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a synoptic survey with comments on potential resources

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EXPLOITED MARINE FISHERY RESOURCES OF INDIA: A SYNOPTIC SURVEY, WITH COMMENTS ON POTENTIAL RESOURCES

Abstract

The present status of the exploited marine fishery resources of India, based on available data, is reviewed here. Details of the estimates of catch by mechanised and non-mechanised boats as well as effort and catch per unit effort have been analysed year-wise (1962-1974) for the maritime States. Attention is also drawn to some of our potential marine fishery resources and to the new fishing grounds which have been investigated in the recent past.

There is an urgent need for planned exploration of new grounds; identification of new resources; exploitation of non-conventional resources; diversification of fishing, particularly fishing by mechanised crafts which are now almost exclusively engaged in trawling for prawns; the introduction of new and better techniques for capture fisheries; utilization of diverse resources; and the development of proper infrastructure facilities in the Marine Fisheries Sector. The needs and possibilities are discussed here.

Introduction

India has a coastline of about 5,650 km with nearly 2,000 fishing villages along the coast (CMFRI, 1975). The marine fish caught from the inshore waters by indigenous as well as langer mechanised vessels are landed during almost all hours of the day and often at night round the year at about 1,300 landing centres (CMFRI, 1972). The Central Marine Fisheries Research Institute is the only organisation estimating the total marine fish production for the country as a whole on the basis of a sampling design involving space-time stratification (Banerji, 1968). The annual marine fish production in India for 1973 and 1974 have been estimated at 1.220 and 1.218 million tonnes respectively. The provisional estimate for 1975 is 1.32 million tonnes.

The need for an overall presentation of the present status of the exploited marine fishery resources of the country has been keenly felt. In the accompanying maps, figures and Tables, some of the salient features of our exploited marine fishery resources are given in order to highlight the trends in fish production, both total and season-wise for the States and the country as a whole, productive areas, and the dominant species or groups occurring in the catch, effort expended and catch per unit effort.

All India Marine Fish Production

For the thirteen-year period 1962 - 1974, the maximum, minimum and average marine fish production for the country as a whole were 1,220,240 tonnes (1973), 644,244 tonnes (1962) and 950,427 tonnes respectively.

Figure 1 depicts the annual landings of both pelagic and demersal fishes along the Indian Coasts for the period 1962 — 1974. Most of the fishing at present is confined to the near-shore waters upto about 50 m depth. In the figures the 75 and 182-m (100 fathom) depth contours are shown, the latter indicating the edge of the continental shelf. Along the southwest coast of India, fishing has been extended to grounds beyond 75 m to about 450 m along the upper continental slope for perches, deep-water lobsters, prawns and fishes (Suseelan and Mohamed, 1968; Silas, 1969; Mohamed and Suseelan, 1973). The explored areas of the continental shelf edge and the upper continental slope are also shown in Fig. 1, especially to stress the need for further exploration of the fishery resources of the shelf edge and the upper continental slope along the remaining parts of the Indian seas. The total marine fish production in India for the thirteen year period 1962 - 1974 is grouped under two major categories - Pelagic and Demer-

TABLE 1. *Details of State-wise marine fish catch*

Maritime States	Coast line (Km)	Rank in Fishing	Marine Fish yield during the period 1962-1974 (in Tonnes)			Dominant fishery	Pelagic(P) and Demersal(D)				Percentage in total All India catch	Major fishing season (Quarter)	Major composition of fishes
			Maximum (year)	Minimum (year)	Average			Maximum (year)	Minimum (year)	Average			
West Bengal & Orissa	680	8	31,403 (1970)	8,387 (1962)	18,380	Pelagic	P :	21,190 (1970)	3,803 (1962)	9,850	2.0	IV	PELAGIC: *Harpodon* sp., Sardines and other Clupeids.
							D :	16,392 (1968)	4,157 (1966)	8,530			DEMERSAL: Prawns, Scianeids and *Saurida* sp.
Andhra Pradesh	970	5	158,818 (1974)	60,521 (1962)	83,542	Pelagic	P :	86,805 (1974)	32,479 (1963)	47,640	8.8	I	PELAGIC: Ribbon fishes, Seer fishes, Sardines and other Clupeids.
							D :	72,013 (1974)	22,294 (1966)	35,902			DEMERSAL: Elasmobranchs, Cat fishes, Scianeids, *Leiognathus* sp., *Gazza* and Perches.
Tamil Nadu	960	3	191,101 (1973)	106,029 (1965)	151,349	Pelagic	P :	100,158 (1973)	57,797 (1965)	77,221	15.9	I	PELAGIC: Ribbon fishes, Sardines and Carangids.
							D :	107,585 (1974)	46,270 (1963)	74,128			DEMERSAL: Elasmobranchs, *Leiognathus* sp., *Gazza*, Perches, Scianeids, Cat fishes, Prawns and other Crustaceans.
Kerala	560	1	448,269 (1973)	192,470 (1962)	338,938	Pelagic	P :	355,008 (1971)	121,162 (1962)	247,093	35.7	IV	PELAGIC: Oil sardines, Mackerel, other Sardines, Carangids and Ribbon fishes.
							D :	194,018 (1974)	49,160 (1965)	91,844			DEMERSAL: Prawns, Soles, Cat fishes and Elasmobranchs.
Karnataka	270	6	116,936 (1970)	39,176 (1963)	78,186	Pelagic	P :	98,847 (1964)	28,638 (1962)	61,846	8.25	IV	PELAGIC: Oil sardine, Mackerel, Seer fishes and Carangids.
							D :	32,869 (1974)	5,371 (1964)	16,347			DEMERSAL: Elasmobranchs, Prawns and Cat fishes.
Goa *	110	7	39,980 (1971)	12,460 (1967)	22,679	Pelagic	P :	38,976 (1971)	8,932 (1967)	19,445	2.4	IV	PELAGIC: Mackerel and Sardines.
							D :	6,692 (1965)	1,004 (1971)	3,234			DEMERSAL: Elasmobranchs, *Leiognathus* sp., and *Gazza*.
Maharashtra	600	2	226,696 (1973)	123,916 (1968)	162,666	Demersal	P :	87,044 (1973)	48,531 (1963)	62,498	17.1	IV	PELAGIC: *Harpodon* sp., Mackerel, other Clupeids, Ribbon fishes and *Bregmaceros*.
							D :	153,883 (1972)	74,907 (1968)	100,168			DEMERSAL: *Saurida* sp., Prawns, Scianeids, Cat fishes, Perches, Pomfrets and Elasmobranchs.
Gujarat	1,500	4	145,309 (1974)	75,633 (1967)	93,265	Pelagic	P :	75,804 (1963)	46,820 (1973)	61,011	9.8	IV	PELAGIC: *Harpodon* sp., and other Clupeids.
							D :	82,207 (1974)	16,607 (1967)	32,254			DEMERSAL: *Saurida* sp., Pomfrets, Elasmobranchs, Cat fishes, Prawns and Scianeids.
Lakshadweep	—	9	2,232 (1974)	79 (1964)	976	Pelagic		—	—	—	—	IV	PELAGIC: Tunas.
Andamans	—	10	920 (1974)	148 (1964)	446	—		—	—	—	—	IV	PELAGIC: Anchovies. DEMERSAL: Perches.
All India	5,650	—	1,220,240 (1973)	644,244 (1962)	950,427	Pelagic	P :	760,397 (1971)	365,736 (1962)	583,126	100	IV	PELAGIC: Sardines, Mackerel, Bombay duck, Anchovies and other Clupeids.
							D :	621,804 (1974)	240,646 (1965)	362,074			DEMERSAL: Prawns, Elasmobranchs, Cat fishes, Scianeids and Silver bellies.

* Data available from 1965 to 1974.

sal (Fig. 1). The major groups or species of the pelagic fish along the Indian Coasts consist of the oil sardine, lesser sardines, *Chirocentrus* spp., *Hilsa* spp., *Anchoviella* spp., *Thrissocles* spp., other clupeids, Bombay duck, half beaks, gar fishes, flying fishes, ribbon fishes, carangids, mackerel, seer fishes, tunnies, *Sphyraena* spp., *Mugil* spp., and *Bregmaceros* sp. Demersal fishes considered here comprise elasmobranchs, eels, cat fishes, perches, lizard fishes, red mullets, polynemids, sciaenids, silver bellies, *Lactarius* sp., pomfrets, soles, prawns, other crustaceans and cephalopods other than squids. In Lakshadweep, the bulk of the catch consists of tunas, particularly the skipjack. Perches and anchovies form the major fishery in the Andaman Islands. Shell-fishes such as clams and mussels which amount to a few thousand metric tonnes and which form sustenance fishery in some areas are not included here due to absence of proper resources data.

Percentage of catch : State-wise

The annual estimates of variety-wise marine fish production shown in Fig. 1, are based on regular observations carried out by the Institute from landing centres in 55 zones along the coast. The data are analysed State-wise and season-wise (Fig. 2). It will be seen that among the maritime States Kerala ranks first in the total marine fish production in the country (35.7%) followed by Maharashtra (17.1%), Tamil Nadu including Pondicherry (15.9%), Gujarat (9.8%), Andhra Pradesh (8.8%), Karnataka (8.2%), Goa (2.4%), and West Bengal & Orissa (2.0%). The Union Territories of Andamans and Lakshadweep contribute less than 0.1 per cent. The percentages given here are based on the average annual catch for 13 years (1962-1974) except for Goa for which the average for 1965-1974 has been taken.

SEASONAL VARIATION IN CATCH STATE-WISE

The seasonal variation in catch for the different areas during the four quarters of the year throws light on the seasons of better fishing for different areas (Fig. 2). The average catch data for the period 1962-1974 indicate that the best fishing season for the country as a whole is during the fourth quarter *viz.*, October to December, when all the maritime States of the west coast of India record higher landings. For Maharashtra and Gujarat the period July to September (3rd Quarter) and for Kerala and Karnataka the period April to June (2nd Quarter) are relatively poor. On the east coast, conditions vary from State to State. In West Bengal and Orissa, the peak fishing period is during October to December (4th Quarter) while in Andhra Pradesh and Tamil Nadu it is from January to March (1st Quarter). Fishing is relatively poor in these two States during the period April to June (2nd Quarter).

The State-wise details regarding the maximum, minimum and average yield, the major constituents forming the fishery, and the fishing season are indicated in Table 1.

VARIETY-WISE ABUNDANCE

The State-wise distribution of important varieties of fishes (average for 1962-1974) (Fig. 2) shows that the bulk of the oil sardine and mackerel catches are from along the coasts of Kerala and Karnataka [161,613 and 30,111 tonnes of oil sardine and 27,065 and 21,915 tonnes of mackerel respectively (Fig. 6)]. The highest catches of Bombay duck are recorded along Maharashtra and Gujarat Coasts, each contributing 27,777 and 45,701 tonnes respectively (Fig. 7).

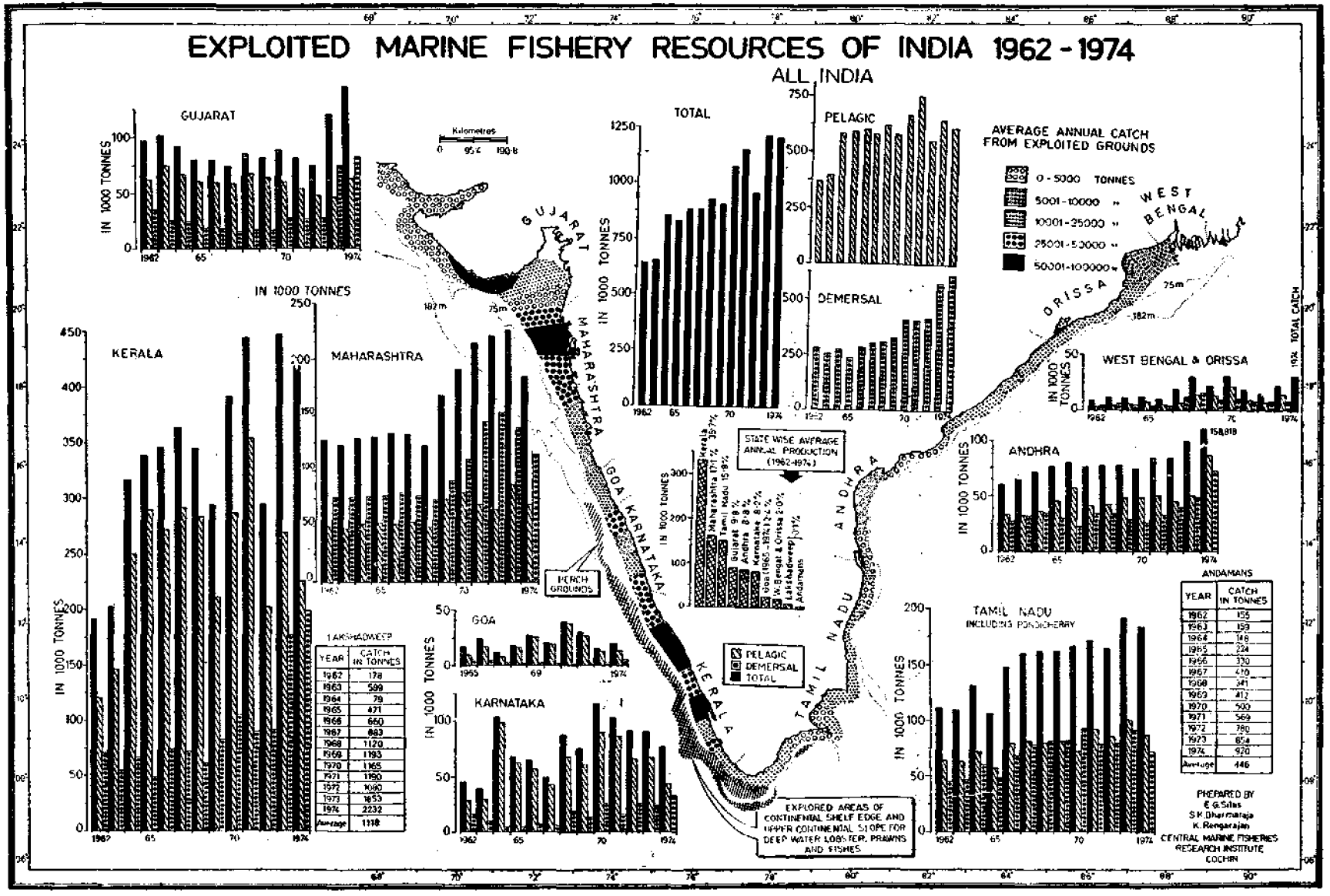
Prawns are caught in all the maritime States of India, and landings (average for 1962-1974) in the order of abundance in the different States are shown below:

State	Average (1962-1974) Prawn catch in tonnes (Average of last five years - 1970 to 1974 in parenthesis)		
	Total	Penaeids	Non-penaeids
Maharashtra	57,348 (80,060)	13,912 (19,961)	43,436 (60,099)
Kerala	36,114 (50,659)	35,744 (49,811)	370 (848)
Andhra Pradesh	6,479 (8,643)	5,430 (7,419)	1,049 (1,224)
Tamil Nadu (including Pondicherry)	5,368 (5,770)	5,075 (5,351)	293 (419)
Gujarat	3,944 (4,607)	3,352 (4,302)	592 (305)
Karnataka	4,475 (8,192)	4,473 (8,188)	2 (4)

TABLE 2. *State-wise effort in* 1000 *man-hours and catch per unit effort (in parenthesis) in Kg during* 1967 *to* 1974

(Both mechanised and non-mechanised boats combined)

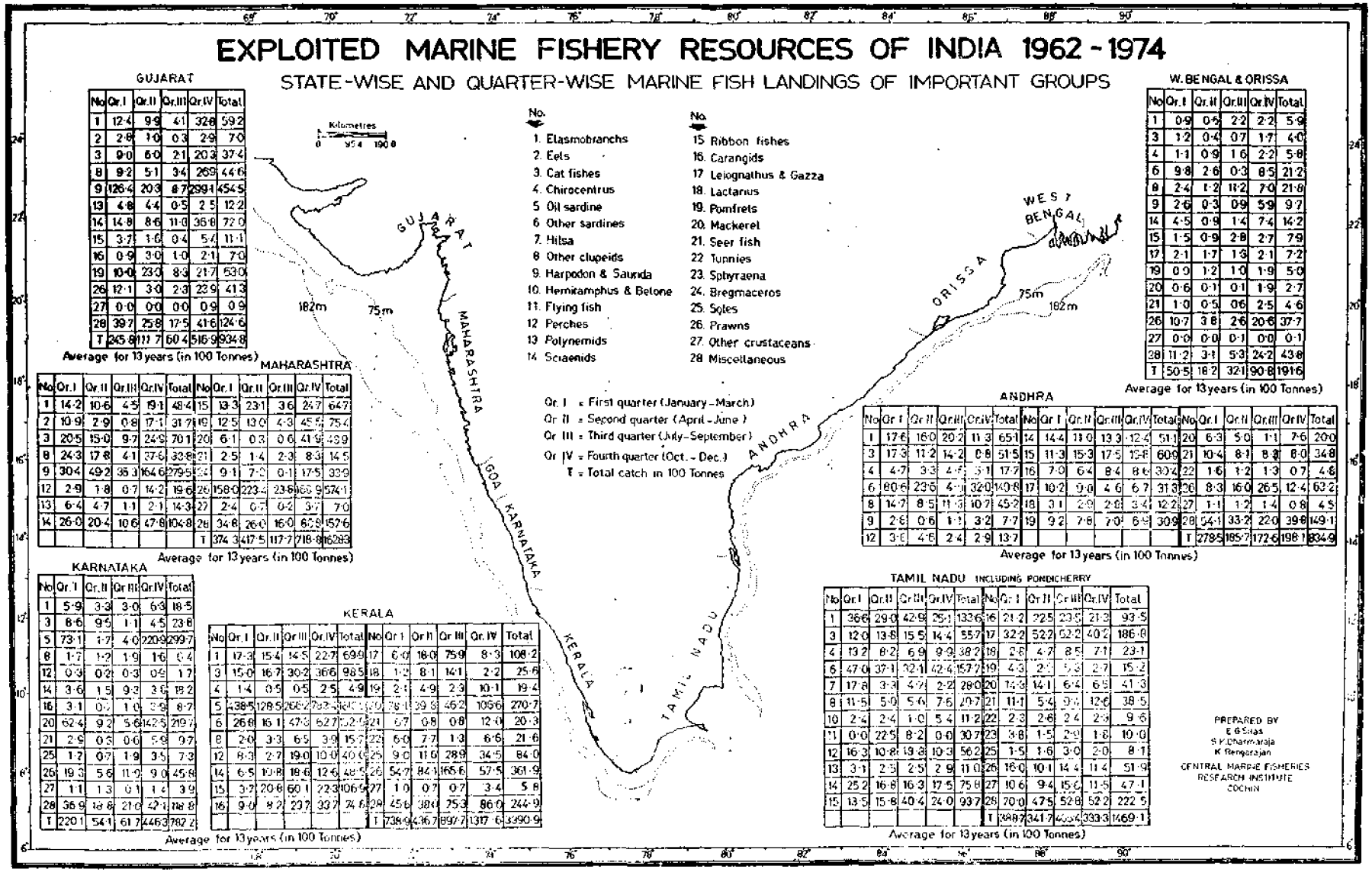
State	1967		1968		1969		1970		1971		1972		1973		1974	
West Bengal and Orissa	11,486	(1.65)	15,224	(1.97)	13,683	(1.63)	15,887	(1.94)	12,904	(2.11)	14,464	(0.98)	15,590	(1.38)	21,582	(1.17)
Andhra Pradesh	38,335	(1.98)	35,898	(2.10)	30,219	(2.51)	33,249	(2.12)	40,403	(2.06)	44,092	(1.90)	38,424	(2.50)	42,556	(3.61)
Tamil Nadu	43,018	(2.89)	45,148	(2.76)	46,359	(3.27)	44,235	(3.37)	46,517	(3.44)	55,910	(2.77)	53,936	(3.38)	49,037	(3.58)
Pondicherry	2,148	(3.73)	3,391	(2.40)	3,969	(2.68)	4,014	(2.65)	3,355	(3.12)	2,969	(3.33)	2,445	(3.55)	2,122	(3.63)
Kerala	43,476	(8.28)	41,332	(8.28)	36,308	(8.00)	39,691	(9.74)	45,018	(9.90)	57,106	(5.11)	69,748	(6.28)	86,711	(4.68)
Karnataka	5,281	(8.57)	7,214	(11.49)	7,608	(8.84	7,824	(13.58)	10,559	(9.85)	8.861	(9.41)	9,360	(7.78)	10,915	(5.18)
Maharashtra	25,326	(5.21)	21,567	(5.64)	25,545	(6.50)	17,401	(10.32)	28,451	(7.60)	27,614	(7.93)	27,451	(8.25)	21,817	(8.47)
Gujarat	17,784	(4.25)	18,902	(4.58)	12,986	(6.33)	16,213	(5.49)	19,311	(4.40)	14,257	(5.31)	17,695	(6.89)	28,161	(5.16)
All India (excluding Goa, Andamans and Lakshadweep)	186,854	(4.70)	188,676	(4.85)	176,677	(5.01)	178,514	(5.96)	206,518	(5.42)	225,001	(4.15)	234,649	(4.95)	262,901	(4.39)



YEAR	CATCH IN TONNES
1962	178
1963	599
1964	79
1965	471
1966	660
1967	883
1968	1120
1969	1193
1970	1165
1971	1190
1972	1080
1973	1653
1974	2232
Average	1118

YEAR	CATCH IN TONNES
1962	155
1963	159
1964	148
1965	224
1966	330
1967	410
1968	341
1969	412
1970	500
1971	569
1972	780
1973	854
1974	920
Average	446

FIG. 1. Exploited Marine Fishery Resources of India 1962-1974 : Map indicating the All India and the State-wise annual fish catch. The pelagic and demersal components for All India and the maritime States are also indicated.



GUJARAT

No	Qr.I	Qr.II	Qr.III	Qr.IV	Total
1	12·4	9·8	4·1	32·8	59·2
2	2·8	1·0	0·3	2·9	7·0
3	9·0	6·0	2·1	20·3	37·4
8	9·2	5·1	3·4	26·9	44·6
9	126·4	20·3	8·7	299·1	454·5
13	4·8	4·4	0·5	2·5	12·2
14	14·8	8·6	11·0	36·8	72·0
15	3·7	1·6	0·4	5·4	11·1
16	0·9	3·0	1·0	2·1	7·0
19	10·0	23·0	8·3	21·7	53·0
26	12·1	3·0	2·3	23·9	41·3
27	0·0	0·0	0·0	0·9	0·9
28	39·7	25·8	17·5	41·6	124·6
T	245·8	111·7	60·4	516·9	934·8

Average for 13 years (in 100 Tonnes)

MAHARASHTRA

No	Qr.I	Qr.II	Qr.III	Qr.IV	Total	No	Qr.I	Qr.II	Qr.III	Qr.IV	Total
1	14·2	10·6	4·5	19·1	48·4	15	13·3	23·1	3·6	24·7	64·7
2	10·9	2·9	0·8	17·1	31·7	19	12·5	13·0	4·3	45·5	75·4
3	20·5	15·0	9·7	24·9	70·1	20	6·1	0·3	0·6	41·9	48·9
8	24·3	17·8	4·1	37·6	83·8	21	2·5	1·4	2·3	8·3	14·5
9	30·4	49·2	35·3	164·6	279·5	23	9·1	7·2	0·1	17·5	33·9
12	2·9	1·8	0·7	14·2	19·6	26	158·0	223·4	23·8	169·9	574·1
13	6·4	4·7	1·1	2·1	14·3	27	2·4	0·7	0·2	3·7	7·0
14	26·0	20·4	10·6	47·8	104·8	28	34·8	26·0	16·0	62·8	157·6
						T	374·3	417·5	117·7	718·8	1628·3

Average for 13 years (in 100 Tonnes)

KARNATAKA

No	Qr.I	Qr.II	Qr.III	Qr.IV	Total
1	5·9	3·3	3·0	6·3	18·5
3	8·6	9·5	1·1	4·5	23·8
5	73·1	1·7	4·0	220·9	299·7
8	1·7	1·2	1·9	1·6	6·4
12	0·3	0·2	0·3	0·9	1·7
14	3·6	1·5	9·3	3·8	18·2
16	3·1	0·2	1·0	3·9	8·7
20	62·4	9·2	5·6	142·5	219·7
21	2·9	0·3	0·6	5·9	9·7
25	1·2	0·7	1·9	3·5	7·3
26	19·3	5·6	11·2	9·0	45·8
27	1·1	1·3	0·1	1·4	3·9
28	36·9	18·8	21·0	47·1	124·8
T	220·1	54·1	61·7	446·3	782·2

Average for 13 years (in 100 Tonnes)

KERALA

No	Qr.I	Qr.II	Qr.III	Qr.IV	Total	No	Qr.I	Qr.II	Qr.III	Qr.IV	Total
1	17·3	15·4	14·5	22·7	69·9	17	0·0	18·0	75·9	8·3	108·2
3	15·0	16·7	30·2	36·6	98·5	18	1·2	8·1	14·1	2·2	25·6
4	1·4	0·5	0·5	2·5	4·9	19	2·1	4·9	2·3	10·1	19·4
5	438·5	128·5	266·2	28·3	861·5	20	78·1	39·8	46·2	105·6	270·7
6	26·8	16·1	47·3	62·7	152·9	21	0·7	0·8	0·8	12·0	20·3
8	2·0	3·3	6·5	3·9	15·7	23	6·0	7·7	1·3	6·6	21·6
12	8·3	2·7	19·0	10·0	40·0	25	9·0	11·9	28·9	34·5	84·0
14	6·5	10·8	18·6	12·6	48·5	26	54·7	84·1	165·6	57·5	361·9
15	3·2	20·6	60·1	22·3	106·9	27	1·0	0·7	0·7	3·4	5·8
16	9·0	8·2	23·7	33·7	74·6	29	45·6	38·1	75·3	86·0	244·9
						T	738·9	436·7	897·7	1317·6	3390·9

Average for 13 years (in 100 Tonnes)

W. BENGAL & ORISSA

No	Qr.I	Qr.II	Qr.III	Qr.IV	Total
1	0·9	0·5	2·2	2·2	5·9
3	1·2	0·4	0·7	1·7	4·0
4	1·1	0·9	1·6	2·2	5·8
6	9·8	2·6	0·3	8·5	21·2
8	2·4	1·2	11·2	7·0	21·8
9	2·6	0·3	0·9	5·9	9·7
14	4·5	0·9	1·4	7·4	14·2
15	1·5	0·9	2·8	2·7	7·9
17	2·1	1·7	1·3	2·1	7·2
19	0·9	1·2	1·0	1·9	5·0
20	0·6	0·1	0·1	1·9	2·7
21	1·0	0·5	0·6	2·5	4·6
26	10·7	3·8	2·6	20·6	37·7
27	0·0	0·0	0·1	0·0	0·1
28	11·2	3·1	5·3	24·2	43·8
T	50·5	18·2	32·1	90·8	191·6

Average for 13 years (in 100 Tonnes)

ANDHRA

No	Qr.I	Qr.II	Qr.III	Qr.IV	Total	No	Qr.I	Qr.II	Qr.III	Qr.IV	Total	No	Qr.I	Qr.II	Qr.III	Qr.IV	Total
1	17·6	16·0	20·2	11·3	65·1	14	14·4	11·0	13·3	12·4	51·1	20	6·3	5·0	1·1	7·6	20·0
3	17·3	11·2	14·2	0·8	51·5	15	11·3	15·3	17·5	15·8	60·9	21	10·4	8·1	8·3	8·0	34·8
4	4·7	3·3	4·5	5·1	17·7	16	7·0	6·4	8·4	8·6	30·4	22	1·6	1·2	1·3	0·7	4·8
6	80·6	23·6	4·1	32·0	140·8	17	10·2	9·0	4·6	6·7	31·3	26	8·3	16·0	26·5	12·4	63·2
8	14·7	8·5	11·3	10·7	45·2	18	3·1	2·9	2·8	3·4	12·2	27	1·1	1·2	1·4	0·8	4·5
9	2·6	0·6	1·1	3·2	7·7	19	9·2	7·6	7·0	6·9	30·9	28	54·1	33·2	22·0	39·6	149·1
12	3·0	4·6	2·4	2·9	13·7							T	278·5	185·7	172·6	198·1	834·9

Average for 13 years (in 100 Tonnes)

TAMIL NADU INCLUDING PONDICHERRY

No	Qr.I	Qr.II	Qr.III	Qr.IV	Total	No	Qr.I	Qr.II	Qr.III	Qr.IV	Total
1	36·6	29·0	42·9	25·1	133·6	16	21·2	22·5	23·5	21·3	93·5
3	12·0	13·8	15·5	14·4	55·7	17	32·2	52·2	62·2	40·2	186·8
4	13·2	8·2	6·9	9·9	38·2	18	2·8	4·7	8·5	7·1	23·1
6	47·0	37·1	32·1	42·4	157·7	19	4·3	2·1	5·3	2·7	15·2
7	17·8	3·3	4·7	2·2	28·0	20	14·3	14·1	6·4	6·5	41·3
8	11·5	5·0	5·6	7·6	29·7	21	11·1	5·4	9·6	12·6	38·5
10	2·4	2·4	1·0	5·4	11·2	22	2·3	2·6	2·4	2·3	9·6
11	0·0	22·5	8·2	0·0	30·7	23	3·8	1·5	2·9	1·8	10·0
12	16·3	10·8	13·8	10·3	56·2	25	1·5	1·6	3·0	2·0	8·1
13	3·1	2·5	2·5	2·9	11·0	26	16·0	10·1	14·4	11·4	51·9
14	25·2	16·8	16·3	17·5	75·8	27	10·6	9·4	15·6	11·5	47·1
15	13·5	15·8	40·4	24·0	93·7	28	70·0	47·5	52·8	52·2	222·5
						T	388·7	341·7	466·6	333·3	1469·1

Average for 13 years (in 100 Tonnes)

Fig. 2. Exploited Marine Fishery Resources of India 1962 - 1974 : State-wise and quarter-wise marine fish landings of important groups.

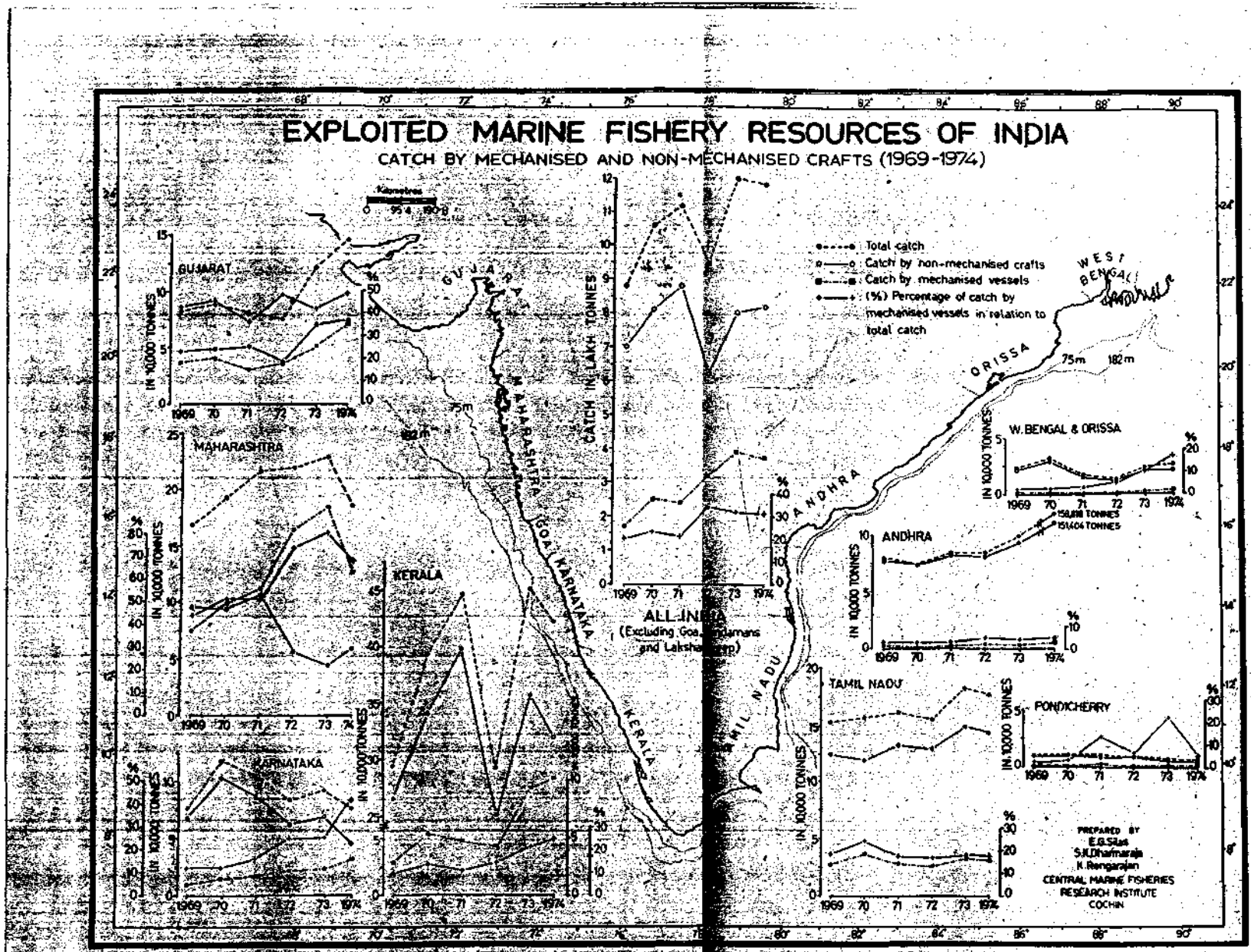


Fig. 1. Exploited Marine Fishery Resources of India. Catch by mechanised and non-mechanised crafts for the period 1969 - 1974 for All India and the maritime States. The total catch, catch by mechanised vessels, catch by non-mechanised crafts in relation to total catch are indicated.

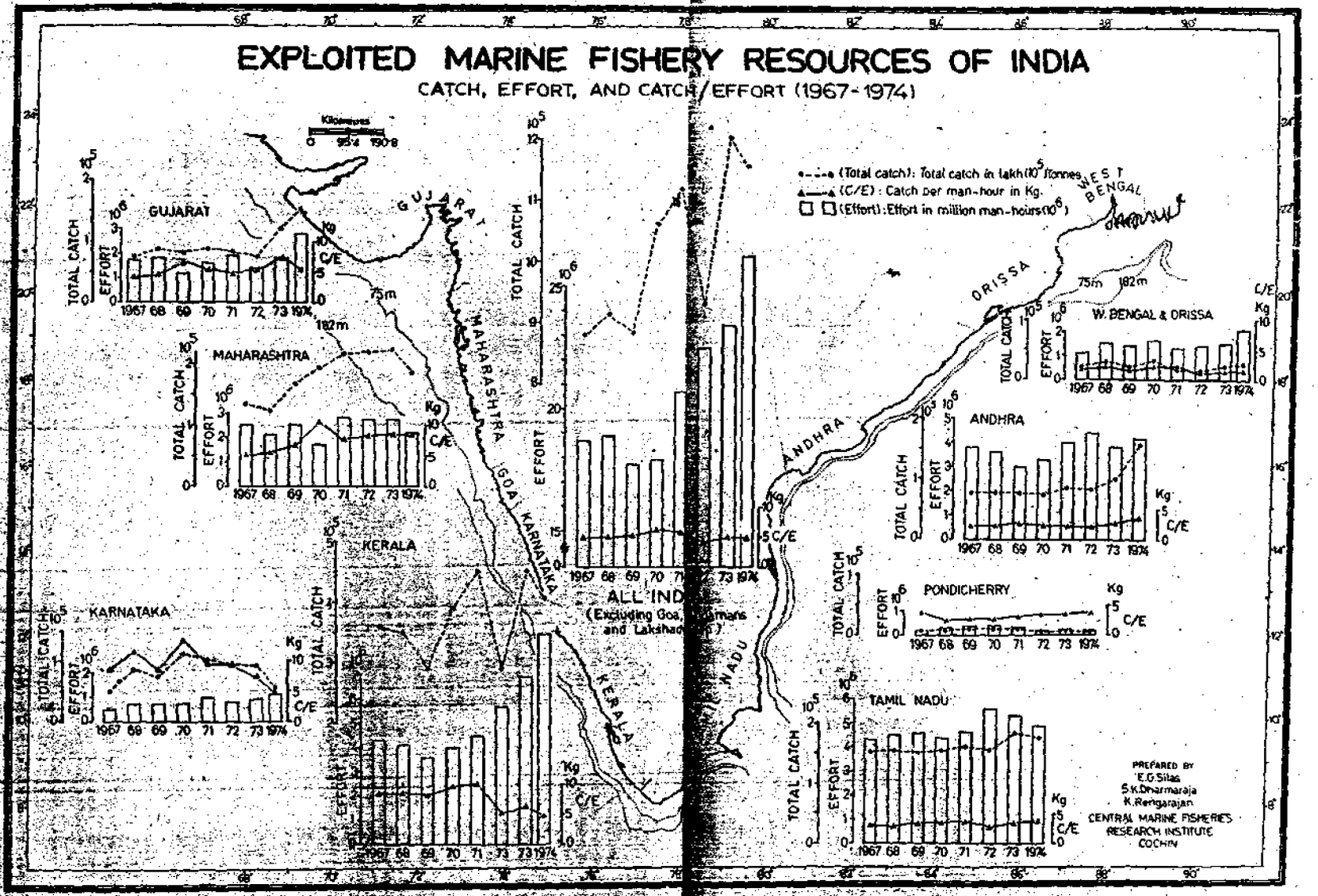


Fig. 4. Exploited Marine Fishery Resources of India : Catch, effort and catch per unit effort for the period 1967 - 1974 for All India as well as the maritime States are indicated.

On the basis of the trends seen of the exploited resources, an arbitrary grading to indicate the more productive areas of the inshore waters is possible. Market demands and lack of landing facilities in some cases result in the landings of catch at distant ports. A good example is Bombay [Sasoon Dock where the higher landings are contributed also by fish brought from distant grounds such as Karnataka (Mackerel)]. The fishing harbour facilities and other infrastructures developed in some centres for operating mechanised boats and diversification of fishing should also in future result in higher landings in some of the zones. Besides this, an increase in the catch may be expected with more intensive fishing from the inshore waters along the east coast. It is likely that some of the centres such as Mangalore, Beypore, Neendakara, Vizhinjam, Tuticorin, Mandapam, Cuddalore, Royapuram (Madras), Visakhapatnam and Paradeep where fishing harbour facilities are being developed, may show marginal to substantial increase with planned systematic exploitation of resources in future. The relative productiveness of inshore fishing grounds indicated in Fig. 1, has limitations, but gives an arbitrary measure which is likely to change with changes in fishing efforts and development of infrastructure facilities such as fishing harbours, freezing and cold storage plants, and improved handling and marketing facilities.

Demersal fishery

The trend of exploitation of marine fishery resources in our waters shows that there has been steady increase in the demersal fish catches along the Maharashtra Coast upto 1973 (Fig. 1). However, during 1974 there has been a decline in the catch from 2.27 to 1.85 lakh tonnes, partly due to a reduction in fishing effort (Table 2). The major factor contributing to the marked increase in the total catch of marine fish for Maharashtra during 1969-1973 has been the steep increase in the catch of prawns, especially non-penaeid prawns. This should partly explain the slight but steady increase in the demersal fish catch for the country as a whole from 1969-1973. Diversification of fishing and exploitation of new grounds will no doubt augment the catch. The catch trends as seen for the period 1969-1974 shows an increasing trend for demersal catches, particularly penaeid and non-penaeid prawns, sciaenids, silver bellies and pomfrets, though in 1974 there is a marginal decline in most of the demersal fisheries.

However, in majority of cases, trawling is almost exclusively carried out for prawns on account of the export market. It is felt that this may to some extent affect the overall anticipated increase in the demersal catch of the country due to increased effort in only limited grounds and the lesser exploitation of other demersal resources. The economic feasibility of operating fishing vessels in off-shore and distant grounds also needs urgent consideration to enable planned diversification of fishing. This is particularly so along the northwest coast for the shelf waters of Maharashtra and Gujarat as well as along most parts of the east coast.

Pelagic fishery

It may be noted that the trend in the catch of pelagic fishes along the west coast of India, particularly during the last five years show fluctuations. A decreasing trend in the fishery for Bombay duck in the Gujarat waters (during 1974) and the failure in the mackerel and sardine fishery along the Kerala, Karnataka and Goa Coasts during this period have been mainly responsible for this. The latter is particularly significant since an all time high mackerel catch (about 2 lakh tonnes) was recorded along Kerala, Karnataka and Goa Coasts during 1971 but, the catch fell to 79,423 tonnes during 1973 and has further declined to 37,462 tonnes in 1974. The oil sardine catch which showed an all-time record of 3.01 lakh tonnes during 1968 declined to 1.27 lakh tonnes in 1972 and 1974. However, it has shown a very slight increase (1.44 lakh tonnes) in 1973.

Hardly anything is known about the pelagic fishery resources of the northwest coast and the east coast. Available information indicates the occurrence of mackerel, sardine, lesser sardines, anchovies and other important groups of pelagic fishes from these areas also. Epipelagic and mesopelagic fishes such as Myctophidae and oceanic squids may also form important components in these areas. There is an urgent need for planned exploratory surveys in these areas to assess the pelagic fisheries potential.

Estimates of total fish production

Estimates of 10 to 20 million tonnes of potential fish production for the Indian Ocean have been given by various authors (Panikkar, 1967; Jones and Banerji, 1973; Prasad *et al.*, 1969) based on the relative productivity of the waters, exploratory surveys and so on. For the Indian seas,

the potential annual fish production has been estimated at about 4 million tonnes (Nair *et al.*, 1973) which in other words represents slightly over a three-fold increase from the present.

Trend of Marine Fish Production along the East and West Coasts

In Fig. 5, the total catch for the east coast and the west coast (excluding Lakshadweep and Andamans) for the years 1962-1974 is shown. It will be seen that the total catch along the west coast shows considerable fluctuations. Along the east coast, a general increasing trend is noticeable except for minor decline in 1965, 1969, 1971 and 1974. Along the west coast, although there has been a steep decline in the total catch due to the failure of oil sardine and mackerel fisheries during 1971 and 1974, an overall increase from 1962 to 1974 is noticeable (Table 3). The average catch for 13 years shows 229,793 tonnes (24.31%) for the east coast and 715,408 tonnes (75.69%) for the west coast.

From the available data it could be said that there is an increase of about 188,952 tonnes of fish production in 1974 along the east coast at present as compared to the total for east coast for 1962. This increase should be attributed mainly to the significant increase in mechanised fishing effort, particularly for groups such as prawns, silver bellies and catfishes; and the introduction of nylon nets and better fishing gear; and a rapidly developing infrastructure for the fishing industry. Along the east coast, multiple-species fishery is a prominent feature as compared to the west coast where single-species fishery such as that of oil sardine, mackerel and Bombay duck contributes to the major fisheries. Owing to the absence of large scale fluctuations in the fisheries along the east coast, the impact of mechanisation towards an increase in overall production could be more easily seen. Along the west coast also there has been a general trend of increase, though year-to-year fluctuations have been marked during certain periods as could be seen from Table 3.

TABLE 3. *Trend of marine fish production along the west and east coasts showing the year to year increase|decrease and increase|decrease over* 1962 *(base year)*

	WEST COAST					*EAST COAST*			
Years	Total catch	Total catch excluding oil sardine and mackerel	Increase in catch compared to 1962 from column 3	Successive increase or decrease compared to previous year		Total catch	Increase in catch compared to 1962	Successive increase or decrease compared to previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1962	488,234	352,580	—	—	—	156,010	—	—	—
1963	493,193	356,853	4,273	+ 4,273	+ 1.21	162,291	6,281	+ 6,281	+ 4.03
1964	666,597	373,415	20,835	+ 16,562	+ 4.64	192,985	36,975	+ 30,694	+ 18.91
1965	660,673	357,980	5,400	− 15,435	− 4.14	172,104	16,094	− 20,881	− 10.82
1966	677,673	402,683	50,103	+ 44,703	+ 12.49	212,638	56,628	+ 40,534	+ 23.55
1967	661,817	381,942	29,362	− 20,741	− 5.15	230,071	74,061	+ 17,433	+ 8.20
1968	685,448	368,291	15,711	− 13,651	− 3.57	249,163	93,153	+ 19,092	+ 8.30
1969	672,330	410,539	57,959	+ 42,248	+ 11.47	241,300	85,290	− 7,863	− 3.16
1970	833,952	474,222	121,642	+ 63,683	+ 15.51	251,655	95,,645	+ 10,355	+ 4.29
1971	913,780	505,446	152,866	+ 31,224	+ 6.58	247,609	91,599	− 4,046	− 1.61
1972	743,490	523,750	171,170	+ 18,304	+ 3.62	236,559	80,549	− 11,050	− 4.46
1973	930,284	720,865	368,285	+ 197,115	+ 37.64	289,956	133,946	+ 53,397	+ 22.57
1974	872,835	716,204	363,624	− 4,661	− 0.65	344,962	188,952	+ 55,006	+ 18.97

Besides these, there are some localised, seasonal sustenance fisheries such as flying-fish fishery along the Coromandal Coast (Tamil Nadu and Pondicherry), lobster fishery along the southwest coast of Kerala and Tirunelveli and Kannyakumari Districts of Tamil Nadu, mussel fishery which is quantitatively negligible at present along the south and central Kerala Coast.

Estimation of Catch in Terms of Mechanised and Non-Mechanised Fishing Crafts

All India

The data available for the years 1969-1974 in respect of the catch by mechanised and non-mechanised boats for the different maritime States indicate the trends shown in Fig. 3. The details in relation to the base year 1969 for the country as a whole; the east and west coasts, and the different maritime States are given in Tables 3 to 13. The salient features noticeable are:

1. The overall picture for the country showed a slight decrease in total production from 1973 to 1974. The catch by mechanised fishing vessels also showed a decrease by about 18,743 tonnes chiefly on account of reduction of non-penaeid prawns landing along the Maharashtra Coast.
2. The maximum total catch by mechanised vessels during 1969-1974 period was in 1973 when 392,575 tonnes were landed. This, when compared to the figure of 1969, is 214,548 tonnes more. The major components contributing to this were prawns, scianeids and pomfrets.
3. The maximum catch by non-mechanised boats was during 1971 when the oil sardine and mackerel fisheries were good and the total catch by non-mechanised boats amounted to 922,369 tonnes. The steep fall in the mackerel and oil sardine catch in 1972 is also reflected in the fall in the non-mechanised boats landings to the tune of 266,105 tonnes over the previous year. During the year this total catch (All India) was also low, being 980,049 tonnes.

In view of the fact that mackerel and oil sardine fisheries show considerable annual fluctuations, the year-wise catch excluding these two are shown in column 3 of Table 3.

East and West Coasts

Estimates of catch by non-mechanised and mechanised boats along the east and west coasts (Table 5) indicate that (a) the total catch by non-mechanised boats along the east coast shows an increasing trend except in 1972 and by mechanised boats also shows a similar trend except in 1971 and 1972.

TABLE 4. *Trend of marine fish catch by mechanised and non-mechanised vessels in India during* 1969-1974

Year	Catch by non-mechanised crafts						Catch by mechanised vessels			
	Total catch	Total catch excluding oil sardine and mackerel	Total catch	Increase or decrease compared to 1969 from column 4	Successive increase or decrease from previous year		Total catch	Increase or decrease compared to 1969 from column 8	Successive increase or decrese from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10	11
1969	913,630	647,544	735,603	—	—	—	178,027	—	—	—
1970	1085,607	719,404	839,841	+ 104,238	+ 104,238	+ 14.2	245,766	+ 67,739	+ 67,739	+ 38.1
1971	1161,389	747,553	923,369	+ 187,766	+ 83,528	+ 9.9	238,020	+ 59,993	− 7,746	− 3.2
1972	980,049	743,510	657,264	− 78,339	− 266,105	− 28.8	322,785	+ 144,758	+ 84,765	+ 35.6
1973	1220,240	996,422	827,665	+ 92,062	+ 170,401	+ 25.9	392,575	+ 214,548	+ 69,790	+ 21.6
1974	1217,797	1053,659	843,965	+ 108,362	+ 16,300	+ 2.0	373,832	+ 195,805	− 18,743	− 4.8

(b) the successive increase or decrease from previous years shows that in 1974 catch by both non-mechanised and mechanised boats along the west coast is less by 6.4% and 5.9% respectively as compared to 1973. However, along the east coast, for both non-mechanised and mechanised boats an increase by 21.5% and 4.2% respectively is seen during 1974 as compared to 1973.

TABLE 5. *Trend of marine fish catch by mechanised and non-mechanised vessels along the west coast and the east coast of India during* 1969-1974

WEST COAST

Year	Total catch	Total catch excluding oil sardine and mackerel	Catch by non-mechanised crafts: Total catch	Increase or decrease compared to 1969 from column 4	Successive increase or decrease from previous year		Catch by mechanised vessels: Total catch	Increase or decrease compared to 1969 from column 8	Successive increase or decrese from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10	11
1969	672,330	410,539	524,863	—	—	—	147,467	—	—	—
1970	833,952	474,222	627,831	+ 102,968	+ 102,968	+ 19.6	206,121	+ 58,654	+ 58,654	+ 39.8
1971	913,780	505,446	708,668	+ 183,805	+ 80,837	+ 12.9	205,112	+ 57,645	− 1,009	− 0.5
1972	743,490	523,750	453,794	− 71,069	− 254,874	− 35.9	289,696	+ 142,229	+ 84,584	+ 41.2
1973	930,284	720,865	579,552	+ 54,689	+ 125,758	− 27.7	350,732	+ 203,265	+ 61,036	+ 21.1
1974	872,835	716,204	542,613	+ 17,750	− 36,939	− 6.4	330,222	+ 182,755	− 20,510	− 5.9

(TABLE 5 *Continued*)

EAST COAST

Year	Total catch	Catch by non-mechanised crafts: Total catch	Increase or decrease compared to 1969 from column 13	Successive increase or decrease from previous year		Catch by mechanised vessels: Total catch	Increase or decrease compared to 1969 from column 17	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
	12	13	14	15	16	17	18	19	20
1969	241,300	210,740	—	—	—	30,560	—	—	—
1970	251,655	212,010	+ 1,270	+ 1,270	+ 0.6	39,645	+ 9,085	+ 9,085	+ 29.7
1971	247,609	214,701	+ 3,961	+ 2,691	+ 1.3	32,908	+ 2,348	− 6,737	− 17.0
1972	236,559	203,470	− 7,270	− 11,231	− 5.2	33,089	+ 2,529	+ 181	+ 0.6
1973	289,956	248,113	+ 37,373	+ 44,643	+ 21.9	41,843	+ 11,283	+ 8,754	+ 26.5
1974	344,962	301,352	+ 90,612	+ 53,239	+ 21.5	43,610	+ 13,050	+ 1,767	+ 4.2

Maritime States

West Bengal and Orissa

While catch by non-mechanised fishing crafts show year to year fluctuations, the landings by mechanised fishing boats showed an increasing trend between 1969 and 1974 excepting a slight decrease during 1971 (Table 6). A significant feature noticed is that the landings of mechanised boats which were of the order of about 500 to 600 tonnes during 1969 to 1971, increased by 269% during 1972 which was not only maintained during 1973, but the catch significantly increased during 1974 by 95.4% as compared to 1973.

Andhra Pradesh

Year to year fluctuation was seen in the catch of both non-mechanised and mechanised boats. However, a record catch of both non-mechanised and mechanised fishing crafts was the highlight during 1974 when the increase noticed in respect of non-mechanised and mechanised catch was 59.6% and 58.6% respectively as compared to 1973 (Table 7).

Tamil Nadu

The landings by non-mechanised and mechanised boats were fluctuating the same way as that of the total catch. During 1974 the catch of both non-mechanised and mechanised crafts was slightly lower as compared to 1973 (Table 8).

Pondicherry

The catch of non-mechanised boats was steadily falling from 1969 to 1973, but improved during 1974. But the landings by mechanised boats decreased by 76.7% in 1974 as compared to 1973 although the catch was significantly higher during 1971 and 1973 (Table 9).

Kerala

The landings by non-mechanised boats show year to year fluctuations, but the catch of mechanised vessels has shown an increasing trend from 1972 to 1974 after a year to year fluctuation from 1969 to 1971 (Table 10). While the catch by non-mechanised boats showed a decline of about 10% in 1974 as compared to 1973, those of mechanised boats increased by 8.0% during the year.

Karnataka

The catch by both non-mechanised and mechanised boats shows year to year fluctuation. While the non-mechanised catch has declined by 35.0% during 1974 as compared to 1973, mechanised catch increased by 38.5% during the year (Table 11).

Maharashtra

While the landings by non-mechanised boats show year to year fluctuation, those by mechanised vessels showed a steady increase between 1969 and 1973, but sharp decline during 1974 (Table 12). When the catch by non-mechanised boats increased by about 35.3% during 1974 as compared to 1973, that of mechanised boats decreased by 31.3%.

Gujarat

The landings from both non-mechanised and mechanised boats showed an increasing trend between 1969 and 1974 excepting a decrease in 1972 in the case of non-mechanised boats and in 1971 and 1972 in the case of mechanised vessels. A record catch of both non-mechanised and mechanised boats was seen during 1974, the respective landings being 74,008 and 71,301 tonnes (Table 13).

Since there is little diversification of fishing by mechanised boats and as they are all primarily involved with trawling for shrimp, any fluctuation in the catch of mechanised boats is mainly dependent upon the availability of this resource. This trend of selective fishing by mechanised vessels is bound to show favourable trends as long as the shrimp resources are sufficiently large to bear sustained exploitation.

Effort and Catch per Unit Effort

The details of catch, effort and catch per unit effort (mechanised and non-mechanised) are shown in Fig. 4 and Table 2 for the years 1967-1974 for which period the data are available. The All India fishing effort shows an increase except in 1969 and 1970. However, at the same time, the catch and the catch per unit effort evince fluctuations mainly due to the large scale fluctuation in the major pelagic fisheries for mackerel and oil sardine. Nevertheless, it is seen that the catch per man-hour in Kg shows slight decrease from 1970 to 1972, but a slight increase since then. More specifically this trend will be clear from the data given for Kerala in Fig. 4.

As regards the catch per unit effort for the country as a whole, it is not more than 5 Kg per man-hour. Along the west coast, in Gujarat the

catch per unit effort is less than that of the other States.

From Table 2, it is noticed that Karnataka accounted for the highest catch per man-hour in India until 1972 while in 1973 (8.25 Kg|hr) and 1974 (8.47 Kg|hr) Maharashtra recorded the highest catch per unit effort. West Bengal and Orissa accounted for the lowest (1.17 Kg in 1974) catch per man-hour.

It is evident from the Table 2 that the effort expended on the whole was maximum in 1974 (262846 x 10^3) but the catch per unit effort for

TABLE 6. *Trend of marine fish catch by mechanised and non-mechanised vessels along the coast of West Bengal and Orissa during* 1969-1974

Year	Catch by non-mechanised crafts					Catch by mechanised vessels			
	Total catch	Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	22,879	22,299	—	—	—	580	—	—	—
1970	31,403	30,803	+ 8,504	+ 8,504	+ 38.1	600	+ 20	+ 20	+ 3.5
1971	18,032	17,474	− 4,825	− 13,329	− 43.3	558	− 22	− 42	− 7.0
1972	15,330	13,271	− 9,028	− 4,203	− 24.1	2,059	+ 1,479	+ 1,501	+ 269.0
1973	22,736	20,457	− 1,842	+ 7,186	+ 54.2	2,279	+ 1,699	+ 220	+ 10.7
1974	26,092	21,639	− 660	+ 1,182	+ 5.8	4,453	+ 3,873	+ 2,174	+ 95.4

TABLE 7. *Trend of marine fish catch by mechanised and non-mechanised vessels along the coast of Andhra Pradesh during* 1969-1974

Year	Catch by non-mechanised crafts					Catch by mechanised vessels			
	Total catch	Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	77,526	75,540	—	—	—	1,986	—	—	—
1970	74,459	72,592	− 2,948	− 2,948	− 3.9	1,867	− 119	− 119	− 6.0
1971	84,010	81,809	+ 6,269	+ 9,217	+ 12.7	2,201	+ 215	+ 334	+ 17.9
1972	84,480	79,785	+ 4,245	− 2,024	− 2.5	4,695	+ 2,709	+ 2,494	+ 113.3
1973	99,544	94,868	+ 19,328	+ 15,083	+ 18.9	4,676	+ 2,690	− 19	− 0.4
1974	158,818	151,404	+ 75,864	+ 56,536	+ 59.6	7,414	+ 5,428	+ 2,738	+ 58.6

TABLE 8. *Trend of marine fish catch by mechanised and non-mechanised vessels along the coast of Tamil Nadu during* 1969-1974

Year	Total catch	Catch by non-mechanised crafts				Catch by mechanised vessels			
		Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	151,876	124,198	—	—	—	27,678	—	—	—
1970	155,516	118,733	− 5,465	− 5,465	− 4.4	36,783	+ 9,105	+ 9,105	+ 32.9
1971	160,619	131,921	+ 7,723	+ 13,188	+ 11.1	28,698	− 1,020	− 8,085	− 21.9
1972	155,153	129,490	+ 5,292	− 2,431	− 1.8	25,663	− 2,015	− 3,035	− 10.6
1973	182,419	149,447	+ 25,249	+ 19,957	+ 15.4	32,972	+ 5,294	+ 7,309	+ 28.5
1974	175,713	144,416	+ 20,218	− 5,031	− 3.4	31,297	+ 3,619	− 1,675	− 5.1

TABLE 9. *Trend of marine fish catch by mechanised and non-mechanised vessels along the coast of Pondicherry during* 1969-1974

Year	Total catch	Catch by non-mechanised crafts				Catch by mechanised vessels			
		Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	10,637	10,321	—	—	—	316	—	—	—
1970	10,624	10,229	− 92	− 92	− 0.9	395	+ 79	+ 79	+ 25.0
1971	10,454	9,003	− 1,318	− 1,226	− 12.0	1,451	+ 1,135	+ 1,056	+ 267.3
1972	8,980	8,308	− 2,013	− 695	− 7.7	672	+ 356	− 779	− 53.7
1973	8,682	6,766	− 3,555	− 1,542	− 18.6	1,916	+ 1,600	+ 1,244	+ 185.1
1974	7,698	7,252	− 3,069	+ 486	+ 7.2	446	+ 130	− 1,470	− 76.7

TABLE 10. *Trend of marine fish catch by mechanised and non-mechanised vessels along the Kerala Coast during* 1969-1974

Year	Total catch	Catch by non-mechanised crafts: Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Catch by mechanised vessels: Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	294,787	266,610	—	—	—	28,177	—	—	—
1970	392,880	340,309	+ 73,699	+ 73,699	+ 27.6	52,571	+ 24,394	+ 24,394	+ 86.6
1971	445,347	398,056	+ 131,446	+ 57,747	+ 17.0	47,291	+ 19,114	− 5,280	− 10.0
1972	295,618	256,970	− 9,640	− 141,086	− 35.4	38,648	+ 10,471	− 8,643	− 18.3
1973	448,269	354,610	+ 88,000	+ 97,640	+ 38.0	93,659	+ 65,482	+ 55,011	+ 142.3
1974	420,257	318,845	+ 52,235	− 35,765	− 10.1	101,412	+ 73,235	+ 7,753	+ 8.3

TABLE 11. *Trend of marine fish catch by mechanised and non-mechanised vessels along the coast of Karnataka during* 1969-1974

Year	Total catch	Catch by non-mechanised crafts: Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Catch by mechanised vessels: Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	75,793	66,699	—	—	—	9,094	—	—	—
1970	116,936	102,194	+ 35,495	+ 35,495	+ 53.2	14,742	+ 5,648	+ 5,648	+ 62.1
1971	103,724	87,159	+ 20,460	− 15,035	− 14.7	16,565	+ 7,471	+ 1,823	+ 12.4
1972	92,676	43,602	− 23,097	− 43,557	− 49.9	49,074	+ 39,980	+ 32,509	+ 196.3
1973	91,484	68,578	+ 1,879	+ 24,976	+ 57.3	22,906	+ 13,812	− 26,168	− 53.3
1974	76,263	44,539	− 22,160	− 24,039	− 35.1	31,724	+ 22,630	+ 8,818	+ 38.5

TABLE 12. *Trend of marine fish catch by mechanised and non-mechanised vessels along the coast of Maharashtra during* 1969-1974

Year	Total catch	Catch by non-mechanised crafts				Catch by mechanised vessels			
		Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	168,720	94,658	—	—	—	74,062	—	—	—
1970	192,361	94,081	− 577	− 577	− 0.6	98,280	+ 24,218	+ 24,218	+ 32.7
1971	215,305	104,774	+ 10,116	+ 10,693	+ 11.4	110,531	+ 36,469	+ 12,251	+ 12.5
1972	220,002	55,506	− 39,152	− 49,268	− 47.0	164-496	+ 90,434	+ 53,965	+ 48.8
1973	226,696	43,738	− 50,920	− 11,768	− 21.2	182,958	+ 108,896	+ 18,462	+ 11.2
1974	184,961	59,176	− 35,482	+ 15,438	+ 35.3	125,785	+ 51,723	− 57,173	− 31.3

TABLE 13. *Trend of marine fish catch by mechanised and non-mechanised vessels along the coast of Gujarat during* 1969-1974

Year	Total catch	Catch by non-mechanised crafts				Catch by mechanised vessels			
		Total catch	Increase or decrease compared to 1969 from column 3	Successive increase or decrease from previous year		Total catch	Increase or decrease compared to 1969 from column 7	Successive increase or decrease from previous year	
	Tonnes	Tonnes	Tonnes	Tonnes	%	Tonnes	Tonnes	Tonnes	%
1	2	3	4	5	6	7	8	9	10
1969	82,248	46,144	—	—	—	36,104	—	—	—
1970	89,027	48,499	+ 2,355	+ 2,355	+ 5.1	40,528	+ 4,424	+ 4,424	+ 12.3
1971	82,159	51,434	+ 5,290	+ 2,935	+ 6.1	30,725	− 5,379	− 9,803	− 24.2
1972	75,846	38,368	− 7,776	− 13,066	− 25.4	37,478	+ 1,374	+ 6,753	+ 21.9
1973	121,963	70,754	+ 24,610	+ 32,386	+ 84.4	51,209	+ 15,105	+ 13,731	+ 36.6
1974	145,309	74,008	+ 27,864	+ 3,254	+ 4.6	71,301	+ 35,197	+ 20,092	+ 39.2

the same year showed a slight decrease (4.39 Kg|hr) as compared to the previous years from 1967 to 1973 except in 1972 which was a lean year with total production the lowest and the catch per unit effort 4.15 Kg|hr.

Potential Resources for Exploitation

Having discussed the salient features about the exploited marine fishery resources of the country, it is also appropriate to indicate here the potential resources, the magnitude of the resources where the information is available and the details of the new fishing grounds which have been investigated in the recent past. This is possible only by taking into consideration the salient findings of the investigations of the Central Marine Fisheries Research Institute and the other organisations such as Integrated Fisheries Project (formerly Indo-Norwegian Project), Exploratory Fisheries Project, UNDP|FAO Pelagic Fishery Project and the Central Institute of Fisheries Operatives. Any large scale developmental programme for our fisheries should give diversification of fishing of both conventional and non-conventional resources a high priority. Broadly speaking the known information may be categorised as

i. Fishing grounds along the continental shelf edge and the upper continental slope, their resources and potential estimates;

ii. Conventional demersal fishery resources available for exploitation;

iii. Conventional pelagic fishery resources available for exploitation;

iv. Non-conventional pelagic and demersal fishery resources of the shelf waters for exploitation;

v. Pelagic oceanic fishery resources for exploitation;

vi. Coastal aquaculture (Mariculture), and

vii. Marine living resources for industrial and pharmaceutical use.

i. *Fishing grounds along the continental shelf edge and the upper continental slope, their resources and potential estimates*

Hardly anything was known about the commercial trawling possibilities along the continental shelf edge and the upper continental slope till recent years. During 1963-1969, the Research Vessel VARUNA and the Mechanised Fishing Vessels KLAUS SUNNANA, TUNA and VEL-AMIN of the Integrated Fisheries Project and M. V. BLUEFIN and M. V. RED SNAPPER of the Central Institute of Fisheries Operatives made exploratory surveys along the west coast and the southeast coast of India to explore the potential fishery resources in depths beyond 50 m. These surveys indicated that potentially good fishing grounds for demersal fishes and shellfish exist at different depths along the continental shelf edge and the upper continental slope (Silas, 1969; Silas

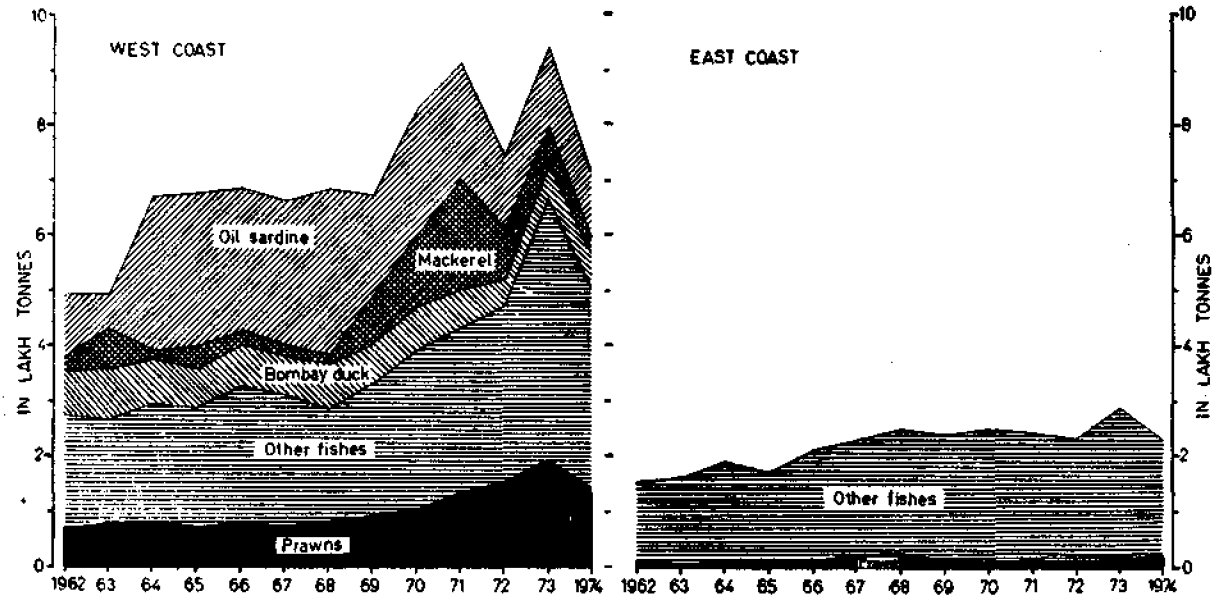


Fig. 5. Marine Fish Production along the east and west coasts for the period 1962 - 1974.

and Prasad, 1966; Tholasilingam *et al.*, 1964, 1964a, 1973; Rao, 1969; Menon and Joseph, 1969). These surveys also brought to light the potential resources of the sub-surface or column waters in the deeper neritic zones and the upper continental slope, particularly the resources of the fisheries such as the threadfin bream *Nemipterus* spp., *Emmilichthys* sp., *Psenes indicus, Chlorophthalmus agassizi, C. corniger, Cubiceps natalensis, Pseniopsis cyanea* and prawns *Parapandalus spinipes, Heterocarpus gibbosus, H. wood-masoni* (Silas, 1969; Silas and Prasad, 1966).

Along the northwest coast of India an abundance of catfishes in the depth zone 40 - 59 m (Ratnagiri) and elasmobranches in the depth zone 60 - 79 m (Bombay) has been recorded by Joseph (1974).

The good catches of deep-sea lobster *Puerules sewelli* and the deep-sea prawns *Penaeopsis rectacutus, Aristeus semidentatus,* etc. along the upper continental slope off Quilon are an indication of good potential resources along the upper continental slope (Silas, 1969; Mohamed and Suseelan, 1973). *Heterocarpus wood-masoni* and *Parapandalus spinipes* represent the major portion in the deep water prawn landings.

TABLE 14. *Estimated potential demersal fishery resources of the continental shelf edge and the upper continental slope off the southwest coast of India** (after Silas, 1969)

Depth Zone	Area (Sq. Km.)	Estimated total demersal fishery resources based on average catch rates** (in Tonnes)	Estimated potential sustainable yield at 60% (in Tonnes)
Depth Zone — I (75 — 100 m)	11,363	7,542	4,525
Depth Zone — II (101 — 179 m)	11,916	32,556	19,539
Depth Zone — III (180 — 450 m)	20,240	58,891	35,335

* From trawling grounds only. This will not include demersal resources such as 'Kalava' or perches found in depth zone — I.

** Estimated at average catch of 62.42, 256.87 and 273.65 Kg|hr or trawling for depth zones I, II and III respectively.

For the first time using acoustic aids, Silas (1969) made an assessment of the 'Kalava grounds' (Perch grounds) and estimated the resources along the southwest coast of India. Catch rates| 100 hooks|hr from 68.75 Kg to as high as 441.25 Kg were obtained during these surveys. The catch rates estimated by Menon and Joseph (1969) for Kalava in experimental fishing from corresponding areas have varied from 134.38 Kg to 365.25 Kg| 100 hooks|hr. Innovation in the fishing methods such as the use of line haulers and traps are likely to give higher catch rates. This is an important resource along the southwest coast of India which awaits exploitation.

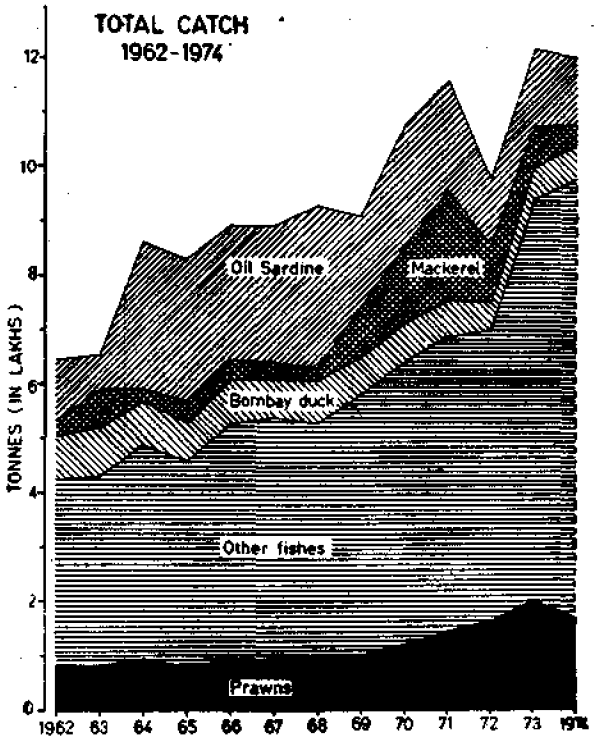


FIG. 6. Total All India catch of marine fish for the period 1962 - 1974 indicating the fluctuations and trends in the major components.

At present, the magnitude of the resources of deep-sea lobsters, prawns and shoaling fishes such as *Emmilichthys* sp., *Cubiceps natalensis* and *Chlorophthalmus agassizi* are not known. In the course of the exploratory surveys on certain occasions 3 to 4 tonnes of these fishes or shellfishes have been obtained indicating the richness of some of these grounds. Commercial exploitation of these resources may be considered. If necessary, this may be combined along with Kalava fishing from the adjacent grounds or perhaps light fishing for squids or pelagic fishes such as anchovies.

ii. *Conventional demersal fishery resources available for exploitation*

Areas of potential fishing grounds off different maritime States and Union Territories along the continental shelf are shown in Table 15.

As indicated earlier, the depths upto 40 m are being fished intensively along certain stretches of the coast. Since there has been a concerted effort on the part of those using mechanised boats for almost exclusively trawling for prawns resulting in a shift in gear and effort towards prawn fisheries, some of the inshore fisheries have remained underexploited or unexploited. Diversification of fishing, combined with proper infrastructure development for marketing the catch and utilization are bound to increase production from the inshore waters.

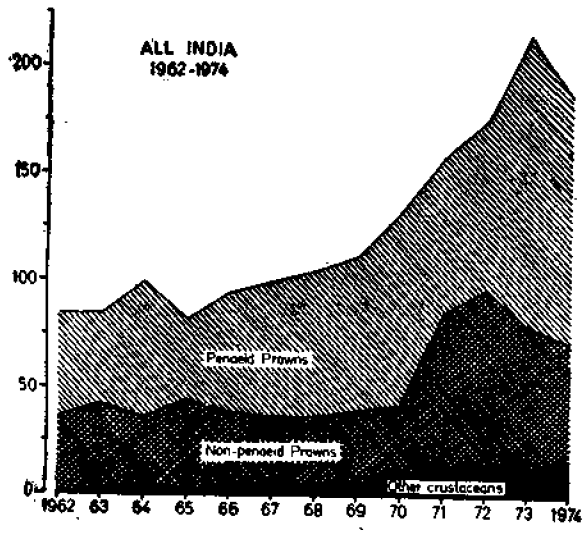


FIG. 7. Total All India catch of marine prawns and other crustaceans for the period 1962-1974. The trends of three major components *viz.*, Penaeid, non-penaeid and other crustaceans including crabs and lobsters are shown.

In the shelf waters beyond 50 m there are considerable resources which remain virtually untapped. Silas (1969) has shown that in the depth zone 75 - 100 m the threadfin bream *Nemipterus japonicus* predominated in exploratory and experimental fishing operations often forming 75% of the trawl catch. Interestingly enough, a similar trend of predominance of *Nemipterus japonicus* in the fish catch from 80 to 125 m along the northeastern Arabian Sea has also been reported by Zupanovic and Mohiuddin (1975). Although Krishnamoorthi (1973) has indicated the percentage of catch of *Nemipterus japonicus* in exploratory survey along the Andhra and Orissa Coasts to be low, he has shown that *N. japonicus* contributed 13.8% of 'All fish' catches or 23.67% when considered as part of the 'Miscellaneous - Small' fish catches along the Andhra and Orissa Coasts. We feel that *N. japonicus* resource along the east coast is equally high, but sufficient fishing effort has not been expended along this coast in the depth zone in which this species is predominant to obtain a clear picture of the resources.

The various assessment reports on demersal fishery resources, that appeared in the "Proceedings of the Symposium on Living Resources of the Seas around India" published by the Central Marine Fisheries Research Institute (1973:Pages 1 - 748) give further instances of underexploited demersal fish stock.

In short, there is every reason to be optimistic that with diversification of fishing to exploit all types of demersal fishery resources, the fish catch rates and production should go up considerably.

Already we have encouraging signs of mechanised boats at centres such as Neendakara and Azhikode along the Kerala Coast being involved with fishing for quality fish such as pomfrets and seerfishes using drift nets at night besides going for prawn fishing during daytime.

The present energy crisis and consequent increase in the fuel cost combined with poor fishing in some inshore areas have now led to the use of

TABLE 15. *The areas of potential fishing grounds*

State|Union Territories	Area in 1000 hectre	
	Upto 50 metres	50-200 metres
West Bengal	994	2,286
Orissa	1,707	2,363
Andhra Pradesh	1,661	3,104
Tamil Nadu including Pondicherry	2,326	4,142
Kerala	1,257	3,594
Karnataka	794	2,547
Goa	285	998
Maharashtra	2,551	10,476
Gujarat	6,481	9,937
Andamans	—	1,533
Nicobar	—	73
Lakshadweep	—	434

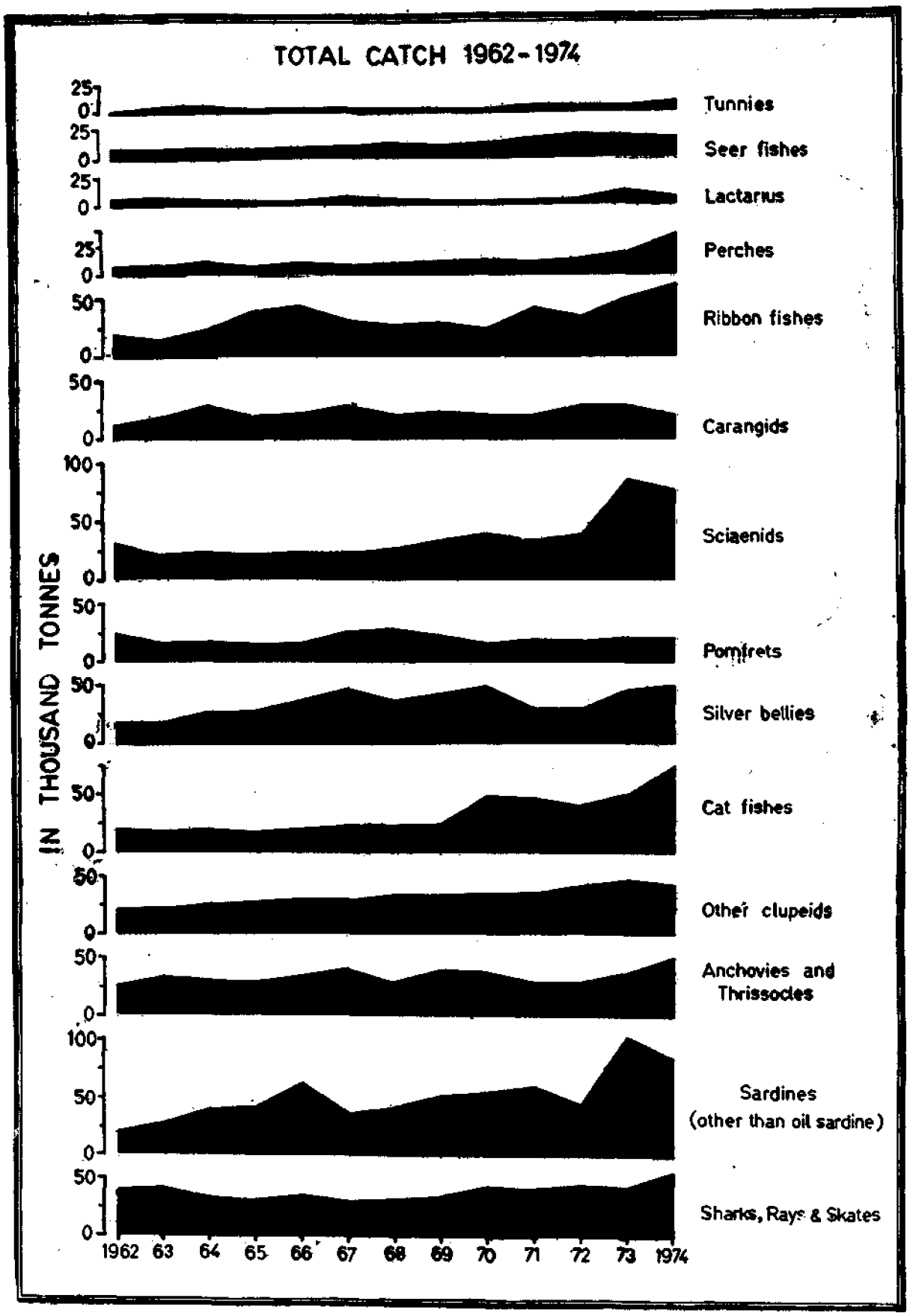


Fig. 8. Total catch of some of the important groups of fishes for the period 1962 - 1974.

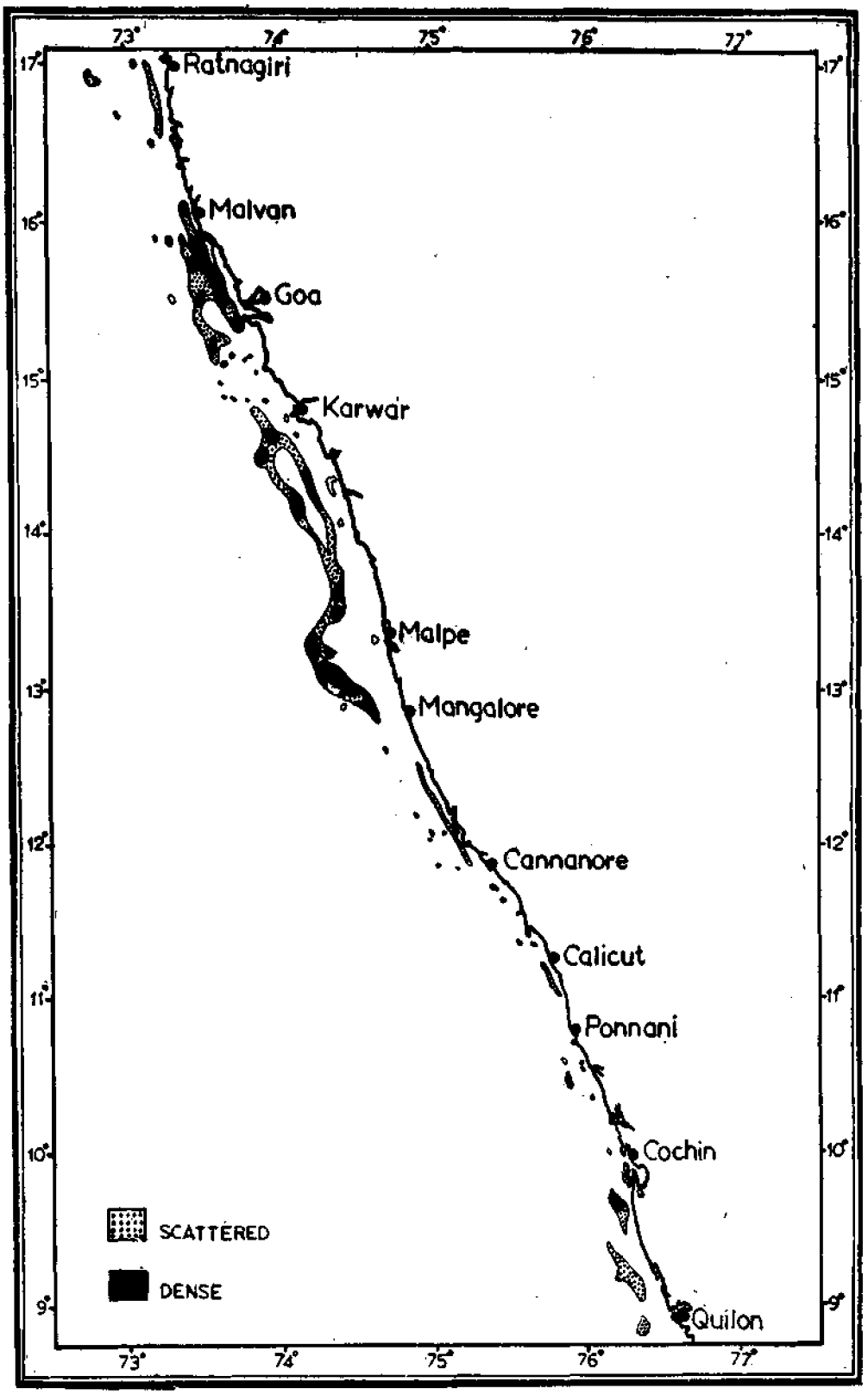


FIG. 9. Pelagic fish school areas along the west coast of India determined from combined aerial survey and vessel observations during October 1972 (after UNDP|FAO Pelagic Fishery Project (IND|93) Progress Report No. 4).

mechanised boats to tow country crafts for drift net fishing in areas beyond 40 m off Calicut resulting in good catches of billfishes and other pelagic fishes seasonally (Balan, MS).

iii. *Conventional pelagic fishery resources available for exploitation*

The Institute's findings are that in the traditional inshore fishing grounds, an increase in the fishing effort will not yield any increase in the catch of pelagic fishes particularly of oil sardine and mackerel. The average annual stock of these two major fisheries for 1960-1971 has been estimated as 57,000 tonnes for mackerel and 4,00,000 tonnes for oil sardine in the present fishing grounds. It has been long suspected that both oil sardine and mackerel resources are available in abundance beyond the traditional fishing grounds. The recent investigations by aerial and acoustic surveys conducted along the west coast of India by UNDP| FAO Pelagic Fishery Project, Cochin (Figs. 9, 10 and 11) have confirmed that both oil sardine and mackerel shoals occur in neritic waters particularly between 19 and 40 fathoms (UNDP|FAO Pelagic Fishery Project Report No. 8) and their salient findings are as follows:

> ". . . . . the sardine schools were in general located closer to the shore than those of mackerel, and there were also clear trends in the school distribution of the different subareas along the coast. The total area occupied by sardine and mackerel schools came to 1,445 nm^2, of which mackerel occupied 55% and sardine 45%. The estimated number of schools was 25,000 for sardine and 36,000 for mackerel. For both sardine and mackerel the area between 10° to 13° was particularly rich, with 84% and 92% respectively, of the total number of schools located in the whole area. . . . . the magnitude of sardine resources at the time of the aerial survey may be assessed as 350,000 to 400,000 tonnes in weight or 1.3×10^{10} to 1.5×10^{10} in numbers. . . . . it is suggested that the right order of magnitude for mackerel resources is about 450 thousand tonnes by weight or 5.5×10^{9} in numbers" (UNDP|FAO Pelagic Fishery Project Report No. 8).

The UNDP|FAO Pelagic Fishery Project (Report No. 2) has confirmed the earlier findings that along the west coast in depths upto 40 m there exists a diversity of species predominantly constituted by the oil sardine, mackerel, *Anchoviella* spp., ribbonfishes, catfishes, silver bellies and lesser sardines estimated a total stock magnitude of several hundred thousand tonnes. The UNDP| FAO Report has also drawn attention to the possibilities to exploring for commercial utilization of these resources particularly of the pelagic stock with relatively smaller vessels that are at present used for trawling in inshore waters for prawns. We would like to cite the following from the Report to emphasise the urgent need for developing a proper action plan for the exploitation and utilization of these resources by the concerned State.

> "This resource is at present almost completely unexploited, and if the fish can find a market it could form the basis of a substantial small vessel fishery. It has the advantage that it is available throughout the year although the total biomass appears to be largest just prior to the southwest monsoon season. It is therefore proposed that experimental pelagic trawl fishing be started with types and sizes of vessels as the existing ones, and that pilot scale experiments of marketing and processing the fish be undertaken, including trails of using the fish for production of fish meal intended for human consumption" (UNDP| FAO Pelagic Fishery Project Report No. 2).

In addition to these significant findings of unexploited and underexploited conventional pelagic fishery resources along the southwest coast and Wadge Bank, there are indications that similar resources of *Anchoviella* spp., lesser sardines, cat fishes and ribbon fishes also occur along the east coast.

Along the east coast we are now aware that there are two species of mackerel *Rastrelliger kanagurta* and *Rastrelliger faughni* and the latter is considered to be an oceanic species, the resources of which are unknown. The mackerel resources of Andamans (*Rastrelliger kanagurta* and *Rastrelliger brachysoma*) are also underexploited at present. Along the southeast coast there are possibilities of developing the flying fish fishery which at present is carried on traditional lines.

Stray catches of large size mackerel from the deeper waters along the Maharashtra Coast and the appearance of oil sardine schools occasionally in the inshore waters along Maharashtra Coast are indications of the possible existence of good pelagic resources of mackerel and sardine in the off-shore waters off Maharashtra as well.

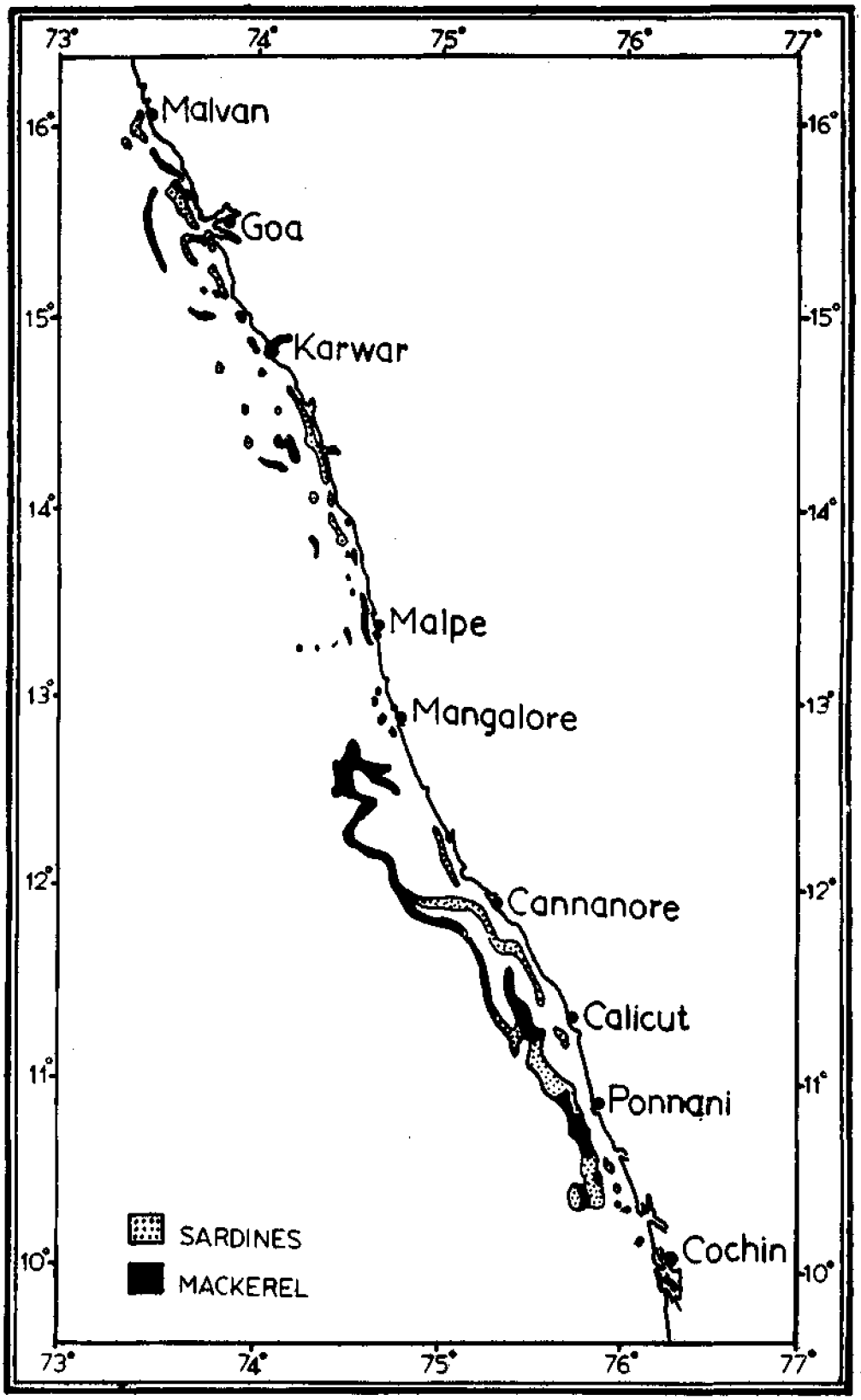


FIG. 10. Sardine and Mackerel schools along the west coast of India observed by aerial survey during September — October 1973 (after UNDP/FAO Pelagic Fishery Project (IND/593) Progress Report No. 8).

iv. *Non-conventional pelagic and demersal fishery resources of the shelf waters for exploitation*

By non-conventional pelagic and demersal fishery resources we mean the harvesting and utilization of such resources which are at present not properly exploited or still remains unexploited. Any overall programme at the exploitation and utilization of such resources should considerably help in the diversification of fishing and a more balanced development of the fishing industry. A few examples should suffice to indicate the possibilities of such planned diversification of fishing to take in non-conventional resources.

A good example would be the development of fishery for cuttle fishes and squids. Until recently, cuttle fishes forming part of the bye-catch in the regular trawling operations were the first item to be thrown out into the sea as there was hardly any local market for these. Another reason for discarding them from the catch was to avoid contamination of the catch, particularly of prawns from the ink ejected from the ink sac of the cuttle fishes and squids. Today there is a rapidly developing export market for cuttle fishes and at present an awareness has crept in for saving cuttle fishes from the bye-catch for supplying to the processors. We are informed that the processed cuttle fish fetches about $ 4 - 4.5|Kg head on and even fin trimmings are salable. Cuttle bone has a traditional internal as well as external market and the statistics compiled by the Marine Products Export Development Authority indicate that 45,642 Kg of cuttle bones were exported during 1973 fetching Rs. 404,944.

There is perceptible improvement in the cuttle fish fishery along our coasts during the last 2 or 3 years inview of the export market demand. We have now information that the landing of cuttle fish may be anywhere between 2 and 11% of the bye-catch in the trawling along the southeast and southwest coasts from depths upto 40 m. Large sized cuttle fish also occur along the Maharashtra and Gujarat waters.

Landings of cephalopods (largely squids and cuttle fishes) in India during 1962-1974 are shown below:

Year	Tonnes	Year	Tonnes
1962	96	1969	769
1963	260	1970	1,184
1964	463	1971	1,505
1965	265	1972	1,026
1966	964	1973	1,394
1967	640	1974	3677
1968	1,617		

Similarly attention has recently been drawn to the occurrence of commercially important species of squids such as *Symplectoteuthis oualaniensis* along the west coast of India (Silas, 1969). There are also good resources of *Loligo* spp. in good concentrations along the west coast of India (Silas, 1969). There are also good resources of *Loligo* spp. in this area but upto now no special fishing methods such as light fishing with jigs, have been taken up for exploiting the squid resources.

Suda (1973) has drawn attention to the large potentiality of Myctophidae in the Indian Ocean and has indicated the importance of this resources in view of their high vitamin 'A' content as well as oil content (110 litres per ton). In Indian Seas myctophids form an important constituent of the Deep Scattering Layers (Silas, 1972). Large concentrations of myctophids occur along the west coast, especially near the Angria Banks, and off the Bombay shelf waters. Exploratory surveys along the upper continental slope off the west coast of India have also shown good concentrations of grenadiers and macrurids (Silas, 1969). We will have to develop proper technologies for harvesting these epi- and mesopelagic resources.

Along the continental edge of the southwest coast as well as on the east and northwest coast of India, large quantities of the swarming crab *Charybdis (Goniohellenus) edwardsi* form a dominant constituent of the demersal fishery resources (Silas, 1969) which at present remains unexploited. Along the southwest coast of India in the depth zone 101 - 179 m catch as high as 3.5 tonnes|hr of trawling of this species have been obtained during the exploratory surveys. The utilization of this resource if not for crab meat atleast for the manufacture of crab meal will have to be explored.

Silas (1969) has drawn attention to the occurrence of large quantities of deep-sea gastropod *Pirula investigatoris* and the deep-sea echinoid *Elipneustes denudates* and several other deep-sea fishes and crustaceans along the upper continental slope off the southwest coast of India. There is an urgent need for evolving some methods for economically harvesting and utilising these and other such resources.

v. *Pelagic oceanic fishery resources for exploitation*

Pelagic oceanic fisheries comprise the fisheries of the fishes and other organisms which inhabit the oceanic realms outside the continental shelf; chiefly they are:

1. *Fishes*: Tunas and related species; bill fishes (Marlins, sailfish, spearfish and swordfish); pelagic sharks; sauries; flying fishes; etc.,
2. *Squids*: Oceanic squids,
3. *Marine Turtle* (now needing conservation measures to protect them, especially the green turtles); and
4. *Whales*: Baleen whales; sperm whales; lesser toothed whales; dolphins and porpoises (some needing urgent conservation measures to protect them from exploitation).

The importance of tunas and billfish resources of the Indian Ocean were well apprised by the Japanese as early as 1952 when they started systematic exploitation in the Indian Ocean using longlines. By 1962 the Japanese were fishing from all over the Indian Ocean, with the longline catch estimated to yield about 150,000 to 175,000 tonnes annually. The landings of billfishes in the Indian Ocean may be to the tune of 15 — 20 thousand tonnes. There is no precise estimate for the landings of pelagic sharks caught in tuna longlining. In quantity it should equal, if not exceed the longline tuna catch. Hence, it may not be unreasonable to estimate a catch of atleast 1.0 to 1.5 lakh tonnes as the catch of pelagic sharks from the Indian Ocean. The sharks caught with this gear are not fully utilized except for their fins.

Besides this, indications are that approximately 40,000 tonnes of tunas are caught in the coastal waters along the Indian Ocean with diverse gears. The introduction of purse seining for coastal species of tunas and tuna like fishes such as *Euthynnus affinis, Thunnus tonggol* and *Sarda orientalis* should considerably increase the overall production. Some species of carangids (horse mackerel) which shoal like tunas in surface waters could also be exploited by purse seine. This resource is hardly exploited at present.

What is most significant is that hardly any effort is at present being expended to harvest the large pelagic resources of tuna-like fishes *viz.*, the skipjack *Katsuwonus pelamis* and the frigate mackerel *Auxis thazard* and *A. rochei* in the Indian Ocean. By using livebait and pole and line in the Lakshadweep and Maldive Archipelago a few thousand metric tonnes of skipjack are harvested at present. Development of suitable techniques for purse seining for surface and subsurface shoals of these species would yield good result.

Recent works of Silas (1968), Filippova (1968) and Clarke (1966) have drawn attention to the occurrence of several commercially important species of squids in the Indian Ocean. Quantitative estimates of these resources are not available, nor are they being exploited at present. We consider this as a potentially important resource for the exploitation of which the areas of abundance have to be located and suitable methods have to be developed for their capture.

In the context of the 200 mile economic zone that may be approved by maritime countries, the stratagy of development of pelagic oceanic fisheries particularly for tunas, bill-fishes, pelagic sharks and squids will have to be reapprised. While the acceptance of this concept universally may be discouragement for further development of large scale distant water fisheries by countries remote from the Indian Ocean, it should enable us to develop capabilities for the proper development and utilization of the pelagic oceanic fisheries in the Indian Ocean.

vi. *Coastal Aquaculture (Mariculture)*

One method of augmenting marine fish production is by the adoption of suitable techniques for coastal aquaculture. There has been a global awareness for the need for developing coastal aquaculture, particularly in view of the uncertainties and large scale fluctuations so chronic of some of the major marine capture fisheries. Although coastal aquaculture has been practiced traditionally in many developing countries, the introduction of more scientific methods and technologies have shown that scientific farming could increase productions several fold.

In India, the potential for coastal aquaculture is considerable taking into account the vast areas along our coast which include inundated areas, coastal lagoons, swamps, etc. which harbour diversified marine and estuarine organisms that could be cultured suitably in such areas.

Fish and prawn culture experiments carried out by the Central Marine Fisheries Research Institude indicate that there is considerable scope

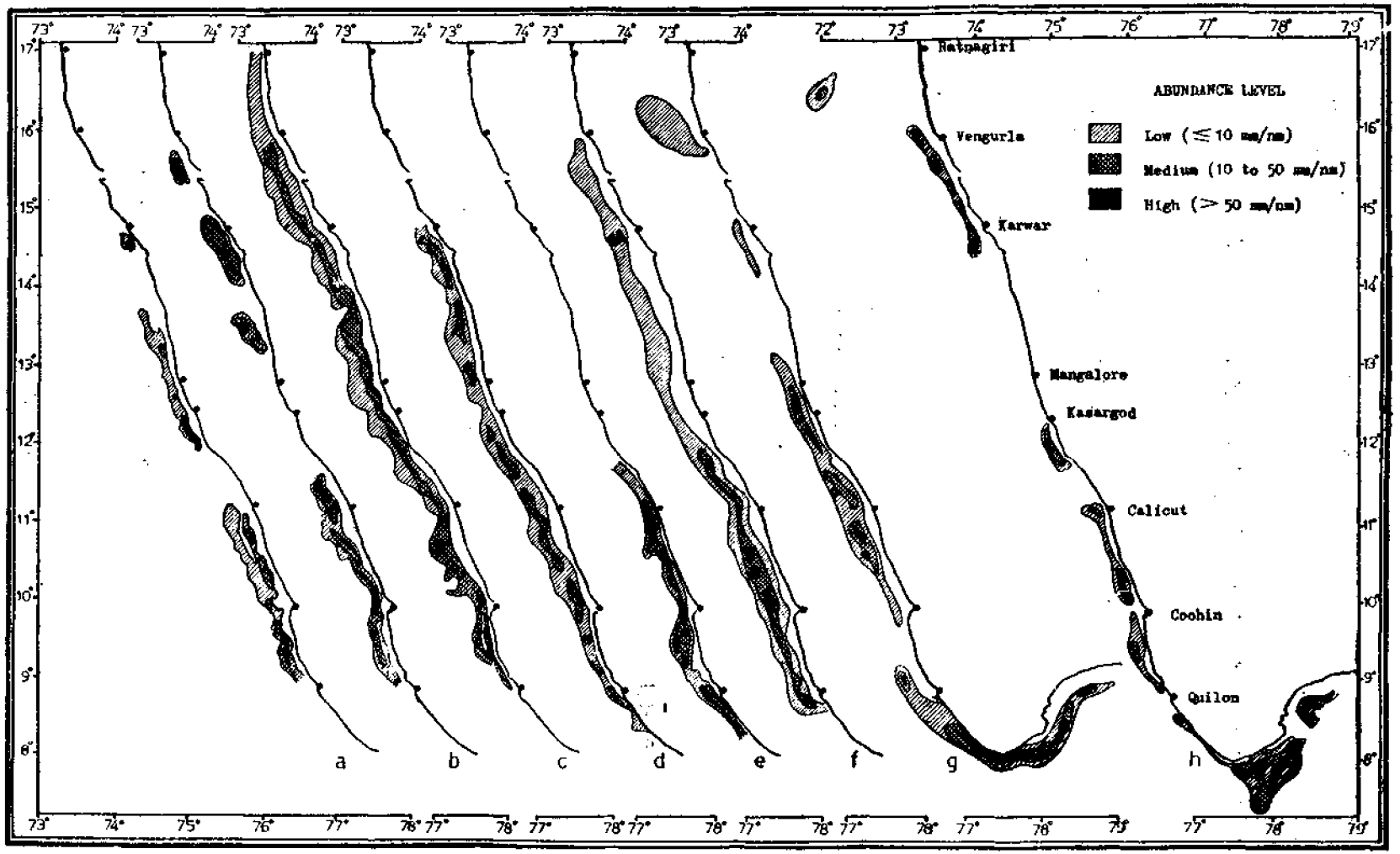


FIG. 11. Distribution and abundance of whitebait recordings during a. 3 October to 2 November 1972; b. 3 October to 2 November 1972; c. 15 January to 3 March 1973; d. 12 March to 12 April 1973; e. 16 to 27 April 1973; f. 11 May to 8 June 1973; g. 12 June to 12 July 1973 and h. 18 July to 25 August 1973 (after UNDP/FAO Pelagic Fishery Project (IND/593) Progress Report No. 6).

have precise data on the Exploited marine fishery resources, the trend in marine fish production area-wise and for the country as a whole, and if possible short-term or long-term predictions. The planned development of the mechanism of collecting, analysing, processing and disseminating these informations on the exploited resources gain more importance in this context. Some of the facts of the exploited marine fishery resources discussed here cover aspects which need continued attention. The Fishery Data Centre of the Central Marine Fisheries Research Institute which has been developed with such an objective is involved with this task. The planned exploration and judicious exploitation of the conventional and non-conventional resources and their utilization are also essential for an integrated development of the Marine Fisheries Sector.

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for improving the production of prawns in the paddy fields (Pokhali fields) and backwater areas in central Kerala and extending such practices to similar areas in coastal Karnataka, Goa and south Maharashtra. The techniques of obtaining prawn seeds in desired quantities and the production of suitable feed for culture practices when perfected will enable large scale farming of quality species thereby not only increasing total prawn production but also improving the economy of the rural areas.

Promising results have been obtained in the culture of edible molluscs particularly the green and brown mussels (*Perna viridis* and *Perna* sp. respectively) in the sea and edible oysters in the estuarine areas. Annual production rates as much as 60 tonnes per hectre have been obtained for the brown mussel.

Culture of fishes such as the milk fish *Chanos chanos,* mullets, *Sillago* sp. and the pearl spot *Etroplus suratensis* have got great possibilities in coastal aquaculture. Elver resources of the fresh water eel *Anguilla bengalensis* and *A. bicolor* are plentiful in certain estuarine locations and there is a good export market for both live elvers as well as eels.

There is considerable scope for the culture of economically important seaweeds in our coastal waters. Culture experiments carried out by the Central Marine Fisheries Research Institute indicated that in species such as *Gracillaria edulis*, 1.25Kg of weeds seeded on ropes in culture frame yielded about 43 Kg (wet weight) within 80 days. Promising results have also been obtained with other species. The possibility of culturing seaweeds in the lagoons in Lakshadweep group of islands and in the protected bays in the Andaman and Nicobar Islands as well as along some areas on the east coast particularly in Gulf of Mannar and Palk Bay are great. This should help to meet our country's need in the production of agar agar, alginic acid and other bye-products such as iodine to meet the requirements of textile, leather, electrical and photographic industries and confectionaries and pharmaceuticals.

Sea cucumber (Holothurians) have a good export market (Beche-de-mer) and can be cultured in the lagoons and protected bays. It will not be too long before proper techniques for the culture of lobsters and other animals such as turtles especially the green turtle *Chelonia mydas* are developed.

vii. *Marine living resources for industrial and pharmaceutical use*

The importance of processed fish in various forms, fish oil, etc. needs hardly any emphasis here.

The technical feasibility of producing cultured pearls of good quality has already been demonstrated by the Central Marine Fisheries Research Institute. The economic feasibility of large scale culture of pearl oysters for the production of cultured pearls in places where oysters are available seems bright. As indicated in the foregoing section the use of seaweeds in the industry as well as pharmaceuticals is manifold. There is considerable demand for seaweeds and the prospect of large scale culture of seaweeds is also bright.

The industrial use of corals for the production of calcium carbonate and in the manufacture of cement and other products is now well known. The exploitation of this resource has, however, many limitations and will have to be done with utmost care.

The Horse shoe crab *Limulus gigas* and *L. moluccanus* plentiful in some areas along the Bay of Bengal, are not commercially fished but they can either be utilized in India in the manufacture of colour films and medicines (blood of *Limulus* which contains traces of copper was believed to be a cure for Cholera) (Lakshminarayana *et al.*, 1972).

There are several other species of marine animals and plants which have medicinal value and the demand for these are likely to grow in the future.

Conclusion

The country's Fifth Five Year Plan envisages a substantial investment of about 160.5 crore rupees (subject to revision) towards the development of fisheries and a bulk of this is earmarked for the development of the marine fisheries, by the Centre as well as by the States, to be spent for the construction of suitable crafts and gear and the setting up of a proper planned infrastructure including the construction of fishing harbours and facilities such as storing, processing and marketing of fishery products on a scale never attempted in the country upto now. Research and Development, and Extension in fisheries are other spheres to be strengthened to a large measure during the plan period. With such an expanded programme in the offing, it is essential that we

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