



A new freshwater goby, *Rhinogobius lianchengensis* (Teleostei: Gobiidae) from the Minjiang river basin, Fujian Province, China

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Abstract

A new freshwater goby of *Rhinogobius* Gill, 1859, were collected from the Minjiang river basin, Fujian Province, PR China. The new goby, *Rhinogobius lianchengensis* n. sp. can be well distinguished from other congeneric species by the following combination of features: second dorsal fin I/8; anal fin I/6-7; pectoral fin modally 16–17; longitudinal scale rows 33–34; predorsal scales 0–3; vertebral count 27; and specific coloration pattern: scale pocket of lateral body with distal brown to blackish brown mark; cheek deep brown on dorsal half with 7–8 somewhat parallel oblique deep brown bars after the vertical stripe on snout in male; opercle brown to yellowish brown with net-like deep brown marks in both sexes; branchiostegal membrane bright yellow background with 16-19 deep red or brownish red spots in male; first dorsal fin with a black mark in male; pectoral fin base with a median patch of blackish spots surrounding with some irregularly large brown marks; and caudal fin yellow with 3–4 vertical rows of deep brown spots. A diagnostic key to all nominal *Rhinogobius* species from Fujian Province, PR China is provided.

Key words: *Rhinogobius*, new goby, Minjiang river basin, mainland China, fish taxonomy

Introduction

Freshwater gobies are very important component of benthic inland fish fauna in East Asia. The freshwater gobiid genus, *Rhinogobius* Gill, 1859, is widely distributed on islands of the western Pacific including Japan (Masuda *et al.* 1989; Akihito *et al.* 1993, 1984, 2002; Suzuki *et al.* 2011), Taiwan (Chen *et al.* 1998; Chen & Fang 1999; Chen & Shao 2002; Lee & Chang 1996), Hainan (Wu & Ni 1986; Chen *et al.* 2002), and Philippines (Herre 1927) and also continental Asia, including Russia, Korea, China, Vietnam, Laos, Cambodia, and Thailand (Chu & Wu 1965; Chen & Miller 2008; Chen *et al.* 1999a–c, 2008; Chen & Kottelat 2000, 2003, 2005; Li *et al.* 2007; Wu *et al.* 2009).

The life history of *Rhinogobius* species indicates that the genus includes mainly amphidromous species and non-diadromous, fluvial species (Mizuno 1960; Iguchi & Mizuno 1991; Akihito *et al.* 1993, 1994; Chen & Fang 1999, 2006; Huang & Chen 2007; Chen 2009;) as well as lake-river migratory species and lentic species (Takahashi & Okazaki 2002). At present, the first author (ISC) estimates that at least over 90 species are known in East and Southeast Asia and some of them still need formal description (Chen & Fang 2006; Chen & Miller 2008; Wu *et al.* 2009).

In Fujian Province, despite of amphidromous species including *R. similis* Gill, 1859 and *R. leavelli* (Herre, 1935), one endemic, fluvial species, *R. xianshueiensis* Chen *et al.*, 1999b, was described from the upper tributary of the Mulan River basin. Two more fluvial species were described from the upper tributaries of Hanjiang basin as *R. ponkouensis* Huang & Chen, 2007 and *R. changtinensis* Huang & Chen, 2007. The fourth fluvial species was described from the largest basin in this Province, the Minjiang river basin, as *R. reticulatus* Li *et al.*, 2007. The fifth fluvial species was described as *R. longyanensis* Chen *et al.*, 2008 had just described from the Julongjiang basin, middle area of Fujian Province. Furthermore, two more fluvial species were described as both *R. rubrolineatus* Chen & Miller, 2008 and *R. sagittus* Chen & Miller, 2008.

A series of freshwater fish collections from the tributary of Minjiang river basin, which flows into the Formosan strait in middle area of Fujian Province has been examined, and then one undescribed species had been founded. The aim of this paper would formally document and publish the new species. An artificial key to all valid species of *Rhinogobius* from Fujian Province, China is also provided.

Materials and methods

Type specimens of these new goby were collected by hand-net and cast-net. All counts and measurements were made from specimens preserved in 70% ethanol. Morphometric methods follow Miller (1988) and meristic methods follow Akihito *et al.* (1984), and Chen & Fang (2006). Terminology of the cephalic sensory canals and free neuromast organs (sensory papillae) is from Wongrat & Miller (1991), based on Sanzo (1911). Meristic abbreviations are as follows: A = anal fin; C = caudal fin; D1 = first dorsal fin; D2 = second dorsal fin; LR = longitudinal scale series; P = pelvic fin; PreD = predorsal scale series; SDP = scale series from origin of first dorsal fin to upper pectoral fin origin; TR = transverse scale series from second dorsal to anal fin; V = pelvic fin; VC = vertebral count.

All fish lengths are expressed by standard length (SL). The type specimens and comparative materials are deposited in the Biodiversity Research Center, Academia Sinica, Taipei (ASIZP); the Biological Laboratory, Imperial Household, Tokyo (BLIH); Pisces collection of National Taiwan Ocean University, Keelung (NTOUP); and the Zoological Reference Collection of Biodiversity Research, Singapore (ZRC). The comparative materials of congeneric species are listed in Appendix I.

Taxonomy

Rhinogobius lianchengensis n. sp.

Figures 1–5

Materials examined:

Holotype.-

NTOUP-2019-12-316, 1 specimen, 35.4 mm SL, male, Shen-Shiu-Tang, a tributary of Minjiang river basin, Liancheng County, Fujian Province, PR China, Coll. S.C. Wang & K.Y. Chen. Dec. 23, 2019.

Paratypes.-

NTOUP-2019-12-317, 3 specimens, 28.5–42.4 mm SL, 2 males and 1 female, all others same as above.

Diagnosis.

Rhinogobius lianchengensis can be well distinguished from all other congeners by the unique combination of following features: second dorsal fin I/8; anal fin I/6-7; pectoral fin modally 16–17; longitudinal scale rows 33–34; predorsal scales 0–3; vertebral count 27; and specific coloration pattern: scale pocket of lateral body with distal brown to blackish brown mark; cheek deep brown on dorsal half with 7–8 somewhat parallel oblique deep brown bars after the vertical stripe on snout in male; opercle brown to yellowish brown with net-like deep brown marks in both sexes; branchiostegal membrane bright yellow background with 16–19 deep red or brownish red spots in male; first dorsal fin with a black mark in male; pectoral fin base with a median patch of blackish spots surrounding with some irregularly large brown marks; and caudal fin yellow with 3–4 vertical rows of deep brown spots.

Descriptions.

Body proportions in Table 1. Body cylindrical anteriorly, compressed posteriorly. Head rather large, somewhat depressed in male. Eye large, dorsolateral. Snout pointed. Cheek slight fleshy in male. Lips thick. Mouth oblique, rear edge extending to vertical of anterior margin of pupil. Both jaws with 3–4 rows of conical teeth, and outer jaws enlarged. Tongue margin rounded. Anterior nostril in a short tube and posterior nostril as a round hole. Gill opening extending ventrally to vertical midline of opercle. Vertebral count 10+17=27 (n=4).

Fins.- D1 VI, D2 I/8; A I/6; P 16-17 (modally 16); V I/5+I/5 (distribution frequency in Table 2). D1 in lacking filamentous ray, 3rd and 4th spinous rays longest, with rear tip extending to origin of second dorsal fin in both sexes.

Origin of A inserted about below origin of 2nd branched ray of D2. The rear tips of D2 and A when depressed rather far from the procurrent rays of C. P moderate large, the rear tip not reaching the vertical of origin of D2. C elliptical, rear edge rounded.

Scales.- Body with moderately large ctenoid scales, most of anterior predorsal area naked; belly cycloid. LR 33-34 (modally 33); TR 8-9 (modally 9); PreD 0-3; and SDP 8-9. Head and prepelvic region naked. Anterior tip of midpredorsal squamation very limited, either naked or extending far from vertical of upper origin of pectoral fin base.

TABLE 1. Morphometry of *Rhinogobius lianchengensis* from Minjiang, China

Type	Holotype	Paratypes	
Cat. No.	NTOUP-2020-02-316	NTOUP-2020-02-317	
Sex.	male	male	female
SL (mm)	35.4	29.1	42.4
% in standard length			
Head length	27.5	28.6	25.3
Predorsal length	36.3	37.3	35.4
Snout to 2nd dorsal origin	57.8	58.6	56.2
Snout to anus	55.9	56.1	58.5
Snout to anal fin origin	62.1	60.1	57.3
Prepelvic length	29.0	30.4	28.6
Caudal peduncle length	25.8	24.4	25.0
Caudal peduncle depth	9.0	10.0	9.0
First dorsal fin base	15.6	14.2	16.9
Second dorsal fin base	19.7	18.2	16.6
Anal fin base	14.8	14.0	13.5
Pelvic fin length	18.0	19.6	14.2
Body depth of pelvic fin origin	14.5	14.7	12.3
Body depth of anal fin origin	14.0	13.9	15.1
Body width of anal fin origin	11.1	10.6	11.4
Pelvic fin origin to anus	28.1	28.1	30.3
% in head length			
Snout length	35.2	31.8	34.7
Eye diameter	23.3	22.3	20.8
Postorbital length	46.2	52.5	53.8
Cheek depth	33.4	32.0	29.3
Head width in upper gill opening	46.2	53.4	54.7
Head width in maximum	65.2	67.1	80.7
Fleshy interorbital width	26.1	25.3	20.7
Bony interorbital width	9.9	7.5	8.3
Lower jaw length	42.2	38.8	35.6
Caudal peduncle depth/ length	35.3	39.6	36.1

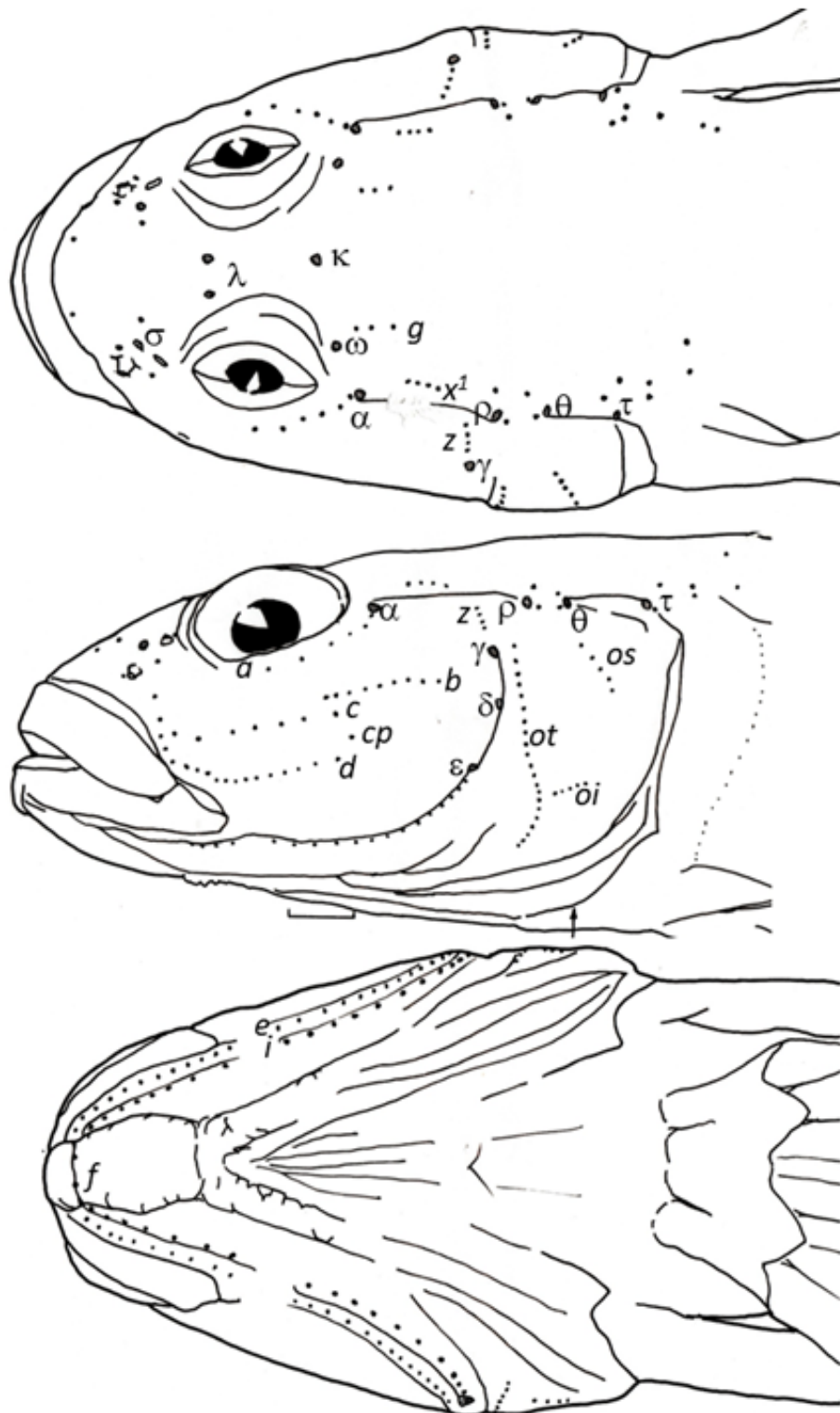


FIGURE 1. Head lateral-line system of *Rhinogobius lianchengensis* n. sp., NTOUP-2019-12-316, holotype, 35.4 mm SL, male, Liancheng County, the Mingjiang basin, Fujian, China.

Head lateral-line system. (Figure 1)

Canals.-Nasal extension of anterior oculoscapular canal with terminal pore σ located behind rear margin of anterior nostril. Anterior interorbital sections of oculoscapular canal with paired pore λ . A single pore κ in rear of interorbital region. Pore ω present near posterior edge of eye. Lateral section of anterior oculoscapular canal with pore α and terminal pore ρ . Posterior oculoscapular canal with two terminal pores θ and τ . Preopercular canal present, with three pores γ , δ , and ε .

TABLE 2. Comparison of frequency distribution of fin-ray counts of *Rhinogobius* species with longitudinal infraorbital papillae from Fujian Province, China

	D1			D2 rays						A rays						P rays				
	V	VI	VII	M	6	7	8	9	M	6	7	8	9	M	15	16	17	18	19	
<i>R. lianchengensis</i> n. sp.	4	6.0	4	8.0	2	2	2	2	6.5	5	3									
<i>R. changtingensis</i>	9	6.0	2	7.8		2	7	7.8			2	7	7.7	2	11					
<i>R. leavelli</i>	5	6.0	4	8.2		4	1	8.2			4	1	8.2					1	4	
<i>R. longyanensis</i>	10	6.0	10	8.0	1	4	5	7.4									14	4		
<i>R. ponkouensis</i>	5	6.2	1	8.0	3	19	4	8.0			5	1	7.2	6	4					
<i>R. reticulatus</i>	13	6.0	7	8.5		9	4	7.3						5	7					
<i>R. rubrolineatus</i>	6	6.0	6	8.0		6		7.0			6		7.0	1	6	1				
<i>R. sagittus</i>	4	6.0	4	8.0		4		7.0			4		7.0	3	2					
<i>R. xanshuei</i> ensis	4	5.8	18	8.1	5	14	1	6.8			10		10							

	LR										TR				
	27	28	29	30	31	32	33	34	M	7	8	9	10	M	
<i>R. lianchengensis</i> n. sp.							6	2	33.3	1	3	8.8			
<i>R. changtingensis</i>	2	5	11				29.2	2	7.8						
<i>R. leavelli</i>				2	5	3	33.1	5	10.0						
<i>R. longyanensis</i>			10	8	2		30.6	1	8.0	8	1				
<i>R. ponkouensis</i>				4	5	3	32.9	1	7.8						
<i>R. reticulatus</i>	6	5	2				27.7	13	9.0						
<i>R. rubrolineatus</i>	2	7	3				29.1	4	9.3						
<i>R. sagittus</i>			1	5	2		30.1	2	9.5						
<i>R. xanshuei</i> ensis			3	9	7	1	30.3	18	9.1						

TABLE 2. (Continued)

	PreD													M			
	0	1	2	3	4	5	6	7	8	9	10	11	12		13	14	15
<i>R. lianchengensis</i> n. sp.	1	1	2														1.8
<i>R. changtingensis</i>	1	6	2														1.2
<i>R. leavelli</i>										1	1	1	1	1	1	1	12.8
<i>R. longyanensis</i>						1	8	1									7.9
<i>R. ponkouensis</i>				5	1												4.2
<i>R. reticulatus</i>			2	4	3	4											4.7
<i>R. rubrolineatus</i>			1	4	1												4.0
<i>R. sagittus</i>			2	2													3.5
<i>R. xanshuei</i> ensis			1		8	9	2										5.6

	SDP										VC							
	6	7	8	9	10	M	26	27	28	M	26	27	28	M				
<i>R. lianchengensis</i> n. sp.	2	2	2	2	8.5	27.0	4	4	4	27.0								
<i>R. changtingensis</i>	7	2	2	2	8.2	27.0	8	8	8	27.0								
<i>R. leavelli</i>	2	3	3	3	8.6	26.0	5	5	5	26.0								
<i>R. longyanensis</i>	9	1	1	1	7.1	27.0	10	10	10	27.0								
<i>R. ponkouensis</i>	5	5	5	5	8.2	28.0	6	6	6	28.0								
<i>R. reticulatus</i>	8	5	5	5	7.4	26.5	7	7	7	26.5								
<i>R. rubrolineatus</i>	6				6.0	26.0	6	6	6	26.0								
<i>R. sagittus</i>	1	3	3	3	6.8	26.0	4	4	4	26.0								
<i>R. xanshuei</i> ensis	1	1	17	1	8.0	27.0	20	20	20	27.0								

Sensory papillae.—Row *a* extending beyond middle vertical line of orbit. Row *b* long, slightly shorter than eye diameter. A single *cp* papilla. Gap between two oculoscapular canals shorter than length of posterior oculoscapular canal. Row *f* paired. The anterior opercular rows *ot* and *oi* slightly separate.

Colouration in fresh. (Figures 2–5)

Body light brown to yellowish brown. Scale pocket of lateral body with distal brown to blackish brown mark in male; lateral body with conspicuous 5–6 large blackish brown blotches in female. Side of body with connected deep brown region, merely with about 4–6 main patches of yellowish brown or light brown marks on dorsal half. Dorsal side with 4 yellow marks under deep brown background. Caudal fin base with a blackish brown arrow shape mark surrounding with yellow background.

Head light brown to yellowish brown. Dorsal side of snout with a pair of brownish red to brown stripes united to snout tip; another pair of brownish red to brown stripes below orbit extending vertically to the edge of lower lip. Cheek deep brown on dorsal half with 7–8 somewhat parallel oblique deep brown bars after the vertical stripe on snout in male, yellow to yellowish brown with irregularly short deep brown bars on dorsal and posterior half in female. Opercle brown to yellowish brown with net-like, reticulate deep brown marks in both sexes. Nape with deep brown irregularly net-like pattern anteriorly and large deep brown mark posteriorly. Both lips yellowish. Branchiostegal membrane bright yellowish background with 16–19 deep red or brownish red spots on each side in male, but uniformly pale brown in female.

First dorsal fin pale white, to light yellow with grayish area and distal white margin, a black mark in between 1st and 2nd spines in male, fin yellow with 3–4 rows of deep brown spots in female. Second dorsal fin pale yellow with 4–5 longitudinal rows of deep brown spots with distal gray margin in male; pale yellow with 5–6 longitudinal rows of deep brown spots in female. Anal fin grayish yellow to whitish in both sexes. Pectoral fin base with a median patch of blackish spots surrounding with some irregularly large brown marks and other brown spots or bars. Pelvic fin grayish in both sexes. Caudal fin yellow with 3–4 vertical rows of deep brown spots in both sexes.

Etymology.

The specific name, *Rhinogobius lianchengensis* is referred to type locality in “Liancheng County”, a tributary of the Minjiang River basin, Fujian Province, China.

Distribution.

So far, the species merely found from the tributaries of Minjiang River basin around Liancheng County, Fujian Province, China.



FIGURE 2. *Rhinogobius lianchengensis* n. sp., A. male, holotype, 35.4 mm SL, B. female, paratype, 42.4 mm SL, Liancheng County, Minjiang river basin, Fujian, China.



FIGURE 3. Ventral view of head coloration pattern of *Rhinogobius lianchengensis* n. sp., male, paratype, 29.1 mm SL.

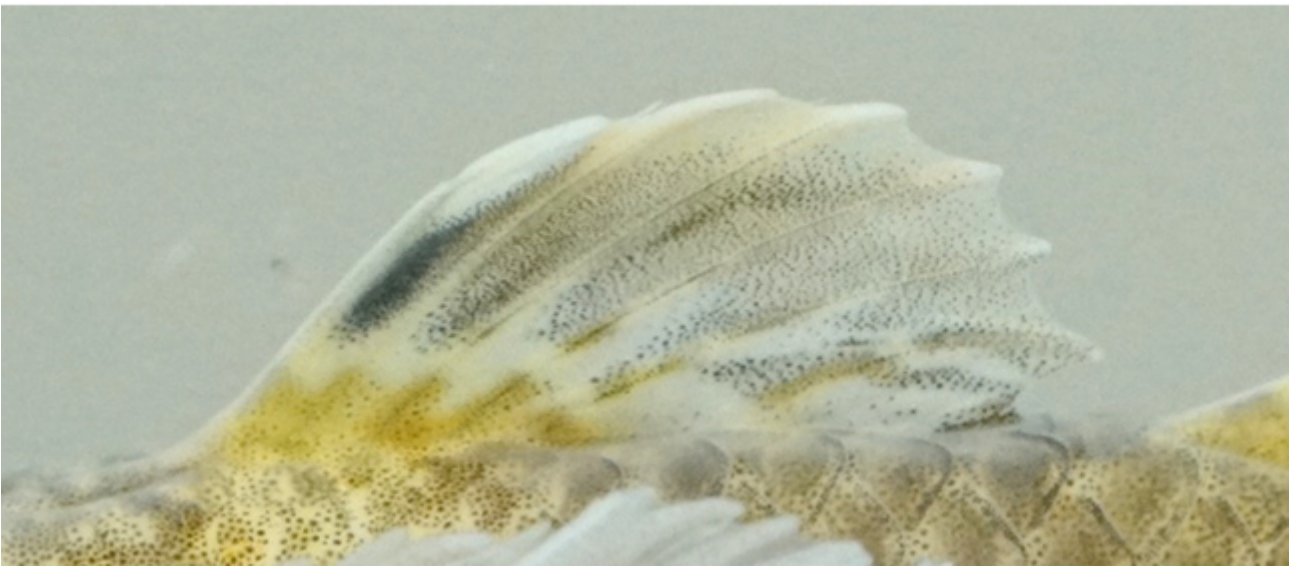


FIGURE 4. First dorsal-fin colouration pattern of *Rhinogobius lianchengensis* n. sp., male, 29.1 mm SL.

Remarks.-

In overall colouration of pattern, this new species, *R. lianchengensis*, more resembles *R. xianshueiensis* from Mulan River basin than any other congeneric species in Fujian Province, China. However, *R. lianchengensis* can be well distinguished from *R. xianshueiensis* by the following features: (1) longitudinal scale rows 33–34 (vs. modally 30–31); (2) predorsal scales 0–3 (vs. modally 5–6); (3) head canal pore: $\omega 1$ absent (vs. always present); (4) cheek colouration in male with 6–7 somewhat parallel grayish brown stripes (vs. unmarked); and (5) pectoral fin base with several irregularly blackish brown bars and marks on upper 2/3 region in male (vs. typically netlike pattern in male).

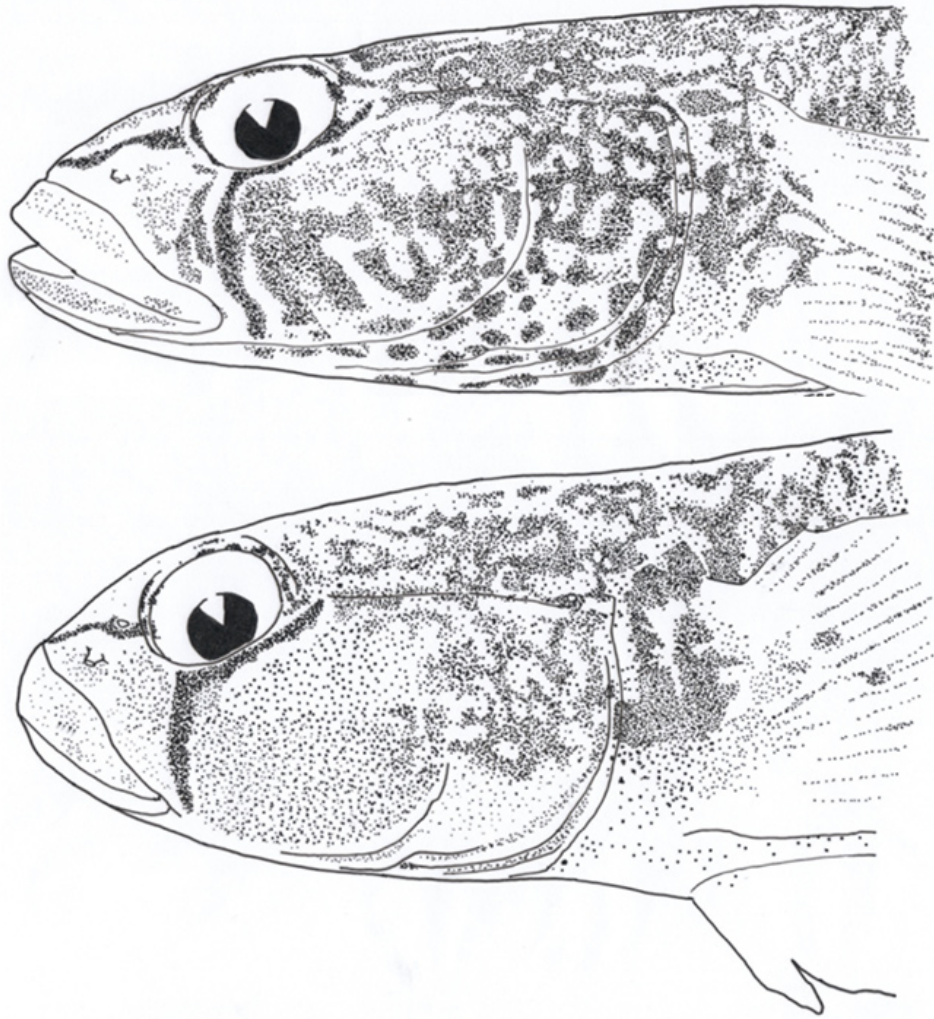


FIGURE 5. Lateral head illustration of *Rhinogobius lianchengensis* n. sp., male, above, holotype, 35.4 mm SL; female, below, paratype, 42.4 mm SL.

Key to all nominal species of *Rhinogobius* with longitudinal infraorbital papillae from Fujian Province, China

- 1a Pectoral fin rays usually 19–20; predorsal scales 10–16 *R. leavelli* (Hanjiang basin)
- 1b Pectoral fin rays no more than 18; predorsal scales 0–7 2
- 2a Cheek with many rounded spots, branchiostegal membrane with several parallel red stripes in male
 *R. reticulatus* (Minjiang river basin)
- 2b Cheek and branchiostegal membrane without such marks 3
- 3a Head canal pore ω 1 present, pectoral fin base with reticulate orange pattern in male . . . *R. xianshueiensis* (Mulan river basin)
- 3b Head canal pore ω 1 absent, pectoral fin base without such pattern 4
- 4a Infraorbital stripe short and not extending ventrally to edge of upper lip in male 5
- 4b Infraorbital stripe long and extending ventrally to edge of upper lip or lower edge of cheek in male 6
- 5a Pectoral fin rays modally 17; pectoral fin base with one black bar; 27 vertebrae *R. longyanensis* (Julongjiang basin)
- 5b Pectoral fin rays modally 16; pectoral fin base with two rounded black bars; 28 vertebrae . . . *R. ponkouensis* (Hanjiang basin)
- 6a Opercle unmarked; longitudinal scale rows 28–31 7
- 6b Opercle with net-like, reticulate deep brown marks; longitudinal scale rows 33–34
 *R. lianchengensis* n. sp. (Minjiang river basin)
- 7a Predorsal scales 3–6; 26 vertebrae 8
- 7b Predorsal scales 0–2; 27 vertebrae *R. changtingensis* (Hanjiang basin)
- 8a Cheek with 2 brown bars; the vertical infraorbital red stripe extending to edge of upper lip in male
 *R. rubrolineatus* (Minjiang river basin)
- 8b Cheek with 4–5 brown bars, the brown infraorbital marks as arrow shape curve in male *R. sagittus* (Minjiang river basin)

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Appendix I

Comparative materials of *Rhinogobius* species of Fujian, southern China

Rhinogobius leavelli (Herre, 1935)

NTOUP 2006-4-470, 2 specimens, 28.6-30.9 mm SL, Mei-Chou City, Hanjiang basin, Guangdong Province, China, Coll. J.H. Wu & J.W. Wang, April, 2004. NTOUP 2006-4-271, 2 specimens, 50.8–51.1 mm SL, Mu-Loon, Lieojiang, Xijiang, Pearl River basin, Guangxi Province, China, Coll. B. Chen *et al.*, Oct. 2002.

Rhinogobius xianshuiensis Chen *et al.*, 1999

Holotype: ASIZP057440, 29.6 mm SL, 29.6 mm SL, small unnamed tributary of Xianshui Brook, about 25 km north of Xianyou County, Fujian Province, China, Coll. I-S. Chen, 19 Aug. 1994.

Paratypes: ASIZP057441, 17 specimens, 20.7–35.0 mm SL, data same as holotype above. ASIZP057442, 2 specimens, 26.6-30.5 mm SL, 20 Aug. 1994, other data same as holotype.

Rhinogobius ponkouensis Huang & Chen, 2007

Holotype: ZRC-50526, 30.2 mm SL, Pon-Kou County, Hanjiang basin, Fujian Province, China; Coll. I-S. Chen, 10 Spt. 2002.

Paratypes: NTOUP 2005-7-010, 4 specimens, 28.7–30.3 mm SL, all remaining data same as holotype above. ASIZP 0066341, 26.2 mm SL, all remaining data same as holotype above.

Rhinogobius changtingensis Huang & Chen, 2007

Holotype: ZRC-50527, 34.1 mm SL, small hill-stream near the free way terminal, tributary near Chang-Ting County, Fujian Province, Hanjiang basin, China, Coll. I-S. Chen, 10 Spt. 2002.

Paratypes: NTOUP 2005-7-011, 7 specimens, 22.4–26.3 mm SL, all other data same as holotype above. ASIZP0066340, 24.8 mm SL, all other data same as holotype above.

Rhinogobius longyanensis Chen *et al.*, 2008

Holotype: NTOUP 2006-3-465, 40.7 mm SL, a small tributary of Long-Chuang River in the Julongjiang basin, Dong-Hsiao, Long-yan City, Fujian Province, China, Coll. I-S. Chen, 10 Spt. 2002.

Paratypes: ASIZP20067105, 2 specimens, 29.3–35.1 mm SL, collected with holotype. BLIH 20020548, 42.5 mm SL, collected with holotype. NTOUP 2006-3-467, 5 specimens, 28.7–35.5 mm SL, a small tributary of Shi-Nan River in the Julongjiang basin, Shi-Nan, Jarn-Ping, Longyan City, Fujian Province, China, Coll. I-S. Chen, 15 Spt. 2002.

Rhinogobius rubrolineatus Chen & Miller, 2008

Holotype: NTOUP 2008-06-390, 33.7 mm SL, Wen-choan-shi in Minjiang river basin, Ju-shi, Lian-chen County, Longyan City, Fujian Province, China, Coll. I-S. Chen, 24 June 2006.

Paratypes: NTOUP 2008-06-391, 5 specimens, 29.5–42.3 mm SL, all other data same as holotype.

Rhinogobius sagittus Chen & Miller, 2008

Holotype: NTOUP 2008-06-392, 35.1 mm SL, Nan-Shi, Minjiang river basin, Shi-yang-jen, Yun-an City, Fujian Province, China, Coll. I-S. Chen, 25 June 2006.

Paratypes: NTOUP 2008-06-393, 3 specimens, 30.5–35.4 mm SL, other data same as holotype.

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