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RESOURCES OF HORSE MACKEREL OFF THE SOUTH WEST COAST OF INDIA

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INTRODUCTION

The resources surveys conducted by the research vessels **Sardinella** and **Rastrelliger** of the Pelagic Fishery Project for the past four years from Ratnagiri to Gulf of Mannar have not only enhanced our knowledge of the magnitude, seasonal distribution and abundance of the pelagic fish resources but also of the efficient methods of harvesting the resources. One of the resources of considerable magnitude and of great importance in the Project area is that of horse mackerel comprising mainly true horse mackerel *(Megalaspis cordyla)*, scads *(Decapterus* spp.*)* and trevallies *(Caranx* spp.*)*. This resource, comprising on an average about 13% of the total fish biomass, can sustain an important pelagic fishery if developed, employing efficient and modern methods of capture. The average annual landings of horse mackerel during the past decade is 20,973 tonnes which is only 2.1% of India's marine fish production. Surprisingly, in the project area alone, the average standing stock of horse mackerel estimated through stock assessment surveys is of the magnitude of 1,41,000 tonnes which is considerably higher than the present all India yield.

Studies on the biology and fishery of horse mackerel comprising true horse mackerel, scads and trevallies is very limited in detail and extent from the Indian waters. Information on the food and feeding habits of various species of horse mackerel is given by Chidambaram and Venkataraman (1946), Devanesan & Chidambaram (1948), Chacko & Mathew (1954), Datar (1954), Kuthalingam (1959), Venkataraman (1960), Reuben (1968) and Srinivasan (1974). Similarly maturity condition, spawning season and early development of some of the species have been dealt with in some detail (Chacko & Mathew, 1954; Vijayaraghavan, 1957; Kuthalingam, 1959; Subrahmanyam, 1966 and Rao & Girijavallabhan, (1973). Details of the commercial fishery are available from the accounts given by Devanesan & Chidambaram (1948), Chacko and Mathew (1954) and Radhakrishnan (1973).

Information on the biology, especially the seasonal and spatial distribution and magnitude of the stocks supporting the fishery will be of considerable value in assessing the fishery potential and regulating the fishery to obtain maximum sustainable yield. It is, therefore, hoped that this account dealing with the commercial potentials of the horse mackerel resource along the south west coast of India will further the judicious planning, exploitation and utilisation of this important pelagic fish resource of our country.

PRESENT LEVEL OF EXPLOITATION

The relative contribution of horse mackerel in the all India marine fish production at present, is insignificant. This is mainly because the traditional methods of fishing are inefficient and exploitation is marginal as the resources are, for most part of the year, distributed on the middle and outer shelf and hence out of reach to the traditional fisheries.

Presently horse mackerel are seasonal fisheries only both on the west and east coast of India and are supported by several species, mainly true horse mackerel *(Megalaspis cordyla)*, scads *(Decapterus kurra* and *D. russelli)* and trevallies (important ones being *Caranx carangus, C. malabaricus, C. malam, C. mate, C. malampygus* and *C. ignobilis)*. Of these, the true horse mackerel and scads are the most widespread and are landed in fair quantities in Kerala and Tamil Nadu. Trevallies, though common all along the coast, are taken in quantities only in Tamil Nadu and Kerala.

Field key for the commercially important species of horse mackerel based on Day (1878–88), Smith (1953) and Munro (1955) is given below, to facilitate easy identification of common species.

Body oblong, ovate or sub-cylindrical in shape, strongly or feebly compressed and with small thin cycloid scales, those on lateral line often enlarged characteristically into scutes. Mouth moderate, teeth usually feeble, sometimes wanting. Front two anal spines separate and usually strong. Detached finlets behind dorsal and anal fins sometimes present.

1. Body sub-cyclindrical; finlets present behind dorsal and anal fins ... 2

   Body laterally compressed; no true finlets behind dorsal and anal fins ... 4

2. Finlets 6–9: laterial line with 53–58 large scutes, reaching below spinous dorsal fins; body torpedo-shaped, bluish green above, silvery below; fins yellowish, edged with black ... *Megalaspis cordyla*

   One finlet behind soft dorsal and anal fins ... 3

3. Body cigar-shaped; teeth on vomer in two anterior patches; lateral line with about 40 scutes; bluish superiorly becoming silvery below; fins yellowish, darker distally ... *Decapterus russelli*

   Body spindle-shaped; teeth on vomer in a transverse line or arrow head form; lateral line with 32–38 scutes; bluish green above becoming silvery on sides and ventrally: fins pale yellowish ... *Decapterus dayi**

* The species mentioned as *D. kurra* in the present account is synonymous with *D. dayi.*

4. Breast completely scaled ... 5

Breast naked ventrally and sometimes laterally ... 6

5. A groove in shoulder girdle under operculam; teeth small and uniform... 8

No groove in shoulder girdle: teeth in outer series enlarged, often caniniform anteriorly: lateral line with 36–38 scutes: dark bluish dorsally becoming pale below: fins often with black tips ... *Caranx melampygus*

6. Teeth in several rows anteriorly in lower jaw; 25–29 scutes in lateral line; gill rakers 23–25: silvery blue green: fins whitish ...*Caranx malabaricus*

Teeth in single series in lower jaw 7

7. Lateral line with 27–30 scutes; gill rakers 15; olive green above, fins yellow ... *Caranx ignobilis*

Lateral line with 33–37 scutes: few breast scales near pectoral; golden yellow above, silvery below: small opercular spot; soft dorsal and upper lobe of caudal fin edged blackish ... *Caranx carangus*

8. Last dorsal and anal rays finlet-like and a little separated; lateral line with 40–45 broad scutes, the broadest 6–7 in body height: grey or slaty above, silvery white below: large black blotch on shoulder girdle ... *Selar mate*

Last dorsal and anal rays not separated: lateral line with 48–56 narrow scutes, the broadest 9-10 in body height: dark green or brownish above, lighter below: 6–9 cross bars above lateral line: a distinct black shoulder spot: soft dorsal and caudal blackish ... *Selar malam*

The average annual landing of horse mackerel during the last decade (1965–74) is 20,973 tonnes which is about 2.1% of the total marine fish landings in India (Table 1). An examination of the catch data over the same period shows very little variation in the annual landings. The bulk (71%) of the annual landings is from the states of Tamil Nadu and Kerala contributing about 35% and 34% respectively to the catches. While fair amounts of these species are caught in Andhra Pradesh (12%) and Maharashtra (9%), the landings are negligible in other states. Majority of the horse mackerel landings are in the third and fourth quarters in the states of Kerala, Tamilnadu and Andhra Pradesh and in the fourth quarter along the coasts of Karnataka and Maharashtra. The estimated average annual landings of horse mackerel over the past decade in the Project area comes to only about 10,400 tonnes.

MAGNITUDE OF THE RESOURCES

From the fish resources surveys conducted by the Pelagic Fishery Project, it has become possible to chart out the pattern of distribution and abundance of the horse mackerel resources in space and time, as well as to assess the size of the standing stock off the south west coast of India. The investigations have shown that,

TABLE – 1. *All India and statewise annual landings (in tonnes) of horse mackerel (1965–1974)**

Year	Gujarat	Maha-rashtra	Karnataka & Goa	Kerala	Tamilnadu & Pondicherry	Andhra Pradesh	Orissa, W. Bengal & Andamans	All India total
1965	926	707	511	3,959	9,198	2,287	31	17,619
1966	916	405	281	7,848	8,286	1,793	152	19,681
1967	878	771	1,027	9,742	8,839	2,987	197	24,441
1968	887	620	1,305	4,827	5,172	2,740	533	16,084
1969	736	3,899	1,587	3,592	9,234	1,958	416	21,422
1970	371	5,251	860	2,633	6,798	2,565	900	19,378
1971	899	2,414	440	4,975	9,514	2.499	155	20,896
1972	443	400	520	14,914	7,449	2,425	166	26,317
1973	442	888	1,226	14,372	5,858	2,589	238	25,413
1974	1,089	2,539	783	5,394	5,662	2,901	110	18,478
Average	738.7	1,789.4	854.0	7,225.6	7,601.0	2,474.4	289.8	20,972.9
% of total	3.5	8.5	4.1	34.5	36 2	11.8	1.4	100.00

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

on an average, the standing stock of these species in the area is of the order of 1,41,000 tonnes.

While biomass of horse mackerel from October 1972 to September 1973 has been grouped with "Other fish" biomass, separate assessments have been made for each coverage since September/October 1973. The biomass estimates of this resource for the period from October 1972 to September 1973 have per force been derived by extrapolation based on the data of subsequent coverages.

Horse mackerel recordings are generally found in good concentrations on the middle and outer shelf extending from 30 m to 100 m bottom depth; in certain seasons and areas, however, their distribution extends shorewards upto 15 20 m depth. The echo recordings of horse mackerel, while in dispersed state appear as slightly elongated dark dots and in schools appear as very dark, vertically oriented and well defined narrow markings. The pattern of echo recordings of horse mackerel is easily distinguishable from that of other fishes (Anonymous, 1974).

Species of horse mackerel show marked diurnal behaviour and distribution pattern which are more pronounced in the case of true horse mackerel *(Megalaspis cordyla)* and scads *(Decapterus* spp.*)* than in the case of trevallies *(Caranx* spp.*)*. Generally, during day, they are found as dense vertically extended schools at or near the bottom and ascending to surface layers at night when they are found either in dispersed state or in schools (Fig. 1).

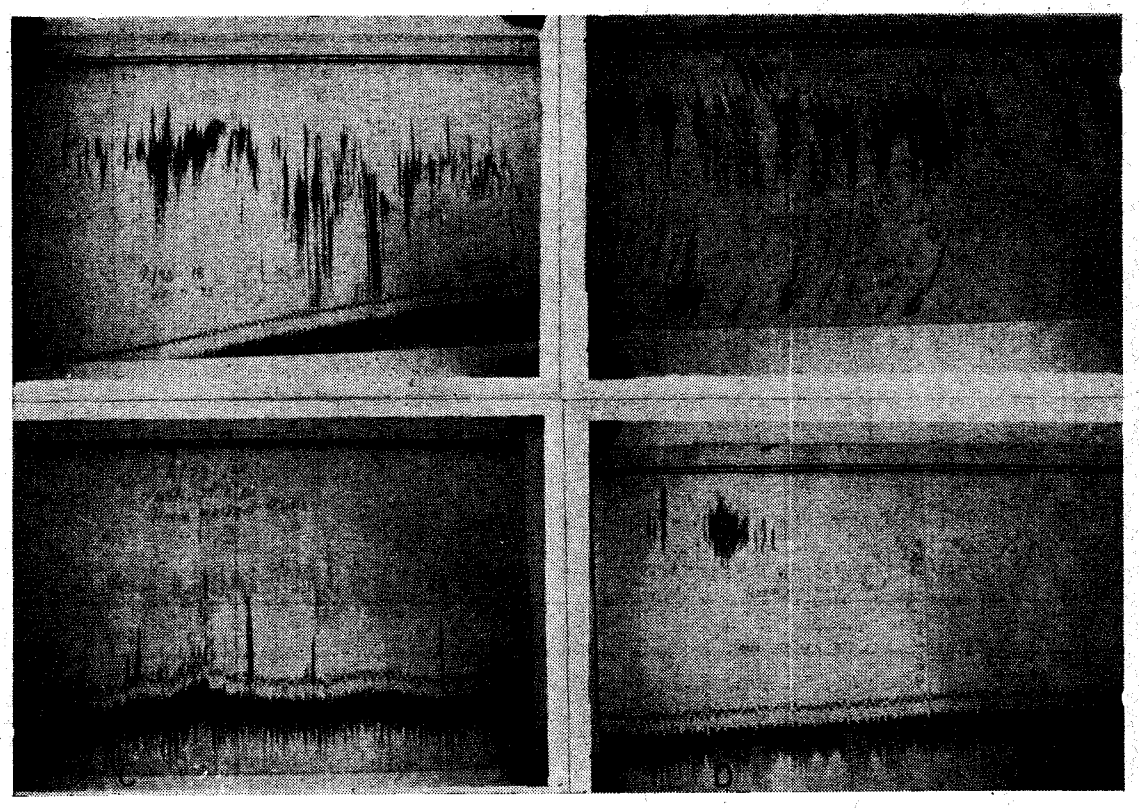

Fig. 1. Echo recordings of horse mackerel. A. At early morning, B. Spawning concentrations in midwater during forenoon, C. School concentrations at bottom during noon and D. Dispersed recordings and diffuse school recordings at night (Photos by Mr. Asmund Hermansen).

The biomass estimates of the horse mackerel resources in the Project area for each coverage period from October 1972 to July/August 1975 are given in Table 2. Horse mackerel constitutes by far an important pelagic resource and contributes an average of 13.2% to the total fish biomass in the Project area. The average standing stock per coverage was estimated to be in the order of 1,40,500 tonnes with the highest estimate in 1973 being, 1,69,300 tonnes (July/August), in 1974 2,29,300 tonnes (October/November) and in 1975 5,52,800 tonnes (April/May). It is observed that the average stock is the highest along Kerala coast (70,259 tonnes), followed by that of Southern Tamilnadu (56,246 tonnes), Karnataka (20,202 tonnes) and Southern Maharashtra (12,852 tonnes). It is also evident from the data (Table 2) that the highest abundance of the horse mackerel resources off Southern Maharashtra occurs during the first and second quarters, along the coast of Goa and Karnataka it is during the second and fourth quarters, and off the Kerala and Southern Tamilnadu coasts it is during the second and third quarters of the year.

TABLE 2. *Distribution of biomass estimates (in tonnes) of horse mackerel by coverage and area.*

	Area Coverage	Southern Maharashtra	Karnataka	Kerala	Tamilnadu (Gulf of Mannar & West coast)	Total
1972	Oct	0	3,846	19,997	—	23,843
	Nov	2,383	48,145	12,367	—	62,895
1973	Jan/Feb	16,088	5,031	29,702	4,321	55,142
	Mar/Apr	0	8,061	56,348	34,815	99,224
	Apr	—	—	37,481	—	37481
	May/Jun	8,936	11,478	37,820	10,449	68,683
	Jun/July	12,181	11,284	45,157	76,710	1,45,332
	July/Aug	0	4,467	90,650	74,162	1,69,279
	Sept	—	—	78,527	—	78,527
	Sept/Oct	0	—	86,072	—	86,072
	Oct/Nov	0	6,105	40,827	16,696	63,628
	Dec	5,016	29,140	11,328	0	45,484
1974	Jan/Feb	4,972	14,043	27,763	43,030	89,808
	Mar/Apr	635	4,636	16,172	2,099	23,542
	Apr/May	0	—	22,730	25,140	47,870
	Jun/July	6,710	10,029	39,315	—	56,054
	Aug	0	1,342	84,348	18,629	1,04,319
	Sept/Oct	—	4,977	1,26,759	47,983	1,79,719
	Oct/Nov	4,031	43,067	1,28,107	54,119	2,29,324
	Nov/Dec	4,984	22,515	46,562	10,118	84,179
1975	Feb/Mar	56,487	46,800	1,10,576	1,80,116	3,93,979
	Apr/May	44,394	31,415	2,46,742	2,30,220	5,52,771
	May/Jun	99,754	78,586	1,55,922	72,914	4,06,176
	July/Aug	3,325	19,076	1,34,933	1,11,899	2,69,233
Total		2,69,896	4,04,043	16,86,205	10,12,420	33,72,564
Average		12,852	20,202	70,259	56,246	1,40,524

The horse mackerel stocks in the Project area consist mainly of true horse mackerel *(Megalaspis)*, scads *(Decapterus kurra* and *D. russelli)* and travallies *(Caranx carangus, C. malabaricus, C. malam* and *C. mate)* and are shown in Fig. 2. The relative abundance of the constituent species in the biomass of horse mackerel

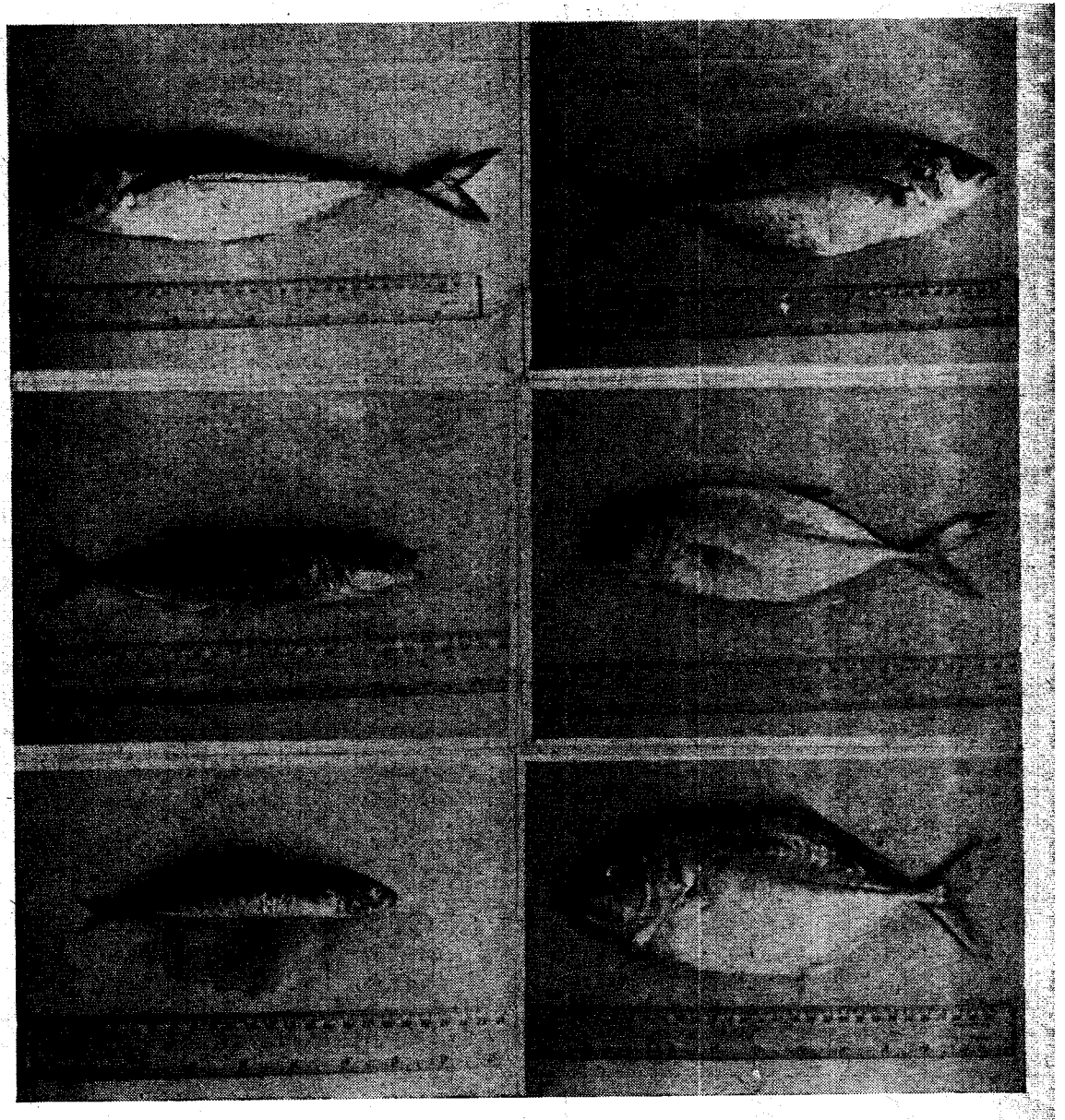

Fig. 2. Some common species of horse mackerel in the Project area. A. *Megalaspis cordyla*, B. *Decapterus kurra*, C. *Decapterus russelli*, D. *Caranx malam*, E. *Caranx carangus* and F. *Caranx malabaricus*. (Photos by Mr. Asmund Hermansen).

resources of the area, based on the catch data of the project vessels, is presented in Fig. 3. The data show that on an average travallies form about 43.8%, true horse mackerel 34.2% and scads 22.0% of the total biomass of horse mackerel in the Project area. It should be emphasised, however, that the above proportions are to be considered, at best, as only approximations rather than the true relative

abundance of the species in the total biomass. In fact, young fish surveys conducted by the Pelagic Fishery Project have shown that scads form by far the largest fraction of the young fish biomass of horse mackerel in the area (Anonymous, 1975).

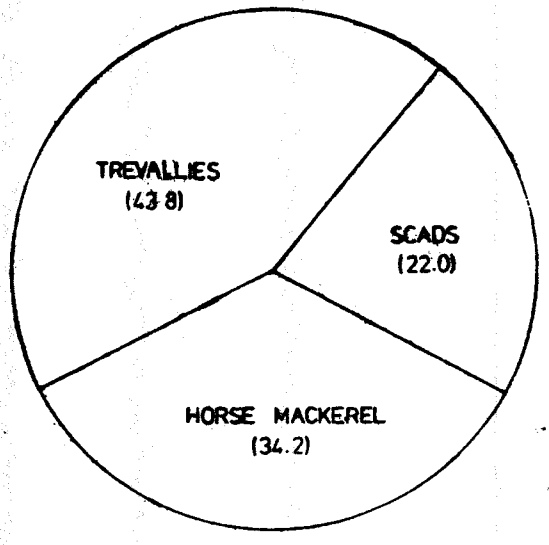

FIG. 3 PERCENTAGE WEIGHT PROPORTIONS OF THE CONSTITUENT SPECIES IN THE BIOMASS OF HORSE MACKERELS BASED ON THE PROJECT VESSEL'S CATCH DATA (1973-'75)

Horse mackerel are found distributed on the southern shelf, south of 10°N and on the Wadge Bank in a wide and continuous belt in varying intensities during major part of the year. Medium to dense concentrations are found generally on the middle and outer part of the shelf. They spread out to central and northern regions of the Project area by October/November when they are found in patchy distributions mostly on the middle and outer shelf (Fig. 4). In the subsequent months, the distribution becomes widespread on the central and northern shelf and are found not only in a continuous belt but also spread closer to the shore by April / May (Fig. 5). This process seems to culminate by May / June when the distributions are found widespread over the entire shelf. Both during April / May and May / June medium to high concentrations are found mainly between Ratnagiri and Mangalore and between Cochin and Cape Comorin. By July / August the whole concentrations of horse mackerel appear to move out of the central and northern regions for, except in one elongated and narrow patch off Karwar, no horse mackerel recordings are found on the whole shelf region north of 10°N. During this period they are recorded only on the southern shelf south of Cochin, with medium to high concentrations in patches off Cochin, Quilon and Cape Comorin. In general, horse mackerel are found distributed closer to the shore in the southern area than in the central and northern regions (Anonymous, 1975 and 1976).

TABLE-3. *Relative abundance (% wt.) of horse mackerel species by area based on the Project vessels data (1973-75)*

	AREA		
	Southern shelf (7°-9°N)	Central shelf (9°-13°N)	Northern shelf (13°-17°N)
Horse mackerel	14.7	32.9	70.2
Scads	21.7	23.9	18.4
Trevallies	63.6	43.2	11.4

Regular fishing experiments conducted by the Project vessels for diversified fishing with bottom trawl. midwater trawl and

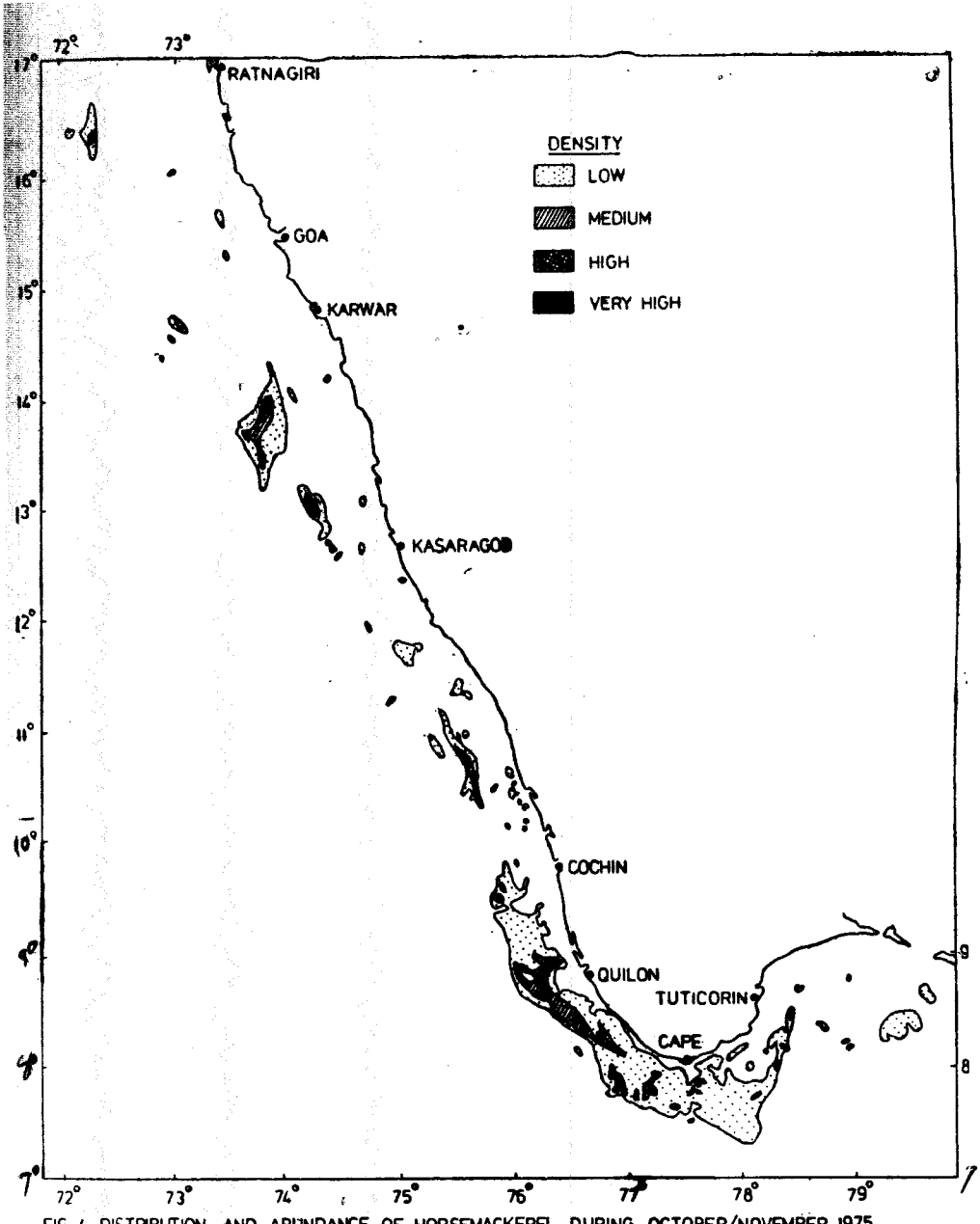

FIG. 4 DISTRIBUTION AND ABUNDANCE OF HORSEMACKEREL DURING OCTOBER/NOVEMBER 1975

purse seine on horse mackerel type of recordings have shown the pattern of distribution and abundance of the constituent species in different depths and areas. The results have shown that true horse mackerel is generally more abundant on the central shelf (9°–13°N) and northern shelf (13°-17°N) than on the southern shelf. While the scads are more or less equally abundant in the three regions, trevallies are most abundant on the southern shelf (7°–9°N) including Wadge Bank and central shelf than in the northern area (Table 3). The horse mackerel and the scads are taken in good quantities mainly from 20 to 80 m bottom depth, whereas trevallies are more abundant in less than 50 m depth (Table 4). From the data, it is also obvious that true horse mackerel appears to be more oceanic in distribution than either of scads or trevallies.

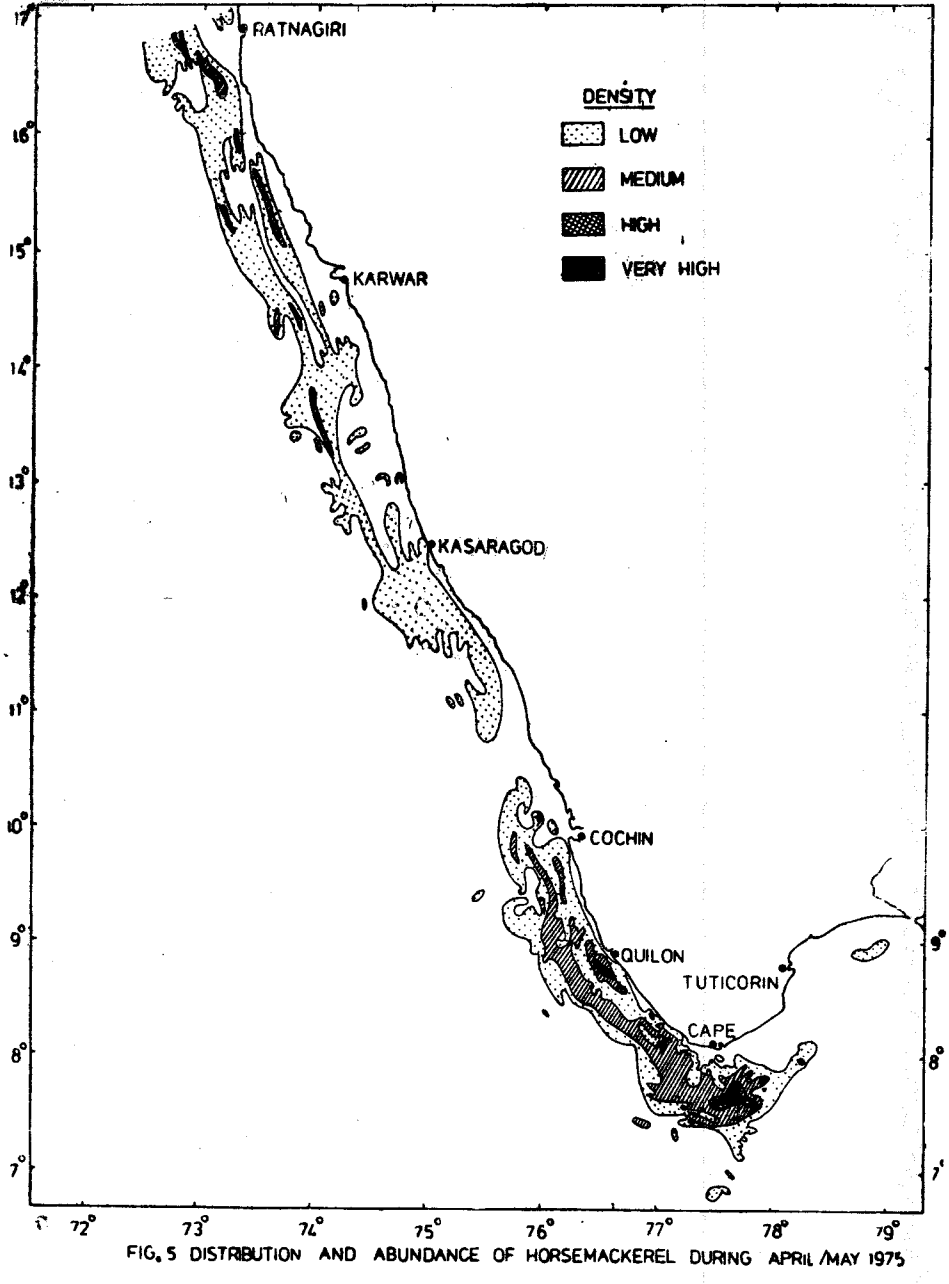

FIG. 5 DISTRIBUTION AND ABUNDANCE OF HORSEMACKEREL DURING APRIL/MAY 1975

Investigations made by the Pelagic Fishery Project indicate that generally the adult fish are found in shoals and young fish in dispersed condition. The shoaling behaviour appears to be more pronounced in the breeding and feeding fish than in others. The observations made, on board the research vessels, on the surface school concentrations show that they are generally abundant during October–December and March–April on the southern shelf, September-November and February–June on the central shelf and mainly during September–February on the northern shelf. Although, the shoals are found distributed on the entire shelf between 20 m and 100 m, the main concentration is limited to 30 to 50 m bottom depth.

TABLE 4 – *Relative abundance (% wt.) of horse mackerel species by depth based on the Project vessels data (1973–75)*

Species	Bottom depth (m)			
	< 19	20-49	50-79	> 80
Horse mackerel	4.0	53.3	37.7	5.0
Scads	11.1	64.6	21.5	2.8
Trevallies	34.2	42.4	23.0	0.4

While the medium sized and adult fish of true horse mackerel *(Megalaspis cordyla)* and scads *(Decapterus* spp.*)* were dominant in the catches over a number of months

from the whole area, those of trevallies (*Caranx* spp.) were abundant mainly during August to January from the southern and central shelf regions. The predominant sizes were 17–25 cm and 28–35 cm for true horse mackerel; 14–16 cm and 18–22 cm for scads and 16–20 cm, 25–30 cm and 40–50 cm for trevallies. The studies made by the Project indicate that the species of true horse mackerel and scads have a relatively short life span than those of trevallies.

Adults of true horse mackerel, scads and trevallies with ripe and running gonads were observed in the Project area over several months from October–November to July–August, whereas spent fish were mainly observed from April–May to July–August. Fry of these species ranging in size from 15 to 60 mm were generally captured in appreciable numbers in October–November, February–March and June–July, indicating that the species breed on the shelf over an extended period with two or three peaks in an year. The studies made at the Project indicate that the fry of true horse mackerel and scads are widespread on the shelf and good numbers occur in the northern area during January-March whereas their accumulation in the central and southern shelf areas occurs progressively in later months. The fry of trevallies are caught mainly from the central and southern shelf during April–July and October–November. It is observed that the current system on the shelf plays a vital role in their distribution. Good quantities of young fish have been taken by midwater trawl mainly from the central and southern shelf including Wadge Bank indicating that these areas form important nursery grounds for the species (Anonymous, 1975 & 1976).

The species of the horse mackerel are fast swimmers, highly schooling and migratory. Experimental fishing conducted by the Project vessels in good school concentrations have shown that midwater trawl, while being successful to some extent in capturing midwater concentrations, is unsuccessful in capturing surface schools, as the species quickly avoid the trawl. On the other hand purse seine proved a very efficient gear for capture of these species. The Project vessels SARDINELLA and RASTRELLIGER have obtained with midwater trawl, average catch rates of 310 kg and 445 kg per trawling hour respectively; and with purse seine catches ranging from 850 kg to 4,000 kg and 1,000 kg to 4,000 kg per operation. Similarly medium boats and NORIND of the Integrated Fisheries Project have conducted very successful purse seining experiments with light attraction and have obtained catches upto 2 to 3 tons per operation.

The estimates of horse mackerel biomass during different coverage period in different areas shows wide fluctuations with some regularity in the pattern of distribution which indicates seasonal movement. Although the available data do not permit us to draw precise conclusions regarding the migratory pattern of different species which have different habits, a general trend in their seasonal abundance has been clearly evident. Good concentrations shift northwards from southern shelf to the central and northern shelf areas by

September–October, with maximum accumulations occuring in the northern area by May–June. Thereafter the emigration of the horse mackerel stocks from the central and northern regions of the Project area takes place both to oceanic area as well as to southern latitudes, It is evident from the distribution pattern and the biomass estimates of the resources that high level of abundance of the horse mackerel is available for much longer period off the coasts of Kerala and Southern Tamilnadu and for much shorter duration off Karnataka and Southern Maharashtra.

The studies by the Project have also indicated that true horse mackerel, scads and trevallies, as they grow bigger and older take up to oceanic habitat and their inshore migration during post monsoon is mainly for the purpose of breeding and feeding. It has been observed that the best school concentrations occur mainly in waters beyond 30 m bottom depth and the results of fishing confirm the availability of bigger fish in commercial concentrations in offshore waters.

PROSPECTS FOR EXPLOITATION

The resources surveys conducted by the Pelagic Fishery Project have shown that the average potential of the horse mackerals in the Project area is in the order of 1,41,000 tonnes and this could be exploited with advantage employing efficient methods of capture. The assessment data also indicate that the stocks are subjected to great annual variations, although surprisingly the annual yields from the traditional fisheries do not show such variations.

The biomass of horse mackerel, on an average, constitutes 13.2% of the total fish biomass in the area and is exploited at present only to a marginal extent. The standing stock of horse mackerel is about 13 times higher than the average annual landings in the Project area and about 6 times higher than the all India landings. It is, thus, an under exploited resource of great potential and offers scope for the future expansion of the fishery. A comparison of the average potentials along the coasts of Southern Maharashtra, Karnataka, Kerala and Southern Tamilnadu and the average annual landings in the respective regions shows some very interesting features (Fig. 6). It is immediately obvious that the level of average standing stock is the highest off Kerala, followed by Southern Tamilnadu, Karnataka and Southern Maharashtra; and that the present level of exploitation is comparatively better along the Kerala coast than in other regions. The average stock potentials of the coasts of Southern Tamilnadu, Kerala, Karnataka and Southern Maharashtra are about 29.6, 9.7, 23.7 and 28.8 times higher than the average landings in the respective regions, indicating vast scope for the increased exploitation of the resources. It should be evident from the above that at least five fold increase in the present catches of horse mackerel in the Project area is possible without adversely affecting the stocks. It should be emphasised that there is tremendous scope for the expansion of the fishery in all States, especially so off the coasts of Karnataka, Southern Tamilnadu and Kerala.

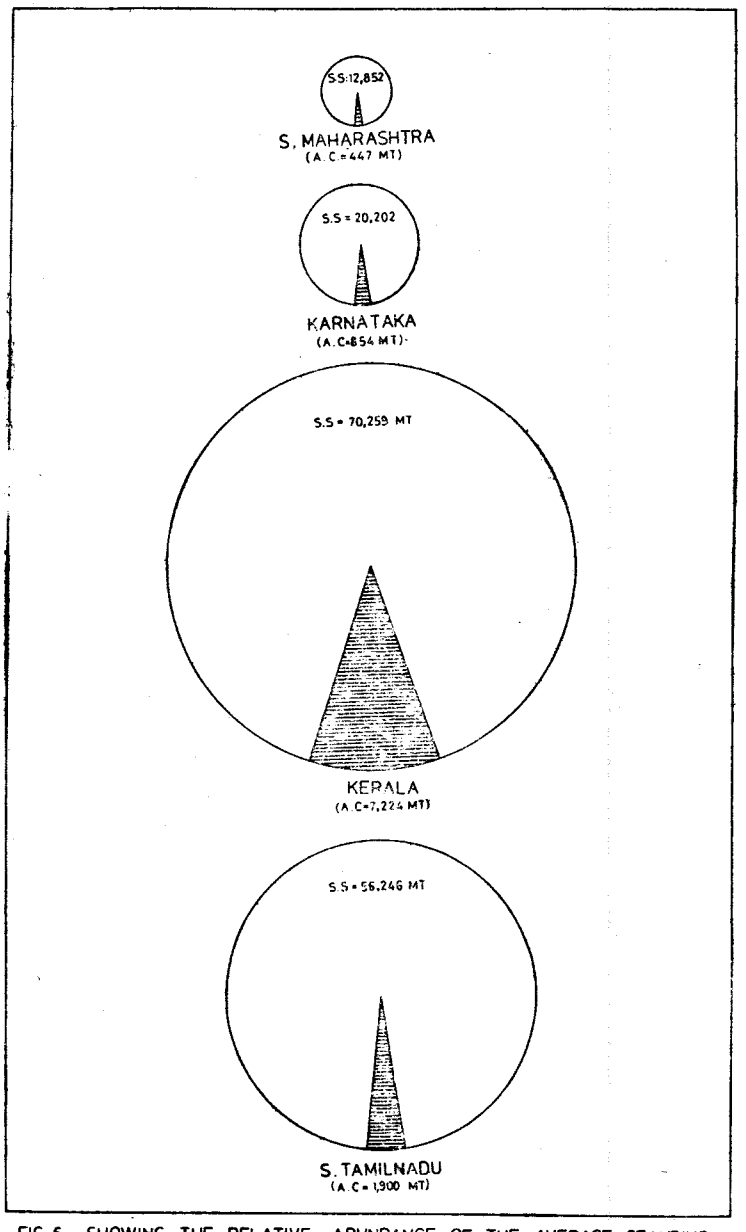

FIG. 6 SHOWING THE RELATIVE ABUNDANCE OF THE AVERAGE STANDING STOCK (□) AND THE AVERAGE ANNUAL CATCH (▨) OF HORSE MACKEREL IN DIFFERENT SECTORS OF THE PROJECT AREA

The present pitiably low yield of horse mackerel is obviously due to the inaccessability of the stocks to the non-mechanised and relatively immobile traditional fishery which exploits marginally and mainly depends on the stocks that undertake seasonal inshore migrations. These small non-mechanised boats cannot venture far out from the coast as their range of operations is limited. Secondly the fishing craft and gear presently employed by the traditional fishery are not quite efficent to harvest the fast swimming and highly migratory schooling species like horse mackerel. Thirdly the traditional fishery exploits more often the younger fish available in the inshore grounds, while the fully grown larger fish, generally available in dense concentrations in deeper waters, are out of reach to the fishery.

Experimental fishing conducted by the Pelagic Fishery Project and the Integrated Fisheries Project have enable us to understand generally the effective methods of capture of horse mackerel. Midwater trawl operations with the Project vessels, have given some encouraging results in capturing school concentrations located in subsurface waters. However, they were not so sucessful with the school concentrations found at or near the surface and have been generally disappointing. In view of the prospective importance of this fishing

technique for harvesting under exploited pelagic fish resources, especially those of horse mackerel in the nearshore and offshore waters, efforts on the midwater trawling need be intensified to establish the essential technical requirements. Possibly pair trawling will prove to be a suitable method, especially when the horse mackerel are forming dense school concentrations at or near the surface. On the other hand, purse seining proved to be a very efficient method for harvesting the horse mackerel concentrations. In fact, medium and NORIND type of boats of the Intigrated Fisheries Project, in commercial operations, have very successfully purse seined horse mackerel. Most species of horse mackerels like scads and true horse mackerel are attracted by light. Some successful purse seining experiments with light attraction have also been conducted by the Integrated Fisheries Project, indicating it has a prospective method of capture of horse mackerel especially when the fish are dispersed. Drift gill netting may also prove to be an effective method especially for the large sized species like trevallies and true horse mackerel.

From the experience gained so far, it is suggested that purse seining and pair trawling with medium sized mechanised boats could be employed as very effective methods of fishing for the horse mackerel resources. With the exception of some attempts in purse seining operations for the pelagic species like mackerel, oil sardine and horse mackerel, surprisingly little technological effort has so far been spent in our country, for improving the existing or developing new fishing methodologies specifically adapted to capturing our pelagic fish species. In fact, the development of a moderate fleet of mechanised fishing boats equipped for midwater trawling and purse seining will go a long way in the proper exploitation of the under-exploited pelagic fish resources like horse mackerel.

It has been indicated that the proportion of large sized adult horse mackerel is considerably higher in the offshore waters than on the inshore grounds now being fished by the traditional fisheries. With the exception of a few species of trevallies, all the other species have a relatively short longeivity of about 3 to 4 years and have a high rate of natural mortality. The fishing mortarity generated by the traditional fishery is expected to be negligible. A rational exploitation policy, therefore, demands a high rate of fishing pressure for the proper utilisation of the resources.

From the foregoing, it should be evident that one of the best ways to increase the harvesting of the horse mackerel resources is to intensify fishing pressure by employing efficient mechanised purse seiners and trawlers on the traditional grounds as well as by the extension of the operations to offshore waters where higher concentrations occur. The large under-exploited resources, existing beyond the reach of the traditional fisheries offer excellent prospects for the development and extension of the purse seine and midwater trawl fisheries.

UTILISATION

Horse mackerel are esteemed as food fishes both in fresh and in salted and dried conditions by the common man. A good proportion of the present landings are consumed in fresh state and the remaining is salt cured and dried. The latter commodity has a good market in the southern states. Most species of trevallies and the true horse mackerel fetch fairly good price both in fresh and cured condition.

Fair returns for the catches to the primary producer will act as an incentive for better exploitation of the horse mackerel resources. The proper utilisation of the catch that results from mass production by an expanding fishery from the presently under-exploited resource should be the prime consideration for achieving this objective. This will largely depend on the course of progress in relevant spheres. Increased and economic exploitation of the resources of the horse mackerel is possible not only by employing efficient capture technology but also by maintaining high quality at all levels involving handling, storage, processing and distribution. To maintain high quality of the catches of horse mackerel, it is necessary that they are properly handled and preserved on board. The handling of these fishes on board may not pose any great problem as they are comparatively hardy species. The catches of overnight trips can be brought ashore fresh, except in hot season when icing the catches is preferable. For short periods upto 2 to 3 days, boxing, after mixing with crushed ice and storage in the fish hold may be adequate. Long range operations require bigger boats with deep freezing and cold storage facilities to keep the catches in good quality.

Adequate shore facilities for handling, preserving and processing the catches on landing should also be provided if the increased landings have to be properly utilised. After meeting the demands of the local and nearby markets for the fresh or iced fish, a good portion of the catch can be filleted and frozen for subsequent marketing for which most species of trevallies and the true horse mackerel are ideally suited. Scads are good for canning and suitable consumer market for the canned product can be developed both in the country and outside. The remaining portion of the catch can be salted and dried under hygenic conditions, employing processing methodology developed in the country, to maintain high quality and to increase shelf life. If these products are packed in suitable wrappers or cartons, they will be readily acceptable to the consumer. In a vast country like ours, where large sections of the people suffer from protein deficiency and demand for fish for consumption is high, the first priority of the fishing industry should be to supply the fish and its products in the form acceptable and within easy reach of the common man. It should be emphasised that only after meeting the demands of the internal market, other avenues of processing the catch into products which are in great demand and fetch remunerative prices in the international market need be explored. The reduction of fish into meal and oil is an important factor in preventing waste which ensures proper utilisation of the fish catches that cannot be directly used as human food. Only potential waste of by-catch and the residues left after filleting and other processing need to be turned for reduction into fish meal and oil. It hardly need be emphasised that in any developing fishery, essential facilities for harvesting, handling, storage and processing must be concurrently developed in a balanced manner, to prevent waste and to ensure proper utilisation of the resources for the human welfare.

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