A REPORT ON THE FISHERIES OF THE MAHANADI ESTUARINE SYSTEM, ORISSA

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BARRACKPORE, WEST BENGAL,
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I N D I A

FOREWORD

The Mahanadi estuary in Orissa State extends over a wide area in Cuttack and Puri districts with extensive distributaries and supports a substantial fishery. The entire estuary with its ramifications is in a highly underdeveloped area and there was no precise information on the nature of the fisheries in the estuarine system at the time this Institute started investigations there.

In order to assess the extent of the fisheries and to study their nature and fluctuations, a small team of this Institute was asked to undertake studies in the area. The main object of the team was to survey the present fishing grounds, disposition of the fisheries, nature and composition of the fish catches, present assembly centres, mode of disposal, market survey, estimation of present catches, fresh and dry fish trade and also information on fishing communities, etc. The work was carried out by the team from 1957 to 1964. The results of the survey and investigations carried out in the area are contained in this report.

This is, in fact, a project report embodying details of the present status of the fisheries in the Mahanadi estuary and suggestions for further development of the fisheries and the fish trade in the area. This Institute places on record its appreciation and thanks to Shri G.N. Mitra, the then Director of Fisheries, Orissa, for his invaluable help and suggestions in regard to the work of the team in the area.

B.S. BHIMACHAR
DIRECTOR

The 25th March 1965
Central Inland Fisheries
Research Institute,
Barrackpore,
West Bengal.

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C O N T E N T S

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I. INTRODUCTION

The ever increasing demand for fresh fish from Calcutta markets in recent years has focussed the attention of authorities and fish merchants on potential supply centres in the neighbouring States. In Orissa, besides the Chilka Lake, the Mahanadi estuarine system forms an important source of high quality fish supply and has been receiving more and more of attention in recent years. However, as yet there is no work on record regarding the fishery resources and potentials of this estuary, nor about the status of the various commercially important fisheries. It is highly imperative to investigate the extent of resources and the effects of unregulated fishing practices on fish populations, in order to be able to formulate suitable measures either for conservation or for stepping up production to the optimum level. With this in view, a programme of investigations was initiated by the Central Inland Fisheries Research Institute in 1957, in order to obtain detailed preliminary information on the various aspects of fish and fisheries of this estuarine system. The results embodied in this report are based on data collected upto February 1964. Inspite of the limited staff available for this work and the remoteness of the fishing areas, the major productive portion including the main river and most of the other more important fishing areas were included within the purview of the investigations, while the entire system was covered for an inventory of fishermen population, their craft and tackle and the fish fauna.

The first author was responsible for the formulation and initiation of the survey programmes and the identification and compilation of the systematic list of fishes, prawns and crabs and was in charge of the execution of the programmes till about the middle of 1962. The second author was in charge of the investigations from 1962 to '64, while the third author was largely responsible for the compilation and analysis of the data on catch statistics. The first author is largely responsible for the writing of the report.

II. HYDROGRAPHICAL FEATURES

Topography

The Mahanadi estuarine system is spread over a wide area in the districts of Cuttack and Puri, draining into the Bay of Bengal at several places along a coastline of roughly 165 kilometres. It is located within latitudes 19° 47' N and 20° 30' N and longitudes 85° 33' E and 86° 49' E. It extends from the northern end of Hukitola lake in the north in Cuttack district, to the north-eastern extremity of Chilka Lake in the south in Puri district (text fig.1). The developing Paradip Port is situated near the mouth of the main estuary. The main Mahanadi river gives off a major distributary, the Katjuri, just west of Cuttack and continues eastwards to flow into the Bay of Bengal. It's tidal stretch starts at Taldanda, about 32 km from the sea. At Paradip, it is joined by a major tributary from the north-west, the Nuna river, along which the tidal stretch extends upto Marsaghai. A series of estuarine creeks proceeding northwards connect the main estuary with the Hukitola lake, an oblong body of brackishwater, covering an area of about 104 sq km, with a length of about 13 km and a width of about 8 km at its north-eastern end. Into the south-western part of the lake drain the streams Kharnasi, Ramchandi and Gobri, while Kandrapatia opens into it at its north-western end. It has a wide opening into the sea at its north-eastern end. The lake is so shallow in its western and southern regions, that a good portion is exposed or is left with very little water during low tides. Another series of creeks on the southern side of the main estuary connectsit with Jatadharmohan, an extensive sprawling body of brackishwater, opening independently into the sea. The Katjuri takes a south-eastern course, gives off a distributary, the Koyakhai, and then flows down to the sea as Devi river, which in its estuarine stretch is almost as extensive as the main Mahanadi estuary. The tidal effect is felt up to Goladhari, about 42 km from the river mouth. There are two extensive loops in the estuarine stretch, one near Machgaon and the other near the river mouth, the Nagar Nadi. A little to the south of Bhubaneswar, the Koyakhai divides into two tributaries, the Daya and Bhargavi, which flow south-east towards the Chilka lake, into which they open at its north-eastern end shortly after rejoining with each other. A blind tributary, river Nun, joins them at about the point of their confluence near Chilka Lake. Before joining up with the Bhargavi, the Daya gives off a branch, the Makra, a little above Jankia.

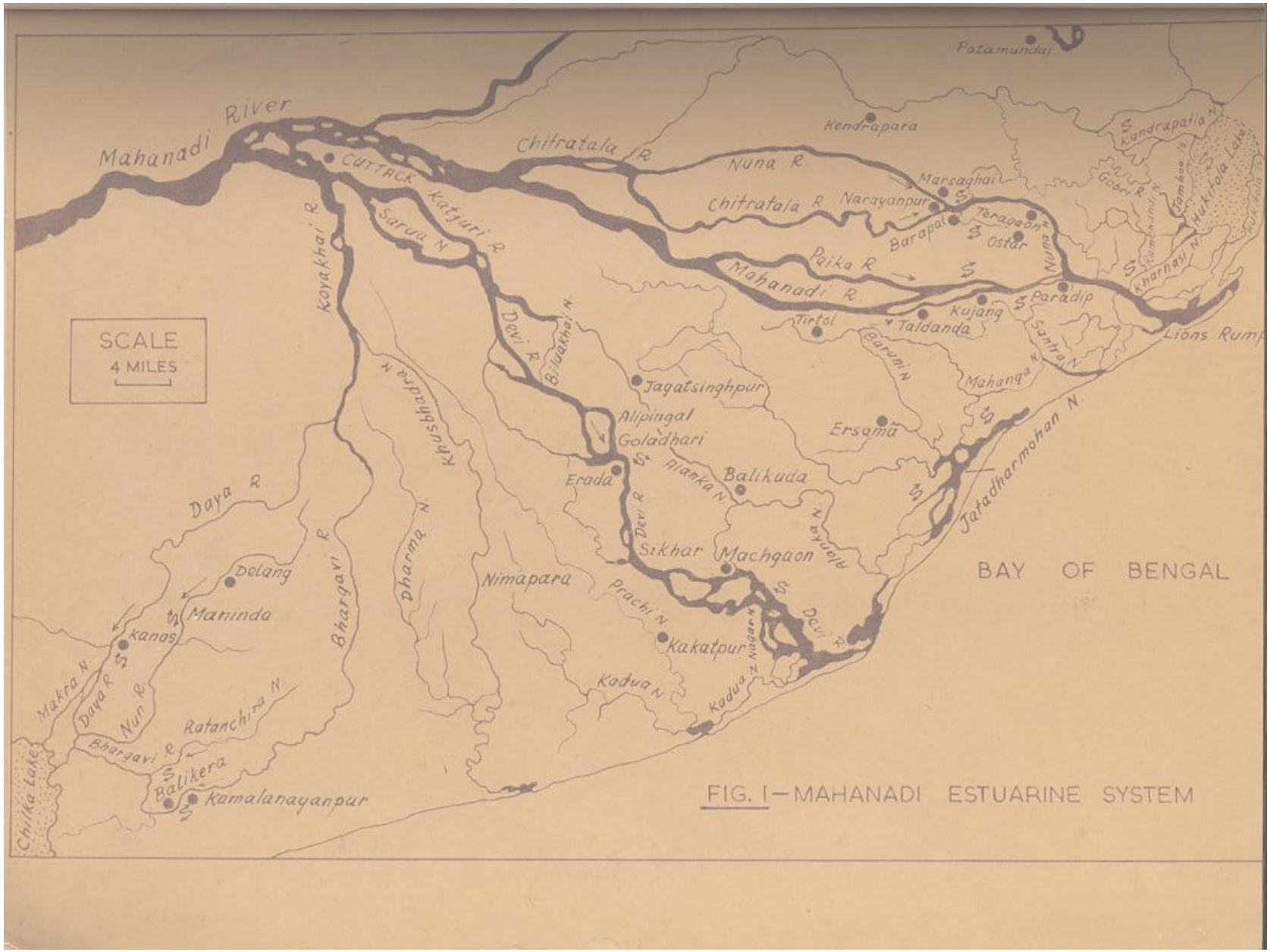


FIG. I—MAHANADI ESTUARINE SYSTEM

The Makra opens independently into the Chilka Lake, but is connected with Daya through a transverse loop near Jagulipadar. It is fairly deep in its middle and upper stretches, but is quite shallow at its mouth. The upper portion of this branch is referred to by some as Utharda and the lower stretch as Telinala. A blind tributary, the Ratanchira Nadi, joins Bhargavi near Khajuria. It remains mostly dry in its upper reaches and only during summer there is incursion of saline water upto about 5 km of this branch. The greater portions of these southern tributaries are rather shallow and the waters remain saline only for about four months in a year.

A good portion of the Mahanadi estuarine system is hardly accessible, because of the thick jungles flanking the water courses and the lack of suitable roads.

Temperature

The average annual range between the maximum and minimum temperatures of surface water in the various zones varied from 6.5°C to 9.2°C. The maximum and minimum temperatures recorded were 34.0°C (in April in Jatadharmohan) and 19.4°C (in December in the main estuary) respectively.

The temperature presented two peaks, the major one in May - June and the minor one in September - October. Similar temperature conditions have been recorded by Shetty et al (1961) for the Hooghly and Rupnarain estuaries in West Bengal. As in the Hooghly, December to February constituted the low temperature period, with the temperature ranging from about 22.0°C to 26.0°C, while it remained fairly high during April to October, generally ranging from about 28.5°C to 32.0°C. January constituted the coldest month of the year in zones I to V, while it was December in the remaining zones.

The average temperature ranges in the different areas were as follows: Hukitola Lake (Zones I-III)-22.0°C to 31.9°C; Nuna-Chitratola (Zones IV & V)-22.7°C to 30.9°C, main estuary (Zones VI & VII)-22.1°C to 30.9°C and Jatadharmohan (Zone VIII)-22.3°C to 31.5°C.

Salinity

The estuarine effect is in general felt upto a distance of about 32 km in the major sections of the system like the main estuary and the Devi river. Along the main estuary the tidal effect is felt

upto Taldanda, about 32 km from the mouth of the estuary. However, above Kujang the salinity never goes up beyond 'traces' during any part of the year. Along the Devi river the tidal stretch extends upto Goladhari situated at a distance of about 42 km from the river mouth. The incursion of saline water is, however, upto Sikhar Ghat, located about 10 km below Goladhari. It is learnt that prior to the construction of the Hirakud Dam, the tidal effect used to be felt upto Alipingal, which is about 8 km east of Jagatsinghpur, and the incursion of saline water used to be upto Goladhari. But, now, it is learnt, that because of the voluminous discharges from Hirakud the water in the river remains fresh almost down to Machgaon for the greater part of the year. Earlier, prior to the construction of the Dam, it is gathered, that the waters above Machgaon used to remain saline for about four months in a year, while now this has been reduced to hardly two months.

The Hukitola Lake and the adjoining creeks like Kharnasi, Ramchandi, etc.remain saline almost throughout the year. Along the Nuna the tidal effect is felt upto Marsaghai. Along the Bhargavi tidal effect is felt upto Kamalanayanpur (Balioopar), while incursion of saline water is upto Balikera. Maninda marks the upper tidal limit of R. Nun, while along the Daya estuarine effect is felt upto Kanas, about 16 km from its mouth. The entire stretch of Makra is subjected to tidal effect. In the Ratanchira, which remains mostly dry in its upper stretches, saline water goes upto about 5 km in summer. In all these southern tributaries the water remains saline for only about four months (summer) in the year.

In general, high salinity values were observed during the period March - June, with the peak during May. There is thus a near coincidence of the temperature and salinity peaks during May. The minimum salinity values were obtained during the late monsoon months. These findings are similar to those recorded for the Hooghly and the Rupnarain estuaries by Shetty et al (op. cit.).

The water remains almost fresh throughout the year in zones IV & V and is mildly saline in zone VI for the greater part of the year. In zones I - III & VIII, salinity remains fairly high during the summer months and falls considerably during the monsoon and post-monsoon months. In zone VIII, salinity continues to be low during the winter months as well.

The average salinity ranges in the different areas were as follows: Hukitola Lake (Zone I - III)-2.9‰ - 35.38‰; Nuna -

Chitratola (Zones IV & V)-traces - 0.75‰; main estuary (Zones VI & VII)-Traces - 34.25‰ and Jatadharmohan (Zone VIII)- 1.53‰ to 34.59‰.

III. INVENTORY OF FISHERMEN POPULATION, FISHING CRAFT AND GEAR

1. Fishermen population

The inventory of fishermen population was confined to those who were actually engaged in fishing and excluded those who were fishermen by caste only, but had given up fishing altogether for some other occupation. It also excluded those who were engaged only in the trade of Mahanadi estuarine catches like the fisher-folk of Gopaljipatna, Aul, Balkathi and Chāndbāli in the north and Astarang, Lataharan, etc. in the south. A total of 6858 fisher-folk were listed during the survey.

Village-wise and region-wise details of craft, tackle and fishermen population are given in Appendix V.

2. Fishing craft

A total of 1733 boats of varying sizes and tonnage are possessed by the fishermen of the Mahanadi estuarine system. They have been classified on the basis of their tonnage into small (upto 15 mds), medium (16-30 mds) and large (above 31 mds). In general, the majority of boats measure 27'-30' in length, 20"-28" in breadth and 17"-27" in height, with a tonnage varying from 12-25 maunds. The cost varies from about Rs.100/- to Rs.1800/- depending on the dimensions of the boat and the wood used.

3. Fishing gear and their modes of operation

The various fishing gear can be roughly grouped into nine different categories, namely seines, gill nets, bag nets, drag nets, set barriers, cast nets, scoop nets, hooks and line and spears. Of these, the first five are more predominant than the rest. Gill nets constitute about 66% of the total fishing gear of the Mahanadi fishermen, with drag nets, seines, set barriers and cast nets coming

next in the order of importance. Even though large numbers of long lines are possessed by the refugee fishermen, they are not being put to use because of certain restrictions, as elucidated elsewhere. Much of the gill nets are meant for hilsa fishing and as such in lean hilsa seasons, they largely lie idle.

Details of the principal types of fishing gear and their modes of operation are elucidated below:

a) Seines

i) Kukut jal: This is a boat seine, with a bag in the centre and on either side two long wings, varying in length from 18-45 ft. The bag, which may be as long as 20 ft, has its distal end closed with a rope. The wings are provided with wooden floats on their upper margins (about seven in each wing) and stone sinkers on their lower margins (about 4 in each wing), while the bag has one sinker and one float in the centre of its porximal end. The mesh size progressively decreases from the proximal end of the wing to the distal end of the bag from 2½" bar down to ½" bar. The net is made of either cotton thread only or of cotton thread and Sunn-hemp fibre. This net costs approximately Rs.300/-.

It is operated either from two boats on the water or from one boat at one end and a man on the river bank at the other end. In the latter case, a fisherman holds one wing tied to the branch of some tree on the bank and the boat with three other men describes a rough semicircle, paying out the net on their way. The net is hauled by pulling in the two wings, and the catch is collected by opening the distal end of the bag. A single operation of this net hardly takes about 5-10 minutes. This net is operated throughout the year.

ii) Torania jal: This is also a boat seine which is mostly operated in shallow areas, since it is desirable that the lower end should touch the bottom. It is almost wholly made of cotton thread only, with only the upper margin of about 4" made up of Sunn-hemp. In operation, which requires 1 boat and 2 men, several pieces are joined together. Each piece measures about 18-21 ft by 4½-6 ft, with a mesh size of ½" bar (or 1½" diagonally). The net is provided with floats and sinkers at the upper and lower margins respectively. There is a continuous bag-like transverse fold (ghai) at the lower end of the net, about 6" broad. The upper end of this fold is laced up to the net at regular intervals so as to make a series of pockets. This

feature is noteworthy since according to Hornell (1924) pocketed seines and drag nets are characteristic of the Ganges and Brahmaputra valley only and are unknown elsewhere in India.

Operation: One end of the net is held fast by a man on the river bank, while the other man on the boat pays out the net, after completing which he describes a circle holding the other end of the net, all the while beating the sides of the boat with sticks, thereby scaring the fish towards the net. While the smaller fishes get gilled in the net, the bigger fishes get entrapped in the 'ghai'.

b) Gill nets

i) Suta jal: This is otherwise known as Chara jal and rarely as Bhasa jal. It is a drifting gill net made up of thread (No.16), with each piece of net measuring about 60'-250' or even more in length and about 5' in breadth (height). The mesh size varies from 1-1½" diagonally (about 1" bar). While it has wooden floats on the upper margin, there are no sinkers at the lower end. The net, consisting of several pieces, is operated across the stream with both the boat and the net drifting with the tide. One end of the net is held fast from the boat while the other end is left free in the water. It is mostly operated at nights, since during daytime, according to the fishermen, the fishes are able to avoid the net. In areas where there is a strong current, some sinkers may be used to keep the net erect. Otherwise since the boat is also moving with the tide, the net remains almost vertical.

ii) Chandi or Ilish jal: This is a gill net, which has already been described earlier (Govt. of India, 1941; Jones, 1959; etc.). The mesh size is usually 2" bar or 3½" diagonally. It is operated generally as a set gill net or as a drifting gill net; but at times it is also operated as a boat seine, wherein two boats carrying the net start from a point and move apart describing a circle, at the same time paying out the net, while some other fishermen in a third boat move into circle and start beating about the boat and water in order to frighten and drive the fishes towards the circular barrier of nets, where they get gilled. The size of each piece of net is generally found to be 16' x 16', 12' x 12' or 15' x 12'.

Jones (op. cit.) has given a detailed account of hilsa fishing in the Mahanadi estuary by collective fish drives, using the Chandi jal and Chowka jal.

(iii) Chowka jal: It is a gill net similar to the Chandi in dimensions, structure and operation, but with a smaller mesh size, namely 3" diagonally. It is a sturdier net, made up of thick strands of Sunn-hemp.

(iv) Ghai jal: This is also similar to Chandi and Chowka, but it has a continuous 18" wide transverse fold or ghai at its lower end. It is made of Sunn-hemp and at intervals along the upper end of ghai are tied a number of baked mud sinkers. The mesh size (diagonal) of the ghai is 2¼", while it is 1½" above in the main body of the net. Each piece generally measures 4½' x 9' and several such pieces are joined together in operation. This net is usually dragged along by 2 boats, with its lower end grazing the river bed.

This is quite often used in combination with Chandi and Chowka jals to catch big shoals of hilsa. A full barrier is made across the river or creek by fixing poles at intervals and attaching both Chandi and Chowka jals to the poles, one besides the other, with the Chandi jal facing the ghai jal. The mesh size of the Chandi jal (3½") is a little bigger than that of Chowka jal (3"). After the barrier is set up, the Ghai jal is let down into the water usually at low tides by several boats and men about ½ half a furlong or more above the barrier. It is then slowly taken towards the barrier along with the current, driving the fish in front of it. Those that move towards the barrier get gilled in the Chandi, if sufficiently big, while the smaller ones get gilled in the Chowka. Others that rush back strike the Ghai jal and get trapped in the ghai.

(v) Soru jal: This is also simillar to Chandi, but is made of thin thread and has a slightly bigger mesh size. Each piece measures 15' x 12'. This net is also quite often used in combination with Chandi and Chowka for Hilsa fishing. Soru jals of smaller mesh size (¼" x ¼") are used in the Devi river for catching small-sized prawns, mullets and engraulids.

(vi) Noli jal: This net, which is quite common in the Chilka lake, is seen only with a few fishermen on the southern tributaries of the Mahanadi, bordering Chilka lake. Even so, they are operated mostly in the neighbouring Chilka lake, to where these fishermen go regularly for fishing. However, this net is also operated in the Makra river. It is made up of strings prepared from a kind of tall grass, and measures 100' in length and 1½'-2' in breadth, with a mesh size of 1¼" bar. To the upper margin are attached a number of 2" long pith floats, while there are no sinkers at the lower end. Jhingran et al (1963) have described this net as a drifting gill net, while elsewhere it has

been termed as cast net (Government of India, 1941) and inshore drag net (Government of India, 1951). But in Makra, it was seen to be operated as a bottom set gill net.

vii) Bhasani or Chauhara jal: It is a surface gill net with a mesh size of ½"-¾" bar, operated mainly for mullets. The length of the net may be 120' or even more, but the height (breadth) is always 6'. There are wooden floats on the upper side. This net is usually operated in conjunction with the Chandi jal, being held a little behind it, while they are held or slowly moved (dragged) against the current. The Chandi jal retains the Hilsa, while the smaller mullets which escape it, get gilled in the Bhasani jal.

viii) Jagar jal: This is a kind of gill-cum-drag net found mostly in the southern Devi river villages. It is utilised mainly for catching small sized mullets, specially Mugil parsia. It is operated like Chandi jal as a gill net, and at times it is converted into a simple drag net by tying two poles at either end or a more complex drag net called Khadi jal by tying a number of sticks (vide infra). The fishermen of Kaliakone, Nagar and Alasahi use this net mainly as a gill net, while those of Jharling, Biluamandali, Tonda, Sovanah and Balisahi use it as a drag net (Khadi jal). The mesh size of Jagar jal varies from ¼" to ½" bar.

ix) Bhida jal: This is another kind of gill net of varied mesh size (1½"-2") which is operated along the Daya and Makra estuaries, often as a complete barrier across the river. The catch is miscellaneous.

(x)-(xii) Bada jal and Bhekti jal are two other types of gill nets employed along the Devi river. Menji jal, another gill net, is owned by the fishermen of Kaudakani on river Makra, but it is operated only in the Chilka lake.

c) Bag nets

i) Mala jal: This is a small fixed bag net without distinct wings. It is operated mainly for prawns. The length of the bag varies from about 20' to 72' in extreme cases. It has about 350-600 meshes at its mouth and the mesh size decreases progressively from 1" bar at the mouth to ¼" at the cod end. It is operated only at nights during low tide and is set against the current. In addition to the prawns, small sized engraulids and carangids are also caught in this net.

ii) Khod jal: This is a bigger bag net of the refugee fishermen, with wide meshes and long wings. It is designed to catch bigger fishes like the Bhekti and Sahal and in operation is held right across the river. The bag varies in length from 45' - 75' and is about 27' across at its mouth, with each wing about 12' long. The mesh size decreases progressively from about 4½" near the mouth to 1½" at the cod end. In some the mesh size is as big as 6". The two wings are held stretched and fixed on the two banks and the operation is carried out both during the low and high tides.

iii) Behundi jal: This is a bag net used by a few refugee Bengali fishermen. This is similar to the Behundi jal or the Been jal of Bengal, which has already been described by Jones (op. cit.).

d) Drag nets

i) Khadi jal or Khati jal: It is a trough-shaped drag net resembling in all essentials the Vadivala of the Kerala backwaters, which has been described in detail by Hornell (1938). This net is seen only in the southern sector from Jatadharmohan southwards right down to Chilka lake. The fishermen of the erstwhile Kujang State do not possess this type of net. The net is generally about 18' long and each of the 12-14 vertical poles tied across the mouth of the trough is about 4' long. In operation, after dragging the net for a while the mouth is gradually closed by gathering together the vertical poles from both the sides. Majority of these nets are used for catching prawns, in which case the mesh size is generally 1 cm. However, in the Devi river area Khadi jals of bigger mesh sizes are used for catching big sized fishes and they go by different names depending on the fish they are intended to catch e.g. Dhondi jal for Mugil cephalus and Dhasando jal for Lates calcarifer. The small meshed Khadi jal meant for catching prawns is often termed as Chingudi jal. The bigger meshed Khadi jals are usually used in conjunction with some gill nets like Soru jal or Chandi jal, where the latter are set up as barriers across a stream and the former are operated in the area thus enclosed.

As has already been pointed out above, the Khadi jal is often converted into Jagar jal and used as a gill net ~~in~~ along the lower stretches of Devi river.

ii) Jalei or Netha jal: This is a small meshed (½ cm bar) conical bag net, which is dragged along in shallow water for catching prawns. The conical bag proper, about 10' long, leads on to a broader

anterior part, about 5 ft long, to which are attached two bamboo poles at either end along its longitudinal axis, with the anterior tip of each pole ending at the mouth of the net. At this point of each pole is tied the anterior end of another bamboo pole and the two poles are further connected to each other by a cord at about the middle of their length. To the lower half of the mouth of the net are attached a number of sinkers. In operation, the net is dragged against the current by means of the outer poles.

iii) Patua jal: This is a drag net made of thread, employed along the Daya river. Its catch is miscellaneous.

e) Set barriers

i) Salua: This is a fish screen, made of slender bamboo strips held together by a few widely separated lines of Sunn-hemp string, leaving a gap of about ½" between individual strips. Each piece measures about 30' in length and 2½' - 3' in height. In operation, several pieces are lashed together and a wide shallow semi-circular area towards the bank is cordoned off by this screen during high tide. During low tide when the water ebbs out of the enclosed region, the fishes are stranded in shallow puddles, from where they are caught either by hand or by small nets. This screen is almost exclusively used by the Ghokas, who are not entitled to use other nets. The catch is miscellaneous, consisting mainly of Bhekti, Khoinga, Sahal and Catfishes.

ii) Pata jal or Gora jal: This net is made of cotton thread (No.20) and is operated like the Salua as a set berrier, making use of the tidal flows. Each piece measures 27' - 45' in length and 9' - 11' in height. The mesh size varies from 1½" - 2" diogonally. In operation, several pieces are lashed together and with the aid of bamboo poles the net is fixed during low tide in a semi-circle facing the bank. At the height of high tide, the net, which till then remains at the bottom of the poles, is raised to its full height. During low tide after the water has drained out of the enclosed area, the stranded fishes are collected. The catch varies from a few seers to a maund and consists mainly of Bhekti, polynemids and mullets.

Along the Nun river in the south, occassionally some wide - meshed fibre nets are used in the manner of Pata jal for catching big-sized carps and catfishes.

iii) Sahal jal: This is similar to the Pata jal, but is made of Sunn-hemp and has a mesh size of 2" (D). Each piece measures 6'.x 18'. It is used by the Devi river fishermen near the mouths of creeks. As the name suggests, the catch mainly consists of polynemids.

f) Cast nets

i) Jhaki jal, Khepla jal or Khepa jal: The cast net possessed by the indigenous Oriya fishermen is termed the Khepa jal, while that possessed by the refugee Bengali fishermen is known as the Jhaki jal or the Khepla jal. Cast net fishing in Mahanadi is seen mainly along its southern tributaries Daya, Bhargavi, Makra and Nun, where the cast net is the most dominant fishing gear, often the only type of gear in some fishing villages. They are not very prevalent north of × × × × × the main estuary and the only cast nets met within that region belong to the refugee Bengali fishermen. However, fairly good numbers of cast nets are found in the villages south of the main estuary. No cast nets are possessed by the fishermen of the Devi river area.

The Mahanadi cast net resembles the Gangetic cast net or Khepla jal in almost all respects, specially in the inward folding of its lower margin to form a series of looped-up pockets, as against Hornell's (1924) observation of this feature being peculiar to the Gangetic cast nets only. The net measures about 15' - 20' in length and has a mesh size varying from $\frac{3}{4}$" to 1" (D). The width of the lower pockets, which in the Gangetic nets varies from 1 - 2 ft (Hornell, 1924), is only about 8" in the Mahanadi net. The catch is miscellaneous, consisting of engraulids, Bhekti, polynemids, mullets, carps, catfishes, prawns, etc.

g) Scoop nets

i) Pelana jal: It is a small scoop net attached to a triangular bamboo frame and operated in shallow waters against the current for catching small fishes. The cod end of the bag-like net is open and is tied up with a string at the time of operation.

ii) A type of still smaller scoop net attached to a circular frame is used in the Hukitola region for scooping out crabs nibbling at baits attached to a long line. The net is quite shallow and has no opening at its cod end.

h) Hooks and line

Long lines are almost exclusively owned by the refugee Bengali fishermen of Kharnasi and Ramnagar villages and are operated in the Hukitola region for catching a variety of fish, specially the Bhekti, Sahal, Khoinga and crabs. Pieces of shark meat are used as bait for the crabs.

i) Juti (Spear)

Spear fishing is also resorted to only by the refugee fishermen, specially to catch Bhekti. Quite often 5 or 6 spears are lashed together to make a Juti. The fisherman patiently waits in his boat till he sights the fish near the surface and then plunges the Juti deftly down on to the fish. Since the spears end in recurved hooks, the fish is unable to escape.

IV. FISH AND FISHERIES

1. Fishing grounds and fish disposal centres

a) Fishing grounds

All over the estuary fishing is carried out almost throughout the year with, however, definite concentrations in a few places, specially in and around the main estuary and the Hukitola lake. Regular fishing is done mostly in the lower reaches of the estuary in the main river, as well as in its principal distributary, the Devi river. The upper reaches are frequented mainly for Hilsa, when it occurs, or for catfishes and sciaenids off and on throughout the year. In the main estuary, the estuarine fishing grounds extend from about the river mouth at Lions Rump upto Kujang, with the region around Paradip, known as Chowmohani, being the most exploited area. Generally, fishing operations are few above Chowmohani and are quite rare above Hadkhal. Even though fishing is done all over the Hukitola lake, it is concentrated mostly in its southern and north-western parts. A number of estuarine streams flowing into the lake at its southern end, namely the Gobri, Ramchandi and Kharnasi rivers, constitute rich fishing grounds. Other important fishing grounds include the Nuna river near Chowmohani, Jatadharmohan and Devi river below Machgaon, including its numerous extensions, specially on the southern side. Among the southern distributaries flowing into Chilka lake,

the Daya river from its confluence with Chilka lake upto Dokanda, the lower stretches of Nun river, the middle stretches of R.Bharghavi and the whole of R.Makra above Subhadrapur constitute commonly exploited fishing grounds. In addition to these, active fishing is also carried out along a number of estuarine creeks adjoining the main streams of the system. There does not appear to be year-round concentrated fishing in the southern tributaries for lack of availability of commercially important species of fishes and several fishermen of the area regularly go to Chilka lake for fishing to earn better dividends.

b) Landing places or fish disposal centres

There are no all-the-year-round regular landing places for the Mahanadi estuarine catch, except probably for Paradip on the main river. A few seasonal landing centres crop up during the winter months, when normally fishes are landed in large quantities. Even in those cases, the landings in some places are quite often by the middlemen and not by the fishermen, since the former collect the catches right on the fishing grounds from the latter. Since a good number of these fishermen are indebted to the middlemen, they have hardly any choice in the disposal of their catches and as such auctioning on the landing places is hardly ever seen in Mahanadi.

Among the several landing or assembly centres may be mentioned Kujang and Paradip on the main river, Jamboo ghat, Kandrapatia Mohan and Hukitola Island on Hukitola lake and Machgaon on Devi river (see fig.1). Of these, Kujang forms the only regular assembly centre for the fish brought by merchants from various parts of the estuary for final packing in ice, before despatching them to Cuttack. However, this centre also does not function throughout the year for lack of sufficient quantities of exportable fish during certain months. The export position at Kujang has reportedly worsened during the recent months, because of the diversion of fresh fish to camps of Paradip Port Project workers. Paradip serves as landing centre for the catches in the main river and adjoining creeks, while Jamboo ghat, Kandrapatia Mohan and Hukitola Island serve for the catches made in the south-west, north and south-east parts of Hukitola lake respectively and Machgaon for those made in the lower stretches of Devi river. In addition to the above, during the earlier part of this survey there used to be regular landings during the winter months in the village Kharnasi adjoining the Kharnasi river, the catches being those made by the refugee fishermen of the villages Kharnasi and Ramnagar. This has, however, ceased to be a landing

centre, in view of the prevailing fishing restrictions (vide infra).

During the main fishing season, when the catches are usually heavy, a large number of fish merchants or middlemen frequent the fishing grounds and collect the catches straight-away from there. Only when such merchants fail to turn up, do the fishermen land their catches in any of the above mentioned landing centres or quite often on the land nearest to the fishing ground, where the fishes are cut open, salted and spread out on the ground for drying. Not infrequently, the whole operation is carried out inside the fishing boat itself and the fishing unit keeps moving from place to place.

Along the southern tributaries, the catches are usually sold in fresh condition in the neighbouring villages. Whenever there are heavy catches, like that of Hilsa during the monsoon months, merchants from Kaluparaghat, Bhusandpur and Khurda Road visit the fishing grounds for purchasing the catches.

2. Collection and calculation of catch statistics

The sampling designs adopted for the collection of catch statistics of this estuary have been described by Shetty and Ghosh (in press). To start with, a complete inventory of the fishing villages, fishermen and their craft and tackle was carried out and a survey programme similar to the one adopted for the Hooghly-Matlah estuarine system (Pillay, 1960) was initiated in the main estuary and its northern tributaries. It consisted of a multi-stage random sampling survey, wherein a few representative fishing villages were randomly selected as sampling centres, the fishing efforts of which were to be made use of for estimating total catch, as well as catch per unit of effort. This presupposes the fishermen of the selected villages fishing always near their respective villages. But in the later half of 1958 when the first author took charge of the investigations, it was discovered that the above programme was totally unsuitable to this estuary, because of the extensive migratory nature of the local fishermen, who have rights of unrestricted fishing all over these waters, which made it impossible to estimate the catch and effort of the selected ××××××villages. Therefore, after an extensive survey and study of the fishing industry, the original programme was replaced by two new programmes, one for estimating the total catch and other principally for estimating the catch per unit of effort and secondarily for estimating the total catch as well.

Since fishing in the southernmost tributaries, the Daya and Bhargavi, was negligible and the areas were very much inaccessible, and also due to the paucity of personnel for survey work, only the region above the Devi River (inclusive of it) was taken up for collection of catch statistics.

a) Market survey programme for estimating total catch

The initial survey had revealed that almost the entire catch was marketed either in fresh or dry condition along certain regular channels. Therefore, a scheme of market survey was worked out, which consisted of total enumeration of the fresh fish exported out from the estuary and the estimation of total dry fish marketed in the area, to arrive at the total landing figures.

Kujang, situated on the main estuary, is the only regular fresh fish exporting centre. This single channel of fresh fish export facilitated easy collection of the relevant figures at Kujang. Whenever additional exporting centres cropped up due to heavy landings of Hilsa, they were also fully covered by the Survey staff for obtaining the export figures.

The fish thus exported out forms only about 1/3 of the total annual catch, while the remaining 2/3 are salt-cured or sun-dried and marketed wholly within the State in a number of bi-weekly haats or shandies. To start with,a complete survey was made of all the haats, wherein Mahanadi fish were being marketed. Of these, the 'primary' haats, where the dry fish enter the market for the first time, were separated from the 'secondary' haats, where the fish marketed are those that have already been marketed elsewhere earlier in some primary haat. Only the primary haats were taken up for survey, since they account for all the dry fish marketed. The primary haats were further subdivided into 'major' and 'minor', depending on the quantity of fish disposed off in them. A full list of the haats, both primary and secondary, is given in Appendix II, while the location of all the primary haats and the principal secondary haats is shown in text figure 2.

2. The survey programme adopted consisted of a stratified random sampling survey for major haats and two-stage random survey for the minor haats, wherein all the major primary haats and a few representative minor haats were surveyed twice a month, taking care to cover both the weekly haat days. Full information was obtained by the Survey Assistants regarding species-wise disposal and other aspects, as per details shown in Proforma 'A'

(see Appendix I). From the data thus obtained the monthly dry fish disposals at the major and minor haats were calculated separately as follows :-

i) Major haats

$$\hat{D}_1 = \sum_{i=1}^{k} \sum_{j=1}^{n_i} \frac{N_i}{n_i} d_{ij}$$

Where,

$\hat{D}_1$ = Estimated total monthly disposal at major haats

d_{ij} = Disposal at the i^{th} haat on the j^{th} sampled haat day

n_i = Number of haat days sampled in the i^{th} haat

N_i = Number of haat days in the month in the i^{th} haat

k = Number of major haats

ii) Minor haats

$$\hat{D}_2 = \frac{M}{m} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \frac{N_i}{n_i} d_{ij}$$

Where,

$\hat{D}_2$ = Estimated total monthly disposal at minor haats

M = Number of minor haats

m = Number of sampled minor haats

$\hat{D}_1 + \hat{D}_2 = \hat{D}$ gives the total monthly disposals of dry fish at all the haats. This dry fish weight is then converted into fresh fish weight by multiplying it by 2.5 and the total monthly landing figures from the estuary are obtained by adding this to the total monthly fresh fish export figures.

The above survey design, however, excludes a certain percentage of dry fish that is sold by hawkers from house to house and the fish that is disposed off locally near the fishing grounds in fresh condition. These are, however, believed to be negligible.

b) Water zonation survey

This programme was designed for the purpose of estimating catch per unit of effort, as well as for a better estimation of total catch, which would serve as check on the first programme. This was also utilised for the collection of essential biological data like size frequency, sex, maturity, etc. Only the area above Devi river was taken up for this study, in view of the lack of sufficient number of personnel and equipment. To start with, the entire fishing area under observation was divided into eight water zones, on the basis of convenience of survey operations (text figure 3). The details of demarcation of the various zones are given in Appendix III. The programme designed consisted of a stratified two-stage sampling, with systematic cluster sampling in the first stage (- just systematic sampling only in Zones IV & V -) and simple random sampling in the second stage.

Each zone, except Zones IV, V & VIII, was surveyed for two consecutive days in a fortnight, while Zones IV & V were surveyed for only one day in a fortnight, in view of their being comparatively poorer fishing grounds. For reasons of inaccessibility, remoteness and lack of sufficient staff, Zone VIII was surveyed for 2 consecutive days every month. As far as possible, an interval of about 15 days was kept between the sampling dates of different fortnights. On the sampling day, the entire zone which was being sampled was, to start with, quickly covered by a swift-moving motor boat and the total number of different kinds of fishing units operating therein was noted. Of these, not less than 20% randomly selected units of each kind were sampled for obtaining details regarding the nets used, total catch landed, species composition by weight, etc., as per details

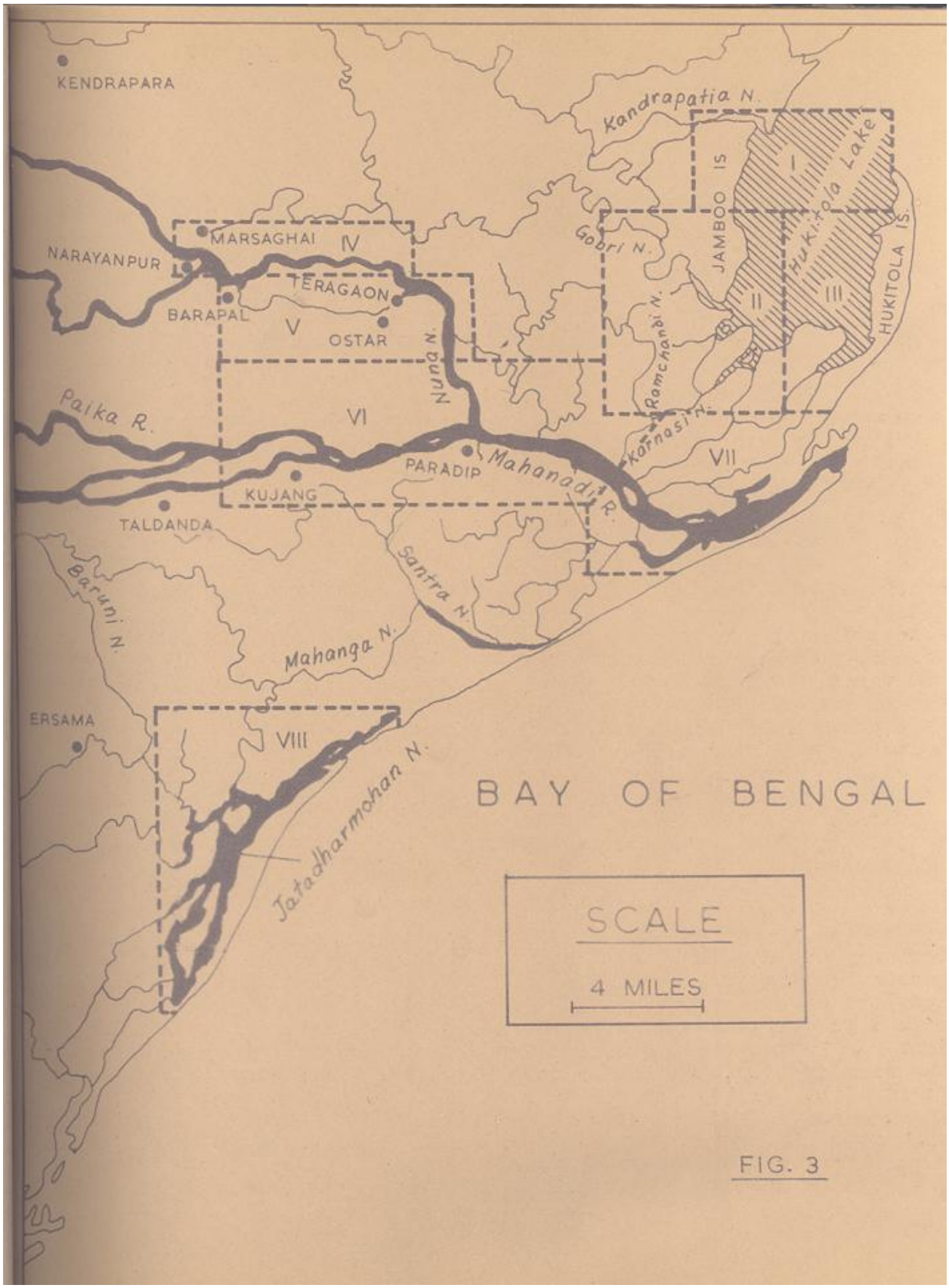

KENDRAPARA
Kandrapatia N.
JAMBOO IS
I
Hukitola Lake
HUKITOLA IS.
II
III
Gobri N.
Ramchandi N.
Karnasi N.
MARSAGHAI
IV
NARAYANPUR
TERAGAON
BARAPAL
V
OSTAR
Nuna N.
Paika R.
VI
PARADIP
Mahanadi R.
VII
KUJANG
TALDANDA
Baruni N.
Santra N.
Mahanga N.
ERSAMA
VIII
Jatadharmohan N.
BAY OF BENGAL
SCALE
4 MILES

FIG. 3

shown in 'proforma B' (see Appendix I). Further, information was also obtained regarding the number of days in the preceding fortnight during which each sampled unit operated in that zone.

From the above data, the total monthly catch (i) and monthly effort (ii) for all zones by all gears could be calculated by first estimating the catch and effort by each type of gear at each zone as follows :-

i) $$\hat{C}_{ij} = \sum_{k=1}^{n_{ij}} \frac{N_{ij}}{n_{ij}} C_{ijk}$$

$$\therefore \hat{C} = \sum_{i,j} \hat{C}_{ij}$$

$$\hat{E}_{ij} = \sum_{k=1}^{n_{ij}} \frac{N_{ij}}{n_{ij}} E_{ijk}$$

$$\therefore \hat{E} = \sum_{i,j} \hat{E}_{ij}$$

Where,

$\hat{C}_{ij}$ = Estimated monthly catch at the i^{th} zone by the j^{th} type of gear

$\hat{C}$ = Estimated total monthly catch by all gears over all zones

$\hat{E}_{ij}$ = Estimated monthly effort at the i^{th} zone by the j^{th} type of gear

$\hat{E}$ = Estimated total monthly effort by all gears over all zones

C_{ijk} = Catch by the j^{th} type of gear in the i^{th} zone on the k^{th} operating day in the sample

E_{ijk} = Effort or the number of units of the j^{th} type of gear operating in the i^{th} zone on the k^{th} operating day in the sample

n_{ij} = Number of operating days in the sample for the j^{th} type of gear in the i^{th} zone

N_{ij} = Number of operating days in the month for the j^{th} type of gear in the i^{th} zone

$\sum_{ij}$ = Summation over all zones (i) and all gears (j).

Likewise, the monthly catch per unit of effort (= catch per unit-day) for each type of gear could be estimated as follows:

Total monthly catch by the j^{th} type of gear over all the zones $= \sum_i \hat{C}_{ij} = \hat{C}_j$

Total monthly effort by the j^{th} type of gear over all the zones $= \sum_i \hat{E}_{ij} = \hat{E}_j$

Hence, catch per unit of effort $= \dfrac{\hat{C}_j}{\hat{E}_j}$

The data gathered by the programme are comprehensive enough to calculate the catch per unit of effort in a variety of ways. The estimation, however, is to a certain extent handicapped by the unstandardised nature of certain gear. Further, the migratory nature of the fishermen makes it difficult to adjust the number of their operating days over different zones. If the number of operating days in a particular zone only are taken into consideration, there is a likelihood of the operating days in other zones being missed, which will lead to underestimation of catches. If, on the other hand, all the operating days of each unit are taken into consideration while surveying a particular zone, irrespective of where the operation took place, there is a possibility of overlapping of data, leading to over-estimation of catches. This could best be overcome by increasing the number of sampling days and taking the average of catches

obtained on those days as representing the trend of catches and effort during the entire month. This could further be improved by sub-dividing the present zones into smaller zones, which will ensure more effective coverage of the fishing operations.

c) Calculation of errors of estimate

For lack of all-weather boats and sufficient number of personnel, the water zonation survey could not be carried out effectively to cover all the zones all through the year, and as such, the data obtained thereby could not be utilised for the estimation of total catch, but only for that of catch per unit of effort. Hence, errors of estimate have been calculated only for the market survey programme. The data gathered during the summer months March-May, 1960 have been analysed for the purpose.

Datails of market arrivals in the sampled haats during the above period and the calculation of errors of estimate are shown below:

Market disposals (in lbs) of dry fish on sampled 'haat days during March - May, 1960

'Haats	March		April		May	
(i) Major haats						
Kujang	1086.50	1236.50	584.50	1126.00	1260.00	1175.00
Marsaghai	74.00	202.00	18.00	67.00	24.00	272.00
Audhanga	1089.50	1080.75	1538.50	1086.50	1149.50	1287.00
Siddhesh-warpur	1452.50	960.50	2307.75	1629.75	1724.25	1930.50
(ii) Minor haats						
Borikina	-	-	1.50	22.50	74.00	9.75
Ghodadiha	-	-	7.00	16.50	10.25	10.00
Patamundai	-	-	-	-	-	15.00

'Haats'	March		April		May	
Kendrapara	-	-	17.00	-	-	-
Patpur	5.00	6.50	-	-	-	-
Jaipur	-	-	-	-	-	-
Nischintakoil	-	-	-	-	-	-

Calculation of error

The calculations were worked out on the basis of the following formulae :

i) Estimated variances within major haats

$$\hat{V}(\hat{D}_1) = \sum \frac{N_i(N_i-n_i)}{n_i} \quad s_i^2$$

ii) Estimated variances between and within minor 'haats'

$$\hat{V}(\hat{D}_2) = \frac{M^2N^2}{mn} \left\{ \frac{M-m}{m} s_b^2 + \frac{N-n}{N} \frac{m}{M} s_w^2 \right\}$$

Where, N = the number of 'haat days in each of the sampled 'haats', which contributed to the disposals; and

n = the number of sampled haat days in each of the sampled 'haats'.

/Note: The number of 'haat days in each of the sampled 'haats' that contributed to the disposals happened to be the same in the present case and hence the above formula. In cases where this number (N_i) varies, a more general formula can be employed./

Estimated variances within major haats $[\hat{V}(\hat{D}_1)]$

Name of the haat	MARCH			APRIL			MAY		
	N_i	$\frac{N_i(N_i-n_i)}{n_i}$	s_i^2	N_i	$\frac{N_i(N_i-n_i)}{n_i}$	s_i^2	N_i	$\frac{N_i(N_i-n_i)}{n_i}$	s_i^2
Kujang	9	31.5	22,500	9	31.5	293222	9	31.5	61504
Marsaghai	9	31.5	16,384	8	24.0	2401	9	31.5	7225
Audhanga	8	24.0	13,6161	9	31.5	204304	9	31.5	18906
Siddhesh-warpur	9	31.5	24,2064	9	31.5	459684	9	31.5	42539

Analysis of variance for minor haats

Source of variation	Degrees of freedom	Sum of Squares		
		March	April	May
Between haats	6	56.67	411.46	2813.06
Within haats	7	1.13	410.13	2176.56
Total:	13	57.80	821.59	4989.62

Estimated variances between and within minor haats $[\hat{V}(\hat{D}_2)]$

	M	m	N	n	$\frac{M^2N^2(M-m)}{mnM}$	$\frac{M^2N^2(N-n)m}{mn\ MN}$	s_b^2	s_w^2
March	18	7	9	2	8019/7	567	9.44	0.16
April	18	7	8	2	6336/6	432	68.58	58.59
May	18	7	9	2	8019/7	567	468.84	310.94

			March	April	May
	$\hat{D}_1$	(kg)	13516	17042	18007
	$\hat{D}_2$	(kg)	60	302	625
	$\hat{D}$	(kg)	13576	17344	18632
$\hat{V}\hat{V}$	$(\hat{D}_1)$	(lbs)	12117726	30209739	4100841
$\hat{V}$	$(\hat{D}_2)$	(lbs)	10905	87386	7733393
$\hat{V}$	$(\hat{D})$	(lbs)	12128631	30297125	4813874
S.E.	$\hat{D}$	(kg)	1580	2497	995
C.V.	$\hat{D}$		11.6%	14.4%	5.3%

From the above it could be seen that the coefficient of variation for the months analysed ranged from 5.3% in May to 14.4% in April, with an average of 10.43% for the entire period, which appears fairly satisfactory.

3. Fish landings

The ensuing account is based on figures obtained through the market survey programme. While the quantities of fish disposed off in fresh condition are actually landed at about the time of disposal, those disposed off in dried condition are not necessarily so, and as such the monthly disposal figures do not always reflect the trend of landings during these particular months. The market figures, however, provide a fairly accurate approximate idea of total landings, since quantities whose disposal does not come within the purview of this survey, viz. the fresh fish disposed off near the fishing grounds to consumers and the dry fish sold outside the haats by house to house hawking, are estimated at less than about 10% of the total landings.

Tables 1 and 2 show the monthly dry and fresh fish disposal for the years 1960-'61 to 1963-'64 in terms of actual weight and as percentage by weight of total disposals respectively. The former is also schematically represented in text-figure 4. As could be seen from the tables, the disposals were the heaviest during the quarter December to February in all the four years, constituting as much as 45.6%, 38.6%, 32.4% and 62.4% respectively of the total annual

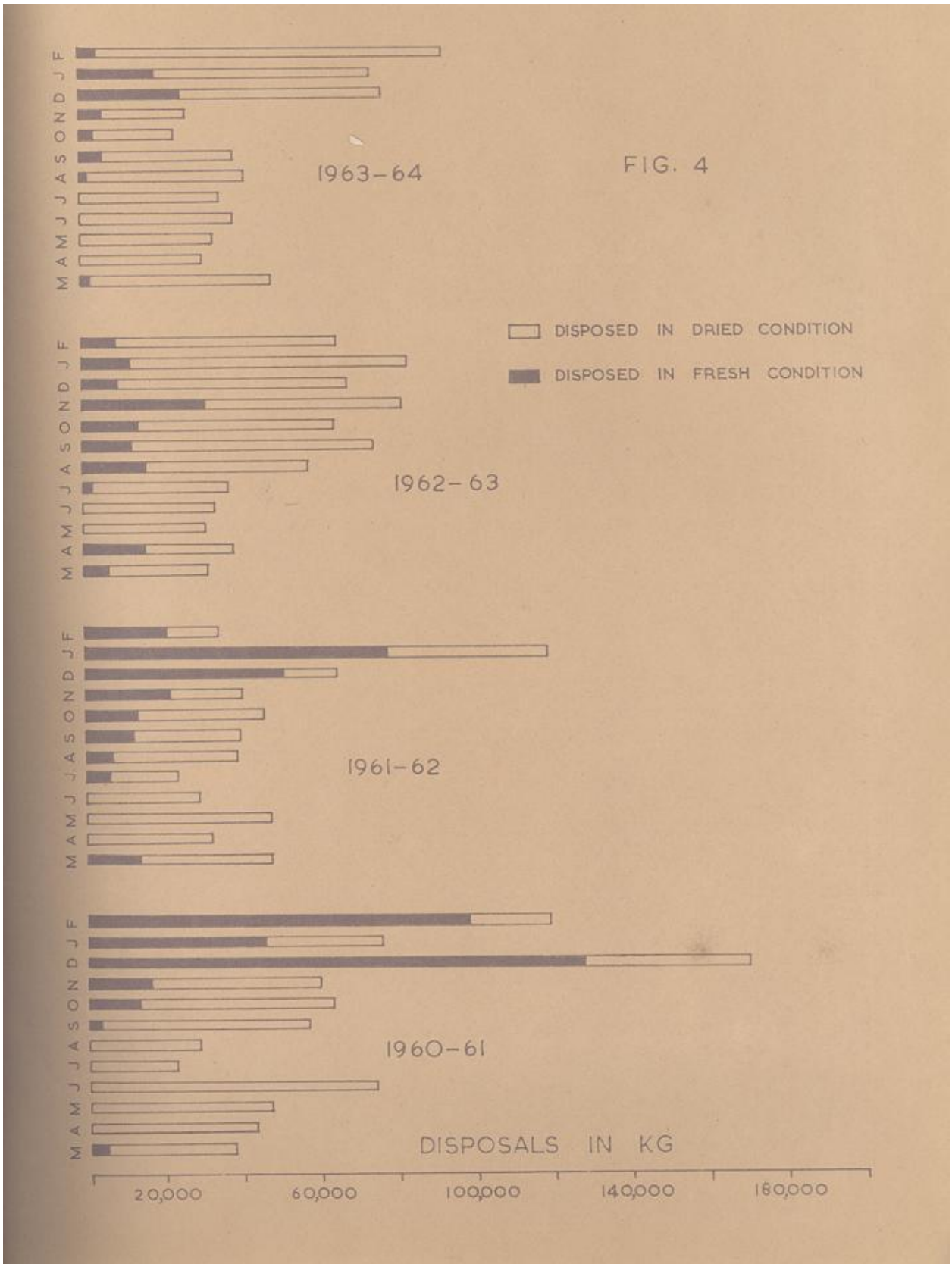

M A M J J A S O N D J F
1963-64
1962-63
1961-62
1960-61
DISPOSED IN DRIED CONDITION
DISPOSED IN FRESH CONDITION
DISPOSALS IN KG
20,000
60,000
100,000
140,000
180,000

FIG. 4

TABLE 1

MONTHLY DISPOSALS (In kg) FOR THE YEARS 1960-'61 to 1963-'64
MAHANADI ESTUARY

YEARS	1960-'61			1961-'62			1962-'63			1963-'64		
MONTHS	*Fresh	**Dry	Total	*Fresh	**Dry	Total	*Fresh	**Dry	Total	*Fresh	**Dry	Total
March	4,278	33,940	38,218	13,865	33,978	47,843	6,206	25,880	32,086	2,593	46,287	48,880
April	-	43,360	43,360	874	31,738	32,612	15,812	23,068	38,880	530	30,632	31,162
May	-	46,579	46,579	-	48,298	48,298	641	31,332	31,973	154	33,502	33,656
June	-	75,807	75,807	-	29,842	29,842	84	34,183	34,267	222	39,128	39,350
July	-	23,395	23,395	5,644	18,515	24,159	2,518	34,975	37,493	148	34,765	34,913
August	350	29,325	29,675	6,593	32,825	39,418	17,185	40,668	57,803	2,350	40,110	42,460
September	3,440	52,689	56,129	12,667	27,252	39,919	12,487	62,025	74,512	5,354	33,682	39,036
October	13,543	49,789	63,332	13,539	32,608	46,147	13,722	50,430	64,152	3,784	20,612	24,396
November	16,132	44,072	60,204	21,847	19,212	41,059	31,592	50,180	81,772	7,098	20,330	27,428
December	126,316	43,564	169,880	50,930	13,830	64,760	9,320	58,812	68,132	25,383	51,255	76,638
January	46,178	30,744	76,922	77,516	41,030	118,546	12,316	70,795	83,111	19,221	54,708	73,929
February	98,263	20,466	118,729	21,548	13,680	35,228	9,282	55,532	64,814	5,338	86,729	92,567
Total:	308,500	493,730	802,230	225,023	342,808	567,831	131,115	537,880	668,995	72,675	491,740	564,415

* Disposed in fresh condition

** Disposed in dried or cured condition, but expressed in terms of fresh weight

TABLE 2

MONTHLY DISPOSALS SHOWN AS PERCENTAGE OF TOTAL FOR THE YEARS

1960-'61 to 1963-'64

MAHANADI ESTUARY

YEARS	1960-'61			1961-'62			1962-'63			1963-'64			1960-'64 (Poole		
MONTHS	*Fresh	**Dry	Total	*Fresh	**Dry	Total	*Fresh	**Dry	Total	*Fresh	**Dry	Total	*Fresh	**Dry	Tot
March	1.4	6.9	4.8	6.2	9.9	8.4	4.7	4.8	4.8	3.6	5.9	5.7	3.7	6.5	5.
April	-	8.8	5.4	0.4	9.3	5.7	12.0	4.3	5.8	0.7	3.9	3.6	2.3	6.0	5.
May	-	9.4	5.8	-	14.1	8.5	0.5	5.8	4.8	0.2	4.3	3.9	0.1	7.4	5.
June	-	15.5	9.4	-	8.7	5.3	0.1	6.4	5.1	0.3	5.0	4.6	-	8.3	6.
July	-	4.7	2.9	2.5	5.4	4.3	1.9	6.5	5.6	0.2	4.5	4.1	1.1	5.2	4.
August	0.1	5.9	3.7	2.9	9.6	6.9	13.1	7.6	8.6	3.2	5.1	5.0	3.6	6.6	5.
September	1.1	10.7	7.0	5.6	7.9	7.0	9.5	11.5	11.1	7.4	4.3	4.6	4.6	8.2	7.
October	4.4	10.1	7.9	6.0	9.5	8.1	10.5	9.4	9.6	5.2	2.6	2.9	6.0	7.1	6.
November	5.2	8.9	7.5	9.7	5.6	7.2	24.1	9.3	12.2	9.8	2.6	3.2	10.4	6.2	7.
December	40.9	8.8	21.2	22.6	4.0	11.4	7.1	10.9	10.2	34.9	16.4	18.0	28.8	11.3	15.
January	15.0	6.2	9.6	34.5	12.0	21.0	9.4	13.2	12.5	26.5	17.5	18.3	21.1	13.0	15.
February	31.9	4.1	14.8	9.6	4.0	6.2	7.1	10.3	9.7	8.0	27.9	26.1	18.3	14.2	15.

* Disposed in fresh condition

** Disposed in dried or cured condition, but expressed in terms of fresh weight

disposals. On an average, 46.2% of the annual landings was disposed off during this quarter. Calm weather conditions, coupled with the influx into the estuary from the sea of certain important species, such as the Hilsa and mullets, seem to be largely responsible for the heavy catches made during this period. The landings were generally poor during the period April to August, partly due to inclement weather conditions during the later half of the period. The percentage of fish disposed off during the period in the years 1960-'61 to 1963-'64 were 27.2, 30.7, 29.9 and 25.8 respectively, with an average of 26%. These disposals consisted mostly of dry fish. This was due not only to the poor landings, but also to the fact that whatever was caught had mostly to be dried for lack of transport facilities for fresh disposal during this part of the year.

Tables 3 and 4 show the estimates of annual dry and fresh fish disposals, species-wise, over the years 1960-'61 to 1963-'64, in terms of actual weight and as percentage by weight of total catches respectively. The latter is also depicted in text-figure 5. The clupeoids, mullets and prawns dominated the fishery during all the four years. While the clupeoids constituted the single largest group during the first two years, mainly due to Hilsa ilisha, the mullets dominated the fishery in the later two years.

Considerable fluctuations were noticed in clupeoid landings, depending largely on the failure or success of the Hilsa fishery. The Hilsa landings fluctuated very widely, ranging from 309.77 metric tonnes in 1960-'61 to 13.70 in tonnes in 1963-'64. Other species that contributed appreciably to the clupeoid landings were Nematalosa nasus, Sardinella spp. and Thrissocles spp. and to a lesser extent Ilisha spp. As in the case of Hilsa, the total clupeoid landings also showed a progressive decline and constituted 47.3%, 40.2%, 13.7% and 14.6% respectively of the total annual landings during the four years and 30% of the total landings of the entire period.

Taking the entire four-year period, the mullets constituted 30.1% of the total landings, with their annual contributions ranging from 134 to 250 metric tonnes. Mugil cephalus, M.cunnesius and M.parsia dominated the mullet landings. There was progressive increase in the mullets' contribution to the total annual landings during the four years, from 22.1% in 1960-'61 to 44.1% in 1963-'64.

Compared to the above two groups, the prawns exhibited lesser fluctuations, with their annual landings varying from 55 metric tonnes in 1963-'64 to 114 metric tonnes in 1962-'63. They

contributed to 12.4% of the four-year catches.

The threadfins, Bhekti, sciaenids and catfishes also fluctuated within comparatively narrow ranges and constituted 5.4%, 3.7%, 4.9% and 1.9% respectively in the total catches of the four years. Among the threadfins, Eleutheronema tetradactylum was landed in much larger quantities than Polydactylus indicus during the later two years, while the reverse was the case during 1961-'62. The contribution of the polynemids to the total annual landings varied from 4% to 7% during the period under study. The sciaenid landings exhibited alternate abundance and paucity during the four years, while the catfish landings showed a progressive decline, being particularly poor during the year 1963-'64, when they constituted only 0.5% of the total landings. The Bhekti landings also declined considerably during 1963-'64.

Fishes grouped under 'miscellaneous' consisted mostly of perches and perchlets like Sillago spp., Epinephalus malabaricus, Ambassis spp., Leiognathus spp., Lutianus johnii, Datnoides quadrifasciatus, Sparus berda, etc. Beloniform fishes (Tylosurus spp. & Hemiramphus spp.) also formed an appreciable part of this group. The annual landings of this group varied from 38 to 113 metric tonnes, forming 5.7% to as much as 20% of the total annual landings. The group contributed to 10.6% of the total four-year catches.

A classified list of the fishes, prawns and crabs recorded during the survey is given in Appendix IV.

4. Catch-per-unit-of-effort and species selectivity of the gear

a) Catch-per-unit-of-effort

Studies relating to catch per unit of effort and gear selectivity were carried out from October 1957 to February 1962, with a six-month break from September 1959 to February 1960. These studies were to some extent handicapped by the unstandardized nature of some of the gear. The estimated figures pertain to catch per unit per day, irrespective of the number of boats, men and pieces of nets involved in individual units. This has been chosen, since mostly the various gears were operated in single pieces, with a definite number of men and boat. Combinations of several pieces of the same gear or of different gears were employed less frequently and mostly for Hilsa fishing, when that species occurred in huge shoals.

PERCENTAGE IN TOTAL CATCH

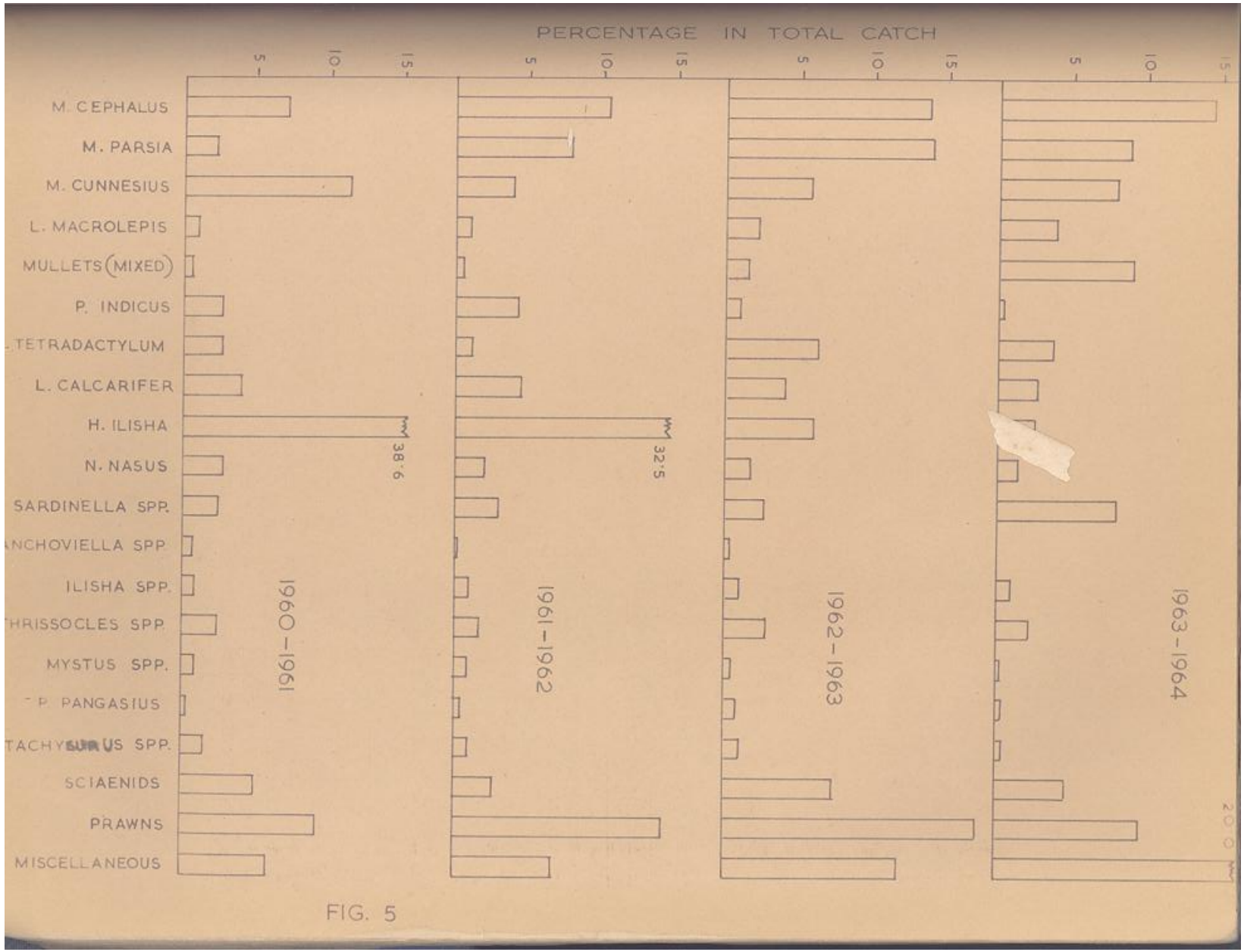

PERCENTAGE IN TOTAL CATCH
5
10
15
M. CEPHALUS
M. PARSIA
M. CUNNESIUS
L. MACROLEPIS
MULLETS (MIXED)
P. INDICUS
TETRADACTYLUM
L. CALCARIFER
H. ILISHA
N. NASUS
SARDINELLA SPP.
ANCHOVIELLA SPP.
ILISHA SPP.
THRISSOCLES SPP.
MYSTUS SPP.
P. PANGASIUS
TACHYSURUS SPP.
SCIAENIDS
PRAWNS
MISCELLANEOUS
38·6
32·5
200
1960–1961
1961–1962
1962–1963
1963–1964

FIG. 5

TABLE 3

ANNUAL DISPOSALS OF COMMERCIALLY IMPORTANT SPECIES IN THE YEARS 1960-'61 to 1963-'64 (FIGURES IN KG)

NAME OF FISH	1960-61			1961-62			1962-63			1963-64		
	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total
M.cephalus	3,583	51,812	55,395	12,281	45,880	58,161	19,679	71,040	90,719	7,263	74,778	82,041
M.cunnesius	1,536	89,607	91,143	1,436	20,302	21,738	777	39,180	39,957	3,886	40,635	44,551
M.parsia	3,923	13,935	17,858	5,398	38,832	44,230	9,399	84,138	93,537	5,067	44,842	49,909
M.tade	2	810	812	6	1,590	1,596	-	277	277	-	205	205
L.macrolepis	687	7,238	7,925	2,518	3,975	6,493	6,852	8,010	14,862	5,207	17,398	22,605
Mullets (mixed)	98	3,718	3,816	1,395	180	1,575	1,038	9,340	10,378	13,432	36,170	49,602
Mullets (sub-total)	9,829	167,120	176,949	23,034	110,759	133,793	37,745	211,985	249,730	34,855	214,058	248,913
P.indicus	2,673	16,460	19,133	6,337	18,888	25,225	118	5,060	5,178	99	1,998	2,097
E.tetradactylum	399	19,128	19,527	1,229	5,300	6,529	5,608	35,288	40,896	1,570	18,955	20,525
Polynemids (sub-total)	3,072	35,588	38,660	7,566	24,188	31,754	5,726	40,348	47,074	1,669	20,953	22,622
L.calcarifer	12,741	17,548	30,289	11,621	14,145	25,766	15,715	10,220	25,935	4,260	10,305	14,565
Hilsa ilisha	249,892	59,884	309,776	136,060	48,218	184,278	25,011	13,640	38,651	4,994	8,715	13,709
Nematalosa nasus	-	21,588	21,588	120	10,400	10,520	112	11,392	11,504	15	7,170	7,185
Sardinella spp	-	18,547	18,547	-	16,652	16,652	-	16,665	16,665	-	44,430	44,430
Anchoviella spp	558	4,450	5,008	195	618	813	-	565	565	-	135	135
Ilisha spp	864	5,365	6,229	4,165	2,342	6,507	2,501	3,908	6,409	1,935	2,927	4,862
Thrissocles spp	2,607	15,970	18,577	2,793	6,678	9,471	1,854	16,005	17,859	2,958	8,992	11,950
Clupeoids (Sub-total)	253,921	125,804	379,725	143,333	84,908	228,241	29,478	62,175	91,653	9,902	72,369	82,271

contd.....

NAME OF FISH	1960-61			1961-62			1962-63			1963-64		
	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total
Mystus spp	857	5,848	6,705	835	4,958	5,793	84	2,470	2,554	-	523	523
O.militaris	5	228	233	28	10	38	20	155	175	-	-	-
P.pangasius	507	158	665	2,664	25	2,689	544	3,760	4,304	80	397	477
Arius spp	750	10,542	11,292	1,397	4,838	6,235	1,904	4,960	6,864	170	1,367	1,537
Catfishes (sub-total)	2,119	16,776	18,895	4,724	9,831	14,555	2,552	11,345	13,897	250	2,287	2,537
Sciaenids	2,781	35,437	38,218	4,747	10,068	14,815	2,993	46,525	49,518	1,580	23,833	25,413
Prawns	7,569	66,147	73,716	16,292	64,197	80,489	16,423	97,505	113,928	5,971	49,043	55,014
Miscellaneous	16,468	29,310	45,778	13,706	24,712	38,418	20,483	57,777	78,260	14,188	98,892	113,080
GRAND TOTAL:	308,500	493,730	802,230	225,023	342,808	567,831	131,115	537,880	668,995	72,675	491,740	564,415

Note:- 1) Fresh means disposed in fresh condition

2) Dry means disposed in dried or cured condition but converted into fresh weight

TABLE 4

ANNUAL DISPOSALS OF COMMERCIALLY IMPORTANT SPECIES AS PERCENTAGES OF TOTAL CATCHES FOR THE YEARS 1960-'61 TO 1963-'64

NAME OF FISH	1960-'61			1961-'62			1962-'63			1963-'64			1960-'61 to '63-'64		
	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total
M.cephalus	1.2	10.5	6.9	5.5	13.4	10.3	15.0	13.2	13.6	10.0	15.2	14.5	5.8	13.0	11.0
M.cunnesius	0.5	18.1	11.4	0.6	5.9	3.8	0.6	7.3	6.0	5.3	8.3	7.9	1.0	10.2	7.6
M.parsia	1.3	2.8	2.2	2.4	11.3	7.8	7.2	15.6	14.0	7.0	9.1	8.8	3.2	9.7	7.9
M.tade	*	0.2	0.1	*	0.5	0.3	-	0.1	*	-	*	*	*	0.2	0.1
M.macrolepis	0.2	1.5	1.0	1.1	1.2	1.1	5.2	1.5	2.2	7.2	3.5	4.0	2.1	2.0	2.0
Other Mullets	*	0.8	0.5	0.6	0.1	0.3	0.8	1.7	1.5	18.5	7.4	8.8	2.2	2.6	2.5
Sub-total (Mullets)	3.2	33.9	22.1	10.2	32.4	23.6	28.8	39.4	37.3	48.0	43.5	44.1	14.3	37.7	31.1
P.indicus	0.9	3.3	2.4	2.8	5.5	4.4	0.1	1.0	0.9	0.1	0.4	0.4	1.3	2.3	2.0
P.tatradactylum	0.1	3.9	2.4	0.5	1.6	1.1	4.3	6.6	6.1	2.2	3.9	3.6	1.2	4.2	3.4
Sub-total (Polynemids)	1.0	7.2	4.8	3.3	7.1	5.5	4.4	7.5	7.0	2.3	4.3	4.0	2.5	6.5	5.4
L.calcarifer	4.1	3.6	3.8	5.2	4.1	4.5	12.0	2.0	3.9	5.9	2.1	2.6	6.0	2.8	3.7
T.ilisha	81.0	12.1	38.6	60.5	14.1	32.5	19.1	2.5	5.8	6.9	1.8	2.4	56.4	7.0	20.9
Hematolosa nasus	-	4.4	2.7	0.1	3.0	1.9	0.1	2.1	1.7	*	1.5	1.3	*	2.7	2.0
Sardinella spp.	-	3.8	2.3	-	4.9	2.9	-	3.1	2.5	-	9.0	7.9	-	5.2	3.7
Anchoviella spp.	0.2	0.9	0.6	0.1	0.2	0.1	-	0.1	0.1	-	*	*	0.1	0.3	0.3
Ilisha spp.	0.3	1.1	0.8	1.9	0.7	1.1	1.9	0.7	0.9	2.6	0.6	0.9	1.3	0.8	0.9
Thrissocles spp.	0.8	3.2	2.3	1.2	1.9	1.7	1.4	3.0	2.7	4.1	1.8	2.1	1.4	2.5	2.2
Sub-total (Clupeoids)	82.3	25.5	47.3	63.8	24.8	40.2	22.5	11.5	13.7	13.6	14.7	14.6	59.2	18.5	30.0

contd.....

NAME OF FISH	1960-'61			1961-'62			1962-'63			1963-'64			1960-'61 to '63-		
	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Total	Fresh	Dry	Tota
Mystus spp.	0.3	1.2	0.8	0.3	1.4	1.0	0.1	0.4	0.4	-	0.1	0.1	0.2	0.7	0.6
O.militaris	*	*	*	*	*	*	*	*	*	-	-	-	*	*	*
P.pangasius	0.2	*	0.1	1.2	*	0.5	0.4	0.7	0.6	0.1	0.1	0.1	0.5	0.2	0.3
Arius spp.	0.2	2.1	1.4	0.6	1.4	1.1	1.4	1.0	1.0	0.2	0.3	0.3	0.6	1.2	1.0
Sub-total (Catfishes)	0.7	3.3	2.3	2.1	2.8	2.6	1.9	2.1	2.0	0.3	0.5	0.5	1.3	2.1	1.9
Sciaenids	0.9	7.2	4.8	2.1	2.9	2.6	2.3	8.6	7.4	2.2	4.8	4.5	1.6	6.2	4.9
Prawns	2.5	13.4	9.2	7.2	18.7	14.2	12.5	18.1	17.0	8.2	10.0	9.7	6.3	14.9	12.4
Miscellaneous	5.3	5.9	5.7	6.1	7.2	6.8	15.3	10.7	11.7	19.5	20.1	20.0	8.8	11.3	10.6

Note - Fresh: disposed in fresh condition

Dry: disposed in dried or cured conditions but expressed in terms of fresh weight

* negligible quantity

Table 5 shows the observed catches per unit day in kilograms. It is evident that Torania and Kukut were the most extensively used gear in the estuary, being in operation almost throughout the year. While the catch per unit of effort in the case of Torania ranged from 0.67 - 23.66 kg, the Kukut yielded appreciably higher catches, ranging from 4.54 - 43.06 kg. The Torania and Kukut were estimated to have contributed to 8.6% and 5.9% respectively of the total catches made during the period 1960-'62.

Suta jal, Mala jal and Salua were three other gears, which were employed fairly extensively during the major part of the year, and were estimated to have contributed to 6.3%, 7.6% and 8.5% respectively of the total 1960-'62 catches. Suta was generally less efficient than Torania and Kukut, while Mala jal generally landed heavier catches than those of Suta. However, about 90% of the Mala jal catches consisted of small-sized prawns, having little market value. The Salua catches were generally heavier than those of the other gear so far mentioned, with the catch per unit of effort varying from 1.81 - 224.50 kg. The Salua landings consisted essentially of quality fish.

In terms of catch per unit of effort figures as furnished in Table 5, some of the composite fishing nets, consisting of two or three types of gear, appear to be the most efficient. However, it is to be borne in mind that these units frequently consist of enormous number of individual nets, with an equally large number of boats and men. Soru-Chandi-Chowka and Chandi-Chowka-Bada were the two most effective combinations, being used exclusively for fishing Hilsa, when it occured in huge shoals, their respective contributions to the total catches of the period 1960-'62 being estimated at 26.5% and 14.5%. The maximum catch per unit of effort was about 2612 kg in the case of both these composite units.

Soru jal, though operated less frequently than many of the other gears, was estimated to have contributed to as much as 10.1% of the total landings, with its catch-per-unit-of-effort ranging from 11.25-50.90 kg. This was due to the employment of large number of units of this gear for fishing Hilsa, when it occurred in enormous shoals.

In terms of their estimated contribution to the total catches of the period 1960-'62, the most effective gears were the Soru-Chandi-Chowka, Chandi-Chowka-Bada, Soru, Torania, Salua, Mala, Suta and Kukut, in the order mentioned (see Table 6).

b) Species selectivity of the gear

Table 6 presents the selectivity of various gears in respect of species shown as estimated percentage of pooled gear-wise catches for the years 1960-'61 and 1961-'62. The data presented therein bring out the following points:

i) Torania, Kukut, Chowka, Khadi and Ghai-chandi are more selective in respect of Bhekti. However, taken as a group, the mullets dominate the Torania catches.

ii) Juti (Spears) and Bekta jal are almost exclusively selective of Bhekti.

iii) The Hilsa fishing units, namely the Chandi, Soru, Chandi-Chowka-Bada, Suta-Chandi-Chowka and Soru-Chandi-Chowka, are either most selective or exclusively selective in respect of Hilsa.

iv) Khepa, Suta-Chandi, Salua, Torania-Salua, Ghai-Salua and Chandi-Chowka-Torania are more selective in respect of mullets.

v) Clupeoids other than Hilsa (mainly Ilisha spp. and Thrissocles spp.) are largely caught by Suta and Soru.

vi) Jalei and Mala are most selective in respect of prawns.

vii) Sciaenids, catfishes and polynemids are caught by most of the individual gears, other than those that are more or less specific to certain species.

viii) Torania, Suta, Khadi and Salua show less of selectivity than the others, in that they catch most of the different groups of fishes.

5. Salient features of the fisheries and Biology of Economic species

In view of the limited number of staff at the disposal of the Mahanadi Investigations Unit, it was not possible to carry out detailed biological studies of all the commercially important species. Further, most of the nets were highly selective in that the fishes caught fell within only a narrow size range and as such did not fully reflect the entire populations. In the following account, brief mention is made of the various economic species with regard

TABLE 5

FLUCTUATIONS IN CATCH PER UNIT OF EFFORT
(IN KG) OCTOBER 1957 - FEBRUARY 1962

GEARS \ MONTHS AND YEARS	October 1957	November '57	December '57	January '58	February '58	March '58	April '58	May '58	June '58
1. Torania	18.81	2.89	7.29	12.89	7.10	7.04	7.42	5.77	7.40
2. Kukut	14.17	26.36	24.32	20.33	18.23	12.94	8.25	6.35	4.95
3. Bekta	-	-	-	-	-	-	-	-	-
4. Suta	-	-	4.91	4.43	4.95	3.99	4.39	4.16	1.81
5. Ghai	-	-	-	-	-	-	-	-	-
6. Chandi	-	-	39.01	197.77	-	-	-	-	-
7. Chowka	-	-	-	-	-	-	-	-	-
8. Soru	-	-	-	-	-	-	-	-	-
9. Khadi	-	-	-	-	-	-	-	-	0.45
10. Salua	-	-	-	14.39	-	-	1.81	-	-
11. Mala	-	-	-	-	-	-	16.69	-	-
12. Jalei	-	-	-	-	-	13.61	29.52	8.11	-
13. Khepa	4.15	1.24	0.37	0.27	0.21	0.81	0.39	6.35	-
14. Bachari	-	48.08	-	-	-	-	-	-	-
15. Juti	-	2.72	-	-	-	-	-	-	6.37
16. Torania & Salua	-	-	-	-	-	-	-	-	-
17. Ghai & Salua	-	-	-	-	-	-	-	-	-
18. Ghai & Chandi	-	-	-	-	-	-	-	-	-
19. Chandi & Chowka	-	-	-	-	-	-	-	-	-
20. Chandi, Chowka & Bada	-	-	-	-	-	-	-	-	-
21. Suta & Chandi	-	-	-	-	-	-	-	-	-
22. Suta, Chandi & Chowka	-	-	-	-	-	-	-	-	-
23. Soru, Chandi & Chowka	-	-	-	-	-	-	-	-	-
24. Chandi, Chowka & Torania	-	-	-	-	-	-	-	-	-
25. Hilsa unspecified	-	-	-	-	-	-	-	-	-
26. Long lines	-	27.22	9.43	7.95	10.75	11.79	-	5.20	-
27. Gora	-	22.68	-	-	-	15.88	-	-	-
28. Khuntia	-	-	-	-	-	-	-	-	-
29. Torania & Suta	7.38	9.36	-	-	-	-	-	-	-

Contd.....

TABLE 5 (Contd.)
ii

GEARS \ MONTHS AND YEARS	July 1958	August '58	September '58	October '58	November '58	December '58	January '59	February '59	March '59
1.	12.45				23.66	6.45	9.32	12.82	9
2.	11.59	5.79	10.43	8.56	14.35	16.51	12.20	8.35	19
3.									
4.									
5.						5.44	10.57	7.15	5
6.									
7.									
8.									
9.									
10.	3.63					31.71			3
11.						31.40	11.79	6.96	15
12.	3.63			3.18					
13.		0.45		4.50	0.45				
14.									
15.		9.98							
16.									
17.									
18.									
19.							337.93	139.48	
20.									
21.									
22.									
23.									
24.									
25.									
26.	3.88	2.09	3.27	4.20					
27.				11.03	8.95				
28.						18.60			
29.									

Contd.....

TABLE 5 (Contd.)

iii

YEARS / MONTHS AND YEARS	April 1959	May '59	June '59	July '59	August '59	March '60	April '60	May '60	June '60	July '60
1.	9.40	-	6.09	3.84	-	6.79	7.07	9.52	4.22	4.08
2.	16.72	9.42	14.06	5.82	12.06	-	-	-	4.54	17.64
3.	-	-	-	-	-	-	-	-	-	-
4.	4.95	-	-	-	-	1.14	-	0.69	-	-
5.	-	-	-	-	-	-	-	-	-	-
6.	-	-	-	-	-	-	-	-	-	-
7.	-	-	-	-	-	-	-	-	-	-
8.	-	-	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	11.07	-	-	11.83
10.	-	-	-	-	-	-	-	-	-	9.97
11.	9.53	11.52	-	-	-	-	-	-	-	14.87
12.	-	-	-	10.21	-	-	-	-	-	4.33
13.	-	-	-	-	-	-	-	-	-	-
14.	-	-	-	-	-	-	-	-	-	-
15.	-	-	-	-	-	-	-	-	-	-
16.	-	-	-	-	-	-	-	-	17.91	-
17.	-	-	-	-	-	-	-	-	-	-
18.	-	-	-	-	-	-	-	-	-	-
19.	-	-	-	-	-	-	-	-	-	-
20.	-	-	-	-	-	-	-	-	-	-
21.	-	-	-	-	-	-	-	-	-	-
22.	-	-	-	-	-	-	-	-	-	-
23.	-	-	-	-	-	-	-	-	-	-
24.	-	-	-	-	-	-	-	-	-	-
25.	-	-	-	-	-	-	-	-	-	-
26.	-	-	-	-	-	-	-	-	-	-
27.	-	-	-	-	-	-	-	-	-	-
28.	-	8.28	-	-	-	-	-	-	-	-
29.	-	-	-	-	-	-	-	-	-	-

Contd.....

TABLE 5 (Contd.)

iv

YEARS \ MONTHS AND YEARS	August 1960	September '60	October '60	November '60	December '60	January '61	February '61	March '61	April '61
1.	-	15.46	12.37	9.52	14.29	14.75	7.59	3.92	4.7
2.	12.71	10.54	13.76	11.41	43.06	8.26	-	17.76	-
3.	-	-	15.75	-	-	-	11.35	-	-
4.	-	-	-	9.10	14.58	9.09	7.99	3.69	-
5.	43.32	-	12.24	11.89	13.62	-	-	-	-
6.	-	-	-	-	-	-	-	24.29	-
7.	-	-	28.32	-	-	-	-	-	-
8.	-	-	-	-	-	-	28.89	-	50.9
9.	-	15.03	-	12.09	-	-	-	-	-
10.	17.40	-	49.12	20.47	72.10	26.95	57.62	7.02	224.5
11.	12.21	-	10.97	-	4.67	-	13.00	-	-
12.	-	13.61	-	9.77	-	-	11.33	-	13.3
13.	-	-	-	-	-	-	-	-	3.3
14.	-	-	-	-	-	-	-	-	-
15.	-	-	-	-	-	-	-	-	-
16.	-	-	-	-	-	-	-	-	-
17.	-	89.36	-	-	-	-	-	-	-
18.	-	-	-	69.41	-	-	-	-	-
19.	-	-	-	-	0.60	-	-	-	-
20	-	-	-	-	115.00	2612.69	-	-	-
21.	-	-	-	-	-	-	-	-	-
22.	-	-	-	-	-	-	-	-	-
23.	-	-	-	-	2611.33	-	336.83	-	-
24.	-	-	-	-	-	-	-	24.06	-
25.	-	-	-	-	-	-	-	-	-
26.	-	-	-	-	-	-	-	-	-
27.	-	-	-	-	-	-	-	-	-
28.	-	-	-	-	-	-	-	-	-
29.	-	-	-	-	-	-	-	-	-

Contd.....

TABLE 5 (Contd)
v

YEARS \ MONTHS AND YEARS	May 1961	June 1962	July 1962	August '61	September '61	October '61	November '61	December '61	January 1962	February '62
1.	5.46	7.06	-	-	-	0.67	-	-	15.25	5.67
2.	15.05	7.58	15.15	11.80	16.09	7.04	5.85	5.17	36.76	15.21
3.	-	-	-	-	-	-	-	-	-	-
4.	3.33	-	-	-	-	-	-	7.78	20.96	2.43
5.	-	-	-	-	-	-	-	-	-	-
6.	-	-	-	-	-	-	-	-	-	-
7.	20.71	-	-	-	-	-	-	-	-	-
8.	-	-	-	-	-	-	-	-	-	-
9.	4.50	-	-	-	-	-	-	11.60	11.25	15.45
10.	41.25	27.93	-	-	-	-	-	-	-	-
11.	0.75	4.08	-	-	-	-	5.25	32.57	10.53	15.67
12.	4.47	-	-	-	-	18.67	-	32.60	10.53	15.50
13.	-	-	-	16.58	-	-	-	-	-	-
14.	-	-	-	-	-	-	-	-	-	-
15.	-	-	5.39	-	-	-	-	-	-	-
16.	-	-	-	-	-	-	-	-	-	-
17.	-	-	-	-	-	-	-	-	-	-
18.	-	-	-	-	-	-	-	-	-	-
19.	-	-	-	-	-	-	-	-	-	-
20.	-	-	-	-	-	-	-	-	-	-
21.	-	-	-	-	-	-	-	-	140.33	-
22.	-	-	-	-	-	-	-	-	-	98.56
23.	-	-	-	-	-	-	-	-	-	-
24.	-	-	-	-	-	-	-	-	-	-
25.	-	-	-	-	-	-	-	-	-	37.33
26.	-	-	-	-	-	-	-	-	-	-
27.	-	-	-	-	-	-	-	-	-	-
28.	-	-	-	-	-	-	-	-	-	-
29.	-	-	-	-	-	-	-	-	-	-

TABLE 6

Selectivity of gears in respect of commercially important species/groups shown as estimated percentage of gearwise catches during the period 1960 - 62

Name of fish / Gears	Torania	Kukut	Bekta	Suta	Ghai	Chandi	Chowka	Soru	Khadi	Salua	Mala
M. cephalus	3.2	0.7					1.1		0.2	1.9	
M. cunnesius	18.4			7.9					2.2	22.5	
M. parsia	13.1			5.7					0.1	5.8	
M. tade	0.2									0.1	
L. macrolepis	0.6								0.2	0.3	
Other Mullets										8.4	
Sub-total (Mullets)	35.5	0.7		13.6			1.1		2.7	39.0	
P. indicus	5.9	14.4		*	16.8		21.3			5.9	
P. tetradactylum	0.6	*		1.5	13.1			0.3		1.7	
Sub-total (Polynemids)	6.5	14.4		1.5	29.9		21.3	0.3		7.6	
L. calcarifer	26.0	31.0	93.0		13.7		45.8	*	59.6	7.1	
H. ilisha						67.3		49.8		0.1	
Nematalosa nasus				0.3					0.4		
Sardinella spp.											0.2
Anchoviella spp.											
Ilisha spp.	0.3			17.6				30.4			
Thrissocles spp.	1.1	*		49.4				14.2		1.4	0.3
Sub-total (Clupeoids)	1.4	*		67.2		67.3		94.4	0.4	1.5	0.5
Mystus spp.	2.4	1.6		0.7			3.0	0.6	3.7	4.2	*
O. militaris		0.8		3.2						0.9	
P. pangasius	1.7	2.6				32.7	7.1	0.1		0.2	
Arius spp.	5.6	6.2		2.5	0.4		4.7	2.2	0.2	1.6	
Sub-total (Catfishes)	9.7	11.2		6.4	0.4	32.7	14.8	2.9	3.9	6.9	*
Sciaenids	14.4	15.2	7.0	1.9	45.8		10.9	0.5	19.3	3.7	1.9
Prawns	1.6	2.1			1.3				10.8	4.4	90.1
Miscellaneous	4.9	25.2		9.3	8.9		6.1	1.9	3.3	29.8	7.5
Contribution of gears shown as estimated of total catches	8.6	5.9	0.1	6.3	1.1	0.2	0.4	10.1	2.5	8.5	7.6

contd.....

TABLE 6
(contd.)

GEARS

Spp V	Jalei	Khepa	Juti	Torania & Salua	Ghai & Salua	Ghai & Chandi	Chandi & Chowka	Chandi, Chowka & Bada	Suta & Chandi	Suta, Chandi & Chowka	Soru, Chandi & Chowka	Chandi, Chowka & Torania	Hilsa - Unspeci-
1.	0.7			35.4	43.6	11.1							
2.				25.4									
3.						2.6							
4.													
5.												24.4	
6.									96.9			18.8	
7.	0.7	90.9		60.8	43.6	13.7							
8.					33.0				96.9			43.2	
9.		9.1				16.4		0.1					
10.	0.7	9.1			33.0	16.4							
11.	0.2		100.0		20.3	65.3		0.1					
12.												9.5	
13.				10.2				98.5	2.6	82.5	100.0		100.0
14.													
15.	1.6												
16.													
17.				5.1									
18.	1.6			15.3									
19.				5.1				98.5	2.6	82.5	100.0		100.0
20.													
21.													
22.	0.1				3.1	4.6		0.2		10.0			
23.	0.1			5.1	3.1	4.6		0.2		10.0			
24.	1.9			15.2									
25.	96.5							1.1					
26.	1.1			3.6			100.0	0.1	0.5	7.5		47.3	
27.	2.6	*	*	0.1	0.4	0.5	*	14.5	0.2	3.6	26.5	0.2	*

Note : * means negligible

to the salient features of their commercial fishery, their susceptibility to different gears, sizes in commercial catches and the distribution of their larvae and juveniles.

a) MULLETS

i) Mugil cephalus Linnaeus ("Khoinga")

Taking the four-year period as a whole, the 'Khoinga' constituted the most important mullet, and was next only to Hilsa. It contributed to as much as 11% of the total landings. The annual landings ranged from 55.4 to 90.7 metric tonnes, there being a progressive increase in its contribution to the total landings from 6.9% in 1960-'61 to 14.5% in 1963-'64 (Tables 3 and 4).

On an average, about 85% of the Khoinga landings was disposed off in dried condition. However, it usually formed a major portion of the fish disposed off in fresh condition, with its contribution varying from 1.2% in 1960-'61 to 15.0% in 1962-'63. While in the year 1963-'64 it contributed more than any other species to the total fresh disposals, it was second only to Hilsa in the two previous years. Taking the four-year period as a whole, Khoinga dominated the dry disposals, while only Hilsa and Bhekti had contributed more to the fresh disposals. The fresh disposal of 'Khoinga' was maximum during the period October-December, while August-September constituted the peak months of dry disposal. There was a distinct improvement in the fresh disposal of 'Khoinga' during the second and third years, possibly due to the improved transportation and preservation facilities. But this fell again during the fourth year, due evidently to the diversion of effort of fresh fish merchants and middlemen to the more remunerative work in the Paradip Port Project. The monthly disposals of Khoinga during the four years are shown in Table 7.

Khoinga is most susceptible to Ghai-Salua, Torania-Salua and Ghai-Chandi. Appreciable quantities are also landed by Torania and Salua.

The main areas of availability of Khoinga are the Hukitola lake and its adjoining streams, lower Mahanadi below Paradip, Jatadharmohan and the lower stretches of Devi river below Machgaon. Even though it is fished in the above regions almost throughout the year, the early winter months constitute the main fishing season. Besides, appreciable quantities of Khoinga are also occasionally landed in

the lower stretches of the southern distributaries, the Daya, Bhargavi, Makra and Nun, during the summer months.

The size of Khoinga encountered in the commercial catches ranged generally from about 101 to 560 mm. The great majority of individuals were, however, within the size range of 220-420 mm, with a peak at 301 mm (text fig.6). While no larvae of this species were encountered in the estuary, post-larvae measuring 12-13 mm were recorded in the northern part of Hukitola lake and at Jatadharmohan from January to May. Juveniles measuring 100-150 mm were observed in Ramchandi during April and in the lower Mahanadi during May. The occurrence of gravid individuals from September onwards and spent ones from December is possibly indicative of this species breeding during the period September-December, probably in the inshore waters of the sea. Regular seaward breeding migration of this species during October-December from the Chilka lake has been recorded by Jhingran et al (op. cit.). The occurrence of gravid females, possibly late breeders, in Hukitola during April, together with other evidences, such as the occurrence of post-larvae upto May, is suggestive of this fish having a protracted breeding season and the possibility of its breeding more than once during the season.

ii) Mugil parsia (Hamilton) ("Khasuli")

Mugil parsia was the second most important mullet of the estuary and taking the four-year period as a whole it ranked third in the order of abundance, next only to Hilsa and 'Khoinga', having contributed to 7.9% of the total estimated landings (Table 4). However, in the year 1962-'63, Khasuli was the most dominant species, having contributed to as much as 14% of the total landings, while during 1963-'64 it was second only to 'Khoinga (Tables 3 and 4). The annual landings ranged from 17.8 m tonnes in 1960-'61 to 93.5 m tonnes in 1962-'63.

Of the total 'Khasuli' landings, fresh disposals ranged from about 10 to 22%, with an average of 13.5%. Table 8 shows the monthly dry and fresh fish disposals relating to Khasuli for the four years. The periods November-December and March-June generally constituted the peak periods for fresh and dry disposals respectively. There was hardly any fresh disposal during the months March to August.

As can be seen from Table 6, Khasuli is caught mainly by Torania, Suta and Salua. Hukitola lake (mainly Zone II) and the main Mahanadi below Paradip (Zones VI & VII) constitute the main fishing

FIG. 6

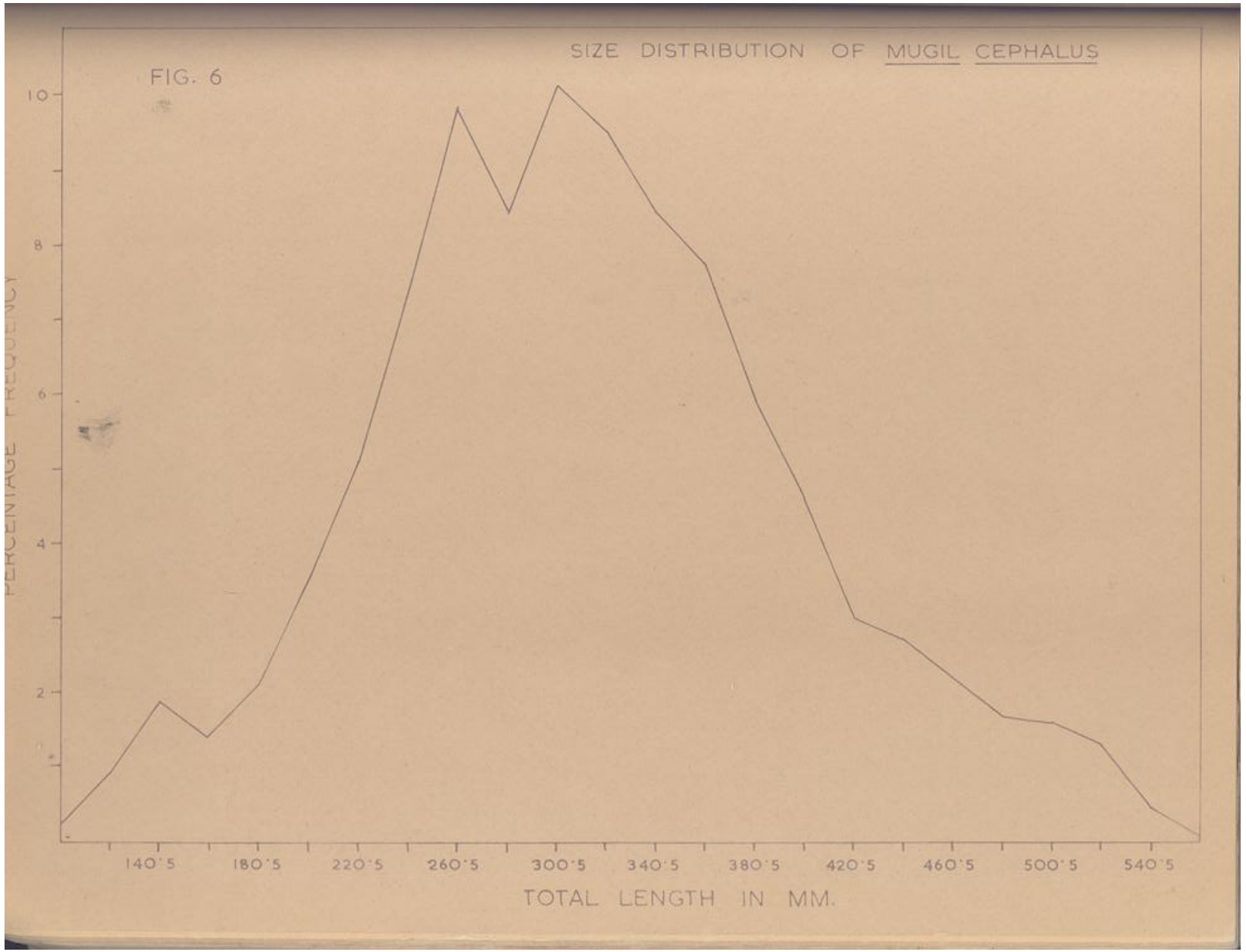

SIZE DISTRIBUTION OF MUGIL CEPHALUS
PERCENTAGE FREQUENCY
10
8
6
4
2
140·5
180·5
220·5
260·5
300·5
340·5
380·5
420·5
460·5
500·5
540·5
TOTAL LENGTH IN MM.

TABLE 7

MONTHLY DISPOSALS OF MUGIL CEPHALUS (IN KG) DURING THE YEARS 1960-'61 to 1963-'64

MONTHS	1960-61			1961-32			1962-63			1963-64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	1,202	19	1,221	628	98	726	450	323	773	2,480	42	2,522
April	1,602	-	1,602	1,542	-	1,542	745	-	745	3,455	7	3,462
May	3,310	-	3,310	6,112	-	6,112	2,865	429	3,294	2,153	22	2,175
June	4,868	-	4,868	3,765	-	3,765	4,268	-	4,268	5,218	123	5,341
July	765	-	765	7,918	1,116	9,034	6,685	75	6,760	10,232	-	10,232
August	5,462	-	5,462	8,900	2,492	11,392	8,808	827	9,635	14,030	59	14,089
September	16,782	515	17,297	5,770	2,501	8,271	16,305	3,783	20,088	9,935	946	10,881
October	9,338	1,343	10,681	5,962	2,864	8,826	10,958	3,330	14,288	6,948	628	7,576
November	4,255	1,524	5,779	2,170	2,078	4,248	4,845	6,765	11,610	7,545	681	8,226
December	3,362	-	3,362	930	623	1,553	6,613	1,064	7,677	8,270	3,892	12,162
January	612	42	654	2,178	136	2,314	5,625	2,430	8,055	2,942	526	3,468
February	250	140	390	5	373	378	2,875	653	3,528	1,570	337	1,907
Total:	51,812	3,583	55,395	45,880	12,281	58,161	71,040	19,679	90,719	74,778	7,263	82,041

* Expressed in terms of fresh weight

TABLE 2

MONTHLY DISPOSALS OF MUGIL PARSIA (IN KG) DURING THE YEARS 1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	1,517	103	1,620	230	264	494	2,512	43	2,555	8,351	57	8,408
April	995	-	995	11,398	-	11,398	6,718	-	6,718	6,703	8	6,711
May	740	-	740	16,712	-	16,712	10,365	58	10,423	3,952	4	3,956
June	1,460	-	1,460	3,955	-	3,955	11,148	-	11,143	1,835	4	1,389
July	618	-	618	1,175	-	1,175	6,470	-	6,470	1,750	-	1,750
August	330	-	330	-	-	-	4,505	4	4,509	3,262	-	3,262
September	305	18	323	130	-	130	8,998	1,941	10,939	5,762	-	5,726
October	325	298	623	308	205	513	5,572	392	5,964	1,460	198	1,658
November	5,205	1,997	7,202	1,705	2,431	4,136	5,672	5,897	11,569	1,205	672	1,877
December	1,770	112	1,882	718	1,432	2,150	5,418	448	5,866	4,685	3,348	8,033
January	488	893	1,381	2,142	759	2,901	10,405	541	10,946	2,355	361	2,716
February	180	502	682	360	307	667	6,360	75	6,435	3,522	415	4,824
Total:-	13,935	3,923	17,858	38,832	5,398	44,230	84,138	9,399	93,537	44,842	5,067	46,909

* Expressed in terms of fresh weight

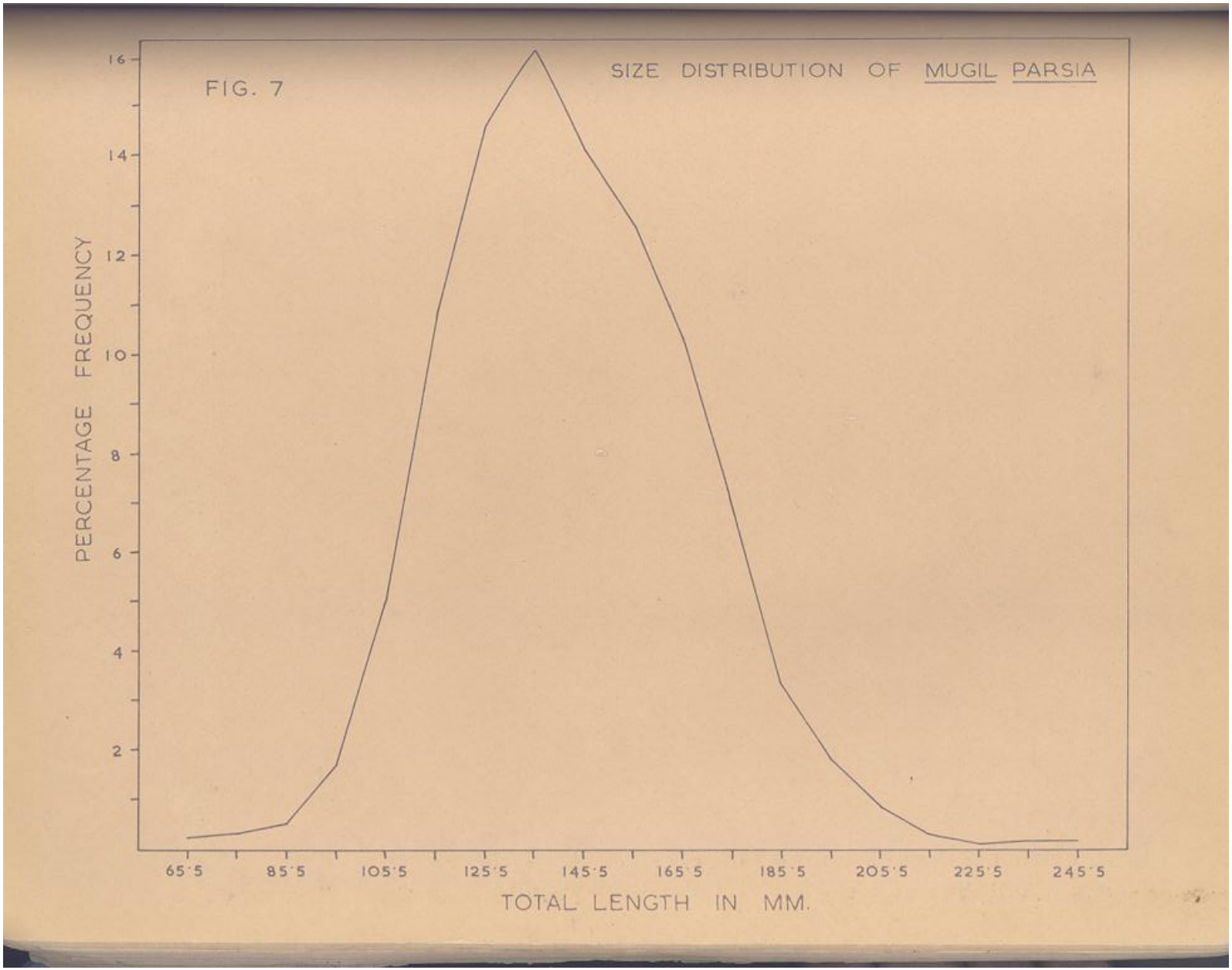


FIG. 7
SIZE DISTRIBUTION OF MUGIL PARSIA
PERCENTAGE FREQUENCY
16
14
12
10
8
6
4
2
65·5
85·5
105·5
125·5
145·5
165·5
185·5
205·5
225·5
245·5
TOTAL LENGTH IN MM.

grounds and had contributed to as much as 97.5% of the total Khasuli landings from the sampled catches of the period 1960-'62. Khasuli is also caught in appreciable quantities in Jatadharmohan and in the lower stretches of Devi.

The size range of the individuals encountered in commercial catches exhibits a unimodal distribution (text figure 7). It varied from 66 to 246 mm, with the mode at 146 mm. The majority of individuals were within the size range of 106-186 mm. Post-larvae and juveniles were observed in the Hukitola and main Mahanadi from November to January, and this, coupled with the occurrence of mature individuals during the period, suggests that the early winter months possibly constitute the breeding season of the species.

iii) Mugil cunnesius Cuv. & Val. ("Chara")

Taking the four-year period as a whole, Chara ranked fourth in the order of abundance, having contributed to 7.6% of the total estimated landings (Table 4). While in general it was less prominent than 'Khoinga and 'Khasuli', during the year 1960-'61 it was the most predominant mullet and was second only to Hilsa. The annual landings fluctuated fairly widely from 21.7 m tonnes (1961-'62) to 91.1 m tonnes (1960-'61), i.e. 3.8-11.4% of the total estimated landings (Tables 3 and 4).

The extent of dry disposal of Chara varied from 91.3% to 98.3% during the different years, with an average of 95.2%. Only during the year 1963-64 was there an appreciable fresh disposal. Details of month-wise disposals are depicted in Table 9. As was the case with most other species, fresh dispoals of Chara were maximum during the winter months, while no set pattern was noticeable regarding the dry disposals. The fact that large quantities of dry Chara were often marketed during the off-season months, indicates that there is often an appreciable time lag between the landings of this fish and its marketing in dry condition. This may be partly due to the convenience in storing it in well-dried condition, because of its small size.

Like 'Khasuli', Chara is also caught mainly by Salua, Torania and Suta. It is also landed in appreciable quantities by Torania-Salua. It forms by far the most important constituent of the Salua catches. Hukitola lake (Zones I - III) constitutes the main fishing ground for Chara, followed by the main estuary below Paradip, (Zones VI & VII). The quantities landed at Jatadharmohan are comparatively negligible.

In fact, in Hukitola lake Chara is landed in larger quantities than any other species, with the sole exception of Hilsa when it occurs in enormous shoals. While in Hukitola Chara is available almost throughout the year, in the main estuary it is mainly caught during April-May and September-October. The gear used being highly selective for certain size-groups, the great majority of individuals encountered in the commercial catches fall within a narrow size range of 145-195 mm, with a single mode at 165 mm (text figure 8). As such, only one age group seems to dominate the entire fishery. Maturing and mature forms were mainly encountered during the winter months, while post-larvae and juveniles were observed in Zones I, V & VII during June-July. The breeding period of the fish probably extends over the late winter and early summer months.

iv) Liza macrolepis (Smith) /"Dangra"/

Apart from Khoinga, Dangra is the only other major large-sized mullet of the estuary. It contributed to 2% of the total estimated landings of the four years and shared the eighth place in the order of abundance with Nematalosa nasus and Polydactylus indicus Although in terms of total quantities landed, it compares unfavourably with the other three mullets dealt with above, it is of considerable commercial value because of its large size, which lends itself to high consumer preference and as such is exported in fresh condition in large quantities during the winter months. In fact, a greater percentage of the Dangra landings was disposed off in fresh condition than was the case with any other species, except Hilsa and Bhekti. Even in terms of actual quantities, only Hilsa, Bhekti, Khoinga and Khasuli were disposed off in larger quantities in fresh condition.

The annual landings of Dangra varied from 6.4 m tonnes in 1961-'62 to 22.60 m tonnes in 1963-64. There was an increasing trend in its contribution to the total landings from 1.0% in 1960-'61 to 4.0% in 1963-'64, it being particularly noticeable during the later two years (Tables 3 and 4). The fresh disposals ranged from 8.6% to 46.1%, with an average of 29.1%. Table 10 shows the monthly disposals of Dangra during the four years. The winter months almost wholly accounted for the fresh disposals and it was during the same period that greater part of the dry disposals also took place, except in the first year.

Dangra forms the major constituent of the Suta-chandi catches. It is also caught in Chandi-Chowka-Torania, Torania, Salua and

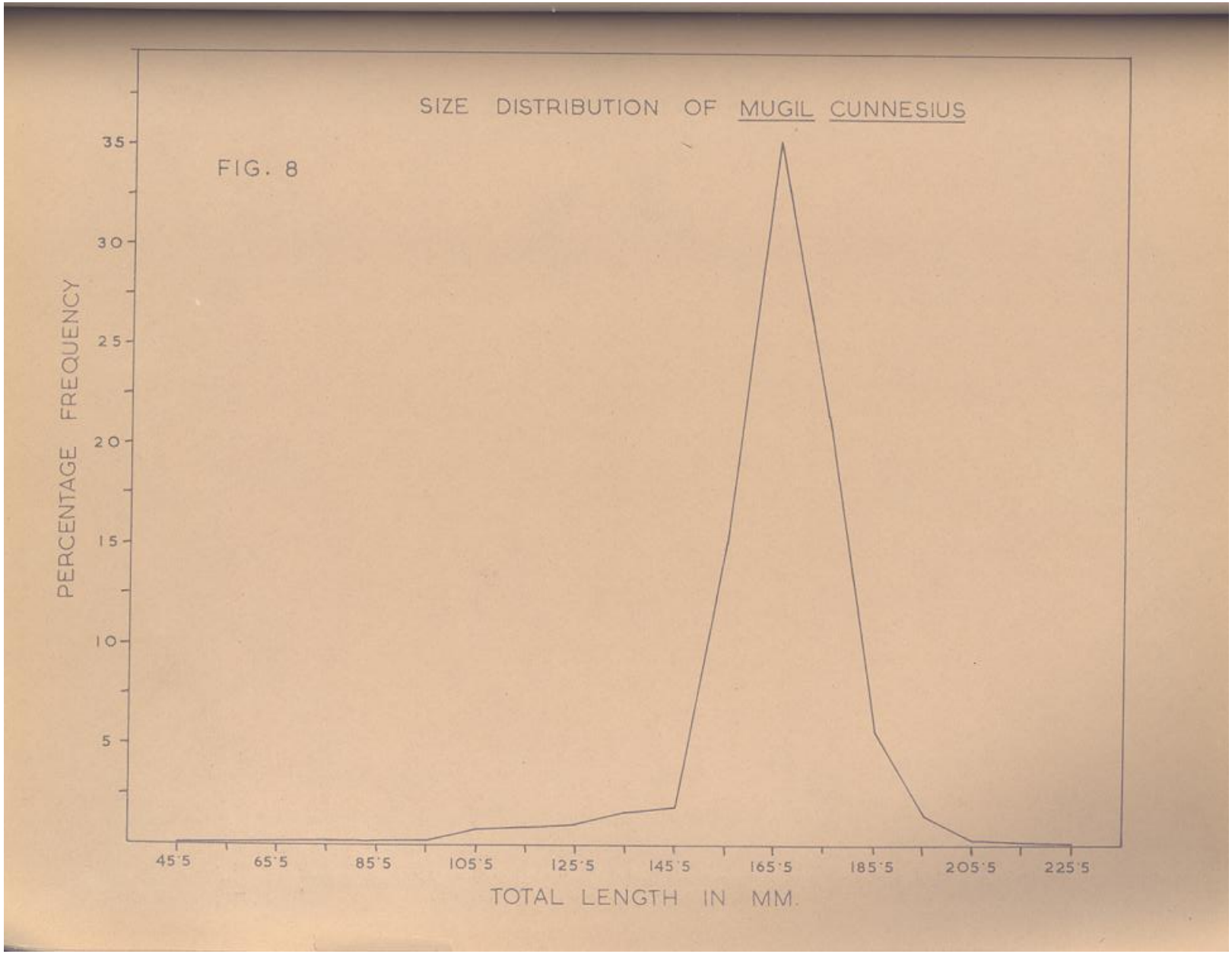

SIZE DISTRIBUTION OF MUGIL CUNNESIUS
FIG. 8
PERCENTAGE FREQUENCY
35
30
25
20
15
10
5
45·5
65·5
85·5
105·5
125·5
145·5
165·5
185·5
205·5
225·5
TOTAL LENGTH IN MM.

TABLE 1

MONTHLY DISPOSALS OF MARINE CONFESIONS (IN KG) DURING THE YEARS 1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	3,950	37	3,987	5,010	81	5,091	1,275	93	1,368	5,228	23	5,251
April	10,988	-	10,988	712	-	712	4,072	28	4,100	4,213	35	4,248
May	8,330	-	8,330	3,472	-	3,472	3,078	-	3,078	2,588	-	2,588
June	37,743	-	37,743	788	-	788	2,138	-	2,138	1,552	-	1,552
July	6,432	-	6,432	1,310	19	1,329	135	-	135	3,720	1	3,721
August	6,072	-	6,072	1,605	-	1,605	7,115	112	7,227	775	-	775
September	9,085	-	9,085	1,440	167	1,607	5,338	-	5,338	2,515	-	2,515
October	1,788	428	2,216	2,480	353	2,833	3,742	187	3,929	2,160	-	2,160
November	2,788	913	3,701	52	-	52	1,020	-	1,020	1,375	9	1,384
December	1,875	9	1,884	295	443	738	870	-	870	7,855	2,801	10,656
January	205	149	354	2,743	65	2,808	5,222	226	5,448	3,762	276	4,038
February	362	-	362	395	308	703	5,175	131	5,306	4,922	741	5,663
Total:-	89,607	1,536	91,143	20,302	1,436	21,738	39,180	777	39,957	40,665	3,886	44,551

* Expressed in terms of fresh weight

TABLE 20

MONTHLY DISPOSALS OF LIZA MACROLEPIS (IN KG) DURING THE YEARS 1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	1,025	-	1,025	310	74	384	130	81	211	560	75	635
April	422	-	422	333	-	333	28	-	28	1,285	-	1,285
May	2,168	-	2,168	230	-	230	185	-	185	925	-	925
June	172	-	172	258	-	258	315	-	315	632	-	632
July	255	-	255	305	-	305	200	-	200	1,570	-	1,570
August	332	-	332	607	-	607	153	-	153	533	-	533
September	498	-	498	185	93	278	245	5	250	258	338	596
October	802	-	802	505	670	1,175	522	149	671	347	91	438
November	255	241	496	875	1,235	2,110	810	4,591	5,401	542	559	1,101
December	708	-	708	55	260	315	1,272	636	1,908	4,458	2,491	7,449
January	280	186	466	120	148	268	3,025	159	3,184	3,038	550	3,588
February	318	260	578	192	38	230	1,125	1,231	2,356	3,050	1,103	4,153
Total:-	7,238	687	7,925	3,975	2,518	6,493	8,010	6,852	14,862	17,398	5,207	22,305

* Expressed in terms of fresh weight

Khadi. Like other mullets, it is also caught essentially in the lower stretches, specially in the Hukitola lake and at Jatadharmohan. It is reported that Dangra, along with Khoinga, dominates the summer catches in the southern distributaries.

Individuals in commercial catches generally ranged in size from 150-650 mm, with the great majority of them falling within the size range of 200-350 mm. From the occurrence of mature and spent fish, it appears reasonable to presume that the species probably breeds during the winter months, possibly in the inshore waters of the sea. Fry of Dangra were observed in Hukitola and Jatadharmohan in fairly appreciable numbers.

b) POLYNEMIDS

i) Eleutheronema tetradactylum (Shaw) /"Bhusa Sahal"/

Bhusa Sahal is the more important of the two major polynemids of the estuary. It constituted 3.4% of the total four-year landings, with its annual contributions ranging from 1.1-6.1%. The annual landings varied from 6.5 m tonnes in 1961-'62 to 40.89 m tonnes in 1962-'63. The fishery underwent a sharp decline in the second year, followed by a significant improvement in the third year. It declined again during the fourth year.

A major portion of the landings (81-98%) was disposed off in dry state. Only during the third year an appreciable quantity was exported out in fresh condition during the period September-December. Details of monthly disposals of Bhusa Sahal during the four years are shown in Table 11. No set pattern could be discerned regarding dry disposals, but generally the post-monsoon or winter months constituted the peak period.

Bhusa Sahal is more susceptible to Ghai and Ghai-Chandi. It is also caught in Suta, Torania, Salua and Khepa. Among the sampled areas, Hukitola (mainly Zones I & II), main Mahanadi (Zones VI & VII) and Jatadharmohan (Zone VIII) constitute the main fishing grounds for this species. It is also caught in appreciable quantities in the lower stretches of Devi river and is reported to form a fishery of some magnitude in the southern distributaries during the summer months. The main fishing season for the species extends from August to February.

Unlike many other species, several size groups contributed to the Bhusa Sahal fishery, the size range being 110-790 mm (Text

figure 9). The majority were, however, within the size range of 190-390 mm, with the most prominent mode at 270 mm. The other modes that are discernible are at 370, 450 and 530 mm stages.

Post-larvae of this species, measuring 7.0-9.0 mm, were observed during the months February to July in the Hukitola lake at the points of inflow of streams like Kandrapatia, Gobri and Kharnasi. The period of occurrence of the post-larvae coincides with that of the same species in West Bengal waters, mainly in the sea at Jaunput, as observed by Sarojini and Malhotra (1952).

ii) Polydactylus indicus (Shaw) / "Nakkuda Sahal /

Nakkuda Sahal constituted 2% of the total four-year landings, with its contributions to the total annual landings ranging from 0.4% in 1963-'64 to 4.4% in 1961-'62. During the first year (1960-'61) it was landed in more or less equal quantities as Bhusa Sahal. However its fishery distinctly dominated that of the latter in the main Mahanadi and the adjoining waters down to Jatadharmohan. Only in Devi river Bhusa Sahal dominated the polynemid catches. The predominance of Nakkuda Sahal was more pronounced and was extended to the whole of the estuarine system in the second year, when its total landings amounted to 25.2 m tonnes. This was followed by a sharp decline in its fishery all over the estuary during the later two years.

There was hardly any fresh disposal of the species during the later two years, while it amounted to about 14% and 25% of the total landings during the years 1960-'61 and 1961-'62 respectively. Details of monthly disposals are depicted in Table 12.

Nakkuda Sahal is mainly caught by Kukut, Ghai, Chowka and Ghai-Salua. It is also caught in appreciable numbers by Torania and Salua. Zones I and II (Hukitola lake) and Zones VI & VII (main estuary) constitute the principal areas of availability. It is also available in Zones III and VIII and in the lower stretches of Devi river. While the months October-January constitute the main season of availability of the species in the main estuary and Jatadharmohan (Zones VI - VIII), it is fished almost throughout the year in the Hukitola lake, with the periods April-August and October-December constituting the more favourable periods.

As in the case of Bhusa Sahal, several size groups contributed to the Nakkuda Sahal fishery. The individuals varied in size from 110-830 mm, with a great majority of them falling within the

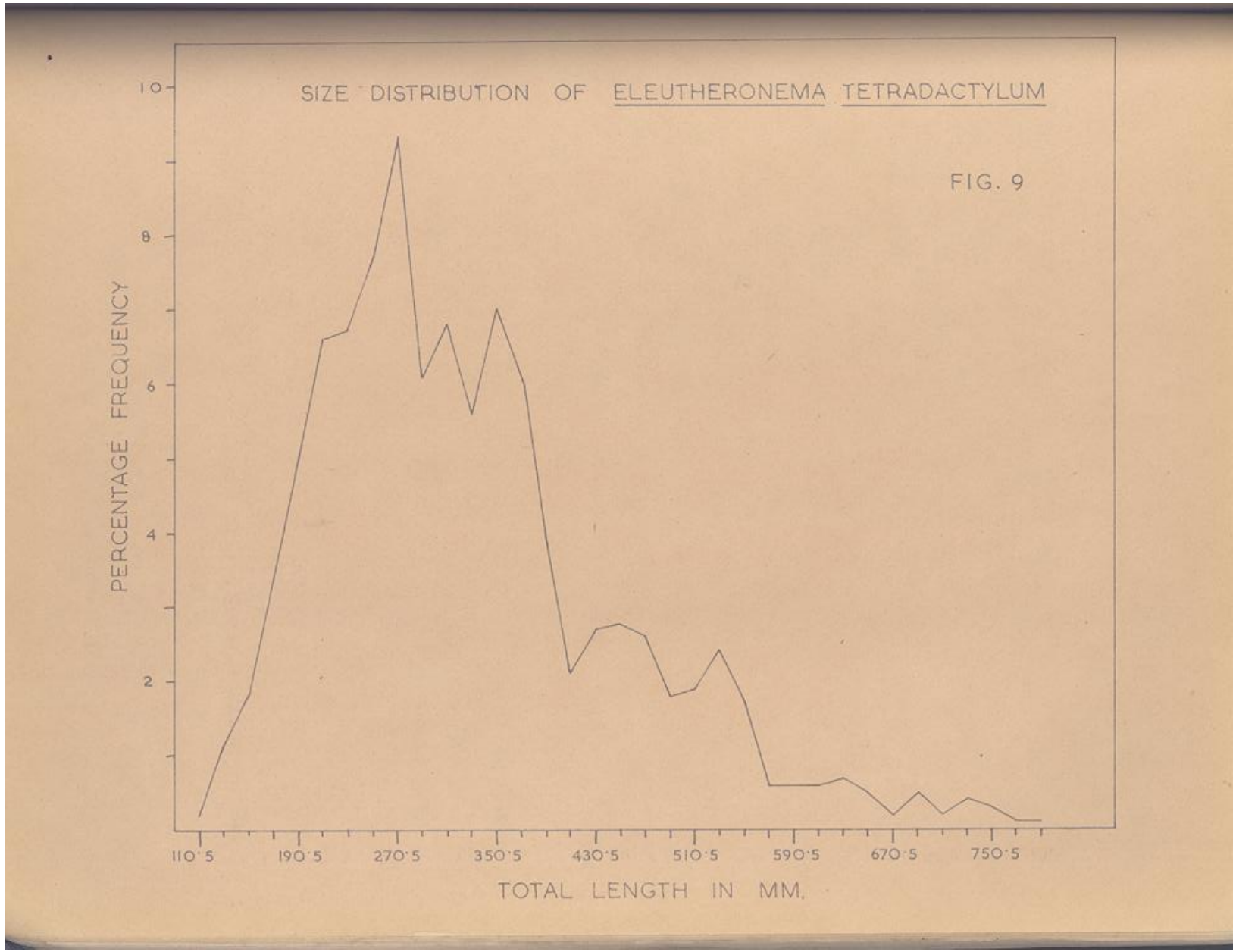

SIZE DISTRIBUTION OF ELEUTHERONEMA TETRADACTYLUM
FIG. 9
PERCENTAGE FREQUENCY
10
8
6
4
2
110·5
190·5
270·5
350·5
430·5
510·5
590·5
670·5
750·5
TOTAL LENGTH IN MM.

TABLE 11

MONTHLY DESPOSALS OF ELEUTHERONEMA TETRADACTYLUM (IN MT) DURING THE YEARS 1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	1,755	-	1,755	140	-	140	235	116	351	1,098	238	1,381
April	1,572	-	1,572	525	-	525	325	-	325	770	9	779
May	1,812	-	1,812	768	-	768	348	37	385	1,218	-	1,218
June	638	-	638	295	-	295	1,125	-	1,125	748	-	748
July	352	-	352	352	-	352	2,007	37	2,044	1,507	-	1,507
August	1,912	-	1,912	2,008	-	2,008	3,337	211	3,548	1,730	37	1,767
September	4,987	-	4,987	230	-	230	5,810	1,511	7,321	2,542	1	2,543
October	3,827	74	3,901	242	-	242	5,360	317	5,677	1,257	-	1,257
November	485	325	1,553	348	821	1,169	3,738	1,493	5,231	1,378	125	1,503
December	1,640	-	1,640	127	16	143	3,275	1,586	4,861	4,460	662	5,122
January	102	-	102	187	226	413	7,528	300	7,928	1,365	450	1,815
February	45	-	45	78	166	244	2,100	-	2,100	882	3	885
Total:-	19,128	399	19,527	5,300	1,229	6,529	35,288	5,608	40,896	18,955	1,570	20,525

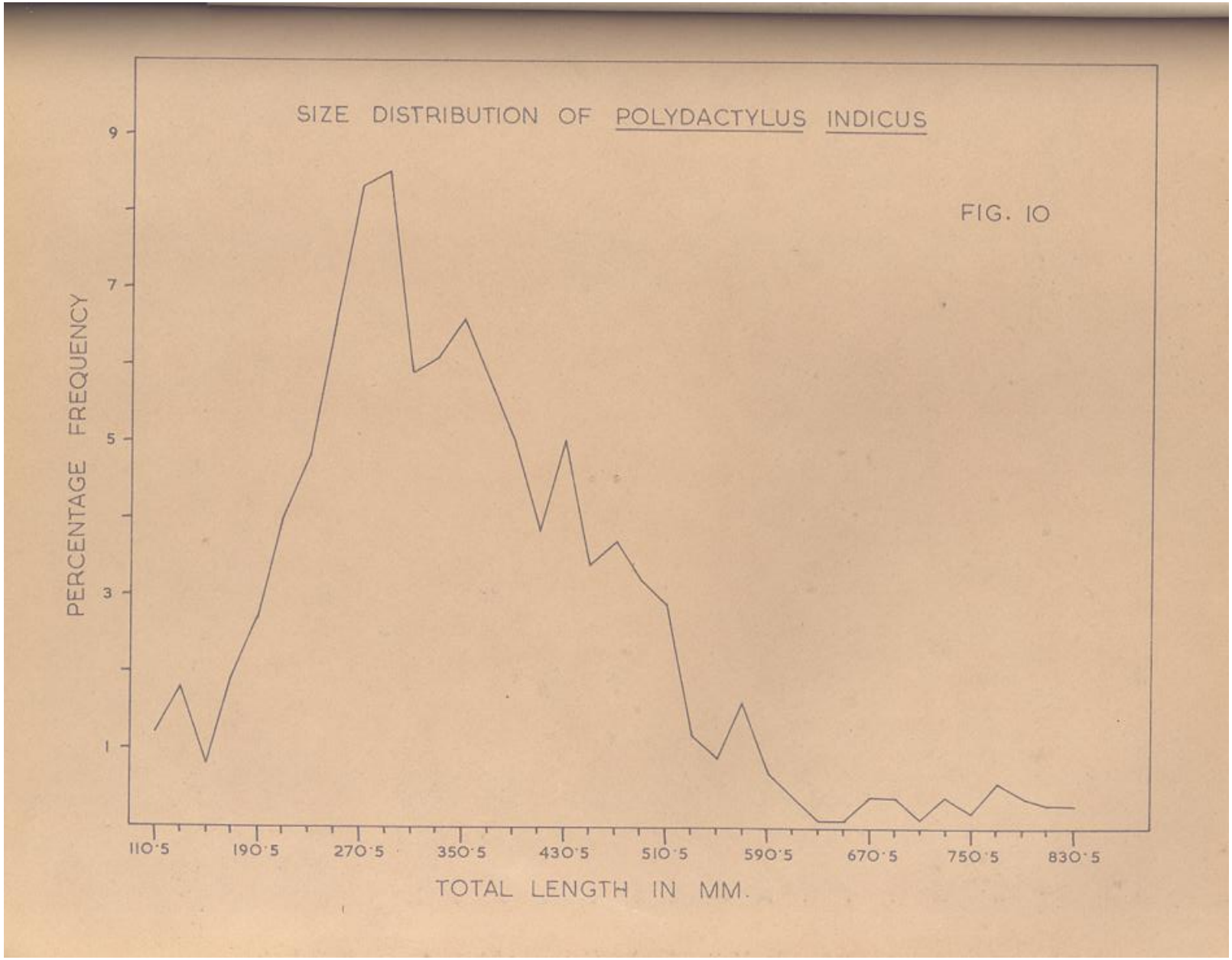
* Expressed in terms of fresh weight

TABLE 12

MONTHLY DISPOSALS OF POLYDACTYLUS INDICUS (IN KG) DURING THE YEARS 1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	280	37	317	1,275	23	1,298	185	62	247	480	1	481
April	1,242	-	1,242	890	-	890	105	-	105	282	13	295
May	1,410	-	1,410	792	-	792	465	-	465	90	6	96
June	2,238	-	2,238	807	-	807	1,540	-	1,540	73	2	75
July	918	-	918	1,330	3,310	4,640	148	-	148	-	-	-
August	1,072	-	1,072	4,503	74	4,577	270	-	270	130	6	136
September	1,700	582	2,282	4,413	1,460	5,873	38	-	38	200	-	200
October	2,565	1,060	3,625	4,040	828	4,868	372	-	372	248	-	248
November	2,960	259	3,219	433	374	807	252	37	289	458	-	458
December	930	9	939	40	47	87	640	19	659	25	70	95
January	348	716	1,064	215	81	296	707	-	707	12	-	12
February	795	10	805	150	140	290	338	-	338	-	1	1
Total:	16,460	2,673	19,133	18,888	6,337	25,225	5,060	118	5,178	1,998	99	2,097

* Expressed in terms of fresh weight


SIZE DISTRIBUTION OF POLYDACTYLUS INDICUS
FIG. 10
PERCENTAGE FREQUENCY
9
7
5
3
1
110·5
190·5
270·5
350·5
430·5
510·5
590·5
670·5
750·5
830·5
TOTAL LENGTH IN MM.

size range of 210-470 mm. The size frequency presents a multimodal curve, with the most prominent mode at 290 mm, followed by those at 350, 430 and 570 mm stages (text fig.10).

c) PERCHES

i) Lates calcarifer (Bloch) /"Bhekti", "Bhekta","Potti"/

An economically important fish, the Bhekti contributes to a flourishing fishery almost throughout the estuarine system, excluding the southernmost distributaries, where it is caught only sparingly in Daya and Makra during the summer months. On an average, it contributed to 3.7% of the total annual landings and taking the four-year period as a whole, it ranked fifth in the order of abundance, next to Hilsa, Khoinga, Khasuli and Chara. The annual landings ranged from 14.5-30.2 m tonnes. The fishery was more or less steady during the first three years and showed a sharp decline in the fourth year.

Being a highly-prized, quality fish, about 44% of the annual landings was disposed off in fresh condition, on an average. Among the major fisheries, this was exceeded only in the case of Hilsa. Even in terms of actual quantities of fresh disposal, Bhekti was second only to Hilsa. Details of monthly disposals are shown in Table 13. As could be seem therefrom, the period August-February accounted for almost the whole lot of fresh disposals, while dry disposals were spread out throughout the year.

Bhekti is caught by a variety of gear. It forms the exclusive catch of Juti and the major catch of Bekta, Torania, Kukut, Chowka, Khadi and Ghai-Chandi. It is also susceptible to Ghai, Ghai-Salua and Chandi-Chowka-Torania.

Bhekti is available all over the estuarine system. The main estuary below Paradip, Hukitola lake with the adjacent streams and Jatadharmohan form the main fishing grounds, with the main estuary accounting for 67.1% of Bhekti observed in the sampled catches of 1960-'62 (Table 16). Occasionally heavy catches of Bhekti were also made in Zone V. The Bhekti fishery in Devi river is comparatively poor. It can be seen from Table 17 that Bhekti formed the major component of the sampled catches of 1960-'62 in Zones V, VII & VIII.

The main fishing season for Bhekti extends from July to March, with the months October to December accounting for the greater part of the catches.

Individuals encountered in the commercial catches ranged in size from 110-890 mm, with most of them falling within the size range of 190-390 mm, with a prominent mode at 310 mm (text figure 11). Smaller distinct modes are discernible at 430, 510 and 630 mm stages. Fully mature individuals were observed in the winter catches at Jatadharmohan and fingerlings (60-80 mm) in large numbers were encountered in the same area during January and February.

d.) CLUPEOIDS

i) Hilsa ilisha (Hamilton) /"Ilish"/

Hilsa is by far the most important fish of the estuary, but is subject to very wide fluctuations in the magnitude of its fishery. While it completely dominated the estuary in the first two years, contributing to as much as 38.6% and 32.5% respectively of the total annual landings, its fishery underwent a sharp decline during the later two years, when it formed only 3.9% and 2.6% respectively of the total annual landings. In fact, there has been a progressive decline in its landings over the four years, from 309.7 m tonnes in 1960-61 to only 13.7 m tonnes in 1963-64. The reported silting up of the inshore areas of the sea adjoining the estuarine mouths and of certain interior estuarine areas like Jatadharmohan, might partly account for this decline.

Fresh Hilsa being in great demand in the Calcutta market, the major portion of the landings is exported out in fresh condition. The fresh disposals ranged from about 65-81% of the annual landings in the first three years and only during the fourth year it declined to 36.4%. It formed 56.4% of the total four-year fresh disposals of all species, with its annual contributions ranging from 6.9% to as much as 81.0%. As can be seen from Table 14, November-April and December-May constituted the peak periods of fresh and dry disposals respectively.

Hilsa is most susceptible to the gill nets Chandi and Soru and the composite gill net units Chandi-Chowka-Bada, Suta-Chandi-Chowka and Soru-Chandi-Chowka.

Hilsa ascends all parts of the estuarine system, including the southern distributaries. While above Devi river the main Hilsa fishery occurs during the winter months, it is during the monsoon months in the southern distributaries. Hukitola (specially Zone I),

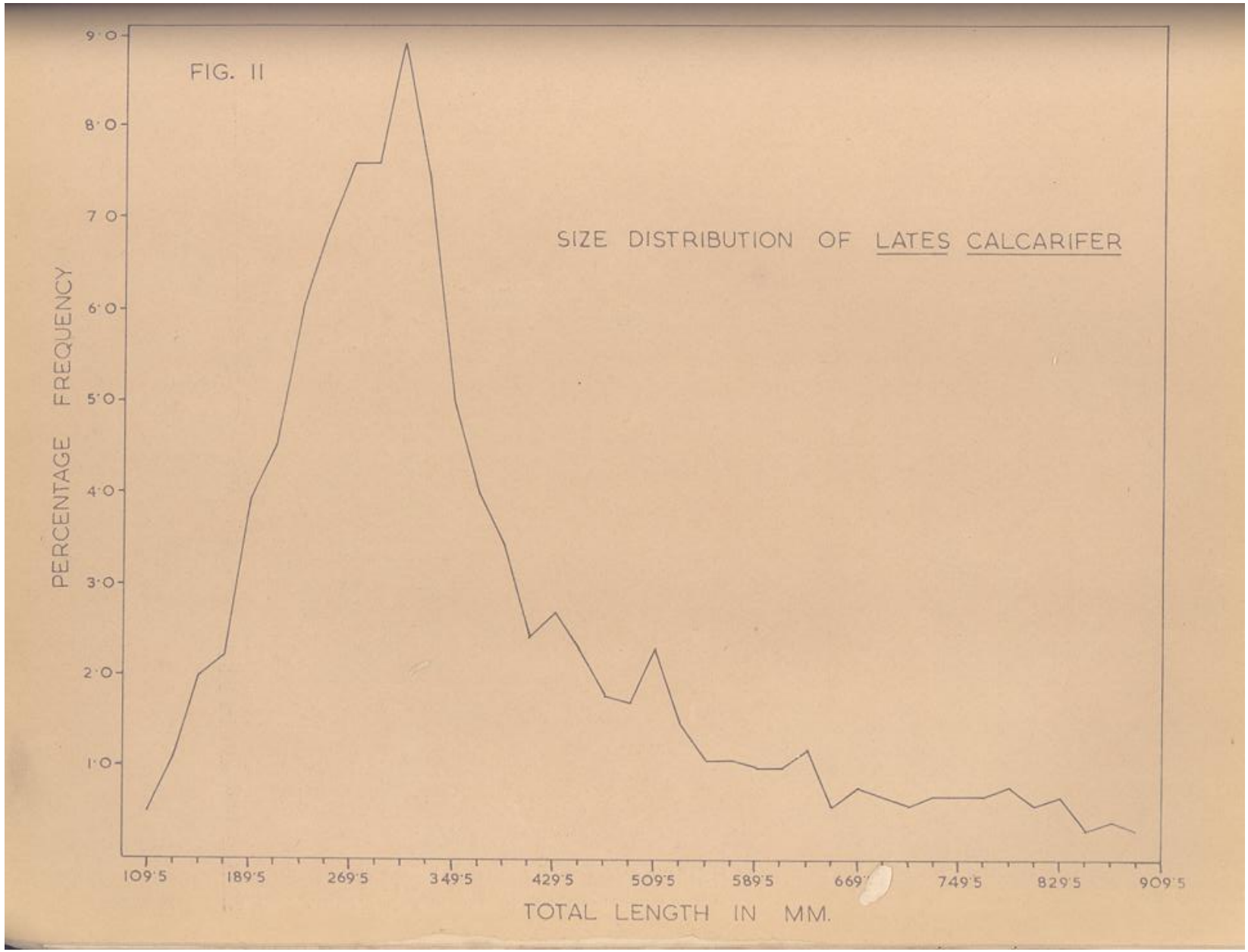


FIG. II
SIZE DISTRIBUTION OF LATES CALCARIFER
PERCENTAGE FREQUENCY
9·0
8·0
7·0
6·0
5·0
4·0
3·0
2·0
1·0
109·5
189·5
269·5
349·5
429·5
509·5
589·5
749·5
829·5
909·5
TOTAL LENGTH IN MM.

TABLE - 13

MONTHLY DISPOSAL OF LATES CALCARIFER (IN KG) DURING THE YEARS

1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	605	84	689	332	550	882	148	689	837	522	121	643
April	962	-	962	222	-	222	65	-	65	648	152	800
May	1,105	-	1,105	990	-	990	140	19	159	608	63	671
June	552	-	552	1,005	-	1,005	772	3	775	850	13	863
July	1,160	-	1,160	1,450	-	1,450	370	179	549	472	20	492
August	1,678	-	1,678	2,528	140	2,668	812	1,226	2,038	1,252	344	1,596
September	3,010	744	3,754	3,545	493	4,038	1,175	3,508	4,683	542	7	549
October	2,373	4,165	6,538	2,195	1,265	3,460	810	1,693	2,503	1,835	90	1,925
November	3,648	6,951	10,599	1,295	4,900	6,195	1,228	5,328	6,556	630	483	1,113
December	1,952	34	1,986	125	1,934	2,059	3,118	2,314	5,432	2,318	1,655	3,973
January	460	660	1,120	130	506	636	1,042	737	1,779	260	1,219	1,479
February	45	130	148	328	1,833	2,161	540	19	559	368	93	461
Total:-	17,548	12,741	30,289	14,145	11,621	25,766	10,220	15,715	25,935	10,305	4,260	14,565

* Expressed in terms of fresh weight

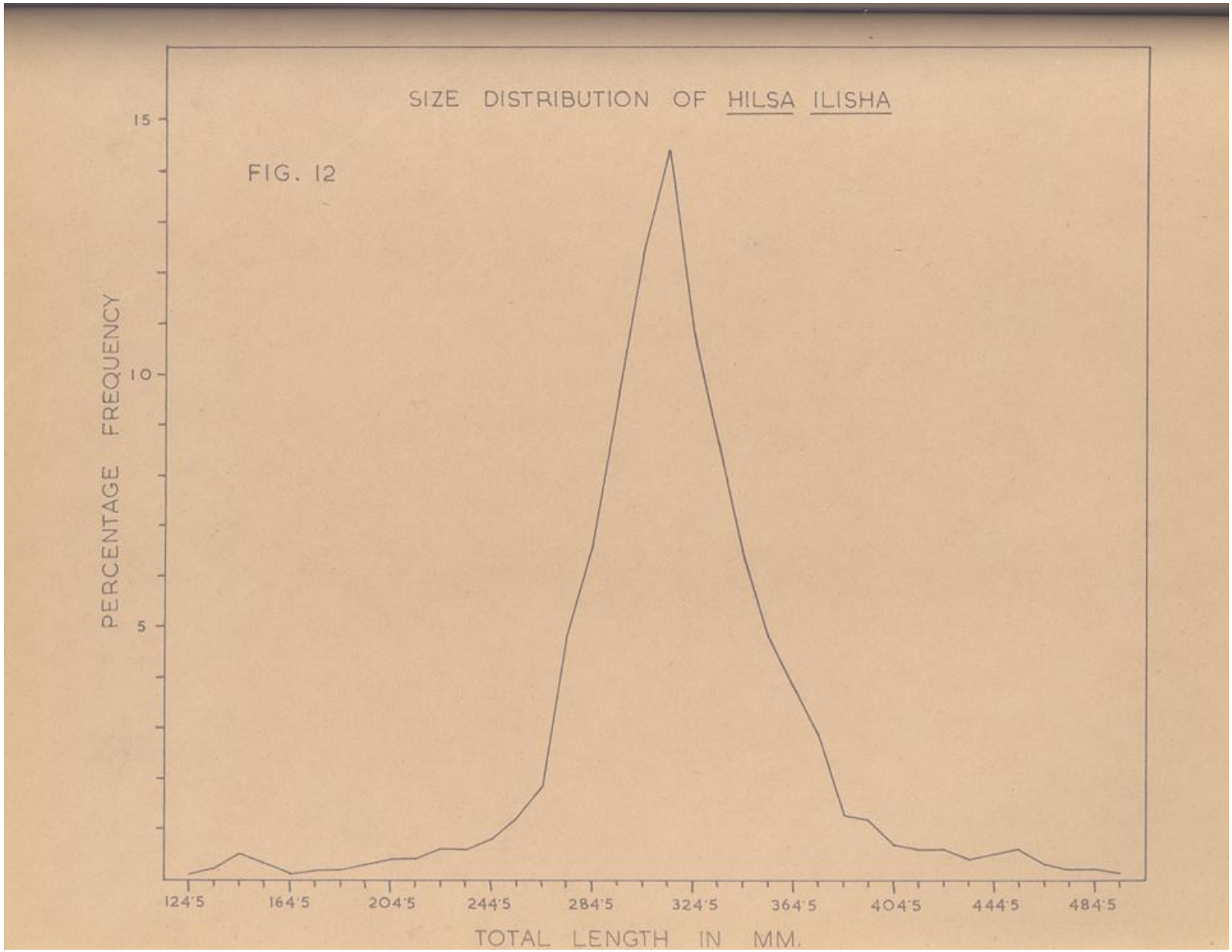
TABLE 14

MONTHLY DISPOSALS OF HILSA ILISHA (IN KG) DURING THE YEARS

1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	4,062	3,831	7,893	12,390	10,377	22,767	3,142	1,729	4,871	3,987	213	4,200
April	2,680	-	2,680	4,162	726	4,888	2,693	15,144	17,837	218	14	232
May	1,465	-	1,465	7,542	-	7,542	2,225	-	2,225	278	-	278
June	140	-	140	462	-	462	810	-	810	45	18	63
July	25	-	25	-	-	-	95	-	95	-	-	-
August	-	-	-	-	186	186	-	-	-	1,405	-	1,405
September	-	-	-	-	-	-	-	18	18	108	-	108
October	-	-	-	-	-	-	15	75	90	-	-	-
November	368	149	517	242	5,337	5,579	-	9	9	-	-	-
December	17,302	125,011	142,313	4,353	40,510	44,863	-	355	355	1,032	720	1,752
January	19,658	39,612	59,270	15,378	66,046	81,424	-	3,613	3,613	340	2,945	3,285
February	14,185	81,289	95,474	3,683	12,878	16,566	4,660	4,068	8,728	1,302	1,084	2,386
Total:-	59,884	249,892	309,776	48,218	136,060	184,278	13,640	25,011	38,651	8,715	4,994	13,709

*Expressed in terms of fresh weight


SIZE DISTRIBUTION OF HILSA ILISHA
FIG. 12
PERCENTAGE FREQUENCY
15
10
5
124·5
164·5
204·5
244·5
284·5
324·5
364·5
404·5
444·5
484·5
TOTAL LENGTH IN MM.

Chowmohani (Zone VI), Narayanpur (Zone IV), Ostar (Zone V), Jatadharmohan and Devi river constitute the main fishing grounds. During the bumper year 1960-'61, as much as 700 maunds of hilsa were at times landed in a single operation, involving hundreds of men, boats and nets. Hilsa formed the major component of the sampled catches of 1960-'62 in Zones I, IV & VI (table 17). Its ascent up the estuary in huge shoals generally commences in November and lasts upto April.

The length frequency distribution of individuals encountered in the commercial catches presents a unimodal curve, indicating thereby the narrow range of selectivity of the gear used. The individuals ranged in size from 125-495 mm, with the 275-355 mm size group constituting the major bulk. The modal langth was 315 mm.

Mature specimens of Hilsa were observed both during the monsoon and winter months. Post-larvae of Hilsa, measuring 4.0-15.0 mm, were encountered in large numbers in the Hukitola lake at the points of inflow of the streams Kandrapatia and Kharnasi from July to October. This is indicative of the possibility of Hilsa breeding in the Hukitola lake. Even though Hukitola is close to the sea, the breeding evidently occurs during the monsoon months, when the salinity is considerably lowered by the flood waters. The possibility of similar breeding of Hilsa in the northern part of Chilka lake, when its waters become practically fresh due to discharges from rivers like Daya, has been suggested by Mitra and Devasundaram (1954).

Large number of post-larvae of Hilsa, measuring 8.0-17.0 mm were seen from June to April in the upper stretches of the main estuary between Paradip and Taldanda, with the heaviest concentration between Kujang and Taldanda, a stretch of about three miles. This forms the fresh water zone of the estuary and it is very likely that this region forms one of the main spawning grounds of Hilsa, both during the monsoon and early winter months. Further, according to Jones and Menon (1951) and Jones and Sujansingani (1951), Hilsa breeds in the lower reaches of Daya during the monsoon months, as evidenced by the presence of its eggs and larvae.

ii) Other Clupeoids

Clupeoids other than Hilsa, constituted on an average 9.4% of the annual landings. The fishes involved were Sardinella spp., Thrissocles spp., Nematalosa nasus, Ilisha spp. and Anchoviella spp., Because of the inability of the field staff to identify the individual species, specially in dried condition, species-wise data could not be obtained, except for Nematalosa nasus.

Nematalosa nasus (Bloch), termed locally as 'Bolong', formed 2.0% of the total four-year landings, with its annual contributions varying from 1.3-2.7%. The landings were maximum during the first year (21.5 m tonnes) and declined considerably in the subsequent years. Practically the entire catch was disposed off in dry condition. Bolong is mainly susceptible to Suta, Khadi and Torania-Salua. Although it is encountered in most regions of the estuary, it formed a sizable fishery from March to September mainly in Devi river and at Jatadharmohan.

Even though Sardinella spp. together contributed to 3.7% of the total four-year landings, they commanded little commercial value and almost the entire catch was marketed in salt-cured condition. No Sardinella was ever observed in the sampled catches of Zones I - VIII and almost all the landings were reportedly from near the mouth of Devi river. It is possible that at least a part of the catch is actually taken from the inshore waters of the sea adjoining the Devi river mouth. The fishery was more or less steady during the first three years, while it increased considerably during the fourth year. The annual landings ranged from 16.6 to 44.4 m tonnes.

Thrissocles spp. ('Phasa') were available almost throughout the estuary and formed a sizable fishery in the main estuary and to a lesser extent in the Hukitóla lake. The main estuary accounted for 93.5% of Thrissocles spp. in the catches sampled during the period 1960-'62 (table 16). As could be seen from table 17, they formed a major component (20.5%) of the catches of —— Zone VII during the period. While December-January constituted the main fishing season for Thrissocles spp. in the Hukitola lake, it lasted over a longer period from November to May in the main estuary. Individuals in commercial catches ranged in size from 100-310 mm, with the great majority measuring between 150 and 200 mm. They were caught mainly by Suta and Soru. T.mystax was the dominant species, the others being T.purava, T.kammalensis, T.hamiltonii and T.rambhae.

Post-larvae of T.mystax, measuring 5.5-25.0 mm, were observed from April to August in all the zones, except Zone IV and V, with maximum concentrations in the Hukitola lake at the points of inflow of Kandrapatia, Kharnasi and Ramchandi streams, during the months of April and May. Post-larvae of T.kammalensis were observed in the Hukitola lake during November, while those of T.purava in the main estuary during May and June.

The fishery for Ilisha spp. remained more or less steady throughout the four years, with the annual landings ranging from

4.8-6.5 m tonnes. They formed only 0.9% of the total four-year landings. However, because of their large size a good portion (about 40%) of the landings was disposed off in fresh condition. Lower Mahanadi (Zone VII), which constituted the main fishing ground, contributed to 83.4% of Ilisha spp., observed in the sampled catches of 1960-'62. They formed the major component of Zone VII catches during the period. The main fishery generally lasted from December to April. They were mainly caught by Suta and Soru. Three species, namely I.elongata, I.motius and I.filigera, contributed to the Ilisha fishery.

Except in the first year, when a total of 5.0 m tonnes was landed, there was hardly any fishery for Anchoviella spp. They were caught in very negligible quantities in Mala and Jalei, whose main catch consisted of prawns.

e) CATFISHES

The catfishes together contributed to only 1.9% of the total four-year landings, with their annual landings varying from 2.5-18.8 m tonnes. Pangasius pangasius, Tachysurus spp. and Mystus spp. constituted the main constituents of the catfish fishery. Occasionally Osteogeneiosus militaris was also landed in appreciable quantities. Catfishes other than the above formed only a negligible part of mixed miscellaneous catches and as such have been taken under the 'miscellaneous' group in computing catch statistics.

Tachysurus spp. formed 1% of the total four-year landings. From a landing of 11.3 m tonnes in the first year, the fishery dwindled to 1.5 m tonnes in the fourth year. They were available in all the zones almost all through the year, being more common during the early winter months. Zones I, II, IV, VI & VIII constituted the main fishing grounds. They were susceptible to a variety of gear, specially the Torania, Kukut, Suta and Soru. T.jella was the most dominant species.

Pangasius pangasius ("Jalanga") afforded a fishery of some magnitude only in the upper stretches, with occassional heavy landings mainly during the period October-March. Zones IV, V & VI and the upper stretches of Devi river constituted the main fishing grounds. It was susceptible to Chandi and Suta-Chandi-Chowka in the main and to a lesser extent to Chowka, Torania and Kukut.

Mystus spp. are widely distributed in the estuarine system, with greater concentration in the lower stretches, specially of the

main estuary. September to December constituted the main fishing season. On an average they contributed to only 0.6% of the total annual landings. Among the five species recorded, M gulio. M.seenghala and M.aor were more common. They were mainly landed by Salua, Khadi and Torania.

f) SCIAENIDS

The annual landings of sciaenids ranged from 14.8-49.5 m tonnes, forming 2.6-7.4% of the total annual landings. Several large-sized forms like Otolithoides biauritus, O.brunneus, Sciaena cuja and Sciaena miles dominated the sciaenid catches. This is probably the first record of O.brunneus on the east coast of India and that too in commercial quantities. A major part (68-94%) of the sciaenid landings was disposed of in dry condition, as these constitute low quality fish.

Sciaenids are landed by a wide variety of gear, the more important among them being Torania, Kukut, Ghai, Khadi and Salua. They are widely distributed, with greater concentrations in the lower stretches. Hukitola lake and the main estuary form the main fishing grounds. The landings were generally heavier during the early winter months.

g) PRAWNS

Taken as a group, the prawns constituted the third most important group, next only to the mullets and clupeoids. On an average they contributed to about 12.5% of the total annual landings. The annual landings progressively increased from 73.7 m tonnes in 1960-61 to 113.9 m tonnes in 1962-'63, after which there was a sudden decline. They afforded a fishery of some magnitude in all the zones, but Hukitola and Jatadharmohan were the main fishing grounds, where the prawns constituted the major component of the catches. While the winter months formed the main fishing season for prawns in Hukitola, it was during the monsoon months in Jatadharmohan and the main estuary. Prawns are most susceptible to Mala, Jalei and Khadi. Bigger individuals are also landed by Kukut and Torania. About 10-20% of the annual landings were exported out in fresh condition. Details of monthly disposals are shown in table 15.

Leander styliferus, Penaeus indicus, P.carinatus, Metapenaeus brevicornis and Acetes sp. were more prominent in the catches

TABLE 15

MONTHLY DISPOSALS OF PRAWNS (IN KG) DURING THE YEARS 1960-'61 TO 1963-'64

MONTHS	1960-'61			1961-'62			1962-'63			1963-'64		
	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total	*Dry	Fresh	Total
March	1,415	-	1,415	2,605	1	2,606	1,555	32	1,587	7,348	-	7,348
April	2,958	-	2,958	5,518	-	5,518	1,620	16	1,636	5,098	-	5,098
May	3,627	-	3,627	2,570	-	2,570	2,762	6	2,768	6,550	9	6,559
June	6,157	-	6,157	1,508	-	1,508	3,552	50	3,602	6,352	7	6,359
July	6,995	-	6,995	1,882	744	2,626	11,438	1,951	13,389	2,172	41	2,213
August	4,615	350	4,965	10,352	3,552	13,904	4,432	2,496	6,928	8,492	682	9,174
September	3,470	362	3,832	8,215	6,230	14,445	6,058	672	6,730	2,858	2,793	5,651
October	14,725	4,276	19,001	11,848	3,989	15,837	10,073	6,423	16,496	2,085	1,747	3,832
November	15,258	2,450	17,775	8,805	488	9,293	22,940	4,740	27,680	2,950	465	3,415
December	3,385	9	3,394	5,365	1,240	6,605	18,225	37	18,262	2,125	208	2,333
January	230	10	240	5,190	37	5,227	9,282	-	9,282	1,688	-	1,688
February	318	112	430	340	11	351	5,568	-	5,568	1,325	19	1,344
Total:-	66,147	7,569	73,716	64,197	16,292	80,489	97,505	16,423	113,928	49,043	5,971	55,014

* Expressed in terms of fresh weight

TABLE 16

ZONE-WISE ABUNDANCE (%) OF VARIOUS SPECIES/GROUPS IN THE SAMPLING ZONES, DURING 1960-'62

Species \ Zone	1	2	3	4	5	6	7	8	Total
1. Mullets:									
(a) M.cephalus	8.9	14.1	5.0	-	-	27.4	-	44.6	100.0
(b) M.cunnesius	40.4	22.7	18.5	0.5	-	8.0	8.9	1.0	100.0
(c) M.parsia	-	21.4	3.5	-	-	34.4	38.3	2.4	100.0
(d) M.tade	-	8.5	-	-	-	30.9	-	60.6	100.0
(e) L.macrolepis	69.3	-	-	-	-	4.5	1.0	25.2	100.0
(f) Mullets mixed	-	1.7	-	-	-	-	98.3	-	100.0
Sub-total	24.1	18.7	10.9	0.2	-	15.9	23.5	6.7	100.0
2. Polynemids:									
(a) P.indicus	27.9	28.9	7.1	-	-	14.0	16.3	5.8	100.0
(b) E.tetra-dactylum	15.8	40.6	0.2	-	-	8.0	21.2	14.2	100.0
Sub-total	25.5	31.3	5.7	-	-	12.8	17.3	7.4	100.0
3. Perches:									
L.calcarifer	5.4	6.0	2.7	0.8	9.9	30.8	36.3	8.1	100.0
4. Cluepoids:									
(a) Hilsa ilisha	29.3	-	-	6.1	0.2	60.0	4.4	-	100.0
(b) Nematalosa spp.	-	-	-	-	-	-	-	100.0	100.0
(c) Sardinella spp.	-	-	-	-	-	-	-	-	-
(d) Anchoviella spp.	-	100.0	-	-	-	-	-	-	100.0
(e) Ilisha spp.	-	0.1	-	-	-	3.9	96.0	-	100.0
(f) Thrissocles spp.	1.7	2.6	1.0	0.5	-	10.1	83.4	0.7	100.0
Sub-total	24.8	0.3	0.1	5.2	0.2	51.7	17.6	0.1	100.0
5. - - -									
(a) Mystus spp.	-	8.3	0.3	8.3	-	28.4	43.4	11.3	100.0
(b) O.militaris	38.8	5.6	35.4	-	-	20.2	-	-	100.0
(c) P.pangasius	2.2	-	3.3	66.9	12.2	15.4	-	-	100.0
(d) Arius spp.	13.8	14.5	2.6	12.4	0.4	21.8	31.3	3.2	100.0
Sub-total	10.1	8.8	5.3	22.5	2.9	21.8	24.4	4.2	100.0
6. Sciaenids	5.3	28.5	2.2	5.2	1.2	23.7	27.6	6.3	100.0
7. Prawns	2.1	29.1	2.3	1.4	3.1	17.5	3.8	40.7	100.0
8. Miscellaneous	9.7	23.6	2.5	20.8	0.2	6.0	31.9	5.3	100.0
Grand total	18.8	8.9	1.9	5.5	1.3	37.7	19.5	6.4	100.0

TABLE 17

PERCENTAGE SPECIES COMPOSITION OF SAMPLED CATCHES IN VARIOUS ZONES DURING 1960-'62

Specius \ Zone	1	2	3	4	5	6	7	8	Total
1. Mullets:									
(a) M.cephalus	0.4	1.2	1.9	-	-	0.5	-	5.3	0.7
(b) M.cunnesius	8.8	10.4	39.1	0.3	-	0.9	1.9	0.6	4.1
(c) M.parsia	-	4.8	3.7	-	-	1.8	4.0	0.8	2.0
(d) M.tade	-	0.1	-	-	-	0.1	-	0.6	0.1
(e) L.macrolepis	1.0	-	-	-	-	*	*	1.1	0.3
(f) Mullets mixed	-	0.1	-	-	-	-	3.7	-	0.7
Sub-total	10.2	16.6	44.7	0.3	-	3.3	9.6	8.4	7.9
2. Polynemids:									
(a) P.indicus	3.4	7.4	8.3	-	-	0.9	1.9	2.1	2.2
(b) E.tetra-dactylum	0.5	2.5	0.1	-	-	0.1	0.6	1.2	0.6
Sub-total	3.9	9.9	8.4	-	-	1.0	2.5	3.3	2.8
3. Perches									
L.calcarifer	2.0	4.7	9.9	1.1	54.1	5.8	13.2	9.0	7.1
4. Cluepoids:									
(a) Hilsa ilisha	76.1	-	-	53.9	8.7	77.9	11.1	-	49.0
(b) Nematalosa spp.	-	-	-	-	-	-	-	0.6	*
(c) Sardinella spp.	-	-	-	-	-	-	-	-	-
(d) Anchovi ella spp.	-	0.6	-	-	-	-	-	-	0.1
(e) Ilisha spp.	-	*	-	-	-	0.4	20.8	-	4.2
(f) Thrissocles spp.	0.4	1.4	2.5	0.4	-	1.3	20.5	0.5	4.8
Sub-total	76.5	2.0	2.5	54.3	8.7	79.6	52.4	1.1	58.1
5. Cat fishes:									
(a) Mystus spp.	-	0.8	0.1	1.3	-	0.7	1.9	1.6	0.9
(b) O.militaris	0.7	0.2	6.1	-	-	0.2	-	-	0.3
(c) P.pangasius	0.1	-	1.3	9.4	7.3	0.3	-	-	0.8
(d) Arius spp.	1.0	2.4	2.0	3.3	0.4	0.8	2.4	0.7	1.4
Sub-total	1.8	3.4	9.5	14.0	7.7	2.0	4.3	2.3	3.4
6. Sciaenids	1.1	12.2	4.4	3.6	3.6	2.4	5.4	3.8	3.8
7. Prawns	1.2	34.2	12.4	2.7	25.0	4.9	2.1	66.8	10.5
8. Miscellaneous	3.3	16.9	8.2	24.0	0.9	1.0	10.5	5.3	6.4
Grand total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Among the others, mention should be made of Palaemon carcinus, large-sized males and berried females of which could be observed in fairly large numbers at Chowmohani and Hukitola from February to April.

6. Summary of the distribution and abundance of various fisheries in the sampling zones

For reasons already enumerated earlier, the 'Water Zonation Survey' could not be effectively carried out and as such the data gathered therefrom may not exactly reflect the correct disposition of the various fisheries in the sampling zones. It is, however, believed that the available data at least throw some light on the likely trends and much of it could be confirmed to a large extent by personal observations, while in some others the incompleteness of the data was only too glaring. The data presented in tables 16 and 17 require to be viewed in the light of the above statement.

Table 16 presents zone-wise abundance, in percentages, of various species or groups in the sampling zones for the period 1960-'62. While Mugil cephalus and M.tade were caught in their largest numbers in Zone VIII, M.cunnesius and Liza macrolepis were most abundant in Zone I and Mugil parsia in Zone VII. Zone II and Zone VII constituted the principal fishing grounds for the polynemids and Bhekti respectively. Hilsa was most abundant in Zone VI, while the adjoining Zone VII was the main fishing ground for the clupeids Thrissocles spp. and Ilisha spp. and the catfishes Mystus spp. and Tachysurus spp. Zone II, closely followed by Zones VII and VI, formed the principal fishing grounds for the sciaenids, while the prawns were most abundant in Zone VIII, followed by Zone II.

In table 17 is presented the percentage species composition of the sampled catches in various zones for the period 1960-'62. Hilsa conspicuously dominated the catches in Zones I, IV and VI, while Bhekti and Chara were likewise predominant in Zones V and III respectively. In Zone VIII prawns were the most predominant, followed by Bhekti and Khoinga.

7. Occurrence of fish larvae and juveniles

Mention has already been made in a preceding section regarding the occurrence of larvae and juveniles under individual species. A consolidated account is given below of their distribution in time and space in the estuary.

Larvae and juveniles of several non-economic species were commonly encountered in the collections. However, the survey also brought out some important facts regarding a few of the economic species.

Large numbers of post-larvae of Hilsa ilisha occur during the monsoon months in Hukitola lake and from June to April in the upper stretches of the main estuary between Paradip and Taldanda, specially in the stretch between Kujang and Taldanda. The occurrence of eggs and larvae of Hilsa in the lower reaches of Daya has been reported by earlier workers, as already pointed out in a preceding section.

In the area around Nuliasahi in Jatadharmohan, large numbers of fingerlings of Bhekti (Lates calcarifer), measuring 60-80 mm, were encountered in the collections during December and January. This fact combined with the availability of fully ripe specimens in the area, indicates the possibility of its breeding near this region, probably in the adjoining inshore waters of the sea. This area can serve as a good collection centre for the seed of Bhekti. Jhingran et al (op. cit.) have reported the occurrence in Chilka lake of advanced fry and advanced fingerlings of Bhekti during July-August and September-October respectively and have inferred June-July as its likely breeding period. In the case of Mahanadi Bhekti on the other hand, the breeding period appears to be a little later, probably during October-November.

Post-larvae of the threadfin Eleutheronema tetradactylum could be obtained all over the Hukitola lake from February to June, while those of the cultivable fish Megalops cyprinoides were encountered in good numbers from April to August in the Hukitola lake, lower reaches of the main estuary and Jatadharmohan. These are evidently brought in from the inshore areas of the sea along with the tide.

Several centres for the collection of mullet seed have been located in the estuary. Post-larvae and juveniles of Mugil cephalus were encountered in good numbers from January to May in the Hukitola lake, Ramchandi R. and lower Mahanadi. Post-larvae and juveniles of M.parsia and M.cunnesius were found in appreciable numbers in the Hukitola and lower Mahanadi during November-January and June-July respectively. Post-larvae of M.corsula were available in the upper reaches of the main estuary during the winter months.

Post-larvae and juveniles of Thrissocles mystax were encountered in appreciable numbers in all the zones, except Zones IV & V, from April to August. Post-larvae of T.kammalensis were recorded in the Hukitola lake and in Jatadharmohan during November.

V. FISH TRADE

As has already been pointed out earlier, the greater portion of the Mahanadi estuarine catches is disposed off along certain regular channels. On an average about 72% of the catches is Sun-dried or salt-cured, while the remaining 28% is disposed off in the fresh condition. While over 70% of the fresh fish is exported out of the State to the Howrah wholesale market, the dry fish is marketed entirely within the State through a series of haats or shandies, spread out all over the Mahanadi deltaic area and even beyond up to Jajpur and Chandbali.

1. Fresh fish trade

More often than not, specially during the winter season, fresh fish from distant places like Jatadharmohan and Hukitola region is collected at the fishing ground itself by fish merchants or their agents and carried by them to packing centres in their boat, which is either an ordinary country boat, or a small mechanised boat with outboard motor. During some years the Orissa Directorate of Fisheries has been operating a carrier launch service from Hukitola to Kujang during the peak season, collecting hire charges from the fishermen or fish merchants making use of the launch. The catches made in the vicinity of Paradip are mostly landed at Paradip and similarly the Hukitola catches are at times landed at Jamboo-ghat or even at Paradip, if they are not sold off on the fishing ground itself. Quite a few of the fishermen have to sell their catches to some particular fish merchants, to whom they are indebted through loans or advance payments. Others have the choice to invite bidding from the merchants at landing centres like Paradip and Jamboo ghat. The catches that are being taken to Kujang from Paradip and Hukitola regions are carried right through in boats, while those from Jatadharmohan are taken upto Balitutha by boat and from there as head-loads to Kujang. Usually the merchants take some ice with them to the fishing grounds for preliminary packing and later at Kujang the fishes are finally packed with intermediate layers of ice in bamboo baskets and sent by truck or jeep to Cuttack, from where most of it is exported to Howrah. During

the earlier part of the Survey, the State Dept. of Fisheries was providing the ice and the truck on some fixed charges, while later on the ice and truck were being provided by a private party (Messrs Sardar & Bros.). In addition to this a few merchants were transporting fish thro' their own trucks or jeeps.

Some merchants frequent Jamboo-ghat and Marsaghai on bicycles for collecting fresh fish for sale in towns like Kendrapara or in haats of the area. For some time a carrier truck was operating between Jamboo and Jagatpur and the catches thus carried were being sent to Howrah from Jagatpur.

The catches of the Devi river, assembled at Machgaon during the peak season, are taken by merchants in their trucks or jeeps to Cuttack and sent from there to Howrah by rail. Since there is no ice plant at Machgaon, the merchants carry it from the Bhima Ice Factory, Cuttack. The occasional heavy catches made in the southern tributaries are usually collected by merchants from Kaluparaghat, Bhusandpur and Khurda Road and they are dispatched from those respective places to Howrah by rail.

2. Dry fish trade

During the off-season and when fresh fish merchants fail to turn up during the peak season, the catch is either sold to dry fish merchants who frequent the fishing grounds or is dried or cured by the fishermen themselves. The merchants usually come in big spacious boats and the curing is done mostly in their boats themselves, while the fishermen do it either in their boats or on land nearest to the fishing ground. There is no fixed place, noris there any curing yard. The bilaterally flattened fishes like some of the engraulids, clupeids, Silver bellies, and juveniles of many other fishes and small-sized prawns are usually sun dried, while others are salt cured. For curing, an incision is made first on the right side just anterior to the caudal fin and then the incision is extended along the dorso-median line right up to the snout tip; the gut and gonad are removed and the fish salted and dried. In the case of big individuals of mullets, threadfins, Hilsa, etc., the gonad is also cured separately.

The fish thus dried are generally marketed in a large number of bi-weekly haats or shandies, spread out all over the Mahanadi deltaic area and even beyond the north as far up as Jajpur and Chandbali. In the haats of the Mahanadi deltaic area the dry fish are mostly sold by the local fishermen, while in the northern regions

the trade is dominated by merchants from Gopaljipatna and Balkathi, who collect Mahanadi fish mainly from the fishing grounds and at times also from Kujang and Marsaghai haats . Their boats carry about 150-200 maunds of dry fish. Usually these merchants do not themselves sell the fish in haats . They sell to other retail merchants and hawkers either from their godowns or directly from their boats wherever they are camping. Most of the fish is taken north, while at times they go along the Taldanda canal to Cuttack, Suvarnapur and Bankī.

Of the numerous haats only a few are primary haats , where the fish enters the open market for the first time. Others are fed from these haats and hence termed secondary. In addition to their marketing in haats , dry fish are also sold by hawkers to some extent. In some parts, this is reported to be considerable in certain seasons.

Weighing of both the dry and fresh fish is done thro' a locally contrived balance, known as the "Bissa Kathi", which consists of a single pan suspended from narrow end of a heavy beam. Only Hilsa, when it is landed in good numbers, is sold by numbers, in terms of "Pān" (80) or "Kahān" (16 "Pāns").

VI. FISHING COMMUNITIES, FISHING RIGHTS AND SOCIO-ECONOMICS

1. Fishing communities

As has been pointed out earlier, fishing in the Mahanadi's estuarine areas is carried out by the Koibartas, the caste fishermen and to a lesser extent by the Ghokas. Subsistence fishing is sporadically resorted to by some other higher communities as well, like the Kondayats, Chowkias (Vaishnav sect), etc, wherein unconventional methods are employed, since they have no legal rights to fish with nets. In every village where fishermen are present, their houses are clustered together separately, a little away from the houses of other communities. Among the refugee fishermen around Jamboo, those engaged in fishing belong to the Kshatriya and Sudra communities.

2. Fishing rights

The system of fishing rights is not uniform throughout the estuarine system. The fishermen of the erstwhile Kujang State have the freedom of unrestricted fishing in the waters above Jatadharmohan, for which it is gathered, they collectively pay an annual tax of Rs.501/- to the State Government. On the other hand in the rivers Devi, Daya, Bhargavi, Nun and Makra, definite water areas are annually leased out by auction to fishermen from the adjoining villages. As such in the latter case, in any water area only those who have obtained the lease right can fish. There is no separate licensing of the gear anywhere in the system. In addition to the normal fishermen community of Koibartas or Keoots, as they are called, fishing is also carried out by Ghokas, belonging to the depressed classes. However, they do not have any right to fish with nets and therefore they resort to fishing with bamboo screens (Salua), used as set barriers along the shore. The fishing rights in the estuarine areas of erstwhile Kujang state, held by its fishermen, are so rigid, as not to permit new fishermen settling in the area any fishing right. As such the large number of well-equipped and enterprising Bengali fishermen in the refugee villages of Jamboo, Kharnasi and Ramnagar are unable to resort to their traditional profession. During the early part of the survey it was found that fairly heavy catches were landed by the refugee fishermen from the Hukitola lake and the adjoining creeks Ramchandi and Kharnasi and there was even a flourishing assembly centre in Kharnasi village. This activity came to an abrupt end due to the strong opposition of the indigenous fishermen.

The fishermen in Sikhar and the adjoining villages in the upper estuarine stretches of R.Devi do not seem to be engaged in fishing in any professional manner. Many have given up fishing altogether and taken to cultivation and labour. This is apparently due to the exploitation of the leasing system by the 'Mokaddams' (land lords) It is gathered that prior to the abolition of Zamindari, half of the proceeds of fishing had to be given over to the 'Mokaddams', who owned the bordering lands. However, with the abolition of Zamindari, the leasing rights were taken over by the Government, except at Billipara. But even in those areas where the rights have been taken over by the Government, the 'Mokaddams', specially those in Erada and Goladhari, have managed to obtain the lease and as such again it is only through them that the actual fishermen can fish in these waters under conditions, which practically remain the same as before. It is learnt that the 'Mokaddam' demands 37 paise out of every rupee worth of fish caught.

3. Socio-economics

All the fishermen are not engaged in fishing. Some have given up fishing altogether, while some others resort to it as a subsidiary means of livelihood, the main occupation being agricultural labour, or cultivation. Among the rest, some are engaged only in fish trade, specially dry fish trade, while the others are engaged both in fishing and to a lesser extent in fish trade.

The majority of fishermen are essentially poor and find it difficult to make both ends meet out of fishing alone, due to several reasons discussed elsewhere. Practically from almost every family at least one male member has migrated to Calcutta in search of better prospects. The women help their men folk in marketing the catches, while male children quite often assist their elders in certain fishing operations.

Fishing is carried out practically throughout the year, except during the floods and during their annual festival "Chaitra parba". Fishing is not suspended on any day, even though the catches are quite poor for five days from the 7th to 11th day of each fortnight. The fishermen often go to distant areas, camp there and fish for several days at a stretch, after which they return to their villages to market their catches and remain there for about a week or so and during this time fishing remains suspended.

Educationally the Mahanadi fishermen are quite backward and the percentage of literates among them is staggeringly low. There are schools only in a few villages and even where schools are present, the fishermen are often unable to send their children, either for want of money to finance their books and clothes or simply because the assistance of children is needed at home or the fishing ground.

To-date there are no co-operative societies in any of the fishing villages. However, a group of nine fishing villages in the lower stretches of R. Devi (Kaliakone, Nagar, Patsundarpur, Alasahi, Jharling, etc.) have organised themselves into one unit and have taken some initial action towards forming a comprehensive co-operative society. Similar initial action is also reported to have been taken by fishermen of Nuagan and Gajrajpur on the upper stretches of Devi river.

VII. DISCUSSION AND RECOMMENDATIONS

The essential steps to be undertaken for developing the fishing industry of the Mahanadi estuary and to increase fish production thereby, have been suggested in brief by Shetty (1963). They are elucidated below in detail.

1. Facilities for fresh fish disposal

The marketable surplus of fish from the Mahanadi estuarine system above Devi river (inclusive of it) varied from 802 m tons in 1960-'61 to 564 m tons in 1963-'64. The total landings from the estuary seem to have declined since the first year of observation. Further the percentage of fish disposed off in the fresh condition has decreased from about 38% and 40% in 1960-'61 and 1961-'62 respectively to 20% and 13% respectively in the years 1962-'63 and 1963-'64, with resultant reduction in the income of the primary producer. This is essentially due to the lack of a suitable machinery for fresh fish disposal during a good part of the year and this forms a major factor limiting the exploitation of the estuary and the income of the primary producer.

The marketable surplus figures furnished above, are exclusive of certain quantities of fresh fish disposed off locally at or near the fishing grounds and of dry fish sold outside the 'haats', either through hawkers or straight from the fish merchants' houses. Taking into consideration such quantities of fish not covered by the market survey and the likely production of fish from the southern tributaries at about 10% each of the marketable surplus, the total production from the system during 1960-'61 might roughly be put around 1000 m tons. Taking the average of last four years' fresh fish disposal percentage, viz. 28%, the value of 1000 m tons is estimated at about Rs.12.3 lakhs, at the rate of Rs.2.50 per kg of quality fresh fish, as well as quality dry fish, and Re.1.00 and Re.1.50 respectively per kg of low grade fresh and dry fish. This value can be raised to 20 lakhs, if an efficient machinery can be brought into use for the disposal of the estuarine catch in fresh condition. Since the returns for disposal in dried or cured condition are not commensurate with the effort put in, the fishermen turn to other more paying and less tedious professions. This tendency has become very much pronounced in recent months, with more and more of fishermen taking to labour in the Paradip Port Project, with resultant reduction in fishing effort and consequently production. In remote areas of the

estuary, specially during the off season, fishing is often restricted to days when there are haats in the area or just for subsistence only. Most of the fishermen of the southern tributaries go for fishing to Chilka lake, where there are suitable facilities to dispose off their catches in fresh condition.

Therefore, in order to step up production from the estuary and to give more income to the primary producer and more fresh fish to the consumer public, it is highly imperative to provide some essential facilities on an urgent basis. In this regard, the following points merit immediate consideration. Good roads are lacking in many of the areas, which in fact restrict the movement of vehicles, if at all possible, to fair weather only and as such those places are not frequented by fish merchants on any regular basis. Therefore, it is necessary to substantially improve the transportation facilities, by laying all-weather roads to all important fishing centres and by the provision of sufficient number of carrier launches and trucks to transport the catches from the fishing ground to the landing centre and from the landing centre to the exporting centre respectively. These facilities are specially needed for Jatadharmohan and Devi river areas. Catches from Jatadharmohan are brought by country boat to Balitutha, from where usually they are carried by fishermen as head loads or on slings to Kujang, about seven miles away. The road from Kujang to Balitutha must be converted into an all-weather road to facilitate the movement of trucks. Astarang, which forms a focal point for the South Devi river villages, is connected with Cuttack through only a kutcha road. It would be advantageous to make this road an all-weather one. At least during the winter season, when the landings are usually heavy, regular truck service must be provided to collect fish from centres like Jamboo, Marsaghai, Paradip, Balitutha, Machgaon and Astarang. These must be supplemented by stationing carrier launches at Jamboo, Paradip, Balitutha and Machgaon.

In addition to the one at Kujang, Flake Ice Plants must be installed at some key centres like Jamboo, Paradip and Machgaon to facilitate quick preservation of the catches.

The above-mentioned places must be made into regular landing centres, so as to facilitate proper preservation and easy disposal of catches. It will also help the fishery biologists to collect comprehensive data pertaining to catch statistics and fishery biology.

2. Establishment of curing yards

Since at present curing of fish is done under very unhygienic conditions, it is highly imperative to establish a number of hygienic curing yards, specially in remote areas, which are not easily accessible to fresh fish merchants. This will merit top-priority consideration, if immediate provisions cannot be made for fresh fish disposal, since over 70% of the total landings is dried or cured.

3. Establishment of Fishermen Co-operative Societies

Since a large number of fishermen are indebted to fish merchants through loans, they have no choice in the disposal of their catches, which are quite often delivered on the fishing ground itself to the respective merchants. The fishermen, thus, have no chance to invite bidding from merchants at landing places. This difficulty could be overcome by helping the fishermen to get rid of their obligations to merchants by way of Government loans in kind or cash. This could further be achieved by organising regional Fishermen Co-operative Societies, to help fishermen pool their resources for obtaining better dividends.

4. Utilization of East Bengal refugee fishermen

Efforts must be made to utilize the rich experience of East Bengal refugee fishermen resettled in these areas, in order to increase fish production by giving them fishing rights, which they do not presently have. In the alternative, necessary help in kind or cash may be provided to equip them for sea-fishing, which they are prepared to undertake. Fishermen of Nagar and Kaliakone on the lower stretches of Devi river are also anxious to undertake sea-fishing, provided necessary help is forthcoming from the Government.

5. Exploitation by "Mokaddams"

Exploitation of the leasing system by "Mokaddams" along the upper stretches of Devi R., resulting in almost the practical cessation of fishing by actual fishermen of the area has already been referred to above, Necessary action is required to be taken to see that only the actual fishermen get the leases, in the interest of greater yield from the estuary.

6. Supply of improved types of gear

As has already been pointed out, over 65% of the gear consist of gill nets, the majority of which are meant for Hilsa fishing. As such, whenever the Hilsa fishery fails, which has been the case after 1961, the production from the estuary goes down, since the fishermen are ill-equipped to exploit other fishes suitably. When Hilsa does occur in large shoals, the fishermen give their entire attention to it, almost to the complete negligence of the other fishes. As such, it appears that the resources are basically under-exploited, as far as the fishes other than Hilsa are concerned. This can best be overcome by providing the fishermen with suitable effective gear, preferably of synthetic material. However, before making any specific recommendations, it would be necessary to conduct experimental fishing in the estuary in order to determine the types and designs of gear that are most suitable for exploiting the commercially important fish stocks of the estuary.

7. Collection of catch statistics and studies on fishery biology and population dynamics

Detailed studies are required to be carried out on the fishery biology and population dynamics of commercially important species of fishes and prawns of the estuary for further management of the resources. This requires total and effective coverage of the production centres. Of the two programmes employed during the present survey, the market survey programme gives a correct estimate of the marketable surplus only and not of the total production. Further, the monthly dry fish disposal figures obtained through this survey, do not actually reflect the production trends of the respective months, since there is an indefinite time lag between the landing of the catches and the marketing of the cured fish. On the other hand, the second programme, viz. the Water Zonation Survey, can yield accurate estimates of production trends, month-wise, gear-wise and area-wise, if it is effectively implemented. Under the existing conditions of the fishing industry, this programme alone seems most suitable for the collection of catch statistics and biological data. For lack of sufficient number of personnel and equipment, this programme could not be put through effectively during the present survey. In order to facilitate the effective coverage of fishing grounds, it is necessary to sub-divide the present eight zones into smaller units and to increase the number of sampling days. Further, similar survey should also be extended to the Devi river. This will necessarily mean the pressing into service of a few more motor boats and survey personnel, than what the present survey permitted.

8. Location and exploitation of seed collection centres

During the present survey it has been possible to locate some fairly rich collection centres for the seed of cultivable brackishwater fishes like Bhekti, mullets and polynemids. These centres could be profitably exploited for stocking brackishwater farms. Similar study should be intensified in the area so far covered and should further be extended to the Devi river.

VIII. SUMMARY

In view of the lack of any previous work, a programme of investigations, aimed at obtaining detailed preliminary information on various aspects of the fish and fisheries of the Mahanadi estuarine system, was initiated in 1957 by the Central Inland Fisheries Research Institute. The results embodied in this report are based on data collected upto February 1964.

The topographical and some hydrological (temperature and salinity) features of the estuary are described. The temperature showed two peaks, a major one in May-June and a minor one during September-October. The salinity peak coincided with the major temperature peak.

Data pertaining to the inventory of fishermen population, fishing craft and gear are presented village-wise and region-wise. The different types of gear and their modes of operation are described. Gill nets are found in maximum numbers, even though they are utilised fully only when Hilsa occurs in large shoals.

Based on the local conditions, two survey designs were evolved for estimating catch statistics. While one of the designs consisted of a market survey of dry and fresh fish, the other consisted of sampling fishing units on the fishing ground itself, after dividing the entire fishing area into several water zones. The estimated total annual marketable surplus ranged from 802 t in 60-61 to 564 t in 63-64. While the clupeoids, largely Hilsa, dominated the catches during 1960-'61 & 1961-'62, the mullets were most abundant in the subsequent two years. Polynemids, Bhekti, prawns and sciaenids also contributed appreciably to the total landings. The quarter December to February accounted for the greater portion of the annual landings.

The main features of the fisheries of various economic species of fishes are elucidated, as well as the selectivity of gear and catch per unit of effort of different gears. The centres of occurrence of fish seed of cultivable fishes and the likely breeding grounds of some of them have been pointed out.

The trade practices in dry and fresh fish are described in detail. Over 70% of the total landings is dried or salt-cured and marketed wholly within the State, while the major portion of the remaining 30% is exported to Calcutta in fresh condition. Facilities for disposal of fish in fresh condition are largely lacking during the greater part of the year. The curing methods are crude and unhygienic.

While in the southern distributaries, definite water areas are leased out, above Jatadharmohan, the native fishermen have rights of unrestricted fishing all over the area. A brief mention has been made of socio-economics of fishermen communities.

An eight point programme has been suggested towards achieving greater production from the estuary, greater income for the primary producer and greater quantities of fresh fish to the consumer public.

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APPENDIX I

Proforma A

Market arrivals of dry fish
Mahanadi Estuary

1. Name oof market .....
2. Name oof surveyor .....
3. Date of observation .....
4. Date of last observation .....
5. Number of market days between the two dates in the (i) previous month
(ii) current month.

Name of merchant and his village	Whole saler or re-tailer	Source of supplies: If from primary source: Name of source (Fishing camp)	Name (s) of market (s), if any sold during transit	Whether including any once brought to this market. If so, mention the Qty.	Name of market, if from secondary source.	Species-wise dry weight of fish arriving from primary source (in lbs.): Quantities sold	Quantities left over and their likely mode of disposal.	Total weight of dry fish from secondary source (in lbs): Qty. sold	Qty. left over	Sold to: Dealers for re-sale at...	Hawkers	Consumers

Proforma 'B'

Proforma for collection of Total Catch, Effort & Catch-per-unit-effort data from Mahanadi Estuary.

Sampling ZZone .....
Name of Suurveyor .....
Name of Unnit .....

Date of observation .....
Date of last observation .....
No. of units operating .....
No. of fishing days for the unit between the two dates of observation in the
(i) Current month .....
(ii) Previous month .....

Sl. No.	Composition of unit: No. oof men	No. of boats	Size & No. of nets	Hours of operation	No. of hauls made	Fishing ground	Tidal condition	Species caught	No. of fish caught of each species (if possible)	Species-wise weight	Likely mode of disposal — whether for fresh sale or for drying	Remarks

APPENDIX II

LIST OF DRY FISH MARKETING 'HAATS'

(i) Primary major 'haats'

1. Kujang
2. Marsaghai
3. Audhanga
4. Machgaon
5. Siddheswarpur

(ii) Primary minor 'haats'

1. Balipatna
2. Borikina
3. Ghodadiha
4. Kendala
5. Jaipur
6. Katara
7. Jhankad
8. Patpur
9. Salipur
10. Nischintakoil
11. Kendupatna
12. Kendrapara
13. Indipur
14. Keshpur
15. Patamundai
16. Nihala
17. Kondia

(iii) Secondary major 'haats'

1. Jagatsingpur
2. Nuahat
3. Thakurani

(iv) Secondary minor 'haats'

1. Astarang
2. Balikuda
3. Dahisahi
4. Kanakdurga
5. Raghunathpur
6. Ersama
7. Nemalo
8. Bilahat
9. Kaijanga
10. Mathahat
11. Rahama
12. Bhagabatpur
13. Sanpur
14. Birudi

15. Nandasahi
16. Radhua
17. Nuapalam
18. Nuagan
19. Alanahat
20. Gardapur
21. Kalabuda
22. Pundalo
23. Mahala
24. Karilopatna
25. Chandola
26. Balia
27. Derabish
28. Thakurpatna
29. Utarkul
30. Jhermpuri
31. Kishorenagar
32. Bodhapur
33. Thakurhat

(v) Occasional marketing centres

1. Chandbali
2. Jajpur
3. Binjarpur
4. Balamukli
5. Cuttack
6. Suvarnapur
7. Banki

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APPENDIX III

SAMPLING ZONES FOR THE ESTIMATION OF CATCH STATISTICS OF MAHANADI ESTUARINE SYSTEM ABOVE JATADHARMOHAN

Zone I	-	North Hukitola	- Northern half of Hukitola lake and Kandrapatia R.
Zone II	-	South-West Hukitola	- South-West region of Hukitola lake, Gobri R., Ramchandi R. and northern half of Kharnasi R.
Zone III	-	South-East Hukitola	- South-east region of Hukitola lake, east of Kharnasi river mouth and including lighthouse region.
Zone IV	-	Narayanpur region	- From Narayanpur to Teragaon on Nuna R.
Zone V	-	Ostar region	- Lower loop of Nuna R., near ostar.
Zone VI	-	Upper Mahanadi	- Upper stretches of main estuary around Paradip down to Kharnasi river mouth and including lower stretches of Nuna and Kharnasi rivers.
Zone VII	-	Lower Mahanadi	- Lower stretches of main estuary east of Kharnasi river mouth.
Zone VIII	-	Jatadharmohan	

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APPENDIX IV

CLASSIFIED LIST OF FISHES, PRAWNS AND CRABS OF THE MAHANADI ESTUARINE SYSTEM, RECORDED DURING THE SURVEY.

/Oriya names, wherever known, are indicated within inverted commas/

F I S H E S*

Class : Elasmobranchi — Sub-class : Selachii

Order : Rajiformes

Family : Trygonidae

1. Trygon zugei Muller and Henle

Class : Teleostomi — Sub-class : Actniopterygii

Order : Clupeiformes

Sub-order : Clupeoidei

Family : Elopidae

2. Elops saurus (Linnaeus) "Naum"

Family : Megalopidae

3. Megalops cyprinoides (Broussonet) "Paniyakia"

Family : Clupeidae

4. Hilsa toli (Cuvier and Valenciennes) "Ilish"

5. Hilsa ilisha (Hamilton) "Ilish"

6. Nematalosa nasus (Bloch) "Bolong"

7. Anodontostoma chacunda (Hamilton)

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* The classification followed upto the families is that of L.S. Berg /"Classification of fishes, both recent and fossil", Trav. Inst. Zool. Acad. Sci. URSS, 5(2): 1940./

8. Gudusia chapra (Hamilton)
9. Ilisha motius (Hamilton) "Pholera"
10. Ilisha filigera (Valenciennes) "Pholera"
11. Ilisha elongata (Bennett) "Pholera"
12. Gonialosa manmina (Hamilton)
13. Harengula punctata (Ruppel)

Family : Engraulidae

14. Thrissocles mystax (Schneider) "Phasa"
15. Thrissocles kammalensis Bleeker "Phasa"
16. Thrissocles purava (Hamilton) "Phasa"
17. Thrissocles hamiltonii (Gray) "Phasa"
18. Thrissocles rambhae (Chaudhuri) "Phasa"
19. Coilia ramcarati (Hamilton) "Olai"
20. Coilia borneensis Bleeker "Olai"
21. Coilia reynaldi Cuvier & Valenciennes "Olai"
22. Setipinna phasa (Hamilton) "Phasa"
23. Setipinna taty (Cuvier & Valenciennes) "Phasa"
24. Anchoviella tri (Bleeker) "Manohar"

Sub-order : Chirocentroidei

Family : Chirocentridae

25. Chirocentrus dorab (Forskal)

Sub-order : Chanoidei

Family : Chanidae

26. Chanos chanos (Forskal) "Shiba khoinga"

Sub-order : Notopteroidei

Family : Notopteridae

27. Notopterus notopterus (Pallas)

Order : Cypriniformes

Division : Cyprini

Sub-order : Cyprinoidei

Family : Cyprinidae

28. Catla catla (Hamilton) "Bakur"
29. Cirrhina mrigala (Hamilton) "Mirgal"
30. Cirrhina reba (Hamilton)
31. Labeo calbasu (Hamilton) "Kala-Baiynshi"
32. Labeo bata (Hamilton)
33. Labeo rohita (Hamilton) "Rohi"
34. Labeo gonius (Hamilton)
35. Puntius sarana (Hamilton) "Serana"
36. Barbus stigma (Cuvier & Valenciennes)
37. Chela untrahi (Day)
38. Oxygaster bacaila (Hamilton)
39. Osteobrama vigorsii (Sykes)
40. Esomus danrica (Hamilton)

Division: Siluri

Sub-order : Siluroidei

Family : Ariidae

41. Tachysurus crossocheilus (Bleeker)
42. Tachysurus jeila (Day) "Redua"
43. Tachysurus sona (Hamilton) "Redua"
44. Tachysurus macronotacanthus (Bleeker) "Redua"
45. Tachysurus subrostratus (Cuv. & Val.) "Redua"
46. Tachysurus venosus (Cuvier & Valenciennes) "Redua"
47. Osteogeneiosus militaris (Linnaeus) "Sunga"

Family : Plotosidae

48. Plotosus canius Hamilton

Family : Siluridae

49. Wallago attu (Bloch and Schneider) "Baliya"
50. Ompok bimaculatus (Bloch) "Pabda"
51. Batrachocephalus mino (Hamilton) "Bachua"
52. Gagata cenia (Hamilton)

Family : Schilbeidae

53. Pangasius pangasius (Hamilton) "Jalanga"
54. Eutropiichthys vacha (Hamilton) "Bacha"
55. Silonia silondia (Hamilton)

Family : Bagridae

56. Mystus gulio (Hamilton) "Kontia"
57. Mystus cavasius (Hamilton) "Kontia"
58. Mystus seenghala (Sykes) "Adi"
59. Mystus vittatus (Bloch)
60. Mystus aor (Hamilton)

Order : Anguilliformes

Sub-order : Anguilloidei

Family : Muraenidae

61. Moringua raitaborua (Ham. Buch)
62. Muraena punctata (Bloch & Schneider)
63. Muraena Gymnothorax meleagris Shaw

Family : Ophichthyidae

64. Ophichthys microcephalus Day

Order : Beloniformes

Sub-order : Scomberesocoidei

Family : Belonidae

65. Tylosurus strongylurus (van Hasselt) "Gangaithuri"
66. Tylosurus leiurus (Bleeker) "Gangaithuri"

Sub-order : Exocoetoidei
Family : Hemiramphidae

67. Hemiramphus limbatus Cuv. & Val. "Kangora"
68. Hemiramphus cantori Bleeker "Kangora"
69. Hemiramphus marginatus (Forskal) "Kangora"

Order : Syngnathiformes
Family : Syngnathidae

70. Syngnathus sp.

Order : Cyprinodontiformes
Sub-order : Cyprinodontoidei
Family : Cyprinodontidae

71. Oryzias melastigma (McClelland)

Order : Mugiliformes
Sub-order : Sphyraenoidei
Family : Sphyraenidae

72. Sphyraena jello Cuvier & Valenciennes
73. Sphyraena obtusata Cuvier & Valenciennes

Sub-order : Mugiloidei
Family : Mugilidae

74. Mugil tade Forskal "Bedanga"
75. Mugil cephalus Linnaeus "Khoinga", "Kabla".
76. Mugil parsia Hamilton "Khasuli"
77. Rhinomugil corsula (Hamilton) "Kokaranda", "Endula"
78. Liza macrolepis (Smith) "Dangra"
79. Mugil jerdoni Day
80. Mugil cunnesius Cuv. & Val. "Chāra"
81. Mugil carinatus Cuv. & Val.
82. Mugil belanak Bleeker

Order : Polynemiformes

Family : Polynemidae

83. Polydactylus indicus (Shaw) "Nakkuda Sahal"

84. Eleutheronema tetradactylum (Shaw) "Bhusa Sahal"

85. Polynemus paradiseus Linnaeus

Order : Ophiocephaliformes

Family : Ophiocephalidae (Channidae)

86. Channa punctatus (Bloch)

Order : Perciformes

Sub-order : Percoidei

Family : Latidae

87. Lates calcarifer (Bloch) "Bhekti", "Bhekta", "Potti".

Family : Ambassidae

88. Ambassis nama (Hamilton) "Pholgorae", "Kokurvi"

89. Ambassis ranga (Hamilton) "Pholgorae", "Kokurvi"

90. Ambassis commersonii Cuv. & Val. "Pholgorae", "Kokurvi"

Family : Serranidae

91. Serranus malabaricus (Bl. Schn.)

Family : Sillaginidae

92. Sillago panijus (Hamilton) "Bali-Shrungi"

93. Sillago sihama (Forskal) "Bali-Shrungi"

~~94. Sillago domina (Gill)~~

Family : Carangidae

95. Caranx sexfasciatus - Quoy & Gaimard

96. Scomberoides lysan (Forskal)

Family : Lutianidae

97. Lutianus johnii (Bloch)

Family : Lobotidae

98. Lobotes surinamensis (Bloch)
99. Datnoides quadrifasciatus (Sevastianov) "Khuranti"

Family : Leiognathidae

100. Leiognathus equula (Forskal) "Chandi"
101. Leiognathus fasciatus (Lacepede) "Chandi"
102. Leiognathus brevirostris (Cuvier & Valenciennes) "Chandi"
103. Secutor insidiator (Bloch) "Chandi"

Family : Gerridae

104. Gerres filamentosus Cuvier & Valenciennes
105. Gerres setifer (Hamilton)
106. Gerres lucidus Cuvier & Valenciennes

Family : Pomadasyidae

107. Pomadasys hasta (Bloch) "Kurkura"
108. Gaterin cinctus (Schlegel)

Family : Sciaenidae

109. Pama pama (Hamilton) "Jamna Borai"
110. Sciaena coitor (Hamilton)
111. Pseudosciaena diacanthus (Lacepede) "Thelia"
112. Sciaena miles (Lacepede)
113. Sciaena glaucus (Day)
114. Otolithoides biauritus (Cantor)
115. Pseudosciaena sina (Cuvier & Valenciennes)
116. Sciaena cuja (Hamilton) "Herkura"
117. Sciaenoides brunneus (Day) "Bādiya"

Family : Sparidae

118. Sparus berda Forskal

Family : Toxotidae

119. Toxotes chatareus (Hamilton) "Kavva"

Family : Platacidae

120. Platax pinnatus (Linnaeus)

Family : Drepanidae

121. Drepane punctata (Linnaeus) "Bichchani"

Family : Scatophagidae

122. Scatophagus argus (Linnaeus)

Family : Cichlidae

123. Etroplus suratensis (Bloch) "Kundal"

Family : Trichiuridae

124. Trichiurus savala Cuvier "Rupbati"

Family : Cybidae

125. Cybium sp.

Family : Stromatoidae

126. Pampus argenteus (Euphrasen) "Bahal"

127. Pampus chinensis (Euphrasen) "Bahal"

Family : Gobidae

128. Glossogobius giuris (Hamilton) "Bali-Gurdia", "Balguri"

129. Gobioides rubicundus Hamilton

130. Apocryptes lanceolatus (Bloch & Schneider)

131. Gobius personatus Bleeker

132. Boleopthalmus boddaerti Cuvier & Valenciennes

133. Trypauchen vagina Bloch & Schneider

Sub-order : Cottoidei

Family : Platycephalidae

134. Platycephalus indicus (Linnaeus)

Family : Soleidae

135. Solea ovata Richardson

136. Synaptura orientalis (Bl. & Schn.)

137. Plagusia marmorata Bleeker

Family : Cynoglossidae

138. Cynoglossus lingua Hamilton

Order : Echeneiformes

Family : Echeneidae

139. Echeneis naucrates Linnaeus

Order : Tetrodontiformes

Sub-order : Balistoidei

Family : Triacanthidae

140. Triacanthus brevirostris Schlegel

Sub-order : Tetrodontoidei

Family : Tetrodontidae

141. Tetrodon cutcutia Hamilton "Bengphula"

P R A W N S

Family : Palaemonidae

142. Palaemon carcinus Fabricius "Ghosora Chingudi"

143. Palaemon rudis Heller

144. Leander styliferus Milne-Edwards

Family : Penaeidae

145. Metapenaeus dobsoni Miers

146. Metapenaeus monoceros Fabricius "Paththa Chingudi"

147. Penaeus indicus (Milne-Edwards) "Halda Chingudi"

148. Penaeus carinatus Dana "Bagda or Bagadi Chingudi"

149. Metapenaeus brevicornis (Milne-Edwards)

Family : Sergestidae

150. Acetes sp. "Netha"

C R A B S

Family : Calappidae

151. Matuta planipes Fabricius

Family : Portunidae

152. Scylla serrata (Forskal)

- - - -

APPENDIX V

INVENTORY OF FISHERMEN, CRAFT AND TACKLE OF THE MAHANADI ESTUARINE SYSTEM

(a) ZONAL TOTALS

CRAFT TACKLE AND FISHERMEN / ZONE / THANA	Fishing villages north of main Mahanadi I Patkura, Mahakalpara and Tirtol (north)	Fishing villages south of main Mahanadi, down to Jatadharmohan II Tirtol (South) and Ersama	Fishing villages on Devi river III Kakatpur Jagatsinghpur & Balikuda	Fishing villages on Daya, Bhargavi Nun & Makra IV Brahmagiri, Satyabadi & Puri Sadar	TOTAL Puri and Cuttack Districts
I. NETS					
(a) GILL NETS					
1. Chandi	6328	13299	3554	59	23240
2. Suta	252	4730	19	-	5001
3. Chowka	1126	1641	1700	-	4467
4. Bhasani or Chouhara	29	331	-	-	360
5. Soru	114	-	15	-	129
6. Jagar	15	-	1070	-	1085
7. Ghai	-	2995	-	-	2995
8. Bhekti	-	-	90	-	90
9. Noli	-	-	-	114	114
10. Bada	-	-	18	-	18
11. Menji	-	-	-	460	460
(b) DRAG NETS					
1. Khadi	9	527	168	2525	3229
2. Patua	-	-	-	2052	2052
3. Jalei	230	704	-	-	934
(c) SEINES					
1. Thorania	841	3248	-	-	4089
2. Kukut	123	-	-	-	123
3. Ber	1	-	-	-	1
(d) SET-BARRIERS					
1. Sahal	-	-	10	-	10
2. Salua	419	1508	-	-	1927
3. Gora or Patajal	35	-	-	-	35
(e) CAST NETS					
1. Khepa		285		655	940
2. Khepla or Jakijal	44				44
(f) BAG NET					
1. Mala	48	347			395
(g) SCOOP NET					
1. Pelana	24	106	13		143
(h) HOOKS & LINES					
1. Long lines	4350	4			4354
(i) SPEAR					
1. Juti	15				15
(j) NOT CLASSIFIED					
1. Kekenda			94		94
2. Khadi/Jagar			137		137
3. Kutia	158				158
4. Khia	36				36
5. Dora	1				1
II. BOATS					
1. Large	85	20		3	108
2. Medium	18		56	14	88
3. Small	28	83	185	4	300
4. Unspecified	178	796	48	215	1237
Total	309	899	289	236	1733
III. FISHERMEN	1106	2682	2319	751	6858

APPENDIX V (Contd)
(b) VILLAGE-WISE FIGURES

CRAFT TACKLE AND FISHERMEN	Zone	I											
	DISTRICT	CUTTACK											
	SUB-DIVISION	KENDRAPARA											
	THANA	PATKURA											
	Village	Bandhakata	Garajanga	Pentha	Sashanipara	Talasangha	Manikpur	Berhum	Tikhiri	Nuagan	Dhaniapara	Botira	Antai
I. NETS													
(a) GILL NET													
1. Chandi		8	139	60	111	185	75	25	135	68	48	380	56
2. Suta			3						13			25	
3. Chowka			60		44	74	30	10				162	48
4. Bhasani or Chouhara													
5. Soru									114				
6. Jagar													
7. Ghai													
8. Bhekti													
9. Noli													
10. Bada													
11. Menji													
(b) DRAG NET													
1. Khadi													
2. Patua													
3. Jalei		2	28	8	4	14		5	1	9	3	39	8
(c) SEINE NET													
1. Thorania			70							25	9	82	
2. Kukut												1	
3. Ber													
(d) SET-BARRIER													
1. Sahal													
2. Salua													
3. Gora or Patajal													
(e) CAST NET													
1. Khepa													
2. Khepla or Jakijal													
(f) BAG NET													
1. Mala		2	2					1					
(g) SCOOP NET													
1. Pelana		1											
(h) HOOKS & LINES													
1. Long lines													
(i) SPEAR													
1. Juti													
(j) NOT CLASSIFIED													
1. Kekenda													
2. Khadi/Jagar													
3. Kutia													
4. Khia													
5. Dora													
II. BOATS													
1. Large		1		2									3
2. Medium													
3. Small													4
4. Unspecified			12		5	6		1	19	3	2	19	
5. Total		1	12	2	5	6		1	19	3	2	19	7
III. FISHERMEN		6	33	18	17	26	11	5	28	9	7	61	11

APPENDIX V (Contd.)
(b)VILLAGE-WISE FIGURES

CRAFT TACKLE & FISHERMEN	Zone	I																	
	DISTRICT	CUTTACK																	
	SUB-DIVISION	KENDRAPARA																	
	THANA	PATKURA																	
	Village	Teragaon	Gardromito	Athabatia	Danharmunda	Patulipanka	Khurusia	Ostar	Gotanoi	Karmakul	Balikuda	Badapal	Palashpur	Dashipur	Baghardia	Marsaghai	Narayanpur		
I. NETS																			
(a)																			
1.			444	176		520	50	120	85	16	48	116		72	16	56		92	
2.			22	30							5	23							
3.				41		104	10	48	46	4	12	49				18			
4.						2										4			
5.																			
6.																			
7.																			
8.																			
9.																			
10.																			
11.																			
(b)																			
1.																			
2.																			
3.			6	17			4	4	7	3		6	1	1	7	8			
(c)																			
1.				84				18	27	18	50	68				3			
2.			6					1						8	80	6		3	
3.																			
(d)																			
1.																			
2.		136			34														
3.																			
(e)																			
1.																			
2.																			
(f)																			
1.														9					
(g)																			
1.			1																
(h)																			
1.																			
(i)																			
1.																			
(j)																			
1.																			
2.																			
3.								18	32										
4.																			
5.																			
II. BOATS																			
1.			6		1	6		4	3					9	6	2		5	
2.		5																	
3.			1			1								1		2			
4.				12						2	5	9							
5.		5	7	12	1	7		4	3	2	5	9		10	6	4		5	
III. FISHERMEN		34	39	38	17	45	7	23	18	4	12	28	2	22	15	16		24	

APPENDIX V (Contd)

(b) VILLAGE-WISE FIGURES

Zone		I														
District		Cuttack														
Sub-divn.		Kendrapara														
Thana		Mohakalpara														
F'MEN CRAFT & TACKLE	Village	Kurutapanga	Jagati	Akalpur	Baraditha	Babar	Bahakud	Kharnashi	Jamboo	Ramnagar	Mangalpur	Baulpara	Palli	Bazarpur	Sathiabati	Karanje
I. NETS																
(a) GILL NET																
1. Chandi	99	24	36	96	24	76				15	25	10	15	65	120	
2. Suta	62					8					2				1	
3. Chowka	42									6	10	4	6	26	48	
4. Bhasani or Chouhara				4												
5. Soru																
6. Jagar	15															
7. Ghai																
8. Bhekti																
9. Noli																
10. Bada																
11. Menji																
(b) DRAG NET																
1. Khadi																
2. Patua																
3. Jalei	10										1			4	4	
(c) SEINE NET																
1. Torania	22										1			4		
2. Kukut				2												
3. Ber							1									
(d) SET-BARRIER																
1. Cahal																
2. Salua																
3. Gora or Patajal							15	5	15							
(e) CAST NET																
1. Khepa																
2. Khepla or Jakijal							23	15	6							
(f) BAG NET																
1. Mala																
(g) SCOOP NET																
1. Pelana						4										
(h) HOOKA & LINES																
1. Long Lines							3150		1200							
(i) SPEAR																
1. Juti							8	7								
(j) NOT CLASSIFIED																
1. Kekenda																
2. Khadi/Jagar																
3. Kutia																
4. Khia		3														
5. Dora									1							
II. BOATS																
1. Large				3			1									
2. Medium							3	7	3							
3. Small	4			1		1										
4. Unspecified	4						13		3		1				3	
5. Total	8			4		1	17	7	6		1				3	
I FISHERMEN	22	6	3	9	2	9	36	11	15	2	5	2	3	11		

APPENDIX V (Contd.)
(b)VILLAGE-WISE FIGURES

Zone	I											
District	Cuttack											
Sub-divn.	Kendrapara									Cuttack Sadar		
Thana	Mohakalpara									Tirtol		
FISHERMEN CRAFT & TACKLE / Village	Gookhakhati	Sanagan	Jadupur	Gaurdabalpur	Chandiapalli	Sahabazpur	Orota	Sankhapada	Vijoyanagar	Joyasankhapur	Jeelanashi	Tentulia Khamar
I. NET												
(a)												
1.	10	230	340						612	1059	225	146
2.		3								39	8	2
3.	4	92	128									
4.			16						2	1		
5.												
6.												
7.												
8.												
9.												
10.												
11.												
(b)												
1.			2						7			
2.												
3.	1	9	14						2			
(c)												
1.		48	114							136	32	30
2.		1	2						12	1		
3.												
(d)												
1.												
2.				70	71	90		18				
3.												
(e)												
1.												
2.												
(f)												
1.			1				5		28			
(g)												
1.							6		12			
(h)												
1.												
(i)												
1.												
(j)												
1.												
2.												
3.			108									
4.							7		26			
5.												
II. BOATS												
1.			9	3	2	4			2	9	2	2
2.												
3.			8		1	1				2		1
4.	1	12					5		29	11	1	
5.	1	12	17	3	3	5	5		31	22	3	3
III. FISHERMEN	2	46	68	15	14	18	10	9	77	74	19	14

APPENDIX V (Contd.)

(b) VILLAGE-WISE FIGURES

Craft tackle & fishermen. \ Village	Barriha	Sondhapur	Raypur	Madhupur	Kothuasahi	Taldanda	Arakhia	Kartuta	Malasahi	Balarampur	Chandamundai	Pandia
Zone	II											
District	Cuttack											
Sub-divn.	Cuttack Sadar											
Thana	Tirtol											
I. NETS												
(a)												
1.	1238	6	6	55	28	160	15	40	92	498	53	126
2.	348			40			4			300	30	
3.	73			8	8	17			10		5	20
4.	40									2		
5.												
6.												
7.	281											
8.												
9.												
10.												
11.												
(b)												
1.	26	1			3				9			
2.												
3.	37	1		5	3	9	3	6	1	49	3	10
(c)												
1.	193		6	22				14	10	3		
2.												
3.												
(d)												
1.												
2.												
3.												
(e)												
1.	13			6		3	2			15		
2.												
(f)												
1.	37									4		2
(g)												
1.	14			1			3					9
(h)												
1.										4		
(i)												
1.												
(j)												
1.												
2.												
3.												
4.												
5.												
II. BOATS												
1.					1	1				1		
2.	1	1										
3.	58			2					1	1		2
4.	59	1		2	1	1			1	9		3
5.										11		5
III. FISHERMEN	180	1	1	13	2	16	7	7	7	86	9	14

APPENDIX V(Contd.)

(b) VILLAGE-WISE FIGURES

II

District	Cuttack															
Sub-divn.	Cuttack Sadar															
Thana	Tirtol															
MEN CRAFT & TACKLE / Village	Kabulpur	Gandikipur	Fatepur	Gothudiha	Taldanda (Gopiakud)	Santra	Dassina	Mangarajpur	Biswali	Nanuka	Bhutamundai	Chakradharpur	Pipala	Paradipgarh	Lalitapur	Jhimani
I. NETS																
(a)																
1.	599	2058	377	857	690	52	386	1416	2571	123	4	10	234	822	268	
2.	266	1155	125	229	199	16	154	591	420	56	4	30	131	364	133	
3.	97	334	33	65	62		142	290	57				10	22	30	
4.	39	105	1[illegible]	38	40		9	40	19			[illegible]	3	12	6	
5.																
6.																
7.	127	689	40	126	182		88	369	366	20		20	60	225	52	
8.																
9.																
10.																
11.																
(b)																
1.	10	94	14	34	32		21	98	26	2				12	3	
2.																
3.	11	136	22	58	32	5	19	79	50	10	9	3	17	39	17	8
(c)																
1.	131	827	99	182	264	16	86	345	744	23		14	27	99	36	
2.																
3.																
(d)																
1.																
2.											410		340			410
3.																
(e)																
1.	15	46	8	11	6	3	7	36	18	5		7	12	48	10	
2.																
(f)																
1.	45	34	5	17	8		7	45	4	1		3	6	24	5[illegible]	
(g)																
1.	15	5	4	5	4	2	2	6	1	1	2	1	3	2	2	2
(h)																
1.																
(i)																
1.																
(j)																
1.																
2.																
3.																
4.																
5.																
II. BOATS																
1.	2		1	2	1			1	1	1		1	1	1	1	1
2.																
3.	1	1	1	1	1		1	1	1	1			1	1	1	
4.	75	223	35	64	70	1	14	92	63	5	2	3	17	3[illegible]	13	[illegible]
5.	78	224	37	67	72	1	15	94	65	7	2	4	19	38	15	6
III. FISHERMEN	105	407	72	209	173	14	91	343	258	27	42	25	83	141	55	4[illegible]

APPENDIX V (Contd.)

(b) VILLAGE-WISE FIGURES

Zone / District / Sub-Division / Thana / Village — F.MEN, CRAFT & TACKLE	Nwadia	Balia	Damoka	Balitutha	Gobindpur	Garh Kujang	Noliasahi	[illegible]	Japa	[illegible]	Bhendasahi	Praharajpur
Zone	II											
District	Cuttack											
Sub-Division	Cuttack Sadar											
Thana	Ersama											
I. NETS												
(a)												
1.	36	28	4			118	29		10	3	4	[illegible]
2.	14	18				99	59					
3.	8	4	4			118	39		10	3	4	18
4.	1											
5.												
6.												
7.	4		4			114	85		15	8	6	27
8.												
9.												
10.												
11.												
(b)												
1.			6	1	1	69	94	1				
2.												
3.	3	4							4			
(c)												
1.		13				69						
2.												
3.												
([illegible])												
1.												
2.												
3.							59					
(e)												
1.	3	1		1	4	1		1				
2.												
(f)												
1.			1			46			5	3	2	9
(g)												
1.		1				17						
(h)												
1.												
(i)												
1.												
(j)												
1.												
2.												
3.												
4.												
5.												
II. BOATS												
1.				1	1							
2.												
3.				2		19	12		3	4	1	3
4.						2						
5.				3	1	21	12		3	4	1	3
III. FISHERMEN	9	10	5	4	5	58	44	1	5	4	2	9

APPENDIX V (Contd.)
(b)VILLAGE-WISE FIGURES

Zone	II								III			
District	Cuttack								Puri			
Sub-divn.	Cuttack Sadar								Puri Sadar			
Thana	Ersama								Kakatpur			
F.MEN CRAFT & TACKLE / Village	Jireila	Kimila	Ambiki	Ersama	Trilochanpur	Balisahi	Jharling	Sovanah	Babrampatna	Balipatna	Patsunderpur	Phulpatna
I. NETS												
(a)												
1.	6	8	8	48	36	60	80	10	24	110	686	200
2.	4	6			12							
3.	6	8	8	48	16	4	5	4				150
4.												
5.												
6.												
7.	6	8	8	48	6							200
8.												
9.												
10.												
11.												
(b)												
1.												
2.									7	20	89	20
3.	3	3	5	31	7							
(c)												
1.			1		4							
2.												
3.												
(d)												
1.												
2.					210							
3.												
(e)												
1.					3							
2.												
(f)												
1.	3	1	5	26								
(g)												
1.	1	1			2							
(h)												
1.												
(i)												
1.												
(j)												
1.												
2.						20	50	12			30	52
3.												
4.												
5.												
II. BOATS												
1.					1							
2.												
3.	2	2	2	14	2	8	8	4		2	1	13
4.					3					18	25	
5.	2	2	2	14	6	8	8	4		20	26	13
III. FISHERMEN	4	6	7	49	27	40	50	24	28	74	256	250

APPENDIX V (Contd.)

F. MEN CRAFT AND TACKLE	Zone	III												
	District	Puri										Cuttack		
	Sub-divn.	Puri Sadar										Cuttack Sadar		
	Thana	Kakatpur										Jagatsinghapur		
	Village	Vurasuni	Marchipur	Rahama	Tonda	Alasahi	Nagar	Kaliakone	Biluamandali	Bhandisahi	Sankardiha	Bachchalo	Sikhar	Kantisal
I. NETS														
(a)														
1.		125	150	300	14	320	400	600	60	3	27	2	1	
2.														
3.		30	60	120	4	320	400	600	3					
4.														
5.											15			
6.		40	130	200		125	150	225						
7.														
8.		15	50	25										
9.														
10.														
11.														
(b)														
1.												2	3	
2.														
3.														
(c)														
1.														
2.														
3.														
(d)														
1.					10									
2.														
3.														
(e)														
1.														
2.														
(f)														
1.														
(g)														
1.														
(h)														
1.														
(i)												2		
1.														
(j)														
1.														
2.					15				40			2		
3.														
4.														
5.														
II. BOATS														
1.														
2.		6	22	15										
3.					6	25	25	60	9		1			
4.														
5.		6	22	15	6	25	25	60	9		1			
III. FISHERMEN		60	200	180	30	160	200	300	40	2	14	2	4	

APPENDIX V (Contd.)

Zone	III													IV		
District	Cuttack													Puri		
Sub-Divn.	Cuttack Sadar													Puri Sadar		
Thana	Balikuda													Brahmagiri		
CRAFT, TACKLE & FISHERMEN / Village	Bhatana	Parisikhar	Pataligaon	Bodal	Bainyapara	Balisahi	Karuo	Erada	Gandhan	Nuagan	Gajarajpur	Goladhari	Thorimara	Telisahi	Koramala	Nijagarhkolai
I. NETS																
(a)																
1.	10	16	8		38	3				5	2		300			
2.	9				10											
3.																
4.																
5.																
6.																
7.																
8.																
9.															8	
10.										4	14					
(b)																
1.	3	3			2	1	1				2		15		9	25
2.																
3.																
(c)																
1.																
2.																
3.																
(d)																
1.																
2.																
3.																
(e)																
1.														6		30
2.																
(f)																
1.																
(g)																
1.										5	6					
(h)																
1.																
(i)																
1.																
(j)																
1.			2	1							7					
2.																
3.																
4.																
5.																
II. BOATS																
1.																1
2.														1	1	
3.	1	1	1			2	1						30			
4.	3	1			1									4	1	17
5.	4	2	1		1	2	1						30	5	2	18
III. FISHERMEN	21	12	1	1	17	17	17			6	13		300	11	12	58

APPENDIX V (Contd.)

Zone / District / Sub-Div. / Thana / F.MEN CRAFT & TACKLE / Village	Khajuria	Badaora	Kaudakhani	Naikulpatna (Garisagoda)	Jagulipadar	Muagaon	Balabhadrapur	Jankia	Dokonda	Navikulpatna	Janghara	Kamalanayan-pur	Charbatia
	IV												
	PURI												
	PURI SADAR												
	BRHMAGIRI						SATYABADI					PURI SADAR	
I. NETS													
(a)													
1.									59				
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.		60		36		10							
10.													
11.			460										
(b)													
1.		60	115	72	2223		21						
2.					2052								
3.													
(c)													
1.													
2.													
3.													
(d)													
1.													
2.													
3.													
(e)													
1.	65	30		180		8	21	11	220	3	44	25	12
2.													
(f)													
1.													
(g)													
1.													
(h)													
1.													
(i)													
1.													
(j)													
1.													
2.													
3.													
4.													
5.													
II. BOATS													
1.	1						1						
2.	1		1		1	2	3			2		1	1
3.				1					1		1		1
4.	4	30	29	31	37		8		31		11	5	7
5.	6	30	30	32	38	2	12		32	2	12	6	9
III. FISHERMEN	61	50	118	102	171	6	16	21	63	5	23	16	18