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DEMERSAL FISHERIES RESOURCES OFF THE SOUTH WEST COAST OF INDIA

By

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FOREWORD

The current Bulletin on Demersal Fishery Resources of the South west coast is the third in the series released by the Director of the Exploratory Fisheries Project based on the charting and survey of fishery resources carried out by the Project from its southern bases.

The information furnished should be of considerable direct interest to the fishery industry for economic evaluation and for feasibility studies. The limitations of survey due to difficulties for employment of identical types of crafts and gear and reduced efforts in the outer belts have also been pointed in order to make the results more realistic. The new programmes being introduced in the current plan period will remedy the defects already noticed and discussed. The series of charts and bar diagrams will enable the reader to make quick comparison of resources availability in the different zones, both in time and space.

The authors, the Project Director, his officers and crew deserve congratulation in carrying out the surveys and for bringing out the results of survey for the use of the fishing industry. I hope the bulletin would be found useful as an informative guide on the catch composition, relative abundance and seasonal variations of bottom fish stock in the offshore areas of the south west coast.

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1. INTRODUCTION

Organised exploratory trawl fishing in Indian waters began only with establishment of the Deep Sea Fishing Station, Bombay, the fore-runner of the present Exploratory Fisheries Project, by the Government of India in 1946. Joseph (1974) has presented the results of exploratory otter trawling conducted by the Exploratory Fisheries Project, Bombay, along the Gujarat and Maharashtra coasts since its inception upto 1973 covering a period of about 27 years. The present bulletin, the third in the series, deals with the results of demersal fisheries resources survey carried by the Exploratory Fisheries Project vessels during the period from 1957 to 1974 along the South west coast of India. This bulletin, like the former one, has been released to meet mainly the requirement of the industry and the Government.

It is a well known fact that proper assessment of potential fisheries resources and the appropriate documentation of it, form the basis of establishing an information retrieval system from which the industry and the Government can draw the requisite information for making investment decisions, resources management policies etc. The release of Bulletin No.1 of the Exploratory Fisheries Project, high-lighting the present status of the exploratory demersal fisheries survey along the North west coast of India, which was well received by industry, entrepreneurs and Government, both State and Central, gave initial momentum to process accumulated data at hand pertaining to other regions.

The first attempt at mechanised bottom trawling along the South west coast of India was made in 1902 by a company known as the Pearl Fisheries Ltd., Ceylon (Gravely, 1929; Raj, 1933). Since 1908, the then Madras Government made several sporadic attempts at

introducing trawling along the Kerala and South Kanara coast, the most important among them being the one by S.T. Lady Goschen during 1927-29 between Mangalore and Cape Comorin. The results of these earlier operations, the scope of which were rather restricted, were discussed by Raj (1933); Chidambaram (1953); Gopinath (1954); John et al (1959) and John (1959). With the establishment of the erstwhile Indo-Norwegian Project at Quilon in 1953, the opening of the Exploratory Fisheries Project bases at Cochin and Mangalore in 1958 and 1962 respectively and with the commencement of deep sea trawling by the larger vessels of the Integrated Fisheries Project, Cochin, from 1967, the exploratory fishing programme along the South west coast has gained considerable momentum. The fishing programme included exploratory/experimental demersal trawling, kalava hand lining, bull trawling etc. Some information pertaining to these surveys are available in several reports viz. Bapat et al (1968); Silas (1969); Menon and Joseph (1969); Menon (1968); Joseph (1969,1970,1971,1972 and 1973); Kuthalingam (1970); Tholasilingam et al (1973); Suseelan and Mohammed (1973) and Rao (1969).

Although the Exploratory Fisheries Project base at Cochin was established in 1958 only, the vessels of the Project began survey based at Cochin from 1957 onwards. The Exploratory Fisheries Project base at Mangalore was first established in 1962 but had to be closed down in 1965 due to shortage of vessels. The base was reopened in 1973 when the Project took over a large number of 17.5 m indigenously constructed trawlers. The information furnished in this bulletin is also based on the results of operations of vessels attached to the Exploratory Fisheries Project base at Tuticorin which was established in 1959, to a limited extent.

The views and interpretations expressed in this bulletin are of the authors only and do not necessarily reflect the views of the Government of India.

The authors wish to take this opportunity to express their sincere thanks to Mr. S.P. Balasubramaniam, Joint Secretary(Fisheries), Ministry of Agriculture and Irrigation (Department of Agriculture), Government of India for the keen interest he has evinced in the preparation of this bulletin. Our sincere thanks are also due to Prof. P.C. George, Joint Commissioner(Fisheries), Government of India for going through the manuscript and for his valuable suggestions. Our thanks are also due to M/s. Antony Joseph and Y.B. Goudar for the assistance they have rendered in the processing of the data and in the preparation of text figures.

2. AREA OF STUDY

Figure 1 shows the area under investigation and its stratification into divisions and sub-divisions on the basis of longitude and latitude and depth. This area falls between the latitudes $7^{\circ}N$ and $15^{\circ}N$ and the longitudes $73^{\circ}E$ and $78^{\circ}E$ and embraces the entire coastal belt of Kerala and Karnataka and also the west coast of Tamil Nadu. The entire length of the coast in this area is about 800 km of which about 500 km belongs to Kerala, 250 km to Karnataka and the remaining to the west coast of Tamil Nadu.

In contrast to the North west coast of India, the continental shelf in this part is relatively narrow and varies from a maximum width of about 125 km off Coondapur and to about 50 km off south of Cochin. The profile of the shelf is with a uniform gradient upto about 80 m depth and thereafter the slope appears to be more pronounced (Kurian, 1969). As a result of the narrowness of the shelf, the shelf area in this region is only about 80,000 sq.km in contrast to about 2,25,000 sq. km in the North west coast. Out of the 80,000 sq. km, about 40,000 sq. km and 27,000 sq. km lies off the coast of Kerala and Karnataka respectively whereas the rest lies off the west coast of Tamil Nadu.

Kurian (1953), Menon and Joseph (1969) and Silas (1969) have earlier discussed the nature of the shelf in this area. It was noticed that the shelf upto a depth of about 60 m is muddy from south west off Alleppy towards north, while it is sandy from south west of Alleppy to further south. The sea bottom seems to be hard and slightly uneven from 60 - 90 m depth while it is unlevelled with rocky and coral formations between 90 - 120 m depth, the width of this unlevelled portion being about two nautical miles. The sea bottom between 120 - 200 m depth appears to be hard and even, indicating prospects for trawling, especially the area between Cochin and Karwar. Stray occurrences of rocky grounds are also noticed in this depth range between Ponnani and Alleppy.

This area possesses certain unique features from the oceanographic point of view which influences the fishery fluctuations of the important commercial species to a great extent. The area is subjected to two monsoons viz., south west and north east monsoons. There is an average annual rainfall of about 300 cm of which about 75% occurs during the period from May to September. The south west monsoon commences during May/June and lasts upto September while the north east monsoon prevails during the months of October to December every year. Based on monsoonic periodicity, three seasons could be recognised viz., pre-monsoon (February-May), monsoon (June-September) and post-monsoon (October-January). The average values of salinity ranges between 34‰ to 37‰. It is well known that the salinity of Arabian Sea is greater than that of the Bay of Bengal due to the flow of high saline water from the Red Sea and Persian Gulf. In the coastal waters during monsoon, relatively low salinity and temperature are observed due to the influx of fresh water from back waters, rivers and by precipitation.

The hydrographic conditions along the South west coast of India differ markedly during the south west monsoon, from

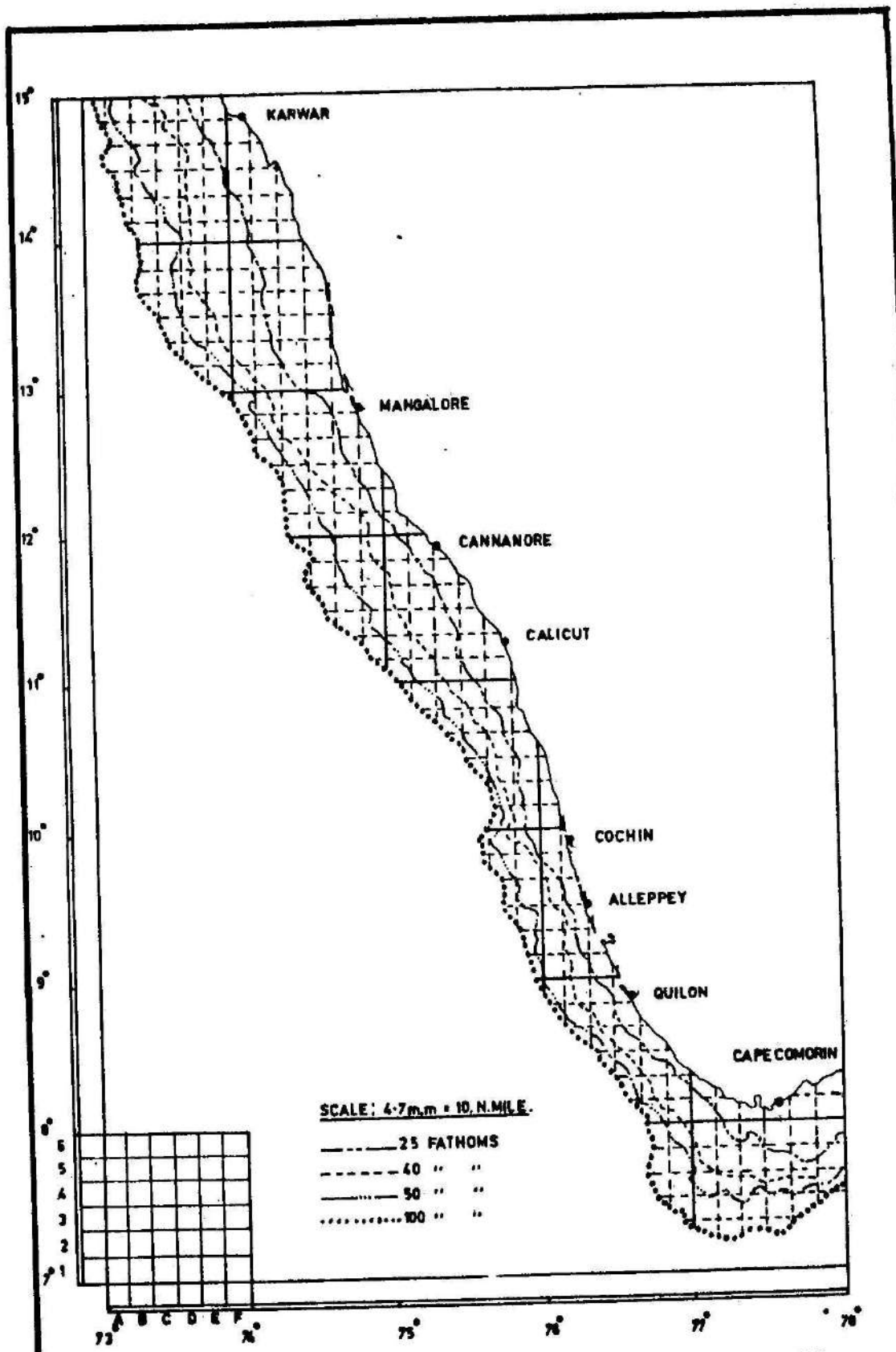


FIG. 1: AREA OF SURVEY SHOWING DIFFERENT DEPTH CONTOURS.

those of the other seasons. During the two monsoon periods many complex and dynamical changes of water circulation and mixing processes have been reported in this region. An intensive clock-wise circulation appear to have been established in the Arabian Sea during the south west monsoon which is formed by the union of one of the branches of the Somali stream, the fastest current in the Indian Ocean, with the south west monsoon current (Panikkar, 1969). A southerly drift is established along the west coast of India as a result of this circulation. This southerly drift is specially noticed in the region between Calicut and Karwar and by the end of south west monsoon, this flow is weakened and a northward coastal current is found along the coast by December (Jones and Banerji, 1973). The south west monsoon also coincides with the period of upwelling and phytoplankton bloom, the former phenomenon occurring in the area during the south west monsoon especially during the month of July. The northern limit of upwelling appears to extend upto $17^{o}N$. This area is rated to be having the second highest rate of primary production in the Indian Ocean and this is attributed mainly to the upwelling which takes place during the south west monsoon (Cushing, 1971). Hence, the intensity and duration of upwelling along the coast is of considerable importance to the fishery potentiality of the region.

This coast is also peculiar by the formation of an annual phenomenon called 'mud banks' which is observed along the Kerala coast between Quilon and Cannanore in several localities. In the shallow sea adjacent to the coast, smooth water tracts occur during the south west monsoon which are referred to as mud banks. This formation is locally known as 'Chakara' and extends seawards for a few miles in a semi-circular form. Mud banks which are store houses of nutrients like phosphates, promote rich

plankton production which resulted in the abundance of large number of species of fish and crustaceans in the area. It also provided shelter to organisms during the monsoon period when the adjacent areas are subjected to severe turbulent conditions. The mud bank is also associated with fisheries of considerable magnitude, especially those related to prawns, oil sardines, mackerel, soles etc.

3. VESSELS EMPLOYED

During the period under observation, 16 vessels which vary in design, size, horse power etc., were employed besides two vessels operated only for short periods. The major specifications of these vessels such as length, make of engine, horse power, gross tonnage, etc., are furnished in Table I. While assessing the potentiality of fishery resources of a given area, based on the results of operation over a large number of years, it is necessary that certain variable factors viz., horse power, tonnage etc., of the vessels operated during different years should be taken into consideration. It is a well known fact that the fishing capability of a trawler is mainly dependent on its horse power. Vessels operated in this region during the period under study is classified into five classes (Joseph, 1974) on the basis of horse power and the results are discussed separately. The classification of the vessels is as follows:

Class.	Horse Power.	Name of the vessel.
I	42	Sardinella, Meena Lochani, Tarpon, Samudra, Sagar Vihari, Sagar Kumari, and Sagar Sundari.
II	56	Durga and Flying Fish
III	200	Meena Utpadak, Meena Sangrahak, Meena Tarangini, and Meena Saudagar.
IV	215	Bangada.
V	240	Ashok and Pratap.

Of these, Pratap and Ashok were typical side trawlers which were used mostly as stern trawlers by making necessary alterations in the rigging. These vessels conducted bull trawling also during the period 1957-59 with Cochin as Base. Meena Utpadak, Meena Sangrahak, Meena Tarangini and Meena Saudagar commissioned during 1972 are indigenously constructed 17.5 m stern trawlers. Bangada was a tuna clipper which was converted for trawling. Flying Fish, Durga, Tarpon, Samudra, Sagar Viheri and Sagar Kumari were wooden stern trawlers received under T.C.M. Aid. In addition, two other vessels viz., Meena Bharati and Kalyani V had also operated in this area with Tuticorin as Base for a short period.

Some of the above mentioned vessels were also conducting resources survey in other areas during certain years of the period under study. Therefore, it appears necessary to detail their period of operation, the number of days fished and the hours of actual fishing effort expended by them in this area (Table II). These vessels were operated from the Exploratory Fisheries Project Bases at Mangalore and Cochin. It may be seen from Table II that the vessels Durga and Flying Fish have operated in this area with Cochin as Base for about 13 years. The smaller vessels were operated in this area from Cochin and Mangalore Bases for about eight years from 1959 to 1967. Bangada conducted fishing operations for about four years from 1960 and 1962 to 1965 while Pratap conducted trawling operations during the years 1957 to 1961 and 1967 to 1969. The 17.5 m vessels viz., Meena Tarangini and Meena Saudagar from Mangalore Base and Meena Sangrahak and Meena Utpadak from Cochin Base operated in this region from 1972 onwards. As stated elsewhere the vessels Kalyani V and Meena Bharati have also operated in this region for short periods during the years 1964 and 1968 respectively.

Sl. No.	Name of vessel	Year built	Place built	Length B.P. (m)	Beam (m)	Depth amid-ship (m)	Hull material	Make of engine	B.H.P.	G.R.T.	Crew strength
1.	Sardinella	1954	Japan	10.1	3.5	1.2	Wood	Yanmar 3 LDG	42	9.9	6
2.	Tarpon	1954	Japan	10.5	3.5	1.2	Wood	Yanmar 3 LDG	42	9.9	6
3.	Sagar Sundari	1954	Japan	10.1	3.5	1.2	Wood	Yanmar 3 LDG	42	9.9	6
4.	Samudra	1954	Japan	10.5	3.5	1.2	Wood	Yanmar 3 LDG	42	9.9	6
5.	Sagar Vihari	1954	Japan	10.5	3.5	1.2	Wood	Yanmar 3 LDG	42	9.9	6
6.	Meena Lochani	1954	Japan	13.7	3.5	1.2	Wood	Yanmar 3 LDG	42	9.9	6
7.	Sagar Kumari	1954	Japan	10.5	3.3	1.2	Wood	Yanmar 3 LDG	42	9.9	6
8.	Flying fish	1955	Japan	10.9	3.5	1.5	Wood	Yanmar 4 LDG	56	12.8	6
9.	Durga	1955	Japan	10.9	3.5	1.5	Wood	Yanmar 4 LDG	56	12.8	6
10.	Meena Utpadak	1969	India	16.3	5.2	3.0	Steel	Kirloskar M.A.N.	200	56.8	10
11.	Meena Saudagar	1971	India	16.3	5.2	3.0	Steel	Kirloskar M.A.N.	200	56.8	10
12.	Meena Tarangini	1971	India	16.3	5.2	3.0	Steel	Kirloskar M.A.N.	200	56.8	10
13.	Meena Sangrahak	1969	India	16.3	5.2	3.0	Steel	Kirloskar M.A.N.	200	56.8	10
14.	Bangada	1954	Norway	15.6	5.2	2.8	Wood	Caterpillar D.364	215	44.6	8
15.	Ashok	1949	Holland	25.4	6.3	2.9	Steel	B & W	240	91.7	12
16.	Pratap	1949	Holland	25.4	6.3	2.9	Steel	B & W	240	91.7	12
17.	Meena Bharati	1965	India	20.9	5.9	3.4	Steel	M.A.N.	262	69.1	12
18.	Kalyani V	1955	Japan	27.8	5.4	2.8	Steel	Hayashikane	300	123.2	14

Table I Major specifications of the vessels employed for exploratory fishing.

Vessels	Period From	To	No.of days fished	Fishing effort (hrs.)
Small vessels	1959	1967	1,932	8,415
Durga and Flying Fish	1959	1972	2,924	10,742
17.5 m vessels	1972	1974	1,269	5,397
Bangada	1960 and 1962	1965	393	1,193
Pratap	1960	1961		
	1967	1969	396	3,532

Table II Period of operation of different classes of vessels and the fishing effort expended by them by trawling.

4. TYPES OF TRAWLS OPERATED

Different sizes of shrimp and fish trawls were operated by the vessels during the period of investigation. The major specifications of these trawls are given in Table III. Smaller vessels like Tarpon, Samudra operated 14 m and 15 m shrimp trawls, while Durga and Flying Fish operated 17 m and 18.5 m shrimp trawls. Pratap fished with 19.5 m and 26 m hoover trawls. The principal types of trawls operated by the 17.5 m vessels were 28 m and 42.5 m shrimp trawls and 24 m fish trawls.

Sl. No.	Type of trawl	Head rope (m)	Foot rope (m)	Mesh size maximum and minimum (stretched) mm	Weight and size of otter board
1.	14 m Shrimp trawl	14.0	14.0	50-25	45 kg. 0.68 sq.m Rectangular
2.	15 m Shrimp trawl	15.0	18.0	50-25	45 kg. 0.68 sq.m Rectangular
3.	17 m Shrimp trawl	17.0	17.0	50-25	62 kg. 1.15 sq.m Rectangular
4.	18.5 m Shrimp trawl	18.5	21.6	50-25	62 kg. 1.15 sq.m Rectangular
5.	21 m Shrimp trawl	21.0	21.6	50-25	62 kg. 1.15 sq.m Rectangular
6.	24 m Shrimp trawl	24.0	24.3	75-35	62 kg. 1.15 sq.m Rectangular
7.	19.5 m Hoover trawl	19.5	24.3	125-75	220 kg. 2.9 sq.m Rectangular
8.	24 m Fish trawl	24.0	32.0	140-50	180 kg. 1.8 sq.m Oval
9.	26 m Hoover trawl	26.0	29.0	50-35	220 kg. 2.9 sq.m Rectangular
10.	28 m Shrimp trawl	28.0	32.5	50-38	180 kg. 1.6 sq.m Oval
11.	42.5 m Shrimp trawl	42.5	46.9	50-25	180 kg. 1.6 sq.m Rectangular

Table III Major specifications of the important types of trawls operated

5. DISTRIBUTION AND INTENSITY OF SAMPLING

5.1. Sampling distribution by area

As stated elsewhere, the area under investigation lies between the latitude 7°N and 15°N. This area was divided into 16 divisions on the basis of latitude and longitude. Each division is further divided into 36 squares or sub-divisions of 10 minutes latitude and 10 minutes longitude. The area of each of these small squares works out to about 100 sq. nautical miles or 343 sq. km.

Figs. 2 - 6 shows the distribution and intensity of sampling in respect of different classes of vessels operated and Fig. 7 summarises the total fishing effort expended by all vessels in different sub-divisions from 1959 to 1974. The data pertaining to the exploratory fishing operations conducted by the vessels attached to the Cochin Base during the years 1957 and 1958 are incomplete due to reasons explained by Joseph (op. cit.) and hence dealt with separately. During this period, the vessels Ashok and Pratap were conducting bull trawling while the smaller vessels viz., Tarpon, Samudra and Durga conducted shrimp survey. The results of fishing in respect of these vessels prior to 1959 are given in Table IV.

It may be seen from Fig. 2 that the sampling effort of smaller vessels is mostly confined to four divisions viz., 9-76 and 10-76 off Cochin and 12-74 and 13-74 off Mangalore. This may probably be due to the fact that the operational range of these vessels were limited. In the case of Flying Fish and Durga (Fig.3) Bangada (Fig.4) the distribution of sampling was mostly confined to areas 9-75, 9-76, 10-75 and 10-76 while that of Pratap (Fig.5) to 9-76 and 7-77. The sampling of 17.5 m vessels operated from Mangalore and Cochin Bases since 1972 covered a wider area than that of the other classes of vessels. The intensively explored areas by these vessels are

9-75, 9-76, 12-74 and 13-74. The vessels, Kalyani V and Meena Bharati with Tuticorin as Base fished in the southernmost areas of this region for short periods. The effort expended by them in the area is detailed below.

Area/Sub-area.	Fishing effort in hours	
	Kalyani V.	Meena Bharati
8-77/1F	4	7
2F	13	31
7-77/5F	-	2
6E	-	4
TOTAL:	17	44

It may be seen from Fig. 7 that out of the 16 divisions in the region, 11 divisions have been surveyed by the vessels of the Project. Of these, the areas 9-75, 9-76, 10-75, 10-76, 12-74 and 13-74 can be considered rather intensively surveyed. About 60% of the total fishing effort appears to have been spent in area 9-76, 18% in area 10-76 and 9% in 12-74. The sub-divisions 6A and 6B of the area 9-76 are the most heavily explored areas amongst the various sub-divisions. The Figs. 2 - 7 give an overall idea about the distribution of sampling and also helps to point out the areas which are adequately sampled and which are deficient in sampling effort. It can be seen from the figures that areas 14-73, 14-74, 13-73, 12-75 and 7-76 have not been surveyed by the vessels of the Project and that these areas need special attention while planning future exploratory surveys.

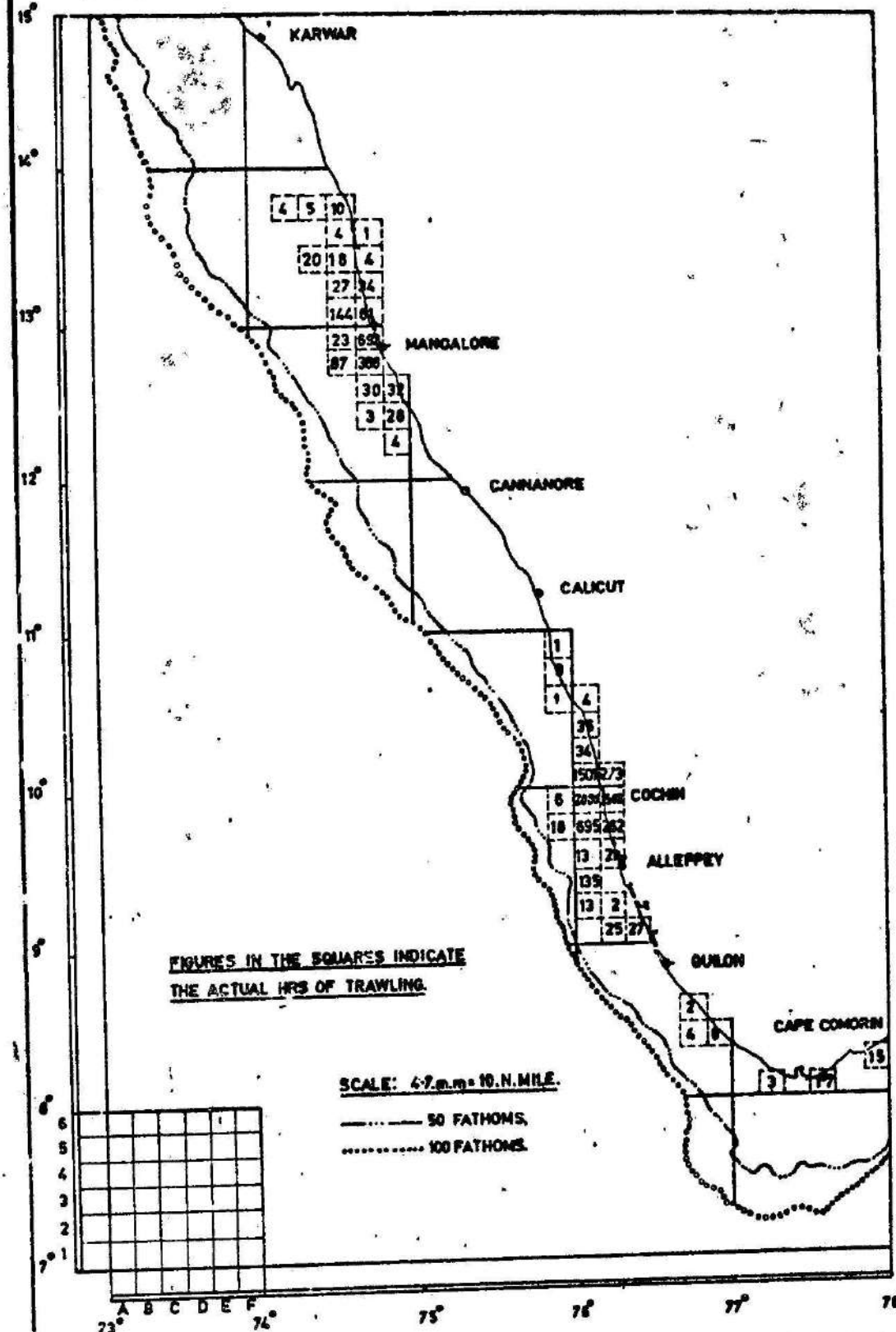


FIG.2: DISTRIBUTION AND INTENSITY OF SAMPLING BY SMALL VESSELS.

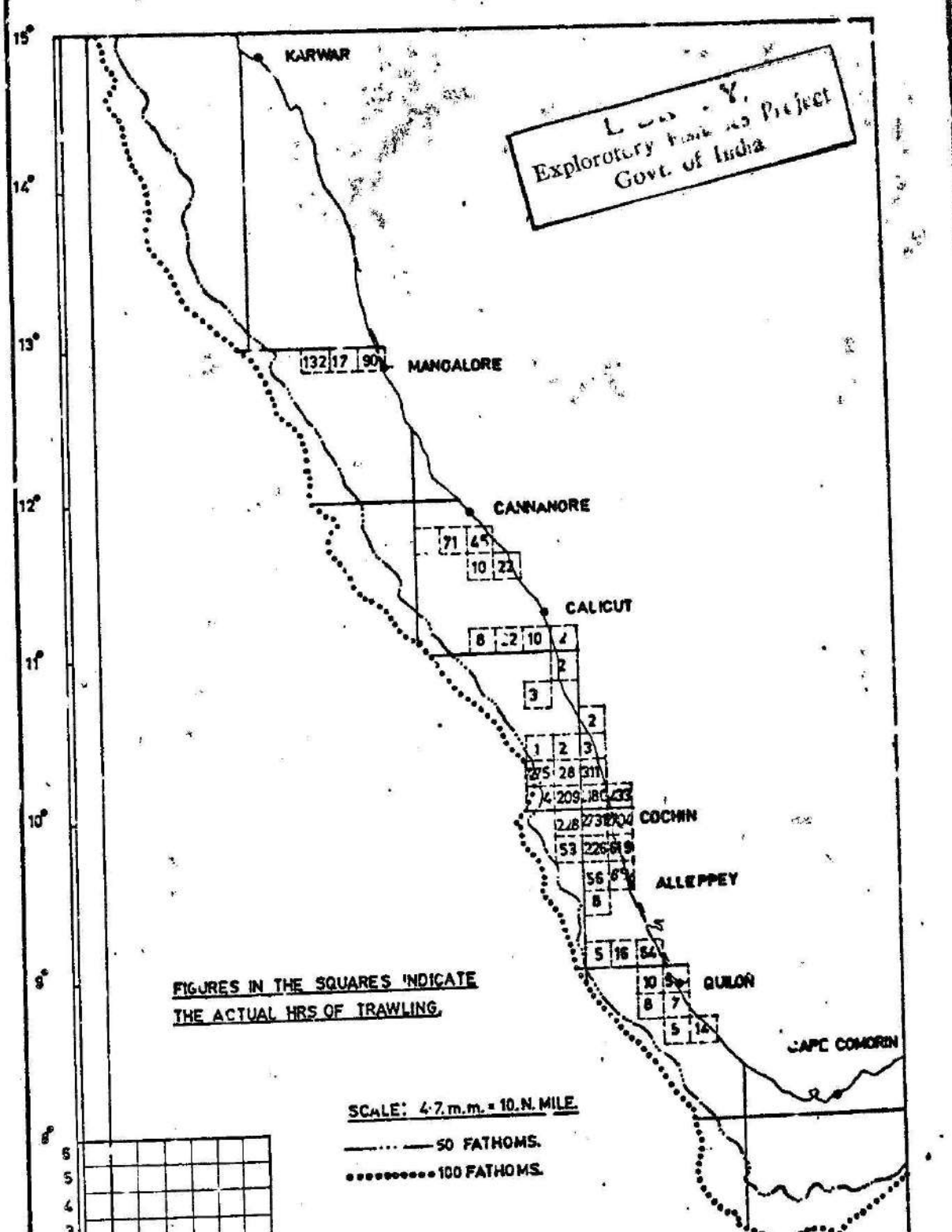


FIG. 3: DISTRIBUTION AND INTENSITY OF SAMPLING BY DURGA & FLYINGFISH

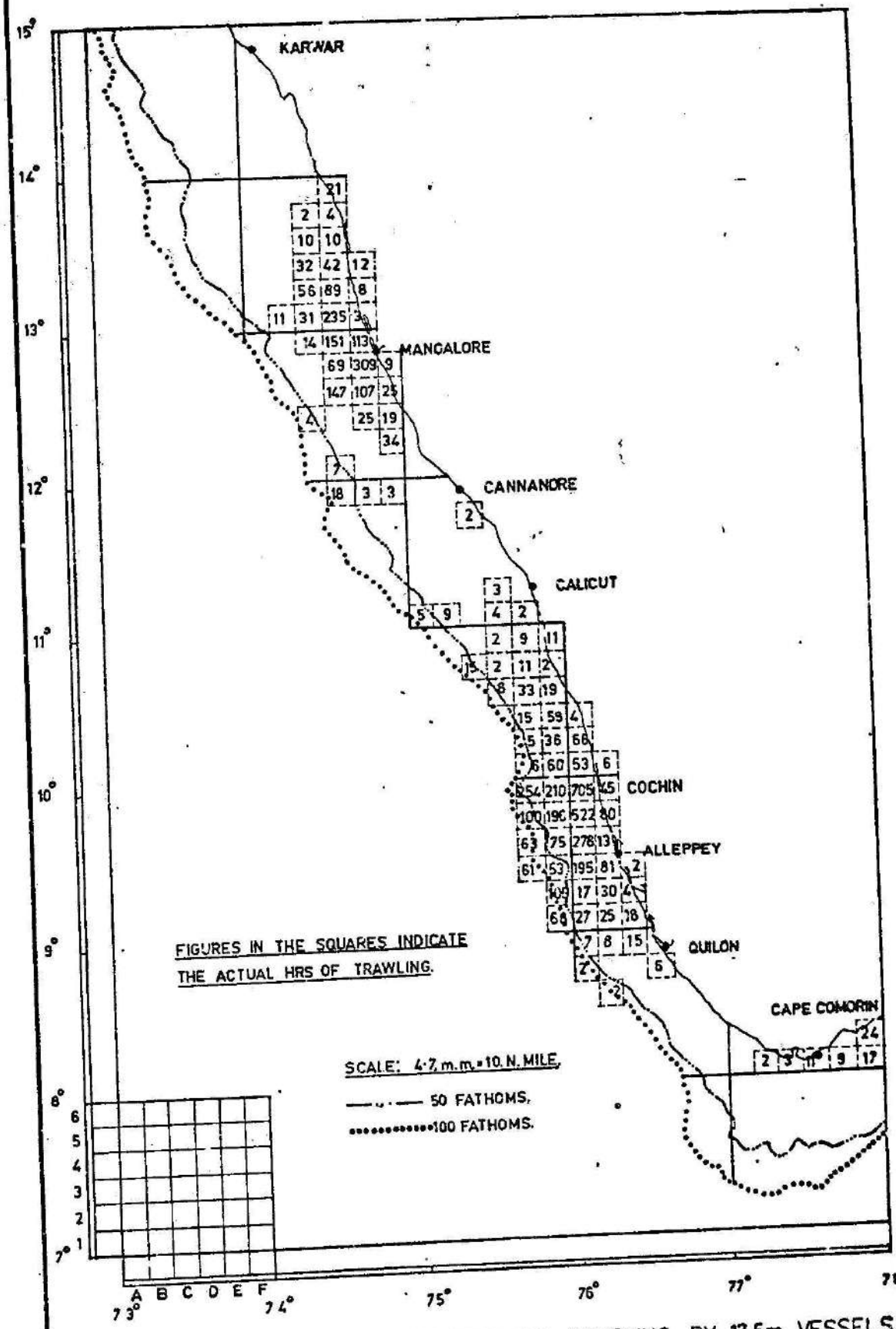


FIG. 4: DISTRIBUTION AND INTENSITY OF SAMPLING BY 17·5m VESSELS.

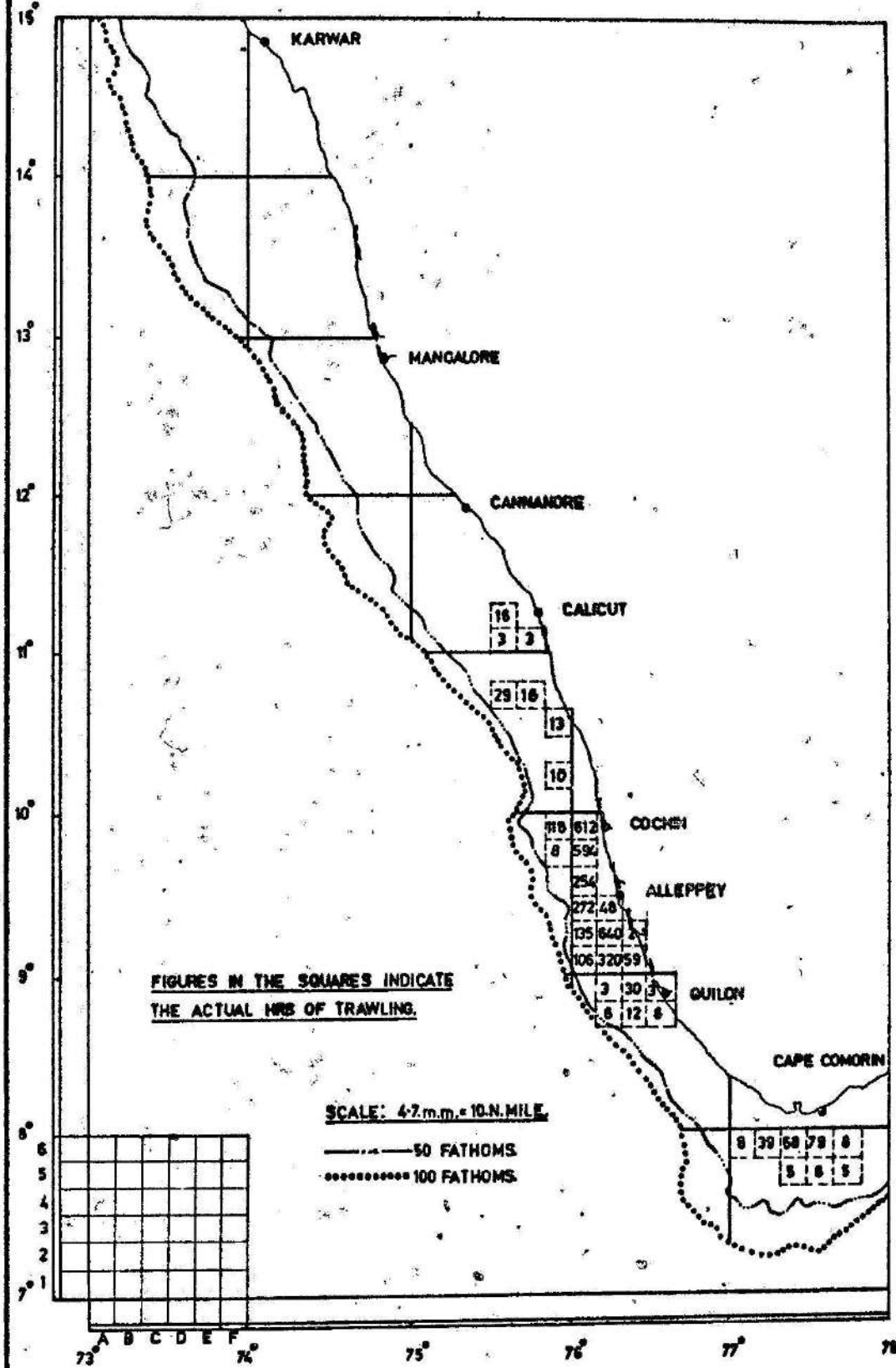


FIG. 5: DISTRIBUTION AND INTENSITY OF SAMPLING BY PRATAP.

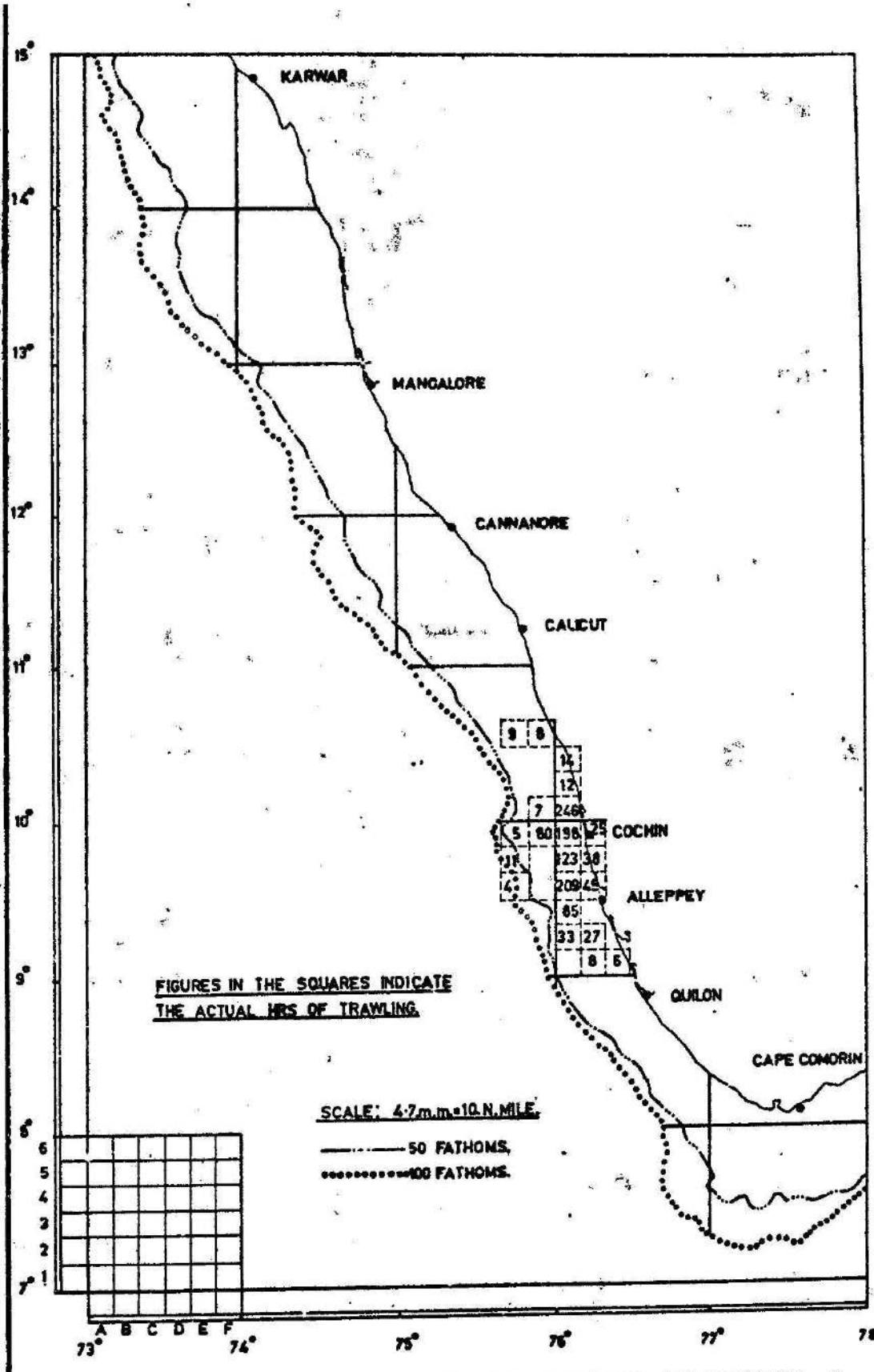


FIG. 6. DISTRIBUTION AND INTENSITY OF SAMPLING BY BANGADA.

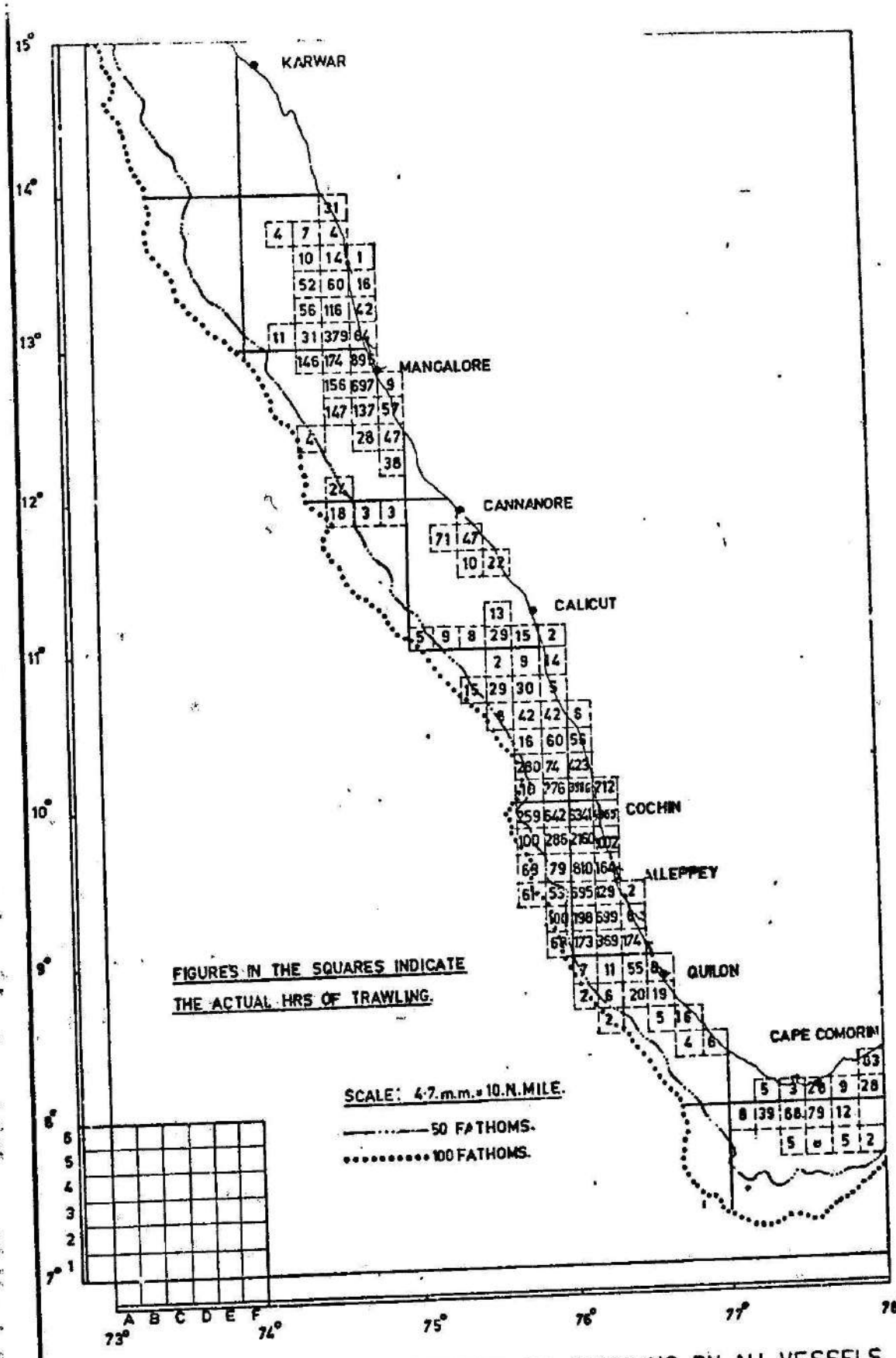


FIG. 7: DISTRIBUTION AND INTENSITY OF SAMPLING BY ALL VESSELS.

Name of vessel	Year.	Fishing days.	Fishing effort (Hrs.)	Catch /hour (kgs)	Gear used
1. Ashok & Pratap	1957	97	307	557	Bull trawl
Ashok & Pratap	1958	91	338	1055	Bull trawl
2. M.L. Durga	1957	54	304	115	Shrimp trawl
M.L. Durga	1958	108	639	100	Shrimp trawl
3. M.F.V. Tarpon	1958	78	326	93	Shrimp trawl
M.F.V. Tarpon	1959	163	626	151	Shrimp trawl
4. M.F.V. Samudra	1958	77	310	71	Shrimp trawl

Table IV Results of fishing by the Project vessels prior to 1959.

5.2. Distribution and sampling effort by area and depth

Table V shows the distribution of sampling effort by all vessels by area and depth. The shelf is stratified at 20 m intervals for this purpose. It may be seen from the table that the vessels spent a total of about 29,340 hours of fishing in the region under study since 1959. The table also indicates the fishing effort expended by the vessels in each of the five depth zones viz., 0-19 m, 20-39 m, 40-59 m, 60-79 m and 80-99 m. About 65% or about 19,000 hours of the total fishing effort was expended in 20-39 m depth zone. In the order of intensity of sampling, the depth strata 0-19 m and 40-59 m come next. The fishing effort spent in these strata works out to about 23% and 10% respectively of the total fishing effort.

It has already been stated elsewhere in this bulletin that about 60% or about 17,000 hours of actual fishing effort was spent in area 9-76. Area 10-76 comes second in the order of sampling intensity where about 5000 hours of actual fishing was done. In areas 9-75, 9-76, 10-76 and 12-74, the sampling intensity was found to be above 1000 hours of actual fishing whereas in areas 10-75 and 13-74 it was above 800 hours. Out of the 11 areas surveyed, only one area viz., 11-74 the effort put in was less than 100 hours. Thus, it was possible on the basis of this study to distinguish areas and depth ranges which have been adequately surveyed from those which have been partially/scarcely surveyed. This analysis enables one to give appropriate priority to areas deficient in fishing effort, while planning future exploratory fishing programme.

Depth range (Metres) / Area	0-19	20-39	40-59	60-79	80-99	Total
7-77	-	6	192	28	-	226
8-76	-	73	86	2	-	161
8-77	34	118	4	-	-	156
9-75	4	1177	479	47	4	1711
9-76	3259	12219	1777	19	4	17278
10-75	13	758	133	9	-	913
10-76	2456	2708	19	-	-	5183
11-74	-	-	24	-	-	24
11-75	24	183	18	6	-	231
12-74	958	1445	156	-	-	2559
13-74	136	618	141	3	-	898
TOTAL:	6884	19305	3029	114	8	29340

Table V Combined fishing effort of all vessels by area and depth.

5.3. Distribution of sampling by area and time

Table VI shows the yearly distribution of sampling in the eleven divisions surveyed by the Project vessels since 1959. All the eleven divisions, except 11-74 were sampled during three or more years. Among these areas, 9-76, 10-76 and 9-75 were successively sampled from 1959 to 1974 while areas 12-74 and 10-75 were sampled for a period of nine years. Areas 7-77, 8-76, 8-77, 11-75 and 13-74 were surveyed between 3- 8 years. On a detailed examination of the table, it will be seen that the areas surveyed by less than 100 hours is only 11-74. The actual fishing effort spent in areas 7-77, 8-76, 8-77 and 11-75 ranges between 100 - 500 hours while that spent in areas 10-75 and 13-74 varies between 500 - 1000 hours. The effort expended in areas 9-75 and 12-74 ranges between 1000 - 3000 hours, while that spent in 10-76 and 9-76 are about 5000 hours and 17000 hours respectively.

Area/ Year	7-77	8-76	8-77	9-75	9-76	10-75	10-76	11-74	11-75	12-74	13-74	Total.
1959	-	-	-	-	1627	-	489	-	-	138	-	2254
1960	87	21	-	122	2549	68	443	-	77	101	-	3468
1961	133	39	29	7	2606	-	406	-	-	183	-	3403
1962	-	-	-	14	1675	-	238	-	-	71	-	1998
1963	-	-	-	41	1046	290	433	-	-	453	27	2290
1964	-	-	17	80	360	111	549	-	49	249	161	1576
1965	-	18	3	98	602	33	411	-	65	331	144	1705
1966	-	45	3	66	965	65	949	-	4	-	-	2097
1967	-	-	-	5	1023	-	432	-	-	-	-	1460
1968	6	-	38	23	463	53	329	-	12	-	-	924
1969	-	-	-	49	398	-	26	-	-	-	-	473
1970	-	-	-	2	516	-	163	-	-	-	-	681
1971	-	-	-	16	548	-	128	-	-	-	-	692
1972	-	2	14	409	1401	65	58	24	9	-	-	1982
1973	-	30	-	542	718	23	54	-	5	523	-	1895
1974	-	6	52	237	781	205	75	-	10	510	566	2442
Total:	226	161	156	1711	17278	913	5183	24	231	2559	898	29340

Table VI Distribution of sampling by area and time by the Project vessels from 1959-74.

6. CATCH COMPOSITION

It is a known fact that an essential part of any modern fishery programme is the assessment of the catch per unit of fishing effort in the different fishing grounds and the following up of the changes in the same from season to season and from year to year. Commercially important species of fish, crustaceans and molluscs obtained in the trawl catches from this region are listed in Table VII, which also gives the scientific, common and local names of each species.

6.1. Catch composition by area

For a correct assessment, the whole area under investigation was sub-divided into four regions viz., Cape Comorin, Cochin, Cannanore and Mangalore for studying the pattern of occurrence of various commercially important groups of fishes including prawns. The geographical divisions falling in these four regions were as follows:

Cape Comorin	.. 7-77, 8-76 and 8-77
Cochin	.. 9-75, 9-76, 10-75 and 10-76
Cannanore	.. 11-74 and 11-75
Mangalore	.. 12-74 and 13-74

The percentage composition of nine important varieties such as prawn, elasmobranchs, perch, Lactarius, ribbon fish, cat fish, 'kilimeen', lizard fish and 'dhoma' in the above mentioned four regions are shown in Fig. 8. It may be seen from the figure that prawn accounted for 12 and 14% of the total catch from Mangalore and Cochin respectively. The percentage was only about eight and one respectively in Cannanore and Cape Comorin. Elasmobranchs represented the highest percentage in the total catch in all regions except Cannanore, the highest being 36% from Cape Comorin. Further, it was observed that there was a progressive decrease in the percentage composition of elasmobranchs from south to north i.e. Cape Comorin to Mangalore. Perches accounted for about 13% of the total catch in Cape Comorin region. The occurrence of 'kilimeen' was about 12% in Cannanore while in all other regions it was below 10% of the catch. 'Dhoma' recorded the highest percentage with 31% in the Cannanore region. The occurrence of other varieties like lizard fish, Lactarius etc., was less than 10% in all the regions under review.

Sl. No.	Scientific name.	Common English name.	Local name.
1.	Scoliodon spp.	Shark	Sravu
2.	Chiloscyllium indicum	Cat shark	Odumpu sravu
3.	Pristis spp.	Saw fish	Kompan Sravu
4.	Aetobatus narinari	Eagle ray	Kakathirandi
5.	Trygon and Raja spp.	Sting ray	Thirandi
6.	Opisthopterus tardoore	Long finned herring	Thada vellori
7.	Dussumieria spp.	Sprat	Kokola
8.	Anodontostoma chacunda	Shad	Thodi
9.	Anchoviella spp.	Anchovy	Natholi
10.	Thrissocles spp.	Anchovy	Kottal
11.	Chirocentrus dorab	Dorab	Mulluvala
12.	Saurida spp.	Lizard fish	Aranameen
13.	Trachysurus spp.	Cat fish	Thedu
14.	Muraena spp.	Eel	Vlanku
15.	Sphyraena spp.	Barracuda	Seelavu
16.	Mugil spp.	Millet	Kanambu
17.	Epinephelus spp.	Reef cod	Kalava
18.	Lates calcarifer	Giant perch	Narimeen
19.	Ambassis gymnocephalus	Glassy perchlet	Nanthen
20.	Lactarius lactarius	Butter fish	Parava
21.	Megalaspis cordyla	Torpedo trevally	Vankada
22.	Selaroides leptolepis	Slender scaled scad	Kottam para
23.	Caranx spp.	Trevelly	Vatta
24.	Chorinemus spp.	Leather skin	Kola
25.	Trachinotus spp.	Dart	Vellodu

Sl. No.	Scientific name.	Common English name.	Local name.
26.	Mene maculata	Moon fish	Kannadi Karal
27.	Lutianus argentimaculatus	Red snapper	Chempalli
28.	Nemipterus japonicus	Thread fin bream	Kilimeen
29.	Leiognathus spp.	Silver belly	Mullan
30.	Pomadasys maculatus	Spotted Grunters	Ezuthun kora
31.	Sciaena and Johnius	Jew fish	Kutten kora
32.	Otolithus spp.	Jew fish	Palli kora
33.	Upeneus and Parupeneus spp.	Goat fish	Nakara Kilivaranda
34.	Callyodon spp.	Parrot fish	Thathachundan
35.	Trichiurus spp.	Ribbon fish	Pampada
36.	Rastrelliger kanagurta	Mackerel	Ayala
37.	Cybium spp.	Seer fish	Naimeen
38.	Parastromateus niger	Brown pomfret	Machenavoli
39.	Pampus argenteus	Silver pomfret	Velutha avoli
40.	Pampus chinensis	Chinese pomfret	Karutha avoli
41.	Thysanophrys spp.	Flat head	Oratha
42.	Cynoglossus spp.	Sole	Manthal
43.	Psettodes erumei	Indian halibut	Ayiran palli
44.	Metapenaeus dobsoni	Prawn	Poovalan
45.	Metapenaeus affinis	Prawn	Kazhanthan
46.	Penaeus indicus	White prawn	Naran
47.	Penaeus monodon	Tiger prawn	Karachemmeen
48.	Parapenaeopsis stylifera	Prawn	Karikkadi
49.	Panulurus spp.	Rock lobster	Kalliral
50.	Thenus orientalis	Sand lobster	Ral
51.	Sepia spp.	Cuttle fish	Kallu Kanava
52.	Loligo spp.	Squid	Kanava

Table VII List of commercially important species of fish, prawn and mollusc occurring in the trawl catches from South west coast of India.

Cochin and Mangalore exhibited almost identical percentage composition of the catch. In Cape-Comorin, elasmobranchs and perches formed about 50% of the total catch. The netting of prawn, Lactarius, ribbon fish, lizard fish and 'dhoma' appeared to be negligible in this region. 'Dhoma' and elasmobranchs accounted for about 45% of the total catch in the Cannanore region. It may also be mentioned that the percentage composition of miscellaneous types of fish ranged between 20-50 which have not been indicated in the figure presented.

Fig. 9 shows the percentage composition of the nine important varieties in the catches viz., prawn, elasmobranchs, cat fish, perch, 'kilimeen', 'dhoma', ribbon fish, Lactarius and lizard fish from six intensively surveyed areas i.e., 9-75, 9-76, 10-75, 10-76, 12-74 and 13-74. About 50% of the total catch in areas 9-76, 12-74 and 10-75 were constituted by these varieties while about 40% in areas 10-76 and 13-74. Mention may be made of the fact that in area 9-75 they formed about 70% of the total catch.

In areas 9-76 and 10-76 prawn and elasmobranchs recorded about 15% each of the total catch. The highest percentage of prawn viz., about 23% appeared to be from area 10-76. In area 9-75 a slightly different mode of distribution was noticed where 'kilimeen' and cat fish accounted for about 40% of the total catch. The percentage of ribbon fish was also high in this area while prawn registered the lowest percentage. In area 10-75 elasmobranchs, prawn and 'kilimeen' were the dominant species which collectively formed about 40 % of the total catch. In area 12-74 prawn and elasmobranchs were the dominant varieties in the total catch which formed about 25%. In this area cat fish and 'dhoma' showed slight increase in their percentage composition. In the case of area 13-74, cat fish registered the highest percentage in the total catch which may be of special significance.

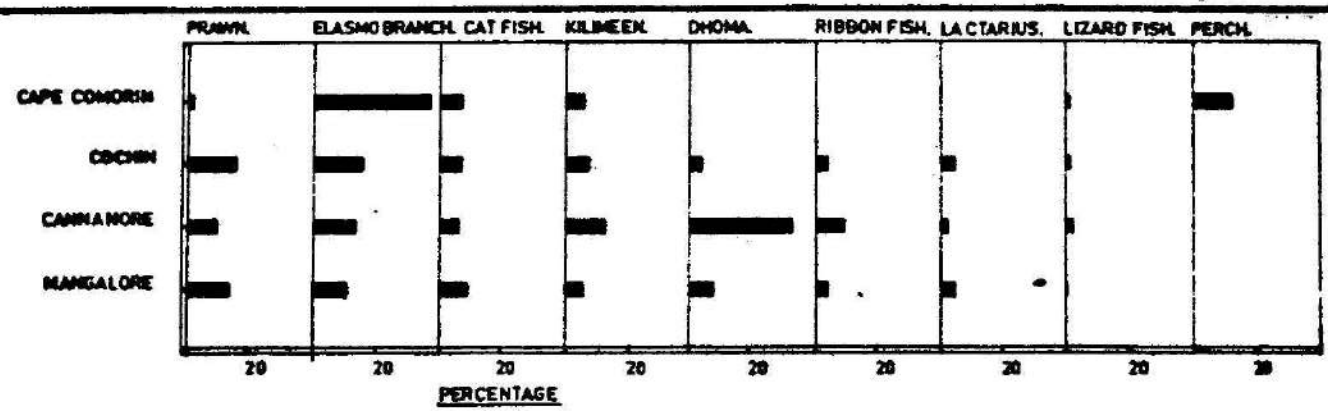


FIG.8: IMPORTANT VARIETIES AND THEIR PERCENTAGE OF THE TOTAL CATCH BY REGION.

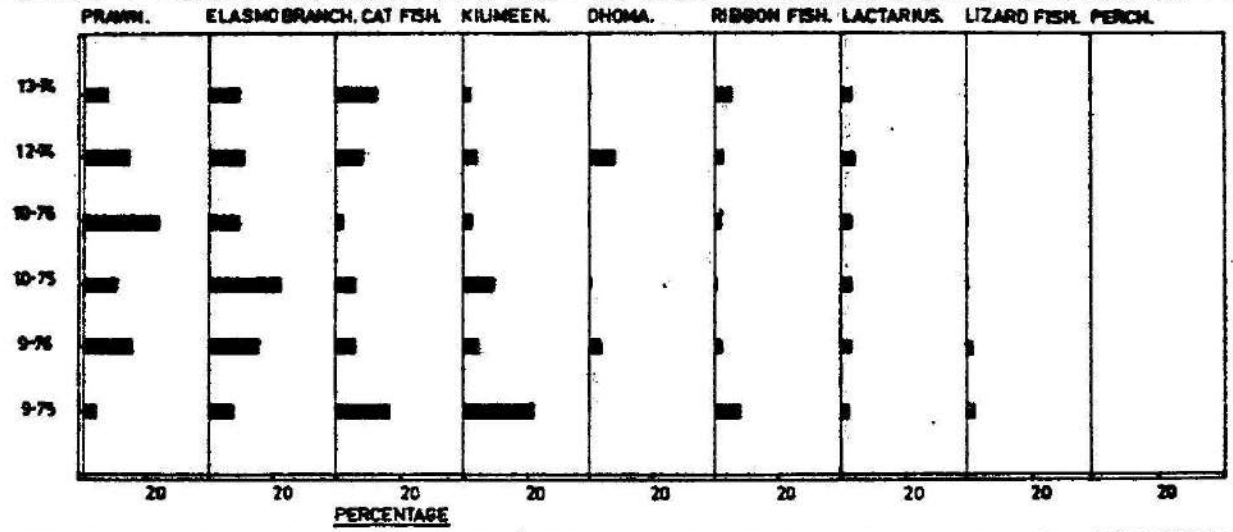


FIG.9: IMPORTANT VARIETIES AND THEIR PERCENTAGE OF THE TOTAL CATCH IN THE SIX INTENSIVELY SURVEYED AREAS.

6.2. Catch composition by depth and area

The percentage composition of the 11 varieties including miscellaneous species in the total catch by depth in the above mentioned four regions are given in Table No.VIII. Remarkable changes with regard to the occurrence of these species from various depth belts can be noticed from the table. In the case of prawn, a very perceptible decrease in percentage was noticed from shallow to deeper areas. It is also noteworthy that the highest percentage of prawn recorded in all regions studied except Cape Comorin was within the 20 m depth range. In Cochin region, the percentages of prawn were 28, 14, 3, 2 and 1 respectively in depth ranges 0-19 m 20-39 m 40-59 m 60-79 m and 80-99 m. Elasmobranchs showed an increase in the percentage with depth and the peak percentage was observed in depth range 40-59 m in all regions except Cape Comorin where the highest percentage was noticed in 0-19 m depth. Percentage of perches appeared to be more or less equal in depth ranges 0-19, 20-39 and 40-59 m in Cape Comorin whereas in all other regions the nettings were negligible. Cat fish showed an increased percentage in depth range 60-79 m in Cape Comorin and Cochin and 40-59 m depth belt in Cannanore and Mangalore whereas the percentage of 'kilimeen' was high in 20-59 m depth belt in all the four regions and the highest percentage of about 32% was recorded from 40-59 m depth zone in Cannanore. The percentage of Lactarius appeared to be high in 20-39 m depth belt in Cochin and Mangalore whereas the highest percentage was recorded in Cannanore region from 60-79 m depth. The highest percentage of ribbon fish was recorded from 40-59 m depth in Cochin and Cannanore and 20-39 m depth in Mangalore. In the case of lizard fish the highest percentage was observed in 60-79 m depth in Cape Comorin and Cochin areas while in Cannanore and Mangalore areas the occurrence of this group was mostly found in 20-59 m depth belt. 'Dhoma' accounted for the highest percentage in 20-59 m depth in all regions except Cape Comorin where its percentage composition to the total appeared to be almost negligible.

Depth (m) / Species	0-19	20-39	40-59	60-79	0-19	20-39	40-59	60-79	80-99
	CAPE COMORIN				COCHIN				
Prawn	0.1	1.5	1.2	-	27.6	13.5	3.3	2.4	0.9
Elasmobranchs	52.3	22.6	34.3	-	7.9	15.1	21.6	21.5	15.6
Perch	15.8	13.5	12.0	-	-	0.1	0.2	1.0	-
Cat fish	9.0	7.9	2.4	51.3	0.4	6.1	10.0	19.9	20.5
'Kilimeen'	-	2.6	9.5	-	2.8	6.3	5.3	0.2	0.6
Lactarius	-	0.1	-	-	2.5	3.1	0.4	0.7	0.8
Ribbon fish	-	0.9	-	-	0.5	1.6	2.6	-	-
Lizard fish	-	1.1	1.2	6.2	-	1.0	0.9	3.5	2.3
'Dhoma'	-	-	-	-	0.3	2.8	0.1	1.0	-
Other quality fish	13.5	7.4	1.6	1.5	1.1	2.5	2.5	14.0	7.8
Misc. fish	9.3	42.4	37.8	41.0	56.9	47.9	53.1	35.8	51.5
	CANNANORE				MANGALORE				
Prawn	31.2	8.1	1.7	4.8	26.2	5.9	0.7	-	*
Elasmobranchs	2.8	10.8	23.9	11.4	9.2	9.0	15.5	3.3	*
Perch	-	-	-	-	-	-	-	-	-
Cat fish	-	-	18.3	3.0	0.1	11.7	14.9	7.2	*
'Kilimeen'	8.3	5.9	31.5	6.6	0.3	5.8	2.2	-	*
Lacterius	0.9	0.5	1.5	13.3	1.3	5.6	3.9	2.5	*
Ribbon fish	-	6.6	12.4	-	0.5	3.9	0.5	-	*
Lizard fish	-	2.2	2.5	-	-	0.1	0.1	-	*
'Dhoma'	-	44.4	-	-	1.5	8.4	-	-	*
Other quality fish	-	3.6	1.6	7.2	1.5	2.4	0.6	-	*
Misc. fish	56.8	17.9	6.6	53.7	59.4	47.2	61.6	87.0	*

*Fishing effort Nil.

Table VIII Percentage composition of species by region and depth.

From the available data it is seen that from Cape Comorin to Mangalore region the occurrence of prawns in relatively large quantities were noticed in depth belts 0-19 m, elasmobranchs in 40-59 m, cat fish in depth belts 40-99 m, 'kilimeen' in 20-59 m, Lacterius in 20-79 m and ribbon fish in 20-59 m depth belts. A broad indication about the distribution of the resources has been mentioned here for exploration, while considering the commercial exploitation of the different species.

7. RELATIVE ABUNDANCE

It is well known that the catch per unit effort is a measure of the available stocks and it is this parameter which gives the most important clue for developing a suitable conservation and management policy for any fishery. It is also generally accepted that the same criterion (and not the total catch) that is valid in comparing the performance of different vessels. In view of the fact that trawling operations have been in progress for a few years in the fishing grounds referred to in this bulletin, it would be useful to follow the trends of productivity in the different regions as seen by the catch rates of the different trawlers.

7.1. Relative abundance by area

Fig. 10 shows the average catch per hour of trawling obtained by the five classes of vessels from the various geographical divisions of the region under study. It can be seen from the figure that the catch per hour of trawling varies widely from vessel to vessel in the same area. This may probably be due to varying fishing capabilities of these vessels, the type and size of gear employed, depth range and period of operation. Out of the 11 divisions surveyed only three divisions viz., 9-75, 9-76 and 10-75 were

surveyed by all the five classes of vessels. Areas 8-76, 10-76 and 11-75 were covered by four classes of vessels, while the area 12-74 by three classes of vessels. The remaining divisions were surveyed by one or two classes of vessels during the whole period of observation.

Based on the fishing effort expended by different vessels it was stated earlier that out of the 11 divisions surveyed six divisions viz., 9-75, 9-76, 10-75, 10-76, 12-74 and 13-74 can be said to have been intensively surveyed. Based on the catch rates obtained by different vessels from these six divisions, these areas in the order of relative abundance can be rated as 9-75, 9-76, 12-74, 13-74, 10-75 and 10-76. The high catch rates obtained by the 17.5 m vessels from areas 11-74 and 8-76 were of special significance.

Figures 11 to 14 show the catch rates of dominant species such as prawn, elasmobranchs, perch, Lacterius, ribbon fish, 'kilimeen', cat fish, lizard fish and 'dhoma' obtained by different types of vessels from different geographical divisions. It is evident from the figures that the catch rates of these species varied from vessel to vessel and from region to region. Generally elasmobranchs, prawn and cat fish formed the bulk of the aggregate catch from most of the areas.

From Fig. 11 it can be seen that in the case of small vessels, prawn registered high catch rates from areas 12-74, 9-76, 13-74 and 10-76 while elasmobranchs were high in areas 9-75, 12-74 and 9-76. 'Kilimeen' showed high catch rate from area 9.75.

While comparing the data for Durga and Flying Fish the catch rate of prawn was high in areas 9-76, 12-74 and 10-76 whereas elasmobranchs recorded high rates in areas 9-75, 10-75 and 12-74, 'dhoma' in areas 12-74 and 11-75, while 'kilimeen' in areas 9-75, 10-75 and 11-75 (Fig. 12).

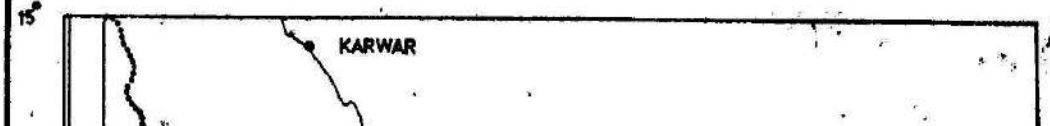


FIG.10: CATCH PER HOUR OF TRAWLING OF DIFFERENT CLASSES OF VESSELS BY AREA.

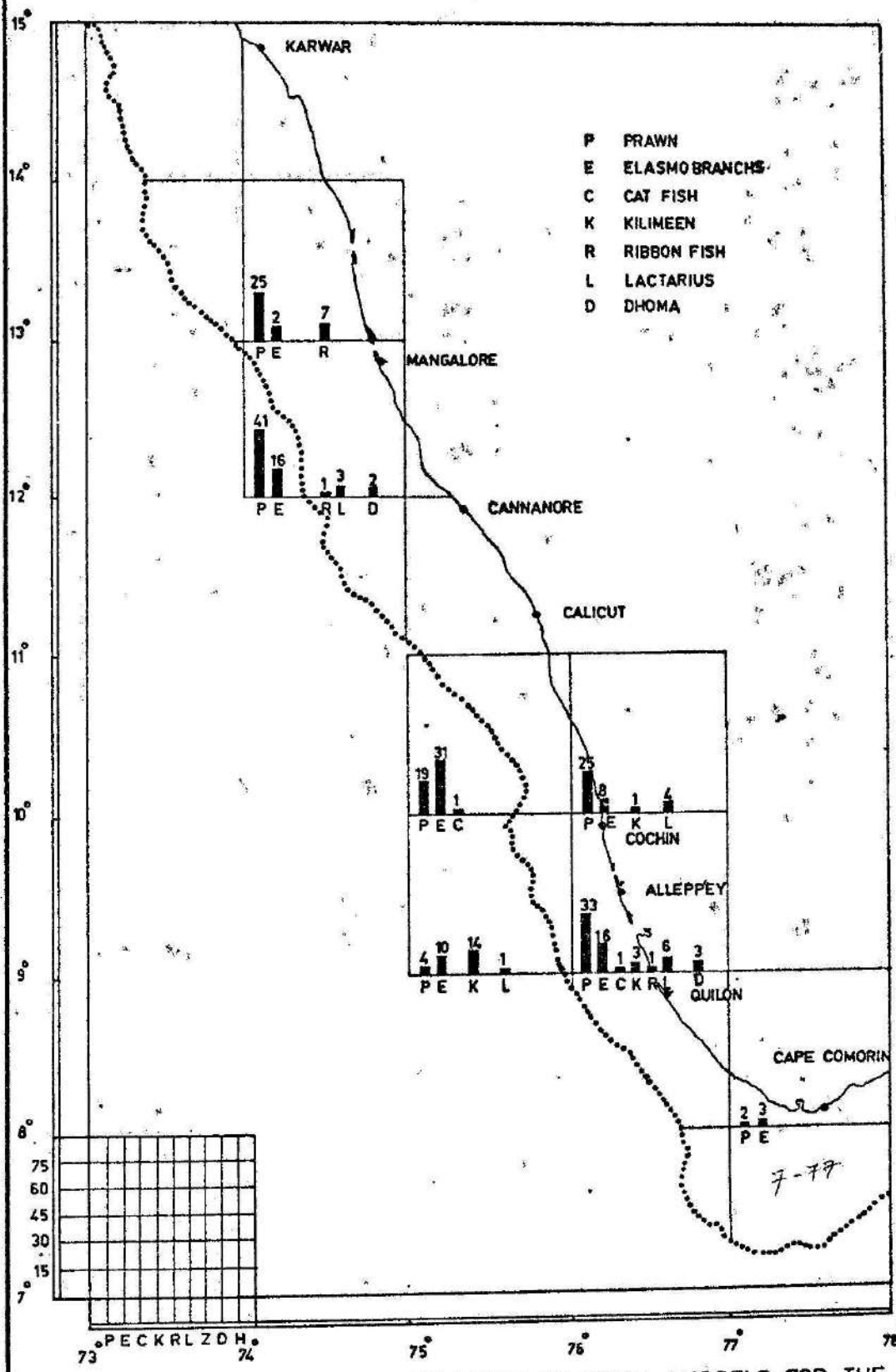


FIG.11: CATCH PER HOUR OF TRAWLING OF SMALL VESSELS FOR THE IMPORTANT VARIETIES BY AREA.

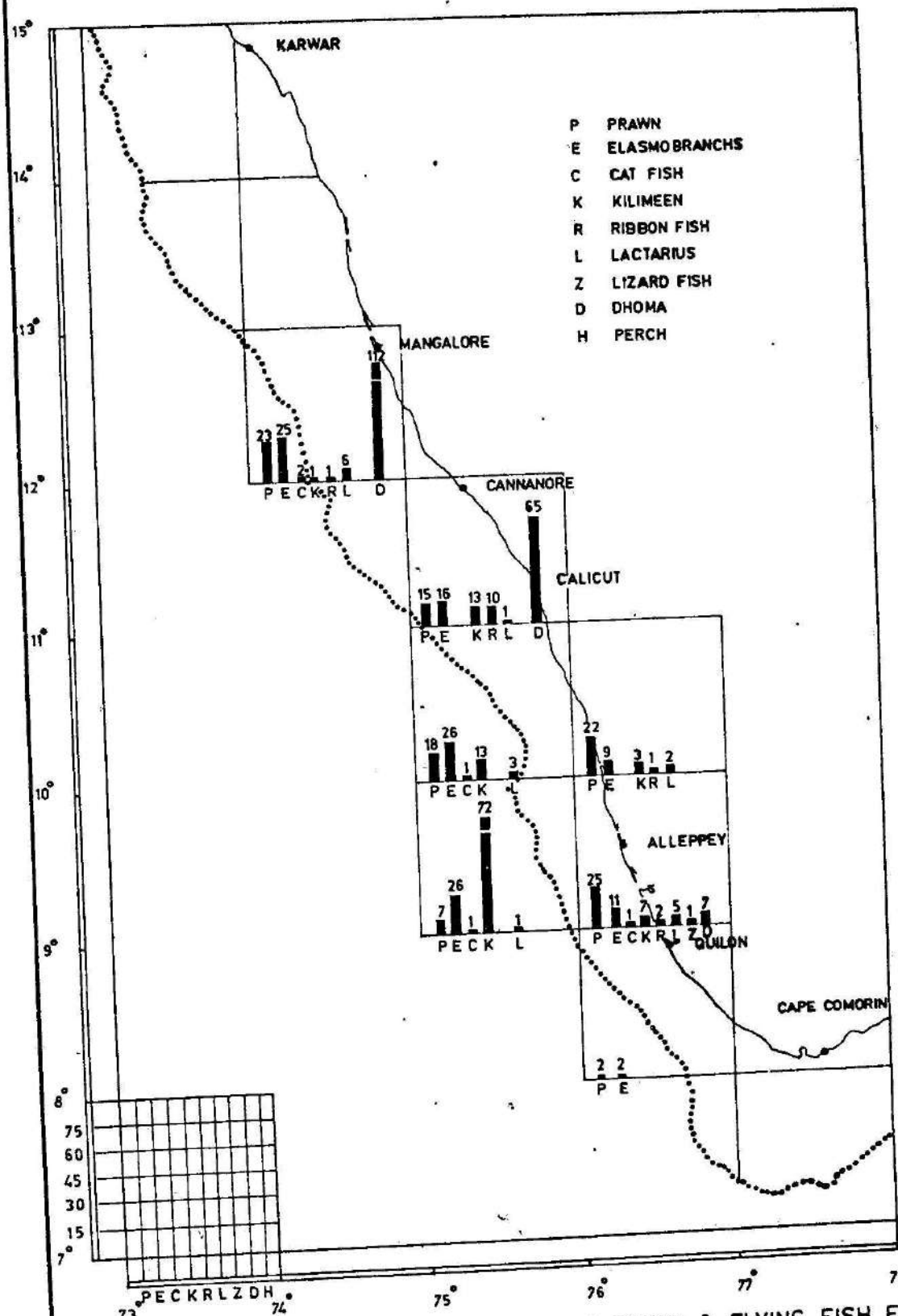


FIG.12: CATCH PER HOUR OF TRAWLING OF DURGA & FLYING FISH FOR THE IMPORTANT VARIETIES BY AREA.

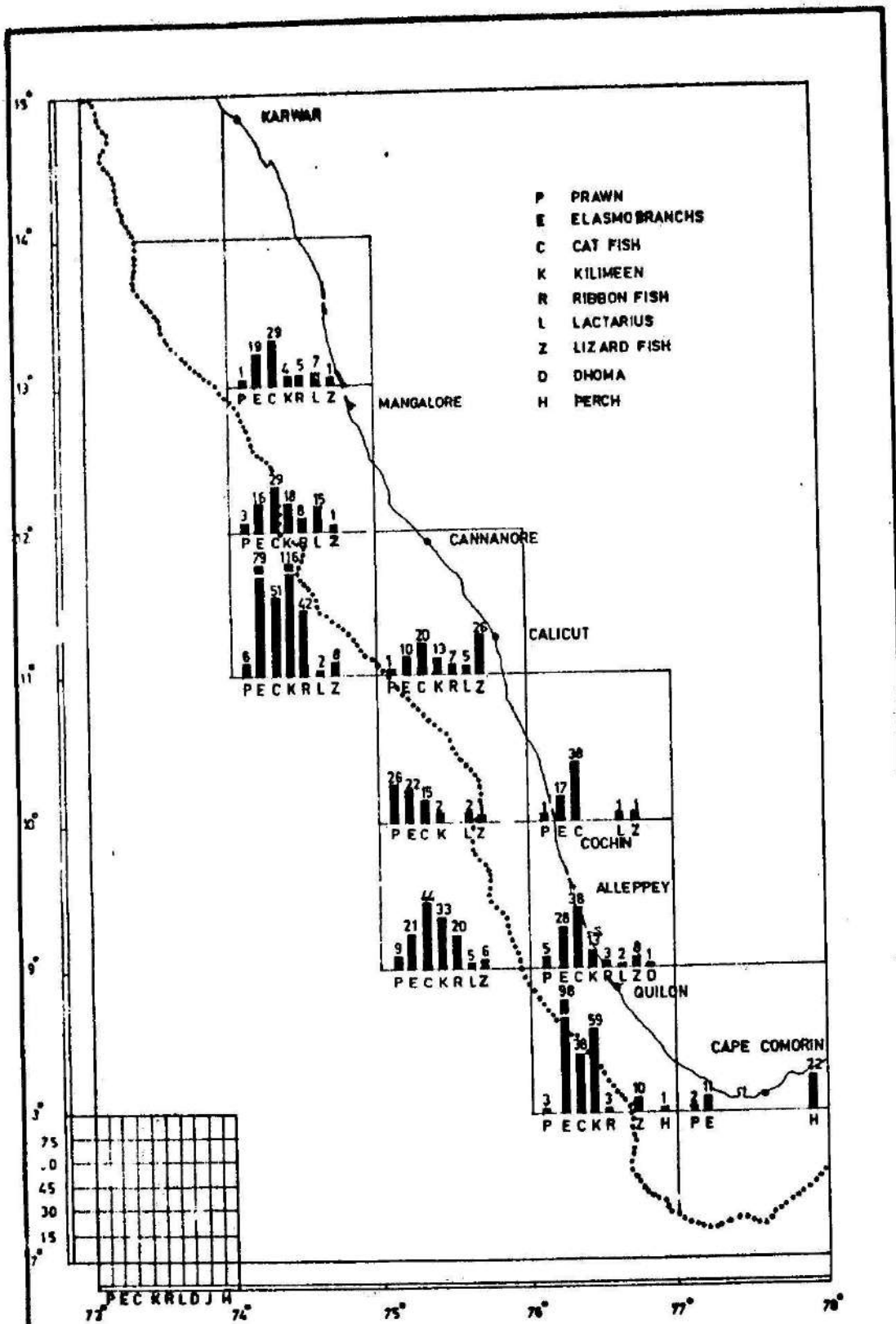


FIG.13: CATCH PER HOUR OF TRAWLING OF 17·5 M. VESSELS FOR THE IMPORTANT VARIETIES BY AREA.

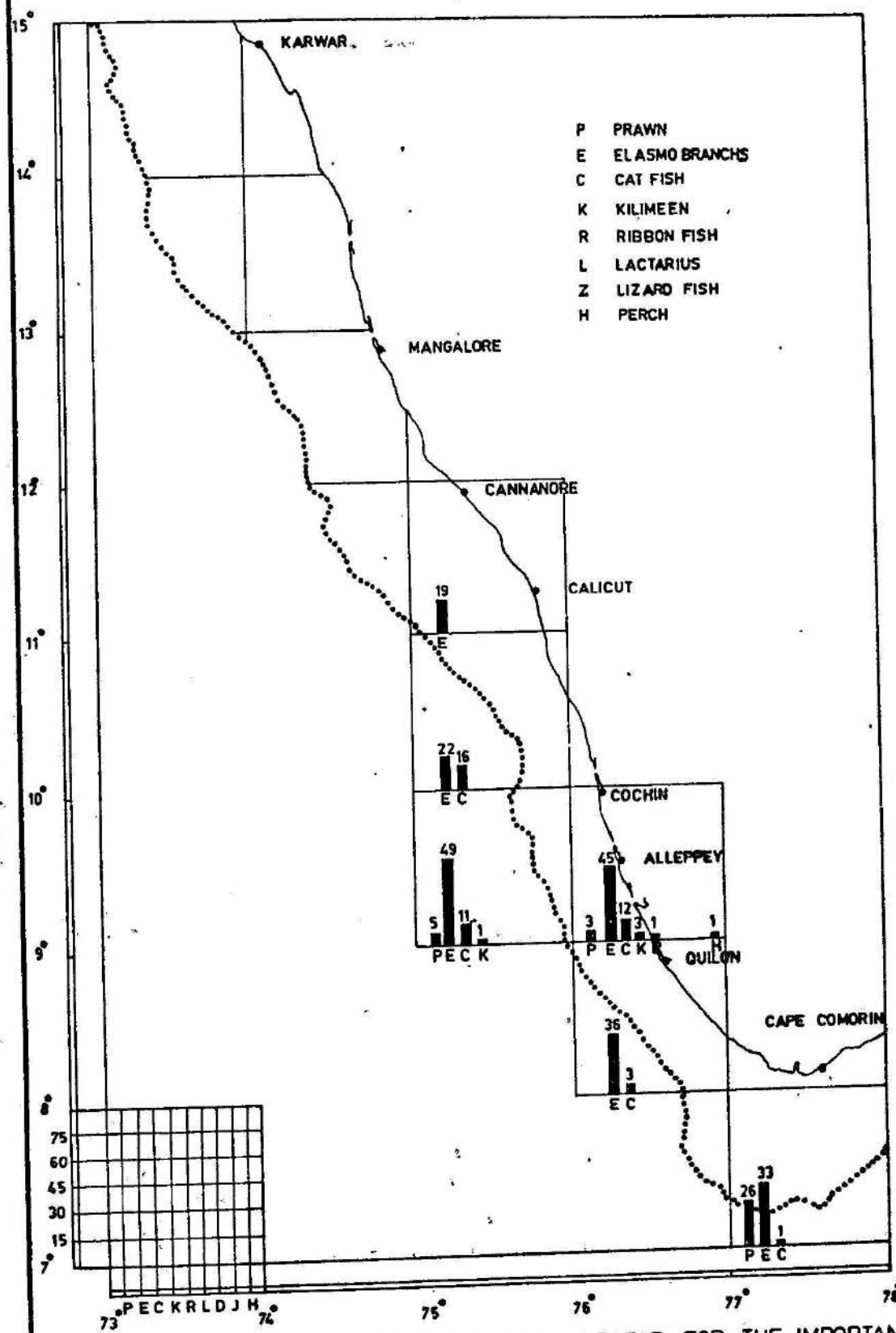


FIG. 14: CATCH PER HOUR OF TRAWLING OF PRATAP FOR THE IMPORTANT VARIETIES BY AREA.

In the case of 17.5 m vessels prawn registered the highest catch per hour from area 10-75 (Fig. 13). In all other areas the catch rate of prawn was relatively poor. Elasmobranchs accounted for high catch rates from 11-74 and 8-76 while in all other areas it was almost evenly distributed. The occurrence of 'kilimeen' appeared to be high in areas 11-74, 8-76 and 9-75 while ribbon fish in areas 11-74 and 9-75. These vessels registered higher catch rates of cat fish than other classes of vessels from several areas surveyed and the highest rate was recorded from area 9-75.

From Fig. 14 it may be seen that in the case of Pratap, elasmobranchs were the abundant group from many of the areas surveyed and no significant variation in the catch rate was noticed. Prawn and cat fish showed relatively high catch rate from area 7-77 and 10-75 respectively.

A close scrutiny of the Figs. 11 to 14 show that the abundance of prawn was relatively high in areas 12-74 and 13-74 off Mangalore and 10-75, 10-76 and 9-76 off Cochin. Elasmobranchs as recorded in the order of relative abundance were viz., 11-74, 8-76, 10-75, 9-75 and 9-76. In general, the catch rate of cat fish was relatively high in almost all areas south of Cannanore. Among the different classes of vessels, the catch rate obtained by 17.5 m vessels from areas 11-74 and 9-75 is noteworthy. 'Kilimeen' recorded relatively high catch rates from areas 11-74, 8-76, 9-75 and 12-74, 'dhoma' from areas 11-74 and 11-75, Lacterius from areas 12-74 and 13-74, ribbon fish from areas 11-74 and 9-76 and lizard fish from areas 11-75 and 8-76. Perches registered comparatively high catch per hour from area 8-77 off Cape Comorin.

7.2. Relative abundance by area and depth

Figs. 15 to 18 shows the catch rates obtained by selected classes of vessels from various depth ranges of each division surveyed. For the purpose of studying bathymetrical distribution of resources, the shelf area was stratified into zones of 10 m depth intervals.

It can be seen from Fig. 15 that small vessels conducted survey upto 60 m depth belt and that the operation of these vessels were confined mainly to two regions viz., Mangalore and Cochin. In the Mangalore region, these vessels recorded the highest catch per hour of 222 kg. from the depth zone 30-39 m in area 12-74 while the next highest rate viz., 212 kg. per hour was recorded from depth zone 40-49 m from area 13-74. In the Cochin region the highest catch per hour was also obtained from 30-39 m depth range from area 9-76.

It can be seen from Fig. 16 that the vessels Durga and Flying Fish obtained the highest catch rate from 40-49 m depth zone, both from Mangalore and Cochin. The depth zone 30-39 m stood next in the order of relative abundance in both the regions. Further, it may be stated that the depth zone 20-29 m registered the highest catch rate from Cannanore region.

The 17.5 m vessels surveyed almost all the depth zones within 90 m depth from all the four regions. In Mangalore region the highest catch per hour viz., 460 kg. was obtained from the depth range 60-69 m from area 13-74. But this depth zone was fished only for three hours. The next highest catch rate of 253 kg. was obtained from 50-59 m depth. But in the neighbouring area 12-74, the highest average catch rate was recorded from 30-39 m depth zone.

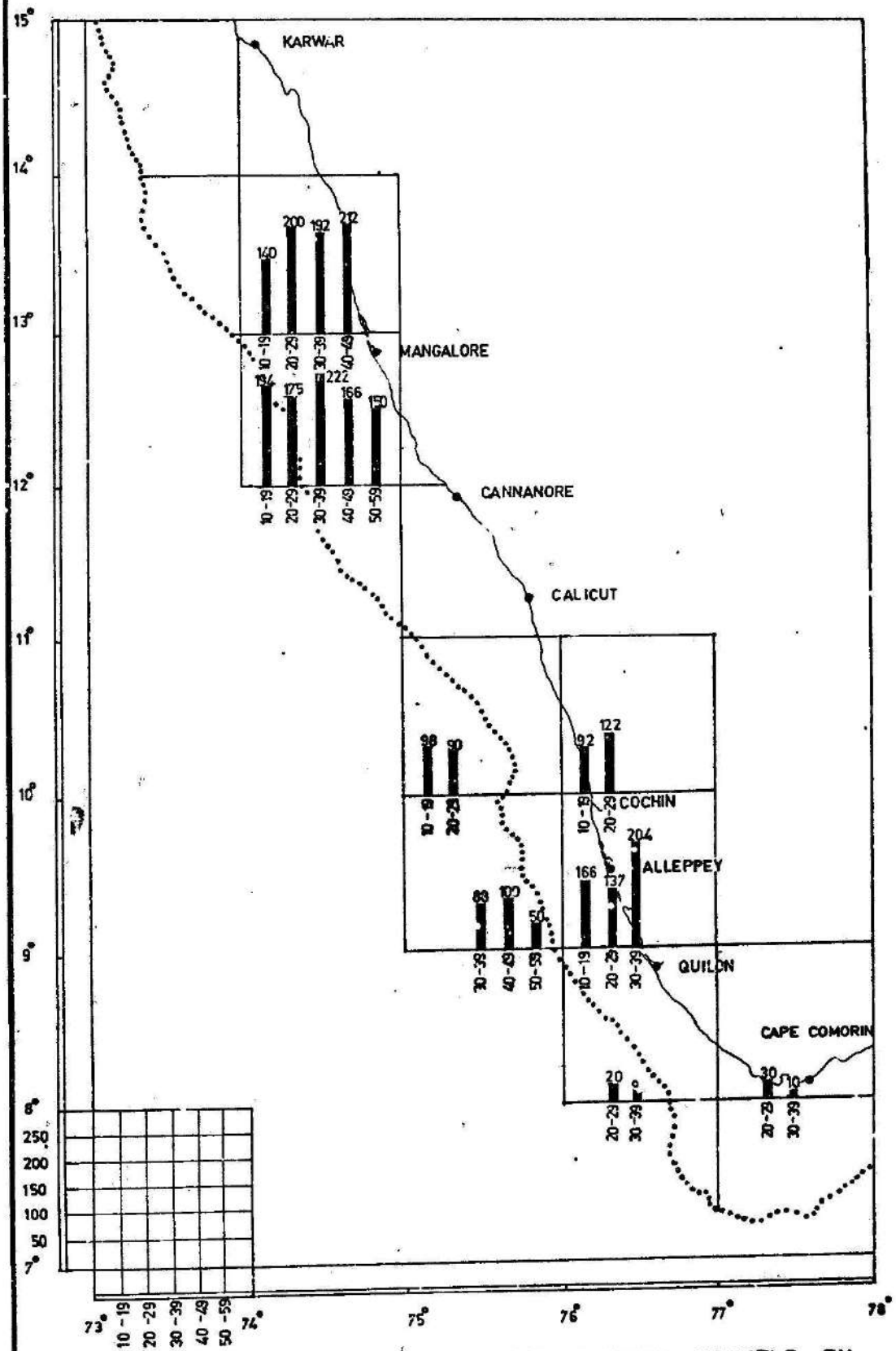


FIG. 15: CATCH PER HOUR OF TRAWLING OF SMALL VESSELS BY AREA AND DEPTH.

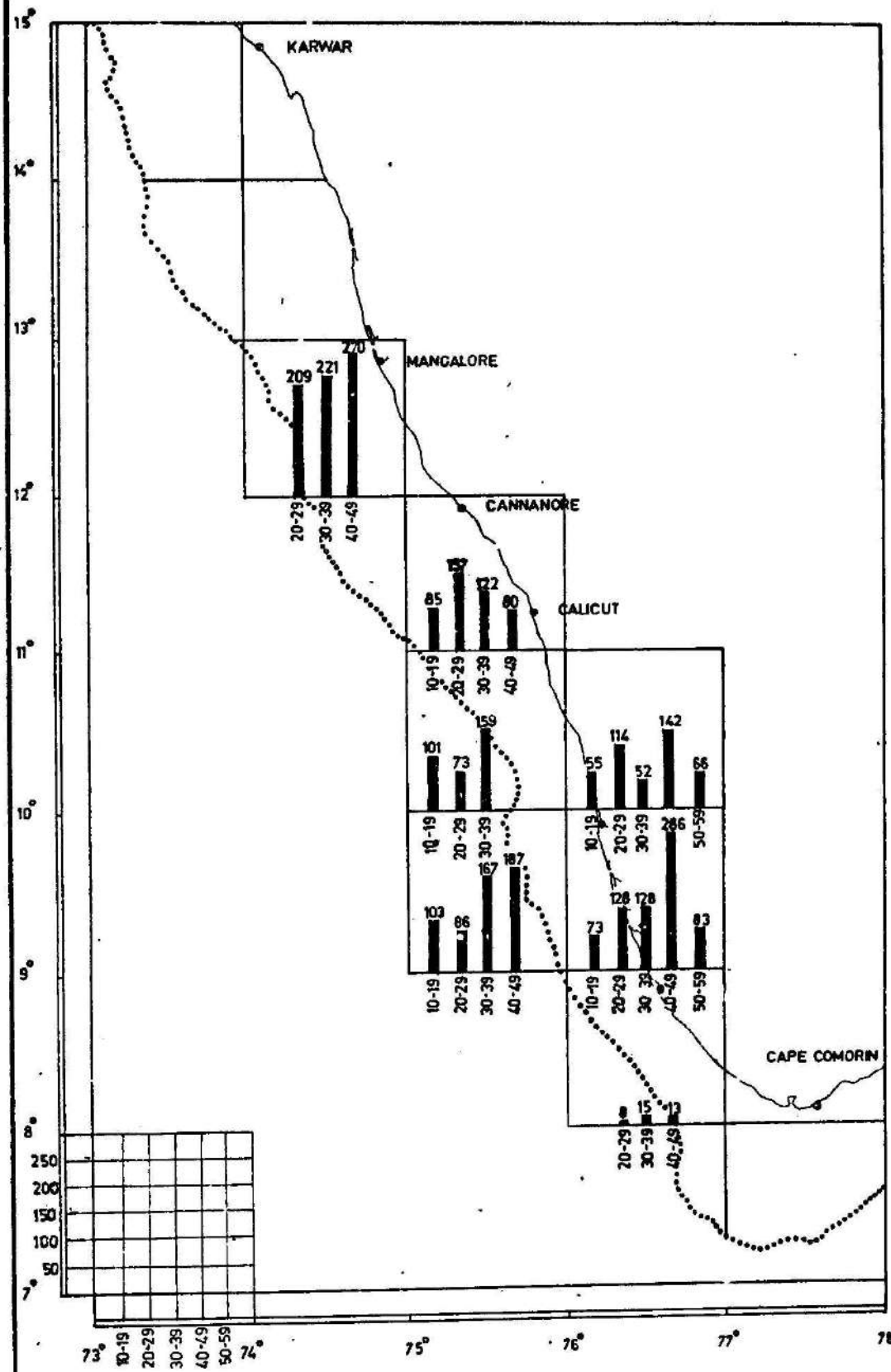


FIG. 16: CATCH PER HOUR OF TRAWLING OF DURGA & FLYING FISH BY AREA AND DEPTH.

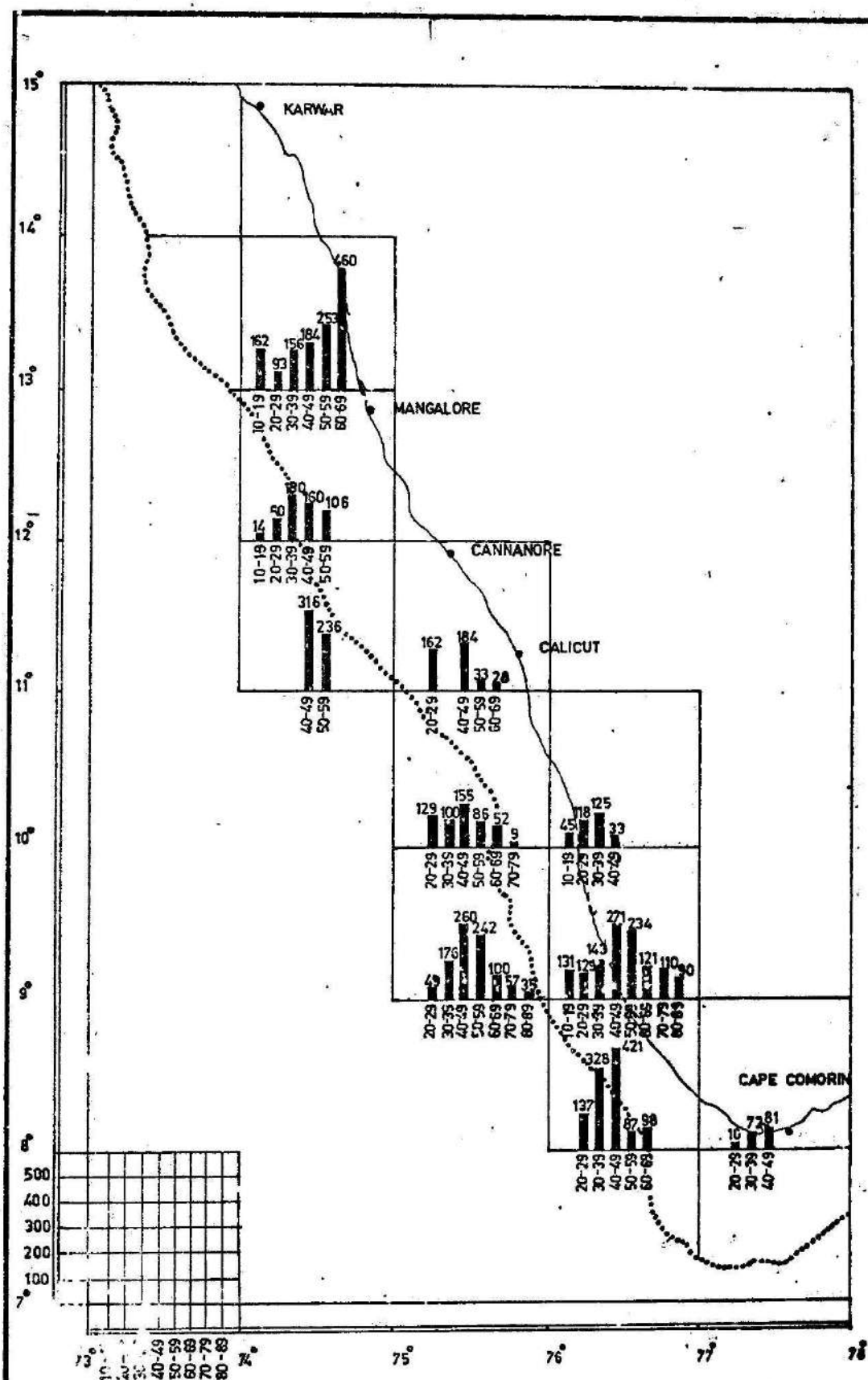


FIG. 17 CATCH PER HOUR OF TRAWLING OF 17·5 m. VESSELS BY AREA AND DEPTH.

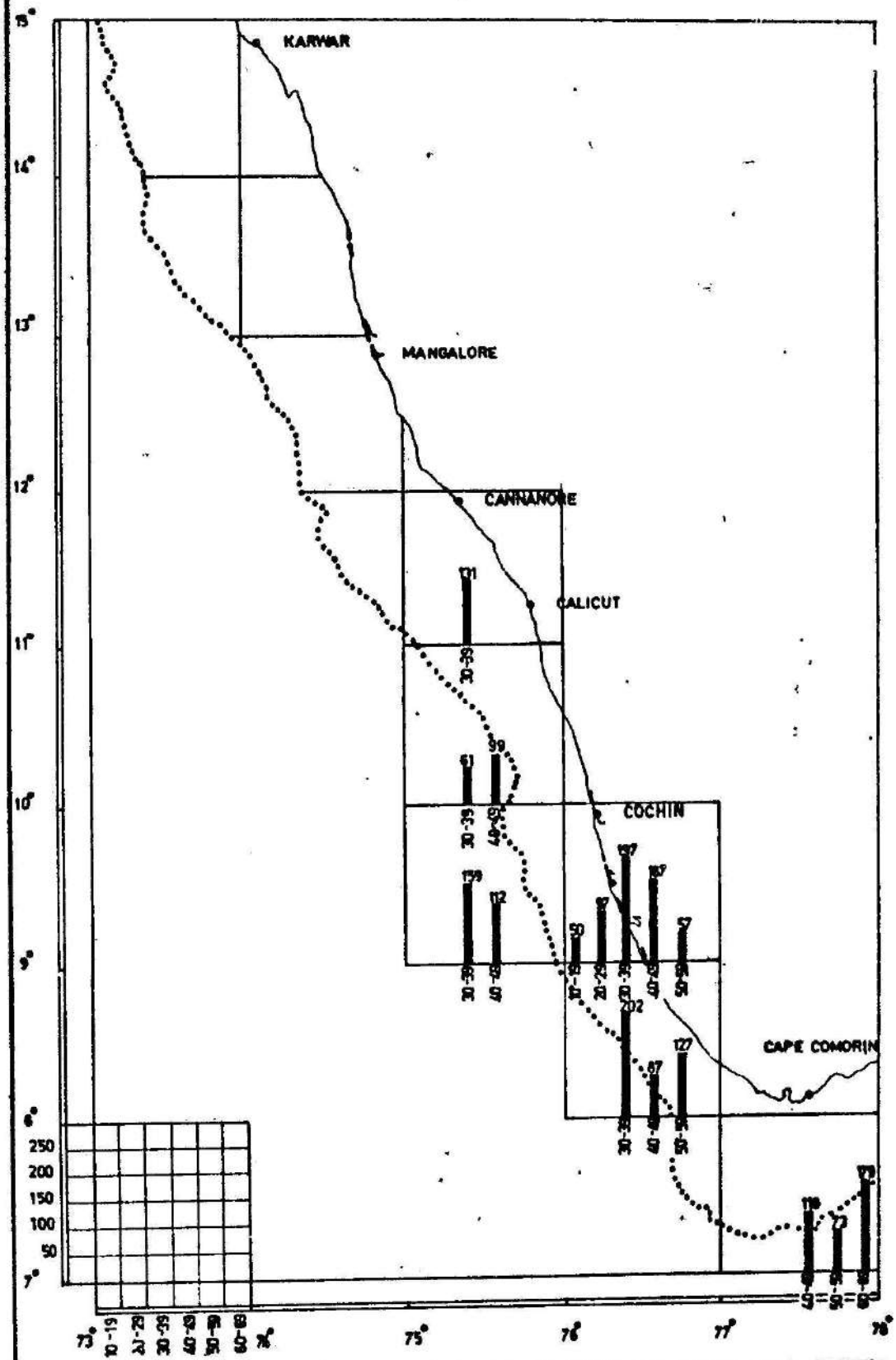


FIG.18: CATCH PER HOUR OF TRAWLING OF PRATAP BY AREA AND DEPTH.

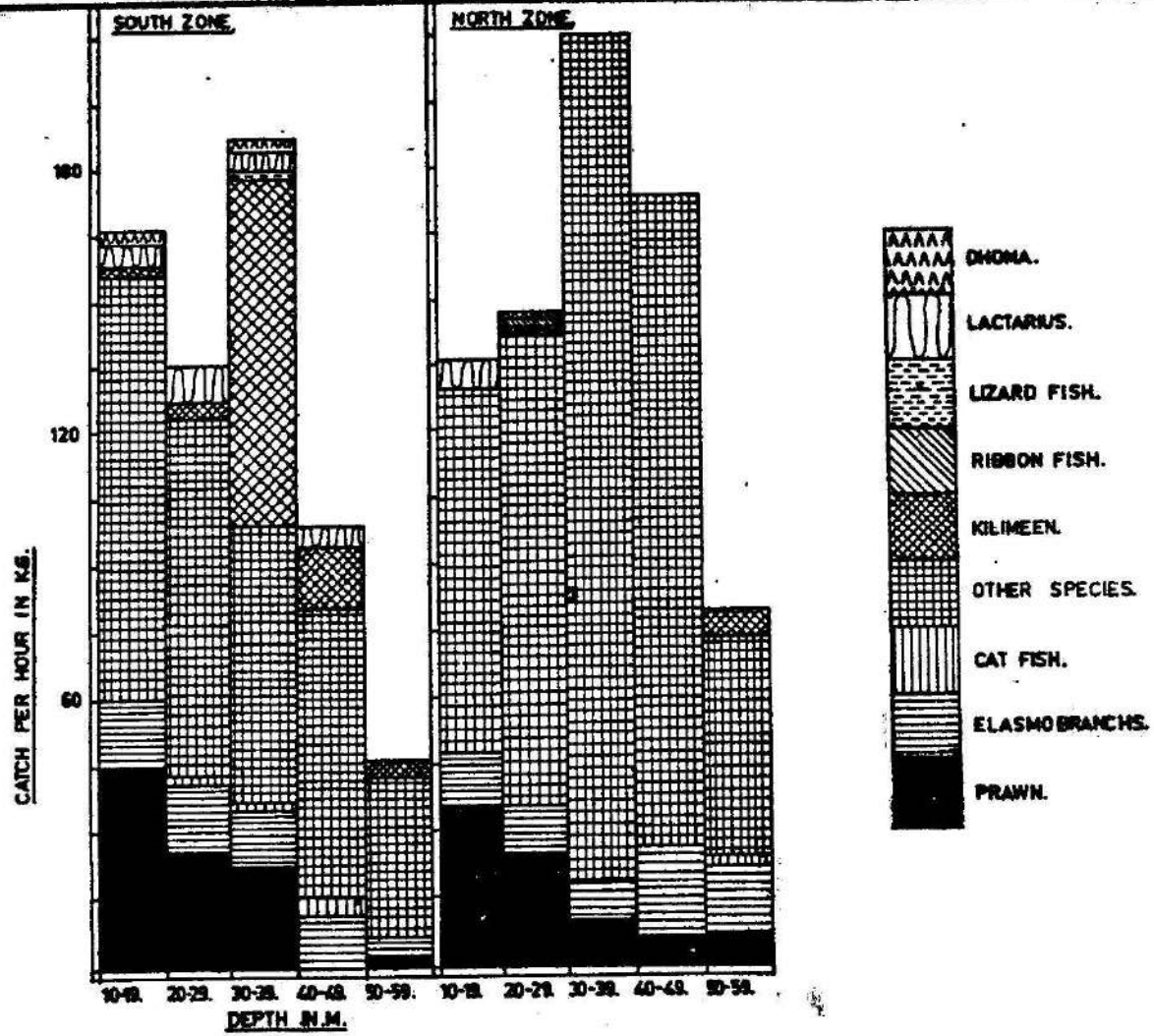


FIG.19: CATCH PER HOUR OF TRAWLING OF IMPORTANT VARIETIES OBTAINED BY SMALL VESSELS BY REGION & DEPTH.

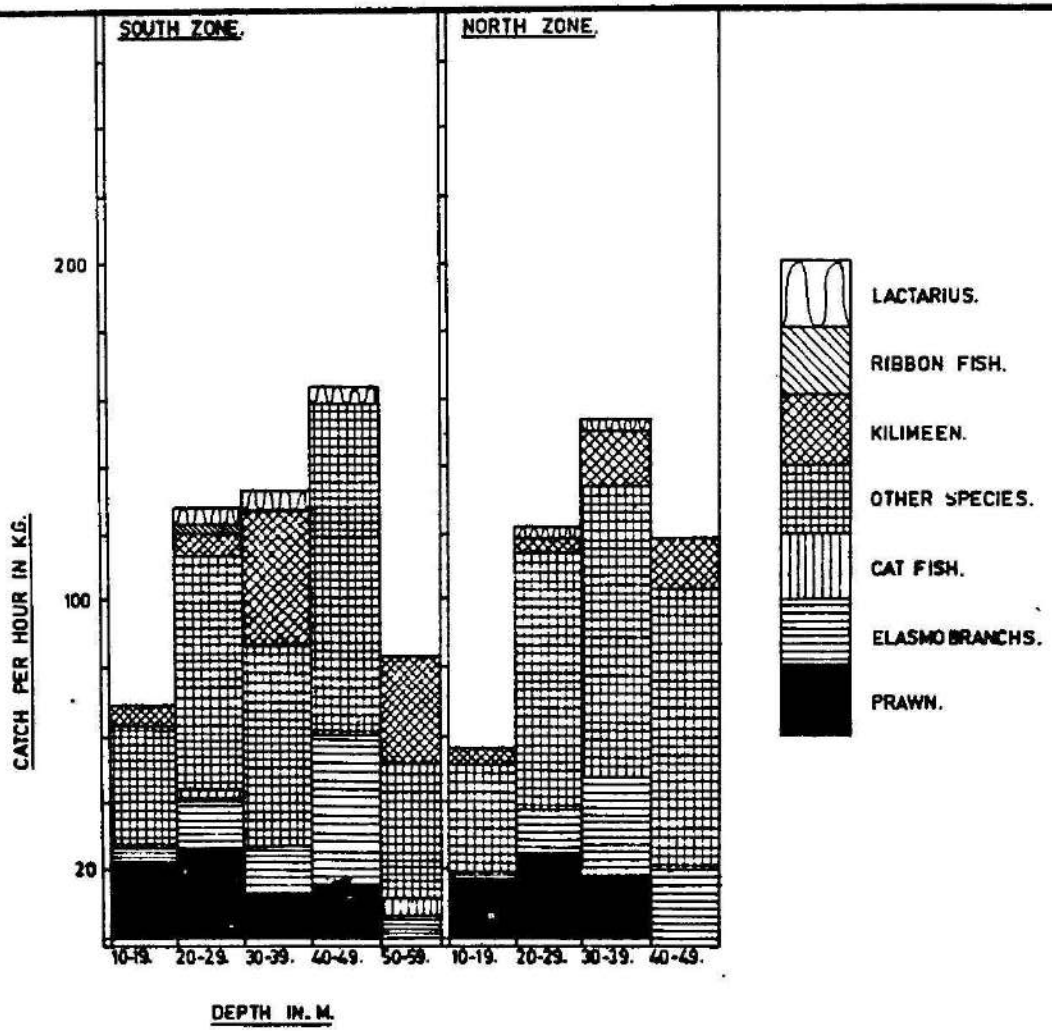


FIG.20: CATCH PER HOUR OF TRAWLING OF IMPORTANT VARIETIES OBTAINED BY DURGA AND FLYING FISH BY REGION AND DEPTH.

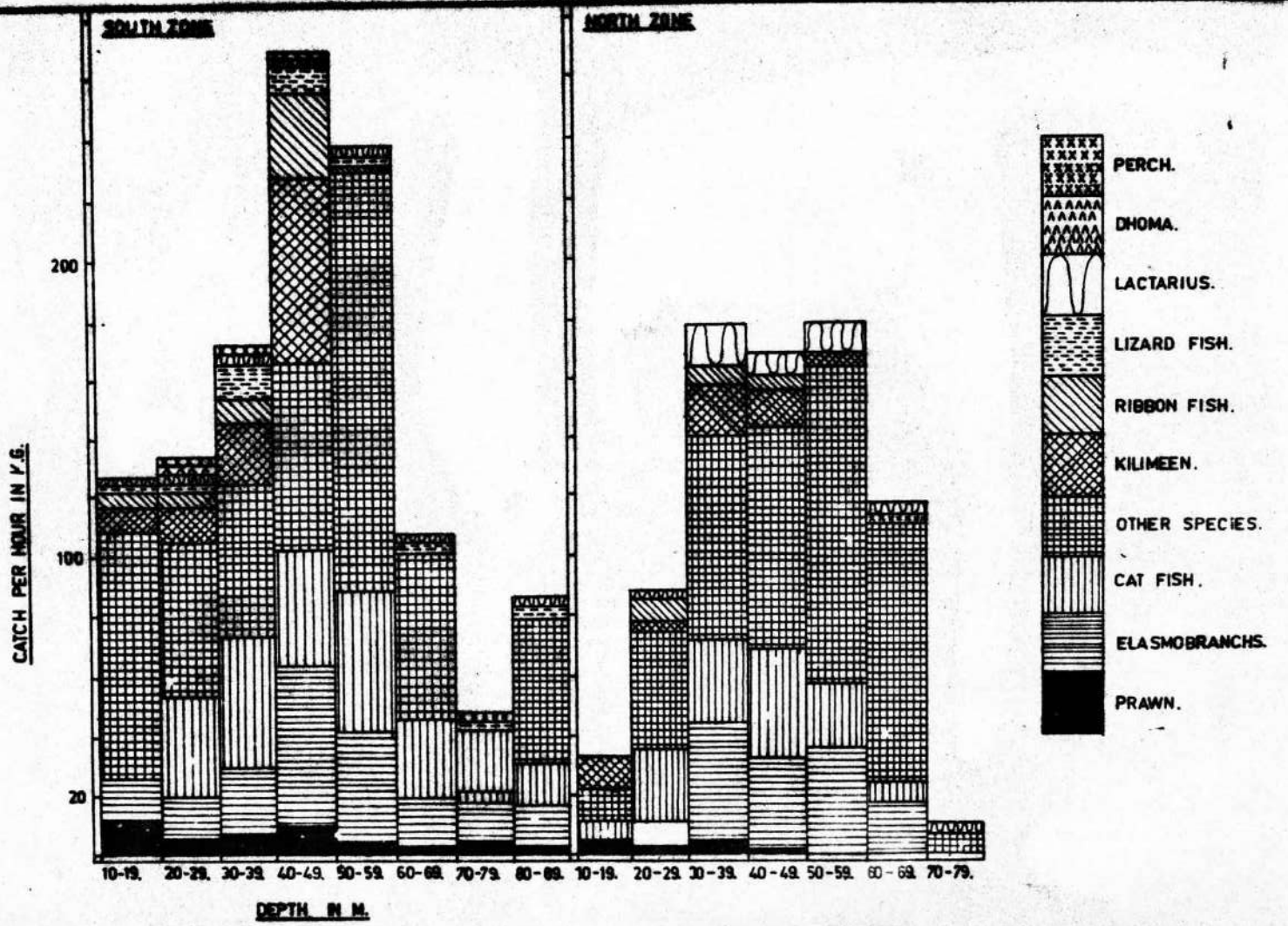


FIG.21: CATCH PER HOUR OF TRAWLING OF IMPORTANT VARIETIES OBTAINED BY 17·5 M. VESSELS BY REGION AND DEPTH.

In all the other areas such as 11-74, 11-75, 10-75, 9-75 etc., the depth range 40-49 m registered the highest catch rates. Amongst these, in the Cochin region where extensive survey was conducted in all the depth ranges, no significant variations in catch rates were noticed in the depth zones lying between 20-50 m depth. It was also recorded that there was a progressive decrease in the catch rates from 50 m depth to deeper waters in this region.

From Fig. 18 it can be seen that in the case of Pratap, relatively high catch rate was recorded from 30-39 m depth belt from Cochin region whereas from Cape Comorin it was from 60-69 m depth belt.

Fig. 19 to 21 illustrate the distribution of dominant varieties in different depth zones. For the purpose of this study, the whole area under investigation was divided into two zones viz., South Zone (Cape Comorin and Cochin) and North Zone (Cannanore and Mangalore). In both the zones the small vessels registered high catch rates of prawn in 10-19 m depth belt whereas in the case of Durga and Flying Fish the highest catch rate was recorded from 20-29 m depth zone (Fig. 20). A remarkable decrease in catch rate of prawn was also noticed from shallow to deeper waters in the case of smaller vessels. Elasmobranchs appeared to be relatively abundant in 40-49 m in the South Zone whereas it was recorded in 30-39 m from the North Zone. As stated elsewhere in this report that 17.5 m vessels registered higher catch rates of cat fish than all other classes of vessels and in both zones, the area between 20-60 m appeared to be the best productive zone. In the case of 'kilimeen' the occurrence appeared to be relatively high in 30-49 m depth belt in the South Zone.

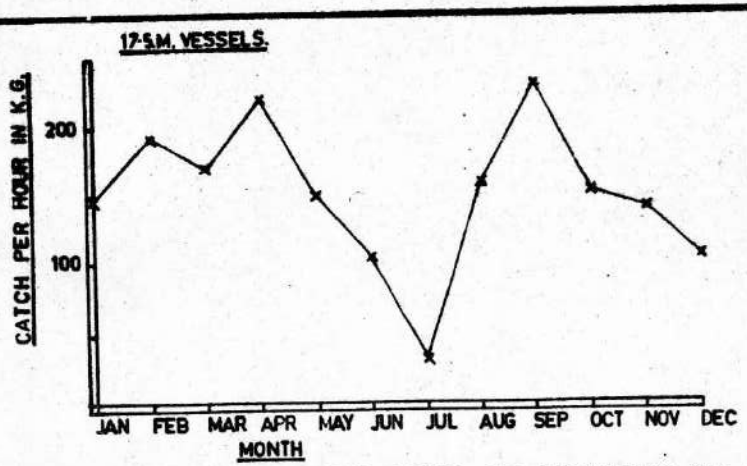
8. SEASONAL VARIATION

Figs. 22 and 23 show the monthly variation in the catch rates of different classes of vessels from the whole area under investigation. It may be seen from the figures that two peak seasons of productivity viz., September - November and February - April are clearly discernable. Characteristically the catch rate is the poorest during the monsoon months of June - July.

Out of the five classes of vessels, 17.5 m vessels have conducted survey from Cochin and Mangalore round the year. (Fig. 25). In the case of smaller vessels (Fig. 24) there was no operation during the monsoon months of June to September at Mangalore and during August at Cochin. Based on a comparative study of seasonal distribution of resources of Cochin and Mangalore regions on the results obtained by these two classes of vessels, it could be noticed that both the classes of vessels showed more or less similar seasonal pattern of catch rates in Cochin. Two peak seasons are noticed viz., February - April and September - November. The highest catch rate was recorded during the post-monsoon month i.e.,September in the case of 17.5 m vessels while the smaller vessels registered highest catch rate in the premonsoon month i.e., April. The least productive months are the monsoon months of June and July.

In the case of Mangalore region, slightly different trend was recorded from that of Cochin in the monthly catch rates, the peak period being February - April. In this region the pre-monsoon months appeared to be the best productive season in contrast to Cochin region where the post-monsoon period was recorded as the best.

The monthly variation in the catch rates of important groups like prawn, elasmobranchs, cat fish, 'kilimeen' etc., obtained from selected classes of vessels are indicated in figures 26 to 28. It can be seen from the figures that in the case of prawn high catch rates



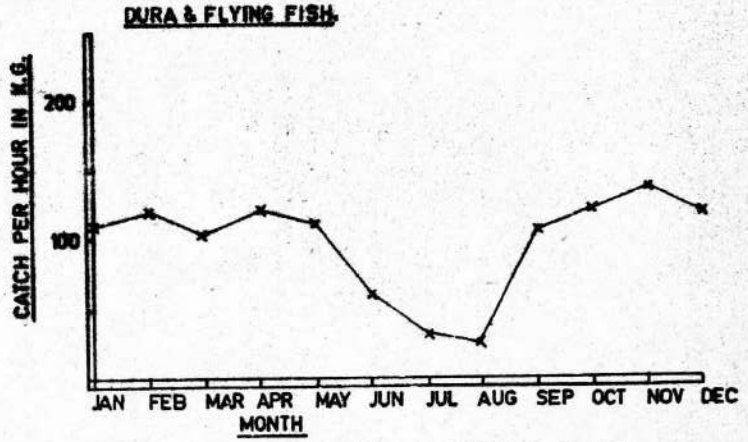
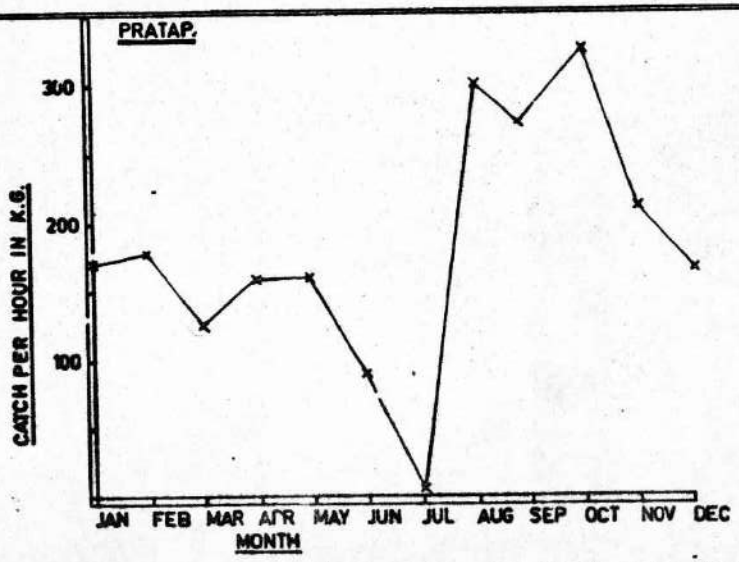


FIG. 22: MONTH-WISE CATCH PER HOUR OF TRAWLING OF 17·5.M. VESSELS AND DURGA & FLYING FISH.



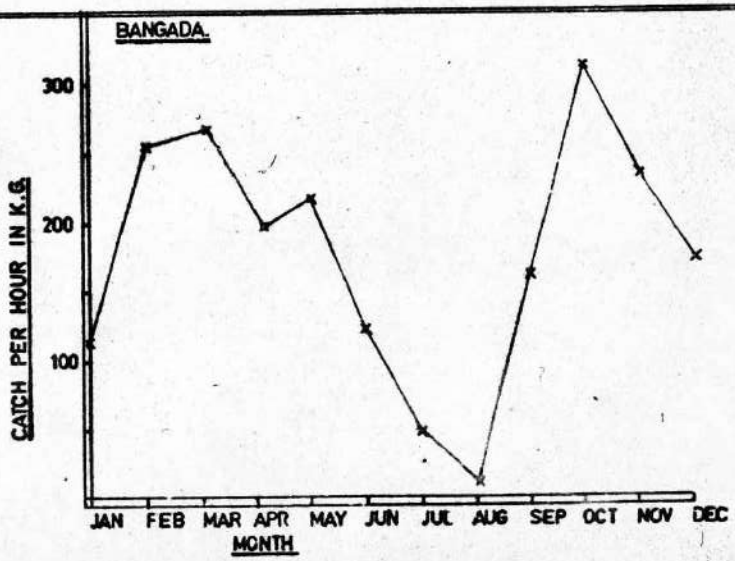


FIG. 23: MONTH-WISE CATCH PER HOUR OF TRAWLING OF PRATAP AND BANGADA.

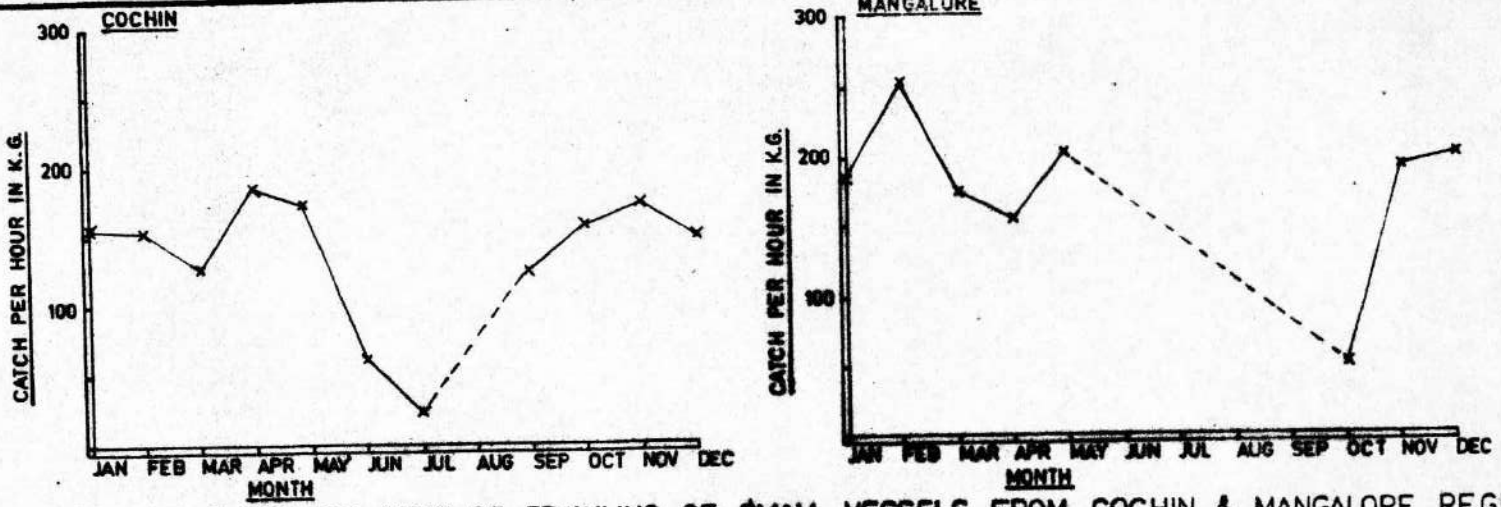


FIG. 24: MONTH-WISE CATCH PER HOUR OF TRAWLING OF SMALL VESSELS FROM COCHIN & MANGALORE REGIONS.

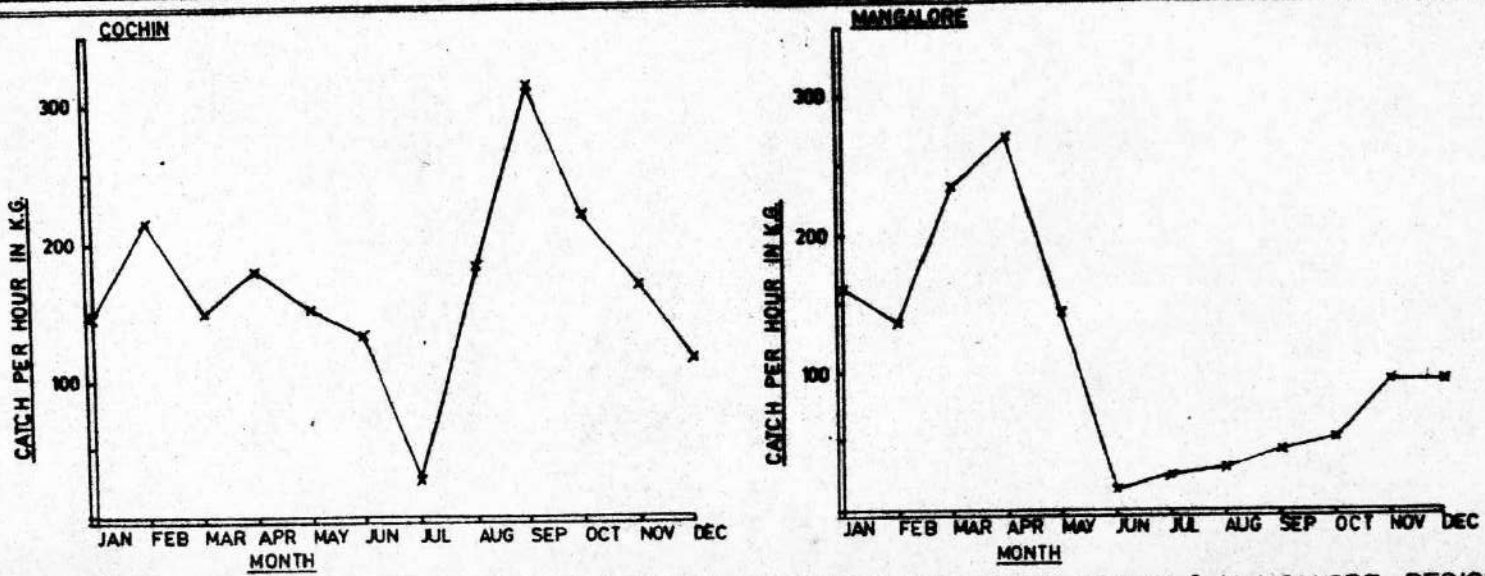
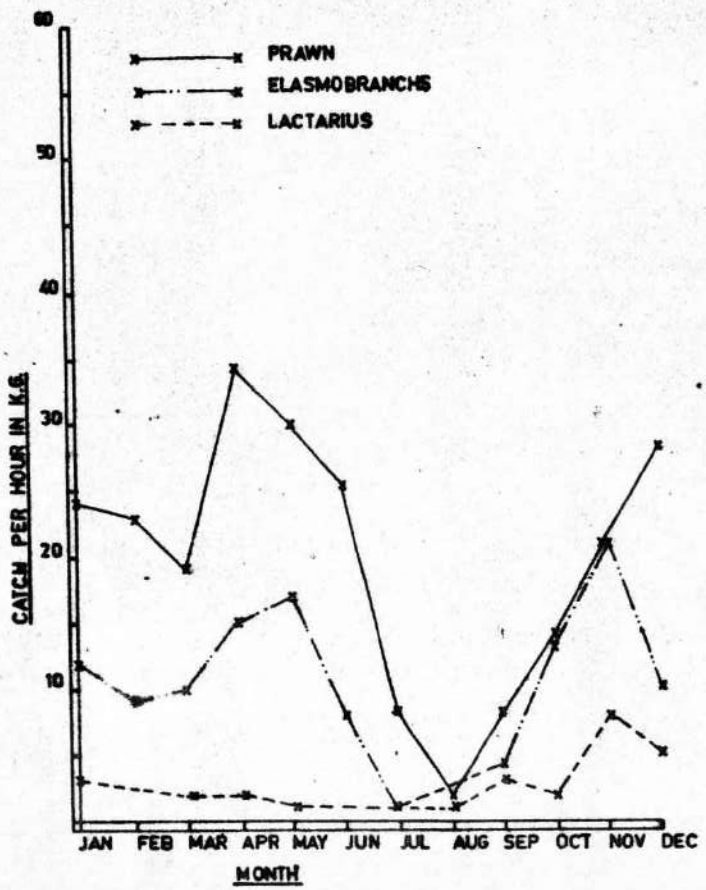


FIG. 25: MONTH-WISE CATCH PER HOUR OF TRAWLING OF 17·5 M. VESSELS FROM COCHIN & MANGALORE REGIONS.



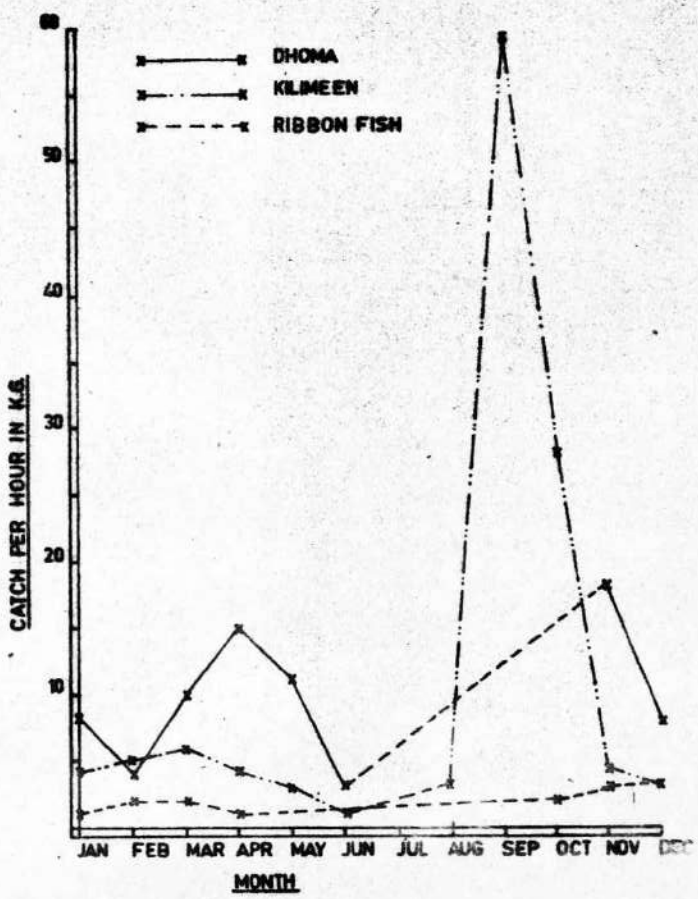
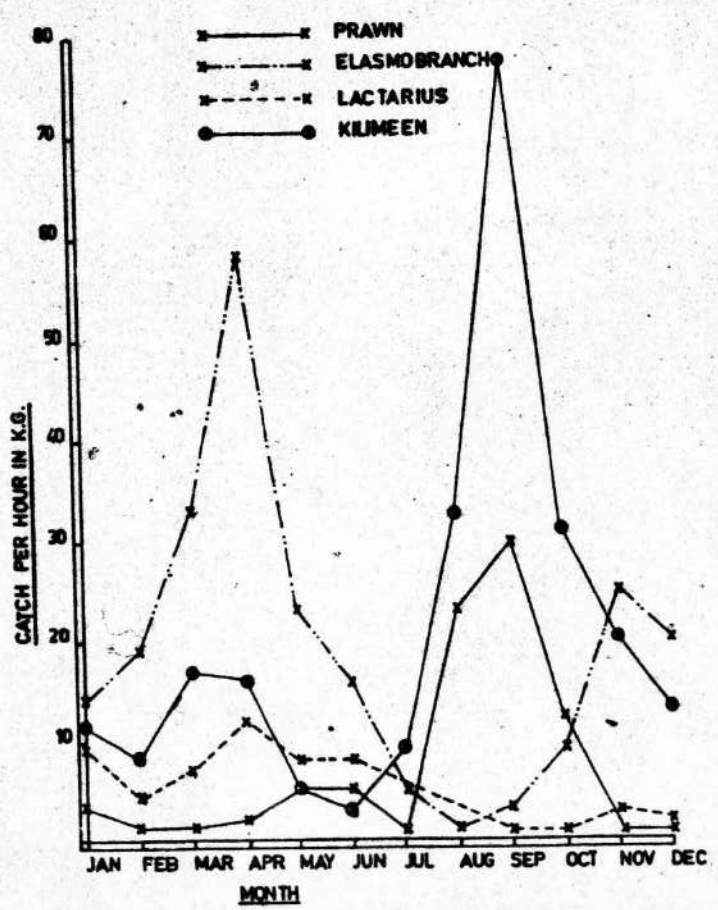


FIG. 26: MONTH-WISE CATCH PER HOUR OF TRAWLING OF IMPORTANT VARIETIES OBTAINED BY DURGA & FLYING FISH.



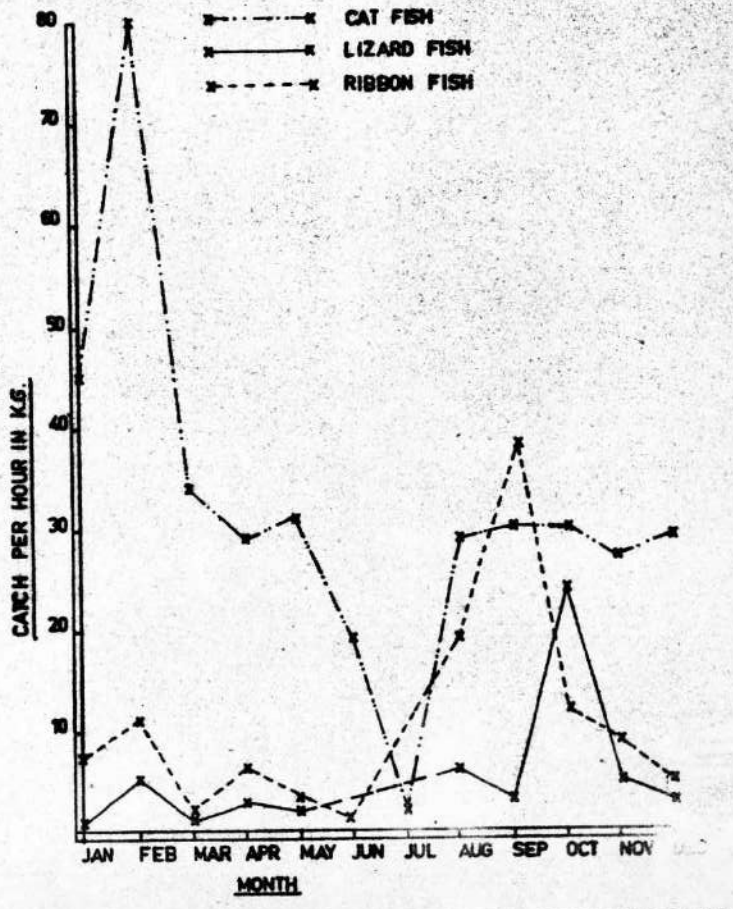
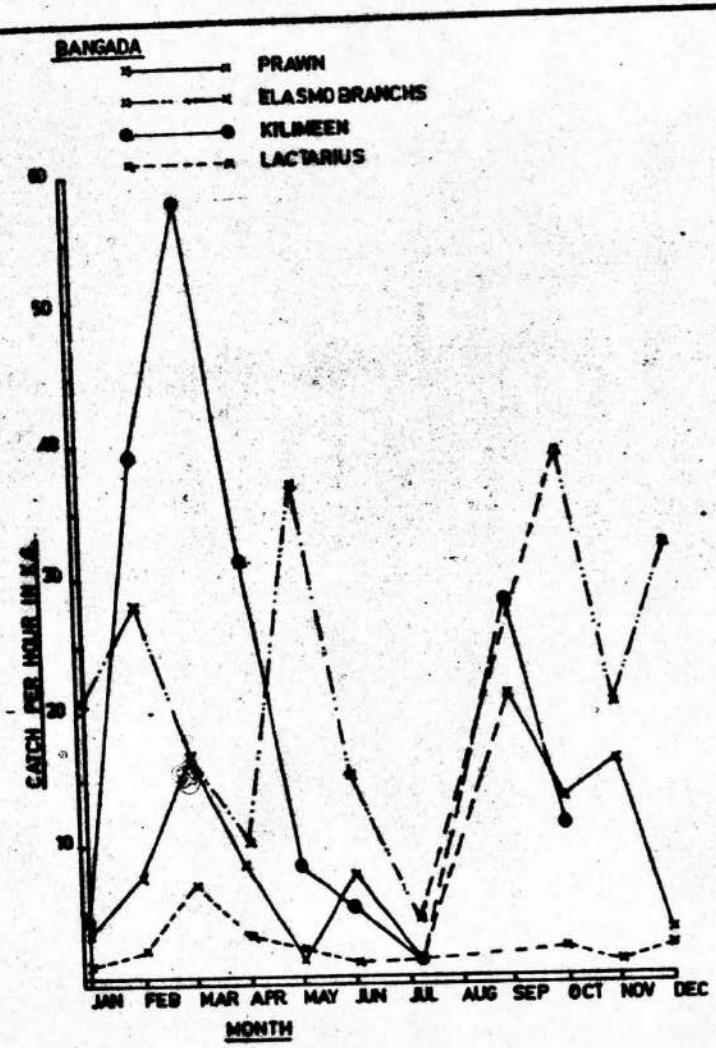


FIG. 27: MONTH-WISE CATCH PER HOUR OF TRAWLING OF IMPORTANT VARIETIES OBTAINED BY 17·5.M.VESSELS.



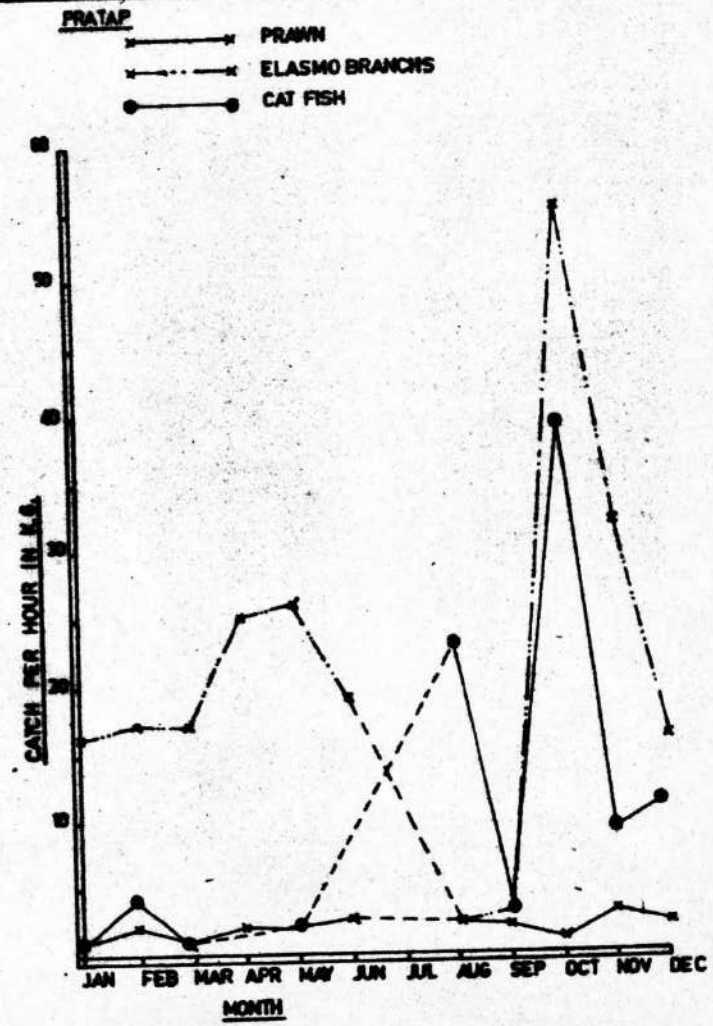


FIG.28: MONTH-WISE CATCH PER HOUR OF TRAWLING OF IMPORTANT VARIETIES OBTAINED BY BANGADA AND PRATAP.

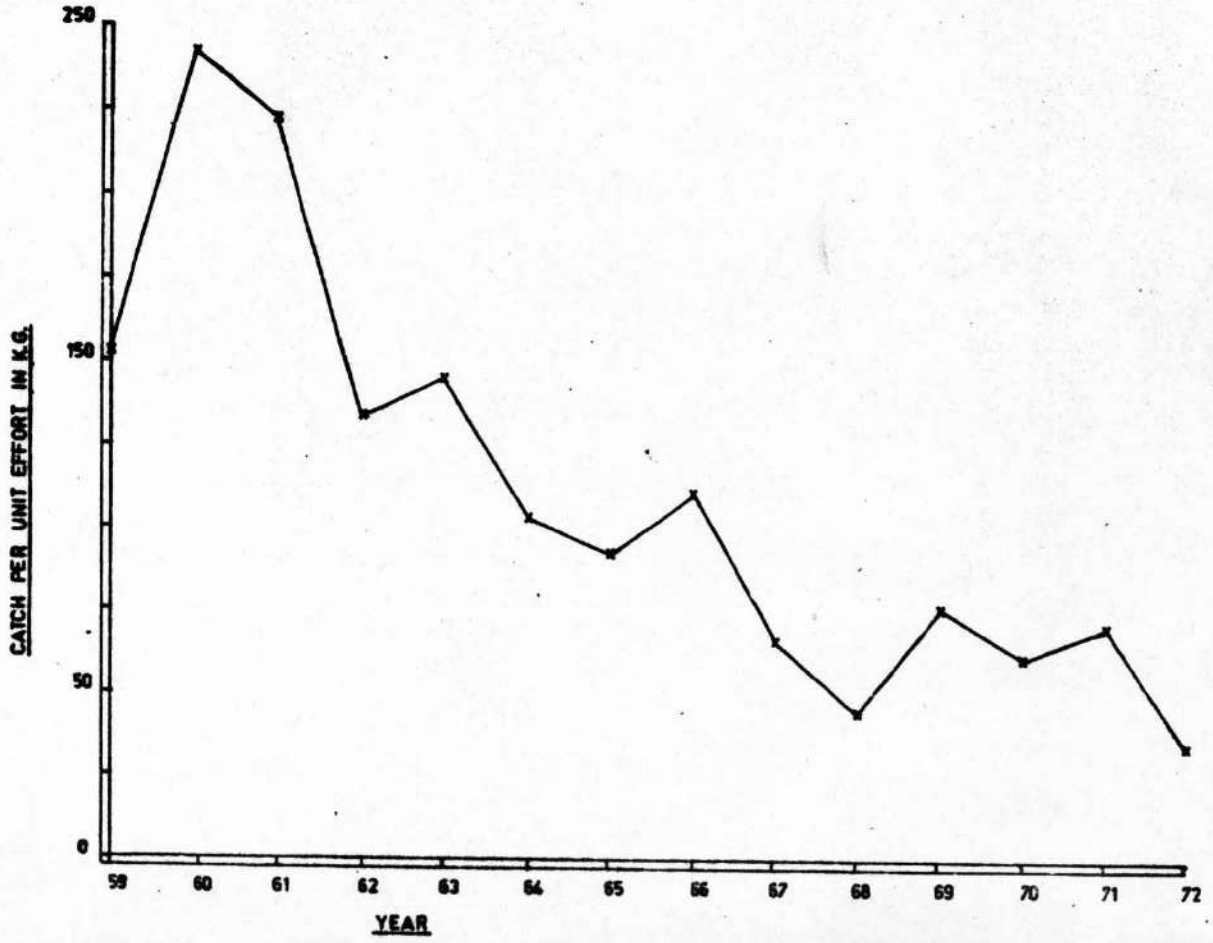


FIG.29: YEAR-WISE AVERAGE CATCH PER UNIT EFFORT OBTAINED BY DURGA & FLYING FISH FROM COCHIN DURING 1959-72.

were obtained during the months of September and November. The months of March, April and May also appeared to be good fishing season for prawn. Elasmobranchs registered high catch rate during April/May and October/November. Lactarius recorded relatively high catch rates during the months of March and April except in the case of Durga and Flying Fish where November appeared to be the peak month. The period from August to October was the best season for 'kilimeen' while March/April can be considered as secondary peak period. Two peak periods were noticed in the case of cat fish viz., January - February and August - October. Lizard fish and ribbon fish registered high catch rates during October and August/September respectively.

Among the vessels surveyed in this region, the vessels Durga and Flying Fish have fished for more than 13 years continuously from Cochin base. These two vessels have in fact, witnessed the growth and stabilisation of the shrimp fishing industry in Cochin waters. Joseph (op. cit.) has discussed the declining trend in the catch rate of prawn by the mechanised boats operated in Cochin area on the basis of the resource monitoring done by these two vessels during their uninterrupted exploratory surveys since 1959 to 1973.

Fig. 29 indicates the average catch per hour of fish and prawn obtained by these two vessels from 1959 to 1972. From the figure, it may be seen that there had been a remarkable decline in the catch rate from 1962 onwards. This may be due to several reasons, the most important among them being the phenomenal increase in the number of small mechanised boats fished in this area during the Sixties. It is also believed that the shrimp stock off the Kerala coast is exploited to the maximum substantiate level of yield (Joseph op. cit., Qasim 1972). A suitable allowance may also have to be given for the deterioration in the condition of the vessels and the consequent decline in their catching efficiency due to age.

9. BULL TRAWLING

During the period from 1957 to 1959, two identical vessels of the Project viz., Ashok and Pratap having 240 H.P. each carried out "bull trawling" along the south west coast. This method of fishing is also known as pair boat trawling which is used at present in Japan and Philippines. In this, the trawl is dragged by two vessels which keep a certain distance apart so as to spread the two wings of the net properly. Shooting and hauling are done by both the vessels alternatively. The main difference between bull trawling and otter trawling lies in the absence of otter boards and in the enormous size of the bull trawl itself in the former method of fishing. The net used had the following dimensions.

Length of head rope	...	58.4 m
Length of foot rope	...	62.5 m
Size of cod-end mesh	...	65 mm

The survey data pertaining to the years 1957 and 1958 are rather incomplete especially with regard to the information about area operated, depth range, species composition etc. Therefore, these are treated separately and are presented in Table . III. During this period these vessels carried out bull trawling, in areas between Cannanore and Cape Comorin. It may be seen from Table III that during 1958 the vessels recorded a catch rate of 1055 kg. /hour of trawling.

The results obtained during the year 1959 are detailed in Table No.IX. During this year bull trawling was carried out for six months i.e. from January to June in areas 7-76 and 9-76. The average catch /hour for the whole period of operation worked out to 860 kg. Of the two areas surveyed, area 7-76 registered the highest catch rate of 881 kg. /hour. It is evident from the table that during the six months survey period, the month of April recorded the highest catch rates viz., 1341 kg. and 1286 kg. /hour from areas 9-76 and 7-76 respectively. The month of May recorded the second highest catch rate from both the areas.

Month/year	Depth range (m)	Fishing effort (hrs.)	Total catch (kg)	Catch per hour in kg. Prawn.	Elasmo-branchs.	Cat fish.	Perch.	Li-zard fish.	'Dhoma'	Other qua-lity fish.	Misc. fish.	Total
7-76.												
January 1959	30-45	33	19415	3.3	280.6	23.8	0.2	-	0.2	63.0	217.2	588.3
February	35-46	20	15405	11.1	265.4	7.9	0.5	-	108.0	84.9	292.5	770.3
March	30-50	26	28733	11.3	700.5	8.5	-	-	0.1	28.0	356.7	1105.1
April	36-40	7	9000	-	414.7	14.6	-	-	-	73.6	782.9	1285.8
May	36-42	8	10241	20.4	192.8	8.5	-	-	-	24.5	1034.0	1280.2
Sub-total	30-50	94	82794	8.4	396.0	12.0	0.2	1.3	23.1	54.2	385.6	880.8
9-76.												
January 1959	28-52	59	34012	11.9	231.8	6.6	0.6	-	0.2	59.4	266.0	576.5
February	30-48	30	11550	2.7	176.9	6.8	0.2	-	2.1	28.6	167.7	385.0
March	32-50	22	16923	25.1	360.2	3.3	-	-	4.1	36.7	339.7	769.1
April	30-42	45	60348	13.1	374.1	15.3	1.5	28.4	1.6	97.2	809.8	1341.0
May	26-46	35	41408	11.7	380.4	10.7	0.3	18.9	0.7	46.9	713.5	1183.1
June	34-44	6	3218	19.7	135.0	-	-	-	-	15.0	366.7	536.4
Sub-total	26-52	197	167459	12.5	293.7	8.8	0.6	9.8	1.3	57.2	466.1	850.0
Grand Total:	26-52	291	250253	11.1	326.8	9.8	0.5	7.1	8.3	56.3	440.1	860.0

Table IX Results of Bull Trawling carried out by Ashok and Pratap during 1959.

The catch rates of important species during different months of operation are also given in Table IX. It is clear from the table that prawn recorded relatively high catch rates during the months March and June from area 9-76 and during May from area 7-76. Amongst these two, the area 9-76 appeared to be more productive with respect to prawn. The seasonal abundance of elasmobranchs appeared to be almost similar in both the areas. The highest catch rate of 701 kg. /hour was recorded during the month of March from area 7-76 whereas in area 9-76 high catch rates were noticed during the period March - May. Cat fish recorded high catch rates during January and April from area 7-76 and during April from area 9-76. A catch rate of 108 kg. /hour was observed in the case of 'dhoma' from area 7-76 during the month of February.

It is interesting to note that the average catch /hour obtained by the vessel Pratap during 1960-61 during otter trawling operation in areas 9-76 and 8-76 was 162.5 kg. as against the average rate of 860 kg. obtained in 1959 during bull trawling by her and her sister vessel Ashok. Does this show that bull trawling, which is still popular in Taiwan, Japan, etc., is a more effective and economical type of fishing than otter trawling? The data available at present are inadequate to investigate further into this question.

10. EXPLORATORY KALAVA FISHING

Systematic survey along the South west coast of India for 'kalava' (Rock Cods and Snappers) was started since 1956. The results of the investigations have earlier been discussed at length by Menon and Joseph (1969) and Silas (1969). The accounts given by John (1948) Chacko and Shariff (1949) and Gopinath (1954) are also worth-mentioning.

In 1973, Exploratory Fisheries Project commenced a preliminary hand line survey of 'kalava' resources off the South west coast of India. A 17.5 m vessel viz., Meena Sangrahak was utilised for this purpose.

10.1. Topography of 'kalava' grounds

Topography of the south west coast has already been discussed in the early part of this bulletin. In this region the shelf upto 35 fm is muddy while the shelf between 35 fm to 55 fm is hard and unlevelled with long ridges of rock and coral formations. Mostly 'kalava' abounds on these on these rocky ridges of the bottom and hence 'kalava' grounds are mostly located between 35 fm to 55 fm depth belts in this region.

10.2. Fishing gear and methods

The fishing gear employed for exploratory 'kalava' fishing consisted of a main line made of synthetic monofilament of 2 mm diameter, which is attached with 4 - 6 hooks. The length of the main line varies from 120 - 150 m and the hooks are attached to the main line by branch lines, the length of which is approximately 3 - 4 cm. No.7 Mustad hooks were used. Generally the distance between two branch lines may be about 60 cm. Hand operated rollers, which are fixed to the gunwale of the starboard side of the ship are used for the purpose of shooting and hauling up of the lines, the distance between two rollers being about 2 m.

The most important tasks in hand line operation are the location of the exact fishing grounds and keeping of the vessels at the same spot. For the purpose of locating 'kalava' grounds an echo-sounder is indispensable. Perches have the habit of concentrating in rocky or coral areas of uneven bottom. When a rocky area is located the echo-sounder is geared to search the fish schools.

When 'kalava' schools are located the vessel is manoeuvered in such a way that the starboard side of the vessel face the shoal and the bow heading towards the wind and current. After keeping the vessel in correct position the hooks are baited and the lines are shot to the required depth using hand rollers. Lines are hauled up as soon as fishes are hooked which can be found out by a feel of the line. Immediately after hauling up the line the fishes are removed and the hooks are rebaited for next shooting of the line. The hand rollers make the work more easier and faster. Four rollers are operated from the vessel and each roller is handled by a person. A wide varieties of fishes are used as baits of which the common are sharks, rays, sardines, 'kilimeen', ribbon fish etc.

10.3. Area and intensity of sampling

During the period under study two areas viz., 9-75 and 10-75 off Cochin were surveyed between 30-100 m depth belt. The distribution and intensity of sampling in different areas and sub-areas are given in Table X. It can be seen from the table that a total of 571 hours of actual fishing effort was expended, out of which 187 hours and 384 hours were spent in area 9-75 and 10-75 respectively.

10.4. Catch composition

The catch consisted mainly of a number of species belonging to the families of Serranidae and Lutianidae. The important species obtained in the catches were Epinephelus diacanthus, E. areolatus, E. chlorostigma and Pristipomoides typus (Velameen). Of these, E. diacanthus was common in the catches though Lutianus argentimaculatus (Red snapper) also occur in good quantities.

10.5. Relative abundance

The catch/hour of trawling is taken as an index of availability of trawl fishing, while in hook and line fishing the quantity of fish caught /line/hour of fishing seems to be the most reliable index of the availability of fish.

Table X indicates the fishing effort expended, the number and quantity of 'kalava' caught, catch/line/hour etc. It is evident from the Table that area 9-75 yielded an average catch rate of three fish or 5.0 kg./line/hour, while area 10-75 recorded an average catch rate of four fish or 6.7 kg./line/hour. The average value for the whole area of investigation worked out to four fish or 6.1 kg. /line/hour. Out of the total 26 sub-areas of 9-75 and 10-75 surveyed the sub-area 10-75/6A registered the highest catch rate of 13 fish or 18.5 kg./line/hour. The second highest catch rate of 11 fish or 15.1 kg. was obtained from area 10-75/5B. Amongst these 26 sub-areas surveyed, the catch rate varied from five to 13 fish in 10 sub-areas and three to four fish in seven sub-areas. Higher catch rates were noticed from most of the sub-areas of 10-75 which may probably be due to the nature of the sea bottom. More rocky areas are noticed in the northern areas of Cochin than in southern areas.

The month-wise catch rates are furnished in Table XI. The highest catch rate of seven fish or 9.5 kg./line/hour was obtained during the month of May. The period November - January occupied second position having a catch rate of five fish /line/hour.

Area/Sub-area	Depth (m)	Fishing effort (hrs.)	Quantity of 'kalava' caught		Catch/line/hour	
			Number	Weight (kg.)	Number	Weight (kg.)
9-75/2E	48	1.30	2	3	1	0.57
2F	48 -96	3.30	28	35	2	2.65
3E	62 -98	28.45	124	161	1	1.41
3F	60	0.95	-	-	-	-
4E	42 -48	27.75	414	748	4	6.74
5B	150-160	1.30	4	10	1	1.92
5D	130-140	21.00	448	800	5	9.52
5E	60-96	38.75	439	732	3	4.72
6D	120-130	28.30	418	725	4	6.40
6E	30-96	35.75	273	470	2	3.29
Sub-total	30-160	186.85	2150	3684	3	4.93
10-75/1D	40- 59	3.00	11	23	1	1.92
1E	43- 48	24.75	595	880	6	8.89
2D	46- 50	35.00	589	852	4	6.09
2E	42- 50	19.00	320	449	4	5.91
2F	80	18.45	351	675	5	9.15
3C	145-150	8.00	167	243	5	7.59
3D	50- 90	129.20	2443	3881	5	7.59
3E	80- 90	52.60	617	972	3	4.62
4B	45- 50	6.75	48	68	2	2.52
4C	150-160	22.00	501	703	6	7.99
4D	80- 86	29.20	375	632	3	5.41
5B	140-150	4.30	185	260	11	15.12
5C	130-145	12.00	86	120	2	2.50
6A	150-155	3.00	160	222	13	18.50
6B	85- 90	6.00	170	238	7	9.92
6E	50- 60	11.03	211	141	5	3.20
Sub-total	42-160	384.28	6829	10359	4	6.74
Grand Total:	30-160	571.13	8979	14043	4	6.15

Table X Area-wise details of 'kalava' hand line fishing by Meena Sangrahak during 1973.

Month/year.	Depth range (m)	Fishing effort (hrs.)	Quantity of 'kalava' ceught		Catch/line/hour	
			Number	Weight (kg.)	Number	Weight (kg.)
January 1973	80- 90	98.45	1780	2974	5	7.55
February	80- 90	96.43	1419	2835	4	7.34
March	80- 90	76.00	1047	1595	3	5.24
April	-	-	-	-	-	-
May	80- 86	29.35	785	1115	7	9.49
June	-	-	-	-	-	-
July	60- 62	4.85	-	-	-	-
August	60- 80	16.30	-	-	-	-
September	30- 98	33.15	204	388	2	2.92
October	40- 69	69.15	716	892	3	3.22
November	40- 50	63.30	1223	1730	5	6.83
December	43-160	84.15	1806	2514	5	7.46
Total:	30-160	571.13	8980	14043	4	6.14

Table XI Month-wise details of 'kalava' hand line fishing conducted by Meena Sangrahak during 1973

11. STOCK ASSESSMENT

11.1. Standing stock

An effort has been made to estimate the standing stock of demersal fishery resources in the area of investigation between 0-40 fm depth. Mitra (1973) Jones and Banerji (1973) etc., have earlier studied the potential yield from the region. A comparative study of the various estimates is given at the end of this chapter.

The intensity and distribution of sampling by all vessels in various depth zones viz., 0-10 fm, 10-40 fm and 40-50 fm are given in Table XII. It may be seen that the sampling intensity in 0-10 fm depth zone except the areas 8-76, 9-75, 10-75, 11-75, 12-75 and 14-74 and in depth zone 10-40 fm except 7-76, 11-74, 12-75, 13-73, 14-73 and 14-74 can be considered reasonably adequate for the purpose of standing stock assessment. As far as areas beyond 40 fm depth are concerned, very little sampling has been done by the Project vessels except in areas 9-75 and 9-76 in the depth zone 40-50 fm.

For finding out the trawlable shelf area in each geographical division, the continental shelf has been stratified into three depth zones viz., 0-10 fm, 10-40 fm, 40-100 fm on the basis of the depth contour markings in the Admiralty Charts. Table XIII shows the total area of the shelf coming under each depth zone in respect of each geographical division. The line of demarcation of the shelf between Karnataka and Kerala has been placed at lat. $12^{o}.50'$ N and between Kerala and Tamil Nadu at lat. $8^{o}.10'$ N. On the basis of this state-wise demarcation of the shelf it can be seen that the total shelf area of Karnataka state works out to about 27,000 sq. km of which about 15,000 sq. km or 57% of the total area is within 10-40 fm depth belt.

Area	Depth range in (fm)		
	0 - 10	10 - 40	40 - 50
7-76	*	-	-
7-77	*	226	-
8-76	-	161	-
8-77	34	122	*
9-75	4	1695	12
9-76	3259	14022	17
10-75	13	898	2
10-76	2456	2727	*
11-74	*	24	-
11-75	24	207	-
12-74	958	1601	-
12-75	-	-	*
13-73	*	-	-
13-74	136	762	-
14-73	*	-	-
14-74	-	-	*
Total :	6884	22425	31

* Shelf area is nil.
\- Fishing effort is nil.

Table XII Distribution of actual fishing effort in various depth zones.

Depth range (fm) / Division	0-10 Area in sq.km	10-40 Area in sq.km	40-100 Area in sq.km	Total 0-100 Area in sq.km.
7-77	-	4802	3259	8061
7-76	-	70	1801	1871
8-77	343	1972	-	2315
8-76	-	172	344	516
Sub-total West coast of Tamil Nadu	343	7016	5404	12763
8-77	86	172	-	258
8-76	343	4116	1628	6087
9-76	943	3088	133	4164
9-75	-	1115	1518	2633
10-76	514	429	-	943
10-75	429	4287	1457	6173
11-75	1372	6089	686	8147
11-74	-	1029	2316	3345
12-75	685	258	-	943
12-74	685	3859	2486	7030
Sub-total Kerala state	5057	24442	10224	39723
12-74	172	858	429	1459
13-74	1200	6689	258	8147
13-73	-	1715	3945	5660
14-74	1200	2830	-	4030
14-73	-	3259	4459	7718
Sub-total Karnataka state	2572	15351	9091	27014
Grand Total:	7972	46809	24719	79500

Table XIII Extent of continental shelf area in different bathymetrical and geographical divisions.

The continental shelf area of Kerala works out to about 40,000 sq. km of which about 24,000 sq. km or about 62% of the area is within 10-40 fm depth. The extent of continental shelf along the west coast of Tamil Nadu comes to about 13,000 sq. km of which about 7000 sq. km or about 55% of the area lies between 10-40 fm depth belts. In the case of all the three states, major portions of the shelf happens to be within 10-40 fm depth zone. In nutshell, shelf area of the South west coast comprising Kerala, Karnataka and west coast of Tamil Nadu is as follows:

States	0-10 Area sq.km	10-40 Area sq.km	40-100 Area sq.km	Total 0-100 Area sq.km.
Tamil Nadu	343	7016	5404	12,763
Kerala	5057	24442	10224	39,723
Karnataka	2572	15351	9091	27,014
	7972	46809	24719	79,500

An approximate standing stock estimate in an area can be worked out by using the average trawling speed, mouth opening of the standard trawl and the extent of exploitable area. The procedure followed is by multiplying the average catch per hour with the total area and dividing the same by the area swept by the net during one hour of trawling.

Estimates were made on the basis of results obtained by vessels viz., Pratap, 17.5 m vessels, Durga and Flying Fish and smaller vessels. The 17.5 m vessels operated 28 m shrimp trawl while Pratap operated 24 m fish trawl. Durga and Flying Fish and smaller vessels operated 17 m and 14 m shrimp trawls respectively. The area of coverage with an average speed of two knots worked out to 0.048 sq. km, 0.047 sq. km, 0.025 sq. km and 0.021 sq. km respectively for 28 m, 24 m, 17 m and 14 m nets.

Division	0-10 fm		10-40 fm		Total 0-40 fm	
	Area surveyed sq.km.	Standing stock m.t.	Area surveyed sq.km.	Standing stock m.t.	Area surveyed sq.km.	Standing stock m.t.
7-77	-	-	4802	10612	4802	10612
8-77	343	490	1972	4314	2315	4804
8-76	-	-	172	465	172	465
Sub-total Tamil Nadu	343	490	6946	15391	7289	15881
8-77	-	-	172	377	172	377
8-76	-	-	4116	18080	4116	18080
9-75	-	-	1115	4349	1115	4349
9-76	943	7459	3088	12907	4031	20366
10-75	-	-	4287	17894	4287	17894
10-76	514	2264	429	983	943	3247
11-75	-	-	6089	21692	6089	21692
12-74	685	6341	3859	9558	4544	15899
Sub-total Kerala	2142	16064	23155	85840	25297	101904
12-74	172	1592	858	2504	1030	4096
13-74	1200	7971	6689	19698	7889	27669
Sub-total Karnataka	1372	9563	7547	22202	8919	31765
Grand Total	3857	26117	37648	123433	41505	149550

Table XIV Standing stock estimates for areas surveyed upto 40 fm depth.

The standing stock estimates made on this basis in respect of areas actually and adequately surveyed in the depth zones 0-10 fm and 10-40 fm for Karnataka, Kerala and Tamil Nadu coast are furnished in Table XIV. The findings can be summarised as follows:

State	0-10 fm		10-40 fm		0-40 fm	
	Area surveyed sq.km.	Standing stock m.t.	Area surveyed sq.km.	Standing stock m.t.	Area surveyed sq.km.	Standing stock m.t.
Tamil Nadu	343	490	6946	15391	7289	15881
Kerala	2142	16064	23155	85840	25297	101904
Karnataka	1372	9563	7547	22202	8919	31765
Total	3857	26117	37648	123433	41505	149550

It can be seen that in the west coast of Tamil Nadu the total standing stock of the demersal fish in an area of about 7000 sq. km surveyed by the Project is about 16,000 m.t. while in respect of the Kerala coast it is about 1,02,000 m.t. from an area of about 25,000 sq. km. lying between 0-40 fm depth. In the case of the Karnataka coast the standing stock of demersal fish of this depth belt i.e., 0-40 fm is worked out to about 32,000 m.t. from about 9,000 sq. km of area surveyed.

On the basis of these studies, the average standing stock for the west coast of Tamil Nadu in respect of 0-40 fm depth works out to 2.2 m.t./sq.km. The depth zone 0-10 fm registers 1.4 m.t./sq.km as against 2.2 from 10-40 fm depth zone. In the case of Kerala coast the average standing stock for 0-10 fm depth is 7.5 m.t./sq.km while the same is 3.7 m.t./sq.km for 10-40 fm depth belt. The average standing stock in 0-40 fm depth zone is about 4.0 m.t./sq.km. In the case of Karnataka the average standing

stock is 7.0 m.t./sq. km for 0-10 fm depth belt and 2.9 m.t./sq.km for 10-40 fm depth zone. The average value for 0-40 fm depth zone is 3.5 m.t./sq.km. Of the three states the highest average standing stock value of 4.0 m.t./sq.km is obtained from Kerala coast. Karnataka comes second with an average standing stock of 3.5 m.t./sq.km. The average for the entire South west coast between 0-40 fm depth belt works out to 3.6 m.t./sq. km as against 4.38 m.t./sq. km in the case of North west coast (Joseph 1974).

As stated elsewhere in the paper the assessment of standing stock has been made only for areas where sampling intensity was considered adequate for the purpose. The total standing stock in the entire inshore and offshore waters of South west coast has however been estimated on the basis of the average values discussed and are furnished below:-

State	Inshore (0-10 fm)			Offshore (10-40 fm)			0-40 fm		
	Observed value m.t./sq.km	Total area sq. km	Standing stock m.t.	Observed value m.t./sq.km	Total area sq. km	Standing stock m.t.	Area sq. km	Standing stock m.t.	Standing stock m.t./sq.km
West coast of Tamil Nadu	1.4	343	490	2.2	7016	15435	7359	15925	2.2
Kerala coast	7.5	5057	37935	3.7	24442	90432	29499	128367	4.3.
Karnataka coast	7.0	2572	18004	2.9	15351	44518	17923	62522	3.5
Total:	7.1	7972	56429	3.2	46809	150385	54781	206814	3.8

It may be seen that the estimated standing stock of demersal fish for west coast of Tamil Nadu, Kerala and Karnataka are about 16,000 , 1,28,000 and 63,000 m.t. respectively and for the entire South west coast it is about 2,07,000 m.t.

11.2. Potential yield

On the basis of the standing stock assessment the potential yield of demersal fishery resources from the inshore and offshore waters of the South west coast comprising Karnataka, Kerala and the west coast of Tamil Nadu is estimated and furnished below. The potential yield is estimated at 60% of the standing stock since the main stay of the demersal fisheries of this region is prawn and the main types of trawls operated during the survey were shrimp trawls with relatively smaller meshes. It may also be recalled that Silas (1969) has computed the potential yield from the deeper waters of this region at 60% of the standing stock.

State	Potential yield in m.t.		
	0-10 fm	10-40 fm	0-40 fm
West coast of Tamil Nadu	294	9261	9555
Kerala	22761	54259	77020
Karnataka	10802	26710	37512
Total:	33857	90230	124087

Jones and Banerji (1973) on the basis of landings as well as productivity studies have worked out the potential yield of the demersal fishery resources of the continental shelf i.e. 0-100 fm in the South west coast of India. Mitra (1973) has also

estimated the potential yield of demersal fisheries resources of the inshore and offshore waters in this area. Silas (1969) has worked out the potential yield of the demersal fisheries stock from 75-450 m depth on the basis of the results obtained by the exploratory fishing vessels of the Integrated Fisheries Project. Joseph (1972) has also furnished potential yield estimates for some of the important species of demersal fishes such as deep sea prawn, deep sea lobster, deep sea fish and perch. A comparative statement of the potential yield estimates by the various authors mentioned above and also of the present authors are furnished in Table XV.

State	Potential yield in m.t./sq.km						
	0-10 fm		10-40 fm		0-100 fm		40-100 fm
	Mitra (1973)	Present authors	Mitra (1973)	Present authors	Jones and Banerji (1973)	Present authors and Silas (1969)	Silas (1969)
West coast of Tamil Nadu	-	0.9	-	1.3	2.9		
Kerala	16.00	4.5	1.43	2.2	2.5	1.9	1.0
Karnataka	3.45	4.2	1.60	1.7	1.5		
		4.2	1.5	1.9	2.2	1.9	1.0

Table XV Statement showing the average potential yield by various authors

From the Table it may be seen that the average potential yield for the inshore waters of the Karnataka coast estimated by the present authors compares favourable with that of Mitra (op. cit.). However the estimates of Mitra appears to be rather very high for the inshore waters of Kerala as compared to that of the present authors.

According to the present authors, there is no significant variation in the average potential yield /unit area from the inshore waters of Karnataka and Kerala. The low value in respect of the inshore waters of the west coast of Tamil Nadu is understandable as there are only few trawlable grounds in this belt due to the presence of rocky and coral out crops.

The potential yield estimate of the authors in respect of offshore waters (10-40 fm) in the South west coast is a little more than that by Mitra (op. cit.). According to Mitra the potential yield from the offshore waters of South west coast is about 86,000 m.t. while that by the present authors is about 90,000 m.t. The estimate in respect of Kerala is about 37,000 and about 54,000 m.t. respectively by Mitra and by the present authors. The estimated potential for the offshore waters of Karnataka is about 49,000 m.t. by Mitra and by the present authors is about 27,000 m.t. The potential yield estimate from 0-40 fm depth belt of Kerala waters is about 77,000 m.t. while the present demersal fish landing estimated at 20% of the three years average total sea fish landing of the state is about 78,000 m.t. Similarly, the estimated potential yield from 0-40 depth belt of Karnataka waters is about 38,000 m.t. while the present estimated landing of demersal fish is about 18,000 m.t. From the foregoing it may be seen that of the two states Karnataka appears to have relatively better scope for the development of demersal fisheries from within 40 fm depth.

The average potential yield estimate for the 10-40 fm by the present authors is 1.9 m.t./sq.km while that for the area between 40-100 fm by Silas (op. cit.) is 1.0 m.t./sq.km. The average for the entire shelf upto 100 fm worked out on the basis of the present

authors calculation upto 40 fm and that of Silas (op. cit.) upto 100 fm is about 1.9 m.t./sq.km. It may be seen from the Table XV that Jones and Banerji (op. cit.) have estimated a demersal fishery potential yield of 2.2 m.t./sq.km for the South west coast. It may be mentioned that the average potential estimate for the shelf by the present authors is a little less than that by Jones and Banerji (op. cit.). It may also be mentioned that the present estimates are based on more extensive and recent surveys conducted in the area.

Jones and Banerji (op. cit.) have estimated the potential yield of demersal fishery resources on the continental shelf (0-100 fm) of the South west coast at about 1,51,000 m.t. On the basis of the estimates of the present authors, as discussed earlier in this paper, the potential yield from the shelf i.e. 0-100 fm is estimated at about 1,48,000 m.t. Silas (op. cit.) has also estimated an additional demersal fishery potentiality of about 35,000 m.t. from 100-250 fm depth zone. A major component of this additional estimated catch comprises deep sea prawn and lobster. The present production of demersal fish including prawns from the South west coast estimated at about 20% of the total sea fish landing of Karnataka and Kerala works out to about 96,000 m.t. It may be mentioned that almost the entire estimated present production is from within 40 fm depth belt. A comparative evaluation of the demersal fisheries potential of the North west coast and South West coast vis-a-vis their present exploitation may, perhaps, reveal that there is relatively better scope for the development of demersal fisheries in the North west coast.

12. ECONOMICS OF FISHING

The economics of fishing of demersal fishery resources in the area have earlier been discussed by several authors. Menon and Joseph (op. cit.) have discussed the economics of 'kalava' fishing and the type of vessels that are suitable for this type of fishing. Joseph(1973) while dealing with the present status of mechanised fishing along the Kerala coast has also dealt with the economics of operation of smaller trawlers based on the 13 years data of the vessels Durga and Flying Fish.

Joseph (1973) has worked out the economics of operation of the indigenously constructed 17.5 m steel trawlers on the basis of the experimental fishing conducted by Meena Utpadak along the Kerala coast. During the one year period, the vessel fished for 203 days and landed 196.4 tons of catch, the average catch per day being a little less than a ton. On the basis of the performance of this experimental fishing, the author has concluded that an identical vessel if operated on a commercial basis might land about 430 tons of fish and prawn and that the operation would be economically viable.

Joseph (1970 and 1971) has also furnished the basic parameters required to work out economics of fishing of the deep sea prawn and deep sea lobster found in the deeper waters along the South west coast. Nair (1970) has dealt with the economics of deep sea fishing along the Kerala coast on the basis of operation of Klaus Sunnana, a vessel belonging to the Integrated Fisheries Project, Cochin. Anon (1973) on the basis of information furnished by the Integrated Fisheries Project regarding the operation of their vessels Klaus Sunnana, Velameen and Tuna has also given some interesting information about the economics of fishing in deeper waters along the South west coast. Mention may also be made of the information furnished by Perumal (1973) on the economics of operation of a 93' and 57' training vessels in this region.

13. SUMMARY AND DISCUSSION

An attempt is made in this bulletin to study the demersal fishery resources of the South west coast of India between latitudes 7°N and 15°N and longitudes 73°E and 78°E based on the results of survey conducted by the Exploratory Fisheries Project vessels during the period from 1957 to 1974. The region of study comprises the entire coast line of Karnataka, Kerala and the west coast of Tamil Nadu and the total length of the coast involved is about 800 km and the total shelf area is about 80,000 sq. km.

Eighteen vessels of varying sizes, horse power, tonnage etc., were employed in the survey. The distribution of sampling intensity in the areas of operation, the relative abundance of the demersal resources in general and of commercially important species in particular with reference to area, depth and time were studied in detail and are presented. A study of the distribution of sampling effort has revealed intensively/partially surveyed areas. It is seen that areas 14-73, 14-74, 13-73, 12-75 and 7-76 out of the 16 divisions in this region have not been surveyed by the vessels of the Project, which require consideration while planning surveys in future. Out of a total of 29,400 hours of actual fishing, about 65% was expended in areas within 20-39 m. The intensity of the sampling in 0-19 m and 40-59 m were of the order of 23% and 10% respectively of the total fishing effort. The effort put in 60-79 m and 80-99 m belts appears to be rather deficient. It can be said that the areas within 59 m depth zone of the geographical divisions lying off Cochin and Mangalore can be regarded fairly surveyed.

This aspect was studied with reference to specific areas, which enables one to give appropriate priority to those areas while chalking out future programmes to fill up the gap in the investigation.

The pattern of occurrence of various commercially important groups in areas off Mangalore, Cannanore, Cochin and Cape Comorin have been studied in detail. A further analysis has been done with regard to the catch composition by depth and area which has revealed some interesting observations. The occurrence of prawn in abundant quantities were noticed in areas below 20 m, elasmobranchs in 40-59 m, 'kilimeen' and Lactarius in 20-39 m and cat fish in 40-79 m from the different regions studied thus giving an idea of the resources for future exploitation.

It is seen that the catch rates of the different species varied from vessel to vessel and from region to region and that generally elasmobranchs, prawn and cat fish formed the bulk of the aggregate catch from most of the areas. While comparing the catch rates obtained from different vessels, it may be concluded that the following areas were found to be comparatively rich in respect of the following species:

Prawn:	12-74, 13-74 off Mangalore; 10-75, 10-76, 9-76 off Cochin;
Elasmobranchs:	8-76 off Cape Comorin; 10-75, 9-75, 9-76 off Cochin; 11-74 off Cannanore, 12-74 off Mangalore;
Lactarius:	12-74, and 13-74 off Mangalore;
'Kilimeen':	8-76, off Cape Comorin; 9-75, 10-75 off Cochin; 11-75, off Cannanore;
Ribbon fish:	9-75, off Cochin; 11-74 off Cannanore;
Cat fish:	11-74, 9-75 and 10-76 off Cochin.

Comparing the higher catch rates obtained by different vessels, the following tentative findings are made. The higher catch rates for smaller vessels obtained at Cochin and Mangalore respectively were 204 kg. and 222 kg. per hour recorded from 30-39 m belt, whereas for Durga and Flying Fish, the catch recorded reached the highest in 40-49 m zone at Cochin and Mangalore with catch rates 266 kg. and 270 kg. per hour respectively. The 17.5 m vessels also recorded the highest catch rates from 40-49 m depth zone from Cape Comorin, Cochin and Cannanore and the catch rates were 421 kg., 271 kg., and 316 kg., respectively. Pratap also has recorded high catch rate in Cape Comorin region from 60-69 m and in Cochin from 30-39 m.

The monthly variation in the catch rates of important groups like prawn, elasmobranchs, cat fish, 'kilimeen' etc., obtained from selected classes of vessels are discussed and the period of occurrences of the different species exploitable are indicated. The shrimp survey conducted in areas below 25 fm belt in areas adjacent to Cochin and Mangalore can be considered fairly adequate. However, it has to be emphasised that it is desirable to conduct intensive shrimp survey in other areas of this depth zone particularly in areas of north of Mangalore and further surveys in areas beyond 25 fm in the entire area.

A brief note on the bull trawling carried out by Ashok and Pratap during 1957-59 are presented. It is seen that the vessels recorded a catch rate of 1055 kg. and 860 kg./hour during 1958 and 1959 respectively as against about 162 kg./hour obtained during otter trawling by Pratap during 1960-61. The catch rates of important species obtained from 7-76 and 9-76 during 1959 are presented.

The results of 'kalava' fishing conducted by the vessel Meena Sangrahak at Cochin gave a picture of the relative abundance of 'kalava' in two areas viz., 9-75 and 10-75. It was observed that the area 10-75 recorded an average catch rate of four fish or 6.7 kg. /line/hour while the area 9-75 yielded an average catch rate of three fish or 5.0 kg. per line per hour. The average value for the whole area of investigation worked out to four fish or 6.1 kg. /line/hour. This data supplement the information furnished by Menon and Joseph (1969) and Silas (1969).

An effort has been made to find out the standing stock on demersal fishery resources in the shelf areas upto 40 fm depth. The average standing stock per sq. km in respect of the coast of Tamil Nadu, Kerala and Karnataka, between 0-40 fm depth worked out to 2.2, 4.3 and 3.5 m.t./sq.km respectively. The average for the entire area worked out to 3.8 m.t./sq.km as against 4.38 m.t./sq.km for the North west coast.

The sustainable potential yield of demersal fisheries between 0-40 fm for the entire area is worked out to about 124000 m.t. The potential yield estimates compare favourably with those by earlier authors. The present studies indicate that there is relatively better scope for Karnataka to develop demersal fisheries than Kerala. Similarly it is also seen that there is better scope for the development of demersal fisheries in the North west coast than from the South west coast.

An upto-date review of the studies conducted by various authors on the economics of fishing employing, small, medium and larger trawlers along the South west coast is also given.

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