OBSERVATIONS ON THE SEAWARD MIGRATION OF THE SO-CALLED INDIAN SHAD, *HILSA ILISHA* (HAMILTON).

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(Plate IX.)

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Hilsa is undoubtedly one of the most important edible fish of the country, whether from the point of view of the numbers caught or in view of the esteem in which it is held by the fish-eating population. Unfortunately our knowledge of the bionomics of this species is very limited and what little is known is very confused and often contradictory. Further, this information is not easily available, and we have, therefore, thought it advisable to preface our observations with a detailed summary of the subject.

SUMMARY OF EARLIER LITERATURE.

Hilsa, also known as the Indian Shad, was in the 18th and even in the beginning of the 19th century generally known as the Sable Fish in Calcutta[1], but this popular name has long since fallen into disuse,—the popular names at present in vogue are *Ilish*, *Ilisha* or *Hilsa* in Bengal and Orissa ; *Ilihi* in Assam ; *Palasah* in Telegu-speaking areas ; *Oolum* or *Ulum* in the Tamil-speaking areas ; *Nga-tha-louk* in Burma ; and *Pulla*, *Pala* or *Palo* in Sind. The species was first described and figured by Russel (1803, p. 78) from Vizagapatam where apparently it was taken in the foreshore waters of the Bay of Bengal. Dr. Russel remarked :

" This fish is known at Calcutta under the name of Sable fish, and highly esteemed. At Vizagapatam it had passed unnoticed, like many others left to the lower ranks of the people. On its appearance, by my request, in the way of experiment at my brother's table, it was recognised by him as a Bengal acquaintance ; and allowed by all to be a rich and luscious fish, with much of the herring flavour.

" On questioning the fishermen why it had never been brought before to the Chief's table, they replied, ' It was not a gentlemen's fish ; the multitude of small troublesome bones utterly disqualifying it.' I found it however well known to the Portuguese race, who used it sauced, or prepared with tamarinds.

[1] Day (1873, pp. 22, 23) and following him Gupta (1908, p. 92) state that it is also known as the Sable fish in Madras. Our account is based on the definite contemporary statements of Russel (1803, p. 78) and Hamilton (1822, p. 243) that Sable Fish was the name by which this species was known amongst the English in Bengal.

" In some respects it resembles the Shad, or *Clupea Alosa*, but differs in shape, has no spots, and the branchial membrane has only six ossicles."

Russel's work in view of its faulty nomenclature is not, however, recognised, and the next account of the fish was published by Francis Hamilton (formerly Buchanan) (1822, pp. 243-246) under the name *Clupanodon ilisha*. Hamilton discussed the similarities and differences of his species with the Shad and Russel's *Palasah* and remarked :

" Excepting in wanting teeth, the *Ilisha* has the most strong resemblance to the *Shad*, (*Clupea alosa*) and there is reason to suspect that the Indian and Latin names may be radically the same. The *Ilisha* frequents the Bay of Bengal and the large salt water estuaries of the Ganges, and in the rainy season ascends the larger rivers to spawn. I have seen it as high as Agra and Kanpur, but so high up it is very rare. At Patna on the Ganges, and Goyalpara on the Brahmaputra, it is pretty common, but rather poor and exhausted."

He was apparently the first author to refer to the occurrence of this species both in the sea and estuaries, and its ascending into the fresh-water rivers of the Gangetic system during the rainy season for spawning purposes to places as high up as Agra and Cawnpore.

Cuvier and Valenciennes (1847, p. 433) in describing the species under the name *Alausa palasah* stated that

" M. Dussumier, qui a vu ce poisson frais, le décrit comme ayant le dos verdâtre, et tout le reste du corps argenté. Il en a rapporté deux beaux individus, longs de seize pouces, et pris tous deux dans le Gange, où cette espèce est très-abondante en août ; elle remonte le fleuve jusqu'à Chandernagor, et peut-être beaucoup plus haut."

They also remarked that the species was apparently the same which Russel (1803, p. 77, pl. 198) had figured under the name *Palasah* and owing to its having been taken at Bombay by M. Dussumier and at Pondicherry by M. Belanger, they believed that the species probably occurs in the sea all round the Peninsular India. They referred to the probable identity of the species with *Clupanodon ilisha* of Hamilton (1822, p. 243, pl. xix, fig. 73), even though the number of rays in the dorsal and anal fins, according to the descriptions, differed in the two species.

Francis Day (1873 *a*, pp. 22, 23) designated the species as *Clupea palasah* and described its habits as follows :

" *** The *migratory herrings* are those which ascend large rivers from the sea for the purpose of breeding in fresh water, the most important of which is the shad, *Clupea palasah*, known also as the Hilsa or Ilisha, the Palasah of the Telingis, the Ulum of the Tamils, the Pulla of the Indus, the Nga-tha-louk of the Burmese, and the sable fish of the Europeans in Madras. There seem to be two classes of this fish which ascend the large rivers : those below one year of age, and which do not appear to breed, or if they do, it is at the very end of the year, or commencement of the succeeding one ; secondly, there are those which breed at the commencement of, or during the monsoon. In the Cauveri and Coleroon these fish ascend with the first burst of the S. W. monsoon, and continue doing so the four succeeding months, but in diminished quantities, some evidently being later breeders or younger fish. In the Kistna, which has a great velocity, the freshes commence in June and continue until the end of October, after which the river subsides, but it does not become fordable until the middle or end of January. A few of these fishes arrive at the end of September, but it is not until the middle of October and the two following months that their main body appears to ascend, whilst they disappear by April. It is only when the rapidity with which the Kistna flows during the freshes commences to subside that they arrive in large numbers. In the neighbouring river, the Godaveri, which has a less rapid current than the Kistna, the fish ascend earlier, being most numerous from July to September, when the fishermen believe they migrate to the Kistna. In the Hoogli they continue ascending throughout the S. W. monsoon, and many are found to be still full of roe in September. Mr. Blanford has observed them at Mandalay in Upper Burma at the end of the year. In Sind, this fish ascends from the sea about February for the purpose of breeding in the river, from which it again descends to the salt-water about the end of September or commencement of

October, after which none, even young, can be found. They are only taken in *dhánds*, stagnant pieces of water or canals, due to some accidental cause or unnatural obstruction having obliged them to turn aside from their natural breeding grounds. The main body of these fish swarm up the large rivers of India and Burma generally as soon as the S. W. monsoon commences, but not always at the same period, such apparently at times being dependant upon the rapidity of the current and other causes. That it is not solely due to the presence of rain-water is shown by the Indus and Irrawadi; in the former, the floods are mainly caused by melted snows at this period, whilst in the Irrawadi these fish push on to Upper Burma[1], to which country the S. W. monsoon scarcely extends, and there the inundations are also due to melting snows. One reason why periods of floods are selected as those for breeding, appears to be due to their being practically acquainted with the fact, that at these times the shallows are covered with water, rendering ascent practicable, consequently they now come up to deposit their ova, which is always done in the rivers, never in tanks or canals."

Further on he added (Day, App: Sind—p. xxxi) that the Commissioner of Sind had reported that *Pulla* in the Indus are restricted to a particular season, from March until September, and come up from the sea to spawn. Earlier (p. 66) he had referred to the peculiar method of the fishing for this fish as adopted in Sind where the fishermen float down on a gourd or a hollow earthen pot and catch the fish by means of a purse net[2].

In his report on the Marine Fisheries of India (1873*b*) Day recorded the occurrence of extensive fisheries of *Hilsa* at Gwadar on the Baluchistan coast (App. p.i) and at Chandipore on the Balasore coast (App. pp. cxxi, cxxii) and remarked (pp. 24, 25):

"In my fresh-water fishery report I have adverted to the enormous ascents of hilsa (*Clupea palasah*) up all the large rivers for breeding purposes, mostly during the south-west monsoon (June and subsequently), and it is a most important circumstance that they are almost invariably as plentiful in one season as they were in the preceding year, provided no impediments in the rivers exist entirely barring their ascent. If one examines the varieties of fish taken along the sea-coast throughout the year, these hilsa will be found extending their range to wherever food is plentiful; they will only be missed during the breeding season, and even then young ones will be present. This would appear to show that they never migrate any great distance from the shore. In fact this fish is not so capricious in its arrival as are the more marine forms. Thus a periodical supply of food is afforded to people far inland unless man in his greed impedes or entirely arrests their ascent by means of fixed engines and weirs, and so annihilates the supply."

In a later work Day (1878, p. 640) summed up the habits of the fish as follows:

"The main body of these fish swarm up all the larger rivers of India and Burma, generally as soon as the monsoon commences, whilst an important matter appears to

[1] We have not been able to find any connected account of the *Hilsa* fishery in Burma though casual references to it are made in *Reports on Inland and Sea Fisheries in the Thongwa, Myaungmya, and Bassein Districts and the Turtle-Banks of the Irrawaddy Division*, pp. 73, 85, 130, 177 (1911).

[2] The following account of the fishing of the *Hilsa* in the Indus by spearing by Sebastien Manrique [*Travels of Sebastien Manrique*, 1629-43 (Ed. Luard and Hosten, London), Vol. II, pp. 230, 232, 1927] in the seventeenth century may be noted here. In describing the voyage down the river to Bakhar it is stated: "We sailed on peacefully in this way, keeping careful watch at night, finding as we advanced on our road an abundance of good cheap provisions in every place we anchored at. In some places, where the stream was shallow, we met many fishermen, who furnished us with most excellent shad very cheaply.... .They dispense with the encumbrance of nets and assistants as they go out fishing on large earthen vessels with the circumference of ten to twelve palms in breadth, flattened at the rim, and open at the top in a big, circular aperture just of a size to receive the front of a man's stomach, which being pressed into it checks the ingress of the water. It thus serves as a safe receptacle for the fish as well as a steady base and support for the fisherman, who lies upon it directing his earthen ship with his legs, his hands being busy with the spear, piercing the scaly swimming fishes.... .This abundance of fish was most welcome to us Christians travelling there, since it was then Lent." From this it appears that the fish swim very near the surface, as it would not be possible to spot them at any depth in the muddy water of the river.

be the rapidity of the current. The numerous Indian rivers spanned by weirs, destitute of fish passes, is causing enormous injury to these fisheries. Almost fruitless to deposit their eggs below these structures when between the sea and their spawning beds, whilst they are unable to pass them, their partial or even entire extermination in such rivers appears to be merely a question of time."

and quoted almost verbatim his earlier observations on the seasons during which the *Hilsa* were found to ascend the rivers in different parts of India. Day (1889, pp. 376, 377) in the *Fauna* was more definite about the *Hilsa* swarming up the large rivers, generally as soon as the monsoon commences, and added that the rapidity of the current affects the time of migration of this fish. In the Indus they ascend in March and April, when the river is swollen by the melting of Himalayan snow. They have been observed in the Irrawaddy in Burma as high as Mandalay in October.

Günther, it may be incidentally noted, had described *Clupea palasah* as separate from *Clupea ilisha*, the former from the River Ganges and the latter from " the Indian Ocean and Archipelago ", and it was not till Regan's (1917, p. 304) studies on the Clupeoid fishes in 1917 that the exact position of the species was cleared. Regan found that it was necessary to separate *Hilsa*-like Clupeoid fishes of the Indo-Pacific waters into a new genus, *Hilsa*, and stated that Günther's *Clupea ilisha* was the same as *C. kanagurta* of Bleeker, which is widely distributed from Zanzibar to Malay Archipelago, while *Clupanodon ilisha* Hamilton corresponds to *Alausa palasah* of Cuvier and Valenciennes, *Clupea palasah* of Günther and *Clupea ilisha* of Day. This species also is widely distributed, but its range is restricted from the Persian Gulf to Burma.

The work on *Hilsa* in Bengal started with the recommendation of Sir K. G. Gupta in his final report on the Fisheries of Bengal and was continued by the Fisheries Department for the two provinces of Bengal and Bihar and Orissa up to 1923 when the Bengal Fisheries Department was abolished. The work on *Hilsa* in these two provinces and in Eastern Bengal and Assam during this period was summarised by Hora (1938, pp. 147-158), and it is only necessary for us to refer to a few further records in connection with the *Hilsa* which are not included in it.

Day (1873*b*, App. pp. cxxi, cxxii) in his Report on the Sea Fish and Fisheries of India and Burma remarked :

" When I was at Balasore in 1868, I found that the hilsa forms a portion of the fish taken throughout the year, excepting during the time they are ascending the rivers to breed : while in the rivers north of Midnapore the young hilsa were being taken in thousands. Consequently, if weirs are to be erected across the large rivers without gaps or fish passes, permitting neither the old fish to ascend to their breeding grounds nor the young to descend to the sea, the species must of a necessity be exterminated, as it only breeds in fresh water."

He also described the mode of fishing at Chanderpore (=Chandipore) by means of fixed stakes and noted :

" Here I saw a good number of hilsa captured, and the fishermen assured me that they are always present, except during the south-west monsoon, when they ascend the large rivers to breed. I took a full sized one out of season, and another half-grown one that appeared very healthy, therefore it may fairly be concluded that were this species of fish destroyed the coast fishery must suffer,"

In the Gazetteer for Balasore District (O'Malley, 1907, p. 14) also recorded that extensive *Hilsa* fishing is carried out in the sea along the coast :

" The fishermen are particularly keen in their pursuit of the *hilsa*, and a flotilla of sea-going craft will sometime drift along together for days, awaiting the approach of a shoal of that fish. When the shoal arrives, they at once fill their boats, steer straight for shore, and convert their haul into *sukhuā* or sun-dried fragments of fish—a favourite relish with the Oriyas. Besides the *hilsa* the most common sea fish are the *bekti* and *telia*, and the delicious *tapsi* or mango fish is found in the tidal waters of the Subarnarekhā and Burābalang."

We have since found (*vide infra*, p. 535) that this fishery is even today carried on the same lines as detailed by Day and O'Malley. It is unfortunate that whereas in the unpublished records of the Bengal Fisheries Board there are references to the find of *Hilsa* at Balasore, apparently no importance was attached to this find of the *Hilsa* in the sea round this area, and no further investigations in connection with it were carried out by the Fisheries Department. Similarly there are references in the same records to the occurrence of extensive foreshore fisheries for *Hilsa* in the eastern part of the Bay of Bengal, but apparently this line of investigation also was not pursued by the Fisheries Department. The work of the Bengal Fisheries Department in connection with the *Hilsa*, extending from 1907 to 1919, may roughly be summarised as consisting in the recognition of the fish as a true anadromous species and the organisation of research in locating its spawning grounds ; this work was carried on with a view to the artificial propagation of the species and establishing hatchery stations. In 1919, however, doubts were expressed by Prashad (1919, p. 4) regarding the true anadromous nature of *Hilsa* in view of the fact that the species is found in the Gangetic Delta and even some of the upper reaches of the rivers almost throughout the year, while the young of the species, about 6 inches long, locally known as *Jatka*, were found in some of the rivers in Eastern Bengal. Since that date young *Hilsa* of various sizes have also been collected from the river Hooghly and other rivers of the Ganges system, and as has been shown by Hora and Nair (1940, pp. 35-50), *Hilsa* reside almost throughout the year in the rivers, or in the lower reaches in the estuaries, in the Gangetic Delta, and rarely go out to sea. The breeding season of the fish has been found to extend almost throughout the year, though the peak period occurs during the rainy season. The young of the species migrate down into the estuaries wherefrom, it is surmised that they later migrate out into the sea. Another discovery of great interest by these authors is that the young of *Hilsa* flourish and continue to grow to the adult size in the freshwater settling tanks of the Water Works at Pulta, but apparently the fish in these tanks do not breed.

In a recent official publication the work of the Madras Fisheries Department on *Hilsa* has been summarised as follows :

" Along with actual operations in the Hatchery, a study of the fish in the rivers was made and a search for its young and eggs carried out. After the subsidence of the flood the occasional occurrence in the months of October and November of young Hilsa measuring 2 to 4 inches in the Cauvery and its channels was observed and recorded during 1914-1921. In 1925-26 when the Hilsa hatchery was transferred to the Kistna and Godavari, the field studies were extended to those rivers. In 1933-34 a study of the fishery in the lower reaches of the Godavari showed the existence of Hilsa in the river throughout the year.

" Considerable progress was made in Hilsa investigations in the Cauvery, Kistna and Godavari by 1935-36 which has thrown much light on the life-history of this important food fish. From all these investigations, it has been proved (1) that Hilsa take two years to grow to the adult size, (2) that the fish spend the first two years of their life in the lower reaches of rivers and go to the sea only in the third year, and (3) that when they leave the river, they do not go far into the sea but move about in shoals in the shallow flats close to the river mouths. Recently these tentative conclusions have been found to hold good for Hilsa in the Ganges also. In tanks watered by the Cauvery, yearling Hilsa ranging in size from 2 to 4 inches along with adult specimens were discovered in 1935 while the examination of specimens from the lower reaches of the Godavari which unlike the tanks of the Cauvery delta are perennially open to the sea also showed similar growth-stages more or less, *viz.*, half and full-grown fish. The latter on dissection proved to be virgin fish. The two sizes could belong only to two successive seasons and so the age of the fish before they migrate to sea was proved to be two years. The fish-curing yards close to the mouths of all the 3 rivers obtain only adult sized Hilsa, from the sea when they approach the rivers for their breeding migrations upstream and subsequently when they leave the rivers. Their appearance and behaviour and range of size at sea have also been studied.

" The facts ascertained offered a satisfactory explanation of the unexplained absence of the fish on the West Coast of Peninsular India, *viz.*, that the short rivers of the West Coast do not offer to Hilsa the facilities for two years' sojourn and growth to adult stage. The period they spend at sea and whether they breed more than once in rivers and the age limit of the fish remain yet to be discovered and can be ascertained only by marking experiments. Proposals to mark Hilsa was deferred by Government in 1931 but last year Government have indicated their intention to sanction my proposals."

EARLIER RECORDS OF THE OCCURRENCE OF *Hilsa* IN THE SEA.

As the main fishery of *Hilsa* depends on its migration into fresh waters, little attention seems to have been paid to the seaward journey and marine life of the species. However, it will be seen from the summary of the earlier literature given above that Russel's specimens of *Palasah* were apparently taken in the foreshore waters of the sea at Vizagapatam. According to Cuvier and Valenciennes, Dussumier obtained examples of the species at Bombay and Belanger at Pondichery. Hamilton had also recognised the fact that " The Ilisha frequents the Bay of Bengal and the large salt water estuaries of the Ganges ", whence it ascends the larger rivers to spawn. In the recent scientific literature there are two definite records of the capture of *Hilsa* from the sea in Madras waters. Nayudu (1920, p. 129) in his statistical analysis of an inshore fishing experiment at Madras during 1919 stated that *Hilsa* was caught only twice during the year as noted below :—

	Lb.	Rs. A. P.
" 1919, April	4	0 4 0
1919, August ..	365	31 8 0
	369	31 12 0

" The following table furnishes the data of their appearance and the quantity caught :—

1919, August 7	First caught off Mylapore by the local fishermen in their Vala Valai. They measured 12″ to 15″ in length, one of which 13·5″ long had just developing ova.
1919, August 9	238 were caught in our Chala Vala and drift nets.
1919, August 10	145 were caught in our Chala Vala.
1919, August 11	Only a few were caught.

"They were never seen again till October 4th, when a few were caught by local men.

"August to September seems to be the spawning season for Hilsa. All the five specimens examined on 9th August 1919 were females with about half-matured ova and these specimens measured 11·5″ to 14″ long. Evidently these being anadromous, were from the shoals that were on the look out for any river mouths through which to ascend higher up for spawning."

The second record is to be found in the Administration Report of the Madras Fisheries Department for 1930-31 (Raj, 1932, p. 32), where it is stated that:

"From the records of Palk Bay fish-curing yards recently scrutinized in connexion with the bulletin on fish that is under preparation, it was found that shoals of hilsa visit the Bay annually from November to May when a regular sea fishery takes place. This discovery that hilsa fisheries occur also in the sea (Palk Bay) from November to May after the fish have left the rivers therefore offers unique opportunities for investigating their movements, growth, and migration in the sea, regarding which nothing is at present known."

In February-March 1939, a party of the Zoological Survey of India in the course of their investigations on the fauna of the Balasore Coast at Chandipore found extensive catches of *Hilsa* in *Ber* fishery and a number of specimens were collected and brought to Calcutta. This confirmed Day's and O'Malley's earlier observations referred to above (*vide supra*, p. 533).

The *Hilsa* fishery along the Balasore Coast seems to be fairly extensive as is shown by our observations recorded below (*vide infra*, pp. 537-541).

In the "Statesman" of the 7th September, 1938, Mr. Stanley Howard contributed a note on "The Hilsa", and *inter alia* made the following observations on the marine life of the species:—

"During the monsoon the adult fish ascend the Hooghly and travel as far as Patna and Benares from the sea for the purpose of spawning. The spawn is deposited from about the middle of July to the middle of September, and rivers continue to be the home of these fish until the middle of October when the fish return to the sea. Having deposited their spawn the older fish, or what remains of them, having finished their work die out at sea.

"The young fish after about two months stay in the sea, add considerably to their size and weight, and towards the end of December they return to the estuaries (Sunderbans) in shoals. The fish at about this time are about 7 to 9 inches long and in search of new feeding grounds.

"It is at this time that I have caught them about two miles out at sea, when they have been on their way to the richer feeding grounds of the Sunderbans."

In his account of the foreshore fishing in the eastern part of the Bay of Bengal, Mojumdar (1939 *b*, p. 219) stated that:

"Amongst the sea fishes, the *hilsa* holds an important position even in the fisheries of the coastal region. During the winter season from November to February large shoals of this fish appear in the coastal waters of the Bay."

In an earlier article entitled "Culture of Hilsa", Mojumdar (1939*a*, pp. 294, 295) had given the following as the special characteristics of the coastal *Hilsa*:—

"Though the hilshas of the inland rivers have never been marked to jump up into the air it is a distinctive quality with those[1] of the Eastern coast of the Bay. The people going in country boats hazard a risk if they chance to be in or near a shoal of hilshas as these may jump in and cause the boats to sink.

"The surface moving habit is also another important feature of the sea-hilshas. The fishermen take advantage of this. In some places they are 'skimmed off' the water

[1] Mr. Mojumdar distinguishes three kinds of s a *Hilsa*. Among a sample sent to us we have found specimens of *Hilsa toli* (Ham.), locally known as *Chandana Hilsa*, besides *Hilsa ilisha* (Ham.). It is not certain, therefore, which species of the Clupeidae has this jumping habit.

by nets. In others they are driven to khals (branch rivers) and such means are improvised with nets to prevent their return to the sea. Thousands of hilshas are caught at a single 'drive off'. A cloudy day in the Dala time (when water level is comparatively on the ebb-side in a fortnight) makes favourable conditions for the hilsha fishing during the winter months.

"These are quite in contrast with those of the inland rivers, where they move at a depth sometimes of 30 to 40 cubits under water though on a cool or drizzling day they may come within 4 to 5 cubits from the surface."

Enquiries made from various sources confirmed the observations of Howard and Mojumdar about the existence of extensive fisheries of young *Hilsa* during winter months along the coasts of Bengal. It may now definitely be stated that *Hilsa* of about 9 to 10 inches in length make their appearance, usually in shoals, in October-November every year in the foreshore of the Bay even down to Cox's Bazar. The appearance of the young *Hilsa* in the foreshore waters is undoubtedly for feeding purposes and not, as stated by Mojumdar (1939*b*, p. 219) on the authority of local fishermen, to "liberate eggs" From the sizes of these specimens it can be inferred that they are hardly one year old (Hora and Nair, p. 40) and the majority of them must, therefore, be the progeny of the individuals that spawned either during April-May or July-August.

PROBABLE EXTENT OF THE SEAWARD MIGRATION OF *HILSA*.

There is a popular belief among the fishermen of Bengal (*vide* De, 1910, p. 18; Finlow, 1933, p. 5) that sea is the home of *Hilsa*, but little research has so far been carried out to verify this statement. As a result of an investigation into the *Hilsa* fishery in 1933-34 in the Godavari from the Dowlaishweram anicut to the sea by the Madras Fisheries Department, it was found that fish of varying sizes were present throughout the year and that young *Hilsa* up to $8\frac{1}{4}$ inches in length reside in the lower reaches of the river and do not go out to the sea. The same department through a series of observations carried over a number of years came to the conclusion—

"(1) that Hilsa take two years to grow to the adult size, (2) that the fish spend the first two years of their life in the lower reaches of rivers and go to the sea only in third year, and (3) that when they leave the river they do not go far into the sea but move about in shoals in the shallow flats close to river mouths and their neighbourhood." (Raj, 1937, p. 38).

The Madras Fisheries Department is undertaking marking experiments to trace the wanderings of *Hilsa* in the sea, and this is no doubt the most effective method to elucidate the problem. From the observations recorded above it seems clear that young *Hilsa*, less than one year old, do not always reside in the lower reaches of rivers, but move about in shoals along the Bengal and Balasore coasts. However, we agree with the findings of the Madras Fisheries Department that they do not go far into the sea. We have the following reasons for supporting this view :—

1. The Bengal Government Steam Trawler "Golden Crown" made several cruises in the west coast to places from Pilot Ridge light vessel to south-west of Puri and in the east coast in the neighbourhood of Elephant Point and East Channel light vessel, but it is noteworthy that no *Hilsa* was found among the extensive catches of the Trawler (*vide* Jenkins, 1911, p. 55). The trawling was carried out in waters mostly

over 10 fathoms in depth, and the absence of *Hilsa* in any of the catches seems to indicate that in their seaward migration *Hilsa* do not wander out in waters over 10 fathoms in depth.

2. A Pilot vessel is always stationed at Sandheads, off the mouth of the Hughli River. Over a decade ago both the vessels, which take this duty in turn every month, were equipped with a beam trawl for such marine investigations as the exigencies of their service would permit them. The members of the Bengal Pilot Service have been enriching the collections of the Indian Museum with large numbers of zoological specimens from this area, but no specimen of *Hilsa* was ever found in their catches. In connection with our recent investigations a special request was made for information regarding the period of occurrence of *Hilsa* at the Sandheads. We were informed that no *Hilsa* fish has ever been caught by the Pilot vessels at the Sandheads.

The area of the Sandheads roughly lies in 21°N. 88°E., and, according to Chopra (1933, p. 26), the salinity of the surface water on 18th-19th October, 1932, varied between 16·175 and 20·990 and that it showed tendency to rise and fall with the tides.

These observations, inadequate and inconclusive as they are, lend support to the views of the Madras Fisheries Department that *Hilsa* do not go far into the sea.

INVESTIGATIONS AT CHANDIPORE, BALASORE COAST.

Reference has been made above (*vide supra*, p. 535) to the fishery of *Hilsa* at Chandipore on the Balasore coast and to a number of specimens collected by a party of the Zoological Survey of India in February-March, 1939. Chandipore is situated in 21° 27′ N. and 87° 2′ E. on the sea-coast about 9 miles east of Balasore and 2 miles from the mouth of the Burhabalang river. There is a long level beach along the sea face, and the sea is extremely shallow for a great distance out. The records of the Bengal Fisheries Inquiry show that about the middle of November young of *Hilsa* " size length 2 inches and under ", known as *ela* or *pila*, are to be found in catches at Balasore. In paragraph 168, it is stated that—

" Hilsa is caught in mál nets throughout the season. They are generally found in shoals, some small, some quite big."

In connection with *Hilsa* investigations we visited Chandipore towards the end of April 1939, but the weather was too rough for fishing and no specimens were secured. About the middle of July 1939, an enquiry was made from the Collector of Balasore regarding details of *Hilsa* fishing in July both in the sea and in the river Burhabalang at Chandipore. In reply we were informed that there was at the time no *Hilsa* fishing at Chandipore, but " Hilsa fishing is done from the latter part of July till the end of August near Talpada in Police Station Soro of this district. There is a P. W. D. inspection bungalow there and the Hilsa fishing is done in the sea from the 11th day of the moon till the 3rd day after the full moon, *i.e.*, during the spring tide[1] and again during ebb

[1] It is worthy of remark that in East Bengal (Mojumdar, 1939, p. 295) and the Sunderbans (information supplied by Mr. Stanley Howard) *Hilsa* fishing is done during the neap tide periods. Probably this is due to the methods of fishing employed in the two areas, but the matter requires further elucidation.

tide from the 11th day after the full moon." Accordingly a party was sent to Talpada on the 27th July for about a week, but owing to unfavourable weather no fishing for *Hilsa* was done and, in consequence, the party did not make any direct observations on the fish. Further attempts were made to obtain *Hilsa* from the sea at Talpada during the rainy season, but without success. Reports were, however, received of extensive catches of *Hilsa* during the spring tides during August, September and October. We were able to visit Chandipore later on the 26th November, the day of the full moon, and stayed there for 4 days. On the day of our arrival we purchased 148 specimens of *Hilsa*. The majority of the specimens, 103 in number, were about 24 cm. in length (Table I). The smallest specimen was 11·9 cm. and the largest 38·4 cm. In view of the earlier observations on the growth of *Hilsa* (Hora & Nair, 1940, pp. 40, 41) it can be surmised that, with the exception of a few specimens, almost all the examples were one year old or under. The gonads were not properly developed so it was not possible to distinguish the sexes by naked eye. Though at present no reliable deduction about age can be made from the number of rings on the *Hilsa* scales, it may be stated that two rings could be detected on the scales showing thereby two periods of cessation of growth in one year old *Hilsa*. The edges of the scales showed the " A " phase, indicating that the growth had stopped about November. This was borne out by the fact that in all the specimens the alimentary canal was empty.

Owing to the approach of bad weather, the nets were removed from the night of the 26th and thus no further observations could be made. On the 29th November, one large *Hilsa*, 45·6 cm., was purchased. It was a spent female, but the ovaries were highly vascular indicating that they were about to mature again. Most of the scales of this specimen showed 3 rings, while 4 rings were present in the case of a few. " A " phase had started at the edge of the scales.

Though we were not able to visit Chandipore again, we were fortunate to secure the helpful co-operation of Rai Sahib Tarun Chandra Ghosh, Superintendent, Collector's Office, Balasore. He undertook to send us a few specimens preserved in formalin every now and then. The material thus obtained has yielded the following data :

On the 11th December, Rai Sahib Ghosh informed us that " No *Hilsa* is expected to be caught during the ensuing new moon tide as the sky is overcast with clouds now and the fishermen who generally fix their nets from today will not do so." On the next full moon day, 26th December, 1939, 44 specimens of *Hilsa* collected at Chandipore were received. They ranged in length from 19·6 to 45·8 cm. (Table II). When arranged in 20 mm. difference groups they showed two majority groups, namely, 9 specimens between 20 and 21·9 cm. and 8 specimens between 34 and 35·9 cm. It is significant to note that the fish must have been feeding actively at this time, as their stomachs contained copepods, small molluscs and sand grains[1]. In cases where the stomach was empty, the intestine contained some pulpy matter. The edges of the scales,

[1] From the presence of sand grains in the stomach, it does not necessarily follow that the fish feeds at the bottom. Owing to tidal action, sand grains are sometimes held in suspension and swallowed along with planktonic organisms which form the food of *Hilsa*.

except in the case of a few individuals, showed the growing phase. The scales had two to five rings and the number did not depend upon the size of the individuals.

The next consignment of 24 specimens of *Hilsa* was obtained from the Burhabalang River at Balasore on the 11th January, 1940. Balasore is situated about 16 to 17 miles from the sea by the river route as against about 8 miles by road. All the specimens were relatively larger, their lengths varying from 25·8 to 47·5 cm. with an average length of 35·5 cm. (Table III). All the fish were feeding copiously, their stomachs being distended with filamentous algae, copepods and polyzoa. The scales showed the growing phase at the edge and a considerable number of the specimens had 3 rings on their scales. The gonads were not ripe in any of the specimens.

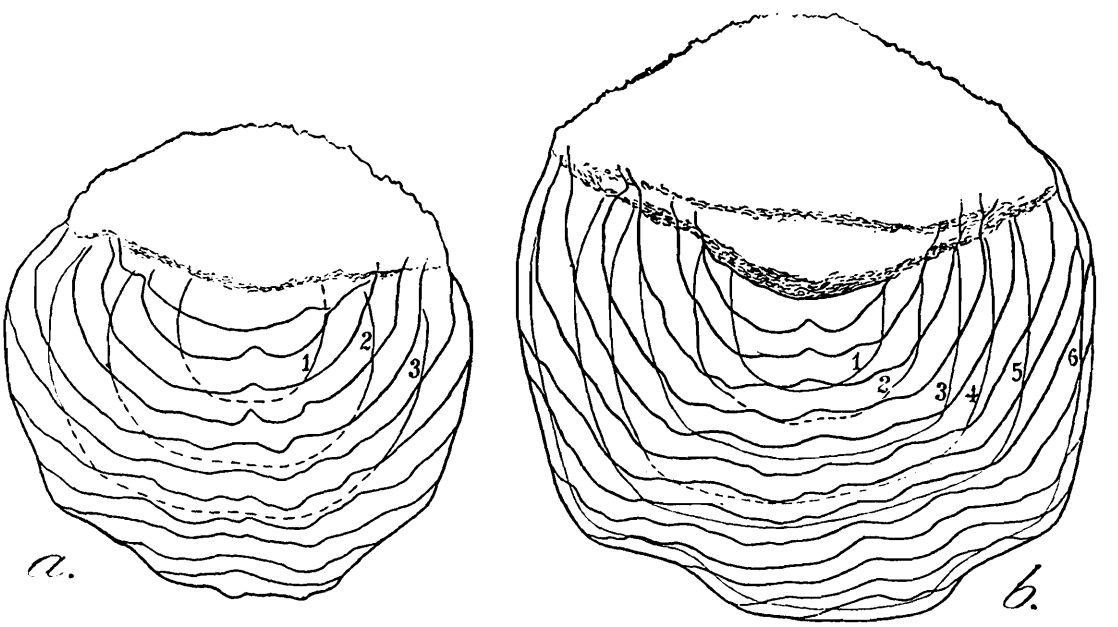
Towards the end of January (full moon) and middle of February (new moon) large number of *Hilsa* were caught at Chandipore in the mouth of the river. A consignment of 21 specimens, sent on the 1st February, 1940, comprised large-sized specimens of an average length of 36·9 cm. (Table IV). Their stomachs contained polyzoa, copepods and algae, and with the exception of a few specimens, the scales showed the growing phase. The collection contained 7 specimens with 3-ringed scales and 7 specimens with 5-ringed scales. The smallest specimen, 19·5 cm. long, had only one ring, while the scales of one specimen had 6 rings.

The intensity of *Hilsa* fishing increased during February and a consignment of 67 specimens caught in the sea on the 25th February was sent to us. These specimens ranged in length from 25 to 30 cm. (Table V), and, with the exception of a few, the alimentary canal was empty. The intestine of some fish contained sand particles and pulp. The scales showed a minimum growth stage.

On the 10th March, 1940, a sample of 22 *Hilsa* was obtained from Chandipore ; they ranged in length from 28·2 cm. to 43·2 cm. (average length 34·8 cm., Table VI) and their stomachs contained polyzoa and copepods. Most of the specimens had 3 rings on their scales and the edges of scales showed that growth had just started after a period of minimum growth. This inference is possible from the fact that in most specimens some scales show a stoppage of growth while others show a growing phase.

Owing to nor '- westers and later the flooding of the country following the heavy monsoon the fishermen were unable to catch fish and we did not receive any specimen from Chandipore during April to July, 1940. Ten specimens caught from the sea by means of the floating nets and ranging in length from 39·1 to 44·5 cm., average length being 41·4 cm. were, however, received on 26th August. Their stomachs were distended with algae, sand and a few copepods. All the specimens were females but the gonads were not much developed. The scales were marked with 4 to 8 rings (one with 4, eight with 6 and one with 8 rings). Most of the scales showed a growing phase, while only a few lateral scales of some individuals showed stoppage of growth. It is of interest to note that in all scales there was a ring close to the periphery of the scale showing thereby that stoppage of growth had taken place recently.

On the 3rd September we were informed that the *Hilsa* fish were being caught in large numbers both at Chandipore and Talpada. On



Two scales of *Hilsa ilisha* (Hamilton) showing varying number of rings of growth; the exact significance of these rings is still obscure : × *ca.* 4½.

a. Dorso-lateral scale of a specimen 352 mm. in length purchased from the Calcutta market and stated to have been imported from Goalundo on the Padma River. It shows three growth rings which are quite marked at the sides, but become indistinct towards the apex.

b. Dorso-lateral scale of a specimen 408 mm. in length obtained from the sea at Chandipore on the 26th August, 1940. It shows six growth rings ; the second and fourth are indistinct towards the apex.

the 5th September a lot of 10 specimens from Talpada was sent, these ranged in length from 34·4 cm. to 48·2 cm., their average length being 42·5 cm. Seven of the specimens were females with ripe ovaries while the gonads of the other three were decomposed. Their stomachs were distended with copepods, polyzoa and large quantities of sand. The scales showed 5 to 8 rings. In 5 specimens all the scales showed a growing phase while in the remaining a few scales were marked with the " A " phase. In all cases the outermost ring was just next to the pheriphery.

The observations recorded above indicate that (*i*) *Hilsa* in all stages of growth[1] from the 12 cm. size is found in the sea at Chandipore and Talpada, (*ii*) the November examples are generally less than one year old, and (*iii*) the cessation of feeding and in consequence of growth takes place in November, and towards the end of February and possibly during May-June ; during the intervening months the fish feeds and grows. Though with the information available at present it is not possible to interpret the exact significance of the scale rings of *Hilsa*, we believe that they are formed not at regular intervals, but whenever the conditions of life become unfavourable. The growth phase, equally with the rings, is of irregular occurrence ; this is clear from the fact that feeding is resorted to at any time of the year, whether in the sea, the estuaries or the fresh-water rivers, both before and after the sexual migrations. More extensive studies of the scales correlated with size,

[1] The records of the Bengal Fisheries Inquiry show that young *Hilsa* of 2 inches and under were found at Chandipore in the middle of November (*vide supra*, p. 537).

condition of gonads, stomach contents, seasons of capture and the habitats would alone make it possible to interpret the exact significance of the rings, but we offer this tentative interpretation as a working hypothesis. We are fully aware that sufficient data are not available at present to elucidate precisely the seaward wanderings of *Hilsa*, but the observations made are offered as suggestions for further investigations on this very important food fish. Though for a full elucidation of the life-history of *Hilsa*, marking experiments are absolutely essential, we feel that a great deal of work is possible by an intensive study of the foreshore fishery of this species along the Balasore and Bengal coasts.

SUMMARY.

A summary of the earlier literature on *Hilsa* fishery is given and attention is directed to the records of the occurrence of *Hilsa* in the sea. Evidence is adduced to show that after leaving the rivers the fish do not go far into the sea but move about in shoals in the estuaries and along the foreshores. An account of the *Hilsa* investigations carried out at Chandipore on the Balasore coast is given and the tentative conclusions are reached that (*i*) *Hilsa* in all stages of growth from 12 cm. size is found in the sea at Chandipore[1], (*ii*) that the November examples at Chandipore are generally less than one year old, and (*iii*) that the cessation of feeding, in consequence of growth, takes place during November and February, and possibly during May-June also.

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TABLE I.

Measurements of Hilsa ilisha *(Ham.) caught at Chandipore on 26th November, 1939.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
1	119 mm.	31mm.	8	202 mm.	53 mm.
2	142 mm.	39 mm.	9	204 mm.	56 mm.
3	158 mm.	44 mm.	10	205 mm.	54 mm.
4	160 mm.	44 mm.	11	205 mm.	54 mm.
5	196 mm.	51 mm.	12	206 mm.	53 mm.
6	201 mm.	52 mm.	13	206 mm.	56 mm.
7	202 mm.	54 mm.	14	207 mm.	52 mm.

TABLE I—*contd.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
15	207 mm.	54 mm.	46	216 mm.	56 mm.
16	208 mm.	52 mm.	47	216 mm.	55 mm.
17	208 mm.	50 mm.	48	217 mm.	58 mm.
18	208 mm.	52 mm.	49	218 mm.	55 mm.
19	209 mm.	54 mm.	50	218 mm.	58 mm.
20	209 mm.	55 mm.	51	218 mm.	59 mm.
21	211 mm.	53 mm.	52	218 mm.	55 mm.
22	211 mm.	55 mm.	53	218 mm.	57 mm.
23	211 mm.	54 mm.	54	220 mm.	55 mm.
24	211 mm.	53 mm.	55	221 mm.	58 mm.
25	211 mm.	56 mm.	56	221 mm.	59 mm.
26	212 mm.	55 mm.	57	221 mm.	55 mm.
27	212 mm.	56 mm.	58	221 mm.	58 mm.
28	212 mm.	52 mm.	59	221 mm.	61 mm.
29	212 mm.	55 mm.	60	222 mm.	57 mm.
30	212 mm.	57 mm.	61	222 mm.	56 mm.
31	213 mm.	54 mm.	62	223 mm.	56 mm.
32	213 mm.	54 mm.	63	223 mm.	59 mm.
33	213 mm.	54 mm.	64	223 mm.	59 mm.
34	213 mm.	57 mm.	65	223 mm.	55 mm.
35	214 mm.	55 mm.	66	223 mm.	55 mm.
36	214 mm.	56 mm.	67	223 mm.	56 mm.
37	214 mm.	55 mm.	68	223 mm.	57 mm.
38	215 mm.	57 mm.	69	224 mm.	56 mm.
39	215 mm.	55 mm.	70	224 mm.	58 mm.
40	215 mm.	54 mm.	71	224 mm.	55 mm.
41	215 mm.	55 mm.	72	224 mm.	58 mm.
42	215 mm.	56 mm.	73	224 mm.	61 mm.
43	215 mm.	57 mm.	74	224 mm.	58 mm.
44	216 mm.	56 mm.	75	224 mm.	63 mm.
45	216 mm.	58 mm.	76	225 mm.	59 mm.

Table I—*contd.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
77	225 mm.	60 mm.	108	235 mm.	62 mm.
78	225 mm.	59 mm.	109	235 mm.	55 mm.
79	225 mm.	57 mm.	110	235 mm.	58 mm.
80	225 mm.	54 mm.	111	235 mm.	56 mm.
81	226 mm.	59 mm.	112	235 mm.	59 mm.
82	226 mm.	61 mm.	113	235 mm.	59 mm.
83	226 mm.	56 mm.	114	236 mm.	58 mm.
84	226 mm.	61 mm.	115	236 mm.	61 mm.
85	226 mm.	58 mm.	116	236 mm.	57 mm.
86	227 mm.	59 mm.	117	236 mm.	64 mm.
87	227 mm.	57 mm.	118	237 mm.	64 mm.
88	228 mm.	58 mm.	119	238 mm.	57 mm.
89	228 mm.	57 mm.	120	238 mm.	58 mm.
90	228 mm.	58 mm.	121	238 mm.	62 mm.
91	228 mm.	54 mm.	122	239 mm.	62 mm.
92	229 mm.	60 mm.	123	239 mm.	58 mm.
93	231 mm.	58 mm.	124	241 mm.	61 mm.
94	231 mm.	60 mm.	125	242 mm.	63 mm.
95	231 mm.	62 mm.	126	242 mm.	62 mm.
96	231 mm.	59 mm.	127	243 mm.	59 mm.
97	231 mm.	59 mm.	128	244 mm.	61 mm.
98	232 mm.	60 mm.	129	244 mm.	61 mm.
99	232 mm.	56 mm.	130	245 mm.	63 mm.
100	232 mm.	53 mm.	131	246 mm.	62 mm.
101	233 mm.	55 mm.	132	246 mm.	64 mm.
102	233 mm.	58 mm.	133	246 mm.	63 mm.
103	234 mm.	61 mm.	134	247 mm.	64 mm.
104	234 mm.	58 mm.	135	248 mm.	64 mm.
105	234 mm.	59 mm.	136	249 mm.	65 mm.
106	234 mm.	56 mm.	137	251 mm.	66 mm.
107	234 mm.	57 mm.	138	251 mm.	62 mm.

TABLE I—*concld.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
139	253 mm.	66 mm.	144	258 mm.	64 mm.
140	253 mm.	63 mm.	145	261 mm.	66 mm.
141	256 mm.	63 mm.	146	262 mm.	66 mm.
142	257 mm.	65 mm.	147	271 mm.	73 mm.
143	258 mm.	66 mm.	148	384 mm.	105 mm.

TABLE II.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 26th December, 1939.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	196 mm.	53 mm.	Digested pulp and few tiny molluscs.	2	Stop in growth.
2	204 mm.	51 mm.	Copepods.	2	Growing phase.
3	205 mm.	52 mm.	Sand grains and copepods	2	Growing phase in majority, few show stop in growth.
4	206 mm.	51 mm.	Digested pulp.	1	Growing phase.
5	212 mm.	55 mm.	Few copepods, sand particles and tiny molluscs.	2	Ditto.
6	212 mm.	66 mm.	Some digested pulp in the intestines.	No clear marks.	Some scales show growing phase while few show stop in growth.
7	214 mm.	56 mm.	Few copepods, digested pulp and sand grains.	No clear marks.	Growing phase.
8	215 mm.	54 mm.	Sand and digested pulp.	2	Stop in growth in majority, few show a growing phase.
9	216 mm.	58 mm.	Sand and copepods.	2 Not quite clear.	Growing phase.
10	219 mm.	59 mm.	Copepods.	2	Ditto.
11	221 mm.	58 mm.	Plenty of copepods and few small molluscs.	2	Ditto.
12	222 mm.	55 mm.	Copepods, small molluscs and sand.	2	Growing phase in majority, few show stop in growth.
13	225 mm.	58 mm.	Digested pulp.	2	Growing phase.
14	231 mm.	59 mm.	Few copepods and sand grains.	2	Stop in growth in majority, few in a growing phase.
15	234 mm.	62 mm.	Stomach empty; pulp in intestines.	3	Growing phase.
16	235 mm.	60 mm.	Half digested copepods and few small molluscs.	2	Growing phase in majority, few shew stop in growth.

TABLE II—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
17	238 mm.	64 mm.	Sand and copepods.	2	Growing phase.
18	242 mm.	59 mm.	Copepods and sand.	2	Ditto.
19	251 mm.	69 mm.	Plenty of sand grains, small molluscs and pieces of crustaceans.	4	Ditto.
20	251 mm.	63 mm.	Ditto.	2	Growing phase in majority, few show stop in growth.
21	252 mm.	58 mm.	Few copepods.	1	Growing phase.
22	262 mm.	65 mm.	Few copepods and digested pulp.	2	Growing phase in majority, few show stop in growth.
23	271 mm.	75 mm.	Stomach full of copepods; small molluscs and pulp in intestines.	2	Ditto.
24	271 mm.	69 mm.	Digested pulp.	3	Stop in growth.
25	285 mm.	85 mm.	Copepods and sand.	4	Growing phase.
26	328 mm.	78 mm.	Copepods.	3	Ditto.
27	336 mm.	82 mm.	Copepods and sand particles.	4	Ditto.
28	336 mm.	81 mm.	Plenty of copepods and digested pulp.	4	Ditto.
29	338 mm.	79 mm.	Plenty of copepods and sand.	4	Ditto.
30	342 mm.	82 mm.	Ditto.	3	Ditto.
31	342 mm.	86 mm.	Copepods and small molluscs.	4	Ditto.
32	345 mm.	82 mm.	Bits of copepods and half digested pulp.	3	Stop in growth in majority, few show a growing phase.
33	345 mm.	78 mm.	Plenty of copepods and sand.	3	Growing phase.
34	348 mm.	84 mm.	Copepods and sand.	4	Stop in growth in majority, few show a growing phase.
35	348 mm.	82 mm.	Few copepods and pulp.	3	Growing phase.
36	349 mm.	82 mm.	Full of copepods; small molluscs and pulp in intestines.	3	Ditto.
37	357 mm.	84 mm.	Full of copepods.	4	Ditto.
38	370 mm.	82 mm.	Digested pulp.	4	Growing phase in majority, few show stop in growth.
39	375 mm.	94 mm.	Copepods, sand and few small molluscs.	3	Stop in growth.
40	378 mm.	89 mm.	Copepods.	4	Growing phase.
41	401 mm.	102 mm.	Full of copepods.	4	Ditto.
42	408 mm.	105 mm.	Copepods, sand and few small molluscs.	4	Ditto.
43	412 mm.	103 mm.	Plenty of sand, small molluscs and copepods.	4	Ditto.
44	458 mm.	115 mm.	Sand and copepods.	5 Not quite clear.	Ditto.

TABLE III.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Balasore on 11th January, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	258 mm.	68 mm.	Plenty of algae and copepods and polyzoa.	3	Growing phase.
2	265 mm.	72 mm.	Ditto.	1	Ditto.
3	265 mm.	75 mm.	Plenty of algae and copepods.	3	Ditto.
4	272 mm.	76 mm.	Plenty of algae, copepods and polyzoa.	2	Ditto.
5	280 mm.	77 mm.	Plenty of algae and copepods.	3	Ditto.
6	293 mm.	84 mm.	Ditto.	2 Not quite clear.	Ditto.
7	307 mm.	75 mm.	Digested pulp.	2	Ditto.
8	311 mm.	90 mm.	Plenty of algae and copepods.	2	Ditto.
9	318 mm.	84 mm.	Alimentary canal empty.	4	Ditto.
10	329 mm.	97 mm.	Plenty of algae, copepods and digested pulp.	2 Not quite clear.	Ditto.
11	331 mm.	78 mm.	Ditto.	2	Ditto.
12	336 mm.	88 mm.	Ditto.	4	Ditto.
13	358 mm.	80 mm.	Ditto.	3	Ditto.
14	365 mm.	100 mm.	Plenty of algae, copepods and polyzoa.	4	Ditto.
15	379 mm.	91 mm.	Ditto.	4	Ditto.
16	397 mm.	124 mm.	Ditto.	4 Not quite clear.	Ditto.
17	402 mm.	110 mm.	Ditto.	3	Stop in growth or 'A' phase.
18	410 mm.	102 mm.	Ditto.	3	Growing phase.
19	423 mm.	101 mm.	Plenty of algae and copepods.	3	Stop in growth or 'A' phase.
20	428 mm.	108 mm.	Plenty of algae and copepods and polyzoa.	3 Not quite clear.	Growing phase.
21	435 mm.	121 mm.	Algae copepods and digested matter.	3	Ditto.
22	445 mm.	122 mm.	Ditto.	3	Ditto.
23	449 mm.	129 mm.	Ditto.	5	'A' phase just started.
24	475 mm.	128 mm.	Plenty of algae, copepods and polyzoa.	3	Growing phase.

TABLE IV

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 1st February, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	195 mm.	50 mm.	Few polyzoa and algae.	1	Growing phase.
2	260 mm.	73 mm.	Few polyzoa and algae and digested pulp.	2	Growing phase in majority, 'A' phase in few.
3	270 mm.	69 mm.	Plenty of polyzoa and few algae.	2	Growing phase.
4	295 mm.	85 mm.	Ditto.	2	Ditto.
5	361 mm.	90 mm.	Ditto.	3	Ditto.
6	364 mm.	99 mm.	Plenty of polyzoa.	3	Ditto.
7	366 mm.	97 mm.	Ditto.	3	Ditto.
8	372 mm.	122 mm.	Ditto. Few algal bits.	3	Ditto.
9	381 mm.	101 mm.	Digested pulp.	5	Ditto.
10	384 mm.	99 mm.	Plenty of polyzoa and copepods.	3	Ditto.
11	387 mm.	92 mm.	Few polyzoa.	3	Growing phase in majority, 'A' phase in few.
12	391 mm.	105 mm.	Half-digested pulp.	5	Growing phase.
13	396 mm.	101 mm.	Plenty of polyzoa and few algae.	3	Ditto.
14	401 mm.	110 mm.	Polyzoa and sand particles	5	Ditto.
15	404 mm.	108 mm.	Few polyzoa and digested pulp.	4	Ditto.
16	412 mm.	105 mm.	Polyzoa and algae.	5	Ditto.
17	414 mm.	113 mm.	Plenty of polyzoa.	5	Ditto.
18	422 mm.	118 mm.	Few polyzoa and copepods.	5	Ditto.
19	435 mm.	108 mm.	Few polyzoa.	6	Ditto.
20	435 mm.	109 mm.	Few polyzoa and copepods.	5	Ditto.
21	441 mm.	115 mm.	Polyzoa and algae.	4	Ditto.

TABLE V

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) cau gh at Chandipore on 25th February, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	235 mm.	57 mm.	Sand and digested pulp.	2	'A' phase just started.
2	241 mm.	54 mm.	Ditto.	2	'A' phase.
3	245 mm.	62 mm.	Digested pulp.	No clear ring marks.	Ditto.
4	255 mm.	64 mm.	Sand and digested pulp.	2 Not quite clear.	Ditto.

TABLE V—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
5	256 mm.	59 mm.	Sand and digested pulp.	2	'A' phase just started.
6	262 mm.	60 mm.	Ditto.	1	'A' phase.
7	265 mm.	64 mm.	Ditto.	2	Ditto.
8	265 mm.	63 mm.	Ditto.	2	'A' phase in majority, few scales show growing phase.
9	266 mm.	64 mm.	Ditto.	1	'A' phase just started.
10	268 mm.	65 mm.	Ditto.	2	Ditto.
11	269 mm.	65 mm.	Ditto.	3	Growing phase in majority, few scales show 'A' phase.
12	269 mm.	62 mm.	Ditto.	2	'A' phase.
13	270 mm.	65 mm.	Alimentary canal empty.	2	Ditto.
14	271 mm.	65 mm.	Sand and digested pulp.	2	Ditto.
15	271 mm.	63 mm.	Alimentary canal empty.	2	Growing phase in majority, few scales show 'A' phase.
16	275 mm.	65 mm.	Sand and digested pulp.	2	'A' phase.
17	275 mm.	65 mm.	Ditto.	2 Not quite clear.	Ditto.
18	275 mm.	64 mm.	Ditto.	3	Growing phase in majority, few scales show 'A' phase.
19	276 mm.	62 mm.	Ditto.	2	'A' phase.
20	276 mm.	64 mm.	Ditto.	3	Growing phase in majority, 'A' phase in few.
21	276 mm.	69 mm.	Alimentary canal empty.	2	'A' phase.
22	276 mm.	84 mm.	Sand and digested pulp.	2	Ditto.
23	277 mm.	64 mm.	Alimentary canal empty.	1	Growing phase in majority, 'A' phase in few.
24	277 mm.	67 mm.	Sand and digested pulp.	2	'A' phase just started.
25	278 mm.	71 mm.	Alimentary canal empty.	2 Not quite clear.	'A' phase.
26	278 mm.	65 mm.	Sand and digested pulp.	2	'A' phase just started.
27	278 mm.	67 mm.	Alimentary canal empty.	2	'A' phase.
28	279 mm.	67 mm.	Sand and digested pulp.	2	Ditto.
29	280 mm.	68 mm.	Ditto.	2 Not quite clear.	Ditto.
30	281 mm.	62 mm.	Ditto.	2 Not quite clear.	Ditto.
31	282 mm.	65 mm.	Ditto.	1	Ditto.
32	283 mm.	64 mm.	Digested pulp.	2 Not quite clear.	Ditto.
33	284 mm.	69 mm.	Sand and digested pulp.	2 Not quite clear.	Ditto.
34	284 mm.	68 mm.	Ditto.	3	Ditto.

TABLE V—*concld.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
35	284 mm.	68 mm.	Sand and digested pulp.	2	'A' Phase.
36	284 mm.	68 mm.	Ditto.	3	Ditto.
37	285 mm.	66 mm.	Ditto.	3	Ditto.
38	285 mm.	70 mm.	Digested pulp.	2	Ditto.
39	285 mm.	67 mm.	Sand and digested pulp.	3 Not quite clear.	'A' phase just started.
40	285 mm.	74 mm.	Ditto.	2	'A' phase.
41	285 mm.	68 mm.	Ditto.	3	Ditto.
42	286 mm.	71 mm.	Ditto.	2	'A' phase just started.
43	287 mm.	72 mm.	Ditto.	4	'A' phase.
44	287 mm.	68 mm.	Digested pulp.	2 Not quite clear.	Ditto.
45	287 mm.	65 mm.	Alimentary canal empty.	2	Ditto.
46	288 mm.	68 mm.	Sand and digested pulp.	4	Ditto.
47	288 mm.	67 mm.	Few copepods, sand and digested pulp.	3 Not quite clear.	Ditto.
48	289 mm.	65 mm.	Digested pulp.	2 Not quite clear.	Ditto.
49	291 mm.	67 mm.	Sand and digested pulp.	2	'A' phase just started.
50	292 mm.	70 mm.	Ditto.	2 Not quite clear.	'A' phase.
51	294 mm.	75 mm.	Alimentary canal empty.	2	Ditto.
52	295 mm.	70 mm.	Sand and digested pulp.	2	'A' phase just started.
53	295 mm.	69 mm.	Ditto.	3	'A' phase.
54	298 mm.	66 mm.	Alimentary canal empty.	2	Ditto.
55	298 mm.	71 mm.	Sand and digested pulp.	2	Ditto.
56	300 mm.	74 mm.	Ditto.	2 Not quite clear.	Ditto.
57	302 mm.	74 mm.	Ditto.	No clear ring marks.	'A' phase just started.
58	303 mm.	74 mm.	Ditto.	2 Not quite clear.	'A' phase.
59	306 mm.	75 mm.	Digested pulp.	2	Ditto.
60	308 mm.	72 mm.	Sand and digested pulp.	No clear ring marks.	Ditto.
61	311 mm.	73 mm.	Digested pulp.	3	Ditto.
62	312 mm.	71 mm.	Alimentary canal empty.	3	Ditto.
63	316 mm.	72 mm.	Sand and digested pulp.	3	'A' phase just started.
64	325 mm.	80 mm.	Sand and few copepods.	2	'A' phase.
65	336 mm.	77 mm.	Sand and digested pulp.	3	Ditto.
66	340 mm.	77 mm.	Ditto.	4	'A' phase just started.
67	367 mm.	89 mm.	Ditto.	4	'A' phase.

TABLE VI.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 10th March, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	282 mm.	71 mm.	Few copepods and polyzoa.	2	Growing phase.
2	305 mm.	79 mm.	Ditto.	3	'A' phase in majority, growing phase in few.
3	306 mm.	87 mm.	Alimentary canal empty.	3	Ditto.
4	321 mm.	75 mm.	Ditto.	3	Growing phase.
5	324 mm.	87 mm.	Sand, polyzoa and copepods.	3	'A' phase in majority, growing phase in few.
6	328 mm.	81 mm.	Alimentary canal empty.	3	Growing phase.
7	329 mm.	81 mm.	Sand, polyzoa, copepods and digested pulp.	2 Not quite clear.	'A' phase.
8	334 mm.	87 mm.	Sand, copepods and polyzoa.	4	Growing phase.
9	335 mm.	75 mm.	Few copepods and polyzoa.	3	'A' phase in majority, growing phase in few.
10	340 mm.	82 mm.	Sand, polyzoa and copepods.	4	Ditto.
11	341 mm.	81 mm.	Ditto.	3	Ditto.
12	342 mm.	87 mm.	Ditto.	3	Ditto.
13	345 mm.	91 mm.	Ditto.	3 Not quite clear.	Ditto.
14	346 mm.	81 mm.	Ditto.	3	Growing phase.
15	354 mm.	71 mm.	Copepods, polyzoa and sand.	3	Ditto.
16	354 mm.	87 mm.	Alimentary canal empty.	3	Ditto.
17	367 mm.	85 mm.	Sand, polyzoa, copepods and digested pulp.	4	Ditto.
18	373 mm.	91 mm.	Sand, copepods and polyzoa.	4	'A' phase in majority, growing phase in few.
19	386 mm.	94 mm.	Sand, polyzoa, copepods and digested pulp.	4	Growing phase.
20	412 mm.	106 mm.	Plenty of copepods, polyzoa and sand.	6	Ditto.
21	418 mm.	106 mm.	Ditto.	4	Ditto.
22	432 mm.	112 mm.	Few copepods and polyzoa.	5	'A' phase in majority, growing phase in few.

TABLE VII.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 26th August, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	391 mm.	116 mm.	Alimentary canal extended with sand, algae and copepods.	6	Growing phase in majority, 'A' phase in few.
2	399 mm.	102 mm.	Ditto.	6	Ditto.
3	400 mm.	113 mm.	Ditto.	6	Ditto.
4	408 mm.	112 mm.	Ditto.	6	Growing phase.
5	409 mm.	121 mm.	Ditto.	6	Ditto.
6	410 mm.	115 mm.	Ditto.	4	Growing phase in majority, 'A' phase in few.
7	413 mm.	121 mm.	Ditto.	6	Growing phase.
8	427 mm.	123 mm.	Ditto.	6	Ditto.
9	433 mm.	116 mm.	Ditto.	6	Growing phase in majority, 'A' phase in few.
10	446 mm.	128 mm.	Ditto.	8	Growing phase.

TABLE VIII.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Talpada on 5th September, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	344 mm.	103 mm.	Plenty of sand, copepods and few polyzoa.	5	'A' phase in majority, growing phase in few.
2	384 mm.	106 mm.	Ditto.	6	Ditto.
3	385 mm.	102 mm.	Ditto.	6	Growing phase.
4	413 mm.	123 mm.	Ditto.	6	'A' phase in majority, growing phase in few.
5	428 mm.	115 mm.	Ditto.	6	Growing phase.
6	444 mm.	124 mm.	Ditto.	8 Not clear	'A' phase in majority, growing phase in few.
7	449 mm.	126 mm.	Ditto.	7	Growing phase.
8	461 mm.	128 mm.	Ditto.	8	Ditto.
9	464 mm.	125 mm.	Ditto.	7	'A' phase in majority, growing phase in few.
10	482 mm.	133 mm.	Ditto.	8	Growing phase.