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Paraxenisthmus cerberusi, a New Species of Xenisthmid Fish from Palau (Percomorpha: Gobioidei)

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***Paraxenisthmus cerberusi*, described from four specimens from Augulpelu Reef, Palau, differs from its only congener (*P. springeri* from the Solomon Islands) in the following characteristics: pectoral fin rays 15–16 (vs. 18); posterior nasal (B) and ventral preopercular (Q′) cephalic lateralis pores absent (vs. present); head, nape, ventral abdomen, and dorsal midline of caudal peduncle naked (vs. scaled); and caudal peduncle with large black blotch (vs. no black blotch).**

XENISTHMIDS are small sand-diving gobioid fishes found throughout the Indo-Pacific. Gill and Hoese (1993) erected the genus *Paraxenisthmus* to include a single species, *P. springeri*, known only from the two type specimens from the Solomon Islands. The genus is readily distinguished from other xenisthmid genera (*Allomicrodesmus*, *Rotuma*, *Tyson*, and *Xenisthmus*) in having vomerine and palatine teeth. Recent fieldwork by the first author in Palau yielded four specimens of a second species of *Paraxenisthmus*, which we describe herein.

MATERIALS AND METHODS

Measurements were made with dial calipers, recorded to the nearest 0.1 mm. All measurements to the snout tip were made to the mid-anterior tip of the upper lip. Standard length (SL) is the distance from the snout tip to the middle of the caudal-fin base. Predorsal, preanal, and prepelvic lengths are distances from the snout tip to the base of the anteriormost spine of the relevant fin. Head length is the distance from the snout tip to the dorsal edge of the gill opening where the gill membrane joins the side of the head. Head width is the broadest measurement between the posterior edges of the preopercles. Body width is the distance between the pectoral-fin bases. Snout length is over the shortest distance from the snout tip to the orbital rim. Orbit diameter is the horizontal width of the eyeball. Bony interorbital width is the least measurement. ''Snout tip to retroarticular tip'' is the distance from the snout tip to the posteriormost tip of the retroarticular bone. Caudal-peduncle length is the distance from the base of the posteriormost anal-fin ray to the ventral edge of the caudal peduncle at the vertical through the posterior edge of the lower hypural plate. Caudal-peduncle depth is the oblique distance between the bases of the posteriormost anal- and dorsal-fin rays. Pectoral-fin base depth is the vertical depth of the fleshy lobe. Pectoral-fin length is the length of the longest ray. Caudal-fin length is the length of the ventralmost ray on the upper hypural plate. Other measurements are self explanatory.

The last ray in the anal and second-dorsal fins is divided at its base and was counted as a single ray. The pattern of interdigitation of first-dorsal-fin proximal pterygiophores between neural spines is given as a dorsal-fin pterygiophore formula following Birdsong et al. (1988). Names of the cephalic lateralis pores follow Lachner and Karnella (1980), with letter codes for these pores as used by Akihito (1984; see also Gill and Randall, 1994: fig. 2) in parentheses. Specimens were temporarily stained with Cyanine Blue 5R to facilitate examination of small structures (Saruwatari et al., 1997). Osteological details were determined from x-radiographs and a cleared-and-stained paratype (ROM 1765 CS, prepared following the methods of Taylor and van Dyke, 1985). Photographs are by the senior author. Institutional codes follow Leviton et al. (1985).

Counts and morphometric values are presented first for the holotype, followed, where different, by value ranges or frequency distributions for paratypes in parentheses. Where counts were recorded bilaterally from the holotype, both counts are given and separated from each other by a slash; the first count presented is the left count.

Paraxenisthmus cerberusi, new species

Figures 1–3

Holotype.—ROM 76575, 20.7 mm SL, male; Palau, Short Drop-off at SW corner of Augulpelu Reef SE of Koror Island, 7°16′54.3″N, 134°31′38.7″E; vertical drop-off with caves and sandy shelves and slopes; hydroids, sea fans, a variety of hard corals, and some *Halimeda*; 15–26.5 m; rotenone; field no. RW 04-19, 28 May 2004, R. Winterbottom, W. Holleman, B. Hubley, and D. Winterbottom.

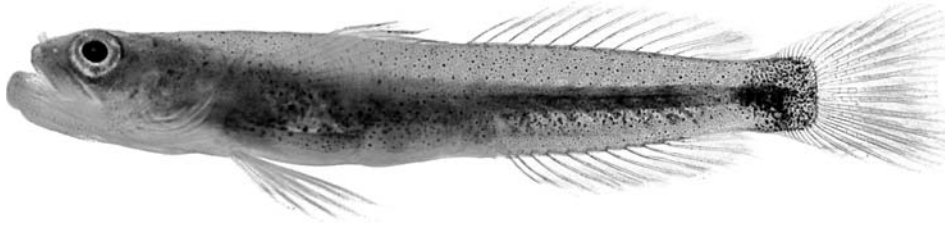

Fig. 1. *Paraxenisthmus cerberusi*, holotype, ROM 76575, 20.7 mm SL male, Palau, Augulpelu Reef.

Paratypes.—ROM 1765 CS, 18.6 mm SL female (cleared-and-stained), collected with holotype; ROM 77854, 13.6 mm SL juvenile, collected with holotype; ROM 76576, 20.8 mm SL female; Short Drop-off at SW corner of Augulpelu Reef SE of Koror Island, 7°16′26.9″N, 134°31′29.3″E; vertical drop-off with caves and ledges, some silty sand; hydroids, sea fans, a variety of hard corals, and some *Halimeda*; 12–21 m; rotenone; field no. RW 04–04, 20 May 2004, R. Winterbottom, B. Hubley, A. Bauman, and S. Kiefer.

Diagnosis.—A species of *Paraxenisthmus* distinguished from its only congener in having pectoral-fin rays 15–16 (vs. 18); cephalic lateralis pore P absent (vs. present); head, nape, ventral abdomen, and dorsal midline of caudal peduncle naked (vs. scaled); and caudal peduncle with large black blotch (vs. no black blotch).

Description.—Dorsal-fin rays VI+I,11 (I,12 once), all (last 10) segmented rays branched (all rays unbranched in 13.6 mm SL paratype); first dorsal-fin pterygiophore formula 3-22110; anal-fin rays I,10, last 9 (8–9) segmented rays branched (all rays unbranched in 13.6 mm SL paratype); pectoral-fin rays 16/15 (16 in all), upper 2/2 (2–3) and lower 2/1 (2) ray(s) unbranched (all rays unbranched in 13.6 mm SL paratype); pelvic-fin rays I,5, all segmented rays unbranched; segmented caudal-fin rays 9+8; branched caudal-fin rays 7+6 (all rays unbranched in 13.6 mm SL paratype); upper unsegmented caudal-fin rays 8 (7 once); lower unsegmented caudal-fin rays 8 (7 once); total caudal-fin rays 33 (31 once); gill rakers absent; vertebrae 10+16; epurals 2.

Scales present on sides of caudal peduncle and on body behind vertical through anal-fin origin, with broad wedge of scales extending anteriorly to beneath pectoral fin (anteriormost extent varying from near fin base to beneath posterior third of fin when adpressed), scales from anteriormost point near pectoral base to hypural edge 49/51 in holotype (40–46 in two largest paratypes; smallest paratype lacking scales); at least some scales on caudal peduncle with 1–4 peripheral cteni; no scales on head, nape, ventral body, or dorsal midline of caudal peduncle.

As percentage of SL (based on holotype and two largest paratypes): head length 28.5 (29.3–29.6); predorsal length 37.2 (38.5–39.8); prepelvic length 26.5 (23.6–29.0); preanal length 59.9

Fig. 2. *Paraxenisthmus cerberusi*, paratype, ROM 77854, 13.6 mm SL juvenile, Palau, Augulpelu Reef. Note: head and anterior body twisted to the left so that head is in dorsolateral view.

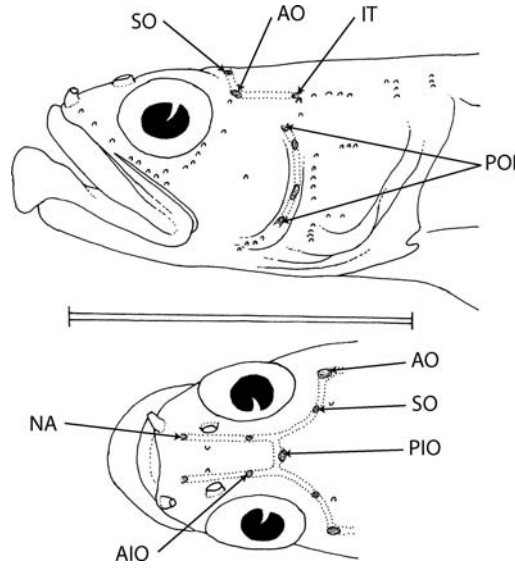

Fig. 3. *Paraxenisthmus cerberusi*, holotype, ROM 76575, 20.7 mm SL male, left lateral (above) and dorsal (below) figures of head to show cephalic lateralis system pores and papillae. Canals outlined by dotted lines, papillae U-shaped, scale bar = 5 mm. Abbreviations: AIO = anterior interorbital; AO = anterior otic; IT = intertemporal; NA = anterior nasal; PIO = posterior interorbital; POP = preopercular; SO = supraotic.

(60.8–62.0); first dorsal-fin origin to second dorsal-fin origin 17.4 (18.8–19.7); second dorsal-fin base length 28.0 (26.0–28.0); anal-fin base length 23.7 (20.7–21.5); pectoral-fin base depth 9.7 (8.2–8.7); first dorsal-fin origin to pelvic-fin origin 19.8 (19.2–21.0); second dorsal-fin origin to anal-fin origin 14.5 (15.4–15.6); snout length 5.8 (6.3–6.5); orbit diameter 7.7 (7.5–8.2); head width 15.9 (16.1–16.8); body width 15.0 (14.9–15.6); bony interorbital width 3.9 (3.2–3.4); snout tip to retroarticular tip 14.5 (15.1–15.9); caudal-peduncle length 18.4 (17.7–18.3); caudal-peduncle depth 10.6 (9.1–9.7); length of first spine of first dorsal fin 12.1 (9.7–10.6); length of third spine of first dorsal fin 11.1 (10.8–11.5); length of sixth spine of first dorsal fin 5.8 (5.3–7.5); length of spine of second dorsal fin 5.8 (8.7); length of first segmented ray of second dorsal fin 10.6 (9.7–10.6); length of last segmented ray of second dorsal fin 11.1 (8.1–10.1); anal-fin spine length 6.8 (6.5–7.2); length of first segmented anal-fin ray 8.7 (8.6–10.1); length of last segmented anal-fin ray 11.1 (9.7–11.1); pectoral-fin length 19.8 (17.3–18.3); fourth segmented pelvic-fin ray length 24.2 (20.4–22.1); caudal-fin length 17.9 (16.3–16.7).

Head pores (Fig. 3): anterior nasal (A′), anterior interorbital (C), posterior interorbital (D, single twice, double once), supraotic (E), anterior otic (F), intertemporal (H′), four preopercular (M'NOP′), all head pores absent in 13.6 mm SL paratype; sensory papillae much reduced, especially on cheek where there is a single papilla at mid-cheek; lower lip fleshy and protruding, with uninterrupted, free ventral margin; anterior naris in short tube; posterior naris with raised rim, without prominent membranous flap anteriorly; tongue indented anteriorly; gill opening extending anteriorly to vertical through posterior edge of eye.

Upper jaw with two or three (anteriorly) or one or two (posteriorly) rows of slightly curved conical teeth; lower jaw with two or three (anteriorly) or two (posteriorly) rows of slightly curved conical teeth; vomer with two widely separated, triangular to oval patches of slightly curved conical teeth arranged in 1–3 rows; each palatine with an elongate patch of large, conical teeth arranged in 1–3 rows.

Coloration at capture.—Based on color slides of the 20.6 mm SL adult holotype and a 13.6 mm SL juvenile paratype. Adult (Fig. 1) with a broad, red stripe, eye diameter in width, with diffuse edges covering the snout and upper jaw and passing posteriorly and a little ventrally so that the dorsal edge of the stripe lies level with the dorsal margin of the pectoral fin, the stripe continuing posteriorly, the ventral half ending at the end of the abdominal cavity, the dorsal half continuing posteriorly covering the vertebral centra where it is heavily invested with melanophores, ending in a diffuse, almost rectangular, black blotch about 1.5 times eye diameter in width and covering the end of the vertebral column as far posteriorly as the bases of the caudal-fin rays. Numerous large melanophores, apparently on the peritoneum, are visible in the abdominal region. Above the stripe, the body is semi-translucent, with a moderate scattering of small melanophores and orange-red chromatophores, the latter internal and more or less confined to the neural spines. The region below the caudal vertebrae is similar to that above it, but the melanophores in the distal half are much larger and more irregular in shape and the orange-red chromatophores do not clearly delineate the haemal spines. The tip of the lower jaw is faintly red, with the ventral region of the head and the area anterior to the pelvic-fin base semi-translucent and without pigmentation. The fin elements of the dorsal and pectoral fins are faintly reddish, those of the other fins unpigmented. The basal regions of the median fins have a fine diffuse line of red. The juvenile (Fig. 2) has a semi-translucent body densely covered with large melanophores, which often abut each other. The pigmentation is especially concentrated along the vertebral column, lightening a little just anterior to the ural region of the peduncle, and then darkening again to form an intense black blotch, somewhat attenuated anteriorly, covering the end of the peduncle, the procurrent caudal-fin rays, and the bases of the segmented caudal rays. The fin elements of the median fins are lightly margined with melanophores. A thin, somewhat wavy, internal black stripe is visible from above the pectoral-fin base almost to the end of the abdominal cavity, and appears to line the roof of neural canal.

Coloration in preservative.—Body coloration of adult off-white, no traces of red or orange-red pigmentation. Surface melanophores as for fresh specimen, but the only internal pigmentation externally visible through the body wall are the melanophores on the ventral half of the gut. Juvenile similar, although the far more intense coverage of melanophores on the body make it dark overall.

Comparisons.—*Paraxenisthmus cerberusi* differs from its congener, *P. springeri*, in having fewer pectoral-fin rays (15–16 vs. 18); no posterior nasal (pore B) and fewer preopercular pores (pore Q′ absent) vs. both present in *P. springeri*;

and a less complete coverage of scales on the head and body (in *P. springeri* scales are present on the cheeks, anterodorsal part of the operculum, the predorsal area, the pectoral-fin base, the ventral abdomen, and on the dorsal edge of the caudal peduncle). The two species also differ markedly in preserved coloration: in contrast to *P. cerberusi*, *P. springeri* has extensive dusky mottling (which forms a series of 12 bars on the upper sides) and lacks a large black blotch on the caudal peduncle.

Etymology.—Named after Cerberus, the three-headed dog guarding the gates of Hades in Greek mythology, in allusion to the relatively toothy attributes of the genus, and to the black juveniles and red and black adults, colors which are often associated with the darkness and flames of the Christian concept of the Underworld.

Discussion

This species, like its congener, appears to be piscivorous, as the gut of the cleared-and-stained paratype contains several fish vertebrae and scales. However, it also contains several whole and fragmentary crustaceans, some of which are identifiable as copepods.

Gill and Hoese (1993) hypothesised the following relationships among xenisthmid genera: (*Paraxenisthmus* (*Xenisthmus* (*Allomicrodesmus* + *Rotuma* + *Tyson*))). Among the ten synapomorphies of the *Allomicrodesmus* + *Rotuma* + *Tyson* clade are: scales absent (character 17); sensory pores absent (character 18); all segmented dorsal-fin rays unbranched (character 20); all segmented anal-fin rays unbranched (character 21); and all pectoral-fin rays unbranched (character 22). Each of these character states is also present in the smallest paratype of *P. cerberusi*. Given this, and considering the relatively small adult sizes of species of *Allomicrodesmus*, *Rotuma*, and *Tyson*, we conclude that these characters have resulted from developmental truncation.

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