

## THREE NEW FRESHWATER GOBIES OF THE GENUS *RHINOGOBIUS* (TELEOSTEI: GOBIIDAE) FROM NORTHEASTERN LAOS

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**ABSTRACT.** – Three new gobiid fishes of genus *Rhinogobius* Gill, 1859, were collected from the river basins running into the Gulf of Tonkin in northeastern Laos. These new species, *R. milleri*, *R. nammaensis*, and *R. vermiculatus*, are closely related to *R. taenigena* Chen, Kottelat et Miller, 1999; *R. mekongianus* (Pellegrin et Fang, 1940); and *R. albimaculatus* Chen, Kottelat et Miller, 1999 respectively in the tributaries of Mekong basin. They can, however, be distinguished by specific combinations of meristic features, shapes of first dorsal fin and colouration patterns.

**KEY WORDS.** – Gobiidae, *Rhinogobius*, Laos, Vietnam.

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### INTRODUCTION

The Asiatic freshwater goby genus *Rhinogobius* Gill, 1859, is widely distributed on some islands of the West Pacific including Japan (Masuda et al., 1984; Kawanabe & Mizuno, 1989; Akihito et al., 1993), Taiwan (Aonuma & Chen, 1996; Chen & Shao, 1996; Lee & Chang, 1996; Chen et al., 1998), Hainan (Wu & Ni, 1986; Chen et al., 1999), Philippines (Herre, 1927), and also in continental Asia in Russia, Korea, China, Vietnam, Laos, Cambodia, and Thailand (Chu & Wu, 1965; Kottelat, 1989; Chen & Miller, 1998; Chen, Kottelat & Miller, 1999; Chen, Wu & Shao, 1999; Chen, Yang & Chen, 1999; Chen & Kottelat, 2000). The life histories of species of *Rhinogobius* indicate that the genus includes both amphidromous and landlocked species (Mizuno, 1960; Mizuno & Goto, 1987; Iguchi & Goto, 1991; Akihito et al., 1993). We estimate that at least 70 species are known in East and Southeast Asia and some of them still await formal description.

There is almost no published information on the genus *Rhinogobius* in the basins draining toward the Gulf of Tonkin in Vietnam and northern Laos. The only exception is Mai (1978) who reported one species of *Rhinogobius* (*R. leavelli* (Herre, 1935)) from Vietnam. *Rhinogobius leavelli* is a valid member of the genus *Rhinogobius*, which is also widely distributed in southern China (Chen, in prep.). Chen, Kottelat & Miller (1999) and Chen & Kottelat (2000) recently

reported five species of *Rhinogobius* from the Mekong basin in Thailand and Laos. These five species belong to a group with a relatively high vertebral count (27-28) (Chen & Kottelat, 2000). Surveys conducted by MK (Kottelat, 2001a, b) in the rivers of northeastern Laos draining to the Gulf of Tonkin yielded *Rhinogobius leavelli* with 26 vertebrae (which belongs to a group of species with low vertebral count) but also three species of the group with high vertebral number. Kottelat (2001a) recorded *R. honghensis*, *R. duospilus*, *R. leavelli*, *R. giurinus* and 5 unnamed species from northern Vietnam. He also listed the 3 species described below by the same names, these are nonima nuda in that book. Kottelat (2001b) used the same three names accompanied by diagnoses, but the names are not available from that work as there is a disclaimer (see ICZN art. 8.3). These three species are new to science and were described below.

### MATERIALS AND METHODS

Morphometric methods follow Miller (1988) and meristic methods follow Chen & Shao (1996) and Chen et al. (1999). Terminology of cephalic sensory canals and free neuromast organ (sensory papillae) is from Miller (1986) and Wongrat & Miller (1991) based on Sanzo (1911). Meristic abbreviations: A, anal; C, caudal; D1, D2, 1st and 2nd dorsal fins; C, caudal fin; LR, longitudinal scale series; P, pectoral fin; PreD, predorsal scales; SDP, scale series from origin of

Table 1. Morphometry of three species of *Rhinogobius* species from northeastern Laos.

Species	<i>R. milleri</i>		<i>R. nammaensis</i>		<i>R. vermiculatus</i>	
	Male	Female	Male	Female	Male	Female
Sex						
No. specimens	4	6	6	10	5	8
(% in SL)						
Caudal length	23.4-26.4(24.8)	22.4-26.6(24.4)	21.5-23.7(22.8)	22.3-25.7(24.2)	21.9-24.8(22.8)	21.2-23.2(22.2)
Head length	29.5-31.6(30.6)	27.8-29.7(28.9)	29.3-31.2(30.3)	27.1-30.3(29.0)	29.4-31.3(30.4)	27.2-29.6(28.3)
Predorsal length	38.5-40.5(39.5)	37.2-38.3(37.7)	36.9-39.4(38.2)	35.6-39.2(37.7)	36.9-38.2(37.8)	36.9-39.0(37.6)
Snout to 2nd dorsal origin	56.8-58.9(58.1)	54.9-59.1(57.7)	56.2-59.3(57.8)	56.1-60.8(58.1)	56.4-58.7(57.5)	57.0-60.5(58.2)
Snout to anal origin	59.5-63.8(62.3)	57.6-64.6(61.6)	58.6-62.4(60.8)	58.5-63.5(61.4)	58.3-64.0(61.0)	60.3-64.9(62.5)
Snout to anus	56.9-59.1(58.2)	52.5-58.8(56.7)	56.0-58.8(57.8)	55.7-60.2(58.0)	53.8-58.1(56.6)	53.9-59.7(57.2)
Prepelvic length	28.4-32.0(29.6)	25.8-28.2(27.0)	28.0-31.8(29.3)	26.5-29.5(28.3)	29.3-33.8(30.7)	27.6-29.9(28.4)
Caudal peduncle length	23.9-27.4(25.5)	23.7-28.9(25.9)	26.0-27.8(26.9)	25.4-29.6(27.6)	25.0-26.4(25.7)	23.2-26.8(24.7)
Caudal peduncle depth	11.3-12.1(11.6)	11.1-11.7(11.4)	11.6-12.2(11.9)	10.9-12.9(11.9)	9.2-11.0(10.3)	9.8-11.0(10.4)
1st dorsal fin base	16.4-17.6(17.0)	14.8-17.9(17.0)	15.8-18.4(17.1)	15.1-19.5(17.3)	15.5-17.2(16.2)	15.9-17.3(16.8)
2nd dorsal fin base	17.3-19.9(18.8)	17.7-19.8(18.5)	16.4-19.7(18.4)	15.1-20.7(18.6)	17.9-20.8(18.7)	17.9-20.5(19.0)
Anal fin base	13.4-15.4(14.7)	12.8-16.7(14.6)	13.7-16.7(14.9)	12.6-16.8(14.4)	13.7-16.1(15.0)	12.8-15.2(14.1)
Pectoral fin length	25.0-25.7(25.3)	24.4-29.2(26.7)	24.5-27.8(25.8)	23.2-27.5(25.4)	23.9-26.0(25.0)	23.5-25.4(24.5)
Pelvic fin length	16.4-19.7(18.6)	17.5-21.7(18.8)	16.6-18.2(17.4)	17.1-19.7(18.5)	15.4-17.5(16.3)	15.1-17.2(16.2)
Body depth of pelvic fin origin	16.5-18.3(17.3)	15.6-16.8(16.2)	17.6-19.0(18.2)	17.5-20.6(18.8)	14.0-16.9(15.6)	15.2-16.5(15.9)
Body depth of anal fin origin	15.4-16.9(16.1)	15.9-16.8(16.1)	16.7-17.9(17.3)	17.0-19.2(18.1)	13.0-16.3(14.4)	14.3-16.6(15.4)
Body width of anal origin	11.4-13.6(12.3)	10.8-12.2(11.7)	13.0-13.8(13.3)	11.3-14.5(13.3)	10.0-13.7(11.8)	11.5-13.4(12.7)
Pelvic fin origin to anus	28.0-31.1(29.5)	25.9-33.7(29.8)	28.1-30.5(29.4)	29.5-33.1(30.7)	23.5-28.4(26.0)	27.7-32.4(29.7)
(% in head length)						
Snout length	27.6-33.3(30.4)	27.5-31.4(28.7)	26.7-30.5(28.4)	24.5-30.3(27.3)	28.0-35.2(31.6)	27.6-31.1(29.4)
Eye diameter	18.9-21.6(20.0)	19.0-22.2(21.1)	19.7-23.3(21.2)	19.7-25.1(22.6)	15.8-22.6(19.3)	19.7-23.7(21.2)
Cheek depth	29.0-36.5(31.8)	26.6-34.5(28.6)	23.2-28.3(26.5)	22.9-29.1(25.7)	24.1-28.7(25.7)	25.8-30.8(27.4)
Postorbital length	51.5-57.0(53.0)	49.4-55.6(52.4)	47.3-53.3(49.0)	45.8-52.4(48.6)	48.3-58.1(52.2)	48.6-52.3(50.8)
Head width in maximum	64.5-69.0(67.4)	59.1-70.0(63.7)	61.3-70.4(65.2)	60.3-76.5(66.6)	65.1-75.5(69.2)	64.3-72.2(68.4)
Head width in upper gill opening	46.0-53.3(48.3)	45.4-50.5(48.3)	46.1-53.3(49.6)	49.7-58.7(52.7)	42.3-47.9(45.0)	46.8-55.5(50.9)
Bony interorbital width	6.9- 8.2(7.2)	6.2- 8.6(7.6)	8.9-10.9(9.5)	8.5-11.9(10.3)	7.0- 9.4(7.9)	6.7-11.2(8.3)
Fleshy interorbital width	19.9-25.5(22.9)	19.5-25.0(22.0)	19.9-28.6(19.9)	21.4-28.0(24.2)	17.2-20.6(19.2)	19.5-24.2(21.7)
Lower jaw length	37.9-43.8(40.8)	31.2-38.3(33.9)	34.4-38.6(37.6)	32.5-36.8(34.3)	33.1-46.8(40.4)	29.6-34.0(32.0)
(% in caudal peduncle length)						
Caudal peduncle depth	42.6-50.6(45.7)	39.5-48.5(44.2)	41.3-45.3(44.2)	39.6-47.5(43.2)	36.3-43.3(40.2)	39.0-47.4(42.0)
(% in pelvic fin origin to anus)						
Pelvic fin length	56.5-67.2(62.9)	52.3-83.5(64.0)	56.2-61.8(59.1)	53.6-66.2(60.3)	55.9-67.8(63.0)	50.4-58.6(54.7)

Note: Value in brackets is average.

1st dorsal fin to upper pectoral origin; TR, transverse scale series; V, pelvic fin; VC, vertebral count. All lengths are standard length (SL). The type specimens and comparative materials are deposited in the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC); Living Aquatic Resources Research Institute, Vientiane (LARReC); National Museum of Marine Biology & Aquarium, Pingtung (NMMBA); and the collection of M. Kottelat, Cornol (CMK). Comparative material is listed in Chen, Kottelat & Miller (1999) and Chen & Kottelat (2000).

## SYSTEMATICS

### *Rhinogobius* Gill, 1859

*Rhinogobius* Gill, 1859: 145. (type species: *Rhinogobius similis* Gill, 1859).

*Tukugobius* Herre, 1927: 119 (type species: *Rhinogobius carpenteri* Seale, 1909).

### *Rhinogobius milleri*, new species

(Figs. 1, 4, 7)

**Material examined.** – Holotype – ZRC 46581, 39.8 mm SL, Laos: Xiangkhouang Prov., Nam Kuang (a tributary of Nam Mat), about 2 km SW of Ban Lao, 19° 38'35''N 103° 28'52''E, coll. M. Kottelat et al., 2 May.1999.

Paratypes – ZRC 47674, 4 specimens, LARReC uncat., 4 specimens, CMK 15249, 12 specimens, 14.1 – 45.8 mm SL, data same as holotype. NMMBA uncat., 4 specimens, CMK 15256, 16 specimens, 22.0 – 33.8 mm SL, Laos: Xiangkhouang Prov., Nam Tian, about 2 km upstream of its confluence with Nam Mat, 19° 34'40''N 103° 41'12''E, coll. M. Kottelat et al., 2 May.1999. CMK 15272, 5 specimens, 27.3 – 45.7 mm SL, Laos: Xiangkhouang Prov., Nam Ken, a small creek making the border with Vietnam at Ban Xayden, 19° 28'19''N 104° 5'4''E, coll. M. Kottelat et al., 3 May.1999. CMK 15283, 24 specimens, 12.9 – 30.1 mm SL, Laos: Xiangkhouang Prov., Nam Mat about 1 km East of Ban Phathang, 19° 36'33''N 103° 42'10''E, coll. M. Kottelat et al., 4 May.1999.

**Diagnosis.** – *Rhinogobius milleri* can be distinguished from all other species of the genus by the unique combination of

Table 2. Comparison of frequency distribution of meristic features of eight *Rhinogobius* species from Laos.

	D1				D2						A					P					
	V	VI	VII	$\bar{X}$	I/6	I/7	I/8	I/9	I/10	$\bar{X}$	I/6	I/7	I/8	I/9	$\bar{X}$	14	15	16	17	18	$\bar{X}$
<i>R. milleri</i> , new species	-	10	-	6.0	-	-	10	-	-	8.0	-	10	-	-	7.0	-	3	7	-	-	15.7
<i>R. nanmaensis</i> , new species	-	10	-	6.0	-	1	6	3	-	8.2	-	5	5	-	7.5	-	1	6	2	1	16.3
<i>R. vermiculatus</i> , new species	1	17	1	6.0	-	-	2	17	-	8.9	-	19	-	-	7.0	-	2	13	2	2	16.2
<i>R. albimaculatus</i>	-	22	-	6.0	-	-	-	18	4	9.2	-	22	-	-	7.0	-	15	7	-	-	15.3
<i>R. lineatus</i>	-	4	-	6.0	-	-	-	4	-	9.0	-	4	-	-	7.0	-	1	3	-	-	15.8
<i>R. maculicervix</i>	-	16	-	6.0	-	-	-	16	-	9.0	-	-	14	2	8.1	-	6	9	1	-	15.7
<i>R. mekongianus</i>	-	22	1	6.0	-	2	20	1	-	8.0	3	19	1	-	6.9	-	6	14	3	-	15.9
<i>R. taenigena</i>	-	2	-	6.0	-	-	1	1	-	8.5	-	-	2	-	8.0	-	1	1	-	-	15.5

	LR				TR				PreD										SDP				VC												
	28	29	30	31	32	33	34	$\bar{X}$	8	9	10	11	$\bar{X}$	0	1	2	3	4	5	6	7	8	9	10	11	$\bar{X}$	5	6	7	8	$\bar{X}$	27	28	$\bar{X}$	
<i>R. milleri</i> , new species	2	4	3	1	-	-	-	24.3	3	6	1	-	8.8	-	-	-	-	-	-	-	-	-	3	6	1	-	8.8	-	3	5	2	6.9	10	-	27.0
<i>R. nanmaensis</i> , new species	-	-	1	3	6	-	-	31.5	-	1	5	4	10.3	-	-	-	-	1	7	2	-	-	-	-	-	6.1	-	4	6	-	6.6	-	15	28.0	
<i>R. vermiculatus</i> , new species	-	-	-	-	9	7	3	32.7	-	11	8	-	9.4	-	-	-	-	-	1	5	4	6	3	9.3	-	4	15	-	6.8	-	10	28.0			
<i>R. albimaculatus</i>	-	5	10	7	-	-	-	30.1	1	16	5	-	9.2	-	-	-	-	1	4	3	4	9	1	8.9	-	4	16	2	6.9	-	22	28.0			
<i>R. lineatus</i>	-	1	1	-	2	-	-	30.8	-	1	3	-	9.8	-	-	-	-	3	1	-	-	-	-	6.3	-	3	1	-	6.3	-	4	28.0			
<i>R. maculicervix</i>	-	2	7	6	1	-	-	30.4	-	1	11	4	10.2	1	3	5	8	-	-	-	-	-	-	2.3	-	2	14	-	6.9	-	10	28.0			
<i>R. mekongianus</i>	-	11	10	2	-	-	-	30.1	12	11	-	-	8.5	-	-	-	1	16	6	-	-	-	-	5.2	-	20	3	-	6.1	-	15	28.0			
<i>R. taenigena</i>	-	2	-	-	-	-	-	29.0	-	2	-	-	9.0	-	-	-	-	-	-	-	-	-	1	1	10.5	1	1	-	5.5	1	-	27.0			

Note. Data of 5 nominal species of *Rhinogobius* from Chen, Kottelat & Miller (1999); Chen & Kottelat (2000).

the following characters: second dorsal fin rays modally I/8; anal fin rays I/7; pectoral fin rays modally 16; longitudinal scale series 28-31; predorsal scales 6-10; vertebral counts 10+ 17 = 27; first dorsal fin with rays IV and V longest; body with 8 somewhat squarish dark brown blotches and wider than interspaces; lower edge of cheek with three brownish black spots and branchiostegal membrane with 35 - 50 small, rounded white spots in male; and caudal fin base with vertical black bar.

**Description.** – Body cylindrical anteriorly and compressed posteriorly. Body proportions in Table 1. Head moderately large; quite depressed in male. Eye large, dorsolateral. Snout pointed. Cheek very fleshy. Lips thick. Mouth oblique, rear edge reaching vertical through middle of orbit. Both jaws with 3-4 rows of conical teeth, and outer rows enlarged. Tongue margin rounded. Anterior nostril a short tube and posterior one a round hole. Gill-opening extending near edge of preopercle. Isthmus broad. 10 + 17 = 27 vertebrae.

**Fins.** D1 VI; D2 I/8; A I/7; P 15-16 (mode 16); V I/5 + I/5 (frequency distribution in Table 2). D1 IV and V spinous rays longest, with rear tip extending to base of 2nd branched rays of D2 in male, not extending to origin of D2 in female. Origin of A inserted below origin of 3rd branched ray of D2. P large and oblong, its rear margin extending to vertical through anus in male, never reaching this vertical in female. V disc rounded, spinous rays with pointed membranous lobe. C elliptical, rear edge rounded.

**Scales.** Body with moderately large ctenoid scales, anterior predorsal area naked; posterior predorsal region and belly cycloid; scales in longitudinal series 28-31 (mode 29); transverse series 8-10 (mode 9); predorsal median series 8-10 (mode 8-9); series between 1st dorsal and upper pectoral fin origin 6-8 (mode 7) (frequency distribution in Table 2). Head including opercle, preopercle, and prepelvic areas

naked. Predorsal squamation with trifurcate anterior edge, anterior tip of predorsal middle squamation reaching about vertical of middle region of posterior oculoscapular canal, lateral squamation extending to gap between two oculoscapular canals.

**Head lateral-line system.** Canals. Nasal extension of anterior oculoscapular canal with terminal pores  $\sigma$  slightly in front of posterior nostril. Anterior interorbital sections of oculoscapular canal separated, with paired pores  $\lambda$ . A single pore  $k$  in posterior interorbital region. Pore  $\omega$  present at posterior dorsal edge of eye. Gap between anterior and posterior oculoscapular canals smaller than length of posterior oculoscapular canal. Preopercular canal present with pores  $r$ ,  $\theta$  and  $\epsilon$ . Sensory papillae. Row  $a$  extending to vertical through middle of orbit. Length of row  $b$  about equal to orbit. Rows  $c$ ,  $d$  long, but not reaching vertical of pore  $\alpha$ . A single  $cp$  papilla. Row  $f$  paired. Opercular rows  $ot$  and  $oi$  slightly connected. Other details in Fig.4.

**Colouration in alcohol.** – Head and body yellowish brown in female and brown in male. Body always with 8 somewhat square blackish brown blotches. Blotches wider than interspaces. Four discontinuous, longitudinal dark brown lines on lateral side. Belly yellowish to light grey. Nape with dark brown bars and stripes. C base with a conspicuous short, black bar. Dorsal side of snout with a pair of blackish brown lines united at tip of snout. A square greyish brown mark below eye. A longitudinal brown line on middle of cheek. Lower part of cheek with irregular tiny brown dots, and lower edge of cheek with three rounded, brownish black spots in male. Branchiostegal membrane grey with 35 - 50 densely-set, small, rounded white spots (reddish orange or red in life) in male; membrane uniform dark grey and unmarked in female.

First dorsal fin grey with light margin and black marks in

front of 3rd spinous ray in male, yellowish with 2-3 rows of brown spots in female. Second dorsal fin grey with 2-3 longitudinal rows of brownish black spots in male, yellowish white with 3-4 longitudinal rows of dark brown spots in female. Pectoral fin grey with radiating black lines on membrane, a black spot slightly above middle region of base, and usually another black spot on lower basal part in adult male. Pectoral fin yellowish with a black spot above middle of base in female. A semicircular yellowish grey region near pectoral fin base in both sexes. Membrane of anal fin grey to dark grey with narrow white margin. Caudal fin pale or yellowish with 3-5 vertical rows of dark brown spots in male and in some larger males with many radiating greyish brown lines on membranes; and with 5-6 rows of blackish brown spots in female. Pelvic fin dark grey in male and yellowish in female.

**Distribution.** – *Rhinogobius milleri* has only been found in small forest creeks of the Nam Mat and Nam Mo basins in Laos. Its distribution range is expected to extend into Vietnam and possibly to other basins draining to the Gulf of Tonkin.

**Etymology.** – The new species is named for Prof. Peter J. Miller in appreciation for his very kind support to the studies and researches of the first author.

**Remarks.** – Among the species recorded from the adjacent river basins, *R. milleri* seems to be most similar to *R. taenigena* Chen, Kottelat & Miller, 1999, based on similar scale counts and coloration pattern of cheek consisting of a greyish longitudinal stripe. However, it can be distinguished from *R. taenigena* by the following combination of characters: fewer anal fin rays (I/7 vs. I/8); lower margin of cheek always with 3 black spots in male (vs. 4); and branchiostegal membrane with more round spots in male (35-50 vs. 23-25).

### *Rhinogobius nammaensis*, new species

(Figs. 2, 5, 8)

**Material examined.** – Holotype – ZRC 46582, 43.0 mm SL, Laos: Houaphan Prov., Nam Et upstream of Muang Et, Nam Ma basin, 20° 48'25''N 104° 00'18''E, coll. M. Kottelat et al., 8 May. 1999.

Paratypes – ZRC 47675, 10 specimens, LARReC, uncat., 10 specimens, NMMBA uncat., 10 specimens, CMK 15370, 102 specimens, 20.3 – 40.8 mm SL, same data as holotype.

**Diagnosis.** – *Rhinogobius nammaensis* is distinguished from all other species of the genus by combination of the following characters: second dorsal fin rays modally I/8; anal fin rays I/7-8; pectoral fin rays modally 15; longitudinal scale series modally 32; vertebral count 11 + 17 = 28; first dorsal fin with rays III and IV longest; body with 6-7 lateral greyish to dark brown blotches; lateral side with 4-5 longitudinal rows of orange brown spots in male; cheek and opercle with 30-40 small, rounded brown spots and branchiostegal membrane with about 20 rounded light yellow spots in male.

**Description.** – Body cylindrical anteriorly and compressed posteriorly. Body proportions in Table 1. Head moderately large, somewhat depressed in male. Eye large, dorsolateral. Snout in male slightly longer than in female. Bony interorbital narrow. Cheek fleshy in male. Lips thick. Mouth oblique, its rear edge extending to vertical through middle of orbit in male, merely reaching vertical through anterior margin of pupil in female. Both jaws with 3-4 rows of conical teeth, outer rows enlarged. Tongue tip rounded. Anterior nostril a short tube, posterior nostril a round hole. Gill-opening wide, extending downward and slightly crossing the rear vertical of preopercle. Isthmus broad. 11 + 17 = 28 vertebrae (in 15 specimens).

Fins. D1 VI, D2 I/7-9 (mode 8); A I/7-8; P 15-18 (mode 16); V I/5 + I/5 (frequency distribution in Table 2). D1 rays III and IV longest, rear tip just reaching origin of D2 when depressed in male, not extending to origin of D2 in female. D2 slightly higher than D1. D2 and A rear tips far away from C base when depressed. A origin inserted below vertical between 2nd and 3rd branched rays of D2. P oblong, rear tip extending to vertical of posterior end of D1, not reaching vertical of anus. V disc rounded, spinous rays with pointed membranous lobe. C elliptical, rear margin rounded.

Scales. Lateral trunk with moderately large ctenoid scales, anterior predorsal region naked; middle belly cycloid; scales in longitudinal series 30-32 (mode 32); transverse series 9-11 (mode 10-11); predorsal median series 5-7 (mode 6); series between 1st dorsal and upper pectoral fin origin 6-7 (frequency distribution in Table 2). Head including opercle, prepectoral and prepelvic areas naked. Predorsal squamation with bifurcate anterior edge, anterior margin of predorsal middle squamation reaching vertical of pore  $\tau$ , lateral squamation extending anteriorly beyond vertical through middle of posterior oculoscapular canal.

Head lateral-line system. Canals. Nasal extension of anterior oculoscapular canal with terminal pores  $\sigma$  in front of posterior nostril. Anterior interorbital sections of oculoscapular canal separated, with paired pore  $\lambda$ . Pore  $\omega$  present at posterior edge of eye. Posterior orbital section of anterior oculoscapular canal with pore  $\alpha$ , and terminal pore  $\rho$  but no pore  $\beta$ ; posterior oculoscapular canal present (with pores  $\theta$  and  $\tau$ ), gap between two oculoscapular canals about half of length of posterior oculoscapular canal. Preopercular canal present, with pores  $r$ ,  $\delta$  and  $\epsilon$ . Sensory papillae. Row  $a$  extending to vertical through middle of orbit. Length of row  $b$  shorter than orbit. Rows  $c$ ,  $d$  long, but not reaching to vertical of pore  $a$ . A single  $cp$  papilla. Row  $f$  paired. Opercular rows  $ot$  and  $oi$  slightly connected. Other details in Fig. 5.

**Colouration in alcohol.** – Head and body yellowish brown or brown, body with 6-7 deep greyish to blackish brown blotches, more distinct and darker in female. Body with 4-5 longitudinal rows of densely arranged brown spots in male, no such regularly-set rows of spots in female. Ventral side light yellow. Nape with irregularly deep or blackish brown marks. Dorsal side of snout with a V-shape dark brown stripe.

Blotches sometimes irregularly marmorated or as a reticulated pattern in female. Cheek and opercle with 30-40 small, rounded brown spots in male, which size about half of pupil, and with several tiny irregular dark brown bars in female. Branchiostegal membrane greyish, in male with 15-25 rounded light yellow spots (which might have been orange when fresh) and size modally about equal to pupil; membrane unmarked in female.

First dorsal fin grey with 2 black spots on middle of fin membrane before 3rd rays and basal half with 2 rows of dark spots in male; first dorsal fin yellowish with 3-4 rows of dark brown spots in female. Second dorsal fin with 4 longitudinal rows of dark brown spots and a narrow white edge. Anal fin grey and darker in distal half, with narrow white edge. Pectoral fin base with cluster of dark spots in upper part and a vertical row of spots at base in male, with a deep black spot in upper half in female. Caudal fin pale with 4-6 vertical rows of dark greyish brown spots. Pelvic fin pale and darker in basal part.

**Distribution.** – *Rhinogobius nammaensis* is presently known from the Nam Ma basin, in northeastern Laos, where it occurs in a variety of habitats from small forest streams to the main Nam Ma river, over stony substrate, in moderate current.

**Etymology.** – Named for the Nam Ma basin.

**Remarks.** – *Rhinogobius nammaensis* is very similar to *R. mekongianus* (Pellegrin & Fang) from the Mekong basin based on the similarly spotted cheek and similar fin-ray counts. However, it is distinguished from *R. mekongianus* by the following features: slightly higher counts of longitudinal scale rows (mode 32 vs. 29-30); length of row *b* shorter; smaller cheek spots in male; and lateral body lacking small rounded dark spots (except for the large blackish blotches) in female (vs. always with several longitudinal rows of dark spots).

### ***Rhinogobius vermiculatus*, new species**

(Figs. 3, 6, 9)

**Material examined.** – Holotype – ZRC 46583, 39.0 mm SL, Laos: Houaphan Prov., Houay Tangoua, small stream entering Nam Xam in Ban Houtangoua, 20° 09' 24'' N 104° 32' 50'' E, coll. M. Kottelat et al., 5 May. 1999.

Paratypes – ZRC 47676, 2 specimens, LARReC, uncat., 2 specimens, NMMBA 464, 2 specimens, CMK 15306, 10 specimens, 16.6 – 47.7 mm SL, same data as holotype. CMK 15321, 4 specimens, 29.5 – 34.1 mm SL, Laos: Houaphan Prov., Nam Hang, small stream on road from Xam Tai to Ban Tao, about 6 km from Xam Tai, 19° 59' 06'' N 104° 40' 30'' E, coll. M. Kottelat et al., 6 May. 1999.

**Diagnosis.** – *Rhinogobius vermiculatus* can be distinguished from all other species of the genus by the combination of the following characters: second dorsal fin rays modally I/9; anal fin rays I/7; pectoral fin rays modally 16; longitudinal scale series 32-34; vertebral counts 10 + 18 = 28; first dorsal

fin with rays III and IV longest; body with 6-7 dark brown blotches and female with 5 longitudinal dark brown lines. Opercle with vermiculate lines against brown background and branchiostegal membrane with small dark greyish brown spots in male; and caudal fin base with a dark brown mark.

**Description.** – Body cylindrical anteriorly and compressed posteriorly. Body proportions in Table 1. Head moderately large, and depressed in adult male. Eye large, dorsolateral. Snout pointed and longer in male. Bony interorbital quite narrow. Cheek very fleshy in male. Lips thick, and with projecting lateral side of upper lip (especially in male). Mouth oblique, maxillary extending to vertical through middle of orbit. Both jaws with 3-4 rows of conical teeth, outer rows enlarged. Tongue tip rounded, entire. Anterior nostril a short tube, posterior one merely a very shallow tube. Gill-opening extending to vertical through posterior extremity of preopercle. Isthmus broad. 10 + 18 = 28 (in 10 specimens).

Fins. D1 V-VII (mode VI); D2 I/8-9 (mode 9); A I/7; P 15-18 (mode 16); V I/5+I/5 (frequency distribution in Table 2). D1 rays III and IV longest and somewhat filamentous in male, with D1 rear tip reaching 1st or 2nd branched rays of D2 when depressed in male, not extending to D2 origin in female. D2 and A rear tips not reaching procurvent rays of C. Origin of A inserted at vertical line between 2nd and 3rd branched rays of D2. P oblong, rear tip not extending to anus. V disc rounded, spinous rays with pointed membranous lobes. C elliptical with rounded rear edge.

Scales. Lateral body with moderately large ctenoid scales, anterior predorsal area naked, posterior predorsal region and belly scales cycloid, with 7-11 middle series of predorsal scales; scales in longitudinal series 32-34 (mode 33); transverse series 9-10; series between D1 origin and upper P origin 6-7 (frequency distribution in Table 2). Head including opercle, preopercle, and prepelvic area naked. Predorsal squamation with trifurcate anterior edge, anterior tip of middle series reaching vertical through middle of opercle; both tips of lateral squamation extending forward to above pore  $\theta$  of posterior oculoscapular canal.

Head lateral-line system. Canals. Nasal extension of anterior oculoscapular canal with terminal pores  $\sigma$  located at middle between anterior and posterior nostril. Anterior interorbital sections of oculoscapular canal separated, with paired pores  $\lambda$ . A single pore  $k$  in posterior interorbital region. Pore  $\omega$  present at posteriodorsal edge of eye. Gap between anterior and posterior oculoscapular canals somewhat smaller than length of posterior oculoscapular canal. Preopercular canal present with pores  $r$ ,  $\delta$  and  $\epsilon$ . Sensory papillae. Row *a* extending to vertical through middle of orbit. Length of row *b* slightly shorter than orbit. Rows *c*, *d* long, and row *c* reaching or slightly beyond vertical of pore *a*. A single *cp* papilla. Row *f* paired. Opercular rows *ot* and *oi* slightly separated. Other details in Fig. 5.

**Colouration in alcohol.** – Body yellowish brown with 6-7 dark brown blotches; 5 longitudinal dark brown lines in female, indistinct markings except darker margins of lateral



Fig. 1. *Rhinogobius milleri*, CMK 15249, paratypes, (a) male, 39.2 mm SL, and (b) female, 45.8 mm SL; Laos: Nam Kuang.



Fig. 2. *Rhinogobius nammaensis*, (a) ZRC 46582, holotype, male, 43.0 mm SL, and (b) CMK 15370, female, 36.1 mm SL; Laos: Nam Ma basin.

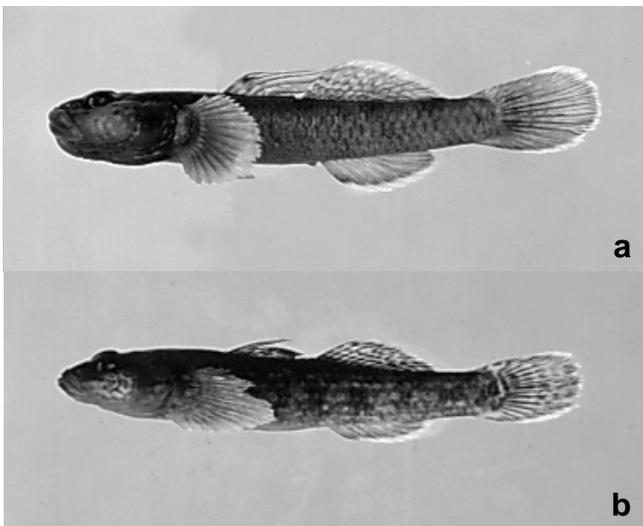


Fig. 3. *Rhinogobius vermiculatus*, CMK 15306, paratypes, (a) male, 34.1 mm SL, and (b) female, 41.1 mm SL; Laos: Nam Hang.

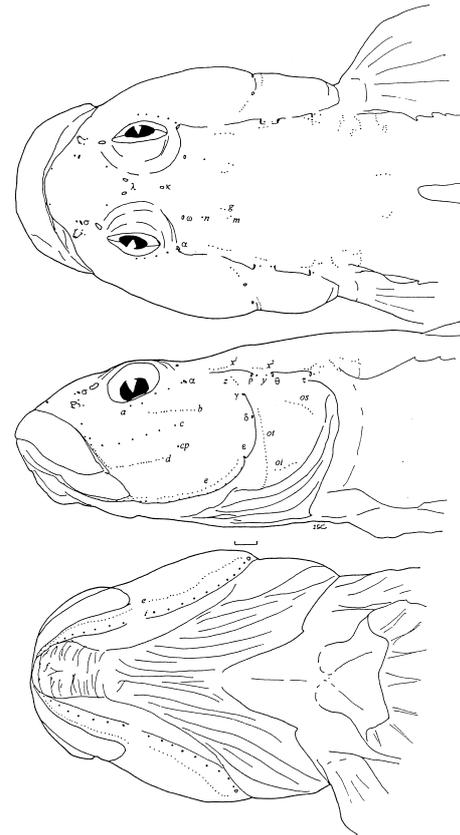


Fig. 4. *Rhinogobius milleri*, holotype, ZRC 46581, 39.8 mm SL; head lateral-line system. Scale bar = 1 mm.

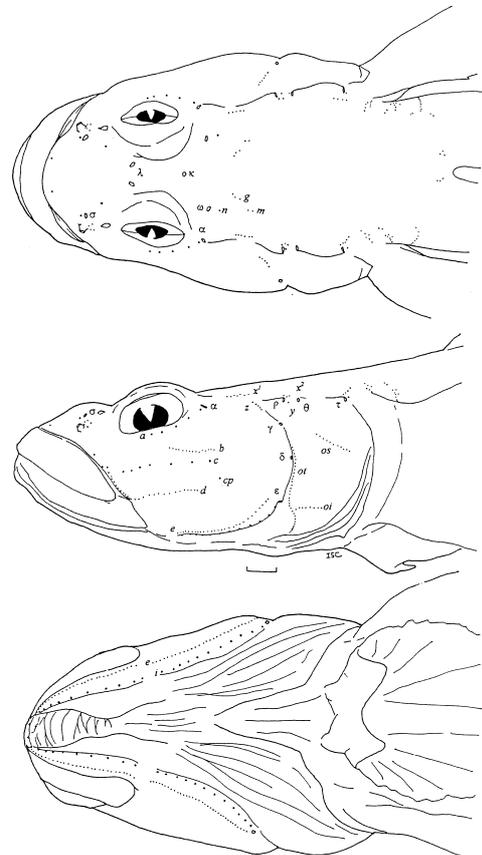


Fig. 5. *Rhinogobius nammaensis*, ZRC 46582, 43.0 mm SL; head lateral-line system. Scale bar = 1 mm.

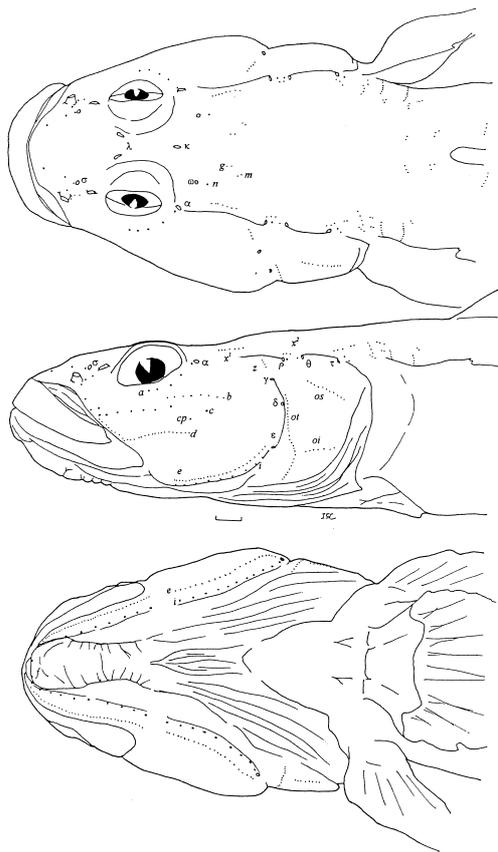


Fig. 6. *Rhinogobius vermiculatus*, CMK 15306, 47.7 mm SL; head lateral-line system. Scale bar = 1 mm.

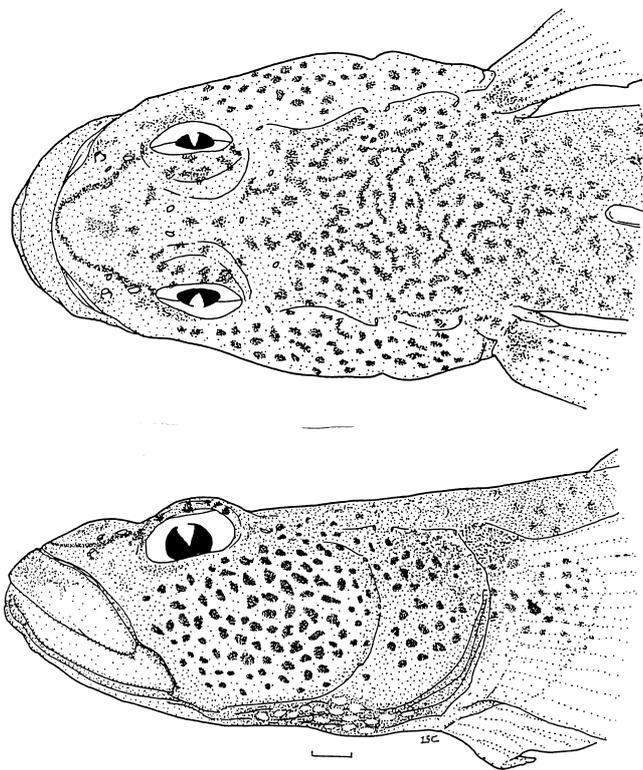


Fig. 8. *Rhinogobius nammaensis*, holotype, ZRC 46582, 43.0 mm SL; cephalic colour pattern of male. Scale bar = 1 mm.

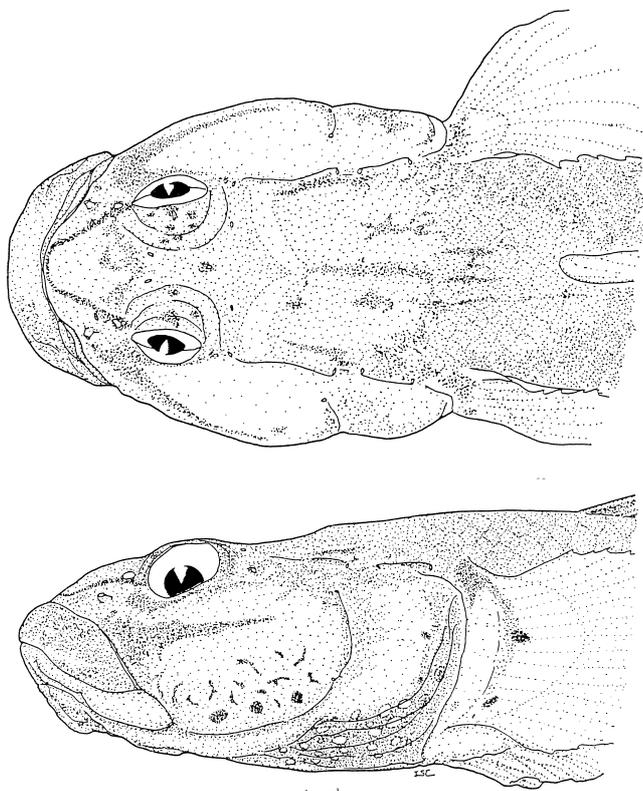


Fig. 7. *Rhinogobius milleri*, holotype, ZRC 46581, 39.8 mm SL; cephalic colour pattern of male. Scale bar = 1 mm.

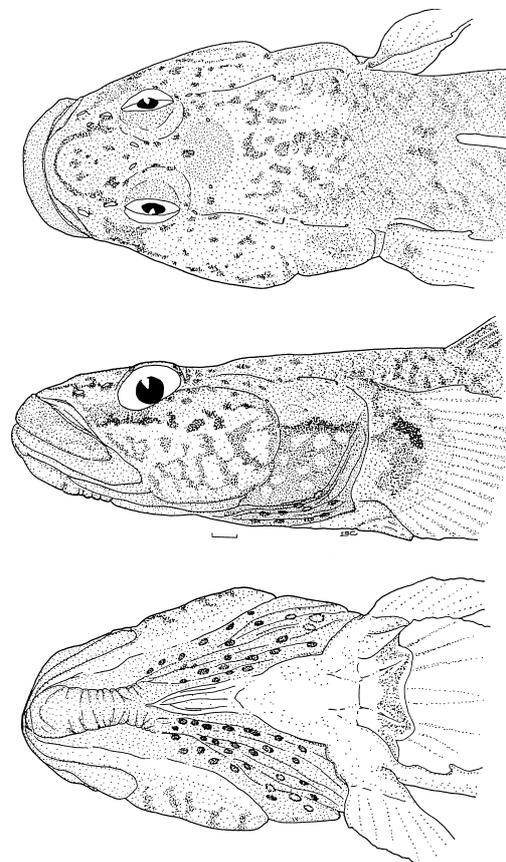


Fig. 9. *Rhinogobius vermiculatus*, CMK 15306, 47.7 mm SL; cephalic colour pattern of male. Scale bar = 1 mm.

scales in larger male. Predorsal region with several short, dark brown bars. Cheek with many irregular brown stripes or spots and a horizontal brownish black bar crossing anterior part, that of lower half near preopercle with few white rounded spots. Opercle with 8-10 white vermiculations on brown background on lower half in male, usually indistinct with 3-4 larger spots or plain in female. Snout with a pair of brownish black lines uniting at anterior tip. A brownish black line behind orbit along lateral section of anterior oculoscapular canal. A somewhat squarish, brownish grey blotch below eye. Branchiostegal membrane scattered with dark greyish spots (which may have been brownish red when fresh) in male, unmarked in female.

First dorsal fin membranes between three anterior rays with a black spot, rest of fin with 2-3 rows of dark brown spots in male, with 3-4 rows of dark spots in female. Caudal fin greyish with 4-6 vertical rows of dark brown spots in male, with 4-5 rows of greyish to dark brown spots in female. Caudal fin base with a vertical, dark brown curved bar. Anal fin greyish black on distal half with narrow white margin in male, uniform whitish in female. Pectoral fin with a conspicuous black spot on upper part of base, and a brown blotch on lower portion; basal region with a semicircular mark. Pelvic fin greyish near basal portion in male whitish in female.

**Distribution.** – *Rhinogobius vermiculatus* has been collected only in small forest streams, with stony substrate and rapid current of the Nan Xam basin, northeastern Laos. Its presence is expected in the same basin in Vietnam.

**Etymology.** – From the Latin, *vermiculatus* (vermiculated), refers to the coloration pattern on the opercle.

**Remarks.** – *Rhinogobius vermiculatus* is more similar to *R. albimaculatus* Chen, Kottelat & Miller, 1999, than any other species of *Rhinogobius*. They share the similar development of predorsal scales. However, *R. vermiculatus* can be distinguished from *R. albimaculatus* by more pectoral fin rays (modally 16 vs. 15), more scales on longitudinal rows (modally 32-33 vs. 30), few large, vermiculated lines on opercle (vs. many tiny round spots on cheek and opercle); branchiostegal membrane with rounded dark greyish brown spots in male (vs. with white spots on a dark brown background).

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