

SURVEY OF FISHING RESOURCES IN THE KONKAN REGION  
OF MAHARASHTRA  
NOVEMBER 1962 TO JUNE 1967

by

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ABSTRACT

The paper reviews the fishery survey conducted for the last five fishery years in Konkan region of Maharashtra State (India). Factors influencing the catch, relative gear efficiency, and the catch composition with special reference to prawns have been discussed and the results of the preliminary survey are indicated.

INTRODUCTION

On the west coast of India, the State of Maharashtra has 700 km. of coastline along the four maritime districts of which the two northern districts, Thana and Greater Bombay, are comparatively better developed in fisheries; the two southern districts, Kolaba and Ratnagiri, which together constitute the south Konkan region, have remained comparatively underdeveloped, with only about six per cent of the total number of mechanized fishing fleet in the State. The main reason for this has, probably, been the fishermen's fear that the fishing in this region might not be as gainful as off Greater Bombay and Thana districts. With a view to charting the fishing grounds and indicating their potentialities, and marking underwater obstructions to fishing, an exploratory scheme, to survey the sea of this Konkan region between ports Vengurla in Ratnagiri District ( $15^{\circ}50'N$ ) and Revdanda in Kolaba District ( $18^{\circ}35'N$ ), and between  $19^{\circ}10'N$  and  $20^{\circ}00'N$  in Thana District was started as a Pilot Project in November 1962, with the help of four medium-sized motor fishing vessels SAVITRI, SHIVANERI, JANJIRA and KUNDALIKA.

VESSEL, EQUIPMENT, GEAR

The vessels were built at the boat building yard of a fishermen's co-operative society in the State, to the design provided by FAO. Each vessel is powered by a four stroke 87 H.P. Lister marine diesel engine, the hull being built of teakwood and sheathed with copper to water level. Other particulars are:

(a) Dimensions

Overall length	14.49 m
Breadth	4.11 m
Depth	1.9 m
Draft	1.62 m
Displacement (DWL)	30.6 m tons
Tonnage (Gross)	34.83 tons
Fish hold (Insulated)	10-ton capacity

(b) Equipment

1. "Bendix" echo-sounder, capable of recording depth upto 60 fathoms.
2. Gurdy and net roller for gill net operation.
3. Tripod gallows.
4. Mechanical trawl winch - Drum capacity 200 fathoms.

(c) Gear

1. Trawl nets 45' and 75' Hoover type; 14 m and 60' Russian type; with suitable otter boards.
2. Gill nets:
  - Surface : 1,000 fathoms length of 210/3/3 nylon; shrinkage 0.5; mesh - (stretched) 5 1/2", 6" and 6 1/2"; floats - Spheroid black plastic (4" dia.).
  - Bottom set : 1,000 fathoms of 210/8/3 nylon; shrinkage 0.5; mesh - (stretched) 5 1/2", 6" and 6 1/2"; floats - Japanese Pama F.S.1 floats.
3. Long lines : SAVITRI and SHIVANERI have been each provided with 1,000 fathoms line with 500 hooks of "0" number.

(d) Deck layout (Fig. 1)

1. To facilitate stern-trawling operations, the winch has been placed on the foredeck and its position is conventional. Two gallows are on the aft deck, one to starboard and one to port. The warp (12 m diameter) is led from the winch to the gallows through pulley blocks on either side. With suitable pulley blocks at the foot of the stern mast and on the starboard side, the cod end of the trawl net is hauled up on the winch by a 9 mm warp.

2. For gill netting, the gurdy with its control and the net roller are suitably positioned on the starboard side of the vessel.

#### AREA OF OPERATION (Fig. 2)

Considering the expanse of the sea off the Konkan coast, between  $15^{\circ}50'N$  and  $20^{\circ}00'N$ , a phased programme had to be followed.

#### Ratnagiri District

(a) SHIVANERI and SAVITRI - From November 1962 to June 1963, an area of 900 sq.km. between the port of Paos  $16^{\circ}50'N$  in the south and the port of Tiwari  $17^{\circ}10'N$  in the north and out to about 30 fathoms depth (C.f. Fig. 2, 1) was surveyed by undertaking daily trips from Ratnagiri as the base of operations. During July-September 1963, fishing during monsoon was carried out, which incidentally was the first attempt in the Konkan region.

During the fishing season, October-May, of 1963-64, an area of 1,489 sq.km. was covered, ranging from  $73^{\circ}7\frac{1}{2}'E$  Longitude, roughly the 30 fathom line, to the short limits between Vengurla port ( $15^{\circ}50'N$ ) and Mithbao port ( $16^{\circ}17\frac{1}{2}'N$ ) (Fig. 2, 1-A) with Malwan port as the base of operation, by daily fishing trips. However, from December 1963, the trips were larger, occupying 72 hours.

In the fishing season of 1964-65, approximately 1,450 sq.km. were surveyed between the port of Tiwari ( $17^{\circ}10'N$ ) and the port of Harnai ( $17^{\circ}50'N$ ) and outwards  $72^{\circ}55'E$  (Fig. 2, 2-B). The entire work was completed by making daily trips only from the port of Harnai and the port of Palshet as bases of operation.

The remaining area, between above latitudes and west of  $72^{\circ}55'E$  (Longitude) upto 30 fathoms depth (Fig. 2, 2-C), and measuring 1,632 sq.km. was covered between October 1966 and March 1967. All the four survey vessels made long trips only for this work, with Ratnagiri port as base of operations.

#### Kolaba District

JANJIRA and KUNDALIKA - During December 1962 to May 1963, an area of approximately 675 sq.km. was surveyed ranging from the 12 fathom line falling on  $72^{\circ}50'E$  Longitude, to the shore line between Harnai ( $17^{\circ}50'N$ ) and Murud ( $18^{\circ}20'N$ ) Latitude), by undertaking daily trips from Shriwardhan as the base of operations (Fig. 2, 2). These vessels did monsoon fishing in 1963, off Bombay. From October 1963, the vessels were operated in Kolaba District again to cover the area of 2,250 sq.km. (Fig. 2, 2-A) lying between longitude  $72^{\circ}20'E$  and  $72^{\circ}50'E$  and latitudes  $17^{\circ}50'N$  to  $18^{\circ}20'N$ , including the Direction Bank. This area was explored by making daily trips from Murud as the base of operations, which was changed to Bombay for long trips from mid November 1963 onwards.

SAVITRI - In the fishing season of 1964-65 an area of 280 sq.km. was surveyed along the shore line from 18°20'N to 18°27 1/2'N and out to 72°40'E (Fig. 2, 2-D). This work was done by daily trips from port Murud (Janjira) as base of operations.

The remaining area (Fig. 2, 2-E), approximately 864 sq.km. between 18°27 1/2'N and 18°35'N and out to 30 fathoms depth (72°25'E Longitude) was covered in the 1965-66 season by SAVITRI and KUNDALIKA, which made long trips for this purpose from Bombay.

#### Thana District

During April and May 1967 (i.e. fishing season of 1966-67), JANJIRA and KUNDALIKA were operated from Bombay, to cover an area of 528 sq.km. in the Thana District, between 20 to 25 fathoms and between latitudes 19°10'N and 19°35'N (Fig. 2 - Table I).

#### METHOD OF WORKING

Each boat recorded the quantity and composition of the catch, and variations if any, with reference to gear, season, depth and nature of bed. Submerged obstructions detrimental to fishing were also charted. With a view to assigning survey areas for each vessel, the 30 fathom sea off the Konkan region was arbitrarily divided into squares of 16 sq.km. each. To make the fishing effort comparable, each vessel was allotted equal number of squares, each square being fished for about 8-10 hours. In order to cover as much area as possible within the time-schedule, most of the squares could not be surveyed more than once, although the need for repeating the survey in each square was always felt.

#### OBSERVATIONS

Considering the total area of about 11,663 sq.km. surveyed by the four trawlers, it was observed that, except for certain patches, the entire area had muddy and sandy bottom, suitable for trawling. Hefford (1949), while reporting on the work of the S.T. WILLIAM CARRICK, remarked that the sea bottom off the Bombay Presidency from close proximity to the shore out to and beyond the 100-fathom line, consisted almost entirely of dark grey clayey mud, interspersed with patches of sand mixed with broken shells and coralline patches, including the Direction Bank, which are all relatively insignificant in extent. These mostly occur between 30 and 100 fathoms.

Any benthic region, although suitable for trawling, may not necessarily yield catches in such quantities as to be economical from the viewpoint of fishing operations. This survey was undertaken with particular reference to the catch-yield and the depth range. Hefford (*op. cit.*) recorded the best catches up to Bankot, 18°N lat., only between 15 and 25 fathoms. Jairaman *et al.* (1959) concluded that the bulk of the yield is to be found at about 20 fathoms. The present survey, conducted by the four trawlers, covered trawling grounds only upto 30 fathoms. The programme of the survey, however, envisages extending observations beyond 30 fathoms in the future.

(A) Fishing Performance

Factors taken into consideration to make the data understandable and comparable are as follows:

(i) Fishing time: FAO has suggested the following standards of India; the seatime for a vessel should be 75 per cent of the calendar time and the actual fishing time (towing time in the case of a trawl net) should be 25 per cent of seatime for daily trips and 40 per cent of seatime for long trips. The vessel by vessel regime and performance, with reference to seatime and fishing time, are given in Table I.

Before discussing the fluctuations in the averages of seatime and fishing time for the five fishery years, it is pointed out that a fishery year, of 12 months, includes the monsoon season (July to September), during which fishing conditions all along Maharashtra coast are adverse, resulting in curtailment of seatime and consequently of fishing time. The fishing time average during 1962-63 is 23.4% of seatime; the year did not incorporate the monsoon period owing to the commissioning of the vessels only in November-December, 1962. Comparing the remaining four fishery years, all incorporating monsoon seasons, the averages for both seatime and fishing time range between 27.5 and 54.7% of calendar time, and 15 to 23.5% of seatime respectively. For the whole period, the overall vessel averages for seatime (41.8% of calendar time) and fishing time (20.2% of seatime), indicate that the four vessels did not operate enough to reach the minimum standards with regard to seatime and fishing time as prescribed by FAO. Failure to reach such standards seems to be, however, a common feature of fishing in India, as stated by Poliakov (1962). For the whole period (1962-67), the lay-up period of 48.2% for all vessels can be accounted for as mainly due to non-availability of engine parts and the long time taken for either fabrication or repairs.

(ii) Catch/fishing hour/H.P. (kg/hr/H.P.): Poliakov (*op. cit.*) expects a trawl catch of 1.2 kg/hr/H.P. for the Arabian Sea. Monthly all gear catches/hr/H.P. for each survey boat from November 1962 to June 1967 are given in Table II. The whole-period averages for each vessel and all-vessels are given.

For the whole period, all gear average catch of 1.3 kg/hr/H.P. for all vessels, and 1.4 kg/hr/H.P. for each vessel except SHIVANERI (1.1 kg/hr/H.P.), are slightly more than the minimum of 1.2 kg/hr/H.P. required for trawling only. A catch, higher than this minimum, is generally attributed for shorter voyages in rich areas. While explaining the higher catch of CHAMPA (1.25 kg/hr/H.P.) in the Bay of Bengal than that of ASHOK (0.73 kg/hr/H.P.) and PRATAP (0.96 kg/hr/H.P.), Poliakov (*op. cit.*) mentions that this was due to the fact that CHAMPA conducted trawling operations in the vicinity of Visakhapatnam - an area already explored. The present survey has given a whole period all gear average catch of 1.3 kg/hr/H.P. for all the four vessels, although the vessels operated in unexplored grounds and used different types of gear viz. gill nets, long lines and trawl nets. Taking these facts into consideration, the performance can be rated as satisfactory.

(iii) Catch per fishing hour:

(a) All gears: Besides trawl nets, the survey boats occasionally operated drift and bottom set nylon gill nets and long lines. The catch/per hour by gear, by vessel-wise and for all vessels for the five fishery years is given in Table III.

From the view point of quantity of catch by these gears, it is deduced that the superiority of trawl net is beyond doubt, if production of fish is the target. In 1966-67, the only gear operated was the trawl net; the catch/hr. was, however, lower than the corresponding catch in the previous three years. This may be due to the comparatively poorer fishing grounds, where the vessels were operated.

(b) Trawl net: Monthly averages of trawl catch by each of the four survey vessels, along with average for each fishery year and for all vessels together, are given in Table IV. The averages for SAVITRI and SHIVANERI in 1962-63 were 89.0 kg. and 104.8 kg., respectively, and those for JANJIRA and KUNDALIKA were 50.4 and 58.4 kg. respectively. Average for all the four vessels was 74.9 kg. The mode of operation was hand trawling, as the winches had not then been properly set to function. With the winches operating in the subsequent years, the all-vessels average catch per trawling-hour was increased considerably. In 1963 monsoon, the average came to 114.6 kg. The average for the whole fishery year i.e. July 1963 to June 1964, for each of the four vessels ranged between 115.7 and 175.1 kg., and for all vessels the average was 163.5 kg. From November 1964 to June 1965, the average for each of the four vessels ranged between 146.2 to 242.6 kg. and the all-vessels average came to 194.5 kg. For 1965-6 and 1966-67 fishery years, the ranges were 163.5 to 229.6 kg. and 84.7 to 157 kg., averaging 172.1 kg. and 133.3 kg. for all vessels respectively.

The monsoon fishing off Bombay was quite encouraging. The catch per trawling hour varied between 68 kg. to 360 kg. Comparatively poor results of monsoon fishing off Ratnagiri in 1963-64, by SAVITRI and SHIVANERI suggest that the monsoon conditions at sea in that area are not as favourable.

These averages, when considered with some of those already recorded for other fishing vessels in India, can constitute a basis for comparison. Deshpande (1960) recorded an average catch of 63.63 kg/hr. for hand trawling and 124.5 kg/hr. for which trawling off Cochin. Hefford (*op. cit.*) computed the winch trawl catch/hr. for WILLIAM CARRICK, in Bombay region at 50 kg. Jairaman *et al.* (*op. cit.*) have remarked that the highest catch/hr. for ASHOK and PRATAP in the Dwarka region (Arabian Sea) was 84.9 kg. and that the average varied between 42 and 57 kg/hr.; these two vessels, when operated in Bay of Bengal, off Vishakhapatnam, gave an average of 192 kg/hr. as mentioned by Poliakov (*op. cit.*). This rise was attributed by him to the new design of the trawl and oval-shaped otter-boards, and as such may not necessarily, therefore, be due to richer grounds. A further basis of comparison is afforded by the operation of the following vessels in the Gulf of Manaar for three years (1959-61), as mentioned in the 1963 report of the Central Offshore Fishing Station, Tuticorin.

<u>Vessel</u>	<u>H.P.</u>	<u>Catch/trawling hour whole period 1959-61 kg.</u>
MV. MEENLOCHANI	50	76.6
MV. MEENAKSHI	42	44.0
MV. SARDINELLA	42	52.1
MV. SAGARSUNDARI	42	59.9
MV. SAGARKUMARI	42	64.5

On the basis of the minimum expected trawl catch of 1.2 kg/hr/H.P., each of the four survey vessels, fitted with an 87 H.P. engine, should bring a catch of 104.4 kg/hr. Considering that these boats were undertaking survey-cum-exploratory fishing, the all-vessels' whole period average of 167.9 kg/hr. (winch trawling) is not only above the minimum requirement, but compares favourably with the averages of other vessels. As for hand trawling, the average of 74.9 kg/hr. (1962-63), as compared to that stated by Deshpande (*op. cit.*), was also more than satisfactory. Even the hand trawling and winch trawling overall average (159.9 kg/hr.) for whole period (1962-67) can be considered fairly satisfactory, as it works out to be 1.83 kg/trawling hr/H.P.

(iv) Efficiency:

(a) Gear: To find out the comparative efficiency of different types of trawl nets used, such data on operations undertaken in the same month and same area by a pair of vessels are given in Table V.

In March 1963, the 12 M. Russian trawl gave a better catch per trip than by 45' Hoover trawl. In May and June 1963, the 14 M. Russian trawl also yielded better catches per trip than by 55' Hoover trawl. It may, however, be mentioned that the Russian design with larger cod end mesh (40 mm Bar) permitted better filtration, minimizing the prawn percentage and functioning purely as a fishnet. It has been pointed out by Poliakov (*op. cit.*) that a 16 M. HOOVER trawl was found to be rather heavy for even a vessel like PRATAP having an engine of 240 H.P.

The Central Off-shore Fishing Station, Tuticorin, in its report (*op. cit.*), on exploratory fishing operations in the Gulf of Manaar, has also recorded that its vessels, with 42 to 50 H.P. had landed a catch of 275 kg. per day during 1959-61, using cotton shrimp trawls with 15-19 m head rope. The same vessels, between April and October 1962 (217 fishing days), by using a smaller 12 m head rope, could land a catch of 556 kg. per day. The former category of nets was obviously too heavy for the vessels with H.P. between 42 and 50. Hoover trawl nets of 75' were found to be heavy for the survey vessels, especially in muddy bottom, where these offered more towing resistance. It was possible in the 1963-64 season to operate efficiently the 14 m Russian trawl nets, with suitable modification in the cod end mesh for a better prawn catch. In January 1965, a trial was also given to a 4-seam 60' trawl net with 1" (stretched) mesh in the cod end. The working of this net was found satisfactory, and yet the net was not too heavy for the 87 H.P. engine of each vessel. It was, therefore,

subsequently tried for longer periods. Though quite satisfactory in all respects, the 4-seam nets have been found to take a longer time for repairs, which are not as easy as in a 2-seam net. For all these types of nets, the rectangular otter-boards were used. The oval otter-boards, which are reported to give better catches, were also tried for a short while. It was noted that the improvement in catches was only marginal. It appears necessary that the oval otter-boards be tried for rather longer periods to confirm their efficiency of giving a better net-spread and hence higher catches.

(b) Warp: Following Scharfe (1962), warp of 12 mm diameter was used to achieve full towing power. In 1964-65, on SAVITRI and KUNDALIKA, warps of 9 mm dia. gave as good results as with 12 mm warp.

In 1962-63 season, 18 mm manila rope was used for hand-trawling. The manila rope, while being towed, offered more resistance than the wire rope; this resulted in getting less spread of the net. This has been observed also in the case of operation of the trawl net by SAGARKUMARI (Deshpande, 1960). The hand-hauling of the trawl, commonly prevalent in the Konkan region, though distinctly disadvantageous, cannot at present, be eliminated until replacement with mechanized winches can be achieved.

(c) Towing speed: Poliakov (*op. cit.*) advocated a towing speed of about 3.5 knots for the Bay of Bengal, and Scharfe (*op. cit.*) also considers a sufficiently high trawling speed, i.e. about 3.5 knots, in the Mediterranean, as a factor of great importance.

The towing speed, in the view of the writer, should depend upon the nature of the sea-bed and the type of gear, especially the mesh size, and the fish concentrations in the area.

The survey boats were operated upto a towing speed of 3.0 knots and it was found that even 2.5 knots gave satisfactory results. It may be mentioned, that while operating the 75' Hoover trawl net at this speed (2.5 knots), it got stuck in the muddy bottom.

(d) Deck arrangements: The roles of various mechanical devices on a trawler have an impact on the efficiency of its operation. The deck arrangements for the survey vessels have already been described. Although enough working space is essential on deck, there are certain limitations on the vessels, as the warp has to pass over the fish-hold and then goes back to the gallows. In the light of the experience of 57 months trawling, it is felt that the following arrangements may, perhaps, have suited better:

- (1) For stern trawling, the winch has to be necessarily on the aft-deck, and its position should be fore-and-aft. This will help to lead the warp to the gallows breadthwise away first and then for a short distance along the length, thus keeping the deck clear of any obstruction. The gallows, instead of tripod type could, perhaps, be of inverted 'U' shape, the pulley block finding its position in the concavity of the inverted 'U'.



- (2) For side trawling, the winch could be on fore-deck and its position fore-and-aft. This will facilitate leading the warps on one side only (starboard) to the fore-and-aft gallows.
- (3) On the survey vessels, the position of the gurdy and the net roller is as on a gill-netter. But, since a multi-purpose vessel cannot make full use of various types of gears, it may be considered whether "one vessel-one gear" principle should be adopted.

(e) Environmental factors: Factors such as temperature, water movements, light (day and night fishing) etc. have been considered by various workers with reference to fishing.

Temperature: Mackenzie (1934; 1936), Graham (1951), Vladykov (1933), Kawana (1937), Doudoroff (1938), Nakamura (1954) and Chidambaram (1950) have stressed the effect of temperature on fishing, but no specific optimal temperature as a controlling factor has been established. Jairaman *et al.* (*op. cit.*) have expressed the view that, owing to the limited variations in the temperature found in Indian trawling grounds, its importance may be less than in the temperate waters.

In the absence of requisite equipment on the four vessels for determination of temperature at various depths, the relevant data could not be collected. However, since the catches during summer and winter showed no variation, the temperature does not seem to have had much effect on fishing.

Light: Jairaman *et al.* (*op. cit.*) and Poliakov (*op. cit.*) have pointed out that the day catches were better than at night; the latter found out that the prawn percentage was, as a rule, higher in the night hauls. The catch-records of the four vessels, during day and night, also indicate that although the catches are low, the prawn percentage is higher at night.

Tide and currents: Correlation of catches with lunar phases has been a common practice amongst the fishermen of Maharashtra; particularly for operation of gill nets, such considerations have been found to be useful. Various authors like Hickling (1946), Rounsefell and Everhart (1953), Menon and Raman (1961) have tried to establish relationship between lunar phases and catches. From the present survey, it has been generally noted that the catches were only slightly higher towards spring tide periods. Since no current measurements were taken, the possible effects on catches, therefore, cannot be discussed here. It may, however, be mentioned that the currents in the areas of operation in Ratnagiri and Kolaba districts were too weak to affect the trawling operations. The currents were fairly strong in Thana District area, and adjustments to towing speed and direction have been found essential.

(B) Catch Composition

The comparative richness of the grounds, surveyed from the viewpoint of different constituents of the catch, has been determined. The catch mainly consisted of fish and prawns. The bulk of the fish consisted of sciaenids, with other miscellaneous types such as leiognathids, clupeids, carangids, pomacentrids, etc. The large fishes such as catfish and elasmobranchs (sharks, skates and rays), which have been grouped together, also formed a fair percentage of the total.

The area surveyed was arbitrarily divided into 1, 1 A, etc. (Fig. 2) and the percentage composition of the main constituents of the trawl catch in the respective regions is given in Table IV. Off Ratnagiri District, the areas 1, 1A, 1B, 2B and 2C, sciaenids and miscellaneous fishes constitute 60-70 per cent in the total catch. The percentage of catfishes and elasmobranchs has shown variations corresponding to the increase or decrease of the percentage of prawns. In the areas 2 and 2A off Kolaba District, the sciaenids and elasmobranchs did not show much change in their respective percentages. In area 2D, observations for 3 months indicate that the percentage of elasmobranchs was as high as 40, mainly due to a large proportion of rays. In area 2E, this percentage was reduced to 30 and prawn percentage almost doubled.

The catch, in all these areas, indicated a general consistency of fish composition; sciaenids and miscellaneous fish comprised as much as 60-70 per cent, whereas prawns and elasmobranchs together constituted 30-40 per cent. It was observed that in suitable fishing grounds beyond 20 fathoms, the elasmobranch percentage increased, showing a proportionate decrease in the prawn percentage.

The occurrence of prawns in the trawl catches has indicated the comparative potentialities in the Konkan region, where prawn fishing was not much known before the survey was undertaken. Areas 1 and 1A in Ratnagiri District and 2E in Kolaba District yielded a much higher percentage of prawns than other areas.

It may be interesting to note that there have been certain patches, especially in areas 1, 1A, 1B, 2B and 2E where the prawn percentage was as high as 80-90. Fishing in these areas could not be repeated because of the scheduled programme of the vessels to extend the exploratory survey to other areas. But this was, however, confirmed from the landings of large quantities of prawns by 28 trawlers in the private sector from Ratnagiri in 1963-64, and by about 70 trawlers in subsequent seasons. About 1200 M.T. of prawn were landed in Ratnagiri port alone in 1965-66.

Prawns being an important commercial commodity now in great demand for export from India, due importance was given to further analysis of the catch-data. The monthly prawn percentages are given in Table VII and in Fig. 3. It should, however, be noted that these percentages refer to the fishing efforts undertaken in certain squares of each specified area.

Some of the revealing features of prawning in the areas explored so far by the four survey vessels are as follows:

- (i) Monsoon trawling (July-September) conducted in areas 1, 2 and 2A, gave better catches in the latter two areas. In the monsoon season, there was a gradual rise in the prawn catch, particularly in area 2 in the three months. It may, therefore, be concluded that the monsoon fishing, in general, can be productive for prawn catch. However, this has to be established by making further observations with more intensified fishing during the monsoon.
- (ii) In area 1, it is observed that the period December-March seems to be a favourable prawning season, with January-February as peak period.
- (iii) In the area 1A, the period November-May yielded fairly good catches of prawns; the decline in January seems to be a fluctuating phenomenon.
- (iv) The areas 1B and 2B were comparatively poor. It may, however, be remarked that these low percentages should be considered in relation to the general failure of the prawn fishery on the entire west coast of India in 1964-65.
- (v) The fishing grounds in areas 2 and 2A did not seem to be as rich in prawns as areas 1 and 1A. The rise in prawn percentage in Area 2A is attributed to the suitable fishing areas extending upto 20 fathoms whereas in area 2 such grounds seem to extend upto 12 fathoms only.
- (vi) The northern fishing grounds in area 2E upto 72°45'E (longitude) also recorded a better prawn percentage.
- (vii) Prawn catches off Bombay were appreciably high between March and May 1966.

### (C) Survey

The following features with reference to the comparative richness of the areas surveyed, annual landings of catch by four vessels, in respective areas have been given in Table VIII and Fig. 4.

- (i) Of the total landings of 163,577.95 kg. in 1962-63, the landings in area 1 were nearly twice those of area 2.
- (ii) In 1963-64, the landings of areas 1A and 2A were nearly equal.
- (iii) In 1964-65, the landings of 1B and 2B were also fairly comparable.
- (iv) In 1965-66 and 1966-67, the landings were only from areas 2E and 2C, respectively. Landings for area T1 in 1966-67 were the result of only two months survey.

- (v) Fishing conducted in each of the squares in any single area recorded differences in their potentialities, indicating their respective suitability. The squares yielding good catches (i.e. minimum 1.2 kg/fishing hr./H.P.) were, then considered to constitute suitable fishing grounds within each area (Table IX). These grounds, in each of the areas surveyed, as shown in Fig. 2.

With reference to depth range, it was found that the productive grounds off Ratnagiri and Kolaba districts extend mainly as far as 20 fathoms only, although in areas 1A and at some places in 1B and 2B, these extend up to the 30 fathom line. Off Thana District, the area between 20 and 25 fathoms only was surveyed.

Of the total area of 7,029 sq.km. surveyed off Ratnagiri District, 3,804 sq.km. appears to be suitable for trawling. Off Kolaba District, 2,090 sq.km. of the total 4,106 sq.km. surveyed, appears suitable. A survey of Thana District has now been initiated.

The eastward or south-eastward topography of the Direction Bank is primarily responsible for the very poor results in areas 2A and 2E, between  $72^{\circ}20'E$  long and  $72^{\circ}30'E$  long., where sudden variations in depth at short distances - adversely affected fishing gear in general and trawl net in particular.

A study of the suitable areas, starting from south ( $15^{\circ}50'N$  Latitude) to north ( $18^{\circ}20'N$  Latitude) indicates the following significant features (Fig. 2).

- (i) In areas 1A, 1B and 1, i.e. between the ports of Vengurla and Tiwari, the extent of suitable trawling grounds narrows northwards.
- (ii) In area 2B, these grounds spread out westwards.
- (iii) In areas 2 and 2A, although the suitable grounds extend further westwards to longitude  $72^{\circ}30'E$ , these are restricted, probably because of the Direction Bank.
- (iv) The extent of the continental shelf, i.e. 100 fms. line off the Konkan Coast (Fig. 5) shows a gradual south-east decline. Between latitudes  $17^{\circ}10'N$  and  $16^{\circ}30'N$ , however, the continental shelf shows an eastward thrust from longitude  $71^{\circ}50'E$  to  $72^{\circ}20'E$  (marked M). This thrust, incidentally, corresponds to areas 1 and major portion of 1B, where the fishing grounds are respected as stated in (i) above.

SUMMARY

(1) The nature of survey work undertaken by four vessels has been given.

(2) The vessels, equipment, gear and deck layout have been described. Deck arrangements have been discussed and modifications with reference to deck layout are suggested for more labour-saving and efficient fishing operations.

(3) The areas of operation by four vessels for fishery years 1962-63 to 1966-67 have been described.

(4) Method of working has been explained and mention of the vessels' inability to repeat studies in these areas has also been made.

(5) Observations regarding the suitability of areas, percentage composition of whole-period catches in respective areas, have been made with special reference to prawn percentages. These, along with other features like vessel's regime, catch per hour per H.P., catch per fishing hour, efficiency, factors affecting the catch and prawn fishery are discussed.

It has been inferred that catch per hour could be taken as a criterion for deciding the suitability of an area. Mention of catches tending to be better during day time than at night and in spring tides has been made.

The prawn fishery has been discussed, including variations in catches with reference to seasons. Monsoon fishing operation undertaken off Ratnagiri and Bombay have been compared and discussed.

The fishing grounds 1, 1A and B and 2B and C off Ratnagiri District were found to be better for prawns than those 2, 2A, 2D and 2E off Kolaba District. A possible correlation between the eastward thrust of the continental shelf, including the resulting hydrological changes and the limited extent of suitable ground in areas 1 and 1B point the need for further study.

(6) The multi-purpose use of survey vessels, employing various gears, has been discussed and "One vessel-one gear" system has been suggested, with a view to avoiding under-estimation of the real value of gears other than trawl.

(7) Catches from different gears have been compared and those by trawling have been found to be the best.

(8) The performance of all the four survey vessels from November 1962 to June 1967 is considered to be satisfactory from the viewpoints of different standards described in this paper.

ACKNOWLEDGEMENTS

The author expresses his deep sense of gratitude to Dr. C.V. Kulkarni, Director of Fisheries, Maharashtra State, for the very keen interest taken in the Pilot Project, right from its formative stage; I am greatly indebted to him for all the encouragement and technical advice. My thanks are also due to Dr. H.G. Kewalramani, Senior Scientific Officer, for correcting the manuscript and offering valuable suggestions. I am grateful to Shri A.G. Kalawar, Deputy Director of Fisheries (Headquarters), but for whose very helpful attitude, both in administrative and technical matters from the very beginning, the smooth running of the scheme would hardly have been possible. I am also thankful to Dr. M.R. Ranade, Research Officer, Marine Biological Research Station, Ratnagiri, for having allowed unreserved use of the station's library. My thanks are also due to the Bosuns of the vessels with all their staff, for co-operation in the entire survey work.

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TABLE I

Actual vessel-wise regime and performance of Survey Boats - Maharashtra - for each fishery year 1962-63 to 1966-67 and whole period.

Vessel	Regime	Cal. days	SEA TIME		FISHING TIME		Total catch (kg) (all gear)	Catch (kg) P. Hour (all gear)
			Days	% to oal. time	Hours	% to sea time		
<b>1962-63</b>								
MFV. Savitri	13/11/62 to 30/6/63	230	129	56%	696	22.5%	50,103.30	71.9
MFV. Shivneri	-do-	230	188	55.7%	574	21.9%	55,225.90	81.9
MFV. Janjira	3/12/62 to 30/6/63	210	110	52.3%	592	22.7%	27,278.00	46.0
MFV. Kundalika	-do-	220	102	48.5%	646	26.4%	20,768.00	47.9
Averages .. 53.1% .. 23.4% .. 69.4								
<b>1963-64</b>								
MFV. Savitri	1/7/63 to 30/6/64	366	207	56.5%	1106	24.6%	160,085.00	144.7
MFV. Shivneri	-do-	366	195	53.2%	1018.75	21.7%	158,591.00	155.7
MFV. Janjira	-do-	366	200	54.6%	946.25	19.7%	144,732.00	157.9
MFV. Kundalika	-do-	366	200	54.6%	1102.65	22.5%	169,366.00	151.3
Averages .. 54.7% .. 21.6% .. 151.1								
<b>1964-65</b>								
MFV. Savitri	1/7/64 to 30/6/65	365	171	46.9%	679	16.5%	120,597.00	177.4
MFV. Shivneri	-do-	365	120	32.8%	542.25	18.8%	93,906.00	172.1
MFV. Janjira	-do-	365	138	37.5%	538	16.9%	98,822.00	179.0
MFV. Kundalika	-do-	365	164	44.9%	841.25	2.2%	109,617.00	130.3
Averages .. 40.5% .. 18.4% .. 164.4								
<b>1965-66</b>								
MFV. Savitri	1/7/65 to 30/6/66	365	136	38.0%	511	15.3%	93,409.00	182.7
MFV. Shivneri	-do-	365	23	6.3%	211	38.3%	12,712.00	60.1
MFV. Janjira	-do-	365	117	32.0%	677	24.1%	81,241.00	119.9
MFV. Kundalika	-do-	365	123	35.8%	476	16.4%	78,825.00	165.6
Averages .. 27.5% .. 23.5% .. 132.0								
<b>1966-67</b>								
MFV. Savitri	1/7/66 to 30/6/67	365	152	41.6%	660	18.1%	83,494.00	126.3
MFV. Shivneri	-do-	365	83	22.7%	393	15.7%	33,203.00	84.7
MFV. Janjira	-do-	365	175	47.8%	647	12.5%	102,701.00	157.0
MFV. Kundalika	-do-	365	140	38.3%	674	20.0%	77,462.00	144.3
Averages .. 37.5% .. 15.0% .. 128.0								
<b>WHOLE PERIOD 1962-67</b>								
MFV. Savitri	13/11/62 to 30/6/67	1691	798	47.2%	3652.75	19.0%	507,478.30	138.9
MFV. Shivneri	-do-	1691	549	32.4%	2840.00	21.5%	353,697.90	124.6
MFV. Janjira	3/12/62 to 30/6/67	1671	738	44.1%	3445.50	19.2%	454,774.00	130.2
MFV. Kundalika	-do-	1671	729	43.6%	3740.90	21.3%	486,241.00	129.9
All vessels whole period 6724 2814 41.8% 13649.15 20.2% 1,802,331.20 131.0								

\* Hand trawling in 1962-63. Winch trawling in the remaining years.

TABLE III

Average catch (kg)/fishing hour for each gear

Fishery year	Gear	Vessel-wise catch in kg/P.Hr. Savitri, Shivneri, Janjira, Kundalika			Caton/P.Hr. (all vessels) kg.
		Savitri	Shivneri	Janjira, Kundalika	
1962-63	Gill net	20.7	10.09	5.12	8.9
	Long lines	6.7	5.1	-	5.6
	Winch trawling	89.0	104.8	50.4	58.4
1963-64	Gill net	19.3	12.1	4.51	3.04
	Long lines	4.7	5.0	-	3.2
	Winch trawling	168.5	175.1	156.9	155.7
1964-65	Gill net	10.6	-	-	0.92
	Long lines	7.2	7.8	-	17.37
	Winch trawling	210.5	242.6	179.0	186.2
1965-66	Gill net	-	1.8	-	1.8
	Long lines	-	57.8	79.2	71.9*
	Winch trawling	182.7	229.6	163.5	165.6
1966-67	Winch trawling (only)	126.3	84.7	157.0	144.3

\* Special shark fishing off Veraval (Gujarat).

TABLE II

Vessel-wise monthly all gear catch (kg) per fishing hour per H.P. from November, 1962 to June 1967.

Month	U.S.S.B & L.S.				Remarks
	MFV Savitri	MFV Shivneri	MFV Janjira	MFV Kundalika	
<b>1962</b>					
November	.08	.1	-	-	
December	.5	.7	.1	.3	
<b>1963</b>					
January	1.2	1.1	.4	.4	
February	1.0	1.1	.5	.6	
March	1.2	1.2	.6	.5	
April	1.2	1.0	.8	.8	Repairs
May	Repairs	Repairs	.6	.9	
June	.3	.8	1.1	1.4	
July	.6	1.1	1.2	1.6	
August	.06	.5	2.6	2.0	Monsoon
September	.2	1.2	1.8	3.2	fishing
October	1.2	1.2	1.3	1.1	
November	1.7	2.6	2.1	1.6	
December	1.8	2.2	.9	.7	
<b>1964</b>					
January	1.8	1.7	2.1	2.1	
February	2.5	1.9	2.1	1.5	
March	2.4	1.7	2.1	2.1	
April	1.3	2.4	2.9	2.6	
May	1.5	1.3	2.1	2.4	
June	1.8	1.3	1.4	1.6	
July	.9	Repairs	1.4	1.3	Monsoon
August to October	Repairs	Repairs	Repairs	Repairs	fishing 3 months
November	.9	4.9	3.1	.7	Repairs
December	1.8	1.9	1.4	.9	
<b>1965</b>					
January	2.9	3.5	2.5	1.8	
February	2.6	2.8	2.1	2.3	
March	1.6	1.6	2.2	2.0	
April	1.3	1.4	1.8	1.6	
May	1.9	1.9	2.2	1.3	
June	2.3	Repairs	2.1	1.5	
July	3.1	-do-	Repairs	2.8	
August	3.4	-do-	-do-	2.4	Monsoon
September	2.4	-do-	-do-	4.1	fishing
October	3.7	-do-	3.3	Repairs	
November	2.7	0.8	2.2	-do-	
December	1.8	0.6	0.9	1.5	
<b>1966</b>					
January	1.0	0.7	1.1	1.2	
February	1.2	Repairs	0.7	2.1	
March	1.6	-do-	1.1	1.4	
April	2.5	-do-	1.8	2.3	
May	1.5	-do-	1.9	2.1	
June	2.3	-do-	1.2	1.4	
July	Repairs	-do-	Repairs	1.5	
August	-do-	-do-	-do-	1.9	Monsoon
September	1.5	-do-	0.5	0.7	fishing
October	0.5	-do-	2.0	0.4	
November	2.0	-do-	2.1	2.1	
December	2.0	-do-	2.5	2.4	
<b>1967</b>					
January	1.9	1.1	1.6	1.0	
February	1.6	1.6	2.2	1.6	
March	1.6	1.3	1.2	1.2	
April	0.9	0.8	1.4	1.5	
May	0.9	0.7	1.6	1.5	
June	0.8	0.6	1.5	Repairs	
Whole period (Nov 62 to June 67)	1.4	1.1	1.4	1.4	All vessel's whole period average - 1.3 kg/hr/H.
Average					



TABLE IV  
Vessel-wise monthly catch (kg) per trawling hour  
from November 1962 to June 1967

Months	V E S S E L S				Remarks
	1 Savitri	2 Shivneri	3 Janjira	4 Kundalika	
1962-63					
November	-	-	-	-	:
December	56.9	89.8	15.0	56.0	:
January	100.0	97.8	35.4	39.4	:
February	93.3	98.0	41.7	33.7	: Regular survey
March	87.6	104.9	48.5	43.0	: work
April	103.8	117.4	69.0	Repairs	:
May	Repairs	Repairs	52.9	75.5	:
June	-do-	69.6	125.7	119.1	:
Averages	89.0	104.8	50.4	58.4	74.9 all vessels
1963-64					
July	58.0	94.8	104.6	145.1	:
August	7.2	41.2	230.9	178.8	: Monsoon fishing
September	26.2	46.6	159.4	228.2	: Average: 114.6
October	161.4	174.3	160.6	132.2	:
November	198.2	296.8	181.7	140.3	:
December	161.8	195.8	79.6	69.1	:
January	154.0	142.2	72.4	73.7	:
February	219.1	169.7	126.4	136.0	: Regular survey
March	211.5	156.4	137.1	185.6	:
April	113.9	217.0	295.2	232.8	:
May	136.2	119.0	186.7	211.6	:
June	157.3	120.5	128.6	147.0	:
Averages	168.5	175.1	156.3	155.7	163.5 all vessels
1964-65					
July	85.3	Repairs	122.7	107.7	: Monsoon fishing
August	Repairs	-do-	Repairs	Repairs	:
September	-do-	-do-	-do-	-do-	:
October	-do-	-do-	-do-	-do-	:
November	284.9	429.2	276.0	110.0	:
December	161.2	168.2	128.9	11.3	:
January	244.2	305.9	221.0	159.3	:
February	232.2	245.0	187.7	200.6	: Regular survey
March	145.9	170.5	195.2	174.4	: work
April	117.5	220.8	157.6	134.2	:
May	171.8	173.3	111.1	115.3	:
June	186.1	Repairs	183.8	140.2	:
Averages	210.5	242.6	179.0	146.2	194.5 all vessels
1965-66					
July	273.4	Repairs	Repairs	216.6	: Monsoon fishing
August	298.8	-do-	-do-	211.4	:
September	210.7	-do-	-do-	360.0	:
October	324.8	-do-	293.8	Repairs	:
November	240.9	229.6	196.8	-do-	:
December	156.6	L.L.	L.L.	131.2	:
January	91.5	L.L.	L.L.	109.5	:
February	120.4	Repairs	117.4	188.6	:
March	145.7	-do-	153.6	129.3	: Regular survey
April	225.0	-do-	160.9	203.7	: work
May	132.9	-do-	167.2	191.0	:
June	205.7	-do-	106.6	128.0	:
Averages	182.7	229.6	163.5	165.6	172.1 all vessels
1966-67					
July	Repairs	Repairs	Repairs	134.0	:
August	-do-	-do-	-do-	172.0	:
September	131.0	-do-	39.2	88.0	:
October	43.0	-do-	178.9	41.5	:
November	176.4	-do-	183.9	175.0	: Regular survey
December	174.4	-do-	221.8	212.7	: work
January	164.7	97.2	143.5	140.3	:
February	114.0	140.1	159.4	144.7	:
March	140.3	115.3	107.4	106.8	:
April	77.7	66.9	126.4	189.2	:
May	75.3	64.7	140.4	110.0	:
June	76.1	56.9	129.6	Repairs	:
Averages	126.3	84.7	157.0	144.3	133.3 all vessels

Vessel-wise whole period (November 1962 to June 1967) (172.0) W (183.0) W (1963.9) W (152.9) W average.

W = Winch trawling  
L.L = Long lines

All vessels Hand trawling average (62-63 only): 74.9 kg/hr.  
All vessels' winch trawling average (July 63 to June 67): 167.9 kg/hr.

TABLE V

Vessel	Month	Gear	Catch in kg.	Fishing trips	Catch per trip
Savitri	March 1963	45' H. Trawl	8,776	20	438.80 kg.
Shivneri	March 1963	12 N.R.Trawl	12,274	24	564.33 kg.
Janjira	May 1963	14 N.R.Trawl	6,133	14	438.07 kg.
	June 1963	14 N.R.Trawl	4,826	11	438.80 kg.
	January 1965	60' H.Trawl not	19,646	22	893.00 kg.
Kundalika	May 1963	55' H.Trawl	4,933	16	309.68 kg.
	June 1963	55' H.Trawl	5,341	14	367.57 kg.
	January 1965	14 N.R.Trawl	16,754	22	734.3 kg.

NOTE: H = Ktaw; H = Hoover; R = Russian

TABLE VI  
Areas catch composition

Area No.	Pelagic & Miscellaneous	Prawns	Offfish, Rays, Sharks & Skates
1	60 %	23.6%	16.4%
1A	60 %	24.5%	25.5%
1B	65 %	4.4%	30.6%
2B	71.8%	9.4%	18.8%
2C	70.1%	9.6%	20.3%
2	76 %	2.7%	22.3%
2A	71 %	6.1%	22.5%
2D	51.1%	8.9%	40 %
2E	53.2%	16.5%	30.5%
II	75.1%	10.1%	14.8%

TABLE VII

Regionwise monthly prawn percentages - December 1962 to June 1967

Month	RAJNAGIRI DISTRICT				KOLABA DISTRICT				THANA DISTRICT		REMARKS
	1A	1B	2B	2C	2	2A	2D	2E	THANA DISTRICT	THANA DISTRICT	
1962 Dec.											
1963 Jan.	23.7	-	-	-	2.0	-	-	-	-	-	
Feb.	40.0	-	-	-	3.0	-	-	-	-	-	
Mar.	32.0	-	-	-	4.2	-	-	-	-	-	
Apr.	18.3	-	-	-	1.5	-	-	-	-	-	
May	9.6	-	-	-	0.8	-	-	-	-	-	
June	14.8	-	-	-	2.5	-	-	-	-	-	
July	4.3	-	-	-	5.1	-	-	-	-	-	
Aug.	Nil	-	-	-	-	-	-	-	-	-	10.1 :
Sept.	10.9	-	-	-	-	-	-	-	-	-	12.7 : Monsoon
Oct.	-	6.35	-	-	8.0	-	-	-	-	-	16.1 : 1963
Nov.	-	24.5	-	-	5.0	-	-	-	-	-	
Dec.	-	11.8	-	-	Nil	-	-	-	-	-	
1964 Jan.	-	5.0	-	-	0.5	-	-	-	-	-	
Feb.	-	16.6	-	-	0.6	-	-	-	-	-	
Mar.	-	21.0	-	-	5.5	-	-	-	-	-	
Apr.	-	16.9	-	-	23.7	-	-	-	-	-	
May	-	13.2	-	-	15.0	-	-	-	-	-	
June	-	8.5	-	-	2.8	-	-	-	-	-	
July	-	22.5	-	-	1.7	-	-	-	-	-	: Monsoon
Aug.	-	R	-	-	R	-	-	-	-	-	: 1964
Sept.	-	R	-	-	R	-	-	-	-	-	
Oct.	-	R	-	-	R	-	-	-	-	-	
Nov.	-	4.5	3.4	-	-	-	-	-	-	-	
Dec.	-	1.5	4.9	-	-	-	-	-	-	-	
1965 Jan.	-	1.9	4.8	-	-	-	-	-	-	-	
Feb.	-	1.8	3.7	-	-	-	-	-	-	-	
Mar.	-	5.9	5.6	-	-	-	-	-	-	-	
Apr.	-	4.5	4.6	-	12.9	-	-	-	-	-	
May	-	4.5	2.8	-	3.0	-	-	-	-	-	
June	-	8.7	8.9	-	8.9	-	-	-	-	-	
July	-	-	-	-	-	-	-	-	-	-	7.0 :
Aug.	-	-	-	-	-	-	-	-	-	-	Monsoon
Sept.	-	-	-	-	-	-	-	-	-	-	5.8 :
Oct.	-	-	-	-	-	-	-	-	-	-	1965
Nov.	-	-	-	-	-	-	-	-	-	-	6.0 :
Dec.	-	-	-	-	-	-	-	-	-	-	0.9 :
1966 Jan.	-	-	-	-	-	-	-	-	-	-	7.5 :
Feb.	-	-	-	-	-	-	-	-	-	-	4.0 :
Mar.	-	-	-	-	-	-	-	-	-	-	
Apr.	-	4.5	-	-	-	-	-	-	13.7	-	
May	-	6.7	-	-	-	-	-	-	6.5	-	
June	-	26.9	-	-	-	-	-	-	-	2.9	
July	10.5	-	-	-	-	-	-	-	-	0.8	
Area-wise Average	16.4	14.1	4.1	6.0	8.4	2.7	6.2	8.9	16.3	10.1	10.6

R .. indicates repairs.

TABLE IX

Suitable fishery areas with reference to depth-range

District	Area No.	Total area surveyed	Suitable area	Suitable depth range
Ratnagiri	1	900 sq.km.	225 sq.km.	Upto 20 fms mainly 8 to 15 fms.
	1A	1485 sq.km.	1037.5 "	Upto 30 fms.
	1B	1562.5 "	825 "	Upto 24 fms.
	2B	1450 "	1125 "	Upto 15 fms(N.) & upto 28 fms (S.)
	2C	1632 "	592 "	Mostly between 13 & 18 fms.
	Total	7029.5 "	3804 "	
Kolaba	2	704 "	352 "	Upto 10 fms.
	2A	2250 "	970 "	11-21 and 16-26 fms. (in two district N.S. strips).
	2D	280 "	224 "	Upto 15 fms.
	2E	864 "	544 "	Upto 24 fms.
Total	4106 "	2090 "		
Thana	T1	*528 "	*128 "	From 19°10'N to 19°15'N and 19°25'N to 19°30'N.
		(*Between 20 & 25 fms. only).		

TABLE VIII

Annual areawise Gearwise Landings

Fishery year	Gear	Vessel-wise landings (kg) from respective areas			TOTAL
		Shivani	Shivani-neri	Janjira Kundalika	
1962-63	Gill net	1,372.30	911.90	293.50	1,225.75
	Long lines	88.00	138.00	-	227.00
	Hand trawling	48,743.00	54,157.00	26,984.50	29,763.00
	Totals	50,103.30	55,225.90	27,278.00	30,988.75
	Areas	(1)	(1)	(2)	(2)
1963-64	Gill net	1,323.00	705	96	67
	Long lines	402	368	-	2,770
	Winch trawling	158,160.00	125,518	144,636	169,299
	Totals	160,385	158,581	144,732	169,366
	Areas	(1A)	(1A)	(2A)	(2A)
1964-65	Gill nets	597	-	24	721
	Long lines	329/28	1,770	1,010	3,109
	Winch trawling	83,795	92,136	98,822	168,583
	Totals	35,766/20	93,906	98,822	109,612
	Areas	(2B & 2D)	(2B)	(1B)	(1B)
1965-66	Gill net	-	37	-	37
	Long lines	-	10,493	27,803	38,296
	Winch trawling	93,409*	2,182*	53,438*	78,825*
	Totals	93,409	12,712	81,241	78,825
	Areas	38,012(2E)	-	4,713(2E)	37,271(2E)
					79,996(2E)
					*Survey landings
1966-67	Winch trawling (only)	83,494*	33,209*	102,701*	97,465
	Areas	47,563(2E)	7,907(2E)	64,534(2E)	55,665
	*Survey landings			15,200(T1)	31,200(T1)
					16,000(T1)

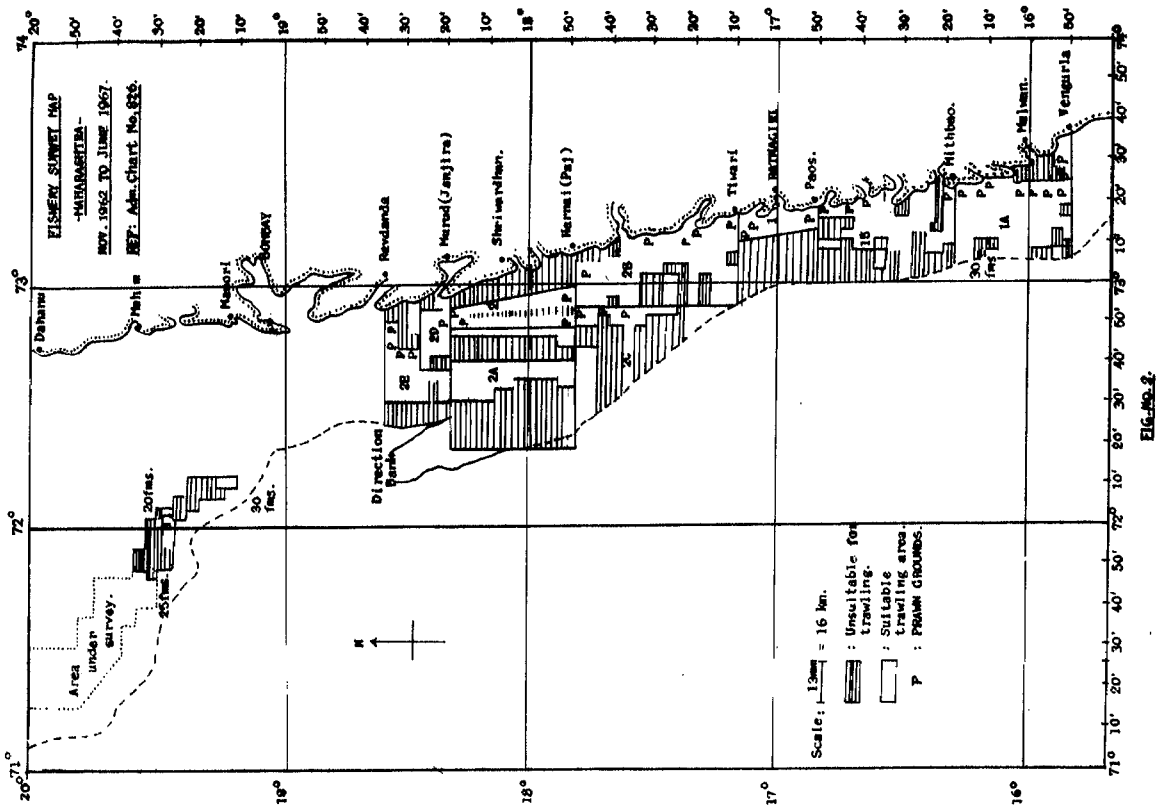
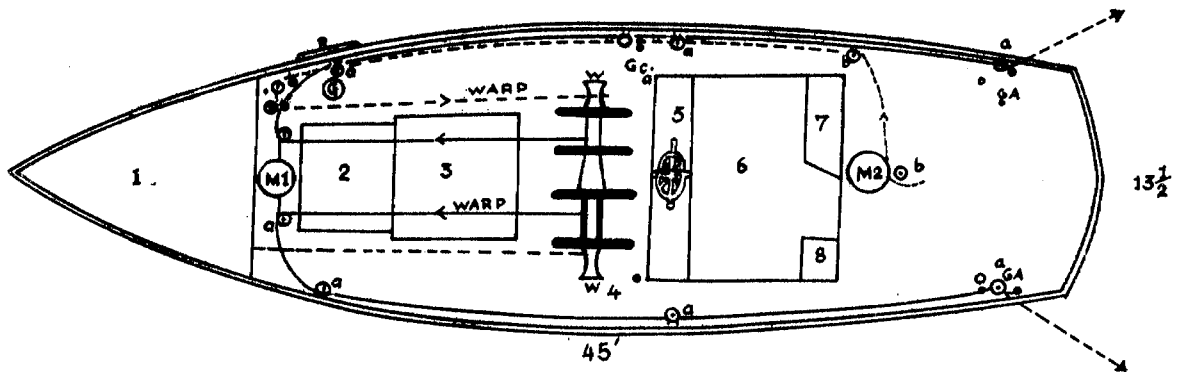


FIG. No. 2

FIG- No 1

Deck layout of typical maharaja type fishery vessel of "Switzer" type



REGULATED MONTHLY FISH CATCHES (MT. TABLE NO. VII)

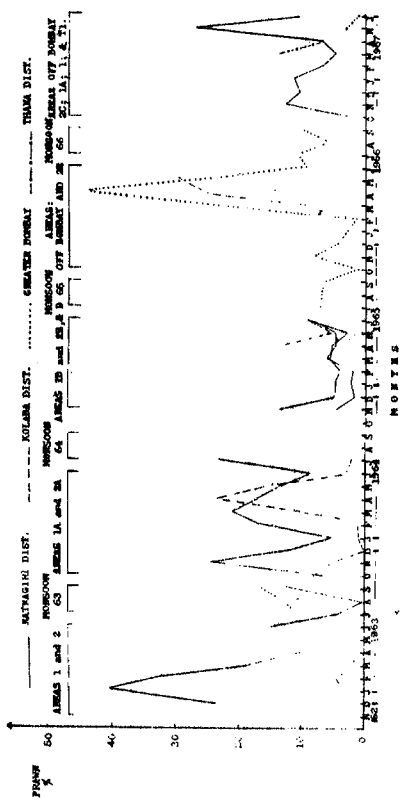


FIG. NO. 5

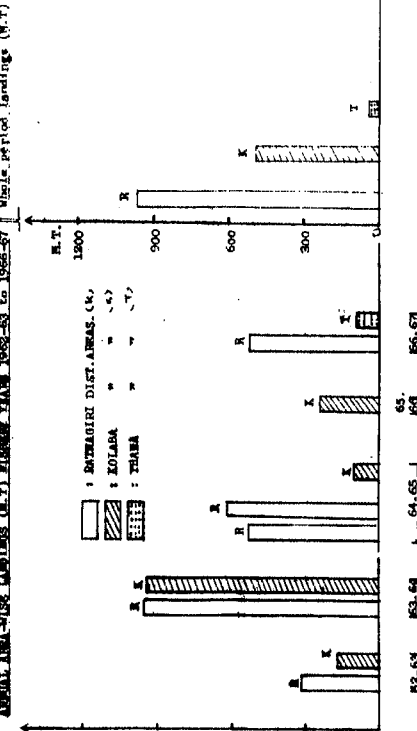


FIG. NO. 6

Relative positions of continental shelf and areas surveyed.

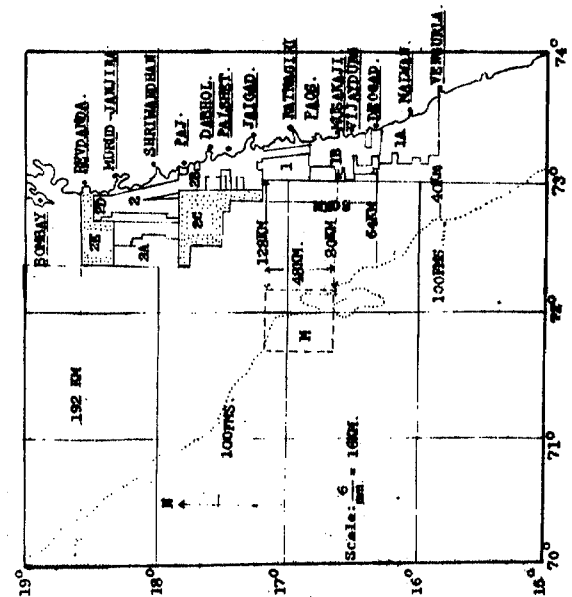


FIG. NO. 8