

## *Harpodon nehereus*, a Non-luminous Fish

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THE GENUS *Harpodon* of the fish family Synodontidae is found in the seas of India, Burma, Malaya, Sumatra, Java, Borneo, Thailand, Indo-China, and China. It has been recorded from Zanzibar and East Africa; a single species has been recorded from Japan.

Four species appear to be known: *Harpodon nehereus*, *H. squamosus*, *H. macrochir*, and *H. mortenseni*.

The first, *H. nehereus* (Ham. Buch.), is the commonest and occurs in varying abundance in shallow coastal waters and estuaries, mostly in India, Burma, Malaya, Java, Sumatra, and Borneo. When salted and dried it forms the well-known product known as Bombay duck, or bummaloe, which serves as a condiment with curries. In Malaya, Java, and Sumatra it is generally known either alive or dead as ikan lumi or luli or aruan tassik, although occasionally it may have other names in scattered localities. As far as is known, *H. nehereus* is the only species found in Malaya (Günther, 1864; Fowler, 1938).

The first scientific reference to the fish known as "Bombay Duck" is found in Hamilton's book on Gangetic fishes (Hamilton-Buchanan, 1822). The species was discovered by him in the mouths of the Ganges, and was doubtfully referred to the genus *Osmerus*. However, in 1825 Lesueur proposed the genus *Harpodon* for Hamilton's species of *Osmerus*. The synonyms of *H. nehereus* are numerous. It was first known as *Osmerus ? nehereus* (Hamilton, 1822) then later as *Salmo (Harpodon) microps* (Lesueur, 1825), *Saurus Ophiodon* (Cuvier et Valenciennes,

1849), *Saurus nehereus* (Cantor, 1850), and finally as *Harpodon nehereus*.

The second species, *H. squamosus*, was taken in deep water in the Bay of Bengal, at depths varying from 120 to 300 fm., and was described by Alcock in 1891.

The third species, *H. macrochir*, was named by Günther (1887: 180) from a single specimen from Tokyo, Japan. Neither the depth nor the locality in which it was caught is known.

The fourth species, *H. mortenseni* (Hardenberg, 1933), was caught by trawl at a depth of 300 m. by Dr. Mortensen, after whom the species was named. It was taken in the Bali Sea.

There seems to be no reason why *H. squamosus* should not be admitted to the deep-sea fauna on the evidence available; however, there is no evidence to show that either *H. macrochir* or *H. nehereus* is a deep-sea fish.

Günther (1887) says the species *H. macrochir* is named from a single specimen 27 inches long which was obtained at Tokyo, Japan, although at what depth it was taken is not known, "but it is evident from its organization that it should be referred to the deep sea fauna."

Boulenger (1904) states that *Harpodon nehereus* is adapted to a bathybial existence, and at the same time comments on its luminosity, although stating that it is not known to inhabit deep water and is not confined to the sea but is abundant in estuaries. He points out further that *H. squamosus* lives in depths from 120 to 300 fm. but says nothing about its luminosity. Since so many statements have appeared in ichthyological publications concerning its luminosity, I decided

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to ascertain the nature of the luminosity, and, if it was found to be luminous, to locate and describe the luminous organs.

Cuvier and Valenciennes (1849), discussing the economic uses of this fish, stated that they were informed "that when exposed to the air they give out during the night a living phosphorescent luminescence." Cantor (1850) said, "It is very short lived . . . and the whole body becomes at certain seasons brilliantly phosphorescent." Günther (1880: 584) stated "that when newly taken its body is brilliantly phosphorescent." Kemp (1917: 238), in his observations on specimens from the Matlah River, was not able to corroborate this statement. Hora (1934) also agrees with Kemp's observations. Boulenger (1922: 613) states that "*H. nehereus* when newly taken is brilliantly phosphorescent all over the body." Kyle (1926) wrote of "the remarkable *Harpodon* which when caught becomes brilliantly luminescent all over the body." Norman (1931) stated "it is brilliantly phosphorescent all over when newly caught without possessing any light producing organs."

Whether these statements are the results of personal observation is not known, but they seem to refer to the condition of the fish after it has been caught or "newly caught," whatever this may mean.

Cuvier's material was undoubtedly dead, as was Cantor's, since the latter comments on the fact that the fish is short lived. None of the other statements refers to actual living material, and the expression "newly caught," at least as far as Malayan material is concerned, may have no significance whatever for the following reasons.

The *Harpodon* which are caught in Malaya are taken in nets which are set in estuaries, or between adjacent islands where there is a strong tidal stream during the ebb and flood of the tides.

The nets are long bag-like affairs with meshes almost as fine as those of coarsely

woven sackcloth. They lie on the bottom and are furnished with a wide-open mouth which faces the current. Through this mouth is swept into the nets, by the tidal stream, a mixed assortment of feebly swimming fishes, squid, crustacea, jellyfish, and a miscellaneous assortment of debris from the land, such as leaves, twigs, etc. Once in the net there is no escape for those animals which cannot swim against the stream, and they remain crammed and compressed in the net by the constant addition of material which collects there.

The nets remain there without attention until slack water, when they are lifted, emptied, and reset to face the stream as it reverses its direction with the change of tide. Most of the fishes and other animals are dead or dying when the nets are lifted, and only those caught last may be alive, since they are not subjected to anything but the pressure of the water.

The time during which the nets remain unattended is about 6 hours, and most of the catch is taken during that 3-hour period when the tidal stream flows strongest, which may occur an hour to an hour and a half after the setting of the net and last until an hour to an hour and a half before lifting it. There is a further delay in the handling of the catch when the fishermen have to lift the nets, dump the catch into a boat (incidentally dumping the dead on top of the more recently caught, crushing and killing them in turn), and then row their catch ashore for sorting. This may account for a delay of at least an hour if not more, and it should be realised that by this time there is little chance of securing any living specimens of such a feeble, short-lived fish as *Harpodon*. "Newly caught" material may have been dead for 5 to 6 hours at the most and for 2 or 3 hours at the least, and this fact is very important. There is no definite record of any observation on the luminosity of actually living material. In order to secure live specimens I had to

stay by the nets, hoping that with careful sorting there might be some living material available when the nets were lifted.

Fortunately I was able to secure some, and the results will show the significance of distinguishing between living material and that which may have been the material described so often as "newly caught."

I examined very carefully a considerable amount of dead but fresh material in the Singapore Fish Market during November, 1943, and February, 1944, in order to determine whether there were any luminous organs or luminous spots, but failed to find any. In April, 1944, I was able to obtain living material by crossing over to Karimon and actually staying by the nets which are set in the Gelam Straits off Tanjong Balai, Karimon Island, Rhio Archipelago.

It is significant that of all the living specimens I obtained, not a single one displayed the slightest luminescence. On the other hand, all of the dead specimens were strongly luminescent. In some cases the whole body was luminous; in others only a part was luminous. Moreover, the luminosity in some cases was confined to the surface of the whole body, while in others it could be seen deep inside the body.

Another interesting observation was that the luminosity of *Harpodon* was much brighter than that of the other kinds of fish, crustaceans, etc., in the catch, which, incidentally, were luminous, but to a lesser degree.

Bacteriological cultures were made from both the outside and inside of the bodies of this dead luminous material, and subjected to the usual bacteriological tests. The results indicate that the luminosity of *Harpodon*, when dead, is due simply to luminous saprophytic bacteria and that it differs in no way from that which can be observed in other dead fish and other animals taken at the same time.

It must not be overlooked that the flesh of *Harpodon* is almost like jelly, possessing an

extremely high water content, and is an excellent medium for the easy invasion and rapid development of bacteria, much more so than the tough muscular flesh of other fishes and crustacea.

The rapidity with which bacteria develop in tropical countries is well known, and this case furnishes an excellent illustration. In 4 to 5 hours after death the effects of luminous bacteria are already visible on the surface of the body. After 7 to 8 hours luminosity can be seen to have extended to the innermost parts of the body.

It is clear, therefore, that what is meant by "newly caught" material should be expressed more precisely. More frequently this expression means "newly landed" either at the place normally used by fishermen for landing their catches, or perhaps in the market place, miles from where the fish were caught. The primitive and slow methods of handling and marketing fish in tropical countries are proverbial and there would be ample time for *Harpodon* to become luminous as a result of bacterial action even if "newly caught" according to tropical standards.

Luminosity is so associated with deep-sea fishes that it seems to be considered a reasonable possibility that if a fish is either luminous or an inhabitant of the deep sea it is probably both, especially if it has any resemblance to some well-known form of luminous deep-sea fish.

With its gaping mouth, large teeth, small eyes, and soft body, the resemblance of *Harpodon* to some of the Chauliodontidae might well encourage the belief that it was a deep-sea fish, and that the luminosity seen after death was normal during life. This resemblance to a deep-sea form misled even so great an authority as Günther (1880: 584).

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#### REFERENCES

- ALCOCK, A. W. 1891. On the deep-sea fishes collected by the "Investigator" in 1890-1891. *Ann. and Mag. Nat. Hist.* VI, 8: 16-34.
- BOULENGER, G. A. 1904. Systematic account of Teleostei. In: *Cambridge Natural History* 7: 541-727.
- CANTOR, T. E. 1850. Catalogue of Malayan fishes. *Roy. Asiatic Soc., Bengal, Jour.* 18: 983-1043.
- CUVIER, G. L. C. F. D., and A. VALENCIENNES. 1849. *Histoire naturelle des poissons*. Vol. 22. xx + 92 + 532 pp. P. Bertrand, Paris.
- FOWLER, H. W. 1938. *A list of the fishes known from Malaya*. Fisheries Bul. 1. Singapore.
- GÜNTHER, A. 1864. *Catalogue of fishes in the British Museum*. Vol. 5. xxii + 455 pp. British Museum (Nat. Hist.), London.
- 1880. *An introduction to the study of fishes*. xvi + 720 pp. Adam and Charles Black, Edinburgh.
- 1887. In: *Rept. Sci. Res. Challenger*, 22: 180-181. 1xv + 335 pp. London.
- HAMILTON-BUCHANAN, F. 1822. *An account of the fishes found in the river Ganges and its branches*. vii + 405 pp., 39 pls. Edinburgh and London.
- HARDENBERG, J. D. F. 1933. Some new or rare fishes of the Indo-Australian Archipelago, II. *Treubia* 14: 221-222, 1 fig.
- HORA, S. L. 1934. Wanderings of the Bombay-Duck, *Harpodon nehereus* (Ham. Buch.), in Indian waters. *Bombay Nat. Hist. Soc., Jour.* 37(3): 640-654.
- KEMP, S. 1917. Notes on the fauna of the Matlah River in the Gangetic Delta. *Indian Mus., Rec.* 13(4): 238.
- KYLE, H. M. 1926. *The biology of fishes*. xvi + 396 pp. Sidgwick & Jackson Ltd., London.
- NORMAN, J. R. 1931. *A history of fishes*. 463 pp., 146 figs., 7 pls. Ernest Benn Limited, London.