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SOME OBSERATIONS ON POTENTIAL FISHERY RESOURCES FROM THE INDIAN EXCLUSIVE ECONOMIC ZONE(EEZ)*

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India with a coastline of 6100 km, continental shelf of 0.451 million sq.km. and EEZ of 2.02 million sq.km. has a rich marine fishery potential (Fig. 1). Several authors have attempted to estimate the potential of the fish resources of the Indian waters. Jones and Banerjee (1973) estimated the potential yield (PY) at about 2.3 million tonnes, while the National Commission on Agriculture (Anon, 1976) placed the harvestable fish resources from Indian waters at 3.15 million tonnes. George et al (1977) have estimated the annual potential yield from the Indian EEZ to be 4.47 million tonnes. Silas (1977) has placed the PY at 4 million tonnes while Joseph (1980) estimated the potential yield of demersal fish from within 70 m depth at 1.7 million tonnes. Although some of these authors have indicated the species composition of the PY estimates, hardly any estimate is available indicating the type of species available and their relative abundance in different fishing grounds in relation to region, depth, distance etc.

If catch composition in relation to specific fishing grounds are not known the economic viability of fishing operation cannot be worked out. This difficulty to a great extent has been reduced in recent times as a result of the exploratory surveys carried out by the larger fishing vessels of the Fishery Survey of India (FSI) from different parts of the coast. These surveys have resulted in a better understanding of the distribution and relative abundance of a large number of species of demersal fish which were hitherto not clearly known. The main objective of this paper is to present a brief account of the potential fishery resources as evidenced by the last half a decade of survey by FSI employing sophisticated large fishing vessels.

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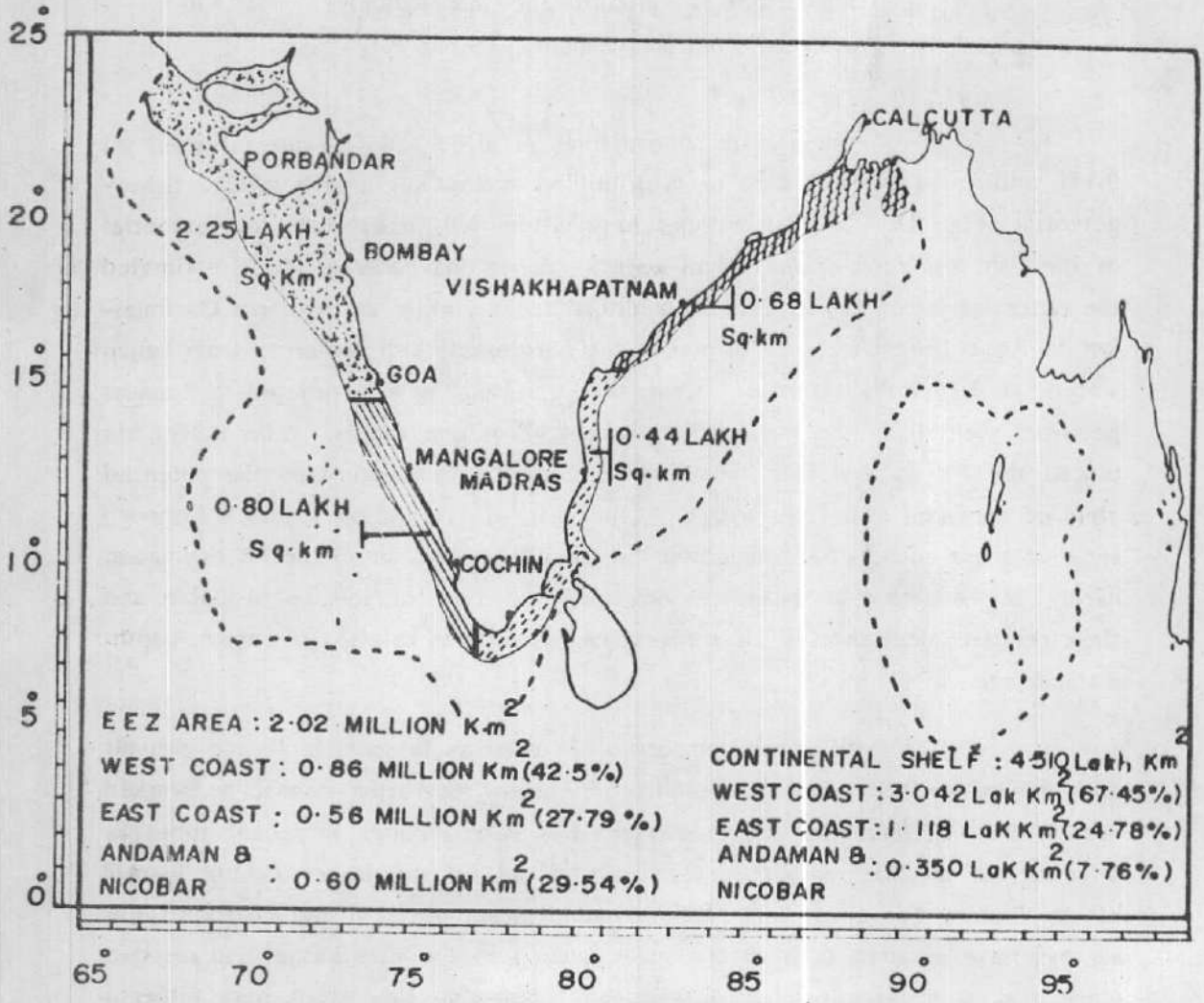

Fig: 1 -- INDIAN CONTINENTAL SHELF AND EXCLUSIVE ECONOMIC ZONE (EEZ)

Vessels and their deployment

The details of the vessels, the type of fishing they carried out and the place of their operation are given below.

Base	Name of the vessel	Type of fishing	G.R.T.
Porbandar & Cochin	Matsya Nireek-shani	Demersal trawling	329.36
Porbandar & Cochin	Matsya Varshini	Purse seining	268.88
Cochin	Matsya Sugundhi	Tuna long lining	248.45
Mangalore	Matsya Shakti	Demersal trawling	327.18
	Matsya Vishwa	Demersal trawling	327.18
Madras	Matsya Jeevan	Demersal trawling	327.18
	Matsya Harini	Tuna long lining	257.95
Visakha-patnam	Matsya Shikari	Demersal trawling	352.47
	Matsya Darshini	Demersal trawling	268.88

Observations on Potential Fishery Resources

Potential fishery resources can perhaps be considered under three categories viz. (i) exploited resources promising further potential for exploitation, (ii) unexploited demersal fish resources in the outer continental shelf and on the continental slope and (iii) oceanic resources consisting mainly of tuna, tuna-like fishes and sharks.

1. Exploited resources promising further potential for exploitation.

Exploratory surveys carried out by FSI employing large survey vessels since 1981 have indicated the occurrence of some of the presently exploited species in depths upto 200 m and beyond. Because of the exclusively prawn oriented development of marine fishing industry it is also likely that several pockets which do not have adequate abundance of prawns have remained unexploited in the relatively shallow water areas within 70 m depth. Besides, some areas such as Wadge Bank and certain areas along Gujarat coast remain unexploited due to a variety of reasons including inaccessibility by small trawlers.

Since the operational range of large majority of mechanised vessels and tradjtional crafts now in operation are limited to about 50-60 m depth, the shallow water resources which have extended distribution beyond this limit also remain unexploited. Some of the species/groups which appear to offer very good scope for increased production either from the presently exploited coastal belt or outside of it or from both, are discussed below.

1.1 Thread fin breams

The present landing of nemipterids is about 30,000 tonnes. Although it contributed substantially to the trawl catches from certain areas, even now it is grouped along with other minor species as "miscellaneous variety" in our statistics on marine fish landings. The fishery appears to be supported mainly by two species, Nemipterus japonicus and N. mesoprion. Silas (1969) has reported that nemipterids predominated in the trawl catches from 75-100m depth during exploratory survey along the south-west coast of India. Joseph (1985) on the basis of exploratory survey has estimated a potential yield of 13,000 tonnes of nemipterids. The general lack of awareness about the magnitude of this fishery is evident from the fact that it does not figure as a potential resource in any of the fishery resources studies published till recently.

The catch per hour of trawling obtained from different areas along west and east coasts alongwith their percentage contribution is given in Table-1:

Region	West coast				East coast		
	8°-11° N	11°-15°N	15°-18°N	Wadge Bank	Gulf of Mannar	10°-15°N	15°-20°N
Catch/hour (kg)	42.0	23.0	29.0	30.0	3.0	5.0	7.0
Percentage	38.7	21.9	22.3	23.8	2.4	6.6	4.0

Table-1: Catch rate and percentage contribution of Nemipterids in different regions surveyed

From Table-1 it will be seen that this fishery contributes on an average more than 22% to the demersal fishery resources obtainable from

the Kerala-Karnataka and south Maharashtra areas between 50-200 m depth. In Wadge Bank it contributes to 23.8% of the total trawl catches. Its percentage contribution appears to be comparatively less along the east coast being 4-7%.

The highest average catch rate has been obtained from the depth zone 100-200 m along the west coast, the catch ranged from 100-430 kg/hr. Along the Karnataka coast in 100-200 m depth, the catch rate was 102kg/hr while it worked out to 123 kg/hr along the south Maharashtra coast. It was caught at the rate of 146 kg/hr from the same depth along the Kerala coast while 425 kg/hr was recorded from Wadge Bank. In the area 12-80 in the lower east coast about 16 kg/hr of nemipterids were obtained from 100-200 m depth belt. Undoubtedly, nemipterids emerge as one of the most promising demersal resources on a quantitative basis.

1.2 Carangids

Carangids consisting of a large number of species belonging to genera Caranx, Decapterus, Carangoide, Megalaspis etc. appear to contribute significantly to demersal and pelagic fisheries. Caranx and Carangoides grow to fairly large size and are caught generally in demersal trawling while others such as Megalaspis and Decapterus, which are smaller in size are caught mainly by purse seining and mid-water trawling. The individuals belonging to the latter two genera often form large shoals. It appears this fishery is underexploited at present, the current landing being 4900 tonnes. The relative abundance of carangids in different regions surveyed by demersal trawling is furnished in Table-2.

Region	West coast			East coast		
	8°-11°N	11°-15°N	Wadge Bank	Gulf of Mannar	10°-15°N	15°-20°N
Catch/hour (kg)	19.0	22.0	8.0	17.0	17.0	41.0
Percentage	15.0	21.1	5.7	12.0	19.1	23.0

Table -2: Catch rate and percentage contribution of carangids in different regions surveyed

Megalaspis cordyla recorded an average catch rate of 158.6 kg/hr in midwater trawling by M.T.Murena (Anon, 1979) along the north-west coast between 50-180 m and catches of 5-10 tonnes per haul were not uncommon. In bottom trawling the vessel recorded an average catch rate of 7 kg/hr of carangids. Along the Kerala coast in demersal trawling it was caught at the rate of about 10-20 kg/hr from 50-200 m depth. Along the Karnataka coast from 50-100 m depth belt 23 kg/hr of carangids were caught. Along the east coast also carangids appear to constitute an important fishery. In the lower east coast an average catch of 17 kg/hr was recorded from 20-200 m depth. It appears to contribute to about 23% of the catch with 41 kg/hr from 50-200 m depth along the upper east coast. The predominant group was decapterids. Some species especially of genus Decapterus have extended distribution upto 200 m along both the coasts and in particular in the east coast.

1.3. Perches

Perches consisting mainly of epinephelids, lutjanids and lethrinids appear to offer scope for further exploitation along both the coasts and especially in areas such as Wadge Bank. Menon & Joseph (1969) have furnished a detailed account of the possibilities of hand line fishing along the Kerala coast in 60-90m depth zone. The average catch per line per hour of fishing was 8 fish weighing 13.5 kg while the highest catch rate was 39 fish weighing 45 kg during the exploratory fishing. Silas (1969) has also shown that there is considerable scope for exploitation of perches along the south-west coast.

Recent surveys show that perches constitute 36.7% of the total catch and an average catch per hour of 67 kg/hr from Wadge Bank. 75-100 kg/hr of catch was obtained from within 50 m depth. An average peak catch rate of 147 kg was recorded during August. The catch rate and percentage contribution of perches in different regions are furnished in Table-3.

Region	WEST COAST				EAST COAST		
	8°-11°N	11°-15°N	15°-18°N	Wadge Bank	Gulf of Mannar	10°-15°N	15°-20°N
Catch/hr (kg)	6.0	22.0	12.0	67.0	27.0	10.0	9.5
Percentage	5.3	21.5	11.2	36.7	18.2	12.0	6.0

Table-3: Catch rate and percentage contribution of perches in different regions surveyed.

From south Karnataka coast perches were taken from 50-100 m depth in sizable quantities. Between the lat. 15°-16°N along the west coast an average catch rate of 52 kg/hr was obtained from the same depth zone. From the Gulf of Mannar on an average 26.5 kg/hr of trawling was caught in 50-100 m depth belt. In area 11-80 along lower east coast an average catch of 27 kg/hr was obtained while from upper east coast 9.6 kg/hr was obtained from 40-80 m. Since the trawling operations of the mechanised boats are restricted to about 60 m depth, it is likely that the resource remains unexploited in certain areas and underexploited in other areas. The estimated landing of perches at present is about 30,000 tonnes.

1.4 Lizard fish

As in the case of nemipterids, saurids is an another group of currently exploited fishes, the distribution of which extends upto 200 m or beyond. It has been caught in appreciable quantities from the deeper waters all along the west coast. The catch per hour varied between 5 and 18.6 kg along the west coast in 50-200 m depth. The highest average catch rate of 18.60 kg was obtained from 100-200 m depth zone. Although the average catch per hour of lizard fish as compared to the thread fin breams is less, it appears to have equally wide distribution along entire west coast. Presently about 7,700 tonnes of saurids are landed.

1.5. Cat fishes

The distribution of cat fishes seems to extend upto 150 m depth in appreciable quantities along the west coast and to certain extent on east coast. M.T.Murena recorded a catch rate of 14.6 kg/hr from north-west coast in 1979. The results of the surveys carried out by FSI vessels in respect of cat fishes are furnished in Table-4.

Region	West coast				East coast		
	8°-11°N	11°-15°N	16°-18°N	Wadge Bank	Gulf of Mannar	10°-15°N	15°-20°N
Catch/hr (kg)	20.0	18.0	15.0	4.2	3.9	6.0	15.0
Percentage	10.5	12.0	8.0	3.0	2.7	7.6	7.0

Table-4: Catch rate and percentage contribution of cat fishes in different regions surveyed

Along the Karnataka coast catch rates of 30.5 and 21.6 kg/hr respectively were obtaiened from within 50 m and between 50-100 m depth. Cat fishes formed 10.25% or about 20 kg/hr of the catch from 50-150 m along the Kerala coast. From the lower east coast an average catch per hour of 6 kg was recorded while from upper east coast, it was obtained at 15 kg/hr. The highest catch rates were obtained from 40-70 m depth. The present landings of cat fishes are estimated at 66,900 tonnes.

1.6 Barracuda

A significant achievement of the demersal fish resources survey in Gulf of Mannar is the location of rich barracuda resource in 100-200 m depth zone. The catch consisted of 5 species of genus Sphyraena. An average catch rate of 16.6 kg/hr was recorded from the Gulf of Mannar while the average catch rate from 100-200 m depth was 90 kg/hr. Catch rates upto 1400 kg were taken from the area. At present this resource is not being exploited as it is beyond the reach of the mechanised boats.

1.7 Mackerel

The mackerel landings along the east coast during 1979 was about 10,000 tonnes and during 1984 the landings are estimated at 20,000 tonnes almost double the quantity landed in 1979. 50% of the landings are accounted by Tamil Nadu while the remaining is landed in Andhra Pradesh and Orissa. A good percentage of this catch is reported to be taken by the mechanised trawlers. Two species, Rastelliger kanagurta and R. faughni are known to support the fishery.

During the demersal trawl survey since 1981, mackerel used to be caught for about 8 months from June to February by the survey vessels along the upper east coast. The results are furnished in Table-5.

Region	East coast		
	10°-15°N	16°-18°N	20°-21°N
Catch/hour (kg)	4.4	17.92	105.0
Percentage	5.4	5.35	61.5

Table-5: Catch rate and percentage contribution of Mackerel on east coast.

Between lat. 16°N and 18°N it formed 6% of the trawl catches, the average catch rate being 17.92 kg/hr from 60-90 m depth. During 1985 the vessel Matsya Darshini has recorded an average catch rate of 105 kg/hr from the sandheads in the depth 60-120 m. The average catch rate between latitude 18°N and 21°N is about 23 kg/hr. Catches upto 2800 kg were obtained from the area 20-88. Along the lower east coast mackerel formed about 5.4% of the catch from 20-200 m depth during 1984-85. In the area 13-80 its share was 27% in an average catch rate of 87 kg/hr. Occasional catches of mackerels were also taken in trawls along north-west coast. The occurrence of mackerel in the trawl catches from deeper waters seems to indicate existance of offshore mackerel fishery along the upper east coast.

1.8 Squids and cuttle fish

In 1984 cephalopods constituting mainly of squids and cuttle fish accounted for 19,700 tonnes. Of this about 15,000 tonnes were landed along the west coast and in particular Kerala, Maharashtra and Gujarat. The landings have been increasing over the years. The FSI vessels have recorded 20 kg/hr of squids and cuttle fish from Wadge Bank and 22 kg/hr from Kerala coast. Squids and cuttle fish appear to have been one of the most sought after groups by the chartered vessels operating along the west coast of India. An analysis of the catches of some of these vessels indicate that they were taking sizable quantities of squids and cuttle fish ranging from 60-80% of the total catch declared by them. Some of the areas where from they have reported good catches and the catch rate obtained are given in Table-6.

Area	West coast			
	7°-9°N	10°-12°N	13°-14°N	16° - 17° N
Catch/hr (kg)	61.9	106.0	76.2	100.6

Table-6: Catch rates obtained by chartered vessels in different areas along west coast.

In one of the most recent cases a vessel has reported 106kg/hr of squids and cuttle fish and a total catch of 120 tonnes from the west coast between the depth 60-80 m. From this analysis it appears that there is good scope for increasing the landings of squids and cuttle fish by trawling from the west coast of India. Reports are very scanty from the east coast and in the exploratory surveys the catch rate reported is 3 kg/hr.

1.9 Lesser sardines

Among the other conventional species, lesser sardines appear to promise scope for further expansion especially from the deeper waters along the upper east coast. During 1983 and 1984, lesser sardines used to be taken regularly in the trawl catches between 16°N - 18°N from the east coast. In area 17-82 an average catch rate of 42 kg/hr was obtained while in 17-83 average catch rate of 108.72 was recorded. The preferred depth range is 50-110m, with 123 kg/hr from 71-100 m depth. Presently about 70,000 tonnes of lesser sardines are landed.

2. Unexploited demersal fish resources in the outer continental shelf and on the continental slope.

Recent surveys by the large vessels of FSI in different sections along the east and west coast have revealed the existance of new fish resources on the outer half of the continental shelf and on the continental slope. It is observed that the demersal fishery beyond 100 m depth is supported mainly by three or four species in contrast to the inner shelf where it is supported by a large number of species. Of these, two groups namely nemipterids and squids are presently exploited as discussed elsewhere in this paper. The new groups are priacanthids, black ruff and Indian drift fish besides a large number of other deep sea fishes. The edge of the continental shelf and slope in certain regions have crustacean resources consisting mainly of deep sea lobster, deep sea prawns and crabs.

2.1. Big eye

Priacanthids popularly known as 'Big eye' or 'Bulls eye' is reported to be a common food fish in south east Asian countries. In 1984 Thailand and Hongkong have landed about 33,000 tonnes of big eye from south China sea (Anon, 1983). During recent surveys by FSI vessels big eye has been found to occur all along both the coasts. It is available from 50 to 200 m depth with peak catch rates in 100-200 m depth both along the west coast and east coast. Its availability in less than 100 m depth appears to be seasonal and related to cold water currents. The average catch rate obtained from the different sections of the shelf are furnished in Table-7.

Region	West coast			East coast	
	8°-11°N	11°-15°N	15°-18°N	10°-15°N	15°-18°N
Catch/hour (kg)	14.2*	18.0*	39.0*	6.0	7.2
Percentage	10.18	12.0	32.35	7.0	3.5

*Areas between 100-200 m

Table-7: Catch rate and percentage contribution of Bulls eye in the regions surveyed

An average catch rate of 14.2 kg/hr was obtained from 100-200m depth in the area 8°N and 11°N while from the same depth range 18.0 kg/hr was obtained from lat. 11°N and 15°N along the west coast. Between 15°N-18°N from 100-200 m depth zone 39 kg/hr was recorded. The lower east coast yielded about 6 kg/hr while the upper east coast recorded 7.2 kg/hr. From 100-200 m depth zone the catch rates were 8-12 kg/hr.

2.2 Black ruff

The black ruff, Centrolophus niger, is another deep sea fish with distinct ecological habitat, which contributes significantly to the catches from areas deeper than 200 m. It formed on an average 158 kg/hr from the depth 200-500 m depth zone along the Karnataka coast. Along Kerala coast it was caught at about 53 kg/hr from depth beyond 200 m. The catch rates obtained from different regions are furnished in Table-8.

Region	West coast			East coast	
	8°-11°N	11°-15°N	15°-18°N	10°-15°N	15°-18°N
Catch/hour (kg)	53.0*	158.0*	2.0	4.3	4.3
Percentage	60.0	68.9	1.33	5.3	2.0

* From areas 200 m beyond.

Table-8: Catch rate and percentage contribution of black ruff in different regions surveyed.

From the foregoing it may be seen that black ruff is very abundant along the south-west coast comprising Kerala and Karnataka. Areas beyond 200 m depth in other regions are yet to be adequately surveyed.

2.3. Indian drift fish

The Indian drift fish, Psenes indicus is another important food fish species that supports the demersal fishery of the outer continental shelf along east and west coast. It was caught at the rate of 2 kg/hr along the Karnataka coast from 50-200 m depth. The highest catch rate was 3 kg/hr from 100-200 m depth zone. Along the east coast a catch rate of 2 kg/hr was recorded from Gulf of Mannar while 6 kg/hr was recorded from upper east coast. The highest average catch rate was 18.3 kg/hr in the depth zone 60-150 m, from area 17-82 along the east coast. From the lower east coast, a catch rate of about 15 kg/hr was obtained from the area 14-80, while the average catch rate was 3 kg/hr.

2.4 Deep sea prawns

Deep sea prawns were found to occur between 150-400 m depth in several parts along the east coast and west coast. A large number of species belonging to genera Parapandalus, Heterocarpus, Aristeus, Parapenaeus, Parapenaeopsis, Metapenaeopsis and Solenocera were found to contribute to the catch along Kerala and Karnataka coast i.e 8°N - 11°N and 11°N-16°N. It was also found to occur in south Maharashtra coast, lower east coast and to a lesser extent in the upper east coast. Joseph (1970) and Mohmed and Suseelan (1973) have furnished detailed accounts of the results obtained in surveys conducted by the Indo-Norwegian Project from 1968. From Kerala coast average catches of 118, 141 and 224 kg/hr of deep sea prawns were recorded by three different vessels during the period 1968-70. An average catch rate of about 18 kg/hr was obtained from 200-300 m depth between lat. 11°N-15°N along the west coast. The deep sea prawns were also recorded from the lower east coast between 10°-11°N. Detailed surveys using shrimp trawls along both the coasts are proposed in order to establish the relative abundance of the deep sea prawns from different areas as the multi-purpose trawls do not give the representative catch of these small sized prawns. Nevertheless, the

present indications are that they are available in commercially exploitable quantities in several sections of the continental shelf and slope.

2.5. Deep sea lobster

As in the case of deep sea prawns, the occurrence of deep sea lobster in commercial quantities was also first reported by the trawlers of erstwhile Indo-Norwegian Project, Cochin (Joseph, 1971 a). Deep sea lobster fishery constitutes a single species viz., Puerulus sewelli. Oommen (1980) has estimated a potential yield of about 3000 tonnes for the deep sea lobster from south Kerala coast and about 1100 tonnes from the Gulf of Mannar. The recent surveys by Fishery Survey of India have reconfirmed the availablility of deep sea lobster in Gulf of Mannar, along the slope of Wadge Bank and along the Kerala coast. It was found to constitute 5.2% of the catch with 12.4 kg yield per hour between lat. 13°N and 15°N in the depth range 200-300 m in 2 years survey along the Karnataka coast. An average catch of 18 kg/hr was recorded between lat. 15°N and 18°N in the same depth range. In the lower east coast between the lat. 10°N and 11°N deep sea lobster has been recorded. However, it has not been recorded along the upper east coast yet. Perhaps a systematic survey for lobster along the continental shelf and slope during the season of its availability should prove useful. It is known that the deep sea lobster forms a seasonal fishery commencing from December and ending in April along the west coast.

There are a number of other species which are available in deeper waters in the depth zone 200-500 m. Other species include Chlorophthalmus agassizi, Cubiceps spp., Epinula spp. etc.

3. Oceanic resources

Several authors have found that the Indian Ocean has very good potential of oceanic resources comprising skipjack and larger tunas, and pelagic sharks (Hsayasi, 1971; Gulland, 1971; Silas and Pillai, 1982). Potential yield estimate for tuna and skipjack vary from 0.5 million tonnes to 0.8 million tonnes, although the present landing is only a small percentage of it. The potential of larger tunas is estimated at about 150000 tonnes. Oceanic sharks is estimated to have a potential of one million tonne. Japan, South Korea and Taiwan are

known to have been carrying out long lining for tuna since the fifties in the Indian ocean. India made an attempt to take up long line fishing for tuna during 1961-63 and later in 1968-71, employing two modified trawlers under the guidance of the Japanese experts obtained through international assistance (Eapen, 1964; Joseph, 1971 b). With the acquisition of two tuna long liners under Japanese assistance in 1980, one for training and other for survey, India began to acquire expertise in tuna long lining and knowledge about the fishing grounds and resources from 1981. Some relevant observations made on the resources in the Indian EEZ in paricular during the operations of Matsya Sugundhi, the survey long liner from 1983-85 are discussed below. During the two years period November 1983 to October 1985, the vessel has carried out 24 voyages and conducted systematic long lining in west coast of India, Bay of Bengal and equatorial waters.

The catches comprised yellowfin tuna (Thunnus albacares), big-eye tuna (T.obesus), albacore (T.alalunga), skipjack tuna (Katsuwonus pelamis), striped marlin (Tetrapturus audax), blue marlin (Makaira nigricans), black marlin (M. indica), sail fish (Istiophorus platypterus), Broad bill sword fish (Xiphias gladius), pelagic sharks, dolphin fish and other varieties. The species-wise hooking rate recorded from different regions is given in Table-9. The highest rate of hooking (12.27%) in respect of yellowfin tuna was obtained from the areas 14-72, followed by 13-73 (4.9%), 12-70 (2.5%) and 1-69 (2.5%). Big-eye tuna were hooked at higher rate in the area 3-77 (0.5%) followed by 5-68 and 7-91 (0.4% each). Skipjack tuna recorded maximum hooking rate of 0.58% in the area 13-70 and 14-83.

Species	Hooking rate (%)			
	West coast	East coast	Andaman sea	Equatorial sea
Yellowfin tuna	0.72	0.61	0.49	1.05
Big eye tuna	0.05	-	0.02	0.12
Skipjack tuna	0.07	0.13	0.02	0.12
Albacore	-	-	0.01	-
Marlin	0.13	0.22	0.18	0.70
Pelagic sharks	1.28	0.75	0.68	0.57
Other species	0.18	0.32	0.13	0.10
Total	2.13	2.03	1.53	2.66

Table 9: Species-wise and region-wise hooking rate obtained by Matsya Sugundhi during the period November'83 to October'85

The resources structure varied widely in different areas which is depicted in 5° lat. 5° long. - squares in fig.2. From the figure it may be seen that among the areas surveyed the area between lat. 0-5°N and long. 65-70°E, lat. 5-10°N and long 65°-70°E, lat. 10°-15N and long. 70°-75°E, lat. 5°-10°N and long. 85°-90°E and lat. 15°-20°N and long. 80°-85°E, have yielded very high percentage of tuna, viz. 35-82% of the total catch. The percentage of sharks was found to be very high in the EEZ along the south-west coast from lat. 5°N-16°N. The hooking rate of different species worked out on bimonthly basis is furnished in Table-10.

Species/group	Jan-Feb.	Mar Apr.	May-June	July-Aug.	Sept. Oct.	Nov.-Dec.
Yellow fin tuna	0.62	0.63	0.19	0.14	1.50	0.67
Big eye tuna	0.03	0.01	0.06	0.02	0.03	0.09
Skipjack tuna	0.07	0.07	0.08	0.03	0.07	0.07
Marlin	0.12	0.17	0.13	0.06	0.12	0.14
Sharks	0.56	0.69	0.90	1.56	1.34	1.06
Other species	0.23	0.29	0.22	0.27	0.11	0.18
Total	1.63	1.86	1.58	2.08	3.17	2.21

Table-10: Seasonal change in hooking rate of major species in long lining - Matsya Sugundhi

It will be seen from the Table that the period September-October has yielded the highest catch rate for tuna in the Indian EEZ. The season for tuna fishing begins in September and ends in December - January in south west coast, while it starts in Bay of Bengal in January and ends by April - May.

The survey proves that tuna is available in commercial concentrations in a few areas in the south-west coast and in several areas in Bay of Bengal within the Indian EEZ and areas immediately adjoining it.

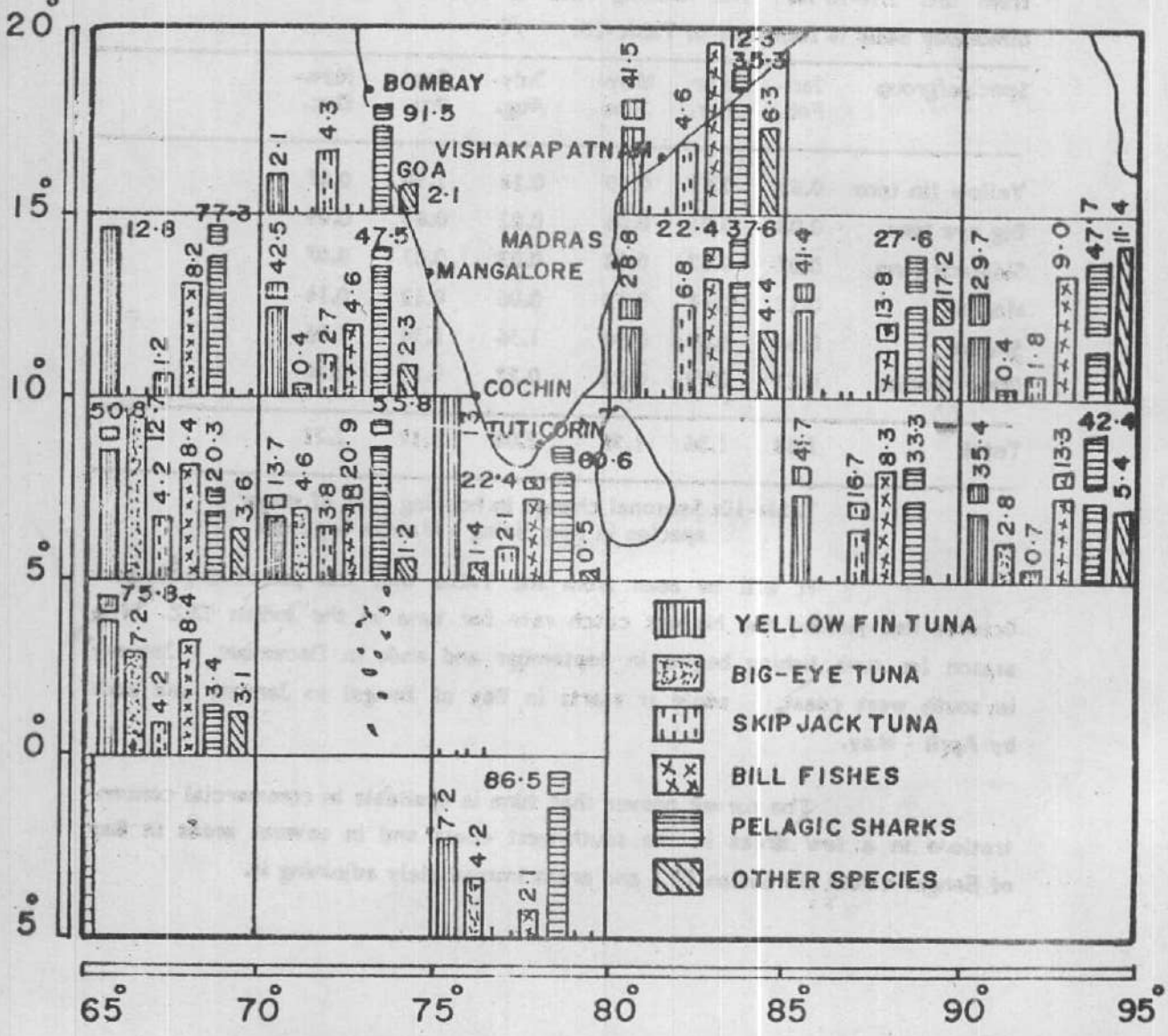

Fig: 2-TUNA LONG LINE CATCH COMPOSITION (PERCENTAGE) IN SQUARES OF 5° LAT X 5° LONG — MATSYA SUGUNDHI.

Discussion

Some of the fish resources found to have significant scope for commercial exploitation, during the exploratory survey in deeper waters have been indicated in the foregoing account. These include carangids, perches, nemipterids, cat fishes, lizard fish, lesser sardine, mackerel, squids and cuttle fish, barracuda, etc. among the presently exploited fish resources in particular demersal; big eye, black ruff, Indian drift fish, deep sea prawns and lobster among the non-exploited resources; and tuna and pelagic sharks from the oceanic waters. Of these, the lesser sardines and mackerel are found to have more potential probably along the east coast, nemipterids, saurids, big eye and black ruff appear to form the mainstay of the deep sea fish resources found in the outer continental shelf. Horse mackerel, decapterids, mackerel and lesser sardines may offer scope for purse seining/midwater trawling, while most of the other species discussed are exploitable by demersal trawling.

While all the presently exploited species, except probably oil sardine, mackerel (from west coast), polynemids, ribbon fish, Bombay duck, prawns, etc. appear to have scope for increased exploitation, the resources mentioned in the above para seem to have substantial scope for expanded fishing. Oil sardine, polynemids, Bombay duck, ribbon fish etc. mentioned in the above para have shown either declining catch trends or no significant increase in their landings over the last five years, although very high potentials were projected for these by some authors (George, et al: 1977). The landings of the lesser sardine, carangids, squids and cuttle fish and other species which includes nemipterids have shown substantial increase over the same period (Table II). In fact as Krishnamurthy (1973) has remarked bulk of the socalled 'Miscellaneous' is likely to be made up of nemipterids. Many authors (op.cit) who have made potential yield estimates for different groups, did not indicate separate estimates for nemipterids, saurids and other deep sea fishes, referred in this paper, which appear to support the demersal fishery of the outer continental shelf to a large extent.

Table - 11: All India marine fish landings during 1979, 1983-1984 (Average) and estimated potential yield

('00 tonnes)

Species/groups	1979	Average for 1983 & 1984*	P.Y.estimated by-George et al(1977)
Elasmobranchs	393	527	3100
Cat fishes	491	669	3100
Bombay duck	1216	1038	1000
Perches	333	301	2500
Polynemids	230	71	400
Sciaenids	1275	1143	2100
Silver belly	313	519	1000
Pomfret	333	527	850
Oil sardine	2184	2033	1950
Lesser sardine	355	700	1400
Ribbon fish	774	638	2700
Carangids	266	429	2650
Mackerel	868	434	1050
Seer fish	258	333	450
Tunnies	233	224	2400
Penaeid prawns	855	1104	1800
Non-penaeid prawns	972	876	1050
Other Crusaceans	168	222	400
Cephalopods	110	148	1800
Others	3325	4546	14250
Total	14948	16482	44700

* Hand Book on Fisheries Statistics 1985 (M.S.)
Ministry of Agriculture & Rural Development

The distribution of tuna is determined mainly by water temperature and oxygen. Survey and location of potential grounds, besides development of fishing skills are therefore pre-requisites for the development of a successful tuna long line fishing industry. The results of survey during the last two years have pointed out the existence of rich fishing grounds in the Indian EEZ and adjoining waters. The hooking rate for yellow fin tuna obtained during the survey seems to compare favourably with the average hooking rate reported by commercial long liners during 1971-76 (Anon,1980). It goes to prove that the Indian Ocean tuna fishery including that of yellow fin which is reported to have been declining since 1968 is reviving on the one hand and shows that it is time to initiate commercial fishing.

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PRELIMINARY OBSERVATIONS ON TUNA RESOURCES OF THE ARABIAN SEA WITH PARTICULAR REFERENCE TO DISTRIBUTION PATTERN OF YELLOW FIN TUNA, THUNNUS ALBACARES (BONNATERRE)*

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Fishery Survey of India

While acquiring sovereign rights for exploitation and management of living and nonliving resources in the 200 mile zone, the Maritime Zones Act of 1976 has also prevented fishing by foreign vessels in the Indian Exclusive Economic Zone. The tuna fleets of non-Indian Ocean countries were known to operate since 1950's in the Indian Ocean reaching upto northern Arabian Sea as well as Bay of Bengal. Prevention of fishing by foreign fleets had tremendously relieved the fishing pressure in Indian Seas leaving the entire resources for our own exploitation. In the context of the stagnant level of marine fish production in India over the past several years, diversification of effort oriented to tapping the hitherto unconventional resources assumes great significance. Geographical position of our country and its proximity to the fishing grounds place us in a highly advantageous position for tuna fishing. Inspite of a recent recession, tuna still commands high price in export market and the demand among domestic consumers is also on the increase.

The recent trends in tuna fisheries in Indian Ocean has been documented by Silas et al (1979). Tuna is one of the least exploited resources of Indian Seas, the average catch for 1970-79 period being 11,542 tonnes. The highest landing of 26,595 tonnes was recorded in 1979. The percentage contribution of tuna landing in all-India marine fish production ranged from 0.3 to 1.92 during the last decade. The fishery still remains confined to the

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shelf oriented species such as little tuna (Euthynnus affinis), frigate tuna (Auxis thazard), bullet tuna (A. rochei), long tail tuna (thunnus tonggol) etc. In Lakshadweep islands, Skipjack tuna (Katsuwonus pelamis) and a small percentage of young yellow-fin tuna (Thunnus albacares) are taken in pole and line fishery.

Several authors have given detailed accounts on the distribution of tuna resources in Indian Ocean. Suda (1974), Suzuki (1979), Sivasubramaniam (1981), Silas and Pillai (1982), Silas (1983), Dwivedi and Devaraj (1983) are among the most recent ones. Silas (1983) has reviewed the tuna fisheries in Indian Ocean and found that resources availability is never a constraint in its development. Sivasubramaniam (1981) has discussed the tuna fishery in the EEZ's of India, Maldives and Sri Lanka while Eapen (1964) and Joseph (1972) have given some aspects of developmental prospects of tuna fishing in Indian waters on the basis of exploratory surveys conducted during the sixties. Varghese et al (1984) have made preliminary observations on the tuna resources of northern Indian Ocean based on the exploratory tuna long line survey carried out during 1983-84. The present paper deals with tuna resources off south-west coast of India and adjacent oceanic waters with particular reference to the distribution and relative abundance of yellow-fin tuna, based on exploratory survey carried out by Fishery Survey of India during October'83 to December'85.

Survey Vessel and Gear

The Japanese built tuna long liner, Matsya Sugundhi (OAL 31.5m, GRT 250 tonnes) operating from Cochin Base of Fishery Survey of India was deployed for the survey. Imported long line of the following structure was the gear used.

Branch line per basket	: 5	Branch line length	: 12 m
Mainline length	: 300 m	Sekiyama (Steel)	: 6 m
Float line length	: 22 m	Leader wire (Steel)	: 2 m

Area of study and sampling effort

A fairly good coverage has been made in the Arabian Sea extending upto the peripheral squares of Indian EEZ and equatorial waters on western side of Maldive Islands between lat. 0° to 15°N and long. 65° to 80°E. The results of effort expended by the vessel in other parts of Indian coast are excluded from the current study.

Altogether 1,15,000 hooks were operated in the survey with an average 750 hooks per set. The explored areas and distribution of sampling intensity represented by number of hooks immersed in each square of 1° lat.x 1° long. is presented in fig. 1.

Resource structure

Catch recorded in the survey was 3711 larger pelagic fishes weighing 118.5 tonnes. The scombroids represented by four species viz. Yellowfin tuna (Thunnus albacares), big eye tuna (T. obesus), albacore (T. alalunga) and skipjack tuna (Katsuwonus pelamis) formed half of the total catch by number. Bill fishes, dominated by Indian sail fish (Istiophorus platypterus) and further consisting of striped marlin (Tetrapturus audax), blue marlin (Makaira nigricans), black marlin (Makaira indica) and sword fish (Xiphias gladius) accounted for 8.5%. Pelagic sharks formed 39.9% and other species 1.6%. By weight tuna made up 48.6%, bill fishes 9.6%, sharks 41.6% and other varieties 0.2%. The percentage composition of catch by number alongwith average weight of each species is given in Table 1.

Species	% by number	Average wt.(kg)	Species	% by number	Average wt.(kg)
Yellowfin tuna	46.46	31.8	Black marlin	1.18	76.3
Big eye tuna	1.56	42.4	Sail fish	3.58	26.4
Albacore	0.02	1.9	Sword fish	0.92	21.4
Skipjack tuna	1.97	4.1	Sharks	39.99	33.2
Striped marlin	0.46	38.2	Other species	1.03	-
Blue marlin	2.37	36.7			

Table 1: Catch composition and average weight of each species

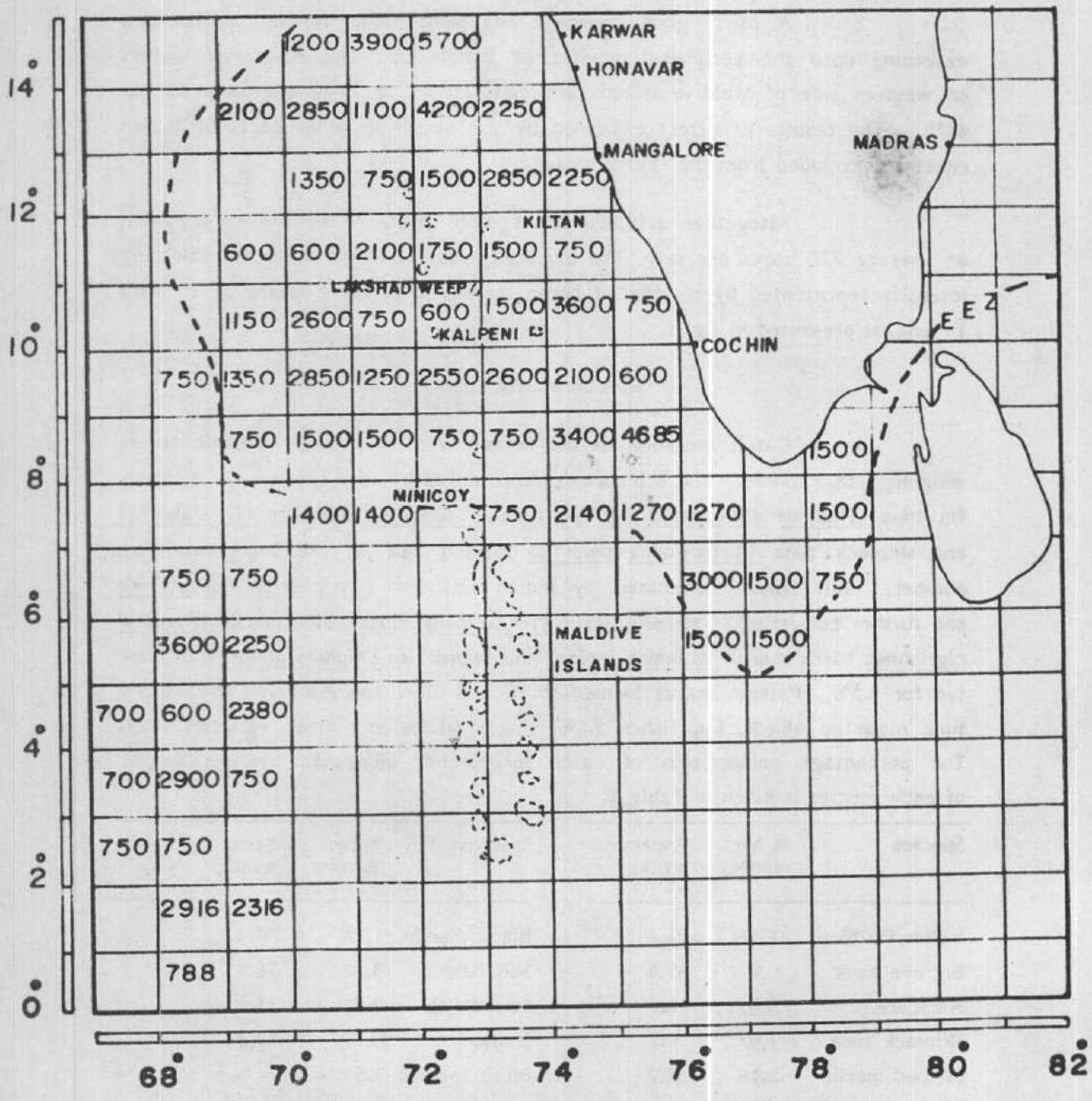

Fig:1 - AREA SURVEYED AND SAMPLING INTENSITY
(NO. OF HOOKS OPERATED)

On examining the catch composition separately for the different geographical divisions of 5° lat. x 5° long. it was found that the highest percentage of tuna catch was obtained from areas west of Maldive Islands and Minicoy in 0°-5°N and 5°-10°N from where 85.2% and 67.8% of catch was scombroid species. The coastal sector of west coast between lat. 10° to 15°N in long. 70° to 75°E also yielded considerably higher percentage (59.6%) of tuna. Bill fishes which formed an average 8.5% of catch contributed higher proportion ranging from 20.5% to 22.5% in areas east of long. 70° between lat. 5° and 10°N.

A comparision of catch structure in the different areas surveyed is given in Table 2.

Lat.	Long.	Hooking rate(%)	Percentage composition			
			Tuna	Bill fishes	Sharks	Others
0°-5°N	65°-70°E	1.52	85.2	8.5	6.3	-
5°-10°N	65°-70°E	1.25	67.8	8.5	23.7	-
5°-10°N	70°-75°E	1.75	21.3	20.5	57.1	1.1
5°-10°N	75°-80°E	2.17	16.4	22.5	60.6	0.5
10°-15°N	65°-70°E	2.88	24.3	8.1	67.6	-
10°-15°N	70°-75°E	5.17	59.6	4.0	34.9	1.5
10°-15°N	75°-80°E	1.47	-	-	95.5	4.5

Table 2: Catch structure in geographical divisions of 5° lat. x 5° long.

The Hooking Rates

The average catch rate by number worked out to 3.09 fishes per 100 hooks and by weight 96.94 kg per 100 hooks. Further description is based on hooking rate by number alone and the corresponding catch rate by weight can be obtained by taking the product of hooking rate by number and the average weight of the species concerned.

The individual hooking rates of the different species recorded in the survey are given below.

Yellowfin tuna	1.43	Black marlin	0.04
Big eye tuna	0.05	Sail fish	0.11
Albacore	0.01	Sword fish	0.03
Skipjack tuna	0.06	Sharks	1.24
Striped marlin	0.01	Other species	0.05
Blue marlin	0.07		

The index of relative abundance being the hooking rate in the different areas covered, it was examined for each 1° square for all fishes together and separately for each species. Maximum rate of 12.9% hooking was recorded in area 14-72 followed by 11.3% in 13-73 and 8.2% in 14-71. Altogether 14 squares, out of which 10 lying between lat. 11° and 14°N yielded hooking rates above the average level. The hooking indices aggregate as well as in respect of scombroids, for every 1° square of the survey area is furnished in fig. 2.

For a comprehensive understanding of the spatial relative abundance pattern of total resources and major groups, the survey results are pooled into regions of 5° lat. x 5° long. and the hooking rates of tuna, bill fishes and pelagic sharks along with total hooking rate in such regions are given in fig. 3. The ground bordering the continent and surrounding the Lakshadweep Archipelago, between lat. 10°-15°N and long. 70°-75°E was observed to be the most productive area with aggregate hooking rate of 5.17% in which tuna hooking rate was 3.08, bill fishes 0.21 and sharks 1.80. Next in terms of total hooking rate was the adjacent square on western side with 2.88% hooking whereas the equatorial region with 1.52% hooking ranked as the second productive area with respect to tuna.

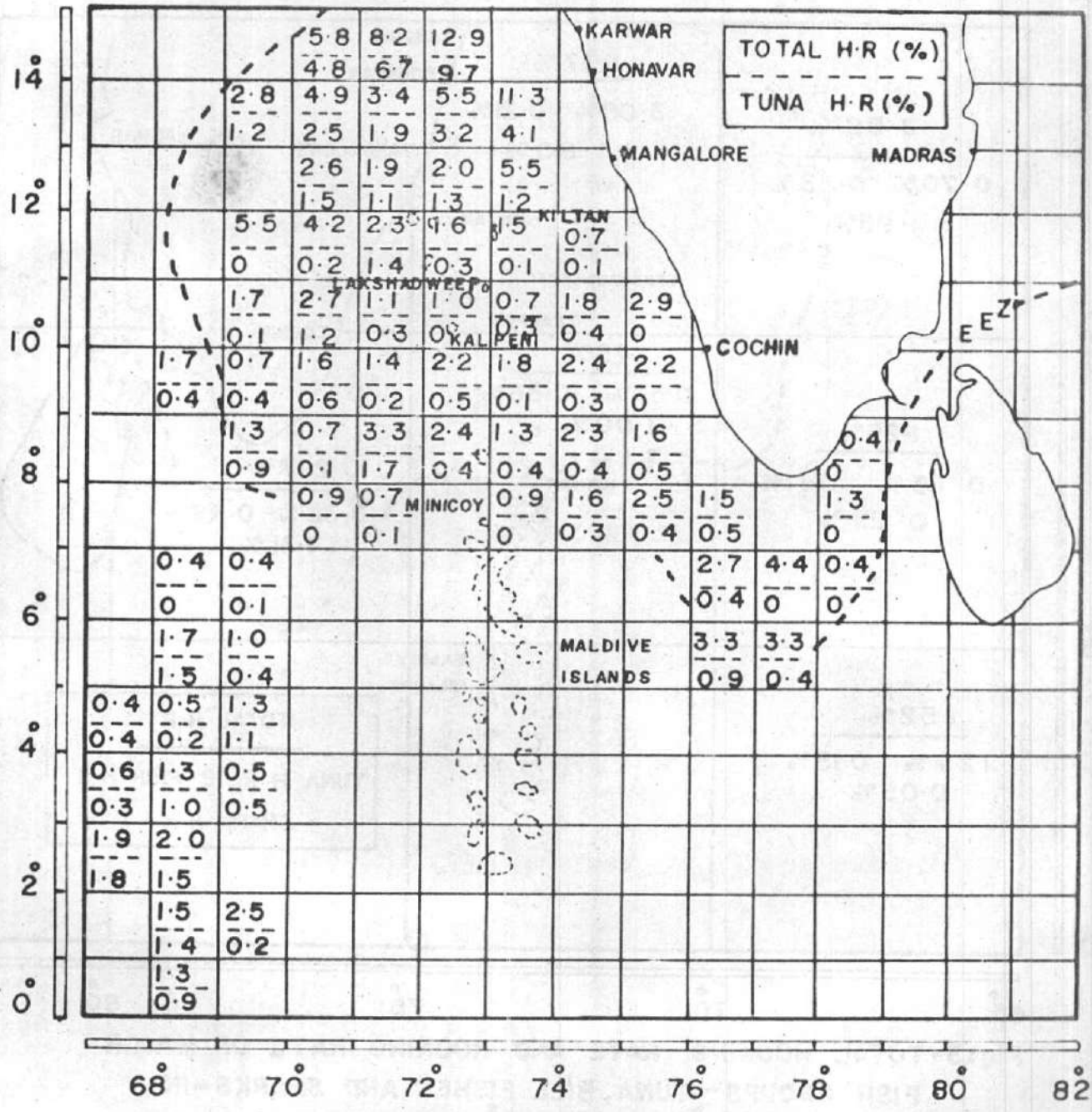

Fig:2- TOTAL HOOKING RATE AND HOOKING RATE OF ALL TUNAS TOGETHER IN 1° SQUARES

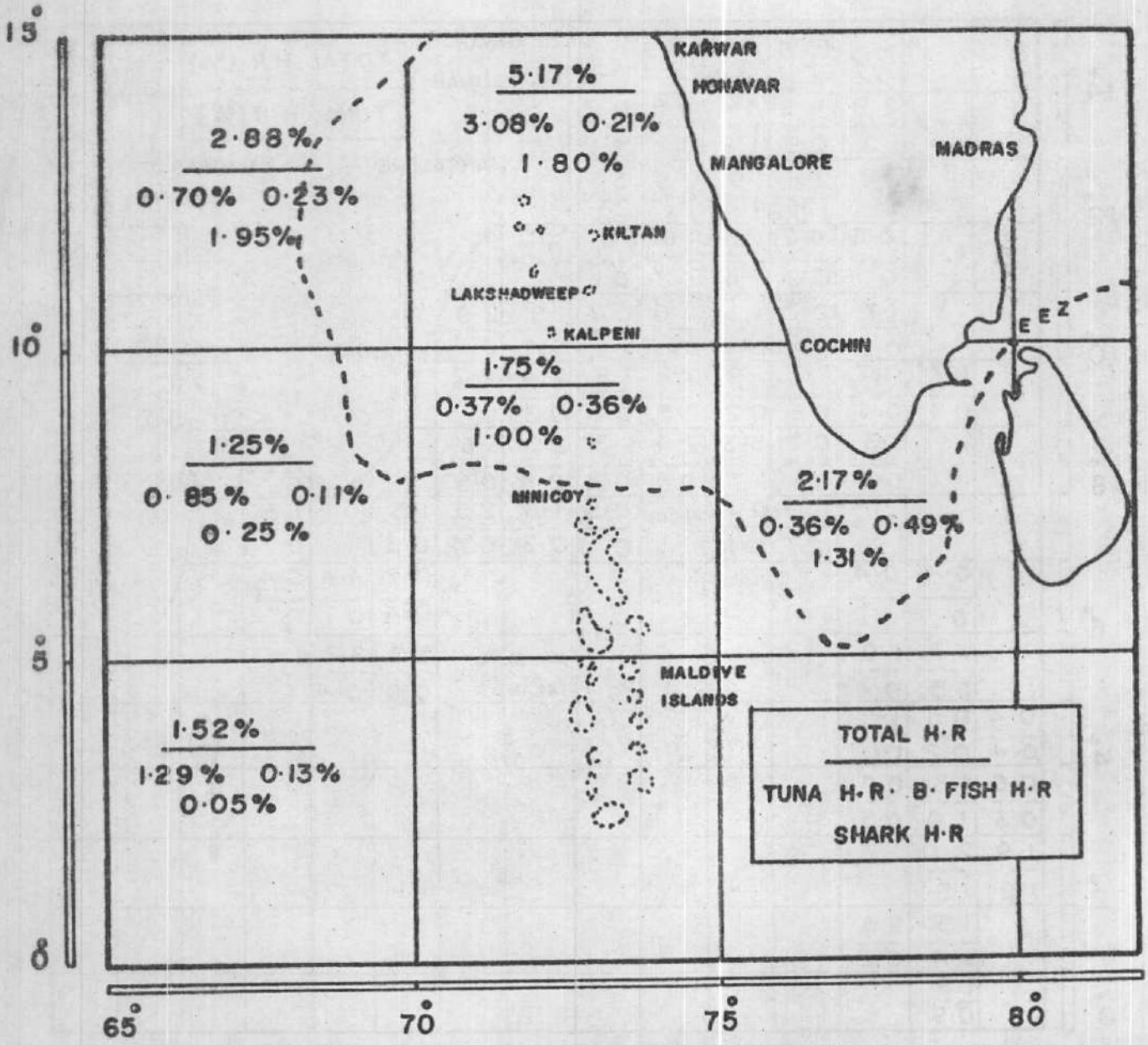

Fig.3-TOTAL HOOKING RATE AND HOOKING RATE OF MAJOR FISH GROUPS—TUNA, BILL FISHES AND SHARKS-IN DIVISIONS OF 5° LATITUDE X 5° LONGITUDE.
(SEQUENCE OF FIGURES IS INDICATED WITHIN THE ILLUSTRATION)

Yellowfin Tuna

Yellowfin tuna with over 1700 numbers (54.8 tonnes) was the most potential resource in the long line catches forming 46.46% of aggregate catch and 92% of scombroid group. By weight, contribution of the species in total catch and in scombroid catch was 46.28% and 95.25% respectively.

The mean catch rate of yellowfin tuna recorded in the survey was 1.43%. The size of fish ranged from 50 cm to 185 cm length with 136-140 cm as modal class. Average weight was 31.82 kg.

Spatial distribution

The share of yellowfin tuna in total catch varied widely in different areas. When considered in 5° squares, proportion of the species was as high as 75.85% in equatorial followed by 57.86% in south-west coast between lat. 10°-15°N and long. 70°-75°E. The percentage of the species in total catch and its hooking rate in the 5° squares are furnished in Table 3.

Lat.	Long.	Yellowfin tuna in total catch	Yellowfin tuna hooking rate
0°-5°N	65°-70°E	75.85%	1.15
5°-10°N	65°-70°E	50.85%	0.63
5°-10°N	70°-75°E	13.92%	0.24
5°-10°N	75°-80°E	12.96%	0.28
10°-15°N	65°-70°E	23.42%	0.68
10°-15°N	70°-75°E	57.86%	2.99
10°-15°N	75°-80°E	-	-

Table 3: Percentage of yellowfin tuna and its hooking rate in divisions of 5° lat. x 5° long.

From the table above it is seen that availability of yellowfin tuna was remarkably high between lat. 10°-15°N and long. 70°-75°E where an average hooking rate of 2.99% was obtained. Second in the order of abundance was the equatorial waters with 1.15% hooking.

The abundance index when examined for each 1° square, it was observed that the highest rate of hooking 9.7% was obtained from the area 14-72 followed by 6.7% in 14-71, 4.7% in 14-70 and 4.1% in 13-73. The hooking rate of the species in different squares is furnished in Fig. 4 from which it can be read that 10 squares yielded catch rates above the average level of 1.43%.

Seasonal fluctuation

On segregating the effort and catch data into six bimonthly components it was observed that the post-monsoon season from September to December forms the most productive period for tuna long line fishing. Aggregate hooking rate of 4.25% was obtained in November - December and 3.17% in September - October. The yield of yellowfin tuna in November - December was 55.3% of total catch and in September - October the species made up 47.62%. The corresponding hooking rates were 2.35% and 1.5%. During this season highly potential grounds were identified between Malpe and Karwar within 150 miles off the coast line and also on the western side of Maldive Islands and Lakshadweep Archipelago. Hooking rate as high as 23.9% was recorded from the area 14-72 during October 1985. Proportion of yellowfins in January - February was also quite substantial (37.8%). But the months of July - August and May - June were found to be the least productive period for yellowfin tuna when its percentage in total catch was 6.84% and 12.23% respectively.

Though the data is not included for discussion in this paper, the most recent observations indicate that the Karnataka coast yields very high percentage of yellowfin tuna (91.29%) in January with an excellent hooking rate of 24.96%.

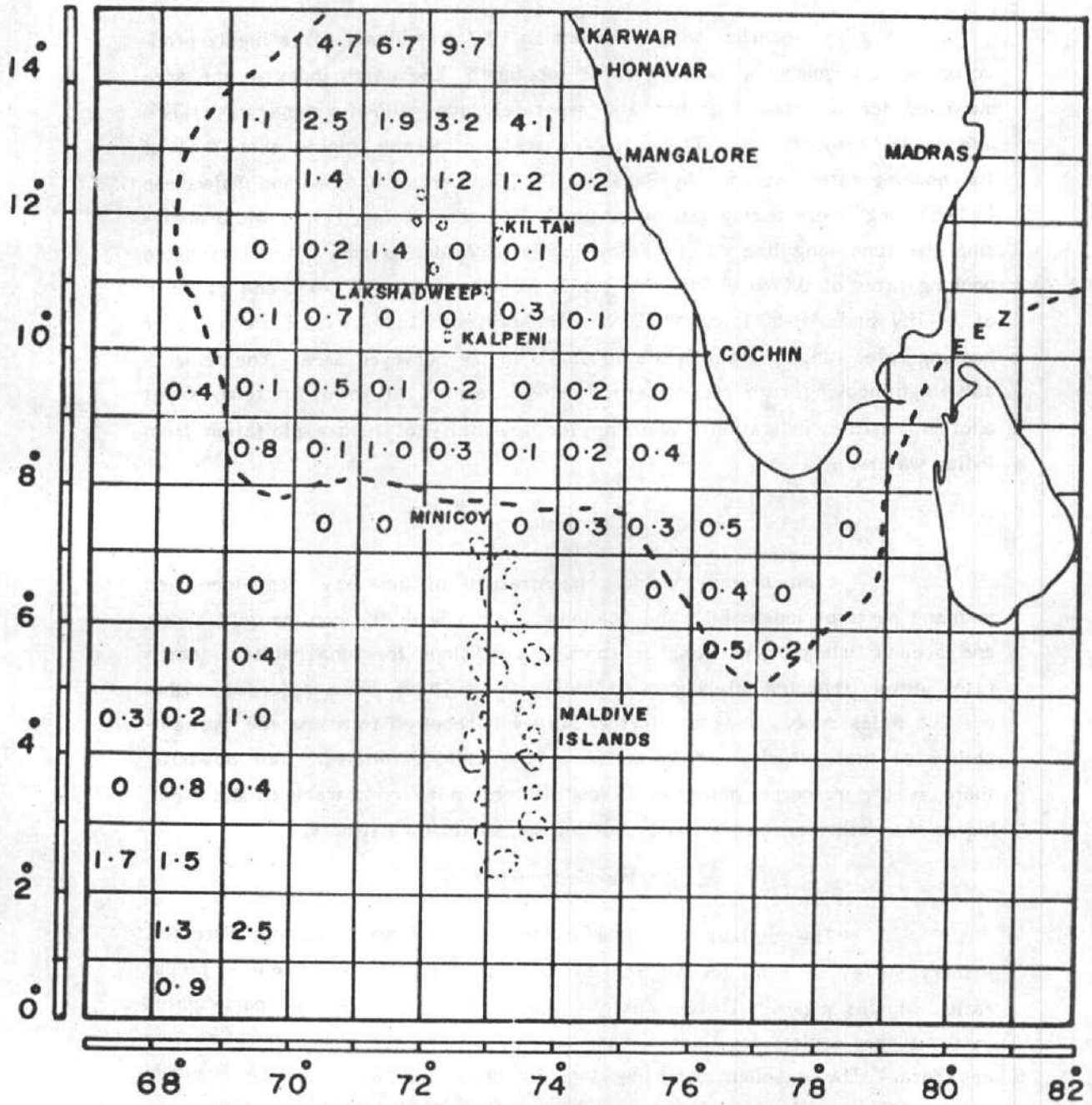

Fig:4- HOOKING RATE OF YELLOWFIN TUNA

Discussion

Some areas within the Indian EEZ was found to be highly productive with encouraging hooking rates for tuna. The catch index in the area surveyed for all tuna together and seperately for yellowfin tuna was 1.54% and 1.43% respectively. These figures are considerably higher than that of the hooking rates recorded by Japanese (0.23%) Korean (0.62%) and Taiwanese (0.17%) long liners during late seventies. Sivasubramaniam (1981) while analysing the tuna long line catches close to India, Maldives and Srilanka reported hooking rates of 0.07%, 0.19% and 1.50% from the areas 70°-75°E and 75°-80°E of 0°-5°N and 75°-80°E of 5°-10°N. The present study reveals much higher hooking rates ranging from 0.36% to 3.08% in the surveyed area. The remarkably high hooking rate recently recorded in respect of yellowfin tuna is yet another positive indication supporting the feasibility of tuna exploitation from Indian waters.

Conclusion

Commercially viable concentrations of tuna have been identified in many parts of Indian EEZ and adjoining areas. With the continental border and oceanic islands generating appropriate conditions for tuna habitat, catch rates never reported elsewhere in Indian Ocean have been recorded within our 200 miles zone. However, further survey is required to assess the sustainability of these stocks and to arrive at the yield estimates. But obviously there is the resource potential in our waters quite comparable to and even higher than other oceanic areas supporting successful tuna fishery.

Acknowledgement

The authors are thankful to Shri T.E.Sivaprakasam, Director, Fishery Survey of India for his valuable guidance and encouragement in preparation of this paper. Thanks are also due to the scientists who participated in the survey cruises for their sincere effort in systematic collection of resources data. The excellent work by the Master and crew of Matsya Sugundhi and by officers and staff of Cochin Base of Fishery Survey of India in implementation of the survey programme is duly acknowledged.

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KEY TO SPECIES OF FISHES OCCURRING IN THE TRAWL CATCHES OF VISAKHAPATNAM

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Introduction

It is often lamented that biologists, particularly those interested in applied aspects of biology, tend to underestimate the importance of systematics and identify their material on a cursory examination. This rather casual appoach has, indeed, oftentimes caused considerable confusion as it has been virtually impossible to correlate unequivocally in the fishery data collected about a particular species or even genus. Fishery scientists studying the fishery resources of certain regions as a whole have very rarely paid adequate attention to the correct identification of fish and this had led to serious controversies and created problems in understanding the bionomics of the same species from different geographical areas and the bionomics of related species from the same area. A classical example of mistaken identify of an important food fish has been that of the Malabar Sole.

Realising the need to establish the correct identities of the different species contributing to the trawl fishery of Visakhapatnam or occurring incidentally in the trawl catches, a careful study of their systematics was undertaken. Material drawn over a period of eleven years from 1969-1979 from small, medium and large trawlers operating off the Visakhapatnam coast was examined.

Observations

During the present study, which forms the first special attempt to identify the different species occurring in the offshore area of the Visakhapatnam coast, only material collected from the coast line falling between

Lat. 17°N and 18°N, approximately covering the coastline of the Visakhapatnam district, have been taken into consideration. This study has also taken note of the numerous taxonomic revisions in recent years resulting in many nomenclatural changes. It was, therefore, considered useful to update our information regarding the species occuring in this region. Besides the fish collected during this investigation, those that were recorded off the Visakhapatnam coast by earlier workers and available in the National Zoological Collections, Zoological Survey of India, Calcutta, were also examined.

A total of 273 speices belonging to 166 genera drawn from 81 families are now known to occur in the trawl catches off Visakhapatnam though only about 50 of them are commercially important. For the benefit of students of ichthyology, particularly those who have to make reliable and accurate identifications quickly in the field, a key to the identification of fish species occurring in the trawl catches off Visakhaptnam has been prepared. In this publication, however, no check list has been included.

Acknowledgements

I gratefully acknowledge the help rendered by Dr. P.K.Talwar, Zoological Survey of India, Calcutta. The key could not have been prepared without his expert guidance and cooperation.

I thank Shri T.E.Sivaprakasam, Director, Fishery Survey of India, Bombay for arranging publication of the paper.

KEY TO SPECIES

1.	(a)	Few separate gill-openings on each side	:	2
	(b)	Single gill-opening on each side of body	:	30
2.	(a)	Gill slits situated on sides of body	:	3
	(b)	Gill slits confined to underside (ventral) of body	:	14
3.	(a)	Head singularly formed, hammer-shaped.	: Sphyrna blochii	
	(b)	Head normal, shark-shape	:	4
4.	(a)	Eyes with nictitating fold or membrane	:	5
	(b)	Eyes without nictitating fold or membrane	: Chiloscyllium indicus	
5.	(a)	Spiracles present	: Galeocerdo cuvier	
	(b)	Spiracles absent	:	6
6.	(a)	First dorsal-fin origin not behind inner pectoral-fin corner by a distance greater than or equal to that from 1st to 5th gill slits	: Scoliodon laticaudus	
	(b)	First dorsal-fin origin behind inner pectoral-fin corner by a distance greater than or equal to that from 1st to 5th gill slits	:	7
7.	(a)	Second dorsal-fin origin over or behind the centre of anal fin base.	:	8
	(b)	Second dorsal-fin origin in front of the centre of anal fin base.	:	9

8.	(a)	Upper labial furrow short or virtually absent, 0 to 1.3% of total length (rarely more than 1%)	:	Rhizoprionodon oligolinx
	(b)	Upper labial furrow longer, always present, more than 1.1% of total length (usually more than 1.3%)	:	Rhizoprionodon acutus
9.	(a)	Second dorsal fin not larger than anal fin	:	Carcharhinus temminckii
	(b)	Second dorsal fin larger than anal fin	:	 10
10.	(a)	Teeth in lower jaw not serrated, upper half of second dorsal fin usually deep black	:	Carcharhinus menisorrah
	(b)	Teeth in lower jaw serrated	:	 11
11.	(a)	Second dorsal fin distinctly smaller than anal fin	:	 12
	(b)	Second dorsal and anal fin subequal	:	 13
12.	(a)	Interdorsal ridge present	:	Carcharhinus sorrah
	(b)	No interdorsal ridge	:	Carcharhinus limbatus
13.	(a)	Preoral length distinctly less than width of mouth	:	Carcharhinus melanopterus
	(b)	Preoral length equal to or more than width of mouth	:	Carcharhinus dussumieri
14.	(a)	Snout saw-like	:	 15
	(b)	Snout not formed into a saw	:	 16
15.	(a)	A distinct lower (subcaudal) caudal fin lobe	:	Pristis cuspidatus
	(b)	No lower (subcaudal) caudal fin lobe	:	Pristis pectinatus

16.	(a)	Disc narrow and rather elongate	:	 17
	(b)	Disc broad and expanded,discoid	:	 19
17.	(a)	Caudal fin conspicuously bilobed	:	**Rhynchobatus djiddensis**
	(b)	Caudal fin not bilobed	:	 18
18.	(a)	Nostril length 2 to 3 times in width of mouth, about equals internarial space	:	**Rhinobatus granulatus**
	(b)	Nostril length less than twice width of mouth, greater than internarial space	:	**Rhinobatus thouiniana**
19.	(a)	Large prominent electic organs in head region	:	 20
	(b)	Electric organs absent in body	:	 22
20.	(a)	Origin of first dorsal fin opposite pelvic fins	:	**Torpedo panthera**
	(b)	Origin of first dorsal fin distinctly behind pelvic fins	:	 21
21.	(a)	Uniform brown above	:	**Narcine brunnea**
	(b)	Brown spotted above	:	**Narcine timlei**
22.	(a)	A distinct dorsal fin present	:	 23
	(b)	Dorsal fin absent	:	 25
23.	(a)	Anterior face of cranium nearly straight, subrostral fin (snout) not incised	:	 24
	(b)	Anterior face of cranium concave; subrostral fin incised (bilobed)	:	**Rhinoptera javanica**

24.	(a)	Teeth in a single transverse series; caudal fin spine present	:	**Aetobatus narinari**
	(b)	Teeth in three transverse series; no caudal fin spine	:	**Aetomylaeus nichofii**
25.	(a)	Buccal papillae on floor of mouth	:	 26
	(b)	No buccal papillae on floor of mouth	:	**Gymnura poecilura**
26.	(a)	Tail with longitudinal cutaneous folds (which do not extend to its tip)	:	 27
	(b)	Tail without dorsal and ventral longitudinal cutaneous folds	:	 29
27.	(a)	No buccal papillae on floor of mouth	:	**Dasyatis zugei**
	(b)	Two buccal papillae on floor of mouth	:	 28
28.	(a)	Tail short, about as long as length of disc.	:	**Dasyatis imbricata**
	(b)	Tail long, exceeding length of disc.	:	**Dasyatis kuhlii**
29.	(a)	Two buccal papillae on floor of mouth	:	**Dasyatis bleekeri**
	(b)	Four buccal papillae on floor of mouth	:	**Dasyatis uarnak**
30.	(a)	Body bilaterally symmetrical, eyes situated on both sides of longitudinal plane of head	:	 31
	(b)	Body asymmetrical, eyes on one side (right or left of body) body markedly laterally compressed	:	 251
31.	(a)	Body eel-like, long, rounded in section	:	 32
	(b)	Body neither eel-shaped nor much elongate	:	 43

32.	(a)	Large canine teeth (fang-like) on roof of mouth (vomer)	.....	33
	(b)	No large canine teeth on vomer	.....	41
33.	(a)	Pectoral fins present, well developed	.....	34
	(b)	Pectoral fins absent	.....	35
34.	(a)	Canine teeth on vomer conical, or if flattened, then not bulging on bases	.....	35
	(b)	Distinct bulge at bases of canine teeth on middle part of vomer	**Muraenesox cinereus**	
35.	(a)	Pectoral fin about 3 times in length of head	**Congresox telabon**	
	(b)	Pectoral fins shorter, atleast 4 times in length of head	**Congresox telabonoides**	
36.	(a)	Some teeth blunt or molariform, sometimes as pavement	.....	37
	(b)	Teeth sharp, no molariform teeth	.....	38
37.	(a)	Tail about half length of rest of body	**Echidna zebra**	
	(b)	Tail about as long as rest of body (vent about midway)	**Echidna nebulosa**	
38.	(a)	Edges of atleast some teeth serrate	**Gymnothorax reticularis**	
	(b)	Edges of all teeth smooth	.....	39
39.	(a)	One or more long median depressible fangs in front of upper jaw	.....	40
	(b)	No long median depressible fang in upper jaw, at most a single median stout conical tooth in front	**Sideria picta**	

40.	(a)	Cleft of mouth 2-3 in head length	:	**Lycodontis meleagris**
	(b)	Cleft of mouth 3.8 - 4.2 in head length	:	**Lycodontis tile**
41.	(a)	Posterior nostril within of piercing upper lip	:	:.... 42
	(b)	Posterior nostril not labial but dorsal or lateral	:	**Uroconger lapturus**
42.	(a)	Pectoral fins present	:	**Pisodonophis cancrivorus**
	(b)	Pectoral fins absent	:	**Caecula pterygera**
43.	(a)	Gill opening reduced to a small opening on upper side of head.	:	 44
	(b)	Not as above	:	 45
44.	(a)	Anal fin with 8 rays	:	**Callionymus japonicus**
	(b)	Anal fin with 9-10 rays	:	**Callionymus sagitta**
45.	(a)	Mouth very small; maxillaries generally closely united with premaxillaries, sometimes even fused with them; gill openings small;	:	 46
	(b)	Mouth not so small, if maxillaries fused with premaxillaries or mouth relatively small, then gill openings as a rule of normal size.	:	 58
46.	(a)	Teeth coalesced, forming a beak with the jaws; a spinous dorsal fin generally present	:	 47
	(b)	Teeth not coalesced; no spinous dorsal fin	:	 51
47.	(a)	Both jaws with a median suture	:	 48
	(b)	Jaws without median suture	:	**Diodon hystrix**

48.	(a)	Nasal organ - a more or less elevated hollow papilla, pierced by two openings	:	 49
	(b)	Nasal organ a single or bifid elevated tube	:	**Tetrodon immaculatus**
49.	(a)	Caudal fin truncate or rounded	:	**Sphoeroides oblongus**
	(b)	Caudal fin lunate	:	 50
50.	(a)	No spines on back	:	**Sphoeroides inermis**
	(b)	Whole of back spiny	:	**Sphoeroides lunaris**
51.	(a)	Pelvic fins paired, each of a long spine	:	 52
	(b)	Pelvic fins absent or fused into a single, generally movable, spine	:	 55
52.	(a)	A second dorsal-fin spine much less than half length of first spine	:	 53
	(b)	Second dorsal-fin spine more than half length of first spine	:	 54
53.	(a)	Snout concave	:	**Triacanthus biaculeatus**
	(b)	Snout straight	:	**Triacanthus brevirostris**
54.	(a)	Snout straight	:	**Pseudotriacanthus strigilifer**
	(b)	Snout concave	:	**Trixiphichthyes weberi**
55.	(a)	Body encased in a carapace	:	**Ostracion gibbosus**
	(b)	Body covered with hard or spinous scales	:	 56
56.	(a)	Scales small or minute, not in regular series	:	**Alutera scripta**
	(b)	Scales moderate or small, in regular series	:	 57
57.	(a)	A deep groove before the eye, below the nostril	:	**Balistes stellatus**
	(b)	A very shallow groove before eye	:	**Balistes fuscus**

58.	(a)	Snout markedly elongate, tubular at the end of which the small mouth is situated	:	.....	59
	(b)	Snout not tubular	:	.....	60
59.	(a)	Mouth toothed; body covered with long plates beneath the skin in parts	:	**Fistularia villosa**	
	(b)	Mouth toothless; body covered with dermal plates	:	**Trachyrhamphus longirostris**	
60.	(a)	First dorsal fin transformed into a sucking organ	:	.....	61
	(b)	First dorsal fin normal	:	....	62
61.	(a)	Body slender	:	**Echeneis naucrates**	
	(b)	Body robust	:	**Echeneis remora**	
62.	(a)	Gill openings situated under or behind pectoral fins, but not in front of them	:	.....	63
	(b)	Gill openings placed wholly in front of pectoral fins	:	.....	65
63.	(a)	Spinous dorsal fin with more than 3 rays	:	**Chirolophius mutilus**	
	(b)	Not more than 3 rays in the spinous dorsal fin	:	.....	64
64.	(a)	Spinous dorsal fin with only one ray	:	**Halieutaea stellata**	
	(b)	Spinous dorsal fin with 3 rays	:	**Antennarius hispidus**	
65.	(a)	Anal fin with 4 spines; angle of preoperculum with enlarged spine at angle	:	**Adioryx rubrum**	
	(b)	Not as above	:	.....	66
66.	(a)	Two dorsal fins, the 1st fin composed of a single elongated ray on head	:	**Bregmaceros macclellandi**	
	(b)	Not as above	:	.....	67
67.	(a)	Body naked (without scales) 3 to 4 pairs of barbels usually around mouth	:	.....	68
	(b)	Not as above	:	.....	74

68.	(a)	Caudal fin more or less pointed and confluent with dorsal and anal fins	:	**Plotosus lineatus**
	(b)	Caudal fin forked	:	 69
69.	(a)	Mandibular barbels present	:	 70
	(b)	No mandibular barbels	:	**Osteogeniosus militaris**
70.	(a)	Teeth on palate in 1 or 2 patches	:	 71
	(b)	Teeth on palate on 3 patches on each side, arranged in a large triangular group	:	**Arius thalassinus**
71.	(a)	Teeth on palate in 1 patch on each side (no teeth on vomer)	:	 72
	(b)	Teeth on palate in 2 patches on each side.	:	**Arius dussumieri**
72.	(a)	Teeth on palate villiform	:	**Arius caelatus**
	(b)	Teeth on palate granular or molar-like	:	 73
73.	(a)	Premaxillary tooth band distinctly divided in the middle; palatine patch of teeth placed at posterior extremity of roof of mouth	:	**Arius tenuispinis**
	(b)	Premaxillary tooth band continuous; palatine patch of teeth not placed or backwards on roof of mouth		**Arius jella**
74.	(a)	Dorsal and anal fins have soft rays, no spines	:	 75
	(b)	Dorsal and anal fins with spines and soft rays	:	 108
75.	(a)	Dorsal adipose fin present	:	 76
	(b)	Dorsal adipose fin absent	:	 80
76.	(a)	Caudal fin trilobed	:	**Harpadon nehereus**
	(b)	Caudal fin forked	:	 77

77.	(a)	Pelvic fin with 9 rays	:	.....	78
	(b)	Pelvic fin with 8 rays	:	.....	79
78.	(a)	Snout obtusely pointed; upper edge of caudal fin without back dots	:	**Saurida tumbil**	
	(b)	Snout rounded, upper edge of caudal fin with 4 to 7 distinct dark spots.	:	**Saurida undosquamis**	
79.	(a)	Eye opposite midpoint of upper jaws; head depressed	:	**Synodus indicus**	
	(b)	Eye nearer to anterior end of upper jaw; head not depressed	:	**Trachinocephalus myops**	
80.	(a)	Dorsal fin long, with 43 to 65 soft rays; no keeled scutes on belly	:	.....	81
	(b)	Dorsal fin short, never more than 25 soft rays; abdomen often with keeled scutes along the belly	:	.....	82
81.	(a)	Dorsal fin originating on head, with 48 to 65 soft rays	:	**Coryphaena hippurus**	
	(b)	Dorsal fin origin far behind head, with 43 to 45 soft rays	:	**Mene maculata**	
82.	(a)	Dorsal fin set well behind midpoint of body; mouth large with fang-like teeth in both jaws	:	**Chirocentrus dorab**	
	(b)	Dorsal fin more advanced, usually at midpoint of body; teeth in jaws small or absent	:	.....	83
83.	(a)	Articulation of lower jaw under or before eyes; mouth more or less terminal; snout not 'pig-like'	:	.....	84
	(b)	Articulation of lower jaw behind eyes; mouth 'under slung' (inferior); snout strongly projecting and usually 'pig-like'	:	.....	96

84.	(a)	Branchiostegal rays 14 to 19; body smooth (no abdominal scutes)	:	**Dussumieria acuta**	
	(b)	Branchiostegal rays 4 to 8; scutes on belly	:	.....	85
85.	(a)	Anal fin long (more than 30 rays)	:	.....	86
	(b)	Anal fin short (less than 30 rays)	:	.....	92
86.	(a)	Toothed hypomaxilla present	:	**Pellona ditchela**	
	(b)	Toothed hypomaxilla absent only a ligament present	:	.....	87
87.	(a)	Pelvic fins present	:	.....	89
	(b)	Pelvic fins absent	:	.....	88
88.	(a)	Dorsal fin present	:	**Opisthopterus tardoore**	
	(b)	Dorsal fin absent	:	**Raconda russelliana**	
89.	(a)	Swim bladder without post-coelomic extensions	:	**Ilisha sirishai**	
	(b)	Swim bladder with tubular post-coelomic extensions	:	.....	90
90.	(a)	Swim bladder with paired post-coelomic extensions	:	**Ilisha melastoma**	
	(b)	Swim bladder with a single post-coelomic extension on right side of body	:	.....	91
91.	(a)	Body depth 30-34% of standard length; dorsal fin origin midway between caudal fin-base and snout tip.	:	**Ilisha filigera**	
	(b)	Body slender, its depth 24-28% of standard length; dorsal fin origin nearer to caudal fin-base than to snout-tip	:	**Ilisha elongata**	
92.	(a)	Mouth inferior	:	**Anodontostoma chacunda**	
	(b)	Mouth terminal	:	.....	93
93.	(a)	Pelvic fin rays 7	:	**Escualosa thoracata**	
	(b)	Pelvic fin rays 8 or 9	:	.....	94

94.	(a)	Fronto-parietal striae (on top of head) 3 to 6	:	**Herklotsichthys punctatus**
	(b)	Fronto-parietal striae 7 to 14	:	 95
95.	(a)	Post-pelvic scutes 12 to 14	:	**Sardinella fimbriata**
	(b)	Post-pelvic scutes 15 to 16	:	**Sardinella gibbosa**
96.	(a)	Body tapering, rat-tailed	:	**Coilia dussumieri**
	(b)	Body normal	:	 97
97.	(a)	Abdominal scutes present only before pelvic fin-base; anal fin short, with less than 25 rays	:	 98
	(b)	Abdominal scutes present before and behind pelvic fin-base; anal fin longer with more than 30 rays	:	 102
98.	(a)	Muscular portion of isthmus not reaching to hind border of branchio stegal membrane, leaving portion of urohyal exposed	:	**Stolephorus heterolobus**
	(b)	Muscular portion of isthmus extending forward beyond hind margin of branchio stegal membrane	:	 99
99.	(a)	Hind border of pre-operculum evenly rounded near maxilla tip	:	 101
	(b)	Hind border of pre-operculum indented near maxilla tip	:	 100
100.	(a)	Double pigment line along back behind dorsal fin	:	**Stolephorus macrops**
	(b)	No double pigment line on back, melanophores irregularly scattered or absent	:	**Stolephorus andhraensis**
101.	(a)	Posterior frontal fontanelles broad, lateral borders sigmoid	:	**Stolephorus commersonii**
	(b)	Posterior frontal fontanelles narrow, lateral borders straight	:	**Stolephorus bataviensis**

102.	(a)	No abdominal scutes before pectoral fin, or 1 or 2 followed by a gap	:	**Thrissina baelama**
	(b)	Pre-pectoral abdominal scutes present	:	 103
103.	(a)	First pectoral fin ray filamentous	:	**Setipinna taty**
	(b)	First pectoral fin ray normal	:	 104
104.	(a)	Upper jaw (maxilla) very long; extending to beyond pectoral fin tip	:	**Thryssa setirostris**
	(b)	Upper jaw not extending beyond pectoral fin tip	:	 105
105.	(a)	Upper jaw (maxilla) short, not reaching to pectoral fin base	:	**Thryssa hamiltonii**
	(b)	Upper jaw long, reaching to pectoral-fin base or beyond	:	 106
106.	(a)	Gillrakers serrae uneven but not clumped	:	**Thryssa mystax**
	(b)	Gillrakers serrae in distinct clumps	:	 107
107.	(a)	Maxilla reaching 1/2 to 7/8 along pectoral fin; post-pelvic scutes 7 to 9	:	**Thryssa dussumieri**
	(b)	Maxilla shorter, reaching 1/3 along pectoral fin; post-pelvic scutes 9 to 12	:	**Thryssa vitrirostris**
108.	(a)	Pectoral fin divided into two parts, the upper with rays attached and the lower with 4 to 7 free rays	:	 109
	(b)	Pectoral fins normal, without free rays in lower part	:	 112
109.	(a)	Five free pectoral filamentous rays	:	**Polynemus indicus**
	(b)	Six to seven pectoral filamentous rays	:	 110

110.	(a)	Seven free pectoral filamentous rays	:	**Polynemus heptadactylus**
	(b)	Six free pectoral filamentous rays	:	 111
111.	(a)	Upper pectoral fin rays unbranched	:	**Polynemus kuru**
	(b)	Upper pectoral fin rays mostly unbranched	:	**Polynemus sextarius**
112.	(a)	Dorsal fins widely separated from each other	:	 113
	(b)	Dorsal fins with contiguous bases or nearly so	:	 114
113.	(a)	Gillrakers present on first arch	:	**Sphyraena obtusata**
	(b)	Gillrakers absent on first arch	:	**Sphyraena jello**
114.	(a)	Head and/or body tend to be spiny or body plated	:	 115
	(b)	Not as above	:	 127
115.	(a)	Inner rays of pectoral fins free	:	 116
	(b)	Inner rays of pectoral fins attached (not free)	:	 118
116.	(a)	Two free spines before the two dorsal fins; pectoral fins tremendously enlarged	:	Dactyloptera orientalis
	(b)	No free spines before the two dorsal fins; pectoral fins moderate	:	 117
117.	(a)	Body with scales	:	**Lepidotrigla spiloptera**
	(b)	Body entirely encased in heavy spine-bearing plates	:	**Peristedion halei**
118.	(a)	Pelvic fins widely separated	:	 123
	(b)	Pelvic fin bases adjacent	:	 119
119.	(a)	Gill membranes free from isthmus	:	 120
	(b)	Gill membranes united with isthmus	:	 122

120.	(a)	All pectoral rays simple	:	 121
	(b)	Median rays of pectoral fins deeply forked	:	**Pterois zebra**
121.	(a)	Scales in the lateral line 80-88	:	**Pterois russelli**
	(b)	Scales in the lateral line 91-106	:	**Pterois volitens**
122.	(a)	Dorsal fin with more spines (13) than soft rays (9)	:	**Choridactylus multibarbis**
	(b)	Dorsal fin with approximately same number of spines as soft rays	:	**Minous monodactylus**
123.	(a)	Lateral line entire, smooth (with no spines)	:	 124
	(b)	Lateral line armed with spines	:	 125
124.	(a)	Teeth on vomer in one patch	:	**Platycephalus indicus**
	(b)	Teeth on vomer in patches	:	**Platycephalus pristiger**
125.	(a)	All scales of lateral line with spines	:	**Platycephalus scaber**
	(b)	Only anterior scales of lateral line with spines	:	 126
126.	(a)	Four to eight spines on anterior scales of lateral line	:	**Platycephalus bengalensis**
	(b)	Fifteen to twenty spines as anterior scales of lateral line		**Platycephalus rodericensis**
127.	(a)	Lateral line short and rudimentary; males with a characteristic occipital hook	:	**Kurtus indicus**
	(b)	Not as above	:	 128
128.	(a)	Pelvic fins united	:	 129
	(b)	Pelvic fins separated	:	 131
129.	(a)	Pelvic fins united at base only	:	**Trypauchan vagina**
	(b)	Pelvic fins fully united	:	 130

130.	(a)	Lateral line high, ending near middle of dorsal fin	:	**Opisthognathus rosenbergii**
	(b)	Barbels on head	:	**Parachaeturichthys polynema**
131.	(a)	Jaws with comb-like teeth, pelvic fins anterior to pectoral fins	:	**Xiphasia setifer**
	(b)	Not as above	:	 132
132.	(a)	Eyes dorsal; lips fringed	:	 133
	(b)	Not as above	:	 134
133.	(a)	Preorbital with a distinct spine	:	**Uranoscopus guttatus**
	(b)	Preorbital without a distinct spine	:	**Uranoscopus fuscomaculatus**
134.	(a)	Pelvic fins each with 2 strong spines and 3 soft rays between them	:	 135
	(b)	Pelvic fins with at most 1 spine each	:	 136
135.	(a)	Last dorsal-fin spine much longer than first spine	:	**Siganus javus**
	(b)	Last dorsal-fin spine equal to or shorter than first spine	:	**Siganus canaliculatus**
136.	(a)	Toothed seccular out-growths in gullet behind last gill arch	:	 137
	(b)	No toothed saccular out-growths in gullet behind last gill arch	:	 140
137.	(a)	Dorsal fin continuous; body very deep	:	 138
	(b)	Two distinct, though scarcely separated dorsal fins	:	 139
138.	(a)	Dorsal and anal fins falcate, caudal fin strongly forked	:	**Pampus argenteus**
	(b)	Dorsal and anal fins not falcate; caudal fin emarginate	:	**Pampus chinensis**

139.	(a)	Body silvery with purple tinge	:	**Ariomma indica**
	(b)	Body silvery with scattered dark brown rounded spots	:	**Ariomma maculatus**
140.	(a)	Upper jaw protrusible	:	 141
	(b)	Upper jaw non-protrusible	:	 143
141.	(a)	Caudal peduncle with one or more spines	:	**Ctenochaetus strigosus**
	(b)	Caudal peduncle unarmed	:	 142
142.	(a)	Two long barbels on chin; two widely separated dorsal fins	:	 143
	(b)	No barbel on chin; when present (as in Sciaenidae) dorsal fin single but netched	:	 146
143.	(a)	Teeth on vomer and palatines	:	 144
	(b)	No teeth on palate (vomer and palatines)	:	**Parupeneus indicus**
144.	(a)	No cross-bars on caudal fin	:	**Upeneus sulphureus**
	(b)	Dusky cross-bars on caudal fin	:	 145
145.	(a)	Caudal fin with 5 to 6 dusky cross-bars on upper lobe only	:	**Upeneus moluccensis**
	(b)	Caudal fin with black cross-bars on both lobes	:	**Upeneus vittatus**
146.	(a)	Six to nine short free spines ahead of long dorsal fin	:	**Rachycentron canadus**
	(b)	No free spines in front of dorsal fin	:	 147
147.	(a)	Two detached spines in front of anal fin	:	 148
	(b)	First two spines of anal fin not detached from rest of fin	:	 174

148.	(a)	Some scutes present on posterior part of lateral line; pectoral fins long and sickle-shaped	.....	149
	(b)	Lateral line without scutes; pectoral fins short, not sickle-shaped	.....	169
149.	(a)	One or more finlets behind 2nd dorsal and anal fins	.....	150
	(b)	No finlets behind 2nd dorsal and anal fins	.....	151
150.	(a)	One finlet behind 2nd dorsal anal fin	**Decapterus dayi**	
	(b)	Eight to nine finlets behind 2nd dorsal and anal fins	**Megalaspis cordyla**	
151.	(a)	Body apparently naked, scales minute and embedded in skin; first dorsal fin with 6 small spines, not connected by a membrane	.....	152
	(b)	Body with small scales; not embedded in skin; first dorsal fin with 7 or 8 spines	.....	153
152.	(a)	Eye-diameter equal to or slightly less than suborbital depth	**Alectis ciliaris**	
	(b)	Eye-diameter 1.4-1.7 times in suborbital depth	**Alectis indicus**	
153.	(a)	A groove along belly (accommodating pelvic fins etc.)	**Atropus atropus**	
	(b)	No groove along belly	.....	154
154.	(a)	No teeth in upper jaw	.....	155
	(b)	Teeth present in both jaws	.....	156
155.	(a)	Single row of minute teeth in lower jaw	**Selaroides leptolepis**	
	(b)	No teeth in either jaw	**Gnathanodon speciosus**	

156.	(a)	No teeth on vomer and palatines	:	Uraspis helvolus
	(b)	Teeth present on roof of mouth (vomer and palatines)	:	 157
157.	(a)	Adipose tissue of eye covering all but central slit	:	Atule mate
	(b)	Adipose tissue leaving anterior half of eye exposed	:	 158
158.	(a)	A deep furrow on lower part of gill opening	:	Selar crumenophthalmus
	(b)	No furrow on lower part of gill opening	:	 159
159.	(a)	Single row of fine teeth in each jaw (except cluster at tip of upper jaw), none enlarged	:	 160
	(b)	Fins villiform teeth in bands, in jaws, outer row may be slightly enlarged	:	 162
	(c)	Teeth in a band in upper jaw, outer row enlarged; a single row in lower jaw, with 2 to 4 anterior canines	:	 164
160.	(a)	Spinous dorsal fin distinctly black	:	Alepes melanoptera
	(b)	Spinous dorsal fin pale	:	 161
161.	(a)	Lateral line moderately arched anteriorly to below 4th to 6th soft dorsal fin ray; ventral profile of body much more convex than dorsal profile	:	Alepes kalla
	(b)	Lateral line strongly arched anteriorly to below 2nd to 4th soft dorsal-fin ray; dorsal and ventral profile of body evenly convex	:	Alepes djedeba
162.	(a)	Naked area of breast low, triangular, highest part in front halfway between the isthmus and pectoral-fin base	:	Carangoides ferdau
	(b)	Naked area of breast extends more than halfway between isthmus and pectoral-fin base	:	 163

163.	(a)	Naked area on breast extending dorsally to lateral line	:	**Carangoides malabaricus**
	(b)	Naked area on breast extending dorsally not beyond the pectoral-fin base (sometimes including base of pectoral fin)	:	 164
164.	(a)	Gill rakers 20 to 23 on lower arm of first arch; head profile strongly arched, with hump at nape	:	**Carangoides ciliaris**
	(b)	Gill rakers 16 on lower arm of first arch, straight profile in front of eye, without prominent hump at nape	:	**Carangoides chrysophrys**
165.	(a)	Breast completely scaled	:	 166
	(b)	Breast naked ventrally, with a small patch of scales immediately in front of pelvic fins	:	 167
166.	(a)	Upper jaw reaching to below front edge of eye (front edge of pupil in juveniles)	:	**Caranx melampygus**
	(b)	Upper jaw reaching to below posterior edge of pupil or eye	:	**Caranx sexfasciatus**
167.	(a)	Lateral line with 28 to 30 scutes	:	**Caranx ignobilis**
	(b)	Lateral line with 33 to 37 scutes	:	 168
168.	(a)	Eye-diameter 5.5-6.3 in head length	:	**Caranx sem**
	(b)	Eye-diameter 3.5-4.0 in head length	:	**Caranx carangus**
169.	(a)	Second dorsal and anal fin bases about equal in length	:	 170
	(b)	Second dorsal-fin base much longer than anal-fin base	:	 173

170.	(a)	Body deep; soft dorsal and anal fins strongly falcate; scales circular	:	**Trachinotus blochii**
	(b)	Body slender; soft dorsal and anal fins not strongly falcate; scales elongate or needle-like	:	 171
171.	(a)	Scales narrow, needle-like, indistinct, giving the skin a striated appearance	:	**Scomberoides tala**
	(b)	Scales small, lanceolate, but distinct	:	 172
172.	(a)	Double row of black spots on side of body	:	**Scomberoides lysan**
	(b)	Single row of round blotches on side of body	:	**Scomberoides commersonianus**
173.	(a)	One finlet behind 2nd dorsal and anal fins	:	**Elagatis bipinnulatus**
	(b)	No finlets behind 2nd dorsal and anal fins	:	**Seriolina nigrofasciata**
174.	(a)	Anterior rays of soft dorsal and anal fins markedly elongate, giving both fins a sickle shape, body deep	:	**Monodactylus argenteus**
	(b)	Anterior rays of soft dorsal and anal fins usually not elongate, but when elongate they do not give either fin a sickle shape.	:	 175
175.	(a)	Body very deep, its depth more than half total body length; single dorsal fin, spines clearly distinguishable	:	 176
	(b)	Body oblong or moderately deep, its depth less than half total body length; when deep-bodied and with a single dorsal fin, there are no spines or the spiny rays difficult to distinguish from soft rays	:	 183

176.	(a)	No procumbent spine in dorsal fin; body deep, discus-shaped; dorsal fin single and continuous	.....	177
	(b)	First spine of dorsal fin procumbent (visible only in juveniles); spinous part of dorsal fin distinct from soft-rayed part (except in genus **Platax**)	.....	180
177.	(a)	Strong spine at angle of preopercle	**Holacanthus xanthurus**	
	(b)	No strong spine at angle of preopercle	.....	178
178.	(a)	Fourth dorsal-fin spine prolonged, often filamentous	**Heniochus acuminatus**	
	(b)	None of dorsal fin spines prolonged	.....	179
179.	(a)	Anterior part of soft dorsal fin with a dark, white-edged ocellus	**Chaetodon jayakari**	
	(b)	No ocellus on soft dorsal fin	**Chaetodon vagabundus**	
180.	(a)	Anal fin with 4 spines	**Scatophagus argus**	
	(b)	Anal fin with 3 spines	.....	181
181.	(a)	Mouth protractile; pectoral fins falcate	**Drepane punctata**	181
	(b)	Mouth not protractile or scarcely so; pectroal fins short, rounded	.....	182
182.	(a)	Spinous dorsal fin separated from soft-rayed portion by a deep notch	**Ephippus orbis**	
	(b)	Spinous dorsal fin concluent with soft-rayed portion, with no notch	**Platax pinnatus**	
183.	(a)	Single dorsal fin with no spines	**Apolectis niger**	
	(b)	One or two dorsal fins having well developed spines	.....	184

184.	(a)	Two dorsal fins, well separated when close together they are not joined by a membrane	:	 185
	(b)	Single dorsal fin, often deeply notched but the membrane is intact	:	 190
185.	(a)	Anal-fin base considerably longer than 2nd dorsal-fin base	:	Lactarius lactarius
	(b)	Anal-fin base as long as or shorter than 2nd dorsal-fin base	:	 186
186.	(a)	Anal fin with 3 spines	:	Ambassis commersoni
	(b)	Anal fin with 2 spines	:	 188
187.	(a)	Two distinctly separated dorsal fins, the first with 6 to 8 spines	:	 187
	(b)	Two dorsal fins (small or no inter space), the first with 10 to 11 spines	:	Sillago sihama
188.	(a)	Caudal fin rounded or subtruncate	:	Apogon taeniatus
	(b)	Caudal fin emarginate or forked	:	 189
189.	(a)	Body with longitudinal bands	:	Apogon septemstriatus
	(b)	Body without longitudinal bands	:	Apogon enneastigma
190.	(a)	Scaly process in pelvic-fin axis	:	 191
	(b)	No scaly process in pelvic fin axis, anal fin with 3 spines	:	 235
191.	(a)	Anal fin with 2 spines	:	 192
	(b)	Anal fin with 3 spines	:	 207
192.	(a)	Gas bladder with 1 or 2 pairs of simple or branched appendages	:	 193
	(b)	Gas bladder with more than two pairs of branched appendages	:	 195

193.	(a)	Gas bladder appendages wholly directed forward from anterior end of bladder	:	**Kathala auxillaris**	
	(b)	Gas bladder appendages with at least the main part lying parallel to the bladder	:	.....	194
194.	(a)	Gas bladder with one diverticulum on each side, attached near posterior end.	:	**Otolithoides biauritus**	
	(b)	Gas bladder with the diverticulum of each side arising from anterior end and immediately dividing into a cephalic and abdominal branch	:	**Panna microdon**	
195.	(a)	Gas bladder hammer-shaped	:	.....	196
	(b)	Gas bladder carrot-shaped	:	.....	199
196.	(a)	No barbel on chin	:	**Johnius amblycophalus**	
	(b)	A barbel on chin	:	.....	197
197.	(a)	Teeth in lower jaw in a band, uniform in size	:	**Johnius carutta**	
	(b)	Teeth in lower jaw more or less enlarged; spaced	:	.....	198
198.	(a)	Snout and preorbital inflated	:	**Johnius dussumieri**	
	(b)	Snout decurved, but not inflated	:	**Johnius sina**	
199.	(a)	Anterior pair of pores on chin close together behind symphysis or united by a groove	:	.....	200
	(b)	Anterior pair of pores in front of chin separated by symphysis	:	.....	202
200.	(a)	Anterior pair of gas bladder appendages cephalic, extending into head	:	.....	201
	(b)	Anterior pair of gas bladder appendages branching on posterior surface of traverse septum and not entering head	:	**Protonibea diacanthus**	

201.	(a)	Soft dorsal fin with 28-31 rays	:	Nibea soldado	
	(b)	Soft dorsal fin with 24-25 rays	:	Nibea maculata	
202.	(a)	Outer row of teeth in upper jaw enlarged and spaced, but no outstanding canine teeth	:	.....	203
	(b)	One or two pairs of canine teeth near symphysis of upper or both jaws	:	.....	204
203.	(a)	Gas bladder appendages each with distinct dorsal and ventral limbs	:	Atrobucca nibe	
	(b)	Gas bladder appendages wing-like, without a dorsal limb.	:	Pennahia macrophthalmus	
204.	(a)	Canine teeth in upper jaw only, mouth inferior	:	Chrysochir aureus	
	(b)	Canine teeth in both jaws; lower jaw projecting	:	.....	205
205.	(a)	Soft anal fin with 10 to 11 rays	:	Pterotolithus maculatus	
	(b)	Soft anal fin with 7 or 8 rays	:	.....	206
206.	(a)	Gillrakers 8 to 11 on lower arm of first arch	:	Otolithes ruber	
	(b)	Gillrakers 12 to 14 on lower arm of first arch	:	Otolithes cuvieri	
207.	(a)	Mouth highly protrusible	:	.....	208
	(b)	Mouth moderately protrusible	:	.....	218
208.	(a)	Upper surface of head having bony ridges and nuchal spine on nape, head naked	:	.....	209
209.	(b)	Upper surface of head smooth; head scaly	:	.....	216
209.	(a)	Distinct canine teeth in jaws	:	Gazza minuta	
	(b)	No canine teeth in jaws	:	.....	210

210.	(a)	Mouth when protracted forming tube directed upwards	:	 211
	(b)	Mouth when protracted forming a tube directed forward or downwards	:	 212
211.	(a)	Body depth 1.5-1.8 in standard length	:	Secutor ruconius
	(b)	Body depth 2.0-2.3 in standard length	:	Secutor insidiator
212.	(a)	Cleft of mouth at or below lower edge of eye	:	Leiognathus dussumieri
	(b)	Cleft of mouth opposite lower third of eye	:	 213
213.	(a)	Beast with small scales	:	Leiognathus bindus
	(b)	Breast entirely naked	:	 214
214.	(a)	Dark saddle on nape	:	Leiognathus brevirostris
	(b)	No drak saddle on nape	:	 215
215.	(a)	Black blotch on upper half of of spinous dorsal fin	:	Leiognathus daura
	(b)	No black blotch on upper half of spinous dorsal fin	: :	Leiognathus equulus .....
216.	(a)	Anal-fin base longer than soft dorsal-fin base	:	Pentaprion longimanus
	(b)	Anal-fin base shorter than soft dorsal-fin base	:	 217
217.	(a)	Six to eleven greyish-black spots above and below lateral line	:	Gerres filamentosus
	(b)	Five to ten brownish diffuse crossbar on back of body	:	Gerres macracanthus
218.	(a)	Distal end of premaxillae overlapping maxillae externally	:	 219
	(b)	Maxillae not overlapped by tip of premaxillae	:	 220

219.	(a)	Elongated spines in dorsal fin	:	**Argyrops spinifer**	
	(b)	No elongated spines in dorsal fin	:	**Rhadbosargus sarba**	
220.	(a)	Suborbital process well-developed, sometimes with a spine posteriorly	:	.....	221
	(b)	Suborbital process either absent or weakly developed	:	.....	233
221.	(a)	No teeth on roof of mouth (vomer and palatines)	:	.....	222
	(b)	Teeth present on roof of mouth	:	.....	228
222.	(a)	Backward-pointing spine below eye	:	**Scolopsis vosmeri**	
	(b)	No spine below eye	:	.....	223
223.	(a)	Interspinous membrane of dorsal fin deeply notched	:	**Nemipterus tolu**	
	(b)	Interspinous dorsal fin membrane entire or slightly emarginate	:	.....	224
224.	(a)	Upper lobe of caudal fin prolonged into a filament	:	.....	225
	(b)	Upper lobe of caudal fin normal, not prolonged into a filament	:	.....	226
225.	(a)	First and second spines of dorsal fin close together and forming a single long filament	:	**Nemipterus luteus**	
	(b)	First and second spines of dorsal fin normal, not prolonged	:	**Nemipterus japonicus**	
226.	(a)	A spot below origin of lateral line	:	**Nemipterus hexodon**	
	(b)	No spot near or below origin of lateral line	:	.....	227

227.	(a)	Flanks of body with two principal yellow bands, other less distinct bands may also be present.	:	**Nemipterus bleekeri**	
	(b)	Flanks of body with five to seven green/yellow upward curved stripes; an arrow mark usually on head	:	**Nemipterus delagoae**	
228.	(a)	Soft dorsal and soft anal fins scaleless	:	**Pristipomoides typus**	
	(b)	Soft dorsal and soft anal fins scaled, or with a low basal scaly sheath	:	.....	229
229.	(a)	Longitudinal rows of scales above lateral line parallel to it anteriorly, ascending somewhat below posterior part of soft dorsal fin	:	**Lutjanus johni**	
	(b)	Longitudinal rows of scales above lateral line appear to rise obliquely to dorsal profile, those in front of and below anterior part of spinous dorsal fin sometimes parallel to lateral line	:	.....	230
230.	(a)	Scales on head beginning above middle of eyes or nearly so, temporal region scaly	:	**Lutjanus lutianus**	
	(b)	Scales on head beginning behind eyes; temporal region naked or nearly so	:	.....	231
231.	(a)	Longitudinal rows of scales below lateral line parallel to axis of body	:	**Lutjanus bohar**	
	(b)	Longitudinal rows of scales below lateral line appear to rise obliquely to dorsal profile, sometimes horizontal anteriorly	:	.....	232

232.	(a)	Interorbital width 4.4-5.0 in head length; head profile straight or concave	:	**Lutjanus sanguineus**
	(b)	Interorbital width broader 3.0-3.7 in head length; head profile convex	:	**Lutjanus malabaricus**
233.	(a)	Chin with 6 pores and no groove	:	**Diagramma pictus**
	(b)	Chin with 2 pores and longitudinal groove	:	 232
234.	(a)	Nape and back of body with a series of incomplete cross-bars	:	**Pomadasys maculatus**
	(b)	Not as above	:	 235
235.	(a)	Dorsal fin with 2 to 3 rows of brown spots	:	**Pomadasys hasta**
	(b)	Dorsal fin without spots	:	**Pomadasys guaraca**
236.	(a)	Inner ray(s) of pelvic fins attached to abdomen by a membrane	:	 237
	(b)	Inner ray of pelvic fins not connected to body by a membrane	:	 238
237.	(a)	Dorsal fin with 8 spines	:	**Diploprion bifasciatum**
	(b)	Dorsal fin with 10 spines	:	 239
238.	(a)	Dorsal fin with 14 to 15 soft rays	:	**Priacanthus hamrur**
	(b)	Dorsal fin with 12 to 13 soft rays	:	**Priacanthus tayenus**
239.	(a)	Opercle with 3 spines	:	 240
	(b)	Opercle with 1 or 2 spines	:	 241
240.	(a)	Caudal fin truncate or slightly emarginate	:	**Epinephelus areolatus**
	(b)	Caudal fin rounded	:	**Epinephelus tauvina**
241.	(a)	Gill membranes united to isthmus	:	**Pelates quadrilineatus**
	(b)	Gill membranes free from isthmus	:	 242

242.	(a)	Dark longitudinal bands on body curved	:	Terapon jarbus
	(b)	Dark longitudinal bands on body straight	:	Terapon theraps
243.	(a)	Body ribbon-shaped	:	 244
	(b)	Body spindle-shaped	:	 248
244.	(a)	Pelvic fins present, appearing as scale-like structures; lower hind border of operculum convex	:	 245
	(b)	Pelvic fins absent, lower hind border of operculum concave	:	 246
245.	(a)	Dorsal fin with 123-131 soft rays	:	Eupleurogrammus glossodon
	(b)	Dorsal fin with 139-147 soft rays	:	Eupleurogrammus muticus
246.	(a)	Post-anal scute prominent and dagger-like, its size about half eye-diameter	:	Lepturacanthus savala
	(b)	Post-anal scute not enlarged, less than width of pupil of eye	:	 247
247.	(a)	Head length 8.0-8.8 in total length	:	Trichiurus pantului
	(b)	Head length 6.7 - 7.6 in total length	:	Trichiurus lepturus
248.	(a)	Two small keels on either side of caudal peduncle	:	Rastrelliger kanagurta
	(b)	Two small keels and another between them on either side of caudal peduncle	:	 249
249.	(a)	Dark horizontal narrow streaks on side of body, breaking up into spots ventrally	:	Scomberomorus lineolatus
	(b)	Vertical bars on prominent round spots on sides of body	:	 250

250.	(a)	Dark prominent spots on sides of body	:	Scomberomorus guttatus
	(b)	Numerous wavy vertical bars along sides of body	:	Scomberomorus commerson
251.	(a)	Dorsal fin not extending on to head	:	Psettodes erumei
	(b)	Dorsal fin extending onto head at least to eyes	:	 252
252.	(a)	Preopercular margin free and distinct, not covered by skin	:	 253
	(b)	Preopercular margin not entirely free, covered by skin	:	 261
253.	(a)	Pelvic fins with short equal bases	:	 254
	(b)	Pelvic fin base of eyed side normally much longer than that of blind side	:	 258
254.	(a)	Head length about 2.5 in standard length	:	Cephalopsetta ventrocellatus
	(b)	Head length at least 3.0 in standard length	:	 255
255.	(a)	Anterior rays of dorsal fin larger than those following; gillrakers 23-25 on lower arm of first arch	:	Pseudorhombus triocellatus
	(b)	Anterior rays of dorsal fin not prolonged; gillrakers 8-15 on lower arm of first arch	:	 256
256.	(a)	Maxillary extending to below posterior edge of lower eye	:	Pseudorhombus arsius
	(b)	Msaxillary not extending beyond middle of lower eye	:	 257
257	(a)	Upper profile on head curved or very slightly notched in front of eyes	:	Pseudorhombus javanicus
	(b)	Upper profile of head notched in front of eyes	:	Pseudorhombus elevatus

258.	(a)	Mouth small, hardly any teeth on eyed side of jaws	:	Laeops quentheri	
	(b)	Mouth larger, teeth on both sides of jaws	:	.....	259
259.	(a)	Distance between eyes 0.5-1.0 eye-diameter	:	Parabothus polylepis	
	(b)	Distance between eyes more than eye-diameter	:	.....	260
260.	(a)	Scales of eyed side strongly ctenoid	:	Crossorhombus yalde-rostratus	
	(b)	Scales of eyed side feebly ctenoid	:	Bothus pantherinus	
261.	(a)	Eyes on right side	:	.....	262
	(b)	Eyes on left side	:	.....	268
262.	(a)	Snout forming a distinct hook	:	Heteromycteris oculus	
	(b)	Snout not forming a distinct hook	:	.....	263
263.	(a)	Caudal fin separate from dorsal and anal fins	:	.....	264
	(b)	Caudal fin confluent with dorsal and anal fins	:	.....	266
264.	(a)	Pectoral fins well developed	:	.....	265
	(b)	Pectoral fins absent	:	Asaraggodes cyaneus	
265.	(a)	Body ovate, its depth 2.0-2.2 in total length	:	Solea ovata	
	(b)	Body elongate, its depth 2.5-3.0 in total length	:	Solea elongata	
266.	(a)	First ray of dorsal fin enlarged and free	:	Aesopia cornuta	
	(b)	First ray of dorsal fin modified	:	.....	267
267.	(a)	Body with 10 to 12 paired cross-bands on ocular side	:	Zebrias quagga	
	(b)	Body with 14 unpaired cross-bands on ocular side	:	Zebrias altipinnis	

268.	(a)	Two lateral lines on blind side of body	:	**Cynoglossus bilineatus**
	(b)	No lateral line on blind side of body	:	 269
269.	(a)	Cycloid scales on blind side of body	:	**Cynoglossus arel**
	(b)	Ctenoid scales on blind side of body	:	 270
279.	(a)	Angle of mouth distinctly nearer to gill-opening than to end of snout	:	**Cynoglossus lida**
	(b)	Angle of mouth nearer to end of snout than to gill-opening	:	**Cynoglossus cynoglossus**

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