

NOTES ON FIVE FOOD-FISHES OF LAKE BUHI, LUZON, PHILIPPINE ISLANDS.

BY HUGH M. SMITH.

As a meager contribution to the ichthyology of the Philippine Islands, the following notes on a few specimens of fishes recently sent to the United States Commission of Fish and Fisheries are offered. The fish were collected in Lake Buhi, province of Camarines Sur, Luzon, in July, 1901, by Dr. F. W. Richardson, contract surgeon, U. S. Army, and forwarded through the Surgeon-General's Office. Dr. George A. Zeller, acting assistant surgeon, U. S. Army, had previously sent from Lake Buhi specimens of dried fish-cakes made by the natives.

Lake Buhi is described as a beautiful mountain lake, 3 miles wide and 6 miles long, and 500 to 1,000 feet above the sea. It is reputed to be very deep, and is said to have been formed by a volcanic upheaval before the Spanish occupation, when one side of Mount Iriga was blown out, and hills of lava were scattered for miles to the southeast of the mountain.

All of the species hereafter referred to are used for food. The size of some of them indicates that nothing is too small or insignificant for the Filipinos to eat. In Lake Buhi very few fish are caught with hook and line, the native appliances being a fine-meshed net used as a seine and a trap made of bamboo.

Mistichthys luzonensis H. M. Smith. "*Sinarapan*."

In an article (*Science*, January 3, 1902) entitled "The Smallest Known Vertebrate," the writer gave a preliminary notice and brief description of this new genus and species of goby from Lake Buhi. The genus *Mistichthys* (*μειστός*, the smallest; *ἰχθύς*, fish) may be diagnosed as follows:

Body elongate, compressed. Head rather large. Dorsal fins widely separated, the anterior very low, containing 3 weak spines joined by a membrane, the posterior high, with 8 or 9 branched rays; anal fin similar to soft dorsal; pectorals long and rounded; ventrals 1, 5, coalescent, not adnate to abdomen; caudal well developed, bluntly pointed. A single series of rather long, curved conical teeth in each jaw. Scales large, ctenoid. Gill membranes joined to isthmus. A large genital papilla in each sex. Coloration plain. Size minute, the males rather smaller than females.

Mistichthys luzonensis may be more particularly described as follows:

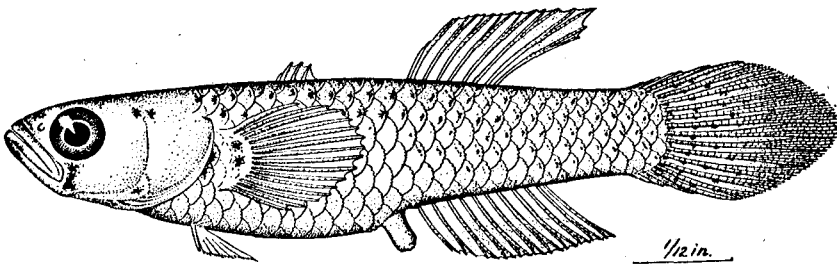
Form elongated, compressed, tapering but slightly to the rather wide caudal peduncle. Depth of body equals about one-fourth total length, the female being slightly deeper than the male. Head large, its length contained 3.3 times in body; mouth large, oblique, the maxillary extending to a point under anterior border of pupil; lower jaw slightly longer than upper, the chin projecting; teeth short and numerous, arranged in a single row in each jaw; eye large, 3.3 in head; snout blunt, two-thirds diameter of eye; interorbital space about one-half eye; branchial membranes not united and joined to the isthmus. The dorsal fins are separated by an interval rather less than half the head; the anterior consists of 3 weak spines and a rudiment adnate to the first spine, and is very low, its height being less than half diameter of eye; the second dorsal contains 8 or 9 rays, of which the posterior

are longest, and is comparatively high, the longest rays being nearly two-thirds length of head and 5 times length of dorsal spines; the origin of anterior dorsal is 0.4 distance from end of snout to base of caudal, that of the posterior dorsal is 0.4 distance from base of caudal to end of snout, and over origin of anal. Anal fin large, of 11 branched rays of nearly equal length, rather less than height of second dorsal. Pectorals two-thirds as long as head, rounded, with broad base, the central rays extending as far as vent; rays 15. Ventrals 1, 5, short, coalescent, not adnate to abdomen. Caudal large, central rays produced, its length equal to five-sixths of head. Genital papilla in the male slender, tapering, longer than first anal ray and 1.5 times diameter of eye; that in the female half as long and twice as broad as in the male. Scales large, strongly ctenoid, 23 or 24 in lengthwise series and 6 in transverse series.

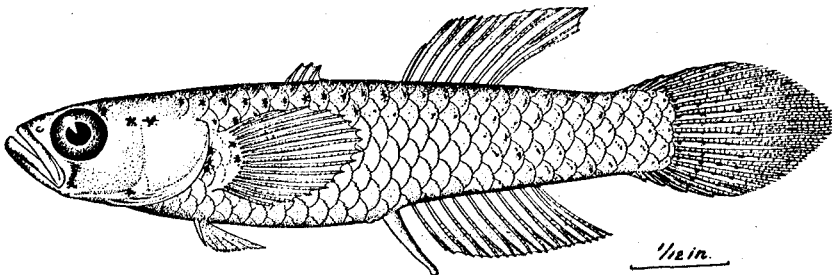
Colors: In life, apparently almost transparent; muzzle black; a black line at base of anal; back and head sparsely spotted with black; a narrow black stripe under eye.

Average length about 12.5 mm., the males somewhat smaller than the females.

Types (Nos. 50303 and 50304, U. S. National Museum), collected in Lake Buhi, Luzon, Philippine Islands, July 5, 1901, by Dr. F. W. Richardson.



MISTICHTHYS LUZONENSIS Smith. Female. Enlarged 8½ times.



MISTICHTHYS LUZONENSIS Smith. Male. Enlarged 8½ times.

This is apparently the smallest known species of fish. The average length of females among the specimens at hand is 13.5 mm., the minimum under 12 mm. The average length of males is 12.5 mm., the minimum under 10 mm., and the maximum 13.5 mm. The average length of 50 specimens taken at random, both sexes about equally represented, was 12.9 mm.

That these specimens are mature is shown by the presence of ripe ovarian eggs and by the extrusion of perfect eggs when the fish were placed in the preserving fluid. The average diameter of the extruded eggs is 0.5 mm.

The shape of the genital papillae suggests that the eggs are deposited in crevices or under objects, and there fertilized.

Prof. H. V. Wilson, of the University of North Carolina, has examined this fish with reference to its eggs, and communicates the following notes thereon:

"The ripe ovarian egg is uniformly filled with granular yolk. It is of a rounded shape, frequently elliptical in outline. It lies inside a comparatively thick shell, which has an irregularly polyhedral shape. One facet of the shell is convex and bears a small, rounded depression, from which radiate

dichotomously branching fibers, which cover all facets of the shell except the one opposite the depression. The fibers adhere closely to the surface of the shell and may be continuous with it. Around the margin of the bare surface the fibers may extend beyond the egg, lying in an intricately coiled condition in the spaces between the eggs. The fibers are probably to be looked on as ridges of the eggshell which become free with continued growth.

"The ripe eggs are packed together closely in the ovary, adhering by their flattened surfaces. Between and beneath them numerous small ovarian ova, with relatively large nucleus and nucleolus, are present. Such small ova have not yet developed a shell. I believe the ripe eggs are arranged in a single layer around the axial cavity of the ovary, with the convex depression-bearing surfaces facing the cavity. The fibers or filaments suggest, of course, that the egg is attached to something during its development.

"In the discharged eggs examined the filaments project from one side in the form of a tuft. No signs of segmentation could be made out in surface view of eggs in clove-oil, and yet the shape of the blastoderm was so embryo-like that I thought it necessary to section a mass of the eggs taken directly from the fish. The sections permit the blastoderm to be seen distinctly as well as the yolk. The blastoderm is much thicker on one surface of the yolk than on the opposite surface, but is quite unsegmented. I have examined a large number and find no trace of segmentation.

"The highly developed egg-membrane, with its filaments, is certainly a very unusual feature. I know of no similar case, but I have not at hand literature which would enable me to say whether or not such a membrane has been described. The disk-like area from which the filaments radiate is exceedingly thin in the center, but is not perforated. I can not make out a micropyle. The appearance of several eggs indicates that when the egg is laid an outer membrane, with the filaments, is split and recurved, leaving the egg surrounded by a thin membrane, at some point of which the micropyle should be.

"There is certainly nothing in the appearance of the eggs (egg-membrane, yolk, blastoderm) to suggest that they develop in the mother. The complicated egg-membrane, on the contrary, strongly suggests that the egg develops outside the mother, attached by filaments to some body. All this is, of course, negative evidence."

An interesting fact regarding this species is that it is a food-fish of considerable importance. In forwarding samples of the fish as dried for food, Dr. Zeller wrote as follows:

"I inclose herewith samples of a strange article of diet greatly relished by the Bicolos, among whom I have been stationed for the past eighteen months. Rice and fish are the staple articles of diet for most Filipinos, and in the provinces of the Camarines there is little variation from these two. Fishes of every size and many varieties are prepared in every conceivable form, but the samples inclosed are unique in that they are found here and nowhere else. * * * Many varieties of fish abound in the lake, but by far the most numerous are these minute specimens. They are called in the native Bicol tongue 'sinarapan,' and when dried in the sun on a leaf are called 'badi.' [They are caught by a large sheet of close web, which is dipped under wherever a school congregates. They are put into tightly woven baskets from which the water soon drains, leaving a compact mass of fish.] They are not minnows or immature fish. They are adults and attain no greater size. [The natives buy them eagerly; and when the little fleet of fishermen return from their morning's quest and place their baskets upon the ground on the market place, they are instantly surrounded by a crowd of waiting children who, armed with every sort of dish, are anxious to take home the family meal. They bring three or four potato tubers, a handful or two of rice, or a few copper pennies, and in exchange receive about a pint of fish. In the kitchen the fish are made up with peppers or other spiced herbs, and they do not taste bad. The soldiers have become quite fond of this food, and liberally patronize the little native restaurants where it is served.]"

Gobius sternbergi, new species.

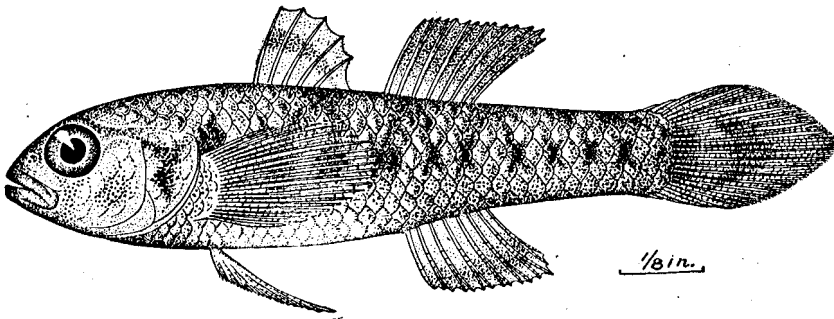
Form elongate, rather robust, slightly compressed, the depth contained 4 times in length. Head rather large, its length about one-third total length of body; mouth rather small, terminal, nearly horizontal, the maxillary not extending to vertical from anterior edge of pupil; snout short and very blunt, about three-fourths diameter of eye; eye large, superior, bulging, less than 4 in head; interorbital one-half eye. Teeth in upper jaw in about 3 irregular rows, of which the outer row contains the largest teeth; teeth in lower jaw in a band, some larger than others and canine-like. Branchial membranes broadly united to the isthmus. D. v, 8; A. 8; caudal pointed; ventrals long, extending nearly or

quite to vent; pectorals long, the central rays produced and extending opposite origin of second dorsal. Scales large, those on sides, abdomen, and most of back finely ctenoid, those on anterior part of back mostly cycloid; posterior edge of scales angular; opercle, preopercle, and top of head as far forward as interorbital space covered with large cycloid scales; scales in lateral series 25 or 26, in transverse series 8; 12 scales before anterior dorsal.

Colors: Head, sides, and back dusky, the under parts white. Sides marked by about a dozen short, irregular, vertical, blackish blotches, a prominent one above base of pectorals; muzzle dark; a dark area on opercle; anterior dorsal pale at base, blackish distally; second dorsal irregularly marked with dark stripes; anal and caudal dusky; pectorals and ventrals plain.

Types (No. 50536, U. S. National Museum), 6 specimens 20 to 27 mm. long, collected in Lake Buhi, Philippine Islands, by Dr. F. W. Richardson, July 5, 1901.

This species seems to agree with none of the 20 or more species of *Gobius* already described from the Philippine Islands. It is named for Dr. George M. Sternberg, Surgeon-General of the United States Army.



GOBIOUS STERNBERGI, new species.

Hemirhamphus cotnog, new species. *Half-beak*; "*Cotnog*."

Body rather slender, the depth contained 8 times in length (from end of upper jaw to caudal base); sides somewhat compressed, vertical; thickness of body one-half less than depth; length of head (with lower jaw) 2.3 in total length of body; length of lower jaw (beyond extremity of upper jaw) rather greater than remainder of head and 4.4 in body; premaxillaries broader than long, their length less than eye; eye large, 1.6 in postorbital space; top of head flat; interorbital 1.2 width of eye. Dorsal very low, the longest of the 12 rays not exceeding eye; dorsal origin slightly in advance of anal; anal very short, but much higher than dorsal; 13 anal rays, the first short, the next 4 long and broad, the middle rays shorter than the last, the free margin of the fin incised and nearly vertical; caudal rounded; ventrals very short, less than eye, much nearer to base of caudal than to axil of pectorals; length of pectorals slightly exceeding depth of body. Scales 65 in lengthwise series, about 9 rows between dorsal and anal.

Colors (in formalin): Greenish above, the scales with dark edges; white below; a silvery lateral stripe increasing in width from before backward; dorsal dusky, other fins plain; lower jaw black.

Type (No. 50537, U. S. National Museum), a specimen 106 mm. long, collected in Lake Buhi, July 5, 1901.

The writer hesitates to add another species of half-beak to the already large number of real and nominal forms recorded from oriental waters, but is unable to make other disposition of the specimen in hand. The combination of reduced number of dorsal and anal rays, small scales, and rounded tail with the modified anal rays suffices to distinguish it.

This fish is called "*cotnog*" in the Bicol tongue, and is said to attain a weight of 1½ to 2 pounds in Lake Buhi.

Anabas scandens (Daldorf). *Climbing Perch*; "*Atlas*"; "*Poyo*."

Two young examples, 4 and 4.5 cm. long, are referable to this species. Head 2.5 in length; depth 2.5 in length; D. XIX, 8 and XVIII, 9; A. X, 9 and XI, 9; scales 31. Color greenish, lighter below; body

marked by about 12 narrow, dark vertical stripes; a blackish spot at base of caudal surrounded by a lighter area. The denticulations on the preorbital are concealed by a fold of skin, and the spines on the opercle are less numerous and less strongly developed than in a specimen of similar size in the U. S. National Museum from Ceylon and than in examples figured by Bleeker and Day, but in other respects these specimens conform with the descriptions of *A. scandens*.

Dr. Richardson states that this fish is known as "attas" at Buhi and as "poyo" in other Bicol towns. It is reported to attain a weight of $1\frac{1}{2}$ to 2 pounds. If this is correct, the Lake Buhi fish is larger than the specimens recorded from any other waters.

This is the celebrated climbing perch of the fresh waters of India, China, and the East Indies. By means of a freely movable opercle, it is enabled to ascend trees for a distance of 5 to 7 feet; and the possession of an accessory breathing apparatus makes it adapted to both an aquatic and a terrestrial existence. The fish is said to die when prevented from exercising its aerial respiration.

The climbing fish is highly esteemed for food, and in India is extensively employed for stocking ponds.

Ophiocephalus striatus Bloch. "*Oroon*"; "*Terebog*"; "*Talosog*."

Two young specimens, 73 and 87 mm. long, respectively, were received. Head 3 in length; depth 6 in length; eye 7 in head, 1.5 in snout; dorsal 44; anal 26; scales 53-15.

According to Dr. F. W. Richardson, this fish in Lake Buhi attains a weight of 5 pounds and is called by the Bicolos "ovoon" when young, and "terebog" or "talosog" when grown. It is an important food-fish of the lake, probably exceeded in importance only by the "sinarapan."

This species is known from other parts of the Philippine Islands, and is widely distributed in the fresh waters of China, Burma, and India. According to Day (*Fishes of India*), it attains a length of 3 feet or more, takes a bait, especially a frog, very readily, and is said to rise to a salmon fly. Day gives the following general information about the *Ophiocephalidae*, or serpent-headed fishes:

The *Ophiocephalidae*, having hollow cavities in their heads and an amphibious mode of respiration, are able to exist for lengthened periods out of their native element and can travel some distance over the ground, especially when moist. They possess an accessory cavity to the gills, and are able to respire direct from the atmosphere. Jugglers both in India and China exhibit these fishes walking on the land, and children amuse themselves by making them crawl along. "In China they are often carried alive in pails of water and slices are cut for sale as wanted, the fish selling dear whilst it retains life, while what remains after death is considered as of little value." Owing to the breadth of their bodies, they are able to progress in a serpentine manner, chiefly by means of their pectoral and caudal fins, first one of the former being advanced and then its fellow. They are exceedingly difficult to retain in aquaria, unless the top is covered over, as otherwise they manage to escape and proceed on their travels. These fishes appear to be monogamous, some breeding in grassy swamps or the edges of tanks; some in wells or stone-margined receptacles for water, and others again in holes in the rivers' banks. When very young the fry of all these species keep with and are defended by their parents, but as soon as they are sufficiently strong to capture prey for themselves, they are driven away to seek their own subsistence; those which are too obstinate to leave being, it is believed, eaten by their progenitors. The varieties which live in tanks and swamps delight in residing at their shallow and grassy edges, so that they can take in with ease their modicum of air for the purpose of breathing, or capture any frog that may incautiously venture too close to their lair. These fishes appear to be well adapted for pisciculture, as some grow to a large size, whilst all are good eating. The smallest, *O. gachua*, attains about a foot in length and thrives in almost any situation. They are rather voracious, but appear to consider a frog, mouse, or rat as luscious a morsel as a fellow fish. They assist in keeping water pure by destroying either animal or vegetable substances which may come in their way.