



Taxonomy of freshwater gobies of the genus *Rhinogobius* (Oxudercidae, Gobiiformes) from central Vietnam, with descriptions of two new species

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Abstract

Taxonomy of the genus *Rhinogobius* was investigated for the first time in Central Vietnam. Five species occurring in this region can be distinguished by shape of their head, number of pectoral-fin rays, vertebral counts, arrangements of scales and cutaneous sensory papillae, and coloration. Two species are described as new, *Rhinogobius rong* **sp. nov.** and *R. nami* **sp. nov.**, and the remaining three were identified as *R. taenigena*, *R. leavelli*, and *R. similis*. Though the morphology of *R. leavelli* and *R. similis* differed slightly between localities, counts and measurements overlapped, and coloration was variable. This study tentatively identifies all of those populations as *R. leavelli* or *R. similis*, but further research using additional specimens from a wider geographic range is required to clear the identity of the *Rhinogobius* occurring in this region. *Rhinogobius rong*, *R. similis*, and *R. leavelli* are distributed in both Da Nang City and Thua Thien Hue Province, with the first two species occurring widely in coastal areas, and *R. leavelli* restricted to inland areas. On the other hand, *Rhinogobius nami* and *R. taenigena* occur only in inland areas of Da Nang City and Thua Thien Hue Province, respectively.

Key words: goby, freshwater fish, Da Nang, Thua Thien Hue

Introduction

Rhinogobius is a genus of freshwater gobies distributed in East and Southeast Asia, including continental waters from the Russian Far East, the Korean Peninsula, China to Vietnam, Laos, Thailand, and Cambodia, as well as in the islands of Sakhalin, Japan, Taiwan, Hainan, and the Philippines (Maeda *et al.* 2021). In Vietnam, this genus is distributed in northern and central regions, with Ninh Thuan Province being the southern limit (Serov *et al.* 2006; Fig. 1). In northern Vietnam, the following ten species are known from the Red River drainage and the northeastern regions: *Rhinogobius boa* Chen & Kottelat, 2005, *R. honghensis* Chen, Yang & Chen, 1999, *R. imfasciocaudatus* Nguyen & Vo, 2005, *R. leavelli* (Herre, 1935), *R. ngutinhoceps* Endrueit, 2018, *R. phuongae* Endrueit, 2018, *R. similis* Gill, 1859, *R. sulcatus* Chen & Kottelat, 2005, *R. variolatus* Chen & Kottelat, 2005, and *R. virgigena* Chen & Kottelat, 2005 (see Chen & Kottelat 2005; Endrueit 2018). Though Kottelat (2001a) and Chen & Kottelat (2003) expects that the three species found in Laos (*R. milleri* Chen & Kottelat, 2003, *R. nammaensis* Chen & Kottelat, 2003 and *R. vermiculatus* Chen & Kottelat, 2003) are present in some basins of Vietnam, these are yet to be recorded. Kottelat (2001a) recorded *R. duospilus* (Herre, 1935) from Quang Ninh Province and the Lo River basin in northern Vietnam, but subsequently Chen & Kottelat (2005) clarified this as a misidentification of *R. sulcatus*.

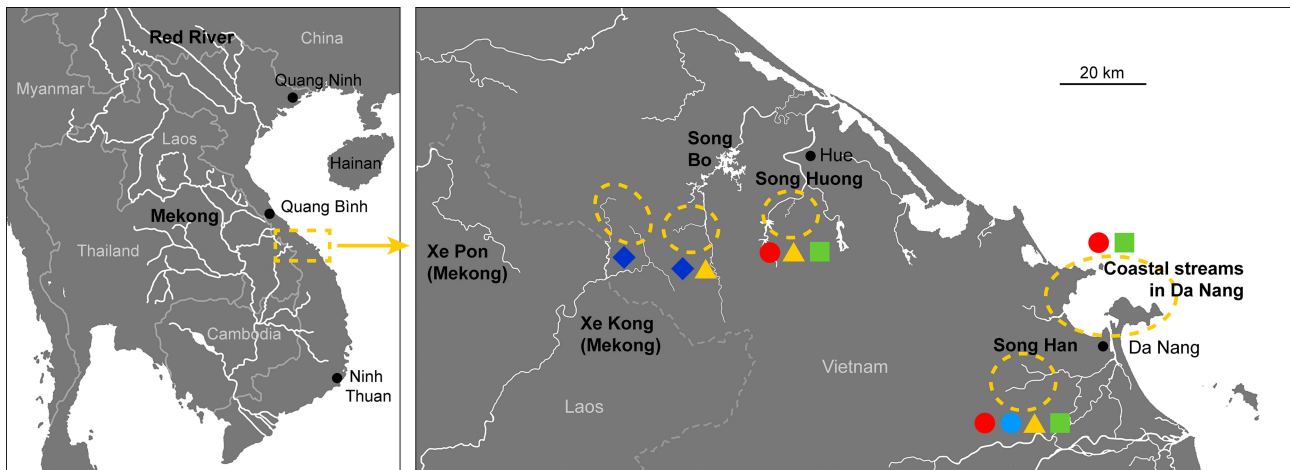


FIGURE 1. Map of South East Asia showing Vietnam, the Mekong and the Red River basins (left), and collection sites for *Rhinogobius* in Da Nang City and Thua Thien Hue Province in central Vietnam (orange dashed circles, right). Symbols below or above orange dashed circles indicate the occurrence of *R. rong* (red circles), *R. nami* (light blue circle), *R. taenigena* (deep blue diamonds), *R. leavelli* (orange triangles), and *R. similis* (green squares) at their respective locations.

Many rivers flow into the South China Sea (Bien Dong) from central Vietnam between the Mekong and Red River (Song Hong) basins, in which Gobies (Gobiiformes) are one of the dominant taxa. Recently, assemblages of amphidromous gobies, including the genus *Stiphodon*, *Sicyopterus*, and *Sicyopus*, were reported in rivers and streams of central Vietnam (Maeda *et al.* 2015; Donaldson *et al.* 2023). Most of these species inhabit tropical island streams, and in Vietnam, they are restricted to short, steep, coastal streams with few non-diadromous freshwater fish species (Donaldson *et al.* 2023). On the other hand, *Stiphodon multisquamus* Wu & Ni, 1986 is abundant in larger inland rivers, where it shares its habitat with many non-diadromous fish groups, such as cyprinids and loaches (Maeda *et al.* 2015). Along with *S. multisquamus*, Maeda *et al.* (2015) also recorded four species of *Rhinogobius*, but they were not identified to the species level, except for *Rhinogobius giurinus* Rutter, 1897, a species currently considered a junior synonym of *Rhinogobius similis* Gill, 1859 (see Suzuki *et al.* 2016).

Species of *Rhinogobius* in central Vietnam are poorly known, although Serov *et al.* (2006) recorded *R. giurinus* (= *R. similis*, see above), *R. leavelli*, and *R. taenigena* Chen, Kottelat & Miller, 1999, and later Maeda *et al.* (2015) recorded *R. giurinus* (= *R. similis*) and three unidentified species. In the present study, we describe the morphology of five species of *Rhinogobius* collected in rivers in Da Nang City and Thua Thien Hue Province in central Vietnam, including two new species, thus establishing the foundation for taxonomy of this genus in Central Vietnam.

Materials and methods

Specimens were collected using hand nets by the authors. After being euthanized with 2-phenoxyethanol solution, the right pectoral fins were removed and preserved in 99.5% ethanol for genetic studies. Samples were then fixed in 10% formalin and preserved in 70% ethanol for morphological examination. Collections in Vietnam were performed with permits provided by the Ministry of Natural Resources and Environment, and with Prior Informed Consent Certificates from all relevant provinces and cities. Procedures used to handle fish specimens in this study were approved by the Animal Care and Use Committee of the Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan.

Measurements and counts were taken from the left side of each fish. Measurements were made point to point to the nearest 0.1 mm, using a vernier caliper under a stereomicroscope, and were expressed as a percentage of standard length (SL). Measurements and counts followed Nakabo (2002), with the modifications: body depth was measured at the pelvic- and anal-fin origins; the first and second dorsal and anal fin length was measured from the anterior origin of each fin to the farthest point where the fin was adpressed; longitudinal scale counts comprise the number of oblique (anterodorsal to posteroventral) scale rows taken from the dorsal to upper attachment of the opercular membrane, posteriorly to the mid-base of caudal fin; transverse scale counts comprise the number of scales from

origin of the second dorsal fin downward and backward to base of the anal fin; and transverse scales on caudal peduncle were counted along a vertical zigzag line around the narrowest point of caudal peduncle from a scale on the dorsal midline to a scale on the ventral midline. Abbreviations pertaining to the cephalic sensory pore system followed Akihito *et al.* (1984). Number of vertebrae and pattern of interdigitation of dorsal fin pterygiophores and neural spines (P-V) were observed from radiographs of selected specimens. P-V was expressed using the method of Akihito *et al.* (1984). Color in life was described based on photographs of fish taken *in situ*, including those of individuals that were not collected. Codes for natural history collections follow Sabaj (2023), except for OISTICH (an ichthyological collection newly established under the OIST Natural History Collection, Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan).

Results

Distribution. *Rhinogobius* is a major component of the freshwater fish fauna of central Vietnam. Five species of *Rhinogobius* were recorded in Da Nang City and Thua Thien Hue Province of central Vietnam. Three of these species were identified as *R. taenigena*, *R. leavelli*, and *R. similis*, while the remaining two are described below as new species.

Rhinogobius occurred at almost all of the freshwater-stream and river sites surveyed in this region, but species composition varied among sites. *Rhinogobius rong* sp. nov. and *R. similis* are distributed widely in coastal areas of Da Nang City and Thua Thien Hue Province (Fig. 1). They were found in lower and middle reaches of rivers, including short, steep, coastal streams (sicydiine-goby habitat reported in Donaldson *et al.* 2023), and absent in upper reaches of inland areas. *Rhinogobius leavelli* is also distributed in both Da Nang and Thua Thien Hue, but it was not found in short, steep, coastal streams.

Rhinogobius nami sp. nov. is known only from middle to upper reaches of the Song Han (Han River) in Da Nang City (Fig. 1). In middle reaches (30–37 km from the mouth), it shares habitats with *R. rong* sp. nov., *R. similis*, and *R. leavelli*, but only *R. nami* sp. nov. is distributed in upper reaches (45 km from the mouth) near the headwaters.

Rhinogobius taenigena was found in upper reaches of the Song Bo (Song Huong basin) and tributaries of the Xe Kong (Mekong basin) in Thua Thien Hue Province (Fig. 1). At a site in the Song Bo, *R. taenigena* co-occurred with *R. leavelli*, but only *R. taenigena* was found in the Mekong basin of this region (Fig. 1).

Rhinogobius rong, sp. nov.

(Figs. 2, 3a–c, 4, 5, 6a, b; Tables 1–7)

Holotype. NSMT-P 147886, male (45.6 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District, Da Nang City (15°57'60.0"N 108°01'44.2"E), 2 March 2016.

Paratypes. HNUE-F 343, female (41.4 mm SL), a stream north of Kim Lien Station, Lien Chieu District, Da Nang City (16°08'50.5"N 108°06'34.6"E), 3 March 2016; HNUE-F 344, female (47.5 mm SL), a stream north of Kim Lien Station, Lien Chieu District, Da Nang City (16°08'50.1"N 108°06'34.1"E), 25 January 2018; HNUE-F 345, male (30.4 mm SL), a stream in Son Tra Peninsula, Son Tra District, Da Nang City (16°06'09.2"N 108°16'58.4"E), 19 June 2019; HNUE-F 346, male (43.3 mm SL), a tributary of Song Huong flowing along the border between Binh Thanh and Huong Tho, Huong Tra District, Thua Thien Hue Province (16°20'22.4"N 107°32'35.1"E), 21 June 2019; NSMT-P 147885, female (39.2 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District, Da Nang City (15°59'57.7"N 108°04'10.0"E), 1 March 2016; OISTICH 244–248, 1 male (43.1 mm SL) and 4 females (37.0–38.7 mm SL), a stream north of Kim Lien Station, Lien Chieu District, Da Nang City (16°08'50.5"N 108°06'34.6"E), 3 March 2016; OISTICH 249–251, 1 male (60.0 mm SL) and 2 females (33.1–42.6 mm SL), a stream north of Kim Lien Station, Lien Chieu District, Da Nang City (16°08'50.1"N 108°06'34.1"E), 25 January 2018; OISTICH 252, female (42.6 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District, Da Nang City (16°00'01.3"N 108°03'33.2"E), 17 June 2019; OISTICH 253–254, 1 male (32.9 mm SL) and 1 female (52.7 mm SL), a stream in Son Tra Peninsula, Son Tra District, Da Nang City (16°06'09.2"N 108°16'58.4"E), 19 June 2019; OISTICH 255, female (46.1 mm SL), a tributary of Song Huong flowing along the border between Binh Thanh and Huong Tho, Huong Tra District, Thua Thien Hue Province (16°20'22.4"N 107°32'35.1"E), 21 June 2019.

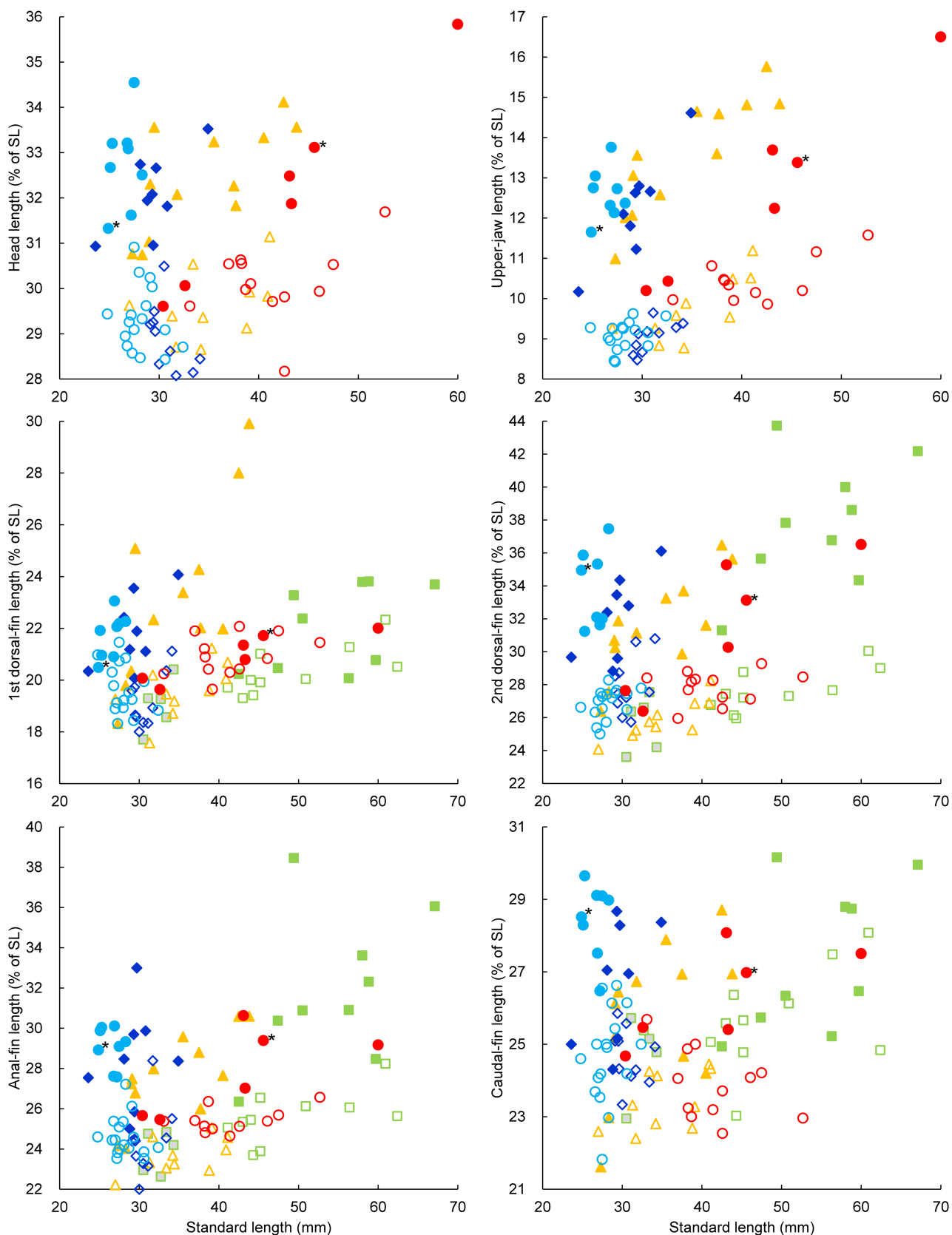


FIGURE 2. Proportions of head length, upper-jaw length, first dorsal-, second dorsal-, anal-, and caudal-fin lengths to standard length (SL) of *Rhinogobius rong* (red circles), *R. nami* (light-blue circles), *R. taenigena* (deep-blue diamonds), *R. leavelli* (orange triangles), and *R. similis* (green squares) collected from Da Nang City and Thua Thien Hue Province. Solid symbols represent males, open symbols represent females, and symbols filled with grey represent specimens of unknown sex (for *R. similis*). Symbols with an asterisk are holotypes.

Diagnosis. With mouth closed, anterior tip of lower jaw protruding significantly beyond upper jaw in larger males (>40 mm SL). Pectoral fin with 18–20 rays (usually 19). Second dorsal, and anal fin usually with one spine and eight soft rays. Number of vertebrae usually 26. Nape and posterior part of occipital region covered by cycloid scales; scaled area extending anteriorly to posterior margin of preopercle. Longitudinal scales 31–34, predorsal scales 11–17. Cephalic sensory pore system usually with B', C, D(S), E, F, H', K', L', M', N, and O'. Cheek with four longitudinal rows of cutaneous sensory papillae and no transverse row. Two broad, diagonally downward orange stripes, and one or two large orange spot(s) on cheek of living males; thinner and reddish-brown or grey similar markings in females.

Description. Body nearly cylindrical anteriorly and somewhat compressed posteriorly. Head depressed and larger in large males (> 40 mm SL) than females (head length 31.9–35.8 vs. 28.2–31.7% of SL; Fig. 2). Eyes located dorsolaterally. Mouth terminal and oblique with thick upper and lower lips. With mouth closed, anterior tip of lower jaw protruding significantly beyond upper jaw in large males (> 40 mm SL), and upper and lower jaws almost even in females, and two smaller males (30.4- and 32.6-mm SL). Posterior end of upper jaw exceeding anterior margin of eye. Mouth larger in large males (> 40 mm SL) than females (upper-jaw length 12.2–16.5 vs. 9.9–11.6% of SL; Fig. 2), and end of upper jaw reaching middle of eye in larger males. Upper and lower jaws usually with 3–4 rows of conical teeth; those on outermost row enlarged and those on inner rows irregularly aligned. Mental flap on chin bilobed (Fig. 3c), rounded rectangular, or trapezoidal (posterior end forming long side). Anterior nostril short, tubular;

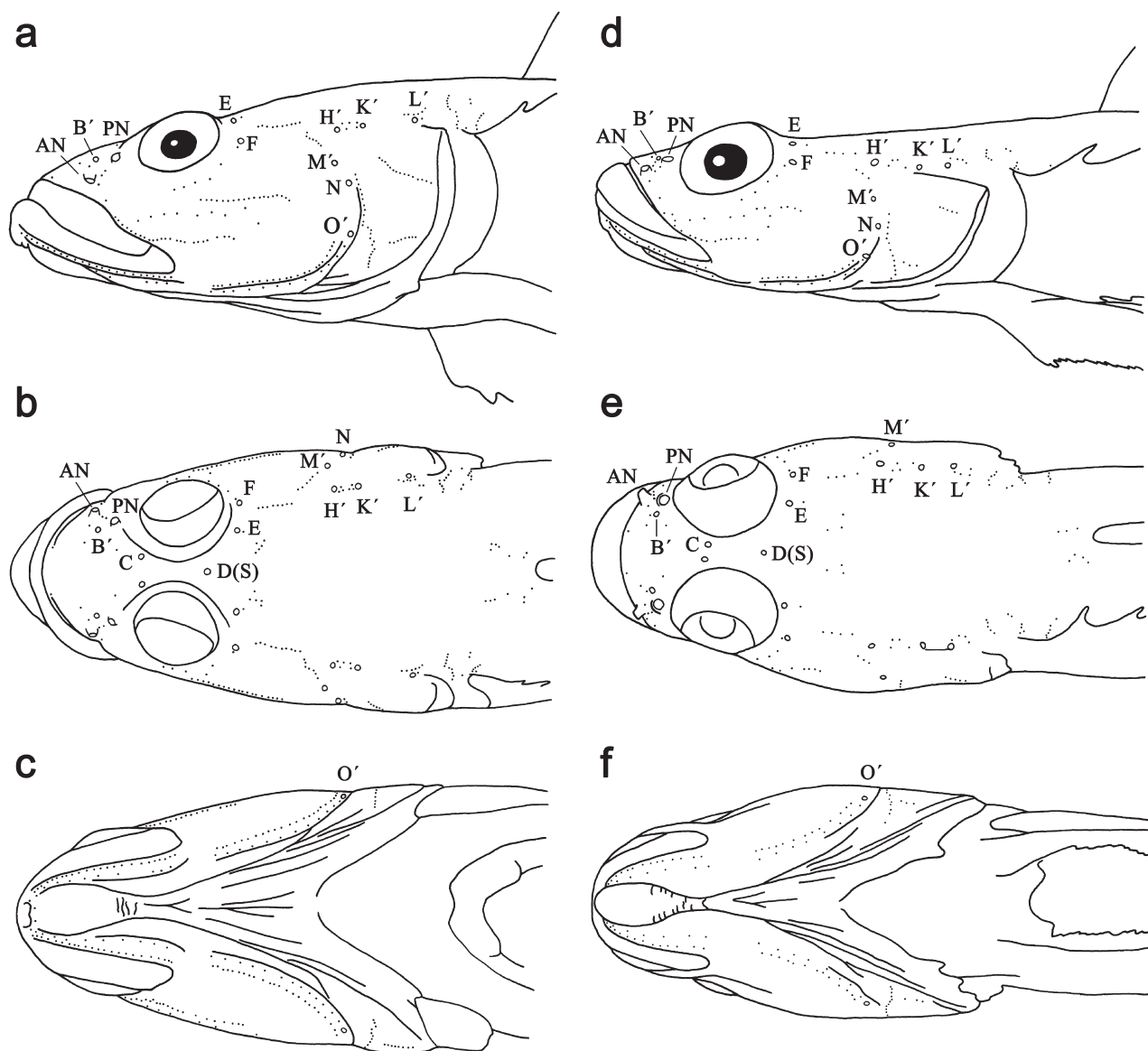


FIGURE 3. Arrangement of cephalic sensory pores and cutaneous sensory papillae in *Rhinogobius rong* (a–c, NSMT-P 147886) and *Rhinogobius nami* (d–f, NSMT-P 147890). a, d, lateral view; b, e, dorsal view; c, f, ventral view. AN, anterior naris; PN, posterior naris.

posterior nostril a pore. Cephalic sensory pore system with B', C, D(S), E, F, H', K', and L' in oculoscapular canal and M', N, and O' in preopercular canal of both left and right sides in nine of 18 specimens examined (including holotype; Fig. 3a–c), but one specimen with single Y-shaped pore C and longitudinal groove-like pore D, one specimen with additional pore behind pore F of left oculoscapular canal, one specimen having pore G in left oculoscapular canal, three specimens lacking pores N in one preopercular canals (either left or right), two specimens lacking pore N in both preopercular canals, and one specimen having only pore O' in right preopercular canal. Arrangement of cutaneous sensory papillae of head shown in Fig. 3a–c. Cheek having four longitudinal rows of papillae and no transverse row. Vertebrae 10+15=25 (n=1) or 10+16=26 (n=12; Table 1), P-V 3/II II I I 0/9 (n=8).

TABLE 1. Number of vertebrae in various species of *Rhinogobius* examined in the present study. * Includes the holotype.

	Number of vertebrae			
	25	26	27	28
<i>Rhinogobius rong</i>	1	12*	-	-
<i>Rhinogobius nami</i>	1	13*	-	-
<i>Rhinogobius taenigena</i>	-	1	11	2
<i>Rhinogobius leavelli</i> (Da Nang)	1	8	1	-
<i>Rhinogobius leavelli</i> (Thua Thien Hue)	-	6	-	-
<i>Rhinogobius leavelli</i> (northern Vietnam)	-	16	-	-
<i>Rhinogobius similis</i> (central Vietnam)	-	10	-	-
<i>Rhinogobius similis</i> (northern Vietnam)	1	9	-	-
<i>Rhinogobius similis</i> (Okinawa)	-	8	-	-
<i>Rhinogobius virgigena</i>	-	10	1	-
<i>Rhinogobius variolatus</i>	3	13	1	-
<i>Rhinogobius boa</i>	-	1	9	1
<i>Rhinogobius sulcatus</i>	-	1	11	-

TABLE 2. Number of soft rays on the second dorsal fin and anal fin of various species of *Rhinogobius* examined in the present study. * Includes the holotype.

	Second dorsal-fin rays			Anal-fin rays			
	7	8	9	6	7	8	9
<i>Rhinogobius rong</i>	2	16*	-	-	-	18*	-
<i>Rhinogobius nami</i>	3	22*	-	-	4	21*	-
<i>Rhinogobius taenigena</i>	4	11	3	2	10	6	-
<i>Rhinogobius leavelli</i> (Da Nang)	3	13	-	-	5	10	1
<i>Rhinogobius leavelli</i> (Thua Thien Hue)	-	6	-	-	-	6	-
<i>Rhinogobius leavelli</i> (northern Vietnam)	1	22	-	-	1	22	-
<i>Rhinogobius similis</i> (central Vietnam)	-	24	-	-	1	23	-
<i>Rhinogobius similis</i> (northern Vietnam)	1	19	1	-	2	18	1
<i>Rhinogobius similis</i> (Okinawa)	-	32	-	-	1	31	-
<i>Rhinogobius similis</i> (Izu)	-	19	-	-	-	18	1
<i>Rhinogobius virgigena</i>	-	10	1	-	-	11	-
<i>Rhinogobius variolatus</i>	3	14	-	2	14	1	-
<i>Rhinogobius boa</i>	1	8	2	3	7	1	-
<i>Rhinogobius sulcatus</i>	1	16	3	4	16	-	-

First dorsal fin with six spines. Second dorsal fin usually with one spine and eight soft rays, but two specimens with one spine and seven soft rays (Table 2). First and second dorsal-fin bases separated by a small space (1.3–3.5% of SL; Table 3). First dorsal fin rounded, usually almost semi-circular; posterior tips of fin (usually tips of fourth to sixth spines) not reaching second dorsal-fin origin (in ten smaller males and ten females), touching base of second

dorsal-fin spine (two males and two females), or exceeding base of second dorsal-fin spine, but not reaching base of first soft ray of second dorsal fin (two males). Anal fin with one spine and eight soft rays (Table 2). Caudal fin with 17 segmented rays including 14 branched rays, except one specimen with 18 segmented rays including 16 branched rays; posterior margin rounded. Large males (> 40 mm SL) having larger second dorsal, anal, and caudal fins than females (second dorsal-fin length 30.3–36.5 vs. 25.9–29.3% of SL, anal-fin length 27.0–30.6 vs. 24.6–26.6% of SL, and caudal-fin length 25.4–28.1 vs. 22.5–25.7% of SL; Fig. 2). Pectoral fin with 18–20 rays (usually 19) (Table 4). Pelvic fin with one spine and five soft rays. Pelvic fins joined to form cuplike disc with fleshy bilobed frenum.

TABLE 3. Morphometrics of *Rhinogobius rong* and *R. nami*, expressed as percentages of standard length. D₁, first dorsal fin; D₂, second dorsal fin; A, anal fin; C, caudal fin; P₂, pelvic fin.

	<i>R. rong</i>			<i>R. nami</i>		
	Holotype	Paratypes	Paratypes	Holotype	Paratypes	Paratypes
	Male	Male	Female	Male	Male	Female
Number of specimens	1	5	12	1	7	17
Standard length (mm)	45.6	30.4–60.0	33.1–52.7	24.9	25.1–28.3	24.8–32.4
Head length	33.1	29.6–35.8	28.2–31.7	31.3	31.6–34.5	28.4–30.9
Snout length	9.4	8.2–12.0	7.5–9.3	7.6	7.8–10.0	6.5–7.9
Eye diameter	6.1	5.5–6.6	6.3–7.6	7.2	5.9–7.6	6.9–7.7
Postorbital length of head	18.6	15.1–19.0	14.6–16.7	17.3	16.9–18.6	14.8–16.4
Upper-jaw length	13.4	10.2–16.5	9.9–11.6	11.6	12.1–13.8	8.4–9.6
Body depth at P ₂ origin	18.2	15.8–18.9	15.4–18.6	14.1	13.4–17.5	12.7–17.9
Body depth at A origin	17.1	13.0–19.3	15.0–19.6	14.1	13.4–16.4	13.4–17.5
Depth at caudal peduncle	12.1	10.2–12.9	10.8–12.8	11.2	11.3–12.7	10.7–13.1
Length of caudal peduncle	27.0	25.3–29.3	25.5–27.4	28.1	26.5–28.3	25.1–28.7
Predorsal length	39.5	35.9–40.0	36.2–39.3	38.2	37.8–40.4	36.8–39.5
Preanal length	56.6	54.3–58.7	55.2–58.4	55.0	55.5–57.1	54.8–59.7
Length of D ₁ base	19.3	18.3–19.4	18.4–20.8	16.1	16.7–18.0	16.0–19.3
D ₁ length	21.7	19.6–22.0	19.6–22.1	20.5	20.9–23.0	18.3–21.5
Interval between D ₁ and D ₂ bases	1.8	1.3–3.4	1.8–3.5	4.4	3.0–4.4	2.8–5.8
Length of D ₂ base	17.5	15.6–16.9	14.9–16.9	16.5	14.9–16.5	14.6–17.0
D ₂ length	33.1	26.4–36.5	25.9–29.3	34.9	31.2–37.5	25.0–28.3
Length of A base	15.1	13.3–15.5	13.1–14.5	12.9	11.9–15.2	12.1–14.5
A length	29.4	25.5–30.6	24.6–26.6	28.9	27.6–30.1	23.5–27.2
C length	27.0	24.7–28.1	22.5–25.7	28.5	26.5–29.6	21.8–26.6

Ctenoid scales covering lateral, dorsal, and ventral surfaces of body except nape and belly. Dorsal surface of nape and posterior part of occipital region covered by cycloid scales, but four specimens (three females and one smaller male) with a few ctenoid scales along dorsal midline near first dorsal-fin origin; scaled area extending anteriorly to around posterior margin of preopercle, or slightly anterior to this point in males, and around this point or little posterior to this point, in females. Sides of posterior occipital region and nape covered with ctenoid scales. Other regions of head naked. Belly and breast (pre-pelvic area) covered with cycloid scales. First and second dorsal, and anal-fin bases covered with ctenoid scales, sometimes with a few small cycloid scales interspersed. A few cycloid scales also interspersed with ctenoid scales on flank behind pectoral fin and on proximal part of caudal fin. Pectoral-fin base usually naked (at least invisible without staining with alizarin red; see Suzuki *et al.* 2016), but 1–2 cycloid scale(s) sometimes visible. Longitudinal scales 31–34, transverse scales 10–12 (usually 10), transverse scales on caudal peduncle 7–9, and predorsal scales 11–17 (Tables 5–7).

TABLE 4. Pectoral-fin ray counts of various species of *Rhinogobius* examined in the present study. * Includes the holotype.

	Pectoral-fin ray counts						
	14	15	16	17	18	19	20
<i>Rhinogobius rong</i>	-	-	-	-	2	14*	2
<i>Rhinogobius nami</i>	5	16*	4	-	-	-	-
<i>Rhinogobius taenigena</i>	-	4	13	1	-	-	-
<i>Rhinogobius leavelli</i> (Da Nang)	-	-	3	4	8	1	-
<i>Rhinogobius leavelli</i> (Thua Thien Hue)	-	-	-	-	1	5	-
<i>Rhinogobius leavelli</i> (northern Vietnam)	-	-	-	-	12	11	-
<i>Rhinogobius similis</i> (central Vietnam)	-	-	-	1	5	13	5
<i>Rhinogobius similis</i> (northern Vietnam)	-	-	-	-	2	16	3
<i>Rhinogobius similis</i> (Okinawa)	-	1	-	-	12	18	1
<i>Rhinogobius similis</i> (Izu)	-	-	-	1	6	11	1
<i>Rhinogobius virgigena</i>	3	6	2	-	-	-	-
<i>Rhinogobius variolatus</i>	-	13	4	-	-	-	-
<i>Rhinogobius boa</i>	-	1	8	1	1	-	-
<i>Rhinogobius sulcatus</i>	-	2	16	2	-	-	-

TABLE 5. Longitudinal scale counts of various species of *Rhinogobius* examined in the present study. * Includes the holotype.

	Longitudinal scale counts								
	26	27	28	29	30	31	32	33	34
<i>Rhinogobius rong</i>	-	-	-	-	-	4*	5	8	1
<i>Rhinogobius nami</i>	-	-	1	3	10*	11	-	-	-
<i>Rhinogobius taenigena</i>	-	-	-	-	1	4	12	1	-
<i>Rhinogobius leavelli</i> (Da Nang)	-	-	-	1	4	6	5	-	-
<i>Rhinogobius leavelli</i> (Thua Thien Hue)	-	-	-	-	1	3	2	-	-
<i>Rhinogobius leavelli</i> (northern Vietnam)	-	-	-	-	5	8	8	2	-
<i>Rhinogobius similis</i> (central Vietnam)	-	-	-	3	12	8	1	-	-
<i>Rhinogobius similis</i> (northern Vietnam)	-	-	-	-	6	15	-	-	-
<i>Rhinogobius similis</i> (Okinawa)	-	-	-	3	9	16	2	-	-
<i>Rhinogobius similis</i> (Izu)	-	-	1	4	8	5	1	-	-
<i>Rhinogobius virgigena</i>	-	-	-	-	2	3	6	-	-
<i>Rhinogobius variolatus</i>	1	5	6	4	1	-	-	-	-
<i>Rhinogobius boa</i>	-	-	-	-	4	7	-	-	-
<i>Rhinogobius sulcatus</i>	-	-	-	-	5	9	6	-	-

Color in life and fresh (Figs. 4 and 5): in male, background of head and body greenish or yellowish-grey, but whitish on ventral side. An orange stripe connecting snout tip and anterior margin of eye; this stripe continuing posteriorly from posterior margin of eye to region above gill opening. Faint orange stripe running horizontally below eye to opercle; often intermittent. Broad, diagonally downward orange stripe running from above middle of upper lip to cheek (sometimes intermittent); another short, orange stripe running above posterior end of upper lip parallel to broad stripe; one or two large orange spot(s) on cheek posterior to broad stripe. Broad, orange stripe running almost horizontally (but slightly diagonally upward) along middle of opercle and subopercle; extending posteriorly on pectoral-fin base, where it being darker. Opercular membrane, interopercle, and lower part of subopercle with light orange or yellow markings arranged almost horizontally. Six indistinct dusky-grey blotches and five indistinct cream bands between them sometimes appearing laterally on body from flank to caudal peduncle. Many orange spots scattered on lateral and dorsal sides of body and dorsal side of head.

TABLE 6. Transverse scale counts of various species of *Rhinogobius* examined in the present study. *Includes the holotype.

	Transverse scale counts						
	6	7	8	9	10	11	12
<i>Rhinogobius rong</i>	-	-	-	-	14*	3	1
<i>Rhinogobius nami</i>	-	-	13*	12	-	-	-
<i>Rhinogobius taenigena</i>	-	-	5	12	1	-	-
<i>Rhinogobius leavelli</i> (Da Nang)	-	-	-	6	10	-	-
<i>Rhinogobius leavelli</i> (Thua Thien Hue)	-	-	-	1	5	-	-
<i>Rhinogobius leavelli</i> (northern Vietnam)	-	-	-	6	17	-	-
<i>Rhinogobius similis</i> (central Vietnam)	-	-	-	8	16	-	-
<i>Rhinogobius similis</i> (northern Vietnam)	-	-	-	2	17	1	-
<i>Rhinogobius similis</i> (Okinawa)	-	-	-	3	23	5	1
<i>Rhinogobius similis</i> (Izu)	-	-	-	3	14	-	-
<i>Rhinogobius virgigena</i>	-	-	-	7	3	1	-
<i>Rhinogobius variolatus</i>	1	5	9	2	-	-	-
<i>Rhinogobius boa</i>	-	-	3	8	-	-	-
<i>Rhinogobius sulcatus</i>	-	-	10	9	1	-	-

TABLE 7. Predorsal scale counts of various species of *Rhinogobius* examined in the present study. * Includes the holotype.

	Predorsal scale counts														
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>Rhinogobius rong</i>	-	-	-	-	-	-	-	-	2	1	3	7	3	1	1*
<i>Rhinogobius nami</i>	-	-	-	1	1	5*	5	8	3	-	-	-	-	-	-
<i>Rhinogobius taenigena</i>	-	-	3	1	3	4	3	1	1	2	-	-	-	-	-
<i>Rhinogobius leavelli</i> (Da Nang)	-	2	-	4	3	1	4	-	2	-	-	-	-	-	-
<i>Rhinogobius leavelli</i> (Thua Thien Hue)	1	2	-	2	-	1	-	-	-	-	-	-	-	-	-
<i>Rhinogobius leavelli</i> (northern Vietnam)	-	2	4	6	2	1	1	2	4	1	-	-	-	-	-
<i>Rhinogobius similis</i> (central Vietnam)	-	-	-	-	-	1	1	11	10	1	-	-	-	-	-
<i>Rhinogobius similis</i> (northern Vietnam)	-	-	-	-	-	-	3	12	6	-	-	-	-	-	-
<i>Rhinogobius similis</i> (Okinawa)	-	-	-	-	-	-	-	4	12	7	4	2	-	-	-
<i>Rhinogobius similis</i> (Izu)	-	-	-	-	-	-	2	3	11	2	-	-	-	-	-
<i>Rhinogobius virgigena</i>	-	-	-	-	-	-	-	1	1	3	3	2	1	-	-
<i>Rhinogobius variolatus</i>	-	1	1	1	4	3	5	-	-	-	-	-	-	-	-
<i>Rhinogobius boa</i>	-	-	-	-	-	-	2	5	3	1	-	-	-	-	-
<i>Rhinogobius sulcatus</i>	-	-	-	2	2	4	7	3	2	-	-	-	-	-	-

First dorsal fin greyish translucent, with a black spot just below middle on membrane between first and second spines; upper part of this spot bluish. Some orange markings aligned along proximal part of fin and on middle to distal parts of fourth, fifth, and sixth spines. Distal part of fin yellowish, especially on membrane between first and second spines; middle to distal part of membrane between second and third spines light blue. Second dorsal fin greyish translucent, with many orange markings forming four or five indefinite horizontal stripes. Two orange markings on center of caudal-fin base; dorsal one directed upward and ventral one directed downward. Remaining caudal fin greyish translucent, with many orange markings forming five to seven vertical bands. Anal fin greyish translucent proximally, orange distally, with a bluish-white margin. Pectoral fin translucent, but its proximal part cream yellow or yellowish-grey with orange markings aligned vertically along this cream yellow or yellowish-grey part both on proximal and distal sides. Pelvic disc translucent or grey without clear marking.



FIGURE 4. *Rhinogobius rong* immediately after fixation. a, NSMT-P 147886, holotype, male, 45.6 mm SL; b, OISTICH 255, paratype, female, 46.1 mm SL.

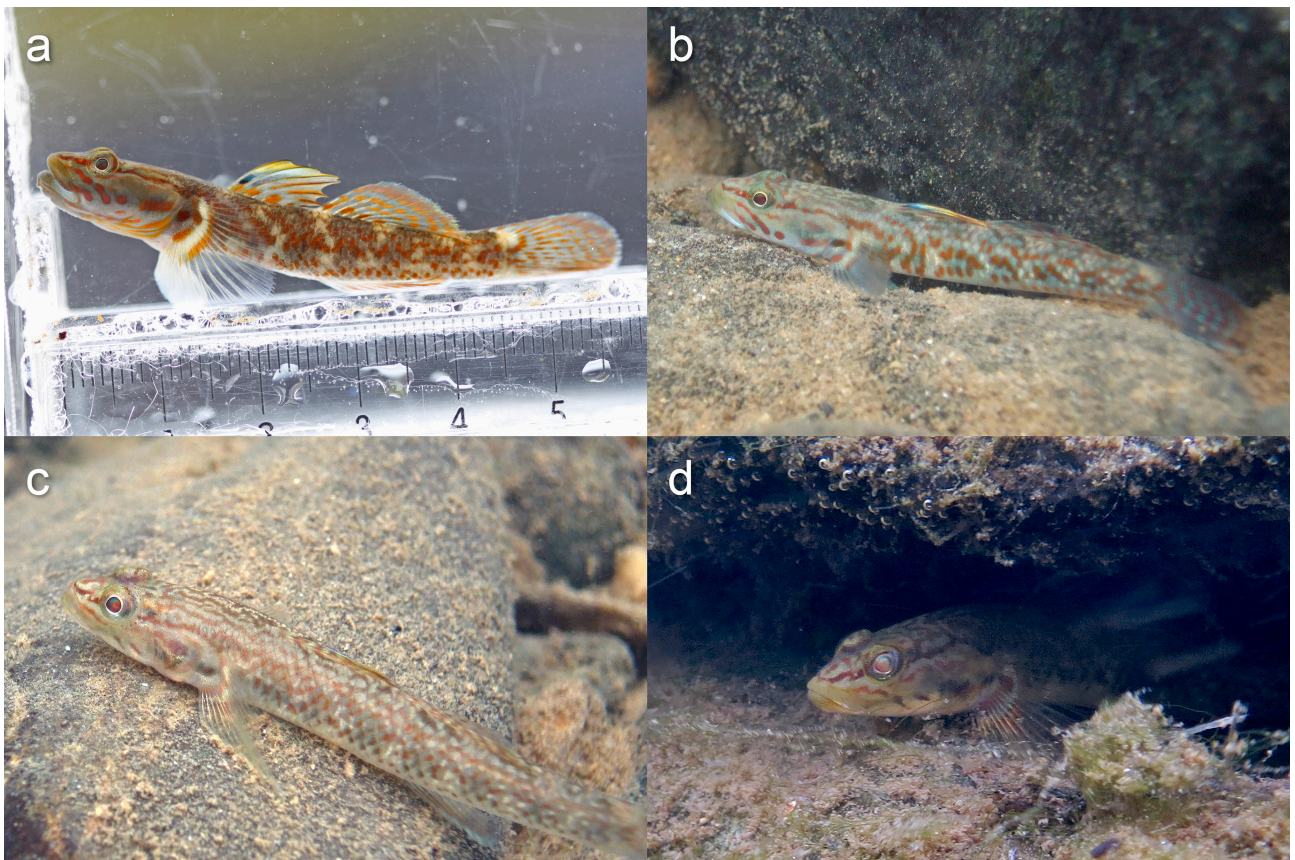


FIGURE 5. Live images of *Rhinogobius rong* in aquarium (a) and *in situ* underwater footage from Da Nang City, Vietnam (b–d). a, b, males, 12 January 2013; c, female, 12 January 2013; d, female, 1 March 2016 (photo by K. Maeda).

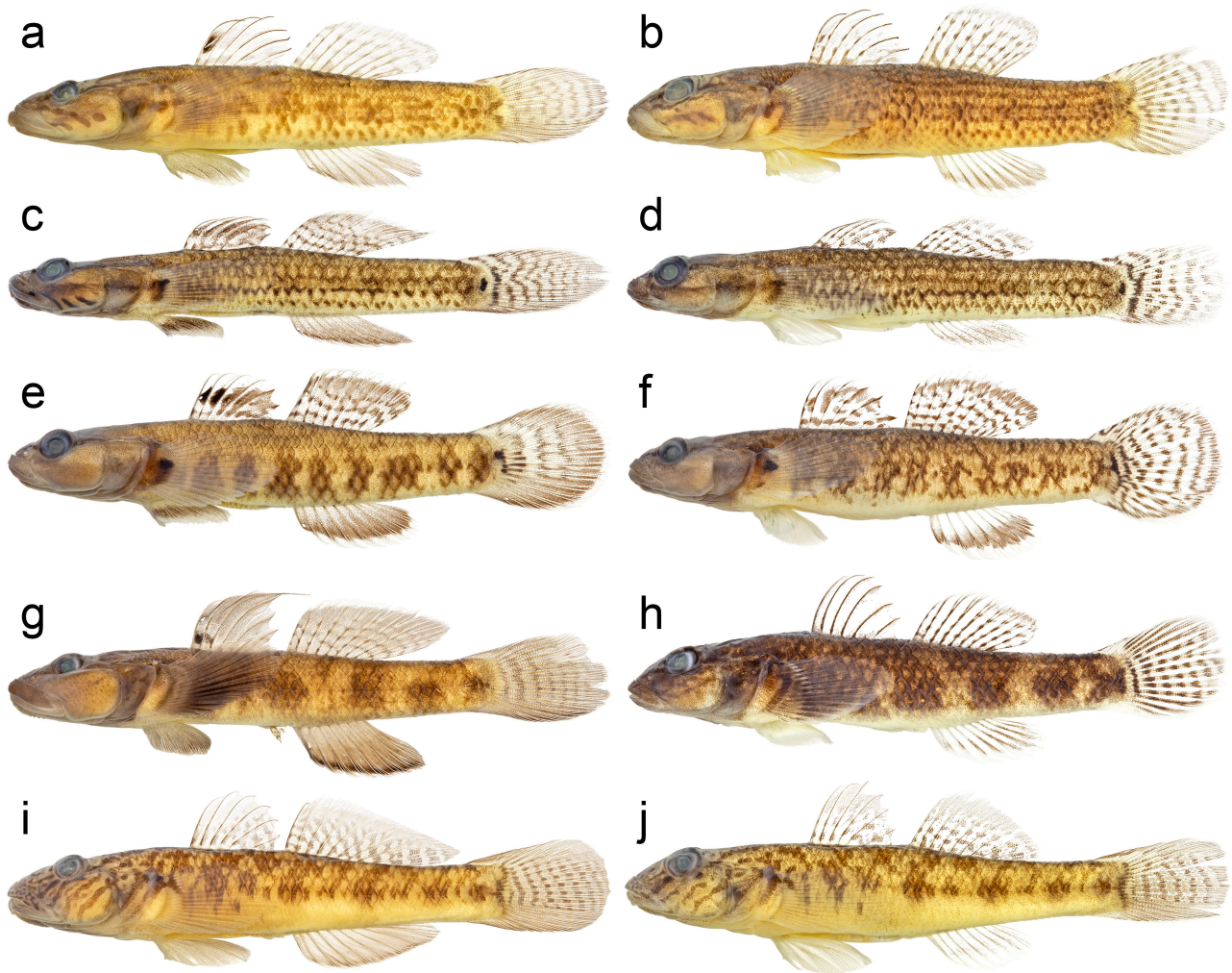


FIGURE 6. Preserved specimens of *Rhinogobius rong* (a, b), *R. nami* (c, d), *R. taenigena* (e, f), *R. leavelli* (g, h), and *R. similis* (i, j) collected from Da Nang City and Thua Thien Hue Province, Vietnam. Specimens on left side are males, right are females. a, NSMT-P 147886, holotype, 45.6 mm SL; b, OISTICH 254, paratype, 52.7 mm SL; c, NSMT-P 147890, holotype, 24.9 mm SL; d, OISTICH 290, paratype, 27.0 mm SL; e, OISTICH 299, 23.6 mm SL; f, OISTICH 305, 34.1 mm SL; g, NSMT-P 147888, 43.8 mm SL; h, NSMT-P 147887, 41.1 mm SL; i, OISTICH 240, 56.3 mm SL; j, OISTICH 241, 45.2 mm SL.

In female, markings and background color of body and fins similar to those of male, but markings reddish-brown or grey instead of orange and each marking smaller or less distinct. Diagonal stripe from above middle of upper lip usually broken in middle; posterior half of this marking forming part of series of markings horizontally aligned on cheek. First dorsal fin with no or faint black spot between first and second spines; yellowish and bluish color in distal part of fin indistinct. Pectoral fin with a pale-yellow spot on upper-proximal part. Pelvic disc translucent or light yellowish-grey.

Color in preservative (Fig. 6a, b): background of head and body cream and that of fins translucent or light grey. Orange, reddish-brown, and grey markings observed in life becoming brown. Pale orange or yellow patterns on opercular membrane, interopercle, and lower part of subopercle disappeared. All other yellow and bluish markings also disappeared.

Etymology. The new species is named *Rhinogobius rong* because its pointed appearance is reminiscent of the Vietnamese dragon (“rồng” in Vietnamese). The new specific name is a noun in apposition.

Comparison. The new species, *Rhinogobius rong*, is unique in that the anterior tip of the large (>40 mm SL) male’s lower jaw protrudes significantly beyond upper jaw. In most other species, the anterior tips of lower and upper jaws are in approximately the same position, or the upper jaw protrudes more forward. *Rhinogobius ngutinhoceps* is the only other species known to have a lower jaw that protrudes beyond the upper jaw, but it has fewer pectoral-fin rays (16–17 vs. 18–20) and greater number of vertebrae (29 vs. 25–26) than the new species (Endruweit 2018). The

new species is also distinguished from other species by its distinctive markings, particularly the orange, reddish-brown, or grey markings on the head.

***Rhinogobius nami*, sp. nov.**

(Figs. 2, 3d–f, 6c, d, 7, 8; Tables 1–7)

Holotype. NSMT-P 147890, male (24.9 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District, Da Nang City (16°00′01.3″N 108°03′33.2″E), 17 June 2019.

Paratypes. HNUE-F 351–352, 1 male (27.2) and 1 female (24.8 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (15°59′58.1″N 108°04′12.7″E), 27 January 2018; HNUE-F 353–354, 1 male (25.1) and 1 female (28.7 mm SL), same data as holotype; NSMT-P 147889, female (32.4 mm SL), same data as holotype; OISTICH 272–273, 1 male (26.9 mm SL) and 1 female (27.5 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (15°59′57.7″N 108°04′10.0″E), 1 March 2016; OISTICH 274–275, 1 male (27.5 mm SL) and 1 female (30.6 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District (15°57′20.2″N 107°58′16.4″E), 2 March 2016; OISTICH 276–278, 3 females (28.0–29.3 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (15°59′58.1″N 108°04′12.7″E), 27 January 2018; OISTICH 279, female (26.8 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District (15°57′20.2″N 107°58′16.4″E), 27 January 2018; OISTICH 280–290, 3 males (25.3–28.3 mm SL) and 8 females (27.0–30.6 mm SL), same data as holotype.

Diagnosis. Pectoral fin with 14–16 rays. Second dorsal and anal fins usually with one spine and eight soft rays. Number of vertebrae usually 26. Nape and posterior part of occipital region covered by cycloid scales; scaled area extending anteriorly to about halfway between posterior margins of preopercle and opercle. Longitudinal scales 28–31, transverse scales eight or nine, and predorsal scales 6–11. Cephalic sensory pore system usually with B', C, D(S), E, F, H', K', L', M', N, and O'. Five, longitudinal, reddish-brown or dusky-brown stripes (dotted lines) running from trunk to caudal peduncle both in male and female; fourth (from dorsal) one slightly below lateral midline most distinct and others sometimes unclear. Male having three parallel, diagonally downward, reddish-brown or dusky-brown stripes on ventral part of cheek. Opercular membrane, interopercle, and lower part of subopercle of live male specimen light bluish-grey with many red or orange spots.

Description. Body nearly cylindrical anteriorly and somewhat compressed posteriorly. Anterior tip of head pointed in female but rounded in male. Head larger in male than female (head length 31.3–34.5 vs. 28.4–30.9% of SL; Fig. 2, Table 3). Eyes located dorsolaterally. Mouth terminal and oblique with thick upper and lower lips. When mouth closed, anterior tips of upper and lower jaws almost even or lower jaw protruding slightly beyond upper jaw. Upper jaw extending posteriorly to center of eye in male, but ending below anterior part of eye (between anterior margin of eye and anterior margin of pupil) in female. Mouth larger in male than female (upper-jaw length 11.6–13.8 vs. 8.4–9.6% of SL; Fig. 2, Table 3). Upper and lower jaws usually with 2–4 rows of conical teeth; those in outermost row enlarged and those in inner rows irregularly aligned. Mental flap on chin usually round or rectangular, often with a small central projection. Anterior nostril short tubular, posterior nostril a pore. Cephalic sensory pore system with B', C, D(S), E, F, H', K', and L' in oculoscapular canal and M', N, and O' in preopercular canal of both left and right sides in 20 of 25 specimens examined (including holotype; Fig. 3d–f), but three specimens having pore G in one or both side(s), and two specimens having an additional pore behind pore F (not G, but near F) in one or both side(s). Arrangement of cutaneous sensory papillae of head shown in Fig. 3d–f. Cheek having no significant transverse row of papillae. Vertebrae 10+15=25 (n=1) or 10+16=26 (n=13; Table 1), P-V 3/II II I I 0/9 (n=14).

First dorsal fin usually with six spines, but one specimen with five. Second dorsal fin usually with one spine and eight soft rays, but three specimens with one spine and seven soft rays (Table 2). First and second dorsal-fin bases separated by a small interval (2.8–5.8% of SL; Table 3). In female, first dorsal fin rounded, almost semi-circular; posterior tip of fin (tips of fourth to sixth spines) not reaching second dorsal-fin origin. In male, first dorsal fin in parallelogram shape; posterior tip of fin (usually fourth spine) extending to, or exceeding base of second dorsal-fin spine, but never reaching base of second soft ray of second dorsal fin. Anal fin with one spine and seven (n=4) or eight (n=21) soft rays (Table 2). Caudal fin with 17 segmented rays including 12 (n=15), 13 (n=9), or 14 (n=1) branched rays; posterior margin rounded. Male having larger second dorsal, anal, and caudal fins than female (second dorsal-fin length 31.2–37.5 vs. 25.0–28.3% of SL, anal-fin length 27.6–30.1 vs. 23.5–27.2% of SL, and caudal-fin length 26.5–29.6 vs. 21.8–26.6% of SL; Fig. 2, Table 3). Pectoral fin with 14–16 rays (mode 15 rays)

(Table 4). Pelvic fin with one spine and five soft rays; pelvic fins joined together to form a cuplike disc with fleshy bilobed frenum.

Ctenoid scales covering lateral, dorsal, and ventral surfaces of body posterior to flank except belly. Nape and posterior part of occipital region covered by cycloid scales; scaled area extending anteriorly around middle between posterior margin of preopercle and posterior margin of opercle both in male and female. Other regions of head naked. Belly and flank covered with cycloid scales. First and second dorsal, and anal-fin bases covered with ctenoid scales and a few small cycloid scales mixed. Proximal part of caudal fin covered with cycloid scales. Scales on breast (pre-pelvic area) difficult to detect, but cycloid scales observed in a few individuals. Pectoral-fin base probably naked (at least invisible without staining with alizarin red; see Suzuki *et al.* 2016). Longitudinal scales 28–31, transverse scales eight or nine, transverse scales in caudal peduncle seven, and predorsal scales 6–11 (Tables 5–7).

Color in life and fresh (Figs. 7 and 8): in male, background of head and body cream or yellowish-brown, but whitish on ventral side. A clear, reddish-brown stripe across center of upper lip; stripe splitting to left and right sides at snout and extending to anterior margin of eyes and continuing posteriorly from posterior margin of eye to region above gill opening, but posterior half indistinct. Dorsal side of head above this stripe, grey or brown. Lower half of cheek and opercular region darker than upper half, sometimes strongly contrasting. Reddish-brown or dusky-brown spot at posterior part of upper lip. Three parallel, diagonally downward, reddish-brown or dusky-brown stripes on ventral part of cheek. Opercular membrane, interopercle, and lower part of subopercle light bluish-grey with many red or orange spots. Posterior part of lower lip also often light bluish-grey. Five longitudinal, reddish-brown or dusky-brown stripes (formed by dotted lines) running on lateral and dorsal sides from trunk to caudal peduncle; fourth one (counted from dorsal) slightly below lateral midline being most distinct and others sometimes unclear. Three to six indefinite dusky transverse bands sometimes appearing on lateral side of body.

First dorsal fin with series of black or dusky-brown markings on middle parts of membranes between first to fifth spines; marking between first and second spines largest and clearest, and posterior ones sometimes unclear. Distal part of membrane light blue or white between first and second spines, and orange or red between second and fifth spines. Distal part of spines black or grey. Reddish-brown spots on proximal part of first to fourth spines; spines and membranes white between proximal reddish-brown spots and middle black or dusky-brown markings. Two or three indefinite reddish-brown stripes on membranes posterior to fifth spine and white between stripes (in most specimens, as in Fig. 8a, but stripes sometimes disordered, as in Fig. 7a). Second dorsal fin with three to six reddish-brown spots aligned along each spine and soft rays; membrane around these spots also reddish-brown and forming stripes across fin. Proximal and middle parts of spine, soft rays, and membranes white between reddish-brown spots. Distal margin of second dorsal fin white or light blue. Black, vertical rectangular or elliptical spot surrounded by cream and orange at middle of proximal part of caudal fin. Remainder of caudal fin white or translucent with many reddish-brown spots forming five to eight vertical bands, but ventral part orange or dark brown. Anal fin orange, but dusky brown distally with bluish-white margin. Pectoral fin greyish translucent or grey, but its proximal part light yellowish-brown or light grey with large black or reddish-brown blotch at middle of pectoral-fin base. Pelvic disc greyish translucent or dark grey with white or light blue margin.

In female, markings and background color of head and body similar to those of male, but lacking three parallel, diagonally downward stripes from ventral part of cheek. Opercular membrane, interopercle, lower part of subopercle, and posterior part of lower lip yellowish-brown or dark grey without red spots. First dorsal fin translucent with one to five indefinite reddish-brown spots along each spine; proximal parts of spines white between reddish-brown spots; distal part of fin yellow. Markings and background of second dorsal, caudal, and pectoral fins similar to those of male, but white margin of second dorsal fin thinner and often indistinct, and ventral part of caudal fin translucent instead of orange. Anal fin translucent, but reddish or dark brown distally with thin, bluish-white margin. Pelvic disc translucent with white margin.

Color in preservative (Fig. 6c, d): background of head and body cream and that of fins translucent or light brown. Reddish-brown markings observed in life becoming dark-brown, and dusky-brown markings becoming black. Light bluish-grey color on opercular membrane, interopercle, and lower part of subopercle of male becoming dark brown, and red and orange spots becoming light brown (dark and pale pattern opposite from that in life). Red, orange, white, and bluish colors of fins disappeared.

Etymology. The specific name of the new species is dedicated to the late Chu Hoang Nam, who helped our surveys in Vietnam during 2018 and 2019.



FIGURE 7. *Rhinogobius nami* immediately after fixation. a, NSMT-P 147890, holotype, male, 24.9 mm SL; b, OISTICH 282, paratype, female, 26.6 mm SL.

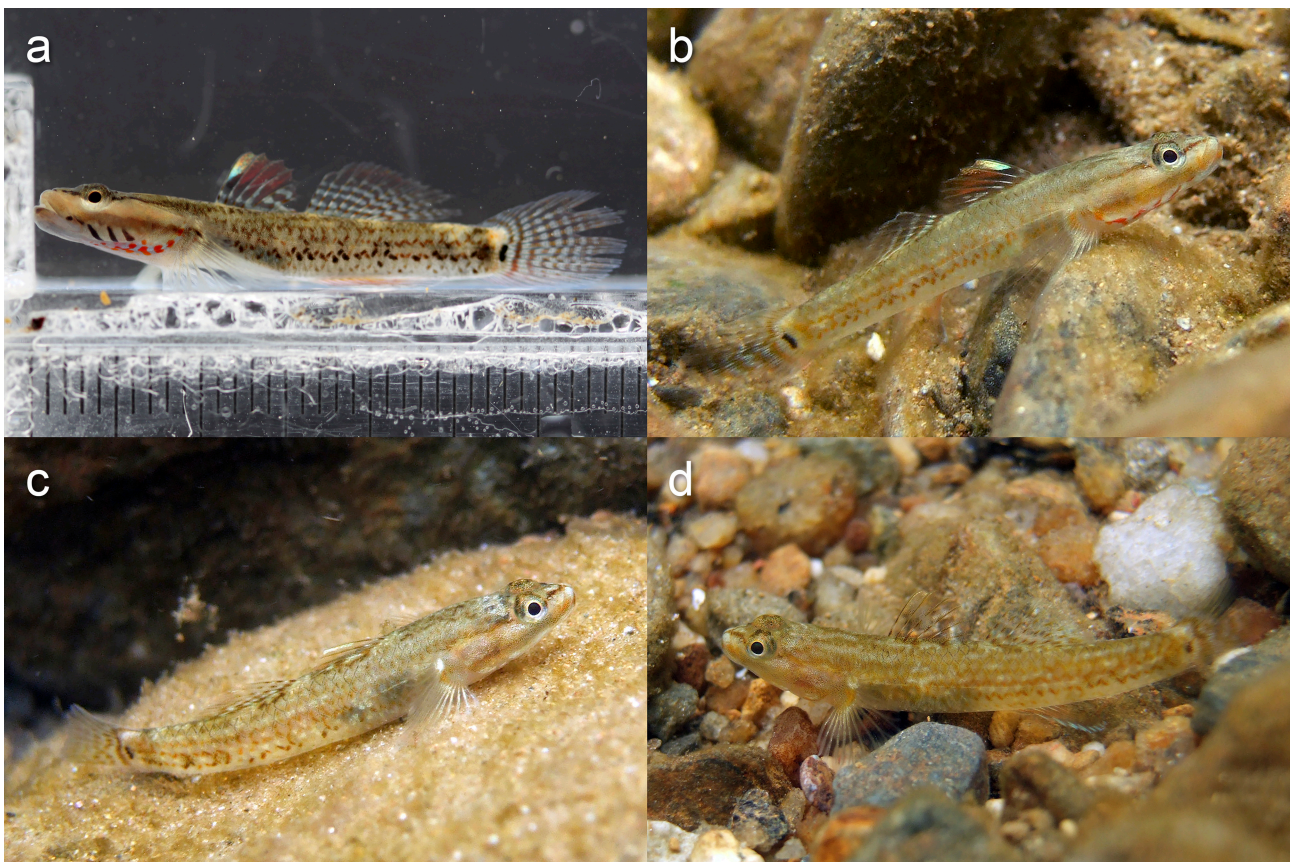


FIGURE 8. Live images of *Rhinogobius nami* in aquarium (a) and *in situ* underwater footage from Da Nang City, Vietnam (b–d). a, male, 12 January 2013; b, male, 13 January 2013; c, d, females, 13 January 2013 (photo by K. Maeda).

Comparison. *Rhinogobius nami* shares many morphological features with *R. sangenloensis* Chen & Miller, 2014 from Hainan, China. The coloration is nearly identical, including the longitudinal stripes on body and fin markings, but the male of new species has three reddish-brown or dusky-brown stripes on cheek (absent in *R. sangenloensis*; Chen & Miller 2014), and the mode count of pectoral-fin rays is also different (15 in *R. nami* vs. 17 in *R. sangenloensis*; Chen & Miller 2014). Both males and females of *R. nami* have a black, vertical rectangular or elliptical spot at the middle of caudal-fin base, while *R. sangenloensis* female has a black horizontal bar (Chen & Miller 2014).

The three oblique stripes on the cheek of male specimens of *R. nami* is one of the features of the new species. Several Chinese and Vietnamese species of the genus also have oblique stripes on the cheek. The new species however differs from most of these species having a thinner and/or more numerous stripes (in *R. changtinensis* Huang & Chen, 2007, *R. lingtongyanensis* Chen, Wang, Chen & Shao, 2022, *R. longyanensis* Chen, Cheng & Shao, 2008, *R. lungwoensis* Huang & Chen, 2007, *R. rubrolineatus* Chen & Miller, 2008, *R. sagittus* Chen & Miller, 2008, and *R. wangi* Chen & Fang, 2006) (Chen & Fang 2006; Chen & Miller 2008; Chen *et al.* 2008, 2022a; Huang & Chen 2007) (Table 8).

TABLE 8. Various species of *Rhinogobius* with oblique stripes on cheeks.

	Number of stripes	Stripe thickness	Position of stripe	Number of vertebrae (mode)
<i>R. nami</i> n. sp.	3	Broad	Limited to lower half of the cheek	26
<i>R. lungwoensis</i>	1	Slightly broad	Limited to lower half of the cheek	28
<i>R. rubrolineatus</i>	2	Thin	Reaching upper half of the cheek	26
<i>R. changtinensis</i>	3	Thin	Reaching upper half of the cheek	27
<i>R. longyanensis</i>	3	Thin	Limited to lower half of the cheek	27
<i>R. lingtongyanensis</i>	4	Thin	Limited to lower half of the cheek	26
<i>R. sagittus</i>	4–5	Thin	Reaching upper half of the cheek	26
<i>R. wangi</i>	modally 7	Thin	Reaching upper half of the cheek	27
<i>R. sulcatus</i>	3–4	Broad	Reaching upper half of the cheek	27
<i>R. duospilus</i>	1–3	Thin or broad	Reaching upper half of the cheek	27
<i>R. ponkouensis</i>	2	Broad	Reaching upper half of the cheek	28
<i>R. virgigena</i>	1–3	Thin or broad	Limited to lower half of the cheek	26

Male of *R. sulcatus* Chen & Kottelat, 2005 has three broad stripes similar to those of the new species, but the stripes are longer (often reaching upper half of cheek) (Fig. 9a), and often branched and connected with each other, forming a reticulate pattern. *Rhinogobius sulcatus* also differs from the new species in lacking longitudinal, reddish-brown or dusky-brown stripes on sides of the body (Fig. 9a, b) (five stripes in male and female of *R. nami*; Fig. 7a, b), seven soft rays on anal fin (vs. usually eight in *R. nami*; Table 2), 16 pectoral-fin rays (vs. 15; Table 4), and 27 vertebrae (vs. 26; Table 1).

Males of *R. duospilus* (Herre, 1935), *R. ponkouensis* Huang & Chen, 2007, and *R. virgigena* Chen & Kottelat, 2005, have two or three stripes on cheek, but lack the longitudinal stripes along sides of the body (Herre 1935a; Wu & Ni 1986; Wu 1991; Chen & Kottelat 2005; Huang & Chen 2007; Wu & Zhong 2008; observation on *R. virgigena* in the present study; Fig. 9e, f) (vs. five stripes in *R. nami*; Fig. 7a, b), 27 and 28 vertebrae in *R. duospilus* and *R. ponkouensis*, respectively (Huang & Chen 2007) (vs. usually 26 in *R. virgigena* and *R. nami*; Table 1).

Among species from central Vietnam described in the present study, *R. nami* is most similar to *R. taenigena*, sharing the same markings on fins, and the red and light bluish-grey patterns on opercular membrane, interopercle, and lower part of subopercle of the male (Figs. 7a and 11a, b). However, *R. nami* can be distinguished from *R. taenigena* in the presence of five longitudinal stripes on sides of the body (absent in *R. taenigena*), three oblique stripes on the male's cheek (vs. absent) and presence of 26 vertebrae (vs. 27; Table 1).

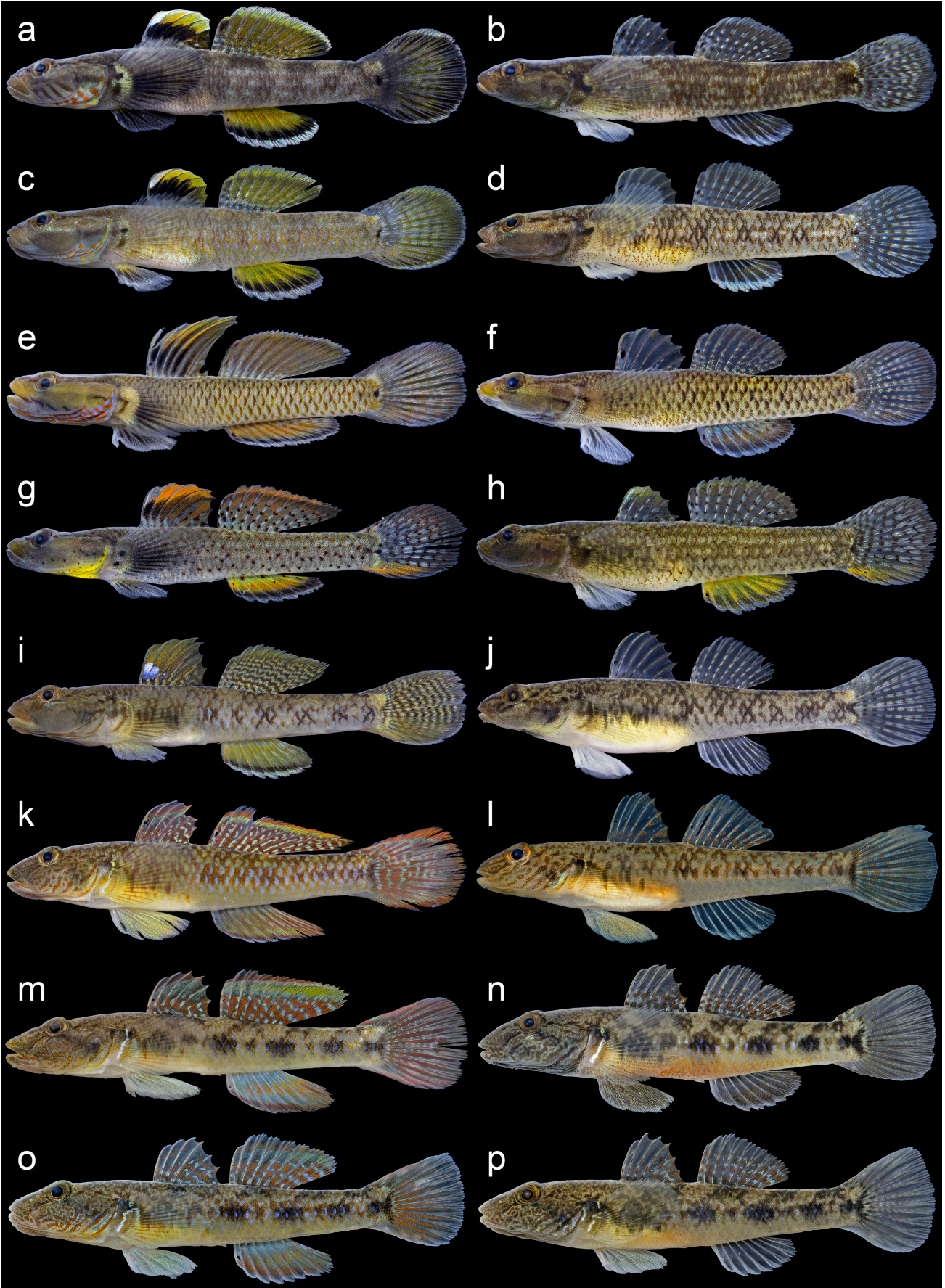




FIGURE 9. Comparative material of the genus *Rhinogobius* from northern Vietnam (a–l) and Japan (m–p) observed in the present study. Photographs were taken immediately after fixation. Specimens on left side are males, right are females. a, b, *R. sulcatus* (a, OISTICH 184, 30.4 mm SL; b, OISTICH 190, 32.4 mm SL); c, d, *R. boa* (c, OISTICH 161, 25.4 mm SL; d, OISTICH 160, 28.0 mm SL); e, f, *R. virgigena* (e, NSMT-P 147872, 36.1 mm SL; f, OISTICH 154, 33.7 mm SL); g, h, *R. variolatus* (g, OISTICH 169, 31.4 mm SL; h, OISTICH 170, 28.8 mm SL); i, j, *R. leavelli* (i, OISTICH 209, 38.1 mm SL; j, OISTICH 210, 35.4 mm SL); k, l, *R. similis* (k, OISTICH 222, 54.4 mm SL; l, NSMT-P 147882, 44.7 mm SL); m, n, *R. similis* from Okinawa Island (m, URM-P 49149, 48.6 mm SL; n, OISTICH 2, 63.6 mm SL); o, p, *R. similis*, from Izu Peninsula (o, OISTICH 330, 47.6 mm SL; p, OISTICH 332, 51.0 mm SL).

***Rhinogobius taenigena* Chen, Kottelat & Miller, 1999**

(Figs. 2, 6e, f, 10a–c, 11, 12; Tables 1, 2, 4–7, 9)

Rhinogobius taenigena Chen, Kottelat & Miller, 1999: 29 (type locality: Xe Pon between rapids upstream and downstream of Ban Fuang, Xe Bang Hiang basin, Mekong basin, Savannakhet Province, Laos, 16°37'06"N, 106°33'30"E); Kottelat 2001b: 158–159 (Xe Bang Hiang basin, Laos); Serov *et al.* 2006: 295 (Gianh River basin to Phong Nha River, Quang Binh Province, Vietnam); Nagao Natural Environment Foundation 2021: 441 (Mekong basin in Savannakhet Province, Laos).

Material examined. Thirteen specimens from the Mekong basin and five specimens from the Song Huong (Perfume River) basin, both in Thua Thien Hue Province, Vietnam.

Mekong basin. HNUE-F 355–356, 1 male (19.3 mm SL) and 1 female (29.5 mm SL), a tributary of Xe Kong in Hong Trung, A Luoi District (16°21'23.6"N 107°09'15.8"E), 20 June 2019; NSMT-P 147891–147892, 1 male (28.1 mm SL) and 1 female (30.0 mm SL), a tributary of Xe Kong in Hong Trung, A Luoi District (16°21'23.6"N 107°09'15.8"E), 20 June 2019; OISTICH 291, 292, 294, 299, 1 male (23.6 mm SL) and 3 females (29.1–31.7 mm SL), a tributary of Xe Kong in Hong Trung, A Luoi District (16°21'23.6"N 107°09'15.8"E), 20 June 2019; OISTICH 301, male (29.7 mm SL), a tributary of Xe Kong in Hong Kim, A Luoi District (16°17'45.5"N 107°12'33.8"E), 20 June 2019; OISTICH 302–305, 2 males (30.8–34.9 mm SL) and 2 females (30.5–34.1 mm SL), a tributary of Xe Kong in Hong Kim, A Luoi District, (16°18'17.0"N 107°12'46.0"E), 20 June 2019.

Song Huong basin. HNUE-F 357–358, 1 male (29.4 mm SL) and 1 female (31.1 mm SL), a tributary of Song Bo in Hong Ha, A Luoi District (16°18'00.0"N 107°19'29.1"E), 20 June 2019; OISTICH 310–312, 1 male (28.8 mm SL) and 2 females (29.6–33.4 mm SL), a tributary of Song Bo in Hong Ha, A Luoi District (16°18'00.0"N 107°19'29.1"E), 20 June 2019.

Description. Body nearly cylindrical anteriorly and somewhat compressed posteriorly. Anterior tip of head pointed in female, but rounded in male. Head larger in male than female (head length 30.9–33.5 vs. 28.1–30.5% of SL; Fig. 2, Table 9). Eyes located dorsolaterally. Mouth terminal and oblique with thick upper and lower lips. When mouth closed, anterior tips of upper and lower jaws almost even, but lower jaw sometimes slightly protruding beyond upper jaw. Upper jaw extending posteriorly to about anterior margin of pupil. Mouth larger in male than female (upper-jaw length 10.2–14.6 vs. 8.5–9.6% of SL; Fig. 2, Table 9). Upper and lower jaws usually with 2–4 rows of conical teeth; those in outermost row enlarged and those in inner rows irregularly aligned. Mental flap on chin usually rectangular or trapezoidal (posterior end forming long side), often with a small central projection. Anterior nostril short and tubular, posterior nostril a pore. Cephalic sensory pore system with B', C, D(S), E, F, H', K', and L' in oculoscapular canal and M', N, and O' in preopercular canal of both left and right sides in 11 of 18 specimens examined (Fig. 10a–c), but one specimen having an additional pore behind pore F (not G, but near F) on left side, two specimens having pore G on one side and pore H' longitudinal groove-like on another side of one of two specimens, one specimen having an additional pore between pores E and F in right side, one specimen having a single heart-shaped pore C, two specimens having two pores aligned longitudinally on one side of C (total three pores at C) and oculoscapular canal of one side without pore M' and with vertical groove-like N' instead in one of two specimens, and oculoscapular canal of one side lacking N in another one. Arrangement of cutaneous sensory papillae of head shown in Fig. 10a–c. Cheek having no significant transverse papilla rows. Vertebrae 10+16=26 (n=1), 10+17=27 (n=11), 10+18=28 (n=1), or 11+17=28 (n=1; Table 1), P-V 3/II II I I 0/9 (n=12), P-V 3/II II I I I 0/10 (n=1), or 3/II III 0 I 0/9 (n=1).

TABLE 9. Morphometric data of *Rhinogobius taenigena*, *R. leavelli*, and *R. similis* from central Vietnam, expressed as percentages of standard length. D₁, first dorsal fin; D₂, second dorsal fin; A, anal fin; C, caudal fin; P₂, pelvic fin. * Includes five specimens of unknown sex.

	<i>R. taenigena</i>		<i>R. leavelli</i>		<i>R. similis</i>	
	Male	Female	Male	Female	Male	Female*
Number of specimens	8	10	12	10	9	15
Standard length (mm)	23.6–34.9	29.1–34.1	27.3–43.8	27.0–41.1	42.5–67.1	30.5–62.4
Head length	30.9–33.5	28.1–30.5	30.7–34.1	28.7–31.1	30.5–34.0	28.9–34.0
Snout length	7.8–10.3	7.1–8.2	9.7–12.1	8.2–9.8	11.1–13.9	9.0–12.3
Eye diameter	6.0–7.1	5.9–6.8	6.6–7.7	6.6–8.1	6.2–7.3	6.9–8.5
Postorbital length of head	16.1–18.1	14.7–16.4	14.1–16.4	13.4–14.8	13.3–16.0	12.8–15.3
Upper-jaw length	10.2–14.6	8.5–9.6	11.0–15.8	8.8–11.2	12.6–17.6	9.5–12.2
Body depth at P ₂ origin	14.2–16.5	14.2–17.2	14.8–17.3	15.5–18.5	16.2–19.3	16.4–19.6
Body depth at A origin	13.6–17.4	14.5–17.7	14.4–17.2	15.1–17.8	14.6–17.9	16.5–18.1
Depth at caudal peduncle	10.9–12.5	11.1–12.9	10.4–12.3	10.1–12.0	10.1–12.1	9.5–11.5
Length of caudal peduncle	25.3–28.4	25.7–29.0	25.7–29.1	25.6–28.8	26.5–28.6	26.1–30.2
Predorsal length	38.1–40.9	35.0–38.0	37.4–39.8	36.7–39.4	36.8–40.4	36.1–40.2
Preanal length	55.8–59.0	56.0–59.7	54.6–57.5	55.0–60.8	53.7–56.3	49.2–58.0
Length of D ₁ base	15.7–18.9	16.4–19.5	14.4–19.4	16.7–19.3	17.5–19.4	15.7–19.8
D ₁ length	20.1–24.1	18.0–21.1	18.3–29.9	17.6–21.2	20.1–23.8	17.7–22.3
Interval between D ₁ and D ₂ bases	1.7–4.4	2.3–4.8	1.1–7.2	3.2–5.4	1.0–3.0	1.6–4.3
Length of D ₂ base	15.7–19.1	14.3–18.2	15.6–17.1	14.9–16.6	17.2–18.7	16.0–18.8
D ₂ length	28.8–36.1	25.7–30.8	26.4–36.5	24.1–28.2	31.3–43.7	23.6–30.0
Length of A base	13.3–15.7	11.0–15.5	13.2–15.8	12.0–14.2	14.7–16.5	13.7–15.9
A length	25.0–33.0	22.0–28.4	24.0–30.6	22.2–25.1	26.4–38.5	22.6–28.2
C length	24.3–28.7	23.3–25.9	21.6–28.7	22.4–24.4	24.9–30.2	23.0–28.1

First dorsal fin usually with six spines, but one specimen with seven spines. Second dorsal fin with one spine and seven (n=4), eight (n=11), or nine (n=3) soft rays (Table 2). First and second dorsal-fin bases separated by a small interval (1.7–4.8% of SL; Table 9). In females, first dorsal fin rounded, almost semi-circular; posterior tip of fin (usually tips of sixth spines) not reaching second dorsal-fin origin. In males, first dorsal fin rounded or parallelogram; posterior tip of fin (usually fourth or fifth spine) extending to, or exceeding base of second dorsal-fin spine, but never exceeding base of second soft ray of second dorsal fin. Anal fin with one spine and six (n=2), seven (n=10), or eight (n=6) soft rays (Table 2). Caudal fin with 17 segmented rays including 12 (n=3), 13 (n=2), 14 (n=12), or 15 (n=1) branched rays; posterior margin rounded. Males having larger second dorsal, anal, and caudal fins, than females (second dorsal-fin length 28.8–36.1 vs. 25.7–30.8% of SL, anal-fin length 25.0–33.0 vs. 22.0–28.4% of SL, and caudal-fin length 24.3–28.7 vs. 23.3–25.9% of SL; Fig. 2, Table 9). Pectoral fin with 15–17 rays (mode 16 rays) (Table 4). Pelvic fin with one spine and five soft rays; joined together to form a cuplike disc with fleshy bilobed frenum.

Ctenoid scales covering lateral, dorsal, and ventral surfaces of body posterior to flank except belly. Nape and posterior part of occipital region covered by cycloid scales; scaled area extending anteriorly to area above opercle both in males and females. Other regions on head naked. Belly and flank covered with cycloid scales. First and second dorsal, and anal-fin bases covered with ctenoid scales, and mixed with a few small cycloid scales. Proximal part of caudal fin covered with cycloid scales. Pectoral-fin base and breast (pre-pelvic area) probably naked (at least invisible without staining with alizarin red; see Suzuki *et al.* 2016). Longitudinal scales 30–33 (usually 31 or 32), transverse scales 8–10, transverse scales in caudal peduncle usually seven but six in a single specimen, and predorsal scales 5–12 (Tables 5–7).

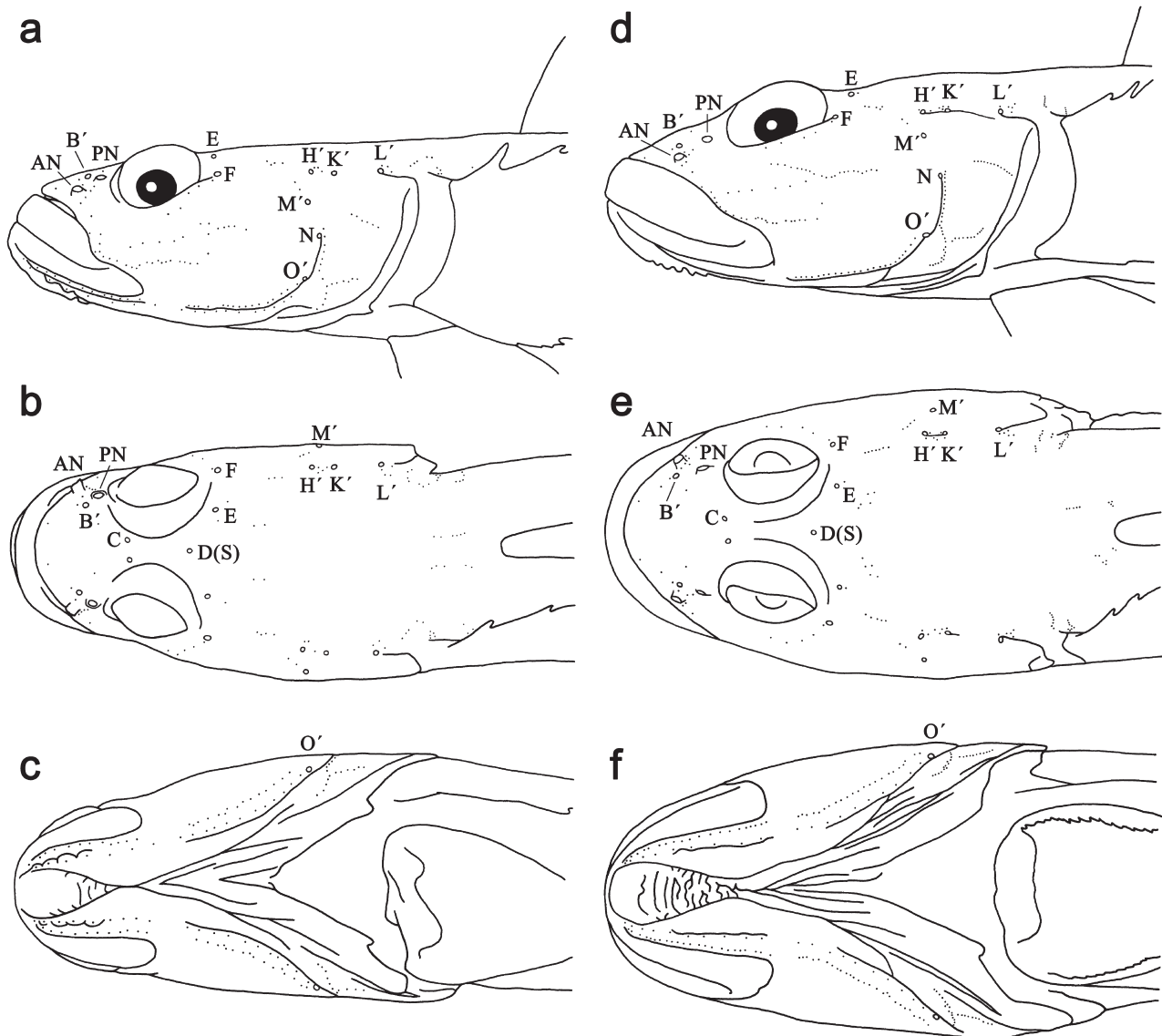


FIGURE 10. Arrangement of cephalic sensory pores and cutaneous sensory papillae in *Rhinogobius taenigena* (a–c, OISTICH 303) and *Rhinogobius leavelli* (d–f, NSMT-P 147888). a, d, lateral view; b, e, dorsal view; c, f, ventral view. AN, anterior naris; PN, posterior naris.

Color in life and fresh (Figs. 11 and 12): in males, background of head and body grey or yellowish-brown, but whitish on ventral side. Reddish-brown stripe connecting posterior margin of center of upper lip and anterior margin of left and right eyes; thinner and unclear stripe continuing posteriorly from posterior margin of eye, but ending immediately and not reaching posterior margin of preopercle. No or faint reddish-brown marking at center of upper lip. Dorsal side of head often darker than lateral side. Lower half of cheek and opercular region often darker than upper half. Opercular membrane, interopercle, and lower part of subopercle light bluish-grey with many small red or orange spots. Six to eight, dark-brown transverse bands regularly aligned along lateral side of body from flank to caudal-fin base, and intervals light blue, but this pattern sometimes irregular and unclear. Many small, orange spots sometimes scattered on sides of body.

First dorsal-fin with series of black or reddish-brown markings on middle parts of membranes between first to fifth spines; anterior two markings (between first and second, and second and third spines) usually black and clear, but posterior ones reddish-brown and often unclear. Distal part of membrane light blue or white between first and second spines, and orange or red between second and fifth spines. Distal parts of spines black or grey. Reddish-brown spots on proximal part of first to fourth spines; spines and membranes light bluish-grey, both above and below reddish-brown spots. Membranes posterior to fifth spine light bluish-grey with some reddish-brown spots.

Second dorsal-fin reddish-brown with four to seven light bluish-grey stripes across fin, and with a broad, orange or pale-yellow band at distal margin. A black, vertical rectangular or elliptical spot at middle proximal part of caudal fin, with a yellowish-brown or grey blotch above black spot, but this blotch often unclear. Other part of caudal fin yellowish or greyish translucent with five or six reddish-brown vertical bands with a pale-yellow margin (Fig. 11b), or dusky grey or reddish-brown with a pale-yellow margin without distinct vertical bands (Fig. 11a). Anal fin orange,

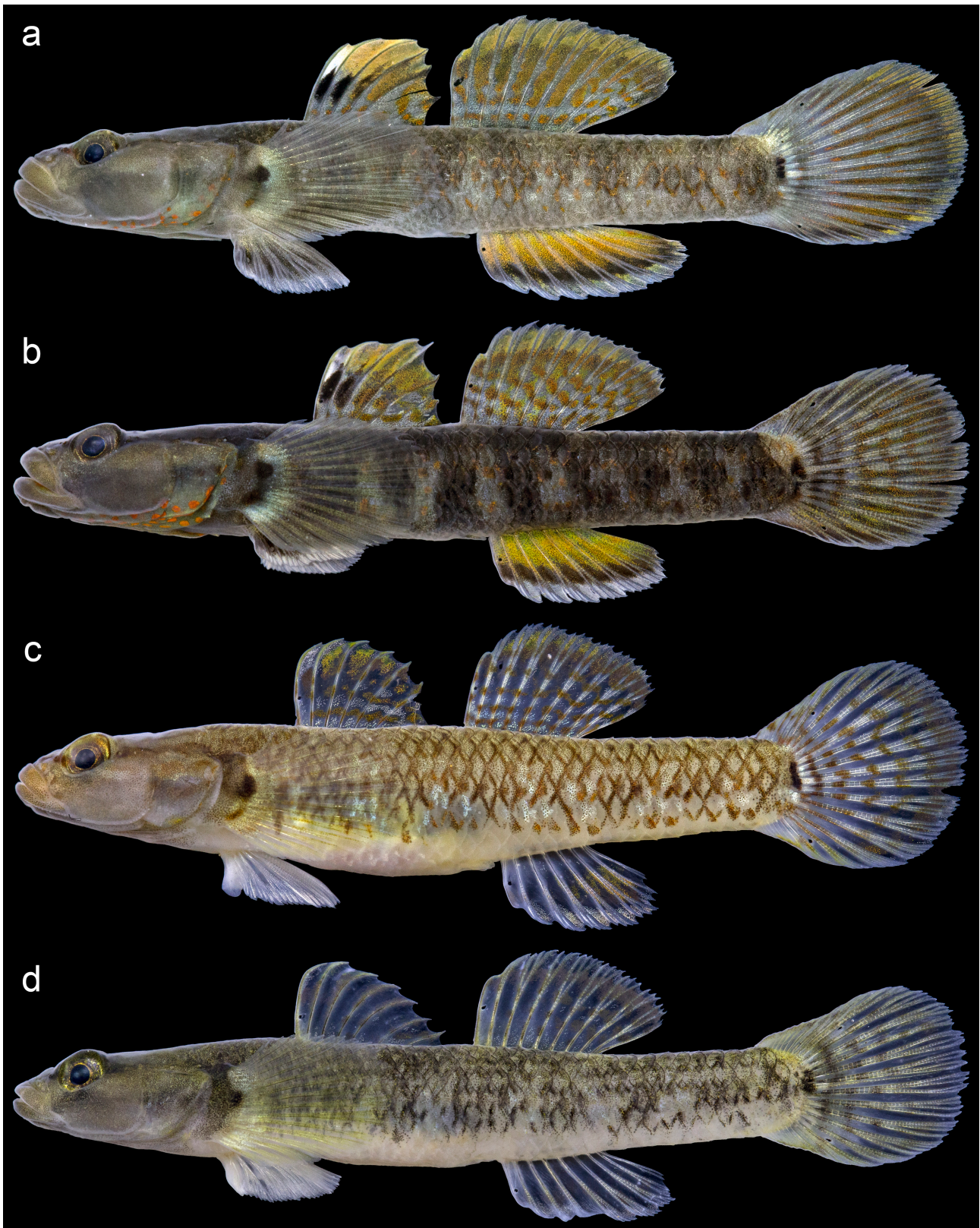


FIGURE 11. *Rhinogobius taenigena* immediately after fixation. a, OISTICH 303, male, 30.8 mm SL; b, OISTICH 312, male, 28.8 mm SL; c, OISTICH 304, female, 30.5 mm SL; d, OISTICH 311, female, 33.4 mm SL.

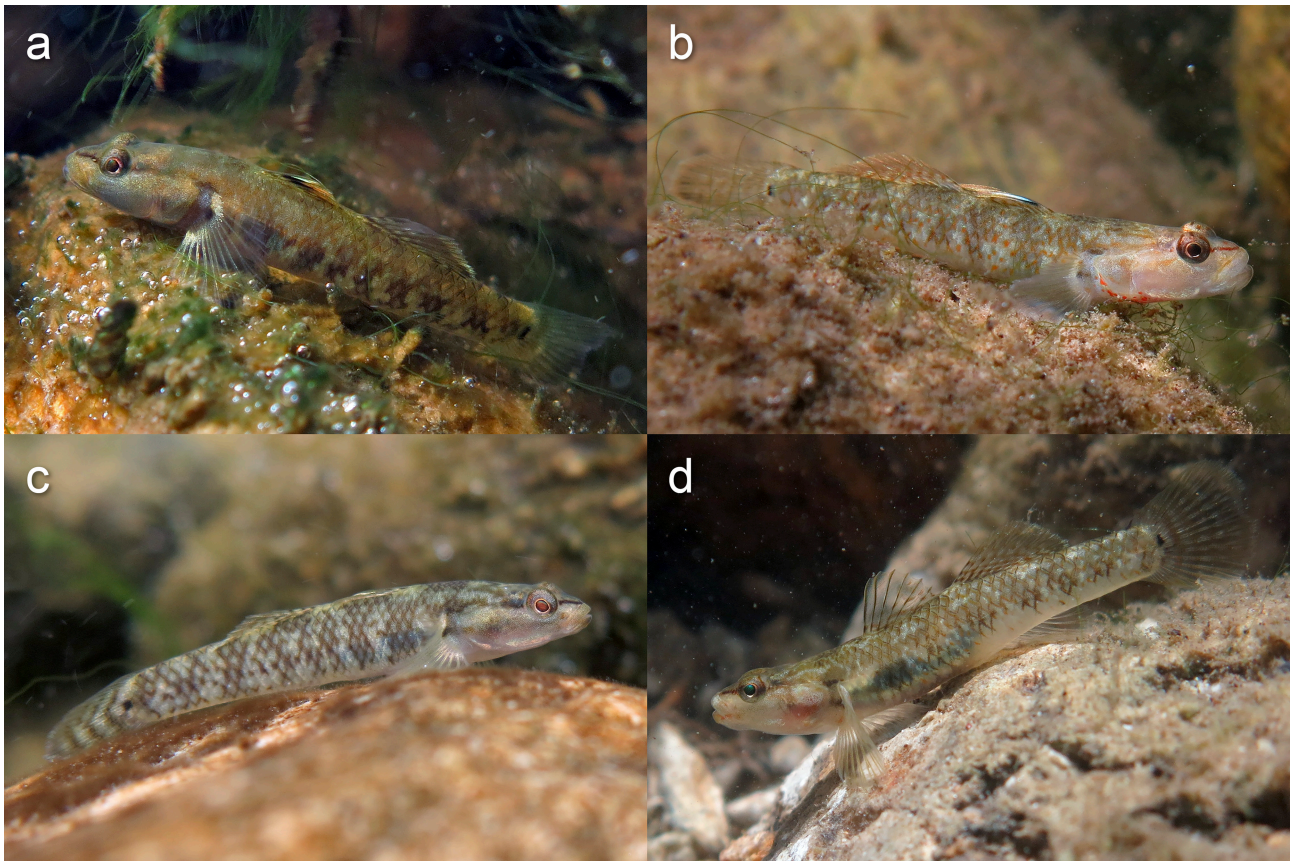


FIGURE 12. *In situ* underwater photographs of *Rhinogobius taenigena* in the upper reaches of Xe Kong (Mekong basin) in Thua Thien Hue Province, Vietnam. a, b, males, 20 June 2019; c, d, females, 20 June 2019 (photo by K. Maeda).

but dark brown distally with broad, bluish-white margin. Pectoral fin grey or greyish translucent, its proximal part pale yellowish-brown or pale grey with a black spot at middle of base; an additional black spot often appearing at lower part of pectoral-fin base, which is sometimes combined with middle one forming a large black blotch. Pelvic disc dark grey with a white or light blue margin.

In females, markings and background color of head and body similar to those of males, but opercular membrane, interopercle, and lower part of subopercle yellowish-brown or dark grey without red spots. First dorsal fin having two to four, indefinite brown stripes; intervals translucent or white; distal part of fin yellow or bluish-white. Second dorsal fin with four to five, brown stripes, intervals white or translucent; with a yellow or bluish-white margin. Caudal fin translucent or white with five or six brown bands with a thin, pale-yellow margin; color and markings of proximal part of fin similar to those in males. Anal fin translucent, but reddish-brown or dark brown distally with a bluish-white margin. Pectoral fin translucent with a pattern on its base similar to that in males. Pelvic disc translucent or grey with a white margin.

Color in preservative (Fig. 6e, f): background of head and body cream and those of fins translucent or light brown. Reddish-brown markings observed in life become dark brown, and dusky-brown markings become black. Light bluish-grey color on opercular membrane, interopercle, and lower part of subopercle of male become dark brown, and red and orange spots become light brown (dark and pale pattern opposite from that in life). Red, orange, white, and bluish colors of fins disappeared.

Remarks. The type locality of *R. taenigena* is Xe Pon (Se Pon), a tributary of the Banghiang River in the Mekong basin (Chen *et al.* 1999). Though located in Laos, it is close to the border with Vietnam (a little downstream from the Xe Pon reaches shown in Fig. 1). This species was also reported from Quang Binh Province (Fig. 1) in Vietnam from the Gianh River basin to Phong Nha River (Serov *et al.* 2006). We found this species in two river systems in Thua Thien Hue Province of Vietnam (Fig. 1). One of them, Xe Kong (Se Kong), is a tributary of the Mekong, originating in Thua Thien Hue Province and flowing through southern Laos and eastern Cambodia. It joins the Mekong near Stung Treng, Cambodia. Another site is in the upper reaches of the Song Bo (Bo River), a tributary

of the Song Huong (Perfume River), which flows directly to the South China Sea near the city of Hue. These suggest that this species could be widely distributed in river systems near the Vietnam-Laos border in this region.

Chen *et al.* (1999) described “four small blackish-brown spots on ventral edge of cheek” (on the ventral margin of the preopercle according to their fig. 16) of a male as a diagnostic character of *R. taenigena*. They described the coloration based on “observations from color slides taken of freshly preserved specimens.” Nagao Natural Environment Foundation (2021) noted that “the spots are not always evident” in specimens freshly collected near the type locality, and “if present, the number varies from one to four.” Photographs by the Nagao Natural Environment Foundation (2021: 441) show orange spots similar to spots on the opercular membrane, interopercle, and lower part of subopercle. Our material from Vietnam has neither blackish-brown spots nor spots of any other color on the preopercle, either in fresh or after preservation. This is the only point on which our observations do not agree with previous descriptions. No significant morphological differences were also found between the Xe Kong and Song Bo populations.

***Rhinogobius leavelli* (Herre, 1935)**

(Figs. 2, 6g, h, 10d–f, 13–15; Tables 1, 2, 4–7, 9)

Ctenogobius leavelli Herre, 1935b: 396 (type locality: hill streams around Wuchow, Kwangsi Province, China).

Rhinogobius leavelli: Herre 1938: 436 (Lung T'au Shan, Kwangtung Province, China); 436; Kottelat 2001b: 157 (Laos); Chen *et al.* 2002: 269 (Hainan, China); Chen & Kottelat 2005: 1427 (northern Vietnam); Serov *et al.* 2006: 294 (but photo of *R. similis* shown as *R. leavelli*; central Vietnam); Wu & Zhong 2008: 604 (China).

Ctenogobius cervicosquamus Wu, Lu & Ni in Wu & Ni, 1986: 291 (type locality: Changhua River, Qiongzong, Hainan, China); Wu 1991: 485 (Hainan, China).

Ctenogobius brunneus (not of Temminck & Schlegel): Luo 1989: 349 (Pearl River in Guangdong, Guangxi, and Guizhou); Wu 1991: 483 (Guangdong).

Material examined. Sixteen specimens from Da Nang City and six specimens from Thua Thien Hue Province, Vietnam.

Da Nang City. HNUE-F 347–349, 1 male (31.8 mm SL) and 2 females (31.3–31.7 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (16°00'01.3"N 108°03'33.2"E), 17 June 2019; HNUE-F 350, male (37.5 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District (15°58'01.9"N 108°02'08.5"E), 17 June 2019; NSMT-P 147887, female (41.1 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (15°59'57.7"N 108°04'10.0"E), 1 March 2016; NSMT-P 147888, male (43.8 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District (15°57'60.0"N 108°01'44.2"E), 2 March 2016; OISTICH 256–258, 2 males (29.5–42.5 mm SL) and 1 female (33.4 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (15°59'57.7"N 108°04'10.0"E), 1 March 2016; OISTICH 259, female (40.9 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District (15°57'60.0"N 108°01'44.2"E), 2 March 2016; OISTICH 260–261, 1 male (29.0 mm SL) and 1 female (38.8 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (15°59'58.1"N 108°04'12.7"E), 27 January 2018; OISTICH 262, male (29.1 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District (16°00'01.3"N 108°03'33.2"E), 17 June 2019; OISTICH 263–265, 1 male (35.5 mm SL) and 2 females (34.2–34.4 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District (15°58'01.9"N 108°02'08.5"E), 17 June 2019.

Thua Thien Hue Province. OISTICH 266–268, 3 males (27.3–37.7 mm SL), a tributary of Song Bo in Hong Ha, A Luoi District (16°18'00.0"N 107°19'29.1"E), 20 June 2019; OISTICH 269–271, 1 male (40.5 mm SL) and 2 females (27.0–39.1 mm SL), a tributary of Song Huong flowing along the border between Binh Thanh and Huong Tho, Huong Tra District (16°20'22.4"N 107°32'35.1"E), 21 June 2019.

Description. Body nearly cylindrical anteriorly and somewhat compressed posteriorly. Head depressed and larger in males than females (head length 30.7–34.1 vs. 28.7–31.1% of SL; Fig. 2, Table 9). Eyes located dorsolaterally. Mouth terminal and oblique with thick upper and lower lips. When mouth closed, anterior tips of upper and lower jaws very close together, but upper lip usually extending slightly beyond lower jaw. Mouth larger in males than females (upper-jaw length 11.0–15.8 vs. 8.8–11.2% of SL; Fig. 2, Table 9). Upper and lower jaws usually with 2–4 rows of conical teeth; those in outermost row enlarged and those in inner rows irregularly aligned. Mental flap on chin rounded rectangular, trapezoidal (posterior end forming long side), emarginate, or lunate, and often with a small central projection. Anterior nostril short tubular, posterior nostril a pore. Cephalic sensory pore system usually with B', C, D(S), E, F, H', K', and L' in oculoscapular canal and M', N, and O' in preopercular

canal (Fig. 10d–f), but two of 22 specimens lacking pore N of both left and right sides. Arrangement of cutaneous sensory papillae of head shown in Fig. 10d–f. Cheek having four longitudinal rows of papillae and no transverse row. Vertebrae 10+15=25 (n=1), 10+16=26 (n=14), or 10+17=27 (n=1; Table 1), P-V 3/II II I I 0/9 (n=14) or 3/II II I I 1/9 (n=1; seventh pterygiophore without spine).

First dorsal fin usually with six spines, but one specimen with five spines. Second dorsal fin with one spine and seven (n=3) or eight (n=19) soft rays (Table 2). First and second dorsal-fin bases separated by a small interval (1.1–7.2% of SL; Table 9). In female, first dorsal fin rounded, almost semi-circular; posterior tip of fin (tips of third to sixth spines) not reaching second dorsal-fin origin. In males, first dorsal fin parallelogram or triangular; third and/or fourth spines often elongate and their tips exceeding base of fourth soft ray of second dorsal fin in longest case, but some individuals with shorter spines not reaching second dorsal-fin origin. Anal fin with one spine and seven (n=5), eight (n=16), or nine (n=1) soft rays (Table 2). Caudal fin with 17 segmented rays including 12 (n=1), 13 (n=6), 14 (n=12), or 15 (n=2) branched rays, but one specimen with 14 segmented rays including 11 branched rays; posterior margin rounded. Males having larger second dorsal and anal fins than female (second dorsal-fin length 26.4–36.5 vs 24.1–28.2% and anal-fin length 24.0–30.6 vs 22.2–25.1% of SL; Fig. 2, Table 9). Pectoral fin with 16–19 rays (mode 18 rays) in Da Nang City population and 18–19 rays (mode 19 rays) in Thua Thien Hue Province population (Table 4). Pelvic fin with one spine and five soft rays; pelvic fins joined together to form a cuplike disc with fleshy bilobed frenum.

Ctenoid scales covering lateral, dorsal, and ventral surfaces of trunk and tail, except belly. Nape and posterior part of occipital region covered by cycloid and ctenoid scales; cycloid scales occupied dorsal surface along midline in 9/12 males and 4/10 females, but with one or two, or 1–9 ctenoid scales along dorsal midline of nape near first dorsal-fin origin in other males and females, respectively. Ctenoid and cycloid scales mixed on sides of occipital region, and side of nape covered with ctenoid scales. Scaled area usually extending anteriorly to area above opercle in both male and female, but not reaching posterior margin of opercle in four males and one female; scaled area never extending to area above preopercle. Other regions on head naked. Belly covered with cycloid scales. First and second dorsal-, and anal-fin bases, and small area behind pectoral fin covered mainly with ctenoid scales, and mixed with a few small cycloid scales. Proximal part of caudal fin covered with cycloid scales and a few ctenoid scales. Pectoral-fin base and breast (pre-pelvic area) probably naked (at least invisible without staining with alizarin red; see Suzuki *et al.* 2016). Longitudinal scales 29–32, transverse scales 9–10, transverse scales in caudal peduncle usually seven, but eight in one specimen; predorsal scales 3–11 (Tables 5–7).

Color in life and fresh (Figs. 13 and 14): in males, background of head and body grey or yellowish-brown, but whitish on ventral side. Reddish-brown stripes connected posterior margin of center of upper lip and anterior margin of left and right eyes. Short, horizontal reddish-brown stripe on upper part of cheek just below eye. Many reddish-brown, small spots scattered on cheek. Larger reddish-brown markings with various shapes scattered on opercle. Opercular membrane, interopercle, and lower part of subopercle grey with many orange stripes running along margin of preopercle and opercle. Five dark-brown, indefinite blotches aligned along lateral midline of body from flank to caudal-fin base; these blotches sometimes subdivided, or smaller blotch sometimes inserted between blotches. These blotches united with dark-brown irregular blotches on dorsal side to form various shapes. Scales on sides of body with orange edges. A male showed a higher contrast with black bands and white intervals when it courted a female (Fig. 14a).

First dorsal fin reddish-brown, with 1–3 black spots on proximal parts of membranes between anterior 2–4 spines (usually two black spots between first and third spines); upper parts of black spots light blue. Second dorsal fin reddish-brown with three to five olive or whitish-grey stripes across fin. A large orange blotch at proximal part of caudal fin; remainder of caudal fin reddish-brown with four to six olive or whitish-grey bands across fin. Anal fin reddish-brown, but olive or whitish-grey proximally and dark brown distally with a bluish-white margin; sometimes with orange spots on membrane. Pectoral fin greyish translucent or dark grey, but its proximal part olive or light yellowish-brown with two reddish-brown bands along base; a band on base clear and another faint. Pelvic disc grey or dark grey.

In females, markings and background color of head and body similar to those of male, but cheek without small reddish-brown spots, and opercular membrane, interopercle, and lower part of subopercle yellowish-brown without orange stripes. First dorsal fin with dark-brown spines and translucent membranes; faint yellow or grey markings partly. Spine and soft rays of second dorsal fin with 3–5 dark-brown spots; membranes translucent with faint yellow or grey markings partly. Caudal-fin rays with 4–6 dark-brown spots and white interval; membranes translucent.

In anal fin, distal half of soft rays dark brown, but other parts almost translucent. Pectoral fin translucent, but its proximal part light yellowish-brown with two reddish-brown bands along base; band on base clear and another faint. Pelvic disc white.



FIGURE 13. *Rhinogobius leavelli* immediately after fixation. a, NSMT-P 147888, male, 43.8 mm SL; b, OISTICH 265, female, 34.4 mm SL.

Color in preservative (Fig. 6g, h): background of head and body cream. Reddish-brown markings observed in life become dark brown. Orange markings disappeared. Olive, whitish-grey, and light yellowish-brown parts of fins become light brown. Black spots of first dorsal fin of male remained, but blue spots disappeared.

Remarks. Populations of *R. leavelli* in central Vietnam observed in this study differ somewhat in morphology from populations in northern Vietnam. There are slight differences between specimens from Da Nang City and Thua Thien Hue Province, even within central Vietnam. Pectoral-fin ray counts are 16–19 (usually 16–18) in Da Nang, but 18–19 (usually 19) in Thua Thien Hue, and 18–19 (almost same frequency) in northern Vietnam (Table 4). The caudal peduncle is lower and longer in Da Nang than Thua Thien Hue, and those are further lower and longer in northern Vietnam (Fig. 15). Body coloration is also slightly different. Fish in central Vietnam usually have five, dark-brown lateral bands which are often V-shaped or triangular saddles, while the body usually has seven indistinct blotches regularly aligned along the lateral midline in northern Vietnamese populations (Fig. 9i, j).

However, differences in counts and measurements overlap. Coloration is variable and also differs individually; therefore, the difference between localities is not clear. In the present study, only specimens from a few localities were compared, and it is unclear whether the differences are continuous, or if there is a geographical boundary.

This species was originally described from Wuzhou, Guangxi in southern China by Herre (1935b), and has since been reported from a larger area encompassing southern China, Vietnam, and Laos (Kottelat 2001b; Chen & Kottelat 2005; Wu & Zhong 2008). *Ctenogobius cervicosquamus* Wu, Lu & Ni in Wu & Ni, 1986 from Hainan Island is also considered a synonym (Wu & Zhong 2008). We tentatively identify the population in central Vietnam as *R. leavelli*, but clarifying this issue would require extensive examination of specimens from other regions, especially southern China.

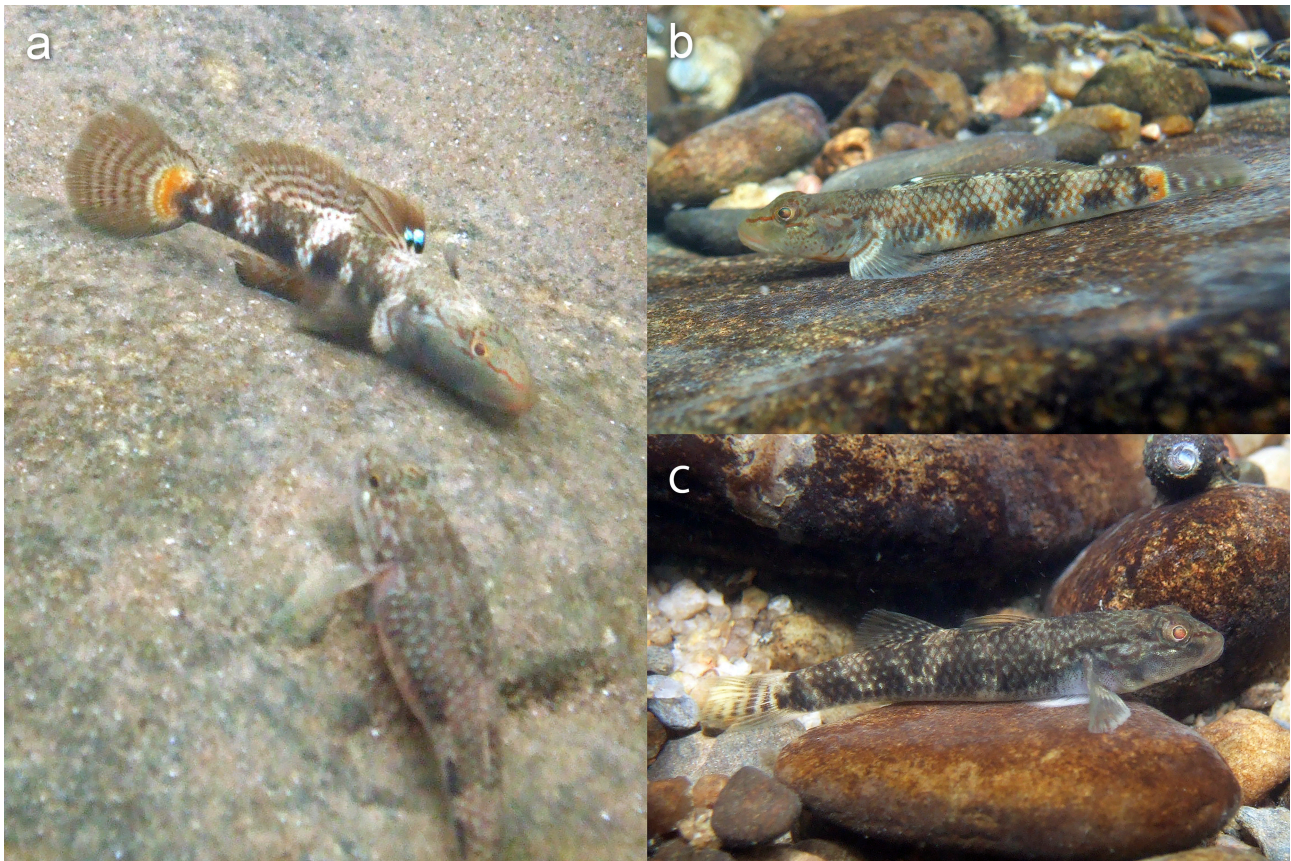


FIGURE 14. *In situ* underwater photographs of *Rhinogobius leavelli* in Da Nang City, Vietnam. a, male (top) and female (bottom), 13 January 2013; b, male, 12 January 2013; c, female, 12 January 2013 (photo by K. Maeda).

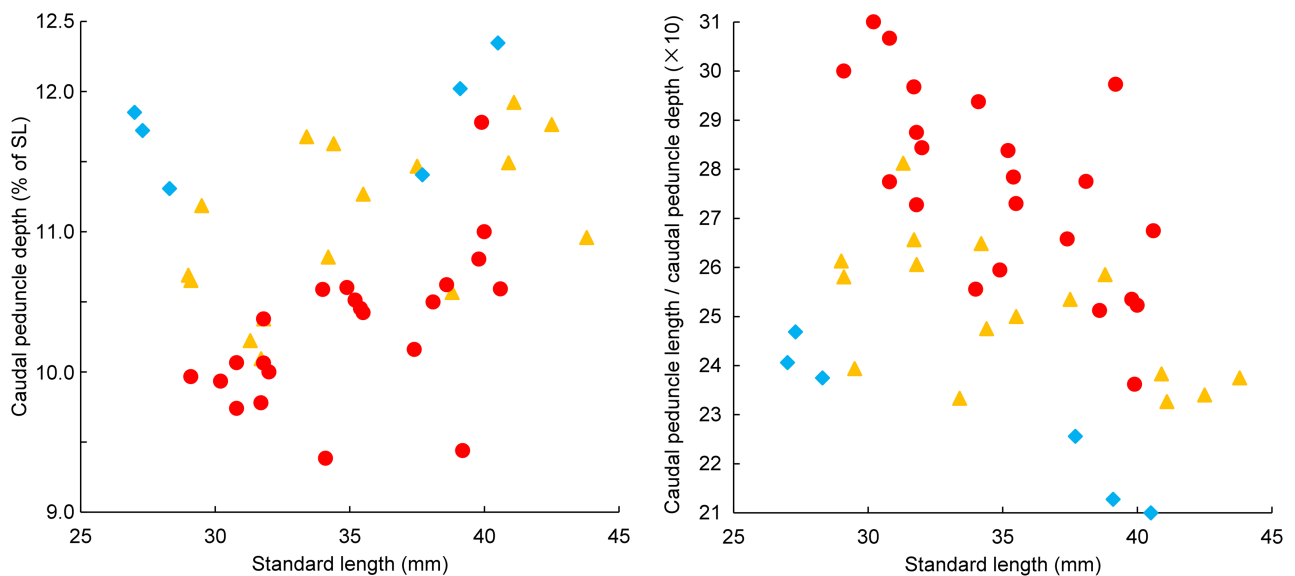


FIGURE 15. Relationships of caudal peduncle depth (% of standard length) and caudal peduncle length (/ caudal peduncle depth) to standard length in *Rhinogobius leavelli* from Da Nang City (orange triangles) and Thua Thien Hue Province (blue diamonds) in central Vietnam and Quang Ninh Province in northern Vietnam (red circles).

Rhinogobius similis Gill, 1859

(Figs. 2, 6i, j, 16–19; Tables 1, 2, 4–7, 9)

Rhinogobius similis Gill, 1859: 145 (original locality: Shimoda, Izu Province, Japan); Suzuki *et al.* 2016: 230 (redescription with neotype collected in Inouzawa River, Shimoda, Shizuoka Prefecture, Japan; published online in 2015 without page numbers).

Gobius giurinus Rutter, 1897: 86 (type locality: Swatow, coast of southeastern China).

Ctenogobius hadropterus Jordan & Snyder, 1901: 60 (type locality: Nagasaki, Japan).

Aboma tsinanensis Fowler, 1930: 30 (type locality: Da Ming Hu, Tsinan, China).

Ctenogobius lini Herre, 1934: 289 (type locality: Fu River at Wuchow, Kwangsi Province, China)

Ctenogobius giurinus: Wu & Ni 1986: 288 (Hainan, China); Luo 1989: 348 (Pearl River in Guangdong and Guangxi); Wu 1991: 480 (Guangdong).

Rhinogobius giurinus: Serov *et al.* 2006: 293; Wu & Zhong 2008: 594 (China).

Rhinogobius longipinnis Nguyen & Vo in Nguyen, 2005: 636 (type locality: Nui Coc Lake, Dai Tu District, Thai Nguyen Province, Vietnam).

Material examined. Twenty-three specimens from Da Nang City, and one specimen from Thua Thien Hue Province, Vietnam. It was not always possible to confidently distinguish the sex of smaller individuals (<40 mm SL).

HNUE-F 337–338, 1 male (49.4 mm SL) and 1 female (44.0 mm SL), a stream north of Kim Lien Station, Lien Chieu District, Da Nang City (16°08'50.5"N 108°06'34.6"E), 3 March 2016; HNUE-F 339–340, 1 female (43.0 mm SL) and 1 specimen of unknown sex (30.5 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District, Da Nang City (15°58'58"N 108°04'32"E), 4 March 2016; HNUE-F 341–342, 1 male (42.5 mm SL) and 1 female (44.3 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District, Da Nang City (16°00'01.3"N 108°03'33.2"E), 17 June 2019; NSMT-P 147883–147884, 1 male (58.8 mm SL) and 1 female (50.9 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District, Da Nang City (15°59'57.7"N 108°04'10.0"E), 1 March 2016; OISTICH 228–237, 2 males (47.4–67.1 mm SL), 4 females (45.2–62.4 mm SL), and 4 specimens of unknown sex (31.1–34.3 mm SL), Suoi Hoa, a tributary of Song Han, Hoa Vang District, Da Nang City (15°58'58"N 108°04'32"E), 4 March 2016; OISTICH 238, 1 male (58.0 mm SL), a stream north of Kim Lien Station, Lien Chieu District, Da Nang City (16°08'50.1"N 108°06'34.1"E), 25 January 2018; OISTICH 239, 1 male (50.5 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District, Da Nang City (15°59'58.1"N 108°04'12.7"E), 27 January 2018; OISTICH 240–241, 1 male (56.3 mm SL) and 1 female (45.2 mm SL), Suoi Mo, a tributary of Song Han, Hoa Vang District, Da Nang City (16°00'01.3"N 108°03'33.2"E), 17 June 2019; OISTICH 242, 1 female (41.1 mm SL), a stream in Son Tra Peninsula, Son Tra District, Da Nang City (16°06'09.2"N 108°16'58.4"E), 19 June 2019; OISTICH 243, 1 male (59.7 mm SL), a tributary of Song Huong flowing along the border between Binh Thanh and Huong Tho, Huong Tra District, Thua Thien Hue Province (16°20'22.4"N 107°32'35.1"E), 21 June 2019.

Description. Body nearly cylindrical anteriorly, and somewhat compressed posteriorly. Head depressed and eyes located dorsolaterally. Mouth terminal and oblique, with thick upper and lower lips. When mouth closed, anterior tip of upper jaw slightly protruding beyond lower jaw, or both jaws almost even. Mouth larger in males than females (upper-jaw length 12.6–17.6 vs. 10.9–12.2% of SL). Upper and lower jaws usually with 3–5 rows of conical teeth; those in outermost row enlarged and those in inner rows irregularly aligned. Mental flap on chin usually rectangular, trapezoidal (posterior end forming long side), or emarginate, and often with a small central projection. Anterior nostril short and tubular, posterior nostril a pore. Cephalic sensory pore system usually with B', C, D(S), E, F, H', K', and L' in oculoscapular canal and M', N, and O' in preopercular canal (Fig. 16), but one specimen lacking pore C on left side, one specimen lacking pore N on right side, and one specimen having two pores F on both left and right sides. Arrangement of cutaneous sensory papillae of head shown in Fig. 16. Cheek having several short transverse rows of papillae below eye and between two longitudinal rows across center of cheek. Vertebrae 10+16=26 (n=10; Table 1), P-V 3/II III I 0/9 (n=10).

First dorsal fin with six spines, and second dorsal fin with one spine and eight soft rays (Table 2). First and second dorsal-fin bases separated by a small interval (1.0–4.3% of SL). In females, first dorsal fin rounded, almost semi-circular; posterior tip of fin (tips of third to fifth spines) not reaching second dorsal-fin origin (n=4), just touching base of second dorsal-fin spine (n=1), exceeding base of second dorsal-fin spine, but not reaching base of first soft ray of second dorsal fin (n=1), or just touching base of first soft ray of second dorsal fin (n=1). In males, first dorsal fin rounded, but spines slightly more elongated than those on females; posterior tip of fin (tips of fourth to sixth spines) usually extending to, or exceeding second dorsal-fin origin and extending to base of second soft ray

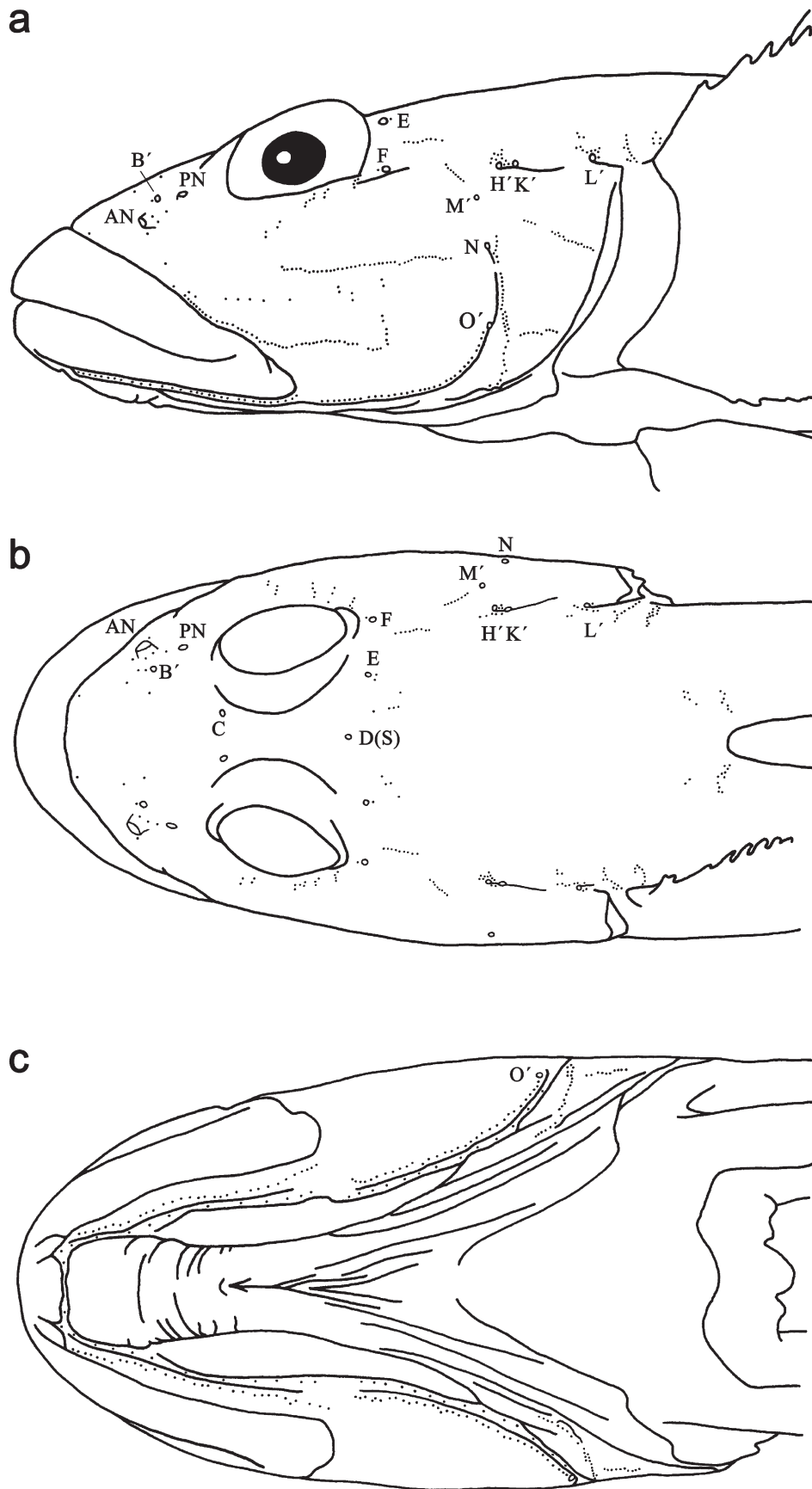


FIGURE 16. Arrangement of cephalic sensory pores and cutaneous sensory papillae in *Rhinogobius similis* (OISTICH 228). a, lateral view; b, dorsal view; c, ventral view. AN, anterior naris; PN, posterior naris.



FIGURE 17. *Rhinogobius similis* from Da Nang City (a, b) and Thua Thien Hue Province (c) immediately after fixation. a, OISTICH 240, male, 56.3 mm SL; b, OISTICH 241, female, 45.2 mm SL; c, OISTICH 243, male, 59.7 mm SL.

of second dorsal fin in two specimens. Anal fin with one spine and seven ($n=1$) or eight ($n=23$) soft rays (Table 2). Caudal fin with 17 segmented rays including 12 ($n=3$), 13 ($n=15$), 14 ($n=5$), or 15 ($n=1$) branched rays; posterior margin rounded. Males having larger second dorsal and anal fins than females (second dorsal-fin length 31.3–43.7 vs 26.0–30.0% and anal-fin length 26.4–38.5 vs 23.7–28.2% of SL; Fig. 2). Pectoral fin with 17–20 rays (mode 19 rays) (Table 4). Pelvic fin with one spine and five soft rays; pelvic fins joined together to form a cuplike disc with fleshy bilobed frenum.

Ctenoid scales covering lateral, dorsal, and ventral surfaces of body, except belly. Dorsal surface of nape and occipital region covered by cycloid and/or ctenoid scales; most or all of scales along predorsal midline cycloid usually in males, while more than half of them usually ctenoid in females and in small specimens of unknown sex; scaled area extending anteriorly to near posterior margin of eye in both males and females. Other regions on head naked. Belly and breast (pre-pelvic area) covered with cycloid scales. First and second dorsal-, and anal-fin bases covered with ctenoid scales, and a few small cycloid scales mixed in some specimens. A few cycloid scales also often mixed with ctenoid scales on flank behind pectoral fin. Proximal part of caudal fin covered with ctenoid scales and with a few cycloid scales. Presence of scales on pectoral-fin base unclear in many specimens (usually invisible

without staining with alizarin red; see Suzuki *et al.* 2016), but a few cycloid scales sometimes visible. Longitudinal scales 29–32, transverse scales nine or ten, transverse scales on caudal peduncle seven, and predorsal scales 8–12 (Tables 5–7).

Color in life and fresh (Figs. 17 and 18): in males, background of head and body grey or yellowish-brown, and whitish ventral side. Head with many reddish-brown dots and lines forming many nearly parallel stripes running diagonally upward from anterior to posterior parts. An indistinct broad blackish band sometimes connecting middle of upper lip and anteroventral margin of eye, and also connecting posteroventral margin of eye and lower part of opercle. Pectoral-fin base with a black blotch on its upper part, and a white, transverse band. Dark-brown markings forming indefinite, bands and blotches on lateral and dorsal sides of body, often irregularly placed and uncountable. Scales on sides of body edged with orange, and each scale having a light blue (lower part) or white (dorsal part) center.

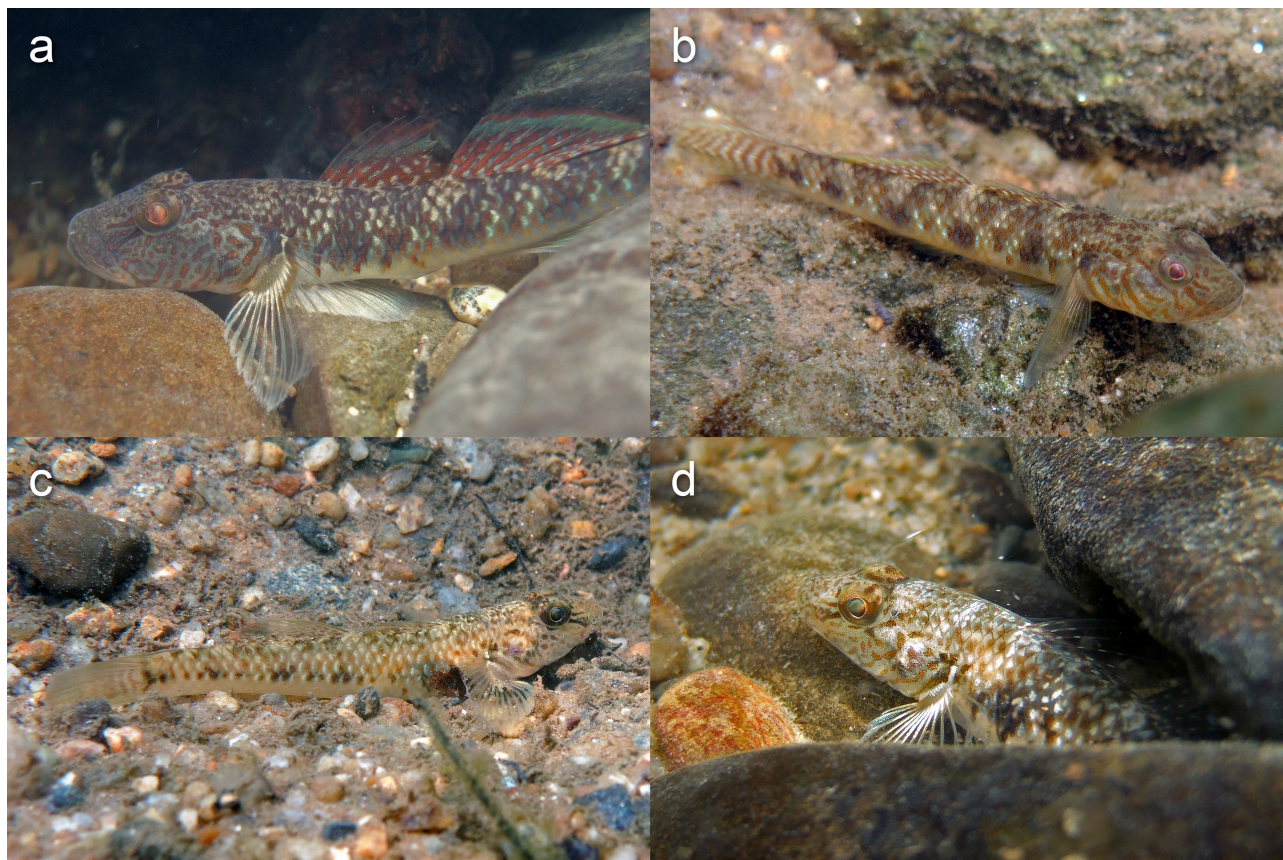


FIGURE 18. *In situ* underwater photographs of *Rhinogobius similis* in Da Nang City, Vietnam. a, male, 12 January 2013; b, male, 4 March 2016; c, female, 4 March 2016; d, female, 12 January 2013 (photo by K. Maeda).

First and second dorsal fins orange or reddish-brown with many bluish-white spots, and with an orange margin and a yellow submarginal stripe. Caudal fin with a vertical blackish band on its base; 6–10 orange or reddish-brown vertical bands on middle part from base to tip, and their intervals bluish-white; an orange stripe running along dorsal margin and a yellow stripe below orange stripe. Anal fin reddish- or yellowish-brown, with a dark grey or dark orange margin. Pectoral fin translucent or greyish, but its lower proximal part pale yellow with a reddish-brown band dorsally on pale-yellow part. Pelvic disc yellowish translucent or grey.

In females, markings and background color of head and body similar to those in males, but females usually appear lighter colored than males. Orange margin of scales on sides of body relatively inconspicuous. First and second dorsal fins translucent, with many reddish-brown and bluish-white spots alternately aligned along spines and soft-rays; distal parts reddish-brown translucent. Caudal fin similar to that of males, but without clear orange and yellow, dorsal stripes. Anal fin translucent with faint yellowish markings, and with dark-grey soft rays. Pectoral fin translucent, but its lower proximal part white, with a dorsal reddish-brown band. Pelvic disc yellowish translucent.

Color in preservative (Fig. 6i, j): background of head and body cream. Reddish-brown markings observed in life become dark brown. Orange, light blue, white, and yellow markings disappear, and those on fins become pale brown.

Remarks. Specimens from Da Nang have larger head length than those from northern Vietnam (in specimens larger than 40 mm SL, head length is 29.9–34.0 vs. 28.7–31.2% of SL), but smaller than those from Japan (vs. 32.1–35.5% of SL) (Fig. 19). Although coloration of specimens from central and northern Vietnam are similar (Figs. 9k, l and 17), these differ from Japanese populations. Vietnamese specimens usually lack the large black blotches on lateral side of the body, while Japanese specimens always have five, large black blotches along the lateral midline (Figs. 9m–p and 17). A yellow longitudinal stripe on the second dorsal fin of the males is thinner in Vietnamese than in Japanese specimens. The ventral surface of the head in females is often black in Japanese specimens, especially in gravid individuals, but none of the Vietnamese specimens showed this black color. *Ctenogobius hadropterus* Jordan & Snyder, 1901 is a synonym of *R. similis* and its holotype collected in Nagasaki, Japan before 1901, also has distinct lateral blotches (Fig. 20d).

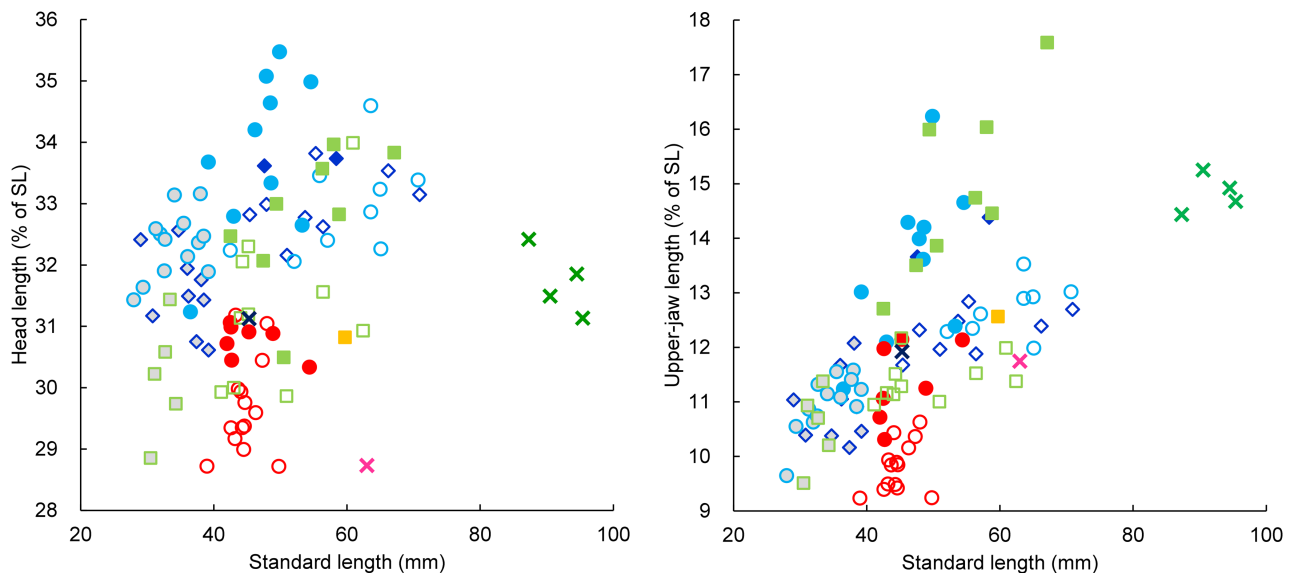


FIGURE 19. Relationships of head length and upper-jaw length to standard length (SL) in *Rhinogobius similis* collected from Da Nang City (light green squares) and Thua Thien Hue Province (orange square) in central Vietnam, Quang Ninh Province in northern Vietnam (red circles), Okinawa Island (light blue circles) and Izu Peninsula (deep blue diamonds) in Japan, holotype and paratypes of *Ctenogobius lini* Herre, 1934 from Wuzhou, China (deep green x), holotype of *Gobius giurinus* Rutter, 1897 from Shantou, China (pink x), and holotype of *Ctenogobius hadropterus* Jordan & Snyder, 1901 from Nagasaki, Japan (deep blue x). Solid symbols represent males, open symbols represent females, and those filled with grey represent specimens of unknown sex.

We did not observe fresh specimens of *R. similis* from China, but the type specimens of *Ctenogobius lini* Herre, 1934, collected from Wuzhou, China in 1934, retain the distinct markings on head and fins, but lack the lateral blotches on their body (Fig. 20a, b). In the holotype of *Gobius giurinus* Rutter, 1897, collected from Shantou, China before 1885, the presence of lateral blotches is unknown (because all markings are unclear although small melanophores are visible) (Fig. 20c), but the head is as small as in the specimens from northern Vietnam (Fig. 19). These observations suggest that morphology of specimens from China is similar to those from Vietnam, but they are significantly different from *R. similis* from Japan (including type locality of *R. similis*).

Rhinogobius similis has the widest distribution range among members of this genus, and it is found in continental regions spread across Korea, China from the northeast to south, and Vietnam, as well as on islands in Japan, Taiwan, and Hainan (Suzuki *et al.* 2016). Those from Vietnam could be a different species from *R. similis* in Japan, but since determining their taxonomic status requires a comprehensive comparison of specimens from a wider distribution range, as well as a review of all nominal species currently considered synonyms of *R. similis*, we tentatively identify our Vietnamese specimens here as *R. similis*, following Suzuki *et al.* (2016).

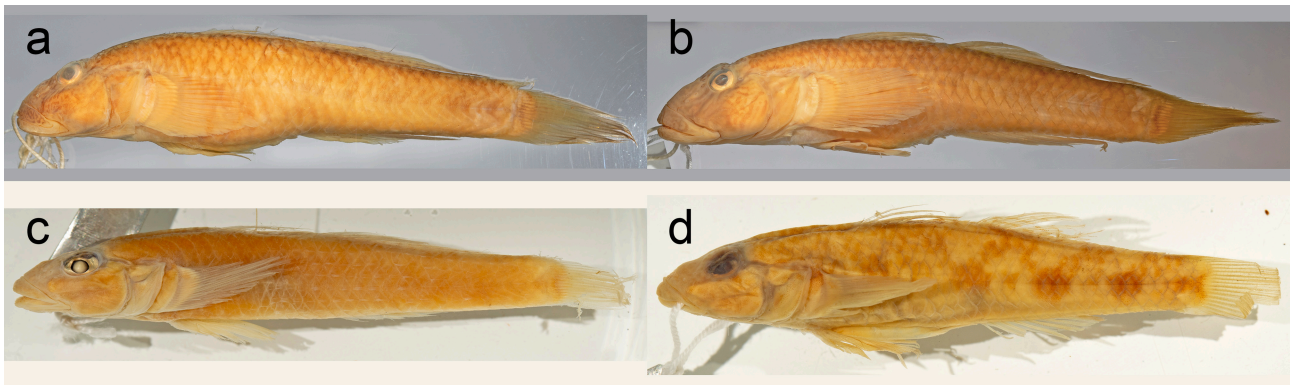


FIGURE 20. Type specimens of species currently considered synonyms of *Rhinogobius similis* Gill, 1859. a, b, CAS-SU 29089, possible types of *Ctenogobius lini* Herre, 1934 (a, 95.4 mm SL; b, 94.5 mm SL; one of them should be the holotype and the other is a paratype); c, CAS-SU 4990, holotype of *Gobius giurinus* Rutter, 1897 (63.0 mm SL); d, CAS-SU 6449, holotype of *Ctenogobius hadropterus* Jordan & Snyder, 1901 (45.3 mm SL).

Key to the species of *Rhinogobius* in Da Nang City and Thua Thien Hue Province, Vietnam

- 1 Predorsal scales extending anteriorly to near posterior margin of eyes; cheek with several short transverse rows of cutaneous sensory papillae, and reddish-brown dots and lines forming diagonal stripes running upward from anterior to posterior *R. similis*
- Predorsal scales not reaching posterior margin of preopercle or ending shortly anterior to it (not reaching close to eyes); cheek without transverse row of cutaneous sensory papillae, and without diagonal stripes, or with diagonal stripes directing downward from anterior to posterior 2
- 2 When mouth closed, anterior tip of lower jaw significantly protruding beyond upper jaw in larger male (>40 mm SL); pectoral fin usually with 19 rays; orange (male), reddish-brown, or grey (female) diagonally downward stripes on cheek *R. rong*
- Positions of anterior tips of lower and upper jaws approximately same, or upper jaw protrudes more anteriorly; pectoral fin with 18 or fewer rays (sometimes 19 in *R. leavelli*); cheek with three parallel, diagonally downward, reddish-brown or dusky-brown stripes (male of *R. nami*), or without diagonal stripes (other species) 3
- 3 Dark-brown vertical band at caudal-fin base often combined with larger dark-brown lateral blotch on caudal peduncle; opercular membrane, interopercle, and lower part of subopercle of male grey with many orange stripes running along margin of preopercle and opercle; first dorsal fin of male with 1–3 distinct black spots on proximal parts (not in middle) of membranes between anterior 2–4 spines; pectoral fin with 16–19 rays *R. leavelli*
- Black, vertical rectangular or elliptical spot at mid-base of caudal fin; opercular membrane, interopercle, and lower part of subopercle of male light bluish-grey with many red or orange spots; first dorsal fin of male with series of black or brown markings on middle parts of membranes between first to fifth spines (anterior one or two markings usually clear); pectoral fin usually with 14–16 rays 4
- 4 Five, longitudinal, reddish-brown or dusky-brown stripes (dotted lines) running on lateral and dorsal sides from trunk to caudal peduncle; three parallel, diagonally downward, reddish-brown or dusky-brown stripes on ventral part of cheek in male; number of vertebrae usually 26 *R. nami*
- Lateral and dorsal sides of body without longitudinal stripes; cheek without diagonal stripes; number of vertebrae usually 27 *R. taenigena*.

Discussion

Gobies (Gobiiformes) comprise a diverse order of ray-finned fishes, which currently includes more than 2000 species, with *Rhinogobius* being one of the speciose genera (Nelson *et al.* 2016). Within *Rhinogobius*, 94 species are currently recognized as valid, including the two new species described in this paper (Maeda *et al.* 2021; Suzuki *et al.* 2022; Chen *et al.* 2022a, 2022b; Wang & Chen 2022; this study). The islands of Japan and Taiwan, as well as continental Asia from the Yangtze basin in China to northern Vietnam are considered to be the hotspots for diversification of this genus. In the present study, five species were identified from central Vietnam, with three or four species distributed sympatrically in river basins in Da Nang City and Thua Thien Hue Province. This is comparable to the diversity we observed in rivers in Quang Ninh Province in northeastern Vietnam (five species in the Ba Che River and three species in the Tien Yen River; see comparative material). Thus, central Vietnam also has the great diversity of *Rhinogobius*, though a significant share of this diversity remained unknown until this study.

Three species, *R. rong*, *R. leavelli*, and *R. similis*, are distributed over a relatively wide area of the central Vietnamese coastal region, whereas two species, *R. taenigena* and *R. nami*, are distributed in the upper reaches of limited streams and rivers thus having important implications for the phylogeography of this genus in central Vietnam. *Rhinogobius taenigena* is distributed in eastward coastal drainages, as well as in the Mekong basin, and therefore it is likely that range expansions occurred beyond the boundary of these basins in the past. The direction of the expansion is unknown, but colonization from more diverse coastal rivers to the Mekong may be more likely.

Rhinogobius nami in Da Nang is morphologically similar to *R. sangenloensis* (from the upper reaches of the Wanquan River flowing to the southeast coast of Hainan Island) than to the species occurring in the Indochinese Peninsula and northern Vietnam. Today, Da Nang and Hainan Island are separated by the Gulf of Tonkin (more than 250 km), but this gulf is shallow and was probably largely exposed as land during the glacial period when sea levels were low (Voris 2001; Wetzel & Unverricht 2020). Both species are assumed to have diverged from a common ancestor that inhabited a region near the lower reaches of the ancient Red River, which flowed through the Gulf of Tonkin (around the present entrance to the gulf; Voris 2001) during the glacial period, and thus became isolated on both sides of the ocean because of the marine expansion.

In Japan, ecological traits such as egg size and migration pattern differ among species of *Rhinogobius*. For example, some small-egg spawners are amphidromous and their larvae grow in the sea, while some large-egg spawners stay in freshwater habitat throughout their lives (Kondo *et al.* 2013). Such changes of migration patterns have occurred independently in several lineages (Yamasaki *et al.* 2015, 2020). No such ecological or phylogenetic information is available for species occurring in central Vietnam. Future studies on the phylogeny, life history, and migration patterns of the Vietnamese species will provide new insights into their distribution and evolutionary histories.

Comparative material

Rhinogobius sulcatus from Quang Ninh Province in northern Vietnam: HNUE-F 323–328, 3 males (26.6–38.0 mm SL) and 3 females (30.0–37.6 mm SL), stream at Cam Pha, 30 January 2018; NSMT-P 147877, 147878, 1 male (30.6 mm SL) and 1 female (35.1 mm SL), stream at Cam Pha, 30 January 2018; OISTICH 175,176, 181–190, 5 males (26.8–37.4 mm SL; Fig. 9a) and 7 females (27.9–36.9 mm SL; Fig. 9b), stream at Cam Pha, 30 January 2018.

Rhinogobius boa from Quang Ninh Province in northern Vietnam: HNUE-F 313–316, 3 males (19.8–28.0 mm SL) and 1 female (26.8 mm SL), tributary of Ba Che River, 31 January 2018; NSMT-P 147873, 147874, 1 male (24.7 mm SL) and 1 female (26.9 mm SL), tributary of Ba Che River, 31 January 2018; OISTICH 157–161, 3 males (21.8–25.4 mm SL; Fig. 9c) and 2 females (21.7–28.0 mm SL; Fig. 9d), tributary of Ba Che River, 31 January 2018.

Rhinogobius virgigena from Quang Ninh Province in northern Vietnam: HNUE-F 309–312, 3 males (30.9–33.9 mm SL) and 1 female (33.4 mm SL), Tien Yen River, 26–27 February 2016; NSMT-P 147872, 1 male (36.1 mm SL; Fig. 9e), Tien Yen River, 1 February 2018; OISTICH 151, 152, 1 male (33.9 mm SL) and 1 female (35.1 mm SL), Tien Yen River, 26–27 February 2016; OISTICH 153, 1 female (30.3 mm SL), tributary of Ba Che River, 31 January 2018; OISTICH 154–156, 2 males (31.5–35.2 mm SL) and 1 female (33.7 mm SL; Fig. 9f), Tien Yen River, 1 February 2018.

Rhinogobius variolatus from Quang Ninh Province in northern Vietnam: HNUE-F 317–320, 3 males (22.8–24.9 mm SL) and 3 females (24.1–27.2 mm SL), tributary of Ba Che River, 31 January–2 February 2018; NSMT-P 147875, 147876, 1 male (30.2 mm SL) and 1 female (27.3 mm SL), Ba Che River, 2 February 2018; OISTICH 162, 1 female (22.0 mm SL), stream in Cong Hoa, Cam Pha, 30 January 2018; OISTICH 163–167, 2 males (24.5–24.6 mm SL) and 3 females (25.1–25.5 mm SL), tributary of Ba Che River, 31 January–2 February 2018; OISTICH 168–170, 2 males (31.4–33.2 mm SL; Fig. 9g) and 1 female (28.8 mm SL; Fig. 9h), Ba Che River, 2 February 2018.

Rhinogobius leavelli from Quang Ninh Province in northern Vietnam: HNUE-F 329–330, 1 male (30.8 mm SL) and 1 female (39.8 mm SL), Tien Yen River, 26–27 February 2016; HNUE-F 331–332, 1 male (39.2 mm SL) and 1 female (29.1 mm SL), stream at Cong Hoa, Cam Pha, 30 January 2018; NSMT-P 147879, 147880, 1 male (31.8 mm SL) and 1 female (38.6 mm SL), Tien Yen River, 26 February 2016; OISTICH 196–199, 2 males (34.0–34.9 mm SL) and 2 females (31.0–37.4 mm SL), Tien Yen River, 26–27 February 2016; OISTICH 200–206, 2 males (30.8–40.0 mm SL) and 5 females (30.2–39.9 mm SL), stream at Cong Hoa, Cam Pha, 30 January 2018; OISTICH

207, 1 male (40.6 mm SL), tributary of Ba Che River, 31 January 2018; OISTICH 208, 1 female (46.0 mm SL), Tien Yen River, 1 February 2018; OISTICH 209–212, 1 male (38.1 mm SL; Fig. 9i) and 3 females (31.7–35.4 mm SL; Fig. 9j), Ba Che River, 2 February 2018.

Rhinogobius similis from Quang Ninh Province in northern Vietnam: HNUE-F 333–336, 2 males (42.7–48.9 mm SL) and 2 females (42.6–43.7 mm SL), Tien Yen River, 27 February 2016; NSMT-P 147881, 147882, 1 male (45.3 mm SL) and 1 female (44.7 mm SL; Fig. 9l), Tien Yen River, 27 February 2016; OISTICH 213–221, 2 males (42.0–42.6 mm SL) and 7 females (43.2–48.0 mm SL), Tien Yen River, 27 February 2016; OISTICH 222–226, 1 male (54.4 mm SL; Fig. 9k) and 4 females (39.0–49.8 mm SL), Tien Yen River, 1 February 2018; OISTICH 227, 1 male (42.5 mm SL), Ba Che River, 2 February 2018.

Rhinogobius similis from Okinawa Island, Japan: OISTICH 1, 1 female (65.1 mm SL), Kunigami-son, 16 April 2022; OISTICH 2, 3, 2 females (57.1–63.6 mm SL; Fig. 9n), Nago-shi, 22 May 2022; OISTICH 4–6, 3 females (63.6–70.7 mm SL), Nago-shi, 12 February 2023; OISTICH 7, 1 male (53.3 mm SL), Kunigami-son, 11 March 2023; URM-P 48983, 48984, 2 males (46.2–49.9 mm SL), Uruma-shi, 5 February 2015; URM-P 48996, 489967, 2 males (48.5–54.6 mm SL), Nago-shi, 18 February 2015; URM-P 49122, 49124–49133, 49138, 49139, 49142, 49147–49149, 4, males (39.2–48.6 mm SL; Fig. 9m), 3 females (39.2–55.9 mm SL), 10 specimens of unknown sex (31.3–38.5 mm SL), Nago-shi, 6 April 2015; URM-P 49150–49153, 1 male (36.5 mm SL), 1 female (52.1 mm SL), 2 specimens of unknown sex (28.0–29.4 mm SL), Ogimi-son, 16 April 2015.

Rhinogobius similis from Izu Peninsula, Shizuoka, Japan: OISTICH 316–334, 2 males (47.6–58.4 mm SL; Fig. 9o), 8 females (45.4–70.9 mm SL; Fig. 9p), 9 specimens of unknown sex (29.0–39.2 mm SL), Inouzawa-gawa (type locality of *R. similis* Gill, 1859), Shimoda-shi, 10 June 2023.

Rhinogobius similis from Nagasaki, Japan: CAS-SU 6449, holotype of *Ctenogobius hadropterus* Jordan & Snyder, 1901 (45.3 mm SL; Fig. 20d), Nagasaki, Hizen (Nagasaki Prefecture).

Rhinogobius similis from China: CAS-SU 4990, holotype of *Gobius giurinus* Rutter, 1897 (63.0 mm SL; Fig. 20c), Swatow (Shantou), Guangdong, collected prior to 1885; CAS-SU 29089, holotype and 3 paratypes of *Ctenogobius lini* Herre, 1934 (87.3, 90.5, 94.5 and 95.4 mm SL; one of the larger two specimens should be the holotype and the others are paratypes; Fig. 20a, b), Fu River, Wuchow (Wuzhou), Guangxi, 12 February 1934.

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