Bay of Bengal Programme

Marine Fishery Resources Management

MARINE FISHERY RESOURCES

OF THE BAY OF BENGAL

BOBP/WP/36

UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

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MARINE FISHERY RESOURCES OF THE BAY OF BENGAL

BOB P/WP/36

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This paper attempts to summarize available knowledge, and identify the gaps in that knowledge, on marine fisheries and fishery resources in the Bay of Bengal region. It provides information on Bangladesh, Burma, India, Indonesia, Maldives, Malaysia, Sri Lanka and Thailand—their marine fisheries, fishery resources, status of important stocks, etc.

The Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal, Chittagong, Bangladesh, June 1980, was the first major attempt to collect the knowledge available on marine fishery resources in the Bay of Bengal (see BOBP/REP/10.1, BOBP/REP/10.2 and BOBP/WP/7). That attempt did not cover Maldives and Indonesia. This paper updates the three earlier papers, besides providing information on Maldives and Indonesia. The data covered is largely for the period 1974-82.

It is hoped that this document will serve as a handy reference to those interested in the subject and also provide pointers to activities that are required in the area of marine fishery resource management.

The preparation of this paper is an activity of the 'Marine Fishery Resources Management' component of the Bay of Bengal Programme (BOBP). The project commenced in January 1983 and has a duration of four years. It is funded by the UNDP (United Nations Development Programme) and executed by the FAD (Food and Agriculture Organization of the United Nations) its immediate objective is to improve the practice of fishery resources assessment among participating countries and to stimulate and assist in joint management activities between countries sharing fish stocks.

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SUMMARY

Area studied

The area under review is bounded by the equatorial line in the south; the Maldive islands and the east coast of India on the west; Bangladesh in the north; and the west coast of Thailand, the west coast of Malaysia and the northern half of Sumatra (Indonesia) on the east. The EEZs cover about three quarters of the project area.

The study indicates that a number of fish stocks are probably being shared by two or more countries, but joint management of any kind is absent. The BOBP's FAO/UNDP project, 'Marine Fishery Resources Management in the Bay of Bengal', has selected a few of these stocks for joint studies by participating countries.

Data considered in this paper relate mainly to the period 1974-1982.

Fishing craft and gear

About 325,000 fishing crafts of various types, primarily of the small-scale variety, operate in the project area.

In India, Burma, Bangladesh, Maldives and north Sumatra, the number of non-mechanized craft far exceeds that of mechanized craft. The percentage of non-mechanized craft is 95% in India and Burma, 80% in the Maldives, 75% in Bangladesh, and 72% in the northern half of Sumatra. In Thailand and Malaysia, the mechanized fleet significantly exceeds the non-mechanized fleet which accounts for only 10-12% of the total number. In Sri Lanka, the two types are almost equal with non-mechanized craft making up 51% of the fleet.

Only Malaysia and Thailand exploit about 50% or more of their EEZs in the project area.

The number of fishing craft has increased significantly in Bangladesh and Burma in recent years; this trend is not visible in other countries.

A few types of traditional craft are common to some countries. Examples: the log rafts of Sri Lanka and India, and the pole-and-line crafts in the Maldives and India. On the whole, however, traditional crafts in different countries are not directly comparable in design and operational and fishing efficiency.

Production highlights and trends

The annual production from the EEZs of project countries is approximately 2.2 million tonnes, while the production from international waters of the area—by far eastern nations—is in the region of 6,000 tonnes/annum, excluding sharks.

Percentage contributions to the total production, according to available figures, are: Malaysia 20%, Burma 20%, India 19%, Indonesia 15%, Sri Lanka 8.8%, Thailand 8.7%, Bangladesh 6.6%, Maldives 1.4%.

Only Sri Lanka and Bangladesh claim a steady increase in total production. The years of peak production for other countries: Thailand (west coast) 1973, India (east coast) and Sumatra island 1975, Malaysia (west coast) 1980, Burma and Maldives 1981.

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The reliability of catch statistics for at least some of these countries is a matter for concern. The production from the international waters may have peaked in 1980, but data available to confirm this observation are incomplete.

Fish species

Over 215 demersal fish species, 65 pelagic species, 20 shrimp species and 40 cartilagenous species enter the fisheries of the project area. Estimates of catch composition are reasonably good in some countries, incomplete in a few and totally lacking in the others. The grouping of species differs from country to country.

In Maldives, Sri Lanka and the west coast of Sumatra, the production of pelagics exceeds that of demersals, according to available information. In other countries or EEZs, the production of demersals exceeds that of pelagics.

In recent years, ponyfishes on the east coast of India; small demersals (trash fish) and mackerels in Malaysia; and *Hilsa* in Bangladesh appear to showa significant increase in production. Shrimp production and catch rates show a declining trend in the project area, except in Sri Lanka and Bangladesh, which, however, are minor producers. The production of coastal surface tuna fluctuates in the Maldives and India, and shows a slight increase in Sri Lanka, Thailand and Sumatra. Since 1980, there has been no evidence of increased production of oceanic deep-swimming tunas.

The production of small pelagics has declined in Sri Lanka, India (particularly the state of Tamil Nadu), Thailand and Indonesia, as also that of valuable demersals in Bangladesh, Thailand and Malaysia. The demersals of Indonesia declined sharply before the 1980 ban on trawling.

An increase in the catches of threadfin breams *(Nemipterus* spp.) and bulls eye *(Priacanthus* spp.) is evident in Thai and Malaysian fisheries, because the trawl fishery has moved to deeper waters.

Status of exploited stocks and potential for development

Reliable estimates of catch in relation to effort are lacking in almost all the participating countries. Biological studies have been qualitative and insufficient for stock assessment. Correct species identification also presents a problem in some areas.

This paper discusses the reliability of various methods used to estimate resource potential and the types of shared stocks. It summarizes, for each country, estimates of maximum sustainable yield and potential yield on the basis of past studies.

In the Maldives, the main tuna stocks in the exploited range appear to have been intensively exploited; further increases may have to come from the unexploited range of its EEZ. However, production of other pelagics and demersals from the reef waters could go up.

In Sri Lanka too, the production of large pelagics seems to show a trend similar to that in the Maldives; the status of small pelagics could not, however, be evaluated. As for demersals, the production of valuable demersals could possibly rise; that of small and less valuable demersals could rise significantly.

On the east coast of India, major stocks appear to have been intensively exploited; a significant increase from exploited areas seems unlikely, a possible exception being the northern part.

In Bangladesh, demersal production may be close to optimum yield levels, shrimp production may be close to the maximum potential or perhaps beyond it; the status of pelagics is rather vague.

In Burma, recent surveys indicate the possibility of a 35% rise in production from the continental shelf area.

In Thailand and Malaysia, the major resources are already being heavily exploited. A rational increase in production from the exploited ranges does not seem possible. Possible exceptions: some crustaceans and molluscs.

In the Indonesian waters of the Malacca Straits, demersal fish and shrimp stocks exceeded the **MSY before** the 1980 ban on trawling, but a 20% increase in the production of small pelagics over the 1980 level seems possible. On the west coast, a 40% increase in demersal production may be possible, but the prospects for small pelagics and shrimps in presently exploited areas are not bright.

Potential in unexploited ranges of the EEZs

Acoustic surveys and experimental trawling operations indicate substantial resources of deep sea fish, shrimp and lobsters in the unexploited ranges (80-350m) of almost all the EEZs. However, the economic viability of harvesting deep sea shrimps and lobsters is uncertain; so is the commercial value of deep sea fishes.

Tunas and sharks constitute the main pelagic resource in the unexploited ranges of the EEZs, excluding that of Malaysia. Possibilities for expanding surface fishery for tunas are favourable in the EEZs of Maldives, Sri Lanka, India, Thailand and Indonesia (west coast of Sumatra). The oceanic longline fishery for deep-swimming tunas in the Indian Ocean as a whole exceeded the MSY in the 1970s. Future entry into this fishery in the project area, therefore, depends on the reduction of fishing effort by the far eastern nations.

Management of marine fishery resources in the region

Management of marine resources is difficult at the national level; it is even more so at a multinational or regional level. Nonetheless, it is essential.

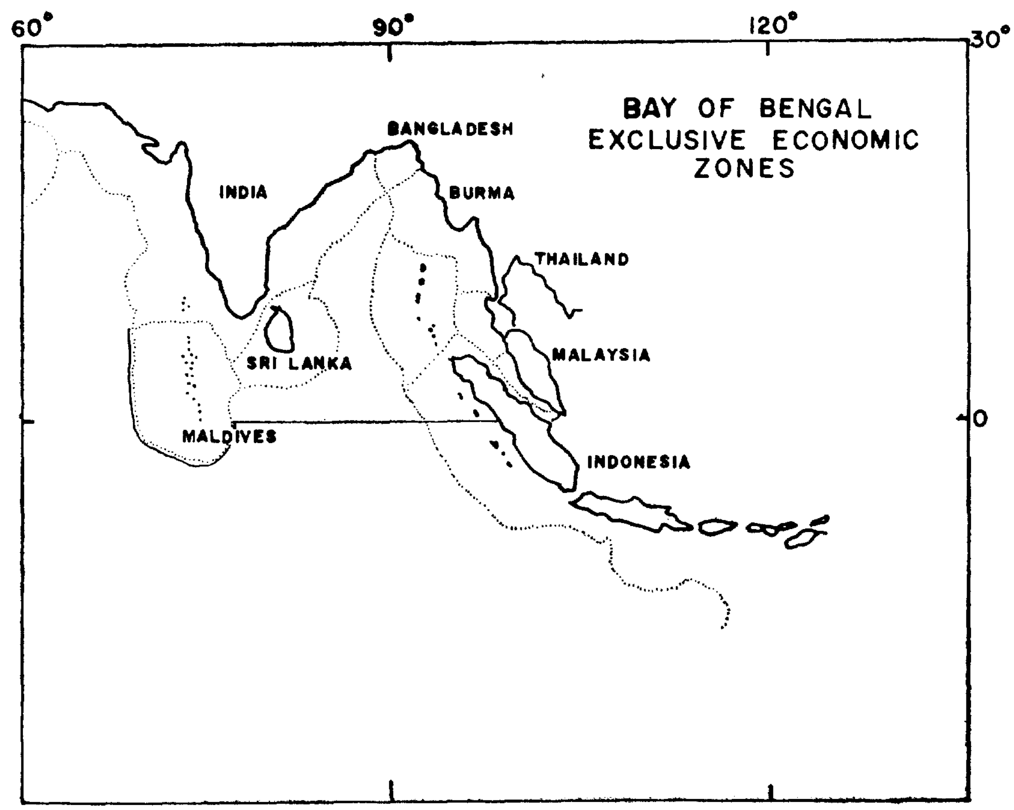
Some of the problems in determining and applying management measures are lack of biological and economic information; poor linkage between research and statistical institutions; insufficient coordination; enforcement problems such as non-cooperative fishermen socio-political factors; difficulties of inspection; limited power vested in enforcement officers; and the cost of the whole process of implementation, inspection and legal action against erring fishermen.

Some of the management measures that one does encounter in the area are mesh-size regulation; allocation of fishing ranges according to craft size and type of fishing; ban on trawling; closed fishing seasons and areas.

1. INTRODUCTION

With the establishment of Exclusive Economic Zones, more than 90% of the marine fish catches **of the world are taken within the** jurisdiction of the coastal states and this situation has increased the responsibility of the coastal states for developing, utilizing and managing the marine fishery resources in their respective EEZs. Extension of the jurisdiction of each coastal state, over a wider area has also increased the need for collaboration and cooperation in controlling exploitation and management of resources shared by adjacent EEZs. In fact, this is one of the main reasons for including the Republic of Maldives and Indonesia also in the project on 'Marine Fishery Resources Management in the Bay of Bengal' (RAS/81/051).

In view of the geographic distribution of the participating countries *vis-a-vis* the Bay of Bengal area, it was suggested that the project mrea should be bounded by the equatorial line in the south, Maldive islands and the east coast of India on the western side, Bangladesh in the north and the west coast of Thailand, the west coast of Malaysia and the east coast of Sumatra (Indonesia) down to the Equator. This would include the Bay of Bengal proper, the Andaman sea, Malacca Straits and the seas around Maldives and Sri Lanka, The entire EEZs around Maldives, Sri Lanka, Bangladesh and the Andaman-Nicobar islands and the parts of the EEZs on the east coast of India, west coast of Thailand, west coast of Malaysia and on both sides of Sumatra (Indonesia) area, north of the Equator, fall within this project area. These EEZs cover the major part of the sea within the boundaries, except for a longitudinal strip of international waters which is less than a quarter of the project area. The EEZ on the west coast of India, including Laccadive-Minicoy islands, has also been annexed only for any considerations on the tuna stocks which may be shared by India, Maldives and Sri Lanka (Fig. 1). Though Burma is not participating



Fig, 1. EEZ boundaries of the littoral and island nations in the Bay of Bengal region (Based on Klawe, 1981) in this project at present, relevant information from the EEZ of this country has also been included in order to achieve a more complete coverage of the project area.

Available information and discussions with fisheries scientists in the Bay of Bengal region indicate the existence of number of fish stocks which are probably shared by two or more countries. But joint management measures of any sort do not appear to exist at present. A few of these have been selected for joint studies by participating countries concerned, under the 'Marine Fishery Resources Management' project.

The status and development of marine fisheries, statistical systems applied and the nature of fisheries statistics available, estimations of fishery resource potentials and assessments of the status of various stocks, in the participating countries, are of different levels and kinds. The last consultation on stock assessment in the Bay of Bengal region reviewed the situation until 1979 (BOBP/REP 10.1 and 10.2; 1980) but it did not include Maldives, Indonesia and Burma.

This report is an attempt to review the present knowledge of the resources including those of the Maldives and Indonesia and to identify major gaps in knowledge.

2. GENERAL FEATURES OF THE PROJECT AREA

The Bay of Bengal as a whole, is an area subject to the influence of monsoon conditions, particularly the cyclonic conditions prevalent during the north-east monsoon. Upwelling in this sub-region is associated with the two monsoons. Upwellings have been recorded off Orissa (N.E. of India), Andaman islands, west coast of Burma and Thailand and Sri Lanka, during the north-east monsoon and off the west coast of Thailand and Sumatra and north-east coast of India, during the sbuth-west monsoon. These upwellings generally have a localised influence. Primary production in the Bay of Bengal has been reported to be rather high during the north-east monsoon (0.15— >1.45 gC/ m^2/d; Cushing 1971). The productivity during the south-west monsoon is not well established due to lack of seasonal coverage. Zooplankton biomass is reported to be high north-east of Sri Lanka (>25 ml/ m^2 1.63 gC/ m^2) during north-east monsoon but it is low close to Burma, Thailand and east of Andaman islands (0.98 gd/ m^2/d). However, high biomass appears to extend from Andaman islands to the Coromandel Coast of India (3.90 gC/ m^2). Large concentrations of fish eggs have been observed in the Bay of Bengal and west of Andaman islands. It is conjectured that dense spawning occurs across the Bay of Bengal during the south-west monsoon and tuna larvae are also abundant during this period. Estimated tertiary production in the sub-region is 290,000—2,038,000 t per 5° square (wet weight/i 80 d) during the north-east monsoon and slightly higher (590,000—2,260,000 t per 5° square) during the south-west monsoon. The production in the centre of the Bay is low (<500,000 t per 5° square) (Cushing 1971).

Swampy areas exist along the coastlines of the northern coast of Sri Lanka, south-east and north-east coasts of India and from the Bangladesh coastline to the southern end of the Malacca Straits. Maldive islands are unique in being made up of coral islands with reef waters within the numerous atolls. Thus, all five major ecosystems of tropical waters—(a) estuarine and mangrove areas; (b) coral sea area; (c) upwelling areas; (d) coastline areas outside upwelling areas; and (e) offshore and oceanic areas—are represented within this region.

The Maldive islands hardly have any continental shelf area because of the sharp gradient of the bottom, seawards. The islands forming the atolls enclose typical reef-waters with inter-atoll basins. Around Sri Lanka, the slope begins very abruptly in most areas except in the Palk Bay, Gulf of Mannar and Pedro Bank areas. The shelf is generally rocky, particularly between Colombo and Batticaloa. However, sand occurs even in rocky areas. The northern part is predominantly muddy or muddy-sand.

From Puttalam to Colombo, the shelf has an extensive trawlable bottom but the south-west part has a rough and uneven bottom. The Hambantota area has a limited trawlable bottom. There are smooth bottoms only in the inshore areas south of Triconamalee, but north of it, the bottom is suitable for trawling. On the east coast of India, the continental shelf is relatively wide, varying from 100 km off Point Calimere to 200 km in the upper Bay of Bengal. Shallow waters along lower east coast, between 40-100 m depth have an uneven bottom with crests and troughs. Rocky outcrops and gorgonid patches make trawling difficult in many places. The areas deeper than 100 m are relatively even, although narrow, and suitable for trawling up to 400 m. Along the upper east coast, the bottom is comparatively even with good trawlable grounds up to 500 m.

Opposite Bangladesh, the bottom gradient is low and the shelf is relatively wide. The bottom up to 40 m depth is mostly alluvial silt and mud. The bottom is sandy in the deeper waters. The salinity in the coastal waters is low—17-18 ppt in monsoon season and 31 ppt in the dry season. The coastal waters are turbid due to suspended matter from the rivers. There are about 450,000 acres of estuarine areas.

Off Burma, the Rakhine coast is narrow and rough and not actively fished. The Tenasserim coast has mud, sand coral and rocks mixed; the Mergui area is a rocky, hard bottom and the rest is trawlable up to 120 m and beyond 250 m. The delta area is also trawlable. The west coast of Thailand has a rough bottom with rocks and sea mounts. The depth increases abruptly. There are areas of mangrove forests along the coast and numerous islands with hard corals.

In the southern half of the Malacca Straits, trawlable areas decline in the southerly direction, both inshore and offshore. It is more rough in the deeper areas beyond 50 m. Monsoons have less influence on the generel pattern of circulation. There is transport of water from west to east through the Malacca Straits, throughout the year which is higher during the north-east monsoon. The oxygen profile indicates more stagnant bottom water.

The extent of the coastlines, the shelf area and area of the EEZs of countries in the project area are indicated in Table 1. The EEZ boundaries are shown in Fig. 1 and the major ecological boundaries in Fig. 2.

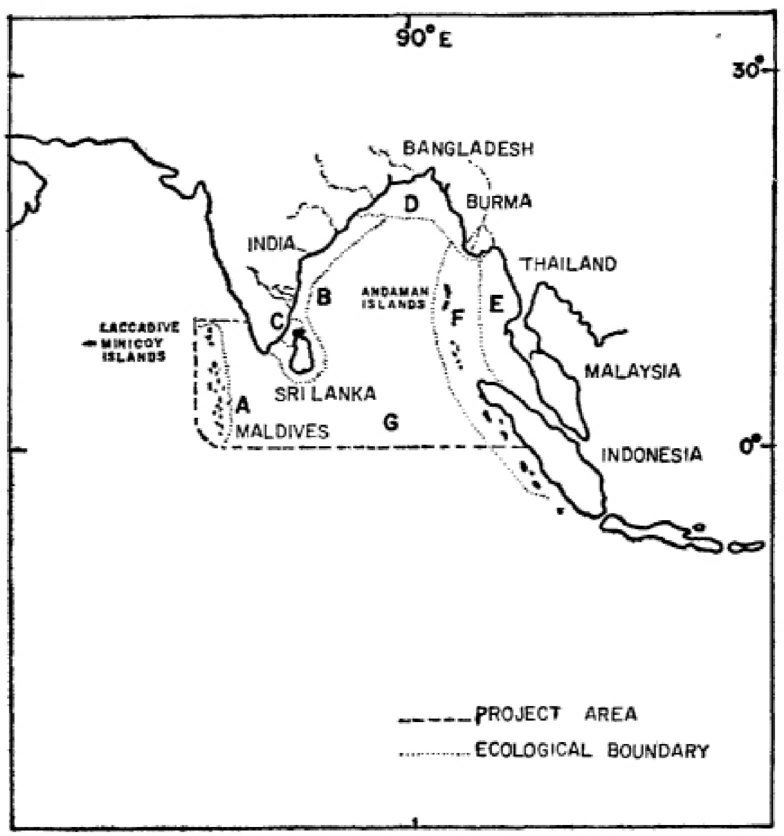


Fig. 2. Provisional demarcation of major ecological boundaries within the project area.

Table 1

Approximate estimates of the coastline, continental shelf and EEZ areas of the countries within the project area

Country	Coastline km	Continental shelf area km-	FEZ area km2
Maldives	–	–	843,247
Sri Lanka	1,760	30,000	256,410
India (east)	3,000	33,836	1,157,942
Bangladesh	480	69,900	
Burma	2,800	280,000	–
Thailand (west)	740	44,000	111,000
Malaysia (west)	8001 (?)	–	69,413
Indonesia (N.E. Sumatra)	1300(?)	–	100,000

3. FISHING CRAFT AND GEAR

About 325,000 fishing craft, primarily small ones of various types, operate in the EEZs of the seven countries within the project area. Burma and the east coast of India have a larger number of craft than the others. However, in these two nations, the non-mechanized craft form nearly 95% of their fishing fleets; they are followed by Maldives (80%), Bangladesh (75%), northern half of Sumatra (72%) and Sri Lanka (51%). The west coasts of Thailand and Malaysia have relatively fewer non-mechanised craft (10-12%) (Table 2).

None of the countries is presently fishing in its entire EEZ. The fleets on the west coasts of Thailand and Malaysia probably cover 50% or more of their EEZs on their west coasts, and Indonesia too may have covered an equivalent extent of its EEZ in the Malacca Straits, prior to the banning of trawlers. But the coverage by the fleet on its west coast is very poor. The fleets of other participating nations cover about one quarter, or less, of their EEZs. None of these countries has fishing craft or vessels operating in the international waters within the project area, which is being exploited by tuna longliners from Taiwan, Korea and Japan.

There is no evidence of significant increase in the strength of the fleet of some countries like Maldives, Sri Lanka or even India. However, there have been increases and decreases within classes of mechanized and non-mechanized crafts, which may have been compensatory, as in the case of Maldives and Sri Lanka. Fluctuations in the size of total fleet may be observed in the case of countries like Thailand or Sumatra (Indonesia) because of seasonal or periodic immigration to and emigration from the project area, due to fishing conditions in the areas outside the project area. A significant increase is apparent in Bangladesh and Burma.

Maldives is atypical in that the entire fleet operates as day-boats and no fishing operations are conducted at night or overnight. In other countries, a majority of the crafts operate one-day trips while some of the larger crafts conduct 2-4 day trips. In Bangladesh and Burma, mother-ship-type operations, involving a mechanized mothership craft and a fleet of non-mechanized crafts, in gillnetting and set bagnet fisheries, with each trip lasting as much as two weeks, are

Table 2
Estimated number of fishing crafts/vessels in the countries within the project area

Type of craft	Maldives (1983)	Sri Lanka (1982)	India (east coast) (1982)	Bangladesh (1984)	Burma (1982)	Thailand (west) (1980)	Malaysia (west) (1982)	Indonesia (1981) Malacca Straits	Indonesia (1981) North-west Sumatra
Non-mechanized traditional	4380	7764	96185	14970	102872	—	1557	23174	10207
Mechanized traditional	1074	3048					6294	867	1133
Mechanized non-traditional			6024	3300	5288				
LOA <10′	0								
10′-20′	0	5879				1550	888		
20′-30′	0					127[5]	17697[5]	8710[6]	773[6]
>30′	0	3347[1]	60[2]	74[3]	64[4]	12[5]			
Total	5454	20038	102269	18344	108224	1689	26436	32751	12113

Notes: [1]Gillnetters (large mesh), trawlers, longliners, P. seiners.
[2]Shrimp trawlers × 25
mixed × 26
fish trawls × 23
[3]Shrimp trawls—21, fish trawls—25
[4]Shrimp & fish trawls.
[5]P.seiners, trawlers.
[6]Purse seiners, Danish seiners.

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Table 3

Main fishing methods (in descending order of importance) used by mechanized and non-mechanized crafts operating in the project area

Maldives		Sri Lanka		India (east-Coast)		Bangladesh	
Mechanized	*Nonmechanized*	*Mechanized*	*Nonmechanized*	*Mechanized*	*Nonmechanized*	*Mechanized*	*Nonmechanized*
Pole & line (Tunas)	Troll (Tunas)	Driftnet (Tunas, king mackerel & sharks)	Beach seine (Mixed)	Trawl (Shrimps & demersals)	Beach seine (Mixed)	Gillnet (Hilsa & other pelagics)	Bagnet (Mixed)
Troll	Handline (Reef fish)	Gillnet (Sardines & mackerels)	Handline (Carangids & demersals)	Gillnet (King mackerel, mackerels, tunas, sardines & anchovies)	Handline (Large pelagics & demersals)	Bagnet (Mixed) Tramel net (shrimps)	Stake net (Mixed)
Handline (Reef fish)		Trawl (Shrimps & demersals) Trolling (Tunas & king mackerels) Pole & line (Tunas) Bottom gillnets (Large demersals) Bottom longline (Large demersals) Tuna longline (Tuna & sharks) P.seine (Sardines)	Liftnet (Bait fish) Traps (Mixed)		Bagnet (Mixed) Traps (Mixed)	Trawl (Shrimps & demersals) Seine net (Hilsa, mackerels)	Handline (Demersals) Castnet (Mixed) Longlines (Demersals)

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Table 3 *(continued)*

Burma		Thailand (west-coast)		Peninsular Malaysia (west-coast)		Indonesia (Sumatra—North of the Equator)	
Mechanized	*Nonmechanized*	*Mechanized*	*Nonmechanized*	*Mechanized*	*mechanized*	*Mechanized*	*Nonmechanized*
Gillnet (Hilsa, mackerel, etc.)	Gillnet Set bagnet (Mixed)	Gillnet (small pelagics, demersals & shrimps)	Traps (Mixed fish & lobsters)	Trawl (Shrimp, demersals, mackerels)	Gillnet (Mixed fish & shell fish	Gillnet (Mixed, shrimps & finfish)	Gillnet (Mixed)
P. seine (mackerels, scads & sardines)	Surrounding net (mackerels, sardines & hilsa)	Trawl (Shrimps & demersals)	Castnet	P. seine (Mackerels, scads, sardines, tunas)	Traps (Mixed)	Danish seine (Mixed, shrimp & finfish)	Beach seine (Mixed)
Trawl (Shrimps & fish)	Handline (Demersals)	P. seine (Mackerels, scads, anchovy & tunas)	Handline (Demersals)	Gillnet (Small pela-gics & shrimps)	Handline (Demersals)	P. seine (Mackerels, scads, tunas & sardines)	Liftnet (Small pelagics)
Set bagnet **(Mixed)**	Stake net (Mixed)	Dredge (clams & gastropods, cockles)		Liftnets (Scads & clupeids)	Castnet (Mixed)	Encircling net (Small pelagics)	Traps (Shrimps & mixed fish)
	Beach seine (Mixed)	Push net (Shrimps & demersals)			Bagnets	Trolling (Tuna-like fish)	Bagnet (Mixed)
	Drag net (Mixed)	Traps (Mixed)		Dredge (cockles, clams, etc.)		Traps (Shrimps & finfish)	
	Cast net **(Mixed)**	Handline **(Demersals)**					

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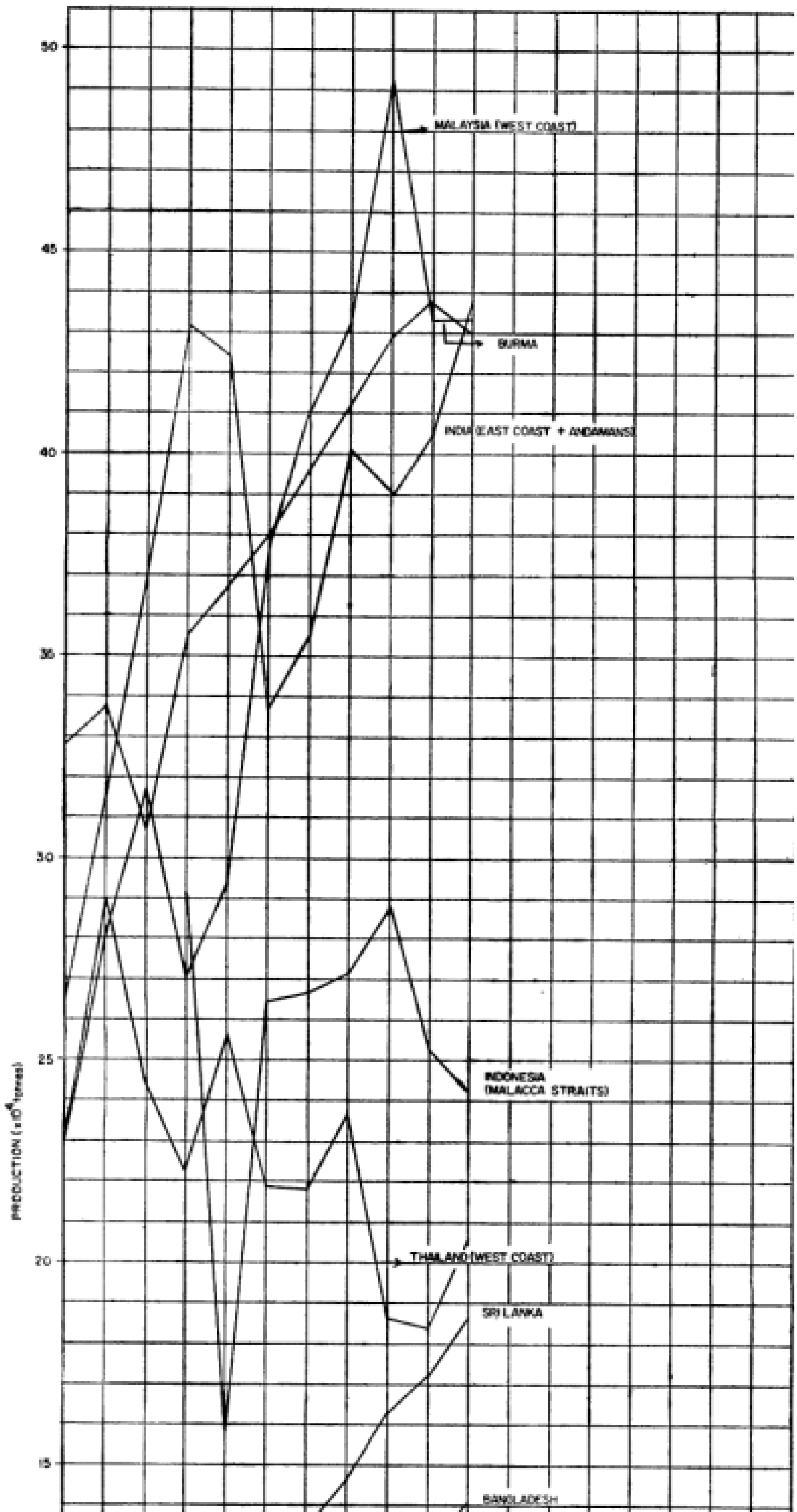
PRODUCTION (x10⁴ tonnes)
50
45
40
35
30
25
20
15
MALAYSIA (WEST COAST)
BURMA
INDIA (EAST COAST + ANDAMANS)
INDONESIA (MALACCA STRAITS)
THAILAND (WEST COAST)
SRI LANKA
BANGLADESH

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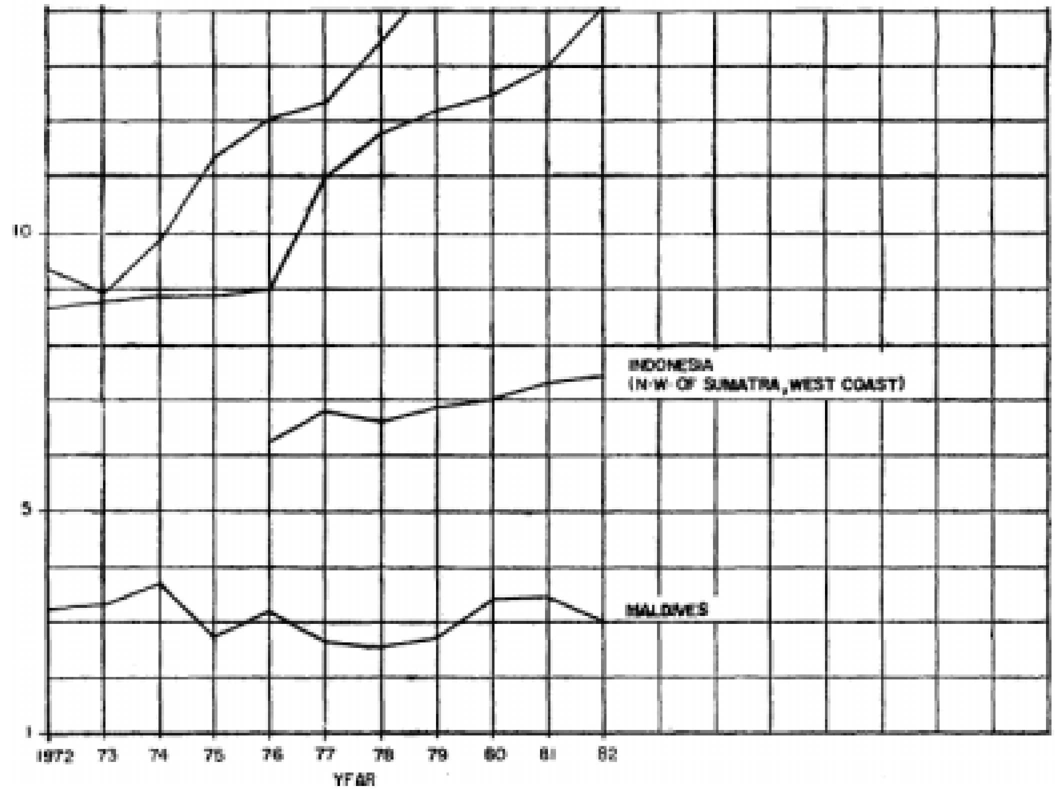

Ag. .3 Annual marine fishery production in project area, 1972-1982

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also undertaken. Purse seining crafts on the west coast of Thailand use fish finding equipment. The common fishing methods adopted by various nations in the project area are listed in Table 3.

Some types of traditional crafts are common to some countries—log rafts in Sri Lanka and India, pole-and-line crafts in the Maldives and India (Minicoy-Laccadive islands)—but on the whole, traditional crafts in different countries are not directly comparable in design and operational and fishing efficiency. On the other hand, modern types of craft, particularly trawlers and purse seiners tend to have comparable classes, which is convenient for comparison and compatible for statistical purposes.

Sri Lanka suspended oceanic longlining a few years ago and the fleet operating from the base in Sabang (Indonesia) has been moved out of the project area. Maldives, which practised the hook-and-line method in its fishery almost exclusively has relaxed the restriction on the use of net methods since May 1984.

4. ANNUAL PRODUCTION

Available figures indicate that the annual total marine production from the EEZs within the project area is approximately 2.2 million tonnes. The production from the international waters within the project area, by far eastern nations is in the region of 6,000 t/annum excluding sharks.

According to available figures (Table 4 and Fig. 3), two nations—Malaysia and Burma contribute about 40% (20% each) of the production, followed by India (18.9%), Indonesia (Malacca Straits and N.W. Sumatra) (15.1%), Sri Lanka (8.8%), Thailand (8.7%), Bangladesh (6.6%) and Maldives (1.4%).

Of these seven countries, only Sri Lanka and Bangladesh have shown a steady increase in annual production up to 1982, according to available figures. However, it is evident that Bangladesh has problems in collecting data for reliable estimates of production except for the data on landings by commercial trawling operations. The total production in the Maldives shows fluctuation with the peak production in 1974. In the last decade, the east coast of India and the west coast of Thailand had their peak productions in 1975 and 1973, respectively, and since then their production figures have been fluctuating at lower levels.

On the east coast of India, the state of West Bengal shows a tremendous increase in annual production since 1976 but this has been attributed to additional districts being included in West Bengal. Other states have indicated a decline in 1981; only Andhra Pradesh showed a noticeable increase in 1982. No significant changes were noticeable in the production trend in the Andaman Sea. On the west coast of Thailand, the increase after 1962 was due to immigration of fishermen from the Gulf of Thailand and the introduction of purse seining and gillnetting. In 1969, modified trawls for catching pelagics also contributed to the increase. As a result the peak level of production reached in 1969 was even higher than the subsequent peak in 1976.

The west coast of Peninsular Malaysia and the northern half of Sumatra (Indonesia) showed a decline in 1981, while Burma and Maldives exhibited a decline in 1982. The production on the west coast of Malaysia showed peaks in 1968, 1974 and 1980 but that of 1980 was the highest. The first and the third peaks were contributed by significant increases in the production of pelagics through the purse seine fishery and the high-opening bottom trawl fishery, respectively, while the second peak was attributed to a significant increase in demersal and shell fish catches (cockles & shrimp). The decline in the Indonesian area may be attributed

Table 4

Annual total marine production in the project area by country (1972-1982) (tonnes)

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Maldives	32200	33700	37500	27900	32300	26300	25800	27700	34600	34900	30300
Sri Lanka	93400*'	89874	99217	113054	120849	123411	134744	146507	162661	172318	187302
India (East coast & Andamans)	264723	314235	369241	431868	424090	336557	355846	400775	390072	405818	437259
Bangladesh	87000*	88000*	89000*	89000*	90000*	110000	118000	122000	125000	130000	141000
Burma	329100*	338100*	307600*	355140*	367190*	379800	396100	412800	429300	438262	430800
Thailand (west coast)	230097	291194	244492	222188	256050	218861	218014	237668	186211	184389	204949**
Malaysia (West coast)	230029	280544	317710	270664	294574	378470	410774	432347	493495	433371	433986
Indonesia (Sumatra north of 00) Malacca Straits (East coast)			—	291874	158925	264964	266822	271305	288194	252774	242568
N.W. of Sumatra (West coast)					62301	68378	66443	68903	70322	73304	74837

*Saurcepublications of the respective Ministries of Fisheries Statistics and *FAQ Year Book.*
**Fishery Statistical Bulletin (1982) of SEAFDEC.

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to the prohibition of trawling at the end of 1980. The fishery statistics are unsatisfactory in Burma too, as in the case of Bangladesh, and hence it is difficult to comment on the production trend except to state that the offshore production declined very significantly after 1980/81 while the production from inshore fishery increased up to 1981 /82 and remained the same in 1982/83. In the case of Maldives, preliminary estimates available for 1983 indicate that production may have recovered from the decline observed in 1982 and may perhaps have reached the level of 1974. This view is subject to confirmation and with some reservations on the production estimates obtained by the application of conversion factors on the estimated number of fish landed.

Yellowlin *(T. albacares)* and bigeye tuna *(T. obsesus)* are the two main species contributing to the deep sea or oceanic tuna longline fishery within the project area. Production of these deep swimming tunas, by distant nations (Japan, Korea and Taiwan) fishing within the project area, was estimated from the catch statistics published by those nations. Data was available from all three countries for the period up to 1979, from Japan and Taiwan for 1980 and from Taiwan for 1981 and 1982.

In the project area, west of Sri Lanka, the estimated production in 1979 with relatively very high effort, was 783 **t** of yellowfin and 787 **t** of bigeye tunas. The actual effort level after 1979 is not known because data from all three countries are not available. In 1982, production by Taiwan was in the region of 300 **t** of both species (226 **t** bigeye and 73 **t** yellowfin).

In the Bay of Bengal area, available data showed the highest tuna longline effort in the year 1980 and in this year the production of yellowfin and bigeye tunas was 1911 **t** and 2965 **t**, respectively. In 1982, Taiwan had an estimated catch of 883 **t** and 2437 **t** of the respective species. Some albacore *(T. alalunga)* was also caught in the north equatorial current area but the quantity was negligible.

Estimation of the production of billfishes and sharks was not attempted. However it is conjectured that the production in each of these categories may not be less than 50% of the production of yellowfin tuna from the project area.

5. **SPECIES COMPOSITION**

The catch composition is dependent on the type of gear used and the area exploited. Considering the fact that multi-gear combinations are applied and multi-species catches are made in this region, it is assumed that the overall catch composition will reflect the species composition in the exploited areas. The catch composition, based on the most recent data available and on the basis of the variety-wise breakdown, is presented in Table 5. It will be evident that reasonably detailed separation of varieties is being attempted by India, Thailand, Malaysia and Indonesia, but this is relatively incomplete in Sri Lanka and the Maldives and perhaps completely lacking in the cases of Bangladesh and Burma. In the case of Maldives, the main fishery is on the tunas for which species-wise estimates are available but not for the reef fishes and other by-catches of the tuna fishery.

The catch composition in Table 5 indicates that most varieties are found in all the countries within the project area but their relative proportions may vary from country to country. Contribution by 'indicator varieties', such as hilsa, anchovy, scads and mackerels, tunas, sharks and skates, catfish, perches (Lutjanids and Lethrinids, in particular), croakers, threadfins, ponyfishes and shrimps, to the production from waters close to the seven countries, tend to exhibit probable ecological strata with a relatively higher level of uniformity within each stratum than between strata (Fig. 2). As each stratum tends to extend into two or more of the EEZs, the probability of some of the stocks within a stratum being shared tends to be high.

Table 5

Catch composition (%) of the countries within the project area

	Maldives	Sri Lanka	India N. East	India S. East	India Andaman	Bangladesh	Bangladesh	Burma	Thailand (west)	Malaysia (west)	Indonesia N. Sumatra Malacca St.	Indonesia N. Sumatra W. Coast
Wolf herring	—	x	2.8	0.8	1.3	7.5		x	0.6	0.7	1.9	0.1
Oil Sardine	—	x	8.1	0.05	—	—	—	—	—	—	—	—
Other sardine	—	x	—	11.9	14.1	—		x	1.3	1.8	2.8	6.5
Hilsa shad	—	—	9.2	1.4	—	37.2	—	xx	—	—	—	—
Anchovy	x	xx	0.9	9.2	9.9	—	3.4	x	0.4	7.5	2.8	13.3
Other clupeids	—	35.1	8.5	3.0	1.3	—	7.4	x	—	—	—	—
Half beaks	—	x	0.0	0.2	0.9		—	—	—	—	0.1	0.9
Flying fish		x	0.0	0.8	0.2	—	—	—	—	—	—	—
Ribbon fish	—	x	2.1	4.6	1.3	—	3.6	x	0.3	0.7	0.7	1.2
Queen fish	—	x	0.5	0.3	—	4.8	—	x	0.3	0.1	0.1	0.8
Jacks/scads	x	x		—	—	—	26.8	xx	0.9	5.7	1.7	2.1
Mackerels	x	x	1.5	2.1	8.3	—	46.1	xx	1.4	13.9	4.4	9.7
King mackerel	3	1.9	6.6	2.6	8.0	10.0	x	x	1.1	1.3	1.6	2.4
Tunas &billfishes	80	21.8	0.4	1.2	2.2	—	x	—	0.4	1.2	3.9	17.6
Barracuda	x	x	0.0	0.3	2.1	—	2.2	x	0.7	0.3	0.1	1.2
Mullets	—	x	0.0	0.2	4.2	—	—	—	0.3	0.8	0.9	0.8
Others	4	5.9	—	—	—	40.5	10.5	—	6.8	4.5	2.4	1.9
						Mech. Boat catch	Dr. Fridtjof Nansen Survey					
Sharks/skates	x	10.5	6.8	5.4	1.8	5.2	x	x	1.4	1.3	1.5	3.6
Eels	x	—	0.04	0.1	—	1.4	—	x	—	—	—	—
Catfish	—	x	18.8	2.3	1.2	37.3	39.4	x	0.8	0.9	0.6	0.4
Lizard fish	x	x	1.4	1.0	—	—	7.6	x	0.2	0.4	0.0	1.0
Perches	x	5.3	0.3	3.7	10.3	1.1	3.7	xxx	1.0	1.5	1.5	6.6
Goat fishes	—	x	0.2	0.6	—	—	2.6	x	—3.9	0.2	0.6	0.5

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Threadfins	—	**x**	**1.6**	**0.3**	—	1.1	0.8	xx	0.0	0.3	1.4	1.0
Croackers	—	x	4.3	5.9	—	—	17.4	xx	1.4	1.4	5.5	0.1
Carangids	x	4.6	0.6	6.0	10.5	—	x	—	0.5	0.3	1.9	3.8
Ponyfishes	x	xx	1.3	17.7	14.7	—	5.6	xx	10.2	0.1	0.8	3.3
Pomfrets	—	x	12.5	1.0	0.3	1.3	2.4	x	0.4	0.9	1.1	0.3
Soles	x	x	0.1	1.1	—	—	x	x	0.5	0.7	0.8	0.0
Threadfin breams	x	—	—	—	—	—	x	x	1.3	1.4	0.3	2.8
Others	12	5.9	0.1	0.5	—	11.1	—	—	**3.1**	—	—	—
Penaeids	x	4.1	2.8	5.9	1.4	1.9	x	xx	3.7	13.7	1.5	0.1
Non-penaeids	—	—	2.3	0.7	—	—	**x**	**xx**	4.1	—	22.9	1.5
Lobsters	x	0.3	0.0	0.1	0.05		—	x	0.04	0.0	0.0	0.1
Other crustacean	x	—	0.5	3.3	0.7	—	x	—	4.0	0.8	0.5	0.04
Molluscs	x	—	0.1	0.6	—	—	x	x	4.2	2.9	11.9	0.4
Miscellaneous	—	4.4	5.5	4.8	4.7	39.6	20.5	—	44.8	34.7	23.8	16.4
Total production(t)	28200 (1982)	187302 (1982)	55768 (1981)	348273 (1981)	1862 (1981)	BFDC Trawl catch 574 (1980)	Dr. F. Nansen Survey		186211 (1980)	372226 (1980)	271305 (1980)	78699 (1980)

x—iridicates presence of these varieties identified through surveys.

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There is some difference in the grouping of demersal and pelagic varieties between countries in this region. It will be useful to have a common system for classifying a variety as demersal or pelagic for comparisons between countries. Available information indicates that in the Maldives, Sri Lanka and the west coast of north Sumatra, the production of pelagics exceeds that of the demersals and in all other areas demersal production is higher than that of pelagics. The production of pelagics on the west coast of Thailand is surprisingly low (Table 6).

Table 6

Percentage composition of pelagics, demersals and shellfish

in the production by various countries

Country	Pelagics	Demersals	Shellfish	Unclassified
Maldives (1982)	90	10	0	–
Sri Lanka (1982)	64.7	26.8	4.1	4.4
India				
(1981) N. East	37.2	51.7	5.7	5.4
(1981) S. East	34.0	50.9	10.6	4.5
Bangladesh* (1982)	38	48	14	–
Burma	Unknown	–	–	–
Thailand (West) (1980)	7.5	76.1	16.3	–
Malaysia (1980)	27.0	44.0**	25.0	4.0
Indonesia (1980)				
West of N. Sumatra	63.5	34.2	2.3	–
East of N. Sumatra	24.2	36.6	24.5	14.7

*Bangladesh_Author's estimated values.
**Demersals including prawns.

A crude estimate indicates that there are over 21 5 demersal species, over 65 pelagic species, over 20 shrimp species and over 40 cartilagenous species frequently observed in the various fisheries within the project area. The predominant species caught by any one of these countries may be less than half these numbers and many of them are common to all the countries. In many cases the specification has been inadequate and requires verification or confirmation.

Except in a few cases where catches of individual species have been found to be very significant, such as in tunas, mackerels, shrimps, etc., catch compositions are generally available on a variety-wise basis. In this region 'varieties' may include more than a single family of fishes, a single family or a sub-group of a family.

In areas where the shellfish production exceeds 10% of the total, the shrimp production is 15,000 t/annum or more. The west coast of Malaysia has a shrimp production of about 50,000 t/annum. The trends indicated above are for the most recent year for which information is available.

Major species-wise estimates of production are generally lacking in the region as a whole but this is being attempted in respect of a few selected species, in some of the countries. One group or variety for which a relatively better degree of species-wise separation is available from all countries fishing for it, in the project area, is the tunas (Table 7).

It will be evident from the differences in catch composition of tuna species in the inshore waters that there are different groupings of countries:

(1) Maldive islands, Laccadive-Minicoy islands, Sri Lanka and north-west coast of Sumatra with primarily skipjack, little tuna and yellowfin,

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Table 7

Tuna catch compositions in the EEZs and international waters within the project area **(tonnes)**

Coastal waters	Frigate tuna (*Auxis* spp.)	E. Little Tuna (*E. affinis*)	Skipjack (*K. pelamis*)	Longtail tuna (*T. tonggol*)	Yellowfin tuna (*T. albacares*)	Bigeye (*T. obesus*)	Billfish & others
Maldives (1981)	1800	1800	18100	0	3900	0	?
Sri Lanka (1982)	5924	11000	15011	0	8968	0	?
India (East)	77	3367	19	0	0	0	1000
Andaman islands	—	—	33	—	—	—	9
India (West)	1125	8258	7	83	(?)	0	1589
Laccadive islands (1981)	(?)	23	1744	0	(?)	0	469 (Probably yellowfin)
Bangladesh	No Fishery—Incidental Catch Negligible						
Burma	No Fishery—Incidental Catch Negligible						
Thailand (west) (1980)		79**	0	709	0	0	
P. Malaysia (West) (1981)	0	(?)	0	2632*	0	0	70
Indonesia							
N.W. Sumatra		5329**	5333	0	3151	0	(?)
N.E. Sumatra (1980)		8220**	2063	0	456	0	(?)
Sub-total	8926	38076	42310	3424	16475	0	3137
International waters							
(A) 0°—10°N, 70°—80°E Taiwan & Korea (1980) Tuna longline	0	0	0	0	73	226	?
(B) 80°—100°E, 0°—20°N (1980) Tuna longline	0	0	0	0	1911	2965	800
Sub-total					1984	3191	800

* Longtail and eastern little tunas mixed.
** Frigate and eastern little tunas mixed—almost equal quantities.

(2) West coasts of India, Thailand and Malaysia with primarily frigate tuna, eastern little tuna and longtail tuna,

(3) East coast of India and Andaman islands with eastern little tuna and skipjack.

In the case of Laccadive islands, though no catch has been recorded under yellowfin tuna, significant contribution by this species has been mentioned by Silas and Jones (1963). Probably this species contributes a large component of the catch recorded under the 'others' category. Similarly, in the case of west coast of Peninsular Malaysia, it is known though not recorded, that eastern little tuna are landed. This species is most likely to be present in the catches off Andaman islands too. The peripheral areas of the EEZs of the countries, excluding the west coast of Malaysia, and the international zone within the project area have predominantly yellowfin, bigeye and skipjack tunas.

Though the species-wise breakup of chub mackerels is not available in all the exploited ranges within the project area, it is evident that *Rastre//iger kanagurta* (Indian mackerel) is the main species on western side of the Bay of Bengal, whereas both *Rastrel/iger brachysoma* (Indo-Pacific mackerel) and *R. kanagurta* are significant contributors to the fishery on the eastern side.

6. TRENDS IN THE FISHERIES

(a) *Ma/dive islands—Each* tuna species has shown fluctuations in the annual production since 1970, with peaks for skipjack tuna in 1970 and 1974, yellowfin tuna in 1973 and 1981, little tuna in 1982 and frigate tuna in 1973. The production of 'other varieties' also showed fluctuations. Since the introduction of a significant number of mechanised pole-and-line crafts, in 1976, the catch rates have shown a decline from 280 kg/trip in 1979 to 150 kg/trip in 1982. This happened in spite of a slightly declining trend in the total number of pole-and-line crafts in that country. However, it is known that a mechanized craft is four or five times more efficient and the trolling crafts have an efficiency of only about half that of non-mechanized pole-and-line crafts.

The annual increase in the number of mechanized crafts has been compensated by a decrease in the non-mechanized pole-and-line crafts. Hence, in terms of efficiency factor, the total effort standardised to that of the mechanized crafts, would have been increasing annually. Further, the conversion factors used for estimating production of tunas, in terms of weight from numbers, were increased after 1975 but the production of the main species (skipjack) did not increase over the peaks reached in the pre-1975 period. The efforts by pole-and-line and trolling crafts have been allocated entirely to the tuna fishery and the handline operations for reef fishes have not been taken into consideration. However, the reef fish production had its peak in 1974 and the production in 1982 was less than that in 1981, in spite of the fact that the conversion factor was raised from 1.36 kg to **2** kg/fish in 1982. In general, the distribution of effort does not correspond with the catch rates in the various areas around the country.

The production of yellowfin tuna is more from the western side of the atolls while that of skipjack tuna is more on the eastern side. The catch rates of yellowfin are higher in the northern atolls and decline southwards rapidly but that of skipjack are higher in the southern part and decrease towards the north, though less rapidly. (F.A.O. 1983).

(b) *Sri Lanka* is one of the two countries which have recorded a steady increase in total marine production over the last decade. The few available variety-wise break-ups of the catch show that annual production of tuna increased till 1982. Small pelagics (including sardines, anchovies and mackerels), king mackerel and carangids have shown a declining trend since 1980 and 1981.

There has been a significant decline in the number of traditional craft, particularly the out-rigger canoes and log rafts, over the last decade and an increase in mechanized craft. Decline in beach seining, pole-and-line fishing, tuna longlining, is evident as against a significant increase in driftnetting for large and small pelagics and trawling for demersals and shrimps. The significant increase in small demersal species may be attributed to the larger quantity of by-catch from shrimp trawling. Trawling, trapping, bottom set gilinetting being the predominant methods in the northern part of the island, nearly 80% of the demersals are produced from that area. Larger pelagics, such as tunas, are caught mainly on the west, south and south-west coasts, followed by north-west and east coasts. The north and north-east coasts contribute negligibly to the tuna production but significantly to the production of other large pelagics such as king mackerels. Shrimp production is mainly from the north-west, north and east coasts.

Individual fisheries have not been monitored except in the case of tunas. It appears that the catch rate of skipjack tuna, which is the predominant tuna species, has declined from an average of 46.2 kg/trip in 1972 to 28.4 kg/trip in 1982/83 (Joseph, 1984). In view of this trend, it is clear that there should have been a tremendous increase in the gillnet effort on tunas to achieve the present level of production.

Landmarks in the marine fishery of Sri Lanka are the mechanization of fishing crafts in the 1950s, abandoning of commercial scale trawling on the Wadge Bank since 1979 when the fishing rights on this ground was officially transferred to India, and the suspension of the oceanic tuna longlining operation around 1977 due to non-profitability.

(c) *India—East coast—The* varieties contributing more than 10% of the marine production are ponyfish and sardines in Andhra, Tamil Nadu and Pondicherry (south-east coast) and catfish and pomfrets in West Bengal and Orissa states (north-east coast). Hilsa forms a very significant component in the production by the latter area while tunnies, anchovies, carangids, perches and penaeids are significantly greater in the former area.

The annual production in West Bengal has shown a tremendous increase since 1976 and this has been attributed to additional districts being included in the state. There has been a decline in the annual production in Orissa, mainly contributed by the drop in production of pomfrets and hilsa shad, However, catfish and sardines show an increasing trend. In Andhra Pradesh, the annual production was higher in 1975 than in subsequent years which show some degree of fluctuation. Ribbon fish, mackerels, croakers, and non-penaeid shrimps show a decrease in 1981 while ponyfish, catfish, sardine, perches and penaeid shrimps show an increase. Tamil Nadu, which has the largest annual production, appears to maintain that position steadiiy. The production level in 1981 is the same as that in 1975. Though there has been an increase in the production of ponyfishes (very significant), penaeid shrimps and anchovy, those of croakers, lesser sardines, sharks/skates and king mackerels have declined in this area in 1981. The Pondicherry area contributes the least to the production on the east coast but there has been an annual fluctuation with only a negligible increase in 1981, contributed by carangids, flying fish and perches.

(d) *Bangladesh—An* analysis of the trends in the marine fisheries of Bangladesh is difficult due to the limited availability of information and statistics on the small-scale fishery which is estimated to contribute nearly 95% of the marine production. The commercial or large-scale fishery trends are relatively more clear because statistics of the catches of fish and shrimp trawler operations are available.

In the small-scale fishery, driftnet and gillnet fisheries have been the major contributors to the production and preliminary studies have shown that mechanized craft operating large-mesh nets averaged 1340 kg/trip, 190 kg/fishing day or 120 kg/per day out and those operating small-mesh nets averaged 2060 kg/trip, 280 kg/fishing day or 180 kg/day out. The former category conducts trips of 9 to 13 days with an average 11.3 days/trip while for the latter, the corresponding figure is 5-9 fishing days with an average of 7.3 days/trip (Bergstrom, 1982). Set bagnet fishery catch rates varied between 4.3 and 79 kg/lift, depending on the area and season. An average of three lifts are made per day. Seine nets averaged 3996 kg/trip in 1982,

The hilsa shad is the main species contributing to the pelagic fishery in Bangladesh. Of about 100,000 tonnes of hilsa produced per annum, about 50% is assumed to be from the marine environment. Crude estimates of production showed a decline in the production from 1956 to 1962 and an increase up to 1982 (Antony Raja, 1984). Recent indications are that hilsa production has increased to about 150,000 t/annum and that the production from marine and estuarine sectors has increased while the production from the riverine system has declined. An examination of the catch composition of gilinet boat landings at Cox's Bazaar, between 1967 and 1972, also showed an increasing trend for hilsa but a declining trend for king mackerels, wolf herring and sharks/rays (Mohiuddin et *at.,* 1980).

By July 1984, permission had been accorded for the import of 250 trawlers. Of this numbers '114 arrived in the country by December 1984. The actual number of trawlers under operation was, however, 74 (inclusive of 5 BFDC trawlers). It has been reported that despite the increased number of trawlers during 1983/84, the average catch rates increased from 337 kg/trawler/day in 1982/83, to 564 kg/trawler/day in 1983/84 and also that the total production in '1983/84 was double the figure for 1982/83 (see Tables 8 and 9).

The number of vessels operating in the fishery and the production of shrimp by these vessels are shown in Table 8. The average catch rate in 1982/83 declined by about 40% of the rate in 1978179. However, the catch rate for 1983/84 has been reported to be better than that at the beginning of the shrimp fishery in 1978. According to these figures (Table 8), the performance of vessels appears to have improved from an average of 51 fishing days/boat/year in 1979/80 to 107 fishing days/boat/year in 1983/84.

It further appears that trawlers licensed for finfish production are also catching shrimp but may not always declare such catches (verbal communication by Shahidullah). Penaeid shrimps entering the trawl fishery are also being caught by the set bagnet fishery in the estuaries but no production estimates are available for this source either.

Table 8

Annual changes in trawling fleet, shrimp catch and catch rates (1979-1984)—Bangladesh

Year	Number of vessels	Shrimp catch **(t)**	Tonnes/day/vessel based on shrimp trawlers
1978/79	9	240	0.533
1979/80	127	3350	0.518
1980/81	131	2760	0.436
1981/82	18	1020	0.368
1982/83	45	1630	0.337
1983/84	74	4500	0.564

Source—White and Khan (1985).

Large quantities of the fish caught by both shrimp and fish trawlers are discarded as trash fish and hence a significant difference in the estimates of production and landing (Table 9).

Table 9

Estimates of production and landing of fish caught by trawlers in Bangladesh (1978-84)

Year	No. of vessels	Fish landed (t)	Fish caught (t)
1978/79	9	1300	2600
1979/80	127	16700	36800
‘1980/81	131	11500	25500
1981/82	18	1800	7000
1982/83	45	8600	19500
1983/84	74	10000	35000

Source—White and Khan (1985).

However, in the case of shrimp, the estimated landing is probably the quantity actually recorded and the estimated production would then include an estimate for the unrecorded landings. A small quantity of shrimp, which are very small in size, may be lost along with the trash fish.

Two joint ventures in demersal fish and shrimp fishery—(1) United Fisheries of Kuwait—Bangladesh Fisheries Development Corporation venture with 5 trawlers, and (2) Thailand-Bangladesh venture with 113 trawlers—were started in the late 70s and discontinued in October 1 980, due to uneconomical operations, declining catch rates and difficulties of proper inspection/surveillance of licensed fleet in their EEZs.

The contribution of various types of fisheries in the marine sector, at present, is evident from the estimates presented below:

Gear	Fish (t)	Shrimp (t)
Trawl	35000	4500
Gillnet & seine	90000	—
Set bagnet	60000	1000
Bottom longline	3000	—
Others	20000	500
Culture	5000	5000
Shrimp gillnet	—	450
Total	213000	11450

Estimates, excluding those for the trawl fishery, are not based on samplings conducted ona year-round basis (Shahidullah 1983).

Brackishwater aquaculture, bhery culture systems in low lying areas with channels for tidal flow which brings in juveniles and larvae of fish and shrimp, dykes constructed around mangrove areas and polders in the tidal zone contribute to the production of shrimp at a level equivalent to that of commercial fishery. Recently 5000 acres of mangrove area were leased to private parties for establishing 39 farms of 40-60 ha each. The larvae and juveniles trapped for such culture programmes are mainly contributed by the marine shrimp stocks. The country's target for 1984/85, under the Second Five-Year Plan is tabulated below:

Craft	System	Number expected to be operational	Projected production (t)
Trawlers	Private	62	31000
	Public	12	6000
Mech. boats	Private	1000	30000
	Public	3000	90000
Traditional sail craft	–	9000	63000
Total		'13074	220000

(e) *Burma—The* non-availability of detailed catch statistics limits the discussion on this aspect. Though overall production estimates are available from onshore, inshore and offshore ranges of the marine sector, production, catch rates and spatial distribution of the catch are not readily available for any of the major fishing methods. The estimated annual production from the marine sector has increased steadily from 1972 to 1981 and a slight decrease is indicated in 1982 and 1 983. The production from the onshore range declined with the total production but those of the inshore and offshore ranges increased upto 1 982 and 1 981, respectively, and then declined. The decline in the offshore sector is very significant (Table 10) according to available figures.

Production by varieties is not available. The purse seine fishery is not considered to be efficient and it is reported that minor modifications in design and construction could save netting material and improve efficiency. No private companies engaged in fisheries and up to the early 70s, fishing was restricted to the Delta area for trawling and gillnetting, Tavoy area for trawlers and south of Mergui for purse seiners. The rest of the coastline and particularly the Rakhine coast was not exploited. The mackerel fishery is active close to the Thailand border while round scads are fished mainly at the southern tip of Rakhine coast and southern end of Burma, close to Thailand. The present levels of production of hilsa and mackerels are considered to be in the region of 1 0,000 t and 4,000 t respectively.

(f) *Thailand—There* was a significant increase in fishing effort due to migration of fishermen from the Gulf of Thailand, introduction of purse seining and gillnetting and modification of trawis for catching pelagics also, just prior to this period.

Trawling contributed nearly 55% of the demersal landings in 1966-68 and 75% in 1969-80. Demersals peaked in 1976 and then declined. With the decline in the catch rates closer to shore, the trawl fishery appears to have extended into deeper waters. This is evident from the changes in the catch composition of trawlers between 1966 and 1982. There is a marked

Table 10

Marine production from onshore, inshore and offshore ranges of Burma

Range	1972/73	1973/74	1974/75	1975/76	1976/77	1979/80	1980/81	1981/82	1982/83
Onshore	129099	129100	130391	131694	135100	149200	162520	155250	151720
Inshore	127884	108831	135884	140965	148600	168400	180100	226040	222710
Offshore	75912	64907	83369	88844	96100	111700	125420	69270	68490
Marine total	332895	302838	349644	361503	379800	429300	468240	450560	442920

Source—Ministry of Agriculture and Forestry, Burma.

increase in the percentage of varieties such as *Nemipterus* spp., *Saurida* spp., and *Priacanthus* spp. while that of typical shallow water varieties has decreased (Table 11).

Table 11

Changes in the percentage composition of certain demersal varieties (1966-1982)—Thailand (%)

Varieties	1966	1982	
Leiognathids (Ponyfishes)	29.9	1.3	mainly in the 30-40 m depth range
Mullids (Goat fishes)	10.9	2.6	
Sciaenids (Croakers)	8.3	0.19	
Tachysurids (Catfish)	5.7	0.20	
Carangids	5.4	0.60	
Sphyraenids (Barracuda)	2.8	0.8	
Trichiurids (Ribbon fishes)	1.6	0.3	
Nemipterus (Threadfin bream)	3.2	7.8	mainly in the 40-80 m depth range
Synodontids (Lizard fishes)	2.1	4.3	
Priacanthus (Bulls eye)	5.9 (1969)	15.7 (1972)	

Source—Bhatia *et al.*, 1983.

Pelagics have also declined after a peak in 1973 and this is due to a decline in the production of a majority of the pelagic varieties. The peak years for major pelagic varieties were as follows: Indo-Pacific mackerel 1975, Indian mackerel 1973, king mackerel 1979, round scads 1971, anchovy 1974, sardines 1979, hardtail scads 1979 and coastal tuna 1979, A significant decrease in the catch rates has also been observed.

Shellfish production reached a peak in 1973, decreased, peaked again in 1979 and then declined (Table 12). This pattern is also observed in the case of shrimp production.

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Table 12

Trends in the production of pelagics, demersals and shellfish on the west coast of Thailand (1966-1 981)

	1966	1967	1968	1969	1970	1971	1972	1973
Pelagics	*	*	*	*	*	45632	43359	56965
Demersals	16680	63360	90920	216440	183060	177089	168457	203599
Shellfish	*	*	*	*	*	14847	18281	30630
TOTAL	30146	114524	162248	270172	237128	237568	230097	291194

	1974	1975	1976	1977	1978	1979	1980	1981
Pelagics	31108	35874	24554	33593	18881	34551	15157	13926
Demersals	198315	170360	211500	159892	147811	150355	137707	140367
Shellfish	15069	15954	19996	25376	33221	34610	33277	30096
TOTAL	244492	222188	256050	218861	199913	219516	186141	184389

*Not available

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The catch rate trends observed in the various fisheries have been summarised in Table 13.

Table 13

Catch rate trends in various fisheries on the west coast of Thailand (1973-1979)

(kg)

	1973	1974	1975	1976	1977	1978	1979
Otter trawl[1] (all classes)	414	275	284	226	193	207	209
Pair trawl[1] (all classes)	—	**393**	—	—	160	125	
Thai P. seine[2]	1040	958	1064	1434	4266	4725	972
Chinese P. seine[2]	729	600	698	744	478	104	301
Anchovy P. seine[2]	162	223	269	455	301	200	170
Luring P. seine[2]	—	—	—	—	—	—	1550
King mackerel[2] gillnet	27	30	26	28	36	20	61

Source—Bhatia, 1980 and 1983.
[1]kg/hr
[2]kg/trip

Though the percentage of demersals in the total production has not changed significantly in recent years, that of pelagics has declined from 19.2% in 1971 to 7.5% in 1981 and that of shellfish has increased from 6.2% to 16.3% in the same period.

(g) *Malaysia*—The 1974 peak was influenced by the trend in the production of demersals. However, the demersal production reached another peak in 1977 and has fluctuated at a lower level since then, with a tendency to decline. Trawler landings increased by 40% between 1967 and 1981 mainly due to increase in trash fish production. Food fish declined since the 1968 peak, reaching a low point in 1975. It increased again up to 1978 and declined. Food fish was 54% in 1967 and 21% in 1981. In 1981, trawlers alone contributed 89% of the trash fish landed. An increase in the number of 'mini trawlers' is supposed to have affected the handline and trap fishery. As in the case of Thailand, expansion of the trawl fishery towards deeper waters has resulted in changes in the catch composition. In 1981, only *Nemipterus* spp. recorded a slight increase; catfish remained unchanged; soles, jewfish and rays showed a decline. In the late 60s and early 70s, trawlers made daily trips and the average duration of a haul was about one hour but since the late 70s, the duration of a trip has been more than a day and each haul is of 3 hours duration. Despite increasing effort, the catch is not proportionately larger. Monitoring surveys indicated that the trawl catch rate was 131 kg/hr in 1970 and 40 kg/hr in 1981 (Table 14). The decline in the catch rate of commercial operations is indicated in Table 15.

Table 14

Monitoring survey—trawl

1970	131.1	kg/hr
1973	125.0	..
1974	92.1	..
1978	69.4	..
1981	40.0	

Table 15

Catch rate of 30 t trawler

1966	877.6	kg/boat/day
1967	803.2	..
1968	841.9	..
1969	693.7	..
1970	515.5	..
1971	427.6	..
1972	299.7	..
1973	306.6	..
1974	246.8	..

Source—Shaari *et al.* 1976; Shaari, 1976; Chang and Pathansali, 1977.

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Table 16

Variation in the annual marine production on the west coast of Peninsular Malaysia (1970-1981)

	Demersal	Pelagic		Shellfish	squids,	Others	Total
1969	—	12900					
1970	73345	79532	38157	32341	2119	7065	232559
1971	86575	81673	46703	29372	1746	6368	252477
1972	98048	45910	36961	30210	1526	17374	230029
1973	127199	66610	45575	31215	2104	7841	280544
1974	150289	56462	48642	49067	4010	9240	317710
1975	136237	45812	37967	34000	5311	11337	270664
1976	141999	56423	43940	32295	8616	11301	294574
1977	183840	68453	51592	48522	11583	14480	378470
1978	178500	86672	63017	56098	11778	14709	410774
1979	174700	113788	56686	64412	12371	10390	432347
1980	166437	131354	51081	123390	8923	12310	493495
1981	173524	116673	45521	71089	8975	17589	433371

Source_AnonYmous, 1983.

<<

Pelagics showed peak production in 1968, declined until 1975 and then steadily increased to an all-time high in 1980 (Table 16). In 1981, the decline was attributed to a drop in the contributions of hardtail scads, anchovy, sardines, tuna and chub mackerel. Trawlers with high-opening nets and driftnetters contribute substantially to the production of mackerels, compared to the purse seiners.

The shrimp production trend is similar to that of demersal fish. The good years were 1971, 1974 and 1978. Trawler landings were lower than those of gilinet and bagnet; the latter have increased. From 1968 to 1978, shrimp landings by trawlers increased from 21.6% to 71.0% of the production by all types of gears, but declined to 48% in 1981. This has been due to the enforcement of a law prohibiting trawling operations in the inshore waters.

Unlike on the west coast of Thailand, the percentage of pelagics in the total production has increased from 17.7% in 1969 to 26.6% in 1981. The corresponding percentages for demersals and shellfish have declined.

(h) *Indonesia—The* production from the eastern part of the North Sumatra province showed peaks in '1975 and 1980 but the latter was lower than the former. The prohibition of trawling, after 1980, would have had a significant impact on the production but the figure for 1981 indicates that effort through various other alternative methods has increased substantially. The trawl catch rates showed a steep drop from 181 kg/hr in 1976 to 38 kg/hr in 1978, according to available information. Danish seines, trammel nets, gilinets and traps have increased to keep up the production of shrimp and demersal fish in the inshore waters. However, offshore areas exploited by trawlers are not being covered by the existing methods.

On the one hand, the production of mackerels and scads appears to have declined in this area, due to the target species of the lift nets being shifted to anchovy, but on the other, purse seining is becoming more popular for mackerels and surface tunas. The average catch rates for the purse seiners in the various provinces are as follows:—

Banda Aceh (West)	—21.5 t/unit gear/annum
(East)	—32.4
Central Malacca Strait (N. Sumatra province)	—37.1
Riau Province	—Nil
West Sumatra province	—Nil
N. West Sumatra Province	—62.2

(Based on Anonymous, 1982)

The tuna catch rates by various methods have been estimated as:

(kg/haul)

	Longtail tuna	Eastern little tuna
Driftnet	8.2	3.3
Luring P. seine	114	12.2
Regular P. seine	42.6	38.5

The average catch per unit craft per annum in the provinces of Sumatra are

Indian Ocean	Banda Aceh	6.7 t	*Malacca Strait*	Banda Aceh	5.7 t
	N. Sumatra	5.1 t		N. Sumatra	8.9 t
	W. Sumatra	6.2 t		Riau	11.4 t

<<
d on Anonymous, 1982)

The development of fisheries in this area appears rather slow, particularly on the west coast.

(i) *Oceanic area—The* oceanic province within the project area is presently exploited only by distant nations but in the recent past, Sri Lanka and Indonesia had tuna longliners based and operating within this area. Both countries abandoned these operations due to economic reasons. Indonesia, however, has moved its fleet from Sabang to operate in areas close to Bali.

Japanese tuna longline operations in the Bay of Bengal area commenced in 1953 and Taiwan and Korea entered this area in the late 60s. Since about mid-70s, the Japanese fleet has gradually reduced its effort in the equatorial region and the Bay of Bengal, to concentrate on the bluefin tuna *(T. macoyli)* in the southern part of the Indian Ocean. The efforts by Taiwan and Korea continued to increase in the project area until the end of the 70s. Though comprehensive data for recent years are not readily available, it is felt that the effort within the project area may have begun to decline due to the prevailing unfavourable tuna market situation, falling catch rates, rising costs of operation and the new law of the sea.

In the project area west of Sri Lanka, available effort data indicate a relatively high level of 3,095,013 hooks in 1979 but the highest hook rate of 1.4/100 hooks for yellowfin tuna was observed in 1978 and 1.1/100 hooks of bigeye tuna was realised in 1977. The hook rates appear to have declined in '1982. These trends are based on incomplete data, and differences in the seasonal coverages by the three countries involved, within and between years, have not been taken into consideration. (Table 17)

In the Bay of Bengal area, the total catch of yellowfin and bigeye tuna showed a steady increase from 1976 to 1980, even though Korea's contribution has not been included for 1980. The production by Taiwan in 1982 equalled that of all three countries in 1978 for bigeye tuna, and in 1977 for yellowfin tuna. These trends are attributed to the increase in effort. Mean hook rates for bigeye and yellowfin tunas fluctuated between 0.3 and 0.6 and between 0.3 and 0.8 per hundred hooks, respectively. No major changes in the trend were evident. Tuna hook rates were relatively better in 1978 particularly for bigeye in the equatorial belt (0°-5°N), in respect of all three countries (Table 18). Korea achieved equally good hook rates for bigeye tuna, even in the higher latitudes within the Bay, while the other two countries showed a decline in the hook rates of both bigeye and yellowfin but more significantly for the former species and as a result, the hook rate of yellowfin became greater than that of bigeye tuna. The hook rates for 1982 indicate an eastward declining trend in the Bay of Bengal.

Korean longliners have been reported to use gears with deeper fishing depths than the others, in order to get better hook rates of bigeye tuna. Comparison of the hook rates of the three countries in the project area for the period 1976 to 1979 failed to show significantly higher hook rates for bigeye tuna caught by Korean vessels, in the 0°-5°N belt. However, in the higher latitudes the hook rates of Korean vessels appear to be better than those of the other two. The mean weights of the tunas, as recorded by Taiwan, tend to show an increase towards the higher latitudes (Table 18) and this may also influence the performance of the gears fishing at different depth ranges, and be one of the contributory factors to the trend observed.

Table 17

Tuna longline catches of bigeye and yellowfin tunas in the project area (1976-1982)

Vl/Of Sr/Lanka	1976	1977	1978	1979	1980	1981	1982
No. of hooks	581730	1535980	1458756	3095013	611971	613500	866300
Bigeye tuna (Number)	3677	15019	15180	27337	3942	2883	6580
Hook rate	0.63	0.98	1.04	0.88	0.64	0.47	0.76
Yel!owfjn tuna (Number)	5108	12060	20660	25160	2470	3199	2186
Hook rate	0.88	0.79	1.42	0.81	0.40	0.52	0.25
Bay of Bengal							
No. of hooks	3028271	3425060	7965090	9781609	13923411	11893500	8378000
Bigeye tuna	10381	18459	49304	55648	65470	43451	50359
Hook rate	0.34	0.54	0.62	0.57	0.47	0.37	0.60
Yellow tuna	1763S	28464	36025	30850	54778	31712	26612
Hook rate	0.53	0.83	0.45	0.32	0.39	0.27	0.32

Includes Japan, 1976-1980; Korea, 1976-1979; and Taiwan, 1976-1982.
Source—Anonymous 1976-1980; Anonymous, 1975-1979 and Anonymous, 1976-1982.

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Table 18

Bigeye and yellowfin tuna catches (number), hook rates (number/100 hooks) and mean weights in 5° x 5° grids within the project area

Longitude	Latitude	1978 0°—5°S**	1978 0°—5°N	1978 5°—10°N	1982 0°—5°S	1982 0°—5°N	1982 5°—10°N
70°—75°E	No. of hooks	584275	286310		290800	76000	—
	Bigeye	7158	4131	—	1461	744	
	C/E	1.23	1.44	—	0.50	0.98	
	Mean weight						
	Yellowfin	8938	2986		1188	52	
	C/E	1.53	1.04		0.41	0.07	
	Mean weight						
75°—80°E	No. of hooks		395175	192996		499500	12000*
	Bigeye		3462	429		4375	12
	C/E		0,87	0.22		0.88	0.10
	Mean weight						
	Yellowfin		6599	2137		946	0
	C/E		1.66	1.11		0.19	0
	Mean weight						

Longitude	Latitude	1978 0°—5°N	1978 5°—10°N	1978 10°—15°N	1978 15°—20°N	1982 0°—5°N	1982 5°—10°N	1982 10°—15°N	1982 15°—20°N
80°—85°E	No. of hooks	372661	97862	430078	44929	1237000	0	142100	0
	Bigeye	6825	217	359	0	9897		2	
	C/E	1.8	0.22	0.08	0	0.80		0.0	
	Mean weight	32.4	57.4	60.6		36.8		75	
	Yetlowfin	3137	412	1427	310				
	C/E	0.84	0.42	0.33	0.68				
	Mean weight	31.9	39.2	40.3	27.4				

Table 18 *(Continued)*

		Year							
		1978				1982			
	Latitude	O°—5°N	5°—i0°N	1O°—15°N	15°—20°N	0°—5°N	5°—10°N	10°—15°N	15°—20°N
Longitude	No.of hooks	1342646	981519	2445407	307594	2886000	610400	1370000	93800
	Bigeye	14846	6743	874	5	23607	1407	503	58
85°—90°E	C/E	1.10	0.68	0.08	0.0	0.82	0.23	0.03	0.06
	Mean weight	33.8	48.8	53.8	40.0	35.0	(48.0)	42.3	30.0
	Yellowfjn	4724	5998	8361	606	5627	1764	9427	623
	C/E	0.35	0.61	0.34	0.19	0.19	0.28	0.68	0.66
	Mean weight	31.1	36.0	38.6	39.5	(32.0)	34.8	32.8	33.2
	No.of hooks	1603761	81779	0	7950	1988000	25500	15600	0
	Bigeye	14778	215		0	14739	108	15	
90°—950E	C/E	0.92	0.26			0.74	0.42	0.09	
	Mean weight	33.0	48.3			34.7	40.5	61.3	
	Yellowfin	7163	293		61	4924	31	100	
	C/E	0.44	0.36		0.76	0.24	0.12	0.64	
	Mean weight	32.5	33.2		36.9	32.5	30.5	37.9	
	No. of hooks	229852	13452	5600	*0*	9600	0	0	0
	Bigeye	3149	251	42		23			
95°—i00°E	C/E	1.37	1.86	0.75		9.24			
	Mean weight					34.8			
	Yeflowfin	911	184	12		17			
	C/E	0.39	1.36	0.21		0.17			
	Mean weight					35.8			

*1981 data—as no data available for 1982. **EEZ of Maldives.

Sources—Anonymous, 1976-1980; Anonymous, 1975-1979: and Anonymous, 1976-1982.

7. BIOLOGICAL INFORMATION

The commercially important varieties in the continental shelf areas of the participating countries are a wide range of mixed species with varying biological characteristics such as life span, growth rates, size, fecundity, spawning, feeding habits, natural mortality rates, etc.

A perusal of the marine catches by countries will show that there are individual species contributing very significantly to the fishery in each country. The skipjack tuna *(Katsawonuspelamis)* in the Maldives and Sri Lanka, hilsa *(H/lsa ilisha)* in Bangladesh and Burma, Indo-Pacific mackerel *(Rastrelliger brachysoma)* in Thailand, Malaysia and N. Sumatra (Indonesia) are some of the outstanding cases. However, numerous varieties or species collectively contribute to the economic exploitation of the resources available with multiple gears and a biological study of the major species itself will be a labour- and capital-intensive activity, particularly for developing nations such as those participating in the Bay of Bengal Programme. As a result, biological studies have been of a qualitative nature in many of these countries and limited to seasonal availability, size ranges entering the fishery, general distribution pattern, catch composition and good estimates of density distribution/catch rates in very few cases. It is evident that relatively better knowledge on the biology of fishes is available from the west coast of India, east coasts of Thailand and Malaysia and the eastern part of Indonesia, than for the corresponding areas on the opposite sides of the respective countries. The major differences in the environmental/ecological characteristics and the marine life between the two sides mentioned above, make it uncertain whether the biological parameters from one side can be directly applied to the other side. In the case of others—Maldives, Sri Lanka, Bangladesh and also Burma—which do not have such marked differences between their eastern and western sides or have sea frontage only on one side, the biological information available is relatively poorer and systematic compilation of such information has not been attempted until now.

Summarizing the available biological information is beyond the scope of this report as it is inconclusive in the present context and only some observations applicable in general to the whole project area are mentioned below.

Considering the hypothesis of a relationship between spawning/recruitment patterns and monsoon winds, as suggested by Weber (1976) and Johannes (1 978) for various areas of the tropical Indo-Pacific region and the results of the monsoon-induced seasonality in the recruitment of 112 stocks of teleosts in the Philippines (Pauly and Navaluna, 1983), it is conjectured that the majority of the fishes in the project area also have two annual recruitments. Even in the case of shellfish such as shrimp, a similar pattern has been observed in a number of tropical areas and is perhaps generally applicable in this area too.

An examination of the depth-wise distribution of demersal species in the region reveals that the most productive range for commercially valuable species is generally the 20-60 m depth range. More shallow waters yield shrimp and smaller and less valuable species such as Lelognathids or juveniles of larger species. In the productive depth range, skates/rays, Lutjanids, Lethrinids, Ariids, Carangids, Sciaenids, Polynemids, Leiognathids, Pomadasyids and squids are common. Beyond this depth range and up to about 100 m, Nemipterids, Priacanthids,Triglids, *Psenes* sp. and Mullids tend to predominate. In depths greater than 200 m, *Chlorophthafmus* spp., *Cubiceps* spp., *Per/stedion* spp., tend to become dominant and these are all non-commercial species at present. In this depth range, deep sea lobsters, *Peurulus sewelli,* and deep sea shrimps *Heterocarpus* spp. and *Aristeus* spp. appear practically around the Bay (Stromme, 1983; Bliendheim and Foyn, 1980; Saetre, 1981; Stromme, Nakkan, Saan Aung and Saetersdal, 1981; Aglen, 1981; Nair and Joseph, 1984). This trend is not applicable to the Maid ives because of the absence of a proper continental shelf area. However, in the inter-atoll channels which have a trawlable bottom at 250-350 m depth, the deep sea forms described above are present (Stromme, 1983).

Mesopelagic fish beyond the continental shelf around the Bay are the Myctophids. Pelagic fishes in the inshore waters are generally anchovy, sardine, chub mackerels, scad mackerels, king mackerels, smaller tunas and hilsa in the upper Bay. These varieties decline in the offshore range and are not of an exploitable concentration in the oceanic provinces. The main commercially valuable pelagics in the offshore and oceanic ranges arethe largertunas, billfishes and pelagic sharks. Again in the case of Maldives, an insignificant neritic province deprives that country of exploitable stocks of small pelagics mentioned above and oceanic varieties contribute to the pelagic fishery. Reef waters inside the atolls con itrbute coral reef demersal forms such as snappers, emperor fishes, fusiliers, butterfly fishes, groupers and carangids. The predominance of fusiliers and pelagic species such as rainbow runners and dogtooth tuna is noteworthy. Anchovies, silversides, cardinal fishes and red bait in the reef waters are the main source of live bait forthe pole-and-line fishery which is the mainstay of that industry.

Another noteworthy biological feature in the area is the occurrence of deep bodied and narrow bodied variations in the hilsa *(Hilsa ilisha)* found in the north-east of India, Bangladesh and Burma. The significance of this difference has not been clearly established (Naumov, 1971 Quddus *et al.,* 1984).

8. STATUS OF EXPLOITED STOCKS AND POTENTIAL FOR DEVELOPMENT

An assessment of the status of the exploited stocks is problematic as good estimates of the catch in relation to the effort applied are basically lacking in almost all the countries in the project area. Though some kinds of estimates are available in some of these countries, their reliability is questionable. The effort estimates available are either indirectly obtained by using the estimated production of certain groups of varieties and their catch rates in the main fishing methods used, determined by sampling, or by using the number of units of the gear licensed as an index of effort. In this approach, the estimated catch or landing has to be reliable. But for reliable estimates, it is necessary to stratify the samples according to the gear and craft used and the areas and seasons fished. A multigear approach to the exploitation of any stock makes it more complex and laborious to execute such sampling programmes in this region, except perhaps in the Maldivian fishery in which there is only one primary method and only one primary group of fish.

Attempts to apply surplus yield models to catches of groups with widely varying biological characteristics have been found to be misleading particularly when changes in species compositions have not been taken into consideration. Changes in catch composition are evident in some of the cases discussed in the earlier sections of this report. This is particularly the case in demersal fishery. None of the other known methods of assessment has been applied in this region, due to lack of vital statistics or parameters such as natural mortality rates, growth rates and ages of the fish. Scarcity of input data, difficulties of ageing tropical fish and application of series of analyses for numerous species, are major problems. Recently, 'length based models' rather than 'age structured models' have been applied by some of the participating countries such as Sri Lanka, Burma, Malaysia and Indonesia. In the absence of reliable information on catch, effort and age structure, the new approach provides a simplified and quick access to the study of the tropical fisheries and their exploited populations, within the limitations of skilled personnel, funds and time confronting the majority of the countries in this region.

However, this should not be carried out at the expense of the traditional catch-effort data collection, age determination, etc,, and collection of such information should continue uninterrupted. No extra burdens are anticipated and both approaches will be useful for cross checking.

Even in the case of production models, for which reliable estimates of effort values and realistic catch rates in commercial fisheries are difficult to obtain, it has been shown that a plot of catch vs. total mortality which can also be obtained from the 'length based model', gives a parabola as in the Schaefer model with the intercept cutting the X-axis at the average level of natural mortality (Csirke and Caddy 1983).

The potential yield levels in the project area have been estimated mainly through primary productivity studies, swept area method, acoustic method of estimation of abundance and also on the basis of yield per unit area. The primary productivity method faces the problems of realistic estimations of conversion factors at various trophic levels in the complex food chains of the tropical eco-systems but could serve as a general guideline for management until this technique is improved. The swept area method is a reliable means of determining the potential yield level for demersals. The acoustic method has limitations at present in the coverage of the entire column of a unit area, subjective separation of plankton and pelagics or pelagics and demersals, compensation for the effects of temperature gradients or thermoclines and the application of target strengths for the numerous species in a tropical sea. From the experience of acoustic surveys in various countries within the project area, there is a strong temptation to state that it tends to overestimate the biomass of small pelagics in spite of the failure to cover the first 5-1 0 m near the surface and to underestimate the demersal biomass. Further, the conversion of biomass into potential yields in the project area has been affected by the lack of realistic estimates of natural mortality rates and production levels of the resources surveyed.

The yield per unit area values are useful for comparing the prevailing yield levels in two or more areas but fail to show that they are the optimum yield per unit area because it is not known whether the resources are under-utilized or over-utilized. The yield per unit area should be used along with the other indicator parameters.

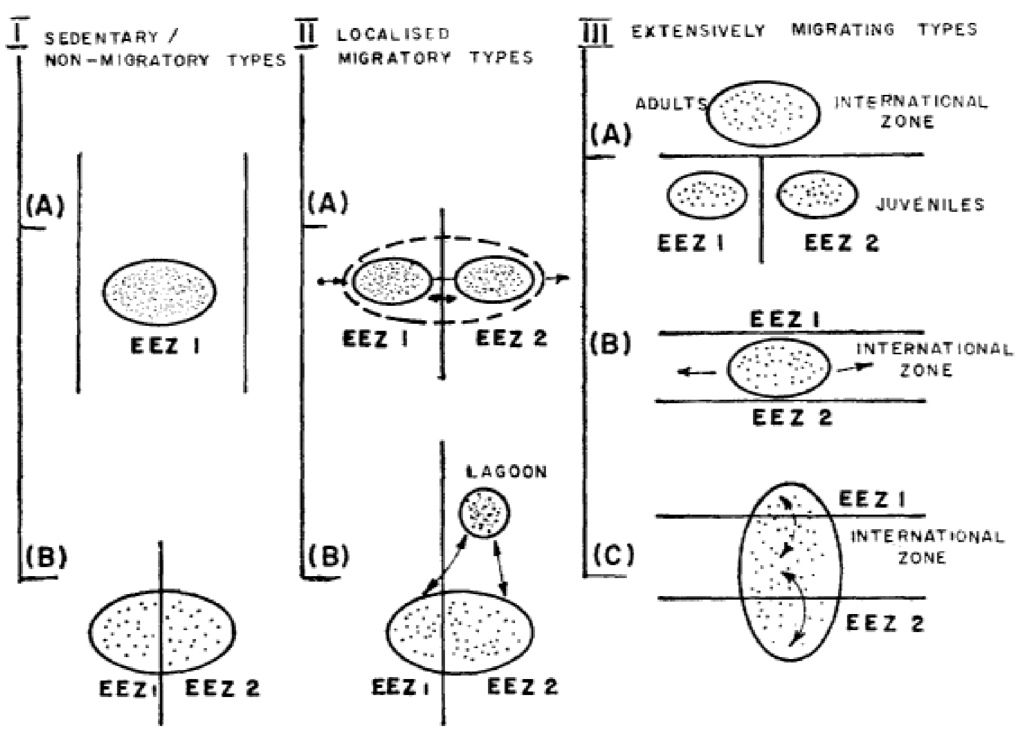

Fig. 4. Diagrammatic representation of the types of exploited stocks in the project area.

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Based on a preliminary examination of existing marine fisheries in the project area, in conjunction with the geographic distribution of the species exploited, the types of stocks may be broadly classified as:

(I) sedentary/non-migratory;
(II) localised migratory; and
(III) highly migratory (see Fig. 4).

Within each of these broad categories, there might be further sub-divisions.

Even the sedentary/non-migratory types may exhibit some movement or highly localised migration at least in the development stages of their life and also may shift from shallow to deep waters within an area. However, they tend to have a contiguous dispersion. The holothurian fishery in Sri Lanka, the reef fish fishery of the Maldives, and some demersal species on the east coast of India are some examples of type 1(A). Type 1(B) may be similar to 1(A) except that the stock may be distributed over a ground in the path of the man-made EEZ boundary, as in the case of some demersal species in the Palk Bay area, the north-eastern corner of the Bay of Bengal and other similar situations. A typical instance of the 11(A) type may be the mackerel fishery in the Malacca Straits. Type 11(B) is a possible situation in the cases of the shrimp fishery and the hilsa fishery in the upper Bay of Bengal. However, type II may have several independent units of stock within a single EEZ. Migration may be due to changes in environmental conditions and/or growth and development, spawning, nursery and feeding grounds. Generally, movements from the nursery area to the adult habitat tend to be at right angles to the shore line while migration due to environmental changes tend to be in a north-south direction. Therefore, stocks may move from the inshore to the offshore ranges of the same FEZ or of different EEZs.

There could also be a shift in the vulnerability of the species to the gears used, depending on the selectivity of the gear and behavioural changes in the fish with growth.

Type III is represented mainly by the tuna species in the project area. Though the general pattern is characteristically exhibited by yellowfin, bigeye and skipjack tunas, there are some differences in the exploitation and in the biology of the exploited components of these stocks, Yellowfin tuna is of type III (A) where juveniles enter the surface fisheries of the coastal states, and adults the longline fishery of distant nations. A negligible quantity of the adults are being caught within the EEZ by small scale fisheries. The bigeye tuna is almost entirely exploited by distant nations and juveniles are not recorded in the surface fisheries of any of the coastal countries in the project area. Again a negligible amount of adults may be entering the small scale longline fishery in one or two of the participating countries (Type III(B)). The areas of occurrence of the juveniles are not known. The skipjack tuna has a widespread distribution in the project area, with juveniles and adults being exploited by coastal nations and by distant nations (incidental) in the EEZs and international zone, respectively. Hence this (Type III (C)) tends to differ from the other two species discussed above. Changes in these three patterns in the future, when tuna fishery develops to the peripheral area of the respective EEZs, cannot be ruled out.

It is also evident that multi-species and multi-gear exploitation prevails in almost all types of stocks in the region and the chances of sequential passage of a cohort through separate fisheries in the same EEZ, or even the same type of fishery in separate EEZs at successive stages or ages of their life, are extremely high.

As such, cumulative effects must be taken into consideration. Major examples are the shrimp fishery in Bangladesh where the larval stages are trapped in the lagoons and estuarine areas for culture, post-larve and juveniles are caught by the bagnet fishery and commercial trawlers exploit the adults in the open sea; increasing exploitation of shrimps in the shallow waters (<5 miles) of western peninsular Malaysia, by gillnetters while the trawl fishery beyond 5 miles is showing a declining catch rate trend; expansion in the surface exploitation of juvenile yellowfin tunas while there is a declining trend in the abundance of the deep-swimming component;

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significant increase in the mackerel production by gillnets and high-opening trawls in Malaysia, while the mackerel purse seine fishery is showing a declining catch rate.

Estimations of biomass, standing stock, potential yields and maximum sustainable yields, have been compiled in Table 19. These are based on the literature available and may not be complete. Variations in the estimates with authors, approaches adopted and time are evident. In Maldives, Thailand, Malaysia and Indonesia, maximum sustainable yield levels have been evaluated but in the case of the others, mainly the potential yields have been estimated from biomass values obtained through organic production level, primary, secondary and tertiary production levels, acoustic surveys and swept area methods. A comparative study of the potential yield and sustainable yield levels and the corresponding production trends in the respective areas, was attempted for determining the status of the exploited stocks.

In the Maldive islands, the main tuna stocks appear to be intensively fished within the exploited range and there are possibilities of increasing the production of pelagic and demersal species mainly in the reef waters in which the effort is minimal at present. in the case of skipjack and yellowfin tunas, the estimated optimum effort level within the exploited range is about 130,000 trips per annum, on the basis of existing combinations of craft (FAO, 1983; Anonymous, 1984). In view of the significantly higher efficiency of the mechanized craft, the optimum effort will be less if the number of mechanized craft is increased. In Sri Lanka too, the production of large pelagics showed a similar trend, considering the catch rates. Due to lack of sufficient data, it is difficult to evaluate the status of the small pelagics. In respect of the demersals, it appears that the exploitation may not have reached the optimum level in areas such as the west, south-west and south-east coasts for larger varieties, but significantly larger quantities of the small and less valuable varieties can be obtained from the exploited ranges, around the country, particularly in the south-west and northern areas. It may not be possible to increase shrimp production from the exploited areas without concomitant detrimental effects. Though a potential of 170,000 t of small pelagics has been shown by the acoustic survey as against a production of about 75,000 t in 1982, it is probable that the remainder may be too sparsely distributed in some areas within the exploited range and even beyond, for viable exploitation by existing methods. Fishing in such areas and seasons of low densities may become possible by adapting fish aggregating methods and using more efficient techniques such as purse seining. Components of this potential may also include non-commercial species or other pelagic organisms.

Assuming that the fishing effort on the east coast of India would not have declined, if not increased, the production trends of major stocks tend to be unsteady and declining except in the north-eastern area. The trends indicate intensive exploitation of the major stocks on this coast and any significant and steady increase from within the exploited range seems unlikely except in the West Bengal area. Recent newspaper articles, which expressed Indian Government's concern over the marine fishery production at present, confirm this view. The fisheries are in a developing stage in the Andaman-Nicobar and Laccadive-Minicoy islands. The production levels are negligible and potentials estimated by some authors for the shelf areas are also very low (Kumaran, 1973; Jones & Bannerjee, 1973) (Table 19). Hence it is difficult to comment on the status of the marine fisheries in these two areas. Catch and effort values (or catch rates) are desperately needed to evaluate more precisely the status of stocks on the east coast of India.

In Bangladesh, though the potential yields estimated through organic and primary productivity rates, acoustic survey, swept area methods and catch and effort data are different, they are well within reasonable limits. On the continental shelf, potential estimates of 100-150,000 t for pelagics and 2500 t for shrimps appear to be reasonable ranges (Table 19). If these are acceptable, then the present level of demersal fish production may be close to the optimum yield level. In fact, the yield level is supposed to have exceeded the potential level in 1979/80 during the joint venture operations between Bangladesh and Thailand.

Further, it is reported that a large proportion of the catch turned out to be trash fish. Considering that about 100,000 t of hilsa are caught in Bangladesh (of which nearly 50% is from the marine environment), and adding it to the pelagic production, it would appear that the pelagic resources are being significantly exploited except for the component including the tunas, mackerels and wolf herrings which contribute very little to the present production. Actual abundances of the latter varieties have not been determined but George (1982) estimates this component to provide a potential yield of 30-35,000 t (one-third of the 100,000 t potential for pelagics). West's (1973) estimate of 9000 t for shrimps, certainly appears to be a very high value in comparison with the results of subsequent commercial operations (Penn, 1982). Penn's average potential value of 4165 t is based on annual productions of 2900 and 6216 t per annum, during 1979/80 and 1981/82, respectively. However, the author, using catch and catch rate figures provided by White and Khan (1985), found extremely poor correlation between catch rate and effort and these would not fit surplus yield models. The validity of the catch and effort estimates, perhaps, requires further verification.

Reduction in the sustainable yield level may also be attributed to the reported increase in the acreage under various types of shrimp culture programmes which are trapping the larvae, and to the production of juvenile shrimp by set bag nets, which are being exported (verbal communication—Fisheries Cooperative in Bangladesh). The shrimp culture programme contributes an amount almost equivalent to the trawler production of shrimps. Shahidullah (1983) states that the 1982/83 trends in trawler production of shrimp indicate a yield of 2800 t for the year 1983, which exceeds the MSY. The absence of reliable estimates of production makes it difficult to determine the potential yield for increasing the production of demersals and pelagics on the shelf area but it is conjectured that another 10-15% increase in the total fish production may be rational until the necessary statistics are collected.

Various estimates of demersal and pelagic fish biomass and potential yields are available for the Burmese waters (Table 19). The most recent estimate of demersal fish biomass (Rijavec and Htun, 1984) is very close to that of the 'Dr. Fridtjof Nansen' acoustic survey (1979) but the potential yield estimated by the former is much higher than that by the latter. Pauly (1984) considers the demersal potential of 310-550,000 t estimated by Rijavec and Htun to be an overestimate and suggests a range of 160-400,000 t. A potential yield of 700,000 t from pelagic and demersal resources (Table 19) appears to be a reasonable figure. However, catch statistics are not available for determining the levels of exploitation of the two major components. In relation to the total potential, the total production appears to be about 65%. If this is correct, then there is room for another 30-35% increase in overall production from the shelf area. The Rakhine coast seems to be less exploited than the Delta area and the Tennaserim coast, because of the bottom condition.

On the west coast of Thailand, the estimates of maximum sustainable yield levels for demersals vary from 56,000 t to 205,000 t, but production trends showed a decline every time after the production reached a little over the 200,000 t level. Probably the MSY is somewhere in the region of 100-250,000 tin the presently exploited range in which case, the demersal resources are being very intensively exploited or over-exploited and no further increase is likely in the exploited range. The MSY for pelagics is about 65,000 t and the fishery has exceeded this level. Declining catch rates are also evident in the case of a number of species.

In recent times, the effort is being shifted from one target species to another—chub and scad mackerels to hardtails, tunas and sardines. The shellfish production also shows heavy exploitation in terms of the MSY estimates and there are no indications of an increase in production, except perhaps a marginal increase in the cases of lobsters and cephelapods. In general, the resources are heavily exploited or over-exploited in many cases and there is hardly any room br expansion within the exploited range except for tunas in the peripheral region of the EEZ.

In the west coast of the peninsular Malaysia too, the situation is rather similar. The 'Dr. Fridtjof Nansen' survey provided equally low demersal potential yields from the acoustic survey and the swept area method, compared to the maximum sustainable yield estimates. Pathansali (1976) and Buzeta (1981) used an MSY of 58,000 t while the FAO/SCSP Workshop (1976) derived an MSY of 160,000 t. Even accepting the higher MSY value, the present demersal fishery is over-exploiting the resources. The MSY estimates for pelagics are within the range of 81-91,000 t and this too was exceeded a few years ago. As against an estimated MSY of 21,000 t for chub mackerels its production is estimated to have exceeded 50,000 t in 1982! Interaction

Table 19

Summary of estimates of biomass, standing stock, potential yields and sustainable yields, by country and source

Country	Author	Resources	Biomass/ standing stock (t)	Potential yie u (t)	Max. sust. yie	Approach	Varieties	MSY
Ma/dives	GOPA Consultants (1977)	Total pelagics			50,000	Historical catch, effort data		
	Tuna Working Group (1984)	Skipjack tuna			20,000	Catch and effort		
		Yellowfin tuna			9,000			
		Total tuna		39,000		Yield/unit area upto 60 miles		
				40,000		Average school count & size upto 60 miles		
Sri Lanka	Tiews (1 966)	Demersals		60,000		Exploratory trawl fishery		
	Jones and Bannerjee (1973)	Demersals		52,000		Organic productivity		
	Blendheim and Foeyn (1980)	Demersals		80,000		Acoustic Survey—10,000 for North		
	Sivasubramaniam (1983)	Demersals		74,000		Acoustic and swept area methods—30,000 included for North		
	Jones and Bannerjee (1973)	Pelagics		90,000		Organic productivity		
	Blendheim and Foeyn (1980)	Pelagics		170,000		Acoustic methods—inshore and offshore		
	Sivasubramaniam (1977)	Large pelagics		29,000		Production trend and survey catches only for the offshore and oceanic ranges of the EEZ.		
	F.AO. (1984)	EEZ—tunas		56,600		School Count		
				44,188		Mean catch rate! unit area		

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Table 19 *(Continued)*

Country	Author	Resources	Biomass/ standing stock (t)	Potential	Max.sust	Approach	Varieties	MSY
India	Jones and Bannerjee (1973) (East Coast shelf)	Demersals		143,000		Organic productivity		
		Pelagics		672,000				
	Nair *et al.* (1973) (E. Coast shelf)	Demersals & pelagics		600,000		Primary productivity		
	Joseph at *af.* (1976)	Demersals	372,000	186,000		Exploratory fishery— North-east half only. Swept area (Andhra Er Orissa)		
	George *et al.* (1977) (E. Coast shelf)	Demersals & pelagics		1.2-1.4 million		Primary productivity and density		
	Krishnamurthy (1976)	Demersats	419,000	209,000		Exploratory fishery, Andhra Er Orissa only		
	Antony Raja (1980) (E. Coast)	Pelagics			124,000	Catch and effort		
	Antony Raja (1974)	Demersals Er		926,000		Total for East coast; demersal and pelagic equal components.		
	Antony Raja (1980)	pelagics		103,900		Tertiary production trend		
	(Andaman Sea)			98,000				
	George (1977) (Andaman Sea)			160,000		Exploratory survey		
	Kumaran (1973) (Shelf-Andaman Sea)			2,700				
	Jones Er Bannerjee (1973) (Andaman Sea)	Demersals		4,000		Organic production and yield/unit area		
		Pelagics		8,000				
	Sudarshan (1978) (Nicobar only)	Demersals	45,000			Exploratory survey		

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	Anonymous (1976) (Gulf of Mannar)	Total fish	127-970,000			Acoustic survey
		Stolephorus only	55-804,000			Acoustic survey
	Williams (1981)			350,000		EEZ of Tamil Nadu
				406,800		EEZ of Andhra Pradesh
	Roy (1981)			120,000		EEZ of Orissa
Bangladesh	Tiews (1966)	Shrimp		3,400-5,700		Swept area
		Total demersals		120,000		
	Prasad *et al.* (1970)	Demersals only		98,000		Primary productivity
		Total fish		348,000		
	F.A.O. Survey (1971)	Demersals	264-373,000	175,000		Swept area
	Shomura (1969)	Total fish		175,000		Density/unit area
	F.A.O. (1972) (Continental shelf)	Demersals		120-150,000		(?)
		Pelagics		30-60,000		(?)
		Shrimp			4-5,000	Catch and effort
	B. West (1973)	Demersals	264-373,000	130,000 to 180,000		Swept area
		Shrimp		9,000		
	Karim (1978)	Pelagics	200,000			(?)
	Mohiuddin *at at.* (1980)	Demersals & pelagics	552,000			(?)
	Dr. Fridtjof Nansen Survey (1980)	Demersals		100,000		Acoustic survey
		Pelagics		100,000		
	George (1982)	Shrimp			2,500	Catch and effort (Up to 1981)
	Penn (1982)	Demersals			100,000 to 137,000	Catch and effort
		Pelagics			30,000 to 60,000	
		Shrimp	2,902 to 6,216	2,902 to 6,216 (av. 4165)		Catch and effort
	Anonymous (1982)	Demersals		57,000		(?)
Burma	Shornura (1969)	Demersals & pelagics		625,000		Density based

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Table 19 *(Continued)*

Country	Author	Resources	Biomass/ standing stock (t)	Potential ye	Max. sust. yie	Approach	Varieties	MSY
	Prasad *et al.* (1970)	Demersals Pelagics		326,000 400,000		Primary productivity		
	Based on Gulland's density estimate (1971)			150,000		Rakhine coast only		
	Jones and Bannerjee (1973)	Demersals Pelagics		326,000 400,000		Organic productivity		
	Dr. Fridtjof-Nansen Survey (1980)	Demersals Pelagics	750-80,000* 620-1,330,000*	200,000* 500,000		Acoustic method* and Swept area		
	Rijavec and Htun (1984)	Demersals	755-815,000 ±184to ±250,000	310-550,000		Swept area		
Thailand (West Coast)	hews (1966)	Demersals			56,000	(?)	*Rastreiiger* spp. (1969-1977)	31,926
							R. brachysoma (1983)	20,000
							R. Kanagurta	(?)
	Isarankura (1971)	Demersals			85,000	Catch and effort	*Rastreiiger* spp. (Standardised to Thai. P. seine up to (1980))	20,000
	Jones & Bannerjee (1973)	Demersals Pelagics		58,000 20,000		Organic productivity ..	Scads. (1976) (1983)	5,000 2,700
							Mullets (1976)	4,000
	Marr *et al.* (1976)	Demersals			150,000	Catch and effort	Others (1983)	4,000
							Plankton shrimp	7,800
							Large shrimp	10,000
	FAO/SCSP Workshop (1976)	Demersals			205,000	Catch and effort	Other shrimp	10,000
							Crabs	5,000
	Bhatia *et al.* (1979)	Cephelapods Shrimp			10,290 7,840	Catch and catch rates		

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Table 19 *(Continued)*

	Vibhasiri (1980)	Shrimp			14,191	Catch and effort		
	Aglen et. al (1981)	Pelagic	140,000			Acoustic survey		
		Demersal	70,000					
		Cephelapods			10,000	Commercial catch data		
	Bhatia *eta!.* (1983)	Total pelagics			65,000			
	Hayase (1983)	Demersals		120,000		Swept area		
Peninsular Malaysia (West-Coast)	Tiews (1966)	Demersals		39,053		Density based		
	Latiff *at at.* (1976)	Demersals-North		6,945		Swept area		
		Demersals-South		13,890		Swept area		
	Gulland's density estimate based (1971)			35,000		Density based		
	Pathansali (1976)	Demersals		55,000 to 58,000		Catch and effort	*FAO/SCSP Workshop* *Rastreiiger* spp. (1976)	25,000
		Pelagics		81,000			Anchovy	17,000
		Shrimps		35,000			Round scads	10,000
							Hardtails	10,000
	FAO/SCSP Workshop (1976)	Demersals		160,000		Catch and effort	Sardines	6,000
		Pelagics		88,000			S. tunas	5,000
		Shrimp		53,000			Kig mackerel	4,000
							Wolf herring	5,000
							Mullets	2,000
							Others	4,000
	Chang Er Pathansali (1977)						*Rastreiiger* spp. (1983)	21,000
		Demersals			23-24,000 Penang area	Catch and effort	*Decapterus* spp. (1983)	5,800
	Chang (1976)	Pelagics			90,000			
	Chee Ean (1979)	Anchovy			18-25,000			
	Dr. Fridtjof Nansen Survey (1980)	Demersals	34,000			Swept area, coastal and offshore.		
		Demersals	30,000			Acoustic method		
		Pelagics	300,000					
		Total	700,000					
	Buzeta (1981)	Demersals			58,000	Catch and effort		

Table 19 *(Continued)*

Country	Author	Resources	Biomass/ standing stock (t)	Potential yield (t)	Max. sust. yield (t)	Approach	Varieties	MSY
Indonesia (Sumatra)							*Rastrelliger* (1983)	17,691
							Decapterus spp.	2,700
	R. V. Mutiara IV Survey (1975) (Malacca Strait)	Demersals		123,172 133,345		Swept area		
	FAO/SCSP Workshop (1976) (Malacca Strait)	Demersals			70,000			
	Sujastani *et at.* (1976) (Malacca Strait)	Demersals	79,415	(Virgin biomass) 146,000		Swept area		
	Sujastani at *a!.* (1976) (Malacca Strait)	Demersals	126,000	58,000		De Lury method M = 1.0		
	(Malacca Strait)	Demersals			85,000	Catch and effort		
						40% coverage, hence MSY may be 120,000		
	Dr. Fridtjof Nansen Survey (1981)	Demersals	120,000			Acoustic survey		
		Pelagics	250,000			Acoustic method		
	Tampubolon (1983) (West Sumatra)	Demersals			5,070-7,250	Catch and effort		
	(West Coast of N. Sumatra)	Demersals			26,000	Catch and effort		
	(Malacca Strait)	Small Pelagics			126,500			
	(West Side)	Small Pelagics			12,406			
	(West Side)	Large Pelagics			7,120			
	Tampubolon and Sutedjo (1983) (Malacca Strait)	Shrimp			17,597 to 25,734	Catch and effort		
	(W. Sumatra)				630			
	(W. Coast of N. Sumatra)				1,506			
Entire Malacca Straits	FAO/SCSP Workshop (1976)	Demersals			318,000	Single estimates with pooled data Catch and effort		
		Pelagics			254,000			
	BOBP/P. 51 Working Group (1983)	*Rastrelliger* spp.			54,841			
		Decapterus spp.			9,724			

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of the mackerel fishery in the Malacca Straits, by Thailand and Malaysia and Indonesia, is a subject under study at present. The present level of shrimp production in this area is roughly in level with the MSY estimated during the FAO/SCSP Workshop (1976) but is very much higher than Pathansalis estimate (Table 19). Trawler landings of shrimp have decreased, compared to the gilinet and bagnet catches, which have increased, while trawler and gillnet landings of mackerels have increased more than that of the mackerel purse seiners. This coast of Malaysia has fully or over-exploited its major stocks in the exploited area and a rational increase in production from the exploited range is not evident, except perhaps from smaller stocks of other crustaceans and molluscs.

The Indonesian waters in the Malacca Straits are also a heavily fished area. The demersal production has exceeded the MSY estimates. The impact of the prohibition of trawling in this area on demersal stocks, is yet to be determined. However, in the case of shrimps, Tampubolon and Satedjo (1 983) estimated the MSY to be 17,597-25,734 **t** and though the catch in 1 980 was estimated at 19,540 **t**, the production in 1981 is given as 9,1 67 **t** due to the banning of trawling.

The production of demersals on the west coast of Sumatra has not reached the MSY estimated by Tampubolon (1983) and a 40% increase may be possible. The pelagics in the Malacca Straits area may permit another 20% increase over the 1980 production level of 97,294 **t.** Within the exploited range but on the west coast, the production in 1981 and 1982 was 19,500 **t** and 24,644 **t**, respectively, and exceeded the MSY of 19,526 **t** (Tampubolon 1983). This is applicable to both large and small pelagics in the present fishery. The migratory tunas on the west coast and north coast of Sumatra are not being fully exploited by Indonesia.

On the basis of various estimates of maximum sustainable and potential yield values for all the countries, a modest estimate of the potential yield from the continental shelf within the project area is about 2.9 million tonnes and the production level is already around 2.2 million tonnes! annum. If these figures are reasonably correct, the potential for further expansion of the fisheries on the shelf may not be substantial for heavy investment required for exploiting the unexploited portion of the continental shelf.

In the international zone within the project area, the tuna longline fishery is exploiting the yellowfin and bigeye tuna, billfishes, sharks and some skipjack tuna. The MSY for the two major species have been estimated at 39,000 **t** and 32,300 **t**, respectively (Lee and Yang, 1983), in the Indian Ocean. These had been surpassed in 1977 and 1975 respectively and were around 34,000 **t** and 30,000 t,respectively, in 1981. Relatively better hook rates were obtained in the project area in 1977 and 1978 but there was a significant increase in effort and decrease in hook rates in subsequent years for yellowfin and bigeye tunas. Unless there is a signifcant reduction in effort, the hook rates are not likely to show steady improvement and this may not encourage the coastal nations to enter or re-enter this fishery.

9. POTENTIAL IN THE UNEXPLOITED RANGES OF THE EEZs

Potential marine resources in the unexploited ranges in the EEZs of the project area have been identified baskally as deep sea fish, shrimp and lobster, myctophids and components of mackerel and tuna stocks extending beyond the range of the exploited components. These have been identified by occasional surveys in most countries with foreign assistance, and through systematic surveys around India, carried out by the Fisheries Survey of India. Unfortunately, the deep sea demersals and mesopelagics are not valuable species and hence the viability of their exploitation will depend on the utilization of such species. Even the deep sea lobsters and shrimps have large ‘heads’ and relatively small ‘tails’ and hence there will be heavy loss in weight on removing the exoskeleton and the head.

In the inter-atoll channels in the Maldive islands at 250-350 m depth, a mean catch of 260 kg/hr was obtained by 'Dr. Fridtjof Nansen' during the survey in 1983. Shrimps were caught at a mean rate of 12.5 kg/hr and the rest were fish *species—Priancanthus arenatus, Peristedion adeni, Synagrops* spp., *Cubiceps* spp., *Ch/orophthalmus* spp., and *Myctophidae.* A biomass of 3,000 t of shrimp and 60,000 t of fish was estimated for a channel area of 3,600 N.m^2, south of Male. In the north, adjacent to the An atoll, 24 kg/hr of deep sea lobsters were caught in an area of 220 N.m^2, which gives a biomass of about 180 t. The occurrence of deep-swimming large tunas and surface swimming tunas, in ranges beyond 25 miles, is known. A modest increase of about 10,000 t of skipjack and juvenile yellowfin was estimated for the range up to 60 miles from shore (Table 19) in the absence of a proper survey around Maldives. However, it may be stated that an increase in prcduction of tunas can be achieved through an expansion of the surface fishery and introduction of medium-scale longline fishery in the unexploited range of the Maldives EEZ.

Whether pole-and-line fishery could be extended into this range is uncertain in view of the limited live bait availability and the specialised nature of long range pole-and-line crafts. With the relaxation of regulations controlling net fishing in the country, driftnetting may be a convenient method that can be operated without specialised deck arrangements and equipment and would be effective even when schools are not observed.

Around Sri Lanka, the demersal fishery may be extended up to about 80 m depth for valuable carangids, grunts and serranids, but the catch rates in relation to the size of trawlers required may become an economic constraint. Even vertical longlining in depths up to 100 m in the north-east coast may yield up to 117 kg/100 hooks. Beyond the shelf, particularly in the 200 to 350 m depths on the north-west and north-east coasts, trawl catches of 3700 kg/hr and 1220 kg/hr, respectively, of deep sea fish, shrimps and lobsters can be realised (80-90% fish: 3-7% lobsters• and '1-5% shrimp).

A spiny shark caught in the 200-400 m depth range, has become economically valuable because of its highly valued liver oil. Though a bottom longline fishery is developing rapidly around Sri Lanka, the potential yield from this resource is not known.

Again, the economic viability of exploiting these species must be considered. Considering the estimated tuna potential in the EEZ (Table 19) and the present tuna yield level, it appears that the estimated potential of 29,000 tin the oceanic and offshore ranges (Sivasubramaniam 1977) may be a reasonable value. However, economic viability should be established through experimental fishing with driftnets, longlines and other methods.

Sri Lanka conducted experimental tuna longlining operations in the project area. The results are given in Table 20. The average catch was just under 1 ton/operation during both cruises. The catch rate of billfish was much higher in the higher latitudes than in the lower while those of tunas and sharks declined, The catch in numbers was not available for calculating the hook rates. The operational cost of the two cruises was Rs. 700,000 but the revenue was Rs. 626,144—a loss of Rs. 74,000 over a two-month period.

Extensive trawl operations beyond the 50 m isobath on the east coast of India have provided information on the resources available in deep waters. Off the Andhra coast, 88-1230 kg/hr of pomfrets were caught and one haul contained 5 t. In the lower east coast, cephelapods, perches and threadfin breams were the main catches in the depth range of 50-125 m. Beyond 150 m and upto 400 m, deep sea lobsters and shrimp were found. Potentially rich grounds have been identified for *Pr/acanthus* spp. (bulls eye) off West Bengal and Orissa, Andhra and Tamil Nadu with catch rates between 150 and 309 kg/hr in the 100-180 m depth range.

Psenesindicus (Indian drift fish) isanotherfish species in thedeepwaters and yieldsanaverage of 62-70 kg/hr and 400 kg/hr at 120-220 m, in the lower east coast. In the upper east coast, the abundance of this species is more in the shallow waters and contributed 25.6% of the overall catch. Giant cuttlefish and deep sea arrow squid *(Loilgo* spp.) have also been located at 300-310 m, yielding 25 kg/hr (3-5 pieces/kg). An average catch rate of 8 kg/hr of deep sea lobsters and shrimps *(Aristeus* spp. and *Puerulus* spp.) and 5 kg/hr of pink deep sea prawns

Table 20

Results of the tuna longline fishing trials conducted by Sri Lanka (1982-83)

Area	Season	No. of operations	No. of hooks		Catch (kg)					
					Yellowfin	Bigeye	Billfish	Shark	Others	Total
1°—5°N	9/7/82	19	23750	Catch	8301.6	922.4	2048	6436	790	18478
77°—83°E	to 4/8/82			Catch/operation	436.9	48.5	107.7	338.7	41.5	973
				%	44.8	4.8	11.2	34.8	4.3	—
5°-8° N	5/4/83	23	35650	Catch	4865.4	540.6	8518	6570	552	21046.5
79°—83°E	to 4/5/83			Catch/operation	211.5	23.5	370.3	285.6	24.0	915
				%	23.1	2.5	40.4	31.3	2.6	—

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(Sol2nocera hextii) were observed in the 200-300 m depth range. Trawling in deep waters also seems to produce significant quantities of pelagic species. Trawling at the 40-80 m depth range produced 551 .2 kg/hr with '10% Indian mackerel. A higher average of mackerels, 173.6 kg/hr, was obtained in 40-60 m depth, similar to the pomfrets. Horse mackerels are present at 40-200 m but a good yield of 1083 kg/hr in 80-100 m depth and 800 kg/hr in 100-1 20 m depth, were obtained. Of the overall catch during north-east monsoon, 16% was horse mackerel. An average catch of 160 kg/hr of sardines caught by trawling at 40-110 m off Andhra Predesh, is noteworthy and it is equally significant that purse seining at the same time and at the same location, could not catch or chserve large surface schools. Commerciallyexp!oita ble quantities of barracudas *(S. obtusata)* were also found in the1 00-200 ni depth rrnge in the Gulf of Manrar, with an average catch rate of 92 kg/hr and the highest catch rate of 1 350 kg/hr. Barracudas formed 22% of the total catch during the survey. Purse seining trials in the deep sea areas on the east coast were not very successful. Tuna longlining trials were conducted south-west of Irdia, and west of Maldives from April to December 1983 and on the east coast of India from January to April 1984.

The composition of the catches was similar to the commercial catches from these areas but the mean hook rates were particularly low for the bigeye tuna close to the equatorial region west of Maldives, and those of the yellowfiri tuna were close to the expected values in the east coast and west of Maldives, in comparison to the prevailing trends in the commercial tuna fishery in these areas (Table 20a).

Table 20a

Experimental tuna longlining around India (1983-84)

Species	West of Maldives	Hook rates (%)	
		South-west	South-east
Bigeye	0.16	0.96	0.0
Yellowfin	1.14	0.96	0.05
Skipjack	0.03	0.20	—
Marlins	0.06	0.25	0.07
Sailfish	0.05	0.20	0.08
Swordfish	0.01	0.07	—
Pelagic sharks	0.09	0.47	2.38
Others	6.02	0.04	0.03

Source—Nair and Joseph (1984).

George *eta!.* (1977) estimated a potential yield of 240,000 t of tunas from the EEZs of India (NW. coast1 0,000 t, SW. coast 60,000 t, lower east coast 10,000 t, upper east coast 10,000 t, Lacccdives 50,000 t and Andamans 100,000 t). This appears to be a rather high estimate in light of the production trends in the Indian ocean. However, even if 50% of this is exploitable, it will be a major component for future development.

In the EEZ of Bangladesh, there is little evidence of great potential in the unexploited area. Analysis of the 'Dr. Fridtjof Nansen' survey data for trawl catch rates in 30' × 30' grids, for the two seasons covered (Figure 5) indicates that the possibilities of extending the demersal fishery beyond the 80 m depth are not encouraging. However, it is noted that a high percentage of mackerels enter the demersal catches in the 50-70 m depth and contribute to the significant seasonal differences in the catch rates, probably due to the migration of the pelagic component of the catch.

Such a fishery may contribute to the increase in production of pelagics and to an even distribution of the trawling effort which at present is more concentrated in areas where shrimps are also concentrated. Pelagic gillnetting in the offshore areas also has to be experimented with, in view of the encouraging evidence obtained from gi!Inetting during the Bangladesh-Thailand joint expedition in the late 70s. Myctophids seeni to be the dominant pelagic stock beyond the 1 50 m depth range.

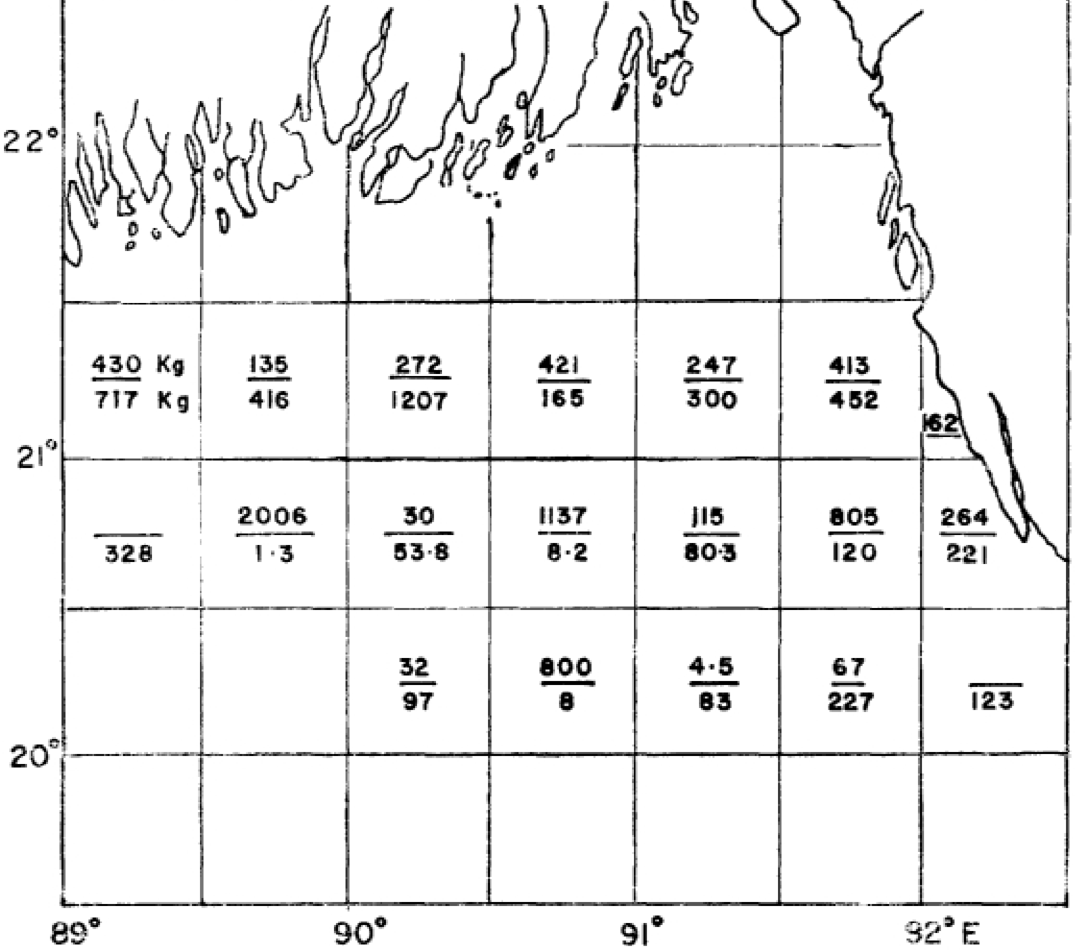

Fig. 5. 'Dr. Fridtjof Nansen'-Bottom trawl catch per hour during October/November 1979 (Numerator) and May 1980 (Denominator) in 30' X 30' Grids within the EEZ of Bangladesh.

Tunas are bound to occur in the peripheral part of the EEZ, in view of the operation of tuna longliners up to 15°-20°N. In fact, 78,612 hooks had been set by distant nations fishing within the EEZ of Bangladesh in 1977 and a total of 60,391 number of yellowfin, bill-fishes and bigeye tuna were caught (Klawe 1980). The hook rates in 1970 were: yellowfin 1.09, bigeye 0.01 and billfishes 1.3 (Sivasubramaniam 1975). Exploratory fishing may be useful for determining the feasibility of tuna fishing.

Off Burma, trawling in the 90-100 m depth range has been shown to yield 259 kg/hr. but this declines steeply at greater depths. Average trawl catch rates appear to be relatively high in the 10-70 m depth range. According to Rijavec and Htun (1984) *Nemipterus japonicus, Lutjanus sanguineus,* and *Ar/us cae!atus* are the predominant species in the 51-100 m depth range but *Pr/acanthus macracanthus* and *Peristedion weberi were* most significant in the 100-150 m depth, though *N. japonicus* was the most frequently occurring species. At greater depths (151-350 m) *Peristedion weberi* and *Puerulus sewe/li* were noticeably significant. It is also noted that *Decapterus maruadsi* and *D. macrosoma* contributed nearly 20% of the trawl survey catches in the 101-150 m depth range on the Rakhine coast but their percentage contribution was found to be less and in lesser depths (50-100 m), off the Delta and Tenasserim coasts. The demersal fishery (trawl fishery) could be extended beyond the present limits if feasibility exists for other non-popular varieties which may be absorbed by the presently starved market for fish sauce and fish meal. Though experimental purse seining was not successful, after the 'Dr. Fridtjof Nansen' survey, it has been reported that the existing purse seine fishery could be improved considerably by making changes in the design and construction of that gear. Tuna longline operations had been carried out within the EEZ of Burma up to the early 70s but not recently. A hook rate of 0.5/100 hooks was obtained for yellowfin tuna. The present status is unknown and the possibility of exploiting the tuna resource has to be investigated.

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Thailand exploits a little over 50% of its EEZ on the west coast. Its fleet of trawlers and purse seiners is so well developed, or even over-developed, that it is forced to seek joint ventures with neighbouring countries and fish outside the EEZ. The viability of expanding the existing fisheries into the peripheral area of the EEZ is unknown. Survey and experimental pole-and-line fishing in the offshore range showed a potential for expansion of the surface fishery for tunas. An average of 468 kg/fishing day was realised and the average catch per school was 195 kg but the average number of schools sighted was 12/day which is encouraging. The catch composition was 84.2% longtail tuna *(T. tonggoi)* 11 .9% skipjack tuna, 3.2% little tuna, 0.5% frigate tuna *(Auxis* spp.) and only 0.1% of yellowfin tuna. This indicates that longtail tuna is the predominant species (Lee, 1982) in the area. The pole-and-line method is unfamiliar to the fishermen on the coast and they have not shown interest in this method of fishing. Alternative methods, such as expansion of the purse seine fishery to cover their range or driftnet fishery, may have to be experimented with. Thailand is also preparing to carry out tuna longline trials on this coast.

The west coast of Peninsular Malaysia has a limited EEZ area which is being reasonably well covered. Perhaps, the expansion of the trawl fishery into the deeper end of its EEZ may become inevitable in the future.

The 'Dr. Fridtjof Nansen' survey irt 1 980 observed 395 kg/hr of trawling at 90 m depth, in the northern part, mainly for threadfin breams *(Nemipterus* spp.) and bulls eye *(Pr/acanthus* spp.). The total standing stock of 700,000t indicates limited potential for further expansion. Malaysia has not shown interest in the tunas because of the limited entry of this species into the Malacca Straits. However, tunas are incidental catches of mackerel purse seiners. The EEZ does not provide encouragement for tuna longlining.

Indonesia has a limited EEZ area in the Malacca Straits which had been reasonably well covered until 1 980. The withdrawal of the trawlers has reduced demersal exploitation in the offshore range. Until the impact of this action is evaluated, it may be difficult to consider possible expansion of the production from this side. The west coast of Sumatra is relatively less productive in the inshore range and the offshore range may be favourable for expanding the pelagic fishery. The availability of skipjack tuna resources and deep-swimming larger tunas has been well established. Determining viable means of exploitation is the major step to be taken. The tuna longline fleet which was based in Sabang was not found to be viable. However, smaller scale operations involving smaller crafts may be experimented with. The northern area of Sumatra is developing fast as a purse seining fleet base. Mackerel and tuna purse seiners operating from Banda Aceh are fishing rather inshore. Expansion into deeper areas should yield better results with skipjack, yellowfin and eastern little tunas.

10. MANAGEMENT OF MARINE FISHERY RESOURCES IN THE REGION

Some management measures have been proposed, legislated or enforced in the participating countries but these are far from being complete in covering the major resources of any one of the nations involved. Management of marine resources is a difficult task even at the national level; at the multi-national or regional level it is even more so. It is, nonetheless, necessary.

The basic factors affecting the determination and application of management measures are:

(1) Lack of information required for identification or determination of measures—biological and economic;

(2) Poor linkage between research and statistical units or institutions in the respective countries;

(3) Insufficient coordination with other agencies or controlling bodies;

(4) Difficulties in enforcing such measures because of powers and influences beyond the control of management officers.

The lack of proper fisheries statistics in relevant areas is the primary factor affecting the identification or determination of management measures. Systems to collect statistics are generally inadequate in the various countries around the Bay of Bengal. None of these countries is in a position to claim satisfaction, though some countries are relatively better placed than the others, in this respect. Improvements may be achieved in the cases of Maldives, Sri Lanka, India, Thailand, Malaysia and Indonesia but the introduction of proper statistical systems is required in the cases of Bangladesh and Burma. The degree of improvement required, increases from Thailand and Malaysia to India, Maldives, Sumatra (Indonesia) and Sri Lanka. Linkage between research and statistical units is known to exist in India and Malaysia. Marine research units are in the process of being established in Maldives, Bangladesh and Burma. In other countries, there appears to be a one-way flow of information from the statistics unit to the research unit, mainly because of insufficient coverage by research units, compared to the statistics units of such countries. Most of the participating countries are starved of biological information from the project area, which is vital to the assessment of the resources and derivation of parameters for regulatory measures.

Coordination between the fisheries development authority and the licensing authority may be smooth if both authorities are under a single Ministry. In Bangladesh, the licensing of fishing crafts and vessels is controlled by the Industries Ministry while fisheries development is under the Ministry of Fisheries and Livestock. In Burma, licensing of crafts is with the Inland Revenue and not with the Ministry of Livestock Breeding and Fisheries.

Enforcement of management measures is made difficult by the non-cooperative attitude of the fishermen, socio-political reasons, practical difficulties in inspection, limited power vested in the enforcing officers and heavy costs of implementing, inspecting and taking legal action against errant fishermen.

In the Maldives, traditionally, net fishing was never encouraged except for live bait collection. However, in May 1984, the Government of the Republic relaxed this regulation and net fishing such as driftnetting is expected to commence soon. Harpooning or spear gun fishing and dynamiting are prohibited within the atolls. Every fisherman is expected to submit catch particulars to each island Chief and certify the record sent to the Ministry of Fisheries. There is also a regulation controlling the species of ornamental fish that can be caught and exported. In Sri Lanka, dynamiting and the capture of endangered species such as dugong and leathery turtle are prohibited. Lobster fishing in the inshore waters off Colombo area and selling berried lobsters, or lobsters less than 8 cm in carapace length or 11.5 cm in 'tail length', are prohibited.

There is also a minimum size regulation for chanks to be collected. In addition, the National Environmental Act (1980), the Coast Conservation Act (1981) and the NARA Act (1981) contain legislation for conservation, preservation and management of Sri Lanka's marine and coastal resources, on a broad basis.

In India, various measures are under consideration—number of vessels, mesh size, catch limits and closed season. One step enacted is that the first 10 km from shore is reserved for traditional and non-mechanized fishing crafts; 10-23 km for mechanized vessels and beyond 23 km for large shrimp trawlers and deep-seas vessels.

In Bangladesh, recommendations made were (Anon., 1972) that the number of trawlers should not exceed 40, shrimp trawlers in operation and those for which licences have been issued or funds disbursed, may be allowed to complete and operate but further import/construction of shrimp trawlers should be stopped and up to 20 finfish trawlers may be allowed to be imported or constructed locally under a pay-as-you-earn system, provided viability is established and it is guaranteed that they will not do shrimp trawling. The import of second hand trawlers should not be allowed anymore; a committee should be established to inspect unauthorised shrimping by non-shrimping trawlers and trawlers should be standardised as to hull, engine, endurance, efficiency, etc. Recommendations have also been made for mesh size control—shrimp trawls 45 mm, fish trawls 60mm in the cod-ends; small-mesh gillnets 100 mm, large-mesh gilinets 200 mm and set bagnets 30 mm, stretched mesh.

This is expected to be implemented soon. Export of shrimps with counts of 71 -90 and below for marine varieties and 61 -70 for fresh water varieties, is banned.

In Thailand, the minimum mesh size permitted for block nets, bambco screens and block-traps is 2 cm and that for lamp luring liftnet is 3.2 cm. Dynamiting and use of chemicals, fishing by electricity, fishing and exporting corals, sponge collection, catching of turtles, collecting turtle eggs without licence and capturing dugong are prohibited. Trawling within 3 km from shore is also prohibited. Production of large quantities of juvenile chub mackerels by purse seiners is destructive and control through closed area and season is being tried out. Preparations are underway to introduce a closed season from 15 April to 15 June in the area from Phuket to Krabi province, for purse seines other than those with 4-7 cm mesh size.

In the west coast of Malaysia, beam-trawls, paired trawls and collection of cookies by mechanical means are prohibited. The minimum permitted mesh size for trawl cod-ends is 1½'' (38 mm). Intensive fishing and excess of fishing units are their main problem. The licensing policy has been formulated with a strategy to allocate fishing zones as follows:

(1) <5 miles for owner-operated traditional gears;

(2) 5-1 2 miles for owner-operated trawlers and purse seiners (40 Gr. T);

(3) 12-30 miles for owner-operated trawlers and purse seiners (> 40 Gr. T);

(4) > 30 miles—EEZ boundary for joint ventures, charters and other gears.

Studies have shown that there is a need for controlling the licenses issued for operating anchovy purse seines. 'Increased trawl fishermen will have negative impact on income and affect implementation of management policies with the exclusion of small boats from trawling industry. The requirement is, therefore, for the removal of fishermen from west coast by encouraging vessels to fish on the east coast. Savings generated from not investing in new boats in the east coast could then be diverted to upgrade the standard of living of fishermen on both coasts, through settlement schemes or by the creation of other productive employment opportunity' (Chang Ling Yap, 1970).

In Indonesia, the most significant management measure enforced is the ban on trawling in the EEZ of that country, except near West Irian, in 1 980. A few years have passed and the impact study is anxiously awaited. It has also been recommended that purse seine nets for chub mackerel should not be permitted to use a mesh size less than 50 mm in the wings and 25 mm in the bunt. It has also been suggested that all nets with mesh sizes less than 25 mm should be prohibited and that the skipjack tuna purse seine should have a mesh size of not less than 60 mm. It appears that there are regulations enacted by the Ministry of Agriculture in 1976, concerning fishing belts and boat-building regulations for fishing ground appointment applicable to boats being built, in order to control the distribution of boats by area and according to the resource situation.

All participating countries in the project area have jointly agreed that there are marine resources that are probably being shared by two or more countries and have identified the following resource areas for further investigation, and for joint assessment with the help of the 'Marine Fishery Resources Management Project' (RAS/81/051). They have also agreed to consider joint management measures, if found necessary.

(1) Tunas in the western part of the project area—Maldives and Sri Lanka;

(2) Hilsa in the Upper Bay of Bengal—Bangladesh (inclusion of Burma and India would be desirable)

(3) Mackerels (chub and scad) in the Malacca Straits—Indonesia (Sumatra), Malaysia and Thailand (inclusion of Burma desirable);

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(4) Demersals (finfish and shrimps) in the southern half of the Malacca Straits—Indonesia and Malaysia;

(5) Tunas in the Andaman Sea area—Indonesia and Thailand.

The sequence of action for the above, as recommended by the project, is presented in Appendix I.

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SEQUENCE OF ACTION FOR MARINE FISHERY RESOURCES MANAGEMENT IN THE REGION

I	*Data collection*	Scientific activity at national level. Responsibility of member countries.
II	*Compilation and redistribution of data among member countries directly concerned*	Scientific activity. Responsibility of identified groups/sub-groups involved on the joint study of particular shared stock. Participation of interested non-coastal or non-member states sharing the particular resource should be considered.
III	*Analyses of data*	Scientific activity. To be carried out independently or jointly (in the case of shared stocks) by groups or sub-groups mentioned above.
IV	*Workshop/Seminar*	To discuss the progress at Stage III, which will primarily concern distribution and migratory patterns, to identify characteristics of stocks and to ascertain the shared stocks. Scientists directly concerned will participate.
V	*Assessment of the status of stocks and current levels of fishing*	Scientific activity. Responsibility of groups or sub-groups concerned. To determine the degrees of sharing, levels of exploitation by member countries.
VI	*Workshop*	Scientific activity—to discuss the results from Stage V.
VII	*Planning fisheries*	Scientific activity—individually and jointly by fisheries research institutions in the member countries. On aspects and areas identified frcm above stages. May primarily concern under-utilized and un-utilized resources in EEZs.
VIII	*Planning for development and management*	Scientific and administrative (policy-makers) action at national level. Combination of biological, economic and social factors influencing the respective countries.
IX	*Negotiations on shared stocks*	Administrative activity at regional or sub-regional levels, including agreements on objectives and search for common fishing rates.
X	*Formulation of development plans*	Administrative activity at national and sub-regional levels, depending on the nature of the stocks involved—shared, not shared.
XI	*Implementation of regulations and surveillance*	Administrative activity at national, sub-regional and regional levels.

Actions VIII to XI will be the responsibilities of national, sub-regional and regional committees which will function on a continuing basis.

Publications of the Bay of Bengal Programme (BOBP)

The BOBP brings out six types of publications:

Reports (BOBP!REPJ....) describe and analyze completed activities such as seminars, annual meetings of BOBP's Advisory Committee, and projects in member-countries for which BOBP inputs have ended.

Working Papers (BOBP/WP/....) are progress reports of ongoing BOBP work.

Miscellaneous Papeïs (BOBP/MIS/) concern work not originated by BOBP staff or consultants—but which is relevant to the Programme's objectives.

.J'Iewsleflers (Bay of Bengal News), issued quarterly, contain illustrated articks and features in non-technical style on BOB? work and related subjects.

Information Documents (BOBP/INF. . ..) are bibliographies and descriptive documents on the fisheries of member-countries in the region.

Manuals and Guides (BOBPIMAG/.. .) are instructional documents for specific audiences.

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