A SURVEY OF THE TRAWL FISH RESOURCES OFF KARWAR, INDIA

by

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ABSTRACT

Exploratory trawl fishing operations were conducted by the Indo-Norwegian Project authorities with Karwar as base from November 1963 to May 1966. Three vessels, namely, Karwar-1, M1/M4 and INP 167 with 90, 48 and 24 HP engines respectively were commissioned for the purpose. The data collected from these vessels is utilized to show the trawl fishing potentiality of the grounds, favourable seasons for trawling, the quality and distribution of the catch, the catch rate per unit of effort, etc. in time and space.

INTRODUCTION

Authentic information on the ground fish resources along the coasts of India has become an absolute necessity and forms an integral part of the fisheries research programme. Commercial trawling along the coasts of India is gaining momentum due to the impetus given to the industry under the phased five-year plans of the Union Government and the maritime states.

The history of trawl fishing in Indian waters is given by Chidambaram (1953). Jayaraman et al reviewed the work of S.T. Premier, S.T. William Garrick, S.T. Madras and discussed in detail the operations of the trawlers M.T. Ashok and M.T. Pratap of the Government of India and also the Japanese vessel Taiyo Maru No. 17 of the Taiyo fishing company. The vessels M.T. Ashok and M.T. Pratap fished independently and jointly and operated a midget trawl and bull trawl respectively, while the Taiyo Maru operated the V.D. Trawl throughout. The area of operation covered by these vessels extended from the southern point of Gulf of Cutch to a little south of Bombay between Lat. 18° - 22°. 40'

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and Long. 68° - 72°. 30'. This exploratory fishing survey has added considerably to our knowledge about the existence of various trawl fisheries, their seasons and areas of occurrence, variation of the catch in time and space, etc. An account of the estimation of trawl landings in the Bay of Bengal with Calcutta as base is given by Kuthalingam (1962). Rao *et al.* (1966) studied the relative abundance of trawl fishes in the Bombay-Saurashtra waters.

Most of the maritime states have large, well-conceived boat building programmes. They have opened training centres for mechanized fishing to impart the technical know-how to the fishermen. Mechanized boats built in these yards and fitted with gear are given to the trained fishermen on loan-cum-subsidy basis and this will undoubtedly give an impetus to the fishing industry in the course of the next few years. It is therefore necessary to know the various potential trawling grounds along with the other relevant data such as, seasons of fishing, the catch rate per unit of effort, etc. These preliminary data besides indicating the magnitude of the fishery resources of the area, would also reflect the changes taking place in the fishery from year to year. Such knowledge, when readily available, would assist in the proper management of the fisheries and would also to a great extent safeguard the interest of the fishing industry.

Very little attention has been given to trawl fishing along the Canara coast. This may probably be due to a greater emphasis being given to the shoaling fisheries abounding in these waters such as the mackerel and the sardines. The first attempt in trawling along this coast was made by the Japanese trawler M.S. Kaiko Maru in 1960-61 at the request of the Government of Mysore. This trawler had a total tonnage of 62-64 tons and was equipped with a 180 HP marine diesel engine. Trawling operations were conducted along the Mysore coast from January 25 to March 3, 1961, i.e., for a brief period of about 37 days. During this period she operated for 10 days with Karwar as the base in February 1961. As the fishing period was limited, the Japanese experts recommended to the Government of Mysore that the survey should be conducted for a period of one year or more to arrive at definite conclusions. The limited number of hauls taken by this trawler showed poor returns. Subsequently with a view to implement the above recommendation the Government of India and the Government of Mysore under the auspices of the Indo-Norwegian Project decided to commence trawl fishing with Karwar as base. Three small vessels, viz., Karwar-1 M1/M4 and INP 167 were commissioned in November 1963. Since then, these vessels have been operating fairly regularly for 6-7 months (excluding the monsoon months) in a year. Since the boats were small in size, only daily trawling operations were conducted and these were limited to the 20 fathom line or about 13 nautical miles from the coast.

The nature of these fishing operations being more or less exploratory, with no rigorously planned scientific programme attached to it, there was a tendency among the boats to fish in areas which yielded the most. This resulted in somewhat uneven sampling of the area. However in the absence of any other data, it was considered advantageous to study the data collected by the INP vessels which have formed the basis of the present paper.

MATERIAL AND METHODS

All the three vessels were stern trawlers and operated the shrimp trawl throughout the period under review. The skippers of all the vessels maintained records of the catch haul by haul along with other data like location/area no., depth, nature of bottom, time of shooting and hauling, etc. Research personnel went on board the trawlers to check the accuracy of these data twice a week and recorded additional information. Each day's catch was examined at the time of unloading. Full particulars of the vessels and the gear used by them, are given in Table I. The fishing usually commenced after the monsoon and the operations were continued till April-May.

The catch was mostly composed of small fish like *Leiognathus* spp., *Opisthopterus tardoore*, Sciaenids, Carangids, *Lactarius lactarius*, etc. and it was extremely difficult to sort them out on board. The catch for each haul was kept separately and the total catch was weighed and recorded at the time of marketing. In order to determine the catch composition, a random sample of unsorted fish from each haul was taken, sorted out and weighed. Based on the weight of different categories in the random sample, an estimate of the different varieties in the haul was obtained. As for bigger fish like sharks, rays etc. the actual weight in the haul was recorded.

AREA OF OPERATION

The fishing grounds were confined to near about Karwar and covered about 900 sq. miles demarcated by Lat. 14° 30' - 15° 00' and Long. 73° 40' - 74° 20'. During the first two years, the trawling was restricted to the area covered by Lat. 14° 43' - 14° 55' and Long. 73° 54' - 74° 10' and was extended in the 3rd year to cover the entire range. The entire fishing area was divided into smaller squares of 25 sq. miles each to facilitate recording and comparison of data from each haul. This was necessary to understand the fishery trend, seasonal abundance of catches and making an assessment of the trawl fishery potential of each area and the Karwar region as a whole. During the first two years of fishing, the areas were divided into smaller units of one square mile. Later, it was noticed that over-lapping of a haul from one area to another was bound to occur as the trawling speed of the vessels varied between 1-2 nautical miles per hour and it would

become difficult to apportion a haul to a particular area. This anomaly was removed in the third year by increasing the size of the fishing area and the accuracy of recording by the skippers of the vessels greatly improved. The data collected in the first two years was reallocated to the new areas and reanalysed. This had an added advantage in comparing the results of the three successive years. The fishing areas were distributed amongst the three vessels depending on the depth of the waters. Thus INP 167 was allotted areas upto 10 fathoms depth, M1/M4 areas between 10-15 fathoms and Karwar-1 between 15-20 fathoms. The allocation of areas was made with a view to cover the entire sampling areas.

FISHING EFFORT AND TOTAL YIELDS

A summary of the trawling operations of these three vessels in terms of total fishing effort, the total catch and the catch rates is given in Table II. It would be seen from the above table that 442,165 kg of fish were landed after putting in an effort of 2303 hrs, the overall catch rate being 191.95 kg/hr for all the three vessels together. In terms of individual vessels during the three year period the average catch rate of 248.59 kg/hr by M1/M4 was the best, closely followed by Karwar-1 at 235.73 kg/hr. In case of INP 167, the average yield was 108.48 kg/hr. In terms of catch/hr/HP the performance of the medium sized boats M1/M4 with 5.18 kg proved to be the best. This was followed by INP 167 and Karwar-1 with 4.52 kg and 2.62 kg respectively.

The highest effort of 383 hours put in by Karwar-1 during 1965-66 had a return of 177.23 kg/hr. The highest catch by the same vessel was in 1964-65, the catch rate being more or less the same as in the previous year. In respect of the vessel M1/M4 the highest catch rate of 298.86 kg/hr was recorded in 1965-66 but this should not be relied on, in view of the low effort put in. During the previous year with 137 hours of fishing the yield was 40,586 kg with a catch rate of 295.89 kg/hr, a little less than the following year. During 1963-64 M1/M4 spent 353 hours in trawling with a catch rate of 226.43 kg/hr which appears to be a good return as well. The smaller boat INP 167 put in the maximum number of 355 fishing hours during 1965-66 yielding 109.97 kg/hr, which was close to the highest catch rate of 114.54 kg/hr recorded in 1964-65. The fluctuations in the catch rate of INP 167 during the three years were not very significant, whereas in the medium boat M1/M4 it was low in 1963-64 as against 1965-66 in the case of Karwar-1.

Table III gives a monthly summary of the catch rates for all fish for the three vessels during the period of the present investigation. In case of Karwar-1, it will be seen that the catches were generally good in April, October, November, February and March, the highest catch rate being 290.43 kg/hr or 3.22 kg/hr/HP in April. The catch rates were comparatively lower in December and January. As for M1/M4 the values were higher in April, November, February and March when the catch rates were more than 270 kg/hr. The maximum yield of

350.11 kg/hr or 7.29 kg/hr/HP was obtained in the month of November followed by the next highest value of 338.06 kg/hr or 7.04 kg/hr/HP in April. During May, October, December and January the fish landings were relatively low and varied between 104.95 - 202.11 kg/hr. A comparatively high catch rate of 177.00 kg/hr/HP was obtained by INP 167 in April. The catch rate was more than 100 kg/hr during November, February and March. A very low yield of 29.74 kg/hr was recorded in October.

From these data it can be concluded that trawl fishing around Karwar is generally promising during April, November, February and March and somewhat lean during May, October, December and January.

TRAWLING AREAS COVERED BY DIFFERENT VESSELS

KARWAR-1

Fig. 1 shows the areas covered by Karwar-1 during the three years and the variation of the catch rate and the fishing effort, year by year. It will be seen that the vessel covered 8 areas, namely, 14-73/5F2, 5F3, 5F4, 6F1, 6F2, 14-74/5A1, 5A3, and 6A1 in all the three years. The fishing effort put in, in these areas during the period varied between 22-212 hrs and the catch rate varied from 179-354 kg/hr. The distribution of effort in the two areas, viz., 14-74/5A2 and 5A4 were 62.50 and 24.35 hrs in two seasons which gave a yield of 213 and 244 kg/hr respectively. The fishing effort involved in areas 14-74/4A3 and 4A4 is more than 20 hours but fishing operations were restricted to one year, 1965-66. All the remaining areas were fished during the 1965-66 season and the fishing effort has been less than 20 hours. Although the catch rate in some of these areas, namely 14-73/4E4, 6E2, 6F4, 14-74/4A1, 4A2 has been around 200 kg/hr, they have not been considered for detailed examination since the fishing effort involved was low.

Further particulars in respect of these twelve areas, where the fishing effort exceeded 20 hours, are given in Table IV. It will be seen from this table that 91.20% of the total effort and 94.00% of the total catch with a catch rate of 242.93 kg/hr came from these twelve areas. The maximum effort of 233 hours and a highest yield of 58,185 kg in March and the lowest values for effort and yield in October. The highest catch rate of 326.38 kg was in April followed by 288.96 kg. in February and 284.14 in October. In the remaining months the catch rate varied between 184.51 - 249.72 kg, the lowest value recorded being in January. From the available data we can conclude that the months of February, March, April and October are more productive giving a return of 250 kg/hr or more.

Table IV also gives information relating to the catch rates in different months in individual areas, the total yield from different areas and the overall catch rates for these areas. The maximum fishing effort of 212.20 hours was in area 14-73/5F4 followed by 159.25 hours in 14-74/5A3 and 126.45 hours in 14-73/6F2. In the remaining areas the fishing effort varied between 20.10 - 86.20 hours. The highest yield of 52,972 kg was taken from area 14-73/5F4, where the fishing effort was also the highest. The next best value of 39,426 kg was from area 14-74/5A3 followed by 35,344 kg from area 14-73/6F2. In the remaining areas the total yield varied between 2,975 - 19,657 kg, the lowest value being from area 14-74/4A4 where the fishing effort was also the lowest. The overall catch rates for these twelve areas are shown in Fig. 2.

The highest catch rate of 354.40 kg/hr was from area 14-74/6A1 but the fishing effort was comparatively low (34.05 hours). The next best value, 278.85 kg/hr was from area 14-73/6F2 with a fishing effort of 126.45 hours. Therefore, it is reasonable to conclude that this area was comparatively more productive than the rest. The next best value of 249.47 kg/hr was from area 14-73/5F4 where the highest fishing effort of 212.20 hours was put in. This was followed by catch rates of 247.31 kg and 244.4 kg/hr from areas 14-74/5A3, and 5A4 with a fishing effort of 159.25 and 24.35 hrs. respectively. An examination of Fig. 2 shows that these five areas referred to above adjoin each other covering about 100 sq.miles and they could be classed as having rich ground fish resources. Based on the available information we may reasonably conclude that a yield of 250 kg/hr can be expected from these potentially rich trawl fishing grounds under normal fishing conditions with a vessel of this class. Areas 14-73/5F2, 6F1, 14-74/5A1, 5A2 yielded more than 200 kg but less than 230 kg/hr. It can be seen from Fig. 2 that these areas are located around the rich grounds referred to earlier. The yield from the remaining three areas, viz. 14-73/5F3, 14-74/4A3 and 4A4 was relatively low and varied between 147-179 kg/hr. The highest catch of 1000.00 kg/hr was from the area 14-73/5 in November 1963. Substantially high catch rates of 547 kg and 514 kg/hr were obtained from areas 14-73/5F2 and 6F2 in January 1964 and February 1965 respectively.

M1/M4 (Medium boat)

Fig 3. shows the areas fished by the medium boat during the three years under review and also indicates the fluctuations in the catch rates and the fishing effort. The medium boat covered four areas namely, 14-74/5A1, 5A2, 5A3 and 5A4 in all the three years and the remaining three areas viz., 14-73/5F4, 6F2 and 14-74/6A1 during 1963-1964 and 1964-1965. The fishing effort in each area varied between 13.15 - 197.30 hrs. for all the three seasons together. The overall catch rate was promising and fluctuated between 189.97 - 271.45 kg/hr in these nine areas. The lowest fishing effort of 13.15 hours was in area 14-74/5A4, whereas the highest fishing effort of 197.30 hours was in area 14-74/5A3. In the remaining areas the fishing effort varied from 33.00 - 94.00 hours. Table V gives the

catch rates by month and by area for all these areas except area 14-74/5A4 where the fishing effort has been low, less than 20 hours, during the three seasons together. It will be seen that 503.25 hours i.e. 97.43% of the total effort by the medium boats was spent in these six areas yielding 125,192 kg of fish i.e. 97.47% of the total catch. The highest catch of 27,787 kg was in the month of April giving a maximum catch rate of 356.24 kg/hr. The next best value of 350.10 kg/hr was in November with a total yield of 19,256 kg during the three seasons together. These values were comparatively higher than the yields of Karwar-1. The third best catch rate was 285.21 kg/hr in March with a yield of 27,499 kg. February also yielded a high catch rate of 270.55 kg/hr. In the other months the catch rate varied between 107.19 - 201.11 kg/hr, the lowest value being in October. The overall catch rate for the entire period of study for the medium boat worked out to 248.68 kg/hr.

The fishing effort of 503.25 hrs. put in by the medium type boats in these areas varied from 33.00 - 197.30 hrs., the maximum effort and yield being from area 14-74/5A3. The lowest effort of 33.00 hrs. in area 14-74/5A1 resulted in comparatively poor return with a catch rate of 189.97 kg/hr. When the distribution of area of the total catch by the medium boat is examined, it will be seen that the maximum yield of 49,387 kg with a catch rate of 250.06 kg/hr came from area 14-74/5A3. The next high value of 21,330 kg was taken from area 14-73/6F2 with a catch rate of 226.91 kg/hr. The third best value of 20,796 kg came from the adjoining area (See Fig.4) 14-74/6A2. The highest average catch rate of 293.24 kg/hr was obtained from area 14-74/5A2. In areas 14-73/5F4 and 14-74/5A1 and 6A1 the total landings were 8,408 kg, 6,269 and 19,002 kg respectively, the catch rates varying between 221.26 - 271.45 kg/hr. The highest catch rate of 454 kg/hr was obtained from area 14-74/5A3 in November. In some months very high catch rates were obtained from adjoining areas viz., 809 kg/hr in January 1965 from area 14-74/5A4; 623 kg/hr in March 1965 from area 14-74/5A2, 600 kg/hr in March 1965 from area 14-74/5A3 and 546 kg/hr in April 1965 from area 14-74/5A3 etc. indicating their potentiality.

Thus the fishing operations by the medium boat confirms the findings of Karwar-1, the areas yielding high catch rates remaining the same.

INP 167

Figure 5 shows the areas fished by the small boat INP 167 indicating the fluctuations in the catch rate and the fishing effort during the period under study. This vessel covered four areas 14-74/5A2, 5A3, 5A4 and 6A1 in all the three years, area 14-74/5A1 in two years and areas 14-73/6F2 and 14-74/6A2 in one year. A total fishing effort of 844.50 hrs was put in during the period of investigations and varied from 2.45 - 481.50 hrs in individual areas. 96.5%

of the total fishing effort was put in to obtain 97.30% of the total catch from four areas, viz., 14-74/5A2, 5A3, 5A4, 6A1. As these areas were sampled satisfactorily they were examined in detail.

Table VI gives the details of the monthly catch rate, for the above four areas with a summary of the total catch, catch rate, etc. After putting in 815.45 hrs of fishing effort the small boat caught 89,170 kg of fish with an overall catch rate of 109.31 kg/hr during the three seasons under study. The highest effort of 203.30 hours was in March followed by 116.15 hours in February and 114.00 hours in January. The maximum yield of 25,895 kg was recorded in March, the next best values of 14,978 kg and 14,211 kg were in February and April respectively. The highest catch rate of 175.99 kg/hr was obtained in April after expending 80.45 hrs of fishing effort. February and March gave a very good yield of 128.84 kg/hr and 127.25 kg/hr respectively. During November-December the catch rates varied between 84.09 - 104.75 kg/hr. May and October appeared to be lean months and yielded 73.56 kg/hr and 23.23 kg/hr respectively. It can therefore be concluded that the period from February-April appears to be more productive as the catch rates exceeded the average value during these months.

When the distribution of effort within the areas is considered it will be seen that area 14-74/5A3 received more attention as 481.50 hrs i.e. more than 50% of the total effort was expended here. The fishing effort in other areas varied between 91.45 - 136.50 hours. Area 14-74/5A3 also accounted for the highest yield of 54,824 kg of fish, which was more than 50% of the total catch.

As far as catch rate is concerned the fluctuations are not marked and varied between 90.41 - 122.83 kg/hr, the highest value coming from area 14-74/5A2 followed by 5A3. All these areas are adjoining each other as can be seen from Fig. 6 and are within 10 miles from the coast. The lowest catch rate of 90.41 kg/hr came from area 14-74/5A4 which is along the coast of Karwar-head and the vicinity of the area to the shore may be one of the factors responsible for the low return. Some individual hauls of INP 167 have yielded very high catch rates viz., 390 kg/hr from area 14-74/6A1 in January 1966, 321 kg/hr from area 14-73/6F2 in December 1965 and 319 kg/hr from area 14-74/5A1 in November 1965.

It will thus be seen from Figures 2, 4 and 6 that the potentially rich fishing grounds for all the three vessels are common and adjoining each other. The variation in the catch rates appear to depend on the capacity of the operating vessels but the yields obtained have been of a very high order from these areas.

CATCH COMPOSITION

The catches of all the three trawlers consisted mainly of *Leiognathus* spp., *Opisthopterus tardoore*, *Lactarius lactarius*, Sciaenids, Sharks, Rays and Prawns. In the initial stages of the investigation, the records from the log sheets were taken wherein only *Lactarius lactarius*, Sciaenids, Sharks, Rays and Prawns were reported separately treating the rest of the catch as miscellaneous. But observations at the time of landing and on board the vessels showed that *Leiognathus* spp. and *Opisthopterus tardoore* together accounted for more than 50% of the catch in most of the hauls. Therefore a sampling technique was evolved in January 1965 by which the major groups cited above were separated and recorded haul by haul. However, the data on Prawns, Sciaenids, Sharks and Rays recorded in the log report prior to January 1965 has also been taken into consideration. It will be noticed that prior to January 1965 the miscellaneous catch was of a very high order, varying from 60-90%. Subsequently with the separation of the major genera of *Leiognathus* and *Opisthopterus* there was a substantial decrease in the percentage of miscellaneous catch. In spite of this the miscellaneous fish formed a substantial part of the catch. The following is the break up of the different constituents of miscellaneous fish based on five random samples examined.

1.	*Trichiurus* spp.	26.32%
2.	*Saurida* spp.	14.40%
3.	*Therapon* spp.	14.14%
4.	*Thrissocles* spp.	10.21%
5.	*Sciaenids* (small)	9.43%
6.	*Arius* spp (small)	5.97%
7.	*Synagris* spp.	4.48%
8.	*Gynoglossus* spp.	4.08%
9.	*Pellona* spp.	1.73%
10.	*Platycephalus* spp.	0.77%
11.	*Dussumieria* supp.	0.63%
12.	*Polynemus* spp.	0.39%
13.	*Touthis* spp.	0.31%
14.	Crabs spp.	3.61%
15.	Cuttle fish	1.33%
16.	Prawns (small)	1.18%

At it was not practically feasible to sort out the groups separately, it was treated as miscellaneous. The seven major components cited earlier have been examined for their fluctuations and distribution since January 1965. The data collected prior to 1965 is also presented to depict the fluctuations in components which were sorted out earlier.

KARWAR-1

During the period January 1965 to March 1966, Karwar-1 landed 127,621 kg of fish. The percentage catch composition of the different components was as below.

Components	Catch in kg	%
Leiognathus	38437	30.12
O. tardoore	26932	20.10
Sciaenids	10857	8.51
L. Lactarius	3887	3.04
Sharks	5952	4.46
Rays	2821	2.21
Prawns	1581	1.24
Misc. fish	37154	29.11

It will be seen from the above that *Leiognathus* spp. and *O. tardoore* formed the main bulk and accounted for more than 50% of the total catch. The percentage of Sciaenids, *Lactarius lactarius*, Sharks and Rays varied from 2.21-8.5%. Prawns, the principal item of commercial importance in the catch, were few and accounted for 1.24% of the total landings.

The percentage catch composition of the above groups by area during the three seasons is shown in Fig. 7. The predominance of the miscellaneous catch during 1963-64 and to some extent in 1964-65 has already been explained earlier. Amongst the 20 areas shown in the Graph only 12 have been visited frequently where the fishing effort has been more than 20 hours in all seasons together as pointed out earlier. The areas with less than 20 hours of fishing effort were 14-73/4F4, 5F1, 6F3, 6F4, 14-74/4A1, 4A2, 4B1 and 4B3.

Opisthopterus tardoore, as a single species has been taken in fairly large quantities from all the areas. The highest record of 31% came from areas 14-73/6F1 and 6F2 amongst the twelve adequately surveyed areas. Similarly the silver bellies represented by two species, namely *Leiognathus splendens* and *L. insidiator* were also taken in large percentages from almost all the areas. This group accounted for more than 50% of the catch from area 14-73/6F4 and 41% from 14-73/6F3 which are adjoining areas as well. But the effort in these areas was not adequate enough to conclude that these areas abound in silver bellies. Amongst the adequately fished areas the highest percentage of 36.33 came from 14-74/5A4 during the second season and in six more areas they accounted for nearly 30% of the catch.

The contribution of Sciaenids to the total catch during the three seasons was generally low, the highest percentage of 16.54 coming from area 14-74/6A1 during the second year. Areas 14-74/5A1 and 5A2 have given a return of more than 5% in two successive seasons. They were also taken to the extent of 10% from areas 14-73/6F2 and

14-74/5A3 during 1964-65 and from area 14-74/4B1 in 1965-66. In view of the low percentage and more or less uniform distribution in all the areas, it is difficult to distinguish one area richer than the other in regard to this group of fishes.

Lactarius lactarius formed nearly 10% of the catch from area 14-74/4A2 and were recorded in small quantities from all the areas. They were taken in slightly larger quantities during the 1965-66 season. They were generally common in the major area 14-73/5F and 6F in all the three seasons, probably indicating a slightly deep water habitat.

The sharks and rays were obtained from almost all areas in more or less equal quantities during all the three seasons. Area 14-74/4B1 gave a high yield of 23% sharks in 1965-66 but the fishing effort was only 3.00 hrs. and therefore it is difficult to say that this area is really rich in sharks. Except for this instance sharks and rays generally ranged from 6-8% of the total catch.

The percentage occurrence of prawns, the only commercially and economically important group shows interesting results. The prawn catch varied from 0.95%-6.66%, 0.17-4.05% and 0-1.48% in different areas during 1963-64, 1964-65, and 1965-66 respectively, thus indicating a gradual decline in the prawn landings from season to season although the total catch was increasing year after year. This is clearly evident in the areas where the fishing effort has been more than 20 hours. They were more common in major area 14-73 than 14-74 which is farther away from the shore indicating a deeper habitat. They were taken in higher percentages in the 1963-64 season from areas 14-73/5F4, 6F1, 6F2, 14-74/5A1 and 5A3 and from 14-73/5F2, 5F3, 6F1 and 14-74/5A4 in 1964-65.

M1/M4

The medium boat conducted trawling operations for only two months, March and April 1965 during the period when the landings were analysed according to principal groups. Therefore data in respect of this vessel is not presented. It may, however, be pointed out that the two genera *Opisthopterus* and *Leiognathus* dominated the catch and formed nearly 50% of the total catch.

INP 167

The total catch landed by the small vessel INP 167 during the period January 1965 - March 1966 was 53,130 kg. The percentage catch composition of the different categories was as below:

Components	Catch in kg	%
Leiognathus spp.	12,580	23.68
O. tardoore	9,198	17.31
Sciaenids	2,582	4.86
L. lactarius	255	0.48
Sharks	444	0.83
Rays	860	1.62
Prawns	1,176	2.21
Misc. fish	26,035	49.00

As in the case of Karwar-1, *Leiognathus* spp. and *O. tardoore* accounted for 41% of the total catch. The yield of prawns was relatively good as they formed 2.21% of the total catch. Seven areas were fished during 1963-66 by INP 167 of which four areas have been visited frequently where the effort put in was more than 20 hours.

As can be seen from Fig. 8, comparatively high catches of *Opisthopterus tardoore* were recorded from the areas 14-73/6F2, 14-74/5A1, 5A2, and 6A1. But the fishing effort in areas 14-73/6F2 and 14-74/5A1 was not adequate enough to give an overall picture of the intensity of their occurrence in these areas. The other areas, viz. 14-74/5A2, 5A3, 5A4 and 6A1 were found to be rich in *Opisthopterus tardoore* where they accounted for 20% of the catch. Silver-bellies formed the principal catch and their percentage varied between 24-35% in areas extensively fished; their percentage was invariably more than that of *Ophisthopterus tardoore* and *Leiognathus* spp. is not significant, it can be said that they abound in these waters.

Sciaenids varied between 1-7% of the total catch during the three seasons put together. The highest percentage was from area 14-74/5A3 and the lowest from 14-74/6A2. The areas 14-74/5A1, 5A2 and 5A4 gave a return of 5% of the total catch. The lowest percentage was noted from area 14-74/6A2.

Lactarius lactarius were taken in very small quantites when compared to the landings by Karwar-1. Therefore they have not been shown in the graph. It may be of interest to point out that INP 167 generally fished within 5-10 fathoms range, whereas Karwar-1 fished between 10-20 fathoms. Therefore the absence of this category probably indicates a slightly deeper water habitat.

The sharks and rays were taken from all areas in small percentage, the latter being more common. Sharks were taken in good numbers from areas 14-74/5A1 and 6A1. The rays were landed in comparatively larger numbers (10% or more) from areas 14-73/6F2 and 14-74/5A4.

The prawn catch varied between 0-21%. The highest catch was recorded from area 14-74/6A2. But the effort put in, in this area was not adequate to arrive at definite conclusion. The percentage composition of prawns in areas where more than 20 hours of fishing effort was put in varied between 1-6%, the higher percentage coming from area 14-74/5A4.

PRINCIPAL TRAWL FISHERIES OFF KARWAR

I. *Opisthopterus tardoore:* More than 100 kg of *Opisthopterus tardoore* per trawling hour were obtained from few areas; viz., 14-73/6F4, 14-74/4A1, 5A2, and 5A3 during the period January-February by Karwar-1. The remaining areas with more than 20 hours of fishing effort yielded more than 50 kg/hr during the period December to March. The smaller vessel INP 167 also landed good catches at the rate of 30 kg/hr from areas 14-74/5A1, 5A2, 5A3, 5A4 and 6A1 during December-January. They were taken at a lesser rate of 10-30 kg/hr during January-March. It can therefore be concluded that December-March is the season when *Opisthopterus tardoore* can be taken in trawls to the best advantage, with a peak fishing season for two months January-February.

II. *Leiognathus* spp.: Siver-bellies were obtained with a catch rate of 100 kg/hr or more by Karwar-1 from areas 14-73/5F2, 5F4, 6F1, 6F2, 14-74/5A1, 5A3, 5A4 and 6A1 during January-February. During February almost all areas nearer the shore yielded good catches. During the period November-February they were taken at a rate of 50 kg/hr or more from majority of the areas. The fishing operations of INP 167 showed that during December-January, areas 14-74/5A2, 5A4, and 6A1 yielded more than 30 kg/hr. The catch rates during November-March were found to be good. Therefore December to February appears to be the fishing season for taking Silver-bellies, although they were obtained throughout the trawling season from October to May. 90% of the Silver belly catch consisted of *L. splendens*. The peak seasons for *O. tardoore* and silver-bellies appear to coincide, indicating similar habits and environment.

III. *Sciaenids:* This group formed the third item in order of abundance. Karwar-1 yielded comparatively good catches, the catch rate being above 30 kg/hr during December-March from areas 14-73/6F2, 14-74/5A1, 5A2, 5A3, 5A4 and 6A1 and it was 10 kg/hr or more from the remaining areas. The catch rate of sciaenids by INP 167 was comparatively low, only stray catches being recorded from all the areas. However, during the month of March, all the areas fished yielded more than 10 kg/hr. The period January-March appears to be the season for Sciaenids in this region.

IV. *Lactarius lactarius*. These fish were mostly taken by Karwar-1 during December and February, the landings by INP 167 being almost insignificant. They were taken at a rate of 30 kg/hr or more from areas 14-73/5F4 and 14-74/4A2. From areas 14-73/5F1, 5F2, 5F3, 5F4, 6F1 and 6F2 they were taken at a rate of 10 kg/hr or more during December and February and from 14-74/4A1, 4A3, 5A1, 5A2, 5A3, they were obtained at a rate of 10 kg/hr or more only in February.

V. Sharks and Rays: These categories were taken in small quantities from all areas and in all the months and there was nothing particular to report about their season of occurrence or distribution.

VI. Prawns: As pointed out earlier, the percentage of prawn landings was on the decrease year by year. During 1963-64 they formed 6.66% of the total catch which was the highest. Their availability in different areas and months during this year was examined in detail and the results are presented in Fig. 9. It can be seen from the graph that prawns formed an important fishery during February 1964 when nearly 100 kg/hr were taken by M1/M4 from area 14-73/5F4. During the same period and area Karwar-1 obtained them at 88 kg/hrs. The catch rate of Karwar-1 from different areas in February varied from 8-62 kg/hr. Similar values for M1/M4 and INP 167 were 5-92 kg/hr and 5-18 kg/hr respectively.

The next best months for prawn fishing by Karwar-1 were March and May when the catch rate varied from 5-25 kg/hr. In case of M1/M4 the next best fishing periods were November and April when the catch rate fluctuated between 5-60 kg/hr. The prawn landings by INP 167 excepting February were low.

An areawise distribution of the prawns shows that the yield from the major area 14-74 was comparatively higher than the area 14-73. They were common in areas 14-73/5F4, 6F2, 14-74/5A1, 5A2, 5A3, and 6A1 in order of abundance. The areas 14-73/5F3, 5F2, 6F1 and 14-74/5A4 gave comparatively low returns. December and January appeared to be lean months for prawn fishing.

DISCUSSION

The potential ground fish resources of the coastal waters of Mysore and particularly areas off Karwar were not known until the present survey, spread over three fishing seasons from October 1963 to March 1966, was undertaken. In 1963 under the auspices of the Govt. of India and the Indo-Norwegian Project it was decided to conduct a survey with Karwar as the base. The scope of the survey was limited to areas off Karwar and its neighbourhood covering an area of about 900 square miles.

In the present survey only shrimp trawls were operated within the 20 fathom line i.e., roughly 10-15 nautical miles away from the coast. The fish trawl was never operated by any of the boats and therefore it has to be borne in mind that the fish resources explored now are known with certain limitations. All the same, the productive potentiality of the area under investigation clearly shows the presence of rich trawl fishing grounds off Karwar. The catch rates obtained by the three boats have been very encouraging. All the vessels together put in 2303 hours of fishing giving a catch rate of 191.95 kg/hr. It can be seen from Fig. 2 which shows the yields of Karwar-1 in areas where a reasonable amount of fishing effort has been put in, the catch rates varied between 147.52 to 354.4 kg/hr. In nine areas the catch rate has been more than 200 kg/hr and five of them viz., 14-73/6F2, 5F4, 14-74/5A3, 5A4 and 6A1 yielded more than 240 kg/hr. These five areas cover more than 100 sq. miles and are rich fishing grounds. Within this 100 sq. miles there was a patch of about 25 sq. miles, area 14-74/6A1 where the yield has been 354 kg/hr. The areas adjoining these are also potentially rich as can be seen from Fig. 2. The rich fishing grounds explored by the medium boats M1/M4 are shown in Fig. 4. It will be seen that three areas, namely 14-74/5A2, 5A3 and 6A1 have yielded between 250-293 kg/hr and two areas, namely 14-73/5F4, and 6F2, 220 kg/hr. The results of the small boat INP 167 confirm the findings of the other vessels. Areas 14-74/5A2, 5A3 and 6A1 yielded 101-122 kg/hr whereas 14-74/5A4 gave a return of 90.41 kg/hr. Based on these observations, it can be safely concluded that areas 14-73/5F2, 5F4, 6F1, 6F2, 14-74/5A1, 5A2, 5A3, 5A4 and 6A1 are potentially rich fishing grounds off Karwar. The depth range in these areas varied between 9-15 fathoms; and as the range was comparatively small, the depthwise distribution of the catch could not be attempted. All these areas are deltaic and are greatly influenced by the influx of freshwater from the Kali river. It is very likely that the rich nutrients drained out from the river influence the sustained growth of the food organisms of fishes taken in the trawl catch and thereby support the fishery. This aspect has to be examined further before arriving at any definite conclusions.

It would be of interest to compare the results of the present survey with the trawl fishery along the Bombay and Kerala coast. The boats operating in those areas were generally bigger and were equipped with higher horse power for propulsion and fishing. Data in respect of some vessels readily available is presented in Table VII.

Compared to the operations of the above vessels the performance of the small boats of the Indo-Norwegian Project based at Karwar was more than satisfactory. In spite of smaller tonnage, low horse power and smaller gear operated, the catches compare very favourably. This tends to show that the fishing grounds explored off Karwar are potentially rich in ground fish resources.

The catch composition studies show that *Opisthopterus tardoore* and *Leiognathus* spp. are the principal fish and account for nearly 50% of the catch. Therefore these two genera can be termed the principal trawl fish off Karwar. Economically these fisheries do not appear to be very important and the problem of their disposal would arise if commercial exploitation on bigger scale is to be taken up. It would therefore be necessary to devise methods for proper utilization of this valuable protein food. The record catch of *Opisthopterus tardoore* was taken from areas 14-73/6F1 and 6F2 whereas species of *Leiognathus* were taken in large quantities from area 14-74/5A4. The rich grounds cited above support these fisheries in general throughout the season, particularly during January-February.

Sciaenids and *Lactarius lactarius* formed the lesser fisheries of some economic value. The former were taken by all the three vessels in small quantities throughout. But the latter was taken mostly by Karwar-1, during December and January. As Karwar-1 was operating mostly in deeper waters within the 9-20 fathom range, a slightly deep water habitat is indicated for this species.

The prawn catches taken by these vessels have not been very encouraging. The percentage of prawn varied from 6.66% in 1963-64 to 1.48% in 1965-66 indicating a gradual decline in quantities landed year after year. They were more common in the major area 14-73 which is relatively distant from the coast. However, the prawn yields during the year 1963-64 were comparatively more from the major area 14-74 whence the medium boat landed good catches. The record catch rate of 88 and 102 kg/hr were obtained by Karwar-1 and the medium boat respectively from area 14-73/5F4 in February 1964. They formed a good fishery during February 1964 when all three boats landed their highest catches.

It can thus be seen that the Indo-Norwegian Project vessels have proved beyond doubt that there are potentially rich fishing grounds off Karwar. The catch return even by small size trawlers compared very well with the bigger boats operating in other areas on the west coast of India.

SUMMARY

A preliminary survey of the ground fish resources off Karwar was undertaken by the Indo-Norwegian Project during the years 1963-66. They covered an area of 900 sq. miles in the neighbourhood of Karwar. The three vessels, Karwar-1, medium boats M1/M4 and the small boat INP 167 operated shrimp trawls during the period under review. The following conclusions were arrived at based on those operations.

1. All the three vessels together put in a total fishing effort of 2303 hours and landed 442,165 kg of fish giving an average catch rate of 191.95 kg-hr during the three years.

2. Karwar-1 fished for 942 hours during this period and landed 222,079 kg of fish with an average catch rate 235.73 kg/hr. The highest catch rate of 280.01 kg/hr was obtained during the year 1964-65.

3. The medium boats M1/M4 trawled for 516 hours and landed 128,436 kg of fish with an average catch rate of 248.59 kg/hr. The highest catch rate of 295.89 kg/hr with an effort of 137 hours was obtained during 1964-65.

4. The small boat INP 167 worked for 845 hours landing 91,650 kg of fish with an average catch rate of 108 kg/hr. The highest catch rate of 114.54 kg/hr was during 1964-65 was the best for trawl fisheries in this region as all the three types of boat yielded high catch rates during that period.

5. The catch rates obtained for these three vessels when compared with bigger vessels with more power operating in other areas indicate that the fishing grounds off Karwar are potentially rich.

6. The months of February, March, April and October were good for trawling when high catch rates were obtained.

7. Twelve areas, namely, 14-73/5F2, 5F3, 5F4, 6F1, 14-74/4A3, 4A4, 5A1, 5A2, 5A3, 5A4, and 6A1 covering an area of 300 sq. miles were reasonably well surveyed during these three years by Karwar-1. Of these twelve areas, area 14-74/6A1 gave a return of 354 kg/hr, areas 14-73/5F4, 6F2, 14-74/5A3 and 5A4, between 244-278 kg/hr. The remaining adjoining areas gave a catch rate between 147-227 kg/hr.

8. Six areas, viz., 14-73/5F4, 6F2, 14-74/5A1, 5A2, 5A3 and 6A1 covering 150 sq. miles were surveyed by the medium boats M1/M4 with a fishing effort varying between 33-197 hours. Area 14-74/5A2, 5A3 and 6A1 gave a yield between 250-293 kg/hr and in the remaining areas the catch rate varied from 189-226 kg/hr.

9. The small boat INP 167 covered only four areas, namely 14-74/5A2, 5A3, 5A4 and 6A1 putting in 91-481 hours of fishing effort and yielded a catch rate between 90-122 kg/hr.

10. It will thus be seen that a stretch of about 200 sq. miles located infront of the Kali river mouth and covering 9 areas form rich trawling grounds.

11. Studies on catch composition have shown that the principal trawl fisheries of the area are for *Opisthopterus tardoore* and species of *Leiognathus* which together accounted for nearly 50% of the catch. The lesser fisheries are those Sciaenids and *Lactarius lactarius*. Prawns, Sharks and Rays were also taken in small percentages.

12. *Opisthopterus tardoore* was obtained at 100 kg and above per trawling hour from areas 14-73/6F4, 14-74/4A1, 4A2 and 5A3 during January-February. The Silver-bellies came from areas 14-73/5F2, 5F4, 6F1, 6F2, 14-74/5A1, 5A3, 5A4 and 6A1 at a rate exceeding 100 kg/hr during January-February.

13. *Sciaenids* were obtained at a rate of 30 kg and above from areas 14-73/6F2, 14-74/5A1, 5A2, 5A3, 5A4 and 6A1 during December-March period. *Lactarius lactarius* was taken at a rate of 30 kg/hr or more during December and February from areas 14-73/5F4 and 14-74/4A2.

14. Sharks and Rays were obtained from all areas in small quantities throughout the season.

15. Prawns were common in areas 14-73/5F4, 6F2, 14-74/5A1, 5A2, 5A3 and 6A1 showing that the yield from the major area 14-74 was comparatively higher than 14-73. They were taken during February and the catch rate from different areas varied from 8-62 kg/hr, 5-92 kg/hr and 5-18 kg/hr in respect of Karwar-1 medium vessels M1/M4 and INP 167.

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Table I

	KARWAR-1	M1/M4	INP 167
Length	13.1 metres	10.6 metres	8.5 metres
Beam	3.6 "	3.3 "	2.7 "
Draft	1.8 "	1.5 "	1.2 "
Gross tonnage	20	15	6
Horse power	90	48	24
Shrimp trawl measurements.			
Length of head rope	36.5 metres	34.7 metres	27.4 metres
Length of foot rope	6.8 "	6.1 "	5.1 "
Length of hunt rope	7.9 "	6.9 "	5.5 "
Size of cod end mesh	13 mm	13 mm	13 mm
Material used for netting	Couslene	Couslene	Couslene
Otter boards length & breadth	160 x 90 cm	130 x 70 cm	90 x 60 cm
Otter boards weight	120 kg	90 kg	60 kg

Table II

Period	Fishing effort in Hrs. Mts.	Total catch in kg	Catch/hr in kg	Catch/hr/HP in kg
I. KARWAR-1				
1963-64	234.30	63,324	270.04	3.00
1964-65	324.30	90,862	290.01	3.11
1965-66	383.05	67,893	177.23	1.97
Total	942.05	222,079	235.73	2.62
II. M1/M4				
1963-64	353.00	79,930	226.43	4.76
1964-65	137.10	40,586	295.89	6.16
1965-66	26.30	7,920	298.86	6.22
Total	516.40	128,436	248.59	5.18
III. INP 167				
1963-64	235.15	23,698	100.73	4.20
1964-65	254.45	29,180	114.54	4.77
1965-66	354.50	38,772	109.97	4.55
Total	844	91,650	108.48	4.52
Total for the three vessels	2,303.05	442,165	191.95	

Table III

Showing the catch in kg of all fish per trawling hour and* catch/hour/HP by all vessels during different months (1963-64) to 1965-66 at Karwar

Name of vessel	Years	April	May	October	November	December	January	February	March
KARWAR-1	1963-64	--	--	--	417.25 (4.64)	279.28 (3.10)	224.85 (2.49)	227.78 (2.53)	295.11 (3.28)
	1964-65	343.25 (3.81)	216.77 (2.41)	--	--	102.99 (1.14)	155.45 (1.73	394.26 (4.32)	299.30 (3.32)
	1965-66	237.61 (2.64)	--	284.14 (3.15)	129.94 (1.44)	179.09 (1.99)	178.13 (1.98)	192.16 (2.13)	177.13 (1.87)
	Average	290.43 (3.22)	216.77 (2.41)	284.14 (3.15)	173.59 (3.04	187.12 (2.08)	186.14 (2.07)	271.40 (2.99)	257.18 (2.82)
M1/M4	1963-64	--	--	104.95 (2.18)	350.11 (7.29)	202.11 (4.19)	160.17 (3.34)	270.89 (5.64)	265.27 (5.53)
	1964-65	377.27 (7.86)	178.75 (3.72)	--	--	--	--	--	315.62 (6.57)
	1965-66	298.86 (6.22)	--	--	--	--	--	--	--
	Average	388.06 (7.04)	178.75 (3.72	104.95 (2.18)	350.11 (7.29)	202.11 (4.19)	160.17 (3.34)	270.89 (5.64)	290.44 (6.05)
INP 167	1963-64	--	--	28.10 (1.17)	107.73 (4.49)	73.66 (3.01)	88.87 (3.70)	165.95 (6.91)	136.25 (5.68)
	1964-65	167.41 (6.97)	73.56 (3.06)	00.00 (0.00)	164.88 (6.87)	34.27 (1.43)	25.68 (1.07)	181.26 (7.56)	126.05 (5.25)
	1965-66	186.59 (7.77)	--	61.11 (2.54)	87.07 (3.63)	107.86 (4.49)	118.09 (4.92)	91.76 (3.82)	107.85 (4.49)
	Average	177.00 (7.37)	73.56 (3.06)	29.74 (1.23)	119.89 (4.99)	71.93 (2.97)	77.54 (3.23)	146.32 (6.09)	123.38 (5.14)

* Figures in brackets catch/hour/HP in kg

Table IV

Showing the average catch rate in different months and areas, the total effort and catch etc. during October 1963 - March 1966 for KARWAR-1

Area	Catch rate in kg/hr during different months								Total catch in kg	Total effort in Hrs.Mts.	Catch/ in kg
	October	November	December	January	February	March	April	May			
14-73/5F2	--	262.00	327.00	191.55	210.56	146.88	233.33	181.66	12147	59.50	230.01
/5F3	--	0.00	130.33	145.16	145.06	117.33	391.66	275.00	3958	22.05	179.23
/5F4	--	310.25	239.81	205.46	238.39	252.63	351.00	215.00	52972	212.20	249.47
/6F1	--	197.25	190.93	135.91	191.75	265.50	352.40	170.00	6368	29.30	215.86
/6F2	--	326.95	211.91	231.69	295.68	290.75	316.17	221.43	35344	126.45	278.85
14-74/4A3	--	154.00	133.50	122.00	190.65	208.99	--	--	3812	21.20	178.69
/4A4	--	142.00	136.50	152.00	130.93	173.62	--	--	2975	20.10	147.52
/5A1	172.00	249.71	215.55	178.78	168.09	278.39	366.40	330.00	19657	86.20	227.69
/5A2	287.00	88.28	120.85	168.12	176.00	314.41	281.43	165.00	13997	62.50	213.26
/5A3	310.75	175.82	196.05	170.02	423.19	243.37	285.38	205.00	39426	159.25	247.31
/5A4	--	191.50	79.00	167.87	357.30	315.60	380.00	--	6002	24.35	244.14
/6A1	--	226.21	--	--	384.77	350.40	285.00	--	12079	34.05	354.40
Total catch	1989	12302	24420	31813	48449	58185	24859	6720	208737		
Total effort	7.00	57.05	115.15	172.25	167.20	233.00	76.10	31.00		859.15	
Catch/ hour	284.14	215.51	211.89	184.51	288.96	249.72	326.38	216.77			242.93

Total catch for Karwar-1 from all areas .. 222079 Total catch for Karwar-1 from the above area.. 208737 (94.00%)

Total effort for Karwar-1 for all areas .. 942.05 Total effort for Karwar-1 for the above areas.. 859.15 (91.20%)

Table V

Showing the average catch rate in different months and areas, the total effort and catch etc. during October 1963 – March 1966 for M1/M4

Area	Catch rate in kg/hr during different months								Total catch in kg.	Total effort in Hrs. Mts.	Catch/hr
	October	November	December	January	February	March	April	May			
14-73/5F4	130.00	223.00	265.00	253.57	293.33	157.50	218.33	246.55	8408	38.00	221.26
/6F2	117.20	281.82	197.00	176.72	363.33	287.00	481.80	171.40	21230	94.00	226.91
14-74/5A1	0.00	151.25	130.00	106.66	200.00	232.50	326.75	236.00	6269	33.00	189.97
/5A2	0.00	363.12	240.00	145.00	282.77	313.32	316.30	70.00	20796	70.55	293.24
/5A3	131.71	454.04	207.44	139.03	233.41	252.94	336.00	170.78	49387	197.30	250.06
/6A1	208.00	284.00	160.00	142.49	258.00	346.86	499.90	132.20	19002	70.00	271.45
Total catch	5038	19256	12067	10891	14610	27499	27787	8044	125192		
Total effort	47.00	55.00	60.00	68.00	54.00	96.25	78.00	45.00		503.25	
Catch/ hour	107.19	350.10	201.11	160.16	270.55	285.21	356.24	178.75			248.68

Total catch for M1/M4 from all areas .. 128436 Total catch for M1/M4 from the above areas .. 125192 (97.47%)

Total effort for M1/M4 for all areas .. 516.40 Total effort for M1/M4 for the above areas .. 503.25 (97.43%)

Table VI

Showing the average catch rate in different months and areas, the total effort and catch etc. during October 1963 - March 1966 for INP 167

Area	Catch rate in kg/hr during different months								Total catch in kg	Total effort in Hrs. Mts.	Catch/ hour in kg
	October	November	December	January	February	March	April	May			
14-74/5A2	0.00	75.00	104.95	122.55	133.61	113.80	243.75	--	11270	91.45	122.83
/5A3	24.29	120.60	90.39	96.16	135.63	127.32	182.51	71.00	54824	481.50	113.78
/5A4	29.93	55.62	63.16	81.06	87.57	158.96	171.60	109.00	12371	136.50	90.41
/6A1	23.82	88.80	68.48	111.20	145.78	106.14	109.17	77.33	10705	105.20	101.63
Total catch	1725	10082	9061	11256	14978	25895	14211	1692	89170		
Total effort	74.15	96.15	107.45	114.00	116.15	203.30	80.45	23.00		815.45	
Catch/ hour	23.23	104.75	84.09	101.10	128.84	127.25	175.99	73.56			109.31

Total catch for INP 167 from all areas .. 91650 Total catch for INP 167 from the above areas .. 89170 (97.30%)

Total effort for INP 167 for all areas .. 844.50 Total effort for INP 167 from the above areas .. 815.45 (96.56%)

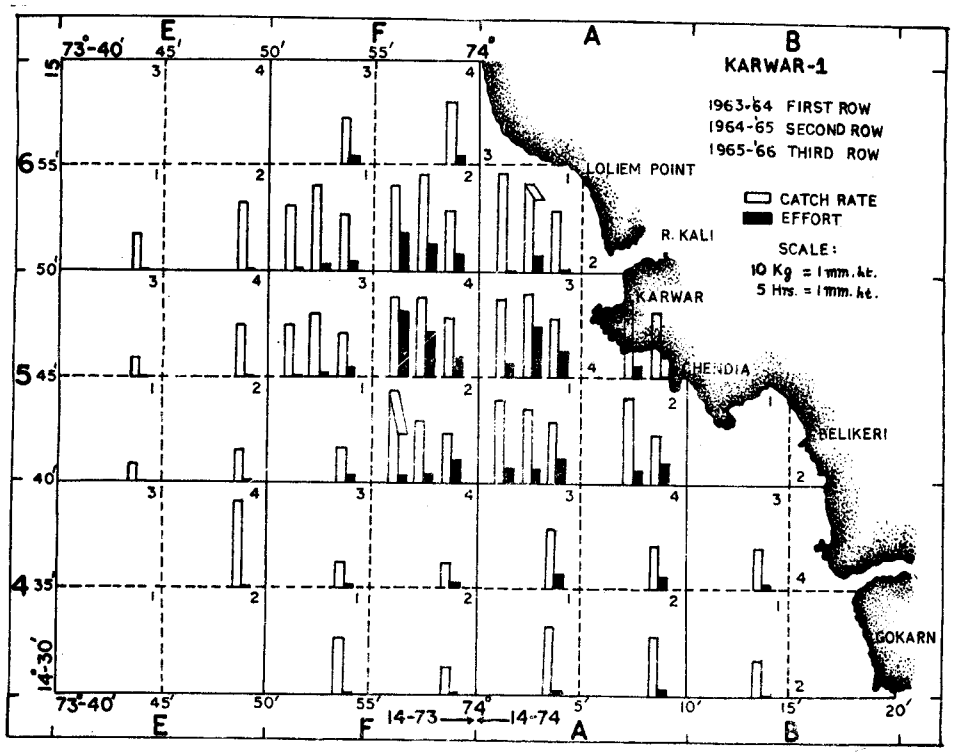

Fig. 1. Chart showing catch/hr and fishing effort during 1963-1964, 1964-1965 and 1965-1966 by Karwar-1 in different areas.

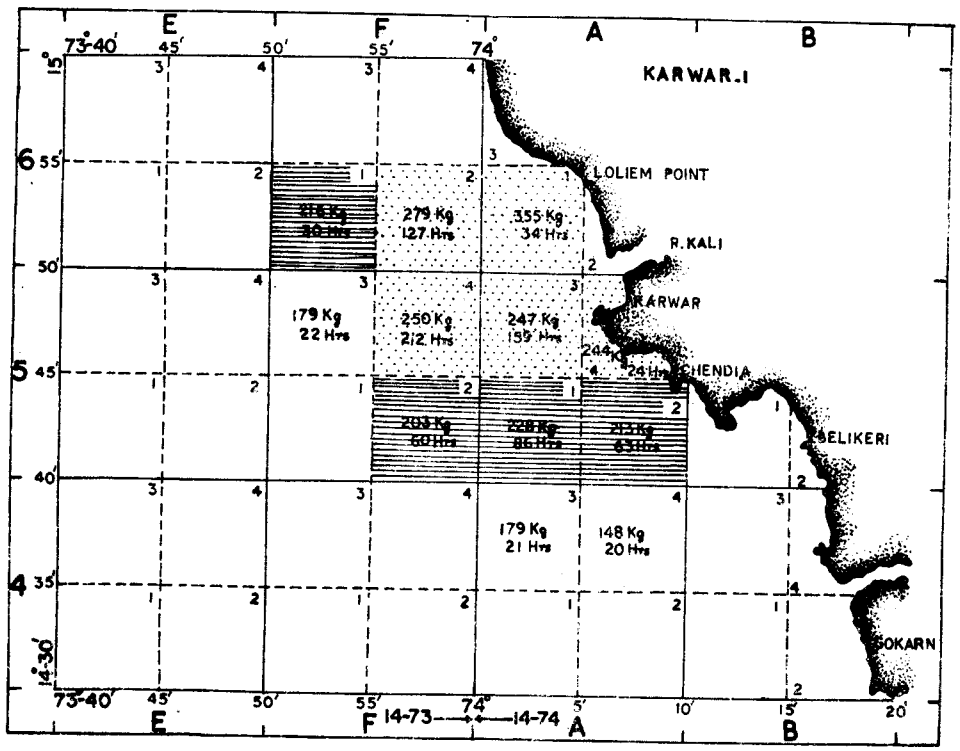

Fig. 2. Chart showing rich fishing grounds explored by Karwar-1 with catch rates and fishing efforts.

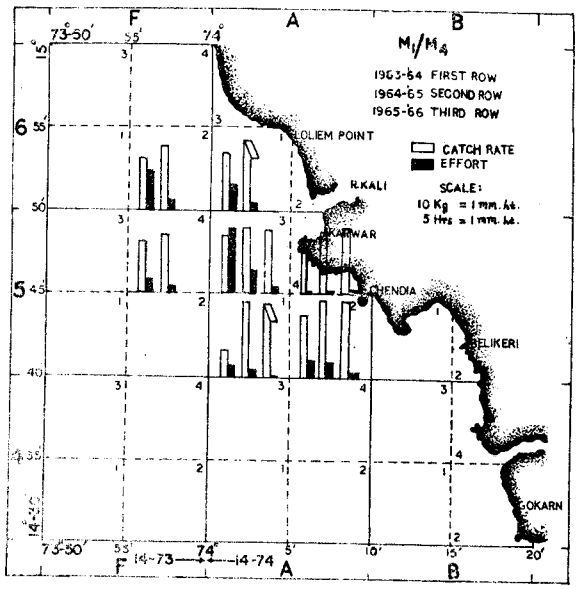

Fig. 3. Chart showing catch/hr and fishing efforts during 1963-1964, 1964-1965 and 1965-1966 by M1/M4 in different areas.

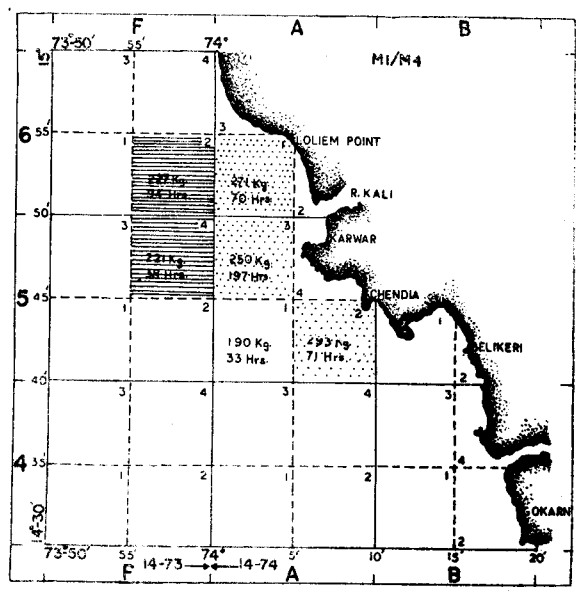

Fig. 4. Chart showing rich fishing grounds explored by M1/M4 with catch rates and fishing efforts

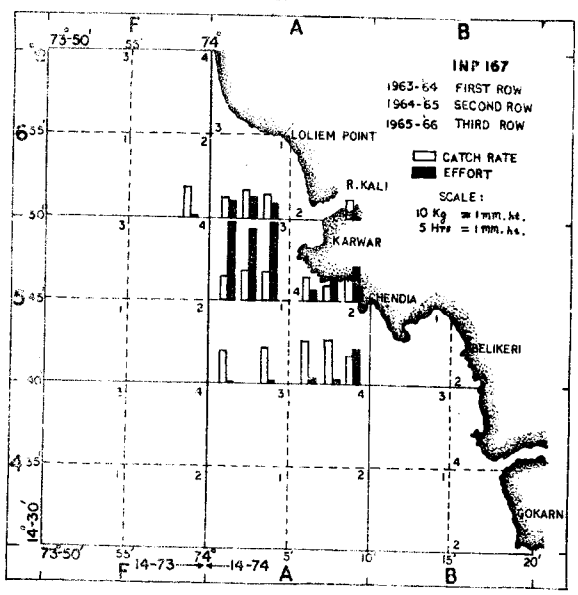

Fig. 5. Chart showing catch/hr and fishing efforts during 1963-1964, 1964-1965 and 1965-1966 by INP 167 in different areas.

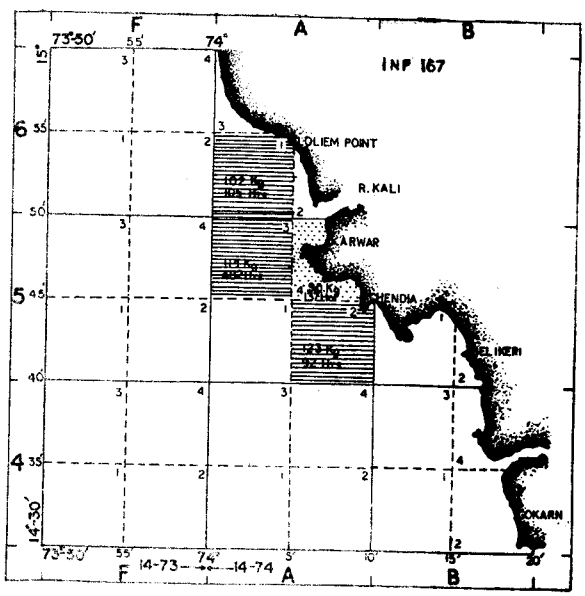

Fig. 6. Chart showing the rich fishing grounds explored by INP 167 with catch rates and fishing efforts

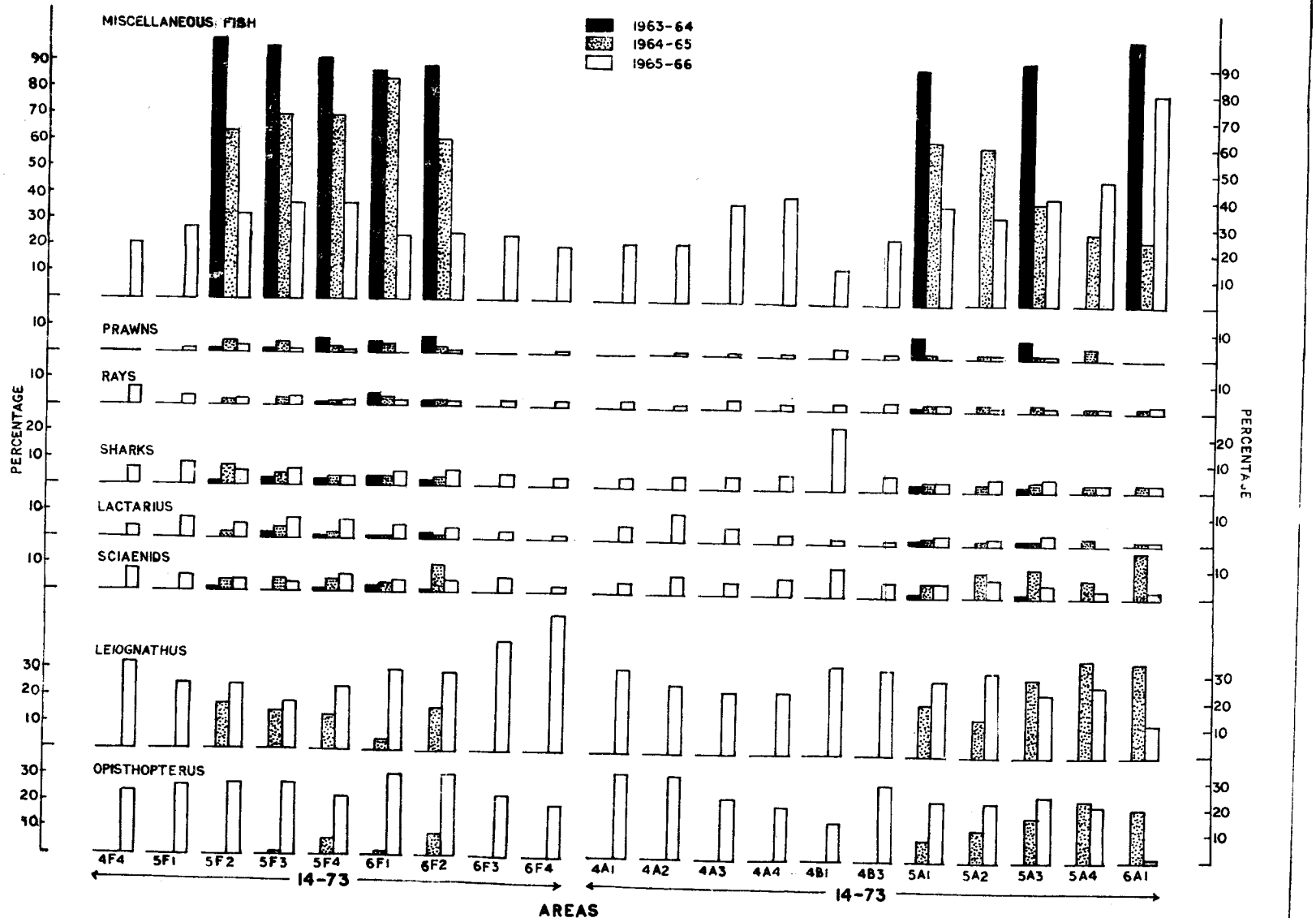

Fig. 7. Histogram showing the catch composition of Karwar-I during 1963-64 to 1965-66 from different areas.

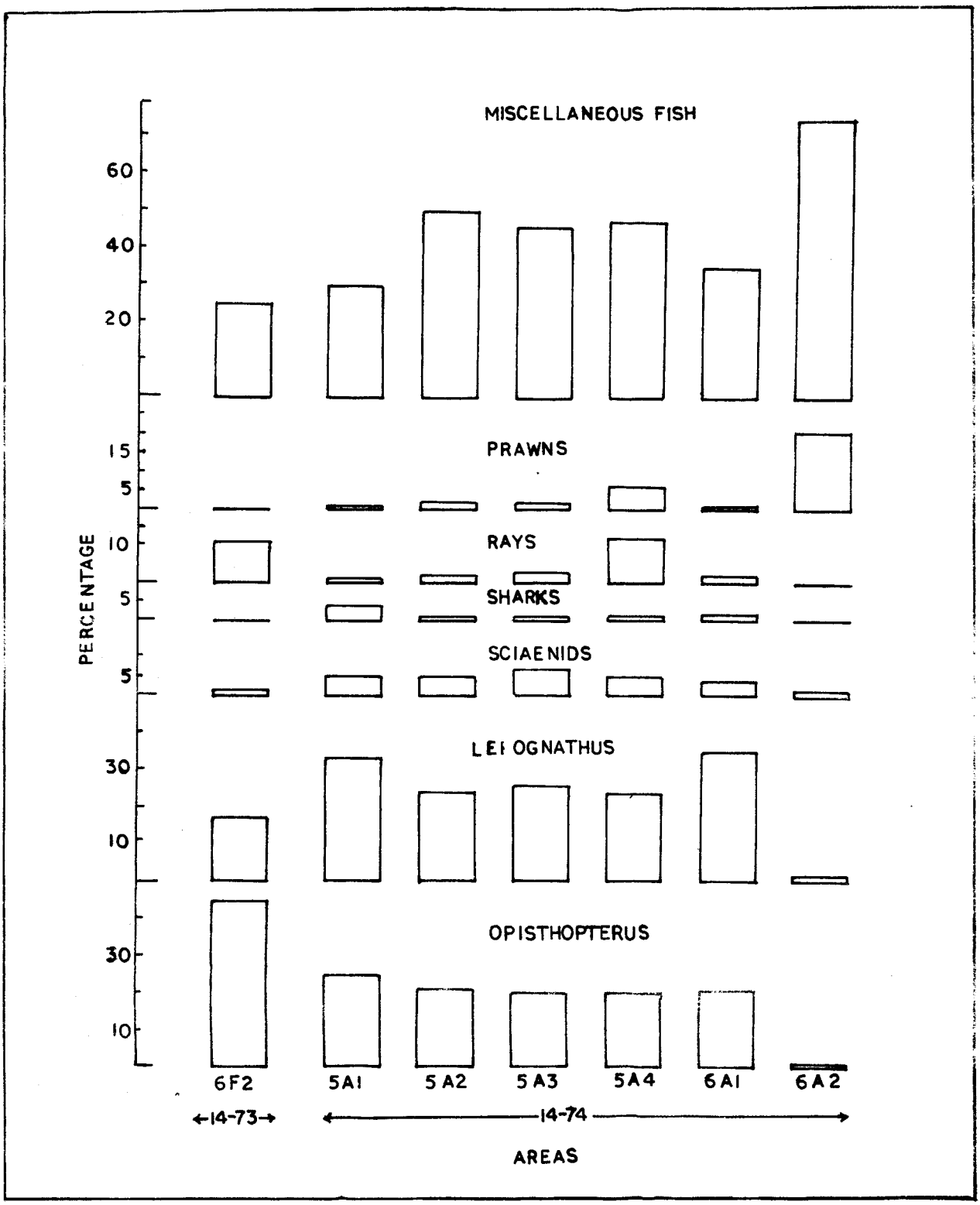

Fig. 8. Histogram showing the catch composition of INP 167 during 1965-66 from different areas.

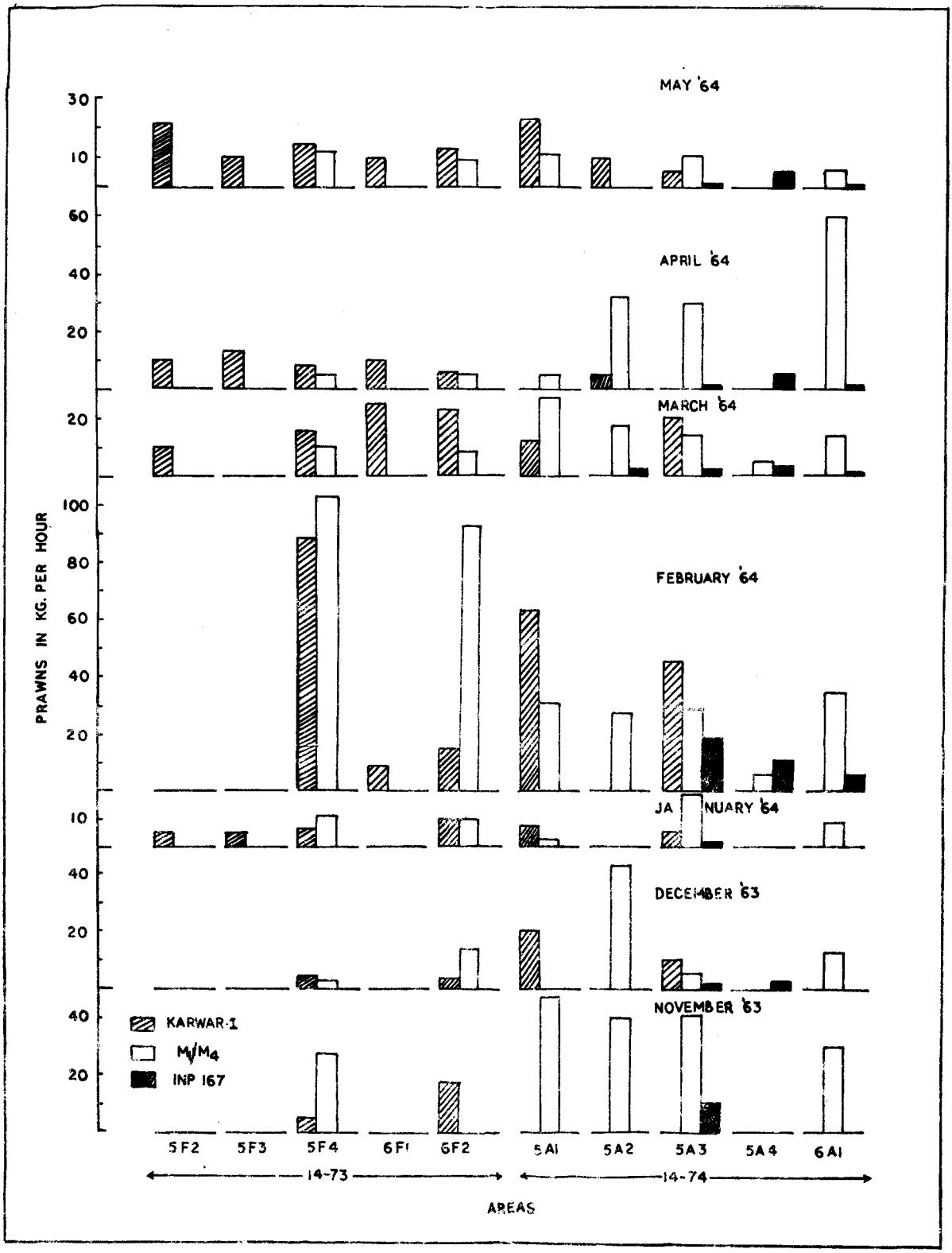

Fig. 9. Histogram showing the catch rate of prawns from different areas during different months in 1963-64 by the three vessels.