

A new species of *Rhinogobius* (Teleostei: Gobiidae) from the Julongjiang Basin in Fujian Province, China

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Abstract Ten specimens of a new freshwater goby, *Rhinogobius longyanensis* were collected from the small tributary of the Julongjiang Basin, Fujian Province, south-eastern China. The new species can be distinguished from all congeneric species by following unique combination of features: second dorsal fin rays I, 8; anal fin rays I, 7–8; pectoral fin rays modally 17; longitudinal scale series 30–32; predorsal scales 6–8; vertebral count $10 + 17 = 27$; three parallel, deep brown oblique stripes crossing on cheek; branchiostegal membrane with 24–28 orange red spots in male; body with 5–6 deep brown blotches; pectoral fin base with a blackish brown bar. A diagnostic key to all nominal species with high vertebral counts from mainland Southeast Asia, China, Taiwan, and Japan is also provided.

Keywords Gobiidae · *Rhinogobius longyanensis* sp. nov. · Higher vertebral count · China · Fish taxonomy

Introduction

The Asiatic freshwater goby genus *Rhinogobius* Gill 1859 is widely distributed on some islands of the western Pacific, including Japan (Akihito Prince et al. 1984; Akihito et al. 1993, 2002; Masuda et al. 1989; Yoshigou 2003), Taiwan

(Aonuma and Chen 1996; Chen and Shao 1996; Lee and Chang 1996; Chen et al. 1998), Hainan (Wu and Ni 1986; Chen et al. 2002), Philippines (Herre 1927), and also in continental Asia, in Russia, Korea, China, Vietnam, Laos, Cambodia, and Thailand (Kottelat 1989; Chen and Miller 1998; Chen et al. 1999a, b, c; Chen and Kottelat 2000, 2003; Sakai et al. 2000; Chen and Fang 2006; Huang and Chen 2007). The life histories of *Rhinogobius* species indicate that the genus includes mainly amphidromous species and nondiadromous, landlocked, fluvial species (Mizuno 1960; Mizuno and Goto 1987; Iguchi and Mizuno 1991; Akihito et al. 1993, 2002) as well as lake–river migratory species and lentic species in Lake Biwa, Japan (Takahashi and Okazaki 2002). So far, the first author (ISC) estimates that at least 70 species are known in eastern and southeastern Asia and some of them still need formal description (Akihito et al. 2002; Chen and Kottelat 2003, 2005).

In southern and southeastern mainland China, most known species of *Rhinogobius* belong to nondiadromous, landlocked species with large egg sizes (Chen and Miller 1998; Zhong and Tzeng 1998; Chen et al. 1999b, c; Chen et al. 2002). Most of them usually have a high vertebral count of 27–29, like that of Japanese endemic, landlocked, fluvial Kawa-yoshinobori, *Rhinogobius flumineus* (Mizuno 1960), with at least two different, endemic geographical phenotypes (Yoshigou 2003).

So far, only two nondiadromous, fluvial species with high vertebral count have been found in the insular streams and rivers of Japan and Taiwan as *Rhinogobius flumineus* and *Rhinogobius rubromaculatus* Lee and Chang 1996 respectively.

Around continental Asia, the highest species diversity of fluvial species with high vertebral counts (27–29) can be found in the running freshwaters of mainland China. There

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are 20 nominal, valid species, as follows: *Rhinogobius davidi* (Sauvage and Dabry de Thiersant 1874), *Rhinogobius cheni* (Nichols 1931), *Rhinogobius lindbergi* Berg 1933, *Rhinogobius duosplius* (Herre 1935), *Rhinogobius henryi* (Herre 1938), *Rhinogobius filamentosus* (Wu 1939), *Rhinogobius szechuanensis* (Tchang 1939), *Rhinogobius multimaculatus* (Wu and Zheng in Zheng and Wu 1985), *Rhinogobius lentiginis* (Wu and Zheng in Zheng and Wu 1985), *Rhinogobius yaoshanensis* (Luo 1989a), *Rhinogobius parvus* (Luo 1989b), *Rhinogobius genanematus* Zhong and Tzeng 1998, *Rhinogobius xianshuiensis* Chen, Wu, and Shao 1999b, *Rhinogobius honghensis* Chen, Yang, and Chen 1999c, *Rhinogobius linshuiensis* Chen, Miller, Wu, and Fang 2002, *Rhinogobius wangchuangensis* Chen, Miller, Wu, and Fang 2002, *Rhinogobius wangi* Chen and Fang 2006, *Rhinogobius changtinensis* Huang and Chen 2007, *Rhinogobius lungwoensis* Huang and Chen 2007, *Rhinogobius ponkouensis* Huang and Chen 2007.

Furthermore, tropical mainland southeastern Asia (including Vietnam, Laos, Thailand), is another important area with a very high diversity of fluvial species of high vertebral count (27–28). There are 11 nominal species, as follows: *Rhinogobius chiengmaiensis* Fowler 1934, *Rhinogobius mekongianus* Pellegrin and Fang 1940, *Rhinogobius albimaculatus* Chen, Kottelat, and Miller 1999a, *Rhinogobius lineatus* Chen, Kottelat, and Miller 1999a, *Rhinogobius taenigena* Chen, Kottelat, and Miller 1999a, *Rhinogobius maculicervix* Chen and Kottelat 2000, *Rhinogobius milleri* Chen and Kottelat 2003, *Rhinogobius nammaensis* Chen and Kottelat 2003, *Rhinogobius vermiculatus* Chen and Kottelat 2003, *Rhinogobius boa* Chen and Kottelat 2005, and *Rhinogobius sulcatus* Chen and Kottelat 2005, which have been described in recent 9 years.

In the Julongjiang basin, which originates in the southwestern region in Fujian Province, there were no well-preserved collections of small freshwater gobies of *Rhinogobius* before our field trip investigating freshwater fish fauna in September 2002. Here we describe an endemic and new species from this basin which possesses a high vertebral count. A diagnostic key to all nominal species of *Rhinogobius* with high vertebral count from mainland southeastern Asia, China, Taiwan, and Japan is also provided.

Materials and methods

Type specimens of the new species were collected by hand-net. All counts and measurements were made from specimens preserved in 70% ethanol. Morphometric methods follow Miller (1998) and meristic methods follow Akihito Prince et al. (1984), Chen and Shao (1996), and Chen et al.

(1999b). Terminology of cephalic sensory canals and free neuromast organs (sensory papillae) is from Wongrat and Miller (1991), based on Sanzo (1911). All fish lengths are expressed in standard lengths (SL). The meristic values of the holotypes are marked with underlines in the following description.

The type specimens were deposited in the Biodiversity Research Center, Academia Sinica, Taipei (ASIZ P), the Biological Laboratory, Imperial Household, Tokyo (BLIH), and the Pisces collection of the National Taiwan Ocean University, Keelung (NTOU P). The comparative materials were examined or borrowed from the following institutions: American Museum of Natural History, New York (AMNH); Australian Museum, Sydney (AMS); American Museum of Natural Science, Philadelphia (ANSP); British Museum of Natural History, London (BMNH); California Academy of Sciences (CAS); Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University, Hakodate (HUMZ); Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan (IHASW).

Rhinogobius longyanensis sp. nov. (Figs. 1–3, Tables 1, 2)

Holotype. NTOU P 2006-03-465, 40.7 mm SL, male, a small tributary of Long-Chuang River in the Julongjiang Basin, Dong-Shiao, Long-Yan City, Fujian Province, China, 10 September 2002, coll. by I-S. Chen.

Paratypes. ASIZP 0067105, 2 specimens, 29.3–35.1 mm SL, males, collected with holotype (2 originally from NTOU P 2006-03-468); BLIH 20020548, 1 specimen, 42.5 mm SL, male, collected with holotype (originally from NTOU P 2006-03-466 + 468); BLIH 20020549, 1 specimen, 33.8 mm SL, male, collected with holotype (originally from NTOU P 2006-03-466 + 468); NTOU P 2006-03-467, 5 specimens, 28.7–35.5 mm SL, males, a small tributary of Shi-Nan River in the Julongjiang Basin, Shi-Nan, Jarn-Ping, Long-Yan City, Fujian Province, China, 15 September 2002, coll. by I-S. Chen.

Diagnosis. *Rhinogobius longyanensis* can be distinguished from all other species of *Rhinogobius* by the unique combination of the following characters: second dorsal fin rays I, 8; anal fin rays I, 7–8; pectoral fin rays modally 17; longitudinal scale rows 30–32; predorsal scales 7–8; and vertebral count $10 + 17 = 27$; body with 5–6 blackish brown blotches; 3 parallel, deep brown oblique stripes crossing on cheek in male; branchiostegal membrane with 24–28 shiny orange red spots in male; pectoral fin base with a horizontal, deep black bar which is sharply pointed posteriorly.

Description. Body proportions are described in Table 1. Body rather cylindrical anteriorly, compressed posteriorly. Head moderately large, quite depressed in male. Eye small,

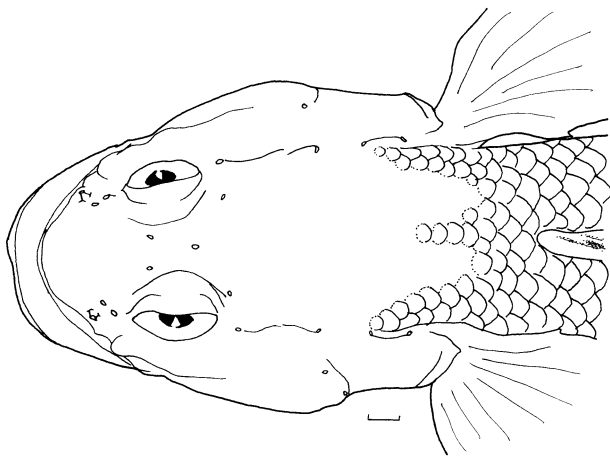


Fig. 1 Predorsal squamation of *Rhinogobius longyanensis* sp. nov., holotype, NTOU P 2006-03-465, 40.7 mm SL, male, Julongjiang Basin, Fujian Province, China. Bar 1 mm

dorsolateral. Snout tip pointed in dorsal view. Cheek very fleshy in male. Lips thick. Mouth oblique, rear edge extending near the vertical line through the middle of pupil in male. Both jaws with 3–4 rows of taper teeth, and outer rows enlarged. Anterior margin of tongue rounded. Anterior nostril a short tube and posterior nostril a round hole. Gill opening extends near vertical from margin of preopercle. Isthmus broad. $10 + 17 = 27$ (10 specimens) vertebrae.

Fins. First dorsal fin rays VI (10); second dorsal fin rays I, 8 (10); anal fin rays I, 6 (1), I, 7 (4), I, 8 (5); pectoral fin rays 17 (14), 18 (4). First dorsal fin with third and fourth spinous rays longest, and its rear tip extending to base of 1st branched ray of D2 when depressed in male. Origin of anal fin inserted below origin of 2nd branched ray of second dorsal fin. The rear tips of both second dorsal fin and anal fin rays when depressed do not reach the procurrent rays of caudal fin. Pectoral fin large and oblong, its rear margin extending to vertical through anus in male. Pelvic fin disc rounded, spinous rays with pointed membranous lobe. Caudal fin elliptical, rear edge rounded.

Scales. Body with rather large ctenoid scales, anterior predorsal area naked; posterior predorsal region and belly cycloid; longitudinal scale rows 30 (10), 31 (8), 32 (2); transverse scale rows 8 (1), 9 (8), 10 (1); predorsal scales 6 (1), 7 (8), 8 (1); scales between pectoral and first dorsal fin origin 7 (9), 8 (1). Head and prepelvic region naked. Predorsal squamation with trifurcate anterior edge, anterior tip of midpredorsal squamation reaching to a vertical line through gap between the anterior and posterior oculoscapular canals (Fig. 1).

Head lateral line system (Fig. 2): **Canals.** Nasal extension of anterior oculoscapular canal as pores σ . Anterior interorbital sections of oculoscapular canal separated, with paired pores λ . A single pore κ on posterior interorbital region. Pore κ present near posterior edge of eye. Lateral

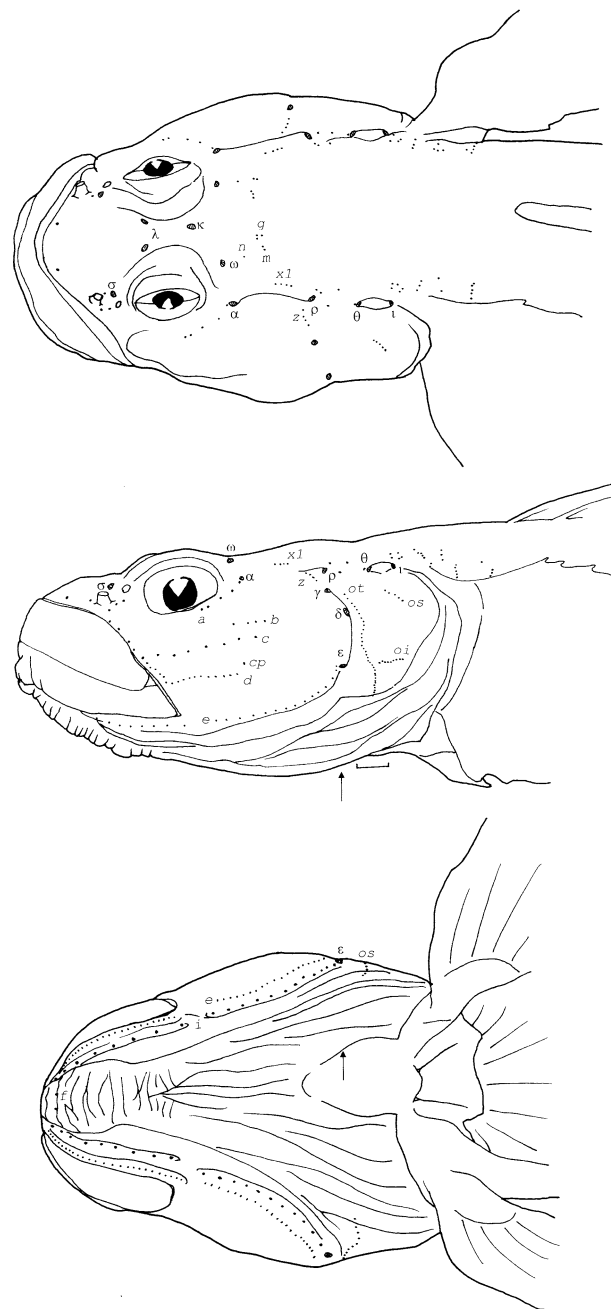


Fig. 2 Head lateral line system of *Rhinogobius longyanensis* sp. nov., holotype, NTOU P 2006-03-465, 40.7 mm SL, male, Julongjiang Basin, Fujian Province, China. Bar 1 mm

section of anterior oculoscapular canal with pores α and terminal pore ρ . Posterior oculoscapular canal with two terminal pores θ and τ . Gap between anterior and posterior oculoscapular canals slightly greater than the length of posterior oculoscapular canal. Preopercular canal present, with three pores γ , δ , and ε . **Head papillae.** Row *a* extending near vertical through middle of orbit. Row *b* short, about half the length of orbit. Rows *c* and *d* long, row *c* extends beyond the vertical of pore α . A single *cp* papilla.



Fig. 3 *Rhinogobius longyanensis* sp. nov. **a** Lateral view of holotype, NTOU P2006-03-465, 40.7 mm SL, male. **b** Ventral view of paratype, BLIH 20020548, 42.5 mm SL, male

Row *f* as a pair of papillae. The anterior edge of opercular rows *oi* and *ot* slightly separated. Row *os* short and well separated from row *ot*.

Coloration in fresh preservative (Fig. 3). Head and body brown to deep brown. Body with 5–6 lateral blackish brown blotches. Blotches wider than interspaces. Belly pale brown. Dorsal region darker on upper 2/3 region. Dorsal side of snout with a pair of blackish to reddish brown lines united at tip of snout. A small, square brownish black mark below eye. Nape with a few irregular brown spots. A series of three parallel, long deep brown stripes positioned from upper anterior region downward to posterior region covered on cheek. Branchiostegal membrane grayish yellow with 24–28 (25–26) shiny orange red spots in male. First dorsal fin light brown with deep brown spinous rays; the membrane with two deep black spots in male between anterior two spinous rays. Second dorsal fin pale white with 3–4 horizontal rows of deep brown spots and with distal white margin. Anal fin gray with distal black line and with white margin in male. Caudal fin base with a large brownish black mark that is somewhat larger than the pupil. A light white spot just above the mark of the caudal fin base. Caudal fin with dark gray membrane usually in lacking distinct dark spots. Pectoral fin grayish with a horizontal, deep black bar which is sharply pointed posteriorly near the fin base, and the basal region with a light grayish yellow semicircular mark and distal 2/3 region as grayish black. Pelvic fin blackish brown.

Distribution. Known only from small tributaries near Dong-Shiao and Shi-Nan, Long-Yan City, Julongjiang

Basin, Fujian Province, China. This species should be endemic only within this basin.

Etymology. The specific name, *longyanensis*, refers to the type locality of “Long-Yan City,” Julongjiang Basin in Fujian Province, China.

Remarks. Although the current collection of this new goby from Julongjiang Basin contains only male specimens, most species of *Rhinogobius* from south China represent diagnostic features from males rather than females, especially for coloration pattern, which may strongly link to the courtship of mating. It will be necessary to obtain females when specimens become available in the near future to create a comprehensive record and coloration notes. However, the key to all valid species of *Rhinogobius* species from the assigned region, given below, is based only on comparison with the male features from the new species.

Among the 33 nominal species of *Rhinogobius* fauna with high vertebral count (27–29) in mainland SE Asia, China, Taiwan, and Japan, this new species, *Rhinogobius longyanensis*, can be immediately distinguished from the following five species with reduced head canal systems (see Fig. 2): as *R. davidi*, *R. lentiginis*, *R. multimaculatus*, *R. rubromaculatus* and *R. szechuanensis*. The new species, *Rhinogobius longyanensis*, can also be well distinguished from *R. lindbergi* since it normally has three pores on preopercular canals versus the two terminal pores present on the other species. *Rhinogobius longyanensis* shares the higher morphological similarity of the species group, *R. duospilus* complex which characterized with oblique-striped cheek in

Table 1 Morphometry of *Rhinogobius longyanensis* sp. nov. from Fujian Province, China

Sex	Male	Males	
Number of specimens	1	9	10
Types	Holotype	Paratypes	
Size (mm SL)	40.7	28.7–42.5	
% SL			
			Mean
Head length	32.3	31.5–32.8	32.3
Predorsal length	39.2	37.7–39.7	38.6
Snout to 2nd dorsal fin origin	58.2	55.7–60.1	58.1
Snout to anal fin origin	61.1	59.0–62.2	60.9
Snout to anus	57.9	55.7–58.0	57.1
Prepelvic length	31.8	30.8–32.5	31.8
Caudal peduncle length	18.9	18.9–21.4	20.0
Caudal peduncle depth	11.0	11.0–12.8	12.0
1st dorsal fin base	19.3	15.3–19.3	16.5
2nd dorsal fin base	19.2	19.0–20.9	19.8
Anal fin base	15.2	14.8–16.6	15.8
Caudal fin length	21.8	21.5–25.0	23.6
Pectoral fin length	22.6	22.5–25.5	24.4
Pelvic fin length	16.7	14.9–18.8	16.8
Body depth of pelvic fin origin	15.2	15.2–17.3	16.3
Body depth of anal fin origin	15.7	15.1–16.9	16.0
Body width of anal fin origin	12.3	11.0–14.8	13.2
Pelvic fin origin to anus	28.3	24.1–28.3	26.3
% HL			
Snout length	32.4	30.6–32.7	31.6
Eye diameter	18.8	18.3–21.6	19.5
Cheek depth	35.0	34.3–38.5	36.2
Postorbital length	57.7	54.9–57.7	56.0
Head width in upper gill opening	51.7	51.7–55.6	53.4
Head width (maximum)	72.8	69.4–72.8	71.2
Fleshy interorbital width	39.1	35.4–39.8	38.1
Bony interorbital width	9.2	8.3–10.5	9.1
Lower jaw length	34.5	32.0–36.9	34.0
% Caudal peduncle length			
Caudal peduncle depth	58.3	58.1–61.3	60.1

adult male as following eight nominal species: *R. changtinensis*, *R. duospilus*, *R. genanematus*, *R. henryi*, *R. lungwoensis*, *R. ponkouensis*, *R. sulcatus*, and *R. wangi* compared to the remaining 20 nominal species with 27–28 vertebrae. *Rhinogobius longyanensis* can be well separated from *R. genanematus* due to its higher counts of pectoral fin rays modally 17 (vs. 15 in *R. genanematus*), modally 3 diagonal long deep brown stripes from the anterior region downward to the posterior region on cheek in male (vs. 3 diagonal oblique stripes in the opposite direction from the posterior region downward to the anterior region on cheek in male), respectively. *Rhinogobius longyanensis* can also be

differentiated from *R. wangi* by having higher counts of pectoral fin rays modally, 17 (vs. 16 in *R. wangi*), higher counts of longitudinal scale rows, always 30–31 (vs. 26–27), modally 3 diagonal long deep brown stripes on the cheek in male (vs. modally 7 diagonal stripes on the cheek in male); and no longitudinal dark lines on lateral side of body (vs. 6–7 longitudinal dark lines present on lateral). *Rhinogobius longyanensis* can be differentiated from *R. sulcatus* by having higher counts of pectoral fin rays modally 17 (vs. 15 in *R. sulcatus*), unmarked opercle (vs. opercle with two oblique dark bars), and a pectoral fin base with a horizontal deep black bar which is sharply pointed posteriorly (vs. two rounded black spots). *Rhinogobius longyanensis* can be distinguished from both *R. lungwoensis* and *R. ponkouensis* by higher counts of pectoral fin rays 17 (vs. modally 16 in those two species), lower number of vertebrae 27 (vs. 28), and modally three oblique stripes on cheek in male (vs. modally 1–2 oblique stripes on cheek in male), and pectoral fin mark with a horizontal deep black bar which is sharply pointed posteriorly (vs. two rounded black spots). *Rhinogobius longyanensis* can be distinguished from *R. changtinensis* by more pectoral fin rays 17 (vs. modally 16 in *R. changtinensis*), more predorsal scales as 6–8 (vs. modally only 1), and the infraorbital region is a small, square brownish black mark (vs. a vertical dark brown line). *Rhinogobius longyanensis* can be distinguished from *R. henryi* by more predorsal scales as 6–8 (vs. entirely naked predorsal midline in *R. henryi*), lower number of vertebrae 27 (vs. 28), and a pectoral fin mark with a horizontal deep black bar which is sharply pointed posteriorly (vs. two rounded black spots). *Rhinogobius longyanensis* can be distinguished from *R. duospilus* by a pectoral fin base with a horizontal deep black bar which is sharply pointed posteriorly (vs. always two dark brown marks on the basal region in *R. duospilus*), and round-spotted branchiostegal membrane in male (vs. stripe-marked branchiostegal membrane).

In mainland China, it appears that further field surveys are still needed for this genus, especially in river basins from the Yangtsi to Pearl River (Juiang) basins around southeastern China.

Diagnostic key to nominal species of *Rhinogobius* with high vertebral counts (27–29) in mainland SE Asia (Thailand to Vietnam), China, Taiwan, and Japan

- 1a. Head without head canals and pores..... 2
- 1b. Head at least with an anterior oculoscapular canal..... 3
- 2a. Second dorsal fin rays I, 9; anal fin rays I, 8; lateral body as dark brown net-like pattern; pectoral fin base with a vertical blackish brown bar.....
..... *R. szechuanensis* (Szechuan Province, China)

Table 2 Comparison of vertebral count and head canal pores among 34 *Rhinogobius* species with high vertebral counts (27–29) in mainland SE Asia (Thailand to Vietnam), China, Taiwan, and Japan

Species	Number of vertebrae	Head canal pores												Sources
		σ	λ	κ	ω	$\omega 1$	α	ρ	θ	τ	γ	θ	ε	
<i>R. longyanensis</i> sp. nov.	27	2	2	1	2	–	2	2	2	2	2	2	2	This paper
<i>R. albimaculatus</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (1999a)
<i>R. boa</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen and Kottelat (2005)
<i>R. changtinensis</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Huang and Chen (2007)
<i>R. cheni</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	This paper
<i>R. chiengmaiensis</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	This paper
<i>R. davidi</i>	28	2	–	1	–	–	2	–	–	–	–	–	–	Chen and Miller (1998)
<i>R. duospilus</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Huang and Chen (2007)
<i>R. filamentosus</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	This paper
<i>R. flumineus</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (1999b)
<i>R. genanematus</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen and Fang (2006)
<i>R. henryi</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	This paper
<i>R. honghensis</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (1999c)
<i>R. lentiginis</i>	27	–	–	–	–	–	–	–	–	–	–	–	–	Chen and Miller (1998)
<i>R. lindbergi</i>	27	2	2	1	2	–	2	2	2	2	2	–	2	This paper
<i>R. lineatus</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (1999a)
<i>R. linshuiensis</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (2002)
<i>R. lungwoensis</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Huang and Chen (2007)
<i>R. maculacervix</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Chen and Kottelat (2000)
<i>R. mekongianus</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (1999a)
<i>R. milleri</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen and Kottelat (2003)
<i>R. multimaculatus</i>	29	2	–	1	–	–	2	–	–	–	–	–	–	Chen and Miller (1998)
<i>R. nammaensis</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Huang and Chen (2007)
<i>R. parvus</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	This paper
<i>R. ponkouensis</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Huang and Chen (2007)
<i>R. rubromaculatus</i>	27	2	–	1	–	–	2	–	–	–	–	–	–	Chen and Shao (1996)
<i>R. szechuanensis</i>	27	–	–	–	–	–	–	–	–	–	–	–	–	This paper
<i>R. sulcatus</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen and kottelat (2005)
<i>R. taenigena</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (1999a)
<i>R. vermiculatus</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	Chen and Kottelat (2003)
<i>R. wangchuangensis</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen et al. (2002)
<i>R. wangi</i>	27	2	2	1	2	–	2	2	2	2	2	2	2	Chen and Fang (2006)
<i>R. xianshuiensis</i>	27	2	2	1	2	2	2	2	2	2	2	2	2	Chen et al. (1999b)
<i>R. yaoshanensis</i>	28	2	2	1	2	–	2	2	2	2	2	2	2	This paper

1 single pore, 2 paired double pores, – no such pores

- 2b. Second dorsal fin rays I, 8; anal fin rays I, 7; lateral side with 6–7 dark brown blotches; pectoral fin base with a horizontal dark brown mark.....
..... *R. lentiginis* (Zhejiang Province, China)
- 3a. Preopercular canal and posterior oculoscapular canal absent..... 4
- 3b. Preopercular canal and posterior oculoscapular canal present..... 6
- 4a. Predorsal midline naked..... 5
- 4b. Predorsal scales 9–12... *R. rubromaculatus* (Taiwan)
- 5a. Longitudinal scale rows 35–36; second dorsal fin rays I, 10; cheek with many tiny black spots...
.....*R. multimaculatus* (Zhejiang Province, China)
- 5b. Longitudinal scale rows 30–31; second dorsal fin rays I, 9; cheek spotless.....
..... *R. davidi* (Zhejiang Province, China)

- 6a. Postorbital region usually with paired pores ω and ω_1 ; opercle with red reticulation.....
..... *R. xianshuiensis* (Fujian Province, China)
- 6b. Postorbital region merely with paired pore ω 7
- 7a. Preopercular canal merely with 2 terminal pores...
..... *R. lindbergi* (Amur River basin, China)
- 7b. Preopercular canal always with 3 pores..... 8
- 8a. Scales between first dorsal and upper pectoral fin origins 9–11; caudal fin with basal large vertical “<”-shaped brownish black mark at least in female which occupied more than 2/3 depth of caudal fin base.... 9
- 8b. Scales between first dorsal and upper pectoral fin origins 5–8; caudal fin without such large-size vertical dark mark in both sexes..... 10
- 9a. First dorsal fin with 4th ray longest and large, square bluish-black mark on anterior 2/3 of first dorsal fin in male..... *R. flumin-eus* (blotch dorsal form) (Honshu and Kyushu, Japan)
- 9b. First dorsal fin with 2nd and 3rd rays longest and pale lacks this large dark mark in male.....
..... *R. flumineus* (pale dorsal form) (Honshu, Japan)
- 10a. Predorsal scales 14–15; prepelvic region with small cycloid scales.....
..... *R. yaoshanensis* (Gwangxi Province, China)
- 10b. Predorsal scales 0–11; prepelvic region naked... 11
- 11a. Rear tip of first dorsal fin extending to the insertion of 6–7 branched rays of second dorsal fin when depressed in male..... *R. filamentosus* (Gwangxi and Gwangdong Provinces, China)
- 11b. Rear tip of first dorsal fin not extending to vertical midline of second dorsal fin base when depressed in male..... 12
- 12a. Nape with one (sometimes split into two) conspicuous brownish black blotch... *R. maculicervix* (Laos)
- 12b. Nape without such a mark..... 13
- 13a. Longitudinal scale rows 34–36.....
..... *R. cheni* (Jiangxi Province, China)
- 13b. Longitudinal scale rows less than 33..... 14
- 14a. Pectoral fin base with a vertical dark brown line..... *R. parvus* (Gwangxi Province, China)
- 14b. Pectoral fin base lacks such mark..... 15
- 15a. Cheek or opercle with white round spots in male..... 16
- 15b. Cheek and opercle without such mark in male... 17
- 16a. Longitudinal scale rows 29–31; pectoral fin rays modally 15; 60–75 tiny round spots on cheek and opercle in male..... *R. albimaculatus* (Laos)
- 16b. Longitudinal scale rows 32–34; pectoral fin rays modally 16; 7–10 large round spots on opercle in male..... *R. vermiculatus* (Laos)
- 17a. Cheek with very conspicuous median longitudinal dark stripe in male..... 18
- 17b. Cheek without this mark in male..... 21
- 18a. Lower half of lateral cheek with 8–10 brownish red spots in male.....
..... *R. linshuiensis* (Hainan Province, China)
- 18b. Cheek has less than five round dark spots in male..... 19
- 19a. Pectoral fin base with two conspicuous dark brown to black spots..... 20
- 19b. Pectoral fin base with only one black spot..... *R. taenigena* (Laos)
- 20a. Predorsal scales 11–12; cheek with 2 black spots on lower margin in male..... *R. boa* (Vietnam)
- 20b. Predorsal scales 8–9; cheek with 4 black spots on lower margin and some irregularly short brown bars on ventral region in male..... *R. milleri* (Laos)
- 21a. Cheek and opercle with over 10 round conspicuous red to black round spots in male..... 22
- 21b. Cheek and opercle without such numerous dark marks in male..... 26
- 22a. Cheek and opercle with 11–14 brownish black spots in male; lateral side with 6–7 dark brown longitudinal lines..... *R. lineatus* (Laos)
- 22b. Cheek and opercle with over 30 rounded dark spots in male..... 23
- 23a. Pectoral fin rays modally 17; predorsal scales 0–3; almost round dark spots on cheek as large as pupil size in male.....
..... *R. honghensis* (Yunnan Province, China)
- 23b. Pectoral fin rays modally 16; predorsal scales 5–7; all or some round spots on cheek smaller than pupil in male..... 24
- 24a. Branchiostegal membrane with large spots about 2/3 pupil size; cheek and opercle with about 40 round dark spots in male.....
..... *R. mekognianus* (Thailand and Laos)
- 24b. Branchiostegal membrane with tiny yellow to orange spots less than 1/2 pupil size; cheek and opercle with about 55–80 round dark spots in male..... 25
- 25a. Longitudinal scale rows modally 32; predorsal scales 6–7; nape without dark cross-bars.....
..... *R. nammaensis* (Laos)
- 25b. Longitudinal scale rows modally 30; predorsal scales 3–4; nape with a pair of short deep brown cross-bars..... *R. chiengmaiensis* (Thailand)
- 26a. Cheek with 1 or more oblique dark line in male... 27
- 26b. Cheek with 2 ventral dark spots in male.....
..... *R. wangchuangensis* (Hainan Province, China)
- 27a. Cheek with 3 stripes from ventral side backward and upward to upper area in male.....
..... *R. genanematus* (Zhejiang Province, China)
- 27b. Cheek with stripe(s) from dorsal side backward and downward to lower region in male..... 28
- 28a. Cheek with 6–7 oblique dark brown stripes in male..... *R. wangi* (Gangdong Province, China)

- 28b. Cheek with 1–3 oblique, parallel dark stripes in male..... 29
- 29a. A horizontal brownish black bar or spot on pectoral fin base..... 30
- 29b. A pair of black spots on pectoral fin base..... 31
- 30a. Pectoral fin rays modally 16; predorsal scales 0–2; infraorbital mark as a horizontal brown bar below orbit turning into a vertical brown line.....
..... *R. changtinensis* (Fujian Province, China)
- 30b. Pectoral fin rays modally 17; predorsal scales 7–8; infraorbital mark as a small, square dark brown mark.....
..... *R. longyanensis* sp. nov. (Fujian Province, China)
- 31a. Predorsal midline naked.....
..... *R. henryi* (Gwangdong Province, China)
- 31b. Predorsal scales 4–12..... 32
- 32a. Branchiostegal membrane with several parallel orange-red stripes in male.....
..... *R. duospilus* (Gwangdong Province, China)
- 32b. Branchiostegal membrane with round orange or red spots in male..... 33
- 33a. Predorsal scales 8–11; opercle with oblique dark stripes in male; vertebral count 27.....
..... *R. sulcatus* (Vietnam)
- 33b. Predorsal scales 4–6; opercle without such mark; vertebral count 28..... 34
- 34a. Cheek with modally 1 oblique dark stripe in male, branchiostegal membrane with 20–28 orange-red spots or bars.....
..... *R. longwoensis* (Gwangdong Province, China)
- 34b. Cheek with modally 2 oblique dark stripes in male, branchiostegal membrane with 15–18 small orange-red spots.....
..... *R. ponkouensis* (Fujian Province, China)

Comparative materials examined. Most comparative materials of *Rhinogobius* species used here have been documented in the series of publications of the first author (ISC), which are listed in the reference citations in Table 2.

The remaining comparative materials were first mentioned as listed as below: *Rhinogobius cheni*: (types of *Gobius cheni*) AMNH 9694, holotype, 55.5 mm SL, Chao-Shan, Yangtsi River basin, Kiangsi (Jiangxi) Province, China. AMNH 11671, paratypes, 2 specimens, 46.4–51.8 mm SL, all other data as holotype. *Rhinogobius chiengmaiensis*: ANSP 59774, holotype, 23.0 mm SL, Chiangmai (Chiang Mai), Chiang Mai Province, north Siam (Thailand). ANSP 59772, paratype, 28.0 mm SL; ANSP 59773, paratype, 29.0 mm SL, all data as holotype. AMS I.25972001, 5 specimens, 18.6–19.8 mm SL, 10 April 1985, 60 km N of Chiang Mai, Mae Nam Ping, Chiao

Phraya basin, Chiang Mai Province, Thailand. *Rhinogobius filamentosus*: IHASW 75IV2553, 52.0 mm SL; IHASW 75IV2559, 46.4 mm SL; both April 1975, a tributary of Shulun County, Xijiang River basin, Gwangxi Province, China. *Rhinogobius henryi*: (types of *Ctenogobius henryi*) CAS 132993 (SU 32993), holotype, 34.2 mm SL, 20 January 1929, clear stream with rocky bottom at Mui-Yen, Lung-Nga Mountain, Kwangtong (Gwangdong) Province, China. BMNH 1938.12.1.186, paratype, 32.1 mm SL, all other data as holotype. CAS 132884 (SU 32994), paratypes, 4 specimens, 27.1–33.6 mm SL, all other data as holotype. *Rhinogobius lindbergi*: HUMZ 164191, 38.7 mm SL, 25 August 1995, Kyiya River, Amur River basin, China. HUMZ 164192–164193, 2 specimens, 22.4–24.7 mm SL, 25 August 1995, Ovor River, Amur River basin, China. HUMZ 164195–164198, 5 specimens, 21.4–27.1 mm SL, 28 August 1995, Oligovta River, Amur River basin, China. HUMZ 164199–164200, 2 specimens, 26.3–26.4 mm SL, Hoydur River, Amur River basin, China. *Rhinogobius parvus*: (types of *Ctenogobius parvus*) IHASW 81XII0213, paratype, 29.9 mm SL; IHASW 81XII0248, paratype, 31.8 mm SL, all in December 1981, Longchou, Xijiang Basin, Gwangxi Province, China. *Rhinogobius szechuanensis*: NTOU P-2007-05-003, 17 specimens, 34.1–47.5 mm SL, 12 July 1996, west of Chengdu (Chengtu), the tributary of Torjiang River, Yangtsi River basin, Szechuan Province, China. *Rhinogobius yaoshanensis*: (type of *Ctenogobius yaoshanensis*) IHASW No.5-Daryaoshan, paratype, 52.7 mm SL, Daryaoshan, the Xijiang basin, Gwangxi Province, China.

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