

## Revision of the Oriental fishes of the Family Mastacembelidae

By S. M. K. SUFI, B.Sc.

Zoological Survey Department,

Government of Pakistan, Karachi, Pakistan

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### Introduction

A SYNOPTIC REVIEW of the genus *Mastacembelus* covering both the Oriental and African forms was published in 1912 by Boulenger, who recognised 15 species from the Oriental Region. Since then ten nominal Oriental species have been added to this genus and one to the only other genus, *Macrognathus*. During my tenure of a Fellowship at the British Museum (Natural History) under the Colombo Plan in 1954-1955, Dr. E. Trewavas, who felt the need of bringing together all the scattered knowledge about this family, pointed out some inaccuracies in Boulenger's revision and suggested that I should revise the oriental species of this group. She very kindly placed at my disposal the entire collection in the B.M. (N.H.), along with an unnamed collection sent by Mr. M. W. F. Tweedie from the Raffles Museum.

### Acknowledgments

I am indebted to the Director of the British Museum (Natural History) and to Dr. H. W. Parker, Keeper of Zoology, for giving me facilities to work at the Museum. I am especially indebted to Dr. E. Trewavas, who not only suggested to me this problem but has guided me at every step and has helped me with her criticism and advice, and has been kind enough to revise the manuscript at the expense of her other work. I am thankful to Mr. D. W. Tucker of B.M. (N.H.) for his kind advice from time to time, to Mr. A. C. Wheeler and Mr. P. E. Purves of the same Museum for radiographs of the various specimens. I am thankful to Dr. S. L. Hora of the Indian Museum for the loan of types of *Mastacembelus circumcinctus*, *Mastacembelus manipurensis* and *Rhynchobella dhanashorii*, and some specimens of *Mastacembelus pancalus* and also for permitting me to reproduce some of his figures; to Mr. H. W. Fowler of the Philadelphia Academy for the loan of paratypes of *Mastacembelus taeniagaster* and *Mastacembelus paucispinis* and for permitting me to reproduce some of his figures; to Dr. J. J. Hoedeman of Amsterdam Museum for the loan of specimens of *Mastacembelus billitonensis* and two unidentified specimens of *Mastacembelus*; to Dr. J. C. A. Junge of the Rijksmuseum, Leiden, for his valuable information about the specimens of *Mastacembelus unicolor* collected by Kühl and Van Hasselt. I am also thankful to Prof. L. Bertin of Paris Museum for providing me with every facility during my visit to that Museum; and to Prof. M. Yamada of the University of Okayama, Japan, for his help in translating M. Oshima's paper on *Mastacembelus kobayashii* into English. To the British Council and the Commonwealth Relations Office I am grateful for the help and various facilities they provided me during my stay in the United Kingdom and also for giving me the opportunity to examine the Mastacembelid collection in the Paris Museum by granting the necessary funds. Last but not least I am indebted to Dr. A. R. Ranjha, Officer-in-Charge, Zoological Survey Dept., Pakistan, for giving me the opportunity to work in the B.M. (N.H.) by granting me the fellowship without which this work would not have been possible, and also for dispatching the Mastacembelid collection from Pakistan for my study.

The figures of *Mastacembelus caudiocellatus*, *Mastacembelus argus*, *Mastacembelus erythrotaenia* and three figures of *Mastacembelus armatus* showing the colour variation were drawn by Miss Buswell under my supervision; the two figures of the Paris Museum specimen of *Mastacembelus erythrotaenia*, one of *M. mastacembelus* and the anatomical figures were drawn by myself.

## Redefinition of the Order Opisthomi

Gr. *Opisth(o)*, behind, and *Om(o)*, shoulder.

Fishes of this order are characterized by their eel-like, compressed and elongated body, covered with minute scales; non-protractile mouth and elongated snout supported by a cartilaginous rod and ending in a sensitive tip flanked by the tubular anterior nostrils, which are thus remote from the posterior; by flake-like palatines, fused to the ethmo-vomer; by long soft dorsal and anal fins, preceded by 7 to 40 detached, depressible dorsal spines and 1 to 3 anal; by the absence of ventral (pelvic) fins and of a post-temporal bone (except its lateral line components), the pectoral girdle not being attached to the skull. Caudal short, either confluent with dorsal and anal or narrowly separated. Air-bladder without an open duct.

So defined, the order contains a single family, Mastacembelidae.<sup>1</sup>

**Anatomy.** Skull elongated, gradually narrowing forwards; roof smooth. Large nasals separated in the middle line by the narrow upper edge of the mesethmoid.<sup>2</sup> Large frontals. Parietals separated by supraoccipital. No opisthotic or intercalare. Pterotics, sphenotics and epiotics present. Long prootic separating the pleurosphenoid from the parasphenoid; latter reaching the hind margin of the skull. No trace of orbitosphenoid,<sup>3</sup> but a very small basisphenoid present, at least in some species.<sup>4</sup> Lateral ethmoid small. Mesethmoid compressed, forming a narrow vertical septum between the nasal cavities.

Vomer toothless (pace Günther, Day and Regan).<sup>5</sup>

Palatines narrow flakes of bone immovably united to mesethmoid, vomer and parasphenoid, bearing teeth in some African species, toothless in other African and all Asiatic species. Pterygoids movably united to lateral ethmoid outside the palatine.

Premaxilla non-protractile, united by fibrous tissue to ethmo-vomer, and to a fibre-ensheathed rostral cartilage which separates it from its fellow. Maxilla attached by ligament to ethmoid close to the union of this bone with the premaxilla, otherwise separate from the latter.<sup>6</sup>

1. Annandale (1918) erected the Family *Chaudhuriidae* to receive *Chaudhuria caudata* and assigned it to the Order Apodes. Regan (1919), considering that the characters described for *Chaudhuria* showed its relationship to *Mastacembelus*, placed it in the Opisthomi. Subsequently Annandale and Hora (1923) agreed with this decision and gave new anatomical characters to support it. Jordan (1923) followed this classification and Mitra & Ghosh (1931), describing the soft anatomy, came to the same conclusion. Berg (1940), however, remarking that *Chaudhuria* is "so specialized that it plainly deserves the rank of a special order", assigned it to a separate Order, Chaudhuriiformes. Annandale & Hora point out the differences as well as the resemblances between *Chaudhuria* and the Mastacembelidae, and in view of these, and especially of the lack of specialization of the snout, I am inclined to agree with Berg.

2. I confirm this observation of Ghosh (1930) on dry and alizarin preparations of both genera. Regan (1912), Gregory (1933) and Berg (1940) state that the nasals meet in the middle line, as in some incompletely prepared or shrunken dried skulls they may appear to do at first sight.

3. Ghosh (op. cit.) states that the orbitosphenoid is very rudimentary, sometimes fused with prootics, but I could not find any trace of orbitosphenoid, thus agreeing with Regan (op. cit.) and Gregory (op. cit.).

4. Although Regan (op. cit.), Gregory (op. cit.) and Berg (op. cit.) have observed that no basisphenoid is present, I have found a very small basisphenoid in an alizarin preparation of *M. maculatus* and in a dry skull of *Macrognathus*, thus confirming the finding of Ghosh (op. cit.).

5. Confirmed in dry skeletons of several African and Asiatic species and in alizarin preparations of both genera and in microscopic sections of *Macrognathus*.

6. I cannot agree with Regan (op. cit.) and Gregory (op. cit.) that the maxilla is firmly attached to the premaxilla. In dry skeletons of both genera, in alizarin preparations and in transverse sections of *Macrognathus*, the two bones are widely separated for the greater part of their length. At the anterior end of the maxilla, where both bones are attached by separate ligaments to the ethmoid, the two lie close together, but the fibres between them do not run from one to the other, but from both to the ethmoid. At the angle of the mouth, the end of the premaxilla and the expansion of the maxilla are together surrounded by fibrous tissue as in most fishes.

Preorbital bone large, articulating with lateral ethmoid, and lying on outer side of nasal; in some species of *Mastacembelus* produced into a strong spine which is usually pungent. No suborbital bones, but alizarin preparations show the infraorbital lateral line canal to be weakly ossified along part of its course.<sup>1</sup>

No post-temporal, but the lateral line canal is ossified in this region and also passes through the supracleithrum; supracleithrum attached by ligament to the 2nd, 3rd or 4th vertebra. No mesocoracoid; hypercoracoid perforated; hypocoracoid with a strong post-coracoid process; radials four, two on the hyper- and two on the hypo-coracoid (Fig. 3, Plate 14).

Centrum of first vertebra convex in front, fitting into a cavity formed by basi- and ex-occipitals. First 4 to 8 vertebra with flattened neural spines; epipleurals on the first and a few of the following vertebrae; pleural ribs on parapophyses on the third to last abdominal vertebrae; posterior ventro-lateral processes (zygapophyses) on each vertebra except a few (1-3) anterior.

Tail homocercal; 5 to 7 hypurals.

Six (2 + 4) branchiostegal rays. Four gills; a slit between the fourth and the toothed fifth ceratobranchial. Pharyngobranchials of 2nd, 3rd and 4th arches expanded and bearing teeth. Finely toothed plates may be present on hypo- and cerato-branchials. Gill-rakers, if present, rudimentary.

A pseudobranch in the form of a *rete mirabile*, inconspicuous in the adult, present at least in some species.<sup>2</sup>

Stomach U-shaped. Two pyloric caeca, beyond which the intestine extends forwards for a short distance, then bends backwards and follows a straight course to the anus.

#### Habitat and Bionomics

*Mastacembelids* abound in plains and at high altitudes, in running and still waters, clear as well as muddy, usually lurking in crevices of the rocks or among stumps of plants near the bank.

They have been found buried in soil when the water is dried up. Day (1877, p. 214) exhumed specimens of *Macrognathus aculeatus*, still lively, from the nearly dry beds of ponds, and Job (1941, p. 131) has found a pair of *Mastacembelus pancalus* buried deep in the mud in a drying pool. The latter species was noticed by Job (op. cit.) to bury the greater portion of its body including its snout in the mud during the cold winter months, even in the presence of water in an aquarium, for longer or shorter periods, the opercular flaps, when visible, exhibiting no respiratory movements. From this he concluded, "This species is capable of resorting to longer or shorter periods of hibernation during which even the breathing movement is suspended."

Some of these fishes are nocturnal in habits. Sundara Raj (1916, p. 289) and Job (op. cit., p. 130) have noticed that in an aquarium *Macrognathus aculeatus* and *Mastacembelus pancalus*, both lie buried in the mud or sand during the day, while in the night they swim about freely. I can endorse the views of Sundara Raj and Job, having observed

1. In my alizarin preparations of *M. maculatus* the infraorbital lateral line canal is ossified for a short distance behind the preorbital bone; and in an alizarin preparation of a young *Macrognathus aculeatus* the infraorbital canal is weakly ossified in sections corresponding to suborbital bones, but without any plate-like expansions. The supraorbital canal is similarly ossified in front of the nasal bone to its termination near the tip of the snout (see p. ), although this is such a thin shell that the alizarin has the effect of making its course clear without appearing red. Sections reveal the bony tube.

2. In *M. armatus* and *M. pancalus*; see Bhargava, 1953.

the same behaviour in these fishes. The act of burrowing, an interesting phenomenon, has been described in *Mastacembelus pancalus* by Job (op. cit.) who says, "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."

That the spines have a defensive function is illustrated by the statement of Deraniyagala concerning *Mastacembelus armatus* (1932, p. 269): "When held in the hand the fish wriggles backward and its short dorsal spines act like the teeth of a saw, inflicting a nasty slash in the palm of the inexperienced fisherman."

Hora (1935, p. 8-9) stated that these species "are fully adapted for aerial respiration" and that air "is taken in through the mouth and passed out through the gill-openings." He maintains (p. 14) that the gills are capable of both aquatic and aerial respiration. Experiments have been conducted on *Macrognathus aculeatus*, *Mastacembelus armatus* and *Mastacembelus pancalus* to ascertain whether the fish becomes "drowned" if not allowed to reach the surface, but there is some dissension among the various workers. According to experiments conducted by Dobson (1874, p. 318 & 321), the time required to cause asphyxia in *Macrognathus aculeatus* is 5 hrs. 15 mins., and in *Mastacembelus pancalus* 5 hrs. 35 mins.; according to the findings of Day (1876, p. 339) *Macrognathus aculeatus* "becomes drowned if placed in water so as to be unable to reach the surface." Ghosh (1933, p. 328 & 329) and Hora (1934, p. 8), however, in their experiments have found that all the specimens of *Macrognathus aculeatus*, *Mastacembelus pancalus* and *Mastacembelus armatus* continued to live for a week when confined in a cage and not allowed to reach the surface. According to Hora (p. 14) death of fishes in the earlier experiments was either due to "the foulness of water or on account of air being locked up in their air-chambers." Job's observation suggests that it is by inanition, with respiration at a minimum or even at a standstill, that survival may occur, rather than by special modes of respiration. The air bladder is closed, and there seems to be no special respiratory structures other than the gills. However to come to any definite conclusion, I think it is necessary to conduct some more experiments correlating the time of survival with the condition of the water and amount of activity displayed by the fish.

Not much is known about the food of these fishes. Cuvier and Valenciennes (1831, p. 459) found small scales in the stomach of *Mastacembelus armatus* and debris of fresh water worms in the stomach of *Macrognathus aculeatus*. Hamid Khan (1934, p. 661) describing the feeding habits of *Mastacembelus armatus* remarks "It is carnivorous and has minute teeth in the jaws and is very destructive to eggs and fry of other fishes." Deraniyagala (1932, p. 268) states that *Mastacembelus armatus* "Usually feeds on earthworms and is frequently taken on rod and line with this bait or shrimps", while *Macrognathus aculeatus* subsists on earthworms, insects and organic matter. Job (1941, p. 131) who has studied thoroughly the food of *Mastacembelus pancalus* says "In the young stages the fish is found to subsist mainly on Entomostracan Crustacea, the items in the order of preponderance being Daphnids, like *Macrothrix orientalis*, Ostracods and traces of Cyclops, and larvae of insects as *Ceratopogon* sp. and other Chironomids, Coleopterans and occasionally larvae of mosquitoes and other Dipterans. As the fish grows larger the proportion of insect larvae increases and larger Crustacea begin to form a fair portion of the diet. Only in one instance were Teleostean remains noted among the gut contents; these consisted of a single egg and a part of a fin."

Knowledge about the breeding habits and development of these fishes is mainly confined to *Mastacembelus panicus*. This species, according to Sundara Raj (op. cit., p. 290), breeds in cold weather; he obtained young specimens averaging 30 mm. in length from the Spur tank, Egmore (Madras) early in February. D'Abreu (1925; as quoted by Job, op. cit., p. 123), has obtained 28 mm. fry of this species in the Ambajhari tank at Nagpur (India) in April, while Prashad and Mukerji (1930, p. 169) obtained 50 mm. specimens from Manchar Lake, Sind (Pakistan) in November. Job (op. cit.), who made a detailed study of the life-history of this species, records that in the railway borrow pits in Ulubaria the fish breeds from May to November with the peak period at the commencement of the monsoons. The eggs, 1.3 to 1.35 mm. in diameter, are demersal, but are laid in masses, which lie among the algal meshes. The change from the yolk-laden larva to the adult structure takes over a month and maturity is attained in about one year. As regards the breeding season of *Mastacembelus armatus* Sundara Raj (loc. cit.) records mature ova in a female caught early in February; while Deraniyagala (op. cit. 268 & 269) has obtained mature males and females in October, November and December, numerous young under 50 mm. in length in February and two of 68 and 70 mm. in July, from various parts of Ceylon. Sexually ripe males and females of *Macrognathus aculeatus* were taken by Deraniyagala (loc. cit.) from various parts of Ceylon in March, May and September. According to him, the eggs are pale green, numerous, small, 1.28 mm. in diameter and are laid in fresh water.

#### Economic importance

Some of the spiny eels grow to quite a large size. Among those examined for this study the longest is a specimen of *Mastacembelus erythraenia*, 690 mm. in total length. *Mastacembelus armatus* is said to grow to 3 ft. (Job, op. cit.). Regarding their importance as food, Day (op. cit., p. 338), considers them excellent and says that they salt well, but their flesh is said to be heating. In some places, especially at Nagpur (D'Abreu, 1925; as quoted by Job, op. cit.), Madras (Sundara Raj, op. cit.), Bengal (Hamilton, 1822, p. 27), southern Shan States (Annandale, 1918, p. 54), Siam (Smith, 1945, p. 64), they are regarded as excellent food fish; but in other places, for example Punjab (Hamid Khan, loc. cit.) and Sind, they are despised owing to their snake-like appearance, and are eaten by poor people only.

#### Family MASTACEMBELIDAE

With the characters of the Order as here restricted.

##### The genera of Mastacembelidae

Like all authors except Bleeker and Jordan (see p. 105), I recognise only two genera. Both have the snout extending in front of the mouth with the tubular anterior nostrils forming with it a trilobed rostrum.

1. In *Macrognathus* (p. 99) the snout is very long and accommodates on its under surface, behind the anterior nostrils, a concave prolongation of the upper jaw consisting of a paired series of toothed bony plates. One species, widely distributed in Asia.
2. In *Mastacembelus* (p. 105) the premaxillaries are simple, and end anteriorly a little in front of the tip of the lower jaw; in front of them the snout is conical with the anterior nostrils opening near its tip. Numerous species in Asia and Africa.

## Methods of measurement

Total length:	distance between tip of rostrum (fleshy appendage) and tip of caudal fin.
Standard length:	distance from tip of rostrum to base of caudal fin.
Depth of body:	vertical distance at deepest part of body, at origin of soft dorsal or anal.
Length of pectoral:	length of longest pectoral ray.
Length of head:	distance between tip of rostrum and posterior angle of gill-opening, i.e. including rostral appendage.
Length of snout:	distance between tip of rostrum and anterior margin of eye.
Diameter of eye:	horizontal diameter of orbit.
Interorbital space:	width of roof of skull between orbits.
Length of lower jaw:	distance between tip of dentary and posterior end of articular.
Length of gape of mouth:	tip of lower jaw to angle of mouth-opening.

Genus *Macrognathus*( *Macros* Gr. large; *gnathos* Gr. jaw)[*Mastacembelus* (part.) Gronovius, L. T., 1763, *Zoophylac*, Pt. 1: 133].*Mastocembelus* (part, ex Gronovius, errore pro *Mastacembelus*) Scopoli, J., 1777, *Intro. Hist. Nat.*: 458.*Macrognathus* (part.) Lacepède, C., 1800, *Hist. Nat. Poissons* II: 283 (type *Ophidium aculeatum* Bloch).*Rhynchobdella* (part.) Schneider, J., 1801 Blochii *Syst. Ichthyol.* II: 478 (type *Rhynchobdella orientalis* Schneider = *Ophidium aculeatum* Bloch).

I agree with the reasons given by Smith (1945, p. 62) for using the earlier *Macrognathus* instead of *Rhynchobdella*, which is commonly used. All the early generic names proposed for Mastacembelidae included a species of each of the two genera now recognised, but whereas Gronovius first described the "simack" sent to him by Russell and defined his genus with that in mind, Lacepède's first species was the *O. aculeatum* of Bloch and the meaning of the generic name is evidently derived from the great upper jaw of that species. Moreover, although Cuvier & Valenciennes used *Rhynchobdella*, they recognised *Macrognathus* as a synonym of it, and not of *Mastacembelus*, thus implicitly restricting it.

**Definition.** A Mastacembelid with the snout prolonged to accommodate on its concave under surface a paired series of toothed bony plates, which are an anterior extension of the premaxillary.<sup>1</sup>

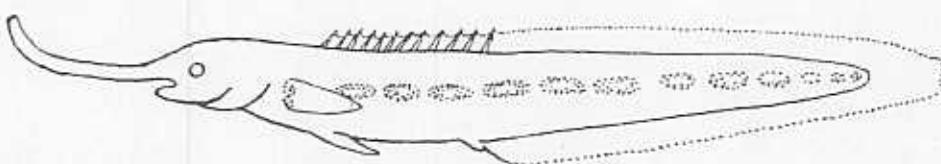
A single species.

<sup>1</sup> Although Günther (1861) and Day (1876) stated that vomerine teeth are present in *Macrognathus*, and Regan (1912) included in the ordinal characters that vomerine teeth may be present or absent, I can find none, either in sections, alizarin preparations, spirit specimens or a dry skeleton.

## Structure of the rostrum (Figs. 4, 5 and 6, Plates 15-17)

**Historical.** The unique structure of the snout has attracted the attention of almost all naturalists who have seen this fish, but, so far as I know, none has furnished either a detailed account or an anatomical figure of it. Amongst the pre-Linnacan workers Ruysch (1718), Renard (1718-19 and 1754, see text fig. 1) and Valentyn (1726) published figures which Cuvier & Valenciennes (1831, p. 463) say were taken from an unpublished drawing by Vlaming (ca. 1715) labelled with the Malay name *ikan-gaya* meaning elephant-fish. I have not seen Vlaming's drawing, but the figures of the other authors, although showing an exaggerated snout, yet on the evidence of the long dorsal and anal fins, with free spines before the dorsal, are probably inspired by our fish, remembered "with advantages." At least, in over two centuries no Asiatic fish has been found whose snout better deserved comparison with an elephant's trunk.

Bloch (1786) calls the fish "der Elephantenrüssel" and Schneider (1801) writes (in translation) "Upper lip produced into a rostrum excavated below, with numerous transverse folds, divided by a longitudinal keel (like those of the cephalic shield of *Echeneis*)."



Text Fig. 1. Ikan-Gaya. Outline drawing (by E. Trewavas) from the coloured figure 78 of folio 13 of Renard's "Poissons, écrevisses et crabes . . . des îles Moluques", 1718-19.

These comparisons are apt. Like an elephant's trunk, the snout is mobile and prehensile, has transverse ridges on its lower, concave surface and nostrils near its tip. As in the sucker of *Echeneis*, the ridges are supported by bones and bear denticles.

No one, however, has described these bony plates. Cuvier & Valenciennes (t.c. pp. 444-5) refer to the possibility of embracing objects in the concavity of the under surface and consider that the ridges must be highly sensitive. They say that the intermaxillary bones support only the base of the snout, and scarcely pass beyond the end of the lower jaw. In pl. IV, fig. 1 a of the "Disciples' Edition" of the *Règne Animal* (1841), Valenciennes figures the under surface of the snout and in the explanation of the plate refers to the ridges and to the anterior nostrils.

Day (1876, p. 338) and Hora (1921, p. 205) similarly illustrate and briefly describe the snout. Deraniyagala, however (1932 and 1952), correctly describes the teeth as "villiform on jaws, and as transverse patches in rostral groove", and adds (1952) that there are 20-26 of these cross bands.

**Description.** I have examined alizarin preparations and transverse sections of the snout of *Macrognathus aculeatus*.

The rostral cartilage is a slender rod, firmly united by fibrous tissue to the front of the ethmo-vomer and tapering to end at the tip of the rostrum, between the two anterior nostrils. Throughout its length it is wrapped in a thick layer of circular fibres.

In front of the expanded anterior end of each toothed premaxillary bone a series of 20 to 26 narrow, toothed, bony plates extends to near the anterior end of the rostrum, each plate being curved to fit the concavity of the snout. In section the plates appear

exactly like the premaxillary, and they are probably best regarded as a segmented anterior extension of this bone. There are 25 pairs of plates in my 72 mm. alizarin preparation, and 21 in a specimen of 225 mm., so that between these sizes there is evidently no increase in number of plates.

Above each row of plates the nasal tube runs from the anterior nostril backwards to the olfactory organ, under the nasal bone, and opens behind this at the posterior nostril, between the nasal bone and the eye.

Above each nasal tube runs a canal of the lateral line system, in an extremely thin tube of bone. It opens above the anterior nostril near the tip of the snout, and can be traced backwards into the nasal bone. It is thus the rostral extension of the supraorbital canal.

To left and right of the rostral cartilage and above it, outside its fibrous sheath, lie three bundles of longitudinal fibres, attached anteriorly to the tip of the rostral cartilage and posteriorly, the dorsal to the anterior end of the ethmoid, the lateral to the premaxillary near its junction with the sheath of the rostral cartilage. There is a layer of circular fibres under the epidermis, but only on the upper and lateral walls, not extending to the lower concave surface, nor to the boundary edge between the concave and convex surfaces. The melanophores, lie outside and inside the fibrous layer, and some among the fibres.

The fibres, both of the longitudinal bundles and of the cutaneous layer have the appearance of collagen fibres, but the observed mobility of the snout in the living fish can hardly be explained unless at least some of these are contractile. I have labelled the longitudinal bundles as ligaments, however. (Fig. 6, Plate 17).

The epidermis of the convex surface of the snout consists of columnar epithelium including mucus-secreting cells and sensory buds. The sensory organs are most abundant near the tip of the snout, where, as in *Mastacembelus*, the skin is liberally supplied with blood vessels and nerve endings.

**Function.** Cuvier & Valenciennes (1831) believed that the concave lower surface of the snout, by its power of embracing objects and its transverse ridges, had a sensory function. The structure shows, however, that the sensory function is confined to the tip and the convex surface, as well as the olfactory and lateral line organs, while the concave surface is really an extension of the upper jaw, enabling the fish to seize food organisms and pass them back to the mouth, aided by the orally directed teeth.

We know that *Macrognathus* is nocturnal, and the sense organs of the rostrum are doubtless of value in helping the fish to find its way. By day the fish is in the habit of lying buried in the mud, and the firm axis of the rostrum and its mobility probably fit it for use as a burrowing organ.

#### *Macrognathus aculeatus* (Bloch). Figs. 7-10, Plate 18

*Ophidium aculeatum* Bloch, M. E., 1787, Ausl. Fische., II: 72 taf. clix fig. 2 (East Indies); Gmelin, J. F., 1788, Linn. Syst. Nat. 13th ed.: 1147 (copied).

*Macrognathus aculeatus*, Lacepede, C., 1800, Hist. Nat. Poissons, II: 284 (India); Hamilton Buchanan, 1822, Fish, Ganges, 29 (Ganges); Herre, A. W. C. T. and Myers, G. S., 1937, Bull. Raffles Mus., 13: 74 (Singapore; outlet of Lake Chin Chin, Jasin, Malacca; and Bukit Merah Reservoir, Perak); Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 61 (Menam Chao Phya, Menam Sak, Menam Chi, tributaries of Menam Mao and in lakes, swamps and ditches of the central plain of Siam).

*Rhynchosbella orientalis* Schneider, J., 1801, Blochii Syst. Ichthyol., 478 (India and Ceylon).

*Rhynchosbella aral* Schneider, J., 1801, *Blochii Syst. Ichthyol.*, :479 Taf. Ixxxix (Tranquebar); Cuvier, G. and Valenciennes, A., 1831, *Hist. Nat. Poissons*, VIII: 451, pl. 239.

*Ophidium rostratum* Shaw, G., 1803, *Zool.*, IV: 73, pl. vii.

*Macrognathus ocellatus* Hamilton Buchanan, 1822, *Fish. Ganges*, :29.

*Rhynchosbella ocellata*, Cuvier, G. and Valenciennes, A., 1831 *Hist. Nat. Poissons*, VIII: 455 (Bengal); Bleeker, P., 1850, *Verh. Batavia. Genoot.*, 23: 3 (Java, Ceylon, Pondicherry, Tranquebar and Bengal), :5 (Batavia, Purworejo, Surabaya, Modjokerto, Surakarta) and :9; Id., 1865, *Ned. Tijdschr. Dierk.*, 2: 34 and 174 (Siam).

*Rhynchosbella oculata*, Jerdon, T. C., 1848, *Madras J. Lit.*, 15: 147 (rivers and tanks of Carnatic); Günther, A., 1861, *Cat. Fish.*, III: 540 (Calcutta, Madras, Assam, Borneo, Ceram, Moluccas); Peters, W. C. H., 1863, *Mber. preuss. Akad. Wiss. Berlin*: 263 (Java); Martens, E. von, 1876, *Preuss. Exped. O-Asien. Zool.*, I, pt. 2: 396 (Bangkok); Day, F., 1876, *Fish. India*, :338 pl. Ixxii, fig. 1 (brackish waters and deltas of large Indian, Burmese and Sind rivers; Borneo, Moluccas); Vinciguerra, D., 1883, *Ann. Mus. Stor. nat. Genova*, 18: 652 (copied locs. and R. Irrawaddi); Sauvage, H. E., 1883, *Bull. Soc. philom. Paris*, (7) 7: 151 (Menam Chao Phya, Siam); Day, F., 1889, *Faun. Brit. India*, II: 331 fig. 110; Vinciguerra, D., 1890, *Ann. Mus. Stor. nat. Genova*, (2) 9: 178 (copied locs. and Mandalay, Bhamo, Burma); Vaillant, L., 1893, *Nouv. Arch. Mus. Paris*, (3) 5: 42 (West Borneo, Sonda Is. and India); Reuvens, C. L., 1894, *Notes Leyden Mus.*, 16: 175 (Brantas R., Java); Volz, W., 1907, *Natuurk. Tijdschr. Ned.-Ind.*, 66: 134 (copied locs. and Palembang, Sumatra); Jenkins, J. T., 1907, *Rec. Indian Mus.*, 3: 287 (Sur Lake, Orissa); Willey, A., 1908, *Nature*, 77: 345 (Ceylon) and 1910, *Spolia zelani*, 7: 84 (Barave nr. Hanvelia); Dalglish, G., 1910, *J. Bombay nat. Hist. Soc.*, 20: 433 (Tirhoot, Bengal); Duncker, G., 1912, *Mitt. naturh. Mus. Hamburg*, 29: 256 (Ceylon); Weber, M. and Beaufort, L. F. de, 1912, in *Maass, Durch Zentral-Sumatra*, II: 20 (Gunung Sahilan, Sumatra); Sundara Raj, B., 1916, *Rec. Indian Mus.*, 12: 289 (fresh and brackish waters of Madras); Hora, S. L., 1923, *J. nat. Hist. Soc. Siam*, 6: 180 (Bangkok); Chabaud, P., 1924, *Bull. Econom. Indochine (N.S.)*, 6: 580 (G. of Siam); D'Abreu, E. A. D., 1925, *J. Bombay nat. Hist. Soc.*, 30: 710 (Chapra, Ghogra R., Bihar) and :711 (Naghbir, N. of Chanda Distr. C.P.); Chevey, P., 1929, *Notes Inst. oceanogr. Indochine*, 6: 171 (Cochinchina); Pillay, R. S. N., 1929, *J. Bombay nat. Hist. Soc.*, 33: 376 (Trevandrum); Deraniyagala, P. E. P., 1932, *Ceylon J. Sci.*, 16: 266 (Ceylon); Fowler, H. W., 1934, *Proc. Acad. Nat. Sci. Philad.*, 86: 146 (Chantaboon, Siam); Chevey, P., 1934, *Notes Inst. oceanogr. Indochine*, 7: 184; Fowler, H. W., 1935, *Proc. Acad. nat. Sci. Philad.*, 87: 134 (Bangkok) and :513 (Old Chiengsen); Suvatti, C., 1936, *Index Fish. Siam*, 21 (Nong Mong Krabinburi, E. Siam; Lopburi, Central Siam, Pechabun and Menam Chai at Udon); Shaw, G. E. and Shebbeare, E. O., 1937, *J. Asiatic Soc. Bengal*, (3) 3: 127 text-fig. 129 (muddy streams, Apalchand Forest, W. of Duars, N. Bengal); Fowler, H. W., 1937, *Proc. Acad. nat. Sci. Philad.*, 89: 222 (Bangkok, Tachin, Mepoon, Kemrat, Siam); Misra, K. S., 1938, *Rec. Indian Mus.*, 40: 257 (Nallamalai Hills, tanks at Prema (alt. 800 ft.); Hora, S. L., 1940, *Rec. Indian Mus.*, 42: 366 (market at Sihawa, Raipur Distr.), :369 (Mahanadi R.), and :370, 371; Chevey, P. and Poulaun, F. L., 1940, *Mem. Inst. oceanogr. Indochine*, 5: 22; Mahmood, S. and Rahimullah, M., 1947, *J. Bombay nat. hist. Soc.*, 47: 109 (Nizamabad Distr., Hyderabad State); Sinha, B. M. and Shiromany, P. A., 1953, *Rec. Indian Mus.*, 51: 63 (Kalinadi, Meerut, U.P.).

*Mastacembelus pentophthalmus* Gray, J. E., 1854, *Cat. fish . . . Gronow*: 172.

*Rhynchosbella aculeata* var. *siamensis* Günther, A., 1861, *Cat. Fish.*, III: 540 (Pachchore, Siam).

*Rhynchosbella* (sic) *aculeata*, Sauvage, H. E., 1881, *Nouv. Arch. Mus. Paris*, (2) 4: 160 (copied locs. and Mekong, Siam).

*Rhynchosbella dhanashorii* Hora, S. L., 1921, *Rec. Indian Mus.*, 22: 205, pl. ix, fig. 2 (Dhanashori stream, nr. Dimapur, Assam).

*Rhynchosbella dhanasorii* (sic) Hora, S. L. and Mukerji, D. D., 1935, *Rec. Indian Mus.*, 37: 384 (Brahmaputra system).

*Mastacembelus paucispinis* (nec Boulenger, 1899) Fowler, H. W., 1939, *Proc. Acad. nat. Sci. Philad.*, 91: 75, fig. 23 (Waterfall at Trang, Siam); Suvatti, C., 1950, *Faun. Thailand*: 206 (copied).

*Mastacembelus paucispinis*, Smith, H. M., 1945, *Bull. U.S. Nat. Mus.*, 188: 66 (copied).

*Macrognathus aculeata*, Suvatti, C., 1950, *Faun. Thailand*: 207 (as for *R. aculeata* in 1936).

*Macrognathus aculeata* var. *siamensis*, Suvatti, C., 1950, *Faun. Thailand*: 207 (copied).

*Macrognathus aculeatus aculeatus*, Deraniyagala, P. E. P., 1952, *Atlas Vertebrates Ceylon*, I: 132 (India, Burma, Borneo and Moluccas (copied) and Ceylon).

D XIV-XXII 42-58; A III 42-58; P 17-25; C 13-16.

Scales between and around eye and posterior nostril, and from the latter to the maxilla. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum naked. No spines on either preorbital or preoperculum. Gape of mouth very small, not extending to below the posterior nostril. Teeth small, pointed; present in both jaws and on the segmented anterior extension of the upper jaw. No gill-rakers.

Spinous dorsal originating far behind the end of pectoral, last spine small. Anal spines close together, second largest, last small; soft anal originating below the soft dorsal.

Vent nearer to base of caudal than to snout. Caudal distinctly separated from the dorsal and anal, or, exceptionally, united with anal (c.f. *M. paucispinis* Fowler).

**Proportions as % of standard length**

Depth of body: 11.0 to 16.1.

Length of head (17.5) 19.0 to 24.0 in specimens of S.L. 109-255 mm., up to 27 in smaller specimens.

Length of pectoral: 5.6 to 7.3.

**Proportions as % of length of head**

Length of snout: 42.8 to 54.1.

Diameter of eye: 7.2 to 11.8, negatively allometric.

Interorbital space: 4.1 to 5.5.

Length of lower jaw: 25.0 to 33.0.

Length of gape of mouth: 8.7 to 11.1.

**Colour** in spirit brown or light brown on the back and sides, paler on the belly. Body either marked with dark brown, broad oblique bars emerging from the back and becoming obscure on the belly (Sumatra, Malaya, Singapore, Burma and Siam); or with pale narrow oblique lines, which are sometimes broken into spots, emerging from the back, becoming obscure on the belly, anastomosing behind the vent to form a reticulation (Assam and Ceram). A pale lateral band, above the lateral line from eye to tail may be present or absent. Head brown on the back and sides, paler underneath; undersurface of head sometimes marked with variously broken cross bars.

Dorsal fin pale or orange, with dirty white spots or with longitudinal stripes; 3 to 10 ocelli at the base may be present or absent; if they are absent, the fin is marked with basal spots which are the continuation of the dark brown body bars. Anal fin pale or orange, occasionally with 2 ocelli; sometimes with bars which continue the dark brown body bars; speckled with dirty white spots or striped. Caudal striated with white spots, occasionally with one ocellus. Pectoral pale or orange sometimes with a dark basal spot.

**Habitat.** India, Pakistan, Burma, Ceylon, Siam, Malay Peninsula, Java, Sumatra, Borneo and Moluccas, in a wide range of habitats from fresh to brackish and running to stagnant water. Chabanaud (1924) lists it from the Gulf of Siam as a euryhaline species but gives no definite marine locality.

## Study Material.

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector or other Source
BM (NH) 1845.11.5.25	117? (damaged) ..	Calcutta	Griffith
.. 1845.6.22.175-6	153 & 149 ..	Moluccas & Borneo <sup>1</sup>	Frank
.. 1845.6.22.177-9	131, 142 & 149 (bleached) ..	Borneo	Frank
.. 1847.7.27 ..	109 (bleached) ..	Madras	Boileau
.. 1852.9.13.234 ..	95 & 113.5 ..	Zoo. Soc. Collection	Zoo. Soc. Collection
.. 1853.8.12.53 ..	135, 139 & 140 ..	Khasya	Hooker
.. 1858.3.24.65 ..	139 ..	Ceram	Pfeiffer
.. 1858.8.15.51.3 ..	123.5 & 213 ..	India	Waterhouse
.. 1860.3.19.942 ..	74 & 97.5 ..	Calcutta	Cantor's Collection
.. 1860.3.19.958 ..	(damaged) ..	Calcutta	von Schlagintweit
.. 1861.10.8.14. Type of <i>Rhynchobdella aculeata</i> var. <i>siamensis</i> ..	155.5 ..	Pachebore	Mouhot
.. 1870.6.14.55 ..	255 ..	—	Day
.. 1872.4.17.38 ..	251 ..	N. E. Bengal	Jerdon
.. 1880.12.1.36 ..	115 ..	Tenasserim (Burma)	Wood Mason
.. 1883.11.28.15 ..	245.0 ..	Singapore	Governor of Singapore
.. 1889.2.1.3622-5 ..	91, 118, 124, 138.5 ..	Madras	Day
.. 1889.2.1.3626-7 ..	132, 155 ..	Debroo	Day
.. 1889.11.12.52 ..	176 ..	Sumatra	Moesch
.. 1894.5.21.16-20 ..	141, 164, 166, 204, 233 ..	Toungoo (Burma)	Oates
.. 1894.5.21.21 ..	alizarin preparation ..	Toungoo (Burma)	Oates
.. 1894.5.21.22 ..	Skeleton ..	Toungoo (Burma)	Oates
.. 1898.4.2.127-8 ..	199.5 (2nd damaged) ..	Meenam R.	Royal Siamese Museum
.. 1922.5.19.115 ..	(damaged) ..	R. Trembling, Malay Peninsula	Kloss
.. 1934.10.17.112-113 ..	128, 161.5 ..	Alahabad, Ganges	Das
Type of <i>Ophidium rostratum</i> ..	216 ..	—	—
BM (NH) 1863.12.8.60-71 ..	149, 151, 168, 183, 187, 187.5, 189, 193.5, 203.5 and 237 ..	In a pond near Connoor, Madras	Mitchell
.. — ..	150 ..	Mandalay	—
Zoological Survey Pakistan ..	95 ..	Sakrand Dhand, Sakrand District, Sind, Pakistan	Sohrab Ali Nov. 1954
Zoological Survey Pakistan ..	177, 208, 243 ..	East Bengal, Pakistan	Dr. N. Ahmad Nov. 1954
Zoological Survey Pakistan ..	130, 148, 157, 158 ..	Pond near Char Matiari village District Pabna, East Bengal Pakistan	Sohrab Ali
Zoological Survey Pakistan ..	156.5 ..	East Bengal, Pakistan	Dr. N. Ahmad
Acad. Nat. Sci. Philad., No. 68518 Paratype of <i>Mastacembelus paucispinis</i> ..	70.5 ..	Waterfall at Trang, Siam	R. M. de Schauensee 13th Oct., 1936
Indian Museum, F. 9989/1 Type of <i>Rhynchobdella dhanashorii</i> ..	91 ..	Dhanashori stream, Dimapur, Assam	Hora

1. One specimen from each locality, but there is now no means of knowing which.

## Notes on the synonymy

1. *R. dhanashorii* Hora was based on a single specimen and distinguished from *M. aculeatus* by its proportions, coloration and habitat. The proportions as given by Hora fall within the range of *M. aculeatus*, with the exception of the head, which is relatively smaller. I was therefore glad to see the type and measure it uniformly with my material. I measure the head without rostral appendage as 18 mm. (14 mm. Hora), with rostrum 21.5 mm. and 23.6 per cent of the standard length. Although this is within the range for *M. aculeatus* it is smaller than in my four specimens nearest in total length, which have it 25 to 27 per cent. I find the colour pattern, believed characteristic, also in specimens from other regions, whereas other Assamese specimens have a more typical pattern. Finally fresh waters far inland are not an exceptional habitat for *M. aculeatus* as Hora thought (see H. M. Smith, 1945, and my specimens from Allahabad and Sakkard Distr. as well as records from N. Bengal, Raipur Distr., Nizamabad and Meerut).

In view of the variability in size of head in the species; in view also of the fact (established by Martin, 1949) that such proportions may be affected by rate of growth, and this again by environment, I do not feel able to recognize this specimen as the representative of a distinct species on its small head alone.

Nevertheless the eighteen other specimens do not show a smooth progress from a relatively larger head in the young to a relatively smaller head in the fullgrown. The smallest head (17.5 per cent of S.L.) is found in a specimen of unknown locality (S.L. 199.5 mm.), and this specimen and *M. dhanashorii* stand out of series whether the rostral appendage is included or not, so the varied conditions in which this is preserved cannot explain the irregular variation in size of head. Although, therefore, on my material I cannot recognise more than one species, I commend attention to size of head to anyone able to study a large material in the eastern parts of the range.

2. It was a surprise, on receiving Mr. Fowler's kind loan of the paratype of '*Mastacembelus paucispinis*', to find that he had overlooked the characteristic snout of a *Macrognathus*. The colour pattern comes well within the range of *M. aculeatus* in Siam and elsewhere. The paratype is exceptional in having the last anal rays adnate to the base of the caudal (Plate 18, Fig. 10), but in one or two of my specimens the two fins are barely separated.

3. *R. aculeata* var. *siamensis* has already been accepted by Smith (1945) as coming within the range of *M. aculeatus* in colour pattern and number of dorsal spines, and this is all the easier since I now find 15, not 13, spines in the type of this "variety".

4. In using a trinomen, Deraniyagala (1952) implies the existence of other subspecies, but I find no reason to recognise such.

Genus *Mastacembelus*

[*Mastacembelus* (part.) Gronovius, L.T. 1763 *Zooph. I*: 133].

*Mastocembelus* (ex Gronov., errore pro *Mastacembelus*) (part.) Scopoli, J., 1777, *Introd. Hist. Nat.*: 458. (type, ex Gronov., Simak il Inglese of A. Russell = *Ophidium mastacembelus* Solander in P. Russell).

*Macrognathus* (part., not the type species) Lacépède, C., 1800, *Hist. Nat. Poissons II*: 285.

*Rhynchobdella* (part., not the type species) Schneider, J., 1801, *Blochii Syst. Ichth. II*: 478. *Pararhynchobdella* Bleeker, P., 1874, *Versl. Akad. Wet. Amsterdam (2) 8*: 368 (type *Rhynchobdella maculata* Reinhardt).

*Bdellorhynchus* Jordan, D. S. & Tanaka, S., 1927, *Ann. Carneg. Mus.* 17: 391 (type *Rhynchobdella maculata* Reinhardt).

In addition, species of *Mastacembelus* have been placed in two Blennioid genera, in *Ophidium* by Waibau (1792), P. Russell (1794) and Shaw (1803), as Bloch had already placed *Macrognathus aculeatus*; and in *Zoarchias* by Mori (1928).

### Definition

Mastacembelid fishes with the premaxillary simple, not prolonged far in front of the tip of the lower jaw as a paired series of toothed plates; snout conical, with the tubular anterior nostrils opening near its tip, supported internally by a rod-like rostral cartilage as in *Macrognathus* (Fig. 11, Plate 19).

Fifteen (or fourteen?) species in Asia and more in Africa.

### Notes on the synonyms

*Mastacembelus* was proposed by Gronovius in his *Zoophylacium*, a work which in Opinion 89, the International Commission on Zoological Nomenclature declared eliminated from consideration for nomenclature. The name was validated by Scopoli, who, in taking it from Gronovius, mis-spelt it. I cannot find any derivation for the word other than *Mastax* (-*akos*), jaw or mouth, and *embolos*, peg or wedge<sup>1</sup>, and I feel justified, therefore, in assuming that Scopoli's spelling was a slip or error. Smith (1945) expresses the same opinion on p. 347, although on p. 62 he uses Scopoli's spelling. If the suggested derivation is correct, Gronovius' spelling of the second part of the word is also wrong, but I am here concerned to justify the long-accepted spelling.

Both *Pararhynchobdella* and *Bdellorhynchus* were defined as differing from *Mastacembelus* in the absence of preopercular spines. Since the type of *Mastacembelus*, *M. mastacembelus*, also lacks preopercular spines, the definitions of these "genera" are unsound. On p. 116 below, I have given reasons to doubt whether the presence or absence of preopercular spines is always specific. Further, I am unable to recognise a group of species related to *M. maculatus* as being distinct from the group represented by *M. mastacembelus* on any other definition.

### The question of generic divisions within *Mastacembelus*

Although I have not studied the African species fully I have considered whether they might be regarded as a group apart from the Asiatic forms; but although they add to the diversity of the genus I have not found means to define them. In one species, *M. paucispinis* Blgr., the soft dorsal extends forwards at the expense of the spines, which are reduced to VII, but in most, the numbers of spines and soft rays are comparable to those of the Asiatic species. In all African species the three vertical fins are confluent, but the Asiatic species show all grades from confluent to distinct. Some African forms are described as having A I or II, but they should be re-examined for a possible second or third hidden spine (I find one in *M. sclateri*). There are species with preorbital and preopercular spines and others without or with only preopercular. In dry skeletons of *M. sclateri*, *M. longicauda* and *M. congicus*, which have preopercular spines, I find the palatines toothed; in *M. batesi*, a species with unarmed head, they are toothless, as they are in all the Asiatic forms whether with or without head spines. The teeth of the jaws may be equal and villiform (c.f. the Asiatic *M. zebrinus* and *M. sinensis*) or with an outer series of enlarged teeth (c.f. *M. mastacembelus* and *M. caudocellatus*).

Similarly in Asia there is no correlation of distinguishing characters such as would indicate phyletic groupings. There seems to be no middle course between recognising one broad genus and the creation of numerous monotypic or small genera, and I prefer the former course, at least pending a full analysis of the African species.

<sup>1</sup> Klein (1744) had used *Mastacembelus* for another fish, deriving the second part of the word from Gr. *helo*, an arrow or spear.

## KEY TO THE ASIATIC SPECIES OF MASTACEMBELUS

I. No preopercular spines

A. Third anal spine distant from the others and larger than the first; D XXXI-XXXV 54-72; A III 45-70; C 8-9 ..... 1. *sineus* p. 108

B. All three anal spines close together, the third small and hidden beneath the skin; C 11-19.

1. Outer teeth much larger than inner; D XXXI-XXXV; a preorbital spine present and usually pungent.
  - a. Soft D 62-66; soft A 60-65; interorbital width 4-5% of length of head ..... 2. *caudocellatus* p. 110
  - b. Soft D 70-90; soft A 72-90; interorbital width 3-4% of length of head ..... 3. *mastacembelus* p. 111
2. Teeth of jaws approximately equal; D XXVI-XXXI 55-70; A III 58-70.
  - a. A pungent preorbital spine ..... 4. *maculatus* p. 113
  - b. No preorbital spine ..... 5. *perakensis* p. 117

II. Preopercular spines present, pungent or (rarely) hidden beneath the skin.

A. Dorsal spines and soft rays totalling 100 or less (exceptionally more in *M. guentheri*).

1. Caudal rays 11-16.
  - a. Top of snout naked.
    - (i) Dorsal XXVI-XXXI 58-68.
      - \* Scales between origin of soft D and lateral line 14-17; length of head in specimens of 100 mm. or more S.L. 15.5 to 18.5% of S.L. .... 4. *maculatus* p. 113
      - \*\* Scales between origin of soft D and lateral line 22-25; length of head in specimens of 100-191 mm. S.L. 20 to 22% of S.L. .... 6. *keithi* p. 117
    - (ii) Dorsal XXVI-XXIX 46-57 ..... 7. *circumcinctus* p. 119
  - b. Top of snout scaly, at least between the posterior nostrils.
    - (i) Dorsal XXIV-XXXI 30-42, or even fewer
      - 8. *pancalus* p. 120
    - (ii) Dorsal XXVII-XXX 58-74 ..... 9. *guentheri* p. 123
2. Caudal rays 17-21.
  - a. Gape of mouth 9 to 12% of the length of head. P. 17-19; top of snout scaly ..... 10. *zebrinus* p. 124
  - b. Gape of mouth 13 to 16.5% of the length of head; P. 23-24; top of snout naked ..... 11. *oatesi* p. 125

B. Dorsal spines and soft rays totalling more than 100.

1. Gape of mouth 12 to 13.5% of length of head ..... 12. *alboguttatus* p. 127
2. Gape of mouth 14 to 22% of length of head.
  - a. Gape not extending to below posterior nostrils; pectoral fin with a broad melanin-free (yellow or red in life?) band at the posterior margin, and banded in contrasting colours (fig. 25)
    - 13. *unicolor* p. 127
  - b. Gape extending to below posterior nostrils or beyond.
    - (i) Pectorals surrounded by a melanin-free (red or yellow?) margin, and usually with bold markings of the same colour on the dark ground within this margin; head and body with longitudinal red bands anteriorly, variously broken into reticulations and spots posteriorly (figs. 27, 28)
      - 14. *erythrotenia* p. 130
    - (ii) Pectorals plain or spotted; body variously marked with dark brown or black bands, series of blotches, sometimes linked by a zig-zag band, or reticulations (figs. 29-31)
      - 15. *armatus* p. 134

SUMMARY OF THE FIN-RAY NUMBERS IN *MASTACEMBELUS*

Species	D spines	D soft	A soft	C	P
<i>sinensis</i>	31-35	54-72	45-70	8-9	22-23
<i>mastacembelus</i>	31-35	70-90	72-90	16-19	20-22
<i>caudiocellatus</i>	31-34	62-66	60-65	15-18	19-22
<i>maculatus</i>	26-31	55-70	58-70	11-16	20-24
<i>perakensis</i>	29	60	58	?	?
<i>keithi</i>	26-27	56-58	48-60	16	26
<i>circumcinctus</i>	26-29	467-57	41-57	12-13	18-22
<i>guentheri</i>	27-30	58-74	59-75	11-13	17-21
<i>rancalus</i>	24-26	(24) 30-42	(29) 31-46	11-13	17-19
<i>zebrinus</i>	28-31	49-55	51-59	17-19	17-19
<i>oatesii</i>	29-34	48-55	46-55	21	23-24
<i>alboguttatus</i>	35-37	75-85	70-82	22-23	22-24
<i>unicolor</i>	32-35	74-94	75-98	?	?
<i>erythrotaenia</i>	32-38	70-80	70-80	14-17	?
<i>armatus</i>	32-40	64-92	64-90	14-17	21-27

1. *Mastacembelus sinensis* Blkr. Fig. 12, Plate 20

*Ophidium aculeatum* (nec Bloch) Basilewsky, S., 1855, Nouv. Mem. Soc. Nat. Moscow (2) 10: 248 (near Pekin).

*Rhynchobdella sinensis* Bleeker, P., 1870, Versl. Akad. wet. Amsterdam, 4: 249, fig. 2 (China, in fresh waters) and 252.

*Mastacembelus maculatus?* (nec Cuv. & Val.) Dabry de Thiersant, P., 1872, Pisciculture et Pêche en Chine: 186 pl. XLIV fig. 5, (Yangtse-Kiang), [?Sauvage, H. E. and Dabry de Thiersant, P., 1874, Ann. Sci. nat. Zool. Palaeont., (6) 1 Art. 5 ("Sud de la Chine"). (See note under *M. maculatus*, p. 115 below.)].

*Mastacembelus sinensis*, Günther, A., 1873, Ann. Mag. nat. Hist. (4) 12: 243 (Shanghai); Sauvage, H. E. and Dabry de Thiersant, P., 1874, Ann. Sci. nat. Zool. Palaeont. (6) 1 Art. 5 (China); Kreyenberg, M. and Pappenheim, P., 1908, S.B. Ges. naturf. Fr. Berl. 95 (Fishmarket Hankau) and 1909, Abh. Mus. Nat. -u. Heimatk. Magdeburg, 2: 23 (copied); Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad. (2) 15: 200 (copied); Fowler, H. W. and Bean, B. A., 1920, Proc. U.S. Nat. Mus., 58: 321 (Soochow, China); 1924, Mem. Asia. Soc. Bengal, 6: 519 (Soochow, China) and Bull. Amer. Mus. nat. Hist., 50: 375 (Ningkow, China); Reeves, C. D., 1927, J. Pan-Pacific Res. Inst. 2: 7 (copied); Nichols, J. T., 1928, Bull. Amer. Mus. nat. Hist. 58: 5; 1930-1931, Bull. Peking Nat. Hist., 5: 17; and 1943, Natural History of Central Asia, IX. Fresh water Fishes of China: 30, pl. ii fig. 2 (Ningpo and Shanghai; Tungtin Lake, Hunan, Anhwei; Kiangsi; Shantung).

*Mastacembelus kobayashii* Oshima, M., 1926, Dobuts. Zasshi, Tokyo, 38: 194 (Formosa).

*Mastacembelus aculeatus*, Rendahl, H., 1927, Zool. Anz. Leipzig, 71: 175; and 1928, Ark. Zool., (1) 20A: 187; Wu, H. W., 1931, Bull. Mus. Hist. nat. Paris, (2) 3: 438 (Hang-Tchou, Tsien-Tang River); Mori, T., 1936, Studies on the Geographical distribution of fresh water fishes in Central Asia: 28 and 38 (Hoang-Ho and Pei-Ho Rivers, China); Herre, A. W. C. T. and Liang, S. Y., 1936, Bull. Chekiang Prov. Fish. Expt. Sta., Ting-hai, 2 No. 7: 4 (Tsien-Tang River System); Liang, S. Y., 1946, J. Arts Sci. Canton, 1: 10 (Tan-Po, China).

*Bdellorhynchus maculatus* (part), Jordan, D. S. and Tanaka, S., 1927, Ann. Carneg. Mus., 17: 391 (Peking, China and Taihoku, Formosa); Reeves, C. D., 1927, J. Pan-Pacific Res. Inst., 2: 7 (copied).

*Zoarchias anguillaris* Mori, T., 1928, Jap. J. Zool., 2: 71 pl. fig. 3 (Tsien-nan, China).

*Rhynchobdella aculeata?* (nec Bloch) Mori, T., 1952, Mem. Hyogo Univ. Agri., 1: 185 (Fusan, Korea).

D XXXI-XXXV 54-72; A III 45-70; P 22-23; C 8-9.

Scales present between and around eye and posterior nostril and extending from the latter to the maxilla. Top of snout, internasal space, interorbital space and top of head, as far as hind edge of the preoperculum naked. No spines on the preoperculum. One

strong preorbital spine piercing the skin in all the specimens. Gape of mouth extending to below the eye (3 specimens) or below the posterior nostrils (3) or intermediately (3). Teeth sharp, well developed, in bands in both jaws. No gill rakers.

Spinous dorsal originating above posterior third of pectoral fin; last dorsal spine not hidden beneath the skin. Anal spines 3. First and second close together, third larger than the first and at a distance from the others; soft anal originating slightly in advance of soft dorsal.

Vent nearer to base of caudal than to snout. Caudal completely united with dorsal and anal fins.

Proportions as % of standard length (8 specimens)

Depth of body 6.9 to 11.1, irrespective of length. *Mean*: 8.8.

Length of head: 15.6 to 17.4.

Length of pectoral: 3.7 to 4.2 (6 specimens), irrespective of length of fish.

Proportions as % of length of head (8 specimens)

Length of snout: 28.3 to 33.3.

Diameter of eye: 9.3 to 10.8, negatively allometric throughout the size range examined.

Interorbital space: 4.2 to 5.0. *Mean*: 4.6.

Length of lower jaw: 32.4 to 37.0, showing no correlation with standard length. *Mean*: 35.2.

Length of gape of mouth: 21.1 to 24.0. *Mean*: 22.4.

Colour in spirit brown or pale brown; body sometimes with dark vertical bars, belly and under surface of head with yellowish spots. Vertical fins with bold dark brown reticulations, their outer margins dirty white; pectorals dirty white.

Habitat. Fresh waters of China, Formosa (and Fusan in Korea?).

The type cannot be found (I am indebted to Dr. Boeseman and Dr. Hoedeman for searching the collections of Leiden and Amsterdam for it).

Study Material (21 specimens).

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector
BM (NH) 1873.7.30.56	166.0 and 183.0	Shanghai, China	Purchased of Swinhoe
" 1883.3.23.60-62	115.0, 146.0 and 160.0	Kiukiang, China	Styan
" 1895.5.31.13	196.0	Shanghai, China	Styan
" 1895.5.31.14	Skeleton	Shanghai, China	Styan
" 1927.1.5.9 and 1927.10.1.19	117.5 and 2nd damaged	Nanking, China	Ping
Mus. Paris 5230	1855.3.27.20	176.5	Fortune's Collection
" 5021	2 specimens	Chikiang, China	David
" 7851	1 specimen	China	Dabry de Thiersant
" 5022	1 specimen	China	Dabry de Thiersant
" 7490	1 specimen	China	Dabry de Thiersant
" 7358	1 specimen (damaged)	China	David
" 5573	4 specimens	China	Dabry de Thiersant
			David

### Notes on the synonymy

(1) Oshima (1926) while describing *M. kobayashii* from Formosa was probably ignorant of the occurrence of *M. sinensis* Blkr. on the Chinese mainland. In the comparison of his specimens with other Mastacembelids, he does not mention *M. sinensis*, to which in fact his specimens belonged.

(2) Rendahl (1927) maintained that *Ophidium aculeatum* Basilewsky was the first name available for this species, but it falls in the synonymy on one of two counts. Basilewsky may have misidentified his species with *Ophidium aculeatum* Bloch (= *Macrognathus aculeatus*); he does not however mention Bloch in this connection and was probably proposing it as a new name. In this case it falls out as a homonym of *O. aculeatum* Bloch.

(3) Mori (1928) figures an unmistakable *M. sinensis* Blkr., placing it in the Blennioid genus *Zoarchias* Jordan and Snyder; his fin ray counts ("D XXXIII, 45 (?); A III, 38 (?); C about 18") need not be taken too seriously.

(4) Mori (1952) records the occurrence of *Rhynchobdella aculeata* Basilewsky in Fusan, Korea, and refers to *Ophidium aculeatum* Basilewsky (= *M. sinensis* Blkr.) in his synonymy. Verification of the identity of this fish is desirable.

(5) Jordan and Tanaka (1927), having erroneously proposed a new genus *Bdellorhynchus* for those *Mastacembelus* which lack preopercular spines, placed this species (*M. sinensis* Blkr.), as synonymous with *M. maculatus* C. & V., under the name *Bdellorhynchus maculatus*. *M. maculatus* C. & V. and *M. sinensis* Blkr. are distinct species, distinguished from each other by the following characters:—

#### *M. sinensis* Blkr.

- (1) Dorsal fin XXXI-XXXV 54-72. Last dorsal spine larger than first and not hidden beneath the skin.
- (2) Anal fin III 45-70. First and second anal spines close together, third at a distance, not hidden beneath the skin and larger than the first.
- (3) Spinous dorsal fin originating above the posterior 1/3 of the pectoral fin.
- (4) Gape of mouth more than half length of lower jaw, extending to below the posterior nostrils or beyond.
- (5) No gill rakers.
- (6) Vertical fins with bold brown reticulations and without any basal spots.

#### *M. maculatus* C. and V.

- Dorsal fin XXVI-XXXI 55-70. Last dorsal spine smaller than the first and hidden beneath the skin.
- Anal fin III 58-70. All the anal spines close together, last hidden beneath the skin and smaller than the first.
- Spinous dorsal fin originating on a vertical behind the end of the pectoral fin.
- Gape of mouth less than half length of lower jaw, not extending to below the posterior nostrils.
- Rudimentary gill rakers present on second and third gill arches.
- Vertical fins striated with minute dark brown spots and with large basal spots.

### 2. *Mastacembelus caudiocellatus* Blgr. Fig. 13, Plate 20

Boulenger, G. A., 1893, Ann. Mag. nat. Hist., (6) 12: 199 (Fort Stedman, 3,000 ft.) and 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 ("Iruwaddy" but see note under 'Habitat' below); Annandale, N., 1918, Rec. Indian Mus., 14: 34, 53, pl. 1 fig. 3 (Inle Lake and He-Ho basin, Burma) and 211.

D XXXI-XXXIV 62-66; A III 60-65; P 19-22; C 15-18.

Scales present below eye and posterior nostril and from the latter to the maxilla. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum naked. No spine on the preoperculum. One strong preorbital spine piercing the skin in all the specimens. Gape of mouth not extending to below the posterior nostril. Teeth present, sharp, conical, in bands in both the jaws; teeth of outer row larger than the inner. Rudimentary gill rakers present on the gill arches more distinct on 2nd and 3rd.

Spinous dorsal originating above extremity of pectoral; last spine small hidden beneath the skin. Anal spines close together; last small and inconspicuous; soft anal originating just below soft dorsal.

Vent nearer to base of caudal than to snout. Caudal united with the dorsal and anal only at the base.

**Proportions as % of standard length**

Depth of body: 9.9 to 12.1. Mean: 10.93.

Length of head: 20.0 to 22.3.

Length of pectoral: 3.5 to 3.8.

**Proportions as % of length of head**

Length of snout: 34.6 to 35.1.

Diameter of eye: 9.6 to 10.4.

Interorbital space: 4.3 to 4.7

Length of lower jaw: 34.0 to 34.7.

Length of gape of mouth: 17.0 to 18.1.

**Colour** in spirit brown, becoming yellow on the belly. Two to three blackish streaks along the sides, the upper proceeding from the eye; blackish marbling below these lateral streaks. A series of blackish ocelli with yellowish centres along the side of the tail. Vertical fins and pectorals yellowish, reticulated with black.

**Habitat.** Inle Lake basin, Shan States, Burma. See note under *M. oatesii*.

**Study Material.**

B M (N H) Reg. No.	Standard Length (mm.)	Locality	Collector
1893.6.30.130-132 (Types)	128.5 171.0 219.0	Fort Stedman, Inle Lake	E. W. Oates

**3. *Mastacembelus mastacembelus* (Solander in Russell) Fig. 14, Plate 20**

[*Ophidium*, *Simack*, Walbaum, J. J., 1792, Arctedi Ichthyol., III: 159 (Halepum = Aleppo) (non-binom.).]

*Ophidium Mastacembelus* Solander in Russell, A., 1794 (ed. by Russell, P.), Nat. Hist. Aleppo, 2nd. Ed. vol. II: 209 pl. vi<sup>1</sup> (Aleppo, R. Kowick); Shaw, G., 1803, Zoology, IV: 71 (R. Kowick) (spelt *Mastacembalus*).

*Rhynchohædella halepensis* Schneider, J., 1801, Blochii Syst. Ichthyol.: 480 (Halepī = Aleppo).

*Mastacembelus halepensis* Cuvier, G. and Valenciennes, A., 1831, Hist. Nat. Poissons, VIII: 454 (R. Couaic nr. Aleppo); Heckel, J., 1843, Russelger's Reise, II, pl. xix fig. 3; Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 (Tigris and Euphrates); Hora, S. L. and Misra, K. S., 1943, J. Asiat. Soc. Bengal., (3) 9: 1 & 2, text fig. 1 (Iraq).

*Mastacembelus syriacus* Gray, J. E., 1854, Gronovius Syst. Cat. Fish., :172.

*Mastacembelus aleppensis* (part.) Günther, A., 1861, Cat. Fish., III: 541 (Tigris and Euphrates).

*Mastacembelus simack*, Berg, L. S., 1949, Trav. Zool. Inst. Moscow, 8: 855 (copied).

<sup>1</sup>. See Wheeler, A. C. *supra* p. 91.

D XXXI-XXXV 70-90; A III 72-90; P 20-22; C 16-19.

Scales present around lower half-circumference of eye, below posterior nostril and between the latter and the maxilla; space between posterior nostril and eye, top of snout, internasal and interorbital spaces and top of head as far as hind edge of preoperculum naked. No spines on preoperculum. One strong preorbital spine piercing the skin (11 specimens) or not pungent (3 specimens). Gape of mouth to below posterior nostrils (12 specimens) or anterior border of eye (2). Teeth in broad bands in both jaws, the outer larger and sharp. No gill-rakers.

Spinous dorsal originating above posterior third of the pectoral fin; last dorsal spine small, hidden beneath the skin. Anal spines close together, second largest, last small and hidden beneath the skin. Soft anal originating slightly in advance of soft dorsal.

**Proportions as % of standard length**

Depth of body: 7.1 to 10.5, irrespective of length; *Mean*: 8.4.

Length of head: 15.8 to 20.0, negatively allometric with S.L.

Length of pectoral: 4.1 to 4.8, irrespective of length of fish.

**Proportions as % of length of head**

Length of snout: 34.2 to 38.4.

Diameter of eye: 6.1 to 13.0, negatively allometric throughout the size range examined.

Interorbital space: 3.0 to 4.0, isometric. *Mean*: 3.4.

Length of lower jaw: 32.3 to 39.3, isometric. *Mean*: 36.0.

Length of gape of mouth: 16.4 to 25.5.

Colour in spirit pale brown, becoming darker on the back. Dusky blotches or bars along the entire length of the body, sometimes confluent into reticulate patterns. The higher ventral surface sprinkled with yellowish spots. Vertical fins yellowish; dorsal and caudal striated with minute dusky bars, while the anal is less striated and has a few bars and spots which may be confluent with the bars of the body. Pectorals yellowish and barred with rows of minute dusky spots.

**Habitat.** Tigris and Euphrates, Shatt-el-arab, Fao and R. Kowick.

**Study Material (15 specimens).**

BM (NH) Regd. No.	Standard Length (mm)	Locality	Collector or other source
1955.6.25.4-6 (Types) (newly reg. from old colln.)	289.5 356 544	Aleppo	A. Russell
1874.4.28.10	353	Tigris near Bagdad	Colvill
1875.1.14.7	584	Sharpey Tigris	
1891.6.19.3	304.5	Fao, Persian Gulf	W. D. Cumming
1892.9.1.25	Skeleton	Fao, Persian Gulf	W. D. Cumming
1920.3.3.297-300	237 250 267.5 292	Basra	C. Christy
1912.5.2.8	314.5	Shatt-el-arab	N. Kinnear
1920.3.5.7.	105	Basra	Bombay Natural History Society
1922.3.25.1	433.5	Bagdad	Presented by Sir P. Cox
1936.3.10.4	441	Nasiriyah, Euphrates	— Kennedy

## Notes on the synonyms

Berg has considered *Ophidium simack* Walbaum to be the first available name for this species. Walbaum has, however, explained his principles of nomenclature in his Pars II (1789) and by his own criterion this name was not intended to parallel the binomina which he quotes from the works of others. Since it has not been in general use there is no need to make an exception in its favour.

I should have been glad to retain the well-used *haleppensis*, but there seems to be no question of the validity of the name published by P. Russell in 1794, and its tautonymy with the generic name makes it acceptable for the type species of the genus. The name *haleppensis* has not been so much used in general or applied zoology that the present change will cause confusion in wider circles.

4. *Mastacembelus maculatus* Cuv. & Val. Figs. 15, 16, Plates 20, 21

Cuvier, G. and Valenciennes, A., 1831, Hist. Nat. Poissons, VIII: 461 (Moluccas); Valenciennes, A., 1841<sup>1</sup> Régne Anim. Illustr., Poiss.: 128, pl. IV, fig. 1 (Moluccas); Bleeker, P., 1850, Verh. Batavia. Genoot., 23: 3 (Moluccas) and 1852, Natuurk. Tijdschr. Ned. Ind., 3: 93 (Moluccas, Blitong, Java and Sumatra); Günther, A., 1861, Cat. Fish. III: 543 (copied); Martens, E. Von., 1876, Preuss. Exped. O.-Asien, Zool., 1 pt. 2: 304 and 396 (Seminis, Borneo); Vaillant, L., 1893, Nouv. Arch. Mus. Paris, (3) 5: 43 (West and South Borneo; Sunda Is.); Weber, M., 1894, Zoolog. Ergebn. Reise Niederr. Ost-Indien, 3: 415 (Buitenzorg, Java and Kajutamam, Sumatra); Volz, W., 1903, Zool. Jahrb. Syst., 19: 378 (Sumatra); Volz, W., 1904, Rev. Suisse Zool., 12: 461 (Sumatra); Id., 1907, Natuurk. Tijdschr. Ned. Ind., 66: 135 [Malacea, Billiton, Java (copied); Kajutamam, Solok, Pajakumbuh, Palembang, Deli, Langkat (Sumatra)]; Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 [Java, Blitong (copied), Borneo and Sumatra]; Fowler, H. W. and Bean, B. A., 1927, Bull. U.S. Nat. Mus., 71: 2 (Kipahiang); Herre, A. W. C. T., 1940, Bull. Raffles Mus., 16: 55 [Mandai Rd., Singapore; Kota Tinggi, Johore; Pahang, Selangor (Malay Peninsula); and Sarawak]; Tweedie, M. W. F., 1940, Bull. Raffles Mus., 16: 77 (R. Benus, Pahang; Sadong, R., Sarawak); Suvatti, C., 1950, Fauna Thailand: 206 (copied).

*Mastacembelus maculatus* var. *chrysogaster* Bleeker, P., 1852, Natuurk. Tijdschr. Ned. Ind., 3: 93 [Java (Buitenzorg, Tjiparnas) and Sumatra (Pajacombo, Solok)].

*Mastacembelus maculatus* var. *dictyogaster* Bleeker, P., loc. cit. (Blitong = Billiton).

*Macrogastthus maculatus*, Bleeker, P., 1865, Ned. Tijdschr. Dierk., 2: 174 (Siam).

*Rhynchobdella maculata*, Bleeker, P., 1870, Versl. Akad. Wet. Amsterdam, (2) 4: 250.

*Pararhynchobdella maculata*, Bleeker, P., 1874, Versl. Akad. Wet. Amsterdam, (2) 8: 368.

*Mastacembelus guentheri* (Günther Day), Vaillant, L., 1893, t.c.: 106 (Kina Balu, Borneo); Herre, A. W. C. T., 1940, loc. (Mandai Rd., Singapore, Selangor and Patani).

*Mastacembelus vaillanti* Fowler, H. W., 1905, Proc. Acad. nat. Sci. Philad., 57: 491, fig. 8 (Borneo).

*Mastacembelus maculatus*, Regan, C. T., 1920, J. F. M. S. Mus., 8: 309, Korinchi (2,450 ft.) and Sungai Penoh (3,600 ft.), Korinchi Valley, Sumatra (erroneo pro *Mastacembelus*).

*Bdellorhynchus maculatus* (part), Jordan, D. S. and Tanaka, S., 1927, Ann. Carneg. Mus., 17: 391 (Blitong, Java, Sumatra, Moluccas).

*Mastacembelus billitonensis* Beaufort, L. F. de, 1939, Treubia, 17: 194 (Billiton and Wai Lima, Lampung Distr., Sumatra).

*Mastacembelus maculatus*, Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 63 (copied).

D XXVI-XXXI 55-70; A III 58-70; P 20-24; C 11-16.

Vertebrae: abdominal 31-33 (23 specimens); caudal 45-47 (4); total 76-79 (4).

Scales present between eye and posterior nostril; in some specimens both posterior nostril and eye surrounded by scales on all sides, in others scales present only on lower half of circumference of eye and of posterior nostril and extending from the latter to the maxilla. Top of snout, internasal space, interorbital space and top of the head as far

1. This, according to Sherborn, 1922 (Ann. Mag. nat. Hist. (9) 10: 555) is the probable date of publication of the part containing p. 128.

as hind edge of preoperculum naked.<sup>1</sup> Edge of preoperculum smooth or with two spines. One strong preorbital spine piercing the skin in all the specimens. Gape of mouth not extending to below the posterior nostril. Teeth present in broad bands on both jaws, comparatively smaller on the upper jaw and sharp and conical on the lower. Rudimentary gill-rakers present on 2nd and 3rd gill-arches. 14-17 scales between origin of soft dorsal and lateral line. Spinous dorsal originating on a vertical behind end of pectoral fin; last spine small and hidden beneath the skin. Anal spines close together, second largest, last small; soft anal originating in advance of soft dorsal.

Vent nearer to base of caudal than to snout. Caudal united with dorsal and anal.

**Proportions as % of standard length**

Depth of body: 7.2 to 12.8, irrespective of length. *Mean*: 10.3.

Length of head: 14.4 to 20.2, less than 20 in specimens over 100 mm. S.L.

Length of pectoral: 3.4 to 5.3, irrespective of length of fish.

**Proportions as % of length of head**

Length of snout: 32.7 to 45.0.

Diameter of eye: 7.5 to 13.1, negatively allometric throughout the size range examined.

Interorbital space: 4.1 to 5.8. *Mean*: 4.3.

Length of lower jaw: 25.9 to 33.0. *Mean*: 28.9.

Length of gape of mouth: 9.7 to 14.7 (15.4 in the smallest specimen.).

**Colour** in spirit light or dark brown. Under surface of the head with or without reticulations enclosing pale spots. Upper side of head darker with or without a more or less straight band from the eye to the hind edge of preoperculum. Trunk and tail in some specimens marked with dark broad transverse oblique bands narrowing towards the belly, sometimes fusing dorsally to form either cloudy markings or a bold reticulate pattern, ventrally either ending in bifurcations or anastomosing with neighbouring bands and encircling the belly. In others trunk and tail without transverse bands and belly immaculate or marked with reticulations enclosing pale spots. Vertical fins with dirty white or pale margins; either with brown basal spots, and fin usually striated with series of minute brown spots, more distinct in the young, or with the transverse oblique bands of the tail extending on the fins, where they may fuse so that the fins appear to be of a uniform black colour with dirty white margins. Pectorals dirty white or pale with irregular dark vertical bands.

Pale spots enclosed in reticulations on the belly occur in specimens from Malaya, Sumatra and Borneo. Bands across the belly are present in the types and two specimens from Sumatra of "*M. billitonensis*", also in one specimen of unknown locality from Bleeker's collection. Specimens of uniform dark brown colour, paler on the belly are from Malaya and Borneo.

**Habitat.** Moluccas, Blitong (Billiton), Java, Sumatra, Borneo, Siam and Malay Peninsula.

**Types** in the Paris Museum. Type of *M. vaillanti* (not seen) in the Wistar Institute of Anatomy, Philadelphia. Types of *M. billitonensis* in the Amsterdam Museum.

<sup>1</sup>. *Pace* Boulenger 1912; see note under *M. guentheri*, p. 124.

## Study Material (53 specimens).

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector or other source
Mus. Paris 5378 (Types)	190 and 195	Moluques (Moluccas)	Reinwardt
BM (NH) 1880.4.21.170	260	—	Bleeker
" 1889.11.12.8	147	—	Moesch
" 1892.9.2.56-58	127.5 and 227 (3rd specimen damaged)	Deli, Sumatra	Everett
" 1893.3.6.156-7	♀ 206 and ♂ 263	Tagora R., Sumatra	
" 1893.3.6.158-160	♂ 136, ♀ 155, ♂ 198	Merabah, North Borneo	Everett
" 1893.3.6.161	Skeleton	Senah, Sarawak	Everett
" 1904.7.2.9	196	Senah, Sarawak	Everett
" 1908.13.15-16	127 and 206	Sarawak	C. J. Brooks
" 1915.8.24.17-18	54 and 117 (3rd specimen damaged)	Sumatra	W. Morton
" 1915.8.24.19	212	Sungei Penoh, Sumatra	Robinson Kloss Expedition
" 1931.8.21.59-60	88 and 129.5	Lake Korinchi, Sumatra	Robinson Kloss Expedition
" 1931.8.21.61	92	Terachi, East of Seremban, Negri Sembilan	Birtwistle
" 1955.6.22.5-6	105, 130	River Mertang, Negri Sembilan	
Raffles Museum	95, 97.5, 100, 117, 145	Kuala Tahan, Pahang (George V National Park)	Raffles Mus.
BM (NH) 1955.6.22.3-4	87, 127	R. Ketil, Kelantan	"
Raffles Museum	160	Jalong, Perak	"
BM (NH) 1955.6.22.2	♂ 158	R. Condor, Kelantan	"
Raffles Museum	133	" "	"
BM (NH) 1955.6.22.7-9	61, 71, 86		
" 1955.6.22.10-11	about 70 (Alizarin preparations)		
Raffles Museum	70, 71.5, 72, 75, 80		
	230		
BM (NH) 1955.6.22.1	♀ 187	Kota Tinggi, Johore	"
Raffles Museum	116	Billiton	F. J. Kuiper 1937
Amsterdam Museum (paratype of <i>M. billitonensis</i> )	225.5	" "	
" " (as <i>M. billitonensis</i> )	75, 195 and 209.5	Wai Lima, Lampung Distr., Sumatra	Karney 15.XII 1921

I have seen in the Paris Museum 11 specimens collected by David and Dabry de Thiersant, and Professor Bertin tells me that they are the only *Mastacembelus* from these collectors. They are all labelled *M. sinensis*, and I have confirmed the correctness of these determinations. There is thus no evidence to support the record by Dabry de Thiersant (1872) and by Sauvage and Dabry de Tiersant (1874) (see p. 108) of the existence in China of *M. maculatus*.

While I was engaged in synthesising the data regarding this species Prof. de Beaufort, after granting me permission to have a figure of a paratype of *M. billitonensis* made for publication, kindly informed me that he considered his species to be identical with Bleeker's *M. maculatus* var. *dictyogaster* ("ventro fusco reticulata"), also from Billiton. In comparing the paratype with specimens of *M. maculatus* from other localities, I find the characteristic conspicuous belly markings in only one specimen, B.M. (N.H.) 1880. 4.21.170, from Bleeker's collection, locality unknown. Similar markings, but not identical, with less contrast and with the dark oblique bands narrower, not anastomosing ventrally, are found in the two Sumatran specimens assigned by Prof. de

Beaufort to *M. billitonensis*. Some of the specimens from Borneo, Malaya and Sumatra, have pale rounded spots surrounded by dark reticulation on the belly, but only "*M. billitonensis*" and the specimen of unknown locality (perhaps also from Billiton?) have the pattern described by de Beaufort and probably also by Bleeker (*dictyogaster*). The finding of this pattern in Billiton after an interval of 87 years suggests that it may be characteristic of this island. I am unwilling, however, to give it a subspecific name for three reasons, (1) the Billiton population cannot be considered to be thoroughly known from two samples described, (2) in Sumatra, Borneo and Malaya the colour pattern is so variable that it cannot be said to characterise the population of either region and (3) the two types of *M. maculatus* are the only described specimens from the Moluccas and although in Valenciennes' time the lower part of the head and the chest were white and brown streaks were described only on the sides (c.f. Bleeker's var. *chrysogaster*), it is not known what range of colour pattern may be found in those islands.

#### The presence or absence of preopercular spines

(Note by E. Trewavas and S. M. K. Sufi)

Although the number of preopercular spines is variable in those species which possess them, their presence or absence elsewhere characterises any one species. In including in this species specimens with and without such spines we reverse the decision of some previous authors.

Vaillant (1893) recorded from Borneo a damaged *Mastacembelus* which he determined as *M. guentheri*. The snout was destroyed, so that he could not know to what extent it was scaled, but he distinguished it from *M. maculatus* because it had preopercular spines. Boulenger considered it to be *M. maculatus* and so labelled two Bornean specimens registered in 1893, although they too have spines on the preoperculum.

Herre (1940), followed by Tweedie, determined some Malayan specimens as *M. guentheri*, although they differed from typical *M. guentheri* in having a naked snout. From one locality (Mandai Road, Singapore) Herre recorded both this "*M. guentheri*" and *M. maculatus*. The British Museum has Bornean specimens both with and without preopercular spines, but otherwise resembling each other so closely that it is difficult to believe that they are not conspecific. The two with spines (1893.3.6.156-7) are male and female, and the Bornean specimens with smooth preopercles also include both sexes, so this cannot be a secondary sexual character.

*M. maculatus* and *M. guentheri* are evidently closely related, and the decision as to the nature of the relationship and the position of the dividing line between them cannot be finally made on the material available and by a museum study. It would seem arbitrary to decide that the squamation of the snout is a character more reliable than the presence or absence of preopercular spines, but the decision accords with geographical distribution. Moreover it derives some support from the colour-markings. A similar basic colour pattern is found in at least some specimens of both *M. guentheri* and *M. maculatus*, but the pale lateral-line is accompanied by black spots or bars only in specimens here recognised as *M. guentheri*, that is, those from Malabar and Travancore and that said to be from Assam (see p. 124).

On p. 123 is described the enlarged genital papilla of a ripe female *M. guentheri*. The Bornean female with preopercular spines (1893.3.6.157) also has an enlarged papilla, but it is not triangular like that of the Travancore female. We do not stress this difference, however, as it may be associated with the more advanced condition of the ova of the Travancore fish.

5. *Mastacembelus perakensis* Herre & Myers. Fig. 17, Plate 21

Herre, A. W. C. T. and Myers, G. S., 1937, Bull. Raffles Mus., 13: 74 pl. vii (Bukit Merah Reservoir, Krian Distr., Perak and Singapore Island).  
"DXXIX 60, A III 58".

"Snout entirely scaleless, both above and on the sides. No trace of preorbital or preopercular spines." "Mouth not nearly extending to below nostril."

Spinous dorsal (pl. vii) originating on a vertical just at the end of pectoral fin, last spine small "somewhat detached, and almost concealed." "Anal spines close together, the second one largest and the third very small and inconspicuous." Soft anal (pl. vii) originating in advance of soft dorsal.

Vent nearer to base of caudal than to snout. "Dorsal completely confluent with the rounded caudal." "Anal continuous with the caudal but with an inconspicuous notch at the junction."

## Proportions as % of standard length

Depth of body: 11.3.

Length of head: 17.0.

Length of pectoral: 4.2.

## Proportions as % of length of head

Length of snout: 41.6.

Diameter of eye: 8.3.

Colour "in alcohol bluish slate, becoming marbled with yellow on lower and posterior parts. Dorsal and anal fins yellow with diagonal bands, the margins whitish."

Length of type (including caudal fin and rostrum) 151 mm.; S.L. 141 mm.

Habitat. Perak (Bukit Merah Reservoir, Krian Distr.) and Singapore.

Type in Stanford University Museum, California; paratype in U.S. National Museum, Washington, D.C.

This species is evidently very closely related to *M. maculatus* C. & V., specimens of which have also been taken in Perak. In its body proportions, fin formula, absence of preopercular spine, positions of origin of soft and spinous dorsals, it resembles *M. maculatus*. It differs from all my specimens of that species in the absence of a preorbital spine, but in some species (e.g. *M. mastacembelus*, *H. armatus* and *M. erythraenia*) this spine is variable, either pungent or hidden beneath the skin. In describing it as distinct from *M. maculatus* it is possible that the authors were influenced by Boulenger's attribution of a wholly scaled snout to that species. However, as I have not examined the type, I reserve my decision and describe it here as a doubtful species. My description is entirely based on that of the holotype by Herre and Myers (1937).

6. *Mastacembelus keithi* Herre. Fig. 18, Plate 21

Herre, A. W. C. T., 1940, Bull. Raffles Mus. 16: 24 pl. xix (Segaliud R., Kibili R., Southern end of Sandakan Bay and Gum Gum River, Sandakan Distr., British North Borneo).

DXXVI-XXVII 56-58; A III 48-60; P 26; C 16.

Scales present on each side between and around the eye and posterior nostril, and extending from the latter to the maxilla. Top of the snout, internasal space, interorbital space, and top of the head as far as the hind edge of the preoperculum naked. Two spines present on the preoperculum. One strong preorbital spine piercing the skin. Gape of mouth not extending to below the posterior nostrils. Bands of small teeth present in both jaws. No gill-rakers.

Scales very small 22 (Herre) to 25 (B.M. paratype) between origin of dorsal and lateral line.

Spinous dorsal originating on a vertical behind the end of the pectoral fin; last spine small and hidden beneath the skin. Anal spines close together, last small and inconspicuous; soft anal originating just below the soft dorsal. Vent nearer to base of caudal than to snout. Caudal fin distinct but united at the base with dorsal and anal.

Proportions of a paratype (132 mm.) in the British Museum and, in [ ], of the type (191 mm.) and another paratype (125 mm.) as given by Herre.

as % of standard length

Depth of body: 14.7 [13.6].

Length of head: 22.5 [20].

Length of pectoral fin: 6.1 [6.3].

as % of length of head

Length of snout: 40.3 [39.1 from the figure].

Diameter of eye: 10.0 [9.2-10.0].

Interorbital space: 4.0.

Length of lower jaw: 30.2.

Length of gape of mouth: 12.2.

**Colour** "in alcohol is dusky brown, with narrow vertical cross bars of very pale reddish brown or whitish, which divide the ground colour into 20 or more dusky cross bars, wider than the pale bands, and descending to the abdominal region and anal fin. Scattered over the side and particularly abundant below the lateral line are white dots or circular spots; a black stripe extends from the rostral tip across the eye to the angle of the opercle, and usually backwards on the trunk for a distance nearly equal to the head. The dark bands on the body extend upward, to form a row of dusky spots on the dorsal base; on the anal base is a row of white or clear spots. The soft dorsal and caudal are barred with dusky lines; the anal is dark brown, with a white margin. There is a dusky cross bar on the pectoral base." (Herre 1940).

The paratype in the British Museum is similar, but the dark marks on the dorsal fin may be opposite either the dark or the pale bars on the body, and the ground colour of the belly and lower part of the caudal region is paler than in the figure of the type (reproduced here). There is a small dark spot near the upper end of the pectoral base, on the axillary surface, instead of a cross bar. The lateral line is indicated by a thin white line, broken on the posterior half of the trunk.

**Habitat.** Gum Gum River, Sandakan Distr.; Segaliud River and Kibili River (British North Borneo).

**Type** and paratype in the Natural History Museum of Stanford University, California, U.S.A. A paratype in the British Museum.

#### Study Material.

BM (NH) Reg. No.	Standard Length (mm.)	Locality	Collector
1938.12.1.267 (paratype) ..	132.0 .. ..	Segaliud River, British North Borneo	Herre, Oriental Expedition, 1936-37

<sup>1</sup>. The ratios given by Herre, equivalent to 31.5 to 32.3 respectively, are for the snout without rostral appendage. This also explains his smaller head/S.L. ratio.

This species is well distinguished from *M. maculatus*, including specimens with preopercular spines, and from *M. guentheri* and *M. circumcinctus* by the very small scales and the large head.

7. *Mastacembelus circumcinctus* Hora. Fig. 19a, b, Plate 21

Hora, S. L., 1924, Mem. Asiat. Soc. Bengal, 6: 475, Text fig. 3 (Patelung River, Tale Sap, Siam); Fowler, H. W., 1934, Proc. Acad. nat. Sci. Philad., 86: 146 (Chanthabun); Suvatti, C., 1936, Index Fish. Siam: 20 (Nong O, Canthaburi; Pong Raet Waterfall, Canthaburi; Khlong Nakhon Noi, Pen, Siam; Thale Noi, Pen, Siam; Thale Sap Songkhla; Khlong Ranot); Beaufort, L. F. de, 1939, Treubia, 17: 195; Suvatti, C., 1950, Faun. Thailand: 206 (copied).

*Mastacembelus circumcinctus*, Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 65 (Tale Noi and Klong Nakon Noi in the town of Nakon Sritamarat).

*Mastacembelus taeniagaster*, Fowler, H. W., 1935, Proc. Acad. nat. Sci. Philad., 87: 136, fig. 97-101 (Chanthabun, South East Siam); Suvatti, C., 1950, Faun. Thailand: 206 (copied).

*Mastacembelus taeniagaster*, Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 66 (copied).

D XXVI-XXIX 46? - 57<sup>1</sup>; A III 41-57; C 12-13; P 18-22.

Scales present between and around eye and posterior nostril, and extending from the latter to gape of mouth. Top of snout, interorbital space, internasal space and top of head, as far as hind edge of preoperculum naked. Two or three spines on preoperculum. One preorbital spine piercing the skin. Gape of mouth not extending to below the posterior nostril. Teeth present in bands in both jaws. No gill rakers.

Spinous dorsal originating above posterior third of pectoral fin, last spine small and hidden beneath the skin. Anal spines close together, second largest, last small; soft anal originating slightly in advance of the soft dorsal.

Vent nearer to base of caudal than to snout. Caudal fin completely united with dorsal and anal.

Measurements and proportions of the specimens examined

		Paratype of <i>M. taeniagaster</i>	Malayan specimen	Type of <i>M.</i> <i>circumcinctus</i>
Standard length mm.	..	81.5	89.5	156.5
Depth of body mm.	..	10.0	10.5	22.5
Depth of body % S.L.	..	12.2	11.7	14.3
Length of head mm.	..	17.5	19.5	29.5
Length of head % S.L.	..	21.4	21.7	18.8
Length of pectoral mm.	..	5.25	5.5	8.0
Length of pectoral % S.L.	..	6.4	6.1	5.1
Length of snout mm.	..	7.0	8.0	12.5
Length of snout % H.	..	41.0	41.0	42.3
Diam. of eye mm.	..	2.0	2.0	2.5
Diam. of eye % H.	..	11.4	10.2	8.4
Interorbital w. mm.	..	0.75	0.75	1.5
Interorbital w. % H.	..	4.2	3.8	5.0
Length of lower jaw mm.	..	5.25	6.0	9.0
Length of lower jaw % H.	..	30.0	30.7	30.5
Length of gape mm.	..	2.0	2.5	4.0
Length of gape % H.	..	11.4	12.8	13.5

<sup>1</sup>. 50 in the Malayan specimen here recorded, 57 in the paratype of *M. taeniagaster* now in the British Museum (radiographed). The range given by Fowler did not include anything above 48, and the numbers recorded by Fowler in the type and other paratypes may also prove to be too low. The type of *M. circumcinctus* is slightly damaged and I cannot confirm or deny the count of 46 given by Hora.

Colour in spirit: back and sides brown or greenish brown with darker brown or greenish brown markings; ventral surface yellowish or whitish. A dark bar across the interorbital. A dark band crossing the eye extends forwards to some distance on the side of snout; posteriorly this band may extend to the base of the pectoral, where it loses its identity. Above and parallel to this band a very narrow whitish streak usually originating behind the eye runs backwards, either reaching to above the anal fin or stopping just short of it; along the greater part of its length it is broken into long narrow dots. Under surface of the head with narrow, dark cross-bars variously broken, but usually more or less complete, one of them radiating from the eye. Trunk and tail marked with dark vertical or slightly oblique bands, broader above and narrowing downwards. The bands on the trunk completely encircle the belly, while those of tail either reach the edge of the anal fin or stop just short of the edge, or join the blackish brown streak on the anal fin a little below the middle of the fin depth.

Dorsal and caudal fins pale with short wavy oblique dark bars. Base of the dorsal with dark spots which are continuations of the body bands. Pectoral fin pale, with dark transverse bars.

**Habitat.** Siam and Kuala Brang, Trengganu (Malaya). This is the first record of this fish from Malaya; hitherto it was known only from Siam.

**Type of *M. circumcinctus*** in the Indian Museum. Types of *M. taeniagaster* in the Philadelphia Academy; a paratype in BM (NH).

#### Study Material.

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector
BM (NH) 1955.8.24.1 (Acad. Nat. Sci. Philad., No. 59859) Paratype of <i>M. taeniagaster</i> Indian Museum F10342/1 Type of <i>M. circumcinctus</i>	81.5 ..	Chantabun, South east Siam	R. M. de Schauensee
..	156.5 ..	Near mouth of Pate-lung River in the inner portion of Tale-Sap (Siam)	N. Annandale
BM (NH) 1955.6.22.12	89.5 ..	Kuala Brang, Trengganu (Malaya)	M. W. F. Tweedie

The range of variation in colour pattern shown in Fowler's drawings of *M. taeniagaster* needs very little extension to include the type of *M. circumcinctus*; and since the specimens of both "species" examined by me agree in every other respect I follow de Beaufort (1939) in regarding the former as a synonym of the latter.

#### 8. *Mastacembelus pancalus* (Ham. Buch). Fig. 20, Plate 22

*Macrognathus pancalus* Hamilton Buchanan, 1822, Fish. Ganges: 30 and 364 pl. XXII fig. 7 (tanks in Bengal).

*Mastacembelus pancalus*, Cuvier, G. & Valenciennes, A., 1831, Hist. Nat. Poissons, VIII: 455; Bleeker, P., 1853, Verh. batavia Genoot., 25: 98 [Calcutta in R. Hoogly and Chilianwallah, Jihlum [(= Chillianwala, Jhelum)]; Günther, A., 1861, Cat. Fish., III: 541 (freshwaters of Bengal); Day, F., 1876, Fish. India, 34 pl. LXXII fig. 4 (Deltas of large rivers of India and localities near sea; Hurdwar, near where Ganges debouches from Himalayas; Jubbulpore; not south of R. Kistna) and 1889, Faun. Brit. India, II: 333; Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad. (2) 15: 199 (Ganges and lower Kistna); Jenkins, J. T., 1907, Rec. Indian Mus., 3: 287 (Sur Lake or Sar Lake, Orissa); Sundara Raj, B., 1916, Rec. Indian Mus., 12: 251 and 290 (Madras and Cooum); Prashad, B., and Mukerji, D. D., 1930, J. Bombay nat. Hist. Soc., 34: 165 and 169

(Mancher Lake, Sind); Hora, S. L., 1936, Rec. Indian Mus., 38: 1 (Chitaldrug Distr., Mysore); Shaw, G. E. and Shebbeare, O. E., J. Asiatic Soc. Bengal (3) 3: 126 (text fig. 128 (Streams of Terai and Duars, Northern Bengal); Misra, K. S., 1938, Rec. Indian Mus., 40: 257 (Nallamalai Hills; streamlet at Mahanadi (alt. 800 ft.); Acharya, H. G., 1939, J. Bombay nat. Hist. Soc., 40: 772 (Sabarmati River and tank near Ahmedabad); Hora, S. L., 1940, Rec. Indian Mus., 42: 369 (Mahanadi River at Rudri and Dhamtari Bazaar, C.P.) and 370; Job, T. J., 1941, Rec. Indian Mus., 43: 121, text figs. 1 to 5; Hora, S. L. and Naur, K. K., 1941, Rec. Indian Mus., 43: 367 (Timarni Nullah on Timarni Road, S. of Harda, Satpura Range, Hoshangabad Distr.); Hora, S. L., 1942, Rec. Indian Mus., 44: 198 ("Northern India generally; its records South of Kistna are few"); Rahimullah, M., 1944, J. Bombay nat. Hist. Soc., 45: 76 (Rivers Manjra, Haldi and Aleru, Distr. Medak, Hyderabad State); Setna, S. V. and Kulkarni, C., 1946, J. Bombay nat. Hist. Soc., 46: 129 (Ahmedabad); Chauhan, B. S., 1947, Rec. Indian Mus., 45: 271-276 (Patna State); Rahimullah, M. & Mahmood, S., 1947, J. Bombay nat. Hist. Soc., 47: 109 (Nizamabad Distr., Hyderabad State); Sinha, B. M., & Shiromany, P. A., 1953, Rec. Indian Mus., 51: 63 (Kalinadi, Meerut); Chauhan, B. S., & Ramakrishna, G., 1953, Rec. Indian Mus., 51: 397 & 416 [Patna State (copied)].

*Mastacembelus punctatus* Cuvier, G., & Valenciennes, A., 1831, Hist. Nat. Poissons, VIII: 463 (Brackish ponds, Calcutta).

D XXIV-XXVI 30-42; A III 31-46; P 17-19; C 11-13. (An 87 mm. Ganges specimen has D XXV 24, A III 29.).

Snout entirely scaly both above and on sides; behind this top of head naked as far as hind edge of preoperculum. Two to five spines on the preoperculum. One strong preorbital spine piercing the skin in all the specimens. Gape of the mouth not extending to below the nostrils. Teeth present in both the jaws, small and spread in bands. No gill rakers.

Spinous dorsal originating above the middle of the pectoral fin, last spine small and not hidden beneath the skin. Anal spines close together, last spine small and not hidden beneath the skin, soft anal originating in advance of the soft dorsal.

Vent nearer to the base of caudal than to snout. Caudal fin distinctly separated from the dorsal and anal.

#### Proportions as % of standard length

Depth of body: 10.7 to 15.6, irrespective of length. *Mean*: 13.4.

Length of head: 18.5 to 25.3.

Length of pectoral: 6.0 to 7.3, irrespective of length of fish.

#### Proportions as % of length of head

Length of snout: 39.6 to 43.8.

Diameter of eye: 7.9 to 13.0, negatively allometric throughout the size range examined.

Interorbital space: 5.0 to 6.0, isometric. *Mean*: 5.5.

Length of lower jaw: 28.9 to 32.6, isometric. *Mean*: 30.9.

Length of gape of mouth: 9.4 to 11.2.

**Colour** in spirit brown, darker along the back and yellowish on the belly. Sides covered with round white spots and sometimes striped with dark brown vertical stripes; the latter may sometimes be confined to the posterior half of the body. In some specimens the stripes join together forming a net-work. Soft dorsal, anal, caudal and pectoral yellow with numerous minute black spots.

**Habitat.** India and Pakistan south of Himalayas.

**Types.** Three specimens in the British Museum, reg. no. 1858.8.15.80, were stated by Günther to be the types of this species. Hora (1929, p. 176) however, gives reasons

for believing that the collection presented by G. R. Waterhouse, at one time curator of the museum of the Zoological Society of London, did not contain any of Buchanan-Hamilton's collection; in fact there is much evidence that Buchanan-Hamilton preserved no collection. It would, however, be convenient to establish as neotypes the specimens that have so long been regarded as types, and this I intend to ask the International Commission on Zoological Nomenclature to sanction.

### Study Material.

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector
BM (NH) 1848.8.22.59-65 (bleached and damaged) ..	85, 108, 119, 138 ..	India ..	Stevens
BM (NH) 1855.12.26.604 ..	120 ..	Ganges ..	McClelland
1858.8.15.80 (regarded by Günther as types; here proposed as neotypes; see above) ..	99, 99, 120 ..	Ganges ..	G. R. Waterhouse
BM (NH) 1858.8.13.128 ..	103 ..	India ..	G. R. Waterhouse
1860.3.19.933-935 ..	78.5 ..	Calcutta ..	Von Schlagintweit Collection
(Two specimens. One damaged) ..			
BM (NH) 1860.3.19.116-117 ..	119.5 and 168 ..	Bengal ..	Tyler
" 1889.2.1.3642-3643 ..	103 and 128 ..	Kistna ..	F. Day
" 1889.2.1.3644 ..	141 ..	Jubbulpore ..	F. Day
" 1889.2.1.3645 ..	88 ..	Debroughar, Assam ..	F. Day
" 1889.2.1.3641 ..	121 ..	Nepal ..	F. Day
" 1934.10.17.109 ..	87 ..	Allahabad, Ganges ..	F. Day
" 1935.10.18.71 ..	138.5 ..	River Moosi, Hyderabad ..	Das
Zoological Survey, Pakistan ..	83 ..	Village Bubak Distr. Dadu, Sind, Pakistan ..	Dr. A. R. Ranjha
Z. S. Pakistan ..	88.5 ..	Sakrand Dhand Sakrand Distr., Sind, Pakistan ..	Sohrab Ali
Z. S. Pakistan ..	39.5, 50, 94 ..	Makli Lake Distr. Tatta, Sind Pakistan ..	S. M. K. Sufi
Z. S. Pakistan ..	110, 114, 123, 147, 169.5 ..	East Bengal, Pakistan ..	Dr. Nazir Ahmed
Z. S. Pakistan ..	96, 106, 107, 115 and 122 ..	Pond near Char Matiari Village Distr. Pabna, east Bengal, Pakistan ..	Sohrab Ali
Indian Museum, Cat. 386 ..	119 ..	Calcutta Bazar ..	—
Indian Museum, F128271/1 ..	122 ..	Slow streamlets at Mohanadi, Nallamalai Hills, India ..	—
Indian Museum, F12026/1 ..	113 ..	Ahmedabad ..	Prof. J. J. Asana
Indian Museum, F4588/1 ..	71.5 ..	Jawawari River ..	
Indian Museum F13158/1 (Slightly damaged) ..	102 ..	Saran, Distr. Bihar India ..	
Indian Museum F26181/1 ..	119 ..	Mahanadi R. Rudri, C.P. ..	
Indian Museum Cat. 385 ..	119 ..	Salt Lake, Puri Distr. Orissa ..	
Indian Museum ..	111, 112, 113, 115, 117, 121, 125, 126, 129, 130 ..	Orissa ..	
		Pond near Rly. Stn. at Ulubaria, Howrah Distr. West Bengal ..	A. K. Dutta

9. *Mastacembelus guentheri* Day. Fig. 21, Plate 22

*Mastacembelus guentheri* Day, F., 1865, Proc. Zool. Soc. London.: 37 (Malabar); 1865, Fish. Malabar: 154, pl. xi (Trichoor, Malabar); 1876, Fish. India: 341, pl. Ixxiii fig. 3 (Malabar Coast) and 1889, Faun. Brit. India II: 334 (copied); Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 [Malabar Coast (copied)]; Pillay, R. S. N., 1929, J. Bombay nat. Hist. Soc., 33: 376 (Travancore); John, C. C., 1936, J. Bombay nat. Hist. Soc., 38: 707 and 715 (marshy canals and rivers of Travancore); Hora, S. L. & Law, N. C., 1941, Rec. Indian Mus., 43: 239 (Travancore) and 240; Silas, E. G., 1949, J. Bombay nat. Hist. Soc., 48: 793 (pools and running water of Kalikayam Stream, Travancore) and 795 (Alleppey Canals).

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

Scales present between and around eye and posterior nostril and extending from the latter to the maxilla. Top of snout, interorbital and internasal spaces scaly, and only top of head behind orbit to hind edge of preoperculum naked [four specimens, including the two types in the B.M. (N.H.)]; or internasal and interorbital spaces scaly, with naked regions in front and behind [one specimen, B.M. (N.H.) 1912.7.20.27]. Two or three spines on the preoperculum. One strong preorbital spine piercing the skin. Gape of mouth not extending to below the posterior nostril. Teeth present in bands in both jaws.

Spinous dorsal fin originating on a vertical behind the end of pectoral fin, last spine small and hidden beneath the skin. Anal spines close together, second largest, last small. Soft anal originating slightly in advance of the soft dorsal.

Genital papilla large in ripe female.<sup>1</sup> Vent nearer to base of caudal than to snout. Caudal completely united with dorsal and anal, sometimes with a slight notch apparent in the adult.

## Proportions as % of standard length

Depth of body: 10.8 to 11.3 in three of 141-185 mm. S.L., 9.1 in a young and dessicated specimen, 13.3 in a ripe ♀ of 247 mm.

Length of head: 16.0 to 18.3, negatively allometric with S.L.

Length of pectoral fin: 4.2 to 5.0 (4 specimens only).

## Proportions as % of length of head

Length of snout: 39.5 to 42.

Diameter of eye: 8 to 9 (10 in the 109 mm. specimen).

Interorbital space: 4 to 5.

Length of lower jaw: 29.3 to 30.5.

Length of gape of mouth: 12 to 12.5.

**Colour** in spirit, light or dark brown, yellowish on the belly, some black bands radiate from the dorsal surface of the snout and cross the under surface of the jaws. A light narrow streak originating just above the eye passes along the upper edge of the lateral line to the base of the caudal. In all specimens examined by me (but not in Day's figure), along this streak are scattered a number of black spots or short, narrow black bars. Short oblique bars or marbling may exist on the body, and are continued on the vertical fins. Pectorals light brown usually marked with oblique bars.

<sup>1</sup>. The only ripe female examined is one of 247 mm. S.L., in which the genital papilla is triangular, with a base of 6 mm. and a length of 9 mm. The eggs are about 1.5 mm. in diameter.

**Habitat:** Malabar, Travancore, Assam?

**Types in the British Museum.**

**Study Material.**

Museum and Reg. No.		Standard Length (mm.)	Locality	Collector or Other Source
BM (NH) 1865.7.17.26-27	(Syn- types)	141.25 and 150	Malabar	F. Day
BM (NH) 1865.7.17.18	..	185	..	F. Day
..	1889.2.1.3633	109	..	F. Day
..	1912.7.20.27	1247	..	F. Day
Mus. Paris, 4576	..	198, 209 and 257	Travancore	Trevandrum Mus.
..	5349	212, 220 and 257	Alipey (Alleppey), Dussumier	Dussumier

Six specimens, Nos. 4576 and 5349 in the Paris Museum, collected by Dussumier at Alipey (Alleppey) were wrongly labelled "*M. maculatus* C. & V. (Type)."

Vaillant recorded a Bornean specimen as *M. guentheri*. The whole of the front part of the head was destroyed, but Vaillant assigned it to *M. guentheri* on its fin formula and the presence of preopercular spines, the latter differentiating it from *M. maculatus*. Boulenger, however, placed it with *M. maculatus* and it is under this heading that I discuss it (p. 116).

I do not here accept any records from Malaya and Borneo as referring to typical *M. guentheri*.

The small specimen (1889.2.1.3633) registered in the British Museum as one of three determined as *M. armatus* from Assam was part of a large collection from various localities received from Day. It has the fin-formula, scaly snout, armed head and colour-pattern of *M. guentheri*. The two true *armatus* registered with it are larger and differently preserved, and this specimen and its label are therefore poor evidence for the occurrence of the species in Assam.

**10. Mastacembelus zebrinus** Blyth, Fig. 22, Plate 22

Blyth, E., 1859, J. Asiatic Soc. Bengal, 28: 281 (Maulmein); Günther, A., 1861, Cat. Fish., III: 541 (copied); Day, F., 1876, Fish. India: 339, pl. IXXII fig. 3 (fresh waters of Burma—Irrawaddi, far above Ava) and 1889, Faun. Brit. India, Fish. II: 333 fig. 111 (copied); Vinciguerra, D., 1882, Ann. Mus. Stor. nat. Genova, 18: 653 (Irrawaddi) and 1890 (2) 9: 178 (Rangoon and Mandalay); Jenkins, J. T., 1910, Rec. Indian Mus. 5: 138 (Mandalay); Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 199 (Irrawaddy); Hora, S. L., and Mukerji, D. D., 1936, Rec. Indian Mus., 38: 18 (Rangoon); Fowler, H. W., 1939, Notul. nat. Philad., 17: 10 (Rangoon).

D XXVIII-XXXI 49-55; A III 51-59; P 17-19; C 17-19.

Snout entirely scaly, scales present in the internasal space, interorbital space and between the eyes and posterior nostrils. Top of the head as far as the hind edge of the preoperculum naked. Two to four spines on the preoperculum. One strong preorbital spine piercing the skin in all the specimens. Gape of mouth not extending to below the posterior nostrils. Teeth in bands in both jaws. No gill rakers.

Spinous dorsal 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.

Scales small, 21-23 between origin of soft dorsal and lateral line.

Vent nearer to base of caudal than to snout. Caudal free from the dorsal and anal fins.

In one of the 17 specimens from the Sittang River the caudal is confluent with dorsal and anal, but, it appears that at some stage the caudal fin was broken and has been imperfectly regenerated, so that the confluence is not normal.

**Proportions as % of standard length**

Depth of body: 10.9 to 14.3. *Mean*: 12.4.

Length of head: 17.5 to 20.1.

Length of pectoral fin: 6.2 to 7.6.

**Proportions as % of length of head**

Length of snout: 38.2 to 41.7.

Diameter of eye: 7.6 to 11.1.

Interorbital space: 4.0 to 5.0. *Mean*: 4.5.

Length of lower jaw: 29.0 to 31.3. *Mean*: 30.1.

Length of gape of mouth: 9.1 to 11.8.

**Colour** in spirit brown, darker along the back and paler on the belly. Body with dark brown vertical bars, edged with yellowish, sometimes alternating with broader yellowish bars. In the caudal region the bars may be forked or curved, or (one specimen, asymmetrically) interrupted by one to four yellow-ringed dark spots. 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.

**Habitat.** Rivers Irawaddy (Rangoon to Mandalay), Sittang and Salween (Moulmein), Burma.

**Type** unknown, probably non-existent.

**Study Material.**

BM (NH) Reg. No.	Standard Length (mm.)	Locality	Collector
1870.6.14.42	170.0	Rangoon	F. Day
1889.2.1.3646	123.0	Burma	F. Day
1891.11.30.115-123	169.0 to 240.0 (17 specimens)	Sittang R.	E. W. Oates
1891.11.30.124	Skeleton	Sittang R. Mandalay	E. W. Oates

**11. *Mastacembelus oatesii* Blgr. Fig. 23, Plate 22**

Boulenger, G. A., 1893, Ann. Mag. nat. His., (6) 12: 199 (Fort Stedman, Inlé Lake) and 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 ("Irawaddy", but see below); Annandale, N., 1918, Rec. Indian Mus., 14: 34 and 54 pl. 1 fig. 2 (Inlé Lake) and 211; Prashad, B. and Mukerji, D. D., 1929, Rec. Indian Mus. 31: 169 (copied).

D XXIX-XXXIV 48-55; A III 46-55; P 23-24; C 21 (caudal rays counted in one specimen only).

Scales 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. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum naked. Three or four spines on the preoperculum. One strong preorbital spine piercing the skin (all the specimens). Gape of mouth not extending to below the posterior nostrils. Teeth in bands in both jaws, the first row being composed of larger teeth. No gill-rakers.

Scales small, 21-25 between origin of soft dorsal and lateral line. Spinous dorsal originating above middle of pectoral, last dorsal spine small and hidden beneath the skin. Anal spines close together, the second largest, the last small and inconspicuous; soft anal originating in advance of the soft dorsal.

Vent nearer to base of caudal than to snout. Caudal united with dorsal and anal only at the base.

**Proportions as % of standard length**

Depth of body: 9.6 to 10.3. *Mean*: 10.0.

Length of head: 15.4 to 16.2.

Length of pectoral: 5.0 to 5.5.

**Proportions as % of length of head**

Length of snout: 39.8 to 42.1.

Diameter of eye: 8.1 to 8.5.

Interorbital space: 4.5 to 4.7. *Mean*: 4.6.

Length of lower jaw: 33.3 to 34.1. *Mean*: 33.7.

Length of gape of mouth: 12.9 to 16.4.

**Colour.** The types are uniformly pale brown. Annandale (1918) records that "Fully adult individuals are of an almost uniform dark greenish colour, but 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), while the sides of the head are ornamented with alternate dark and pale horizontal lines and bars. The caudal fin at this stage is black with a broad white vertical bar; the ventral fins are pale with a dark edge and the pectorals are almost wholly pale."

**Habitat.** Inlé Lake basin, Shan States, Burma.

**Size.** Attain a length of 370 mm. (Annandale).

Annandale (1918) referring to this species and *M. caudiocellatus* writes, "Dr. Boulenger's statement that they occur in the Irawaddi is due, as he informs me, to a misapprehension." The Inlé Lake is a high mountain basin, fed by a stream from a higher basin, the Hé-Ho, now, or at the time when Annandale saw it, dry. Annandale was not certain whether Oates' specimens came from Inlé Lake itself or from the affluent stream. He therefore describes these species as endemic to the Inlé and Hé-Ho basins.

**Study Material.**

BM (NH) Reg. No.	Standard Length (mm.)	Locality	Collector
1893.6.30.113-118 (Types)	258.5, 266.5, 274.5, 275.0 (One specimen is damaged)	Fort Stedman, Inlé Lake	E. W. Oates

This species may be related to *M. zebrinus*; however, it can be distinguished from the latter by its relatively larger gape of mouth, smaller pectoral with more rays, by its colour pattern and naked snout.

12. *Mastacembelus alboguttatus* Blgr. Fig. 24, Plate 23

Boulenger, G. A., 1893, Ann. Mag. nat. Hist. (6) 12: 200 and 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 (Sittang River, Burma).

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

Scales present between and around eye and posterior nostril, and extending from the latter to gape of mouth. Top of the snout, internasal space, interorbital space and top of the head as far as the hind edge of preoperculum naked. Three or four spines on the preoperculum. One strong preorbital spine piercing the skin in all the specimens. Gape of mouth small and not extending to below the posterior nostrils. Sharp teeth in bands in both the jaws. No gill-rakers.

Spinous dorsal fin originating above middle of pectoral; last dorsal spine small and hidden beneath the skin. Anal spines close together, second largest, last small and hidden beneath the skin.

Vent nearer to base of caudal than to snout. Caudal completely united with dorsal and anal fins.

## Proportions as % of standard length

Depth of body: 9.9 to 11.0.

Length of head: 15.8 to 17.2.

Length of pectoral: 6.0 to 6.9.

## Proportions as % of length of head

Length of snout: 43.7 to 45.2.

Diameter of eye: 6.4 to 7.7.

Interorbital space: 4.4 to 4.7.

Length of lower jaw: 31.4 to 33.0.

Length of gape of mouth: 12.2 to 13.4.

Colour in spirit body brown, darker along the back, lighter underneath. The body with vertical and pectoral fins marked with roundish white spots. In three type specimens out of four examined large blackish blotches are scattered on the body and in the fourth they seem to be absent.

Habitat. Sittang River, Burma.

## Study Material.

BM (NH) Reg. No.	Standard Length (mm.)	Locality	Collector
1891.11.30.135-138 (Types) ..	367.5, 379.0, 396.0, 493.5	Sittang River, Burma	E. W. Oates

This species is well differentiated from *M. armatus* and other species with high numbers of fin rays by its long snout and very small mouth.

13. *Mastacembelus unicolor* (Kuhl & Van Hasselt) Cuv. & Val. Fig. 25, Plate 23

Cuvier, G. & Valenciennes, A., 1831, Hist. Nat. Poissons, VIII: 453 (Java); Bleeker, P., 1850, Verh. Batavia, Genoot., 23: 3 and 5 (Batavia, Sarang, Surakarta, Modjokerto, Surabaya); Günther, A., 1861, Cat. Fish., III: 543 (copied); Day, F., 1876, Fish. India, 1: 339 pl. Ixxii fig. 2 (Rangoon and Burma to Java); Day, F., 1889, Faun. Brit. India, II: 332 (copied); Vinciguerra, D., 1890, Ann. Mus. Stor. nat. Genova, (2) 9: 179 (Mandalay); Vaillant, L., 1893, Nouv. Arch. Mus. Paris, (3) 5: 43 (South Borneo).

Sunda Is.) and :108 (Kapoas, Borneo); Weber, M., 1894, Zool. Ergebn. Nied. Ost-Indien, 3: 415 (L. Singkarah, stream near Solok, Sumatra; Buitenzorg, Garut, Java); Reuvens, C. L., 1895, Notes Leyden Mus., 16: 176 (R. Brantas, Java); Volz, W., 1903, Zool. Jahrb. Syst., 19: 378 (Bingin, Telok, R. Rawas trib. of Musi (Sumatra); Volz, W., 1904, Rev. Suisse Zool., 12: 461 (Laut Tador, Upper Langkat, Wampu and Selapian Rivers in Sumatra); Fowler, H. W., 1904, J. Acad. nat. Sci. Philad., (2) 15: 501, pl. viii upper fig., (Batu Sangkar in Padangsche Bovenland, Sumatra); Fowler, H. W., 1905, Proc. Acad. nat. Sci. Philad., 57: 489 (Borneo); Volz, W., 1907, Nat. Tijds. Ned. Ind., 66: 135 (Malacca, Borneo, Java and the foll. Sumatran localities: Singkarek, Solok, L. Manindjau, Pajakumbuh, Siboga, Padang, Palembang, Lahat, Rivers Rawas, Indragiri, Deli, Langkat); Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 [Banka, Borneo and Java (copied), Sumatra.] Machan, B., 1930, Ann. naturh. Mus. Wien, 44: 439 (Padang).

?*Mastacembelus unicolor* var., Weber, M., 1894, Zool. Ergebn. Nied. Ost-Indien, 3: 415 (Buitenzorg, Java).

*Mastacembelus dayi* Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 (Irawaddy).

D XXXII-XXXV 74-94; A III 75-98.

Vertebræ: abdominal 38, caudal 50; total: 88 (Counted in one specimen only). Scales present around eye and posterior nostril, extending from the latter to maxilla and present or absent between eye and posterior nostril. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum naked. In all the specimens examined (by myself and Dr. Junge of Leiden) the preoperculum bears 2 to 4, usually 3, pungent spines, except in one, the largest, 485 mm. in standard length, in which there is only 1 preopercular spine, and this does not pierce the skin. One strong preorbital spine piercing the skin (all specimens examined). Gape of mouth not extending to below posterior nostril. Teeth present in bands in both jaws.

Spinous dorsal originating above posterior half of pectoral fin; last spine small and hidden beneath the skin. Anal spines close together; second largest, last small; soft anal originating just below origin of soft dorsal.

Vent nearer to base of caudal than to snout. Caudal either entirely free from dorsal and anal or united with one or both only at the base or completely confluent with anal and united only at the base with dorsal.

#### Proportions as % of standard length

Depth of body: 9.6 to 12.3. Mean: 11.4.

Length of head: 17.3 to 21.4.

Length of pectoral: 4.8 to 5.4.

#### Proportions as % of length of head

Length of snout: 38.3 to 40.5.

Diameter of eye: 7.4 to 8.6.

Interorbital space: 4.0 to 4.7. Mean: 4.4.

Length of lower jaw: 29.0 to 34.5. Mean: 32.5.

Length of gape of mouth: 16.8 to 18.2. Mean: 17.4.

Colour in spirit light or dark brown, darker along the back and paler on the belly. Sides with or without light brown or blackish spots; belly with or without yellowish oblong spots. Vertical fins light or dark brown with a yellowish or pinkish margin. Pectorals with two brownish or blackish vertical bars and with a yellowish or pinkish margin.

**Habitat.** Burma, Malay Peninsula, Java, Sumatra, Moluccas, Borneo and Banka.

**Type in Paris Museum; paratypes (?) in Leiden Museum.** Type of *M. dayi* figure 2 pl. lxxii of Day (1876).

**Study Material.**

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector or other source
Mus. Paris No. 5693 (Type)	138	Java	Kuhl V. Hasselt
BM (NH) 1862.2.4.16	343	—	Purchased of Franks
" 1880.4.21.171	287	—	Bleeker's collection
" 1889.11.12.53	315	Deli, Sumatra	Moesch
" 1922.5.19.121	284	River Tembeling, Malaya	Kloss
" 1932.5.19.32	205	Telom River, Pahang Malaya	Coll. Holloway Pres. Vernay
" 1955.6.22.24	485	Malaya	Raffles Museum
Mus. Amsterdam	174	Batang, Sumatra	March, 1914

Dr. G. C. A. Junge has also given me some valuable information about the following specimens in the Rijksmuseum at Leiden:—

No. 1354, 2 specimens from Java, Coll. Kuhl and Van Hasselt.

No. 5205, 6 specimens from Java, Coll. Moll (det. Reuvens).

No. 5215, 10 specimens from Malaya, Coll. Bleeker.

Cuvier & Valenciennes attributed the name *M. unicolor* to Kühl and Van Hasselt, stating that the species had been sent by them from Java to the Royal Netherlands Museum, "qui a cédé un échantillon au Cabinet du Roi." I can find no trace of a publication of this name by Kuhl & Van Hasselt and it is always attributed to C. & V. The specimen in the Paris Museum must therefore be considered the type, but those in the Leiden Museum from the same collectors perhaps have the rank of paratypes. It is important therefore to know that all the specimens of Kuhl and Van Hasselt have three spines on the preoperculum. Of the other sixteen *M. unicolor* examined by Dr. Junge at Leiden, 13 have three spines, 2 have two and 1 has four. Seven of the specimens examined by me, ranging from 138 to 343 mm. in standard length, have 3 or 4 preopercular spines, piercing the skin; the eighth, 485 mm. has no pungent preopercular spine; it has been dissected on one side, and this reveals only one spine, hidden beneath the skin.

Boulenger (1912), considering Day's (1876) *M. unicolor* as a distinct species named it *M. dayi*, evidently with Day's figure as type. Boulenger gave no description, but from the positions of *M. unicolor* and *M. dayi* in the synoptic key it is evident that he considered them to differ as follows:—

<i>M. dayi</i>	<i>M. unicolor</i>
Snout entirely scaly.	Snout naked or scaly on the sides.
3 to 5 preopercular spines.	No preopercular spines.
Gape of mouth not extending to below nostril.	Gape of mouth extending to below nostril.
Caudal fin free from dorsal and anal.	Caudal fin embraced by dorsal and anal.

After examining the type of *M. unicolor* in Paris Museum I find Boulenger's description of this species to be incorrect. The type possesses 3 preopercular spines, the gape of the mouth does not extend to the posterior nostrils and the caudal fin is confluent with dorsal and anal only at its base. Further, Day in his account did not mention anything about the scales on the snout, so that Boulenger's placing of *M. dayi* among species in which the snout is entirely scaly is without foundation. I, therefore, reckoning Day's identification of his fish as correct, place Boulenger's *M. dayi* as a synonym of *M. unicolor*.

Boulenger's error is the more surprising since he left as *M. unicolor* the two specimens of unknown locality listed above, as well as the Sumatran specimen so catalogued by himself in 1889. He must have been influenced by the completely free caudal in Day's figure, in contrast to the greater or less union of this fin with the dorsal and anal in the three specimens before him. The variability of this character is discussed on p. 105.

#### 14. *Mastacembelus erythraenia* Blkr. Figs. 27, 28, Plate 24

*Mastacembelus erythraenia* Bleeker, P., 1850, Verh. Batavia Genoot., 23: no. 11: 6 (Bantam, Borneo); Günther, A., 1861, Cat. Fish., III: 542 (Rivers of Borneo); Martens, E. von, 1865, Preuss. Exped. O-Asien, Zool., I: 304 and 396 (Sintang, Borneo); Sauvage, H. E., 1881, Nouv. Arch. Mus. Hist. nat. Paris, (2) 4: 160 (Siam); Vaillant, L., 1893, Nouv. Arch. Mus. Hist. nat. Paris, (3) 5: 43 (West and South Borneo); Volz, W., 1904, Rev. Suisse Zool., 12: 461 [Sungei Mahe, Laut, Tador, Indragiri, Unterlangkat (Sumatra)]; Volz, W., 1907, Natuurk. Tijdschr. Ned.-Ind., 66: 135 [Palembang, Djambi, Indragiri, Batu Bahra, Deli, Langkat (Sumatra); Penang and Borneo]; Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 201 (Malay Peninsula, Sumatra, Borneo); Suvatti, C., 1936, Index Fish. Siam: 21 (Siam); Herre, A. W. C. T., 1940, Bull. Raffles Mus., 16: 55 (Chendroh Dam, Perak and Kuching, Sarawak); Suvatti, C., 1950, Faun. Thailand: 206 (copied).

*Mastacembelus argus* Günther, A., 1861, Cat. Fish., III: 542 (freshwaters of Siam); 1864, Mouhot, Travels in Indochina (Siam), Cambodia and Laos, II Appendix: 179 (Siam and Cambodia); Peters, W. C. H., 1868, Mber. Preuss. Akad. Wiss., Berlin, 263 (Siam); Martens, E. von, 1876, Preuss. Exped. O-Asien, Zool., I: 210 and 396, pl. X fig. 4 (Bangkok and Petshaburi, Siam); Sauvage, H. E., 1881, Nouv. Arch. Mus. Hist. nat. Paris, (2) 4: 160 (Saigon, Siam); Sauvage, H. E., 1883, Bull. Soc. philom., Paris, (7) 7: 151 (Meenam); Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 201 (Siam); Hora, S. L., 1924, Mem. Asiatic Soc. Bengal, 6: 475 (Patelung River in the inner Lake of the Tale Sap); Chevey, P., 1929, Notes Inst. oceanogr. Indochine, 6: 171 and 1934, 7: 185 (Indochina, record only); Fowler, H. W., 1935, Proc. Acad. nat. Sci. Philad., 87: 134, figs. 93-96 (Bangkok); Suvatti, C., 1936, Index Fish. Siam: 20 (copied); Fowler, H. W., 1936, Proc. Acad. nat. Sci. Philad., 91: 47 (Krabi); Chevey, P. and Poulaire, F. L., 1940, Mem. Inst. oceanogr. Indochine, 5: 22 (Cambodge); Suvatti, C., 1950, Faun. Thailand: 206 (copied).

*Macrogynathus erythraenia* Bleeker, P., 1865, Ned. Tijdschr. Dierk., 2: 34 (Siam) and :174 (Siam).

*Macrogynathus argus* Bleeker, P., 1865, Ned. Tijdschr. Dierk., 2: 34 (Siam) and :174 (Siam).

*Mastacembelus argus* Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 64 (copied).

*Mastacembelus erythraenia* Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 66 (copied).

D XXXII-XXXVIII 70-80; A III 70-80; C 14-17. (In the type of *M. argus* the tail is damaged; its fin formula therefore, DXXXIII 58 + ?; A III 59 + ?, cannot be completed; another "*M. argus*", BM (NH) 1878.2.14.10, has D XXXIV 75; A III 75; C 14).

Vertebrae: abdominal 37-39, caudal 47-48; total 85-87. (Counted in four specimens only).

Scales present between eye and posterior nostril and from the latter to maxilla. Both eye and posterior nostril may be surrounded by scales or eye may be completely surrounded and posterior nostril on the lower half circumference only. A few scales

may be present in the internasal and interorbital space or not. Top of snout and top of head, as far as hind edge of preoperculum naked. Two to four spines on the preoperculum. One strong preorbital spine either piercing the skin or hidden. Gape of mouth extending to below posterior nostril. Teeth conical, in bands in both jaws.

Spinous dorsal originating above middle of pectoral fin; last spine small and hidden beneath the skin. Anal spines three close together, second largest, last small; soft anal originating below origin of soft dorsal. Vent nearer to base of caudal than to snout. Caudal fin confluent with dorsal and anal.

Colour pattern	S.L. (mm)	Depth "/%S.L.	H "/%S.L.	P "/%S.L.	Sn. "/%H	E "/%H	Int. "/%H	L.J. "/%H	Gape "/%H	Pr. sp.
Typical	658.5	9.5	16.5	5.4	40.2	6.2	5.6	31.1	20.7	h-h
do.	593.0	11.2	17.2	5.2	39.4	6.6	5.4	32.3	19.7	h-h
do.	531.0	10.8	18.7	6.4	41.2	7.0	4.5	29.8	18.8	h-h
do.	494.5	12.7	15.3	4.5	38.4	7.2	5.6	29.4	14.8	?
do.	473.5	10.8	19.0	5.9	42.1	7.2	4.7	30.6	18.9	p-p
do.	461.0	10.8	19.0	4.8	37.3	7.4	4.8	29.5	17.2	p-p
do.	431.0	12.9	17.1	5.3	37.1	7.4	5.4	28.3	16.8	?
do.	420.0	11.9	16.7	4.5	38.4	7.4	5.7	29.4	14.8	?
do.	389.0	11.5	18.2	5.3	37.1	7.7	5.0	30.7	15.5	?
do.	344.5	11.1	19.3	5.3	37.5	7.6	4.5	29.6	17.2	p-p
"Argus"	343.2	11.0	19.8	4.8	38.7	7.7	5.1	30.1	18.3	p-p
Typical	338.0	10.3	18.7	4.7	40.1	7.8	5.5	31.4	17.3	p-p
Intermediate	338.0	11.5	18.6	4.4	41.2	7.9	5.5	31.7	17.4	p-p
Typical	332.5	12.6	21.4	5.0	41.3	7.7	5.7	31.6	18.9	p-p
Intermediate	281.0	12.2	21.1	5.0	40.3	7.5	4.9	29.4	16.8	p-p
"Argus"	245.0	11.0	18.5	5.4	40.6	8.2	4.4	30.7	17.5	p-p
Typical	230.0	10.4	20.0	4.7	40.2	8.6	5.2	28.4	16.3	p-p
"Argus"	213.0	10.3	18.7	5.0	38.7	8.7	4.7	30.9	17.5	p-p
do.	212.5	11.2	21.1	5.1	39.7	8.8	5.3	30.8	17.7	p-p

Table showing proportions of body depth (Depth), length of head (H) and length of pectoral fin (P) as percentages of the standard length (S.L.); and of length of snout (Sn.), diameter of eye (E), interorbital space (Int.), length of lower jaw (L.J.) and gape of mouth (Gape) as percentages of length of head (H); and preorbital spine (Pr. sp.) piercing the skin (p) or hidden (h) on left and right sides; ? signifies skin damaged. By "typical" colour-pattern is meant within the range hitherto described for *M. erythrotaenia*; by "argus" as in type of *M. argus*.

**Colour.** General ground colour brown, paler on the belly and nearly black or dark brown on the back. Head and body with a pattern of red (white and dirty white in preserved specimens) stripes, bars, spots and reticulations which vary individually or even on the left and right side of one fish. The pattern may be analysed as follows:—

- (a) A red marginal band without admixture of melanin, surrounds the vertical fins and includes the dorsal spines and often a narrow area at their base.
- (b) The pectorals are margined with a melanin-free red bar and one or more similar bars or spots may be present on the fin.

- (c) A melanin-free red band above the pectoral extends forwards where it merges either in a bar behind the angle of mouth or in a bar rising obliquely to the eye. Posteriorly the band may extend, continuous or interrupted, to the caudal region to merge in the reticulation there; or at varying distances behind the pectoral it may break, either into horizontal or oblique bars and then into round spots which may extend as a conspicuous series along the lower part of the caudal region to near its end, or simply into roundish spots which lose their identity at a short distance from the caudal fin or may continue as a series of spots at the bases of the vertical fins.
- (d) Below and parallel to this a variously interrupted bar crosses the pectoral base and continues forwards along the lower edge of the lower jaw; behind the pectoral it either soon breaks up and then loses its identity or breaks up into round spots, which continue as a second series below the first (c).
- (e) Below the pectoral a third parallel band extends forwards on to the isthmus; it may be broken into bars and posteriorly it soon breaks up and loses its identity among spots, bars and reticulations.
- (f) A narrow median red bar on the dorsal side of the snout which either loses its identity after proceeding backwards to some distance behind the eye, or unites with the red marginal band surrounding the dorsal spines and vertical fins (a), or forks before the posterior nostril to form a pair of supra-orbital bars which extend backwards to become continuous either with the red band that includes the dorsal spines (a) or one of the dorso-lateral bands [(g) below].
- (g) One to four narrow dorso-lateral bands, duller from admixture of melanin, may be present or not. If present they lie between band (c) and the dorsal spines and continue for varying distance before merging in the posterior reticulations.
- (h) The lower lip is partly red; a red bar runs back from the angle of the mouth joining the band (c) or not; a red mark on the lower edge of the preoperculum may be present or not and if present may extend forwards and backwards; red margins of the gill-covers meet and extend as a median band or series of spots forwards between the rami of the lower jaw.
- (i) In addition to the round spots formed by the breaking of bands, in some fishes there is present a row of melanin-free roundish spots at the base of both dorsal and anal fins.

Although the degree of development of the red pattern is roughly the same on right and left side, the symmetry is not exact, notably in the distribution of the roundish spots at the base of the vertical fins and also when one of the supra-orbital bands joins the band that includes the dorsal spines.

This is one of the few species in which the colours of living specimens have been described, and I have therefore been able to interpret the white markings of spirit specimens as red.

**Habitat.** Malay Peninsula, Sumatra, Borneo, Siam and Cambodia.

The Type appears to be a specimen of 301 mm., one of six numbered 6437, in the Leyden Museum. (I am indebted to Dr. M. Boeseman and Dr. J. J. Hoedeman for coming to this conclusion as a result of searching the collections of Leyden and Amsterdam respectively). Type of *M. argus* in the British Museum.

## Study Material (21 specimens).

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector
BM (NH) 1880.4.21.172	230	—	Bleeker's collection
.. 1889.11.12.7	658.5	Deli, Sumatra	Moesch
.. 1891.1.27.10	389	Baram, Borneo	Hose
.. 1894.1.20.9	473.5	Sarawak, Borneo	Purchased of E. Bartlett
1849.10.9.19 (216 <i>M. "pictus"</i> <sup>1)</sup>	332.5	Borneo	Frank
(" <i>M. giganteus</i> " <sup>1)</sup>	461	Borneo	Frank
.. 1906.7.18.5	593	Kuala Kelantan Malay Peninsula	Gimlette
.. 1879.7.5.1	531	Sarawak, Borneo	Crocker
.. 1859.7.1.46 (type of <i>M. argus</i> )	212.5	Freshwaters of Siam	Mouhot
.. 1878.2.14.10 (" <i>M.</i> <i>argus</i> ")	343	Siam	Newman
Paris Mus. No. 1863 ..	338 and 338	Bangkok	Bocourt
Paris Mus. No. 4571 (" <i>M. argus</i> ")	213	Siam	Castelnau
Paris Mus. No. 4575 (" <i>M. argus</i> ")	320.5 and 397.5	Cambodge	Julien
Paris Mus. No. 4578 ..	245 and 281	Bangkok	Bocourt
Paris Mus. No. 5703 ..	344.5	Sumatra	Bleeker
BM (NH) 1955.6.22.25-26	494 and 420	Chenderoh Lake, Perak	Raffles Mus.
Raffles Museum ..	431	"	"

The fin formulae of specimens assigned to *M. argus* come within the range of *M. erythraenia*. Günther and Boulenger distinguished the two by colour-pattern and presence or absence of preorbital spine. The same elements were present in the colour-pattern in both, except that a series of round spots at the bases of the vertical fins, present in *M. argus*, was not found in *M. erythraenia*. A preorbital spine was said to be present in *M. argus*, absent in *M. erythraenia*.

A glance at the table (p. 131) will show that a preorbital spine is present even in some of the specimens recognised by Boulenger as *M. erythraenia*, while in others it is present but not pungent. The latter are the largest specimens available, suggesting that the skin may close over the spine as the fish grows older.

The "argus" spots were found in only two specimens in the British Museum, the type of *M. argus* and another Siamese specimen. It was therefore with great interest that I examined Siamese specimens assigned to both species in the Paris Museum, including those recorded by Sauvage. From Bangkok there are four specimens (Nos. 1863 and 4578, coll. Bocourt) of which one has the typical *erythraenia* pattern, one the *argus* pattern and two are intermediate and different on right and left sides (see fig. 28). Fowler (1935 figs. 94 and 95) also describes a variable colour-pattern.

This makes it impossible to define the two as species, but it is to be noted that the only specimens with the *argus* pattern so far recorded are from Siam and Cambodia.

1. These names, attached by an unknown person to specimens in the British Museum, were recorded by Günther in listing his material of *M. erythraenia* and thus, although attached to definite specimens, have no status in nomenclature.

15. *Mastacembelus armatus* Lacep. Figs. 29-32, Plates 25, 26

*Macrognathus armatus* Lacepède, C., 1800, Hist. Nat. Poissons, II: 286 (locality unknown); Bleeker, P., 1865, Ned. Tijdschr. Dierk., 2: 174 (Siam).  
*Rhynchobdella polyacantha* Schneider, J., 1801, Blochii Syst. Ichthyol., 479 (Tranquebar).  
*Macrognathus armatus* (excl. syn. *O. simack*), Hamilton Buchanan, 1822, Fish. Ganges: 28, pl. xxxvii, fig. 6 (Rivers of Bengal).  
*Mastacembelus armatus*, Cuvier, G. & Valenciennes, A., 1831, Hist. Nat. Poissons, VIII: 456 pl. ccxl (Bengal); Sykes, W. H., 1841, Trans. zool. Soc. London, 2: 351 (Dukhun = Deccan); Bleeker, P., 1853, Verh. Batavia Genoot, 25: 97 [Calcutta River Hoogly; Chillianwallah, Jihlum (= Chilianwala, Jehlum)]; Günther, A., 1861, Cat. Fish., III: 542 (Chusan (copied); Ceylon, Bengal, Nepal, Siam); Day, F., 1865, Fish. Malabar: 153 (rivers of Malabar and freshwaters of India, Ceylon and China) and 1876, Fish. India: 340, pl. lxxiii fig. 2 (Sind, fresh and brackish waters of plains and hills of India Ceylon and Burma to China); Martens, E. von., 1876, Preuss. Expend. O-Asien, Zool., I pt. 2: 396 (Bangkok); Sauvage, H. E., 1881, Nouv. Arch. Mus. Hist. nat. Paris, (2) 4: 160 (Siam, Ceylon, Bengal, Nepal); Vinciguerra, D., 1882, Ann. Mus. Stor. nat. Genova, 18: 653 (India Ceylon and China (copied) and Irawaddy, Burma); Day, F., 1889, Faun. Brit. India, II: 334; Vinciguerra, D., 1890, Ann. Mus. Stor. nat. Genova, (2) 9: 180 (Mandalay, Bhamo); Volz, W., 1903, Zool. Jb., 19: 380 (Deli, Sumatra) and 1904, Rev. suisse. Zool., 12: 492 (Sumatra) and 1907, Natuurk. Tijdschr. Ned.-Ind., 66: 135 (India, Ceylon, Chusan, Nepal, Malacca, Siam, Java (copied) and Deli, Sumatra); Jenkins, J. T., 1907, Rec. Indian Mus., 3: 287 (Sur Lake or Sur Lake, Orissa); Willey, A., 1910, Spolia Zeylon, 7: 89 (Barave near Hanwella); Duncker, G., 1912, Mitt. naturh. Mus. Hamburg, 29: 256 (Gingangabe, Vakvella, Ceylon); Weber, M., 1912, in Maass, Durch Central Sumatra, II: 20 (Taluk, Sumatra); Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 200 (India, Ceylon, South China to the Malay Peninsula and Sumatra); Zugmayer, E., 1913, Abh. bayer. Akad. Wiss. Math. Phys., 26 pt. 6: 34 (Las Bela, Baluchistan); Sundara Raj, B., 1916, Rec. Indian Mus., 12: 251 and 290 (Madras); Annandale, N., 1919, Rec. Indian Mus., 16: 125 (Yenna at Medha, Satara Distr. Bombay); Hora, S. L., 1923, Mem. Indian Mus., 5: 762 (Patshanipur, Chilka Lake, India) and 769 (India, Ceylon and China (copied)); Nicholas, J. T., 1928, Bull. Amer. Mus. nat. Hist., 58: 5 (copied); Pillay, R. S. N., 1929, J. Bombay nat. Hist. Soc., 33: 376 (Trevandrum); Prashad, B. & Mukerji, D. D., 1929, Rec. Indian Mus., 31: 166, 169 and 213 (Indawgyi Lake, Burma) and 1930, J. Bombay nat. Hist. Soc., 34: 165 and 169 (Manchar Lake, Sind); Deraniyagala, 1932, India, Nepal, Siam, East Indies, China (copied) and Batuluoya, Thabbova väva (N.W.P.), Veyangoda, Gampaha, Hanwella, Colombo, Kelaniya, Badurueliya (W.P.), Mahaoya River near Rambukkana, Levalla, Gammaduva (C.P.), Bibile (E.P.), Vakvalla (S.P.), Nachchikudda (E.P. Ceylon); Mukerji, D. D., 1933, J. Bombay nat. Hist. Soc., 36: 815 (Tributaries of Mali River, Myitkyina Distr., upper Burma) and 1934, J. Bombay nat. Hist. Soc., 37: 76 (Phungin Hka and Tang Hka, Myitkyina Distr., Upper Burma); Hora, S. L. and Mukerji, D. D., 1934, Rec. Indian Mus., 36: 124 and 138 (Gyobya Chaung, Western drainage of Pegu Yomas, Burma); Fowler, H. W., 1934, Proc. Acad. nat. Sci. Philad., 86: 146 (Chieng Mai, Bua Yai, Siam) and 1935, Proc. Acad. nat. Sci. Philad., 87: 134 (Bangkok); Hora, S. L. and Mukerji, D. D., 1936, Rec. Indian Mus., 38: 134 and 145 (India, Ceylon, Burma, China (copied) and Lachhiwall and Satnaraia, Song and Suswa Rivers, Eastern Doons.); John, C. C., 1936, J. Bombay nat. Hist. Soc., 38: 707 and 714 (rivers and canals of Travancore); Mori, T., 1936, Geog. distr. freshwater fish. Eastern Asia: 47 (South China); Suvatti, C., 1936, Index Fish. Siam, 20 (Upper Bangpakong, Mae-nam Cau Phaya, Bangkok and Maenam Cau Phaya at Ko Yai, Siam); Hora, S. L., 1939; Rec. Indian Mus., 39: 7 (Tunga R. at Shimoga, Mysore); 16 (Sagar Rest house and Stream near Kugwe, 4 miles west of Sagar, Shimoga Distr., Mysore); 19 (Cauvery R., Coorg State) and: 339 (Nandhaur and Kalauna R., Outer Himalayan hills below Naini Tal); Shaw, G. E. & Shebbeare, E. O., 1937, J. Asiatic Soc. Bengal, (3) 3: 126 text fig. 127 (Clear streams Terai and Duars, Northern Bengal); Hora, S. L. and Misra, K. S., 1937, J. Bombay nat. Hist. Soc., 39: 516 (Darna R. South of Lahavit Rly. Stn., Deolali); Hora, S. L., 1938, Rec. Indian Mus., 40: 171 and 172 (Santal Parganas); 238 (Stream south of Timinar at the foot of Bailadila Ridge about 1,700 ft. C.P., India) and: 256 (Fish Market, Kodur, alt. 600 ft. and stream near Razampeta, alt. 500 ft., Cuddapah Distr., India); Hora, S. L. and Misra, K. S., 1938, J. Bombay nat. Hist. Soc., 40: 21 (copied); Das, K. N., 1939, Rec. Indian Mus., 41: 438 (Tributary stream of Buraker R., south of Surajpura on Barhi Rd., about 16 miles from Hazari Bagh; Damodar R. near Ramgarh town 32 miles from Hazari Bagh on Ranchi Rd. and stream north of Canary Hill, Hazari Bagh, India); Acharya, H. G., 1939, J. Bombay nat. Hist. Soc., 43: 83 (Sabarmati R. and tanks near Ahmedabad, North Gujarat); Chevey, P. and Poulain, F. L., 1940, Mem. Inst. oceanogr. Indochine, 5: 22 (Cambodge); Hora, S. L., 1940, Rec. Indian Mus., 42: 370 (Mahanadi irrigation Canal, Rudri).

C.P.); Hora, S. L. and Gupta, J. C., 1940, J. Asiatic Soc. Bengal, (3) 6: 80 (Kalimpong Duars and Silguri Terai, Northern Bengal); Herre, A. W. C. T., 1940, Bull. Raffles Mus., 16: 54 (Mawai Distr. Johore, Sahang); Tweedie, M. W. F., 1940, ib.: 77 (Mawai Distr.); Hora, S. L. & Law, N. C., 1941, Rec. Indian Mus., 43: 235 (Kallar Stream, 30 miles N.E. of Trevandrum); 239 (copied) & 240 & 256 (Pool at foot of largest fall of Pruntenaruvi, tributary of Pamba R.; Edakadathy and Achenkovil R., 7 miles S.E. of Konni, Central Travancore); Hora, S. L. and Nair, K. K., 1941, Rec. Indian Mus., 43: 367 (Timarni Nullah on Timarni Rd., south of Harda); 368 (Anjal Nullah and Midkul Nullah ca. 2 miles S.W. of Harda) and 369; Hora, S. L., 1942, Rec. Indian Mus., 44: 198 (copied); Fraser, A. G. L., 1942, J. Bombay nat. Hist. Soc., 43: 83 (stretch about 2 miles east of Fitzgerald Bridge, Poona); 86 (Mula R. near the Ice Factory, Kirkee); 88 (Mula R., Bombay Presidency); Hora, S. L. and Misra, K. S., 1942, J. Bombay nat. Hist. Soc., 43: 219 (copied); Rahimullah, M., 1943, J. Bombay nat. Hist. Soc., 43: 651 (Godavari R. near Nander and Basar) and 653 (Sidhna R. near Bhainsa, Nander Distr. Hyderabad State) and 1943, J. Bombay nat. Hist. Soc., 44: 89 (Himayat Sagar, Osman Sagar, Meer Alam Tank, Hyderabad, Dn.); Nichols, J. T., 1943, Nat. Hist. Central Asia, IX: 29; Rahimullah, M., 1944, J. Bombay nat. Hist. Soc., 45: 73 (Mahboob Sagar, Sangareddy); 74 (Andol and Medak); 75 (Pocharam Reservoir, Medak Distr.) and 76 (Manjra, Haldi and Aleru, R., Medak Distr. Hyderabad State); Setna, S. V. and Kulkarni, C. V., 1946, J. Bombay nat. Hist. Soc., 46: 129 (Ahmedabad); Herre, A. W. C. T., 1946, Spolia zelan., 24: 179 (Peradeniya, Piliandela and Yakvala, Ceylon); Chauhan, B. S., 1947, Rec. Indian Mus., 45: 272 (Maharani Sagar, Balangir, Patna State) and 276 (Kudal Darh, Belgaon, Patna State, Orissa); Mahmood, S. and Rahimullah, M., 1947, J. Bombay nat. Hist. Soc., 47: 109 (Nizamabad Distr.); Kulkarni, C. V., 1947, J. Bombay nat. Hist. Soc., 47: 321 (Powai Lake, 17 miles N.E. of Bombay); Berg, L. S., 1949, Trav. zool. Inst. Moscow, 8: 856 (copied); Menon, A. G. K., 1949, Rec. Indian Mus., 47: 225 (Moola-mootha R., Poona) and J. Bombay nat. Hist. Soc., 48: 540 (Kosi R., Almorah); Hora, S. L., 1949, J. Zool. Soc. India, 1: 2 (Rihand R., U.P. India); Menon, A. G. K., 1950, Rec. Indian Mus., 48: 106 (Isri R., foot of Parasnath hill, ChotaNagpur, India); Mathur, B. B. L., 1951, Rec. Indian Mus., 50: 106 (Phulad R., Rajasthan, India) and 108 (Balaram R., Rajasthan, India); Silas, E. G., 1951, J. Bombay nat. Hist. Soc., 50: 326 (High range of Travancore); 327 and 674 (pools in stream near Vannamadi Bridge, Western Ghats); Sinha, B. M. and Shiromany, P. A., 1953, Rec. Indian Mus., 51: 63 (Kalinadi, Meerut, U.P.); Chauhan, B. S. and Ramakrishna, G., 1953, Rec. Indian Mus., 51: 397 and 416 (Tanks at Balangir, Kudal Darh of the Tei R. at Balangir); Ranade, M. R., 1953, J. Bombay nat. Hist. Soc., 51: 473 (fresh waters of Baroda).

*Mastacembelus ponticerianus* Cuvier, G. and Valenciennes A., 1831, Hist. Nat. Poissons, VIII: 460 (Pondichery); Jerdon, T. C., 1848, Madras J. Lit., 15: 147 (record only).

*Mastacembelus marmoratus* Cuvier, G. and Valenciennes, A., 1831, Hist. Nat. Poissons, VIII: 461 (Mysore); Jacquemont, V., 1844, Voy. Inde. Poissons, pl. xiv fig. 2; Jerdon, T. C., 1848, Madras J. Lit., 15: 147 (Tanks near Bangalore and tributaries of Cauvery).

*Macrognathus caudatus* McClelland, J., 1842, Calcutta J. nat. Hist., 2: 586 (no exact locality, probably Indus valley. See p. 141).

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

*Macrognathus hamiltonii* McClelland, J., 1844, Calcutta J. nat. Hist., 4: 393.

*Macrognathus undulatus* McClelland, J., 1844, Calcutta J. nat. Hist., 4: 393 and 398, pl. xxii, fig. 1 (Chusan).

*Mastacembelus malabaricus* Jerdon, T. C., 1848, Madras J. Lit., 15: 147 (Malabar).

*Mastacembelus aleppensis* (part, specimen d.) Günther, A., 1861, Cat. Fish., III: 543.

*Mastacembelus armatus* var. *armata* Günther, A., 1861, Cat. Fish., III: 543 (Siam, Calcutta, East Indies).

*Mastacembelus armatus* var. *ponticeriana* Günther, A., 1861, Cat. Fish., III: 543 (Ceylon, Nepal, East Indies).

*Mastacembelus caudatus* Boulenger, G. A., 1912, J. Acad. nat. Sci. Philad., (2) 15: 201 [Afghanistan (Oxus?)], but see below, p. 141.]

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

*Mastacembelus armatus* var. *javus* Hora, S. L., 1923, Mem. Asiatic Soc. Bengal, 6: 474, text fig. 2 (Mouth of Patelung R., Tale Sap and Bangkok); Suvatti, C., 1936, Index Fish. Siam, 20 (Khalong Maela, Singburi, Siam) and 1950, Faun. Thailand: 206.

*Mastacembelus armatus undulatus* Nichols, J. T. and Pope, C. H., 1927, Bull. Amer. Mus. nat. Hist., 54: 389, fig. 49 (Nodoa, Hainan);<sup>3</sup> Nichols, J. T., 1928, Bull. Amer. Mus. nat. Hist. 58: 5 (Chusan-Ningpo region, China) and 1943, Nat. Hist. Central Asia, IX: 29, fig. 3 and pl. ii, fig. 3 (Hainan).

*Mastacembelus armatus undulatus* Mori, T., 1936, Geog. distr. fresh water fish. Eastern Asia; 51 (Hainan).

*Mastacembelus favus* Fowler, H. W., 1937, Proc. Acad. nat. Sci. Philad., 89: 222 figs. 204 to 209 (Mepoon, Bangkok).

*Mastacembelus perakensis* (nec Herre and Myers) Herre, A. W. C. T., 1940, Bull. Raffles Mus., 16: 55 (Mawai Distr. of Johore).

*Mastacembelus armatus armatus* Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 63 (Siam or Thailand); Deraniyagala, P. E. P., 1952, Atlas Vertebrate Ceylon, I: 133, pl. xxxiv (Ceylon).

*Mastacembelus armatus favus* Smith, H. M., 1945, Bull. U.S. Nat. Mus., 188: 64 (Tale Sap and upper waters of the Machem, tributary of Meping, Northern Thailand).

*Mastacembelus armatus armatus* Suvatti, C., 1950, Faun. Thailand: 205.

D XXXII-XL 64-92, A III 64-90, C 14-17, P 21-27.

Vertebrae: abdominal 27 to 43; caudal: 49 to 55; total: 86-96 (counted in 22 specimens.).

Scales present between eye and posterior nostril, and either surrounding eye and posterior nostril or present only on their lower sides, and between latter and maxilla. Top of snout, internasal space, interorbital space and top of head as far as hind edge of preoperculum naked. Two to five spines on preoperculum usually conspicuous, but in some specimens one or more may be held down by the skin and barely pungent.<sup>1</sup> One strong preorbital spine usually piercing the skin, but in some hidden beneath the skin on one or both sides.<sup>2</sup> Gape of mouth extending to below posterior nostril or at least to its anterior margin. Sharp teeth in bands in both jaws.

Spinous dorsal 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;<sup>3</sup> soft anal originating in advance of soft dorsal.

Vent nearer to base of caudal than to snout. Caudal smoothly confluent with dorsal and anal or junction with anal or with both marked by a slight notch.

#### Proportions as % of standard length

Depth of body: 7.2 to 12.9.

Length of head: 15.2 to 21.0.

Length of pectoral: 4.0 to 6.3.

#### Proportions as % of length of head

Length of snout: 35.2 to 41.0 (in one specimen 129 mm. in standard length: 32.3).

Diameter of eye: 7.2 to 15.9, allometric.

Interorbital space: 4.0 to 5.2.

Length of lower jaw: 30.0 to 35.9 (in one specimen 329 mm. in S.L. 37.1).

Length of gape of mouth: 16.1 to 20.9 (in one specimen of 129 mm. S.L. 15.6; in another, 329 mm. 21.9).

<sup>1</sup> Dr. E. Trewavas who has examined the types of *M. marmoratus* in the Paris Museum informs me that in one specimen (S.L. 515 mm.), with two preopercular spines, the lower spine is pungent and the upper held down by the skin, and in another (S.L. 486 mm.), also with two preopercular spines, both spines are barely pungent.

<sup>2</sup> Preorbital spine in specimen B.M. (N.H.) 1858.6.15.17-18 and in one of the types of *M. marmoratus*, (S.L. 486 mm.) is pungent on the left side and is hidden beneath the skin on the right; in B.M. (N.H.) 1932.2.20.56, is pungent on the right side, covered by the skin on the left; and in the second syntype of *M. marmoratus* (515 mm.) is hidden on both sides.

<sup>3</sup> According to Nichols and Pope (1927) in *M. armatus undulatus* from Hainan the first anal spine is obscure and the "last anal spine much the larger". Although they give A III the use of 'larger' and not 'largest' suggests that in this statement they were overlooking the small third spine. A large third spine characterises *M. sinensis*, but the other characters of this specimen are those of *M. armatus*.

Colour subject to considerable variation on the same basic pattern. In preserved specimens this consists of a median band (*a*) on the head running from between the eyes to the nape or beyond; two to four lateral bands (*b*, *c*, *d*, *e*) either breaking into spots or taking an undulating course emitting cross bars or anastomosing to form bold reticulation or losing their identity in marblings of darker colour on the body; and one median ventral band (*f*) on the belly. Usually in young specimens the colour pattern is more definite becoming vague with growth, until some of the adult specimens appear to be uniformly dark with a few darker spots along the base of the spinous dorsal.

Deraniyagala (1932) states of this species in Ceylon that the colour is "subject to considerable variation with age and habitat, specimens from flowing water being lighter than those from sedentary waters."

Below are described the variations on this pattern observed in the material examined by me according to locality.

**Sind, Bengal, Assam, Burma, Ceylon, some Malayan specimens**

Body including head is light or dark brown on the back and sides and paler underneath. Bands are blackish or greyish brown. Band (*a*) when present runs from between the eyes to the nape or beyond. Band (*c*) runs from the snout passes through the eye and is either continued backwards in an undulating course emitting cross bars, which join together forming a bold reticulation (Sind, Bengal, Assam and Sittang R. Burma) or breaks into vertical bars which join with spots of the band (*b*) (Sind) or breaks into spots which continue into the tail region, where they lose their identity (Malaya). Band (*b*) anteriorly may fuse with band (*c*) behind the eye or not; posteriorly, in some specimens (Sind, Bengal, Assam and Ceylon), it breaks into a row of spots at the base of spinous and soft dorsal; in some specimens those spots may unite with their counterparts across the back. In other specimens (Sittang R. Burma) band (*b*) breaks into a row of spots, then proceeds as a band to below soft dorsal and again breaks into spots. Band (*d*) when present runs from behind the pectorals emitting cross bars and anastomoses with band (*c*) forming bold reticulations (Bengal, Assam, Sittang R. Burma and Ceylon.) Band (*e*) when present (Sittang R. Burma) runs below the lateral band (*d*) in an undulating course and anastomoses with lateral bands (*c*) and (*d*), forming bold reticulation. A very narrow median ventral band (*f*) (Sind, Bengal, Sittang R.) from the isthmus to the vent may be present or absent.

Vertical fins yellowish (Ceylon), olive or greyish, either barred or spotted or plain; caudal with transverse bars; dorsal usually with large basal spots but in some of the Sittang River specimens the reticulations of the body are continued on to dorsal and anal fins and Deraniyagala's figure shows these fins with a yellow basal band. Pectorals yellowish (Ceylon) or light brown, and spotted.

**Siam ("*M. armatus* var. *favus*". Fig. 30, Plate 25)**

Body marked with bold reticulations of dark brown or black bands enclosing large oval or roundish pale spots. This pattern may extend to the chest and abdomen. Head dark brown on the back and sides, paler underneath. A median frontal dark brown band on the head runs posteriorly to the nape or beyond; anteriorly it meets an interorbital band, forming a (—). A lateral dark brown band runs from the snout through the eye and is lost in the body pattern. In some, the colour pattern of the body may continue on the under surface of the head and on the gill cover; in others only a few faint brown markings are present in this region.

Vertical fins dark brown, the body pattern being continued on them. Pectoral pale with a dark basal spot.

## N.E. Bengal (one specimen), Assam (two) and Malaya (ten specimens)

These are intermediate in pattern between typical *M. armatus* and "*M. armatus* var. *favus*". In them the reticulate pattern does not wholly oust the bands, and the spots outlined by the reticulations are more cloudy, giving less contrast than in var. *favus*.

## Malaya (1955.6.22.15, one specimen. Fig. 32a, Plate 26)

Body dark brown on the sides, paler beneath. Sides above lateral line with a few pale spots and vertical stripes. Below the lateral line a row of roundish pale spots, enclosing dark brown spots, runs from the pectoral and is lost in the tail region. A pale median dorsal band runs from the snout, enclosing spinous dorsal, interrupted in the interorbital space, to base of soft dorsal.

Another light brown band variously broken runs from the base of pectoral losing its identity posteriorly. A median ventral row of spots runs from the isthmus and is lost on the belly. Upper half of the head dark brown, lower half pale. A dark vertical band from the eye to the posterior extremity of the mandible. Interoperculum with a black spot situated below the angle of preoperculum. A dark brown stripe on the ventral surface of the head proceeds forwards and backwards encircling the isthmus.

Vertical fins pale, anal with triangular basal spots. Pectoral with a dark brown basal spot.

## Singapore and Sumatra [three specimens, 1883.11.28.16 (Fig. 31, Plate 26) and 1889.11.12.54]

A wide, median, light brown dorsal band, enclosing the spinous dorsal, runs from the head to the base of soft dorsal. Below this a wide band runs from the head to the base of soft dorsal enclosing pale spots. Yet another band variously broken runs from the pectoral and is lost after proceeding backwards to some distance. Rest of the sides light brown mottled with brown spots. Head brown on the back and sides, ventrally lighter with a few brown spots. A brown vertical band from the eye to the posterior extremity of the mandible.

Vertical fins pale with brown spots or bars. Pectoral pale with brown spot.

## Sumatra (1908.7.13.17, one specimen. Fig. 32b, Plate 26)

Sides to a little below lateral line blackish with a few reddish brown spots and vertical bars, rest of the sides pale with a reddish tinge. A reddish brown, median dorsal band, runs from the tip of snout to the base of soft dorsal, enclosing the spinous dorsal. A blackish lateral band runs from the base of pectoral becoming vague, as it proceeds backwards and is eventually lost in the ground colour. Chest and abdomen pale. Upper half of the head black, lower half pale. A black vertical band from eye to posterior extremity of mandible. Interoperculum with a black spot situated below angle of preoperculum.

Vertical fins pale variously spotted and barred. Pectoral pale with a black basal spot.

**Habitat.** Baluchistan, Pakistan, India, Ceylon, Nepal, Burma, Siam, Cambodia, Tonkin, Hainan Island, Southern China, Malaya, Sumatra, Java.

Type a dried specimen of about 36 cms., no. 5431 in the Paris Museum. Types of *M. ponticerianus* (no. 5375), of *M. marmoratus* (no. 5348) and probably of *M. venosus* also in the Paris Museum. Types of *M. manipurensis* (F. 13630/1) and of *M. armatus* var. *favus* in the collection of the Zoological Survey of India. Type of *M. caudatus* in the British Museum (1860.3.19.918). The types of *M. hamiltonii* and *M. undulatus* do not exist, and neither does that of *M. malabaricus*.

## Study Material.

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector or other Source
BM(NH)1845.1.12 " <i>M. hodgsonii</i> " Kaup	133.5 ..	Nepal ..	B. H. Hodgson
" 1848.8.22.59-60	207 and 224 (Bleach-ed)	India ..	—
" 1848.8.22.65	174.5 (Bleached) ..	India ..	Stevens
" 1853.12.27.7	395 ..	Ceylon ..	Cuming
" 1858.6.15.17-18	56, 63, 92.5, 154, 182.5 ..	Ceylon ..	Cuming
" 1858.5.31.19	206 ..	Ceylon ..	Cuming
" 1858.10.19.107	333 ..	Ceylon ..	Cuming
"	(Skeleton) ..	Ceylon ..	Cuming
" 1859.7.1.47-49	125, 168.5, 172.5 ..	Siam ..	Mouhot
" 1860.3.19.932	212 ..	Calcutta ..	Schlagintweit
" 1860.3.19.918. The 423 mm. specimen is la- belled <i>M. caudatus</i> , (see notes on p. 141)	423 (2nd specimen damaged) ..	—	East India Company
" 1865.4.28.20	212 ..	Siam ..	R. Schomburgk
" 1871.11.16.16	67.5 ..	Ceylon ..	Thwaites
" 1872.4.17.7	233.5 ..	North East Bengal ..	Jerdon
" 1880.2.2.105-106	98 and 121 ..	Dukhun (=Deccan) ..	Sykes
" 1880.10.20.33-35	137 and 141 ..	Nepal ..	J. Scully
" 1883.11.28.16.	429 ..	Singapore ..	Governor of Singa- pore
" 1888.11.6.29	511 ..	East Coast, Madras ..	Thurston
" 1889.2.1.3628-3631	197, 318.5, 375.5 and 498 ..	Calcutta ..	F. Day
" 1889.2.1.3632	214.5 ..	Gowhatta, Assam ..	F. Day
" 1889.2.1.3634-3635	182 and 186.5 ..	Assam ..	F. Day
" 1889.2.1.3636-3638	186, 220 and 232 ..	Ceylon ..	F. Day
" 1889.2.1.3640 " <i>M. ar- matus</i> var. <i>ponticerianus</i> "	170 ..	Madras ..	F. Day
" 1889.11.12.54-55	182 (2nd specimen damaged) ..	Deli, Sumatra ..	Moesch
" 1891.11.30.125-133	420, 452, 465, 468, 470, 480, 481, 522 and 523 ..	Sittang R. Burma ..	F. W. Oates
" 1891.11.30.134	Skeleton ..	Sittang R. Burma ..	E. W. Oates
" 1897.10.8.124-5	107, 158 ..	Upper Bangpakong R. ..	Siamese Mus.
" 1898.11.8.91.92	203.5 and 291 ..	R. Meenam, Bangkok ..	S. S. Flower
" 1908.7.13.17	174.5 ..	Sumatra ..	W. Morton
" 1922.5.19.116-120	107.5, 108, 249, 270 and 298 ..	River Tembling Malay Peninsula ..	Kloss
" 1925.2.19.14	207 ..	Thai Nien, basin of Red River, Tonkin ..	H. Stevens
" 1932.2.20.56	329 ..	Chhanawan, Gujran- wala, Punjab ..	Hamid Khan
" 1934.10.17.110-111	197 and 336.5 ..	Allahabad, Ganges ..	B. K. Das
" 1935.10.18.70	296.5 ..	River Moosi, Hyde- rabad (Dn) ..	B. K. Das
" 1935.10.18.72	129 ..	River Moosi, Hyde- rabad (Dn) ..	B. K. Das
" 1937.9.17.64	305 ..	Bac Kan, Tonkin ..	Paris Museum
" 1867.2.14.22-23	(2 specimens damaged) ..	Poona, Mhou ..	Playfair
" 1867.5.12.1	168 ..	—	R. C. Beaven
" 1858.8.15.87	535 ..	—	Haslar Coll.
" 1863.12.8.82-4	227 and 320.5 ..	Madras ..	Mitchell

1. So recorded by Günther (1861) in the list of material of "*M. armatus* var. *ponticerianus*". Günther gives no reference to a publication by Kaup and I cannot find that Kaup ever published the name. As a name published without "indication" except association with a museum specimen, "*M. hodgsonii*", has no status in nomenclature (Rules of Zool. Nomencl. Art. 25 and Opinion 1).

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector or other Source
BM (NH) 1956.3.2.32	47 ..	Silalpati, Khola, 3,500 ft. Sarda, Nepal	Williams
" 1955.6.22.22-23	159, 161 ..	Jalong, Perak, Malay Peninsula	Raffles Mus.
Raffles Museum ..	150, 156, 185 ..	Jalong, Perak, Malay Peninsula	—
BM (NH) 1955.6.22.13	295.5 ..	River Sapiu, Pahang, Malay Peninsula	Raffles Mus.
" 1955.6.22.14	218.5 ..	Kuala Tahan, Pahang, Malay Peninsula	Raffles Mus.
Raffles Museum ..	257 ..	Kuala Tahan, Pahang, Malay Peninsula	—
" ..	172, 277 ..	Jalong, Perak, Malay Peninsula	—
BM (NH) 1955.6.22.18	226 ..	Kaki Bukit, Perlis, Malay Peninsula	Raffles Mus.
" 1955.6.22.21	162 ..	Baling, Kedah, Malay Peninsula	Raffles Mus.
" 1955.6.22.16-17	195 and 201 ..	Kuala Tahan, Pahang, Malay Peninsula	Raffles Mus.
Raffles Museum ..	148, 198 ..	Kuala Tahan, Pahang, Malay Peninsula	—
BM (NH) 1955.6.22.19-20	117, 178 ..	Kaki Bukit, Perlis, Malay Peninsula	Raffles Mus.
Raffles Museum ..	154 ..	Kaki Bukit, Perlis, Malay Peninsula	—
BM (NH) 1955.6.22.15	82 ..	Kota Tinggi, Johore	Raffles Mus.
Raffles Museum ..	251 ..	Mandalay	—
BM (NH) 1956.3.6.1	184 ..	Comilla, East Bengal, Pakistan	Dr. N. Ahmed (Nov. 1954)
Zoological Survey Pakistan ..	196, 196.5, 252.5, 483 (and one specimen damaged)	Ponds about 1½ miles from Bubak Dak Banglow, Distr. Dadu, Sind, Pakistan	Misbah and Azhar (Nov. 1950)
Zoological Survey Pakistan ..	86 and 115 ..	Dhund Rawat Khan, about 3 miles from Dak Banglow, K. N. Sha, Distr. Dadu, Sind, Pakistan	S. M. K. Sufi (Dec. 1950)
Zoological Survey Pakistan ..	484 ..	Backwater pool off canal bed, 1½ fur- longs from I. B., Bano Distr., Dadu, Sind, Pakistan	M. Qutubuddin (April 1954)
Zoological Survey Pakistan ..	195, 215, 227, 282 and 289 ..	Backwater pool off canal bed, 1½ miles N.E. of I.B., Daro Distr. Dadu, Sind, Pakistan	M. Qutubuddin (April 1954)
Zoological Survey Pakistan ..	175, 204 and 291 ..	Kinjer Lake, Distr. Tatta, Sind, Pakistan	S. M. K. Sufi (July 1950)
Zoological Survey Pakistan ..	273 and 390.5 ..		

Museum and Reg. No.	Standard Length (mm.)	Locality	Collector or other Source
Zoological Survey Pakistan	327	South and south-east bank of Kinjer Lake, Distr. Tatta, Sind, Pakistan	M. S. U. Siddigi (Jan. 1952)
Zoological Survey Pakistan	262	Indus River, 1 mile from Sonda Dak Banglow, Distr. Tatta, Sind, Pakistan	S. M. K. Sufi
Zoological Survey Pakistan	254, 263, 278 and 310	Makli Lake, Tatta, Distr. Tatta, Sind, Pakistan	S. M. K. Sufi
Zoological Survey Pakistan	325, 335 and 338	Suneri Lake, Distr. Tatta, Sind, Pakistan	S. M. K. Sufi (July 1950)
Zoological Survey Pakistan	327.5 and 334.5	Nourang canal about 2½ miles from Kambar Ali Khan, Distr. Larkana, Sind, Pakistan	Sohrab Ali (Nov. 1954)
Zoological Survey Pakistan	160.5, 161 and 183	Kazi Dhora about 3 miles from I.B., Kashmor, District Jacobabad, Sind, Pakistan	S. M. K. Sufi (Feb. 1951)
Zoological Survey Pakistan	147, 167, 218 and 220	Ponds near Char, Matiari village, Distr. Pabna, East Bengal Pakistan	Sohrab Ali (Dec. 1954)
Zoological Survey Pakistan	136, 139, 140, 150, 155, 156, 157, 163, 164, 195, 200, 217 and 227	Ponds near Char, Tapari Village, Distr. Pabna, East Bengal Pakistan	Sohrab Ali (Jan. 1955)
Zoological Survey India, F. 13630, 1 (Type of <i>M. manipurensis</i> )	426	Khurda stream one mile from Thanga Manipur, Assam, Irawaddy Basin	S. L. Hora
Paris Museum, 1862	241, 262, 286 and 198	Bangkok	Bocourt
Paris Museum, 1864	259	Siam	Bocourt
Paris Museum, 4534	267	Siam	Castelnau
Paris Museum, 4579	200, 215.5 and 219	Siam	Bocourt
Paris Museum, 5375 Type of <i>M. ponticerianus</i> (examined by Dr. E. Trewavas)	138, 158	Pondicherry	Leschenault
Paris Museum, 5348 Type of <i>M. marmoratus</i> (examined by Dr. E. Trewavas)	468 and 575	Mysore	Dussumier

## Notes on the synonyms

*Macrognathus caudatus* was imperfectly described by McClelland (1842) and the type was sent to London. Day (1876) suggested that it may be the specimen (*d*) listed by Günther (1861) under *Mastacembelus aleppensis*, received from the East India Company and stated to have 35 dorsal spines. Günther placed the name *M. caudatus* with a query in the synonymy of *M. aleppensis*, but Day put it, also queried, as a synonym of *M. armatus*. Boulenger (1912) recognised *M. caudatus* as a species distinguished from *M. armatus* by the absence of a preorbital spine and the specimen mentioned above is now labelled "*M. caudatus* (type)". I have examined this fish, now much faded; dissection reveals a short, hidden spine on both sides. I agree with Day in

assigning it to *M. armatus*, in which the preorbital spine, though usually pungent, may be hidden (see p. 136). The fin formula is D XXXVII 78, A III 77, C 16 (radiograph study), and it agrees in proportions with *M. armatus*.

This specimen may now safely be accepted as the type of *M. caudatus* and I therefore omit the query in synonymizing that name with *M. armatus*. Although it appears in McClelland's paper at the end of the new species of the "Afghan collections", there is no reason to suppose that it came from Afghanistan. These were the collections made on Griffith's Afghan journey, which began at Ludhiana, explored the Indus valley by way of Ferozepore and so down the Indus which it left for the Bolan Pass and Afghanistan by way of Shikarpore. Quotations from Griffith's notes include (p. 565), "The characteristic forms of Afghan fish are doubtless the small scaled Barbi and Orcini, . . . No Ophicephali, none of the Indian Siluridae, no Macrognathi," etc.

McClelland lists among the previously known species of Griffith's collections a specimen of "*Macrognathus ornatus*", a name not found elsewhere in the literature. Perhaps it is the damaged *M. armatus* now in the same jar with the type of *M. caudatus*.

*Macrognathus undulatus* was established by McClelland (1848) to receive a Chinese specimen. I follow Günther (1861), Day (1876) and subsequent workers in considering it a synonym of *Mastacembelus armatus*. Nichols & Pope (1927) described a specimen from Nodoa, Hainan, with D XXXII about 75, A III about 75 (the first spine obscure), as *M. armatus undulatus* (McClelland). Later Nichols (1943) described this subspecies as possessing D XXXII about 75, A II about 75, and in his key to the Chinese species distinguished it from *M. sinensis* by the number of anal spines. As I have not seen this specimen to discover which of the descriptions is correct in the number of anal spines, I have assumed that it is not different from other oriental *Mastacembelus* in this respect, and consider it also to be *M. armatus*.

Jerdon (1848) states that *Mastacembelus malabaricus* is closely related to *M. armatus* (= *M. armatus*), differing from it in having the body less thick in proportion to its length. Day (1876) found his specimens of *M. guentheri* less thick-bodied than his *M. armatus* and for this reason put Jerdon's species, with a query, under *M. guentheri*, assuming "37 to be a misprint for 27" as the number of dorsal spines. I find the range of body-width to differ very little in my material of the two species, hence I prefer to accept Jerdon's count of the spines and to put *M. malabaricus* in the synonymy of *M. armatus*.

Hora (1921) in describing *Mastacembelus manipurensis* admitted that he could not make exact fin counts. With the help of a radiograph I am now able to correct the fin formula, given by him as D XXXVII 66-72, A III about 50, to D XXXVIII 74, A III 70, C 17. This falls within the range of *M. armatus*, which *M. manipurensis* also resembles in body proportions, size of mouth, preopercular spines and preorbital spine (variable in *M. armatus* as stated above). In contrasting it with *M. caudatus*, a synonym of *M. armatus*; Hora was evidently relying on a description in which that species was wrongly regarded as a synonym of the large-mouthed "*M. aleppensis*" (= *M. mastacembelus*).

The 156 mm. fish assigned by Herre (1940) to *M. perakensis* was described as having D XXXVII-60, A II-60, and no trace of preorbital or preopercular spines. The dorsal formula diverges widely from that of *M. perakensis* (XXIX) and is within the range of *M. armatus*, which is also variable in the development of the head spines. Leaving open the possibility of the existence of only two anal spines in an Asiatic *Mastacembelus*, I suggest that Herre's specimen may be *M. armatus*.

*M. armatus* var. *favus* Hora, is evidently the characteristic colour variety in Siam, but the presence of intermediate colour-patterns in Malaya and Assam suggests that it may be the extremity of a cline, and I do not adopt the varietal name as a trinomen. Other modifications of the colour pattern in Malaya and Sumatra suggest that another cline may radiate from the centre of distribution of the species, or that the colour may be responsive to environmental influences.

#### Abbreviations used in the figures

a.n.	anterior nostril	n.	nasal bone
bl.v.	blood-vessel	ne.	nerve
boc.	basioccipital	n.t.	nasal tube
bsp.	basisphenoid	olf.	olfactory membrane
cl.	cleithrum	p.	parietal
cor.	hypocoracoid	p.co.	post coracoid process
d.pl.	dental plates	plsp.	pleurosphenoid
eoc.	exoccipital	pmx.	premaxilla
epo.	epiotic	pr.	preorbital
eth.	mesethmoid	pro.	prootic
eth.-vo.	ethmo-vomer	psp.	parasphenoid
fib.i.n.	fibres uniting right and left nasals.	p.tem.	post-temporal canal bone
fib.r.	fibres surrounding rostral cartilage.	pto.	pterotic
f.	frontal	r.	rays
l.eth.	lateral ethmoid	r.ca.	rostral cartilage
lig.eth.n.	ethmo-nasal ligament	rd.	radials
lig.r.d.	dorsal rostral ligament	sc.	hypercoracoid
lig.r.l.	lateral rostral ligament	scl.	supra cleithrum
l.l.	lateral line	soc.	supraoccipital
mx.	maxilla	spo.	sphenotic
		vo.	vomer

#### Explanation of Plates

(For lettering of anatomical drawings, see above)

Plate 13, Fig. 1. *Mastacembelus armatus*, skull  $\times 3$ , in A, dorsal, B, ventral view.

Plate 14. Fig. 2 (above). *Mastacembelus armatus*, skull  $\times 3$  in lateral view; basisphenoid inserted from an alizarin preparation of *M. maculatus*. Fig. 3 (below). *M. maculatus*, right pectoral girdle  $\times 24$ ; the dorsal side is on the right, the bases of the pectoral rays are at the top of the figure.

Plate 15, Fig. 4. *Macrognathus aculeatus*, alizarin preparation of snout in lateral view, showing the left anterior premaxillary plates, the rostral cartilage and the lateral line canal of the snout,  $\times 27$ . The bases of the premaxillary teeth are shown as circles, the lower jaw is not shown.

Plate 16, Fig. 5. *Macrognathus aculeatus*, alizarin preparation of snout in ventral view; md. l. l., lateral line pore in the lower jaw.

Plate 17, Fig. 6. *Macrognathus aculeatus*, transverse sections of snout; the outlines are accurate, but diagrammatic conventions are used to represent the tissues.

A, section near the anterior end of the rostral dental plates. B, through the posterior dental plates and the anterior ends of the main premaxillary bones; the snout is curved in this specimen so that several pairs of plates appear in one section. C, through the ethmo-vomer, the olfactory organs and the anterior ends of the nasal bones, the latter united over the ethmoid by a sheet of fibrous tissue.

In A the tapering rostral ligaments are merging with the fibrous sheath of the rostral cartilage. In B the three rostral ligaments are cut transversely in the middle of their course. Shortly behind C the nasal bone expands and fuses with the bony lateral line tube. In C there is a fibrous connection between the two and a ligament also joins the lateral line tube to the ethmoid; the nerves and blood vessels of the olfactory and lateral line organs are conspicuous. Smaller nerves and vessels have been omitted from A and B.

Plate 18. Fig. 7. *Macrognathus aculeatus*, redrawn by K. M. Foong from Day, 1876, pl. Ixxii, 1. Fig. 8. *M. aculeatus*, type of *R. dhanashorii*, from Hora, 1921, pl. ix, 2. Fig. 9. *M. aculeatus*, type of *Mastacembelus paucispinis* Fowler, from Fowler, 1939, fig. 23. Fig. 10. *M. aculeatus*, outlines to show relation between dorsal, caudal and anal fins in two specimens in which they are united. a, a paratype of *M. paucispinis* Fowler, 70.5 mm. long; b, a 200 mm. specimen from the River Meenam.

Plate 19. Fig. 11. *Mastacembelus armatus*, transverse section of snout through the anterior parts of the premaxillaries. In contrast to *Macrognathus*, note the folded lip with the subcutaneous circular fibres continued into it (in front of the premaxillaries these completely surround the snout). ca is a small unpaired nodule of partly ossified cartilage lying near, but not in, the fibres uniting the rostral cartilage and the ethmoid; it is probably only of individual significance.

Plate 20, Fig. 12. *Mastacembelus sinensis*, redrawn by K. M. Foong from Bleeker, 1870. Fig. 13. *M. caudiocellatus*, redrawn by K. M. Foong from Annandale, 1918. Fig. 14. *M. mastacembelus*, BM (NH) 1936.13.10.8, from Nasiriyah, Euphrates. Fig. 15. *M. maculatus*, redrawn by K. M. Foong from Valentiniennes in Cuvier's *Regne Animal, Illustr. Poissons* (1841), pl. iv, 1.

Plate 21, Fig. 16. *Mastacembelus maculatus*, paratype of *M. billitonensis* de Beaufort. Fig. 17. *M. perakensis*, from Herre & Myers, 1937. Fig. 18. *M. keithi*, from Herre, 1940. Fig. 19. *M. circumcinctus*, a, type from Hora, 1924; b, from the type series of *M. taeniagaster* Fowler, 1935.

Plate 22, Fig. 20. *Mastacembelus pancalus*, redrawn by K. M. Foong from Day, 1876, pl. Ixxii, 4. Fig. 21. *M. guentheri*, redrawn by K. M. Foong from Day, 1876, pl. Ixxiii, 2. Fig. 22. *M. zebrinus*, redrawn by K. M. Foong from Day, 1876, pl. Ixxii, 3. Fig. 23. *M. oatesii*, redrawn by K. M. Foong from Annandale, 1918, pl. i, 2.

Plate 23, Fig. 24. *Mastacembelus alboguttatus*, syntype. Fig. 25. *M. unicolor*, redrawn by K. M. Foong from Day, 1876, pl. Ixxii, 2 (type of *M. dayi*). Fig. 26. *M. unicolor*, outlines of caudal end to show various degrees of union between the vertical fins, a, 287 mm., locality unknown; b, 315 mm., Sumatra; c, 205 mm., Malaya.

Plate 24, Fig. 27. *Mastacembelus erythrotaenia*, a, from Kuala Kelantan, Malaya; b, type of *M. argus*, Siam. Fig. 28. *M. erythrotaenia*, right and left sides of a specimen from Bangkok (Mus. Paris 4578).

Plate 25, Fig. 29. *Mastacembelus armatus*, a, redrawn by K. M. Foong from Day, 1876, pl. Ixxiii, 3; b, type of *M. manipurensis*, from Hora 1921. Fig. 30. *M. armatus*, type of *M. a. var. favus*, from Hora, 1923.

Plate 26, Fig. 31. *Mastacembelus armatus*, Singapore. Fig. 32. *M. armatus*, a, a Malayan specimen from the Raffles Museum; b, a specimen from Sumatra.

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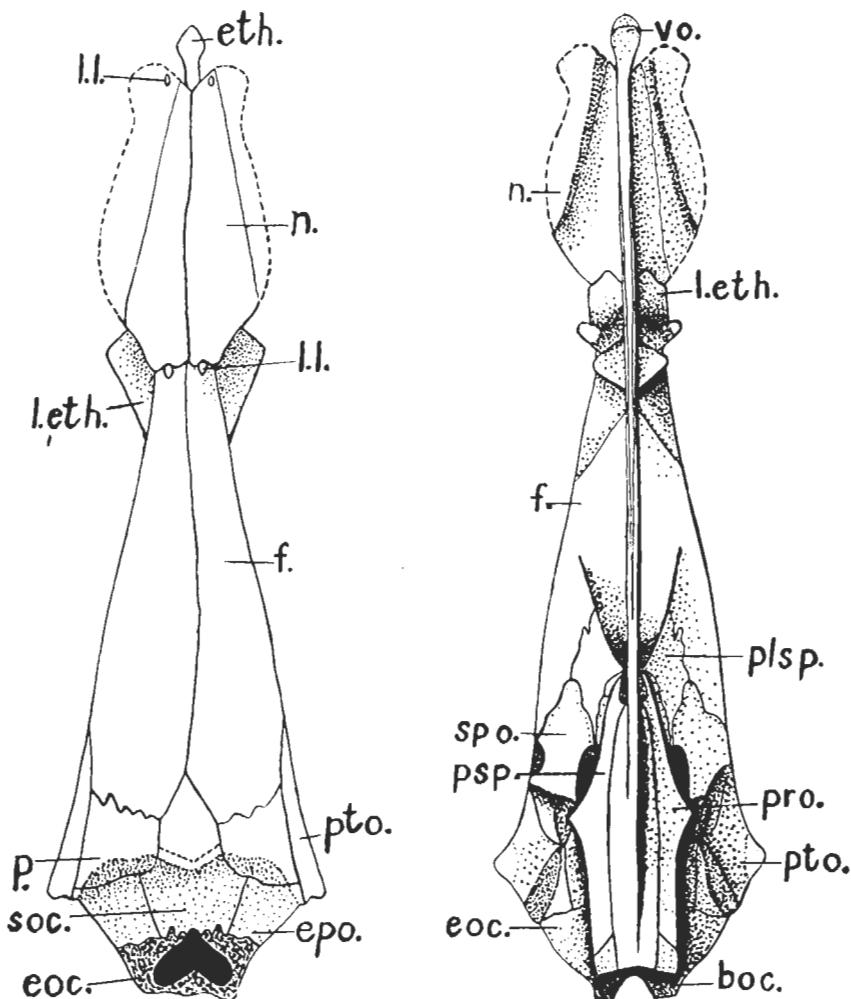
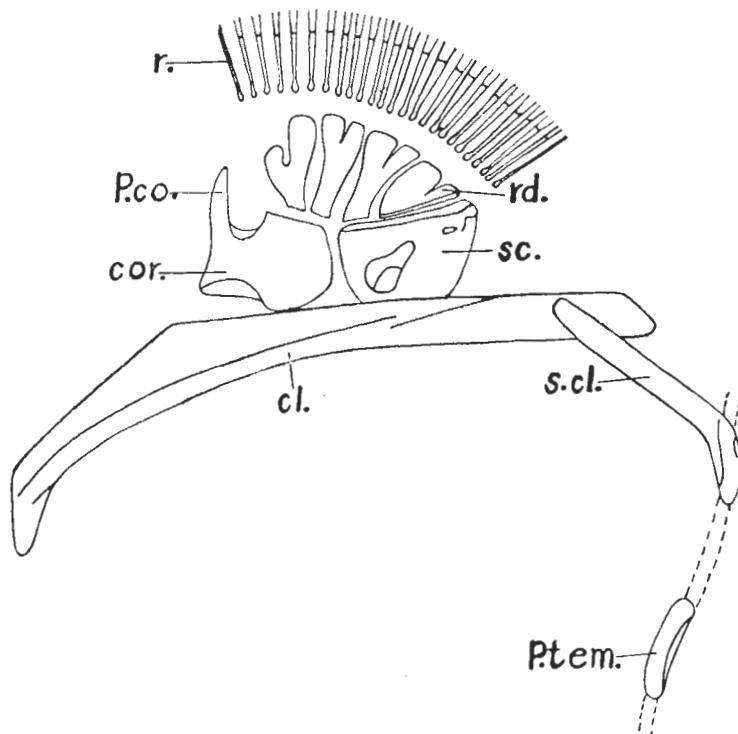
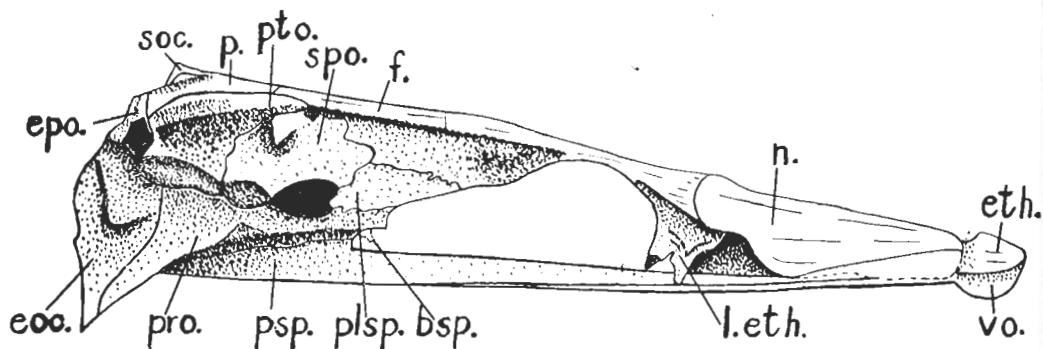


Fig. 1. Skull of *Mastacembelus armatus*. (S. M. K. Sufi).

(The pointer PSP. should extend to the middle line).



Figs. 2, 3. Skull and right pectoral girdle of *Mastacembelus armatus*. (S. M. K. Sufi).

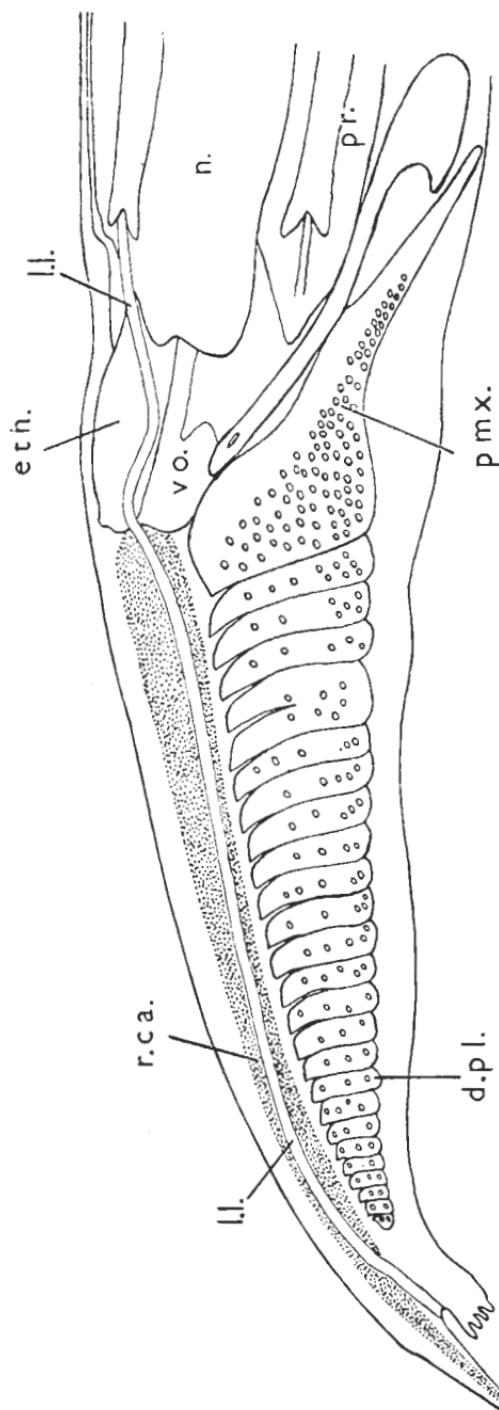


Fig. 4. *Macrognathus aculeatus*, Alizarin preparation of snout. (S. M. K. Sufi).

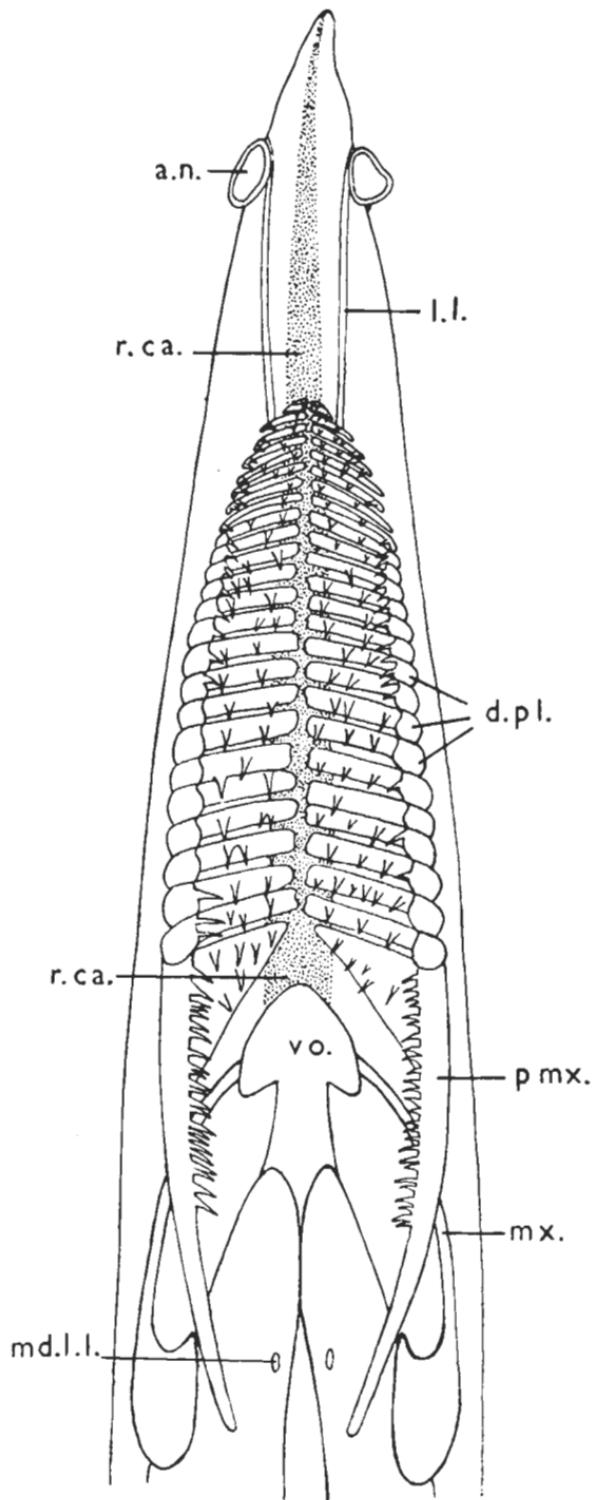


Fig. 5. *Macroglossus aculeatus*. Alizarin preparation of snout. (S. M. K. Sufi).

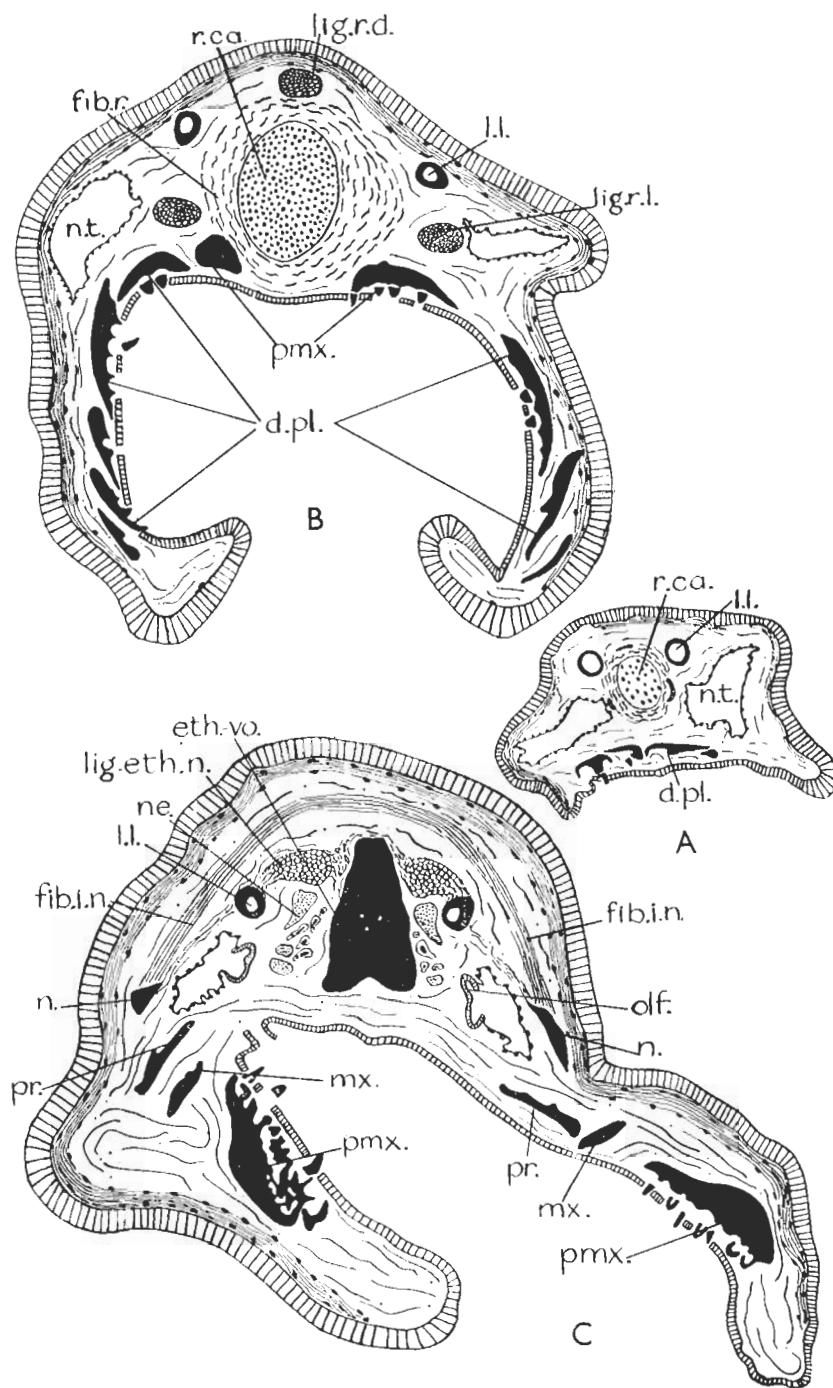
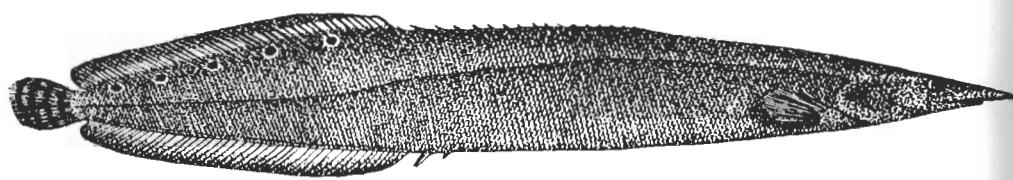


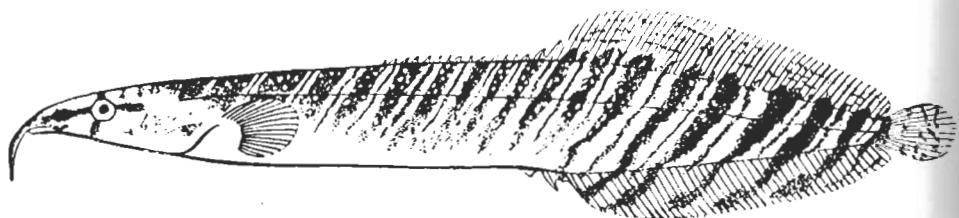
Fig. 6. *Macroglossus aculeatus*, transverse sections of snout. (S. M. K. Sufi).



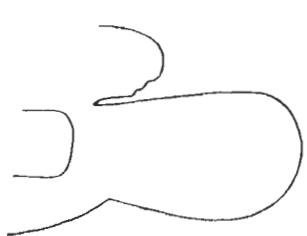
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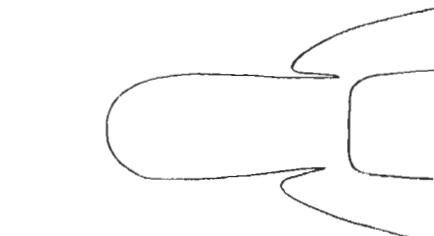
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9



a



b

Figs. 7-10. *Macrognathus acuteatus*. (S. M. K. Sufi).

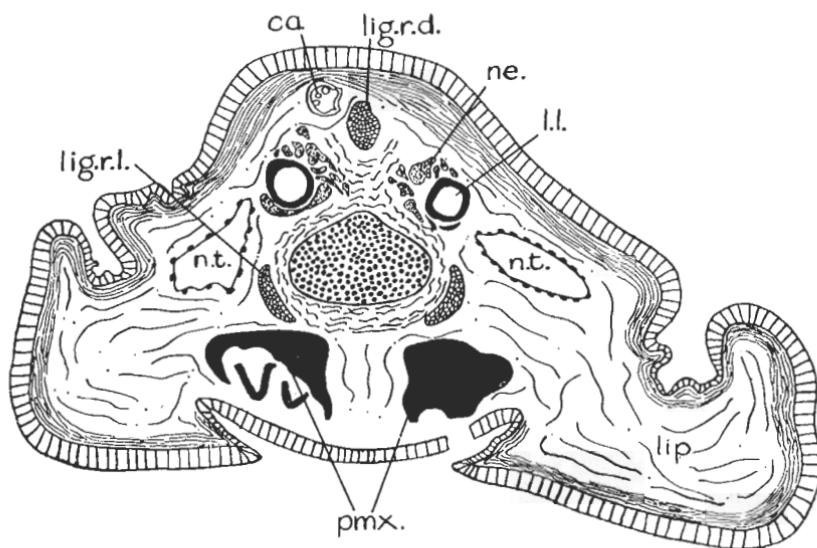
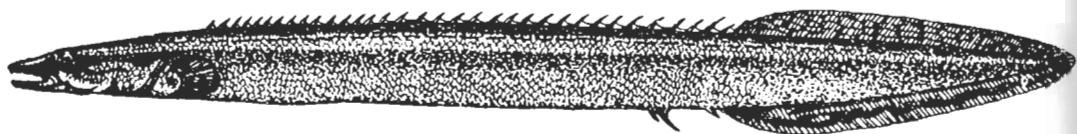
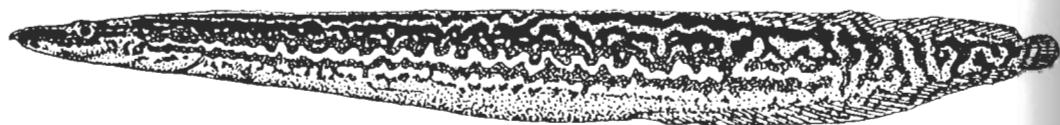


Fig. 11. *Mastacembelus armatus*, transverse section of snout. (S. M. K. Sufi).



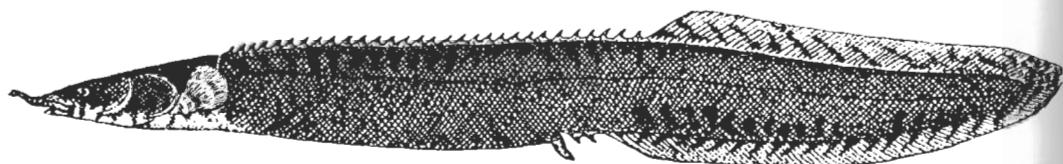
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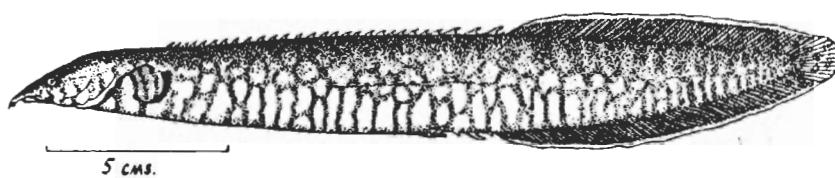


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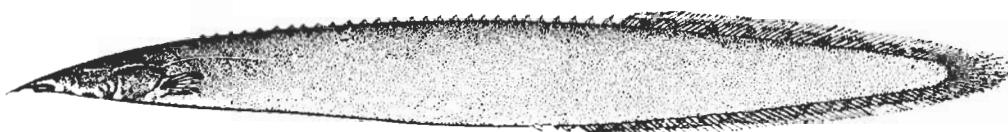


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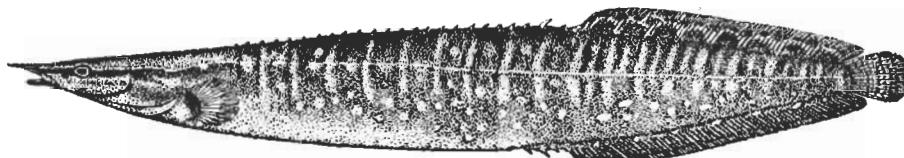
Figs. 12-15. *Mastacembelus sinensis*, *M. caudiocellatus*, *M. mastacembelus* and *M. maculatus*, (S. M. K. Sufi).



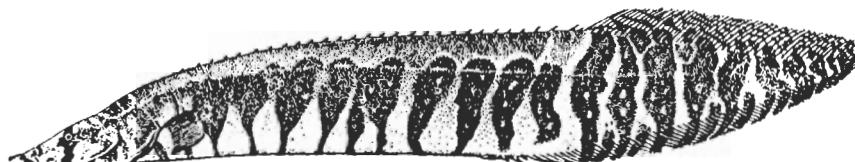
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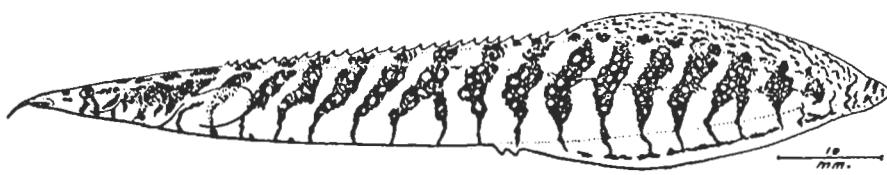
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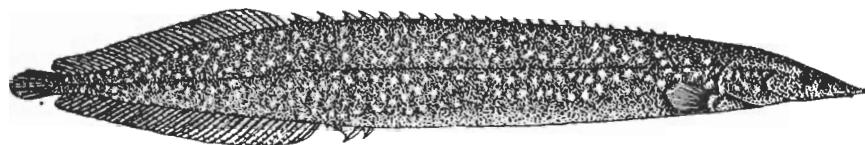


19a

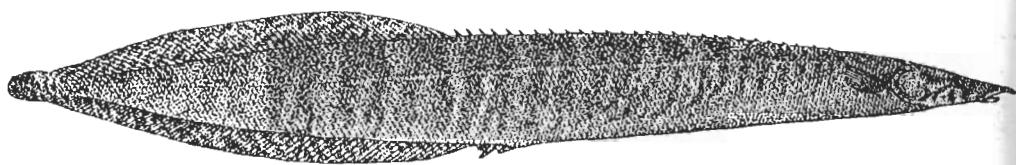


19b

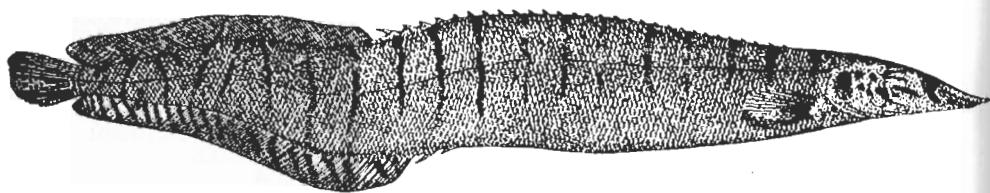
Figs. 16-19. *Mastacembelus maculatus*, *M. perakensis*, *M. keithi* and *M. circumcinctus*. (S. M. K. Sufi).



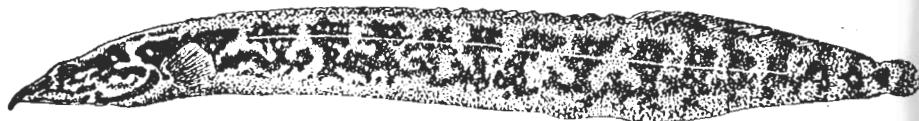
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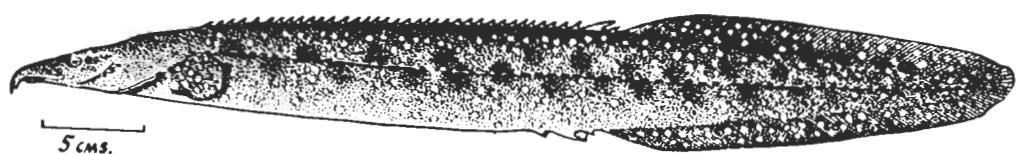


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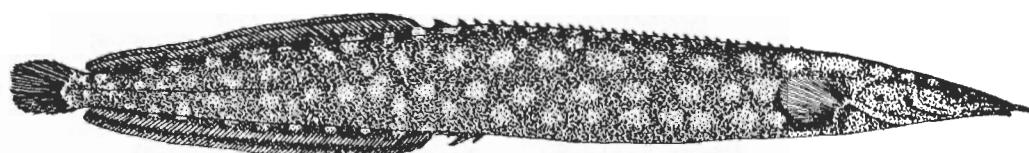


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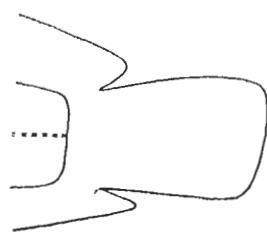
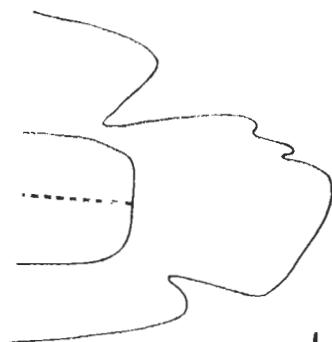
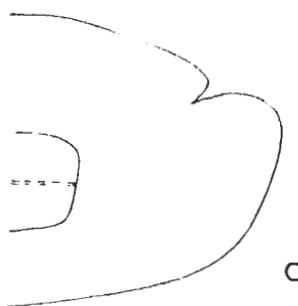
Figs. 20-23. *Mastacembelus pancalus*, *M. guentheri*, *M. zebrinus* and *M. oatesii*. (S. M. K. Sufi).



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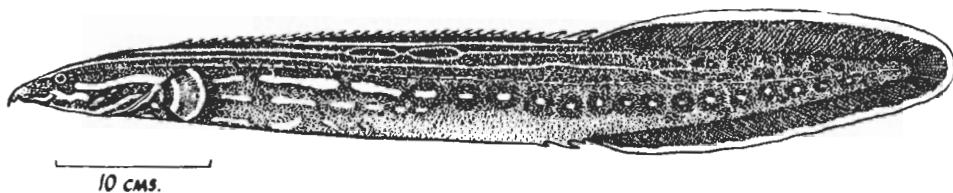


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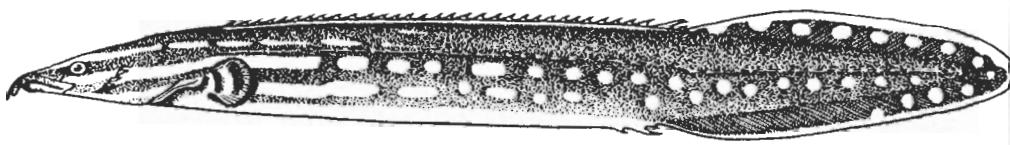


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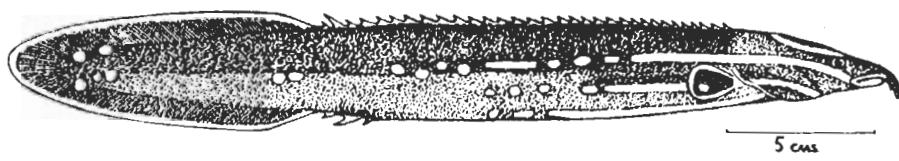
Figs. 24-26. *Mastacembelus alboguttatus* and *M. unicolor*. (S. M. K. Sufi).



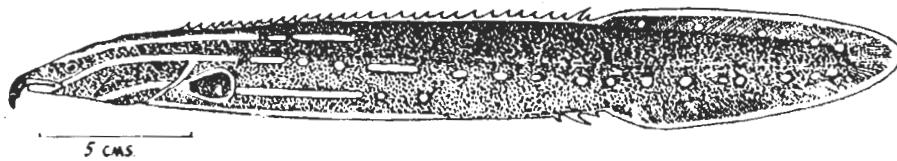
27a



27b

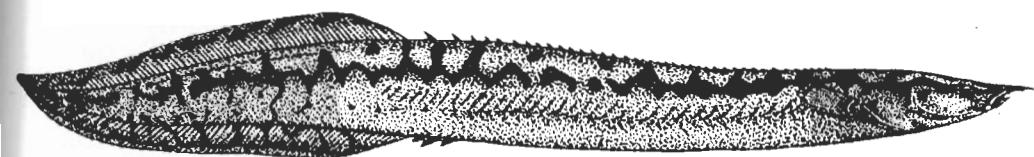


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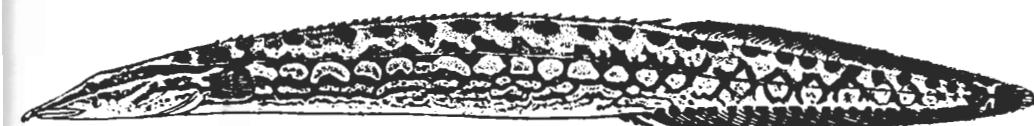


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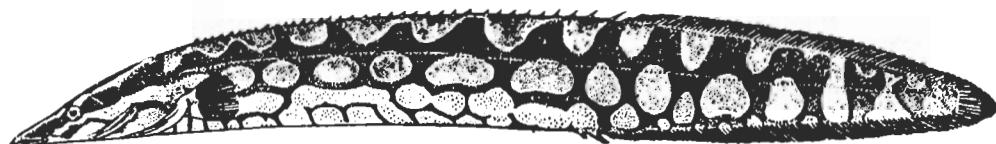
Figs. 27, 28. *Mastacembelus erythraenia*. (S. M. K. Sufi).



29a

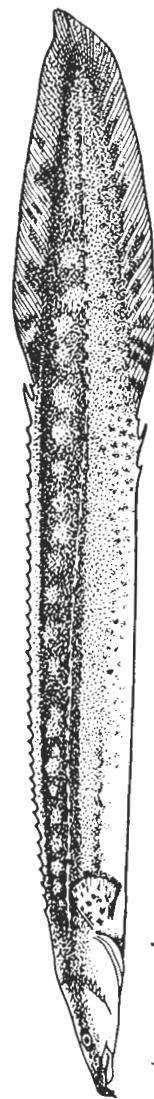


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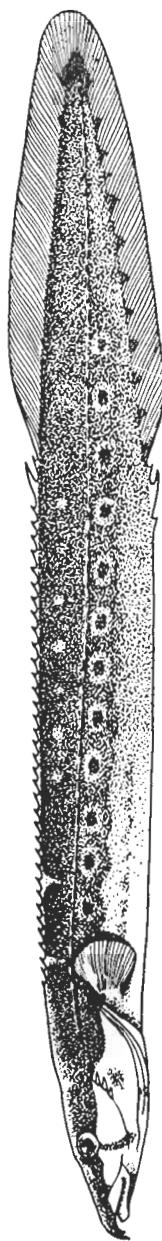
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Figs. 29, 30. *Mastacembelus armatus*. (S. M. K. Sufi).



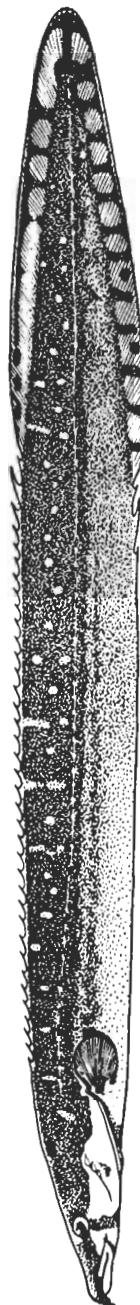
31

5 CMS.



32a

1 CM.



32b

2 CMS.

Figs. 31, 32. *Mastacembelus armatus*. (S. M. K. Sufi).