

**A new species of triplefin (Perciformes: Tripterygiidae),
Enneapterygius senoui,
from Japan with a discussion of its *in situ* colour pattern**

Hiroyuki Motomura^{1*}, Shigeru Harazaki² and Graham S. Hardy³

1) Kanagawa Prefectural Museum of Natural History, 499 Iryuda, Odawara, Kanagawa 250-0031, Japan. Present address: Ichthyology, Australian Museum, 6 College Street, Sydney, New South Wales 2010, Australia. E-mail: motomurah@austmus.gov.au

2) Mori-To-Umi, 1559-1 Miyanoura, Kamiyaku-cho, Kumage-gun, Kagoshima 891-4205, Japan

3) Old Kaiatea Road, R. D. 3, Whangarei, New Zealand

*Corresponding author: Tel. +61-2-9320-6310 – Fax +61-2-9320-6059. E-mail: motomurah@austmus.gov.au

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Abstract

Enneapterygius senoui, a new species of small triplefin, is described on the basis of six specimens collected from Hachijo-jima Island, the Izu Islands and Chichi-jima Island, Ogasawara Islands, Japan. This species is distinguished from other congeners by the following combination of characters: 14 or 15 (mode 15) second dorsal fin spines; 20 or 21 (21) pored lateral line scales; 17-19 (17) notched lateral line scales; 2 or 3 (2) scale rows above first pored lateral line scale; 2 or 2 1/2 (2 1/2) scale rows above last pored lateral line scale; 3 or 4 (3) scale rows below first notched lateral line scale; 4-5 + 1-2 + 4-5 mandibular pores; nasal tentacle unbranched flat, broad distally; a broad vertical white band on caudal peduncle behind third dorsal fin, and blue lines or spots on head in both sexes; anterior two-thirds of body and fins black, and posterior tip of anal fin yellow in melanistic males; reddish spots on head and body, and anal fin yellow basally in pale males and females. The species is further confirmed from Izu-oshima Island and the east coast of Izu Peninsula on the basis of underwater photographs. *In situ* colour pattern and variations are also described and discussed.

Zusammenfassung

Enneapterygius senoui, eine neue Art der kleinen Spitzkopfschleimfische wird auf der Grundlage von sechs Exemplaren beschrieben, die an den Inseln Hachijo-jima, Izu und Chichi-jima der Ogasawara-Gruppe, Japan, gesammelt wurden. Durch die Kombination der folgenden Merkmale unterscheidet sich die neue Art von den anderen in der Gattung: 14 oder 15 (meist 15) Flossenstrahlen in der zweiten Rückenflosse; 20 oder 21 (21) Schuppen der Seitenlinie mit

Poren; 17-19 (17) gekerbte Seitenlinien-Schuppen; 2 oder 3 (2) Schuppenreihen oberhalb der ersten porigen Seitenlinien-Schuppe; 2 oder 2 1/2 (2 1/2) Schuppenreihen oberhalb der letzten porigen Seitenlinien-Schuppe; 3 oder 4 (3) unterhalb der ersten gekerbten Seitenlinien-Schuppe; 4-5 + 1-2 + 4-5 Unterkiefer-Poren; Nasententakel unverzweigt flach, am distalen Ende breit; ein breites, senkrechtes weißes Band auf dem Schwanzstiel hinter der dritten Rückenflosse; und blaue Linien oder Flecken auf dem Kopf bei beiden Geschlechtern; die vorderen zwei Drittel von Rumpf und Flossen schwarz; sowie eine gelbe hinten liegende Spitze der Afterflosse bei melanistischen Männchen; bei blassen Männchen und Weibchen hingegen rötliche Flecken auf Kopf und Rumpf und eine an der Basis gelbe Afterflosse. Außerdem wurde die Art für die Izu-oshima-Insel und die Ostküste der Izu-Halbinsel durch Unterwasser-Fotos nachgewiesen: Schließlich werden die Farbmuster und Variationen *in situ* beschrieben und diskutiert.

Résumé

Enneapterygius senoui, une nouvelle espèce de petit Tripterygiidé, est décrit à partir de six spécimens collectés aux environs de l'île Hachijo-jima, des îles Izu et de l'île Chichijima, des îles Ogasawara, au Japon. Cette espèce se distingue de ses autres congénères par la combinaison des caractères suivants: 14 ou 15 (généralement 15) rayons durs à la deuxième dorsale; 20 ou 21 (21) écailles perforées sur la ligne latérale; 2 ou 2 1/2 (2 1/2) rangées d'écailles au-dessus de la dernière écaille perforée de la ligne latérale; 3 ou 4 (3) rangées d'écailles sous la première écaille cténoïde de la ligne latérale; 4-5+1-2+4-5 pores mandibulaires; excroissance nasale non ramifiée, plate, distalement large; une large bande blanche verticale sur le pédoncule caudal après la troisième dorsale, et des lignes bleues ou des taches sur la tête pour les deux sexes; les deux-tiers

antérieurs du corps et des nageoires, noirs, et l'extrémité postérieure de l'anale, jaune chez les mâles mélaniques, taches rougeâtres sur la tête et le corps, et anale jaune à la base pour les mâles et femelles claires. L'espèce est aussi relevée près de l'île Izu-oshima et sur la côte est de la péninsule d'Izu, sur base de photographies sous-marines. Le patron des couleurs et leurs variations *in situ* sont également décrits et commentés.

Sommario

Enneapterygius senoui, una nuova specie di tripterygide, è descritta sulla base di sei esemplari raccolti all'isola Hachijo-jima, Isole Izu, e all'isola Chichi-jima, delle Isole Ogasawara, Giappone. Questa specie si distingue dai suoi congeneri per la seguente combinazione di caratteri: 14 o 15 (moda 15) spine nella seconda pinna dorsale; 20 o 21 (21) scaglie porose della linea laterale; 17-19 (17) scaglie dentellate in linea laterale; 2 o 3 (2) file di scaglie sopra la prima scaglia porosa della linea laterale; 2 o 2 1/2 (2 1/2) file di scaglie sopra l'ultima scaglia porosa della linea laterale; 3 o 4 (3) file di scaglie sotto la prima scaglia dentellata della linea laterale; 4-5 + 1-2 + 4-5 pori mandibolari; tentacoli nasali non ramificati appiattiti, allargati distalmente; un'ampia banda verticale bianca sul peduncolo caudale dietro la terza pinna dorsale e linee blu o macchie sul capo in entrambi i sessi; due terzi anteriori del corpo e pinne neri, punta posteriore della pinna anale gialla in maschi melanistici; macchie rossastre sul capo e sul corpo e base della pinna anale gialla in maschi e femmine chiari. Sulla base di fotografie subacquee la specie è inoltre confermata all'isola Izu-oshima e sulla costa orientale della penisola Izu. Sono infine discusse variazioni *in situ* della colorazione.

Introduction

The triplefin genus *Enneapterygius* Rüppell, 1835 (Perciformes: Tripterygiidae) in the western and central Pacific Ocean was recently reviewed by Fricke (1997); 37 species were recognized in the area, including 13 described as new. *Enneapterygius*, the largest genus of tripterygiids, has been defined by a discontinuous lateral line with an anterior series of 6-22 pored scales and posterior series of 13-27 notched scales, first dorsal fin with 3 spines, anal fin with 1 spine, pelvic fin with 1 spine and 2 soft rays, and head, opercle, pectoral fin base and abdomen naked (Fricke, 1997). However, synapomorphies for the genus have not been defined, and further investigation at the generic level is therefore necessary.

During a survey of the ichthyofauna of Hachijo-jima Island, Izu Islands, off the Pacific coast of central Honshu, Japan (Senou *et al.*, 2002), 5 specimens of a species attributed to *Enneapterygius* (with the anterior two-thirds of the body and fins black in melanistic males, anal fin yellow in females and the caudal

peduncle with a broad white band in both sexes) were collected inshore on rocky substratum in a depth range of 3-7 m. The specimens were similar to *E. etheostoma* (Jordan and Snyder, 1902) in their overall appearance, co-occurring with the latter at Hachijo-jima Island, but differed in several aspects, including the shape of the tentacle on the anterior nostril, scale and mandibular pore-counts, and the head, body and fin coloration.

Subsequently, we found a single museum specimen, apparently conspecific with those from Hachijo-jima Island, collected from Chichi-jima Island, Ogasawara Islands, Japan. In addition, several underwater photographs of the same species were taken at the Izu Islands and the east coast of Izu Peninsula, Japan. The species is herein described as new on the basis of the specimens from Hachijo-jima Island and Chichi-jima Island, and the live coloration of both sexes is described in detail on the basis of the underwater photographs. *In situ* colour patterns of the species, including variations, are also discussed.

Methods

Counts and measurements follow Hubbs and Lagler (1947); they are taken, on the left side if possible. Measurements were made to the nearest 0.1 mm with needle-point calipers under a dissecting microscope. Standard length is abbreviated as SL. Counts are given as the range with the mode in parentheses. Counts for the holotype are in square brackets. The mandibular pore formula follows Fricke (1997). Osteological characters were confirmed from X-ray photos taken of all type specimens. Underwater observations of the species were made by S. Harazaki at Hachijo-jima Island from April 2002 to July 2003. Institutional codes follow Leviton *et al.* (1985), with an additional institutional abbreviation as follows: Kanagawa Prefectural Museum of Natural History, Odawara, Japan (KPM). Colour photographs of the holotype and 4 paratypes (taken when fresh) are registered in the Image Database of Fishes in KPM.

Enneapterygius senoui n. sp.

[New Japanese name: Kibire-hebiginpo]
(Figs. 1-6)

Holotype: KPM-NI 9613, male, 27.2 mm SL, inside Sokodo fishing port, Hachijo-jima Island, Izu Islands, off Pacific coast of central Honshu Island, Japan, 3 m depth, 5 June 2002, hand net, coll. by H. Senou.

Paratypes: AMS I. 43160-001, male, 24.1 mm SL, Nazumado, Hachijo-jima Island, Izu Islands, 7 m depth, 4 June 2002, hand net, coll. by H. Senou; BPBM 39136, male, 26.2 mm SL, Ishiura, Chichi-jima Island, Ogasawara Islands, 8-10 m depth, 2 June 1992, rotenone, coll. by J. E. Randall and collaborators; KPM-NI 9606, male, 27.0 mm SL, same data as

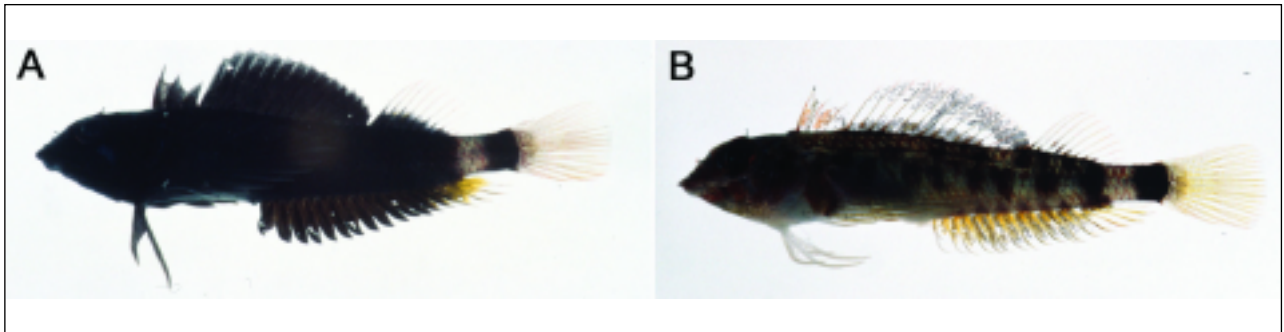


Fig. 1. *Enneapterygius senoui*. **A**, holotype, KPM-NI 9613, male, 27.2 mm SL; **B**, paratype, KPM-NI 9612, female, 27.0 mm SL. Photos by H. Senou.

holotype; KPM-NI 9612, female, 27.0 mm SL, same data as holotype; KPM-NI 9614, female, 18.4 mm SL, same data as holotype.

Diagnosis

A small species of *Enneapterygius* with the following combination of characters: 14 or 15 (mode 15) second dorsal fin spines; 9-11 (10) third dorsal fin soft rays; 18-20 (19) anal fin soft rays; 14-17 (16) pectoral fin rays; 20 or 21 (21) pored lateral line scales; 17-19 (17) notched lateral line scales; 2 or 3 (2) scale rows above first pored lateral line scale; 2 or 2 1/2 (2 1/2) scale rows above last pored lateral line scale; 3 or 4 (3) scale rows below first notched lateral line scale; mandibular pore formula 4-5 + 1-2 + 4-5; nasal tentacle unbranched flat, broad distally; height of first dorsal fin less than that of second dorsal fin; a broad vertical white band on caudal peduncle behind third dorsal fin, and blue lines or spots on head in both sexes; anterior two-thirds of body and fins black, and posterior tip of anal fin yellow in melanistic males; reddish spots on head and body, and anal fin yellow basally in pale males and females.

Description

First dorsal fin with 3 spines; second dorsal fin with 14 or 15 (mode 15) [15 in holotype] spines; third dorsal fin with 9-11 (10) [11] soft rays; anal fin with 1 spine and 18-20 (19) [20] soft rays; all dorsal and anal fin rays simple; caudal fin with 13 principal rays, upper and lowermost 2 rays simple, remaining rays branched; 8 dorsal and 7 ventral series of caudal procurrent rays; pectoral fin with 14-17 (16) [14] rays, uppermost 2 or 3 [2] simple, lowermost 6-8 (7) [7] rays simple and thickened, remaining rays branched; pelvic fin with 1 spine and 2 soft rays; pored lateral line scales 20 or 21 (21) [21]; notched lateral line scales 17-19 (17) [17]; scale rows above first pored lateral line scale 2 or 3 (2) [2]; scale rows from origin of first second dorsal fin spine to above pored lateral line scales 3; scale rows above last pored lateral line scale 2 or 2 1/2 (2 1/2) [2 1/2]; scale rows below first notched lateral line scale 3 or 4 (3) [4]; 1 or 2 (1) [1]

symphyseal mandibular pores; 4 or 5 [5] lateral mandibular pores on each side of the lower jaw.

Morphometric data, expressed as percentage of SL, for the holotype are presented first, followed by paratype data and mean values in parentheses: Head length 30.2% of SL in holotype (29.9-31.8% in paratypes; mean 30.8%); body depth 19.5 (17.1-19.5; 18.9); predorsal length 26.3 (24.5-27.5; 26.0); second dorsal fin base length 35.1 (33.6-37.1; 35.4); anal fin base length 43.1 (37.8-40.4; 40.3); first spine length of first dorsal fin 10.1 (8.7-10.9; 10.0); third spine length of first dorsal fin 7.8 (7.0-8.4; 7.7); longest spine length of second dorsal fin 13.3 (13.1-15.5; 14.0); longest ray length of third dorsal fin 13.5 (13.4-14.8; 13.8); pectoral fin ray length 31.5 (29.6-35.3; 31.9); pelvic fin ray length 22.2 (19.2-21.5; 20.7); anal fin spine length 4.7 (4.6-5.0; 4.8); longest anal fin ray length damaged in holotype (9.8-11.6; 10.4); caudal peduncle length 12.3 (9.5-12.3; 11.5); caudal peduncle depth 8.4 (7.6-8.4; 8.0). Morphometrics expressed as percentage of head length: Snout length 28.4% of HL in holotype (28.8-31.8% in paratypes; mean 29.6%); orbit diameter 31.9 (30.9-33.1; 31.8); interorbital width 7.8 (5.8-8.0; 7.1); postorbital length 43.1 (40.2-43.2; 41.9); upper jaw length 36.8 (31.4-39.0; 35.5).

Body moderately elongate, slightly compressed anteriorly, progressively more compressed posteriorly; dorsal profile of snout not steep; anterior nostril a short membranous tube with an unbranched, flat, distally broad tentacle (see Fig. 3A) [distal margin of tentacle on left nasal curved in one paratype (KPM-NI 9606) and pointed in one paratype (BPBM 39136)]; anterior nostril located at mid-level of eye, slightly closer to eye than to upper lip base; posterior nostril opening elliptic; eyes oriented dorsolaterally; a minute, simple tentacle on upper posterior part of eye; interorbital space very narrow, width less than pupil diameter; mouth slightly oblique; posterior margin of maxilla reaching to or extending slightly beyond level of middle of pupil; uppermost anterior margin of upper jaw approximately level with lowermost margin of orbit; 2-4 rows of numerous inner fringes anteriorly on

upper jaw lip, 1 or 2 inner rows posteriorly; upper jaw with 1 or 2 outer rows of incurved canines and an inner band of anteriorly broad villiform teeth, narrowing posteriorly; lower jaw with an outer row of incurved canines (sometimes absent) and an inner band of anteriorly broad villiform teeth, narrowing posteriorly; width of tooth bands on upper and lower jaw approximately equal; villiform teeth on vomer; posterior tip of opercle extending beyond level of origin of second first dorsal fin spine.

Lateral line discontinuous, with an anterior series of pored scales and a 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 or penultimate pored scale and ending at caudal fin base; no vertical scale row (rarely one scale row) between posteriormost pored scale and anteriormost notched scale; body covered with ctenoid scales; size of scales

above and below lateral lines approximately equal; head (including maxilla, interorbital space, preopercle and opercle), pectoral fin base, pre- and inter pelvic region and abdomen naked; no scales between head and first spine of first dorsal fin; fins naked, except on caudal fin base.

First dorsal fin origin above middle of opercle, first spine longest, third spine shortest (1.3-1.5 in first spine); distal margin of first dorsal fin membrane strongly notched; second dorsal fin origin above fourth pored lateral line scale, third or fourth spine longest (longer than first spine of first dorsal fin); third dorsal fin origin above scale adjacent to last pored lateral line scale; second or third soft ray longest; pelvic fin origin anterior to first dorsal fin origin; uppermost pectoral fin ray origin below second spine of first dorsal fin; pectoral fin pointed, posterior tip of longest ray below twelfth to fourteenth spine of second dorsal fin, not reaching to level of third dorsal fin origin; anal fin

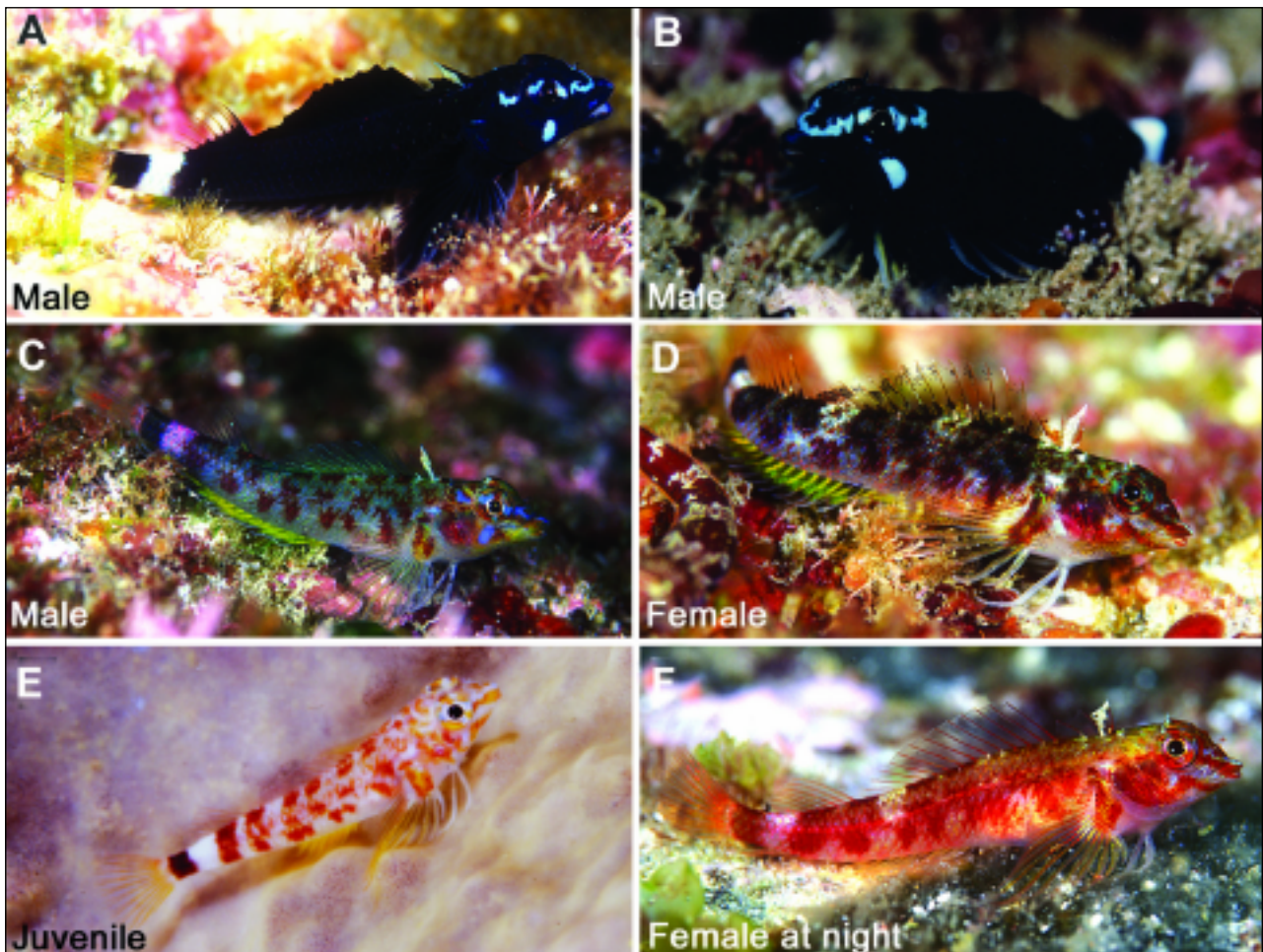


Fig. 2. Underwater photographs of *Enneapterygius senoui*. **A**, male, depth 4 m, Sokodo, Hachijo-jima Island, Izu Islands (photo by S. Harazaki); **B**, male, depth 3 m, Akinohama, Izu-oshima Island, Izu Islands (photo by H. Onuma); **C**, male, same data as A; **D**, female, same data as A; **E**, juvenile (sex undetermined), depth 5 m, Izu Oceanic Park, east coast of Izu Peninsula (photo by K. Imai); **F**, female, depth 10 m, Nazumado, Hachijo-jima Island, Izu Islands, photo taken after sunset by S. Harazaki.

origin below sixth to eighth spine of second dorsal fin, second to sixth soft ray longest, fin base longer than second dorsal fin base; distal margin of caudal fin slightly rounded.

Colour in life of melanistic males: Based on several underwater photographs (see Fig. 2A-B): Two blue lines on head running through eye from near upper end of each side of preopercle to base of upper jaw lip, joining at base of upper jaw lip; upper jaw lip sometimes with a blue line; cheek with an elliptic blue marking; head otherwise black; membrane between first and second spine of first dorsal fin usually black, otherwise bluish, remaining parts black; second dorsal fin black; third dorsal fin base and lowermost one-third of fin black, transparent distally; anterior margin of lower pectoral fin rays grey, remaining parts black; pelvic and anal fins black; caudal peduncle with a white vertical band, broader than pupil, behind last ray of third dorsal fin and an adjacent, equally broad black vertical band to base of caudal fin; remainder of body black; caudal fin base white; caudal fin membrane transparent.

Colour in life of pale males: Based on several underwater photographs (see Fig. 2C): Two blue lines (sometimes blue spots) on head running through each eye except pupil, from near upper end of each side of preopercle to base of upper jaw lip, joining at base of upper jaw lip; upper jaw lip with a blue line; cheek with an elliptic blue marking; posterior of upper jaw lip and posterior margin of eye sometimes greenish-yellow; other parts of head with poorly defined purplish-red spots; membrane between first and second spine of first dorsal fin white, sometimes transparent, remaining parts transparent; second and third dorsal, and pectoral fins transparent; pelvic fin white; anal fin base greenish-yellow, transparent distally; caudal peduncle with a reddish-white vertical band, broader than pupil, behind last ray of third dorsal fin and an adjacent, equally broad black vertical band to base of caudal fin; remainder of body (except abdomen and pre- and inter pelvic region) with poorly defined irregular purplish-red spots; caudal fin base white; caudal fin membrane transparent.

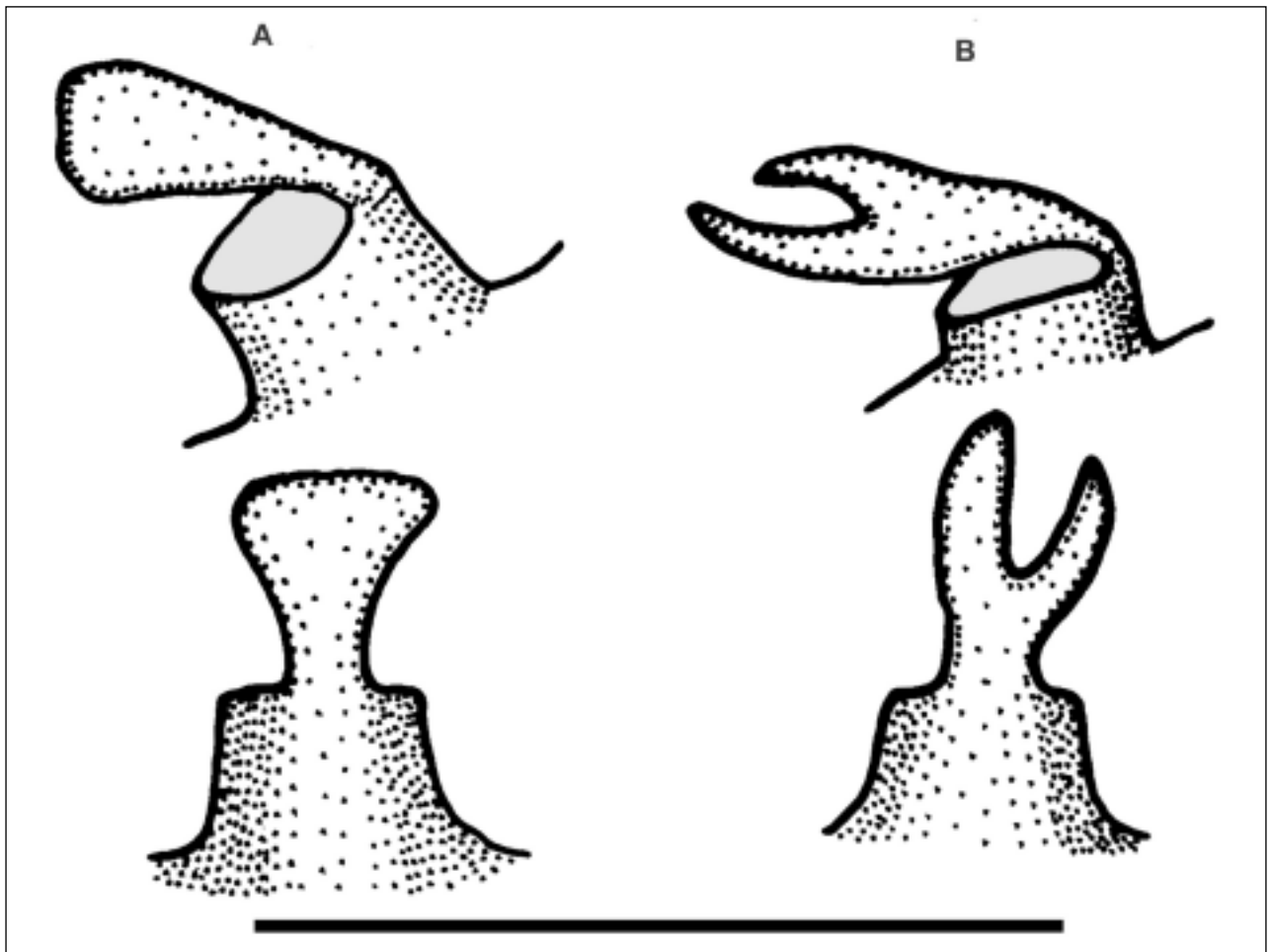


Fig. 3. Tentacle on the anterior nostril. **A**, holotype (KPM-NI 9613) of *Enneapterygius senoui*; **B**, holotype (SU 7065) of *Tripterygium etheastoma* (= *Enneapterygius etheastoma*). Upper and lower represent lateral and posterior views, respectively. Bar 1 mm. Drawn by H. Motomura.

Colour in life of females: Based on several underwater photographs (see Fig. 2D): blue spots around eye, except on pupil; upper jaw lip sometimes with a blue line; cheek sometimes with an elliptic blue mark-

ing; other parts of head with poorly defined dark red spots; membrane between first and second spine of first dorsal fin white, sometimes transparent; second dorsal fin gray basally and distally, remainder transparent (sometimes uniformly transparent); third dorsal and pectoral fins transparent; pelvic fin white; anal fin base greenish yellow, transparent distally; caudal peduncle with a white vertical band, broader than pupil, behind last ray of third dorsal fin and an adjacent, equally broad dark red vertical band to base of caudal fin; remainder of body (except abdomen and pre- and inter pelvic region) with poorly defined irregular dark red spots; caudal fin base white; caudal fin membrane transparent. At night, head and body, and spines and soft rays of all fins, except for pelvic and anal fins, reddish; pelvic fin white; anal fin reddish yellow (see Fig. 2F, photograph taken after sunset, 7:20 pm).

Colour in life of juveniles: Based on several underwater photographs (see Fig. 2E): Head and body white with poorly defined irregular yellow and reddish yellow spots; first, second and third dorsal, and caudal fins transparent, yellowish basally (sometimes uniformly transparent); pectoral fin largely transparent, yellowish distally (sometimes uniformly transparent); pelvic fin white; anal fin yellow (sometimes uniformly transparent); caudal peduncle with a white vertical band, broader than orbit, behind last ray of third dorsal fin and an adjacent, narrower black vertical band to base of caudal fin.

Colour of males soon after death: Based on photographs of holotype (see Fig. 1A) and 2 paratypes collected from Hachijo-jima Island: Blue lines or spots on head in live fish not apparent; head, and first and second dorsal fins black; third dorsal fin base and lower one third of fin, black, remainder of fin transparent; pectoral and pelvic fins black; membranes between fourteenth or fifteenth soft ray to last soft ray in anal fin bright yellow, remaining parts black; caudal peduncle with a white vertical band, broader than pupil, behind last ray of third dorsal fin and an adjacent, equally broad black vertical band to base of caudal fin; remainder of body black; caudal fin base white; caudal fin membrane transparent, slightly yellowish basally.

Colour of females soon after death: Based on photographs of 2 paratypes (see Fig. 1B): No blue lines or spots on head; membranes between first and third spines of first dorsal fin tinged reddish orange; second dorsal fin grey basally and distally, remainder transparent; third dorsal fin transparent; pectoral fin gray; pelvic fin white; anal fin membranes yellow basally, grey distally; caudal peduncle with a white vertical band, broader than pupil, behind last ray of third dorsal fin and an adjacent, equally broad black vertical band to base of caudal fin; other parts of body with indefinite irregular purple spots; caudal fin base white; caudal fin membrane transparent with slightly yellowish basally.

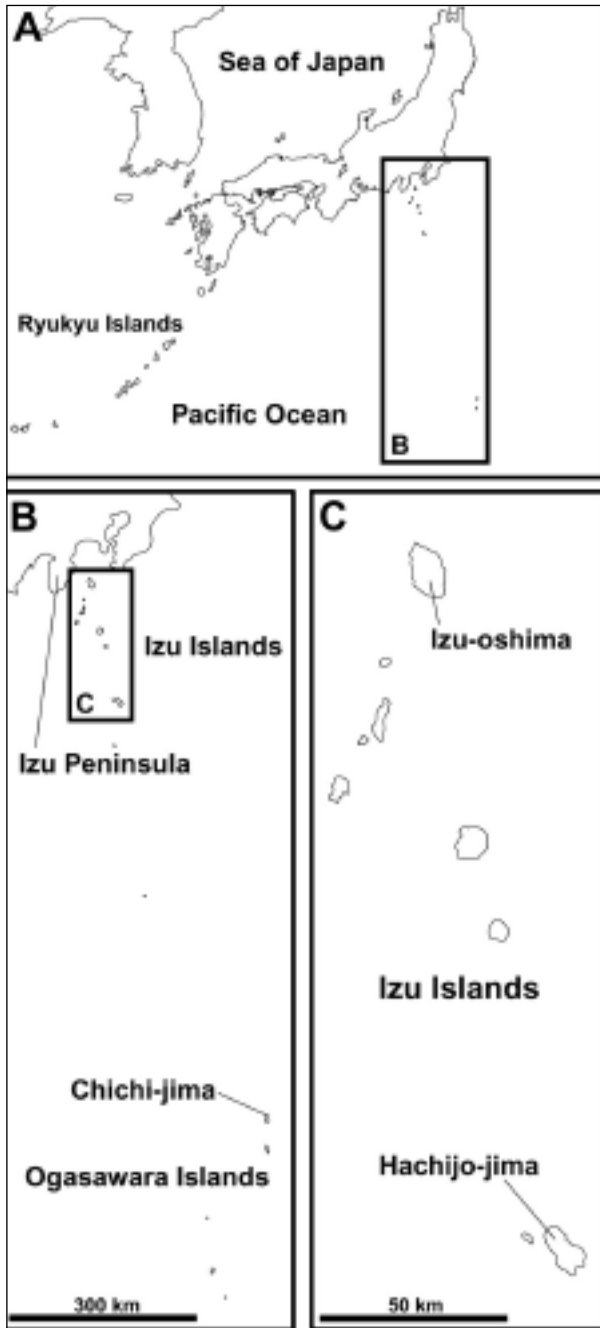


Fig. 4. Geographic distribution of *Enneapterygius senoui*. The species has been recorded from the east coast of Izu Peninsula, Izu-oshima Island, Hachijo-jima Island (type locality) and Chichi-jima Island. **A**, map of Japan (except Hokkaido) and Korean Peninsula; **B**, map of Izu and Ogasawara Islands (enlarged map of B in map A); **C**, Izu Islands (enlarged map of C in map B). Drawn by H. Motomura.

Colour of males in alcohol: No blue lines or spots on head; occipital region brown, other parts of head black; first and second dorsal fins black; third dorsal fin base and lower one third of fin black, remainder transparent; pectoral and pelvic fins black; membranes between fourteenth or fifteenth soft ray to last soft ray in anal fin white (yellow colour disappeared quickly after death); caudal peduncle with a white vertical band, broader than pupil, behind last ray of third dorsal fin and an adjacent, equally broad black vertical band to base of caudal fin; other parts of body black; caudal fin base white; caudal fin membrane transparent.

Colour of females in alcohol: No blue lines or spots on head; membranes between first and third spines of first dorsal fin transparent; second dorsal fin grey basally and distally, remainder transparent; third dorsal and pectoral fins transparent; pelvic fin white; anal fin membranes grey; caudal peduncle with a white vertical band, broader than pupil, behind last ray of third dorsal fin and an adjacent, equally broad black vertical band [broader in a young specimen (KPM-NI 9614, 18.4 mm SL)] to base of caudal fin; other parts of body white with poorly defined irregular grey spots; caudal fin base white; caudal fin membrane transparent.

Distribution

The species is currently known only from Japan (see Fig. 4); from the east coast of Izu Peninsula (Izu Oceanic Park, Futo, Ito, based on underwater photographs, see Fig. 2E), and the Izu (Hachijo-jima Island, based on type specimens, and Izu-oshima Island, based on underwater photographs, see Fig. 2B) and Ogasawara Islands (Chichi-jima Island, based on type specimen).

Habitat and ecological notes

Based on regular underwater observations over 15 months at Hachijo-jima Island, Izu Islands. *Enneapterygius senoui* was common in depths of 3-6 m, but was not recorded in tidal pools or deeper than 11 m. The species usually occurred in areas with strong regular surges generated by wave swells, but was not found in areas with strong unidirectional currents or breaking waves. Individuals usually inhabited inclined, usually near vertical, flat surfaces of large rocks, being found near the substrate, whereas *Helcogramma nesion* Williams and Howe (a larger species of Tripterygiidae) was found further off the substrate. Such vertical segregation of the two

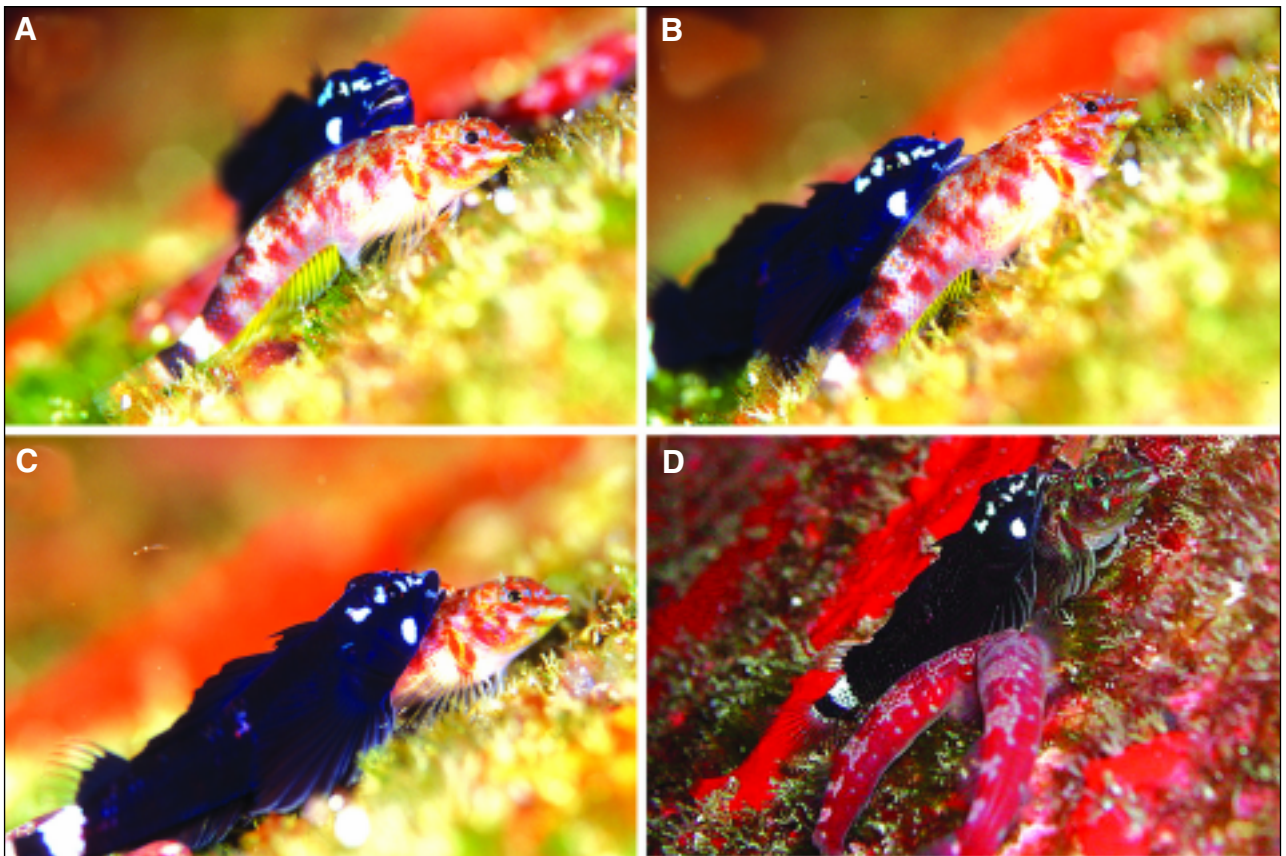
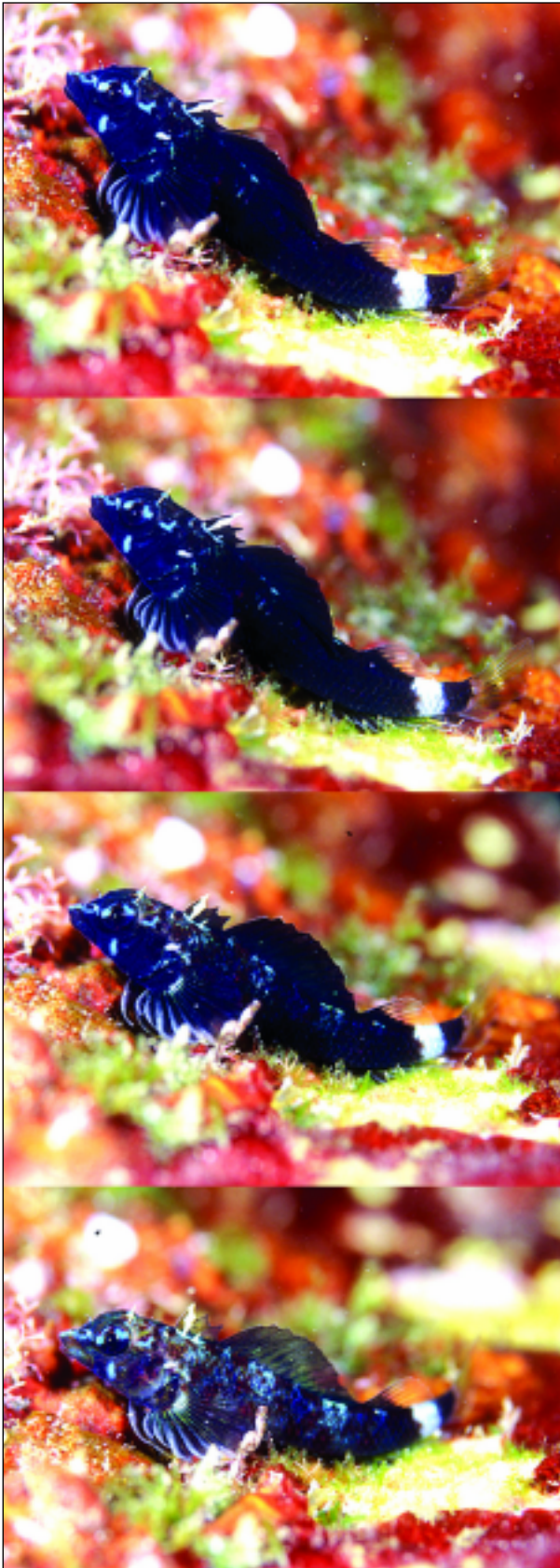


Fig. 5. Spawning behavior of *Enneapterygius senoui* in Nazumado, Hachijo-jima Island (depth 6 m). **A-C**, melanistic male approaches and leans against female; **D**, release of gametes (eggs preyed upon by two gobiesocids). Photos by S. Harazaki.



species may be due to competitive interactions or species-specific preferences for different light intensity. Spawning of *E. senoui* at Hachijo-jima Island began in early morning until 8:00 am, from the end of March to July.

Etymology

The species is named in honour of Dr. Hiroshi Senou, who collected the holotype and 4 paratypes of the species and made them available to us.

Discussion

Although the coloration of melanistic males (Fig. 2A-B) differed significantly from females (Fig. 2D), both sexes were recognized as the same species, as mating was observed underwater on several occasions (see Fig. 5). Although the pale coloration of some males (Fig. 2C) was similar to that of females (Fig. 2D), reddish spots on the body and blue lines on the head of the former were brighter than those of females, although female coloration became brighter (like pale males) during spawning. In addition to color and genital duct differences, *E. senoui* exhibited sexual dimorphism in body depth and first dorsal fin first spine length, males [19.5% of SL and mean 10.5% (range 10.1-10.9%) of SL, respectively] being greater than females [mean 18.0% (range 17.1-18.8%) of SL and 9.3% (8.7-9.9%) of SL, respectively].

As seen in other members of the family, male *E. senoui* were observed to change their coloration quickly to nearly entirely black (within a few seconds; see Fig. 6). Randall and Clark (1993) believed that a color change to black in males of an Indonesian triplefin, *Helcogramma vulcanum*, was not associated with the attainment of sexual maturity. However, such a colour change in male *E. senoui* is apparently associated with the attainment of sexual maturity, because black juveniles of the species have never been observed or collected and the melanistic period (end of March to July) of males at Hachijo-jima Island was entirely concurrent with their spawning season. Melanistic males were never observed outside of the spawning season. Melanistic males retained their black coloration during mating displays and reproduction (early morning until 8:00 am; see Fig. 5), but later frequently changed coloration (from black to pale and from pale to black) (see Fig. 6), although some males retained the black coloration throughout the day. Accordingly, the black coloration in males seems to be related to both sexual maturity and spawning.

Jeffrey T. Williams (pers. comm. in Randall and Clark, 1993) suggested that melanistic tripterygiid

Fig. 6. Color change from melanistic to nearly pale in same male individual of *Enneapterygius senoui* over a 15 second period. Taken at 4 m, Sokodo, Hachijo-jima, Izu Islands. Note: following the final photograph, the fish immediately reverted to melanistic. Photos by S. Harazaki.

males may be dominant in the local population. However, all adult *E. senoui* males during the spawning season at Hachijo-jima exhibited the black coloration at least in the morning. Accordingly, a colour change to black in males is not associated with individual status in *E. senoui*. This aspect of tripterygiid coloration requires further study.

The coloration is the most useful character for the identification of species of *Enneapterygius*. *Enneapterygius senoui* is easily distinguished from all other congeners in the western and central Pacific Ocean, and Australian and New Zealand regions (see Fricke, 1994, 1997) by having the anterior two-thirds of the body and fins (including the head, first and second dorsal fins, pectoral fin, pelvic fin and at least the anterior part of the anal fin) black in melanistic males, and a white band on the caudal peduncle and caudal fin transparent (yellowish basally) (no melanophores or stripes) in both sexes (see Figs. 1-2).

Enneapterygius senoui appears to belong to the *E. etheostoma* species group, as defined by Fricke (1997) by having higher counts of the second dorsal spines, pored lateral line scales and notched lateral line scales (see Fricke, 1997: 143-145, 153-160). The species-group comprises three East Asian endemic species: viz. *E. etheostoma* (*E. etheostomus* was in error because the original description used the name, *etheostoma*, as a noun in apposition), *E. miyakensis* Fricke, 1987 and *E. vexillarius* Fowler, 1946. The latter two species are easily distinguished from *E. senoui* by having seven dark brown streaks on the lateral surface of the body in males of *E. miyakensis* and pale (not black) body and fins in males of *E. vexillarius* (Fricke, 1997; vs. no dark brown streaks and mostly black body and fins in males of *E. senoui*). In

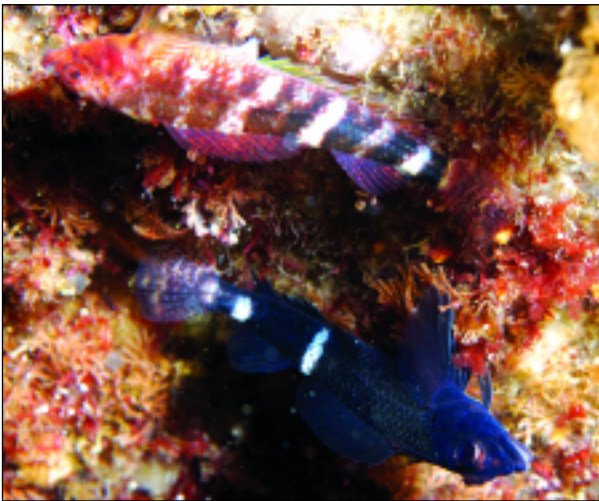


Fig. 7. Underwater photograph of a pair *Enneapterygius etheostoma*. Upper and lower fish represent female and melanistic male, respectively, taken at 5.2 m, Izu Oceanic Park, east coast of Izu Peninsula. Photo by T. Hara.

the overall appearance, *E. senoui* is closest to *E. etheostoma* (see Fig. 7), which is known from East Asia (southern Korea, Japan, China and northern Vietnam; Fricke, 1997) and co-occurs with the former at the Izu Islands and Izu Peninsula. *Enneapterygius senoui* differs in its male coloration from *E. etheostoma* in lacking a vertical white band before the third dorsal fin (vs. a white band broader than the pupil, present in the latter) and spots on the caudal fin (vs. numerous small dark brown spots present), and in having blue lines or spots on the head in life (vs. blue lines absent), a transparent third dorsal fin, except for a black base in melanistic males, and a uniformly transparent third dorsal fin in pale males (vs. third dorsal fin uniformly black in melanistic males and with small dark brown spots in pale males). *Enneapterygius senoui* also has yellow membranes between the fourteenth or fifteenth soft ray to the last soft ray in the anal fin in melanistic males and the anal fin yellow basally in pale males (vs. anal fin uniformly black in melanistic males and with small dark brown spots in pale males of *E. etheostoma*) (see Figs. 1A, 2A-C, 5, 6 for males of *E. senoui* and Fig. 7 for a male of *E. etheostoma*). The female coloration of *E. senoui* differs in the absence of spots on the second and third dorsal, anal and caudal fins (vs. numerous small reddish spots present), and in having yellow anal fin membranes basally (vs. transparent), and the head with blue spots in life (vs. blue spots absent) (see Figs. 1B, 2D, 5 for females of *E. senoui*, and Fig. 7 for a female of *E. etheostoma*).

Although most meristic characters, including fin ray and lateral line scale counts, overlapped between the two species, *E. senoui* further differs from *E. etheostoma* in having a simple nasal tentacle (see Fig. 3A vs. bilobed tentacle in the latter; Fricke, 1997; this study: Fig. 3B), 4 or 5 pores in the lateral mandibular pore series (vs. 3; Fricke, 1997), 2 or 3 scale rows above the first pored lateral line scale (vs. 5-7; based on 48 specimens of *E. etheostoma* examined in this study; listed below), 2 or 2 1/2 scale rows above the last pored lateral line scale (vs. 3 or 3 1/2; this study) and 3 or 4 scale rows below the first notched lateral line scale (4 1/2-5 1/2; this study).

Randall *et al.* (1997) reported *E. etheostoma* from the Ogasawara Islands from the following specimens: BPBM 35214 (5 specimens), BPBM 35222 (2 specimens) and BPBM 35296 (3 specimens). However, the largest specimen (21.5 mm SL) and 4 smaller specimens (17.5-21.0 mm SL) of BPBM 35214 and 2 specimens (21.5-23.0 mm SL) of BPBM 35222 have presently been identified as *Helcogramma chica* Rosenblatt in Schultz *et al.*, 1960, *Enneapterygius rubicauda* Shen, 1994 (excluded from BPBM 35214 and re-registered as BPBM 38722) and paratypes of *E. nigricauda* Fricke, 1997, respectively. Although Randall *et al.* (1997) reported 3 specimens in BPBM 35296, this lot actually contains 4 specimens (23.0-

26.2 mm SL, 1 large male and 3 smaller females). Consequently, the male specimen of BPBM 35296 was identified as *E. senoui* and re-registered as BPBM 39136 (paratype). The three female specimens were identified as *E. bahasa* Fricke, 1997. A figure (pl. 15B), reported as *E. etheostoma* by Randall *et al.* (1997), represents a male of *E. senoui* and a female of *E. bahasa*.

Enneapterygius senoui (27.2 mm maximum SL) is smaller than *E. etheostoma* (54 mm maximum reported SL; Fricke, 1997; this study). Underwater observations of spawning *E. senoui* indicated that the species attains sexual maturity at about 20 mm SL.

Comparative material examined

Enneapterygius etheostoma: California Academy of Sciences (CAS) SU 7065 at CAS, holotype of *Tripterygium etheostoma* Jordan and Snyder, 1902, 53.7 mm SL, Misaki, Miura Peninsula, Kanagawa, Japan; SU 7100 at CAS, 27 paratypes of *Tripterygium etheostoma*, 26.7-54.3 mm SL, Misaki, Miura Peninsula, Kanagawa, Japan; Kanagawa Prefectural Museum of Natural History (KPM-NI) 3804, 41.8 mm SL, Manazuru, Izu Peninsula, Japan; KPM-NI 6639, 6 specimens, 43.6-51.7 mm SL, Manazuru, Izu Peninsula, Japan; KPM-NI 6640, 5 specimens, 42.8-52.9 mm SL, Manazuru, Izu Peninsula, Japan; National Science Museum, Tokyo (NSMT-P) 6651, 36.6 mm SL, Amatsukominato, Chiba, Pacific coast of Honshu, Japan; NSMT-P 18871, 47.1 mm SL, Yoshimi, Shimonoseki, Yamaguchi, Sea of Japan; NSMT-P 19684, 42.7 mm SL, Oga Peninsula, Akita, Sea of Japan; NSMT-P 29912, 3 specimens, 31.2-38.1 mm SL, Shima, Kii Peninsula, Pacific coast of Honshu, Japan; NSMT-P 58167, 41.9 mm SL, Tanegashima Island, Kagoshima, Kyushu, Japan; NSMT-P 59416, 38.1 mm SL, Tokushima, Shikoku, Japan.

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