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Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal

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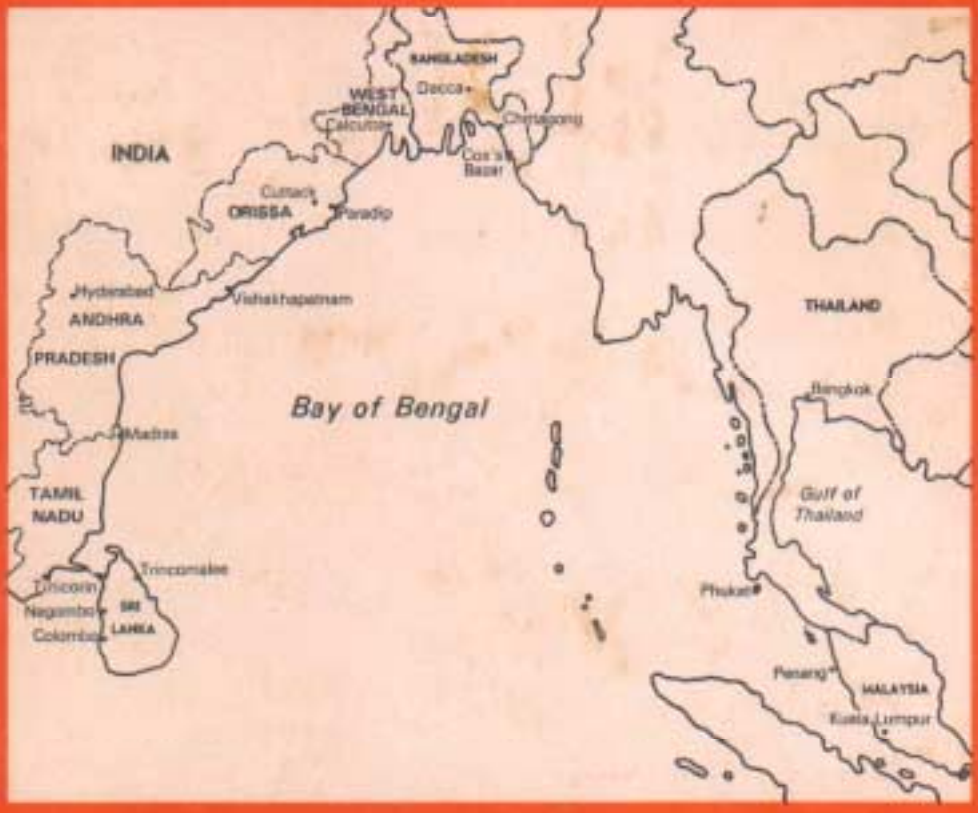

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FOOD AND AGRICULTURE ORGANIZATION
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BAY OF BENGAL PROGRAMME BOBP/REP/10.2
Development of Small-Scale Fisheries (GCP/RAS/040/SWE)

Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal

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PREFACE

This document is the second part of the report of a consultation on stock assessment for small-scale fisheries in the Bay of Bengal, held in Chittagong, Bangladesh, June 16-21, 1980. Fourteen fisheries scientists from the five member-countries of the Bay of Bengal Programme (BOBP) — Bangladesh, India, Malaysia, Sri Lanka and Thailand -took part in the consultation, along with BOBP staff and observers.

The document contains the complete texts of status papers prepared for the consultation by scientists in the member-countries. The papers have not been edited, and in content and composition fully reflect the views of their authors rather than of the FAO, the BOBP, or of the member-countries of the BOBP.

Fisheries scientists concerned with stock assessment, planners responsible for fisheries management and development, and officials concerned with small-scale fisheries development in general, may find this report useful.

The consultation was an activity of the Bay of Bengal Programme for the Development of Small-Scale Fisheries, referred to in brief as the Bay of Bengal Programme. This is a regional FAO programme that seeks to develop and demonstrate appropriate technologies and methodologies in several areas of small-scale fisheries — such as fishing craft, fishing gear, fish handling and utilisation, coastal aquaculture. The programme's goals are to improve the conditions of small-scale fisherfolk and the supply of fish from the small-scale sector. The BOBP is funded by the Swedish International Development Authority and executed by the Food and Agriculture Organisation of the United Nations.

STOCK ASSESSMENT CONSULTATION
Volume 2

BANGLADESH
Status Paper on Coastal Fishery Resources

by

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ABSTRACT

Coastal fisheries of Bangladesh have been described with reference to location, area and physico-chemical characteristics of coastal water, potential fishing grounds, extent of standing stock, yield, species composition, method of exploitation, fishing efforts, methodology of stock assessment and catch statistics with reference to vessels, gear and time.

Coastal area of Bangladesh is 37,000 km^2 lying between Lat. 20.4ºN and 22.0ºN,and Long. 89ºE, which is no deeper than 50 m. Potential fishing grounds as have been charted by a resource survey are (i) South Patches (20.8ºN - 21.4ºN and 90ºE - 91 ºE), (ii) Middle Ground (20.82ºN - 21.65ºN and 91ºE - 91.8ºE), (iii) Swatch of no ground (21.0ºN - 21.6ºN and 89.0ºE - 91ºE). The standing stock of the Bangladesh continental shelf has been estimated to be 552,500 tons (318,500 tons demersal fish, 200,000 tons pelagic fish, 9000 tons crustaceans and 25,000 tons others). Annual yield from the coastal waters has been estimated at 100,000 tons comprising 475 species of finfish and 25 species of shrimps. Of the total yield, 95% comes from small scale fishing and the rest from trawl catch. Dominant species of the catch by groups are catfish, Indian salmon, Bombay duck, shark and skates, jew-fish and eels. A total of 45,200 indigenous fishing boats and 1156 mechanised fishing boats are operated in the coastal belt of Bangladesh by about 156,000 fishermen directly engaged and 92,000 fishermen indirectly engaged in fishing. At present 17 trawlers are being operated by BFDC and 75 trawlers under joint venture with Thailand.

CONTENTS

		Page
1.	Introduction	1
2.	Methodology for collection of catch statistics and the organizational set-up for collection and processing of catch statistics	9
3.	Catch statistics with reference to species, seasons, areas, types of vessels and areas and fishing effort in hours	9
4.	Method of stock assessment employed, if any, and the results obtained	11
5.	Basic biological characteristics of major exploited coastal fishes and shrimps	14
6.	Yield trends over the years against fishing effort	15
7.	Conclusion : (problems/constraints and solutions)	18
	References	20

Abbreviations used:

(i) B.F.D.C. : Bangladesh Fisheries Development Corporation

(ii) B.J.M.S.S. : Bangladesh Jatiya Matshaya-Jibi Sambaya Samiti (Bangladesh National Fishermen's Co-operative Society)

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1. Introduction

Bangladesh is endowed with vast marine and inland waters having high fisheries potential. The Republic has a 480 km long coastal line on the Southern Zone of the country and approximately 1.0 million hectacres of territorial water extending up to 19 km up to the sea. The nation's economic zone extends 320 km out to the sea from the coast line. Geographically the entire coastal area lies within Lat. 20.4ºN - 22.0ºN and Long. 89.0ºE-92.0ºE.

The continental shelf of Bangladesh covers an area of 69,900 sq.km., of which 37,000 sq.km. is no deeper than 50 m. The bottom materials of the waters up to 40 m depth are mostly alluvial silt and mud. Sand bottom occurs in deeper waters. These waters are relative!y rich and contain high oxygen (4.8 ppm at the surface and 4.0 ppm at 35 m depth), carbohydrates, nitrates and plankton, but relatively low salinity (17 - 18 ppt. in monsoon and 31 ppt.'in the dry season). The coastal waters are usually turbid due to suspended particles carried by the rivers and due to wave action. The salinity and turbidity are influenced by the inflow of the Ganges system.

The coastal water of Bangladesh is one of the most productive zones in the world and is rich in fish, shellfish and other aquatic resources. The estimated standing stock of Bangladesh continental shelf is on the average 552,500 m tons, i.e. 264,000 - 373,000 m tons of demersal (West, 1973). 200,000 m tons of pelagic (Karim, 1978b), 9000 m tons of shrimp (West, 1973) and 25,000 m tons of others (Anon, 1974b). A survey conducted under UNCF/PAK-22 Project in 1967-68 (Anon, 1972) reveals that sustainable yield of 57,000 m tons of demersal fish are available for exploitation in addition to the present catch of approximately 100,000 m tons per annum.

The economy of the country is predominantly agricultural and the people depend largely on fish for animal protein, An average person requires about 25 grams of animal protein, but in Bangladesh per capita consumption of protein is hardly one third of the requirement and more than 80% of animal protein intake comes from fish alone. A review of the current literature on nutrition reveals that the average per capita consumption of fish intake has fallen from the 1962 level of 32.8 gms to 22.3 gms in 1976. The continental shelf of the country is almost 5 times the perennial inland waters. The ecology of the inland waters, particularly open waters, has been disturbed due to human interference like construction of irrigation and flood control structures, indiscriminate use of insecticides, etc. And due to heavy fishing pressure with increase of demand as a result of rapid population influx, the inland fisheries are on the verge of decline or have declined. On the other hand, the vast marine waters are virgin with untapped fisheries resources. With proper scientific management, the marine fisheries may make a significant contribution to animal protein supply and to the economy of this country by earning foreign exchange.

In this respect the development of small-scale coastal fishery which contributes about 95% of total marine catch, along with the development of deep sea fisheries, is of prime importance. It is possible to develop small-scale fisheries with less investment and effort, with which the fate of thousands of fishermen are linked. For development of the small-scale fisheries, knowledge on the present status of the fisheries is essential but this information is scanty and what is available is not properly presented and compiled. An attempt has therefore been made in this paper to present and compile the available information of the marine fisheries with particular reference to small-scale fisheries and its development.

1.1 Method of exploitation

Two principal methods of exploitation of coastal and off-shore waters are in practice at present: (i) Exploitation by traditional boats (non-mechanized and mechanized) at small-scale level and (ii) by trawlers at large-scale level. Three types of traditional fishing craft namely *Dinghi,*

Chandi and *Balam* are used in estuarine and marine waters of Bangladesh. The type *Balam* is exclusively used for marine waters, while the *Dinghiand Chanditypes* are used in both estuarine and marine (inshore) waters.

(a) *Dinghi:* A plank-built shallow boat about 6 m - 8 m long, 1.0 m - 1.5 m wide, and 0.75 m - 1.5 m deep with pointed bow and stern. There are ribs and cross-beams to strengthen the hull. The decking consists of detachable and half split bamboo. They are propelled by long oars and/or by sail. A dinghi costs about Taka 2,000. It is operated by 2-3 persons. A large quantity of seine net is generally operated by a dinghi.

(b) *Chandi:* This is also a plank-built boat. Its length varies from 5 m to 26 m, beam from 1 m to 3 m and depth from 1.0 m to 1.5 m. It has a stern slightly higher than the bow. Part of the vessel is decked with planks; the rest may be decked with split bamboo. The mast is far forward and carries usually a square sail. It carries a crew of 7 to 15 people and is used extensively for laying *Chandi* jal (drift gillnet) for catching *Hilsa.*

(c) Balam: The hull is a dug-out. The bow and the stern are slightly raised. The sides are built up by fitting planks to the dug-out. These planks are tied with "rattan" and made water tight by plugging the joints with weeds; this is renewed every year. A small balam has no deck or hood. The bamboo mast carries a square sail. A large balam is 15 m to 20 m long, the medium ones are 10 m to 15 m. These boats are used for operating big *behundi* nets (fixed purse net-set bag nets) by the Chittagong fishermen and operated in the open sea off Cox's Bazar and Dubla Island. The number of crew varies from 10 to 20 according to the size of the boat.

(d) *Motorized traditional boats:* These crafts are usually of the Cox's Bazar type (balam) of a length between 12 m and 14 m, equipped with 15-23 hp engines. They mainly use gillnets, but also operate the *behundi* and/or *funda* nets. They carry 100 pieces of gillnets of a total length of 1,400 m on average. The number of crew is 8.

(e) Trawlers: The Bangladesh Fisheries Development Corporation at the moment owns a fleet of 17 trawlers. The particulars of these trawlers are given in Table 1.1.1.

Table 1 .1 .1

Particulars of trawlers owned by BFDC

No. of trawlers	Length of trawler (in metres)	Made in
1	17.7	Holland
2	18.3	U.K.
5	25.0	Thailand
3	27.0	U.S.S.R.
1	27.5	Thailand
3	30.5	Denmark
1	44.0	U.S.S.R.
1	44.0	Thailand

Since liberation in 1972, the Government has sanctioned so far about 140 trawlers for operation in the Bay of Bengal by private sector and the joint venture with other countries.

Gillnets, castnets, stakenets, set-bag nets, seines and longlines are common nets, of which, *Behundi* (bag nets) and *Funda* (stake nets) are largely used in coastal fishing.

(a) *Behundi net:* This is a fixed bag net with a 15 m · 30 m circular mouth. Wings are often attached on the two sides of the mouth which increase the total fishing areas of the nets. The net tapers from its mouth and ends in a bag 25 m to 30 m from the mouth. The mesh size decreases continuously from the mouth to the bag and the bag is of fine mesh (½" · 3½"). The mouth of the net is kept open by two vertical bamboo poles. The net is fixed by tying the two ends of its mouth to wooden poles driven into the bottom. Thus fish, which come with the current (tide), enters into the mouth and ends up in the bag. A *behundi* net has a life span of about 5 years, and costs Taka 2,500 to 10,000 depending on the size.

(b) *Funda net:* A *Fonda* net is 55 m long and 3 m · 4 m deep, with 10 cm meshes. It is a stake net used off Chittagong in the open sea from November to March for capturing *Bhekti* (Cock-up) and *Lukwa* (Indian salmon). The price of a *funda* net is in the order of Taka 6,000 and has an average life-span of 5 years.

1.2 Annual catches

A survey (1972) estimated the marine fish catch (excluding the estuarine catch) at 100,000 tons. Ninety-five per cent of the total marine catch is harvested from the near shore waters by small-scale fishermen, many of them fishing without boat. Presently l-5 per cent of the total marine catch is harvested from the deeper waters by trawlers operated by BFDC and private parties and Thai-Bangladesh joint ventures.

7.3 *Species composition*

A total of 475 species of fishes and 25 species of shrimps have so far been identified from the marine waters of Bangladesh.

The quantitative estimation of the marine catch as a whole,species-wise, is not available. However, some statistics on the catch composition of BFDC trawlers, mechanized boats operated in the Cox's Bazaar zone, and stock assessment study data of the Irrigation Fisheries Development Project are represented in Table 1.3.1, 1.3.2 and 1.3.3 respectively.

Table 1.3.1

Percentage composition of the BFDC trawler catch

Group Name	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80 (up to March)
Mixed small fish	75.80	68.20	72.70	56.46	73.50	62.16	*44.96*	*39.58*
Sharks, skates, rays	3.60	3.52	5.20	*3.89*	6.01	3.50	5.87	5.25
Shrimp	0.80	0.80	0.70	0.58	0.22	2.42	0.89	1.89
Indian salmon	5.80	4.52	2.40	1.83	1 .45	4.33	4.91	1.09
Pomf ret	1.20	1.62	0.80	0.31	1 .00	0.76	1.59	1.27
Eel	3.60	3.80	3.60	4.15	4.20	5.40	3.59	1.40
Grunter, Croaker, Grouper, Red Snapper	4.87	5.20	5.10	1.18	1.82	2.34	2.50	1.08
Cat fish	2.40	7.14	8.50	22.00	5.53	14.60	25.69	37.32
Mixed big fish	1.93	5.20	1 .00	9.60	6.27	4.49	10.10	11.12
Grand Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Catch (Tons)	4766	2616	4034	1218	1356	1400	1100	1377

Source : BFDC

Table 1.3.2

Important species of fishes and shrimps caught by the research vessel Machhranga from the Meghna river estuary and the Bay of Bengal during 1977-78

Name of the species	Weight (kg)
Fishes	
Arius serratus	30.49
Muraesox Cenereus	23.20
Harpodon nehereus	14.77
Pangasius pangasius	4.64
Osteogehesis militaris	3.08
Pama pama	2.62
Sillaginopsis panijus	1.77
Arius Caelatus	1.20
Scoliodon walbeehmi	0.74
Trichiurus hanmela	0.45
Tachysurius gagora	0.37
Polydactylus indicus	0.32
Prawns	
Palaemon temuipes	1.49
Macrobrachium mirabilis	1.23
Palaemon styliferus	0.29
Parapenaeopsis sculptilis	0.26
Palaemon sp.	0.14

Source: Kibria and Rainboth, 1978 (data unpublished).

Table 1.3.3

Comparative statement of species-wise catch of mechanised boats at Cox's Bazar (% of weight)

Name of species	1967-68	1968-69	1969-70	1970-71	1971-72
Hilsa ilisha	12.75	14.40	24.00	30.24	31.52
Hilsa kanagurta	05.62	04.20	08.10	07.30	05.70
Stromateus cinereus					
Stromateus chinensis					
Parastromateus niger	09.83	03.80	11.20	12.74	08.18
Cybium guttatum	20.80	15.60	14.00	10.21	10.00
Chirocentrus dorab	08.05	07.00	06.20	06.78	07.51
Chorinemus lysan	03.50	06.90	03.20	02.80	04.80
Jew fish	01.30	03.30	01.40	01.31	03.16
Sharks and Rays	14.75	14.70	04.90	00.84	00.30
Others	23.40	30.10	27.00	27.77	28.83
Total	1 00.00	100.00	100.00	100.00	100.00
Total catch (tons)	467	685	607	594	574

Source: BFDC

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1.4 Commercial catch and effort data

Fishing effort can be described and measured by the following (Chong, 1979) :

(a) Types and number of boats and their capacities (length).

(b) Types and number of gear and their catching power.

(c) Number and skill of fishermen.

(d) Time spent in fishing.

1.4.a *Types and number of boats:* A survey carried out by BFDC (Bangladesh Fisheries Development Corporation) in collaboration with FAO/UNDP in 1967-68 indicated that about 9,563 sail boats and 41 mechanised boats were employed in the marine small-scale fisheries all along the coast of the country of which 2,170 were simple dug-out canoes and others were planked vessels of different types. Mechanization programmes became popular and at present about 1,400 mechanised boats operate all along the coast of the country but largely from bases at Cox's Bazar and Chittagong (Ali and Haque, 1980).

Another survey conducted by BJMSS (Bangladesh Jatiya Matshayajibi Sambaya Samity-Bangladesh National Fishermen's Cooperative Society) in 1974-75 gave an estimate of 45,199 non-mechanised boats and 1156 mechanised boats operating in the estuarine and marine waters (Table 1.4.1).

Table 1.4.1

Statistics of fishing crafts used in estuarine and coastal fishing

Fishing implement	1967/68[1]	1974-75[2]
Boats		
Total number	9563	46,355
Dugouts	2170 }	45,199
Planked boats	7352 }	
Motorized boats	41	1,156
Trawlers		203
25-50 ft.		3
51 -70 ft.		4
71-100 ft.		4
Above 100 ft.		9

Note: (1) Data relates to marine fisheries only.
(2) Data relates to both estuarine and marine fisheries.
(3) 1976 figures.

Source: BFDC and BJMSS

1.4.b *Types and number of gear and their catching power:* Six types of gear (gillnets, castnets, stakenets, setbag nets, seines and long lines) are used in the small-scale coastal fishery, of which setbag nets *(Behundi)* and stakenets *(Funda)* are largely used. All the six types contribute to a total of 22,905 pieces of different gears as detailed in Table 1.4.2. Among the gear types, setbag was found to be the most important fishing gear yielding more than 42% of the total marine catch. Set and drift gillnets were responsible for 33%, while seine nets, longlines, and castnets account for 7%, 6% and 6% respectively.

According to the survey conducted by BJMSS in 1974-75, a total of about 758,497 pieces of different types of nets are being used to fish in the riverine, estuarine and coastal areas of Bangladesh.

Table 1.4.2

Statistics of Gear used in coastal fishery

Fishing implements	1967 /68 pieces of gear	Total catch (tons)	Percentage of total catch
Gear Total	22,905	93,119	100.0
Gillnets	4,878	32,670	35.1
Setbag nets	4,808	41,580	44.6
Cast nets	4,906	5,643	6.0
Seine nets	2,601	7,227	7.8
Longlines	2,215	5,940	6.4
Miscellaneous	3,497	59	0.1

Source; BFDC and BJMSS

The catch figures per fishing unit per day are not available for the coastal fishery. However, some data from the Feni river estuary and Halda-Karnafuli river estuary are available from the survey results of the Irrigation Fishery Development Project of the Directorate of Fishery under the "Fishermen Economic and Catch Assessment Programme" (Table 1.4.3).

Table 1.4.3

Commercial catch and effort data of the Feni and Karnafuli river estuary (1967-68)

	Average daily catch (kg) per fishing unit	Fishing effort			Species composition	
		Hrs. per day	Days per week	Weeks per year		
Feni	9.79	7.0	6.56	38.08	Hilsa ilisha	71%
					Macrobrachium sp.	17%
					Setipinna sp.	2%
Karnafuli	6.13	11.10	6.33	44.33	Macrobrachium sp.	76.6%
					Miscellaneous varieties	23.4%

Source: Morris, 1977

1.5 Resources Survey by National/International Agencies

Several surveys have been conducted to estimate the resource potential of the Bay of Bengal. These are :

(1) Japanese research vessel Chosuimaru belonging to the Fisheries Training School of Nagasaki prefecture, Japan, in November-December, 1958.

(2) Japanese research and survey vessel Kagawamaru in the first three months of 1960.

(3) Investigation by Japanese vessel Kinkimaru during December 1961 to December 1965.

(4) The research vessel Anton Brunn visited the Bay of Bengal in April 1963, in connection with the international Indian Ocean Expedition.

(5) The research vessel Jalwa of the then Pakistan Marine Fisheries Department with the help of a FAO expert under the technical assistance programme from 1962-1966.

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(6) Pre-investment survey by research-cum-survey *vessel Sagar Sandhani* and *Meen Sandhani* under the United Nations Special Fund Assistance (1968-1971) known as Fl: SF/ PAK-22(FAO).

(7) U.S.S.R. research vessel *Lesoni* from November 1969 to January 1970.

(8) investigations by U.S.S.R. research *vessel Tamanog* and *SRTM* 8-449 from June, 1972 to November 1972.

(9) R. V. Fisheries Research 2 of Thailand from 7th March to 19th March, 1979.

(10) R. V. Dr. Fridtjof Nansen under FAO/NORAD Programme during November-December, 1979.

Among the surveys that have been conducted, the most comprehensive one was the UNSF/ PAK-22 Project conducted by Bangladesh Fisheries Development Corporation in collaboration with FAO/UNDP (1968-71). The survey covered an area of about 26,000 km^2 mostly north of latitude 20º40'N (St. Martin's Island).

As a result of this survey three major fishing grounds could be charted in the Bay of Bengal viz. (1) South Patches (6,200 sq.km) lying between 20.8ºN - 21.4ºN and 90ºE - 91°E; (2) Middle Ground (4,600 sq.km) between 20.82ºN - 21.65ºN and 91 ºE - 91.8ºE; (3) Swatch of no ground (3,800 sq.km) between 21 .0ºN - 21.65ºN and 89ºE - 90ºE (Illus. 2). Of the three fishing grounds, the South Patches was found the most productive with an estimated standing stock of 11.4-16.0 ton per square mile followed by 10.2-l 4.4 ton in the Swatch of no Ground, and 8.4-l 2.0 ton in the Middle Ground (Table 4.2).

Another survey was undertaken by Norwegian research vessel *Fridtjof Nansen* during November-December 1979 which covered the area between 10 m and 200 m depth of the Bay of Bengal. According to this survey the shelf area of Bangladesh is estimated to be about 40,000 km^2 (10 m - 200 m depth) as shown in Table 1.5.1.

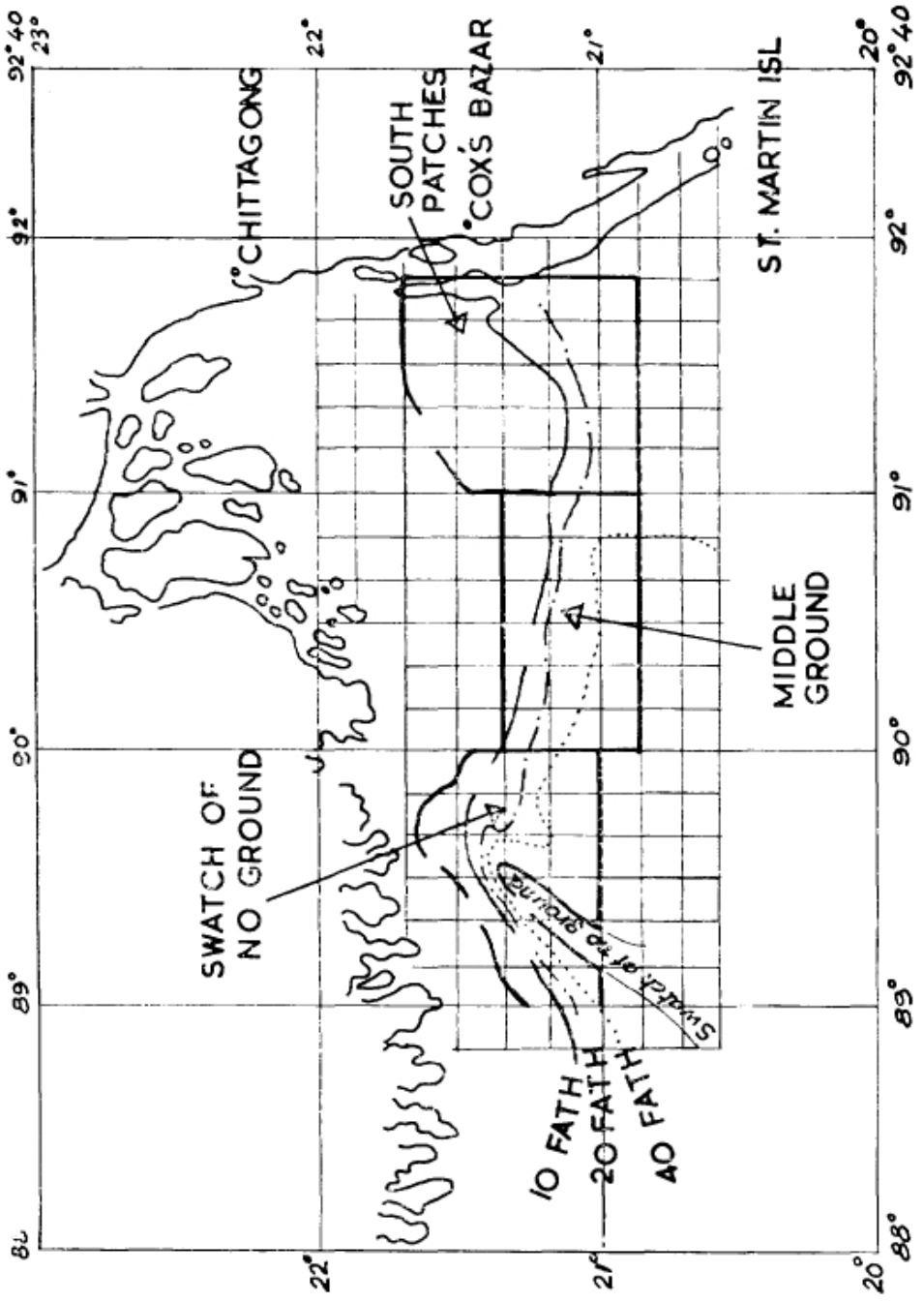
Table 1.5.1

Area of the shelf of Bangladesh (km^2)

Depth zones	Area
10-24	8,400
25-49	4,800
50-74	5,580
75-99	13,410
100-199	10,250
Total	42,440

Source: Chowdhury *et al. (1979)*

The maximum average catch rates of 672 kg/hr occurred during this survey at 50-74 m depths. The highest densities of demersal fishes were observed off Cox's Bazar at 20-30 m depths and along the north eastern edge of Swatch of no Ground between 60 and 100 m depths. The dominant species in the area off Cox's Bazar were catfish and Bombay duck, *Harpodon nehereus.* In the depth zone 10-24 m, the catches were dominated by croakers, *Scianidae* sp., catfish and Bombay duck. Catfish and croakers were also among the important species at the 25-49 m depth zone. At 50-74 m depth, catfish contributed about 75% of the catch. This was mostly due to one large catch of 4000 kg/hr. At 75-99 m depth, the contribution of catfish to the total catches decreased sharply and the most important species appeared to be threadfin bream, *Nemipterus japonicus,* followed by bigeye, *Priecanthus hamrur,* and lizardfish, *Saurida* spp. At depths deeper than 100 m, these species also dominated the catches.



ILL 2 MAIN FISHING GROUNDS IN THE BAY OF BENGAL

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The highest concentrations of pelagic fishes were found in approximate position N 20º15', E 91º20', which consisted of Indian mackerel, Rastrelliger kanagurfa. At depths of 10-24 m, most of the pelagic fish catches consisted of members of the clupeidae and Engraulidae families with Sardine/a fimbriata and Setipinna taty as dominant species. The most abundant species down to 75 m depth was Carangoides malabaricus while round scad, Decapterus maruadsi were dominant at 75-100 m. At depths deeper than 25 m, Ilisha megaloptera dominated catches of the clupeidae family. The most abundant species of the Scombridae and Leiognathidae families were Rastrelliger kanagurta and Leiognathus bindus respectively. Lantern fishes of Myctophidae dominated the pelagic trawl catches over bottom depths of more than 150 m.

The survey indicated that the standing stock of demersal fishes off Bangladesh is 150,000 tons and of pelagic fishes about 60,000 tons. The estimate is probably too low, as a large part of the shelf which is shallower than 10 m was not surveyed.

1.6 ***Organic productivity***

Data on the organic productivity is not available as no surveys were made to determine the productivity of the Bangladesh coast.

2. Methodology for collection of catch statistics and the organisational set-up for collection and processing of catch statistics

The Directorate of Fisheries and the Fisheries Development Corporation are responsible for development, management and conservation of the fishery resources of Bangladesh. But no systematic method has so far been employed by these organisations for collection of catch statistics of the country. However, data on fish catch and landing for some particular fishery or region are collected by these organisations on a regular basis or on a sampling basis. Fish landing at Cox's Bazar from the catch in coastal waters and the Hilsa landing at Chandpur and Goalando are recorded regularly by the BFDC and the Directorate of Fisheries respectively. The catches of trawlers operated by BFDC in the Bay of Bengal are recorded and processed. Besides, catch statistics are sometimes collected for specific fisheries or regions from the study of fishing gear on sampling basis.

3. Catch Statistics with reference to species, seasons, areas, types of vessels and areas and fishing effort in hours

3.1 Catch statistics with reference to vessels and effort: According to the survey made by ***Jalwa*** (76 feet) in the Bay of Bengal (3-32 fathom), the catch per haul per hour along with the catch composition during the year from 1963-1966 for all seasons of the year, is as follows :

Table 3.1 .1

Catch rates of "Jalwa"

Year	Maximum catch per haul	Average catch per hour	Species composition	
1963-64	**1800** kg	**125** kg	Catfish	**- 30%**
1964-65	**2500** kg	190 kg	Sharks, skates	**- 16%**
1965-66	1010 kg	90 kg	Jew fish	**- 15%**
			Salmon	**- 14%**
			Ribbon fish	**- 07%**
			Bombay duck	**- 06%**
			Eel	**- 04%**
			Croakers	**- 04%**
			Pomfrets	**- 02%**
			Miscellaneous	**- 02%**

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According to another survey by the vessel *Sagar* Sandhani (30 m) in Bay of Bengal during 1967 to 1971, an average landing of 35 kg per hour with a maximum of 450 kg per hour were recorded. The catch composition of the survey is given in Table 3.1.2.

Table 3.1.2

Catch composition of "Sagar Sandhani"

Indian salmon (Polynemus indicus)	- 8.1%
Eels	- 3.2%
Bombay duck (Harpodon nehereus)	- 11.0%
Cat fish *(Tachysurus* sp.)	- 11.0%
Sharks, rays, etc.	- 16.0%
Pomfrets	- 6.0%
Snappers	- 2.0%
Shrimp	- 0.7%
Miscellaneous	- 24.0%

Source: **Zobairi (1970)**

The survey conducted by Fridtjof Nansen employed both bottom and pelagic trawls.

Table 3.1.3 gives the average catch rates with bottom trawls at different depth zones. The maximum average catch rate of bottom trawl occurred at 50-70 m depth, reaching a value of 672 kg/hr. There was an abrupt change in the catch rate at a depth of more than 100 m which corresponded to the sharp decrease in oxygen content. The highest catch rate 4000 kg/hr was obtained with catfish, Arius thalassinus. Also the threadfin bream, Namipterus japonicus, contributed significantly to the higher catch rates.

The catch rates with pelagic trawl were Usually lower, varying between 10 and 100 kg/hr. The maximum catch rate was 170 kg/hr, of which the major contribution was the anchovy, Stole-*phorus sp.*

Table 3.1.3

Distribution of average catch rates (kg/hr) from bottom trawl at different depth zones

No. of trawling stations	9	10	11	14	15
Depth zone	10-24	25-49	50-74	75-99	100-150
Pelagic fish	71.0	58.3	123.0	194.2	0.1
Demersal fish	173.5	185.3	537.6	258.8	13.7
Sharks/rays	18.4	3.7	7.3	2.5	—
Crustaceans	4.7	13.9	2.3	12.0	5.5
Squids	1.1	4.9	1.7	5.0	—
Total	268.7	266.1	671.9	472.5	19.3

Source: **Chowdhury et** *al. (1979)*

Of the seven longline operations that were carried out at depths between 10 and 95 m, the maximum catch was 12 kg/100 hooks.

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3.2 Catch composition with reference to gears. The catch data relating to gear types particularly from the coastal areas of Bangladesh are not available.

4. Method of stock assessment employed, if any, and the results obtained

Several surveys have been made to assess the standing stock of finfishes and shellfishes in the Bay of Bengal by national/international agencies. But all the previous surveys were designed mainly for demersal fish and were mostly limited to day time. The previous surveys were made without considering the potential catch of pelagic fish. The available information of present standing stock of fish and shelifish of the Bay of Bengal are presented in Table 4.1 .1.

Table 4.1 .1

Estimates of present standing stock of finfishes and shellfishes in the Bay of Bengal (in thousand tons)

Demersal	Pelagic	Crustacean	Others
264-373@	**200***	**9@**	**25+**

Source: @ West (1973)
* Karim (1978b)
\+ Anon (1974b)

The survey conducted in 1967-71 under UNDP/FAP Project PAK-222 made an estimate of the standing stock of demersal fishes of the Bay of Bengal by using the following formula.

$$\text{Size of standing stock} = \frac{A \times C}{a}$$

where : A := total area under survey
a = area covered by trawl in one hour
C = catch per hour of trawling

The details of the estimates are furnished in Table 4.2.1.

The Irrigation Fisheries Development Project of the Directorate of Fisheries undertook a comprehensive programme on stock assessment during 1977-79 on the different habitats and as a part of this programme, the standing crop of ichthyomass (both finfish and shellfish) in terms of kilogramme per haul was determined for the Meghna river estuary and the Bay of Bengal. The results obtained are given in Table 4.3.1.

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Table 4.2.1

Estimates of the standing stock of demersal fish in Bangladesh continental shelf waters

	South Patches and adjacent coast areas	Middle Ground	Swatch of No Ground	All Areas investigated	Total Shelf Area
Average catch/hr (kg)	522	388	468	447	447
Area under survey (square miles)	3000	1800	1600	11400	27000
Average trawling speed (knots)	3.5	same	same	same	same
Effective opening width between danlenos or swivels (feet)	85-120	same	same	same	same
Area covered by net in one hour (square miles)	0.0648 - 0.0914	same	same	same	same
Standing stocks (x 10^3 tons)					
(i) assuming no escapement	17.1 - 24.2	7.6 - 10.8	8.2 - 11.6	54.8 - 78.6	132.0 - 186.3
density/square mile (tons)	5.7 - 8.0	4.2 - 6.0	5.1 - 7.2	4.9 - 6.9	4.9 - 6.9
(ii) assuming 50 per cent escapement	34.2 - 48.4	15.2 - 21.6	16.4 - 23.2	111.6 - 157.2	264.0 - 372.6
density/square mile (tons)	11.4- 16.0	8.4 - 12.0	10.2 - 14.4	9.8 - 13.8	9.8 - 13.8

Source: West (1973)

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Table 4.3.1

Average standing crop (kg per ha) of the Meghna river estuary and the Bay of Bengal during March and April 1978

Stations	Standing Crop
Meghna river estuary	
Gazipur	9.35
Hatila	1.65
Sandwip	0.70
Bay of Bengal	
Off Karnafuli river mouth	2.46
Off Kutubdia island	14.55
Off Cox's Bazar	9.23

Source: Kibria and Rainboth, 1979 (data unpublished)

The survey made by *Fridtjof Nansen* estimated the abundance using the average catch rates on the assumption that catch per effort is a function of the stock density. The fish density was obtained from the mean catch rates and the areas swept by the trawl. The biomass of demersal fish calculated from bottom trawl catches is shown in Table 4.4.1

Table 4.4.1

Biomass of demersal fish calculated by means of bottom trawl catches

Depth zones (m)	Density (kg/km^2)	Stock (tonnes)
10-24	2082	17489
25-49	2223	10670
50-74	6451	35997
75-99	3105	41638
100-150	164	1681
Total		107475

$B = \phi\, {}^{p}A^{d}A = C.M.A.$

where B is the demersal fish biomass,
PA the fish density expressed in weight per unit area,
C is a conversion coefficient
M is the average integrater reading, and
A the corresponding area.

The numerical value of C applied in these calculations was: $C = \frac{L}{b}$ tons/mm.(n.m.)^2, where L is the average length in cm.

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An average length of 25 cm was chosen as a whole for the demersal stock which gives C=5 tonnes/mm $(n.m.)^2$. Under this assumption, the acoustic abundance estimated was about 40,000 tonnes. However, the acoustic estimate of demersal fish will usually be an under-estimate (Chowdhury *et* al., 1979) due to the limitation of the echo sounder and integrator in making recordings very close to the bottom. The abundance of demersal stock off Bangladesh was suggested to be about 150,000 tonnes, and of pelagic fish, 60,000 tonnes.

5. Basic biological characteristics of major exploited coastal fishes and shrimps

5.1 *Hilsa ilisha* (Sable fish, River shad, *Ilish* or Hilsa): It is a medium sized (up to 60 cm) planktonivore, essentially an estuarine fish but it is abundantly caught in the Meghna, the Padma and some other rivers in Bangladesh. It shows a typical anadromous, migratory pattern ascending major rivers for spawning. It migrates to fresh water in two runs, in monsoon and in winter. The area from Chandpur to Hatia and Chandpur-Goalando are the major Hilsa fishing grounds. Mature fishes are mostly caught in the Meghna and Padma rivers from middle of May to middle of October. The fingerlings, *Jatka,* are caught in the rivers Buriganga, Sitalakhya and Meghna from January to June. The growth rate of the species is more rapid during the hot season than in winter. Fry increases in length one inch per month. It generally attains maturity at the age of two years. It feeds on zooplankton and phytoplankton. From the rivers Meghna and Padma, *Hilsa* sp. are being caught by mainly *Chandi jal* (drift gillnet) and by *Shanla jal* (clapnet), *Kona* and *Bundh.* Each individual of *Hilsa* may carry 2,34,170 to 15,77,600 eggs (Hussain, 1971 ; Anon., 1974a ; Rainboth, 1978b).

5.2 Hilsa kanagurta (Sea shad or *Chandana ilish):* This fish almost resembles *H. ilisha* but it inhabits only the marine environment with its spawning and feeding ground in the sea. It grows to a maximum size of 52 cm. This fish is caught in large commercial quantities from the coastal waters of Bangladesh, particularly offshore waters of Cox's Bazaar. Different varieties of gillnets and local purse-seine nets are used to catch this fish (Hussain, 1971).

5.3 Harpodon nehereus (Bombay duck or *Loitta):* This fish is small to medium-sized (maximum 40 cm), a predator-cum-scavenger which ascends to the upper part of the estuarine zone. It is one of the important fishery species of the upper Bay of Bengal. The fish is caught in good quantities from the shallow waters of the estuaries, mainly in the river mouths by trawl and *behundi* nets. (Hussain, 1971 ; Rainboth, 1978a).

5.4 *Tachysurus* sp. (Catfish or *Kata machh):* This species is purely a marine form and found in large quantities in the estuaries and adjacent offshore waters. *Jachysurus thalassinus,* also called giant catfish, grows to a maximum of 150 cm. This is one of the important commercial species of the Bay of Bengal, caught by trawl nets (Hussain, 1971 ; Rainboth, 1978b).

5.5 Polynemus indicus (Indian salmon or *Lakhua)* : One of the most abundant commercial marine species which is caught in large quantities from "South Patches", "North Patches", and "Swatch of No Ground" areas by trawl nets and from the shallow estuarine waters by fixed gillnets. Average size of the species is 70-80 cms and the maximum size recorded is 142 cms (Hussain, 1971 ; Rainboth, 1978b).

5.6 Lates calcarifer (Cock-up or *Bhekti):* This is a large predatory fish, grows to 180 cms (6 feet) length and may weigh 90 kg (200 lbs). It frequents the mouths of rivers and occassionally ascends them for fair distances. It is usually taken by gillnets in good quantities from the near-shore shallow estuaries and river-mouths at depths up to 4-5 fathoms especially around Hatia, Barrichar, Rabnabod and Sandwip Islands. The species spawns in the high saline zone of the estuary from May to October and feeds on fishes, shrimps, snails and worms (Hussain, 1971 ; Rainboth, 1978b).

5.7 Rastrelliger kanagurta (Indian Mackerel or *Champa):* It is one of the most abundant commercial species of the Bay of Bengal. It is a column feeding planktonivore. Maximum size of the species is recorded at 35 cm length, but the most common size is 20-25 cm. The species is caught mainly by gillnets and purse seine nets (Jhingran, 1977).

5.8 Palaemon (Exopalaemon) Styliforus (Gura chingri): It inhabits shallow coastal waters and brackishwaters of the estuaries. The maximum size of the species recorded is 100 mm. The breeding period extends from October to July. Hatching of the species occurs in the more saline zone of the estuary or inshore waters (Kibria. 1980).

5.9 Penaeus indicus (Indian prawn or *Chapda chingri):* The adults inhabit the sea, whereas fry and juveniles are carried into the estuary and inshore waters by the tide/current. It is the most important species of shrimps, on account of its great abundance both in the estuarine and open waters. It is a bottom feeder and omnivorous. The species is reported to have a deep water spawning habit (Kibria, 1980).

5.10 Penaeus monodon (Tiger prawn or *Bagda chingri):* This is a large 300 mm fish and one of the most important commercial shrimps of Bangladesh. Fry are reported to be available the year round from the estuarine area of Bangladesh. Adults and mature specimens are abundantly available in the Bay of Bengal off Cox's Bazaar. The species is omnivorous and a bottom feeder. The breeding period of the species extends from January to April. The spawning ground of the species seems to be the offshore of Cox's Bazaar. Chakria-Sundarban and Khulna-Sundarban estuaries are known as the main seed collecting centres in Bangladesh (Kibria, 1980).

5.11 Metapeneus monoceros (Sand shrimp or *Honye chingri):* It inhabits sea and brackish-water zones of the estuary. Juveniles are found in estuaries and backwaters of reduced salinity; adults occur in the sea. The species is reported to breed throughout the year with two peaks, one in July and August and the second in November and December. The adults are generally available in the sea in slightly deeper waters than the other species of *Metapenaeus.* It is recorded *to* grow up to 155 mm from Bangladesh waters (Kibria, 1980).

6. Yield trends over the years against fishing effort

Real statistics of fish production in Bangladesh are not available. Fishing activity is extremely scattered and varied, and there is no built-in method for collection of catch and effort data. Nearly all the marine catch is harvested from the coastal and estuarine waters by small-scale fishermen, and it is very difficult to get actual production data. However, different agencies have estimated the production figures of both freshwater and marine fish. Available production statistics are furnished in Table 6.1 .1.

Table 6.1 .1

Estimates of marine fish catch in Bangladesh (in thousand tons)

	1960 *	1962-63	1965 *	1967-68	1971 *	1972-73 *	1973 *	1974 +	1975 +	1978 +
Marine	55.4	55.0	66.9	99.0	63.0	90.0	85.0	90.0	90.0	100.0
Freshwater	—	—	—	—	—	732.0	—	734.0	732.0	—

Source: + Karim (1978)
* Anon (1974b)

The above estimates are of a conjectural nature rather than based on actual field surveys. However all the estimates consistently indicate that 80-90 per cent of the total catch is the contribution of inland waters, According to the nutrition survey carried out during the year 1962, fish production has been estimated at 677,000 tons. The scientists are of the opinion that fresh water fish production has either declined or at best remained static since 1962 due to various reasons. Marine catch, is however, estimated to have increased about two-fold. A survey conducted by the Bangladesh Fisheries Development Corporation (BFDC) in 1967-68 under FAO guidance

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estimated the marine fish catch (excluding the estuarine catch) at approximately 99,000 tons. The district of Chittagong contributed the most to the total marine catch accounting for 70 per cent of the total marine harvest. The rest comes from Noakhali, Barisal, Patuakhali and Khulna districts.

Ninety five per cent of the total marine catch is harvested from nearshore water by small-scale fishermen, fishing with or without boats. Presently 3-4 per cent of the total marine catch is harvested from the deeper waters by trawlers operated by BFDC and a few private parties, Year-wise landings of marine fish by BFDC trawlers are furnished in Table 6.2.1.

Table 6.2.1

Marine fish landings by BFDC trawlers

Year	No. of trawlers in possession	Catch in tons
1972-73	11	4766
1973-74	11	2616
1974-75	14	4049
1975-76	14	1218
1976-77	14	1356
1977-78	10+ 7*	1400
1978-79	8+ 7*	1100
1979-80 (up to March)	10+ 7*	1377

Source: BFDC

*Thailand vessels referred to in Table 1 .1.1

The catch rates from October to January as worked out from the BFDC trawler operation are presented in Table 6.3.1.

Table 6.3.1

Average catch rates per hour: BFDC trawlers of various sizes
(Catch rates in kg. per hour)

Year	Trawler size — in metres					
	54	44	30	27	18	17.5
1972-73	**559**	542	—	329	—	—
1973-74	262	378	—	222	—	—
1974-75	331	288	319	171	155	89
1975-76	238	251	292	123	93	67
1976-77	212	327	281	183	88	49
1977-78	255	193	171	50	135	42
1978-79	—	299	299	134	169	87

Source: BFDC

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The catch from the Cox's Bazar coastal region by the indigenous and mechanised boats with gillnet are landed in the BFDC landing centre and in the municipal landing centre on Cox's Bazar. Year-wise landing of the mechanised boats at the landing centre are furnished below in Table 6.4.1.

Table 6.4.1

Mechanised boat landings at Bangladesh Fisheries Development Corporation terminals at Cox's Bazar

Year	Quantity (tons)
1967-68	467
1968-69	685
1969-70	607
1970-71	594
1971-72	574
1972-73	1470
1973-74	1426
1974-75	1297
1975-76	1352
1976-77	1133
1977-78	1467
1978-79	925

Source: BFDC

Detailed qualitative, quantative and statistical analysis on the gillnet catches of the mechanised boats landed at the Bangladesh Fisheries Development Corporation fish landing terminal at Cox's Bazar has been made under the Pre-Investment Survey Scheme of Bangladesh Fisheries Development Corporation during the years 1967-68 to 1971-72. A comparative statement of details of the above analysis is given in Table 6.51.

Table 6.5.1

Analysis of gillnet catch: Mechanised boats at Cox's Bazar

Particulars	1967-68	1968-69	1969-70	1970-71	1971-72
Average number of boats operated per day	32	42	29	29	41
Average number of fishermen	5.00	3.63	5.11	4.97	4.96
Average number of nets per boat	13	10	13	13	12.48
Average weight of nets (lbs) per day	221	170	221	221	221
Number of days counted for fishing	212	212	212	184	243
Actual number of fishing days	176	176	171	153	143
Annual total catch (kg)	466,660	684,200	607,400	594,346	574,100
Total catch per fishing day (kg)	2,561.5	3,887.5	3,582	3,884.6	4,014.7
Catch per boat per day (kg)	82.86	92.81	119.78	107.7	38.64
Catch per net per day (kg)	6.37	9.28	9.21	8.3	7.58
Catch per lb net per day	0.37	0.54	0.54	0.49	0.45

Source: BFDC

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From Table 6.3.1 and Illustration 3 it appears that the catch per hour of trawling for different sizes of trawlers has significantly dropped in 1973-74 and thenceforth it is maintaining a more or less static level. The total catch of the BFDC trawlers shows a gradual decrease from 4766 tons in 1972-73 to 1100 tons in 1978-79, in spite of increasing the number of trawlers. A survey conducted by R.V. *Dr. Fridtjof* Nansen under the FAO/NORAD Programme over the entire Bay of Bengal in November-December 1979 gives a catch rate of 390 kg per hour (including trash fish). Another survey conducted in the Bay of Bengal by a Thai fishery research vessel under the Bangladesh-Thailand Agreement on Co-operation in Fisheries during March 7-18, 1979, yielded a catch of 649 kg per trawling hour, more than 50% of which comprised trash fish. The catch rate of good fish amounted to 325 kgs. The catch per trawling hour as estimated by these surveys is in close conformity with the catch of BFDC trawlers with reference to time and size of the trawlers. The reasons for the sudden fall in the catch rates in 1973-74, followed by a more or less static position thereafter, have not been investigated. This may be attributed to a decrease in gear efficiency or to change in stock abundance due to the effects of environmental factors. However, a systematic and exhaustive study of population dynamics of the fish and shellfish is very much needed to ascertain the status of fish stock so that the maximum sustainable yield can be obtained from the Bay.

The landings at Cox's Bazar from the catches in coastal waters near Cox's Bazar by mechanised boats over the period from 1967-68 to 1971-72 (Table 6.4) show that the catch increased suddenly to about 2½ times in the year 1972-73 and remained more or less in that state up to 1977-78, followed by a decrease in 1978-79. Total effort employed during this period is not available. So it is difficult to identify the reason for these trends in the catch. However, the increase and the fluctuations in the catch since 1972-73 may be due to addition of more fishing effort or due to changes in stock abundance affected by environmental factors.

7. Conclusion

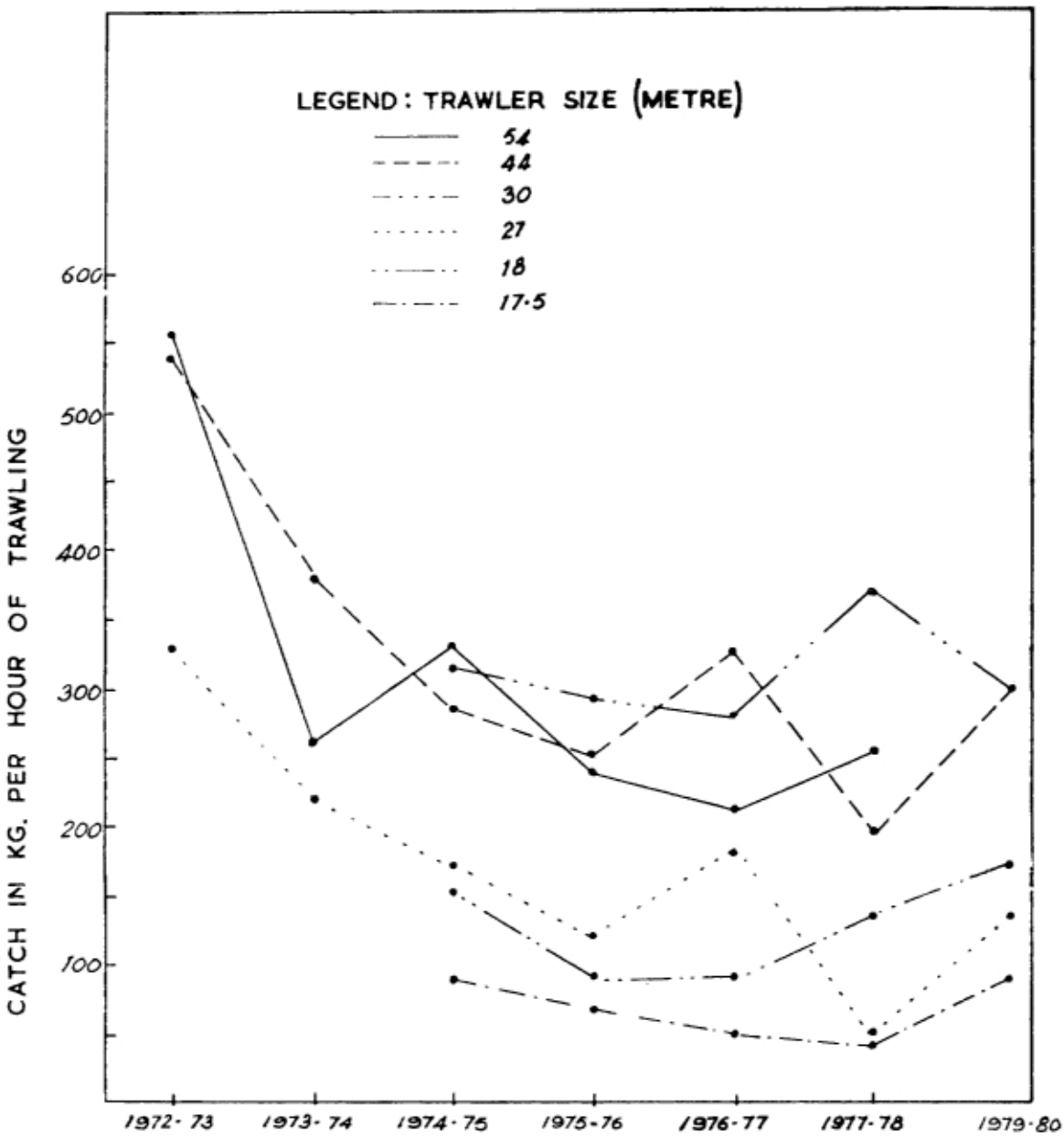
(Problems/constraints and solutions) : Information on fishery resources essential for management and development of coastal fishery is lacking. There is no built-in method for recording catch and the importance of statistics is inadequately appreciated.

Due to inadequate manpower, financial and other facilities, no programme exclusively for fishery resources survey and monitoring resource information in inland and marine waters, could be undertaken and as such no comprehensive data on fisheries resources could be built up in the country. However, the Directorate of Fisheries, BFDC and BJMSS have from time to time undertaken programmes for collection of fisheries statistics for some specific purpose from particular areas of the country but the reliability of this data is, perhaps, below the acceptance level due to various reasons, such as,

1. Shortage of adequate skilled manpower.
2. Shortage of transport for collecting fisheries statistics from the river, coastal zone and remote areas of the country.
3. Fishing activity is extremely scattered and varied and there are no specific fish landing centres in most areas and as such it is very difficult to put the fishing activity under a system for collection of data.
4. It is very difficult to collect actual information by interviewing the people concerned who generally conceal actual information out of fear of being taxed.

For assessment of standing stock of the Bay of Bengal, a number of exploratory surveys have been undertaken during the last decade but the investigations were restricted mostly to shallow water for part of the year from September to May and the areas investigated may not be more than one third of the continental shelf of Bangladesh.

Therefore, the need for undertaking surveys on the remaining portion of the shelf as well as in the deeper waters all round the year for assessment of fishable stock, studies on biological characteristics of the fish and shellfish, on organic productivity and on environmental parameters has been recognized. For the purpose of collecting and processing fisheries resources statistics,



ILL-3 CATCH PER HOUR OF TRAWLING BY DIFFERENT SIZES OF TRAWLERS OVER THE PERIOD FROM 1972-73 TO 1978—79

it is most essential to set up a separate division under the Directorate of Fisheries exclusively for assessment of fish stock in different habitats so as to facilitate proper planning of fisheries development programmes in the country. Skills of manpower as are now available under the Directorate of Fisheries and the BFDC may be utilized to initiate the programme. The remote sensing technology by Landsat may be used for assessing and monitoring oceanographic parameters in turbidity, up-welling zone and chlorophyll content. Skills and facilities in this field are also available in the country.

Under the programme, provision has to be made for adequate manpower, their training and other necessary inputs. Still there may be problems in getting actual data from the people concerned. However,thissituation may be improved by tactfully convincing the people,providing them with help in the form of loan, fishing equipment, including mechanized boats, technical know-how, marketing facilities so that they can get actual value for their catch. Landing facilities are to be created where necessary so that landing data can be easily collected. For monitoring statistics of fish catch, effort and socio-economic conditions of the fishermen, regulation must be made to register each and every fishing unit of the country, but as the fishermen are illiterate it will not be possible to get the proforma filled by them for daily catch and other information. About 95% of the total marine catch is contributed by the small-scale fishermen of the coastal areas of the country. The fisherfolk in this country are generally poor and very little attention was given previously for improvement of their socio-economic condition. With the improvement of their fishing equipment and other facilities, the catch may be increased from the coastal waters. It is therefore necessary to provide the fishermen with equipment such as mechanized fishing boats, nets, twine, life safety measures, etc. so that the fishing efficiency is increased.

References

Ahmed, S. 1977 — Export potentiality of the marine fishery products of Bangiadesh. *National Marine Fisheries Seminar Proceedings.*

Ali. M. Y. and Haque, K.A. 1980 — Country status report on Bangladesh. Symposium on the development and management of small-scale fisheries, *IPFC/80/SYM/CSR/4 Kyoto, Japan.*

Anon. 1969 — Pre-investment survey for the development of fisheries in East Pakistan. *interim Report,* F.I: SF/PAK-22, November 1969.

— 1972 — Terminal report on the survey for the development of fisheries. Bangladesh FI : SF/PAK-22 (FAO).

— 1972 — Report on the marine fishing village identification surveys in Bangladesh, *1967-68 UNDP Project Publication No. 2, 7972.*

— 1974a — Abstracts of fishery research report, 1963-l 972. Research report series *No. 1, Freshwater Fisheries Research Station,* Government of Bangladesh.

— 1974b — Fishery development perspective. Sub-Region (II) Bay of Bengal. *IPFC,* 16th session, Jakarta, Indonesia.

— 1975 — Socio-economics of fishermen of Bangladesh, BJMSS (unpublished).

— 1975 — FAO yearbook of fishery statistics-catches and landings.

Chong, K. C. 1979 — An economic appraisal of the fisheries in the Chandpur, Muhuri, Halda and Ichamatic Project areas. *Irrigation Fishery Development Project.* Working Document No.

<<

13, Directorate of Fisheries, Bangladesh and Snell Environmental Group, Inc., U.S.A.

Chowdhury, W. N., Md. G. Kahn, S. Myklevoll and R. Saetre 1979 — Preliminary results from a survey on the marine fish resources of Bangladesh, November-December 1979. Reports on surveys with the R.V. Dr. Fridtjof Nansen, 28 *PP.*

Haque, N. 1977 — Trawl fishing in the Bay of Bengal, its problems and prospects. National Marine Fisheries Seminar Pro- *ceedings,*

Hill, M. T. and Kibria, G. 1979 — Fish stock assessment programme. Fishery development in irrigation and flood control systems, second annual report, Directorate of Fisheries, Bangladesh and Snell Environmental Group, Inc. U.S.A.

Hussain, M. M. 1971 — Commercial fishes of the Bay of Bengal. UNDP Project Publication No.1

Islam and Quereshi. .1965 — Trawling operations in the Bay of Bengal. ***FAO No.*** 2121.

Jhingran, V. G. 1977 — Fish and fisheries of India. ***Hindustan Publishing Corporation (India).***

Karim, M. 1978 — ***Status and potential of Bangladesh fisheries.*** Ministry of Fisheries and Livestock, Government of Bangladesh, 125 pp.

— 1978 — General description of small-scale fisheries, Bangladesh. Project for the development of small-scale fisheries in the Bay of Bengal — Preparatory phase Vol. 2 : Working papers, Working Paper No. ***3, IOFC/DEV/78/44.2.***

Kibria, G. 1979 — The qualitative and quantitative study of the finfish and shellfish of the different habitats of the Chandpur irrigation project area. ***Irrigation fisheries development project,*** Working document No. 24, Directorate of Fisheries, Bangladesh and Snell Environmental Group, Inc., U.S.A.

— 1980 — Taxonomy, distribution, migration and spawning ground of Bangladesh prawns and shrimps. Special paper, ***Irrigation Fisheries Development Project,*** Directorate of Fisheries, Bangladesh and Snell Environmental Group, Inc., U.S.A.

— Rainboth, W. J. 1978 — The catch composition of different gear types of the Feni river estuary during 1978 (unpublished).

Rainboth, W. J. 1979 — Abundance, distribution and standing crop of finfish and shellfish of the Meghna river estuary and the Bay of Bengal during 1979 (unpublished).

Morris, E. L. 1977 — Results of the economic and catch assessment programme (First Survey — July and August, 1977) in the Chandpur, Muhuri, Halda and Ichamati Project areas. */bid.,* Working Document No. 4.

Perera, L. C. 1977 — Fishery resources of the Bay of Bengal with special reference to operation of small mechanized boats from

<<

Bangladesh for their exploitation. *National Marine Fisheries Seminar Proceedings.*

Pietersz, V. L. C., A. Andreasson and H. Copper, 1978 — Assessment of problems and needs in marine small-scale fisheries, Bangladesh. Project for the development of small-scale fisheries in the Bay of Bengal — Preparatory Phase Vol. 2: Working papers, Working paper No. 11, *IOFCIDEV/78/44.2,7pp.*

Rainboth, W. J. 1978a — The fish and prawn stocks in the Muhuri irrigation project and its surrounding region, with special reference to the potential impacts of the Feni River, cross-dam and regulator on the fish and fisheries. *irrigation Fishery Development Project.* Working Document No. 17.

— 1978b — The fishes and prawns of the Halda and Ichamati units of the Karnafuli flood control and irrigation project, with reference to potential impacts of the development scheme. *Ibid.,* Working Document No. 18.

Rainboth, W. J. and Kibria, G. 1978 — Trawling survey in the Meghna river, tidal zone, Bangladesh, using the R.V. Machranga. *Ibid.,* Working Document No. 9.

West, W. O. R. 1973 — Fishery resources of the upper Bay of Bengal. *IOFC/DEV/73/28, FAO, Rome.*

Zobairi, A. R. K. 1970 — Survey of the Bay of Bengal, *East Pakistan Fisheries Development Corporation,* East Pakistan.

STOCK ASSESSMENT CONSULTATION
Volume 2

INDIA

Status Paper on Coastal Fishery Resources along the East Coast

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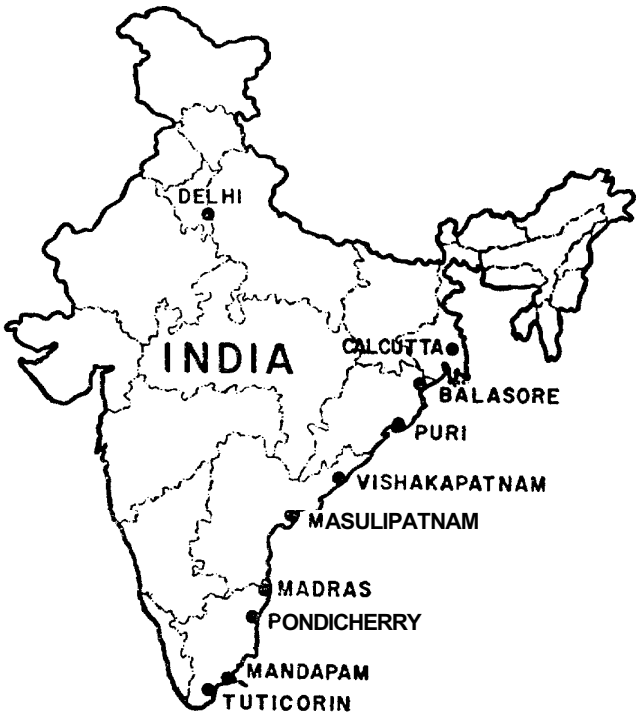

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CONTENTS

		Page
1.	Existing knowledge on the status of exploited coastal stocks and estimates of exploited yields	25
2.	Methodology for collection of catch statistics and the organisational set-up for collection and processing of catch statistics	27
3.	The extent of availability of catch statistics with reference to species, areas, types of vessels and gear and fishing effort in hours	28
4.	Methods of stock assessment employed, if any and the results obtained. Nature of studies presently undertaken and those in the pipeline	29
5.	Brief information on the fishery and biological characteristics such as age/ size, composition, growth, feeding habits, maturity and spawning and estimates, if any of population parameters of major exploited species	29
6.	Yield trends over the years against fishing effort	33
7.	Problems/constraints in the collection and processing of fishery statistics and in the assessment of coastal stocks	33
8.	Requirements for solving/removing the above problems/constraints	33
	Selected references	34

Tables

1.	Percentage contribution of important varieties of fish to the total catch of the east coast	37
2.	Estimated marine fish landings on the east coast of India during the years 1975 to 79, in tonnes	38
3a.	Estimated marine fish landings in Tamil Nadu during the years 1975 to 1979, in tonnes	39
3b.	Estimated marine fish landings in Pondicherry during the years 1975 to 1979, in tonnes	40
3c.	Estimated marine fish landings in Andhra Pradesh during the years 1975 to 1979, in tonnes	41
3d.	Estimated marine fish landings in Orissa during the years 1976 to 1979, in tonnes	42
3e.	Estimated marine fish landings in West Bengal during the years 1975 to 1979, in tonnes	43
3f.	Estimated marine fish landings in Andamans during the years 1975 to 1979, in tonnes	44

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1. Existing knowledge on the status of exploited coastal stocks and estimates of exploited yields

The total marine fish production in India has been estimated at an average of 1.37 million tonnes a year for the two year period of 1978-79. Roughly two thirds of this is contributed by the traditional small-scale fisheries and the rest by small and medium sized mechanised 'boats using mostly bottom trawls and gill nets. Nearly 30% of the marine fish produced in India is landed along the east coast.

There has been an increase in the marine fish production of India by about 50, per cent as compared to 1969 (0.9 million). This increase is mainly due to factors such as the progressive introduction of mechanised crafts, use of synthetic fibre fishing gears and improvement in infrastructure facilities for landing, transporting and marketing. With the recent introduction of larger trawlers by private agencies, India has ventured into commercial off-shore, and deep-sea fishing. The present paper gives an appraisal of the fishery resources in the seas bordering the east coast of India comprising the coasts of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Pondicherry and the Andaman and Nicobar Islands.

1.1 *Coastal fisheries*

Marine fishery resources in the east coast are constituted of a large variety of fin and shellfishes, typical of tropical waters. These comprise pelagic resources such as lesser sardines, ribbon fish, white baits, hilsa, horse mackerel, Indian mackerel, seer fish and flying fish; demersal resources such as silver bellies, elasmobranchs, sciaenids, catfish, threadfin ,breams and other perches and pornfrets; crustacean resources such as prawns, lobsters and crabs and molluscan resources such as mussels, oysters and clams, cuttlefish and squids.

1.2 *The coastline, shelf area and fishing grounds*

The eastern seaboard of India has a coastline of about 3,000 km and the Andaman Nicobar Islands about 1,500 km. The total continental shelf covers an area of about 67,000 sq.km up to 50 m depth and 1 .1 0,000 sq.km up to 200 m. In the Andaman Nicobar seas the continental shelf covers about 16,000 sq.km up to 200 m. The average width of the continental shelf is 43 km off the Tamil Nadu coast, 32 km off the Andhra coast and 68 km off the Orissa-West Bengal coast.

On the east coast, trawling grounds are in general less extensive. In the southern sector, the Wadge Bank south of Cape Comorin and the Pedro Bank in the Palk Bay have been traditional trawling grounds. Potentially good shark fishing grounds from Point Calimere to Cuddalore, perch grounds from Point Calimere to Pondicherry and horse mackerel from Pondicherry to Madras are indicated. Palk Bay and Gulf of Mannar abound in silver bellies. Large concentrations of white baits have been noticed in the Gulf of Mannar during the June to September months. Threadfin bream, catfish and ribbonfish have been caught in abundance off the Andhra coast. Recent exploratory surveys along Orissa-West Bengal coasts have shown several productive grounds off Sand heads, Tiger point, Baitarani, Devi and Prachi river mouths, Black Pagoda, Puri, Chilka and Gopalpur. The 'swatch of no grounds' have yielded quality fish in significant quantities.

1.3 *Andaman and Nicobar Islands*

In the Andamans commercial fishing is carried out mainly from Port Blair, Rangat, Mayabander and Diglipur. Subsistance fishing is prevalent in the narrow eastern coastal belt of Andamans and neighbouring islands.

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The continental shelf is narrow and within two km of the coast line depths of 45 to 180 m depth are seen. Weather conditions are rough May to October, and calm November to April.

1.4 Census of fishermen and fishing craft

1.4.1 East coast

According to the figures obtained through an all-India census carried out in marine fishing villages by the Central Marine Fisheries Research Institute (C.M.F.R.I.) around 1975, the total marine fishermen population in the states along the east coast was about 0.6 million inhabiting 982 coastal villages. 25 per cent of them were active fishermen. Based on this census and other currently available information the number of mechanized fishing craft would be about 4,000, mostly trawlers. Non-mechanized boats number about 70,000 the most common among them being catamarans, dugout canoes and plank-built boats. The most commonly used gears were gillnet, drag net, boat-seine, bag net and hooks and lines.

1.4.2 Andaman, Nicobar Island groups

The fishermen numbering about 1,000 are of Andhra, Tamil Nadu, Kerala, Bengal and afewof Burmese origin. The local fishing fleet consists of about 500 craft, mainly dug-out canoes. The traditional gears are cast net, hook and line, gill net, shore-seine, stake net and anchor trawl net. Mechanized trawling has not yet been established in the Andaman waters. Andamans based joint ventures with international collaboration have been in operation during the last two years, with trawling mainly along the Orissa - West Bengal coast.

1.5 *Annual catches*

The figures of the annual catches in the east coast for the five years 1975 to 1979 and the percentage contribution of important varieties of fish are given in Table 1. The detailed species-wise figures for the east coast area as a whole are given in Table 2 and the figures separately for each state are shown in Table 3(a) to 3(f). Broadly the total production showed a declining trend from 1975 to 1977 and thereafter an increasing trend is seen. Similar trends are also seen for the states of West Bengal, Orissa, Tamil Nadu and Pondicherry, while in Andhra region the declining trend continued till 1978. This can be partly ascribed to the series of cyclones that hit especially the Andhra coast, the most devastating being the one of November 1977.

It is seen that lesser sardines, ribbon fishes, white baits, carangids, seer fish and Hilsa form the bulk of the pelagic fishes caught on the east coast (Table 1). Silver bellies, sharks and rays, jew fishes, catfishes, perches and pomfrets constitute the major demersal groups caught. Penaeid prawns form about 5 per cent of the total catch.

Latest landing figures (1978) available for the Island group of Andamans show an estimate of 1579 t (Table 3) of which about 500 t can be classified as demersal consisting of perches, elasmobranchs, silver bellies and catfish. The pelagic group consisting of carangids, seer fish mackerel, lesser sardines, tunas, barracudas, mullets, white baits etc. contribute nearly 1,000 t and the Penaeid prawns 38 t.

A catch of about 5,500 t of fish including 227 t of prawns is landed by the joint venture deep sea operations from the east coast in 1978.

1.6 *Effort*

Data on catch and effort are being collected at the national level by the Central Marine Fisheries Research Institute through its scientifically planned sample surveys, and state-wise and species-wise catch are estimated and published periodically. While overall effort is estimated at CMFRI gear-wise estimates pose a major problem as the fishery is one of multi-species operated by multigears.

1.7 Resources survey

The C.M.F.R.I. carries out continuous monitoring of the resources of all important exploited fisheries in the seas around India. Along the east coast, fisheries such as those of lesser sardines, silver bellies, ribbon fishes, sciaenids, white baits, catfish, perches, seer fish and penaeid prawns are monitored for the fishery and biological characteristics. Trawling data collected by the Exploratory Fisheries Project vessels operating off Tuticorin, Madras, Kakinada, Waltair, Paradeep and Calcutta form additional sources for studying the resources position in the area. Catch rate and depth-wise and region-wise catches are calculated for both pelagic and demersal resources. The erstwhile FAO/UNDP sponsored Pelagic Fisheries Project had carried out extensive surveys on pelagic resources from Ratnagiri to Tuticorin. The data collected resulted in a better understanding of the stock abundance and distribution of the major fish resources of the area.

1.8 Organic productivity

Studies on primary productivity have been made by C.M.F.R.I. in the inshore waters of Gulf of Mannar and Palk Bay. The reports of the 'Galathea' Expedition and the International Indian Ocean Expedition also dealt with primary productivity in the Bay of Bengal. The production rate in the Bay of Bengal region was found to be on the average 0.19 $gC/m^2/day$ in the deeper part while the shelf area showed a higher productivity rate of 0.63 $gC/m^2/day$. In the inshore regions of Gulf of Mannar and Palk Bay the value was much higher. Taking the average to be 0.63 $gC/m^2/day$, the net organic productivity for the east coast shelf was estimated at 15 million tonnes of carbon and the potential fish yield over 6 lakh tonnes.

1.9 Statistical models

Data on biological, physiological and nutritional aspects such as growth, mortality, reproduction, migration and feeding habits, chemical and physical properties of the inshore and off-shore waters and the interaction and dynamics of population are essential to study the behaviour of the marine system, the knowledge of which is a pre-requisite for reliable prediction and efficient management of the fisheries. Due to the inherent complexities of the fisheries and lack of suitable data some of the fishery problems cannot be directly investigated. In such situations one may resort to simulation techniques involving use of mathematical and statistical models. System analysis techniques have been suggested to fisheries problems only recently. While no advances have been made in this direction in the country, the C.M.F.R.I. proposes to initiate such studies for the marine systems in the Indian seas.

2. Methodology for collection of catch statistics and the organisational set-up for collection and processing of catch statistics

2.1 *Methodology*

The C.M.F.R.I. is the nodal organisation engaged in the task of collection of marine fish catch statistics and data on biological characteristics on a nation-wise basis. The Institute has played a pioneering role in developing .a suitable sampling design for the collection of catch data. The procedures have been undergoing modifications to accommodate the innovations introduced in the fishing industry from time to time.

At present the Institute is following a stratified multistage probability sampling design for estimation of marine fish landings in the country. The design involves a space-time stratification. Each maritime state is divided into zones based on criteria such as intensity of fishing, type of fishing and geographical conditions. A zone consists of about 20 to 30 landing centres. A ten day period in a month forms the time-stratum. From the first five days of the month a day is selected randomly which together with the next 5 consecutive days form the first cluster. The next 6 days from the other two groups of ten days are so selected that a ten day gap falls between the starting day of two consecutive clusters. Three centres are randomly selected for observations over 6 days and each selected centre is observed for two days, first day in the afternoon and second day in the morning for a six-hour duration each day. On the day of

observation, based on the landings of a sample number of boats (units) selected in a systematic way, detailed recordings are made on items such as species-wise composition of catch, type of crafts and gears used and effort. The total number of boats landed during the observation period is also recorded. A sub-sample of commercially important fishes is collected for biological observation. Landings made at night which are generally of a much smaller magnitude are recorded through careful enquiry.

In zones where considerable variation is observed in the landing pattern, sub-stratification is made based mostly on the intensity of landings and sampling is done from within the substratum. In fact the stratification procedure often undergoes continuous change depending on the intensity of landings. Work programmes are prepared according to the random procedure every month afresh for implementation at the field level.

From the landings of selected boats (units) the landings for all the boats (units) during the observation period are estimated first. By adding the estimated quantities landed during the two six-hour periods and during the night (12 hrs.) the quantity landed for one day (24 hrs.) at a centre is calculated. By using appropriate raising factors the monthly zonal landings are estimated. By pooling the zonal estimates for all the months the figures of annual landings are obtained. The standard errors of the estimates are also computed for the annual estimates of catch.

2.2 Organization

The Institute maintains a well-trained field staff in 42 research/field centres located along the coastline to monitor the catch. They are specially trained to identify the various species and to collect the needed biological statistics. The scientific and senior technical personnel posted at headquarters and different research centres to implement the research programmes of the Institute carry out supervision of the work of the collection of statistics at the field level.

The data collected for a month are sent within the first ten days of the succeeding month to the Data Centre maintained at the headquarters of the Institute. Scrutiny and processing of data are done by a team of qualified computing staff using partly calculators and partly programmable computers. The processed results are examined and interpreted and the information is disseminated periodically through the Institute's publications.

Some of the states like Maharashtra, Gujarat and Tamil Nadu are also collecting catch statistics from the landing centres located within the respective states employing random sampling procedures. Frequent dialogues are arranged between the scientists of the Institute and the officials of the State Fisheries Departments to examine the figures obtained by the two agencies. As per the recommendation of the National Commission on Agriculture, an integrated methodology is being evolved so that the C.M.F.R.I. and the State Departments may be able to combine their efforts to arrive at more precise estimates. In case of states where no system of collection of catch statistics exists, the C.M.F.R.I. is giving the necessary technical support.

3. The extent of availability of catch statistics with reference to species, areas, types of vessels and gear and fishing effort in hours

The Central Marine Fisheries Research Institute publishes state-wise and species-wise estimates of fish catch and supplies the details to national and international agencies. The species are combined to form 27 groups as shown in Table 2 mentioned earlier. Proposals to record species in more detail are already on. Thus pomfrets will be grouped into 3 namely the white, grey and black pomfrets. Similarly for all the commercially important varieties more detailed species-wise identification and recording will be made. District and season-wise estimates are also under preparation.

The types of craft used, both mechanized and non-mechanized, with further details are recorded during the observation period. Information on total man-hours of fishing is also collected. However, gear-wise estimates of effort for any particular species pose a major problem as the fishery is one of multiple species operated by multigears. Efforts are under way to standardise

the effort for selected commercially important species with reference to the most important gear prevalent in an area.

4. Methods of stock assessment employed, if any, and the results obtained. Nature of studies presently undertaken and those in the pipeline

4.1 *Methods*

While several procedures are followed by research workers, a commonly used method based on landed catches is summarised here. On the basis of length and weight measurements made on a representative sample of fish catch, express the total catch in numbers and segregate the length data into different year classes by using a method like 'length frequency plot'. The instantaneous total mortality (z) is estimated by comparing the abundance of fish at successive years. An estimate of natural mortality (M) is obtained as the intercept of the line of regression of Z on fishing effort. The instantaneous rate of fishing mortality (F) can then be directly computed. From known values of F and M the rate of exploitation and consequently the stock can be estimated.

Some estimates of the magnitude of potential stocks in the Arabian Sea and the Bay of Bengal have been published based on primary productivity figures and the average rates of fish production per unit area. (Prasad et al, 1970, Cushing, 1971, Jones and Banerji, 1973, Nair et al., 1973 and George et al., 1977). Systematic acoustic surveys in Indian waters have been conducted only along the SW coast of India and the segment of the SE coast (Gulf of Mannar) covered during the studies gave assessment figures of the migrant white bait stocks in the Gulf of Mannar during the June-September period (Anon 1976b). Jones and Banerji (1973) estimated a potential yield of 815,000t of fish from the shelf of the east coast split into 143,000 t of demersal fish based on records of average catches and 672,000 t of pelagic fish based on primary productivity rates. Nair et *al.* (1973) estimated on the basis of primary productivity studies, a potential of little over 600,000 t of fish for the east coast shelf. George et al. (1977) computed figures of potential yield for the east coast shelf on the basis of primary productivity as well as rate of fish production per sq.km and has arrived at 1.2 and 1.4 million tonne respectively as the magnitude of the potential yield. The acoustic surveys of the Pelagic Fishery Project revealed that almost the whole stock of white baits migrated from the SW coast to the Gulf of Mannar on the SE coast during the June-September period. The highest concentration of this stock observed in August-September 1974, was estimated at about 800,000 t.

5. Brief information on the fishery and biological characteristics such as age/ size, composition, growth, feeding habits, maturity and spawning and estimates, if any, of population parameters of major exploited species

A few species of comparative importance from the point of view of production, namely, lesser sardines, ribbon fishes, white baits, silver bellies, jew fishes, pomfrets and shrimps are briefly dealt with here.

5.1 Fishes

5.1 .1 Lesser sardines

Among lesser sardines the commercially important species are *Sardinella gibbosa, S. fimbriata, Sualbella* and *S. sirm.* The fishery is restricted to the inshore waters within 25 km from the shore and mainly supported by O-year class fish. They mature and breed at the end of first year of life and their life span is about 2 years. The first three species mentioned above have more or less the same rate of growth reaching about 120-130 mm total length at the end of the first year when they attain maturity. S. *sirm* attains 170-180 mm length at the end of first year. The lesser sardines have similar food preferences, zooplankton being the most dominant food item.

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5.1.2 Ribbon fishes

Ribbon fishes form fishery of considerable magnitude along the east coast, particularly along Tamil Nadu and Andhra coasts. A limited fishery exists in the Hooghly-Matlah estuaries. The most dominant species caught is *Trichiurus lepturus* which grows up to 1.5 m. Average commercial size is 75 cm. The other species *Lepturacanthus savala, Eupleurogrammus intermedius* and *E. muticus* are smaller in size. Large shoals of *T. lepturus* are caught from the inshore waters of peninsular India during August and October. Ribbon fishes breed more than once in a year. *L. savala* is the predominant species in Hooghly Matlah estuaries. Commercial size of this species is *15-50* cm *E. intermedius* is abundant in Palk Bay and *E. muticus* along Orissa coast. Commercial size of *E. intermedius* is 14-35 cm and the life span about 4 years. Commercial size of *E. muticus* is 35-50 cm. Ribbon fishes are carnivorous, the food consisting of crustaceans and fishes. Spawning of ribbon fishes appear to be in offshore waters.

5.1.3 Seer fishes

The fishery is constituted by *3* species, *Scomberomorus commersoni, S. guttatus* and *S. lineolatus.* Seer fishes are caught from the inshore waters by gill nets, drift nets and hook and lines. The fishing season extends from October to March. The spawners have been met with during May to July period. The size at maturity is about 50 cm. The fishery is dominated by this size group assigned to the third year class.

5.1.4 White baits

White baits *(Stolephorous* spp.) occur mostly in areas with bottom depths between 20 and *50* m. *S. heterolobus, S. zollingeri, S. bataviensis, S. commersoni, S. baganensis, S. devisi* and *S. indicus* are the common species. The fishery seasons are from May to November along Tamil Nadu and November to April along Andhra coast. Large concentrations of the fish are observed in the Gulf of Mannar during the June-September period. The fishery is contributed mainly by O-year class fish, the mean age being about 6 months when they first spawn. Spawning is noticed throughout the year in white baits. White baits mainly feed on zoo-plankton. Life span of the whitebaits is estimated to be about 2 years.

5.1.5 Silver bellies

Leiognathus, Secutor and *Gazza* spp. are landed in large quantities along the Tamil Nadu and Andhra coasts. *Leiognathus splendens* is the most abundant species, which grows up to a length of *15* cm. *L. equulus* attains the largest size up to 24 cm. The catches of silver bellies comprise mostly of fish less than one year old. Their life span is considered to be less than 2 years. *L. splendens* caught in November to June along SW coast are found in spawning condition. Peak catches are obtained in Madras during October to December and in Andhra, Orissa and West Bengal from January to June.

5.1.6 Jew fishes

Several species of jew fishes mainly *Pseudosciaena, Johnius, Otolithoides* and *Otolithus* spp. contribute to the fishery along the east coast. *P. diacanthus* the largest of the jew fishes found on SE coast grows up to 120 cm in length. This fish attains sexual maturity at 70-80 cm. Smaller species are caught by trawlers in large quantities from coastal waters. Along the NE coast some species enter the river systems and are fished from the estuaries. The average length of the Ganges Jew fish *(Pseudosciaena coibar)* from the commercial catches is about 92 cm.

5.1.7 Pomfrets

There are three species of pomfrets fished along the Indian coasts, the black pomfret *(Formio niger),* the white or silver pomfret *(Pampus argenteus),* and the Chinese or grey pomfret *(P.*

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Chinensis). The black pomfret is fished off the coasts of Orissa and W. Bengal, mostly from June to September.

5.1.8 Threadfin breams

Exploratory trawling off Andhra and Orissa coasts has indicated good resources of threadfin bream Nemipterus ***Japonicus*** in the area during the January-April period.

5.1.9 Catfish

Tachysurus thalassinus and T. tenuispinis are the major catfishes caught along the east coast. T. jella and T. dissumieri are two other species caught. Exploratory trawling up to 100 m depth along the Andhra-W. Bengal coast showed about 28% of catfishes in the catch. ***T. thalassinus*** of 6-80 cm and ***T. tenuispinis*** of 6-60 cm size ranges are landed commercially.

5.1 .10 Mackerel

Of the total mackerel landings of India roughly 10 per cent only is caught from the east coast. In addition to the major species Rastrelliger kanagurta two others R. brachysoma and R. faughni occur in the east coast. Most of the landings on the east coast are along Tamil Nadu and Andhra coasts. The size of R. kanagurta in the commercial catch ranges from 12-23 cm which belong to 0 and 1 year class. In the Andamans in addition to R. kanagurta, R. brachysoma is also caught. In 1978 only 106 tonnes of mackerel were caught in Andamans. The fish are known to breed all the year round.

5.2 Prawns

Considerable information on biological characteristics of different species of prawns contributing to the fishery is available. Both penaeid prawns and non-penaeid prawns occur in the fishery. Features of some of the important species are summarised.

5.2.1 Penaeus indicus

Distributed along the entire coast of India up to the 50 m depth zone, juveniles occurring in estuaries and backwaters. Rao (1968) estimated the size of the female at first maturity at 130.2 mm. Fecundity ranges from 68,000 to 7,31,000 ova in females measuring 140 mm and 200 mm respectively. At Madras peak spawning activity was observed from May to September. Feeds on both vegetable and animal matter, consisting of mainly crustaceans. Juveniles grow at an average monthly rate of 10 mm in Chilka lake, 14.4 mm in Ennur estuary, 16.0 at Adyar estuary and 24.0 mm in Covelong backwaters. The adults show a growth of 5.6/7.0 mm in males and females at Madras. Males and females attain a length of 156/1 38 mm at the end of first year and 189/181 mm at the end of the second year of life. Fishing is supported by the O-year old in the estuaries and by O-year (80-120 mm) and 1 -year olds (95-175 mm) in the marine region. Within the size range the modal sizes vary from place to place and season to season. The estimated annual total mortality in the fishery at one centre in SW coast is 3.1 in males and 2.1 in females.

5.2.2 Penaeus monodon

These are commonly distributed in the north east coast. Number of eggs varies from 3 to 7 lakhs. Breeds in the same grounds as ***P. indicus.*** Food consists of large crustaceans, vegetable matter, polychaetes, molluscs and fish. Largest recorded size is 337 mm. In the Chilka lake the juveniles grow at a rapid rate of 25 mm per month and at Madras it reaches 160-170 mm size in 6 months in brackish water. Commercial catches are formed by O-year and 1-year class. Attains about 250 mm in one year.

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5.2.3 Penaeus semisulcatu s

More common on the east coast. The size of female at first maturity is 23 mm carapace length. Fecundity ranges from 67,900 to 660,900 eggs in different sizes, June to September and January, February are peak spawning season in Gulf of Mannar and Palk Bay. Maximum size attained is about 250 mm. It consumes large quantities of animal matter as well as diatoms and algal filaments. In the estuary it grows to about 150 mm forming the O-year class. The marine fishery is contributed by sizes ranging from 120 to 230 mm, consisting of both O-year and 1 -year classes.

5.2.4 Metapenaeus monoceros

Distributed in both estuarine and marine regions. Maturity attained in the sea after *120* mm size. Fecundity ranges from 155,000 to 338,000 eggs. Peak spawning in July-August and November-December. It grows to maximum size of 190 mm. Feeds mostly on small crustaceans. In Godvary estuary migration out of the estuary was mostly nocturnal and immigration mostly at dawn. The estuarine fishery is contributed by O-year class. Marine fishery mostly contributed by sizes 125 mm to 150 mm of the 1 -year class.

5.2.5 Metapenaeus dobsoni

Distributed up to a depth of about 40 m, with large quantities in the brackish water areas. The size at first maturity is 64 mm. Fecundity ranges from 34,500 eggs in 70 mm prawn and 160,000 eggs in 120 mm size. Maximum size attained is 130 mm. Breeds in the inshore waters inside the 25 m depth region. The species is a detritus feeder. Juveniles grow in the estuarine environment at an average monthly rate of about 10 mm. Bulk of the fishery in the backwaters and the sea is supported by 3-12 month old prawns. The total annual instantaneous mortality rate on the west coast ranges from 3.1 to 3.8.

5.2.6 Metapenaeus brevicornis

Distributed in the northern region of the coast. Attains maximum size of 135 mm and maturity at about 75 mm. In the Hooghly estuarine system there are two spawning seasons, in March, April and July, August. Major food items are vegetable matter and crustacean remains. Growth rate varies with salinity and temperature of the environment. In the estuary the sizes range from 15 to 115 mm constituted by 0 to 2 year groups.

There are several other species of penaeid prawns which occur in small quantities in the fishery of different areas and different seasons. The important non-penaeid species which contribute to the fishery of mostly Andhra coast and in the northern region are Acetes indicus, Palaemon tenoipes, Palaemon styliferus an d Hippolysmata ensirostris.

5.3 Lobsters

Spiny lobsters are distributed along the SE coast and forms good fishery at Tuticorin, Mandapam areas and Madras. The important species are Panulirus homarus, P. ornatus and P. versicolor. The first two species are equally abundant. The peak seasons are January to March and July to September. Along the Bengal coast *P.polyphagus* is the dominant species. In the south east coast the sizes of lobsters in the fishery ranges from 110 mm to 370 mm. In Mandapam area population estimates of the lobsters for the period 1965-67 were made by George (1973) using the Petersen method. An estimated population of 2.6 tonnes was obtained with a rate of exploitation of 22.7%.

5.4 Crabs

Crab fishery also is gaining importance in several centres along the east coast. The important species which are exploited from the marine sector are Portunus pelagicus and Portunus sangu

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inolentus. In the brackishwater environments Scylla *serrata* is dominant. The size ranges in carapace width of the three species in the fishery are 30-185 mm, 20-94 mm and 30-126 mm respectively.

6. Yield trends over the years against fishing effort

Yield trends in the fishery of certain individual groups and species of fishes and shellfishes have been studied from specified regions along the west coast of India. Similar studies from the east coast on particular groups are envisaged in the project oriented research programmes of the CMFRI. This would require standardised effort data pertaining to each fishery. These data are available with the Institute but remain to be processed. For example in the case of the shrimp fishery of SW coast of India, relation between catch per unit effort as well as total catch and total effort for the period 1957 to 1970 for the different constituent species of Cochin area were studied (Anon 1971). From the yield curves drawn from the data it was concluded that in the case of the shrimps additional yield from further increase in fishing will be only marginal. Similar studies on the yield trends over the last 10 years against fishing effort in the case of shrimps at different centres along the east coast of India are in progress.

7. Problems/constraints in the collection and processing of fishery statistics and in the assessment of coastal stocks

(a) A number of fishing harbours are coming up, many of them requiring exclusive coverage for fish landings. This combined with the changing patterns of fishing, necessitates more intensive monitoring.

(b) Data acquisition, processing and dissemination need strengthening. This would help in formulating suitable policies for efficient management of fisheries.

(c) Development of a proper catch monitoring system in the estuaries and backwaters of coastal areas requires attention.

(d) Another problem which has been already mentioned is that the fishery dealt with is one of multispecies operated by multigears. There is an urgent necessity for standardising the effort in relation to gears for the major commercial species and fishing crafts of different types.

(e) Improvements in the handling, preservation, transport and marketing systems are necessary.

(f) The process of modernisation of the traditional fisheries has its own impact on the socio-economic conditions of the fisherfolk. There is need for making socio-economic surveys at a number of centres so as to assess any adverse impact and arrive at timely remedial measures. Studies are also required to be undertaken to get an insight into the economic structure governing various activities directly and indirectly related to fisheries.

8. Requirements for solving/removing the above problems/constraints

(a) Programmes for increasing the frequency of collection of data from landing centres; round the clock collection of data from fishing harbours and other centres of concentration of boats; evolving special designs for collection of data from operation of gears such as purse-seines are already under way. In the country's 6th Five Year Plan it is proposed to make these systems more efficient and effective.

(b) The fishery data centre at CMFRI headquarters is being computerised and the efforts for aquisition, processing and dissemination of information are being strengthened to enable short term forecasts and implementation of extension programmes for the benefit of the small scale sector.

(c) A suitable statistical design for covering the landings of estuarine and brackishwater areas is being formulated.

(d) Methods for standardisation of effort in relation to gears and major commercial species are being worked out.

(e) The difficulties in handling, preservation and marketing have been identified as the primary areas for improvement. With the introduction of quality control in products going for export, development programmes involving states, central organisations including the funding agencies and co-operatives are being evolved.

(f) A major thrust during the 6th Five Year Plan period will be for integrated rural development of the coastal sector. This will involve considerable amount of base line studies to understand the gaps and deficiencies, to formulate remedial measures for improving the socio-economic conditions. This would also help monetary benefits and other advantages from the developmental programmes to reach the large number of traditional fishermen operating non-mechanised craft.

Selected References

Anon. 1971 — Report of the working group for the assessment of prawn fisheries with special reference to Cochin area, CMFRI (Mimeo).

Anon. 1972 — 25 years of marine fisheries research — Handbook-Silver Jubilee, CMFRI, 72 pp.

Anon. 1972 — Symposium on the pelagic fisheries resources of the seas around India, 11-13 December *1972, Abstracts.*

Anon. 1973 — Proceedings of the symposium on the living resources of the seas around India (1967), 1-748.

Anon. 1976a — *Report of the National Commission on Agriculture* Part VIII. Fisheries : 270 pp.

Anon. 19766 — Progress Report No. 13: Survey results 1974/75 UNDP/FAO-Pelagic Fishery Project (Ind 69/593).

Anon. 1977 — *Indian Fisheries* — 1947-77. Published by M PEDA, Cochin — Ed. E. G. Silas.

Borisow, N. I. 1962 — Report to the Government of India on experimental and exploratory fishing in the Bay of Bengal. *Report No. 7466, F.A.O. of the United Nations, Rome, I-29.*

George, M. J. 1970a — Synopsis of biological data on penaeid prawn, *Metapenaeus dobsoni* (Miers). *1878. FAO Fisheries Report* (57) Vol. 4, 1335-I 357.

George, M. J. 1970b — Synopsis of biological data on penaeid prawn, Meta*penaeus affinis* (H. Milne Edwards) 1837. *FAO Fisheries Report (57)* Vol. 4, 1359-1375.

George, M. J. 197Oc — Synopsis of biological data on penaeid prawn, Meta*penaeus monoceros* (Fabricius) *1798. FAO Fisheries Report (57)* Vol. 4, 1539-1557.

George, M. J. 1970d — Synopsis of biological data on penaeid prawns *Metapenaeus brevicornis* (H. Milne Edwards) 1837. *FAO Fisheries Report (57)* Vol. 4, 1559-1573.

<<

George, M. J. 1972 — On the zoogeographic distribution of Indian penaeidae. Indian Journal of Marine Sciences, 1 (1), 89-92.

George, M. J. 1973 — Lobster fishery resources of India. Proceedings of the symposium on living resources of the seas around India, Special Publication CMFRI(1967) 570-580

George, M. J. and K. H. Mohamed 1966 — An assessment of marine prawn fishery resources of Kanyakumari District -south west coast of India. Proceedings of the Indo-Pacific Fisheries Council: 12(2), 210-219.

George, P. C., B. T. Antony Raja and K. C. George 1977 — Fishery resources of the Indian economic zone : Souvenir, Integrated Fisheries Project, Cochin, 79-120.

Hida, T. S. and W. T. Pereyra 1966 — Results of bottom trawling in Indian seas, R. V. Anton Bruun in 1963. Proceedings of the Indo-Pacific Fisheries Council, 11(11) , 156- 17'1.

James, P. S. B. R. 1973 — Sharks, rays and skates as potential fishery resources off the east coast of India. Proceedings of the symposium on living resources of the seas around India, CMFRI. 481-494.

Jones, S. and S. K. Banerji 1973 — A review of the living resources of the Central Indian Ocean. Ibid., 1-17.

Joseph, K. M. 1971 — Crustacean fisheries of the west coast of India. ***IOFC/*** DEV/71/21. F.A.O. of the United Nations. Rome.

Joseph, K. M. 1974 — Demersal fisheries resources off the north west coast of India. Bulletin of the Exploratory Fisheries Project, No. 1,1-45.

Joseph, K. M. 1976 — Results of Demersal Fisheries Resources survey along the east coast of India 1959-74. ***Bulletin of the Exploratory Fisheries Project, No. 5.***

Krishnamoorthy, B. 1973 — An assessment of Memipterus fishery off Andhra-Orissa coasts based on exploratory fishing. ***Proceedings of the symposium on living resources of the seas around India, CMFRI, 493-516.***

Kumaran, M. 1973 — The fishery potential of Andaman and Nicobar Islands. ***Proceedings of the symposium on living resources of the seas around India, 387-389.***

Menon, P. M. G. 1977 — The economic development of Andaman and Nicobar islands by increased fisheries developmental activities. ***Seafood Export Journal, 9(9), 9-15.***

Mitra, G. N. 1968 — Fisheries Development in Andaman Group of islands ***Project Report*** No. 3, Ministry of Food and Agriculture, New Delhi, 47 pp.

Mohamed, K. H. 1970a — Synopsis of biological data on the jumbo tiger prawns ***Penaeus monodon*** Fabricuis, ***1798 FAO Fisheries Report*** (57), Vol. 4,1251-1 256.

Mohamed, K. H. 1970b — Synopsis of biological data on the Indian prawn ***Penaeus indicus*** H. Milne Edwards, 1837. ***FAO Fisheries Report (57),*** Vol. 4, 1267-1288.

Mohamed, K. H. 1973 — Penaeid prawn resources of India. *Proceedings of the symposium on living resources of the seas around India. Special Publication.* CMFRI 1967, 548-556.

Naumov, K. V. 1961 — A survey of the fisheries resources of the Bay of Bengal. *Report No. 1393. F.A.O. of the U.N., Rome, I-60.*

Pai, M. V. and Mahadevan Pillai 1973 — Trawl fishery potential of the south east coast of India. *Proceedings of the symposium on living resources of the seas around India, CMFRI,* 261-279.

Poliakov, M. P. 1961 — Interim Report to the Govt. of India on experimental and exploratory trawling in the Bay of Bengal in 1960-61. *F.A.O.* (Mimeo), 1-23.

Prasad, R. R., S. K. Banerji and P. V. Ramachandran Nair 1970 — A quantitative assessment of the potential fishery resources of the Indian Ocean and adjoining seas. *Indian Journal of Animal Sciences 40(1), 73-98.*

Prasad, R. R. and P. V. Ramachandran Nair 1973 — India and Indian Ocean fisheries, *Journal of the Marine Biological Association of India. 15(1) , 1-19.*

Rao, K. Virabhadra 1969 — Distribution pattern of the major exploited marine fishery resources of India. *Bulletin of the Central Marine Fisheries Research Institute No. 6,1*-69.

Rao, P. Vedavyasa 1968 — Maturation and spawning of the penaeid prawns of the south west coast of India. *FAO Fisheries Report 57(2), 285-302.*

Rao, P. V. and S. Choudhury 1979 — Ganjam coast in Orissa can support good trawl fishery. *Seafood Export Journal, 9(3),* 15-17.

Sekharan, K. V. 1973 — On the catfish resources of the coasts of Andhra Pradesh, Orissa and West Bengal. *Proceedings of the symposium on living resources of the seas around India, CMFRI, 517-536.*

Shariff, A. T. 1961 — Survey of the offshore demersal fisheries of the Andaman and Orissa coasts 1960. Souvenir, Fisheries of Gujarat, *46-54.*

Shomura, R. S. 1970 — Indian Ocean coastal waters- *Fish Resources of the Oceans* ed. J. A. Gulland, 115-119.

Silas, E. G., S. K. Dharmaraja and Rengarajan 1976 — Exploited marine fisheries resources of India. *Bulletin of the Central Marine Fisheries Research Institute, 27, 1-24.*

Sudarsan, D. and P. J. Joseph 1978 — Indian fisheries- the role of the east coast, eastern states, and the Bay of Bengal. *Seafood Export Journal, 10(9) 11-23.*

West, W. Q. B. 1973 — Fishery resources of the Upper Bay of Bengal. IOFC/DEV/73/28: *F.A.O. of the United Nations,* Rome, I-39.

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Table 1

Percentage contribution of important varieties of fish to the total catch of the East Coast

Name of fish	Year					Average over the years
	1975	1976	1977	1978	1979	
Lesser Sardines	16.36	12.26	11.80	9.14	11.32	12.18
Ribbon fish	7.19	7.72	4.09	9.93	7.25	7.24
Anchoviella	4.31	4.67	6.98	4.80	4.59	5.07
Caranx	2.47	2.57	3.22	1.55	2.87	2.54
Seer fish	2.33	2.02	3.13	2.41	3.51	2.68
Hilsa	1.27	1.55	1.02	2.27	2.75	1.77
Leiognathus	7.54	8.19	7.24	9.41	12.47	8.97
Elasmobranchs	7.46	6.94	8.01	7.76	6.09	7.25
Sciaenids	6.13	6.20	7.53	7.64	7.59	7.02
Catfishes	4.80	3.31	6.60	3.00	2.65	4.07
Perches	3.19	1.90	3.35	3.40	2.64	2.90
Pomfrets	2.21	3.84	1.31	2.62	3.59	2.71
Penaeid prawns	5.01	4.87	4.76	6.98	5.30	5.38
Crabs & other Crustaceans	3.42	4.08	3.58	2.82	1.85	3.15
Total per cent accounted for	73.69	70.12	72.62	73.73	74.47	72.93
Total fish production in tonnes	431,868	424,090	336,557	355,846	388,130	—

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Table 2

Estimated marine fish landings on the East Coast of India during 1975-1979, in tonnes

Sl. No.	Name of fish	1975	1976	1977	1978	1979
1.	Elasmobranchs	32,218	29,431	26,950	27,624	23,629
2.	Eels	1,955	834	676	1,410	453
3.	Catfishes	20,746	14,022	22,201	10,679	10,266
4.	*Cbirocentrus*	5,503	4,759	4,652	4,439	4,357
5.	(a) Oil sardine	131	112	714	36	1,011
	(b) Lesser Sardine	70,673	51,983	39,700	32,534	43'925
	(c) Hilsa ilisha	5,476	6,578	3,428	8,093	10,663
	(d) Other *Hilsa*	2,559	4,424	7,998	6,530	4,230
	(e) Anchoviella	18,608	19,819	23,476	17,063	17,811
	(f) *Thrissocles*	6,848	12,193	5,373	7,750	9,929
	(g) Other clupeids	16,437	26,824	6,509	7,640	9,247
6.	(a) *Harpodon nehereus*	3,403	2,554	2,120	2,778	2,126
	(b) *Saurida & Saurus*	1,318	1,095	1,555	2,294	3,189
7.	*Hemirhamphus & Belone*	1,582	769	1,766	904	758
8.	Flying fish	1,800	1,397	613	1,641	2,528
9.	Perches	13,788	8,035	11,287	12,080	10,253
10.	Red mullets	2,401	1,259	1,184	2,409	2,078
11.	Polynemids	3,413	4,096	2,726	3,182	2,784
12.	Sciaenids	26,464	26,291	25,327	27,180	29,463
13.	Ribbon fish	31,049	32,756	13,763	35,326	28,156
14.	(a) *Caranx*	10,678	10,902	10,850	5,525	11,122
	(b) *Chorinemus*	3,045	2,742	2,398	2,522	2,093
	(c) Trachynotus	6	29	73	84	182
	(d) Other carangids	16	912	100	258	79
	(e) Coryphaena	316	203	198	45	47
	(f) *Elacate*	113	231	247	295	535
15.	*(a) L eiognathus*	32,553	34,736	24,349	33,469	48,396
	(b) *Gazza*	130	55	61	104	197
16.	*L actarius*	4,371	2,615	2,066	1,536	2,281
17.	Pomfrets	9,528	16,269	4,401	9,305	13,915
18.	Mackerel	9,909	14,672	7,418	4,454	6,847
19.	Seer fish	10,039	8,544	10,542	8,581	13,622
20.	Tunnies	2,474	3,355	3,761	2,166	3,679
21.	*Sphyraena*	1,680	1,806	1,898	2,299	1,551
22.	*Mugil*	2,679	1,289	1,237	1,226	437
23.	*Bregmaceros*	–	–	–	–	–
24.	*Soles*	1,245	1,225	1,738	2,163	3,135
25.	*(a)* Penaeid prawns	21,622	20,656	16,015	24,845	20,561
	(b) Non-penaeid prawns	6,885	5,252	5,556	2,863	4,279
	(c) Lobsters	592	561	308	271	448
	(d) Crabs & other crustaceans	14,769	17,281	12,039	10,022	7,169
26.	Cephalopods	3,164	1,931	1,845	1,409	2,488
27.	Miscellaneous	29,682	29,593	27,439	30,812	27,611
	Total	4,31,868	4,24,090	3,36,557	3,55,846	3,88,130

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Table 3a

Estimated marine fish landings in Tamil Nadu during the years 1975 to 1979, in tonnes

Sl. No.	Name of fish	1975	1976	1977	1978	1979
1.	Elasmobranchs	20,614	19,039	18,327	15,121	12,358
2.	Eels	110	620	232	325	119
3.	Catfishes	7,469	5,033	15,205	5,252	5,615
4	Chirocentrus	1,811	2,058	2,475	1,736	1,839
5:	(a) Oil sardine	---	---	714	36	1,011
	(b) Lesser Sardines	35.610	25,169	26,259	21,050	33,289
	(c) Hilsa ilisha	121	22	343	161	41
	(d) Other Hilsa	1,158	2,331	5,784	4,166	2,761
	(e) Anchoviella	10,873	7,869	13,388	7,447	11,061
	(f) Thrissocles	3,127	8,362	3,008	4,719	5,542
	(g) Other clupeids	5,406	15,851	2,652	3,043	3,564
6.	(a) Harpodon nehereus	1	--	14	--	1
	(b) Saurida & Saurus	1,026	823	572	1,100	1,498
7.	Hemirhamphus & Belone	1,482	717	1,574	759	624
8.	Flying fish	1,657	1,232	526	1,092	1,599
9.	Perches	8,153	5,341	7,918	9,241	5,865
10.	Red mullets	1,566	626	832	1,963	1,448
11.	Polynemids	1,339	1,944	1,592	706	353
12.	Sciaenids	10,096	10,562	13,756	14,239	18,944
13.	Ribbon fish	17,782	19,054	4,594	28,664	21,040
14.	(a) *Caranx*	6,225	7,082	6,120	3,104	7,015
	(b) Chorinemus	1,090	646	1,465	971	844
	(c) *Trachynotus*	—	28	73	84	182
	(d) Other carangids	8	907	22	171	23
	(e) *Coryphaena*	65	105	58	18	37
	(f) Elacate	87	217	230	239	535
15.	(a) Leiognathus	20,142	29,664	17,783	30,281	42,872
	(b) Gazza	29	6	54	104	197
16.	*Lactarius*	1,822	775	740	840	1,323
17.	Pomfrets	1,303	822	628	789	877
18	Mackerel	5,826	10,488	5,674	1,453	3,521
19	Seer fish	4,100	3,784	6,424	4,700	5,228
20.	Tunnies	1,785	2,923	3,238	1,169	3,211
21	*Syphraena*	1,506	1,554	1,702	2,147	1,463
22:	Mugil	1,566	285	923	829	229
23.	Bregmaceros					
24.	Soles	785	909	908	1.580	2.337
25:	(a) Penaeid prawns	11,460	8,864	8,197	13,327	10,222
	(b) Non-penaeid prawns	573	169	159	585	897
	(c) Lobsters	465	525	286	249	340
	(d) Crabs & other Crustaceans	13,896	16,413	11,018	9,290	5,883
26.	Cephalopods	2,953	1,451	1,375	1,042	1,902
27	Miscellaneous	16,128	11,808	19,204	19,107	17,106
	Total	2,21,215	2,26,078	2,06,046	2,12,899	2,34,816

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Table 3b

Estimated marine fish landings in Pondicherry during the years 1975 to 1979, in tonnes

Sl. No.	Name of fish	1975	1976	1977	1978	1979
1.	Elasmobranchs	129	165	352	199	222
2	Eels	4	6	5	--	88
3.	Catfishes	55	66	137	168	51
4	*Chirocentrus*	50	63	63	111	167
5.	(a) Oil sardine					
	(b) Lesser Sardnies	1.046	1,839	1,156	1,184	1,998
	(c) Hilsa ilisha	31	---	—		—
	(d) Other *Hilsa*	277	121	43	108	12
	(e) Anchoviella	412	178	548	521	346
	(f) *Thrissocles*	337	565	405	258	429
	(g) Other clupeids	50	1	—	281	345
6.	(a) *Harpodon nehereus*					
	(b) *Saurida & Saurus*	4	105	103	132	622
	Hemirhamphus & Belone	55	2	4		6
8	Flying fish	142	165	3	480	854
9:	Perches	389	769	391	487	1,004
10.	Red mullets	100	77	32	109	203
11.	Polynemids	14	26	5	27	14
12.	Sciaenids	212	434	258	374	306
13.	Ribbon fish	314	428	143	139	129
14	(a) *Caranx*	610	501	490	218	537
	(b) *Chorinemus*	—	2	5	33	27
	(c) Trachynotus	—	—	—	—	—
	(d) Other carangids	—				
	(e) Coryphaena	—	7	2	3	2
	(f) *Elacate*	--	---	*1*		
15.	(a) *Leiognathus*	511	482	318	372	746
	(b) *Gazza*				—	—
16.	*Lactarius*	30	121	175	—	11
17.	Pomfrets	13	44	53	50	35
18.	Mackerel	2,259	1 ,598	398	178	424
19.	Seer fish	23	28	34	41	105
20.	Tunnies	—	1		3	I
21.	*Sphyraena*	27	15	9	25	22
	M ugil	31	4	14	26	27
23.	*Bregmaceros*					
24.	*Soles*	125	254	78	109	162
25.	(a) Penaeid prawns	62	93	103	245	532
	(b) Non-penaeid prawns	2			71	72
	(c) Lobsters	25	33	20	2	5
	(d) Crabs & other Crustaceans	260	516	296	251	242
	26. Cephalopods	58	211	62	36	50
	27. Miscellaneous	453	1,203	747	586	632
	Total	8,150	10,123	6,462	6,828	10,068

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Table 3c

Estimated marine fish landings in Andhra Pradesh during the years 1975 to 1979, in tonnes

Sl. No.	Nameoffish	1975	1976	1977	1978	1979
1.	Elasmobranchs	9,977	6,688	6,450	8,704	6,985
2.	Eels	1,837	205	438	1,082	245
3.	Cat fishes	9,824	6,131	5,662	3,281	3,770
4.	*Chirocentrus*	2,920	1,837	1.217	1,262	976
5.	(a) Oil sardine	131	112		---	--
	(b) Lesser Sardines	32,994	23,220	10,972	7,685	6,180
	(c) *Hilsa ilisha*	70	280	41	2	78
	(d) Other *Hilsa*	930	1,815	1,654	1,349	1,092
	(e) *Anchoviella*	7,037	11,309	8,947	7,810	5,888
	(f) *Thrissocles*	1,776	1,763	1,398	1,824	3,433
	(g) Other clupeids	7,536	8,410	2,363	1,794	2,518
6.	(a) *Harpodon nehereus*	359	214	960	1,099	717
	(b) *Saurida & Saurus*	242	166	875	1,057	1,379
7.	*Hemirhamphos & Belone*	24	14	135	60	100
8	Flying fish	1		84	65	71
9.	Perches	4,888	1,751	2,727	1,945	3.092
10.	Red mullets	721	553	315	335	426
11	Polynemids	1,836	1,813	698	1,075	1,412
12:	Sciaenids	11,682	10,891	10,182	5,597	8,825
13.	Ribbon fish	11,701	12,443	8,546	5,505	6,335
14.	(a) *Caranx*	3,498	3,047	4,003	2,000	3,185
	(b) Chorinemus	1,790	1,820	530	665	444
	(c) *Trachynotus*	6	1	-	-	
	(d) Other carangids	6	5	78	87	56
	(e) *Coryphaena*	251	89	137	24	7
	(f) *Elacate*	25	14		53	-
15.	(a) *Leiognathus*	11,268	3,876	5.90;	2,174	3,585
	(b) *Gazza*	101	48			
16.	*Lactarius*	2,513	1,718	1,132	684	945
17.	Pomf rets	5,697	4,088	2,529	2,445	2,069
18	Mackerel	1.593	2,084	1,040	2,520	2,621
19.	Seer fish	5,277	3,412	3,261	2,600	5,547
20	Tunnies	664	334	449	328	437
21.	*Sph yraena*	119	187	108	43	62
22	Mugil	954	892	170	237	159
23.	*Bregmaceros*		-			
24.	Soles	305	56	680	347	610
25	(a) Penaeid prawns	7,152	8,833	6,266	8,031	8,610
	(b) Non-penaeid prawns	3,523	2,275	5,109	1,532	3,117
	(c) Lobsters	102	3	2	20	103
	(d) Crabs & other Crustaceans	605	329	719	477	1,039
26.	Cephalopods	151	242	408	297	523
27.	Miscellaneous	3,552	8,353	4,561	6,021	4,538
	Total	1,55,638	1,31,321	1,00,756	82,116	91,182

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Table 3d

Estimated marine fish landings in Orissa during the years 1976 to 1979, in tonnes

St. No.	Nameoffish	1976	1977	1978	1979
1.	Elasmobranchs	2,974	1,658	3,386	3,837
2.	Eels	1	–	3	1
3.	Catfishes	1,988	1,035	1,784	694
4.	*Chirocentrus*	517	752	1,073	1,568
5.	(a) Oil sardine	..	..	..	..
	(b) Lesser sardines	1,657	1,227	2,514	2,458
	(c) *Hilsa ilisha*	5,477	2,948	71737	9,884
	(d) Other *Hilsa*	129	492	348	327
	(e) *Anchoviella*	339	486	1,169	502
	(f) *Thrissocles*	106	197	175	255
	(g) Other clupeids	772	778	1,330	1,303
6.	(a) *Harpodon nehereus*	87	86	314	197
	(b) *Saurida & Saurus*	1	5	5	50
7.	*Hemirhamphus & Belone*	1	–	13	23
8.	Flying fish			4	4
9.	Perches	31	55	173	66
10:	Red mullets	1	1	2	1
11.	Polynemids	244	406	1,287	833
12.	Sciaenids	333	312	5,198	474
13.	Ribbon fish	130	174	336	361
14.	(a) *Cafanx*	147	103	68	315
	(b) *Chorinemus*	237	386	815	711
	(c) *Trachynotus*	–	–	–	–
	(d) Other carangids	..	-	-	
	(e) Coryphaena	2	1	3	1
	(f) *Elacate*				
15.	(a) *Leiognathus*	378	233	256	1,097
	(b) *Gazza*	1	–	–	
16.	*L actarius*	*1*	*18*	*12*	*2*
17.	Pomfrets	10.699	1,018	5,714	10,012
18:	Mackerel	425	195	196	281
19.	Seer fish	940	672	1,059	2,411
20.	Tunnies	84	37	609	30
21.	*Sphyraena*	1	3	4	4
22.	Mugil	5		3	22
23.	*Bregmaceros*		–		–
24.	Soles	6	72	103	26
25.	(a) Penaeid prawns	688	802	2,599	787
	(b) Non-penaeid prawns	100	17	12	32
	(c) Other crustaceans	23	6	4	5
26.	Cephalopods	27			13
27.	Miscellaneous	1,271	888	848	2,778
	Total	29,823	15,072	39,670	41,370

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Table 3e

Estimated marine fish landings in West Bengal during the years 1975 to 1979, in tonnes

Sl. No.	Name of fish	1975*	1976	1977	1978	1979
1.	Elasmobranchs	1,450	493	73	125	227
2	Eels	4	1	1	–	–
3.	Catfishes	3,383	785	134	151	136
4	*Chirocentrus*	687	251	107	217	407
5:	(a) Oil Sardine	--	--	—	—	—
	(b) Lesser Sardines	957	12		4	
	(c) *Hilsa ilisha*	5,254	799	96	193	660
	(d) Other *Hilsa*	181	-	-	28	38
	(e) *Anchoviella*	207	6	4	24	14
	(f) *Thrissocles*	1,608	1,397	365	774	270
	(g) Other clupeids	3,436	1,790	705	1,174	1,517
6.	(a) *Harpodon nehereus*	3,043	2,253	1,060	1,365	1,211
	(b) *Saurida & Saurus*	6	—	—		—
7.	*Hemirhamphus & Belone*	5	—	—	11	—
8	Flying fish			—	—	
9.	Perches	201	1	—	—	223
10.	Red mullets	14	—	—	—	—
11	Polynemids	224	69	25	87	172
12.	Sciaenids	4,474	4,066	819	1,772	914
13.	Ribbon fish	1,252	701	306	681	291
14	(a) *Caranx*	237	--	--	2	70
	(b) *Chorinemus*	165	37	12	38	67
	(c) *Trachynotus*		—	—	—	—
	(d) Other carangids	2	—	—	—	—
	(e) *Coryphaena*		—	—	—	—
	(f) *Elacate*	1				
15.	(a) *Leiognathus*	552	219	15	297	96
	(b) *Gazza*	—	—	—	—	—
16.	*Lactarius*	6		1		
17.	Pomfrets	2,501	586	143	282	922
18	Mackerel	116				
19:	Seer fish	554	287	32	54	331
20.	Tunnies	16	—	—	—	—
21.	*Sphyraena*	3	—	—	—	—
23	Mugil	44	2	—	—	—
	Bregmaceros	—	—	—	—	—
24:	Soles	30	-	-	24	
25.	(a) Penaeid prawns	2,920	2,139	602	605	410
	(b) Non-penaeid prawns	2,787	2,708	269	663	161
	(c) Other crustaceans	8	—	—	—	—
26.	Cephalopods	2	.	.	30	.
27.	Miscellaneous	9,431	6,809	1,920	4,153	2,556
	Total	45,761	25,411	6,689	12,754	10,694

* West Bengal & Orissa combined estimate.

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Table 3f

Estimated marine fish landings in Andamans during the years 1975 to 1979, in tonnes

Sl. No.	Name of fish	1975	1976	1977	1978	1979*
1.	Elasmobranchs	48	72	90	89	
2	Eels	—	1	—		
3.	Cat fishes	15	19	28	33	
4	*Chirocentrus*	35	33	38	40	
5:	(a) Oil sardine	—	—	—	—	
	(b) Lesser sardines	66	86	86	97	
	(c) *Hifsa ilisha*	—	—	—	—	
	(d) Other *Hilsa*	13	28	25	31	
	(e) *Anchoviella*	79	118	103	92	
	(f) *Thrissocles*		—			
	(g) Other clupeids	9	—	11	18	* Not
6.	(a) *Harpodon nehereus*	—	—	—	—	available
	(b) *Saurida & Saurus*	—	—	—	—	
	Hemirhamphus & Belone	16	35	53	61	
8	Flying fish	—	—	—	—	
9.	Perches	157	142	196	234	
10.	Red mullets	—	—	4	—	
11.	Polynemids	—		—	—	
12.	Sciaenids	—	5	—	—	
13	Ribbon fish					
14:	(a) *Caranx*	108	125	134	133	
	(b) *Chorinemus*	—	—	—	—	
	(c) *Trachynotus*	—	—	—	—	
	(d) Other carangids	—	—	—	—	
	(e) *Coryphaena*	—	—	—	—	
	(f) *Elacate*					
15.	(a) *Leiognathus*	80	117	97	89	
	(b) *Gazza*				—	
16.	*Lactarius*	80	7	7	-	
17.	Pomfrets	14	30	30	25	
18.	Mackerel	115	77	111	106	
19.	Seer fish	85	93	119	127	
20.	Tunnies	9	13	37	57	
21.	*Sphyraena*	25	49	76	80	
22.	Mugil	84	101	130	131	
23.	*Bregmaceros*	—	—	—	—	
24.	Soles					
25.	(a) Penaeid prawns	28	39	45	38	
	(b) Non-penaeid prawns	—	—	—	-	
	(c) Other crustaceans	—	—	—	-	
26.	Cephalopods					
27.	Miscellaneous	118	149	119	97	
	Total	1,104	1,334	1,532	1,579	

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STOCK ASSESSMENT CONSULTATION
Volume 2

MALAYSIA

Status Paper on Coastal Fishery Resources

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CONTENTS

	Page
1. Introduction	48
2. Status of the coastal fisheries (Peninsular Malaysia)	48
3. Fishermen	53
4. Fishing fleet	53
5. Fishing gear	53
6. Biological information on important genera	54
7. Yield trends over the years against fishing effort	55
8. Stock assessment	56
9. Methodology for collection of catch statistics and the organisational set-up for collection and processing of catch statistics	57
10. Types of catch statistics available	58
11. Problems/constraints in the collection and processing of fishery statistics and requirements for their solution	58
12. Problems/constraints faced in stock assessment and requirements for their solution	60
References	61

Tables

1. Estimated landings by gear groups in operation (1977) Peninsular Malaysia	64
2. Total marine fish landings, Peninsular Malaysia 1968-1977	64
3. Marine fish landings by resource groups, Peninsular Malaysia 1968-1977	65
4. Demersal fish landings (1968-1977), west coast of Peninsular Malaysia	66
5. Average catch rates (kg/hr) obtained by research vessel in waters between Pulau Langkawai and Pulau Pangkor, west coast of Peninsular Malaysia	66
6. Pelagic fish exploited in Peninsular Malysia	67
7. Maximum sustainable yields (MSY) of pelagic fish as estimated by the Workshop on the Fishery Resources of the Malacca Straits 1976	67
8. Landings of pelagic fish in Peninsular Malaysia	68
9. Demersal fish landings (1968-1977), east coast of Peninsular Malaysia	68
10. Average catch rates (kg/hr) obtained by research vessel in waters off the east coast of Peninsular Malaysia	69

<<

Page

11. Types of fishing vessels (1977), Peninsular Malaysia 69

12. Numbers and types of fishing gears licensed (1977), Peninsular Malaysia 69

13. Estimated numbers and types of fishing gears in operation (1977), Peninsular Malaysia 70

14. Growth parameters of *Rastrelliger neglectus* 70

15. Size at first maturity of *stolephorus* spawn 71

16. Food of *Stolephorus* spp. 71

17. Growth parameters for *stolephorus* spp. 71

18. Annual landings by trawlers on west coast and east coast of Peninsular Malaysia 1971 – 1977 72

19. Percentage of seine net landings on the west and east coasts of Peninsular Malaysia 73

20. Summary of trawl survey results carried out by Fisheries Research Institute, Fisheries Division, Ministry of Agriculture 74

21. Estimates of maximum sustainable yield (MSY) and optimal effort for the *Stolephorus* fishery on the west coast of Peninsular Malaysia 75

Illustrations

1. Total landings of marine fish in Peninsular Malaysia by species and by year 76

2. Landings by seine nets and number of seine nets licensed in Peninsular Malaysia 77

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1. Introduction

The marine fisheries resources of the coastal waters of the West and East coasts of Peninsular Malaysia and East Malaysia (Sarawak and Sabah) are rather distinct and at different levels of exploitation. As only Peninsular Malaysia is of immediate relevance to the geographical coverage of the Bay of Bengal Programme (in particular, the West Coast of Peninsular Malaysia), the coastal fisheries of Peninsular Malaysia only are presented in this country report. In the presentation of the country report, the coastal marine fisheries of the West and East Coasts of Peninsular Malaysia are treated separately as they are quite distinct and at different rates of development.

2. Status of the coastal fisheries (Peninsular Malaysia)

2.1 West Coast of Peninsular Malaysia

2.1.1 Methods of Exploitation: The fishermen on the West Coast of Peninsular Malaysia employ a large variety of fishing gears, ranging from traditional fishing stakes, push nets, hand-lines, portable traps, driftnets and bagnets to more modern gear like purse-seines and trawl nets. Prior to the mid-sixties, marine fish were mainly landed by traditional gear. However, with the introduction of trawl fishing in Peninsular Malaysia around 1963, and its subsequent expansion, the otter trawl is now the most important gear employed by the fishermen on the West Coast. Next to the otter trawl, the seine net group (mostly purse-seines) is also an important gear on the West Coast of Perinsulsr Malaysia.

Out of the recorded 378,470 metric tons of marine fish landed on the West Coast in 1977, trawl nets accounted for some 60% or 226,522 metric tons of the landings, followed by the seine net group which landed 14% or 53,030 metric tons of fish (Table 1).

2.1.2 Annual landings: The total marine fish landings from the West Coast of Peninsular Malaysia accounted for some 76% of the total catch landed in Peninsular Malaysia in 1977. Total marine fish landings from the West Coast of Peninsular Malaysia for the years 1968-I 977 are shown in Table 2. During the years prior to 1965, increases in the total marine fish landings were rather insignificant, but thereafter landings increased rapidly to a peak in 1968. The total marine fish landings reached 282,513 metric tons in 1968 but declined through 1969 to 1972 and recovered somewhat in 1973 where landings of around 280,544 metric tons were recorded. The total marine fish landings fluctuated between 270,664 metric tons and 317,710 metric tons during the years 1973-1976. In 1977, there was another dramatic increase in total marinefish landings with 378,470 metric tons being recorded for the West Coast of Peninsular Malaysia. The increase in 1977 was attributed to increases in trash fish and prawn landings by trawlers, better catches for the pelagic fisheries as well as increase in cockle production.

2.1.3 Coastal Resources: The coastal fisheries resources are those resources found within *50-60* miles of the coastline. For the purpose of discussion in this country report, the coastal fisheries resources are generally grouped into demersal, pelagic, prawn and others. The demersal fish resource contains a wide variety of demersal and semi-pelagic species ranging from large fish of commercial value, such as snappers and groupers, to small ones which are generally classified as trash fish for animal feed and fish meal. The pelagic fish resource includes important pelagic schooling species like the chub mackerels, anchovies, tunas, sardines and herrings as well as round scads and yellow banded scads. The prawn resource, on the other hand, contains only the penaeid prawns which include high priced species like *Penaeus monodon* and *Penaeus merguiensis,* as well as smaller sized species of other genera. In the group "others", crabs, cuttlefish, squids, sergestid shrimps and cockles are included. The landings of these different groups (demersal, pelagic, prawns and others) for the years 1968-1977 are shown in Table 3.

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2.1.3.1 *Demersal Fish Resources:* The estimated landings of demersal food fish and trash fish from 1968-1977 for the West Coast of Peninsular Malaysia are shown in Table 4. Commercial landings of demersal fish increased from 89,799 metric tons in 1968 to 183,840 metric tons in 1977. This tremendous increase in demersal fish landings is mostly due to the rapid development of the commercial trawl fishery. However, it is observed that although the total demersal fish landings have increased by slightly more than two-fold from 1968 to 1977, the actual increase in landings is due mainly to the landings of trash fish. The food fish/marketable fish component of the landings had decreased since 1968 until 1976. In 1977, however, there was a slight increase to 48,516 metric tons in the food fish landings. Whilst in 1968 food fish accounted for about 42% of the total demersal fish landings, it dropped to only about 26% in 1977.

The bulk of the demersal fish stocks are exploited by the otter trawls. Other fishing gear employed include bag nets, handlines and portable traps. Demersal fish landed by the trawlers accounted for some 84% of the demersal fish landings in 1977. The demersal fish landing includes a very large number of species, none of which is individually very abundant. Some of the more common families landed are the Sciaenidae, Cynoglossidae, Nemipteridae, Mullidae, Tachysuridae and Synodontidae. In addition to these, the higher priced demersal fish species landed include those from the families Serranidae and Lutianidae.

Various estimates of optimum potential yield from the demersal fish stocks on the West Coast of Peninsular Malaysia have been made. The maximum sustainable yield for the West Coast was initially estimated at around 90,000-94,000 metric tons (Pathansali 1973). However, in 1974, it was re-estimated that the demersal fish stocks on the West Coast could sustain a catch of 103,000 metric tons (Pathansali 1974). Subsequently, the FAO/SCSP Workshop on the Fishery Resources of the Malacca Straits estimated the total maximum sustainable yield of demersal fish available to the West Coast of Peninsular Malaysia as probably around 160,000 metric tons (Anon 1976), which includes probable yields from deeper waters off the West Coast. Comparing the annual demersal fish landings and the various estimates of potential yields, it can be observed that the landings had exceeded the lower estimales of 103,000 metric tons since 1973 and the higher estimate of 160,000 metric tons had been exceeded since 1977.

Resource surveys conducted by the Fisheries Research Institute, Fisheries Division, Ministry of Agriculture in waters off the northern West Coast of Peninsular Malaysia between Pulau Langkawi and Pulau Pangkor also clearly indicate that the demersal fish stock, in the coastal waters mentioned above, is declining and not sustaining itself. The overall average catch rate in these waters had declined from 141.6 kg/hr. in 1971 to 92.1 kg/hr. in 1974 and further declined to 69.4 kg/hr. in 1978 (Table 5).

From the foregoing observations, it is clearly seen that the demersal fish resources are being maximally exploited, particularly in the northern half of the West Coast of Peninsular Malaysia.

2.1.3.2 *Pelagic Fish Resources:* The major groups of fishes that are currently being exploited are the mackerels, anchovies, clupeids, carangids and tunas. A breakdown of these groups is given in Table 6. Of major importance are the Indian and short-bodied mackerels of the genus *Rastrelliger,* which as an individual genus, contributed to approximately 25% of the total amount of marine fish landed in Peninsular Malaysia in 1968. [Fig. 1 (a)].

The bulk of pelagic stocks are fished mainly by seine net. This category of gear includes the purse seine and beach seine but the purse seine is the chief gear type used. Other gear that are used include the drift gillnet, and fishing stakes.

Within the present fishing area in the Malacca Straits, the pelagic resources have been fully exploited. However, actual estimations of the stocks have been rather scanty owing to the general lack of relevant information on fishing effort. The determination of potential yield had been difficult and had to rely on the past trend of catches based on commercial boat landings. Pelagic stock assessment had been curtailed by the lack of research vessels well equipped for pelagic surveys. The estimates for the states of the pelagic stocks must therefore be used with caution.

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It was estimated that the total potential pelagic catch for the West Coast could be between 81,000 tons and 91,000 tons (Chong 1976). Of this potential, the maximum yields for *Rastrelliger* and Stolephorus were estimated at 41,000 tons and 30,000 tons respectively. Other species such as *Megafaspis, Decapterus* and *Scomberomerus* could add a further 10,000 tons to 20,000 tons. In 1974 it was estimated that the pelagic fishery on the West Coast could sustain a catch of 70,000 tons. (The National Delegation 1974). The Workshop on the Fishery Resources of the Malacca Straits estimated the total pelagic maximum sustainable yield available to Malaysia as 88,000 tons (Anon. 1976). A summary for the maximum sustainable yields for the various groups of fishes is given in Table 7.

The landings of pelagic fish recorded for the West Coast of Peninsular Malaysia had fluctuated between 46,000 tons and 132,000 tons over the past 10 years (Table 8). Comparing the various estimates for the potential and the annual landings of pelagic fish, it can be seen that from 1968 to 1971, the landings had exceeded the lowest estimated potential of 70,000 tons The landings of 1968 and 1969 had also exceeded the highest estimated potential of 91,000 tons, the total pelagic resource of the West Coast. The trends of the quantities of fish landed in Peninsular Malaysia had been influenced mainly by a few groups or species of fish and not equally by all species e.g. the decline of marine fish landed in 1969 was due to the exceptional abundance of *Rastrelliger* landed in 1968. The 1975 decline in total marine fish landings over the 1974 landings had been due to drops of cockles and trash fish by about 20,000 tons each (Merican unpublished). With this realisation, a few important groups of fishes have been singled out and their resources have been assessed.

The resources of mackerels *(Rastrelliger),* roundscads *(Decapterus)* and anchovies *(Stolephorus)* have drawn considerable interest and have been assessed. It had been found that the *Rastrelliger* stock in the Malacca Straits had been subjected to a high fishing effort and was considered to be possibly over-exploited (Anon, 1978b). The MSY for mackerels in the Malacca Straits (Andaman Sea — Northeast Sumatra) was estimated at around 98,000 tons using the Malaysian purse seine as the standard gear. The optimum effort was estimated to be 770 fishing units. These values had been exceeded by commercial boats as early as 1968 and *1969.* The *Rastrelliger* stock in the Malacca Straits had therefore been over-exploited and a reduction in fishing effort is urgently required (Anon 1978a).

The roundscads *Decapterus,* are also subjected to rather high fishing effort in the Straits of Malacca. The potential in this area is undetermined but it is estimated to be substantially above the present catch. The stocks along the Thai coast are slightly exploited while they are moderately exploited along the Malaysian coast (Anon. 1978a).

The resources of hardtails, anchovies, small tunas and Spanish mackerel were also estimated (Table 7). While data for these groups were Incomplete, the only stock showing definite evidence of full exploitation is that of the *Stolephorus* stock off Malaysia where it seems probable that overfishing is occurring (Anon. 1976, 1978b).

The above assessment of the resources of the various groups of fishes indicates that the pelagic resources on the West Coast of Peninsular Malaysia have been fully if not over-exploited.

2.1.3.3 Prawn Resources: Prawn fishing is traditional along the West Coast of Peninsular Malaysia where the main traditional fishing gears have been bagnets, seines and gillnets. With the introduction of trawling in the mid-sixties, and its subsequent rapid expansion, the otter trawl is now the major gear employed in the prawn fishery. Trawl fishing accounted for about 76% of the total prawn landings on the West Coast in 1977. Six genera consisting of 28 species of penaeid prawns from the commercial catches have been recorded (Lee 1972). These are the Metapenaeus, Parapenaeopsis, Penaeos, Trachypenaeus, Metapenaeopsis and Solencera of which Metapenaeus, Parapenaeopsis and Panaeus are the major genera of commercial importance. The most important species are Metapenaeus affinis, Metapenaeus brevicornis, Metapenaeus lysianassa, Parapenaeopsis coromandelica, Parapenaeopsis hardwickii, Penaeus merguiensis and Penaeus monodon. The most important genus commercially is Metapenaeus due to its abundant occurrence in commercial catches, while the genus *Penaeus* although not abundant, command a high price by virtue of the quality of their meat and large size.

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The annual prawn landings on the West Coast of Peninsular Malaysia during the years 1965 and 1966 were in the region of 13,000 metric tons, but increased at a more rapid rata thereafter as more and more trawlers switched over to prawn fishing in the following years. The annual landings of prawns for the years 1968-1977 are shown in Table 3. Landings of prawns increased from 26,716 metric tons in 1968 to a peak of 46,703 metric tons in 1971, but fluctuated thereafter between 36,962 metric tons and 51,592 metric tons between 1972-1977.

The maximum sustainable yieid of prawns available to the West Coast of Peninsular Malaysia was estimated to be in the region of 40,000 metric tons (Pathansali 1973). In 1976, the Workshop on the Fishery Resources of the Malacca Straits estimated the maximum sustainable yield of prawns available to the West Coast of Peninsular Malaysia as around 53,000 metric tons with the observation that the prawn landings from waters off the northern half of the West Coast is probably very close to their maximum yields (Anon. 1976).

2.1.3.4 Others: The most important species in this group is the bivalve, Anadara granosa which is cultured on estuarine and coastal mudflats. Other important species in this group are the sergestid shrimp (Acetes sp.) crabs, squids and cuttlefish. The bivalves constitute about half to two thirds of the total landings of this group (Labon 1974). The annual landings of this group have increased steadily from 34,314 metric tons in 1968 to 74,585 metric tons in 1977 (Table 3). The increase is mainly attributed to increases in cockle *(Anadara granosa)* production as well as increases in landings of squids and cuttlefish. While it has been estimated that the maximum yield for this group is around 40,000 to 45,000 metric tons (Labon 1974), the landings recorded in 1977 appear to have already far exceeded the maximum yield estimated, primarily due to the great increase in cockle production and landings of squids and cuttlefish, as well as sergestid shrimps.

2.2 East coast of Peninsular Malaysia

2.2.1 Methods of Exploitation: The fishing gear employed by the fishermen on the East Coast of Peninsular Malaysia ranges from portable traps, hook and lines, driftnets, and liftnets to seine nets and otter trawl nets. The major gear are the seine nets and the otter trawl nets. They collectively accounted for some 66% of the total landings on the East Coast in 1977. The liftnets are a special feature of the East Coast, and in 1977 this gear group contributed about 9% to the total landings in the region. However, it is noted that the pelagic fisheries dominate on the East Coast of Peninsular Malaysia.

2.2.2 Annual Landings: The annual total marine landings from the East Coast of Peninsular Malaysia for the years 1968-1977 are shown in Table 2. The total marine fish landings increased from 62,327 metric tons in 1968 to a peak of 121,801 metric tons in 1974 but thereafter fluctuated between 104,570-120,086 metric tons from 1975 to 1977. It is also of interest to note that there are no landings of cockles (bivalves, Anadara granosa) on the East Coast of Peninsular Malaysia.

2.2.3 Coastal Resources: For ease of discussion, the coastal resourcesof the East Coast of Peninsular Malaysia are again grouped into demersal, pelagic, prawns and others as has been done for the West Coast of Peninsular Malaysia discussed earlier in this report.

2.2.3.1 Demersal Resources: Table 9 shows the estimated landings of demersal food fish and trash fish from 1968-1977. Total demersal fish landings increased from 18,776 metric tons in 1968 to a peak of 52,519 metric tons in 1976. The bulk of the demersal fish stocks is fished by trawlers and the increase in demersal fish landings is mainly attributed to the development of trawl fishing on the East Coast of Peninsular Malaysia. Landings by trawlers accounted for about 66% of the total demersal fish landed on the East Coast in 1977. As in the West Coast, demersal fish landed on the East Coast include a wide variety of species, none of which are individually very abundant. The more common families landed are more or less similar to those on the West Coast.

The maximum sustainable yield estimated for the demersal fish stocks on the East Coast of Peninsular Malaysia within the present range of operation of the fishing vessels is between

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80,000-l 20,000 metric tons (Pathansali 1976). Thus it would appear that the level of exploitation of the demersal fish stocks on the East Coast could be intensified to some extent as the peak landing of demersal fish was only 52,519 metric tons in 1976. While the comparison of landings and estimated maximum sustainable yield indicates that intensification of exploitation of demersal fish stocks is possible on the East Coast, it is noted that results of trawl surveys with research vessels show a decline in the overall catch rates since 1970 from 515.6 kg/hr to 238.1 kg/hr in 1974. This decline in catch rates, however, is attributed to the trash constituent of the catch comprising of exceptionally large amount of Paramonocanthus which occurred only once in 1970. Commercial fish catch rates for the surveyed region was 184.7 kg/hr in 1970 and has since only decreased to 143.6 kg/hr (Table 10). However, it is noted that the demersal fish resources in waters off certain parts of the East Coast are already well exploited.

2.2.3.2 Pelagic Resources: The species of pelagic fish exploited are as given in Table 6. The landings of some selected species are shown in Fig. 1 (b). Again as on the West Coast, the chief gear used is the purse seine. Drift gillnets, liftnets, fishing stakes and fishing lines are the other gear used.

On the east coast of Peninsular Malaysia, the level of exploitation of pelagic stocks is not as high as the West Coast. This is shown by the fewer number of seine nets licensed (Fig. 2). The landings of pelagic fish on the East Coast have, therefore, been generally lower than those recorded for the West Coast. The lower catches could mean that the pelagic resource is small or the fishermen were fishing only on the fringes of a greater stock that may be available (Chong 1976). Elliston (1966) attributed the lower catches to the general lack of capital and technology introduced into the fishery.

With the availability of the various species of pelagic fish, it was estimated that the maximum catch of pelagic fish could be around 80,000 tons if not more. (The National Delegation 1974). The total potential yield from the schcoling pelagic fish in the coastal waters could be between 56,000 tons and 75,000 tons (Labon 1974).

In 1977, the landings of pelagic fish were recorded as around 69,000 tons (Table 8). This figure showed an increase of about 15,000 tons over the landings of 1976 and is the highest of the recorded landings of pelagic fish for the past 10 years. This figure is just slightly below the estimated maximum potential. There is therefore only a slight scope for further expansion of the coastal pelagic fisheries on the East Coast.

The *Rastrelliger* stocks were estimated to be 13,000 tons and are probably nearly fully exploited (Anon. 1978a).

Chong (1976) estimated the probable upper limit for *Rastrelliger* as 15,000 tons. The highest *Rastrelliger* landings recorded over the past ten years was 12,000 tons in 1974. The *Decapterus* stocks were reported to be only moderately exploited and were estimated to be roughly 15,000 tons (Anon. 1978a). However, this value was reached in 1977. No estimates for tuna could be obtained. However, there is probably little scope for any further development of the tuna fishery in the distant waters of the South China Sea since this fishery is rather welt developed due to the great demand for tuna. The prospects for harvesting the other smaller species of schooling pelagic fish in the distant waters of the South China Sea appear good. Of the total 4.2 million tons of resources in the South China Sea, only 2.0 million tons have been exploited (Labon 1974).

2.2.3.3 Prawn Resources: The annual prawn landings on the East Coast of Peninsular Malaysia from 1968 to 1977 are shown in Table 3. As on the West Coast, prawns are landed mainly by trawlers on the East Coast of Peninsular Malaysia. In 1977, trawlers accounted for some 87% of the total prawn landings. Landings of prawns had fluctuated between 1,643 metric tons and 4,070 metric tons during the years 1968 to 1977. The fluctuations were due mainly to the effect of the prevailing conditions during the north east monsoon when prawns are in season and the extent of trawling activity for prawn (Labon 1974).

Landings of prawns depend partly on coastal semi-resident stocks which show seasonal variation and partly on migrant stocks which appear in the coastal waters during the period of

the northeast monsoon. Whilst the former stocks are fairly well exploited the latter stocks appear to be inefficiently exploited. As such, the potential yield possible is estimated to be around 5,000 to 6,000 metric tons (Pathansali 1976).

The penaeid prawn species recorded from commercial catches include all the 6 genera of penaeid prawns found on the West Coast of Peninsular Malaysia. However, three genera appear to be found only on the southern part of the East Coast, i.e. East Johore State in a study carried out by Lee, *1972.* These are the genus *Solenocera, Metapenaeopsis* and *Trachypenaeus.*

2.2.3.4 Others: While the group "Others" on the West Coast includes landingsof the bivalve, *Anadara granosa* it is noted that there are no landings of *Anadara granosa* on the East Coast of Peninsular Malaysia. Landings of this group "Others" (consisting of the sergestid shrimp Acetes, squids, cuttlefish and crabs) for the years 1968-1977 are shown in Table 3. The landings of this group increased from around 1,600 metric tons in 1968 to about 6,000 metric tons in 1976 but declined the following year (1977) to around 3,000 metric tons. The increase in landings is mainly attributed to increased landings of squids and sergestid shrimps. The maximum yield estimated for this group is around 3,000 to 4,000 metric tons (Pathansali 1976).

3. Fishermen

The fishing population shows a fluctuating trend over the years. According to the 1977 fisheries statistics record there are 75,645 fishermen in Peninsular Malaysia. Of this total, some 48,690 (64%) are from the West Coast of Peninsular Malaysia, and 26,955 (36%) from the East Coast.

4. Fishing fleet

The fishing fleet of Peninsular Malaysia in 1977 consisted of 24,081 licensed vessels, 17,075 (71%) of which are operating on the West Coast of Peninsular Malaysia whilst 7,002 units (29%) are found on the East Coast. About 70% of the total fleet strength are boats powered with inboard engines, 12% with outboard engines and the remaining 18% are non-powered. Of the total 17,075 fishing vesesls on the West Coast of Peninsular Malaysia, 83% are powered (69% powered by inboard engines, 14% by outboard), while the balance of 17% are non-powered. On the east coast, the powered fishing vessels constitute 80% of the fishing fleet, of which 73% have inboard and 7% outboard engines. The rest of the fishing boats (20%) are non-powered (Table 11).

Although there is a wide range in the engine horsepower used, the majority are under 40 horse-power and only a small percentage are about 100 horsepower, of which quite a number are industrial engines converted to marine use (Labon 1974). All the fishing vessels are constructed of wood.

5. Fishing gear

As mentioned earlier in the paper, the Malaysian fishermen employ a large variety of fishing gear ranging from traditional fishing stakes, traps, liftnets, and driftnets to more modern gear like trawl nets and purse-seine. The numbers of different types of fishing gear licensed in 1977 are shown in Table 12.

On the West Coast of Peninsular Malaysia, licensed drift/gillnets constituted about 44% of the total fishing gear licensed while trawl nets, seine nets, bagnets and shellfish collectors made up 15%, 9%, 7% and 16% respectively of the total gear licensed. However, it is noted that not all the gear licensed are in operation and the trawl nets estimated to be in operation are greater in number than those actually licensed. The estimated number and types of fishing gear in operation in 1977 are shown in Table 13. It can be seen from Table 13 that trawl nets accounted for some 29% of fishing gear estimated in operation in 1977 as compared to 15% licensed for that year.

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6. Biological information on important genera

6.1 Rastrelliger spp.: The biology of *Rastrelliger neglectus* in the Gulf of Thailand had been comprehensively studied by various Thai workers (Vanichkul and Hongskul 1966, Sucendhamarn 1970, Horrgskul 1974). In the Straits of Malacca, work was mainly centred on *R. kanagurta* landed in Pangkor (Pathansali 1961, 1967). Chong and Chua (1974) studied aspects in the growth and spawning of *R. neglectus* in the northern Straits of Malacca.

6.1.1 Spawning: It has been known that in *Rastrelliger,* like in some other scombrid fishes, the eggs in the ovary ripen asynchronously. Only a small portion of the eggs are fully mature at any one time. This results in the release cf different batches of eggs over an extended spawning period. Pathansali (1967) reported that at least two batches of eggs could be spawned.

In *R. Kanagurta* the spawning season extends from October/November to April (Pathansali 1961). In a later study made on fish sampled in Penang, the spawning season extended from May to January (Chee 1978). These probably show that while *R. kanagurta* spawns throughout the year, there are more prominent spawning peaks exhibited. The main spawning season of *R. neglectus* extends from October to December annually (Chong and Chua 1974).

6.1.2 Size at first maturity: The size at first maturity of *R. Kanagurta* was reported to be 18.75 cm total length (Pathansali 1961) and 16.6 cm standard length (Chee 1978), respectively. *R. neglectus* was reported to have attained first maturity at 18.5 cm total length (Chong and Chua 1974).

6.1.3 Fecundity: Studies on the size distribution of *eggs* in the ovary of *Rastrelliger* spp. revealed that only a small portion of eggs in an ovary seemed to be spawned at one spawning season (Pathansali 1967). It was estimated that a female would release only about one-tenth of the total number of eggs in an ovary, 20,000 to 30,000 at a spawning season (Anon 1978a).

6.1.4 *Food:* The main food items consumed in order of percentage occurrence in the stomachs of *R. Kanagurta* are Phytoplankton, Copepods, Decapods, Ostracods, bivalve larvae and Dinoflagellates (Pathansali 1961).

6.1.5 Size composition: The mainstay of the *Rastrelliger* fishery at Pulua Pangkor on the West Coast of Peninsular Malaysia as observed by Pathansali (1961) was medium-sized *R. kanagurta* between 16.75 cm and 20.26 cm.

As for *R. neglectus,* a recruitment population of sizes 10 cm to 14 cm appeared in the landings January to March while adult fish were caught from May till September. The fishery thus depended on one-year olds or *"0"* year class of *R. neglectus* (Chong and Chua 1974).

6.1.6 Growth of R. neglectus: Four broods of fish, as determined by growth curves, were analysed by Chong and Chua (1974). $L\infty$, K and t_o were determined. The results obtained were summarised in Table 14.

6.2 Stolephorus spp.: The bulk of the studies on the biology of *Stolephorus* in the Malaysia region, had been carried out in the Straits of Singapore. Although this fishery is important in the straits of Malacca, very little work has been done in this area. Presently some studies on this genus have been initiated by the Fisheries Research Institute, Penang. The results obtained will be published in due course.

6.2.1 Spawning: From length-frequency studies carried out by Tham (1966) it was found that *S. heterolobus* (formerly *S. pseudoheterolobus)* spawns throughout the year probably at intervals of one to two months. Some of these spawning periods may be more intense than others. Although members of the genus *Stolephorus* have plantonic eggs, few eggs had been encountered in the Straits of Singapore (Tham 1966). As such their spawning grounds may be located further out at sea as was reported by Delsman (1931) who made a thorough survey of *Stolephorus* eggs and larvae in the Java Sea.

6.2.2 Size at first maturity: The sizes at which some *Stolephorus* spp. reach first maturity are as shown in Table 15. These were reported by Tham (1967a).

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6.2.3 *fecundity:* Tham (1974) recorded the number of mature eggs in a single female S. heterolobus at a standard length of 55 mm to be 1,000. A fish of standard length 62 mm was reported to have 2,500 eggs. Tiews et a/ (1970) who studied the biology of anchovies in Philippine waters recorded the number of *eggs* in *S. buccaneeri* as between 7,000 and 11,000 per fish. *S. commersoni* and *S. bataviaensis* were reported to have 5,000 to 10,000 eggs while *S. indicus* had 9,000 to 14,000 eggs per fish.

6.2.4 *Food:* The main food item of *Stolephorus* as reported by Tham (1974) is as shown in Table 16.

6.2.5 Size composition: Casual observation revealed that fish between 30 mm and 60 mm can be commonly encountered in the catch throughout the year. However, for the first half of the year, small fish can be encountered more. Larger fish are more commonly caught during the last six months of the year. Tham (1968) noted that *S. heterolobus* entered the commercial fishery at a standard length of 15 mm.

6.2.6 *Growth:* The following results on growth were obtained by Tham (1967b).

6.3 Decapterus spp. : Most of the biological information on *Decapterus* spp. is available from Philippines and Thailand where this fish is better developed. Information from Malaysia is limited ; however, work on the biology of this genus has been initiated by the Fisheries Research Institute, Penang.

7. Yield trends over the years against fishing effort

As mentioned earlier in the paper, the trawl and seine fisheries are the two most important fisheries in Peninsular Malaysia. It is, therefore, proposed to examine the yield trends against fishing effort over the years of these two fisheries in this section of the paper.

7.1 Trawl Fishery:

7.1 .1 West Coast of Peninsular Malaysia: The landings by trawlers from 1971 to 1977 are shown in Table 18. Total landings by trawlers on the West Coast of Peninsular Malaysia increased from 94,763 metric tons in 1971 when 3,252 trawlers were estimated in operation, to 226,521 metric tons in 1977 with 4,195 trawlers estimated in operation. The increases in trawl landings prior to 1976 are mainly attributed to increased landings of trash fish while increases in 1976 and 1977 are mainly due to increases in landings of trash fish as well as pelagic fish (principally *Rastrelliger* spp.) and squids. The increase in pelagic fish landings-by trawlers is attributed to the use of high opening trawl nets by the fishermen, of which the main target catch is the *Rastrelliger* spp.

7.1.2 East Coast of Peninsular Malaysia: Development of the trawl fishery on the East Coast of Peninsular Malaysia has not been as rapid as on the West Coast. The total trawl landing on the East Coast was 19,238 metric tons in 1971 with an estimated 1020 trawlers in operation. The trawl landings dropped slightly in 1972 but thereafter increased to around 42,777 metric tons in 1974 and fluctuated between 45,084 and 34,603 metric tons between 1976 and 1977. While it is observed that the trawl landings have increased generally from 1971 to 1977, the estimated number of trawlers that were in operation over the same period appears to have declined generally from 1971 to 1973 viz. 1020 trawlers estimated in 1971 to 730 units in 1973, and then gradually increased to around 1059 units in 1976 but again decreased to around 984 units in 1977 (Table 18).

7.2 Trend of the Seine Net Fishery: The general trend of the seine net fishery is shown in Table 19. There was a general decline in the total amount of fish landed by seine nets from 1968 to 1972. In 1968, 148,000 tons of fish were landed by seines. This figure dropped to only 67,000 tons in 1972. Landings increased in 1973 and 1974 to just around 90,000 tons but dropped again in 1975 to 68,000. The total landings by seine nets in 1977 were around 97,000 tons for the whole of Peninsular Malaysia.

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From 1968 to 1971, the landings of fish by seines operated along the West Coast contributed to the major bulk of the total seine net landings. In 1968 and 1969, 90% of the total seine net landings were recorded to be from the West Coast. Landings by the same gear on the East Coast made up only 10% of the total seine net landings.

The pattern changed after 1971. The East Coast landings increased considerably and contributed to 35% of the seine net landings in 1972. Although this dropped to 27% in 1973, the subsequent landings picked up to reach 46% in 1977 (Table 5(1).

Earlier it had been reported that the high landings of marine fish recorded in 1968 had been attributed to the exceptional abundance of *Rastrelliger.* The landings of 95,000 tons of *Rastrelliger* in 1968 were exceptionally high as compared to the usual 20,000 to 30,000 tons landed prior to 1968. This demonstrates that the decline in fish landings had been due to one or a few species and had not been due equally to all species. Attention has therefore been focussed on these species. Their status had been discussed in an earlier section. The crucial problem faced now is one of management and not of exploitation since our coastal pelagic stocks both on the West and East Coasts have been fully if not over-exploited.

8. Stock assessment

Systematic trawl surveys have been carried out by the Fisheries Research Institute, Fisheries Division, Ministry of Agriculture on both the East and West Coasts of Peninsular Malaysia. Results from these surveys have been utilised to assess and monitor the abundance/state of the coastal demersal fish resources. Catch rates of the research vessel carrying out the trawl surveys have been used as indices of abundance of demersal fish stocks in the surveyed regions, while stock densities within the surveyed areas have been computed from the results using the "Swept Area" method. The results of the trawl surveys carried out since 1970 on the East and West Coast of Peninsular Malaysia are summarised in Table 19.

In addition to the demersal trawl surveys mentioned above, estimates of optimum yields have been made from commercial catch and effort data by employing logistic type models (linear logistic as well as exponential logistic models). These analyses have been applied by Pathansali (1976(a) and 1976(b)) to the demersal fishery of the West Coast of Peninsular Malaysia.

These logistic models have also been employed to determine the optimal yield and effort for the *Stolephorus* fishery on the West Coast of Peninsular Malaysia, but the results of the analyses are only preliminary findings which can be improved as more detailed data are collected (Chee 1979). A summary of the preliminary findings on the *Stolephorus* fishery on the West Coast of Peninsular Malaysia is shown in Table 21. Results from the analyses using the linear logistic and exponential logistic models for the *Stolephorus* fishery on the West Coast indicate a great difference in the estimates of maximum sustainable yield and optimal effort between the two models employed. However, observations on the *Stolephorus* fishery indicate that the linear model appears to fit the fishery more realistically than the exponential logistic model.

To improve and enlarge the data base necessary for more precise and realistic estimates of optimal yields and effort for the demersal and pelagic fisheries, research activities currently undertaken by the Fisheries Research Institute, Fisheries Division, Ministry of Agriculture, have been expanded to include studies on the trash and commercial fish by catch of prawn trawlers as well as regular collection of more detailed catch and effort data of the commercial trawlers and purse-seine boats to supplement the national statistical data published by the Fisheries Division, Ministry of Agriculture, which at the moment lacks sufficient detailed data required by the scientists for stock assessment.

Prawn resource surveys will also be conducted with a research vessel in the near future to assess the abundance and distribution of the prawn stocks on both the East and West Coasts of Peninsular Malaysia. These surveys will be carried out as soon as the prawn resource survey vessel, currently nearing completion, is made available to the Fisheries Research Institute. Acoustic surveys with another research vessel will also be conducted on the pelagic stocks with priority being given to the assessment of the pelagic stocks on the East Coast of Peninsular Malaysia.

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The collection of detailed commercial catch and effort data will also be expanded by the Fisheries Research institute, with particular emphasis on the collection of effort statistics, to more fish landing centres in the country. In addition, biological studies on selected important fish and prawn species will be intensified.

9. Methodology for collection of catch statistics and the organisational set-up for collection and processing of catch statistics

9.1 **Methodology:** In 1977, two methods were employed for the collection of catch statistics. These were (a) Complete enumeration for trawl fishery, (b) "Random" sampling for all other fisheries.

(a) **Complete enumeration:** It is a policy requirement that all trawlers be licensed only through co-operative societies/fishermen associations. As such these organisations keep records of the daily catches from all trawlers under their charge through the trawl sales receipts produced by the operators. The fishery enumerators therefore obtain trawl catch data from these records every month. The data obtained are tabulated according to tonnage, class and species.

(b) *Random sampling:* For all other fisheries, estimates of catch data are made through a simple sampling method.

The fishery enumerator, being the licensing officer in the district in which he is stationed, maintains a fishing gear register which is a record of all types of fishing gears licensed in his district by type of gear and village. Using this register as a frame, the enumerator then selects, for each type of gear, samples for enquiry. The number of samples selected for each month will vary according to the number of gear in operation. A rough schedule for sample selection is as follows :—

Number of units in operation	Sample size
less than 10	all
11-20	1 in 2
21-50	1 in5
more than 50	1 in10

Having selected the samples, the enumerator visits all the villages under his jurisdiction at least once a month and from each village he selects a number of samples. The number of samples per gear will depend upon the number of units in operation in that village. However, he makes sure that the samples are distributed proportionally throughout the village in his district. Having selected his samples, he then enquires from the operators of these samples, their catches, by species, for the previous month.

At the same time he will also confirm by enquiry, the actual number of units in operation in the village for the month in question and adjust his frame accordingly. The enquiries are then entered into prescribed forms and from his samples he calculates the average catch per unit for the type of gears in question. This average catch per unit multiplied by the number of units in operation in the district for that month will give the estimate of the catch for the previous month for his district. This process is repeated for every type of gear in operation in his district so that a monthly estimate of catch for the district by type of gear and by species can be made.

9.2 Organisational set-up: The 11 states which make up Peninsular Malaysia are divided into 32 marine districts. Each district is placed under the charge of a Fishery Assistant whose duties are multi-functional. One such function is the collection of catch statistics.

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The catch data gathered for every calendar month is entered into the prescribed forms and sent to the statistics unit at Fisheries Headquarters at Kuala Lumpur where these reports are processed and compiled.

The Statistics Unit at Headquarters is a unit under the Planning and Development Section headed by a Fishery Officer (Statistics) and assisted by two Senior Fisheries Assistants, six Fisheries Assistants and a clerk. This unit is responsible for the processing of all monthly reports sent in by the districts and the data is tabulated into catch by tonnage class, gear groups, species, months, by districts and by States which are then published as quarterly and annual reports.

10. Types of catch statistics available

While catch statistics with reference to species, seasons (months of the year), areas, types of vessels and gear are available to some extent from the Annual Fisheries Statistics published by the Fisheries Division, Ministry of Agriculture, the catch statistics with reference to fishing efforts in hours is currently not available. However, effort statistics with reference to numbers of different types of fishing gear estimated in operation during a particular year is available.

The extent of catch statistics with reference to species, seasons, areas, types of vessels and gears available is as follows:

10.1 With reference to species; The types of catch statistics with reference to species available **are :**

(a) By species and areas (States)

(b) By species and months

(c) By species and gear groups

(d) By species and vessel tonnage groups (trawlers only).

10.2 With reference to seasons (months)

(a) By month and species

(b) By month and gear groups

(c) By month and areas (Fisheries Districts and States)

10.3 With reference to areas

(a) By area (Fisheries Districts and States) and gear groups

(b) By area (States) and species

(c) By area (States) and months

(d) By area (States) and vessel tonnage groups (trawlers only)

10.4 With reference to types of vessels

Catch statistics with reference to vessel types are available for trawlers only :

(a) By trawler tonnage group and species

(b) By trawlers tonnage group and areas (States)

10.5 With reference to gear

(a) By gear group and areas (States and Fisheries Districts)

(b) By gear groups and months

(c) By gear groups and species.

11. Problems/constraints in **the collection and processing of fishery statistics and requirements for their solution**

11.1 Problems/Constraints: Although we have very comprehensive statistics on fisheries catch, there are however, many weaknesses in the existing system which question the reliability of these data. As far as trawl data is concerned, due to poor management of many Co-operative Societies/Fishermen's Associations the catch data of trawlers are not properly kept. Besides

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the trawler members of these organisations always give information on their catch which are lower than the true figure. This is because the trawl operators have to give a commission to the Co-operative Society every month based on the volume of their catches. Thus, in order to avoid paying a higher commission they understate their catches. The operators also practise this to avoid detection by the income tax authority. Another major flaw is that only records of catches of licensed trawlers are kept by these organisations. The unlicensed trawlers in the fishing centres, not being members of the Co-operatives, do not supply catch data to these organisations. Thus, catch by unlicensed trawlers in many cases are left out in the monthly enumeration.

As far as other fisheries are concerned where the sampling system is used the major weaknesses are :

(i) Samples selected by the enumerators are not based on any scientific method but rather according to the convenience of the enumerators. This leads to the embodiment of bias in the data collected. Besides this, the catch data are collected by enquiry and as such depends to a great extent on the reliability and good memory of the fishermen interviewed. As it is very difficult for any fisherman to remember what he caught the previous month (the fishermen do not keep records of their catches) most of the statistics so collected may be unreliable. Also the fishermen interviewed sometimes intentionally understate or overstate their catches depending on what their motives are. For example if he fears taxation then he understates his catches, on the other hand if he is intending to apply for subsidy given to progressive fishermen, he overstates his catches.

(ii) Another very important problem is the raising factor used in the present method, i.e. the number of fishing units actually in operation in any area and at any time. Although good records exist on the number of licensed units in any districts and the Fishery Assistant double checks this information before he computes the monthly catch data, there may be error as to the actual number of units in operation, because not all units operateall round the month and also some local units may be landing their catches in other landing centres.

(iii) Staff shortage is another big problem. The field enumerator who is the District Fishery Assistant is not responsible for statistics collection alone. As his duties are multi-functional only about 10% of his time is used for statistics work. With the developments in the industry which bring new problems and new duties, the District Fisheries Assistant devotes only a fraction of his time for statistics work as it is treated as a low priority subject among his many duties. This factor is one of the biggest problems facing the present statistics collection system. This also contributes to delay in the submission of the monthly reports to the Statistics Unit in Kuala Lumpur which in turn holds up the processing work and the publication of the statistics reports.

11.2 *Requirement for solving/removing the above problems/constraints:* The basic requirement for solving the above problems is to have special staff exclusively for statistics collection and also the employment of a sampling system based on observation rather than on enquiry. I am happy to say that both these requirements have been partially fulfilled since 1979 when new staff exclusively for statistics work were recruited. With the assistance of the South China Sea Programme the whole statistics system in Peninsular Malaysia has been overhauled. However, due to limitation in manpower and money, the new system has been only partially implemented. As the trawl and purse seine fishery contribute to more than 70% of Peninsular Malysia's marine catches, therefore, the sampling system by observation is used to estimate the catch of these fisheries. The other fisheries which make up less than 30% of the catch are mainly traditional small-scale fisheries where the old system by enquiry is still employed. This is because the existing staff and funds are inadequate to cover all fisheries at the present moment. It is hoped that in the next few years with additional staff and money the new system will be employed to cover all fisheries.

The new system for catch estimation of trawl and purseseine fishery is briefly described below:

A frame survey of all trawl and purse seine units in a State is made and based on this frame three centres for each type of gear are selected at random with the aid of the random number

table using the technique of probability proportional to size. The Fishery Assistants responsible for the State will then observe catches in each centre for five consecutive days. Each day a complete count of all units landed at the centre is made and 3-5 samples for each type of gear is taken. The catches of each sample are recorded through observation. The average catch per unit multiplied by the number of units landed for the day will give the estimate of the catch landed for the day observed. This process is repeated for five consecutive days at the same centre. At the end of the fifth day the average per day for the five days is calculated which when multiplied by the total number of fishing days in the month will give an estimate of the monthly landing for that centre. This total for the month divided by the number of fishing units based at the centre will give the average catch per unit per month for that centre. This process is repeated at the next two centres and the average for the three centres will give the average catch per unit per month which is used as the average for the whole state. This average catch per unit per month for the State multiplied by the total number of units operating in the State gives the estimated catch for the gear in question for the whole month.

This system of catch estimate is only used for trawls and purse seines whereas for all other gear in the State the sampling by enquiry is done to estimate catch. This new approach to statistics collection has increased to a great extent not only the accuracy and reliability of catch but has also cut delays in the reporting procedures.

12. Problems/constraints faced in stock assessment and requirements for their solution

The major problems/constraints currently faced in stock assessment work in Malaysia and the requirements for their solution may be categorised under the following :

12.1 Catch and Effort Statistics: One of the main problems faced is the inadequate detailed commercial catch and effort statistics currently available. There is an urgent need to collect more detailed statistics on commercial fishing effort that is being exerted on the fish stocks currently exploited by the different fishing gears in the coastal waters. In the absence of detailed fishing effort data, good estimates of optimum yield from the coastal fish stocks would not be possible.

Thus greater effort should be made in the collection of detailed effort statistics at the national level. For stock assessment at the regional level, efforts should also be made to standardise the fishing effort units used by the various regional countries to facilitate assessment of regional fish stocks, particularly with reference to pelagic stocks.

12.2 *Biology of Tropical Fish Species:* Another problem faced in stock assessment is the lack of knowledge on the biology of our many tropical fish species. Due to multispecies nature of our tropical coastal fish stocks, there is a great need to obtain basic biological information, e.g., food and feeding, growth, reproduction, behaviour, seasonal fluctuations, migration pattern, etc. of the various fish species that are being exploited. Therefore, studies on the biology of the numerous species need to be intensified not only at the national level but also at the regional level.

12.3 Population Dynamics: Estimates of optimum yields from the coastal fish stocks have been made by employing logistic models in Malaysia. However, these models were developed primarily for monospecies fisheries in temperate waters, and while these models may provide very rough estimates of optimum yield and effort, they appear to be less suitable for tropical demersal fish stocks which contain a multitude of species.

Therefore, there is need to develop a model for the tropical fish stocks in order that better estimates of optimum yield and effort could be made. Such a model is currently not available for the multispecies fisheries of tropical waters.

12.4 Trained Personnel: One of the main constraints in stock assessment work in Malaysia is a general lack of personnel who are well-trained in stock assessment work. In order that this constraint may be solved, it is strongly urged that Regional/International Agencies provide training assistance to fisheries research officers currently engaged in stock assessment work

in Malaysia. Regional/international agencies could provide funds for training the officers in appropriate institutions where training in stock assessment techniques could be given. Alternatively regional/international agencies could establish and fund a Regional Training Centre to cater for the training of fishery scientists in stock assessment techniques.

References

Anonymous. 1976 — Report of the Workshop on the Fishery Resources of the Malacca Straits- Part 2. South China Sea Fisheries Development and Co-ordinating Programme.

Anonymous. 1978a — Report of the workshop on the biology and resources of mackerels (Rastrelliger spp.) and round scads (Decapterus spp.) in the South China Sea — Part 1. South China Sea Fisheries Development and Co-ordinating Programme.

Anonymous. 1978b — Report of the workshop on management of resources of the Sunda Shelf, Malacca Straits and related areas. South China Sea Fisheries Development and Co-ordinating Programme.

Chee, P. E. 1978 — The reproductive pattern of *Rastrelliger Lanagurta.* Proceedings Second Annual Seminar, Malaysia Society of Marine Sciences, 33-42.

Chee, P. E. 1979 — A preliminary study of the pukat jerut bilis fishery of the North-West Coast of Peninsular Malaysia. Mal. Agric. J.S2(1) : 43-50.

Chong, B. J. 1976 — The status of pelagic fisheries resources in Malaysia. In: Fisheries Bulletin No. 5, Ministry of Agriculture, Malaysia : 27-46.

Chong, B. J. and Chua, C. W. 1974 — Growth, age determination and spawning of ikan kembung, *Rastrelliger neglectus* (Van kampen) in the northern Straits of Malacca. Mal. Agric. J. 49: 344-356.

Delsman, H. C. 1931 — Fish eggs and larvae from the Java Sea 17. The genus *Stolephorus.* Treubia XII : 217-243.

Elliston, G. R. 1966 — A survey of the economics of the Malaysian pukat jerut (purse seine) industry in 1966.

Hongskul, V. 1974 — Population dynamics of Platu *Rastrolliger neglectus* (Van Kampen) in the Gulf of Thailand. Proceedings, Indo-Pacific Fisheries Council 15(3) : 297-342.

Jothy, A. A., Rauck, G. Mohd. Shaarib, S. A. L., Ong, K. S. Liong, P. C. and Carvelho, J. L. 1975 — Demersal fish resources in Malaysian waters- 3. Second trawl survey of the coastal waters off the East Coast of Peninsular Malaysia. In: Fisheries Bulletin No. 4, Ministry of Agriculture, Malaysia.

Labon, A. 1974 — Malaysia long-term fisheries development plan until 1995. FAO/UN DP South China Sea Fisheries Development and Co-ordinating Programme.

Lam, W. C., Weber, W., Lee, A. K. Ong, K. S. and Liong, P.C. 1975a — Demersal fish resources in Malaysian waters — 7. 3rd. East Coast trawl survey off the East Coast Peninsular Malaysia. In: Fisheries Bulletin No. 9, Ministry of Agriculture, Malaysia.

Lam, W. C., Mohd. Shaarib, S. A. L., Lee, A. K. and Weber, W. 1975b — Demersal fish resources in Malaysian waters- 5. Second West Coast trawl survey off the West Coast of Peninsular Malaysia. In : Fisheries Bulletin No. 7, Ministry of Agriculture, Malaysia.

Lamp, F. and Mohd. Shaarib, S. A. L. 1976 — Demersal fish resources in Malaysian waters — 10 Fourth trawl survey of the coastal waters off the East Coast of Peninsular Malaysia. In: Fisheries Bulletin No. 12, Ministry of Agriculture, Malaysia.

Lee, S. S. 1972 — Commercial Species of penaeid prawns in West Malaysia. Mal. Agric. J. 48(3) : 264-277.

Malaysia. — Annual Fisheries Statistics, Fisheries Division, Ministry of Agriculture, Malaysia. 1968-1977.

Mohd. Shaarib, S. A. L. 1976 — Demersal fish resource surveys and problems of fisheries resource management. In : Fisheries Bulletin No. 15, Ministry of Agriculture, Malaysia.

Mohd. Shaarib, S. A. L. and Chai, H. L. 1976 — Demersal fish resources in Malaysian waters — 11. Third trawl survey off the West Coast of Peninsular Malaysia. In: Fisheries Bulletin No. 13, Ministry of Agriculture, Malaysia.

Mohd. Shaarib, S. A. L., Rauck, G., Ong, K. S. and S. P. Tan. 1974 — Demersal fish resources in Malaysian waters-2 Trawl survey of the coastal waters off the West Coast of Peninsular Malaysia. In: Fisheries Bulletin No. 3, Ministry of Agriculture, Malaysia.

Mohd. Shaarib, S. A. L., Weber, W. and Liong, P. C. 1976 — Demersal fish resources in Malaysian waters-8, Trawl survey off the West Coast of Peninsular Malaysia (Southern part of the Malacca Straits). In: Fisheries Bulletin No. 10, Ministry of Agriculture, Malaysia.

Pathansali, D. 1961 — A preliminary report on the *Rastrelliger* fishery in Malaya. Proceedings, Indo-Pacific Fisheries Council 2(2) : 37-48.

Pathansali, D. 1967 — Observations on the gonad maturity stages of female *Rastrelliger kanagurta* cuvier. Proceedings Indo-Pacific Fisheries Council 12(2) : 112-l 15.

Pathansali, D. 1973 — Status of the marine fisheries with assessment of potential yields from the coastal marine fisheries resources of Malaysia. Technical seminar on South China Sea Fisheries Resources, South East Asian Fisheries Development Centre, 21-25 May 1973, Bangkok, SEAFDEC/ *SCS. 73: 5-25 : 12* pp.

Pathansali, D. 1976a — Some observations on catch and effort of commercial and research trawler with estimates of yield. Proceedings of the International Seminar on Fisheries Resources Management and Their Management in South East Asia, Berlin 19th November-6th December, 1974. pp. 248-255.

Pathansali, D. 1976b — Assessments of potential yields from the coastal marine fisheries resources of Malaysia. In: Fisheries Bulletin No. 15, Ministry of Agriculture, Malaysia : 47-60.

Pathansali, D., Rauck, G. Jothy, A. A. Mohd. Shaarib, S. A. L. and Curtin. T. B. 1974 — Demersal fish resources in Malaysian waters (trawl survey of the coastal waters off the East Coast of West Malaysia). In: Fisheries Bulletin No. 1, Ministry of Agriculture, Malaysia.

Sucondhamarn, P., Tantisawetrat C., and Sriruangcheep U. 1970 — Estimation of age and growth of chub mackerel *Rastrelliger neglectus* (Van Kampen) in the western Gulf of Thailand. In: The Kuroshio, East-West Centre Press, 471-477.

Tham, A. K. 1966 — A contribution to the biology of ikan bilis, *Stolephorus pseudoheterolobus* Hardenberg. Bull. Natn. Mus. St. Singapore 33.

Tham, A. K. 1976a — A contribution to the study of the growth of members of the genus *Stolephorus* in Singapore Straits. Proceedings, Indo-Pacific Fisheries Council 12(2) : l-25.

Tham, A. K. 1976b — Studies on the growth of fish in Malaysia and Singapore waters. Proceedings, Second Symposium on Scientific and Technological Research in Malaysia, 94-104.

Tham, A. K. 1968 — Synopsis of biological data on the Malayan anchovy, *Stolephorus pseudoheterolobus* Hardenberg 1933. In : The Kuroshio, East-West Centre Press, 481-490.

Tham, A. K. 1974 — *Stolephorus* resources in the South China Sea. Proceedings, Indo-Pacific Fisheries Council 15(3) : 182-l 91.

The National Delegation 1974 — Country Report: The present status of the fisheries, its development and management in Malaysia. Proceedings of the International Seminar on Fisheries Resources Management and Their Management in South East Asia.

Tiews, K., Ronquillo, I. A. and Santos, L. M. 1970 — On the biology of anchovies *(Stolephorus facepede)* in Philippine waters. Proceedings, Indo-Pacific Fisheries Council 13(2) : 20-48.

Vanichkul, P. and Hongskul, V., *1966* — Length-weight relationships of chub mackerel *(Rastrelliger* sp.) in the Gulf of Thailand 1963. Proceedings, Indo-Pacific Fisheries Council 1(2) : 20-33.

Table 1

Estimated Landings by Gear Groups in Operation (1977), Peninsular Malaysia

Gear Groups	West Coast		East Coast		Peninsular Malaysia	
	Catch (Metric tons)	%	Catch (Metric tons)	%	Catch (Metric tons)	%
Trawl Nets	226,522	59.8	34,603	28.8	261 ,1 25	52.4
Seine Nets	53,030	14.0	44,436	37.0	97,466	19.6
Dirft/Gill Nets	16,712	4.4	8,397	7.0	25,109	5.0
Lift Nets	137	0.1	11,126	9.2	11,263	2.3
Fishing Stakes	4,483	1.2	544	0.4	5,027	1.0
Traps	886	0.2	3,320	2.8	4,206	0.8
Lines	4.098	1.1	13,236	11.0	17,334	3.5
Bagnets	22,909	6.1	4,044	3.3	26,953	5.4
Barrier Nets	430	0.1	55	0.1	485	0.1
Push Nets	751	0.2	9	0.1	760	0.1
Shellfish Collectors	48,091	12.7	—	—	*48,091	9.7
Miscellaneous	421	0.1	316	0.3	737	0.1
Total	378,470	100.0	120,086	100.0	498,556	100.0
% Total		75.9		24.1		100.0

Source: Annual Fisheries Statistics, Fisheries Division, Ministry of Agriculture, Malaysia.

* Mainly cockles *Anandara granosa* from culture beds.

Table 2

Total Marine Fish Landings: Peninsular Malaysia 1968-I 977 (Metric Tonnes)

Year	West Coast Peninsular Malaysia	East Coast Peninsular Malaysia	Peninsular Malaysia
1968	282,513.49	62,326.61	344840.10
1969	248,654.42	55,105.81	303,760.23
1970	232,558.60	64,798.43	297,357.03
1971	252,377.51	69,950.35	322,327.86
1972	230,028.70	80,648.66	310,677.36
1973	280,543.65	90,605.61	371,149.26
1974	317,709.67	121,800.97	439,510.64
1975	270,664.03	104,570.18	375‘234.21
1976	294,574.53	116,388.84	410,963.37
1977	378.470.24	120,085.62	498,555.86

<<

Table 3

Marine Fish Landings by Resource Groups, Peninsular Malaysia 1968-1977 (Metric Tonnes)

West Coast Peninsular Malaysia	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Demersal	89,799.12	76,090.92	73,344.80	86,515.52	98,048.26	127,199.03	150.289.41	136,236.96	141,998.86	183,839.79
Pelagic	131,684.06	102,847.98	79,531.79	81.673.51	45,910.l0	66,689.73	56,461.71	45,811.98	56,423.36	68,453.28
Prawns	26,715.77	30,148.29	38,156.95	46,703.15	36,961.54	45,575.27	48,641.71	37,967.23	43,940.20	51,592.31
Others	34,314.54	39,567.23	41,525.06	37,485.33	49,108.80	41,159.62	62,316.84	50,647.86	52,212.11	74,584.86
Total	282,513.49	248,654.42	232,558.60	252,377.51	230,028.70	280,543.65	317,709.67	270,664.03	294,574.53	373,470.24

East Coast Peninsular Malaysia	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Demersal	18,776.17	19,739.07	28,535.88	30,685.11	26,591.12	39,215.36	51,943.42	44,718.85	52,518.43	44.388.02
Pelagic	39,424.17	31.601.03	30,961.60	33,775.36	48,490.30	43,955.95	61,256.49	52,557.65	53,470.57	68,632.72
Prawns	2,511.08	1,642.95	3,170.77	2,557.47	2,790.13	2,524.31	3,183.92	3,033.81	4,069.80	3,598.12
Others	1,615.19	2,122.76	2,130.18	2,932.41	2,777.11	4,989.99	5,417.14	4,259.87	6,330.04	3,466.76
Total	62,326.61	55,105.81	64,798.43	69,950.35	80,648.66	90,685.61	121.800.97	104,570.18	116,388.84	120.085.62

Peninsular Malaysia	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Demersal	108,575.29	95,829.99	101,880.68	117,200.63	124,639.38	166,414,39	202,232.83	180,955.81	194,517.29	228,227.81
Pelagic	171,108.23	134,449.0l	110.493.39	115,448.87	94,400.40	110,565.68	117.718.20	98,369.63	109,893.93	137,086.00
Prawns	29,226.85	31,791.24	41,327.72	49,260.62	39,751.67	48,099.58	51,825.63	41,001.04	48,010.00	55,190.43
Others	35,929.73	41,689.99	43,655.24	40,417.74	51,885.91	46,069.61	67,733.98	54,907.73	58,542.15	78,051.62
Total	344,840.l0	303,760.23	297,357.03	322,327.86	310,677.36	371,149.26	439,510.64	375,234.21	410,963.37	498,555.86

Other = Kerang, ketam, udang baring,siput dan sotong.

Table 4

Demersal Fish Landings (1968-1977), West Coast of Peninsular Malaysia (Metric Tons)

Year	Food fish	*Trash	Total
1968	42,418	47,381	89,799
1969	34,123	41,968	76,091
1970	29,356	43,989	73,435
1971	27,737	58,779	86,516
1972	30,038	68,010	98,048
1973	32,370	94,829	127,199
1974	31,652	118,637	150,289
1975	32,317	103,920	136,237
1976	41,389	100,610	141,999
1977	48,516	135,324	183,840

Source: Annual Fisheries Statistics, Fisheries Division, Ministry of Agriculture, Malaysia.

* Fish species not used for food as well as foodfish too small to be sold for food. These fish are normally used for duck feeding and fishmeal manufacture.

Note: Demersal fish landings exclude penaeid prawns, squids/cuttlefish, crabs, shellfish, sergestid shrimps, and pelagic fish (pomfrets, seads, anchovies, wolf herrings, sardines, tunas/bonitos, chub mackerels, Spanish mackerels, herrings, mullets, leatherskins, and sailfish/marlins).

Table 5

Average Catch Rates (Kg/hr) Obtained by Research Vessel in Waters Between Pulau Langkawi and Pulau Pangkor, West Coast of Peninsular Malaysia

Year	1970	1971	1974	1978
Commercial Fish	82.2	87.3	67.3	50.6
Trash Fish	48.9	54.3	24.8	18.8
Total	131.1	141.6	92.1	69.4

<<

Table 6

Pelagic Fish Exploited in Peninsular Malaysia

Rastrelliger s p .
Stolephorus sp.
Decapterus sp.
Megalaspis cordyla
Euth ynnus sp.
Kishinoella tonggol
Scomberomerus sp.
Chirocentrus dorab
Caranx sp.
Selar sp.
Selaroides leptolepis
Clupea sp.
Stromateus nigra

Table 7

Maximum Sustainable Yields (MSY) of Pelagic Fish as Estimated by the Workshop on the Fishery Resources of the Malacca Straits, 1976

Species or group	MSY (x100 tons)
Rastrelliger sp.	25
Anchovies	17
Roundscads	10
Hard tails	10
Sardines	6
Small tunas	5
Spanish mackerel	4
Wolf herrings	5
Mullets	2
Others	4
Total pelagic	88

<<

Table 8

Landings of Pelagic Fish in Peninsular Malaysia (Metric Tons)

Year	West Coast	East Coast	Total
1968	131,684.06	39.424.17	171 ,108.23
1969	102,847.98	31,601.03	134,449.01
1970	79,531.79	30,961.60	110,493.39
1971	81.673.51	33,775.36	115,448.87
1972	45,910.10	48,490.30	94,400.40
1973	66,609.73	43,955.95	110,565.68
1974	56,461.71	61,256.49	117,718.20
1975	45,811.98	52,557.65	98,369.63
1976	56,423.36	53.470.57	109,893.93
1977	68,453.28	68,632.72	137,086.00

Table 9

Demersal Fish Landings (1968-1977). East Coast of Peninsular Malaysia (Metric Tons)

Year	Foodfish	*Trash	Total
1968	11,751	7,025	18,776
1969	11,909	7,830	19,739
1970	16,000	12,536	28,536
1971	14,724	16,411	30,685
1972	14,194	12,397	26,591
1973	20,098	19,117	39,215
1974	23,960	27,983	51,943
1975	23,453	21,265	44,718
1976	25,647	26,872	52,519
1977	24,717	19,671	44,388

Source: Annual Fisheries Statistics, Fisheries Division, Ministry of Agriculture, Malaysia.

* Fish species not used for food as well as food fish too small to be sold for food. These fish are normally used for duck feeding and fishmeal manufacture.

Note: Demersal fish landings exclude penaeid prawns, squids/cuttlefish, crabs, shellfish, sergestid shrimps, and pelagic fish (pornfrets, scads, achovies, wolf herrings, sardines, tunas/bonitos, chub mackerels, Spanish mackerels, herrings, mullets, leatherskins, and sailfish/marlins).

<<

Table 10

Average Catch Rates (Kg/hr) Obtained by Research Vessel in Waters Off the East Coast of Peninsular Malaysia

year	1970	1972	1974
Commercial Fish	184.7	146.5	143.6
Trash Fish	330.9	108.3	94.5
Total	515.6	254.8	238.1

Table 11

Types of Fishing Vessels (1977), Peninsular Malaysia

	Inboard Engine		Outbaard Engine		Non-powered		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Peninsular Malaysia	16,977	70	2,775	12	4,329	18	24,081	100
West Coast	11,831	69	2,299	14	2,945	17	17,075	100
East Coast	5,146	73	476	7	1,384	20	7.006	**100**

Source; Annual Fisheries Statistics, Fisheries Division, Ministry of Agriculture, Malaysia.

Table 12

Numbers and Types of Fishing Gear Licensed (1977), Peninsular Malaysia

Gear Groups	West Coast		East Coast		Peninsular Malaysia	
	No.	**%**	**No.**	**%**	**No.**	**%**
Trawl Nets	3,029	15.0	1,256	25.5	4,285	17.1
Seine Nets	1,877	9.3	562	11.4	2,439	9.7
Drift/Gillnets	8,932	44.2	1,635	33.2	10,567	42.1
Lift Nets	52	0.3	230	4.7	282	1.1
Fishing Stakes	234	1.2	120	2.4	354	1.4
Traps	212	1.1	476	9.7	679	2.7
Lines	674	3.3	331	6.7	1,005	4.0
Bagnets	1,559	7.7	284	5.7	1,843	7.3
Barrier Nets	191	0.9	34	0.7	225	0.9
Push Nets	1	0.1	—	—	1	0.1
Shellfish Collectors	3,356	16.6	—	—	3,356	13.4
Miscellaneous	71	0.3	—	—	71	0.2
Tota l	20,188	100.0	4,919	100.0	25,107	100.0

<<

Table 13

Estimated Numbers and Types of Fishing Gears in Operation (1977), Peninsular Malaysia

Gear Groups	West Coast		East Coast		Peninsular Malaysia	
	No.	%	No.	%	No.	%
Trawl Nets	4,195	29.0	984	23.4	5,179	27.7
Seine Nets	1,204	8.3	324	7.7	1,528	8.2
Drift/Gill Nets	5,951	41.1	713	17.0	6,674	35.8
Lift Nets	36	0.2	189	4.5	225	1.2
Fishing Stakes	242	1.7	50	1.2	292	1.6
Traps	98	0.7	270	6.4	368	2.0
Lines	788	5.5	1,170	27.8	1,958	10.4
Bagnets	638	4.4	286	6.8	924	4.9
Barrier Nets	80	0.6	7	0.2	87	0.5
Push Nets	579	4.0	15	0.4	594	3.2
Shellfish Collectors	461	3.2	–		461	2.5
Miscellaneous	181	1.3	192	4.6	373	2.0
Total	14,463	100.0	4,200	100.0	18,663	100.0

Table 14

Growth Parameters of R. Neglectus

Brood	L_∞ (cm)	K	t_o
I	19.60	0.37	+0.366
II	20.10	0.36	+ 0.400
III	19.78	0.44	+ 0.393
IV	20.05	0.38	+0.533

<<

Table 15

Size at First Maturity of *Stolephorus* Spawn

Species	Size (in mm standard length)
S. heterolobus	50
S. *bataviaensis* (formerly S. *insularis)*	50
S. indicus	116-125

Table 16

Food of *Stofephorus* Spp.

Species	Main food items
S. heterolobus	Calanoid and harpacticoid copepods, ostracods, *Leptochefa,* brachyuran zooea, other decapod larvae, polychaete larvae and phytoplankton
S. bataviaensis	*Leptochela*
S. indicus	Calanoid, copepods, mysids, *Leptochela,* brachyyuran megalopa, Squilla larvae and fish larvae.

Table 17

Growth Parameters for *Stolephorus* Spp.

Species	L (mm)	K (for 1 day)	t_o
S. indicus	*190*	0.00195	- 4 6
S. bataviaensis	*99*	0.0057	- 4 6
S. heterolobus	*99*	0.0057	- 1 6

<<

Table 18

Annual Landings by Trawlers on West Coast and East Coast of Peninsular Malaysia (1971-1977)

	1971	1972	1973	1974	1975	1976	1977
West Coast							
Demersal	59,198.98	65,636.20	89,925.40	115,613.04	109,433.42	121,367.16	153,942.59
Pelagic	2,292.19	3,455.24	3,485.25	3.545.91	4,471.51	10,481.31	19,135.19
Prawns	31,112.31	23.690.84	29,172.39	28,730.46	26,651.57	32,797.97	39,076.17
Others	2,160.12	2,190.87	3,214.87	4,926.19	6,796.85	10,944.10	14,367.61
Total (m. ton)	94,763.60	94,973.15	125,797.91	152,815.60	147,353.35	175,590.54	226,521.56
No. of trawl nets licensed	2,594	2,846	2,897	2,928	2,815	3,039	3,029
No. of trawl nets estimated in operation	3,252	4,068	3,267	3,909	3,873	4,008	4,195
East Coast							
Demersal	16,225.10	13,314.39	22,390.38	35,561.09	29,072.58	36,678.38	29,216.42
Pelagic	525.59	438.41	1,544.70	1.484.61	929.89	1,182.2	702.79
Prawns	1,830.19	2.048.88	1,962.97	2,718.09	2,675.98	3,402.47	3,120.44
Others	657.95	946.93	2,016.46	3.014.17	2,855.76	3,821 .1 6	1,563.39
Total (m.ton)	19,238.83	16,748.61	27.914.51	42.777.96	35,534.21	45,084.21	34,603.04
No. of trawl netslicensed	892	1,127	1,171	1,229	1,353	1,276	1,256
No. of trawl nets estimated in operation	1,020	1,310	730	808	910	1,059	984

Note: **'Others' include sergistid shrimps, shellfish, crabs, squids and cuttlefish,**

<<

Table 19

Percentage of Seine Net landings on the West and East Coasts of Peninsular Malaysia

Year	West Coast Landings (m. tons)	%	East Coast Landings (m. tons)	%	Total (in tons)
1968	132,876	91	13,836	9	146,712
1969	111,285	90	12,913	10	124,198
1970	79,529	86	12,837	14	92,366
1971	78,688	87	11,261	13	89,929
1972	43,127	65	23,445	35	66,572
1973	64,300	73	23,475	27	87,775
1974	59,074	67	29,726	33	88,800
1975	41,751	62	25,917	38	67,668
1976	45,309	60	30,571	40	75,880
1977	53,029	54	44,436	46	97,465

<<

Table 20

Summary of Trawl Survey Results Carried out by Fisheries Research institute, Fisheries Division, Ministry of Agriculture

Area	Sub-Areas	Month & Year	Total No. Hauls	Average Catch Rate (Kg/hr.)			Reference
				Commercial (%)	Trash (%)	Total	
East Coast Peninsular Malaysia	I-IV Kelantan to East Johore 14,825 n.mls^2	August-October 1970	151	184.71 (35.8)	**330.90** ***(64.2)***	515.60	Pathansali ***et al., 1974,*** Mohd. Shaari 1976
		March-May 1971	150	82.88 (49.7)	***83.75*** (50.3)	***166.63***	Jothy ***et al., 1975,*** Mohd. Shaari 1976
		August-September ***1972***	***144***	***146.52 (57.5)***	108.25 (42.5)	254.77	Lam ***et al.,*** 1975a, Mohd. Shaari 1976
		July-August 1974	97	***143.63 (60.3)***	94.47 (39.7)	238.10	Lam & Mod. Shaari 1976
West Coast Peninsular Malaysia	I-II Perlis-Perak 3,175 n.mls^2	December 1970 - January 1971	81	82.20 (62.7)	**48.90** ***(37.3)***	131.10	Mohd. Shaari ***et al., 1974*** Mohd. Shaari, 1976
		November 1971 - January 1972	97	87.26 (61.6)	54.39 ***(38.4)***	141.65	Lam ***et al.,*** 1975b, Mohd. Shaari 1976
		November-December 1974	90	67.31 (73.1)	24.78 (26.9)	92.09	Mohd. Shaari & Chai 1976
		October-November 1978	114	50.61 (72.9)	***18.78 (27.1)***	***69.39***	
West Coast Peninsular Malaysia	III-VI S. Perak-W. Johore 3,950 n.mls^2	April 1973	96	86.60 (69.3)	38.43 (3.07)	125.03	Mohd. Shaari ***et al., 1976*** Mohd. Shaari 1976
	Deep water off Penang (60-120 m.deep) 40-90 n.mls. offshore around P. Perak 6,500 n.mls^2	September-October 1971	55	39.64 (43.1)	52.26 (56.9)	91.90	Mohd. Shaari 1976

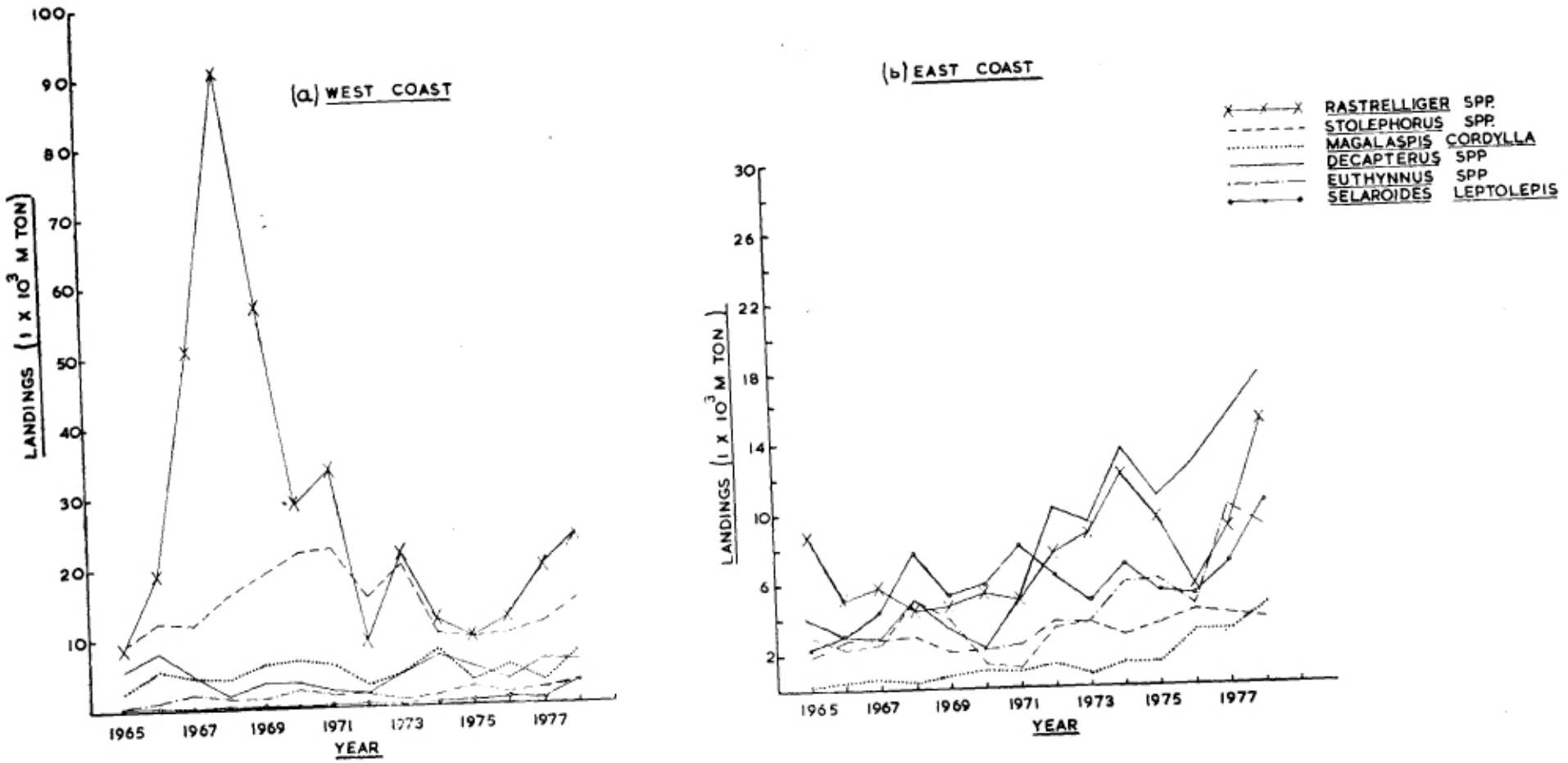
<<

Table 21

Estimates of Maximum Sustainable Yield (MSY) and Optimal Effort for the *Stolephorus* Fishery on the West Coast of Peninsular Malaysia

Model	M.S.Y. (metric tons)	Optimal Effort (Purse-seine boats)
Schaefer (linear logistic)	18,485	74
Gulland-Fox (Exponential logistic)	25,961	39

ILL.1. **TOTAL LANDINGS OF MARINE FISH IN PENINSULAR MALAYSIA BY SPECIES AND BY YEAR**



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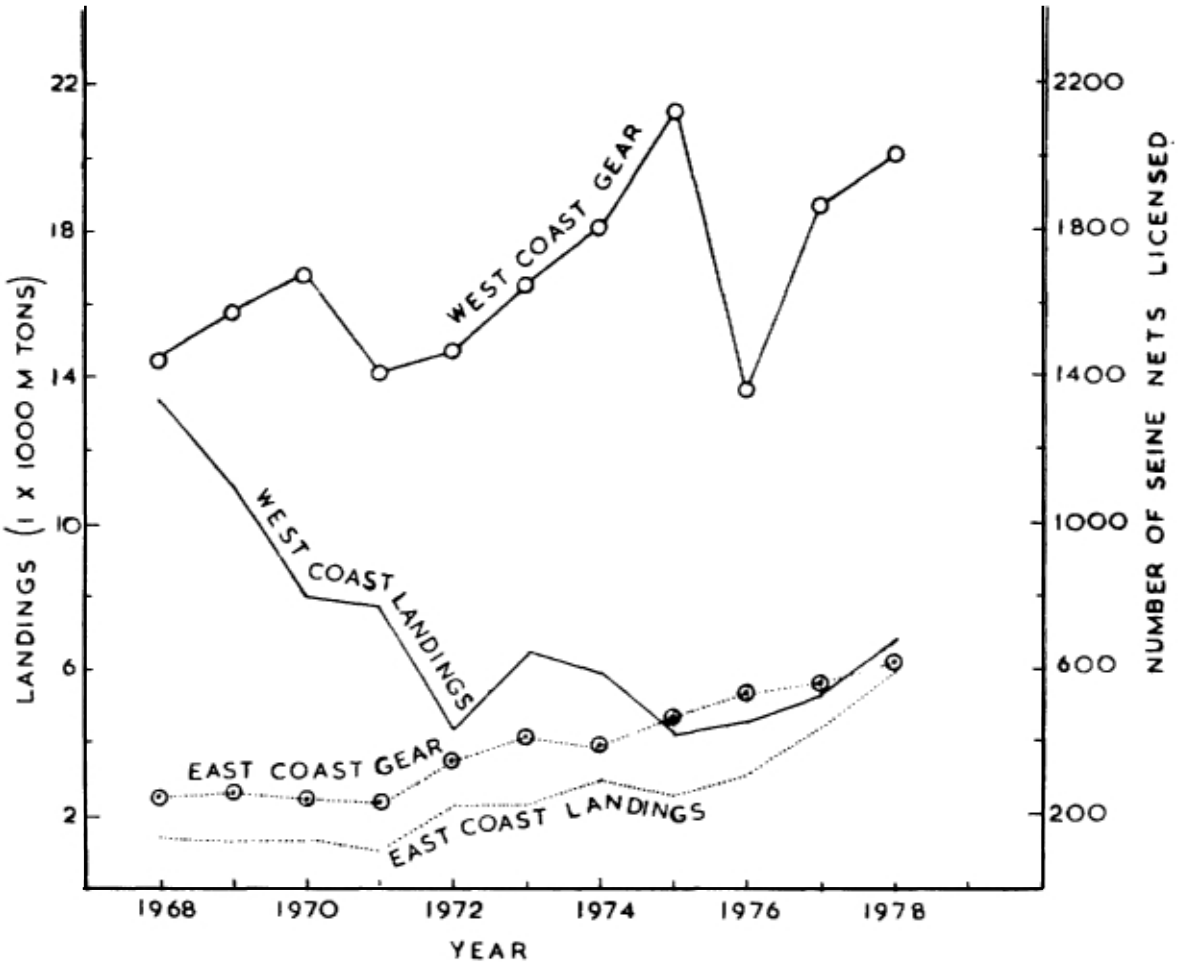

ILL2. LANDINGS BY SEINE NETS AND NUMBER OF SEINE NETS LICENSED IN PENINSULAR MALAYSIA

STOCK ASSESSMENT CONSULTATION

Volume 2

SRI LANKA

Status Paper on Coastal Fishery Resources

by

K. P. Hapuarachchi

D. S. Jayakody

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CONTENTS

		Page
1.	Introduction	81
2.	Fishing grounds	81
3.	Census of fisheries	83
4.	Methods of exploitation	85
5.	The fish production for different varieties for the years 1973-1979	87
6.	Resources surveys	87
7.	Methodology for collection of catch statistics	93
8.	Methods of stock assessment used	94
9.	Basic biological characteristics	95
References		97

Appendices

1 a.	Estimated fresh fish production by varieties - 1979	**99**
1 b.	Estimated fresh fish production by varieties - 1978	**100**
1 c.	Estimated fresh fish production by varieties - 1977	**101**
1 d.	Estimated fresh fish production by varieties - 1976	102
1 e.	Estimated fresh fish production by varieties - 1975	103
If.	Estimated fresh fish production by varieties - 1974	104
lg.	Estimated fresh fish production by varieties - 1973	105
2.	No. of crafts operating at the beginning of 1977	106
	No. of crafts operating at the beginning of 1978	106
	No. of crafts operated as on 30-6-1979	106
3.	Yield trends over the months against fishing effort: Station-Negombo	107
	Yield trends over the months against fishing effort : Station-Chilaw	108

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1. Introduction

Sri Lanka is situated in the Indian Ocean, south east of India, between latitude 6-10 degrees North and longitude 80-82 degrees East (Fig. 1). The coastline is 1,1 00 miles in length. Fishing takes place all round the coast. It is concentrated primarily within the continental edge, which is an area rarely extending beyond 25 miles, and averaging 14 miles in width. In this area, there are good resources of pelagic and demersal species with an annual sustainable yield of 250,000 tons (Saetersdal and de Bruin, 1979). In the offshore and deep sea fisheries from the edge of the shelf to the boundary of Sri Lanka's EEZ, the fish are mainly large migratory pelagic species. There is a further substantial fish resource available in this area. There are 344,000 acres of inland tanks and reservoirs and 300,000 acres of brackish water lagoons, estuaries, and mangrove swamps available for stocking and harvesting fish. The potential annual yield from these resources depends on the intensity of fish stocking but the harvest could be raised to 50.000 tons.

The fisheries sector in Sri Lanka has a relatively high importance in the economy compared to that in most countries. The total value added by domestic fish production to the GDP in 1978 was Rs. 69.9 million. Total full-time employment in the fishing industry is 79,000 persons. There is a further considerable number of part-time employees. The industry supplied a substantial proportion of the animal protein consumed by the population in 1978. Fish exports were valued at Rs. 233 million, while fish imports were valued at Rs. 34 million.

The bulk of the fish production in 1978 came from the coastal fishing fleet. About 65,000 persons were employed by this fleet, which comprised 23,000 vessels of less than 32 ft. in length, 7,000 of which had inboard or outboard engines. The production of this fleet was 135,000 tons representing 87% of the domestic fish supply. This represented 52% of the potential sustainable yield. Fishing activity was relatively intense in Negombo, Puttalam, Mannar and Jaffna districts where about 50% of the marine fish catch was taken. The resources on the east coast were more lightly exploited. Drift netting was the major method used by nearly 50% of the vessels. Shore seining, cast netting, handlining, trawling, pole and lining and long lining were other popular methods.

Despite the rising total income and output of the coastal fishing sector, most fishermen still suffer from primitive living conditions and relatively low income which inhibit savings and investment. About 16,000 tons of fish, 10% of the domestic fish supply in 1978, came from inland waters. Many of the fishermen in this fishery are seasonal migrants from coastal areas. Over 1000 non-mechanised boats of traditional design are used in the harvest. Most of them use gill nets. There are also a substantial number of fishermen who fish from the edge of the tanks using cast nets. The living conditions and incomes from the inland fishermen are worse than those of the coastal fishermen.

Domestic fish production in the offshore and deep sea fishery was only 3,000 tons. The small catch was due to the small number of domestic fishing vessels capable of operating in deeper waters. Most of these operated at below capacity either because they were very old and suffered frequent breakdown or that they were very new and suffered teething troubles. Nevertheless, after the introduction of new 38 foot boats under the South West Coast Fishery Project, the results have been encouraging and substantial catches have been landed.

2. Fishing Grounds

Several research programmes have been conducted by the Ministry of Fisheries to locate fishing grounds for tuna, prawns, lobsters, baits and demersal fish resources. The results of the above work are briefly described.

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2.1 Tuna and Shark

Sivasubramaniam (1969) discussed the distribution of predatory pelagic sharks in the tuna grounds in the Indian Ocean. His conclusions are as follows:

> The pattern of distribution of tuna and shark species arrived at earlier has been confirmed. There is a notable decline in the number of species of sharks and other varieties in the catches made in the fishing grounds south of 30ºs. The number of shark species appearing in the long-line catches in the equatorial region declines towards the higher latitudes of the south and north.
>
> The mackerel shark *(Lamna litropis)* appears in the catches from grounds south of 30ºS, the lancet fish *(Alepisaurus borealis)* appears in the long-line catchesfrom all latitudinal ranges but probably more frequently in the latitudes of the south. In the central part of the north — equatorial region *Lamna falciformis* has the highest 'density of distribution for any shark species in the tuna ground of the Indian Ocean.

Sivasubramaniam (1975) states that of the estimated annual production of 100,000 tons of fish, skipjack tunas contribute about IO-12% which comes mainly from the drift net fishery. The potential for increased production is expected chiefly from the surface and sub-surface tunas, marlin and shark resources in the offshore and oceanic ranges.

2.2 Prawns

The Fisheries Research Division of the Department of Fisheries undertook surveys of the seas and lagoons of Sri Lanka during the last 20 years with a view to ascertain whether any unexploited resources of prawns existed. Untapped prawn resources were located at the north of the island, a new fishery ground between Kachchativu and Rameswaram temple, and a narrow stretch of prawn ground from Pesalai at depth of 3-5 fathomextendingalong the Palk Strait up to Dhanuskodi Point. A new resource was also located south-east of the Mullaithivu Light House at depths 8-12 fathom stretching southwards to a point west of Pullimoddai. The above findings are reported in the bulletins of the Sri Lanka Fisheries Research Station (De Bruin, 1965, 1970 and 1971). The narrow coastal stretch extending from Colombo to Chilaw at depths of 3-10 fathom is a prawn ground that has been used for a long period of time.

2.3 Spiny Lobster Resources

Investigations into the resources of spiny lobsters in Sri Lanka waters were first begun in 1958. Initially it was carried out at night by skin-diving surveys of sand-stone and rocky areas. Lobster traps of different designs were introduced later. These investigations revealed lobsters in large concentrations especially on the south-west, south and west coasts (De Bruin, 1960, 1962 and 1969). One of the most productive areas discovered during later surveys was the sand · stone reef lying at depths of one foot to six fathom between Galle Buck, Light House and Mount Lavinia Hotel (De Bruin 1962). Fishing in a restricted area of 52,000 sq.ft. for two consecutive years, six months per year and seven days per month, showed no effect on the modal or mean carapace length of the population or on the average catch per day. The total catch for this period was 8,000 lobsters, the average catch in two hours by two skin divers being 50 lobsters. This indicates that the maximum sustainable yield for this area is over 8,000 lobsters or approximately 8,000 lbs (De Bruin, 1962).

2.4 Bait Fishing Grounds

According to a live bait survey carried out by the vessel *Hingura* very good catches of live bait varieties were found in the north east, west, east and southwest coasts. The above survey and another survey by the vessel *Kosei Maru* showed that most of the bait species were concentrated in the belt between 4-15 fathom around the coast and the pelagic types, such as the sardines, showed a wider scatter within this belt than some of other types such as the red bait which showed definite concentration between 6-10 fathom range (Sivasubramanian, 1977).

2.5 *Demersal Fish Grounds*

(i) Wadge Bank

In 1967, it was estimated that 15,000 tons of good quality fish could be harvested each year by trawlers operating on this bank. It was suggested that 20 trawlers similar in size to the ones being operated by the Ceylon Fisheries Corporation, namely, 110 ft. in length and 238 tons in weight, could exploit this resource.

More recently in 1972, the survey carried out by the Russian research ship SRTM *Optimist* (500 GRT) was able to show that 5-6 trawlers of that class could operate on the Wadge and Pedro Banks to bring in 10-15,000 tons of fish annually.

(ii) Pedro Bank

The quantity of fish that could be taken annually from Pedro Bank was estimated to be 2,600 tons as seen from the report on the survey carried by *Optimist.*

(iii) Deep Water Trawling

In *1972, Optimist* carried out a series of deep water trawling outside Sri Lanka's territorial waters. Such trawlings were limited as only a very small part of the continental shelf lies outside Sri Lanka's waters. Accordingly bottom trawling was only possible in the Gulf of Mannar at latitude 8°31' and on the continental slope in the south of Sri Lanka.

Generally such trawlings were carried out at 200-350 metres depth from where several species of fish were taken. Many of them were of no established commercial food value and could be used only for fish meal. No estimate was made of the quantities of fish available in these deep waters. In addition to fish, several species of deep water crustaceans, spiny lobsters, shrimp and crabs were also found. While the lobsters and shrimps are of commercial importance, the crabs in these deep waters could only be used for production of fish meal. No estimates of quantity of these varieties were made.

(iv) Small boat trawling in coastal waters

Since 1953, surveys have been carried out to determine the feasibility of conducting small boat trawling in coastal waters. These surveys along with the mechanisation of the indigenous crafts and the introduction of mechanised boats for coastal fishery has paved the way for coastal trawler operations in the southwestern, north-western and northeastern coastal waters. Catches have been found to be encouraging particularly in Palk Bay where the yield for one hour's trawling varied between 200 and 500 kg. Small boat trawling could be profitably carried out in the northeastern area going right up to the Pedro Bank and even exploiting the shallower area of the Pedro Bank proper.

(v) Handlining for Ground Fish

There are areas in our continental shelf, where trawling is not possible even by small trawlers due to the nature of the sea bottom. In such areas, handlining could be conveniently carried out. A specific area in the southeast sector of the island includes the waters around the Little and Great Bases light houses. The JAMARAC (Japan Marine Fishery Resource Research Centre) survey in 1975 indicated unexploited resources of breams and flame snappers, thirty or more miles from the shore in the northeast coastal sector. The survey also highlighted the presence of demersal fishes around the edges of the continental shelf in the southern waters of the island.

3. Census of Fisheries

The first census of fisheries was conducted during the months of October, November and December 1972, on the primary features of fish production, fishing households, fishing man-power, fishing effort, fishing craft and gear, etc. for the purpose of: *(i)* clarifying the structure of the fishing industry as basis for the formulation of fishery development plans, and *(ii)* providing a

suitable frame for designing a continuous sample survey for the measurement of fish production, fishing effort and other current fishery statistics. The census covered all fishing or fish processing households in the entire marine sector including brackish water fisheries of the country and in the fresh water fishery region, 23 major irrigation tank areas where fishing is of commercial importance.

The census in marine areas was planned **to be** carried out in three stages namely:

(i) Identification and listing of fishing and fish processing household so as to provide the necessary frame for the census.

(ii) Complete enumeration of fishing households listed in a fishing village to obtain basic data relating to the number of fishing households, fishing population, ownership and type of fishing crafts and gear in use, type of participation in fishing and fishing grounds and source of income and

(iii) Sample enumeration of selected fishing management units and fishing partner and labour households to obtain additional data relating to fishing activity and socio-economic conditions of the fishing population. A total of 104 fishing villages was selected for this purpose.

The Ceylon Fisheries Corporation, being a government owned enterprise was excluded from the census. Arrangements have already been made to conduct the second fisheries census during the latter part of 1980. The following basic data were obtained from the census of fisheries — 1972 (Preliminary report, Census of Marine Fisheries, 1972).

Table 1

Number of Fishing Villages by Size

Size (households)		No. of villages	No. of fishing or fish processing households
Small	(1-19)	497	3,939
Medium	(20-99)	352	16,029
Large	(100 and above)	120	23,684
	Total	969	43,652

Table 2

Fishing and Fish Processing Households

Category	No. of Households
Fishing only	43,194
Fishing and fish processing	3,075
Fish processing only	83
Total	46,352

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Table 3

Number of fishing crafts used by type, both mechanised and non-mechanised, with percentages in brackets

Type of craft	Total	Mechanised	Non-mechanised
(a) Introduced Crafts			
(i) 3½ ton boats	1,859	1859(100)	—
(ii) Fibreglass boats	***874***	***874(100)***	—
(b) Indigenous crafts			
(i) Planked	***2,474***	***106(4.3)***	***2306(93.2)***
(ii) Dugout with outrigger	***7,189***	***259(3.6)***	***6930(96.4)***
(iii) Dugout without outrigger	1,155	57(4.9)	1098(95.1)
(iv) Lografts	6,015	1896(31.5)	***411 9(68.5)***

Table 4

Number of fishing management units by major type of gear used with percentage in brackets

Type of fishing gear	No. of fishing management units
1 . Gillnet	9,648(42.9)
2. Cast net	***5,700(25.4)***
3. Hook and line	***2,506(11.2)***
4. Stationary gear	***2,371(10.6)***
5. Seine net	1,658(7.4)
6. Shrimp drag net	***504(2.2)***
7. Trawl	***75(0.3)***
Total	***22,462(100.0)***

4. Methods of Exploitation

There are mainly two types of indigenous crafts operated in the coastal waters. They are :

(i) ***ORUS*** and ***(ii) TEPPAMS.*** ***Orus*** can be further classified according to their sizes, namely, small and large or bala oru. Different techniques are used by different types of crafts and are briefly described below.

4.1 Simple hook trolling line

This method of fishing is principally adopted by small ***Orus*** that are operated on surface or little below the surface by 3 to 4 trolling lines. The principal species caught are Seer fish (Scomberomorus spp;) Mackerel Tuna (Eughymus affinis or attavalla) Frigate Mackerel (Auxis thazard, Auxis rochei or Ragoduwa), Skip-jack Tuna (Katsuwonus pefamis or Bafaya), Yellow Fin Tuna (Thunnus albacares or Kelawalla) Horse Macekrel (Carangidae or Paraw). Queen fish (Chroinemidae or katta), and Sharks (Carcharhinidae or mora).

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4.2 Multiple hook trolling line

This method of fishing is a special device to catch many fish at a time from a single school. The main species caught are Mackerel Tuna and Frigate Mackerel. This technique is mainly used by small *Orus.*

4.3 Pole and line with barbless hooks

The large type of *Orus (Bala Orus)* use this technique to catch skip jack tuna. They operate around continental edge or near oceanic waters. The operations commence after capturing the bait fish, *Dipterygonotus leucogrammious* (Red Bait or *Hingura).* This is a seasonal type of fishing.

4.4 Various methods are used by *Teppams* or long-raft to catch several varieties of fish. Sharks and skates are caught by bottom set net. Indian Mackerel *(Kumbalawa),* Indian Herrings *(Hurulla)* and Sardines *(Salaya)* are caught using small meshed drift net.

Many of the *Teppams* were replaced by 17-18 ft. fibreglass boats with outboard motors. Small meshed gillnets are used by these boats.

Orus have been replaced partly by 17-18 ft. and 28 footers. Some of the 17-18 footers use large meshed gillnets and this method is also seasonal.

The 28 footers originally used floating long-line and caught Marlin *(Koppara),* Sail-fin (Thala-patha), Yellow Fin Tuna *(Kelawalla)* Big eye Tuna (Asgedi Kelawalla) and Shark. The catch decreased mainly due to bait problem and thus these boats became uneconomical. Today a few boats are operated off Negombo, Beruwala and the south coast. This technique is also used during the height of the season for these fish.

Now the major fishing gear used by these vessels is the large meshed gillnet to catch Mackerel Tuna, Frigate Mackerel, Skip jack Tuna, Yellow Fin Tuna, Sharks of various species and Marlin.

Sivasubramaniam recently studied the average catch per set of 30 nets for six centres, and it was revealed that the 28 footers do not use more than 20 nets. Furthermore, it has been noted that catch rate for 30 nets has been halved and this indicates a shift in abundance. It should also be noted that size of all species has reduced to a great deal indicating that the lowered catch rate may be due ta fishing.

4.5 Shore seining — (Madel a)

It is a common gear operated from a 20-30 feet long, wide flat bottomed boat known as Madel *Paru.* The nets are manually operated, the operation being paddling the boat with this net out to sea, shooting the net and then hauling the net on to the shore.

This method of fishing can be successfully carried out only in calm waters. The operation is also limited to a radius of 1 to 1½ miles from the shore where the bottom of the sea has no sharp rocks or other obstacles (De Bruin, 1977). The species of fish caught are small varieties such as Herrings, Indian Mackerel, Sardines, Silver Bellies and juveniles of larger species such as Horse Mackerel, Queen fish, Travelly, Spanish Mackerel, Mackerel Tuna, Frigate Mackerel, Sharks and Skates. The following table gives production data from 1975 to 1979, from shore seining.

Year	Production in tons
1975	4946
1976	7644
1977	8179
1978	7263
1979	8822

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Although total landings from beach seines appear to be high, it is not a very efficient form of fishing, considering the large number of people employed in a single operation and that the catch per man-hour is only about 8 lb (De Bruin, 1977).

5. The fish production for different varieties for the years 1973 to 1979 is given in Appendix 1 (a) to 1 (g) and the number of different fishing crafts for the years 1977 to 1979 in Appendix II.

6. Resources Surveys

Several research programmes have been conducted by various national and international agencies in collaboration with the Ministry of Fisheries. Following is a brief description of the above work.

6.1 *Survey by Fridtjof Nansen*

In an agreement under the general programme fcr development cooperation between the Governments of Norway and Sri Lanka, the services of the fishery research vessel "Dr. Fridtjof Nansen" were made available to Sri Lanka for a period of 1½ months during August to September 1978. During the period of 16-22 August, the vessel undertook a survey of the NW coast of Sri Lanka. The task in this area was to map and study more closely the deep water trawling grounds for lobster and shrimp located in 1972 in the Gulf of Mannar. During the subsequent period from 3 to 20 September, the coastal shelf from Colombo southwards and around the island up to and including the Pedro Bank was covered.

During the final part of the survey, from 22 to 27 September, certain parts of the shelf area on the south west and west coasts were covered in more-detail. Theoverall objective of thesurvey was to describe and assess the demersal, semi-demersal and pelagic resources available on the Sri Lankan coast, principally over the shelf banks. Because of the extreme shallow waters of the Palk Bay and Strait, these areas could not be included.

The study mainly covered the following:

(a) Bottom conditions

(b) Hydrographic features

(c) Fishing grounds

(d) Estimate of fish biomass

A summary of the findings of the above survey is given below :

(i) Observations on the type of bottom confirmed the previous findings that areas of good trawling grounds are limited, mostly to the shallow inshore parts of the shelf and the shallow northern area.

(ii) Hydrographic observations enabled a description of the water masses along and on the continental shelf, the depth of the thermochine and the oxycline. The content of dissolved oxygen below the oxycline was, in most cases, around 1 ml/l. In this environment, significant quantities of commercial types of fish were not available.

(iii) Invastigation of the deep sea trawling ground in the Gulf of Mannar was carried out. Trawlable area was located and mapped, but found to be rather limited in extent, only about 2 by 6 nautical miles. Catches comprised deep sea lobsters, deep sea prawns and deep water fish, in the approximate ratio 1:3:8.

(iv) According to the echo records, different types of resources were identified. The two most important were (i) demersal and semi-demersal large fish such as snappers, groupers, breams and travellys and (ii) smaller pelagic schooling fish such as scads, sardines, silver bellies etc.

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Based on acoustic survey preliminary estimates of total biomass in some areas of Sri Lanka, as made by this vessel, are as follows:

Area	Biomass in 1000 tonnes	Bank area inside 100 fathoms (nm^2)	Type of resources
(1) Negombo Galle	220	1,350	Mostly demersal and semi-demersal
(2) Hambantota	100	940	Demersal with some small pelagic
(3) East Coast	120	1,300	Pelagic and demersal
(4) Trincomalee to Mullaitivu	50	500	Mostly small pelagic
(5) Pedro Bank	30	1,020	Demersal and pelagic

6.2 Exploratory Fishing under the Colombo Plan 1955- 7960

6.2.1 The Department of Fisheries had already carried out experimental fishing with other types of gear such as trawls, bottom long lines, drift nets, shark lines, hand lines, troll lines, and lift nets with light attraction, in collaboration with Canadian fisheries biologists under the Colombo Plan.

A summary of the results of the operations using two 45 ft. wooden Canadian boats, "North Star" and "Canadian" are as follows :

Table 5

Average catch per man-hour for gears used by "Canadian" and "North Star" from April 1, 1955 March 30, 1957
Operations by M.F.V. "Canadian"

Gear	Catch (lb)	No. of man hours	Catch/man- hour
Otter trawl	10,207.00	1223.2	8.3
Mid-water trawl	8.00	28.0	0.3
Gillnets	1.762.00	2041.5	0.9
Hand lines	2,965.00	521.5	5.7
Troll lines	2,533.00	2816.6	0.9
Ring net	285.00	16.4	17.4
Lift net	18,941 .00	224.4	77.5

Average catch per man-hour from April 1, 1955 – March 30, 1957
Operations by M.F.V. "North Star"

Gear	Catch (lb)	No. of man-hours	Catch/man-hour
Bottom long line	48944	2427.9	20.2
Shark line	17844	417.6	42.7
Drift line	1023	109.5	9.4
Hand line	1075	207.6	5.2
Troll line	1868	1624.4	1.1

According to the results the best catches were obtained by the "Canadian" with the use of light attraction and lift nets. Gillnets, as fished with the "Canadian" were not successful. The best catches obtained by the "North Star" were with bottom long lines and shark lines.

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6.2.2 Bottom Long Lining

According tc the results obtained from the survey, another most promising type of gear is the bottom long line. The coast around Sri Lanka is not uniform and for the long lines it was found that some areas are very much better than the others. The following results indicate that long line is a successful gear for the East Coast.

Table 6

Long Lining Operations from April 1, 1955 to March 30, 1957 by "North Star"

Total number of sets	224
Total number of hooks	224,276
Total number of hours fished	809.3
Total catch (lb)	48,944
Average duration of set in hours	3.6
Average number of hooks per set	1,100
Average catch per 100 hooks	20
Average catch per set	218
Average catch per hour fished	60
Average catch per man-hour	20

Table 7

Comparison of long line catches on the east, west and south-west coasts of Sri Lanka from April 1, 1955 – March 30, 1957

Area	No. of sets	Hours fished	Catch (lb)	Catch/1000 hooks
East Coast	154	545.6	38551	22.6
West Coast	44	184.5	3183	7.9
South West Coast	22	72.6	23800	27.5

6.2.3 Shark Lining

Shark lining was carried out between Chilaw and Puttalam on the West Coast and off Mullaitivu on the East Coast in 1956. The research vessel "North Star" obtained the following results from February 1956 **to** March 1957.

Table 8

Summary of shark lining operations of "North Star" from February 3, 1956 to March 30, 1957

Total number of sets	34
Total number of hooks	2632
Total number of hours fished	139.2
Average duration of set in hours	4.1
Average number of hooks per set	77.4
Total catch (lb)	17844
Average catch perset	524.4
Average catch per 100 hooks	678.0
Average catch per man-hour	42.7

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In this explanatory fishery survey they also compared the yields of shark lines and long lines. This experiment was done during January, February and March in 1957 and the results obtained are as follows :

Table 9

Comparison of catches made with shark lines and long lines off Galle in January, February, March 1957

	Shark Lines	Long Lines
Total number of days fished	16	22
Total number of hours fished	57.2	72.6
Total number of hooks	1220	23800
Average duration of set in hours	4.6	3.3
Total catch (lb)	13848	6542
Average catch per set (lb)	865.5	297.4
Average catch per 100 hooks (lb)	1135.1	27.5
Average catch per man-hour (lb)	80.7	30.0

According to the results, it is clear that the shark lines are as profitable as long lines, but the fish caught were of a poor quality.

6.2.4 Handlining

The boats "North Star" and "Canadian" also carried out handlining operations off the coast of Sri Lanka between November 9, 1955 and February 5, 1957. The results obtained are as follows :

Table 10

Summary of handlining operations carried out by local fishermen aboard "Canadian" and "North Star" from November 9, 1955 to February 1, 1957

	"Canadian"	"North Star"	Both Vessels
Total number of days fished	32	12	44
Total number of hours fished	129.5	57.2	186.7
Total number of man-hours	521.5	207.6	729.1
Total number of line hours	607.5	234.1	841.6
Total catch (lb)	296.5	1075	4040
Average catch per day out (lb) ..	92.6	89.6	91.8
Average catch per line hour (lb) ..	4.9	4.6	4.8
Average catch per man-hour (lb) ..	5.7	5.2	5.5

Hand lining operations were also carried out on the Pedro Bank off Point Pedro from July 22 to October 25, 1956. The results are as follows :

Total number of days out	35
Total number of hours fished	211.0
Total number of man-hours	1853.0
Total catch (lb)	8976
Average catch per day out (lb)	256.4
Average catch per man-hour (lb)	4.8

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6.2.5 Lift net fishing

Lift net fishing with light attraction was carried out in Trincomalee Harbour in July 1956. The plankton, which had been attracted by the bright lights (Two 1000 W bulbs), concentrated under the bulb of low wattage in the form of a red ball about one foot in diameter. Immediately the fish in the vicinity aggregated and started attacking the plankton. The 1" meshed lift net, lying well under the school of fish, was then quickly lifted up. The results are as follows:

Table 11

Operation of lift net with lights in Orlando Cave, Trincomalee, on July 16-17, 1956

Set No.	Time of lifting	Catch (lb)
1	8.15 p.m.	100
2	8.30 „	224
3	8.45 "	280
4	9.00 "	224
5	9.15 "	308
6	9.40 "	182
7	9.50 "	280
8	10.10 "	295
9	10.25 "	125
10	10.35 "	290
11	10.50 "	156
12	11.05 "	127
13	11.25 "	119
14	11.45 "	127
15	Midnight	84
16	0.05 a.m.	118
17	0.35 "	70
18	0.45 "	28
19	1.00 "	89
20	1.15 „	84
21	1.30 "	20
22	1.50 "	84
23	2.00 "	5
	Total	3466

According to the results obtained, it is clear that the best catches are obtained between 8.30 p.m. and 10.30 p.m. After 10.30 p.m. the catches get progressively reduced. The main species caught is the Russel's scad which swarms regularly in Trincomalee Harbour in the months of July and August.

6.2.6 Otter trawling

Otter trawling operations were carried out with "Canadian" using a three-quarter Yankee 35" trawl of the type used by small trawlers.

The trawl had a 40 ft. head rope and a 50 ft. ground rope. The cod end had 35" stretched mesh. The results obtained are as follows:

Area	No. of Tows	No. of hours fished	Total catch (lb)	Catch/two (lb)
Chilaw	48	42.1	605	12.6
Negombo/Colombo ..	12	12.8	574	47.8
Mankerni (East Coast) ..	84	85.1	1093	13.0
Mullaitivu (East Coast) ..	118	1340.0	7399	62.7
Point Pedro (North) ..	2	2.0	89	44.5
Kayts (North)	5	5.8	42	8.4
Palk Bay	20	24.0	405	20.3
All areas	*289*	305.8	10207	35.3

The average catch made by the Canadian in trawling operations was only 30.6 lb per tow of an average of one hour's duration. This is an extremely poor value compared to what might be expected from commercial trawling operations.

6.3 Exploratory Fishing Operations

Apart from those mentioned under section 2, the following are the important works on exploratory survey:

Mr. Illugasson, FAO Master Fisherman, and de Bruin continued exploratory trawling for prawns and fish in the continental shelf areas around Sri Lanka from 1961-I 963 but were unable to locate prawn grounds other than those in previous operations.

6.4 De Bruin (1970) reports on the results of drift net fishing in Sri Lanka waters during 1966-1968 with nylon gillnets. According to the results, drift net fishing was indeed a lucrative method and he further says that a boat, the size of the *Canadian* (45') could bring in an average weight of 1000 lb of fish per day if she were to use 30-40 nylon nets in the operations.

6.5 Sivalingam (1964) outlines the results of bottom longlining and hand lining operations on the Pedro Bank in the month of August 1961. In the bottom longline construction, the ground lines were 18 lb steam-tarred cotton rope, each 50 fathoms long with side lines 18" long. 35 hooks were attached to the line 1½ fathoms apart. Clupeids and squids were used as bait. The trials were carried out northeast of Point Pedro at depths of 10-40 fathoms. The average catch for these trials (8.9 lb per 100 hooks) was very low as compared to the results obtained in 1956 (32.6 lb per 100 hooks) (Jean, 1958).

6.6 Berg (1971) carried out investigations into the bottom conditions and the possibilities for marine prawn and fish trawling on the north and east coasts of Sri Lanka. He mentions that there are 3000 km^2 of soft bottom situated in the Palk Bay and southeast of Mullaitivu and 5000 km^2 of hard bottom on the Pedro Bank and the regions north of Pedro Bank along the southeast coast of India. The soft bottoms consist of mud, including organic material, and the hard bottoms of coral, shell and flat rocks covered with gorgonids and sponges.

6.7 Demidenko (1972) outlines the results of the joint fishery investigation with the Soviet SRTM, *Optimist* during March-December 1972. The survey covered the northwest and northeast of Sri Lanka and the Wadge Bank. The survey included 400 trawl hauls as well as some experimental fishing with gill nets. The major new discovery was the location of a dep water prawn and lobster ground west of Kudremali Point, 79º23'-79º40'E, 08" 30'N-08º 48'N an area of about 200 square miles but the trawlable area was only 12 sq.miles as determined later.

6.8 Joseph (1975) describes the results of purse seining for small pelagic species of fish at the tail end of the northeast monsoon. Surface lamps, each of 500 watts intensity was changed to 1500 watts between December 1973 and January 1974 and again changed to 3000 watts between February and May. On the west coast between November 1973 and April 1974, the major species caught in the purse seine were sardines, and red bait anchovies, in the order of

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34.5%, 30.8% and 13.6% respectively. On the southwest coast, during the same period, the major species caught were sardine, herring, anchovy and red bait in the order of 31 .1%, 23.4%, 15.0% and 10.8% respectively. On the northeast coast, the major species were sardine, herring and carangids forming 43.2%, 29.2% and 10.2% respectively, while on the east coast, during the same period, the major species were sardine and herring forming 46.3% and 44.6% respectively.

6.9 Anon. (1975) reports on the programme carried out with the 500 GRT vessel Hoyo *Maru* from January to March 1975 which included hand lining, drift netting and shrimp basket fishing off the northwest and northeast coasts. Demersal fish were located by echo sounders and fished with a vertical baited line. He carried out altogether 544 experiments and found that the best concentrations of demersal fish were located on the continental shelf in the north eastern area. He further says that closer to the coast, the fish schools observed were smaller and only small quantities were caught. In the northwest area, less demersal fish were caught and their sizes were smaller than in the eastern area.

6.10 Sivasubramaniam (1977) described the experimental fishery survey for skipjack and other tuna species by pole and line and drift net method in Sri Lanka conducted by the Japanese vessel *Kosei Maru.* From the results obtained, he explained the possibilities of establishing small-scale pole and line fisheries in Chilaw, Negombo, Colombo and Mullaitivu. Furthermore he says that, to obtain the maximum yield, pole and line fisheries must be combined with drift net fisheries on a year round basis.

6.11 Pajot (1977) carried out an exploratory fishing survey programme for live bait for the skipjack and other commercially important small species of fish around the island from 1972-1977. According to his results there are sufficient live bait resources around the island for an expansion of the existing pole and line fishery as well as for an offshore pole and line fishery. Three types of gear were used for capturing live bait and other small pelagic species. The overall average catch with these three types of gear were 56 kg, 262 kg and 580 kg for the lampara net, half ring net and purse seine respectively. It is concluded that the current yield of 40,000 tonnes does not represent a full exploitation of these resources and the introduction of small purse seines is recommended.

7. Methodology for collection of catch statistics

The island is divided into thirteen District Fisheries Extension Officers (DFEO) divisions for administrative purposes and estimates of catch and effort at DFEO division level (Fig. 1) are separately recorded for the following types of fisheries :

1. Crafts with inboard engines (IB crafts)
2. Crafts with outboard engines (OB crafts)
3. Beach seines
4. Non-mechanised crafts (NM crafts)
5. Inland water fisheries

The boats that are operated in the coastal fishery also operate in lagoons, so that estimates of catch data for lagoons are included in the coastal estimate. As such, a separate scheme is not adopted to estimate data for lagoons. The method of estimation of catch from inland waters is also not discussed in this paper.

A stratified two-stage sampling design with landing centres as primary sampling units (PSUs) and crafts as second stage sampling units has been used for the estimation of catch from the marine sector. The strata consists of 13 DFEO divisions and the DFEO divisions are further stratified into smaller areas known as Fishery Inspector (FI) divisions.

For the purpose of sampling it is necessary to prepare separate lists of landing centres together with the number of boats for each type of craft (e.g. a list of landing centres for IB crafts, a list cf landing centres of OB crafts, etc). These lists will form the basic sampling frame.

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The first stage of sampling is the selection of two landing centres from each of the Fl divisions. This is done with probability proportional to the number of crafts operated in each Fl division. Ten crafts are then selected at random from the selected landing centres. This procedure is repeated for OB, IB and NM crafts separately (e.g. two landing centres for OB craft;, two landing centres for IB crafts, etc.).

There are three types of field officers (Fishery Inspectors, Statistical Collectors and Preventive Guards) engaged in the collection of statistics. They are expected to visit the selected landing centres in their divisions twice a week and record the catch by varieties together with other information such as total number of immigrant crafts, total number of immigrant fishermen and total number of fishing days. The completed monthly statistical returns are then forwarded to the Statistical Division of the Ministry of Fisheries through the respective DFEO. The analysis and presentation of catch by DFEO division, months and varieties are done at the head office.

7.1 The method of estimation is similar for all types of craft and is given below in algebraic terms.

Let in a particular sector of fisheries (e.g. OB craft) n out of N landing centres in a DFEO division be selected at random. Let Mi be the number of craft of the corresponding fisheries sector at the ith centre and $M = \sum Mi$ is the total number of crafts in the DFEO division. Let Lij be the number of craft that actually land and lij is the number of sampled boats examined on the jth day at the ith centre. If uijk represents the landing of kth boat on jth day at ith centre, then y the estimated monthly landings at the ith centre is given by

$$= \frac{D}{d} \sum_{j} \frac{Lij}{lij} \sum_{k} yijk$$

where d is the number of observation days at the ith centre (equal to 8 per month) and D is the number of days in a month excluding Sundays.

The DFEO division estimate is then obtained as :

$$Y = M \sum_{1=i}^{n} \hat{Y}_i / \sum M$$

The DFEO division estimates are then summed up to obtain the island total.

7.2 The collection of fishery statistics is carried out by Fishery Inspectors attached to various DFEO divisions. An examination of the existing system of collection of data indicates several deficiencies. The statistical forms have not been properly filled up. There is no uniformity in the reporting of species composition of landings, most probably due to lack of basic knowledge in identification of fish species.

Instructions to collect data on a specified number of bcats have not always been followed, It is apparent that the field staff are not adequately trained. Furthermore, there is a problem of supervision or inspection of the field work in the operational phase.

It is hardly necessary to emphasize that the successful implementation of any survey requires a group of well-trained field staff under adequate supervision and guidance. It is to be ensured that they strictly follow the field instructions given to them and collect data according to a prescribed plan. It is therefore suggested that separate field staff should be set apart exclusively for collection of statistics. They could then be trained and motivated.

In addition to the field staff it is necessary to have some supervisory staff who will supervise, conduct regular inspections of field work and will also ensure timely submission of statistical returns to headquarters. It is needless to emphasize again that both field and supervisory staff should be directly under the control of the Statistician of the Fisheries Ministry.

8. Methods of stock assessment used

Two research programmes have been carried out by the Research Division of the Ministry of Fisheries to estimate the prawn population. In De Bruin's study (unpublished), the major

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prawn fishing grounds in the island have been defined, while Sideek (1977) hasseiected Chilaw area in his study mainly because it is one of the most productive centres.

8.1 De Bruin has observed weekly samples from the catches by local fishermen for a long period of time. The number of weekly samples was different from one area to another. He has estimated the production of penaeid prawns from the lagoons and inshore waters of Sri Lanka to be in the region of 1000-l 500 tonnes per annum. It is however, to be noted that these figures were based mainly on eye estimates of catches made over a long period of time from samples of boats of the main productive centres of the island, and raised for the whole island.

8.2 Sideek's study (1977), prawn catches by local fishermen were recorded from 13 January 1977 to 1st March 1977 together with the number of boats operated and number of fishing hours on each day. The catch per hour of effort (C_t) and accumulated catch ($A_,$) were then calculated and C_t was plotted against At for four species of prawns, M. *dobsoni,* P. *stylifera,* P. *coromandalica* and P. *cornuta.* Following De Lury's method and fitting the data to the regression $C_t = a + bA_t$, where a is a constant and b is the catchability, he obtained the following values of the initial population (A_o) of above species of prawns.

Prawn species	Initial population
M. dobsoni	21,166 lb
P. stylifera	7,181 lb
P. coromandalica	
P. cornuta	349 lb

8.3 At present a study has been undertaken by Jayakody of the Research Division, Ministry of Fisheries. The aspects that are covered in his study are :

(a) Total weight of prawns caught and catch per effort.

(b) Determination of the maturation and breeding periods of some commercially important penaeid prawn species.

(c) Species composition of the catches.

(d) Size at maturity of commercially important penaeid prawn species *(P. monodon, P. indicus, P. semisulcatus, P. merguiensis).*

He expects to continue his research along the lines put forward by Sideek (1977). The preliminary results of his study are reported in Appendix lll.

9. Basic biological characteristics

There are three research programmes to ascertain some of the basic biological characteristics of some prawn species conducted by the Research Division of the Ministry of Fisheries.

Mutwal, Negombo, Chilaw are selected for the research work on prawns, as these regions are the most productive centres in the island. Weekly visits are made to these places and the following information is collected from random samples of prawns.

1. Maturation and breeding periods of penaeid prawns
2. Species composition
3. Size at maturity of commercially important prawn species
4. Total weight of prawns caught and catch per effort values.

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9.1 Maturity and breeding periods

Random samples were examined from the catches for the maturity stages, undeveloped, developing and developed. Using the above data percentage maturity values were calculated for different species. From the results of the research work carried out during the last year the following tentative conclusions can be put forward:

(i) Mature females of small prawns such as *M. dobsoni* and *P.* stylitera are found throughout the year.

(ii) P. indicus breeds in February, March, April and again in November and December.

(iii) Most of the females of *P. semisulcatus* are caught in November and most of them are mature but it is difficult to determine the breeding periods as the catch is low.

(iv) Diligent observations are carried out for *P. monodon* to determine the breeding periods but it was not possible to do so as the catch of the mature females was poor.

9.2 Size (length group) at maturity

Prawns were categorised into maturity stages and length groups from random samples. This method has been repeated for all commercially important large prawn species and the results obtained are as follows :

P. indicus : Size varies up to 20.00 cm. Below 13.50 cm 90% females are not developed, between 13.50- 18.50 cm gravid, developed and developing females are found.

P. merguiensis : Size varies up to 25.50 cm gravid, developed and developing females were found. Data are insufficient to indicate sizes from which various maturity stages are available.

P. semisulcatus : Size varies up to 20.50 cm. Below 90% females are not developed. Between 14.00-20.5 cm, gravid, developed and developing females were found.

P. monodon : Few gravid females were found throughout the survey period. All were beyond 20.00 cm size. Most of the females found were not developed.

9.3 Breeding cycles of some Penaeid Prawns

Breeding cycles of species *P. indicus, P. semisulcatus. P. monodon* and *P. merguiensis* are being studied from the presence of gravid females in samples obtained throughout the year (1978-1979). Samples of the prawn species were collected off the west coast, mainly from Negombo and Chilaw and the percentages of gravid females of the above species were calculated for the different months.

(1) In Negombo, over 50% of the females of *P. merguiensis* (Banana prawn) were seen to be gravid during the months of October to February- the peak being in February, In Chilaw, it is during December and January.

(2) In Negombo, over 50% of the females of *P. semisulcatus* were seen to be gravid during January and February- the peak being in January, In Chilaw, it is from December to February the peak being in January.

(3) In Negombo, nearly 50% of the females of *P. indicus* were seen to be gravid in February. In Chilaw, over 50% of the females of *P. indicus* wereseen to be gravid during January and February — the peak being in February.

(4) The breeding cycle of P. monodon could not be determined accurately as only a few of them were present in the samples collected. However, specimens of gravid females were present only during the months of November, December, January and February. Its breeding cycle may therefore be similar to other species.

For other fishes, research on basic biological characteristics were not carried out.

References

Anon. 1975 — Report of exploratory fishing in the coastal waters of Sri Lanka by *Hoyo Maru. Japan Marine Fishery Research Centre,* June 1975.

Berg, S. E. 1971 — Investigations on the bottom conditions and the possibility for marine prawn and fish trawling on the north and east coast of Sri Lanka. *Bulletin of the Fisheries Research Station, Sri Lanka, 22(142) : 53-88.*

De Bruin, G. H. P. 1960 — Lobster fishing in Sri Lanka. *Bulletin of the Fisheries Research Station,* Sri Lanka. 9

De Bruin, G. H. P. 1962 — Spiny lobsters of Sri Lanka. *ibid.,* 14.

De Bruin, G. H. P. 1969 — The ecology of spiny lobsters, *Panulirus* spp. of Sri Lanka waters. *Ibid., 20(2)* 171-l 78.

De Bruin, G. H. P. 1970 — The distribution of penaeid prawns in Sri Lanka waters. *Ibid., 21.*

Demidenko, U. 1972 — Information about the results of the joint Soviet-Lankan investigations carried out in waters adjacent to Sri Lanka Island. *Manuscript Report,* Fisheries Research Station, Sri Lanka.

FAO/UNDP Indian Ocean Programme. 1975 — Improvement of national fishery statistics.

Jean, Y. 1958 — Summary of operations of "Canadian" and "North Star" from April 1, 1955 to March 30, 1957. Manuscript *Report.* Canadian Fisheries Project, Sri Lanka.

Joseph, B. D. L. 1975 — Purse-seining for small pelagic fish around Sri Lanka at the tail end of the north east monsoon. *Bulletin of the Fisheries Research Station,* Sri Lanka 26(1-2) : 31-43.

Ministry of Fisheries Sri Lanka. 1980 — Master plan for the development of fisheries in Sri Lanka, 1979-83.

Pajot, G. 1977 — Exploratory fishing for live-bait and commercially important small pelagic fish species. *UNDP-Sri Lanka Fishery Development Project:* Technical Report No. 3.

Pajot, G. 1978 — Fishing gear methods for offshore fishing in Sri Lanka.

Pajot, G. 1978 — Inshore fishing boats, Sri Lanka.

Saetersdal, G. S. and G. H. P. De Bruin (Eds.) — Report on a survey of the coastal fish resources of Sri Lanka. August-September 1978. *Reports on surveys with the R/V Dr. Fridrjof Nansen.*

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Sideek, M. S. M. 1978 — Estimating the population density of prawns by the use of catch per effort data from prawn trawlers. *Bulletin of the Fisheries Research Station,* Sri Lanka 28.

Sivalingam, S. 1964 — Assessment and possible resources of the Pedro Bank. *Bulletin of the Fisheries Research Station,* Sri Lanka *18(2).*

Sivasubramaniam, K. 1970 — Sri Lanka's tuna long-line fishing effort and catch distribution in the Indian Ocean */bid., 22.*

Sivasubramaniam, K. 1971 — Apparent abundance of yellowfin and big-eye tuna, in the offshore inshore and near oceanic ranges around Sri Lanka Ocean. */bid., 22.*

Sivasubramaniam, K. 1975 — An analysis of experimental pole and line fishing conducted around Sri Lanka by Nichimo Company of Japan. */bid., 26(1-2) : 61-82.*

Sivasubramaniam, K. 1977 — Experimental fishery survey for skipjack and other species by pole and line and driftnet fishing method in Sri Lanka. *UNDP-Sri Lanka Fishery Development Project. Technical* Report No. 4.

Sivasubramaniam, K. 1978 — Pelagic fishery resources of Sri Lanka and its present level of exploitation with special reference to off-shore and deep-sea resources *Bulletin of the Fisheries Research Station,* Sri Lanka 28.

Appendix Ia

Estimated Fresh Fish Production by Varieties — 1979

(in tons)

	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Lobsters	Prawns	Others	Total
Colombo	213	246	153	75	155	94	63	288	183	—	130	48	1648
Negombo	328	278	1279	1440	1076	2364	255	231	8138	05	849	202	16445
Kalutara	124	211	314	288	748	417	322	545	2346	—	01	03	5319
Galle	331	299	422	291	1587	61	92	1493	1611	—	—	269	6456
Mullaitivu	252	433	180	—	21	316	241	2497	6988	24	76	62	11100
Trincomalee	210	1053	886	51	927	650	696	3680	3785	88	86	187	12299
Batticaloa	162	243	514	102	101	153	138	221	1274	—	02	48	2958
Kalmunai	504	403	390	155	1013	149	123	1118	5616	—	02	187	9660
Puttalam	112	15	775	1883	05	147	84	471	13936	40	219	1065	18752
Matara	421	230	2049	1461	1779	626	244	539	2596	—	—	90	10035
Hambantota	302	202	770	295	556	298	129	372	4174	09	56	190	7353
Jaffna	990	5691	447	05	73	1804	1488	5189	15909	55	1132	1399	34182
Mannar	306	667		24	100	741	935	1978	4963	09	785	692	10300
Total	4255	9971	8179	6070	8141	7820	4810	17722	71529	230	3338	4442	146507

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Appendix Ib

Estimated Fresh Fish Production by Varieties — 1978
(in tons)

D.F.E.O's Division	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Prawns	Lobsters	Others	Total	Per cent
Colombo	146	324	158	105	134	103	44	624	957	911	32	7	3545	2.6
Negombo	310	247	1203	1357	1014	2215	176	22	8055	1167	—	42	15808	11.7
Kalutara	276	475	848	562	629	485	243	462	716	—	2	—	4698	4.6
Galle	412	514	1640	605	1030	187	28	650	584	27	—	90	5767	4.3
Mullaitivu	118	324	65	62	19	124	92	739	4115	259	52	7	4976	4.4
Trincomalee	147	863	849	50	962	599	588	3551	3178	81	93	177	11138	8.3
Batticaloa	273	400	879	301	379	465	273	471	2150	108	—	26	4725	4.2
Kalmunai	49	78	262	88	89	122	128	763	5024	—	—	—	6603	4.8
Puttalam	225	656	1510	515	269	193	356	1383	11075	369	379	532	17462	12.0
Matara	243	329	2533	1320	2147	677	139	953	1467	—	—	126	9934	7.4
Hambantota	306	123	475	291	460	196	84	267	2523	3	14	365	5107	3.8
Jaffna	879	5034	396	5	67	1612	1425	5155	15592	1113	51	1378	32707	24.3
Mannar	261	611	—	24	99	678	807	942	5664	770	12	406	10274	7.6
Total	3645	9978	10818	5285	7298	7656	4383	15982	51100	4808	635	3156	134744	100.0
Per cent	2.7	7.4	8.3	3.9	5.4	5.7	3.3	11.9	45.4	3.6	0.5	1.9	100.0	

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Appendix Ic

Estimated Fresh Fish Production by Varieties — 1977

(in tons)

D.F.E.O's Division	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Prawns	Lobsters	Others	Total
Negombo	152	176	1266	1422	961	1117	227	116	10120	935	28	110	1663
Colombo	235	447	424	154	178	288	64	552	545	176	36	2	3101
Kalutara	159	363	900	342	236	429	166	270	883	—	—	—	3748
Galle	313	627	545	259	736	173	124	1296	530	34	3	29	4669
Matara	317	277	1618	1331	1450	860	218	767	1279	30	—	180	8327
Hambantota	263	203	646	310	462	418	208	314	1152	12	106	16	4110
Jaffna	821	3146	539	32	168	558	940	4777	13530	411	15	884	25821
Mannar	229	673	—	19	98	679	,841	883	9853	660	1	221	14127
Mullaitivu	372	439	168	119	15	209	163	989	2878	416	—	85	5853
Trincomalee	227	940	645	72	846	700	753	2128	2549	150	128	149	9287
Batticaloa	294	328	1031	348	417	452	328	352	2366	108	—	88	6112
Kalmunai	169	237	565	126	183	385	390	616	2454	72	—	32	5229
Puttalam	163	764	2852	1123	557	220	187	2294	6597	860	2	748	16367
Total	3714	8620	11199	5657	6307	6488	4609	15354	54736	3864	319	2544	123411

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Appendix Id

Estimated Fresh Fish Production by Varieties — 1976

(in tons)

	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Prawns	Lobsters	Others	Total
Negombo	245	429	2001	2934	509	2828	560	273	9837	22	415	319	20372
Colombo	107	180	13	8	61	339	325	189	221	45	152	—	1640
Kalutara	289	188	798	392	206	407	324	446	640	—	—	22	3712
Galle	513	692	343	130	579	253	225	848	861	25	55	57	4581
Matara	167	314	1813	1141	1541	407	356	1167	1020	22	2	109	8059
Tangalle	268	338	1056	408	562	627	215	889	727	63	—	6	5159
Jaffna	833	2474	657	—	106	897	1007	2858	13209	94	761	593	23409
Mannar	332	1003	231	17	41	1102	814	1738	6321	3	196	378	12236
Mullaitivu	577	138	192	—	88	639	226	727	3261	3	934	434	7220
Trincomalee	597	706	628	89	26	600	1062	1725	2968	75	521	393	9390
Batticaloa	204	218	972	459	376	407	253	150	1204	7	903	387	5540
Kalmunai	353	236	569	192	344	417	318	663	1801	6	165	60	5114
Puttalam	112	567	2667	1037	622	516	82	230	6715	—	728	141	14417
Total	4597	7483	11940	6807	5061	9439	5828	12903	48785	285	4832	2889	120849

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Appendix le

Estimated Fresh Fish Production by Varieties-l 975

(in tons)

District	Seer Fish	Carangids	Blood Fish	Shark and Skate	Rock fish	Shore Seine Varieties (1)	Shore Seine Varieties (2)	Other Species	Total
Negombo	338	114	5996	4023	506	144	6062	1201	18384
Colombo	27	350	95	121	190	206	1322	611	2922
Kalutara	139	85	3086	481	155	335	924	73	5278
Galle	281	364	2299	94	386	60	253	236	3973
Matara	75	162	3862	660	656	333	515	165	6428
Tangalle	300	164	2467	343	454	220	1006	117	5071
Jaffna	748	1534	4110	3209	5150	574	4532	2228	22085
Mannar	218	862	89	1490	1324	1767	4874	416	11040
Mullaitivu	370	591	741	241	166	2205	2515	483	7312
Trincomalee	288	818	1573	390	1949	633	1269	299	7219
Batticaloa	244	206	1296	446	308	212	1436	1324	5472
Kalmunai	109	113	455	308	305	63	1076	263	2692
Puttalam	283	656	3622	842	986	1116	6238	1395	15178
Total	3420	6019	29731	12648	12535	7868	32022	8811	113054

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Appendix If

Estimated Fresh Fish Production by Varieties and by Districts — 1974

District	Seer Fish	Caran-gids	Blood Fish	Shark and Skate	Rock Fish	Rock Fish (Small)	Shore Seine Varieties (1)	Shore Seine Varieties (2)	Other Species	Total
Negombo	185	589	4868	5816	203	114	51	1834	1760	15420
Colombo	72	239	181	1	286	84	19	255	130	1267
Kalutara	182	57	1846	1570	102	15	58	300		4130
Galle	135	141	1837	134	245	99	67	287	63	3008
Matara	669	65	2546	331	429	64	495	505	263	5367
Hambantota	287	143	2781	601	536	93	61	206	64	4772
Jaffna	1359	3481	1211	2598	2852	3066	1439	6657	1453	24116
Mannar	210	1164	153	958	299	641	385	4982	484	9276
Mullaitivu	513	717	335	271	310	296	195	1300	646	4583
Trincomalee	377	1120	1328	576	1070	748	834	3492	217	9762
Batticaloa	92	132	1072	406	85	171	157	749	1007	3871
Kalmunai	91	257	437	171	89	247	64	1910	366	3632
Puttalam	181	659	3396	1468	482	654	414	1983	776	10013
Total	4253	8764	21991	14901	6988	6292	4239	24460	7229	99217

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Appendix 1g

Estimated Fresh Fish Production by Varieties — 1973

	Seer Fish	Caran-gids	Blood Fish	Shark and Skate	Rock Fish	Rock Fish (Small)	Shore Seine Varieties (1)	Shore Seine Varities (2)	Other Species	Total
Negombo	25%	168	3177	10352	233	108	144	1014	532	15986
Colombo	107	133	131	2	246	17	33	456	294	1419
Kalutara	148	44	1484	709	169	14	127	312	2	3009
Galle	87	146	1294	126	206	77	103	393	129	2561
Matara	60	106	2258	507	317	74	671	633	142	4768
Hambantota	169	173	2704	405	459	60	18	72	332	4392
Jaffna	1356	1709	1521	1986	4003	3086	1344	5536	1905	22446
Mannar	331	1367	586	1088	313	564	1044	4438	299	10080
Mullaitivu	38	102	43	144	32	138	184	483	232	1396
Trincomalee	295	812	1570	570	1218	677	633	3073	191	9039
Batticaloa	72	243	1249	214	169	3011	113	653	104	4038
Kalmunai	93	227	446	73	138	266	141	1530	652	3566
Puttalam	496	438	2033	802	293	549	251	1600	712	7174
Total	3510	5665	18496	16977	7800	5932	4806	20242	6446	89874

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Appendix II

Number of crafts operating at the beginning of 1977

D.F.E.O. Division	Inboard	Outboard	Non-mechanised	Total
Colombo	79	52	592	723
Kalutara	113	30	612	755
Galle	103	99	853	1055
Matara	294	04	951	1249
Tangalle	199	202	907	1309
Kalmunai	31	32	553	616
Batticaloa	80	124	563	767
Trincomalee	77	72	1193	1342
Mullativu	97	397	430	924
Jaffna	414	1401	1597	3412
Mannar	132	511	481	1124
Puttalam	304	926	2629	3859
Negombo	239	1192	930	236
Tota l	2162	5042	12291	19495

Number of crafts operating at the beginning of 1978

Colombo	79	52	602	733
Kalutara	113	30	634	777
Galle	103	99	916	1118
Matara	288	04	923	1215
Tangalle	199	16	1164	1379
Kalmunai	31	32	872	935
Batticaloa	82	124	1890	2096
Trincomalee	77	72	1207	1356
Mullativu	97	397	426	920
Jaffna	426	1470	2029	3925
Mannar	133	511	481	1125
Puttalam	304	1022	3016	4342
Negombo	239	1201	1584	3024
Total	2171	5030	15744	22945

Number of fishing crafts operated as on 30-6-1979

D.F.E.O. Division	Inboard	Outboard	Non-mechanised	Total
Colombo	37	37	230	304
Kalutara	117	35	634	786
Galle	118	131	1040	1289
Matara	328	381	924	1633
Tangalle	219	106	1300	1625
Kalmunai	29	200	334	563
Batticaloa	49	143	561	763
Trincomalee	120	239	1633	1992
Mullativu	35	668	445	1148
Jaffna	471	1979	1689	4151
Mannar	266	446	1152	1152
Puttalam	535	1728	1276	3539
Total	2626	6740	11063	20452

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Appendix III

Yield trends over the months against fishing effort:
Station — Negombo

Pra wns

Year 1979

Month	Total Catch	lbs	No. of boats operating	Catch/effort value (Catch/Boat/Day)
February	Small prawns	22,467.26	1825	12.311 lbs
	Large ..	1,627.07		0.892 "
March	Small ..	85,856.72	2000	42.928 "
	Large ..	3,980.85		1.990 "
April	Small ..	62,318.19	1975	31.554 "
	Large ..	3,301.91		1.67 "
May	Small ..	19,195.65	725	26.477 "
	Large ..	1,597.65		2.203 "
June	Small ..	26,212.16	1325	19.783 "
	Large ..	1,658.88		1.252 "
July	Small ..	21,880.80	1075	20.354 "
	Large ..	2,624.12		2.441 "
August	Small ..	50,226.94	1700	29.569 "
	Large ..	3,752.46		2.207 "
September	Small ..	54,938.87	2025	27.13 "
	Large ..	4,653.50		2.29 "
October	Small ..	37,746.54	2100	17.97 "
	Large ..	2,439.45		1.162 "
November	Small ..	34,668.40	2065	16.15 ,,
	Large ..	1.886.55		0.506 "
December	Small ..	28,333.04	1881	14.485 "
	Large ..	990.31		0.506 "
Year 1980				
January	Small ..	30503.25	1413	21.587 "
	Large ..	1.094.00		0.774 "
February	Small ..	28,728.65	1188	24.182 "
	Large ..	1,275.90		1.073 "
March	Small ..	30,417.45	1952	19.106 "
	Large ..	1 ,1 19.97		0.703 "

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Appendix III — (Contd.)

Yield trends over the months against fishing effort: Station — Chilaw

Prawns

Year 1979

Month	Total Catch lbs		No. of boats operating	Catch/effort value (Catch/Boat/Day)
February	Small prawns	15,522.80	1975	7.859 lbs
	Large ..	13,026.75		6.595 "
March	Small ..	24,920.17	1950	12.780 "
	Large ..	28.289.38		14.5071 "
April	Small ..	7,204.99	1925	3.743 "
	Large ..	19,561.89		10.162 "
May	Small ..	12,213.73	1725	7.080 "
	Large ..	16,079.31		9.321 "
June	Small ..	13,577.20	1600	7.146 "
	Large ..	10,486.71		5.519 "
July	Small ..	17,213.21	1075	16.012 "
	Large ..	6,582.06		6.123 "
August	Small ..	12,327.84	950	12.977 "
	Large ..	8,819.46		9.284 "
September	Small ..	6.820.75	1356	5.03
	Large ..	7,090.20		4.8896 "
October	Small ..	21,967.74	1450	15.15 "
	Large ..	7,090.20		5.8896 "
November	Small ..	43,981.60	1875	22.55 "
	Large ..	10,732.54		5.50 "
December	Small ..	48,824.448	2000	23.552 "
	Large ..	6,660.94		3.213 "
Year 1980				
January	Small ..	23,552.0	1275	18.472 "
	Large ..	4,933.75		3.869 "
February	Small ..	19,194.25	1563	12.28 "
	Large ..	3,403.50		2.235 "
March	Small ..	7,656.43	1163	6.583 "
	Large ..	6,910.64		5.942 "

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STOCK ASSESSMENT CONSULTATION
Volume 2

THAILAND

Status Paper on Coastal Fishery Resources

by
Udom Bhatia
Somsak Chullasorn

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CONTENTS

		Page
1.	Introduction	112
2.	Existing knowledge on the status of coastal fisheries	112
3.	Methodology for collection of catch statistics	115
4.	Brief information on the basic biological characteristics	115
5.	Stock assessment	115
6.	Problems/constraints and requirements in the collection and processing of fishery statistics and in the assessment of coastal stocks	117
	References	118

Tables

1.	Annual marine fishery production of Thailand, 1960-l 977	120
2.	Number of registered fishing vessels in the west coast of Thailand	120
3.	Number of fishing gear units employed in the west coast of Thailand	121
4.	Number of fishermen by working status	121
5.	Monthly catch (tons) by species and group of demersal fishes caught by commercial trawlers along the west coast of Thailand, 1976	122
6.	Monthly catch (tons) by species and group of pelagic fishes along the west coast of Thailand, 1976	123
7.	Total catch (A), fishing effort (B), and catch per hour surveyed by R. V. Pramong 3 (C) along the Indian Ocean coast of Thailand, 1966-l 978	124
8.	Catch rate (kg/hr) by depth ranges of the demersal fishes made by R. V. Pramong 3 along the Indian Ocean coast of Thailand	125
9.	Percentage of demersal fish species (or groups) composition along the Indian Ocean coast of Thailand in 1966-1979 surveyed by R. V. Pramong 3	126
10.	Percentage of catch composition by year of major group of demersal fishes in each depth range 1968-l 978	127
11.	Annual catch (tons) by major fishing gear and percentage of pelagic fish caught by them along the west coast of Thailand, 1971-l 978	130
12.	Summary of biological information on the major species of the west coast of Thailand	130-A
13.	Annual catches, and catch per hour (estimated by grid) of the demersal fishes surveyed by R. V. Pramong 3 and estimated effort along the Indian Ocean coast of Thailand, 1966-l 977	131
14.	Annual catch, fishing effort and catch per unit of effort of *Rastrelliger* spp. along the west coast of Thailand	131

15. Annual catch, fishing effort and catch per unit of effort of sardines along the west coast of Thailand 132

16. Annual catch, fishing effort and catch per unit of effort of anchovies along the west coast of Thailand 133

17. Summary of the estimated maximum sustainable yields (MSY) for each of the main pelagic species groups of the west coast of Thailand 133

18. Catch composition by species or group of total demersai resources caught along the west coast of Thailand compared with catch taken from small-scale fishing gear, 1976 and 7978 134

19. Catch composition (tons) by species or group of species of pelagic fishes caught along the west coast of Thailand, compared with catch taken from small-scale fishing gear, 1976 and 1978 135

Illustrations

1. Fishing areas **along** the Indian Ocean coast of Thailand 136

2. Comparison of the catch rate (kg/hr) by grids between 1969 and 1978 137

3. Catch and catch per unit of fishing effort related to the total standard effort of the demersal fishes in the west coast of Thailand, 1966-1977 138

4. Catch and catch per unit of effort related to the total standard effort of the *Rastrelliger* spp. along the west coast of Thailand, 1971-I 978 139

5. Catch and catch per unit of effort related to the total standard effort of sardines in the west coast of Thailand 140

6. Catch and catch per unit of effort related to the total standard effort of the anchovies in the west coast of Thailand 141

Publications of the Bay of Bengal Programme 142

STATUS OF COASTAL FISHERIES ON THE WEST COAST OF THAILAND

1. Introduction

Marine fisheries play an important role in the national economy of Thailand. It provides highly nutritious animal protein at cheap price for Thai people. Although the marine fisheries of Thailand are basically commercial rather than small-scale or artisanal oriented, the majority of the fishing vessels (about 85 per cent) are small wooden boats of less than 14 m in length operating in the coastal areas and only 15 per cent are larger than 14 m in length with modern fishing and navigation equipment.

After the advent of otter board trawling in early 1960, the vast expansion of trawling fleet had spreaded out and began to fish along the west coast of Thailand since 1965. The total marine production from the west coast had rapidly increased and reached to the peak of *270,000 metric* tons in 1973, which was 26 times that of 1960. After 1973, the annual production had gradually declined. This phenomenon, however, may indicate the decrease in the abundance of fish stocks due to the heavy fishing in this area.

2. Existing knowledge on the status of coastal fisheries

2.1 *General characteristics of the fishing grounds*

The west coast or Indian Ocean coast of Thailand extends westward to Andaman and Nicobar Islands, northward to Burma waters and southward to the west coast of Peninsular Malaysia and Sumatra Island. The coast line which starts from Ranong to Satul Province, is about 740 kilometres long. The fishing area of the shelf from the coast to the 100 metres depth contour is about 44,000 km^2. In the north off Ranong Province, or the Burma/Thai border the continental shelf to 100 m depth is some 60 miles wide, narrows to about 20 miles off Phuket Island, and then widens to over 160 miles off Satul Province or the Thai/Malaysian border.

In comparison with the Gulf of Thailand, the grounds on Indian Ocean side are much rougher, consisting of rocks and sea mounts, and the depth increases abruptly outward from shore. There are vast area of mangrove forests along the coast and numerous islands with hard coral in offshore areas. Nevertheless, along this coast is the good area for nursery and living grounds of marine animals. The Andaman sea has been the traditional fishing ground for the fishermen who live along the coastal area from Ranong to Satul Province. All the fishing activities however were done nearshore at depths of less than 90 m.

2.2 Productivity of the area

An investigation was carried out on the primary production in waters around Surin Islands off the west coast of Thailand (Wium-Andersen, 1977). The results show that the highest primary production was 23 mg C/m^3/day. The photosynthesis was 3-4 times higher at the bay station than at the offshore station with values from 65-83 mg C/m^3/day, the latter value being correlated with a bluegreen algae bloom which indicate upwelling. Net phytoplankton from all stations (>30μ) were dominated by bluegreen algae and diatom, in addition, dinophyceae were seen.

2.3 Census of fishing craft/gear and active fishermen

During the early stages of trawling expansion along the west coast of Thailand, many boats built for other types of fishing such as seining, gillnetting and bamboo stake traps were converted to trawlers; but in recent years the numbers of trawler and seiner have decreased while the numbers of small-scale fishing gears were increasing. Table 2 shows the numbers of fishing

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boats by size categories from 1970 to 1978 and Table 3 indicates the numbers of fishing units by types of fishing methods from 1970-l 978.

The Department of Fisheries undertook a census of the marine fishing population in 1967, 1970, 1973 and 1976. During 1970 to 1976, the total fisheries population dropped from 51,177 in 1970 to 38,578 in 1976 and the number of active fishermen decreased from 16,664 in 1970 to 11,177 in 1976 as shown in Table 4. The census in 1970 showed that 73.2% of fishermen were engaged solely in fishing and the percentage has increased to 74.8% in 1976.

2.4 Fisheries development and method of exploitation

In the early days, prior to 1961, the marine fisheries developed in the west coast of Thailand at a low pace, being confined to the coastal waters and carried out mostly by non-powered boats, using traditional gears and methods. Since 1961, some fishermen in the Gulf of Thailand had moved to this area and introduced the more conventional types of fishing gear like purse seines and gillnets to catch inshore pelagic fish. Later on, more effective fishing gears such as trawls and push nets to catch the demersal fish were introduced and being popularly used up to the present. Since then, the marine fisheries has experienced rapid growth mainly due to the rapid development of trawl fisheries as well as the purse seines fisheries development.

With gradual mechanization of fishing boats and gear improvement, the fishing grounds have been extended further from shore. Since 1969, Thai fishermen have modified trawl nets for catching pelagic fish such as mackerels, Spanish mackerels etc. in substantial quantities. In 1973 the purse seine fishermen have developed the fishing method by employing light luring purse seines for catching pelagic fish both inshore and offshore areas. The squid fishery has greatly expanded and the jelly fish fishery has also been developed.

At present, attention is being focussed on pole and line fishing for small tuna and skipjack. Pole and line fishing and experimental fishing of live bait is carried out jointly by the UNDP/FAO of the United Nations and the Thai Department of Fisheries which became operational in October 1978. The results of the experiments so far indicated the possibility of developing the lift net fishery for small pelagic shoaling fish (such as sardines and anchovies) as well as pole and line fishing for large pelagic fish (skipjack tuna, longtail tuna, little tuna, rainbow runner and dolphin fish).

2.5 Annual catch

The annual landing from the west coast of Thailand had drastically increased from 10,731 metric tons in 1960 to the peak of 291 ,194 metric tons in 1973 or increased from 7 per cent to 19 per cent of the whole country's annual marine catch. After 1973, the annual catch had gradually and fluctuatedly decreased to 218,861 metric tons in 1977 which was only 11 per cent of the whole country's annual marine catch (Table 1).

The major contribution of this expansion resulted from the demersal fish landed by trawlers (mainly otter board trawlers) which dominated about 55 per cent of the total marine landings in 1966-1968 and about 75-85 per cent in 1969-1977. The demersal catch had significantly increased from 16,680 metric tons in 1966 to 216,000 metric tons in 1969 and 1973 but gradually decreased to 170,800 metric tons in 1977.

The pelagic fisheries (dominated mainly by purse seine and gillnets) in the west coast of Thailand which has considerably developed since 1963 contributed substantial quantities in the annual catch in the earlier years. The pelagic annual production had reached the peak of 56,965 metric tons in 1973, and then declined significantly to 33,593 metric tons in 1977.

2.6 Catch by seasons

There are two monsoon seasons in a year through the west coast of Thailand-namely the North East monsoon and the South West monsoon. The North East monsoon operates from

October to January and the South West monsoon operates from late April to September. It has been observed that the catch varies with the change of monsoon period. From Table 5, it is indicated that the high catch of demersal fish occurred during the early period of South West monsoon, but the South West monsoon reduces considerably the activities of the smaller vessels, particularly, Thai purse seine and Chinese purse seine during, roughly, the months of June to September. However, the high catches of pelagic fishes were taken during the North East monsoon and the period at the beginning of the South West monsoon as shown in Table 6.

2.7 Catch by areas

The fishing areas in the west coast of Thailand are arbitrarily divided into 4 sub-areas as shown in Ill. 1. The 60 gross-tonnage fishery research vessel, Pramong 3 of Phuket Marine Fisheries Station has been used to survey the demersal resources during 1966 to 1978. The results of the survey showed the differences in catch rate (catch per hour) in each sub-area which is shown in Table 7. Sub-area 2, which covers the area of Taimuang District, Phang Nga Province down to the west coast of Phuket Island and to Raja Islands, was mostly found to have a higher catch rate than other areas in almost every year. It was also observed that the average catch rate of all four sub-areas had significantly decreased from 190.8 kg/hr. in 1969 to 67.6 kg/hr. in 1978 (Table 7 and Illustration 2).

2.8 Catch by depths

Considering the catch rates by depths of the waters ranging from IO-SO metres during the surveyed period by the research vessel, it was found that the demersal fish caught in various depths in each year from 1967 to 1971 fluctuated and have a generally decreasing trend (Table 8). It is obvious that at depths of less than 20 metres and beyond 70 metres, the catch rates were lower than other depth ranges. The high catch was obtained at depths between 30-60 metres.

2.9 Catch by species

The fish caught in the west coast of Thailand were composed of many species both in demersal and pelagic groups.

Based on the catch composition from the surveys by research vessel, the demersal fishes were sorted into groups which represented species or family as appeared in Tables 9 and 10. It is obvious that the catch composition varied from year to year and also according to depth ranges of the waters. Among the demersal food fishes, the top-ten of major species are shown in Table 9. It appears that only three groups of fish belonged to family Nemipteridae, Synodontidae and Priacanthidae, showed an increasing trend in percentage of total catches, while the other groups decreased in succeeding years especially Leiognathidae and Mullidae which declined drastically. The catch composition of major species groups by depth ranges of waters are shown in Table 10. It appears that the groups of Leiognathidae, Sciaenidae and Sphyraenidae were dominant at the depth of 31-40 m. The Synodontidae, Nemipteridae, Priacanthidae and Mullidae showed significant abundance at 40-80 m depth, while the Carangidae was generally found at the depth of 20-50 m and Trichiuridae could be caught over the whole range from 30-80 m depth. The Tachysuridae was found in estuaries and also found at depths between 40-80 m.

Taking into account the pelagic fishes caught by major fishing gears along the west coast of Thailand, the most important pelagic fishery is for mackerels which yielded more than 40 per cent of the total pelagic catches (Table 11). Landings of mackerels during 1971-1978 showed a peak of 23,334 metric tons in 1973, after which the landings steadily decreased to 4,678 metric tons in 1978. Other pelagic fisheries which played an important role are that for sardines, anchovies, scads, little tunny, hardtail scads and trevallies. It is seen that the percentage of landings for sardines showed a considerably increasing trend while a rapidly decreasing trend appeared in landings of anchovies.

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3. Methodology for collection of catch statistics

The Fisheries Statistical Organisation set-up for collection and processing of catch statistics is the fisheries statistical section which is under the Fisheries Economics and Planning Sub-division, Department of Fisheries.

The new marine fisheries production survey which was basically designed on sample theory was launched in 1969. The objectives of the surveys are to secure data necessary fo: fishery administration and fish stock assessment by providing catch data by species and its associated fishing efforts for each type of fishing gear.

The surveys are conducted through the field set-up of the Department of Fisheries, in which 6 supervisors and *70* enumerators have been assigned to this survey. The survey covers all types of marine fisheries including mariculture and brackishwater culture.

The surveys are applied to major types of fishing methods; after 1973, the numbers of fishing methods covered by these surveys were 11.

In the survey, a fishing unit is regarded as a sampling unit. A fishing unit is defined as a technical unit for a fishing operation normally consisting of boats, gear and areas. The operator of sample fishing unit is requested to keep a record of catch and fishing efforts for each trip by means of a log book.

A simple estimation mothod adopted in the Log Book Survey is applied with the following formula :

$$\hat{T} = \frac{N}{n} \sum_{k=1} Xk$$

where $\hat{T}$ = Estimated catch

N =Total number of fishing units by strata

n = Number of fishing units

X_k =Catch of the k^{th} sample fishing unit.

4. Brief information on the basic biological characteristics

Preliminary studies on the biology and early life history which include spawning seasons and grounds, feeding habit, growth, mortalities and other biological aspects of some economically important pelagic and demersal species in the west coast of Thailand have been being carried out by fisheries biologists at Phuket Marine Fisheries Station.

Pelagic species selected for the studies include Indo-Pacific mackerel *(Rastrelliger brachysoma),* Indian mackerel *(Rastrelliger kanagurta),* Malabar trevally (Carangoi malabaricus), hardtail scad *(Megalaspis* cordyla), little tunny *(futhynus affinis)* and frigate mackerel *(Auxis thazard).*

For demersal species, threadfin bream *(Nemipterus delagoe,* N. tolu), sillago whiting (Sillage *sihama, S. ciliata),* monocle bream *(Scolopsis taeniopterus),* big-eye snapper *(Priacanthus tayenus)* and grouper *(fpinephelus sexfasciatus)* are selected for the study.

Some penaeid shrimps such as tiger shrimp *(Penaeus semisulcatus),* jumbo tiger shrimp (P. *monodon)* and white shrimp *(P. merguiensis)* have been selected for study of the spawning in order to support culture and propagation.

The results of the study are summarised in Table 12.

5. Stock assessment

Method of stock assessment employed : For assessment of the stocks, direct methods which employed a simple mathematical model based on the relation between the fishing effort and its associated catch namely Schaefer's and Fox's models (Schaefer, 1954, and Fox, 1970) are used to estimate the maximum sustainable yield (MSY).

5.1 Stock assessment for demersal resources

Many studies have been done on the assessment of demersal stock along the Indian Ocean coast of Thailand. Isarankura (1971) reviewed the data on catch and effort during the years 1965-1968, when the total catch had reached 88,000 tons and suggested that the MSY had already been reached. Marr *et al. (1976),* after examining the additional data concluded that MSY will be substantially greater-probably around 150,000 tons. The results of the workshop on the Fishery Resources of the Malacca Strait in March, 1976 showed the estimated MSY for the demersal stocks within the 90 m depth contour off the Thai west coast to be of about 200,000 tons and the corresponding optimum fishing effort is estimated to be around 1.3 million trawling hours of the commercial fleet, which is slightly comparable to that in 1969..

Based on the data by the research vessel, Pramong 3, during 1966-l 977 except the years 1972-1973 which show estimated value, the average catch per hour and the total estimated effort regarding the research vessel as standard unit (Table 13), the yield trends over the years against the fishing effort were established by using the exponential model (Fox, 1970) as shown in III. 3. The estimated MSY was calculated to be 205,460 tons with its corresponding optimum fishing effort of 1.65 million hours. This estimation, however, is rather close to the previous estimated MSY of the Malacca Strait Workshop. This suggests that the MSY was probably reached in 1974. Therefore, with the increasing trend of fishing effort afterwards to nearly double of the optimum effort in 1976-1977, the demersal catch had declined to lower level than the estimated MSY.

5.2 Stock assessment for pelagic resources

5.2.1 Mackerels

The mackerel *(Rastrelliger* spp.) are the most important pelagic species group in the west coast of Thailand, comprising more than 45% by weight of the total pelagic catches in the succeeding years (Table 11). The annual landings of *Rastrelligers* captured in the west coast of Thailand increased from approximately 9,700 metric tons in 1972 to the peak of over 23,000 metric tons in 1973. In recent years, there has been a steadily decreasing trend in the amount of mackerel catch and was about 4,700 metric tons in 1978 because the fishing effort in this fishery was declining. Many fishing boats of this area were used for other occupations e.g. dredging for tin.

Based on the fact that the Thai purse seine which is the major gear for catching *Rastrelligers* could provide the catch and effort data since 1971 to 1978, Thai purse seine is, therefore selected as the standard gear for the estimation of total effort expended for the mackerel fishery. The estimated total effort was obtained by dividing the total catch of mackerel by all gears by the catch per day of Thai purse seine. The data on catch and its corresponding total effort are presented in Table 14. The relation of CPUE and annual catch related to fishing effort are shown in III. 4. The estimated maximum sustainable yield is likely to be 20,000 tons at the effort of about 38,000 days of Thai purse seine unit.

5.2.2 Sardines

The fisheries for sardines are by the same purse seines that catch the mackerel operating in shallow water. Sardines are not the main species sought and may be considered as a by catch because of their low price in the market; almost all of the catch were sold to the fish meal factories for producing the food stuff. Sardines in the west coast of Thailand include several species of which *Sardine//a gibbosa* are the most abundant. The annual catch of sardines from 1971-l 978 are shown in Table 15. The catch considerably increased from 100 metric tons in 1971 to the peak of about 5,500 metric tons in 1976. From 1976, the catch declined due to the decrease of fishing effort and yielded about 3,000 metric tons in 1978.

As sardines are not the target species for the seiners which are regarded as the standard gear, the catch per unit of fishing effort (catch per day of purse seiners) would not therefore

reflect the abundance of these species. It is probable that there are substantial quantities in the stock of sardines along the west coast of Thailand and the status of the fishery may be one of light exploitation. The MSY is considered to be not less than 5,000 metric tons (Ill. 5).

5.2.3 Anchovies

Anchovies caught along the west coast of Thailand are of several species of the genus Stolephorus, the most important species in *Stolephorus heterolobus.* Anchovies are mostly caught by small meshed anchovy purse seines, push nets and tidal traps. Some species of anchovies are also caught by trawlers especially *Stolephorus indicus* and *S. buccaneeri.* Table 16 shows the available annual catch of anchovies caught from 1972-1978; it is obvious that there is rapidlydecreasing trend in the catch after 1974 which yielded the highest catch of about 7,500 metric tons. The downward tendency of the catch may be due to the small amount of effort expended to the fishery.

Ill. 6 shows the annual catch and catch per unit of effort (ton/day) related to the total fishing effort (number of days fished of anchovies by purse seine). The obtained MSY from the yield curve is about 7,700 metric tons at the optimum effort of about 18,000 days of anchovies purse seine unit. It is indicated that there is still a room of expansion for the anchovies fisheries along the west coast of Thailand; increasing the fishing effort would result in increasing the catch to the maximum level as mentioned earlier.

52.4 Other pelagic species

After summarising the data for other pelagic species caught along the west coast of Thailand, the determination of the potential yield has been difficult due to the absence in many cases of the relevant information on fishing effort. Therefore, the assessment of these stocks has been omitted.

However, an attempt was made to give an estimate of MSY for other pelagic species at the Malacca Strait Workshop in 1976. Table 17 summarises the results of the assessment of pelagic fish according to species group which also include the results obtained from the previous estimation at Malacca Strait Workshop. It is seen that the total maximum sustainable yield for pelagic fish is considered to be around 60,000 metric tons, while the mean catch during 1971 to 1978 was only 39,000 metric tons per annum, just slightly more than half the potential. The pelagic fish in the west coast of Thailand appear to be capable of some expansion in the future.

5.3 Other resources

It should be noted that other groups of marine resources such as shrimps, molluscs (including squid and cuttle-fish) and other invertebrates have been omitted from these assessment, largely due to inadequate information. The small-scale fishery is reported to be catching substantial quantities of those resources. Tables 18 and 19 show the species composition of demersal and pelagic catches compared with the catch taken from small-scale fishing gears. It is seen that some demersal and pelagic species and particularly most invertebrates were mainly caught by small-scale fishing gears. It is clearly known that this fishery is poorly documented, particularly in the information on fishing effort, and these data are not enough to be able to draw any definite conclusion.

6. Problems/constraints and requirements in the collection and processing of fishery statistics and in the assessment of coastal stocks

According to the rapid development of marine fisheries of Thailand and the requirements of international fishery bodies in the field of fishery statistics collection, attempts are now being devoted by the Department of Fisheries to improve the methods of sampling survey and the techniques of data collection. However, a major problem, i.e. the problem of the reliability and the adequacy of the data collected, exists because of the difficulty in collecting data from fishermen and fishery industry. As is the case also in other countries, the fishermen and

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the industry provide incorrect information on catch statistics and fishing grounds. A proper understanding by fishermen and the industry about the important role of fishery statistics in resources assessment and fishery management is probably a good solution to this problem. It is also recommended that a national fishery data center should be established to process the large volume of fishery statistics data.

Regarding stock assessment, the information on catch and effort by fishing gears and by important species or groups of species is the most significant data for assessing the surplus production of resources. While the catch and effort statistics of 11 major commercial fishing gears are available, the statistics from small-scale fisheries which is a significant sector in marine fisheries of Thailand have been far from complete. As far as the commercial fishery statistics are concerned, the information on the monthly catch composition by species and by fishing areas is not available. In order to overcome these problems, improvement of the sampling methods and the expansion of the survey are needed. Consequently, the fishery statistics is useful not only for commercial fishery management but also for small-scale fisheries management and for resources assessment.

As regards the methodology of stock assessment, it is recognised that the methods developed by temperate countries and applied in temperate waters could not directly apply in tropical waters as in Thai waters. The multistocks and multispecies characteristics of the resources in this region as well as the multifisheries characteristics in developing countries are considered to be the main constraint in applying those methods Therefore, the modification of the conventional methods and/or the development of new proper methods of stock assessment are strongly recommended. Both the modified methods and any new methods developed should take note of the multistocks and multispecies problems as well as the multifisheries problems.

References

Anon. 1976a — Report of the Workshop on the Fishery Resources of the Malacca Strait. Part I. 29 March-2 April 1976, Jakarta. Manila, South China Sea Fisheries Programme, 1976. SCS/GEN/76/2,89 pp.

— 1976b — Report of the Workshop on the Fishery Resources of the Malacca Strait. Part II: 29 March-2 April 1976, Jakarta. — Manila, South China Sea Fisheries Programme, 1976. SCS/GEN/76/6,122 pp.

Bhatia, U. *et al. 1979* — Report on the results of the seminar on the marine Fisheries Developmental Project. (ed) V. Hongskul Technical Report of the Marine Fisheries Division No. 79/1, Department of Fisheries, Thailand, 230 pp. (in Thai)

Bhati, U. and T. Chantawong 1979 — The present status of demersal fishery along the Indian Ocean Coast of Thailand. Paper presented to FAO/ DANIDA Seminar on the Management of Tropical Demersal Fisheries, Bangkok, 1979, 22 pp.

Department of Fisheries 1971-76 — Fisheries record of Thailand 1970-77. Bangkok.

Fox, W. W. Jr. 1970 — An exponential surplus - yield model for optimising exploited fish population. *American Fisheries Society, 99 (1), 80-88.*

Gulland, J. A. 1969 — Manual of methods for fish stock assessment. Part I. Fish population analysis. *FAO, Manual of Fisheries Science, (4),* 154 pp.

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Hongskul, V. 1974 — Population dynamics of Plat Tu *Rastrelliger neglectus* (Van Kampen) in the Gulf of Thailand. *Proceedings,* IPFC 15 (III), 297-343.

Hunting Technical Services Ltd. 1974 — South Thailand Regional Planning Study. 3 volumes.

Isarankura, A. P. 1971 — Assessment of stocks of demersal fish of the west coast of Thailand and Malaysia, FAO/UNDP Indian Ocean Fishery Commission. IOFC/DEV/71/20, 20 pp. FAO, Rome.

Kangwankij, P., *et al. 1973* — A survey of the distribution and abundance of economically important shrimp along the Indian Ocean coast of Thailand. Fisheries contribution No. 3, Phuket Marine Fisheries Station, Phuket, 9 pp.

Kangwankij, P., *et al. 1973* — Observation on the spawning season of three economically important species of shrimps from the Indian Ocean coast of Thailand, estimated from gonad index. Fisheries contribution No. 4, Phuket Marine Fisheries Station, Phuket, 8 pp.

Lohakarn, N., *et al. 1979* — Pole and line tuna fishing project in Southern Thailand. Technical report, Marine Fisheries Division, Department of Fisheries, November 1979, 37 pp. (in Thai)

Marr, J. C., G. Campleman and W. R. Murdoch. 1976 — An analysis of the present and recommendations for future fishery development and management policies, programmes and institutional arrangements for the Kingdom of Thailand. SCS/76/WP/45, 185 pp. — (Restricted).

Menasveta, D., S. Shindo and S. Chullasorn. 1974 — Pelagic fishery resources of the South China Sea and prospects for their development. SCS/DEV/73/6,68 pp., FAO, Rome.

Pimolchinda, C., and C. Chirasatit. 1977 — Preliminary study on the spawning season of mackerel in the Indian Ocean coast of Thailand, 1976-1977. Technical Report No. 12, Phuket Marine Fisheries Station, Department of Fisheries, 13 pp. (in Thai)

Pimolchinda, C. and C. Chirasatit. 1977 — Preliminary study on the spawning season of whiting sillage in the Indian Ocean coast of Thailand, 1976-1977. Technical Report No. 2, Phuket Marine Fisheries Station, Department of Fisheries, 8 pp. (in Thai)

Pimolchinda, C., and C. Chirasatit. 1978 — Length-weight relationship of the Indo-Pacific Mackerel in the Indian Ocean coast of Thailand, Technical Report No. 4, Phuket Marine Fisheries Station, Department of Fisheries, 11 pp. (in Thai)

Wium-Andersen, S. 1977 — Primary production in waters around Surin Islands off the west coast of Thailand. Research Bulletin No. 16, Phuket Marine Biological Centre, Phuket, Thailand, 4 pp.

Table 1

Annual marine fishery production of Thailand, 1960-1977

Year	Total (tons)	Gulf of Thailand		West Coast of Thailand			
		Tons	%	Pelagic (tons)	Demersal (tons)	TotaI (tons)	%
1960	146,470	135,740	93	—	—	10,731	7
1961	233,275	227,746	98	—	—	5,529	2
1962	269,709	256,649	95	—	—	13,060	5
1963	323,374	314,964	97	—	—	8,410	3
1964	494,196	472,226	96	—	—	21,970	4
1965	529,483	513,096	97	—	—	16,387	3
1966	635,165	605,020	95	—	16,680	30,146	5
1967	762,188	647,664	85	-	63,360	114,524	15
1968	1,004,058	841,810	84	-	90,920	162,248	16
1969	1,179,595	909,423	77	-	216,440	270,172	23
1970	1,335,690	1,098,562	82	-	183,060	237,128	18
1971	1,470,289	1,232,721	84	45,632	186,300	237,568	16
1972	1,548,157	1,318,060	85	43,359	187,089	230,097	15
1973	1,538,016	1,246,822	81	56,965	216,007	291,194	19
1974	1,351,591	1 ,1 07,098	82	31,108	209,504	244,492	18
1975	1,394,608	1,172,420	84	35,874	184,867	222,188	16
1976	1,551,792	1,295,742	84	24,554	150,215	256,050	16
1977	2,067,533	1,848,672	89	33,593	170,824	218,861	11

Source: Department of Fisheries, Statistical Section.

Table 2

Number of registered fishing vessels in the west coast of Thailand

Size of boat (metres)	Year								
	1970	1971	1972	1973	1974	1975	1976	1977	1978
L14	131	145	235	440	343	265	388	813	1,151
14- 18	180	176	248	375	352	339	289	365	399
18-25	99	109	131	172	206	167	140	166	127
25+	3	2	-	-	-	2	1	3	12
Unknown	5	2	-	-	-	-	-	—	—
TotaI	418	434	614	987	901	773	818	1,347	1,689

Source: Department of Fisheries, Statistical Section.

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Table 3

Number of fishing gear units employed in the west coast of Thailand

Type of fishing methods	1970	1971	1972	1973	1974	1975	1976	1977	1978
Otter board trawl	251	269	372	553	479	419	353	426	623
Pair trawl	—	—	—	—	—	2	18	28	50
Beam trawl	—	1	—	—	—	11	—	—	—
Thai purse seine	51	61	54	68	112	85	89	22	47
Chinese purse seine	31	27	32	50	37	17	15	22	15
Anchovy purse seine	16	2	20	37	36	10	13	5	3
Luring purse seine	—	—	—	—	1	—	—	95	68
Spanish mackerel drift gillnet	37	17	20	61	28	43	22	38	36
Pomfret gillnet	2	—	—	—	—	2	—	—	1
Mackerel encircling gillnet	1	—	—	1	1	—	—	—	1
Shrimp gillnet	—	13	15	41	28	—	115	309	466
Other gillnets	22	13	15	41	28	35	22	132	116
Push net	15	37	95	158	151	142	147	231	289
Luring lift net	3	2	—	—	1	—	—	—	—
Long line	—	—	—	3	—	2	—	—	1
Other nets	—	—	6	18	24	5	21	36	90
Bamboo stake trap	152	85	58	—	—	—	—	—	—
Total	581	527	687	1031	926	773	815	1344	1806

Source: Department of Fisheries, Statistical Section.

Table 4

Number of fishermen by working status

Status	Year	
	1970	1976
Total fishing population	51,177	38,578
Number of active fishermen	16,664	11,177
— Solely	12,198	8,356
— Mainly	2,466	2,259
— Partly	2,000	562

Source: The marine fisheries statistics, based on the sample survey, 1971 and 1977. Statistical Section, Department of Fisheries.

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Table 5

Monthly catch (tons) by species and group of demersal fishes caught by commercial trawlers along the west coast of Thailand, 1976

Species	Jan.	Feb.	March	April	May	June	July	August	Sep.	Oct.	Nov.	Dec.
Totaldemersalfishes	*11.755*	9,312	72,473	71,665	11.257	17,138	10,460	8,810	9,917	8,459	8,814	12,784
Threadfin bream	164	94	163	176	173	140	127	-	66	96	222	848
Lizard fish	175	345	488	107	72	112	73		193	38	321	437
Baracuda	101	52	70	78	69	86	65	-	42	63	52	62
Redsnapper	81	32	29	32	17	10	24	-	27	15	14	144
Marine catfish	466	579	676	136	74	71	127	111	197	110	374	606
Croaker	644	615	857	192	197	207	88	-	285	518	328	484
Bigeyesnapper	124	99	109	85	80	61	68	-	22	61	53	588
Hairtail	15	17	42	24	45	44	33	-	17	17	58	43
Shark	98	213	271	74	53	91	130	44	55	28	96	191
Ray	92	961	506	564	215	578	103	65	75	69	106	285
Trash fish	7,629	6,192	8,003	9,533	9,669	15,086	9,157	7,776	7,978	5,960	5,962	16,188

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Table 6

Monthly catch (tons) by species and group of pelagic fishes along the west coast of Thailand, 1976

Species	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Total pelagic fishes	1599	2972	2663	3070	1609	1374	1358	1756	1567	2662	1966	3078
Indo-Pacific mackerel	283	680	422	1154	372	304	173	285	532	537	232	624
Indian mackerel	159	399	523	824	828	501	555	565	438	738	412	308
King mackerel	30	85	248	44	36	28	25	40	66	41	65	48
Wolf herring	34	29	51	45	38	42	149	65	64	26	23	52
Little tunny	95	108	217	146	120	192	68	245	113	268	164	188
Scads	190	636	159	197	49	36	66	63	50	214	139	204
Hardtail scad	109	223	228	315	41	110	117	263	80	207	151	209
Trevallies	161	232	333	165	24	62	17	85	87	233	214	467
Sardines	292	542	418	169	82	92	185	131	61	240	473	838
Anchovies	–	–	–	–	–	–	–	–	–		—	10
Black pomfret	20	16	25	7	8	4	2	7	38	61	54	43
White pomfret	225	21	34	4	6	1	1	7	36	91	37	74

Source: The landing place survey 1976, Department of Fisheries, Thailand.

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Table 7

Total catch (A), fishing effort (B) and catch per hour surveyed by R.V. Pramong 3 (C) along the Indian Ocean coast of Thailand, 1966-1978

A. Totalcatch (kg)

Area	Year								
	1966	1967	1968	1969	1970	1971	1976	1977	1978
I	-	-	714.1	15,537.l	1,966.9	-	709.9	1,202.4	946.6
II	19,631.8	12,326.9	9,120.8	10,778.4	2,373.9	1,700.8	811.8	1,497.8	1,438.l
III	1,194.5	5,919.0	30,278.7	29,812.9	331.5	7,898.3	2,287.7	2,974.2	3,228.5
IV	1,434.3	-	9,214.9	16,386.8	265.3	3.501.4	2.521.5	3.357.	82,712.8
I-IV	22.260.6	18,245.9	49,328.5	72,514.2	4,936.9	13.100.5	6,330.9	9,032.2	8,236.0

B. Effort (hr.)

Area	Year								
	1966	1967	1968	1969	1970	1971	1976	1977	1978
I	—	—	3	79	19	-	29	30	18
II	44	39	29	39	23	6	20	35	18
III	5	23	134	102	5	75	51	57	50
IV	6	-	63	160	4	32	46	59	37
I-IV	55	62	229	380	51	113	146	181	123

C. Catch per hour (kg)

Area	Year								
	1966	1967	1968	1969	1970	1971	1976	1977	1978
I	—	—	238.0	196.7	103.5	-	24.5	40.1	52.6
II	446.2	316.1	314.5	276.4	103.2	283.5	40.6	42.8	79.9
III	238.9	257.3	226.0	292.3	66.3	105.3	108.9	52.2	64.6
IV	239.1	-	146.3	102.4	66.3	109.4	54.8	56.9	73.3
I-IV	404.7	294.3	215.4	190.8	97.0	115.9	43.5	48.0	67.6

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Table 8

Catch rate (kg/hr.) by depth ranges of the demersal fishes made by R.V. Pramong 3 along the Indian Ocean coast of Thailand

Depth ranges (m)	Year					
	1967	1968	1969	1970	1971	1976
< 10	—	145.80	89.77	—	88.70	16.90
11-20	105.0	107.77	184.40	47.78	66.89	19.53
21 -30	144.55	145.89	215.04	34.50	62.65	43.92
31 -40	250.96	136.77	160.95	55.75	41.61	53.59
41 -50	158.50	174.75	204.71	57.31	105.01	49.34
51 · 60	262.0	111.46	173.74	120.66	95.37	66.16
61 -70	118.7	108.51	127.35	43.24	115.30	40.11
71-80	118.3	142.98	95.29	40.47	54.32	49.52
81 -90	-	-	160.56	25.82	—	

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Table 9

Percentage of demersal fish species (or groups) composition along the Indian Ocean coast of Thailand in 1966-1979 surveyed by R.V. Pramong 3

Soecies	Year									
	1966	1967	1968	1969	1970	1971	1976	1977	1978	1979
Total catch (kg)	22,260,6	18,245.9	49,328.5	72,514.2	4,936.9	13,100.5	6,330.9	9,032.2	8,236.0	4,010.3
Food fishes total %	77.7	56.9	32.3	41.0	67.1	32.5	70.9	69.7	54.1	53.1
1. Leiognathidae	29.9	7.8	2.0	3.0	6.0	2.3	10.8	18.5	10.9	11.2
2. Mullidae	10.9	5.2	3.3	2.4	1.8	1.8	6.5	2.1	1.2	2.2
3. Sciaenidae	8.3	5.9	0.3	1.0	1.2	0.3	—	0.5	3.6	0.0
4. Tachysuridae	5.7	3.8	2.1	1.9	0.5	0.5	—	1.1	0.3	0.1
5. Carangidae	5.4	3.2	1.9	1.9	3.2	1.4	5.6	4.9	5.4	1.9
6. Nemipteridae	3.2	3.2	4.3	7.1	2.6	2.4	6.7	5.4	4.8	7.4
7. Sphyraenidae	2.8	0.6	2.2	1.3	0.2	0.5	—	1.1	0.8	—
8. Synodontidae	2.1	2.8	2.0	2.6	0.9	0.6	2.6	4.2	4.8	7.5
9. *Priacanthus tayenus*	—	—	—	5.9	8.6	7.1	8.9	8.3	4.7	15.7
10. *Trichiurus haumela*	1.6	10.9	0.8	1.7	12.5	1.7	1.8	1.8	0.3	0.3
Subtotal %	69.9	43.4	18.9	28.8	37.5	18.6	42.9	47.9	36.8	*46.31*
Trash fish	22.3	43.1	67.7	59.0	38.9	67.5	29.1	30.3	45.9	36.4

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Table 10

Percentage of catch composition by year of major group of demersal fishes in each depth range 1968-1978

Species	Year	Depth range								
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Leiognathidae	1968	—	0.22	–	1.92	5.23	4.05	–	–	–
	1969	–	0.19	0.84	2.99	7.78	2.66	2.30	1.01	–
	1970	–	0.52	–	7.02	10.30	0.35	8.33	0.51	–
	1971	–	0.05	0.03	4.98	9.57	0.33	0.10	2.08	–
	1976	–	0.57	13.25	33.20	7.11	14.66	6.12	14.37	–
	1977	–	0.30	0.28	0.43	–	–	0.48	–	–
	1978	–	1.40	1.91	1.56	–	1.37	–	–	–
Mullidae	1968	2.80	1.06	1.45	2.39	2.87	5.61	2.92	6.12	–
	1969	–	0.25	0.87	4.97	4.43	3.65	1.64	1.82	2.83
	1970	–	0.31	0.58	2.07	4.14	0.25	0.99	0.61	1.03
	1971	–	0.01	0.44	5.31	5.08	1.91	1.08	0.94	–
	1976	–	1.29	2.03	2.74	5.39	2.20	2.30	10.26	–
	1977	–	0.01	0.42	0.72	2.98	1.00	1.99	32.32	–
	1978	–	–	–	2.40	3.32	4.79	–	–	–
Sciaenidae	1968	2.29	0.79	0.43	0.53	0.14	0.34	0.12	–	–
	1969	0.26	0.68	0.75	2.68	1.67	0.30	–	–	–
	1970	–	9.05	–	4.01	0.10	–	–	–	0.03
	1971	0.06	0.16	2.63	0.24	0.33	0.01	–	–	–
	1976	0.15	0.06	0.60	0.02	–	–	–	–	–
	1977	–	1.21	3.41	0.02	–	–	–	–	–
	1978	–	–	2.15	16.15	–	–	–	–	–
Tachysuridae	1968	2.25	1.64	1.46	1.77	2.48	3.36	–	7.33	–
	1969	1.63	0.76	1.07	3.53	2.81	2.82	5.07	0.53	–
	1970	–	0.31	–	1.79	0.32	0.02	0.03	0.24	–
	1971	0.03	0.23	0.09	0.09	0.36	0.24	2.64	0.18	–
	1976	–	0.08	0.04	–	0.73	0.17	0.77	–	–
	1977	–	0.18	0.74	1.48	1.67	0.75	0.95	–	–
	1978	–	0.78	0.37	0.41	0.52	0.92	0.47	–	–

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Table 10 — (Contd.)

Percentage of catch composition by year of major group of demersal fishes in each depth range 1968-1978

Species	Year	Depth range								
		I-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Carangidae	1968	0.96	2.27	1.12	1.96	5.33	10.75	2.49	10.74	—
	1969	1.74	4.16	2.16	2.67	2.57	4.57	5.11	2.57	1.08
	1970	-	15.01	1.01	10.20	2.37	1.03	3.95	4.49	2.32
	1971	0.03	0.24	0.16	3.21	4.18	1.39	2.39	1.06	—
	1976	7.54	6.58	2.27	2.90	2.26	1.54	4.16	1.43	—
	1977	-	5.35	7.21	6.09	1.03	1.36	3.31	1.69	—
	1978	-	5.88	3.83	3.16	19.20	2.18	4.00	2.43	—
Nemipteridae	1968	1.35	1.17	1.77	3.97	1.34	10.30	12.13	4.63	—
	1969	0.73	1.92	2.92	6.27	5.36	8.16	6.36	5.14	3.86
	1970	-	0.21	1.45	3.66	2.63	1.40	3.22	3.04	1.48
	1971	-	0.02	0.14	6.61	5.43	2.52	3.60	1.17	—
	1976	2.51	3.89	5.08	5.07	13.12	13.67	13.33	9.17	—
	1977	-	1.79	2.43	4.98	7.89	7.37	6.89	0.42	—
	1978	-	1.97	2.20	9.40	6.23	6.09	6.13	5.12	—
Sphyraenidae	1968	0.01	1.02	0.67	6.64	2.29	1.28	-	0.10	-
	1969	0.64	0.57	0.68	1.32	2.43	3.91	0.15	-	-
	1970	-	-	-	0.24	0.31	0.23	0.07	0.04	-
	1971	0.06	0.05	0.24	0.51	0.34	0.45	2.13	-	-
	1976	-	0.19	0.07	0.78	0.58	1.48	0.04	2.41	-
	1977	-	0.31	0.08	2.77	4.34	0.33	0.23	-	-
	1978	-	-	-	-	0.99	1.20	1.80	-	-
Synodontidae	1968	3.14	1.57	1.38	3.03	2.75	2.33	1.18	1.76	-
	1969	0.87	2.26	1.97	4.44	1.91	3.36	4.17	4.94	5.34
	1970	-	0.78	-	0.25	0.65	0.28	0.82	1.42	1.19
	1971	0.34	0.21	0.52	1.44	0.46	0.69	1.36	0.57	-
	1976	0.44	2.67	1.88	2.60	1.92	2.79	6.81	3.63	-
	1977	-	3.59	1.70	3.07	2.71	8.51	4.61	3.39	-
	1978	-	4.15	3.81	3.55	1.55	7.57	9.21	12.8	-

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Table 10 — (Contd.)

Percentage of catch composition by year of major group of demersal fishes in each depth range 1968-1978

Species	Year	Depth range								
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Priacanthidae	1968	—	—	—	0.01	0.06	-	-	-	-
	1969	-	0.02	0.51	3.35	11.52	13.90	9.41	3.04	1.95
	1970	—	—	1.45	0.54	1.24	9.58	15.27	9.41	2.93
	1971	-	0.01	0.09	2.64	20.62	13.99	4.44	7.64	-
	1976	—	0.27	3.40	-	-	-	-	-	-
	1977	-	1.64	—	-	—	-	-	-	-
	1978	—	—	—	—	18.21	4.87	5.81	5.12	-
Trichiurus haumela	1968	-	0.12	1.12	0.40	1.40	0.53	-	-	-
	1969	0.55	0.15	0.99	3.34	3.29	2.32	1.43	1.94	0.51
	1970	-	1.25	0.58	1.03	4.33	0.16	3.39	6.28	6.13
	1971	-	0.32	16.86	0.54	0.50	0.14	0.32	-	-
	1976	7.39	0.78	6.86	1.27	0.25	2.55	0.11	0.34	-
	1977	-	0.30	1.22	4.20	0.08	1.03	0.21	1.41	-
	1978	—	—	—	—	—	—	0.47	7.70	-

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Table 11

Annual catch (tons) by major fishing gear and percentage of pelagic fish caught by them along the west coast of Thailand, 1971-1978

Species	Unit	Year							
		1971	1972	1973	1974	1975	1976	1977	1978
Indo-Pacific mackerel	tons	12,313	5,702	13,005	5,120	7,979	3,141	4,492	2,287
	%	54.7	25.1	32.7	17.3	26.4	15.9	27.1	15.2
Indian mackerel	tons	3,856	3,966	10,329	6,050	5,722	5,329	2,501	2,391
	%	17.1	17.5	26.0	20.4	18.9	27.0	15.1	15.9
King mackerel	tons	182	1,614	216	217	150	499	937	696
	%	0.8	7.1	0.5	0.7	0.5	2.53	5.6	4.6
Wolf herring	tons	7	165	119	84	344	299	227	493
	%	0.03	0.7	0.3	0.3	1.1	1.5	1.4	3.3
Little tunny	tons	1,884	1,691	1,705	1,210	2,916	1,813	1,510	2,095
	%	8.4	7.4	4.3	4.1	9.7	9.2	9.1	13.9
Scads	tons	1,780	1,475	811	1,415	1,535	1,044	1,450	886
	%	7.9	6.5	2.0	4.8	5.1	5.3	8.7	5.9
Hardtail scad	tons	1,205	996	1,836	1,538	1,452	444	811	623
	%	5.4	4.4	4.6	5.2	4.8	2.2	4.9	4.1
Trevallies	tons	778	1,055	1,692	1,516	935	601	178	462
	%	3.5	4.6	4.2	5.1	3.1	3.0	1.1	3.1
Threadfin	tons	16	153	1,096	1,658	1,735	122	31	2
	%	0.1	0.7	2.7	5.6	5.7	0.6	0.2	0
Sardines	tons	99	654	2,050	2,073	2,659	5,456	2,874	3,032
	%	0.4	2.9	5.1	7.0	8.8	27.7	17.3	20.2
Anchovies	tons	-	6,109	4,597	7,465	3,700	869	3	826
	%	-	26.9	11.6	25.2	12.3	4.4	0	5.5
Mullet	tons	—	-	-	-	1	3	-	-
	%					0	0		
Black pomfret	tons	100	289	254	248	196	102	712	457
	%	0.4	1.3	0.6	0.8	0.6	0.5	4.3	3.0
White pomfret	tons	269	185	2,069	1,066	866	-	870	765
	%	1.2	0.8	5.2	3.6	2.9	—	5.2	5.1
Total pelagic fishes	tons	22,492	22,705	39,779	29,660	30,190	19,722	16,596	15,015

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Table.12

Summary of biological information on the major species of the west coast of Thailand

Species	Spawning season	Size at first maturity (cm)	Sex ratio 0 : 0	Recruitment Month	Recruitment LB (cm)	Mean length in catch (cm)	Stomach content	Lt.+Wt. relationship	Description
Pelagic fish									
RastreHiger brachysonia	February . March July . August	17 5	1 1 7 1 0 9	April August. December	9 5 12 5	17 5	Phytoplankton, Zooplankton, Diatom, Copepods Dinoflageflates, Poriferans, Ciliophorans	Log W=1 887443 2104 Log L	Ranong, Phang Nga- Phuket. krabi, Satul
R. kanagurta	December . February	19.0	1 : 1.2	May, December	13 - **14**	**19.2**	**Phytoplankton,** Zooplenkton, Crustaceans, Fish larvae		
Carangoides malabaricus	Throughout the year **with the peak in** February . **May** **March** . April **August** . September	19.5	1 : 1.08	January, March, **July**	10 - 11	**14.7**		Log W = - 4.2245+2.8884 LogL	Ranong Setul (very abundant at Sunn Islands,**Ranong** Prov., Kantang Bay,Ada***ng Is.,*** Latul Prov.).
Megalaspis cordyla	March . April	28.0	1 : 1.24	September,December	15.2	34.2			
Euthynnus affinis	January					26.9			
Auxis thazard	February . March		1 : 1.12	July	10.5 . **11.5**	**27**.0			**Ranong,Phang Nga,Phuket,** krabi,Satul.
Demersal fish									
Sillago sihama	**January** . March **May** . June	11 6	1 0 72	November		14 8		Log **W=—4** 4.1538+2.6596 Log L	Demersal fishes distribute throughout the coral and rock line along the coastand around islands fVOifl RaflOflg province Satulprovince.
S citiata	**November** . December June-July	11 8	1 0 95			13 9		Log W= 3837+2 7716 Log L	
Nemipterus delagoae	January . February April . May	16.0	1 : 1.45	December, April July	9.5 . 10.5 12	**14.6**	**Metapenaeus Crabs, Squids,** Shell,Annellids	Log W=—4.3522+2.8881 Log L	
N. tolu	December . January February . March **June** . **July**	17.0	1 : 1.06			13.6		Log **W=4.1514+2.8014 Log L.**	
Scolopsis taeniopterus	October . November January . February June-July December January	16.0	1 : 0.125			15.2		Log W=3.7031+2.6095 Log L	
Priacanthustayenus		17.0				13.5		Log W——3.3815+2.4807Log **L**	
Epinophelus sexfasciatus		14.7				17.2		Log W —4.3022+2.8983 Log L	
Penacus semisulcatus	January . February	16.0							
P. monodon	June August, February	20.0							Veryabundantinsandybottorn atdepth35.4m.
p. merguiensis	July August	13.0							

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Table 13

Annual catches, and catch per hour (estimated by grid) of the demersal fishes surveyed by R.V. Pramong 3 and estimated effort along the Indian Ocean coast of Thailand, 1966-1977

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Catch (ton)	16,680	63,360	90,920	216,440	1,83,060	186,300	187,089	216,007	209,504	184,867	150,215	170,824
CPUE (kg/hr.)	405.0	179.8	313.9	224.4	96.5	188.0	—	—	85.8	84.1	51.9	52.5
Effort x 10^3 hr.	41.2	352.4	289.6	964.5	1,897.0	990.9	-	—	2,441.8	2,198.0	2,894.3	3,253.8

Table 14

Annual catch, fishing effort and catch per unit of effort of Rastrelliger spp. along the west coast of Thailand

	Year							
	1971	1972	1973	1974	1975	1976	1977	1978
Total catch (tons)	16,169	9,668	23,334	11,170	13,701	8,470	6,993	4,678
Estimated total standard effort (days of TPS. unit)	21,757.1	20,336.6	24,397.7	17,232.3	9,523.2	12,014.2	7.165.7	7,100.8
Catch per unit of effort (ton/day of TPS. unit)	0.7432	0.4754	0.9564	0.6482	1.4387	0.7050	0.9759	0.6588

Source: Fisheries Statistical Section, Department of Fisheries.

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Table 15

Annual catch, fishing effort and catch per unit of effort of sardines along the west coast of Thailand

	Year							
	1971	1972	1973	1974	1975	1976	1977	1978
Total catch (tons)	99	654	2,050	2,073	2,659	5,456	2,874	3,032
Estimated total standard effort (days of TPS. unit)	1,931 .0	28,432.3	25,857.4	17,599.9	9,958.4	12,487.1	3,271.6	6,345.0
Catch per unit of effort (ton/day of TPS. unit)	0.0513	0.0230	0.0793	0.1178	0.2670	0.4369	0.8785	0.4779

Source: Fisheries Statistical Section, Department of Fisheries.

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Table 16

Annual catch, fishing effort and catch per unit of effort of anchovies along the west coast of Thailand

	Year					
	1972	1973	1974	1975	*1976*	**1978**
Total catch (tons)	6,109	4,597	7,465	3,700	888	826
Estimated total standard effort (days of anchovies seine unit)	3,570	6,644.6	10,61 6.6	8,810.6	1,293.9	2,825.4
Catch per unit of effort (ton/ day of anchovies seine unit)	1.7112	0.6918	0.7031	0.4199	0.6863	**0.2923**

Source: Fisheries Statistical Section, Department of Fisheries.

Table 17

Summary of the estimated maximum sustainable yields (MSY) for each of the main pelagic species groups of the west coast of Thailand

(Thousand tons)

Species	MSY
Rastrelliger spp.	20.0
Sardines	5.0
Anchovies	7.7
King mackerel	4.0[1]
Wolf herring	2.0[1]
Little tunny	5.0[1]
Scads	5.0[1]
Hardtail scad	5.0[1]
Mullets	3.0[1]
Others	4.0[1]
Total Pelagic	60.7[1]

[1] The estimated MSY from the Workshop on the Fishery Resources of the Malacca Strait, March 1976.

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Table 18

Catch composition by species or group of total demersal resources caught along the west coast of Thailand compared with catch taken from small-scale fishing gear, 1976 and 1978

Species	1976			1978		
	Total catch (tonnes)	Catch from small-scale fishing gear	%	Total catch (tonnes)	Catch from small-scale fishing gear	%
Indian halibut	186	—	—	1,473	—	—
Tongue Et Soles	602		—	2,238	374	16.17
Marine catfish	2,099	1,170	55.74	3,368	481	14.28
Lizard fish	844	—	—	3,097	—	—
Ginger eel	676	—	—	1,554		—
Sillago whiting	234	—	—	476	—	—
Red snapper	3,307	3,108	93.98	1,157	283	24.46
Threadfin bream	1,728	4	0.23	2,493	714	28.64
Croaker	2,118	9	0.42	5,513	516	9.36
Bigeye snapper	603	24	3.98	1,990	176	8.84
Baracuda	723	87	12.03	1,247	146	11.71
Shark	2,477	1,904	76.87	1,334	41	3.07
Ray	2,921	1,754	60.05	2,132	42	1.97
Trashfish	74,267	8,862	11.93	133,540	7,852	5.88
Subtotal demersal fishes		16,941			10,642	
Penaeid prawn	3,821	2.399	62.78	5,763	4,183	72.58
Non-penaeid prawn	8,527	4,834	56.69	10,238	3,267	31.91
Squid	2,205	77	3.49	5,045	269	5.33
Cuttle fish	2,239	193	8.62	4,328	38	0.88
Sea mussels	10	—	—	—	—	
Blood cockle	42	42	100.00	—	—	—
Jelly fish	4,015	4,015	100.00	—	—	—
Swimming crab	2,887	2,281	79.01	5,101	3,075	60.28
Mangrove crab	695	667	95.97	4,445	3,818	85.89
Subtotal	24,441	14,508	59.63	34,920	14,654	41.96
Total	161,168	31,449	19.51	225,105	25,278	11.23

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Table 19

Catch composition (tons) by species or group of species of pelagic fishes caught along the west coast of Thailand, compared with catch taken from small-scale fishing gear, 1976 and 1978

Species	1976			1978		
	Total catch	Catch from small-scale fishing gear	%	Total catch	Catch from small-scale fishing gear	%
Indo-Pacific mackerel	3,141	—		4,623	67	1.45
Indian mackerel	5,384	55	1.02	2,545	1	0.04
King mackerel	1,532	1,030	67.43	1,931	581	30.10
Wolf herring	588	289	49.15	1,068	680	63.67
Little tunny	1,827	14	0.77	1,636	—	—
Scads	1,047	27	2.58	1,450		—
Hardtail scad	447	3	0.67	811	1	0.12
Trevallies	924	323	34.96	1,211	649	53.59
Sardines	5,456	—	—	2,982	73	2.45
Anchovies	907	907	100.00	737	737	100.00
Black pomfret	402	343	85.32	720	114	15.83
White pomfret	345	217	62.90	872	36	4.13
Threadfin	133	11	a.27	31	13	41.94
Hairtail	516		—	1,502	—	—
Mullet	610	610	100.00	1,876	1,511	80.54
Total	24,554	3,832	15.61	23,995	4,463	18.60

Source: Department of Fisheries, Statistical Section.

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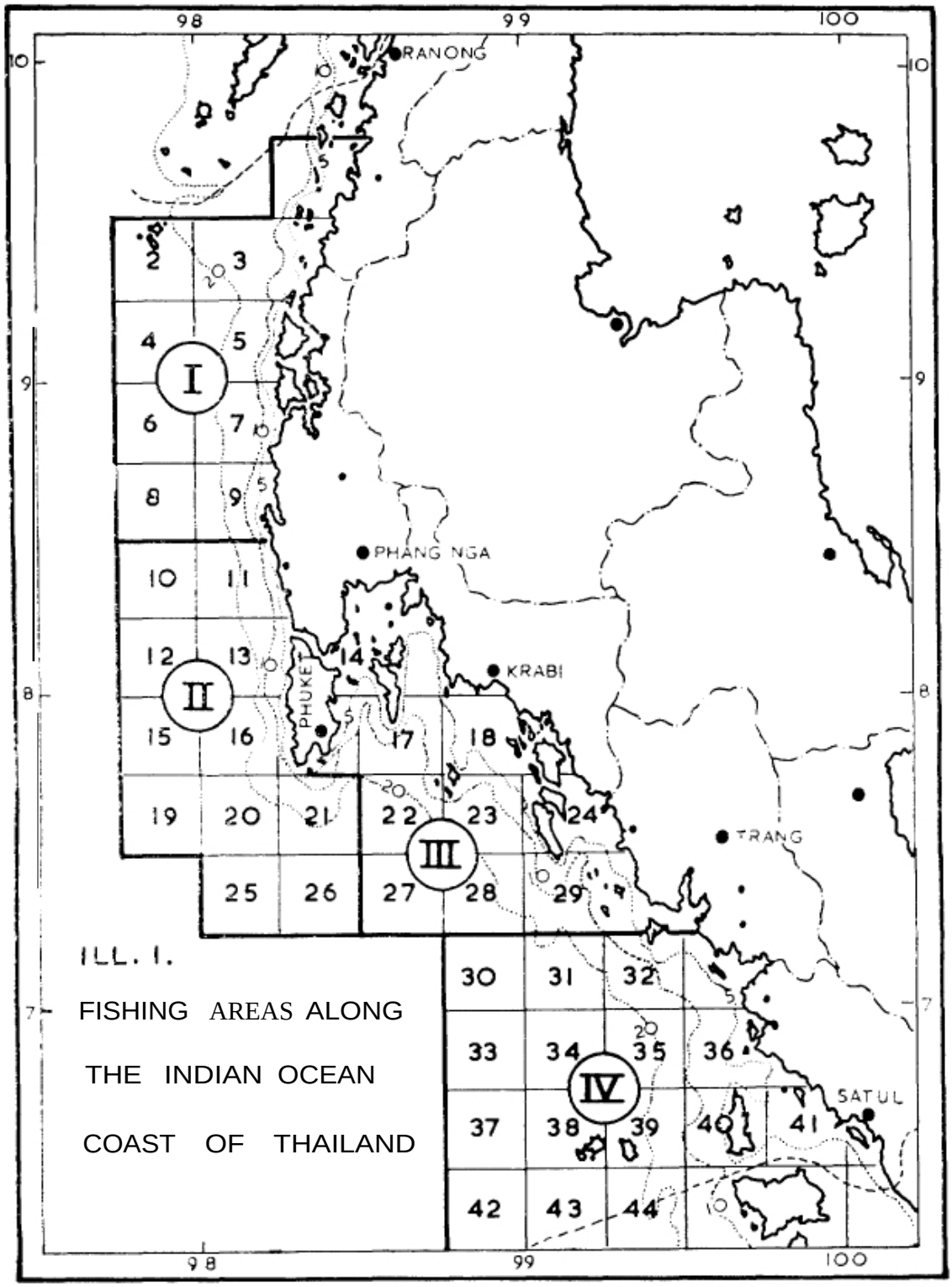

ILL. 1.

FISHING AREAS ALONG THE INDIAN OCEAN COAST OF THAILAND

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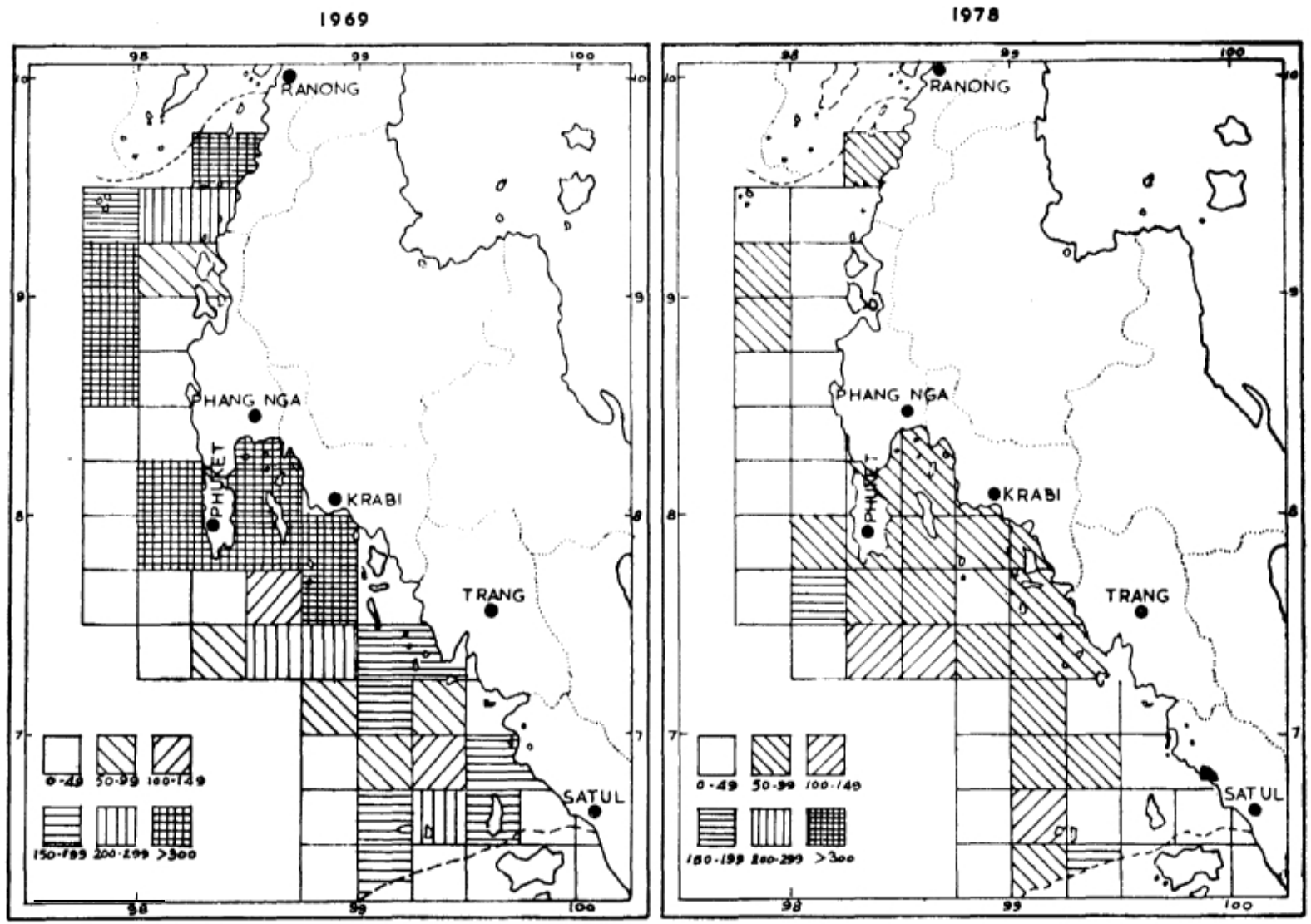
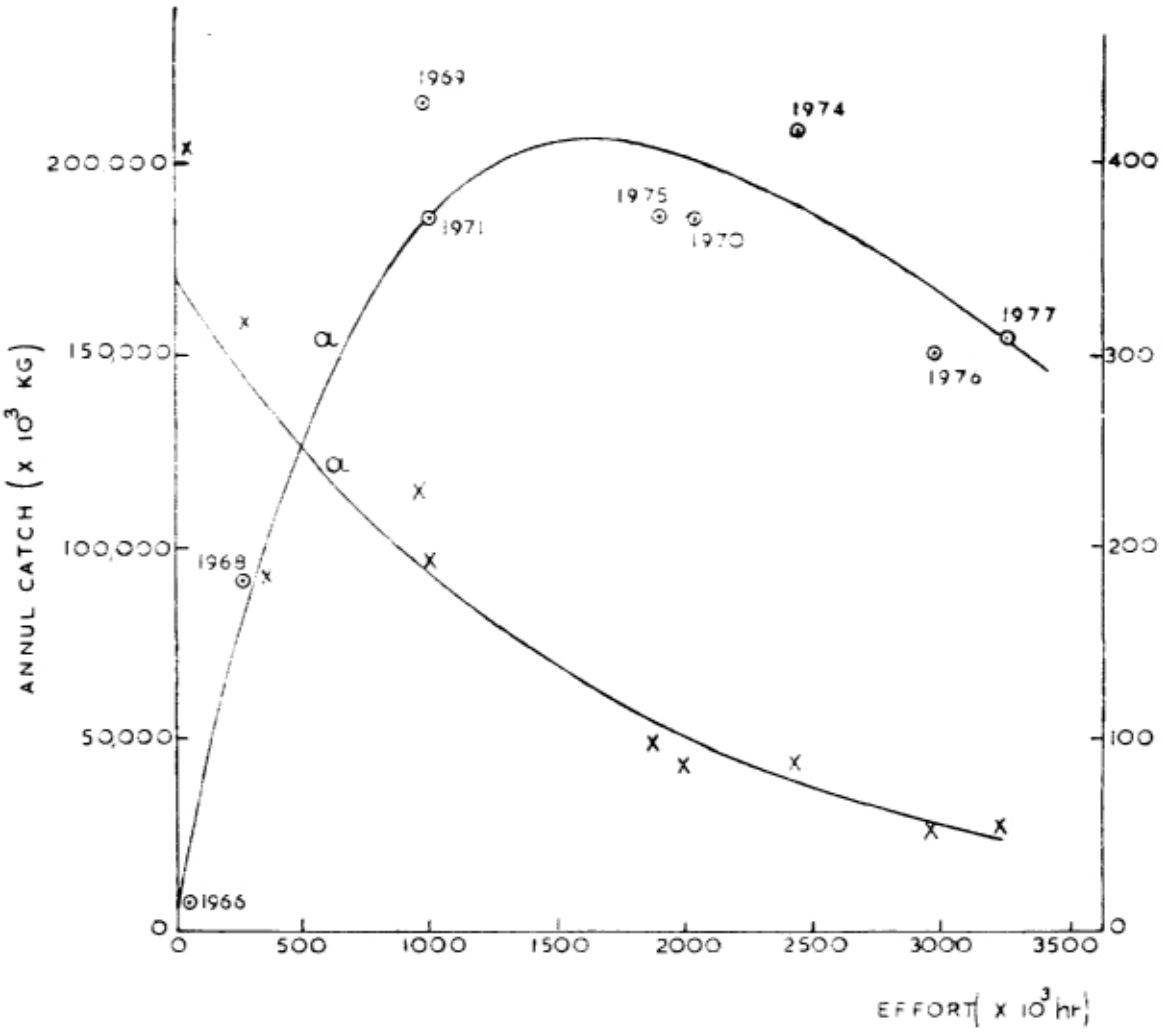
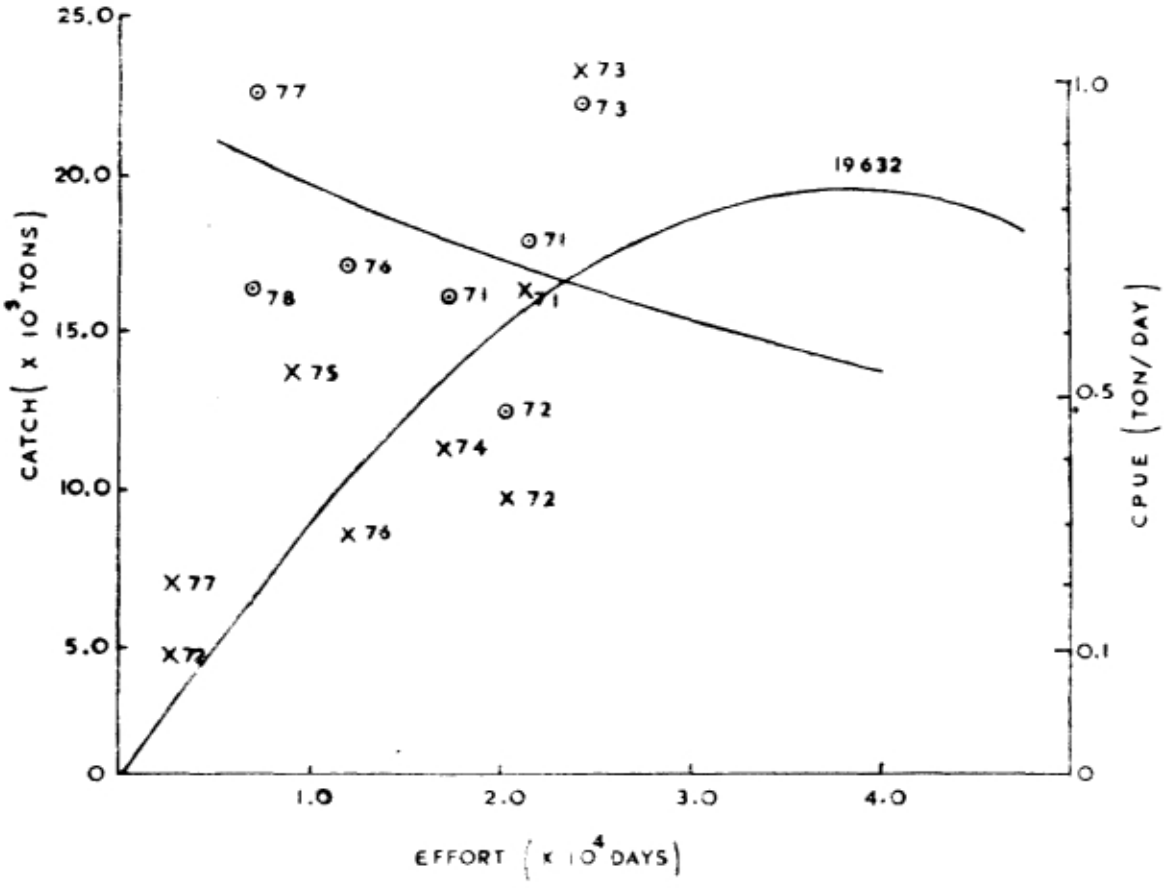


ILL. 2 COMPARISON OF THE CATCH RATE (KG./ HR.) BY GRIDS BETWEEN 1969 AND 1978



ILL-3 CATCH AND CATCH PER UNIT OF FISHING EFFORT RELATED TO THE TOTAL STANDARD EFFORT OF THE DEMERSAL FISHES IN THE WEST COAST OF THAILAND, 1966— 1977



ILL.4. CATCH AND CATCH PER UNIT OF EFFORT fiELATED TO THE TOTAL STANDARD EFFORT OF THE RASTRELLIGER SPP. ALONG THE WEST COAST OF THAILAND 1971 – 1978

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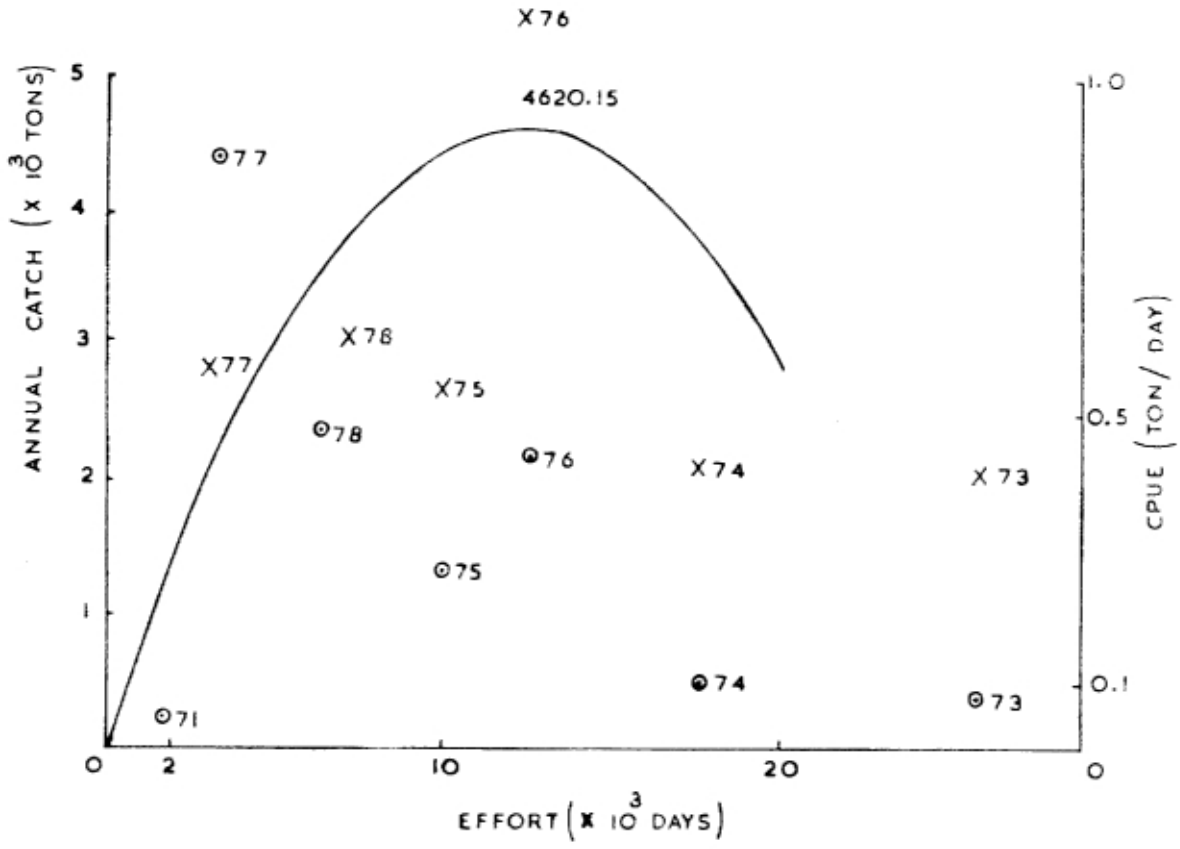

ILL.5. CATCH AND CATCH PER UNIT OF EFFORT RELATED TO THE TOTAL STANDARD EFFORT OF **SARDINES** IN THE WEST COAST OF THAILAND

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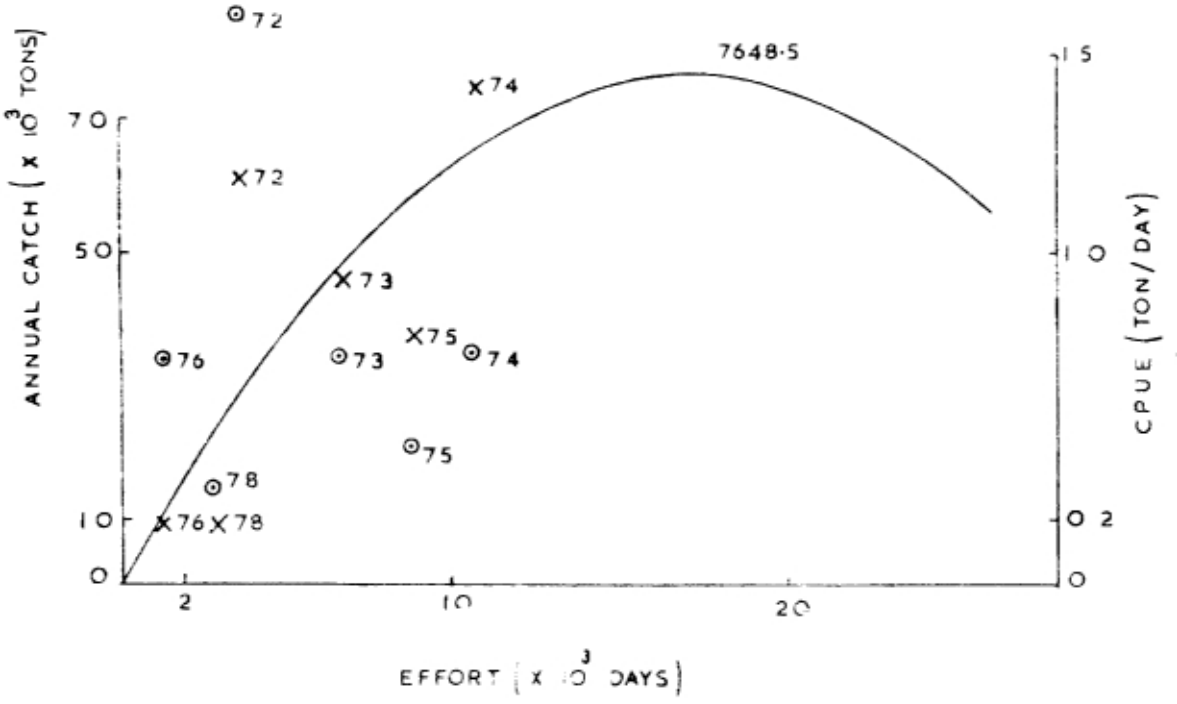

ILL.6. CATCH AND CATCH PER UNIT OF EFFORT RELATED TO THE TOTAL STANDARD EFFORT OF THE ANCHOVIES IN THE WEST COAST OF THAILAND

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Publications of the Bay of Bengal Programme (BOBP)

Development of Small-Scale Fisheries (GCP/RAS/040/SWE)

Reports (BOBP/REP/. . . .)

1. **Report of the First Meeting of the Advisory Committee. Colombo, Sri Lanka, 28-29 October 1976. (Published as Appendix 1 of IOFC/DEV/78/44.1, FAO, Rome, 1978)**

2. **Report of the Second Meeting of the Advisory Committee. Madras, India, 29-30 June 1977. (Published as Appendix 2 of IOFC/DEV/78/44.1, FAO, Rome, 1978)**

3. **Report of the Third Meeting of the Advisory Committee. Chittagong, Bangladesh, I-10 November 1978. Colombo, Sri Lanka, 1978. (Reissued Madras, India, September 1980).**

4. **Role of Women in Small-Scale Fisheries of the Bay of Bengal. Madras, India, October 1980.**

5. **Report of the Workshop on Social Feasibility in Small-Scale Fisheries Development. Madras, India, 3-8 September 1979. Madras, India, April 1980.**

6. **Report of the Workshop on Extension Service Requirements in Small-Scale Fisheries. Colombo, Sri Lanka, 8-12 October 1979. Madras, India, June 1980.**

7. **Report of the Fourth Meeting of the Advisory Committee. Phuket, Thailand, 27-30 November 1979. Madras, India, February 1980.**

8. **Pre-feasibility Study of a Floating Fish Receiving and Distribution Unit for Dubla Char, Bangladesh. G. Eddie, M. T. Nathan. Madras, India, April 1980.**

9. **Report of the Training Course for Fish Marketing Personnel of Tamil Nadu. Madras, India, 3-14 December 1979. Madras, India, September 1980.**

10.1 **Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal. Chittagong, Bangladesh, 16-21 June, 1980. Volume 1 : Proceedings. Madras, India, September 1980.**

10.2 **Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal. Chittagong, Bangladesh, 16-21 June 1980. Volume 2 : Papers. Madras, India, October 1980.**

11. **Report of the Fifth Meeting of the Advisory Committee, Penang, Malaysia, 4-7 November 1980. Madras, India, January 1981.**

12. **Report of the Training Course for Fish Marketing Personnel of Andhra Pradesh. Hyderabad, India, 11-26 November 1980. Madras, India, September 1981.**

Working Papers (BOBPI WP/. .)

1. **Investment Reduction and Increase in Service Life of Kattumaram Logs. R. Balan. Madras, India, February 1980.**

2. **Inventory of Kattumarams and their Fishing Gear in Andhra Pradesh and Tamil Nadu. T. R. Menon. Madras, India, October 1980.**

3. **Improvement of Large-Mesh Driftnets for Small-Scale Fisheries in Sri Lanka. G. Pajot. Madras, June 1980.**

<<

4. Inboard Motorisation of Small G.R.P. Boats in Sri Lanka.
   Madras, India, September 1980.

5. Improvement of Large-Mesh Driftnets for Small-Scale Fisheries in Bangladesh.
   G. Pajot. Madras, India, September 1980.

6. Fishing Trials with Bottom-Set Longlines in Sri Lanka.
   G. Pajot, K. T. Weerasooriya. Madras, India, September 1980.

7. Technical Trials of Beachcraft Prototypes in India.
   ϕ Gulbrandsen, G. P. Gowing, R. Ravikumar. Madras, India, October 1980.

8. Current Knowledge of Fisheries Resources in the Shelf Area of the Bay of Bengal.
   B. T. Antony Raja. Madras, India, September 1980.

9. Boatbuilding Materials for Small-Scale Fisheries in India.
   Madras, India, October 1980.

10. Fishing Trials with High-Opening Bottom Trawls in Tamil Nadu, India.
    G. Pajot, John Crockett. Madras, India, October 1980.

I?. The Possibilities for Technical Cooperation between Developing Countries (TCDC) in Fisheries.
E. H. Nichols. Madras, India, August 1981

Miscellaneous Papers (BOBP/MIS/. . . .)

1. Fishermen's Cooperatives in Kerala : A Critique.
   John Kurien. Madras, India, October 1980.

Newsletters:

1. Bay of Bengal News, January 1981
2. Bay of Bengal News, May 1981
3. Bay of Bengal News, September 1981

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