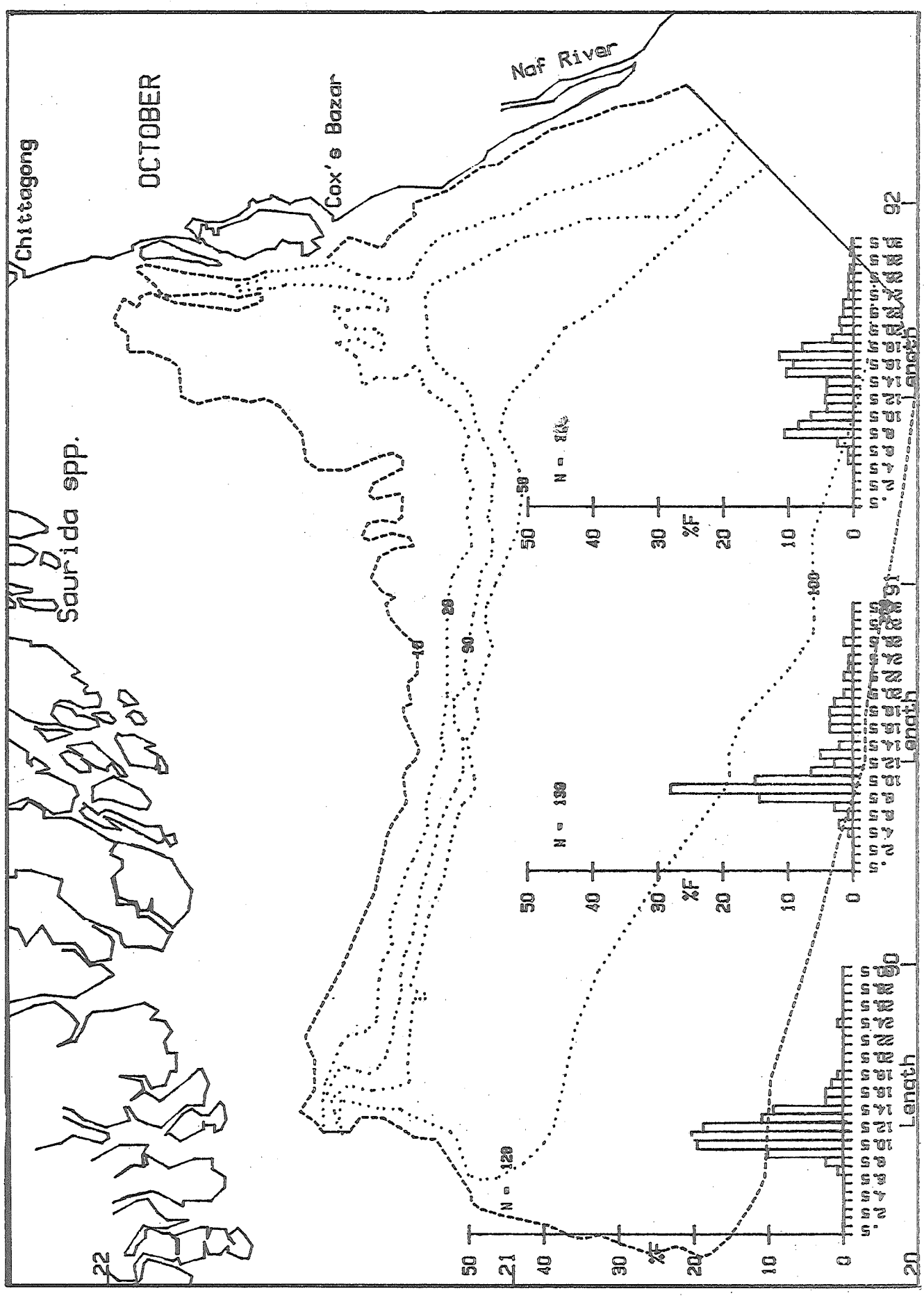

Chittagong
OCTOBER
Cox's Bazar
Naf River
Saurida spp.
10
20
50
100
N = 120
N = 139
N = 84
%F
Length
22
21
20
91
92

FIG. 44

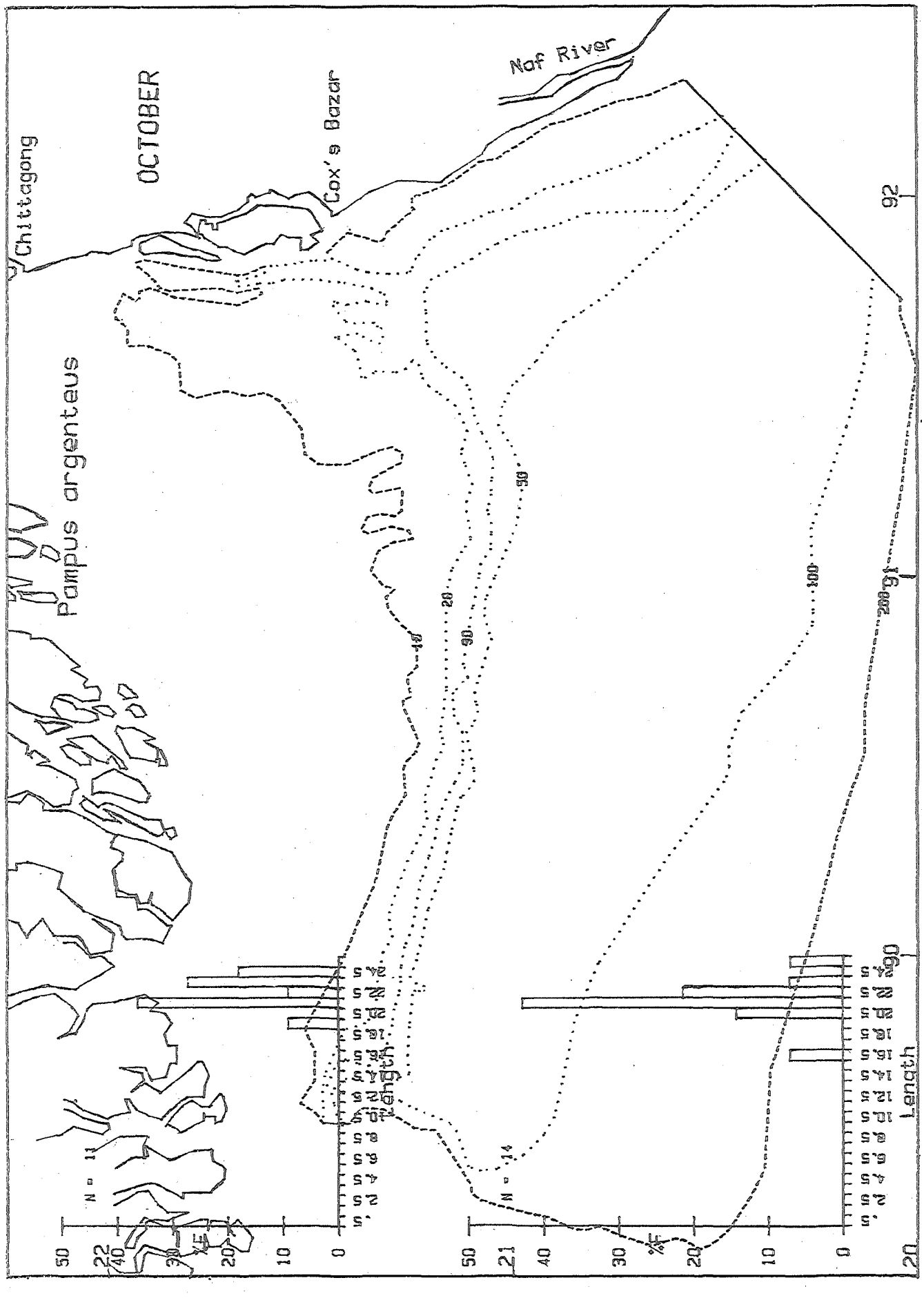

Chittagong
OCTOBER
Cox's Bazar
Naf River
Pampus argenteus
50
40
30
20
10
0
%F
N = 11
Length
50
40
30
20
10
0
%F
N = 14
Length
92
91
20
21
22
%90

FIG. 45

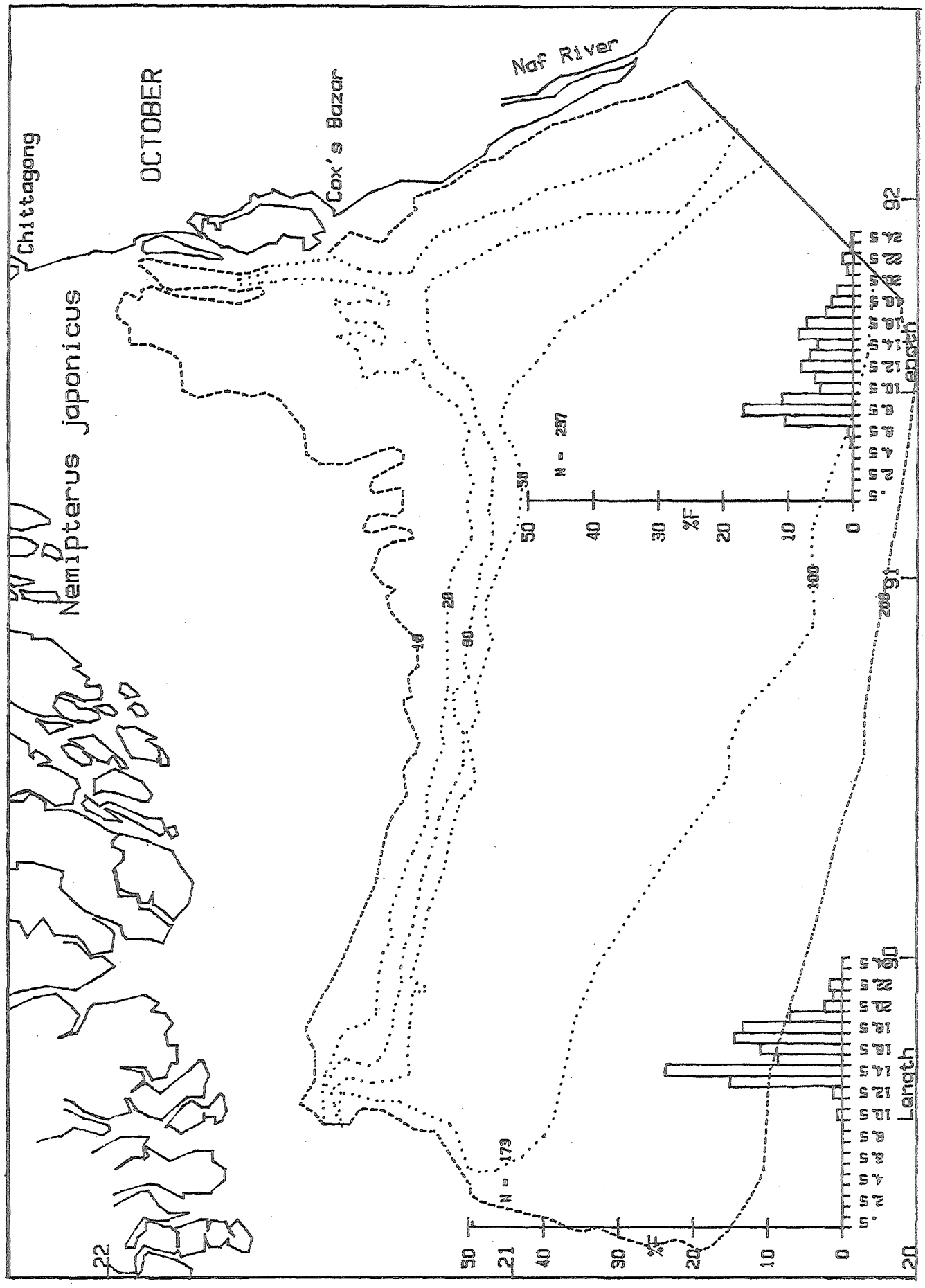

Chittagong
OCTOBER
Cox's Bazar
Naf River
Nemipterus japonicus
22
21
20
N = 179
N = 297
%F
Length
91
92
100
200
20
30
40
50
60
10
0

FIG. 46

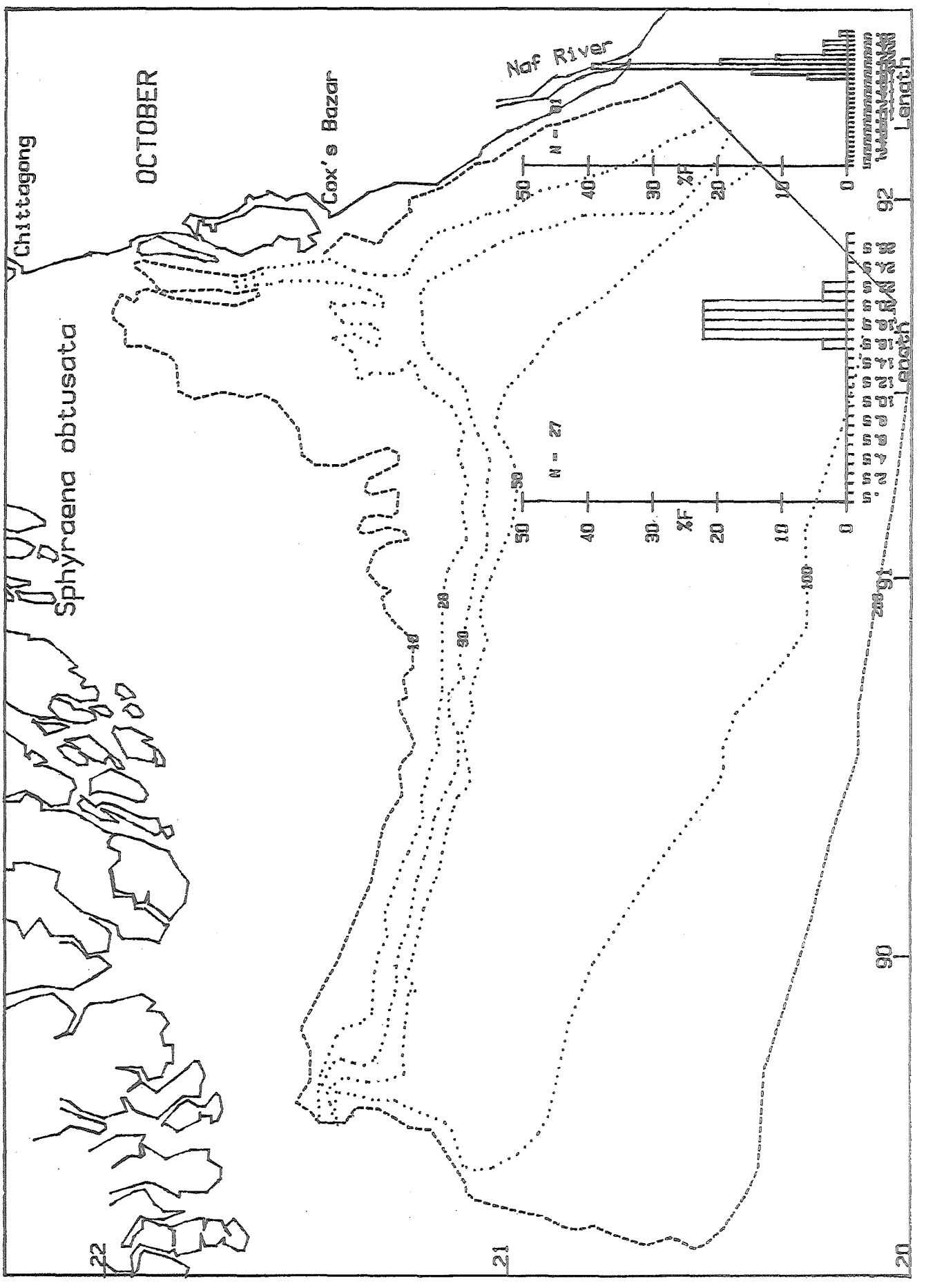

Chittagong
OCTOBER
Cox's Bazar
Naf River
Sphyraena obtusata
N = 27
%F
Length
22
21
20
91
92

FIG. 47

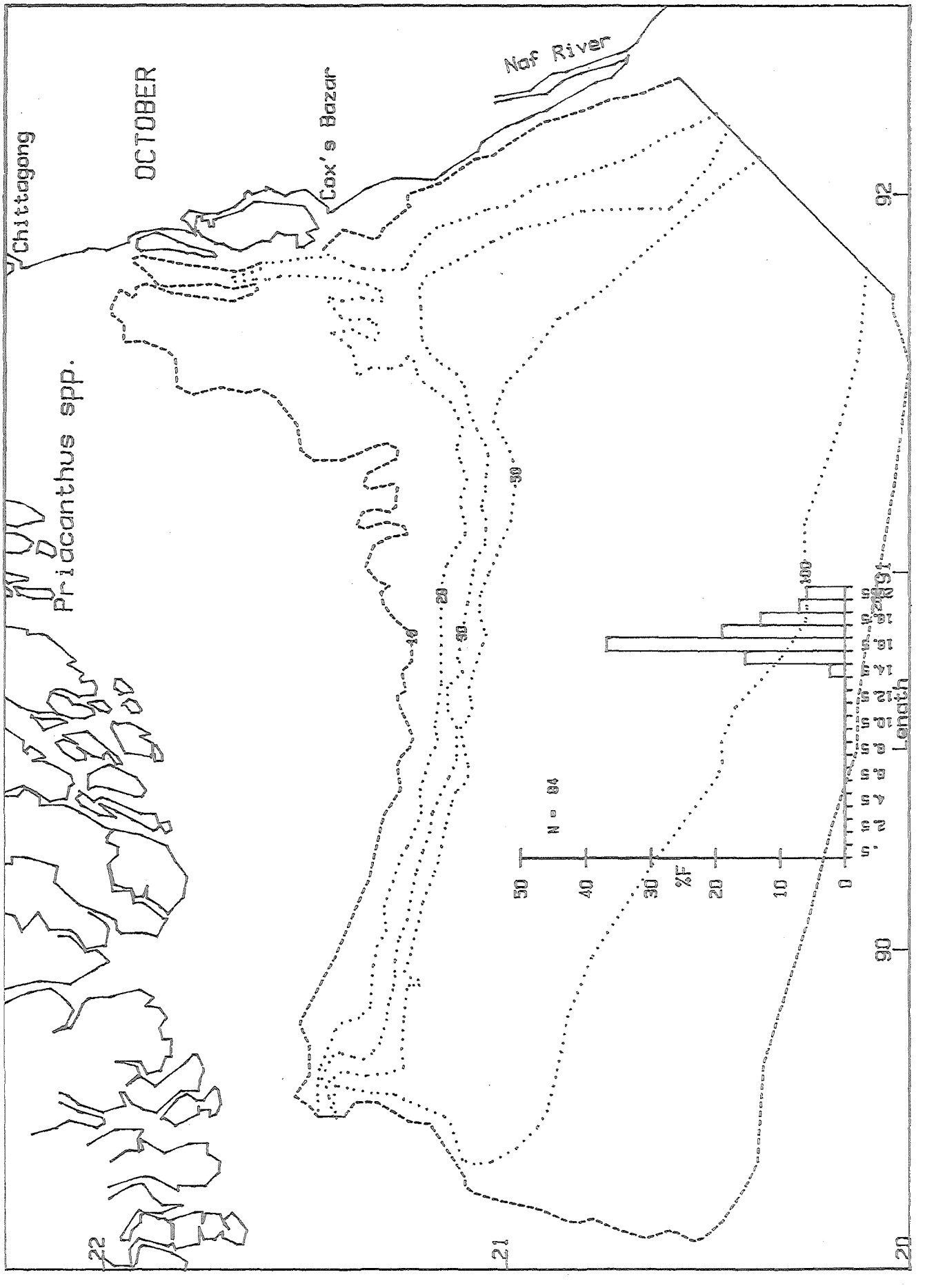

Chittagong
OCTOBER
Cox's Bazar
Naf River
Priacanthus spp.
10
20
50
92
91
90
21
22
N = 84
%F
50
40
30
20
10
0
Length

FIG. 48

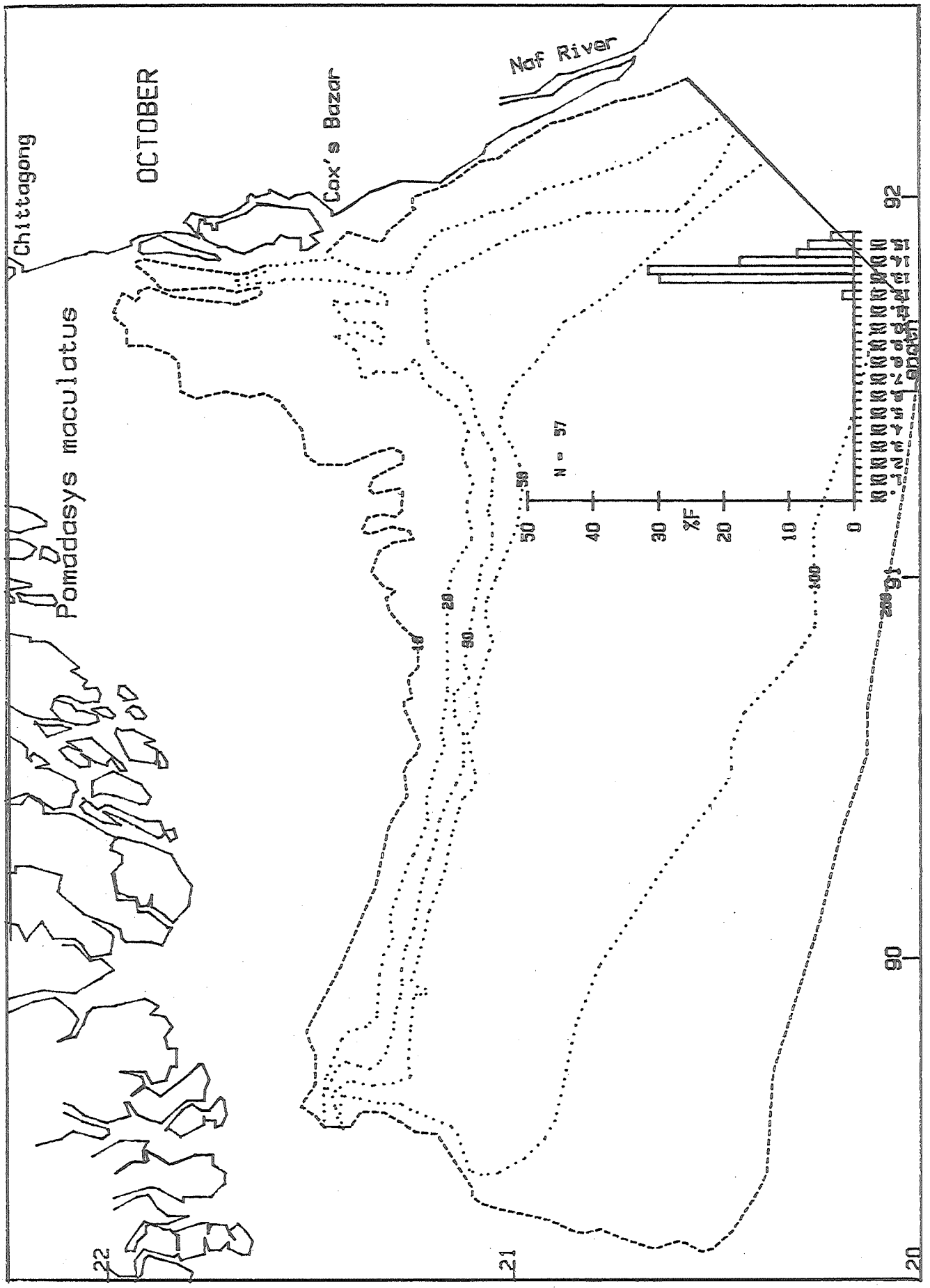

Chittagong
OCTOBER
Cox's Bazar
Naf River
Pomadasys maculatus
N = 57
%F
50
40
30
20
10
0
22
21
20
92
90
28
80
100
200

FIG. 49

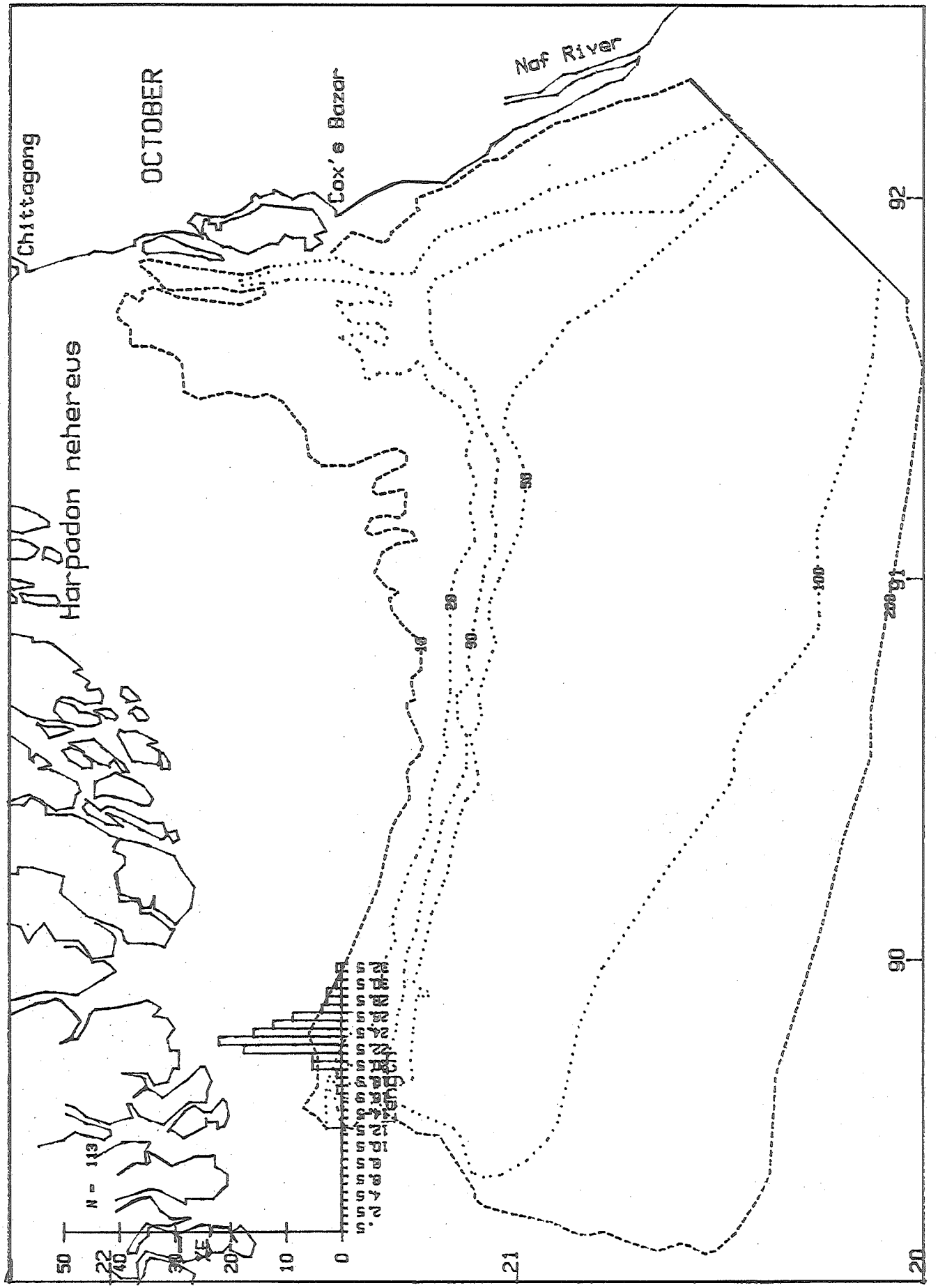

Chittagong
OCTOBER
Cox's Bazar
Naf River
Harpadon nehereus
N = 113
50
40
30
20
10
0
22
21
20
90
92
gt
10
20
50
100
200

FIG. 50

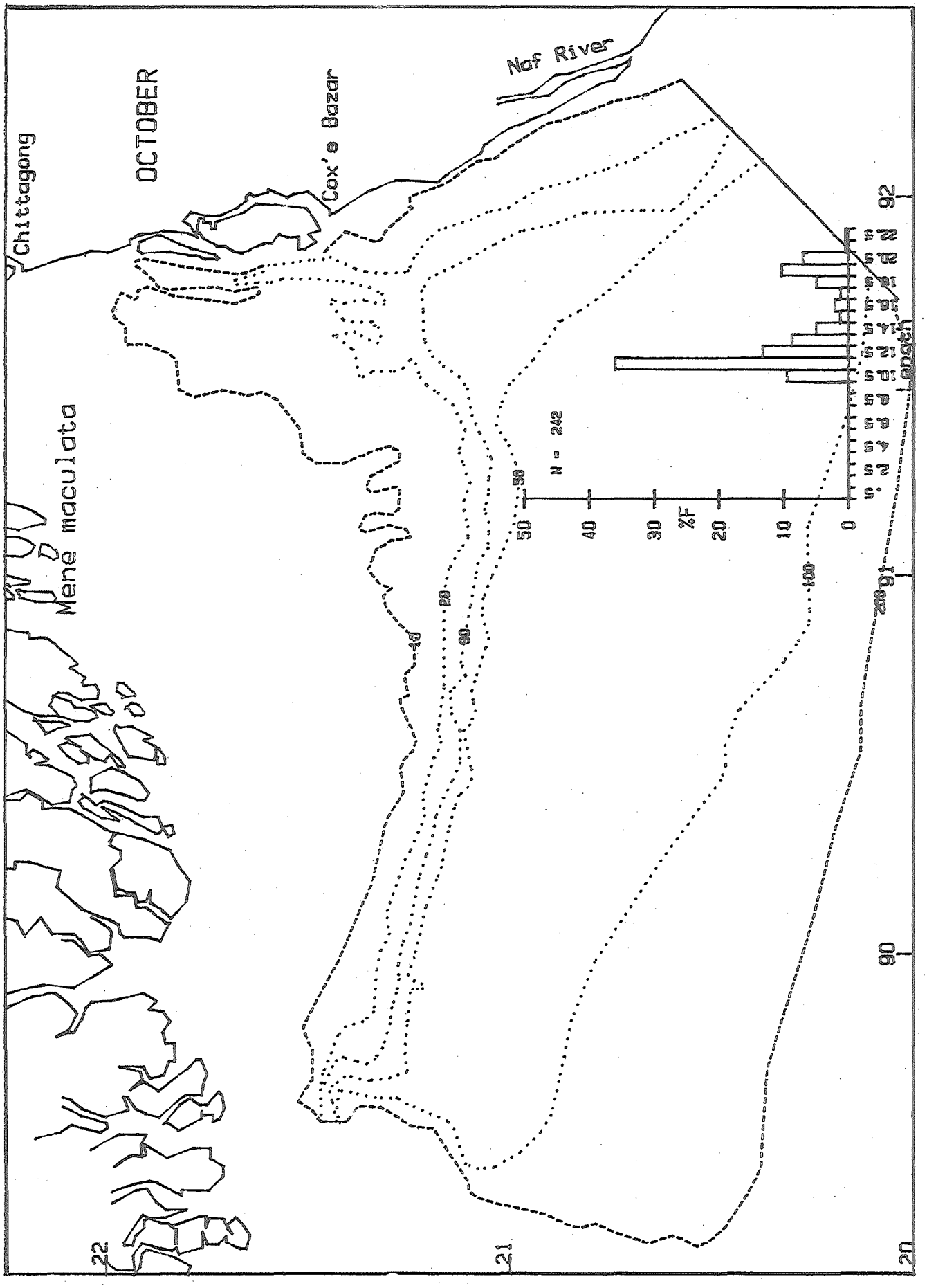

Chittagong
OCTOBER
Cox's Bazar
Naf River
Mene maculata
N = 242
%F
Length
22
21
20
90
92

FIG.51

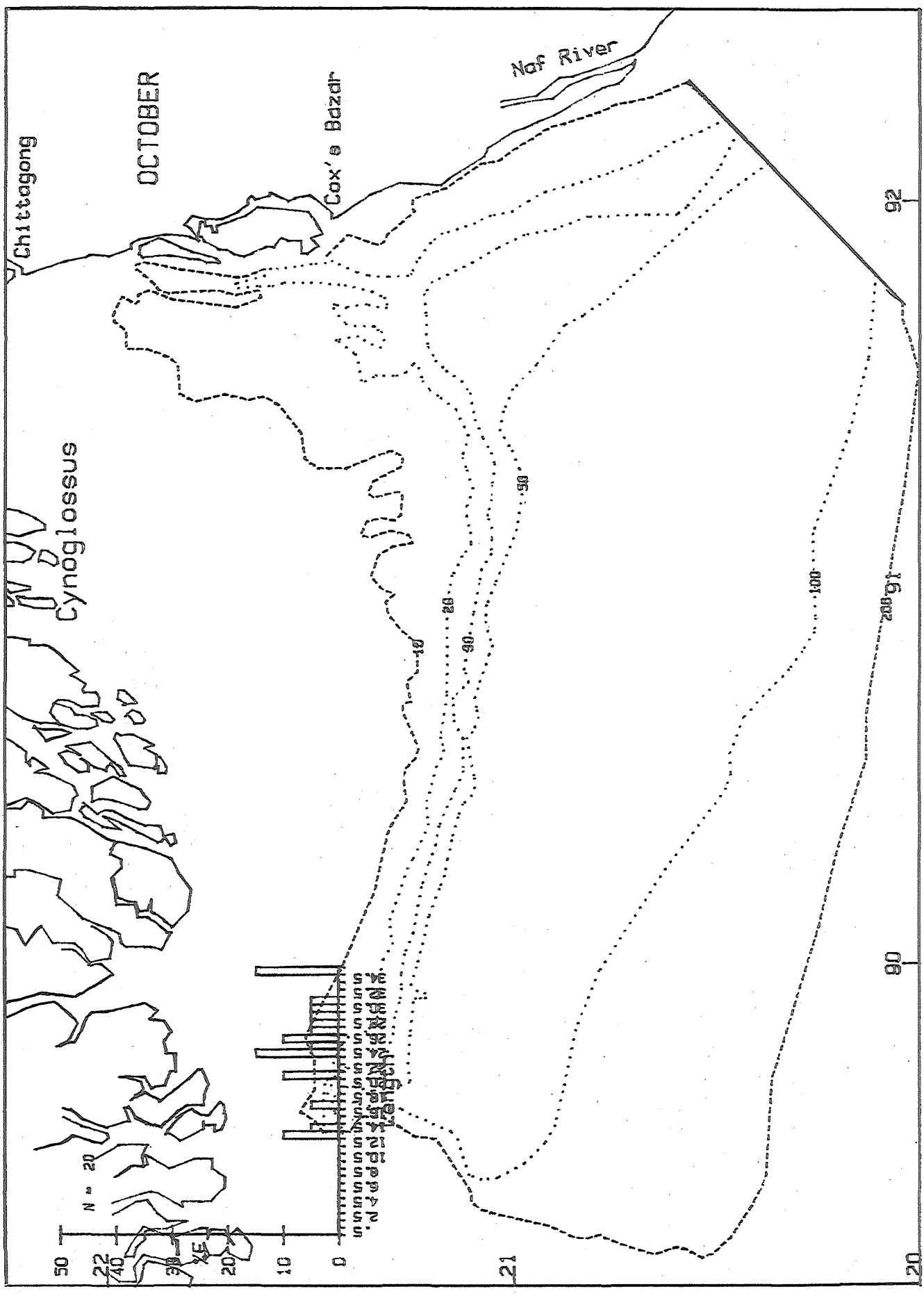

Chittagong
OCTOBER
Cox's Bazar
Naf River
Cynoglossus
92
91
90
21
20
10
20
50
100
200
50
40
30
20
10
0
22
N = 20
XE

FIG. 52

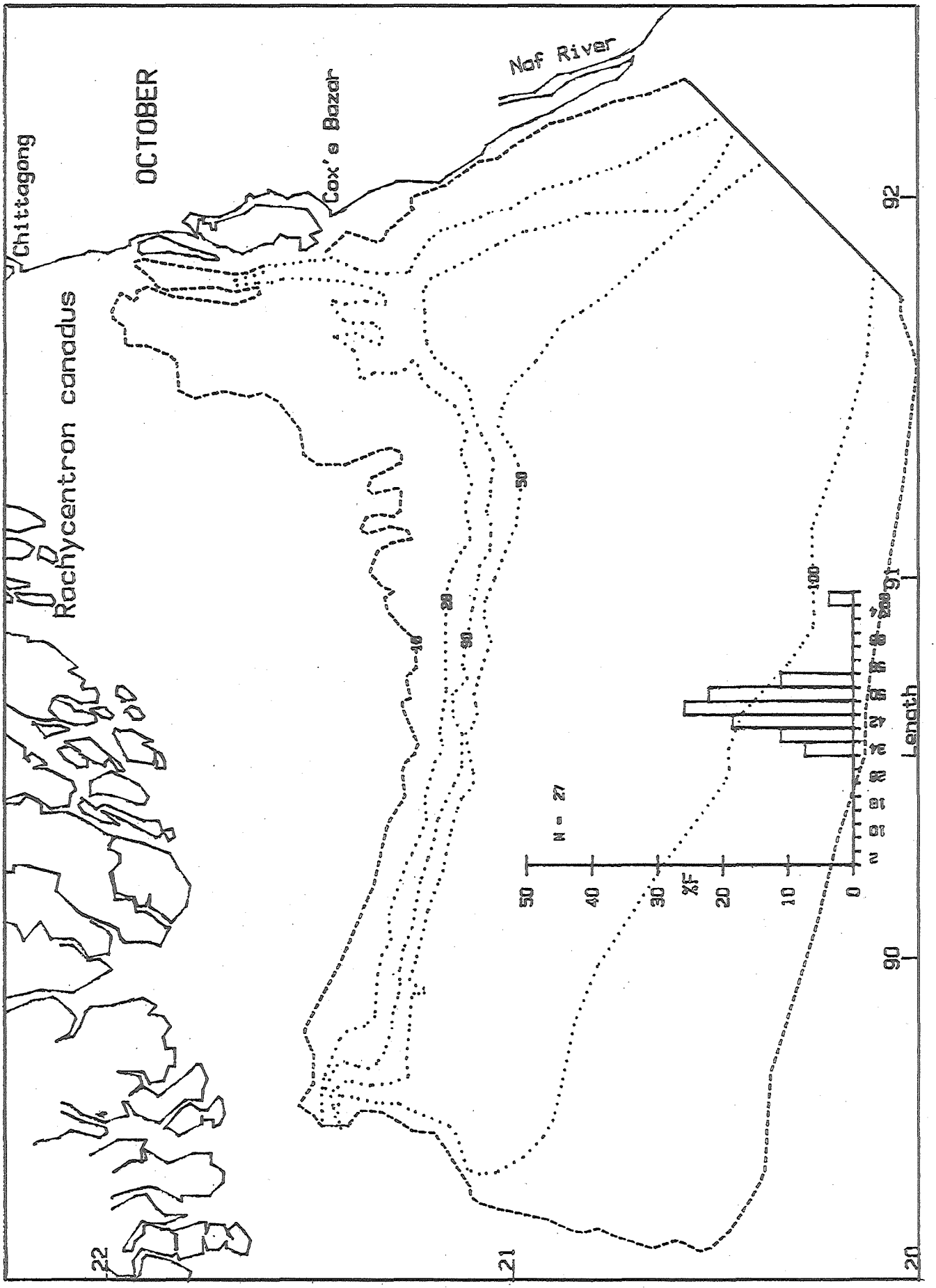

Chittagong
OCTOBER
Cox's Bazar
Naf River
Rachycentron canadus
10
20
30
50
100
N = 27
%F
Length
22
21
20
91
92

FIG.53

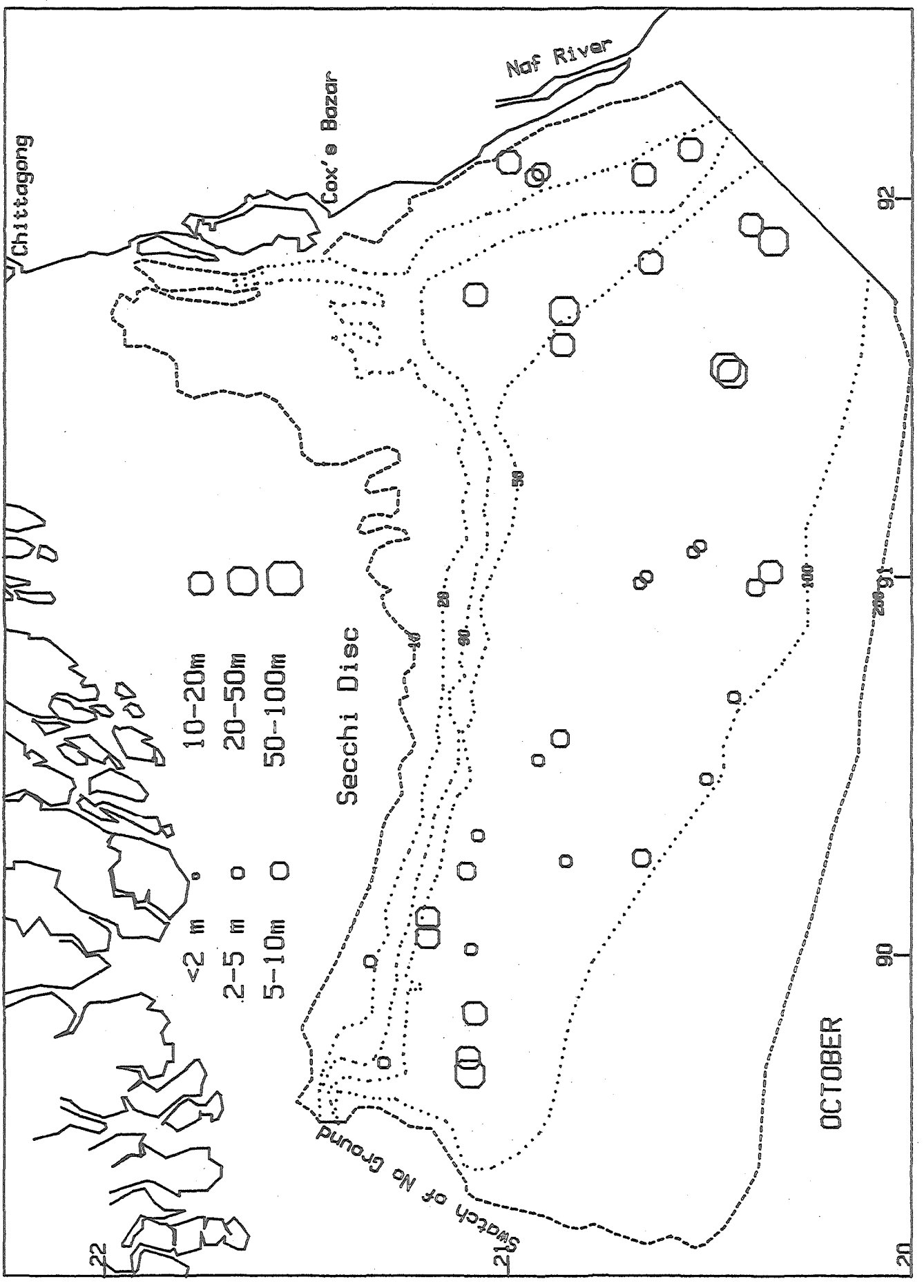

Chittagong
Cox's Bazar
Naf River
Secchi Disc
10-20m
20-50m
50-100m
<2 m
2-5 m
5-10m
Swatch of No Ground
OCTOBER
20
21
22
90
91
92
10
20
50
100
200

FIG. 54

Bathythermograph Profiles
October

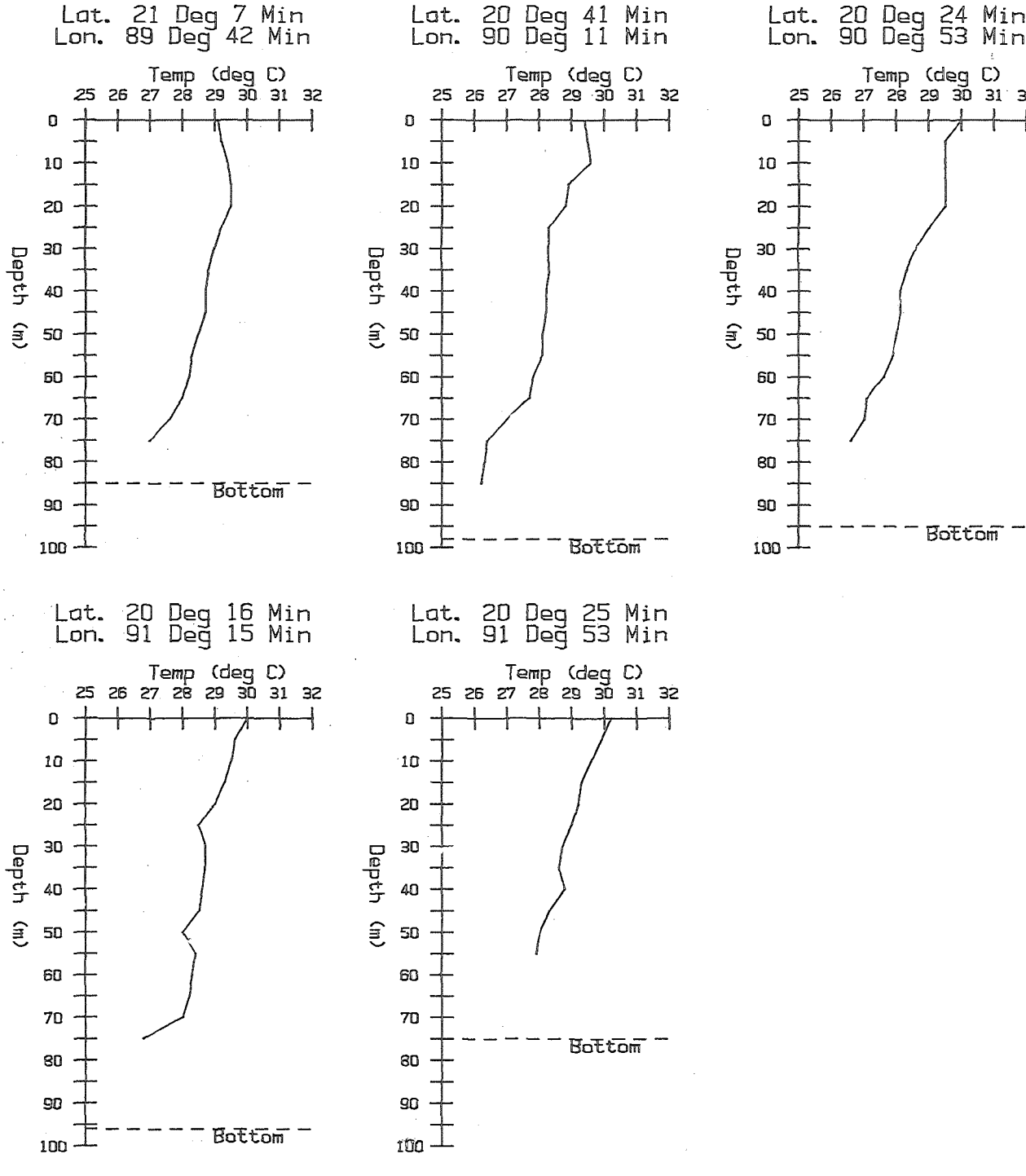


FIG. 55

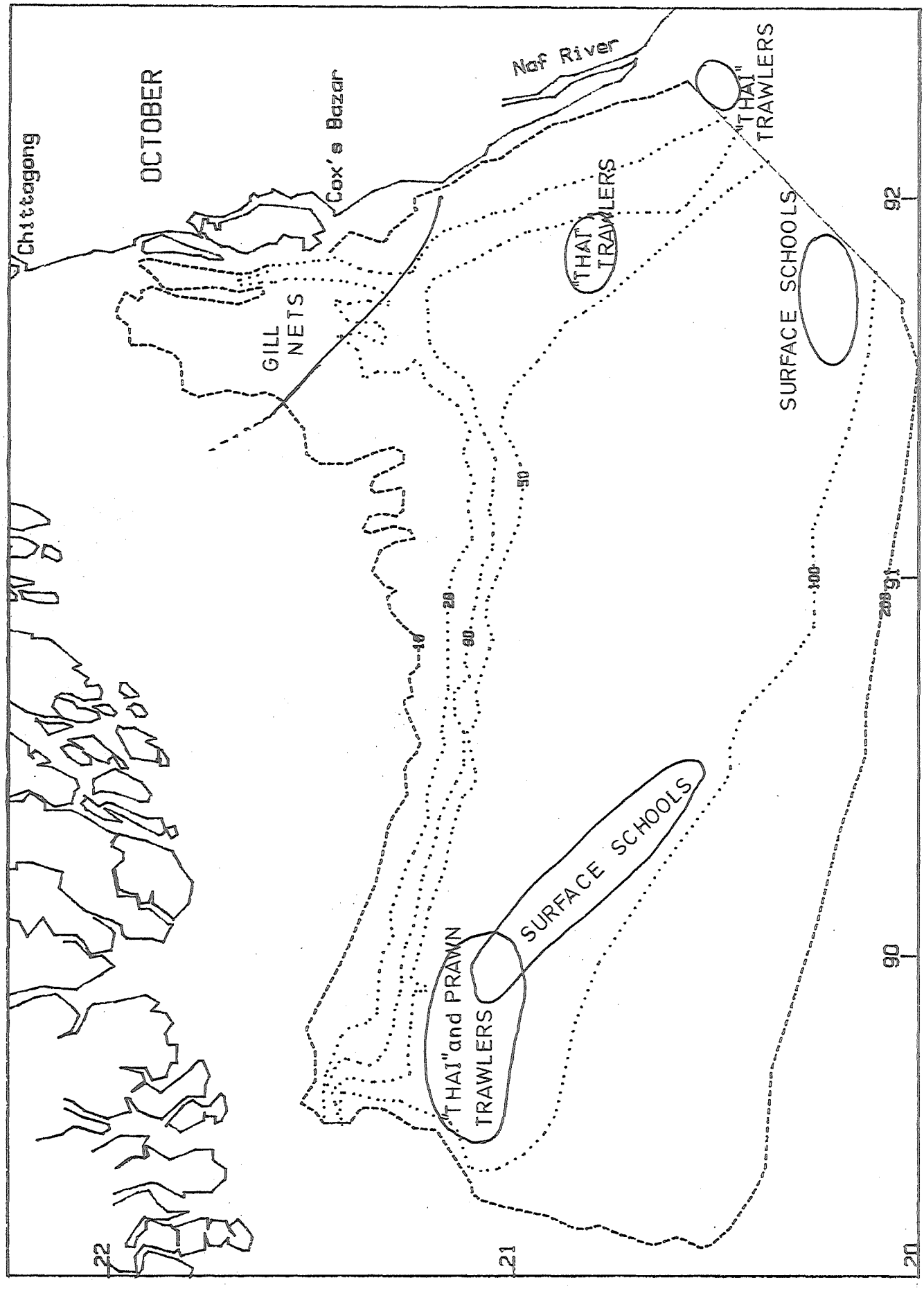
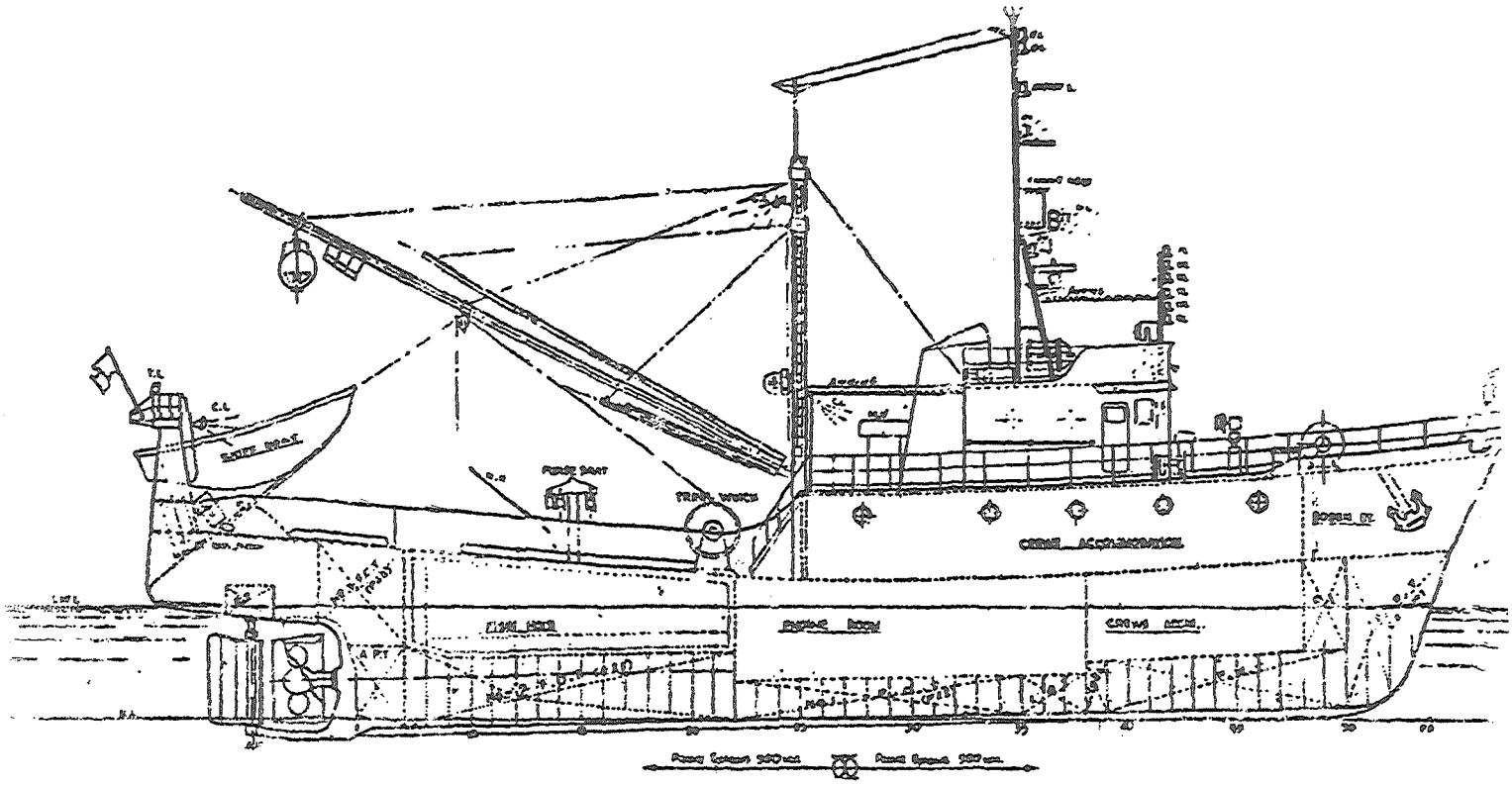

Chittagong
OCTOBER
Cox's Bazar
Naf River
"THAI" TRAWLERS
"THAI" TRAWLERS
SURFACE SCHOOLS
GILL NETS
SURFACE SCHOOLS
"THAI" and PRAWN TRAWLERS
10
20
50
100
200
22
21
20
92
91
90

FIG.56

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

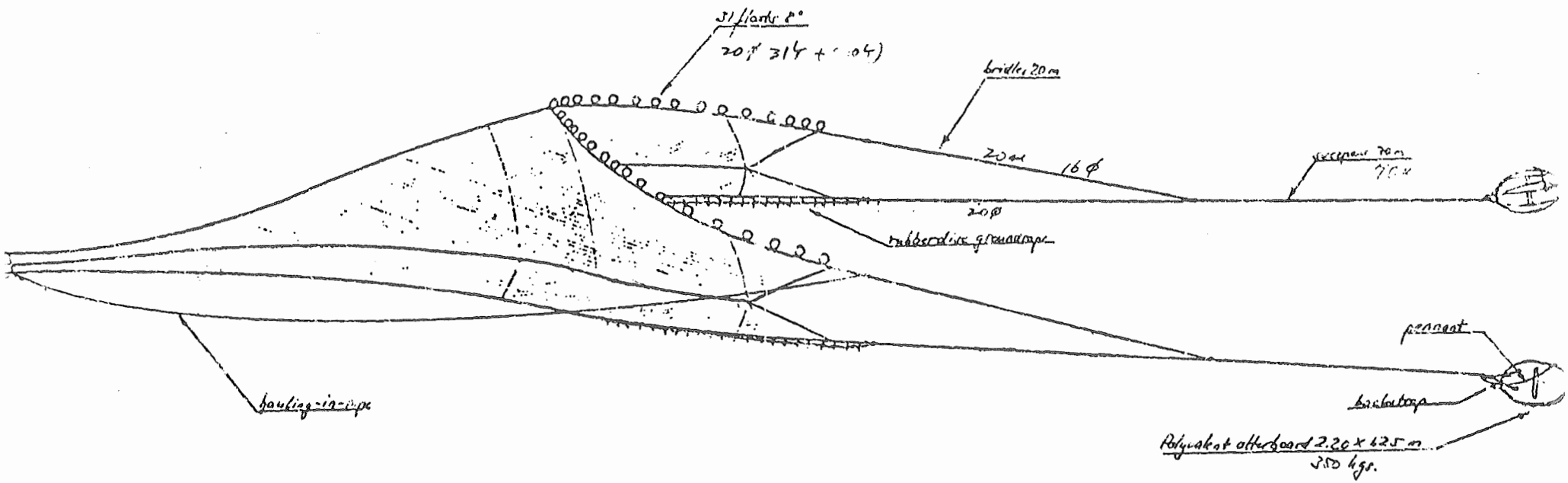
Fish Hold	73.67 M^2
Fuel Oil	88.22 M^2
Fresh water	34.53 M^2
Freezing Room	11.17 M^2

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)	

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

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								
22								
23								
24								
25								
26								
27								
28								
29								
30								

SCIENTIST I/C .....