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THE GENERA OF PHALLOSTETHIDAE.

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The little fishes known as Phallostethidae are among the most remarkable of all living fishes. The males have an extraordinary muscular organ attached to the under side of the head and throat. This structure bears either one or two movable external bones, which Regan, the discoverer and first describer of any of this group, says are not homologous with any bones in ordinary fishes. This whole complicated structure is a priapium, or copulatory organ. The movable bone or bones are used in clasping the female, fertilization being internal. The eggs are thread-bearing and are attached to aquatic plants.

Regan described two genera and three species, from brackish water in Malaya, and placed them in the *Cyprinodontidae.* Some years later I discovered three species, belonging to two genera, in mountain brooks and fresh water lakes in Luzon, P. I. Two species had a first dorsal, a feature not possessed by any cyprinodont, but I blindly followed Regan's arrangement.

The discovery of additional species by Villadolid, Myers, Smith, and Manacop, threw new light on Phallostethid affinities. Hubbs pointed out their relationship to atherinid fishes, and Myers created a new suborder for them in the order Percesoces, equal to the suborders Mugiloidea and Polynemoidea. The work of Bailey seems to lead with little doubt to the conclusion that the priapium is comparable to the pelvic girdle complex of the polynemid fishes.

The arrangement of the 14 different species of Phallostethidae now known, is a matter of some difficulty. Genera have been created by Regan, myself, Myers, and Aurich. The latter writer has done a very fine piece of

work on the skeletal morphology of the priapium, studying four Philippine species, two of which are described by him as new. These two he has placed in a new genus, *Solenophallus*, but they evidently do not belong in the same genus. As he has failed to designate a genotype for his genus, it has no standing under the International Rules of Nomenclature. However, I accept his genus although his defective descriptions of species and genus make it difficult to tell exactly what he had, without specimens for comparison.

In my own papers, as well as in those by Myers, Villadolid and Manacop, a certain error has been repeated. We have all given the name of pulvinulus to what is really the pulvinular appendage. Had any of us studied carefully Regan's excellent figures along with our specimens we would not have made this error. Aurich has recognized the difference, but has rejected Regan's analysis. He names the pulvinulus "Priapbug," and applies pulvinulus to the pulvinular appendage.

The discovery of an additional species in Luzon by Manacop, and one in Borneo by me, and further collections by me in the Philippines, Borneo, and Malaya, and the appearance of Aurich's paper, all in 1936–37, necessitate the diagnosis of additional genera, and a new generic key.

Key to the Genera of Phallostethidae.

A. A toxactinium present, with a shield-like pulvinulus over its base; one ctenactinium present.

B. Anal fin of 26 to 28 rays; ctenactinium serrated; jaws equal or lower slightly included; first dorsal not observed; abdomen of female with a groove.....1. PHALLOSTETHUS Regan

BB. Anal fin of 14 or 15 rays; ctenactinium not serrated; lower jaw projecting; first dorsal of 1 ray; no groove on female abdomen .....2. PHENACOSTETHUS Myers

AA. Toxactinium absent; pulvinulus reduced, small, or even absent, its appendage variously shaped or absent.

C. No first dorsal; 2 ctenactinia, one very short.

D. Nape and opercles scaled. Anal I–13–18; no pulvinulus or appendage visible, the appendage replaced by a thin strip of tender skin....3. MIROPHALLUS Herre

DD. Nape and opercles naked; anal I–18–21; an oval pulvinular appendage visible, its margin free.....
4. SOLENOPHALLUS Aurich

CC. A first dorsal of 1 or 2 rays; nape and opercles naked except 1 species of *Neostethus* with 3 opercular scales.

E. 2 long ctenactinia present; no comb-like cilia on hind end of priapium.

F. No pulvinulus or appendage visible, but only a thin strip of tender skin; mountain brook fishes with rather stout body.....
5. GULLAPHALLUS Herre

FF. Pulvinulus reduced, its appendage visible as an oval plate with depressed center on aproctal side of priapum, its tip or posterior half more or less free, and its margin almost wholly free.
Brackish water fishes of very slender form and strongly marked "neck"; a small fringe of coarse cilia sometimes present on the tissue connecting neck and priapium and concealed by the projecting rounded end of the latter.....6. CERATOSTETHUS Myers

EE. A single long ctenactinium present in adult males; comb-like cilia on hind end of priapium present or absent.

G. Ctenactinium slender, strongly curved, without a membranous fold or margin along its edge; priapium without a flat many-spined process on infrasulcular prominence.

H. Female with a curved, sharp-pointed bony projection from the breast, beneath gill opening and behind anus; males without visible pulvinulus, and no pulvinular appendage; no comb-like fringe of cilia on hind end of priapium.....
7. ACANTHOSTETHUS Herre, new genus

HH. No pointed bony papilla on breast of female; a fringe of comb-like cilia on rear margin of priapium; pulvinular appendage oval, its pointed posterior tip more or less free, its margin free or nearly so.

I. Priapium without an open fringed groove (one species with 3 opercular scales) 8. NEOSTETHUS Regan

II. An open groove on priapium, with a dense fringe along both margins.....
9. CTENOPHALLUS Herre, new genus

GG. Ctenactinium little curved, with a broad membranous margin along lower side of its proximal half; region of infrasulcular prominence with a large flat fleshy process, with 9 or 10 short sharp recurved spines on upper hind border, and 2 longer forward-pointing spines on its front edge; no comb-like fringe on hind end of priapium.....10. PLECTROSTETHUS Myers

Genus PHALLOSTETHUS Regan.

Phallostethus dunckeri Regan.

Only known from Regan's description and specimens from Johore.

Genus PHENACOSTETHUS Myers.

Phenacostethus smithi Myers.

Abundant in canals in Bangkok, Siam; not known elsewhere as yet.

Genus MIROPHALLUS Herre.

Mirophallus bikolanus Herre.

Known only from Lakes Bato and Lanigay, both fresh water, in southeastern Luzon.

Genus SOLENOPHALLUS Aurich.

Solenophallus thessa Aurich.

Known only from the large fresh-water lake, Mainit, in northeastern Mindanao.

Genus GULAPHALLUS Herre.

Gulaphallus eximius Herre.

Scales in longitudinal series, 56–58. Only known from two collections made by me from a mountain brook near Santa Fe, Nueva Vizcaya province, Luzon. This is the largest and bulkiest of known phallostethids.

Gulaphallus mirabilis Herre.

Scales in longitudinal series, 34–38. Abundant in various streams belonging to the drainage system of Manila Bay. Its presence in the Molawin, a brook running through the campus of the College of Agriculture, near Laguna de Bay, Luzon, enabled Villadolid and Manacop to study its habits, breeding, embryology, and the ontogeny of the external parts of the priapium. The osteology has been carefully worked by Bailey.

Genus CERATOSTETHUS Myers.

Ceratostethus bicornis (Regan).

Abundant in brackish waters on the island of Singapore. It is also reported by Myers from Palawan, P. I. The 3 original immature types came from Kuala Langat, on the coast of Selangor, Malay Peninsula.

ACANTHOSTETHUS HERRE, new genus.

Genotype *Acanthostethus falcifer* (Manacop), from central Luzon, P. I.

This genus is set apart from other Phallostethid fishes by the possession in the female of a curved, sharp-pointed bony papilla or projection from the breast. It is beneath the gill opening and behind the anal opening, which is in the throat below the opercle. The abdominal fringe, anus, oviduct, and ureter opening are not in a groove.

In adult males there is a single strongly curved slender ctenactinium, articulated to the side of the enlarged free posterior end of the priapium;

its tip usually lies in a groove between the chin and the anterior end of the priapium, but sometimes it perforates the tissue near the junction of the anterior end of the priapium and the head. On the side opposite the base of the ctenactinium is a small bone just beneath the skin, its hard sharp hooked tip projecting almost at a right angle from the corner of the anterior end of the free part of the priapium. This tiny bone is probably the same as the papillary bone supporting the seminal papilla in *Neostethus*.

There is no visible pulvinulus or pulvinular appendage; the part marked pulvinulus in Manacop's figure is a part of the posterior half of the priapium. There is no comb-like fringe of cilia on the rear end of the priapium, its projecting rounded posterior being perfectly smooth.

The anal fin is of moderate length, II–13–14; first dorsal II, over the anterior half of the anal fin; second dorsal I–6, its origin over the posterior part of the anal fin. The head, nape, and throat are without scales. Scales 30 to 32 in a longitudinal, 7 in a transverse series, and 14 to 16 predorsal scales.

One species known from brooks around Mt. Arayat, and gurami ponds in the municipality of Mexico, Pampanga Province, Luzon. The eggs and embryology of this fish have been studied and reported upon by Manacop.

Genus NEOSTETHUS Regan.

The limits of this genus are not well understood, as no specimens of the type species are available in this country for comparison. There seems to be considerable variation in the development of the small spine called a second actinium by Villadolid and Manacop, and "Priapklaue" by Aurich.

Neostethus lankesteri Regan.

The only specimens known are those described by Regan, 5 adult males and one adult female, from the Muar River, and from Singapore, all from brackish water.

Neostethus amaricola (Villadolid and Manacop).

Widespread in brackish water creeks and mangrove swamps in the Philippines. Originally described from a suburb of Manila, it is known from the northeastern tip of Luzon to Leyte and Negros. It is abundant about Dumaguete, and probably occurs on most Philippine coasts.

Neostethus siamensis Myers.

Only known from one female, collected in the estuary of the Chantabun River, southeastern Siam, by Dr. H. M. Smith.

Neostethus borneensis Herre.

This delicate little fish swarms in tidal creeks and brackish water swamps around Sandakan Bay, British North Borneo. Scales in lateral series 26 or 25 in males, 26 or 27 in females; predorsal scales 15 or 16; rarely more in females; 3 large scales on the opercles. First dorsal II, or rarely I; second dorsal I–4; anal II–13–12; pectoral I–8. Origin of second dorsal over base of 12th or 13th anal ray in males; in females it is over the base of the last ray, or behind the anal.

CTENOPHALLUS HERRE, new genus.

From other phallostethids this genus is separated by the different structure of the priapium. On the ventral side of the penis bone is an open groove, bordered on both margins by fine cilia, as shown in Aurich's figures. The large pulvinular appendage is almost equal to the diameter of the eye. The posterior end of the priapium has a comb-like row of cilia. First dorsal I; second dorsal 5, rarely 6 or 7; anal I–13–16; pectoral I–9 or 10. Gill-rakers long and smooth, 2 plus 13 on the first arch.

Ctenophallus ctenophorus (Aurich).

Only known from specimens collected by Woltereck, and said by Aurich to come from tributaries of Laguna de Bay, Luzon, P. I. It is a pity a more definite locality was not given, as it certainly does not occur in some of the tributaries flowing into this great fresh water lake. In most respects it seems to be very close to *Neostethus amaricola*, a brackish water species.

Genus PLECTROSTETHUS Myers.

Plectrostethus palawanensis Myers.

Known only from the west coast of Palawan, P. I.

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