

HILSA FISHERY IN EAST PAKISTAN

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Hilsa is an anadromous fish. It supports a very important fisheries in East Pakistan and provides employment to a large number of fishermen in that province. It is found that the fisheries is depleting because of wanton destruction of adults and young ones and due to other causes. Its biology, migration and other habits have been studied. It is found in all the rivers of Ganges-Brahmaputra system. There is a summer and a winter run for breeding. Breeding grounds have been located and its presence in the estuarine and foreshore have also been found. Measures have been suggested for its conservation so that more fish may be made available for consumption. It is recommended that in lieu of its importance to East Pakistan intensive research may be conducted and on the basis of the results obtained Hilsa fisheries may be developed.

Introduction

Realising the importance of Hilsa to India, Burma and Pakistan, Indo-Pacific Fisheries Council stressed the need of a cooperative programme and recommended to the Member Governments to take up investigations on Hilsa. A sub-committee was formed at the 3rd Session of the Council in 1951 and a programme was chalked out. India and Pakistan took up the work and two schemes one for East and the other for West Pakistan were sanctioned by the Food and Agriculture Council of Pakistan. In East Pakistan the scheme started functioning in February, 1956 and terminated in June, 1962. During this period efforts were made to do as much work as could be possible with the available resources.

Importance of Hilsa, *Hilsa ilisha* (Hamilton) to this region is great and it is estimated that as much as about 35% of the total catch consists of this fish. In spite of numerous bones this is considered as one of the choicest fishes of East Pakistan.

Hilsa is the most important single fishery in this province and provides employment to a large number of fishermen. It is an anadromous fish, ascending the rivers during the summer floods and also in winter. During the monsoons when sea fishing practically stops, this fishery is the mainstay of fishing community in the estuarine and inland portions of the rivers. Except the districts of Rangpur, Dinajpur, Bogra and Chittagong Hill Tracts all other districts claim good catch of this fish during the seasons.

There are indications that Hilsa fishery has been depleting which in part may be due to the silting of the rivers, catch of undersized fish and absence of close season resulting in indiscriminate fishing. Research on its fishery and biology should

be continued by the Provincial Directorate who have now a very good Biological and Technological Research Station at Chandpur which is considered to be one of the centres of Hilsa fishing.

Ecological Features

East Pakistan lies between 22° and 27° latitudes, and 88° and 93° longitudes. The climate is semi-tropical. The land is flat excepting the Chittagong Hill Tracts. It is traversed by many rivers and their tributaries. The main rivers are the Ganges and the Brahmaputra whose tributaries and distributaries have been given different names. The Ganges enters East Pakistan in the Rajshahi district, and after flowing through Kushtia, Jessore, Khulna and Bakerganj districts divides into distributaries in the lower reaches, finally falls in the Bay of Bengal. The Brahmaputra enters this province in Rangpur district, divides into two branches, the larger one is known as the Jamuna and the smaller one as the Brahmaputra, the latter joins the Meghna near Bhairab Bazar and the Jamuna joins the Ganges near Rajbari. Other important rivers are the Surma and Karnaphuli.

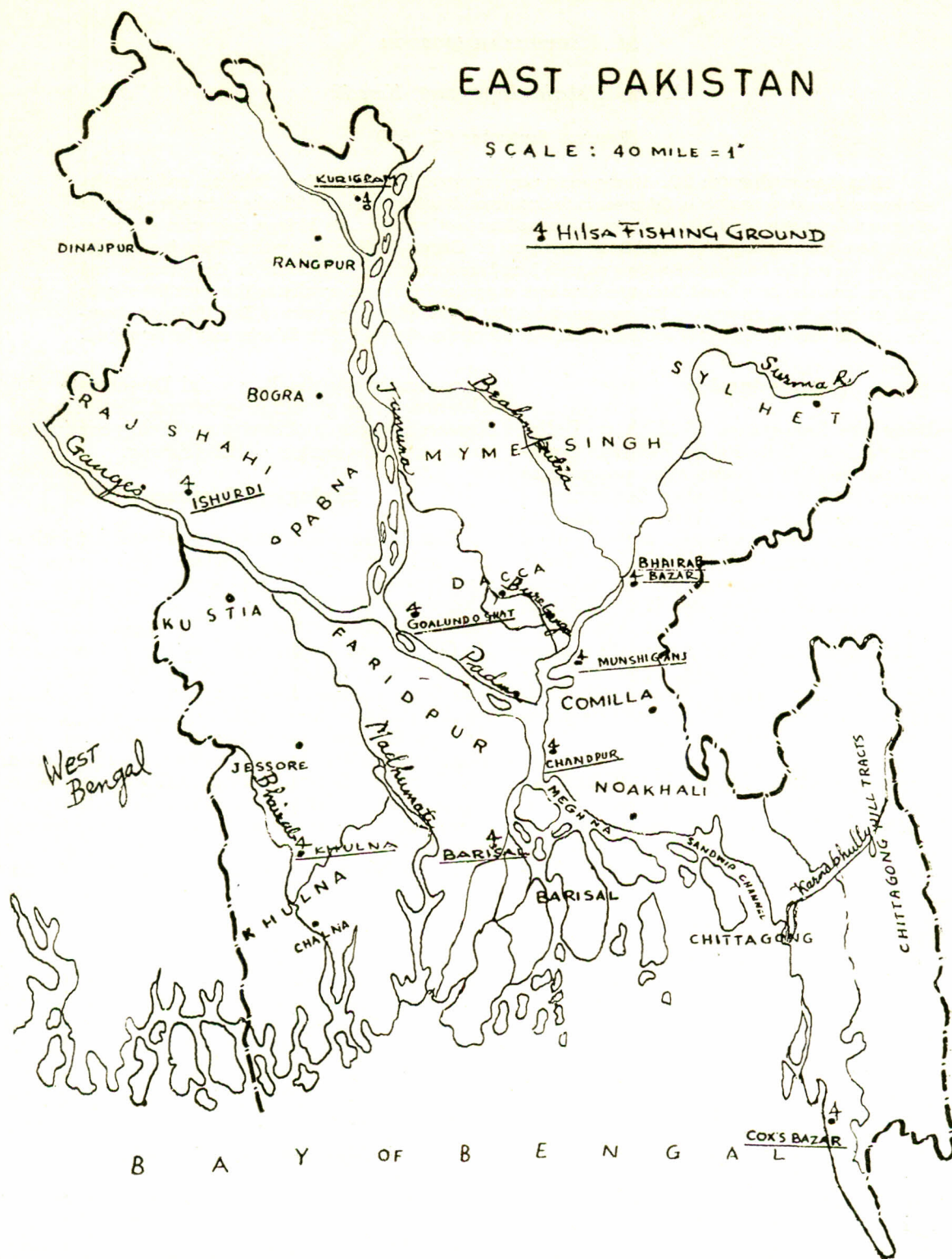
The average rainfall is about 120 inches and the water, received by these rivers in enormous quantities, causes floods every year in the region. Owing to this copious supply of water during the monsoons the conditions become very favourable to Hilsa which ascends and breeds in the rivers. The delta is quite extensive and very rich in fish and other aquatic fauna.

Material and Methods

In order to observe various factors concerning Hilsa, 9 zonal centres were selected which are Kurigram, Ishurdi, Bhairab Bazar, Goalando, Munshiganj, Chandpur, Khulna, Barisal and Cox's Bazar. At each centre one field assistant,

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SCALE : 40 MILE = 1"



4 Hilsa Fishing Ground

West Bengal

B A Y O F B E N G A L

a boat and a boatman were posted for the collection of specimens, statistical and biological data which were communicated to the headquarters for record and compilation. Two hundred and fifty fishing points during summer and 80 during winter were examined, further check points were added as the work progressed.

An inspection launch 'Sandhani' was at the disposal of the Biologist who constantly toured the whole region and checked the work of the Assistants. Assistant Biologist and Statistical Assistant worked at Chittagong who received regularly data from the Field Assistants. Compilation and analyses of data were done at the headquarters and the officers toured occasionally to check up the methods of collection and the field work.

Specimens were collected at random from fishing and fishlanding centres, measurements and weight were recorded for further studies. Extensive survey was conducted for locating spawning grounds in river Padma, Jamuna, Meghna and their tributaries. Since no plankton and small meshed nets were employed the fry and eggs of Hilsa could not be obtained.

Specimens were collected from different centres, meristic and non-meristic characters were studied. Generally, there was very little variation barring one particular example which may be regarded as an exception but no definite conclusions can be based on one or two isolated samples.

From the morphometric study of a large number of specimens it is inferred that there is a single homogeneous stock of Hilsa viz., *Hilsa ilisha* (Hamilton). This has been corroborated by workers from West Bengal also.

Fecundity, Maturation and Spawning

Fecundity.—By many workers it has been observed that the fecundity of fish varies with its size. Some consider that fecundity of a fish increases in proportion to the square of its length. Simpson³² differs with this conception and considers that egg production in any ovary is not a surface phenomenon and that the germinal epithelium is so folded as to fill the volume of the ovary.

For determination of the fecundity, ovaries of 175 specimens ranging between 27.5 cm to 48.3 cm were studied. These contained mature ova; care was taken to avoid spent fish and fish having immature ovary. The ovaries were fixed in 4% formalin for about a week. The number of ova in ripe ovary varied from 85,000 to 2 million.

Maturation and Spawning.—Fishes were collected from nine fishing centres. The eggs were yellowish in colour and more or less of uniform diameter. The size of fully mature ova of Hilsa is only 0.7 mm of oily transparency, pale yellow in colour and demersal in character.

Spawning Grounds.—Amongst the specimens collected from Sunderbans ripe males or females were not found. Some ripe females and males were caught in the rivers Bhairab and Madhumati near Khulna, at the junction of the Ariel and in the Dholeswari near Barisal. Above these points the ripe females and oozing males were common at different places in the rivers Buriganga, Meghna and Padma. The breeding is twice in the year, the summer season is from August to middle of October and the winter season from January to March. Mature specimens are caught as far as Goalondo and have also been reported from Surma river in Sylhet district. From the adjacent West Bengal in India, the spawning grounds are reported by workers in India. It seems that Hilsa does not breed in the estuarine area, it becomes mature after travelling about 45 miles up-stream and breeds only in fresh waters of the rivers. This tallies with the observations made by Devanesan⁷ that the Hilsa would not spawn in the lower estuaries, where the salinity is high.

Only cursory observations have been made on the maturity of male and female fish and sex ratio. The general observations during the months of August and the peak period in September in summer indicate that spent fish goes downwards in September-October. In the winter season the peak period is February after which the juveniles and spent fishes go back to the foreshore and estuarine areas.

About the size of the fish at first maturity, Pillay²⁵ found that males mature when they are 16 cm to 17 cm and females when 19 cm to 20 cm in total length. The growth rate and the maximum observed size of the two sexes are significantly different. There is no direct evidence about the sex ratio also but the general observations are that during the monsoon (summer) the sex ratio is 1:1 but there is predominance of males in the winter season. It has also been observed that the number of males decreases as the season advances and in the months of October and February females are predominant.

Life History, Age and Growth

Life history of Hilsa received attention very early by fishery workers.

In Bengal, Southwell and Prasad³⁵ were



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able to fertilize the eggs but were unable to proceed further, whereas Raj²⁹ records artificial fertilisation of Hilsa eggs by Wilson³⁶ as well as by himself. Nair²³ described a series of early stages of Hilsa, the youngest stage described by him is 14 mm, the earlier life history of the fish was not known till then.

Hora¹¹ made a significant contribution towards the location of the breeding grounds when he discovered the post-larvae and young stages of Hilsa in the settling tanks and the filter beds of the Water Works of the Calcutta Corporation at Pulta, about 16 miles north of Calcutta.

For the benefit of the biologists who may take up this problem the procedure adopted and the observations made by some workers in India are summarised below:—

“The collections of eggs and larvae were made from Hoogly below the Pulta Water Works up to Titaghur Paper Mills with a bolting silk net which was operated from a sail boat against the current. The net was kept at desired depth by means of a pole, it was observed that eggs and larvae were quite abundant near the shore.”

Spawning habits of the fish have been described, indicating that the fish breeds probably in the late hours in the evening. The temperature of water in the Hoogly at the time of collection (February) ranged from about 23°C to 25°C. Fully ripe oozing eggs are almost spherical with a diameter of about 0.70 mm to 0.75 mm of oily transparency, pale yellow in colour and demersal in character. The egg swells in water to about 2 mm in diameter. The earliest stage collected shows a blastodermal cap of cells and a wide perivitelline space. The yolk is segmented and oil globules are found. It is further stated by them that the rate of development varies with temperature; the lower the temperature, the longer the time taken for development. During February, the duration of development from the blastodermal to the hatching stage varied from 22 to 30 hours. Raj³⁰ found that in Madras the period varied from 12 to 18 hours. It is also interesting to note that 24 eggs collected on 11th February 1950 (*i.e.*, a day previous to the cold spell) failed to develop in the laboratory beyond the stage. The temperature of the water in the glass jars in which the eggs were kept dropped from 24°C to 16°C by next morning. During this time the temperature of the river water dropped to 19°C; but as this drop could only have been relatively gradual, the development of the eggs has probably been retarded. However, there appears to have been an interruption in breeding, judging from the absence of eggs and yolked larvae

for a few days during the cold spell from 12th to 16th February 1950.

According to Hora¹¹ the brood of July-August may attain a length of 14–150 mm by the 3rd week of November. Hora and Nair,¹³ on the basis of their observations made in the settling tanks and filter beds of the Pulta Water Works, record a growth of 35 mm per month during November while in the summer months the rate is as high as 50 mm. Their observations made at the Chilka Lake have shown that the early lot, *i.e.* July-August brood, is about 110 to 133 mm by the last week of December. The above rate of growth may not be maintained throughout the life of the fish, as it is only natural that there should be an arrest in growth at the time of spawning.

In East Pakistan no systematic attempt was made to collect eggs, larvae or juveniles with plankton nets. Specimens were collected from the catches of fixed (stake) nets and bag nets which are used only during winter season and are considered unsuitable during monsoon as the currents at that time are too strong to allow the operation of these nets. The breeding grounds are found almost in all rivers but the predominance is in the river Meghna and its tributaries. Post-larvae and juvenile Hilsa (locally known as *Jatka*) varying from 10 mm to 40 mm and above were found in large numbers. No eggs were collected by the nets mentioned above; future workers are advised to use plankton nets at different levels of water. Starting from the surface and going down to the bottom. The stake nets and bag nets are very destructive to Hilsa, adult and juveniles. Their use should be banned or very much restricted to protect the young ones which in turn will provide good fish in future years.

The observations, that *Jatka* is caught in very large number in West Bengal and East Pakistan and that they are not allowed to grow to adult size, are certainly one of the causes for the depletion of Hilsa fisheries.

Sporadic attempts have been made in the sub-continent to determine the age and growth of Hilsa by studying the scales. Amongst the workers, special mention is made of Hora and Nair,¹⁴ and Prashad, Hora and Nair.¹³

Raj³¹ observed that even in the scales of a few weeks old Hilsa, two or more lines of growth occur. He found that in the young as well as adult Hilsa these rings are too numerous to be annual and do not occur at regular intervals. Jones and Menon²⁰ have mentioned that it has not been possible for them to interpret the exact

significance of the growth rings. Chacko, Zobairi and Krishnamurthy⁵ have studied a large number of Hilsa scales. Their inference is that the number of radii on the scales represent the body length in inches. Pillay²⁵ has stated that from the detailed examination of Hilsa scales it appears that they cannot be used for age or growth determination. By the analysis of length frequencies it has been found that males attain modal lengths of 24.7 cm, 34.3 cm and 39.3 cm and females, 26.5 cm, 39.1 cm and 43.6 cm in 1½ and 3½ years, respectively. The growth rates of males and females have been found to be significantly different.

It is suggested here that Eberbach scale-reading machine or similar devices may be used by which the scales are magnified and the radii and circuli are quite distinct. Extensive study is necessary before any conclusions can be drawn.

Length Frequencies.—Since it has been considered that the scale method could not be employed to trace the growth rate to distinguish age groups, some workers have tried length frequencies for the determination of growth of Hilsa. On the basis of his 2-year work mostly on adult specimens, Pillay²⁵ has enumerated the difficulties encountered by him. The first was that it was not possible to distinguish all the males and females in the catches of the fishermen. The second was that very few specimens could be dissected for determination of sex. Jones and Sujangani²⁰ have used, what has been termed "the pressure method" for determination of sex. This has not been found satisfactory in case of immature specimens. The studies carried out by the workers in Pakistan are not so extensive as to draw any definite conclusion. Further intensive work in this regard is necessary. In this regard the works of Kesteven²¹ and of Brock³ may also be consulted.

Migrations and Fishery

The earliest mention of the habits of Hilsa has been made by Day.⁶ Southwell³³ has remarked that Hilsa or the Indian Shad ascends certain Indian and other rivers for the purpose of breeding. It occurs in the higher reaches of the rivers and has, for instance, been reported to have been caught as high up as Delhi. The fish has a very wide distribution in the Indian Ocean. It occurs in the Persian Gulf (ascending the river Tigris), on the coast of India including Sind, Burma, Siam and some of the islands of Malay Archipelago. At all these places it ascends rivers which open into the sea. The general absence of river basins on the west coast of peninsular India results in the restricted distribution which is, of course, clearly due to absence of breeding grounds represented

by the mouths and upper reaches of rivers, such as are necessary for this anadromous fish.

This fish has a summer run starting in May, sometimes later depending on the monsoon, and lasting as long as October-November. The winter run is shorter, extending from January to March. It will thus be seen that Hilsa remains in the rivers of East Pakistan almost throughout the year. Hilsa, besides the big rivers of Ganges, Meghna, Padma and Jamuna are caught in the Sunderbans also in the tributaries and distributaries of practically all the rivers. This fish to a less extent is found in the Karnaphully but its fishery is not of great importance in this river. It has been reported to ascend as far as the Surma in Sylhet.

Pillay²⁵, during his investigations in the river Hoogly, has stated that the main fishing season is during the south-west monsoon when Hilsa ascends up the river. The catches during this period consist of mature fish. He further states that after the main season of migration during the monsoons, a less prominent run occurs in winter. The upward migration starts from December to January and lasts up to about March. Mention may also be made of Prashad²⁶ and Hora and Nair¹³ that the Hilsa is probably not truly anadromous. Their observations were based on the presence of big specimens in the estuarine areas. Hora and Nair¹⁴ have quoted Hamilton¹⁰ who had recorded Hilsa from Cawnpore and Agra and that Day has mentioned its occurrence up to Delhi.

Hora¹³ has used the word "wandering" instead of "migrations" which I think is more appropriate. He has reported that during investigations on the coast of Balasore at Chandipur extensive catches of Hilsa from the sea were found.

The observations were extended along the coasts of Bengal and Orissa and in the estuaries which indicated that young Hilsa about 7 to 10 inches in length were fished extensively during cold months. Hora concludes that after leaving the rivers the fish do not go far into the sea but move about in shoals in the estuaries and foreshore. The fish lives in shallow waters more than a few fathoms deep.

Further observations made by Hora and other workers in India have been corroborated by the biologists from East Pakistan who have recorded specimens of Hilsa from the catches of the fishermen from the coast of Cox's Bazar. In order to establish that Hilsa does not go out away from the coast and remains in the estuaries, more extensive work is necessary and special attention may be

given to this aspect by those who are and will be conducting research on the wanderings of Hilsa.

In order to study the movements of Hilsa tagging is necessary. The tag and the method are described by Pillay. Six specimens tagged at the Central Inland Fisheries Research Station, Barrackpore, situated on the bank of river Hoogly, near Calcutta, were caught by fishermen in East Pakistan. The tags were returned to the Research Station, Barrackpore. The tagging and rearing experiments carried out in India show that Hilsa is not so delicate as observed by previous workers who have stated that the brood fish dies as soon as it touches the net. My experience also disproves these observations, as during the artificial fertilisation and hatching of Hilsa eggs in October, 1940, on the Godavari at Bobberlanka, males were caught and kept alive in conditioning boxes for more than 6 hours. Oozing females were obtained from the catch of the fishermen, stripped and the eggs fertilized. This, alongwith the tagging experiments of Pillay show that the fish is not so delicate as reported by many authors.

Hilsa is the most important single species of fishes in East Pakistan, especially during the monsoon, when fishing activity in the sea and in the *bheels* is very much restricted. Except the districts of Rangpur, Dinajpur, Bogra and Chittagong Hill Tracts, all the other districts produce fairly abundant quantity of this fish. Besides the main rivers, the Meghna, the Ganges or Padma and the Jamuna, it is caught in the Talulia, Kajulia, Joyanti, Kalabadur, Tarki, Andhamomik, Bishkhali, Lohali, Patuakhali, Beglu, Painakhali, Ilisha, Boring, Ariadkhal, Safipur and Nayaletanga rivers in the district of Bakerganj; in the rivers Mathabhanga, Madhumati, Chitra and Nabaganga in Jessore district; in the rivers Dham and Kalimadi in Mymensingh; in the Bhairab, Antharohaki, Atair, Passur and Baleswar rivers in Khulna; and in Surma river in Sylhet. In the Chittagong district it is caught to some extent in Kushiara and Karnaphully rivers. To a lesser extent this fish is found in Mahamanda river in Rajshahi and river Hoorsagar in Pabna, river Madhumati in Faridpur and river Garai in Kushtia. In the Brahmaputra and Tista rivers Hilsa is reported up to Dibrugarh but the quantity is not much most probably due to the fast current of these rivers.

Extensive survey was conducted throughout the province in order to record the types and number of boats employed in this fishery, the types and number of gear used, fishermen working and the catch.

Fishing boats are all built of local timber, ranging in length from 19 to 50 ft. The boats

are generally named after the nets operated on them. All are propelled by oars and sails. The number of boats employed in Hilsa fishery was 1465. Fifteen different types of nets are used in Hilsa fishery and are known by different names. These are cast nets, drift nets, fixed (stake) nets and bag nets. Fixed nets are generally operated in winter and other types are used throughout the year. The nets and their operation have been described by previous workers and it is not desired to go into details of the fishing methods. The number of nets of different types used in East Pakistan in Hilsa fishery was 457,100 according to the survey conducted by the biologists in 1962 against 466,200 in 1961 showing the decrease in number. The fishermen engaged in fishing is about 26,000. It was very difficult to have census of fishermen as they are scattered over a wide area. Catch statistics have been collected for a number of years which fluctuate and show that the peak is reached in the third year of observation and then the quantity decreases in the next two years which may indicate that there is a five-year cycle for Hilsa fishery. It also appears that the fishery is declining which is indicated by catch of this fish for six years, it was 137,580 (1956-57), 134,290 (1957-58), 147,065 (1958-59), 124,951 (1959-60), 95,355 (1960-61) and 96,888 (1961-62) metric tons. However, to say definitely that there is depletion, intensive study for many years is necessary.

Preliminary field data collected by the staff during a period of 5 years are not conclusive for proving definitely that there is depletion in fishery. Detailed studies should be carried out for a number of years. However, the physical factors that may be attributed to cause depletion of Hilsa fishery are as follows:—

- (i) silting of rivers and consequent limnological changes;
- (ii) artificial obstruction in the river preventing smooth migration of the fish to the breeding grounds. These are the fixed nets and large gill nets which are spread across the rivers; and
- (iii) wanton destruction of small Hilsa while going back to the sea.

It has been observed that young Hilsa when going down current towards the sea are caught in large numbers by the bag nets and destroyed, these cause depletion of the fishery and are very harmful. The extensive use of nets across the river blocking the ascent of fish should be strictly controlled under the Fisheries Act which provides regulations to check such harmful practices. In

order to enforce effectively these regulations and to check such harmful practices the Directorate of Fisheries should be provided with patrol boats and adequate staff.

No serious attempts have been made to rear Hilsa in ponds though some experiments have been conducted at Barrackpore, India, to keep small fish in cement cisterns with partial success. Pillay²⁵ has conducted these experiment in cement cisterns.

Hora¹¹ has reported the presence of young Hilsa in large numbers in the settling tanks of Pulta Water Works near Calcutta which clearly proves that Hilsa can be reared in ponds. The presence of Hilsa has been reported from lakes and ponds by many workers. Chilka lake has a regular fisheries as it is connected with the sea. Prashad has reported this fish from Manchar Lake in West Pakistan and this fish has been observed also from Kalri Lake, 76 miles north of Karachi. It is understandable that Hilsa which ascends the rivers may reach lakes and ponds which are fed by them. In this regard it cannot be said definitely whether the fingerlings of Hilsa can be transported easily for stocking the ponds. The second consideration is whether the ecological conditions will suit the fish and the food required by young ones and later grownups will be available in confined waters for proper growth. Anyhow, this is a very interesting problem which needs attention of fish culturists and biologists in this region.

Food and Feeding Habits.—The examination of the alimentary tract of large number of adult specimens of Hilsa indicate that they feed on green and blue algae, diatoms, copepods and mud and sand grains and also unidentified pulpy material are also present. It seems that the fish feeds only in the sea and stops feeding when ascending the rivers. The presence of sand grains and mud is indicative of the bottom-feeding habits of the fish.

It has also been observed that fish caught near Khulna and a little upwards has the organisms in its gut but as it ascends, these are digested and the stomach contains only digested pulp or it is found empty. How the fish exists without food is explained by studying generally its fatty nature. The fish which is caught at or near the mouths of the rivers, contains a large quantity of fat which gradually reduces during its upward journey. The fat is consumed which provides subsistence to the fish. This phenomenon has been described by Greene^{8,9} in the king salmon *Oncorhynchus tshawytscha*. He has dealt with the absorption of fats by the alimentary tract in this fish and has shown that the fish uses its fat during its ascent in the river and stops feeding.

General Conclusions

The present investigation is based on observations conducted in East Pakistan at many points in the main rivers, their tributaries and distributaries. The main ecological features of the country and the rivers are mentioned.

The meristic and non-meristic characters have been studied and it is inferred that *Hilsa ilisha* (Hamilton) consists of a homogenous stock. There are some minor variations and the assumption by some workers in East Pakistan that there may be two races, requires further investigation. I agree with Pillay's²⁵ inference that the relationship of fecundity of Hilsa to the body weight is linear, and that the relations between fecundity and length is exponential.

Maturation and Spawning.—There are two distinct spawning seasons, one starting with the monsoon season and extending up to November and the other during winter, from January to February. Individual fish spawns several times during the spawning season. The fish spawns extensively almost in all rivers in the Ganges-Brahmaputra system. The conclusions of the workers of West Bengal, that the fish that ascend the rivers in the winter season are those that have attained maturity for the first time, and are about 1½ years old and that monsoon run consists of fish of higher age groups, could not be verified. This requires further intensive investigations.

Size at First Maturity and Sexual Dimorphism.—It has been found that there is no conclusive evidence to show that the males mature earlier than the females during the spawning season. The males attain maturity when 16 to 17 cm and females when 19 to 20 cm in total length.

Sex Ratio.—General observations are that the probable sex ratio is 1:1 in the monsoon run but in the winter season there is pre-dominance of males. Generally in the beginning of monsoon season the ratio is as indicated above but it has been observed that the number of males increases with advance of the season and gradually decreases in August and September.

Life History.—Some larvae and juveniles were collected from the catch of the fishermen. In order to help workers taking up this problem in future, mention has been made of the investigations made by Jones and Menon¹⁹ in the river Hoogly, near Calcutta.

Age and Growth.—Very little work of inconclusive nature has been done till now on the age and growth of Hilsa in East Pakistan. In order to give

an idea, the conclusions drawn up by Pillay²⁵ on this fish in the river Hoogly are as follows: "From the detailed examination of Hilsa scales it appears that they cannot be used for age or growth determination. By the analysis of length-frequencies it has been found that males attain modal lengths of 24.7 cm, 34.3 cm. and 39.3 cm; the females, 26.5 cm, 39.1 cm and 43.6 cm in 1½, 2½ and 3½ years, respectively. The growth rate of males and females have been found to be significantly different."

Migration.—It has been found that Hilsa ascends rivers only for spawning and that the spent fish and the young ones travel with the downward stream of the rivers. It has been observed that the estuarine and coastal areas form the habitat of the species. It is suggested that more investigations should be conducted on this problem in order to fully ascertain the factors governing its movements. It has been established that the fish is not so delicate as indicated by some observers. The hardness of the fish has been proved by tagging experiments conducted in the Central Inland Fisheries Research Institute, Calcutta, in the river Hoogly. It is suggested that experiments may be conducted on the culture of this fish by transporting the fry and juveniles to ponds as is done for other fishes in East Pakistan.

The probable causes of the depletion have been discussed. The food of young fish consists of phytoplankton, copepods and other minute organisms. The adult fish does not feed during its ascent but the specimens collected from the lower reaches of the rivers show that it feeds on phyto- and zooplankton, the presence of mud in the stomach contents indicate that it feeds at the bottom of the rivers.

Fishery.—Hilsa fishing methods in the rivers, types of boats and nets employed, manpower engaged and production have been described. It is a very important single species fishery in East Pakistan.

Suggestions.—It is suggested that in view of the great importance of Hilsa, intensive work should be done by the Directorate of Fisheries in East Pakistan as they have established a research station at Chandpur which is situated at a very convenient and suitable point for Hilsa investigation. It is necessary to provide them with a launch which can operate plankton and other nets at different depths and that trained staff be placed at some important centres.

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