

Enneapterygius phoenicosoma, a New Species of Triplefin (Tripterygiidae) from the Western Pacific Ocean

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(Received 19 November 2014; Accepted 13 February 2015)

A new species of triplefin (Tripterygiidae), *Enneapterygius phoenicosoma*, is described on the basis of 71 type specimens (17.2–37.2 mm standard length: SL) from southern Japan. An additional five specimens from the Caroline Islands and Vanuatu are also identified as belonging to this species. Males of the new species have the same distinct nuptial coloration as males of the Hawaiian endemic species *E. atriceps* (Jenkins, 1903). Comparisons of the present material with the holotype and 46 non-type specimens of *E. atriceps* show, however, that *E. phoenicosoma* differs from the latter in having a simple nasal tentacle (vs a bilobed tentacle in *E. atriceps*); lower counts of the anal-fin soft rays (16–18, mode 17 vs 19–21, 19); second dorsal-fin spines (11–13, 12 vs 12–15, 14); scale rows in longitudinal series (32–35, 33 vs 35–37, 36); and pored lateral-line scales (16–19, 17 vs 17–20, 19); a higher count of the pectoral-fin rays (15–17, 16 vs 14–17, 15); and several morphometric features, including the lengths of the dorsal-fin spines and rays, the second dorsal-fin base, and the anal-fin base. The new species grows larger than *E. atriceps* (largest recorded size, 37.2 mm SL vs 26.9 mm SL in *E. atriceps*).

Key Words: Actinopterygii, Teleostei, Perciformes, *Enneapterygius atriceps*, Japan, morphology.

Introduction

The triplefin genus *Enneapterygius* Rüppell, 1835, the largest genus of tripterygiids, has been diagnosed by a discontinuous lateral line with an anterior series of 6–22 pored scales and a posterior series of 13–27 notched scales, a first dorsal fin with three spines, an anal fin with one spine, pelvic fins with one spine and two soft rays, and a naked head, opercle, pectoral-fin base, and abdomen (Fricke 1997). However, synapomorphies for the genus have not been found, and further investigation at the generic level is therefore necessary.

During surveys of the ichthyofauna of southern Japan from southern Kyushu to the Ryukyu Islands (e.g., Motomura and Matsuura 2010, 2014; Motomura *et al.* 2013), 71 specimens of a species attributed to *Enneapterygius* were collected in depths of less than 25 m. The specimens were similar to the Hawaiian endemic species *Enneapterygius atriceps* (Jenkins, 1903) in their overall appearance and the coloration of nuptial males, but differed in several aspects, including the shape of the tentacle on the anterior nostril, scale and fin-ray counts, and various morphometrics. The species from Japan is herein described as new, and five specimens from the Caroline Islands and Vanuatu are also identified as belonging to it.

Materials and Methods

Counts and measurements follow Fricke (1997) and Holleman and Bogorodsky (2012), with the mandibular pore formula following Hansen (1986). Measurements were made to the nearest 0.1 mm with needle-point calipers under a dissecting microscope. Standard length is abbreviated as SL. Nuptial coloration is defined as the coloration of adult males during the courtship display and after death; all collected adult males retained the coloration (except for red colors) after preservation. Curatorial procedures for newly collected specimens followed Motomura and Ishikawa (2013). The specimens examined in this study are deposited in the Academy of Natural Sciences of Drexel University, Philadelphia (ANSP); Bishop Museum, Honolulu (BPBM); Laboratory of Marine Biology, Faculty of Science, Kochi University, Kochi (BSKU); Coastal Branch of Natural History Museum and Institute, Chiba, Katsuura (CMNH); Field Museum of Natural History, Chicago (FMNH); the Kagoshima University Museum, Kagoshima (KAUM); Muséum National d'Histoire Naturelle, Paris (MNHN); National Museum of Nature and Science, Tsukuba (NSMT); Royal Ontario Museum, Toronto (ROM); and National Museum of Natural History, Smithsonian Institution, Suitland (USNM).



Fig. 1. Holotype of *Enneapterygius phoenicosoma* n. sp. (KAUM-I. 21960, male, 35.1 mm SL, Ichiki-kushikino, Kagoshima, Japan). A, fresh specimen; B, preserved specimen.

Enneapterygius phoenicosoma Motomura, Ota, and Meguro, n. sp.

[New English name: Red-bodied Triplefin; new Japanese name: Aka-hebigimpo] (Figs 1–6, 8A–B, 9; Tables 1–3)

Enneapterygius sp. 1: Ogaya in Takagi *et al.* 2010: 115, unnumbered 5 figs (Morode, Ehime, Shikoku, Japan).

Enneapterygius sp. 2: Meguro in Motomura and Matsuura 2014: 457, unnumbered 2 figs (Yoron-jima island, Amami Islands, Kagoshima, Japan).

Enneapterygius sp.: Iwatsubo *et al.* 2014: 89, fig. 11 (off Bando-korobana Nature Park, Ei, Minami-kyushu, Kagoshima, Japan).

Holotype. KAUM-I. 21960, male, 35.1 mm SL, off Nagasaki-bana, Kushikino-kose, Ichiki-kushikino, Kagoshima, Japan, 31°42'24"N, 130°15'44"E, 0.5–1 m, 4 August 2009, T. Yoshida, G. Ogihara, and M. Yamashita.

Paratypes. 70 specimens, 17.2–37.2 mm SL, all from Japan. **IZU PENINSULA:** NSMT-P 62088, female, 27.2 mm SL, off Ryugu-jima island, Shimoda, Shizuoka,

3–5 m, 20 December 2001, G. Shinohara and M. Yanagida. **SHIKOKU:** BSKU 75367, male, 28.6 mm SL, BSKU 75368, female, 30.0 mm SL, Murote Bay, Ainan, Ehime, 10 July 2005, E. Katayama; BSKU 101171, male, 23.7 mm SL, south side of Murote Bay, Ainan, Ehime, 21 April 2005, T. Ogaya; BSKU 101172, male, 22.8 mm SL, south side of Murote Bay, Ainan, Ehime, 18 May 2005, T. Ogaya; BSKU 114638, female, 26.3 mm SL, BSKU 114639, male, 25.9 mm SL, off Tei Beach, Kounan, Kochi, 23 June 2007. **EASTERN KYUSHU (PACIFIC SIDE):** KAUM-I. 6122, male, 33.0 mm SL, KAUM-I. 9623, male, 28.1 mm SL, KAUM-I. 9624, female, 27.8 mm SL, KAUM-I. 9629, female, 25.9 mm SL, KAUM-I. 9630, male, 27.1 mm SL, tidepool at Shirahama, Miyazaki, 31°79'N, 131°48'E, 0.1–0.5 m, 26 April 2008, M. Meguro and H. Iwatsubo. **WESTERN KYUSHU (EAST CHINA SEA SIDE):** KAUM-I. 4249, male, 29.8 mm SL, off Kurose Beach, Kasasa, Minami-satsuma, Kagoshima, 31°22'29"N, 130°10'09"E, 2 m, 28 May 2007, M. Ito; KAUM-I. 16206, male, 33.4 mm SL, KAUM-I. 16207, male, 32.9 mm SL, KAUM-I. 16208, male, 32.9 mm SL, KAUM-I. 16232, male, 27.6 mm SL, MNHN 2015–0122, female, 33.5 mm SL, MNHN 2015–0123, male, 29.2 mm SL, off Nagasaki-bana,

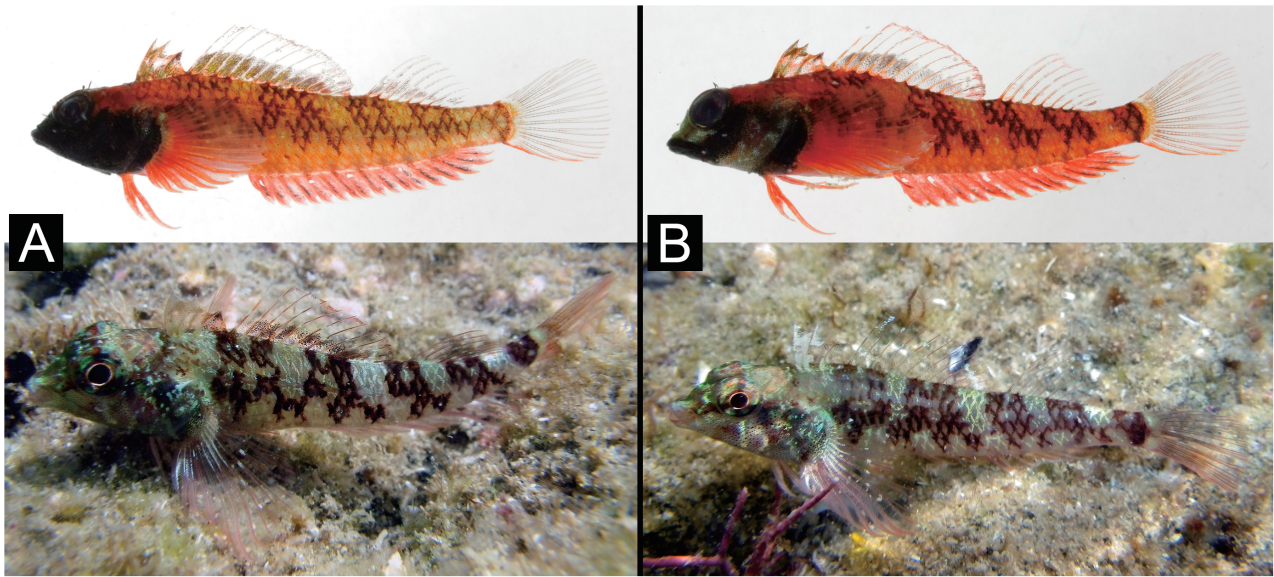


Fig. 2. Males of *Enneapterygius phoenicosoma* n. sp. from Ichiki-kushikino, Kagoshima, Japan. A, KAUM-I. 40972, paratype, 31.0 mm SL; B, KAUM-I. 40973, paratype, 31.7 mm SL. In each case, the preserved specimen and the underwater photograph represent the same individual. Underwater photographs taken at depths of 0.1–0.5 m show the normal coloration of males, and the coloration changes to the nuptial coloration immediately after death.

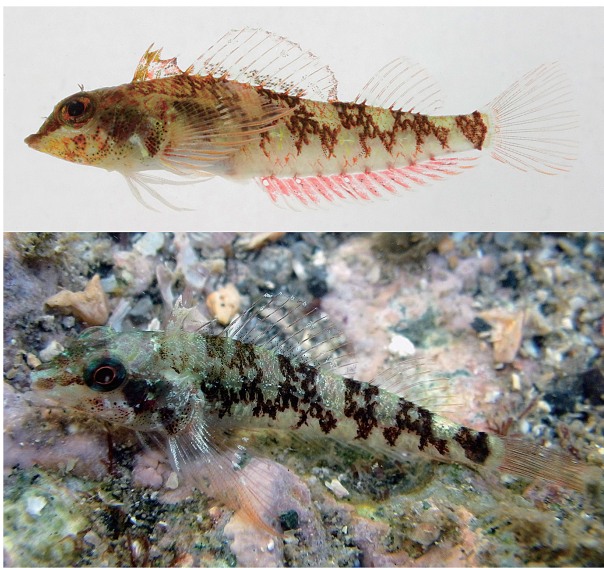


Fig. 3. Female of *Enneapterygius phoenicosoma* n. sp. KAUM-I. 40970, paratype, 28.6 mm SL, Ichiki-kushikino, Kagoshima, Japan. The two photographs represent the same individual.

Kushikino-kose, Ichiki-kushikino, Kagoshima, 31°42'24"N, 130°15'44"E, 0.5 m, 15 March 2009, M. Meguro and T. Yoshida; KAUM-I. 21990, male, 33.9 mm SL, KAUM-I. 21991, male, 32.8 mm SL, KAUM-I. 21994, male, 33.7 mm SL, KAUM-I. 25833, female, 34.5 mm SL, KAUM-I. 26185, male, 33.7 mm SL, KAUM-I. 26186, male, 33.8 mm SL, KAUM-I. 26187, male, 32.1 mm SL, KAUM-I. 26188, male, 36.1 mm SL, KAUM-I. 26189, male, 37.2 mm SL, KAUM-I. 26190, female, 33.9 mm SL, KAUM-I. 26191, female, 31.9 mm SL, KAUM-I. 26192, female, 35.0 mm SL,

KAUM-I. 26206, male, 35.1 mm SL, KAUM-I. 26207, male, 28.6 mm SL, KAUM-I. 26208, male, 30.4 mm SL, KAUM-I. 26209, male, 29.6 mm SL, KAUM-I. 26210, male, 28.5 mm SL, KAUM-I. 26211, male, 27.2 mm SL, KAUM-I. 26250, male, 28.8 mm SL, KAUM-I. 26251, male, 27.5 mm SL, KAUM-I. 26252, female, 32.0 mm SL, KAUM-I. 26253, female, 32.0 mm SL, KAUM-I. 26254, female, 31.8 mm SL, KAUM-I. 26255, female, 31.3 mm SL, KAUM-I. 26256, female, 28.7 mm SL, same data as holotype; KAUM-I. 40970, female, 28.6 mm SL, KAUM-I. 40971, female, 35.3 mm SL, KAUM-I. 40972, male, 31.0 mm SL, KAUM-I. 40973, male, 31.7 mm SL, off Nagasaki-bana, Kushikino-kose, Ichiki-kushikino, Kagoshima, 31°42'24"N, 130°15'44"E, 0.1–0.5 m, 1 August 2011, M. Meguro; KAUM-I. 45375, male, 26.4 mm SL, off Nagasaki-bana, Kushikino-kose, Ichiki-kushikino, Kagoshima, 31°42'24"N, 130°15'44"E, 0.1–0.5 m, 1 August 2011, H. Motomura *et al.* **SOUTHERN KYUSHU:** KAUM-I. 32119, male, 30.2 mm SL, tidepool at Marukihama beach, Kushi, Bonotsu, Minami-satsuma, Kagoshima, 31°17'22"N, 130°12'45"E, 0.5 m, 10 September 2010, H. Motomura *et al.*; KAUM-I. 38722, female, 27.4 mm SL, off fishing port at Kushi, Bonotsu, Minami-satsuma, Kagoshima, 31°18'37"N, 130°13'19"E, 2–25 m, 14 June 2011, A. Simons *et al.*; KAUM-I. 47259, male, 30.0 mm SL, east coast of Chiringa-jima island, Ibusuki, Kagoshima Bay, Kagoshima, 31°16'37"N, 130°40'20"E, 0.3–1 m, 25 May 2012, H. Motomura *et al.*; KAUM-I. 55381, male, 28.3 mm SL, KAUM-I. 55382, male, 31.1 mm SL, KAUM-I. 55383, female, 30.8 mm SL, KAUM-I. 55384, male, 34.1 mm SL, KAUM-I. 55385, male, 31.2 mm SL, off Bandokoro-bana

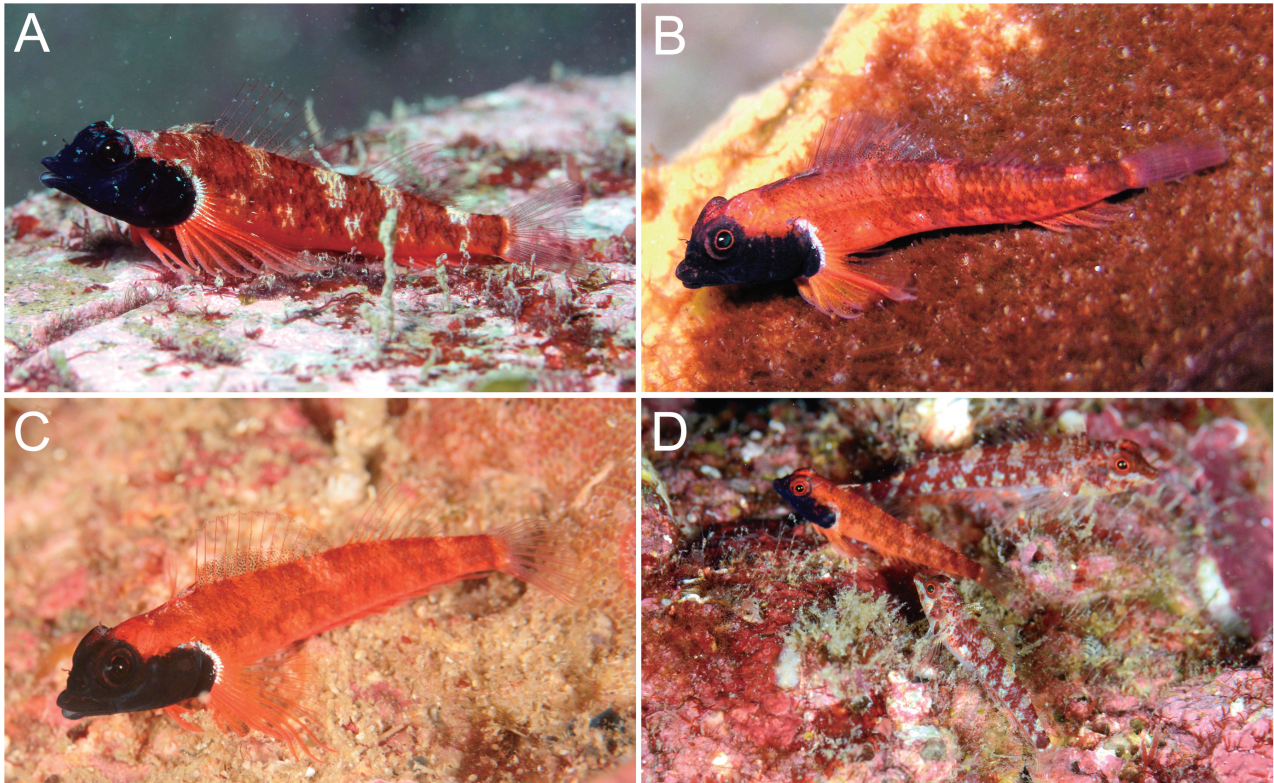


Fig. 4. Underwater photographs of nuptial males and females of *Enneapterygius phoenicosoma* n. sp. A, nuptial male, off Nobeoka, Miyazaki Prefecture, east coast of Kyushu, Japan, 0–2 m depth, 5 August 2007 (photo by K. Ota); B, nuptial male, off east coast of Izu Peninsula, Japan, 6–10 m depth (photo by S. Yamamoto); C, nuptial male, off Kii Peninsula, Japan, 11–15 m depth, 12 October 2008 (photo by D. Itou); D, nuptial male and two females, off Otsuki, Kochi Prefecture, Shikoku, Japan, 5 m depth, 29 October 2014 (photo by K. Matsuno). Live nuptial males have a reddish body with a black head and pectoral-fin base, a distinct white band along the posterior margin of the black area on the pectoral-fin base, and no dense black fins.

National Park, Beppu, Ei, Minami-kyushu, Kagoshima, 31°14'N, 130°26'E, 0.3 m, 23 June 2013, H. Iwatsubo; KAUM-I. 56701, female, 30.3 mm SL, off Bandokoro-bana National Park, Beppu, Ei, Minami-kyushu, Kagoshima, 31°14'N, 130°25'E, 4 m, 29 September 2013, H. Iwatsubo. **OSUMI ISLANDS:** KAUM-I. 29443, male, 31.2 mm SL, south coast of Iou-jima island, Mishima, Kagoshima, 30°46'32"N, 130°16'43"E, 10–20 m, 25 May 2010, KAUM Fish Team; KAUM-I. 53997, male, 28.2 mm SL, off Harutahama, Ambo, east coast of Yaku-shima island, Kagoshima, 30°18'03"N, 130°39'18"E, 8–10 m, 10 April 2013, S. Tashiro; KAUM-I. 56567, male, 19.0 mm SL, off Urata, Kunigami, Nishinoomote, Tanegashima island, Kagoshima, 30°49'36"N, 131°02'11"E, 4–8 m, 19 September 2013, S. Tashiro *et al.* **AMAMI ISLANDS:** CMNH-ZF 11219, male, 25.3 mm SL, Kurasaki, Tatsugo, Amami-oshima island, Kagoshima, 28°25'55"N, 129°37'57"E, 10 m, 1 July 2004, Y. Ikeda and M. Aizawa; KAUM-I. 17513, male, 26.2 mm SL, tidepool at Tsuchihama, Kasari, Amami-oshima island, Kagoshima, 28°24'34"N, 129°40'31"E, 0.5–1.0 m, 27 March 2009, M. Meguro and T. Yoshida; KAUM-I. 40407, male, 21.3 mm SL, KAUM-I. 40408, male, 18.9 mm SL, off Maehama, Yoron-jima island, Kagoshima, 27°01'13"N, 128°26'26"E, 2–10 m, 17 August 2011, M. Meguro and E. Katayama; KAUM-I. 51390, male, 22.4 mm SL, off Chabana, Yoron-jima island, Kagoshima, 27°03'40"N, 128°25'02"E,

8 m, 26 October 2012, KAUM Fish Team; KAUM-I. 55016, male, 17.2 mm SL, off Yoron Port, Yoron-jima island, Kagoshima, 27°03'40"N, 128°25'02"E, 8 m, 29 June 2013, T. Trnski *et al.*; NSMT-P 31249, male, 23.6 mm SL, off Sakinome Beach, Amami-oshima island, Kagoshima, 28°11'N, 128°16'E, 2–3 m, 12 September 1989, M. Aizawa. **OKINAWA ISLANDS:** KAUM-I. 41905, male, 27.6 mm SL, off Nago, Okinawa-jima island, 26°30'N, 128°02'E, 24 March 2011, Y. Sakurai.

Non-type material examined. 5 specimens, 20.4–25.3 mm SL. **CAROLINE ISLANDS:** NSMT-P 22918, male and female, 20.4–22.0 mm SL, south coast of Eten Island, Chuuk Islands, 0.5 m, 6 July 1982, K. Matsuura. **VANUATU:** USNM 362385, male and female, 22.1–23.1 mm SL, Fisheries Wharf, Santo Island, 15°31'30"S, 167°09'32"E, 5 m, 12 May 1997, J. Williams *et al.*; USNM 344010, male, 25.3 mm SL, Port Narevin, Erromango, 18°44'25"S, 169°12'41"E, 5.5 m, 28 May 1996; J. Williams *et al.*

Diagnosis. A small- to medium-sized species of *Enneapterygius* with the following combination of characters: 11–13 (mode 12) second dorsal-fin spines; 8–10 (9) third dorsal-fin soft rays; 15–17 (16) pectoral-fin rays; 16–18 (17) anal-fin soft rays; 32–35 (33) scale rows in longitudinal series; 16–19 (17) pored lateral-line scales; 16–19 (18) notched lateral-line scales; 1 scale row between last pored lateral-line scale and first notched lateral-line scale; mandibular pore

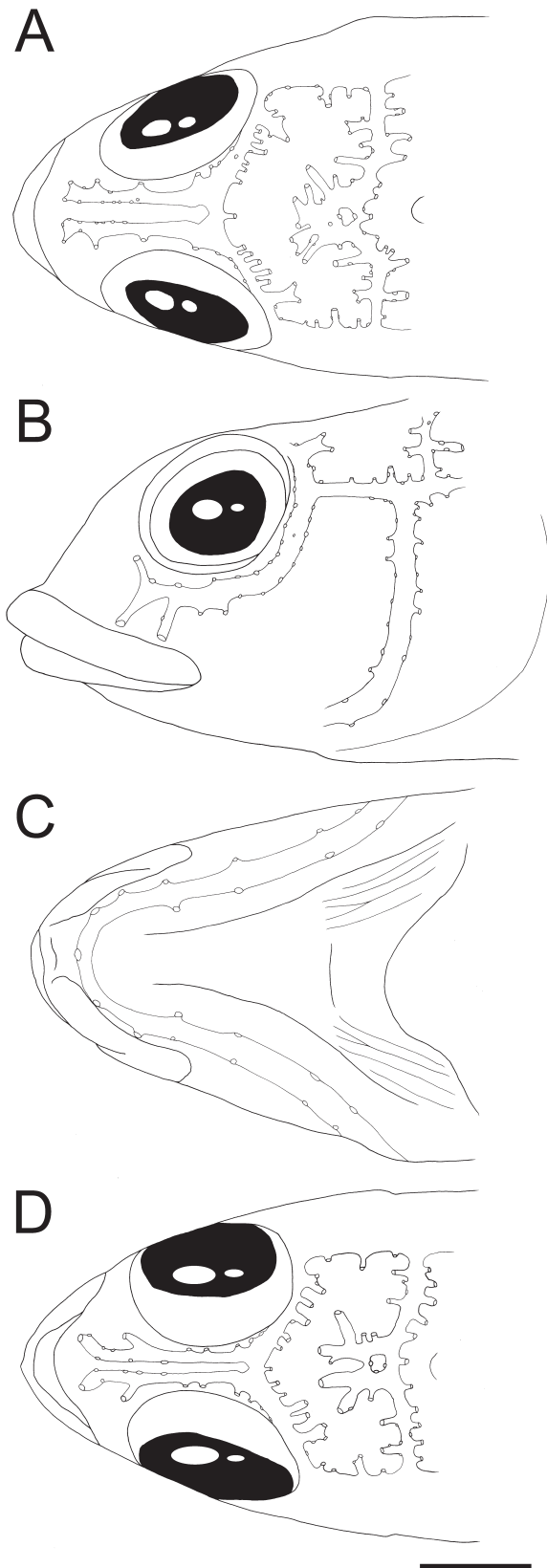


Fig. 5. Cephalic sensory pore system of *Enneapterygius phoenicosoma* n. sp. Dorsal (A), lateral (B), and ventral (C) views of head of holotype (KAUM-I. 21960, male, 35.1 mm SL, Ichiki-kushikino, Kagoshima, Japan); dorsal view (D) of head of paratype (KAUM-I. 26186, male, 33.8 mm SL, Ichiki-kushikino, Kagoshima, Japan). Nostrils and tentacles not illustrated; scale bar 2 mm.

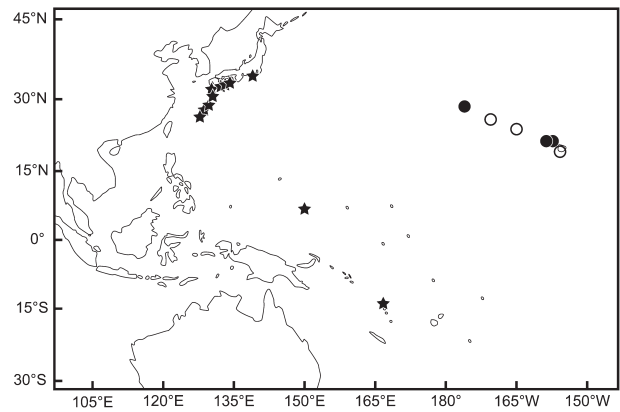


Fig. 6. Distributional records of *Enneapterygius phoenicosoma* n. sp. and *E. atriceps*. Stars, localities of specimens of *E. phoenicosoma*; closed circles, localities of specimens of *E. atriceps* examined in this study; open circles, localities of specimens of *E. atriceps* examined by Fricke (1997).

formula 4-6+1+4-6 (4+1+4); long dorsal-fin spines and rays [e.g., lengths of second spine 8.6–12.6% of SL (mean 10.1%) and third spine 7.2–9.8% of SL (8.5%) in first dorsal fin; first spine 12.8–17.2% of SL (15.2%), second spine 13.8–18.2% of SL (15.9%), and third spine 14.2–18.4% of SL (15.8%) in second dorsal fin; and first soft ray 14.8–19.5% of SL (17.3%), second soft ray 14.7–18.9% of SL (16.9%), and third soft ray 13.9–19.1% of SL (15.9%) in third dorsal fin]; short second dorsal-fin base [25.0–32.9% of SL (mean 29.2%)]; short anal-fin base [36.9–43.5% of SL (mean 40.5%)]; nasal tentacle unbranched, flat, broadened distally (Fig. 8A, B); lower two-thirds of head, including lower half of eye, snout, lips, cheek, and opercle, and pectoral-fin base, dense black in nuptial males; upper head and body reddish-brown in males and females, reddish in nuptial males, with H-shaped and/or upside-down Y-shaped oblique brown bars on lateral surface of body in both sexes; caudal-fin base with vertical brownish band, its width subequal to pupil diameter, and narrow vertical white band behind brownish band in both sexes; narrow, indistinct, white line along posterior margin of black area on pectoral-fin base in nuptial males; pectoral, pelvic, and anal fins reddish in nuptial males; no fins black.

Description. In following text, data for the holotype are presented first, followed by paratype data (if different) in parentheses. Counts and measurements of the holotype, paratypes, and non-types are given in Tables 1–3. The cephalic sensory pore systems of the holotype are illustrated in Fig. 5A–C; major variation of sensory pores on the occipital region is shown in Fig. 5D.

Dorsal fin III, XII, 9 (III, XI–XIII, 8–10); anal fin I, 17 (I, 16–18); 16 (15–17) pectoral-fin rays; 34 (32–35) scale rows in longitudinal series; 17 (16–19) pored lateral-line scales; 17 and 18 (16–19) notched lateral-line scales; 4 (3 or 4) scale rows above first pored lateral-line scale; 3½ and 4 (2½–4) scale rows between first spine base of second dorsal fin and pored lateral-line scale; 3½ (2½–4) scale rows below first notched lateral-line scale; 2½ and 3 (2–3) scale rows above last pored lateral-line scale; 12 (11 or 12) circumpeduncular

Table 1. Counts and measurements, expressed as percentages of standard length, of *Enneapterygius phoenicosoma* n. sp. and *E. atriceps*. Means in parentheses.

	<i>Enneapterygius phoenicosoma</i> n. sp.			<i>Enneapterygius atriceps</i>		
	Holotype KAUM-I. 21960	Paratypes n=70	Non-types n=5	Holotype USNM 50719	Non-types n=46	
Standard length (mm)	35.1	17.2–37.2	20.4–25.3	22.1	14.9–26.9	
Counts						
1st, 2nd, and 3rd dorsal-fin rays	III, XII, 9	III, XI–XIII, 8–10	III, XII–XIII, 8–9	III, XIV, 9	III, XII–XV, 9–11	
Anal-fin rays	I, 17	I, 16–18	I, 16–17	I, 20	I, 19–21	
Pectoral-fin rays (unbranched+branched+unbranched rays)	16 (iii+6+vii)	15–17 (ii–vi+3–7+vi–viii)	15–17 (ii–vi+5–8+viii)	15	14–17 (ii–iv+5–7+vi–viii)	
Scale rows in longitudinal series	34	33–35	32–34	35	35–37	
Pored lateral-line scales	17	16–19 ¹	16–17	—	17–20	
Notched lateral-line scales	17–18 ¹	16–19 ¹	16–18	—	16–20	
Scale rows above 1st pored lateral-line scale	4	3–4	4	—	2–5	
Scale rows between 1st spine base of second dorsal fin and pored lateral-line scale	3½–4	2½–4	3½–4	—	2–5	
Scale rows below 1st notched lateral-line scale	3½	2½–4	3–3½	—	3–5	
Scale rows above last pore lateral-line scale	2½–3	2–3	2½	—	2–4	
Circumpeduncular scales	12	11–12 (usually 12)	11–12	—	12	
Mandibular pore formula	4+1+4	4–6+1 (rarely 3)+4–6	4+1+4	4+1+4	4–6+1 (rarely 2)+4–5	
Measurements						
Body depth	18.8	17.3–21.0 (18.9)	17.8–22.0 (19.5)	20.4	16.8–21.0 (19.1)	
Body width	17.4	15.7–20.6 (17.9)	16.7–20.7 (18.8)	15.7	15.1–18.9 (17.4)	
Head length	29.0	28.0–31.4 (29.5)	29.8–32.1 (30.5)	30.2	26.0–30.2 (28.3)	
Snout length	8.5	7.8–10.5 (9.1)	7.9–10.9 (9.1)	9.0	7.3–9.1 (8.0)	
Orbit diameter	9.5	9.2–11.7 (10.1)	10.2–11.0 (10.5)	10.6	8.8–11.8 (10.5)	
Interorbital width	3.1	2.2–3.3 (2.7)	2.4–3.1 (2.6)	3.1	2.4–3.2 (2.8)	
Upper-jaw length	12.1	10.5–13.1 (11.8)	11.8–13.4 (12.4)	11.8	10.3–12.4 (11.2)	
Postorbital length	13.2	11.5–14.1 (13.0)	13.9–14.4 (14.1)	13.8	11.6–13.6 (12.6)	
Pre-1st dorsal-fin length	24.5	24.5–28.1 (26.2)	25.1–27.1 (26.2)	27.2	23.5–28.9 (26.0)	
Pre-2nd dorsal-fin length	36.5	34.7–39.0 (36.6)	36.9–39.1 (38.0)	39.6	32.1–39.4 (35.9)	
Pre-3rd dorsal-fin length	69.9	68.0–74.1 (70.6)	69.4–72.6 (71.0)	74.6	69.5–76.7 (71.3)	
Pre-anal-fin length	46.7	45.3–53.1 (49.0)	49.5–53.9 (51.4)	48.1	44.3–52.3 (48.0)	
Pre-pectoral-fin length	31.1	29.5–34.2 (31.7)	31.2–34.0 (32.1)	31.3	28.4–33.6 (31.1)	
Pre-pelvic-fin length	21.7	18.3–24.8 (22.0)	19.0–24.7 (20.9)	20.3	19.1–24.4 (22.2)	
Caudal-peduncle length	11.9	8.8–12.4 (10.9)	10.8–12.1 (11.4)	9.5	9.4–13.0 (10.8)	
Caudal-peduncle depth	8.5	7.3–9.9 (8.5)	7.8–8.9 (8.2)	8.8	7.7–10.1 (8.8)	
1st spine length of 1st dorsal fin	11.3	8.8–13.0 (10.7)	12.0–13.7 (13.1)	11.2	8.4–13.0 (10.8)	
2nd spine length of 1st dorsal fin	11.0	8.6–12.6 (10.0)	10.7–12.1 (11.4)	—	8.0–11.3 (9.2)	
3rd spine length of 1st dorsal fin	—	7.2–9.7 (8.5)	8.0–9.8 (8.6)	8.4	6.5–9.1 (7.8)	

Means²

Table 1. Continued.

	<i>Enneapterygius phoenicosoma</i> n. sp.			<i>Enneapterygius atriceps</i>		
	Holotype	Paratypes	Non-types	Holotype	Non-types	
1st spine length of 2nd dorsal fin	15.0	13.7–17.2 (15.3)	12.8–14.2 (13.6)	—	15.2	12.5–14.2 (13.4)
2nd spine length of 2nd dorsal fin	17.9	14.2–18.2 (15.9)	13.8–15.1 (14.3)	13.7	15.9	12.9–15.3 (14.2)
3rd spine length of 2nd dorsal fin	—	14.2–18.4 (15.8)	14.2–15.3 (14.9)	14.7	15.8	13.6–15.8 (14.8)
1st soft ray length of 3rd dorsal fin	17.4	14.8–19.5 (17.3)	14.9–15.9 (15.5)	—	17.3	14.2–17.3 (15.9)
2nd soft ray length of 3rd dorsal fin	18.0	14.7–18.9 (17.0)	15.3–15.4 (15.3)	16.3	16.9	13.6–16.7 (15.6)
3rd soft ray length of 3rd dorsal fin	17.3	13.9–19.1 (15.9)	13.9–15.0 (14.4)	15.4	15.9	13.4–16.2 (14.8)
Pectoral-fin length	34.9	30.6–37.4 (33.6)	28.9–34.6 (32.6)	—	33.5	29.4–35.5 (32.9)
Pelvic-fin spine length	15.8	14.2–19.1 (16.4)	15.6–17.2 (16.6)	18.9	16.5	13.9–18.9 (17.3)
Pelvic-fin soft-ray length	25.0	19.8–26.2 (23.0)	21.3–23.3 (22.4)	24.7	23.2	19.6–26.9 (23.5)
1st dorsal-fin base length	5.5	4.1–6.2 (5.2)	5.3–6.4 (5.7)	6.0	5.2	4.2–6.8 (5.1)
2nd dorsal-fin base length	30.0	25.0–32.9 (29.3)	26.5–29.8 (28.1)	33.6	29.2	27.4–38.1 (31.8)
3rd dorsal-fin base length	16.8	13.9–19.2 (17.1)	15.8–16.9 (16.2)	16.6	17.1	14.4–19.0 (16.6)
Anal-fin base length	41.0	38.1–43.5 (40.6)	36.9–40.4 (38.3)	46.0	40.5	39.5–47.5 (43.1)

¹ Including scale counts of right side of body; ² including data for holotype, paratypes, and non-types; — damaged.

Table 2. Frequency distribution of selected fin ray counts of *Enneapterygius phoenicosoma* n. sp. and *E. atriceps*.

	Second dorsal-fin spines						Third dorsal-fin soft rays			
	11	12	13	14	15	16	8	9	10	11
<i>E. atriceps</i>	—	1	4	39 ¹	1	—	—	25 ¹	18	3
<i>E. phoenicosoma</i> n. sp.	10	59 ¹	6	—	—	—	5	60 ¹	11	—
	Pectoral-fin rays (left)						Pectoral-fin rays (right)			
	14	15	16	17	17	—	14	15	16	17
<i>E. atriceps</i>	2	28 ¹	13	1	—	—	3	22 ¹	15	1
<i>E. phoenicosoma</i> n. sp.	—	8	62 ¹	6	—	—	—	8	49 ¹	7
	Anal-fin soft rays						Anal-fin soft rays			
	16	17	17	18	18	19	19	20	21	21
<i>E. atriceps</i>	—	—	—	—	—	27	—	18 ¹	—	1
<i>E. phoenicosoma</i> n. sp.	4	65 ¹	7	—	—	—	—	—	—	—

¹ Includes count of holotype.

Table 3. Frequency distribution of selected scale counts of *Enneapterygius phoenicosoma* n. sp. and *E. atriceps*.

	Scale rows in longitudinal series (left)							Scale rows in longitudinal series (right)						
	33	34	35	36	37	32	33	34	35	36	37			
<i>E. atriceps</i>	—	—	5 ¹	26	13	—	—	—	3 ¹	26	11			
<i>E. phoenicosoma</i> n. sp.	37	39 ¹	—	—	—	1	39	35 ¹	1	—	—			
	<i>n</i> =44	<i>n</i> =76				<i>n</i> =40	<i>n</i> =76							
	Pored lateral-line scales (left side)							Pored lateral-line scales (right side)						
	16	17	18	19	20		16	17	18	19	20			
<i>E. atriceps</i>	—	2	9	11	6		—	—	9	12	6			
<i>E. phoenicosoma</i> n. sp.	11	46 ¹	3	1	—		12	43 ¹	9	1	—			
	<i>n</i> =28	<i>n</i> =61				<i>n</i> =27	<i>n</i> =65							
	Notched lateral-line scales (left side)							Notched lateral-line scales (right side)						
	16	17	18	19	20		16	17	18	19	20			
<i>E. atriceps</i>	1	6	10	10	1		1	8	12	6	1			
<i>E. phoenicosoma</i> n. sp.	4	20	32 ¹	3	—		6	20 ¹	32	2	—			
	<i>n</i> =28	<i>n</i> =59				<i>n</i> =28	<i>n</i> =60							

¹Includes count of holotype.

scales; 4+1+4 (4–6+1+4–6) mandibular pores.

Body moderately elongate, slightly compressed anteriorly, progressively more compressed posteriorly; dorsal profile of snout not strongly steep. Mouth slightly oblique; posterior margin of maxilla extending slightly beyond vertical drawn through anterior margin of pupil; anterior tip of upper jaw almost reaching as high as ventral margin of orbit. Anterior nostril membranous tube with thin, but distally broadened, unbranched tentacle (Fig. 8A, B); anterior nostril located at level of middle of eye, slightly closer to eye than to upper lip; posterior nostril opening elliptical. Eye oriented dorso-laterally; simple tentacle on posterodorsal margin of eye, its length subequal to length of nostril tentacle. Interorbital space narrow, its width narrower than pupil diameter. Opercular margin extending beyond vertical drawn through base of third spine of first dorsal fin.

Lateral line discontinuous, with anterior series of pored scales and posterior series of notched scales; pored scale series ending below membrane between last spine of second dorsal fin and body; notched scale series beginning below last pored scale (or below third or second scale from last pored scale or below a point just posterior to last pored scale) and ending at caudal-fin base; one scale row between posteriormost pored scale and anteriormost notched scale; one additional notched scale present (or scale absent) anterior to 2 (1–4) normal scales followed by series of notched scales. Body scales ctenoid; no scales on head, including maxilla, interorbital space, preopercle, and opercle, pectoral-fin base, pre- and inter-pelvic-fin region, or pre-dorsal-fin region; no scales on fin membranes except for basal part of caudal fin.

Origin of first dorsal fin at vertical drawn between preopercular and opercular margins; first spine of this fin longest, third spine shortest. Origin of second dorsal fin above fifth (third to fifth) pored lateral-line scale, second (rarely third) spine of this fin longest. Origin of third dorsal fin above 20th (19th to 21st) longitudinal scale; second (or first) ray of this fin longest. Origin of pelvic fin anterior to vertical drawn through base of first spine of first dorsal fin, below posterior edge of preopercle. Base of uppermost pectoral-fin ray below second pored lateral-line scale. Pectoral fin pointing posteriorly, with posterior tip of its longest ray not reaching vertical drawn through origin of third dorsal fin (usually just reaching vertical drawn through base of last spine of second dorsal fin). Origin of anal fin below sixth (fifth to seventh) spine base of second dorsal fin.

Color of nuptial male specimens when fresh—Based on color photographs of holotype (Fig. 1A) and 22 paratypes (Fig. 2): lower two-thirds of head, including lower half of eye, snout, lips, cheek, and opercle, and pectoral-fin base, dense black (dark grey with scattered large gray blotches); remaining part of head and body reddish with 11 (9–12) H-shaped and/or upside-down Y-shaped oblique brown bars on lateral surface of body. Narrow, indistinct, white line along posterior margin of black area on pectoral-fin base. Caudal-fin base with vertical brownish band, its width subequal to pupil diameter, and narrow vertical white band behind brownish band. First dorsal fin semi-transparent,

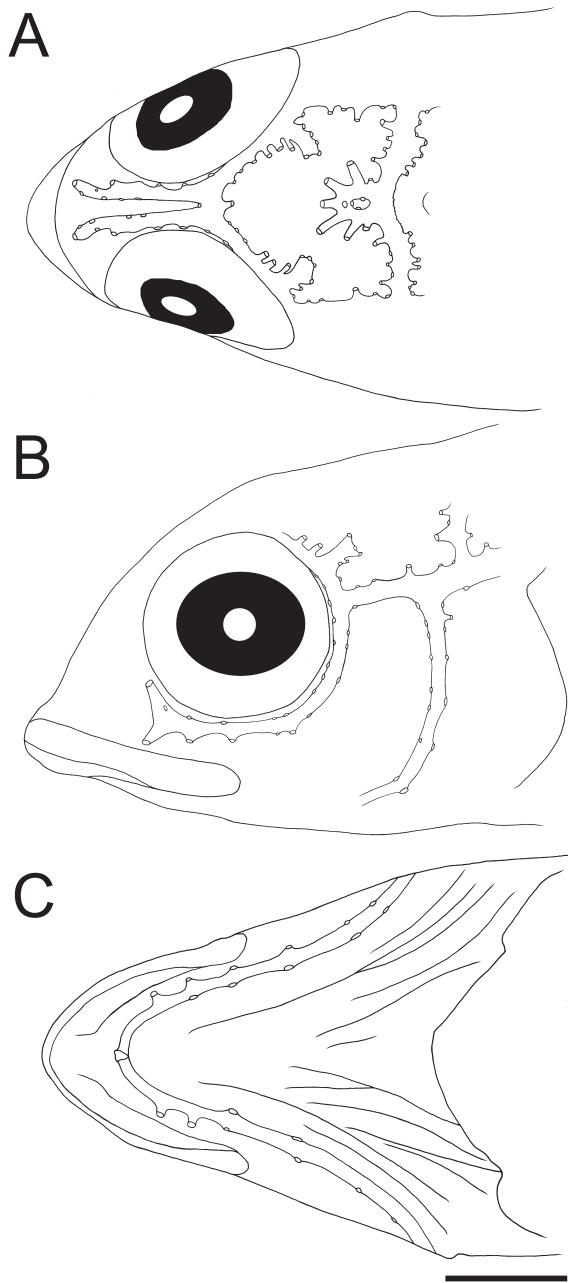


Fig. 7. Cephalic sensory pore system of *Enneapterygius atriceps*. Dorsal (A), lateral (B), and ventral (C) views of head (ANSP 95035, male, 20.8 mm SL, Waikiki, Oahu, Hawaiian Islands). Nostrils and tentacles not illustrated; scale bar 1 mm.

yellowish (or reddish) basally and distally; spines reddish. Second dorsal fin semi-transparent with melanophores scattered on basal one-third of fin, forming broad, pale gray band; distal margin of fin grayish. Third dorsal fin semi-transparent without distinct bands or stripes. Pectoral fin semi-transparent with red rays. Pelvic fin rays red (or pink). Anal fin red with reddish (or whitish) rays. Caudal fin semi-transparent with whitish or reddish rays and without distinct bands or stripes, with reddish ventral margin.

Color in life of nuptial males—Based on several underwater photographs (see Fig. 4): similar to the above, but narrow white line along posterior margin of black area on pectoral-fin base more distinct.

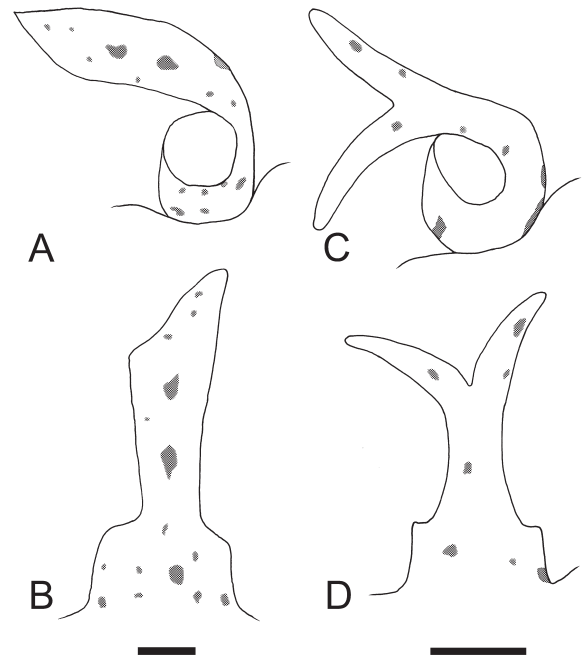


Fig. 8. Tentacle on anterior nostril. A–B, holotype (KAUM–I. 21960, 35.1 mm SL) of *Enneapterygius phoenicosoma* n. sp.; C–D, non-type (ANSP 28022, 18.6 mm SL) of *E. atriceps*. Upper (A, C) and lower (B, D) represent lateral and posterior views respectively. Scale bars 0.1 mm.

Color in life of pale males and females—Based on several underwater photographs (see Figs 2–3): head mottled with brown, white, blue, and green blotches, spots, and lines. Body whitish with 9–12 H-shaped and/or upside-down Y-shaped oblique brown bars on lateral surface of body; caudal-fin base with vertical brownish band and narrow vertical white band behind brownish band. First dorsal fin whitish. Second dorsal fin semi-transparent with pale gray band basally. Third dorsal, anal, and caudal fins semi-transparent. Pectoral fin semi-transparent; narrow white line along posterior margin of pectoral-fin base. Color of female specimens when fresh (Fig. 3) similar to their color in life.

Color in preservative of nuptial males—Lower two-thirds of head, including lower half of eye, snout, lips, cheek, and opercle, and pectoral-fin base black; remaining part of head and body whitish with oblique grayish bars on lateral surface of body. Caudal-fin base with vertical grayish band. Second dorsal fin semi-transparent, grayish basally. Third dorsal, pectoral, anal, and caudal fins semi-transparent with white rays. Pelvic-fin rays white.

Color in preservative of females—Similar to coloration of preserved male specimens, but head and pectoral-fin base pale and mottled with scattered melanophores.

Distribution and ecological notes. Currently known from the western Pacific Ocean: Japan, the Caroline Islands, and Vanuatu. In Japanese waters, *E. phoenicosoma* has been recorded from the Pacific coast of southern Japan, including the Izu Peninsula, Shikoku, and southern Kyushu, and the Ryukyu Islands. This species usually occurs in open tide-pools and areas with strong regular surges generated by wave swells. Individuals usually inhabit the surface of large

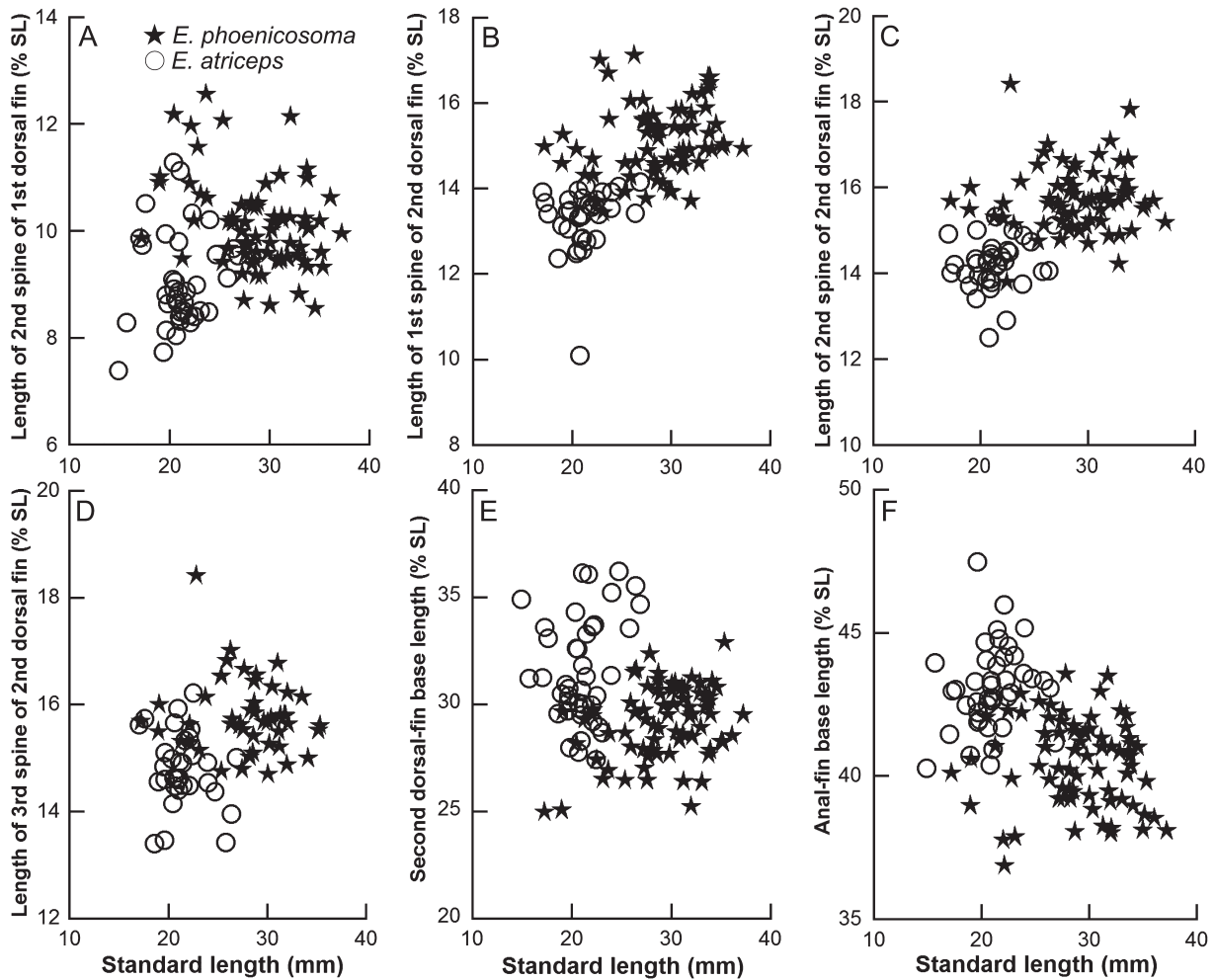


Fig. 9. Comparisons of lengths of (A) second spine of first dorsal fin, (B) first spine of second dorsal fin, (C) second spine of second dorsal fin, (D) third spine of second dorsal fin, (E) second dorsal-fin base, and (F) anal-fin base (% standard length) with standard length in *Enneapterygius phoenicosoma* n. sp. (stars) and *E. atriceps* (circles).

rocks, but also slits and holes in large rocks, at depths of less than 25 m (usually less than 15 m). Spawning of *E. phoenicosoma* at Shikoku occurs from early morning until about 10 am starting in June (Ogaya in Takagi *et al.* 2010; reported as *Enneapterygius* sp. 1).

Etymology. From the Greek “*phoenico*” meaning red and “*soma*” body, in reference to the red body of nuptial males. The name is used as a noun in apposition.

Remarks. The nuptial coloration of males of *E. phoenicosoma* n. sp., including their black head and pectoral-fin base and reddish body, is distinct from the coloration of females; however, detailed analyses of 32 morphometric features (listed in Table 1) revealed no other sexual dimorphism.

Most specimens of the new species were collected from shallow waters in southern Japan, where it is relatively common. We also found a few specimens from the Caroline Islands and Vanuatu, which we have tentatively identified as belonging to this species. More specimens are required to fully assess the taxonomic status of these specimens from the central western Pacific Ocean, so they are excluded from the type series of *E. phoenicosoma*.

Enneapterygius atriceps (Jenkins, 1903)

[English name: Hawaiian Blackhead Triplefin]

(Figs 6–7, 8C–D, 9; Tables 1–3)

Tripterygium atriceps Jenkins, 1903: 505, fig. 46 (type locality: Honolulu, Oahu, Hawaiian Islands).

Enneapterygius atriceps: Fricke 1997: 161, 566, figs 25, 26 (Hawaiian Archipelago, including French Frigate Shoals, Laysan Island, and Midway Atoll); Williams and Fricke 2001: 3534 (name only); Fricke 2009: 38 (Hawaiian Islands, north to Midway Atoll); Randall 2007: 373, unnumbered figs (Hawaiian Islands); Meguro and Motomura in Motomura and Matsuura 2010: 6 (name only).

Holotype. USNM 50719, male, 22.1 mm SL, Honolulu, Oahu, Hawaiian Islands, 1889, O. Jenkins.

Non-type material examined. 46 specimens, 14.9–26.9 mm SL, all from the Hawaiian Archipelago. ANSP 28022, 3 males, 15.7–19.4 mm SL, Honolulu, Oahu, Hawaiian Islands, 1900, O. Jenkins; ANSP 95035, male and female, 14.9–20.8 mm SL, Waikiki, Oahu, Hawaiian Islands, 1992, C. Edmondson; BPBM 3465, male, 25.8 mm SL, Waikiki Reef, Honolulu, Oahu, 1923, V. Pietschmann; BPBM 19658, male

and female, 19.0–20.9 mm SL, Kaneohe Bay, Oahu, 2 m, 13 September 1975, B. Carlson *et al.*; BPBM 34846, 13 males and 5 females, 19.5–23.9 mm SL, southeast side of Sand Island, Midway Atoll, 8 m, 16 September 1991, J. Randall *et al.*; FMNH 47658, male, 22.1 mm SL, Kaneohe Bay, Oahu, April–May 1935, Shedd Aquarium; FMNH 63605, 9 males and 5 females, 17.0–26.9 mm SL, Kahuku, Oahu, 21 April 1961, L. Woods *et al.*; ROM 28022, 3 males (one in poor condition, its SL not included), 16.0–18.5 mm SL, Honolulu, Oahu, US Fish. Commission; ROM 95035, 2 males, 15.6–20.4 mm SL, Waikiki, Honolulu, Oahu, 1922, C. Edmondson.

Diagnosis. A small-sized species of *Enneapterygius* with the following combination of characters: 12–15 (mode 14) second dorsal-fin spines; 9–11 (9) third dorsal-fin soft rays; 14–17 (15) pectoral-fin rays; 19–21 (19) anal-fin soft rays; 35–37 (36) scale rows in longitudinal series; 17–20 (19) pored lateral-line scales; 16–20 (18) notched lateral-line scales; 1 or 2 scale rows between last pored lateral-line scale and first notched lateral-line scale; mandibular pore formula 4–6+1+4–5 (4+1+4); short dorsal-fin spines and rays [e.g., lengths of second spine 8.0–11.3% of SL (mean 9.2%) and third spine 6.5–9.1% of SL (7.8%) in first dorsal fin; first spine 12.5–14.2% of SL (13.4%), second spine 12.9–15.3% of SL (14.2%), and third spine 13.6–15.8% of SL (14.8%) in second dorsal fin; first soft ray 14.2–17.3% of SL (15.9%), second soft ray 13.6–16.7% of SL (15.6%), and third soft ray 13.4–16.2% of SL (14.8%) in third dorsal fin]; long second dorsal-fin base [27.4–38.1% of SL (mean 31.8%)]; long anal-fin base [39.5–47.5% of SL (mean 43.1%)]; nasal tentacle bilobed (Fig. 8C, D; rarely unbranched; 2 of 47 specimens with unbranched tentacle); lower two-thirds of head, including lower half of eye, snout, lips, cheek, and opercle, and pectoral-fin base dense black in nuptial males; upper head and body reddish-brown in females and males, reddish in nuptial males, with 4–6 H-shaped and/or upside-down Y-shaped oblique brown bars on lateral surface of body; caudal-fin base with vertical brownish band, its width subequal to pupil diameter, narrow vertical white band behind brownish band; narrow, indistinct, white line along posterior margin of black area on pectoral-fin base; no fins black.

Distribution. Known only from the Hawaiian Archipelago (Fricke 1997; this study).

Remarks. Counts and measurements of the above-listed holotype and non-types of *E. atriceps* are given in Tables 1–3. The cephalic sensory pore system of the species is illustrated in Fig. 7. Color photographs of male and female specimens were published by Randall (2007: 373).

Comparisons. *Enneapterygius phoenicosoma* n. sp. is similar to the Hawaiian endemic species *E. atriceps* in sharing the following features: 16–20 pored lateral-line scales; a single scale row between the last pored lateral-line scale and the first notched lateral-line scale; the lower two-thirds of the head, including the lower half of the eye, snout, lips, cheek, and opercle, and the pectoral-fin base dense black in nuptial males; the upper head and body reddish in nuptial males but reddish-brown in females and non-nuptial males, with H-shaped or upside-down Y-shaped oblique brown

bars on the lateral surface of the body; the caudal-fin base with a vertical brownish band, its width subequal to the pupil diameter, and a vertical narrow white band behind the brownish band; a narrow, indistinct, white line along the posterior margin of the pectoral-fin base; and no black fins. With the exception of *E. phoenicosoma* and *E. atriceps*, no nominal species with combination of the above-mentioned characters have been reported in the genus (Fricke 1997; this study).

The new species is clearly distinguished from *E. atriceps* by having a simple nasal tentacle (*vs* bilobed in the latter; Fig. 8) and 16–18 (mode 17) anal-fin soft rays [*vs* 19–21 (19); Tables 1–2]. *Enneapterygius phoenicosoma* further differs from *E. atriceps* in having 11–13 (mode 12) second dorsal-fin spines [*vs* 12–15 (14); Tables 1–2], 15–17 (16) pectoral-fin rays [*vs* 14–17 (15); Tables 1–2], 32–35 (33) scale rows in the longitudinal series [*vs* 35–37 (36); Tables 1, 3], and 16–19 (17) pored lateral-line scales [*vs* 17–20 (19); Tables 1, 3].

In morphometrics, *E. phoenicosoma* tends to have slightly longer spines and rays of the dorsal fins than *E. atriceps*: e.g., lengths of the second spine (mean 10.1% of SL *vs* 9.2% in *E. atriceps*; Table 1, Fig. 9A) and third spine (8.5% *vs* 7.8%; Table 1) in the first dorsal fin; lengths of the first spine (15.2% *vs* 13.4%; Table 1, Fig. 9B), second spine (15.9% *vs* 14.2%; Table 1, Fig. 9C), and third spine (15.8% *vs* 14.8%; Table 1, Fig. 9D) in the second dorsal fin; and the lengths of the first soft ray (17.3% *vs* 15.9%; Table 1), second ray (16.9% *vs* 15.6%; Table 1), and third ray (15.9% *vs* 14.8%; Table 1) in the third dorsal fin. In contrast, the lengths of the second dorsal-fin base and anal-fin base in *E. phoenicosoma* tend to be slightly shorter than those of *E. atriceps* (mean 29.2% of SL and 40.5%, respectively, *vs* 31.8% and 43.1%, respectively, in *E. atriceps*; Table 1, Fig. 9E, F).

Enneapterygius phoenicosoma grows larger than *E. atriceps* (largest recorded size, 37.2 mm SL *vs* 26.9 mm SL; this study). Fricke (1997) examined 87 specimens of *E. atriceps* ranging from 11 to 26 mm SL. On the basis of examination of otoliths of *E. atriceps*, Longenecker and Langston (2005) determined the age of the oldest individual of *E. atriceps* as 117 days, with sexual maturity occurring at about 55 days and 15 mm SL. No biological information on *E. phoenicosoma* is known. These two species are allopatrically distributed in the Pacific Ocean (Fig. 6).

Enneapterygius etheostoma (Jordan and Snyder, 1902) co-occurs with *E. phoenicosoma* through at the entire distributional range of the latter in Japanese waters. Coloration of females and pale males in the two species is very similar to each other either in life or when fresh. Besides the coloration of nuptial males, however, *E. phoenicosoma* differs from *E. etheostoma* in the following features: nasal tentacle simple (*vs* bilobed in the latter), 11–13 (mode 12) second dorsal-fin spines [*vs* 12–16 (14)], 16–18 (17) anal-fin soft rays [*vs* 17–20 (19)], 2½–4 (3½) scale rows between base of first spine of second dorsal fin and pored lateral-line scale [*vs* 4–7½ (6)], and 2–3 (2½) scale rows above last pored lateral-line scale [*vs* 3½–5½ (4)] (Fricke 1997; Meguro and Motomura unpub. data).

Acknowledgments

We are especially grateful to M. Sabaj (ANSP), A. Suzumoto and L. O'Hara (BPBM), and J. Williams (USNM) for opportunities to examine specimens deposited in their museums. We thank H. Endo (BSKU), H. Kawase (CMNH), S. Mochel and K. Swagel (FMNH), G. Shinohara and M. Nakae (NSMT), and R. Winterbottom, E. Holm, D. Stacey, and M. Zur (ROM) for loans of specimens, R. Causse and P. Pruvost (MNHN) for registering type specimens, and S. Harazaki, S. Yamamoto, D. Itou, K. Ota, and K. Matsuno for providing underwater photographs. We thank Y. Haraguchi, volunteers, and students of KAUM for their kind assistance with collecting and curating specimens, and G. Yearsley (Ellipsis Editing) for checking an early version of this manuscript. This study was supported in part by Grants-in-Aid for Scientific Research (A: 26241027, B: 24370041 and C: 23580259 and 26450265) from the Japan Society for the Promotion of Science, Tokyo, Japan (JSPS); the JSPS Asian Core Program, "Establishment of Research and Education Network on Coastal Marine Science in Southeast Asia"; the JSPS International Training Program "Protect Diversity of Bioresources in the Tropical Area"; the "Coastal Area Capability Enhancement in Southeast Asia Project" of the Research Institute for Humanity and Nature, Kyoto, Japan; the "Establishment of Research and Education Network on Biodiversity and Its Conservation in the Satsunan Islands" project of Kagoshima University adopted by the Ministry of Education, Culture, Sports, Science and Technology, Japan; and the "Biological Properties of Biodiversity Hotspots in Japan" project of the National Museum of Nature and Science, Tsukuba, Japan.

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