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Exploratory Fishing

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While the exploitation of the inshore fisheries with the help of indigenous non-mechanised craft and gear is being carried out fairly intensively from very ancient times, combing of the depths of the high seas in India using power driven vessels operating trawls and other types of gear has come into vogue only within the last few decades. Different organisations at present are conducting large scale exploratory and commercial offshore fishing operations from different bases viz., Bombay (Government of India Deep Sea Fishing Station, Directorate of Fisheries of Maharashtra State and the New India Fisheries Company Ltd.), Goa (Directorate of Fisheries, Government of Goa), Karwar (Indo-Norwegian Project), Cannanore (Indo-Norwegian Project), Cochin (Government of India Offshore-Fishing Station, Indo-Norwegian Project, The Cochin Company, New India Fisheries Ltd., Island Seafood Private Ltd.), Tuticorin (Government of India Offshore Fishing Station), Mandapam (Indo-Norwegian Project) and Visakhapatnam (Government of India Offshore Fishing Station).

The fishing base at Calcutta of the West Bengal Government which was functioning since 1950 had been closed down in 1963 and some of the vessels had been transferred to the Deep Sea and the Offshore Fisheries Establishments of the Government of India. For want of suitable vessels the Government of India fishing bases at Veraval and Mangalore also had to be closed in 1966. Besides the medium and the large trawlers operating from the aforesaid bases, there are over 3000 mechanised indigenous craft spread over the country and fishing in waters a little beyond the narrow, appoximately the seven mile inshore zone where the local fishermen use their non-powered craft and gear.

The catch data of exploratory and commercial fishing vessel are being analysed by the Central marine Fisheries Research Institute of the Government of India and an outline of results so far obtained is given in the following account for different divisions.

1. NORTH WESTERN DIVISION (Ratnagiri to Kutch)

This division includes areas lying on the continental shelf approximately between latitudes 16° to 23° N and between longitudes 67°–73° E which have been very intensively fished for demersal fishes by a large number of vessels. Especially, the northern areas have revealed excellent trawling grounds for quality fishes like "Ghol" (*Pseudosciaena diacanthus*), "Karkara" (*Pomadasys hasta*), "Dara" (*Polydactylus indicus*), and "Koth" (*Otolithoides brunneus*) which along with other fishes as "Wam" (*Muraenesox talabonoides*), "Doma" (small sciaenids), catfishes, elasmobranchs and miscellaneous fishes contribute to very high catch per hour returns. Although the initial attempts by some of the vessels were not

fruitful, subsequent operations proved that high and sustaining yields could be obtained by trawling in these grounds. Of the earlier trawling operations which are on record namely those of S. T. *WILLIAM CARRICK* and S. T. *MEENA* the catch rates obtained were low but they provided some useful information on the fish distribution pattern on this division.

The catch data of the Government of India vessels *ASHOK* and *PRATAP* and the Japanese fishing vessel *TAIYO MARU* 17 for the period 1949–56 has brought to light much valuable information on the regionwise distribution pattern of the important categories of fish and the environmental factors influencing the fisheries. Five main regions viz., Bombay, Cambay, Veraval, Porbundar and Dwarka have been covered of which the last one was found to be the most productive and the first the least. Dwarka was recognised to be the best at the time when the potential resources of the Kutch region were little understood. While "Ghol" was observed in considerable quantities in all regions, "Dara" and "Koth" were best obtained from Dwarka, "Wam" from Cambay and Veraval, "Karkara" from Porbundar and Dwarka and catfishes and elasmobranchs from Bombay and Cambay. In relation to depth zones, it was observed that the bulk of the catches came from the 20 fathoms line with "Dara" and "Koth" relatively in greater abundance to landward side and "Ghol," "Karkara" and "Wam" to seaward side of this line. The day catches were better than those of the night catches and the neap tide yields higher than the spring tide yields. In the different graded patterns of temperature distribution, within a limited range, "Dara" and "Koth" showed preference to colder regions. It was also found that bull trawling resulted in far better yields than otter trawling in the same grounds.

Following operations of the Government of India vessels, the New India Fisheries Company's bull trawlers, *ARNALA* cum *PAJ* and *SATPATI* cum *PILOTON* very successfully carried out commercial fishing from Bombay base during 1956–'63. In addition to five regions covered by *ASHOK* and *PRATAP*, these vessels covered a sixth region viz., Kutch, which has been found to be far better than any other region on the continental shelf in the Indian territory from the point of view of extremely high catch returns for all fish with preponderance of quality fishes. For the period 1957–62 in which the vessels fished continuously in all months, the annual regional averages of catch, effort in hours and the catch per hour returns (per two vessels) have been worked out along with species composition and seasonal abundance and presented in Figs. 1 & 2. The monetary returns for the period 1956–'63 exceeded over Rs. 1.6 crores for an overall catch, of 26304 tons for an effort of 34953 hours at a catch rate of about 753 kilogrammes per hour of trawling.

The *AKASHI-MARUS* 23 and 25 of the same fishing Company operating from Bombay base since 1964 have also been yielding high catch returns.

Areas (Fig. 1) 43, 48, 10, 11, 17, 18 24, 2, 3, A, D, E, H, K, L, M, N, P, Q, R, S, T, U, V, X and Y have given over 1000 kg/hr of fish in bull trawling in some months. Of these, 11, 18, 48, A, N, R, S and T have yielded more than 1,500 kg/hr. but below 2000 kg/hr The highest catch rate was from area 2 for a catch of 2914 kg/hr. in January 1961.

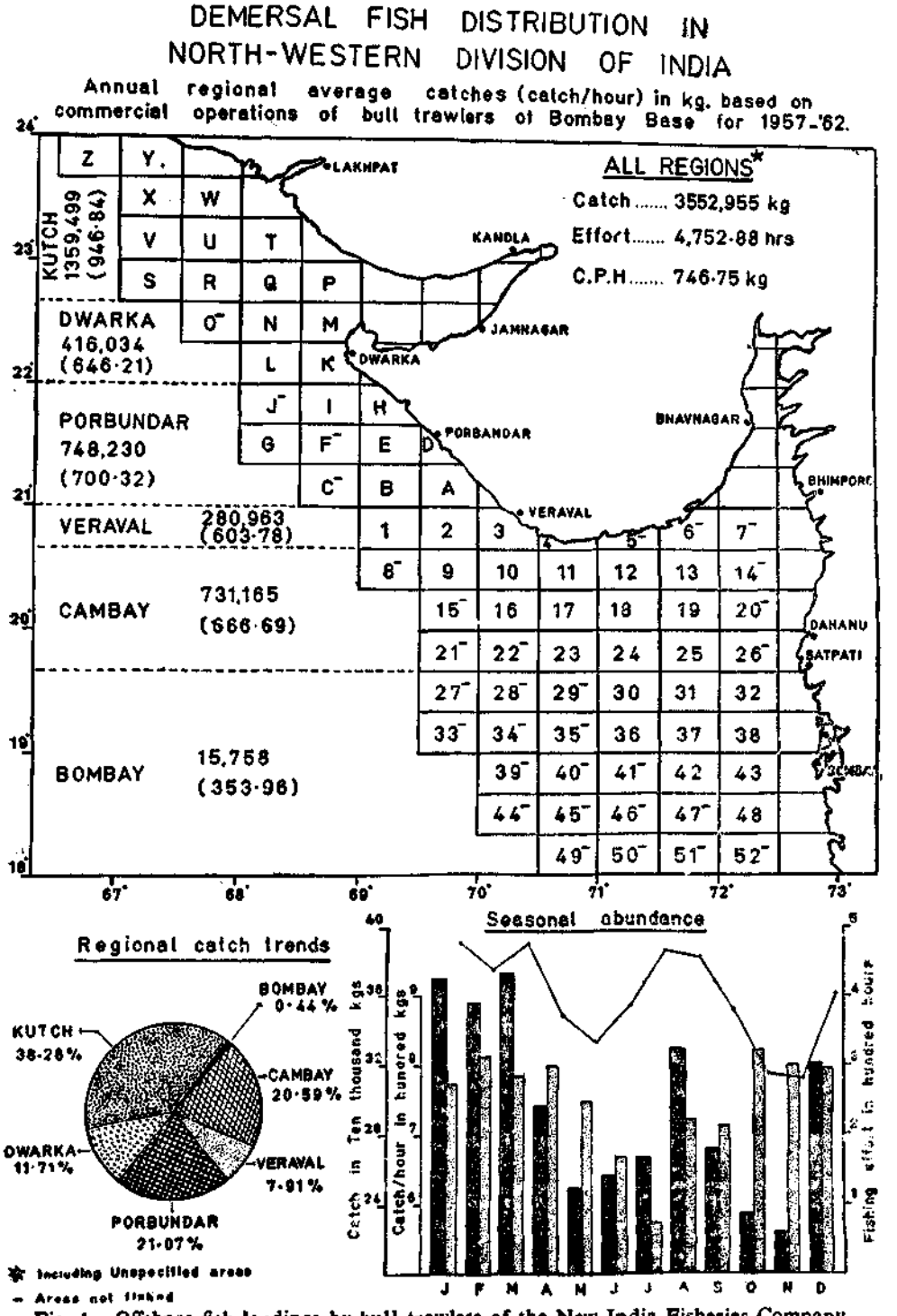

Fig. 1. Offshore fish landings by bull trawlers of the New India Fisheries Company, Bombay with some catch particulars.

During the period 1961 to 1965, very intensive trawling operations were carried out from Bombay base by the Government of India vessels also. The areas covered, the annual catch returns and the catch composition are shown in Fig. 3. Areas 18–72/5D, 19–71/1D, 20–70/1B, 5C, 6A, 20/72/5D, 21–69/3D and 21–70/1A gave at times 1000 kg or more of fish per hour of trawling; similarly 18–72/1D, 19–72/1D, 3A, 20–70/3D, 4C, 5A, 5B, 6B, 21–69/4C, 6A and 22–68/5F gave yields between 750 kg and 999 kg/hr, 17–72/4F, 18–72/5C, 5E, 6E, 19–72/1B, 1C, 20–70/5D, 6C, 21–69/2E, 5B, 5C, 6B, 22–68/4D, 4E, and 5E gave

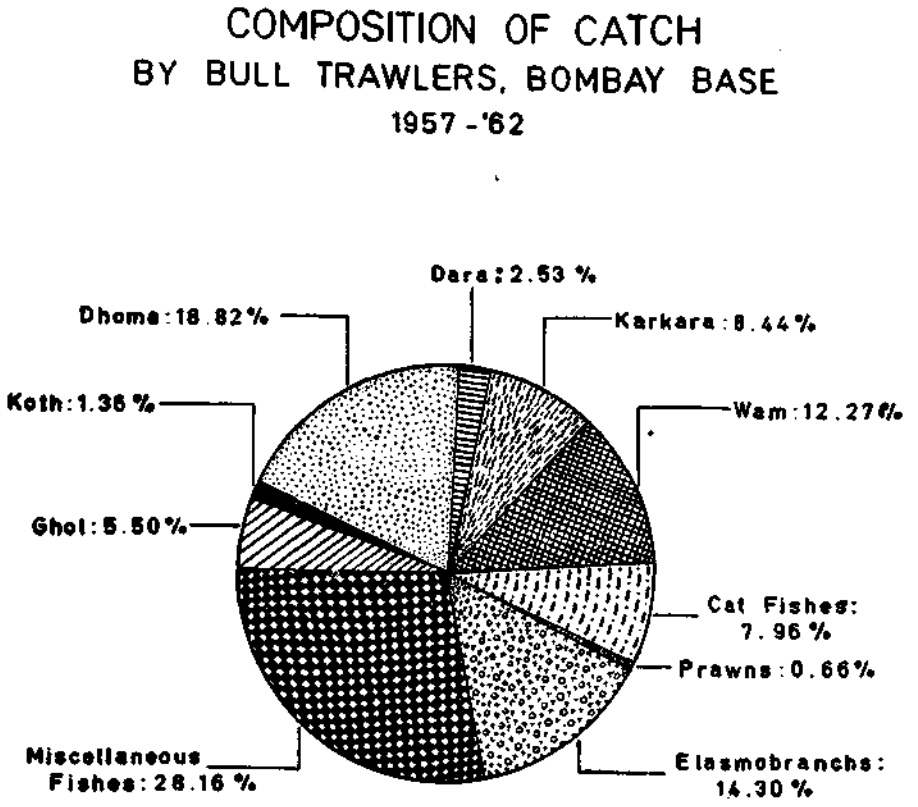

Fig. 2. Species composition of the catches by buil trawlers of Bombay Base: Miscellaneous fishes include Pomfrets–1.39%, Kati–3.33%, Shende–3.26% and other 20–18%.

catch rates between 500 kg and 749 kg/hr. A large number of other squares gave more than 200 kg. but below 499 kg/hr in major area 16–72, 16–73, 17–72, 17–73, 18–72, 19–70, 19–71, 19–72, 20–69, 20–70, 20–71, 20–72, 21–69 and 22–68.

SOUTH – WESTERN DIVISION (Karwar to Cochin)

This division is well-known for the oil sardine and mackerel which together constitute the bulk of the inshore catches. The best of shrimp fishing grounds are also located in

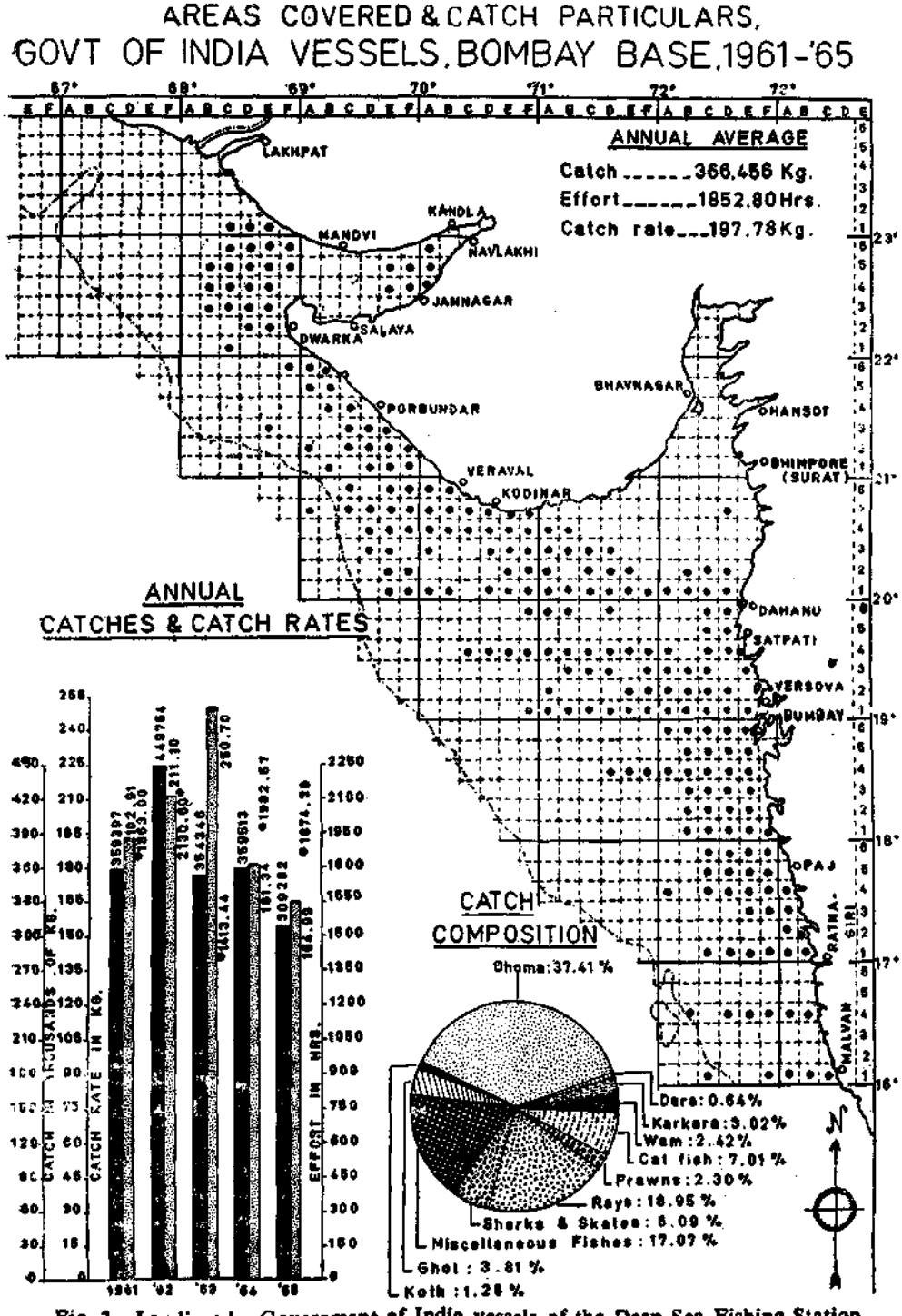

Fig. 3. Landings by Government of India vessels of the Deep Sea Fishing Station, Bombay for 1961-'65 with catch particulars and areas covered.

the southern part of this division. However, the demersal fisheries potential is not yet fully understood. During 1928–'45 some of the Governmental and commercial vessels of Ceylon viz. *BULBUL, TONGKOL, RAGLAN CASTLE* and *ARINGA* and later in 1949-'50 other vessels, *KANYAKUMARI, SAGAR KUMARI* and *ASHOK KUMARI* of the West Coast Fisheries Company of the erstwhile state of Travancore, and *CHANDRIKA* of the Department of Marine Biology and Fisheries, University of Travancore were engaged in deep sea fishing operations in areas around the 'Wadge Bank' but the results were not encouraging.

Subsequently the INP schooners surveyed the coast from Cape Comorin to Kozhikode from 7 miles limit to the edge of the continental shelf, a distance of 240 miles long and 30 miles wide; during 1956-'57 the schooners caught 117 tons of fish at 52.6 kg per fishing hour. Several types of gear were used; they obtained 291.7 kg of fish per trip for purse-seining. On the edge of the continental shelf the rock cod, *Epinephelus* was obtained in considerable quantities by hooks and lines. The Medium boats in 1957 had given better yields of 512.1 kg per trip in shrimp trawling, 249.5 kg per hour in pair trawling, 458.6 kg per trip for purse-seining and 233.1 kg per trip for hooks and lines.

Within the scope of the available information, the results of operations of the offshore fishing vessels at different bases in recent years is given below.

a) *Karwar:* (Approximately between latitudes 14° and 15°N and long. 73°30' and 74°30' E): Some of the vessels of the Indo-Norwegian Project have been exploring the nearby grounds upto 20 fathoms using shrimp trawls and purse seines since September 1963.

During 1963–'64, three vessels netted a total of 167,092 kg of all fish for an effort of 846 hrs. at 197.51 kg/hr. Fish constituted 155,961 kg. and prawn 11,131 kg. The highest monthly catch rate for all fish was 417.3 kg. for the vessel *KARWAR*-I in December '63.

In 1964–'65 the vessels had landed 164,103 kg. of all fish for an effort of 749 hrs. at a catch rate of 219 10 kg/hr. The monthly catch rates for individual vessels varied from 116.21 kg. to 315.62 kg/hr. of trawling. Purse-seining operations have proved in the year a failure with a low catch and a catch rate (102.70 kg/hr.).

In 1965-'66 the vessels obtained by trawling and purse-seining a total of 130,912 kg. of fish for 822.83 hrs. of fishing. The quantity of fish obtained by trawling was 114,585 kg. for an effort of 764.42 hrs. at 149.90 kg/hr; by purse-seining (restricted to October-December) a catch of 16,327 kg. for 58.42 hrs. at a catch rate of 279 48 kg/hr. was obtained.

The trawler catches in the year consisted of miscellaneous fishes 39.99%, *Opisthopterus* 21.35%, *Leiognathus* spp., 24.78%, sciaenids 5.03%, *Lactarius* 2.52%, sharks 3%, rays 2.04 and prawns 1.29%. The purseseine catches consisted of *Rastrelliger kanagurta* 36.09%, *Sardinella longiceps* 29.74%, *S. fimbriata* 21.55% and miscellaneous fishes 12.62%.

b) *Cannanore*: (Lat. 11° to 12° N and long. 74°.30' to 76°E) In 1964–'65 the INP vessels landed 92,099 kg. of fish and 16,107 kg of prawns. The fish catch consisted of *Opisthopterus tardoore*, *Lactarius*, *Leiognathus*, *Johnius*, *Stromateus* and *Cynoglossus* and the prawn catch of *Metapenaeus dobsoni*, *M. affinis* and *Parapenaeopsis stylifera*.

In 1965–'66 M. V. *NORIND* obtained by trawling a catch of 24,111 kg of fish in 75 trips in 289 hauls in 292 fishing hours at 82.56 kg of fish per hour of trawling and M4 by purse-seining a meagre catch of 254 kg. of sardines.

c) *Mangalore*: (from lat. 12° to 14°N and long. 73°.30' to 75°E): Off Mangalore and Malpe in 1964-'65 at total of 3206 metric tons of all fish were landed by the mechanised boats and the Government of India trawlers, M. V *TARPON*, M V. *SAGARVIHARI* and M. V. *SAMUDRA*. The major part of the catch was obtained by the mechanised boats of ex-trainees of the Department of Fisheries, Government of Mysore. Of the total catch, fish were 589.4 metric tons and prawns 2616.6 metric tons The latter formed 18% of the catches. In 1965–'66 the same vessels landed 3976.7 metric tons of all fish. Fish formed 2833.3 metric tons and prawns 1143.4 metric tons (28.75%).

d) *Cochin*: (Lat. 8° to 12°N and long. 75° to 77°30' E): In 1957 the Offshore Fishing Station of the Government of India was opened at Cochin. The trawlers *ASHOK* and *PRATAP* were shifted from Bombay to this base during that year. Subsequently a few other vessels were added. Besides the Government of India vessels, of Indo-Norwegian Project and commercial fishing companies are regularly fishing especially for prawns.

During 1964 March to 1965 March a total of 168,053.5 kg. of fish were landed by the Government of India vessels for an effort of 1482.04 hrs at catch rates of 19.39 kg/hr. for prawn and 94.0 kg/hr. for fish. Prawns formed 17.1% of the total catches. In 1965-'66 the vessels landed 131562 kg. at a catch rate of 111.84 kg/hr. for all fish. Prawns formed 14.13%.

The Indo-Norwegian Project vessels landed 32,445 kg. of all fish during March to June, '64 and September to November '64 for 282.83 hrs. at a catch rate of 114.72 kg/hr. of trawling. The catch included prawns of 4170 kg. at a catch rate of 14 73 kg/hr.

The same vessels in 1965–'66 landed by trawling 29621 kg. of all fish, of which prawns formed 15.16%. The catch rate for all fish was 106.04 kg/hr. *KALAVA* did hand lining in the deeper waters with rocky bottom and obtained large perches etc. to the extent of 28956 kg

The Cochin Company's vessels during January to March '65 landed 54,044 kg of all fish for an approximate fishing effort of 768 hrs. The prawn catch consisted of 1411.75 kg at a catch rate of 18.37 kg/hr During 1965–'66 a catch of 197,714 kg. of fish and prawns was landed for an effort of 2666 hrs. at an average of 74.16 kg/hr. Prawns formed 27.90%. The first catches were generally composed of *Leiognathus*, *Opisthopterus*, *Anchoviella*, *Cynoglossus*, *Trichiurus*, *Pseudosciaena* etc. Among the prawns the dominant species was *Parapaenaeopsis stylifera*.

The region is extremely good for prawns, where large sized species suitable for canning and freezing abound, but very poor for general fish categories which are chiefly small sized uneconomic varieties, occurring sparsely and yielding low catch per hour returns in almost all grounds explored in trawling operations. The landings of shrimp from areas around Cochin by the New India Fisheries Company's vessels and other commercial vessels are high but the actual catch data are not available.

Some of the Government of India vessels operating from Cochin have been doing exploratory fishing for tunas in the region upto the Laccadive Islands. During 1965–'66 the monthly hooking rates for big eyed tuna ranged from 0.07% to 0 34%, yellow fin tuna 0.14% to 0.37%, marlin 0 05% to 0 28%, sailfish 0.06% to 0.15%, sword fish 0.03% to 0.14%, sharks, 0.78% to 2.30% and other 0.05% to 0.16%, rather very low and unimpressive figures from the practical point of view.

SOUTH-EASTERN DIVISION (Pondicherry, Tuticorin, Mandapam)

Of the total marine fish production of India only 20% of the catches are obtained from the east coast. The demersal fisheries like the pelagic fisheries, are much poorer in the grounds of the east coast than those on the west coast. Nevertheless, some important trawling grounds have been located in the recent exploratory fishing operations by the Government of India vessels, the Indo–Norwegian Project's vessels and the West Bengal cutters.

a) *Pondicherry - Tuticorin:* The Government of India vessels started fishing operations with Tuticorin as the base since 1959 in Madras State. The vessels surveyed a very wide region for grounds suitable for trawling and for operating bottom and surface gill nets. The gill net operations were not encouraging.

During 1963–'64 off Tuticorin M. V. *MEENAKSHI* operated in all 153 sets of gill nets in area 8–78 at a depth of 12–55 metres with a total catch of 7800 kg of fish at a catch rate of 47.14 kg per set. Off Pondicherry the same vessel operated 74 sets of gill nets in 15–78 metres depth in areas 12–79 and 12–80 with a catch of 3292 kg of fish at 44.5 kg of fish per set.

Trawling operation off Tuticorin by two of the vessels in 1963–'64 resulted in a catch of 124,810 kg of fish at 152.64 kg per hour of trawling in area 8–78. The sub-area 4B proved to be good with a catch rate of 245.30 kg/hr. In 1964–'65 two vessels trawled for 352.92 hrs in 8–78 and 9–78 obtaining a catch of 43081.5 kg at a catch rate of 122.07 kg/hr 8–78/1F gave a fairly high catch rate of 177.51 kg per hour. In 1965–'66 one vessel trawled in the same major area with a catch of 83526.5 kg for an effort of 568.50 hrs at a catch rate of 146.64 kg/hr 8–78/2A and 4B gave catch rate of 170.15 kg/hr and 155.29 kg/hr respectively. Trawling off Pondicherry in 11–79 resulted in a catch of 13,589 kg of fish with a catch rate of 75.60 kg per hour. The gill net catch was dominated by sharks and catfish and the trawl net catches by leiognathids, sciaenids, *Drepane* etc.

Tuna long lines were tried in areas 8–79, 8–80, 7–79 which gave low catch rates of 38.63 kg of fish per 100 hooks (June 1965).

b) *Mandapam*: With Mandapam as the base of operations, some medium boats of the Indo-Norwegian Project have been fishing with shrimp trawl in the Gulf of Mannar and the Palk Bay since 1964. During August 1965 to February 1966 two of the boats landed 110,109 kg of fish at a catch rate of 233.18 kg/hr. In some of the months the catch rates for individual vessels were as high as 806 kg and 915 kg of fish per hour of trawling. In 1965-'66 two of the boats from this base landed 175, 663 kg of fish for an effort of 788.83 hrs. at a catch rate of 222.69 kg/hr. The monthly catch rates for individual vessels ranged from 155.40 kg/hr. to 385.90 kg/hr. The catch in the region consisted of silver bellies which amounted to over 90%, along with catfishes, *Lactarius*, rays, prawns and mixed fish.

Central and North-Eastern Divisions

These include the demersal fisheries in the Andhra, Orissa and West Bengal States.

a) *Visakhapatnam*: Since the establishment of the Offshore Fishing Station at Visakhapatnam in 1959 several vessels operating from the base surveyed the continental shelf between the river mouths of Godavari and Mahanadi along the coast line of Andhra and Orissa States for a distance of 359 nautical miles. Several types of gear were designed and tried. During 1959-'60, 131,170 kg of fish with an overall catch rate of 89.8 kg of fish per hour of trawling was landed. During 1964-'65, 233,670 kg of fish at a catch rate of 114.66 kg/hr was landed. In 1965-'66 the catch was 109,290 kg at 78.23 kg per trawling hour.

The areas between Visakhapatnam and Bimlipatnam have been intensively fished because of their proximity to the base. However, the catch rates here were only moderate. In grounds south of Visakhapatnam, the catch rates were generally low. Near the False Point in the north as also in the grounds near the mouth of Chilka Lake, the catch rates have been observed to be high. In general, it may be stated that the catch per hour returns increase from south to north. Catfishes, sharks, rays and miscellaneous fishes comprise the catches and the prawns in the region as a whole constitute 2% to 4%.

b) *West Bengal*: Subsequent to the preliminary survey of fishing grounds made by *GOLDEN CROWN* in 1908, systematic exploration in the region was started by the Department of Fisheries of the West Bengal with two Danish cutters in 1950. Three more Japanese trawlers were added in 1965. As a result of continuous fishing by these vessels (*KALYANIS* I to V), some important fishing grounds in the Western Channel, Eastern Channel, Sand Heads, near Baitarni River mouth, off Debi and Prachi Rivers, near Black Pagoda (Konark), off Puri, Chilka Lake and Gopalpur in depth ranges of 10 to 30 fathoms have been located. In 1960 a new fishing ground "Swatch of no grounds" noted for quality fishes has been found. The major groups contributing to the fish catches in the region as a whole were sciaenids, *Kurtus indicus*, eels, *Scomberomorus* spp., *Pomadasys hasta*, *Pampus argenteus*, prawns, sharks and rays, catfishes etc. The catches were sorted into A, B and C classes based on the high, moderate and low prices prevailing in the markets.

These trawlers for the period of 1951 to 1960 had landed 3726.06 metric tons of fish In the year 1961 the catches were excellent for two vessels being 603.5 metric tons; the number of voyages were 36; the catch per voyage worked out to 16.8 m tons and catch per

day's absence from port 2.45 m. tons. The A, B and C categories landed in the year as a whole were 318.2, 274.9 and 10.4 metric tons respectively.

Fishery biological research:- Various aspects of fishery biology of the species contributing to the offshore catches have been under investigation at the Central Marine Fisheries Research Institute's establishments at Veraval, Bombay, Karwar, Mangalore, Ernakulam, Tuticorin and Visakhapatnam. A good deal of useful information on *Polydactylus indicus*, eels, *Otolithoides brunneus*, *Pseudosciaena diacanthus*, *Polynemus heptadactylus*, *Ilisha filigera*, *Parastromateus niger*, *Nemipterus joponicus*, food of trawl fishes of Visakhapatnam Coast, *Decapterus*, bathy-pelagic fishes, plankton in relation to trawl catches, relative fishing powers of the Government of India fishing vessels of Bombay base, some new records of fishes, mackerel catches by trawlers etc.

It may not be out of place to mention here some of the more important observations on the component fish species of the offshore trawling grounds. These are not different from the species caught by non-mechanised craft and gear in the inshore region, but their relative abundance in the two environments may vary and in some there may be periodical migrations from one environment to the other for the purpose of breeding or feeding. The regionwise abundance of fish categories detailed here is determined on the basis of annual average catch rates by bull trawlers for the period 1957-1962 for Bombay to Kutch.

Polydactylus indicus: The "Dara" is a prime fish the landings of which have much dwindled in recent years. It grows to over a metre in length and is carnivorous, feeding mostly on crustaceans, but also on fair amounts of juvenile fishes and molluscs. The catches show about five major size groups. Some maturing "Dara" are known from Bombay and Cambay regions and one with oozing gonads from the Gulf of Kutch. Spawning appears to be twice in a year i. e. in April-June and October-November. There is evidence to show that the species breeds in shallow inshore waters, particularly in the Gulf of Kutch and that the juvenile "Dara", known as "Chelna" enter the offshore grounds in Dwarka and Porbandar, which appear to form the nursery grounds. "Dara" from all regions together forms about 2.5%. The catch rates are the highest from Dwaraka; Kutch and Porbundar rank next.

Otolithoides brunneus: The "Koth", has been showing declining trends in the inshore and offshore catches as "Dara". Sexual maturity is reached at about 120 cm. and the adults grow to over 150 cm. The O-year class dominates the inshore catch and the I and II year classes the offshore catches. It has a very high rate of fecundity and a prolonged spawning commencing about the end of South West Monsoon and extending over several months. The juveniles enter the creeks and other inshore water inlets where they are caught at times in large numbers. The growth checks on scales which are upto 9 in full grown adults, seem to be reliable indicators of the different age groups. The food consists of fishes, crustaceans, stomatopods and squids.

Dwarka registered highest catch rates for this species, Kutch ranking next.

Pseudosciaena diacanthus: The "Ghol" is also one of the prime fishes. The annual fluctuations not being marked, "Ghol" catches have been steady in recent years contributing, on the average, 5% of the total landings. The fish attains sexual maturity at a total length of 800 to 850 mm. and the adults grow to about 1200 mm. Growth checks are upto eight, which have been found useful in determining the age of the fish at different lengths. Most of the fish in the landings are with extroverted stomachs indicating, disgorging of food. Fishes and crustaceans form the food. Spawning appears to take place over a prolonged period of June-September or a still longer period. Spent ones appear in large numbers in October. Juveniles in large numbers are found in the inshore catches from March on. Kutch has been found to give the highest catch rates to this species, Porbundar and Dwarka ranking next. However, it may be stated that fair amounts of "Ghol" are obtained from all other regions also.

The "Wam", (Eels) are highly predaceous feeding on a variety of teleostean fishes, including young eels, and crustaceans as prawns and crabs. *Muraenesox talabonoides*, which grows to about 2 metres in length supports a fishery of much important, on the north western coast of India. Sexual maturity is attained at 120 cm. The rate of fecundity is high and mature individuals are obtained from April onwards. Some with oozing gonads have been met with in July-August. Peak of the landing is in August and the major part of the catch consists of individuals ranging from 120 to 170 cm. Eels form about 12% of the total catches. The catch rates have been the highest form Cambay; Veraval ranks next in catch rates but first in abundance of catches. The systematics of a large number of eels has been studied and the *leptocephali* of several eel species have been described.

The "Karkara", *Pomadasys hasta* is a high quality fish with steady annual catches amounting on the average to over 8% of the total catches from Bombay to Kutch. It grows to a little over 60 cm. in total length. Sexually mature individuals are not met with in fish below 40 cm. Spawning is soon after the South West Monsoon. Juveniles of 5 cm. onwards occur in January-February in the inshore region.

The fish is a bottom feeder both in the adult and juvenile stages, feeding on amphipods, polychaetes, shrimp, small mud crabs, hermit crabs, stompatodods and molluscs. Upto a maximum of five growth checks have been observed in the otoliths. Kutch has given the highest catch rates, Dwarka and Porbundar ranking next. Also fair quantities are caught by trawlers from Bombay, Cambay and Veraval on the west coast and in Andhra and West Bengal along the east coast.

The "Shende", *Polynemus heptadactylus* a small sized fish, which occurs both on the east and the west coasts, is fairly abundant from Bombay to Kutch consisting about 3% of the total catches. The juveniles prefer the surface waters, feeding on *Acetes indicus* and a variety of zooplankton; the adults are more abundant in deeper waters and feed on crustaceans, fishes, polychaetes, molluscs and echinoderms. The third and the fourth year groups viz. fish between 136 mm and 165 mm dominate the trawler catches. Growth checks on scales and otoliths have been found useful in determining the growth and age of

the fish. Breeding seems to take place almost all round the year, with two spawning peaks, in about March-June and August-November. A fair proportion of the adult exhibits hermaphroditism. Catch rates by trawlers have been found to be almost equally high from Kutch-Dwarka and Cambay.

In respect of other groups, the regional abundance may be stated briefly as follows based upon the catch per hour returns: catfish (about 8%) in Kutch followed by Porbundar; "Kati" (*Ilisha filigera* about 3%) in Porbundar and Dwarka followed by Kutch; pomfrets (about 1.39%) in Porbundar followed by Kutch and Dwarka; prawns (about 1%) in Cambay followed by Bombay and Veraval; Elasmobranchs (about 14% in Kutch followed by Cambay and Veraval; "Doma" (mixed uneconomic small sciaenids about 19%) in Porbundar followed by Cambay and Veraval; and miscellaneous fishes in Kutch and Porbundar.

Work is in progress on the fishery biology of "Ghol", other sciaenids, "Karkara", catfishes, *Saurida*, *Ilisha*, carangids, prawns, silver-bellies and prey-predator relationship in trawl fishes.

The research schemes of the Central Marine Fisheries Research Institue in the Fourth Five Year Plan period include 1) continuation of the present programmes on catch analysis of fishing vessels and biological studies of fish species with a view to understanding the causes behind the annual fluctuations and 2) taking up fresh programmes on (a) tagging, (b) determination of inter-relationships between offshore and inshore fisheries (c) study of ecology, including planktology and hydrology of fishing grounds (d) statistical estimation of relative richness of different fishing areas (a) determination of relative fishing efficiency of different types of vessels and (f) standardisation of fishing effort.

It may now be concluded that fishing in deeper offshore regions mostly by trawling and to a limited extent by other types of gear like gill netting, long lining, purse-seining, etc., has come to stay and the activities in this direction are expanding. The expansion of the export trade in frozen and canned marine products, like the shrimps has given a further impetus to mechanised fishing to obtain better catches from known grounds and to look for as yet unexploited grounds. The non-availability of fully equipped ocean going vessels and the lack of adequate fishing harbour and on-shore cold-storage, processing and other facilities are the main factors retarding the progress of the offshore fishing industry in spite of fairly adequate information now available in regard to the exploitable resources of the different fishing grounds explored in the past two decades. The long felt need for suitable research vessels at the Central Marine Fisheries Research Institute for systematic exploration of the fishing grounds, particularly in offshore waters which have not hitherto been covered and for collection of biotic and abiotic environmental data in relation to fish catches requires immediate attention in the Fourth Plan period.