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*EUSTOMIAS CRUCIS* (STOMIATOIDEI, MELANOSTOMIATIDAE). A NEW SPECIES OF DEEPSEA FISH FROM THE EASTERN SOUTH PACIFIC, AND CONTRIBUTIONS TO THE KNOWLEDGE OF *EUSTOMIAS TREWAVASAE* NORMAN

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Among the midwater fishes collected in the eastern South Pacific during cruise 13 of the R/V ANTON BRUUN (Craddock and Mead, 1970) were two species of the genus *Eustomias*. One of these, unfortunately represented by a single specimen, is an undescribed species. The second species is referable to *E. trewavasae* Norman. These are the only two species of *Eustomias* thus far recorded from the eastern South Pacific and the southern portion of the Peru Current. This paper describes the new species and presents new taxonomic and distributional data for *E. trewavasae*.

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Museums at which the specimens are located are indicated by the following abbreviations: BMNH, British Museum (Natural History), London; ISH, Institut für Seefischerei, Hamburg; LACM, Los Angeles County Museum; MCZ, Museum of Comparative Zoology, Harvard University; USNM, National Museum of Natural History, Smithsonian Institution, Washington, D.C.; ZMUC, Zoologiske Museum, University of Copenhagen. Abbreviations used in the descriptions are: SL, standard length; HL, head length.

***Eustomias crucis***, new species

Figure 1

*Holotype and only known specimen*: MCZ 49062, a maturing female, 166.0 mm standard length. R/V ANTON BRUN Cruise 13, collection 26, 31°16'S, 92°28'W to 30°59'S, 92°28'W, 0-380 m, 20-21 January 1966, 2014-0138 hours local time, 10 foot (3-m) Isaacs-Kidd midwater trawl.

*Diagnosis*: A species of *Eustomias* with two pectoral rays and the barbel stem dividing into two main branches.

*Description*: Dorsal rays 25; anal rays 38; pectoral rays 2; pelvic rays 7. Photophores: IP 7, PV 29, VAV 15, four over anal base, the last over anal ray 8, OV 29, VAL 15, AC 21. Premaxillary teeth on left side 12, depressible except numbers 1, 4, and 8, number 3 longest; on right side 11, depressible except numbers 1, 3, and 7, number 2 longest. Maxilla with small serrae. Mandibular teeth 12 on both sides, depressible except numbers 1, 4, and 7, number 1 longest. No teeth on vomer or palatines. Three pairs of teeth on basibranchials. No gill rakers or teeth. Branchiostegal photophores 11. Notochord U-shaped behind cranium; a neural arch but no centrum just behind cranium; an isolated, vertically oriented centrum with haemal arch on descending part of notochord; about four neural and haemal arches, but no centra, on ascending part or second, slight ventrad bend. A continuous row of 65 well-developed centra posterior to the last isolated neural arch.

Measurements, followed by percent of SL in parentheses: snout to dorsal origin 139.8 (84.2), snout to anal origin 121.7 (73.3), snout to



FIG. 1. *Eustomias crucis*, holotype. Head and distal end of barbel. The third mandibular tooth is actually a replacement for the second tooth and is not included in the tooth count. Drawn by Howard E. Hamman.

pelvic insertion 91.6 (55.1), depth behind head 11.0 (6.6), greatest depth 13.2 (8.0), caudal peduncle depth 2.8 (1.7), head length 18.4 (11.1), snout to fleshy orbit 5.9 (3.6, 32.1% of HL), fleshy orbit length 4.6 (2.8, 25.0% of HL), bulb of postorbital organ 1.5 (0.9, 32.6% of fleshy orbit), upper jaw length 16.4 (9.9, 89.1% of HL), longest premaxillary tooth 2.9 (15.8% of HL), longest mandibular tooth 2.1 (11.4% of HL), barbel overall length 103.8 (62.5, 564.1% of HL), barbel stem to junction of two main branches 57.0 (34.3), longer branch overall length 46.8 (28.2), shorter branch length without terminal filaments 23.8 (14.3), pectoral fins broken, the rays closely bound together, pelvic fin length 20.5 (12.3), length of dorsal fin base 21.7 (13.1), length of anal fin base 38.4 (23.1).

Barbel without prominent bulbs, its stem branching into two main distal branches; the longer branch with several smaller branches, some of which contain bulblets; the shorter branch simple until its tip, which ends in a small swelling and several filaments.

Head and body dark brown to black, without organized patches of lighter material. Pectoral fin rays very darkly pigmented; all other fin rays lightly to moderately pigmented, the interradiation membranes transparent.

*Comparisons:* Including *E. crucis*, 15 recognized species of *Eustomias* have two pectoral rays (Morrow and Gibbs, 1964). Of these, *E. crucis* is the only one lacking relatively large bulbs in its barbel. The species in the group that includes *E. bigelowi*, *binghami*, *parvibulbus*, *silvescens*, *schmidti*, *fissibarbis*, and *dendriticus* have relatively short barbels with a well-developed terminal bulb and a branch or three branches arising together from the stem well proximal to the terminal bulb. In *E. brevis-barbatus* and *polyaster* the barbel has two or more distal bulbs, while in *E. xenobolus*, *globulifer*, *leptobolus*, *macrophthalmus*, and *dubius* the barbel has a single terminal bulb; none of these seven species has prebulbar branches.

When the barbel is intact, the only species that closely resembles *E. crucis* is *E. bifilis*, which normally has three pectoral rays, one of which is slightly separated from the other two. These are the only two known species of *Eustomias* with the stem of the barbel dividing into two main branches. Gibbs has examined more than 100 specimens of *E. bifilis*, which is perhaps the most abundant species of *Eustomias* in Indian Ocean and Pacific equatorial and central waters. The barbel of *E. bifilis* varies only slightly from that illustrated in the original description (Gibbs, 1960). A large number of side branches, as are present on the longer branch of the barbel of *E. crucis*, has never been observed in *E. bifilis*, and *E. bifilis* has a small bulb at or near the distal end of both branches. Comparison of meristic and morphometric characters in these two species suffers from lack of information on variation in *E. crucis*. Nevertheless, the fully developed barbel appears to be longer in *E. crucis* (62.5% SL) than in most *E. bifilis* (23–43% SL; in one specimen of 134 mm, 72% SL). In the holotype of *E. crucis*, there are two more photophores in both the ventral and lateral series than have been observed in *E. bifilis* (72 and 65 vs. 64–70 and 58–63), largely due to high counts in the VAV, VAL, and AC portions (15, 15, and 21 vs. 12–14, 12–15, and 16–20); probably there will be overlap when *E. crucis* becomes better known.

*Etymology:* The name *crucis* is the genitive form of the Latin noun *Crux*, referring to the Southern Cross, the constellation that watches over the waters inhabited by this fish.

*Geographic distribution:* The holotype of *E. crucis* was taken at the westernmost of 42 midwater trawling stations that began just off the coast of Valparaiso, Chile (Craddock and Mead, 1970). This suggests that *E. crucis* may belong to the fauna of the South Pacific central waters, a fauna that has been sampled exceedingly poorly.

*Eustomias trevavasae* Norman

Figure 2

Until now, the only published information on this species has been the original description (Norman, 1930), inclusion in a key to known species of *Eustomias* (Morrow and Gibbs, 1964), and the observation,



FIG. 2. *Eustomias trewavasae*, 178.6 mm female. Head and distal end of barbel. This is one of the few specimens in which the second premaxillary tooth is longer than the first. It is also one of the few in which there are no filaments associated with either of the two proximal bulbs of the barbel. Drawn by Howard E. Hamman.

unsupported by data, that it occurs in the Subtropical Convergence of the Atlantic, Indian, and Pacific Oceans (Gibbs, 1968). We present here an extended description of the species and its geographic range.

**Diagnosis:** A species of *Eustomias* with three pectoral rays, a low number of serial photophores (IC 65-72, PV 29-32, AC 14-17), a low number of anal rays (31-37), and an unbranched barbel with four distal bulbs.

**Description:** Meristic characters based on 16 specimens, including the holotype. Dorsal rays 20-26; Anal rays 31-37; Pectoral rays 3; Pelvic rays 7; Photophores in ventral series: IP 7 (or 8), PV 29-32, VAV 14-17, five or six over anal base, the last over anal ray 10 or 11, AC 14-17, IA (series without AC) 51-56, IC (total series) 65-72; in lateral series: OV 30-32, VAL 15-17, OA (series without AC) 46-49,

OC (total row including AC) 60-65. Maxilla with small serrae. Pre-maxillary teeth 8-13, anteriormost tooth usually longest. Mandibular teeth 10-17, second tooth usually longest. No teeth on vomer or palatines. Three pairs of teeth on basibranchials. Branchiostegal photophores 8-11. Notochord U-shaped behind cranium; a neural arch but no centrum just behind cranium; an isolated, vertically-oriented centrum with haemal arch on descending part of notochord. About six neural and haemal arches, but no centra, on ascending part and fairly long following portion, which may be straight or bent ventrad. A continuous row of 59-63 centra posterior to the last isolated neural arch.

Measurements, in percent of SL, from 13 specimens, 45.7-178.6 mm, including the holotype. Snout to dorsal origin 81.6-86.0; snout to anal origin 72.7-76.4; snout to pelvic insertion 57.6-62.5; depth behind head 4.5-7.7; greatest depth 4.5-9.1; caudal peduncle depth 1.5-2.1; head length 12.1-17.0; snout to fleshy orbit in five specimens less than 90 mm, 6.2-8.7 (46.9-51.3% HL), in six specimens longer than 125 mm, 4.2-5.3 (33.1-40.6% HL); fleshy orbit length 2.3-4.0 (17.1-21.8% HL); bulb of postorbital organ in young and females 45.7-178.6 mm, 0.2-0.7 (6.3-26.8% of fleshy orbit), in males 127.3-159.4 mm, 1.4-1.5 (52.9-53.3% of fleshy orbit); upper jaw length 10.5-14.6 (78.1-88.9% HL); longest premaxillary tooth in two specimens less than 60 mm, 2.8 (16.7% HL); in six specimens longer than 70 mm, 1.4-1.9 (11.1-14.2% HL), longest mandibular tooth in six specimens longer than 125 mm, 1.1-1.8 (8.0-14.6% HL); barbel length in two specimens less than 70 mm, 28.9-29.5 (201-237% HL), in eight specimens longer than 70 mm, 44.1-73.3 (336-536% HL); length of largest barbel bulb (usually the first or second) 0.8-1.2 (27.3-44.7% of fleshy orbit), pectoral-fin length in 3 specimens 127.3-141.3 mm, 8.0-10.2; pelvic-fin length 10.5-14.0; length of dorsal-fin base 11.5-14.2, length of anal-fin base in three specimens less than 60 mm, 19.8-22.8, in nine specimens longer than 70 mm, 23.0-24.1.

Barbel with four small distal bulbs, the proximal two (first and second) moderately separated from each other, the distal pair (third and fourth) close together and widely separated from the proximal two. Distalmost bulb commonly constricted, with a broad base and narrower apical lobe. A cluster of short to long filaments usually present at distal end of second bulb (of first bulb in one specimen); several tiny filaments observed at apex of distal bulb in one specimen; no other filaments noted.

Colors of barbel bulbs when freshly caught were observed by Gibbs in two South Atlantic specimens. In the first, the 141.3 mm female, before preservation the first (proximal) bulb was yellowish green, the second pea green, the third dark bluish green, and the fourth (distal) pea green. In the second, the 154.1 mm female that had been in formalin about 8 hours, the first two bulbs were reddish brown, the third bluish green, and the fourth yellowish green. The postorbital photophores in both were white.

Head and body dark brown to black, without organized patches of lighter material. Pectoral- and pelvic-fin rays either very lightly or not pigmented; all other fin rays and all interradial membranes with little or no pigment.

*Comparisons:* Twelve recognized species of *Eustomias* have three pectoral rays (Morrow and Gibbs, 1964; Johnson and Rosenblatt, 1971). Of these, *E. trewavasae* is the only one with four barbel bulbs. Three other species have two or more such bulbs: *E. bibulbosus* has two; *E. melanostigma* has two or, rarely, three; and *E. polyaster* has more than four. Only in *E. bifilis* is the barbel divided into two branches. The remaining seven species have a single terminal bulb (a few specimens of *E. obscurus* have been observed with two bulbs). When the barbel is intact, identification of *E. trewavasae* presents few difficulties.

Although meristic characters of these species with three pectoral rays are very similar, two groups of species can be separated out on the basis of counts. Four species have low numbers of serial photophores (64–72 in the total ventral series, IC): *E. enbarbatus*, *bifilis*, *simplex*, and *trewavasae*. The IC count is 72–80 in the other group of eight species: *E. obscurus*, *bibulbosus*, *melanostigma*, *bulbornatus*, *polyaster*, *gibbsi*, *patulus*, and *longibarba*. The PV portion of the ventral series appears to account for much of the difference: 26–32 in the first group, 30–36 in the second, and the difference is reflected in the anal-ray counts: 31–38 in the first group, 33–46 in the second. The AC photophore count of *E. trewavasae* is distinctly low, 14–17, compared with 16–23 in the other 11 species.

*Sexual dimorphism:* Sex was determined for 9 specimens: 2 males 127.3–159.4 mm and 7 females 71.2–178.6 mm. Only the largest female had well-developed gonads, with eggs about 0.5 mm in diameter. Two others, 45.7–56.8 mm could not be sexed by gross examination (4 more lacked coelomic organs, and the holotype was not sexed).

Males have a larger postorbital organ than females, about half the diameter of the fleshy orbit as opposed to one-fourth or less of the fleshy orbit diameter in females.

The only other suggested dimorphism, based on only three specimens, is in pelvic-fin length, where the fin is 8.0% of SL in one male, 9.9–10.2% in two females.

*Geographic distribution, and variation:* Apparently a member of the Subtropical Convergence fauna, *E. trewavasae* has been taken between 33°41' and 40°14'S in the Atlantic, Indian, and Pacific Oceans.

Although the number of specimens is small, those from the South Pacific (New Zealand to South America) tend to have more photophores and vertebrae than those from the Atlantic and Indian oceans (Table 1). There are no obvious trends that indicate differences between Atlantic and Indian Ocean specimens. These observations suggest that the Pacific population is relatively isolated from those in the Atlantic-Indian Oceans, while the latter two populations experience considerable interchange.

TABLE 1. *Eustomias trewavasae*. Photophores and vertebrae of specimens from three oceans, showing high counts in the Pacific population. Vertebral counts include only those in the continuous series.

	Ventral Photophores (IC)							
	65	66	67	68	69	70	71	72
Atlantic			1	-	-	1	1	
Indian	1	-	-	1	1			
Pacific						3	2	1

  

	Vertebrae					Lateral Photophores (OC)					
	59	60	61	62	63	60	61	62	63	64	65
Atlantic	1	-	-	1			1	1	1		
Indian	3	2	1			1	1	-	1		
Pacific				4	2					2	2

*Vertical distribution:* Diel vertical migration is suggested, although none of the thirteen collections was made with a closing device. Maximum depths of three daytime collections were 820 m to ca. 1250 m, of six night collections 50 to 1015 m (only one was deeper than 700 m). Four collections include crepuscular (migration) periods and are not considered. During the day, *E. trewavasae* appears to live deeper than 800 m, while at night it occurs at depths shallower than 700 m.

*Material examined:* Atlantic Ocean (3 specimens). BMNH 1930.1. 12.531, Holotype (60.4 mm), R/V DISCOVERY sta. 79, 34°48'S, 16°36'W, 0-1000 m, 13 June 1926, 1420-1525 hrs. ISH, 1, female (141.3 mm) FFS Walther Herwig sta. 358/71-III, 39°47'S, 43°30'W, 0-1015 m, 7 March 1971, 2142-2157 hrs. ISH, 1, female (154.1 mm) FFS Walther Herwig sta. 371/71-III, 40°00'S, 30°30'W, 0-700 m, 10 March 1971, 2105-2305 hrs.

Indian Ocean (7 specimens). USNM 201037, 1 (75.7 mm), R/V ANTON BRUUN, cruise 3, trawl 23, 35°09'S, 59°57'W, 0-680 m, 9-10 September 1963, 2300-0140 hrs. USNM 201038, 2 (45.7-56.8 mm) R/V ANTON BRUUN cruise 6, trawl 352 B, 34°14'S, 64°58'E, 0-750 m, 30 June 1964, 1420-2000 hrs. USNM 201036, 1 female (164.2 mm) R/V ANTON BRUUN, cruise 6, trawl 353A, 37°59'S, 64°56'E, 0-2394 m, 2 July 1964, 1115-1925 hrs. MCZ 45992, 3 (56.3-59.7 mm), same data as USNM 200138.

Pacific Ocean (6 specimens). ZMUC P202821, 1 male (159.4 mm), R/V DANA, sta. 3651(1), 35°36'S, 171°52'E, 0-ca. 1250 m, 22 January 1929, 1530 hrs. LACM, 1 female (134.1 mm), USNS ELTANIN, cruise 24, sta. 1738, 40°14'S, 144°45'W, 0-ca. 50 m, 26 July 1966, 0040-0155 hrs. MCZ 49063, 1 female (71.2 mm), R/V ANTON BRUUN, cruise 13, coll. 24, 33°48'S, 90°19'W, 0-2900 m, 19 January 1966, 0300-



0940 hrs. MCZ 49064, 1 female (178.6 mm), R/V ANTON BRUUN, cruise 13, coll. 22, 33°51'S, 87°49'W, 0-375 m, 18 January 1966, 0013-0530 hrs. MCZ 49065, 1 female (88.5 mm), R/V ANTON BRUUN, cruise 13, coll. 17, 33°50'S, 82°06'W, 0-370 m, 14-15 January 1966, 2326-0330 hrs. MCZ 49066, 1 male (127.3 mm), R/V ANTON BRUUN, cruise 13, coll. 40, 33°31'S, 77°29'W, 0-820 m, 28 January 1966, 1113-1440 hrs.

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