

# Resources of Ribbon Fish and Cat Fish off the South West Coast of India

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## Introduction

The acoustic surveys and fishing experiments conducted by the research vessels RASTRELLIGER and SARDINELLA of the Pelagic Fishery Project from Ratnagiri to the Gulf of Mannar for the past four years have considerably enhanced our knowledge of the pelagic fishery resources, their abundance and seasonal distribution and possible methods of exploitation (Anonymous 1974, 1975 & 1976). The average annual landings of ribbon fish and cat fish for the past ten years with 78,000 tonnes form only 7.7% of the total marine fish production in India. However, the available resources of these groups based on the assessment data collected through resources surveys along the south west coast have been found to be of the order of 1,51,000 tonnes in the Project area and are considerably higher than our present all India yield. Information on the biology, especially the seasonal distribution and abundance of the stocks supporting the fishery will go a long way in assessing the fishery potential and in regulating the fishery in order to obtain maximum sustainable yield. This being the situation, it is expected that this account detailing the commercial potentialities of these resources

along the south west coast of India will be of help in the exploitation and utilization of these two important fishery resources of the country.

Information on the food and feeding habits of *Netuma thalassinus*, *Ariodes dussumieri* and *Pseudarius jella* have been given by Chacko (1949), Devanesan and Chidambaram (1953), Venkataraman (1960), Rao (1964), Susheelan and Somasekharan Nair (1972) and Mojumdar (1972a). Very little information is available about the nature of spawning in cat fishes. Fertilized eggs of *P. jella* and *Tachysurus caelatus* and their breeding habits have been described by Chidambaram (1941) and Sekharan and Majumdar (1973). Pantulu (1963) studied the age and growth, fecundity and spawning of *Osteogeneiosus militaris*. Jones and Sujansingani (1954) have reported that *O. militaris*, *T. caelatus* and *T. facarius* breed in the Chilka lake on the east coast. Detailed account of the important species of cat fishes that contribute to the fishery of India has been given by Devanesan and Chidambaram (1953), Sekharan (1968), Sekharan *et al.* (1968) and Radhakrishnan (1975). Sekharan (1968 and 1973) studied the relative abundance of cat fishes in different depth zones in the area between Kakinada and Sand Heads.

Some useful information about the fishery and biology of the common species of ribbon fishes in Indian waters is available. The food and feeding habits of the ribbon fishes have been studied in some detail by various investigators (Venkataraman 1944 and 1960, Chacko 1949, Jacob 1949, Prabhu 1950 and 1955, Devanesan and Chidambaram 1953, Vijayaraghavan 1951, James 1967 b, Kuthalingam and Chellam 1972 and Narasimham 1972). Maturity and spawning of four species of ribbon fishes have been studied by James (1967 b). The eggs and early larval stages of *Lepturacanthus savala* has been described by Chacko (1950). Age and growth of the commonest species have been studied by Prabhu (1955) and James (1967 b). The distribution and fishery of four species of ribbon fishes along the Indian coast have been dealt with in great detail by James (1967 a & b).

### Present Level of Exploitation

Ribbon fish and cat fish form significant commercial fisheries along the coasts of Maharashtra, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh. The all India landings of ribbon fish and cat fish for the past ten years averages 77,970 tonnes amounting to 7.7% of the total marine fish landings (Table 1 and 2). The cat fish and ribbon fish on the average contribute almost in equal proportion to the landings. It can be seen, however, from Tables 1 and 2 that the ratio of the two groups is not the same every year but fluctuates considerably.

**Ribbon fish:** Four species of ribbon fishes viz., *Trichiurus lepturus* Linnaeus, *Lepturacanthus sadala* (Cuvier), *Eupleurogrammus intermedius* (Gray) and *E. muticus* (Gray) support the fishery in different regions along the Indian coasts. *Trichiurus lepturus* is the most predominant species and forms a good fishery along both the

coasts of India. *Lepturacanthus savala* is next in importance and is captured in good quantities in certain areas in southern states. *Eupleurogrammus intermedius* is taken commonly in the Gulf of Mannar and Palk Bay. *E. muticus* is found on the east coast generally from West Bengal to Madras and along the west coast from Bombay northwards. *T. lepturus* is, however, the most dominant species in the Project area (Fig. 1A).

A generalised key for the easy identification of the ribbon fishes and cat fishes of commercial importance in India is given below. Ribbon fishes are extremely elongate, having highly compressed ribbon-like body without scales. Body tapers to a point behind; no caudal fin, Dorsal and anal fins are long with numerous rays. The mouth is armed with prominent canine-like teeth which are adapted for seizing prey.

1. Pelvic fins scale-like, present midway between tip of lower jaw and vent; lateral line gently sloping from upper angle of operculum to tip of tail ... 2

Pelvic fins absent; lateral line abruptly sloping from upper angle of operculum to below pectoral and then runs straight to tip to tail ... 3

2. Origin of anal below D, 31-34; D. III, 123-129; Vertebrae 31-32 + 126 - 131 = 158 - 163

... *Eupleurogrammus intermedius*

Origin of anal below D. 38 - 42; D. III, 139-147; Vertebrae 39 - 42 + 150 - 159 = 189 - 201

... *Eupleurogrammus muticus*

3. Eye 5-7 in head; D. III, 131-135; Vertebrae 38 - 40 + 127 - 137 = 167-175; second anal spine rudi-

TABLE - 1. All India and statewise annual landings (in tonnes) of ribbon fish (1965-1974)\*

Year	Gujarat	Maha- rashtra	Karnataka & Goa	Kerala	TamilNadu & Pondicherry	Andhra Pradesh	Orissa & W. Bengal	All India total
1965	654	6,785	133	13,826	7,806	11,508	586	41,298
1966	1,195	4,986	324	21,102	11,592	4,995	500	44,694
1967	1,476	5,147	343	6,841	7,874	7,417	724	29,822
1968	1,551	5,647	246	992	9,620	6,366	1,026	25,448
1969	1,455	4,794	278	7,446	7,198	9,970	581	31,722
1970	1,656	4,968	340	4,922	7,155	6,473	1,470	36,984
1971	1,145	6,562	353	17,380	10,997	7,432	825	44,694
1972	1,447	8,544	760	10,459	10,900	3,585	530	36,225
1973	938	13,379	186	23,901	10,059	3,761	902	53,126
1974	1,849	9,585	463	30,192	8,605	11,834	549	63,077
Average	1,336.6	7,039.7	342.6	13,706.1	9,180.6	7,334.1	769.3	39,709.0
% of total	3.36	17.73	0.86	34.52	23.12	18.47	1.94	100.00

\* Source : Central Marine Fisheries Research Institute, Cochin-18.

TABLE - 2. All India and statewise annual landings (in tonnes) of cat fish (1965-1974)\*

Year	Gujarat	Maha- rashtra	Karnataka & Goa	Kerala	TamilNadu & Pondicherry	Andhra Pradesh	Orissa & W. Bengal	All India total
1965	2,320	2,438	508	3,565	4,005	4,635	201	17,672
1966	2,631	4,978	624	5,793	5,271	2,369	174	21,840
1967	1,843	5,022	1,669	7,536	3,902	3,657	182	23,811
1968	2,255	4,521	4,472	4,173	3,658	4,269	275	23,623
1969	2,453	6,776	3,972	6,245	4,165	3,088	204	26,903
1970	4,021	10,817	9,305	16,380	7,306	2,346	456	50,631
1971	3,570	18,052	1,415	15,189	7,579	2,724	329	48,858
1972	3,905	12,821	3,465	12,636	5,425	3,651	540	42,443
1973	2,071	9,295	2,602	17,316	9,983	10,780	442	52,489
1974	3,638	7,240	2,318	33,526	10,387	15,890	1,245	74,244
Average	2,870.7	8,196.0	3,035.0	12,235.9	6,168.1	5,340.9	404.8	38,251.4
% of total	7.50	21.43	7.93	31.99	16.13	13.96	1.06	100.00

\* Source : Central Marine Fisheries Research Institute, Cochin-18.

mentary, head and body silvery grey above becoming silvery below; dorsal blackish anteriorly. distal half of dorsal and pectoral fins tinged grey ... *Trichiurus lepturus*

Eye 5.6-9.7 in head; D. IV, 108 - 123; Vertebrae 33 - 37 + 131 - 152 = 167 - 187; second anal spine prominent; head and body silvery, margin of dorsal fin greyish ... *Lepturacanthus savala*

The all India average annual landings of ribbon fish during the decade (1965-74) is 39,709 tonnes which is about 3.9% of the total marine fish landings. However, there is a substantial increase in the total landings of ribbon fish in 1975 with an estimated catch of 63,000 tonnes. Kerala, Tamil Nadu, Andhra Pradesh and Maharashtra together account for about 94% of the ribbon fish catches. The break up for the above states are 34.5%, 21.1%, 18.5% and 17.7%, respectively (vide Table 1).

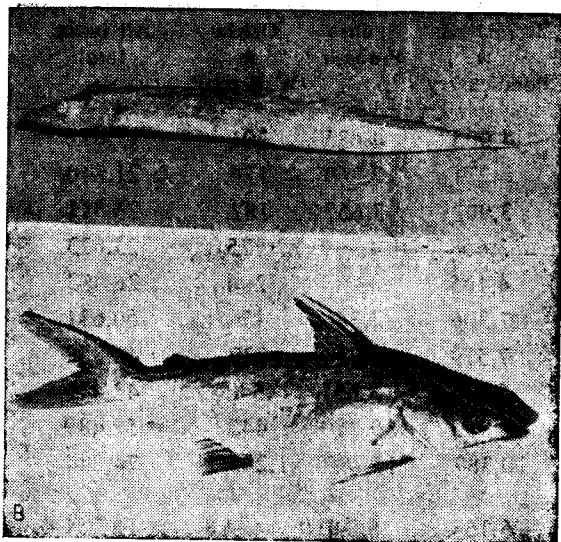


Fig. 1. A. Ribbon fish (*Trichiurus lepturus*),  
B. Cat fish (*Netuma thalassinus*)  
(Photos by Mr. V. N. Bande)

Majority of the ribbon fish landings are in the second and third quarter in Kerala and Andhra Pradesh, whereas it is during the third and fourth quarter in Tamil Nadu and in the second and fourth quarter in Maharashtra. The annual ribbon fish landings in the Project area from Ratnagiri to the Gulf of Manaar on an average is of the order of 18,100 tonnes.

**Cat fish :** *Netuma thalassinus* (Ruppell), *Ariodes dussumieri* (Valenciennes), *Tachysurus caelatus* (Valenciennes), *Pseudarius jella* (Day), *P. tenuispinis* (Day), *P. platystomus* (Day), and *Osteogeneiosus militaris* (Linnaeus) are the species contributing substantially to the cat fish landings in varying degrees of magnitude in different parts of the country. Of these, the first two species are of considerable importance in the Project area (Fig. 1 B).

Cat fishes are elongate and the body which is oval in cross section is naked. Head is depressed and usually covered with bony plates. Adipose fin is present opposite anal. Dorsal and anal fins have serrated pungent spines;

1. Only a pair of stiff osseous, maxillary barbels present; head 4.2-4.5 in total length; width of head equals its length behind angle of mouth... *Osteogeneiosus militaris*  
Maxillary and mandibular barbels present ... 2
2. Teeth on palate villiform, conic or pointed ... 3  
Teeth on palate granular ... 4
3. One large patch of teeth on each side of palate, head shields granular; pectoral spine shorter than dorsal; back dusky brown or

bluish, lower sides whitish; no blotch on adipose fin

... *Tachysurus caelatus*

Three groups of teeth on each side of palate, forming a large triangular patch; head 4.5-5 in length; maxillary barbels reach base of pectoral fin; brownish on back, silvery below, head slightly golden or yellowish, large dark brown blotch on adipose fin

... *Netuma thalassinus*

4. Palatine teeth in four groups; 14-16 anal rays; maxillary barbels reach just beyond base of pectorals; bluish on back, lighter on sides and below... *Ariodes dussumieri*

5. 19 anal rays; head 4 in total length; maxillary barbels longer than head; palatine teeth obtusely conic in 2 pear shaped patches; bluish on back, lighter below; fins slightly gray

... *Pseudarius platystomus*

18 anal rays; head 3.5 in total length; maxillary barbels subequal to head; palatine teeth sometimes absent; grayish silvery on back lighter below

... *Pseudarius tenuispinis*

17-18 anal rays; head 4.5 in total length; maxillary barbels subequal to head; palatine teeth in convex, oblong-ovate patches, slightly convergent behind; silvery gray, white or yellowish on sides and below; dark blotch on adipose fin

... *Pseudarius jella*

The average annual landings of cat fishes amount to 38,251 tonnes which is 3.8% of the total annual all India marine

fish landings (Table 2). An examination of the Table shows that there is a substantial increase in the landings of cat fish over a period of ten years from about 18,000 tonnes in 1965 to about 74,000 tonnes in 1974. The major landings are in the states of Kerala (32.0%), Maharashtra (21.4%), Tamil Nadu (16.1%) and Andhra Pradesh (14.0%). Majority of the cat fish landings are in the second and third quarter in Andhra Pradesh and Tamil Nadu, in the third and fourth quarter in Kerala and in the first and fourth quarter in Maharashtra. The estimated average annual landings of cat fish over a ten year period in the Project area comes only to about 19,306 tonnes.

### The Magnitude of the Resources in the Project Area

From the resources surveys conducted by the Project, it has been possible to indicate the pattern of abundance and distribution of the ribbon fish and cat fish resources in space and time along the south west coast of India. A combined average standing stock of 1,51,000 tonnes for the two resources per average has been found to exist in the Project area (Tables 3 & 5).

The biomass of ribbon fish and cat fish from October 1972 to July/August 1973 was grouped with white bait biomass (Anonymous 1974) and from September 1973 to November/December 1974 with other commercial species (Anonymous 1975). Separate estimates for cat fish/ribbon fish resources have been made for each coverage in 1975 (Anonymous 1976). The estimates of ribbon fish and cat fish from October 1972 to November/December 1974, were therefore, derived by extrapolation based on 1975 data.

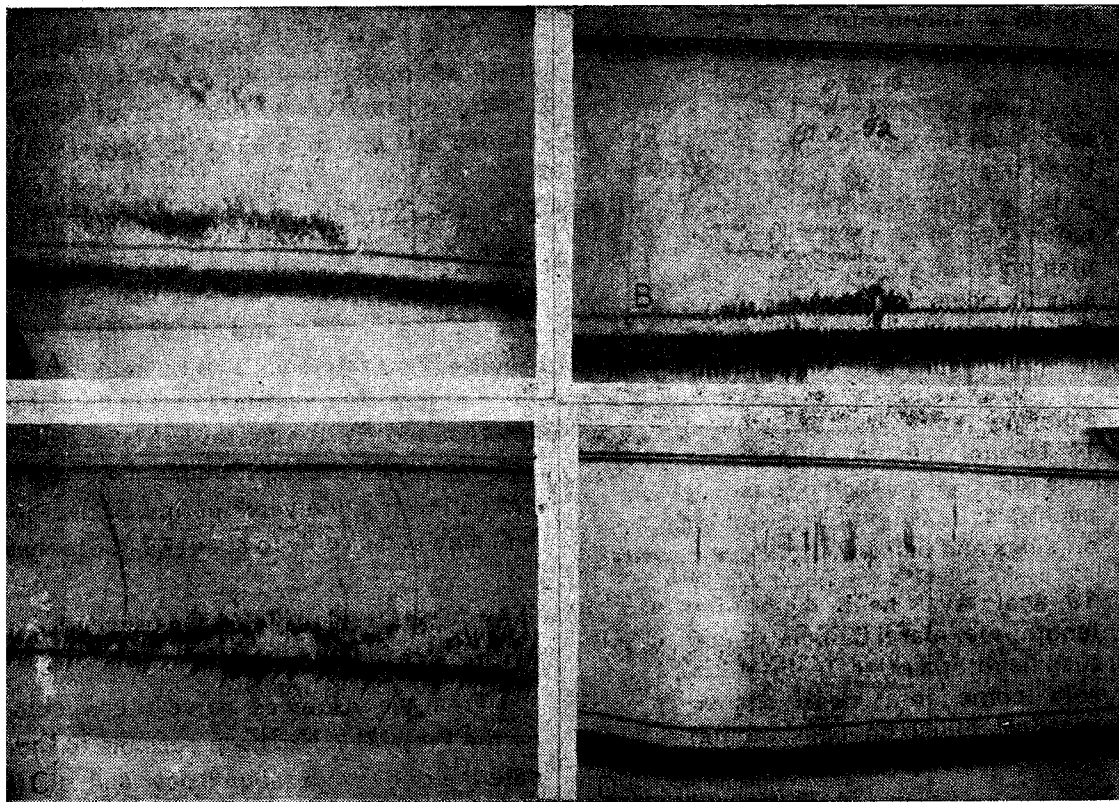


Fig. 2. Echo recordings of cat fish/ ribbon fish. (A) During early morning, (B) Dense bottom concentrations during noon, (C) Concentrations above bottom in the evening and (D) Dispersed recordings during night (Photos by Mr. Asmund Hermansen).

Recording of ribbon fish and cat fish within 10 to 50 m bottom depth were generally mixed with those of white bait. Outside the normal white bait zone, recordings of ribbon fish and cat fish were frequently obtained in depths upto 80 m. The echo recordings of ribbon fish are dark, dense and elongated with distinct boundaries and diffuse in the case of cat fish and these can be distinguished from the pattern of recordings of other fishes. Both cat fish and ribbon fish undertake regular diurnal vertical migration to some extent. Generally, during day time they are found close to the bottom and at night ascend to the vertical

water column and disperse (Fig. 2). However, cat fish are found in school concentration at surface during day time especially during breeding season along the south-west and south-east coast of India.

#### Resources of ribbon fish

The major part of the biomass of ribbon fish in the Project area is made up of *Trichiurus lepturus*. The estimates of the resources of ribbon fish for each coverage from October 1972 to October/November 1975 are given in Table 3. Ribbon fish is by far an important group and contributes on an average 6.9% to the total fish bio-

TABLE 3. *Distribution of biomass estimates of ribbon fish by coverage and area.*

	Area Coverage	Southern Maharashtra	Karnataka & Goa	Kerala	Southern Tamil Nadu (Gulf of Mannar & West Bengal)	Total
1972	Oct	0	169	18,200	—	18,369
	Nov	—	226	17,530	—	17,756
1973	Jan/Feb	16,020	3,626	33,508	0	53,154
	Mar/Apr	0	1,815	49,696	0	51,511
	Apr	—	—	21,479	—	21,479
	May/June	2,320	1,819	85,563	0	89,702
	Jun/Jul	5,384	259	52,914	1,031	59,588
	Jul/Aug	17,931	968	14,112	406	33,417
	Sept	—	901	62,957	—	63,858
	Sept/Oct	0	83	8,252	—	8,335
	Oct/Nov	0	174	19,037	2,696	21,907
	Dec	—	126	6,630	1,082	7,838
	1974	Jan/Feb	13,914	4,156	30,179	0
Mar/Apr		25,000	7,882	19,240	3,750	55,872
Apr/May		10,575	3,398	25,269	5,977	45,219
Jun/Jul		18,818	13,117	77,906	—	1,09,841
Aug		0	408	53,556	7,327	61,291
Sept/Oct		—	60	28,608	9,056	37,724
Oct/Nov		0	89	26,121	404	26,614
Nov/Dec		0	203	5,024	253	5,480
1975	Feb/Mar	60,685	11,587	56,400	0	1,28,672
	Apr/May	49,839	11,927	53,889	9,570	1,25,225
	May/June	1,22,010	25,299	1,60,179	1,823	3,09,311
	Jul/Aug	53,967	21,775	1,69,081	9,642	2,54,465
	Oct/Nov	—	293	21,287	4,639	26,219
<b>Total</b>		<b>3,96,463</b>	<b>1,10,360</b>	<b>11,16,617</b>	<b>57,656</b>	<b>16,81,096</b>
<b>Average</b>		<b>20,866</b>	<b>4,598</b>	<b>44,664</b>	<b>3,034</b>	<b>67,243</b>

mass in the Project area. The average standing stock of ribbon fish per coverage was estimated at 67,200 tonnes, whereas highest estimate in 1973 was during May/June (89,702 tonnes) in 1974 during June/July (1,09,841 tonnes) and in 1975 during May/June (3,09,311 tonnes). The highest average estimate is along the coast of Kerala (44,664 tonnes), followed by that of southern Maharashtra (20,866 tonnes). The estimates for Karnataka and Goa and Gulf of Mannar are in the order of 4,598 and 3,034 tonnes respectively. It is evident from table 3 that the period of greatest abundance along Maharashtra is during the second and third quarter of the year. Along the coasts of Karnataka and Goa the period of abundance is generally during the second and third quarter. Off the coast of Kerala greatest abundance was from May to September, the highest estimate of 1,69,081 tonnes being during July/August 1975. In the western part of the Gulf of Mannar the highest estimate was obtained during the third quarter of the year.

Depthwise abundance of ribbon fish in trawl catches are given in Table 4.

TABLE-4. *Depthwise relative abundance (in % weight) of ribbon fish in trawl catches of the Project vessels from different regions during 1974 & '75.*

Regions	1974			1975		
	0-19 m	20-49 m	50-79 m	0-19 m	20-49 m	50-79 m
Ratnagiri- Mangalore	—	37.6	3.4	12.6	33.2	6.6
Mangalore- Quilon	8.4	26.4	18.5	3.8	16.8	14.3
Quilon-Gulf of Mannar	0.6	5.1	—	7.5	5.3	—
Total	9.0	69.1	21.9	23.8	55.3	20.9

Ribbon fish was caught in good quantities by the Project vessels in waters of 21-50 m bottom depth from Ratnagiri to Mangalore during January to May. In the region between Mangalore and Quilon they were taken in considerable quantities from May to November in waters of 21 to 80 m bottom depth. In the southern region from Quilon to the Gulf of Mannar, ribbon fish was occasionally taken in good numbers upto 50 m bottom depth from Ratnagiri to Cape Comorin supports a very high resource of ribbon fish and that in the central region from Mangalore to Quilon considerable quantities exist even upto a depth of 80 m.

The studies made at the Pelagic Fishery Project indicate that generally adult ribbon fish are found in shoals and the juveniles in dispersed condition. Adult *T. lepturus* having modal sizes from 45 to 50 cm were dominant in the catches from August to December and larger fishes with modal length of 80 to 85 cm were caught over a number of months in wide areas between 7° to 11°N and 12° to 13°N mainly from waters deeper than 50 m bottom depth. Adults with fully developed gonads were common from May to July in the catches between 8° to 10°N latitude and spent fish were found in the same area. Juveniles with modal sizes from 2.5 to 12.5 mm were generally captured in appreciable numbers from December to February and from May to August from the northern and central shelf areas. It is therefore suggested that the species breeds over an extended period; probably with two intensive spawning periods, namely December to January and May to August.

Big concentration of young *T. lepturus* (20-25 cm) was located in March 1973 at 250 m depth on the southern side of Wage Bank which is probably an important nursery ground for the species. The investigations made at the Project have



TABLE 5. *Distribution of biomass estimates of cat fish by coverage and area.*

Area Coverage	Southern Maharashtra	Karnataka & Goa	Kerala	Southern Tamil Nadu (Gulf of Mannar & West coast)	Total
1972 Oct	0	772	21,989	—	22,761
Nov	—	1,028	21,179	—	22,207
1973 Jan/Feb	11,130	50,735	23,141	0	85,006
Mar/Apr	0	25,392	34,321	0	59,713
Apr	—	—	14,834	—	14,834
May/June	1,612	25,446	59,092	0	86,150
June/July	3,740	3,625	36,544	1,024	44,933
July/Aug	12,458	13,542	9,746	402	36,148
Sept	—	12,598	43,479	—	56,077
Sept/Oct	0	1,166	5,699	—	6,865
Oct/Nov	0	2,427	13,147	2,676	18,250
Dec	—	1,767	4,578	1,073	7,418
1974 Jan/Feb	10,510	20,809	33,513	0	64,832
Mar/Apr	18,885	39,463	21,366	4,527	84,241
Apr/May	7,988	17,011	28,061	7,216	60,276
June/July	14,215	65,675	86,512	—	1,66,402
Aug	0	2,042	59,471	8,844	70,357
Sept/Oct	—	301	31,768	10,932	43,001
Oct/Nov	0	445	29,006	488	29,939
Nov/Dec	0	1,014	5,580	306	6,900
1975 Feb/Mar	45,840	58,000	62,629	0	1,66,469
Apr/May	37,647	59,713	59,842	11,551	1,68,753
May/June	92,163	1,26,668	1,77,872	1,201	3,98,904
July/Aug	40,766	1,09,022	1,87,757	11,640	3,49,185
Oct/Nov	—	1,469	23,638	5,600	30,707
<b>Total</b>	<b>2,96,954</b>	<b>6,40,130</b>	<b>10,94,764</b>	<b>68,480</b>	<b>21,00,328</b>
<b>Average</b>	<b>15,629</b>	<b>26,672</b>	<b>43,791</b>	<b>3,604</b>	<b>84,013</b>

shown that the ribbon fish can thrive in oxygen deficient waters as low as 0.5 ml/l indicating that their oxygen requirements are much less than that of other fish species.

#### Resources of cat fish

The cat fish stock within the Project area consists mainly of *Tachysurus dussumieri* and *Netuma thalassinus* of which the former is commercially the most important in the inshore fishing grounds. From Table 5 wherein estimates of total biomass of cat fish for the different coverages are given it may be seen that on an average they form 8.4% of the total fish biomass in the region. The average standing stock of cat fish per coverage was estimated at 84,000 tonnes, whereas the highest for 1973 was during May/June (86,150 tonnes), for 1974 during June/July (1,66,402 tonnes) and for 1975 during May/June (3,98,904 tonnes). The highest estimated average biomass of cat fish is along the coast of Kerala (43,791 tonnes), followed by Karnataka and Goa (26,672 tonnes), southern Maharashtra (15,629 tonnes), with the lowest being in the Gulf of Mannar (3,604 tonnes). Greatest abundance of cat fish, along the coast of southern Maharashtra occurs during the first and second quarter, whereas landings of cat fish in the region is high during the fourth quarter of the year. Off the coast of Karnataka and Goa, estimates in general were high during the second and third quarter and the highest landings in the region were recorded during the second quarter. Along the Kerala coast, the period of abundance is during the second and third quarters of the year, but cat fish landings in the region were high during third and fourth quarters. This anomalous situation is mainly due to the fact that the traditional fishery cannot effectively exploit the resources during the monsoon months when the stocks are in

the highest abundance in the area. Biomass estimates were fairly high in the Gulf of Mannar in the third quarter and the maximum landings were also during that period.

During February-March, cat fish and ribbon fish are distributed discontinuously in two wide belts from 14° to 16°N and 9° to 12°N. The recordings during April/May were also in a discontinuous manner, but with scattered concentrations off Ratnagiri, Karwar, Cochin and Quilon. During May/June recordings were widespread in a continuous belt all along the coast with medium to high concentrations being found in two wide belts, one between Ratnagiri and Karwar and the other between Kasaragod and Cochin (Anonymous, 1976). During July/August cat fish / ribbon fish recordings were made in two wide belts, one between Mangalore and Karwar and the other Cannanore and Quilon (Fig. 3). Within these belts high concentrations were found in patches mainly on the middle shelf regions off Karwar, Calicut and Cochin, and the bulk of the stock was in general located in the central sector.

Even though nothing definite could be said about the migratory behaviour of the cat fish/ribbon fish it appears that there is a general trend of southward shift in concentrations beginning from April till July/August when the bulk of the stocks was found in the central and southern sectors. One of the interesting findings of the Project is the abundance of both cat fish and ribbon fish on the western shelf when it is covered with oxygen deficient water during south west monsoon months. Obviously they can thrive well in such environment which is avoided by typical pelagic species.

Regular fishing trials with pelagic trawl and bottom trawl have shown the

TABLE-6. *Depthwise relative abundance (in % weight) of cat fish in trawl catches of the Project vessels from different regions during 1974 & '75.*

Regions	1974			1975		
	0-19 m	20-49 m	50-79 m	0-19 m	20-49 m	50-79 m
Ratnagiri- Mangalore	27.2	8.3	—	14.5	2.3	2.8
Mangalore- Quilon	11.6	33.6	14.1	46.4	16.4	12.7
Quilon-Gulf of Mannar	1.8	1.1	2.3	4.5	0.4	—
Total	40.6	43.0	10.4	65.4	19.1	15.5

pattern of depthwise distribution of cat fish. The depthwise abundance of cat fish for the years 1974 and 1975 are given in Table 6. In the northern region from Ratnagiri to Mangalore, good quantities were taken in shallow waters upto a depth of 20 m during the first and second quarter of the year. In the central region from Mangalore to Quilon, considerable quantities were caught mostly on the inner shelf with bottom depth upto 50 m in the second and third quarter and fairly high catches were obtained from the outer shelf between 51 and 80 m bottom depth in the second quarter. In the southern region (Quilon to Gulf of Mannar) catches were moderate upto a depth of 50 m during the third quarter of the year.

Young cat fish (5 to 10 cm) were captured in good numbers in February-March between 9° and 14°N, and medium sized fish (15 to 25 cm) from April to July mostly in areas between 8° and 12°N. Larger cat fish with modal sizes from 30 to 40 cm were abundant in the catches mainly during June to November in the whole area but more so towards the central and southern

sectors. Still larger fishes with modal size of 60 to 65 cm were common during the months of January/February in Northern shelf areas (12° to 15°N) and in April mainly in the areas 8° to 11°N. Based on the occurrence of young cat fish, it is believed that the spawning period is of fairly long duration.

Distributions of cat fish and ribbon fish in good concentrations are generally found during monsoon months in areas between 8° to 14° upto 80 m depth. The project vessel RASTRELLIGER fishing in those areas has obtained catch rates as high as 1700 kg. per hour in bottom trawl and 4,000 kg. per hour by pelagic trawl with an average catch rate of 545 kg. Similarly SARDINELLA has obtained average catch rates of 481 kg. and 544 kg. per trawling hour respectively with her pelagic and bottom trawls.

Wide variations in the estimates of cat fish and ribbon fish have been observed during different areas which indicate seasonal movement. Even though no definite conclusions can be drawn regarding the migratory pattern of the individual species of ribbon fish and cat fish, which have different habits, a general trend has been evident. High concentrations shift northwards from 8° to 16°N during November/December and thereafter a southward movement commences by about April/May and a good portion of the biomass is found between 8° and 11°N from July to September (Fig. 3). Thus it is obvious from the distribution pattern and the biomass estimates of the resources of both cat fish and ribbon fish that high level of abundance of these fish is available for longer period (May to September) off Kerala and Karnataka coasts and of much shorter duration off southern Maharashtra and southern Tamil Nadu coasts.

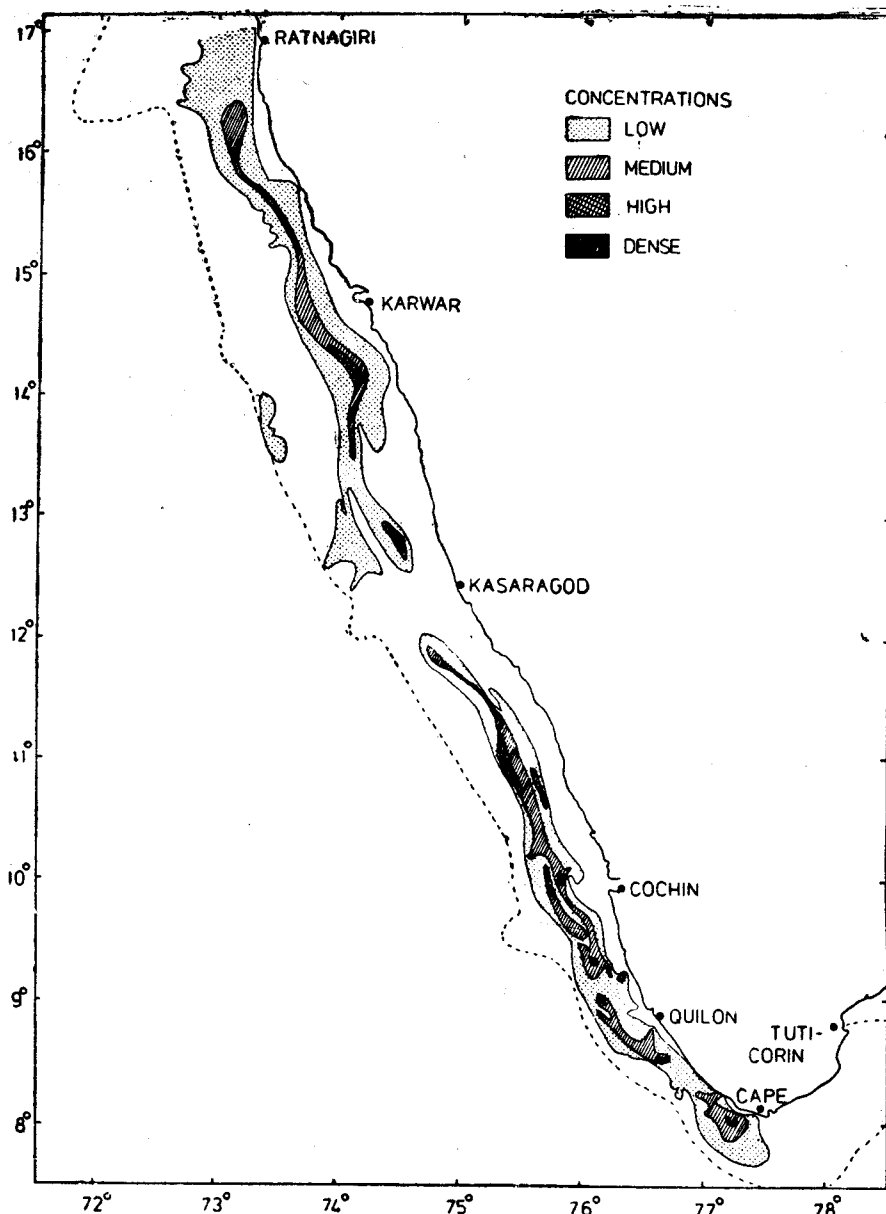


FIG.3. DISTRIBUTION OF RIBBON FISH/CAT FISH DURING JULY/AUGUST 1975.

vessels mainly in depth beyond 50m indicating the availability of commercial concentrations of the bigger adult fish in deeper waters.

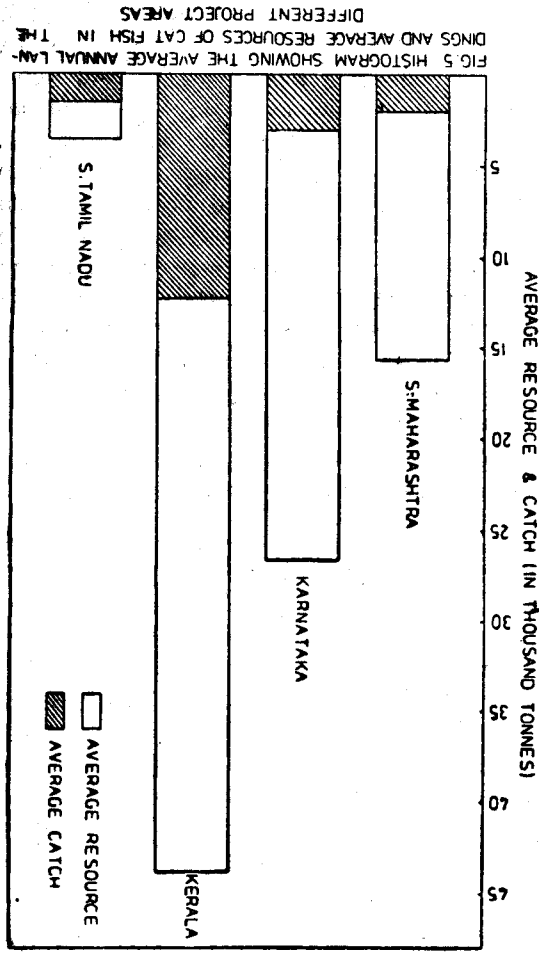
### Exploitation and Utilization

The resources surveys conducted by the Pelagic Fishery Project have shown that the average potentialities of the resources of cat fish and ribbon fish in the Project are in the order of 84,000 and 67,000 tonnes respectively which could be exploited with advantage. The biomass of ribbon fish and cat fish in the region together constitute 15.3% of the total fish biomass and this is exploited at present only to a small extent. The average standing

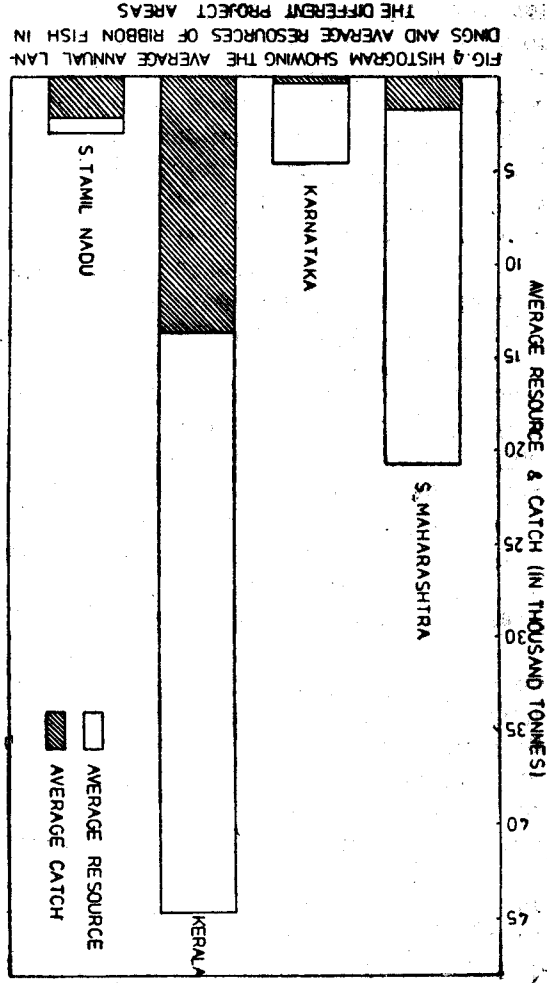
stock of ribbon fish is about 4 times higher than the landings in the Project area and 1.8 times higher than the annual all India landings. The present average potentials off the coasts of southern Maharashtra, Karnataka and Goa, Kerala and Southern Tamil Nadu are 11.8, 13.4, 3.3

The investigations conducted by the Project have also shown the possibility that as the fish grow bigger and older both cat fish and ribbon fish move into outer shelf. In fact some of the best catch rates exceeding 1,000 kgs/hr were taken by the Project

Similarly the average biomass of cat fish in the Project area with an estimate of 84,000 tonnes is about 4.7 times higher than the average landings in the area and 2.3 times higher than the all India landings. The Project findings indicate that the average biomass of cat fish off the coasts of Southern Maharashtra, Karnataka and Goa, Kerala and Southern Tamil Nadu are 7.6, 8.8, 3.6 and 2.3 times higher than the average landings in the respective regions (Fig. 5). Thus the present level of exploitation could easily be increased to two and a half times without effecting the stocks within the Project area. At the same time



landings in the respective regions, indicating great scope for the increased exploitation of this resources (Fig. 4). It should be evident from the above that the ribbon fish catch could be at least doubled within the Project area without adversely affecting the stocks. From the above data it is also evident that there is tremendous scope for increased exploitation especially in the regions off Southern Maharashtra, Goa and Karnataka.



it should be emphasised that the shelf area off Southern Maharashtra, Goa and Karnataka offers greater scope for increased exploitation as compared to southern areas. The reasons for the present low level exploitation of the above two resources are due to the inaccessibility of the resources to the indigenous non-mechanised craft and gear and the small mechanised boats operating bottom trawls which cannot venture far out from the coast. Also that the traditional fisheries exploit mainly younger fish available on the inshore grounds, whereas the fully grown larger fish in good concentrations available in deeper waters are out of reach to the fishery.

Fishing experiments conducted by the Pelagic Fishery Project have enabled us to understand generally the effective methods of their capture. Bottom trawls and pelagic trawls have been operated during day and night by the Project vessels with good results. RASTRELLIGER and SARDINELLA fishing in good concentrations obtained average catch rate of 635 kg/hr and 544 kg/hr respectively by bottom trawl and similarly 545 kg and 481 kg per trawling hour by pelagic trawl.

Sometimes dense surface schools of cat fishes and ribbon fishes suitable for purse seining have also been encountered. Good catches of cat fishes have been taken by purse seining in some instances in the Gulf of Mannar and Arabian sea. Purse seining might prove very efficient for capturing surface school concentrations. In view of the diurnal behaviour, bottom trawling during day and pelagic trawling during night with medium sized vessels is very effective for the exploitation of these resources. In fact commercial type operations by the Integrated Fisheries Project vessels have obtained good quantities by bottom trawling.

The proportion of large sized cat fish and ribbon fish has been found to be considerably higher in the offshore waters than in the shallow regions now being exploited by traditional fisheries. These species have a relatively longer life span and a low natural mortality rate. The fishing mortality caused by the traditional fishery, which is relatively immobile, is not expected to be high. The fishery at present is exploiting mainly young fish of one and two years old

In the area between 9° and 14°N *T. lepturus* larger than 50 cm in length occur in great school aggregations on the middle shelf after July, when most of them are in spent and recovering stages and these concentrations can be harvested with advantage by bottom trawl and midwater trawl.

One of the best ways to increase the harvesting of these two resources is to intensify the fishing pressure during the monsoon months since the highest standing stocks are found at that time on the shelf and to extend the fishing operations as well to deeper waters.

The present fishery is not able to take advantage of the situation because of rough weather conditions prevailing during the monsoon. However, it should be emphasised that only larger vessels could be operated during the south-west monsoon. The resources of large sized unexploited fish existing beyond the reach of traditional fisheries offer good prospects for extension of the operations of larger vessels equipped with bottom and pelagic trawls further offshore than at present.

A better exploitation of the available stock could be made if the producer is assured of a fair return for the catches. Increased exploitation of the resources of cat fish and ribbon fish call for the proper utilization of the catches involving handling, processing and distribution of fresh or iced fish on landing. Ribbon fish and cat

fish though not highly esteemed are really palatable and are consumed fresh or in salted and dried condition by the common man. The handling of these fishes on board the vessels may not pose much problem as they are large sized and can be kept, after removing the entrails, in suitable boxes mixed with ice and stored in the fish hold. A good portion of the catch could be filleted and frozen for subsequent marketing. Air bladder of cat fish could be used as raw material for making isinglass. The remaining portions of the filleted fish can be converted into fish meal. Some portion of the catches could be mixed with salt and sun dried under hygeinic conditions or dried in farge artificial driers. If the dried product is packed in suitably sized poly-thene bags, it will be acceptable to the consumer in large quantities both in internal as well as in external markets. As the dried product will last for a few months and as there is good demand for dried fish products in countries in South East Asia; it should be possible to export dried fish of good quality and earn some foreign exchange.

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