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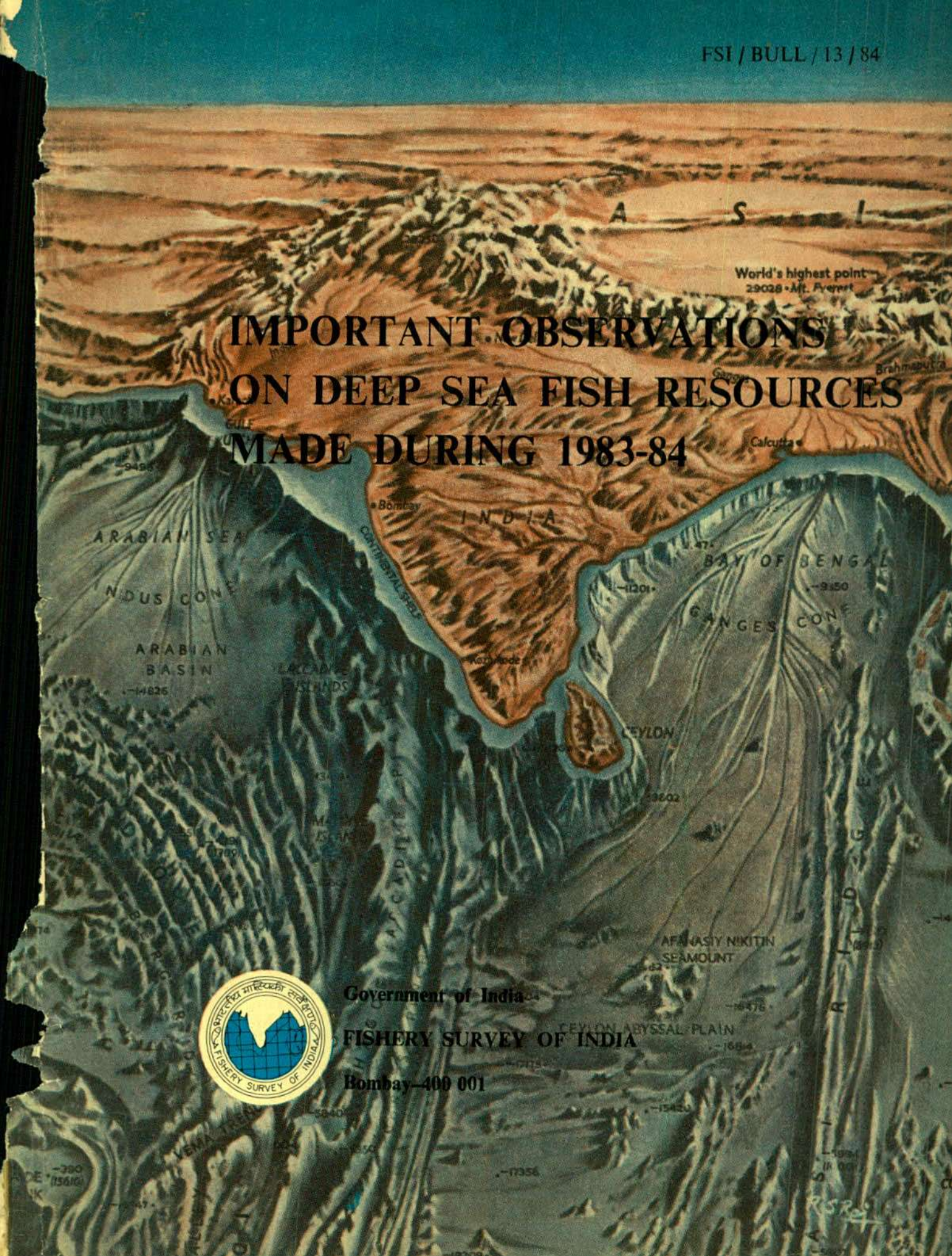

IMPORTANT OBSERVATIONS ON DEEP SEA FISH RESOURCES MADE DURING 1983-84

Government of India

FISHERY SURVEY OF INDIA

Bombay–400 001

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P R E F A C E

Although the Fishery Survey of India is circulating the cruise results of its large survey vessels without interpretation to all members of the Indian Association of Fishing Industry and others interested in deep sea fishing since 1982, we have been convinced as a result of discussions with many members of the industry that there is still a need for periodical dissemination of salient observations made on fishery resources during survey. Perhaps this suggestion may have stemmed from the fact that those who plan, implement and monitor the programmes are in a better position to interpret the data than others. Industry sources have also impressed upon us the need for quick dissemination of such information.

Having regard to this, we have requested all our programme leaders to submit a progress report on each major project indicating salient observations made during the fiscal year 1983-84. Four papers received from the programme leaders and a paper covering the salient achievements of all the programmes are presented in this bulletin. It is proposed to publish Fishery Charts for different regions on completion of the programmes. A fishery chart for Wadge Bank is already in the press. I hope those interested in deep sea fishing and fish resources will find the information contained in this bulletin useful.

BOMBAY
8/5/84

K.M.JOSEPH
DIRECTOR

C O N T E N T S

SALIENT OBSERVATIONS ON THE RESULTS OF FISHERY RESOURCE SURVEY DURING 1983-84

K.M. Joseph

INTRODUCTION

During the fiscal year 1983-84, four planned programmes were undertaken for the survey of demersal fishery resources. These are, survey of the demersal fishery resources between lat. 11°N and 15°N. (Karnataka-Kerala region), lat. 8°N. and 10°N. (Gulf of Mannar), lat. 10°N. and 14°N. (Tamil Nadu region) and lat. 15°N and 18°N. (Andhra Pradesh region). As part of the programme for pelagic and oceanic fishery resources also four planned programmes were undertaken viz. survey of tuna resources by long lining, survey of pelagic resources by purse seining between the lat.10°N and 14°N & 16°N and 18°N along the east coast and lat. 8°N and 11°N along the west coast. A programme leader was assigned to each programme and he was assisted by the available scientific manpower with the organisation. Nine large survey vessels (250-350 GRT) were deployed for these programmes. The salient observations on the results obtained during the year are briefly discussed in the paper.

NEW DEMERSAL FISH RESOURCES

1. Bulls eye

Priacanthus spp., popularly known as 'Bulls eye' or 'Big eye' (plate 1. fig. a), a potentially rich deep water fish resource was located from Goa to Mandapam along the west coast and pt. Calimere to Visakhapatnam along the east coast. Bulls eye was recorded from 50-400 m. depth, along the north Kerala and Karnataka coast with peak occurrence in 100-150 m. depth belt. Its abundance was more during April to June in this region. The highest catch rate was 616 kg per hour while the average was 72.8 kg. It formed 11.26% of 314 tons of fish caught by the two vessels operated from Mangalore. The predominant size

group was 13-21 cm. Bulls eye was available between 90-250 m. depth in the Gulf of Mannar and Wadge Bank and the highest catch per hour recorded was 32.04 kg.

Priacanthids were recorded from 120-200 m. depth along the Andhra Pradesh coast with peak occurrence in 150-170 m. depth belt. While the average catch per hour was about 60 kg, the highest catch rate was 1225 kg. from area 16-82 in January. It formed about 5% of the total catch of about 176 tons of fish caught by *Matsya Shikari*. The common size group was 16-18 cm. *Priacanthus* spp., was also caught by *Matsya Jeevan* operated from Madras between the depth 50-200m. While the average catch rate was about 200 kg per hour, the highest catch rate was about 1700 kg per hour during December. It appears to migrate both across the shelf and parallel to the shelf, probably depending on cold water current.

2. Indian drift fish

Psenes indicus, popularly known as 'Indian drift fish', is another deep water resource located by all the large vessels surveyed for demersal fish resources along both east and west coast. It formed 6.2% of about 314 tons of fish caught by the two survey vessels attached to the Mangalore base. Its occurrence appears to be more predominant in areas south of Mangalore than north of Mangalore. The average catch rate was about 20 kg per hour while the highest catch rate was about 1400 kg. It was found to occur between 200-500 m. depth. Indian drift fish was also found to occur in appreciable quantities along the Wadge Bank and in the Gulf of Mannar in identical depth. While the average catch rate was 16 kg per hour, catch rate as high as 170 kg per hour was also recorded from depth zone 100-150 m. On several occasions it was caught in sizeable quantities with Barracuda, a popular table fish which forms an important fishery in the Gulf of Mannar. The predominant size group along the west coast was 16-20 cms.

Psenes indicus formed about 3% of the catch (176 tons) of *Matsya Shikari* from Andhra Pradesh coast. It was found to occur in appreciable quantities during months November, December and March. It was found to occur between 50-130 m. depth. The average catch rate was about 10 kg per hour as against an highest catch rate of about 400 kg. The Indian drift fish was recorded mainly from 110-400 m. depth from the lower east coast by *Matsya Jeevan*. While the average catch per hour was about 17 kg., the highest catch rate was about 1500 kg. The common size group was 14-18 cm.

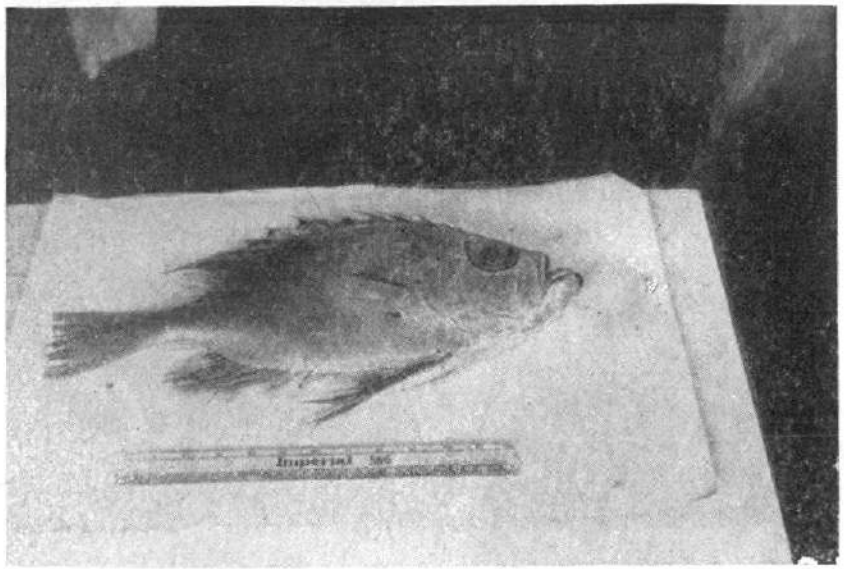
3. Black ruff

Centrolophus niger, popularly known as 'black ruff'(plate 3 fig. b) is found to be one of the most abundant species of deep sea fish caught by *Matsya Vishwa* based at Mangalore. It formed 16.1% of the total catch of 314 tons recorded by the two vessels during the survey. It was found to occur in 250-500 m. depth, with highest catch rate from the depth belt 350-500 m. The average catch rate was about 53 kg per hour, while the highest catch rate was about 2100 kg. It was more abundant during January - February than other months. The common size group was 12-14 cm. Black ruff was also found to occur in Wadge Bank and in Gulf of Mannar in lesser quantities. No appreciable quantity was caught from east coast yet.

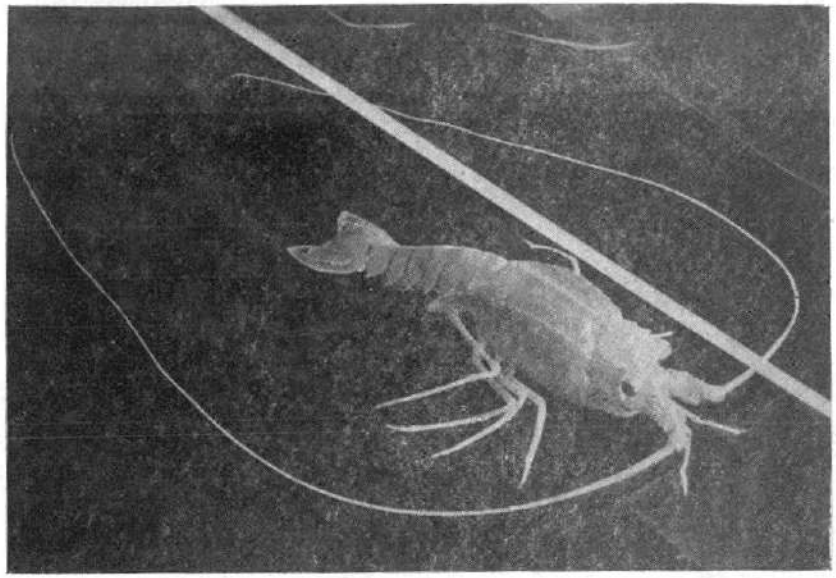
4. Deep sea lobster

Deep sea lobster, *Puerulus sewelli* (plate 1 fig.b) is known to occur along the south west coast of India, in sizeable quantities from 1967. *Matsya Shakti* and *Matsya Vishwa* based at Mangalore and *Matsya Nireekshani* based at Tuticorin, could establish its occurrence along the west coast from Gulf of Mannar to Karwar. It was also found to occur in the lower east coast, between pt. Calimere and Madras.

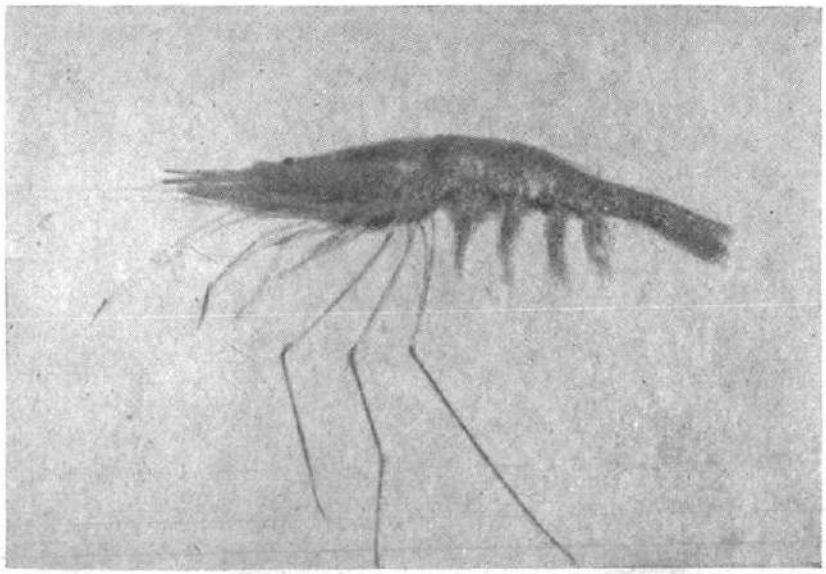
Plate 1

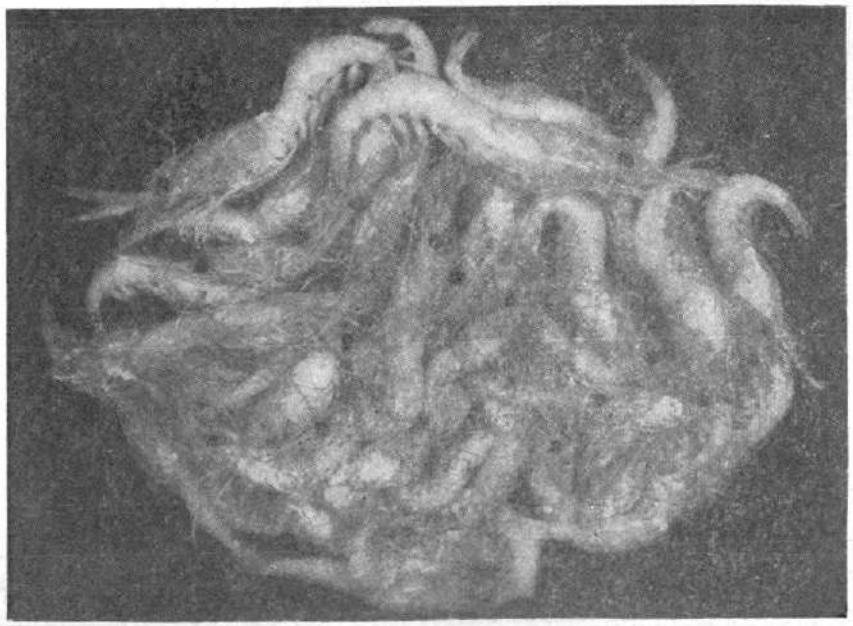


a. **Priacanthus** Sp. ("Bulls eye")



b. **Deep sea lobster**





It occurs generally between 150-250 m. depth. The catch rate varies from a few kg to 300 kg per hour depending on the ground.

5. Deep sea prawn

Deep sea prawns comprising mainly *Aristeus* spp. (plate 1 fig. c) *Heterocarpus* spp. were found to occur along Kerala-Karnataka coast during the year by the vessels operated from Mangalore between the depth range 200-500 m. *Aristeus* spp. was predominant beyond 350 m. whereas *Heterocarpus* spp. was found to be predominant in 250-350 m. depth range. Deep sea prawns formed about 2.5% of the catch landed by fish trawls from this region. Deep sea prawns comprising mainly *Solenocera hextii* (plate 1 fig. d) and *Aristeus* spp. were caught from the Gulf of Mannar, from the lower east coast and from Andhra Pradesh coast in the depth range 150-400 m. Areas 15-81 and 16-81 along the east coast provided relatively better catch than other areas. The average size group was 18-20 cm. Deep sea prawns were observed more during June, July and September along the east coast whereas it was found to be more abundant during September to February along the west coast.

EXPLOITED DEMERSAL FISHERIES FOUND IN DEEPER WATERS

1. Nemipterus spp

Among the exploited fishes, *Nemipterus* spp, popularly known as threadfin bream ("Kilimeen"), is found to be the most predominantly available fish in deeper waters from Wadge Bank to Karwar along the west coast. It formed a little over 17% of the total catch landed by *Matsya Vishwa* and *Matsya Shakti* along the Kerala-Karnataka coast, while it formed about 24% of the total catch landed by *Matsya Nireekshani* from Wadge Bank. It was found to occur throughout the year with a peak catch rate of about 181 kg per hour

during June-July in the Wadge Bank. The peak catch was observed during February-May along the Kerala-Karnataka coast. Threadfin bream was found to occur from shallow waters to 225 m. depth all along the south west coast. An average highest catch rate of about 34 kg. was obtained from 100-200 m. depth belt from Karnataka coast. The dominant size range was 14-26 cm.

Threadfin bream was also caught in appreciable quantities from 50-200 m. depth from the east coast by *Matsya Jeevan* and *Matsya Shikari*. *Matsya Shikari* recorded a highest catch rate of 264 kg per hour from 150 m. depth in area 15-80. However the average catch per hour was found to be about 20 kg. i.e. less than that is available along the west coast. Catch per hour upto 640 kg. was recorded by *Matsya Jeevan*. Its distribution in the deeper waters along both east and west coast in such quantities appears to be very promising to the Indian fishing industry.

2. Sardines

One of the most significant observations made during the year by *Matsya Shikari* was the location of sardines from 40-110 m. depth in appreciable quantities during January-March 84 along the east coast. Sardines constituted 18.5% of the catch taken by the vessel by demersal trawling. Sardines were caught, perhaps, for the first time in such abundance (av. 160 kg per hour) from deeper waters of Andhra Pradesh coast. It formed 18.5% of the total catch of the vessel. It is equally significant to note that during the same time, *Matsya Darshini* which was carrying out purse seining in the same area viz. 16-82, 17-84 and 17-83 could not catch or observe large surface shoals.

3. Large sciaenids

Among other groups big sciaenids consisting mainly of *Pseudosciaena diacanthus* commonly known as "ghol" formed 8.5% of the total catch of *Matsya Shikari*. It was caught mainly from 50-70 m. depth from areas 16-81 and 16-82. Catch rates upto 2600 kg per hour was recorded. It formed about 8% of the catch of *Matsya Jeevan* in November from 100-125 m. depth from area 14-80.

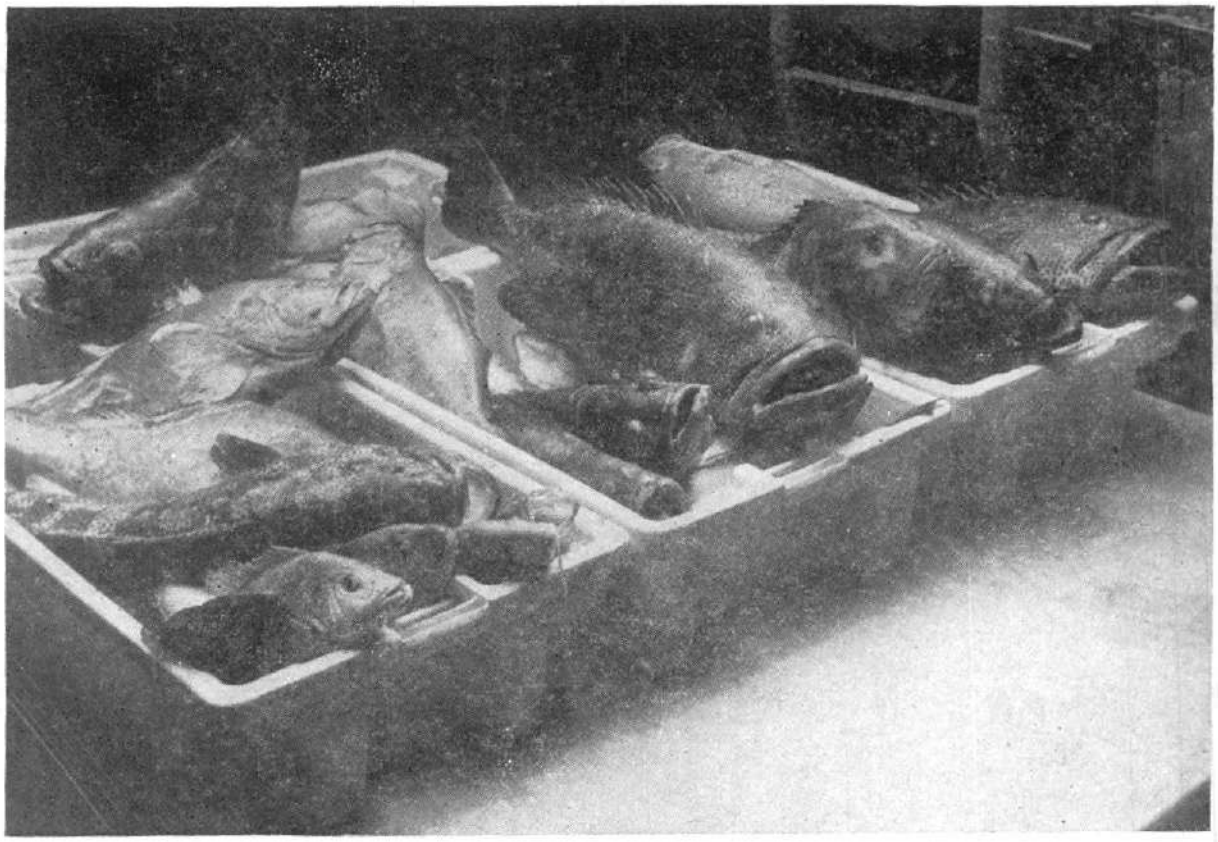
4. Barracuda

One of the most significant observations made during the five months operation of *Matsya Nireekshani* in the Gulf of Mannar is the discovery of Barracuda probably in commercially exploitable quantities in the depth range 100-200 m. The catch consisted of five species belong to the genera *Sphyraena*. The most predominant species was *S. obtusatta*. The average catch rate was 92 kg per hour, while the highest catch rate was 1350 kg per hour. A total of 17 tons of Barracuda was caught during the period. The dominant size groups were 21-25 cm. and 36-40 cm. It was found to occur all throughout the period of survey. Barracuda formed 22% of the total catch of the vessel during the period.

5. Perches

Perches constituted 21% of the catch from Gulf of Mannar during the five months survey from October 83 to March 84. This group consists mainly of *Epinephelus diacanthus* locally known as "Kalava" (plate 2 fig.a) *Lutianus argentimaculatus*, popularly known as 'Red Snapper' and *Lethrinus ramak* commonly known as "Velameen" besides, an assortment of other species. The average catch per hour was about 60 kg, while the highest catch per hour was about 90 kg. It was abundant in the depth belt 30-120 m. A survey of the Wadge Bank completed by

Plate 2



a. **Epinephelus** Sp.

b. Pomfret catch onboard **MATSYA DARSHINI**

Matsya Nireekshani in May 1984 indicated that perches of identical species constituted about 37% of the catch from 20-225 m. depth. It was found to occur in 25-100 kg per hour of trawling. The depth range 25-46 m. and 183-225 m. were found to be most productive for this group. The highest catch per hour was observed during the month of August followed by April-September. It formed about 75% of the catch during March-April. It is note worthy, in this context, that perches constituted only 2% of the catch of *Matsya Shakti* and *Matsya Vishwa* operated from Mangalore.

Perches formed 7% of the catch of Matsya Jeevan. An average catch per hour of 300 kg was obtained during November from 50-160 m. depth from areas north of Madras. Perches mainly belonging to the genera *Pomadasys* formed about 4% of the catch of *Matsya Shikari*. It's peak occurrence (234 kg per hour) was in the month of March in the area 16-81 from 50-70 m. depth. It was available throughout the year from 40-170 m. depth along the east coast.

6. Squids and cuttle fish

Squids and cuttle fish formed about 7% of the catch of *Matsya Nireekshani* from Wadge Bank while it formed only 2% of the catch from Gulf of Mannar. In the Wadge Bank the most abundant area for squids and cuttle fish was found to be the depth range 25-46 m. (15-20 kg per hour). During September and October, squid and cuttle fish formed about 30% of the catch caught from the Wadge Bank. This group constituted 2% of the catch of *Matsya Shakti* and *Matsya Vishwa* from Karnataka region. It formed less than a percent of the catch from the east coast.

7. Cat fish

Cat fish formed about 12% of the catch caught from Karnataka-Kerala coast by the Mangalore based large survey vessels, while it formed about 3% of the catch of *Matsya Nireekshani*

from Wadge Bank. The average catch rate was about 30 kg per hour while the highest catch rate was 1200 kg. It formed about 5% of the catch of *Matsya Shikari* with an average catch rate of 16.4 kg per hour from Andhra Pradesh coast. Both along the east coast and west coast its predominance is more between 50-90 m. depth than other depth ranges.

8. Carangids

Carangids comprising of *Caranx* spp. *Decapterus* spp. *Chorinemus* spp. etc. constituted about 6% of the catch from Wadge Bank and Gulf of Mannar. It was available upto 225 m. depth but with high catch rate of 64 kg per hour during January from 40-90 m. depth. An average highest catch rate of 90 kg per hour was obtained from Wadge Bank. Carangids formed 2% of the catch from Karnataka region. Carangids constituted about 7% of the catch from the east coast. October-November yielded catch rates upto 320 kg per hour from areas north of Madras and from depth range 50-125 m.

9. Pomfret

Some potentially rich fishing grounds in relatively deeper waters were located for Pomfrets, an esteemed table fish and an increasingly important export commodity in the east coast. It was found to occur between 50-90 m. depth, south of Vizag. Pomfret formed 4% of the catch of *Matsya Shikari* and was found to be available throughout the period with peak abundance in the month of March. Pomfrets constituted 2% of the catch of *Matsya Jeevan* from depth range 50-110 m. The areas 15-81, 16-81 and 16-82 appear to be very productive fishing areas for Pomfret along lower east coast. In the Gulf of Mannar, Pomfret contributed to 3% of the catch of *Matsya Nireekshani* mainly from the depth range 30-60 m. Catches upto 113 kg per hour was obtained during December. The catch consisted predominantly of white pomfret (plate 2 fig. b).

PELAGIC FISHERY RESOURCES

1. Survey by purse seining

During the period under review, three large survey vessels viz. *Matsya Darshini*, *Matsya Harini* and *Matsya Varshini* were deployed for purse seining respectively from Vizag, Madras and Cochin. While *Matsya Darshini* and *Matsya Harini* had a Danish and Norwegian master fisherman respectively on board, *Matsya Varshini* did not have any expatriate master fisherman. The results of the survey do not appear to indicate the availability of any sizeable quantities of purseinable pelagic resources in the deeper waters of the continental shelf either in the east coast or in the west coast.

Matsya Darshini operated in areas 16-81, 16-82, 17-83 along the east coast. It cited 142 shoals of varying abundance during the period. Relatively more shoals were found during March, April, May, August and September. From out of the 69 sets the vessel attempted, 24 sets brought some catch and of which five sets yielded catches between 1200 and 7000 kg. The catch consisted mainly of sardines, frigate mackerel, little tuna, pomfret and anchovies. Although the vessel surveyed areas from 30-120 m. depth, all the successful sets were made between 30-60 m. depth especially in areas 14-80, 16-81, 16-82 and 17-82.

Matsya Harini during the same period operating between lat. 10°N. and 14°N. along the east coast sighted 204 shoals. Out of the 51 attempts it made, 11 sets were found to be successful. Of these four sets only yielded catch between 1000 and 2400 kg. The catch consisted mainly of frigate mackerel, carangids and horse mackerel.

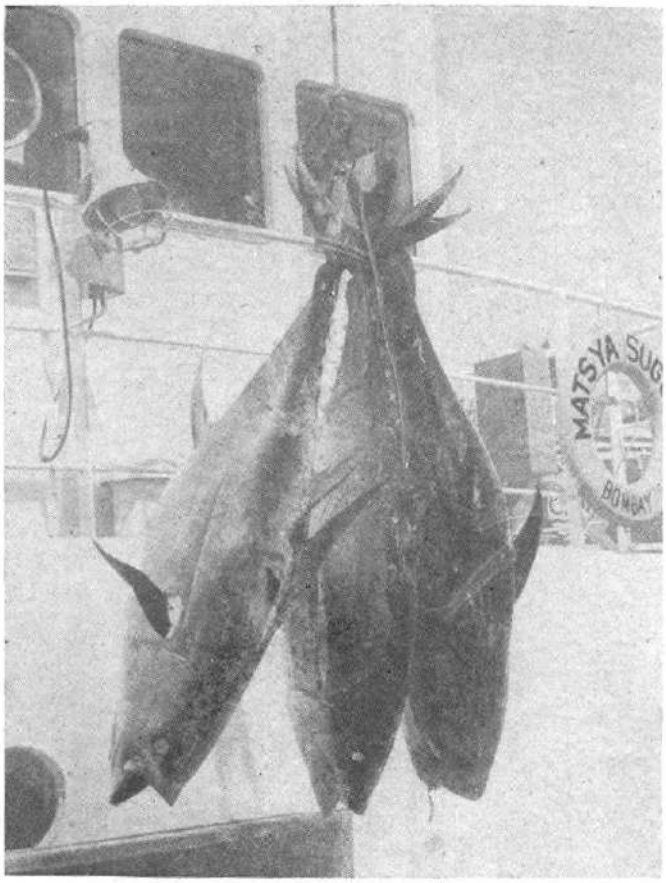
Matsya Varshini which carried out only 3 months purse seine operation from December to March along the south west coast based at Cochin sighted 97 shoals between the lat. 10°N. and

14°N. Out of the 32 sets, it attempted, four proved to be successful. Out of the four, three yielded catch of about 1000 kg or more. The catch comprised carangids and frigate mackerel. The vessel operated mainly outside 50 m. depth.

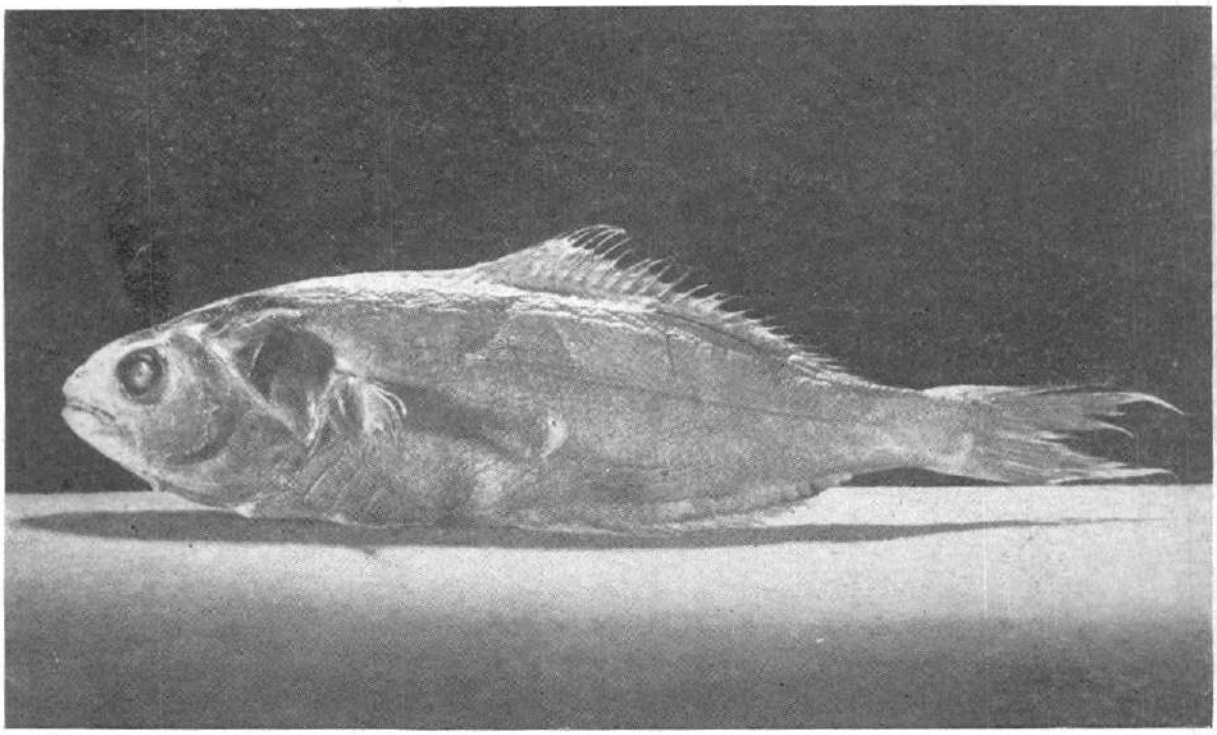
2. Survey by tuna long lining

A major break through in the matter of tuna long lining was made during the period October 83 to March 84 by *Matsya Sugandhi*, a Japanese built tuna long liner operated from Cochin. Although the vessel operated prior to this period, the results of this operation do not appear to be comparable to the period cited above due mainly to the fact that the crew did not have the requisite experience or training and that the vessel operated in areas relatively closer to the shore. From October, the vessel undertook five voyages of 20-40 days duration under the guidance of a Japanese master fisherman, four in the Arabian Sea and one in the Bay of Bengal. During the four voyages in the Arabian Sea, the vessel operated mainly between the lat. 8° and 8°N. and long. 68°E and 72°E. The fifth cruise covering 40 days was in the Bay of Bengal between the lat. 8°N. and 16°N.

An analysis of the data gathered from the six months operation from October indicates that the catch from the equatorial waters consisted 85% of tuna comprising Big eye, Yellow fin and Skip jack. From the east coast on the other hand, tuna comprising of Yellow fin (plate 3 fig. a) and Skip jack formed about 53% of the catch. Big eye, the most esteemed among tunas was caught mainly from the equatorial seas. It is also remarkable that hooking rate upto 2.5% was obtained in the case of Yellow fin tuna from equatorial waters. The combined hooking rate of Big eye, Yellow fin and Striped marlin were 1.3% and 1.2% respectively from the equatorial waters and the Bay of Bengal. It is also noteworthy that tuna was available within the EEZ area of Bay of Bengal in appreciable quantities during the period of survey.



a. Yellow fin tuna being unloaded from **MATSYA SUGUNDHI**



b. **Centrolophus niger.** ("Black ruff")

DEMAND FOR NEW FOUND RESOURCES

Since the deep sea demersal fishery appears to be mainly supported by non-conventional fish resources it is essential that measures are taken up by appropriate authorities with least delay in popularising and promoting their market acceptability. It is learnt that 'Indian drift fish' and 'Bulls eye' are exploited in large quantities by Thailand and some other south east Asian countries. Thailand appears to export these groups in frozen form to Japan.

The author requested the Integrated Fisheries Project, Cochin, the Central Institute of Fisheries Technology, Cochin, the Marine Products Export Development Authority, Cochin and some Fisheries Colleges under Agricultural Universities such as Mangalore Fishery College to carry out necessary studies, product development, test marketing, promotional work etc. The college of Fisheries, Mangalore has reported that Indian drift fish, Bulls eye and Black ruff are as rich in proteins and fats as compared to other common fishes such as cat fish, sardines etc. It is gathered from Integrated Fisheries Project that Bulls eye has a potentially good market as dried, filleted and frozen products. Indian drift fish in fresh form has some demand now at Vizag and Madras. It appears that much remains to be done not only for making a correct assessment of the potential of these resources but to promote their market acceptability and utilisation.

A NOTE ON THE DEMERSAL FISHERY RESOURCES SURVEY OF GULF OF MANNAR

V.S.Somvanshi and P.K.Bhar

INTRODUCTION

The Gulf of Mannar considered rich in fishery resources, has attracted attention of Government as well Fishing industry in recent past. The demersal resources survey conducted by the vessels attached to the base of Fishery Survey of India, Tuticorin so far was limited to areas within 40 fathom depth. A need was therefore keenly felt by this organisation to have a comprehensive picture of demersal fishery resources of this area. It therefore embarked on a systematic and time bound programme of demersal fishery resources survey of continental shelf and upper continental slope of Gulf of Mannar in October 1983 by deploying the largest survey vessel, *Matsya Nireekshani*, from its Tuticorin Base. The vessel operated bottom trawl with mesh size 400 mm in wing and 80 mm in cod end. Five major areas, (7-78, 8-78, 8-79, 9-78 and 9-79) constitute the Gulf of Mannar. The salient observations on the demersal fishery resources of the region as surveyed by the vessel *Matsya Nireekshani*, from October 83 to March 84, are briefed hereunder.

IMPORTANT SPECIES

The main groups/species supporting the demersal fishery in Gulf of Mannar are barracuda (22%), perches (21%), elasmobranchs (16%), carangids (8%) and pomfrets (3%). *Psenes indicus*, *Priacanthus* spp., *Lactarius lactarius*, silverbelly, cat fish, nemipterids, upenoids, sole fish, decapterids and clupeids are the other fin fish resources. Among shell fishes, deep sea lobster - *Puerulus sewelli*, deep sea prawns, *Solenocera hextii*, *Aristeus* sp. and *Heterocarpus* sp., and cephalopods - cuttle fish and squids form part of the catches. The average catch rate for the six months being 130.58 kg per hour, the catch per hour of trawling was maximum during January 211.5 kg per hour followed by 164.5 kg per hour during October and March. The lowest recorded catch rate is 112.8 kg per hour in November.

CATCH BY AREA AND DEPTH

Bulk of the catches, 67.5 tonnes is caught from the area 8-78. Almost all the depth ranges (upto 500 m) are explored in this area. The area 9-79 was found to yield maximum 214.5 kg per hour, followed by 8-78 with 124.2 kg per hour. However, the explorable portion of the area 9-79 is comparatively shallow one (upto 50 m). The catch rates from the remaining areas varied from 52.9 to 96.2 kg per hour.

Major catch comes from the depth ranges, 0-50 m and 101-200 m. The data so far collected reveal that the depth belts 0-50 m, 51-100 m and 101-200 m yield better catch rate (i.e between 151.3 and 171.5 kg per hour). However, the areas in 51-100 m depth zone being highly uneven and rocky. preliminary indications are that the depth ranges 0-50 m and 101-200 m are highly productive and the resources, perches and cuttle fish in the case of former and barracuda in latter depth belts could be commercially exploited.

IMPORTANT FISHERY RESOURCES

Some of the species/groups indicating prospective fisheries in the Gulf of Mannar are briefly described in the ensuing.

Perches

The group perches is constituted mainly by 'Kalava' *Epinephelus diacanthus* and *Epinephelus* spp., "Red Snapper" *Lutianus argentimaculatus* and *Lutianus* spp., and "Velameen" *Lethrinus ramak* and *Lethrinus* spp. Other varieties clubbed in this group are *Acanthurus* spp., *Scolopsis vosmeri*, *S.bimaenlatu*, *Lutianus vitta*.

In aggregate perches contribute to about 38% of the catches from the above referred areas within 125 m. depth with 60 kg per hour yield. The highest catch rate is recorded in the area 9-79 (90 kg per hour), followed by the areas 8-78 and 9-78 with catch rate 55 and 54 kg per hour respectively.

In order of abundance, the varieties among the group perches could be given as 'Red Snapper' (29%), 'Kalava' (27%), 'velameen' (14%), *Gaterin* sp. (9%), *Acanthurus* spp. (11%), *Pomadasys hasta* (7%), *Scolopsis* spp.(2%) and *Lutianus vitta* (1%). The perch fishery in the Gulf during the six months period was supported by individuals dominating in 56-70 cm. with 68% (Kalava), 76-80 cm. with 43% (Red Snapper) 51-60 cm. with 37%(Velameen).

Pomfrets

The silver pomfret, *Pampus argenteus* is the principal constituent of the catches from the Gulf whereas the black pomfret, *parastromateus niger* is occasionally caught. The main area producing this variety of quality fishes being 9-79, they are rarely obtained, in few numbers, from 8-78 and 8-79 also. Pomfrets are present in shallow waters upto 50 m depth. Their month-wise catch rate is furnished below.

Month	October	November	December	February	March
Catch rate (kg per hour)	19.30	12.60	112.90	28.66	42.90

The maximum yield recorded was in December 113 kg per hour followed by March with 43 kg per hour. The aggregate catch rate for the period under survey (24 kg per hour) indicates resource of significant magnitude of this much sought after table fish variety. Moreover, both the silver pomfret and black pomfret caught were in their prime size, 21-30 cm. (94 and 85% of the catch respectively).

Elasmobranchs

Elasmobranchs comprising rays, skates and sharks were found to be distributed in the Gulf waters upto 500 m. Rays occur in comparatively shallow waters than that of sharks. The group as such forms about 16% of the catch. The composition of the group is rays - 72%, sharks - 27% and skates 1%.

Carangids

Several species of genera *Caranx, Decapterus, Chorinemus* alongwith *Seriola* sp. constitute the group carangids. Large growing individuals of the genus, *Caranx* are popularly known as 'Vatta' is an esteemed food item. Other allied species included in this group is King fish, *Rachicentrus canadus*. Carangids are distributed in all the areas in the Gulf of Mannar upto 250 m depth.

As in the case of elasmobranchs, carangids also recorded higher catch rate 63.96 kg per hour in January followed by October (18 kg per hour). The areas 8-78 and 9-79 registered better yield 10.35 and 13.32 kg per hour respectively.

Barracuda

There are in all five species, namely *Sphyraena jello, S.obtusatta, S.langsar, S.picuda* and *S.Commersoni* occurring in Indian waters. However, *S.obtusatta* was found to contribute substantially to the demersal catches in Gulf of Mannar. The barracuda catches were poor during October and November cruises. But high rates were recorded from December. Though most of the areas in the Gulf record rather stray catches of barracuda especially in shallow waters, a good fishery for barracuda exists in 100-200 m. depth belt of the area 8-78. It may be stated that the barracuda fishery commenced during December had consistent record of good season till March. Further survey in progress will throw more light on magnitude of the fishery in time and space. During the six months period about 17 tonnes of barracuda, in the process of exploration, was caught with an aggregate catch rate of 72 kg per hour. The catch rate 1350 kg per hour was the highest yield from the area. The catches were dominated by the individuals in two size groups 21-25 cm (36%) and 36-40 cm (23%).

Bulls eye

The 'bulls eye', *Priacanthus* spp. were mainly obtained in the area 8-78. However, they were also reported to be present. though in little quantities, in the areas 8-79 and 9-79. Their distribution in the Gulf could be traced in 100-250 m. depth belt. About 2.5 tonnes of Bulls eye were caught while surveying deeper waters in the region with an average catch rate of 10 kg per hour.

Indian drift fish

In Gulf of Mannar, Indian drift fish, *Psenes indicus* is found to be distributed in 100-200 m. depth zone chiefly in the area 8-78. During the survey cruises, about 3 tonnes of Indian drift fish was obtained with remarkable aggregate catch rate of 16 kg per hour. The other areas producing this variety are 8-79 and 9-79. The highest catch rate recorded in respect of this species is 157 kg per hour. It could be said that the catch rate to the tune of 16 kg per hour and above during all the months excepting December is a sign of noteworthy resource, *P. indicus* varies in size from 11-25 cm and majority of them were in 16-20 cm (58%) and 21-25 cm (32%) size groups.

Deep sea lobster and prawns

The deep sea lobster, *Puerulus sewelli* is caught throughout the depth belt 150-500 m. in Gulf of Mannar in varying quantities. During the period of survey their catch rate was found to fluctuate between 5 and 13 kg per hour. Instances of the catch rate as high as 38 and 51 kg per hour are also noted in the region.

The deep sea prawns, chiefly *Solenocera hextii* was caught along with deep sea lobster. *Aristeus* sp. and *Heterocarpus* sp. also formed part of the catches. For a proper quantitative evaluation it is proposed to use a Shrimp trawl.

Cephalopods.

Sepiella inermis, *Sepia pharaonis* and *S.aculeata* constitute the group cephalopods, squids being rare and far in between. The cuttle fish species were caught in waters upto 200 m depth mainly in the area 8-78. A total of about 2 tonnes of cuttle fish were caught with an aggregate catch rate of just over 5 kg per hour. They were found more commonly with barracuda in 100-200 m depth. Barracuda being principal species supporting the demersal fishery, the cephalopod by-catches could yield as maximum as 140 kg per hour.

Gulf of Mannar offers several demersal fishery resources their variations, in time and space detailed above signify the scope of fishery development of the region. The area 8-78 inhabits, by virtue of its possessing all the depth ranges, almost all types of resources enlisted for the Gulf, the other areas being habitat of a few groups like perches, carangids, silver belly and pomfrets. The Gulf waters as such appears to be rich in demersal fishery resources as indicated by the high catch rate 13 kg per hour.

OBSERVATIONS ON THE DEMERSAL FISHERY RESOURCES ALONG ANDHRA PRADESH COAST

T.V.Ninan, S.P.Basu and P.K.Bhargava

As per the programme 1983-84, the survey vessel *Matsya Shikari* was to carry out systematic demersal trawling between lat. 14°N. and 18°N. upto 500 m depth along the east coast. The vessel surveyed areas from Pudimadaka i.e. lat. 17°30'N. to Pennar river i.e. 14°40'N. in the depth range 45 to 330 m. The areas covered are 17-83, 17-82, 16-83, 16-81, 15-81, 15-80 and 14-80. During nine voyages of an average duration of about 16 days, covering 617 hours of actual fishing, the vessel landed 176 tons of fish. The vessel also carried out about 321 hours of acoustic survey. The average catch per hour obtained during the year from the area was 335 kg.

AREAWISE ABUNDANCE OF FISH

The areawise catch per hour is presented in fig. 1. In terms of catch per hour the area 17-82 registered maximum of 815.98 kg. This is followed by 363.70 kg per hour in 15-81, 297.86 kg per hour in 16-82, 295.43 kg per hour in 15-80, 273.82 kg per hour in 14-80 and 173.76 kg per hour in 17-83.

DEPTHWISE ABUNDANCE OF FISH

The depthwise analysis of effort and catch per hour is presented in fig. 2. The maximum catch per hour of 456.03 kg. was observed in the depth range of 71-90 m. It is interesting to note that the depth range 131-150 m. registered a catch rate of 454.06 kg per hour. Further the depth range of 151-170 m. recorded 392.62 kg per hour. The lowest catch rate of 141.09 kg per hour was observed in the depth 111-130 m.

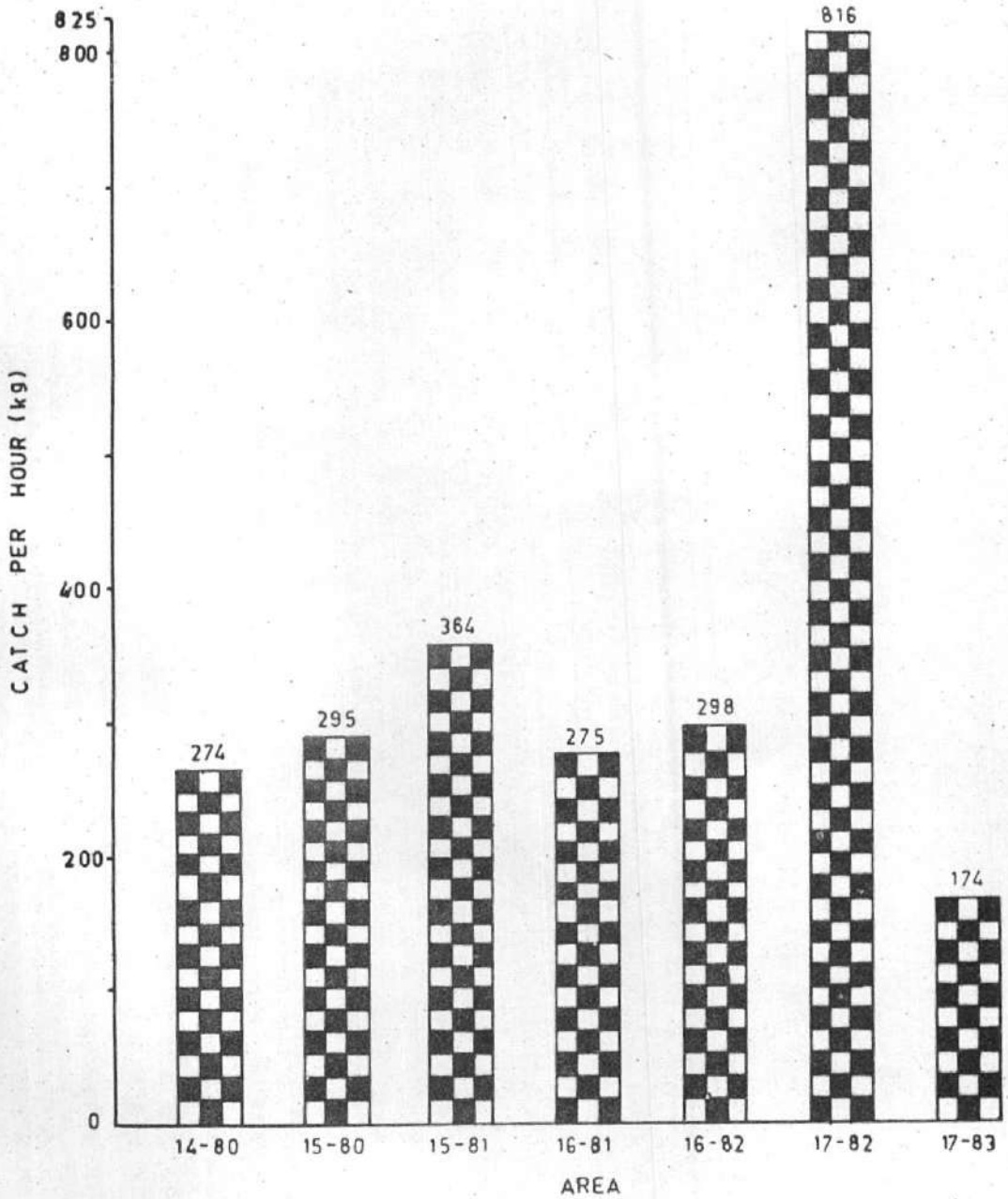


FIG: 1 - AREA WISE CATCH PER HOUR (kg) OBTAINED BY MATSYA SHIKARI ALONG ANDHRA PRADESH COAST

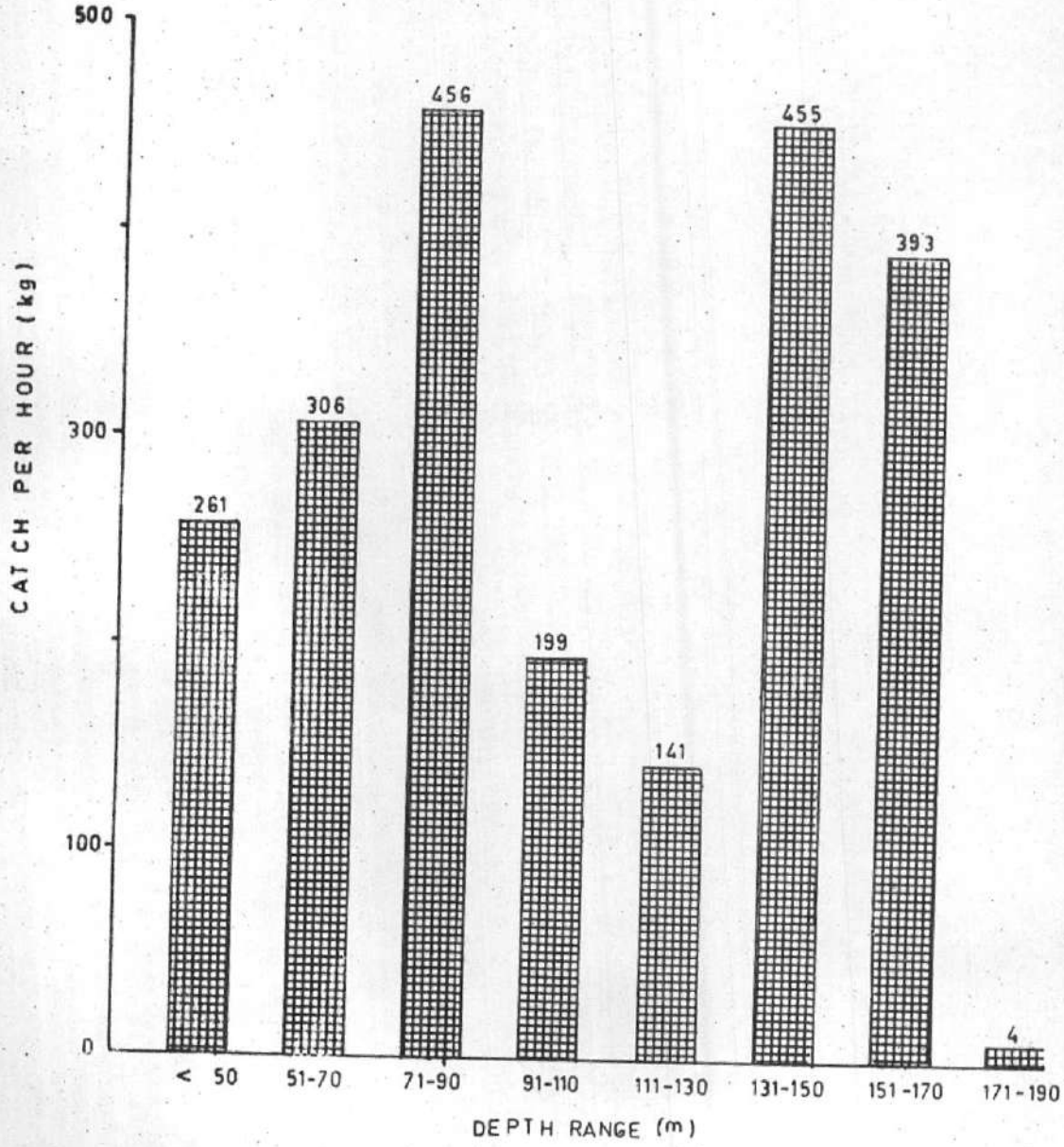


FIG : 2 - DEPTH WISE CATCH PER HOUR (kg) OBTAINED BY MATSYA SHIKARI ALONG ANDHRA PRADESH COAST

SEASONAL VARIATION

The maximum catch of 45.5 tons and catch per hour of 639.00 kg. were obtained in the month of March, 1984 followed by 44.9 tons and 540 kg per hour in the month of February, 1984. The lowest catch per hour of 0.62 kg. was in the month of September, 1983. In the month of March,83 total catch of 17.06 tons and catch per hour of 385.53 kg. was recorded. The month wise fluctuation in the catch rate is given in the fig. 3.

PERCENTAGE COMPOSITION OF SPECIES

The percentage composition of species in the catch is shown in fig. 4. Among the varieties, carangids including horse mackerel comprised 21.4% of the total catch. This is followed by the sardines which is 18.4% of the total catch. Other major varieties in the order of aoundance are big sciaenids (*Pseudosciaena* sp. 8.47%) mackerel 5.35%, elasmobranchs 5.34%, small sciaenids 5.18%, cat fish 4.91%, perches 4.38%, nemipterids 3.74%, *Oplignathus* sp. 3.14%, ribbon fish 2.92%, *Psenes indicus* 1.69%.

CATCH RATES OF SOME OF THE COMMERCIALLY IMPORTANT VARIETIES

1. Pseudosciaena diacanthus ("Ghol")

This species comprised 8.47% of the total catch and 32% of the catch for the month of March,84. A maximum catch rate of 2666 kg. per hour was obtained around depth of 70 m. between lat. 16°N. to 16°22'N. and long. 81°59'E to 82°13'E. Maximum catch of this variety is observed in the area 16-81 and the depth range in which maximum quantity netted was 51-70 m. From the length frequency studies made it is seen that the most common size of the fish was 75-80 cm.

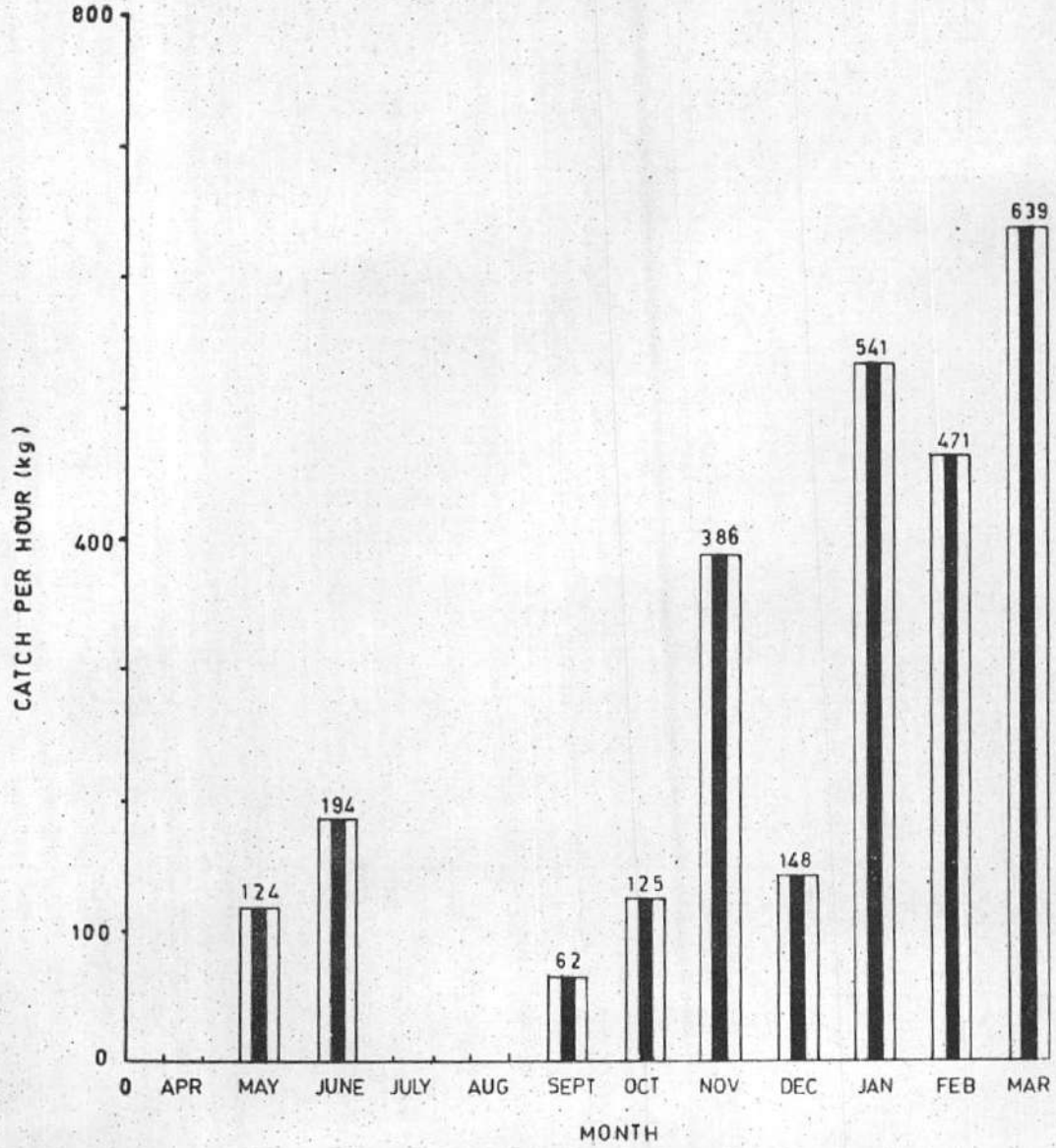
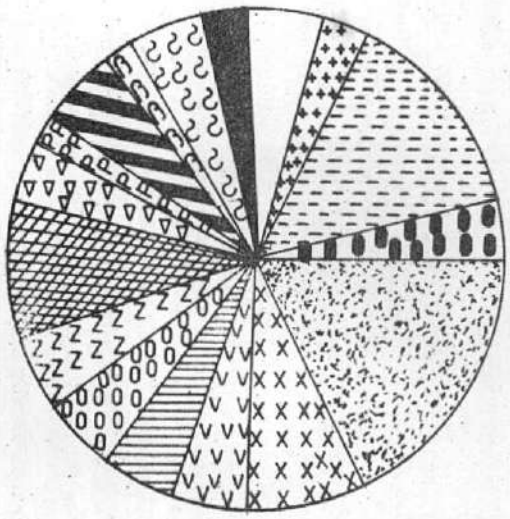


FIG: 3 - MONTH WISE CATCH PER HOUR (Kg) OBTAINED BY MATSYA SHIKARI ALONG ANDHRA PRADESH COAST



SARDINES (18·48 %)
PSEUDOSCIAENA (8·47 %)
SCIAENIDS (5·18 %)
ELASMOBRANCHS (5·34 %)
CAT FISH (4·91)
MACKEREL (5·35%)
OTHER QUALITY FISHES (8·51)
PERCHES (4·38%)
LEOGNATHIDS (1·56%)
NEMIPTERIDS (3·74 %)
PSENES INDICUS (1·69%)
PRIACANTHIDS (4·76%)
RIBBON FISH (2·92%)
CARANGIDS (4·90%)
HORSE MACKEREL (2·39%)
DECAPTERIDS (13·64%)
POMFRET (3·70%)

FIG: 4 – COMPOSITION OF IMPORTANT VARIETIES OF FISH LANDED BY MATSYA SHIKARI ALONG ANDHRA PRADESH COAST

Pomfret

Pomfret occupies 3.70% of the entire catch of *Matsya Shikari* from April,83. A maximum catch rate of 800 kg. per hour was netted during the month of March,84. The best grounds for pomfrets are found between Narasapur and False Devi pt. Areas from where maximum catch obtained are 15-81 (17.19 kg per hour) and 16-81 (29.44 kg per hour). Maximum catch rates for Pomfret are obtained in the depth range 71-90m. (21.47 kg per hour). This is followed by 51-70 m. depth belt (13.61 kg per hour). The most frequent size as per the length frequency study made was 28-31 cm.

Pomadasys spp.

Among the perch group this is the most important variety commonly available in the demersal catch along Andhra Pradesh coast. A maximum catch rate of 234 kg. per hour was obtained in the month of March,84. This variety accounted for 4% of the total catch, 7% of catch in March,84. Maximum catch rate was obtained from the area 16-81 (39.17 kg per hour) and depth range of maximum availability was 51-70 m. (30.48 kg per hour). It is interesting to note that in the depth range of 110-130 m. a catch rate of 17.92 kg. per hour for this variety was recorded. The frequent size as per the length measured was 35 cm.

Sardine

Sardines comprised 18.48% of the total catch for 1983-84. Maximum catches were obtained from the depth range of 80-90 m. between Kakinada and Pentakota. 60% of the catch for February,84 account for *Sardinella* sp. A maximum catch per hour of 1433 kg. for this variety was recorded in the month of February,84 from Kakinada at a depth range of 80-90 m. The areas of abundance for the variety are 17-82 (40 kg per hour) and 17-83 (108.72 kg per hour). The preferred depth range for this variety was around 50 m. (462 kg per hour) followed by 71-90 m. (123 kg per hour). and 91-100 m. (101 kg per hour). The common size as per the length frequency study was 19 cm.

Mackerel and Carangids

Mackerel contributed 5.35% of total catch and carangids including horse mackerel, *Decapterus* spp. 16% of the total catch. Mackerel were obtained in maximum quantity from the area 17-82 where a catch rate of 44.59 kg per hour was noted. The maximum catches were recorded from the depth 51-70 m. (28 kg per hour). This is followed by 26 kg per hour in the depth range 91-110 m. The common size in the catch was 21 cm. Among the carangids *Decapterus* spp. was caught at the maximum rates from Kakinada-Pentakota, where a maximum catch rate of 2000 kg. per hour was netted. The areas of abundance are 17-82 followed by 16-82 in the depth range 71-90 m. It is available upto 150 m. depth in appreciable quantity. The common size in the catch was 19 cm.

Nemipterus spp.

It accounted for 3.74% of the entire catch. Maximum catch rate of 3200 kg. was obtained from depth range 131-150 m. The area of abundance was 15-80.

Priacanthus spp.

Priacanthus spp. accounted for 4.76% of the entire catch. The maximum catch of 6145 kg. of this variety (21%) was netted during January 1984 from the area 16-82. The maximum catch per hour obtained was 1425 kg. from depth of 150 m. From the areas 17-82 and 15-80 an average catch rate of 24.84 kg per hour were noticed. Maximum catch rate was obtained from 151-170 m. depth range (358.79 kg per hour). This is followed by 66.81 kg per hour from 131-150 m. The common size in the catches was 16 cm.

Psenes indicus

Psenes indicus comprised 1.69% of the total catch. The maximum catch rate of 400 kg per hour was obtained from the area 16-82 in the month of March,84. *Psenes indicus* accounted for 4.28% of the total catch of March,84 in the area 16-82. A catch rate of 9.4 kg per hour was recorded from 16-82 whereas

from 15-81 8.36 kg per hour was obtained. The maximum catch rate of 49.58 kg per hour was obtained from depth 90-100 m. From beyond 130 m. this variety was not recorded. This variety has a good market and largely consumed by the local population. The common size in the catch as recorded by length frequency study was 16 cms.

Deep Sea prawn

Deep sea prawn forms small percent from depth beyond 150 m. Two important species recorded are *Aristeus* sp. which was obtained from the area 16-81 at a depth of about 150 m. and *Solenocera hextii* obtained from area 16-81 and 15-81. *Aristeus* sp. obtained was having a maximum length of 19 cm. *Solenocera hextii* is particularly found in the depth beyond 140 m. in the area 16-81. The maximum size measured length was 10 cm.

A NOTE ON THE DEEP SEA DEMERSAL RESOURCES OFF KARNATAKA-NORTH KERALA COAST.

K.P.Philip, B.Premchand, G.K.Avhad and P.J.Joseph

INTRODUCTION

The Fishery Survey of India has been surveying the inshore waters of Karnataka - Kerala Coast with the 17.5 m. indigenously constructed vessels from its Mangalore Base. So far the areas upto 70 m. depth have been adequately surveyed by these vessels. With the acquisition of large survey vessels by the Project, two 36.5 m (O.A.L) combination trawlers were earmarked to the Mangalore Base for the survey of deep sea resources. One vessel viz., *Matsya Shakti* commenced operation from April 1983 while the second viz., *Matsya Vishwa* from October 1983. Both these vessels are provided with all modern fishing and navigational equipment. The vessels conducted mainly demersal trawl survey. Survey of pelagic/columnar resources were also attempted at using midwater trawl.

AREA AND EFFORT

The area between lat. 10^{o}N to 15^{o}N and long. 72^{o}E to 76^{o}E between 50-500 m. depth was taken up for systematic and intensive survey. This area is divided into 5 geographical divisions at the interval of one degree lat. and 3 bathymetrical zones viz., 50-100 m., 100-200 m. and 200-500 m. As envisaged, in almost all the cruises the vessels covered the five geographical divisions and three depth zones with more or less even sampling effort. 27 m. fish trawls and 47 m. shrimp trawls were used for the survey. Generally fish trawls were operated in 50-200 m. depth zone and shrimp trawls in deeper waters beyond

200 m. The area-wise and depth-wise distribution of fishing effort is furnished below:

Area	Depth (m)	Fishing effort (hour)
10°-11°	50-100	95.25
	100-200	16.83
	200-500	6.50
11°-12°	50-100	202.33
	100-200	176.33
	200-500	177.50
12°-13°	50-100	254.42
	100-200	162.25
	200-500	135.25
13°-14°	50-100	308.92
	100-200	94.00
	200-500	43.17
14°-15°	50-100	193.83
	100-200	246.50
	200-500	98.17
15°-16°	50-100	16.50
	100-200	2.00
	200-500	4.00
16°-17°	50-100	17.17
	100-200	3.00
	200-500	3.25

CATCH COMPOSITION

During the period under observation 314 tonnes of fish including crustaceans were recorded by both the vessels. *Nemipterus* spp., cat fish, lizard fish and carangids were the important varieties from areas within 200 m. depth while *Centrolophus niger*, *Priacanthus* spp., *Psenes indicus*, deep sea prawns and

deep sea lobster formed the bulk of the catch from areas beyond 200 m. The catch and percentage of important varieties in the total catch are given below:

Varieties	Catch recorded (kg)	Percentage
Nemipterids	53594	17.08
Cat fish	37939	12.09
Lizard fish	19710	6.28
Decapterus sp.	10216	3.26
Caranx spp.	13160	4.20
Perches	5038	1.61
Squids and cuttle fish	5125	1.63
Shark	5679	1.81
Priacanthus spp.	35320	11.26
Centrolophus niger	50636	16.14
Psenes indicus	19354	6.17
Deep sea prawn	7057	2.39
Deep sea lobster	3330	1.06
Deep sea shark	6063	1.93

DISTRIBUTION AND ABUNDANCE BY AREA

Out of the five geographical divisions surveyed during the period, the highest overall catch rate was recorded from the area between lat. 11°N and 12°N (198.61 kg per hour). It is noticed that comparatively areas south of Mangalore yielded better catch rates than areas north of Mangalore, the overall catch rates being less than 100 kg per hour. The areas of abundance of some important varieties

and their highest catch rate are listed below:

	Area	Highest catch rate (kg.per hour)
Nemipterus sp.	11^{o}-12^{o}	31.53
Lizard fish	10^{o}-11^{o}	14.46
Cat fish	12^{o}-13^{o}	29.98
Carangids	13^{o}-14^{o}	16.73
Perch	14^{o}-15^{o}	4.29
Shark	12^{o}-13^{o}	2.60
Squids and cuttle fish	14^{o}-15^{o}	3.68
Priacanthus sp.	10^{o}-11^{o}	72.38
Centrolophus niger	11^{o}-12^{o}	52.79
Pseres indicus	11^{o}-12^{o}	29.99
Deep sea prawn	11^{o}-12^{o}	7.06
Deep sea lobster	12^{o}-13^{o}	3.26
Other deep sea fish	11^{o}-12^{o}	8.65

It may be seen that lizard fish, *Nemipterus* sp. shark and cat fish recorded relatively high catch rates from southern region, whereas carangids, perches, squids and cuttle fish dominated in the northern region. The deep sea prawns, deep sea lobster and deep sea fish like "black ruff" (*Centrolophus niger*), deep sea sharks, "rat tail" (*Bathygadus* sp) etc. were abundant in areas between lat. 11^{o}N to 13^{o}N. The deep sea prawns caught from deeper waters between the lat. 13^{o}N to 15^{o}N were of smaller varieties with low catch rate (0.39 kg per hour). Two commercially important species of deep sea prawns viz. *Heterocarpus* sp. and *Aristeus* sp. were caught in appreciable quantities from the deeper waters. All other species of prawns were very small in size. The deep sea lobster was represented by one species viz., *Puerulus sewelli*. Among the deep sea fishes *Priacanthus* sp. ("Bulls eye") *Centrolophus* sp. ("Black ruff") *Chlorophthalmus* sp. ("Green eye") and sharks were predominant in the catches.

DISTRIBUTION BY DEPTH

A gradual increase in catch rates with increase of depth is observed during the survey. The overall catch rates recorded from the three bathymetric zones 50-100 m, 100-200 m and 200-500 m were 107.29 kg per hour, 126.69 kg per hour and 230.88 kg per hour respectively.

Cat fish (29.82 kg per hour) carangids (17.85 kg per hour) and sharks (3.98 kg per hour) were abundant in 50-100 m depth range whereas nemipterids (53.37 kg per hour) lizard fish (19.28 kg per hour) squids and cuttle fish (3.91 kg per hour) and perches (2.79 kg per hour) recorded high catch rates from 100-200 m depth range. *Priacanthus* sp. which occured in all the three bathymetric zones was abundant in 100-200 m. depth range.

Among the deep sea varieties, *Centrolophus niger* occured beyond 250 m depth with high catch rate between 350-500 m depth range. Deep seaprawns were abundant in 200-500 m depth belt. They were seen in negligible quantities in 100-200 m depth zone also. It is observed that *Aristeus* sp. were predominant in deeper waters beyond 350 m whereas *Heterocarpus* sp. dominated in 250-350 m depth range. The deep sea lobster was mainly restricted to 300-400 m. depth. This zone also yielded good catches of deep sea shark and other deep sea fishes like "Rat tail" (*Bathygadus* sp.), "Green eye" (*Chlorophthalmus agassizi*) etc.

VARIATION BY MONTH

The highest overall catch rates were obtained during the months of April (289.02 kg per hour) and May (241.89 kg per per hour). The lowest catch rates were recorded during the period July - August and December.

Nemipterus sp. lizard fish, shark, perches and cat fishes were abundant during February - May. In the case of cuttle fish and squids highest catch rate was recorded during September.

Among the deep sea varieties *Priacanthus* sp. was abundant during April to June and *Centrolophus niger* during January and February. Deep sea lobster also recorded high catch rates during February whereas deep sea prawns were predominant during the months September and February.

SIZE DISTRIBUTION

Length and weight of several species of fishes, cuttle fish, deep sea prawns and deep sea lobster were studied. The length range of the selected species reported during the year and their dominant size group are furnished below:

Species	Length range (cm)	Dominant size (Cm)
Nemipterus japonicus	11-29	14-26
Saurida sp.	14-35	23-31
Decapterus sp.	12-25	14-22
Priacanthus sp.	8-29	13-21
Centrolophus niger	7-18	12-14
Sepia sp.	8-20	9-20
Aristeus sp.	8-14	11-14
Heterocarpus sp.	12-18	18

OBSERVATIONS ON THE MEAT CHARACTERISTICS AND CONSUMER ACCEPTABILITY OF SOME OF THE DEEP SEA FISHES.

The College of Fisheries, Mangalore has conducted preliminary studies on the meat characteristics and consumer acceptability of three species viz., *Priacanthus* sp., *Centrolophus niger* and *Chlorophthalmus agassizi* caught by the vessels at the request of Fishery Survey of India. According to their studies all the three species are as nutritive and tasty as any other common table fish and acceptable with regard to culinary and eating qualities.

The proximate composition showed that all the three species are rich in proteins *Priacanthus* sp. - 17.54%, *Centrolophus niger* - 14.90% and *Chlorophthalmus agassizi* - 14.40% and fat contents are 5.08%, 5.80% and 3.80% respectively. It is worthy to note that they are as nutritive as the common market fishes like cat fish (Protein 16.20% and fat 3.50%) and oil sardine (Protein 18.10% and fat 14.34%). At present there is no demand for these varieties in the local market. This is mainly due to the unfamiliarity with these varieties. This was the case with several species like *Nemipterus* sp. etc. during the sixties which now fetches Rs. 2000 to Rs. 4000 per ton depending on the season and landing centre.

SOME OBSERVATIONS ON THE TUNA RESOURCES OF INDIAN OCEAN

K.K.Varghese, M.E.John and V.Shivaji

INTRODUCTION

Survey of the Oceanic larger pelagic by tuna long lining deploying the vessel *Matsya Sugundhi* attached to Cochin Base gained momentum during 1983-84 with expansion of the areas of investigation to deep and distant oceanic waters within and beyond the Indian Exclusive Economic Zone. Uninterrupted survey was done during all 12 months of the fiscal year commencing from April 1983 with wide distribution of sampling in the Arabian Sea, Bay of Bengal as well North West Indian Ocean. Effort during the first two quarters of the year was concentrated in South West coast between Lat. $7^{o}$and 12^{o}N. The third quarter was devoted for sampling the resources in the contiguous high seas extending upto equator on the western side of Maldive Islands. The October cruise in which areas as far as 750 n. miles from the Indian peninsula was sampled was probably the first of its kind in the history of Indian fishing industry. During the last quarter of the year the investigations were extended to the east coast upto Lat. 18^{o}N.

EFFORT AND OUTPUT

The survey was carried out with Japanese built tuna long liner and gear and the intensity of sampling as represented by the number of hooks immersed in each area of operation is depicted in fig. 1. Of the total of over 83,000 hooks operated 47,000 was in South West coast, 20,000 in equatorial waters (between 0^{o} and 6^{o}N) and 16,000 in east coast.

The catch recorded during the survey was 1900 fishes (70 tons) and the aggregate hooking rate worked out to 2.27%. The details of hooking rate recorded for every 1^{o}square is furnished in fig. 2. In terms of total abundance of resources the continental waters were found to be richer than the

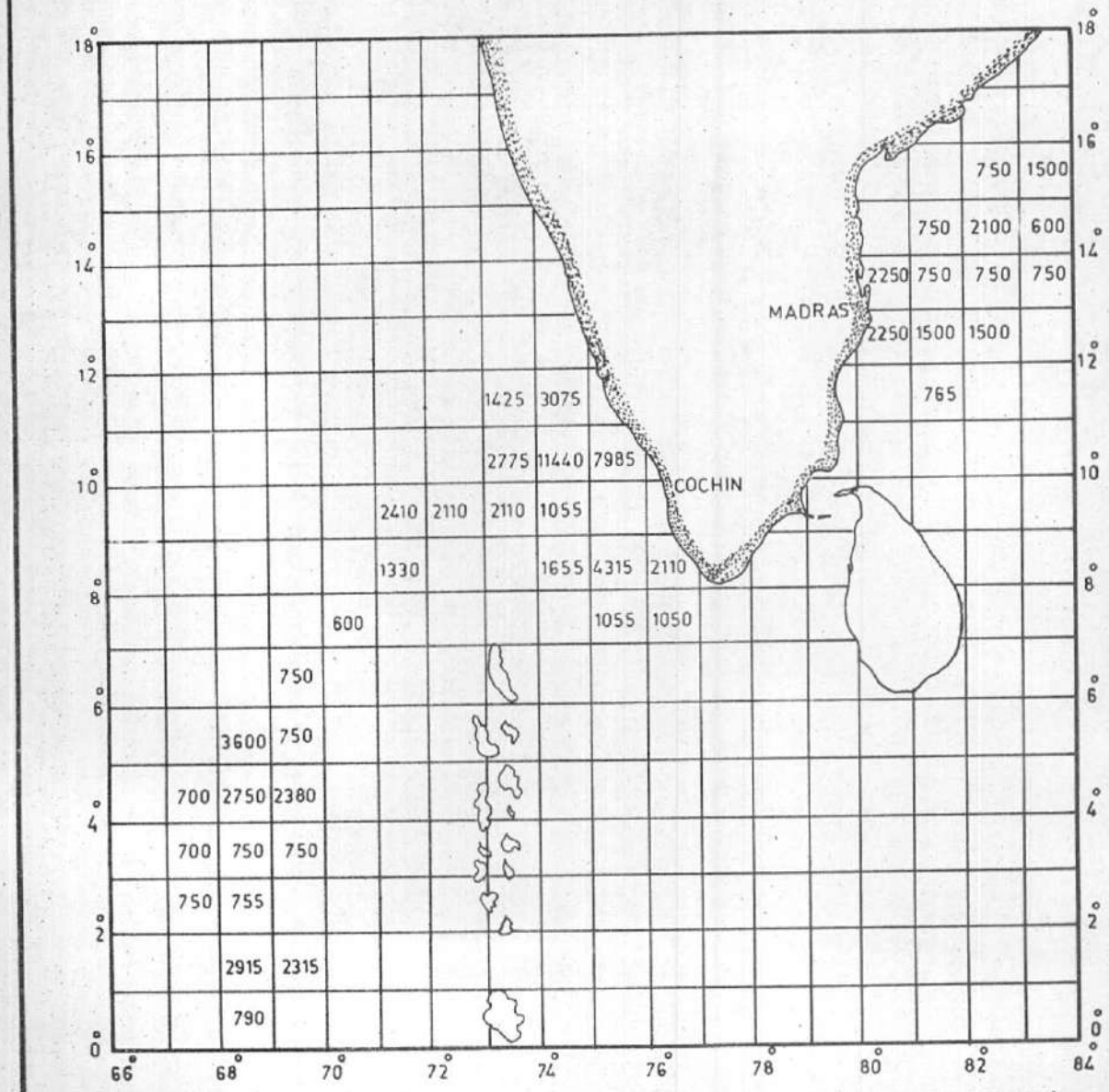


FIG:1-DISTRIBUTION AND INTENSITY OF SAMPLING (NO:OF HOOKS) OF TUNA LONG LINE SURVEY BY MATSYA SUGUNDHI, 1983-84

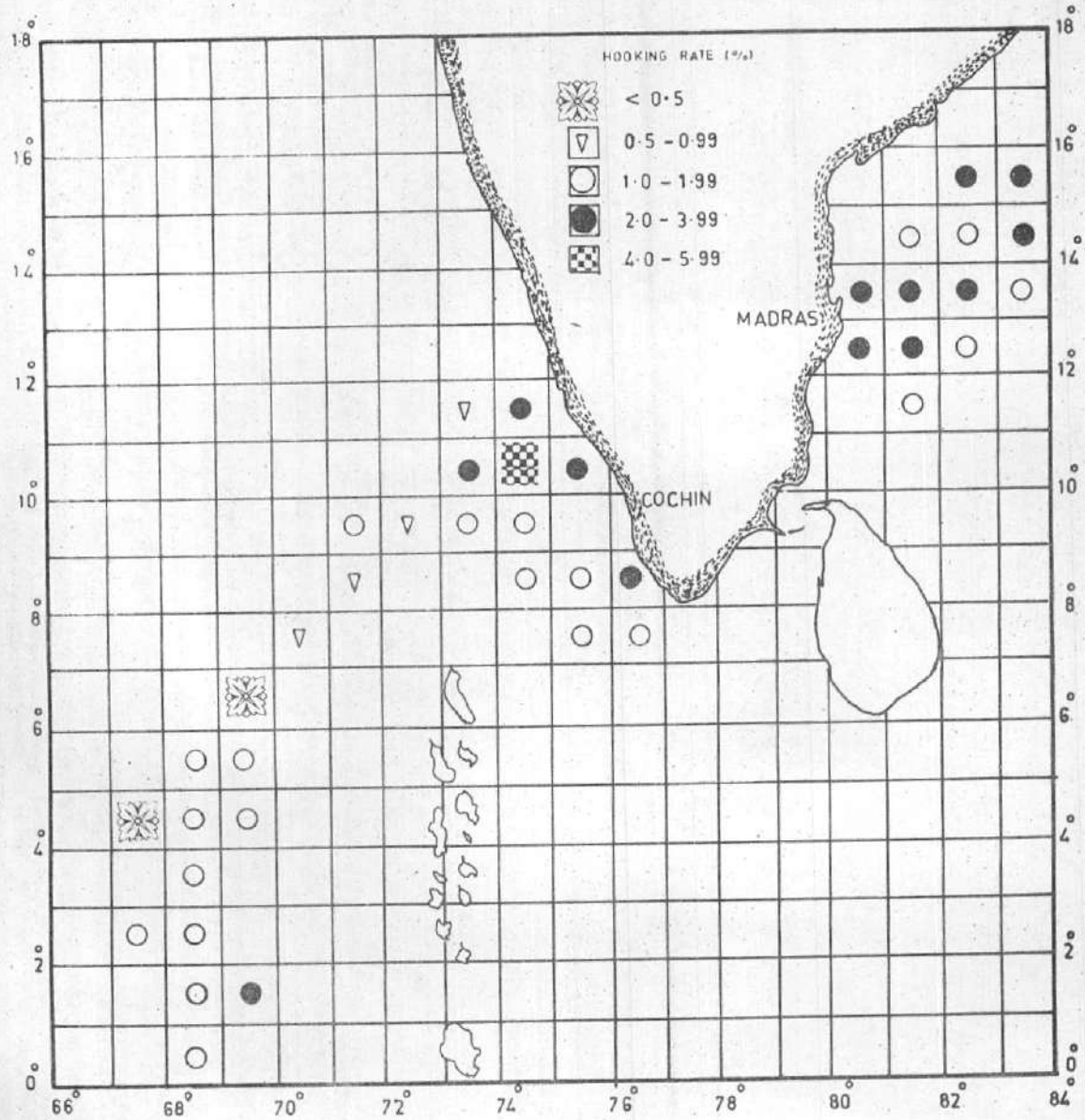


FIG. 2 - AREA WISE HOOKING RATE (%) OBTAINED BY MATSYA SUGUNDHI BY TUNA LONG LINING, 1983-84

equatorial sea. West coast yielded hooking rate of 2.6% and east coast 2.2% whereas equatorial seas gave an average harvest of 1.54%. The area 10-74 situated north west of Cochin recorded the maximum hooking rate of 5% during the survey. It is noteworthy that the same area yielded highest aggregate catch during the survey in 1963-67 also (Joseph 1972). However the aggregate hooking rate cannot be considered as a true index of the species that could viably be exploited.

CATCH COMPOSITION

The catch consisted of three species of tuna viz., Big eye tuna (*Thunnus obesus*), Yellow fin tuna (*Thunnus albacares*) and Skipjack tuna (*Katsuwonus pelamis*) forming 25% of the total catch. Yellow fin tuna was the dominant species contributing 407 numbers and big eye tuna 32 numbers. Among bill fishes which made up 9.4% of catch, striped marlin (*Tetrapturus audax*) and Indian sail fish (*Istiophorus platypterus*) were the more frequent ones. Blue marlin (*Makaira nigricans*) and Broadbil sword fish (*Xiphias gladius*) were caught in small numbers. Pelagic sharks that represented 64.2% of catch included different species viz., Black tip shark (*Carcharinus melanopterus*), white tip shark (*C. longimanus*), Hammar head shark (*Sphyrna Zygaena*), Blue shark (*Prionace glauca*), Thresher shark (*Alopias vulpinus*) Silky shark (*Carcharinus brachyurus*) and Tiger shark (*Galeocerdo* sp.) in their order of abundance. Other varieties hooked were dolfin fish (*Coryphynae hippurus*), barracuda (*Sphyraena barracuda*), seer fish (*Scomberomorus* sp.), Caranx, sunfish (*Mola mola*) etc.

The composition of catch varied widely in the different areas operated which has been pooled into squares of 3^{o}Lat. x 3^{o}long and projected in fig. 3. For a further appreciation of the resource composition, catch from the three regions viz., west coast, east coast and equatorial seas (0^{o} to 6^{o}N) are

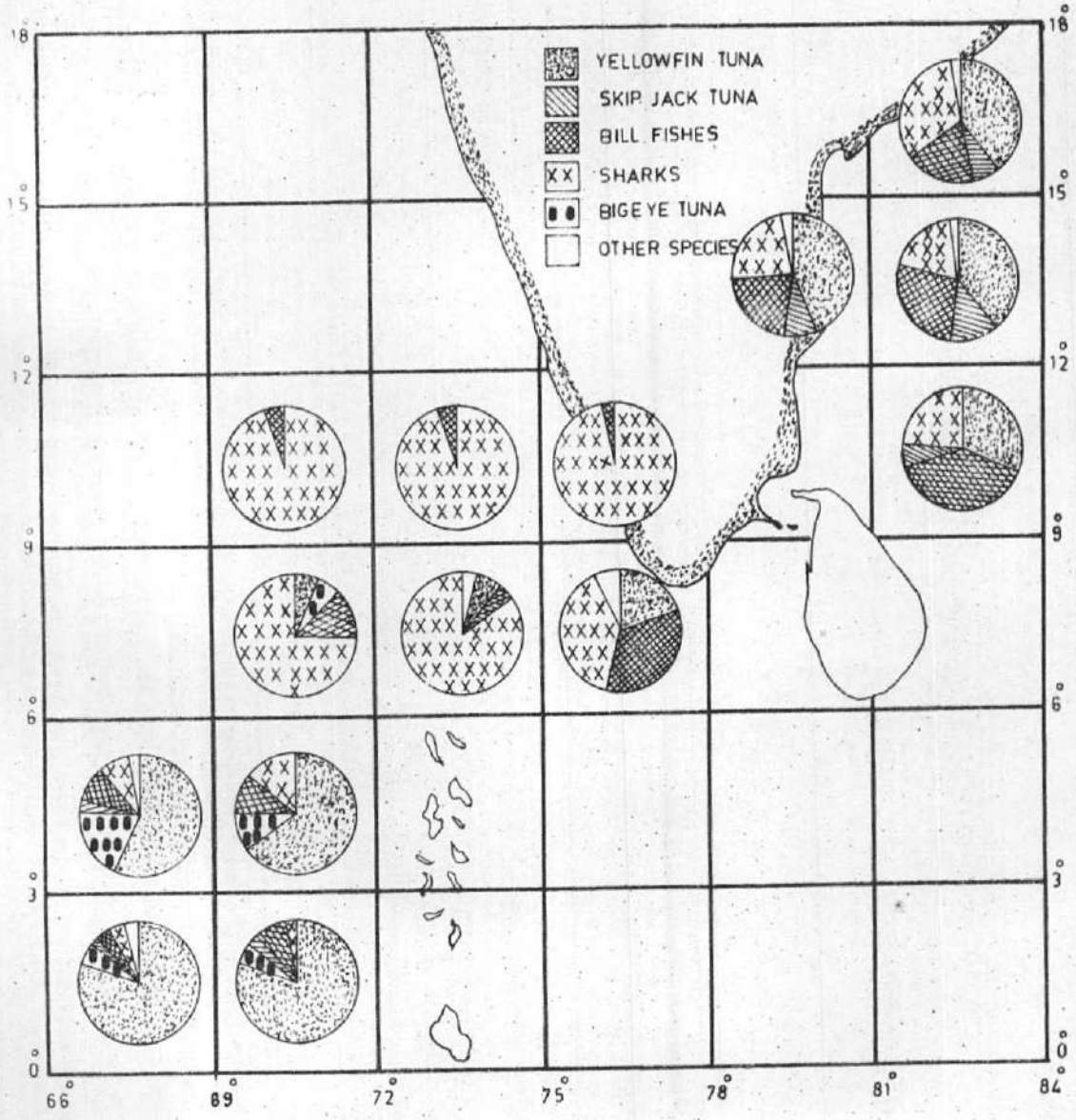


FIG. 3 - COMPOSITION OF TUNA LONG LINE CATCHES FROM DIFFERENT REGIONS BY MATSYA SUGUNDHI, 1983-84

separated and the percentage composition from each of the area has been worked out and furnished in Table I.

Sl. No.	Name of species	Aggregate	Percentage of catch		
			West coast	East coast	Equatorial seas
1.	Big eye tuna	1.69	-	-	10.42
2.	Yellow fin tuna	21.50	2.03	43.82	73.62
3.	Skipjack tuna	2.01	-	8.99	1.95
4.	Marlin	4.38	2.52	11.52	3.58
5.	Sail fish	4.23	3.09	9.27	2.93
6.	Sword fish	0.79	0.08	3.37	0.65
7.	Pelagic sharks	64.24	91.30	21.34	5.54
8.	Other varieties	1.16	0.98	1.69	1.31

Table I. Aggregate and regionwise catch composition

Tunas were harvested in higher percentage (85%) from equatorial sea followed by east coast (53%). Tuna from west coast was negligibly low at 0.03%. The big eye species, most esteemed among tunas was obtained only from the equatorial sea. Bill fishes were found to be more abundant in east coast contributing 24% of the catch. Pelagic sharks formed the major component (91.3%) in west coast and recorded the minimum share (5.5%) in equatorial seas.

HOOKING RATE

Considering the species-wise hooking rate as the true relative abundance index of the resources, it has been worked out for each 1^{o} square and a series of charts are presented in fig.4. Big eye tuna recorded the maximum yield rate of 0.36% from the area 5-68 followed by 0.29% and 0.22% in the adjacent squares of 3-67 and 4-68. In case of yellow fin tuna the hooking rate of 2.5% obtained from the squares 1-69 was the most encouraging

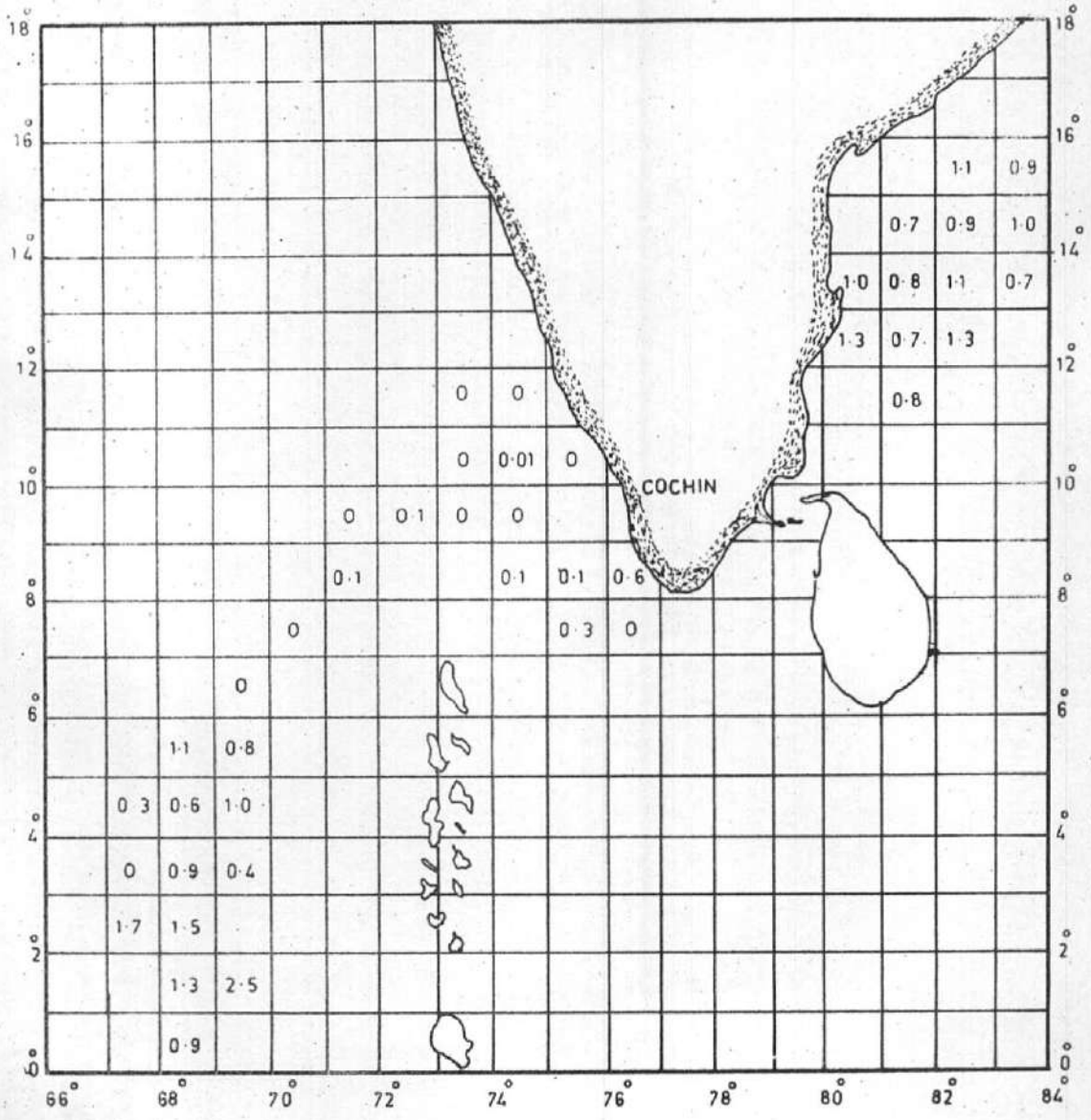


FIG: 4(a) AREA WISE HOOKING RATE (%) OF BIGEYE TUNA OBTAINED BY MATSYA SUGUNDHI BY TUNA LONG LINING, 1983-84

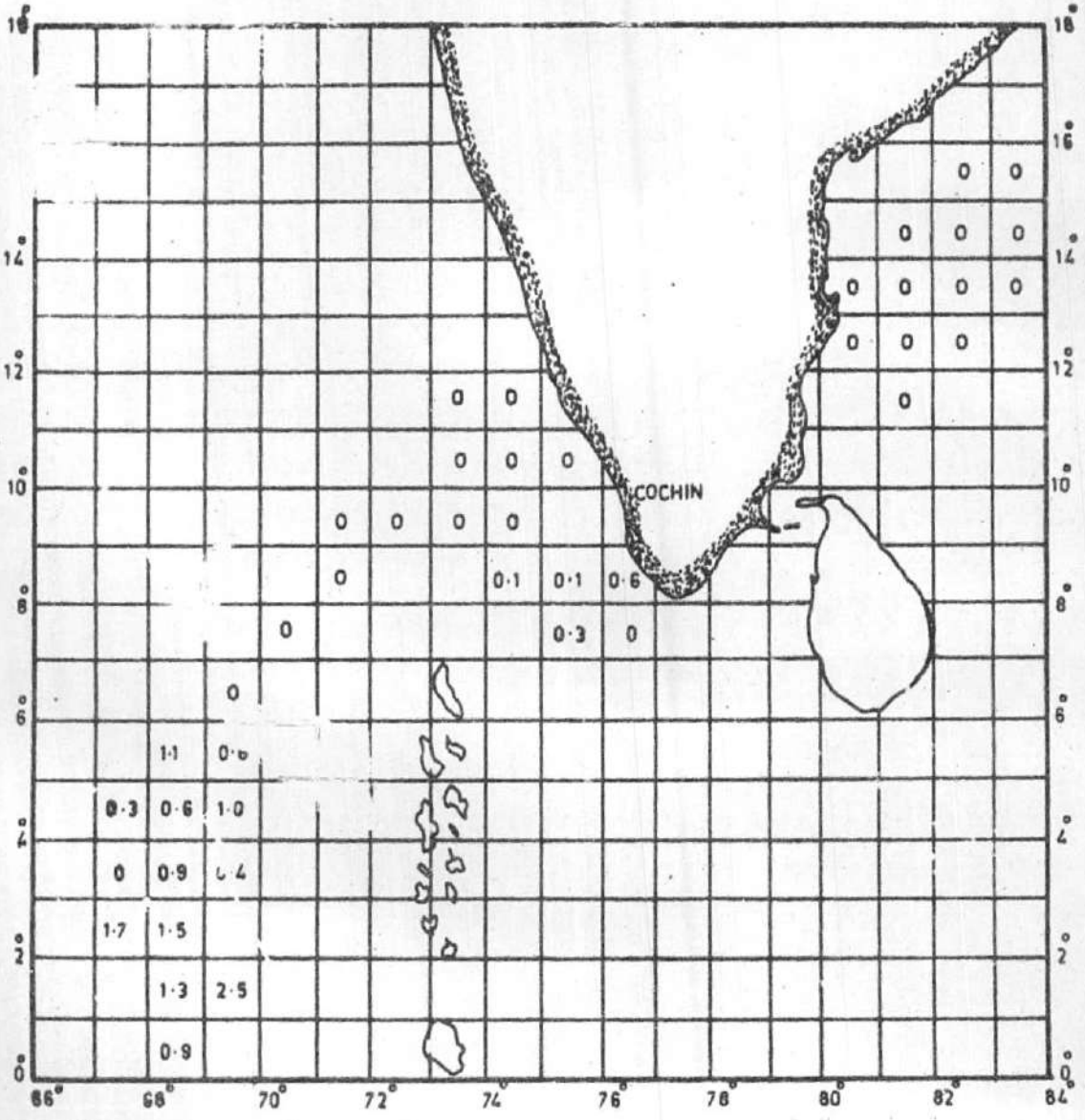


FIG : 4(b)-AREA WISE HOOKING RATE (%) OF YELLOW FIN TUNA OBTAINED BY MATSYA SUGUNDHI BY TUNA LONG - LINING , 1983-84

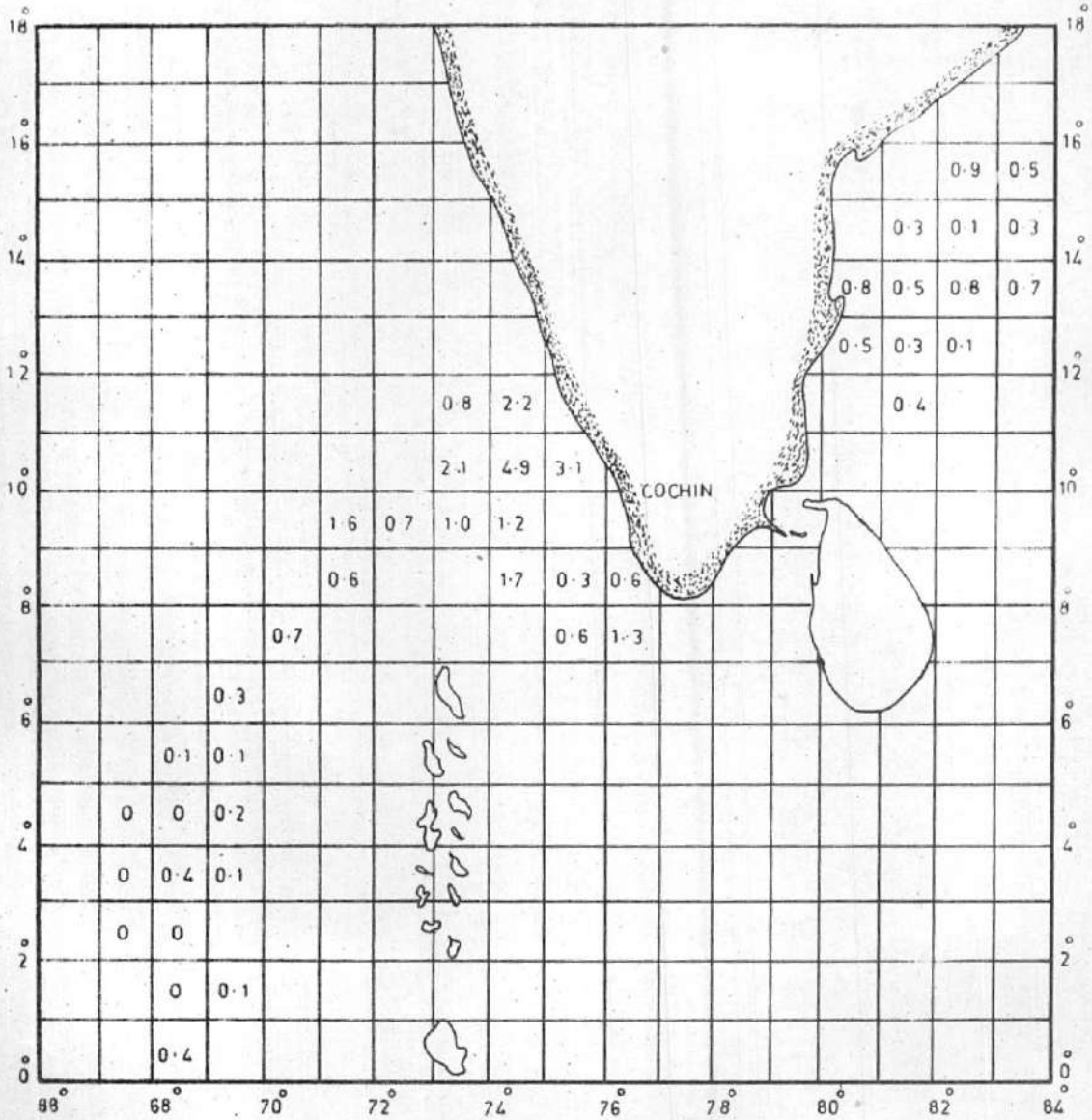


FIG 4(c)-AREA WISE HOOKING RATE (%) OF SHARKS OBTAINED BY MATSYA SUGUNDHI BY TUNA LONG LINING, 1983-84

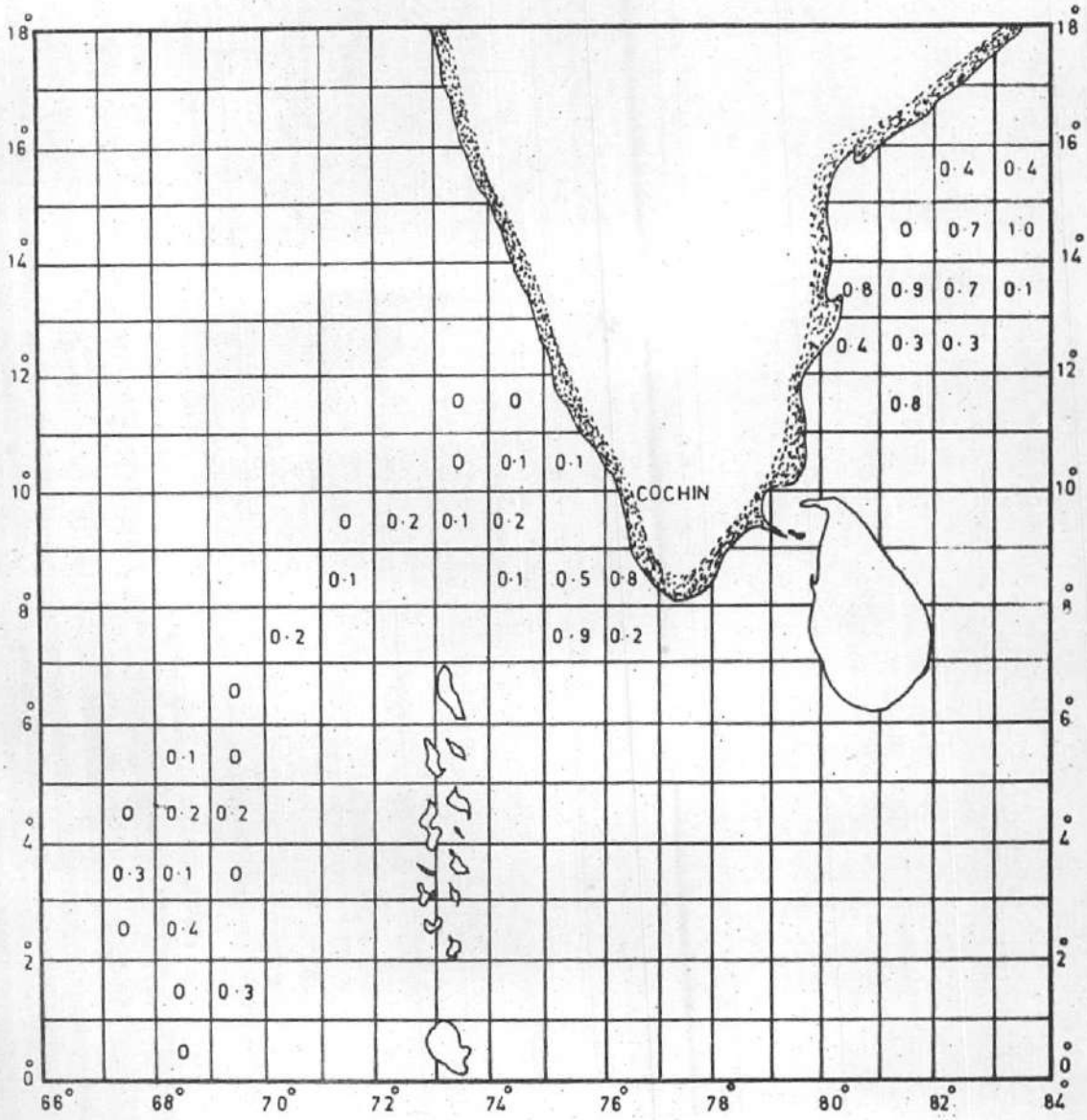


FIG : 4 (d) - AREA WISE HOOKING RATE (%) OF BILL FISHES OBTAINED BY MATSYA SUGUNDHI BY TUNA LONG LINING, 1983-84

followed by 1.73% and 1.46% in the neighbouring areas 2-67 and 2-68.

To make the observation from comprehensive data has been grouped regionwise and the hooking rate pertaining to each region in respect of each species is given in Table 2.

Name of species	Hooking rate (%)		
	West coast	East coast	Equatorial sea
Big eye tuna	-	-	0.16
Yellow fin tuna	0.05	0.96	1.14
Skipjack tuna	-	0.20	0.03
Marlin	0.07	0.25	0.06
Sail fish	0.08	0.20	0.05
Sword fish	-	0.07	0.01
Pelagic sharks	2.38	0.47	0.09
Other species	0.03	0.04	0.02

Table 2. Hooking rate recorded for different species-regionwise

Though equatorial waters gave better harvest rates for yellow fin and big eye tunas, the bill fishes and Skipjack tuna was obtained at higher rates from East coast. The hooking rate of species other than pelagic sharks was insignificantly low in West coast.

CONCLUSION

The general picture that emerges from the survey is that the equatorial waters support comparatively high quality resources with a combined hooking rate of 1.30% with respect to three most valuable species viz., big eye tuna, yellow fin tuna and striped marlin. The availability of the above species is very much comparable (1.2% hooking) in Bay of Bengal within the Indian Exclusive Economic Zone.