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REPORT OF THE THAI-SEAFDEC JOINT FISHERY OCEANOGRAPHIC SURVEY IN THE CENTRAL GULF OF THAILAND

Volume II

Training Department

Southeast Asian Fisheries Development Center

FOREWORD

The work on fishery oceanography is only at the initial stage in the Southeast Asia, despite a number of studies on fisheries resources and the oceanic properties which have greatly expanded since the 1960s. On the other hand, there is a pressing requirement to know more on the effects of various parameters of oceanic environment which play an important role in determining the productivity of resources available to fisheries in all regions.

The coastal areas of the Gulf of Thailand up to the 40-meter depth were studied extensively by the Thai Department of Fisheries during the past two decades. The central part of the Gulf, however, was studied less. The SEAFDEC Training Department therefore initiated a joint survey of the central part of the Gulf in 1984, in cooperation with the Thai Department of Fisheries and other research institutes in Thailand, with a view to collect and compile information on fishery oceanography of this area for further study in the future.

The first volume, published as a Research Paper Series No.4 in July 1985, contained the reports on the investigations on stock density of demersal fishes, marine bivalves, and results of bottom vertical longline experiments in the central part of the Gulf of Thailand. The fisheries oceanographic conditions, distribution of nutrients and dissolved organic carbon as well as the distribution of phytoplankton in this area are also presented. In addition, a study on food composition found in the stomach of squids is included.

The present volume contains the reports on the topographic survey in the central part of the Gulf, the organic carbon contents of sediments, benthic fauna, primary and tertiary productions. Results of investigations on fish eggs and larvae, fish samples obtained from the cruise, round scad and evaluation of demersal fish stocks also presented.

It is our sincere hope that this Report would serve as a stepping stone in fulfilling the information gap for better understanding of the Gulf of Thailand.

Veravat Hongskul

Veravat Hongskul
Secretary-General of SEAFDEC

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PRELIMINARY REPORT ON THE
TOPOGRAPHIC SURVEY
IN THE CENTRAL GULF OF THAILAND

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INTRODUCTION

For marine fishing activities a knowledge of the features of the sea-bed is indispensable, since the bottom topography has an influence on the presence of fish schools. Existing charts of the central Gulf of Thailand were examined and found to contain little detailed isobathic data. It was therefore proposed to undertake topographic and acoustic surveys of the central Gulf to gather complete isobathic data as a basis for drawing up a chart of the fishing grounds in this part of the Gulf. The surveys were carried out on board the training vessel M.V. PAKNAM from 26 February to 26 September 1984.

METHODS

1. A JRC Echosounder was used to sound depth. Transducer frequency, beam width etc. will be covered in the final report.

2. To fix position the following were used observed depth of water, Navy Navigation Satellite System (NNSS), radar and astronomical positions.

3. When NNSS, radar and astronomical positions were not available, dead reckoning was used to fix positions.

RESULTS

1. Three acoustic surveys were carried out in 121 stations i.e. an area of about 27,000 square nautical miles. The area covered represents approximately 62 per cent of the central Gulf of Thailand. The remaining 38 per cent will be surveyed some time in the future.

1st survey	:	26 February - 4 March 1984	(8 days)
2nd survey	:	17 May - 9 June 1984	(24 days)
3rd survey	:	20 September - 26 September 1984	(7 days)
		Total	(39 days)

2. The isobathic charts resulting from the surveys are shown in figure 1 to 12. However, it is intended that a single isobathic chart, natural scale 1:500,000 (at latitude 15^{o}). be drawn up combining all the information found in figs: 1 to 12.

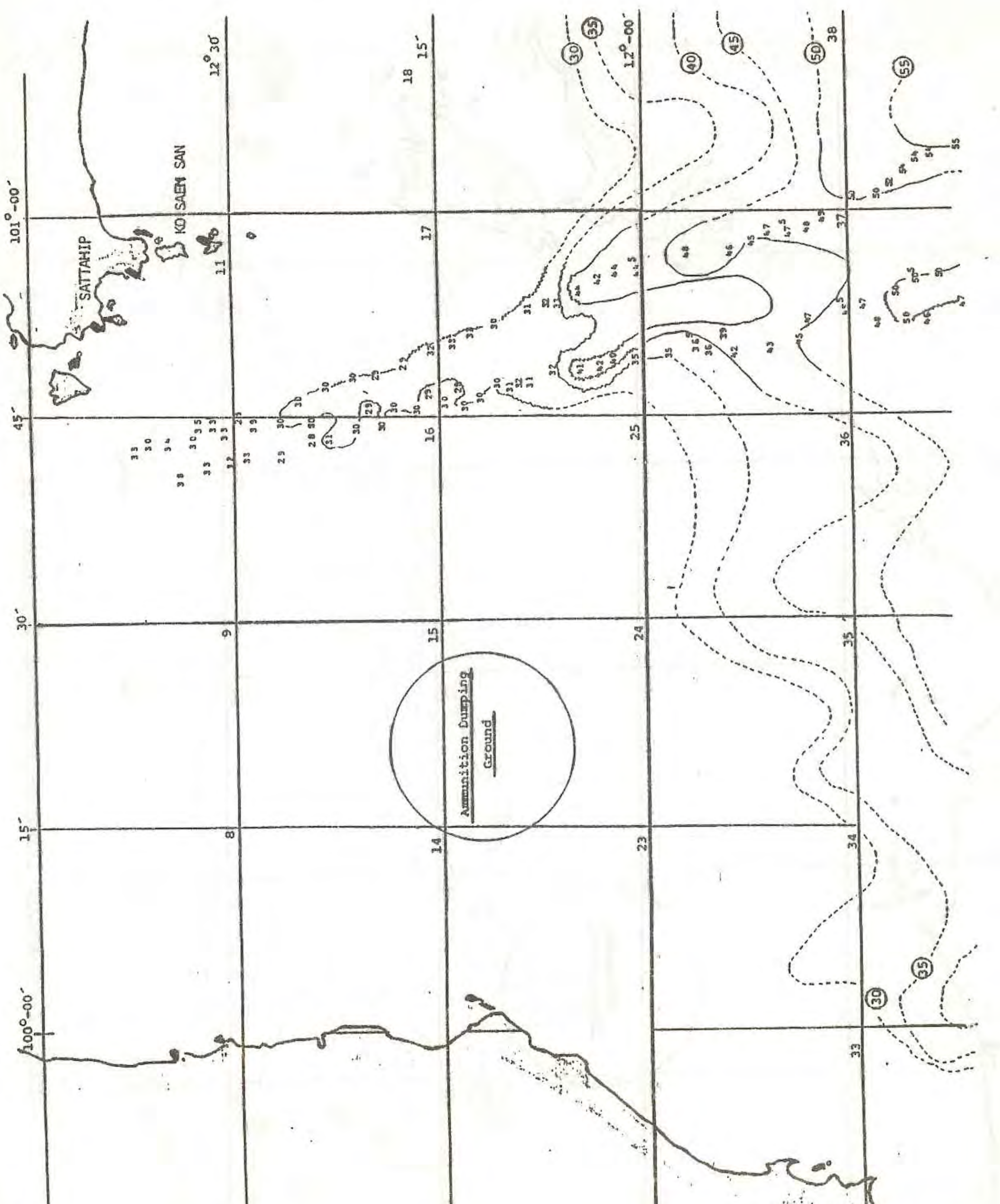


Fig. 1 Contour lines - interval 5 metres Southward from Sattahip

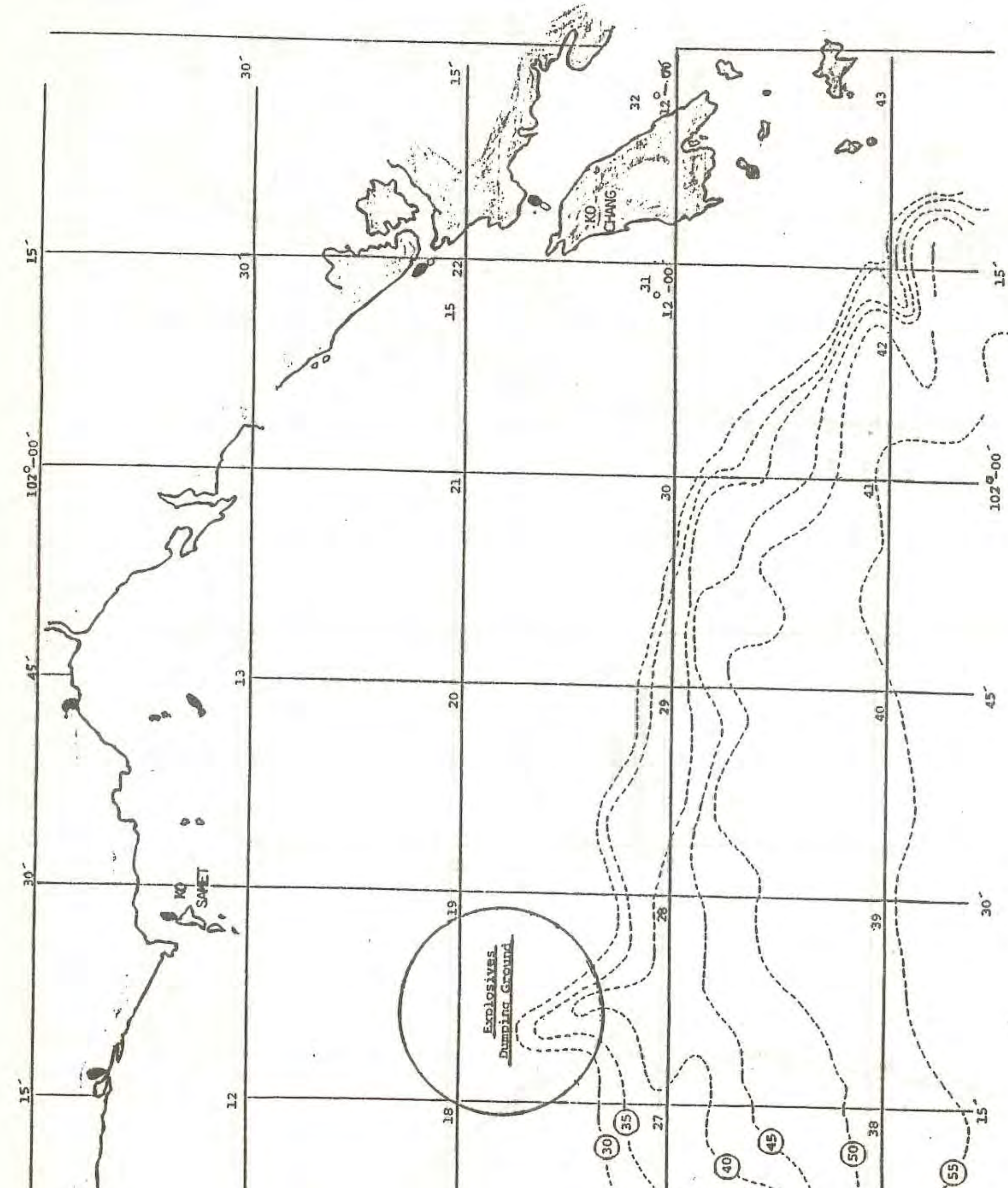


Fig. 2 Contour lines - interval 5 metres off Chang Island

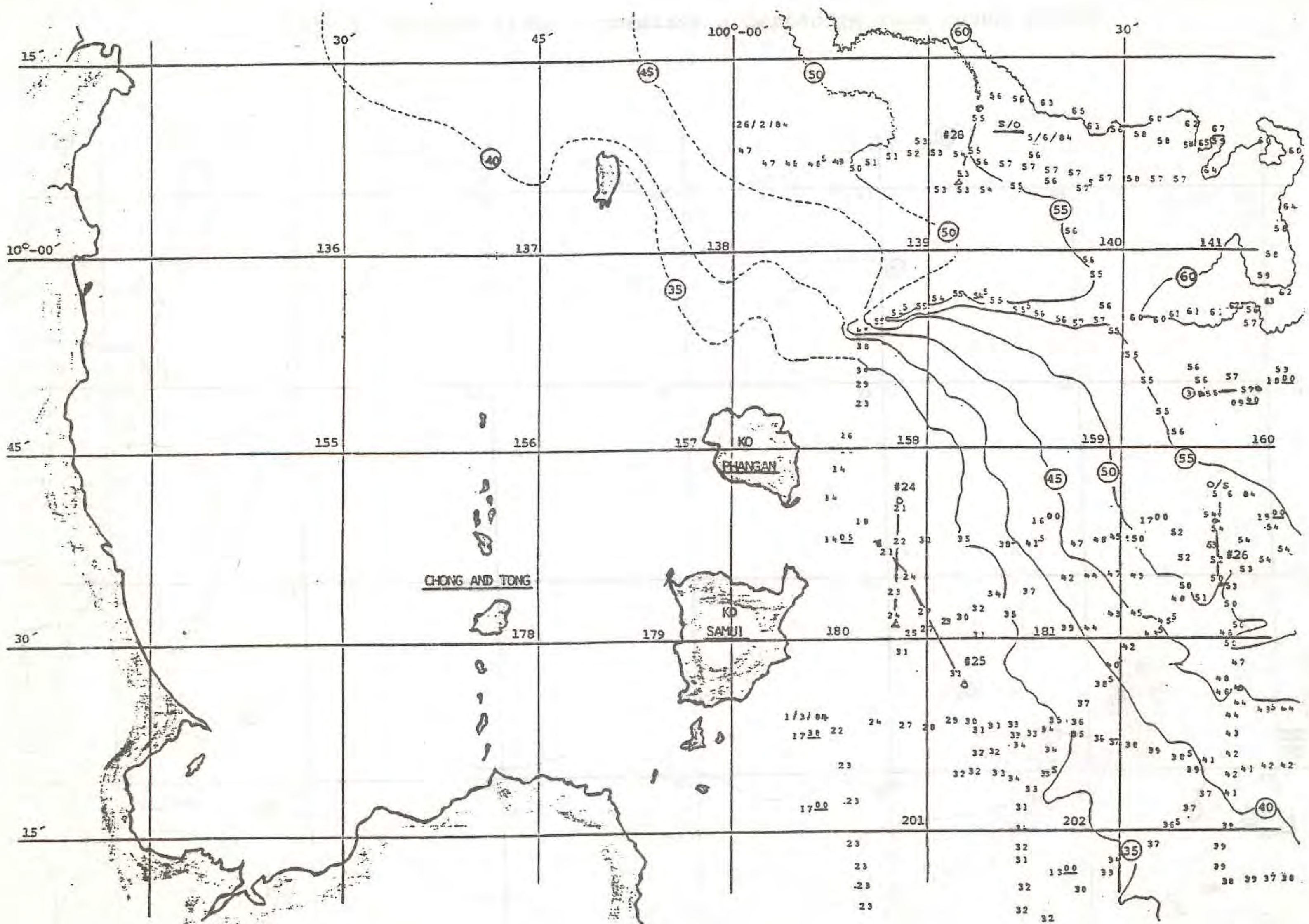


Fig. 3 Contour lines - interval 5 metres off Samui Island

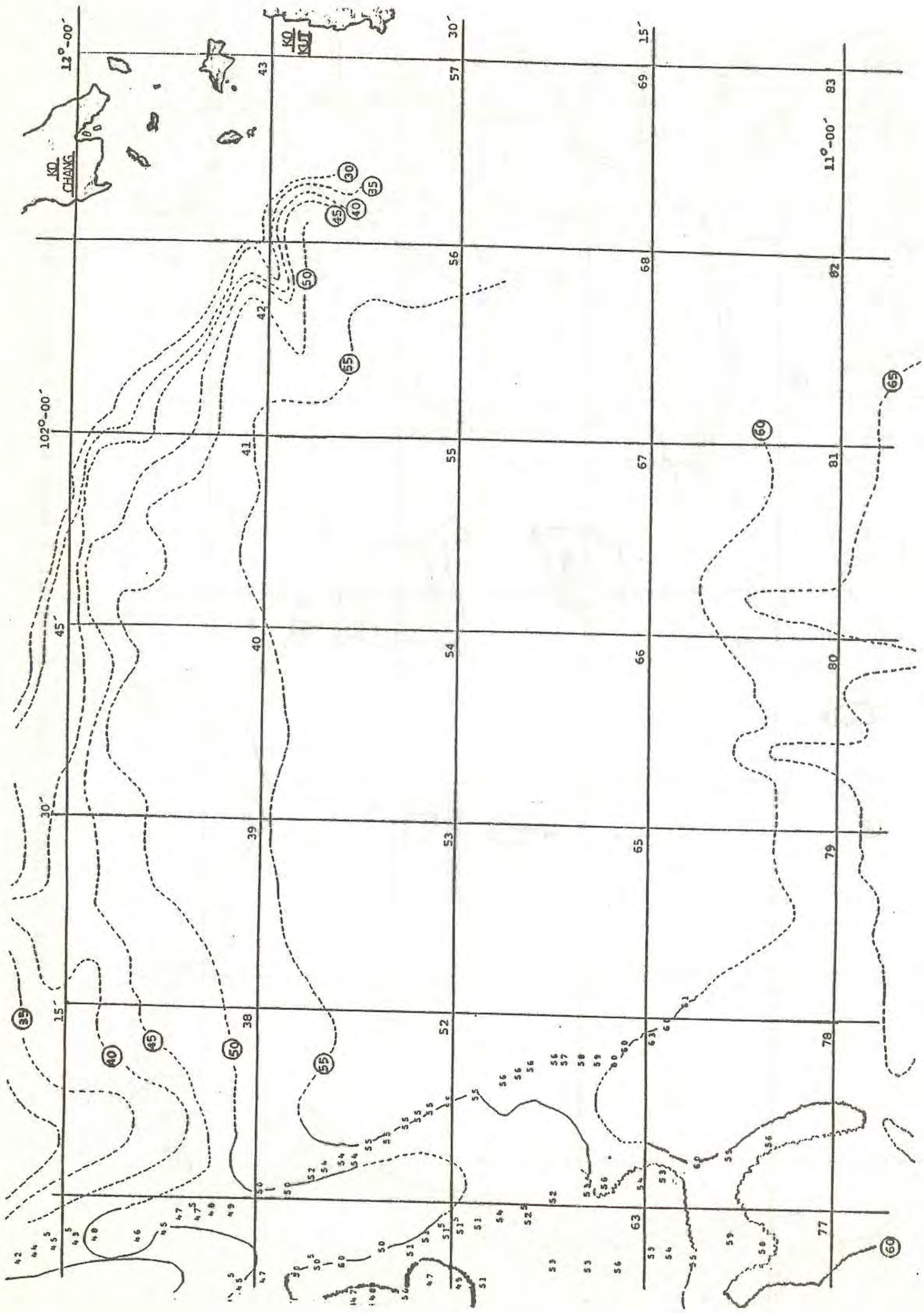


Fig. 4 Contour lines - interval 5 metres SW from Chang Island

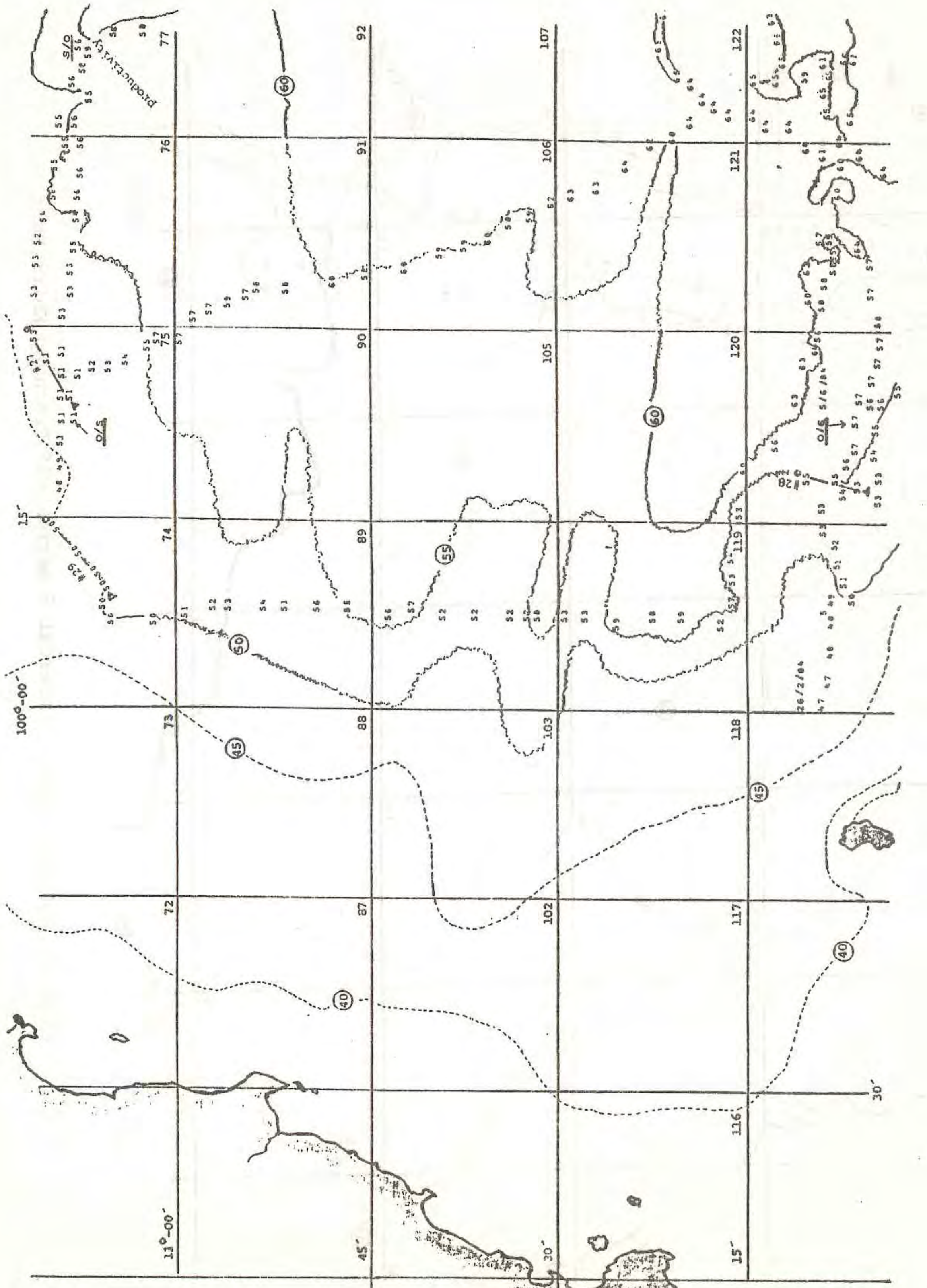


Fig. 5 Contour lines - interval 5 metres off Tao Island

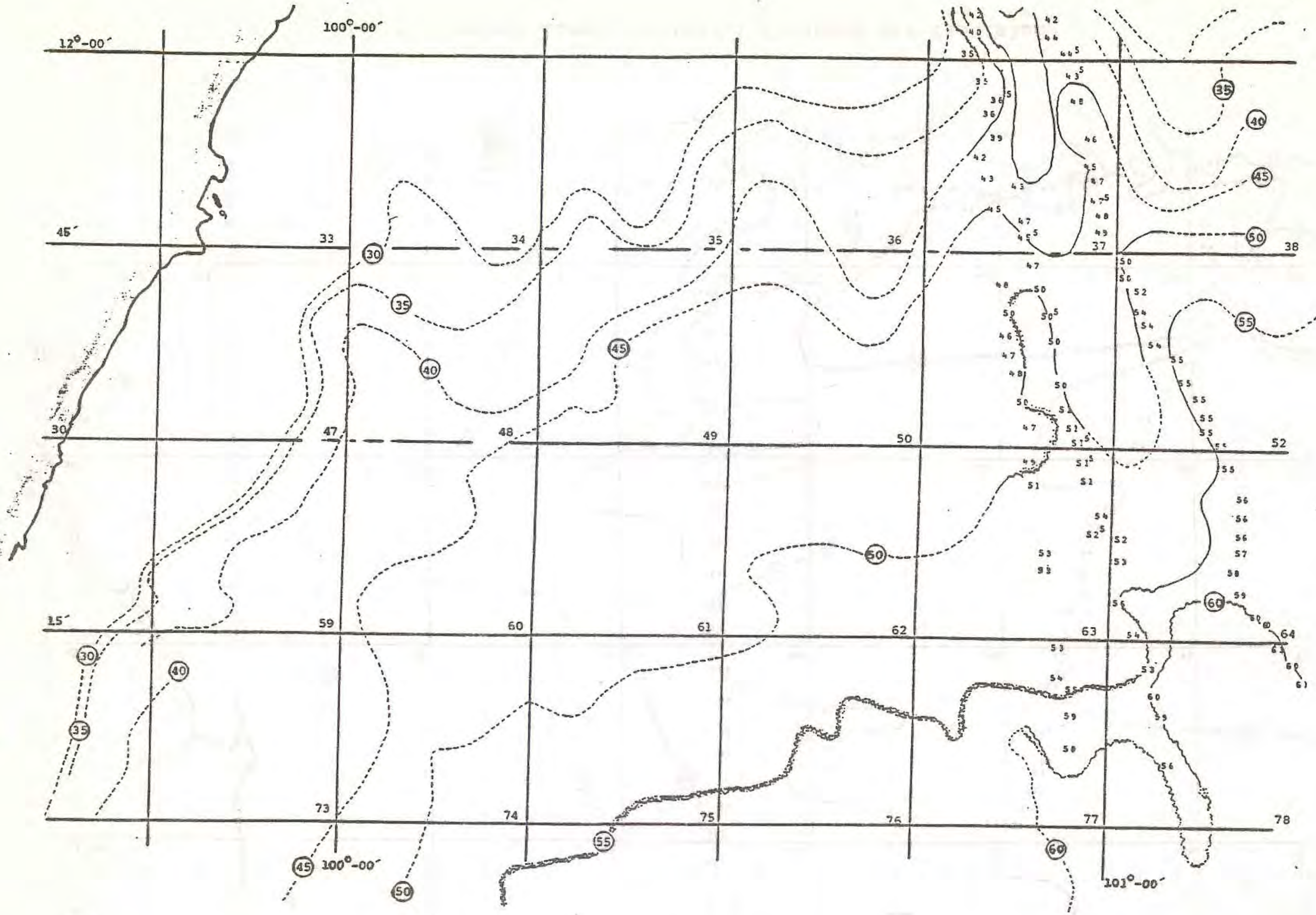


Fig. 6 Contour lines - interval 5 metres off Prachuap Khiri Khan

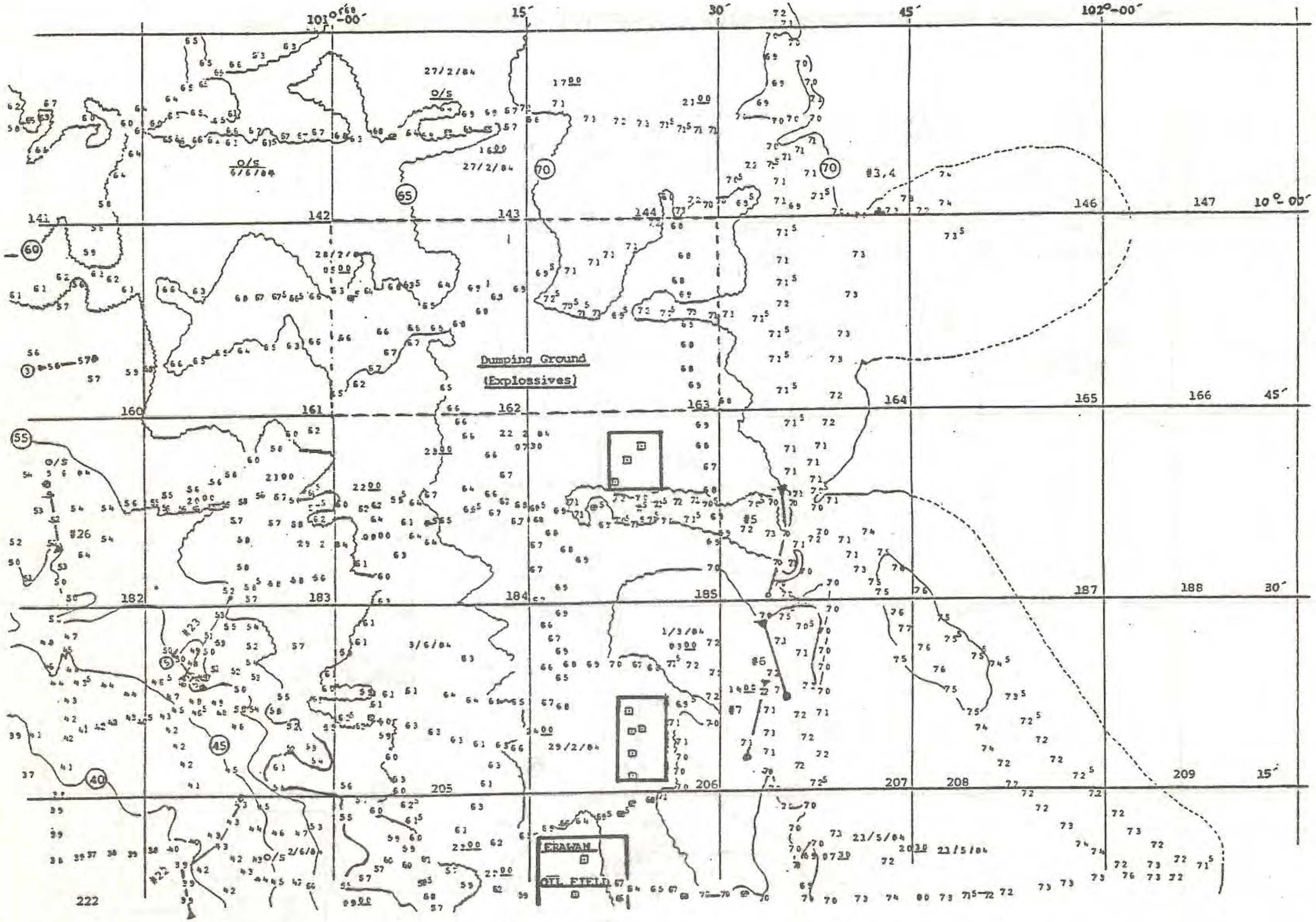


Fig. 7 Contour lines - interval 5 metres Northward from Erawan Gas Field

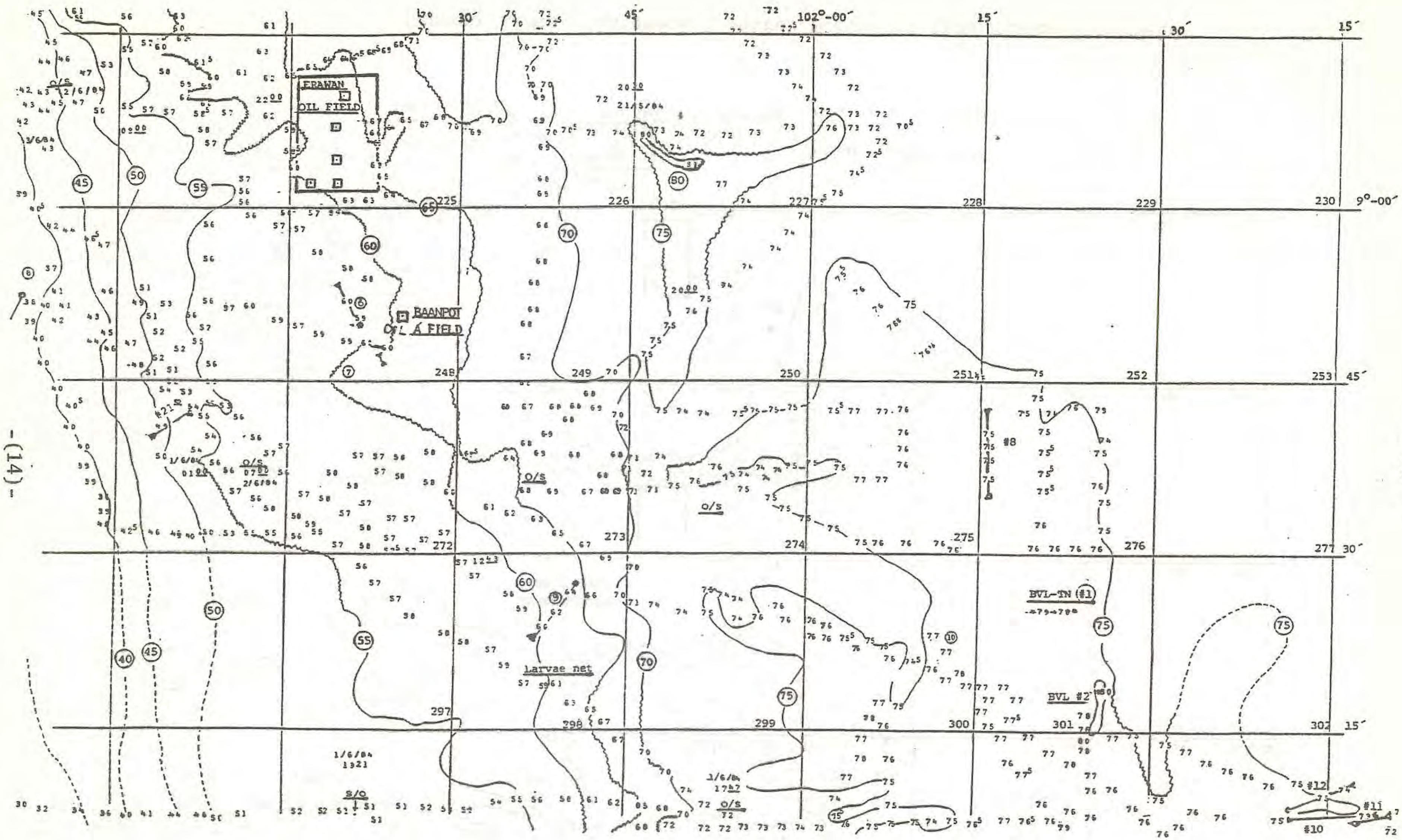


Fig. 8 Contour lines - interval 5 metres Southward from Erawan Gas Field

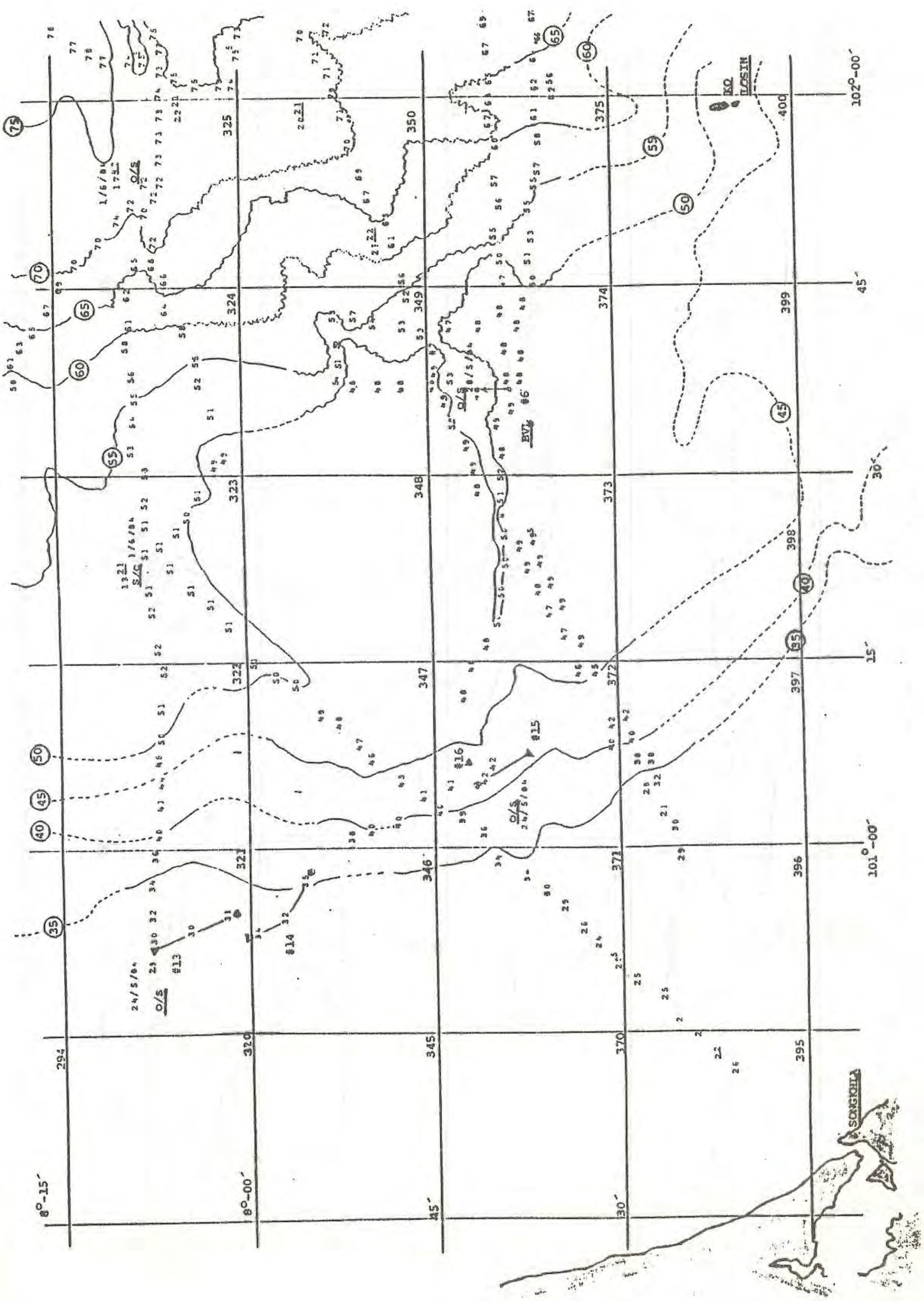


Fig. 9 Contour lines - interval 5 metres Northeastward from Songkhla

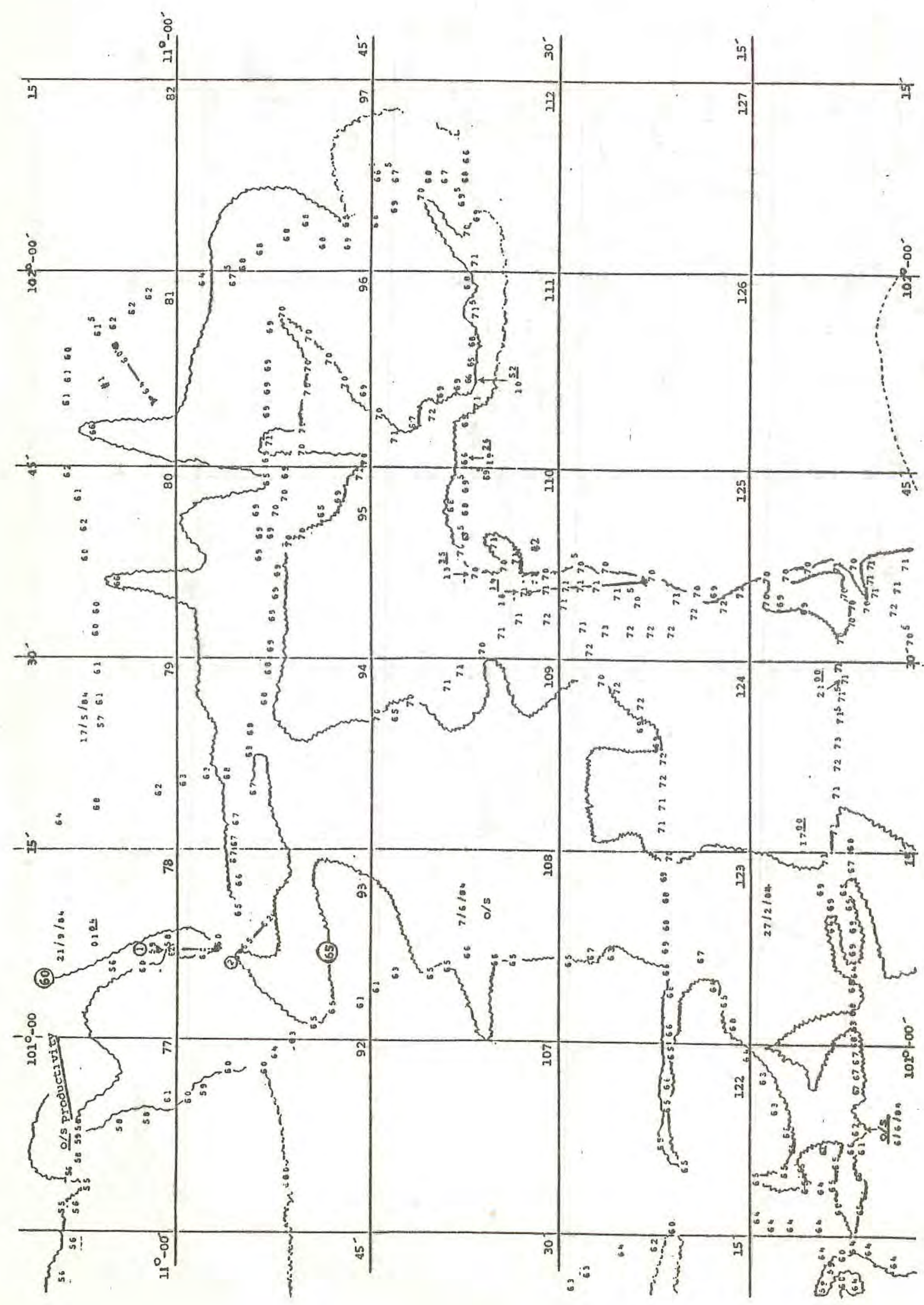


Fig. 10 Contour lines - interval 5 metres Southwestward from Kut Island

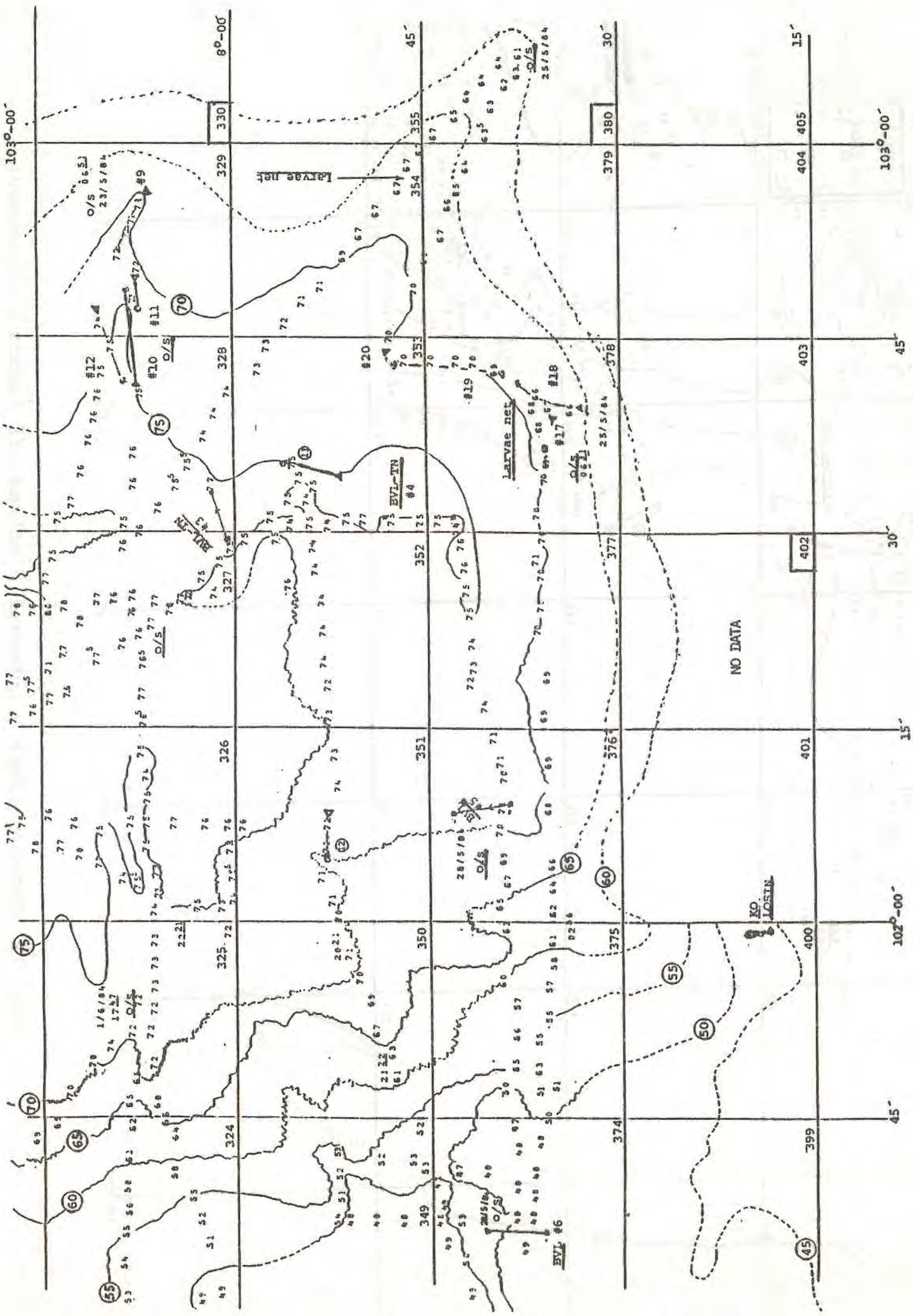


Fig. 11 Contour lines - interval 5 metres Northeastward from Pattani

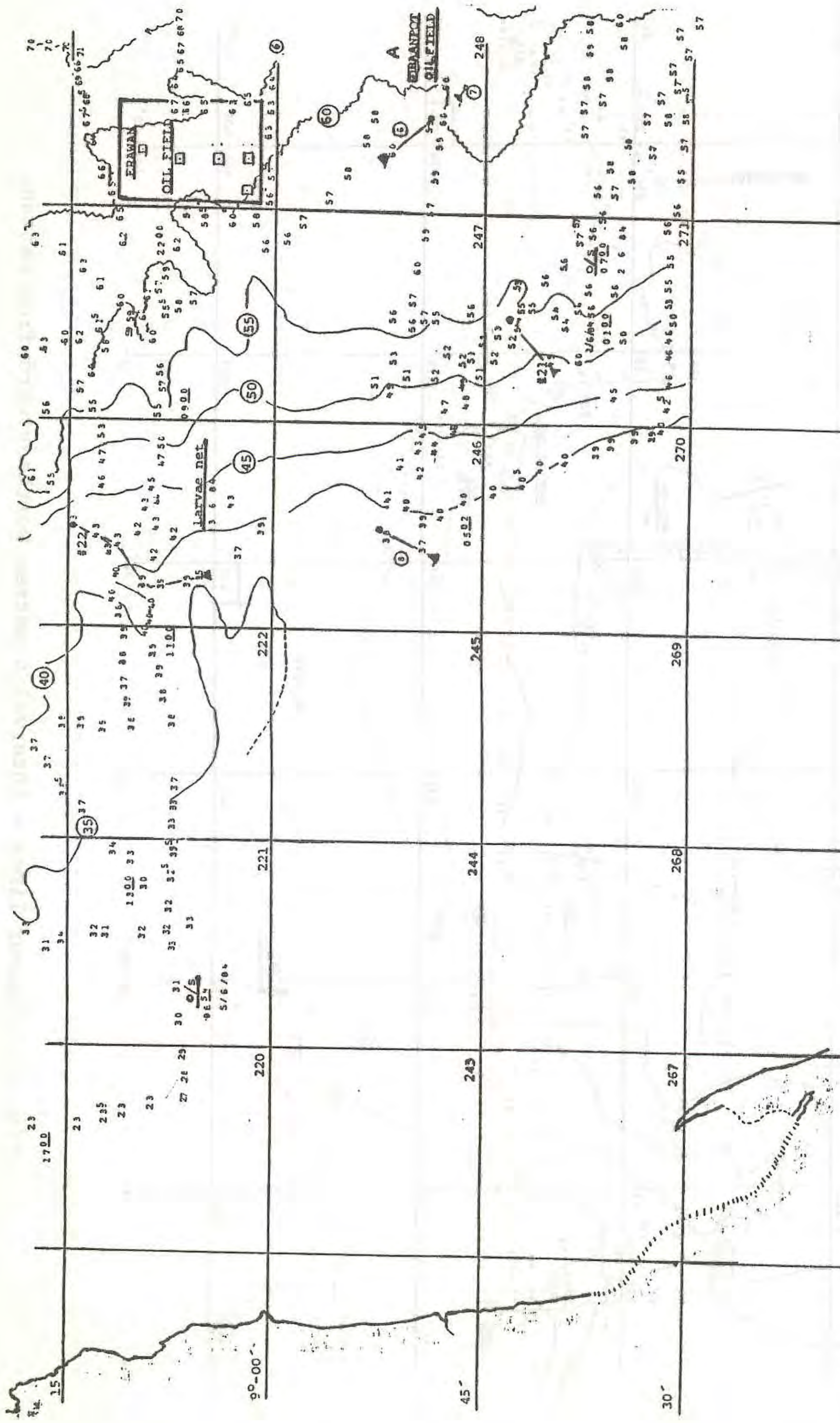


Fig. 12 Contour lines - interval 5 metres off Nakhon Si Thammarat

DISCUSSION

1. According to the data, the uneveness of the floor of the Gulf can be graded from "slightly uneven" to "precipitous" as shown in figure 13.

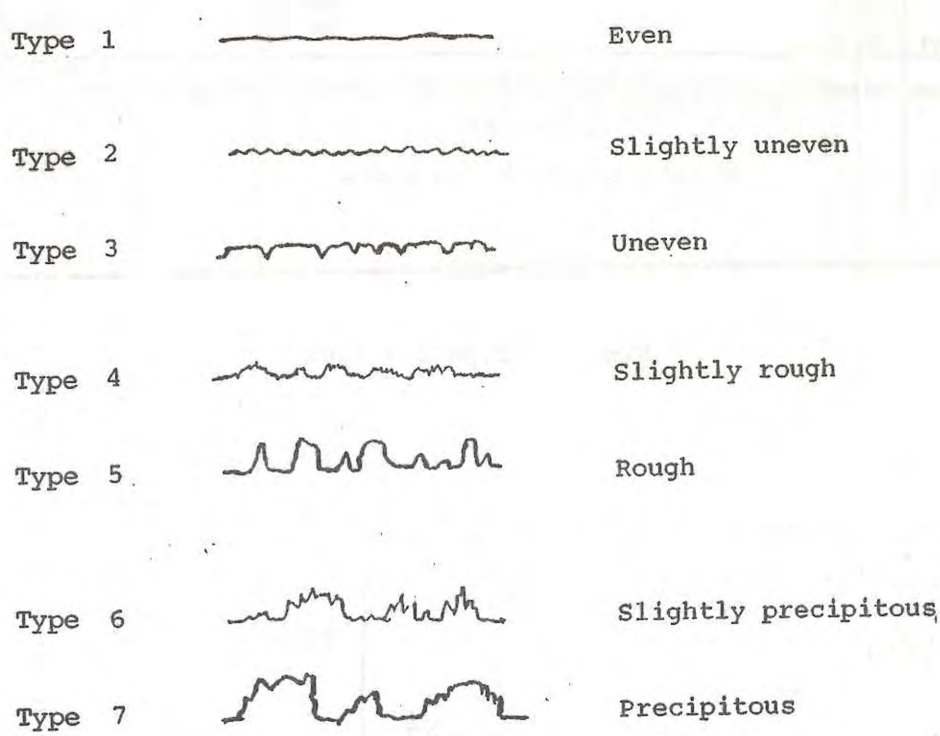


Fig. 13

The recordings of the floor corresponding to types 1 to 7 are shown in figures 14 to 20.

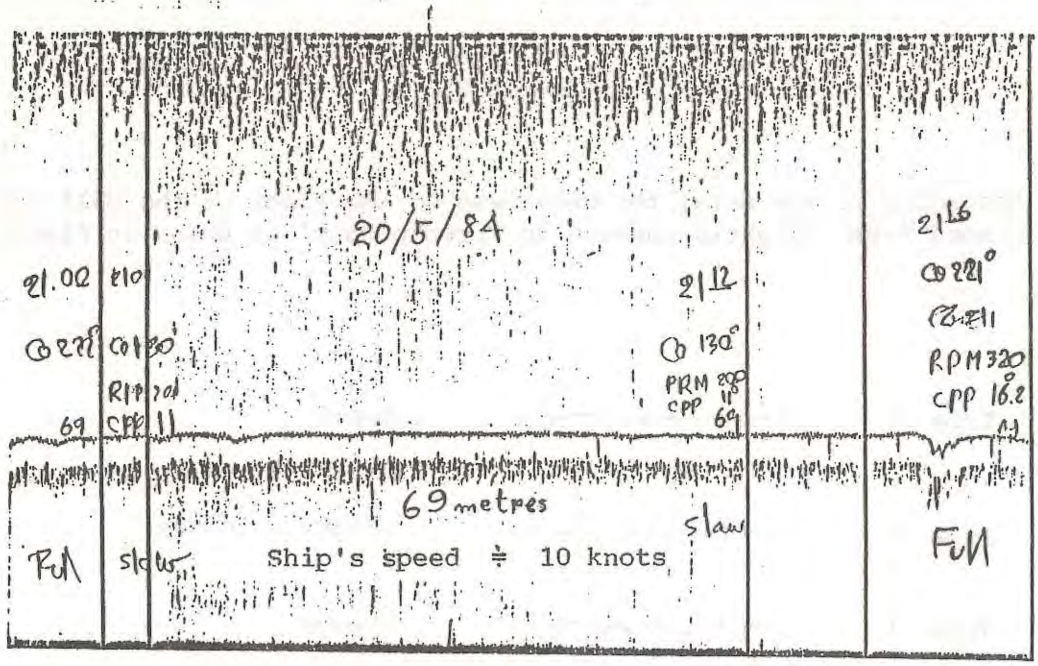


Fig. 14 Type 1 - Even

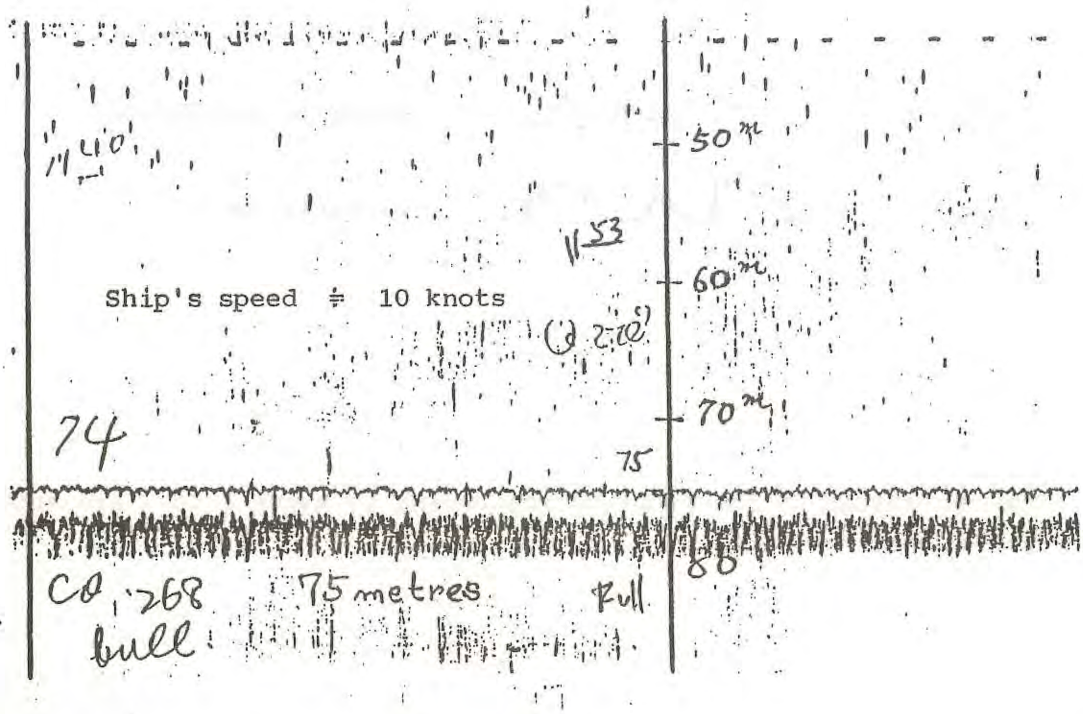


Fig. 15 Type 2 - Slightly uneven

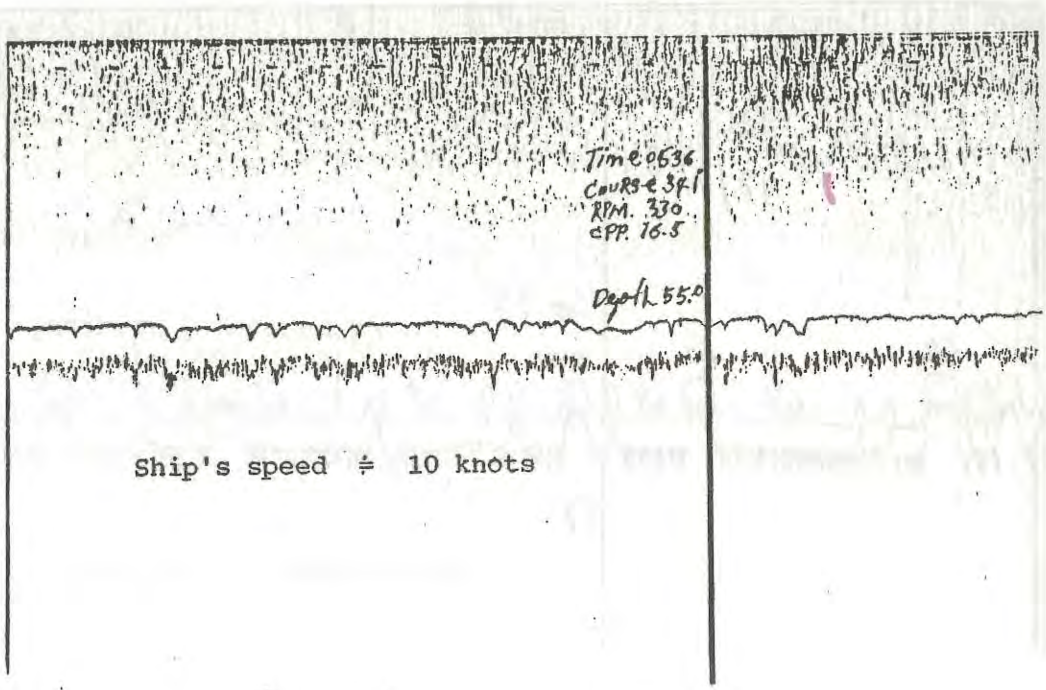


Fig. 16 Type 3 - Uneven

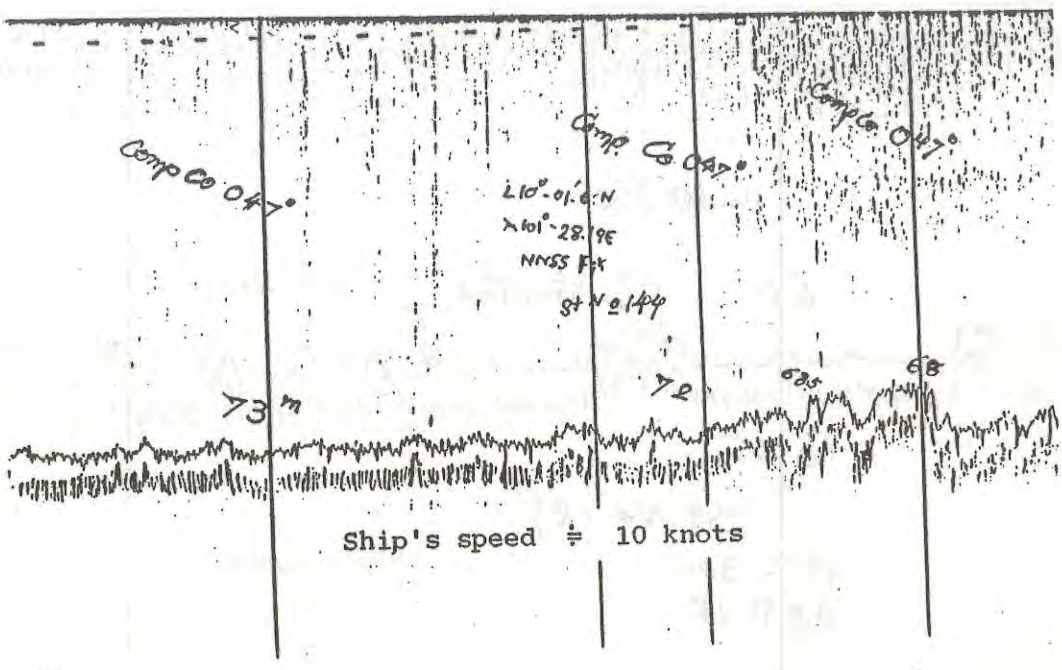


Fig. 17 Type 4 - Slightly rough

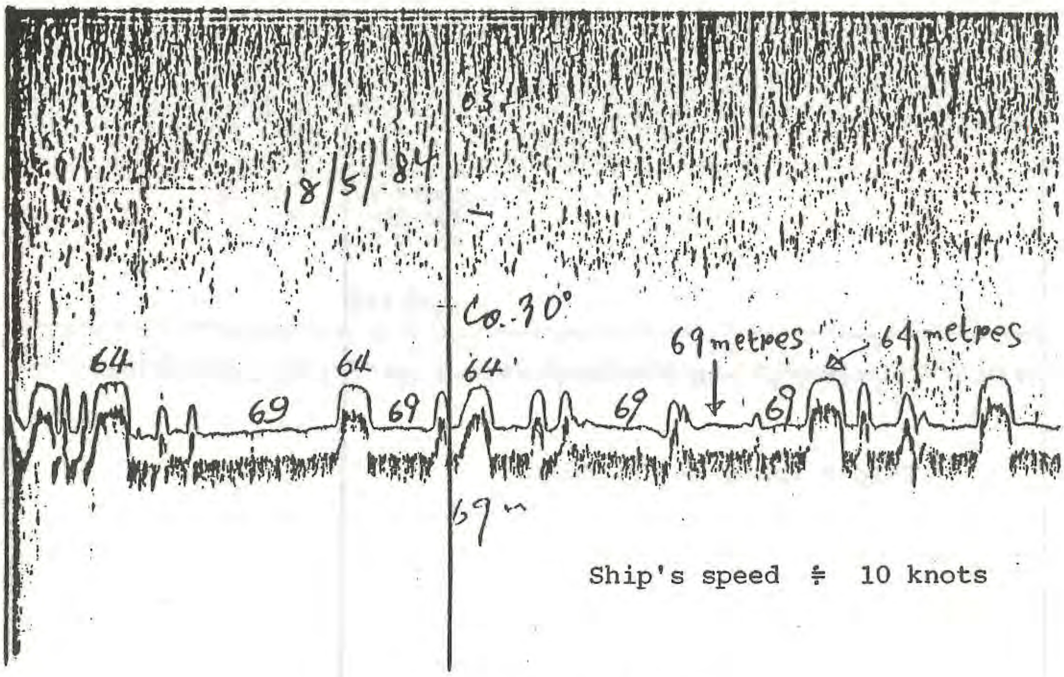


Fig. 18 Type 5 - Rough

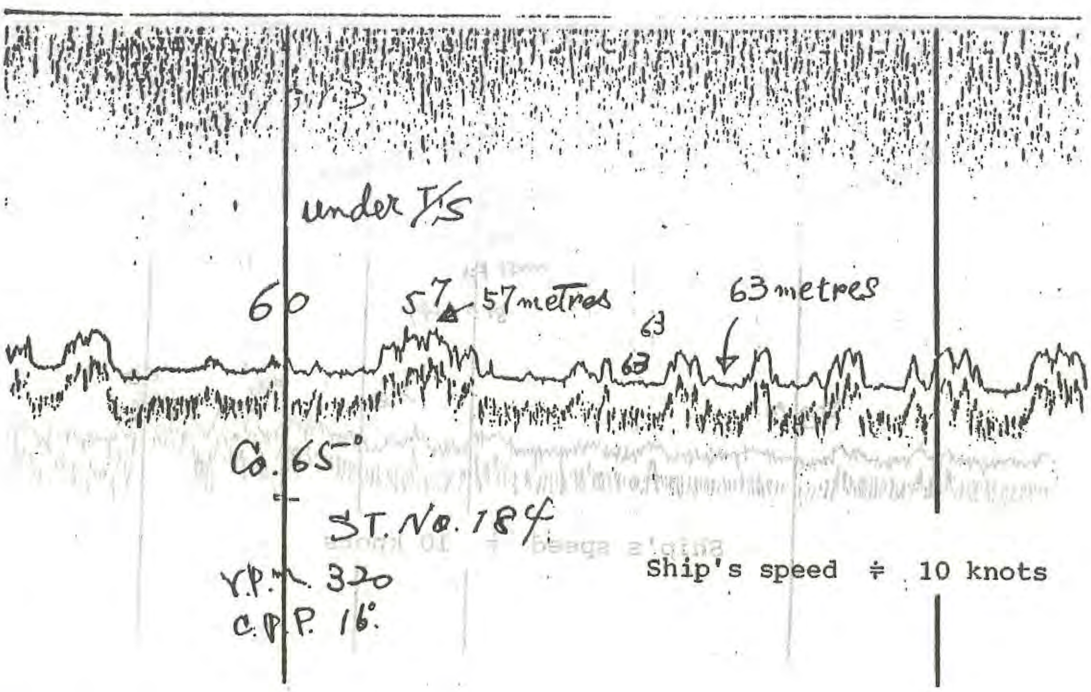


Fig. 19 Type 6 - Slightly precipitous

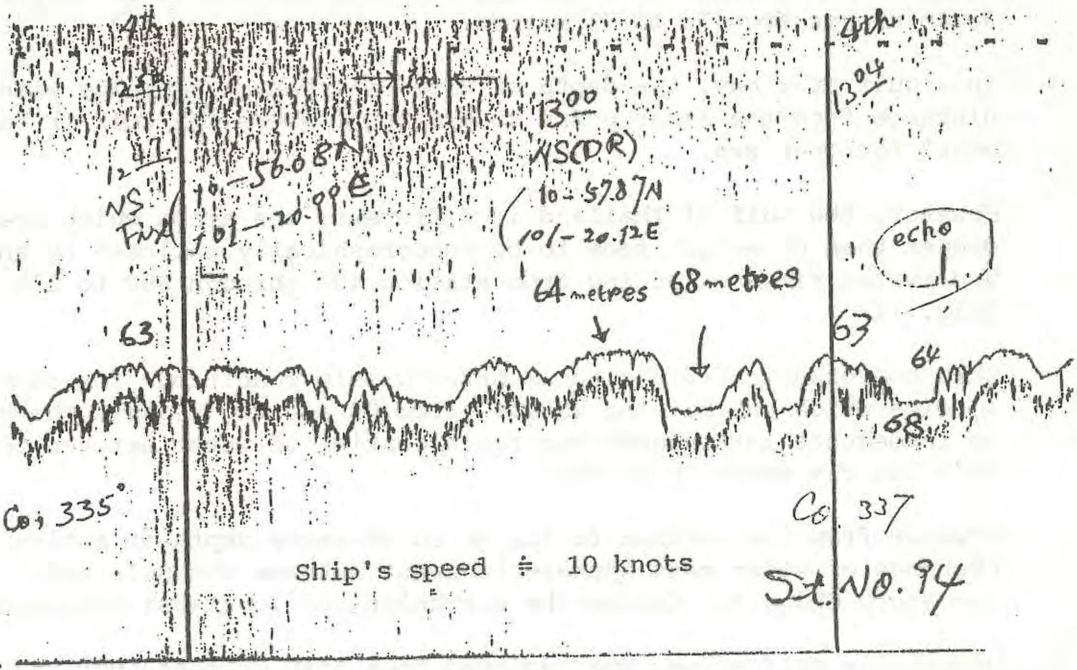


Fig. 20 Type 7 - Precipitous

2. Analysis of depth and isobath, based on the acoustic survey, shows that the deepest area of the Gulf is located between latitudes 7°45'N and 9°30'N, and longitudes 101°45'E and 102°45'E. Here the depth ranges from 75 to 81 metres.

3. In a gulf or a bay, the depth of water increases gradually with distance from the inner point to the mouth where the gulf or bay meets the open sea.

   However, the Gulf of Thailand is different; the areas which are deeper than 60 metres seem to be topographically enclosed by an underwater ridge extending from station 402 through 380 to 330 (Fig. 11)

   This topographic feature shows unfavourable conditions for demersal species which inhabit the waters below 60 metres, because there is an inadequate interchange and reciprocation of water between the Gulf and the South China Sea.

   However from the surface to the 40 to 50-metre depth an active exchange of water mass appears to exist between the Gulf and the South China Sea during the northeast and southwest monsoons.

4. Ordinarily good echoes are recieved from fish schools over the rougher sea-beds at other fishing grounds. In the Gulf of Thailand, however the echosounder seldom had a good echo from fish schools over the rougher sea-beds, in waters more than 50 metres deep.

   This indicates that there are probably unsuitable conditions for demersal species along the deeper bottom (Figs. 21 and 22).

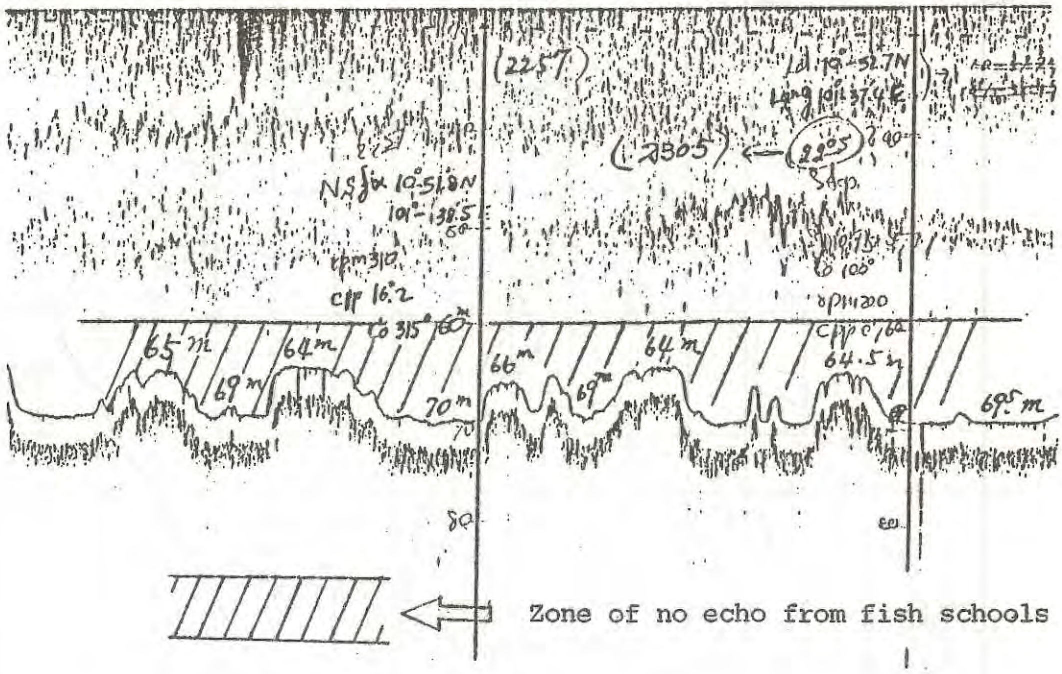

Zone of no echo from fish schools

Fig. 21

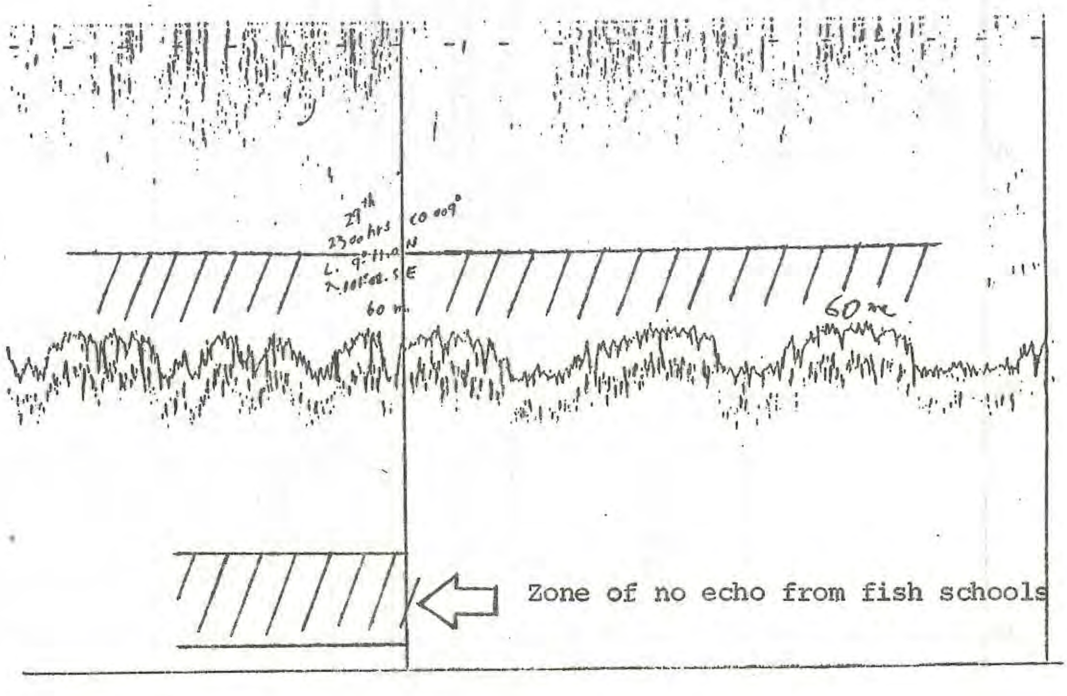
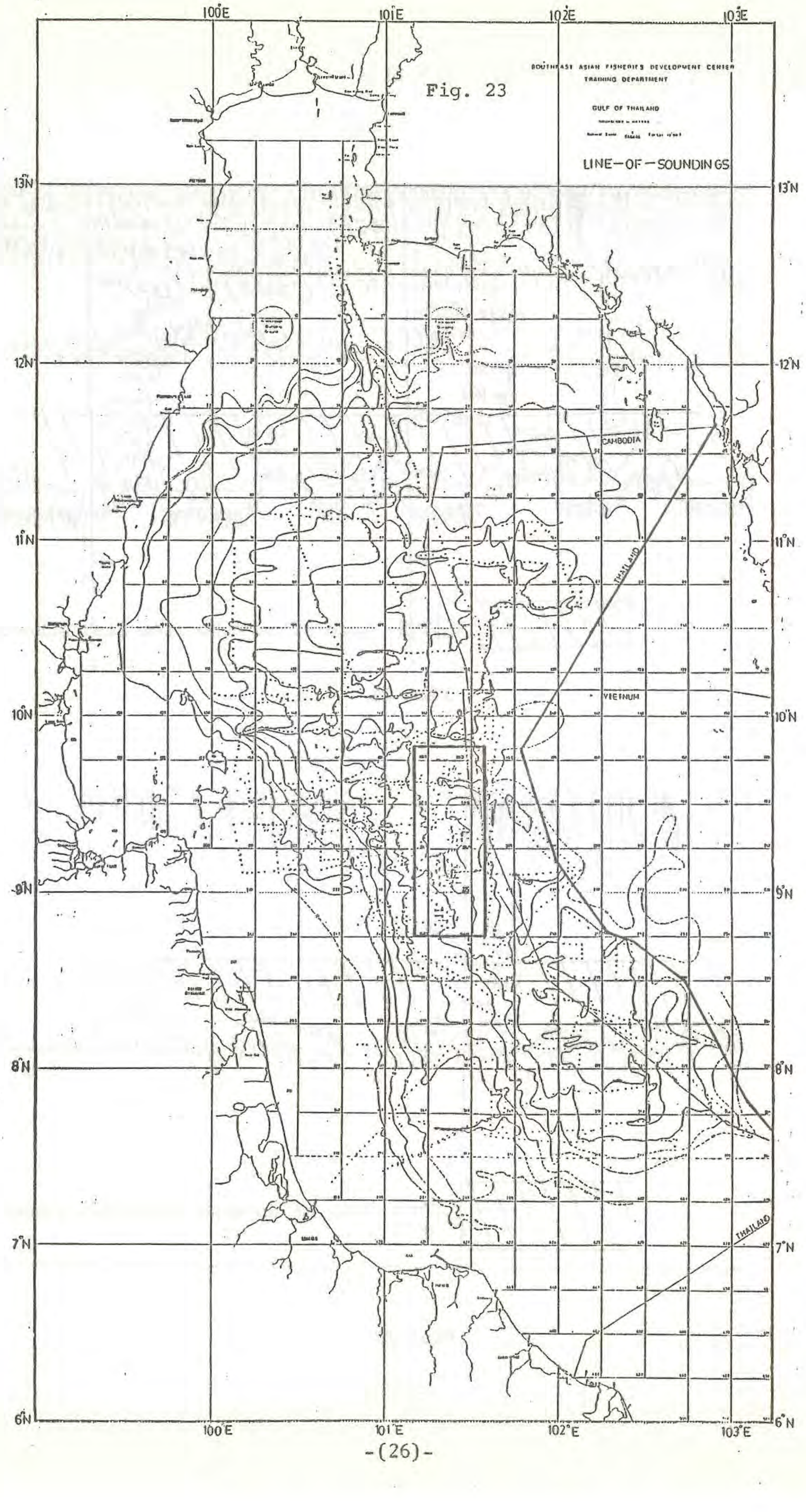

Zone of no echo from fish schools

Fig. 22

Fig. 23


SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
TRAINING DEPARTMENT
GULF OF THAILAND
LINE-OF-SOUNDINGS
100°E
101°E
102°E
103°E
13°N
12°N
11°N
10°N
9°N
8°N
7°N
6°N
CAMBODIA
VIETNUM
THAILAND
THAILAND

TABLE

Legend of the isobathic charts		
1.	S/O or O/S 6/6/84	Oceanographic survey on 6 June 1984
2.		Location of gas rig
3.	Larvae net 3/6/84	Position of towed larvae net on 3 June 1984
4.	————————	Isobath (smooth bottom) ..... solid line
5.		Isobath (rough bottom) ...... wavy line
6.	- - - - - - - -	Estimated isobath ..... dotted line
7.		Estimated isobath (rough bottom) .... dotted wavy line
8.	72	Depth of water 72 metres
9.	——(65)——	Isobath of 65 metres
10.	ammunition dumping ground	Area inside the circle is an ammunition dumping ground
11.		Lighthouse
12.	explo-sives dumping ground	Area inside the circle is an explosives dumping ground
13.	#27 	#27 Trawled track line, trawled direction is from triangle Δ to circle o.
14.	Productivity	Productivity survey's location
15.	Dumping ground EXPLOSIVES	This area is a dumping ground for explosives
16.	1/3/84 03^{00}	Ship's position at 03^{00} HRS on 1 March 1984
17.	 BVL #6	Location of #6 Bottom Vertical Line fishing
18.	 BVL-TV#3	Location of #3 Bottom Vertical Line and Trap net fishing

THE ORGANIC CARBON CONTENT OF SEDIMENTS FROM THE GULF OF THAILAND

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ABSTRACT

Under the Thai-SEAFDEC Joint Research Program sediment samples from 23 stations in the Gulf of Thailand were collected on board M.V. PAKNAM from 19 to 28 November 1985. The samples were analysed for organic carbon content. The amount of organic carbon in the sediments ranged from 0.54 to 2.53 per cent with a mean value of 1.45 per cent. Sediments throughout the study area were predominantly hydrogen sulphide-rich muds of a grey, brown or black colour, depending upon the station, while some stations had sandy or calcareous sediments.

INTRODUCTION

The amount of organic matter deposited in sediments depends upon the rate of sedimentation, bio-productivity and input of organic matter. High sedimentation rates tend to dilute the organic matter with inorganic sediments, whereas very low sedimentation rates allow the organic matter to be oxidized either while it is settling through the water column (Kaplan and Rittenberg 1963) or at the sediment-water interface (Emery, 1960). The amount of organic matter is closely related to the nature of the sediments. The finer the sediments, the higher the organic content (Bordovskiy , 1965). In nearshore sediments, which are newly settled and high in organic content, the decomposition rate of organic matter is high and consequently anoxic conditions are produced. Reduction of nitrates and sulphates occurs with the release of inorganic nutrients and toxic substances such as hydrogen sulphide into the sediments and the overlying water column, which affects the productivity of the area.

The purpose of this study was to determine the organic carbon content in sediments from the Gulf of Thailand. The collection of samples was conducted on board M.V. PAKNAM as part of the Thai-SEAFDEC Joint Research Program. The data obtained may be used to determine the distribution of benthic organisms and the quality of the overlying water, which are related to the productivity and the environmental conditions in the study area.

MATERIALS AND METHODS

1. Collection of Samples

Surface sediment samples were taken with a grab sampler in 23 stations in the Gulf of Thailand, from 19 to 28 November 1985 (Figure 1). The samples were placed in plastic bags and frozen until they could be analysed.

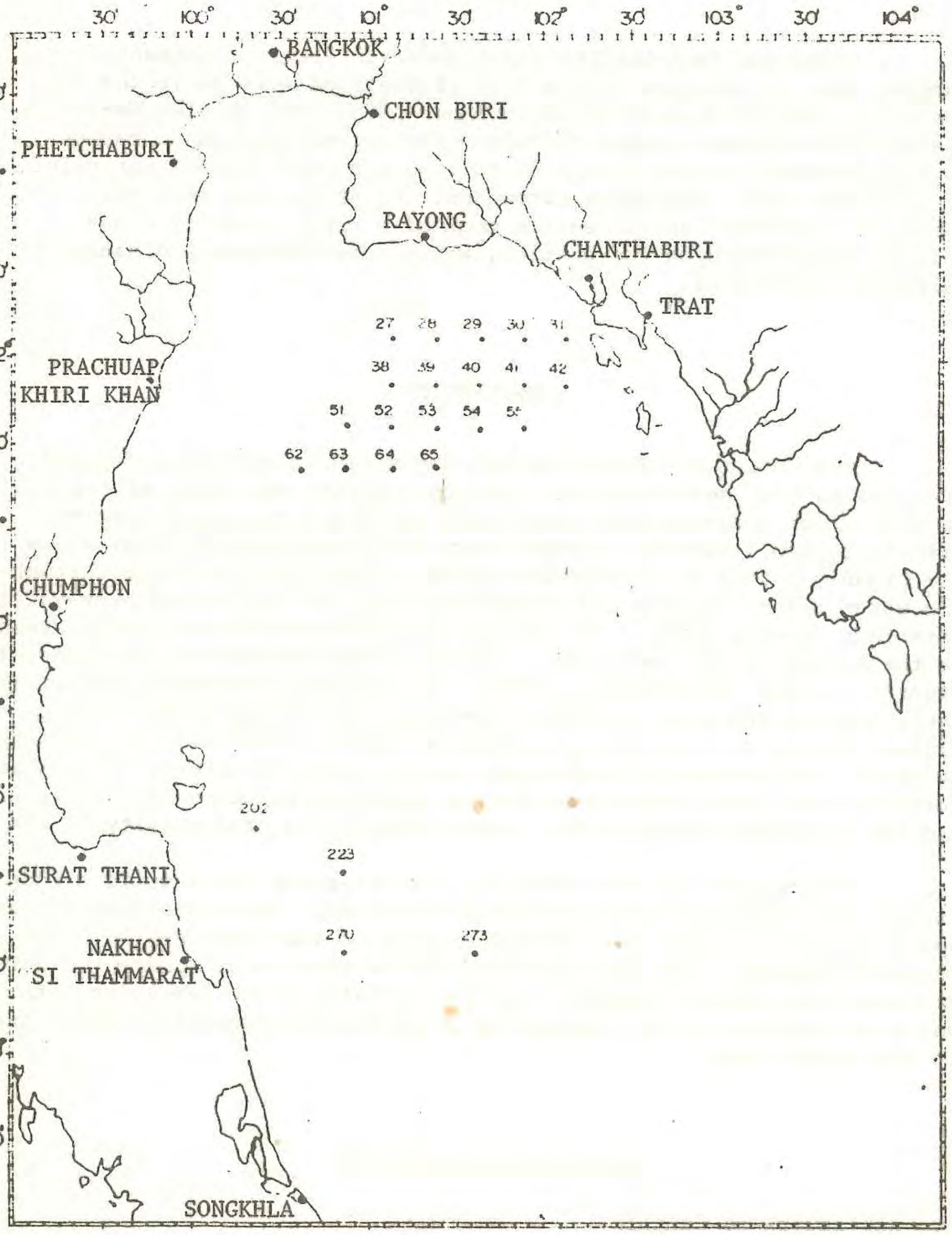

Figure 1. Sediment sampling stations in the Gulf of Thailand, 1985

Table. Organic carbon content in sediments from the Gulf of Thailand

Station no.	Organic carbon content (%)
27	1.05
28	0.94
29	2.31
30	2.25
31	1.97
38	1.38
39	1.79
40	2.18
41	1.35
42	1.14
51	2.53
52	1.55
53	1.74
54	1.81
55	1.22
62	0.54
63	1.34
64	1.44
65	1.00
202	1.29
223	0.84
270	1.14
273	0.67

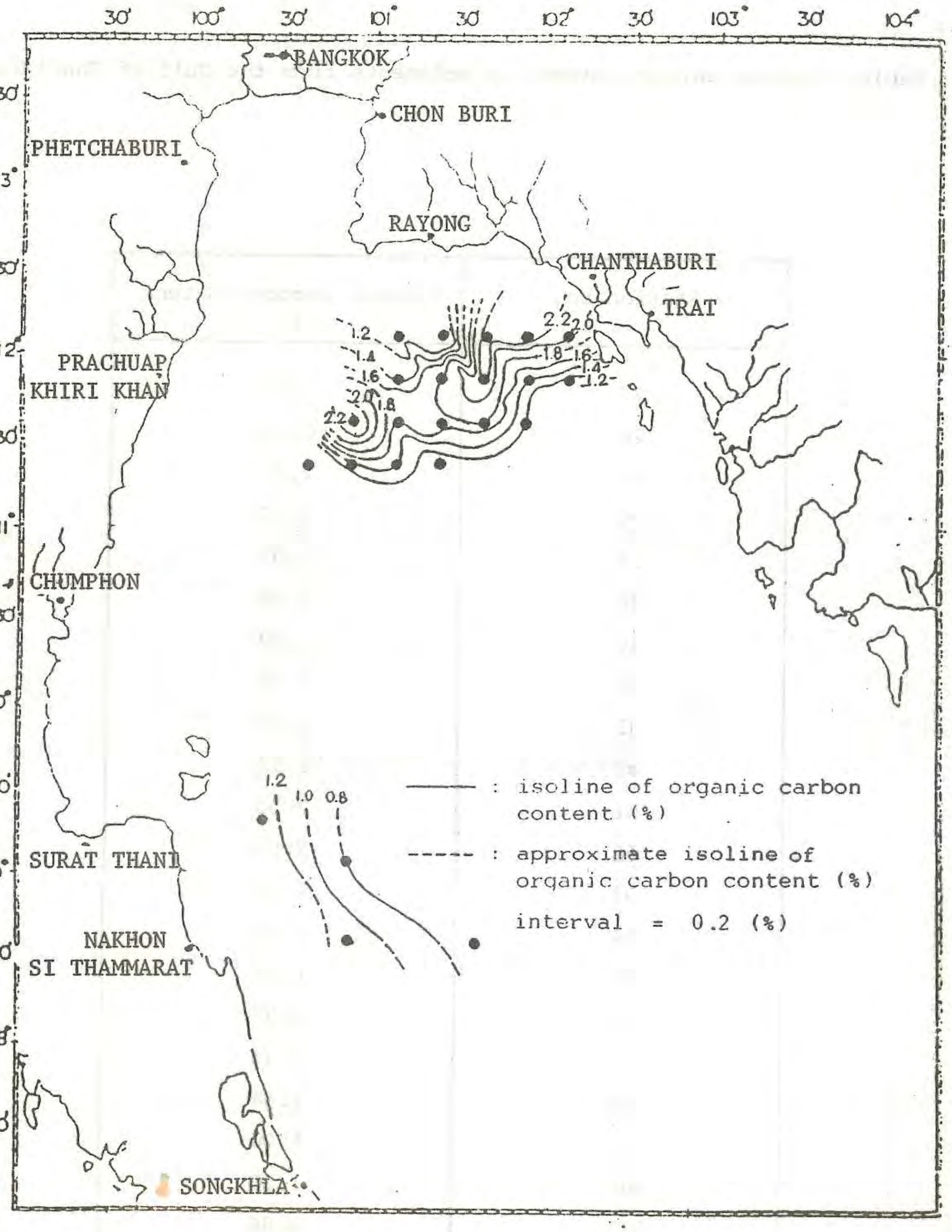

Figure 2. Distribution of organic carbon content in surface sediments from the Gulf of Thailand, 1985

2. Experimental method

The sediment samples were dried in an oven at 110°C for 24 hours and then ground in an agate mortar and passed through an 80-mesh non-ferrous sieve. Samples were analysed for organic carbon by using potassium dichromate and concentrated sulphuric acid to oxidize carbon and titration of excess dichromate with a ferrous ammonium sulphate solution using diphenylamine as an indicator of end point. This is the method followed by Gaudette *et al* (1974).

RESULTS AND DISCUSSION

The organic carbon content in the surface sediment samples from the Gulf of Thailand ranged from 0.54 to 2.53 per cent, with a mean value of 1.45 per cent (Table). Figure 2 illustrates the distribution of organic carbon content in the surface sediments. In general, nearshore sediments have a higher organic content and show a greater rate of change with distance than offshore areas. The organic carbon content was remarkably high at station 51, 29 and 30, whereas the lowest value was at station 62. The high organic carbon content at station 51 is anomalous and cannot be explained at present. Sediments throughout the study area were predominantly hydrogen sulphide-rich muds of a grey, brown or black colour; however, there were also some sandy and calcareous sediments.

ACKNOWLEDGEMENTS

The author is grateful for having been given the opportunity to take part in the sample collection cruise on board M.V. PAKNAM. Special thanks are due to the captain and crew of M.V. PAKNAM for their assistance in collecting the samples.

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BENTHIC FAUNA IN THE CENTRAL GULF OF THAILAND

Joompol SANGUANSIN

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Department of Fisheries
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ABSTRACT

The paper examines the species composition, density, biomass and distribution of the benthic fauna in the central Gulf of Thailand. Samples from 35 stations were collected by dredge and grab between 16 May and 9 June 1984.

Sixty-six species of benthic fauna were collected by dredge, with average biomass value of 21.456/100 m^2 and average density value of 2.11 individuals/100 m^2. Echinoderms were the most abundant. Polychaetes and crustaceans were commonly found. Molluscs, fishes, nemerteans, echiruans, sipunculans, poriferans and anthozoans were also recorded.

One hundred and two species of the benthic fauna were found from grab samples. The average biomass was 9.667 g/m^2 and average density was 68 individuals/m^2. *Callianassa* sp. was the dominant species among crustaceans and *Terebellides* sp. was the dominant species of polychaetes. Both were abundant and very common. Echinoderm biomass was the highest. Fishes, molluscs, nemerteans, echiurans, sipunculans, oligochaetes, nematodes and anthozoans were also recorded.

The benthic fauna collected by dredge and grab was concentrated in shallow areas, especially station 180 (near Ko Samui and Ko Phangan).

INTRODUCTION

The abundance of benthic fauna is used as baseline data to determine the biological productivity of the bottom, and is an indicator of the water quality. The benthic fauna is the main source of food for demersal fishes which are one of the economically important fisheries resources in the Gulf of Thailand. Therefore, in order to evaluate the existing demersal stocks, it is necessary to study the benthic fauna.

Several studies on benthic fauna in different parts of the Gulf of Thailand have been done so far by: Charoenruay *et al.* (1978 and 1983), Ketsamutra *et al.* (1980 and 1980), Piyakarnchana *et al.* (1978), Podapol and Piamthipmanus (1981), and Tanapong and Moordee (1982). However, data on benthic fauna in the central Gulf of Thailand are scarce. The objective of this investigation was to study the species composition, biomass, density and distribution pattern of the benthic fauna in the central part of the Gulf of Thailand.

MATERIALS AND METHODS

Data collection was carried out from 16 May to 9 June 1984, on board the SEAFDEC vessel PAKNAM, at 35 survey stations in the central Gulf of Thailand (Fig. 1 and Table 1) under a joint research program between the Training Department, SEAFDEC, the Department of Fisheries, Thailand, and the Marine Science College, Srinakharinwiroj University.

Samples of benthic fauna were collected by dredge and grab. The dredge had an iron frame 60 cm wide, with a nylon net bag of 1 cm^2 mesh size. The dredge was towed for about 300 m. This distance was calculated from the speed of the vessel and towing time. It covered the sea bottom area of about 180 m^2.

Two random samplings of sediments were collected by using a Petersen grab (area coverage 0.1 m^2) at each station. The bottom sediment samples were taken for grain size, and organic content analysed by Dr. K. Takahashi from SEAFDEC. The remaining samples from both samplings were washed by sea water through a series of stainless steel sieves of mesh size 4, 2 and 1 mm, for sorting of benthic fauna. This method was used to collect benthic fauna which the dredge could not collect. The samples were preserved in a 10% per cent formalin solution. The identification, counting and weighing were done at the Marine Fisheries Division in Bangkok.

The number of individuals from the grab samples of fauna was recorded and averaged from two replicates. The average was converted to the number of individuals per square meter, which represented density. The biomass of benthic fauna was determined by wet weight averaged from two replicates, and was recorded as grams per square meter.

The biomass and density of the benthic fauna collected by dredge were recorded as wet weight in grams per 100 square meters, and the number of individuals per 100 square meters, respectively.

RESULTS

1. <u>Benthic fauna collected by dredge</u>

The species composition of benthic fauna collected by dredge from 34 stations in the central Gulf of Thailand is shown in Tables 2 and 3. No dredge sample was taken at station 273. Sixty-six species of benthic fauna were found in this area: crustaceans (20), molluscs (15), polychaetes (13), fishes (7), echinoderms (6), anthozoan (1), nemertean (1), poriferan (1), sipunculan (1) and echiuran (1). Enchinoderms were dominant, with the highest average biomass and density: 15.764 g/100 m^2 and 0.54 individuals/100 m^2. The most abundant species was *Protankyra* sp. but it was not found at all stations. Crustaceans and polychaetes were commonly found with low biomass and density. Samples from station 180 consisted of 11 species, which was the highest number of species found at one place. It also had the highest density of 17.78 individuals/100 m^2, and high biomass at 68.278 g/100 m^2. The average biomass and density of benthic fauna in the central Gulf of Thailand were 21.456 g/100 m^2 and 2.11 individuals/100 m^2, respectively.

Figure 2 shows the distribution of benthic fauna collected by dredge in the central Gulf of Thailand. The benthic fauna was concentrated at stations 223 and 323 with biomass of more than 100 g/100m^2 (Table 3), followed by station 180 with biomass at 50-100 g/100 m^2. Most areas in the central Gulf of Thailand had low biomass, below 5 g/100 m^2. The biomass of benthic fauna showed a significant inverse correlation with depth ($r_1 = -0.3496$; $p = 0.5$).

2. Benthic fauna collected by grab

Tables 4 and 5 show the composition and the pattern of distribution of benthic fauna collected by grab from 35 stations in the central Gulf of Thailand. One hundred and two species were collected: polychaetes (39), crustaceans (29), echinoderms (9), fishes (7), molluscs (12), nemertean (1), anthozoan (1), echiuran (1), nematode (1), oligochaete (1) and sipunculan (1). The crustaceans were the most abundant and were found in average density of 27.00 individuals/m^2, with average biomass of 1.064 g/m^2. The dominant species was *Callianassa* sp. Polychaetes showed a high average density of 26.57 individuals/m^2, with average biomass of 1.367 g/m^2. The dominant species was *Terebillides* sp. The highest density of 210 individuals/m^2 and the highest number of species, i.e., 22 was found at station 321. Here the biomass was 6.130 g/m^2. Fishes had the highest average biomass, with the value of 2.784 g/m^2. The average biomass and density in the study area were 9.667 g/m^2 and 68 individuals/m^2.

Figure 3 shows the distribution of benthic fauna collected by grab in the central Gulf of Thailand. The highest concentration of benthic fauna was found at station 180 and station 221, with the highest biomass of more than 50 g/m^2. Next came stations 160 and 229, where the biomass was measured at 21-50 g/m^2. Most of the central Gulf of Thailand had low biomass of less than 5 g/m^2. The correlation between the biomass of benthic fauna and the depth was inverse and significant at $p = 0.5$ ($r = -0.7283$). In other words, the biomass of benthic fauna decreased with increased depth.

DISCUSSION

The benthic fauna collected by dredge in the central part of the Gulf of Thailand was found to consist of sixty-six species, with average biomass of 21.456 g/100 m^2 and average density of 2.11 individuals/100 m^2. The average biomass in this area was low in comparison with those in the inner Gulf, the east coast and the west coast of the Gulf of Thailand and Chong Angthong area. Table 6 shows the average biomass, number of species and dominant groups of the benthic fauna in different areas. Echinoderms were the most abundant group in the central Gulf of Thailand. A similar situation prevailed in the inner Gulf, the east coast of the Gulf and Chong Angthong area. The number of species in the central Gulf was less than in the coastal areas.

One hundred and two species of benthic fauna were found in grab samples, with average biomass of 9.667 g/m^2 and average density of 68 individuals/m^2. The average biomass in the central Gulf was lower than in the upper and lower parts of the Gulf or in the Andaman Sea, as reported by Piyakarnchana *et al.* (1978), where the average biomass in respective areas was 95.2, 26.2 and 10 g/m^2. Crustaceans and polychaetes were commonly found in the central Gulf of Thailand and had the highest average density (Table 5). This finding agreed with the results given by Tanapong and Moordee (1982) who studied benthic fauna collected by grab in the central Gulf of Thailand, between latitude 10°41' to 12°0'E and longitude 100°51' to 101°31'N. They found that crustaceans and polychaetes were the most important groups and were commonly found in great numbers.

Podapol and Piamthipmanus (1981) carried out a study on the benthic fauna in deep areas of the Gulf of Thailand, and reported 37 species of benthic fauna which were collected by grab. *Marphysa* sp. and *Eunice* sp. were the dominant polychaetes, and *Alpheus* sp. was the dominant species among shrimps. According to our results, however, *Callianassa* sp. was the dominant species of crustaceans and *Terebellides* sp. was dominant among polychaetes.

The specimens of benthic fauna collected by dredge and grab in the central Gulf of Thailand were concentrated in shallow areas, especially station 180 (near Ko Samui and Ko Phangan). Most areas in the central Gulf in which the depth was more than 50 m had low biomass. It was observed that the quantity of benthic fauna decreased with increased depth, which agreed with the correlation coefficient values between biomass of the benthic fauna (collected by both dredge and grab) and depth (r_1 = -0.3496 and r_2 0.7283: p = 0.5).

This study provides some background information on benthic fauna in the central Gulf of Thailand. Only one cruise was conducted in this area, therefore it is difficult to conclude the pattern of distribution of the benthic fauna and the structure of the community in this area. Further study is needed to investigate the seasonal change of species composition, biomass and density of the benthic fauna.

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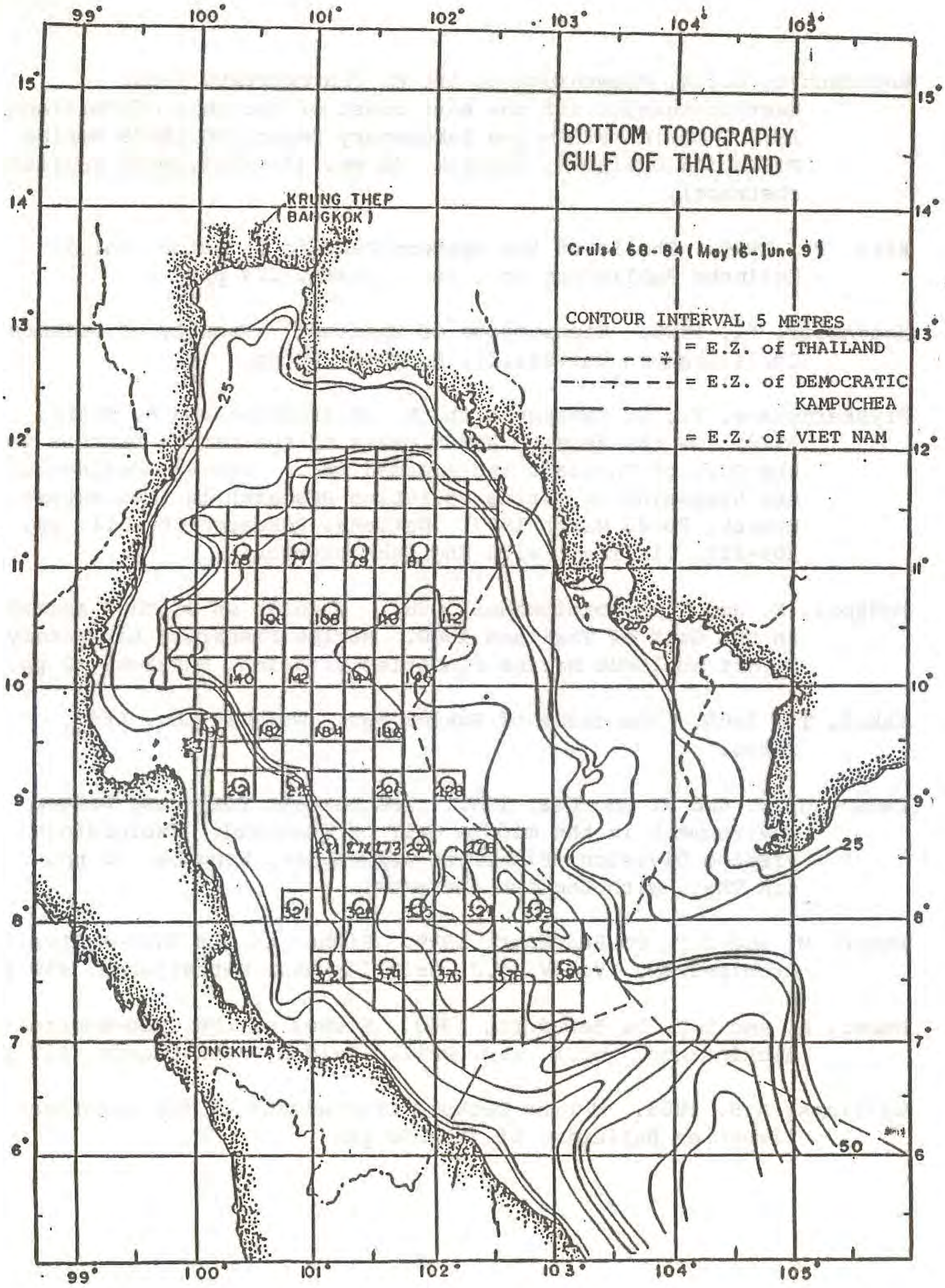

Fig. 1 Stations in the central Gulf of Thailand, where samples of benthic fauna were collected, 1984

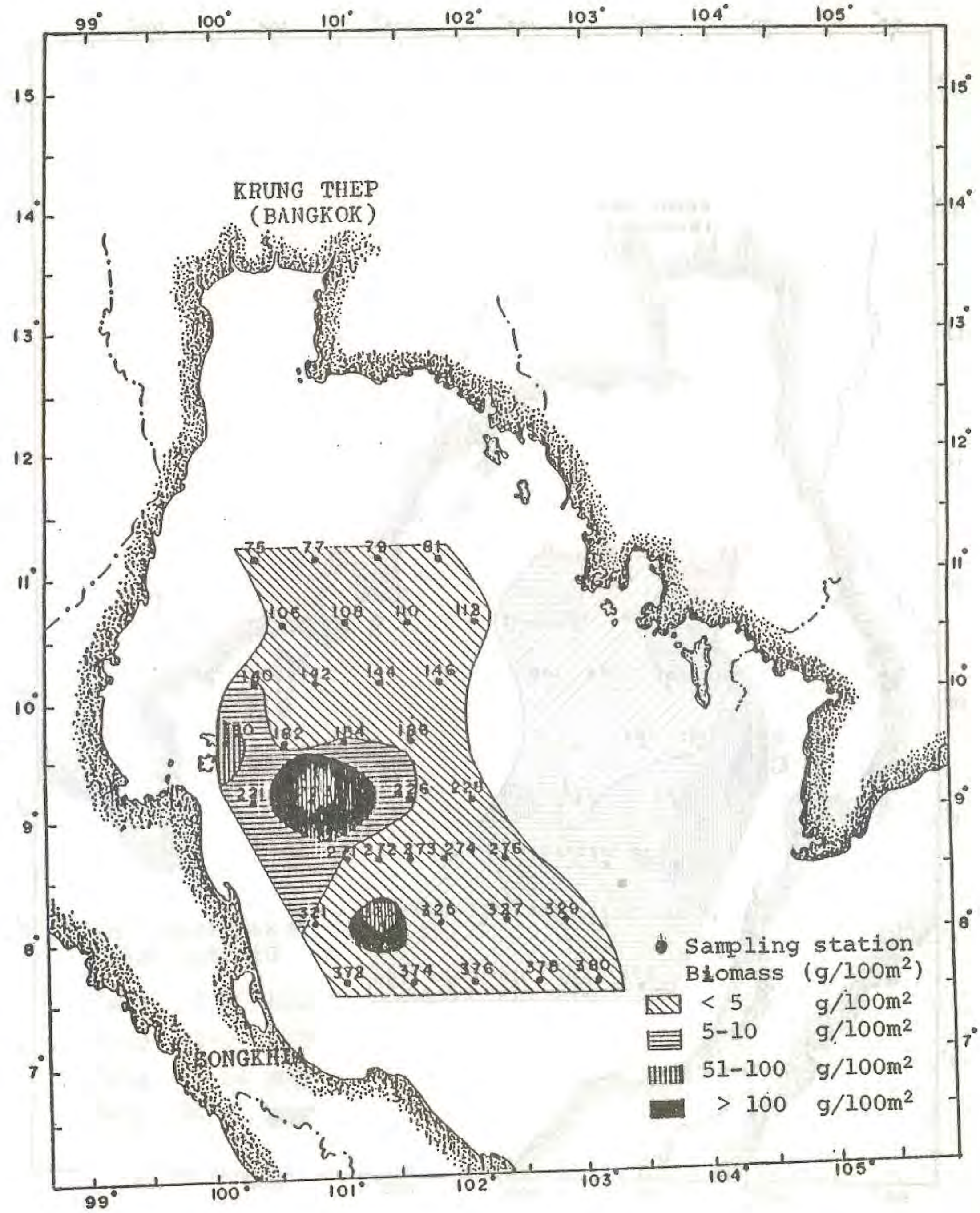

Fig. 2 Distribution of the benthic fauna collected by dredge in the central Gulf of Thailand, 1984

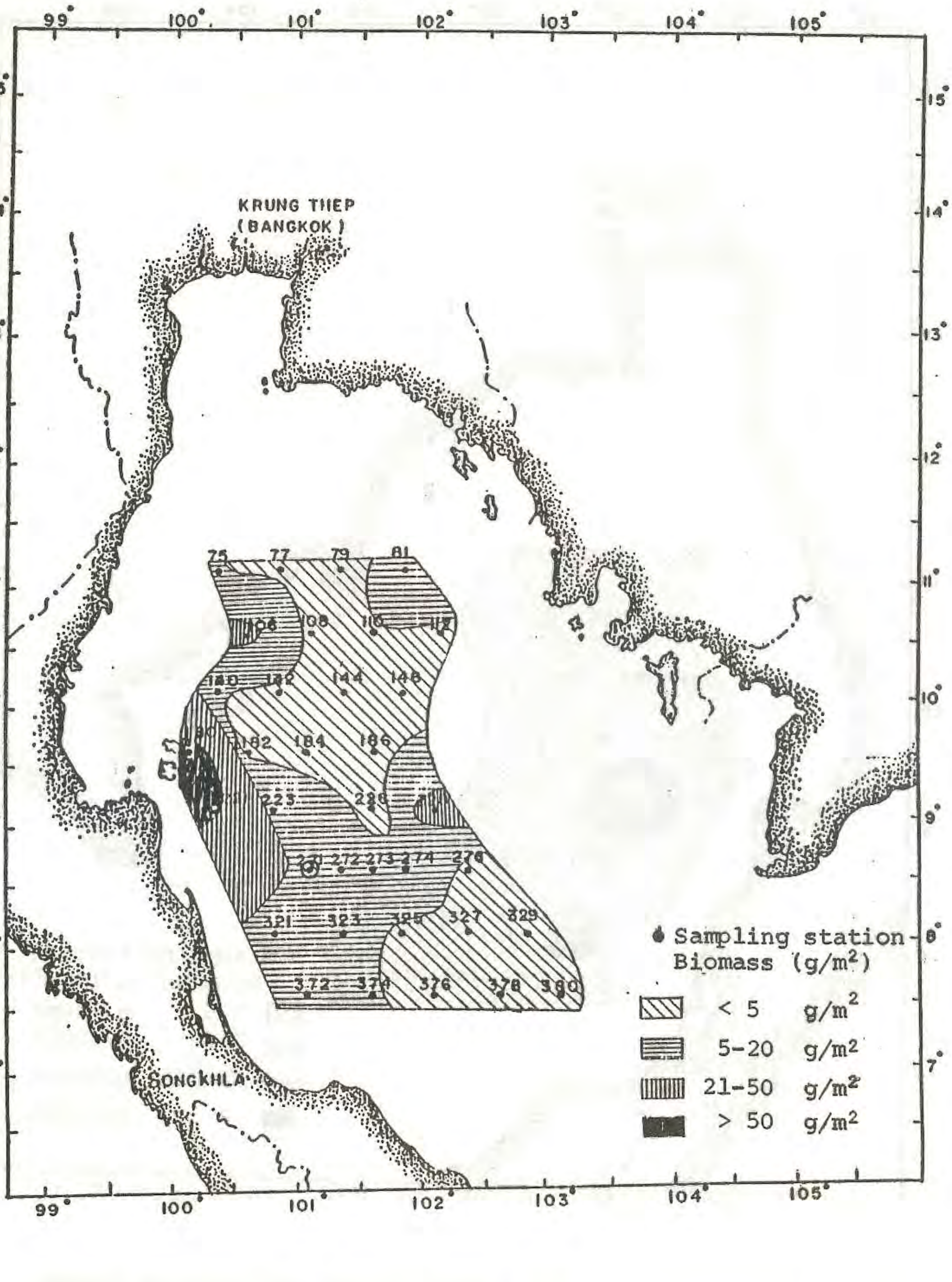

Fig. 3 Distribution of the benthic fauna collected by grab in the central Gulf of Thailand, 1984

Table 1. Record of benthic fauna sampling in the central Gulf of Thailand, 1984.

Station	Position		Date	Time	Depth (m)
	Lat. N	Long. E			
75	11°07' 77"	100°22' 25"	6/6	16.00	50
77	11°07' 20"	100°51' 40"	6/6	22.00	60
79	11°03' 07"	101°24' 2"	17/5	08.55	63
81	11°07' 50"	101°52' 4"	17/5	13.00	67
106	10°37' 18"	100°36' 72"	6/6	10.50	60
108	10°35' 12"	101°06' 12"	7/6	05.58	66
110	10°37' 10"	101°37' 40"	18/5	12.33	69
112	10°36' 84"	102°06' 92"	18/5	07.05	67
140	10°07' 41"	100°22' 52"	5/6	18.43	56
142	10°07' 43"	100°52' 58"	6/6	06.10	66
144	10°03' 80"	101°24' 2"	19/5	07.13	70
146	10°02' 30"	101°47' 60"	19/5	11.00	72
180	9°39' 6"	100°09' 6"	4/6	10.55	17
182	9°40' 81"	100°37' 26"	5/6	14.35	53
184	9°32' 80"	101°07' 40"	3/6	13.54	64
186	9°35' 4"	101°38' 20"	20/5	07.10	71
221	9°07' 19"	100°22' 95"	4/6	07.08	33
223	9°07' 35"	100°52' 23"	2/6	19.25	41
226	9°07' 50"	101°37' 10"	20/5	11.20	70
228	9°06' 50"	102°07' 69"	20/5	16.07	71
271	8°37' 85"	101°08' 08"	2/6	07.00	55
272	8°38' 23"	101°22' 42"	22/5	17.57	57
273	8°37' 80"	101°36' 56"	22/5	15.32	68
274	8°36' 87"	101°52' 25"	22/5	12.20	77
276	8°34' 23"	102°16' 15"	22/5	08.05	76
321	8°08' 8"	100°50' 9"	24/5	09.10	29
323	8°07' 21"	101°22' 03"	1/6	13.32	51
325	8°07' 69"	101° 53'43"	1/6	17.55	72
327	8°07' 72"	102°22' 01"	23/5	21.16	76
329	8°07' 60"	102°53' 31"	23/5	06.43	71
372	7°39' 59"	101°06' 40"	24/5	17.50	43
374	7°38' 18"	101°36' 79"	28/5	16.33	48
376	7°39' 68"	102°08' 28"	28/5	11.50	72
378	7°37' 46"	102°37' 70"	25/5	06.35	69
380	7°37' 07"	103°07' 07"	25/5	17.05	61

Table 2. Species composition of the benthic fauna collected by dredge in the central Gulf of Thailand, 1984.

Species / Station No.	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
No of individuals	6	-	1	1	4	1	1	2	8	-	2	1	32	5	5	2	6	5	2	2	3	2		2	2	5	9	4	1	1	1	6	-	4	3	129
No. of species	6	-	1	1	4	1	1	2	7	-	2	1	11	5	5	2	6	5	2	2	3	2		2	2	4	8	4	1	1	1	5	-	4	3	
Polychaeta																																				
Asychis sp.	1																1															1				3
Diopatra sp.						1							1	1														1						1		5
Goniada sp.																											1									1
Leiocapitella sp.				1																																1
Lumbrineris sp.	1																																			1
Nereis sp.																											1									1
Phyllodoce sp.																																		1		1
Polyodontes sp.	1								1								1															1				4
Sternaspis sp.																													1							1
F. Aphroditidae													2								1															3
F. Arenicolidae																						1														1
F. Maldanidae									1				1																							2
F. Pilargiidae											1					1																				2
Crustacea																							no collection													
Decapoda																																				
Heterocarpoides sp.							1																													1
Processa sp.																								1												1
Calappa sp.																					1															1
Chasmocarcinops gelasimoides									2								1	1										1								5
Clibanarius sp.																														1						1
Leucosia sp.																																			1	1
Liagore rubromaculata																			1																	1
Portunus brockii																					1															1
Portunus tuberculosus															1																					1
Scalopidia spinosipes									1				2																							3
Typhlocarcinops decrescens																										1										1

Table 2. (continued)

Species \ Stations	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
F. Goneplacidae															1			1					no collection									2				4
F. Leucosidae															1																					1
F. Pinnotheridae													1																							1
F. Portunidae																																		1		1
F. Xanthidae	1																			1																2
Stomatopoda																																				
Acanthosquilla multifasciata											1																									1
Coronidopsis sp.	1																																			1
Levisquilla sp.																												1								1
Oratosquilla sp.					1																															1
Mollusca																																				
Pelecypoda																																				
Anadara sp.																											1									1
Chama sp.								1																												1
Dosinia sp.																											1					1				2
Ensiculus philippianus									1																									1		2
Fabulina sp.	1																																			1
Laevicardium sp.																												1								1
Paphia undulata															1																					1
Pecten(Serratovola) tricarinatus															1							1														2
Cultelleus sp.																																			1	1
Tellina sp.																										1										1
Tellina (Angulus) cf. rhondon					1																															1
Nucula (Ennucula) sp.																																1				1
Gastropoda																																				
Bursa sp.									1																											1
Hindsia sp.																												1								1
Zeuxis sp.																								1												1

Table 2. (continued)

Species \ Stations	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
Teleostomi																																				
Bregmaceros sp.																			1																	1
Bregmaceros macclellandi								1				1																								2
Cryptocentrus sp.																		1																		1
Oxyurichthys tentacularis													1																							1
Trypauchen sp.																	1																			1
Trypauchen vagina					1								1												1											3
Symbrancius caligan													1	1																						2
Echinodermata																																				
Ophiuroidea																																				
Ophiothrix			1																																	1
Holothuroidea																																				
Holothuria sp.					1																															1
Molpadia sp.																	1										1									2
Phyllophorus sp.																		1																		1
Protankyra sp.													20				1			1			no collection			2	2								1	27
Echinoidea																																				
Lagarum sp.														1																						1
Anthozon																																				
Sea anemone													1	1																						2
Porifera																											1									1
Nemertinea													1	1										1		1			1							5
Sipuncula															1			1																		2
Echiura									1																											1

Table 3. Biomass (g/100 m²) and density (number of individuals/100 m²) of benthic fauna collected by dredge in the central Gulf of Thailand, 1984.

Station	Polychaetes Biomass	Polychaetes Density	Crustaceans Biomass	Crustaceans Density	Molluscs Biomass	Molluscs Density	Echinoderms Biomass	Echinoderms Density	Fishes Biomass	Fishes Density	Others Biomass	Others Density	Total Biomass	Total Density
75	1.278	1.67	0.389	1.11	0.278	0.56							1.945	3.34
77														
79							0.056	0.56					0.056	0.56
81	0.167	0.56											0.167	0.56
106			0.111	0.56	0.111	0.56	0.139	0.56	1.639	0.56			2.000	2.24
108	0.139	0.56											0.139	0.56
110			0.270	0.56									0.270	0.56
112					0.080	0.56			0.389	0.56			0.469	1.12
140	1.055	1.11	2.611	1.67	0.388	1.11					1.277	0.56	5.331	4.45
142														
144	0.028	0.56	0.111	0.56									0.138	1.12
146									1.667	0.56			1.667	0.56
180	0.611	2.22	2.556	1.67			35.000	11.11	28.333	1.67	1.778	1.11	68.278	17.78
182	0.556	0.56					0.333	0.56	2.611	0.56	0.556	1.11	4.223	2.79
184			1.416	1.67	3.944	1.11							5.360	2.78
186	0.028	0.56									3.944	0.56	3.972	1.12
221	0.667	0.11	0.222	0.56			30.889	1.11	0.278	0.56			32.056	3.34
223			0.167	1.11			405.000	0.56	0.167	0.56	0.167	0.56	405.501	2.79
226			4.056	0.56					1.111	0.56			5.167	1.12
228			0.111	0.56			0.833	0.56					0.944	1.12
271	0.389	0.56	1.167	1.11									1.556	1.67
272	0.500	0.56			1.639	0.56							2.139	1.12
273	no collection													
274			1.056	0.56	0.194	0.56							1.250	1.12
276									0.111	0.56	0.722	0.56	0.833	1.12

Table 3. (continued)

Station	Polychaetes Biomass	Polychaetes Density	Crustaceans Biomass	Crustaceans Density	Molluscs Biomass	Molluscs Density	Echinoderms Biomass	Echinoderms Density	Fishes Biomass	Fishes Density	Others Biomass	Others Density	Total Biomass	Total Density
321			0.111	0.56	0.167	0.56	2.389	1.11			0.028	0.56	2.695	2.79
323	1.444	1.11	0.166	0.56	1.278	1.11	59.944	1.67			111.111	0.56	173.943	5.01
325	0.167	0.56	0.111	0.56	0.833	1.11							1.111	2.23
327	0.528	0.56									0.222	0.56	0.75	1.12
329			0.250	0.56									0.250	0.56
372														
374	0.611	1.11	1.111	1.11	2.556	1.11							4.278	3.33
376														
378	0.667	1.11	1.111	0.56	0.389	0.56							2.167	2.23
380			0.278	0.56	0.444	0.56	0.111	0.56					0.833	1.68
TOTAL	8.835	14.48	17.381	16.73	12.468	10.03	535.971	18.36	36.306	6.15	118.528	6.14	729.489	71.89
Average	0.259	0.43	0.511	0.49	0.367	0.29	15.764	0.54	1.068	0.18	3.486	0.18	21.456	2.11

Table 4. Species composition of benthic fauna collected by grab in the central Gulf of Thailand, 1984.

Station	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
No. of individuals	32	12	3	5	26	20	4	8	13	13	10	7	8	9	20	6	15	18	8	3	31	15	9	16	12	42	20	15	5	17	6	13	12	11	11	475
Species / No. of species	18	8	3	5	17	9	4	6	13	10	5	4	5	7	10	4	11	12	5	3	15	12	9	8	7	22	15	8	5	9	5	9	8	8	9	
Polychaeta																																				
Aglaophamus sp.	1					1				2					1		3				1				2	1	1							2		15
Armandia sp.														1												1										2
Branchiomaldane sp.																		1																		1
Chloeia sp.																											1									1
Diopatra sp.																										1										1
Euclymene sp.		1			1																															2
Eunice sp.									1								1	1				1								1	2					7
Glycera sp.															1											4		1							1	7
Leiochrides sp.									1																											1
Loimia sp.									1																											1
Lumbrineris sp.	1																				1		1			4								1	1	9
Magelona sp.																										1										1
Malmgrenia sp.									1																											1
Marphysa sp.	2																									1										3
Neries sp.																					1						1									2
Nephtys sp.					1			1	1																					1						4
Onuphis sp.		3																																		3
Ophelina sp.																					1					2	1									4
Pectinaria sp.									1				1																							2
Petta sp.																																		1		1
Pherusa sp.		1			1																											1				3
Pista sp.																					1							1								2
Prionospio sp.	1				1												1				1						2									6
Spio sp.									1																											1
Sternaspis sp.																						1						1					1			3
Sthenolepis sp.													1																							1
Syllis sp.																								1												1

Table 4. (continued)

Species \ Station	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
Terebellides sp.	3	1		1	5	3	1			1	1				2			1			10					1		1		2		1		1		35
F. Aphroditidae	1																										1									2
F. Capitellidae	1																					2			1	4			1			1				10
F. Cirratulidae				1					1	1													1			2										6
F. Hesionidae											3																								2	5
F. Maldanidae															1							1													1	3
F. Nereidae	1																																		1	2
F. Opheliidae																									1											1
F. Paraonidae																										4										4
F. Spionidae						2																														2
F. Terebellidae			1																							1					1		1		1	5
Unidentified	3			1		2										1	1				5	2			2	1	2		1	3				2		26
Crustacea																																				
Decapoda																																				
Alpheus sp.										2														2			2							1	1	8
Athanus sp.																		1																		1
Callianassa sp.	5				3	7		3		1	4	3			1	2			3		1						2	6	1	5		4	2			53
Heterocarpoides sp.									1																											1
Heterocarpus sp.					1																											1				2
Leptochela sp.					1			1							1		1		2		1		1			1		2					2			13
Myra elegans																					1															1
Portunus tweediei																							1													1
Processa sp.	1					1																				1										3
Solenocera alticarinata					1																															1
Trachypenaeus sp.													1																							1
Typhlocarcinops decrescens																														1						1
Upogebia sp.	1	1			4		1					1		1	3	2		1				2	1	8	2	5	1									34

Table 4. (continued)

Species \ Station	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
F. Alpheidae	1																									3										4
F. Goneplacidae		2					1							1							2					1						1	1			9
F. Pinnotheridae			1						1									1				1														4
F. Xanthidae																																2				2
Unidentified species	1														1															1					1	4
Amphipoda																																				
Ampelisca sp.	1				1																															2
Byblis sp.					1																															1
F. Eusiroidae									1																											1
Unidentified species	6					2				2				2	5		1	2			2	1					2	1	1	1				2		30
Stomatopoda																																				
Acanthosquilla sp.		2																																		2
Anchisquilla fasciata																							1													1
Clorida sp.					1																		1													2
Cloridopsis sp.																		1																		1
Levisquilla sp.																			1					1												2
Levisquilla inermis																						1														1
Isopoda																																				
Unidentified species																	1						1													2
Mollusca																																				
Pelecypoda																																				
Tellina(Angulus) cf. rhondon																											1									1
Paphia undulata														1																						1
Corbula (Solidicorbula) erythrodon				1																																1
Tellina sp.																	1																			1
Tellinella philippii																										1										1
Tellinides sp.														1																						1
F. Arcidae																							1													1

Table 4. (continued)

Species \ Station	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
F. Veneridae																																				
Unidentified species																	1				1															2
Gastropoda						1				1																										2
Tibia sp.									1																											
F. Naticidae																																				1
Ord. Nudibranchia																															1					1
Teleostomi																			1																	1
Bregmaceros sp.											1									1																
Bregmaceros macclellandi					1								1			1											1						1			4
Oxyurichthys sp.																								1												4
Trypauchen sp.																													1							1
Trypauchen vagina					1																						1			1			1			3
F. Gobiidae		1								1								1													1					3
F. Muraenidae										1								1				1		1	1											6
Echinodermata																																				1
Ophiuroidea																																				
Amphiura sp.																																				
Amphioplus sp.								1	1													1														1
Ophiothrix sp.			1					1				2						6																		2
Ophiura sp.					1																											1				11
Unidentified species	1						1			1	1																					1				2
Crinoidea													2		4		3			1				1	3					2			2	1	2	25
Antedon sp.								1																												
Holothuroidea																																				1
Molpadia sp.																	1																			
Protankyra sp.													4																							1
Unidentified species																																				4
																										1										1

Table 4. (continued)

Species \ Station	75	77	79	81	106	108	110	112	140	142	144	146	180	182	184	186	221	223	226	228	271	272	273	274	276	321	323	325	327	329	372	374	376	378	380	Total
Anthozoa																																				
* Sea anemone (unidentified)																					1															1
Echiura					1																					1	1	2								5
Nematoda																						1														1
Nemertinea	1			1																1													1			4
Sipuncula						1												1	1		1			1												5
Oligochaeta												1																								1

Table 5. Biomass (g/m^2) and density (number of individuals/m^2) of benthic fauna collected by grab in the central Gulf of Thailand, 1984.

Station	Polychaetes		Crustaceans		Molluscs		Echinoderms		Fishes		Others		Total	
	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density
75	4.015	70	0.790	75			0.130	5			0.110	5	5.045	155
77	0.235	30	0.480	30					1.570	5			2.285	65
79	0.65	5	1.01	5			0.055	5					1.715	15
81	0.615	15			6.185	5					4.03	5	10.83	25
106	0.650	45	4.535	65			0.505	5	21.76	10	7.515	5	34.965	130
108	0.585	40	1.175	50	0.065	5					0.215	5	2.040	100
110	0.060	5	0.315	10			0.045	5					0.420	20
112	0.085	5	0.310	20			1.265	15					1.66	40
140	1.655	40	1.580	15	3.545	5	0.195	5					5.985	65
142	1.055	20	1.585	25	0.065	5	0.045	10	1.09	10			3.840	65
144	0.085	20	0.325	20			0.065	5	1.100	5			1.575	50
146			0.295	20			0.075	10			0.540	5	0.910	35
180	7.085	10	1.115	5			18.725	20	50.475	5			77.4	40
182	0.015	5	0.235	20	1.255	10	0.105	10					1.610	45
184	0.010	25	0.405	55			0.250	20					1.665	100
186	0.05	5	1.05	20					0.685	5			1.785	30
221	0.590	30	0.175	15	1.130	10	55.480	20					57.375	75
223	0.985	15	0.265	30			1.640	30	7.005	10	0.260	5	10.155	90
226			0.650	30	0.158	5					1.555	5	2.363	40
228			0.750	5			0.065	5	0.545	5	20.765	5	22.125	20
271	2.015	115	0.685	35	0.140	5					2.070	10	4.910	165
272	12.560	25	0.525	25			0.075	5	0.255	5	0.085	5	13.500	65
273	1.555	10	4.535	30	1.005	5							7.095	45
274	0.055	5	1.765	55			10.76	5	1.54	10	0.560	5	14.68	80
276	0.255	30	0.160	10			0.185	15	0.085	5			0.685	60

Table 5. (continued)

Station	Polychaetes		Crustaceans		Molluscs		Echinoderms		Fishes		Others		Total	
	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density
321	4.080	140	1.270	55	0.255	5	0.240	5			0.285	5	6.130	210
323	1.08	45	0.535	35	2.560	5			0.615	10	3.555	5	8.345	100
325	2.485	20	1.015	45							0.455	10	3.955	75
327	0.760	10	0.755	10					1.050	5			2.565	25
329	0.300	40	0.435	35			1.750	10	1.030	5			3.515	90
372	0.235	10	4.060	5	3.00	5			7.575	5			14.87	25
374	0.765	15	3.005	40			1.745	10					5.515	65
376	0.075	10	0.84	35			0.150	10	1.065	10	0.570	5	2.700	70
378	0.585	35	0.070	5			0.140	5					0.795	45
380	2.590	35	0.535	10			0.190	10					3.315	55
TOTAL	47.830	930	37.235	945	19.363	70	93.880	240	97.445	110	42.570	85	338.323	2380
Average	1.367	26.57	1.064	27	0.553	2	2.682	6.86	2.784	3.14	1.216	2.43	9.667	68

Table 6. Number of species, average biomass and dominant group of benthic fauna (collected by dredge) in different parts of the Gulf of Thailand [after Charoenruay *et al.* (1978 and 1983) and Ketsamutra *et al.* (1980 and 1980)].

Study area	**Number of species and dominant group**	**Average biomass (g/100 m)**
Inner Gulf of Thailand	394/Echinoderms	342.2
East coast of the Gulf	320/Echinoderms	49.0
West coast of the Gulf	163/Polychaetes	74.0
Chong Angthong	101/Echinoderms	291.6
Central Gulf	66/Echinoderms	21.5

ASSESSMENT OF PRIMARY PRODUCTION AND TERTIARY PRODUCTION (FISH PRODUCTION) IN THE CENTRAL GULF OF THAILAND

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FIGURE AND TABLE

ABSTRACT

The organic production beneath a water column in the central Gulf of Thailand is estimated at 1.3659 $gC/m^2/day$ (0.50 $kgC/m^2/yr$). It is about 42.36 per cent lower than the average value between 1971 and 1983, when it was 2.3695 $gC/m^2/day$ (0.64 $kgC/m^2/yr$).

The potential of fish production is estimated from the average value of the primary production beneath a water column 396,237.16 tons/yr, or 3.96×10^5 tons/yr.

INTRODUCTION

A hydrographic survey was conducted in the coastal part of the Gulf of Thailand from 16 May to 9 June 1984 under the Thai-SEAFDEC joint research program. Samples of phytoplankton filtration were sent to the Marine Fisheries Division for pigment extraction and assessment. This report presents the findings of the Marine Fisheries Division.

The objective of the survey was to assess the tertiary or fish production from the primary production. The project included comparing the values of primary production between the coastal areas of less than 50 m depth and offshore areas (deeper than 50 m), assessing the tertiary or fish production under the water column (P col.) in the coastal and deeper areas.

The production of phytoplankton population, the chlorophyll content and the extinction coefficient can be computed by assuming that 3.7 mg of carbon are assimilated per hour, at light saturation, for each milligram of phytoplankton chlorophyll.

The Yentsch, Ryther and Yentsch equation is applicable:

$$P = \frac{R}{K} \times C \times 3.7$$

where C = microgram chlorophyll/m^3 in a sample of an unevenly distributed population

$$\log P = 1.047 + 0.728 \log C - 0.615 \log (D430/665)$$

(This is an estimate of phytoplankton production by Margalef, 1965.)

This is equal to

$$P = 11.1\ C^{0.728}/(D430/D665)^{0.615}$$

since

$$P = 67.7(D665)^{1.343}/(D665)^{0.615} \quad \text{........*}$$

MATERIALS and METHODS

The area of the central Gulf of Thailand is divided into 31 survey stations, as shown in the figure. The water samples were collected by Van Dorn Water Sampler at the 100, 32, 10, 3.2 and 1 per cent light intensity depths, and filtered on the Millipore Filter type HA 0.45 micron, size 47 mm. The plankton was preserved in a magnesium carbonate solution in a dark and cool desiccator until the extraction process could be carried out. The chlorophyll pigment was extracted from phytoplankton cells which remained on the filter, by using a 90 per cent concentrated acetone solution and leaving each sample about 10 minutes in the homogenizer. After that they were kept in a dark place for a few hours to continue the process of extraction. The solution was clarified in a centrifuge and measured by the spectrophotometer at 430 and 665 Angstrom to record the absorbancy at each wave length for each sample.

To compute the value of each sample by Margalef's equation:-

$$P = 67.7(D665)^{1.343}/(D430)^{0.615} \quad \text{........*}$$

The primary production $gC/m^2/day$ was computed from the production $mgC/m^3/hr$ using the readings for light intensity in the sea which were taken every hour from sunrise to sunset. The following equation was used:

$$P \times R \times 24 \times 1000 \quad \text{........*}$$

where

P = phytoplankton production in $mgC/m^3/hr$

R = relative production from the appropriate value of surface radiation

= the accumulation of relative production in each hour from sunrise to sunset and from the accumulation of light intensities from 100, 32, 10, 3.2 and 1 per cent of surface radiation.

one day = 24 hours

one gram Carbon = 1000 mg Carbon

Then the unit of primary production beneath a water column is equal to $gC/m^2/day$.

RESULTS

Estimation of primary production from pigment and light data

The primary production can be estimated from the pigment ratio between D430 and D665 on the basis of mg $Carbon/m^3/hr$ and then as $gC/m^2/day$ by using the light data and the relative productivity, which is computed from the relation of standard logarithms of light intensity in each hour from sunrise to sunset. Assuming that 3.7 mg. of carbon are assimilated per hour at light saturation for each milligram of phytoplankton chlorophyll, Margalef's equation can be used, when an appropriate estimate of production is:-

$$\log P = 1.047 + 0.728 \log C - 0.615 \log(D430/665)$$

equal to

$$P = 11.1C^{0.728}/(D430/D665)^{0.615}$$

Since C is approximately proportional to D665 one could equally well write:

$$P = 67.7\ (D665)^{1.343}/(D430)^{0.615}$$

Some production values obtained from the pigment ratio (Margalef, 1965) are given in the Table. Also included in the table are the data of daily primary production and transparency depth.

Table Primary productivity, transparency and extinction coefficient in the central Gulf of Thailand, 1984

Items	Depth		
	more than 70 m (72-76 m)	more than 50 m (50-70 m)	less than 50 m (15-47 m)
Primary productivity (in $gC/m^2/day$)	range 1.3186-1.4899 Average 1.3957	range 1.0966-1.6949 Average 1.3411	range 0.9089-2.0482 Average 1.4176
Transparency depth (in metres)	range 13.68-14.98	range 9.12-15.63	range 5.68-16.29
Extinction coefficient (per metre)	range .1001-.1096	range .0959-.1645	range .0921-.2558

The average primary production under a water column in each station is shown in the Figure. The highest production was in station number 180, where it amounted to 2.0482 $gC/m^2/day$. In the deepest areas (72-76 m), it ranged from 1.3186 to 1.4899 $gC/m^2/day$; in the areas of 50 to 70 metres in depth the range was from 1.0966 to 1.6949 $gC/m^2/day$; in the shallow areas of less than 50 metres in depth (15-47 m) the range was from 0.9089 to 2.0482 $gC/m^2/day$.

The potential fish production which was estimated from the primary production was equal to 396,237.16 tons per year, by using 270 days which are the season days according to Cushing (1969) for converting the primary production to the tertiary production or fish production.

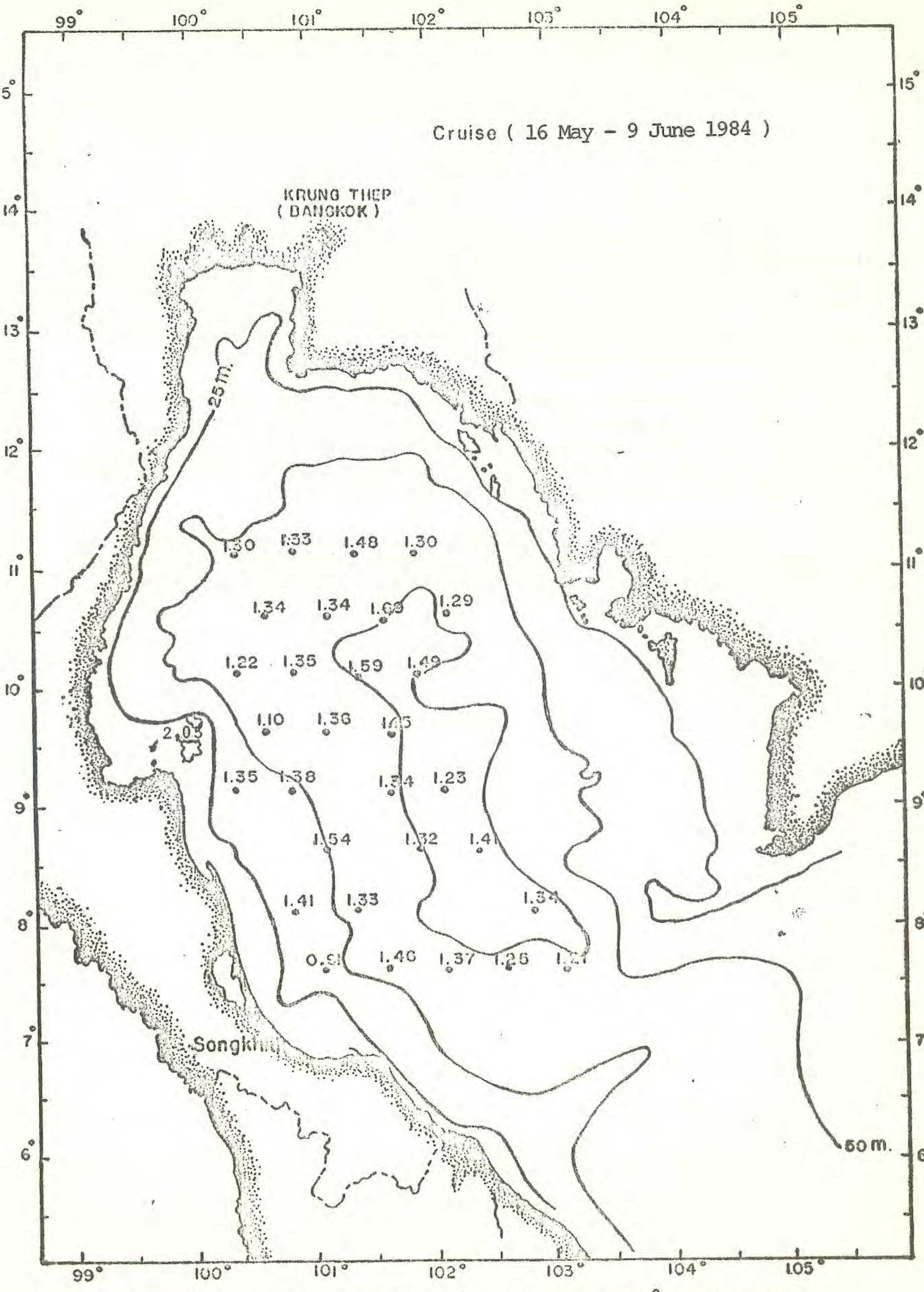

Figure Primary productivity in column (P col. $gC/m^2/day$) in the central Gulf of Thailand, 1984

SUMMARY

An indirect estimate of primary production on the basis of properties present in an ecosystem has to include some terms reflecting quantitatively the structure of the community, such as the pigment ratio D430/D665. Since the pigment ratio D430/D665 is a good indicator of the structural properties of the whole community, it is advisable not to limit the analysis of pigment spectra to a single narrow band.

A well developed primary productivity in the water column is present at a depth where the surface light is reduced to 32 per cent or 10 per cent. It appears that a photo synthetically active phyto-plankton community is adapted to low intensity and the highest produc-tion is at the 32 per cent or 10 per cent light level.

The potential fish production, i.e. tertiary production which is based on the primary production, is equal to 396,237.16 tons/km^2/yr by using Cushing's season days which amount to 270 days per year.

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[illegible] 1980. [illegible]

IDENTIFICATION OF FISH EGGS AND LARVAE COLLECTED IN THE CENTRAL GULF OF THAILAND

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ABSTRACT

This paper presents the results of the identification of the fish eggs and larvae collected during the survey cruise in the central Gulf of Thailand from 21 to 25 September 1984. A total of 652 fish larvae and 796 fish eggs were collected. The larvae represented 19 identified species and 10 unknown species belonging to 24 families; however, most of the fish eggs remain unidentified.

INTRODUCTION

The central Gulf of Thailand has remained a relatively untouched fishing ground. Consequently there is a lack of information relating to the fisheries resources and oceanographic conditions of this area.

The Department of Fisheries of Thailand and the SEAFDEC Training Department conducted a joint research survey with a view to gathering oceanographic data and information on the fisheries resources in the central Gulf of Thailand. This report contains information on the identification of fish eggs and larvae obtained from larvae net sample collections carried out on board M.V. PAKNAM from 21 to 25 September 1984.

Since this study was carried out over a short period, i.e. five days, which included 13 operations, the results cannot be used to interpret the relative abundance as suggested by Alan Sanville (1963).

However, it does provide a rough estimate of the distribution of fish larvae which will be useful for scientists in determining the range or boundary of the spawning grounds of some economically important fish.

MATERIALS AND METHODS

Fish eggs and larvae were collected using a larvae net 4.5 m in length with a mouth opening of 1.3 m in diameter (Marutoku-type). The net is divided into two parts: the anterior part is 3 m in length with a 3 mm mesh size, whereas the posterior part is 1.5 m in length with a very fine mesh (GG 38). An iron ring was attached to the mouth of the net with a flow-meter fixed at the center.

The locations of the operations are shown in Figure 1. At these stations 13 horizontal surface tows were carried out by SEAFDEC vessel M.V. PAKNAM (386 G.T.) at a speed of about 2 to 3 knots. The duration of each tow was 20 minutes, with one-third of the ring being kept above the water surface. The collections were made during the day as well as at night.

The fish eggs and larvae collected were preserved in a 4-10 per cent formalin solution while on board. The samples were sorted counted, identified and measured in the Marine Fisheries Division laboratory.

RESULTS

Species Composition

The fish eggs and larvae collected by larvae net during this cruise belonged to 24 families, the species composition is shown in Table 1, and the conditions of the survey operations are indicated in Table 2.

Table 1. Species composition of fish eggs and larvae collected in the central Gulf of Thailand, 1984.

Species Composition \ Station No.	93	95	110	160	162	184	204	204	246	248	298	300	353	Total
	Number of collected specimens													
FISH LARVAE														
Clupeidae														
Clupea spp.	14	-	-	1	1	-	-	-	-	-	-	9	-	25
Engraulidae														
Stolephorus spp.	1	-	222	-	1	1	37	10	17	-	-	121	1	411
Hemirhamphidae														
Hemirhamphus sp.	3	1	-	16	10	5	-	2	13	2	2	-	3	57
Exocoetidae														
Unknown sp.	-	-	-	-	-	-	-	-	-	2	-	-	-	2
Fistularidae														
Fistularia sp.	-	-	-	-	-	-	-	-	20	-	-	-	-	20
Sphyraenidae														
Sphyraena sp.	-	-	3	-	-	1	-	1	1	-	-	-	2	8
Theraponidae														
Therapon sp.	1	1	2	-	2	6	3	2	11	2	1	1	1	33
Apogonidae														
Apogon sp.	-	-	1	-	-	-	2	-	-	-	-	-	-	3
Carangidae														
Caranx kalla	-	-	-	2	8	-	-	1	1	-	-	-	-	12
C. oruminophthalmus	-	-	-	1	-	-	2	2	1	1	-	-	-	7
C. leptolepis	-	-	1	-	-	-	-	-	1	-	-	1	-	3
C. sp.	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Chorinemus sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Coryphaenidae														
Coryphaena sp.	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Lutjanidae														
Lutjanus sp.	-	-	3	-	-	-	-	-	-	-	-	-	-	3
Leiognathidae														
Leiognathus sp.	-	-	1	-	-	-	1	-	-	-	-	-	-	2
Nemipteridae														
Nemipterus sp.	-	-	-	-	-	-	-	-	-	-	-	2	-	2
Gerridae														
Unknown spp.	-	-	3	2	-	-	-	-	-	-	-	-	-	5
Mullidae														
Unknown spp.	-	1	3	4	2	1	2	-	-	-	1	-	3	17
Cepolidae														
Unknown sp.	-	-	1	-	-	3	-	-	-	-	-	-	-	4
Pomacentridae														
Unknown sp.	-	-	-	-	-	7	-	-	-	-	-	-	-	7
Labridae														
Unknown sp.	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Scaridae														
Unknown sp.	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Blenniidae														
Unknown sp.	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Thunnidae														
Auxis thazard	-	-	4	-	-	-	-	-	1	-	-	-	-	5
Thunnus tonggol	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Gobiidae														
Unknown spp.	-	-	-	-	-	-	2	1	-	-	-	-	-	3
Scorpaenidae														
Unknown sp.	-	-	1	-	-	-	1	-	-	-	-	-	-	2
Bothidae														
Psettina sp.	-	-	6	1		-	3	1	3	-	-	-	-	14
TOTAL FISH LARVAE	19	3	252	27	24	25	56	21	69	7	4	134	11	652
FISH EGGS														
Stolephorus spp.	-	-	-	-	-	-	-	-	-	3	-	-	1	4
Sardinella spp.	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Other eggs	9	42	27	9	71	18	5	101	-	47	350	54	58	791
TOTAL FISH EGGS	9	42	27	9	72	18	5	101	-	50	350	54	59	796

Table 2. Conditions of larvae net operations on board M.V. PAKNAM from 21-25 September 1984

Date	Station No.	Position		Time	Volume of water passing through the net	No. of fish larvae
		Latitude	Longitude	Start-Finish	(m^3)	
21/9/84	93	10°-52′.01 N	101°-06′.2 E	0712-0732	1730.22	19
21/9/84	95	10°-51′.97 N	101°-37′.20E	1449-1509	1650.00	3
21/9/84	110	10°-38′.10 N	101°-41′.20E	1951-1935	1600.48	252
22/9/84	160	09°-50′.10 N	100°-36′.5 E	0713-0733	1755.77	27
22/9/84	162	09°-50′.96 N	101°-08′.06E	1245-1305	1301.78	24
22/9/84	184	09°-22′.80 N	101°-17′.00E	1620-1640	1313.46	25
22/9/84	204	09°-21′.50 N	100°-57′.50E	2037-2057	1571.76	56
23/9/84	204	09°-26′.50 N	100°-56′.9 E	0633-0653	1364.37	21
23/9/84	248	08°-52′.57 N	101°-20′.75E	1315-1335	1340.40	7
23/9/84	246	08°-52′.80 N	100°-53′.30E	1950-2010	1366.75	69
24/9/84	298	08°-22′.84 N	101°-37′.50E	1331-1351	1233.44	4
24/9/84	300	08°-20′.84 N	102°-07′.93E	1855-1915	1558.88	134
25/9/84	353	07°-52′.34 N	102°-35′.05E	1217-1237	1655.94	11

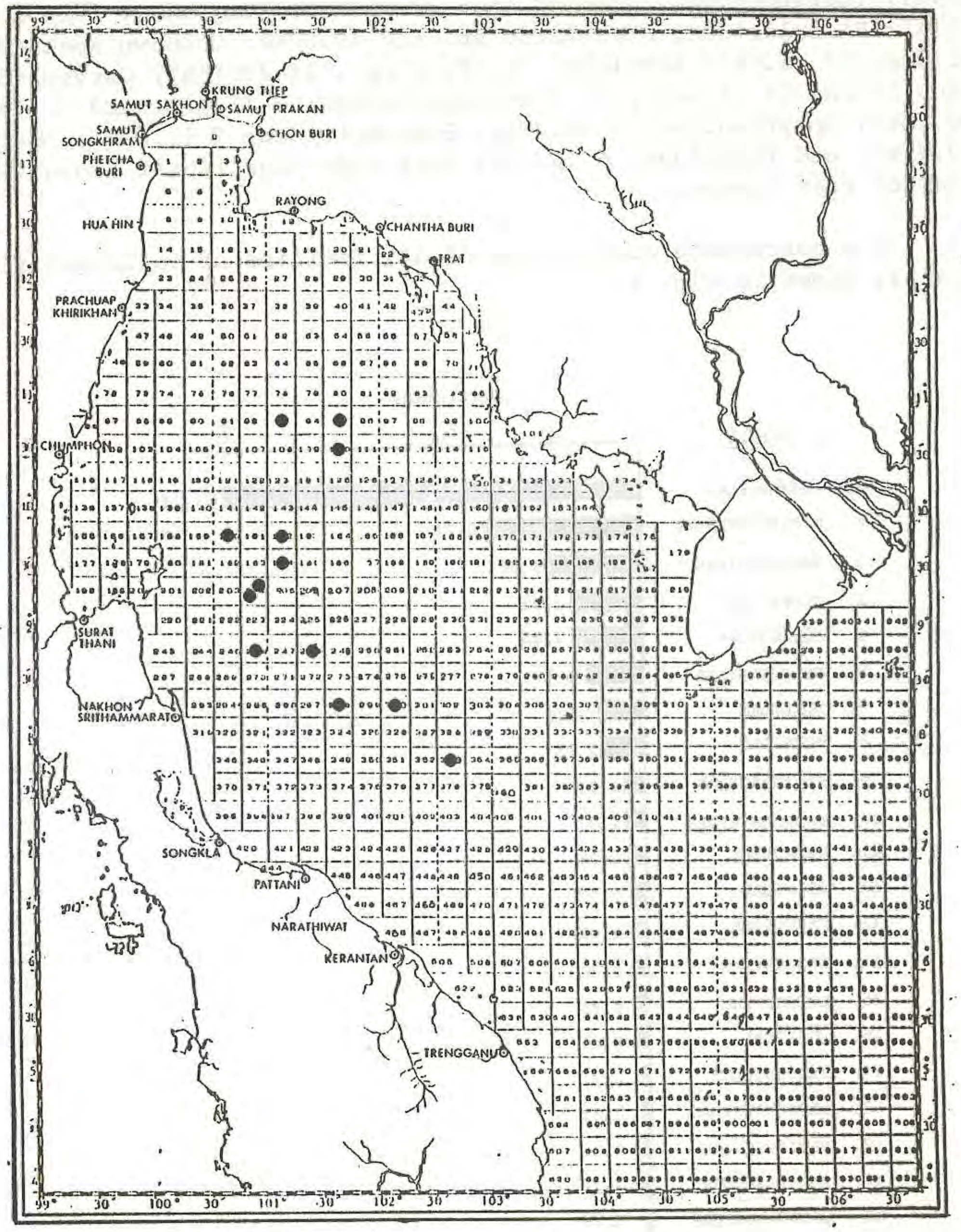

Fig. 1 Locations (marked ●) of larvae net operations in the central Gulf of Thailand, 1984. The numbers in the grid indicate the station numbers.

Among the collected fish larvae, Engraulidae were dominant: 411 (63.04%). The fish larvae of this family represented several *Stolephorus* species. Larvae of other major fish belonged to the following families and species: Hemirhampidae, *Hemirhampus* sp.: 57 (8.74%); Theraponidae, *Therapon* sp.: 33 (5.06%) Clupeidae, *Clupea* sp.: 25 (3.83%); Fistularidae, *Fistularia* sp.: 20 (3.07%); Unknown species of Mullidae: 17 (2.6%); Bothidae, *Psettina* sp.: 14 (2.15%); Carangidae, *Caranx kalla*: 12 (1.84%); *C. cruminiphthalmus*: 7 (1.07%) and *C. leptolepis* 3 (0.46%); Sphyraenidae: 8 (1.23%); Pomacentridae: 7 (1.07%); Gerridae: 5 (0.77%); and Thunnidae: 6 (0.92%) were also significant among the collected fish larvae.

The percentage composition of all families of collected fish larvae is shown in Fig. 2.

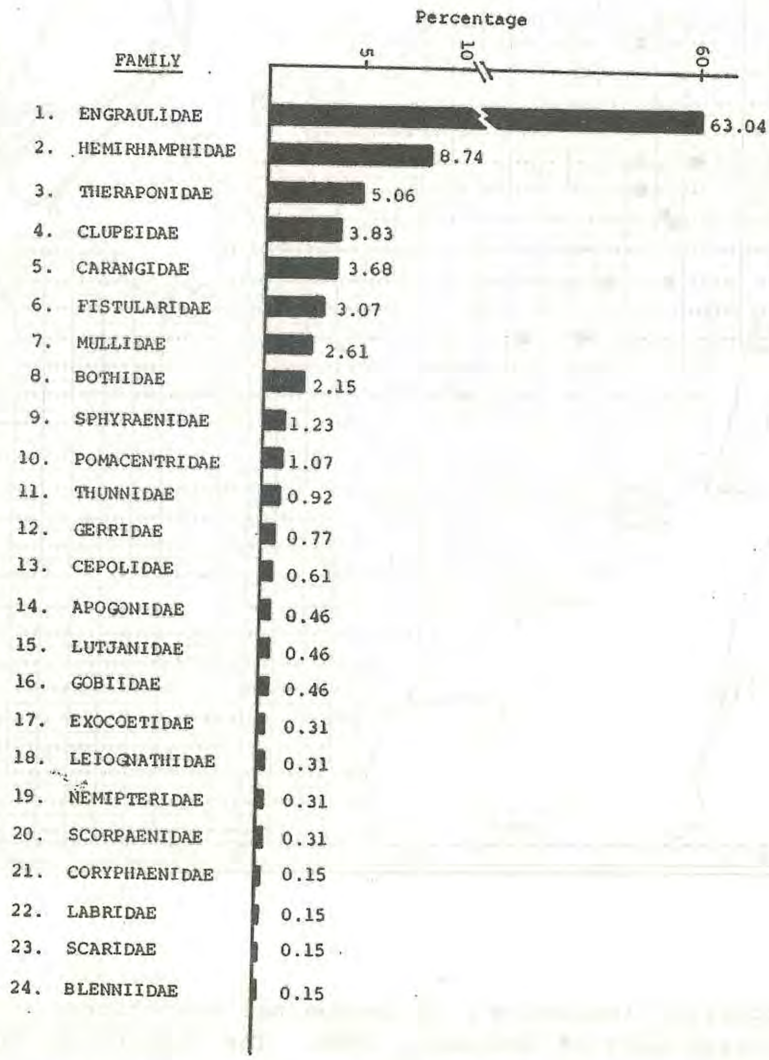

Fig. 2 Percentage composition of fish larvae collected in the central Gulf of Thailand, by family.

Characteristics of fish larvae

Since many characteristics which are important for the identification of adult fish cannot be used to identify the larvae, the following indications of some of the distinctive characteristics of fish larvae will be useful in sorting the larvae into groups or families.

Family *Clupeidae*

Body slender and elongate. Mouth oblique, upper jaw wide. Dorsal and anal fins not overlapping, anal fin far back. Alimentary canal shows vertical muscle strands. Pattern of coloration appears on the lower part of the body. Preanal myotomes 30-40, postanal myotomes about 10.

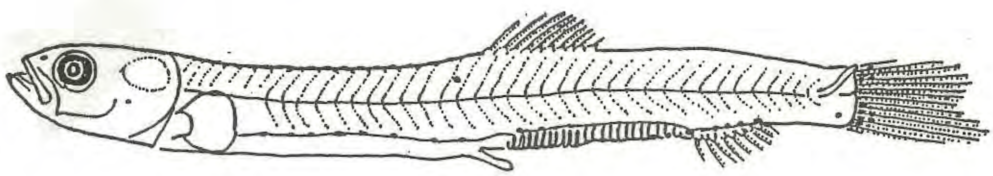

Fig. 3. *Clupea* sp. TL. 12.6 mm.

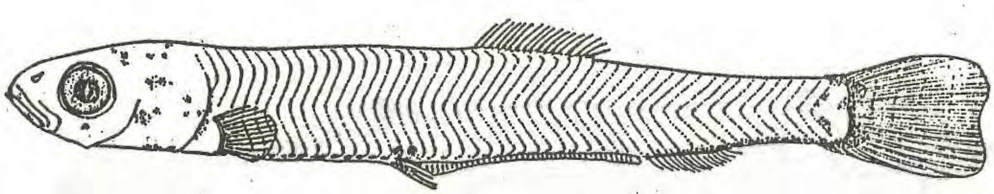

Fig. 4. *Clupea* sp. TL. 22.3 mm.

Family *Engraulidae*

Body slender and elongate. Head slightly rounded, mouth subterminal. Dorsal and anal fins overlapping or close together in a straight line. Little coloration on the body. Numerous myotomes, about 42-45.

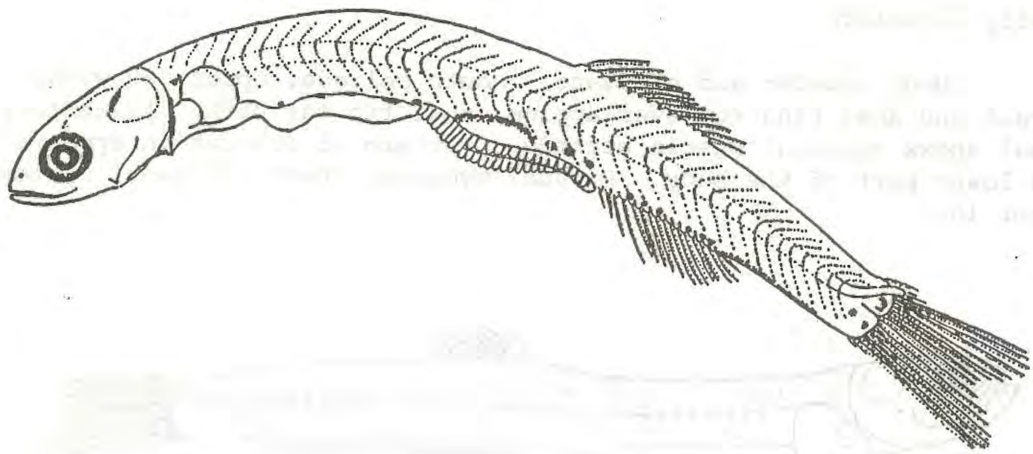

Fig. 5. *Stolephorus* sp. TL. 11.5 mm.

Family *Hemirhamphidae*.

Body elongate and spar-shaped. Snout projecting, mouth oblique. Numerous myotomes, about 47-60. In post larvae lower jaw projects beyond the upper.

Fig. 6. *Hemirhamphus* sp. TL. 9.0 mm.

Family *Exocoetidae*

Body elongate and fusiform. Mouth oblique, protuding lower jaw with barbel. Lower lobe of caudal fin slightly elongated, appearancé of big pectoral and ventral fins. Some parts of body densely coloured. Numerous myotomes, about 30-50.

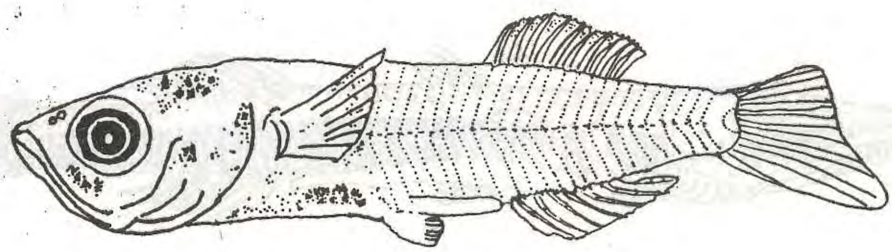

Fig. 7. *Exocoetidae* TL. 8.8 mm.

Family *Fistularidae*

Body slender and elongate, tube-like mouth. Caudal fin with elongated filament. Series of spines appear on the body, one at each mid lateral and another at mid dorsal. In post larvae the mouth projecting forward becomes flute-shaped.

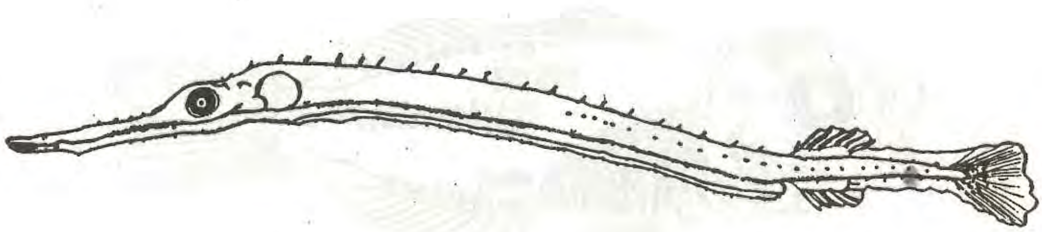

Fig. 8. *Fistularia* sp. TL. 16.5 mm.

Family *Sphyraenidae*

Body rather slender and elongate. Wide mouth, appearance of small canine-like teeth. In the smaller larvae the mouth projects forward. About 24 myotomes.

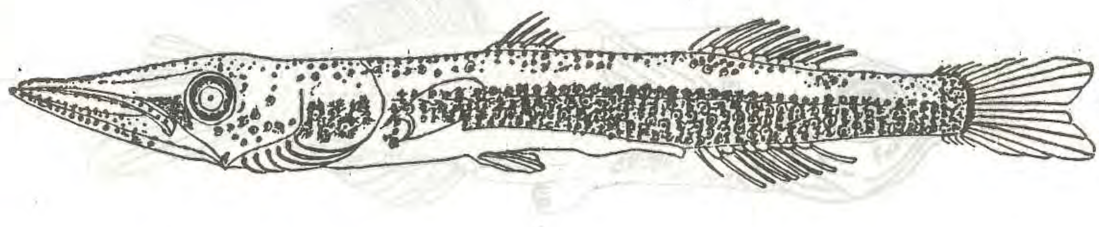

Fig. 9. *Sphyraena* sp. TL 19.1 mm.

Family *Theraponidae*

Body slightly compressed and moderately short. Head has preopercular spine, mouth slightly oblique with villiform teeth in jaw. Dorsal fin long. Some parts of body, particularly head and below pectoral fin densely coloured. Appearance of three lines of coloration along the upper, middle and lower parts of the body. About 24 myotomes.

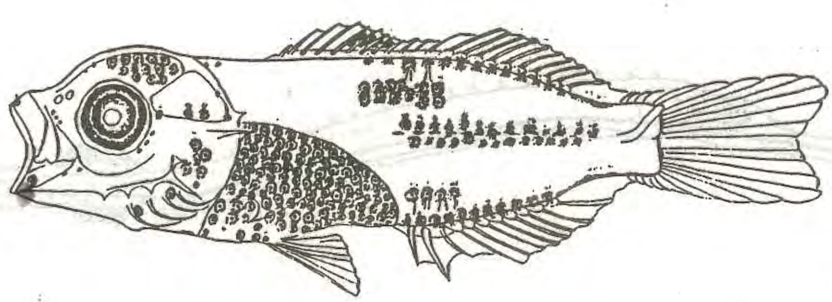

Fig. 10. *Therapon* sp. TL. 8.1 mm.

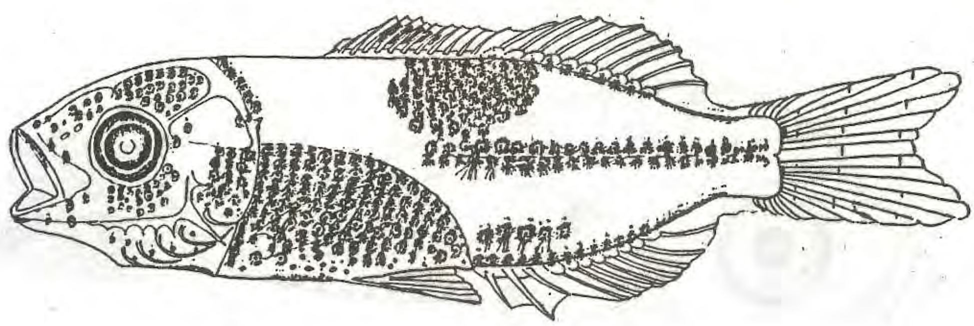

Fig. 11. *Therapon* sp. TL. 9.5 mm.

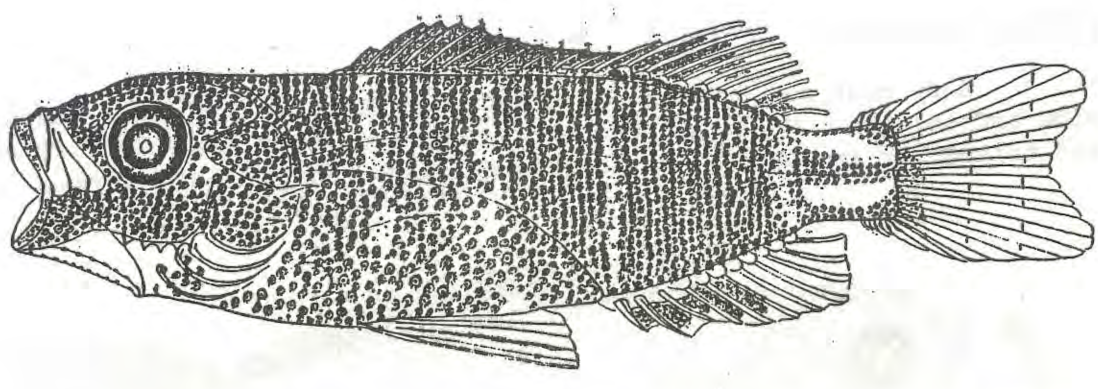

Fig. 12. *Therapon* sp. TL. 12.6 mm.

Family *Apogonidae*

Body moderately short, head large. Mouth wide and oblique with williform teeth in jaws, nostrils and eyes big. Head has preopercular spines and one long dorsal fin fairly near the head. Little coloration on the body. About 24 myotomes.

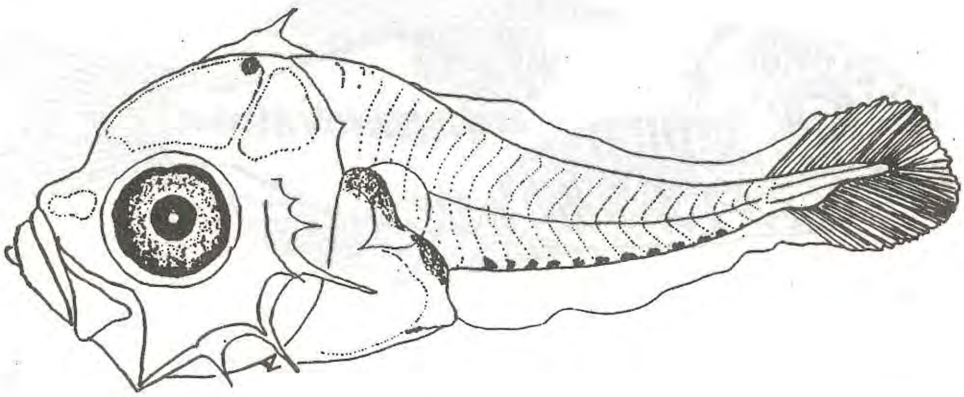

Fig. 13. *Apogon* sp. TL. 3.0 mm.

Family *Carangidae*

Body moderately short, head big, and slightly rounded. Mouth wide and oblique. Head has preopercular spines, eyes big, nostrils big and triangular in shape. One long dorsal fin. About 24 myotomes.

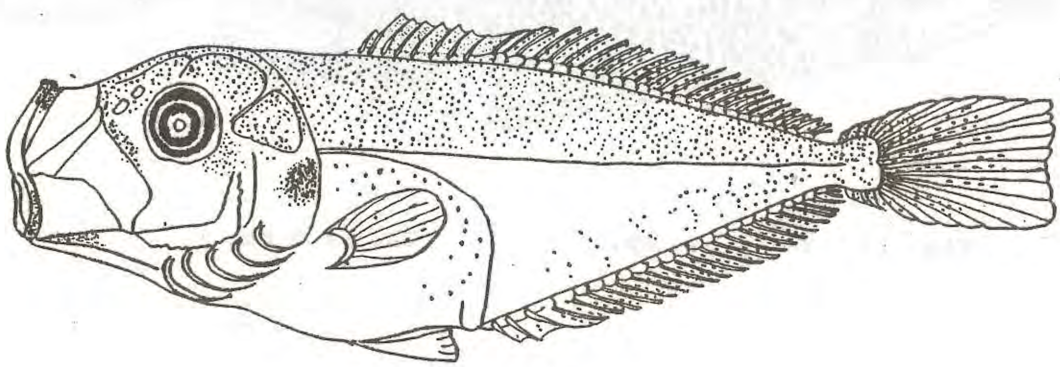

Fig. 14. *Caranx kalla* TL. 26.5 mm.

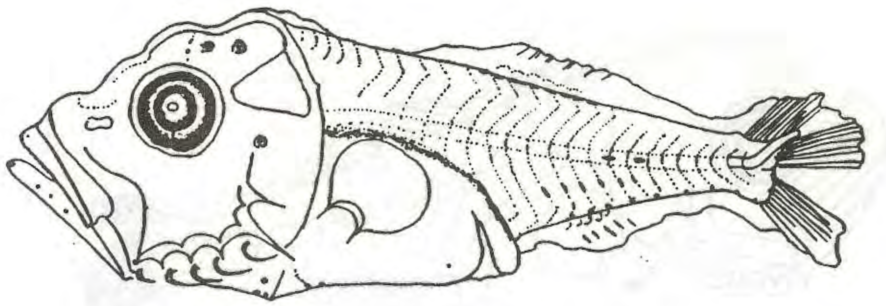

Fig. 15. *Caranx cruminopthalmus* TL. 4.1 mm.

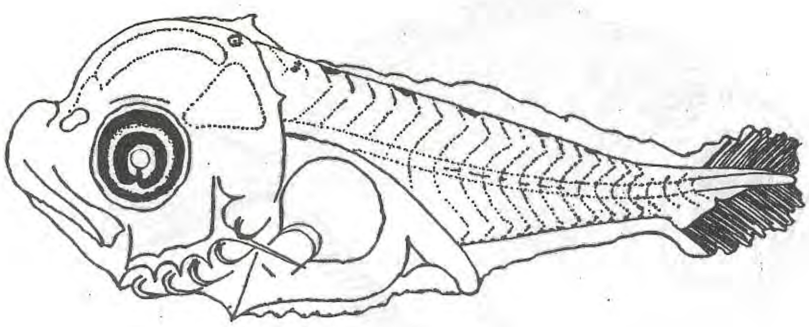

Fig. 16. *Caranx leptolepis* TL. 3.7 mm.

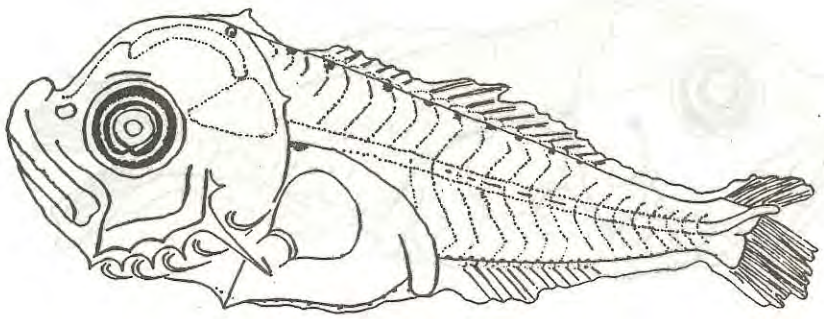

Fig. 17. *Caranx leptolepis* TL. 5.0 mm.

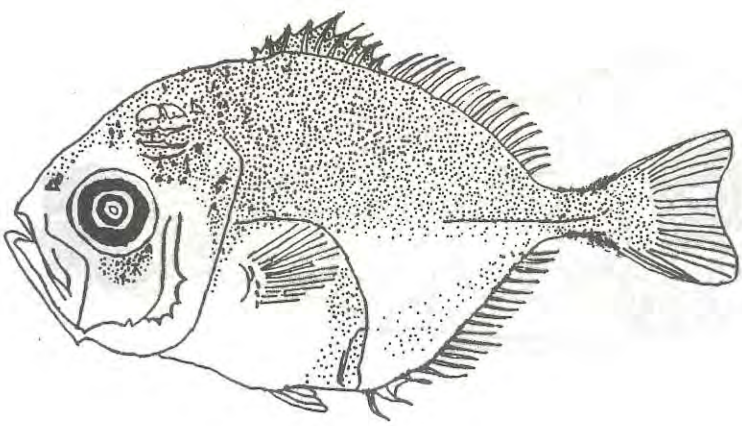

Fig. 18. *Caranx* sp. TL. 11.0 mm.

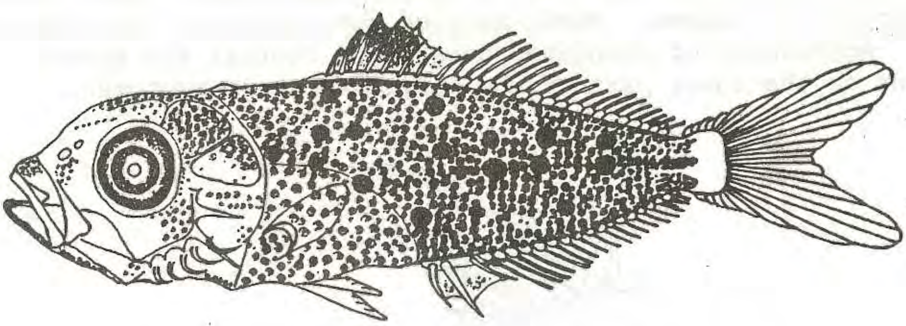

Fig. 19. *Chorinemus* sp. TL. 9.1 mm.

Family *Coryphaenidae*

Body rather slender and elongate. Head has bony crest on the nape and preopercular spines. Mouth wide and oblique. One long dorsal fin. About 40 myotomes (preanal 25 and postanal 15).

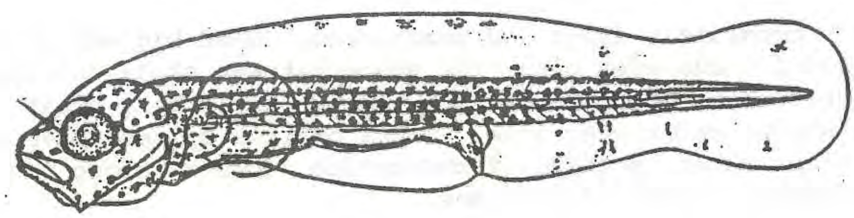

Fig. 20. *Coryphaena* sp. TL. 5.7 mm.

Family *Lutjanidae*

Body moderately short and slightly compressed. Head rather big with preopercular spines. Mouth oblique and wide with villiform teeth in jaws. Appearance of elongated dorsal and ventral fin spines. Some coloration on the lower part of the body. About 24 myotomes.

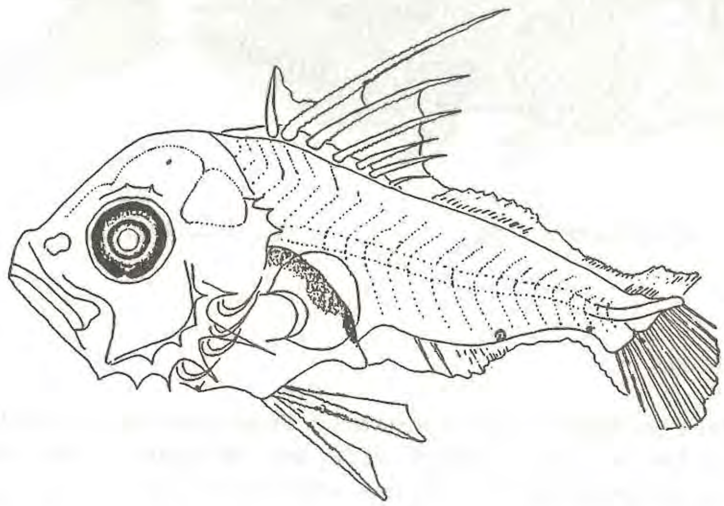

Fig. 21. *Lutjanus* sp. TL. 4.3 mm.

Family *Leiognathidae*

Body moderately short and compressed. Head big and slightly rounded, nostrils and eyes big. The space between skull and brain rather wide. Preopercular spines big, easy to recognize. Bony crest on the nape, very strong and rather long. Supra orbital spines above the eyes. Digestive tract short, pattern of coloration appears along the lower part of the body. About 24 myotomes.

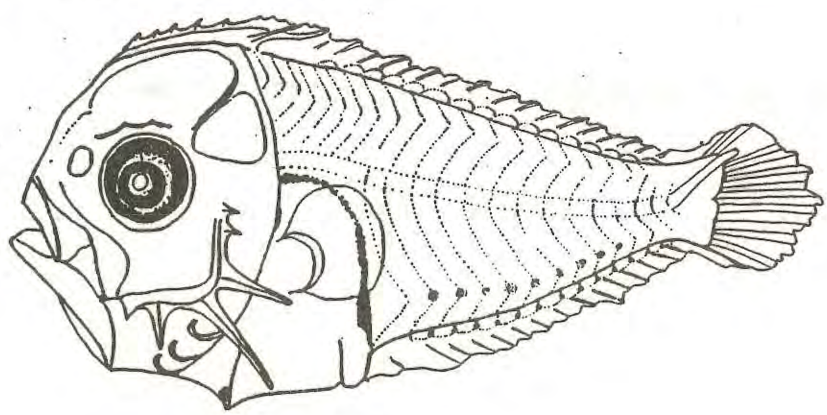

Fig. 22. *Leiognathus* sp. TL. 4.0 mm.

Family *Nemipteridae*

Body rather long and slightly compressed. Eyes big, mouth rather wide, no preopercular spines. Long dorsal fin with 16 spines and anal fin with 10 spines. Pattern of coloration appears on the lower part of the body. Dense coloration particularly on posterior parts of body near the anus. Pigments of lower part of body consist of about 24 spots for small larvae and about 13 for big larvae. About 24 myotomes.

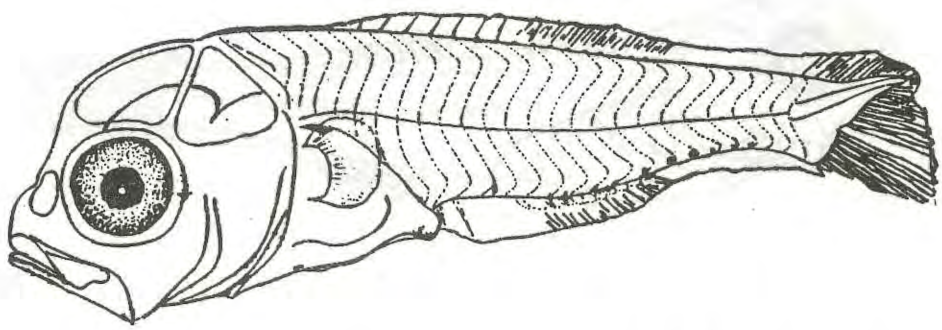

Fig. 23. *Nemipterus* sp. TL. 4.43 mm.

Family *Gerridae*

Body rather slender and compressed. Mouth oblique, protractile downward. Appearance of preopercular spines on cheek. Pattern of coloration appears on lower part of body. In post-larvae there are 4 groups of densely coloured areas along the lateral line of body. About 24 myotomes.

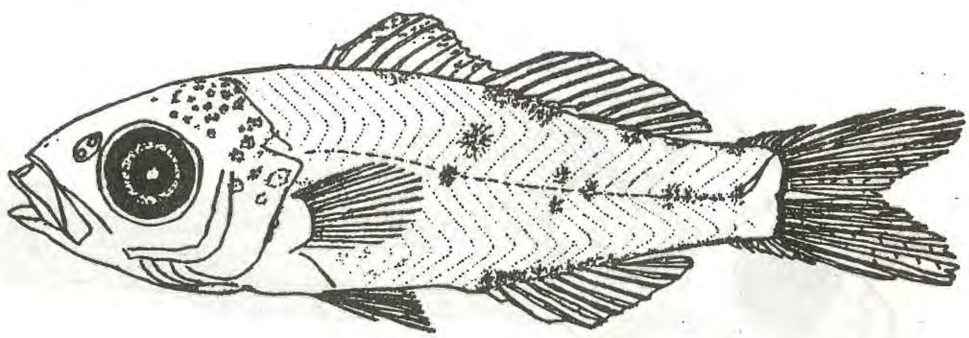

Fig. 24. *Gerridae* TL. 14.8 mm.

Family *Mullidae*

Body rather slender and compressed. Mouth oblique, head has preopercular spines. Two separate dorsal fins. Coloration dense on the head. On the lower and middle parts of the body, particularly in the large larvae the coloration forms a longitudinal band. Some coloration appears on other parts of the body. About 24 myotomes.

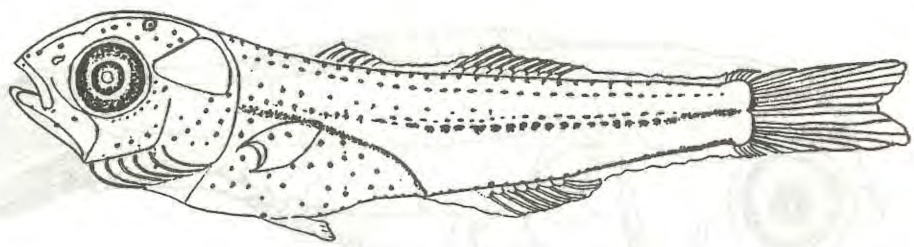

Fig. 25. *Mullidae* TL. 7.0 mm.

Family *Cepolidae*

Body rather slender and compressed. Head big, mouth wide, appearance of strong preopercular spines. Head has bony crest on the nape. Digestive tract short. Dorsal and anal fins long, with numerous spines. Pattern of coloration appears on the lower part of body. Some coloration generally found on head. About 56 myotomes.

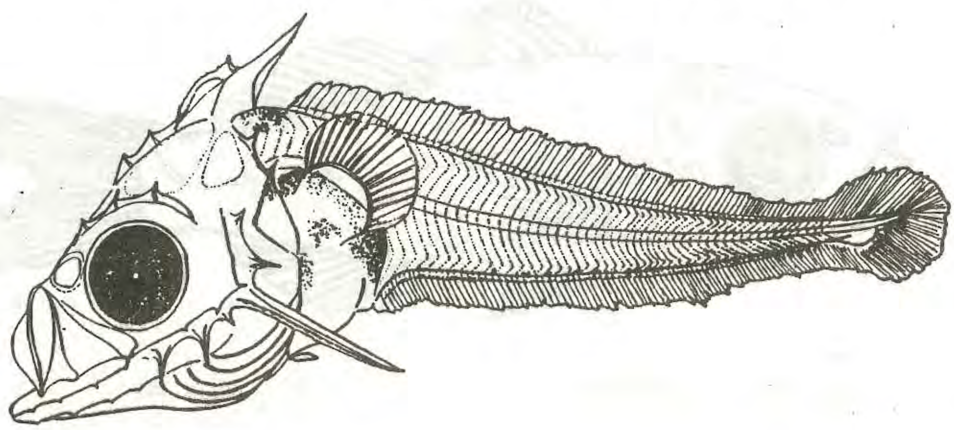

Fig. 26. *Cepolidae* TL. 5.9 mm.

Family *Pomacentridae*

Body moderately short, head rather big. Mouth oblique, eyes big. Appearance of one long dorsal fin. Pattern of coloration appears on lower part of body, and some coloration on the head. Post larvae are densely coloured on head and anterior part of the body. About 24 myotomes.

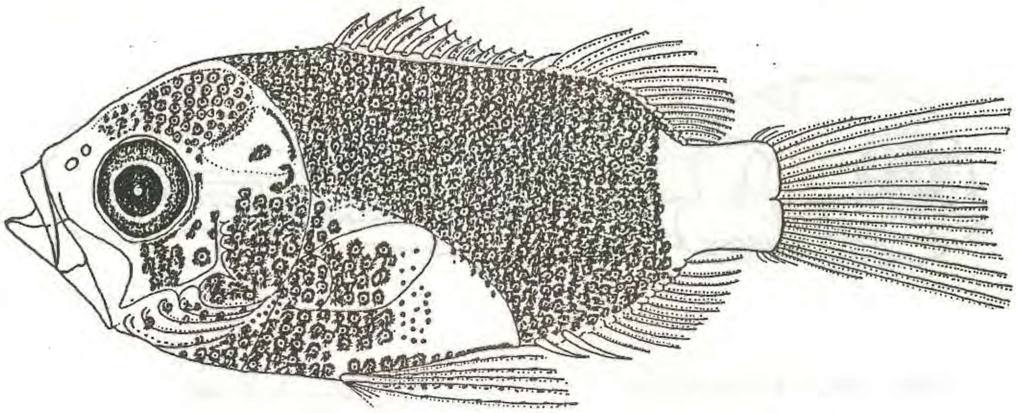

Fig. 27. *Pomacentridae* TL. 6.9 mm.

Family *Labridae*

Body rather long and compressed. Mouth rather big, oblique. Appearance of one long dorsal fin. About 24 myotomes, muscle fibre shows longitudinal pattern. Almost no coloration on body.

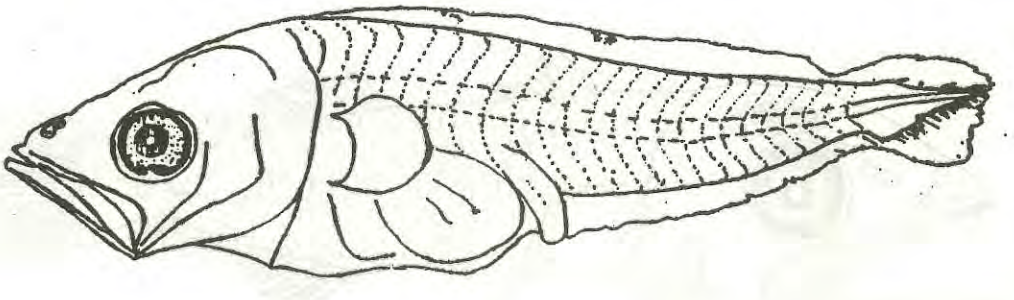

Fig. 28. *Labridae* TL. 4.2 mm

Family *Blenniidae*

Body slender and elongate. Head big, mouth rather small with villiform or canine-like teeth in jaws. Eyes big, appearance of preopercular spines on cheek. Dorsal and anal fins long, in some species there are hook-like spines at the base of the dorsal and anal fins. Myotomes vary between 34-35, some species have up to 126. Pattern of coloration appears on the lower part of the body, some pigmentation on head.

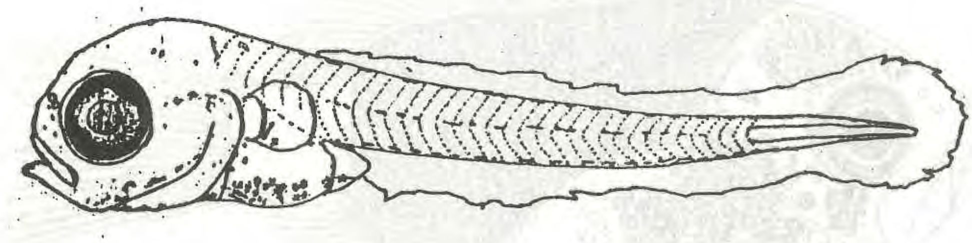

Fig. 29. *Blenniidae* TL. 3.3 mm.

Family *Thunnidae*

Body moderately short and compressed. Head and eyes big, mouth wide with canine-like teeth in jaw. Strong preopercular spines on cheek. Digestive tract short and triangular in shape. Pattern of coloration appears on the head and a little near caudal fin, 38-39 myotomes, the arrangement of muscles shows zig-zag pattern.

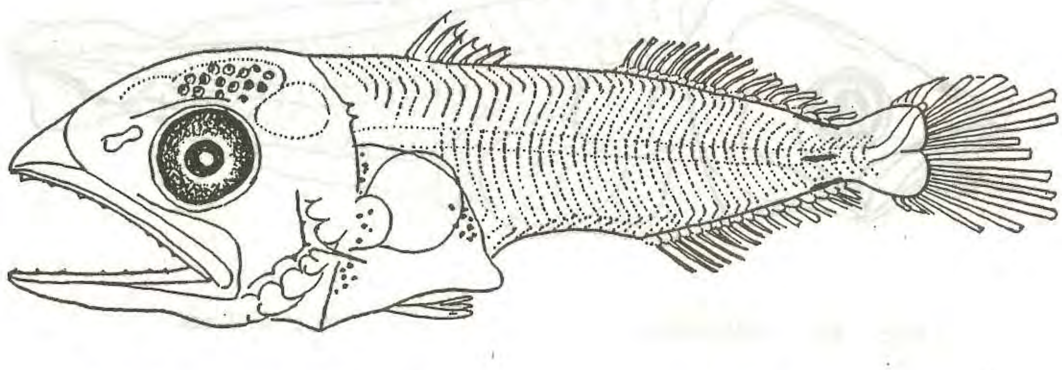

Fig. 30. *Auxis thazard* TL. 8.2 mm.

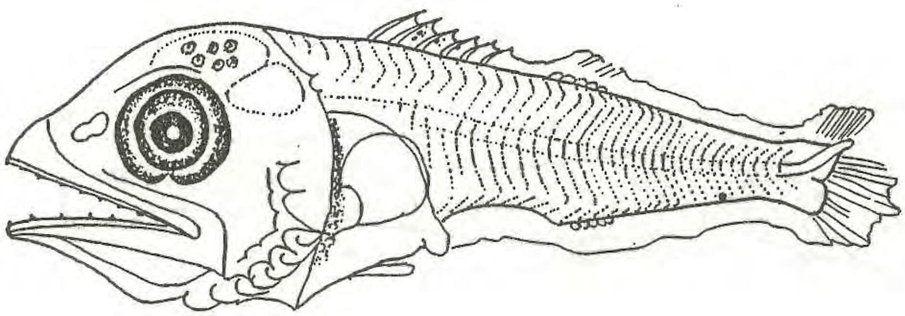

Fig. 31. *Thunnus tonggol* TL. 5.7 mm.

Family *Gobiidae*

Body slender and elongate, mouth oblique. Two separate dorsal fins, one composed of 5-6 hard spines and the other of 9-27 soft spines. The second dorsal fin usually overlaps or is in alignment with the anal fin. The air bladder appears clearly at upper part of digestive tract. Patterns of coloration vary, in some species they appear on the lower part of the body, in others on the dorsal or on the lateral parts of the body, some species have no colour. Myotomes vary from 24 to 30.

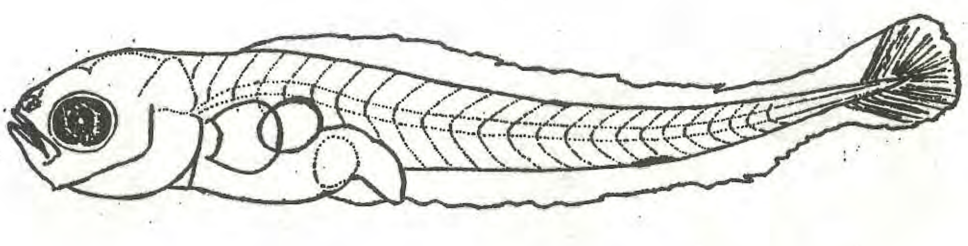

Fig. 32. *Gobiidae* TL. 4.0 mm

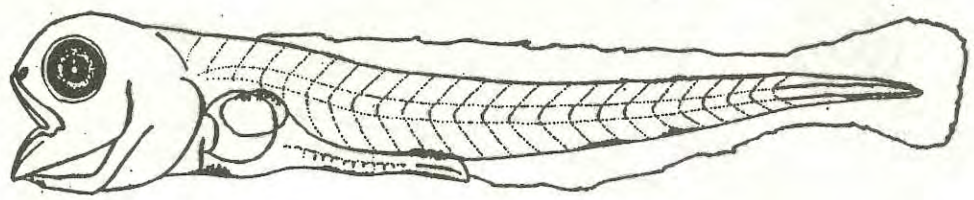

Fig. 33. *Gobiidae* TL. 3.1 mm.

Family *Scorpaenidae*

Body moderately short, head big, mouth wide and oblique. Head has double parietal ridge and bony crest on the nape. Preopercular spines big and strong on cheek. Pelvic fin large, digestive tract short. Little coloration on the body, three short bands of colour on the dorsal, and lateral parts of the body, and lower part near caudal fin. Densely coloured above the pelvic fin. About 24 myotomes.

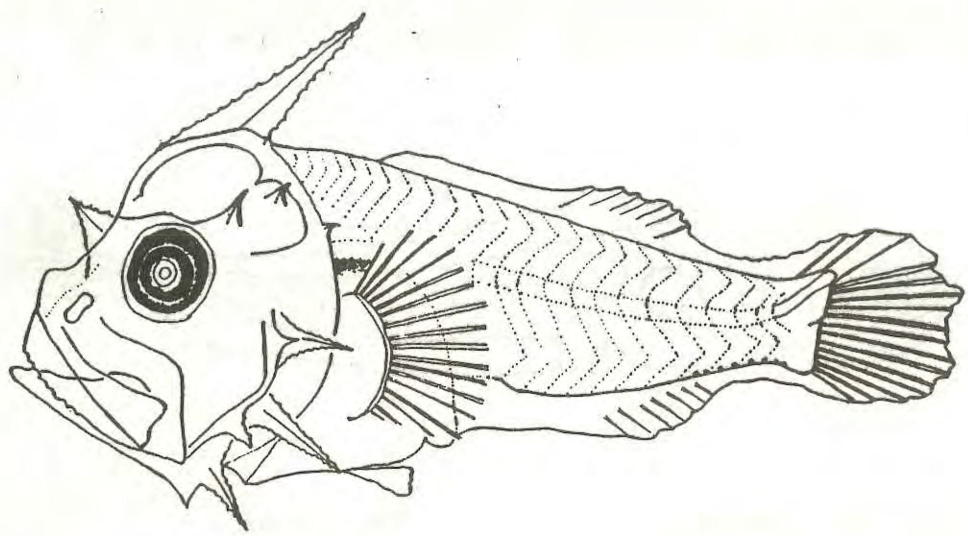

Fig. 34 *Scorpaenidae* TL. 3.7 mm.

Family *Bothidae*

Body deeply compressed. Head big, mouth rather small, a small appendage appears under the chin. Dorsal and anal fins long, dorsal fin starts from the head with a dichotomous ray. This dichotomous ray is very long, in some species longer than the body length. Numerous myotomes show a zig-zag muscle pattern. Patterns of coloration appear on the lower part of the body, and lower part of the head and mouth.

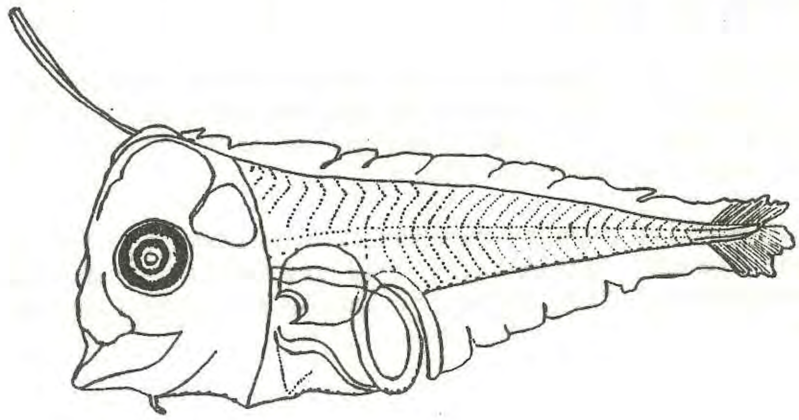

Fig. 35. *Psettina* sp. TL. 3.2 mm.

SUMMARY

1. The fish larvae collected during the survey cruise in the central Gulf of Thailand belonged to 29 species of the following 24 families: Engraulidae, Hemirhamphidae, Theraponidae, Clupeidae, Carangidae, Fistularidae, Mullidae, Bothidae, Sphyraenidae, Pomacentridae, Thunnidae, Gerridae, Cepolidae, Apogonidae, Lutjanidae, Gobiidae, Exocoetidae, Leiognathidae, Nemipteridae, Scorpaenidae, Coryphaenidae, Labridae, Scaridae and Blenniidae.

2. Engraulidae were dominant in the sample (411 individuals) of the larvae collected. The following species were significant in the catch: *Stolephorus* spp. (411), *Hemirhamphus* sp (57), *Therapon* sp (33), *Clupea* spp (25) and *Fistularia* sp (20).

3. Some districtive characteristics of the larvae of the more important species caught during the survey are described in order to distinguish the group of fish larvae or family for more accurate identification.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the Captian and all the crew members of M.V. PAKNAM, SEAFDEC, for their kind co-operation during the survey. Special thanks to Mr. M. Oishi and Mr. Suppachai Ananpongsuk who assisted in the preparation and execution of the experiment. All SEAFDEC fishing trainees (1983-1985) actively participated in collecting the data and their efforts were much appreciated.

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INVESTIGATION OF FISHES FROM THE CENTRAL GULF OF THAILAND

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and
Pichai SONCHAENG

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Srinakharinwirot University

CONTENTS

MAP AND FIGURES

ABSTRACT

This study was carried out in the central and southern parts of the Gulf of Thailand during May-June 1984, on board M.V. PAKNAM, the training vessel attached to the Training Department of the Southeast Asian Fisheries Development Center.

Fishes were collected by trawling in six main locations. Three families and three species of Elasmobranchii, and 53 families of 93 species of Teleostomi were identified. Species of the families Carangidae, Scombridae, Serranidae, Nemipteridae and Lutjanidae were the most commonly found.

INTRODUCTION

This research project was undertaken from 16 May to 4 June 1984, jointly by the Southeast Asian Fisheries Development Center (SEAFDEC) and the Marine Science Center of Srinakharinwirot University at Bangsean.

This investigation was carried out at six main locations in the central and southern parts of the Gulf of Thailand on board M.V. PAKNAM, the training vessel attached to the Training Department of the Southeast Asian Fisheries Development Center.

The purpose of this study was to investigate the species of marine fishes that would be found by trawling in the central and southern parts of the Gulf of Thailand. The specimens thus obtained were kept in the museum collection of Bangsean Marine Science Center.

MATERIALS AND METHODS

LOCATION

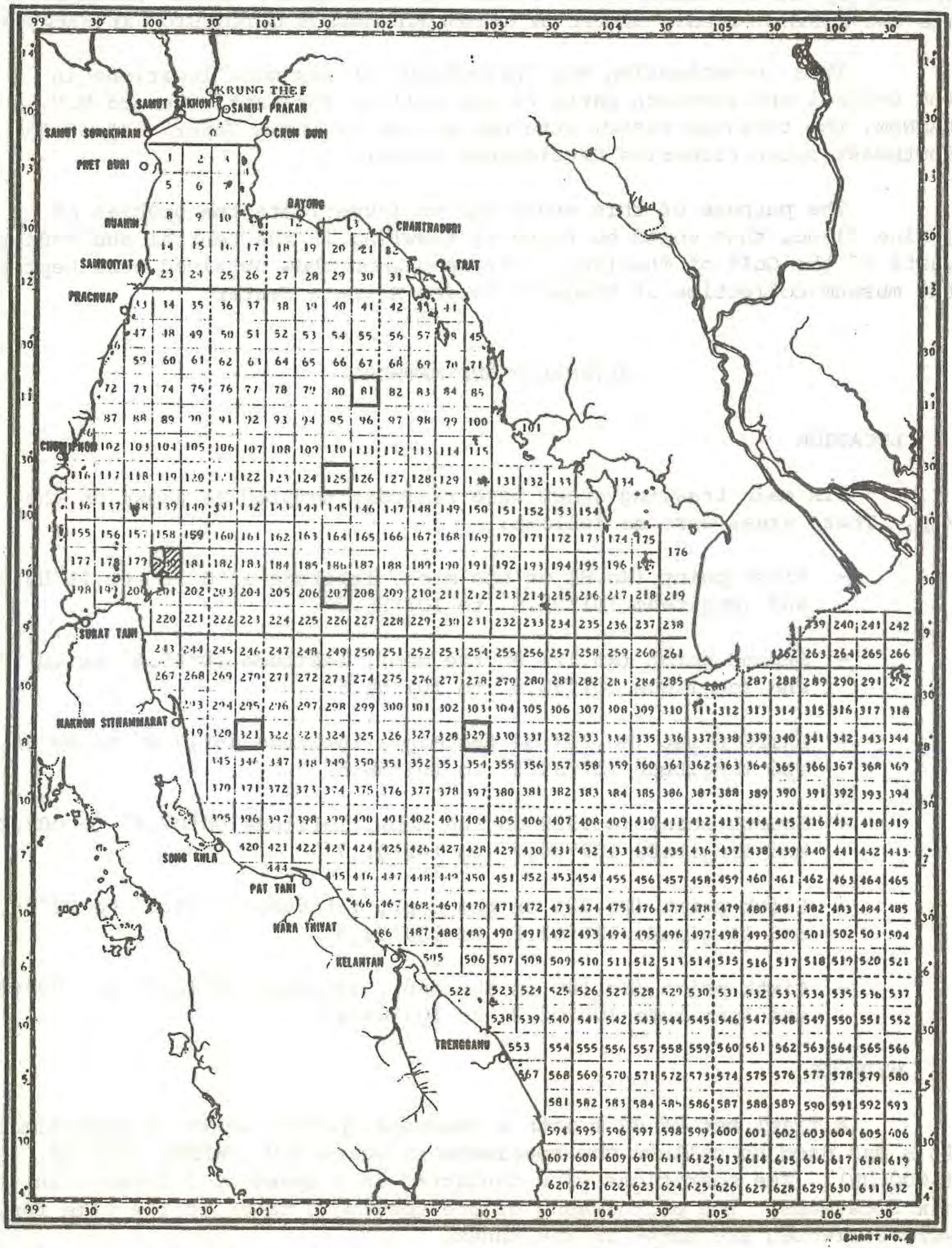
Six main trawling areas were randomly sampled as shown on the Map. These areas were as follows:

- First point (No.81 on the map), latitude 11°02.5´ to 11°03.2´ and longitude 101°51.0´ to 101°56.5´
- Second point (No.125 on the map), latitude 10°25.3´ to 10.°30.2´ and longitude 101°36.0´ to 101°56.5´
- Third point (No.207 on the map), latitude 09°17.8´ to 09°38.6´ and longitude 101°32.1´ to 101°56.5´
- Fourth point (No.329 on the map), latitude 08°07.4´ to 08°.09.0´ and longitude 102°54.7´ to 102°51.7´
- Fifth point (No.321 on the map), latitude 08°07.8´ to 07°54.2´ and longitude 100°51.6´ to 100°54.5´
- Sixth point (No.180 on the map), latitude 09°42.2´ to 09°43.5´ and longitude 100°04.2´ to 100°05.4´

METHODS

A trawl net of 40 m with a headrope opening width of approximately 15 m was used to collect the specimens on board M.V. PAKNAM (387 GT, 42 m, 1,000 HP). The operations were conducted at a speed of 3.0 knots in the six locations. The photographs of the specimens taken at the time they were collected are shown in the Annex.

The specimens were identified at the Bangsean Marine Science Center by a method of counting and measuring based on Berg's classification (1940).



MAP. The Gulf of Thailand, showing the trawling areas (boxed), 1984. The numbers in the grid indicate the station numbers.

RESULTS

There were 3 orders, 3 families, 3 genera and 3 species of Elasmobranchii and 15 orders, 52 families, 72 genera and 93 species of Teleostomi. Most species were pelagic and of economic importance. The names are given in the list below and the photograph of each specimen is reproduced in the Annex.

LIST OF FISH SPECIES

ORDER LAMNIFORMES

Orectolobidae

1. *Chiloscyllium punctatum* Muller and Henle

ORDER RAJIFORMES

Trygoniidae

2. *Dasyatis imbricatus* (Schneider)

ORDER TORPEDINIFORMES

Torpedinidae

3. *Narcine indica* (Henle)

ORDER CLUPEIFORMES

Chirocentridae

4. *Chirocentrus dorab* (Forskal)

ORDER SCOPELIFORMES

Synodontidae

5. *Saurida tumbil* (Bloch)
6. *Saurida grandisquamis* (Gunther)
7. *Saurus variegatus* (Lacepede)

ORDER CYPRINIFORMES

Ariidae

8. *Tachysurus thalassinus* (Ruppell)

Plotosidae

9. *Plotosus lineatus* (Bloch)

ORDER ANGUILLIFORMES

Muraenesocidae

10. *Muraenesox cenereus* (Forskal)

11. *Muraenesox talabon* (Cantor)

Congridae

12. *Uroconger lepturus* (Richardson)

Ophichthidae

13. *Ophichthus apicalis* (Bennett)

ORDER SYNGNATHIFORMES

Centriscidae

14. *Centriscus scutatus* Linnaeus

ORDER BERYCIFORMES

Holocentridae

15. *Holocentrum rubrum* (Forskal)

ORDER MUGILIFORMES

Sphyraenidae

16. *Sphyraena jello* Cuvier and Valenciennes

ORDER SYMBRANCHIFORMES

Symbranchidae

17. *Macrotrema caligans* (Cantor)

ORDER PERCIFORMES

Serranidae

18. *Epinephelus sexfasciatus* (Cuvier and Valenciennes)

19. *Epinephelus areolatus* (Forskal)

20. *Epinephelus sonnerati*

21. *Anthias squamipinnis* (Peters)

Theraponidae

22. *Therapon jarbua* (Forskal)

Priacanthidae

23. *Priacanthus tayenus* Richardson

24. *Pricanthus macracanthus* Cuvier

Apogonidae

25. *Apogon ellioti*

26. *Apogon poecilopterus*

Rachycentridae

27. *Rachycentron canadus* (Linnaeus)

Carangidae

28. *Caranx (Selar) malam* Bleeker

29. *Caranx (Selar) crumenophthamus* (Bloch)

30. *Caranx (Carangoides) armatus* (Forskal)

31. *Caranx (C.) malabaricus* (Bloch and Schneider)

32. *Caranx (Caranx) sexfasciatus* Quoy and Gaimard

33. *Caranx (Selaroides) leptolepis* Cuvier and Valenciennes

34. *Megalaspis cordyla* (Linnaeus)

35. *Seriola nigrofasciatus* (Ruppell)

36. *Chorinemus tol* (Cuvier and Valenciennes)

Menidae

37. *Mene maculata* (Bloch and Schneider)

Lutjanidae

38. *Lutjanus johni* (Bloch)

39. *Lutjanus sebae* (Cuvier and Valenciennes)

40. *Lutjanus malabaricus* (Schneider)

41. *Lutjanus vitta* (Quoy and Gaimard)

42. *Lutjanus lineolatus* (Schneider)

43. *Aprion typus* (Bleeker)

44. *Pinjalo pinjalo* (Bleeker)

Nemipteridae

45. *Nemipterus nematophorus* (Bleeker)

46. *Nemipterus tambuloides*

47. *Nemipterus japonicus* (Bloch)

48. *Nemipterus mesoprion* (Bleeker)

49. *Scolopsis ciliatus*

Leiognathidae

50. *Gerres punctatus* (Lacepede)

51. *Leiognathus fasciatus* (Cuvier and Valenciennes)

52. *Pentaprion longimanus* (Lacepede)

Pomadasyidae

53. *Plectorhynchus pictus* (Thunberg)

Sciaenidae

54. *Johnius carrutta*

Lethrinidae

55. *Lethrinus nebulosus* (Forskal)

Mullidae

56. *Parupeneus lutousinus* (Valenciennes)

57. *Upeneus sulphureus* (Cuvier and Valenciennes)

58. *Upeneus tragula* Richardson

59. *Upeneus bensasi* (Temminck and Schlegel)

Ephippidae

60. *Platax bataviamus* (Forskal)

Cepolidae

61. *Acanthocepola abbreviata* (Cuvier and Valenciennes)

Labridae

62. *Cirrhilabrus* sp.

63. *Halichoeres* sp.

Uranoscopidae

64. *Uranoscopus oligolepis* (Bleeker)

Brotulidae

65. *Monomitopus* sp.

Blenniidae

66. *Xiphasia setifer* (Swainson)

Callionymidae

67. *Dactylopus dactylopus* (Cuvier and Valenciennes)

68. *Callionymus* sp.

Siganidae

69. *Siganus oramin* (Bloch and Schneider)

Trichiuridae

70. *Trichiurus haumela* (Forskal)

Scombridae

71. *Rastrelliger kanagurta* (Cuvier)

Cybiidae

72. *Scomberomorus commersoni* (Lacepede)

Stromateidae

73. *Parastromateus niger* (Bloch)

Synancejidae

74. *Inimicus cuvieri* (Gray)

75. *Minous monodactylus* (Bloch and Schneider)

Platycephalidae

76. *Platycephalus pristiger*

77. *Elates ransonneti* (Steindachner)

Scorpaenidae

78. *Scorpaenopsis novae-guineae* (Cuvier and Valenciennes)

79. *Pterois branchypterus* Cuvier and Valenciennes

80. *Apistus carinatus* (Bloch and Schneider)

Triglidae

81. *Lepidotrigla spiloptera* Gunther

ORDER DACTYLOPTERIFORMES

Dactylopteridae

82. *Dactylopterus orientalis* (Cuvier and Valenciennes)

ORDER PLEURONECTIFORMES

Psettodidae

83. *Psettodes erumei* (Bloch and Scheider)

Soleidae

84. *Synaptura guagga* (Kaup)

Bothidae

85. *Grammatobothus polyophthalmus* (Bleeker)

Cynoglossidae

86. *Cynoglossus macrolepidotus* (Bleeker)

ORDER ECHENEIFORMES

Echeneidae

87. *Echeneis naucrates* Linnaeus

ORDER TETRAODONTIFORMES

Tetraodontidae

88. *Sphoeroides spadiceus* (Richardson)

89. *Sphoeroides lunaris* (Bloch and Schneider)

Diodontidae

90. *Chilomycterus obicularis* (Bloch)

Triacanthidae

91 *Pseudotriacanthus strigilfer* (Cantor)

Balistidae

92. *Balistes stellatus* (Lacepede)

93. *Monacanthus choirocephalus*

94. *Aluterus monoceros* (Linnaeus)

95. *Psilocephalus barbatus* (Gray)

ORDER LOPHIIFORMES

Antennariidae

96. *Antennarius hispidus* (Bloch and Schneider)

DISCUSSION

Specimens collected from this study consist of both pelagic and demersal fishes. Most of them are species of economic importance such as, trevally (Carangidae), mackerel (Scombridae), grouper (Serranidae), Threadfin bream (Nemipteridae) and snapper (Lutjanidae).

The task of counting the fishes was not completed. More time is needed to study the findings and it would be useful to continue this research, if at an possible.

ACKNOWLEDGEMENTS

The authors would like to express their thanks to Dr. Twee Hormchong, the director of Bangsean Marine Science Institute for his helpful comments, and they wish to acknowledge the hospitality and assistance offered by crew members of M.V. PAKNAM and SEAFDEC staff.

Thanks also go to Mr. Jitjaroon Tantiwala and his colleague from the Department of Fisheries for helping to collect the specimens.

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Weber, M. and L.F. de Beaufort. 1911-1962. The Fishes of the Indo-Australian Archipelago (Vol. I-XI). E.J. Brill Ltd. Leiden, Netherlands. Vol. I-XI.

Annex

PHOTOGRAPHS OF SPECIMENS

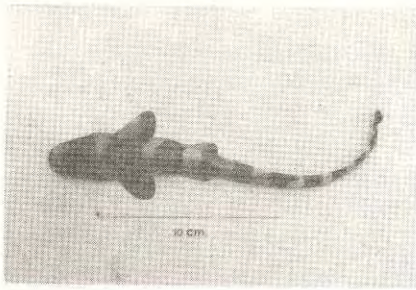


Fig. 1. *Chiloscyllium punctatum*

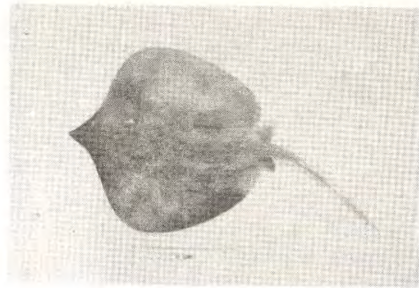


Fig. 2. *Dasyatis imbricatus*

Fig. 3. *Narcine indica*

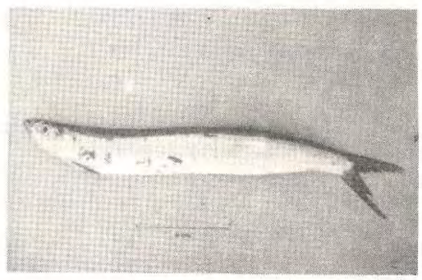


Fig. 4. *Chirocentrus dorab*

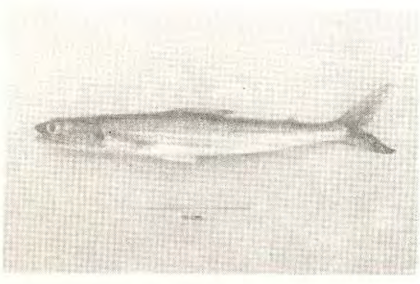


Fig. 5. *Saurida tumbil*

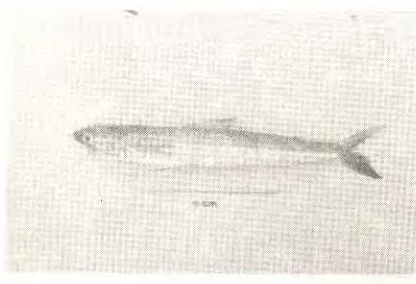


Fig. 6. *Saurida grandisquamis*

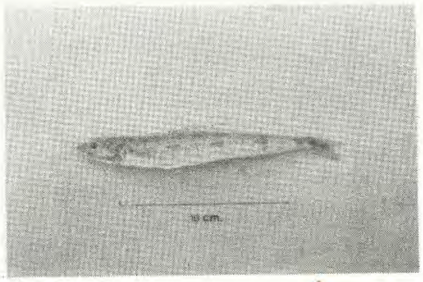


Fig. 7. *Saurus variegatus*

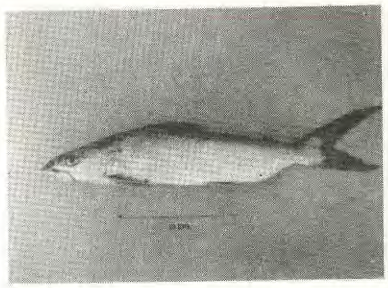


Fig. 8. *Tachysurus thalassinus*

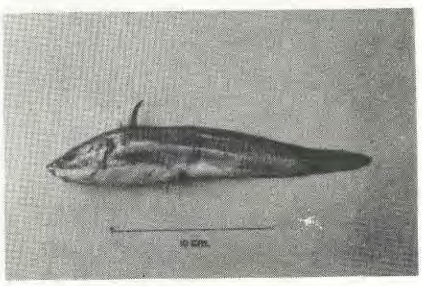


Fig. 9. *Plotosus lineatus*

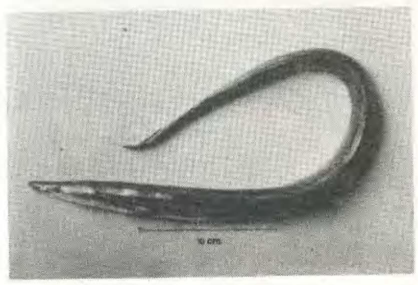


Fig. 10. *Muraenesox cenereus*

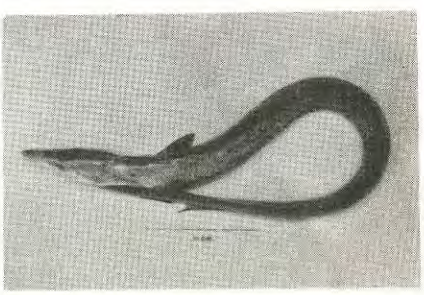


Fig. 11. *Muraenesox talabon*

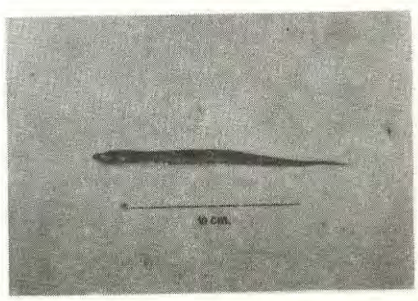


Fig. 12. *Uroconger lepturus*

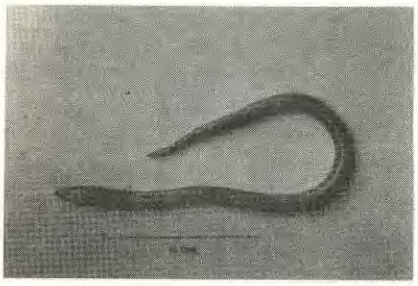


Fig. 13. *Ophichthus apicalis*

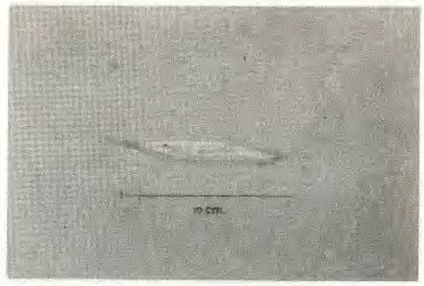


Fig. 14. *Centriscus scutatus*

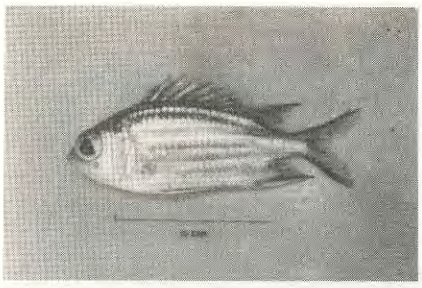


Fig. 15. *Holocentrum rubrum*

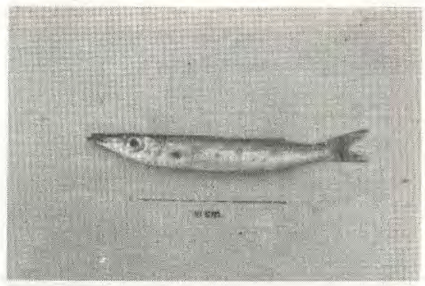


Fig. 16. *Sphyraena jello*

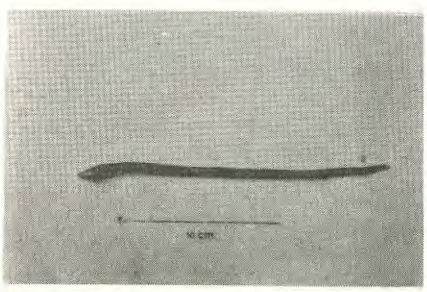


Fig. 17. *Macrotrema caligans*

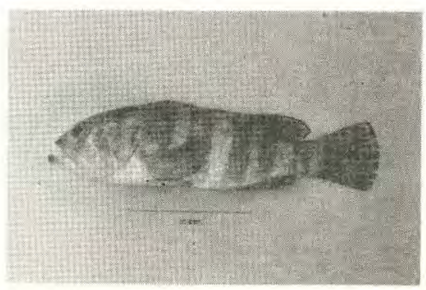


Fig. 18 *Epinephelus sexfasciati*

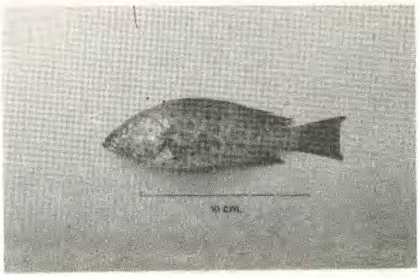


Fig. 19. *Epinephelus areolatus*

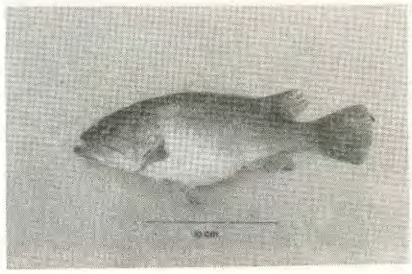


Fig. 20. *Epinephelus sonnerati*

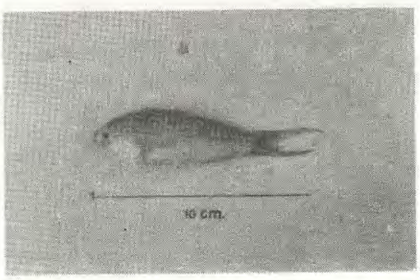


Fig. 21. *Anthias squamipinnis*

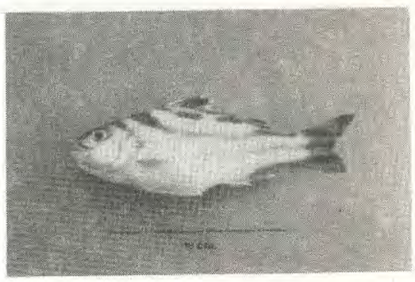


Fig. 22. *Therapon jarbua*

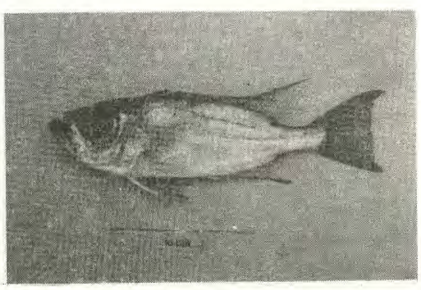


Fig. 23. *Priacanthus tayenus*

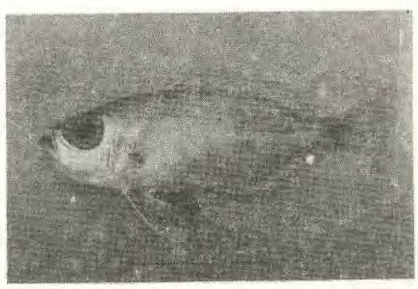


Fig. 24. *Priacanthus macracanthus*

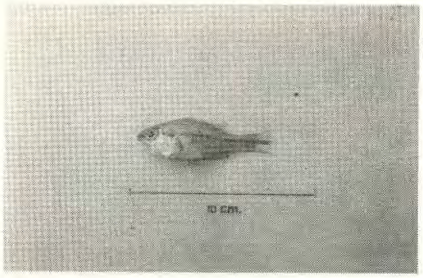


Fig. 25. *Apogon ellioti*

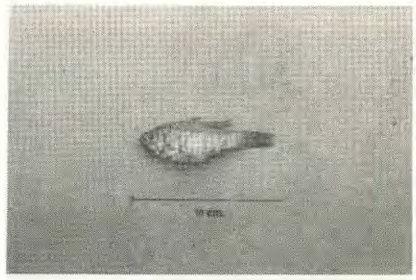


Fig. 26. *Apogon poecilopterus*

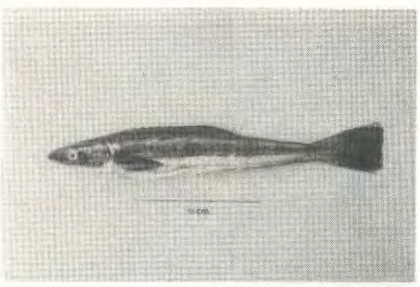


Fig. 27. *Rachycentron canadus*

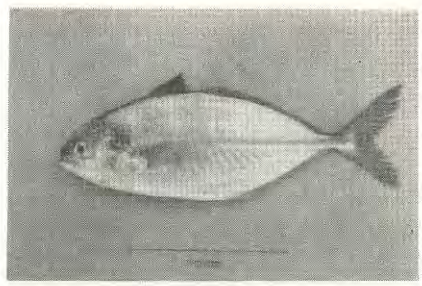


Fig. 28. *Caranx (Selar) malam*

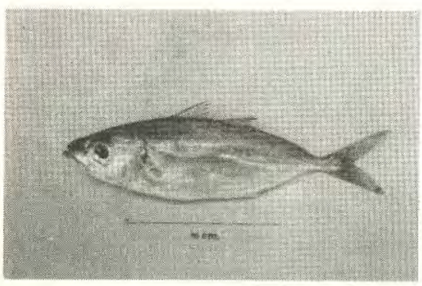


Fig. 29. *Caranx (Selar) crumenophthalmus*

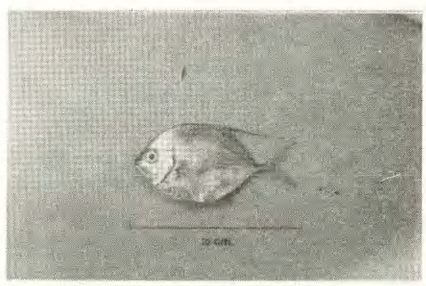


Fig. 30. *Caranx (Carangoides) armatus*

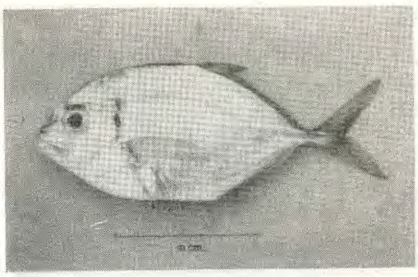


Fig. 31. *Caranx (C.) malabaricus*

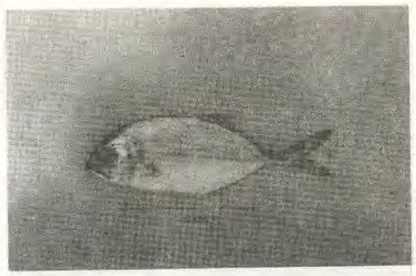


Fig. 32. *Caranx (Caranx) sexfasciatus*

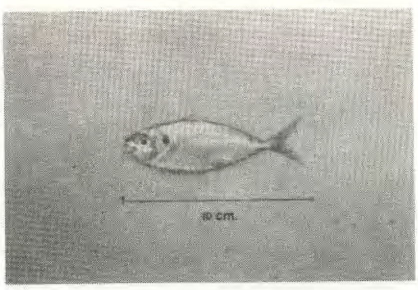


Fig. 33. *Caranx (Selaroides) leptolepis*

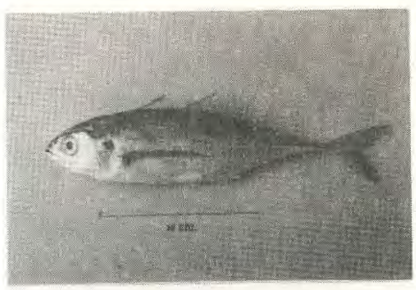


Fig. 34. *Megalaspis cordyla*

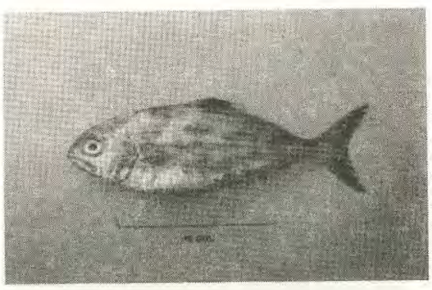


Fig. 35. *Seriola nigrofasciatus*

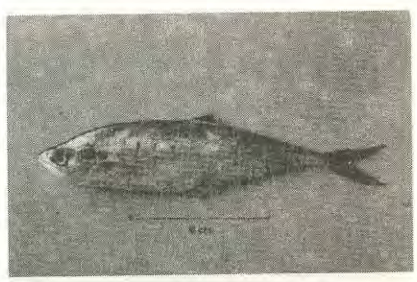


Fig. 36. *Chorinemus tol*

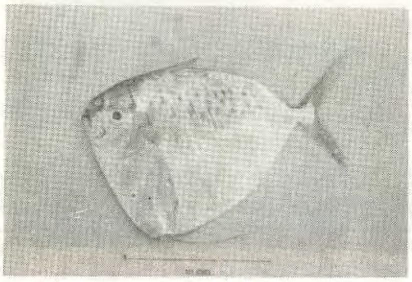
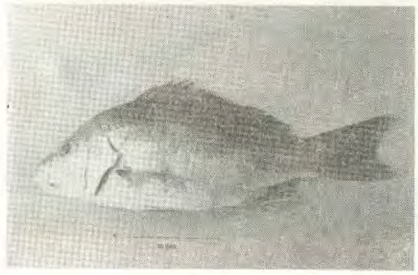


Fig. 37. *Mene maculata*



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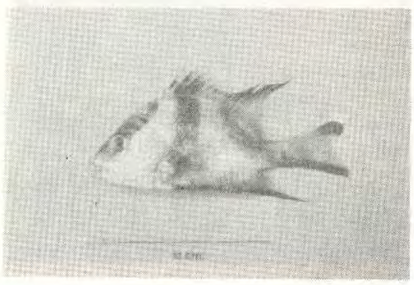

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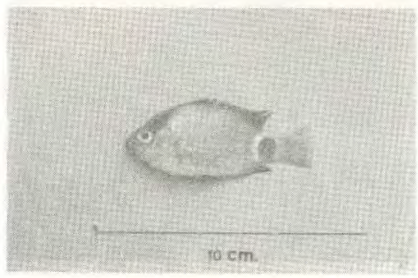

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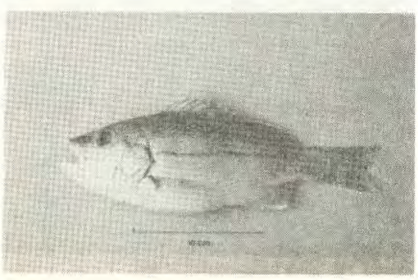

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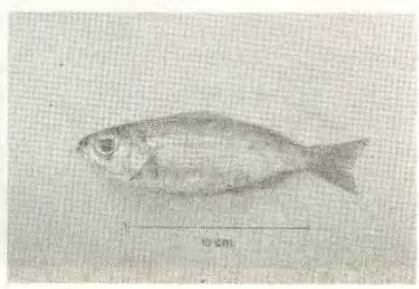

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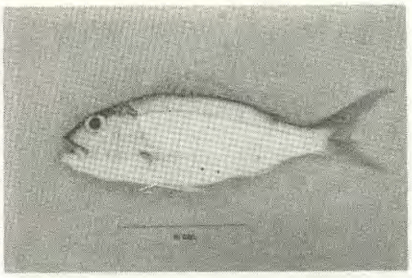

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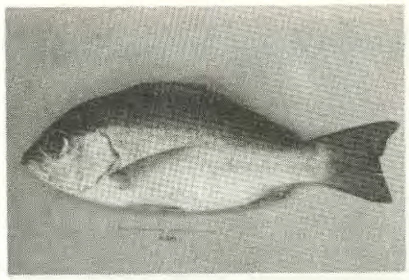

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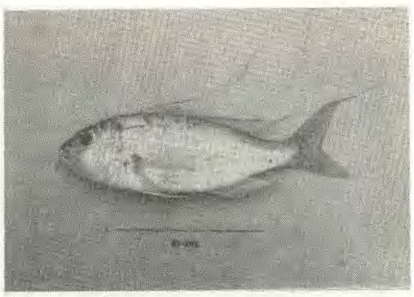

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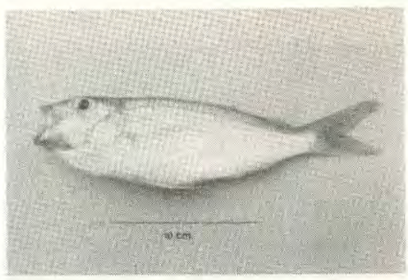

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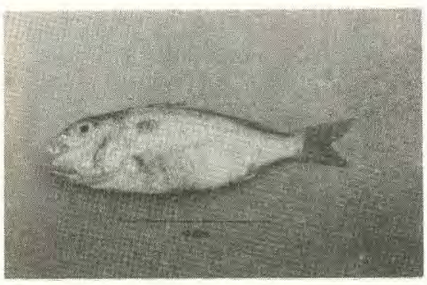

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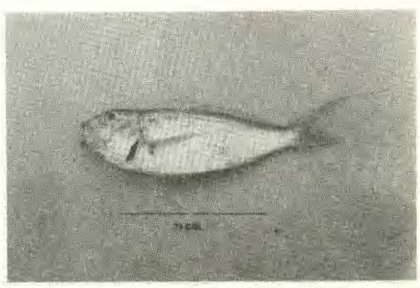

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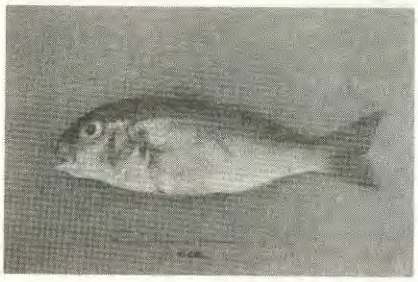

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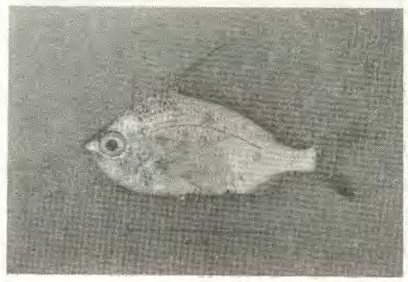

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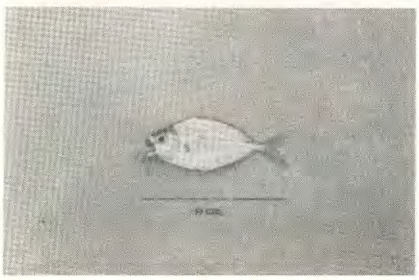

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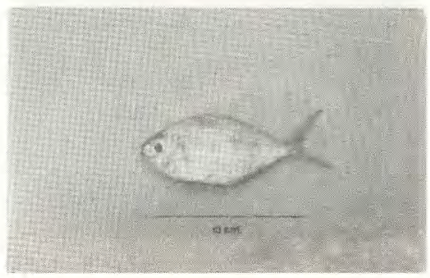

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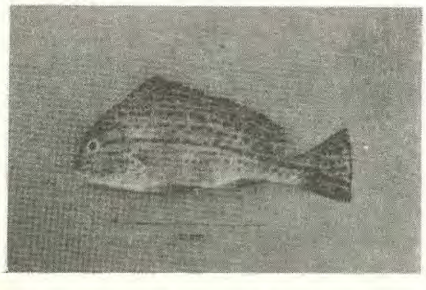

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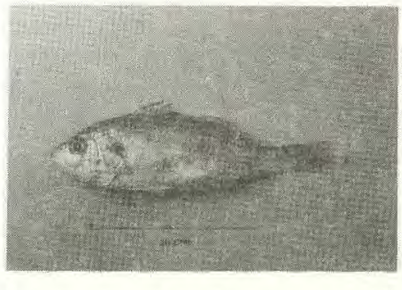

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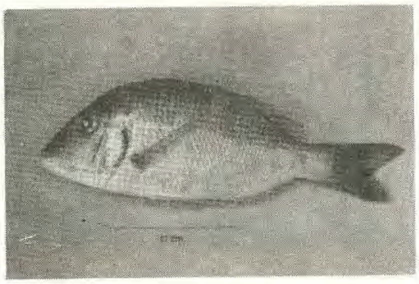

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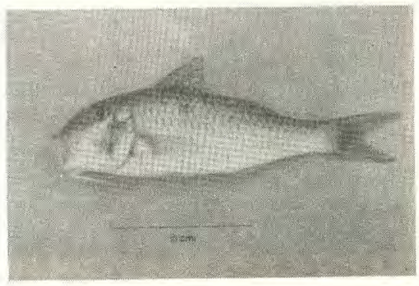

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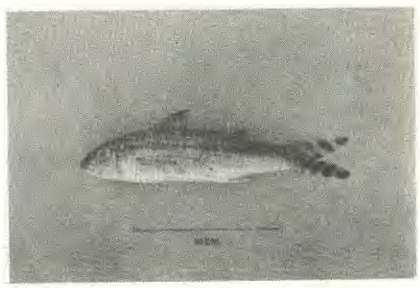

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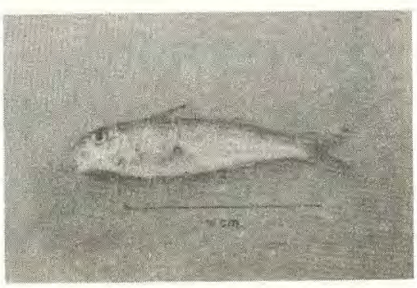

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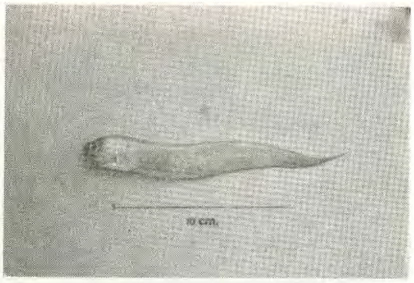

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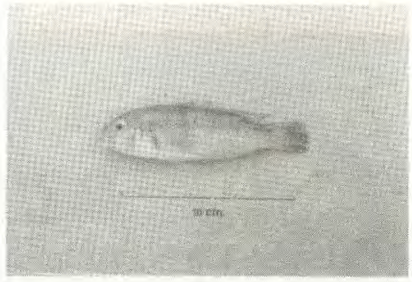

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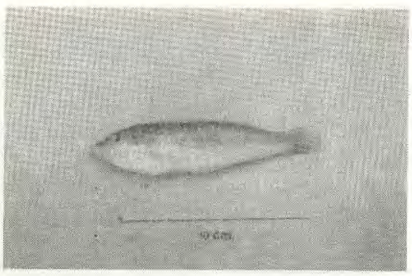

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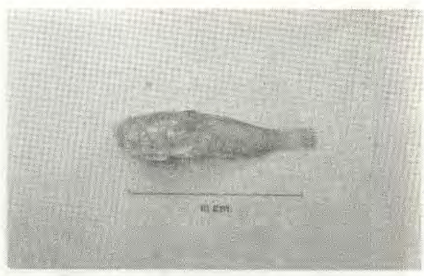

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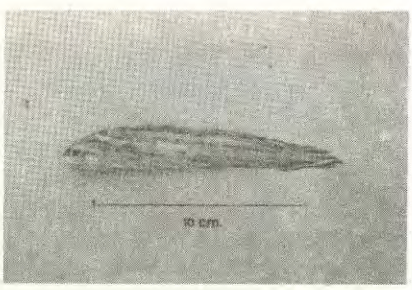

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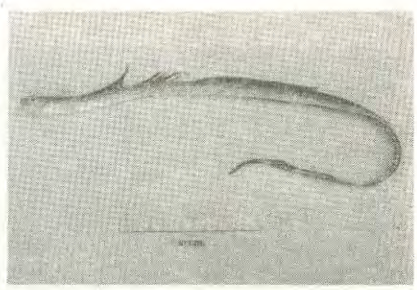

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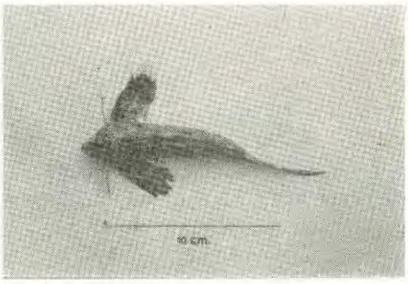

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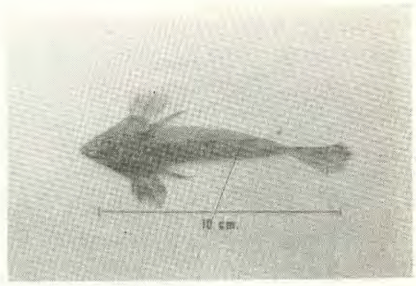

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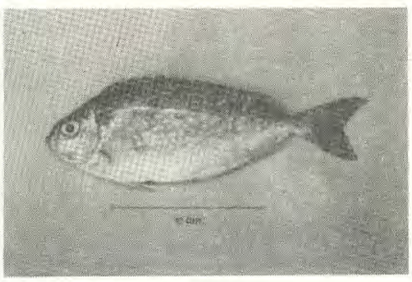

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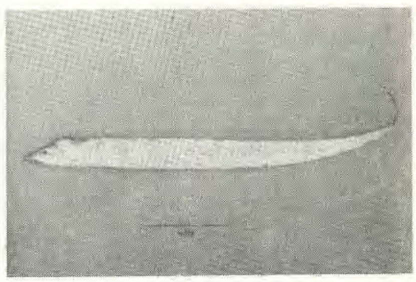

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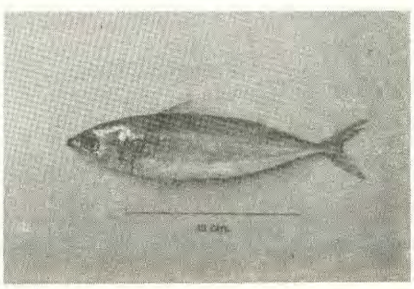

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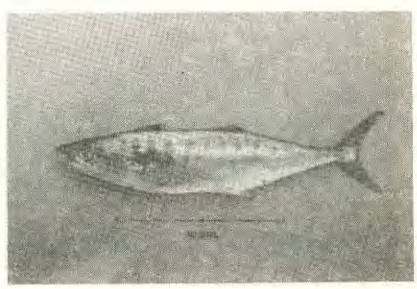

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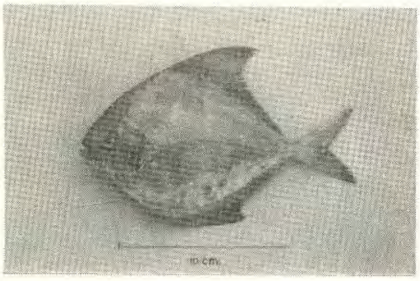

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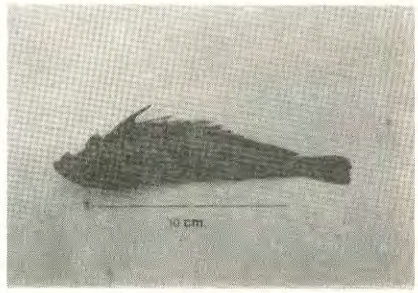

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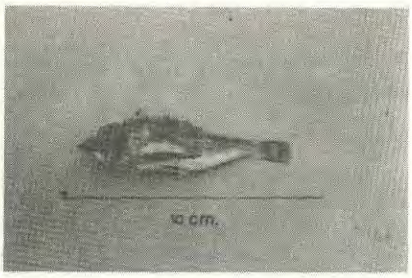

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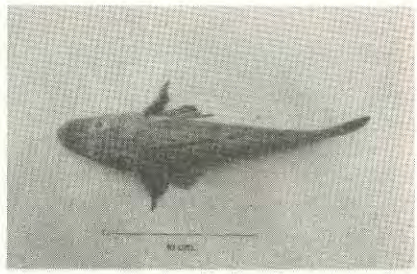

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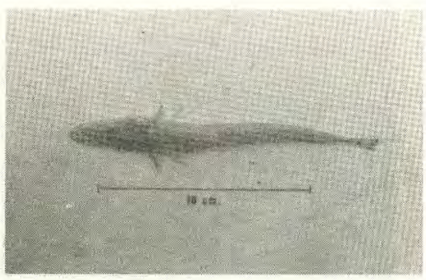

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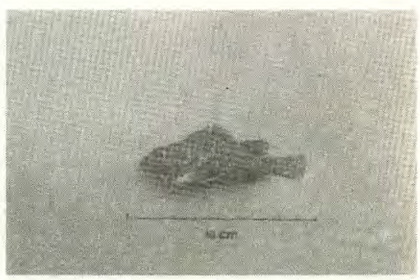

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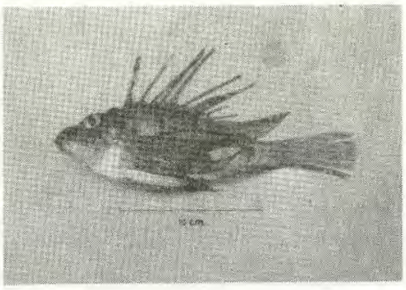

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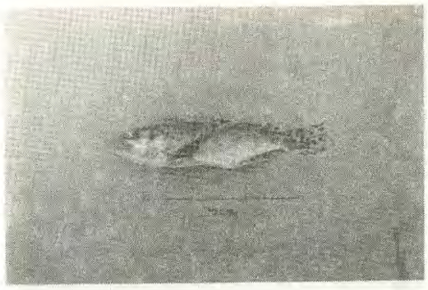

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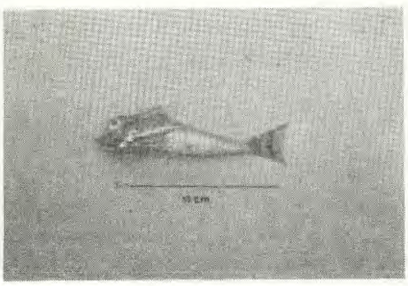

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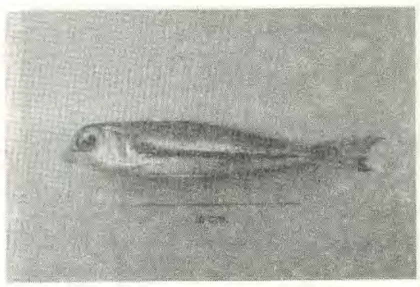

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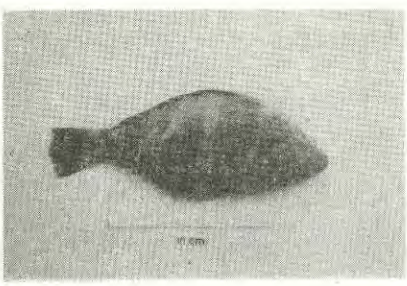

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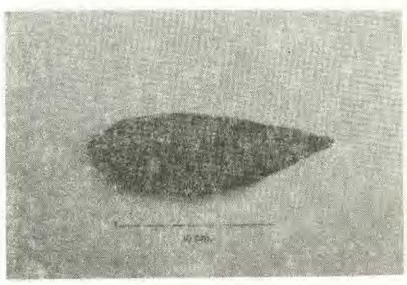

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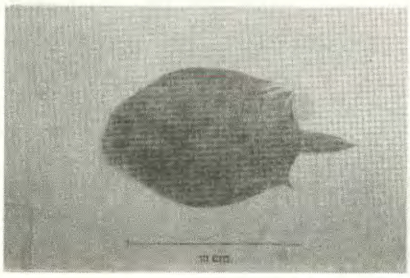

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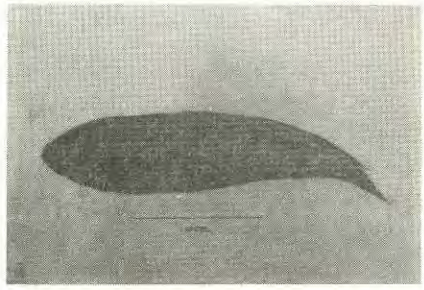

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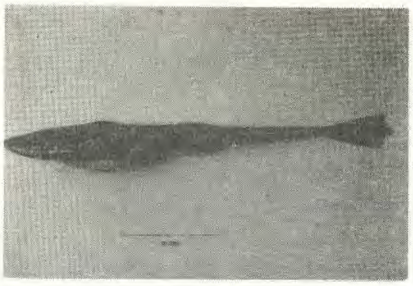

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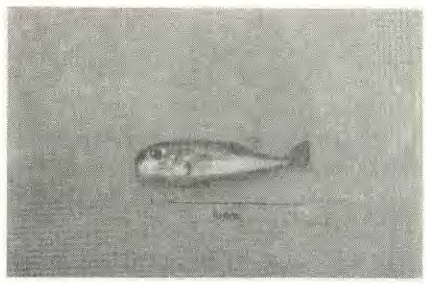

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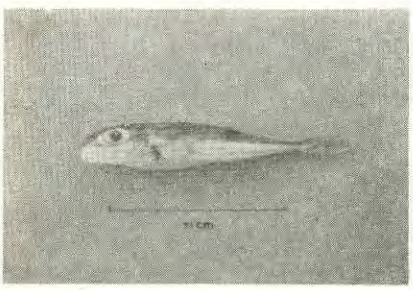

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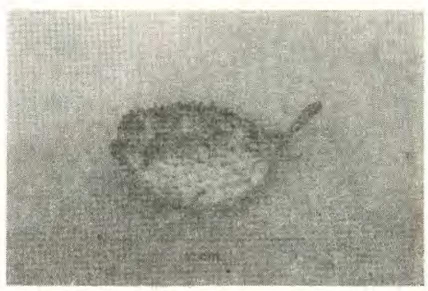

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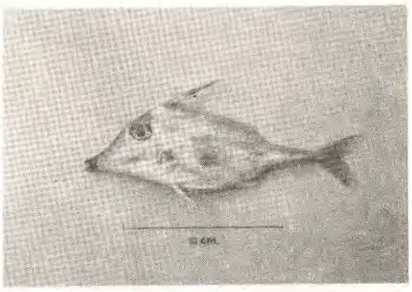

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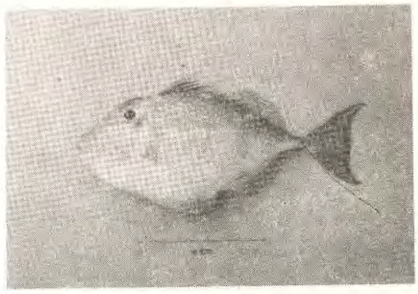

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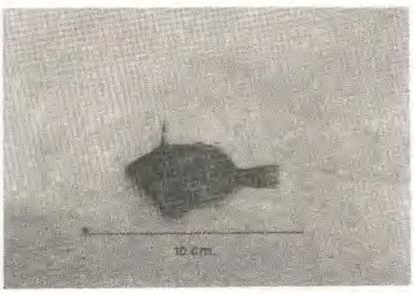

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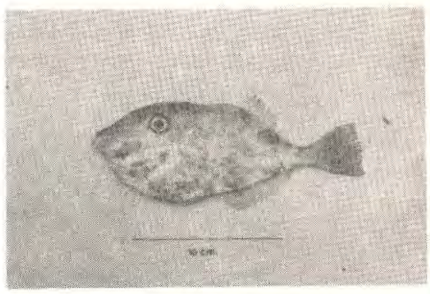

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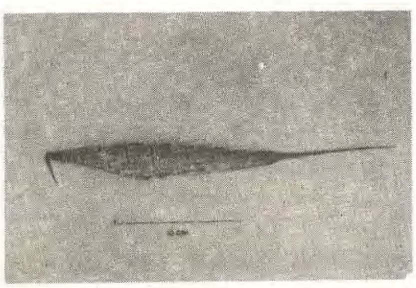

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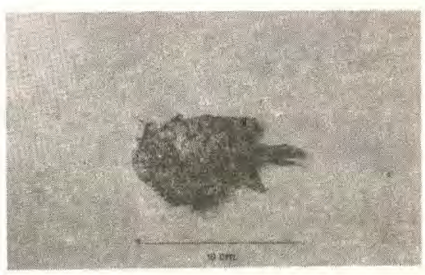

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ROUND SCAD, *DECAPTERUS DAYI* WAKIYA, IN THE GULF OF THAILAND

Preeyanart SUKHAVISIDH

Marine Fisheries Laboratory
Marine Fisheries Division
Department of Fisheries
Ministry of Agriculture and Cooperatives

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ROUND SCAD, *DECAPTERUS DAYI* WAKIYA

IN THE GULF OF THAILAND

INTRODUCTION

The round scad belonging to the genus *Decapterus* is easily distinguishable from other fishes in the family Carangidae, because it has a single detached finlet behind the soft dorsal and anal fins. It has scutes on the straight part of lateral line scales.

The genera *Decapterus* and *Selar* can be distinguished from each other by the latter having a deep groove notch on its shoulder. Among the *Decapterus* spp., however, there is a large intraspecific variation of characters, which is confusing for identification. Therefore, the external characters should be considered in combination with one another, e.g. the profile of body depth or body girth at the origin of the first dorsal fin, length of pectoral fin, length of maxilla, ratio of body length and head length, gill rakers and the number of soft dorsal fins and anal fins.

Decapterus dayi is often misidentified as *D. maruadsi*, as in Fowler's records (1935) of fishes from the Gulf of Thailand.

Decapterus became a very important pelagic species in 1963, when the luring purse seine was introduced. The catch rate increased rapidly and in 1980 the total annual landing was about 56,080 metric tons. The most abundant fishing ground seems to be off Pattani province, where 45 and 37 per cent of total catch of round scads in the Gulf was obtained in 1975 and 1976, respectively (Chullasorn and Yusukswad, 1977).

There are two groups of round scads, according to whether the profile of the cross-section at first dorsal fin is rounded or elliptical. The first group comprises *D. macrosoma* Bleeker, *D. macarellus pinnulatus* and *D. macarellus spp.* The second group, with elliptical profile of cross-section at first dorsal fin includes *D. dayi* and *D. kurroides* found in the Philippines and in the Andaman Sea (see Fig. 1).

The first record of round scads in the Gulf of Thailand appears in Fowler (1935), as *Decapterus maruadsi* (TL = 170 mm). Later Suvatti (1950) recorded *D. russelli* and *D. maruadsi* in the Gulf of Thailand by referring to Fowler. Thein and Thosaporn (1967) also recorded *D. russelli* in a check-list of fishes collected by the Marine Fisheries Laboratory.

Some confusion was created by the Exploratory Fishing Division in 1969, concerning three round scads from the South China Sea and the Gulf of Thailand which were misidentified as *Decapterus kurroides* (Bleeker), *D. maruadsi* (Fowler), *D. russelli* (Rüppell) (see Plate 1).

The picture captioned *D. kurroides* (Bleeker) is in fact *D. macrosoma* Bleeker (referred to by Chan *et al.*, 1974) which Kishida (1982) pointed out should be *D. russelli* (Rüppell).

The photograph captioned *D. maruadsi* (Fowler) shows a *D. kurroides* Bleeker. This fish has a larger eye, about one third of the length of the head, and a greater body depth than other round scads.

The third photograph, which was labelled *D. russelli* (Rüppell) should be *Decapterus dayi* Wakiya, because of the arch of the lateral line and the size of eye.

Smith-Vaniz *et al.* (1979) reclassified *D. killiche* Cuvier & Valenciennes as a neotype of *D. russelli* Rüppell, the type specimen of which was lost, and referred to Article 75 (c-5) of the International Zoological Nomenclature where *D. killiche* from the Red Sea was listed as a junior synonym of *D. russelli* Rüppell.

Decapterus dayi Wakiya 1924

Decapterus dayi Wakiya 1924: 158 pl. 28. Fig. 1 (Taiwan), Gushiken 1976-4; pl 1. (Japan).

Caranx kurra Day: 1878:214 Fig. 5. Pl. 48 (nec Cuvier, India).

MATERIALS

Sixteen specimens (TL 93.6-235 mm) were collected from stations 207, 223 and 378 in the central part of the Gulf of Thailand, during the survey cruise of M.V. PAKNAM from 21 May to 3 June 1984 (see Fig. 2).

Count: D. VIII-I, 27-32 (27 x 1, 28 x 3, 29 x 2, 30 x 1, 31 x 3, 32 x 3, 38 x 1). A. II-I, 22-28 (22 x 2, 26 x 2, 27 x 1, 28 x 7, 29 x 4). P. I, 18-22 (18 x 5, 19 x 5, 20 x 2, 21 x 3, 22 x 2). V. I, 5 gill rakers 27-35 (8-13). Lℓ. scales (47-55) + (35-39).

The characteristics of the specimens collected were as follows:

Proportion of measurement in percentage of standard length: total length 104-122; fork length 98-120; predorsal spine length 29-37; predorsal ray length 50-58; preanal length 56-78; prepectoral length 28-36; head length 23-34.

Percentage of head length: depth of body 63-81, length of snout 33-43, horizontal diameter of eye 23-26.

Interorbital width: 21-25, longest dorsal spine 47-57; longest dorsal ray 41-49; length of right pectoral fin 76-86; length of pelvic fin 41-52.

Body slender and strongly compressed, not round as *Decepterus macrosoma*. Depth of body at the origin of first dorsal fin is about 4.11-5.32 times in standard length, 5.02-5.74 times in total length. Predosal profile slightly curved, tip of premaxilla slightly shorter than lower jaw. Maxillary scarcely reaching front margin of eye; posterior end squarish and weakly concave. Minute teeth in jaw in a single series, and a small oval band of villiform teeth in head portion and on each side of ventral surface and presented on median shaft with medio-ventral tooth crest. Lateral line slightly arched, becoming straight below 13th ray of second dorsal fin, arched portion about 1.10 times longer than straight portion. Straight part of lateral line with pseudo scutes, scutes at hind part expand widely (see Fig. 3). Covered caudal peduncle, at its widest about three quarter times the length of eye. Eye large, about 3.93-4.67 times in head length, with adipose eyelid reaching to the nostrills. Pectoral fin very long, ending at the base of the third dorsal ray.

Color: Blue and greenish above, silver below, black spot at corner of operculum and inner side of pectoral fin. A golden band running from behind the eye to caudal peduncle. Apex of soft dorsal fin greenish. Ventral fin whitish; caudal fin yellowish with a green tinge.

Distribution: wide distribution in the South China Sea from Hong Kong and Taiwan to Viet Nam and Malaysia.

REMARKS

In the description of Wakiya's key there is a greenish apex to the soft dorsal fin; in our specimen that part was whitish with a greenish tinge below.

An easily recognized character was the scutes fully expanded in the straight part of the caudal peduncle.

Wakiya (1924) described only one specimen of *D. dayi* (TL 140 mm) from Taiwan and synonymized it with *Decapterus kurra* Day, not Cuvier (in Cuvier and Valenciennes), that was a junior synonym. He disagreed with the original description of *D. kurra* Cuvier in Cuvier and Valenciennes, which is regarded as synonymous with *D. russelli* Rüppell in having fewer than forty-six scutes and in having the lateral line straighten out at a point a little more forward than below the middle of the soft dorsal.

D. killiche of Cuvier in Cuvier and Valenciennes from the Red Sea and Java, which was presented by Bertin and Dollfus, does not have the same characters as the specimens found in the Gulf of Thailand. The difference can be seen especially in the widest scutes on the straight part of the lateral line and the length of the pectoral fin. Bleeker's *killiche* from Java, on the other hand, has a snout and mixilla similar to specimens from the Gulf of Thailand.

Kimura and Suzuki (1981) reviewed some morphological characters of seven Japanese *Decapterus* and introduced a new key. There are some distinctive characters, especially the ratio of body depth (D) against standard length (SL:D) and the head length (H) against standard length (SL:H). The D:SL ratio of the fishes in Japan increased and the HD:SL ratio decreased with the growth of fish. For the round scad in the Gulf of Thailand, these two ratios are expressed in Figs. 4 and 5. The round scads in the Gulf of Thailand are in a tropical zone so the growth of fish has less correlation to the ratio of head length against standard length (SL:H) and the ratio of body against standard length.

ACKNOWLEDGEMENTS

I am deeply indebted to the crew of M.V. PAKNAM, and especially to Captain V. Sitothai and Masterfisherman M. Oishi, for their help and kindness.

I would like to express my appreciation to the Secretary-General of SEAFDEC, Dr. Veravat Hongskul, and the former Deputy Secretary General, Dr. S. Shindo, for supporting this project.

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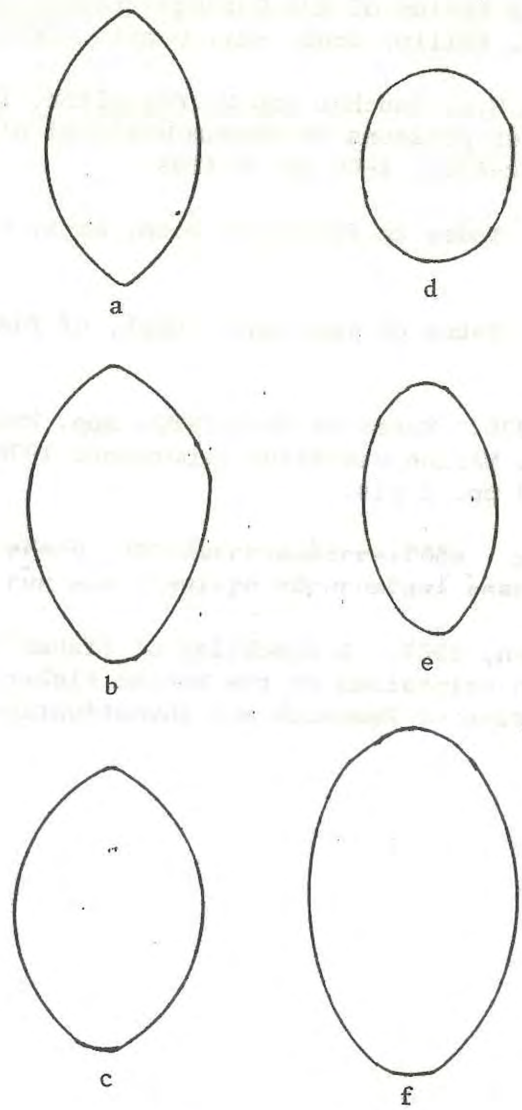


Fig. 1. Sketch profile of the cross-section at the origin of second dorsal fin.
a-c = *Decapterus dayi* range of SL = 195-227 mm,
d = *D. macrosoma* SL = 162.5 mm,
e = *D. kurroides* and
f = *D. macarellus pinnulatus*, SL = 245 mm

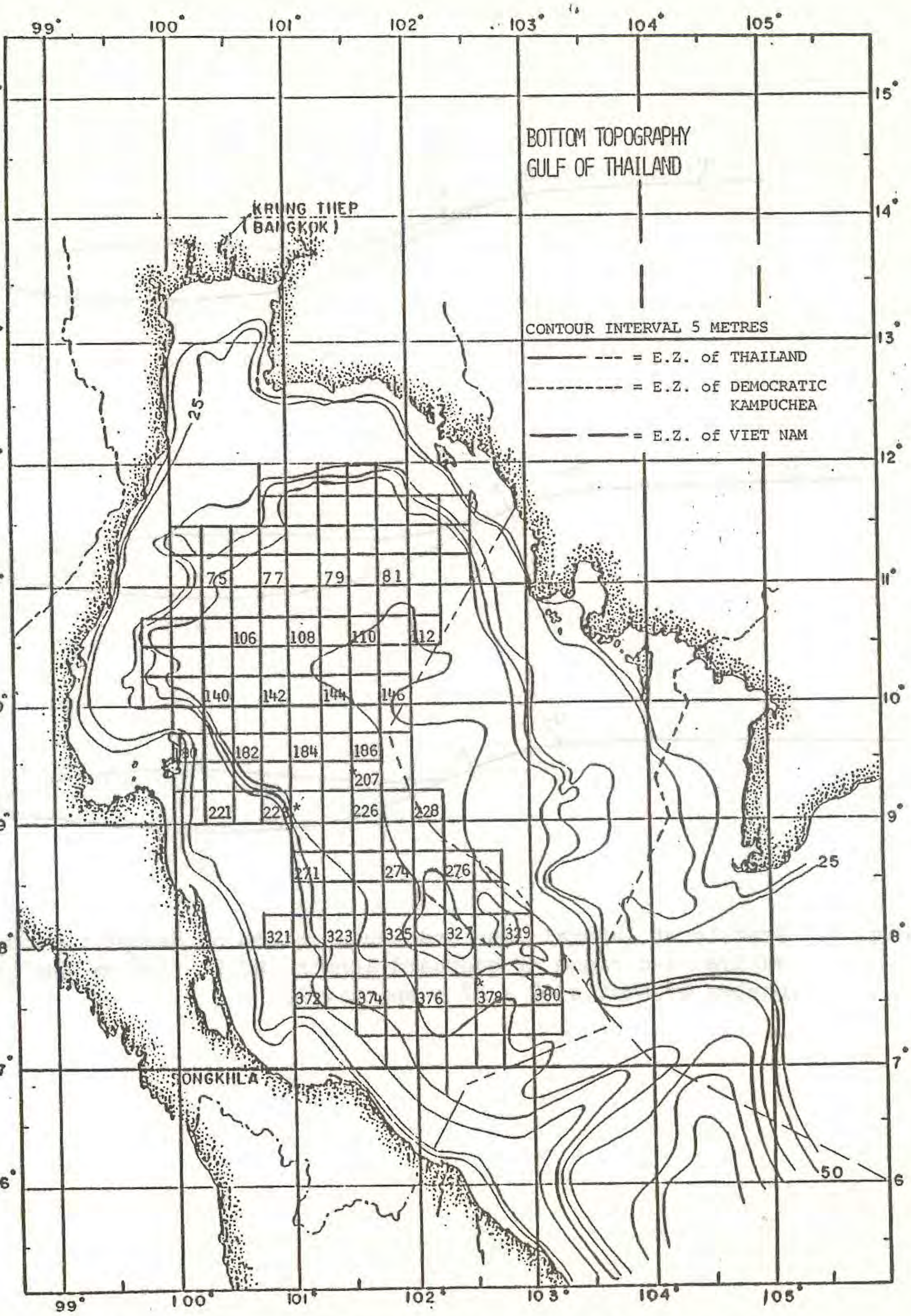


Fig. 2. Stations (marked with asterisk) in the Gulf of Thailand where specimens of round scad were collected, 1984

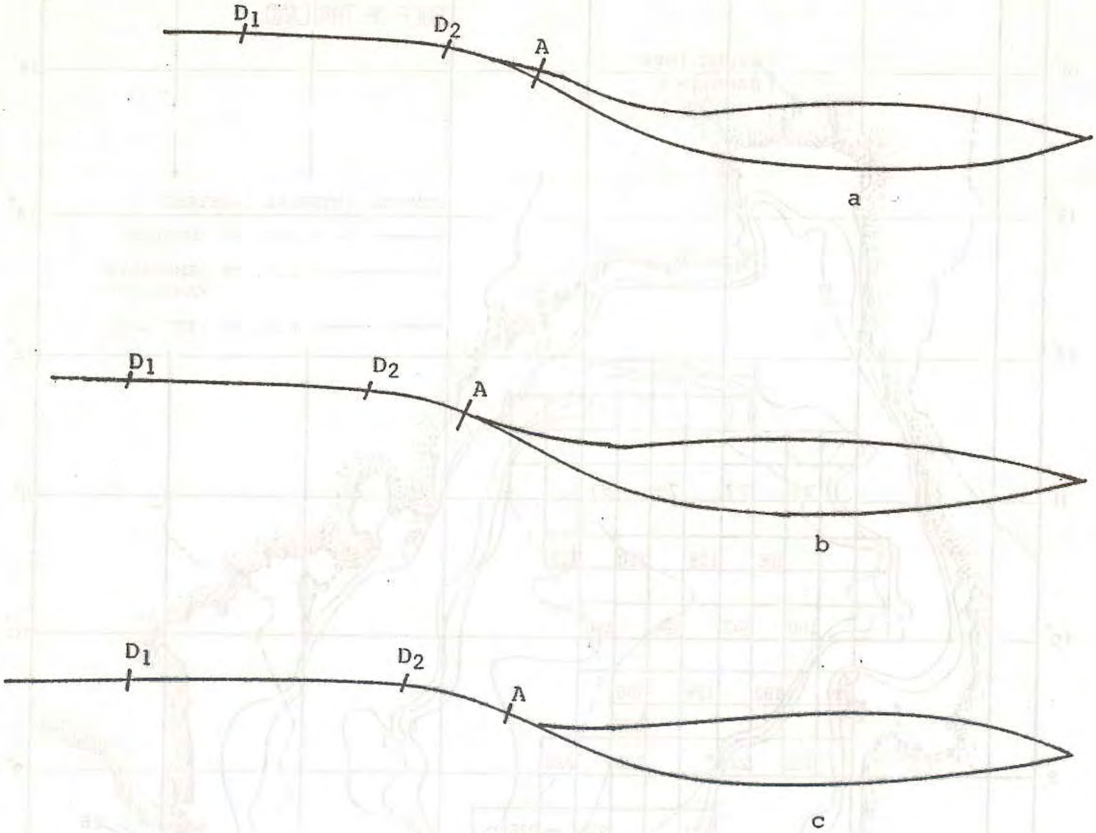


Fig. 3. Profile of lateral line and scute-sheath of *Decapterus dayi* Wakiya: a-c range of standard length 182.5 - 196 mm and the number of scutes 39 - 37 respectively

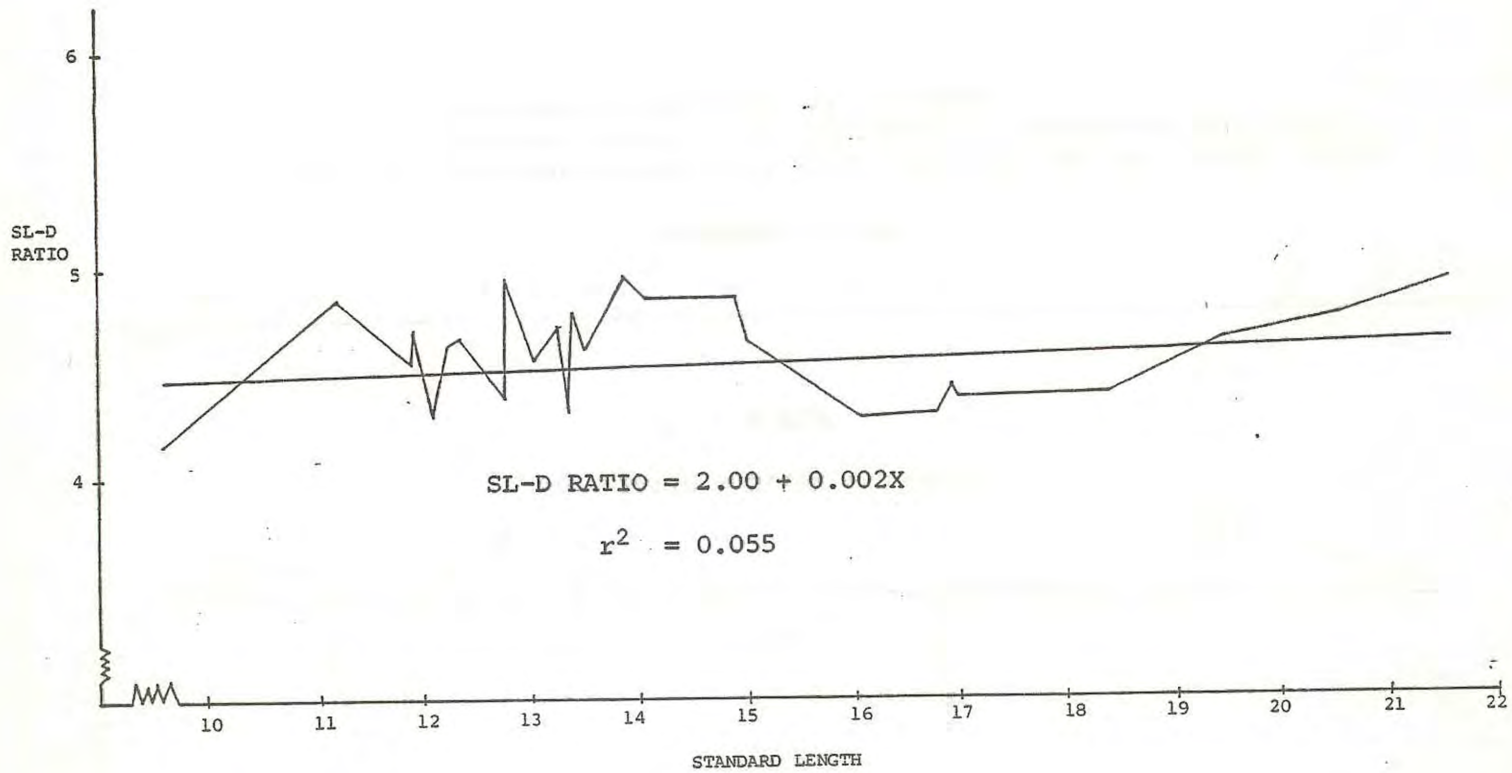


Fig. 4. Relation between SL-D ratio (standard length - depth) against standard length of 32 specimens of *Decapterus dayi* Wakiya show less correlation, $r^2 = 0.055$

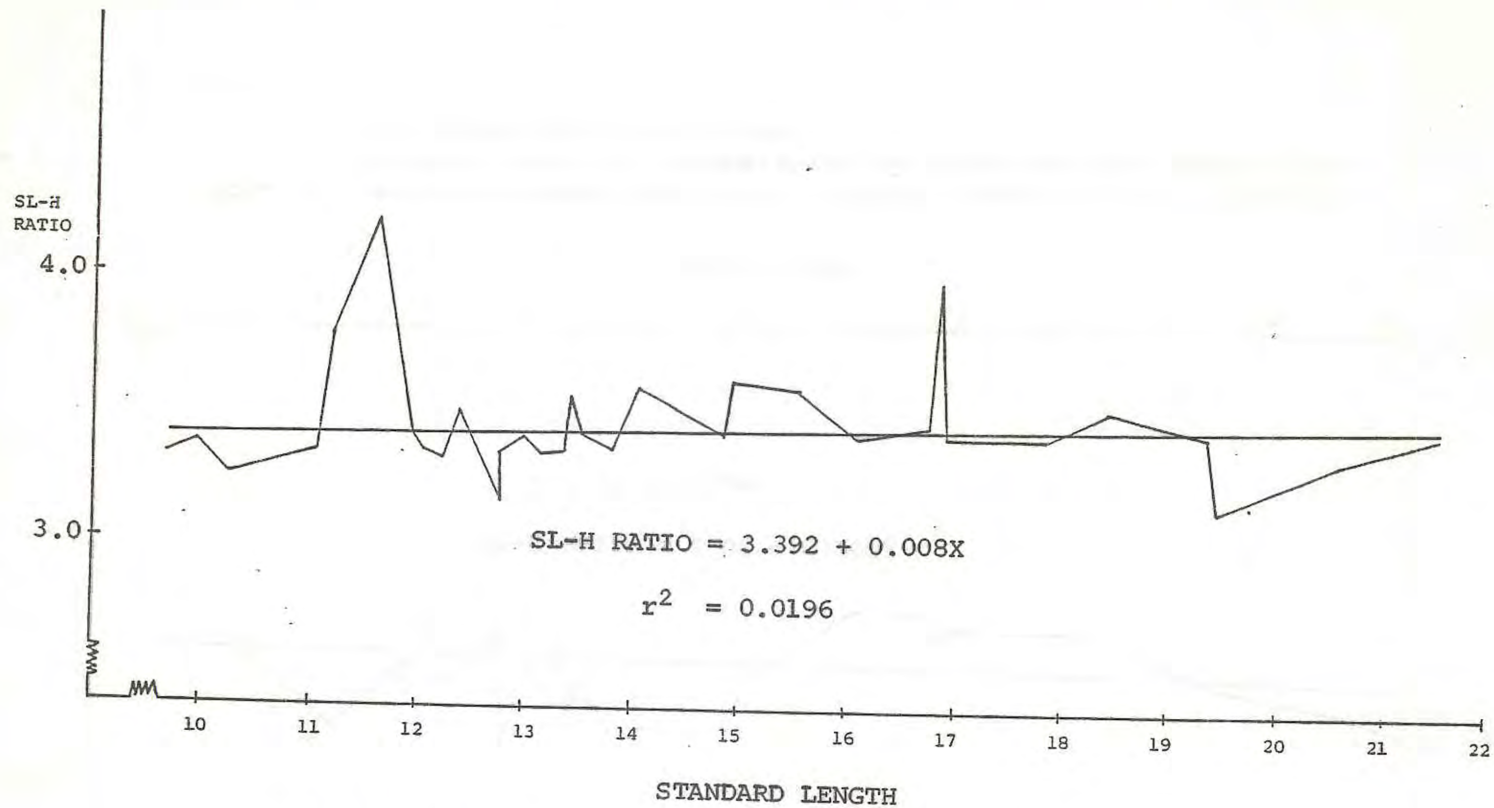
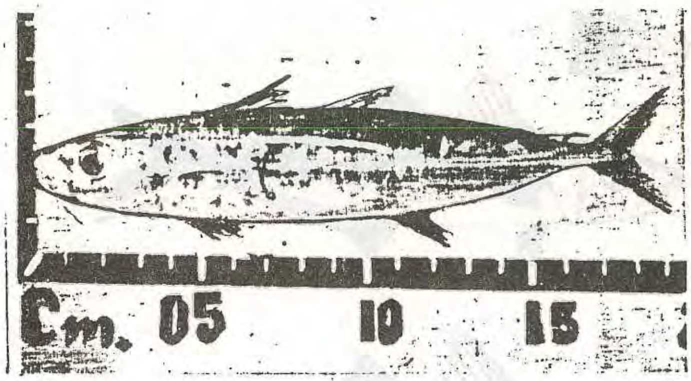
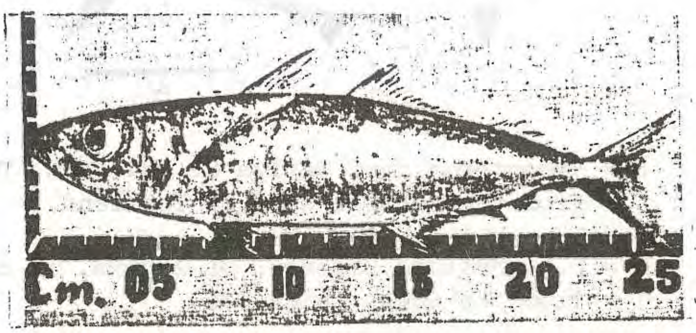


Fig. 5. Relation between SL-H ratio (standard length - head) against standard length of 32 specimens of *Decapterus dayi* Wakiya show less correlation, $r^2 = 0.0196$



ชื่อไทย ทูแขกลูกกล้วย
ชื่ออังกฤษ Ambon
ชื่อวิทยาศาสตร์ *Decapterus kurroides* (Bleeker)

ชื่อไทย ทูแขกตาโต
ชื่ออังกฤษ Blue Mackerel scad
ชื่อวิทยาศาสตร์ *Decapterus maruadsi* (Fowler)



ชื่อไทย ทูแขก
ชื่ออังกฤษ Russell's scad
ชื่อวิทยาศาสตร์ *Decapterus russelli* (Rüppell)

Plate 1. Photographs of *Decapterus, in* Exploratory Fishing Division, 1969. pp. 271-273

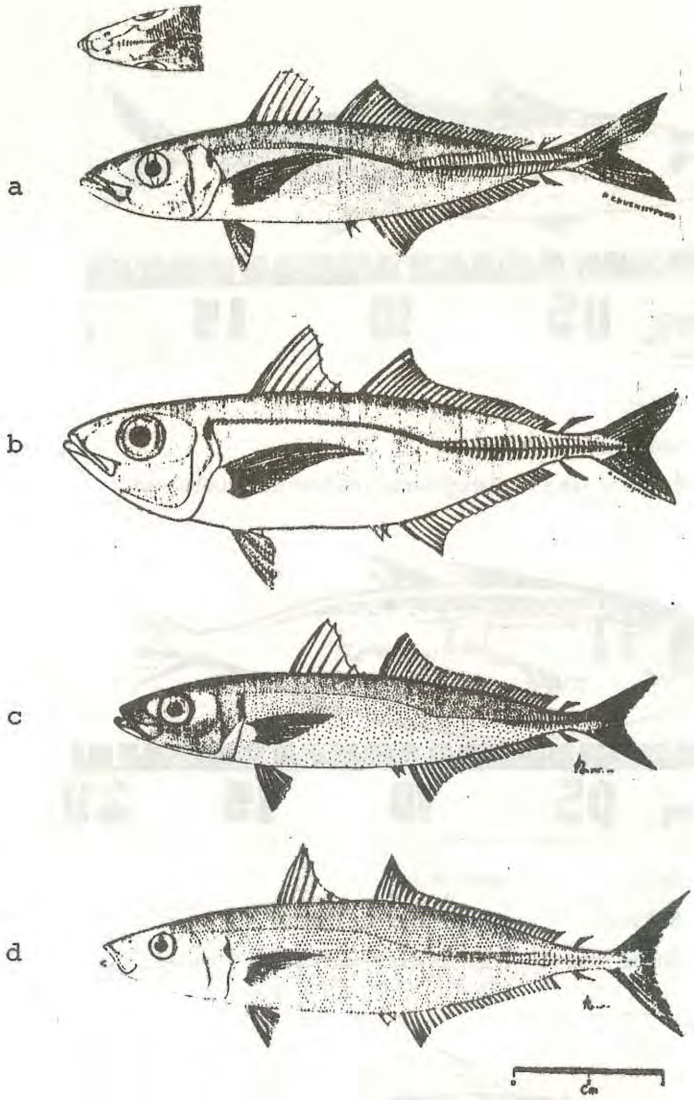


Plate 2. a = *Decapterus dayi* Wakiya SL 184.5 mm, TL 215 mm, from the central Gulf of Thailand.

b = *D. kurroides* Bleeker, SL 200 mm, TL 224 mm, from the South China Sea.

c = *D. macrosoma* Bleeker SL 162.5 mm, TL 192.5 mm, from the Gulf of Thailand.

d = *D. macarellus pinnulatus*, SL 273.5 mm, TL 320 mm, from the Andaman Sea.

Decapterus dayi and *D. kurroides* drawings by Mr. P. Chuenjitpong.
D. macrosoma and *D. macarellus pinnulatus* drawings by Mr. Chow Thewsuwan.

COMPOSITION, DISTRIBUTION AND STOCK EVALUATION OF DEMERSAL FISHES IN THE CENTRAL GULF OF THAILAND

*II. COMPARATIVE STUDY OF CATCH IN DEEP WATERS AND SHALLOW WATERS

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Southeast Asian Fisheries Development Center

* Part I of this paper dealing with the analysis of catch data was published in Volume I of the Report of Thai-SEAFDEC Joint Fishery Oceanographic Survey in the Central Gulf of Thailand (TD/Res/4).

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INTRODUCTION

In 1984, two resource surveys for the evaluation of fishing grounds and on the topography of the central part of the Gulf of Thailand were jointly organized by the SEAFDEC Training Department and the Thai Department of Fisheries. The paper analysing the data collected is incorporated in the Report on the survey published under the symbol TD/RES/4.

A third resource survey was conducted on board M.V. PAKNAM on the fishing grounds and topography of the central part of the Gulf, from 19 to 28 November, 1985.

This paper deals with the analysis of the data on the catch collected by bottom trawl during the third survey. Special emphasis has been placed on the comparison of catch from shallow waters and deep waters. Three subjects are discussed: (i) fish composition of trawl catch, (ii) length composition of trawl catch, and (iii) general observations on the evaluation of demersal stocks and fishing grounds.

It should be noted that owing to constraints in space and time, the data given in this report may not be sufficient to draw conclusions with a high degree of accuracy. Nevertheless, we believe that the information given here is indispensable for any closer study of trawl fishery in the central part of the Gulf of Thailand.

We should like to express our appreciation to Captain Lt. (Sr.) Vichitra Sitothai, RTN, and the crew of M.V. PAKNAM for their cooperation in conducting this survey.

MATERIALS AND METHODS

1. Sampling

Six bottom hauls (sampling by trawl net) were made during the survey. Of these three hauls were conducted in the zone of shallow waters of less than 40 m in depth and the other three hauls were conducted in waters of around 70 m in depth (Table 1, Figure 1).

The hauls were made after about 1.5 hours of towing. The towing speed was 2.5 to 3.0 knots.

Samples of fish larvae by larval net operation and sea water samples by means of the Nansen reversing water bottle sampler were collected in the same places at the same time.

Table 1 Conditions of trawl net operations and total catch

Date	Station No.	Operation No.	Set net Time	Set net Location	Haul net Time	Haul net Location	Trawling time (min)	Speed (Knot)	Depth (m)	Warp length (m)	Wire angle L/R	Type of bottom	Total catch (kg)	Catch p Haul
1/85	202	1	0725	09°-20'7"N 100°-19'4"E	0855	09°-17'1"N 100°-16'07"E	90	3.0	31-32	250	6°/5°	Smooth / Mud	76.5	A = 61. B = 15.
1/85	223	2	1412	09°-05'8"N 100°-52'2"E	1545	09°-00'9"N 100°-54'1"E	93	2.5	39-41	250	12°/4°	Smooth / Mud	421.0	A = 405. B = 15.
1/85	270	3	0722	08°-35'5"N 100°-50'8"E	0835	08°-31'3"N 100°-49'8"E	73	1.5-2.5	33-34	250	8°/5°	Flat(Even)	180.0	A = 164. B = 15.
1/85	273	4	1600	08°-44'3"N 101°-35'3"E	1730	08°-40'3"N 101°-36'9"E	90	2.5-3.0	68-69	300	12°/2°	Rather smooth / Muddy sand	Net broken (15 mins) 81.5	A = 66. B = 15.
1/85	207	5	0710	09°-19'9"N 101°-31'3"E	0840	09°-31'3"N 101°-31'2"E	90	2.5-3.0	71-72	400	6°/3°	Rather smooth	110.5	A = 96.1 B = 14.5
1/85	186	6	1520	09°-37'1"N 101°-31'8"E	1420	09°-29'9"N 101°-31'2"E	90	2.65	72	400	2°/7°	Rather smooth	380.0	A = 365.0 B = 15.0

A : Sample specimens examined on board

B : Sample specimens which were sent to Japan for further analysis.

2. Data Analysis

Sample specimens A (see Table 1) were separated into pelagic fish, demersal fish and trash fish groups, and these were then weighed and the number in each group was recorded.

The fishes belonging to the families CARANGIDAE, ENGRAULIDAE, and SCOMBRIDAE were classified, for the purpose of this study as pelagic species when they occurred in the bottom trawl.

The species determination was mostly based on the FAO Species Identification Sheets for Fishery Purposes (FISCHER & WHITEHEAD (eds.), 1974) and the Fishes of the Japanese Archipelago (Masuda ,Amaoka, Arga, Uyeno and Yoshino (eds.), 1984).

Estimation of abundance of demersal fish was done by the sweep method as explained in a previous paper (see TD/Res/4).

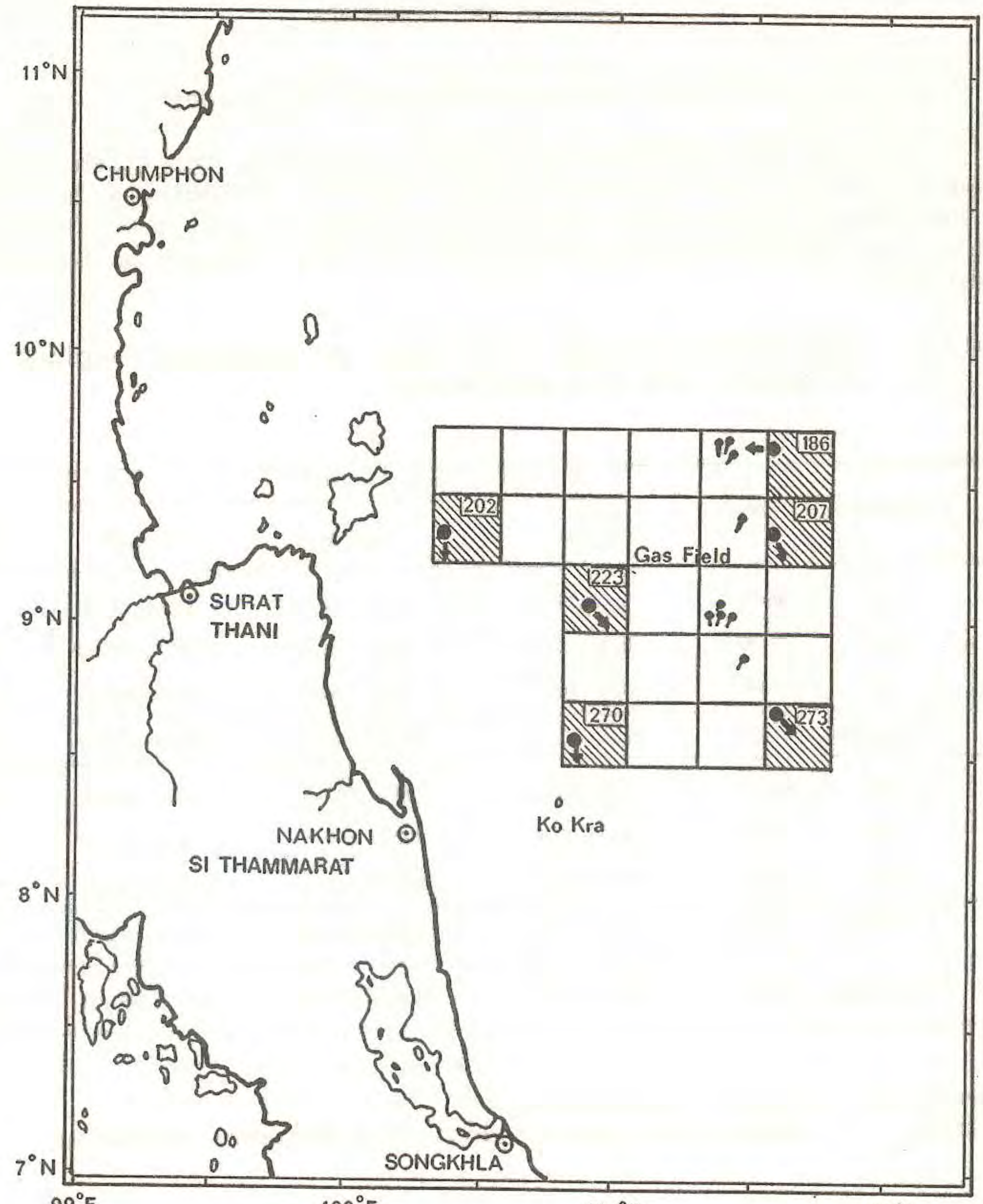

Fig. 1 Location of trawling operations by station (shaded) in the Gulf of Thailand, 1985. Each area is about 771.75 km^2. Arrows indicate the direction of trawling

RESULTS AND COMMENTS

Composition of trawl catch in different depth zones

In the shallow waters of 30-40 m in depth, the trash fish group predominated in the trawl catch (45-76%, averaging about 70% of the total catch); while in the deep waters of more than 70 m in depth, useful demersal resources predominated (41-78%, averaging about 51% (Table 2).

Table 2 Composition of trawl catch from the different sampling stations, in weight and as a percentage

Haul No.	Station No.	Depth (m)	Catch: kg (percentage)			Total catch
			Pelagic	Demersal*	Trash**	
1	202	31~32	6.5 (10.6)	27.4 (44.5)	27.6 (44.9)	61.5
2	223	40~42	30.3 (7.5)	66.0 (16.3)	309.2 (76.2)	405.5
3	270	34	16.7 (10.2)	40.2 (24.4)	107.6 (65.4)	164.5
Sub-total	3 stations	31~42	53.5 (8.5)	133.6 (21.1)	444.4 (70.4)	631.5
4	273	68~69	2.0 (3.0)	41.8 (63.3)	22.2 (33.7)	66.0
5	207	71~72	5.2 (5.4)	74.9 (77.9)	16.0 (16.7)	96.1
6	186	71~72	25.3 (6.9)	149.8 (41.1)	189.9 (52.0)	365.0
Sub-total	3 stations	68~72	32.5 (6.2)	266.5 (50.5)	228.1 (43.3)	527.1
TOTAL	6 stations	31~72	86.0 (7.4)	400.1 (34.5)	672.5 (58.1)	1158.6

* Demersal : Fishes + Invertebrates
** Trash : Except for useful pelagic and demersal resources

This table shows that trash fish in the major group in the composition of the trawl catch in shallow waters and that the catch of useful demersal fish in shallow waters is about half of that in deep waters, whereas the total catch in shallow waters is only slightly higher than that in deep waters.

1. Family level

The catches comprised useful demersal resources belonging to 16 fish families, other fish groups and invertebrates (Table 3-A).

Table 3. Species composition in weight and numbers (in parentheses) in the catch by trawl

A) Demersal resources

Date	24/11/85	24/11/85	25/11/85	25/11/85	26/11/85	26/11/85	
Station No.	202	223	270	273	207	186	Total
Depth (m)	31-32	40-42	34	68-69	71-72	71-72	(kg)
BALISTIDAE	0.0	2.4(10)	0.0	0.7(1)	0.0	8.3(24)	11.4(35)
- Abalistes stellaris	0.0	0.0	0.0	0.7(1)	0.0	1.7(6)	2.4(7)
- Aluterus monoceros	0.0	2.4(10)	0.0	0.0	0.0	6.6(18)	9.0(28)
CYNOGLOSSIDAE	0.4(-)	0.8(8)	0.5(6)	0.0	0.0	0.0	1.7(-)
- Cynoglossus spp.	0.4(-)	0.8(8)	0.5(6)	0.0	0.0	0.0	1.7(-)
GERREIDAE	-	-	-	1.4(5.8)	7.5(-)	6.5(-)	15.4(-)
- Pentaprion longimanus	-	-	-	1.4(5.8)	7.5(-)	6.5(-)	15.4(-)
LETHRINIDAE	0.0	3.6(7)	0.0	0.0	0.0	1.6(4)	5.2(11)
- Lethrinus sp.	0.0	3.6(7)	0.0	0.0	0.0	1.6(4)	5.2(11)
LUTJANIDAE	0.0	0.5(2)	2.0(7)	0.3(2)	8.2(12)	21.0(13)	32.0(36)
- Lutjanus johni	0.0	0.0	2.0(7)	0.0	0.0	0.0	2.0(7)
- L. lineolatus	0.0	0.5(2)	0.0	0.0	1.0(5)	0.0	1.5(7)
- L. sanguineus	0.0	0.0	0.0	0.0	2.0(3)	10.2(7)	12.2(10)
- L. sebae	0.0	0.0	0.0	0.3(2)	0.0	0.2(2)	0.5(4)
- Pristipomoides typus	0.0	0.0	0.0	0.0	5.2(4)	10.6(4)	15.8(8)
MULLIDAE	0.0	2.3(32)	0.0	5.7(166)	3.5(-)	9.3(-)	20.8(-)
- Upeneus spp.	0.0	2.3(32)	0.0	5.7(166)	3.5(-)	9.3(-)	20.8(-)
NEMIPTERIDAE	1.3(69)	10.0(209)	1.8(48)	14.9(287)	27.1(433)	37.1(747)	92.2(1793)
- Nemipterus bleekeri	0.0	0.0	0.0	2.0(24)	7.0(61)	5.0(66)	14.0(151)
- N. hexodon	0 .7(31)	2.5(24)	1.0(20)	0.0	0.0	0.0	4.2(75)
- N. japonicus	0.0	0.0	0.0	0.0	0.0	0.1(2)	0.1(2)
- N. marginatus	0.0	0.0	0.0	0.0	0.0	0.1(1)	0.1(1)
- N. mesoprion	0.6(38)	7.5(185)	0.8(28)	0.0	0.1(1)	0.3(10)	9.3(262)
- N. nematophorus	0.0	0.0	0.0	7.9(175)	12.0(263)	18.0(474)	37.9(912)
- N. nemurus	0.0	0.0	0.0	0.0	0.0	1.6(23)	1.6(23)
- N. tambuloides	0.0	0.0	0.0	5.0(88)	8.0(108)	12.0(171)	25.0(367)
POMADASYIDAE	0.0	0.6(1)	0.0	0.0	1.7(2)	2.0(1)	4.3(4)
- Plectorhynchus pictus	0.0	0.6(1)	0.0	0.0	1.7(2)	2.0(1)	4.3(4)
PRIACANTHIDAE	1.0(29)	5.4(70)	2.2(44)	8.7(96)	7.8(66)	12.6(96)	37.7(401)
- Priacanthus macracanthus	0.0	0.4(6)	0.2(2)	8.0(84)	1.8(11)	8.1(50)	18.5(153)
- P. tayenus	1.0(29)	5.0(64)	2.0(42)	0.7(12)	6.0(55)	4.5(46)	19.2(248)
SCOLOPSIDAE	0.5(4)	1.4(17)	0.0	0.0	0.0	0.0	1.9(21)
- Scolopsis spp.	0.5(4)	1.4(17)	0.0	0.0	0.0	0.0	1.9(21)
SERRANIDAE	0.5(1)	1.5(8)	0.2(3)	0.4(5)	2.8(10)	1.0(4)	6.4(31)
- Epinephelus spp.	0.5(1)	1.5(8)	0.2(3)	0.4(5)	2.8(10)	1.0(4)	6.4(31)
SIGANIDAE	0.5(-)	2.2(32)	0.0	0.0	0.0	1.0(10)	3.7(-)
- Siganus oramin	0.5(-)	2.2(32)	0.0	0.0	0.0	1.0(10)	3.7(-)

Table 3-A (continued)

Station No.	202	223	270	273	207	186	Total(kg.)
SPHYRAENIDAE	0.0	4.8(43)	0.0	1.2(17)	4.0(42)	7.6(77)	17.6(179)
- Sphyraena spp.	0.0	4.8(43)	0.0	1.2(17)	4.0(42)	7.6(77)	17.6(179)
SYNODONTIDAE	3.1(117)	6.8(47)	8.7(476)	3.0(88)	7.0(183)	23.5(512)	52.1(1423)
- Saurida elongata	1.6(100)	5.6(32)	6.0(437)	1.0(24)	5.0(97)	12.5(329)	31.7(1019)
- Saurida undosquamis	1.5(17)	1.2(15)	2.7(39)	2.0(64)	2.0(86)	11.0(183)	20.4(404)
TRICHIURIDAE	4.0(97)	17.4(118)	6.0(80)	0.0	0.4(3)	3.1(21)	30.9(319)
- Trichiurus spp.	4.0(97)	17.4(118)	6.0(80)	0.0	0.4(3)	3.1(21)	30.9(319)
BOTHIDAE	0.0	0.8(10)	1.1(4)	0.0	0.0	-	1.9(14)
- Pseudorhombus spp.	0.0	0.8(10)	1.1(4)	0.0	0.0	-	1.9(14)
OTHERS	-	2.0(-)	2.8(26)	2.5(-)	3.3(-)	4.3(-)	14.9(-)
- Fistularia commersonii	-	-	-	2.0(-)	2.0(-)	3.1(-)	7.1(-)
- Formio niger	0.0	0.0	2.4(25)	0.5(-)	0.0	0.0	2.9(-)
- Rachycentron canadus	0.0	0.0	0.4(1)	0.0	0.0	0.2(1)	0.6(2)
TRIGLIDAE	0.0	0.0	0.0	0.0	1.0(-)	0.0	1.0(-)
- Sharks	0.0	0.0	0.0	0.0	0.0	1.0(2)	1.0(2)
- Rays	0.0	2.0(-)	0.0	0.0	0.3(1)	0.0	2.3(-)
Total demersal fishes	11.3	62.5	25.3	38.8	73.3	138.9	350.1
CRUSTACEANS	5.5	1.0	2.3	2.5	-	5.5	16.8
- Shrimps	4.0	1.0	0.3	1.0	-	2.5	8.8
- Crabs	1.5	0.0	2.0	1.5	-	3.0	8.0
CEPHALOPODS	10.6	2.5	12.6	0.5	1.6	3.0	30.8
- Loligo spp.	6.8	1.0	12.0	-	1.4	1.5	22.7
- Sepia spp.	3.0	1.5	0.6	0.5	0.2	0.5	6.3
- Octopus	0.8	-	-	-	-	1.0	1.8
Shells	-	-	-	-	-	2.4	2.4
TOTAL DEMERSAL RESOURCES	27.4	66.0	40.2	41.8	74.9	149.8	400.1
TRASH FISHES	27.6	309.2	107.6	22.2	16.0	189.9	672.5

Trash fishes are defined here as demersal resources which are not used for direct human consumption. They comprised various kinds of small-sized or juvenile fishes. Among them LEIOGNATHIDAE predominated conspicuously, followed by APOGONIDAE.

The bottom trawl catch included fishes from five pelagic families. CARANGIDAE were predominant both in weight and in numbers, followed by SCOMBRIDAE (Table 3-B).

Table 3 (Continued)

B) Pelagic fishes

Date	24/11/85	24/11/85	25/11/85	25/11/85	26/11/85	26/11/85	
Station No.	202	223	270	273	207	186	Total
Depth (m.)	31-32	39-41	33-34	68-69	71-72	72	(kg.)
CARANGIDAE	3.5(-)	8.2(-)	3.9(93)	2.0(-)	2.1(-)	13.2(-)	42.9
- Alepes melanoptera (Atule malam)	0.2(4)	0.0	0.0	0.0	0.0	0.0	0.2
- Atule mate	0.0	0.0	1.5(35)	0.5(-)	0.3(-)	0.5(-)	2.8
- Carangoides spp.	1.3(-)	4.6(-)	0.8(28)	1.0(-)	0.6(5)	1.0(-)	9.3
- Megalaspis cordyla	0.0	0.0	1.0(10)	0.0	0.0	0.0	1.0
- Scomberoides sp.	0.0	0.6(9)	0.0	0.0	0.0	0.0	0.6
- Selar crumenophthalmus	0.3(4)	9.6(95)	0.0	0.0	0.7(-)	9.3(-)	19.9
- Selaroides leptolepis	0.9(25)	1.2(35)	0.6(20)	0.0	0.0	0.0	2.7
- Seriolina nigrofasciata	0.8(1)	2.2(5)	0.0	0.5(-)	0.5(2)	2.4(11)	6.4
CLUPEIDAE	0.8(16)	1.0(-)	0.3(-)	0.0	0.0	0.0	2.1
- Dussummieria acuta	0.8(16)	0.5(2)	0.3(-)	0.0	0.0	0.0	1.6
- Sardinella spp.	0.0	0.5(-)	0.0	0.0	0.0	0.0	0.5
CHIROCENTRIDAE	0.0	2.3(12)	0.2(1)	0.0	0.1(2)	0.0	2.6
- Chirocentrus dorab	0.0	2.3(12)	0.2(1)	0.0	0.1(2)	0.0	2.6
ENGRAULIDAE	0.0	0.0	0.2(-)	0.0	0.0	0.0	0.2
- Stolephorus sp.	0.0	0.0	0.2(-)	0.0	0.0	0.0	0.2
SCOMBRIDAE	2.2(33)	8.8(92)	12.1(92)	0.0	3.0(4)	12.1(-)	38.2
- Rastrelliger spp.	2.0(32)	5.2(85)	10.0(86)	0.0	0.0	5.5(-)	22.7
- Scomberomorus guttatus	0.0	0.6(2)	0.0	0.0	0.0	0.0	0.6
- S. commerson	0.2(1)	3.0(5)	2.1(6)	0.0	3.0(4)	6.6(11)	14.9
TOTAL (kg.)	6.5	30.3	16.7	2.0	5.2	25.3	86.0

Table 4 gives the catch composition in weight and as a percentage of demersal fish families/groups collected in different depth zones.

Table 4 Catch composition of demersal fish families/groups collected in different depth zones, in weight and as a percentage

	Catch in kg (percentage)		
Depth Zone (m)	31-42 (Shallow)	68-72 (Deep)	Total
No. of hauls	3	3	
Family/Group			
Nemipteridae	13.1(3.3)	79.1(19.8)	92.2(23.1)
Synodontidae	18.6(4.6)	33.5(8.4)	52.1(13.0)
Priacanthidae	8.6(2.1)	29.1(7.3)	37.7(9.4)
Lutjanidae	2.5(0.6)	29.5(7.4)	32.0(8.0)
Trichiuridae	27.4(6.8)	3.5(0.9)	30.9(7.7)
Other fishes	28.9(7.2)	76.3(19.1)	105.2(26.3)
Invertebrates	34.5(8.6)	15.5(3.9)	50.0(12.5)
TOTAL	133.6(33.4)	266.5(66.6)	400.1(100)

The total catch of useful demersal resources in all areas surveyed was about 400 kg, of which more than 66 per cent was caught in deep waters around 70 m in depth.

As regards family groups, five families predominated in the majority of the catches i.e. NEMIPTERIDAE, SYNODONTIDAE, PRIACANTHIDAE, LUTJANIDAE and TRICHIURIDAE in all survey areas.

From the point of view of demersal fishes at their family level, the catch by bottom trawl revealed some interesting data.

NEMIPTERIDAE, which was the most abundant demersal fish in the total catch, was caught (79 kg in weight and 19.84% of total catch) predominantly in deep waters, with only a small catch in shallow waters.

SYNODONTIDAE was caught plentifully both in deep and shallow waters, forming about 8.4 and 4.6 per cent of the total catch, respectively.

PRIACANTHIDAE and LUTJANIDAE ranked third and fourth in importance respectively, in all sampling areas. However, they were dominant only in deep waters.

TRICHIURIDAE was caught particularly in shallow waters.

Other fishes, mainly MULLIDAE, GERREIDAE and SPHYRAENIDAE, were caught plentifully in deep waters.

While invertebrates were more abundant in shallow waters than in deep waters.

2. Genera and species level

2.1 Genera/Species composition in different depth zones

Among demersal fishes (about 23 genera and 45 species) were collected by bottom trawl in this survey, five species of genus *Nemipterus*, two species of genus *Saurida*, two species of genus *Priacanthus*, one species each of genera *Lutjanus* and *Pristipomoides*, and two species of genus *Trichiurus* were predominant both in weight and in numbers (Table 5).

Table 5 Genera/Species composition of major demersal fish caught in different depth zones

Genera Common name	Species	Shallow kg	Shallow No.	Deep kg	Deep No.	Pooled kg	Pooled No.
Nemipterus Threadfin breams	N. bleekeri	0	0	14.0	151	14.0	151
	N. hexodon	4.2	75	0	0	4.2	75
	N. mesoprion	8.9	251	0.4	11	9.3	262
	N. nematophorus	0	0	37.9	912	37.9	912
	N. tambuloides	0	0	25.0	367	25.0	367
	Others	0	0	1.8	26	1.8	26
Saurida Lizard fishes	S. elongata	13.2	569	18.5	450	31.7	1019
	S. undosquamis	5.4	71	15.0	333	20.4	404
Priacanthus Bigeyes	P. macracanthus	0.6	8	17.9	145	18.5	153
	P. tayenus	8.0	135	11.2	113	19.2	248
Lutjanus Snappers	L. sanguineus	0	0	12.2	10	12.2	10
	Others	2.5	9	1.5	9	4.0	18
Pristipomoides Sharptooth snapper	P. typus	0	0	15.8	8	15.8	8
Trichiurus Hairtails	Trichiurus spp.	27.4	295	3.5	24	30.9	319

With regard to the species distribution in different depth zones, the catch of major demersal fishes revealed some specific peculiarities.

Among the threadfin breams, three species of genus *Nemipterus* i.e. *N. nematophorus*, *N. tambuloides* and *N. bleekeri* were caught only in deep waters. While the other two species, *N. mesoprion* and *N. hexodon*, were caught particularly in shallow waters.

The most abundant species (in numbers) of lizard fish, *Saurida elongata* occurred in the catch from both shallow and deep waters. While *S. undosquamis* was abundant in deep waters.

The bigeyes, *Priacanthus macracanthus* and *P. tayenus*, were caught both in shallow and deep waters, with some specific variations in occurrence.

Two snapper, *Lutjanus sanguineus* and *Pristipomoides typus*, were caught only in deep waters with a small proportion of total catch in numbers.

The hairtails, *Trichiurus* spp., were caught particularly in shallow waters.

2.2 Length composition of major fishes in different depth zones

The distribution as regards length of major demersal species in different depth zones revealed some interesting data.

A) Threadfin breams, *Nemipterus* spp.

Each threadfin bream species was found to fall into two or three different size groups, and there was a significant difference in average size between them (Fig. 2-a).

The common size of each species caught and the catch in numbers at common size differed widely (Table 6-a).

The outline of length composition of each species of *Nemipterus* from the trawl catch in different depth zones is given as follows:

In shallow waters:

N. mesoprion : This species consisted of two groups and the number of individuals in them was nearly the same. Therefore the common size of individual appearing in the catch was taken to be from 9 to 18 cm with a mean size of about 14 cm.

Table 6 Length composition of fish caught by trawl in different depth zones

a) Nemipterus spp.

	Species	No. of size groups	Total body length (cm) Common	Catch in Nos.	%	Mode	Reference Data (TL:cm) Common*	Recruitment**
Shallow waters	N. mesoprion	2	9-18	248	99	14	10-15	—
	N. hexodon	3	10-21	68	91	15	15-25	11-12
	Pooled	2-3	9-18	304	93	13.5	—	—
Deep waters	N. nematophorus	2	11-19	812	89	14	12-18	15-17
	N. tambuloides	2	11-26	363	99	18	16-25	—
	N. bleekeri	3	17-25	106	70	21	—	—
	Pooled	2-3	11-23	1260	88	16	—	—
	Nemipterus spp.	2-3	9-23	1564	89	15	—	11-17

* Source : FAO Species Identification Sheets (1974)
** Source : Text/Reference Book No. 8 (D. Menasveta, 1980)

N. hexodon : This species consisted of three different groups with some variations in the number of individuals. The common size is taken to be from 10 to 21 cm with a mean size of about 15 cm. The common size appearing in the catch of this survey was smaller than that of previously reported data.

In deep waters:

N. nematophorus : This species consisted of two groups. The catch in numbers of small-sized individuals was much bigger than that of large-sized ones. The common size appearing in the catch was, therefore, the smallest at 14 cm.

N. tambuloides : This species consisted of two groups, and the catch in numbers of smaller-sized individuals was much bigger than that of larger-sized individuals. The common size lies in the middle at around 18 cm.

N. bleekeri : This species consisted of three groups, and the intermediate-sized group was most abundant. The common size was the biggest at 21 cm in all *Nemipterus* spp.

The relationship between size and catch (in numbers) revealed that the large-sized groups of *Nemipterus* spp. concentrated in deep waters. There was also a tendency for the catch in numbers of each species to become smaller as the common size in catch became larger (Fig. 3-a).

Table 6 (continued)

b) Saurida spp.

Species		No. of size group	Total body length (cm)				Reference Data (TL:cm)	
			Common	Catch in Nos.	%	Mode	Common*	Recruitment**
S. elongata	Shallow	3	8-15	490	86	12.0	25-38	--
	Deep	4	10-18	360	80	13.0		
	Pooled	3~4	8-17	866	85	12.5		
S. undosquamis	Shallow	1	16-28	71	100	20.0	25-30	13-15
	Deep	3	11-24	300	90	17.0		
	Pooled	1~3	11-24	367	91	17.3		
Saurida spp.		1~4	8-24	1285	90	14.1	25-38	13-15

B) Lizard fishes, *Saurida* spp. (Fig. 2-b, Table 6-b)

Saurida elongata: This species consists of 3 to 4 different size groups found in both deep and shallow waters. The common size caught did not vary much between the two fishing areas. However, the common size appearing in the catch of this survey was considerably smaller than that of previously reported data.

S. undosquamis : This species is abundant in deep waters where it consists of three groups. In shallow waters, one group with a mean size of about 20 cm appeared.

The size and catch relationship revealed that *S. elongata* was bigger in number and smaller in size than *S. undosquamis*. There was also a tendency for the catch in numbers of each species to become smaller as the common size in catch became larger (Fig. 3-b)

Table 6 (continued)

c) Priacanthus spp.

Species	Area	No. of size group	Total body length (cm) Common	Catch in Nos.	%	Mode	Reference Data (TL:cm) Common*	Recruitment**
P. tayenus	Shallow	3	11-12	125	93	15.9		
	Deep	2	14-25	109	96	19.4	15-25	10-12
	Pooled	2-3	11-25	242	98	17.6		
P. macracanthus	Deep	3	14-26	141	97	19.9	15-25	--
Priacanthus spp.		2-3	12-26	379	96	18.6	15-25	10-12

C) Bigeyes, *Priacanthus* spp. (Fig. 2-c), (Table 6-c).

Priacanthus tayenus : This species consisted of 2 or 3 different size groups. The common size caught in deep waters is larger than that of shallow waters even though the catch in numbers is almost the same.

P. macracanthus : This species, consisting of 3 different size groups, was caught only in deep waters. The common size (from 14 to 26 cm) was the same as that previously reported.

The relationship between the size and catch suggests that the fluctuation of catch in numbers is very small despite the wide range for common size individuals appearing in the trawl catch (Fig. 3-c).

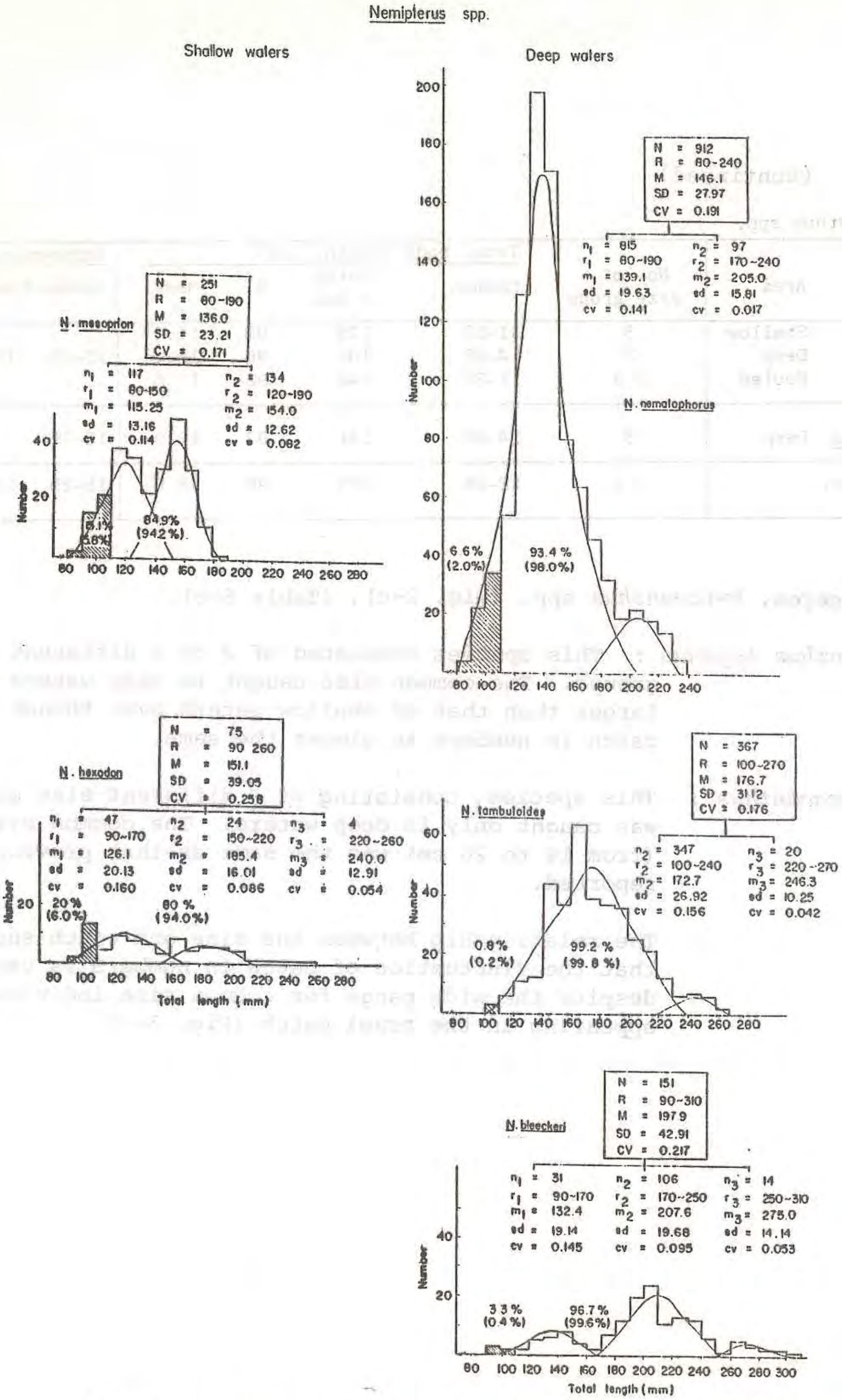

Fig. 2 Length distribution of demersal fish species

a) Nemipterus spp. Shaded parts indicate the proportion of under-recruitment size individuals in numbers and in weight (between parentheses).

Saurida spp.

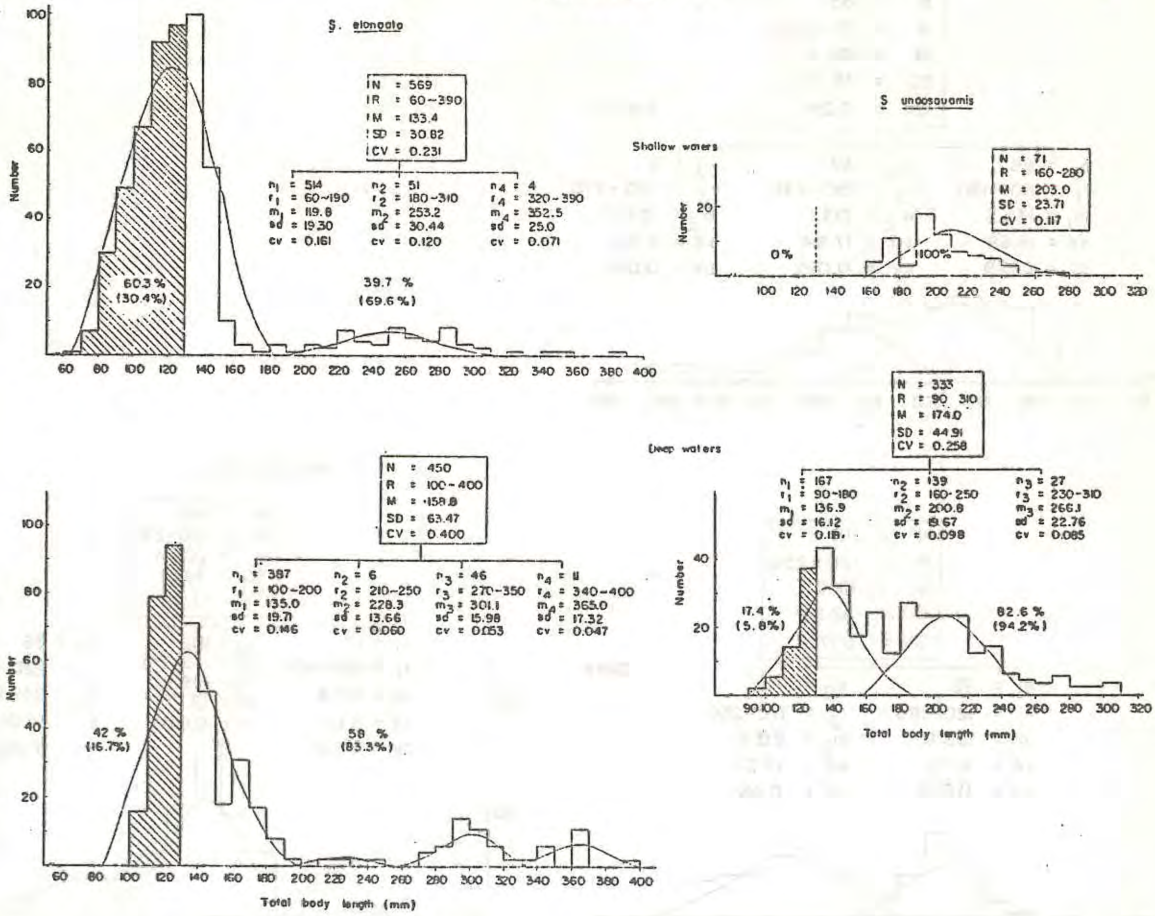

Fig. 2 (continued)
b) Saurida spp.

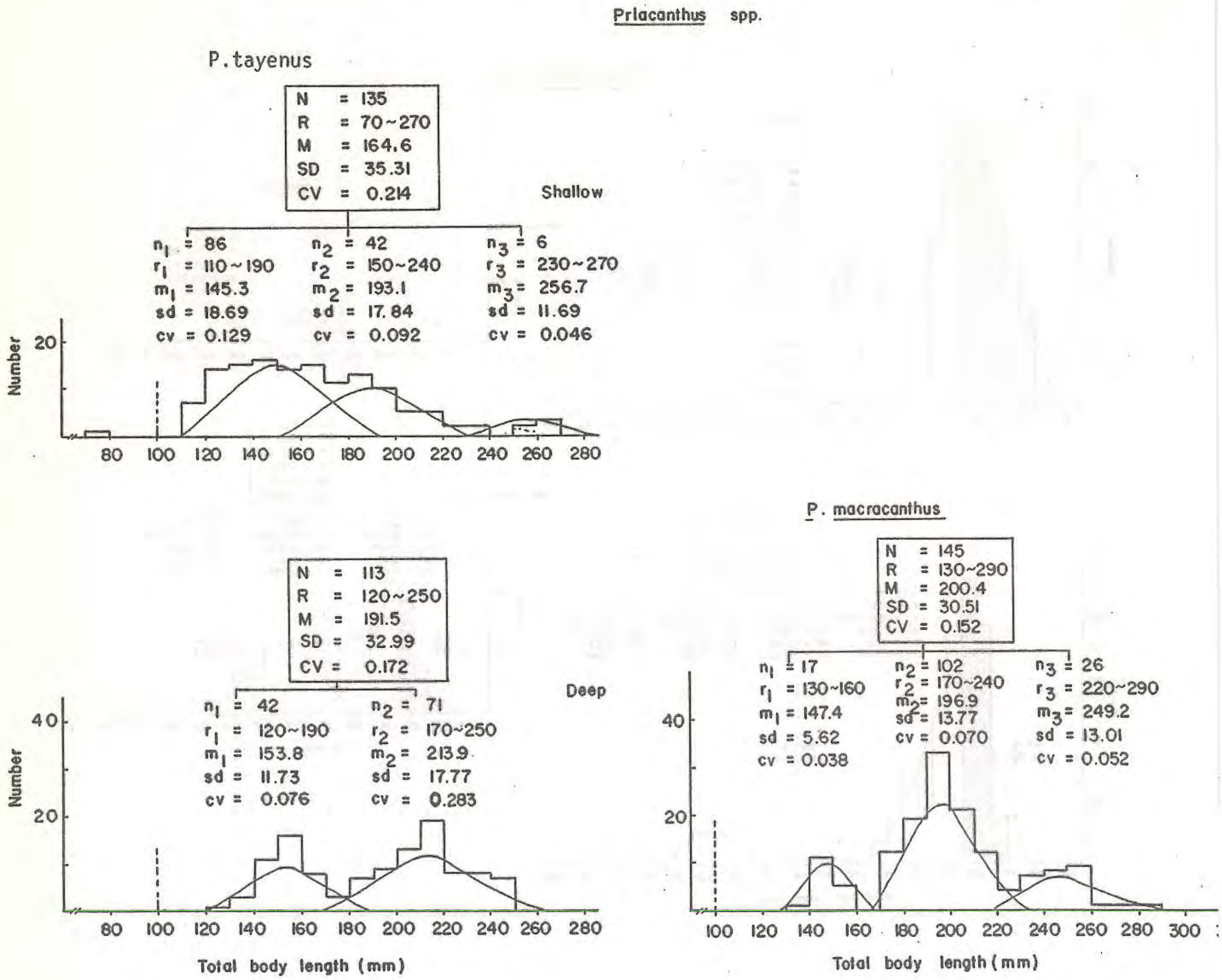

Fig. 2 (continued)
c) Priacanthus spp.

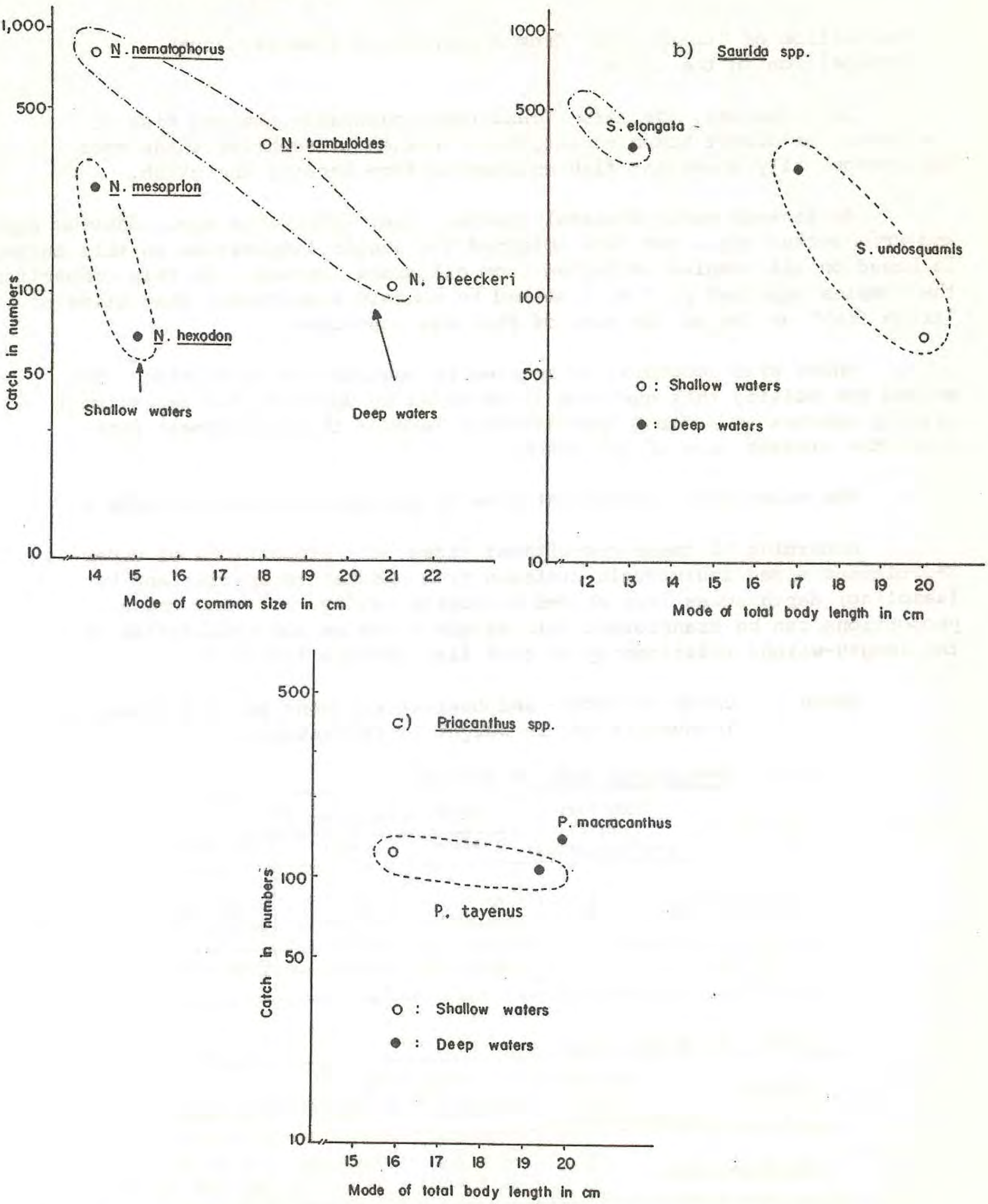

Fig. 3 Relationship between size and number of individuals in catch.
a) Nemipterus spp., b) Saurida spp. and c) Priacanthus spp.

DISCUSSION

1. Definition of "trash fish" from the point of view of length composition in the catch

In fisheries, the term "trash fish" generally denotes fish of low value for direct human consumption. Fishermen separate these from the economically important fish on board before landing the catch.

As regards major demersal species, i.e. *Nemipterus* spp., *Saurida* spp., and *Priacanthus* spp., the data obtained for length composition in this survey is based on all samples collected from all trawl catches. In this connection, the samples appeared in Fig. 2 seemed to contain significant quantities of "trash fish" as far as the size of fish was concerned.

Which size according to species is regarded as trash fish? One method for solving this question is provided by applying the recruitment size by species as a first approximation because the recruitment size means the minimum size of the catch.

The acceptable recruitment size by species is given in Table 6.

According to these recruitment sizes, the proportions of under-recruitment sized individuals differed from species to species and by (sampling) depth zones (see shaded histogram in Fig. 2). And those proportions can be transformed into weight based on the calculation of the length-weight relationship of each fish species (Table 7).

Table 7 Catch of under- and over-recruitment sized individuals, in numbers and in weight as percentages.

A-1) Nemipterus spp. in number

Species	Body Size of recruitment(cm)	Catch in numbers, (%) Shallow	Deep	All areas
Nemipterus spp.	11≥ 11<	53(16.3) 273(83.7)	68(4.8) 1362(95.2)	121(6.9) 1635(93.1)
Pooled		326(18.6)	1430(81.4)	1756(100)

A-2) in weight (kg)

Species	Body Size of recruitment(cm)	Catch in kg, (%) Shallow	Deep	All areas
Nemipterus spp.	11 ≥ 11 <	0.8(5.9) 12.3(94.1)	0.9(1.2) 76.0(98.8)	1.7(1.9) 88.3(98.1)
Pooled		13.1(13.5)	76.9(86.5)	90.0(100)

* Data adapted from Hayase (1983) and recalculated from

$W = 0.027\ L^{2.941}$ W : g, L : cm

Table 7 (continued)

B-1) Saurida spp. in numbers

Species	Body Size of recruitment (cm)	Catch in numbers, (%) Shallow	Deep	All areas
S. elongata	13 ≥	343(60.3)	189(42.0)	532(52.2)
	13 <	226(39.7)	261(58.0)	487(47.8)
A		569(55.8)	450(44.2)	1019(71.6)
S. undosquamis	13 ≥	0(0.0)	58(17.4)	58(14.4)
	13 <	71(100)	275(82.6)	346(85.6)
B		71(17.6)	333(82.4)	404(28.4)
A + B		640(45.0)	783(55.0)	1423(100)

B-2) in weight (kg)

Species	Body Size of recruitment (cm)	*Catch in kg, (%) Shallow	Deep	All areas
S. elongata	13 ≥	4.0(30.4)	3.1(16.7)	7.1(22.4)
	13 <	9.2(69.6)	15.4(83.3)	24.6(77.6)
A		13.2(41.6)	18.5(58.4)	31.7(60.8)
S. undosquamis	13 ≥	0(0.0)	0.9(5.8)	0.9(4.4)
	13 <	5.4(100)	14.1(94.2)	19.5(95.6)
B		5.4(26.5)	15.0(73.5)	20.4(39.2)
A + B		18.6(35.7)	33.5(64.3)	52.1(100)

* Data adapted from Menasveta (1980) and recalculated from

$$W = 0.0175\ L^{2.80} \qquad W: g,\ L: cm$$

The data from Table 7 can be summarized as follows:

1) As the weight of all *Nemipterus* caught, about 5.9 per cent of this species caught in shallow waters and about 1.2 per cent of that caught in deep waters may be included in the "trash fish".

2) Similarly, about 30.4 per cent of *Saurida elongata* caught in shallow waters and about 22.5 per cent of all *Saurida* caught in deep waters may be categorized as "trash fish".

3) The differences in proportion of "trash fish" caught between *Nemipterus* spp. and *Saurida* spp. may be due to differences in their shape (*Nemipterus* spp. have higher body depth than *Saurida* spp.).

4) There is, therefore, a tendency for the *Saurida* spp. caught, especially in shallow waters, to be too small due to an increase in fishing intensity.

2. Evaluation of fish stock and fishing grounds

2.1 Comparison with previous results

The SEAFDEC Training Department initiated a joint survey of the central part of the Gulf of Thailand in 1984, in cooperation with the Thai Department of Fisheries and other research institutes in Thailand, with a view to collect and compile information on fishery oceanography in this area for further study in the future.

The data collected during those surveys were compiled and reported in volume 1, published as research paper series No.4, July 1985.

This study was conducted with the same purpose.

Table 8 gives a summary of the average catch rate (kg/hr) in the same sampling stations between 1984 and 1985.

Table 8 Average catch rate (kg/hr) of demersal fishes collected in each trawling station

Depth zones	Shallow			Deep waters								
Sampling station	St. 223			St. 186			St. 207			Pooled		
Month, Year	May, '84		Nov., '85	May, '84		Nov., '85	May, '84		Nov., '85	May, '84		Nov., '85
NEMIPTERIDAE	4.08	<	6.45	2.88	≪	24.73	10.08	<	18.07	7.64	≪	21.40
SYNODONTIDAE	2.96	<	4.39	2.68	≪	15.67	10.60	>	4.67	7.92	<	10.17
PRIACANTHIDAE	0.64	<	3.48	0.00	<	8.40	13.75	>	5.20	9.09	>	6.80
LUTJANIDAE	1.84	>	0.32	1.71	≪	14.00	7.93	>	5.47	5.82	<	9.73
TRICHIURIDAE	0.32	≪	11.23	0.00	<	2.07	0.00	≈	0.27	0.00	<	1.17
Other fishes	20.60	>	14.45	1.27	≪	27.73	29.95	>	15.20	20.23	<	21.46
All demersal fishes	30.44	<	40.32	8.54	≪	92.60	72.30	>	48.88	50.70	<	70.73
Invertebrates	13.08	≫	2.26	1.66	<	7.27	4.40	>	1.07	3.47	≈	4.17
Trash fishes	420.00	≫	199.48	20.00	≪	126.60	77.50	≫	10.67	58.02	<	68.63
TOTAL RESOURCES	463.52	≫	242.06	30.20	≪	226.47	154.20	≫	60.62	112.19	<	143.53

Shallow waters

In the coastal waters within station 223, the catch rate for all demersal fishes in November 1985 was about 1.3 times higher than that in May 1984. Among major demersal fishes, four genera showed an increase;

particularly TRICHIURIDAE which predominated with 11.23 kg/hr and constituted more than one third of the demersal fishes caught at this station in 1985.

Thus the catch rate for each demersal fish in 1985 showed a slight increase with a small fluctuation by genus.

The catch rates for invertebrates and for trash fishes, on the other hand, were much lower than those of 1984.

It can therefore be concluded that the present stock density of demersal resources in coastal waters is generally decreasing, especially for invertebrates and trash fishes.

Deep waters

In the central part of the Gulf, two trawling stations 186 and 207 showed a distinct contradiction in the catch rate for demersal fish resources between the two years.

The differences are as follows:

(1) In station 186 in 1985, the catch rates for every kind of demersal resource showed a significant increase;

(2) In station 207 in 1985, on the other hand, almost every kind of demersal resource showed a decrease.

We can not readily explain the contradiction between these two sets of data, but it can be inferred that there may be the minutest environmental difference between the fields of the two trawling stations, although these two trawling stations are next door to each other.

It was suggested that, from the rainy season to the dry season, almost every kind of demersal species tends to migrate northward or southward with some monthly variation in migration time (Hayase, 1985).

It should be noted that the 1984 survey was conducted at the beginning of the rainy season (May), while that of 1985 was conducted at the beginning of the dry season (November).

For the average catch rate in the two trawling stations, almost every catch rate in 1985 for demersal resources showed an increase.

It can therefore be concluded that the present stock density of demersal resources in deep waters of the Gulf has an upward trend, so far as the catch rate is concerned.

2.2 Some comments for the evaluation of fishing grounds from the point of view of fish composition and abundance

When the value of a fishing ground is evaluated, the most important components are the quality and the quantity of fish as a commodity for auction at landing sites.

Table 9 gives some information, about fish as a commodity, which can be inferred from the results of this study.

Table 9 Common size (l_c cm) in catch, average weight ($\bar{w}_c$ g) of individual at common size, total catch (W_i kg) in each fish group, proportion (C_i %) of total catch, auction price (P_i baht/kg) and proportion of total production (V_i %) in terms of auction price, which can be inferred from the trawl catch at different depth zones in this survey. The top line indicates each value in shallow waters. and the bottom line indicates that in deep waters.

mily/ Group	l_c[1]	$\bar{w}_c$[2]	W_i	C_i	P_i[3]	V_i	C_iV_i	$\frac{C_iV_i}{\Sigma C_iV_i}$	Rank A[4]	Rank B[5]	Rank Food processing
Nemipteridae	13.5	45	12.3	1.1	9.0	4.5	4.95	1.6	5	12	Fish ball, Fresh
	16.0	56	78.2	7.3	11.1	5.5	40.15	13.2	③	3	(large-size)
Synodontidae	13.5	49	14.6	1.4	4.0	2.0	2.80	0.9	6	13	Salted, Dry, Fish b
	14.8	55	29.5	2.8	5.0	2.5	7.00	2.3	⑦	11	
Priacanthidae	15.9	60	8.6	0.8	5.0	2.5	2.00	0.7	8	15	Fish ball
	19.7	113	29.1	2.7	6.5	3.2	8.64	2.8	⑥	10	
Lutjanidae	20.0	278	2.5	0.2	26.0	12.9	2.58	0.8	7	14	Fresh
	30.0	1092	29.5	2.8	35.2	17.4	48.72	16.1	②	2	
Trichiuridae	70.0	93	27.4	2.6	10.0	5.0	13.00	4.3	4	9	Fish ball
	90.0	146	3.5	0.3	12.0	5.9	1.77	0.6	⑧	16	
Other fish	-	-	28.9	2.7	15.0	7.4	19.98	6.6	2	6	--
	-	-	76.3	7.1	20.0	9.9	70.29	23.2	①	1	
Invertebrates	-	-	34.5	3.2	10.0	5.0	16.00	5.3	3	7	--
	-	-	15.5	1.4	30.0	14.9	20.86	6.9	④	5	
Trash	5-10	-	449.2	41.9	1.5	0.7	29.33	9.7	1	4	Fish meal, Food for
	5-10	-	233.0	21.7	1.5	0.7	15.19	5.0	⑤	8	cultured fish and sl
Sub-total Shallow			578.0	53.9	80.5	40.0	90.64	29.9			
Sub-total Deep			494.6	46.1	121.3	60.0	212.62	70.1			
Total			1072.6	100.0	201.8	100.0	303.26	100.0			

[1] Estimated from Fig. 2

[2] Recalculated from Catch in weight(g)/ Catch in numbers

[3] Source : Fisheries Record of Thailand 1983 by the Department of Fisheries, Mimistry of Agriculture and Cooperatives, Thailand.

[4] Rank within shallow and deep(o) waters in this survey

[5] Rank in all trawling stations in this survey

Figure 4 gives a graphic description of the current situation of fishing grounds (shallow and deep waters covered during this survey) based on the data in Table 9.

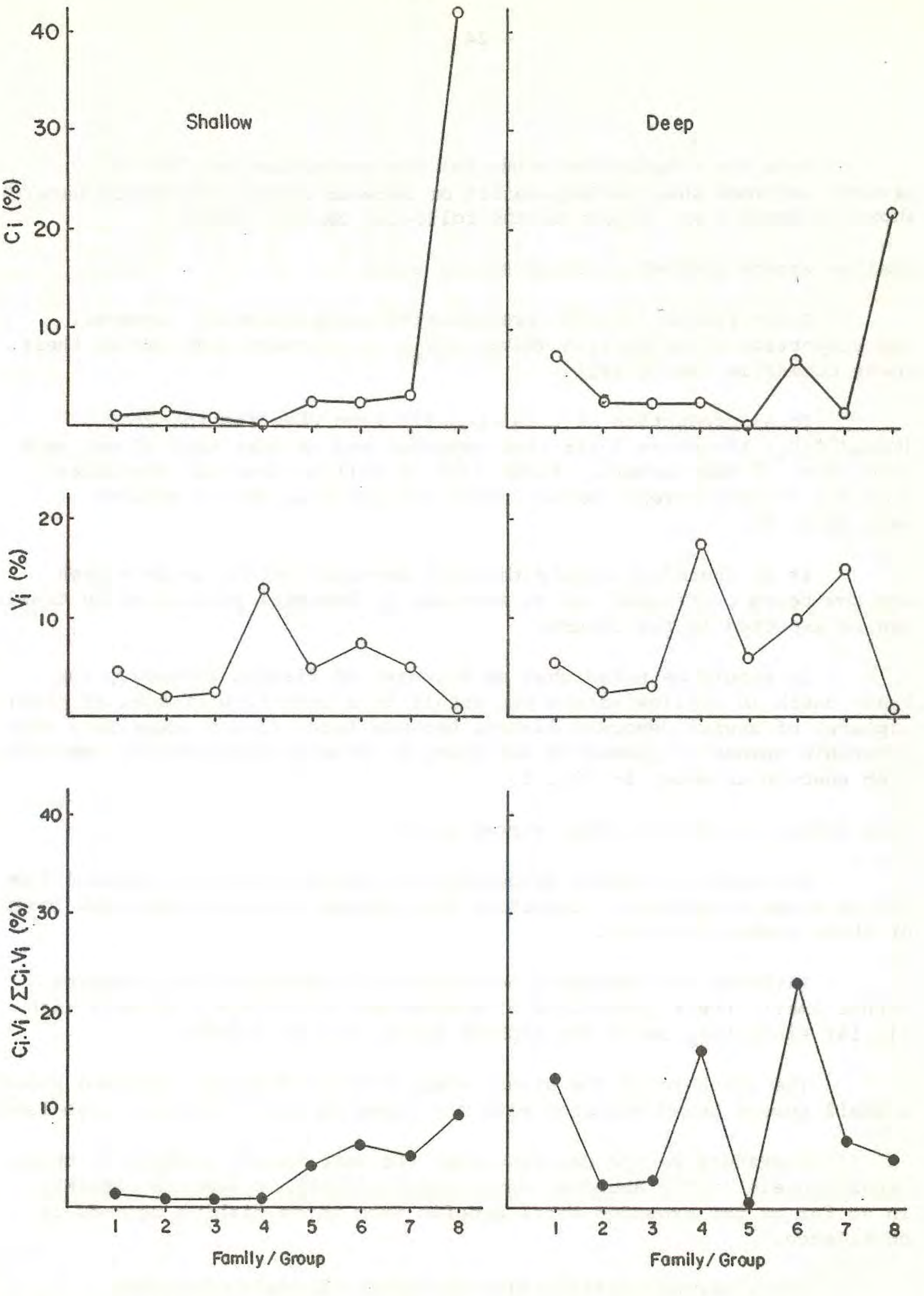

Fig. 4 Weighted proportion of production ($C_iV_i/\Sigma C_iV_i$) by trawl catch both in shallow and deep waters in this study. The production is calculated from frequency occurrence (C_i), price (V_i) of each fish group at auction. Symbols Σ refer to the sum of each family group, which are numbered from 1 to 8.

From the comparative study for the evaluation on fishing grounds (between shallow/deep waters or between coastal/off shore waters) shown as Table 9 and Figure 4, the following can be inferred.

Shallow waters covered in these survey areas

Trash fishes (Code 8) predominated conspicuously. However, the proportion of production ($C_8V_8/\Sigma C_iV_i$) is not very high due to their lower commercial value (V_8).

Total production or total benefit from this fishing ground ($C_9V_9/\Sigma C_iV_i$) therefore lower than expected and is more than 50 per cent below that of deep waters. Trash fish as well as demersal resources showed a downward trend compared with the previous year's results (see Table 8).

It is therefore likely that all demersal stocks in this area are now being overfished and no increase of demersal production by trawls can be expected in the future.

It should be noted that an increase of fishing intensity for trash catch in shallow waters may result in a reduction of age, at first capture, of useful demersal fishes, because trash fishes comprise a considerable number of juveniles and young of several economically important fish species as shown in Fig. 2.

Deep waters covered in these survey areas

Generally, a higher production or benefit could be expected from two or three economically important fish groups such as LUTJANIDAE (code 4) or other fishes (code 6).

Although the frequency occurrence of LUTJANIDAE (C_4) appears rather small, their proportion of production ($C_4V_4/\Sigma C_iV_i$) is very high (16.1%) since they reach the highest price (V_4) at auction.

The catch rates for almost every kind of demersal resource showed a small upward trend compared with the previous year's results (see Table 8).

Therefore we can conclude that the deep waters covered in these areas contain fairly abundant economically important demersal stocks, in so far as the expected total benefit from those fishing grounds is considered.

Since certain difficulties in trawl net towing have been recognized due to rough bottom conditions, as a result of this and a previous survey (Hayase, 1985) (see trawling station 273, Table 1), it has been concluded that it is advisable to use other gears and not trawl for catching demersal fishes in the deep waters of the Gulf of Thailand.

SUMMARY

This paper discusses the evaluation of demersal stocks and fishing grounds in the survey areas. The data were collected during the Thai-SEAFDEC joint survey on board M.V. PAKNAM, from 19 to 28 November, 1985. The results can be summarized as follows:

(1) Demersal fishes caught by trawl were classified into major genera and species groups in accordance with their occurrence in the catch as far as both weight and number were concerned.

(2) In shallow waters, the major group in catch composition was trash fish. Whereas, in deep waters, commercially important demersal fishes were predominant.

(3) Length composition appearing in trawl catch revealed that almost every demersal catch comprised a great number of small-sized or young fish, which generally landed as "trash fish".

(4) General remarks for the evaluation of demersal stocks and fishing grounds were discussed from the point of view of fish composition and abundance, and it was concluded that the deep waters in these survey areas seem to be fairly good fishing grounds, however, the effective area for trawling is limited to only a small part of the survey areas.

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