Original Article

Two New Species of Torrential Gobies of the Genus *Rhinogobius* from the Ryukyu Islands, Japan

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Abstract. Two new freshwater species of the gobiid fish genus *Rhinogobius*, *R. yaima* and *R. yonezawai*, are described based on specimens from swift streams in the Ryukyu Islands, Japan. *Rhinogobius yaima* (16 specimens, 30.2–66.2 mm SL) is distinguished from all congeneric species by the following combination of features: 40–43 longitudinal scales; 10+16=26 vertebrae; head depressed, body and caudal peduncle elongate; first dorsal fin low in males, not extending posteriorly to second dorsal fin; fifth pelvic-fin segmented ray usually divided into five branches at its first (most proximal) segmenting point; pectoral-fin base and prepelvic area naked; belly with small cycloid scales except for a narrow area around ventral midline; a distinct orange oval spot on pectoral-fin base; two orange stripes on temporal region, reaching posteriorly to below origin of second dorsal fin; four vertical rows of orange dots on caudal fin in males; a pair of black blotches at caudal-fin base in females when alive or freshly collected. *Rhinogobius yonezawai* (17 specimens, 45.8–75.2 mm SL) differs from all congeners by the following combination of features: 35–39 longitudinal scales; 10+16=26 vertebrae; first dorsal fin in males high and falcate, non-filamentous, extending posteriorly to second dorsal-fin; fifth pelvic-fin segmented ray divided into four branches; pectoral-fin base and prepelvic area naked; belly with small cycloid scales except for a narrow area around ventral midline or around anterior half of ventral midline; a distinct black oval spot on pectoral-fin base; two orange stripes on temporal region, reaching posteriorly to below first dorsal fin; six to eight vertical red or orange lines on caudal fin in males; a black bifurcated blotch posteriorly at caudal-fin base in females when alive or freshly collected.

Key words: fish taxonomy, amphidromous, *Rhinogobius* sp. DL

Introduction

Rhinogobius Gill, 1859 comprises medium-sized freshwater gobies (reaching up to 100 mm in standard length) and is known from the East and Southeast Asian regions, including the Russia Far East, Japan, Korea, China, Taiwan, the Philippines, Vietnam, Laos, Cambodia, and Thailand (Chen & Miller, 2014). At least in the insular habitats, a majority of the species of the genus are amphidromous; namely, adults spawn in the freshwater habitats, larvae just after hatching immediately go to the coastal marine waters, and after that the juveniles enter the inland waters (Mizuno, 1960a). On the other hand, in the continental areas, many species

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of the genus are non-diadromous and lentic, freshwater inhabitants (e.g., lakes, ponds, and rivers) throughout their life cycle (Huang & Chen, 2007).

Rhinogobius, originally described as a monotypic genus based on *Rhinogobius similis* Gill, 1859, is currently known as the most species-rich freshwater gobiid genus, comprising 83 described, valid species worldwide (Endruweit, 2018; Suzuki *et al.*, 2019), although several unnamed species are left unresolved. Of 17 species hitherto known from the Japanese waters (Akihito *et al.*, 2013), 11 species [viz., *Rhinogobius biwaensis* Takahashi & Okazaki, 2017, *Rhinogobius brunneus* Temminck & Schlegel, 1845, *Rhinogobius flumineus* (Mizuno, 1960b), *Rhinogobius fluviatilis* Tanaka, 1925, *Rhinogobius kurodai* (Tanaka, 1908), *Rhinogobius mizunoi* Suzuki, Shibukawa & Aizawa, 2017, *Rhinogobius nagoyae* Jordan & Seale, 1906, *Rhinogobius ogasawaraensis* Suzuki, Chen & Senou, 2012, *R. smillis, Rhinogobius telma* Suzuki, Kimura & Shibukawa, 2019 and *Rhinogobius tyoni* Suzuki, Kimura & Shibukawa, 2019] have been described (Suzuki *et al.*, 2019). Akihito *et al.* (2013) distinguished the remaining six species, all of which are undescribed, by respective, specific abbreviations, as follows (each vernacular name in Japan is in parenthesis): *Rhinogobius* sp. BB (Aobara-yoshinobori), *Rhinogobius* sp. DL (Hira-yoshinobori), *Rhinogobius* sp. KZ (Kazusa-yoshinobori), *Rhinogobius* sp. MO (Aya-yoshinobori), *Rhinogobius* sp. OM (Oumi-yoshinobori) and *Rhinogobius* sp. YB (Kibara-yoshinobori).

In this paper, we describe two new species of *Rhinogobius*, previously known and confused under the name "Hira-yoshinobori" or "*Rhinogobius* sp. DL" (e.g., Kawanabe & Mizuno, 1989; Akihito *et al.*, 2013; see "Discussion", below). These are amphidromous species, known only from swift streams in the Ryukyu Islands, Japan.

Materials and Methods

The specimens examined in this study are deposited in the following institutions: Kagoshima University Museum, Kagoshima (KAUM); Kanagawa Prefectural Museum of Natural History, Odawara (KPM); Osaka Museum of Natural History, Osaka (OMNH); Institute of Marine Biology, National Taiwan Ocean University, Keelung (NTOU); Museum of Natural and Environmental History, Shizuoka (SPMN).

All specimen lengths given are standard lengths (SL). Measurements were made point-to-point with calipers, or micrometer attached to microscope to the nearest 0.1 mm. The methods for measurements followed those of Hubbs & Lagler (1958) and Huang *et al.* (2016), with exceptions given below (the snout tip refers to the mid-anteriormost point of the upper lip): head length was measured from the snout tip to the posteriormost edge of the gill membrane; cheek depth was measured as the least distance from the orbit downward to the ventral edge of the cheek; caudal-fin length was measured from the base to the tip of the middle ray. The methods for counting followed Prince Akihito *et al.* (1984), except for scales between origin of dorsal fin and dorsal insertion of pectoral fin (counting scales in an oblique row from the dorsalmost point of pectoral-fin base to the origin of first dorsal fin). Data and the other information about squamation and fifth pelvic-fin ray were made based on some paratypes stained with Alizarin Red S The observation of cephalic sensory system and the count of scales were examined based on specimens temporary stained with cyanine blue. Osteological features were observed from radiographs. The number of branches at its first (most proximal) segmenting point of fifth pelvic-fin segmented ray was counted (e.g. Fig. 3A). The method of Akihito *et al.* (2013) is used in describing the pattern of the interdigitation of the dorsal-fin pterygiophores and neural spines ("P-V"). The counts of vertebrae follow Akihito *et al.* (2013). Notations of cephalic sensory-canal pores and sensory-papillae rows followed Prince Akihito *et al.* (1984) and Suzuki *et al.* (2017), respectively. In the description of counts, data from the holotype are indicated by asterisks, and the frequency of each count is given in parentheses following the relevant count. Description of the coloration was based on digital images photographed on a white background. The names of colors follow those of Japan Color Research Institute (1995).

Results

Rhinogobius yaima sp. nov.

(New Standard Japanese name: Yaima-hira-yoshinobori)

(Figs. 1–6; Tables 1 & 3)

Rhinogobius brunneus (not of Temminck & Schlegel): Nakayama, 1975: 114 (in part: Iriomote-jima Island of Yaeyama Group, the Ryukyu Islands, Japan); Hayashi, 1984: 259 (Ishigaki-jima and Iriomote-jima islands of Yaeyama Group, the Ryukyu Islands, Japan).

Rhinogobius sp. DL: Kawanabe & Mizuno, 1989: 589 (in part: Ishigaki-jima and Iriomote-jima islands of Yaeyama Group, the Ryukyu Islands, Japan); Akihito *et al.*, 1993: 1080 (in part: the Nansei Islands, Japan); Akihito *et al.*,

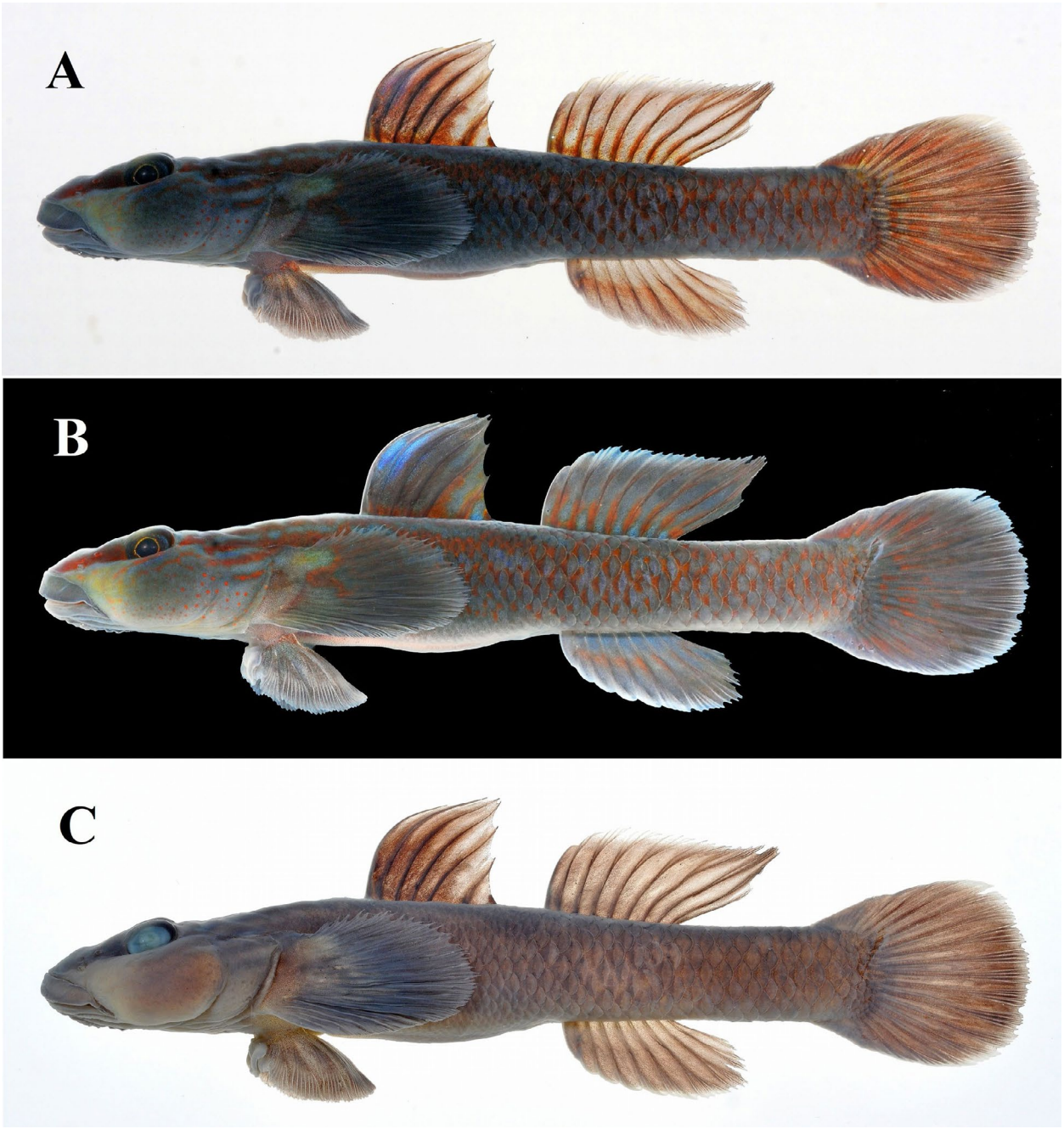

Fig. 1. Holotype of *Rhinogobius yaima* (KPM-NI 52486, male, 60.0 mm SL) collected from Nakara-gawa River, Iriomote-jima Island, the Ryukyu Islands, Japan. A and B: freshly-collected condition; C: alcohol-preserved condition. Photographed by T. Suzuki.

2000: 1252 (in part: the Nansei Islands, Japan); Akihito *et al.*, 2002: 1252 (in part: the Nansei Islands); Suzuki *et al.*, 2004: 450 (in part: Ishigaki-jima and Iriomote-jima islands of Yaeyama Group, the Ryukyu Islands, Japan); Akihito *et al.*, 2013: 1454 (in part: Ishigaki-jima and Iriomote-jima islands of Yaeyama Group, the Ryukyu Islands, Japan).

Holotype. KPM-NI 53486 (formerly OMNH-P 43167), male, 60 mm SL, Nakara-gawa River, Iriomote-jima Island of Yaeyama Group, the Ryukyu Islands, Japan, 24°19' 36.97"N 123°47'57.38"E, 31 July 2015, Fig. 1.

Paratypes. Total 15 specimens (eight males and seven females, 30.2–66.2 mm SL), collected from Yaeyama Group of the Ryukyu Islands, Japan. Iriomote-jima Island: KPM-NI 53487 (formerly OMNH-P 43503), female, 51.1 mm SL, O'omija-gawa River, 24°23'24.97"N 123°51'56.97"E, 26 July 2016, Fig. 2; OMNH-P 31934 and 31935, male and female, 55.6 and 66.2 mm SL, stained with Alizarin Red S, Urauchi-gawa River, 24°21' 18.51"N 123°48'23.77"E, 08 October 2006; OMNH-P 40036, male, 46.8 mm SL, same locality with OMNH-P 31934, 28 March 2012; OMNH-P 43166, male, 66.0 mm SL, collected with the holotype; OMNH-P 43686–43688, two males and a female, 37.1–60.6 mm SL, stained with

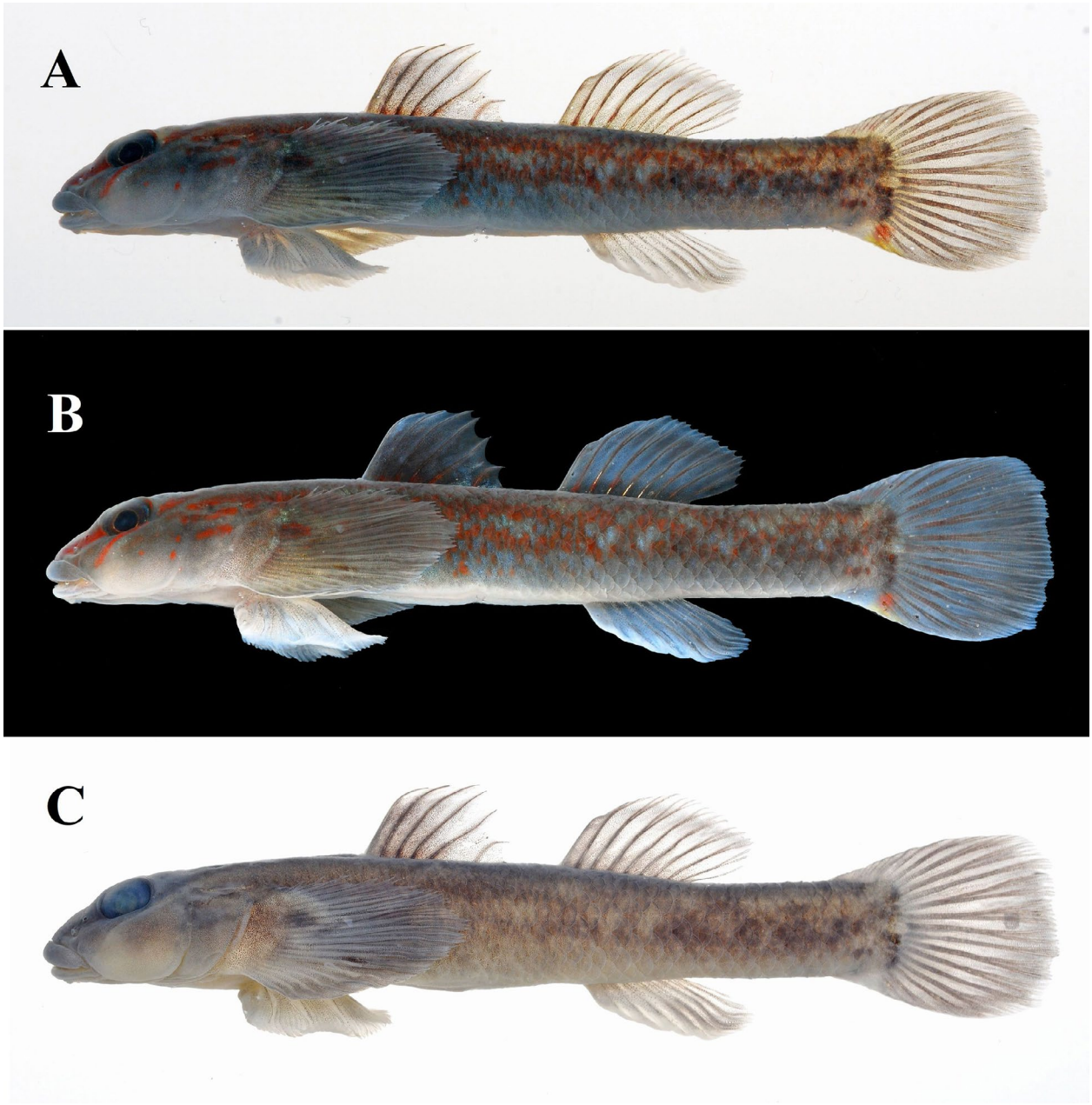

Fig. 2. Female paratype of *Rhinogobius yaima* (KPM-NI 53487, 51.1 mm SL) collected from O'omija-gawa River, Iriomote-jima Island, the Ryukyu Islands, Japan. A and B: freshly-collected condition; C: alcohol-preserved condition. Photographed by T. Suzuki

Alizarin Red S, Urauchi-gawa River, 24°21'25.60"N 123°48'12.37"E, 10 August 1993; SPMN-PI 45461 and 45462 (formerly OMNH-P 44254 and OMNH-P 44255), male and female, 45.7 and 62.9 mm SL, Urauchi-gawa River, 24°21'25.51"N 123°48'12.69"E, 30 July 2019. Ishigaki-jima Island: OMNH-P 43854, male, 47.3 mm SL, stained with Alizarin Red S, Ara-kawa River, 24°26'48.73"N 124°10'46.46"E, 18 August 1991; OMNH-P 43855, female, 43.2 mm SL, stained with Alizarin Red S, same locality with OMNH-P 43854, 19 August 1993; URM-P 48739–48741, two males and a female, 30.2–40.8 mm SL, a freshwater stream near Kabira, 21 February 2019.

Diagnosis. *Rhinogobius yaima* is distinguished from all congeneric species by the following combination of features: head depressed, its maximum depth 65.5–71.6 % of its maximum width; body and caudal peduncle elongate, their depths 13.8–14.5% SL at anal fin origin and 11.4–12.2 % SL, respectively; 40–43 longitudinal scales; 10+16=26 vertebrae; six spines in first dorsal fin; first dorsal fin low in males, not extending posteriorly to origin of second dorsal fin when adpressed; fifth pelvic-fin segmented ray usually divided into five branches at its first (most proximal) segmenting point; pectoral-fin base and prepelvic area naked; belly with small cycloid scales except for a narrow area around ventral midline; sensory-

Table 1. Proportional measurements for *Rhinogobius yaima*

Cat. No.	KPM-NI 53486	OMNH-P 43166	SPMN-PI 45461	KPM-NI 53487	OMNH-P 40036	SPMN-PI 45462
Type status	Holotype	Paratypes				
Sex	Male	Male	Male	Female	Female	Female
SL (mm)	60.0	66.0	61.4	50.3	46.8	45.1
As % in SL						
Head length	31.0	31.1	32.7	27.8	27.4	28.8
Predorsal length	40.0	40.6	40.7	39.8	37.4	40.1
Length of snout to D2 origin	60.8	61.4	62.5	61.6	60.9	62.7
Length of snout to anus	59.2	59.8	59.9	58.6	59.8	59.0
Length of snout to A origin	63.3	62.9	64.2	64.6	62.0	63.9
Prepelvic length	27.5	27.6	28.2	23.9	23.9	27.1
Caudal peduncle length	24.7	25.0	25.2	25.8	26.7	26.8
Caudal peduncle depth	11.6	11.4	11.4	11.7	11.6	12.2
Length of D1 base	17.1	16.6	17.0	17.4	16.8	17.9
Length of longest D1 spine*	19.6 (2nd)	18.6 (3rd)	21.4 (2nd)	14.2 (3rd)	13.6 (2nd)	15.0 (2nd)
Length of D2 base	17.3	16.6	17.3	16.8	15.8	18.3
Length of longest D2 ray*	18.8 (6th)	20.2 (7th)	19.5 (7th)	15.1 (2nd)	13.2 (2nd)	14.3 (2nd)
Length of last D2 ray	15.8	18.0	17.6	10.0	8.7	9.5
Length of A base	14.1	13.0	13.5	12.8	11.8	11.8
Length of longest A ray*	14.3 (7th)	16.8 (6th)	16.2 (6th)	14.5 (5th)	12.4 (5th)	13.3 (4th)
Caudal-fin length	22.5	23.3	24.3	21.9	21.3	22.7
Pectoral-fin length	22.3	22.0	23.3	23.9	21.3	23.9
P2 length	16.7	17.9	17.1	18.7	18.9	18.3
Body depth at pelvic-fin origin	15.0	14.4	15.5	15.1	14.6	14.7
Body depth at anal-fin origin	13.8	13.7	14.2	14.4	13.8	14.5
Body width at anal-fin origin	14.1	13.7	13.8	13.0	13.4	15.2
Length of P2 origin to anus	32.7	33.3	32.6	37.0	37.2	32.2
As % of head lengh						
Snout length	41.4	42.6	37.8	34.6	34.1	35.1
Eye diameter	18.9	19.5	18.4	21.7	23.0	21.2
Postorbital length	42.4	44.0	43.5	45.5	45.3	42.4
Cheek depth	28.1	28.7	27.4	28.5	24.5	23.4
HW at upper gill opening	43.9	40.8	42.1	51.6	52.0	49.7
Maximum head width	67.7	70.7	59.7	77.9	71.3	74.5
Maximum head depth	48.5	46.3	47.3	54.3	53.4	51.2
Bony interorbital width	5.1	5.1	4.7	6.1	5.9	5.8
Upper jaw length	31.2	34.8	34.5	28.5	29.7	28.5
As % of caudal peduncle length						
Caudal peduncle depth	46.9	45.5	45.4	45.3	43.3	45.5

Abbreviations: SL: standard length; D1: first dorsal-fin; D2: second dorsal-fin; A: anal-fin; P2: pelvic-fin; HW: head width. *Longest ray indicates in parenthesis

papillae rows on cheek arranged longitudinally, with no transverse rows; a distinct dull orange oval spot on base of pectoral fin; two orange stripes on temporal region, reaching posteriorly to, or around, a vertical through origin of second dorsal fin; four vertical rows of bright orange dots on caudal fin in males; a pair of vertically-arranged, rounded or rectangular black blotches at base of caudal fin in females when alive or freshly collected.

Description. Dorsal-fin rays VI-I, 7 (1), VI-I, 8* (12) or VI-I, 9 (1); anal-fin rays I, 7 (1) or I, 8* (13); pectoral-fin rays 19* (1), 20 (7), 21 (4), or 22 (2); pelvic-fin rays I, 5* (14); segmented caudal-fin rays (upper part + lower part) 9+8* (14); branched caudal-fin rays (upper part + lower part) 7+7* (11), or 8+7 (3); longitudinal scales 40 (4), 41 (5), 42* (3), or 43 (2); transverse scales 10 (2), 11 (3), 12* (7), or 13 (2); scales between origin of dorsal fin and dorsal insertion of pectoral fin 9 (4), 10* (7), 11 (2), or 12 (1); predorsal scales 0 (1), 5* (3), 6 (3), 8 (1), 10(1), 13(2), 14(1), 15(1), or 17 (1); P-V 3/22110/9* (11); vertebrae (abdominal vertebrae + caudal vertebrae) 10+16=26* (11).

Proportional measurements based on holotype and five paratypes (KPM-NI 53487, OMNH-P 40036, 43166, SPMN-PI 45461, 45462) are given in Table 1. Body slender, almost cylindrical anteriorly, compressed posteriorly. Head moderately large, depressed. Snout nearly pointed and long, longer than eye diameter; snout length of males greater than that of females. Eye large, dorsolateral on head, located slightly behind a vertical through midpoint between snout tip and posterior margin of preopercle. Cheek somewhat bulbous, fleshy. Lips thick and fleshy; upper lip slightly protruding anteriorly beyond lower lip; gape slightly oblique; posterior margin of lower jaw not extending posteriorly to a vertical through anterior margin of eye. Anterior naris a short tube without skin

flap at its tip, usually located slightly before the midpoint between snout tip and anterior margin of eye; posterior naris a round pore with low rim, closer to anterior naris than to eye. Gill opening extending anteriorly to a vertical through posterior margin of preopercle. Gill membranes broadly attached to isthmus. No fleshy papillae or finger-like projections on lateral margin of shoulder girdle. Tongue free from floor of mouth, with rounded anterior margin. Genital papillae cone-shaped in males and oval in females.

Origin of first dorsal fin slightly behind a vertical through dorsal insertion of pectoral-fin; first dorsal fin trapezoid and slightly higher than second dorsal fin in males, whereas, in females, semicircular or trapezoid, and subequal to second dorsal fin in height; second or third spine longest; all dorsal-fin spines slender and flexible, not filamentous; posterior tip of first dorsal fin (usually distal tip of fourth and, fourth, fifth or sixth spines in males and females, respectively) not extending to origin of second dorsal fin when adpressed. First and second dorsal fins not continued by membrane; all segmented dorsal-fin rays branched; sixth or seventh, and second or third branched rays longest in males and females, respectively; posterior tip of second dorsal fin not extending to caudal fin when adpressed; posterior end of base of second dorsal fin above posterior end of anal-fin base. Origin of anal fin usually below a space between bases of first and third second dorsal-fin branched rays; anal fin slightly lower than second dorsal fin in height; all segmented anal-fin rays branched; fifth, sixth, or seventh, and fifth branched rays longest in males and females, respectively; posterior tip of anal fin not extending to caudal fin when adpressed. Pectoral fin oval; pectoral fin extending posteriorly to a vertical through a space between base of fifth spine and posterior end of base of first dorsal fin; pectoral-fin rays branched, except for dorsalmost and/or ventralmost ray(s) unbranched. Pelvic fins fused medially by well-developed frenum (between spines) and connecting membrane (between innermost rays), forming a circular cup-like disc at least in large adults; pelvic fins extending posteriorly to a vertical through a space between bases of third and fourth first dorsal-fin spines, and not reaching to anus; in three small paratypes (36.4–40.8 mm SL), pelvic fins forming an oval cup-like disc, and extending posteriorly to a vertical through a space between bases of fourth and sixth spines, and not reaching to anus; pelvic-fin spine with a rounded membranous lobe at its tip; all segmented rays of pelvic fin branched; fifth segmented pelvic-fin ray divided into five (may be four in smaller specimens) branches at its first (most proximal) segmenting point (Fig. 3A); in three small paratypes (40.8–47.3 mm SL), the number of the branches of fifth segmented pelvic-fin ray is four, but the most inner branch immediately bifurcated. Caudal fin elliptical or fan-shaped.

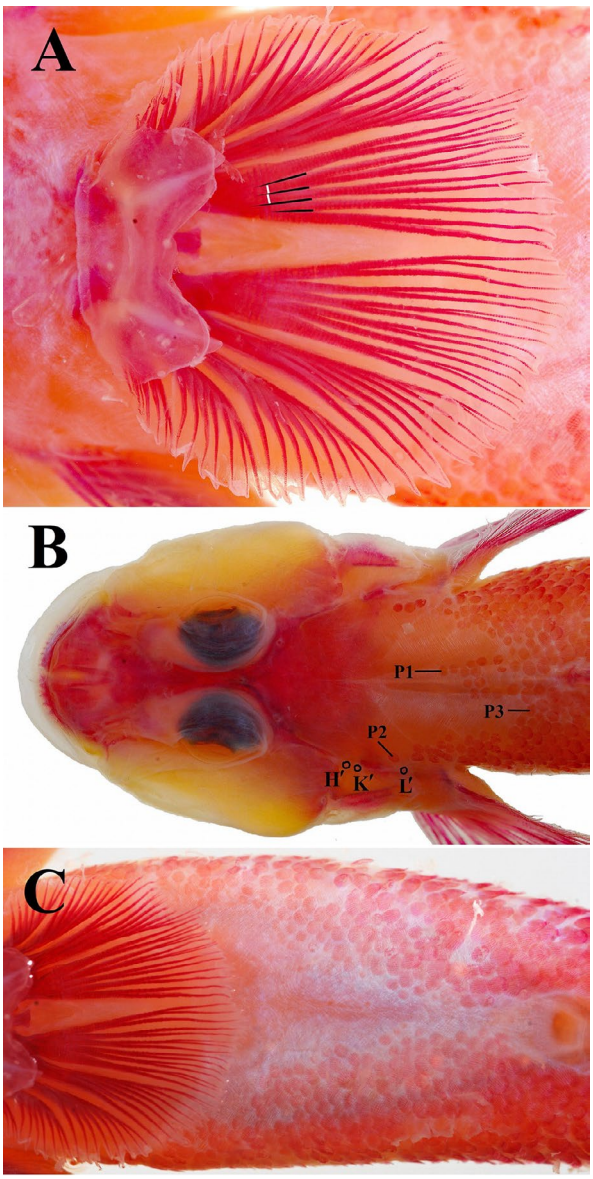

Fig. 3. Ventral view of pelvic fin (A), dorsal view of head (B) and ventral view of belly (C) in *Rhinogobius yaima* (OMNH-P 43686, paratype, male, 60.6 mm SL), stained with Alizarin Red S. White line indicates the most proximal segment of all branches in the fifth segmented ray. Black wedge indicates slits between branches. Black circles with black letters H' , K' , and L' indicate sensory-canal pores. Letters P1, P2, and P3 indicate anteriormost point of anterior extension of scaly area along predorsal midline, anteriormost point of anterior extensions of scaly area on temporal region, and most concaved point of scaly area between P1 and P2, respectively. Photographed and annotated by T. Suzuki.

Scales on body largely ctenoid, becoming smaller anteriorly; a part of basal region of caudal fin, anterodorsal part of body before a diagonal line from a space between

origin and end of second dorsal-fin base to dorsal insertion of pectoral fin, and belly with small cycloid scales; scaled area of belly not extending anteriorly to pelvic-fin insertion. Predorsal squamation usually with trifurcate anterior edge; mid-anterior extension extending anteriorly to a space between transverse lines through a point slightly before origin of first dorsal fin and sensory-canal pore K'; anterior extensions of lateral sides extending anteriorly to a transverse line through posterior oculoscapular canal (Fig. 3B). The other part of head, pectoral-fin base, pelvic-fin axil and following narrow triangular area around ventral midline of belly (Fig. 3C), and prepelvic area naked.

Cephalic sensory systems are illustrated in Fig. 4. Nasal extension of anterior oculoscapular canal with terminal pore B' located above anterior naris. Anterior interorbital sections of anterior oculoscapular canal separated bilaterally, with paired pore C and a single pore D. Pore E present just behind posterior edge of eye. Lateral section of anterior oculoscapular canal with anterior pore F and terminal pore H'. Posterior oculoscapular canal with two terminal pores K' and L'. Gap between anterior and posterior oculoscapular canals much shorter than length of posterior oculoscapular canal. Preopercular canal present, with three pores M', N, and O'. Sensory-papillae row "a" oblique and uniserial, composed of loosely-arranged papillae, extending anteriorly to a vertical through anterior margin of eye. Row "b" longitudinal, composed of loosely-arranged papillae, extending anteriorly to a vertical through pupil; its length longer than eye diameter. Row "c" composed of loosely-arranged papillae, extending posteriorly to a vertical through midpoint of row "b". Row "d" composed of densely-arranged papillae, extending posteriorly to a vertical through posterior margin of pupil. Row "cp" comprising a single papilla. Row "f" comprising paired papillae. Anterior end of row oi slightly separated from a vertical row "ot".

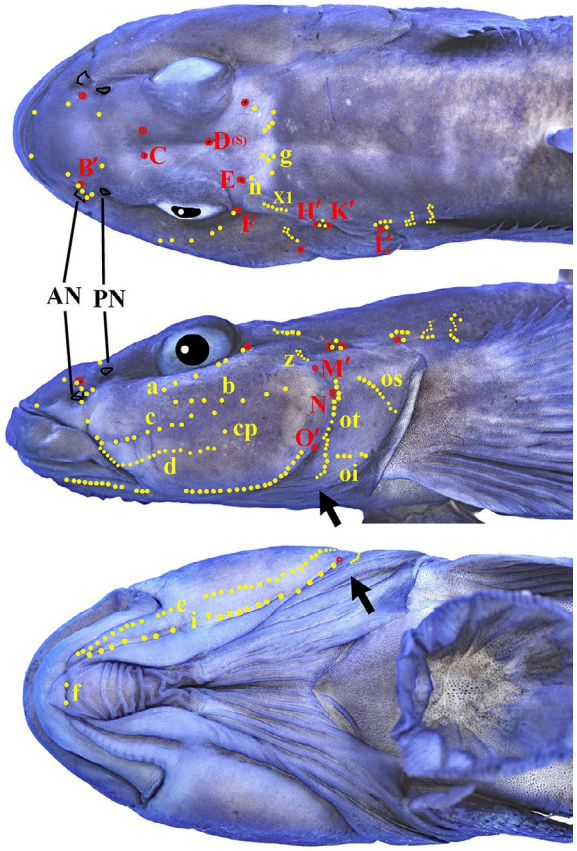

Fig. 4. Dorsal (top), lateral (middle), and ventral (bottom) views of head of *Rhinogobius yaima* (KPM-NI 53486, holotype, male, 60.0 mm SL), showing cephalic sensory pores and papillae. Red circles with red letters indicate sensory canal pores (letters with prime marks indicate terminal openings of sensory canals); rows of yellow dots indicated by yellow letters represent sensory papillae rows; black arrows show ventralmost positions of gill opening. Abbreviations: AN, anterior narial pore; PN, posterior narial pore. Photographed and annotated by T. Suzuki.

Coloration of males when alive [Fig. 5A; Suzuki *et al.*, 2004: 450 (upper figure) and 451 (upper figure)]. Ground color of head and body baby blue. Posterior part of cheek and operculum grayish; cheek and lower half of operculum with many small bright orange dots. Snout with a broad oblique deep-orange stripe between eye and anterior one fourth of upper lip; A large triangular pale-yellow area on anterior part of cheek and lateral side of snout. Several irregular-shaped, deep or dull-orange short stripes and botches on dorsal surface of snout and interorbital space, occipital region and nape; dorsal margin of cheek edged by a narrow deep orange line and bluish green line; upper part of operculum with two oblique dull orange stripes. Temporal region with two dull orange stripes, reaching posteriorly to, or around, a vertical through origin of second dorsal fin. Many of scale pockets on body with dull orange spots. Membranes of vertical fins similar to body in coloration, with black or gray spines/rays; distal margins of vertical fins pale yellow. Caudal fin becoming blackened distally, with a narrow pale-yellow edge; central part of caudal fin with four vertical rows of bright orange dots. Pectoral fin hyaline; central part with two vertical rows of bright orange dots; base of pectoral fin with a distinct dull orange oval spot.

Coloration of female when alive [Fig. 5B; Suzuki *et al.*, 2004: 450 (lower figure)]. Resembles that of male, except as follows. Orange spots on cheek and operculum indistinct, fewer in number. Paler area on anterior part of cheek and lateral side of snout very indistinct. Stripes and blotches on head and body darker. Scale pockets with

Fig. 5. Underwater photographs of *Rhinogobius yaima* taking at Iriomote-jima Island, the Ryukyu Islands, Japan. A: male (photographed by M. Kasai); B: female (M. Suzuki).

indistinct pale spots. Dorsum of body with four saddle-like, large black blotches; anteriormost one at base of first dorsal fin, middle one at base of second dorsal fin, and the other two on caudal peduncle. A longitudinal series of seven large black rectangular blotches on midlateral body; first and second one ventral to first dorsal fin; third one ventral to between dorsal fins, fourth and fifth one ventral to second dorsal fin; sixth and seventh one at caudal peduncle. A pair of vertically-arranged, rounded black blotches at base of caudal fin. Caudal fin without barred pattern.

Coloration when freshly collected. Freshly-collected coloration of males (Figs. 1, 6A) resembles that when alive in underwater photograph, except as follows. Ground color of head and body light or medium gray; head bluish. Ventral side of belly pale white. Branchiostegal membrane pale yellow, with many small bright orange spots. Dorsal and anal-fin membranes yellowish or bluish gray; caudal-fin membrane deep orange; distal margins of vertical fins white. Pectoral and pelvic fins similar to, or slightly more darkened than, body in coloration. Freshly-collected coloration of female (Figs. 2, 6B) resembles that of males, except as follows. Ground color of head and body light bluish gray or yellow gray. Scale pockets with orange spots, forming a network pattern. Fin membranes light or bluish gray. A pair of vertically-arranged rectangular black blotches at base of caudal fin. Caudal fin without barred pattern.

Coloration when preserved in alcohol. All blue, green, orange and yellow color faded; ground color of head and body turns to reddish gray and yellowish gray in males and females respectively; blackish markings on body turn to brown.

Habitat and Distribution. Known from upper reaches of swift freshwater streams in montane areas of Ishigaki-jima and Iriomote-jima islands, Yaeyama Group of the Ryukyu Islands, Japan (Suzuki et al, 2004). It is commonly seen in Iriomote-jima Island, whereas rare in Ishigaki-jima Island. Although a landlocked population is found in O'omija-gawa River of Iriomote-jima Island (T. Tunagawa, personal communication), the species appears to be an amphidromous species, judging from small-sized eggs laid by the females at spawning grounds in Urauchi-gawa River, Iriomote-jima Island (Y. Yamasaki, personal communication).

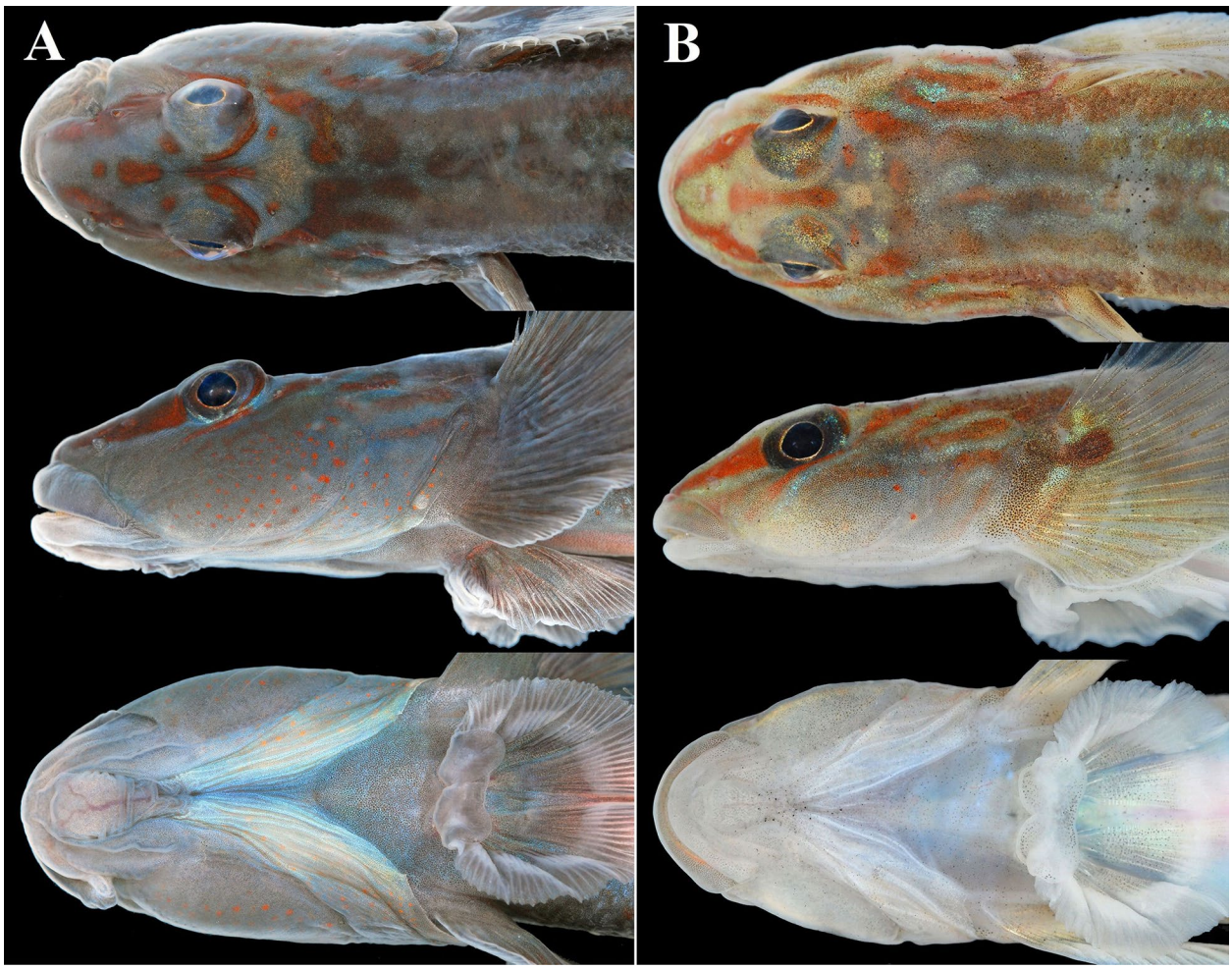

Fig. 6. Dorsal (top), lateral (middle), and ventral (bottom) views of head in *Rhinogobius yaima* showing freshly-collected coloration. A: SPMN-PI 45461, paratype, male, 62.9 mm SL; B: SPMN-PI 45462, paratype, female, 45.7 mm SL. Photographed by T. Suzuki.

Etymology. The specific name, yaima, refers to the Yaeyama Islands, the type locality of this species.

***Rhinogobius yonezawai* sp. nov.**
(New Standard Japanese name: Kemmun-hira-yoshinobori)
(Figs. 7–12; Tables 2 & 3)

Rhinogobius brunneus (not of Temminck & Schlegel): Nakayama, 1975: 114 (in part: Amami-oshima Island of Amami Group, the Ryukyu Islands, Japan).

Rhinogobius sp. DL: Kawanabe & Mizuno, 1989: 589 (in part: Amami-oshima Island of Amami Group, the Ryukyu Islands, Japan); Akihito *et al.*, 1993: 1080 (in part: the Nansei Islands, Japan); Akihito *et al.*, 2000: 1252 (in part: the Nansei Islands, Japan); Sakai *et al.*, 2001: 117 (in part: Tanega-shima and Yaku-shima islands of Osumi Group, and Amami-oshima Island of Amami Group, the Ryukyu Islands, Japan); Akihito *et al.*, 2002: 1252 (in part: the Nansei Islands, Japan); Yonezawa, 2002: 1 (Tanega-shima and Yaku-shima islands of Osumi Group, the Ryukyu Islands, Japan); Suzuki *et al.*, 2004: 450 (in part: Tanega-shima and Yaku-shima islands of Osumi Group, Amami-oshima Island of Amami Group and Okinawa-jima Island of Okinawa Group, the Ryukyu Islands, Japan); Yonezawa *et al.*, 2010: 256 (Yaku-shima Island of Osumi Group, the Ryukyu Islands, Japan); Akihito *et al.*, 2013: 1454 (in part: Tanega-shima and Yaku-shima islands of Osumi Group, Amami-oshima Island of Amami Group and Okinawa-jima Island of Okinawa Group, the Ryukyu Islands, Japan); Motomura & Harazaki, 2017: 139 (Yaku-shima Island of Osumi Group, the Ryukyu Islands, Japan).

Holotype. OMNH-P 44049, male, 75.2 mm SL, Isso-gawa River, Yaku-shima Island of Osumi Group, the Ryukyu Islands, Japan, 30°26'22.45"N 130°28'23.65"E, 16 November 2018, Fig. 7.

Paratypes. Total 16 specimens (six males and 10 females), 45.8–71.0 mm SL, collected from Osumi Group, Amami Group and Okinawa Group, the Ryukyu Islands,

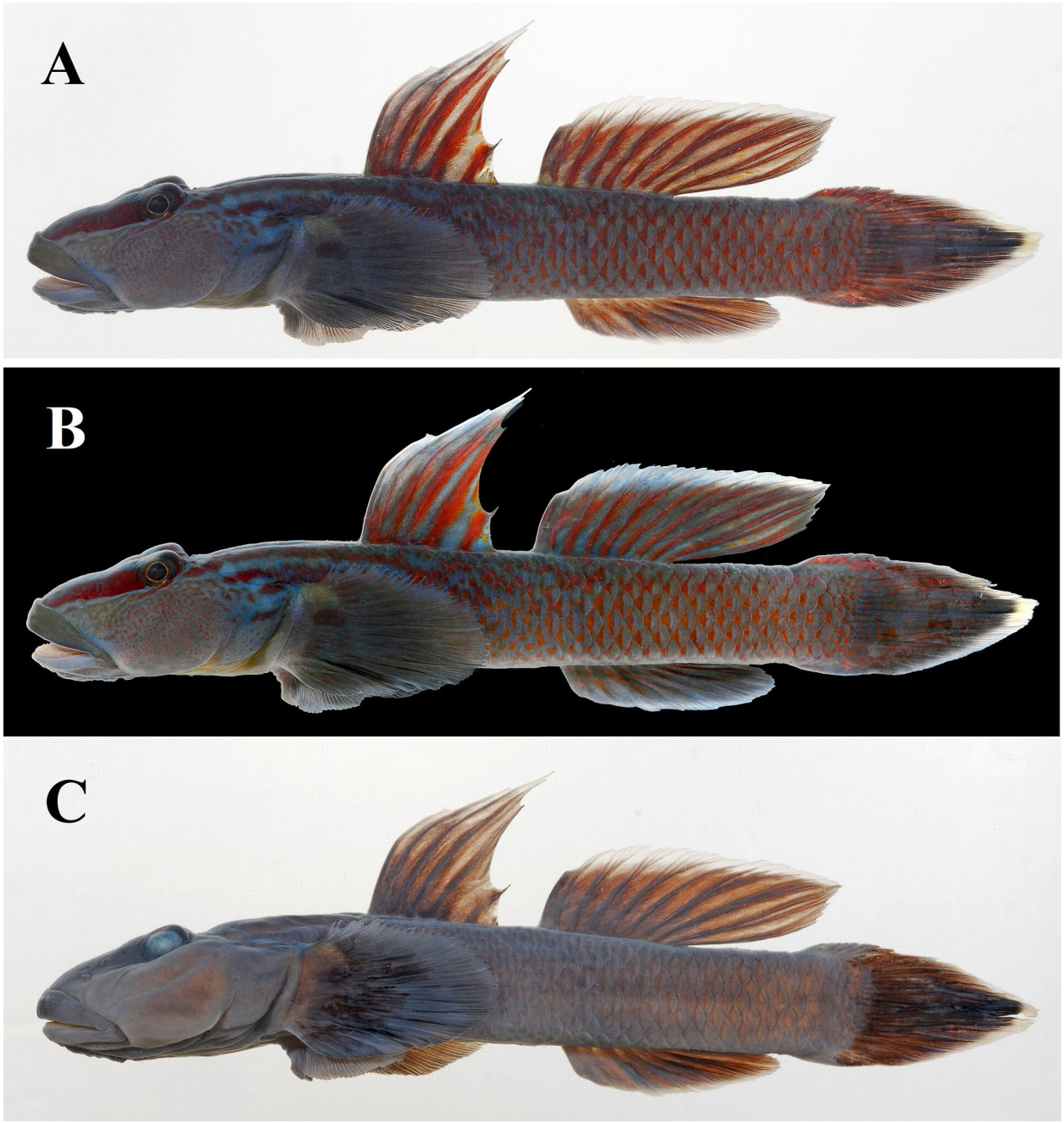

Fig. 7. Holotype of *Rhinogobius yonezawai* (OMNH-P 44049, male, 75.2 mm SL) collected from Isso-gawa River, Yaku-shima Island, Osumi Group, Japan. A and B: freshly-collected condition; C: alcohol-preserved condition. Photographed by T. Suzuki.

Japan. Tanega-shima Island (Osumi Group): KAUM-I. 5753, 5754 (stained with Alizarin Red S), 5755, 5761, 5763, two males and three females, 49.2–64.5 mm SL O'okouda-gawa River, 30°37'34.77"N 131°2'4.02"E, 11 August 2007. Yaku-shima Island (Osumi Group): KPM-NI 53488 and 53489 (formerly OMNH-P 44058 and 44059), male and female, 67.9 and 68.9 mm SL, stained with Alizarin Red S, Jyono-gawa River, 30°23'58.19"N 130°35'22.49"E, 9 December 2018; OMNH-P 44050, female, 60.2 mm SL, collected with holotype, Fig. 8. Amami-oshima Island (Amami Group): OMNH-P 43718, 43720 (stained with Alizarin Red S), 43724, 43726 (stained with Alizarin Red S), two males and two females, 45.8–71.0 mm SL, Kawauchi-gawa River, 28°18'46.10"N 129°25'13.28"E, 31 May 2017. Okinawa-jima Island (Okinawa Group): OMNH-P 43973 and 44082, male and female, 48.7 and 51.3 mm SL, stained with Alizarin Red S, Ufu-gawa River, Aha-gawa River System, 26°44′04.0″N 128°15′12.0″E, 3 October 2005; SPMN-PI 45463 and 45464 (formerly OMNH-P 43692 and 43693), male and female, 59.4 and 63.8 mm SL, Fun-gawa River of Aha-gawa River System, 26°43'29.27"N 128°17'12.65"E, 25 June 2015.

Diagnosis. *Rhinogobius yonezawai* is distinguished

from all congeneric species by the following unique combination of features: 35–39 longitudinal scales; 10+16=26 vertebrae; first dorsal fin in males high and falcate, non-filamentous, longest second and/or third spine(s) extending posteriorly to a space between bases of first and fourth second dorsal-fin branched rays when adpressed; fifth pelvic-fin segmented ray divided into four branches at its first (most proximal) segmenting point; pectoral-fin base and prepelvic areas naked; belly with small cycloid scales except for a narrow area around ventral midline or around anterior half of ventral midline; longitudinal rows of sensory-papillae on cheek with no transverse rows; a black oval spot on base of pectoral fin; two red stripes on temporal region, reaching posteriorly to, or around, dorsum of body below first dorsal fin; six to eight vertical deep-red or reddish-orange lines on caudal fin in males; a black bifurcated blotch posteriorly at base of caudal fin in females when alive or freshly collected.

Table 2. Proportional measurements for *Rhingobius yonezawai*

Cat. No.	OMNH-P 44049	KAUM-I 5763	OMNH-P 43718	SPMN-PI 45463	KAUM-I 5753	OMNH-P 44050	OMNH-P 43724	SPMN-PI 45464
Type status	Holotype	Paratypes						
Locality	Yaku-shima I.	Tanega-shima I.	Amami-oshima I.	Okinawa-jima I.	Tanega-shima I.	Yaku-shima I.	Amami-oshima I.	Okinawa-jima I.
Sex	Male	Male	Male	Male	Female	Female	Female	Female
SL (mm)	75.2	64.5	71.0	63.8	54.9	60.2	56.7	59.4
As % in SL								
Head length	35.6	33.6	32.4	32.1	27.5	29.2	29.1	27.9
Predorsal length	42.6	41.9	42.1	41.4	38.3	37.4	40.4	39.6
Length of snout to D2 origin	62.5	62.8	61.3	61.9	60.1	60.6	63.5	60.9
Length of snout to anus	59.8	61.7	59.3	60.5	60.1	57.3	59.1	61.4
Length of snout to A origin	64.5	64.0	63.4	64.3	63.8	61.6	62.8	65.0
Prepelvic length	30.6	29.8	29.9	28.2	24.6	28.1	26.5	25.3
Caudal peduncle length	23.9	26.0	26.5	25.9	25.1	26.6	27.2	25.3
Caudal peduncle depth	13.3	13.8	12.8	12.7	13.8	13.1	12.7	12.6
Length of D1 base	18.2	17.1	13.4	17.9	17.3	16.4	18.3	17.3
Length of longest D1 spine*	28.7 (3rd)	24.0 (3rd)	24.4 (2・3)	23.1 (2・3)	15.6 (2nd)	15.5 (2nd)	16.4 (2nd)	16.0 (2nd)
Length of D2 base	17.6	17.2	17.9	17.6	16.6	16.4	15.9	16.6
Length of longest D2 ray*	25.9 (7th)	21.1 (7th)	21.5 (7th)	22.0 (7th)	16.6 (2nd)	15.3 (3rd)	15.9 (3rd)	15.2 (3rd)
Length of last D2 ray	24.6	18.4	20.1	20.8	11.6	11.8	12.6	11.0
Length of A base	12.6	13.1	13.6	13.3	13.0	13.6	12.4	13.1
Length of longest A ray*	20.0 (6th)	16.2 (7th)	17.4 (7th)	15.5 (7th)	15.4 (5th)	14.7 (5th)	15.2 (6th)	14.2 (6th)
Caudal-fin length	23.7	25.6	24.6	23.5	22.8	23.9	24.7	20.7
Pectoral-fin length	23.9	24.5	23.9	24.1	22.8	24.6	23.8	22.9
P2 length	23.3	15.5	16.2	16.5	17.8	18.6	18.3	16.8
Body depth at pelvic-fin origin	16.7	15.5	16.1	15.6	16.1	15.8	15.9	15.0
Body depth at anal-fin origin	14.7	16.3	15.0	14.7	17.7	15.5	16.8	15.0
Body width at anal-fin origin	12.5	14.0	12.8	13.4	13.8	12.9	12.9	13.3
Length of P2 origin to anus	29.9	32.2	31.7	32.9	35.5	31.6	34.2	19.9
As % of head lengh								
Snout length	44.4	45.2	43.5	42.6	35.2	37.8	34.5	36.6
Eye diameter	17.0	17.5	16.9	17.1	22.0	18.9	21.3	20.0
Postorbital length	44.8	45.5	45.4	42.6	47.2	44.3	46.1	45.8
Cheek depth	29.1	29.8	28.9	29.2	28.9	26.4	27.6	28.6
HW at upper gill opening	37.2	44.2	41.7	39.9	56.0	49.7	49.5	47.5
Maximum head width	61.6	64.5	60.9	66.8	76.2	71.0	67.9	71.1
Maximum head depth	46.8	46.1	49.6	48.7	58.5	54.0	54.7	53.8
Bony interorbital width	3.5	5.3	3.7	5.1	4.4	5.4	5.8	6.9
Upper jaw length	37.2	35.9	36.8	36.1	31.5	31.8	29.4	30.3
As % of caudal peduncle length								
Caudal peduncle depth	55.4	53.0	48.5	48.9	55.1	49.3	46.9	50.0

Abbreviations: SL: standard length; D1: first dorsal-fin; D2: second dorsal-fin; A: anal-fin; P2: pelvic-fin; HW: head width. *Longest ray is indicated in parentheses.

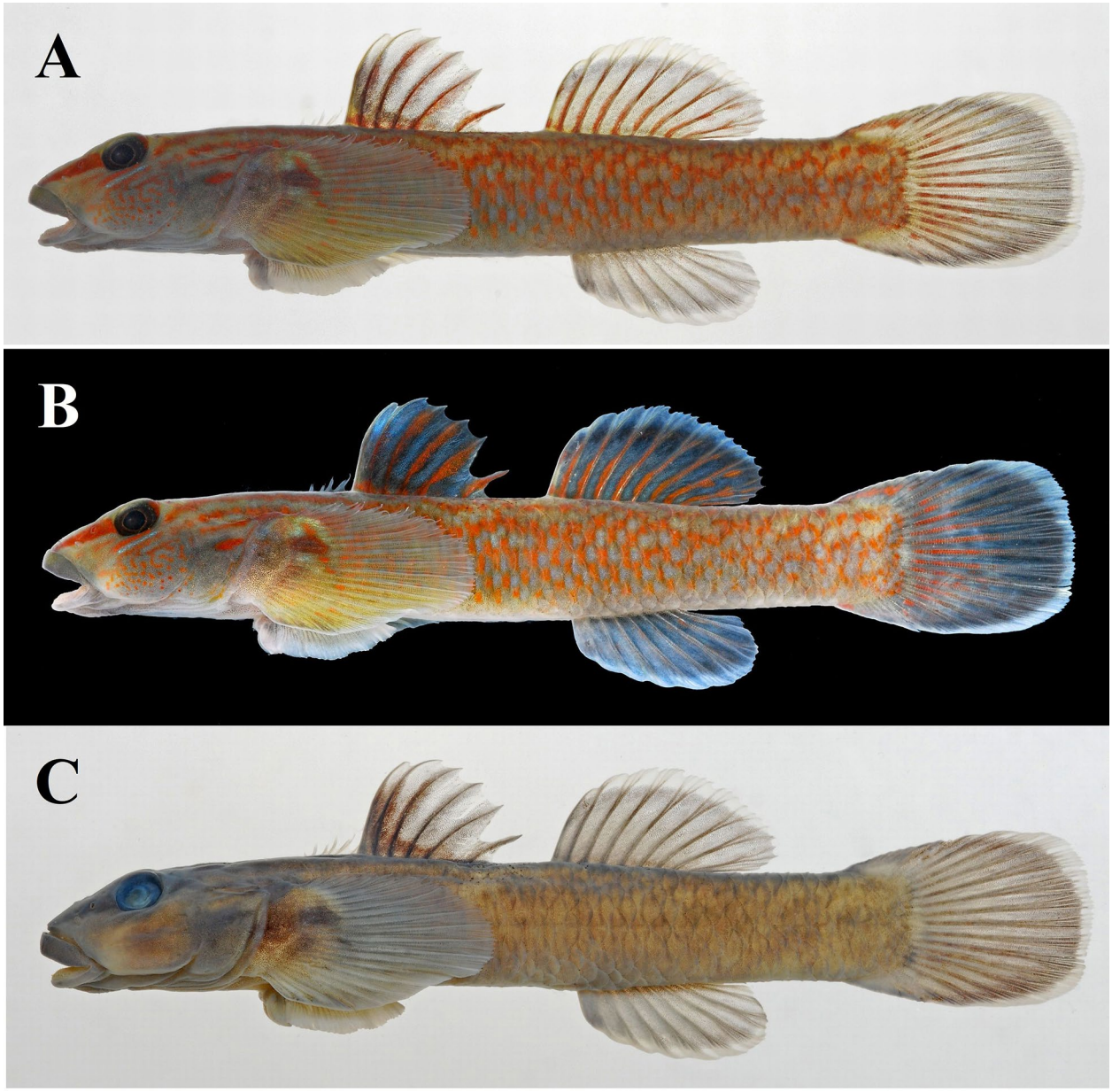

Fig. 8. Female paratype of *Rhinogobius yonezawai* (OMNH-P 44050, 60.2 mm SL) collected with OMNH-P 44050. A and B: fresh condition; C: alcohol-preserved condition. Photographed by T. Suzuki.

Description. Dorsal-fin rays VI-I, 8* (17); anal-fin rays I, 8* (17); pectoral-fin rays 19 (3), 20* (13), or 21 (1); pelvic-fin rays I, 5* (17); segmented caudal-fin rays 8+8 (1), or 9+8* (16); branched caudal-fin rays 7+7* (11), 7+8 (1), or 8+7 (5); longitudinal scales 35 (1), 36 (1), 37* (9), 38* (5), or 39 (1); transverse scales 9 (1), 10 (5), 11* (10), or 12 (1); scales between origin of dorsal fin and dorsal insertion of pectoral fin 8 (7), 9* (4), or 10 (6); predorsal scales 2 (1), 4 (1), 6* (3), 7 (1), 8 (2), 9 (1), 11 (4), 12 (1), 13 (2), or 14(1); P-V 3/21210/9 (1), or 3/22110/9* (14); vertebrae 10+16=26* (15).

Proportional measurements based on holotype and seven paratypes (KAUM-I 5753, 5763; OMNH-P 43718, 43724, 44050; SPMN-PI 45463, 45464,) are given in Table 2. Body slender, slightly compressed anteriorly, compressed posteriorly. Head moderately large, slightly depressed. Snout nearly pointed and long, longer than eye diameter; snout length of males greater than that of females. Eye large, dorsolateral on head, located slightly behind a vertical through midpoint between snout tip and posterior margin of preopercle. Cheek somewhat bulbous, fleshy. Lips thick and fleshy; upper lip slightly protruding anteriorly beyond, or equal to, lower lip; gape slightly oblique; posterior margin of lower jaw not extending posteriorly to a vertical through anterior margin of eye. Anterior naris a short tube without skin flap at its tip, located slightly before the midpoint between snout tip and anterior margin of eye; posterior naris a round pore with low rim, closer to anterior naris than to eye. Gill opening extending anteriorly to a vertical through posterior

margin of preopercle. Gill membranes broadly attached to isthmus. No fleshy papillae- or finger-like projections on lateral margin of shoulder girdle. Tongue free from floor of mouth, with rounded anterior margin. Genital papillae cone-shaped in males and oval in females.

Origin of first dorsal fin slightly behind a vertical through dorsal insertion of pectoral fin; first dorsal fin falcate and much higher than second dorsal fin in males, whereas in females, trapezoid, triangle or semicircular, and subequal to second dorsal fin in height; second and/or third spine(s) longest; all dorsal-fin spines slender and flexible, not filamentous; tip of longest spine (= posterior tip of the fin) extending posteriorly to a space between bases of first and fourth second dorsal-fin branched rays in males,

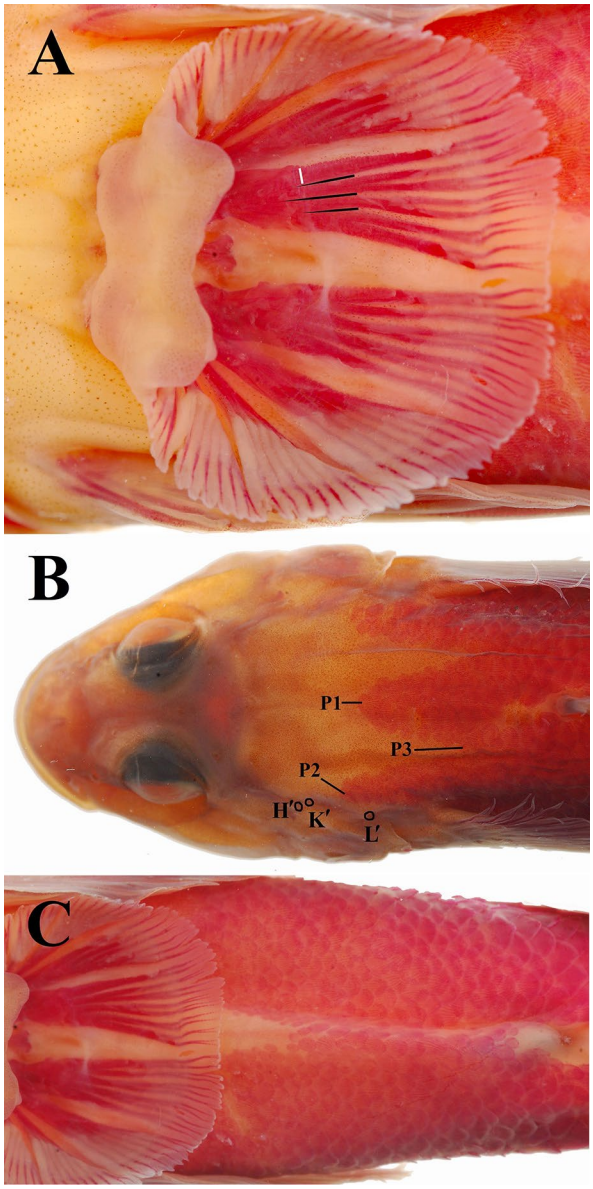

Fig. 9. Ventral view of pelvic fin (A), dorsal view of head (B), and ventral view of belly (C) in *Rhinogobius yonezawai* (KAUM-I 5754, paratype, female, 49.2 mm SL), stained with Alizarin Red S. Annotations are as in Fig. 3. Photographed and annotated by T. Suzuki.

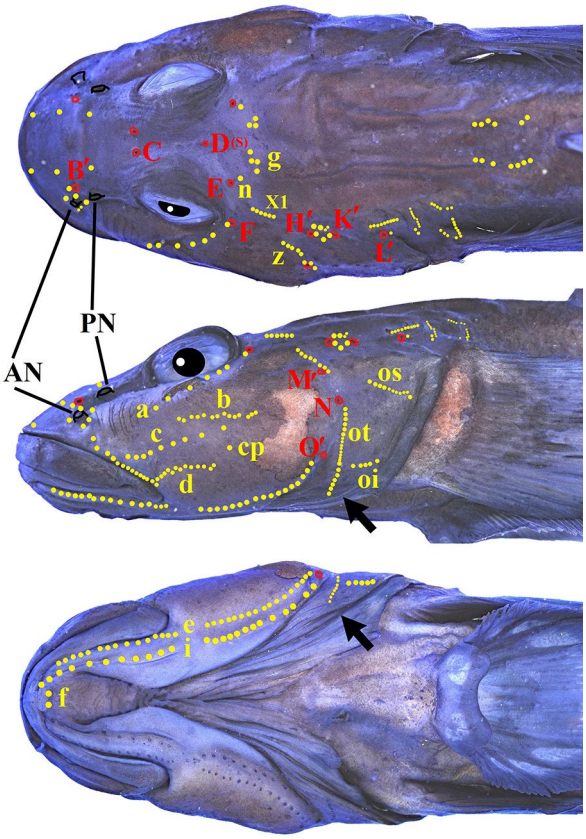

Fig. 10. Dorsal (top), lateral (middle), and ventral (bottom) views of head in *Rhinogobius yonezawai* (KAUM-I. 5755, paratype, male, 54.0 mm SL), showing cephalic sensory pores and papillae. Annotations and abbreviations are as in Fig. 4. Photographed and annotated by T. Suzuki.

but not extending to origin of second dorsal fin in females when adpressed. First and second dorsal fins not continued by membrane; all segmented dorsal-fin rays usually branched; usually seventh and second or third branched rays longest in males and females, respectively; posterior tip of second dorsal fin usually extending to caudal fin in males, but not reaching there in females when adpressed; posterior end of base of second dorsal fin above posterior end of anal-fin base. Origin of anal fin below a space between bases of first and third second dorsal-fin branched rays; anal fin slightly lower than second dorsal fin in height; all segmented anal-fin rays usually branched; sixth or seventh and fifth, sixth or seventh branched rays longest in males and females, respectively; posterior tip of anal fin not extending to caudal fin when adpressed. Pectoral fin oval, extending posteriorly to a vertical through a space between base of fifth spine and end of first dorsal-fin base; pectoral-fin rays branched, except dorsalmost and/or ventralmost ray(s) unbranched. Pelvic fins fused medially by well-developed frenum (between spines) and connecting membrane (between innermost rays), forming

a circular cup-like disc at least in large adults; pelvic fins usually extending posteriorly to a vertical through a space between bases of second and fifth first dorsal-fin spines, and not reaching to anus; pelvic-fin spine with a rounded membranous lobe at its tip; all segmented rays of pelvic fin branched; fifth pelvic-fin segmented ray divided into four branches at its most proximal point with segment of each branch (Fig. 9A). Caudal fin elliptical or fan-shaped.

Scales on body largely ctenoid, becoming smaller anteriorly; a part of basal region of caudal fin, anterodorsal part of body before a diagonal line from base of sixth spine and fourth second dorsal-fin branched ray to dorsal insertion of pectoral fin, belly with small cycloid scales; scaled area of belly not extending anteriorly to pelvic-fin insertion. Predorsal squamation usually with trifurcate anterior edge; mid-anterior extension extending anteriorly to a space between transverse lines through a point slightly before origin of first dorsal fin and sensory-canal pore K'; anterior extensions of lateral sides extending anteriorly to a space between transverse lines through anterodorsal end of gill membrane and pore K' (Fig. 9B) . The other part of head, pectoral-fin base, pelvic-fin axil and following narrow triangular area around ventral midline or around anterior half of ventral midline of belly (Fig. 9C), and prepelvic areas naked.

Cephalic sensory systems are illustrated in Fig. 10. Nasal extension of anterior oculoscapular canal with terminal pore B' located above anterior naris. Anterior interorbital sections of anterior oculoscapular canal separated bilaterally, with paired pore C and a single pore D. Pore E present just behind posterior edge of eye. Lateral section of anterior oculoscapular canal with anterior pore F and terminal pore H'. Posterior oculoscapular canal with two terminal pores K' and L'. Gap between anterior and posterior oculoscapular canals much shorter than length of posterior oculoscapular canal. Preopercular canal

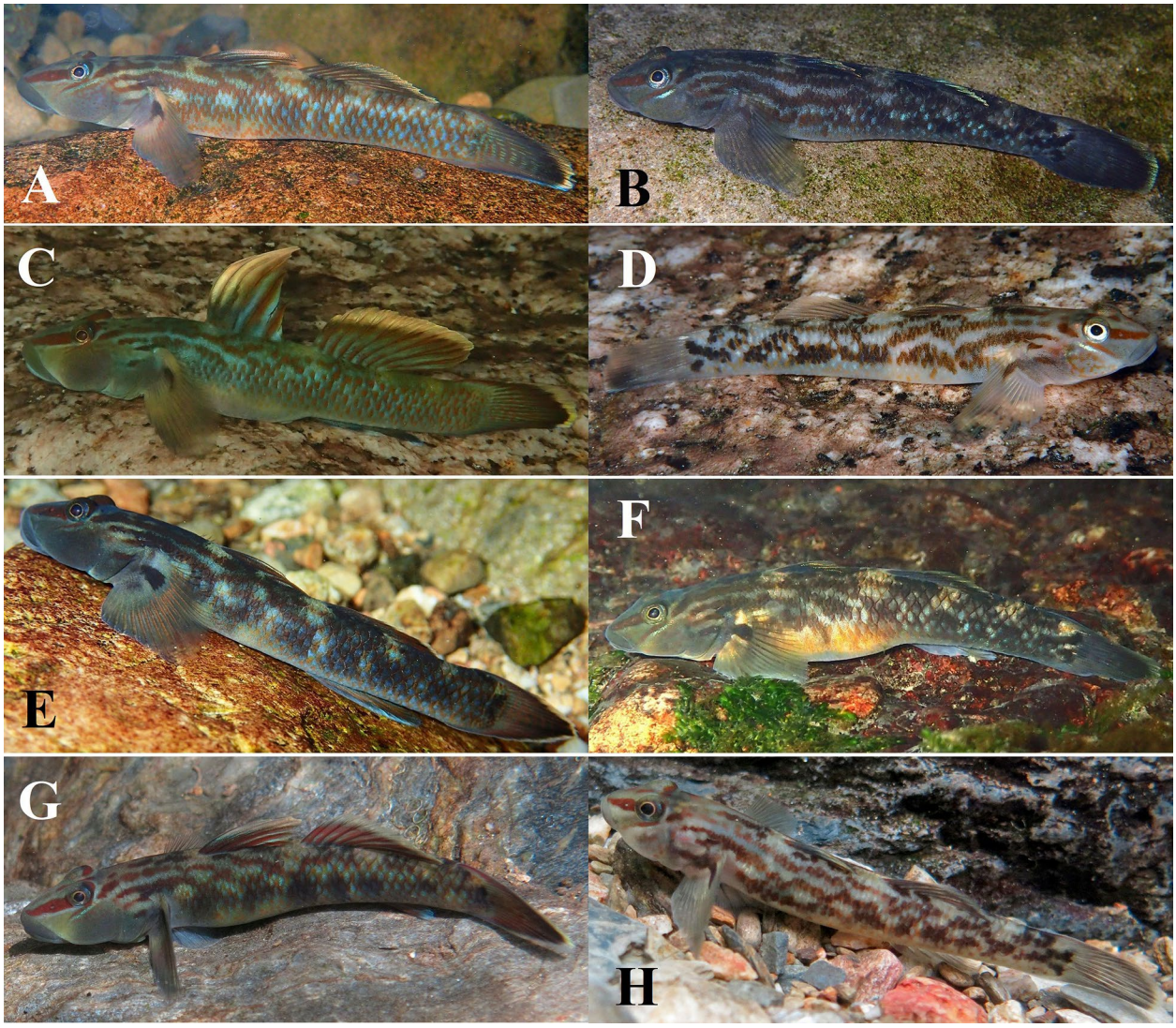

Fig. 11. Underwater photographs of *Rhinogobius yonezawai* taking at Tanega-shima Island (A, B), Yaku-shima Island (C, D), Amami-oshima Island (E, F) and Okinawa-jima Island (G , H), Japan. A, C, E, and G: male; B, D, F, and H; female. A-F, photographed by T. Yonezawa; G and H, photographed by K. Maeda.

present, with three pores M', N, and O' (a paratype without pore N). Sensory-papillae row "a" oblique and uniserial, composed of loosely-arranged papillae, extending anteriorly to a vertical through anterior margin of eye. Row "b" longitudinal, composed of densely-arranged papillae, extending anteriorly to a vertical through pupil; its length slightly longer than eye diameter. Row "c" composed of loosely-arranged papillae, extending posteriorly to a vertical through posterior margin of eye. Row "d" composed of densely-arranged papillae, extending posteriorly to a vertical through posterior margin of pupil. Row "cp" comprising a single papilla. Row "f" comprising paired papillae. Anterior end of row oi slightly separated from a vertical row "ot".

Coloration of males when alive [Figs. 11A, C, E, G; Suzuki *et al.*, 2004: 451 (middle figure)]. Ground color of head and body bluish green or yellow green. Ventral side of belly pale yellow. Cheek and lower half of operculum grayish, with many small deep-red dots, spots and/or short lines forming an irregular network pattern (indistinct in a population in Okinawa-jima Island). Snout with a broad, oblique deep-red stripe between eye and anterior one fourth of upper lip; lateral side of snout sometimes tinged with yellow. Several irregular-shaped, deep-red short stripes and botches on dorsal surface of snout, interorbital space, occipital region and nape; dorsal margin of cheek edged by a narrow deep red line and bluish green line; upper part of operculum with two oblique deep red or black stripes. Temporal region with two deep-red stripes reaching posteriorly to, or around dorsum of body below the first dorsal fin. Many of scale pockets on body with reddish orange spots. Dorsum of body with four saddle-like, large black blotches; anteriormost one at base of first dorsal fin, middle one at base of second dorsal fin, and the other two on caudal peduncle, sometimes indistinct. A longitudinal series of seven large black blotches on midlateral body; first and second ones ventral to first dorsal fin, third one ventral to between dorsal fins, fourth and fifth ones ventral to second dorsal fin, sixth one at middle of caudal peduncle, seventh one at end of caudal peduncle; all these blotches nearly rounded or rectangular, and sometimes indistinct. Membranes of vertical fins similar to body in coloration, with deep-red or reddish-orange spines/rays; distal margins of vertical fins pale yellow. Caudal fin becoming blackened distally, with a narrow pale-yellow edge; central part of caudal fin with six vertical deep-red or reddish-orange lines. Pectoral fin greenish or yellowish, with a central part tinged with red; base of pectoral fin paler, with a distinct black oval spot. Pelvic fins bluish gray.

Coloration of female when alive (Figs. 11B, D, F, H; Suzuki *et al.*, 2004: 451, lower figure). Resembles that of male, except as follows. Ground color of head, body and fins bluish gray, pale sky or pale yellow-green. In spawning season, belly bright yellow (Fig. 11F). Orange dots on cheek indistinct, fewer in number. Many scale pocket spots with pale spots. Stripes and blotches on head and body darker. Seventh midlateral black blotch, located at base of caudal fin, bold and bifurcated posteriorly. Caudal fin without vertical rows.

Coloration when freshly collected. Freshly-collected coloration of males (Figs. 7, 12A) resembles that when alive in underwater photograph, except as follows. Ground color of head and body light or medium gray; head bluish; branchiostegal membrane pale yellow, with many small indistinct bright orange spots. Red and orange markings on head and body darker. Saddle-like black blotches on dorsum and a longitudinal series of black blotches on midlateral body hardly visible. Membranes of vertical fins grayish or reddish brown; distal margins of vertical fins white. Central part of caudal fin with usually six to eight vertical deep-red or reddish-orange lines. Pectoral and pelvic fins similar to, or slightly more darkened than, body in coloration. Freshly-collected coloration of females (Figs. 8, 12B) resembles that of males, except as follows. Ground color of head and body dull yellow or grayish yellow; head and midlateral body bluish. Scale pockets with orange spots, forming a network pattern. Fin membranes light gray. Caudal fin without barred pattern. In some specimens, pectoral fin with two vertical rows of orange dots.

Coloration when preserved in alcohol. All blue, green, orange, red and yellow color faded; ground color of head and body turns to grayish brown and pale yellow in males and females respectively; blackish markings on body turn to brown.

Habitat and Distribution. Known from upper reaches of swift freshwater streams in montane areas of Tanega-shima and Yaku-shima islands of Osumi Group, Amami-oshima Island of Amami Group and Okinawa-jima Island of Okinawa Group, the Ryukyu Islands, Japan; it is an amphidromous species (Takagi *et al.*, 2015), although landlocked in few freshwater reservoirs of Okinawa-jima Island (present study).

Etymology. The specific name, *yonezawai*, refers to Mr. Toshihiko Yonezawa, who offered much information and specimens to us for our study.

Discussion

Nakayama (1975) named a species of *Rhinogobius*

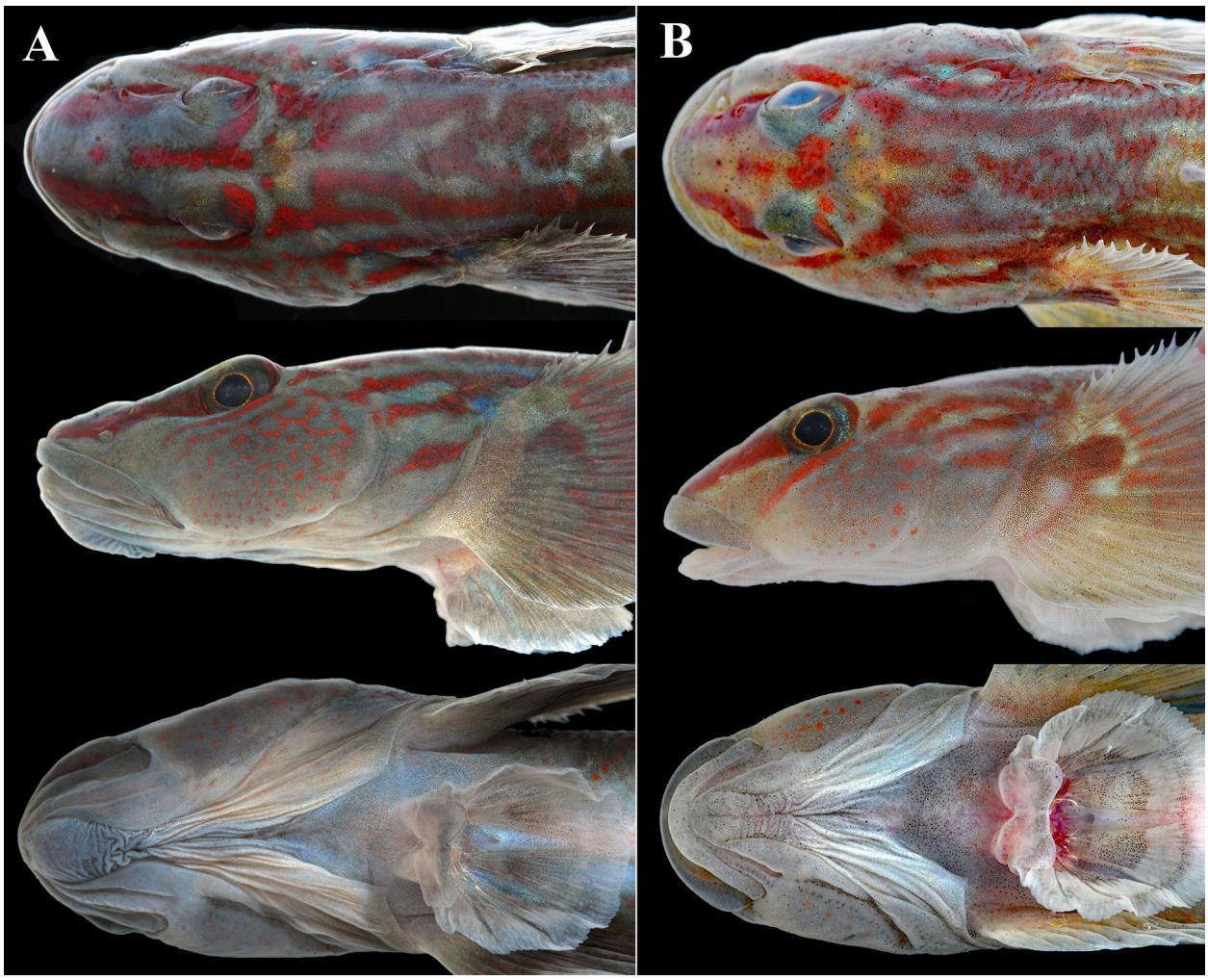

Fig. 12. Dorsal (top), lateral (middle), and ventral (bottom) views of head in *Rhinogobius yonezawai* showing freshly-collected coloration. A: OMNH-P 43718, paratype, male, 71.0 mm SL; B: OMNH-P 43724, paratype, female, 56.7 mm SL. Photographed by T. Suzuki.

collected from Iriomote-jima Island of Yaeyama Group of the Ryukyu Islands as "*Iriomote kokusyoku oogata* (Iriomote large dark morph type)" with a note that it was also distributed in the Amami group of the Ryukyu Islands. Hayashi (1984) applied a new name "*Minami kokusyoku oogata* (South large dark morph type)" for it. Kawanabe & Mizuno (1989) assumed this as a distinct unnamed species, and tentatively named it "*Rhinogobius* sp. DL" with a new standard Japanese name "Hira-yoshinobori". Takagi *et al.* (2015) surveyed the genetic structure of *Rhinogobius* sp. DL in the Ryukyu Islands using three microsatellite loci and clarified that the populations from Yaku-shima/Tanega-shima/Amami-oshima islands are placed in a single cluster, different from a population of Iriomote-jima Island. Our investigation revealed that these two groups are also clearly distinguished from each other in their morphological characters; we thus describe these two as distinct species (*R. yaima* and *R. yonezawai*) here.

Rhinogobius is currently known as the most specious freshwater gobiid genus, comprising 85 valid species (Endruweit, 2018; Suzuki *et al.*, 2019; present study). As indicated by Chen & Shao (1996) and Suzuki *et al.* (2015), the genus is divided into two distinct groups; one comprises only a single species *R. similis*, whereas the other includes all the remaining species. *Rhinogobius similis* differs from the other congeners by having large ctenoid scales on the nape (vs. nape naked or with cycloid scales in the others) and several short transverse rows of sensory papillae on the cheek (vs. no distinct transverse rows of sensory papillae on cheek). Suzuki *et al.* (2019) assigned all species of the genus but *R. similis* to the "*Rhinogobius brunneus* complex", following Chen & Shao (1996). Both of the two new species described here, *Rhinogobius yaima* and *R. yonezawai,* also belong to the *R. brunneus* complex.

Furthermore, Suzuki *et al.* (2019) attempted to divide the *R. brunneus* complex into two subgroups: one almost always has 27 or more vertebrae (they named it "Group I"), whereas the others have lower counts (25–27, almost always 26) ("Group II"). The groups I and II, both of

which appear to be phylogenetic grades merely assembled by the vertebral counts (Suzuki *et al.*, 2019), hitherto comprise at least 46 and 30 described species, respectively. Unfortunately, Suzuki *et al.* (2019) failed to assign the remaining six species to these subgroups due to the lack of information of their vertebral counts (Endruweit, 2019; Suzuki *et al.*, 2019; present study). *Rhinogobius yaima* and *R. yonezawai*, having 26 vertebrae, belong to Group II, making the total number of species in the group 32.

Species of Group II and the assemblage with no information about vertebral counts (total 38 species) are compared in Table 3. Within 38 species, *R. yaima* is most similar to *Rhinogobius bucculentus* (Herre 1927) and *Rhinogobius philippinus* (Herre 1927), by having the following combination of characters: 40 or more longitudinal scales (40–43 in *R. yaima*; 40–44 in *R. bucculentus*; 36–40 in *R. philippinus*); a low first dorsal fin in males, not extending posteriorly to the origin of the second dorsal fin when adpressed. *Rhinogobius yaima* is, however, distinguished from those two species by having a naked area around the ventral midline of the belly (vs. scaly in *R. bucculentus* and *R. philippinus*); and six first dorsal spines (vs. seven spines in *R. bucculentus*; six or seven spines in *R. philippinus*). Data on *R. bucculentus* and *R. philippinus* follow Herre (1927).

Rhinogobius yonezawai can be distinguished from all

Table 3. Comparisons of 38 species of *Rhinogobius* with low or unknown vertebral counts

Species	Vertebrae	Shape of D1 in males	Distal tip of D1 of male extending to*	Longitudinal scales	Squamation at prepelvic area	Squamation at pectoral-fin base	Reference
R. aporus	26	shogi pieces	2nd **	28–31	naked	naked	Zhong & Wu, 1998
R. biwaensis	26–27	trapezoid	1st **	31–36	naked	naked	Takahashi & Okazaki, 2017
R. brunneus	26	falcate	1st–2nd **	32–35	naked	naked or scaled	Oijen *et al* ., 2011; This study
R. candidianus	25–26	falcate	beyond 2nd *	34–38	scaled	naked	Chen & Shao, 1996; Wu & Chen 2008
R. changjiangensis	26	semicircular	not origin of D2	27–30	naked	naked	Chen *et al* ., 2002; Wu & Chen 2008
R. delicatus	26	semicircular	not origin of D2	32–36	scaled	naked	Chen & Shao, 1996; Wu & Chen, 2008
R. fluviatilis	26	falcate	3rd–4th **	32–38	naked	usually scaled	Suzuki & Chen, 2011; Akihito *et al.* , 2013; This study
R. formosanus	26	falcate	or beyond 2nd **	29–34	scaled	naked	Oshima 1919; Aonuma, 1992; Chen & Shao, 1996
R. gigas	26	falcate	2nd–5th **	35–39	scaled	naked	Aonuma, 1992; Aonuma & Chen, 1996
R. henchuenensis	26	falcate	beyond origin of D2	34–37	scaled	naked	Chen & Shao, 1996; Wu & Chen, 2008
R. kurodai	26	shogi pieces	origin–1st **	27–33	scaled	scaled	Suzuki & Chen, 2011; Suzuki *et al* ., 2017
R. lanyuensis	26	semicircular	origin of D2	33–35	scaled	naked	Chen *et al* . 1998
R. leavelli	26	shogi pieces	1st **	30–35	naked	naked	Herre 1935; Li & Zhong 2009; Chen & Miller 2014
R. maculafasciatus	26	trapezoid	origin of D2	30–32	unkown	naked	Chen & Shao, 1996
R. mizunoi	26	falcate	4th **	33–35	naked	scaled	Suzuki *et al.* . 2017
R. nagoyae	26	falcate	4–7th **	32–35	naked	scaled	Jordan & Seale, 1906; Suzuki & Chen, 2011; This study
R. nandujiangensis	25–26	falcate	4–5th **	27–29	naked	unkown	Chen *et al* ., 2002
R. nantaiensis	26	falcate	beyond 1st **	33–36	scaled	naked	Aonuma, 1992; Aonuma & Chen, 1996
R. ogasawaraensis	26	falcate	2–6th **	31–35	naked	naked	Suzuki *et al* ., 2012; This study
R. reticulatus	26–27	semicircular	origin of D2	27–29	naked	naked	Li et al., 2007
R. rubrolineatus	26	falcate	1st **	28–30	naked	unkown	Chen & Miller, 2008
R. sagittus	26	semicircular	origin of D2	29–31	naked	unkown	Chen & Miller, 2008
R. sangenloensis	26	trapezoid	origin of D2	25–27	naked	unkown	Chen & Miller, 2014
R. telma	26	trapezoid	not origin of D2	31–34	naked or scaled	naked or scaled	Suzuki *et al* ., 2019
R. tyoni	26–27	trapezoid	not origin of D2	28–35	naked or scaled	naked or scaled	Suzuki *et al* ., 2017; Suzuki et al., 2019;
R. variolatus	26–27	shogi pieces	not origin of D2	26–27	naked	unkown	Chen & Kottelat, 2005
R. virgigena	26	shogi pieces	not origin of D2	30–31	naked	unkown	Chen & Kottelat, 2005
R. wuyiensis	26	falcate	4–5th **	30–31	naked	naked	Li & Zhong, 2007
R. yaima sp. nov.	26	trapezoid	not origin of D2	40–43	naked	naked	This study
R. yonezawai sp. nov.	26	falcate	1st–4th **	35–39	naked	naked	This study
R. zhoui	26	rectangle	2nd **	29–31	naked	naked	Li & Zhong, 2009
R. bedfordi	26	falcate	6th **	36–38	unkown	unkown	Regan, 1908
R. bucculentus	unknown	trapezoid	not origin of D2	40–44	naked	naked	Herre, 1927
R. cliffordpopei	unknown	semicircular	1st **	28–29	naked	naked	Nichols, 1925; Wu & Chen, 2008
R. fukushimai	unknown	shogi pieces	2nd **	30–31	naked	naked	Mori, 1934; Wu & Chen, 2008
R. philippinus	unknown	shogi pieces	not origin of D2	36–40	naked	naked	Herre, 1927
R. shennongensis	unknown	falcate	3rd–4th **	31–33	naked	naked	Yang & Xie, 1983; Wu & Chen, 2008
R. sowerbyi	unknown	trapezoid	unknown	35–36	unknown	unknown	Ginsburg, 1917

Abbreviations: D1, first dorsal fin; D2, second dorsal fin; *, when the fin adpressed; **, segmented ray base of D2.

other congeners of group II except *Rhinogobius bedfordi* (Regan 1908), *Rhinogobius brunneus* (Temminck and Schlegel, 1845), *Rhinogobius fluviatilis* Tanaka 1925 and *Rhinogobius ogasawaraensis* Suzuki, Chen & Senou 2012 by having the following combination of characters: 35–39 longitudinal scales (35–39 in *R. yonezawai*; 36–38 in *R. bedfordi*; 32–35 in *R. brunneus*; 32–38 in *R. fluviatilis*; 31–35 in *R. ogasawaraensis*); a falcate first dorsal fin extending posterior to, or beyond, the origin of the second dorsal fin in males; no scales on the pectoral-fin base and prepelvic area (both naked in *R. yaima* and *R. ogasawaraenisis*; naked or scaly on the base of pectoral fin, naked on prepelvic area in *R. brunneus* and *R. fluviatilis*; both unknown in *R. bedfordi*). However, *R. yonezawai* is distinguished from *R. bedfordi* by having the second and/or third spine(s) of first dorsal fin longest, not filamentous and extending posteriorly to the space the bases of the first and fourth second dorsal-fin branched rays when adpressed (vs. second spine longest, its tip filamentous and extending to sixth ray base in *R. bedfordi*); the head in males is longer, its length 32.1–35.6 % SL (vs. 30.0 and 30.8% SL in males of *R. bedfordi*); a more slender body in males, its depth at the anal-fin origin 14.7–16.3 % SL (vs. 16.8 and 18.2 % SL in males). *Rhinogobius. yonezawai* is distinguished from *R. brunneus* by being naked around the ventral midline or around the anterior half of the ventral midline of the belly (belly entirely scaly in *R. brunneus*); a black oval spot on upper half of base of the pectoral fin (vs. a dusky crescent mark extending ventrally to ventral half); the midlateral body with no longitudinal series of brown spots or short lined (vs. a longitudinal series of brown spots or short lines); the dorsolateral side of body with no black spots (vs. 3–4 longitudinal series of black spots). *Rhinogobius yonezawai* is distinguished from *R. fluviatilis* by having around ventral midline or around anterior half of the ventral midline of belly naked (belly entirely scaly in *R. fluviatilis*); the temporal region with two red stripes reaching posteriorly to, or around the dorsum of the body below the first dorsal fin (only temporal region with two stripes); a longitudinal series of seven large black blotches on the midlateral body (vs. eight blotches); a black blotch at the base of the caudal fin bold and bifurcated posteriorly (vs. a broad black band); the caudal fin with six to eight vertical red lines in males (vs. no line). *Rhinogobius yonezawai* is distinguished from *R. ogasawaraensis* by having the fifth pelvic-fin segmented ray divided into four branches at its first (most proximal) segmenting point (vs. bifurcated in *R. ogasawaraensis*, Fig.13B). Data on *R. bedfordi, R. brunneus R. fluviatilis,* and *R. ogasawaraensis* were taken from Regan (1908), Oijen *et al.* (2011), Suzuki *et al.* (2004), Suzuki & Chen (2011), Akihito *et al.* (2013), Suzuki *et al.* (2012) and comparative materials.

Yamazaki *et al.* (2015) analyzed nuclear DNA of the Japanese species of *Rhinogobius* and concluded that Rhinogobius sp. DL collected from Iriomote-jima Island (= *R. yaima*) has a sister relationship with *R. fluviatilis* and *R. ogasawaraensis*. *Rhinogobius yaima* is distinguished from *R. fluviatilis* and *R. ogasawaraensis* by having a low first dorsal fin in males, not extending posteriorly to the origin of the second dorsal fin when adpressed (vs. a high first dorsal fin in males, extending posteriorly to a space between bases of the second and sixth second dorsal-fin branched rays in *R. fluviatilis* and *R. ogasawaraensis*); 40–43 longitudinal scales (vs. 34–38 in *R. fluviatilis*; 31–35 in *R. ogasawaraensis*); the fifth pelvic-fin segmented ray usually divided into five branches at its first (most proximal) segmenting point (vs. four and two branches in *R. fluviatilis* and *R. ogasawaraensis*, respectively) (Fig. 13); a naked area around the ventral midline of the belly and the pectoral-fin base (vs. scaly in *R. fluviatilis*). Data on *R. fluviatilis* and *R. ogasawaraensis* were taken from Suzuki

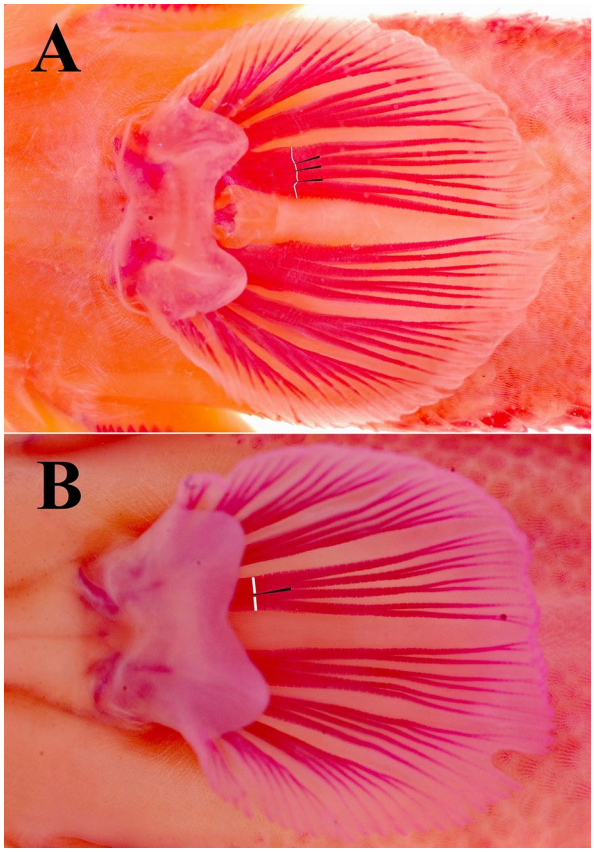

Fig. 13. Ventral views of pelvic fin in *Rhinogobius fluviatilis* (A) and *R. ogasawaraensis* (B), stained with Alizarin Red S. White line indicates at most proximal point with segment of each branch of fifth segmented ray. Black wedges indicate slits between branches. A: OMNH-P 32104, male, 52.4 mm SL; B: NTOU P 2007-02-882, male, 38.6 mm SL. Photographed and annotated by T. Suzuki.

& Chen (2011) and Suzuki *et al.* (2012), respectively, and comparative materials.

Because their coloration and habitat are similar to each other, *R. yaima* and *R. yonezawai* have been regarded as a single species by previous researchers. *Rhinogobius yaima* is, however, distinguished from *R. yonezawai* by having a low first dorsal fin in males, not extending posteriorly to the origin of the second dorsal fin when adpressed (vs. a high first dorsal fin in males, extending posteriorly to a space between the bases of the second and sixth second dorsal-fin branched rays in *R. yonezawai*); the fifth pelvic-fin segmented ray usually divided into five branches at its first (most proximal) segmenting point (vs. four in *R. yonezawai*); a more depressed head, its depth at pelvic-fin origin 14.4–15.5 % SL in males, 14.6–15.8 % SL in females (vs. 15.5–16.7 % SL in males, 15.0–16.8 % SL in females); a more slender body, its depth at the anal-fin origin 13.7–14.2 % SL in males, 13.8–14.5 % SL in females (vs. 14.7–16.3 % SL in males, 15.0–19.6 % SL in females); a more slender caudal peduncle, its depth 11.4–11.6 % SL in males, 11.5–12.2 % of SL in females (vs. 12.7–13.8 % SL in males, 13.1–15.1 % SL in females); the caudal fin with four vertical rows of bright orange dots in males (vs. six to eight vertical deep-red or reddish-orange lines); the base of the caudal fin with a pair of vertically-arranged, rounded or rectangular black blotches in females (a black bifurcated blotch posteriorly).

Rhinogobius yaima is an endemic species of Ishigaki-jima and Iriomote-jima islands, Yaeyama Group of the Ryukyu Islands, and *R. yonezawai* is also endemic to Tanega-shima and Yaku-shima islands of Osumi Group, Amami-oshima Island of Amami Group and Okinawa-jima Island of Okinawa Group, the Ryukyu Islands. In the RDB of Okinawa Prefecture, *Rhinogobius* sp. DL (=*Rhinogobius yaima* and *R. yonezawai*) is designated toas NT (Near Threatened) (Maeda, 2017). *Rhinogobius yaima* is one of the species to have the smallest distribution area and population among the genus from Japan. The habitat of *R. yonezawai* is limited into the Okinawa Island, and the population decreases sharply because of the for influence of the dam construction and the flood caused by the heavy rain. The prompt protection and maintenance of both species are necessary. This account is very important as the first step for their protection and maintenance.

Comparative materials. *Rhinogobius bedfordi*: a radiograph of syntypes [BMNH (British Museum of Natural History, London)1907.12.30.42-46 (https://data.nhm.ac.uk)] of *Ctenogobius bedfordi*; *Rhinogobius brunneus*: 3 specimens: OMNH-P 32106, 32107 and 43683, 2 males and a female, 47.0–54.2 mm SL, stained with Alizarin Red S, To-gawa River, Shimoda, Shizuoka Prefecture, Japan, 29 July 1985. *Rhinogobius fluviatilis*: 7 specimens: OMNH-P 18391 and 18393, 2 males, 70.7 and 86.1 mm SL, Komenotsu-gawa River, Izumi, Kagoshima Prefecture, Japan, 3 September 2003; OMNH-P 18429, female, 67.2 mm SL, Nabeno-gawa River, Izumi, Kagoshima Prefecture, Japan, 24 October 2003; OMNH-P 42882, female, 69.7 mm SL, Sendai-gawa River, Satsumasendai, Kagoshima Prefecture, Japan, 30 September 2014; OMNH-P 32104, 32105 and 43684, 2 males and a female, 50.6–58.1 mm SL, stained with Alizarin Red S, Seto-gawa River, Okabe, Shizuoka Prefecture, Japan, 15 October 1984. *Rhinogobius nagoyae*: 6 specimens: OMNH-P 37977 and 37978, a male and a female, 70.7 and 63.1 mm SL, Inaosawa-gawa River, Shimoda, Shizuoka Prefecture, Japan, 28 August 2011; OMNH-P 43560 and 43565, a male and a female, 60.3 and 58.1 mm SL, Takeno-gawa River, Toyooka, Hyogo Prefecture, Japan, 8 August 2016; OMNH-P 32109 and 43685, a male and a female, 46.9 and 56.3 mm SL, stained with Alizarin Red S, Takizawa-gawa River, Fujieda, Shizuoka Prefecture, 05 March 1985. *Rhinogobius ogasawaraensis*: NTOU P 2007-02-882, male, 38.6 mm SL, stained with Alizarin Red S, a small stream of Oki village, Haha-jima Island, Ogasawara Islands, Japan, 24 November 2001.

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摘　要

鈴木寿之・大迫尚晴・木村清志・渋川浩一 , 2020. 琉球列島の河川急流域に生息するハゼ科ヨシノボリ属魚類 2 新種 . 神奈川県立博物館研究報告（自然科学）, (49): 7–28. [Suzuki, T., N. Oseko, S. Kimura & K. Shibukawa, 2020. Two New Species of Torrential Gobies of the Genus *Rhinogobius* from the Ryukyu Islands, Japan. *Bull. Kanagawa Pref. Mus.* (*Nat. Sci*), (49): 7–28.]

琉球列島の河川急流域に生息するハゼ科ヨシノボリ属魚類 2 新種、*Rhinogobius yaima* と *R. yonezawai* を記載した。*Rhinogobius yaima*（ヤイマヒラヨシノボリ：新称）は縦列鱗数 40–43、脊椎骨数 26、第 1 背鰭棘数 6、頭部はよく縦偏し、体と尾柄は細長い、雄の第 1 背鰭低く後端は倒しても第 2 背鰭起部に達しない、腹鰭第 5 軟条は普通最初に 5 分岐する、胸鰭基底、腹鰭起部前方、腹部腹中線周辺は無鱗である、生時もしくは生鮮時に側頭部から第 2 背鰭起部にかけての背面に橙色または赤色の 2 縦線がある、胸鰭基底に 1 暗色楕円形斑がある、雄の尾鰭に橙色の 4 横点列がある、雌の尾鰭基底に垂直に並んだ 1 対の長方形または円形の黒色斑があるなどの特徴で同属他種から区別できる。*Rhinogobius yonezawai*（ケンムンヒラヨシノボリ：新称）は縦列鱗数 35–39、脊椎骨数 26、雄の第 1 背鰭は高く烏帽子形、その第 2・3 棘が最長で糸状に伸長しないものの倒すと第 2 背鰭第 1 から第 4 軟条基部に達する、腹鰭第 5 軟条は最初に 4 分岐する、胸鰭基底、腹鰭起部前方、腹部腹中線周辺もしくは腹部腹中線前半周辺は無鱗である、胸鰭基底に黒色楕円形斑がある、生時もしくは生鮮時に側頭部から第 1 背鰭下方にかけての背面に橙色または赤色の 2 縦線がある、胸鰭基底に 1 暗色楕円形斑がある、雄の尾鰭に橙色または赤色の 6–8 垂線がある、雌の尾鰭基底に横 Y 字形の 1 黒色斑があるなどの特徴で同属他種から区別できる。