

## TWO NEW FRESHWATER GOBIES OF GENUS *RHINOGOBIUS* (TELEOSTEI: GOBIIDAE) IN SOUTHERN CHINA, AROUND THE NORTHERN REGION OF THE SOUTH CHINA SEA

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**ABSTRACT.** – Two new freshwater gobies of *Rhinogobius* Gill, 1859, were collected from the Minjiang basin around the Formosan Strait, northern region of the South China Sea. Both *Rhinogobius rubrolineatus*, new species, and *Rhinogobius sagittus*, new species, can be well distinguished from other congeners by their specific patterns of colouration and meristic features; and they are belonging to the nondiadromous species with normal vertebral count of 26. A diagnostic key to all valid species from Fujian Province, People's Republic of China, is provided.

**KEY WORDS.** – *Rhinogobius*, new gobies, Minjiang basin, South China Sea, fish taxonomy.

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### INTRODUCTION

Gobioid fishes are the rather important components of freshwater fish fauna in East Asia. The freshwater goby, *Rhinogobius* Gill, 1859, is widely distributed on several islands of the western Pacific including Japan (Akihito et al., 1984, 1993, 2002; Masuda et al., 1989), Taiwan (Aonuma & Chen, 1996; Chen & Shao, 1996; Lee & Chang, 1996; Chen et al., 1998; Chen & Fang, 1999), Hainan (Wu & Ni, 1986; Chen et al., 2002), and Philippines (Herre, 1927), and also continental Asia, in Russia, Korea, China, Vietnam, Laos, Cambodia, and Thailand (Chu & Wu, 1965; Zheng & Wu, 1985; Chen & Miller, 1998; Zhong & Tzeng, 1998; Chen et al., 1999a, 1999b, 1999c; Chen & Kottelat, 2000, 2003, 2005; Chen & Fang, 2006; Huang & Chen, 2007; Li & Zhong, 2007; Li et al., 2007; Chen et al., 2008). The life histories of *Rhinogobius* species indicate that the genus includes mainly amphidromous species and non-diadromous, landlocked, fluvial species (Mizuno, 1960; Mizuno & Goto, 1987; Iguchi & Mizuno, 1991; Akihito et al., 1993; 2002) as well as lake-river migratory species and lentic species (Takahashi & Okazaki, 2002). At present, the first author (ISC) estimates that there are at least over 80 species are known in East and Southeast Asia and some of them still need formal description (Chen & Kottelat, 2003; 2005; Chen & Fang, 2006; Chen et al., 2008; Yang et al., 2008).

One endemic, fluvial species, *R. xianshuiensis*, was described

from the upper tributary of the Mulan River basin, Fujian Province by Chen et al., 1999b. Two more species were recently described from the upper tributaries of Hanjiang basin viz. *R. ponkouensis* Huang & Chen, 2007, and *R. changtinensis* Huang & Chen, 2007. The fourth species was described from the largest basin in this Province, the Minjiang basin, as *R. reticulatus* Li & Zhong, 2007. More recently, another endemic species, *R. longyanensis* Chen et al., 2008, with a higher vertebral count of 27, has just been described from the Julongjiang Basin, middle area of Fujian Province.

Collections from the Minjiang basin, which flows into the Formosan Strait and located in northern area of the South China Sea, have been examined and two undescribed species have been found. A diagnostic key to all valid species of *Rhinogobius* from Fujian Province, China, is also provided.

### MATERIALS AND METHODS

Type specimens of these new gobies 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), Chen & Shao (1996), and Chen et al. (1999b), and Chen & Fang (2006). Terminology of

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 = pectoral fin; PreD = predorsal scales; SDP = scale series from origin of first dorsal fin to upper pectoral origin; TR = transverse scale series from second dorsal to anal fins; 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 (NTOU P); and the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, Singapore (ZRC). The comparative materials of congeneric species are listed in Appendix I.

## SYSTEMATICS

### *Rhinogobius rubrolineatus*, new species

(Figs. 1, 2)

**Material examined.** – Holotype: NTOU P 2008-06-390, 33.7 mm SL, male, Wen-chuan-shi in Minjiang basin, Ju-shi, Lian-chen County, Fujian Province, People's Republic of China, Coll. I-S. Chen, 24 Jun.2006.

Paratypes: NTOU P 2008-06-391, 5 ex., 29.5–42.3 mm SL, 3 males and 2 females, all other data same as holotype.

**Diagnosis.** – *Rhinogobius rubrolineatus* can be distinguished from all other congeners by the unique combination of the following features: second dorsal fin I/8; anal fin I/7; pectoral fin rays 16–17 (modally 17); longitudinal scale series 28–30 (modally 29); predorsal scales 3–5 (modally 4); vertebral count 26; side of body with 6 clusters of blackish-brown marks in male, grayish-brown in female; scale pockets of lateral body with conspicuous deep brown margin in female but indistinct in male; caudal fin base with a median black spot; snout with a dorsal pair of broad bright red stripes, another lateral pair of broad bright red stripe below orbit extending vertically to corner of upper lip; snout orange;

cheek with 2 oblique, parallel deep brown lines in male but absent in female; branchiostegal membrane grayish brown with 9–10 rounded bright orange red spots in male but uniform grayish and spotless in female; first dorsal fin with broad median grayish-black band; basal region of pectoral fin grayish-black with basal, semicircular creamy-yellow region in male, pale in female.

**Description.** – Body proportions in Table 1. Body cylindrical anteriorly, compressed posteriorly. Head rather large, depressed in male. Eye large, dorsolateral. Snout pointed. Cheek rather fleshy in male. Lips thick. Mouth oblique, rear edge extending to middle of orbit in male, but to vertical of anterior edge of orbit in female. Both jaws with 3–4 rows of conical teeth, and outer rows enlarged. Tongue margin rounded. Anterior nostril in a short tube and posterior nostril round. Gill opening extending ventrally to vertical midline of opercle. Vertebral count 10+16=26.

**Fins.** – D1 VI, D2 I/8; A I/7; P 16–17 (modally 17); V I/5+I/5 (distribution frequency in Table 2). D1 3rd and 4th spinous rays longest, with rear tip extending to base of 1st

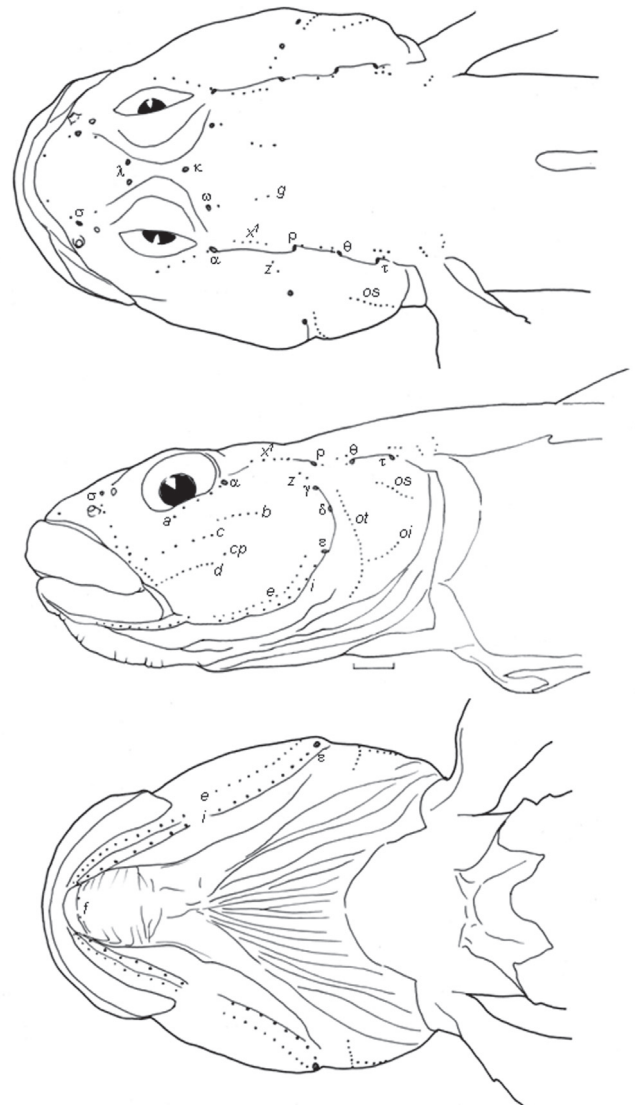


Fig. 2. Head lateral-line system of *Rhinogobius rubrolineatus*, new species: male, holotype, 33.7 mm SL.



Fig. 1. *Rhinogobius rubrolineatus*, new species: a, male, holotype, 33.7 mm SL; b, female, paratype, 42.3 mm SL, Wen-chuan-shi, Minjiang basin, People's Republic of China.

Table 1. Morphometry of two new *Rhinogobius* species from Minjiang basin, China.

	<i>Rhinogobius rubrolineatus</i> , new species			<i>Rhinogobius sagittus</i> , new species		
	holotype	holotype + paratypes	paratypes	holotype	holotype + paratype	paratypes
No. of samples	1	4	2	1	2	2
Sex	M	M	F	M	M	F
Standard length (mm)	33.7	31.6–36.4	29.5–42.3	35.1	33.6–35.1	30.5–35.4
% in SL						
Head length	30.3	30.3–30.8 (30.5)	26.8–28.2 (27.5)	28.6	28.6–29.5 (29.0)	26.7–26.9 (26.8)
Predorsal length	38.4	38.3–40.3 (38.8)	35.0–38.1 (36.6)	38.2	38.2–39.7 (39.0)	34.2–37.7 (35.9)
Snout to 2 <sup>nd</sup> dorsal origin	57.8	57.3–60.4 (58.3)	56.3–60.4 (58.2)	57	57.0–58.5 (57.8)	56.9–57.4 (57.1)
Snout to anus	56.4	54.4–57.3 (56.3)	53.2–59.3 (56.3)	55.5	55.5–59.0 (57.3)	55.4–55.4 (55.7)
Snout to anal fin origin	61.5	59.8–62.3 (61.1)	58.3–64.3 (61.4)	59.8	59.7–59.8 (59.7)	61.5–62.8 (62.1)
Prepelvic length	31.6	30.8–31.8 (31.4)	27.5–30.2 (28.8)	29.3	29.3–30.6 (29.9)	27.9–30.0 (29.0)
Caudal peduncle length	28.1	26.0–28.8 (27.3)	23.4–27.0 (25.2)	28.1	27.1–28.1 (27.6)	26.8–28.3 (27.6)
Caudal peduncle depth	10.6	9.9–10.9 (10.5)	9.2–9.3 ( 9.2)	9.4	9.4–9.9 ( 9.6)	9.5–9.9 ( 9.7)
First dorsal fin base	16.8	15.5–18.8 (17.1)	15.4–16.9 (16.1)	16.8	15.5–16.8 (16.1)	16.7–16.9 (16.8)
Second dorsal fin base	16.1	14.5–17.5 (16.1)	15.1–16.4 (15.8)	17.6	17.6–18.3 (17.9)	16.3–18.3 (17.3)
Anal fin base	13	12.5–14.7 (13.4)	11.7–12.8 (12.3)	13.2	12.2–13.2 (12.7)	10.4–12.0 (11.2)
Caudal fin length	24.7	23.2–25.5 (24.4)	22.8 (22.8)	22.9	22.9 (22.9)	23.2–23.5 (23.3)
Pectoral fin length	26.2	25.0–26.2 (25.6)	24.1–24.3 (24.2)	23.9	23.7–23.9 (23.8)	22.4–24.2 (23.3)
Pelvic fin length	16.1	15.4–16.2 (15.9)	15.3–15.7 (15.5)	15.2	15.2–15.8 (15.5)	13.7–14.7 (14.2)
Body depth of pelvic fin origin	14.9	14.9–15.7 (15.3)	13.7–15.0 (14.4)	13.9	13.9–14.3 (14.1)	14.8–15.6 (15.2)
Body depth of anal fin origin	14.4	14.4–15.5 (14.9)	13.1–14.1 (13.6)	13.5	13.5–13.9 (13.7)	14.7–15.4 (15.1)
Body width of anal fin origin	11.7	11.2–12.1 (11.6)	10.8–11.7 (11.2)	11.8	11.8–12.1 (11.9)	12.3–12.9 (12.6)
Pelvic fin origin to anus	25.1	25.1–26.5 (25.7)	26.7–30.6 (28.7)	26.3	26.3–28.1 (27.2)	27.2–28.1 (27.6)
% in HL						
Snout length	43	31.6–47.1 (40.6)	33.1–34.3 (33.7)	44.3	44.3–44.7 (44.5)	36.1–40.3 (38.2)
Eye diameter	18.1	17.7–18.7 (18.2)	17.9–19.0 (18.4)	18	18.0–20.3 (19.2)	20.4 (20.4)
Postorbital length	51.3	50.4–53.5 (51.8)	51.8–52.2 (52.0)	51.6	51.6–52.3 (51.9)	45.5–51.2 (48.3)
Cheek depth	26.0	25.7–27.3 (26.3)	22.6–23.1 (22.9)	27.8	27.8–28.2 (28.0)	21.8–25.54 (23.6)
Head width in upper gill opening	48.7	43.6–48.8 (47.3)	46.6–52.4 (49.5)	49.1	49.1–51.7 (50.4)	54.5 (54.5)
Head width in maximum	78.1	65.8–78.1 (71.6)	71.6–72.2 (71.9)	67.7	67.7–71.6 (69.7)	73.4–75.9 (74.6)
Fleshy interorbital width	17.6	17.6–18.7 (18.1)	15.5–19.9 (17.7)	18.5	16.3–18.5 (17.4)	17.5–18.1 (17.8)
Bony interorbital width	3.4	3.4–3.7 ( 3.5)	3.8–4.3 ( 4.0)	3.6	3.3–3.6 ( 3.5)	3.6–3.9 ( 3.8)
Lower jaw length	39.7	30.2–41.4 (36.8)	28.1–31.0 (29.5)	43.3	41.8–43.3 (42.6)	30.8–36.3 (33.5)
% in Caudal peduncle length						
Caudal peduncle length	37.7	37.5–41.0 (38.5)	33.8–39.6 (36.7)	33.2	33.2–36.5 (34.9)	35.1–35.5 (35.3)

Values in parentheses are the average.

branched rays of D2 when depressed in male; not extending beyond origin of D2 when depressed in female. Origin of A inserted below origin of 2<sup>nd</sup> branched ray of D2. The rear tips of D2 and A rays when depressed not reaching the procurrent rays of C. P large and oblong, its rear tip extending to vertical line through anus in male, never reaching so far in female. V rounded, spinous rays with pointed membrane lobe. C elliptical, rear edge rounded.

**Scales.** – Body with moderately large ctenoid scales, anterior predorsal area naked; posterior predorsal area and belly cycloid. LR 28–30 (modally 29); TR 9–10 (modally 9); PreD 3–5 (modally 4); and SDP 6. Head and prepelvic region naked. Anterior edge of midpredorsal squamation not extending to vertical through upper end of gill opening.

**Head lateral-line system.** – **Canals:** Nasal extension of anterior oculoscapular canal with terminal pore  $\sigma$  located

on vertical through rear margin of anterior nostril. Anterior interorbital sections of oculoscapular canal with paired pore  $\lambda$ . A single pore  $\kappa$  in rear of interorbital region. Pore  $\omega$  present near posterior edge of eye. Lateral section of anterior oculoscapular canal with pore  $\alpha$  and terminal pore  $\rho$ . Posterior oculoscapular canal with two terminal pores  $\theta$  and  $\tau$ . Preopercular canal present, with three pores  $\gamma$ ,  $\theta$  and  $\epsilon$ . **Sensory papillae:** Row *a* extending beyond middle vertical line of orbit. Row *b* short, about one-half length of orbit. Rows *c* and *d* longer. A single *cp* papilla. Row *f* paired. Anterior edge of opercular rows *ot* and *oi* connected.

**Colouration of freshly preserved material.** – Body grayish brown to yellowish-brown. Scale pockets of lateral body with conspicuous deep brown margin in female but indistinct in male. Side of body with 6 clusters of blackish-brown marks in male, grayish brown ones in female. Caudal fin base with a median black spot. Head grayish-brown to yellowish-

Table 2. Comparison of frequency distribution of fin-ray counts of *Rhinogobius* species from Minjiang basin, 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	20	M											
<i>Rhinogobius rubrolineatus</i> , new species	-	6	-	6.0	-	-	6	-	8.0	-	6	-	-	7.0	-	1	6	1	-	-	17.0											
<i>Rhinogobius sagittus</i> , new species	-	4	-	6.0	-	-	4	-	8.0	-	4	-	-	7.0	-	3	2	-	-	-	16.4											
<i>Rhinogobius changtinnensis</i>	-	9	-	6.0	-	2	7	-	7.8	-	2	7	-	7.7	2	11	-	-	-	-	15.8											
<i>Rhinogobius leavelli</i>	-	5	-	6.0	-	-	4	1	8.2	-	-	4	1	8.2	-	-	-	1	4	2	19.1											
<i>Rhinogobius longyanensis</i>	-	10	-	6.0	-	-	10	-	8.0	1	4	5	-	7.4	-	-	14	4	-	-	17.2											
<i>Rhinogobius ponkouensis</i>	-	5	1	6.2	1	3	19	4	8.0	-	5	1	-	7.2	-	6	4	-	-	-	16.4											
<i>Rhinogobius reliculatus</i>	-	13	-	6.0	-	-	7	6	8.5	-	9	4	-	7.3	-	5	7	-	-	-	16.5											
<i>Rhinogobius xianshuetensis</i>	4	16	-	5.8	-	-	18	2	8.1	5	14	1	-	6.8	10	10	-	-	-	-	15.5											

M is the mean of all distributed values.

Table 3. Comparison of frequency distribution of scale and vertebral counts of *Rhinogobius* from Minjiang basin, China.

	LR													TR													PreD												
	27	28	29	30	31	32	33	34	M	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	M												
<i>Rhinogobius rubrolineatus</i> , new species	-	2	7	3	-	-	-	-	29.1	-	-	-	1	4	1	-	-	-	-	-	-	-	-	-	-	-	4.0												
<i>Rhinogobius sagittus</i> , new species	-	-	1	5	2	-	-	-	30.1	-	-	2	2	9.5	-	-	-	-	-	-	-	-	-	-	-	-	3.5												
<i>Rhinogobius changtinnensis</i>	-	2	11	5	-	-	-	-	29.2	2	9	-	7.8	1	6	2	-	-	-	-	-	-	-	-	-	-	1.2												
<i>Rhinogobius leavelli</i>	-	-	-	-	-	2	5	3	33.1	-	-	5	10.0	-	-	-	-	-	-	-	1	1	1	1	1	1	12.8												
<i>Rhinogobius longyanensis</i>	-	-	-	10	8	2	-	-	30.6	1	8	1	-	8.0	-	-	1	8	1	-	-	-	-	-	-	-	7.0												
<i>Rhinogobius ponkouensis</i>	-	-	-	-	-	4	5	3	32.9	1	5	-	-	7.8	-	-	-	-	-	-	5	1	-	-	-	-	4.2												
<i>Rhinogobius reliculatus</i>	6	5	2	-	-	-	-	-	27.7	-	-	13	-	9.0	-	-	2	4	3	4	-	-	-	-	-	4.7													
<i>Rhinogobius xianshuetensis</i>	-	-	3	9	7	1	-	-	30.3	-	-	18	2	9.1	-	-	8	9	2	-	-	-	-	-	-	5.6													

VC

	SDP							VC						
	6	7	8	9	10	M	26	27	28	M				
<i>Rhinogobius rubrolineatus</i> , new species	6	-	-	-	-	6.0	6	-	-	26.0				
<i>Rhinogobius sagittus</i> , new species	1	3	-	-	-	6.8	4	-	-	26.0				
<i>Rhinogobius changtinnensis</i>	-	-	7	2	-	8.2	-	8	-	27.0				
<i>Rhinogobius leavelli</i>	-	-	2	3	-	8.6	5	-	-	26.0				
<i>Rhinogobius longyanensis</i>	-	9	1	-	-	7.1	-	10	-	27.0				
<i>Rhinogobius ponkouensis</i>	-	-	5	1	-	8.2	-	-	6	28.0				
<i>Rhinogobius reliculatus</i>	-	8	5	-	-	7.4	7	6	-	26.5				
<i>Rhinogobius xianshuetensis</i>	-	1	17	1	-	8.0	-	20	-	27.0				

M is the mean of all distributed values.

brown. Dorsal side of snout with a pair of broad bright red stripes united to snout tip, another pair of broad bright red stripe below orbit extending vertically to corner of upper lip. Cheek with 2 oblique, parallel deep brown lines in male, but none in female. Upper lip and snout area between two red stripes creamy-orange. Branchiostegal membrane grayish-brown with 9–10 rounded bright orange red spots in male, but uniform grayish and spotless in female. First dorsal fin with broad median grayish-black band darkening anteriorly, and distal light margin which snow white anteriorly and orange posteriorly in male but pale brown with distal light margin yellow anteriorly and orange posteriorly in female. Second dorsal fin with a very wide grayish-black band and 1–2 rows of basal brown to orange spots, its outer margin orange in female. Anal fin with basal grayish-orange region and median black band, its outer margin bright white in male, but translucent in female. Pectoral fin grayish-black with basal, semicircular creamy-yellow region in male, pale white with a basal thin, brown vertical line in female. Lower half of prepectoral region brown in male. Caudal fin grayish-black with darker membrane in male, pale white with brown rays on basal half in female. Pelvic fin grayish in male but whitish in female.

**Etymology.** – The specific name, *rubrolineatus*, refers to the conspicuously bright red lines on both snout and anterior region of cheek, derived from Latin words, *rubro* (meaning red) and *linea* (stripe).

**Distribution.** – This new species is, thus far, only found in the tributary Wen-chuan-shi, in Minjiang basin, near Ju-shi Township, Lian-chen County, Fujian Province, People's Republic of China. It occurs in shallow riffles (depth 30–60 cm) with substratum of large pebbles with moderate to fast flowing water.

**Remarks.** – In overall head colouration pattern this new species, *R. rubrolineatus*, resembles *R. changtinensis* Huang & Chen, 2007, more than any other congeneric species in this Province. However, *R. rubrolineatus* can be distinguished from *R. changtinensis* by the following features: (1) pectoral fin rays modally 17 (vs. 16); (2) predorsal scales modally 4 (vs. 1); (3) cheek with 2 thin, oblique brown lines (vs. 3 black lines); (4) infraorbital vertical stripe bright red (vs. the stripe blackish brown); dorsal-snout stripes and infraorbital stripes bright red (vs. blackish brown); and (5) pectoral fin base without distinct dark mark in male (vs. with a deep black spot).

### *Rhinogobius sagittus*, new species

(Figs. 3, 4)

**Materials examined.** – Holotype: NTOU P 2008-06-392, 35.1 mm SL, male, Nan-shi, Minjiang basin, Shi-yang-jen, Yun-an City, Fujian Province, People's Republic of China, Coll. I-S. Chen, 25 Jun.2006.

Paratypes: NTOU P 2008-06-393, 3 ex., 30.5–35.4 mm SL, 1 male and 2 female, other data same as holotype.

**Diagnosis.** – *Rhinogobius sagittus* can be distinguished from all other congeners by the unique combination of the following features: second dorsal fin I/8; anal fin I/7; pectoral fin rays 16–17; longitudinal scale series 29–31 (modally 30); predorsal scales 3–4; vertebral count 10+16=26; gill opening restricted, extending ventrally near vertical midline of opercle; side of body with 5–6 major patches of blackish-brown clusters of irregular small spots in male; caudal fin base with either an arrow-shaped black mark or a rounded black spot in male; dorsal part of snout with a pair of deep red stripes; cheek with an arrow-shaped infraorbital red to brown curve following with 4–5 parallel, oblique brown stripes in male; branchiostegal membrane grayish with 8–10 rounded red spots in male; and pectoral fin base with semicircular creamy yellow background, and a median orange spot and vertical orange bar on lower half.

**Description.** – Body proportions in Table 1. Body cylindrical anteriorly, compressed posteriorly. Head rather large, somewhat depressed in male. Eye large, dorsolateral. Snout pointed. Cheek slightly fleshy in male. Lips thick. Mouth oblique, rear edge extending to middle of orbit in male, but merely extending to vertical of anterior edge of orbit in female. Both jaws with 3–4 rows of conical teeth, and outer rows enlarged. Tongue margin rounded. Anterior nostril in short tube and posterior nostril round. Gill opening restricted, extending ventrally near vertical midline of opercle. Vertebral count 10+16=26.

**Fins.** – D1 VI, D2 I/8; A I/7; P 16–17 (usually 16); V I/5+I/5 (distribution frequency in Table 2). D1 3rd and 4th spinous rays longest, with rear tip extending near origin of D2 when depressed in male; not extending beyond origin of D2 when depressed in female. Origin of A inserted below origin of 2nd branched ray of D2. The rear tips of D2 and A rays when depressed fall well short of procurrent rays of C. P moderate large and oblong, its rear tip extending as far as vertical line through anus in male, never reaching this vertical in female. V rounded, spinous rays with somewhat pointed membrane lobe. C elliptical, rear edge rounded.



Fig. 3. *Rhinogobius sagittus*, new species: a, male, holotype, 35.1 mm SL; b, female, paratype, 35.4 mm SL, Nan-shi, Minjiang basin, People's Republic of China.

**Scales.** – Body with moderately large ctenoid scales, anterior predorsal area naked; posterior predorsal area and belly cycloid. LR 29–31 (modally 30); TR 9–10; PreD 3–4; SDP 6–7 (modally 7). Head and prepelvic region naked. Anterior tip of midpredorsal squamation not extending to vertical through upper end of gill opening.

**Head lateral-line system.** – **Canals:** Nasal extension of anterior oculoscapular canal with terminal pore  $\sigma$  located on vertical through rear margin of anterior nostril. Anterior interorbital sections of oculoscapular canal with paired pore  $\lambda$ . A single pore  $\kappa$  in rear of interorbital region. Pore  $\omega$  present near posterior edge of eye. Lateral section of anterior oculoscapular canal with pore  $\alpha$  and terminal pore  $\rho$ . Posterior oculoscapular canal with two terminal pores  $\theta$  and  $\tau$ . Preopercular canal present, with three pores  $\gamma$ ,  $\theta$  and  $\epsilon$ . **Sensory papillae:** Row *a* extending beyond middle vertical line of orbit. Row *b* short, about one-half length of orbit. Rows *c* and *d* longer. A single *cp* papilla. Gap between two oculoacapular canals slightly larger than length of posterior oculoscapular canal. Row *f* paired. The anterior edge of opercular rows *ot* and *oi* slightly connected.

**Colouration of freshly preserved material.** – Body light brown to yellowish-brown. Side of body with some small orange spots on dorsal half and also 5–6 major patches of irregular small blackish brown spots except for last, a large round mark near caudal base in male; but with reddish-brown scale pockets on dorsal half and a series of 6–7 clusters of irregular net-like blackish-brown pattern along midline in female. Caudal fin base with either an arrow-shaped black mark or a large rounded black spot in male, a small rounded black spot in female. Head grayish-brown to pale brown. Dorsal part of snout with a pair of deep red stripes united on snout tip in male, but deep brown stripes in female. A longitudinal orange stripe just behind eye in male, but a deep brown stripe in female. Cheek with an arrow-shape infraorbital curved mark, red on upper half and reddish-brown on lower half below eye, following by 4–5 (modally 4) parallel, oblique brown stripes in male; cheek uniform brown in female. Upper lip orange. Opercle grayish-black in middle region. Branchiostegal membrane grayish with 8–10 rounded red spots in male, pale and spotless in female. First dorsal fin whitish with median grayish region and yellowish to pinkish distal margin with small black spot in front of second spinopus rays in male, but whitish with brown spinous rays and 3–4 rows of brown spots in female. Second dorsal fin whitish to grayish, with 4–5 longitudinal rows of deep brown spots. Caudal fin grayish to whitish with 4–6 vertical rows of grayish-brown spots. Pectoral fin pale white; its basal portion with semicircular creamy yellow background, and median orange spot and vertical orange bar on lower half. Pre-pectoral region blackish-brown or orange-brown on upper 2/3 region. Anal fin bright orange with distal grayish black band with outer bright white margin in male but uniform translucent in female. Pelvic fin pale white and unmarked.

**Distribution.** – This new species is only found in the following tributary: the Nan-shi in the Minjiang basin, near Shi-yang-jen Township, Yun-an City, Fujian Province, People’s Republic of China. It occurs in shallow riffles (depth 20–40 cm) with substratum of small pebbles with slow to moderate water flow.

**Etymology.** – The specific name, *sagittus*, refers to the “arrow-shape” of the infraorbital deep brown mark on anterior region of cheek in male, derived from Latin word, *sagitto* (meaning arrow).

**Remarks.** – This new species, *Rhinogobius sagittus*, shares with *R. wangi* Chen & Fang, 2006, the several parallel dark lines on the cheek in male. However, *R. sagittus* can be well distinguished from *R. wangi* by the following features: (1) longitudinal scale rows modally 30 (vs. 26–27); (2) predorsal scales 3–4 (vs. 8–9); (3) infraorbital region with an arrow-shaped red to reddish brown curved mark (vs. small square dark brown patch); (4) cheek with 4–5 oblique brown lines in male (vs. 7 oblique brown lines); and (5) lateral body with 6–7 clusters of small blackish brown spots in male (vs. without such dark clusters, but with 6–7 parallel, longitudinal deep brown stripes).

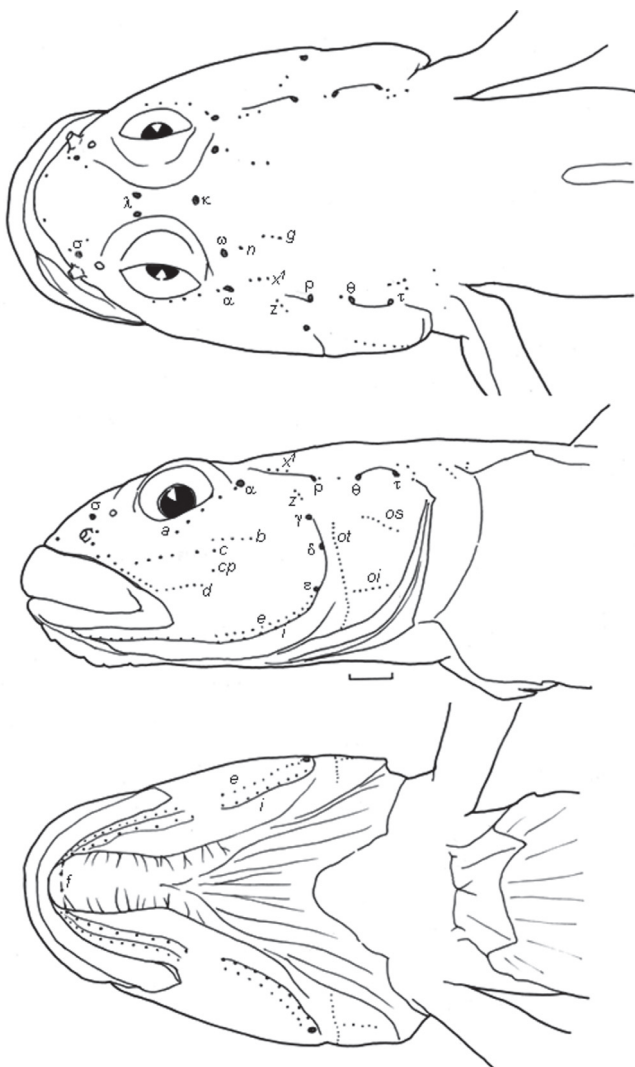


Fig. 4. Head lateral-line system of *Rhinogobius sagittus*, new species: male, holotype, 35.1 mm SL.

**Key to all valid species of *Rhinogobius*  
from Fujian Province**

- 1 Pectoral fin rays usually 19–20; predorsal scales 10–16 .....  
..... *R. leavelli* (Herre, 1935) (Hanjiang basin)
- Pectoral fin rays no more than 18; predorsal scales 0–7 .... 2
- 2 Cheek with many rounded spots, branchiostegal membrane  
with several parallel red stripes in male .....  
..... *R. reticulatus* Li & Zhong, 2007 (Minjiang basin)
- Cheek and branchiostegal membrane without such marks ....  
..... 3
- 3 Pore  $\omega$ 1 present, pectoral fin base with reticulated orange  
pattern in male .....  
..... *R. xianshuiensis* Chen et al., 1999 (Mulan River basin)
- Pore  $\omega$ 1 absent, pectoral fin base without such pattern .... 4
- 4 Infraorbital stripe short and not extending ventrally to edge of  
upper lip in male ..... 5
- Infraorbital stripe long and well extending backward to edge  
of upper lip or lower edge of cheek ..... 6
- 5 Pectoral fin rays modally 17; pectoral fin base with one dark  
bar; 27 vertebrae .....  
..... *R. longyanensis* Chen et al., 2008 (Julongjiang basin)
- Pectoral fin rays modally 16; pectoral fin base with two rounded  
dark spots; 28 vertebrae .....  
.. *Rhinogobius ponkouensis* Huang & Chen, 2007 (Hanjiang  
basin)
- 6 Cheek with a conspicuous arrow-shaped, red to reddish brown  
infraorbital mark always following by 4 oblique dark stripes  
in male ..... *R. sagittus*, new species (Minjiang basin)
- Cheek with 2–3 oblique dark stripes in male ..... 7
- 7 Pectoral fin rays modally 16; predorsal scale modally 1; cheek  
with 3 thin black lines; blackish brown dorsal-snout stripes  
and infraorbital stripes; snout and lips grayish brown; 27  
vertebrae .....  
..... *R. changtinensis* Huang & Chen, 2007 (Hanjiang basin)
- Pectoral fin rays modally 17; predorsal scales modally 4; cheek  
with 2 thin brown lines; bright red dorsal-snout stripes and  
infraorbital stripes; lateral snout and upper lip pink orange in  
male; 26 vertebrae .....  
..... *R. rubrolineatus*, new species (Minjiang basin)

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### Appendix I

#### Comparative material

*Rhinogobius leavelli* (Herre, 1935)  
NTOU P 2006-4-470, 2 ex., 28.6–30.9 mm SL, Mei-Chou City, Hanjiang River basin, Guangdong Province, People's Republic of China, Coll. J. H. Wu & J. W. Wang, Apr.2004. NTOU P- 2006-4-271, 2 ex., 50.8–51.1 mm SL, Mu-Loon, Lieojiang, Xijiang, Pearl River basin, Guangdong Province, People's Republic of China, Coll. B. Chen et al., Oct.2002.

*Rhinogobius xianshuiensis* Chen et al., 1999  
Holotype: ASIZP057440, 29.6 mm SL, small unnamed tributary of Xianshui Brook, about 25 km north of Xianyou, Xianyou County, Fujian Province, People's Republic of China, Coll. I-S. Chen, 19 Aug.1994.

Paratypes: ASIZP057441, 17 ex., 20.7–35.0 mm SL, data same as holotype above. ASIZP0577442, 2 ex., 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, People's Republic of China, Coll. I-S. Chen, 10 Sep.2002.

Paratypes.- NTOU P 2005-7-010, 4 ex., 28.7–30.3 mm SL, all remaining data same as holotype above. ASIZP0066341, 26.2 mm SL, all remaining data same as holotype above.

*Rhinogobius changtinensis* Huang & Chen, 2007

Holotype: ZRC-50527, 34.1 mm SL, small hill-stream near the free way terminal, tributary near Chang-Ting county, Hanjiang basin, Fujian Province, People's Republic of China, Coll. I-S. Chen, 10 Sep.2002.

Paratypes: NTOU P 2005-7-011, 7 ex., 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: NTOU P 2006-3-465, 40.7 mm SL, male, a small tributary of Long-Chuang River in the Julongjiang basin, Dong-Shiao, Longyan City, Fujian Province, People's Republic of China, Coll. I-S. Chen, 10 Sep.2002.

Paratypes: ASIZP 0067105, 2 ex., 29.3–35.1 mm SL, collected with holotype. BLIH 20020548, 42.5 mm SL, collected with holotype. BLIH 20020549, 33.8 mm SL, collected with holotype. NTOU P 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, People's Republic of China, Coll. I-S. Chen, 15 Sep.2002.

### LITERATURE CITED

- Akihito, Prince, M. Hayashi & T. Yoshino, 1984. *Suborder Gobioidae*. In: Masuda, H., K. Amaoka, C. Araga, T. Uyeno, & T. Yoshino, (eds.) *The fishes of Japanese Archipelago*. Tokai University Press, Tokyo, Pp. 228–289.
- Akihito, A. Iwata, K. Sakamoto & Y. Ikeda, 1993. *Suborder Gobioidae*. In: Nakabo, T. (ed.) *Fishes of Japan with pictorial key in the species*. Tokai University Press, Tokyo, Pp. 997–1392 [in Japanese].
- Akihito, K. Sakamoto, Y. Ikeda & K. Sugiyama, 2002. *Suborder Gobioidae*. In: Nakabo, T. (ed.) *Fishes of Japan with pictorial key in the species, 2nd edn*. Tokai University Press, Tokyo, Pp. 1139–1310.
- Aonuma, Y. & I-S. Chen, 1996. Two new species of *Rhinogobius* (Pisces, Gobiidae) from Taiwan. *Journal of Taiwan Museum*, **49**: 7–16.
- Chen, I-S., Y. H. Cheng & K. T. Shao, 2008. A new species of *Rhinogobius* (Teleostei: Gobiidae) from the Julongjiang Basin in Fujian Province, China. *Ichthyological Research*, **55**: 335–343.
- Chen, I-S. & L. S. Fang, 1999. *The freshwater and estuarine fishes of Taiwan*. National Museum of Marine Biology & Aquarium Press, Pingtung, 288 pp. [in Chinese].

- Chen, I-S. & L. S. Fang, 2006. A new species of *Rhinogobius* (Teleostei: Gobiidae) from the Hanjiang basin, in Guangdong Province, China. *Ichthyological Research*, **53**: 247–253.
- Chen, I-S. & M. Kottelat, 2000. *Rhinogobius maculicervix*, a new species of goby from the Mekong basin in northern Laos. *Ichthyological Exploration of Freshwaters*, **11**: 81–87.
- Chen, I-S. & M. Kottelat, 2003. Three new freshwater gobies of the genus, *Rhinogobius* (Teleostei: Gobiidae) from northeastern Laos. *The Raffles Bulletin of Zoology*, **51**: 87–95.
- Chen, I-S. & M. Kottelat, 2005. Four new freshwater gobies of the genus *Rhinogobius* (Teleostei: Gobiidae) from northern Vietnam. *Journal of Natural History*, **39**: 1407–1429.
- Chen, I-S., M. Kottelat & P. J. Miller, 1999a. Freshwater gobies of the genus *Rhinogobius* from the Mekong basin in Thailand and Laos, with descriptions of three new species. *Zoological Studies*, **38**: 19–32.
- Chen, I-S. & P. J. Miller, 1998. Redescription of *Gobius davidi* (Teleostei: Gobiidae) and comparison with *Rhinogobius lentiginis*. *Cybium*, **22**: 211–221.
- Chen, I-S., P. J. Miller & L. S. Fang, 1998. A new species of freshwater goby from Lanyu (Orchid Island), Taiwan. *Ichthyological Exploration of Freshwaters*, **9**: 255–261.
- Chen, I-S., P. J. Miller, H. L. Wu & L. S. Fang, 2002. Taxonomy and mitochondrial sequence evolution in non-diadromous species of *Rhinogobius* (Teleostei: Gobiidae) of Hainan Island, southern China. *Marine and Freshwater Research*, **53**: 259–273.
- Chen, I-S. & K. T. Shao, 1996. A taxonomic review of the gobiid fish genus *Rhinogobius* Gill, 1859, from Taiwan with descriptions of three new species. *Zoological Studies*, **35**: 200–214.
- Chen, I-S., H. L. Wu & K. T. Shao, 1999b. A new species of *Rhinogobius* (Teleostei: Gobiidae) from Fujian Province, China. *Ichthyological Research*, **46**: 171–178.
- Chen, I-S., J. X. Yang & Y. R. Chen, 1999c. A new species of *Rhinogobius* (Teleostei: Gobiidae) from the Honghe basin, Yunnan Province. *Acta Zoologica Taiwanica*, **10**: 45–52.
- Chu, Y. T. & H. L. Wu, 1965. A preliminary study of the zoogeography of gobioid fishes of China. *Oceanology and Limnology Sinica*, **7**: 122–140 [in Chinese].
- Gill, T. N., 1859. Notes on a collection of Japanese fishes by Dr. J. Morrow. *Proceedings of Academy of Natural Sciences Philadelphia*, **11**: 144–159.
- Herre, A. W. C. T., 1927. Gobies of Philippines and China Sea. *Monograph of Bureau Science Manila*, **23**: 1–352.
- Herre, A. W. C. T., 1935. Note on the fishes in the Zoological Museum of Stanford University, new and rare Hongkong fishes obtained in 1934. *Hong Kong Naturalist*, **6**: 285–293.
- Huang, S. P. & I-S. Chen, 2007. Three new species of *Rhinogobius* Gill, 1859 (Teleostei: Gobiidae) from the Hanjiang basin, southern China. *The Raffles Bulletin of Zoology*, Supplement **14**: 101–110.
- Iguchi, K. & N. Mizuno, 1991. Mechanism of embryonic drift in the amphidromous goby, *Rhinogobius brunneus*. *Environmental Biology of Fishes*, **31**: 295–300.
- Lee, S. C. & L. T. Chang, 1996. A new goby, *Rhinogobius rubromaculatus* (Teleostei: Gobiidae) from Taiwan. *Zoological Studies*, **35**: 30–35.
- Li, F. & J. S. Zhong, 2007. A new *Rhinogobius* species from Zhejiang Province, China (Teleostei: Gobiidae). *Zoological Research*, **28**: 539–544 [in Chinese with English summary].
- Li, F., J. S. Zhong & H. L. Wu, 2007. A new species of the genus *Rhinogobius* from Fujian Province, China (Teleostei: Gobiidae). *Acta Zootaxonomica Sinica*, **32**: 981–985 [in Chinese with English summary].
- Masuda, Y., T. Ozawa & S. Enami, 1989. Genetic differentiation among eight color types of the freshwater goby, *Rhinogobius brunneus*, from western Japan. *Japanese Journal of Ichthyology*, **36**: 30–41.
- Miller, P. J., 1998. New species of *Coryrogobius*, *Thorogobius*, and *Wheelerigobius* from West Africa (Teleostei: Gobiidae). *Journal of Natural History*, **22**: 1245–1262.
- Mizuno, N. & A. Goto, 1987. *Japanese freshwater fishes, and their distribution, variation and speciation*. Tokai University Press, Tokyo, 244 pp. [in Japanese].
- Mizuno, N., 1960. Description of a new freshwater goby from Japan. *Memoires of the College Science, University of Kyoto, Series B* **27**: 117–119.
- Sanzo, L., 1911. Distribuzione delle papille cutanee (organi ciatiforme) e suo valore sistematico nei gobi. *Mitteilungen aus der Zoologischen Station zu Neapel*, **20**: 249–328.
- Takahashi, S. & T. Okazaki, 2002. A new lentic form of the Yoshinobori species complex, *Rhinogobius* spp. From Lake Biwa, Japan, compared with lake-river migrating *Rhinogobius* sp. OR. *Ichthyological Research*, **49**: 333–339.
- Wongrat, P. & P. J. Miller, 1991. The innervation of head neuromast rows in eleotridine gobies (Teleostei: Gobioidi). *Journal of Zoology, London*, **225**: 27–42.
- Wu, H. L. & Y. Ni, 1986. *Gobiidae*. In Anonymous (ed.), *The freshwater and estuarine fishes of Hainan Island*. Guangdong Science and Technology Press, Guangzhou, Pp. 259–314 [in Chinese].
- Yang, J. Q., H. L. Wu & I-S. Chen, 2008. A new species of *Rhinogobius* (Teleostei: Gobiidae) from Feiyunjiang basin in Zhejiang Province, China. *Ichthyological Research*, **55**: 379–385.
- Zheng, M. L. & H. L. Wu, 1985. A study of freshwater gobiid fishes of Zhejiang Province, China, with descriptions of two new species. *Acta Zootaxonomica Sinica*, **10**: 328–333 [in Chinese with English summary].