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Edited and published by : D. Sudarsan, Director, Fishery Survey of India, Botawala Chambers, Sir P. M. Road, Bombay-400 001. Technical Assistance : S. Varghese. Secretarial Assistance : Meena A. Chawla and Helan Paul
Drawing : R. V. John. Printing : A. K. Bhattacharya

1. TUNA RESOURCES OFF THE SOUTH-WEST COAST OF INDIA AS SURVEYED DURING 1986-87

T.E. SIVAPRAKASAM and D. SUDARSAN

INTRODUCTION

The Indian Ocean and the Indian seas are traditionally known for rich resources of tuna and tuna-like fishes. Several foreign countries including Japan, Taiwan and Korea were known to be fishing for tuna in the Indian waters since the early fifties. Fishing pressure became so intense that the catch rates of tuna steadily came down over the years and even overfishing of yellowfin stock was reported. The tuna and tuna-like fishes are migratory and global in distribution. The recent concept of Exclusive Economic Zones extending the sovereignity upto 200 nautical miles by most of the coastal nations had a tremendous effect on tuna fisheries. India declared a 200 mile Exclusive Economic Zone during 1976 and as a result the foreign fishing vessels could not freely fish in Indian waters. The resultant reduction in fishing pressure appears to have lead to the recovery of stocks which at present are perhaps at a near virgin state. This is obvious from the tuna catch rate obtained prior to 1976 and in the very recent past.

Although tuna resources of the Indian waters were known from the fishing by foreign vessels during the fifties and sixties, India could not exploit these resources for many reasons such as non-availability of distant water fishing vessels, lack of precise knowledge on the resources and lack of expertise. The Govt. of India, however, had made several attempts to develop the tuna fishery since early sixties. The earlier efforts made in this direction are dealt with by several authors (Eapen, 1964; Joseph, 1972; FAO, 1967, 1976). Organised attempts to survey tuna reesources, train Indian personnel and develop the expertise in tuna long line fishing were however started only in 1980. **Matsya Sugundhi** a tuna long line survey vessel and **M.V. Prashikshani** a tuna training vessel were acquired under Japanese aid. Since the arrival of a Japanese expert in October 1983 these vessels were effectively utilised for survey of tuna resources and training in tuna long line fishing. The initial results of surveys by **Matsya Sugundhi** of Fishery Survey of India operated from the Cochin Base have been well documented. Varghese et al. (1984) dealt

with the period April 1983 to March 1984, Joseph (1986) and Sulochanan et al. (1986) dealt with the period from October 1983 to December 1985. Sivaprakasam and Patil (1986) presented a detailed account of the results of the surveys during the period April 1985 to March 1986 when a break-through was made and exciting information collected on the tuna resources. The results of tuna long line fishing and training by **Prashikshani** are presented by Swaminath et al. (1986). The results of training cruises also yielded valuable information and corroborated the findings of **Matsya Sugundhi.**

The study on tuna resources by Sivaprakasam and Patil (1986) and Swaminath et al.(1986) evoked enthusiastic reaction and interest from the fishing industry as well as Government agencies. While some fishing companies made special requests for a confirmatory survey for one more year, some other companies were already convinced with the availability of tuna resources and made applications to the Govt. for chartering and/or importing tuna long line vessels. The present paper deals with the results of the confirmatory tuna long line survey along south west coast during 1986-87. The survey has confirmed the availability of commercial concentrations of tunas and tuna-like fishes off the south west coast. The surveys have further revealed the availability of resources for 9 months in a year, the remaining three months from June to August being the monsoon season when operational difficulties came in the way of full scale survey operations.

FEATURES OF THE SURVEY

The tuna long line survey vessel **Matsya Sugundhi** (31.5 m OAL, 248 GRT, 650 BHP) was operated from the Cochin base of Fishery Survey of India and deployed for the survey of the oceanic deep swimming tuna resources of the south west coast between lat. 5°N to 15°N and long. 69°E to 79°E (both inclusive) within the Indian Exclusive Economic Zone. The survey was a confirmatory one in the sense that attempts were made to substantiate the results obtained during the previous year. Fishing programme was drawn up in such a way that each one degree (latitude x longitude) square was surveyed atleast once in a quarter. However, for reasons of logistics this could be achieved only in the case of northern latitudes. Surveys were conducted throughout the year for 12 months unlike the previous

year when no information was available for two months. This has enabled us to get very interesting information on extension of the fishing season for 9 months from September to May, as against earlier findings that the season extended only for 6 months from October to March. The tuna long line gear and the bait fish used were the same as in the previous year. As total number of 88,200 hooks were operated during the year. As experienced during the previous year the heavy fish catches and the limited freezing capacity adversely affected continued operations. This brings the total number of hooks operated in the south west coast during the period 85-86 and 86-87 to 1,53,650 hooks. The distribution of the sampling effort in terms of number of hooks operated in each square is presented in Fig.1. It will be seen that during the south-west monsoon months of June and July the effort was low because of difficulties of operation during rough weather.

The data collected were analysed on areawise and monthwise basis to study the distribution of the tuna and tuna-like fishes in space and time. For this purpose the hooking rate (%) or the number of fish hooked per 100 hooks in respect of tunas, bill fishes, sharks and other fish were worked out. Seasonal variations in the tuna long line catch rate are presented on a monthwise basis without reference of areas. The variation in the tuna long line catch rate with reference to months as well as areas with special reference to all fish and tunas are presented seperately. The percentage composition of tuna long line catches by numbers and weight for the whole year is worked out and compared with results obtained during earlier operations.

RESULTS

The species composition of tuna long line catches was the same as reported during the previous year and hence not repeated here.

The total hooking rate for all fishes combined, on areawise basis (not individual sets) varied from 0.13 to 28.13%. A higher hooking rate is apparent

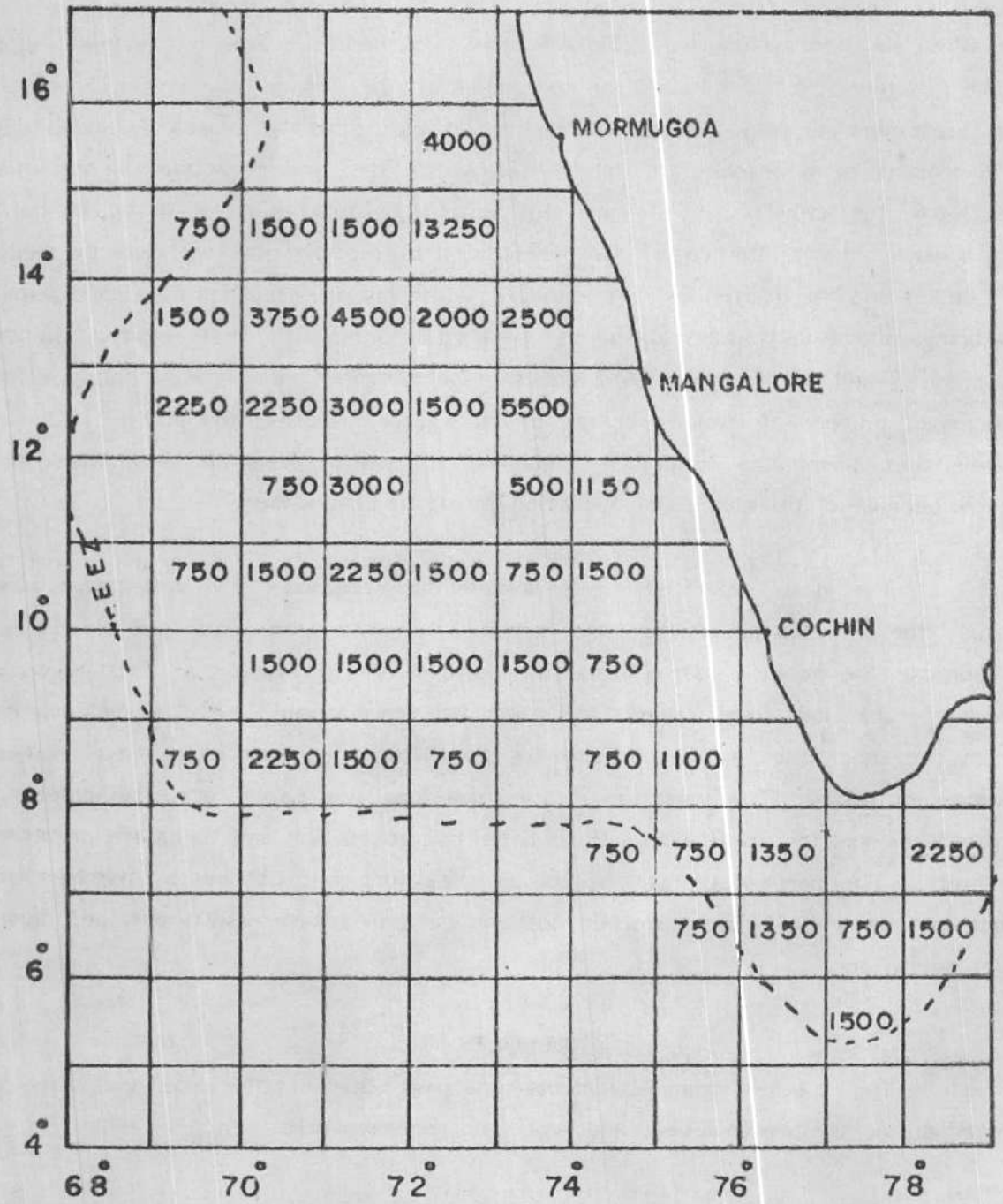

Fig. 1 AREA-WISE DISTRIBUTION OF SAMPLING EFFORT (HOOKS OPERATED)

in the higher latitudes. The latitude-wise hooking rate is as follows:

Latitude (°N)	All fish	Tuna	Latitude (°N)	All fish	Tuna
5	1.47	0.8	11	3.41	2.55
6	1.65	0.78	12	8.21	6.19
7	1.94	0.39	13	9.81	7.69
8	3.22	1.25	14	14.44	10.79
9	1.3	0.34	15	23.57	20.06
10	1.2	0.34			

(Latitude 5° denotes area between latitudes 5° and 6° and so on)

It may be noted that tunas also show a pattern of higher hooking rate in higher latitudes. The annual average rate for the entire area for all fish and tunas seperately were 7.69 and 5.64% respectively. The hooking rate of all fish and tunas vary considerably in the 1° squares in the same latitude (Fig. 2). These are presented for the whole year and on a monthwise basis in Table 1 and Fig.3 (a-l) respectively. The hooking rates of bill fishes, sharks and other fishes on a squarewise basis and also on latitude basis for the whole year can be seen in Table 1. They do not show any definite pattern of abundance in relation to latitudes. However, sharks show an increasing hooking rate with the increasing latitudes.

The seasonal variation in the tuna long line catches are presented on a monthwise basis in Table 2. The hooking rate for all fish varied from 1.26 to 15.15 with the highest rates in February, April and December. A general increase in the catch rate is observed from September to May. However, the ups and downs may also be due to fishing in the different areas in different months. In respect of tunas also a similar trend is observed which may also be for the same reason.

The seasonal variation in the hooking rates of all fish and tuna are presented on areawise and monthwise basis in Fig.3 (a-l). The figure enables choosing the best areas of abundance in each month for the purpose of commercial tuna long line operation.

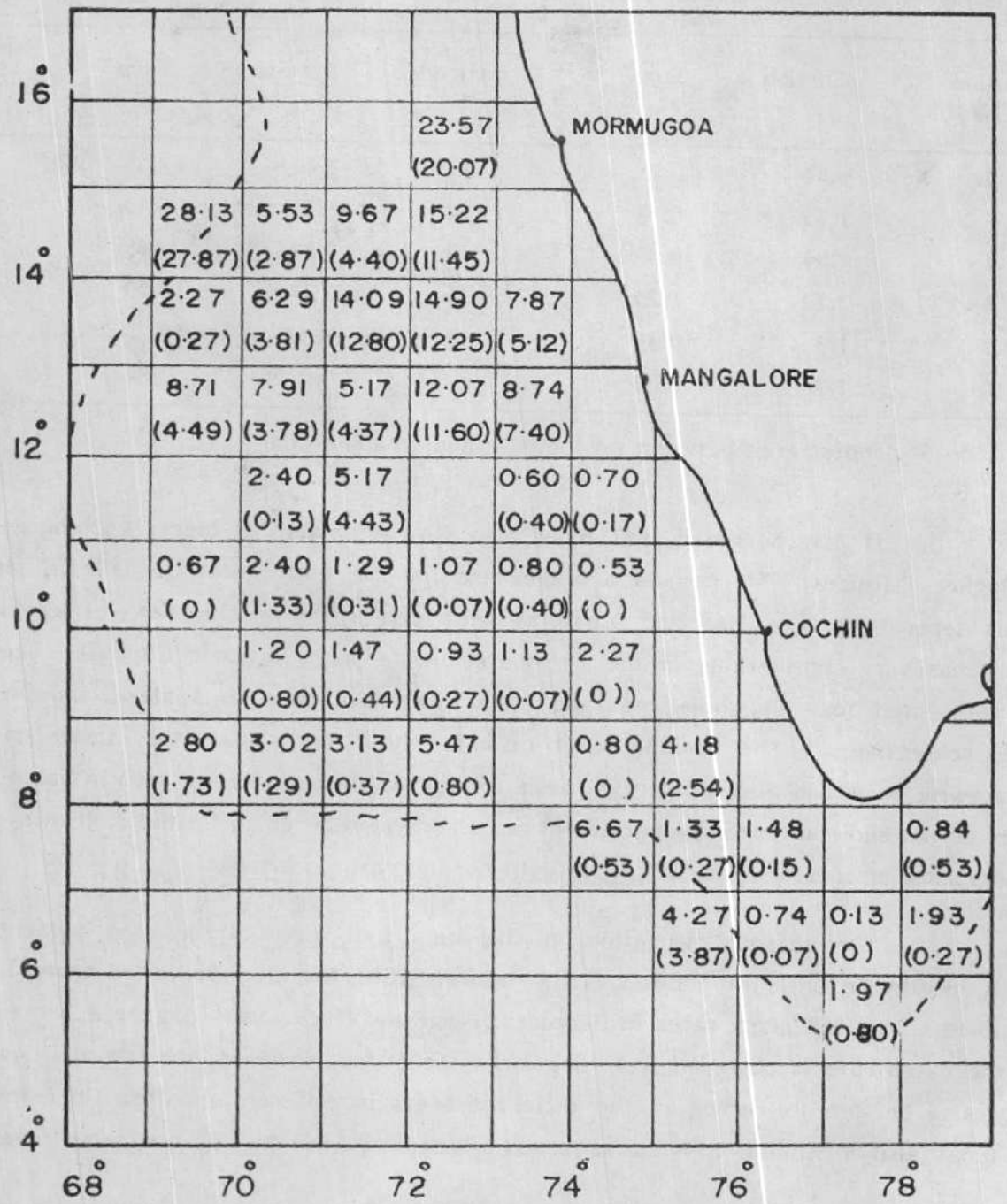

Fig.2 HOOKING RATE (%) ALL FISH AND TUNAS (IN BRACKETS) OBTAINED IN LONG LINE SURVEY DURING APRIL 1986 TO MARCH 1987

Table 1: Results of tuna long line survey conducted during April 1986 to March 1987 in the Arabian Sea off south west coast of India

Area	No.of hooks operated	Total hooking rate(%)	Hooking rate(%)			
			Tunas	Bill fishes	Sharks	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5-77	1500	1.47	0.80	0.07	0.60	-
Lat. 5°N	1500	1.47	0.80	0.07	0.60	-
6-75	750	4.27	3.87	0.13	0.27	-
6-76	1350	0.74	0.07	0.30	0.22	0.15
6-77	750	0.13	-	-	0.13	-
6-78	1500	1.93	0.27	0.13	1.53	-
Lat. 6°N	4350	1.65	0.78	0.16	0.67	0.04
7-74	750	6.67	0.53	0.27	5.87	-
7-75	750	1.33	0.27	0.27	0.80	-
7-76	1350	1.48	0.15	0.89	0.44	-
7-78	2250	0.84	0.53	0.04	0.27	-
Lat.7°N	5100	1.94	0.39	0.33	1.22	-
8-69	750	2.80	1.73	0.27	0.80	-
8-70	2250	3.02	1.29	0.13	1.55	0.04
8-71	1500	3.13	0.87	0.40	1.87	-
8-72	750	5.47	0.80	0.13	4.53	-
8-74	750	0.80	-	0.27	0.54	-
8-75	1100	4.18	2.54	0.81	0.81	-
Lat.8°N	7100	3.22	1.25	0.32	1.63	0.01

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(1)	(2)	(3)	(4)	(5)	(6)	(7)
9-70	1500	1.20	0.80	0.27	0.13	-
9-71	1500	1.47	0.40	0.53	0.53	-
9-73	1500	1.13	0.07	0.07	1.00	-
9-72	1500	0.93	0.27	0.27	0.40	-
9-74	750	2.27	-	-	2.27	-
Lat.9°N	6750	1.30	0.34	0.25	0.71	-
10-69	750	0.67	-	0.13	0.53	-
10-70	1500	2.40	1.13	0.13	1.13	-
10-71	2250	1.29	0.31	0.35	0.62	-
10-72	1500	1.07	0.07	0.13	0.87	-
10-73	750	0.80	0.40	0.13	0.27	-
10-74	1500	0.53	-	-	0.47	0.07
Lat.10°N	8250	1.21	0.34	0.17	0.69	0.01
11-70	750	2.40	0.13	0.27	2.00	-
11-71	3000	5.17	4.43	0.27	0.43	0.03
11-73	500	0.60	0.40	0	0.20	-
11-74	1150	0.70	0.17	-	0.52	-
Lat.11°N	5400	3.41	2.55	0.18	0.65	0.03
12-69	2250	8.71	4.49	0.49	3.73	-
12-70	2250	7.91	3.78	1.02	3.02	0.09
12-71	3000	5.17	4.37	0.30	0.43	0.07
12-72	1500	12.07	11.60	-	0.47	-
12-73	5500	8.74	7.40	0.24	1.05	0.05
Lat.12°N	14500	8.21	6.19	0.38	1.59	0.05

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(1)	(2)	(3)	(4)(	(5)	(6)	(7)
13-69	1500	2.27	0.27	0.40	1.60	-
13-70	3750	6.29	3.81	0.27	2.21	-
13-71	4500	14.09	12.80	0.24	0.95	0.09
13-72	2000	14.90	12.25	0.65	1.95	0.05
13-73	2500	7.84	5.12	0.40	2.20	0.12
Lat.13°N	14250	9.81	7.69	0.35	1.71	0.06
14-69	750	28.13	27.87	-	0.27	-
14-70	1500	5.53	2.87	0.40	2.27	-
14-71	1500	9.67	4.40	0.93	4.27	0.07
14-72	13250	15.22	11.45	0.84	2.75	0.18
Lat.14°N	17000	14.44	10.79	0.77	2.73	0.15
15-72	4000	23.57	20.07	0.30	3.10	0.10
Lat.15°N	4000	23.57	20.07	0.30	3.10	0.10
Total	88200	7.69	5.64	0.38	1.61	0.06

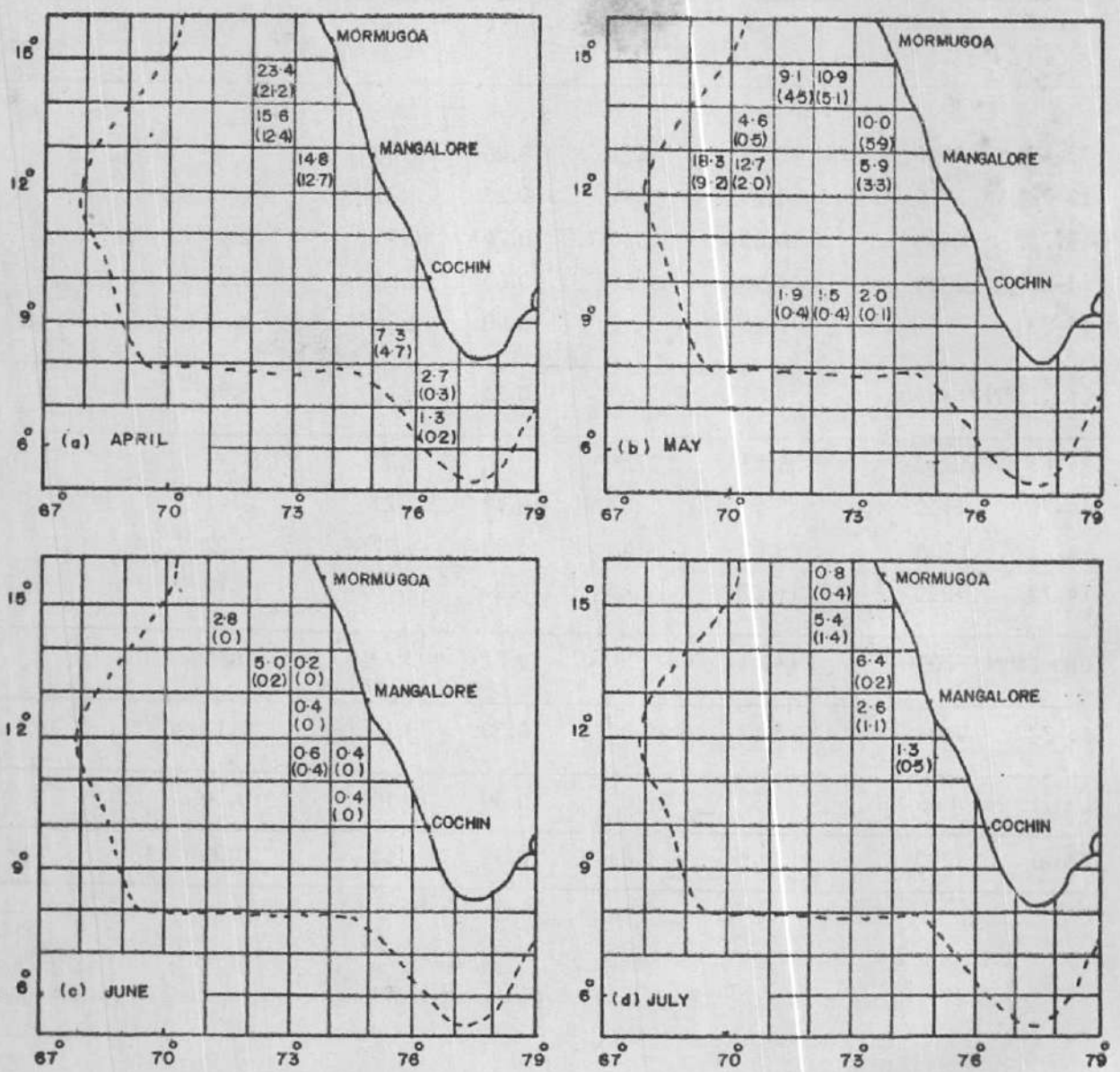


Fig. 3 a-l. AREA-WISE HOOKING RATE (%) OF ALL FISH AND TUNA (IN BRACKETS)- MONTHLY DISTRIBUTION

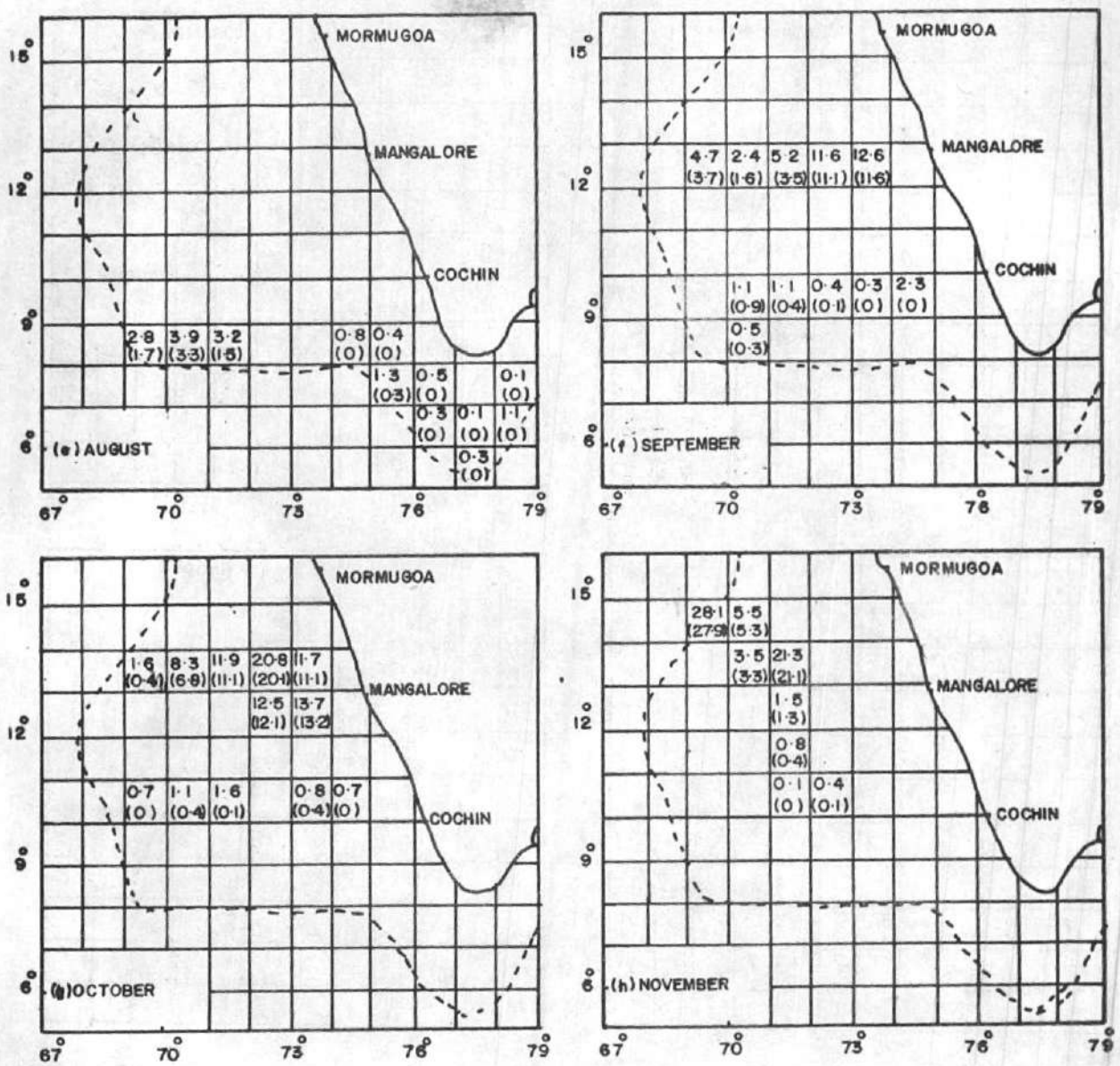
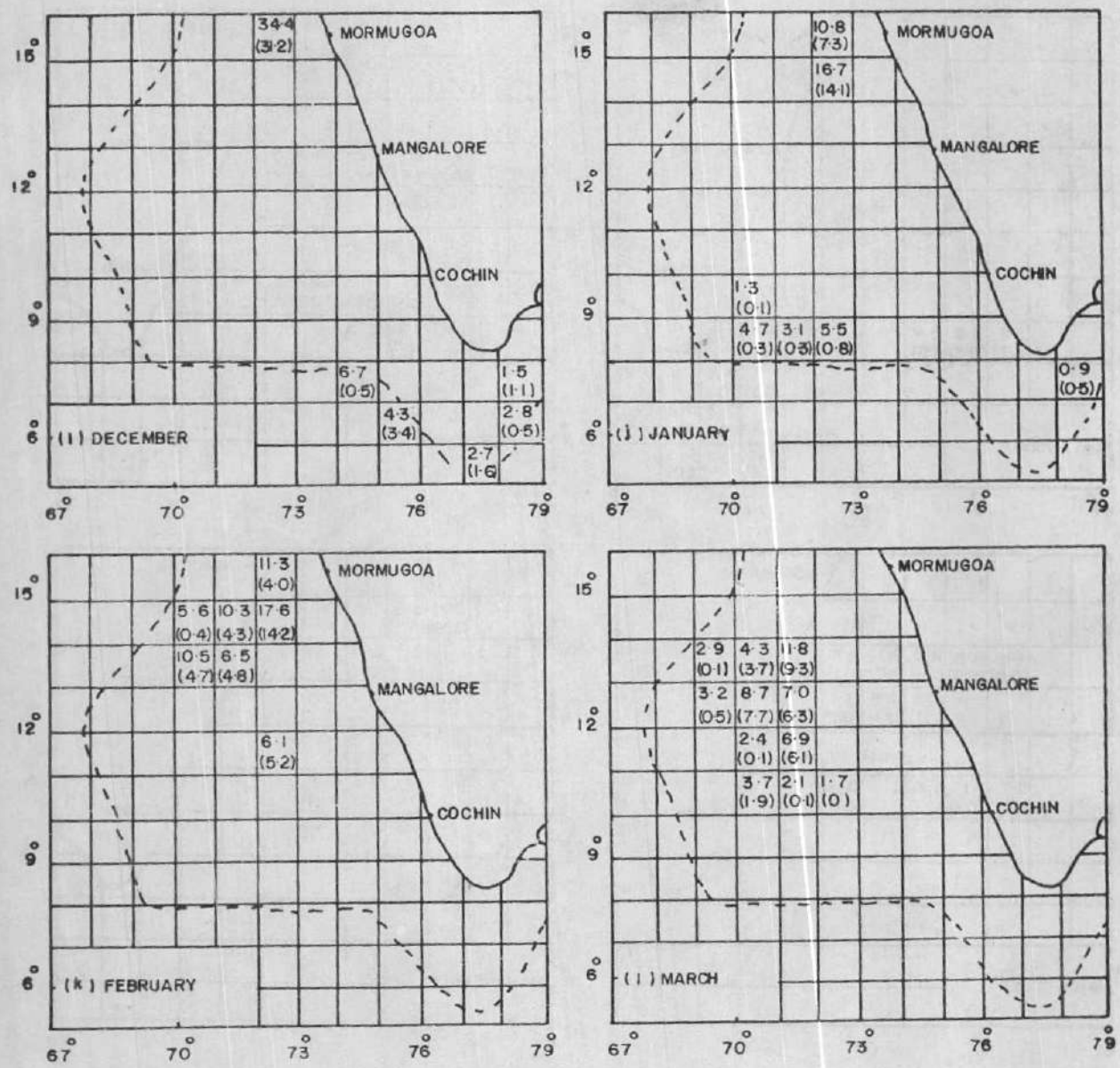


Fig.3 (CONTINUED) , e — h



Fig·3 (CONTINUED) , i— l

Table 2: Seasonal variation in tuna long line catch rates

Month	No.of hooks operat-ed	Total hooking rate (%)	Hooking rate (%)			
			Tunas	Bill fishes	Sharks	Others
Apr 1986	5550	14.81	12.52	1.14	1.06	0.09
May 1986	10250	8.55	3.68	1.06	3.77	0.03
June 1986	4000	1.27	0.07	0.10	0.98	0.12
July 1986	3400	3.68	0.94	0.56	1.97	0.21
Aug 1986	8750	1.26	0.58	0.13	0.54	0.01
Sept 1986	9000	4.55	3.74	0.22	0.60	-
Oct 1986	9000	7.11	6.37	0.18	0.53	0.03
Nov 1986	6750	9.15	8.96	0.06	0.13	-
Dec 1986	6000	15.15	12.90	0.23	2.00	0.02
Jan 1987	6000	7.45	4.75	0.35	2.28	0.07
Feb 1987	9000	13.01	9.02	0.28	3.57	0.14
March 1987	10500	5.74	4.12	0.30	1.25	0.07
Total	88200	7.69	5.64	0.38	1.61	0.06

Composition of tuna long line catches

The percentage composition of tuna long line catches by numbers as well as by weight are presented in Table 3. It will be seen that by numbers, tunas formed 73.36%, bill fishes 4.98%, sharks 20.92% and other fish 0.72%. By weight tunas formed 77.92%, bill fishes 5.63%, sharks 60.35% and other fish 0.08%. Among the tunas, yellowfin tuna formed 98% by number and 99% by weight. The big-eye and skipjack were negligible and for this reason all the tuna species were clubbed together for the purpose of areawise and monthwise analysis.

DISCUSSION

The present survey is much more exhaustive, intensive and wider in coverage than that of 1985-86. A total number of 88,200 hooks were operated as against 65,450 hooks operated during the previous year. While the present survey covered all the 12 months of the year, the survey in 1985-86 covered only 10 months. The latitude 15°N was surveyed for the first time during the present survey. Comparison of the hooking rates of all fish and tunas in each latitude during the two surveys are presented below.

Latitude (°N)	1985-86		1986-87	
	All fish	Tuna	All fish	Tuna
5	2.87	0.26	1.47	0.80
6	1.64	0.18	1.65	0.78
7	1.27	0.40	1.94	0.39
8	1.64	0.52	3.22	1.25
9	1.90	0.26	1.30	0.34
10	1.85	0.52	1.21	0.34
11	2.12	0.07	3.41	2.55
12	7.86	5.79	8.21	6.19
13	9.56	6.82	9.81	7.69
14	20.61	18.00	14.44	10.79
15	-	-	23.57	20.07
Average	8.11	6.09	7.69	5.64

Table 3: Percentage composition of tuna long line catches

	Yellow fin tuna	Big-eye tuna	Skipjack tuna	Marlin	Sail fish	Sword fish	Sharks	Others
By numbers	71.79	0.17	1.40	1.34	3.29	0.35	20.92	0.72
		73.36			4.98			
By weight	77.41	0.30	0.21	2.30	2.89	0.44	16.35	0.08
		77.92			5.63			

Similarly the hooking rates obtained during the two surveys are presented on a monthwise basis in the ensuing statement.

Month	1985-86		1986-87	
	All fish	Tuna	All fish	Tuna
April	Survey elsewhere		14.81	12.6
May	1.80	0.26	9.55	3.68
June	1.43	0.34	1.27	0.07
July	1.44	0.16	3.68	0.94
August	Dry dock repairs		1.26	0.68
September	2.23	0.29	4.55	3.74
October	8.15	6.30	7.11	6.37
November	8.83	6.50	9.15	9.96
December	8.83	5.94	15.15	12.90
January	27.35	24.98	7.45	4.75
February	12.87	10.92	13.01	4.00
March	20.93	17.30	5.74	4.12

A comparison of the percentage composition of tuna long line catches by numbers and weight during the years 1985-86 and 1986-87 are given hereunder.

Year	Yellowfin tuna	Big eye	Skip-jack	Mar-lin	Sail fish	Sword fish	Sharks	Others
1985-86								
By numbers	74.83	0.26	0.67	1.41	2.01	0.47	20.18	0.90
		75.10			3.99			
By weight	74.62	0.35	0.09	2.74	1.67	0.34	21.10	0.05
		75.06			4.20			
1986-87								
By numbers	71.79	0.17	1.40	1.34	3.29	0.35	20.92	0.72
		73.36			4.98			
By weight	77.41	0.30	0.21	2.30	2.89	0.44	16.35	0.05
		77.92			5.63			

It will be seen from the comparative account presented above that the results obtained during 1986-87 not only confirm the findings of 1985-86 but also show considerable improvement in the catch rate, composition, etc. During 1985-86 no data were available for the latitude 15°N. There has been considerable improvement in the catch rate in respect of other latitudes. However, the latitude 14°N shows a fall in the hooking rates from that of the previous year presumably because this latitude was not fished during the peak months September, October, December and March.

During 1985-86 no data were available for south west coast in April and August 1986 whereas during 1986-87 data are available for all months. Besides improvement in the catch rates, the present survey shows that the tuna season is much longer, starting from September onwards and lasting till May. The remaining months are monsoon months and operations during rough weather was considerably difficult and therefore effort was less during June - July and operations were restricted to nearby areas during August'86. The total hooking rate was less during January and March this year as more sampling effort was employed in latitudes 7°, 8° and 9°N during January and in 10° and 11° in March as compared to the previous year. The hooking rate of tuna was also markedly low during January-March for this reason. Further encouraged by our findings during 1985-86 (Sivaprakasam and Patil, 1986) tuna long liners including a dozen chartered vessels are reported to be fishing in this area.

It has been seen that the commercial fishing fleet may not necessarily be able to get the highest catch rate obtained in random sampling in a survey, but the catch rates in the higher ranges are possible and could be used for the feasibility studies. The highest catch rates in individual sets obtained and the corresponding areas in the year 1985-86 and 1986-87 are presented monthwise in Table 4. This will given an insight into the magnitude of the resource and possible catch rates.

A comparison of the percentage composition shows a close agreement in the composition of catch during the two years. By numbers the tunas have slightly come down but by weight they have increased during the present survey.

Table 4: Highest hooking rates in individual sets obtained by Matsya Sugundhi during 1985-86 and 1986-87

Month	1986-87			1985-86		
	Area	Highest hooking rate		Area	Highest hooking rate	
		All fish	Tuna		All fish	Tuna
April	14-72	29.47	27.60		Survey elsewhere	
	14-72	29.07	27.46			
	13-72	15.60	12.40			
May	12-69	18.27	9.20	5-77	3.73	0.40
	12-70	12.67	2.00	6-77	2.27	0.26
	13-73	10.00	5.87	9-75	2.16	-
June	13-72	5.00	0.20	9-72	2.67	0.50
	14-72	2.80	0.00	9-70	1.47	0.13
				10-74	1.47	0.13
July	14-72	7.40	2.00	13-70	5.60	0.53
	13-73	6.40	0.20	12-72	1.73	0.66
				14-70	1.50	-
August	8-70	3.87	3.07	Dry docking repairs		
	8-71	3.20	1.33			
	8-69	2.80	1.60			
September	12-73	21.20	20.27	10-70	5.67	2.50
	12-72	11.60	11.07	11-69	5.50	-
	12-71	5.20	3.47	11-70	4.17	0.16
October	13-72	20.80	20.13	14-72	26.67	23.87
	12-73	13.73	13.20	13-73	12.13	7.73
	12-72	12.53	12.13	12-73	5.60	3.73
November	14-69	28.13	27.87	14-71	22.67	20.50
	13-71	21.27	21.07	14-72	20.83	16.83
	14-70	5.46	5.33	14-70	10.17	4.50

Contd.....

Month	Area	Highest hooking rate		Area	Highest hooking rate	
		All fish	Tuna		All fish	Tuna
December	15-72	44.00	40.53	13-72	15.50	13.00
	15-72	30.43	27.47	14-72	14.33	9.34
	15-72	29.20	27.60	14-71	8.92	7.41
January	14-72	21.87	20.13	14-72	41.80	38.27
	14-72	11.47	8.00	14-72	40.80	39.00
	15-72	10.80	7.20	14-72	38.67	37.20
February	14-72	28.53	26.80	14-72	43.87	41.60
	14-72	23.73	18.40	14-71	41.00	37.83
	14-72	16.13	12.80	13-71	9.83	7.33
March	13-71	12.13	8.93	14-72	36.13	33.30
	13-71	11.47	9.73	12-73	28.67	22.33
	12-70	8.67	7.74	13-72	23.15	19.58

The overall conclusion that could be reached from the present survey are summarised below.

1. The survey confirms beyond doubt the availability of tunas and tuna-like fishes in high commercial concentrations. Presently these resources are practically unexploted except for one private and two Govt. of India vessels and about a dozen chartered vessels. The high concentration of tunas are likely to last for several years to come until there is considerable fishing pressure on these stocks.

2. The tuna resources are practically available throughout the year with high concentration for over 9 months in a year. The season starts from September and lasts till May with peak catches during October to March. During monsoon months from June to August also these resources are available in lesser concentrations.

3. A very high concentration of tunas from lat. 12°N to 15°N is obvious. The present survey shows that the highest concentration is in 15°N off Goa. Commercial ventures could therefore concentrate their operations in the EEZ between these latitudes. It is possible that the concentration extends to even northern latitudes beyond 15°N but we have no information about the resources of these areas.

4. The tuna stocks off south-west coast appear to be practically virgin. The hooking rates obtained by foreign fishing vessels and our own exploratory fishing vessels during fifties and sixties were very low. The average rates obtained now are very high and almost five to six times of the earlier rates. This shows that with the declaration of 200 miles EEZ in 1976 tuna recovered completely because of near total absence of fishing pressure.

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II. TUNA RESOURCES OFF THE EAST COAST OF INDIA AS REVEALED BY CHARTER OPERATIONS

M.E. JOHN, S.M. PATIL and V.S. SOMVANSHI

INTRODUCTION

There is no organised large scale fishery in India to tap the tuna resources. However, in the small-scale sector there is a regular fishery around Lakshadweep islands for the exploitation of skipjack. The pole and line fishery around Lakshadweep produces about 3,000 tonnes of skipjack tuna a year. Tuna landings elsewhere in India (20,500 tonnes) are mainly of the coastal tuna species landed by traditional craft by gill netting, line fishing and trolling. They are also caught in shore seines and purse seines.

Beyond the continental shelf, the oceanic waters within our EEZ are believed to support a commercial fishery based on tuna, the major oceanic resource. However, the tuna fishery is comparatively capital intensive and requires technical know-how, vessels, manpower and infrastructure facilities. In order to acquire these capabilities, Government of India have adopted several measures namely, acquisition of survey vessels, training of personnel and acquisition of commercial fleet of tuna vessels under the import, charter and joint venture schemes.

Survey of tuna resources over a long duration is essential for reliable assessment of the stocks. However, the survey already conducted in a few sections of the EEZ at best provides only indicative data. For making even preliminary estimates of the widely distributed resources in the vast areas of 2.02 million sq km around the Indian subcontinent and the groups of islands, more intensive and exhaustive survey coverage is needed. While building up our own fleet of tuna vessels of required strength is a long term strategy, charter and joint ventures are being implemented as immediate measures to create the necessary impetus. The results of the survey conducted during 1986-87 by the FSI vessel, **Matsya Sugundhi** in south-west coast are presented in the first part of this bulletin. The results of about a dozen chartered vessels engaged in tuna fishing off the east coast of India during 1985-88 are presented in this account which could be of interest to the fishing industry, financing agencies, and all others concerned with development of tuna fishery.

VESSELS AND GEAR

Among the 12 tuna long liners operated in Indian waters 11 vessels have done some of their voyages exclusively off the east coast of India during July 1985 to January 1988 as per details given below.

Sl. No.	Name of the vessel	Voyage period From	To	Days at sea	Days fished
1.	Kin Sin No.11	2.7.85	30.7.85	29	26
		24.1.86	7.4.86	74	58
		19.12.86	11.3.87	83	59
2.	Kin Sin No.16	21.2.86	7.4.86	46	38
		3.2.87	12.3.87	37	33
3.	Shin Lung No.102	10.1.86	13.3.86	63	51
4.	Shin Lung No.12	17.1.86	5.3.86	48	37
5.	Shin Yeou No.1	10.1.86	1.4.86	82	57
6.	Shin Yuh No.101	17.1.86	5.3.86	48	37
7.	Yung Hai	5.3.86	7.4.86	34	31
8.	Hsin Cheng Fa No.16	23.1.87	11.3.87	48	43
9.	Hsin Cheng Fa No.32	23.1.87	11.3.87	48	43
10.	Hai Fa No.11	13.2.87	29.3.87	45	39
11.	Hsin Chene Fa No.16	10.12.87	25.1.88	46	42

Chartering companies:

Sl. No. 1 & 2 : M/s Young Fisheries Pvt.Ltd., New Delhi.

Sl. No. 3 to 6 : M/s Srinivasa Sea Foods Ltd., Visakhapatnam

Sl. No. 7 : M/s Akama Marines Ltd., Visakhapatnam

Sl. No. 8 & 9 : M/s Coastal Trawlers Ltd., Visakhapatnam

Sl. No. 10 & 11 : M/s Star Marine Foods Pvt.Ltd., Hyderabad.

The vessels are of 41-47 m OAL with GRT in the range of 365-492 tonnes. The entire fleet was operating with Madras as the port of call.

The vessels used tuna long line gear, mostly of seven branches per basket. Number of hooks immersed, though varying in different vessels, was about 2100 per set on an average. General scheme of operation was essentially the same as practiced by the tuna long liners of the Government of India, **Matsya Sugundhi** and **Prashikshini** and the only vessel in private sector, **M.V. Lewis**, operating in the country. Shooting of line begins in early dawn, usually between 0300 and 0400 hours and is completed in 3-4 hours. Once the setting is over, the vessel drifts till commencement of hauling by mid-day. The hauling takes about 10-16 hours.

The complement of foreign crew on these chartered vessels generally consist of one Captain, one or two Engineers, one Fishing Mate, one Radio Officer and 14-22 sailors. As per stipulation in the charter agreement all the vessels employ Indian crew equal to 20% of the total crew strength.

FISHING CRUISES AND FISHING EFFORT

After entry to the Indian waters the vessels generally make voyages of 3 to 4 months, divided into 2-3 segments of about 45 days each. In 14 such voyages/part voyages the vessels operated exclusively off the east coast as indicated earlier. Voyages, part of which are operated elsewhere in the EEZ or in other oceanic regions, are not considered in this study. The 14 voyages covered a total of 731 days at sea with 594 days fishing. The ratio of fishing days to days at sea varied from 70 to 90% in case of different vessels, with an average of 81.3%. The aggregate fishing effort worked out to about 12.5 lakh hooks.

DATA BASE

Data considered in this paper is the effort and catch details of 594 sets of long line fishing. After each segment of the voyage the vessels call at port which enables inspection of the operational details as well as catch by the designated officers of Fishery Survey of India. From the ship's log book maintained by the Captain as well as from the fishing log book kept by Indian Skipper/Bosun, the designated officers extract the required information mainly with a view to ensure that the vessels have fished complying with the regulations provided in the terms of charter. Declaration is also obtained from the Captains of respective vessels on

the catch and the composition thereof in respective cruises. Based on these details an inspection report is submitted to the Ministry of Agriculture after each inspection. Information assimilated from 14 such reports form the data base of this study.

There are however several limitations in the study due to lacunae in the available data requiring certain assumptions to be made in order to make the results and inferences comparable to those in reports published from other parts of the world.

(i) The chartered vessels have maintained the catch statistics by weight alone. The distribution and abundance index of the larger pelagic species is most often referred by hooking rate in number which required conversion of the catch recorded as weight to number on the basis of average weights of the specimens of each species reported by earlier workers. Silas and Pillai (1982) based on the data of Japanese long line fishery in the seventies had reported the average weight of some of the species from Bay of Bengal. In case of the species where such data is not available, the average weights recorded in tuna long line survey in Arabian Sea (Sulochanan et al.,1986) is taken. The average individual weights of different species recorded are given below.

Species	Average weight (kg)	
	Bay of Bengal (Silas & Pillai,1982)	Arabian Sea (Sulochanan et al., 1986)
Yellowfin tuna	33	31.8
Skipjack tuna	-	4.1
Marlin - Striped	56	38.2
Blue	75	36.7
Black	90	76.3
Swordfish	40	21.4
Sharks	-	33.2

Though marlins from Bay of Bengal are known to include three species viz. striped marlin (**Tetrapturus audax**), Blue marlin (**Makaira mazara**) and black marlin (**M. indica**) the data provides only aggregate weight of the group. The average weight of the three species is therefore taken for conversion to numerical figures.

(ii) Though information on catch of yellowfin tuna is documented by all the vessels, data with respect to other species are not recorded separately except in few of the reports. Reports in respect of five vessels have grouped all the species except yellowfin tuna under skipjack tuna, whereas in other five reports they are categorised under marlin and swordfish. Composition of the catch is therefore worked out on the basis of two reports of the vessel **Kin Sin No.16** and suitably apportioned to the catch by other vessels.

(iii) Shark catches are reported only by four vessels. In others they are either clubbed with other fishes or a major portion might have been discarded. The reported catches are, therefore, apportioned as stated at para (ii) above.

(iv) The range in the number of hooks operated per set was 1400-3000. A standard effort of 2100 hooks per set is considered for data analysis.

AREA FISHED

The area fished by the different vessels is indicated in Table 1. It extends from Lat. 10° to 20°N and Long. 80° to 88°E covering almost the entire EEZ on east coast and some marginal areas outside the EEZ boundary. However, it is observed that fishing in Lat 10°-12°N and 19°-20°N was considerably less and maximum fishing effort was concentrated between Lat 15° and 18°N (Fig. 1).

RESULTS OF FISHING

The catch details

The total catch recorded in the 594 sets was 1098.3 tonnes. From the vesselwise catch details (Table 1) it can be seen that the maximum catch declared by a vessel was 129 tonnes obtained in a cruise of 37 sets by **Shin Lung No.12.** The average catch per day at sea/fishing day in terms of total as well as the yellowfin tuna component is furnished in Table 2. The highest average catch per day at sea was 2.69 tonnes obtained by the above vessel. Two vessels recorded catch exceeding 2 tonnes per day at sea, 8 vessels in the range of 1 to 2 tonnes and

Table 1: Area fished and catch declared by chartered long line vessels operated off the east coast of India, 1985-88

Vessel	Area fished		No.of sets	Total catch (tonnes)	Catch composition (tonnes)					
	Latitude	Longitude			YFT	SKJ	MAR	SWO	SHK	OTH
Kin Sin No.11	10°-18°N	81°-87°E	143 *	245.6	119.3	-	83.6	24.5	4.10	8.2
Kin Sin No.16	13°-18°N	81°-87°E	71 **	105.0	69.6	2.0	16.3	3.4	1.8	11.9
Shin Lung No.102	10°-18°N	81°-86°E	51	110.0	31.0	79.0	-	-	-	-
Shin Lung No.12	13°-20°N	83°-87°E	37	129.0	26.0	103.0	-	-	-	-
Shin Yeou No.1	12°-19°N	81°-89°E	57	102.5	27.0	75.5	-	-	-	-
Shin Yah No.101	12°-19°N	80°-86°E	37	114.5	28.5	86.0	-	-	-	-
Yung Hai	13°-14°N	80°-82°E	31	63.0	16.5	46.5	-	-	-	-
Hsin Cheng Fa No.16	15°-18°N	82°-86°E	43	73.3	48.9	-	9.6	14.8	-	-
Hsin Cheng Fa No.32	15°-18°N	82°-86°E	43	68.4	36.6	-	14.0	17.8	-	-
Hai Fa No. 11	14°-20°N	80°-88°E	39	62.0	24.6	-	37.4	-	-	-
Hsin Chene Fa No.16	13°-17°N	83°-86°E	42	25.0	13.5	-	6.4	5.1	-	-

Abbreviations used: YFT = Yellowfin tuna, SKJ = Skipjack tuna, MAR = Marlin, SWO = Sword fish, SHK = Sharks, OTH = other fish

*, ** Includes 3 and 2 part-voyages respectively.

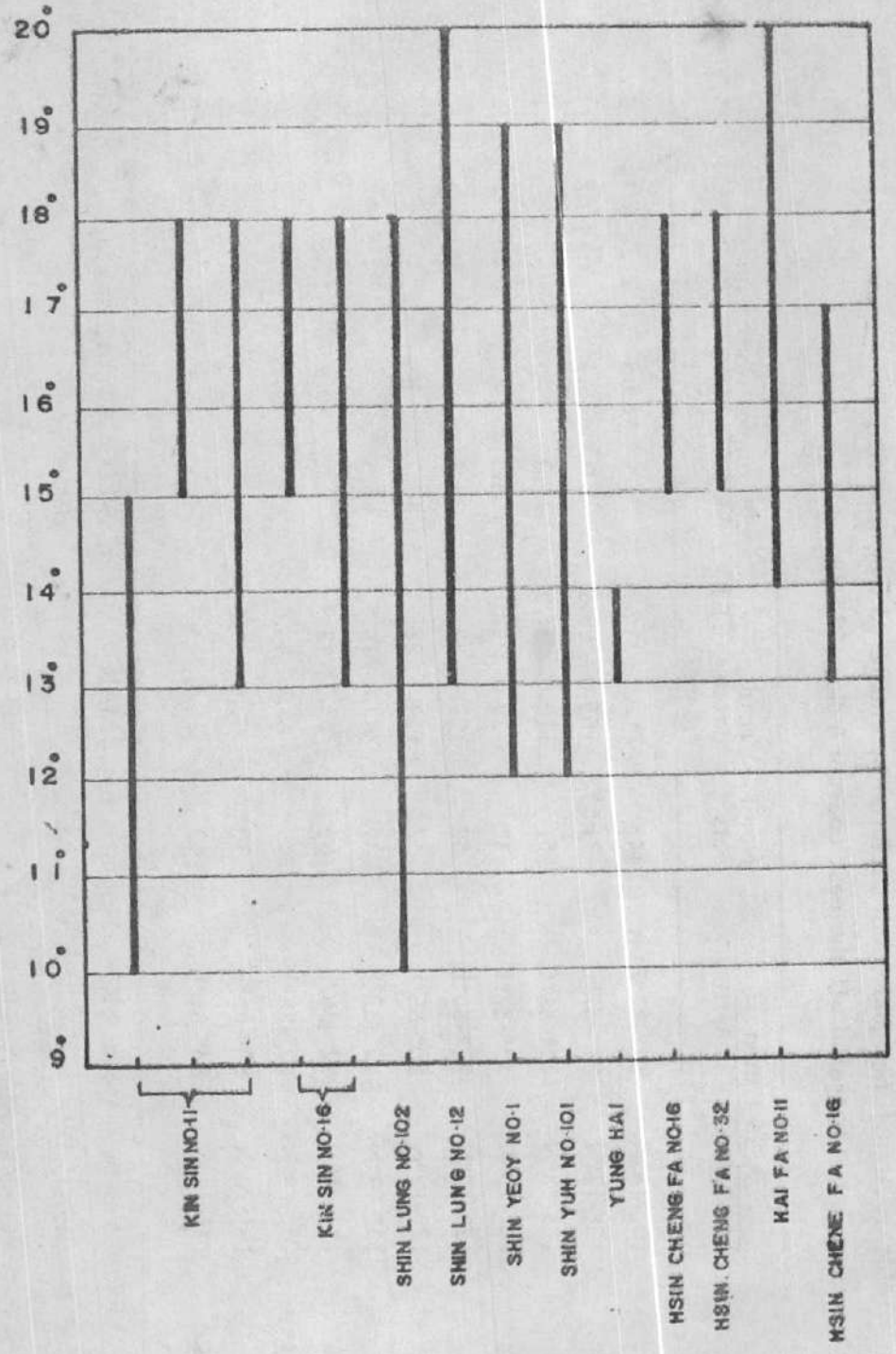

Fig.1 LATITUDINAL COVERAGE OF LONG LINE FISHING BY CHARTERED VESSELS OFF THE EAST COAST OF INDIA,1985-88

Table 2: Average catch per day at sea and catch per fishing day recorded by chartered vessels

(Catch in tonnes)

Vessel	Days at sea	Days fished	Catch per day at sea		Catch per fishing day	
			Yellowfin tuna	Total	Yellowfin tuna	Total
Shin Lung No.12	48	37	0.54	2.69	0.70	3.49
Shin Yeou No.101	48	37	0.59	2.39	0.77	3.09
Yung Hai	34	31	0.49	1.85	0.53	2.03
Shin lung No.102	63	51	0.49	1.75	0.61	2.16
Kin Sin No.16	83	71	0.84	1.63	0.98	1.90
Hsin Cheng Fa No.16	48	43	1.02	1.53	1.14	1.70
Hsin Cheng Fa No.32	48	43	0.85	1.42	0.85	1.59
Hai Fa No.11	45	39	0.55	1.38	0.63	1.59
Kin Sin No.11	186	143	0.64	1.32	0.83	1.72
Shin Yeou No.1	82	57	0.33	1.25	0.47	1.80
Hsin Chene Fa No.16	46	42	0.29	0.54	0.32	0.60

one vessel less than a tonne. In terms of catch per set 2 vessels obtained above 3 tonnes, another 2 vessels 2 to 3 tonnes, 6 vessels 1 to 2 tonnes and one vessel less than a tonne.

Catch composition

Yellowfin tuna **(Thunnus albacares)** constituted 441.5 tonnes (13,379 numbers) forming 40.2% of catch by weight and 41.6% by number. Based on the assumptions described earlier the composition of catch is worked out as follows:

Species/group	By weight		By number	
	Qty (tonnes)	%	No. (x 1000)	%
Yellowfin tuna	441.5	40.2	13.4	41.6
Skipjack	25.6	2.3	6.3	19.4
Marlin	356.1	32.4	4.8	15.0
Sword fish	104.9	9.6	2.6	8.1
Sharks/other fish	170.2	15.5	5.1	15.9
Total	1098.3	100.0	32.2	100.0

Marlin was the second major component which formed 32.4% of catch by weight and 15% by number (Fig. 2).

The hooking indices

The catch rate obtained by the different vessels varied from 28.3 to 166 kg per 100 hooks with an average of 88 kg (Table 3). In case of yellowfin tuna the catch rate was in the range of 15.3 to 54.1 kg. Marlins were caught by these vessels at varying rates of 7.3 to 64.2 kg. The hooking rate varied between 5.6 and 0.7 fishes per 100 hooks (Table 4). The range of hooking rate of yellowfin tuna by the different vessels was 0.5 to 1.6 % whereas marlins recorded hooking rate of

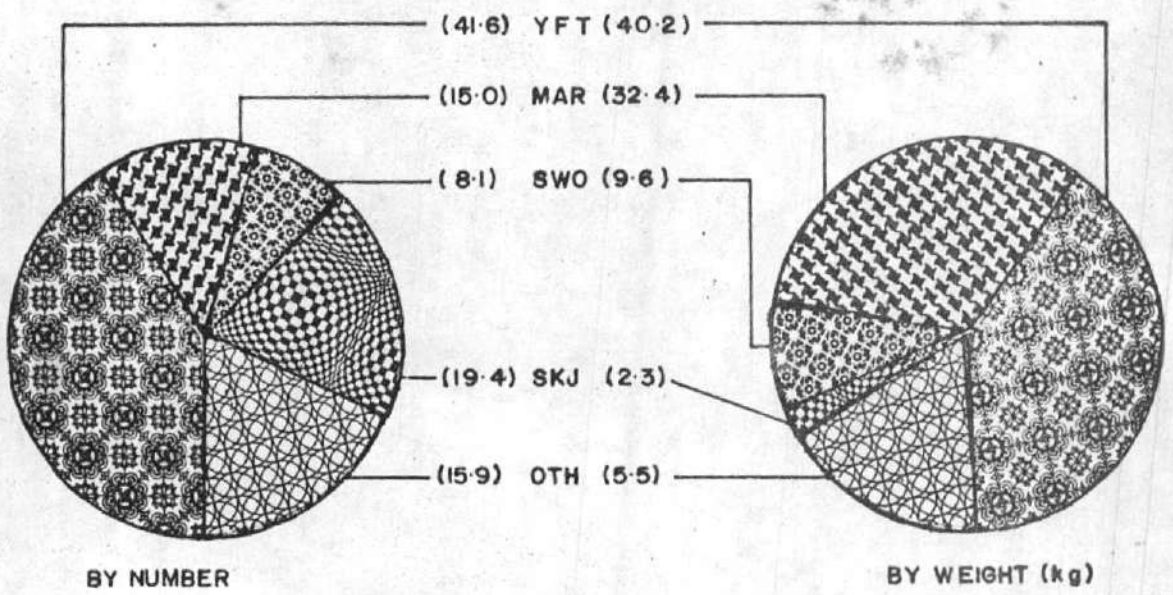

Fig.2 PERCENTAGE COMPOSITION OF LONG LINE CATCH OBTAINED BY CHARTERED VESSELS OFF THE EAST COAST OF INDIA, 1985-88

(YFT = Yellowfin tuna, MAR = Marlin, SWO = Sword fish, SKJ = Skipjack tuna, OTH = Other fish)

Table 3: Catch rate (by weight) obtained by the chartered long line vessels off the east coast (1985-88)

Vessel	Catch rate (kg per 100 hooks)					
	Total	YFT	SKJ	MAR	SWO	SHK/OTH
Kin Sin No.11	81.8	39.7	-	27.9	8.20	6.04
Kin Sin No.16	70.42	46.7	1.36	10.91	2.27	9.18
Shin Lung No.102	102.71	28.94	4.46	35.70	7.42	26.18
Shin Lung No.12	166.02	33.46	8.02	64.16	13.33	47.05
Shin Yeou No.1	85.63	22.56	3.82	30.52	6.34	22.38
Shin Yuh No.101	147.36	36.68	6.70	53.57	11.13	39.28
Yung Hai	96.77	25.34	4.32	34.57	7.18	25.35
Hsin Cheng Fa No.16	81.15	54.13	-	10.63	16.39	-
Hsin Cheng Fa No.32	75.70	40.48	-	15.48	19.74	-
Hai Fa No.11	75.79	30.10	-	45.69	-	-
Hsin Chene Fa No.16	28.34	15.31	-	7.25	5.78	-
Average	88.05	35.39	2.05	28.54	8.41	13.65

Abbreviations used: YFT = Yellowfin tuna, SKJ= Skipjack tuna, MAR = Marlin, SWO = Swordfish, SHK = Sharks, OTH = Other fish

Table 4: Hooking rate (by number) obtained by the chartered/ long line vessels off the east coast (1985-88)

Vessel	Hooking rate (number per 100 hooks)					
	Total	YFT	SKJ	MAR	SWO	SHK/OTH
Kin Sin No.11	1.97	1.20	-	0.38	0.21	0.18
Kin Sin No.16	2.23	1.41	0.33	0.15	0.06	0.28
Shin Lung No.102	3.42	0.88	1.09	0.48	0.18	0.79
Shin Lung No.12	5.59	1.01	1.96	0.87	0.33	1.42
Shin Yeou No.1	2.86	0.68	0.93	0.41	0.16	0.67
Shin Yuh No.101	4.93	1.11	1.63	0.72	0.28	1.12
Yung Hai	3.23	0.77	1.05	0.47	0.18	0.76
Hsin Cheng Fa No.16	2.19	1.64	-	0.14	0.41	-
Hsin Cheng Fa No.32	1.93	1.23	-	0.21	0.49	-
Hai Fa No.11	1.53	0.91	-	0.62	-	-
Hsin Chene Fa No.16	0.70	0.46	-	0.10	0.14	-
Average	2.58	1.07	0.50	0.38	0.21	0.41

Abbreviations used: YFT = Yellowfin tuna, SKJ = Skipjack tuna, MAR = Marlin, SWO = Swordfish, SHK = Sharks, OTH = Other fish

0.1 to 0.9%. Results based on the pooled data for all operations are given below:

Species	Catch/Hooking rate per 100 hooks	
	By number	By weight (kg)
Yellowfin tuna	1.07	35.4
Skipjack	0.50	2.1
Marlin	0.39	28.5
Swordfish	0.21	8.4
Sharks/other fish	0.41	13.6

Yellowfin tuna yielded the highest catch rate by number as well as by weight (Fig.3). Further discussion on catch/hooking rate is by numerical index alone, unless otherwise stated.

The fishing season

The seasonal coverage of fishing by the chartered vessels off the east coast is given in Fig. 4. Most of the vessels conducted fishing during January-March and few vessels continued in April also. During May to November the vessels shifted to grounds elsewhere and there was no fishing activity in east coast except a short cruise of 29 days by one vessel. Fishing is resumed thereafter in December. It is likely that the charter operations were as per the knowledge on the appropriate season acquired by the foreign companies based on their experience in Bay of Bengal prior to the declaration of EEZ.

Seasonality in catch rate

The catch rate of yellowfin tuna as well as other fish obtained by the vessels in different months are indicated in Table 5. The voyages conducted in January/February to March/April yielded highest catch rate per day in respect of yellowfin tuna (834 kg) as well as total catch (2074 kg), whereas the lowest catch

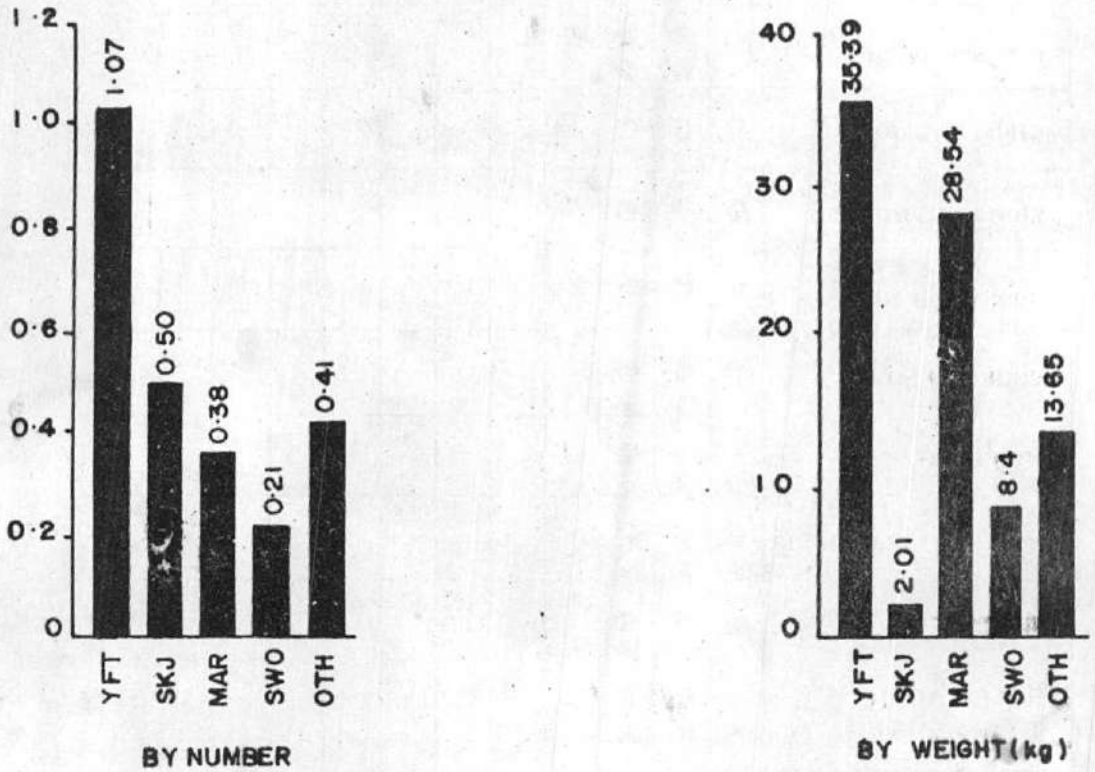

Fig. 3 CATCH/HOOKING RATE (PER 100 HOOKS) OBTAINED BY CHARTERED LONG LINERS OFF THE EAST COAST OF INDIA, 1985-88

(YFT = Yellowfin tuna, SKJ = Skipjack tuna, MAR = Marlin, SWO = Sword fish, OTH = Other fish)

VESSEL	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
KIN SIN NO·11	●●	●●	●●	●			●					●
KIN SIN NO·16		●●	●●	●								
SHIN LUNG NO·102	●	●	●									
SHIN LUNG NO·12	●	●	●									
SHIN YEOU NO·1	●	●	●	●								
SHIN YUH NO·101	●	●	●									
YUNG HAI			●	●								
HSIN CHENG FA NO·16	●	●	●									
HSIN CHENG FA NO·32	●	●	●									
HAI FA NO·11		●	●									
HSIN CHENE FA NO·18	●											●

Fig.4 SEASONAL COVERAGE OF FISHING BY CHARTERED LONG LINERS OFF THE EAST COAST OF INDIA, 1985-88

(Two closed circles indicate fishing in two years)

Table 5: Total catch and yellowfin tuna catch per fishing day obtained in by the chartered long liners

Vessel	Months fished	Catch per fishing day (kg)		
		Yellowfin tuna	Other fish	Total
Shin Lung No.102	Jan-Mar.'86	608	1549	2157
Shin Lung No.12	-do-	703	2784	3487
Shin Yuh No.101	-do-	770	2325	3095
Hsin Cheng Fa No.16	Jan-Mar.'87	1137	567	1704
Hsin Cheng Fa No.32	-do-	850	740	1590
Kin Sin No.11	Jan-Apr.'86	1190	1127	2317
Shin Yeou No.1	-do-	474	1324	1798
Kin Sin No.16	Feb-Mar.'87	1059	395	1454
Hai Fa No.11	-do-	632	959	1591
Kin Sin No.16	Feb-Mar.'86	913	587	1500
Yung Hai	Mar-Apr.'86	532	1500	2032
Kin Sin No.11	July'85	75	136	211
Hsin Chene Fa No.16	Dec.'87-Jan.'88	321	274	595
Kin Sin No.11	Dec'86-Mar.'87	819	973	1792

rates were obtained in July. A summary of the fluctuation in catch rates is given below.

Fishing season	No.of voyages	Catch per fishing day(kg)	
		Yellowfin tuna	All fish
January - April	10	834	2074
March - April	1	532	2032
July	1	75	211
December - January	1	321	595
December - March	1	819	1792

These results lead to the obvious inference that in the east coast tuna appears in abundance from end of December and the availability extends upto April.

DISCUSSION

Yellowfin tuna and skipjack were the only scombroid fishes reported in the catches. Bigeye tuna, though available in the southern latitudes (Silas and Pillai, 1982) as well as eastern sector (Sivasubramaniam, 1985; BOBP, 1987), was totally absent in the catches from east coast. This observation is in conformity with the findings of **Matsya Sugundhi** and **M.V. Prashikshani** during 1983-86 (Varghese et al., 1984; Joseph, 1986; Swaminath et al., 1986).

Yellowfin tuna which forms the mainstay of long line fishery in Indian Ocean gave an average hooking rate of 1.07%. A comparison of the hooking rate of the species in Bay of Bengal reported by different authors is given below:

Author	Region	Data base (Hooks operated-in thousands)	Yellowfin tuna Hooking rate
Varghese et al.(1984)	East coast	16	0.96
Joseph (1986)	East coast	-	0.61
Swaminath et al.(1986)	East coast	45	0.53
Sudarsan (1978)	Andaman Sea (Lat. 10°-13°N Long. 92,93°E)	11	0.59
Swaminath et al. (1986)	Andaman Sea (EEZ)	23	0.36
Sudarsan and Somvanshi (1988)	Andaman Sea (EEZ)	28	0.49
BOBP (1987)	Andaman Sea (Lat. 0°-15°N Long.90°-100°E)	-	0.57 *
Sivasubramaniam (1985)	Bay of Bengal (Lat. 0°-20°N Long.80°-100°E)	59395	0.50
Present study	East coast	1247	1.07

* Average hooking rate of Japanese, Korean and Taiwanese fleets in 1976-82.

The hooking rate of yellowfin tuna in the earlier studies vary from 0.36 to 0.96%, whereas in the present study the index is 1.07%. Among the four estimates confined to east coast, the sampling effort can be considered to be adequate only in the present study (12.47 lakh hooks) and hence the results more reliable.

A comparison of time series data from Bay of Bengal in general as well as in different regions assumes significance in this context. Pooling data from the long line fishery of Japan (1976-80), Korea (1976-77) and Taiwan (1976-82), Sivasubramaniam (1985) reported the average hooking rate of yellowfin tuna (YFT) from Bay of Bengal as 0.5% with annual hooking rates ranging between 0.34 and 0.62 as given below.

Year	YFT hooking rate	Year	YFT hooking rate
1976	0.34	1980	0.47
1977	0.54	1981	0.37
1978	0.62	1982	0.60
1979	0.57		

Highest hooking rates of 0.62% and 0.60% were recorded during 1978 and 1982 respectively. The spatial distribution pattern of yellowfin tuna in these two years from different parts of Bay of Bengal is shown in Fig.5. The data leads to two obvious inferences. First, the hooking rate of 1.07% obtained by the chartered vessels is significantly higher than the hooking rate reported in 1976-82 (0.5%) suggesting revival of the tuna stock in Bay of Bengal consequent on the declaration of EEZ and the withdrawal of alien fleets. Second, the east coast of India within the EEZ is comparatively more productive than the other regions of Bay of Bengal.

Results of recent surveys by **Matsya Sugundhi** and fishing by **M.V.Prashikshani** had revealed interesting observations on the abundance index of yellowfin tuna in the Arabian Sea. Sulochanan et al. (1986) reported hooking rate of 1.4% during 1983-85 whereas Sivaprakasam and Patil (1986) observed 6% hooking in 1985-86. The high hooking rate in the latter study is due to the highly productive grounds off Karnataka - Goa coast located in the post-monsoon season in 1985 and extensively covered in the survey during 1985-86. Based on the most recent survey (1986-87) Sivaprakasam and Sudarsan (1988, in this volume) confirmed the exceptionally high hooking rate of yellowfin tuna in Arabian Sea. Swaminath et al. (1986) have also reported very high hooking rate (6.2%) of this species from south-west coast between Lat. 8° and 15°N.

It is however observed that this remarkably high index is caused by the excellent catch rates obtained from a small section of the coast, Lat.12°N to 15°N and that the hooking index recorded south of Lat. 12°N is in the order of 0.2 to 0.6% as observed in all the surveys referred above. It thus emerges that the catch rate of yellowfin tuna in the east coast of India is remarkably high compared to the vast areas of Arabian Sea (excluding Lat. 12° - 15°N) and the Bay of Bengal.

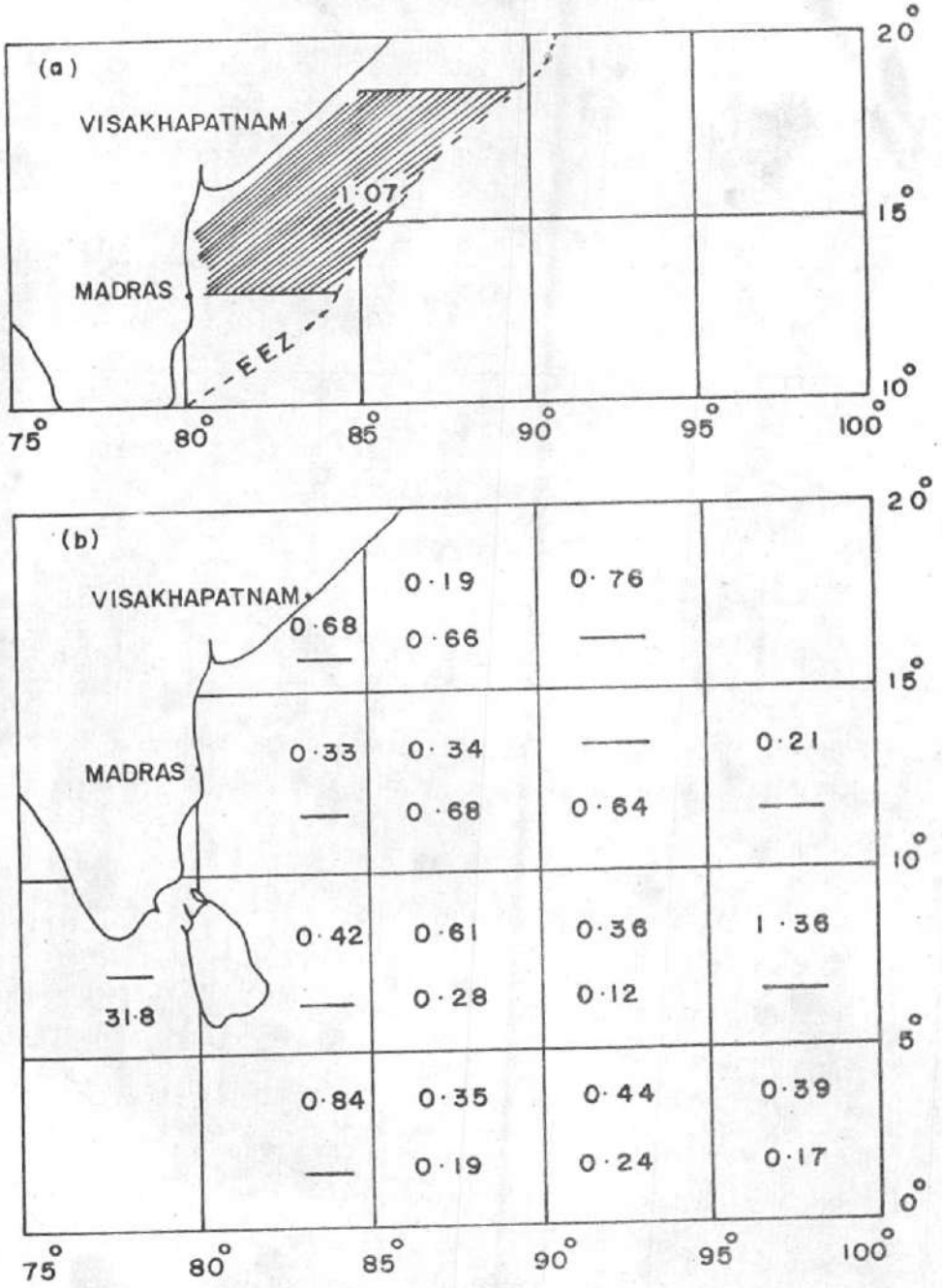

Fig. 5 (a) MAIN AREA OF FISHING BY CHARTERED LONG LINERS OFF THE EAST COAST OF INDIA, AND HOOKING RATE (%) OF YELLOWFIN TUNA OBTAINED, 1985-88

(b) AVERAGE HOOKING RATE (%) OF YELLOWFIN TUNA RECORDED BY JAPANESE, KOREAN AND TAIWANESE FLEETS IN BAY OF BENGAL DURING 1978 (1st Figure) AND 1982 (2nd Figure)

(Data source : Sivasubramaniam, 1985)

As indicated earlier fishing season for tunas off the east coast appears to be confined to a period of about five months from December to April. The survey of **Matsya Harini** of FSI during 1986-87 along Madras coast, as given below, corroborates this observation.

Month	YFT Hooking rate	Month	YFT Hooking rate
April 1986	1.39	October	0.06
May	0.84	November	No data
June	0.17	December	4.12
July	0.03	January 1987	2.15
August	0.27	February	2.10
September	0.03	March	2.51

During the months of December to April the hooking rates were significantly higher than the average level whereas June to October yielded very low rates in the range of 0.03 to 0.27%.

Another positive aspect on the yellowfin resource in east coast is the larger size of specimens compared to the size observed in west coast. It is seen from Fig.6 (a) that the mean weight of the species in east coast is 33 kg whereas in west coast it is in the range of 26 to 28 kg as recorded by the Japanese fleet (Silas and Pillai, 1982). On pooling the data of Japanese, Korean and Taiwanese long liners, Sivasubramaniam (1985) has reported the mean weights obtained in 1978 and 1982 for each 5° grid (Fig. 6 (b). However, in the coastal region north of Lat.15° N, the average weight is low, perhaps due to the preponderance of juveniles which are more vulnerable to surface fishery than the long line gear.

Apart from tuna, marlin and swordfish constitute the most important components in long line fishery. Observations in the survey indicate that striped marlin is the most dominant among the billfishes occuring in Indian waters. Economic importance of striped marlin and swordfish is evident from the annual mean wholesale price of tuna and billfishes recorded at the Tokyo Central Market (Anon,1986), one of the major markets in Japan absorbing enormous quantities of tuna and related species.

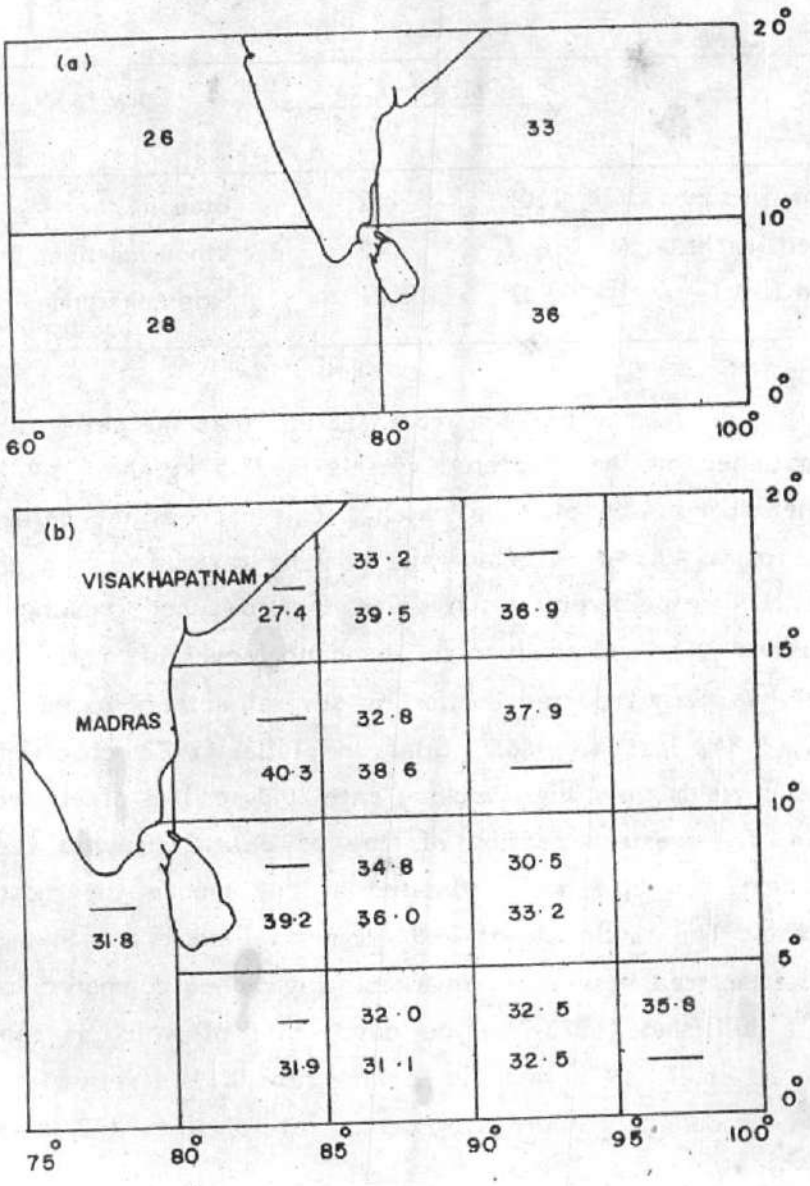

Fig.6 (a) MEAN WEIGHT (Kg) OF YELLOWFIN TUNA RECORDED BY JAPANESE LONG LINE FISHERY (Source: Silas and Pillai, 1982)

(b) MEAN WEIGHT (Kg) RECORDED BY JAPANESE, KOREAN AND TAIWANESE LONG LINE FISHERY (EAST OF LONG. 80°) DURING 1978 (1st Figure) AND 1982 (2nd Figure), AND BY MATSYA SUGUNDHI (WEST OF LONG. 80°) DURING 1983-85 (Data source: Sivasubramaniam, 1985; Sulochanan et al., 1986)

Species	Price per kg		Species	Price per kg	
	Yen	Rs.		Yen	Rs.
Yellowfin tuna	1109	112	Blue marlin	601	61
Striped marlin	1602	162	Other marlins	235	24
Sword fish	997	101	Skipjack tuna	394	40

It may be seen from Table 3 that the catch rate of marlins and swordfish obtained by the chartered vessels is 28.5 kg and 8.4 kg per 100 hooks which together forms 42% of total catch. This exceeds the percentage of yellowfin tuna which forms 40.2%. The average hooking rate of marlin and swordfish was 0.38% and 0.21% respectively which gives the combined hooking rate of 0.59% for the bill fishes. The relatively high abundance level of marlin and swordfish in Bay of Bengal has been reported earlier by several authors based on survey data (Varghese et al., 1984; Joseph, 1986). Silas and Pillai (1982) observed that the first half of the year yields very high hooking rate (0.5 to 1%) of striped marlin along the east coast. The western section of Bay of Bengal (west of Long.90°E), adjoining the east coast, has also been indicated as one among the most productive grounds of swordfish. The catch rate of 36.95 kg per 100 hooks or hooking rate of 0.59% obtained by the chartered vessels is remarkably high when compared to the Indian Ocean statistics of billfishes (1970-76), the catch rate of which is about 7 kg per 100 hooks (Wetherall et al., 1979) and the hooking rate 0.1%. Yellowfin tuna, marlin and swordfish, when pooled together, give hooking rate of 1.66% (72.34 kg).

The general picture that emerges from the study is that the Indian east coast can support a viable long line fishery, during December to April, than any other part of Bay of Bengal and the southern region of Arabian sea. The productivity of larger pelagic species in the area can be rated second only to the rich grounds located in Arabian Sea, off Karnataka - Goa coast. Exploratory survey of this region will however be useful in order to identify the specific areas of abundance and to confirm the feasibility of tuna exploitation from the region.

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