

## EXPLORATORY TRAWL FISHING OFF TIRUNELVELI COAST

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### ABSTRACT

The results of exploratory trawling carried out from 1968 to 1980 on the continental shelf and slope off Tirunelveli Coast, between 07° and 09°N are discussed. Attempt is made to study the relative abundance of major groups of demersal fishes, their seasonal, depthwise and areawise distribution. This throws light into the potentialities of ground fish resources in this area. The Fishery Survey of India trawlers based at Tuticorin, conducted trawling for demersal fish, yielding a production rate of 129.6 kg per hour, revealing the existence of fairly rich fishing grounds in this area especially of perches and elasmobranchs. Perches constituted 33.35% of the total catch in these trawlers. Elasmobranchs ranked next forming 24-26% of the catch. The percentage of perches was as high as 53% and 61% in 08°N subareas 6 B and 6 C during 1976. Perches being a quality fish with high demand and in view of its abundance, its exploitation could be intensified considerably.

### INTRODUCTION

THE MARINE fish production in India has been growing at a very slow pace of 3.4% annually during 1970 – 79 (Chidambaram, 1986) and at a slightly higher rate of 5.5% annually during 1980–85 (CMFRI, 1986). The pelagic resources such as the oilsardine, the mackerel, the Bombay-duck or the shrimp resources might not contribute considerably to further increase the marine fish production in the country. The impetus should now be given to the under-exploited and unexploited resources mainly the demersal resources from the coastal and deeper waters. Joseph (1980) has assessed the demersal fisheries resources from the coastal areas within 70 m depth along east and west coasts as 1.7 million tonnes. The present studies

on the exploratory trawling surveys along the east coast, therefore are thought to be of great use to bring to light, hitherto unknown and potentially rich areas for ground fish resources. Ever since the establishment of the Govt. of India. Exploratory Fisheries Project base at Tuticorin in 1958, some work was being carried out on scientific lines to chart out the fishing grounds off the Tirunelveli Coast. Pai and Pillai (1973) have given the results of exploratory trawling by medium sized trawlers around Tuticorin. The present work is a follow up study of the earlier attempts made by Pai and Pillai (1973).

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## MATERIAL AND METHODS

The data for this study was drawn from the log reports of the fishing voyages of the vessels of the Fishery Survey of India base at Tuticorin, made available to CMFRI Research Centre at Tuticorin. Of the three vessels *Meena Saudagar*, *Meena Niryantak* and *M. V. Jheenga* based at Tuticorin, *Meena Niryantak*, a 17.5 m

vessel *Sagar Sundari* operated during 1968, but is not included in the preview of this paper. All the other vessels are taken as one unit and the effort and catch are pooled together for comparison and discussion. All the vessels operated 20 m, 24 m and 42 m bottom trawls. Due to the rocky and coraline nature of the bottom terrain, the trawls were attached to heavy ground ropes. The trawl nets have 70 mm mesh

TABLE 1. Specifications of the fishing fleet, gears employed, catch and catch per-hour

Name of the Vessel	Length (m)	Horse power (HP)	Gears employed	Year of operation	Fishing effort (hrs)	No. of Hauls	Total catch (kg)	Catch/hour (kg)
MEENA SAUDAGAR	17.5	200	20 m, 24 m & 28 m trawl	1974-1980	3762	2288	422,153.0	112.22
MEENA NIRYANTAK	17.5	200	20 m, 24 m, 42 m and midwater trawl	1972-1980	5271	3769	520,216.5	98.69
MEENA PRAYAS	17.5	200	15 m, 20 m trawls	1970-1971	334	279	46936.0	140.53
M.V. JHEENGA	16.5	153	20 m, 24 m and 42 m trawl	1968, 1970-73, 1976-80	2021	1477	330,199.25	163.4
MEENA BHARATHI	23.0	262	24 m, 30 m, & 45 m trawl	1968, 1970	335	534	100,875.5	301.57

long vessel carried out trawling from 1972 to 1980 continuously except for its absence during dry-docking, repairs, etc. *Meena Saudagar* also 17.5 m long vessel, was engaged in trawling operations during 1974-80 period, whereas the slightly smaller vessel *M. V. Jheenga* conducted fishing in the Gulf of Mannar during the year 1968, 1970-73 and from 1976 to 1980. The other vessels based at Tuticorin which conducted trawling in the Gulf, off the Tirunelveli Coast are *Meena Bharathi*, a 23 m long larger vessel which was engaged in fishing during 1968 and 1970. *Meena Prayas* carried out fishing during 1970-71. A smaller 10.1 m, 42 H. P type

size at the wings and 20 mm at the cod end. Fishing Craft, gear, operational details, etc. are given in Table 1. The fishing operations during this period were mainly confined to the area between 08°00' to 09° 20' N and 77°00' to 79°10' E. The fishing details from the log sheets of the vessels were processed to get a clear picture of the area-wise, season-wise and depth-wise production of demersal fishes in this area. The Maximum sustainable yield, following Schaefer's surplus production model as given by Pauly (1983) in its simplified form has also been worked out for this part of the Gulf of Mannar.

## RESULTS AND DISCUSSION

*Areawise production*

Though the area between 08°00' to 09° 20' N and 77°00' to 79° 10' E was trawled, the most intensively fished area, as also stated

were 6 C, 4 B and 4 C, where the effort expended were 3393 hrs, 1899 hrs and 1919 hrs respectively. The highest catch per hour returns from subarea 4 C which was 158.5 kg/hr. From subarea 4 B, the production rate was 125.17 kg/hr and in subarea 6 C, where

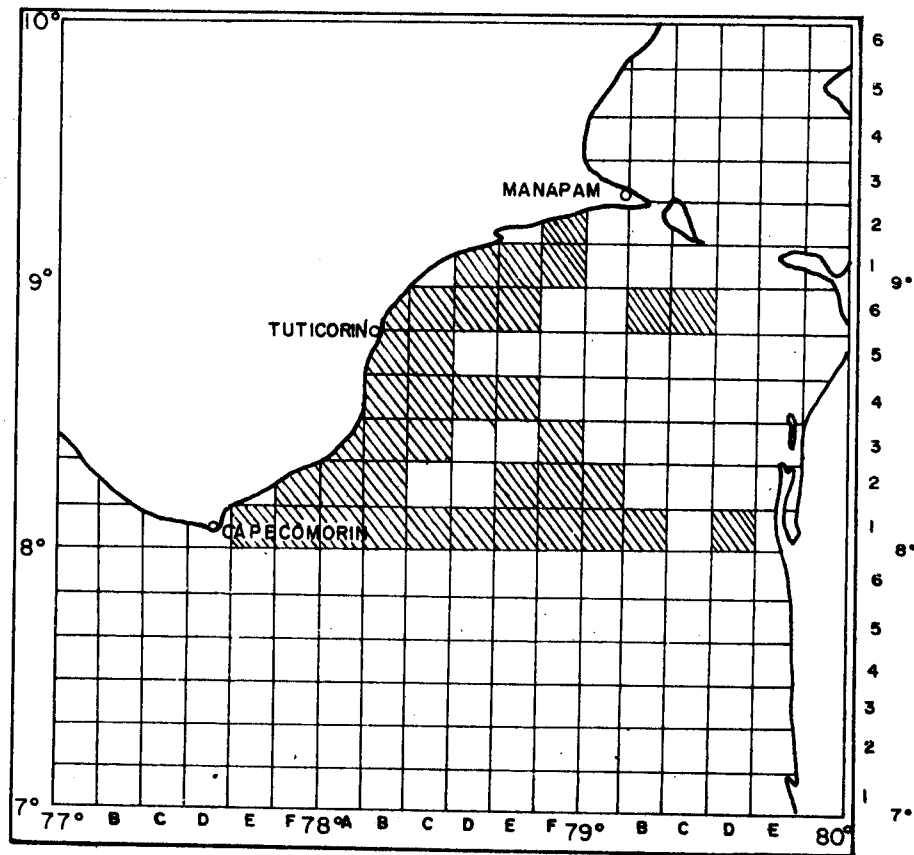


Fig. 1. The area of operation of Trawlers.

by Pai and Pillai (1968) was 08° N – 78° E. This area was trawled in all the years from 1968-1980 except for the year 1969. The entire area was subdivided into 1' square subareas. The areas of operation of the trawlers are given in Fig. 1.

Of the total effort 97.80% was expended in the area 08°00' N – 78°00' E, yielding 97.9% of the total catch. In area 08°00' N – 78°00' E, the more frequently trawled subareas

maximum effort was expended, the yield was 106.7 kg/hr. The catch rate in the case of perches was as high as 43.42 kg/hr in subareas 4 C and 43.01 kg per hour in subareas 6 C. It was much less in 4 B *i.e.* 21.7 kg/hr. With respect to Elasmobranch resources (rays formed 90.8%) rate of production was the highest *i.e.* 38.17 kg/hr in subarea 4 C; 30.65 kg/hr in 4 B, and in subarea 6 C it was 28.41 kg/hr. But the abundance of other quality fishes like

TABLE 2. Area-wise catch (kg) composition during 1968 - '80

Area	Subarea	Hauls	Effort in hrs	Depth in m	Elasmo-branches	Other Quality Fishes	Perches	Catfish	Prawns	Miscellaneous	Total Catch
8/78	4B	2059	2518	6-56	57208.5	30047.2	18886.5	960	727.25	91214	199,043.45
	4C	1948	2193	10-60	60162	23693	70065.5	814	367.5	78406	233508
	5B	413	583.15	10-23	3257	972	4432	—	3	8082	16746
	5C	210	226.15	10-60	3319.5	1838	4959.5	77.5	6.25	10012.5	20213.25
	6B	152	171.30	12-20	4116	1043	3399	15	5	7780.5	16358.5
	6C	2767	3477	10-45	83997.75	26641.5	134371	847	884	59082.7	305823.95
	6D	65	83.45	16-60	1655.5	655.5	3967	43.5	—	1240.5	7562
	6E	35	39.30	20-45	509	93	1020.5	14	—	440	2076.5
	3B	106	110.0	16-40	5141	781	7121.5	4	11	2105.5	15164
	3C	730	830.15	8-100	28352.5	7395	39179	235.5	24.75	12155	87341.75
	2A	96	131.15	17-150	3711.5	888.5	4470.5	55.5	199.25	4545.5	13870.75
	2B	123	133.15	18-45	4650	1172	8851.3	12	125.25	2328	17138.55
	1D	52	64.0	14-100	1008	1045	523	10	14.25	1132.5	3732.75
	1E	46	53.45	15-40	712.5	369	869.5	199	—	471.5	2621.5
	1F	24	25.45	20-45	630	96	538.5	116	—	754.5	2135
	2F	5	7.30	24-32	225	175	85	—	—	220	705
	3F	45	48.0	32-40	613	—	74.5	13	—	1009	1718
1A	27	34.15	18-52	550.5	—	625	154.5	9.5	870.5	2210	
1B	33	33.20	16-24	674	350	345	18	—	3668	5055	
1B	23	28.30	22-45	430	247	263	145	—	3254	4339	
1C	19	39.30	20-48	128	205	287	79	—	788	1500	
1D	81	118.30	15-52	2148.5	1542	3349.5	7	19.25	2387	9453.25	
1E	41	58.45	16-45	1326	451.5	1400	7.5	—	922.5	4107.5	
1F	25	34.45	20-47	432.5	644	277	17	29	638.5	2038	
2F	7	13.10	18-29	374	95	225.5	1.5	0.25	42	737.75	
6D	9	9	30-65	97	—	295	—	—	532	924	
4D	6	6	70-100	62	—	129	—	—	141	332	
1E	3	4.30	24-25	137	50	80	—	—	176	443	
1F	14	19.30	24-150	629.5	111	1102	181	—	961	2984.5	
2F	4	6.00	18-25	410	75	460	—	—	15	960	
6B	185	189	10-18	1816	—	4042	35	—	5811	13537	
6C	585	585	11-40	3649	—	19102	257	—	23077	54403	
1A	49	49	10-20	730	—	732	—	—	1741	3326	
1D	7	7	12-20	125	—	170	—	—	90	385	
1F	45	45	10-20	698	—	730	16	—	2186	3631	

TABLE 3. Yearwise catch (kg) composition (% given in parentheses)

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	TOTAL	%
Sharks	222 (0.145)	—	47 (0.05)	102 (0.09)	161 (1.01)	474.5 (0.7)	138.5 (0.17)	1327.5 (1.09)	270.5 (0.19)	755 (0.33)	158.5 (0.12)	76.5 (0.04)	12042 (8.72)	15775 (1.09)	(1.09)
Skates	4763 (3.11)	—	1133 (1.22)	312 (0.28)	293 (1.85)	2245.5 (3.30)	361 (0.47)	398.5 (0.33)	155.75 (0.114)	986 (0.43)	914 (0.69)	282 (0.18)	4525 (3.28)	16368.75 (1.13)	
Rays	26365 (17.21)	—	13623 (14.65)	11596 (10.53)	3627 (22.88)	20269.5 (29.92)	21386 (27.64)	32293 (26.62)	36332 (26.57)	72445 (31.26)	35168 (26.64)	30401.5 (17.63)	11826 (8.57)	316132 (21.76)	
Others	21678 (14.15)	—	13039 (14.03)	18415 (16.72)	1184 (7.47)	7145 (10.55)	15239.5 (19.70)	27958 (23.04)	15260 (11.16)	43065 (18.58)	20743.5 (15.7)	33846.5 (19.62)	—	217573.5 (14.98)	
Perches	2001 (1.31)	—	33043.55 (3.55)	18010 (16.35)	5343 (33.71)	18212 (26.88)	33805.5 (43.7)	40783.5 (33.62)	53683.5 (39.26)	78936.5 (34.06)	32592 (24.69)	47322.5 (27.44)	44464 (32.21)	379456.5 (26.12)	
Catfish	—	—	—	—	—	—	—	892.5 (0.74)	1440.5 (1.04)	546.5 (0.24)	1027.5 (0.78)	522.5 (0.30)	635 (0.46)	5064.5 (0.35)	
Prawns	1004 (0.66)	—	63.5 (0.07)	450.5 (0.41)	100 (0.41)	949 (0.63)	6.5 (0.40)	157 (0.01)	2.5 (0.13)	10	140.25 (0.11)	57.75 (0.03)	10 (0.01)	3522.5 (0.24)	
Misc.	80459 (52.52)	—	63694 (68.52)	60454 (54.81)	5025 (31.71)	19145 (28.26)	6422.5 (8.3)	14246.5 (11.74)	29589 (21.64)	35178 (15.18)	41106.5 (31.14)	59772 (34.65)	64526 (46.75)	489617 (533.7%)	
TOTAL	153196.5	—	92958.5	110168.5	15849	67749	77359.5	121323	136733	231763	132014	172481	138028	1452679.65	

TABLE 4. Quarterwise abundance of major groups (CPH in parentheses)

	1968				1970				1971				1972				1973				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Total fish	9605 (61)	9429 (98)	11024 (100)	—	12837 (103)	53398 (226.7)	4853 (273)	11759 (603)	—	42938 (66.7)	21962 (254.6)	3111 (115)	15849 (67.4)	23866 (106)	17648 (104)	11290 (74)	14755 (80.3)				
Elasmobranchs	2869 (18.2)	1083 (11.3)	2224 (20.2)	—	4472 (19)	7051 (34)	861 (48.4)	850 (4.4)	—	3060 (4.8)	2220 (25.7)	1414 (52)	4082 (17.4)	8226 (36.6)	5600 (33)	3550 (23.3)	5076 (27.6)				
Perches	—	—	896 (7.9)	—	879 (3.74)	1194 (5.0)	68 (3.8)	690 (3.5)	—	2668 (4.1)	7846 (91)	879 (32.5)	5340 (22.7)	5230 (23)	6199 (36.7)	4681 (30.7)	2106 (11.5)				
Other Quality Fish	3624 (23)	1576 (16.3)	936 (8.5)	—	1650 (13.2)	8240 (8.5)	408 (23)	1327 (6.8)	—	6692 (10.4)	2810 (32.6)	375 (13.9)	1190 (5.0)	3124 (15.2)	1123 (6.6)	681 (4.5)	1815 (9.8)				
	1974				1975				1976				1977								
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Total fish	12027 (75.8)	14003 (89.9)	16806 (112)	16106 (103.9)	29273 (63.4)	36960 (77)	37552 (89.4)	13937 (56.7)	15252 (55.7)	44102 (100.7)	47793 (123.8)	29629 (96.8)	30162 (53.5)	47599 (85.7)	92898 (133.5)	43111 (92.12)					
Elasmobranchs	4997 (31.5)	5289 (33.9)	4963 (33.3)	4621 (29.8)	9370 (19.9)	9841 (20.5)	10282 (24.4)	5014.5 (20.4)	3354 (12.2)	14851.5 (33.9)	9455 (24.5)	9242 (30.2)	11011 (19.5)	17962 (32.3)	32747 (47.05)	12452 (26.6)					
Perches	4040 (25.5)	6428 (41.3)	9196 (61.7)	4861 (31.3)	8364 (17.8)	8064 (16.8)	19015 (45.2)	5907 (24)	3835 (14)	18233.5 (41.6)	21853 (56.6)	9762 (31.9)	9314 (16)	19108 (34.3)	36227 (57.05)	12626 (26.9)					
Others	1823.5 (11.5)	1836 (8.7)	1170 (7.8)	2590 (16.7)	5162 (10.98)	13977 (29.1)	5615 (13.3)	1698 (6.9)	1241 (4.53)	2214 (5.05)	7660 (19.8)	4145 (13.5)	3710 (6.6)	5507 (9.9)	17123 (24.6)	7897 (16.8)					
	1978				1979																
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Total fish	58739.5 (107.2)	15999 (62.0)	23621 (82.0)	33717 (87.8)	27525 (75.6)	36306 (100.6)	43591 (135.2)	63262 (198.3)	58739.5 (107.2)	15999 (62.0)	23621 (82.0)	33717 (87.8)	27525 (75.6)	36306 (100.6)	43591 (135.2)	63262 (198.3)					
Elasmobranch	14307.5 (26.11)	5103 (19.8)	8098 (28.12)	8615.7 (22.44)	5724.5 (15.73)	11067 (30.65)	8255 (25.6)	5713 (17.9)	14307.5 (26.11)	5103 (19.8)	8098 (28.12)	8615.7 (22.44)	5724.5 (15.73)	11067 (30.65)	8255 (25.6)	5713 (17.9)					
Perches	7141.5 (13.0)	6789 (26.3)	8108 (28.15)	10552 (27.5)	9248 (25.4)	13370.5 (37.1)	17184 (53.3)	7521 (25.6)	7141.5 (13.0)	6789 (26.3)	8108 (28.15)	10552 (27.5)	9248 (25.4)	13370.5 (37.1)	17184 (53.3)	7521 (25.6)					
Others	1155 (11.23)	1988.5 (7.7)	4806 (16.7)	7714 (20.08)	5739.5 (15.79)	7936 (22)	11943 (37.03)	8228 (25.8)	1155 (11.23)	1988.5 (7.7)	4806 (16.7)	7714 (20.08)	5739.5 (15.79)	7936 (22)	11943 (37.03)	8228 (25.8)					

Carangids, pomfrets and seerfishes was higher in subarea 6 C *i.e.* 28.05 kg/hr (forming 26.3% of the total catch) when compared to the other subareas. In subarea 6 C, perches constituted 40.3% of the total fish caught, while in subarea 4 C and 4 B, the percentages of perch were 27.4% and 21.7% respectively. Elasmobranchs formed 24.08% of the total in subarea in 08° N – 78° E, which were fished frequently from 3 C, 5 B, 5 C and 3 B; with catch rates of 108.5 kg, 109.35 kg, 85.5 kg and 165.3 kg per hour respectively. The areawise catch figures are given in Table 2.

#### *Depthwise catch and catch rate*

Out of the total catch of 1452.68 tonnes, 94.4% was obtained from depth upto 40 m. Only 5.6% of the catch came from beyond 40 m depth, expending 6.3% of total effort. From depths less than 40 m, 1372 of fish landed; irrespective of the areas, the effort involved was 11290.5 hrs the catch per hour being 121.524 kg of fish.

From beyond 40 m, 80.6 t of fish landed during 766.5 hr of trawling giving a catch per hour of 105.17 kg. Considering the elasmobranch resources 93% was caught from depth less than 40 m, while the remaining 7% came from depths beyond 40 m. The catch per hour of elasmobranchs from depth beyond 40 m depth was only 28.6 kg; 345.3 t of perches were caught from less than 40 m depth, with catch per hour of 30.6 kg, and 33.1 t of perches were from depth more than 40 m giving a catch per hour of 43.23 kg. Although 94.4% of trawling was carried out at depth less than 40 m, the catch rate of elasmobranchs and perches was found to be better from depths beyond 40 m than that from shallower depths.

#### *Yearwise and seasonwise production*

The estimated total catch was 1452 during 1968-80 period with an average catch per hour of 129.63 kg. The yearwise figures are given

in Table 3. The maximum production was obtained during the year 1977 *i.e.* 231.76 t and the rate of production that year was 101.28 kg. The lowest catch, with the lowest catch rates was registered during the year 1972, being 15.85 t and 67.01 kg. The maximum catch rate of 230.36 kg was recorded in 1971.

The two major categories of demersal fishes *viz.* elasmobranchs and perches together constituted more than half of the entire trawl net catch. Elasmobranchs, of which 90% comprised of rays, formed upto 31.26% in 1977, the average figure being 23.97%. Perches on an average, formed 26.2% of the total catch. In 1974, the percentage of perches in these trawlers was as high as 43.7%. The percentages of sharks and skates in the total catch was slightly more than 1%. Seerfish, carangids, pomfrets, etc. which fall under the category 'Other quality fishes' formed 14.9%. Miscellaneous fishes like small perchlets, Sciaenids, carangids, silverbellies, etc. which came to a total of 489.6 t constituted 33.7% of the total catch. Prawns and catfishes were very negligible forming less than 0.5%.

The general trend in almost all the years, except in the year 1978, the maximum catch rate was observed to be during the third quarter *i.e.* during July – September months. The next highest catch per hour was observed in the fourth quarter. The lowest catch rate was observed to be during the first quarter, each year. Hence it could be inferred that there is a season of abundance during July – September months and a lean period during January – March months. This seasonal variation is also noticed in the production of perches. Maximum catch rate of perches was during the third quarter in almost all the years. The other resources *viz.* the elasmobranchs or the other quality fishes do not show much prominent seasonality.

*MSY and optimum effort*

By applying the Schaeffers 'Surplus production modal' the maximum sustainable yield and the optimum effort have been worked out for this part of the Gulf of Mannar, using the date for the period 1968-80. Though the earlier practice was to apply the Schaeffers production modal on a single stock, lately it has been applied to multispecies (Lord, 1971). The maximum sustainable yield off the coast of Tirunelveli is given as 276.26 t and the optimum effort that could be expended at this part as 2849 hrs annually. The MSY and optimum effort have been estimated for different groups of fishes, for the different latitudinal areas and subareas. The calculated values are given in Table 5.

TABLE 5. *Maximum Sustainable Yield and optimum effort for major groups of fishes as well as major areas*

Category	MSY (kg)	Optimum effort (hrs)
All groups together	276,255.4	2849
Perches	296,966.14	22421
Elasmobranchs	370,082.90	28410
Other quality fish	23,470.42	1295
Miscellaneous small fish	51,672.58	1301
Area 8°-78°	301,111.00	4902
Subarea 6 C	68,950.07	1112
Subarea 4 B	52,238.20	703
Subarea 4 C	42,680.62	2795

In the case of perches, the maximum sustainable yield calculated was 297 t and the optimum effort 22421 hrs annually. The MSY here is 9.5 times more than exploited rate of 31.54 t per annum. Elasmobranchs have an MSY value of 370 t and optimum effort 28410 hrs which is 12.8 times higher than the currently exploited rate of 28.94 t per year. Similarly for the other quality fish, which has an MSY value of 23.5 t, while the existing average

catch per annum is only 18.1 t and an optimum effort estimated was 1295 hrs. In the case of the small miscellaneous fishes, the MSY calculated was not very much higher than the presently exploited rate, but for a slight increment of 1.3 times. The maximum equilibrium yield estimated for Andhra - Orissa Coast by Krishnamoorthi (1977) also show a similar trend.

The MSY worked out for 08° N - 78 °E, the maximum exploited area off this coast is 301 t per year which is 2.5 times the presently exploited rate of 118 t. Considering the three subareas in 08° N - 78° E, viz. 6 C, 4 B and 4 C where maximum trawling operations were carried out, the values of MSY were 69 t, 52.2 t and 42.7 t respectively against the present annual catch rate of 36 t, 19.8 t and 21.4 t. In these three subareas, the increment in yield could be to the tune of 1.9 to 2.5 times only.

## DISCUSSION

In the total marine fish production in India, it is true that only 31% is being shared by the east coast, but its contribution to the total demersal resources is not quite insignificant, 49.6% of the total fish production of the east coast is contributed by ground fish resources (MFIS, 1981). Considering the potentialities of ground fishes resources, the east coast is comparable to that of the west coast. Krishnamoorthi (1974) employing the 'Swept Area' method has estimated the Estimated Potentially Sustainable Yield (EPSY) in the northern and Central Bay of Bengal as 63 times the existing catch. Krishnamoorthi (1974, 1977), while discussing the estimated potential yield of the northeast coast, states that this part of the Bay of Bengal is a third as productive as the Goa Coast (Rao and Dorairaj, 1968). This is by far true of the Gulf of Mannar Coast upto 70 m depth, especially in the case of the less exploited groups such



as perches and elasmobranchs. Perches show a MSY of 297 t against the currently exploited rate of 31.54 t. This is 9.5 times the presently exploited rate. In the case of elasmobranchs, the main constituent of which is rays here, the MSY worked out to be 370 t which is 12.8 times the exploited rate at present. Joseph (1986) while giving a comparative study of the catch per unit of effort of different species occurring in the demersal trawl, has given a catch/effort of 27.69 kg for perches and 12.67 kg for elasmobranchs in the Gulf of Manner and Wadge Bank region, whereas the catch/effort in the case of perches and elasmobranchs in the southwest coast are 1.50 kg and 4.73 kg respectively.

In the present study, an increase in production of certain groups like elasmobranchs and perches in the deeper parts was noticed. Irrespective of the areas or subareas, only 6.3% of the total effort was expended at depths beyond 40 m. The catch rate of elasmobranchs was 32 kg from depths greater than 40 m, whereas it was only 28.6 kg from depths below 40 m. Similarly, 345.32 t of perches were caught from less than 40 m depth with a catch per hour of 30.6 kg and 33.12 t from beyond 40 m with catch per hour of 43.23 kg, which was definitely much higher than from shallower depth. This reveals the existence of rich grounds for these resources in the deeper parts.

## REFERENCES

- CHIDAMBARAM, K. 1986. Management of potential fishery resources. *Seminar on potential Marine Fishery Resources*, CMFRI. pp. 109-125
- CMFRI 1981. Trends in total marine fish production in India 1980. *Mar. Fish. Infor. Serv. T & E Ser.*, 32.
- 1986. Marine fish production in India during 1983 - 84 and 1984 - 85. *Ibid.*
- JOSEPH, K. M. 1980. Comparative study of the demersal fishery resources of the Indian waters assessed by 17.5 m trawlers. *Bull. EFP Project*, 10.
- AND M. E. JOHN 1986. Potential marine fishery resources. *Seminar on Potential Marine Fishery Resources*, CMFRI. pp. 5-18
- KRISHNAMOORTHY, B. 1974. An assessment of the demersal fishery resources of the Andhra - Orissa Coast based on exploratory trawling. *Indian J. Fish.*, 21 (2) : 557-565.
- 1977. Maximum equilibrium yield of demersal fisheries based on exploratory trawling. *Ibid.*, 24 (1) : 76-82.
- LORD, G. 1971. Optimum steady state exploitation of a multispecies population with predator prey interaction. *Univ. Wash. Fish. Res. Cont. Quanti. Sci. For Fish Wildl. Quant. Sci. Pap.* 8-29.
- PAI, M. V. and P. K. MAHADEVAN PILLAI 1973. Trawl fishery potential of the southeast coast of India. *Proc. Symp. Living Resources of the Seas around India*. CMFRI. pp. 261-279.
- PAULY, D. 1983. Some simple methods for the assessment of tropical fish stocks. *FAO. Fish. Tech. Pap.* 234 : 52p.
- RAO, K. V. AND K. DORAIRAJ 1968. Exploratory trawling off Goa by the Govt. of India fishing vessels. *Indian J. Fish.*, 15 : 1-14.