OCCASIONAL PAPER NO. 124

Records of the Zoological Survey of India

Contribution To The Fish Fauna of India (Including Adjacent Countries) Order Mastacembeliformes

G. M. Yazdani

Zoological Survey of India

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CONTRIBUTION TO THE FISH FAUNA OF INDIA (INCLUDING ADJACENT COUNTRIES) ORDER MASTACEMBELIFORMES

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Author's Preface

Until the discovery of Burmese eel-like fish, *Chaudhuria caudata* Annandale (Chaudhriidae) in the year 1918, the mastacembeloid fish were known by a single family Mastacembelidae containing spiny eels. Since *Chaudhuria caudata* was a non-spiny fish and exhibited very high degree of specialisation a new order Chaudhuriiformes had to be created for its reception on the ground of discontinuity of characters between Mastacembelidae and Chaudhuriidae as well as the former's isolated occurrence in the Inle Lake, upper Burma, which from zoogeographical stand point belongs to Chindwin drainage system of the Himalayas. However, the discovery of another peculiar eel-like fish, *Pillaia indica* Yazdani (Pillaiidae) from the hill streams of Meghalaya (India) in 1972, clearly showed how the gradual modification or loss of characters from Mastacembelidae to Chaudhuriidae could have occurred through stages resembling Pillaiidae and the wide gap between the former two families has been partially bridged.

The present contribution to the *Fauna of India* volume which comprises only three families *viz.*, Mastacembelidae, Pillaiidae and Chaudhuriidae contains an account of only 12 species and 5 genera occurring in India and adjacent countries. Although these freshwater fishes form a small group, yet they are so distinct and share common basic characters that it was felt justified to group them under a common order Mastacembeliformes after amending its earlier definition.

The introductory part of this volume contains all relevant information covering remarks on the history of group, present status, general morphology, description of taxonomic characters ecology, geographical distribution, affinities etc. and methods of collection and preservation. The systematic account contains classification, key to the taxa of the group, description of each species including synonymy, diagnostic characters, habits, ecology, etc. based on material examined by me as well as on information from the published literature.

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Patna

G. M. Yazdani

INTRODUCTION

Day (1889) recognised two genera of spiny eels, namely *Mastacembelus* and *Rhynchobdella* under the family Rhynchobdellidae of the order Acanthopterygii. He recorded a single species, *Rhyncobdella aculeata* under the genus *Rhynchobdella* and five species, namely *Mastacembelus unicolor*, *M. zebrinus*, *M. pancalus M. armatus*, *M. guentheri* under the genus *Mastacembelus*. Boulenger (1912) published a synoptic review of the genus *Mastacembelus* covering both the Oriental and African forms and recognised 15 species from the Oriental region. Annandale (1918) erected the family Chaudhuriidae to receive *Chaudhuria caudata* Annandale and assigned it to the order Apodes. Regan (1919), considering that the characters described for *Chaudhuria* Annandale showed its relationship to *Mastacembelus*, placed it in the Opisthomi. Annandale and Hora (1923) agreed with Regan (1919) and gave new anatomical characters to support it, Jordan (1923) followed this classification and Mitra & Ghosh (1931) describing the soft anatomy of the families of Opisthomi came to the same conclusion. Berg (1940) placed the families Mastacembelidae and Chaudhuriidae in the order Mastacembeliformes and Chaudhuriformes, respectively and remarked that *Chaudhuria* is so specilised that it plainly deserves the rank of a special order. Sufi (1956), while agreeing with Bergs (1940) view revived the Oriental fishes of the family Mastacembelidae and recognised 15 species of *Mastacembelus* in Asia and expected more from the African region. While considering *Rhynchobdella* to be a junior synonym of *Macrognathus* Sufi (*op cit.*) recognised only one species *i.e. Macrognathus aculeatus* (Block) and synonymised with it *Rhynchobdella dhanshorii* Hora, (1921) from Assam (India). Greenwood *et al* (1966) differed from Berg's (1940) classification and grouped Mastacembelidae and Chaudhuriidae under the suborder Mastacembeloidei of the order Perciformes. Yazdani (1972) established the genus *Pillaia* for the reception of a remarkable new eel-like fish, *Pillaia indica* Yazdani from the Khasi Hills (Meghalaya) & subsequently created the family Pillaiidae for the genus *Pillaia* under the suborder Mastacembeloidei (see Yazdani, 1976a), Talwar, Yazdani and Kundu (1977) added another species *Pillaia khajuriai* to genus *Pillaia* from the plains of Assam region. Yazdani and Talwar (1981) created the genus *Garo* for *Pilliaia khajuriai* as a result of their detailed study of the two species described under Pillaiidae. Jayaram (1981) recognised the order Mastacembeliformes

of Berg but included therein the families Mastacembelidae, Pillaiidae and Chaudhuriidae without emending the definition of the order. He recognised two genera under Mastacembelidae *viz.*, *Macrognathus* Lacépède with a single species and *Mastacembelus* Scopoli with 8 species, a single genus *Pillaia* with two species under Pillaiidae and a single genus *Chaudhuria* with a single species under the family Chaudhuriidae, from India and adjacent countries.

The mastacembeloid fish, containing members of the families Mastacembelidae, Pillaiidae and Chaudhuriidae, form a homogeneous group which is characterised by their eel-like body, non-protractile upper jaw, absence of pelvic girdle and fin, pectoral girdle attached to the vertebral column, short pectoral fin, elongated skull which gradually narrows anteriorly, large nasals, frontal and infraorbitals, small lateral ethmoid and swimbladder without an open duct.

Pillaiidae shows affinities with both Chaudhuriidae and Mastacembelidae. However, the absence of free-maxilla and presence of a single stout bone in the upper jaw in Pillaiidae (Yazdani, 1976b) are such characters which cannot be ignored while considering its relationship with these families. The drawing of the upper jaw bone of *Chaudhuria caudata* (Annandale, 1918) shows striking resemblance with the upper jaw bone of *Pillaia indica*. Though Annandale (*op cit*) does not mention about the presence or absence of maxilla in *C. caudata*, yet his identification of the tooth-bearing upper jaw bone as maxillary clearly suggests that it is the premaxilla rather than maxilla. Presuming that this view is correct, Pillaiidae would show closer resemblance to Chaudhuriidae rather than Mastacembelidae (Yazdani, 1976a).

Berg (1940) remarked that *Chaudhuria* (Chaudhuriidae) is so specialised that it plainly deserves the rank of a special order. While proposing the order Chaudhuriiformes, Berg (*op. cit.*) appears to have been influenced by the discontinuity of various characters between Mastacembelidae and Chaudhuriidae. However, the discovery of Pillaiidae has filled up this gap and a possible evolution of Chaudhuriid type form from Mastacembeloid stock can be easily visualised (Yazdani, 1976a, 1978). It would, therefore, be logical to group all the three families under a common order, *ie.*, Mastacembeliformes after emending the Berg's (1940) definition of this order. This is warranted because Pillaiidae is distinguished from Berg's Chaudhurii-

formes and Mastacembeliformes by combination of contrasting characters (see Yazdani, 1976a, p. 169). Therefore, a re-definition of the order Mastacembeliformes is given hereunder.

Body eel-like compressed or subcylindrical elongated with or without minute scales. Mouth non-protractile. Head may or may not be depressed anteriorly. Snout elongated with a well-developed fleshy rostral appendage or snout short with a very indistinct fleshy rostral appendage or without any trace of such an appendage. Upper jaw with one or two jaw bones. Branchiostegal rays 5 or 6. Scales present or absent on the body. Spines present or absent before dorsal and anal fins. Preopercular with or without spine. Pelvic girdle and fin absent. Pectoral small or large with variable number of rays ranging from 6 to 27. Pectoral girdle (Supracleithrum) attached to the vertebral column. Cleithrum present or fused with supracleithrum. Post temporal partially present or absent. Pectoral radials present or absent. Skull elongated, gradually narrowing forward. Nasal & frontal large. Parietals separated by supraoccipital. Vomer toothless. Caudal fin homocercal, confluent with median fins or narrowly separated. Caudal fin with branched or unbranched rays, ranging from 7 to 15 or more. Palatines narrow flakes of bone immovably united to ethmoid, vomer or parasphenoid. Pterygoid m vably united to lateral ethmoid outside the palatine. Vertebrae ranging from 62 to 96. Stomach and intestine straight or with u-shaped bends. Pyloric caeca present or absent. Swimbladder present. Adult size varying from 52.0 to 750.0 mm in total length.

The mastacembeloid fish are periform derivatives (See Greenwood *et al.*, 1966) and share the basic common features of perches. However, the eel-like elongated body, acquired secondarily in the course of evolution gives a false resemblance to the members of true eels *i.e.* the order Anguilliformes, to which they are unrelated. Among mastacembeloid fish the members of Pillaiidae have subcylindrical body whereas those of the Mastacembelidae and Chaudhuriidae have compressed body ; a gradual broadening of the forehead is seen from Mastacembelidae through Pillaiidae to Chaudhuriidae. The forehead is conical in all the three families, but in Mastacembelidae it appears extremely conical owing to the prolongation of snout into an appendage. The position of eyes also shows a gradual change in the field of vision in members of all these families. Both Mastacembelidae and Chaudhuriidae have lateral eyes but in Pillaiidae the eyes

are placed rather dorsally due to characterstic depression of the forehead. The members of Mastacembelidae have subterminal mouth whereas those of Pillaiidae and Chaudhuriidae possess terminal mouth. In Pillaiidae there is a faint trace of fleshy rostral appendage but in Chaudhuriidae it is totally absent.

The upper jaw is non-protractile in all these fishes. In Mastacembelidae, however, the toothed premaxilla and a toothless maxilla, like that of a percoid fish, are present. But these bones have fused in Pillaiidae and presumbaly in Chaudhuriidae. The loss of true-maxilla in higher teleosts such as Pillaiidae & Chaudhuriidae is a feature so far unknown in the evolutionary history of acanthopterygian fishes.

The pectoral girdle and fins in all these fishes show loss or fusion of bony components from Mastacembelidae through Pillaiidae to Chaudhuriidae. Among them the gradual reduction in the number of pectoral fin rays is found in the following order *Mastacembelus* spp. 17-27, *Garo khajuriai* 19-20, *Pillaia indica* 7-9 and *Chaudhuria caudata* 6.

The caudal skelcton is well developed in members of Mastacembelidae and the number of rays is fairly high *i.e.*, 15 or more. But the elements of those of the other two families are reduced and the number of rays is also low, 7-9, except in *Garo khajuriai* where it is 19-20.

The number of vertebrae is 24 in generalised perciform fishes (See Greenwood *et al.*, 1966). However, the number of vertebrae has increased in all the mastacembeloid fishes owing to the elongation of body. The number of vertebrae among spiny eels (Mastacembelidae) known to be is 85-96 and 62-100 according to Sufi (1956) and Dutt *et al.* (1979), respectively. But that of Pillaiidae and Chaudhuriidae, which contain small sized forms, is 62-70 only. The number of anterior vertebrae possessing flattened neural spine is also higher in Mastacembelidae than that of the other two families.

The alimentary canal is basically similar in all the mastacembeloid fishes. However, a gradual reduction in length is clearly noticeable from Mastacembelidae through Pillaiidae to Chaudhuriidae. The pyloric caeca is present in Mastacembelidae, but it is totally absent in the other two families.

The following morphometric measurements and meristic counts have been found useful as taxonomic characters among the mastacembeloid fishes. However, some of these characters have proved to be more reliable than others and it would be advisable to give weightage to combination of characters.

1. Depth of body in the total or standard length.
2. Length of head in the total or standard length.
3. Length of pectoral in the head length & standard length.
4. Length of snout in the head length & standard length.
5. Diameter of eye in the head length.
6. Post orbital head length in the standard length.
7. Interorbital space in the head length.
8. Length of lower jaw (distance between tip of dentary and posterior end of articular).
9. Length of gape of mouth (tip of lower jaw to angle of mouth opening).
10. Position of vent *i.e.* whether nearer to base of caudal than to snout.
11. Caudal separated from the dorsal or anal or confluent with them.
12. Predorsal and preanal distance in the total and standard length.
13. Number of spines before dorsal and anal.
14. Number of soft rays in the median fin rays.
15. Number of rays in the pectoral fin.
16. Number of branchiostegal rays.

The spiny eels (Mastacembelidae) occur in plains as well as at high altitudes in running and still waters, clear or muddy, usually hiding in crevices of rocks or among vegetation near the bank. In their natural habitat they are known to live over a muddy or sandy bottom, hiding during the day time among plants or even buried in the bottom and towards night fall set forth in search of small prey.

Sundara Raj (1916, p. 289) and Job (1941, p. 130) have observed that both *Macrognathus aculeatus* and *Mastacembelus pancalus* when kept in an aquarium lie buried in the mud or sand during the day, while at night they swim about freely. Job (*op. cit.*) says the following about the burrowing habits of *M. pancalus*. "The fish glides about the bottom nosing the substratum with its mobile trilobed sensitive snout

and selecting a suitable spot, wriggles itself into the substratum by a brisk side to side and forward movement until most of the body and tail are concealed sometimes the tail sticks out as also the tip of the head" Deraniyagala (1932, p. 269) has made the following observations regarding the use of spines by *Mastacembelus armatus* for defensive purpose "When held in the hand the fish wriggles backward and its short dorsal spines act like the teeth of saw inflicting a nasty slash in the palm of the inexperienced fisherman."

The mode of feeding of spiny eels is especially interesting. The movable rostral appendage is first of all oriented to feel the prey, then the food is sipped in with a jerking motion. The food items of spiny eels are not properly known. However, the gut contents of some of these fishes have been found to contain eggs and fry of other fishes (Hamid Khan, 1934, p. 268), crustaceans, larvae of insects, coleopterans (Job, 1941, p. 131). These food items suggest that the spiny eels are carnivorous in habit.

The Indian hill-stream fish, *Pillaia indica* (Pillaiidae) is very inactive and mostly spends its time lying at the bottom either buried in mud or clinging to some submerged vegetation along the edges of streams which have overhanging vegetation (See Yazdani, 1978). It appears to have a very narrow range of habitat preference and even in the same stream it occurs only in certain areas near the edge where the bottom contains a very fine mud. It is only found in those areas of the stream where the water is running very slowly. Its ecological niche is so restricted that no other fish has generally been collected with it. It avoids light and tries to hide into the mud. It has been reported by *Khasi* people that this fish is also found in paddy fields (adjoining the streams) during the rainy season (Yazdani *op. cit.*). *Pillaia indica* is reported to catch the moving food and gulps it while entangling itself to some submerged vegetation in the stream. Its gut contents have been found to contain parts of mayfly (Ephemeroptera) naiads, parts of other insects and spores.

Garo khajuriai, the only other species in the family Pillaiidae has been found to occur in the paddy field of Garo Hills (Meghalaya) and in the Kaziranga Wildlife Sanctuary (Assam) which is situated on the southern bank of R. Brahmaputra, very close to Mikir Hills.

Mastacembelidae occurs both in the Oriental and Ethiopian regions, whereas Chaudhuriidae is restricted in distribution to the

Inle Lake, Upper Burma at an altitude of 3000 ft. (See Annandale 1918) and Pillaiidae to the Khasi & Garo Hills upto an altitude of 3,500 ft. (See Yazdani, 1972, 1976 ; Pillai & Yazdani, 1977) and plains of Assam in India (See Talwar, Yazdani & Kundu, 1977).

Mastacembelidae, Pillaiidae and Chaudhuriidae all share basic common characters. The gradual modification of various characters in each of these families appears to have led to clear adaptive radiation. These fishes seem to have evolved from a perciform stock through stages resembling spiny eel (Mastacembelidae). Pillaiidae is less specialised than Chaudhuriidae and it seems quite probable that the latter evolved from a stock resembling Mastacembelidae through stages comparable to Pillaiidae. Among Pillaiidae' which shows affinities with both Mastacembelidae and Chaudhuriidae, *Garo khajuriai* exhibits a closer reseumblance with the members of spiny eels.

Among mastacembeloid fishes, some members of spiny eels (Mastacembelidae) grow to a large size. Since they occur in a variety of habitat, different gears such as seine net, cast net, bag net and long lines with hooks are used for their collection. The members of Pillaiidae are small fishes which can be collected by bag net from edges of streams, amidst dense over hanging vegetation or from paddy field. The Burmese eel-like fish *Chaudhuria caudata* (Chaudhuriidae) is reported to be obtained in fishing baskets filled with peat and weeds and sunk in the Inle Lake and also from dense vegetation at the edge of floating islands.

For the purpose of study, the specimens of mastacembeloid fish should be preserved in solution of formalin. This solution is made by diluting one part of commercial formaldehyde (of nearly 40% strength) with nine parts of water. The fish should be left in this solution at least for 4 to 5 hours for proper fixation. Large specimens should be split in the belly with a knife to enable formalin to enter the body cavity. Very large specimens are injected with formalin using an ordinary hypodermic syringe. For permanent preservation, the most satisfactory course is to first preserve in formalin and then transfer to alcohol (Rectified spirit). When the specimens are fresh, all colours, colour patterns, spots, blotches shoud be noted in the field note book. Labels should be written on a stout paper with a soft lead pencil or black water-proof Indian ink. The essential particulars required are exact locality, the altitude, where

necessary, date and time of collection, name of collector, gear employed. It is also desirable to mention the nature of water, substratum, extent of vegetation and association of other fauna. For transporation, the preserved specimen should be packed in thin muslin or mulmul cloth. They may also be kept in plastic bags after soaking with formalin-wet cloth or cotton. These specimens should be packed in a suitable container for despatch.

SYSTEMATIC ACCOUNT

The main classification of mastacembeloid fish is given hereunder.

Class : PISCES
Subclass : TELEOSTOMI
Superorder : ACANTHOPTERYGII
Order : MASTACEMBELIFORMES

KEY TO FAMILIES

1.	Free spines before dorsal and anal fins, a well developed appendage and scales present	Mastacembelidae
—	No spines before dorsal and anal fins, scales absent, fleshy rostral appendage absent or very faintly developed ...	2
2.	Caudal fin confluent with dorsal and anal fins, having 8-12 unbranched rays. A very indistinct fleshy rostral process present; branchiostegal 6	Pillaiidae
—	Caudal fin, separated from dorsal and anal, having unbranched rays; fleshy rostral appendage absent; branchiostegals ...	Chaudhuriidae

I Family MASTACEMBELIDAE (Spiny eels)

Body eel-like, compressed and elongated. Snout elongated with a well developed fleshy rostral appendage. Mouth non-protractile. Upper jaw consisting of separate premaxilla bearing teeth and toothless maxilla as is found in all perciform fishes. Branchiostegal rays 6. Minute scales present on the body. Free spines present before long dorsal and anal fins. Preopercular with or without spines. Pelvic girdle and fin absent. Pectoral fin with 17-27 rays. Pectoral girdle (Supracleithrum) attached to the vertebral column, cleithrum present, post temporal (except its lateral line components) absent, pectoral radials present. Caudal fin homocercal, short either confluent with dorsal and anal or narrowly separated, 5 to 7 hypurals bearing 15 or more branched rays. Skull much elongated gradually narrowing

forwards, large nasals, separated in the middle line by the narrow upper edge of the ethmoid, infraorbital (preorbital) bone large, articulating with lateral ethmoid, frontals large, parietals separated by supra occipital, lateral ethmoid small, vomer toothless, palatines narrow flakes of bone immovably united to ethmoid vomer and parasphonoid ; pterygoid movably united to lateral ethmoid outside the palatine. Vertebrae 60 to 100. Stomach and intestine-with u-shaped bends ; pyloric caecae two ; swim bladder present. Two genera are dealt with here.

KEY TO GENERA

1. Snout very long accomodating on its under surface, behind the anterior nostrils, a concave prolongation of the upper jaw consisting of a paired series of toothed bony plates ... ... *Macrognathus* Lacepede
   Snout long, conical, without any prolongation of the upper jaw ... ... Mastacembelus Scopoli

1 Genus **Macrognathus** Lacepede

1800 *Macrognathus* Lacepede, *Hist. Nat. Poiss. 2*, 283 (type species *Ophidium aculeatum* Bloch)

1956 *Macroganthus* Sufi, *Bull. Baffles Mus.*, No. 27, pp 99-105 (Synoptic review)

Body eel-like, elongated, compressed. Head long, pointed. Snout prolonged to accomdate on its concave ventral surface a paired series of toothed bony plates which are anterior extension of the premaxillae. Mouth inferior, cleft narrow. Eye small, not visible from below the ventral surface. Lips thin. Jaws subequal, small pointed teeth present on the jaws as well as on the segmented anterior extension of the upper jaw, on pelate and on vomer. Spines absent on either preorbital or preoperculum. Gill-rakers absent. Dorsal fin inserted far behind, in the posterior half of the body, with 14-22 detached, depressible spines and 42-58 rays. Anal fin with 3 spines and 42-58 rays. Scales small cycloid, present on the body except on top of snout, interorbital space, inter nasal space and top of head as far as posterior edge of preoperculum. Lateral line present. Swimbladder elongated.

Distribution : Throughout India, Bangladesh, Nepal, Pakistan, Burma, Sri Lanka, Malay Archipelago, Thailand, Viet-Nam, China.

The genus *Macrognathus* is represented by a single species.

1 Macrognathus aculeatus (Bloch)
(Text-fig. 1)

1800. *Macrognathus* Lacepede, *Hist. Nat. Poiss*, **2** 283 (type-species; *Ophidium aculeatum* Bloch)

1956. *Macrognathus*, Sufi, *Bull. Raffles Mus.*, No. 27, pp. 99-105 (Synoptic review)

1786. *Ophidium aculeatum* Bloch, *Ausiand Fische*, **2**, p. 72, table 159, fig. 2 (East Indies).

1800. *Macrognathus aculeatus* Lacepede, *Hist. Nat. Poissons*, **2**, p. 283 (India).

1801. *Rhynchobdella orientalis* Bloch & Schneider *Syst. Ichth.*, p. 478 (India and Ceylon).

1822. *Macrognathus aculeatus* Hamilton Buchanan, *Fish Ganges*, p. 29 (R. Ganges).

1831. *Rhynchobdella ocellata* Cuvier & Valenciennes, *Hist. Nat. Poissons*, **8**, p. 445 (Bengal).

1848. *Rhynchobdella aculeata* Jerdon, *Madras J. Lit.*, **15**, p. 147 (rivers and tanks of Carnatic).

1850. *Rhynchobdella ocellata* Bleeker, *Verh. Bat Gen.* **23**, p. 3 (Java, Ceylon, Pondichery, Tranquebar and Bengal).

1861. *Rhynchobdella aculeata*, Gunther, *Cat. Brit. Mus.*, **3**, p. 540 (Calcutta, Madras, Assam, Borne Ceram, Moluccas).

1876. *Rhynchobdella*, Day, *Fish India*, p. 338, pl. 72, fig. 1 (Brackish waters and deltas of large Indian, Burmese and Sind rivers. Borneo, Moluccas).

1889. *Rhynchobdella aculeata*, Day, *Faun. Brit. India*, **2**, p. 331 fig. 110.

1907. *Rhynchobdella aculeata*, Jenkins, *Rec. Indian Mus.*, **3**, p. 287 (Sur Lake, Orissa, India).

1910. *Rhynchobdella aaculeata* Dalgliesh, *J. Bombay nat. Hist. Soc*, **20**, p. 433 (Tirhoot, Bihar, India).

1916. *Rhynchobdella aculeata*, Sundara Raj, *Rec. Indian Mus.*; **12**, p. 289 (fresh and brackish waters of Madras, India).

1921. *Rhynchobdella dhanshori* Hora, *Rec. Indian Mus.*, **22**, p. 205 pl. 9, fig. 2 (Dhanshori stream near Dimapur, Assam, India).

1923. *Rhynchobdella aculeata* Hora, *J. nat. Hist. Soc.* Siam, 6, p. 180 (Bangkok, Thailand).

1925. *Rhynchobdella aculeata* D' Abreu, *J. Bombay nat. Hist. Soc.* **30**, p. 710 (Ghaghra river, Chhapra, Bihar, India).

1929. *Rhynchobdella aculeata*, Pillay, *J. Bombay nat. Hist. Soc.* **33**, p. 376 (Trivandrum, Kerala).

1938. *Rhynchobdella aculeata*, Shaw and Shebbeare, *J. Asiat. Soc. Bengal* (3) 3, p. 127, text-fix 129 (muddy streams, Apalchand Forest, W. of Duars, North Bengal) (1937).

1940. *Rhynchobdella aculeata*, Hora, *Rec. Indian Mus.*, 42, p. 366 (Market at Sihawa, Raipur dist., M.P. India).

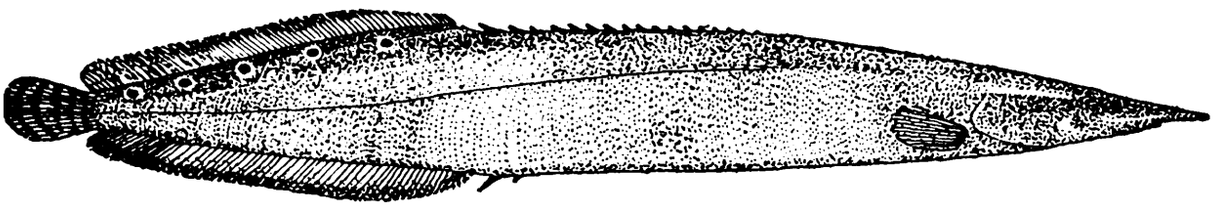
1947. *Rhynchobdella aculeata*. Mahmood & Rahimullah, *J. Bombay nat. Hist. Soc.*, 47, p. 109 (Nizamabad dist., Hyderabad, A.P. India).

1953. *Rhynchobdella aculeata*, Sinha & Shiromany, *Rec. Indian Mus.*, 51, p. 63 (Kalinadi, Meerut, Uttar Pradesh).

1955. *Macrognathus aculeatus*, Munro, *The marine and freshwater fishes of Ceylon*, p. 267.

1956. *Macrognathus aculeatus*, Sufi, *Bull. Raffles Museum*, No. 27, p. 101.

1972. *Macrognathus aculeatus*, Venkateswarlu, *Ind. J. Zool.*, 13, (3) p. 128 (Bihar).



Text-fig. 1 *Macrognathus aculeatus* (Bloch)
D.XIV-XXII. 42-58 ; A.III, 42-58. P. 17-26 ; C. 13-16.

Body eel-shaped tapering to head and tail, Head 17.0 to 25.0, body depth 11.0 to 16.0 as % of standard length. Eyes small 7.0 to 11.0, interorbital space 4.0 to 5.0 as % of head length. Snout long (43.0 to 54.0 in head length), fleshy, having a trilobed extremity with a concave striated lower surface. Length of gape of mouth very small (9.0 to 11.0 as % of head length) not extendig to below the posterior nostril. Lower jaw much shorter (25.0 to 33.0 as % of head length). Teeth small in both jaws and on the segmented anterior extension of upper jaw. Dorsal and anal fins not confluent with caudal, sometimes both fins or anal only totally confluent with caudal. Dorsal spines more or less hidden in the skin when laid down, the last spine small connected by membrane with the base of dorsal fin, the first dorsal spine, originating far behind the end of pectoral nearly at equal distances between posterior extremity of head and first dorsal ray. Anal spines close together, second largest, last small, soft anal originating below the soft dorsal. Pectoral fin

rounded, its length (6.0 to 7.0 in standard length) equal to eye and snout without proboscis. Ventral fin absent. Vent nearer to base of caudal than to snout. Caudal fin rounded. Scales minute, larger on head than those on the body. Top of snout, inter-nasal space, interorbital space and top of head as far as hind edge of preoperculum naked. Scales present around eye and posterior nostril and from the latter to the maxilla. No spines on preorbital or preoperculum. Lateral line well marked. Gill openings inferior. Gill-rakers absent. Swimbladder extends from head to anus.

Colour and colour pattern variable. Colour (in spirit) brown or light brown dorsally and laterally, yellowish ventrally. Body either having dark brown, broad oblique bars emerging from the back and becoming indistinct on the belly or with pale narrow oblique lines, which are sometimes broken into spots, emerging from the dorsal side and becoming obscure on the ventral side. Sometimes a pale lateral band, above the lateral line from eye to tail may be present or absent. Head brown dorsally and laterally, paler ventrally, sometimes the under surface of head marked with variously broken cross bars. Dorsal fin yellow or orange with dirty white spots or longitudinal stripes, its base sometimes having 3 to 10 ocelli when the ocelli are absent the fin is marked with basal spots, which are continuation of dark brown body bars. Anal fin pale or orange, sometimes with bars which continue the dark brown body bars, speckled with dirty white spots or striped, occasionally having 2 ocelli. Pectoral fin pale or orange sometimes with a dark basal spot. Caudal fin striated with white spots, occasionally with one ocellus.

It grows to maximum length of over 350.0 mm.

Habitat : It occurs in wide range of habitats from fresh to brackish and running to stagnant water. It spends most of its time at the bottom and conceals itself in the mud.

Distribution : India, Pakistan, Bangladesh, Burma, SriLanka, Thailand, Malay Peninsula, Java, Sumatra, Borneo, Moluccas, and Korea.

2. Genus **Mastacembelus** Scopoli

1777. *Mastacembelus* Scopoli *Introd. Hist. Nat.*, p. 458 (type-species, *Ophidium mastacembelus* Solander).

1956. *Mastacembelus* Sufi *Bull. Raffles Mus.*, No. 27, pp. 105-143 (Systematic review).

Body eel-like, elongated compressed, long and pointed. Snout not very long, the tip of the upper jaw only slightly in advance of that of the lower jaw, without any transversely striated bony plates on the under surface. Mouth inferior, cleft narrow. Eyes small, placed in the middle of head, not visible from below the ventral surface. Lips thin. Minute teeth on the jaws and on palate. Spines present or absent on the preopercle. However, a preorbital spine present. Dorsal fin originating at a point above middle of pectoral, with 24-39 detached, depressible spines and 50-90 rays. Anal fin with three spines and 31-98 rays. Caudal fin rounded ; median fins may or may not be confluent with the caudal. Scales present. Lateral line present. Swimbladder elongated.

Distribution : West Africa, Syria, Pakistan, India. Nepal, Sri Lanka, Bangladesh, Burma and Malay Archipelago-both in fresh and brackish waters.

The genus *Mastacembelus* is represented by 8 species in the Indian subcontinent.

KEY TO SPECIES

1.	No spine on preopercle ...	*M. caudiocellatus*
—	Spines present on preopercle, occasionally hidden beneath the skin ...	2
2.	Spines and soft rays in the dorsal fin not exceeding 100 (exceptionally more in *M. guentheri*) ...	3
	Spines and soft rays in the dorsal fin exceeding 100	6
3.	11-16 rays in the caudal fin ...	4
—	17-21 rays in the caudal fin ...	5
4.	21-31 spines and 30-42 rays or even fewer in the dorsal fin ...	*M. pancalus*
—	27-30 spines and 58-74 rays in the dorsal fin	*M. guentheri*
5.	Top of snout scaled. 17-19 rays in the pactoral fins	*M. zebrinus*
—	Top of snout scaleless, 23 or 24 rays in the pectoral fin	*M. oatesii*
6.	Gape of mouth 12 to 13% of total length ...	*M. alboguttatus*
—	Gape of mouth 14 to 22% of total length ...	7
7.	Gape of mouth extending to below posterior nostrils or beyond	*M. armatus armatus*
—	Gape of mouth not extending to below posterior nostrils	*M. unicolor*

2. Mastacembelus alboguttatus Boulenger

(Text-fig. 2)

1893. *Mastacembelus alboguttatus* Boulenger, *Ann. Mag. nat. Hist.*, (6) **2**, p. 200.

1912. *Mastacembelus alboguttatus* Boulenger, *J. Acad. nat. Sci. Phtlad*, (2) **15**, p. 200 (Sitang river, Burma).

1956. *Mastacembelus alboguttitus*, Sufi, *Bull. Raffles Mus.*, No. 27, p. 127.

Text-fig. 2 *Mastacembelus alboguttatus* Boulenger

D. XXXV—XXXVII, 75-85; A III, 70-82, P. 22-24 C. 22-23

Body eel-shaped, Head 15.8 to 17.2, body depth 9.9 to 11.0 as % of standard length. Eye diameter 6.4 to 7.7, interorbital space 4.4 to 4.7, snout long, 43.7 to 45.2, length of gape of mouth small, 12.2 to 13.4 and length of lower jaw 31.4 to 33.0 as % of head length. Sharp teeth in bands in both the jaws. Spinous dorsal originating above mid point of pectoral fin, last dorsal spine small, hidden beneath the skin. Anal spines close together, second largest, last small and hidden beneath the skin. Pectoral fin 6.0 to 6.9 as % of standard length. Vent nearer to caudal base than to snout. Caudal fin completely united with dorsal and anal fins. Scales present between and around eye and posterior nostril, and extending from the latter to the gape of mouth. Top of snout, internasal space, interorbital space and top of the head as far as the hind edge of preoperculum scaleless. Three to four spines on the preoperculum. One strong preobital spine piercing the skin present. No gill-rakers.

Colour (in spirit) Body brown, darker along the back lighter underneath, with roundish white spots which are also present on the vertical and pectoral fins.

Habitat : Sittang river, Burma.

Distribution So far known from Sittang river, Burma.

3. **Mastacembelus armatus armatus** (Lacepede)

(Text fig. 3)

1800. *Macrognathus armatus* Lacepede, *Hist. Nat. Poissons*, II, p. 286 (Locality unknown).

1801. *Rhynchobdella polyacantha* Schneider, *Blochii Syst. Ichthyol*, p. 479 (Tranquebar).

1922. *Macrognathus armatus* Hamilton Buchanan *Fish Ganges*, p. 28 pl. 37, fig. 5 (Rivers of Bengal).

1831. *Mastacembelus armatus* Cuvier & Valenciennes, *Hist. Nat. Poissons*, **8**, p. 456 (Bengal).

1831. *Mastacembelus ponticerianus* Cuvier and Valenciennes *Hist. Nat. poissons*, 8, p. 460 (Pondicherry).

1831. *Mastacembelus marmoratus* Cuvier & Valenciennes, *Hist. Nat. Poissons*, **8**, p. 461 (Mysore).

1842. *Macrognathus caudatus* Mc Clelland, *Calcutta J. nat. Hist.* **2**, p. 586.

1844. *Mastacembelus venosus* Jacquemont, *Voy. Inde Poissons*, pl. 14, fig. 1.

1844. *Macrognathus hamiltonii* Mc Clelland, *Calcutta J. nat. Hist.* **4**, p. 393.

1844. *Macrognathus undulatus* McClelland, *Calcutta J. nat. Hist.*, **4**, p. 393, 398, pl. 22 fig. 1.

1848. *Mastacembclus malabaricus* Jerdon, *Madraa J. Lit.* **15**, p. 147 (Malabar).

1853. *Mastacembelus armatus*, Bleeker, *Verh Batavia Genoot* 25, p. 97 (Calcutta: River Hooghly Chillianwallah, Jihlum (Chilianwala, Jehlum).

1861. *Mastacembelus armatus Var armata* Günther *Cat. British Museum* (Fish), **3**, p. 542 (Siam, Calcutta, East Indies).

1861. *Mastacembelus armatus var. ponticeriana* Günther *Cat. Fish* **3**, p. 542 Ceylon, Nepal, East Indies).

1876. *Mastacembelus armatus*, Day, *Fish India*, p. 340, pl. 73, fig. 2 (Sind fresh and brackish waters of plains and hills of India, Ceylon and Burma to China).

1889. *Mastacembelus armatus*, Day, *Faun. Brit. India*, **2**, p. 334.

1921. *Mastacembelus manipurensis* Hora, *Rec. Indian Mus.*, **22**, p. 206 pl. 9, fig. 3 (Khurda stream near Thanga Id : Manipur, Irawaddy basin).

1936. *Mastacembelus armatus* Hora & Mukherjee, *Rec. Indian Mus.*, **38**, pt. 2, p. 145.

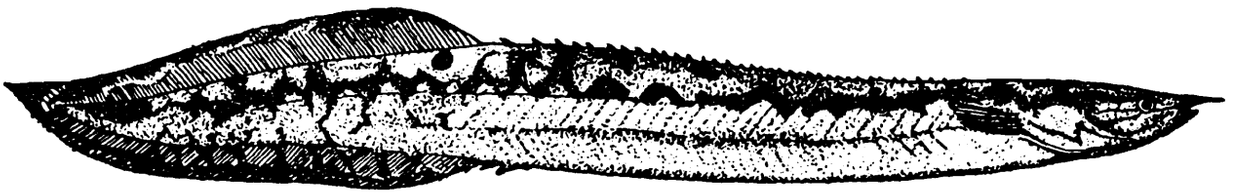
1938. *Mastacembelus armatus* Shaw & Shebbeare, *J. Asiat. Soc., Beng.*, (3) **3**, p. 126, fig. 127 (Clear streams, Terai and Duars, Northern Bengal).

1940. *Mastacembelus armatus*, Horre, *Bull. Raffles Mus.*, **16**, p. 54.

1945. *Mastacembclus armatus*, Smith, *U. S. Nat. Mus. Bull.*, **188**, p. 63.

1956. *Mastacembelus armatus*, Sufi, *Bull. Raffles, Mus.*, **27**, p. 107, 134.

1972. *Mastacembelus armatus*, Venkateswarlu, *Ind. J. zoot.*, **13**, (3), p. 128 (Bihar).



Text-fig. 3 *Mastacembelus armatus* (Lacepede)

D. XXXII—XL 64-92, AIII 64-90, C. 14-17, P. 21-27

An eel-shaped fish tapering to head and tail. Head 15.2 to 21.0, body depth 7.2 to 12.9 as % of standard length. Eyes small (7.2 to 15.9) interorbital space 4 0 to 5.2, length of snout 35.2 to 41.0 as % of head length. The long, fleshy snout has a trilobed extremity with a concave but unstriated lower surface. Length of gape of mouth, 16.1 to 20.9 as % of head length, the gape extending to below posterior nostril or at least to its anterior margin. Length of lower jaw 30.0 to 35.9 as % of head length. Sharp teeth in bands in both jaws. Dorsal and anal fins confluent with the caudal. Spines of dorsal fin originating above middle or posterior third of pectoral fin, last spine small and hidden beneath the skin. Anal spines close together, second largest, last small and hidden beneath the skin ; anal rays originating in advance of soft dorsal. Pectoral fin length. 4.0 to 6.3 as % of standard length. Ventral fins absent.

Vent nearer to base of caudal than to snout. Caudal fin smoothly confluent with dorsal and anal or unite with anal or with both by forming a slight notch. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum scaleless. However, scales are present between eye and posterior nostril, and either surroundig eye and posterior nostril or present only on their lower sides and between latter and maxilla. Spines on preoperculum (2-5) conspicuous.

Colour and colour pattern variable. In preserved specimens it consists of 3-5 bands, a median band on the head running from the eyes to the nape or beyond, 2 to 4 lateral bands either breaking into spots or taking an undulating course emitting cross bars or anastamosing to form bold reticulation or losing their identity in marblings of darker colour on the body, and one median ventral band on the belly. The colour pattern is more definite in young specimens than in adults where the whole body appears to be uniformly dark with a few darker spots along the base of the spinous dorsal.

It is known to grow to a maximum length of over 600.mm

Habitat : It occurs in fresh and brackish waters.

Distribution : Throughout India, Pakistan, Nepal, Bangladesh, Sri Lanka, Burma, Thailand, VietNam. Tonkin. Hainan Island & China, Malaya, Sumatra, Java.

4. **Mastacembelus caudiocellatus** Boulenger
(Text-fig. 4)

1893. *Mastacembelus caudiocellatus* Boulenger, *Ann. Mag. Nat. Hist.* (6) **12**, p. 199 (Fort Stedman, 3000 ft.).

Text-fig. 4 *Mastacembelus caudiocellatus* Boulenger
D. XXXI—XXXIV, 62-66 ; A. III. 60-65, P. 19-22 ; C. 15-18

1912. *Mastacembelus caudiocellatus* Boulenger, *J. Acad. nat. Sci.. Philad.* (2) **15**, p. 200 (Irawaddy).

1918. *Mastacembelus caudiocellatus*, Annandale, *Rec. Indian Mus*, **14**, p. 34, 53, pl. I. fig. 3. (Inle Lake and He-Ho basin, Burma).

1956. *Mastacembelus caudiocellatus*, Sufi, *Bull. Raffles Mus.*, No. 27, p. 110.

Body eel-shaped. Head 20.0 to 22.3, body depth 9.9 to 12.1 as % of standard length. Eye diameter 9.6 to 10.4, interorbital space 4.3 to 4.7, length of snout 34.6 to 34.7 as % of head length. Sharp conical teeth present in bands in both the jaws ; those of the outer row being longer than the inner. Gape of mouth not extendig to below the posterior nostrils. Rudimentary gill-rakers present on the gill arches, more distinct on 2nd and 3rd. Spinous dorsal fin originating above the extremity of pectoral, last spine very small and hidden beneath the skin. Anal spines close together, last being small & inconspicuous. Soft anal fin originating just below the soft dorsal fin. Pectoral fin 3.5 to 3.8 as % of standard length. Caudal fin united with the dorsal and anal fins, only near the base. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum scaleless. Scales present below eye and posterior nostril and from the latter to the maxilla. No spine on the preoperculum ; one strong preorbital spine, piercing the skin, present. Vent nearer to base of caudal than to snout.

Colour in preserved specimen brown becoming yellow on the belly. Blackish streaks, 2-3, present along the sides, the upper one proceeding from the eye. Blackish marbling below these lateral streaks also present. Blackish ocelli, with yellowish centres, present in a series along the sides of the tail. Pectorals and vertical fins yellowish, reticulated with black.

Distribution : Burma, Inle Lake, Shan States.

5. **Mastacembelus guentheri** Day

(Text fig. 5)

1865. *Mastacembelus guentheri* Day, *Proc. Zool. Soc. London*, **37** (Malabar).

1865. *Mastacembelus guentheri*, Day, *Fish Malabar*, 154, pl. 11 (Trichoor, Malabar).

1889. *Mastacembelus guentheri*, Day. *Faun Brit. India*, **2**, 334.

1912. *Mastacembelus guentheri*, Boulenger, *J. Acad. nat. Sci. Philad.*, (2) **15**, p. 200 (Malabar coast).

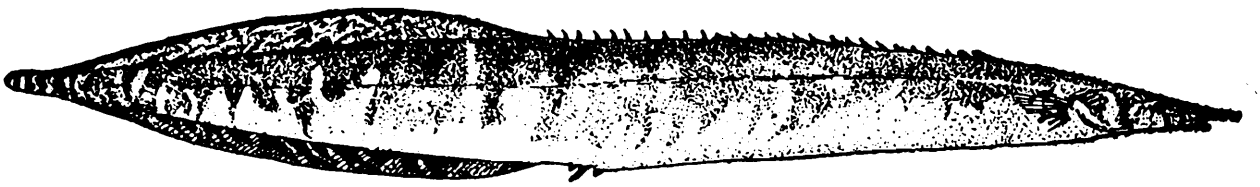
1929. *Mastacembelus guentheri*, Pillay, *J. Bombay nat. Hist. Soc.* **33**, p. 376 (Trivandrum).

1936. *Mastacembelus guentheri*, John, *J. Bombay nat. Hist. Soc.* **38**, pp. 707, 715 (Marshy canals and rivers of Travancore).

1941. *Mastacembelus guentheri*, Hora and Law, *Roc. Indian Mus.*, **43**, p. 239 (Travancore).

1949. *Mastacembelus guentheri*, Silas, *J Bombay nat Hist Soc.* **48**, p. 793 (pools and running water of Kalikayam stream, Travancore), p. 795 : Alleppey canals.

1956. *Mastacembelus guentheri*, Sufi, *Bull. Raffles Mus.* No. 27, p. 123.



Text-fig. 5 *Mastacembelus guentheri* Day

D. XXVII—XXX, 58-74 ; A. III, 59-75, P. 17-21, C. 11-13

Body eel-shaped. Head 16.0 to 18.0, body depth 10.8 to 13.3 as % of standard body length. Eye diameter 8-10, interorbital space 4 to 5, length of snout 39.5 to 42.0, length of gape of mouth 12.0 to 12.5, length of lower jaw 29.3 to 30.5 as % of head length. Gape of mouth not extending to below the posterior nostril. Teeth present in bands in both jaws.

Spinous part of dorsal fin originating on a vertical behind the end of pectoral fin, the last spine small and hidden beneath the skin. Anal spines close together, second largest, last small. Soft part of the anal fin originating slightly in advance of the soft dorsal. Pectoral fin. 4.2 to 5.0 as % of standard body length. Caudal fin completely united with dorsal and anal.

Top of snout, interorbital and internasal spaces scaly and only top of head behind orbit to hind edge of preoperculum naked. Internasal and interorbital spaces scaly with naked regions in front and behind. Scales also present between and around eye and posterior nostril and extending from the latter to the maxilla. Preoperculum with 2-3 spines. Preorbital spine single, strong, piercing the skin. Vent nearer to base of caudal fin than to snout. Genital papillae large in ripe females.

Colour (in sprit) light or dark brown, dull yellow on the belly, some black bands radiate from the eye and dorsal surface of snout and cross the under surface of the jaws. A light narrow streak from above the eye passess along the upper edge of the lateral line to the base of the caudal. Short oblique bars or marblings on body and vertical fins. Pectoral fins light brown, usually marked with oblique bars.

Distribution : Malabar, Travancore (Kerala, India).

Remarks : The reported occurrence of *M. guentheri* in Assam is doubtful.

6. **Mastacembelus oatesii** Boulenger

(Text-fig. 6.)

1893. *Mastacembelus oatesii* Boulenger, *Ann. Mag. nat. Hist.*, (6) **12**, p. 199 (Fort stedman, Inle Lake).

1912. *Mastacembelus oatesii*, Boulenger, *J. Acad. nat. Sci. Philad.*, (2) 15, p. 200 (Irawaddy).

1918. *Mastacembelus oatesii*, Annandale, *Rec. Indian Mus.*, **14**, p. 34 and 54, pl. 1, fig. 2 (Inle Lake).

1929. *Mastacembelus oatesii*, Prashad and Mukerji, *Rec. Indian Mus.*, 3, p. 169.

Text-fig. 6 *Mastacembelus oatesii* Boulenger
D XXIX 48-55, A. III, 46-55, P. 23-24, C. 21

Body eel-shaped. Head 15.4 to 16.2, body depth 9.6 to 10.3 as % of standard length. Eye diameter 8.1 to 8.5, interorbital space 4.5 to 4.7, length of snout 39.8 to 42.1, length of gape of mouth 12.9 to 16.4, length of lower jaw 33.3 to 34.1 as % of head length. Gape of mouth not extending to below the posterior nostril. Teeth in bands in both jaws, the first row consisting of larger teeth.

Spinous part of dorsal fin originating above middle of pectoral fin, last dorsal spine small and hidden beneath the skin. Anal spines

closely placed, the second largest, the last small and inconspicuous. Soft part of the anal originating in advance of the soft dorsal fin. Pectoral fin 5.0 to 5.5 as % of standard body length. Caudal fin united with dorsal and anal fins, only near the base.

Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoprerculum naked. Preoperculum with 3-4 spines. Scales also present between eye and posterior nostril, around the nostril, around the lower half circumference of the eye and from the posterior nostrils to the maxilla. Small scales present (21-25) between origin of soft dorsal fin and lateral line. Preorbital spine single, strong, piercing the skin. Vent nearer to base of caudal fin than to snout. No gill-rakers.

It attains a length of 370.0. mm. (Annandale, 1918).

Colour uniformly pale brown. Colour pattern of young and adult specimens remarkably different. Accoring to Annandale (1918) the adult specimens are of almost uniform dark greenish colour, while in the young the belly is pale and the sides bear a series of irregular dark, pale spotted bars (sometimes broken up into spots or blotches), the sides of the head are ornamented with alternate dark and pale horizontal lines and bars. The caudal fin is black with a broad white vertical bar, the ventral fins are pale with a dark edge and the pectorals are almost wholly pale.

Distribution : Inle lake basin, Shan States, Burma.

7. **Mastacembelus pancalus** (Hamilton)
(Text fig. 7)

1822. *Macrognathus pancalus* Hamilton, *Fish Ganges*, pp. 30, 364, pl. 22, fig. 7 (tank in Bengal).

1831. *Mastacembelus pancalus* Cuvier and Valenciennes, *Hist. Nat. Poissons*, **8**, p. 455.

1831. *Mastacembelus punctatus* Cuvier & Valenciennes, *Hist. Nat. Poissons*, **8**, p. 463 (Brackish ponds, Calcutta).

1853. *Mastacembelus pancalus*. Bleeker, *Verh batavia Genoot.* **25**, p. 98 (Calcutta in R. Hooghly and Chillianwallah, Jihlum (=Chillianwala, Jhelum).

1861. *Mastacembelus pancalus* Gunther, *Cat. Fish* ; **3**, p. 541 (Freshwaters of Bengal).

1876. *Mastacembelus pancalus*, Day, *Fish India*, p. 340, pl. 72, fig. 4 (Deltas of large

rivers of India and localities near the sea, Hardwar near where Ganges debouches from Himalayas, Jabbalpore, not south of R. Krishna).

1889. *Mastacembelus pancalus*, Day, *Faun. Brit India*, **2**, p. 233.

1907. *Mastacembelus pancalus*, Jenkins, *Rec. Indian Mus.*, **3**, p. 287 (Sur lake or Sar lake, Orissa).

1912. *Mastacembelus pancalus*, Boulenger, *J. Acad nat. Sci. Philad.*, (2) **15**, p. 199 (Ganges and lower Kistna).

1916. *Mastacembelus pancalus*, Sundara Raj, *Rec. Indian Mus.*, **12**, p. 251, 290 (Madras and Cooum).

1930. *Mastacembelus pancalus*, Prasad and Mukerji *J. Bombay nat. Hist. Soc.*, **34**, p. 165, 169 (Mancher lake, Sind, Pakistan).

1936. *Mastacembelus pancalus*, Hora, *Rec. Indian Mus.*, **38**, p. 1. (Chitaldurg, Mysore, India).

1938. *Mastacembelus pancalus*, Shaw & Shebbeare, *J. Asiat, Soc. Beng.* (3) **3**, p. 126, text-fig. 128 (Streams of Terai and Duars, Northern Bengal, India).

1938. *Mastacembelus pancalus*, Misra, *Rec. Indian Mus.*, **40**, p. 257 (Nallamalai Hills : Streamlet at Mahanadi (alt. 800ft.).

1939. *Mastacembelus pancalus*, Acharya, *J. Bombay nat. Hist. Soc.* **40**, p. 772 (Sabarmati River and tank near Ahmedabad, Gujarat, India).

1940. *Mastacembelus pancalus*, Hora, *Rec. Indian Mus.*, **42** p. 369, 370 (Mahanadi River at Rudri and Dhamtari Bazar, former Central Province. India).

1941. *Mastacembelus pancalus*, Job, *Rec. Indian Mus.*, **43**, p. 121, text figs. 1 to 5.

1941. *Mastacembelus pancalus*, Hora & Nair, *Rec. Indian Mus.*, **43**, p. 367, (Timarni Nullah on Timarni Road, S. of Horda, Satpura Range, Hoshangabad district, M. P., India).

1942. *Mastacembelus pancalus*, Hora, *Rec. Indian Mus.*, **44**, p. 198 (Northern India, generally its records south of Kistna river are few).

1944. *Mastacembelus pancalus*, Rahimullah, *J. Bombay nat. Hist. Soc.*, **45**, p. 76 (Rivers Manjra, Haldi and Aleru, Dist. Medak, former Hyderabad State, India).

1946. *Mastacembelus pancalus*, Setna & Kulkarni, *J. Bombay nat. Hist. Soc.*, **46**, p. 129 (Ahmedabad, Gujarat, India).

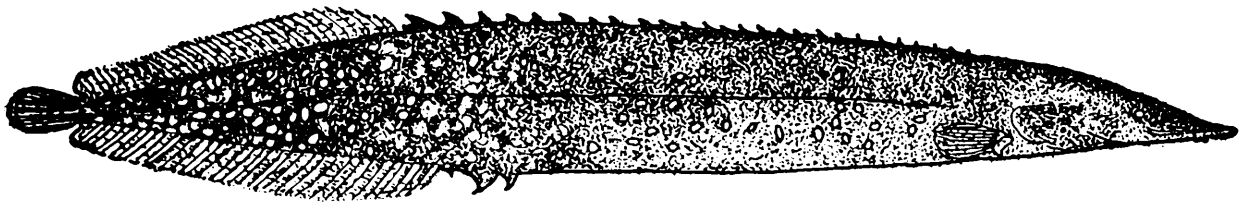
1947. *Mastacembelus pancalus*, Chauhan, *Rec. Indian Mus.*, **45**, p. 271-276 (Patna State, now in Orissa, India).

1947. *Mastacembelus pancalus*, Rahimullah & Mahmood, *J. Bombay nat. Hist. Soc.*, **47**, p. 109 (Nizamabad district, former Hyderabad State, now in Andhra Pradesh, India).

1953. *Mastacembelus pancalus*, Sinha and Shiromany *Rec. Indian Mus.* **51**, p. 63 (Kalinadi, Meerut, U. P., India).

1956. *Mastacembelus pancalus*, Sufi, *Bull Reffles Mus.*, **27**, p. 120.

1972. *Mastacembelus pancalus*, Venkateswarlu, *Ind. J. Zoot* ; **13** (3), p. 128 (Bihar).



Text-fig. 7 *Mastacembelus pancalus* (Hamilton)
D. XXIV—XXVI 30-42, AIII. 31-46, P. 17-19, C. 11-13

An eel-shaped fish tapering to head and tail. Head 18.5 to 25.3, body depth 10.7 to 15.6 as % of standard length. Eye diameter 7.9 to 13.0 (negatively allometric throughout the size range examined), interorbital space 5.0 to 6.0, length of snout 39.6 to 43.8 as % of head length. The long fleshy snout has a trilobed extremity with a concave but unstriated lower surface. Length of gape of mouth 9.4 to 11.2 as % of head length, the gape not extending to below the nostrils. Length of lower jaw 28.9 to 32.6 as % of head length. Teeth, small in bands, present in both the jaws. Dorsal and anal fins distinctly separated from the caudal. Spinous portion of the dorsal fin originating above the middle of the pectoral fin, last spine small and not hidden beneath the skin. Anal spine close together, last spine small and not hidden beneath the skin, soft portion of the anal fin originating in advance of the soft dorsal. Pectoral 6.0 to 7.3 as % of standard length. Snout entirely scaly, both dorsally and laterally, behind this top of head naked as far as hind edge of operculum. Two to five spines on precperculum. One strong preorbital spine, piercing the skin present. Vent nearer to the base of caudal than to snout.

Colour (in spirit) brown dark along the back and yellowish on the belly. Colour of freshly caught specimens greenish olive along the back, yellowish beneath. Sides of body covered with round, white spots and sometimes striped with dark brown vertical stripes, Fins yellow with black spots.

It grows to atleast 177.0 mm in length.

Distribution : Fresh and brackish waters of India and Pakistan.

8. **Mastacembelus unicolor** Cuvier and Valenciennes

(Text fig.8)

1831. *Mastacembelus unicolor* Cuvier & Valenciennes, *Hist. Nat. Poissons*, **8**, p. 453 (Java).

1850. *Mastacembelus unicolor*, Blecker, *Vern. Bat. Genoot*, **23**, p. and 5 (Batavia, Sarang, Surakarta, Modjokerto, Surabya).

1861. *Mastacembelus unicolor*, Gunther, *Cat. Brit. Mus.* (Fish), **3**, p. 542.

1876. *Mastacembelus unicolor*, Day, *Fish India*, p. 339, pl. 72 fig. 2 (Rongoon and Burma to Java).

1889. *Mastacembelus unicolor*, Day, *Faun Brit. India*, **2**, p. 332.

1890. *Mastacembelus unicolor*, Vinciguerra, *Ann. Mus. Stor. nat. Genov.*, (2) **9**, p. 179 (Mandalay. Burma).

1893. *Mastacembelus unicolor*, Vaillant, *Nouv. Arch. Mus.*, Paris, (3) **5**, p. 43 (South Borneo, Sunda Island (Borneo).

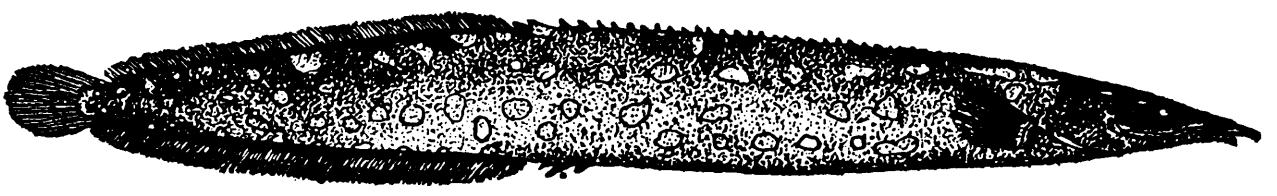
1895. *Mastacembelus unicolor*, Reuvens, *Notes Lcvden. Mus.*, **16**, p. 176 (River Brantas, Java).

1905. *Mastacembelus unicolor*, Fowler, *Proc. Acad. nat. Sci. Philad*, **57**, p. 489 (Borneo).

1912. *Mastacembelus unicolor*, Boulenger, *J. Acad. nat. Sci., Philad*, (2) **15**, p. 200 (Irrawady).

1930. *Mastacembelus unicolor*, Machan *Ann. naturh Mus. Wien*, **44**, p. 439 (Padang).

1956. *Mastacembelus unicolor*, Sufi, *Bull. Raffles Mus.* No. 27, p. 107, p. 127.



Text-fig 8 *Mastacembelus unicolor* C. V.

D. XXXI—XXXV. 74-94 ; A. III. 70-96, P. 23-27 ; C. 25

An eel-shaped fish. Head 17.3 to 21.4, body depth 9.6 to 12.3 as % of standard length. Eye diameter 7 4 to 8.6, interorbital space 4.0 to 4.7 length of snout 38.6 to 40.5 as % of head length. The long fleshy snout has a trilobed extremity. Length of gape of mouth 16-8

to 18.2 as % of head length, the gape not extending to below posterior nostrils. Length of lower jaw 29.0 to 34.5 as % of head length. Teeth present in bands in both jaws. Dorsal and anal fins either completely free from the caudal or one of them *i.e.* dorsal or anal united with caudal or both united with the latter (caudal) at the base or anal completely confluent with the caudal and the dorsal united with the caudal at the base only. Spinous portion of dorsal originating above posterior half of pectoral fin, last spine small and hidden beneath the skin. Anal spine close together, second largest, last small, soft portion of anal fin originating just below the origin of soft dorsal. Pectoral fin 4-8 to 5.4 as % of standard length. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum naked. Scales present around eye and posterior nostril, extending from the latter to maxilla and present or absent between eye and posterior nostril. Two to four, usually 3, pungent spines present on preoperculum. One strong preorbital spine, piercing the skin present. Vent nearer to base of caudal than to snout.

Colour (in spirit) light or dark brown, darker dorsally and paler ventrally, with or without light brown or blackish spots laterally, with or without yellowish oblong spots ventrally. Vertical fins light or dark brown with a yellowish or pinkish margin. Pectorals with two brownish or blackish vertical bars with a yellowish or pinkish margin.

Distribution : Burma, Malay, Peninsula, Java, Sumatra, Moluccas, Borneo and Banka.

9. **Mastacembelus zebrinus** Blyth

(Text-fig. 9)

1859. *Mastacembelus zebrinus* Blyth *J. Asiat. Soc. Beng.*, **28**, p. 281 (Moulmein, Burma).

1861. *Mastacembelus zebrinus*, Gunther, *Cat. Brit. Mus.* (Fish), **3**, p. 541.

1876. *Mastacembelus zebrinus*, Day, *Fish. India*, p. 339, pl. 72. fig. 3. (Freshwaters of Burma-Irrawaddy).

1882. *Mastacembelus zebrinus*, Vinciguerre. *Ann. Mus. stor. nat. Genova*, **18**, p. 653 (Irrawady).

1889. *Mastacembelus zebrinus*, Day, *Faun. Brit. India*, **2**, p. 333, fig. 111.

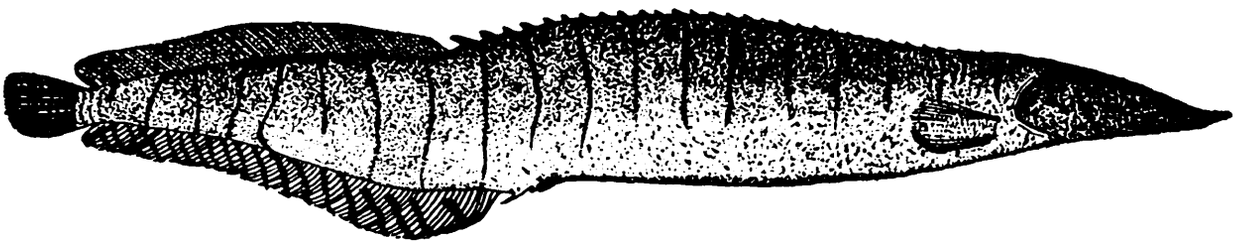
1910. *Mastacembelus zebrinus*, Jenkins, *Rec. Indian Mus.*, **4**, p. 130 (Mondalay, Burma).

1912. *Mastacembelus zebrinus*, Boulenger, *J. Acad. nat. sci. Philad*, (2) **15**, p. 119 (Irrawady R.).

1936. *Mastacembelus zebrinus*, Hora & Mukerji, *Rec. Indian Mus.*, **38**, p. 18 (Rangoon, Burma).

1939. *Mastacembelus zebrinus*, Fowler, *Notul. nat. Philad.*, **17**, p. 10 (Rangoon, Burma).

1956. *Mastacembelus zebrinus*, Sufi, *Bull. Raffles Mus.*, No. 27, p. 107, 124.



Text-fig. 9 *Mastacembelus zebrinus* Blyth

D. XXVIII—XXXI. 49-55, A. III' 51-59, P. 17-19, C. 17-19.

An eel-shaped fish. Head 17.5 to 20.1, body depth 10.9 to 14.3 as % of standard length. Eye diameter 7.6 to 11.1, interorbital space 4.0 to 5.0, length of snout 38.2 to 41.7 as of head length. The long fleshy snout has a trilobed extremity. Length of gape of mouth 9.1 to 11.8 as % of head length, the gape not extending to below the posterior nostrils. Length of lower jaw 29.0 to 31.3 as % of head length. Teeth present in bands in both jaws. Dorsal and anal fins free from the caudal. Spinous portion of dorsal fin originating above the middle of the pectoral fin, last spine small and hidden beneath the skin. Anal spines close together, second largest, last small, soft anal originating in advance of the soft dorsal. Pectoral fin 6.2 to 7.6 as % of standard length. Top of the head as far as the hind edge of the preoperculum naked. Snout, internasal space, interorbital space and between the eyes and posterior nostrils scaled. Scales small 21-23 between lateral line and origin of soft dorsal. Two to four spines on the preoperculum. One strong preorbital spine piercing the skin. Vent nearer to base of caudal than to snout. No gill-rakers.

Colour (in spirit) brown, darker dorsally and paler ventrally. Body with dark brown vertical bars, edged with yellowish bars. Dorsal and caudal fins yellowish and striated with minute brown spots, the anal with the body bars continued on it alternating with shorter dark bars.

Distribution : River Irawaddy, Sittang and Salween, Burma.

II Family : PILLAIIDAE

Body eel-like, subcylindrical and elongated. Head depressed anteriorly. Head and body without scales. Snout short with a very indistinct fleshy rostral appendage. Mouth wide, non-protractile. Upper jaw with a single large, strong, hockey stick-shaped bone bearing teeth. Branchiostegal rays six. Preoperculum with one spine. Pelvic gridle and pelvic fins absent, pectroal fin with seven to twenty rays. Lateral line present.

Supracleithrum attached to vertebral column. Cleithrum present. Post-temperal absent. Pectoral radials absent. Caudal fin homocercal, short, confluent with dorsal and anal fins. Two large hypurals united at their bases, fused with last centrum bearing 8-10 unbranched rays. Nasals large, separated in the middle by a spindle-shaped ethmoid. Infraorbaital bone large. Parietals separated by supraoccipital. Vomer toothless. Palatines narrow flakes of bone movably united to parasphenoid and vomer. Pterygoid movably united to lateral ethmoid outside the palatine. Vertebrae 62-65. No pyloric appendages. Stomach and intestine with u-shaped bends. Swimbladder present. Two genera are dealt with here.

KEY TO GENERA

1. Pectoral fin Small, with 7-9, caudal fin with 8-10, rays. Head depressed, caudal short, moderately tapering. Eyes dorsally placed. Dorsal fin with 34-36 rays. ... ... *Pillaia*
2. Pectoral fin large with 19 or 20, Caudal fin with 12 rays. Head conical. Caudal long and tapering. Eyes laterally placed. Dorsal fin with 40-44 rays. ... ... *Garo*

3. Genus **Pillaia** Yazdani

1972. *Pillaia* Yazdani, *J. Bombay nat. Hist. Soc.*, **69** (1) pp. 134-135 (type-species, *Pillaia indica* Yazdani, by monotypy and original description).

1981. *Pillaia*, Jayaram *Freshwater fishes of India*—a Handbook Zoological Survey of India, Calcutta, p. 390.

1985. *Pillaia*, Yazdani, *Rec. Zool. Surv. India, Occ. Paper* No. 70, p. 39.

Small eel-like fish with subcylindrical body. Abdomen rounded. Head moderately elongate, anteriorly depressed. Snout conical with

an indistinct fleshy rostral appendage bearing anterior tubular nostrils. Mouth wide, terminal and horizontal, its gape extending to anterior border of eye. Eyes fairly prominent, placed dorsally in anterior part of head, not visible from below ventral surface. Lips thick, flap-like laterally. Jaws equal with small sharply pointed inwardly curved teeth in rows, palate edentate. No spine on body before fins or anywhere else. Gill-openings wide extending dorsally to pectoral origin. Gill-membranes free from each other and also from isthmus. Dorsal fin at posterior half of the body, slightly in advance of vertical from vent, fused with caudal and with 34-36 rays. Anal fin with 34-36 rays, also fused with caudal. Caudal fin tapering posteriorly, with 8-10 rays. Pectoral fin with 7-9 rays. Scales absent. Lateral line clearly seen on head, and less distinct on body.

Distribution : India ; Khasi & Jaintia hills near Shillong, Meghalaya.

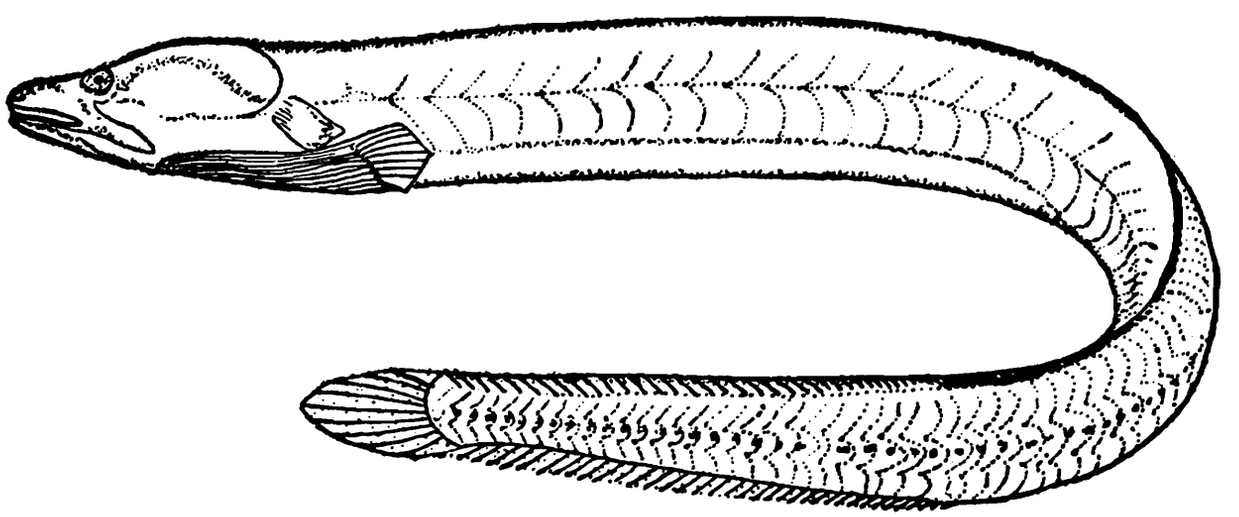
The genus *Pillaia* is represented by a single species.

10. **Pillaia indica** Yazdani
(Text-fig 10)

1972. *Pillaia indica* Yazdani, *J. Bombay nat. Hist. Soc.* **69** (1), pp. 134-135, fig. 1 (Type-locality, Sumer stream near Shillong, Khasi & Jaintia Hills, Meghalaya).

1977. *Pillaia indica*, Pillai & Yazdani, *Rec. Zool. Surv. India*, **72**, p. 20 (Garo Hills, Meghalaya).

1985. *Pillaia indica*, Yazdani, *Rec. Zool. Surv. India, Occ. Paper* No. 70, p. 39, fig. 31 (Khasi Hill, Meghalaya).



Text-fig. 10 *Pillaia indica* Yazdani
B. VI. D. 34-36, A. 34-36, C. 8-10, p. 7-9

Small eel-like fish. Depth of body 7-36 to 9.3, length of head 15.0 to 17.4, snout to dorsal origin 58.7 to 61.1, length of caudal 6.9 to 9.9, length of Pectoral 1.3 to 2.2 in % of standard length. Snout 25.0 to 28.0, eye diameter 7.2 to 8.3, interorbital distance 7.6 to 9.1, post orbital head length 61.5 to 66.6 in % of head length. Head anteriorly depressed. No spines before dorsal or anal fins or anywhere else on the body. Dorsal and anal united with the caudal of 8-10 unbranched rays, without scales ; lateral line clearly discernible on the head and less distinct on the body. Branchiostegals 6. A rather indistinct fleshy rostral appendage bearing anterior tubular nostrils, eyes fairly prominent, placed dorsally ; gill-openings wide, extending dorsally to the level of pectoral origin ; gill membranes free from each other and from isthmus ; mouth wide and horizontal ; teeth on jaws arranged in narrow bands, small sharply pointed and curved inwards ; pectorals small, ventral absent.

Body colour (in spirit) variable, upper part of body light to dark purplish brown, the lower part yellowish or very light brown, fins dirty white, series of open Vs of dark colour and dark lines on either side of the body.

Distribution : India ; Khasi, & Jaintia Hills near Shillong and Garo Hills (Meghalaya).

4. Genus **Garo** Yazdani and Talwar

1981. *Garo* Yazdani & Talwar. *Bull. Zool. Surv. India* 4 (3), pp. 287-288 (Type-species, *Pillaia khajuriai* Talwar, Yazdani & Kundu, by designation).

Body elongate (eel-like) and naked. Head rather conical, mouth wide, terminal with an indistinct fleshy rostral appendage. Gill-openings wide, separate, free from isthmus. Eyes laterally placed. Dorsal and anal fins confluent with the long candal fin ; no spines in dorsal and anal fins ; dorsal fin with 40-44 soft rays, its origin at about mid point of the body (without caudal fin), anal fin with 37-38 soft rays. Pectoral fin fairly large, with 19-20 rays caudal fin with 12 unbranched rays. Vertebrae 65.

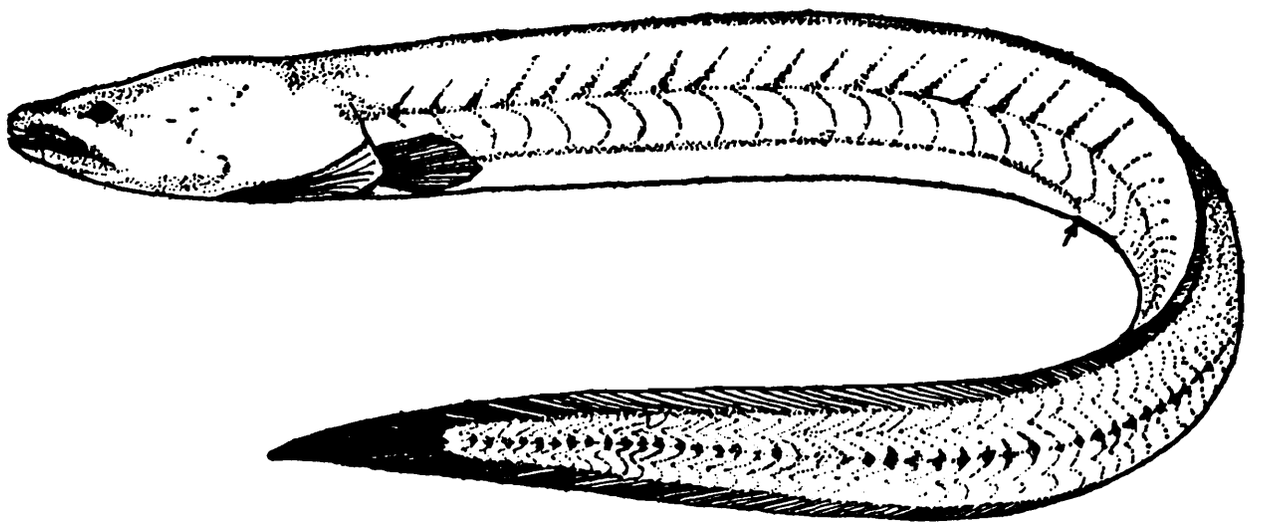
Distribution : India Garo Hills district, Meghalaya and Kaziranga Wildlife Sanctuary, Sibsagar district, Assam.

The genus is represented by a single species.

11 **Garo khajuriai** Talwar, Yazdani & Kundu
(Text-fig. 11)

1977. *Pillaia khajuriai* Talwar, Yazdani & Kundu, *Proc. Indian Acad. Sci.*, **85 B** (2), pp. 53-56.

1981. *Garo khajuriai*, Yazdani & Talwar. *Bull. Zool. Surv. India*, **4** [3], p. 287.



Text-fig. 11 *Garo khajuriai* Talwar, Yazdani & Kundu

B. VI. D. 40-44, A. 37-38, C. 12, P. 19-12.

Small eel-like fish. Depth of body 7.4 to 7.9, length of head 18.4 to 19.3, predorsal distance 52.9 to 54.4, preanal distance 52.9 to 54.4, length of pectoral fin 5.9 to 7.0, all in % of standard length. Length of snout 22.7 to 28.0, diameter of eye 4.5 to 6.0, interorbital post-orbital length of head 63.6 to 80.0, all in % of head length.

Body subcylindrical, naked with a laterally compressed tail which tapers considerably. Head moderately elongate, snout conical. mouth wide, terminal, its gape extending to vertical from anterior border of eye, lips flap-like laterally, anteriorly fairly thick ; faint traces of the fleshy rostral appendage, anterior nostrils tubular. Gill-openings wide, separate, free from isthmus. Vent equally placed between tip of snout and the caudal fin. Lateral line not discernible.

Teeth conical, curved inwards, in three rows at the tip and in two rows along the sides of both jaws.

Dorsal and anal fins fairly well developed ; confluent with the caudal fin. Origin of dorsal fin slightly in advance of vertical from

vent. Pectoral fin placed in the lower half of the body, their bases are partially concealed under the opercula. Caudal fin tapering.

Colour : In alcohol, pale brown with scattered melanophores on head, body and fins.

Distribution : India same as for the genus.

III Family : CHAUDHURIIDAE

Body eel-like compressed, scaleless. Nostrils lateral. Gill-openings separate and integument covering them supported by few branchiostegal rays. All pharyngeal slits wide. Four fully developed gill bearing branchial arches. Snout without rostral appendage. Branchiostegal rays five. Heart close to branchial arches. Vent situated a long distance from head. Teeth arranged in bands on jaws only. Dorsal and anal fins long without spines. Pelvic fins and girdle absent. Caudal fin homocercal, fan-shaped, practically free, provided with well developed rays and supported by a pair of hypural bones. Pectoral fins present. Pectoral girdle attached to the vertebral column.

Cleithrum completely fused with supracleithrum. Post-temporals absent. Pectoral radials absent. Frontal paired. Ethmoid and vomer distinct, former separating maxillaries infront. Well developed zygapophyses on the vertebrae. Two large hypurals. Nasal very largely expanded, not separated in the middle by the ethmoid. Lateral ethmoids small. Frontals large. Parietals separated by supraoccipital. Palatines large joined to the pterosphenoid. Vertebrae 70. No pyloric appendage.

Only a single genus is known.

5. Genus **Chaudhuria** Annandale

1918. *Chaudhuria* Annandale, *Rec. Indian Oue.*, 14, p. 40 (type-species, *Chaudhuria caudata* Annandale by original designation and monotypy).

Body elongated greatly, eel-like, compressed. Head conical, compressed. Snout acuminate, but not produced. Mouth small, horizontal, non-protractile. Eyes well-developed, superior, situated in anterior part of head. Lips tumid, but the lower lip only so at the sides. Lower jaw slightly longer. Teeth small, sharply pointed, slightly curved and in a band on jaws only ; palate edentate. A single dorsal fin, with 39-40 rays. Anal fin with 42-43 rays, both fins confined to the caudal region and united with the caudal fin by a low membrane. Caudal fin rays completely segregated. Caudal

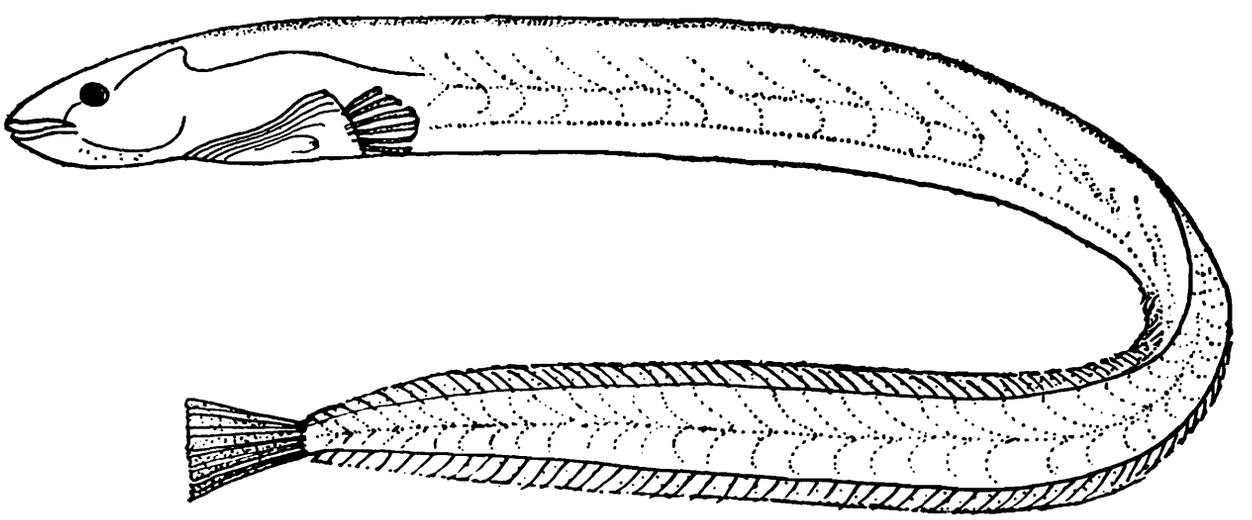
fin markedly asymmetrical when fully expanded, slightly rounded or subtrancate and more strongly developed on the ventral than on dorsal side. Lateral line complete. Caudal region compressed and tapering considerably.

Distribution : Burma : Inle lake, S. Shan States. This genus is so far represented by a single species.

12. **Chaudhuria caudata** Annandale
(Text fig. 12)

1918. *Chaudhuria caudata* Annandale *Rec. Indian Mus.*, **14**, p. 41-42, pl. 1, fig. 1, pl. 4, fig. 1-10 [type-locality : Inle Lake [attitude 5000 ft,] Southern Shan States, Burma.

1923. *Chaudhuria caudata*, Annandale, *Ann. Mag. nat. Hist.*, [9] **11**, p. 327-333.



Text-fig. 12 *Chaudhuria caudata* Annandale
B.V.D. 39-40, A. 42-43, C. 7, P. 6.

Small eel-like fish. Body compressed, more so in the caudal region, tapering posteriorly. Snout considerably longer than the eye. Mouth barely reaching as far back as the level of the anterior border of eye. Eyes fairly big, prominent. The lower jaw projects beyond the upper. The teeth are arranged biserially in the posterior part of both jaws and triserially near the tip ; in the latter region they are slightly enlarged. The branchiostegal rays are long and curved. The internal branchial isthmus is broad.

The pectoral fins are situated about half way up the body, their bases being concealed under the opercula. The dorsal and anal fins

are of almost equal length and depth. In the middle of the caudal region they have each less than half the depth of the body but towards the caudal peduncle they become deeper than the body. The caudal fin is markedly asymmetrical, slightly rounded or subtruncate and more strongly developed on the ventral than on the dorsal side. Lateral line complete, extends along the middle of the caudal peduncle. Vent situated half way between the tip of the tail and that of the snout.

It is known to grow to 52.0 mm. in length. Specimens of little more than half that length are reported to be sexually mature.

Colour : The back and upper part of the sides of the head and caudal region are reported to be dark purplish brown somewhat mottled, the whole ventral surface and the lower part of the sides are yellowish white. The fins are white with very fine and often interrupted dark lines running along each side of each ray, minute dark spots are often present at the base of rays.

Distribution : Burma, Inle Lake, Shan States (alt 3000 ft.)

Remarks : I have not examined any fresh specimen of this species. The description is based on available literature and the type-specimens present at the Zoological Survey of India, Calcutta.

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