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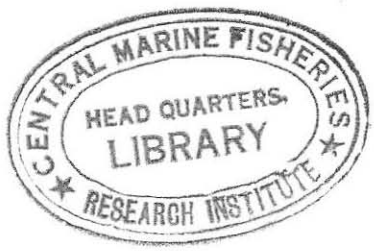

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RESULTS OF THE EXPLORATORY FISHING OPERATIONS OF THE GOVERNMENT OF INDIA VESSELS AT BOMBAY BASE FOR THE PERIOD 1961 - 1967[x]

by

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ABSTRACT

The fishing vessels of the Government of India, Deep Sea Fishing Station, Bombay, conducted exploratory fishing operations in areas between latitudes 15°N to 23°10'N and longitudes 68°10'E to 73°50'E, covering 25,100 nautical square miles on the continental shelf during 1961-1967. The paper presents the results of operations giving details of regional, seasonal and depth distribution of fish categories. The vessels, of different specifications, have been grouped into 3 categories based on B.H.P. and their annual catch rates estimated separately. There was an increase in the abundance of fish catches from the 18°N latitude zone to the 22°N latitude zone. A similar increase in the abundance was also noted from the 18°N latitude zone to the 15°N latitude zone. The seasonal catch trends showed the highest yields in the fourth quarter and the poorest in the third quarter. In spite of the inclement weather conditions which makes fishing operations difficult, the catch rates in some of the monsoon months were high. The seasonal trends in individual categories of fishes varied to some extent from those of the total fish catches. In general, the concentration of fish was high in depths from 41 to 60 metres.

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INTRODUCTION

The Deep Sea Fishing Station of the Government of India was opened in 1946 at Bombay for exploratory fishing on the continental shelf, to assess the fisheries potential, of which very little was then known and also to offer training facilities to technical personnel for operating powered fishing vessels using modernized gear. Results of exploratory fishing by the vessels of the Deep Sea Fishing Station for the earlier period have been reported by the Central Marine Fisheries Research Station (1954), Kristensen (1953) and Jayaraman et al (1959). The exploratory and commercial fishing vessels operating till now from the Bombay base have covered 6 distinct regions from south to north, Bombay, Cambay, Veraval, Porbundar, Dwarka and Kutch, the last of which was found to be the most productive from the point of view of the magnitude of the catches and the abundance of quality fishes (Rao et al, 1966). The present report deals with the trends of the total landings and the component species landed, the seasonal abundance and pattern of distribution by depth in latitude zones at 1^{o} intervals on the continental shelf for a 7 years period from 1961 to 1967.

VESSELS AND GEAR

During the period under report, altogether 11 of the Government of India vessels operated from the Bombay base (Table I), their B.H.P. varying from 42 to 300, gross tonnage from 9.95 to 123.24 and length from 9.62 to 27.82 metres. All the vessels used otter trawls of different specifications. Of these vessels, M.F.V. Jheenga fished in all the years up to April 1967 when she was transferred to the Tuticorin base; M.T. Kalyani III fished from December 1964 to July 1965 when she was unfortunately lost in the sea; M.T. Kalyani IV and V commenced fishing from Bombay from April 1967 and May 1967, respectively; M.F.V. Meenabharathi, a new fishing vessel, started fishing operations from July 1965 and continued up to May 1967 when she was also shifted to the Tuticorin base; M.F.V. Bumili, till April 1965, and M.L. Meera till June 1965, were operating but were subsequently decommissioned; M.V. Sagarkanti and M.V. Sagarvihari fished for a brief period only in 1962; M.V. Sagarkumari fished from April 1966 to December 1967 and M.L. Sagarpravasi for a brief period in 1961 and from June 1965 to May 1967.

Based on the horse powers of the engines, the vessels were grouped under three heads, i.e. those between 201 and 300 H.P., those between 101 and 200 H.P. and others below 100 H.P. There were no vessels above 300 H.P. Specifications of the types of gear commonly used by the different categories of vessels are given in Table II.

The larger vessels viz., Kalyani III, IV and V and Meenabharathi used the fish trawls of 24 M to 30 M and shrimp trawls of 42 M and 45 M. In a few early operations, these vessels tried 14 to 20 M fish trawls. The medium vessels, Jheenga and Bumili have regularly used fish trawls. The medium and occasionally those of 13 to 15 M. Jheenga also used at times the smaller of the shrimp trawls. The smaller vessels used mostly 9 to 14 M fish trawls and very rarely 15 to 18 M ones.

AREAS OF EXPLORATION AND METHODS OF ANALYSIS OF CATCH DATA

The vessels from the Bombay base fished in the areas on the continental shelf of the north western part of India between latitudes 15°N to 23°10'N and longitudes 68°10'E to 73°50'E. The major areas are 1° in latitude by 1° in longitude, having an extent of 3,600 nautical square miles. Each was divided into sub-areas with 10' of latitude and 10' of longitude, having an extent of 100 nautical square miles. In each major area, the sub-areas are named alphabetically A to F on latitude and numerals 1 to 6 on longitude. A total of 251 sub-areas under 20 major areas were fished giving a coverage of 25,100 nautical square miles during the 7 year period. All the areas have not been fished to the same intensity, year after year, and the total annual coverage is dealt with separately.

The nature of the bottom was mostly muddy, but in some areas it was mud mixed up with shell, purely shelly, sandy or strewn with coral. The depth covered were from 7 to 85 metres.

The earlier exploratory programmes had the objective of covering as many areas as possible on the continental shelf to furnish particulars of catch data. In 1963 December a new exploratory fishing programme came into operation which involved systematic linear bottom trawling, repeated at monthly intervals in squares along selected parallels of latitudes passing through different depth ranges across the continental shelf. This programme has been in operation till now for all the Government of India vessels at all bases. For want of an adequate number of suitable fishing vessels, the programmes have not been covered in full, but fairly adequate fishing has been done in a large number of squares to furnish seasonal and regional abundance of fish species as reported in this paper. On the basis of the results obtained an attempt is made to present a picture of the latitudinal distribution of fish species.

For the analysis of the catch data, the log records of the Skippers and Bosuns of the fishing vessels formed the basis. Observations on the biology of fish species and environmental data have also been collected on board the fishing vessels by the staff of the Central Marine Fisheries Research Institute. The primary data were particulars per haul of the fish species from each area by each vessel. These were compiled monthly and by area for each vessel. No. sampling technique was followed for the estimation of catches, but the actual weights of the

species concerned in each haul formed the basis of the catch statistics. The unit of fishing effort is one trawling hour of each vessel and the catch per hour has been used for judging the relative productivity of different areas or the seasonal abundance of catches therein. In simultaneous fishing operations, the catch per unit effort has helped in determining the relative fishing efficiency of different vessels using similar types of gear.

In respect of some of the categories of fishes, the short local names have been used for convenience of description in the text, they being "Ghol" for *Pseudosciaena diacanthus* (Lacep), "Koth" for *Otolithoides brunneus* (Day), "Dhoma" for small mixed sciaenids, "Karkara" for *Pomadasys hasta* (Bloch) and "Wam" for *Muraenesox talabonoides* (Bleeker).

CATCH BY VESSEL PARTICULARS FROM YEAR TO YEAR AND INTENSITY OF FISHING IN MAJOR AREAS

The annual catch and catch per hour returns are shown for each vessel separately in Figures 1 to 5 and based on them, the average catch, effort and catch rate obtained are shown in Table III. These indicate roughly the catch per hour proportions of the 3 different categories of fishing vessels mentioned earlier. M.T. Kalyani III, IV and V and M.F.V. Meenabharathi, the horse powers of which were 300, 300, 300 and 262 respectively, have been treated together. M.F.V. Jheenga and M.F.V. Bumili, the horse powers of which were 153 and 135 respectively were grouped as one class. The rest of the smaller vessels, the horse powers of which ranged between 42 and 60 were grouped to constitute a third category. The average catch per hour value for Kalyani III for the two year period of 1964 and 1965 was only 206.45 kg/hour which is low compared to the yield rates of vessels of this class. This was because her performance was erratic during 1965 before she was finally lost during that year. The annual catch rates for 1964 and 1965 for this vessel were 315.46 kg/hour and 203.05 kg/hour. It may be seen that the annual catch rate for this vessel in 1964 was up to the expected level. Kalyani IV has registered in 1967 a catch rate of 308.56 kg/hour. The catch rate of 403.91 kg/hour for Kalyani V in 1967 was a little high for the reason that she fished for a only few months in fairly productive areas.

M.F.V. Meenabharathi's annual catch rates were 298.52 kg/hour in 1966 and 321.70 kg/hour in 1967. In 1965 the catch rate obtained by this vessel was low, being 146.37 kg/hour (Fig. 3) because the vessel was spending most of the time after her acquisition in testing the engines and gear, making only a few trial hauls. But for this, the annual catch rates were about 300 kg/hour (Figs. 3 to 5 and Table III).

The performance of M.F.V. Jheenga through the entire period of 1961-1967 has been steady, ranging between 201.91 kg/hour to 323.21 kg/hour with an average of 258.05 kg/hour. The average catch rates of M.F.V. Bumili for the years 1961-1965 has been 191.70 kg/hour. In the year 1961 before she underwent repairs and in 1965 when she was condemned and decommissioned, the catch rates varied between 199.51 kg/hour and 262.60 kg/hour. Although the performance of this vessel was below that of M.F.V. Jheenga, the two have been treated together for the reason that some of their annual catch rates were approximately the same (Figs. 1 to 5 and Table III).

In respect of other vessels, the annual yield rates have varied very widely depending upon the extent of the fishing effort, condition of the vessels and the variations in their horse power, but they averaged in general 100 kg/hour. As shown in Table III the average catch rates of vessels under category I are 284 kg/hour, of vessels under category II 235 kg/hour and those of category III 100 kg/hour.

The catch per horse power hour shows in general an inverse proportion to the horse powers of the respective vessels, those having higher horse power giving low catch per hour returns (Table III).

The grouping of the vessels based on variations in the annual catch per hour returns only approximately indicates their relative fishing powers. However, a more detailed investigation was made to determine the relative power factors of the three vessels viz., M.F.V. Jheenga, M.F.V. Bumili and M.L. Meera based on results of simultaneous fishing operations in some of the areas and it was found that the fishing powers of the vessels were in the ratio of 10:7:4 respectively (Rao and Meenakshisundaram, 1967).

The catch particulars year by year for the five year period 1963-1967 in the major areas fished by the vessels at Bombay base are given in Table IV. Figures 1 to 5 show also the sub-areas covered. Altogether 18 major areas have been fished. Seven of them viz., 15-73, 17-72, 18-72, 19-71, 19-72, 20-70 and 20-71 have been fished for over 100 hours. The best fished major area was 18-72 where 7,780.46 hours were spent during the period, followed by 19-72 where 272.95 hours and 20-70 where 220.39 hours were spent. Four of the areas 16-73, 17-73, 20-69 and 21-69 have been fished between 50 and 100 hours. Five other areas viz., 16-72, 18-71, 19-70, 20-72 and 22-68 have been fished between 12.66 hours and 44.92 hours. The remaining major areas viz., 21-68 and 21-70 were fished below 10 hours each.

As may be seen from the overall catch rates obtained, the major areas 15-73, 19-72, 20-70, 21-69, 21-70 and 22-68 appear to be very productive; and areas 16-72, 16-73, 17-72, 18-72, 19-71 and 20-71 good. Areas 18-71 and 19-70 were poor, whereas the remaining areas were moderately good.

THE ANNUAL LANDINGS AND CATCH COMPOSITION

The year to year catch particulars are shown in Figs. 1 to 5. In the seven year period, the catch of 309,133 kg and the catch rate of 164.92 kg/hour were the lowest in 1965; the highest catch of 499,519 kg was in 1966 and the highest catch rate of 250.70 kg/hour was in 1963. The effort expended varied much from year to year. The lowest fishing effort of 1,413.44 hours was in 1963 and the highest fishing effort expended was 2,331.73 hours in 1966. The annual averages of effort, catch and catch per hour values for the period were 1,896.09 hours, 391,568 kg and 206.51 kg/hour respectively. It may be seen that the effort expended in 1961 was about the average; in 1963 and 1967 it was below average and in the rest of the years above the average. The catch was below average in 1961 and in 1963 to 1965. The catch per hour was below the average in 1961, 1964 and 1965. The poorest catch with the lowest catch rate in 1965 does not reflect a very low abundance of fish in the region, the reason being the loss of one vessel in the months of July and the almost total cessation of fishing in the best part of the fishing season viz. October to December. It may be mentioned here that the number and types of vessels operating in different years varied and hence the deviations in the catch rates from the average value have not much significance. Catch particulars per vessel have therefore been examined separately as stated earlier.

The annual catches by categories of fishes, their averages and percentages over the seven year period are shown in Table V. The mixed catch of small sciaenids viz. "Dhoma", formed over a third and rays nearly a quarter of the total catch. Both the groups are relatively low period fish. The catch of miscellaneous fishes was also high, some of them being quality fishes like pomfrets, dorab, Bombay duck, perches, carangids, ribbon fishes and seer fishes. The moderately priced catfishes and skates were fairly abundant, ranking next to miscellaneous fishes. Among the quality fishes "Ghol" (*Pseudosciaena diacanthus*), and prawns (mostly *Metapenaeus affinis*) were a little over 3% each in total catch. Among the rest of the quality fishes, "Karkara" (*Pomadasys hasta*). "Koth (*Otolithoides brunneus*), and "Dara" (*Polydactylus indicus*) ranked next in order. "Wam" (*Muraenesox talabonides*), a moderately priced fish, was less than 2% of the total catches.

Fluctuations in catches and catch rates have been observed in all groups from year to year. As the catch is bound to vary with the effort expended, the catch rates alone have been taken as a measure to ascertain the relative abundance of fish categories from year to year. The annual catch rates of "Ghol" varied from 4.95 kg/hour to 9.34 kg/hour. The yields in general have been more or less steady. The ranges between the minimum and the maximum catch rates of "Koth" (0.8 - 7.19 kg/hour) and of "Dara" (0.25 - 3.53 kg/hour) were very wide. Based on the catch trends of these species in the landings by bull trawlers in Bombay - Saurashtra waters, Rao *et al.*(1966 loc. cit.) indicated declining yields from 1958 onwards. The catch trends reported in the present paper also

show meagre yields. Of the two, the catch rates of "Koth", at least in some years, were a little better than those of "Dara" which were uniformly poor, particularly from 1962 to 1967. The annual catch rates for "Karkara" varied from 2.47 to 9.53 kg/hour. From 1964 onwards the catch rates have declined except for 1965 when it was about the average. The catch rates of "Dhoma" in all years have been higher than any other single category of fish group and its fluctuations from year to year were not marked. However, those of "Wam" were very wide; the catch rates were higher in 1961 and 1965 than in other years. There were no distinct declining trends in "Wam", although the catches have been unsteady. Catfish yield rates have been more or less steady. Prawn catch rates have been steady between 5 and 6 kg/hour from 1961 to 1964 and 1967, but in 1966 the catch rate was over twice the average, being 12.86 kg/hour. In 1965 the catch rate was low for the reason that the fishing was almost nil in the second half of the year. The catch rates of rays, sharks and skates and miscellaneous fishes have shown no marked annual fluctuations.

DISTRIBUTION OF FISHES IN LATITUDE ZONES

The catch particulars of the larger vessels for the period 1963-1967 year-wise in different latitude zones have been studied to assess the regional abundance of the total fish catch (Table VI). For this purpose smaller vessels were not taken into consideration, because their operations were confined to regions in close vicinity to Bombay base. They did not cover the southernmost and the northernmost latitude zones. However, averages for all vessels for the same period for different latitude zones have also been given for comparison. Although the effort and catch particulars are given to arrive at the zonal catch rates, only the catch particulars have been taken for the comparison of the regional productivities.

Altogether 8 latitude zones were covered during the period. It may be seen that the effort spent was not the same in the different latitude zones. It was the highest in 18°N zone because the vessels were fishing in areas in close proximity to the base for most of the time. In the southernmost and northernmost zones, the effort spent was not appreciably high. Still, a distinct pattern of distribution was indicated in the increase in catch rates from 18°N latitude zone with 263.89 kg/hour to the northernmost zone of 22°N with a catch rate of 364.62 kg/hour. In some of the latitude zones south of 18°N zone also there was an increase in the catch rates viz., in 15°N zone off Goa (387.84 kg/hour) and 16°N zone off Malvan (267.40 kg/hour). Systematic exploratory trawling was undertaken towards the end of 1967 (November-December only) off Goa where the effort spent was not of a high order, but the catch rates obtained were fairly high. The increase in catch trends towards north and towards south of 18°N latitude zone is seen not only from the total catch rates for the 5 year period, but also in a general way in the data for the individual years.

The catch rates for all vessels for the 5 years period also showed the same trends in the different latitude zones. However, in 18°N and 19°N zones the overall catch rates for all vessels were a little less than the corresponding values for larger vessels only. This was due to the fact that the smaller vessels with comparatively lower catch rates had brought down the values when all vessels were treated together. In the extreme north and south zones this disparity did not occur because the larger vessels only were in operation.

To ascertain the regional distribution of the different categories of fishes the catch rates and the percentage proportion of each category of fish in 1° latitude zones have been computed and shown in Table VII for the period 1963-1967 for the larger vessels. It is seen that the catch rates and percentage proportion of "Ghol" were the highest in 22°N latitude zone. In general they were fairly high from 18°N to 22°N and poor in 16°N and 17°N latitude zones. A very similar distribution pattern for "Koth" was also seen except that the yields were low in 19°N latitude zone. "Dhoma" catch rates were the highest in 15°N latitude zone and high in 21°N and 22°N latitude zones. The highest percentage yield for this group was from 21°N latitude zone (Porbundar). The yield rates for "Dara" were poor in all zones, but 16°N and 22°N latitude zones were a little better than other zones. Catch rates for "Karkara" were high in 17°N and 18°N latitude zones and moderately high in 19°N, 20°N and 22°N latitude zones. The catch rates for "Wam" were higher in the northern latitude zones of 19°N to 22°N than in the southern zones. The highest catch rate and the percentage catch were from 22°N latitude zone. Catfish yields were extremely good in 15°N to 17°N and 22°N latitude zones. The catch rates and the percentage proportion of prawns were the highest in 18°N latitude zone and ranking next was the 19°N latitude zone. For rays also the catches, catch rates and percentage in total catch were the highest in 18°N latitude zone and ranking next was 20°N latitude zone. Sharks and skates were best obtained from 18°N latitude zone, but their percentage proportion and the catch rates were higher in the 16°N, 19°N, 20°N latitude zones. The catch rates for miscellaneous fishes were the highest from 15°N latitude zone, but 16°N and 19°N latitude zones also gave very high catch rates. The percentage catch was the highest in the 16°N latitude zone and ranking next was 19° latitude zone for this group of fishes.

SEASONAL CATCH TRENDS

Monthly catch particulars for individual years during 1963-1967 and the respective quarterly averages of the total fish are given in Table VIII. It is seen that the average catch and the catch rates for the 5 year period were the highest in the fourth quarter. The third quarter's catch was the lowest, but the catch rate was very high, next in rank to the catch rate of the fourth quarter. The first and the second quarters' catches and the catch rates were fairly high and more or less of the same magnitude. This order of the average quarterly

catches and catch rates was seen in the years 1964, 1966 and 1967. The deviation from the normal trend was seen in the fourth quarter of 1963 and 1965 due to poor fishing (Bumili was laid up in 1963 and Kalyani III was lost in 1965).

The monthly averages followed almost the same trends as in the respective quarters. Taking the monsoon months of July to September, it was found that the catch rates were a little higher than in most other months, August registering the highest monthly average catch rate. Similar trends of very high catch rates in some of the monsoon months are seen in the data for the individual years also.

It may be summed up that fishing was extremely good from October to December, thereafter fair up to May and poor in the monsoon months. The change over from fair to poor fishing activity was about the middle of June. Fishing in the monsoon months cannot be intensive because of the inclement weather conditions, although the catch rates, as stated earlier, were extremely high.

The monthly and quarterly averages for catches and catch rates in respect of the categories of fishes are shown in Figures 6 and 7 and Table IX. "Ghol" catches were found to be highest in the first quarter, lowest in the third quarter and high in the second and fourth quarters. That "Ghol" occurs in equal abundance all the year round was indicated in the catch rates being more or less the same in all the quarters ranging from 7.14 to 8.35 kg/hour. As observed in the total fish catch trends, "Ghol" catch rates also were very high in some of the monsoon months. In general it may be said that the fishery started from October, reached a peak by about January-February and lasted till about the beginning of June.

The catches and the catch rates of "Koth" were the highest in the first quarter and lowest in third quarter. In fourth quarter, the catches and catch rates ranked next to first quarter; the second quarter's yield and yield rate were moderate. The monthly catch trends indicate that the fishery was of a short duration from about November to February with high yields, the catch and catch rates being generally poor in the rest of the months (exception June 1965 when the catch and catch rates were high viz., 2,803 kg and 13.85 kg/hour respectively).

The average catch and catch rates for "Dhoma" were the highest in fourth quarter. In the third quarter, the catch was the lowest, but the catch rate was fairly high ranking next to that of the fourth quarter. The catch and the catch rates were fairly high in the first and the second quarters. The monthly average catch trends indicate extremely high catch rates from October to December. In the rest of the months the catches and catch rates followed the same order as the quarterly averages. In general it may be said that "Dhoma" were obtained best from October to December, but also in fair abundance in the rest of the months.

"Dara" catches have been so extremely poor in recent years that it is not possible to assess any seasonal catch trends. However, with the available data it is seen that the catch and catch rates were the highest in the first quarter. There was a sharp fall in the yields in the second quarter and this continued through the third and fourth quarters. Monthly catch trends indicate that the fishery was at its best from December to March. There is no indication of the monsoon months giving either high catches or high catch rates.

The quarterly averages for "Karkara" showed that the catches were highest in the first quarter, fairly high in the second and fourth quarters and lowest in the third quarter. The catch rates were highest in the fourth quarter, high in the first and the second quarters and lowest in the third quarter. The monthly trends indicate a good fishery from October to May. In June there was a sharp fall in the yields. In August during monsoon months in some years there was a slight increase in the yield rates.

"Wam" is best obtained in the second quarter with very high yield rates. The fishery was fairly good in the first quarter. Yields and yield rates decreased in the third quarter, but showed a slight improvement in the fourth quarter. Monthly catch trends indicate an increase in yield rates from November, continued till July; thereafter they were extremely poor till October.

Cat-fish yields were of more or less of the same high magnitude in the first and the fourth quarters and ranking next in the second quarter. In the third quarter although the yields were the lowest, the catch rate was highest. The peak catches were obtained from November to February. In the rest of the months also the catches and the catch rates were fairly high.

Prawn yields and yield rates were found to be very high in the second and fourth quarters. In the first and the third quarters the yields were more or less of the same magnitude, but the catch rates were the lowest in the first quarter and highest in the third quarter. January-February showed very poor yields; there was slight improvement in the yields in March; peak catches were obtained in April-May; there was a decline in June, but in the succeeding months the catch and catch rates again showed an increase reaching a second peak by about October; by November there was a slight fall in the yields and this continued to December. In some years the first peak in April-May is absent.

The average yields for rays were the highest in the first quarter, lowest in the third quarter and moderately high in the second and fourth quarters. The catch rates were highest in the third quarter and more or less the same in the first, second and fourth quarters. There was no definite season for the fishery, the catches and the catch rates being high in almost all the months.

The quarterly and monthly catch trends for sharks and skates follow exactly the same pattern of distribution as found in rays.

The miscellaneous fishes were best obtained with the highest catch rate in the fourth quarter. Their yields were fairly high in the first and the second quarters, but poor in the third quarter. However, the catch rates in these three quarters were approximately the same (about 28 to 32 kg/hour). Monthly catch trends indicate high yield and high yield rates from September to April.

ABUNDANCE OF FISH CATCHES BY DEPTH

Analysis by depth of the fish catches obtained by the larger vessels (Kalyani III, IV and V, Meenabharathi and Jheenga) during the 3 years period from 1965-1967 in the several 1° latitude zones has been attempted and the results presented in Table X to XII. As seen from Table X, taking all zones together, the catch rates were found to be high from 11 M to 60 M depths; they were particularly very high from 41 M to 60 M depths. The bulk of the catches came from 11 M to 50 M depths, the highest yield being obtained from the 21-30 M depth zone and the 31-40 M zone ranking next. The effort spent in fishing was appreciably higher in the 11 M to 40 M depth zones.

The overall catch rates obtained in individual 1° latitude zones differ only slightly from those observed for all zones combined. In the following account latitude-zoned distribution of total fish and categories of fishes in different depth zones is given.

Depth-wise distribution of all fish in different latitude zones

In the 15°N latitude zone high catch rates were registered from 11 M to 50 M depths. The shallower depths of 11-20 M were found richer than 31-40 M and 41-50 M depth zones. During November and December alone there was fishing. In general the catch rates in November were better than in December, except in 21-30 M zone (Table XI).

In 16°N latitude zone also the catch rates were found to be very high from grounds in 11 M to 50 M depths but the deeper zones of 31-40 M and 41-50 M had given higher catch rates than the shallow depth zones. There was fishing for 4 calender months. In April an extremely high catch rate (637.33 kg/hour) was obtained in 41-50 M depth zone. During the same month high catch rates (333.50 kg/hour to 425.40 kg/hour) were obtained from 11 M to 40 M depth zones also. The catch rates were, however, poor in depths over 51 M (116.14 kg/hour to 125.00 kg/hour).

In 17°N latitude zone the catch rates obtained were much lower than in the 2 preceding latitude zones. The shallower depths up to 40 M had registered only moderately high catch rates (118.57 kg/hour to 160.52 kg/hour). The highest catch rate (294.00 kg/hour) was from 51-60 M depth zone. The effort expended in the different depth zones was poor (Table X). There is, however, some indication that this latitude zone is also somewhat productive for the reason that fairly high catch rates (351.80 kg/hour to 400.00 kg/hour) were obtained in April from depths 11 M to 40 M.

As stated earlier the 18°N latitude zone was most intensively fished. A remarkable increase in catch rates was observed from grounds in very shallow depths to those up to 60 M (104.00 kg/hour to 371.60 kg/hour). The catch rates in still deeper waters showed a downward trend. Fairly high catch rates (301.16 kg/hour to 371.60 kg/hour) were obtained from grounds at depths of 31 M to 60 M (Table X). As in Table XI in the first quarter a greater concentration of fish was observed in the deeper waters viz., 31 M to 70 M than in shallower depths. In April and May fairly high catch rates (up to 382.60 kg/hour) were obtained from all depth zones with a few exceptions. In June the catch rates increased steadily from shallower to deeper waters up to 70 M. In July the concentration of fish was higher in 31-40 M depth zone than in other depth zones fished. In August almost uniformly high catch rates were obtained from 11 M to 50 M depths (293.56 kg/hour to 377.82 kg/hour). In September to December the catch rates showed a tendency to increase on grounds in very shallow waters over those in deeper waters up to 60 M (Table XI).

In 19°N latitude zone the catch rates were very high from 41 M to 60 M (433.47 kg/hour to 439.30 kg/hour) and moderate from 11 M to 40 M depths (158.67 kg/hour to 233.17 kg/hour.) From January to March the catch rates showed an increase from the shallower to the deeper grounds. In April the catch rates were very high (318.80 kg/hour to 460.55 kg/hour) in all depth zones fished. May and June have shown comparatively greater concentrations of fish on the grounds at depths 31 M to 50 M. In September and October extremely high catch rates were registered from grounds at depths of 41 M to 60 M (up to 809.37 kg/hour). In November and December the catch rates were high both in the shallower and deeper waters. Particularly in the latter month the concentration was more in deeper waters of 41 M to 60 M (Table XI).

In 20°N latitude zone uniformly and fairly high catch rates were obtained from 21 M to 60 M. The catch rates were comparatively lower in depths of 61 M to 80 M (Table X). The highest monthly catch rate was in September (1,449.23 kg/hour) from 41-50 M depth zone. In the rest of the months when there was fishing the catch rates were neither appreciably high nor low (Table XI).

In 21°N latitude zone a very high catch rate was obtained from 11-20 M depth zone (320.40 kg/hour). In general at depths of 21 M to 50 M the catch rates were moderately high. The fishing effort expended in this zone was poor and only 3 calendar months were covered. The highest catch rate (320.39 kg/hour) was in February from the 11-20 M depth zone.

In 22°N latitude zone the catch rates were fairly and uniformly high from 21 M to 60 M depths (203.78 kg/hour to 232.79 kg/hour). The fishing effort was very low and the shallower and deeper zones were not covered. There was fishing only in 1 month.

Distribution by depth of fish categories in different latitude zones

As judged by the high catch rates obtained, the concentration of "Ghol" was high in 11 M to 40 M depths in 15°N to 17°N latitude zones. Similar high concentrations occurred in 18°N to 20°N and 22°N latitude zones between depths from 21 M to 50 M or even up to 60 M. Also in deeper waters of 61-70 M and 71-80 M in the 19°N and 20°N latitude zones respectively there was abundance of "Ghol".

"Koth" in the northern latitude zones of 21°N and 22°N was obtained at higher catch rates than in the southern zones. In the said two latitude zones high catch rates were recorded from depths 21 M to 50 M or even up to 60 M. In 19°N and 20°N latitude zones the catch rates were comparatively higher from the 21-30 M zone and the 41-60 M zone respectively. In 18°N latitude zone high catch rates were obtained from grounds in depths of 11 M to 40 M. In 15°N to 17°N latitude zones, in the depths fished "Koth" was either nil or extremely scarce.

Catch rates of "Dhoma" in contrast with those of "Koth" in general were of a high order in all depths in the southern latitude zone of 15°N and poor in 22°N. "Dhoma" catch rates were fairly high in 15 N to 17°N latitude zones in depths of 11 M to 30 M / 50 M. In 17°N latitude zone good concentrations were observed in the 51-60 M zone also. High catch rates were realised in 18°N latitude zone at all depths from 11 M to 70 M. In 19°N, 20°N and 22°N latitude zones "Dhoma" was more abundant in 31 M to 60 M depths. In 21°N latitude zone a significantly high concentration of this group was found only in the 11-20 zone (Table XII).

"Dara" catches were nil at all depths fished in 15°N and 17°N latitude zones. Even in other latitude zones "Dara" was very poorly represented. However, in 16°N and 18°N to 21°N the catch rates were fairly in depths of 21-40 M. In 20°N to 22°N latitude zones also fair catch rates for this species were registered from depths up to 60 M.

"Karara" catch rates in 15°N to 17°N and 20°N latitude zones were fairly high from the 21-30 M depths. In 18°N latitude zone fairly good catch rates were obtained from the 21-30 M zone and high catch rates from the 31-70 M zone. In 19°N, 21°N and 22°N latitude zones high catch rates were observed in the depths from 41 M to 50 M / 60 M depths (Table XII).

"Wam" catch rates were either very poor or nil in the 15°N to 17°N latitude zones in all depths fished. In the 18°N latitude zone appreciably high catch rates were obtained from the 61-80 M zone for this species. In the 19°N latitude zone fairly high catch rates were registered from all depth zones. High catch rates were also obtained from 21°N latitude zones from all depths. However, the concentration of fish was comparatively higher in the 71-80 M zones in the 20°N latitude zone and the 21-50 M zone in the 22°N latitude zones from all depths. However, the concentration of fish was comparatively higher in the 71-80 M zone in the 20°N latitude zone and the 21-50 M zones in the 22°N latitude zone.

Cat-fish catch rates have been high from all depths but in general high concentrations were found in 41-60 M depths in almost all latitude zones fished.

Prawn catch rates were very high from 11 M / 21 M to 30 M depths in the 15°N, 18°N, 19°N and 21°N latitudes zones. In the 16°N latitude zone the highest catch rate was from the 41-50 M depth zone, in the 17°N latitude zone from the 51-60 M depth zone and in the 22°N latitude zone from the 41-50 M depth zone. In the 20°N latitude zone the catch rates were uniformly low in all depths fished but were a little higher from the 51 M to 80 M zone.

The catch rates for rays in all latitude zones were high in depths 11 M / 21 M to 30 M / 50 M.

Sharks and skates have been found in all depths. The differences in their distribution pattern in different depths in different latitude zones were not marked.

In most of the latitude zones the concentration of the miscellaneous fishes was fairly high in depths from 11 M to 60 M. Their catch rates were very high in the 15°N latitude zone from 11 M to 50 M depths. The highest catch rate for this group of fishes was from the 16°N latitude zone at 31-40 M depths.

Thus it may be seen that "Ghol" occurred in all depths up to 60 M in most of the latitude zones and also in deeper waters up to 80 M in some of the northern latitude zones. "Koth" catch rates were high from depths 11 M to 60 M in latitude zones from 18°N to 22°N. "Dhoma" catch rates were high in all latitude zones from all depths except the northern latitude zone where the abundance was mostly in the shallower waters. "Karkara" catch rates were high from 21 M to 70 M depths in

the different latitude zones. A good concentration of "Wam" was found from both the shallower and deeper waters from 19°N to 22°N. Cat-fish catch rates were comparatively higher in the 41 M to 60 M depths in almost all latitude zones. Prawns were abundant in shallower depths up to 30 M in most of the latitude zones and fairly high concentrations were found in grounds from deeper waters also in some of the southern latitude zones. Catch rates for rays were very high from the shallower depths and for sharks and skates from all depths in all latitude zones. Miscellaneous fishes were mostly abundant in depths from 11 M to 60 M.

GENERAL CONSIDERATIONS

The foremost objective of exploratory fishing is to locate regions of abundance of fish by total catches and by categories of fishes so that commercial operations may be successfully undertaken by eliminating less productive regions and intensifying fishing in the more productive ones. The operations of S.T. William Carrick for the period 1921-1922 (Hefford, 1949) indicated for the first time that catch returns from the Gulf of Kutch and Kathiawar coasts were higher than from other regions. Subsequently the exploratory fishing by the Government of India vessels and commercial fishing by the New India Fisheries Company's trawlers furnished very valuable data on the regional catch trends of the fish groups in the 6 regions from Bombay to Kutch in the north western division (Jayaraman *et al.* 1959; Rao *et al.*, 1966 and Rao, 1967).

In this report the catch trends of the Governmnent of India vessels are presented in 1° latitude zone. These zones are all uniform, having a south to north distance of 60 nautical miles. This is not the case in respect of regions hitherto followed; the south to north distance in Bombay is 100, Cambay 60, Veraval 20, Porbundar 60, Dwarka 40 and Kutch 80 nautical miles. Half degree latitude zones are preferable to 1° latitude zones as they aim at greater accuracy in assessing the zonal variations in catch trends, but the coverage of the fishing expecially in the northernmost and southernmost areas is not adequate enough at present to adopt zones less than 1° latitude intervals.

In Table XIII the regional annual catches of all fish obtained by bull trawlers of the New India Fisheries Company for the period 1957-1962 are interpolated to facilitate comparison with the results obtained by the Government of India vessels against 1° latitude zones. The catch per hour values by bull trawling are for a pair of vessels and those by otter trawlers are for single vessel operations. Hence the average zonal catch rates for the Government of India vessels are doubled to equalize the catch per hour data of the bull trawlers (Data after Rao, 1967). As in the earlier findings, the present investigations also show a northward increase in abundance from Bombay to Kutch. In the earlier operations the southern regions were not covered and it is for the first time that a trend towards an increase in catches in the

regions south of Bombay is reported. However, this needs confirmation by further exploration since the effort spent in regions south of Bombay was low.

As regards the regional abundance of fish groups (Table VII) it is seen that "Ghol", "Koth", "Dara", cat-fishes, prawns, rays and sharks and skates follow almost the same pattern as was presented by the bull trawlers operating from this base (Rao, 1966). In the present findings very high catch rates for "Dhoma" are recorded from 15°N (Goa), 22°N (Dwarka, Kutch S) and 21°N (Porbundar) and for miscellaneous fishes from 15°N (Goa), 19°N (Bombay N, Cambay S) and 16°N (Malvan). The bull trawler operations have registered higher catch rates for "Dhoma" from Porbundar, Cambay and Veraval and for miscellaneous fishes Kutch, Porbundar and Veraval. The differences are not significant as these two groups are abundant in all zones. "Karkara" are known from earlier studies to be comparatively more abundant in the northern regions viz., Kutch, Dwarka and Porbundar, but they are also observed in greater quantities from the more southern latitude zones 17°N to 19°N. In respect of "Wam", the earlier findings show its abundance in Cambay, Veraval and Bombay, and it is now reported in greater abundance from 22°N, 19°N and 21°N latitude zones. The low and unsteady yields of both species in recent years make it difficult to assess their overall regional abundance with any accuracy.

Regarding distribution by depth of fishes in the Bombay - Saurashtra waters Jayaraman *et al.* (1959) have shown that the bulk of the yields came from about the 20 fathom line, with "Dara" and "Koth" in relatively greater abundance in the landward side and "Ghol", "Karkara" to the seaward side. In the present investigation, 41 M to 60 M (22-33 fathoms) depths have been found to give very high catch rates for all fishes, the major portion of the yields coming from 21 M to 40 M (12-22 fathoms) depths. The distribution of "Ghol" both in the shallower and deeper waters as revealed in the present investigation is in agreement with the earlier findings; "Koth" and "Dara" were more abundant in shallower waters, with the exception of some of the northern latitude zones where yields were fairly high also from comparatively deeper waters. In general "Karkara" and "Wam" yields were relatively higher from deeper waters as in the earlier findings.

Kagwade (1967) had shown that prawn catch rates were of a very high order in Cambay and Bombay regions in the bull trawler landings during 1956-1963. The present findings also point to comparatively greater abundance in the 18°N latitude zone (Bombay S) and 19°N latitude zone (Bombay N and Cambay S). Kagwade (*loc. cit.*) has found no marked concentration of prawns in any definite depth zone. The present findings report high catch rates both from the shallower and deeper depth zones in some of the latitude zones and taking all the latitude zones together it is seen that the relatively greater abundance of prawns is in the shallower depth zones.

In any zone the subareas vary widely from one another from the point of view of abundance of fish catches. Hence the assessment of yields by subareas is essential. For the period from 1961 to 1965 the productive areas revealed by the exploratory fishing operations by the larger vessels of the Government of India Deep Sea Fishing Station were shown in an earlier publication (Rao, 1967). During the years 1966 and 1967 the subareas 18-72/5C, 6 C, 6D, 19-72/1B and 20-70/6C had given at times over 1,000 kg/hour; areas 15-73/4E, 3D, 18-72/3E, 6B, 19-72/1D and 2A between 750 kg/hour and 999 kg/hour; areas 15-73/2D, 3C, 4C, 5C, 18-72/2D, 5B, 19-72/1C and 20-70/5C between 500 kg/hour and 749 kg/hour; areas 15-73/4D, 18-72/4D, 4E, 1E, 6E and 19-72/1E between 400 kg/hour and 499 kg/hour; areas 15-73/3E, 4B, 5D, 18-72/1F, 2E, 3D, 4C and 19-71/3F between 300 kg/hour and 399 kg/hour and areas 15-73/2C and 16-73/1B between 200 kg/hour and 299 kg/hour.

For initiating commercial trawling operations the fishing industry requires estimates of annual yields by each type of vessel. These are furnished in Table XIV. A vessel of Kalyani type by otter trawling in Bombay - Saurashtra waters is expected to give an annual average yield of about 499 metric tons of fish; of Meenabharathi type about 424 metric tons; of Jheenga type 408 metric tons; of Bumili type 302 metric tons; of Meera type 147 metric tons and Sagarpravasi type 144 metric tons of fish. The maximum and minimum yields are also given in the table. These estimates are based on the observed minimum, maximum and average catch rates obtained by the respective vessels. The number of fishing days alone has been increased to the extent to which operations are considered feasible. The smaller vessels are considered suitable only for daily voyages. As more time is lost in reaching and returning from the fishing grounds the number of hauls taken by them per day is limited to 4, each of one and half hours duration. The larger vessels after reaching the fishing grounds are expected to take atleast 5 hauls a day as they do not return to the port the same day. During the monsoon period of 3 months, the number of fishing days has been reduced to a third of the total days as most days are unsuitable for fishing operations due to inclement weather conditions.

Between latitudes of 15°N to 23°30'N on the continental shelf of the north western division of India from Goa to Kutch up to 100 fathoms depths, there are about 680 small subareas of 100 nautical square miles each, thus giving a total of 68,000 nautical square miles of fishable grounds. Of these in the period of 1961 to 1967 only 251 subareas have been covered, extending over 25,100 nautical square miles. What is required in exploratory fishing is repeated trawling in the squares falling in the same latitude zones at periodical intervals to assess seasonal productivity, but the coverage even in this small number of squares, particularly those in the southernmost and the northernmost latitude zones was most inadequate.

This is because of the insufficient number of suitable exploratory fishing vessels. At no period were more than 6 exploratory vessels operating from the Bombay base. Even among these only 1 or 2 were of the larger type capable of fishing in depths up to 60-80 metres. From Bombay as the base the southernmost latitude zone is about 240 nautical miles and the northernmost latitude zone is about 400 nautical miles. The inadequacy of facilities for berthing and disposal of catches at the nearby ports forced the vessels to return to Bombay base with the catches each time after fishing in the northern or southern grounds. The only base at Veraval with some minimum facilities for the above purposes was closed down in 1966 for want of sufficient number of fishing vessels.

Different types of trawls viz., otter trawls and bull trawls have been tried and their relative merits have been assessed, but other types of gear such as midwater trawls, purse-seines and long lines have been little used in the exploratory fishing operations in this region by the Government of India vessels. Although initial attempts have been made to determine the fishing vessel efficiency, gear efficiency and standardization of fishing effort, these aspects of exploratory programmes have not received much attention.

The correlation of oceanographic and other environmental data with the regional fish catches is important but the information so far available is insufficient for drawing any conclusion, owing to the lack of facilities on board the fishing vessels for the collection of such data. What is most urgently required is a fleet of suitable research-cum-exploratory fishing vessels provided with modern types of fishing gear and oceanographic equipment. The future plans should aim at exploration of the deeper waters of the continental shelf and beyond on to the continental slope. A good deal of information on the biology of the component species of the trawler landings has been collected, but a large number of species still remains to be studied. While the catch per hour returns in the annual landings do not show wide fluctuations, some of the component species like "Dara" and "Koth" have declined sharply in recent years, a matter which requires immediate attention.

SUMMARY

1. Eleven vessels of the Government of India Deep Sea Fishing Station, Bombay, participated in the exploratory fishing operations during 1961-1967. Their B.H.P. varied from 42 to 300, gross tonnage from 9.95 to 123.24 and length from 9.62 to 27.82 metres. They used otter trawls of different specifications.

2. The vessels covered 25,100 nautical square miles on the continental shelf between latitudes 15°N to 23°10'N and longitudes 68°10'E to 73°50'E.

3. The log data of the vessels formed the basis for the analysis of the catch data. The catch per trawling hour was taken for judging the relative productivity of the different areas and seasonal abundance of fish catches.

4. The vessels were grouped in 3 categories viz., those between 201-300 B.H.P., those between 101-200 B.H.P. and the rest below 100 B.H.P. The average annual catch rates were about 284 kg/hour for vessels under category I, 235 kg/hour for those under category II and 100 kg/hour for those under category III.

5. Eighteen major areas were fished. Areas 15-73, 19-72, 20-70, 21-69, 21-70 and 22-68 were found to give very high yields. Among the rest 16-72, 16-73, 17-72, 18-72, 19-71 and 20-71 showed fairly high catch rates.

6. The annual averages in the 7 year period of 1961-1967, for the fishing effort, catch and catch rates were 1,896.09 hours, 391,568 kg and 206.51 kg/hour respectively. The range of the annual catches was from 309,133 kg to 499,519 kg, of effort from 1,413.44 hours to 2,331.73 hours and of catch rates from 164.92 kg/hour to 250.70 kg/hour in different years during the 7 year period.

7. The mixed sciaenids, "Dhoma", formed over a third and rays about a quarter of the total catch. Among the rest, in the decreasing order of abundance, miscellaneous fishes formed 15.04%, cat-fishes 7.05%, sharks and skates 6.31%, "Ghol" 3.63%, prawns 3.07%, "Karkara" 2.69%, "Wam" 1.60%, "Koth" 1.60% and "Dara" 0.65%.

8. The fluctuations in the catch rates from year to year have not been found very wide in "Ghol", "Dhoma", cat-fishes, prawns, rays, sharks and skates and miscellaneous fishes, while those in "Koth", "Dara", "Karkara" and "Wam" were very marked.

9. Eight latitude zones were fished during the 5 year period of 1963-1967. There was a northward increase in the catches from 18°N latitude zone with 263.89 kg/hour to 22°N latitude zone with a catch rate of 364.62 kg/hour. To south of 18°N latitude zone also there was an increase in catch rates to 267.40 kg/hour in 16°N latitude zone and to 387.84 kg/hour in 15°N latitude zone.

10. In respect of categories of fishes the catch rates were the highest for "Ghol", "Koth", "Wam", cat-fishes and sharks and skates in 22°N latitude zone; for prawns in 18°N latitude zone; for "Karkara" in 17°N latitude zone and for "Dhoma" and miscellaneous fishes in 15°N latitude zone. "Dara" catch rates were poor in all zones where they occurred.

11. The seasonal trends for all fishes showed the highest yields in the fourth quarter; the fishery of "Ghol" was found to be from October to June with peak catches in January-February and of "Koth" from November to February with peak catch in about December. "Dhoma" was best obtained from October to December but also in fair abundance in the rest of the months; "Karkara" was best from October to May and "Wam" from November to July. Cat-fishes were abundant all round the year, but best obtained from November to February. Prawns generally showed two peaks, the first in April-May and the second in about October. For rays, sharks and skates there was no distinct season, but the catches were the highest in the first quarter. For miscellaneous fishes the highest yields were from October to April.

12. The analysis by depth of the catches for the period 1963-1965 revealed that the bulk of the catches came from 21 M to 40 M depths. In general taking all latitude zones together, the catch rates were very high from 41 M to 60 M depths. Catch rates for total fish in individual latitude zones follow the same pattern with slight variations. For individual categories of fishes, latitudinal occurrence in different depth ranges at 10 M intervals has been recorded.

13. The merits of taking 1° latitude zones over the higher to adopted regions from Bombay to Kutch have been discussed. The catch trends revealed by the present investigations have been found to be comparable with those in the earlier findings.

14. Similarities and differences in the regional and depth-wise distribution of different categories of fishes between the present and the earlier findings have been pointed out.

15. Productive areas revealed by exploratory fishing have been grouped according to catch per hour returns.

16. Based on the actual minimum, maximum and average catch rates obtained in the exploratory fishing operations, estimates of annual yields by the different types of vessels have been made for helping the fishing industry to promote commercial trawling operations.

17. The future plans for intensifying the exploratory fishing programmes have been outlined.

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TABLE I

SPECIFICATIONS OF THE GOVERNMENT OF INDIA VESSELS OF THE DEEP SEA FISHING STATION, BOMBAY (1961-1967)

Sr. No.	Name of the vessel	Hull	Year & country of built	B.H.P.	Gross tonnage	Nett tonnage	Length (in metres)	Beam	Draft
1.	M.T. Kalyani III	Steel	1951 (Japan)	300	125.24	60.71	27.82	5.43	2.82
2.	M.T. Kalyani IV	"	1954 (Japan)	300	125.24	62.53	27.82	5.43	2.82
3.	M.T. Kalyani V	"	1954 (Japan)	300	125.24	60.71	27.82	5.43	2.82
4.	M.F.V. Meenabharathi	"	1965 (India)	262	70.70	23.00	23.31	5.95	3.28
5.	M.F.V. Jheenga	"	1958 (Holland)	153	48.67	15.70	15.62	5.41	2.41
6.	M.F.V. Bumili	Wooden	1949 (U.K.)	135	31.53	10.01	14.46	5.11	1.62
7.	M.L. Meera	"	1954 (Japan)	60	9.95	5.75	10.37	3.34	1.33
8.	M.L. Sagarpravasi	"	1954 (Japan)	60	12.88	9.80	11.13	3.60	1.56
9.	M.V. Sagarkumari	"	1954 (Japan)	42	11.24	8.45	10.49	3.56	1.25
10.	M.V. Sagarkanthi	"	1954 (Japan)	42	11.77	5.30	9.62	3.76	1.28
11.	M.V. Sagarvihari	"	1954 (Japan)	42	10.98	8.33	10.42	3.56	1.34

TABLE II

PARTICULARS OF FISHING GEAR USED BY THE VESSELS OF THE DEEP SEA FISHING STATION, BOMBAY (1961-1967)

Sr. No.	Size and type of net	Material used	Length of Hunt rope (metres)	Length of Head rope (metres)	Length of Foot rope (metres)	Mesh at cod end (mm)	Weight of otter board (kg)
1.	10 metre trawl	Cotton	8	10	16.2	25	45
2.	11 " "	"	8	11	19.0	25	45
3.	12 " "	"	8	12	18.6	25	60
4.	13 " "	"	8	13	22.0	25	150
5.	14 " "	Nylon/ Cotton	8	14	23.0	25	150
6.	16 " "	Cotton	8	16	24.0	25	150
7.	18 " "	"	8	18	26.0	25	150
8.	24 " "	"	8	24	30.0	25	250
9.	30 " "	Nylon/ Cotton/ Manila	15	30	39.0	25	250/280
10.	42 " shrimp trawl	Nylon	15	42	53.0	25	250/280
11.	45 " "	Monofila-ment	15	45	58.0	25	250/280

TABLE III

ANNUAL AVERAGE CATCH PARTICULARS ACCORDING TO CATEGORIES OF VESSELS

Sr. No.	Name of the vessel	Averages for years	Effort in hrs.	Catch in kg	C.p.h./ H.P.	C.p.h.	C.p.h./ V.C.
1.	M.T. Kalyani III	1964-'65	329.49	68,024	0.69	206.45	
2.	M.T. Kalyani IV	1967	407.25	125,660.5	1.03	308.56	283.99
3.	M.T. Kalyani V	1967	263.06	106.253	1.34	403.91	
4.	M.F.V. Meenabharathi	1965-'67	346.91	101,696	1.18	293.15	
5.	M.F.V. Jheenga	1961-'67	668.38	172,477	1.69	258.05	234.57
6.	M.F.V. Bumili	1961-'65	512.59	98,265	1.42	191.70	
7.	M.L. Meera	1961-'65	409.18	43,977	1.79	107.47	
8.	M.L. Sagarpravasi	1961 &1965-1967	196.56	17,304	1.47	88.04	
9.	M.V. Sagarkumari	1966-'67	368.55	38,908	2.34	105.57	100.86
10.	M.V. Sagarkanthi	1962	72.04	2,180	0.72	30.26	
11.	M.V. Sagarvihari	1962	19.75	173	0.21	8.86	

C.p.h./H.P. = Catch per horse power hour;

C.p.h. = Catch per hour;

C.p.h./V.C. = Catch per hour per vessel category.

TABLE IV

PARTICULARS OF EFFORT IN HOURS, CATCH IN KG, (AND CATCH PER HOUR IN KG) IN MAJOR AREAS FISHED DURING 1963-1967

Major area	1963	1964	1965	1966	1967	Total
15-73	..	..	..	..	134.33	134.33
	..	..	..	..	52,099	52,099
	..	..	..	..	(387.81)	(387.81)
16-72	..	16.00	24.17	..	..	40.17
	..	3,944	5,905	..	..	9,849
	..	(246.50)	(244.31)	..	..	(245.18)
16-73	..	56.08	34.00	..	2.00	92.08
	..	13,772	9,187	..	475	23,534
	..	(245.58)	(273.15)	..	(273.50)	(255.58)
17-72	64.81	33.00	54.82	6.00	6.00	164.63
	17,247	9,573	10,560	nil	nil	37,380
	(266.12)	(190.10)	(192.63)	nil	nil	(227.05)
17-73	3.58	12.18	37.17	4.00	8.00	64.93
	1,848	2,578	7,093	nil	nil	11,519
	(516.20)	(211.66)	(190.83)	nil	nil	(177.41)
18-71	..	12.66	..	..	..	12.66
	..	618	..	..	..	618
	..	(48.81)	..	..	..	(48.81)
18-72	1,142.10	1,631.62	1,255.41	2,318.73	1,432.60	7,780.46
	230,564	292,968	176,213	498,675	304,315.5	1,510,755.5
	(208.90)	(179.56)	(140.36)	(215.06)	(212.42)	(194.15)
19-70	4.00	22.75	2.67	..	..	29.42
	307	1,762	533	..	..	2,602
	(76.75)	(77.45)	(199.62)	..	..	(88.44)
19-71	8.25	47.00	87.01	..	2.00	144.26
	5,279	7,765	17,262	..	785	31,091
	(639.87)	(165.21)	(198.39)	..	(392.50)	(215.52)
19-72	29.50	38.74	120.96	3.00	80.75	272.95
	7,154	8,693	23,634	844	46,612	86,937
	(242.51)	(224.39)	(195.38)	(281.33)	(577.24)	(318.51)
20-69	..	37.40	12.50	..	..	49.90
	..	6,176	2,860	..	..	9,036
	..	(165.13)	(228.80)	..	..	(181.08)
20-70	86.97	22.50	99.67	..	11.25	220.39
	49,929	5,610	22,587	..	5,020	83,146
	(574.09)	(249.33)	(226.62)	..	(446.22)	(377.27)
20-71	40.75	20.00	41.34	..	..	102.09
	8,330	3,661	8,643	..	..	20,634
	(204.41)	(183.05)	(209.07)	..	..	(202.11)
20-72	1.50	21.64	..	..	..	23.14
	1,599	1,116	..	..	..	2,715
	(1,066.00)	(51.57)	..	..	..	(117.32)
21-68	..	3.00	..	..	..	3.00
	..	357	..	..	..	357
	..	(119.00)	..	..	..	(119.00)
21-69	15.80	8.00	73.93	..	..	97.73
	12,784	920	17,608	..	..	31,312
	(809.11)	(115.00)	(238.17)	..	..	(320.39)
21-70	2.00	..	..	..	..	2.00
	1,854	..	..	..	..	1,854
	(927.00)	..	..	..	..	(927.00)
22-68	14.18	..	30.74	..	..	44.92
	9,431	..	6,948	..	..	16,379
	(665.09)	..	(226.02)	..	..	(364.62)

TABLE V

ANNUAL CATCHES IN KG (CATCH RATE IN KG) BY CATEGORIES OF FISHES IN 1961-1967

Category of fish	1961	1962	1963	1964	1965	1966	1967	Average	%
Ghol	9,227 (4.95)	16,725 (8.79)	12,075 (8.52)	11,758 (5.91)	11,698 (7.81)	21,779 (9.34)	11,576 (6.90)	14,263 (7.52)	5.63
Koth	//	1,707 (0.80)	1,784 (1.26)	5,615 (2.85)	6,122 (3.26)	16,758 (7.19)	5,695.5 (3.40)	6,285* (3.50)	1.60
Dhoma	120,715 (64.80)	162,687 (76.36)	123,593 (87.44)	167,215 (84.06)	94,963 (60.62)	159,061 (66.07)	140,428 (83.71)	137,893 (72.62)	35.08
Dara	6,576 (3.53)	2,608 (1.22)	357 (0.25)	1,320 (0.67)	2,301 (1.23)	4,000 (1.72)	607 (0.36)	2,538 (1.36)	0.65
Karkara	10,469 (5.63)	20,309 (9.53)	13,182 (9.33)	6,283 (3.17)	10,871 (6.80)	8,613 (3.69)	1,112 (2.47)	10,556 (5.47)	2.69
Wan	6,916 (3.71)	4,658 (2.19)	2,853 (2.02)	3,847 (1.94)	15,272 (9.11)	7,710 (3.32)	2,656 (1.58)	6,278 (3.31)	1.60
Catfish	29,534 (15.85)	22,590 (10.60)	24,202 (17.12)	17,200 (8.68)	29,356 (15.96)	21,418 (9.20)	27,905 (23.16)	27,686 (14.60)	7.05
Prawns	10,581 (5.68)	10,372 (4.87)	7,436 (5.26)	10,900 (5.50)	5,637 (2.34)	29,952 (12.86)	10,533 (6.28)	12,054 (6.35)	3.07
Rays	106,244 (57.03)	153,777 (62.79)	90,764 (64.21)	52,587 (26.52)	42,606 (22.72)	136,956 (58.76)	76,628 (45.69)	81,466 (53.13)	23.28
Sharks & skates	21,954 (11.77)	29,662 (13.92)	20,541 (14.53)	18,718 (9.44)	21,250 (11.32)	5,715 (1.69)	26,184 (15.80)	23,766 (13.04)	6.01
Miscell-aneous fishes	37,181 (19.96)	42,671 (20.03)	57,559 (40.72)	63,816 (32.19)	66,793 (35.62)	63,167 (27.22)	81,651 (48.67)	59,050 (31.33)	15.04

// Koth not entered separately.

* Average for six years only.

TABLE VI

LATITUDE ZONE-WISE PARTICULARS OF EFFORT IN HOURS AND CATCHES OF ALL FISHES IN KG, (AND CATCH PER HOUR IN KG) FROM 1963-1967

Latitude zones	Larger vessels only						All vessels 1963-1967 total
	1963	1964	1965	1966	1967	Total	
15° N (Goa)	.. .. ..	.. .. ..	.. .. ..	.. .. ..	134.33 52,099 (387.84)	134.33 52,099 (387.84)	134.33 52,099 (387.84)
16° N (Malvan)	.. .. ..	49.00 13,526 (276.01)	58.17 15,192 (261.16)	.. .. ..	2.00 475 (237.50)	109.17 29,193 (267.40)	132.25 33,383 (252.42)
17° N (Ratnagiri)	56.50 15,797 (279.62)	33.00 9,573 (290.09)	90.39 17,267 (191.01)	10.00 nil nil	14.00 3,013 (210.36)	204.49 45,650 (223.01)	229.56 48,899 (213.01)
18° N (Bombay 2)	265.68 131,522 (495.05)	252.86 122,986 (486.47)	486.54 127,862 (262.78)	1,479.19 115,200 (280.72)	843.60 247,085 (292.55)	3,998.89 1,044,695 (263.89)	7,795.12 1,511,373.5 (193.94)
19° N (Bombay N Century S)	1.75 4,088 (512.57)	85.75 16,269 (189.72)	210.82 21,429 (196.66)	3.00 844 (281.33)	82.75 47,397 (572.77)	398.89 110,027 (286.57)	436.64 120,430 (270.09)
20° N (Bombay N Verwal)	87.55 36,204 (413.52)	71.90 14,328 (199.28)	153.51 34,090 (222.07)	.. .. ..	11.25 5,020 (446.22)	324.21 89,642 (276.49)	395.96 115,531 (292.00)
21° N (Porbunder)	11.30 8,010 (711.50)	11.00 1,277 (116.09)	73.93 17,608 (238.17)	.. .. ..	.. .. ..	96.25 26,925 (279.80)	102.75 33,523 (326.27)
22° N (Dwarka Kutch S)	12.18 9,431 (666.09)	.. .. ..	30.74 6,928 (226.02)	.. .. ..	.. .. ..	46.92 16,379 (362.62)	46.92 16,379 (362.62)

TABLE VII

LATITUDE ZONE-WISE PARTICULARS OF CATCHES IN KG, (CATCH PER HOUR IN KG) AND PERCENTAGES OF FISH CATEGORIES FROM 1963 TO 1967

Latitude zones	15° N	16° N	17° N	18° N	19° N	20° N	21° N	22° N
Effort in hours	134.33	109.17	204.49	3,998.89	398.89	325.21	96.23	46.92
Category of fish								
Ghol	845 (6.29) 1.62	124 (1.14) 0.42	514 (2.51) 1.19	45,367 (11.46) 4.34	3,391 (8.50) 2.95	4,798 (14.80) 9.35	1,396 (14.51) 5.19	1,172 (26.09) 7.16
Koth	.. .. ..	20 (0.18) 0.07	23 (0.11) 0.05	23,792 (6.01) 2.28	237 (0.59) 0.21	1,349 (4.16) 1.50	931 (9.67) 3.46	1,273 (28.34) 7.77
Dhoma	21,095 (157.04) 40.49	6,353 (58.19) 21.76	11,054 (54.06) 25.70	331,445 (83.72) 31.73	38,307 (96.05) 33.30	30,085 (92.79) 35.56	11,171 (116.09) 41.49	5,714 (127.20) 34.89
Dara	.. .. ..	290 (2.66) 0.99	.. .. ..	5,860 (1.48) 0.56	396 (0.99) 0.34	366 (1.13) 0.41	62 (0.64) 0.23	99 (2.20) 0.60
Karkara	343 (2.55) 0.66	355 (3.25) 1.22	1,804 (8.82) 4.19	28,590 (7.22) 2.74	2,125 (5.33) 1.85	1,396 (4.31) 1.56	196 (2.04) 0.73	210 (4.47) 1.28
Wan	57 (0.42) 0.11	64 (0.59) 0.22	58 (0.28) 0.13	15,209 (3.84) 1.45	5,372 (13.47) 4.67	3,879 (11.96) 4.33	1,202 (12.49) 4.46	1,186 (26.40) 7.24
Catfish	9,020 (67.15) 17.31	5,984 (54.81) 20.50	8,657 (42.33) 20.13	80,890 (20.43) 7.74	10,101 (25.32) 8.78	7,015 (21.64) 7.83	2,269 (23.54) 8.41	3,174 (70.66) 19.38
Prawns	248 (1.85) 0.48	353 (3.23) 1.21	417 (2.04) 0.97	32,812 (8.29) 3.14	1,478 (3.71) 1.28	735 (2.27) 0.82	59 (0.61) 0.22	40 (0.89) 0.24
Rays	3,810 (28.36) 7.31	3,086 (28.27) 10.57	5,013 (24.51) 11.66	245,159 (61.93) 23.47	6,555 (16.43) 5.70	14,213 (43.84) 15.85	2,616 (27.18) 9.72	1,527 (33.98) 9.33
Sharks & skates	1,845 (13.73) 3.54	2,562 (23.47) 8.78	3,107 (15.19) 7.22	69,322 (17.51) 6.64	8,685 (21.27) 7.38	6,550 (20.20) 7.31	1,416 (14.71) 5.26	1,165 (25.96) 7.12
Miscell-aneous fishes	14,836 (110.44)	10,001 (91.61) 34.26	12,366 (60.47) 28.76	166,229 (41.99) 15.91	38,580 (96.72) 33.54	19,256 (59.39) 21.48	5,611 (58.31) 20.84	819 (18.24) 4.98
Total	52,099 (387.84) 100.00	29,193 (267.40) 100.00	43,013 (210.34) 100.00	1044,695 (265.89) 100.00	115,027 (288.37) 100.00	89,642 (276.49) 100.00	26,925 (279.80) 100.00	16,379 (364.62) 100.00

TABLE VIII

MONTHLY AND QUARTERLY CATCHES IN KG (CATCH RATE IN KG) FOR ALL FISHES DURING 1962 TO 1967

Year Months	1963	1964	1965	1966	1967	Average
January	39,297 (202.25)	33,762 (154.31)	45,350 (165.54)	23,027 (99.16)	54,991 (205.92)	40,085 (165.58)
February	34,510 (181.66)	26,508 (111.81)	48,337 (163.66)	39,739 (146.59)	47,461 (259.97)	37,707 (167.29)
March	51,379 (311.75)	36,485 (130.86)	45,309 (155.04)	46,227 (172.62)	16,725.5 (140.58)	39,225 (173.72)
April	47,859 (194.06)	30,155 (104.21)	58,360 (194.40)	36,724 (181.25)	16,593 (150.82)	37,774 (177.61)
May	51,121 (275.35)	42,949 (184.96)	36,512 (149.97)	66,968 (212.99)	39,690 (175.34)	47,248 (197.34)
June	17,335 (242.18)	11,293 (120.05)	37,401 (184.84)	22,490 (247.39)	8,265 (213.22)	19,577 (198.27)
July	12,574 (342.15)	100 (66.67)	14,082 (152.93)	6,473 (282.54)	.. ..	8,307 (216.84)
August	12,995 (299.22)	.. ..	.. ..	15,536 (433.60)	19,666 (258.76)	16,066 (310.43)
September	8,528 (341.12)	.. ..	.. ..	30,941 (229.19)	27,367.5 (212.50)	22,279 (231.44)
October	19,505 (231.51)	36,790 (263.75)	.. ..	41,954 (231.39)	69,732.5 (299.91)	41,995 (263.47)
November	30,866 (254.33)	66,180 (328.08)	3,310 (90.11)	87,906 (362.89)	54,551 (276.80)	48,563 (179.05)
December	39,078 (202.51)	75,291 (260.38)	16,466 (141.49)	81,537 (140.51)	54,111 (506.89)	52,297 (255.19)
1st quarter	125,305 (294.34) 32.54%	96,755 (131.63) 26.91%	143.002 (161.43) 46.26%	108.990 (142.02) 21.82%	119 330.5 (209 66) 29 15%	116 676 (169 10) 30 20%
2nd quarter	115,495 (276.84) 32.60%	84,597 (137.08) 23.64%	132.273 (177.54) 42.79%	126,182 (207.53) 25.26%	64,548 (176 05) 15 77%	104 579 (189 97) 27 07%
3rd quarter	34,097 (334.18) 9.62%	100 (66.67) 0.03%	14,082 (152.93) 4.55%	52,950 (273.30) 10.60%	47,033.5 (229.67) 11.49%	29 652.5 (248 22) 7 67%
4th quarter	89,449 (224.42) 25.24%	178.261 (282.79) 49.5%	19,776 (130.53) 6.40%	211.397 (277.22) 42.32%	178,394.5 (332.81) 43.59%	135 455.5 (273 16) 35 06%

TABLE IX

QUARTERLY CATCHES IN KG (CATCH RATE IN KG) OF CATEGORIES OF FISHES FROM 1965 TO 1967

Category of fish	Quarter	1965	1966	1967	Average
Ghol	1st	5,081 (10.52)	3,868 (4.72)	4,954 (5.59)	6,813 (9.01)	6,823 (11.99)	5,447 (7.99)
	2nd	4,707 (11.98)	2,936 (4.77)	6,624 (8.89)	3,549 (5.84)	1,852 (5.00)	3,650 (7.14)
	3rd	811 (7.71)	nil "	873 (9.48)	2,846 (11.59)	1,060 (5.18)	998 (8.75)
	4th	1,676 (3.70)	5,348 (8.69)	2,187 (14.13)	9,073 (11.90)	1,861 (3.47)	3,589 (8.04)
Koth	1st	251 (0.51)	3,436 (4.67)	708 (0.80)	6,835 (8.91)	4,003 (7.03)	3,047 (4.42)
	2nd	264 (0.63)	1,491 (2.42)	3,536 (4.75)	3,358 (5.49)	930 (2.54)	1,912 (3.40)
	3rd	127 (1.21)	nil "	53 (0.58)	400 (2.06)	490 (2.39)	214 (1.79)
	4th	1,142 (2.67)	718 (1.14)	1,823 (12.05)	6,185 (8.11)	273 (0.51)	2,028 (4.09)
Dhoma	1st	36,698 (74.33)	24,153 (32.85)	41,168 (46.90)	24,989 (32.56)	24,743 (23.47)	30,532 (43.96)
	2nd	40,032 (99.96)	33,990 (55.21)	43,719 (58.66)	40,712 (66.96)	20,796 (55.72)	35,650 (65.12)
	3rd	14,726 (140.00)	nil "	5,043 (54.77)	16,108 (83.14)	17,219 (84.08)	10,719 (86.89)
	4th	32,227 (80.85)	109,322 (173.43)	4,373 (52.82)	72,252 (94.75)	77,670 (144.81)	59,789 (139.56)
Dara	1st	153 (0.33)	820 (1.12)	927 (0.93)	2,451 (3.19)	494 (0.87)	951 (1.36)
	2nd	130 (0.31)	400 (0.65)	773 (1.05)	714 (1.22)	48 (0.13)	42 (0.76)
	3rd	nil "	nil "	163 (1.77)	14 (0.07)	nil "	35 (0.50)
	4th	64 (0.16)	100 (0.16)	532 (3.51)	791 (1.04)	65 (0.12)	310 (0.80)
Karkara	1st	3,385 (6.87)	2,229 (3.03)	7,552 (8.53)	2,000 (2.61)	1,145 (2.54)	3,322 (4.82)
	2nd	4,335 (10.39)	1,784 (2.90)	3,175 (4.26)	701 (1.19)	962 (2.62)	2,19 (3.98)
	3rd	525 (4.99)	nil "	84 (0.91)	696 (3.99)	117 (0.57)	284 (2.36)
	4th	4,937 (12.39)	2,270 (3.60)	63 (0.42)	5,216 (6.84)	1,618 (3.02)	3,821 (5.69)
Wam	1st	992 (2.01)	1,586 (2.57)	6,068 (6.88)	1,522 (1.90)	642 (1.13)	2,223 (3.23)
	2nd	1,089 (2.61)	1,510 (2.47)	6,784 (9.11)	4,149 (6.42)	1,528 (4.17)	3,014 (5.47)
	3rd	237 (2.24)	nil "	873 (9.48)	71 (0.57)	190 (0.93)	274 (2.30)
	4th	535 (1.34)	448 (0.70)	1,519 (10.02)	1,998 (2.62)	296 (0.55)	95 (1.95)
Catfish	1st	4,574 (9.29)	6,836 (9.30)	11,334 (12.80)	2,975 (3.87)	20,291 (35.65)	9,202 (13.34)
	2nd	13,154 (41.51)	2,120 (3.42)	14,937 (20.05)	3,684 (6.06)	3,867 (10.60)	7,556 (13.75)
Catfish	3rd	1,779 (16.91)	nil "	2,362 (25.65)	5,832 (30.10)	2,760 (13.48)	2,547 (21.32)
	4th	4,695 (11.78)	8,244 (13.08)	1,302 (8.59)	8,959 (11.75)	21,967 (20.96)	9,033 (18.22)
Prawns	1st	309 (0.63)	689 (0.94)	2,095 (2.36)	4,600 (5.99)	521 (0.91)	1,643 (2.38)
	2nd	694 (1.66)	3,902 (6.34)	2,052 (2.75)	17,759 (29.84)	217 (0.59)	4,925 (8.95)
	3rd	2,720 (25.86)	nil "	192 (2.09)	2,036 (10.52)	3,165 (15.45)	1,622 (13.58)
	4th	3,713 (9.32)	6,309 (10.01)	98 (0.65)	5,587 (7.33)	6,632 (12.36)	4,468 (9.01)
Rays	1st	39,752 (80.72)	24,460 (33.26)	21,206 (23.94)	31,353 (40.86)	39,140 (68.77)	31,182 (45.19)
	2nd	30,572 (73.28)	14,679 (23.84)	14,280 (19.17)	34,509 (56.75)	19,582 (53.41)	22,723 (41.26)
	3rd	8,431 (79.29)	100 (66.67)	2,130 (23.13)	15,530 (80.16)	10,165 (49.64)	7,253 (60.72)
	4th	12,099 (30.35)	13,348 (21.17)	4,990 (32.93)	55,570 (72.87)	7,735 (14.42)	18,748 (37.81)
Sharks & Skates	1st	8,341 (16.94)	6,633 (9.02)	10,765 (12.15)	8,993 (11.72)	8,189 (14.39)	8,584 (12.44)
	2nd	7,198 (17.25)	5,556 (9.02)	8,744 (11.74)	6,684 (10.99)	3,040 (13.75)	6,644 (12.07)
	3rd	1,814 (17.25)	nil "	670 (7.28)	2,465 (12.72)	4,925 (21.05)	1,975 (16.53)
	4th	3,186 (8.00)	6,529 (10.36)	1,051 (6.94)	16,573 (21.73)	8,357 (15.54)	7,136 (14.39)
Miscellaneous	1st	15,849 (32.18)	22,165 (30.16)	36,275 (40.95)	16,365 (21.32)	13,040 (22.91)	20,738 (30.06)
	2nd	13,320 (31.93)	16,021 (26.02)	27,661 (37.10)	10,359 (17.04)	9,727 (26.55)	15,414 (28.00)
	3rd	3,017 (28.71)	nil "	1,369 (17.80)	7,552 (38.28)	6,943 (33.90)	3,830 (32.06)
	4th	25,373 (63.67)	25,630 (40.66)	1,258 (8.17)	29,195 (38.28)	51,941 (96.84)	26,675 (53.79)

TABLE X

DISTRIBUTION BY DEPTH OF ALL FISH IN DIFFERENT LATITUDE ZONES (EFFORT IN HOURS AND CATCH RATES IN KG)

Latitude zones	Depth ranges in metres								
	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
15° N	..	13.75	46.58	16.00	38.75	19.25	..	..	..
	..	506.54	470.20	387.06	375.33	129.61	..	..	..
16° N	2.00	12.84	19.00	12.33	3.00	1.00	2.00	1.00	7.00
	3.00	225.75	264.11	417.52	437.33	125.00	125.00	122.00	116.14
17° N	11.17	50.66	30.00	21.16	..	3.00	..	..	..
	120.29	160.52	156.57	118.57	..	294.00	..	..	..
18° N	7.00	814.45	1,080.84	706.16	297.66	83.25	17.50	6.00	..
	104.00	199.28	259.91	304.16	327.81	371.60	236.44	134.17	..
19° N	..	21.16	41.30	87.93	55.17	78.33	13.50	..	..
	..	233.17	158.81	202.63	439.30	433.47	161.18	..	..
20° N	..	..	23.41	69.84	44.67	12.76	8.08	6.00	..
	..	..	256.21	256.22	225.27	223.75	158.54	169.83	..
21° N	..	27.01	9.58	27.75	9.59	..	..	..	..
	..	320.40	197.60	108.86	189.78	..	..	..	..
22° N	..	..	3.17	18.33	3.08	6.16	..	..	..
	..	..	205.76	228.42	232.79	226.21	..	..	..
All zones Effort	20.17	939.87	1,253.88	959.50	451.92	203.75	41.08	13.00	7.00
Catch	2,167	193,861	327,615	271,655	150,269	72,645	7,845	1,946	813
c.p.h.	107.44	206.26	261.29	283.12	332.51	356.54	109.97	149.69	116.14

TABLE XI

MONTHLY DISTRIBUTION BY DEPTH OF ALL FISH (CATCH RATE IN KG) IN DIFFERENT LATITUDE ZONES

Latitude zones	Months fished	Depth ranges in metres								
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
15° N	November	..	665.00	423.92	397.10	414.52	131.31	..	..	..
	December	..	422.20	496.67	290.00	..	..	..	..	..
16° N	January	..	265.06	265.25	244.54	..	..	..	..	..
	April	..	538.50	425.40	359.50	637.33	125.00	125.00	122.00	116.14
	May	3.00	129.60	169.37	..	..	..	..	..	..
	November	..	..	237.50	..	..	..	..	..	..
17° N	January	101.74	256.13	201.00	161.30	..	..	..	..	..
	February	250.00	151.51	216.50	132.33	..	..	..	..	..
	April	..	369.00	351.80	400.00	..	294.00	..	..	..
	June	..	157.39	157.16	156.89	..	..	..	..	..
	September	..	nil	nil	nil	..	..	..	..	..
18° N	January	53.00	161.65	229.30	260.48	260.55	..	..	..	..
	February	81.00	156.76	246.51	323.40	588.37	331.33	343.33	..	..
	March	..	165.37	194.13	239.80	225.26	261.42	..	..	..
	April	..	243.30	208.79	260.73	183.85	362.66	100.00	..	..
	May	..	262.33	329.83	309.60	272.35	..	208.82	134.16	..
	June	..	82.15	177.05	237.15	251.53	267.76	317.81	..	..
	July	..	149.99	145.54	266.12	182.90	..	..	..	..
	August	..	377.82	306.38	308.93	293.56	..	..	..	..
	September	..	187.02	199.80	250.27	282.50	227.50	..	..	..
	October	..	256.96	196.53	279.12	448.65	399.59	..	..	..
	November	..	270.56	429.87	459.86	230.00	nil	..	..	..
	December	234.66	145.54	317.10	361.05	927.80	574.16	..	..	..
19° N	January	..	..	182.35	215.94	210.85	..	..	..	..
	February	..	66.04	128.69	91.89	364.90	..	..	..	..
	March	..	117.33	159.11	223.52	317.20	..	..	..	..
	April	..	408.00	..	318.80	460.55	..	..	..	..
	May	..	..	59.83	285.27	248.00	177.05	115.69	..	..
	June	..	..	159.49	307.80	279.00	125.68	..	..	..
	July	..	..	..	..	..	186.11	194.59	..	..
	September	..	..	..	170.00	323.75	673.15	..	..	..
	October	..	..	..	350.00	809.37	474.84	..	..	..
	November	..	561.00	475.00	nil	212.00	nil	..	..	..
	December	..	..	401.33	..	962.25	1195.71	..	..	..
20° N	February	..	..	268.00	134.16	218.28	..	..	..	..
	March	..	..	294.22	197.72	..	..	..	..	..
	April	..	..	187.00	331.35	287.04	..	..	..	..
	May	..	..	..	..	195.21	251.16	253.66	119.78	169.83
	June	..	..	..	..	..	218.92	202.05	213.81	..
	July	..	..	..	..	..	198.66	255.26	..	..
	September	..	..	..	..	38.75	1449.23	..	..	..
21° N	February	..	320.39	200.00	..	..	..	..	..	..
	April	..	..	..	..	211.03	207.94	..	..	..
	June	..	..	..	196.21	160.84	152.99	..	..	..
22° N	June	..	..	..	203.76	228.42	232.79	226.94	..	..

TABLE XII

DISTRIBUTION BY DEPTH OF CATEGORIES OF FISHES (CATCH RATES IN KG) IN DIFFERENT LATITUDE ZONES

Latitude zone	Depth ranges in metres	Categories of fishes									
		Ghol	Koth	Dhoma	Dara	Harkara	Cat-fish	Prawns	Rays	Shark & skate	Misc. fishes
15°N	11-20	10.18	nil	310.91	nil	0.73	9.73	16.18	0.73	28.36	32.36
	21-30	12.56	nil	248.71	nil	4.29	6.43	33.28	3.39	50.24	12.77
	31-40	6.25	nil	142.50	nil	1.13	nil	71.56	1.87	40.94	11.56
	41-50	nil	nil	76.26	nil	2.06	0.70	120.39	1.29	10.97	10.06
	51-60	1.04	nil	nil	nil	1.82	nil	73.25	nil	nil	11.96
16°N	1-10	nil	nil	nil	nil	nil	nil	1.50	nil	1.50	nil
	11-20	5.68	1.56	51.09	22.59	nil	.98	18.45	3.27	10.90	4.67
	21-30	1.05	nil	77.63	nil	4.74	nil	48.95	4.16	79.74	10.37
	31-40	1.70	nil	82.16	nil	1.62	nil	86.94	11.84	21.01	26.36
	41-50	nil	nil	158.33	nil	nil	nil	78.33	27.00	72.00	33.67
	51-60	nil	nil	50.00	nil	nil	nil	60.00	nil	nil	15.00
	61-70	nil	nil	50.00	nil	nil	nil	60.00	nil	nil	15.00
	71-80	nil	nil	40.00	nil	nil	nil	60.00	nil	nil	15.00
	81-90	nil	nil	38.85	nil	nil	nil	52.85	nil	nil	21.43
17°N	1-10	1.43	nil	39.03	nil	1.79	nil	31.24	nil	24.89	17.91
	11-20	2.40	nil	40.94	nil	3.67	.41	47.20	0.81	22.15	24.67
	21-30	4.50	0.33	42.97	nil	4.50	nil	40.20	1.43	21.57	7.73
	31-40	2.84	0.61	12.76	nil	1.84	nil	29.96	0.38	19.57	4.06
	41-50	nil	nil	108.33	nil	nil	nil	67.33	5.67	19.00	8.00
18°N	1-10	8.57	4.29	30.86	nil	nil	nil	4.00	nil	29.00	8.57
	11-20	8.96	6.81	52.12	1.65	3.89	.82	8.05	13.06	59.11	16.85
	21-30	13.08	8.39	75.20	2.40	5.32	.86	19.13	6.17	71.96	17.30
	31-40	11.45	6.87	92.71	1.29	7.76	.33	30.58	7.24	70.75	19.36
	41-50	18.51	3.22	97.23	1.61	11.14	.09	41.43	6.94	56.01	21.95
	51-60	12.62	0.66	122.04	nil	7.96	.54	54.29	2.74	28.66	22.94
	61-70	9.71	nil	78.46	0.74	8.23	6.91	29.31	3.66	27.66	16.34
	71-80	3.83	0.67	33.83	nil	6.17	33.00	16.83	2.83	nil	6.67
19°N	11-20	4.96	nil	47.68	nil	8.03	6.90	3.17	7.56	12.05	3.69
	21-30	11.74	1.50	30.02	3.78	2.69	35.01	3.58	0.17	16.28	6.01
	31-40	9.37	0.90	72.76	2.42	3.58	6.27	7.52	2.65	22.86	23.29
	41-50	7.14	0.76	189.89	0.49	3.99	7.06	33.39	6.12	11.90	26.41
	51-60	4.47	0.31	166.67	nil	2.91	1.04	65.39	2.34	10.24	33.07
	61-70	16.67	nil	49.63	nil	nil	9.48	35.63	1.48	26.70	13.63
20°N	21-30	17.43	0.64	40.38	4.67	11.58	17.77	4.74	0.43	42.77	16.49
	31-40	16.34	1.53	111.65	1.63	2.78	14.89	13.24	0.69	10.62	14.00
	41-50	17.19	7.21	64.00	0.94	1.88	15.72	23.01	0.34	7.34	15.45
	51-60	15.28	21.24	77.04	3.53	nil	13.09	40.20	1.57	12.30	9.25
	61-70	3.09	3.71	37.62	nil	2.48	12.38	55.94	1.24	nil	15.59
	71-80	16.17	nil	61.67	nil	3.33	30.83	24.17	1.67	0.83	2.67
21°N	11-20	20.03	nil	176.01	0.96	2.78	13.51	3.37	1.29	14.55	8.63
	21-30	10.44	35.91	36.22	1.56	2.09	16.69	28.39	nil	13.05	16.60
	31-40	9.33	12.94	48.76	0.76	1.62	12.65	24.36	0.14	1.41	15.75
	41-50	7.82	9.18	48.28	1.15	3.34	9.65	19.30	0.52	1.98	18.44
22°N	21-30	23.66	24.60	24.60	nil	4.12	37.65	52.05	0.63	nil	3.15
	31-40	13.48	40.70	68.09	2.84	2.64	31.53	36.28	0.93	nil	20.95
	41-50	12.99	41.56	100.55	9.74	3.25	36.36	nil	3.57	nil	14.29
	51-60	9.71	51.94	66.02	1.75	3.68	25.24	41.10	1.62	nil	12.62

TABLE XIII

REGIONAL CATCH TRENDS OF EXPLORATORY FISHING VESSELS AND THE COMMERCIAL BULL TRAWLERS

Latitude zones	Regions	Catch per hour	
		Government of India exploratory vessels[x]	Bull trawlers of New India Fisheries
22° N	Kutch S	729	957
	Dwarka		646
21° N	Porbundar	560	700
20° N	Veraval	523	604
	Cambay N		607
19° N	Cambay S	576	
	Bombay N		354
18° N	Bombay S	528	
17° N	Ratnagiri	420	not fished
16° N	Malvan	534	" "
15° N	Goa	776	" "

[x] Catch rates of the exploratory fishing vessels are doubled to equalize those obtained by paired bull trawlers.

TABLE XIV

ESTIMATES OF CATCHES BY DIFFERENT VESSELS BASED ON OBSERVED CATCH RATES

	Kalyani	Meenabha-rathi	Jheenga	Rumili	Meera	Sagar-kumari
Expected No. of hauls in a day	5	5	5	5	4	4
Duration of one haul in hours	1.50	1.50	1.50	1.50	1.50	1.50
Daily fishing hours	7.50	7.50	7.50	7.50	6.00	6.00
Fishing days X Non-monsoon months	18 X 9	18 X 9	20 X 9	20 X 9	22 X 9	22 X 9
Fishing days in monsoon period	31	31	31	31	31	31
Total fishing days	193	193	211	211	229	229
Total fishing hours	1,447	1,447	1,582	1,582	1,374	1,374
Minimum c.p.h. in kg	306	146	201	141	91	96
Maximum c.p.h. in kg	403	321	323	262	150	116
Average c.p.h. in kg	345	293	258	191	107	105
Minimum expected catch in kg	445,676	211,262	317,982	223,062	125,034	131,90
Maximum expected catch in kg	583,141	464,487	510,986	414,464	206,100	159,38
Average expected catch in kg	499,215	423,971	408,156	302,162	147,018	144,27

AREAS COVERED & CATCH PARTICULARS

GOVT. OF INDIA VESSELS, BOMBAY BASE, 1961-63

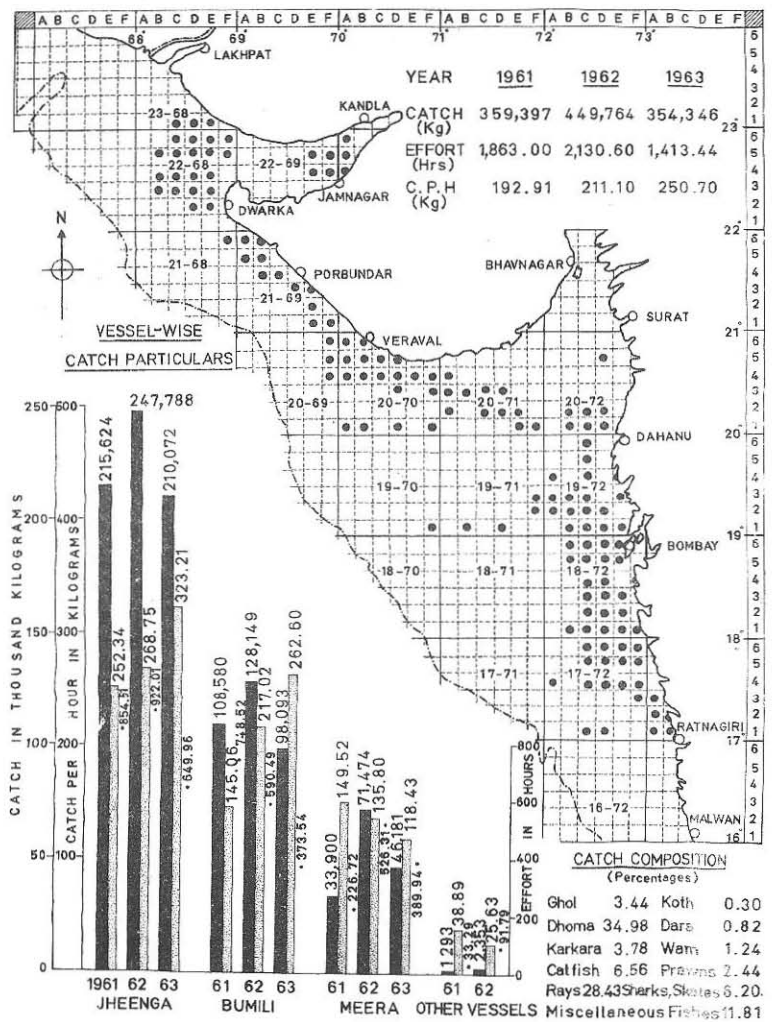


Fig. 1. Annual and vessel-wise landings by the Government of India fishing vessels of Bombay base for the period 1961-63, with particulars of areas covered and the composition of the catches.

AREAS COVERED & CATCH PARTICULARS

GOVT. OF INDIA VESSELS, BOMBAY BASE, 1964

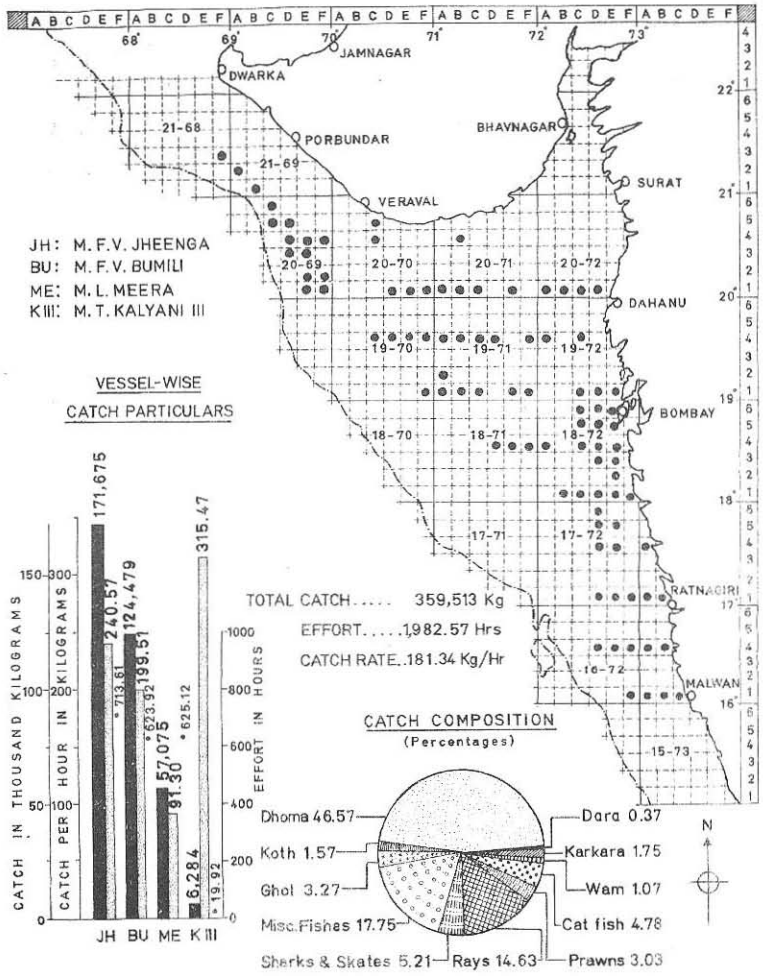


Fig. 2. Vessel-wise and total landings by the Government of India fishing vessels of Bombay base for 1964 with particulars of areas covered and the composition of the catches.

AREAS COVERED & CATCH PARTICULARS

GOVT. OF INDIA VESSELS, BOMBAY BASE, 1965

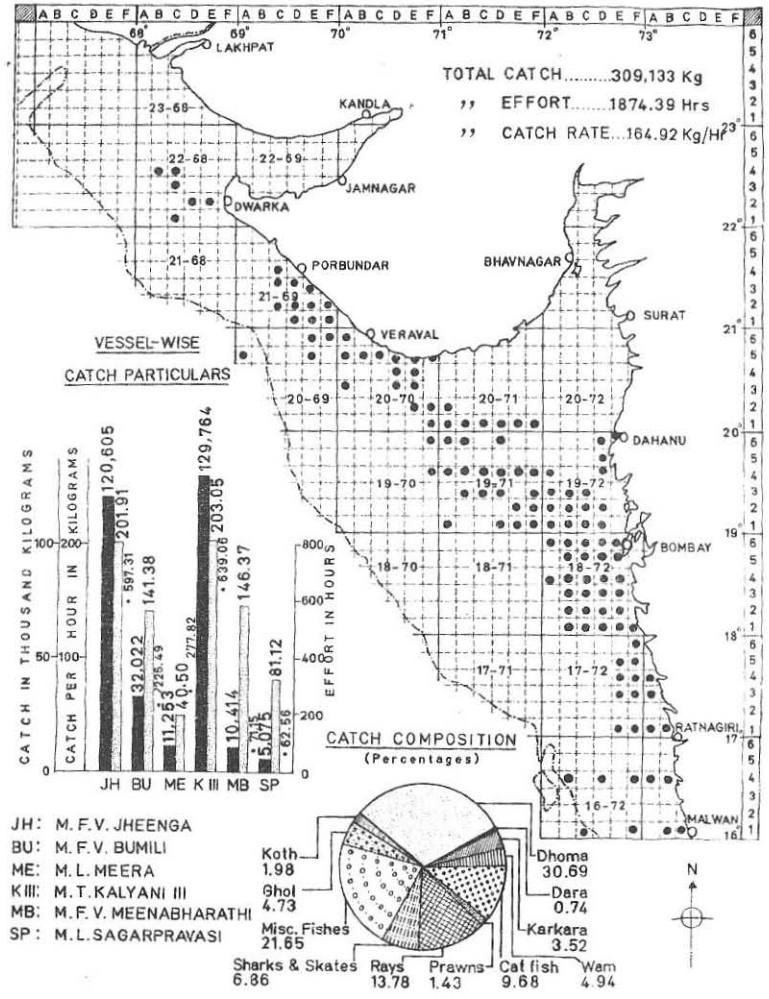


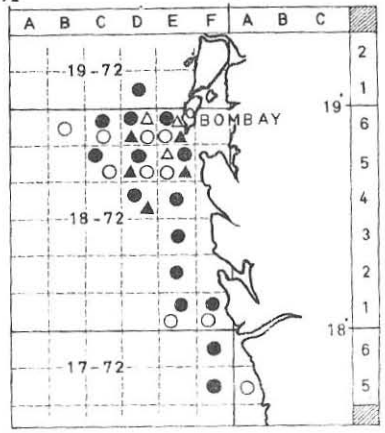
Fig. 3. Vessels-wise and total landings by the Government of India vessels of Bombay base for 1965 with particulars of areas covered and the composition of the catches.

AREAS COVERED & CATCH PARTICULARS

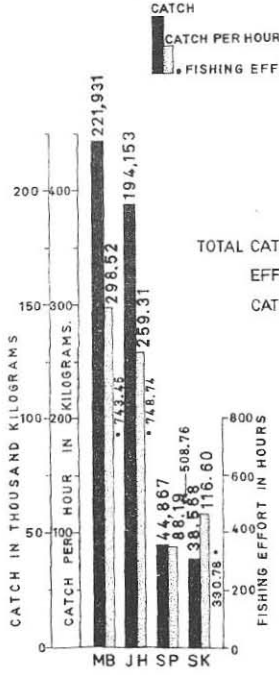
GOVT. OF INDIA VESSELS, BOMBAY BASE, 1966

MB: M.F.V. MEENABHARATHI . . ●
JH: M.F.V. JHEENGA . . . . . ○
SP: M.L. SAGARPRAVASI . . . . ▲
SK: M.V. SAGARKUMARI . . . . △

AREAS FISHED



VESSEL-WISE CATCH PARTICULARS



TOTAL CATCH.....499,519 Kg
EFFORT..... 2,331.73 Hrs
CATCH RATE..214.23 Kg/Hr

CATCH COMPOSITION
(Percentages)

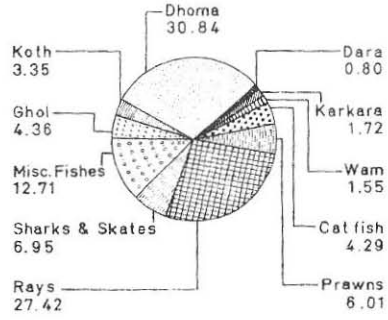


Fig. 4. Vessels-wise and total landings by the Government of India fishing vessels of Bombay base for 1966 with particulars of areas covered and the composition of the catches.

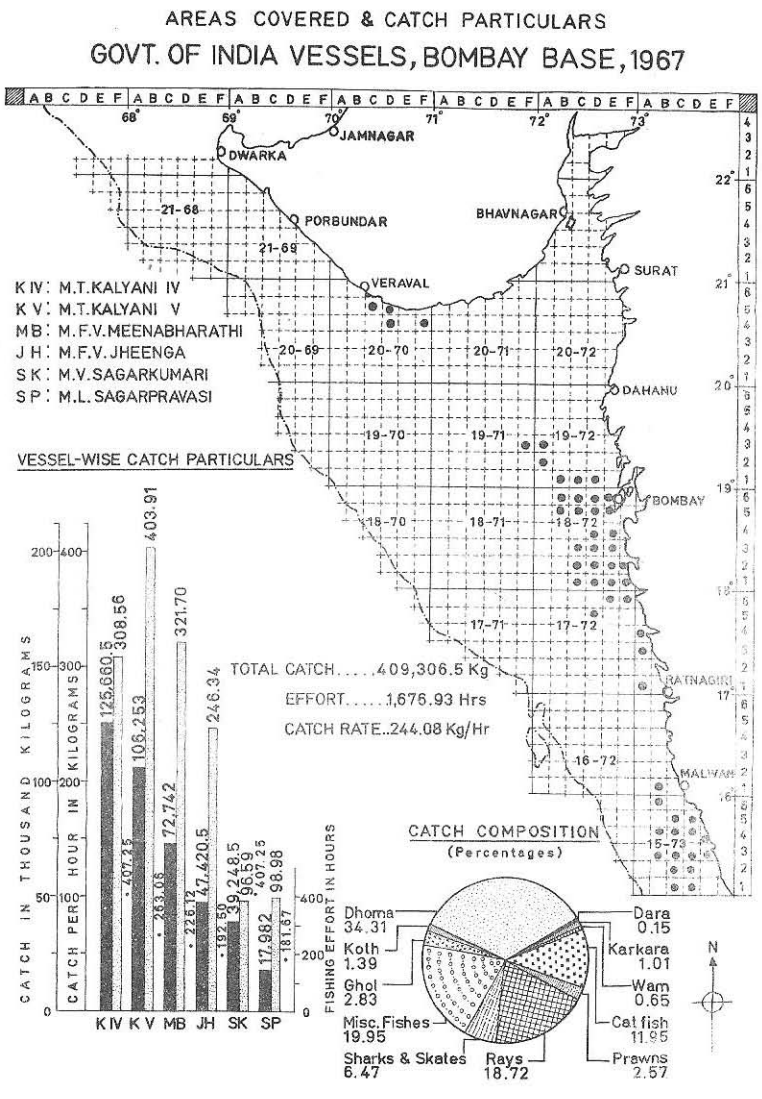


Fig. 5. Vessel-wise and total landings by the Government of India fishing vessels of Bombay base for 1967 with particulars of areas covered and the composition of the catches.

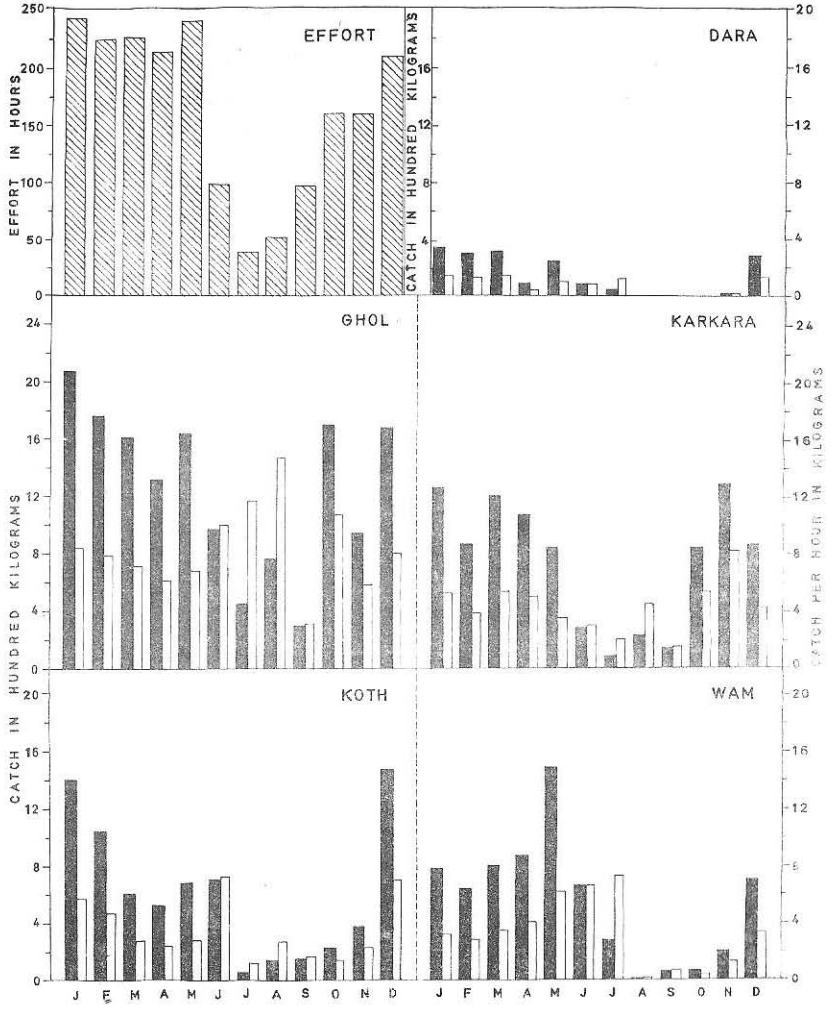


Fig. 6. Monthly catch trends of categories of fishes in the landings by the Government of India vessels of Bombay base.

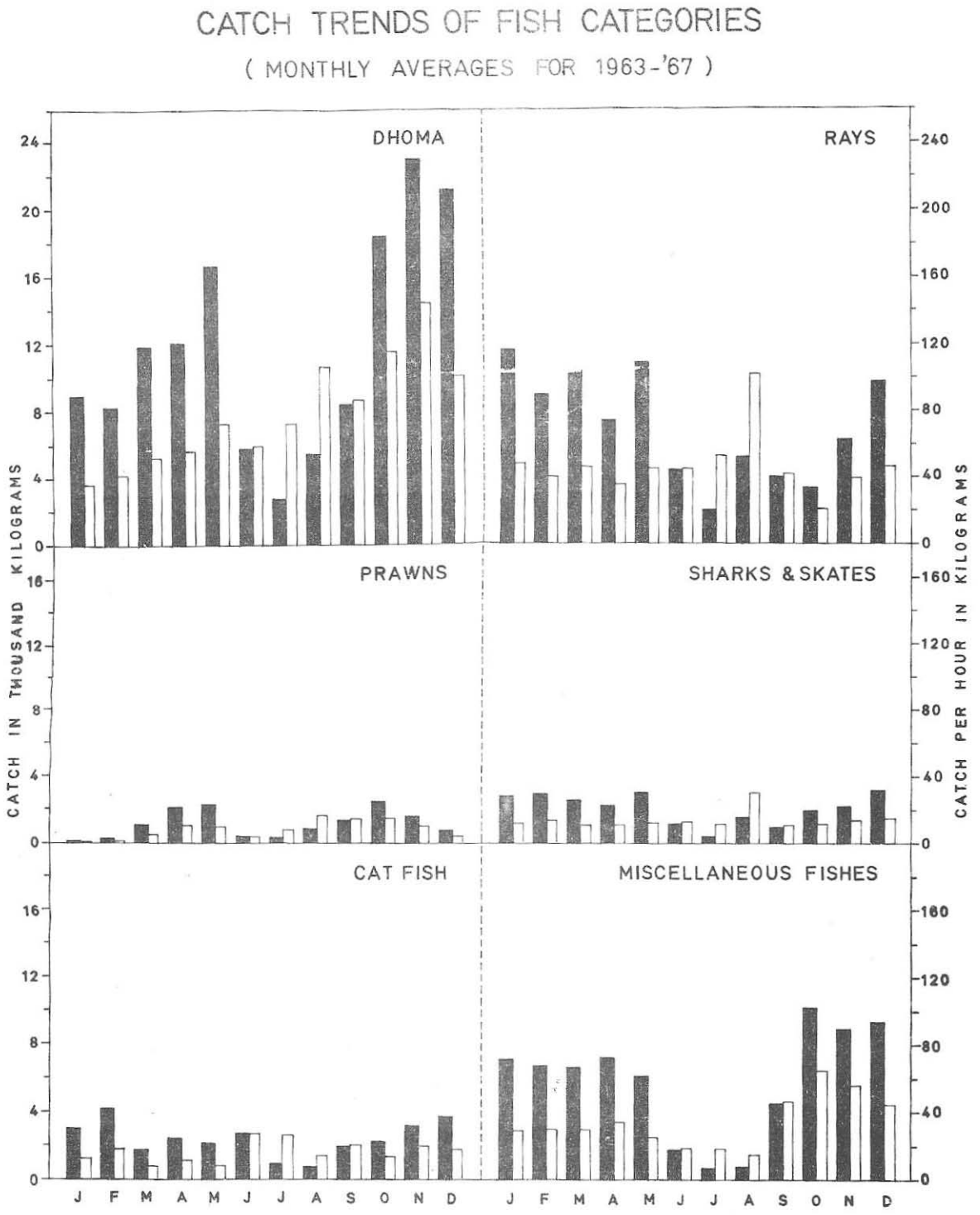


Fig. 7. Monthly catch trends of categories of fishes in the landings by the Government of India fishing vessels of Bombay base.